Reagent Guide

8th Edition

Synthetic Organic Chemistry & Materials Chemistry

Placing Your Order

When you need a product in this catalog

Orders can be placed on our TCI website (eShop)* or with our TCI local offices or distributors.

TCI website (eShop)*

Easy online ordering is available on www.TCIchemicals.com.
An eShop account is necessary to place your orders online. Please register yourself as a "MyTCI" member or consult with your local TCI offices.
**for limited markets only*

TCI local offices or distributors

Please contact your local TCI office or distributor listed on page 376 to 387.
If you can't find a distributor in your country, please contact the TCI Global Business Department listed at the bottom of this page.

Please provide the following information to order:

- **Product number**
  In this catalog, the product number is shown to the left of the chemical name. The product number consists of one letter followed by four digits.
- **Packing unit size**
  Please select the required packing unit size from the list in this catalog.
- **Quantity**
  Please specify the number of bottles required.
  Please consult TCI distributors if you need larger amounts.

If you need a product that is not listed in this catalog

Please consult us if you cannot find the product you require. We will be pleased to provide a quotation for custom synthesis.

Please provide the following information:

- **Name of compound**
- **Structure formula**
- **CAS number**
- **Required purity**
- **Required quantity**
- **Requested delivery time**
- **Any other needs** (physical data, synthesis method, literature, etc.)

You can also send your requests online via our website.

www.TCIchemicals.com/custom/

TOKYO CHEMICAL INDUSTRY CO., LTD.

Global Business Department

Tel: +81-3-5640-8878 Fax: +81-3-5640-8902
E-mail: globalbusiness@TCIchemicals.com

TCI Local Offices: The business names and contact addresses are listed on page 376.
TCI Distributors: The business names and contact addresses are listed on page 377.

Reagent Guide

8th Edition

Synthetic Organic Chemistry & Materials Chemistry

We have reviewed our product line-ups and organized them according to the research areas of synthetic organic chemistry and materials chemistry. We hope that this reagent guide will be of assistance to your research and development laboratories.

However, this guide is not an all inclusive list of all the reagents we deal in. Please be sure to look up our catalog and visit our website as well to remain updated on the latest information in the various fields of your interest.

www.TCIchemicals.com

Contents

Synthetic Organic Chemistry

Materials Chemistry

If you are looking for products in the field of Bioscience & Analytical Science, please see below.

Reagent Guide 8th Edition
Bioscience & Analytical Science

Bioscience
Example :
Antibodies / Sugars / Nucleosides / Amino Acids / Lipids / Terpenes / Steroids etc.

Analytical Science
Example :
GC Derivatizing Reagents / Labeling Reagents for HPLC / Chromatography Columns for HPLC / Derivatization Reagents for Mass Spectrometry etc.

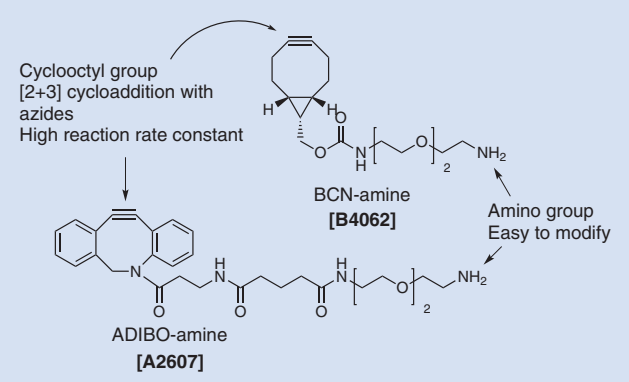
Copper-free Click Reactions

Among the "click chemistry" proposed by K. B. Sharpless in 2001, the Huisgen cyclization using azides and terminal alkynes has been widely used in various reseach fields such as chemical biology and material science due to its excellent chemoselectivity.[1] Generally, the Huisgen cyclization requires some copper salts to promote the reactions. However, use of the copper salt-mediated click reactions for *in vivo* applications is often highly restricted owing to the toxicity of active oxygen *in vivo* generated by the copper salt. Therefore, the development of advanced click reactions without using any copper salt has been investigated.

In the research fields using copper-free click reactions, a number of studies aimed for *in vivo* applications such as living cells and biological experiments on animals have been reported. To be suitable for such purposes, molecular design of alkyne derivatives has been performed mainly to improve two chemical properties of second order reactions, rate constant and lipophilicity (log P).

In 2004, C. R. Bertozzi *et al*. have reported the copper-free click reaction using highly-strained cyclooctyl groups as reactants. These cyclooctyl compounds satisfy the above mentioned two requests and are widely used as a molecular tool to reveal the metabolic systems.[2] Recently, they have been used to construct the microenvironment of hydrogels supporting the basis of regenerative medicine research. Because of that, Bertozzi *et al*. have suggested general and accessible experimental procedures for researchers who don't do major synthetic organic chemistry, and their practical examples can be referred to in the research article.[3]

Furthermore, van Delft *et al.* have developed more effective cyclooctyl compounds usable for *in vivo* bioorthogonal and 3D imaging.[3] For instance, ADIBO-amine and BCN-amine are suitable molecules for the copper-free click reaction in biological research because they have low lipophilicity and high reactivity. Especially, ADIBO-amine is used for PEGylation of proteins and nuclear imaging by positron emission tomography (PET) using a fluorine-18 [18F] radioisotope. As stated above, ADIBO-amine and BCN-amine are expected to be powerful versatile tools for the copper-free click reaction because they can also be used for surface reforming of solid materials and chemical modification of organic molecules in material science research as well as live imaging and microarray analysis in life science research.



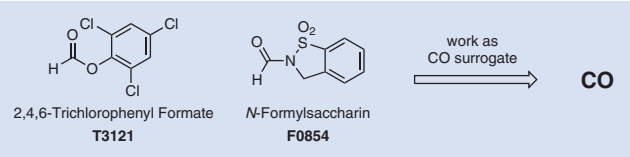
Product No.	Product Name		Unit Size
A2607	9,15-Diaza-18-DBCO-3,6-dioxa-10,14,18-trioxooctadecylamine (ADIBO-amine)		25mg
B4062	*N*-(1*R*,8*S*,9s)-Bicyclo[6.1.0]non-4-yn-9-ylmethyloxycarbonyl-1,8-diamino-3,6-dioxaoctane (BCN-amine)	25mg	100mg

References

1) H. C. Kolb, M. G. Finn, K. B. Sharpless, *Angew. Chem. Int. Ed.* **2001**, *40*, 2004.
2) N. J. Agard, J. A. Prescher, C. R. Bertozzi, *J. Am. Chem. Soc.* **2004**, *126*, 15046.
3) E. M. Sletten, C. R. Bertozzi, *Acc. Chem. Res.* **2011**, *44*, 666.
4) a) J. Dommerholt, S. Schmidt, R. Temming, L. J. A. Hendriks, F. P. J. T. Rutjes, J. C. M. van Hest, D. J. Lefeber, P. Friedl, F. L. van Delft, *Angew. Chem. Int. Ed.* **2010**, *49*, 9422.
b) M. F. Debets, S. S. van Berkel, S. Schoffelen, F. P. J. T. Rutjes, J. C. M. van Hest, F. L. van Delft, *Chem. Commun.* **2010**, *46*, 97.

Easily Accessible Crystalline CO Surrogate Reagents

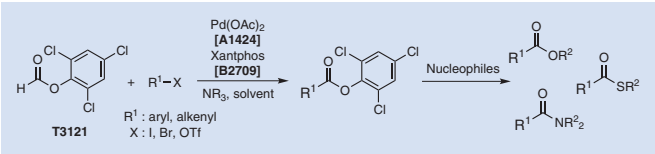
Carbon monoxide (CO) is used as a significant carbonyl group-introducing reagent in organic synthesis. A number of synthetic reactions using CO have been developed. Because CO is a colorless, odorless and toxic gas at room temperature, it is necessary to pay minute attention when using it. For that reason, in the field of the synthetic chemistry using CO, the development of CO surrogate reagents as well as the study of novel synthetic reactions has proceeded.



2,4,6-Trichlorophenyl Formate **T3121**

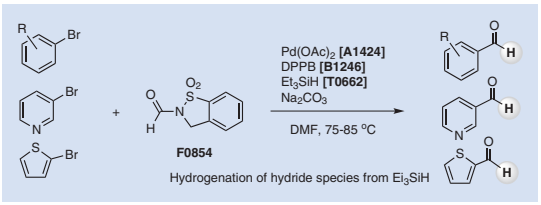
N-Formylsaccharin **F0854**

Manabe *et al*. have investigated novel CO surrogate agents focused on formic acid derivatives and found that 2,4,6-trichlorophenyl formate can act functionally as a CO equivalent.[1)] This compound is a stable crystalline solid at room temperature and it rapidly decomposes into CO and 2,4,6-trichlorophenol by treatment with a trialkylamine. *In situ* generated CO is successfully applied to the palladium-catalyzed carbonylation of aryl/alkenyl halides and triflates to give their 2,4,6-trichlorophenol esters. Continuously, the given esters can be transformed into the corresponding carboxylic acid derivatives by the reaction with various nucleophiles. This carbonylation reaction is a highly practical synthetic method since it does not decrease the reaction yields even in gram-scale reactions.[2)]



T3121

Subsequently, Manabe *et al*. have developed the reductive carbonylation using *N*-formylsaccharin as a CO equivalent.[3)] In this reaction, palladium acetate is used as a catalyst and the reaductive carbonylation of aryl bromides is accomplished in combination with triethylsilane as a nucleophile. The hydrogen atom on a formyl group of formed aldehydes is introduced by the addition of the hydride species from triethylsilane.



F0854

In a case using 2,4,6-trichlorophenyl formate together with other nucleophiles, the carbonylation reaction tends to be complicated because of the nucleophilicity of 2,4,6-trichlorophenol formed as a by-product. However, in the carbonylation reaction using *N*-formylsaccharin, hydrosilanes can be directly used as a nucleophile because the nucleophilicity of formed saccharin is sufficiently inert.

Product No.	Product Name		Unit Size
T3121	2,4,6-Trichlorophenyl Formate	1g	5g
F0854	*N*-Formylsaccharin	5g	25g

References

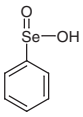
1) T. Ueda, H. Konishi, K. Manabe, *Org. Lett*. **2012**, *14*, 5370.
2) H. Konishi, T. Ueda, K. Manabe, *Org. Synth*. **2014**, *91*, 39.
3) T. Ueda, H. Konishi, K. Manabe, *Angew. Chem. Int. Ed*. **2013**, *52*, 8611.

Oxidation

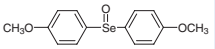
Oxidation, making its target substance lose electrons, is one of the most basic reactions in organic chemistry and is exemplified by the combination with oxygen or a dehydrogenation reaction. In particular, it is often used for the transformation of alcohols to the corresponding aldehydes, ketones or carboxylic acids. Heavy metal compounds, such as chromium (VI) oxide and potassium permanganate, have been exploited for many years. Especially, chromium (VI) oxide has been utilized abundantly, based on the report of the control of oxidization powers by Jones or Sarett.[1] Furthermore, chromium (VI) oxide have been improved as the Collins reagent[2], PCC[3] and PDC[4] and are used in many fields. On the other hand, the Dess-Martin periodinane[5], the Mukaiyama oxidizing agent[6] and oxoammonium salts have been developed without containing harmful metals. Moreover, oxidation reactions employing inexpensive sodium hypochlorite or molecular oxygen have also been reported in the presence of oxidation catalysts such as tetrapropylammonium perruthenate (TPAP)[7] and TEMPO[8]. This section shows the typical oxidizers and the catalysts used for oxidation reactions.

Metal Oxidants

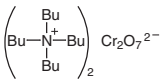
B2134



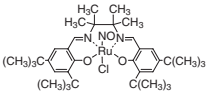
B1375



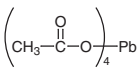
B1123



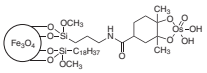
C1944



L0021



O0414



O0308

OsO_4

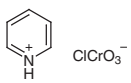
P1910

$12MoO_3 \cdot H_3PO_4 \cdot xH_2O$

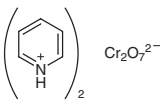
P1742

$KMnO_4$

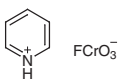
P0930



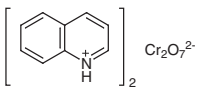
P0931



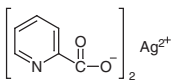
P1088



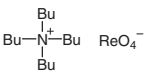
Q0058



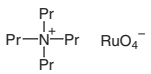
S0815



T1803



T1559

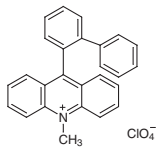


Product No.	Product Name	Unit Size
B2134	Benzeneseleninic Acid	5g
B1375	Bis(4-methoxyphenyl) Selenoxide	1g 5g
B1123	Bis(tetrabutylammonium) Dichromate	10g
C1944	Chloronitrosyl[*N*,*N*'-bis(3,5-di-*tert*-butylsalicylidene)-1,1,2,2-tetramethylethylenediaminato]-ruthenium(IV)	100mg

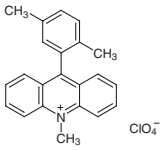
Product No.	Product Name	Unit Size		
L0021	Lead Tetraacetate (contains Acetic Acid)		25g	500g
O0414	Osmium Catalyst supported on Magnetite (0.07-0.09mmol/g)			1g
O0308	Osmium Tetroxide (4% in Water)			10mL
P1910	Phosphomolybdic Acid Hydrate		25g	100g
P1742	Potassium Permanganate			300g
P0930	Pyridinium Chlorochromate	25g	100g	500g
P0931	Pyridinium Dichromate	25g	100g	500g
P1088	Pyridinium Fluorochromate			5g
Q0058	Quinolinium Dichromate		10g	25g
S0815	Silver(II) Pyridine-2-carboxylate		1g	5g
T1803	Tetrabutylammonium Perrhenate		1g	5g
T1559	Tetrapropylammonium Perruthenate		1g	5g

Perchlorates

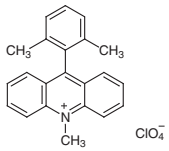
B2897



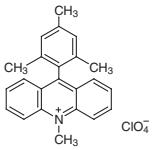
D3428



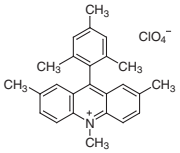
D3429



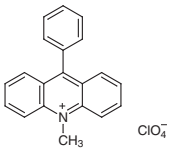
M1774



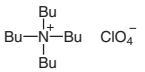
M2072



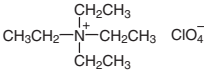
M1775



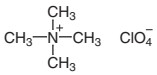
T0836



T0839



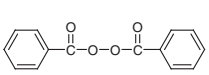
T0841



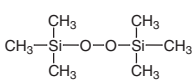
Product No.	Product Name	Unit Size		
B2897	9-(2-Biphenylyl)-10-methylacridinium Perchlorate		1g	5g
D3428	9-(2,5-Dimethylphenyl)-10-methylacridinium Perchlorate		1g	5g
D3429	9-(2,6-Dimethylphenyl)-10-methylacridinium Perchlorate		1g	5g
M1774	9-Mesityl-10-methylacridinium Perchlorate		1g	5g
M2072	9-Mesityl-2,7,10-trimethylacridinium Perchlorate			1g
M1775	10-Methyl-9-phenylacridinium Perchlorate		1g	5g
T0836	Tetrabutylammonium Perchlorate	25g	100g	500g
T0839	Tetraethylammonium Perchlorate			25g
T0841	Tetramethylammonium Perchlorate			25g

Organic Peroxides

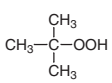
B3152



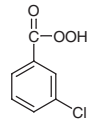
B3497



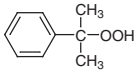
B3153



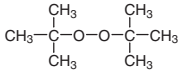
C0357



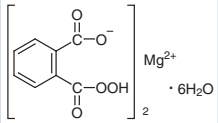
C2223



D3411



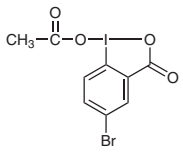
M0927



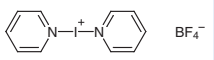
Product No.	Product Name	Unit Size
B3152	Benzoyl Peroxide (wetted with *ca.* 25% Water)	25g
B3497	Bis(trimethylsilyl) Peroxide (contains Hexamethyldisiloxane) (*ca.* 30% in Hexane)	5g
B3153	*tert*-Butyl Hydroperoxide (70% in Water)	100g
C0357	3-Chloroperoxybenzoic Acid (contains *ca.* 30% Water)	25g 250g
C2223	Cumene Hydroperoxide (contains *ca.* 20% Aromatic Hydrocarbon)	100g
D3411	Di-*tert*-butyl Peroxide	100mL
M0927	Monoperoxyphthalic Acid Magnesium Salt Hexahydrate	25g 500g

Hypervalent Iodine Compounds

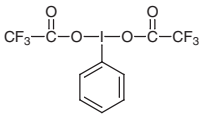
A2678



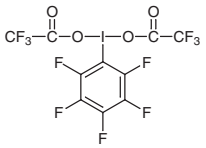
B2539



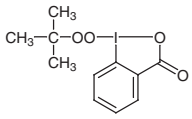
B1175



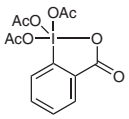
B1616



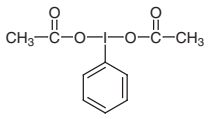
B2121



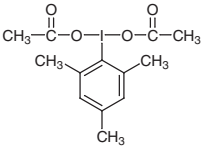
D4477
D2045



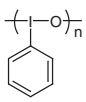
I0330



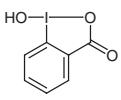
I0479



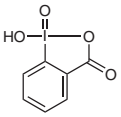
I0072



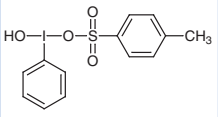
I0073



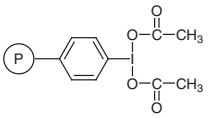
I0791



P1015



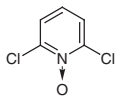
P1415



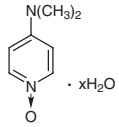
Product No.	Product Name	Unit Size
A2678	1-Acetoxy-5-bromo-1,2-benziodoxol-3(1*H*)-one (ABBX)	1g
B2539	Barluenga's Reagent	1g
B1175	[Bis(trifluoroacetoxy)iodo]benzene (PIFA)	5g 25g
B1616	[Bis(trifluoroacetoxy)iodo]pentafluorobenzene	1g 5g
B2121	1-(*tert*-Butylperoxy)-1,2-benziodoxol-3(1*H*)-one	1g
D4477	Dess-Martin Periodinane (8-12% in Dichloromethane)	25mL 250mL
D2045	Dess-Martin Periodinane	1g 5g 25g
I0330	Iodobenzene Diacetate (PIDA)	10g 25g 250g
I0479	Iodomesitylene Diacetate	5g 25g
I0072	Iodosobenzene	5g
I0073	2-Iodosobenzoic Acid	10g
I0791	2-Iodoxybenzoic Acid (IBX) (stabilized with Benzoic Acid + Isophthalic Acid)	5g 25g
P1015	Koser Reagent	5g 25g
P1415	Poly[4-(diacetoxyiodo)styrene] (PSDIB)	1g 5g

N-Oxides

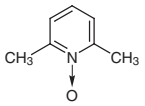
D3219



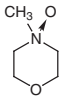
D3220



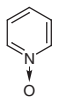
L0069



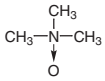
M0981
M2192



P0557



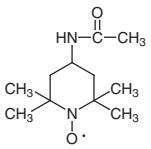
T1362
T0466



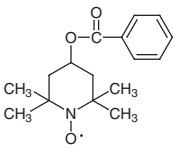
Product No.	Product Name	Unit Size	
D3219	2,6-Dichloropyridine *N*-Oxide		5g
D3220	4-(Dimethylamino)pyridine *N*-Oxide Hydrate	1g	5g
L0069	2,6-Lutidine *N*-Oxide		25g
M0981	4-Methylmorpholine *N*-Oxide (50% in Water, *ca.* 4.8mol/L)	25mL	500mL
M2192	4-Methylmorpholine *N*-Oxide	5g	25g
P0557	Pyridine *N*-Oxide	25g	500g
T1362	Trimethylamine *N*-Oxide Anhydrous	1g	5g
T0466	Trimethylamine *N*-Oxide Dihydrate	25g	500g

TEMPOs

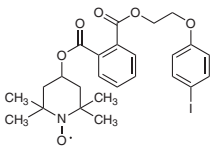
A1348



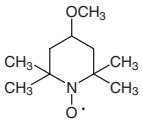
H0878



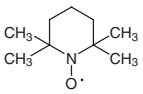
I0908



M1197



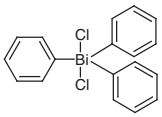
T1560



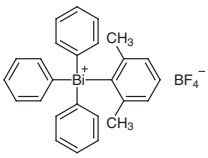
Product No.	Product Name	Unit Size	
A1348	4-Acetamido-TEMPO Free Radical	5g	25g
H0878	4-Benzoyloxy-TEMPO Free Radical	1g	5g
I0908	4-[2-[2-(4-Iodophenoxy)ethoxy]carbonyl]benzoyloxy-2,2,6,6-tetramethylpiperidin-1-oxyl		100mg
M1197	4-Methoxy-TEMPO Free Radical	1g	5g
T1560	TEMPO Free Radical	5g	25g

Organic Bismuth Compounds

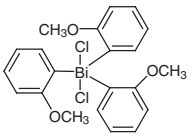
T1837



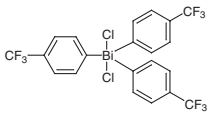
T2507



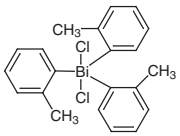
T1956



T2038



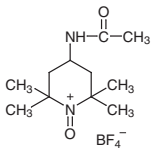
T1957



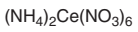
Product No.	Product Name	Unit Size
T1837	Triphenylbismuth Dichloride	5g
T2507	Triphenyl-2,6-xylylbismuthonium Tetrafluoroborate	100mg 1g
T1956	Tris(2-methoxyphenyl)bismuth Dichloride	1g 5g
T2038	Tris(4-trifluoromethylphenyl)bismuth Dichloride	1g
T1957	Tri-*o*-tolylbismuth Dichloride	1g 5g

Others

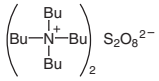
A2065



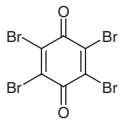
C1806



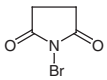
B2151



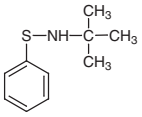
T0617



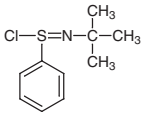
B0656



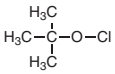
B2240



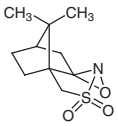
B2188



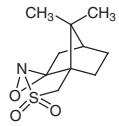
H0362



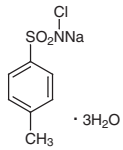
C1326



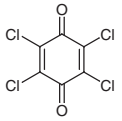
C1327



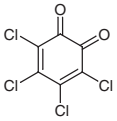
C0076



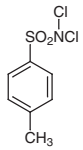
T0061



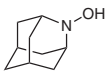
T0970



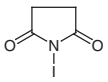
D0318



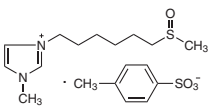
H1404



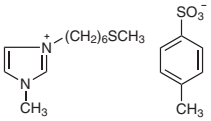
I0074



M2274

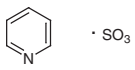


M2321

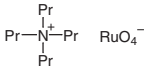


O0310

P0998



T1559



Product No.	Product Name	Unit Size
A2065	4-Acetamido-2,2,6,6-tetramethyl-1-oxopiperidinium Tetrafluoroborate	5g
C1806	Ammonium Cerium(IV) Nitrate	50g 500g
B2151	Bis(tetrabutylammonium) Peroxydisulfate	5g 25g
T0617	Bromanil	5g 25g
B0656	*N*-Bromosuccinimide	25g 100g 500g
B2240	*N*-*tert*-Butylbenzenesulfenamide	1g 5g 25g

Product No.	Product Name		Unit Size	
B2188	*N*-*tert*-Butylbenzenesulfinimidoyl Chloride		1g	5g
H0362	*tert*-Butyl Hypochlorite		25g	500g
C1326	(2*R*,8a*S*)-(+)-(Camphorylsulfonyl)oxaziridine [Asymmetric Oxidizing Reagent]		1g	5g
C1327	(2*S*,8a*R*)-(-)-(Camphorylsulfonyl)oxaziridine [Asymmetric Oxidizing Reagent]		1g	5g
C0076	Chloramine T Trihydrate		25g	500g
T0061	Chloranil		25g	500g
T0970	*o*-Chloranil		5g	25g
D0318	Dichloramine T		25g	500g
H1404	2-Hydroxy-2-azaadamantane	200mg	1g	5g
I0074	*N*-Iodosuccinimide	5g	25g	100g
M2274	1-Methyl-3-[6-(methylsulfinyl)hexyl]imidazolium *p*-Toluenesulfonate		1g	5g
M2321	1-Methyl-3-[6-(methylthio)hexyl]imidazolium *p*-Toluenesulfonate		1g	5g
O0310	Potassium Peroxymonosulfate [>45%(T) as $KHSO_5$]		25g	500g
P0998	Pyridine - Sulfur Trioxide Complex	25g	100g	500g
T1559	Tetrapropylammonium Perruthenate		1g	5g

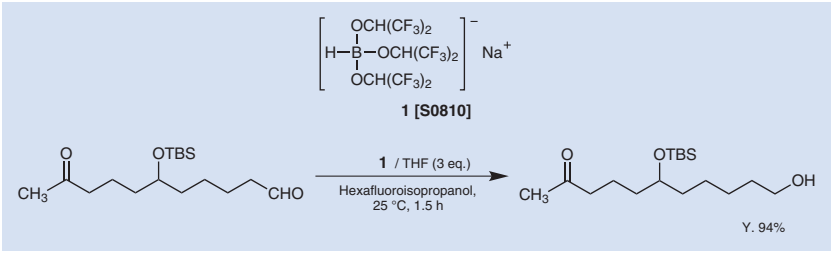
Many oxidizing agents may cause combustion or explosion upon mixture with flammable materials or upon exposure to heat, shock, and friction etc. Sufficient safety measures, such as using safety shields, wearing protective equipment, and using extreme caution should be taken when working with these reagents as well as disposing of the reagents.

References

1) K. Bowden, I. M. Heilbron, E. R. H. Jones, *J. Chem. Soc*. **1946**, 39; Review: S. V. Ley, A. Madin, *Comprehensive Organic Synthesis* **1991**, *7*, 253.
2) J. C. Collins, W. W. Hess, F. J. Frank, *Tetrahedron Lett*. **1968**, *9*, 3363.
3) E. J. Corey, J. W. Suggs, *Tetrahedron Lett*. **1975**, *16*, 2647.
4) E. J. Corey, G. Schmidt, *Tetrahedron Lett*. **1979**, *20*, 399.
5) D. B. Dess, J. C. Martin, *J. Org. Chem*. **1983**, *48*, 4155; R. E. Irekand, L. Liu, *J. Org .Chem*. **1993**, *58*, 2899.
6) J. Matsuo, D. Iida, K. Tatani, T. Mukaiyama, *Bull. Chem. Soc. Jpn*. **2002**, *75*, 223.
7) W. P. Griffith, S. V. Ley, G. P. Whitcombe, A. D. White, *J. Chem. Soc., Chem. Commun*. **1987**, 1625; Review: S. V. Ley, J. Norman, W. P. Griffith, S. P. Marsden, *Synthesis* **1994**, 639.
8) O. L. Lebelev, S. N. Kazarnovskii, *Zhur. Obshch. Khim*. **1960**, *30*, 1631; Review: A. E. J. de Nooy, A. C. Besemer, H. van Bekkum, *Synthesis* **1996**, 1153.

Reduction

Reduction is a chemical reaction in which the target substances receive electrons, and is one of the most fundamental reactions in organic chemistry including the deoxygenation reaction and the hydrogenation reaction. The well-known reducing agents include metal hydrides such as $LiAlH_4$[1], boranes used in the hydride reduction, and hydrazine used in the Wolff-Kishner reduction.[2] Sodium tris(1,1,1,3,3,3-hexafluoroisopropoxy)borohydride (**1**) is a selective reducing agent developed by Toshima *et al*. Aldehydes are selectively reduced in the presence of ketones and other reducible functions using **1** to afford the corresponding primary alcohols in high yields.[3]



In addition, the radical reductive reaction using silane compounds tris(trimethylsilyl)silane[4] and tetraphenyldisilane (TPDS)[5] as radical reducing agents has been developed avoiding the use of highly toxic tin compounds. This section shows the typical reducing agents.

Table. Comparison of reactivities of hydride reducing agents for carbonyl compounds and imines

Reactions \ Reagents	$NaBH_3CN$ **S0396**	$NaBH_4$ **S0480**	$LiBH_4$ **L0186**	$LiAlH_4$ **L0170, L0203**	THF・BH_3 **T2346**
	$NaBH(OCOCH_3)_3$ **S0394**				Me_2S・BH_3 **D1843**
					$PhNEt_2$・BH_3 **D2581**
Imine → Amine					
Aldehyde → Alcohol					
Ketone → Alcohol					
Ester → Alcohol					
Amide → Amine					
Carboxylic Acid → Alcohol					

Reactivity : High | Middle | Low

Metal Hydrides

Aluminum Hydrides

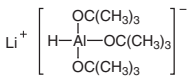
D2972
D2971

$[(CH_3)_2CHCH_2]_2AlH$

L0203
L0170

$LiAlH_4$

L0159



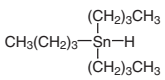
S0467

$NaAl(OCH_2CH_2OCH_3)_2H_2$

Product No.	Product Name	Unit Size		
D2972	Diisobutylaluminum Hydride (17% in Toluene, *ca.* 1.0mol/L)		100mL	500mL
D2971	Diisobutylaluminum Hydride (19% in Hexane, *ca.* 1.0mol/L)		100mL	500mL
L0203	Lithium Aluminum Hydride (Powder)		25g	100g
L0170	Lithium Aluminum Hydride (10% in Tetrahydrofuran, *ca.* 2.5mol/L)			100mL
L0159	Lithium Tri-*tert*-butoxyaluminum Hydride (*ca.* 30% in Tetrahydrofuran, *ca.* 1.0mol/L)			100mL
S0467	Sodium Bis(2-methoxyethoxy)aluminum Dihydride (70% in Toluene, *ca.* 3.6mol/L)	25g	100g	500g

Tin Hydrides

T1473



Product No.	Product Name	Unit Size	
T1473	Tributyltin Hydride (stabilized with BHT)	25g	250g

Other Metal Hydrides

S0481

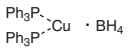
NaH

Z0010

Product No.	Product Name	Unit Size		
S0481	Sodium Hydride (60%, dispersion in Paraffin Liquid)		100g	500g
Z0010	Zirconocene Chloride Hydride	1g	5g	25g

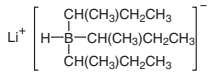
Borohydrides

B1139

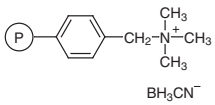


L0186

L0164

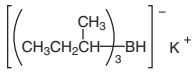


P1719



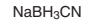
P1681

P1380

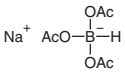


S0480

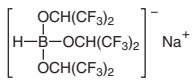
S0396



S0394

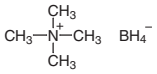


S0810

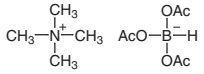


T0917

T0852



T1553

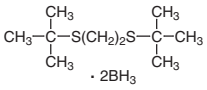


Product No.	Product Name	Unit Size		
B1139	Bis(triphenylphosphine)copper Tetrahydroborate			5g
L0186	Lithium Borohydride (*ca.* 3mol/L in Tetrahydrofuran)			100mL
L0164	Lithium Tri-*sec*-butylborohydride (*ca.* 21% in Tetrahydrofuran, *ca.* 1.0mol/L)			100mL
P1719	(Polystyrylmethyl)trimethylammonium Cyanoborohydride cross-linked with 10% DVB (30-50mesh) (2.6-3.0mmol/g)		5g	25g
P1681	Potassium Borohydride		25g	100g
P1380	Potassium Tri-*sec*-butylborohydride (*ca.* 1.0mol/L in Tetrahydrofuran)			Price on request
S0480	Sodium Borohydride	25g	100g	500g
S0396	Sodium Cyanoborohydride	5g	25g	250g
S0394	Sodium Triacetoxyborohydride		25g	100g
S0810	Sodium Tris(1,1,1,3,3,3-hexafluoroisopropoxy)borohydride			5g
T0917	Tetrabutylammonium Borohydride		5g	25g
T0852	Tetramethylammonium Borohydride		5g	25g
T1553	Tetramethylammonium Triacetoxyborohydride		5g	25g

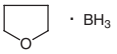
Boranes

Borane Complexes

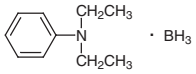
B1827



T2346



D2581

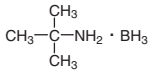


D1843

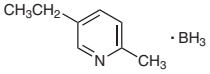
Product No.	Product Name	Unit Size	
B1827	1,2-Bis(*tert*-butylthio)ethane Borane		1g
T2346	Borane - Tetrahydrofuran Complex (8.5% in Tetrahydrofuran, *ca.* 0.9mol/L) (stabilized with Sodium Borohydride)	100mL	500mL
D2581	*N,N*-Diethylaniline Borane	25g	100g
D1843	Dimethyl Sulfide Borane	25mL	100mL

Borane-Amine Complexes

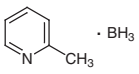
B1264



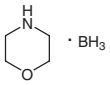
B4084



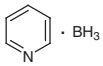
B3018



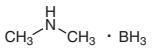
M0898



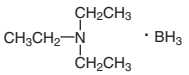
B1569



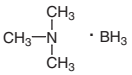
D1842



T1180



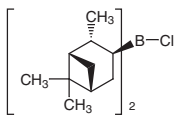
T1181



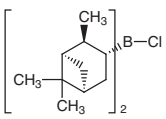
Product No.	Product Name	Unit Size	
B1264	Borane - *tert*-Butylamine Complex	25g	100g
B4084	Borane - 5-Ethyl-2-methylpyridine Complex	25mL	100mL
B3018	Borane - 2-Methylpyridine Complex	5g	25g
M0898	Borane - Morpholine Complex	5g	25g
B1569	Borane - Pyridine Complex		25mL
D1842	Dimethylamine Borane	25g	500g
T1180	Triethylamine Borane		25g
T1181	Trimethylamine Borane		25g

Other Boranes

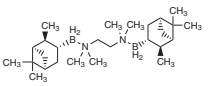
C1614



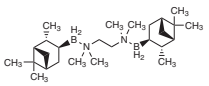
C2023
C1615



I0796



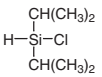
I0797



Product No.	Product Name	Unit Size
C1614	(+)-*B*-Chlorodiisopinocampheylborane (58% in Hexane, *ca.* 1.6mol/L)	100mL
C2023	(-)-*B*-Chlorodiisopinocampheylborane (55-65% in Heptane, *ca.* 1.7mol/L)	100mL
C1615	(-)-*B*-Chlorodiisopinocampheylborane (60% in Hexane, *ca.* 1.7mol/L)	100mL
I0796	(+)-Isopinocampheylborane TMEDA Complex	5g
I0797	(-)-Isopinocampheylborane TMEDA Complex	5g

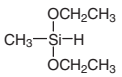
Silanes

C1492

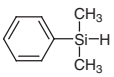


C0778

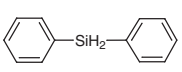
D2403



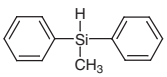
D2196



D2406
D2820

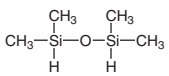


D1825

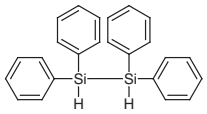


P1291

T1437

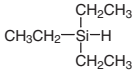


T1896

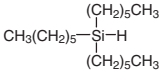


T0398

T0662

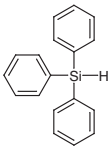


T1334

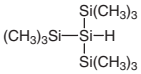


T1533

T0661



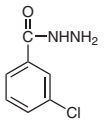
T1463



Product No.	Product Name	Unit Size	
C1492	Chlorodiisopropylsilane	5mL	25mL
C0778	Chlorodimethylsilane	25mL	250mL
D2403	Diethoxymethylsilane [Hydrosilylating Reagent]		25mL
D2196	Dimethylphenylsilane		25mL
D2406	Diphenylsilane	5g	25g
D2820	Diphenylsilane	5g	25g
D1825	Methyldiphenylsilane		25mL
P1291	Phenylsilane	5mL	25mL
T1437	1,1,3,3-Tetramethyldisiloxane	25mL	250mL
T1896	1,1,2,2-Tetraphenyldisilane	1g	5g
T0398	Trichlorosilane	5g	25g 500g
T0662	Triethylsilane	25mL	250mL
T1334	Trihexylsilane		10g
T1533	Triisopropylsilane	5mL	25mL 100mL
T0661	Triphenylsilane		25g
T1463	Tris(trimethylsilyl)silane (stabilized with TBBP)	5mL	25mL

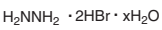
Hydrazines, Hydrazides

C2648

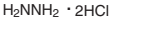


H0697
H0204
H0172

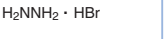
H0169



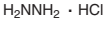
H0170



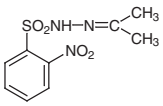
H0173



H0174



I0777

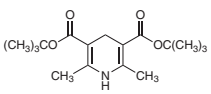


Product No.	Product Name	Unit Size	
C2648	3-Chlorobenzohydrazide	5g	25g
H0697	Hydrazine Anhydrous	10g	100g
H0204	Hydrazine Monohydrate (79%)	25g	500g
H0172	Hydrazine Monohydrate	25mL	500mL
H0169	Hydrazine Dihydrobromide Hydrate	25g	500g
H0170	Hydrazine Dihydrochloride	25g	500g

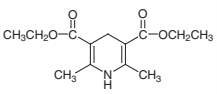
Product No.	Product Name	Unit Size	
H0173	Hydrazine Monohydrobromide	25g	500g
H0174	Hydrazine Monohydrochloride	25g	500g
I0777	*N'*-Isopropylidene-2-nitrobenzenesulfonohydrazide		5g

Others

D4311



D3775



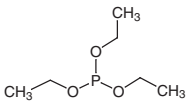
H1221

HI

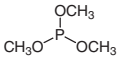
S0494

SmI_2

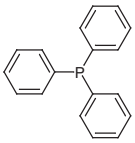
T0430



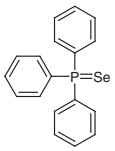
T0488



T0519



T1819



Product No.	Product Name		Unit Size	
D4311	Di-*tert*-butyl 1,4-Dihydro-2,6-dimethyl-3,5-pyridinedicarboxylate		1g	5g
D3775	Diethyl 1,4-Dihydro-2,6-dimethyl-3,5-pyridinedicarboxylate	1g	5g	25g
H1221	Hydriodic Acid (57%)			300mL
S0494	Samarium(II) Iodide (*ca.* 0.1mol/L in Tetrahydrofuran)			25mL
T0430	Triethyl Phosphite		25mL	500mL
T0488	Trimethyl Phosphite			25mL
T0519	Triphenylphosphine		25g	500g
T1819	Triphenylphosphine Selenide			5g

Many reducing agents may spontaneously ignite on contact with air, or may react violently with water to produce flammable gases. Sufficient safety measures, such as using safety shields, wearing protective equipment, and using extreme caution should be taken when working with these reagents as well as disposing of the reagents.

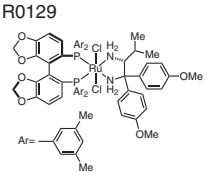
Hydrogenation Catalysts

Product No.	Product Name	Unit Size	
P1785	Palladium 10% on Carbon (wetted with *ca.* 55% Water)	5g	25g
P1491	Palladium 10% on Carbon (wetted with *ca.* 55% Water)	5g	25g
P1701	Palladium 5% on Barium Carbonate		10g
P1702	Palladium 5% on Barium Sulfate	5g	25g
P1703	Palladium 5% on Calcium Carbonate (poisoned with Lead)	5g	25g
P1490	Palladium 5% on Carbon (wetted with *ca.* 55% Water)	5g	25g
P1528	Palladium Hydroxide 20% on Carbon (wetted with *ca.* 50% Water)	10g	50g
P1786	Palladium on SH Silica Gel (0.1mmol/g)		1g
P1720	Platinum(IV) Oxide		200mg
P1944	Poly(methylphenyl)silane supported Palladium/Alumina Hybrid Catalyst [=Pd / ($PSi\text{-}Al_2O_3$)]		1g
R0075	Rhodium 5% on Carbon (wetted with *ca.* 55% Water)		1g
R0076	Ruthenium 5% on Carbon (wetted with *ca.* 50% Water)	5g	25g
S0487	Skeletal Nickel Catalyst slurry in Water		50g

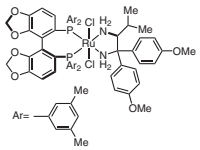
Asymmetric Hydrogenation Catalysts

Ruthenium Complex Catalysts for Asymmetric Hydrogenation of Ketones

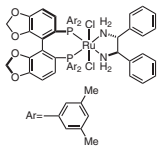
R0129



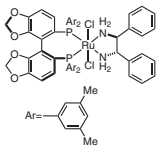
R0128



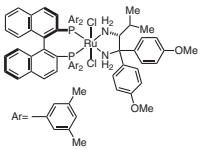
R0131



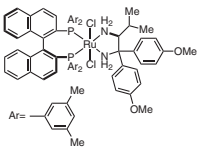
R0130



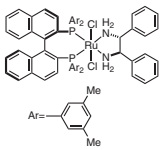
R0133



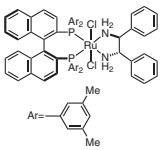
R0132



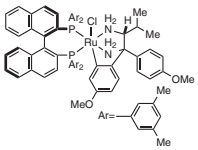
R0135



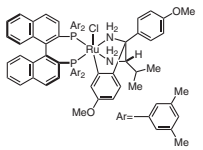
R0134



R0139



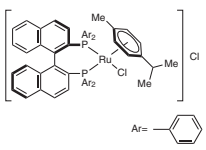
R0138



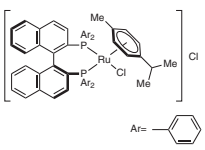
Product No.	Product Name	Unit Size	
R0129	$RuCl_2$[(*R*)-dm-segphos®][(*R*)-daipen]	200mg	1g
R0128	$RuCl_2$[(*S*)-dm-segphos®][(*S*)-daipen]	200mg	1g
R0131	$RuCl_2$[(*R*)-dm-segphos®][(*R*,*R*)-dpen]	200mg	1g
R0130	$RuCl_2$[(*S*)-dm-segphos®][(*S*,*S*)-dpen]	200mg	1g
R0133	$RuCl_2$[(*R*)-xylbinap][(*R*)-daipen]	200mg	1g
R0132	$RuCl_2$[(*S*)-xylbinap][(*S*)-daipen]	200mg	1g
R0135	$RuCl_2$[(*R*)-xylbinap][(*R*,*R*)-dpen]	200mg	1g
R0134	$RuCl_2$[(*S*)-xylbinap][(*S*,*S*)-dpen]	200mg	1g
R0139	(*R*)-RUCY®-XylBINAP	200mg	1g
R0138	(*S*)-RUCY®-XylBINAP	200mg	1g

Ruthenium Complex Catalysts for Asymmetric Hydrogenation of Olefins and Functionalized Ketones

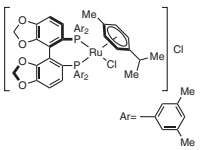
R0146



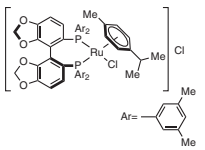
R0147



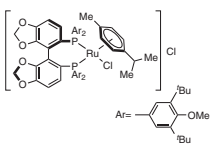
R0156



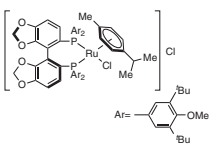
R0157



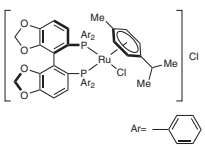
R0158



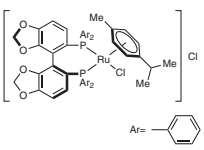
R0159



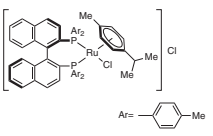
R0154



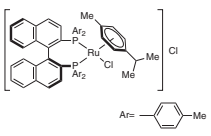
R0155



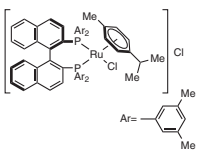
R0148



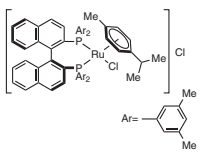
R0149



R0150



R0151

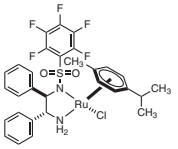


Product No.	Product Name	Unit Size	
R0146	[RuCl(*p*-cymene)((*R*)-binap)]Cl	200mg	1g
R0147	[RuCl(*p*-cymene)((*S*)-binap)]Cl	200mg	1g
R0156	[RuCl(*p*-cymene)((*R*)-dm-segphos®)]Cl	200mg	1g
R0157	[RuCl(*p*-cymene)((*S*)-dm-segphos®)]Cl	200mg	1g
R0158	[RuCl(*p*-cymene)((*R*)-dtbm-segphos®)]Cl	200mg	1g
R0159	[RuCl(*p*-cymene)((*S*)-dtbm-segphos®)]Cl	200mg	1g

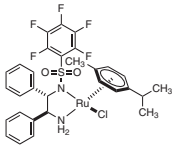
Product No.	Product Name	Unit Size	
R0154	[RuCl(*p*-cymene)((*R*)-segphos®)]Cl	200mg	1g
R0155	[RuCl(*p*-cymene)((*S*)-segphos®)]Cl	200mg	1g
R0148	[RuCl(*p*-cymene)((*R*)-tolbinap)]Cl	200mg	1g
R0149	[RuCl(*p*-cymene)((*S*)-tolbinap)]Cl	200mg	1g
R0150	[RuCl(*p*-cymene)((*R*)-xylbinap)]Cl	200mg	1g
R0151	[RuCl(*p*-cymene)((*S*)-xylbinap)]Cl	200mg	1g

Ruthenium Complex Catalysts for Asymmetric Transfer Hydrogenation of Ketones

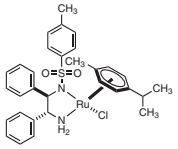
R0123



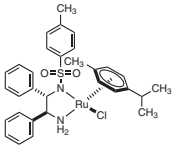
R0122



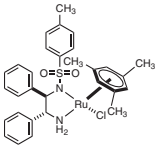
R0125



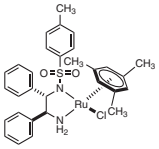
R0124



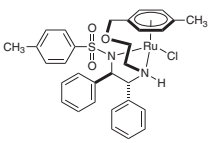
R0127



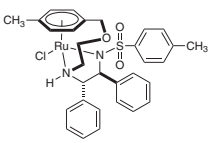
R0126



T3078



T3077



Product No.	Product Name	Unit Size	
R0123	RuCl[(*R*,*R*)-Fsdpen](*p*-cymene)	200mg	1g
R0122	RuCl[(*S*,*S*)-Fsdpen](*p*-cymene)	200mg	1g
R0125	RuCl[(*R*,*R*)-Tsdpen](*p*-cymene)	200mg	1g
R0124	RuCl[(*S*,*S*)-Tsdpen](*p*-cymene)	200mg	1g
R0127	RuCl[(*R*,*R*)-Tsdpen](mesitylene)	200mg	1g
R0126	RuCl[(*S*,*S*)-Tsdpen](mesitylene)	200mg	1g
T3078	(*R*,*R*)-Ts-DENEB®	200mg	1g
T3077	(*S*,*S*)-Ts-DENEB®	200mg	1g

＊These products were merchandised under the technical tie-up with TAKASAGO INTERNATIONAL CORPORATION.
SEGPHOS®, RUCY®, and DENEB® are registered trademarks of TAKASAGO INTERNATIONAL CORPORATION.

References

1) Review: J. Malek, M. Cerny, *Synthesis* **1972**, 217.
2) Review: N. Kishner, *J. Russ. Phys. Chem. Soc.* **1911**, *43*, 582; L. Wolff, *Ann.* **1912**, *394*, 86; R. O. Hutchins, M. K. Hutchins, *Comprehensive Organic Synthesis* **1991**, *8*, 327.
3) Y. Kuroiwa, S. Matsumura, K. Toshima, *Synlett* **2008**, *16*, 2523.
4) C. Chatgilialoglu, D. Griller, M. Lesage, *J. Org. Chem.* **1988**, *53*, 3641.
5) O. Yamazaki, H. Togo, S. Matsubayashi. M. Yokoyama, *Tetrahedron Lett.* **1998**, *39*, 1921.

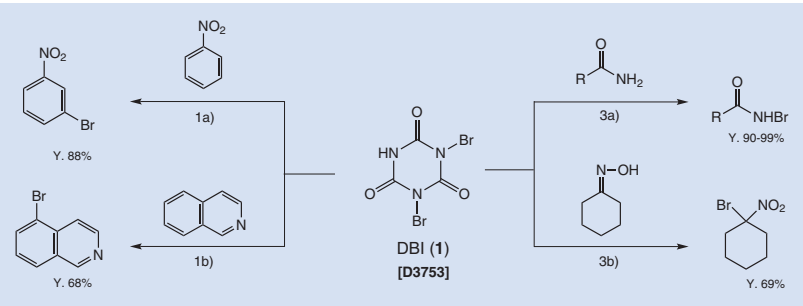
Halogenation

Halogenation is a basic and fundamental transformation in organic chemistry, and halogenated compounds are of extreme importance as building blocks in organic synthesis. The development of modern coupling reactions, such as the Suzuki-Miyaura and Mizoroki-Heck reactions, have greatly increased the demand for halogenated compounds as starting materials. In response to this situation, many novel halogenating reagents have been developed.

The page below shows some examples of brominating and iodinating reagents, which have been released recently in our lineup of products.

Example of brominating products:

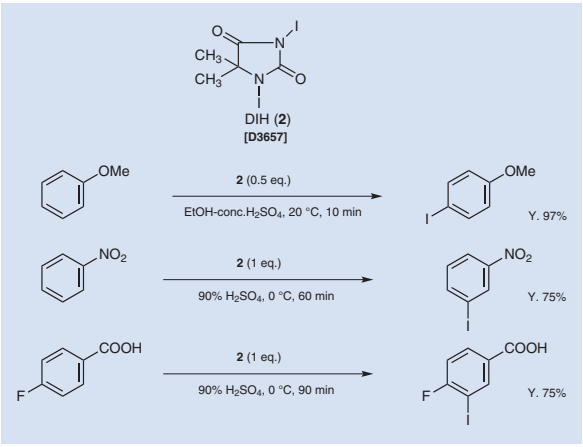
Dibromoisocyanuric acid (DBI) (**1**), which was first reported by Gottardi, is a mild and highly effective brominating reagent,[1,2] and has superior brominating ability when compared with *N*-bromosuccinimide (NBS), which is frequently used in organic synthesis. For instance, nitrobenzene was converted to the 3-bromonitrobenzene in 88% yield with **1** in conc. sulfuric acid in 5 min at 20°C, [1a] but in only 70% yield with NBS in 50% sulfuric acid in 3 h at 85°C. Thus **1** has been widely used as an effective brominating reagent.[3]



Example of iodinating products:

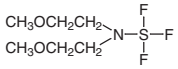
1,3-Diiodo-5,5'-dimethylhydantoin (DIH) (**2**), which was first reported by Ozazi, is an useful iodinating reagent.[4] **2** has higher reactivity and selectivity than molecular iodine or *N*-iodosuccinimide (NIS), which are frequently used for iodination reaction. **2** is a pale yellow solid that does not sublime like molecular iodine, and has low toxicity, which makes it easier to handle. In addition, dimethylhydantoin, which is formed after the reaction, can easily be removed by aqueous extraction.

2 reacts smoothly at room temperature with aromatic compounds in the presence of sulfuric acid to give the corresponding iodinated aromatic compounds in a high regioselectivity and a high yield. Moreover, even low-activated substances such as nitrobenzene can easily be iodinated by using sulfuric acid.[5]

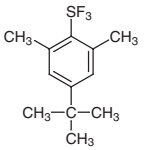


Fluorination

B2440

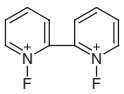


B3664

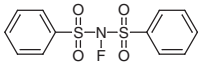


D1868

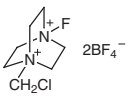
D3812



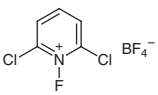
F0335



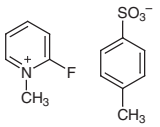
F0358



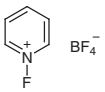
F0344



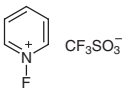
F0225



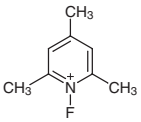
F0343



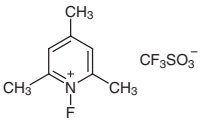
F0327



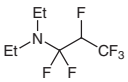
F0346



F0328



H0598



M1573

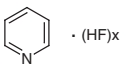
P1758

KF

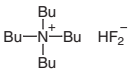
P1888

KHF_2

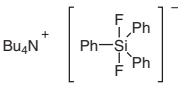
P0999



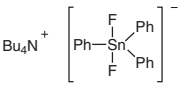
T1295



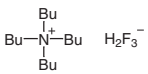
T1909



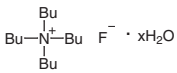
T1592



T1635



T1037
T1339
T1125
T1338



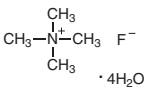
T2027

$(CH_3CH_2)_4NF \cdot 4HF$

T2026

$(CH_3CH_2)_4NF \cdot 3HF$

T2754



T2023

$(CH_3CH_2)_3N \cdot 5HF$

T2022

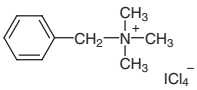
$(CH_3CH_2)_3N \cdot 3HF$

Product No.	Product Name			Unit Size
B2440	Bis(2-methoxyethyl)aminosulfur Trifluoride		5g	25g
B3664	4-*tert*-Butyl-2,6-dimethylphenylsulfur Trifluoride (FLUOLEAD™)			5g
D1868	(Diethylamino)sulfur Trifluoride (DAST)	5g	25g	100g
D3812	1,1'-Difluoro-2,2'-bipyridinium Bis(tetrafluoroborate)			1g
F0335	*N*-Fluorobenzenesulfonimide (NFSI)		5g	25g
F0358	*N*-Fluoro-*N*'-(chloromethyl)triethylenediamine Bis(tetrafluoroborate) (F-TEDA-BF_4)	5g	25g	100g
F0344	1-Fluoro-2,6-dichloropyridinium Tetrafluoroborate		5g	25g
F0225	2-Fluoro-1-methylpyridinium *p*-Toluenesulfonate		5g	25g
F0343	1-Fluoropyridinium Tetrafluoroborate		5g	25g
F0327	1-Fluoropyridinium Trifluoromethanesulfonate		5g	25g
F0346	1-Fluoro-2,4,6-trimethylpyridinium Tetrafluoroborate			5g
F0328	1-Fluoro-2,4,6-trimethylpyridinium Trifluoromethanesulfonate		5g	25g
H0598	Ishikawa's Reagent	25g	100g	500g
M1573	Morpholinosulfur Trifluoride (Morph-DAST)		1g	5g

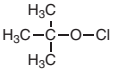
Product No.	Product Name	Unit Size		
P1758	Potassium Fluoride			300g
P1888	Potassium Hydrogenfluoride			500g
P0999	Pyridinium Poly(hydrogenfluoride)		25g	100g
T1295	Tetrabutylammonium Bifluoride		5g	25g
T1909	Tetrabutylammonium Difluorotriphenylsilicate		5g	25g
T1592	Tetrabutylammonium Difluorotriphenylstannate		1g	5g
T1635	Tetrabutylammonium Dihydrogen Trifluoride		5g	25g
T1037	Tetrabutylammonium Fluoride Hydrate		25g	100g
T1339	Tetrabutylammonium Fluoride (70-75% in Water)		25g	500g
T1125	Tetrabutylammonium Fluoride (*ca.* 1mol/L in Tetrahydrofuran)		25mL	100mL
T1338	Tetrabutylammonium Fluoride (*ca.* 1mol/L in Tetrahydrofuran)	25mL	100mL	500mL
T2027	Tetraethylammonium Fluoride Tetrahydrofluoride			10g
T2026	Tetraethylammonium Fluoride Trihydrofluoride			10g
T2754	Tetramethylammonium Fluoride Tetrahydrate		5g	25g
T2023	Triethylamine Pentahydrofluoride			10g
T2022	Triethylamine Trihydrofluoride			10g

Chlorination

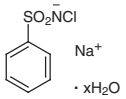
B1543



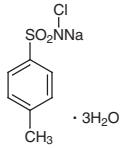
H0362



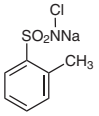
C0075



C0076

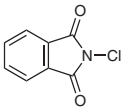


C1374

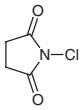


C0202

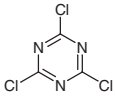
C0802



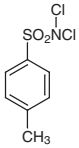
C0291



C0460



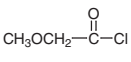
D0318



D1645

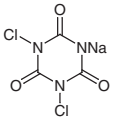
M0094

M0970



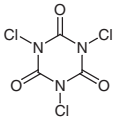
O0082

D1003



T2048
T2040

T0620



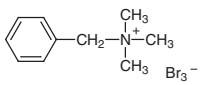
T0611

Product No.	Product Name	Unit Size		
B1543	Benzyltrimethylammonium Tetrachloroiodate			5g
H0362	*tert*-Butyl Hypochlorite		25g	500g
C0075	Chloramine B Hydrate		25g	500g
C0076	Chloramine T Trihydrate		25g	500g
C1374	*o*-Chloramine T			25g
C0202	Chloromethyl Methyl Ether	25g	100g	500g

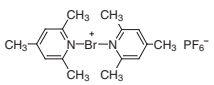
Product No.	Product Name	Unit Size		
C0802	*N*-Chlorophthalimide		25g	500g
C0291	*N*-Chlorosuccinimide	25g	100g	500g
C0460	Cyanuric Chloride		25g	500g
D0318	Dichloramine T		25g	500g
D1645	Dichloromethyl Methyl Ether		25g	250g
M0094	Methanesulfonyl Chloride		25g	500g
M0970	Methoxyacetyl Chloride		25g	500g
O0082	Oxalyl Chloride	25g	100g	500g
D1003	Sodium Dichloroisocyanurate		25g	500g
T2048	Thionyl Chloride (*ca.* 1mol/L in Dichloromethane)			500mL
T2040	Thionyl Chloride			500mL
T0620	Trichloroisocyanuric Acid		25g	500g
T0611	Trichloromethanesulfonyl Chloride		5g	25g

Bromination

T1382



B2358

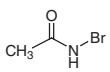


B2553

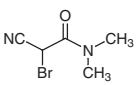
B2414

Br_2

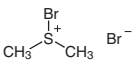
B0530



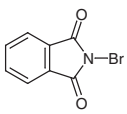
B1016



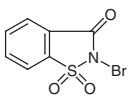
B3311



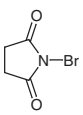
B1697



B2152

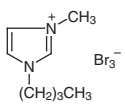


B0656

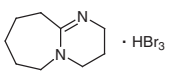


B0662

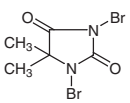
B3596



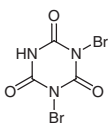
D3976



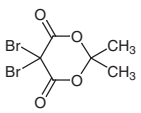
D1265



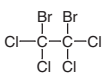
D3753



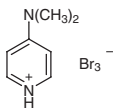
D1710



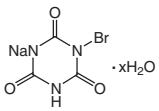
D1987



D1787



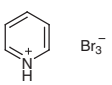
B2148



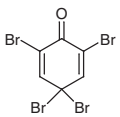
P1743

PBr_3

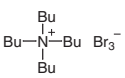
P0825



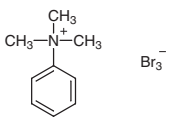
T1235



T1284



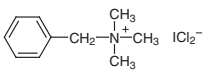
P0928



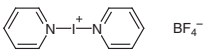
Product No.	Product Name	Unit Size		
T1382	Benzyltrimethylammonium Tribromide		5g	25g
B2358	Bis(2,4,6-trimethylpyridine)bromonium Hexafluorophosphate		1g	5g
B2553	Boron Tribromide (17% in Dichloromethane, *ca.* 1mol/L)			100mL
B2414	Bromine		90g	500g
B0530	*N*-Bromoacetamide		5g	25g
B1016	2-Bromo-2-cyano-*N*,*N*-dimethylacetamide			5g
B3311	Bromodimethylsulfonium Bromide		5g	25g
B1697	*N*-Bromophthalimide		5g	25g
B2152	*N*-Bromosaccharin		5g	25g
B0656	*N*-Bromosuccinimide	25g	100g	500g
B0662	Bromotrichloromethane		25g	500g
B3596	1-Butyl-3-methylimidazolium Tribromide			5g
D3976	1,8-Diazabicyclo[5.4.0]-7-undecene Hydrogen Tribromide			5g
D1265	1,3-Dibromo-5,5-dimethylhydantoin		25g	500g
D3753	Dibromoisocyanuric Acid		5g	25g
D1710	5,5-Dibromomeldrum's Acid (=5,5-Dibromo-2,2-dimethyl-4,6-dioxy-1,3-dioxane)		5g	25g
D1987	1,2-Dibromo-1,1,2,2-tetrachloroethane			25g
D1787	4-Dimethylaminopyridinium Bromide Perbromide		5g	25g
B2148	Monosodium Bromoisocyanurate Hydrate			25g
P1743	Phosphorus Tribromide			300g
P0825	Pyridinium Bromide Perbromide		25g	500g
T1235	2,4,4,6-Tetrabromo-2,5-cyclohexadienone		5g	25g
T1284	Tetrabutylammonium Tribromide	25g	100g	500g
P0928	Trimethylphenylammonium Tribromide		25g	500g

Iodination

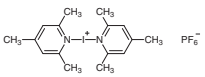
B1604



B2539



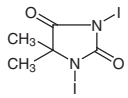
B2359



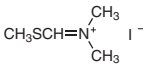
C1190

ICH_2CH_2Cl

D3657



D4340



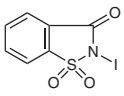
H1221

HI

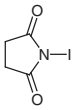
I0604

I_2

I0784

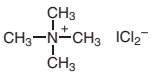


I0074



P2086

T2717



I0308

Product No.	Product Name	Unit Size	
B1604	Benzyltrimethylammonium Dichloroiodate	5g	25g
B2539	Bis(pyridine)iodonium Tetrafluoroborate		1g
B2359	Bis(2,4,6-trimethylpyridine)iodonium Hexafluorophosphate	1g	5g
C1190	1-Chloro-2-iodoethane (stabilized with Copper chip)	1g	5g
D3657	1,3-Diiodo-5,5-dimethylhydantoin	5g	25g
D4340	*N*,*N*-Dimethyl-*N*-(methylsulfanylmethylene)ammonium Iodide	5g	25g

Product No.	Product Name			Unit Size
H1221	Hydriodic Acid (57%)			300mL
I0604	Iodine		25g	500g
I0784	*N*-Iodosaccharin			5g
I0074	*N*-Iodosuccinimide	5g	25g	100g
P2086	Pyridine Iodine Monochloride		1g	5g
T2717	Tetramethylammonium Dichloroiodate			5g
I0308	Trimethylsilyl Iodide (stabilized with Aluminum)		5g	25g

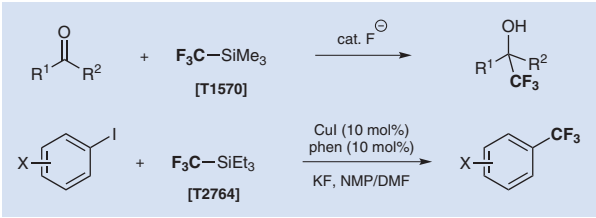
References

1) a) W. Gottardi, *Monatsh. Chem.* **1968**, *99*, 815; b) W. D. Brown, A. H. Gouliaev, *Synthesis* **2002**, 83.
2) S. C. Virgil, in *Encyclopedia of Reagents for Organic Synthesis*, ed. by L. A. Paquette, John Wiley & Sons, Chichester, **2001**, pp. 1560-1561.
3) a) Z. P. Demko, M. Bartsch, K. B. Sharpless, *Org. Lett.* **2000**, *2*, 2221; b) T. R. Walters, W. W. Zajac Jr., J. M. Woods, *J. Org. Chem.* **1991**, *56*, 316.
4) O. O. Orazi, R. A. Corral, H. E. Bertorello, *J. Org. Chem.* **1965**, *30*, 1101.
5) V. K. Chaikovskii, V. D. Filimonov, A. A. Funk, V. I. Skorokhodov, V. D. Ogorodnikov, *Russ. J. Org. Chem.* **2007**, *43*, 1291.

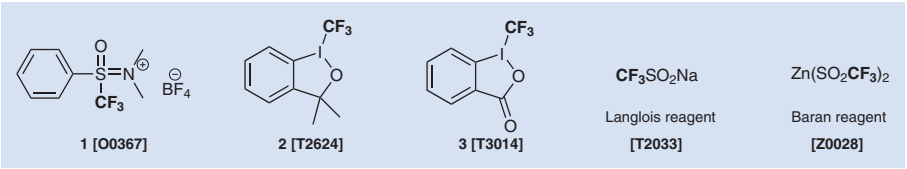
Trifluoromethylation

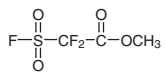
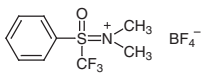
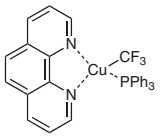
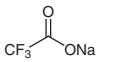
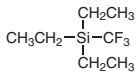
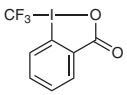
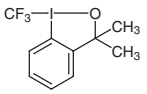
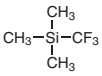
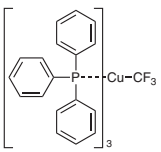
The size of a fluorine atom is similar to a hydrogen atom but the electric property of it is more electronegative. So, by replacing a hydrogen atom of substances with a fluorine atom, their biological properties can be dramatically changed without a conformational change. Recently, the synthetic and biological studies of fluorinated molecules have attracted a lot of interest in the fields of pharmaceuticals and agrochemicals research. Especially, the synthetic study of the trifluoromethyl group-containing compounds is now actively proceeding.

As a method for direct trifluoromethylation, nucleophilic and electrophilic/radical fluorinating reactions are commonly used. Ruppert-Prakash reagent ((Trifluoromethyl)trimethylsilane) is the most popular nucleophilic trifluoromethylating reagent and which readily reacts with a fluoride ion to release the trifluoromethylanion species. This active species shows nucleophilicity and reacts with carbonyl compounds to proceed with the trifluoromethylation.[1] Also, the nucleophilic trifluoromethylation of aromatic halides can be performed with the use of copper catalysts.[2]

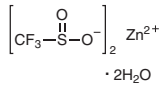


The study of electrophilic trifluoromethylations has lagged compared to that of nucleophilic trifluoromethylations. However, recently some reagents usable for electrophilic trifluoromethylation have been reported. Shibata *et al*. have developed an electrophilic *α*-trifluoromethylation of *β*-ketoesters using the fluorinated Johnson reagent **1**.[3] The hypervalent iodine(III)–CF_3 reagents **2** and **3** developed by Togni *et al*. are widely used for trifluoromethylations of thiols, alcohols, phosphines, and heteroarenes.[4] Also, Baran *et al*. have reported the radical trifluoromethylation of heteroarenes using the Langlois reagent or zinc(II) bis(trifluoromethanesulfinate) ($Zn(SO_2R)_2$) with *tert*-butyl hydroperoxide.[5]



F0311	O0367	P2172	T1336	T2033
				CF_3SO_2Na
T2764	T3014	T2624	T1570	T2883
				

Z0028



Product No.	Product Name		Unit Size	
F0311	Methyl Difluoro(fluorosulfonyl)acetate		5g	25g
O0367	[(Oxido)phenyl(trifluoromethyl)-λ^4-sulfanylidene]dimethylammonium Tetrafluoroborate		200mg	1g
P2172	(1,10-Phenanthroline)(trifluoromethyl)(triphenylphosphine)copper(I)		1g	5g
T1336	Sodium Trifluoroacetate	25g	100g	500g
T2033	Sodium Trifluoromethanesulfinate		5g	25g
T2764	Triethyl(trifluoromethyl)silane		1g	5g
T3014	1-Trifluoromethyl-1,2-benziodoxol-3(1*H*)-one (contains 60% Diatomaceous earth)		1g	5g
T2624	1-Trifluoromethyl-3,3-dimethyl-1,2-benziodoxole		1g	5g
T1570	(Trifluoromethyl)trimethylsilane		5g	25g
T2883	(Trifluoromethyl)tris(triphenylphosphine)copper(I)		1g	5g
Z0028	Zinc(II) Bis(trifluoromethanesulfinate) Dihydrate		1g	5g

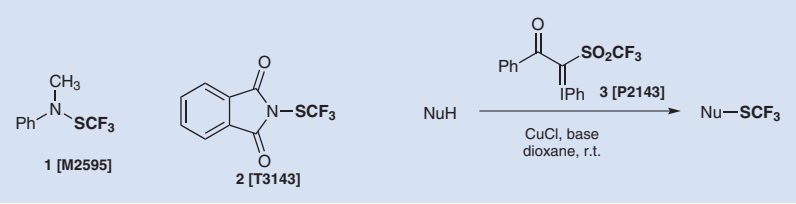
References

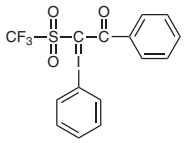
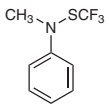
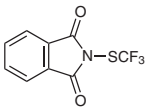
1) a) I. Ruppert, K. Schlich, W. Volbach, *Tetrahedron Lett*. **1984**, *25*, 2195.
b) G. K. S. Prakash, R. Krishnamurti, G. A. Olah, *J. Am. Chem. Soc*. **1989**, *111*, 393.
2) M. Oishi, H. Kondo, H. Amii, *Chem. Commun*. **2009**, 1909.
3) S. Noritake, N. Shibata, S. Nakamura, T. Toru, M. Shiro, *Eur. J. Org. Chem*. **2008**, 3465.
4) a) P. Eisenberger, S. Gischig, A. Togni, *Chem. Eur. J*. **2006**, *12*, 2579.
b) I. Kieltsch, P. Eisenberger, A. Togni, *Angew. Chem. Int. Ed*. **2007**, *46*, 754.
c) P. Eisenberger, I. Kieltsch, N. Armanino, A. Togni, *Chem. Commun*. **2008**, 1575.
d) K. Stanek, R. Koller, A. Togni, *J. Org. Chem*. **2008**, *73*, 7678.
e) P. Eisenberger, I. Kiltsch, R. Koller, K. Stanek, A. Togni, *Org. Synth*. **2011**, *88*, 168.
5) a) B. R. Langlois, E. Laurent, N. Roidot, *Tetrahedron Lett*. **1991**, *32*, 7525.
b) Y. Ji, T. Bruecki, R. D. Baxter, Y. Fujiwara, I. B. Seiple, S. Su, D. G. Blackmond, P. S. Baran, *Proc. Natl. Acad. Sci. USA* **2011**, *108*, 14411.
c) Y. Fujiwara, J. A. Dixon, R. A. Rodriguez, R. D. Baxter, D. D. Dixon, M. R. Collins, D. G. Blackmond, P. S. Baran, *J. Am. Chem. Soc*. **2012**, *134*, 1494.
d) Y. Fujiwara, J. A. Dixon, F. O'Hara, E. Daa Funder, D. D. Dixon, R. A. Rodriguez, R. D. Baxter, B. Herlé, N. Sach, M. R. Collins, Y. Ishihara, P. S. Baran, *Nature* **2012**, *492*, 95.

Trifluoromethylthiolation

The trifluoromethylthio group (CF_3S) has attracted attention as a potentially-significant functional group in the pharmaceutical and agrochemical fields because of its strong electron-withdrawing effect and high lipophilicity. Some methods for direct trifluoromethylthiolation have been developed[1-4] and one of them, copper(I) trifluoromethanethiolate ($CuSCF_3$) is an effective nucleophilic trifluoromethylthiolating reagent. On the other hand, a simple electrophilic reagent, trifluoromethylsulphenyl chloride (CF_3SCl) is gaseous and highly toxic, so it is hardly used now.

Recently, some electrophilic trifluoromethylthiolating reagents which are safer to use and easier to handle, have been reported. Both *N*-methyl-*N*-(trifluoromethylthio)aniline[1] developed by Billard *et al*. and *N*-(trifluoromethylthio)phthalimide[4] developed by Rueping are useful electrophilic trifluoromethylthiolating reagents because their states are liquid and solid respectively. In addition, Shibata *et al*. have developed a hypervalent iodonium ylide having a trifluoromethanesulfonyl group **3**, and used it for the electrophilic trifluoromethylthiolation. In this reaction, it seems that the trifluoromethylthiocation species generated *in situ* by the reduction of **3** acts as an electrophilic trifluoromethylthiolating reagent for enamines, indoles and *β*-ketoesters.[3]



P2143	C1159	M2595	T3143
	CF_3SCu		

Product No.	Product Name	Unit Size	
P2143	Benzoyl(phenyliodonio)(trifluoromethanesulfonyl)methanide	1g	5g
C1159	Copper(I) Trifluoromethanethiolate	1g	5g
M2595	*N*-Methyl-*N*-(trifluoromethylthio)aniline	200mg	1g
T3143	*N*-(Trifluoromethylthio)phthalimide	1g	5g

References

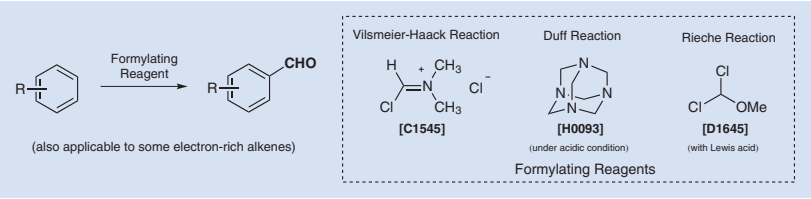
1) a) F. Baert, J. Colomb, T. Billard, *Angew. Chem. Int. Ed.* **2012**, *51*, 10382.
b) A. Ferry, T. Billard, E. Bacqué, B. R. Langlois, *J. Fluorine Chem.* **2012**, *134*, 160.
c) Y. Yang, X. Jiang, F.-L. Qing, *J. Org. Chem.* **2012**, *77*, 7538.
d) A. Ferry, T. Billard, B. R. Langlois, E. Bacqué, *Angew. Chem. Int. Ed.* **2009**, *48*, 8551.
2) X. Shao, X. Wang, T. Yang, L. Lu, Q. Shen, *Angew. Chem. Int. Ed.* **2013**, *52*, 3457.
3) Y.-D. Yang, A. Azuma, E. Tokunaga, M. Yamasaki, M. Shiro, N. Shibata, *J. Am. Chem. Soc.* **2013**, *135*, 8782.
4) R. Pluta, P. Nikolaienko, M. Rueping, *Angew. Chem. Int. Ed.* **2014**, *53*, 1650.

Formylation

Formyl group-containing compounds are important building blocks in organic synthesis since the formyl group can be transformed to other various functional groups. Aldehydes are the most typical formyl group-containing compound and are widely used as a substrate for carbon-carbon bond forming reactions such as the aldol reaction and the Wittig reaction.[1-2] Also, their oxidation/reduction converts them to the related alcohols and carboxylic acids respectively, while the reductive amination is an efficient functional transformation of the formyl group into amines.[3-5] As above reactions,the formyl group is a versatile precursor of organosynthetic reactions and a number of various formyl group introducing reagents have been developed.

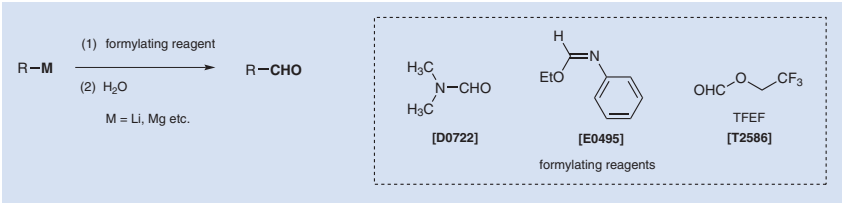
Reagents for the formylation are classified into three types according to their reactivity and substrates: (1) electrophilic aromatic substitution, (2) reaction with carbon nucleophiles, and (3) direct formylation at oxygen or nitrogen atoms.

(1) Electrophilic aromatic substitution



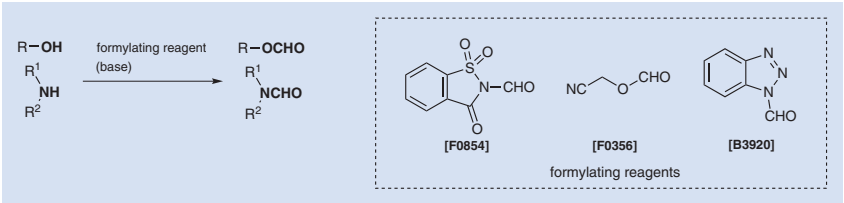
Vilsmeier reagent is a strong electrophile and formylates electron-rich alkenes and aromatic rings by electrophilic aromatic substitution.[6] This reagent is widely used and can be prepared by the reaction of DMF or *N*-methylformanilide with phosphoryl chloride.[7] The Duff reaction using hexamethylenetetramine is effective to formylate electron-rich aromatic compounds such as phenols and indoles.[8] Furthermore, the Riecke reaction using dichloromethyl methyl ether is suitable for formylation at the sterically hindered site of substances.[9]

(2) Formylation by the reaction with carbon nucleophiles

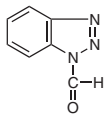
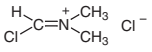
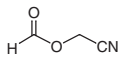
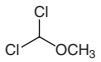
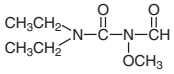
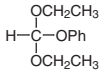
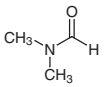
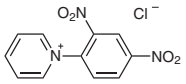
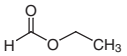
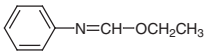
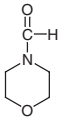
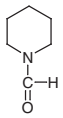
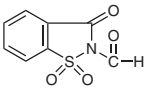
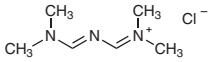
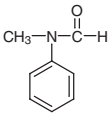
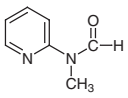
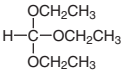
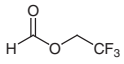
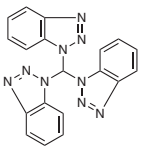


Formyl group-containing compounds can be also synthesized by the reaction of Grignard reagents or organolithium compounds with *N*,*N*-disubstituted formamides, orthoformates, *N*-methoxymethyleneaniline and so on (Bouveault/ Bodroux-Chichibabin aldehyde synthesis).[10,11] In addition, it is known that the direct *C*-formylation of ketones can be performed by the reaction of related ketone enolates with TFEF.[12]

(3) *O*/*N*-Formylation



N-Formylsaccharin, cyanomethyl formate,[13-15] and 1-formyl-1*H*-benzotriazole work as *O*/*N*-formylating reagents, and successfully react with alcohols and amines under mild conditions to afford the desired *O*/*N*-formylated compounds. Especially, *N*-formylsaccharin can be used not only as a formylating reagent but also as a carbon monoxide introducing reagent (for more details, see the page 2.).

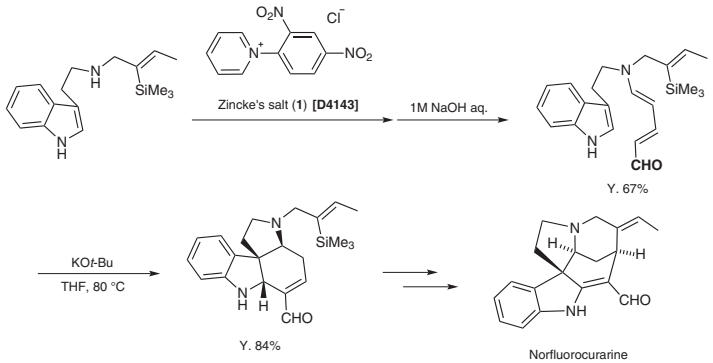
B3920 	C1545 	F0356 	D1645 	D2344 
O0187 	D0722 	D4143 	F0053 	E0495 
F0513 	F0157 	F0234 	F0854 	G0393 
H0093 	M0552 	M1187 	P0018	O0066 
T2586 	O0068 	T3141 		

Product No.	Product Name	Unit Size		
B3920	1*H*-Benzotriazole-1-carboxaldehyde		1g	5g
C1545	(Chloromethylene)dimethyliminium Chloride		25g	250g
F0356	Cyanomethyl Formate		5g	25g
D1645	Dichloromethyl Methyl Ether		25g	250g
D2344	*N*-(Diethylcarbamoyl)-*N*-methoxyformamide			1g
O0187	Diethyl Phenyl Orthoformate		5g	25g
D0722	*N*,*N*-Dimethylformamide	25mL	100mL	500mL
D4143	1-(2,4-Dinitrophenyl)pyridinium Chloride			1g
F0053	Ethyl Formate		25mL	500mL
E0495	Ethyl *N*-Phenylformimidate		5g	25g
F0513	Formic Acid			300mL
F0157	4-Formylmorpholine		25g	500g
F0234	1-Formylpiperidine	25mL	100mL	500mL
F0854	*N*-Formylsaccharin		5g	25g
G0393	Gold's Reagent		5g	25g
H0093	Hexamethylenetetramine		25g	500g
M0552	*N*-Methylformanilide		25g	500g
M1187	*N*-Methyl-*N*-(2-pyridyl)formamide		1g	5g
P0018	Paraformaldehyde		25g	500g
O0066	Triethyl Orthoformate		25mL	500mL
T2586	2,2,2-Trifluoroethyl Formate			5g
O0068	Trimethyl Orthoformate		25mL	500mL
T3141	Tris(1*H*-benzotriazol-1-yl)methane		200mg	1g

References

1) T. Mukaiyama, K. Narasaka, K. Banno, *Chem. Lett*. **1973**, 1011.
2) S. G. Levine, *J. Am. Chem. Soc*. **1958**, *80*, 6150.
3) Seyden-Penne, "Reductions by Alumino- and Borohydrides in Organic Synthesis", 2nd ed., Wiley-VCH, New York, **1997**.
4) B. S. Bal, W. E. Childers Jr, H. W. Pinnick, *Tetrahedron* **1981**, *37*, 2091.
5) A. F. Abdel-Magid, K. G. Carson, B. D. Harris, C. A. Maryanoff, R. D. Shah, *J. Org. Chem*. **1996**, *61*, 3849.
6) a) Tasneem, *Synlett* **2003**, 138.
   b) R. A. Aungst Jr, C. Chan, R. L. Funk, *Org. Lett*. **2001**, *3*, 2611.
7) A. Miyawaki, D. Kikuchi, M. Niki, Y. Manabe, M. Kanematsu, H. Yokoe, M. Yoshida, K. Shishido, *J. Org. Chem*. **2012**, *77*, 8231.
8) a) J. C. Duff, E. J. Bills, *J. Chem. Soc*. **1932**, 1987.
   b) J. C. Duff, E. J. Bills, *J. Chem. Soc*. **1934**, 1305.
   c) J. C. Duff, E. J. Bills, *J. Chem. Soc*. **1941**, 547.
   d) J. C. Duff, E. J. Bills, *J. Chem. Soc*. **1945**, 276.
9) A. Rieche, H. Gross, E. Höft, *Chem. Ber*. **1960**, *93*, 88.
10) L. I. Smith, M. Bayliss, *J. Org. Chem*. **1941**, *6*, 437.
11) L. I. Smith, J. Nichols, *J. Org. Chem*. **1941**, *6*, 489.
12) G. H. Zayia, *Org. Lett*. **1999**, *1*, 989.
13) T. Cochet, V. Bellosta, A. Greiner, D. Roche, J. Cossy, *Synlett* **2011**, 1920.
14) J. Deutsch, H.-J. Niclas, *Synth. Commun*. **1993**, *23*, 1561.
15) G. Bélanger, J. Boudreault, F. Lévesque, *Org. Lett*. **2011**, *13*, 6204.
16) N. U. Hofsløkken, L. Skattebøl, *Acta Chem. Scand*. **1999**, *53*, 258.
17) V. V. Mezheritskii, M. S. Korobov, O. M. Golyanskaya, N. I. Omelichkin, L. G. Minyaeva, G. S. Borodkin, A. A. Milov, A. V. Tsukanov, A. D. Dubonosov, *Russ. J. Org. Chem*. **2012**, *48*, 241.
18) N. Akikusa, K. Mitsui, T. Sakamoto, Y. Kikugawa, *Synthesis* **1992**, 1058.
19) D. Comins, A. I. Meyers, *Synthesis* **1978**, 403.

Zincke Aldehyde Synthesis (introduction of 4-formyl-1,3-butadienyl group)



1-(2,4-Dinitrophenyl)pyridinium chloride (Zincke salt, **1**) reacts with secondary amines to afford the corresponding 5-amino-2,4-pentadienals (Zinke aldehydes).[1)] This type of reaction has been applied to the synthesis of various indole alkaloids.[2)] For example, Vanderwal *et al*. have reported the total synthesis of norfluorocurarine, a Strychnos alkaloid.[3)]

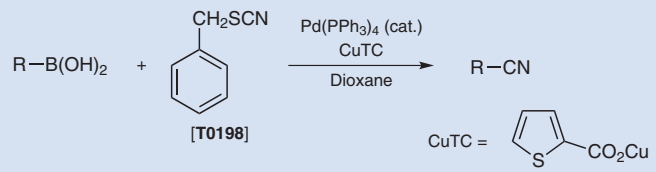
1) T. Zincke, W. Wurker, *Liebigs Ann. Chem*. **1905**, *338*, 107.
2) D. B. C. Martin, L. Q. Nguyen, C. D. Vanderwal, *J. Org. Chem*. **2012**, *77*, 17.
3) D. B. C. Martin, C. D. Vanderwal, *J. Am. Chem. Soc*. **2009**, *131*, 3472.

Cyanation

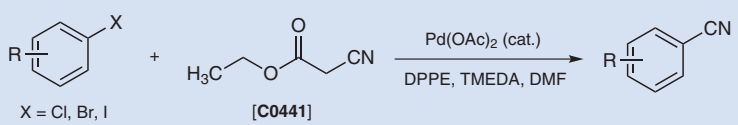
A cyano group is a strong electron withdrawing group and a number of cyanating reagents are widely used in organic synthesis. The cyano group is converted to other functional groups such as carboxylic acids or amides by hydrolysis, and is also converted to amines or aldehydes by reduction with some reducing reagents. Furthermore, alkyl nitriles which are typical cyano group containing compounds are transformed into related ketones by reaction with carbon nucleophilic agents such as Grignard reagents or organolithium reagents. This synthetic method is efficient to synthesize the asymmetric ketones. On the other hand, the cyano group can be used for cycloaddition reactions with other multiple bonds. For instance, alkyl nitriles are additionally cyclized with azides to give the tetrazoles.

As introducing methods for the cyano group, the reaction of potassium cyanide with alkyl halides is a typical synthetic method and the copper cyanide-mediated Sandmeyer reaction and the Rosenmund-von Braun reaction have been known for a long time. Recently, cyanation reactions using palladium catalysts with some cyanating reagents have been developed. In addition, benzyl thiocyanate[1], ethyl cyanoacetate[2], *tert*-butyl isocyanide[3] and acetone cyanohydrin[4] play as cyanide ion sources and can be used for the direct cyanation of various substances.

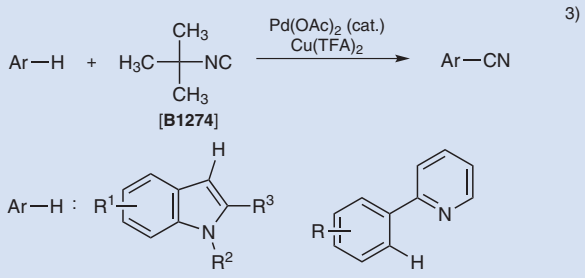
Pd-catalyzed Cross-coupling Cyanation Using Boronic Acids



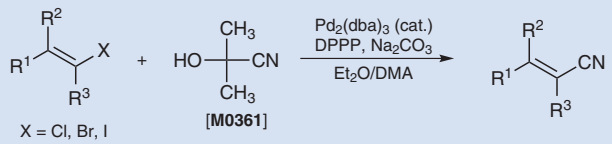
Pd-catalyzed Cyanation of Aryl Halides

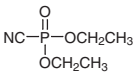
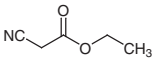
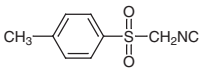
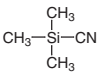


Pd-catalyzed C-H Cyanation



Pd-catalyzed Cyanation of Alkenyl Halides



M0361 	T0198 	B1274 	C3003 	C1952 CuCN
C1242 	C0441 	P1613 KCN	T1046 	T0990 

Product No.	Product Name	Unit Size		
M0361	Acetone Cyanohydrin		25mL	500mL
T0198	Benzyl Thiocyanate		25g	500g
B1274	*tert*-Butyl Isocyanide		5mL	25mL
C3003	2-Chlorobenzyl Thiocyanate		1g	5g
C1952	Copper(I) Cyanide		25g	300g
C1242	Diethyl Cyanophosphonate		5g	25g
C0441	Ethyl Cyanoacetate		25g	500g
P1613	Potassium Cyanide			25g
T1046	*p*-Toluenesulfonylmethyl Isocyanide		5g	25g
T0990	Trimethylsilyl Cyanide	25mL	100mL	500mL

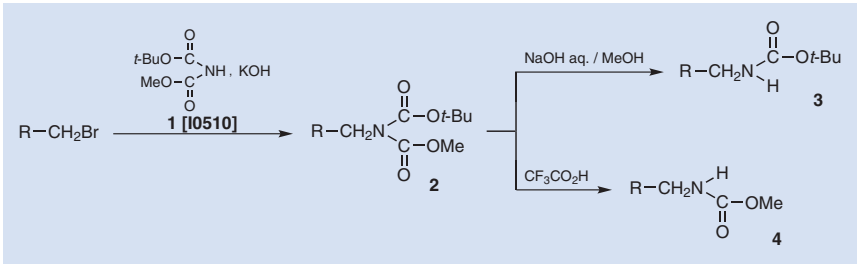
References

1) Z. Zhang, L. S. Liebeskind, *Org. Lett*. **2006**, *8*, 4331.
2) S. Zheng, C. Yu, Z. Shen, *Org. Lett*. **2012**, *14*, 3644.
3) J. Peng, J. Zhao, Z. Hu, D. Liang, J. Huang, Q. Zhu, *Org. Lett*. **2012**, *14*, 4966.
4) K. J. Powell, L.-C. Han, P. Sharma, J. E. Moses, *Org. Lett*. **2014**, *16*, 2158.

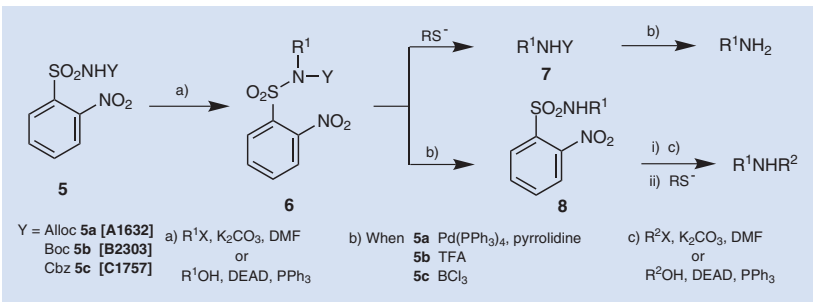
Amination

The Gabriel reagent is widely used as a nucleophilic aminating agent since its reactivity is reliable and its handling is easy.[1] A variety of aminating agents analogous to the Gabriel reagent have been reported.

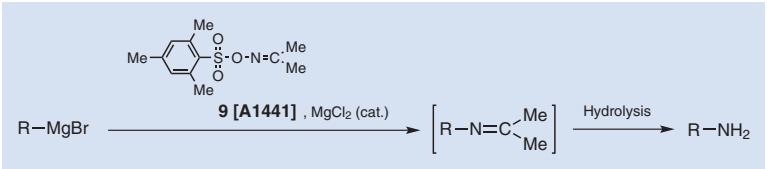
The potassium salt of imide **1** reacts with alkyl halide to give imide **2**. **2** is treated with base or acid to give either *N*-Boc-amine **3** or *N*-methoxycarbonylamine **4**, respectively. Moreover, **1** also serves as an acid nucleophile in the Mitsunobu reaction to allow for the conversion of hydroxy groups to amino groups. Therefore, **1** is a useful reagent to give monoprotected amines.[2]

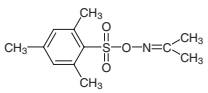
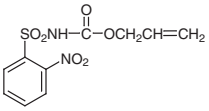
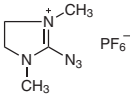


Fukuyama and co-workers have demonstrated various reactions using the *N*-substituted sulfonamide **5**.[3] Smooth reactions of **5** occur with alkyl halides under basic conditions and alcohols under Mitsunobu conditions to provide *o*-nitrobenzenesulfonyl (*o*-Ns) amines **6**. The various *o*-Ns amines (Alloc, Boc, Cbz) **6** obtained from these reactions can be selectively deprotected, under the appropriate conditions, to afford the monoprotected amines **7** and **8**. Furthermore, **7** can be converted to the primary amine in high yields via a second deprotection. **8** can be converted to the secondary amine in high yields by repeating the alkylation and deprotection process.[4]

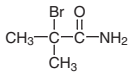


On the other hand, acetoxime *O*-(2,4,6-trimethylphenyl)sulfonate **9** has been reported as a useful electrophilic aminating agent. **9** reacts with Grignard reagents in the presence of a catalytic amount of magnesium chloride to afford primary amines in good yields.[5]

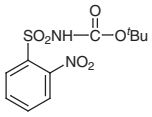


A1441	A1632	A1137	A2457	A1341
				

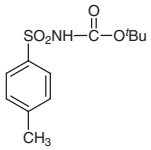
B3380



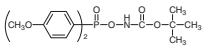
B2303



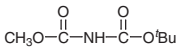
B1648



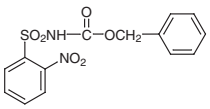
B2857



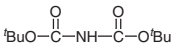
I0510



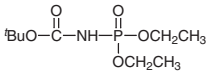
C1757



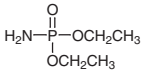
I0497



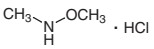
B1734



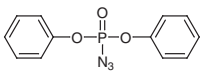
D2361



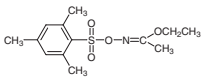
D1899



D1672



M1182

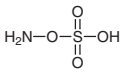


H0093

H0258

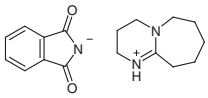
H0196

H0530

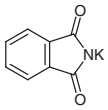


M0886
M0343

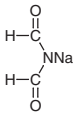
P1235



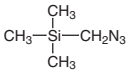
P0403



D2479



T1184



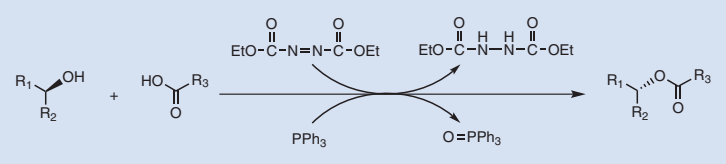
Product No.	Product Name			Unit Size
A1441	Acetoxime *O*-(2,4,6-Trimethylphenylsulfonate)		5g	25g
A1632	*N*-Allyloxycarbonyl-2-nitrobenzenesulfonamide			5g
A1137	4-Amino-1,2,4-triazole		25g	250g
A2457	2-Azido-1,3-dimethylimidazolinium Hexafluorophosphate			5g
A1341	Azidomethyl Phenyl Sulfide			5g
B3380	2-Bromoisobutyramide		5g	25g
B2303	*N*-(*tert*-Butoxycarbonyl)-2-nitrobenzenesulfonamide	1g	5g	25g
B1648	*N*-(*tert*-Butoxycarbonyl)-*p*-toluenesulfonamide		10g	25g
B2857	*tert*-Butyl [Bis(4-methoxyphenyl)phosphinyloxy]carbamate		1g	5g
I0510	*tert*-Butyl Methyl Iminodicarboxylate			5g
C1757	*N*-Carbobenzoxy-2-nitrobenzenesulfonamide		5g	25g
I0497	Di-*tert*-butyl Iminodicarboxylate		5g	25g
B1734	Diethyl *N*-(*tert*-Butoxycarbonyl)phosphoramidate			5g
D2361	Diethyl Phosphoramidate			25g
D1899	*N*,*O*-Dimethylhydroxylamine Hydrochloride	25g	100g	500g
D1672	Diphenylphosphoryl Azide	5g	25g	250g
M1182	Ethyl *O*-Mesitylsulfonylacetohydroxamate	1g	5g	25g
H0093	Hexamethylenetetramine		25g	500g
H0258	Hydroxylamine Hydrochloride		25g	500g
H0196	Hydroxylamine Sulfate		25g	500g
H0530	Hydroxylamine-*O*-sulfonic Acid	25g	100g	500g
M0886	*O*-Methylhydroxylamine Hydrochloride (*ca.* 40% in Water, *ca.* 5.4mol/L)		25mL	500mL
M0343	*O*-Methylhydroxylamine Hydrochloride	25g	100g	500g
P1235	Phthalimide DBU Salt			25g

Product No.	Product Name	Unit Size	
P0403	Phthalimide Potassium Salt	25g	500g
D2479	Sodium Diformylamide		25g
T1184	Trimethylsilylmethyl Azide	1g	5g

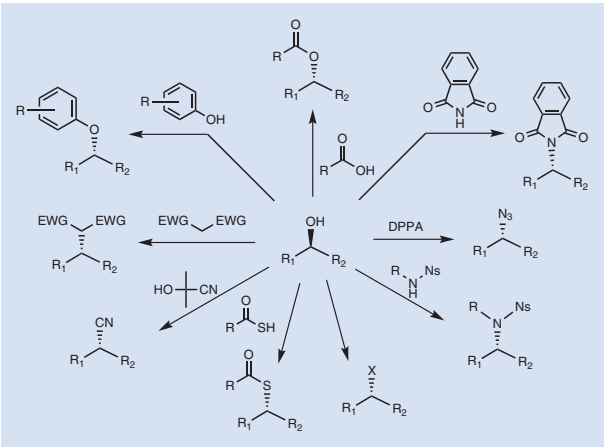
References

1) S. Gabriel, *Ber*. **1887**, *20*, 2224; M. S. Gibson, R. W. Bradshaw, *Angew. Chem. Int. Ed. Engl*. **1968**, *7*, 919; U. Ragnarsson, L. Grehn, *Acc. Chem. Res*. **1991**, *24*, 285.
2) J. D. Elliott, J. H. Jones, *J. Chem. Soc., Chem. Commun*. **1977**, 758; C. T. Clarke, J. D. Elliott, J. H. Jones, *J. Chem. Soc., Perkin Trans. 1* **1978**, 1088; J. M. Chong, S. B. Park, *J. Org. Chem*. **1993**, *58*, 7300.
3) T. Fukuyama, M. Cheung, T. Kan, *Synlett* **1999**, 1301.
4) T. Kan, A. Fujiwara, H. Kobayashi, T. Fukuyama, *Tetrahedron* **2002**, *58*, 6267.
5) E. Erdik, M. Ay, *Synth. React. Inorg. Met.-Org. Chem*. **1989**, *19*, 663.

Mitsunobu Reaction

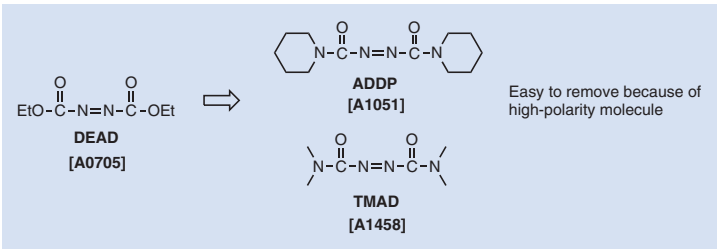


The Mitsunobu reaction is a unique dehydration-condensation reaction of alcohols with various organic acids, which together with azodicarboxylate esters and triphenylphosphine are generally used as dehydration-condensation reagents.[1] The Mitsunobu reaction is carried out under mild conditions and alcohols with a chiral center are inverted with the Walden-inversion. Acid components such as carboxylic acids, phenols, active methylene compounds and imides are applicable for this transformation. Therefore, the Mitsunobu reaction is one of the most useful synthetic methods in organic synthesis.

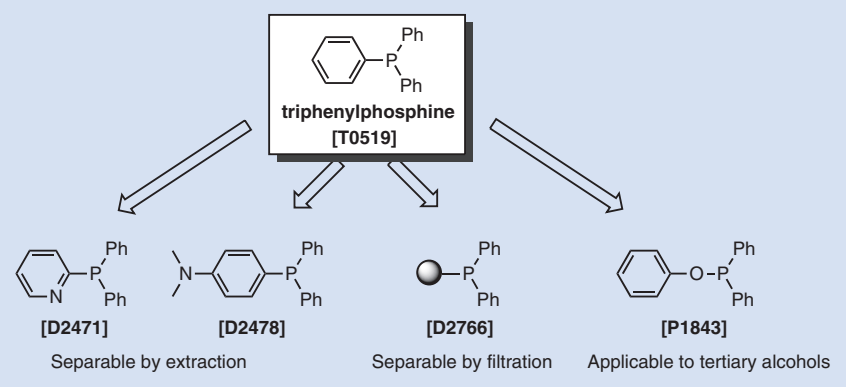


Also, synthetic applications of the Mitsunobu reaction have been widely studied due to its excellent chemical reactivity and various improved synthetic methods have been reported as follows.[2]

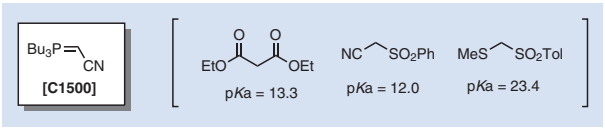
1) The basicity of the azodicarboxyamide derivatives is higher compared to that of azodicarboxylate esters, and its chemical property expands the availability of the acids into weaker acids with high p*K*a value. In addition, after the reactions, these reagents can be easily removed by column chromatography or extraction because they are high-polarity molecules.[3]



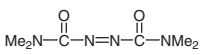
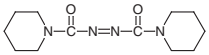
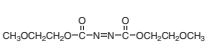
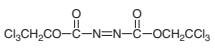
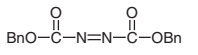
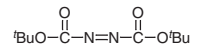
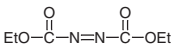
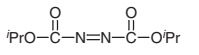
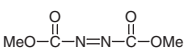
2) By using phosphines with a base moiety[4] or diphenylphosphinopolystyrene resins[5] instead of triphenylphosphine, the generated phosphine oxides can be easily removed. In addition, phenoxydiphenylphosphine is an effective agent when sterically hindered tertiary alcohols are employed.[6]



3) Tsunoda *et al*. have reported that cyanomethylene tributyl phosphorane is an effective agent for improving the Mitsunobu reaction.[7] It plays roles of both azodicarboxylate esters and tributylphosphine independently, and enables the Mitsunobu reaction to proceed even when using nucleophiles such as active methylene compounds with high p*K*a values as well as typical organic acids. However, it is necessary to pay attention when this reagent is used with ketones or aldehydes because it behaves like a Wittig reagent.[8]



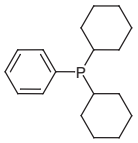
4) It has been reported that the stoichiometry used for the amounts of azodicarboxylate esters can be reduced to catalytic amounts of one by using iodobenzene diacetate or iron phthalocyanine as a reoxidant.[9] This method can reduce the hydrazide by-product to a minimum.

Azodicarboxylates & Amides		A1458	A1051	B3364
				
A1332	A0776	D3544	A0705	A1246
				
A0882				
				

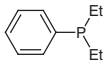
Product No.	Product Name	Unit Size		
A1458	1,1'-Azobis(*N*,*N*-dimethylformamide)		1g	5g
A1051	1,1'-(Azodicarbonyl)dipiperidine		5g	25g
B3364	Bis(2-methoxyethyl) Azodicarboxylate			5g
A1332	Bis(2,2,2-trichloroethyl) Azodicarboxylate			5g
A0776	Dibenzyl Azodicarboxylate (40% in Dichloromethane, *ca.* 1.7mol/L)			25g
D3544	Di-*tert*-butyl Azodicarboxylate (20% in Toluene)			25g
A0705	Diethyl Azodicarboxylate (40% in Toluene, *ca.* 2.2mol/L)	25g	100g	250g
A1246	Diisopropyl Azodicarboxylate (40% in Toluene, *ca.* 1.9mol/L)	25g	100g	250g
A0882	Dimethyl Azodicarboxylate (40% in Toluene, *ca.* 2.7mol/L)			25g

Phosphines (Mitsunobu Reaction)

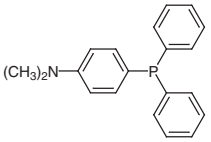
D2411



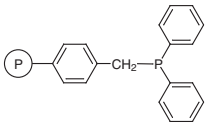
D1019



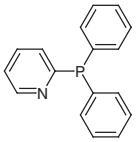
D2478



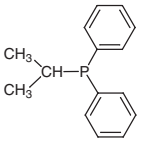
D2766



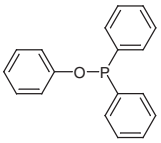
D2471



I0583



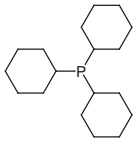
P1843



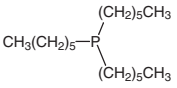
T1912

T0361

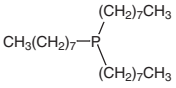
T1165



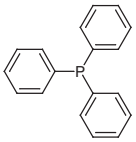
T1005



T0503



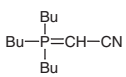
T0519



Product No.	Product Name	Unit Size		
D2411	Dicyclohexylphenylphosphine		1g	5g
D1019	Diethylphenylphosphine		1mL	5mL
D2478	4-(Dimethylamino)phenyldiphenylphosphine		1g	5g
D2766	4-Diphenylphosphinomethyl Polystyrene Resin cross-linked with 2% DVB (200-400mesh) (0.5-1.0mmol/g)			5g
D2471	Diphenyl-2-pyridylphosphine		1g	5g
I0583	Isopropyldiphenylphosphine		1g	5g
P1843	Phenoxydiphenylphosphine		5g	25g
T1912	Tri-*tert*-butylphosphine			5g
T0361	Tributylphosphine	25mL	100mL	500mL
T1165	Tricyclohexylphosphine (contains Tricyclohexylphosphine Oxide) (*ca.* 18% in Toluene, *ca.* 0.60mol/L)			25mL
T1005	Trihexylphosphine			25mL
T0503	Tri-*n*-octylphosphine	25mL	100mL	500mL
T0519	Triphenylphosphine		25g	500g

Modified New Mitsunobu Reaction (Tsunoda Reagent)

C1500



Product No.	Product Name	Unit Size		
C1500	Cyanomethylenetributylphosphorane	1g	5g	25g

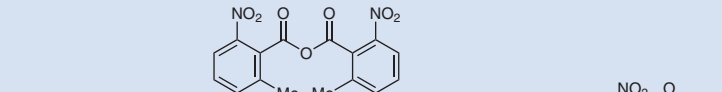
References

1) O. Mitsunobu, *Synthesis* **1981**, 1.
2) T. Onozawa, *TCIMAIL* **1999**, number *104*, 10.
3) a) T. Tsunoda, Y. Yamamiya, S. Ito, *Tetrahedron Lett*. **1993**, *34*, 1639.
b) T. Tsunoda, J. Otsuka, Y. Yamamiya, S. Ito, *Chem. Lett*. **1994**, 539.
c) S. Ito, T. Tsunoda, *Pure & Appl. Chem*. **1994**, *66*, 2071.
d) T. Tsunoda, Y. Yamamiya, Y. Kawamura, S. Ito, *Tetrahedron Lett*. **1995**, *36*, 2529.
4) a) L. D. Arnold, H. I. Assil, J. C. Vederas, *J. Am. Chem. Soc*. **1989**, *111*, 3973.
b) A. R. Tunoori, D. Dutta, G. I. Georg, *Tetrahedron Lett*. **1998**, *39*, 8751.
5) R. A. Amos, R. W. Emblidge, N. Havens, *J. Org. Chem*. **1983**, *48*, 3598.
6) Review: T. Mukaiyama, K. Kuroda, Y. Maruyama, *Heterocycles* **2010**, *80*, 63.
7) T. Tsunoda, M. Nagaku, C. Nagino, Y. Kawamura, F. Ozaki, H. Hioki, S. Ito, *Tetrahedron Lett*. **1995**, *36*, 2531.
8) T. Tsunoda, H. Takagi, D. Takaba, H. Kaku, S. Ito, *Tetrahedron Lett*. **2000**, *41*, 235.
9) a) T. Y. S. But, P. H. Toy, *J. Am. Chem. Soc*. **2006**, *128*, 9636.
b) D. Hirose, T. Taniguchi, H. Ishibashi. *Angew. Chem. Int. Ed*. **2013**, *52*, 4613.

Condensation & Active Esterification

The synthesis of carboxylic esters is one of the most fundamental and important processes for producing useful compounds in organic chemistry. The classical esterification reaction is condensation of a carboxylic acid and an alcohol under acidic conditions. This is an equilibrium reaction, and in order to effectively generate the ester, the equilibrium need to be shift toward the ester. To achieve this equilibrium shift requires adding one of the substrates in large excess and the removal of the generated water by distillation. However, when both carboxylic acid and alcohol are expensive and not easily available, it is not economical to use one of the substrates in large excess. Thus the classical esterification method is not the best method to use in such a case. Furthermore, when the substrate is unstable to heat, the classical method does not always yield the desired results.

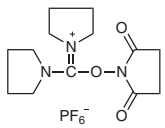
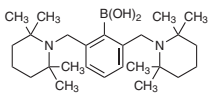
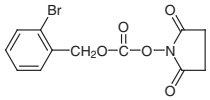
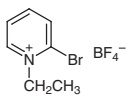
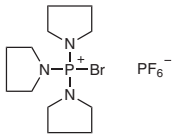
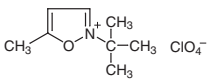
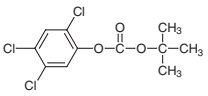
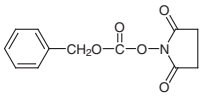
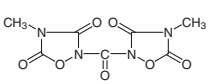
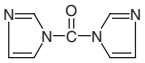
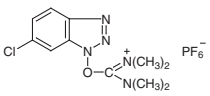
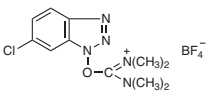
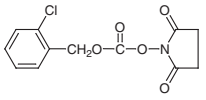
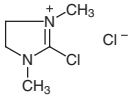
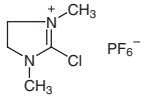
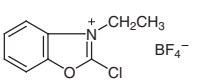
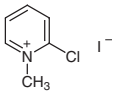
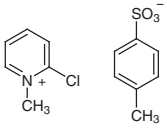
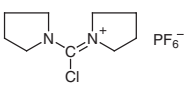
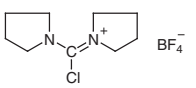
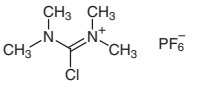
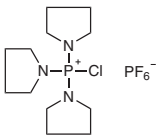
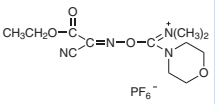
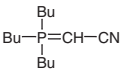
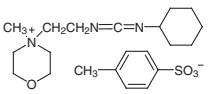
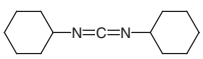
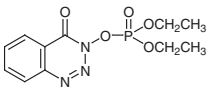
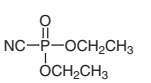
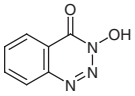
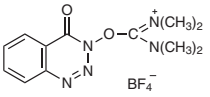
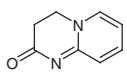
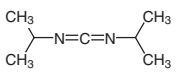
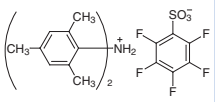
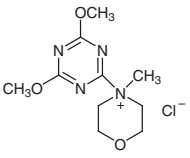
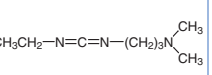
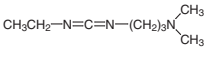
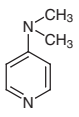
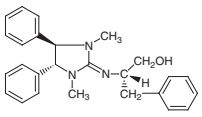
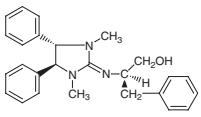
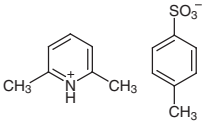
Since esterification is a basic reaction that is applied to many different types of substrates, there is a need for alternative methods which proceed under mild conditions without the need for using large excess of one of the substrates. Over the years, there has been much research done by many chemists, and many useful methods have been reported.

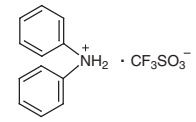
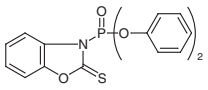
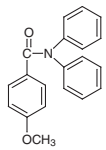
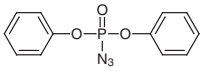
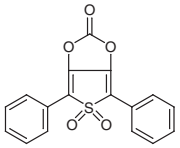
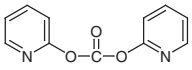
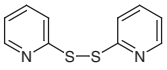
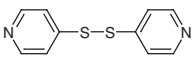
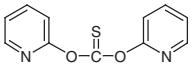
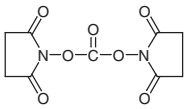
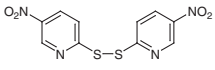
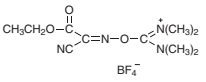
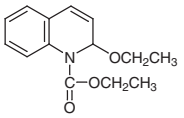
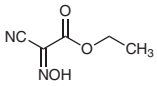
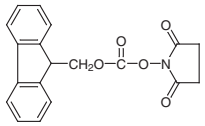
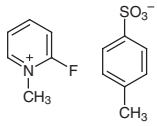
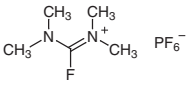
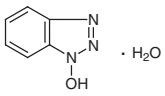
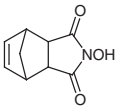
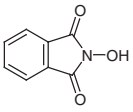
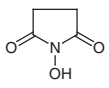
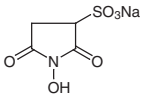
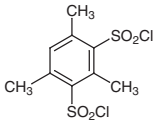
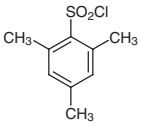
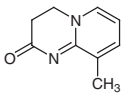
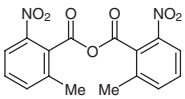
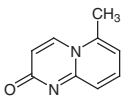
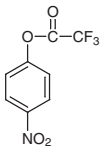
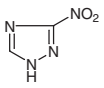
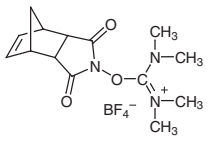
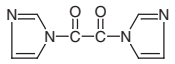
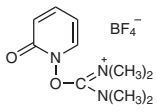
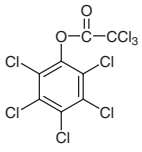
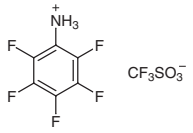
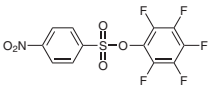
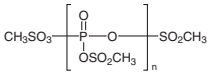
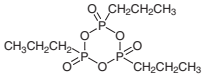
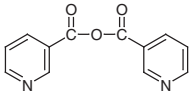
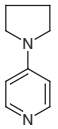


R^1COOH	R^2OH	Y. %	Ester A / Ester B
$Ph(CH_2)_2$	$PhCH_2$	95	>200
$Ph(CH_2)_2$	$THPO(CH_2)_5$	98	>200
$Ph(CH_2)_2$	$CH_2{=}CHCH_2$	92	>200
$Ph(CH_2)_2$	$C_9H_{19}C(CH_3)_2$	94	>200

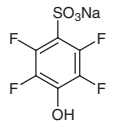
Shiina and co-workers have reported a method using 2-methyl-6-nitrobenzoic anhydride (**1**). This esterification procedure is quite simple. Triethylamine, a catalytic amount of 4-dimethylaminopyridine, and **1** were dissolved in a solvent. The carboxylic acid was added and stirred, and finally a nearly equimolar amount of alcohol was added and the reaction stirred under room temperature. Through this reaction process, the desired ester (ester A) is obtained in high yields. The nitro group on the condensation reagent **1** promotes and facilitates the esterification under room temperature. The introduction of substituents at the two ortho positions of benzene ring controls the generation of byproduct (ester B). These two effects synergistically act to produce the desired ester in excellent yield and high purity. This reaction can also be applied to intramolecular esterification, and can afford lactones in high yields.

A1797	A1861	B3816	B1774	B1651
B1657	B1658	B2771	B1213	B3604

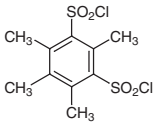
B3817 	B3927 	C1298 	B1036 	B2680 
B0832 	C1574 	C1124 	C1362 	C0119 
C1988 	C1926 	C1131 	C1639 C1408 	C1651 
C0905 	C0903 	C0906 	C1379 	C1375 
C1957 	C2551 	C2733 	C1500 	C0793 
D0436 	D3262 	C1242 	D2039 	D3263 
D1393 	D0254 	D3293 	D2919 	D4029 
D1601 	D1450 	D2898 	D2899 	D1771 

D3683 	D2038 	D1720 	D1672 	D2201 
C1407 	D1114 	D2477 	T1906 	D1662 
D2222 	E0916 	E0363 	E0847 	F0239 
F0225 	F0726 	H0468 	H0528 	H0395 
B0249 H0623 	H1304 	M1186 	M0071 	M0670 
M1439 	M1116 	T0681 	N0477 	N0634 
O0200 	O0390 	T0648 	P1626 	P2231 
P1042 	P1320 P1319 	P1768 	P0939 	Q0016 

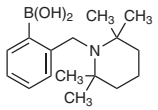
S0836



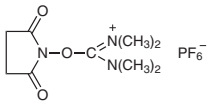
T1562



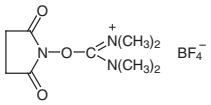
T2908



T2929

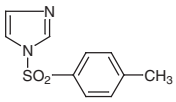


T2224



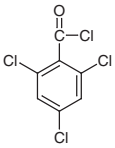
T1017

T1985

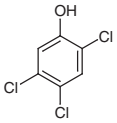


T0340

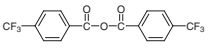
T1413



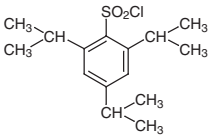
T0389



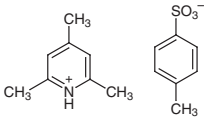
T1593



T0459



T1122



Product No.	Product Name		Unit Size	
A1797	*O*-(7-Azabenzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Hexafluorophosphate		5g	25g
A1861	*O*-(7-Azabenzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		1g	5g
B3816	*O*-(Benzotriazol-1-yl)-*N*,*N*,*N*',*N*'-bis(pentamethylene)uronium Hexafluorophosphate		1g	5g
B1774	1*H*-Benzotriazol-1-yloxytripyrrolidinophosphonium Hexafluorophosphate		5g	25g
B1651	1*H*-Benzotriazol-1-yloxytris(dimethylamino)-phosphonium Hexafluorophosphate	5g	25g	100g
B1657	*O*-(Benzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Hexafluorophosphate	5g	25g	100g
B1658	*O*-(Benzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		5g	25g
B2771	1,3-Bis(2,2-dimethyl-1,3-dioxolan-4-ylmethyl)carbodiimide (This product is only available in Japan.)			1g
B1213	Bis(2-oxo-3-oxazolidinyl)phosphinic Chloride		5g	25g
B3604	Bis(pentafluorophenyl) Carbonate			5g
B3817	*N*,*N*,*N*',*N*'-Bis(tetramethylene)-*O*-(*N*-succinimidyl)uronium Hexafluorophosphate		1g	5g
B3927	2,6-Bis[(2,2,6,6-tetramethyl-1-piperidinyl)methyl]phenylboronic Acid (contains varying amounts of Anhydride)		200mg	1g
C1298	*N*-(2-Bromobenzyloxycarbonyloxy)succinimide			10g
B1036	2-Bromo-1-ethylpyridinium Tetrafluoroborate		5g	25g
B2680	Bromotripyrrolidinophosphonium Hexafluorophosphate		5g	25g
B0832	*N*-*tert*-Butyl-5-methylisoxazolium Perchlorate		1g	5g
C1574	*tert*-Butyl 2,4,5-Trichlorophenyl Carbonate			5g
C1124	*N*-Carbobenzoxyoxysuccinimide		25g	250g
C1362	2,2'-Carbonylbis(3,5-dioxo-4-methyl-1,2,4-oxadiazolidine)			5g
C0119	1,1'-Carbonyldiimidazole		25g	250g
C1988	*O*-(6-Chlorobenzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Hexafluorophosphate		1g	5g
C1926	*O*-(6-Chlorobenzotriazol-1-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		5g	25g
C1131	*N*-(2-Chlorobenzyloxycarbonyloxy)succinimide			10g
C1639	2-Chloro-1,3-dimethylimidazolinium Chloride (*ca.* 25% in Dichloromethane)			25g
C1408	2-Chloro-1,3-dimethylimidazolinium Chloride		5g	25g
C1651	2-Chloro-1,3-dimethylimidazolinium Hexafluorophosphate		5g	25g
C0905	2-Chloro-3-ethylbenzoxazolium Tetrafluoroborate		5g	25g
C0903	2-Chloro-1-methylpyridinium Iodide			25g
C0906	2-Chloro-1-methylpyridinium *p*-Toluenesulfonate			25g
C1379	1-(Chloro-1-pyrrolidinylmethylene)pyrrolidinium Hexafluorophosphate		5g	25g
C1375	1-(Chloro-1-pyrrolidinylmethylene)pyrrolidinium Tetrafluoroborate			5g
C1957	Chloro-*N*,*N*,*N*',*N*'-tetramethylformamidinium Hexafluorophosphate		1g	5g
C2551	Chlorotripyrrolidinophosphonium Hexafluorophosphate		5g	25g
C2733	(1-Cyano-2-ethoxy-2-oxoethylidenaminooxy)dimethylaminomorpholinocarbenium Hexafluorophosphate (This product is only available in Japan.)			5g
C1500	Cyanomethylenetributylphosphorane	1g	5g	25g
C0793	1-Cyclohexyl-3-(2-morpholinoethyl)carbodiimide Metho-*p*-toluenesulfonate		5g	25g
D0436	*N*,*N*'-Dicyclohexylcarbodiimide		25g	400g
D3262	3-(Diethoxyphosphoryloxy)-1,2,3-benzotriazin-4(3*H*)-one			5g
C1242	Diethyl Cyanophosphonate		5g	25g
D2039	3,4-Dihydro-3-hydroxy-4-oxo-1,2,3-benzotriazine		10g	25g

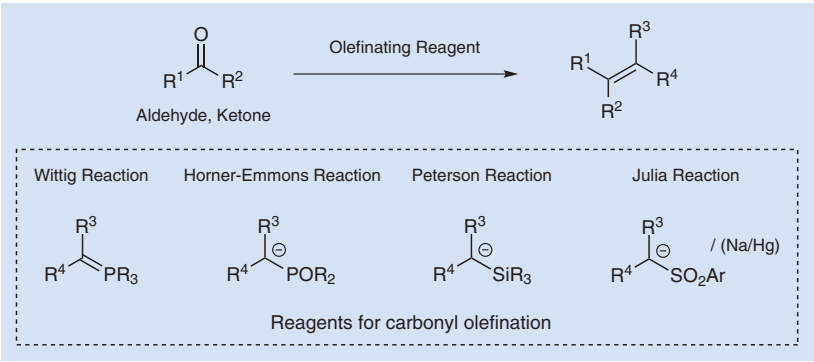
Product No.	Product Name	Unit Size		
D3263	*O*-(3,4-Dihydro-4-oxo-1,2,3-benzotriazin-3-yl)-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		5g	25g
D1393	3,4-Dihydro-2*H*-pyrido[1,2-*a*]pyrimidin-2-one		5g	25g
D0254	*N*,*N*'-Diisopropylcarbodiimide		25g	250g
D3293	Dimesitylammonium Pentafluorobenzenesulfonate		1g	5g
D2919	4-(4,6-Dimethoxy-1,3,5-triazin-2-yl)-4-methylmorpholinium Chloride		5g	25g
D4029	1-(3-Dimethylaminopropyl)-3-ethylcarbodiimide		5g	25g
D1601	1-(3-Dimethylaminopropyl)-3-ethylcarbodiimide Hydrochloride	5g	25g	250g
D1450	4-Dimethylaminopyridine	25g	100g	500g
D2898	(4*R*,5*R*)-1,3-Dimethyl-4,5-diphenyl-2-[(*S*)-1-benzyl-2-hydroxyethylimino]imidazolidine			100mg
D2899	(4*S*,5*S*)-1,3-Dimethyl-4,5-diphenyl-2-[(*R*)-1-benzyl-2-hydroxyethylimino]imidazolidine			100mg
D1771	2,6-Dimethylpyridinium *p*-Toluenesulfonate			25g
D3683	Diphenylammonium Trifluoromethanesulfonate	1g	5g	25g
D2038	Diphenyl (2,3-Dihydro-2-thioxo-3-benzoxazolyl)phosphonate		5g	25g
D1720	*N*,*N*-Diphenyl-4-methoxybenzamide			5g
D1672	Diphenylphosphoryl Azide	5g	25g	250g
D2201	4,6-Diphenylthieno[3,4-*d*]-1,3-dioxol-2-one 5,5-Dioxide			5g
C1407	Di-2-pyridyl Carbonate			5g
D1114	2,2'-Dipyridyl Disulfide	5g	25g	250g
D2477	4,4'-Dipyridyl Disulfide		5g	25g
T1906	*O*,*O*'-Di-2-pyridyl Thiocarbonate			1g
D1662	Di(*N*-succinimidyl) Carbonate		5g	25g
D2222	2,2'-Dithiobis(5-nitropyridine)			5g
E0916	*O*-[(Ethoxycarbonyl)cyanomethyleneamino]-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		1g	5g
E0363	1-Ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline			25g
E0847	Ethyl Cyano(hydroxyimino)acetate			25g
F0239	*N*-[(9*H*-Fluoren-9-ylmethoxy)carbonyloxy]succinimide		5g	25g
F0225	2-Fluoro-1-methylpyridinium *p*-Toluenesulfonate		5g	25g
F0726	Fluoro-*N*,*N*,*N*',*N*'-tetramethylformamidinium Hexafluorophosphate		1g	5g
H0468	1-Hydroxybenzotriazole Monohydrate	25g	200g	500g
H0528	*N*-Hydroxy-5-norbornene-2,3-dicarboximide		25g	250g
H0395	*N*-Hydroxyphthalimide	25g	100g	500g
B0249	*N*-Hydroxysuccinimide			25g
H0623	*N*-Hydroxysuccinimide	25g	100g	500g
H1304	*N*-Hydroxysulfosuccinimide Sodium Salt		200mg	1g
M1186	2,4-Mesitylenedisulfonyl Dichloride		5g	25g
M0071	2-Mesitylenesulfonyl Chloride		25g	500g
M0670	9-Methyl-3,4-dihydro-2*H*-pyrido[1,2-*a*]pyrimidin-2-one			25g
M1439	2-Methyl-6-nitrobenzoic Anhydride	1g	5g	25g
M1116	6-Methyl-2*H*-pyrido[1,2-*a*]pyrimidin-2-one			5g
T0681	4-Nitrophenyl Trifluoroacetate		5g	25g
N0477	3-Nitro-1,2,4-triazole			5g
N0634	2-(5-Norbornene-2,3-dicarboximido)-1,1,3,3-tetramethyluronium Tetrafluoroborate		5g	25g
O0200	1,1'-Oxalyldiimidazole		1g	5g
O0390	*O*-[2-Oxo-1(2*H*)-pyridyl]-*N*,*N*,*N*',*N*'-tetramethyluronium Tetrafluoroborate		1g	5g
T0648	Pentachlorophenyl Trichloroacetate			25g
P1626	Pentafluoroanilinium Trifluoromethanesulfonate	1g	5g	25g
P2231	Pentafluorophenyl 4-Nitrobenzenesulfonate		1g	5g
P1042	Phosphorus Pentoxide - Methanesulfonic Acid		25g	500g
P1320	Propylphosphonic Acid Anhydride (Cyclic Trimer) (48% in *N*,*N*-Dimethylformamide, *ca.* 1.6mol/L)			25g
P1319	Propylphosphonic Acid Anhydride (Cyclic Trimer) (50% in Ethyl Acetate, *ca.* 1.7mol/L)		25g	100g
P1768	3-Pyridinecarboxylic Anhydride		1g	5g
P0939	4-Pyrrolidinopyridine		5g	25g
Q0016	Quinoline-8-sulfonyl Chloride		5g	25g
S0836	Sodium 2,3,5,6-Tetrafluoro-4-hydroxybenzenesulfonate		1g	5g
T1562	2,4,5,6-Tetramethylbenzenedisulfonyl Dichloride			5g
T2908	2-[(2,2,6,6-Tetramethyl-1-piperidyl)methyl]phenylboronic Acid (contains varying amounts of Anhydride)			1g
T2929	*N*,*N*,*N*',*N*'-Tetramethyl-*O*-(*N*-succinimidyl)uronium Hexafluorophosphate		5g	25g
T2224	*N*,*N*,*N*',*N*'-Tetramethyl-*O*-(*N*-succinimidyl)uronium Tetrafluoroborate		1g	5g
T1017	1*H*-Tetrazole		5g	25g
T1985	1-(*p*-Toluenesulfonyl)imidazole		5g	25g
T0340	1,2,4-Triazole	25g	100g	500g
T1413	2,4,6-Trichlorobenzoyl Chloride		5g	25g
T0389	2,4,5-Trichlorophenol		25g	500g
T1593	4-Trifluoromethylbenzoic Anhydride			10g
T0459	2,4,6-Triisopropylbenzenesulfonyl Chloride		25g	500g
T1122	2,4,6-Trimethylpyridinium *p*-Toluenesulfonate			25g

References

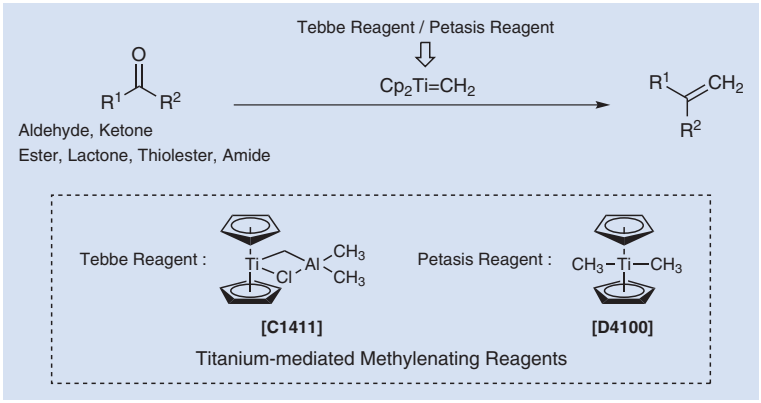
1) I. Shiina, R. Ibuka, M. Kubota, *Chem. Lett.* **2002**, 286.
2) I. Shiina, M. Kubota, R. Ibuka, *Tetrahedron Lett.* **2002**, *43*, 7535.
3) J. Tian, N. Yamagiwa, S. Matsunaga, M. Shibasaki, *Org. Lett.* **2003**, *5*, 3021.
4) I. Shiina, H. Oshiumi, M. Hashizume, Y. Yamai, R. Ibuka, *Tetrahedron Lett.* **2004**, 45, 543.
5) I. Shiina, M. Kubota, H. Oshiumi, M. Hashizume, *J. Org. Chem.* **2004**, *69*, 1822.
6) I. Shiina, *Chem. Rev.* **2007**, *107*, 239.
7) Tokyo Kasei Kogyo Co., Ltd., Jpn. Kokai Tokkyo Koho 2003 335731, **2003**.

Carbonyl Olefination

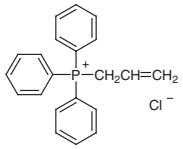
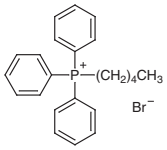
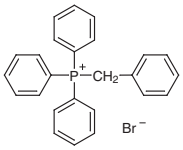
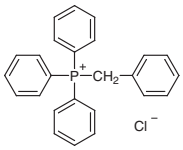
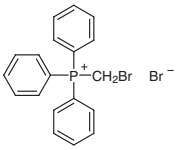
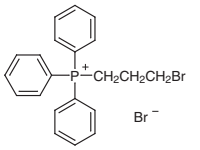
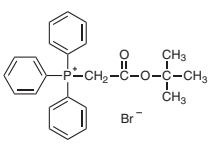
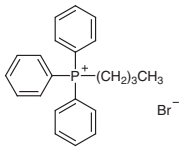
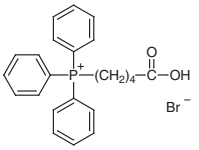
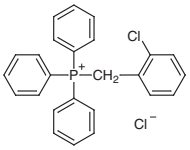
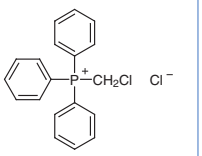
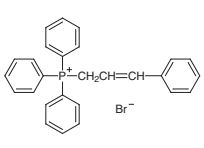
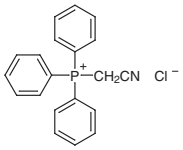
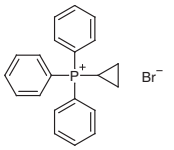
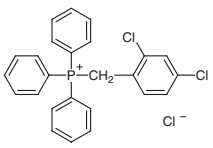
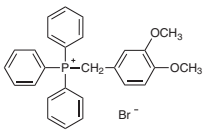
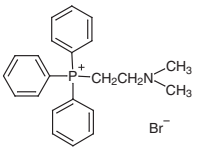
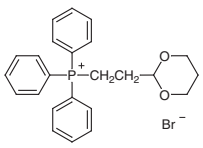
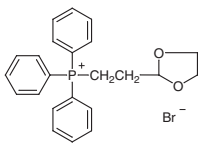
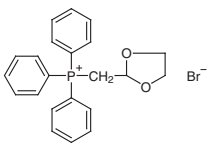
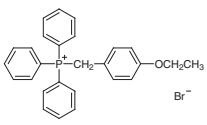
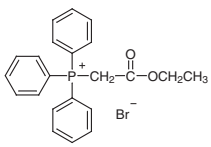
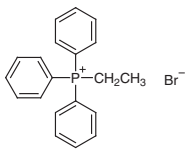
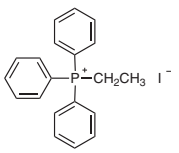
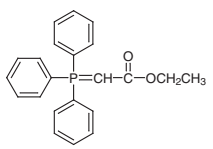
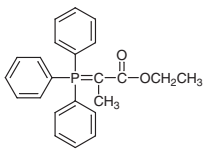
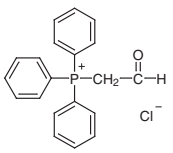
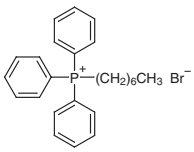
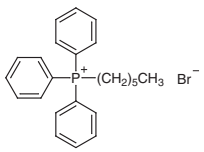
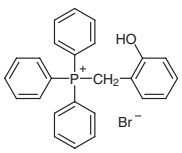
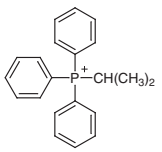
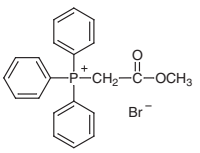
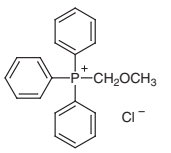
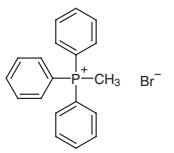
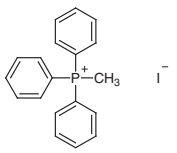
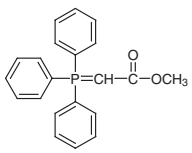
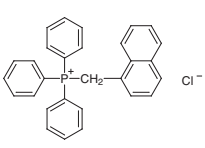
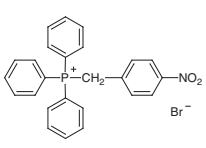
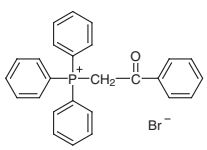
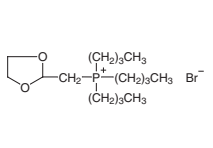
Carbonyl olefination is one of the most fundamental conversions in organic synthesis and a variety of synthetic methods have been developed. Particularly, synthetic methods focused on the chemical properties of heavy-atoms such as phosphorus, silicon and sulfur atoms had long been studied. One of them, the Wittig reaction is the representative carbonyl olefination reaction. Other similar reactions, the silicon-mediated Peterson olefination and two sulfur-based "Julia" carbonyl olefinations named the Julia-Lythgoe olefination and the Julia - Kocienski olefination are also useful olefinating methods. Among them, as the Wittig and Horner-Emmons reactions are the most general carbonyl olefinations, a number of improved synthetic applications have also been investigated. Some of them allow providing easer work-up procedures and increasing the stereoselectivity of the double bond of olefins. They are even now widely used for this transformation.



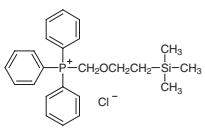
In the 1990s, organotitanium species-promoted carbonyl olefinations had been studied and various successful methods were reported. The biggest advantage of the use of organotitanium species in carbonyl olefination is that not only aldehydes and ketones, but also esters and lactones can be transformed to the corresponding olefins. Furthermore, the basicities of the organotitanium species are weaker compared to that of Wittig type bases and these chemical properties enable easily enolizable substrates to be used in carbonyl olefinations and to produce the desired olefins with high yields.



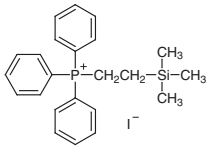
Wittig Reaction	A1305	A1439	A1007

A1012 	A0862 	B2025 	B0824 	B1206 
B1208 	B3928 	B0970 	C1061 	C1759 
C1009 	C1286 	C1739 	C1378 	D2907 
D4072 	D1654 	D1655 	D2056 	D2164 
E0421 	E0407 	E0382 	E0549 	T1944 
C1641 	F0331 	H0545 	H0540 	H1240 
I0552 	M1326 	M0828 	M0779 	M0253 
T1363 	N0700 	N0701 	P1182 	T2718 

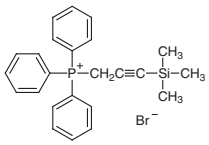
T1458



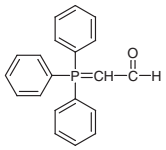
T1510



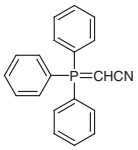
T1498



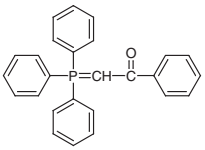
T2001



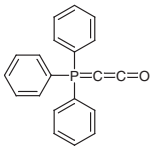
T1958



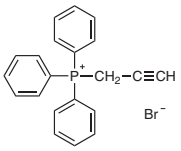
T2002



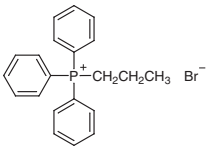
T2565



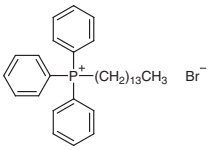
P1438



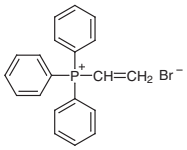
P1200



T1506



T1644

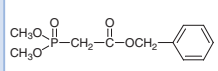


Product No.	Product Name			Unit Size
A1305	Acetonyltriphenylphosphonium Chloride			25g
A1439	(Acetylmethylene)triphenylphosphorane			25g
A1007	Allyltriphenylphosphonium Bromide			25g
A1012	Allyltriphenylphosphonium Chloride			25g
A0862	Amyltriphenylphosphonium Bromide			25g
B2025	Benzyltriphenylphosphonium Bromide		25g	250g
B0824	Benzyltriphenylphosphonium Chloride		25g	500g
B1206	(Bromomethyl)triphenylphosphonium Bromide		5g	25g
B1208	3-Bromopropyltriphenylphosphonium Bromide			25g
B3928	(*tert*-Butoxycarbonylmethyl)triphenylphosphonium Bromide			25g
B0970	Butyltriphenylphosphonium Bromide		25g	250g
C1061	4-(Carboxybutyl)triphenylphosphonium Bromide		25g	250g
C1759	(2-Chlorobenzyl)triphenylphosphonium Chloride			25g
C1009	(Chloromethyl)triphenylphosphonium Chloride		5g	25g
C1286	Cinnamyltriphenylphosphonium Bromide			25g
C1739	(Cyanomethyl)triphenylphosphonium Chloride		25g	100g
C1378	Cyclopropyltriphenylphosphonium Bromide			5g
D2907	(2,4-Dichlorobenzyl)triphenylphosphonium Chloride			25g
D4072	(3,4-Dimethoxybenzyl)triphenylphosphonium Bromide			5g
D1654	2-Dimethylaminoethyltriphenylphosphonium Bromide		5g	25g
D1655	2-(1,3-Dioxan-2-yl)ethyltriphenylphosphonium Bromide		5g	25g
D2056	2-(1,3-Dioxolan-2-yl)ethyltriphenylphosphonium Bromide		5g	25g
D2164	(1,3-Dioxolan-2-yl)methyltriphenylphosphonium Bromide		5g	25g
E0421	4-Ethoxybenzyltriphenylphosphonium Bromide			5g
E0407	Ethoxycarbonylmethyl(triphenyl)phosphonium Bromide		25g	250g
E0382	Ethyltriphenylphosphonium Bromide		25g	500g
E0549	Ethyltriphenylphosphonium Iodide		25g	250g
T1944	Ethyl (Triphenylphosphoranylidene)acetate		25g	250g
C1641	Ethyl 2-(Triphenylphosphoranylidene)propionate			5g
F0331	(Formylmethyl)triphenylphosphonium Chloride			25g
H0545	Heptyltriphenylphosphonium Bromide		25g	500g
H0540	Hexyltriphenylphosphonium Bromide		25g	500g
H1240	(2-Hydroxybenzyl)triphenylphosphonium Bromide		5g	25g
I0552	Isopropyltriphenylphosphonium Iodide		5g	25g
M1326	Methoxycarbonylmethyl(triphenyl)phosphonium Bromide			25g
M0828	(Methoxymethyl)triphenylphosphonium Chloride	25g	100g	500g
M0779	Methyltriphenylphosphonium Bromide	25g	100g	500g
M0253	Methyltriphenylphosphonium Iodide	25g	100g	500g
T1363	Methyl (Triphenylphosphoranylidene)acetate		25g	100g
N0700	(1-Naphthylmethyl)triphenylphosphonium Chloride		5g	25g

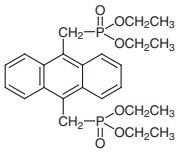
Product No.	Product Name	Unit Size
N0701	(4-Nitrobenzyl)triphenylphosphonium Bromide	25g
P1182	Phenacyltriphenylphosphonium Bromide	25g
T2718	Tributyl(1,3-dioxolan-2-ylmethyl)phosphonium Bromide	5g
T1458	2-(Trimethylsilyl)ethoxymethyltriphenylphosphonium Chloride	5g 25g
T1510	(2-Trimethylsilylethyl)triphenylphosphonium Iodide	5g
T1498	(3-Trimethylsilyl-2-propynyl)triphenylphosphonium Bromide	1g 5g
T2001	(Triphenylphosphoranylidene)acetaldehyde	5g 25g
T1958	(Triphenylphosphoranylidene)acetonitrile	5g 25g
T2002	2-(Triphenylphosphoranylidene)acetophenone	5g
T2565	(Triphenylphosphoranylidene)ketene	1g 5g
P1438	Triphenylpropargylphosphonium Bromide	5g 25g
P1200	Triphenylpropylphosphonium Bromide	25g 500g
T1506	Triphenyl(tetradecyl)phosphonium Bromide	25g
T1644	Triphenylvinylphosphonium Bromide	5g

Horner-Emmons Reaction

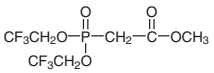
B2815



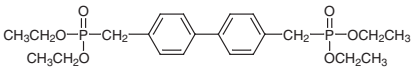
B2801



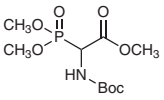
B1714



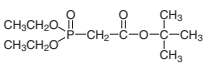
B1923



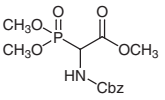
B4011



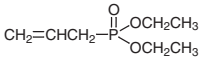
B2814



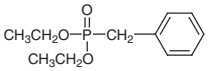
C2440



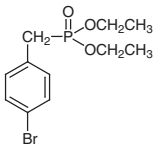
D3069



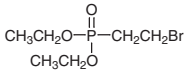
B1795



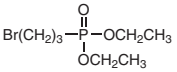
D3688



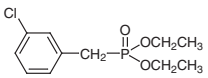
B1781



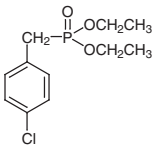
D4434



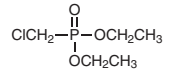
C1595



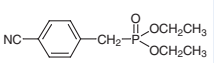
D3335



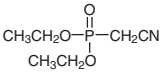
D4588



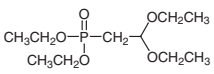
D3323



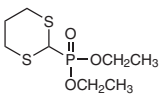
C1430



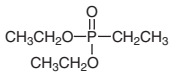
D2423



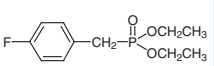
D4074



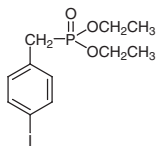
E0483



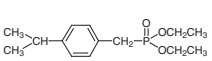
D3324



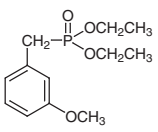
D3689



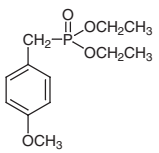
D3325



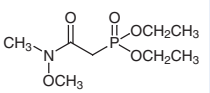
D3326



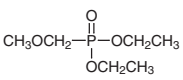
D4000



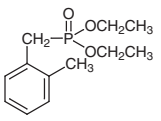
D3708



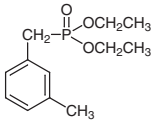
D3873



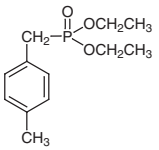
D3327



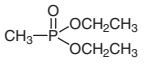
D3328



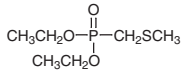
D3336



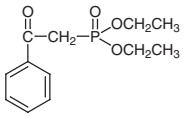
D3827



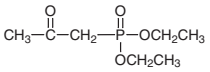
M1208



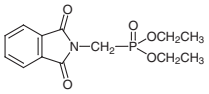
D3339



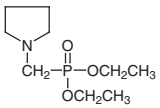
D3174



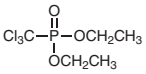
P1193



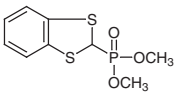
P1258



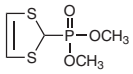
D4607



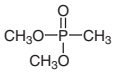
D3992



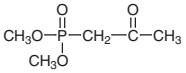
D3981



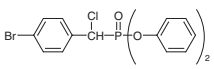
M0943



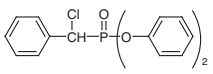
O0208



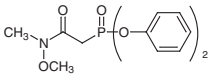
D3875



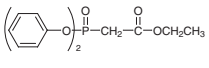
D3824



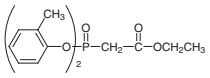
D3709



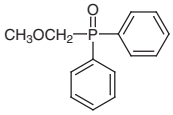
D2547



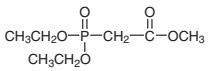
D2548



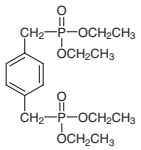
M1210



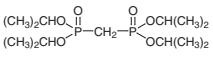
D2873



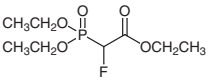
T1582



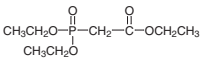
M1319



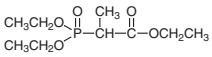
F0340



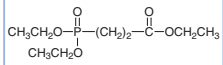
D1523



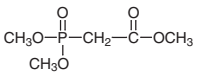
T2135



D1524



P1265

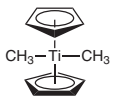


Product No.	Product Name	Unit Size		
B2815	Benzyl Dimethylphosphonoacetate		1g	5g
B2801	9,10-Bis(diethylphosphonomethyl)anthracene		1g	5g
B1923	4,4'-Bis(diethylphosphonomethyl)biphenyl		1g	5g
B1714	Bis(2,2,2-trifluoroethyl) (Methoxycarbonylmethyl)-phosphonate	1g	5g	25g
B4011	*N*-(*tert*-Butoxycarbonyl)-2-phosphonoglycine Trimethyl Ester		1g	5g
B2814	*tert*-Butyl Diethylphosphonoacetate		1g	5g
C2440	*N*-Carbobenzoxy-2-phosphonoglycine Trimethyl Ester		1g	5g
D3069	Diethyl Allylphosphonate		1g	5g
B1795	Diethyl Benzylphosphonate			25g
D3688	Diethyl (4-Bromobenzyl)phosphonate		5g	25g
B1781	Diethyl 2-Bromoethylphosphonate		5g	25g
D4434	Diethyl (3-Bromopropyl)phosphonate		1g	5g
C1595	Diethyl (3-Chlorobenzyl)phosphonate		1g	5g
D3335	Diethyl (4-Chlorobenzyl)phosphonate		5g	25g

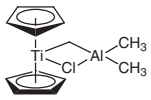
Product No.	Product Name	Unit Size		
D4588	Diethyl (Chloromethyl)phosphonate		1g	5g
D3323	Diethyl (4-Cyanobenzyl)phosphonate		5g	25g
C1430	Diethyl Cyanomethylphosphonate		5g	25g
D2423	Diethyl 2,2-Diethoxyethylphosphonate		5g	25g
D4074	Diethyl (1,3-Dithian-2-yl)phosphonate			5g
E0483	Diethyl Ethylphosphonate			25g
D3324	Diethyl (4-Fluorobenzyl)phosphonate		5g	25g
D3689	Diethyl (4-Iodobenzyl)phosphonate		5g	25g
D3325	Diethyl (4-Isopropylbenzyl)phosphonate			5g
D3326	Diethyl (3-Methoxybenzyl)phosphonate		5g	25g
D4000	Diethyl (4-Methoxybenzyl)phosphonate		5g	25g
D3708	Diethyl (*N*-Methoxy-*N*-methylcarbamoylmethyl)phosphonate		1g	5g
D3873	Diethyl (Methoxymethyl)phosphonate		5g	25g
D3327	Diethyl (2-Methylbenzyl)phosphonate		5g	25g
D3328	Diethyl (3-Methylbenzyl)phosphonate		5g	25g
D3336	Diethyl (4-Methylbenzyl)phosphonate		5g	25g
D3827	Diethyl Methylphosphonate		5g	25g
M1208	Diethyl (Methylthiomethyl)phosphonate		5g	25g
D3339	Diethyl (2-Oxo-2-phenylethyl)phosphonate		1g	5g
D3174	Diethyl (2-Oxopropyl)phosphonate		5g	25g
P1193	Diethyl (Phthalimidomethyl)phosphonate		5g	25g
P1258	Diethyl 1-Pyrrolidinemethylphosphonate			5g
D4607	Diethyl (Trichloromethyl)phosphonate		5g	25g
D3992	Dimethyl 1,3-Benzodithiol-2-ylphosphonate			1g
D3981	Dimethyl 2-(1,3-Dithiole)phosphonate		1g	5g
M0943	Dimethyl Methylphosphonate		25g	500g
O0208	Dimethyl (2-Oxopropyl)phosphonate		5g	25g
D3875	Diphenyl 4-Bromo-*α*-chlorobenzylphosphonate		5g	25g
D3824	Diphenyl *α*-Chlorobenzylphosphonate		1g	5g
D3709	Diphenyl (*N*-Methoxy-*N*-methylcarbamoylmethyl)phosphonate		1g	5g
D2547	Ethyl Diphenylphosphonoacetate		1g	5g
D2548	Ethyl Di-*o*-tolylphosphonoacetate			1g
M1210	Methoxymethyl(diphenyl)phosphine Oxide		5g	25g
D2873	Methyl Diethylphosphonoacetate		5g	25g
T1582	Tetraethyl *p*-Xylylenediphosphonate	5g	25g	100g
M1319	Tetraisopropyl Methylenediphosphonate			25g
F0340	Triethyl 2-Fluoro-2-phosphonoacetate		1g	5g
D1523	Triethyl Phosphonoacetate	25g	100g	500g
T2135	Triethyl 2-Phosphonopropionate			25g
D1524	Triethyl 3-Phosphonopropionate		25g	250g
P1265	Trimethyl Phosphonoacetate		25g	250g

Organotitanium Reagents

D4100



C1411



T2052

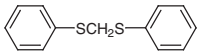
T0616

Product No.	Product Name	Unit Size	
D4100	Dimethyltitanocene (5% in Tetrahydrofuran/Toluene)		100g
C1411	Tebbe Reagent (*ca.* 0.5mol/L in Toluene)		25mL
T2052	Titanium(IV) Chloride (14% in Dichloromethane, *ca.* 1.0mol/L)	100mL	500mL
T0616	Titanocene Dichloride	5g	25g

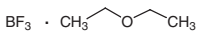
Others

B0041

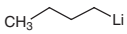
B1444



B0527



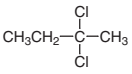
B0396



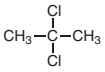
D0184

D0192

D1106

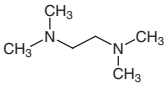


D0400

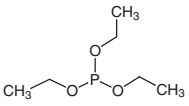


D0610

T0147



T0430

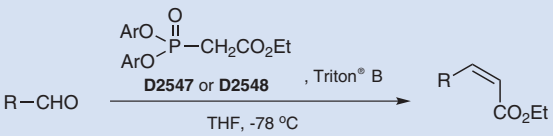


Product No.	Product Name			Unit Size
B0041	Benzenethiol		25mL	500mL
B1444	Bis(phenylthio)methane		5g	25g
B0527	Boron Trifluoride - Ethyl Ether Complex	25mL	100mL	500mL
B0396	Butyllithium (*ca.* 15% in Hexane, *ca.* 1.6mol/L)		100mL	500mL
D0184	1,1-Dibromoethane (stabilized with Copper chip)			5g
D0192	Dibromomethane		25g	500g
D1106	2,2-Dichlorobutane			10mL
D0400	2,2-Dichloropropane			10mL
D0610	Diiodomethane (stabilized with Copper chip)	25g	100g	500g
T0147	*N*,*N*,*N*',*N*'-Tetramethylethylenediamine		25mL	500mL
T0430	Triethyl Phosphite		25mL	500mL

Z-Selective Horner-Emmons Reagent

Horner-Emmons reagents are efficient olefinating reagents for the preparation of α,β-unsaturated esters. Generally, their reaction with aldehydes affords the *E*-isomer of the related olefins preferentially. So, to obtain the *E*-isomer selectively, it is required to investigate the reaction conditions and other effective olefinating reagants.

Ando had studied the *Z*-preferential Horner-Emmons reaction on the basis of detailed analysis of its reaction mechanism, and resultantly it was found that the *Z*-isomer of α,β-unsaturated esters was given with high stereoselectively by use of ethyl (diaryl)phosphonoacetates as olefinating reagents.[1)] In this synthetic method, quaternary ammonium hydroxides stable to water are available as a base, and it doesn't require any special experimental-equipment/-technique. In addition, this method gives *Z*-α,β-unsaturated esters with extremely high stereoelectivity, so ethyl (diaryl)phosphonoacetates are the practical Horner-Emmons reagents.



Reagent	Ar	R	Yield (%)	(*Z*:*E*)
D2547	Ph	Ph	98	93:7
		$^{n}C_7H_{15}$	100	90:10
D2548	*o*-Tolyl	Ph	100	96:4
		$^{n}C_7H_{15}$	97	94:6

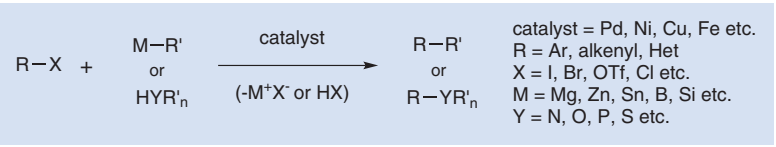
Product No.	Product Name	Unit Size	
D2547	Ethyl Diphenylphosphonoacetate	1g	5g
D2548	Ethyl Di-*o*-tolylphosphonoacetate		1g

References

1) a) K. Ando, *Tetrahedron Lett*. **1995**, *36*, 4105.
b) K. Ando, *J. Org. Chem*. **1997**, *62*, 1934.
c) K. Ando, T. Oishi, M. Hirama, H. Ohno, T. Ibuka, *J. Org. Chem*. **2000**, *65*, 4745.

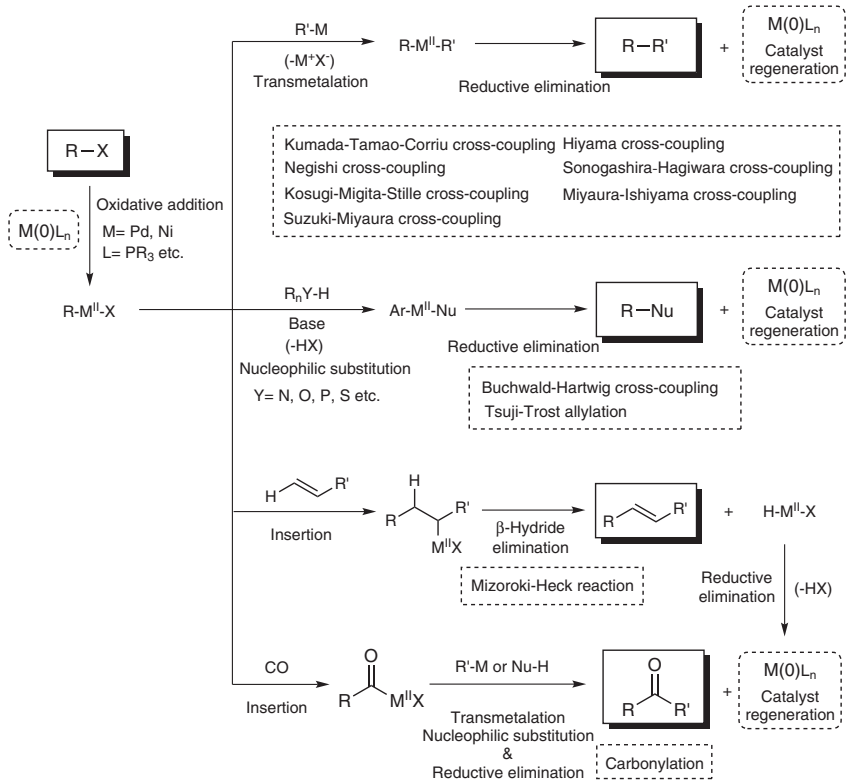
Cross-coupling Reaction Using Transition Metal Catalysts

Cross-coupling reactions using late transition metal catalysts represented by nickel and palladium metals have been widely used for introducing various functional groups into unsaturated substances such as aromatic rings, alkenes, alkynes and so on. In these reactions, carbon-carbon bond forming reactions can be performed by the combination of electrophilic carbon species of aryl/vinyl halides and organometallic agents of Grignard reagents and organoboron compounds. Also, the use of nucleophilic hetero atoms such as phenols and amines is efficient to form carbon-hetero atom bonds. By the development of these synthetic methods, substitution reactions to sp^2 carbon and sp carbon are easily accomplished while it had been difficult to perform these transformations by classical synthetic reactions without using metal catalysts.



Recently, transition metal mediated cross-coupling reactions have been widely used as useful synthetic tools and applied to the synthesis of various functional molecules such as bioactive compounds and biaryls for liquid crystal materials. As a feature of these transformations, it is found that there are many name reactions for each kind of nucleophile used for coupling reactions. And then in 2010, for making a great contribution to develop the metal-based cross-coupling reactions, Richard F. Heck, Ei-ichi Negishi and Akira Suzuki jointly received the Nobel Prize in chemistry, verifying the usefulness of the transition metal mediated cross-coupling reactions.

The following shows the synthetic properties of palladium/nickel catalyzed cross-coupling reactions commonly used with the chemical equations.



Cross-coupling reactions using palladium/Nickel catalysts

Chemical properties and reactivities for organic halides (R-X)

X : I > Br ≈ OTf > Cl >> F	
I	Reactive without phosphine ligands at room temperature
Br	In many cases heating is required for the reactions to proceed.
OTf	Formation of cationic complexes is unfavorable for metal exchange reactions.
	Effective to add some salts like LiCl for the reactions to proceed
Cl	Only in a special case will the reactions proceed.
	Use of highly active catalysts
	Use of heteroaromatic chlorides (R = heteroaromatic rings)
R	The order of the reactivity as follows: Electron-withdrawing group > electron-donating group
	Electron-withdrawing group is effective for oxidative addition.

Chemical properties for Ni/Pd catalysts

Ni	High reactivity but low stability
	Inexpensive and easy to remove
Pd	Chemically stable and easy to handle
	Little by-product
	Expensive and hard to remove

Effect of ligand (L) for reactivity

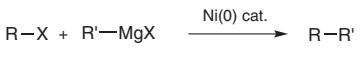
High electron-donation	Improves oxidative addition
High bulky ligand	Improves reductive elimination

As a means for preventing deactivation of catalysts, it is effective to carry out the reaction under inert gas (argon, nitrogen) conditions. In addition, performing degasification of the solvent before the reaction is more effective.

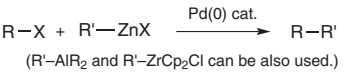
The late transition metal catalyzed cross-coupling reactions are collected based on the reaction modes and show as general synthetic schemes as follows.

Cross-coupling reactions *via* the transmetalation

Kumada-Tamao-Corriu cross-coupling

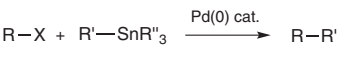


Negishi cross-coupling

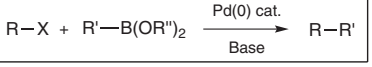


(R'–AlR_2 and R'–$ZrCp_2Cl$ can be also used.)

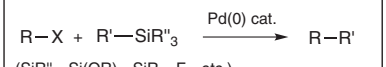
Kosugi-Migita-Stille cross-coupling



Suzuki-Miyaura cross-coupling

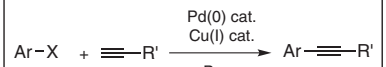


Hiyama cross-coupling

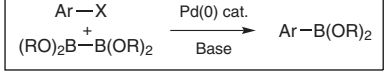


(SiR''_3=$Si(OR)_3$, $SiR_{3-n}F_n$, etc.)
(SiR''_3=$Si(OH)Me_2$: Hiyama-Denmark coupling)

Sonogashira-Hagiwara cross-coupling

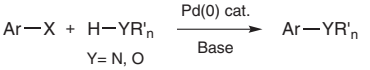


Miyaura-Ishiyama Borylation

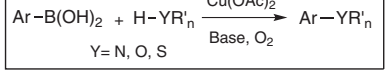


Cross-coupling reactions forming carbon-hetero atom bonds

Buchwald-Hartwig cross-coupling

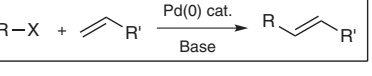


Chan-Lam-Evans cross-coupling

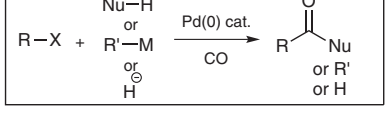


Cross-coupling reactions *via* the insertion

Mizoroki-Heck reaction

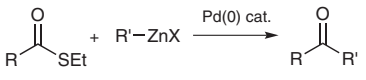


Carbonylation *via* CO insertion

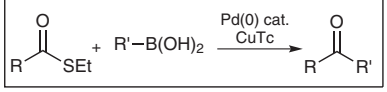


Cross-coupling reactions *via* the oxidative addition of thiolesters

Fukuyama cross-coupling

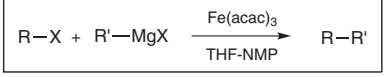


Liebeskind-Srogl cross-coupling



Cross-coupling reactions forming carbon sp^3 – carbon sp^3 bonds

Kochi-Furstner cross-coupling



Palladium Catalysts

The study of coupling reactions using organopalladium complexes has been advanced as well as that using organonickel complexes. Generally, the reactivity of organopalladium complexes is lower compared with organonickel complexes. However, they have higher chemical stability for oxidations and this makes them easy to use. Therefore, palladium complexes are most commonly used for cross-coupling reactions.

(1) Palladium complexes generally used in cross coupling reactions

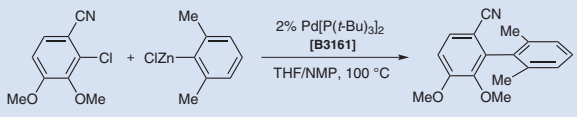
Palladium-phosphine complexes are well used in cross-coupling reactions and commercially available. $Pd(PPh_3)_4$ and $PdCl_2(PPh_3)_2$ are used without any treatment. Also, palladium catalysts are used prepared *in situ* from the precursors such as $Pd(OAc)_2$ and $Pd_2(dba)_3 \cdot CHCl_3$, with appropriate amounts of phosphines. When using divalent palladium complexes such as $Pd(OAc)_2$, once they are reduced to zero-valent palladium species by some organometallic reagents, phosphines and amines, then their catalytic reactions can start.

Palladium-phosphine complexes:
Pd(0): $Pd(PPh_3)_4$, $Pd[P(t\text{-}Bu)_3]_2$ etc.
Pd(II): $PdCl_2(PPh_3)_2$, $PdCl_2[(o\text{-tolyl})_3P]_2$, $PdCl_2$(dppf), $PdCl_2$(dppe), $PdCl_2$(dppp), etc.

Precurcors of palladium catalysts:
Pd(0): $Pd_2(dba)_3 \cdot CHCl_3$, $Pd(dba)_2$ etc.
Pd(II): $Pd(OAc)_2$, $PdCl_2(CH_3CN)_2$, $PdCl_2(PhCN)_2$, $[PdCl(allyl)]_2$, Na_2PdCl_4, $PdCl_2$ etc.

(2) Higher activity palladium catalysts

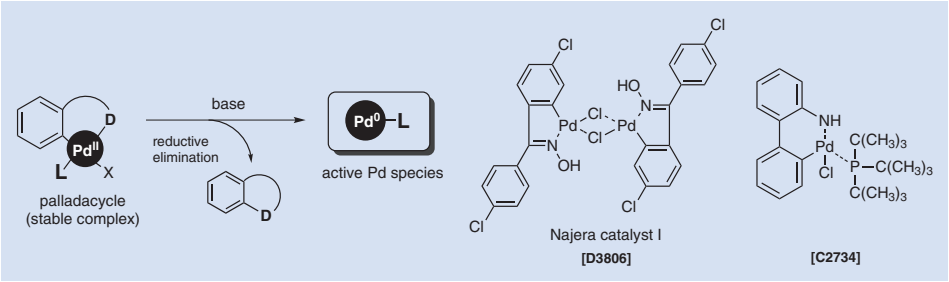
Generally, cross coupling reactions are promoted by using electron-rich and sterically hindered ligands. For example, palladium catalysts when coordinated by tertiary alkyl phosphines such as the *tert*-butyl group, cyclohexyl group and so on are used, show high catalytic activities in cross-coupling reactions. They are effective to use when low reactive aryl chlorides or sterically hindered aromatic halides are employed as reagents. The monomer state of sterically hindered alkyl phosphines is chemically unstable, but they are stabilized by coordinating them with palladium complexes.



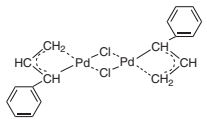
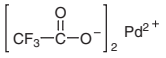
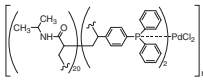
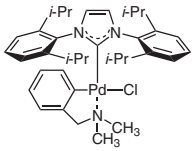
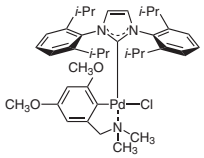
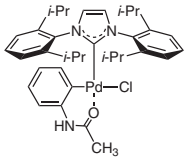
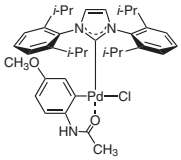
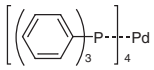
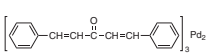
Recently, *N*-heterocarbene (NHC) ligands have been used for cross-coupling reactions because they activate palladium catalysts more effectively than tertiary alkyl phosphines. Palladium-NHC complexes show not only high activity but also high structual stability. In addition, they keep their complex formation without decomposition even after work-up, which is an advantage because it makes removing these complexes easy.

(3) Palladacycle catalysts

In some cases the active palladium species can't be efficiently prepared by the combination of palladium complexes and ligands. To solve this problem, palladacycle catalysts have been developed and used for more efficient preparation of active palladium species. As a property, they easily release the coordinated ligand with treatment of some bases, and afford the related zero-valent active palladium species. On the other hand, they form structurally stable complexes caused by their cyclic structures constructed of the ligand with intramolecular coordinating ability and the palladium species. In addition, their catalytic ability is improved by the addition of bases and they show high turnover frequency.



Palladium Catalysts		A1479	B2029	B1676
B1668	B3224	B1374	B3160	B2031
B2016	B2064	B2192	B2161	B2018
B3161	B2055	B2042	B1667	B2026
C2734	D2604	D3806	P1785 P1491 P1490	A1424

P2106 $[Pd(CH_3COO)_2]_3$	P1489 $PdCl_2$	P2017 	P1528 $Pd(OH)_2$	P1870 
P1425 	P1944 Pd / ($PSi\text{-}Al_2O_3$)	C2372 	C2406 	C2387 
C2407 	S0540 Na_2PdCl_4	T1350 	T2184 	

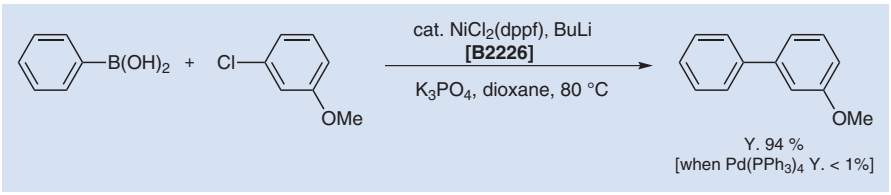
Product No.	Product Name		Unit Size	
A1479	Allylpalladium(II) Chloride Dimer		500mg	1g
B2029	Benzylbis(triphenylphosphine)palladium(II) Chloride		100mg	1g
B1676	Bis(acetonitrile)palladium(II) Dichloride		1g	5g
B1668	Bis(benzonitrile)palladium(II) Dichloride		1g	5g
B3224	Bis[1,2-bis(diphenylphosphino)ethane]palladium(0)		1g	5g
B1374	Bis(dibenzylideneacetone)palladium(0)		1g	5g
B3160	[1,1'-Bis(di-*tert*-butylphosphino)ferrocene]palladium(II) Dichloride		1g	5g
B2031	[1,4-Bis(diphenylphosphino)butane]palladium(II) Dichloride		1g	5g
B2016	[1,2-Bis(diphenylphosphino)ethane]palladium(II) Dichloride		1g	5g
B2064	[1,1'-Bis(diphenylphosphino)ferrocene]palladium(II) Dichloride Dichloromethane Adduct	1g	5g	25g
B2192	[1,3-Bis(diphenylphosphino)propane]palladium(II) Dichloride		1g	5g
B2161	Bis(methyldiphenylphosphine)palladium(II) Dichloride		1g	5g
B2018	Bis(2,4-pentanedionato)palladium(II)		1g	5g
B3161	Bis(tri-*tert*-butylphosphine)palladium(0)		250mg	1g
B2055	Bis(tricyclohexylphosphine)palladium(II) Dichloride		1g	5g
B2042	Bis(triphenylphosphine)palladium(II) Diacetate		1g	5g
B1667	Bis(triphenylphosphine)palladium(II) Dichloride	1g	5g	25g
B2026	Bis(tri-*o*-tolylphosphine)palladium(II) Dichloride		1g	5g
C2734	Chloro[(tri-*tert*-butylphosphine)-2-(2-aminobiphenyl)]palladium(II)			1g
D2604	Dichloro(1,5-cyclooctadiene)palladium(II)		1g	5g
D3806	Najera Catalyst I		250mg	1g
P1785	Palladium 10% on Carbon (wetted with *ca.* 55% Water) [Useful catalyst for coupling reaction, etc.]		5g	25g
P1491	Palladium 10% on Carbon (wetted with *ca.* 55% Water)		5g	25g
P1490	Palladium 5% on Carbon (wetted with *ca.* 55% Water)		5g	25g
A1424	Palladium(II) Acetate		1g	5g
P2106	Palladium(II) Acetate Trimer		1g	5g
P1430	Palladium Catalyst Set (includes useful 7 Palladium catalysts) Palladium(II) Acetate / Allylpalladium(II) Chloride Dimer / Bis(benzonitrile)palladium(II) Dichloride / Bis(dibenzylideneacetone)palladium(0) / [1,1'-Bis(diphenylphosphino)ferrocene]palladium(II) Dichloride Dichloromethane Adduct / Bis(triphenylphosphine)palladium(II) Dichloride / Tetrakis(triphenylphosphine)palladium(0)			1set
P1489	Palladium(II) Chloride		1g	5g
P2017	Palladium(II)(π-cinnamyl) Chloride Dimer			200mg
P1528	Palladium Hydroxide 20% on Carbon (wetted with *ca.* 50% Water)		10g	50g
P1870	Palladium(II) Trifluoroacetate		1g	5g
P1425	Poly[*N*-isopropylacrylamide-*co*-4-(diphenylphosphino)styrene] Palladium(II) Dichloride (ratio, acrylamide:phosphine=20:2)			100mg
P1944	Poly(methylphenyl)silane supported Palladium/Alumina Hybrid Catalyst [=Pd / ($PSi\text{-}Al_2O_3$)]			1g
C2372	SingaCycle™-A1 (This product is unavailable in the U.S.)		200mg	1g
C2406	SingaCycle™-A2 (This product is unavailable in the U.S.)		200mg	1g
C2387	SingaCycle™-A3 (This product is unavailable in the U.S.)		200mg	1g
C2407	SingaCycle™-A4 (This product is unavailable in the U.S.)		200mg	1g
C0540	Sodium Tetrachloropalladate(II)			1g

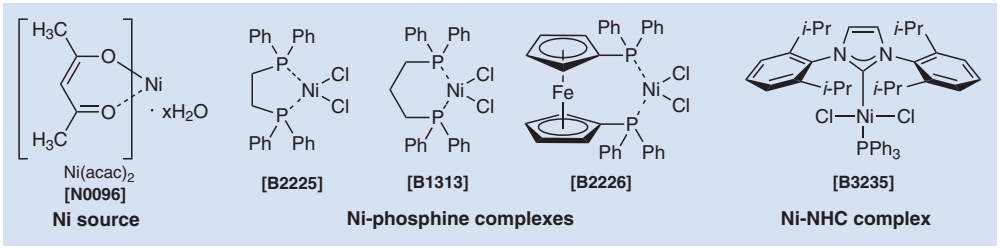
Product No.	Product Name	Unit Size		
T1350	Tetrakis(triphenylphosphine)palladium(0)	1g	5g	25g
T2184	Tris(dibenzylideneacetone)dipalladium(0)		1g	5g

Nickel Catalysts

Nickel catalysts are routinely used for cross-coupling reactions as well as palladium catalysts. In 1972, Kumada and Tamao had reported that nickel catalysts promoted cross-coupling reactions of Grignard reagents with aryl halides or vinyl halides with the proposal their catalytic cycle. The result of this research has contributed to further development of cross coupling reactions.[1)]

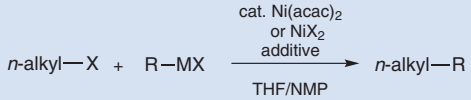
Nickel catalysts are generally inexpensive and show high activities even when using low reactive substrates in cross-coupling reactions. For example, in the presence of butyl lithium, zinc metal or phosphines as a co-reductant, $NiCl_2$(dppf) catalyzed cross-coupling reactions of aryl chlorides/mesylates with aryl borates successfully proceeding to afford the desired biaryls in good yields.[2)] Recently, it has been reported that *N*-heterocyclic carbene (NHC) – nickel complexes show high catalytic activity in cross-coupling reactions.





On the other hand, similar to iron and cobalt catalysts, nickel catalysts are used for the cross coupling reactions of alkyl halides with organometallic species such as organomagnesium, organozinc and organoboric acid compounds. This synthetic means is effective for producing the carbon sp^3 – carbon sp^3 bond. In this reaction, phosphine ligands are less effective and an optimization of the reaction conditions suitable for each substrate was investigated. In a case using primary alkyl halides as a reactant, the coupling reactions are accelerated by using NMP as a solvent and addition of alkenes with electron-withdrawing groups. It is also effective to add butadienes as additives because the reactivity of the coupling reactions improves through the formation of nickel - bis-allyl complexes. The proceeding of cross-coupling reactions with secondary alkyl halides is harder relative to primary alkyl halides, so pyridyl-type chelate ligands such as phenanthrolines, Pybox and diamines are used for promoting those reactions. This has been applied to asymmetric reactions and natural products synthesis.[3)]

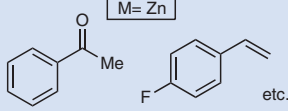
Cross coupling of primary alkyl halides



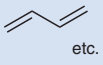
X= I, Br
R= *n*-alkyl, *s*-alkyl, benzyl, aryl

additive:

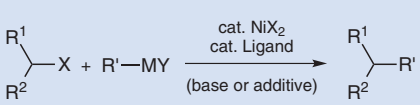
M= Zn



M= Mg

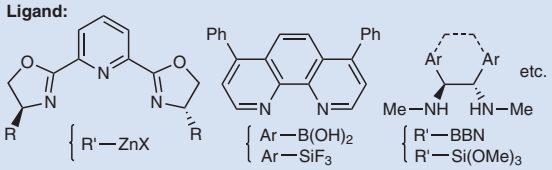


Cross coupling of secondary alkyl halides



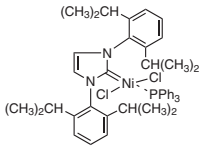
X= I, Br, MY= ZnX, $B(OH)_2$, BBN, SiF_3, $Si(OMe)_3$ etc.
R'= alkyl, aryl, alkenyl

Ligand:

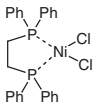


Nickel Catalysts

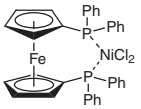
B3235



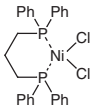
B2225



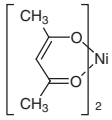
B2226



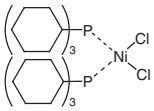
B1313



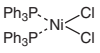
N0096



B3534



B1571



S0487

Ni

Product No.	Product Name			Unit Size
B3235	[1,3-Bis(2,6-diisopropylphenyl)imidazol-2-ylidene]triphenylphosphine Nickel(II) Dichloride		200mg	1g
B2225	[1,2-Bis(diphenylphosphino)ethane]nickel(II) Dichloride	1g	5g	25g
B2226	[1,1'-Bis(diphenylphosphino)ferrocene]nickel(II) Dichloride		1g	5g
B1313	[1,3-Bis(diphenylphosphino)propane]nickel(II) Dichloride		5g	25g
N0096	Bis(2,4-pentanedionato)nickel(II) Hydrate		25g	500g
B3534	Bis(tricyclohexylphosphine)nickel(II) Dichloride		1g	5g
B1571	Bis(triphenylphosphine)nickel(II) Dichloride		10g	100g
S0487	Skeletal Nickel Catalyst slurry in Water [Active catalyst for Hydrogenation]			50g

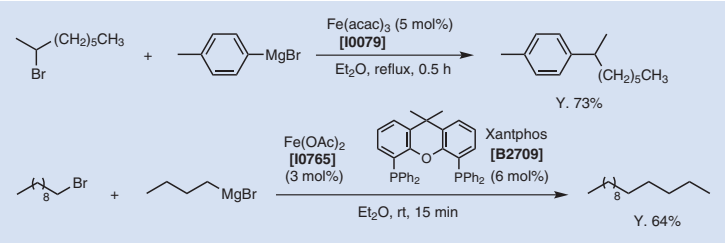
References

1) K. Tamao, K. Sumitani, M. Kumada, *J. Am. Chem. Soc*. **1972**, *94*, 4374.
2) a) V. Percec, J.-Y. Bae, D. H. Hill, *J. Org. Chem*. **1995**, *60*, 1060.
b) S. Saito, M. Sakai, N. Miyaura, *Tetrahedron Lett*. **1996**, *37*, 2993.
c) S. Saito, S. Oh-tani, N. Miyaura, *J. Org. Chem*. **1997**, *62*, 8024.
d) A. F. Indolese, *Tetrahedron Lett*. **1997**, *38*, 3513.
e) K. Inada, N. Miyaura, *Tetrahedron* **2000**, *56*, 8657.
3) Review
a) M. R. Netherton, G. C. Fu, *Adv. Synth. Catal*. **2004**, *346*, 1525.
b) F. Glorius, *Angew. Chem. Int. Ed*. **2008**, *47*, 8347.
c) A. Rudolph, M. Lautens, *Angew. Chem. Int. Ed*. **2009**, *48*, 2656.

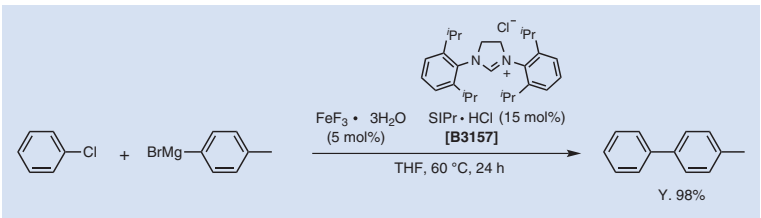
Iron Catalysts

Including palladium catalysts, which are frequently used for the Suzuki-Miyaura coupling reaction, transition metal catalysts, such as nickel, copper, or rhodium, have been widely used for organic synthesis. However, the percentages of these metals in the earth's crust are extremely small, and their prices are rather expensive.[1] On the other hand, iron is abundant and less expensive, therefore, more and more chemists have focused their attention to organic synthesis using iron compounds as a catalyst.

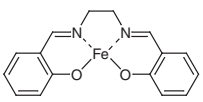
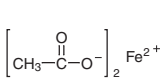
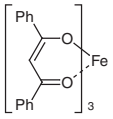
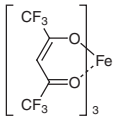
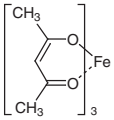
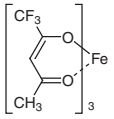
For instance, with regards to the reactions of Grignard reagents with alkyl bromides, Hayashi *et al.*[2] and Chai *et al.*[3] have reported the synthetic methods using $Fe(acac)_3$ as a catalyst, $Fe(OAc)_2$ as a catalyst and Xantphos as a ligand, respectively, by which the desired coupling products can be obtained in good yields.



Furthermore, Nakamura *et al.* have reported the method using the *N*-heterocyclic carbene *in situ* generated from SIPr・HCl, which suppresses the generation of the homo-coupling products, thereby leading to an excellent yield of the desired product.[4]



Thus, synthetic technologies using iron catalysts are being actively developed. It can be expected that iron catalysts will exhibit their own catalytic properties in addition to replacing other metal catalysts in the near future.

Iron Catalysts		D2571	I0765	T1686
				
H0555	I0079	T0750		
				

Product No.	Product Name			Unit Size
D2571	*N*,*N*'-Bis(salicylidene)ethylenediamine Iron(II)		5g	25g
I0765	Iron(II) Acetate		5g	25g
T1686	Tris(dibenzoylmethanato) Iron		5g	25g
H0555	Tris(hexafluoroacetylacetonato)iron(III)			1g
I0079	Tris(2,4-pentanedionato)iron(III)	25g	100g	500g
T0750	Tris(trifluoro-2,4-pentanedionato)iron(III)			5g

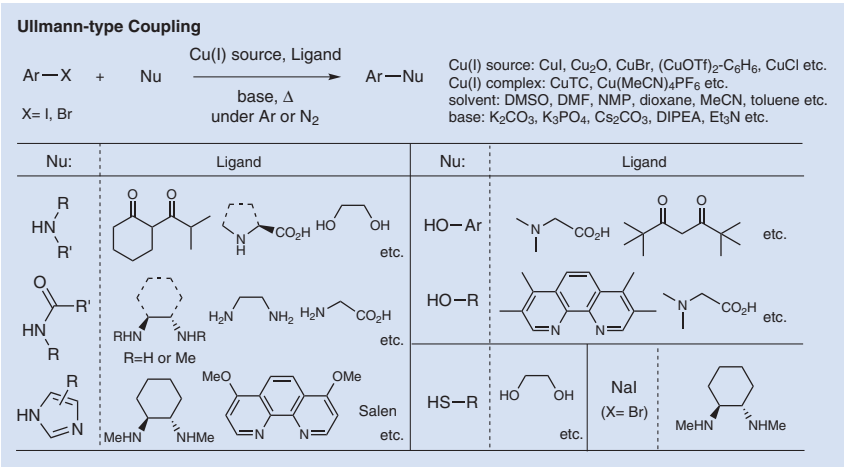
References

1) J. Emsley, in *The Elements*, 3rd ed., Oxford Univ. Press, New York, **1998**.
2) T. Nagano, T. Hayashi, *Org. Lett.* **2004**, *6*, 1297.
3) K. G. Dongol, H. Koh, M. Sau, C. L. L. Chai, *Adv. Synth. Catal.* **2007**, *349*, 1015.
4) T. Hatakeyama, M. Nakamura, *J. Am. Chem. Soc.* **2007**, *129*, 9844.

Copper Catalysts

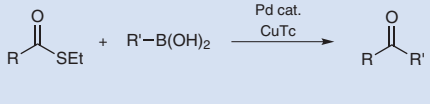
Copper-mediated coupling reactions have been known as a traditional reaction. For instance, homocouplings of aryl halides and alkynes are called the Ullmann reaction and the Glaser coupling respectively, and both of these were discovered over a hundred years ago. Around the same time, carbon-heteroatom bond forming reactions such as the Ullmann ether synthesis and the Goldberg amination were also reported. In early studies of these classical copper-mediated coupling reactions, there were a number of disadvantages needing improvement such as use of over stoichiometric amounts of copper reagents, harsh reaction conditions, and low substrate generality. However, copper-mediated coupling reactions can be carried out at a lower cost compared with using palladium catalysts. So, various modified methods have been studied and more practical reactions have been developed.

Recent advances in the Ullmann-type reactions using aryl halides have been achieved under milder reaction conditions and reducing the amount of copper catalyst by the choice of suitable solvents, bases, and ligands. Also, investigation of effective ligands for these reactions has been developed and found that the diamine and dicarbonyl compounds effectively play as a ligand in preventing side reactions and deactivating a monovalent copper catalyst.



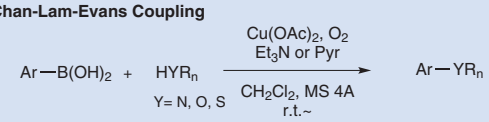
For instance, CuTc (copper(I) 2-thiophenecarboxylate) catalyzed the Ullmann coupling and can proceed at room temperature without having to apply heat. CuTc also acts as a co-catalyst of palladium catalyzed reactions. In a case of the Liebeskind-Srogl cross-coupling reaction, CuTc assisted activation of thioesters plays an important role in promoting the coupling reaction.

Liebeskind-Srogl Cross-coupling Reaction



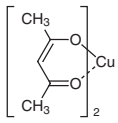
Furthermore, the coupling reaction of aryl boronic acids with amines, phenols, and thiols promoted by a divalent copper and an oxygen from the air as a reoxidant, is known as the Chan-Lam-Evans coupling. This is a halogen-free coupling reaction and the stirring efficiency is important for the reaction to proceed due to reoxidizing the copper catalyst by an oxygen in the air. The rate of this reaction is generally slow and requires several days to complete the reaction, while it is carried out at room temperature.

Chan-Lam-Evans Coupling

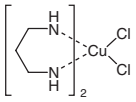


Copper Catalysts

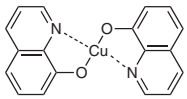
C0384



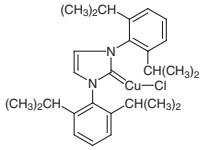
B1513



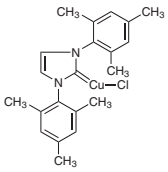
B3834
B1677



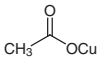
C2304



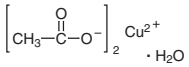
C2422



A1540



C2346



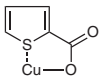
C1952

CuCN

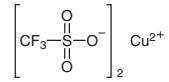
C2410

$Cu(BF_4)_2$

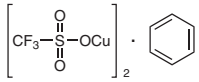
C2312



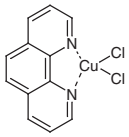
T1292



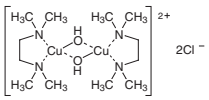
T1442



D3891



D2542



D4395

Li_2CuCl_4

T2665

$(CH_3CN)_4Cu^+ PF_6^-$

T2666

$(CH_3CN)_4Cu^+ BF_4^-$

Product No.	Product Name	Unit Size	
C0384	Bis(2,4-pentanedionato)copper(II)	25g	250g
B1513	Bis(1,3-propanediamine) Copper(II) Dichloride	1g	10g
B3834	Bis(8-quinolinolato)copper(II) (purified by sublimation)		1g
B1677	Bis(8-quinolinolato)copper(II)		25g
C2304	Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]copper(I)	200mg	1g
C2422	Chloro(1,3-dimesitylimidazol-2-ylidene)copper(I)	200mg	1g

Product No.	Product Name	Unit Size	
A1540	Copper(I) Acetate	5g	25g
C2346	Copper(II) Acetate Monohydrate	25g	500g
C1952	Copper(I) Cyanide	25g	300g
C2410	Copper(II) Tetrafluoroborate (*ca.* 45% in Water)		500g
C2312	Copper(I) 2-Thiophenecarboxylate	1g	5g
T1292	Copper(II) Trifluoromethanesulfonate	5g	25g
T1442	Copper(I) Trifluoromethanesulfonate Benzene Complex	1g	5g
D3891	Dichloro(1,10-phenanthroline)copper(II)	1g	5g
D2542	Di-μ-hydroxo-bis[(*N*,*N*,*N*',*N*'-tetramethylethylenediamine)copper(II)] Chloride	5g	25g
D4395	Dilithium Tetrachlorocopper(II) (*ca.* 2.5% in Tetrahydrofuran, *ca.* 0.1mol/L)	100mL	500mL
T2665	Tetrakis(acetonitrile)copper(I) Hexafluorophosphate		5g
T2666	Tetrakis(acetonitrile)copper(I) Tetrafluoroborate	1g	5g

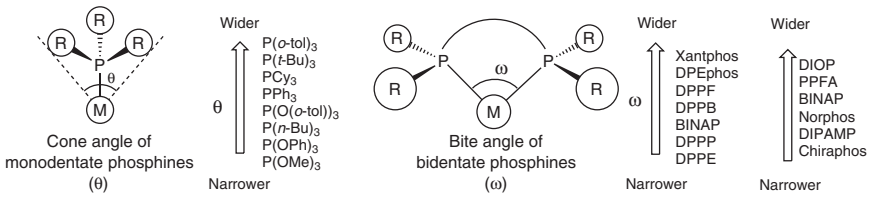
References

1) Review
a) S. V. Ley, A. W. Thomas, *Angew. Chem. Int. Ed.* **2003**, *42*, 5400.
b) G. Evano, N. Blanchard, M. Toumi, *Chem. Rev.* **2008**, *108*, 3054.
c) S. U. Tekale, V. B. Jadhav, V. P. Pagore, S. S. Kauthale, D. D. Gaikwad, R. P. Pawar, *Mini-Rev. Org. Chem*, **2013**, *10*, 281.

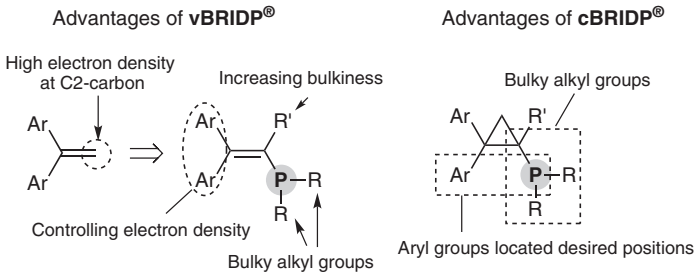
Phosphine Ligands

Phosphines are a three-valent phosphorus compound and act as a 'soft' σ-donating ligand with an unshared electron pair. This gives solubilization and stabilization to organometallic complexes by forming complexes with various transition metal species including latter-period transition metals and others, and is also used for controlling the reactivity and selectivity of the transition metal promoted reactions.

Electron density and bulkiness of phosphine ligands are greatly related to the reactivity of their forming metal complexes. Generally, the phosphine ligands with high electron density increase the reactivity of oxidative addition from a metal center, and their bulkiness improves the reductive elimination. For example, trialkylphosphines especially *tert*-butyl or cyclohexyl group substituted phosphines show the highest electron density while the electron density of triarylphosphines and phosphite are sequentially decreasing. On the other hand, as an index of the bulkiness of phosphine ligands, that of monodentate phosphine ligands shows the cone angle (θ) while bidentate phosphine ligands show the bite angle (ω). As the angle of the phosphine ligands is wider, their steric effect is greater and they are regarded as more bulky phosphine ligands. A monodentate phosphine ligand of tri(*o*-tolyl)phosphine, and bidentate phosphine ligands of 1,1'-bis(diphenylphosphino)ferrocene and Xantphos are known as representative bulky phosphine ligands.

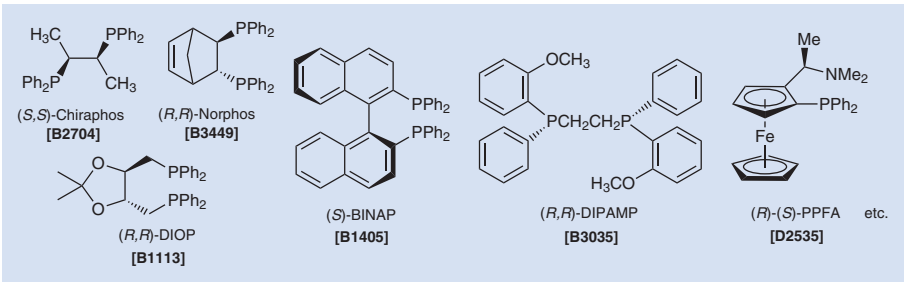


Electron rich and bulky trialkylphosphine ligands such as tributylphosphine and tricyclohexylphosphine are highly effective to use for cross-coupling reactions due to their functionally promoting the process of catalytic cycles, both the oxidative addition and reductive elimination. For instance, aryl chlorides have low reactivity against the oxidative addition of transition metals so it generally doesn't proceed. However, successful oxidative addition of them can be accomplished by the use of bulky trialkylphosphine ligands. In this way, trialkylphosphines have excellent chemical properties but they are unstable in air. So, it is required to handle them in a glove box. As an improvement of this disadvantage, the salt of phosphonium borates is used as a precursor of phosphine ligands. These can be treated in air and after neutralization the generated alkylphosphines are available in the reactions. Recently, alkyl group-substituted biarylphosphine ligands with higher activity have been developed and used in cross-coupling reactions. Also, unique phosphine ligands with high electron density but chemically stable in air named BRIDPs® have been developed.[2)]



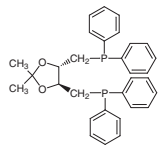
*BRIDP® is a registered trademark of TAKASAGO INTERNATIONAL CORPORATION.

Generally, phosphines are widely used as a ligand for nickel or palladium catalysts in cross-coupling reactions. They are also effective ligands for rhodium, iridium and gold catalysts and used in catalytic reactions such as hydrogenation and cyclization reactions. Furthermore, a number of optically active phosphine ligands with chiral carbon centers, axial chirality, P-chiral center and so on, have been developed. These ligands are applied to catalytic asymmetric reactions such as asymmetric hydrogenations, asymmetric allylations, asymmetric conjugate additions, asymmetric cycloadditions and asymmetric cross-coupling reactions by the combination with various transition metal species.

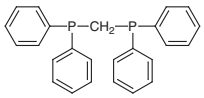


Phosphine Ligands		B2711	B2710	B3449
B3450	B1406	B1405	B1246	B2704
B2709	B1137	B2027	B1959	B1113

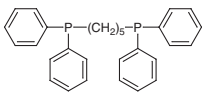
B1112



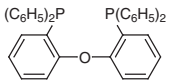
B1982



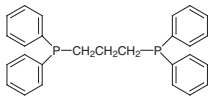
B1960



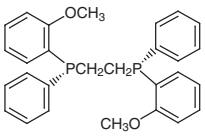
B2867



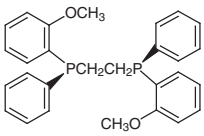
B1138



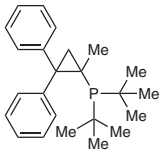
B3035



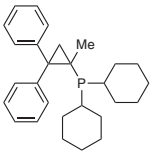
B3036



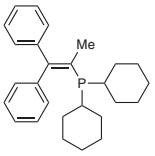
C2979



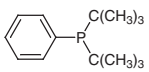
C2980



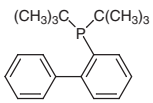
C2981



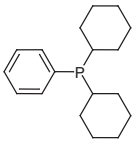
D3940



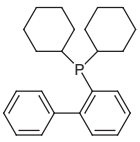
D3387



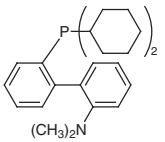
D2411



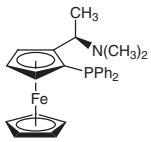
D3388



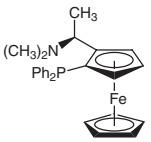
D3389



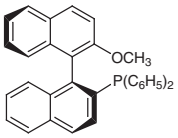
D2535



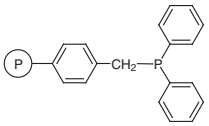
D2536



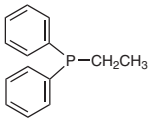
D2775



D2766



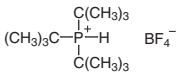
E0519



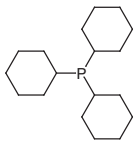
T1912

T0361

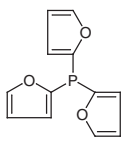
T2584



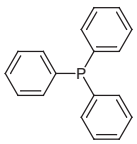
T1165



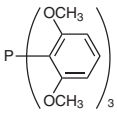
T1643



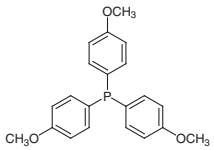
T0519



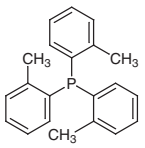
T1614



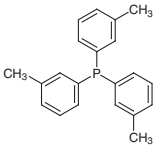
T0861



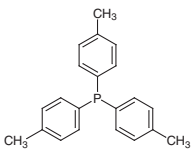
T1024



T1025



T0862



Product No.	Product Name	Unit Size	
B2711	1,1'-Bis(di-*tert*-butylphosphino)ferrocene	100mg	1g
B2710	1,1'-Bis(diisopropylphosphino)ferrocene	100mg	1g
B3449	(2*R*,3*R*)-(-)-2,3-Bis(diphenylphosphino)bicyclo[2.2.1]hept-5-ene ((2*R*,3*R*)-(-)-Norphos)		100mg
B3450	(2*S*,3*S*)-(+)-2,3-Bis(diphenylphosphino)bicyclo[2.2.1]hept-5-ene ((2*S*,3*S*)-(+)-Norphos)		100mg
B1406	(*R*)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl ((*R*)-(+)-BINAP)	1g	5g
B1405	(*S*)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl ((*S*)-(-)-BINAP)	1g	5g

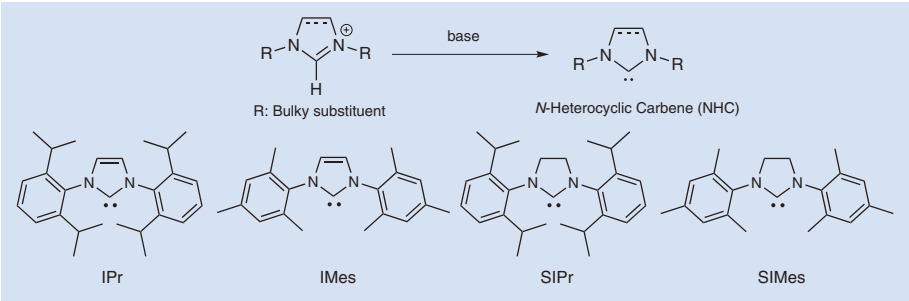
Product No.	Product Name	Unit Size		
B1246	1,4-Bis(diphenylphosphino)butane		5g	25g
B2704	(2*S*,3*S*)-(-)-Bis(diphenylphosphino)butane ((*S*,*S*)-Chiraphos)		100mg	1g
B2709	4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene (Xantphos)		1g	5g
B1137	1,2-Bis(diphenylphosphino)ethane		10g	25g
B2027	1,1'-Bis(diphenylphosphino)ferrocene	1g	5g	25g
B1959	1,6-Bis(diphenylphosphino)hexane		1g	5g
B1113	(2*R*,3*R*)-(-)-1,4-Bis(diphenylphosphino)-2,3-*O*-isopropylidene-2,3-butanediol ((-)-DIOP)			1g
B1112	(2*S*,3*S*)-(+)-1,4-Bis(diphenylphosphino)-2,3-*O*-isopropylidene-2,3-butanediol ((+)-DIOP)			1g
B1982	Bis(diphenylphosphino)methane		5g	25g
B1960	1,5-Bis(diphenylphosphino)pentane			1g
B2867	Bis[2-(diphenylphosphino)phenyl] Ether		5g	25g
B1138	1,3-Bis(diphenylphosphino)propane		5g	25g
B3035	(*R*,*R*)-1,2-Bis[(2-methoxyphenyl)phenylphosphino]ethane ((*R*,*R*)-DIPAMP)			100mg
B3036	(*S*,*S*)-1,2-Bis[(2-methoxyphenyl)phenylphosphino]ethane ((*S*,*S*)-DIPAMP)		100mg	1g
C2979	cBRIDP®		200mg	1g
C2980	Cy-cBRIDP®		200mg	1g
C2981	Cy-vBRIDP®		200mg	1g
D3940	Di-*tert*-butylphenylphosphine			5g
D3387	2-(Di-*tert*-butylphosphino)biphenyl			1g
D2411	Dicyclohexylphenylphosphine		1g	5g
D3388	2-(Dicyclohexylphosphino)biphenyl		1g	5g
D3389	2-(Dicyclohexylphosphino)-2'-(dimethylamino)biphenyl		1g	5g
D2535	(*R*)-*N*,*N*-Dimethyl-1-[(*S*)-2-(diphenylphosphino)ferrocenyl]ethylamine ((*R*)-(*S*)-PPFA)			100mg
D2536	(*S*)-*N*,*N*-Dimethyl-1-[(*R*)-2-(diphenylphosphino)ferrocenyl]ethylamine ((*S*)-(*R*)-PPFA)			100mg
D2775	(*S*)-(-)-2-Diphenylphosphino-2'-methoxy-1,1'-binaphthyl		100mg	1g
D2766	4-Diphenylphosphinomethyl Polystyrene Resin cross-linked with 2% DVB (200-400mesh) (0.5-1.0mmol/g)			5g
E0519	Ethyldiphenylphosphine			5g
T1912	Tri-*tert*-butylphosphine			5g
T0361	Tributylphosphine	25mL	100mL	500mL
T2584	Tri-*tert*-butylphosphonium Tetrafluoroborate		1g	5g
T1165	Tricyclohexylphosphine (contains Tricyclohexylphosphine Oxide) (*ca.* 18% in Toluene, *ca.* 0.60mol/L)			25mL
T1643	Tri(2-furyl)phosphine		1g	5g
T0519	Triphenylphosphine		25g	500g
T1614	Tris(2,6-dimethoxyphenyl)phosphine			25g
T0861	Tris(4-methoxyphenyl)phosphine		5g	25g
T1024	Tri(*o*-tolyl)phosphine		5g	25g
T1025	Tri(*m*-tolyl)phosphine		5g	25g
T0862	Tri(*p*-tolyl)phosphine		5g	25g

References

1) J. F. Hartwig, in *Organotransition Metal Chemistry: From Bonding to Catalysis*, Univ Science Books, **2009**.
2) Reviews for alkylbiaryl phosphine ligands :
a) R. Martin, S. L. Buchwald, *Acc. Chem. Res.* **2008**, *41*, 1461.
b) D. S. Surry, S. L. Buchwald, *Angew. Chem. Int. Ed.* **2008**, *47*, 6338.
3) Review for BRIDPs® : K. Suzuki, Y. Hori, Y. Nakayama, T. Kobayashi, *J. Synth. Org. Chem. Jpn.* **2011**, *69*, 1231.

N-Heterocyclic Carbene (NHC) Ligands

N-Heterocyclic carbene (NHC) is a cyclic carbene species with two neighboring nitrogen atoms. NHC was discovered by Wanzlick *et al*. in 1968, and in 1991, it was isolated and structure determined by Arduengo *et al*. So, for their achievements, NHC is also called as the Wanzlick-Arduengo type carbene. Generally, NHC is hard to isolate as a single carbene monomer because it easily dimerizes or reacts with water to decompose. However, NHC is conformationally stabilized by introducing bulky substituents on the nitrogen atoms of NHC. NHC substituted by a mesityl groups or 2,6-diisopropylphenyl groups is commonly used as a ligand for organometallic complexes.

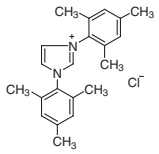


A characteristic property of NHC ligands is their high coordinating ability caused by their bulkiness and strong electron-donating property. Their effect is stronger relative to trialkylphosphines, and allows the formation of metal-NHC complexes by ligand exchange reactions of metal-phosphine complexes with NHC ligands. In this way, NHC ligands strongly form complexes with some metals, and also produce coordinative unsaturation species by pushing out a *trans* position ligand coordinated with the metal center. Therefore, metal complexes coordinated by NHC ligands are highly active species but chemically stable and easy to handle, so they are expected to have a high turnover frequency.

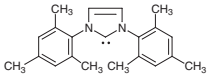
Metal-NHC complexes can be prepared by a complex-forming reaction of metal complexes having anionic ligands such as acetoxy ions with NHC which was previously prepared from imidazolium salts and bases. They can be also prepared *via* the carbene-exchange reaction of silver-carbene complexes prepared from silver(I) oxide and imidazolium salts. This method is effective to use when bases are unavailable for preparing NHC. Metal-NHC complexes have been used for various chemical transformations such as cross-coupling reactions, cycloaddition reactions and C-H bond activation reactions since they have been successfully applied in metathesis reactions. In addition, NHC is used as an organocatalyst for benzoin condensations and acyloin condensations *via* the umpolung process.

N-Heterocyclic Carbene Ligands		B3506	B3157	D3611
B3465	B3158	D3711	D3472	D3882

D3446



D3870



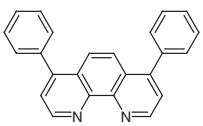
Product No.	Product Name			Unit Size
B3506	1,3-Bis(2,6-diisopropylphenyl)imidazolidin-2-ylidene			1g
B3157	1,3-Bis(2,6-diisopropylphenyl)imidazolinium Chloride (SIPr・HCl)	500mg	1g	5g
D3611	1,3-Bis(2,6-diisopropylphenyl)imidazolium Chloride (IPr・HCl)	500mg	5g	25g
B3465	1,3-Bis(2,6-diisopropylphenyl)imidazol-2-ylidene (IPr)		1g	5g
B3158	1,3-Bis(2,4,6-trimethylphenyl)imidazolinium Chloride (SIMes・HCl)		1g	5g
D3711	1,3-Di-*tert*-butylimidazolium Tetrafluoroborate (I*t*Bu・HBF_4)		1g	5g
D3472	1,3-Di-*tert*-butylimidazol-2-ylidene (I*t*Bu)		1g	5g
D3882	1,3-Dicyclohexylimidazolium Chloride (IcHex・HCl) (This product is only available in Japan.)		1g	5g
D3446	1,3-Dimesitylimidazolium Chloride (IMes・HCl)		1g	5g
D3870	1,3-Dimesitylimidazol-2-ylidene (IMes)		1g	5g

References

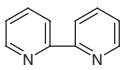
1) S. P. Nolan, in *N-Heterocyclic Carbenes in Synthesis*, Wiley-VCH, Weinheim, **2006**.
2) J. F. Hartwig, in *Organotransition Metal Chemistry: From Bonding to Catalysis*, Univ Science Books, **2009**.

Bases & Additives

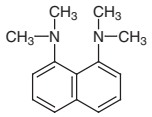
B2695
D0905



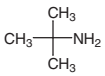
B0468



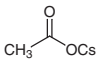
B1018



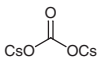
B0709



C2430



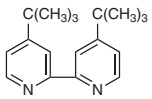
C2160



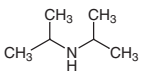
C2204

CsF

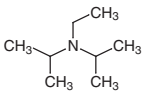
D3134



D0925



D1599

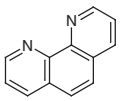


L0204
L0222

LiCl

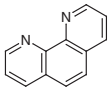
M0508

P0221



・H_2O

P0081



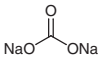
・HCl ・H_2O

P1748

P1758

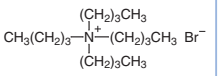
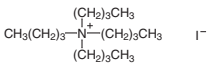
KF

S0560



S0485

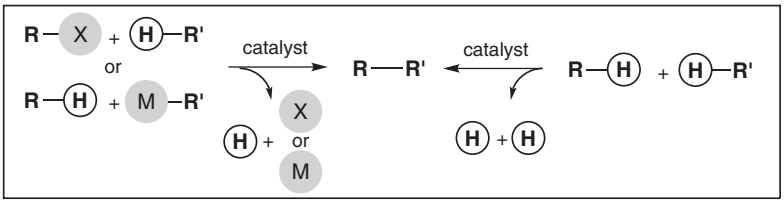
CH_3ONa

T0054	T0057	Z0015
		Zn

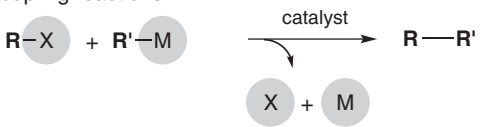
Product No.	Product Name			Unit Size
B2695	Bathophenanthroline (purified by sublimation)			1g
D0905	Bathophenanthroline		1g	5g
B0468	2,2'-Bipyridyl	25g	100g	500g
B1018	1,8-Bis(dimethylamino)naphthalene [for Dehydrohalogenation]	1g	5g	25g
B0709	*tert*-Butylamine	25mL	100mL	500mL
C2430	Cesium Acetate		25g	100g
C2160	Cesium Carbonate		25g	100g
C2204	Cesium Fluoride		25g	100g
D3134	4,4'-Di-*tert*-butyl-2,2'-bipyridyl		1g	5g
D0925	Diisopropylamine	25mL	100mL	500mL
D1599	*N,N*-Diisopropylethylamine	25mL	100mL	500mL
L0204	Lithium Chloride Anhydrous		25g	300g
L0222	Lithium Chloride (2.3% in Tetrahydrofuran, *ca.* 0.5mol/L)			100mL
M0508	1-Methylimidazole	25g	100g	500g
P0221	1,10-Phenanthroline Monohydrate		1g	25g
P0081	1,10-Phenanthroline Hydrochloride Monohydrate			25g
P1748	Potassium Carbonate			300g
P1758	Potassium Fluoride			300g
S0560	Sodium Carbonate			300g
S0485	Sodium Methoxide		100g	500g
T0054	Tetrabutylammonium Bromide	25g	100g	500g
T0057	Tetrabutylammonium Iodide	25g	100g	500g
Z0015	Zinc (Powder)			300g

Activation of Non-active Bonds

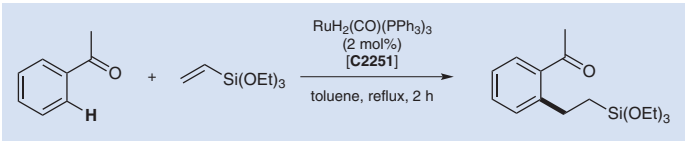
Recently, development of the methodology for activation of unreactive bonds with transition metals and applications for functional transformations have been actively performed. In this study, C-H bond activation is studied as low environmental load type of reactions because this type of reaction proceeds with the cross-coupling reactions without using halides or nucleophilic organometallic species, thereby decreasing the number of reaction steps. A reasonable expression for these functional transformations is "C-H bond transformation" or "C-H bond functionalization".



cf. Cross-coupling reactions



In 1993, Murai *et al*. reported that the *ortho*-position of a C-H bond of aromatic ketones was activated by the action of catalytic amounts of carbonyl(dihydrido)tris(triphenylphosphine)ruthenium(II) and consequently added to olefins siteselectively. After this report, the study of C-H bond activation reactions dramatically progressed.

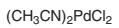


Functional transformation *via* the activation of unreactive bonds is classified into two types of synthetic modes. One is a method to activate by the assist of intramolecular chelation from the directing group in which the activation of unreactive bonds is performed by oxidative addition of lower-valent metal species. The other method is to cleave relatively high acidic C-H bonds with higher-valent metal species. In this method, it is often necessary to use reoxidants for reproducing higher-valent metal species. Even in reactions using higher-valent metal species, the assist of intramolecular chelation from the directing group is effective for performing the activation of unreactive bonds regioselectively.

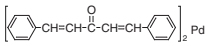
Metal species utilized for functional transformation *via* the activation of unreactive bonds are palladium, ruthenium, rhodium, iridium and so on, with most of them being noble metals. Recently, relatively inexpensive metals such as nickel, copper and iron have also been used in these transformations. Much research has been performed and a number of useful transformations such as arylations, alkenylations, alkynylations, carbonylations and heteroatom functionalizations have been reported. Many of them activate C-H bonds on unsaturated carbons of aromatic rings or alkenes to transform into other functional groups. However, currently, cleavage of C-H bonds on sp^3 carbon which are generally harder to activate are being studied and successful transformations have been developed. There are various ways to activate unreactive bonds. The detail of these chemical properties and reactivities are explained as follows.

Palladium

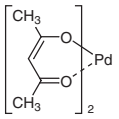
B1676



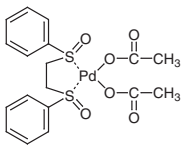
B1374



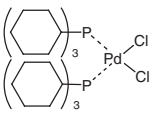
B2018



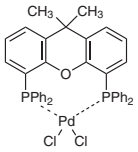
B3292



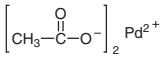
B2055



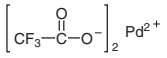
D4333



A1424



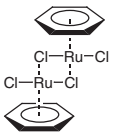
P1870



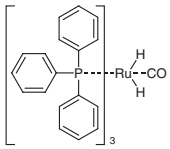
Product No.	Product Name	Unit Size	
B1676	Bis(acetonitrile)palladium(II) Dichloride	1g	5g
B1374	Bis(dibenzylideneacetone)palladium(0)	1g	5g
B2018	Bis(2,4-pentanedionato)palladium(II)	1g	5g
B3292	1,2-Bis(phenylsulfinyl)ethane Palladium(II) Diacetate	200mg	1g
B2055	Bis(tricyclohexylphosphine)palladium(II) Dichloride	1g	5g
D4333	Dichloro[9,9-dimethyl-4,5-bis(diphenylphosphino)xanthene]palladium(II)	200mg	1g
A1424	Palladium(II) Acetate	1g	5g
P1870	Palladium(II) Trifluoroacetate	1g	5g

Ruthenium

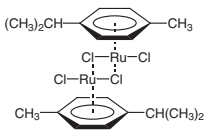
B1902



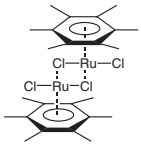
C2251



D2751

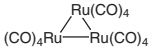


H1010

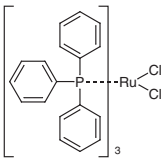


R0074

T2181



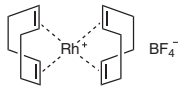
D1997



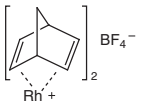
Product No.	Product Name	Unit Size	
B1902	Benzeneruthenium(II) Chloride Dimer	1g	5g
C2251	Carbonyl(dihydrido)tris(triphenylphosphine)ruthenium(II)	250mg	1g
D2751	Dichloro(*p*-cymene)ruthenium(II) Dimer	1g	5g
H1010	(Hexamethylbenzene)ruthenium(II) Dichloride Dimer		1g
R0074	Ruthenium(III) Chloride	1g	5g
T2181	Triruthenium Dodecacarbonyl	100mg	1g
D1997	Tris(triphenylphosphine)ruthenium(II) Dichloride	1g	5g

Rhodium

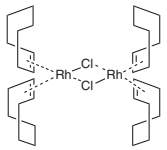
B3961



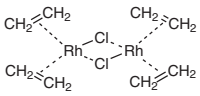
B2091



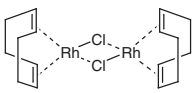
C2253



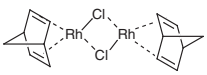
C2461



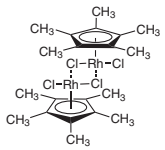
B1045



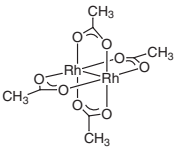
N0453



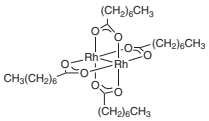
P1788



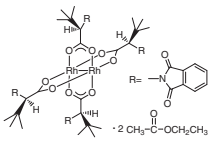
R0069



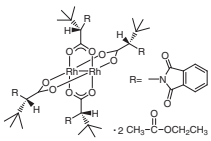
R0161



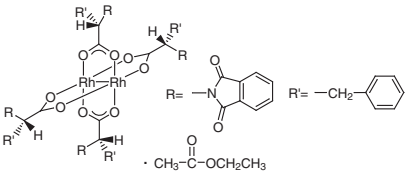
T2054



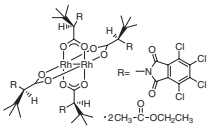
T2055



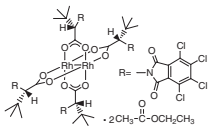
T1551



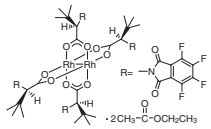
T2658



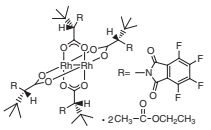
T2659



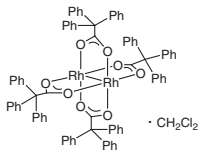
T2660



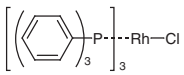
T2661



T1544



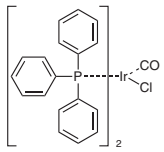
T0931



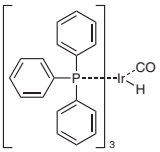
Product No.	Product Name	Unit Size	
B3961	Bis(1,5-cyclooctadiene)rhodium(I) Tetrafluoroborate	100mg	1g
B2091	Bis[η-(2,5-norbornadiene)]rhodium(I) Tetrafluoroborate	100mg	1g
C2253	Chlorobis(cyclooctene)rhodium(I) Dimer	100mg	500mg
C2461	Chlorobis(ethylene)rhodium(I) Dimer		200mg
B1045	Chloro(1,5-cyclooctadiene)rhodium(I) Dimer	100mg	1g
N0453	Norbornadiene Rhodium(I) Chloride Dimer		100mg
P1788	(Pentamethylcyclopentadienyl)rhodium(III) Dichloride Dimer	200mg	1g
R0069	Rhodium(II) Acetate Dimer	100mg	1g
R0161	Rhodium(II) Octanoate Dimer	200mg	1g
T2054	Tetrakis[*N*-phthaloyl-(*R*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		100mg
T2055	Tetrakis[*N*-phthaloyl-(*S*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		100mg
T1551	Tetrakis[*N*-phthaloyl-(*S*)-phenylalaninato]dirhodium Ethyl Acetate Adduct		100mg
T2658	Tetrakis[*N*-tetrachlorophthaloyl-(*R*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		50mg
T2659	Tetrakis[*N*-tetrachlorophthaloyl-(*S*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		100mg
T2660	Tetrakis[*N*-tetrafluorophthaloyl-(*R*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		50mg
T2661	Tetrakis[*N*-tetrafluorophthaloyl-(*S*)-*tert*-leucinato]dirhodium Bis(ethyl Acetate) Adduct		100mg
T1544	Tetrakis(triphenylacetato)dirhodium(II) Dichloromethane Adduct		100mg
T0931	Tris(triphenylphosphine)rhodium(I) Chloride	1g	5g

Iridium

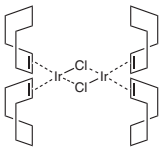
C2252



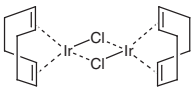
C3040



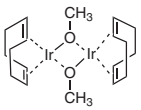
C2985



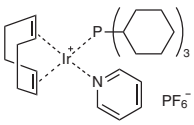
C1807



C2662



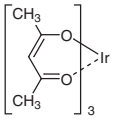
C2824



I0616

$IrCl_3 \cdot xH_2O$

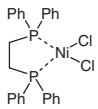
T2557



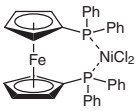
Product No.	Product Name	Unit Size	
C2252	Carbonylchlorobis(triphenylphosphine)iridium(I)	200mg	1g
C3040	Carbonylhydridotris(triphenylphosphine)iridium(I)	200mg	1g
C2985	Chlorobis(cyclooctene)iridium(I) Dimer		200mg
C1807	Chloro(1,5-cyclooctadiene)iridium(I) Dimer	250mg	1g
C2662	(1,5-Cyclooctadiene)(methoxy)iridium(I) Dimer	200mg	1g
C2824	(1,5-Cyclooctadiene)(pyridine)(tricyclohexylphosphine)iridium(I) Hexafluorophosphate		100mg
I0616	Iridium(III) Chloride Hydrate	1g	5g
T2557	Tris(2,4-pentanedionato)iridium(III)		1g

Nickel

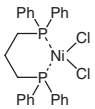
B2225



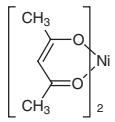
B2226



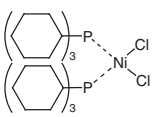
B1313



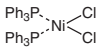
N0096



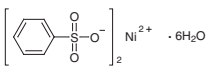
B3534



B1571



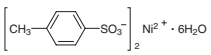
B0034



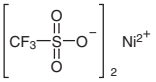
N0850

$NiCl_2$

T0276



N0861

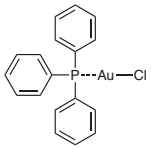


Product No.	Product Name			Unit Size
B2225	[1,2-Bis(diphenylphosphino)ethane]nickel(II) Dichloride	1g	5g	25g
B2226	[1,1'-Bis(diphenylphosphino)ferrocene]nickel(II) Dichloride		1g	5g
B1313	[1,3-Bis(diphenylphosphino)propane]nickel(II) Dichloride		5g	25g
N0096	Bis(2,4-pentanedionato)nickel(II) Hydrate		25g	500g
B3534	Bis(tricyclohexylphosphine)nickel(II) Dichloride		1g	5g
B1571	Bis(triphenylphosphine)nickel(II) Dichloride		10g	100g

Product No.	Product Name		Unit Size
B0034	Nickel(II) Benzenesulfonate Hexahydrate		25g
N0850	Nickel(II) Chloride Anhydrous	25g	500g
T0276	Nickel(II) *p*-Toluenesulfonate Hexahydrate		25g
N0861	Nickel(II) Trifluoromethanesulfonate	1g	5g

Gold

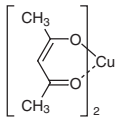
T2994



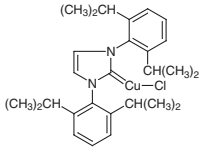
Product No.	Product Name		Unit Size
T2994	(Triphenylphosphine)gold(I) Chloride	200mg	1g

Copper

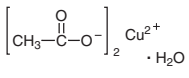
C0384



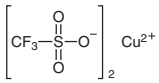
C2304



C2346



T1292



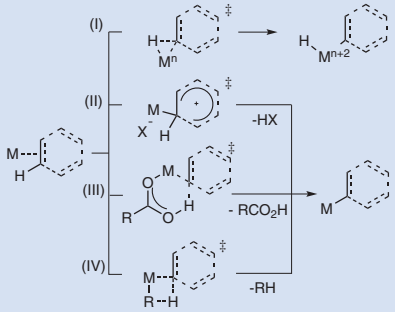
Product No.	Product Name		Unit Size
C0384	Bis(2,4-pentanedionato)copper(II)	25g	250g
C2304	Chloro[1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]copper(I)	200mg	1g
C2346	Copper(II) Acetate Monohydrate	25g	500g
T1292	Copper(II) Trifluoromethanesulfonate	5g	25g

Mechanism of C-H Bond Cleavage and Regioselectivity

Mechanism of a C-H bond cleavage for aromatic rings is classified into four types of modes according to the metal complexes and reactants.

(I) Oxidative addition by low-valent metal species
(II) Electrophilic aromatic substitution (S_EAr) by high-valent metal species
(III) Concerted metalation-deprotonation (CMD) by high-valent metal species
(IV) σ-Bond metathesis

In (I), oxidative addition by low-valent metal species needs the assist of intramolecular chelation from the directing group. In (II) and (III), the C-H bond cleavage by high-valent metal species, it is mostly necessary to add reoxidants for reproducing higher-valent metal species.



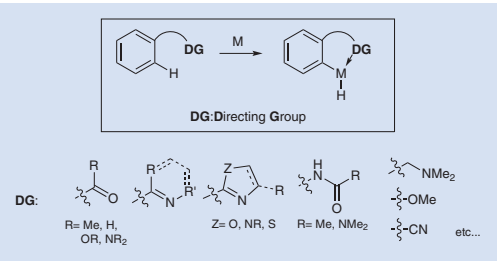
(I) **Oxidative addition**
Hydrides remain on the metals.
Low-valent metals Ru(0), Rh(I), Pd(0), Ni(0) etc. are used.
Effective to assist intramolecular chelation from the directing group

(II) **Electrophilic aromatic substitution (S_EAr)**
Hydrogen atom is pulled out as a proton.
Reactive to electron-rich aromatic rings and five-membered heterocycles
Generally, not rate-limiting step and low KIE(kH/kD=1.2~2.0)

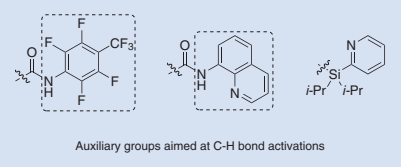
(III) **Concerted metalation-deprotonation (CMD)**
Hydrogen atom is pulled out as a proton.
Reactive to fluorine or nitrogen substituted electron-poor aromatic rings
If C-H bond cleavage is rate-limiting step, showed high KIE(kH/kD=3.5~7.0)

(IV) **σ-Bond metathesis**
Hydrogen atom is pulled out as a hydrocarbon.
Early transition metal complexes with unsaturated coordination state
Activation of sp^3 C-H bonds

In C-H bond activations, it is important that there is an assist of intramolecular chelation from the directing group (DG), because the generated carbon-metal-hydrogen bonding (C-M-H) species by oxidative addition of low-valent metal species are thermally unstable chemical species. However, the thermal stability of C-M-H species is increased by intramolecular coordination from heteroatoms on the directing group, and thereby, the formed metallacycles allow the C-H bond to cleave. Also, by the direction of intramolecular chelation from the directing group, the vicinal position of C-H bonds to the directing group in aromatic rings and the vicinal position of C-H bonds to the hetero atom in heterocycles are regioselectively activated. This synthetic manner can be applied for C-H bond activations by high-valent metal species.



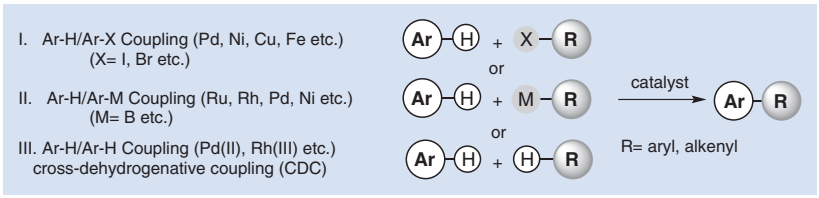
Recently, auxiliary groups aimed at C-H bond activations have been developed. They are effectively used for difficult-to-perform C-H bond activations by simple auxiliary groups.



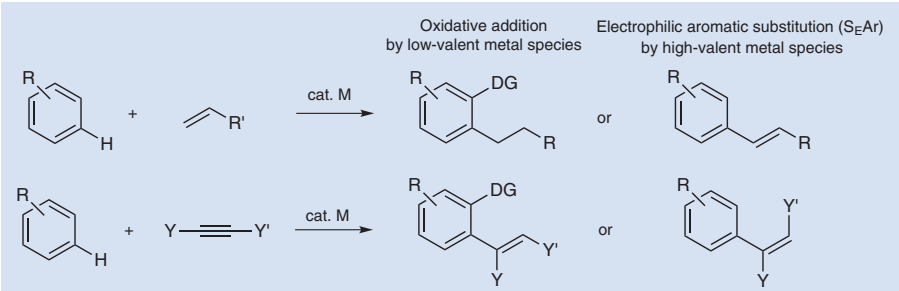
When using substrates with highly acidic hydrogen atoms caused by *ortho-para* orientation and heteroaromatics with relatively highly acidic hydrogen atoms, the acidic hydrogen atoms can be cleaved by high-valent metal species. In this reaction, the regioselective C-H bond activations are performed without the assist from the directing groups.

Typical Reaction Modes by C-H Bond Cleavage

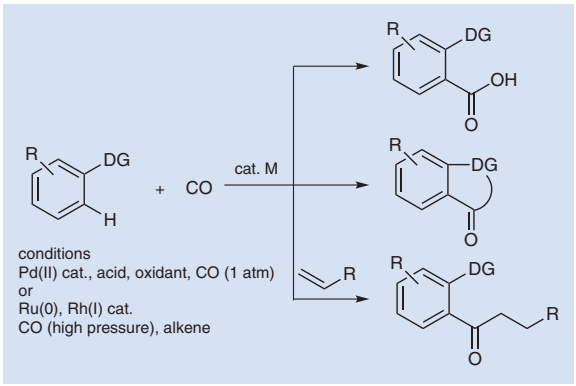
Arylations and alkenylations



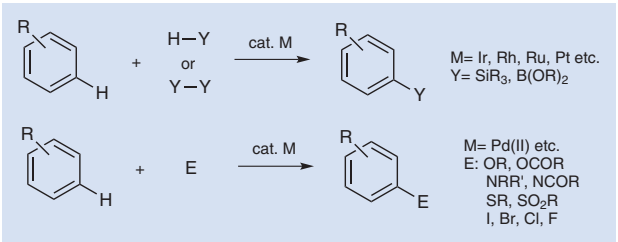
Addition of alkenes and alkynes



Carbonylations *via* CO insertion

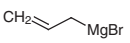
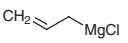
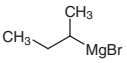
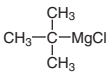
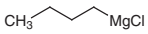
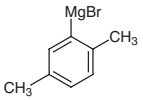
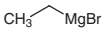
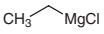
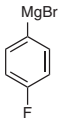
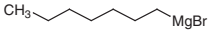
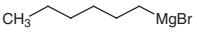
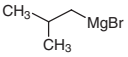
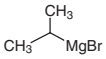
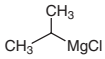
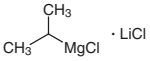
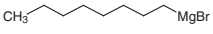
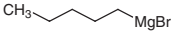
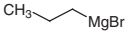
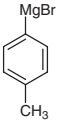
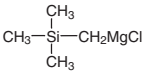


Heteroatom functionalizations

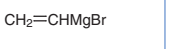


Metal Reagents for Organic Synthesis

Grignard Reagents

	A0963 	A1554 	B1883 B3976 	
B1933 	B1884 	B1148 B1147 	B0726 	C1504 
C1505 	C2039 	D3551 	E0497 E0134 	E0778 E0135 
F0673 	H0822 	H0821 	I0517 	I0518 
I0543 I0542 	I0654 	M0362 M0785 CH_3MgBr	M0364 CH_3MgI	O0240 
P1251 $CH_3(CH_2)_{14}MgBr$	P1177 	P2025 	P1381 	P0191 
P0880 	T1698 	T1699 	T1700 	T1451 T2609 

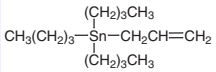
V0053



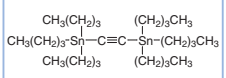
Product No.	Product Name	Unit Size
A0963	Allylmagnesium Bromide (*ca.* 13% in Ethyl Ether, *ca.* 0.7mol/L)	100mL
A1554	Allylmagnesium Chloride (*ca.* 11% in Tetrahydrofuran, *ca.* 1.0mol/L)	100g
B1883	Benzylmagnesium Bromide (*ca.* 12% in Tetrahydrofuran, *ca.* 0.6mol/L)	Price on request
B3976	Benzylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 0.9mol/L)	100g
B1933	Benzylmagnesium Chloride (*ca.* 16% in Tetrahydrofuran, *ca.* 1mol/L)	250g
B1884	*sec*-Butylmagnesium Bromide (*ca.* 16% in Tetrahydrofuran, *ca.* 1mol/L)	100g
B1148	*tert*-Butylmagnesium Chloride (23% in Tetrahydrofuran, *ca.* 2mol/L)	250g
B1147	*tert*-Butylmagnesium Chloride (26% in Ethyl Ether, *ca.* 2mol/L)	250g
B0726	Butylmagnesium Chloride (23% in Tetrahydrofuran, *ca.* 2mol/L)	250g
C1504	Cyclohexylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100g
C1505	Cyclopentylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100g
C2039	Cyclopropylmagnesium Bromide (*ca.* 10% in Tetrahydrofuran, *ca.* 0.7mol/L)	100g
D3551	(2,5-Dimethylphenyl)magnesium Bromide (20% in Tetrahydrofuran, *ca.* 1mol/L)	100g
E0497	Ethylmagnesium Bromide (13% in Tetrahydrofuran, *ca.* 1mol/L)	250g
E0134	Ethylmagnesium Bromide (39% in Ethyl Ether, *ca.* 3mol/L)	250g
E0778	Ethylmagnesium Chloride (*ca.* 1.0mol/L in Tetrahydrofuran) activated with Zinc Chloride (*ca.* 10mol%)	250g
E0135	Ethylmagnesium Chloride (*ca.* 18% in Tetrahydrofuran, *ca.* 2mol/L)	250g
F0673	4-Fluorophenylmagnesium Bromide (*ca.* 19% in Tetrahydrofuran, *ca.* 1.0mol/L)	250g
H0822	Heptylmagnesium Bromide (21% in Tetrahydrofuran, *ca.* 1mol/L)	250g
H0821	Hexylmagnesium Bromide (20% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0517	Isobutylmagnesium Bromide (17% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0518	Isopropylmagnesium Bromide (15% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0543	Isopropylmagnesium Chloride (*ca.* 11% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0542	Isopropylmagnesium Chloride (*ca.* 13% in Ethyl Ether, *ca.* 1mol/L)	250g
I0654	Isopropylmagnesium Chloride - Lithium Chloride (15% in Tetrahydrofuran, *ca.* 1mol/L)	100mL
M0362	Methylmagnesium Bromide (12% in Tetrahydrofuran, *ca.* 1mol/L)	250g
M0785	Methylmagnesium Bromide (35% in Ethyl Ether, *ca.* 3mol/L)	250g
M0364	Methylmagnesium Iodide (33% in Ethyl Ether, *ca.* 2mol/L)	100g
O0240	*n*-Octylmagnesium Bromide (*ca.* 22% in Tetrahydrofuran, *ca.* 1mol/L)	250g
P1251	Pentadecylmagnesium Bromide (*ca.* 15% in Tetrahydrofuran, *ca.* 0.4mol/L)	250g
P1177	Pentylmagnesium Bromide (18% in Tetrahydrofuran, *ca.* 1mol/L)	250g
P2025	Phenylmagnesium Bromide (16% in Tetrahydrofuran, *ca.* 1mol/L)	250g
P1381	Phenylmagnesium Chloride (27% in Tetrahydrofuran, *ca.* 2mol/L)	250g
P0191	Phenylmagnesium Iodide (*ca.* 42% in Ethyl Ether, *ca.* 2mol/L)	250g
P0880	Propylmagnesium Bromide (*ca.* 27% in Tetrahydrofuran, *ca.* 2mol/L)	250g
T1698	*o*-Tolylmagnesium Bromide (*ca.* 17% in Tetrahydrofuran, *ca.* 0.9mol/L)	100g
T1699	*m*-Tolylmagnesium Bromide (19% in Tetrahydrofuran, *ca.* 1mol/L)	100g
T1700	*p*-Tolylmagnesium Bromide (19% in Tetrahydrofuran, *ca.* 1mol/L)	100g
T1451	Trimethylsilylmethylmagnesium Chloride (20% in Ethyl Ether, *ca.* 1mol/L)	100mL
T2609	Trimethylsilylmethylmagnesium Chloride (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100mL
V0053	Vinylmagnesium Bromide (14% in Tetrahydrofuran, *ca.* 1mol/L)	100g

Alkyl Metal Reagents

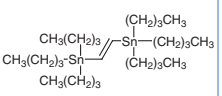
A1222



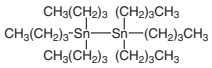
B1974



B1975

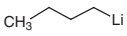


B1832

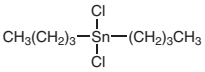


B4209

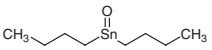
B0396



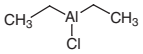
D0223



D0305

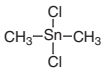


D1340

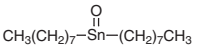


D3902
D3214

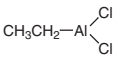
D1338



D1373



E0648



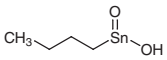
H0842

M1655

M0589

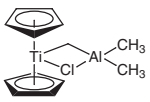
M0258

M0744

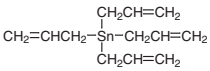


P1429

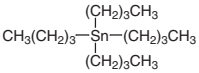
C1411



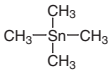
T2009



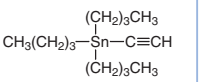
T0058



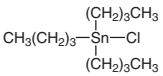
T0919



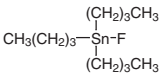
T1750



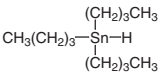
T0363



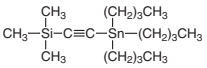
T0678



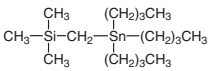
T1473



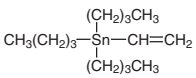
T1865



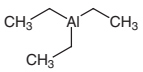
T1866



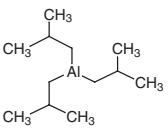
T1794



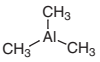
T0783
T0925



T0784



T0782
T1575



T0958

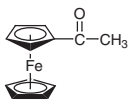
Product No.	Product Name	Unit Size	
A1222	Allyltributyltin	5g	25g
B1974	Bis(tributylstannyl)acetylene	1g	5g
B1975	*trans*-1,2-Bis(tributylstannyl)ethylene	1g	5g
B1832	Bis(tributyltin)	5g	25g
B4209	*tert*-Butyllithium (*ca.* 18% in Pentane, *ca.* 1.9mol/L)		100mL
B0396	Butyllithium (*ca.* 15% in Hexane, *ca.* 1.6mol/L)	100mL	500mL

Product No.	Product Name			Unit Size
D0223	Dibutyltin Dichloride		25g	500g
D0305	Dibutyltin Oxide	25g	100g	500g
D1340	Diethylaluminum Chloride (*ca.* 15% in Hexane, *ca.* 0.87mol/L)			100mL
D3902	Diethylzinc (*ca.* 15% in Toluene, *ca.* 1mol/L)			100mL
D3214	Diethylzinc (*ca.* 17% in Hexane, *ca.* 1mol/L)		100mL	500mL
D1338	Dimethyltin Dichloride	25g	100g	500g
D1373	Di-*n*-octyltin Oxide		25g	500g
E0648	Ethylaluminum Dichloride (17% in Hexane, *ca.* 1mol/L)			100mL
H0842	Hexyllithium (30% in Hexane, *ca.* 2.3mol/L)			100mL
M1655	Methyllithium (*ca.* 3-5% in Ethyl Ether, *ca.* 1-2mol/L)			100mL
M0589	Methylmercuric Chloride			5g
M0258	Methylmercuric Iodide			25g
M0744	Monobutyltin Oxide		25g	500g
P1429	Phenyllithium (*ca.* 16% in Butyl Ether, *ca.* 1.6mol/L)			100mL
C1411	Tebbe Reagent (*ca.* 0.5mol/L in Toluene)			25mL
T2009	Tetraallyltin		1g	5g
T0058	Tetrabutyltin		25g	500g
T0919	Tetramethyltin		5g	25g
T1750	Tributylethynyltin		1g	5g
T0363	Tributyltin Chloride	25g	100g	500g
T0678	Tributyltin Fluoride			25g
T1473	Tributyltin Hydride (stabilized with BHT) [Reducing Reagent]		25g	250g
T1865	Tributyl(trimethylsilylethynyl)tin		5g	25g
T1866	Tributyl(trimethylsilylmethyl)tin			5g
T1794	Tributylvinyltin	1g	5g	25g
T0783	Triethylaluminum (15% in Hexane, *ca.* 1.0mol/L)			100mL
T0925	Triethylaluminum (15% in Toluene, *ca.* 1.1mol/L)			100mL
T0784	Triisobutylaluminum (15% in Hexane, *ca.* 0.50mol/L)			100mL
T0782	Trimethylaluminum (15% in Hexane, *ca.* 1.4mol/L)			100mL
T1575	Trimethylaluminum (15% in Toluene, *ca.* 1.8mol/L)			100mL
T0958	Trimethyltin Chloride		5g	25g

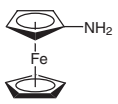
Metallocenes

Ferrocenes

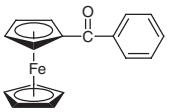
A0775



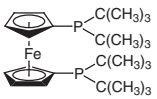
A1601



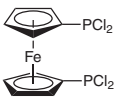
B0886



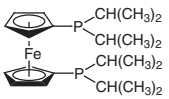
B2711



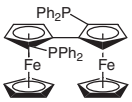
B4272



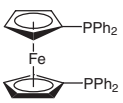
B2710



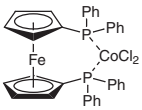
B3196



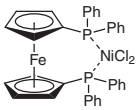
B2027



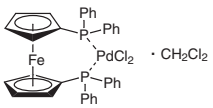
B3374



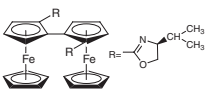
B2226



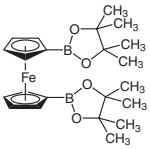
B2064



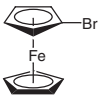
B3197



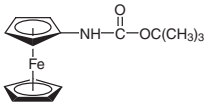
B3501



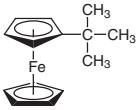
B3476



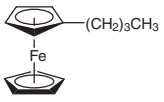
B2227

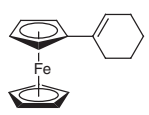
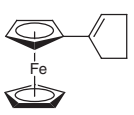
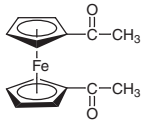
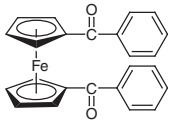
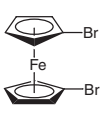
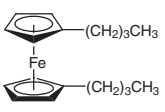
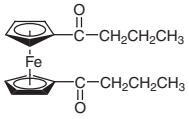
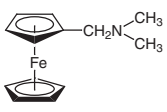
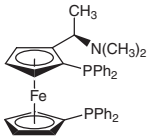
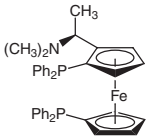
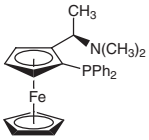
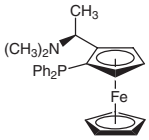
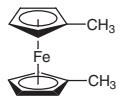
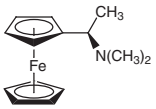
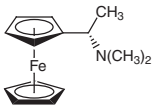
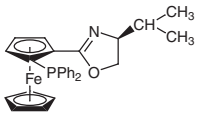
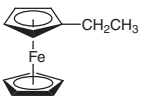
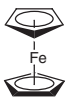
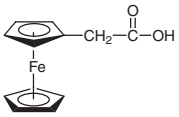
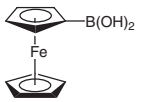
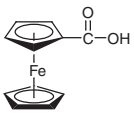
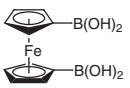
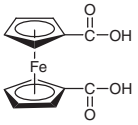
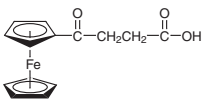
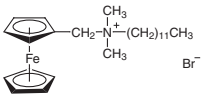
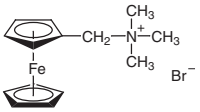
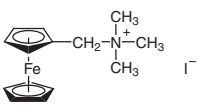
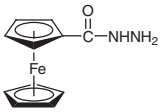
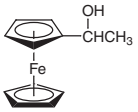
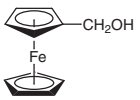
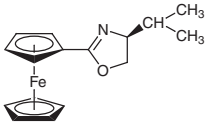
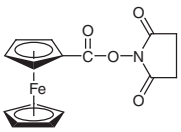
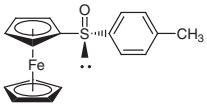
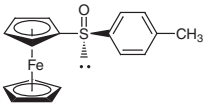
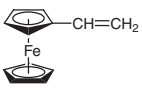


B2063



B0885



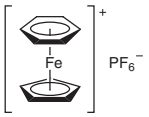
F0312 	F0313 	B0913 	B0915 	D2829 
D1272 	D2951 	D1271 	D2537 	D2538 
D2535 	D2536 	D1273 	D2528 	D2529 
D3822 	E0394 	D0444 	F0406 	F0280 
F0165 	F0664 	B0914 	F0320 	F0286 
F0166 	F0167 	H0941 	H0463 	H0464 
I0749 	S0820 	T2545 	T2546 	V0064 

Product No.	Product Name	Unit Size	
A0775	Acetylferrocene	10g	25g
A1601	Aminoferrocene	100mg	1g
B0886	Benzoylferrocene	5g	25g
B2711	1,1'-Bis(di-*tert*-butylphosphino)ferrocene	100mg	1g
B4272	1,1'-Bis(dichlorophosphino)ferrocene	200mg	1g
B2710	1,1'-Bis(diisopropylphosphino)ferrocene	100mg	1g

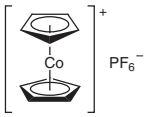
Product No.	Product Name		Unit Size	
B3196	(*R*,*R*")-2,2"-Bis(diphenylphosphino)-1,1"-biferrocene		100mg	500mg
B2027	1,1'-Bis(diphenylphosphino)ferrocene	1g	5g	25g
B3374	[1,1'-Bis(diphenylphosphino)ferrocene]cobalt(II) Dichloride		1g	5g
B2226	[1,1'-Bis(diphenylphosphino)ferrocene]nickel(II) Dichloride		1g	5g
B2064	[1,1'-Bis(diphenylphosphino)ferrocene]palladium(II) Dichloride Dichloromethane Adduct	1g	5g	25g
B3197	(*S*,*S*")-2,2"-Bis[(*S*)-4-isopropyloxazolin-2-yl]-1,1"-biferrocene		100mg	500mg
B3501	1,1'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)ferrocene		1g	5g
B3476	Bromoferrocene		1g	5g
B2227	*N*-(*tert*-Butoxycarbonyl)aminoferrocene			1g
B2063	*tert*-Butylferrocene		1g	5g
B0885	Butylferrocene		10g	25g
F0312	Cyclohexenylferrocene			25g
F0313	Cyclopentenylferrocene			25g
B0913	1,1'-Diacetylferrocene			5g
B0915	1,1'-Dibenzoylferrocene		5g	25g
D2829	1,1'-Dibromoferrocene		1g	5g
D1272	1,1'-Dibutylferrocene		1g	5g
D2951	1,1'-Dibutyrylferrocene		5g	25g
D1271	*N*,*N*-Dimethylaminomethylferrocene		5g	25g
D2537	(*R*)-*N*,*N*-Dimethyl-1-[(*S*)-1',2-bis(diphenylphosphino)ferrocenyl]ethylamine			100mg
D2538	(*S*)-*N*,*N*-Dimethyl-1-[(*R*)-1',2-bis(diphenylphosphino)ferrocenyl]ethylamine			100mg
D2535	(*R*)-*N*,*N*-Dimethyl-1-[(*S*)-2-(diphenylphosphino)ferrocenyl]ethylamine			100mg
D2536	(*S*)-*N*,*N*-Dimethyl-1-[(*R*)-2-(diphenylphosphino)ferrocenyl]ethylamine			100mg
D1273	1,1'-Dimethylferrocene		5g	25g
D2528	(*R*)-(+)-*N*,*N*-Dimethyl-1-ferrocenylethylamine		200mg	1g
D2529	(*S*)-(-)-*N*,*N*-Dimethyl-1-ferrocenylethylamine		200mg	1g
D3822	(*S*)-1-(Diphenylphosphino)-2-[(*S*)-4-isopropyloxazolin-2-yl]ferrocene		200mg	1g
E0394	Ethylferrocene			5g
D0444	Ferrocene	25g	100g	500g
F0406	Ferroceneacetic Acid		1g	5g
F0280	Ferroceneboronic Acid (contains varying amounts of Anhydride) [Cyclic boronating reagent for GC/MS]		100mg	1g
F0165	Ferrocenecarboxylic Acid	1g	5g	25g
F0664	1,1'-Ferrocenediboronic Acid (contains varying amounts of Anhydride)			1g
B0914	1,1'-Ferrocenedicarboxylic Acid		1g	5g
F0320	3-Ferrocenoylpropionic Acid			25g
F0286	(Ferrocenylmethyl)dodecyldimethylammonium Bromide			5g
F0166	(Ferrocenylmethyl)trimethylammonium Bromide		1g	5g
F0167	(Ferrocenylmethyl)trimethylammonium Iodide			5g
H0941	(Hydrazinocarbonyl)ferrocene [for HPLC Labeling]			1g
H0463	1-Hydroxyethylferrocene		1g	5g
H0464	Hydroxymethylferrocene		1g	5g
I0749	(*S*)-(4-Isopropyloxazolin-2-yl)ferrocene			1g
S0820	*N*-Succinimidyl Ferrocenecarboxylate		200mg	1g
T2545	(*R*)-(*p*-Toluenesulfinyl)ferrocene		1g	5g
T2546	(*S*)-(*p*-Toluenesulfinyl)ferrocene			1g
V0064	Vinylferrocene			1g

Others

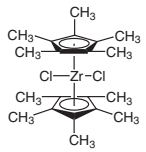
B1951



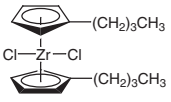
C1589



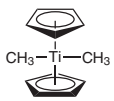
D3307



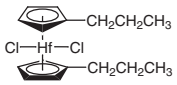
D3321



D4100



D3286



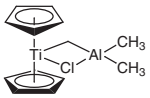
H0914

I0645

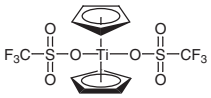
D1574

R0078

C1411



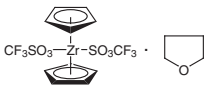
T1658



T0616

V0090

Z0009



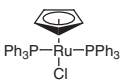
Z0010

Z0007

Product No.	Product Name			Unit Size
B1951	η-Benzene(η-cyclopentadienyl)iron(II) Hexafluorophosphate		1g	5g
C1589	Bis(cyclopentadienyl)cobalt(III) Hexafluorophosphate			1g
D3307	Decamethylzirconocene Dichloride			1g
D3321	1,1'-Dibutylzirconocene Dichloride		1g	5g
D4100	Dimethyltitanocene (5% in Tetrahydrofuran/Toluene)			100g
D3286	1,1'-Dipropylhafnocene Dichloride			1g
H0914	Hafnocene Dichloride	1g	5g	25g
I0645	1,1'-Isopropylidenezirconocene Dichloride			100mg
D1574	Nickelocene		1g	5g
R0078	Ruthenocene			1g
C1411	Tebbe Reagent (*ca.* 0.5mol/L in Toluene)			25mL
T1658	Titanocene Bis(trifluoromethanesulfonate)		100mg	1g
T0616	Titanocene Dichloride		5g	25g
V0090	Vanadinocene Dichloride			1g
Z0009	Zirconocene Bis(trifluoromethanesulfonate) Tetrahydrofuran Adduct		1g	5g
Z0010	Zirconocene Chloride Hydride	1g	5g	25g
Z0007	Zirconocene Dichloride		5g	25g

Half Metallocenes

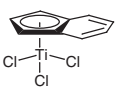
C2201



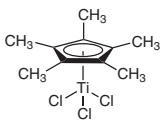
C1994

C1995

I0646



P1651



Product No.	Product Name		Unit Size
C2201	Cyclopentadienylbis(triphenylphosphine)ruthenium(II) Chloride	1g	5g
C1994	Cyclopentadienyltitanium(IV) Trichloride	1g	5g
C1995	Cyclopentadienylzirconium(IV) Trichloride	1g	5g
I0646	(Indenyl)titanium(IV) Trichloride		1g
P1651	(Pentamethylcyclopentadienyl)titanium(IV) Trichloride		1g

Typical Metal Reagents

Li (Lithium)

Product No.	Product Name	Unit Size		
B4209	*tert*-Butyllithium (*ca.* 18% in Pentane, *ca.* 1.9mol/L)			100mL
B0396	Butyllithium (*ca.* 15% in Hexane, *ca.* 1.6mol/L)		100mL	500mL
B4697	Butyllithium (*ca.* 20% in Cyclohexane, *ca.* 2.3mol/L)		100mL	500mL
P1049	Dilithium Phthalocyanine			1g
D4395	Dilithium Tetrachlorocopper(II) (*ca.* 2.5% in Tetrahydrofuran, *ca.* 0.1mol/L)		100mL	500mL
H0842	Hexyllithium (30% in Hexane, *ca.* 2.3mol/L)			100mL
L0060	Lithioncarmine (powder)			1g
L0191	Lithium Acetate		25g	500g
A1478	Lithium Acetoacetate		1g	5g
L0203	Lithium Aluminum Hydride (Powder)		25g	100g
L0170	Lithium Aluminum Hydride (10% in Tetrahydrofuran, *ca.* 2.5mol/L)			100mL
L0267	Lithium Bis(pentafluoroethanesulfonyl)imide			1g
B2542	Lithium Bis(trifluoromethanesulfonyl)imide		25g	250g
H0915	Lithium Bis(trimethylsilyl)amide (*ca.* 26% in Tetrahydrofuran, *ca.* 1.3mol/L)		100mL	500mL
L0186	Lithium Borohydride (*ca.* 3mol/L in Tetrahydrofuran)			100mL
L0210	Lithium Bromide	25g	100g	500g
L0253	Lithium *tert*-Butoxide (*ca.* 10% in Tetrahydrofuran, *ca.* 1mol/L)			100mL
L0224	Lithium Carbonate		25g	500g
L0204	Lithium Chloride Anhydrous		25g	300g
L0222	Lithium Chloride (2.3% in Tetrahydrofuran, *ca.* 0.5mol/L)			100mL
L0171	Lithium Diisopropylamide (*ca.* 20% in Tetrahydrofuran/Ethylbenzene/Heptane, *ca.* 1.5mol/L)		100mL	500mL
F0171	Lithium Formate Monohydrate		25g	500g
L0146	Lithium Hexafluorophosphate		25g	100g
H1057	Lithium 1,1,2,2,3,3-Hexafluoropropane-1,3-disulfonimide		1g	5g
L0225	Lithium Hydroxide Anhydrous	25g	100g	500g
H0580	Lithium DL-2-Hydroxybutyrate		5g	25g
L0144	Lithium L-Lactate			25g
P0659	Lithium Pyruvate Monohydrate [Guaranteed for Standard to GOT, GPT]			25g
S0237	Lithium Stearate		25g	500g
L0133	Lithium Tetrafluoroborate			25g
L0158	Lithium Tetrakis(pentafluorophenyl)borate - Ethyl Ether Complex		1g	5g
L0159	Lithium Tri-*tert*-butoxyaluminum Hydride (*ca.* 30% in Tetrahydrofuran, *ca.* 1.0mol/L)			100mL
L0164	Lithium Tri-*sec*-butylborohydride (*ca.* 21% in Tetrahydrofuran, *ca.* 1.0mol/L)			100mL
L0190	Lithium Triethylborohydride (*ca.* 12% in Tetrahydrofuran, *ca.* 1.0mol/L)		100mL	500mL
T1548	Lithium Trifluoromethanesulfonate			25g
L0240	Lithium Trifluoro(trifluoromethyl)borate - Dimethyl Carbonate Complex		1g	5g
M1655	Methyllithium (*ca.* 3-5% in Ethyl Ether, *ca.* 1-2mol/L)			100mL
L0080	(2,4-Pentanedionato)lithium		25g	500g
P1429	Phenyllithium (*ca.* 16% in Butyl Ether, *ca.* 1.6mol/L)			100mL

Na (Sodium)(excluding simple sodium salts)

Product No.	Product Name	Unit Size		
C0075	Chloramine B Hydrate		25g	500g
C0076	Chloramine T Trihydrate		25g	500g
C1374	*o*-Chloramine T			25g
D1331	5,5-Diphenylhydantoin Sodium Salt		25g	500g
D0923	Dipicrylamine Sodium Salt (contains 10% Water)			1g
D1930	Disodium Dimercaptomaleonitrile		1g	5g
P0973	Disodium Phthalocyanine		1g	5g
M0632	2-Mercaptopyridine *N*-Oxide Sodium Salt (40% in Water, *ca.* 3.3mol/L)		25g	500g
M0096	Methyl Mercaptan Sodium Salt (*ca.* 15% in Water)		25g	500g
S0489	Sodium Azide			100g
H0894	Sodium Bis(trimethylsilyl)amide (contains 2-Methyl-2-butene) (38% in Tetrahydrofuran, *ca.* 1.9mol/L)		100mL	500mL
S0480	Sodium Borohydride	25g	100g	500g
S0396	Sodium Cyanoborohydride [Reducing Agent]	5g	25g	250g
D1003	Sodium Dichloroisocyanurate		25g	500g
D2479	Sodium Diformylamide			25g
D0716	Sodium Dimethyldithiocarbamate Dihydrate		25g	500g
S0548	Sodium Ethoxide (*ca.* 20% in Ethanol)			500mL
S0547	Sodium Ethoxide			100g
E0195	Sodium Ethylxanthate		25g	500g
S0392	Sodium Hexafluorophosphate			25g
S0481	Sodium Hydride (60%, dispersion in Paraffin Liquid)		100g	500g
M0057	Sodium 2-Mercaptobenzothiazole		25g	500g

Product No.	Product Name	Unit Size	
S0486	Sodium Methoxide (*ca.* 5mol/L in Methanol)	100mL	500mL
S0485	Sodium Methoxide	100g	500g
S0540	Sodium Tetrachloropalladate(II)		1g
A5131	Sodium Tetrakis(4-fluorophenyl)borate Hydrate [Precipitation reagent for Cs and titrimetric reagent for nonionic surfactants]	1g	5g
A5130	Sodium Tetraphenylborate [Precipitation reagent for K]	1g	10g
T0193	Sodium 2-Thiobarbiturate	25g	500g
S0394	Sodium Triacetoxyborohydride	25g	100g
B0131	*o*-Sulfobenzimide Sodium Salt Dihydrate	25g	500g

K (Potassium)(excluding simple potassium salts)

Product No.	Product Name	Unit Size		
A1490	Acesulfame K	25g	100g	500g
B1124	Bismuthiol II Hydrate		5g	25g
B4377	Bismuth Tripotassium Dicitrate		1g	5g
C0714	Carbazole Potassium Salt			25g
I0223	Indigodisulfonic Acid Dipotassium Salt			1g
I0019	Indigotetrasulfonic Acid Tetrapotassium Salt Hydrate			1g
I0220	Indigotrisulfonic Acid Potassium Salt		1g	5g
N0428	4-Nitrocatechol Sulfate Dipotassium Salt Hydrate [Substrate for Sulfatase]			1g
P0097	Phenolphthalein Disulfate Potassium Salt Hydrate		1g	5g
P0179	*N*-Phenylglycine Potassium Salt		25g	500g
P0403	Phthalimide Potassium Salt		25g	500g
P1480	Potassium Allyltrifluoroborate		1g	5g
H0893	Potassium Bis(trimethylsilyl)amide (11% in Toluene, *ca.* 0.5mol/L)		100mL	500mL
P1681	Potassium Borohydride		25g	100g
P1807	Potassium (Bromomethyl)trifluoroborate		1g	5g
P1008	Potassium *tert*-Butoxide	25g	100g	500g
P2155	Potassium [[(*tert*-Butoxycarbonyl)amino]methyl]trifluoroborate		1g	5g
B0747	Potassium Butylxanthate			25g
P1613	Potassium Cyanide			25g
E0194	Potassium Ethylxanthate	25g	100g	500g
G0160	Potassium Guaiacolsulfonate Hemihydrate			25g
H0817	Potassium Hexafluoroarsenate			10g
H1058	Potassium 1,1,2,2,3,3-Hexafluoropropane-1,3-disulfonimide		1g	5g
H0652	Potassium Hyaluronate from Cockscomb			1g
P0309	Potassium Hydrogen Phthalate		25g	500g
I0023	Potassium 3-Indoleacetate		1g	25g
P1808	Potassium (Iodomethyl)trifluoroborate		1g	5g
I0177	Potassium Isopropylxanthate			25g
P2153	Potassium (Methoxymethyl)trifluoroborate			1g
T1083	Potassium Monomethyl Terephthalate		25g	500g
N0006	Potassium 1-Naphthaleneacetate			25g
O0056	Potassium Oleate		25g	500g
O0164	Potassium Oxonate		5g	25g
P0534	Potassium Propylxanthate			25g
R0058	Potassium Rhodizonate			1g
S0057	Potassium Sorbate		25g	500g
S0164	Potassium Sulfamate			100g
P2168	Potassium Tetracyanoborate			200mg
A5132	Potassium Tetrakis(4-chlorophenyl)borate [Anion for the neutral carrier type ion electrode]		1g	5g
P1380	Potassium Tri-*sec*-butylborohydride (*ca.* 1.0mol/L in Tetrahydrofuran)		Price on request	
P2114	Potassium Trifluoroacetate			25g
P1692	Potassium Trifluoro(trifluoromethyl)borate	1g	5g	25g
P0475	Potassium Trihydrogen Dioxalate Dihydrate [for Determination of pH]		25g	500g
P1479	Potassium Vinyltrifluoroborate		1g	5g
P0988	Pyridoxylidene-L-glutamic Acid Dipotassium Salt			1g
P0989	Pyridoxylidene-L-isoleucine Potassium Salt			1g
S0156	Sinigrin Hydrate			100mg
S0903	Sinigrin			100mg
A5107	TBPE (=Tetrabromophenolphthalein Ethyl Ester Potassium Salt) [Sensitive spectrophotometric reagent for amines, quaternary ammonium salts and other cations]			1g
T0036	Tetrabromofluorescein Potassium Salt			25g
F0027	Uranine K			25g

Rb (Rubidium)

Product No.	Product Name	Unit Size
F0172	Formic Acid Rubidium Salt	5g

Cs (Cesium)

Product No.	Product Name	Unit Size	
C2430	Cesium Acetate	25g	100g
C2202	Cesium Bromide		25g
C2160	Cesium Carbonate	25g	100g
C2203	Cesium Chloride	25g	100g
C2204	Cesium Fluoride	25g	100g
C2205	Cesium Iodide		25g

Be (Beryllium)

Product No.	Product Name	Unit Size
B0454	Bis(2,4-pentanedionato)beryllium(II)	5g
B4720	Bis[2-(2-pyridinyl)phenolato]beryllium(II)	200mg

Mg (Magnesium)

Product No.	Product Name	Unit Size
A0963	Allylmagnesium Bromide (*ca.* 13% in Ethyl Ether, *ca.* 0.7mol/L)	100mL
A1554	Allylmagnesium Chloride (*ca.* 11% in Tetrahydrofuran, *ca.* 1.0mol/L)	100g
A0484	8-Anilino-1-naphthalenesulfonic Acid Magnesium(II) Salt Hydrate	25g
A5353	ANS-Mg (=Magnesium 8-Anilino-1-naphthalenesulfonate) [Hydrophobic fluorescent probe]	1g
B1883	Benzylmagnesium Bromide (*ca.* 12% in Tetrahydrofuran, *ca.* 0.6mol/L)	Price on request
B3976	Benzylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 0.9mol/L)	100g
B1933	Benzylmagnesium Chloride (*ca.* 16% in Tetrahydrofuran, *ca.* 1mol/L)	250g
H0556	Bis(hexafluoroacetylacetonato)magnesium(II) Hydrate	1g
M0001	Bis(2,4-pentanedionato)magnesium(II)	25g
T0749	Bis(trifluoro-2,4-pentanedionato)magnesium(II) Hydrate	5g
B1884	*sec*-Butylmagnesium Bromide (*ca.* 16% in Tetrahydrofuran, *ca.* 1mol/L)	100g
B1148	*tert*-Butylmagnesium Chloride (23% in Tetrahydrofuran, *ca.* 2mol/L)	250g
B1147	*tert*-Butylmagnesium Chloride (26% in Ethyl Ether, *ca.* 2mol/L)	250g
B0726	Butylmagnesium Chloride (23% in Tetrahydrofuran, *ca.* 2mol/L)	250g
B4643	*sec*-Butylmagnesium Chloride - Lithium Chloride (15% in Tetrahydrofuran, *ca.* 1.2mol/L)	100mL
C0780	Chlorophyll (Total Chlorophyll: *ca.* 6.0%)	25g
C1504	Cyclohexylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100g
C1505	Cyclopentylmagnesium Bromide (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100g
D4683	Di-*sec*-butylmagnesium - Lithium Chloride (13% in Tetrahydrofuran, *ca.* 0.8mol/L)	100mL
D3551	(2,5-Dimethylphenyl)magnesium Bromide (20% in Tetrahydrofuran, *ca.* 1mol/L)	100g
E0094	Ethylenediaminetetraacetic Acid Magnesium Disodium Salt Hydrate	25g
E0497	Ethylmagnesium Bromide (13% in Tetrahydrofuran, *ca.* 1mol/L)	250g
E0134	Ethylmagnesium Bromide (39% in Ethyl Ether, *ca.* 3mol/L)	250g
E0778	Ethylmagnesium Chloride (*ca.* 1.0mol/L in Tetrahydrofuran) activated with Zinc Chloride (*ca.* 10mol%)	250g
E0135	Ethylmagnesium Chloride (*ca.* 18% in Tetrahydrofuran, *ca.* 2mol/L)	250g
F0673	4-Fluorophenylmagnesium Bromide (*ca.* 19% in Tetrahydrofuran, *ca.* 1.0mol/L)	250g
H0822	Heptylmagnesium Bromide (21% in Tetrahydrofuran, *ca.* 1mol/L)	250g
H0821	Hexylmagnesium Bromide (20% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0517	Isobutylmagnesium Bromide (17% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0518	Isopropylmagnesium Bromide (15% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0543	Isopropylmagnesium Chloride (*ca.* 11% in Tetrahydrofuran, *ca.* 1mol/L)	250g
I0542	Isopropylmagnesium Chloride (*ca.* 13% in Ethyl Ether, *ca.* 1mol/L)	250g
I0654	Isopropylmagnesium Chloride - Lithium Chloride (15% in Tetrahydrofuran, *ca.* 1mol/L)	100mL
E0396	Magnesium(II) 2-Ethylbutyrate	25g
G0276	Magnesium(II) Gluconate Hydrate	25g 500g
M0938	Magnesium 4-Nitrobenzyl Malonate Hydrate	25g
P0108	Magnesium Phenoxyacetate Dihydrate	25g
P1018	Magnesium(II) Phthalocyanine	1g
M2209	Magnesium Porphyrin	100mg
S0238	Magnesium(II) Stearate	25g 250g
T1304	Magnesium Trifluoromethanesulfonate	5g 25g
M0362	Methylmagnesium Bromide (12% in Tetrahydrofuran, *ca.* 1mol/L)	250g
M0785	Methylmagnesium Bromide (35% in Ethyl Ether, *ca.* 3mol/L)	250g
M0364	Methylmagnesium Iodide (33% in Ethyl Ether, *ca.* 2mol/L)	100g
M0927	Monoperoxyphthalic Acid Magnesium Salt Hexahydrate	25g 500g
O0240	*n*-Octylmagnesium Bromide (*ca.* 22% in Tetrahydrofuran, *ca.* 1mol/L)	250g

Product No.	Product Name	Unit Size
P1251	Pentadecylmagnesium Bromide (*ca.* 15% in Tetrahydrofuran, *ca.* 0.4mol/L)	250g
P1177	Pentylmagnesium Bromide (18% in Tetrahydrofuran, *ca.* 1mol/L)	250g
P2025	Phenylmagnesium Bromide (16% in Tetrahydrofuran, *ca.* 1mol/L)	250g
P1381	Phenylmagnesium Chloride (27% in Tetrahydrofuran, *ca.* 2mol/L)	250g
P0191	Phenylmagnesium Iodide (*ca.* 42% in Ethyl Ether, *ca.* 2mol/L)	250g
P0880	Propylmagnesium Bromide (*ca.* 27% in Tetrahydrofuran, *ca.* 2mol/L)	250g
T1698	*o*-Tolylmagnesium Bromide (*ca.* 17% in Tetrahydrofuran, *ca.* 0.9mol/L)	100g
T1699	*m*-Tolylmagnesium Bromide (19% in Tetrahydrofuran, *ca.* 1mol/L)	100g
T1700	*p*-Tolylmagnesium Bromide (19% in Tetrahydrofuran, *ca.* 1mol/L)	100g
T2966	Trimagnesium Dicitrate Nonahydrate	25g 500g
T1451	Trimethylsilylmethylmagnesium Chloride (20% in Ethyl Ether, *ca.* 1mol/L)	100mL
T2609	Trimethylsilylmethylmagnesium Chloride (*ca.* 18% in Tetrahydrofuran, *ca.* 1mol/L)	100mL
V0053	Vinylmagnesium Bromide (14% in Tetrahydrofuran, *ca.* 1mol/L)	100g

Ca (Calcium)

Product No.	Product Name	Unit Size
A0422	4-Aminosalicylic Acid Calcium Salt Heptahydrate	25g 500g
A2476	Atorvastatin Calcium Salt Trihydrate	1g 5g
C0930	Bis(2,4-pentanedionato)calcium(II)	25g
A0738	Calcium Alginate	25g 500g
C2789	Calcium Dobesilate Hydrate	1g
G0037	Calcium Gluconate Monohydrate	25g 500g
G0232	Calcium DL-Glycerate Hydrate	10g
G0095	Calcium Glycerophosphate Hydrate	25g 500g
G0200	Calcium Glycolate	25g
H0917	Calcium 3-Hydroxy-3-methylbutyrate Hydrate	25g
H0651	Calcium 2-Hydroxy-4-(methylthio)butyrate	25g
L0006	Calcium Lactobionate Hydrate	25g
L0043	Calcium Levulinate Dihydrate	25g
O0076	Calcium Mesoxalate Trihydrate	5g
M0548	Calcium Methacrylate Hydrate	25g
M0549	Calcium Methanesulfonate	25g 500g
K0021	Calcium 3-Methyl-2-oxobutyrate Hydrate	5g
K0022	Calcium 3-Methyl-2-oxovalerate Hydrate	5g 25g
K0023	Calcium 4-Methyl-2-oxovalerate Hydrate	5g 25g
P0012	Calcium D-Pantothenate	25g 500g
C2003	Calcium Phthalate Hydrate	5g 25g
P0503	Calcium Propionate	25g 500g
S0054	Calcium Sorbate	25g
S0236	Calcium Stearate	25g 500g
T0002	Calcium DL-Tartrate Tetrahydrate	25g
T0004	Calcium *meso*-Tartrate Trihydrate	1g 25g
T0902	Calcium Thioglycolate Trihydrate	25g 500g
T1799	Calcium L-Threonate	25g
C0849	4-Chlorobenzoyl-L-tryptophan Calcium Salt	25g
D1869	Diethylenetriaminepentaacetic Acid Calcium Trisodium Salt Hydrate	25g
E0088	Ethylenediaminetetraacetic Acid Calcium Disodium Salt Hydrate	25g 500g
F0372	Fenoprofen Calcium Salt Dihydrate	25g
L0075	Lithol Rubin BCA	25g
P0274	Phosphocholine Chloride Calcium Salt Tetrahydrate	25g 250g
P0410	Phytin	25g 500g

Ba (Barium)

Product No.	Product Name	Unit Size
A0760	Barium Acrylate Monomer	25g
C0078	Barium Chloranilate Trihydrate	25g
C0978	Barium 2-Cyanoethylphosphate Hydrate [Phosphorylating Agent]	5g 25g
D0876	Barium Diphenylamine-4-sulfonate	1g 5g 25g
E0085	Barium Disodium Ethylenediaminetetraacetate Hydrate	25g
S0235	Barium Stearate	25g 500g
G0052	D-Glucose 6-Phosphate Barium Salt Heptahydrate	100mg 1g
I0039	Inosine 5'-Monophosphate Barium Salt Hydrate	100mg
L0074	Lake Red CBA	25g
M0046	Mannose-6-phosphate Barium Salt Hydrate	100mg
P0257	6-Phosphogluconate Barium Salt Hydrate	Price on request
P0258	3-Phospho-D-glyceric Acid Barium Salt Dihydrate	1g
R0026	Ribose-5-phosphate Barium Salt Hydrate	100mg 1g

Al (Aluminum)

Product No.	Product Name	Unit Size		
A0244	Aluminum *sec*-Butoxide		25g	500g
A0804	Aluminum *tert*-Butoxide			5g
A1831	Aluminum(III) Chloride		100g	500g
A0245	Aluminum Ethoxide		25g	250g
A1200	Aluminum Glycinate		25g	500g
A0246	Aluminum Isopropoxide		100g	500g
B1895	Bis(2-ethylhexanoato)hydroxyaluminum		25g	250g
D1340	Diethylaluminum Chloride (*ca.* 15% in Hexane, *ca.* 0.87mol/L)			100mL
D2972	Diisobutylaluminum Hydride (17% in Toluene, *ca.* 1.0mol/L)		100mL	500mL
D2971	Diisobutylaluminum Hydride (19% in Hexane, *ca.* 1.0mol/L)		100mL	500mL
E0648	Ethylaluminum Dichloride (17% in Hexane, *ca.* 1mol/L)			100mL
L0203	Lithium Aluminum Hydride (Powder)		25g	100g
L0170	Lithium Aluminum Hydride (10% in Tetrahydrofuran, *ca.* 2.5mol/L)			100mL
L0159	Lithium Tri-*tert*-butoxyaluminum Hydride (*ca.* 30% in Tetrahydrofuran, *ca.* 1.0mol/L)			100mL
M1211	Methylaluminum Bis(2,6-di-*tert*-butyl-4-methylphenoxide) (0.4mol/L in Toluene)			50mL
M0468	Mucicarmine			25g
M0469	Mucicarmine Solution acc. to Mayer			500mL
C1167	Phthalocyanine Chloroaluminum			1g
P2280	Polydimethylsilane supported Palladium/Alumina Hybrid Catalyst [=Pd / ($PMPSi\text{-}Al_2O_3$)]		1g	5g
P1944	Poly(methylphenyl)silane supported Palladium/Alumina Hybrid Catalyst [=Pd / ($PSi\text{-}Al_2O_3$)]			1g
S0467	Sodium Bis(2-methoxyethoxy)aluminum Dihydride (70% in Toluene, *ca.* 3.6mol/L)	25g	100g	500g
C1411	Tebbe Reagent (*ca.* 0.5mol/L in Toluene)			25mL
T0783	Triethylaluminum (15% in Hexane, *ca.* 1.0mol/L)			100mL
T0925	Triethylaluminum (15% in Toluene, *ca.* 1.1mol/L)			100mL
T0784	Triisobutylaluminum (15% in Hexane, *ca.* 0.50mol/L)			100mL
T0782	Trimethylaluminum (15% in Hexane, *ca.* 1.4mol/L)			100mL
T1575	Trimethylaluminum (15% in Toluene, *ca.* 1.8mol/L)			100mL
A0241	Tris(2,4-pentanedionato)aluminum(III)	25g	100g	500g
T2238	Tris(8-quinolinolato)aluminum (purified by sublimation)			5g
T1527	Tris(8-quinolinolato)aluminum		25g	250g
A1267	Tris(trifluoro-2,4-pentanedionato)aluminum(III)		5g	25g

Ga (Gallium)

Product No.	Product Name	Unit Size	
G0359	Gallium(III) Chloride Anhydrous	5g	25g

In (Indium)

Product No.	Product Name	Unit Size	
I0778	Indium(III) Chloride Anhydrous	5g	25g
I0020	Tris(2,4-pentanedionato)indium(III)		10g

Tl (Thallium)

Product No.	Product Name	Unit Size
C0954	Cyclopentadienyl Thallium	5g
T1351	Thallium(III) Trifluoroacetate	10g

Sn (Tin)

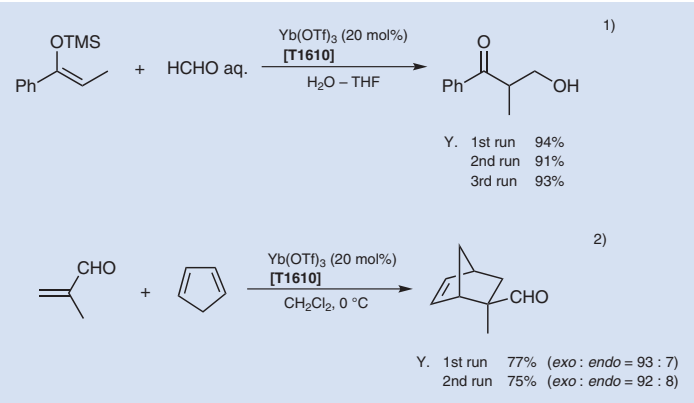
Product No.	Product Name	Unit Size	
A2170	Allenyltributyltin		1g
A1222	Allyltributyltin	5g	25g
A1491	Allyltriphenyltin	5g	25g
B4685	4,8-Bis(2-butyl-*n*-octyloxy)-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene		200mg
B4437	4,8-Bis[5-(2-ethylhexyl)thiophen-2-yl]-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene		200mg
B4378	4,8-Bis(*n*-octyloxy)-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene		200mg
T0650	Bis(2,4-pentanedionato)tin(IV) Dichloride		25g
B1974	Bis(tributylstannyl)acetylene	1g	5g
B1975	*trans*-1,2-Bis(tributylstannyl)ethylene	1g	5g
B0907	Bis(tributylstannyl) Sulfide	1g	5g
B1832	Bis(tributyltin)	5g	25g
B4536	2,5-Bis(trimethylstannyl)thieno[3,2-*b*]thiophene	200mg	1g
B4453	4,7-Bis(5-trimethylstannyl-2-thienyl)-2,1,3-benzothiadiazole		200mg
D2466	Dibutyltin Bis(trifluoromethanesulfonate)		5g

Product No.	Product Name	Unit Size		
D0302	Dibutyltin Diacetate	25g	100g	500g
D0223	Dibutyltin Dichloride		25g	500g
D0303	Dibutyltin Dilaurate	25g	100g	500g
D0304	Dibutyltin Maleate (so called) [for PVC stabilizer]		25g	500g
D0305	Dibutyltin Oxide	25g	100g	500g
D1338	Dimethyltin Dichloride		25g	500g
D4649	Dimethyltin Oxide		25g	100g
D1373	Di-*n*-octyltin Oxide		25g	500g
D2358	Diphenyltin Sulfide [Activator for *O*-Glycoside Synthesis]			1g
H1312	Hexamethylditin		1g	5g
M1494	Methyl Tributylstannyl Sulfide		25g	100g
M0744	Monobutyltin Oxide		25g	500g
P1282	Phenyltin Trichloride		5g	25g
S0909	SnAP-TM Reagent		200mg	1g
T2009	Tetraallyltin		1g	5g
T1592	Tetrabutylammonium Difluorotriphenylstannate		1g	5g
T0058	Tetrabutyltin		25g	500g
T0919	Tetramethyltin		5g	25g
T0165	Tetraphenyltin			25g
T2053	Tin(IV) Chloride (*ca.* 1.0mol/L in Dichloromethane)			100mL
T3149	Tin(II) 2-Ethylhexanoate		100g	500g
T2940	Tin(IV) 2,3-Naphthalocyanine Dichloride		200mg	1g
P1024	Tin(II) Phthalocyanine		1g	5g
P0997	Tin(IV) Phthalocyanine Dichloride			1g
T1194	Tin(II) Trifluoromethanesulfonate	1g	5g	25g
T3191	Tributyl(1-ethoxyvinyl)tin		1g	5g
T1750	Tributylethynyltin		1g	5g
T1797	Tributyl(2-furyl)tin			5g
T2995	Tributyl(4-methoxy-2-pyridyl)tin		1g	5g
T3046	Tributyl(1-phenyl-5-pyrazolyl)tin		1g	5g
T1736	Tributyl(2-pyridyl)tin	1g	5g	25g
T1798	Tributyl(2-thienyl)tin		5g	25g
T0677	Tributyltin Acetate			25g
T0363	Tributyltin Chloride	25g	100g	500g
T0678	Tributyltin Fluoride			25g
T1473	Tributyltin Hydride (stabilized with BHT) [Reducing Reagent]		25g	250g
T1865	Tributyl(trimethylsilylethynyl)tin		5g	25g
T1866	Tributyl(trimethylsilylmethyl)tin			5g
T1794	Tributylvinyltin	1g	5g	25g
T1742	Trimethyl(2-pyridyl)tin		1g	5g
T1928	Trimethyl(4-pyridyl)tin		1g	5g
T0958	Trimethyltin Chloride		5g	25g
T0447	Triphenyltin Chloride			5g

Pb (Lead)

Product No.	Product Name	Unit Size	
E0093	Ethylenediaminetetraacetic Acid Lead(II) Disodium Salt Hydrate	25g	500g
L0279	Lead(II) Iodide [for Perovskite precursor]	1g	5g
N0339	Lead Naphthenate		25g
L0230	Lead(II) Phthalocyanine (purified by sublimation)	200mg	1g
P0766	Lead(II) Phthalocyanine	1g	25g
L0021	Lead Tetraacetate (contains Acetic Acid)	25g	500g
T0164	Tetraphenyl Lead		5g

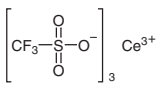
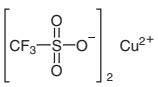
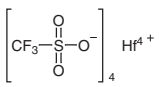
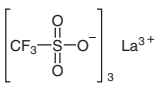
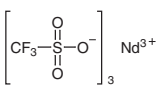
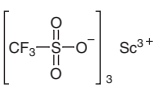
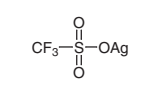
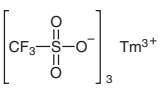
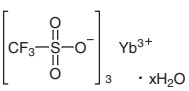
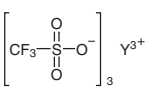
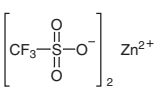
Stable Lewis Acids in Aqueous Media



The Lewis acid-catalyzed C-C bond forming reactions have been of great interest in organic synthesis. While various kinds of Lewis acid-promoted reactions have been developed, these reactions must be carried out under strict anhydrous conditions. The presence of even a small amount of water stops the reaction, because most Lewis acid immediately react with water rather than the substrates and decompose or deactivate.

Recently, Kobayashi and co-worker have found that certain metal triflates are stable Lewis acids in aqueous media. The reaction of silyl enol ethers with commercial formaldehyde solution smoothly proceeds in aqueous media by the certain metal triflates, especially Yb(OTf)3 to give the corresponding aldol adducts in high yields. Moreover, the triflates can also be used in organic solvents in many reactions. In all cases, the reaction is completed by only a catalytic amount of the triflate, and the catalyst can be easily recovered after the reaction was completed and can be reused. On the other hand, in asymmetric synthesis, chiral Lewis acid which was prepared by Sc(OTf)3, chiral binaphthol and an amine affords chiral Diels-Alder adduct in the reactions of dienophiles and dienes. Then, the certain metal triflates, especially Yb(OTf)3, Sc(OTf)3, etc. are expected to be useful as new types of Lewis acid catalysts in many organic reactions.

From the view points of green chemistry, these are also remarkably effective Lewis Acids as non-toxic and nonflammable water can be used as reaction solvent.

T1918 	T1292 	T1708 	I0778 	T1293 
T1919 	T1663 	T1331 	T1920 	T1610 
T1921 	T1294 			

Product No.	Product Name	Unit Size	
T1918	Cerium(III) Trifluoromethanesulfonate	5g	25g
T1292	Copper(II) Trifluoromethanesulfonate	5g	25g
T1708	Hafnium(IV) Trifluoromethanesulfonate	1g	5g
I0778	Indium(III) Chloride Anhydrous	5g	25g
T1293	Lanthanum(III) Trifluoromethanesulfonate	5g	25g
T1919	Neodymium(III) Trifluoromethanesulfonate	5g	25g
T1663	Scandium(III) Trifluoromethanesulfonate	1g	5g
T1331	Silver Trifluoromethanesulfonate	10g	25g
T1920	Thulium(III) Trifluoromethanesulfonate		5g
T1610	Ytterbium(III) Trifluoromethanesulfonate Hydrate	5g	25g
T1921	Yttrium(III) Trifluoromethanesulfonate	5g	25g
T1294	Zinc(II) Trifluoromethanesulfonate		25g

References

1) Aldol reactions in aqueous media
S. Kobayashi, *Chem. Lett*. **1991**, 2187; S. Kobayashi, I. Hachiya, *Tetrahedron Lett*. **1992**, *33*, 1625.
2) Reusable catalysts for Michael and Diels-Alder reactions
S. Kobayashi, I. Hachiya, T. Takahori, M. Araki, H. Ishitani, *Tetrahedron Lett*. **1992**, *33*, 6815.
3) Reviews: S. Kobayashi, *Synlett* **1994**, 689; S. Kobayashi, I. Hachiya, *Yuki Gosei Kagaku Kyokaishi (J. Synth. Org. Chem., Jpn.)* **1995**, *53*, 370; T. Ogino, T. Onozawa, *Yuki Gosei Kagaku Kyokaishi (J. Synth. Org. Chem., Jpn.)*, **1998**, *56*, 71; K. Ishikawa, *TCIMAIL* **2000**, number*107*, 2; S. Kobayashi, T. Hamada, S. Nagayama, K. Manabe, *J. Braz. Chem. Soc*. **2001**, *12*, 627; S. Kobayashi, *Pure Appl. Chem*. **2007**, *79*, 235.

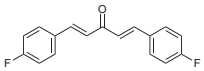
Ligands

Phosphine Ligands (see p.62)
N-Heterocyclic Carbene (NHC) Ligands (see p.66)

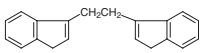
Ene Ligands

A0005

B2283



B2281



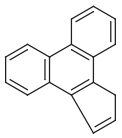
C0572

C0468

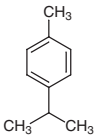
C0503

C0505

C1689

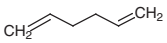


C0513

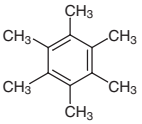


D0443

H0084

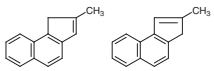


H0087

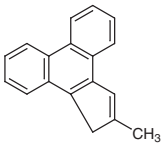


I0016
I0354

M1425



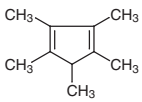
M1411



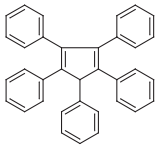
N0346

N0166

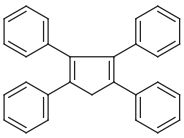
P1292



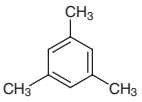
P1633



T1333



T0470

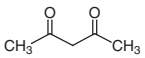


Product No.	Product Name	Unit Size		
A0005	Acenaphthylene			25g
B2283	*trans*,*trans*-1,5-Bis(4-fluorophenyl)-1,4-pentadien-3-one		5g	25g
B2281	1,2-Bis(3-indenyl)ethane		1g	5g
C0572	1,3,5-Cycloheptatriene			25mL
C0468	1,4-Cyclohexadiene (stabilized with BHT)		10mL	25mL
C0503	1,5-Cyclooctadiene [stabilized with Octadecyl 3-(3',5'-Di-*tert*-butyl-4'-hydroxyphenyl)propionate]	25mL	100mL	500mL
C0505	1,3,5,7-Cyclooctatetraene (stabilized with HQ)		1mL	5mL
C1689	1*H*-Cyclopenta[*l*]phenanthrene		100mg	1g
C0513	*p*-Cymene		25mL	500mL
D0443	Dicyclopentadiene (stabilized with BHT) [precursor to Cyclopentadiene]		25mL	500mL
H0084	1,5-Hexadiene		25mL	500mL
H0087	Hexamethylbenzene			5g
I0016	Indene	25mL	100mL	500mL
I0354	Indene			25mL

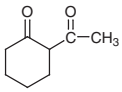
Product No.	Product Name	Unit Size		
M1425	2-Methylbenzo[*e*]indene (mixture of 1*H*- and 3*H*-form)		100mg	1g
M1411	2-Methylcyclopenta[*l*]phenanthrene		100mg	1g
N0346	2,5-Norbornadiene (stabilized with BHT)	25mL	100mL	500mL
N0166	2-Norbornene		25g	400g
P1292	1,2,3,4,5-Pentamethylcyclopentadiene		5mL	25mL
P1633	1,2,3,4,5-Pentaphenyl-1,3-cyclopentadiene		100mg	1g
T1333	1,2,3,4-Tetraphenyl-1,3-cyclopentadiene		1g	5g
T0470	1,3,5-Trimethylbenzene		25mL	500mL

Diketone Ligands

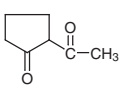
P0052



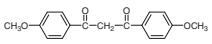
A0881



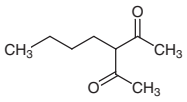
A0869



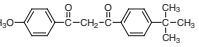
B1733



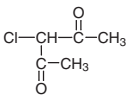
B1457



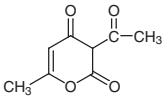
B3382



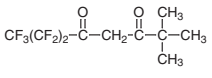
C1277



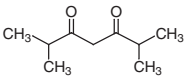
D0039



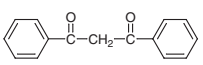
D1729



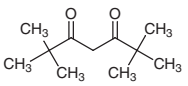
D2413



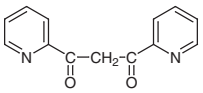
D0910



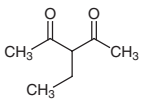
D1678



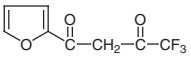
D2512



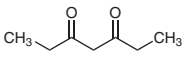
E0405



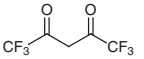
F0083



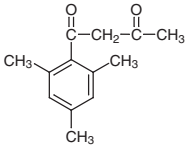
H1395



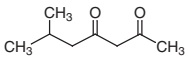
H0476



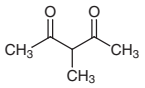
M1272



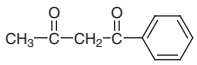
M0597



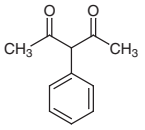
M1132



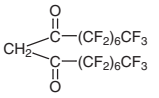
P0160



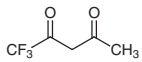
P1297



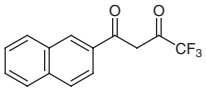
T2037



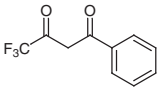
T0434



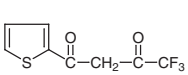
T1583



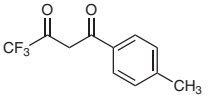
T0437



T0438



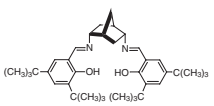
T2997



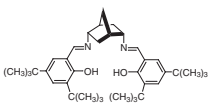
Product No.	Product Name	Unit Size		
P0052	Acetylacetone		25mL	500mL
A0881	2-Acetylcyclohexanone		10mL	25mL
A0869	2-Acetylcyclopentanone			25mL
B1733	1,3-Bis(4-methoxyphenyl)-1,3-propanedione		5g	25g
B1457	3-Butyl-2,4-pentanedione			5mL
B3382	1-(4-*tert*-Butylphenyl)-3-(4-methoxyphenyl)-1,3-propanedione		25g	100g
C1277	3-Chloroacetylacetone			25g
D0039	Dehydroacetic Acid		25g	500g
D1729	2,2-Dimethyl-6,6,7,7,8,8,8-heptafluoro-3,5-octanedione			5g
D2413	2,6-Dimethyl-3,5-heptanedione		5g	25g
D0910	1,3-Diphenyl-1,3-propanedione		25g	500g
D1678	Dipivaloylmethane		5g	25g
D2512	1,3-Di(2-pyridyl)-1,3-propanedione		1g	5g
E0405	3-Ethyl-2,4-pentanedione			5mL
F0083	2-Furoyltrifluoroacetone		5g	25g
H1395	3,5-Heptanedione		5g	25g
H0476	Hexafluoroacetylacetone		5g	25g
M1272	1-(2-Mesitylene)-1,3-butanedione		5g	25g
M0597	6-Methyl-2,4-heptanedione			5mL
M1132	3-Methyl-2,4-pentanedione		5mL	25mL
P0160	1-Phenyl-1,3-butanedione	25g	100g	500g
P1297	3-Phenyl-2,4-pentanedione		1g	5g
T2037	9*H*,9*H*-Triacontafluoro-8,10-heptadecanedione			100mg
T0434	Trifluoroacetylacetone		25g	100g
T1583	4,4,4-Trifluoro-1-(2-naphthyl)-1,3-butanedione	5g	10g	25g
T0437	4,4,4-Trifluoro-1-phenyl-1,3-butanedione			25g
T0438	4,4,4-Trifluoro-1-(2-thienyl)-1,3-butanedione		25g	500g
T2997	4,4,4-Trifluoro-1-(*p*-tolyl)-1,3-butanedione		5g	25g

Salen Ligands

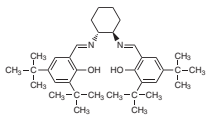
B2652



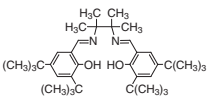
B2653



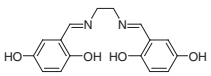
B4418



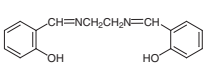
B2619



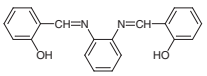
B3015



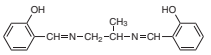
H0199



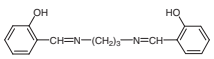
D2572



D1307



D1422

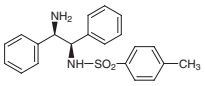


Product No.	Product Name	Unit Size	
B2652	(1*R*,2*R*,4*R*,5*R*)-2,5-Bis(3,5-di-*tert*-butyl-2-hydroxybenzylideneamino)bicyclo[2.2.1]heptane		100mg
B2653	(1*S*,2*S*,4*S*,5*S*)-2,5-Bis(3,5-di-*tert*-butyl-2-hydroxybenzylideneamino)bicyclo[2.2.1]heptane		100mg
B4418	(*R*,*R*)-(-)-*N*,*N*'-Bis(3,5-di-*tert*-butylsalicylidene)-1,2-cyclohexanediamine	5g	25g
B2619	*N*,*N*'-Bis(3,5-di-*tert*-butylsalicylidene)-1,1,2,2-tetramethylethylenediamine	1g	5g
B3015	*N*,*N*'-Bis(5-hydroxysalicylidene)ethylenediamine	1g	5g
H0199	*N*,*N*'-Bis(salicylidene)ethylenediamine	25g	500g

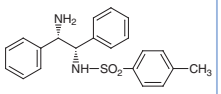
Product No.	Product Name	Unit Size	
D2572	*N*,*N*'-Bis(salicylidene)-1,2-phenylenediamine	5g	25g
D1307	*N*,*N*'-Bis(salicylidene)-1,2-propanediamine		25g
D1422	*N*,*N*'-Bis(salicylidene)-1,3-propanediamine		25g

Amine Ligands

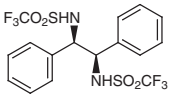
A1548



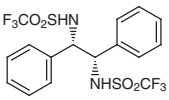
A1699



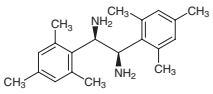
D2520



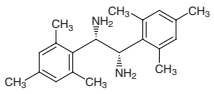
D2521



B2316

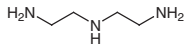


B2317

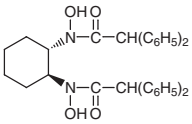


D0134

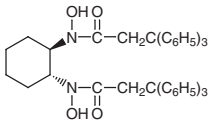
D0493



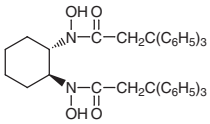
D3716



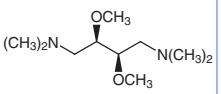
D3719



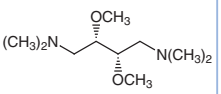
D3720



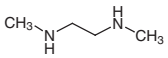
D2395



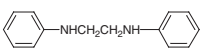
D2396



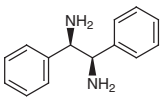
D0720



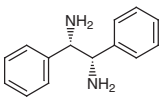
D0887



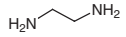
D2176



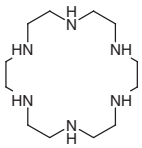
D2175



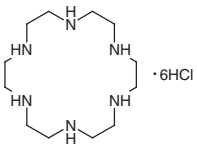
E0077



H1070

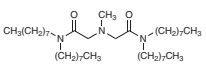


H1215

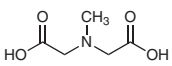


H0093

M2476

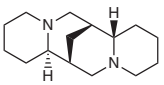


M2090

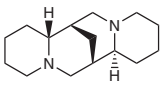


Q0062

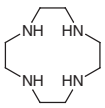
S0884



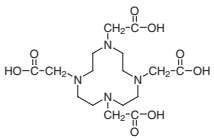
S0461



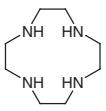
T1874



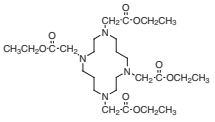
T1875



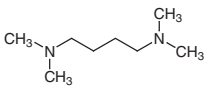
T1426



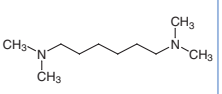
T2540



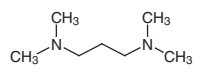
T1289



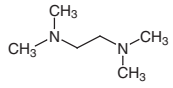
T0537



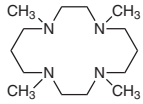
T0548



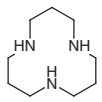
T0147



T1877

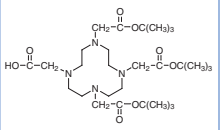


T1876

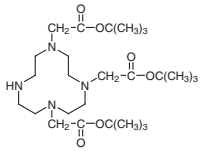


T1878

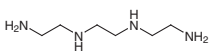
T2642



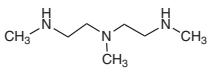
T2541



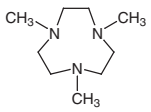
T0429



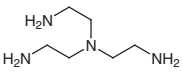
B4304



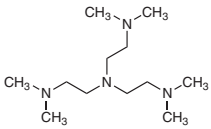
T1879



T1243



T2898

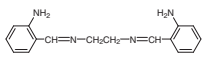


Product No.	Product Name			Unit Size
A1548	(*R*,*R*)-*N*-(2-Amino-1,2-diphenylethyl)-*p*-toluenesulfonamide			1g
A1699	(*S*,*S*)-*N*-(2-Amino-1,2-diphenylethyl)-*p*-toluenesulfonamide			1g
D2520	(*R*,*R*)-*N*,*N*'-Bis(trifluoromethanesulfonyl)-1,2-diphenylethylenediamine			1g
D2521	(*S*,*S*)-*N*,*N*'-Bis(trifluoromethanesulfonyl)-1,2-diphenylethylenediamine			1g
B2316	(1*R*,2*R*)-1,2-Bis(2,4,6-trimethylphenyl)ethylenediamine		100mg	500mg
B2317	(1*S*,2*S*)-1,2-Bis(2,4,6-trimethylphenyl)ethylenediamine		100mg	500mg
D0134	1,4-Diazabicyclo[2.2.2]octane	25g	100g	500g
D0493	Diethylenetriamine		25mL	500mL
D3716	(1*S*,2*S*)-*N*,*N*'-Dihydroxy-*N*,*N*'-bis(diphenylacetyl)cyclohexane-1,2-diamine			100mg
D3719	(1*R*,2*R*)-*N*,*N*'-Dihydroxy-*N*,*N*'-bis(3,3,3-triphenylpropionyl)cyclohexane-1,2-diamine			100mg
D3720	(1*S*,2*S*)-*N*,*N*'-Dihydroxy-*N*,*N*'-bis(3,3,3-triphenylpropionyl)cyclohexane-1,2-diamine			100mg
D2395	(*R*,*R*)-(-)-2,3-Dimethoxy-1,4-bis(dimethylamino)butane		1g	5g
D2396	(*S*,*S*)-(+)-2,3-Dimethoxy-1,4-bis(dimethylamino)butane		1g	5g
D0720	*N*,*N*'-Dimethylethylenediamine		5mL	25mL
D0887	*N*,*N*'-Diphenylethylenediamine			25g
D2176	(1*R*,2*R*)-(+)-1,2-Diphenylethylenediamine		1g	5g
D2175	(1*S*,2*S*)-(-)-1,2-Diphenylethylenediamine		1g	5g
E0077	Ethylenediamine Anhydrous		25mL	500mL
H1070	1,4,7,10,13,16-Hexaazacyclooctadecane			100mg
H1215	1,4,7,10,13,16-Hexaazacyclooctadecane Hexahydrochloride			100mg
H0093	Hexamethylenetetramine		25g	500g
M2476	2,2'-(Methylimino)bis(*N*,*N*-di-*n*-octylacetamide)		1mL	5mL
M2090	*N*-Methyliminodiacetic Acid		5g	25g
Q0062	Quinuclidine		200mg	1g
S0884	(+)-Sparteine			1g
S0461	(-)-Sparteine			1g
T1874	1,4,7,10-Tetraazacyclododecane		1g	5g
T1875	1,4,7,10-Tetraazacyclododecane-1,4,7,10-tetraacetic Acid		200mg	1g
T1426	1,4,7,10-Tetraazacyclododecane Tetrahydrochloride		1g	5g
T2540	Tetraethyl 1,4,8,11-Tetraazacyclotetradecane-1,4,8,11-tetraacetate			200mg
T1289	*N*,*N*,*N*',*N*'-Tetramethyl-1,4-diaminobutane			25mL
T0537	*N*,*N*,*N*',*N*'-Tetramethyl-1,6-diaminohexane		25mL	500mL
T0548	*N*,*N*,*N*',*N*'-Tetramethyl-1,3-diaminopropane		25mL	500mL
T0147	*N*,*N*,*N*',*N*'-Tetramethylethylenediamine		25mL	500mL
T1877	1,4,8,11-Tetramethyl-1,4,8,11-tetraazacyclotetradecane		200mg	1g
T1876	1,5,9-Triazacyclododecane			100mg
T1878	1,4,7-Triazacyclononane	200mg	1g	5g
T2642	Tri-*tert*-butyl 1,4,7,10-Tetraazacyclododecane-1,4,7,10-tetraacetate		100mg	1g
T2541	Tri-*tert*-butyl 1,4,7,10-Tetraazacyclododecane-1,4,7-triacetate			200mg
T0429	Triethylenetetramine		25mL	500mL

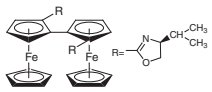
Product No.	Product Name	Unit Size	
B4304	*N*,*N*',*N*"-Trimethyldiethylenetriamine		5mL
T1879	1,4,7-Trimethyl-1,4,7-triazacyclononane (stabilized with $NaHCO_3$)	1g	5g
T1243	Tris(2-aminoethyl)amine	25mL	100mL
T2898	Tris[2-(dimethylamino)ethyl]amine	1g	5g

Imine Ligands

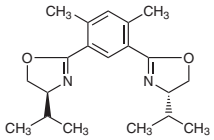
A0261



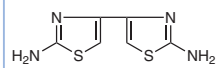
B3197



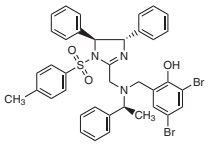
B4196



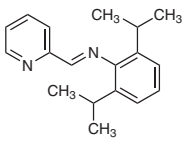
D4273



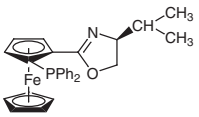
D4168



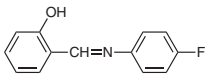
D4652



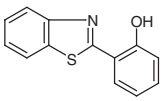
D3822



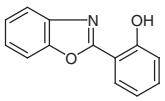
F0893



H0973

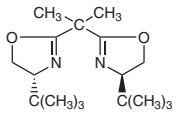


H0291

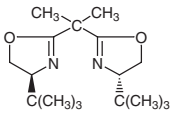


I0001

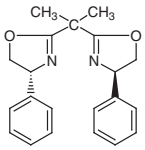
I0795



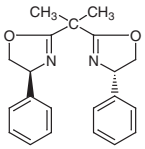
I0567



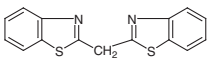
D2823



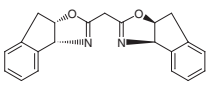
I0582



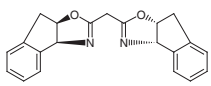
M1390



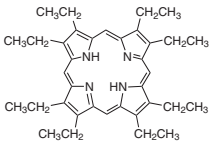
M1401



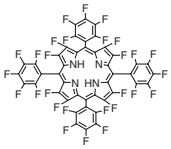
M1402



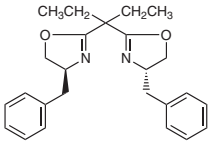
O0234



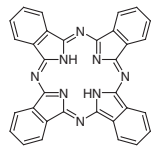
O0319



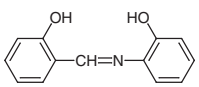
P1947



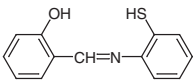
P1795
P0355



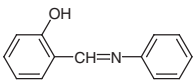
S0328



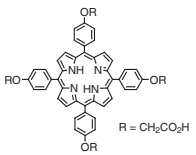
A5019



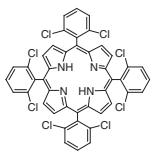
S0267



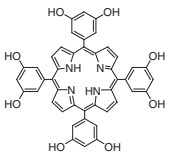
T1495



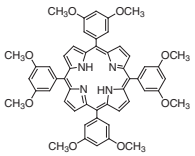
T1438



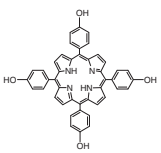
T1815



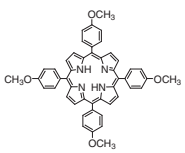
T1832



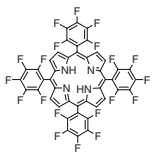
T1497



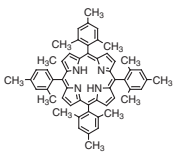
T1360

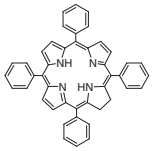
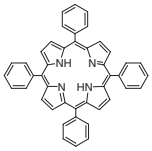
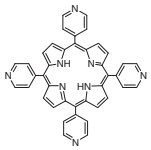
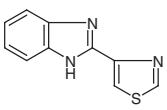
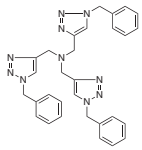


T1730



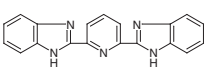
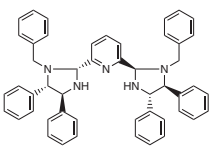
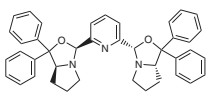
T1729

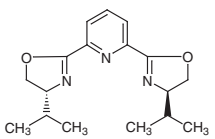
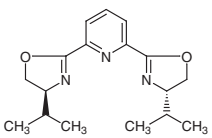
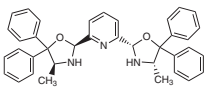
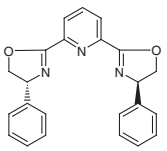
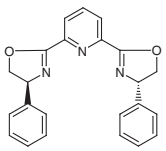


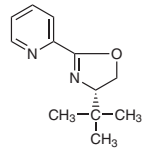
T1358	T1359	T2222	T0830	T2993
				

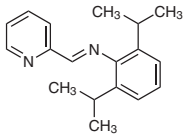
Product No.	Product Name			Unit Size
A0261	*N*,*N*'-Bis(2-aminobenzal)ethylenediamine			1g
B3197	(*S*,*S*")-2,2"-Bis[(*S*)-4-isopropyloxazolin-2-yl]-1,1"-biferrocene		100mg	500mg
B4196	(*S*,*S*)-4,6-Bis(4-isopropyl-2-oxazolin-2-yl)-*m*-xylene			20mg
D4273	2,2'-Diamino-4,4'-bithiazole		200mg	1g
D4168	2,4-Dibromo-6-[[[[(4*S*,5*S*)-4,5-dihydro-4,5-diphenyl-1-tosyl-1*H*-imidazol-2-yl]methyl]-[(*S*)-1-phenylethyl]amino]methyl]phenol			50mg
D4652	*trans*-2,6-Diisopropyl-*N*-(2-pyridylmethylene)aniline		200mg	1g
D3822	(*S*)-1-(Diphenylphosphino)-2-[(*S*)-4-isopropyloxazolin-2-yl]ferrocene		200mg	1g
F0893	4-Fluoro-*N*-salicylideneaniline		1g	5g
H0973	2-(2-Hydroxyphenyl)benzothiazole		5g	25g
H0291	2-(2-Hydroxyphenyl)benzoxazole		1g	25g
I0001	Imidazole	25g	100g	500g
I0795	(*R*,*R*)-(+)-2,2'-Isopropylidenebis(4-*tert*-butyl-2-oxazoline)			100mg
I0567	(*S*,*S*)-(-)-2,2'-Isopropylidenebis(4-*tert*-butyl-2-oxazoline)		100mg	1g
D2823	(*R*,*R*)-2,2'-Isopropylidenebis(4-phenyl-2-oxazoline)	250mg	1g	5g
I0582	(*S*,*S*)-2,2'-Isopropylidenebis(4-phenyl-2-oxazoline)		250mg	1g
M1390	2,2'-Methylenebisbenzothiazole		5g	25g
M1401	(+)-2,2'-Methylenebis[(3a*R*,8a*S*)-3a,8a-dihydro-8*H*-indeno[1,2-*d*]oxazole]		100mg	500mg
M1402	(-)-2,2'-Methylenebis[(3a*S*,8a*R*)-3a,8a-dihydro-8*H*-indeno[1,2-*d*]oxazole]		100mg	500mg
O0234	2,3,7,8,12,13,17,18-Octaethylporphyrin		100mg	1g
O0319	2,3,7,8,12,13,17,18-Octafluoro-5,10,15,20-tetrakis(pentafluorophenyl)porphyrin			100mg
P1947	(4*S*,4'*S*)-2,2'-(Pentane-3,3'-diyl)bis(4-benzyl-4,5-dihydrooxazole)		200mg	1g
P1795	Phthalocyanine (purified by sublimation)			1g
P0355	Phthalocyanine			25g
S0328	2-Salicylideneaminophenol		5g	25g
A5019	Salicylideneamino-2-thiophenol		1g	5g
S0267	*N*-Salicylideneaniline			25g
T1495	5,10,15,20-Tetrakis(4-carboxymethyloxyphenyl)porphyrin			100mg
T1438	5,10,15,20-Tetrakis(2,6-dichlorophenyl)porphyrin			100mg
T1815	5,10,15,20-Tetrakis(3,5-dihydroxyphenyl)porphyrin		100mg	1g
T1832	5,10,15,20-Tetrakis(3,5-dimethoxyphenyl)porphyrin			100mg
T1497	5,10,15,20-Tetrakis(4-hydroxyphenyl)porphyrin			100mg
T1360	5,10,15,20-Tetrakis(4-methoxyphenyl)porphyrin		100mg	1g
T1730	5,10,15,20-Tetrakis(pentafluorophenyl)porphyrin			100mg
T1729	5,10,15,20-Tetrakis(2,4,6-trimethylphenyl)porphyrin		100mg	1g
T1358	*meso*-Tetraphenylchlorin			100mg
T1359	Tetraphenylporphyrin (Chlorin free)			1g
T2222	5,10,15,20-Tetra(4-pyridyl)porphyrin			1g
T0830	2-(4-Thiazolyl)benzimidazole		25g	250g
T2993	Tris[(1-benzyl-1*H*-1,2,3-triazol-4-yl)methyl]amine		1g	5g

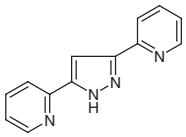
Pyridine Ligands

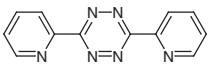
B3510	B3934	B4228
		

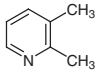
B2217	B2218	B4227	B2219	B2220
				

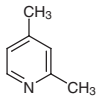
B4104


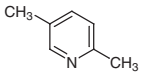
D4652


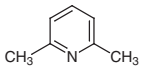
D2037


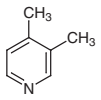
D3640


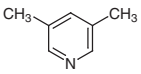
L0063


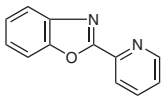
L0085


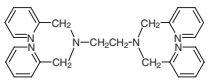
L0065


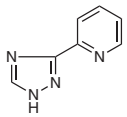
L0067


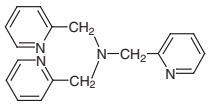
L0066


L0068


P2098


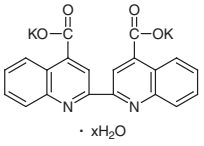
T1487


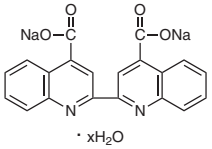
P2100


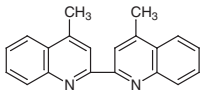
T2671


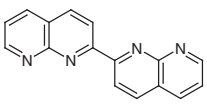
Product No.	Product Name		Unit Size	
B3510	2,6-Bis(2-benzimidazolyl)pyridine		1g	5g
B3934	2,6-Bis[(2*R*,4*S*,5*S*)-1-benzyl-4,5-diphenylimidazolidin-2-yl]pyridine			50mg
B4228	2,6-Bis[(2*S*,5*S*)-4,4-diphenyl-1-aza-3-oxabicyclo[3.3.0]octan-2-yl]pyridine			50mg
B2217	(*R*,*R*)-2,6-Bis(4-isopropyl-2-oxazolin-2-yl)pyridine	250mg	1g	5g
B2218	(*S*,*S*)-2,6-Bis(4-isopropyl-2-oxazolin-2-yl)pyridine		500mg	5g
B4227	2,6-Bis[(2*S*,4*S*)-4-methyl-5,5-diphenyloxazolidin-2-yl]pyridine			50mg
B2219	(*R*,*R*)-2,6-Bis(4-phenyl-2-oxazolin-2-yl)pyridine		250mg	1g
B2220	(*S*,*S*)-2,6-Bis(4-phenyl-2-oxazolin-2-yl)pyridine		250mg	1g
B4104	(*S*)-4-*tert*-Butyl-2-(2-pyridyl)oxazoline		1g	5g
D4652	*trans*-2,6-Diisopropyl-*N*-(2-pyridylmethylene)aniline		200mg	1g
D2037	3,5-Di(2-pyridyl)pyrazole		1g	5g
D3640	3,6-Di(2-pyridyl)-1,2,4,5-tetrazine		1g	5g
L0063	2,3-Lutidine			25mL
L0085	2,4-Lutidine		25mL	500mL
L0065	2,5-Lutidine	5mL	25mL	500mL
L0067	2,6-Lutidine		25mL	500mL
L0066	3,4-Lutidine		25mL	500mL
L0068	3,5-Lutidine		25mL	500mL
P2098	2-(2-Pyridyl)benzoxazole		1g	5g
T1487	*N*,*N*,*N*′,*N*′-Tetrakis(2-pyridylmethyl)ethylenediamine		1g	5g
P2100	2-(1*H*-1,2,4-Triazol-3-yl)pyridine		200mg	1g
T2671	Tris(2-pyridylmethyl)amine		1g	5g

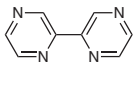
Bipyridine & Terpyridine Ligands

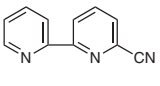
B1077


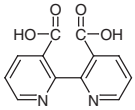
B4509


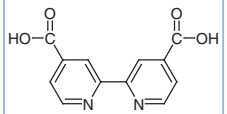
B0841


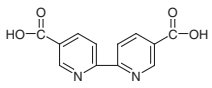
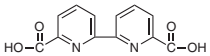
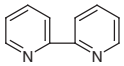
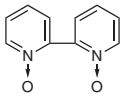
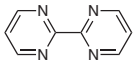
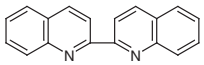
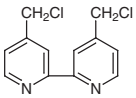
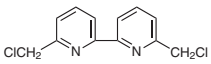
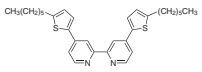
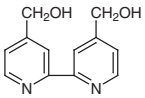
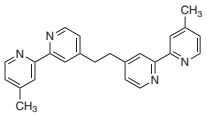
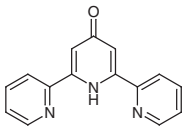
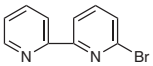
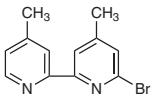
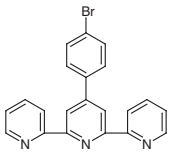
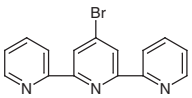
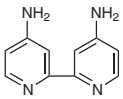
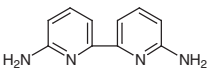
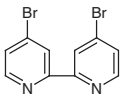
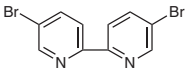
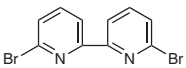
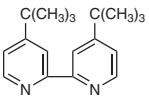
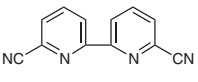
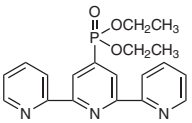
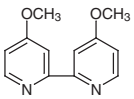
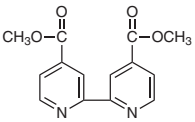
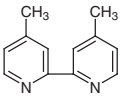
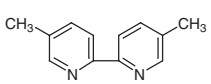
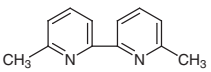
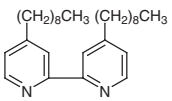
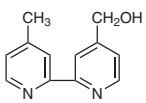
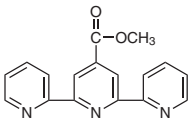
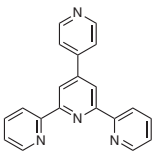
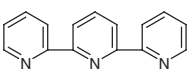
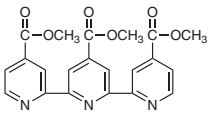
B1423


B4297


B4557


B3622


B1876


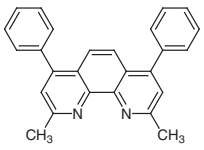
B3502 	B3533 	B0468 	B3859 	B2496 
B0470 	B3572 	B4645 	B4420 	B3511 
B3973 	B3297 	B4114 	B3732 	B3218 
B3219 	D2892 	D2913 	D3919 	D4358 
D3988 	D3134 	D4541 	D4511 	D3886 
D4635 	B0852 	B2138 	B0842 	D3917 
H1347 	M2464 	P2202 	T0024 	T2959 

Product No.	Product Name	Unit Size	
B1077	2,2'-Bicinchoninic Acid Dipotassium Salt Hydrate	1g	5g
B4509	Bicinchoninic Acid Disodium Salt Hydrate	1g	5g
B0841	2,2'-Bi-4-lepidine		100mg
B1423	2,2'-Bi(1,8-naphthyridine)		100mg
B4297	2,2'-Bipyrazine		100mg
B4557	2,2'-Bipyridine-6-carbonitrile	200mg	1g

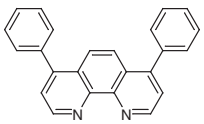
Product No.	Product Name	Unit Size		
B3622	2,2'-Bipyridine-3,3'-dicarboxylic Acid		1g	5g
B1876	2,2'-Bipyridine-4,4'-dicarboxylic Acid		100mg	1g
B3502	2,2'-Bipyridine-5,5'-dicarboxylic Acid			1g
B3533	2,2'-Bipyridine-6,6'-dicarboxylic Acid		1g	5g
B0468	2,2'-Bipyridyl	25g	100g	500g
B3859	2,2'-Bipyridyl 1,1'-Dioxide			5g
B2496	2,2'-Bipyrimidyl		200mg	1g
B0470	2,2'-Biquinoline		1g	5g
B3572	4,4'-Bis(chloromethyl)-2,2'-bipyridyl			1g
B4645	6,6'-Bis(chloromethyl)-2,2'-bipyridyl		200mg	1g
B4420	4,4'-Bis(5-hexyl-2-thienyl)-2,2'-bipyridyl			200mg
B3511	4,4'-Bis(hydroxymethyl)-2,2'-bipyridine		1g	5g
B3973	1,2-Bis(4'-methyl-2,2'-bipyridin-4-yl)ethane		200mg	1g
B3297	2,6-Bis(2-pyridyl)-4(1*H*)-pyridone			1g
B4114	6-Bromo-2,2'-bipyridyl		1g	5g
B3732	6-Bromo-4,4'-dimethyl-2,2'-bipyridyl		1g	5g
B3218	4'-(4-Bromophenyl)-2,2':6',2"-terpyridine		1g	5g
B3219	4'-Bromo-2,2':6',2"-terpyridine		1g	5g
D2892	4,4'-Diamino-2,2'-bipyridyl		200mg	1g
D2913	6,6'-Diamino-2,2'-bipyridyl			250mg
D3919	4,4'-Dibromo-2,2'-bipyridyl		1g	5g
D4358	5,5'-Dibromo-2,2'-bipyridyl			1g
D3988	6,6'-Dibromo-2,2'-bipyridyl		1g	5g
D3134	4,4'-Di-*tert*-butyl-2,2'-bipyridyl		1g	5g
D4541	6,6'-Dicyano-2,2'-bipyridyl			1g
D4511	Diethyl 2,2':6',2"-Terpyridine-4'-phosphonate			200mg
D3886	4,4'-Dimethoxy-2,2'-bipyridyl		1g	5g
D4635	Dimethyl 2,2'-Bipyridine-4,4'-dicarboxylate		1g	5g
B0852	4,4'-Dimethyl-2,2'-bipyridyl	1g	5g	25g
B2138	5,5'-Dimethyl-2,2'-bipyridyl	1g	5g	25g
B0842	6,6'-Dimethyl-2,2'-bipyridyl	100mg	1g	5g
D3917	4,4'-Dinonyl-2,2'-bipyridyl		1g	5g
H1347	4-Hydroxymethyl-4'-methyl-2,2'-bipyridyl		200mg	1g
M2464	Methyl 2,2':6',2"-Terpyridine-4'-carboxylate			100mg
P2202	4'-(4-Pyridyl)-2,2':6',2"-terpyridine			200mg
T0024	2,2':6',2"-Terpyridine		100mg	1g
T2959	Trimethyl 2,2':6',2"-Terpyridine-4,4',4"-tricarboxylate			200mg

Phenanthroline Ligands

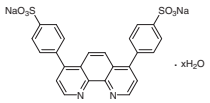
B2694
D0711



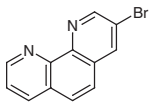
B2695
D0905



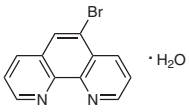
B0989



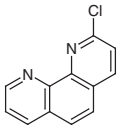
B2632



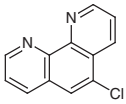
B0429



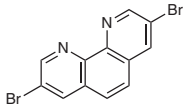
C1560



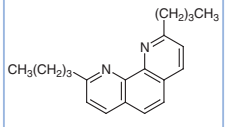
C0786



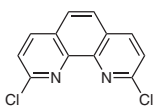
D3209



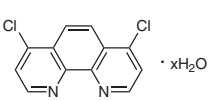
D2565



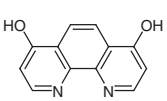
D4186



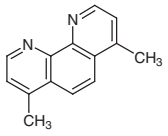
D4421



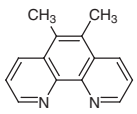
D3869



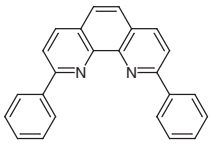
D0772



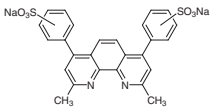
D1559



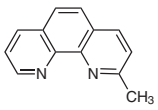
D3849



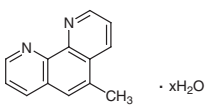
B0985



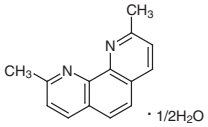
M2512



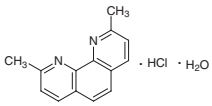
M0300



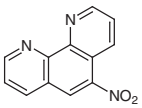
D0771



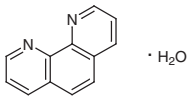
N0423



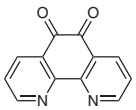
N0214



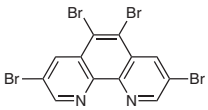
P0221
P0879



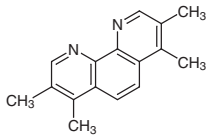
P1973



T3133



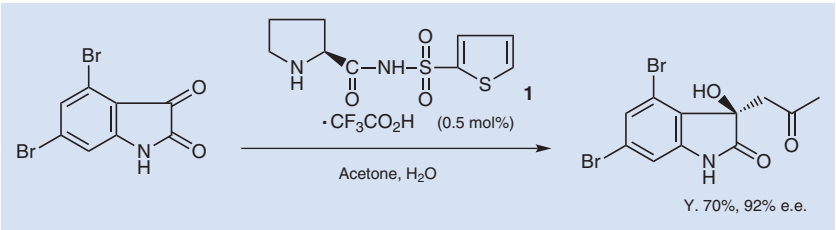
T0847



Product No.	Product Name	Unit Size		
B2694	Bathocuproine (purified by sublimation)		1g	5g
D0711	Bathocuproine		1g	5g
B2695	Bathophenanthroline (purified by sublimation)			1g
D0905	Bathophenanthroline		1g	5g
B0989	Bathophenanthrolinedisulfonic Acid Disodium Salt Hydrate			1g
B2632	3-Bromo-1,10-phenanthroline			200mg
B0429	5-Bromo-1,10-phenanthroline Monohydrate		200mg	1g
C1560	2-Chloro-1,10-phenanthroline		100mg	1g
C0786	5-Chloro-1,10-phenanthroline		100mg	1g
D3209	3,8-Dibromo-1,10-phenanthroline		200mg	1g
D2565	2,9-Dibutyl-1,10-phenanthroline		100mg	1g
D4186	2,9-Dichloro-1,10-phenanthroline		200mg	1g
D4421	4,7-Dichloro-1,10-phenanthroline Hydrate		200mg	1g
D3869	4,7-Dihydroxy-1,10-phenanthroline			1g
D0772	4,7-Dimethyl-1,10-phenanthroline			100mg
D1559	5,6-Dimethyl-1,10-phenanthroline		100mg	1g
D3849	2,9-Diphenyl-1,10-phenanthroline			1g
B0985	Disodium Bathocuproinedisulfonate		100mg	1g
M2512	2-Methyl-1,10-phenanthroline			1g
M0300	5-Methyl-1,10-phenanthroline Hydrate		100mg	1g
D0771	Neocuproine Hemihydrate		1g	25g
N0423	Neocuproine Hydrochloride Monohydrate	1g	5g	25g
N0214	5-Nitro-1,10-phenanthroline			1g
P0221	1,10-Phenanthroline Monohydrate		1g	25g
P0879	1,10-Phenanthroline Monohydrate			25g
P1973	1,10-Phenanthroline-5,6-dione		1g	5g
T3133	3,5,6,8-Tetrabromo-1,10-phenanthroline			100mg
T0847	3,4,7,8-Tetramethyl-1,10-phenanthroline			1g

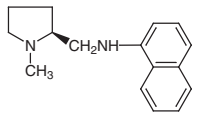
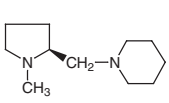
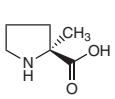
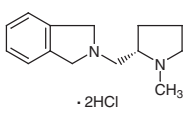
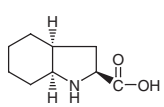
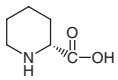
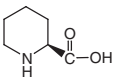
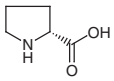
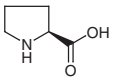
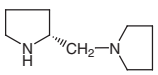
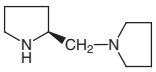
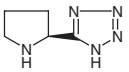
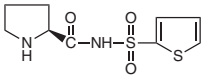
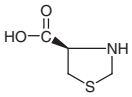
Asymmetric Organocatalysts

Eder *et al*. and Hajos *et al*. separately reported an intramolecular asymmetric aldol reaction which employed proline as the only asymmetric catalyst at the beginning of the 1970s.[1] This reaction was considered to be a special case at that time. Later in 2000, List *et al*. reported an intermolecular asymmetric aldol reaction which used proline as a catalyst.[2] List's report received broad attention and served as a trigger to make research active for asymmetric organic catalysts. Therefore, varieties of asymmetric organic catalysts have been developed and the research has been applied to many areas.[3] The proline derivative **1**, having the heterocyclic ring was developed by Nakamura *et al*. It shows high TON as an asymmetric catalyst for obtaining a chiral aldol adduct.[4]



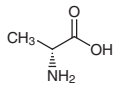
Compared with conventional metal complex catalysts, asymmetric organic catalysts are considered to be environmentally friendly and are expected to be further developed because they are stable, easy to handle and free of harmful metals.

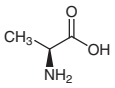
Prolines and Their Analogs		A1301	A0945	A1043
B3440	D3803	D3804	D3185	D3186
D2365	D2735	F0818	H1407	H0784
H0768	I0589	I0395	M1169	M1161

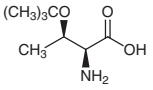
M1097 	M1183 	M2077 	M1995 	O0370 
P1830 	P1404 	P0994 	P0481 	P1925 
P1241 	P1784 	T3080 	T0219 	

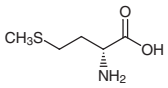
Product No.	Product Name		Unit Size	
A1301	(*S*)-(-)-2-Aminomethyl-1-ethylpyrrolidine		1g	5g
A0945	(*S*)-(+)-2-(Anilinomethyl)pyrrolidine		1g	5g
A1043	L-Azetidine-2-carboxylic Acid		100mg	1g
B3440	*trans*-4-(*tert*-Butyldiphenylsilyloxy)-L-proline		1g	5g
D3803	(*R*)-(+)-2-(Diphenylmethyl)pyrrolidine			1g
D3804	(*S*)-(-)-2-(Diphenylmethyl)pyrrolidine			1g
D3185	(2*R*,5*R*)-2,5-Diphenylpyrrolidine			100mg
D3186	(2*S*,5*S*)-2,5-Diphenylpyrrolidine			100mg
D2365	(*R*)-(+)-α,α-Diphenyl-2-pyrrolidinemethanol		1g	5g
D2735	(*S*)-(-)-α,α-Diphenyl-2-pyrrolidinemethanol		1g	5g
F0818	*trans*-4-Fluoro-L-proline			50mg
H1407	(2*S*)-*N*-[(1*S*)-1-(Hydroxydiphenylmethyl)-3-methylbutyl]-2-pyrrolidinecarboxamide		200mg	1g
H0784	(*R*)-(-)-2-[Hydroxy(diphenyl)methyl]-1-methylpyrrolidine		1g	5g
H0768	(*S*)-(+)-2-[Hydroxy(diphenyl)methyl]-1-methylpyrrolidine	100mg	1g	5g
I0589	(*R*)-(+)-Indoline-2-carboxylic Acid			1g
I0395	(*S*)-(-)-Indoline-2-carboxylic Acid		1g	5g
M1169	(*R*)-2-(Methoxymethyl)pyrrolidine		1g	5g
M1161	(*S*)-2-(Methoxymethyl)pyrrolidine		1g	5g
M1097	(*S*)-(-)-1-Methyl-2-(1-naphthylaminomethyl)pyrrolidine			1g
M1183	(*S*)-(-)-1-Methyl-2-(1-piperidinomethyl)pyrrolidine		1g	5g
M2077	α-Methyl-L-proline		1g	5g
M1995	(*S*)-2-[(1-Methyl-2-pyrrolidinyl)methyl]isoindoline Dihydrochloride		1g	5g
O0370	(2*S*,3a*S*,7a*S*)-Octahydro-1*H*-indole-2-carboxylic Acid		1g	5g
P1830	D-Pipecolic Acid		5g	25g
P1404	L-Pipecolic Acid		1g	5g
P0994	D-Proline		5g	25g
P0481	L-Proline		25g	250g
P1925	(*R*)-(-)-1-(2-Pyrrolidinylmethyl)pyrrolidine			1g
P1241	(*S*)-(+)-1-(2-Pyrrolidinylmethyl)pyrrolidine		1g	5g
P1784	(*S*)-5-(Pyrrolidin-2-yl)-1*H*-tetrazole		100mg	500mg
T3080	*N*-(2-Thiophenesulfonyl)-L-prolinamide			100mg
T0219	L-Thioproline		25g	500g

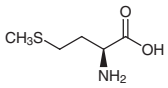
Other Amino Acids

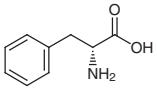
A0177


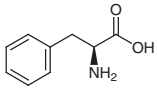
A0179


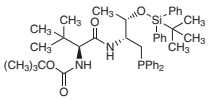
B3398


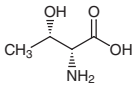
M0102


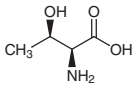
M0099


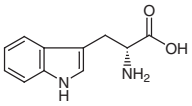
P0135


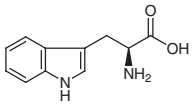
P0134


T2937


T0228


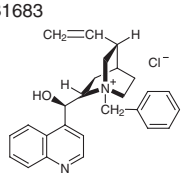
T0230


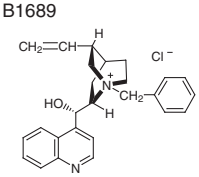
T0539


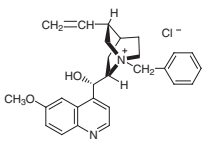
T0541


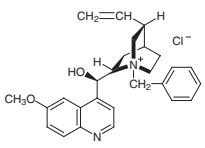
Product No.	Product Name			Unit Size
A0177	D-Alanine		5g	25g
A0179	L-Alanine		25g	250g
B3398	*O*-*tert*-Butyl-L-threonine		1g	5g
M0102	D-Methionine	1g	5g	25g
M0099	L-Methionine	25g	100g	500g
P0135	D-Phenylalanine		5g	25g
P0134	L-Phenylalanine		25g	250g
T2937	*O*-TBDPS-D-Thr-*N*-Boc-L-*tert*-Leu-Diphenylphosphine			100mg
T0228	D-(+)-Threonine		25g	500g
T0230	L-(-)-Threonine	25g	100g	500g
T0539	D-Tryptophan		5g	25g
T0541	L-Tryptophan			25g

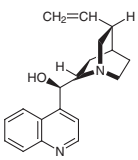
Cinchona Alkaloids

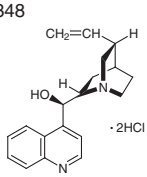
B1683


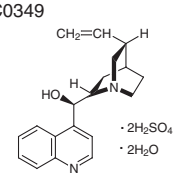
B1689


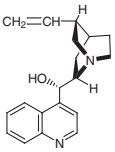
B1684


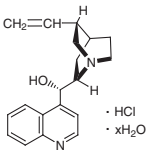
B1685


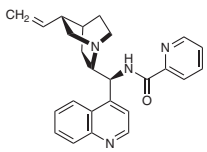
C0347


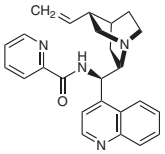
C0348


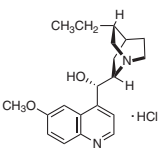
C0349


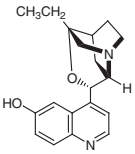
C0350


C0351


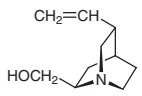
D4306


D4305


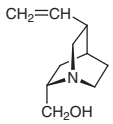
H0752


I0728


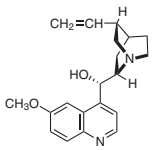
Q0076



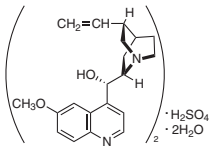
Q0074



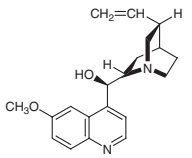
Q0006



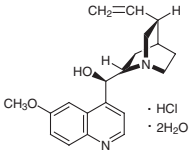
Q0010



Q0028



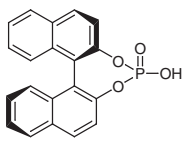
Q0030



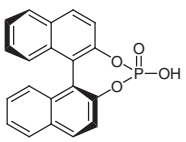
Product No.	Product Name	Unit Size	
B1683	*N*-Benzylcinchonidinium Chloride		10g
B1689	*N*-Benzylcinchoninium Chloride		5g
B1684	*N*-Benzylquinidinium Chloride		5g
B1685	*N*-Benzylquininium Chloride		5g
C0347	Cinchonidine	25g	250g
C0348	Cinchonidine Dihydrochloride		25g
C0349	Cinchonidine Sulfate Dihydrate		25g
C0350	Cinchonine	25g	200g
C0351	Cinchonine Hydrochloride Hydrate		25g
D4306	*N*-(9-Deoxy-*epi*-cinchonidin-9-yl)picolinamide		100mg
D4305	*N*-(9-Deoxy-*epi*-cinchonin-9-yl)picolinamide		100mg
H0752	Hydroquinidine Hydrochloride	25g	250g
I0728	β-Isocupreidine		1g
Q0076	Quincoridine	100mg	1g
Q0074	Quincorine	100mg	1g
Q0006	Quinidine	5g	25g
Q0010	Quinidine Sulfate Dihydrate	5g	25g
Q0028	Quinine	25g	100g
Q0030	Quinine Hydrochloride Dihydrate		25g

Chiral Phosphoric Acids

B1143



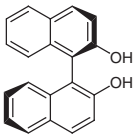
B1144



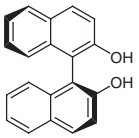
Product No.	Product Name			Unit Size
B1143	(*R*)-(-)-1,1'-Binaphthyl-2,2'-diyl Hydrogen Phosphate	100mg	1g	5g
B1144	(*S*)-(+)-1,1'-Binaphthyl-2,2'-diyl Hydrogen Phosphate		100mg	1g

Chiral Diols

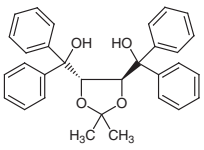
B1142



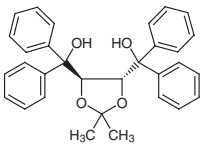
B1100



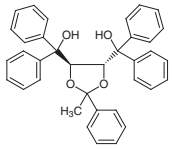
B2048



B1614



B1615

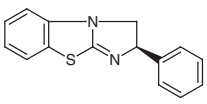


Product No.	Product Name	Unit Size	
B1142	(*R*)-(+)-1,1'-Bi-2-naphthol	5g	25g
B1100	(*S*)-(-)-1,1'-Bi-2-naphthol	5g	25g
B2048	(+)-4,5-Bis[hydroxy(diphenyl)methyl]-2,2-dimethyl-1,3-dioxolane	1g	5g
B1614	(-)-4,5-Bis[hydroxy(diphenyl)methyl]-2,2-dimethyl-1,3-dioxolane	1g	5g
B1615	(+)-4,5-Bis[hydroxy(diphenyl)methyl]-2-methyl-2-phenyl-1,3-dioxolane		1g

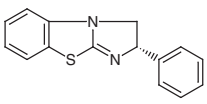
Chiral Phase-transfer Catalysts (see p.110)

Others

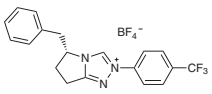
B3296



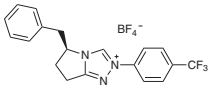
B3549



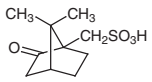
B3592



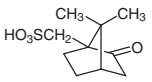
B3593



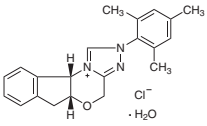
C0015



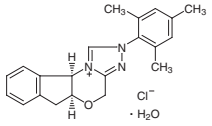
C0972



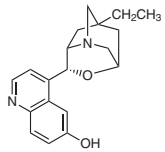
D3983



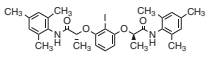
D3984



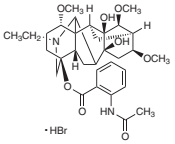
E0974



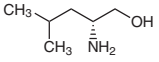
I0807



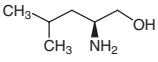
L0272



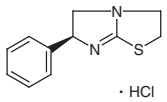
L0236



L0137



T1215



Product No.	Product Name		Unit Size	
B3296	(+)-Benzotetramisole	200mg	1g	5g
B3549	(-)-Benzotetramisole			1g
B3592	(*R*)-Benzyl-2-[4-(trifluoromethyl)phenyl]-6,7-dihydro-5*H*-pyrrolo[2,1-*c*][1,2,4]triazolium Tetrafluoroborate		200mg	1g
B3593	(*S*)-Benzyl-2-[4-(trifluoromethyl)phenyl]-6,7-dihydro-5*H*-pyrrolo[2,1-*c*][1,2,4]triazolium Tetrafluoroborate		200mg	1g

Product No.	Product Name	Unit Size		
C0015	(+)-10-Camphorsulfonic Acid	25g	100g	500g
C0972	(-)-10-Camphorsulfonic Acid		25g	500g
D3983	(+)-(5a*R*,10b*S*)-5a,10b-Dihydro-2-(2,4,6-trimethylphenyl)-4*H*,6*H*-indeno[2,1-*b*][1,2,4]-triazolo[4,3-*d*][1,4]oxazinium Chloride Monohydrate			100mg
D3984	(-)-(5a*S*,10b*R*)-5a,10b-Dihydro-2-(2,4,6-trimethylphenyl)-4*H*,6*H*-indeno[2,1-*b*][1,2,4]-triazolo[4,3-*d*][1,4]oxazinium Chloride Monohydrate			100mg
E0974	(1*R*,3*S*,5*R*,7*R*,8a*S*)-7-Ethylhexahydro-1-(6-hydroxy-4-quinolinyl)-3,7-methano-1*H*-pyrrolo[2,1-*c*][1,4]oxazine			100mg
I0807	(*R*,*R*)-2-Iodo-1,3-bis[1-(mesitylcarbamoyl)ethoxy]benzene			200mg
L0272	Lappaconitine Hydrobromide		200mg	1g
L0236	D-(-)-Leucinol		1g	5g
L0137	L-(+)-Leucinol		5mL	25mL
T1215	Levamisole Hydrochloride		10g	25g

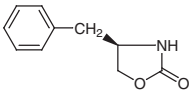
References

1) U. Eder, G. Sauer, R. Wiechert, *Angew. Chem. Int. Ed. Engl.* **1971**, *10*, 496; Z. G. Hajos, D. R. Parrish, *J. Org. Chem.* **1974**, *39*, 1615.
2) B. List, R. A. Lerner, C. F. Barbas III, *J. Am. Chem. Soc.* **2000**, *122*, 2395.
3) Review: K. N. Houk, B. List, *Acc. Chem. Res.* **2004**, *37(8)*, 487-631, "Asymmetric Organocatalysis" (special edition); H. Pellissier, *Tetrahedron* **2007**, *63*, 9267; A. Berkessel, H. Gröger, in *Asymmetric Organocatalysis — from Biomimetic Concepts to Applications in Asymmetric Synthesis*, Wiley-VCH, Weinheim, **2005**.
4) S. Nakamura, N. Hara, H. Nakashima, K. Kubo, N. Shibata, T. Toru, *Chem. Eur. J.* **2008**, *14*, 8079.

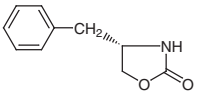
Chiral Auxiliaries

Chiral Oxazolidinones

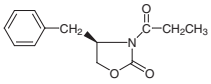
B1786



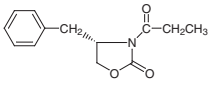
B1754



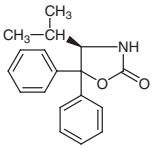
B2165



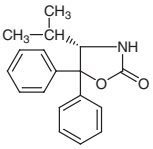
B2166



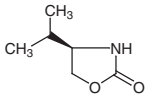
I0761



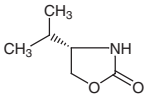
I0762



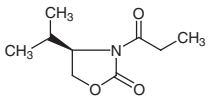
I0572



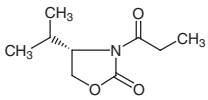
I0451



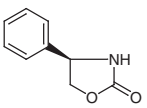
I0594



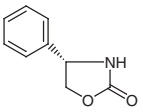
I0573



P1307



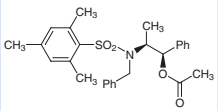
P1308



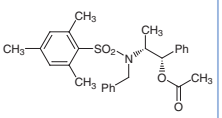
Product No.	Product Name		Unit Size	
B1786	(*R*)-4-Benzyl-2-oxazolidinone		5g	25g
B1754	(*S*)-4-Benzyl-2-oxazolidinone		5g	25g
B2165	(*R*)-(-)-4-Benzyl-3-propionyl-2-oxazolidinone	1g	5g	25g
B2166	(*S*)-(+)-4-Benzyl-3-propionyl-2-oxazolidinone		1g	5g
I0761	(4*R*)-(+)-4-Isopropyl-5,5-diphenyl-2-oxazolidinone		1g	5g
I0762	(4*S*)-(-)-4-Isopropyl-5,5-diphenyl-2-oxazolidinone		1g	5g
I0572	(*R*)-4-Isopropyl-2-oxazolidinone	1g	5g	25g
I0451	(*S*)-4-Isopropyl-2-oxazolidinone	1g	5g	25g
I0594	(*R*)-(-)-4-Isopropyl-3-propionyl-2-oxazolidinone		1g	5g
I0573	(*S*)-(+)-4-Isopropyl-3-propionyl-2-oxazolidinone		1g	5g
P1307	(*R*)-(-)-4-Phenyl-2-oxazolidinone		5g	25g
P1308	(*S*)-(+)-4-Phenyl-2-oxazolidinone		5g	25g

Others

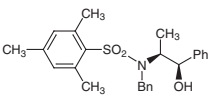
A1534



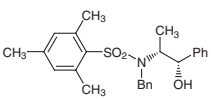
A1535



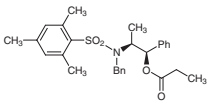
B2103



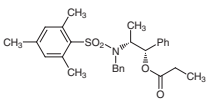
B2104



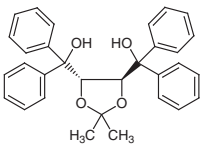
P1371



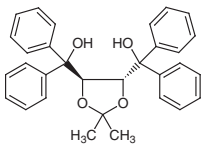
P1372



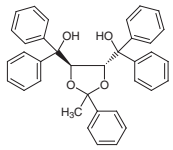
B2048



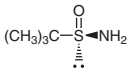
B1614



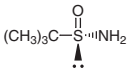
B1615



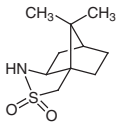
B2907



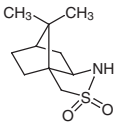
B2908



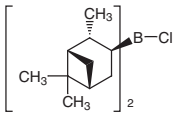
C1324



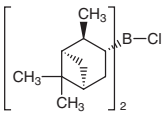
C1325



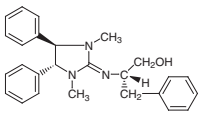
C1614



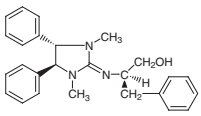
C2023
C1615



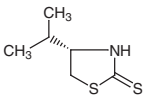
D2898



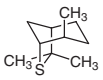
D2899



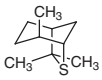
I0575



T2578



T2579

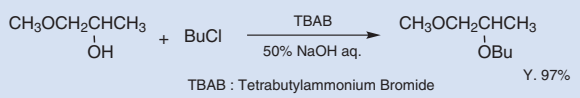


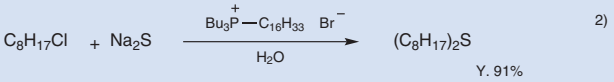
Product No.	Product Name	Unit Size	
A1534	Acetic Acid (1*R*,2*S*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenylpropyl Ester [Reagent for double aldol reaction]		1g
A1535	Acetic Acid (1*S*,2*R*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenylpropyl Ester [Reagent for double aldol reaction]		1g
B2103	(1*R*,2*S*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenyl-1-propanol	1g	5g
B2104	(1*S*,2*R*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenyl-1-propanol	1g	5g
P1371	(1*R*,2*S*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenylpropyl Propionate [Reagent for *anti*-selective asymmetric aldol reaction]		1g
P1372	(1*S*,2*R*)-2-[*N*-Benzyl-*N*-(mesitylenesulfonyl)amino]-1-phenylpropyl Propionate [Reagent for *anti*-selective asymmetric aldol reaction]		1g
B2048	(+)-4,5-Bis[hydroxy(diphenyl)methyl]-2,2-dimethyl-1,3-dioxolane	1g	5g
B1614	(-)-4,5-Bis[hydroxy(diphenyl)methyl]-2,2-dimethyl-1,3-dioxolane	1g	5g
B1615	(+)-4,5-Bis[hydroxy(diphenyl)methyl]-2-methyl-2-phenyl-1,3-dioxolane		1g
B2907	(*R*)-(+)-*tert*-Butylsulfinamide	1g	5g
B2908	(*S*)-(-)-*tert*-Butylsulfinamide	1g	5g
C1324	(+)-10,2-Camphorsultam	1g	5g
C1325	(-)-10,2-Camphorsultam	1g	5g
C1614	(+)-*B*-Chlorodiisopinocampheylborane (58% in Hexane, *ca.* 1.6mol/L)		100mL
C2023	(-)-*B*-Chlorodiisopinocampheylborane (55-65% in Heptane, *ca.* 1.7mol/L)		100mL
C1615	(-)-*B*-Chlorodiisopinocampheylborane (60% in Hexane, *ca.* 1.7mol/L)		100mL
D2898	(4*R*,5*R*)-1,3-Dimethyl-4,5-diphenyl-2-[(*S*)-1-benzyl-2-hydroxyethylimino]imidazolidine		100mg
D2899	(4*S*,5*S*)-1,3-Dimethyl-4,5-diphenyl-2-[(*R*)-1-benzyl-2-hydroxyethylimino]imidazolidine		100mg
I0575	(*S*)-4-Isopropylthiazolidine-2-thione		1g
T2578	(1*R*,4*R*,5*R*)-4,7,7-Trimethyl-6-thiabicyclo[3.2.1]octane	1g	5g
T2579	(1*S*,4*S*,5*S*)-4,7,7-Trimethyl-6-thiabicyclo[3.2.1]octane	1g	5g

Chiral Phase-transfer Catalysts

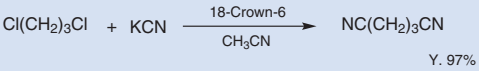
A phase-transfer catalyst enables the reaction in a heterogeneous system between general organic compounds soluble in organic solvents and compounds soluble in water such as inorganic salts. The reaction can be accomplished in a biphasic system of an inexpensive nonpolar aprotic solvent and water without using DMSO or DMF which are high-polar solvents. A phase-transfer catalyst is soluble in both solvents, and it carries anions of inorganic salts into organic solvents and returns them into the water phase. Reactions usually progress under mild conditions with easy work-up procedures. For this reason, they are also used industrially. Typical phase-transfer catalysts are quaternary ammonium salts, crown ethers, and phosphonium compounds etc. Reaction examples are shown as follows.[1-4)]

Alkylation

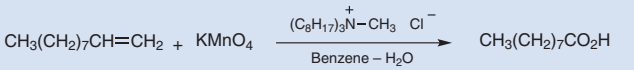




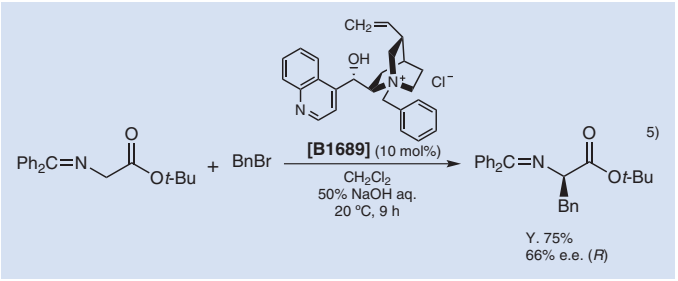
Cyanation

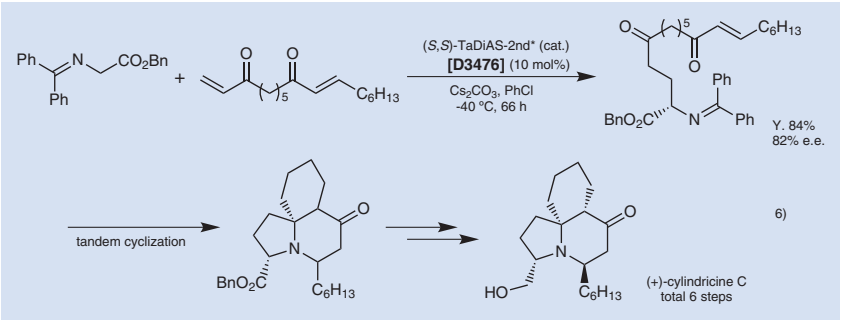


Oxidation



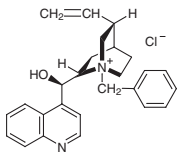
The asymmetric synthesis is realized using optically-active phase-transfer catalysts. The asymmetric synthesis using the cinchona alkaloid derivative as a phase-transfer catalyst was reported in the 1980s.[5)] Shibasaki *et al*. succeeded in the total synthesis of cylindricine C involving the asymmetric Michael addition catalyzed by tartaric acid derivatives.[6)] In this section, we introduce the cinchona alkaloid derivatives and the tartaric acid derivatives as the asymmetric phase-transfer catalysts.



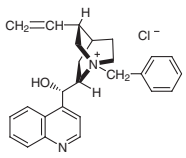


Cinchona Alkaloid Derivatives

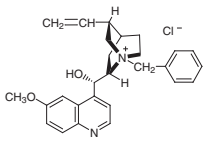
B1683



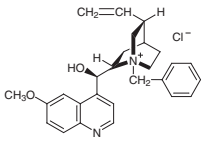
B1689



B1684



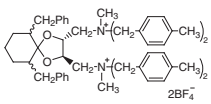
B1685



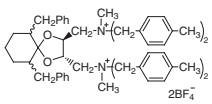
Product No.	Product Name	Unit Size
B1683	*N*-Benzylcinchonidinium Chloride	10g
B1689	*N*-Benzylcinchoninium Chloride	5g
B1684	*N*-Benzylquinidinium Chloride	5g
B1685	*N*-Benzylquininium Chloride	5g

Tartaric Acid Derivatives

D3475



D3476



Product No.	Product Name	Unit Size	
D3475	6,10-Dibenzyl-*N*,*N*'-dimethyl-*N*,*N*,*N*',*N*'-tetrakis(4-methylbenzyl)-1,4-dioxaspiro[4.5]decane-(2*R*,3*R*)-diylbis(methylammonium) Tetrafluoroborate [=(*R*,*R*)-TaDiAS-2nd]	200mg	1g
D3476	6,10-Dibenzyl-*N*,*N*'-dimethyl-*N*,*N*,*N*',*N*'-tetrakis(4-methylbenzyl)-1,4-dioxaspiro[4.5]decane-(2*S*,3*S*)-diylbis(methylammonium) Tetrafluoroborate [=(*S*,*S*)-TaDiAS-2nd]	200mg	1g

References

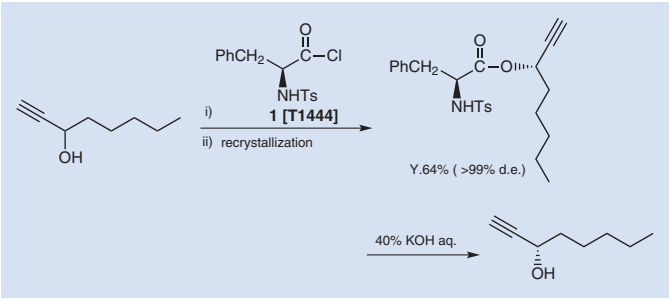
1) H. H. Freedman, R. A. Dubois, *Tetrahedron Lett*. **1975**, *16*, 3251.
2) D. Landini, F. Rolla, *Synthesis* **1974**, 565.
3) F. L. Cook, C. W. Bowers, C. L. Liotta, *J. Org. Chem*. **1974**, *39*, 3416.
4) C. M. Starks, *J. Am. Chem. Soc*. **1971**, *93*, 195.
5) M. J. O'Donnell, W. D. Bennett, S. Wu, *J. Am. Chem. Soc*. **1989**, *111*, 2353.
6) T. Shibuguchi, H. Mihara, A. Kuramochi, S. Sakuraba, T. Ohshima, M. Shibasaki, *Angew. Chem. Int. Ed*. **2006**, *45*, 4635; H. Mihara, T. Shibuguchi, A. Kuramochi, T. Ohshima, M. Shibasaki, *Heterocycles* **2007**, *72*, 421.
7) Review:
Phase-Transfer Catalysts M. Makosza, *Pure Appl. Chem*. **2000**, *72*, 1399; J. M. McIntosh, *J. Chem. Educ*. **1978**, *55*, 235; P. Varughese, *J. Chem. Educ*. **1977**, *54*, 666; G. W. Gokel, H. D. Durst, *Synthesis* **1976**, 168; A. C. Knipe, *J. Chem. Educ*. **1976**, *53*, 618; J. Dockx, *Synthesis* **1973**, 441.
Asymmertic Phase-Transfer Catalysts K. Nagasawa, *Farumashia* **2003**, *39*, 670; K. Maruoka, T. Ooi, *Chem. Rev*. **2003**, *103*, 3013.

Optical Resolving Agents

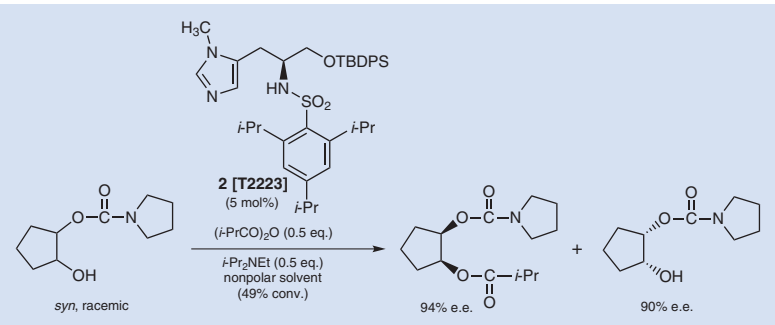
The optical resolution is the method of separating enantiomers from racemates. There are currently many methods to obtain optically active compounds. These methods include asymmetric synthesis, use of chiral building blocks, and optical resolution. In recent years, there has been rapid improvements in asymmetric synthesis, with many reports of success.

Optical resolution is widely used, as it is an easy and practical method. One of the most common optical resolution methods utilizes diastereomer which are obtained from the reaction of racemic compounds and an optical resolving agents. The differences of physical properties between diastereomers are utilized in this method. The optical resolving agents are often easily obtained from natural products. For example, alkaloids are used for the optical resolution of racemic acids and tartaric acid is used for the optical resolution of racemic bases. In both cases, diastereomeric salts are formed. When alcohols are to be resolved, the alcohols are reacted with phthalic anhydride to form half ester. The resulting carboxylic acid (half ester) is often then reacted with alkaloids to form diastereomeric salts, which are then resolved.

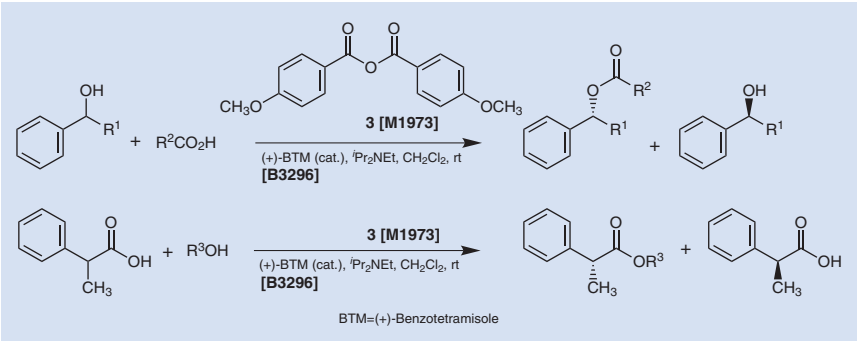
Recently, Ikegami and co-workers have reported a new resolution method for alcohols using amino acid derivatives.[1] According to their report, racemic 1-octyn-3-ol is reacted with (*S*)-*N*-*p*-toluenesulfonylphenylalanyl chloride (**1**), to produce diastereomeric ester. This diastereomeric ester is recrystallized four times from mixed solution of ethanol and hexane, giving the resolved ester with a theoretical yield of 64% (>99% d.e.). Finally, (*S*)-1-octyn-3-ol is obtained by hydrolysis of pure diastereomeric ester (>99% e.e.). This method is drawing attention as an easy and accurate way to optically resolve alcohols.



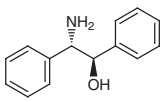
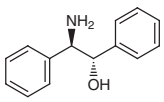
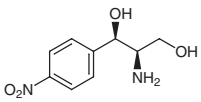
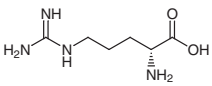
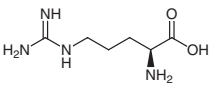
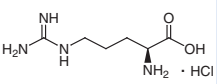
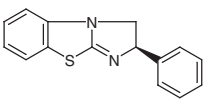
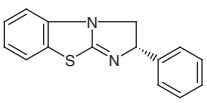
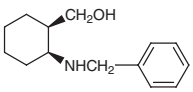
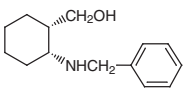
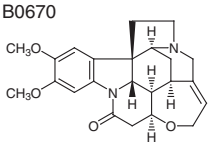
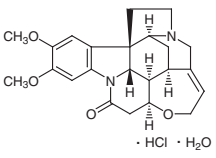
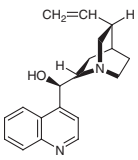
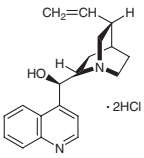
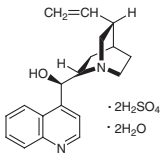
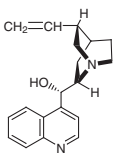
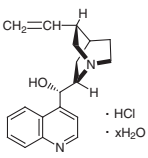
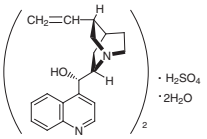
On the other hand, it has been reported that optical resolution is achieved by catalytic amount of chiral source. Ishihara and co-workers have studied minimal artificial enzymes to overcome various problems of enzymatic reactions and to use optical resolution. One reagent that has been developed is N^{α}-(2,4,6-triisopropylbenzenesulfonyl)-*O*-(*tert*-butyldimethylsilyl)-π-methyl-L-histidinol (**2**). They reported that this reagent was a very effective catalyst for kinetic resolution of racemic alcohols by selective acylation[2]. This reagent can also be used as catalyst for the kinetic resolution of 1,2-diols, β-hydroxycarboxylic acids, and 2-amino alcohols after the suitable derivatization.

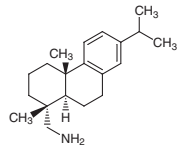


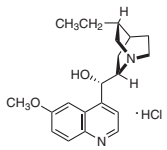
Shiina and co-workers developed the kinetic resolution of racemic alcohols and racemic carboxylic acids using 4-methoxybenzoic anhydride (PMBA) (**3**) and a Birman-type asymmetric catalyst[3] [(+)-benzotetramisole, (+)-BTM].[4] For example, in the reaction of racemic alcohols with achiral carboxylic acids, first the mixed anhydrides are formed from PMBA and the carboxylic acids. Subsequently the mixed anhydrides and one enantiomer of racemic alcohol react preferentially to form optically active esters and optically active alcohols using catalyst (+)-BTM. If this reaction is performed replacing the reactive substrates with racemic carboxylic acids and achiral alcohols, the kinetic resolution proceeds efficiently and optically active esters and optically active carboxylic acids can be obtained. The optical resolution of an anti-inflammatory agent, ibuprofen, has been achieved as an example of this reaction.

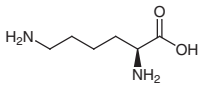


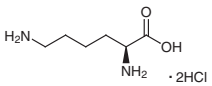
for Resolution of Acids

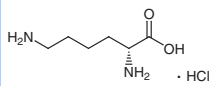
		A1230 	A1231 	A1017 
A1029 	A0526 	A0528 	B3296 	B3549 
B1119 	B1118 	B0946 B0670 	B0671 	C0347 
C0348 	C0349 	C0350 	C0351 	C0791 

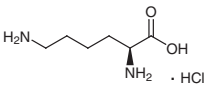
D1588


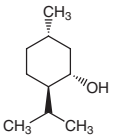
H0752


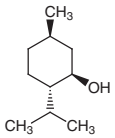
L0129


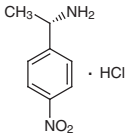
L0131


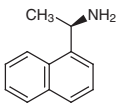
L0128


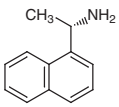
L0071


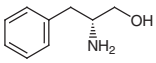
M0826


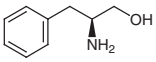
M0545


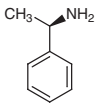
N0543


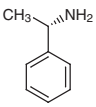
N0482


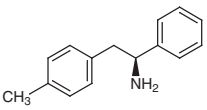
N0481


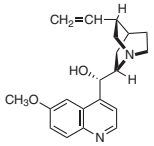
P1289


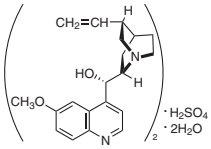
P1028


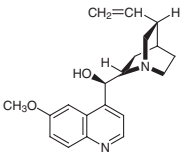
P0794


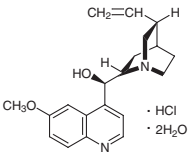
P0793


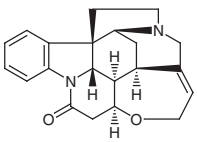
P1118


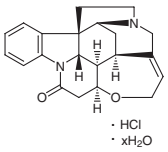
Q0006


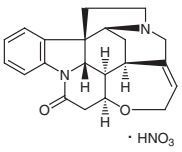
Q0010


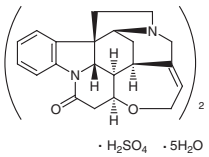
Q0028


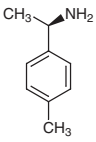
Q0030


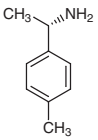
S0249


S0257


S0093


S0094


T1380


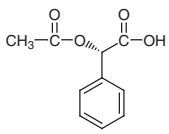
T1381


Product No.	Product Name			Unit Size
A1230	(1*R*,2*S*)-(-)-2-Amino-1,2-diphenylethanol		1g	5g
A1231	(1*S*,2*R*)-(+)-2-Amino-1,2-diphenylethanol		1g	5g
A1017	D-(-)-*threo*-2-Amino-1-(4-nitrophenyl)-1,3-propanediol		25g	500g
A1029	D-(-)-Arginine		1g	5g
A0526	L-(+)-Arginine	25g	100g	500g
A0528	L-(+)-Arginine Hydrochloride		25g	500g
B3296	(+)-Benzotetramisole	200mg	1g	5g
B3549	(-)-Benzotetramisole			1g
B1119	(+)-*cis*-2-Benzylaminocyclohexanemethanol		1g	5g
B1118	(-)-*cis*-2-Benzylaminocyclohexanemethanol		1g	5g
B0946	Brucine Anhydrous			25g
B0670	Brucine Hydrate			25g
B0671	Brucine Hydrochloride Monohydrate			5g
C0347	Cinchonidine		25g	250g

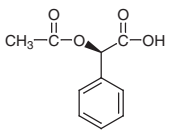
Product No.	Product Name	Unit Size		
C0348	Cinchonidine Dihydrochloride			25g
C0349	Cinchonidine Sulfate Dihydrate			25g
C0350	Cinchonine		25g	200g
C0351	Cinchonine Hydrochloride Hydrate			25g
C0791	Cinchonine Sulfate Dihydrate			25g
D1588	(+)-Dehydroabietylamine		5g	25g
H0752	Hydroquinidine Hydrochloride		25g	250g
L0129	L-(+)-Lysine		5g	25g
L0131	L-(+)-Lysine Dihydrochloride			25g
L0128	D-(-)-Lysine Monohydrochloride		5g	25g
L0071	L-(+)-Lysine Monohydrochloride		25g	500g
M0826	(+)-Menthol		25g	500g
M0545	(-)-Menthol	25g	100g	500g
N0543	(*S*)-α-Methyl-4-nitrobenzylamine Hydrochloride			1g
N0482	(*R*)-(+)-1-(1-Naphthyl)ethylamine		1g	5g
N0481	(*S*)-(-)-1-(1-Naphthyl)ethylamine		1g	5g
P1289	D-Phenylalaninol		5g	25g
P1028	L-Phenylalaninol		5g	25g
P0794	(*R*)-(+)-1-Phenylethylamine	25mL	100mL	500mL
P0793	(*S*)-(-)-1-Phenylethylamine	25mL	100mL	500mL
P1118	(*S*)-1-Phenyl-2-(*p*-tolyl)ethylamine		5g	25g
Q0006	Quinidine		5g	25g
Q0010	Quinidine Sulfate Dihydrate		5g	25g
Q0028	Quinine		25g	100g
Q0030	Quinine Hydrochloride Dihydrate			25g
S0249	Strychnine			25g
S0257	Strychnine Hydrochloride Hydrate			25g
S0093	Strychnine Nitrate			25g
S0094	Strychnine Sulfate Pentahydrate			25g
T1380	(*R*)-(+)-1-(*p*-Tolyl)ethylamine			1mL
T1381	(*S*)-(-)-1-(*p*-Tolyl)ethylamine		1mL	5mL

for Resolution of Bases

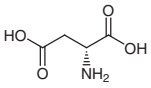
A1454



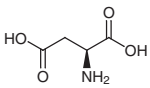
A1453



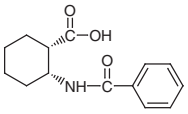
A0545



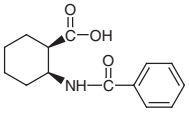
A0546



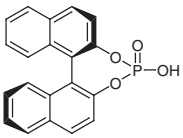
B1121



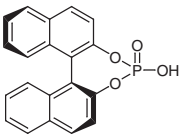
B1120



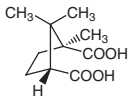
B1143



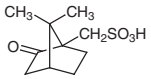
B1144



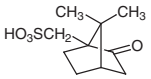
C0012



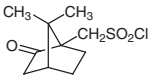
C0015



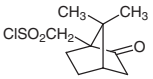
C0972



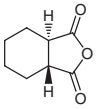
C0998



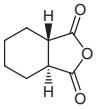
C1308



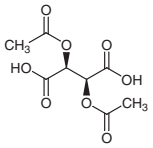
C1417



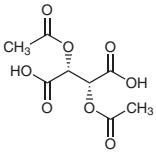
C1418



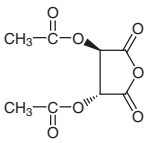
D2636

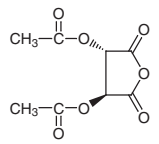


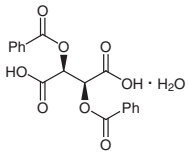
D1386

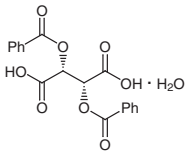


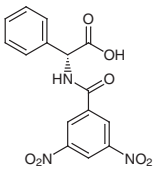
D1911

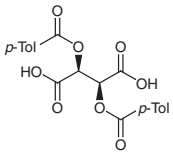


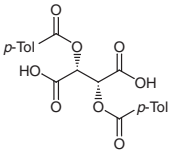
D2645


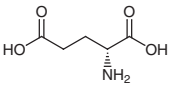
D1398
D3826


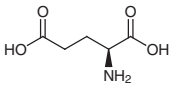
D1354
D3492


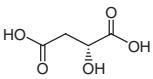
D1853


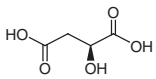
D1417


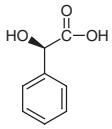
D1387


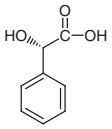
G0057


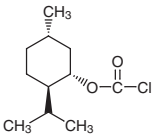
G0059


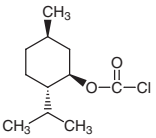
M0021


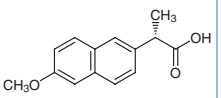
M0022


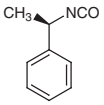
M0662


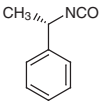
M0661


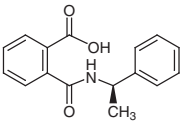
M1221


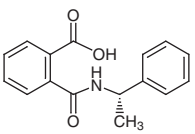
M0990


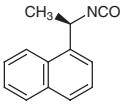
M1021


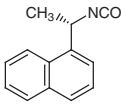
I0334


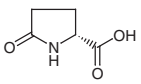
I0335


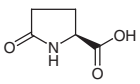
M1622


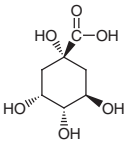
M0824


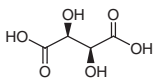
I0336


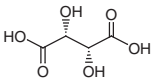
I0398


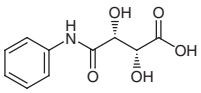
P1354


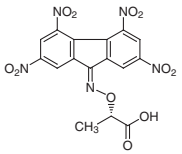
P0573


Q0009


T0026


T0025


T1702


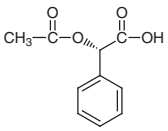
T1163


Product No.	Product Name	Unit Size		
A1454	(+)-*O*-Acetyl-L-mandelic Acid			5g 25g
A1453	(-)-*O*-Acetyl-D-mandelic Acid			5g 25g
A0545	D-Aspartic Acid			25g
A0546	L-Aspartic Acid			25g 500g
B1121	(+)-*cis*-2-Benzamidocyclohexanecarboxylic Acid			5g
B1120	(-)-*cis*-2-Benzamidocyclohexanecarboxylic Acid			5g
B1143	(*R*)-(-)-1,1'-Binaphthyl-2,2'-diyl Hydrogen Phosphate	100mg	1g	5g
B1144	(*S*)-(+)-1,1'-Binaphthyl-2,2'-diyl Hydrogen Phosphate		100mg	1g
C0012	(+)-Camphoric Acid		25g	100g
C0015	(+)-10-Camphorsulfonic Acid	25g	100g	500g
C0972	(-)-10-Camphorsulfonic Acid		25g	500g
C0998	(+)-10-Camphorsulfonyl Chloride		10g	25g
C1308	(-)-10-Camphorsulfonyl Chloride		5g	25g
C1417	(+)-*trans*-1,2-Cyclohexanedicarboxylic Anhydride		100mg	1g

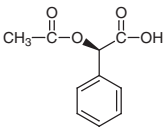
Product No.	Product Name	Unit Size		
C1418	(-)-*trans*-1,2-Cyclohexanedicarboxylic Anhydride	100mg	1g	
D2636	(+)-Diacetyl-D-tartaric Acid		5g	
D1386	(-)-Diacetyl-L-tartaric Acid		25g	
D1911	(+)-Diacetyl-L-tartaric Anhydride		25g	
D2645	(-)-Diacetyl-D-tartaric Anhydride	5g	25g	
D1398	(+)-Dibenzoyl-D-tartaric Acid Monohydrate	25g	500g	
D3826	(+)-Dibenzoyl-D-tartaric Acid	25g	250g	
D1354	(-)-Dibenzoyl-L-tartaric Acid Monohydrate	25g	500g	
D3492	(-)-Dibenzoyl-L-tartaric Acid	25g	250g	
D1853	(*R*)-(-)-*N*-(3,5-Dinitrobenzoyl)-*α*-phenylglycine	1g	5g	
D1417	(+)-Di-*p*-toluoyl-D-tartaric Acid	25g	250g	
D1387	(-)-Di-*p*-toluoyl-L-tartaric Acid	25g	250g	
G0057	D-Glutamic Acid	25g	250g	
G0059	L-Glutamic Acid	25g	500g	
M0021	D-(+)-Malic Acid	5g	25g	
M0022	L-(-)-Malic Acid	25g	100g	500g
M0662	D-(-)-Mandelic Acid	25g	100g	500g
M0661	L-(+)-Mandelic Acid	25g	250g	
M1221	(+)-Menthyl Chloroformate	5mL	25mL	
M0990	(-)-Menthyl Chloroformate	5mL	25mL	
M1021	(*S*)-(+)-2-(6-Methoxy-2-naphthyl)propionic Acid	25g	500g	
I0334	(*R*)-(+)-*α*-Methylbenzyl Isocyanate	1g	5g	25g
I0335	(*S*)-(-)-*α*-Methylbenzyl Isocyanate	1g	5g	
M1622	(*R*)-(+)-*N*-(*α*-Methylbenzyl)phthalamic Acid	1g	5g	
M0824	(*S*)-(-)-*N*-(*α*-Methylbenzyl)phthalamic Acid		1g	
I0336	(*R*)-(-)-1-(1-Naphthyl)ethyl Isocyanate	1g	5g	
I0398	(*S*)-(+)-1-(1-Naphthyl)ethyl Isocyanate	1g	5g	
P1354	D-Pyroglutamic Acid	5g	25g	
P0573	L-Pyroglutamic Acid	25g	500g	
Q0009	D-(-)-Quinic Acid	5g	25g	
T0026	D-(-)-Tartaric Acid	25g	500g	
T0025	L-(+)-Tartaric Acid	25g	500g	
T1702	(2*R*,3*R*)-Tartranilic Acid	1g	5g	
T1163	(+)-*α*-(2,4,5,7-Tetranitro-9-fluorenylideneaminoxy)propionic Acid		1g	

for Resolution of Alcohols & Thiols

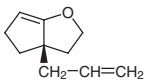
A1454



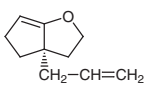
A1453



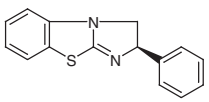
A2128



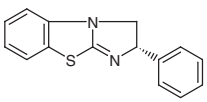
A1984



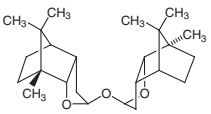
B3296



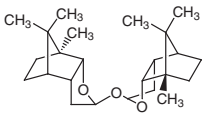
B3549



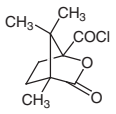
B1219



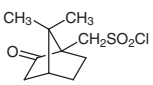
B1220



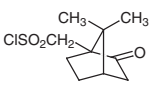
C1022



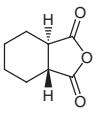
C0998



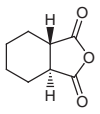
C1308

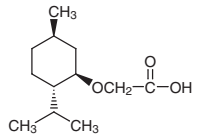
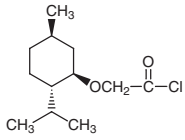
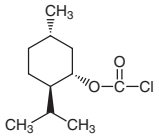
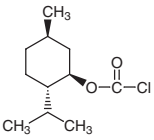
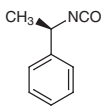
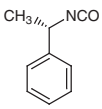
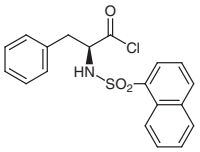
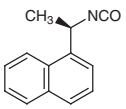
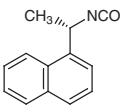
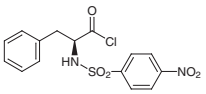
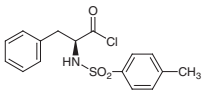
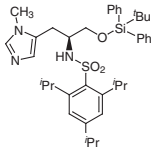


C1417



C1418



M0573 	M0571 	M1221 	M0990 	I0334 
I0335 	N0581 	I0336 	I0398 	N0582 
T1444 	T2223 			

Product No.	Product Name			Unit Size
A1454	(+)-*O*-Acetyl-L-mandelic Acid		5g	25g
A1453	(-)-*O*-Acetyl-D-mandelic Acid		5g	25g
A2128	(*R*)-5-Allyl-2-oxabicyclo[3.3.0]oct-8-ene		1g	5g
A1984	(*S*)-5-Allyl-2-oxabicyclo[3.3.0]oct-8-ene			1g
B3296	(+)-Benzotetramisole	200mg	1g	5g
B3549	(-)-Benzotetramisole			1g
B1219	Bis[(2*R*,3a*S*,4*R*,7a*S*)-octahydro-7,8,8-trimethyl-4,7-methanobenzofuran-2-yl] Ether			100mg
B1220	Bis[(2*S*,3a*R*,4*S*,7a*R*)-octahydro-7,8,8-trimethyl-4,7-methanobenzofuran-2-yl] Ether			100mg
C1022	(-)-Camphanic Chloride	1g	5g	25g
C0998	(+)-10-Camphorsulfonyl Chloride		10g	25g
C1308	(-)-10-Camphorsulfonyl Chloride		5g	25g
C1417	(+)-*trans*-1,2-Cyclohexanedicarboxylic Anhydride		100mg	1g
C1418	(-)-*trans*-1,2-Cyclohexanedicarboxylic Anhydride		100mg	1g
M0573	(-)-Menthoxyacetic Acid		5g	25g
M0571	(-)-Menthoxyacetyl Chloride			10g
M1221	(+)-Menthyl Chloroformate		5mL	25mL
M0990	(-)-Menthyl Chloroformate		5mL	25mL
I0334	(*R*)-(+)-*α*-Methylbenzyl Isocyanate	1g	5g	25g
I0335	(*S*)-(-)-*α*-Methylbenzyl Isocyanate		1g	5g
N0581	*N*-(1-Naphthalenesulfonyl)-L-phenylalanyl Chloride			5g
I0336	(*R*)-(-)-1-(1-Naphthyl)ethyl Isocyanate		1g	5g
I0398	(*S*)-(+)-1-(1-Naphthyl)ethyl Isocyanate		1g	5g
N0582	*N*-(4-Nitrophenylsulfonyl)-L-phenylalanyl Chloride			5g
T1444	*N*-(*p*-Toluenesulfonyl)-L-phenylalanyl Chloride			5g
T2223	N^{α}-(2,4,6-Triisopropylbenzenesulfonyl)-*O*-(*tert*-butyldiphenylsilyl)-*π*-methyl-L-histidinol			100mg

References

1) S. Hashimoto, S. Kase, A. Suzuki, Y. Yanagiya, S. Ikegami, *Synth. Commun*. **1991**, *21*, 833; Tokyo Kasei Kogyo Co., Ltd., Jpn. Kokai Tokkyo Koho 04 273835, **1992**.
2) K. Ishihara, Y. Kosugi, M. Akakura, *J. Am. Chem. Soc*. **2004**, *126*, 12212.
3) V. B. Birman, X. Li, *Org. Lett*. **2006**, *8*, 1351.
4) I. Shiina, K. Nakata, *Tetrahedron Lett*. **2007**, 48, 8314; I. Shiina, K. Nakata, Y. Onda, *Eur. J. Org. Chem*. **2008**, 5887.

Protection & Derivatization

In organic synthesis, when a reaction is to be carried out selectively at one functional group of a multifunctional compound, other reactive functional groups must be converted into inactive functional groups and protected temporarily. Therefore, appropriate use of protecting agents is very important to the synthetic strategy. Useful protecting agents must have properties as follows:

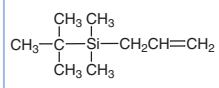
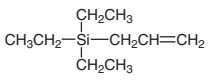
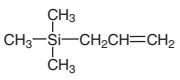
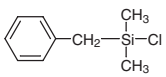
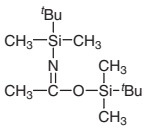
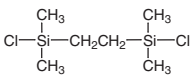
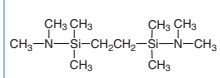
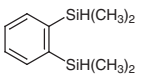
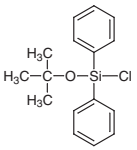
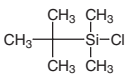
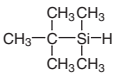
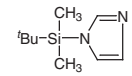
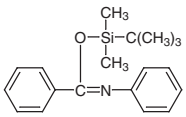
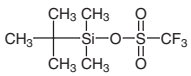
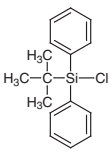
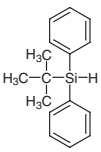
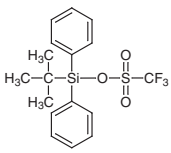
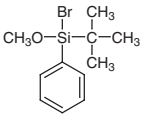
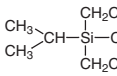
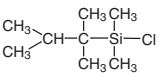
- The protecting agents must selectively react with the desired functional group requiring protection.
- The protecting groups must be introduced in high yields without any side reactions.
- The protected functional groups should be stable under various reaction conditions.
- The protecting groups must be chemoselectively deprotected under specific conditions without deprotection of other kinds of protecting groups.

Especially in the synthesis of structurally complex compounds, designing the synthetic strategies such as selection of protecting groups and the efficient deprotection process are key steps to achieve. It is expected that a wide variety of protecting agents are available.

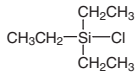
The following shows various kinds of protecting agents available for purchase. They are classified from the viewpoint of deprotection conditions. Please make use of this list for your study of organic synthesis.

●Silylation

Silyl groups are the most commonly used protecting groups to protect hydroxy groups, and also used for the protection of carboxyl groups and amino groups. TMS and TES groups are commonly used as general protecting groups, while TIPS, TBS (TBDMS) and TBDPS groups are used for introducing bulky substituents. Silyl protecting groups are usually deprotected by acid or fluoride ion mediated hydrolysis.

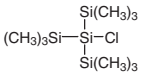
A2298 	A2299 	A0729 	B2334 	B1906 
B1688 	B1773 	B1699 	B1436 	B0995 
B3565 	B1043 	B2697 	T1525 	B1223 
B3566 	B2898 	B1663 	D2262 	T2116 

T0589

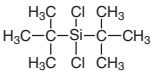


C0306

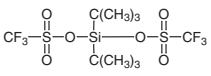
C2411



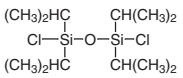
D2469



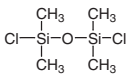
D3135



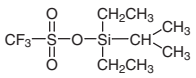
D1608



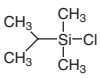
D2334



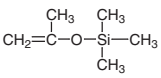
T1468



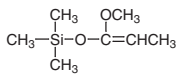
D1594



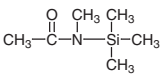
I0324



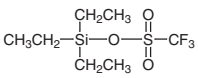
M1199



M0536

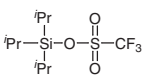


T1689

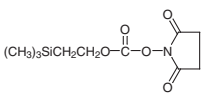


T1078

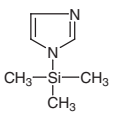
T1588



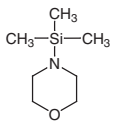
T2591



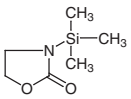
T0585



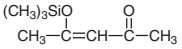
T1277



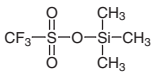
T1535



T1573



T0871



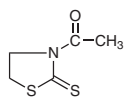
Product No.	Product Name	Unit Size		
A2298	Allyl(*tert*-butyl)dimethylsilane			5g
A2299	Allyltriethylsilane			5g
A0729	Allyltrimethylsilane		25mL	250mL
B2334	Benzylchlorodimethylsilane			5g
B1906	*N,O*-Bis(*tert*-butyldimethylsilyl)acetamide			5g
B1688	1,2-Bis(chlorodimethylsilyl)ethane		5g	25g
B1773	1,2-Bis[(dimethylamino)dimethylsilyl]ethane			5g
B1699	1,2-Bis(dimethylsilyl)benzene			5mL
B1436	*tert*-Butoxydiphenylchlorosilane (stabilized with $CaCO_3$)		5mL	25mL
B0995	*tert*-Butyldimethylchlorosilane	5g	25g	100g
B3565	*tert*-Butyldimethylsilane			5g
B1043	1-(*tert*-Butyldimethylsilyl)imidazole		1g	5g
B2697	*tert*-Butyldimethylsilyl *N*-Phenylbenzimidate			5g
T1525	*tert*-Butyldimethylsilyl Trifluoromethanesulfonate		5g	25g
B1223	*tert*-Butyldiphenylchlorosilane	5mL	25mL	100mL
B3566	*tert*-Butyldiphenylsilane			5g
B2898	*tert*-Butyldiphenylsilyl Trifluoromethanesulfonate		1g	5g
B1663	*tert*-Butylmethoxyphenylsilyl Bromide			1g
D2262	Chlorodiethylisopropylsilane		1g	5g
T2116	Chloro(dimethyl)thexylsilane		5g	25g
T0589	Chlorotriethylsilane	5g	25g	100g
C0306	Chlorotrimethylsilane	25mL	100mL	500mL
C2411	Chlorotris(trimethylsilyl)silane			5g
D2469	Di-*tert*-butyldichlorosilane			5g

Product No.	Product Name	Unit Size		
D3135	Di-*tert*-butylsilyl Bis(trifluoromethanesulfonate)		1g	5g
D1608	1,3-Dichloro-1,1,3,3-tetraisopropyldisiloxane		5g	25g
D2334	1,3-Dichloro-1,1,3,3-tetramethyldisiloxane		5g	25g
T1468	Diethylisopropylsilyl Trifluoromethanesulfonate		1g	5g
D1594	Dimethylisopropylchlorosilane		5mL	25mL
I0324	Isopropenyloxytrimethylsilane			5mL
M1199	1-Methoxy-1-trimethylsilyloxypropene		1g	5g
M0536	*N*-Methyl-*N*-trimethylsilylacetamide		10g	25g
T1689	Triethylsilyl Trifluoromethanesulfonate		5g	25g
T1078	Triisopropylsilyl Chloride	5mL	25mL	250mL
T1588	Triisopropylsilyl Trifluoromethanesulfonate		5g	25g
T2591	*N*-[2-(Trimethylsilyl)ethoxycarbonyloxy]succinimide		1g	5g
T0585	*N*-Trimethylsilylimidazole		25g	100g
T1277	*N*-(Trimethylsilyl)morpholine		5mL	25mL
T1535	3-Trimethylsilyl-2-oxazolidinone			5g
T1573	4-Trimethylsilyloxy-3-penten-2-one			25mL
T0871	Trimethylsilyl Trifluoromethanesulfonate	5g	25g	250g

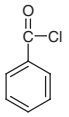
●Acylation

Acyl protecting groups are used for the protection of hydroxy groups and amino groups. Acetyl (Ac), benzoyl (Bz), and pivaloyl (Piv) groups are commonly used. Pivaloyl group can selectively protect less sterically-hindered hydroxy groups due to its steric-hindrance. Generally, it is stable under acidic conditions and oxidative conditions. Acyl protecting groups are deprotected under basic conditions or reductive conditions (DIBAL, LAH, etc.).

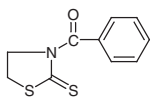
A2301



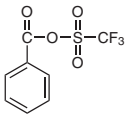
B0105



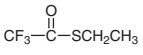
B3571



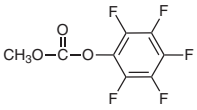
B3567



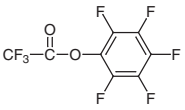
T0872



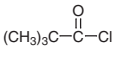
M2594



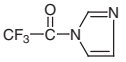
P1894



P0677



T0670

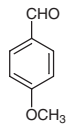
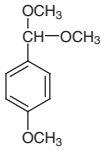
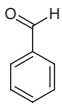
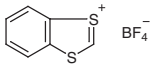
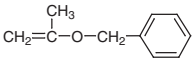
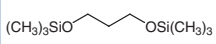
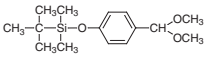
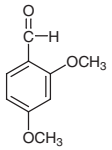
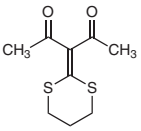
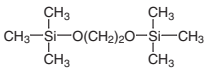
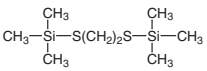
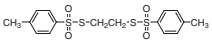
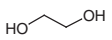
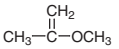
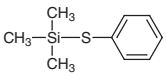
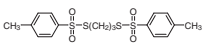


Product No.	Product Name	Unit Size	
A2301	3-Acetylthiazolidine-2-thione		5g
B0105	Benzoyl Chloride	25mL	500mL
B3571	3-Benzoylthiazolidine-2-thione	1g	5g
B3567	Benzoyl Trifluoromethanesulfonate		5g
T0872	*S*-Ethyl Trifluorothioacetate		5mL
M2594	Methyl Pentafluorophenyl Carbonate		1g
P1894	Pentafluorophenyl Trifluoroacetate	5g	25g
P0677	Pivaloyl Chloride	25mL	500mL
T0670	1-(Trifluoroacetyl)imidazole	5g	25g

●Acetalization & Thioacetalization

Acetals and thioacetals are used for the protection of hydroxy groups and thiol groups, the same as for carbonyl groups of aldehydes and ketones. The protecting groups are introduced by the reaction of alcohols or thiols with carbonyl compounds under acidic conditions. Acetals are stable under basic conditions and reductive conditions, and are inert against nucleophiles such as organometallic reagents. The deprotections are carried out by hydrolysis under acidic conditions. Thioacetals are usually stable in both acidic and basic aqueous solutions, and deprotected by hydrolysis with the assist of mercury salts.

In addition, it is known that dithiotosylates can be used for converting active methylene compounds into cyclic dithioacetals and the given cyclic dithioacetals are further transformed into carbonyl groups by hydrolysis. Also, the starting methylene groups are given by reductive desulfurization.[1,2)]

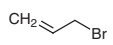
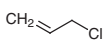
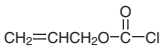
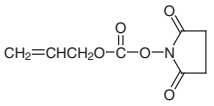
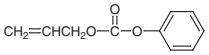
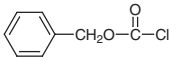
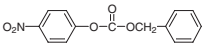
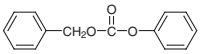
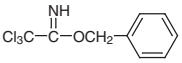
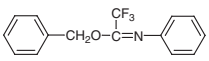
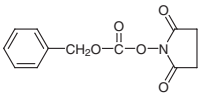
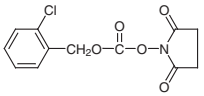
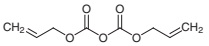
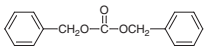
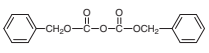
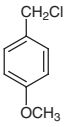
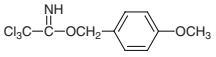
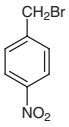
A0480 	A1247 	B2379 	B1151 	B1257 
B3563 	B3577 	D0555 	D0626 	D4208 
E0478 	E0479 	E0471 	E0105 	I0303 
P1378 	P0763 	D2390 		

Product No.	Product Name	Unit Size
A0480	*p*-Anisaldehyde	25mL 500mL
A1247	*p*-Anisaldehyde Dimethyl Acetal	25mL 500mL
B2379	Benzaldehyde	500g
B1151	1,3-Benzodithiolylium Tetrafluoroborate	5g
B1257	Benzyl Isopropenyl Ether	1mL 5mL
B3563	1,3-Bis(trimethylsilyloxy)propane	5g 25g
B3577	*tert*-Butyl[4-(dimethoxymethyl)phenoxy]dimethylsilane	5g
D0555	3,4-Dihydro-2*H*-pyran	25mL 100mL 500mL
D0626	2,4-Dimethoxybenzaldehyde	25g 500g
D4208	3-(1,3-Dithian-2-ylidene)-2,4-pentanedione	1g 5g
E0478	Ethylenedioxybis(trimethylsilane)	25g
E0479	Ethylenedithiobis(trimethylsilane)	5g
E0471	Ethylene Di(thiotosylate) [Protecting Reagent for Active Methylene]	5g 25g
E0105	Ethylene Glycol	25g 500g

Product No.	Product Name	Unit Size	
I0303	2-Methoxypropene	25mL	500mL
P1378	(Phenylthio)trimethylsilane	5g	25g
P0763	1,3-Propanedithiol	25mL	100mL
D2390	Trimethylene Di(thiotosylate) [Protecting Reagent for Active Methylene]	5g	25g

●Allyloxycarbonyl, Benzyloxycarbonyl, Benzyl & Allylation

Allyloxycarbonyl (Alloc), benzyloxycarbonyl (Cbz), benzyl (Bn) and allyl groups are commonly used for the protection of amino groups. These protecting groups are generally deprotected by palladium catalysts.

B0643 	C0274 	A1268 	A2302 	A2303 
B0411 	B0412 	C0176 B3021 	C1591 	B3574 
B1483 	B3234 	C1124 	C1131 	P1277 
C1600 	P1281 	M0676 	M2016 	N0181 

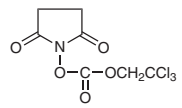
Product No.	Product Name		Unit Size	
B0643	Allyl Bromide		25g	500g
C0274	Allyl Chloride		25mL	500mL
A1268	Allyl Chloroformate		25g	500g
A2302	*N*-(Allyloxycarbonyloxy)succinimide		5g	25g
A2303	Allyl Phenyl Carbonate		5g	25g
B0411	Benzyl Bromide (stabilized with Propylene Oxide)	25g	100g	500g
B0412	Benzyl Chloride (stabilized with ε-Caprolactam)		25g	500g
C0176	Benzyl Chloroformate (30-35% in Toluene)		25mL	500mL
B3021	Benzyl Chloroformate		25g	250g
C1591	Benzyl 4-Nitrophenyl Carbonate			5g
B3574	Benzyl Phenyl Carbonate		5g	25g
B1483	Benzyl 2,2,2-Trichloroacetimidate			25g
B3234	Benzyl 2,2,2-Trifluoro-*N*-phenylacetimidate		1g	5g
C1124	*N*-Carbobenzoxyoxysuccinimide		25g	250g

Product No.	Product Name	Unit Size
C1131	*N*-(2-Chlorobenzyloxycarbonyloxy)succinimide	10g
P1277	Diallyl Dicarbonate	1g 5g
C1600	Dibenzyl Carbonate	1g 5g
P1281	Dibenzyl Dicarbonate	5g 25g
M0676	4-Methoxybenzyl Chloride (stabilized with Amylene)	25mL
M2016	4-Methoxybenzyl 2,2,2-Trichloroacetimidate	5g
N0181	4-Nitrobenzyl Bromide	25g 500g

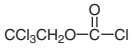
●2,2,2-Trichloroethoxycarbonylation

2,2,2-Trichloroethoxycarbonyl (Troc) group is used as a protecting group for hydroxy groups and amino groups. Troc group is generally deprotected by the treatment with zinc powder or by electrolysis.

T2713



C0795

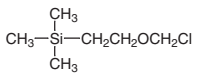


Product No.	Product Name	Unit Size
T2713	*N*-(2,2,2-Trichloroethoxycarbonyloxy)succinimide	5g
C0795	2,2,2-Trichloroethyl Chloroformate	25g 250g

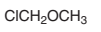
●Methoxymethylation

Methoxymethyl (MOM) group is generally used for the protection of hydroxy groups. They are stable against bases and reducing agents because of their acetal structure. MOM group is deprotected by acid catalyzed hydrolysis.

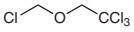
C1339



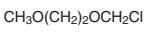
C0202



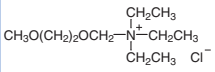
C2412



M0680



M0681

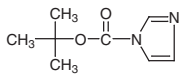


Product No.	Product Name	Unit Size
C1339	2-(Chloromethoxy)ethyltrimethylsilane (stabilized with Diisopropylethylamine)	5mL 25mL
C0202	Chloromethyl Methyl Ether	25g 100g 500g
C2412	Chloromethyl 2,2,2-Trichloroethyl Ether	5g
M0680	2-Methoxyethoxymethyl Chloride	25mL 500mL
M0681	(2-Methoxyethoxymethyl)triethylammonium Chloride	5g

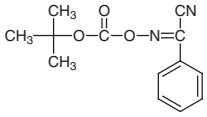
●*tert*-Butoxycarbonylation

tert-Butoxycarbonyl (Boc) group is one of the most commonly used protective groups for amino groups in peptide synthesis. It is also used for the protection of hydroxy groups. It is stable under basic hydrolysis conditions and catalytic reduction conditions, and is inert against various nucleophiles. It is deprotected under acidic conditions commonly with trifluoroacetic acid.

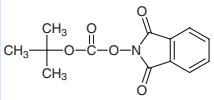
B0916



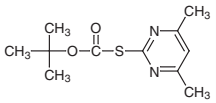
B0988



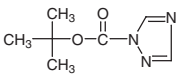
C1573



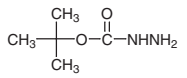
B1089



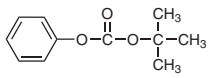
B1969



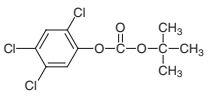
C0933



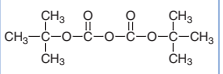
B3590



C1574



D3878
D3879
D3880
D1547

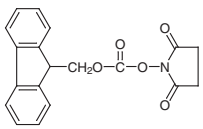


Product No.	Product Name	Unit Size		
B0916	*N*-*tert*-Butoxycarbonylimidazole			10g
B0988	2-(*tert*-Butoxycarbonyloxyimino)-2-phenylacetonitrile		5g	25g
C1573	*N*-(*tert*-Butoxycarbonyloxy)phthalimide			5g
B1089	2-(*tert*-Butoxycarbonylthio)-4,6-dimethylpyrimidine		5g	25g
B1969	1-*tert*-Butoxycarbonyl-1,2,4-triazole		5g	25g
C0933	*tert*-Butyl Carbazate		25g	250g
B3590	*tert*-Butyl Phenyl Carbonate		5g	25g
C1574	*tert*-Butyl 2,4,5-Trichlorophenyl Carbonate			5g
D3878	Di-*tert*-butyl Dicarbonate (*ca.* 30% in Dioxane)		100g	500g
D3879	Di-*tert*-butyl Dicarbonate (*ca.* 30% in Tetrahydrofuran)		100mL	500mL
D3880	Di-*tert*-butyl Dicarbonate (*ca.* 30% in Toluene)		100g	500g
D1547	Di-*tert*-butyl Dicarbonate	25g	100g	500g

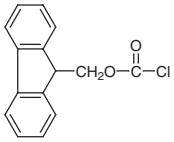
●9-Fluorenylmethyloxycarbonylation

9-Fluorenylmethyloxycarbonyl (Fmoc) group is one of the most commonly used protecting groups for amino groups in solid phase peptide synthesis as well as the Boc group. It is readily deprotected by secondary amines such as piperidine while it is stable under acidic conditions. Therefore, when a molecule contains the Fmoc group and the Boc group, only the Boc group can be selectively removed under acidic conditions.

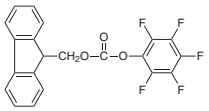
F0239



F0197



F0936

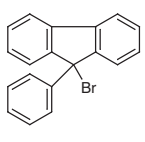


Product No.	Product Name	Unit Size		
F0239	*N*-[(9*H*-Fluoren-9-ylmethoxy)carbonyloxy]succinimide		5g	25g
F0197	9-Fluorenylmethyl Chloroformate	5g	25g	100g
F0936	9-Fluorenylmethyl Pentafluorophenyl Carbonate		1g	5g

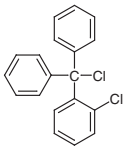
●Tritylation

Trityl (Tr) groups are mainly used for the protection of hydroxy groups. They can selectively protect less sterically-hindered substrates due to their steric-hindrance. They are relatively stable against bases, oxidizing agents, reducing agents and nucleophiles, and the deprotection is carried out under acidic hydrolysis conditions.

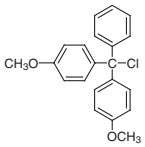
B1702



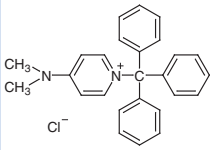
D2504



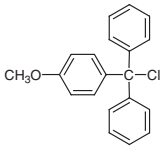
D1612



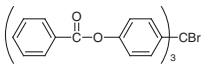
D2915



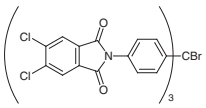
M0790



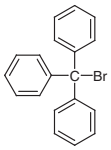
T1071



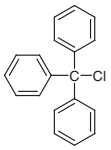
T1526



T0512



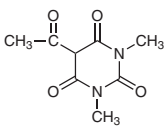
C0308



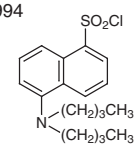
Product No.	Product Name	Unit Size		
B1702	9-Bromo-9-phenylfluorene		5g	25g
D2504	2-Chlorotrityl Chloride			25g
D1612	4,4'-Dimethoxytrityl Chloride		5g	25g
D2915	4-(Dimethylamino)-1-(triphenylmethyl)pyridinium Chloride			5g
M0790	4-Methoxytrityl Chloride		25g	250g
T1071	4,4',4"-Tris(benzoyloxy)trityl Bromide		5g	25g
T1526	4,4',4"-Tris(4,5-dichlorophthalimido)trityl Bromide			1g
T0512	Trityl Bromide		25g	100g
C0308	Trityl Chloride	25g	100g	500g

●Others

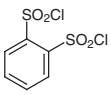
A2555



B1122
B0994

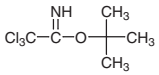


B1128

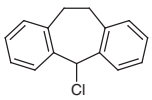


B1655

B1496

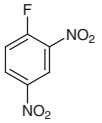


D2461

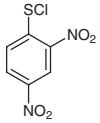


D2159

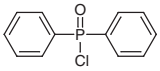
D0835



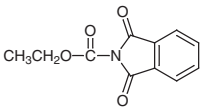
D1463



C1415

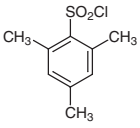


C0683

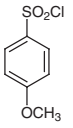


I0060

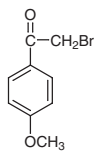
M0071

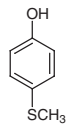


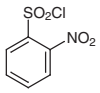
M0802

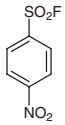


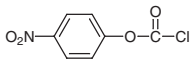
M1004

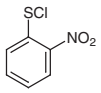


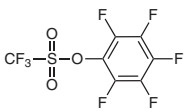
M0441


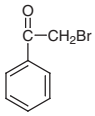
N0142


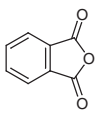
N0507


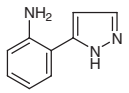
C1400


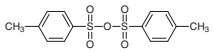
N0363


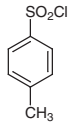
P2188


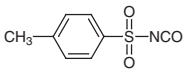
P1782


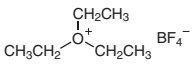
P1614


P1902


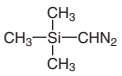
T1485


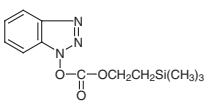
T0272


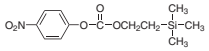
T0998


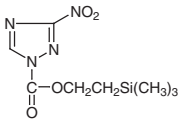
T1606


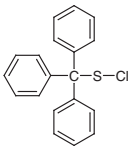
T3177

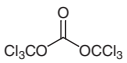

T1146


T2590


T2872


T2544


T1237


T1467


Product No.	Product Name			Unit Size
A2555	5-Acetyl-1,3-dimethylbarbituric Acid			5g
B1122	Bansyl Chloride (10% in Hexane)		1mL	5mL
B0994	Bansyl Chloride		1g	5g
B1128	1,2-Benzenedisulfonyl Dichloride	1g	5g	25g
B1655	Benzenesulfonyl Isocyanate			5g
B1496	*tert*-Butyl 2,2,2-Trichloroacetimidate		5mL	25mL
D2461	Dibenzosuberyl Chloride		5g	25g
D2159	Dimethylthiophosphinoyl Chloride		1g	5g
D0835	2,4-Dinitrofluorobenzene		25g	500g
D1463	2,4-Dinitrophenylsulfenyl Chloride			5g
C1415	Diphenylphosphinic Chloride		10g	25g
C0683	*N*-Ethoxycarbonylphthalimide		25g	500g
I0060	Iodomethane (stabilized with Copper chip)	10mL	100mL	300mL
M0071	2-Mesitylenesulfonyl Chloride		25g	500g
M0802	4-Methoxybenzenesulfonyl Chloride	25g	100g	500g
M1004	4'-Methoxyphenacyl Bromide		5g	25g
M0441	4-(Methylthio)phenol		25g	250g
N0142	2-Nitrobenzenesulfonyl Chloride	25g	100g	500g
N0507	4-Nitrobenzenesulfonyl Fluoride		Price on request	
C1400	4-Nitrophenyl Chloroformate		25g	250g
N0363	2-Nitrophenylsulfenyl Chloride		25g	100g
P2188	Pentafluorophenyl Trifluoromethanesulfonate		200mg	1g
P1782	Phenacyl Bromide		25g	500g
P1614	Phthalic Anhydride			500g
P1902	2-(1*H*-Pyrazol-5-yl)aniline			1g
T1485	*p*-Toluenesulfonic Anhydride		5g	25g
T0272	*p*-Toluenesulfonyl Chloride		25g	500g
T0998	*p*-Toluenesulfonyl Isocyanate		25g	500g
T1606	Triethyloxonium Tetrafluoroborate (15% in Dichloromethane, *ca.* 1mol/L) [Ethylating Reagent]			100mL
T3177	1-(Trifluoromethanesulfonyl)imidazole		1g	5g
T1146	Trimethylsilyldiazomethane (*ca.* 10% in Hexane, *ca.* 0.6mol/L)	10mL	25mL	100mL
T2590	1-[2-(Trimethylsilyl)ethoxycarbonyloxy]benzotriazole		1g	5g

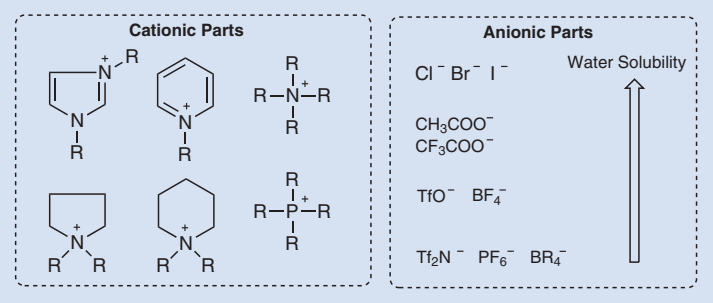
Product No.	Product Name		Unit Size
T2872	4-[2-(Trimethylsilyl)ethoxycarbonyloxy]nitrobenzene		5g
T2544	2-(Trimethylsilyl)ethyl 3-Nitro-1*H*-1,2,4-triazole-1-carboxylate	1g	5g
T1237	Triphenylmethanesulfenyl Chloride		10g
T1467	Triphosgene	25g	250g

References

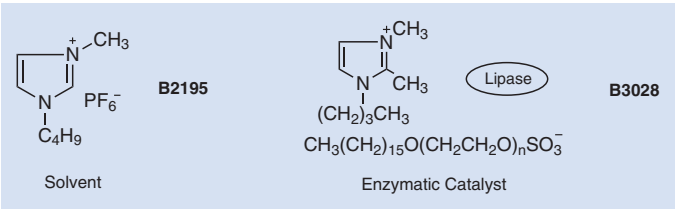
1) R. B. Woodward, I. J. Pachter, M. L. Scheinbaum, *J. Org. Chem.* **1971**, *36*, 1137.
2) R. J. Bryant, E. McDonald, *Tetrahedron Lett.* **1975**, 3841.
3) Review: *Protective Groups in Organic Synthesis*. 3rd ed., ed. by T. W. Greene, P. G. M. Wuts, John Wiley & Sons, Inc., New York, **1999**.

Ionic Liquids

Ionic liquids are organic salts in the liquid state at room temperature and have gained much attention as green reaction solvents taking the place of organic solvents in organic synthesis because of their properties such as almost no vapor pressure and non-flammability. Typical cations are imidazolium, pyridinium, quaternary ammonium and quaternary phosphonium. On the other hand, typical anions are halide, triflate, tetrafluoroborate and hexafluorophosphate.



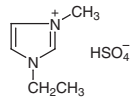
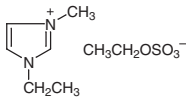
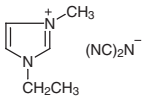
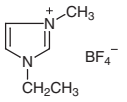
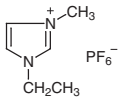
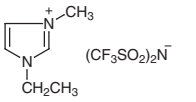
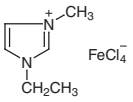
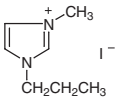
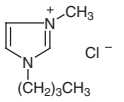
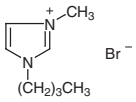
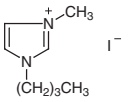
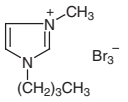
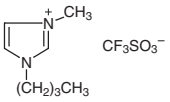
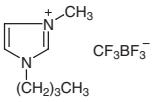
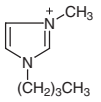
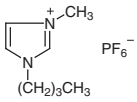
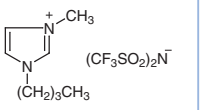
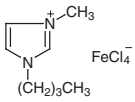
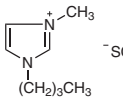
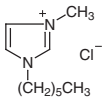
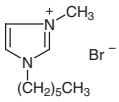
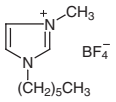
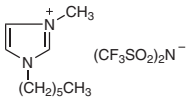
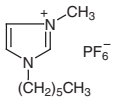
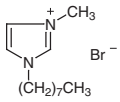
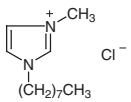
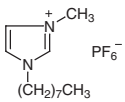
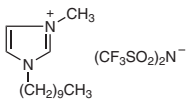
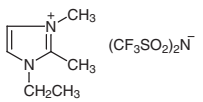
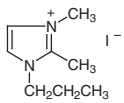
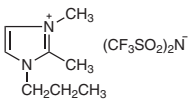
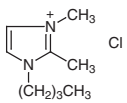
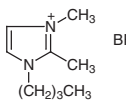
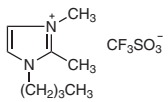
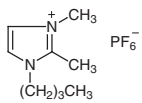
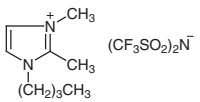
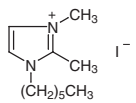
The characteristic feature of ionic liquids is high flexibility for their own molecular design. Their physical properties of melting points, viscosity and electric conductivity can be controlled by the combination of both cationic and anionic ions. In addition, by introducing functional moieties into ionic liquids, they are expected to be used for not only organic solvents but also a wide range of usages such as organocatalysts, metal-scavengers, electrolytes and lubricants.



Recently, SILC (Supported Ionic Liquid Catalyst), wherein catalysts consisting of some metals such as palladium and ruthenium supported on silica gel or alumina gel with the use of ionic liquids, has attracted attention. Generally, ionic liquids have higher viscosity compared to organic solvents, and this property often makes the isolation of reaction products difficult. In contrast, SILC is solid state and can be easily removed from the reaction products by filtration. Furthermore, the collected SILC after the reactions is usable repeatedly.

Imidazolium Salts	D3341	D3240	E0490
	Cl⁻ mp 125 ℃	CH3O, CH3O, O, P, O⁻ Liquid	Cl⁻ mp 84 ℃

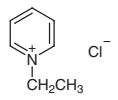
E0543	E0556	E0755	E0494	E0836
Br⁻ mp 74 ℃	I⁻ mp 79 ℃	CH3SO3⁻ Liquid	CF3SO3⁻ Liquid	CF3BF3⁻ Liquid

E0754  Liquid	E0650  Liquid	E0680  Liquid	E0496  Liquid	E0493  mp 61 ℃
E0599  Liquid	E0706  Liquid	M1440  Liquid	B2194  mp 41 ℃	B2193  mp 77 ℃
B2708  Liquid	B3596  mp 8 ℃	B2337  Liquid	B3542  Liquid	B2195  Liquid
B2320  Liquid	B2477  Liquid	B2672  Liquid	B4091  Liquid	H1097  Liquid
H1227  Liquid	H1099  Liquid	H1423  Liquid	H1098  Liquid	M1904  Liquid
M2062  Liquid	M2063  Liquid	D4351  Liquid	E0753  Liquid	D3903  Solid
D4289  Liquid	B2473  mp 99 ℃	B2475  fp 34 ℃	B4182  mp 44 ℃	B2474  mp 38 ℃
B3159  Liquid	H1286  Solid			

Product No.	Product Name	Unit Size		
D3341	1,3-Dimethylimidazolium Chloride		5g	25g
D3240	1,3-Dimethylimidazolium Dimethyl Phosphate		5g	25g
E0490	1-Ethyl-3-methylimidazolium Chloride	5g	25g	250g
E0543	1-Ethyl-3-methylimidazolium Bromide		5g	25g
E0556	1-Ethyl-3-methylimidazolium Iodide		5g	25g
E0755	1-Ethyl-3-methylimidazolium Methanesulfonate		5g	25g
E0494	1-Ethyl-3-methylimidazolium Trifluoromethanesulfonate		5g	25g
E0836	1-Ethyl-3-methylimidazolium Trifluoro(trifluoromethyl)borate			5g
E0754	1-Ethyl-3-methylimidazolium Hydrogen Sulfate		5g	25g
E0650	1-Ethyl-3-methylimidazolium Ethyl Sulfate		5g	25g
E0680	1-Ethyl-3-methylimidazolium Dicyanamide		1g	5g
E0496	1-Ethyl-3-methylimidazolium Tetrafluoroborate		5g	25g
E0493	1-Ethyl-3-methylimidazolium Hexafluorophosphate		5g	25g
E0599	1-Ethyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
E0706	1-Ethyl-3-methylimidazolium Tetrachloroferrate			5g
M1440	1-Methyl-3-propylimidazolium Iodide		5g	25g
B2194	1-Butyl-3-methylimidazolium Chloride	5g	25g	100g
B2193	1-Butyl-3-methylimidazolium Bromide			5g
B2708	1-Butyl-3-methylimidazolium Iodide		5g	25g
B3596	1-Butyl-3-methylimidazolium Tribromide			5g
B2337	1-Butyl-3-methylimidazolium Trifluoromethanesulfonate		5g	25g
B3542	1-Butyl-3-methylimidazolium Trifluoro(trifluoromethyl)borate			5g
B2195	1-Butyl-3-methylimidazolium Tetrafluoroborate		5g	25g
B2320	1-Butyl-3-methylimidazolium Hexafluorophosphate		5g	25g
B2477	1-Butyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
B2672	1-Butyl-3-methylimidazolium Tetrachloroferrate		5g	25g
B4091	1-Butyl-3-methylimidazolium Thiocyanate		5g	25g
H1097	1-Hexyl-3-methylimidazolium Chloride		5g	25g
H1227	1-Hexyl-3-methylimidazolium Bromide		5g	25g
H1099	1-Hexyl-3-methylimidazolium Tetrafluoroborate		5g	25g
H1423	1-Hexyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
H1098	1-Hexyl-3-methylimidazolium Hexafluorophosphate		5g	25g
M1904	1-Methyl-3-*n*-octylimidazolium Bromide		5g	25g
M2062	1-Methyl-3-*n*-octylimidazolium Chloride		5g	25g
M2063	1-Methyl-3-*n*-octylimidazolium Hexafluorophosphate		5g	25g
D4351	1-Decyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
E0753	1-Ethyl-2,3-dimethylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
D3903	1,2-Dimethyl-3-propylimidazolium Iodide		5g	25g
D4289	2,3-Dimethyl-1-propylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
B2473	1-Butyl-2,3-dimethylimidazolium Chloride		5g	25g
B2475	1-Butyl-2,3-dimethylimidazolium Tetrafluoroborate		5g	25g
B4182	1-Butyl-2,3-dimethylimidazolium Trifluoromethanesulfonate		5g	25g
B2474	1-Butyl-2,3-dimethylimidazolium Hexafluorophosphate		5g	25g
B3159	1-Butyl-2,3-dimethylimidazolium Bis(trifluoromethanesulfonyl)imide		5g	25g
H1286	1-Hexyl-2,3-dimethylimidazolium Iodide			5g

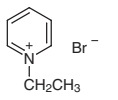
Pyridinium Salts

E0544



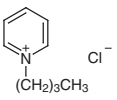
Solid

E0171



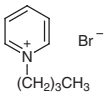
mp 120 ℃

B1329



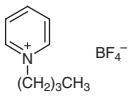
mp 132 ℃

B1743



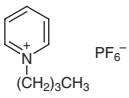
mp 104 ℃

B3232



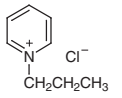
Liquid

B2196



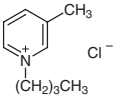
mp 75 ℃

P1393



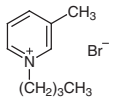
Solid

B3425



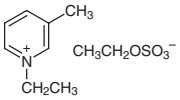
Solid

B3104



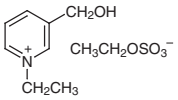
Solid

E0681



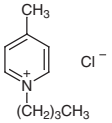
Liquid

E0682



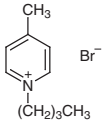
Liquid

B3426



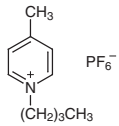
mp 160 ℃

B2700



mp 137 ℃

B2701

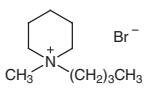


mp 42 ℃

Product No.	Product Name	Unit Size	
E0544	1-Ethylpyridinium Chloride	5g	25g
E0171	1-Ethylpyridinium Bromide		25g
B1329	1-Butylpyridinium Chloride	10g	25g
B1743	1-Butylpyridinium Bromide	5g	25g
B3232	1-Butylpyridinium Tetrafluoroborate	5g	25g
B2196	1-Butylpyridinium Hexafluorophosphate	5g	25g
P1393	1-Propylpyridinium Chloride		5g
B3425	1-Butyl-3-methylpyridinium Chloride	1g	5g
B3104	1-Butyl-3-methylpyridinium Bromide	5g	25g
E0681	1-Ethyl-3-methylpyridinium Ethyl Sulfate	5g	25g
E0682	1-Ethyl-3-(hydroxymethyl)pyridinium Ethyl Sulfate		5g
B3426	1-Butyl-4-methylpyridinium Chloride	5g	25g
B2700	1-Butyl-4-methylpyridinium Bromide	5g	25g
B2701	1-Butyl-4-methylpyridinium Hexafluorophosphate	5g	25g

Piperidinium Salts

B3424

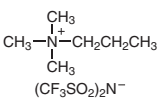


Solid

Product No.	Product Name	Unit Size	
B3424	1-Butyl-1-methylpiperidinium Bromide	5g	25g

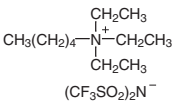
Ammonium, Phosphonium, Sulfonium Salts

T2761



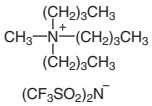
Liquid

A2274



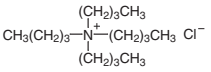
Liquid

T2679



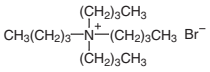
Liquid

T0055



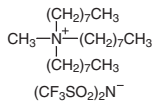
mp 70 ℃

T0054



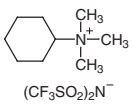
mp 103 ℃

M1660



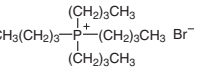
Liquid

C1966



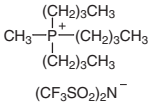
Solid

T1124



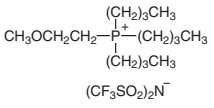
mp 104 ℃

T2680



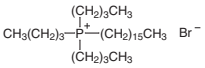
Liquid

T2564



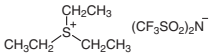
Liquid

H1047



mp 61 ℃

T2314

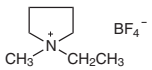


Liquid

Product No.	Product Name			Unit Size
T2761	Trimethylpropylammonium Bis(trifluoromethanesulfonyl)imide		5g	25g
A2274	Amyltriethylammonium Bis(trifluoromethanesulfonyl)imide			5g
T2679	Tributylmethylammonium Bis(trifluoromethanesulfonyl)imide		5g	25g
T0055	Tetrabutylammonium Chloride	5g	25g	100g
T0054	Tetrabutylammonium Bromide	25g	100g	500g
M1660	Methyltri-*n*-octylammonium Bis(trifluoromethanesulfonyl)imide			5g
C1966	Cyclohexyltrimethylammonium Bis(trifluoromethanesulfonyl)imide			5g
T1124	Tetrabutylphosphonium Bromide	25g	100g	500g
T2680	Tributylmethylphosphonium Bis(trifluoromethanesulfonyl)imide			5g
T2564	Tributyl(2-methoxyethyl)phosphonium Bis(trifluoromethanesulfonyl)imide			5g
H1047	Tributylhexadecylphosphonium Bromide			25g
T2314	Triethylsulfonium Bis(trifluoromethanesulfonyl)imide			5g

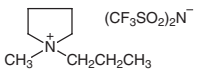
Pyrrolidinium Salts

E0977



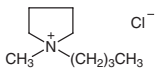
Solid

M2098



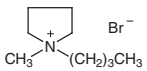
Liquid

B3358



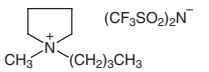
Solid

B3427



Solid

B2851



Liquid

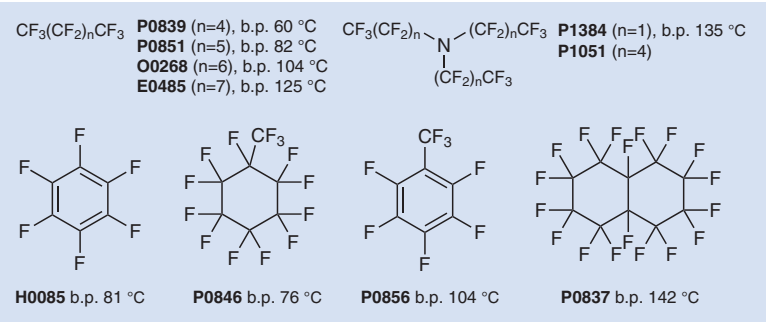
Product No.	Product Name		Unit Size
E0977	1-Ethyl-1-methylpyrrolidinium Tetrafluoroborate	5g	25g
M2098	1-Methyl-1-propylpyrrolidinium Bis(trifluoromethanesulfonyl)imide	5g	25g
B3358	1-Butyl-1-methylpyrrolidinium Chloride	5g	25g
B3427	1-Butyl-1-methylpyrrolidinium Bromide	5g	25g
B2851	1-Butyl-1-methylpyrrolidinium Bis(trifluoromethanesulfonyl)imide	5g	25g

References

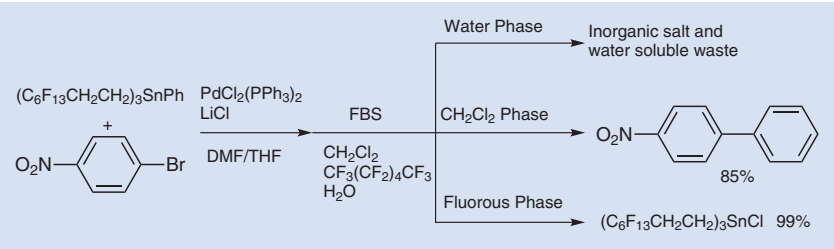
1) F. Kerton, R. Marriott, in *Alternative Solvents for Green Chemistry*, RSC Publishing, **2009**.
2) P. Wasserscheid, T. Welton, in *Ionic Liquids in Synthesis*, Wiley-VCH, Weinheimm, **2003**.

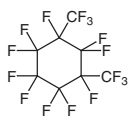
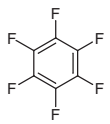
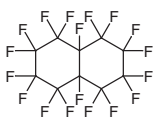
Fluorous Solvents

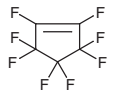
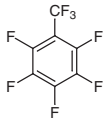
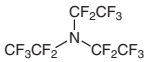
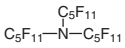
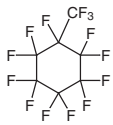
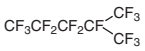
Solvents containing fluorine with a relatively large component in molecules are called fluorous solvents. Most fluorous solvents have high thermostability and chemostability and are low in toxicity.



The characteristic feature of fluorous solvents is that they mix with neither common organic solvents nor water at room temperature thus forming biphasic systems, and they dissolve fluorine-rich compounds well. To utilize these features, a method of separation and purification called a fluorous biphase system (FBS) has been developed. In this synthetic manner, after the reaction of substrates having a perfluoroalkyl group with some reactants in a mixture of fluorous/organic solvents, the fluorous compounds can be selectively recovered from phase-separated fluorous layer. On the other hand, organic compounds without fluorine containing functional groups are recovered from the phase-separated organic layer, so that the FBS allows some purification processes such as column chromatography to be omitted. For example, Curran *et al*. applied FBS to the Stille coupling reaction of organotin compounds having a fluoroalkyl group with aryl bromides. Generally, organotin byproducts are hard to remove but fluorinated organotin byproducts in FBS are easily dissolved in the phase-separated fluorous layer, and can be simply removed by extraction.



D2669	E0485	P0074	H0946	P1755
$CF_3CHFCHFCF_2CF_3$	$CF_3(CF_2)_7CF_3$	$CF_3(CF_2)_3N(CF_2)_3CF_3$, $(CF_2)_3CF_3$	$CF_3(CF_2)_7Br$	$CF_3(CF_2)_{10}CF_3$
P1420	P0851	H0085	P0837	O0268
	$CF_3(CF_2)_5CF_3$			$CF_3(CF_2)_6CF_3$

O0292	P0856	P1348	P1051	P0839
				
P0846	**T1012**	**T2921**		
				

Product No.	Product Name		Unit Size	
D2669	*2H*,*3H*-Decafluoropentane		25g	500g
E0485	Eicosafluorononane			10g
P0074	Heptacosafluorotributylamine [for Mass spectrometry]		25g	100g
H0946	Heptadecafluoro-*n*-octyl Bromide		5g	25g
P1755	Hexacosafluorododecane			1g
P1420	Hexadecafluoro(1,3-dimethylcyclohexane)			25g
P0851	Hexadecafluoroheptane (mixture of isomers)		10g	25g
H0085	Hexafluorobenzene		25g	250g
P0837	Octadecafluorodecahydronaphthalene			25g
O0268	Octadecafluorooctane			10g
O0292	Octafluorocyclopentene			50g
P0856	Octafluorotoluene		5g	25g
P1348	Pentadecafluorotriethylamine		5g	25g
P0867	Perfluoro(2-butyltetrahydrofuran) (so called)			25g
P1051	Perfluorotriamylamine (so called)			25g
P0839	Tetradecafluorohexane	10g	25g	250g
P0846	Tetradecafluoromethylcyclohexane		25g	100g
T1012	Tetradecafluoro-2-methylpentane			25mL
T2921	1,1,1-Trifluoroacetone (in cylinder without valve) [To use this product charged in cylinder, a valve is required which is sold separately (Product Code:V0030)]			100g

References

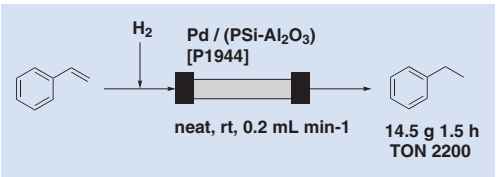
1) F. Kerton, R. Marriott, in *Alternative Solvents for Green Chemistry*, RSC Publishing, **2009**.
2) M. Hoshino, P. Degenkolb, D. P. Curran, *J. Org. Chem.* **1997**, *62*, 8341.

Polymer-supported Reagents

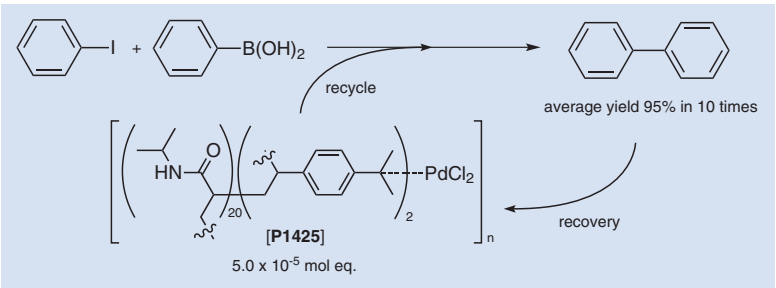
The utility of polymer-supported reagents was discovered by Merrifield and recently, over 300 recyclable polymer-supported reagents have been reported. The ideal polymer-supported reagents need to satisfy the conditions that their reactivity is comparable to the related liquid-phase reactions, and they are separable, recoverable and recyclable after the reactions. By utilizing the above mentioned characteristics, the polymer-supported reagents are used in the synthetic means shown below.

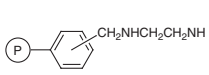
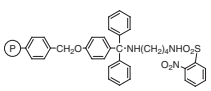
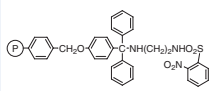
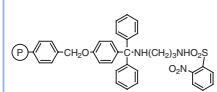
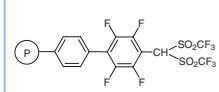
1) Resins for solid-phase reactions
2) Scavengers for excess agents
3) Easily reusable polymer-supported organic and organometallic catalysts
4) Immobilization of barely-separable/harmful reagents

Also, the polymer-supported reagents are used in continuous plug flow reactors. Kobayashi *et al*. have developed a polysilane-supported palladium catalyst (Pd/(PS-Al_2O_3)) and introduced it into the continuous plug flow reactors to perform hydrogenations under hydrogen gas flow conditions, Suzuki-Miyaura coupling reactions, Sonogashira coupling reactions and hydrosilylations.

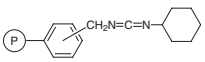


On the other hand, Ikegami *et al*. have developed an amphiphilic polymer-supported palladium catalyst with affinity for water and organic solvents and applied it for organic synthesis. Palladium-supported poly (*N*-isopropylacrylamide) (PNIPAAm) (P1425), polymer-supported tungsten (P1697) and polymer-supported ruthenium (P1698) show amphiphilicity and incorporate both hydrophilic/hydrophobic substrates and reagents to make the reactions proceed smoothly. These catalysts are applicable to Suzuki-Miyaura coupling reactions, oxidative cyclizations of *ω*-unsaturated alcohols and carboxylic acids in the presence of hydrogen peroxide, and oxidations by molecular oxygen. After completion of these reactions, they can be recycled and reused.

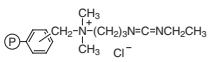


A2006	B2372	B2370	B2371	B2292
				

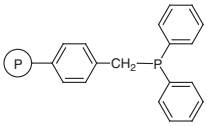
C2141



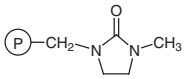
D3525



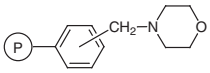
D2766



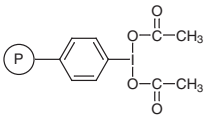
M1452



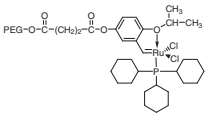
M1857



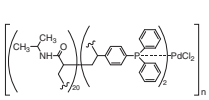
P1415



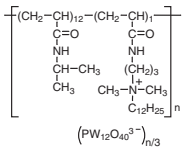
P1427



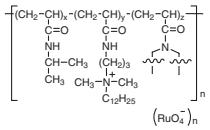
P1425



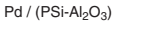
P1697



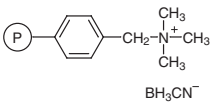
P1698



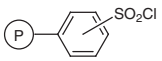
P1944



P1719



S0545



Product No.	Product Name	Unit Size	
A2006	*N*-(2-Aminoethyl)aminomethyl Polystyrene Resin cross-linked with 1% DVB (50-100mesh) (3.1-3.5mmol/g)	5g	25g
B2372	*N*-(4-Benzyloxytrityl)-*N'*-(2-nitrobenzenesulfonyl)-1,4-diaminobutane Resin cross-linked with 1% DVB (200-400mesh) (0.9-1.1mmol/g)		1g
B2370	*N*-(4-Benzyloxytrityl)-*N'*-(2-nitrobenzenesulfonyl)-1,2-diaminoethane Resin cross-linked with 1% DVB (200-400mesh) (0.9-1.1mmol/g)		1g
B2371	*N*-(4-Benzyloxytrityl)-*N'*-(2-nitrobenzenesulfonyl)-1,3-diaminopropane Resin cross-linked with 1% DVB (200-400mesh) (0.9-1.1mmol/g)		1g
B2292	Bis(trifluoromethanesulfonyl)methyltetrafluorophenyl Polystyrene Resin cross-linked with 2% DVB (200-400mesh) (0.9-1.2mmol/g)		100mg
C2141	*N*-Cyclohexylcarbodiimidomethyl Polystyrene Resin cross-linked with 1% DVB (50-100mesh) (1.4-1.6mmol/g)		5g
D3525	1-(3-Dimethylaminopropyl)-3-ethylcarbodiimide Resin cross-linked with 1% DVB (50-100mesh) (1.0-1.3mmol/g)		5g
D2766	4-Diphenylphosphinomethyl Polystyrene Resin cross-linked with 2% DVB (200-400mesh) (0.5-1.0mmol/g)		5g
M1452	3-Methyl-2-oxoimidazolidin-1-ylmethyl Polystyrene Resin cross-linked with 1% DVB		1g
M1857	Morpholinomethyl Polystyrene Resin cross-linked with 1% DVB (50-100mesh) (2.9-3.5mmol/g)		5g
P1415	Poly[4-(diacetoxyiodo)styrene]	1g	5g
P1427	Polyethylene Glycol-bound Ruthenium Carbene Complex		100mg
P1425	Poly[*N*-isopropylacrylamide-*co*-4-(diphenylphosphino)styrene] Palladium(II) Dichloride (ratio, acrylamide:phosphine=20:2)		100mg
P1697	Poly[[*N*-isopropylacrylamide-*co*-[*N*-[3-(dodecyldimethylammonio)-propyl]acrylamide]]-phosphotungstate]	200mg	1g
P1698	Poly[[*N*-isopropylacrylamide-*co*-[*N*-[3-(dodecyldimethylammonio)-propyl]acrylamide]-*co*-(1,3,5-triacryloylhexahydro-1,3,5-triazine)]perruthenate]	200mg	1g
P1944	Poly(methylphenyl)silane supported Palladium/Alumina Hybrid Catalyst [=Pd / ($PSi\text{-}Al_2O_3$)]		1g
P1719	(Polystyrylmethyl)trimethylammonium Cyanoborohydride cross-linked with 10% DVB (30-50mesh) (2.6-3.0mmol/g)	5g	25g
S0545	Sulfonyl Chloride Polystyrene Resin cross-linked with 1% DVB (50-100mesh) (4.5-5.3mmol/g)	5g	25g

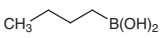
References

1) J.-W. Lee, T. Mayer-Gall, K. Opwis, C. E. Song, J. S. Gutmann, B. List, *Science* **2013**, *341*, 1225.
2) H. Oyamada, R. Akiyama, H. Hagio, T. Naito, S. Kobayashi, *Chem. Commun*. **2006**, 4297.
3) a) Y. M. A. Yamada, K. Takeda, H. Takahashi, S. Ikegami, *J. Org. Chem*. **2003**, *68*, 7733.
b) Y. M. A. Yamada, K. Takeda, H. Takahashi, S. Ikegami, *Org. Lett*. **2002**, *4*, 3371.
c) Y. M. A. Yamada, H. Tabata, M. Ichinohe, H. Takahashi, S. Ikegami, *Tetrahedron* **2004**, *60*, 4087.
d) H. Hamamoto, Y. Suzuki, Y. M. A. Yamada, H. Tabata, H. Takahashi, S. Ikegami, *Angew. Chem. Int. Ed*. **2005**, *44*, 4536.

Boronic Acids & Boronic Acid Derivatives

Alkyl & Alkenylboronic Acids

B0529

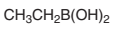


C2188

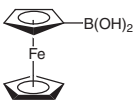
C2893

C2442

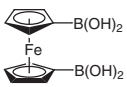
E0913



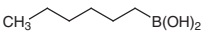
F0280



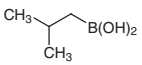
F0664



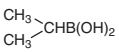
H0913



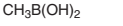
I0597



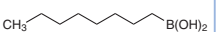
I0787



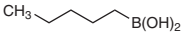
M1553



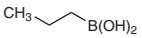
O0452



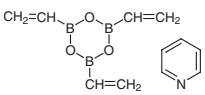
P2267



P1942

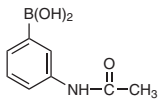


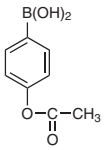
T2498

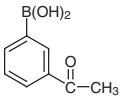


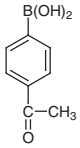
Product No.	Product Name	Unit Size		
B0529	Butylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
C2188	Cyclohexylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2893	1-Cyclopentenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2442	Cyclopentylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0913	Ethylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0280	Ferroceneboronic Acid (contains varying amounts of Anhydride)		100mg	1g
F0664	1,1'-Ferrocenediboronic Acid (contains varying amounts of Anhydride)			1g
H0913	Hexylboronic Acid (contains varying amounts of Anhydride)		1g	5g
I0597	Isobutylboronic Acid (contains varying amounts of Anhydride)		5g	25g
I0787	Isopropylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M1553	Methylboronic Acid (contains varying amounts of Anhydride)		1g	5g
O0452	*n*-Octylboronic Acid (contains varying amounts of Anhydride)		1g	5g
P2267	Pentylboronic Acid (contains varying amounts of Anhydride)		5g	25g
P1942	Propylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
T2498	2,4,6-Trivinylboroxin - Pyridine Complex		1g	5g

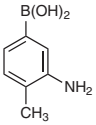
Arylboronic Acids

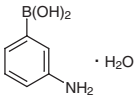
A2453


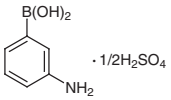
A2818


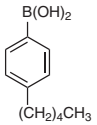
A1942


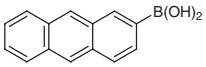
A1907


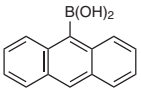
A2745


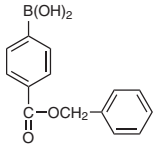
A1281


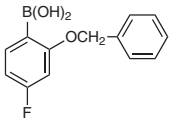
A1774


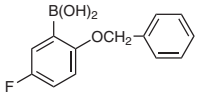
A2336


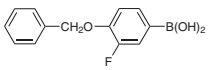
A1843


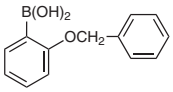
A2328


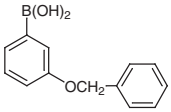
B4725


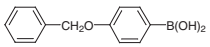
B3779


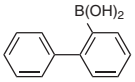
B3683


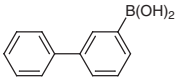
B4639


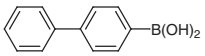
B4590


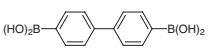
B3056


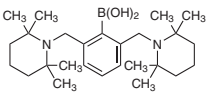
B2145


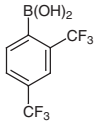
B2488


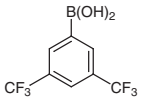
B2489


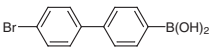
B2294


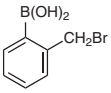
B2490


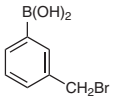
B3927


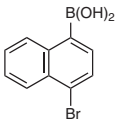
B3022


B1886


B2860


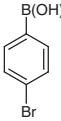
B3600


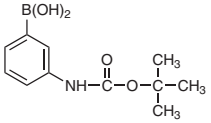
B3814


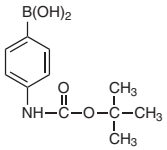
B4463


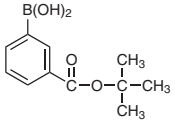
B2889

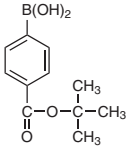

B2890

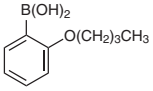

B1858


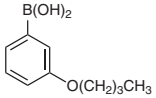
B4279


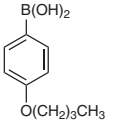
B4335


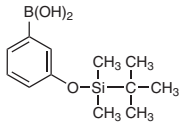
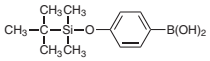
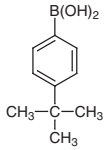
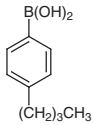
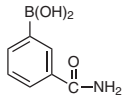
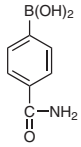
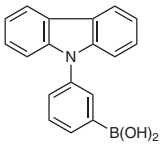
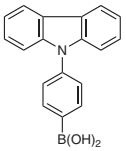
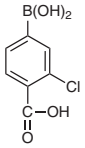
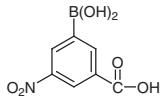
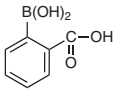
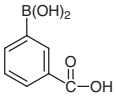
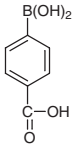
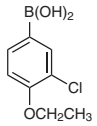
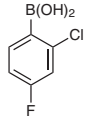
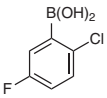
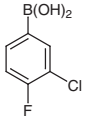
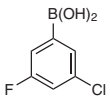
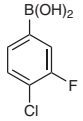
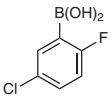
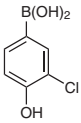
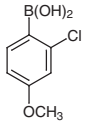
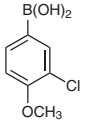
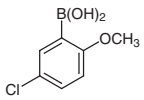
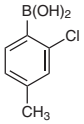
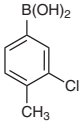
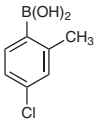
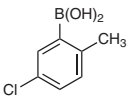
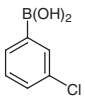
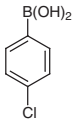
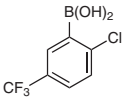
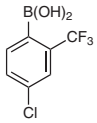
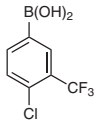
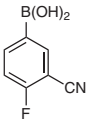
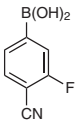
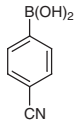
B4726


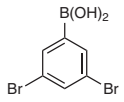
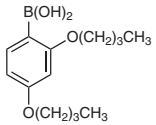
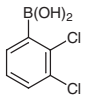
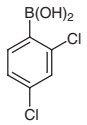
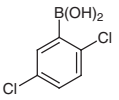
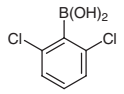
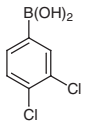
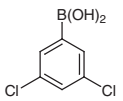
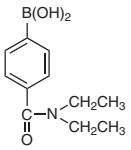
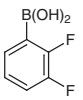
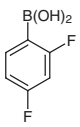
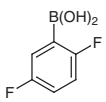
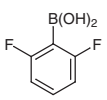
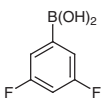
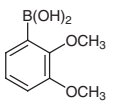
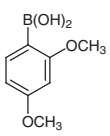
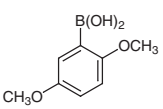
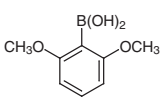
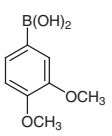
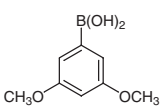
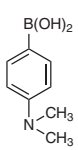
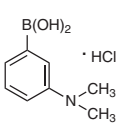
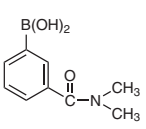
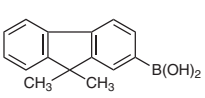
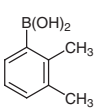
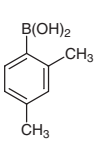
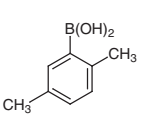
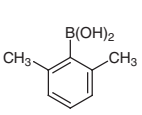
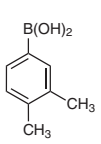
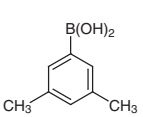
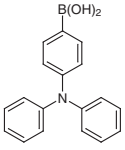
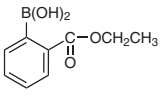
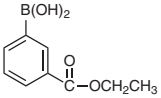
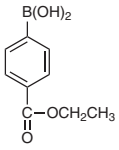
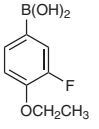
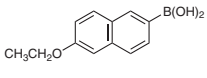
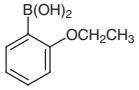
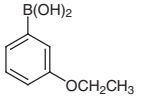
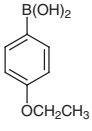
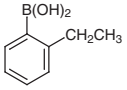
B4772


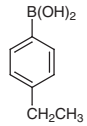
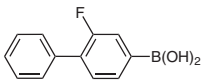
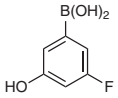
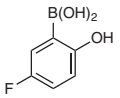
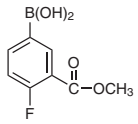
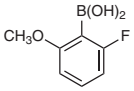
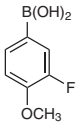
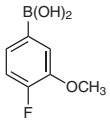
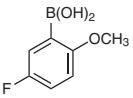
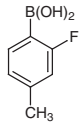
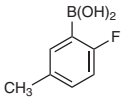
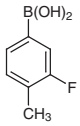
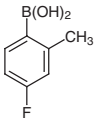
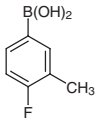
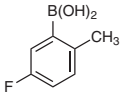
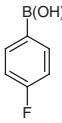
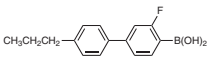
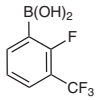
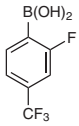
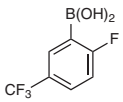
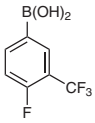
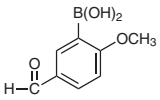
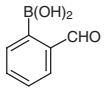
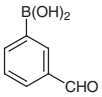
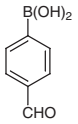
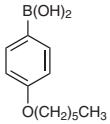
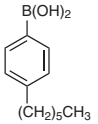
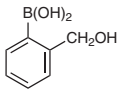
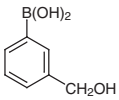
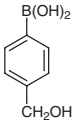
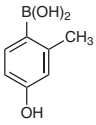
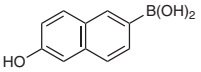
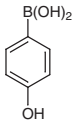
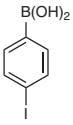
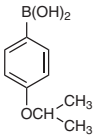
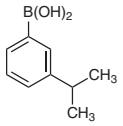
B4700


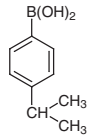
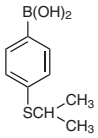
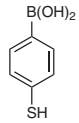
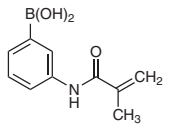
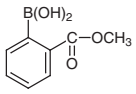
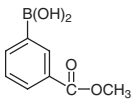
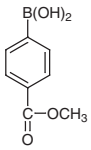
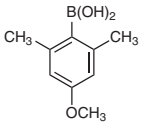
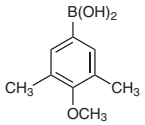
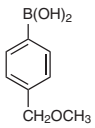
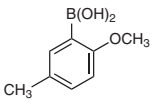
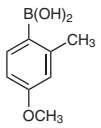
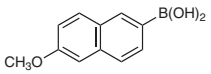
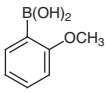
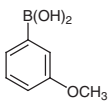
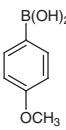
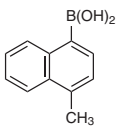
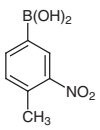
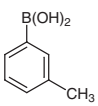
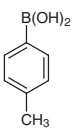
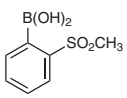
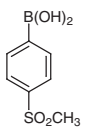
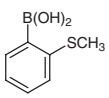
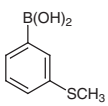
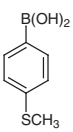
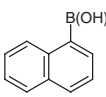
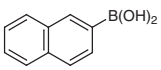
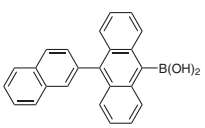
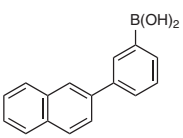
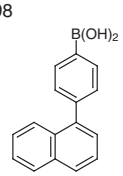
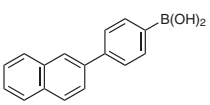
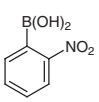
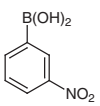
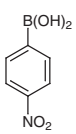
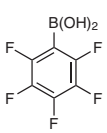
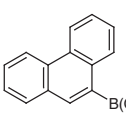
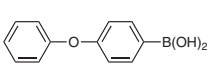
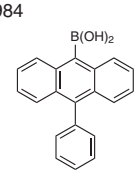
B4640


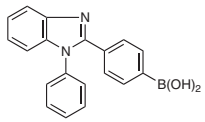
B4727


B3726 	B3739 	B2251 	B2589 	C2992 
C2570 	C2967 	C2926 	C2523 	C2385 
C2501 	C2028 	C1353 	C2664 	C2772 
C2666 	C2946 	C1760 	C2914 	C2749 
C2645 	C2969 	C2386 	C3056 	C2292 
C3049 	C2525 	C2577 	C2665 	C1705 
C1613 	C1473 	C2591 	C2601 	C2571 
C2676 	C2456 	C2416 	C2031 	C1778 

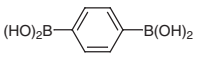
D4670 	D4263 	D3434 	D2494 	D3044 
D3357 	D3783 	D2909 	D4681 	D3523 
D3391 	D3436 	D3087 	D3081 	D3853 
D3521 	D3522 	D3861 	D3512 	D3513 
D4428 	D4013 	D4194 	D3974 	D3516 
D3514 	D3517 	D3633 	D3110 	D3396 
D3537 	E0877 	E0848 	E0868 	E1124 
E1107 	E0723 	E0724 	E0725 	E0818 

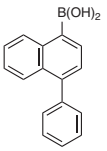
E0720 	F0785 	F0954 	F0977 	F0951 
F0941 	F0876 	F0919 	F0775 	F0683 
F0915 	F0712 	F0666 	F0697 	F0976 
F0407 	F0404 	F0361 	F0942 	F1006 
F0816 	F0788 	F0830 	F0834 	B1873 
F0445 	F0446 	H1357 	H1489 	H1345 
H1244 	H1204 	H1495 	H1402 	H1184 
H1185 	H1228 	I0830 	I0806 	I0887 

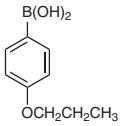
I0620 	I0950 	M2417 	M2418 	M2676 
M1905 	M1906 	M1907 	M2244 	M2685 
M2677 	M2311 	M2255 	M2256 	M1261 
M1322 	M1252 	M2457 	M1127 	M1313 
M1314 	M1126 	M2678 	M1972 	M1570 
M1793 	M1458 	N0630 	N0649 	N0929 
N1009 	N0798 	N0946 	N0811 	N0563 
N0812 	P1904 	P1093 	P1974 	P1984 

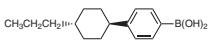
P2158


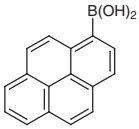
B0857

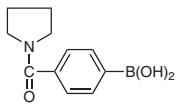

P1358


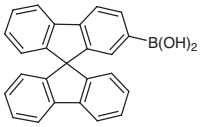
P2290


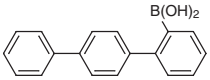
P1968


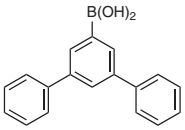
P2162


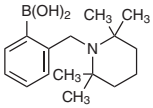
P1625


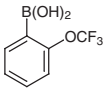
P2105


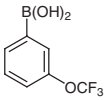
S0831


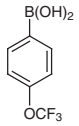
T2412


T2792


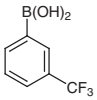
T2908


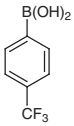
T2413


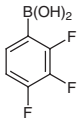
T2362


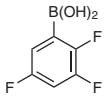
T1773


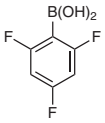
T1800

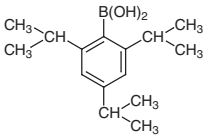

T1793


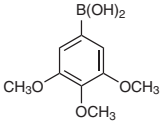
T1788


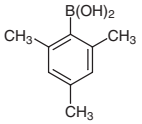
T2574


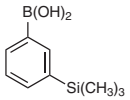
T2874


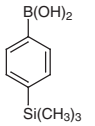
T2804


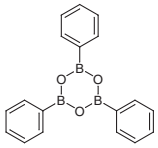
T2654


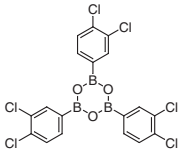
T2837


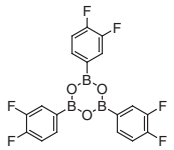
T1960


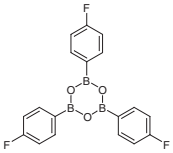
T2663


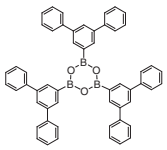
T2664


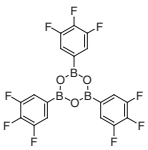
T2640


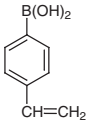
D3435


T2430


T1814


T1887


T1929


V0075


Product No.	Product Name	Unit Size	
A2453	3-Acetamidophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g
A2818	4-Acetoxyphenylboronic Acid (contains varying amounts of Anhydride)	200mg	1g
A1942	3-Acetylphenylboronic Acid (contains varying amounts of Anhydride)	5g	25g
A1907	4-Acetylphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g

Product No.	Product Name	Unit Size		
A2745	3-Amino-4-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
A1281	3-Aminophenylboronic Acid Monohydrate (contains varying amounts of Anhydride)	1g	5g	25g
A1774	3-Aminophenylboronic Acid Hemisulfate	1g	5g	25g
A2336	4-Amylphenylboronic Acid (contains varying amounts of Anhydride)			5g
A1843	2-Anthraceneboronic Acid (contains varying amounts of Anhydride)		250mg	1g
A2328	9-Anthraceneboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4725	4-(Benzyloxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B3779	2-Benzyloxy-4-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B3683	2-Benzyloxy-5-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4639	4-Benzyloxy-3-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4590	2-Benzyloxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B3056	3-Benzyloxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
B2145	4-Benzyloxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B2488	2-Biphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
B2489	3-Biphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
B2294	4-Biphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
B2490	4,4'-Biphenyldiboronic Acid			1g
B3927	2,6-Bis[(2,2,6,6-tetramethyl-1-piperidinyl)methyl]phenylboronic Acid (contains varying amounts of Anhydride)		200mg	1g
B3022	2,4-Bis(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B1886	3,5-Bis(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
B2860	4'-Bromo-4-biphenylboronic Acid (contains varying amounts of Anhydride)			1g
B3600	2-(Bromomethyl)phenylboronic Acid (contains varying amounts of Anhydride)			1g
B3814	3-(Bromomethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4463	4-Bromo-1-naphthaleneboronic Acid (contains varying amounts of Anhydride)			1g
B2889	2-Bromophenylboronic Acid (contains varying amounts of Anhydride)			5g
B2890	3-Bromophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
B1858	4-Bromophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
B4279	3-[(*tert*-Butoxycarbonyl)amino]phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4335	4-[(*tert*-Butoxycarbonyl)amino]phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4726	3-(*tert*-Butoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4772	4-(*tert*-Butoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		200mg	1g
B4700	2-Butoxyphenylboronic Acid (contains varying amounts of Anhydride)			1g
B4640	3-Butoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B4727	4-Butoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B3726	3-(*tert*-Butyldimethylsilyloxy)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B3739	4-(*tert*-Butyldimethylsilyloxy)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B2251	4-*tert*-Butylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
B2589	4-Butylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2992	3-Carbamoylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2570	4-Carbamoylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2967	3-(9*H*-Carbazol-9-yl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2926	4-(9*H*-Carbazol-9-yl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2523	4-Carboxy-3-chlorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2385	3-Carboxy-5-nitrophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2501	2-Carboxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2028	3-Carboxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C1353	4-Carboxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2664	3-Chloro-4-ethoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2772	2-Chloro-4-fluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
C2666	2-Chloro-5-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2946	3-Chloro-2-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C1760	3-Chloro-4-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2914	3-Chloro-5-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2749	4-Chloro-3-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2645	5-Chloro-2-fluorophenylboronic Acid (contains varying amounts of Anhydride)			5g
C2969	3-Chloro-4-hydroxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2386	2-Chloro-4-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C3056	3-Chloro-4-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2292	5-Chloro-2-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
C3049	2-Chloro-4-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2525	3-Chloro-4-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2577	4-Chloro-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2665	5-Chloro-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C1705	2-Chlorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C1613	3-Chlorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
C1473	4-Chlorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
C2591	2-Chloro-5-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2601	4-Chloro-2-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g

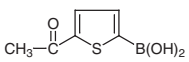
Product No.	Product Name	Unit Size		
C2571	4-Chloro-3-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2676	3-Cyano-4-fluorophenylboronic Acid (contains varying amounts of Anhydride)			1g
C2456	4-Cyano-3-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2416	2-Cyanophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2031	3-Cyanophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
C1778	4-Cyanophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
D4670	3,5-Dibromophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D4263	2,4-Dibutoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3434	2,3-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D2494	2,4-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
D3044	2,5-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3357	2,6-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)			5g
D3783	3,4-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D2909	3,5-Dichlorophenylboronic Acid (contains varying amounts of Anhydride)			5g
D4681	4-(Diethylcarbamoyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3523	2,3-Difluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3391	2,4-Difluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3436	2,5-Difluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3087	2,6-Difluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3081	3,5-Difluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3853	2,3-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)			5g
D3521	2,4-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3522	2,5-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3861	2,6-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3512	3,4-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3513	3,5-Dimethoxyphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
D4428	4-(Dimethylamino)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D4013	3-(Dimethylamino)phenylboronic Acid Hydrochloride (contains varying amounts of Anhydride)		1g	5g
D4194	3-(Dimethylcarbamoyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3974	9,9-Dimethylfluoren-2-boronic Acid (contains varying amounts of Anhydride)		1g	5g
D3516	2,3-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)			5g
D3514	2,4-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3517	2,5-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
D3633	2,6-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3110	3,4-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D3396	3,5-Dimethylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
D3537	4-(Diphenylamino)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0877	2-(Ethoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0848	3-(Ethoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0868	4-(Ethoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E1124	4-Ethoxy-3-fluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E1107	6-Ethoxy-2-naphthaleneboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0723	2-Ethoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0724	3-Ethoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
E0725	4-Ethoxyphenylboronic Acid (contains varying amounts of Anhydride)			5g
E0818	2-Ethylphenylboronic Acid (contains varying amounts of Anhydride)			5g
E0720	4-Ethylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
F0785	2-Fluoro-4-biphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0954	3-Fluoro-5-hydroxyphenylboronic Acid (contains varying amounts of Anhydride)			1g
F0977	5-Fluoro-2-hydroxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0951	4-Fluoro-3-(methoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0941	2-Fluoro-6-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0876	3-Fluoro-4-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0919	4-Fluoro-3-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0775	5-Fluoro-2-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
F0683	2-Fluoro-4-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0915	2-Fluoro-5-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0712	3-Fluoro-4-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0666	4-Fluoro-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0697	4-Fluoro-3-methylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
F0976	5-Fluoro-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0407	2-Fluorophenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
F0404	3-Fluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
F0361	4-Fluorophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
F0942	3-Fluoro-4'-propyl-4-biphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F1006	2-Fluoro-3-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0816	2-Fluoro-4-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0788	2-Fluoro-5-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g

Product No.	Product Name	Unit Size		
F0830	4-Fluoro-3-(trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0834	5-Formyl-2-methoxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B1873	2-Formylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0445	3-Formylphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
F0446	4-Formylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1357	4-Hexyloxyphenylboronic Acid (contains varying amounts of Anhydride)			5g
H1489	4-Hexylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1345	2-(Hydroxymethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1244	3-(Hydroxymethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1204	4-(Hydroxymethyl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
H1495	4-Hydroxy-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1402	6-Hydroxy-2-naphthaleneboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1184	2-Hydroxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1185	3-Hydroxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
H1228	4-Hydroxyphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
I0830	4-Iodophenylboronic Acid (contains varying amounts of Anhydride)			5g
I0806	4-Isopropoxyphenylboronic Acid (contains varying amounts of Anhydride)			5g
I0887	3-Isopropylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
I0620	4-Isopropylphenylboronic Acid (contains varying amounts of Anhydride)			5g
I0950	4-(Isopropylthio)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2417	3-Mercaptophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2418	4-Mercaptophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2676	3-Methacrylamidophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1905	2-(Methoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1906	3-(Methoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
M1907	4-(Methoxycarbonyl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
M2244	4-Methoxy-2,6-dimethylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2685	4-Methoxy-3,5-dimethylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2677	4-(Methoxymethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2311	2-Methoxy-5-methylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M2255	4-Methoxy-2-methylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2256	6-Methoxy-2-naphthaleneboronic Acid (contains varying amounts of Anhydride)			5g
M1261	2-Methoxyphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
M1322	3-Methoxyphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
M1252	4-Methoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M2457	4-Methyl-1-naphthaleneboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1127	4-Methyl-3-nitrophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1313	2-Methylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M1314	3-Methylphenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
M1126	4-Methylphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M2678	2-(Methylsulfonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1972	4-(Methylsulfonyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1570	2-(Methylthio)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M1793	3-(Methylthio)phenylboronic Acid (contains varying amounts of Anhydride)			5g
M1458	4-(Methylthio)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0630	1-Naphthaleneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
N0649	2-Naphthaleneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
N0929	10-(2-Naphthyl)anthracene-9-boronic Acid (contains varying amounts of Anhydride)			1g
N1009	3-(2-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0798	4-(1-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0946	4-(2-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		200mg	1g
N0811	2-Nitrophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0563	3-Nitrophenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
N0812	4-Nitrophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
P1904	Pentafluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
P1093	9-Phenanthreneboronic Acid (contains varying amounts of Anhydride)		1g	5g
P1974	4-Phenoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
P1984	10-Phenyl-9-anthraceneboronic Acid (contains varying amounts of Anhydride)			1g
P2158	4-(1-Phenyl-1*H*-benzimidazol-2-yl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
B0857	Phenylboronic Acid (contains varying amounts of Anhydride)	5g	25g	250g
P1358	1,4-Phenylenediboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
P2290	4-Phenylnaphthalene-1-boronic Acid (contains varying amounts of Anhydride)		1g	5g
P1968	4-Propoxyphenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
P2162	4-(*trans*-4-Propylcyclohexyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
P1625	1-Pyreneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
P2105	4-[(1-Pyrrolidinyl)carbonyl]phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
S0831	9,9'-Spirobi[9*H*-fluorene]-2-boronic Acid		1g	5g
T2412	2-*p*-Terphenylboronic Acid (contains varying amounts of Anhydride)			1g

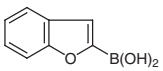
Product No.	Product Name		Unit Size	
T2792	5'-*m*-Terphenylboronic Acid (contains varying amounts of Anhydride)			1g
T2908	2-[(2,2,6,6-Tetramethyl-1-piperidyl)methyl]phenylboronic Acid (contains varying amounts of Anhydride)			1g
T2413	2-(Trifluoromethoxy)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T2362	3-(Trifluoromethoxy)phenylboronic Acid (contains varying amounts of Anhydride)			5g
T1773	4-(Trifluoromethoxy)phenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
T1800	2-(Trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
T1793	3-(Trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T1788	4-(Trifluoromethyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T2574	2,3,4-Trifluorophenylboronic Acid (contains varying amounts of Anhydride)			5g
T2874	2,3,5-Trifluorophenylboronic Acid (contains varying amounts of Anhydride)			5g
T2804	2,4,6-Trifluorophenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T2654	2,4,6-Triisopropylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T2837	3,4,5-Trimethoxyphenylboronic Acid (contains varying amounts of Anhydride)			1g
T1960	2,4,6-Trimethylphenylboronic Acid		1g	5g
T2663	3-(Trimethylsilyl)phenylboronic Acid (contains varying amounts of Anhydride)			5g
T2664	4-(Trimethylsilyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
T2640	2,4,6-Triphenylboroxin		5g	25g
D3435	2,4,6-Tris(3,4-dichlorophenyl)boroxin		5g	25g
T2430	2,4,6-Tris(3,4-difluorophenyl)boroxin		5g	25g
T1814	2,4,6-Tris(4-fluorophenyl)boroxin			10g
T1887	2,4,6-Tris(*m*-terphenyl-5'-yl)boroxin			100mg
T1929	2,4,6-Tris(3,4,5-trifluorophenyl)boroxin		1g	5g
V0075	4-Vinylphenylboronic Acid (contains varying amounts of Anhydride)		1g	5g

Heteroarylboronic Acids

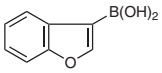
A2364



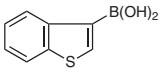
B2978



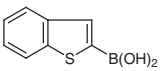
B4522



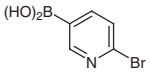
B4774



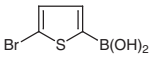
B2893



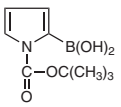
B3307



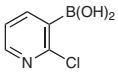
B2862



B4063

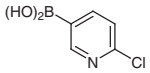


C2560

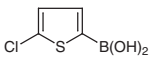


C2589

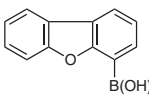
C2288



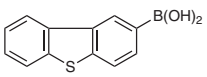
C2066



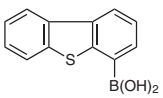
D4567



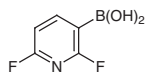
D4373



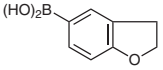
D4057



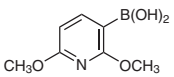
D4006



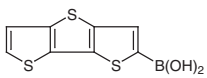
D4711



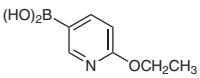
D4690



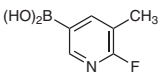
D3823



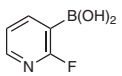
E1115



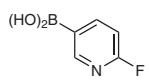
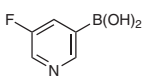
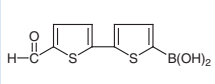
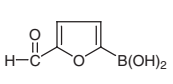
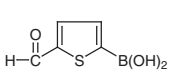
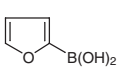
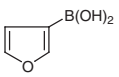
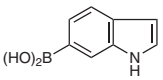
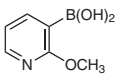
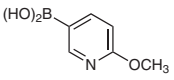
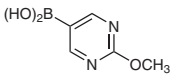
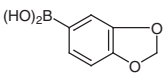
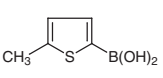
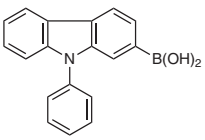
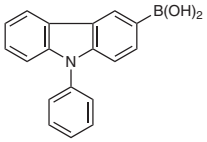
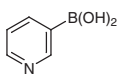
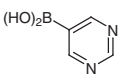
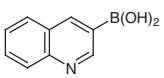
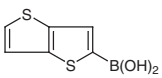
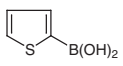
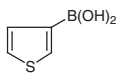
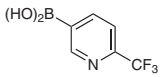
F0984



F0739



F0935

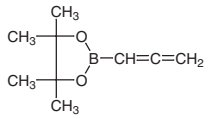
F0770 	F0859 	F0548 	F0611 	F0549 
F0394 	F0438 	I0803 	M2159 	M2029 
M2335 	M2035 	M1850 	P2169 	P2001 
P1673 	P1594 	P1759 	Q0080 	Q0087 
Q0086 	T2621 	T1772 	T1975 	T3188 

Product No.	Product Name	Unit Size	
A2364	5-Acetyl-2-thiopheneboronic Acid (contains varying amounts of Anhydride)	5g	25g
B2978	Benzofuran-2-boronic Acid (contains varying amounts of Anhydride)		1g
B4522	Benzofuran-3-boronic Acid (contains varying amounts of Anhydride)	1g	5g
B4774	Benzo[*b*]thiophene-3-boronic Acid (contains varying amounts of Anhydride)	1g	5g
B2893	Benzo[*b*]thiophene-2-ylboronic Acid (contains varying amounts of Anhydride)	1g	5g 25g
B3307	2-Bromopyridine-5-boronic Acid (contains varying amounts of Anhydride)	1g	5g
B2862	5-Bromo-2-thiopheneboronic Acid (contains varying amounts of Anhydride)	1g	5g
B4063	1-(*tert*-Butoxycarbonyl)-2-pyrroleboronic Acid (contains varying amounts of Anhydride)	1g	5g
C2560	2-Chloropyridine-3-boronic Acid (contains varying amounts of Anhydride)	1g	5g
C2589	2-Chloropyridine-4-boronic Acid (contains varying amounts of Anhydride)	1g	5g
C2288	2-Chloropyridine-5-boronic Acid (contains varying amounts of Anhydride)	1g	5g
C2066	5-Chloro-2-thiopheneboronic Acid (contains varying amounts of Anhydride)	1g	5g
D4567	Dibenzofuran-4-boronic Acid (contains varying amounts of Anhydride)	1g	5g
D4373	Dibenzothiophene-2-boronic Acid (contains varying amounts of Anhydride)	1g	5g
D4057	Dibenzothiophene-4-boronic Acid (contains varying amounts of Anhydride)	1g	5g
D4006	2,6-Difluoro-3-pyridineboronic Acid (contains varying amounts of Anhydride)	1g	5g
D4711	2,3-Dihydrobenzofuran-5-boronic Acid (contains varying amounts of Anhydride)		200mg
D4690	2,6-Dimethoxypyridine-3-boronic Acid (contains varying amounts of Anhydride)	1g	5g
D3823	Dithieno[3,2-*b*:2',3'-*d*]thiophene-2-boronic Acid (contains varying amounts of Anhydride)	200mg	1g
E1115	2-Ethoxypyridine-5-boronic Acid (contains varying amounts of Anhydride)	1g	5g
F0984	2-Fluoro-3-methylpyridine-5-boronic Acid (contains varying amounts of Anhydride)		1g
F0739	2-Fluoropyridine-3-boronic Acid (contains varying amounts of Anhydride)	5g	25g
F0935	2-Fluoropyridine-4-boronic Acid (contains varying amounts of Anhydride)	1g	5g
F0770	2-Fluoropyridine-5-boronic Acid (contains varying amounts of Anhydride)	1g	5g

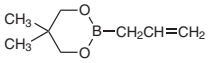
Product No.	Product Name			Unit Size
F0859	5-Fluoropyridine-3-boronic Acid (contains varying amounts of Anhydride)		1g	5g
F0548	5'-Formyl-2,2'-bithiophene-5-boronic Acid (contains varying amounts of Anhydride)			1g
F0611	5-Formyl-2-furanboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0549	5-Formyl-2-thiopheneboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0394	2-Furylboronic Acid (contains varying amounts of Anhydride)		1g	5g
F0438	3-Furylboronic Acid (contains varying amounts of Anhydride)		1g	5g
I0803	6-Indoleboronic Acid (contains varying amounts of Anhydride)			1g
M2159	2-Methoxypyridine-3-boronic Acid (contains varying amounts of Anhydride)		1g	5g
M2029	2-Methoxypyridine-5-boronic Acid (contains varying amounts of Anhydride)		1g	5g
M2335	2-Methoxy-5-pyrimidylboronic Acid (contains varying amounts of Anhydride)		1g	5g
M2035	3,4-(Methylenedioxy)phenylboronic Acid (contains varying amounts of Anhydride)		5g	25g
M1850	5-Methyl-2-thiopheneboronic Acid (contains varying amounts of Anhydride)		1g	5g
P2169	9-Phenylcarbazole-2-boronic Acid (contains varying amounts of Anhydride)		200mg	1g
P2001	9-Phenylcarbazole-3-boronic Acid (contains varying amounts of Anhydride)		5g	25g
P1673	3-Pyridylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
P1594	4-Pyridylboronic Acid (contains varying amounts of Anhydride)		1g	5g
P1759	5-Pyrimidylboronic Acid (contains varying amounts of Anhydride)		100mg	1g
Q0080	Quinoline-3-boronic Acid (contains varying amounts of Anhydride)		1g	5g
Q0087	Quinoline-5-boronic Acid (contains varying amounts of Anhydride)			200mg
Q0086	Quinoline-8-boronic Acid (contains varying amounts of Anhydride)		200mg	1g
T2621	Thieno[3,2-*b*]thiophene-2-boronic Acid (contains varying amounts of Anhydride)			1g
T1772	2-Thiopheneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
T1975	3-Thiopheneboronic Acid (contains varying amounts of Anhydride)		1g	5g
T3188	2-(Trifluoromethyl)pyridine-5-boronic Acid (contains varying amounts of Anhydride)			1g

Alkyl & Alkenylboronic Acid Esters

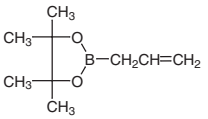
A2086



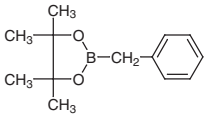
A2574



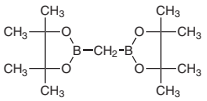
A2157



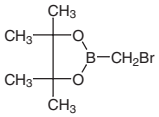
B3448



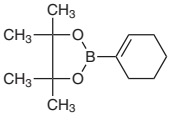
B4103



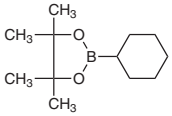
B3199



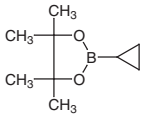
C2707



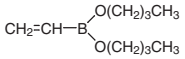
C3101



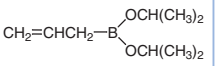
C2276



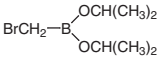
D3596



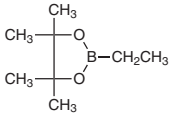
D3738



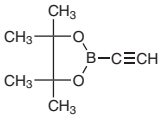
D3649



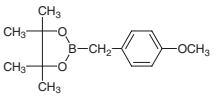
E1116



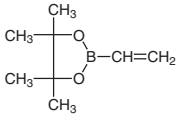
E1074



M2071



T2297

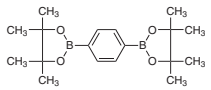


Product No.	Product Name		Unit Size
A2086	2-Allenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g
A2574	2-Allyl-5,5-dimethyl-1,3,2-dioxaborinane (stabilized with Phenothiazine)	1g	5g
A2157	2-Allyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (stabilized with Phenothiazine)	1g	5g
B3448	2-Benzyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g
B4103	Bis[(pinacolato)boryl]methane	1g	5g
B3199	2-(Bromomethyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g

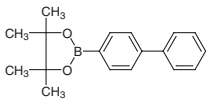
Product No.	Product Name	Unit Size
C2707	2-(1-Cyclohexenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g
C3101	2-Cyclohexyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g 5g
C2276	2-Cyclopropyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g 5g
D3596	Dibutyl Vinylboronate (stabilized with Phenothiazine)	1g 5g
D3738	Diisopropyl Allylboronate	1g 5g
D3649	Diisopropyl (Bromomethyl)boronate	1g 5g
E1116	2-Ethyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g 5g
E1074	2-Ethynyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	200mg 1g
M2071	2-(4-Methoxybenzyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	5g
T2297	4,4,5,5-Tetramethyl-2-vinyl-1,3,2-dioxaborolane (stabilized with Phenothiazine)	1g 5g 25g

Arylboronic Acid Esters

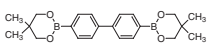
B4633



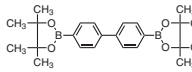
B3019



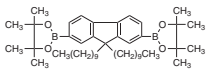
B3151



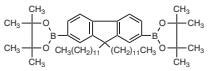
B4166



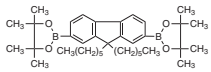
B4588



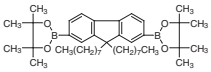
B4624



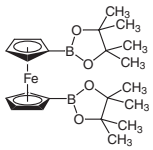
B4029



B3582

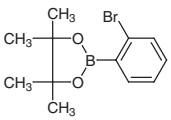


B3501

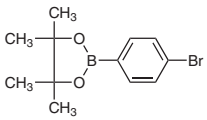


B3956

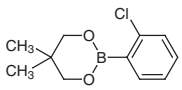
B2828



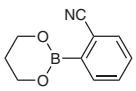
B4771



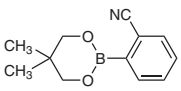
C2004



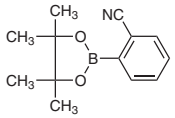
C2993



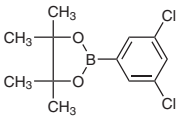
C2823



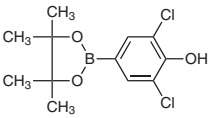
C2621



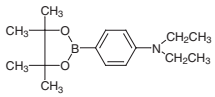
D4575



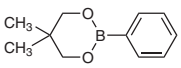
D4201



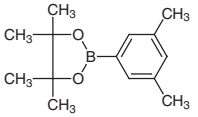
D3601



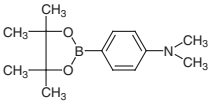
D4195



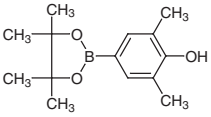
D3533



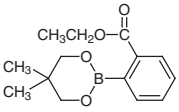
D3832



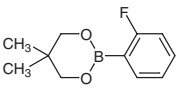
D2853



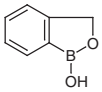
E0667



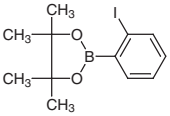
F0531



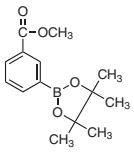
H1280

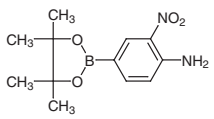


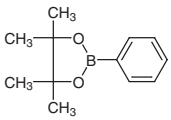
I0653

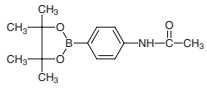


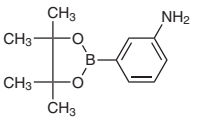
M2665

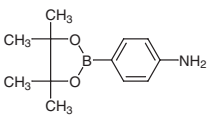


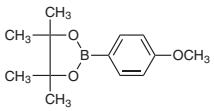
N0824 

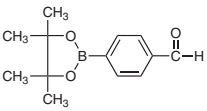
P1855 

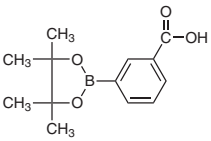
T1950 

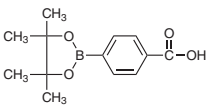
T3028 

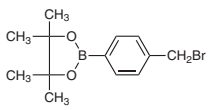
T1951 

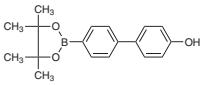
T3196 

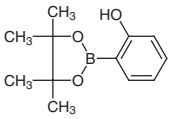
T2923 

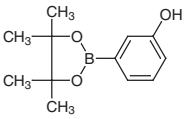
T3162 

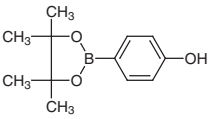
T2841 

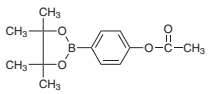
T2945 

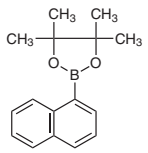
T3031 

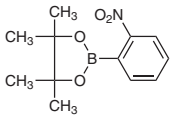
T1952 

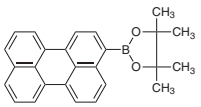
T1953 

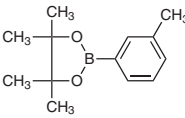
T1954 

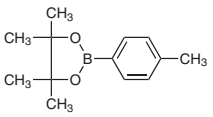
T3224 

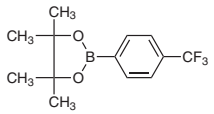
T3218 

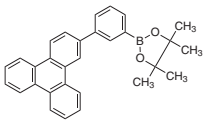
N1006 

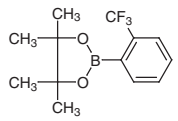
T3089 

T3219 

T2888 

T3103 

T3261 

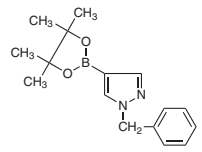
T2428 

Product No.	Product Name	Unit Size	
B4633	1,4-Benzenediboronic Acid Bis(pinacol) Ester	5g	25g
B3019	2-(4-Biphenylyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane		5g
B3151	4,4'-Bis(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)biphenyl		1g
B4166	4,4'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)biphenyl	1g	5g
B4588	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-didecylfluorene		1g
B4624	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-didodecylfluorene		1g
B4029	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-dihexylfluorene		1g
B3582	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-di-*n*-octylfluorene		1g
B3501	1,1'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)ferrocene	1g	5g
B3956	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrene	1g	5g
B2828	2-(2-Bromophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g
B4771	2-(4-Bromophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g
C2004	2-(2-Chlorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane		1g
C2993	2-Cyanophenylboronic Acid 1,3-Propanediol Ester	1g	5g
C2823	2-(2-Cyanophenyl)-5,5-dimethyl-1,3,2-dioxaborinane (This product is only available in Japan.)	1g	5g
C2621	2-(2-Cyanophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (This product is only available in Japan.)	1g	5g
D4575	2-(3,5-Dichlorophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	1g	5g
D4201	2,6-Dichloro-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenol	1g	5g
D3601	*N,N*-Diethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline	1g	5g
D4195	5,5-Dimethyl-2-phenyl-1,3,2-dioxaborinane	5g	25g
D3533	2-(3,5-Dimethylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane		5g
D3832	*N,N*-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline	1g	5g

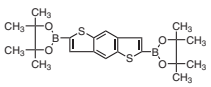
Product No.	Product Name	Unit Size	
D2853	2,6-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)phenol	1g	5g
E0667	Ethyl 2-(5,5-Dimethyl-1,3,2-dioxaborinan-2-yl)benzoate		1g
F0531	2-(2-Fluorophenyl)-5,5-dimethyl-1,3,2-dioxaborinane		1g
H1280	2-(Hydroxymethyl)phenylboronic Acid Cyclic Monoester	1g	5g
I0653	2-(2-Iodophenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane		1g
M2665	Methyl 3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzoate	1g	5g
N0824	2-Nitro-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)aniline		1g
P1855	2-Phenyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane	5g	25g
T1950	4'-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)acetanilide		1g
T3028	3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline	1g	5g
T1951	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline	1g	5g
T3196	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)anisole	5g	25g
T2923	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzaldehyde	1g	5g
T3162	3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzoic Acid	1g	5g
T2841	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzoic Acid		1g
T2945	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzyl Bromide	1g	5g
T3031	4'-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)biphenyl-4-ol	1g	5g
T1952	2-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol	1g	5g
T1953	3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol	1g	5g
T1954	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol	1g	5g
T3224	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl Acetate	1g	5g
T3218	4,4,5,5-Tetramethyl-2-(1-naphthyl)-1,3,2-dioxaborolane	1g	5g
N1006	4,4,5,5-Tetramethyl-2-(2-nitrophenyl)-1,3,2-dioxaborolane	1g	5g
T3089	4,4,5,5-Tetramethyl-2-(3-perylenyl)-1,3,2-dioxaborolane	200mg	1g
T3219	4,4,5,5-Tetramethyl-2-(*m*-tolyl)-1,3,2-dioxaborolane	1g	5g
T2888	4,4,5,5-Tetramethyl-2-(*p*-tolyl)-1,3,2-dioxaborolane	1g	5g
T3103	4,4,5,5-Tetramethyl-2-[4-(trifluoromethyl)phenyl]-1,3,2-dioxaborolane (This product is only available in Japan.)	1g	5g
T3261	4,4,5,5-Tetramethyl-2-[3-(triphenylen-2-yl)phenyl]-1,3,2-dioxaborolane	200mg	1g
T2428	2-[2-(Trifluoromethyl)phenyl]-4,4,5,5-tetramethyl-1,3,2-dioxaborolane		5g

Heteroarylboronic Acid Esters

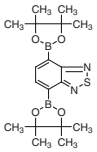
B4364



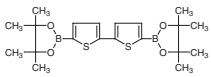
B4158



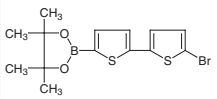
B3573



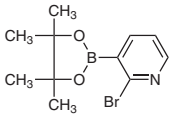
B3363



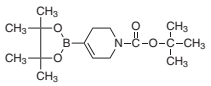
B3200



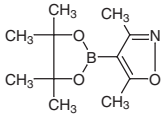
B3749



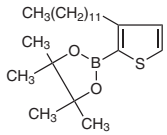
B4051



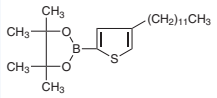
D3772



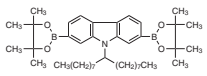
D4290



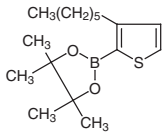
D4291



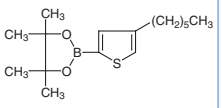
O0428



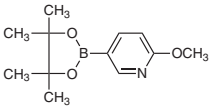
H1298



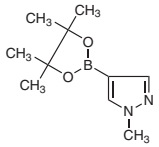
H1294



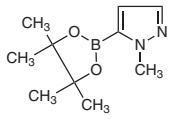
M2650



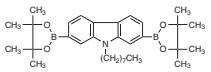
M2339



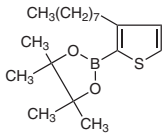
M2681



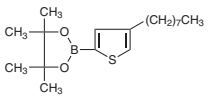
O0439



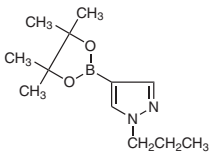
O0410



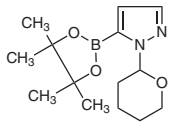
O0411



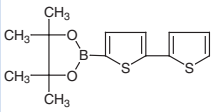
P2277



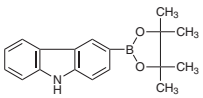
T3215



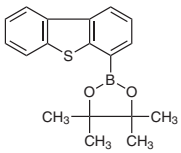
T2518



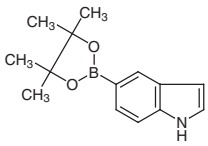
T3117



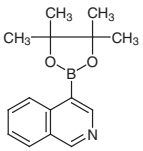
T3236



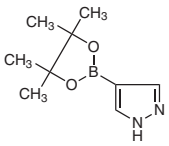
I0590



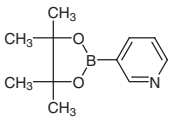
I0739



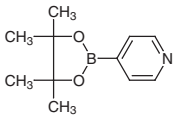
T2756



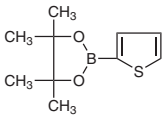
T2345



T2349

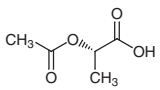
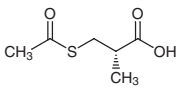
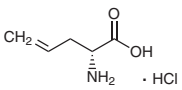
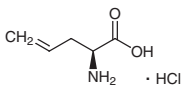
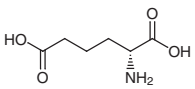
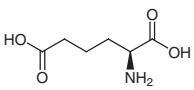
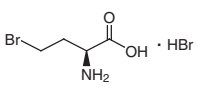
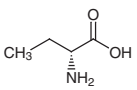
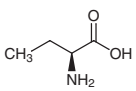
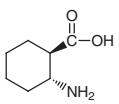
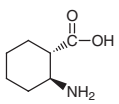
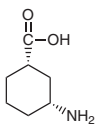
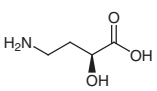
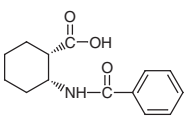
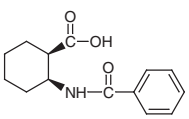
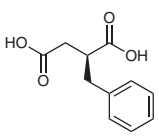
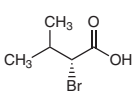
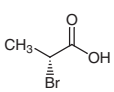
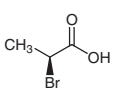
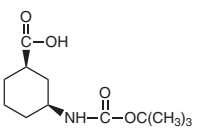
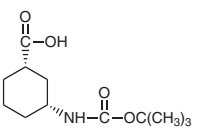
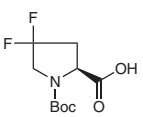
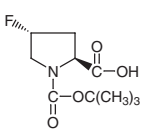
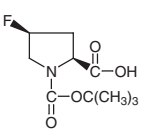
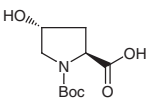
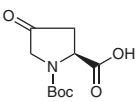
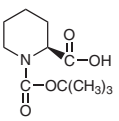
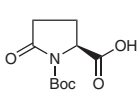
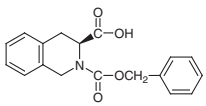
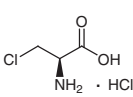
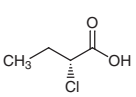
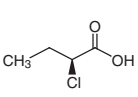


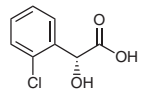
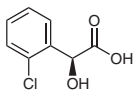
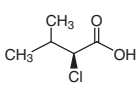
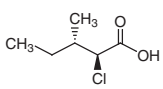
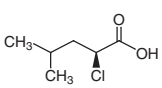
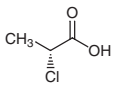
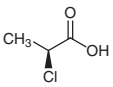
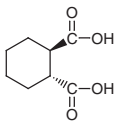
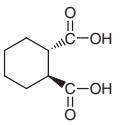
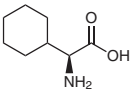
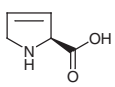
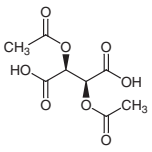
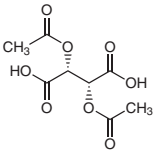
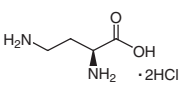
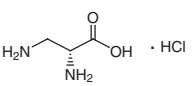
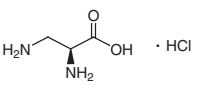
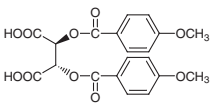
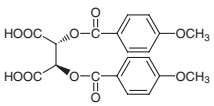
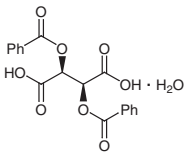
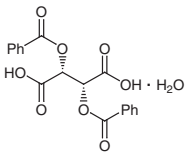
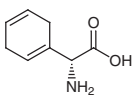
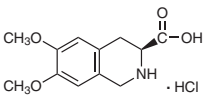
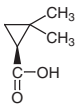
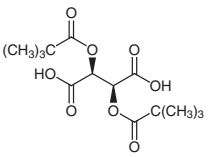
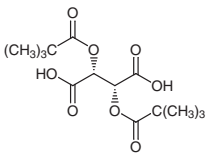
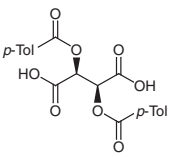
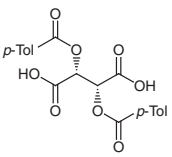
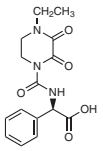
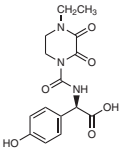
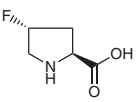
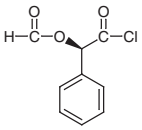
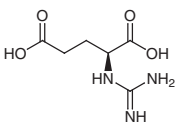
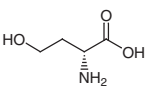
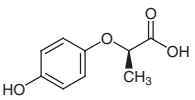
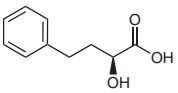
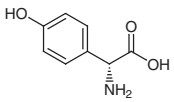
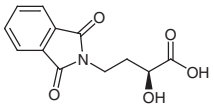
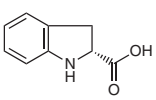
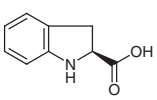
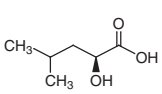
T2924

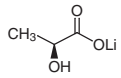
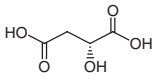
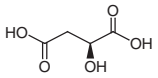
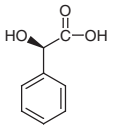
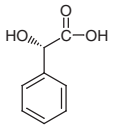
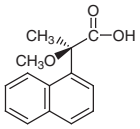
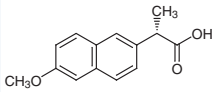
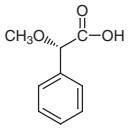
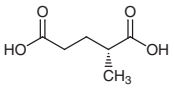
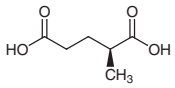
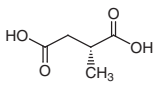
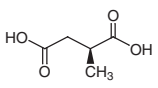
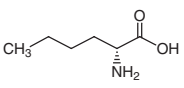
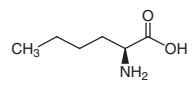
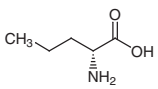
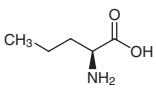
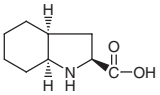
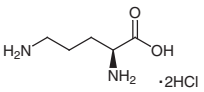
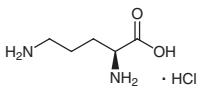
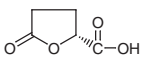
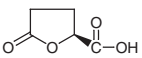
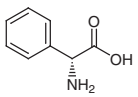
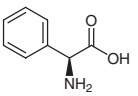
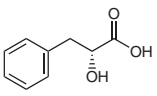
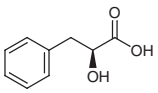
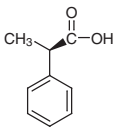
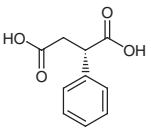
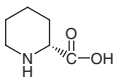
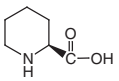
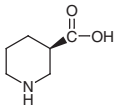
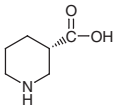
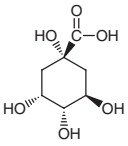
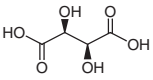
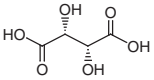
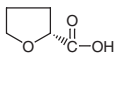
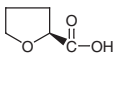
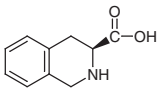
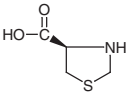
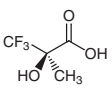


Product No.	Product Name	Unit Size		
B4364	1-Benzyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazole		1g	5g
B4158	2,6-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzo[1,2-*b*:4,5-*b*']dithiophene			1g
B3573	4,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,1,3-benzothiadiazole			1g
B3363	5,5'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene			5g
B3200	5-Bromo-5'-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene			1g
B3749	2-Bromo-3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine		1g	5g
B4051	1-(*tert*-Butoxycarbonyl)-1,2,3,6-tetrahydro-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine			1g
D3772	3,5-Dimethyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)isoxazole		1g	5g
D4290	3-Dodecyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
D4291	4-Dodecyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
O0428	9-(9-Heptadecanyl)-2,7-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-carbazole		200mg	1g
H1298	3-Hexyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene	1g	5g	25g
H1294	4-Hexyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene			5g
M2650	2-Methoxy-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine		1g	5g
M2339	1-Methyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazole		1g	5g
M2681	1-Methyl-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazole		1g	5g
O0439	9-*n*-Octyl-2,7-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)carbazole			200mg
O0410	3-*n*-Octyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
O0411	4-*n*-Octyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
P2277	1-Propyl-4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazole		1g	5g
T3215	1-(Tetrahydropyran-2-yl)-5-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-pyrazole		1g	5g
T2518	5-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene	1g	5g	25g
T3117	3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)carbazole		1g	5g
T3236	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)dibenzothiophene		1g	5g
I0590	5-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-1*H*-indole		1g	5g
I0739	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)isoquinoline		1g	5g
T2756	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyrazole		1g	5g
T2345	3-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine	1g	5g	25g
T2349	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)pyridine		1g	5g
T2924	2-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g

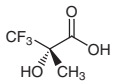
Chiral Building Blocks

Carboxylic Acids		A1299 	A1334 	A1647 
A1648 	A2153 	A1457 	A1450 	A1377 
A0826 	A1688 	A1689 	A2286 	A1438 
A1043 	B1121 	B1120 	B4142 	B4005 
B1756 	B1757 	B3538 	B3539 	B4202 
B3177 	B3178 	B1635 	B4141 	B3700 
B4083 	C1584 	C1612 	C2109 	C1377 

C1663 	C2738 	C1365 	C1372 	C1371 
C1655 	C1373 	C1953 	C1954 	C2569 
D3825 	D2636 	D1386 	D0083 	D1573 
D1377 	D3490 	D3491 	D1398 D3826 	D1354 D3492 
D2539 	D4375 	D3677 	D2702 	D2686 
D1417 	D1387 	E0993 	E0994 	F0818 
F0721 	G0265 	H1224 	H0937 	H1339 
H0758 	H0933 	I0589 	I0395 	L0026 

L0144 	M0021 	M0022 	M0662 	M0661 
M1366 	M1021 	M0830	M0829 	M1228 
M1229 	M1226 	M1227 	N0327 	N0303 
N0673 	N0686 	O0370 	O0089 	O0064 
O0281 	O0276 	P0820 	P1288 	P1981 
P1168 	P1219 	P0936 	P1830 	P1404 
N0654 	N0678 	Q0009 	T0026 	T0025 
T1740 	T1741 	T1515 	T0219 	T1900 

T1901

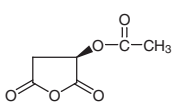


Product No.	Product Name		Unit Size	
A1299	(*S*)-(-)-2-Acetoxypropionic Acid		5g	25g
A1334	(*S*)-(-)-3-(Acetylthio)-2-methylpropionic Acid		5mL	25mL
A1647	D-2-Allylglycine Hydrochloride		200mg	1g
A1648	L-2-Allylglycine Hydrochloride	200mg	1g	5g
A2153	D-2-Aminoadipic Acid		1g	5g
A1457	L-2-Aminoadipic Acid		1g	5g
A1450	(*S*)-(+)-2-Amino-4-bromobutyric Acid Hydrobromide		1g	5g
A1377	(*R*)-(-)-2-Aminobutyric Acid		1g	5g
A0826	(*S*)-(+)-2-Aminobutyric Acid		1g	5g
A1688	(1*R*,2*R*)-2-Aminocyclohexanecarboxylic Acid			100mg
A1689	(1*S*,2*S*)-2-Aminocyclohexanecarboxylic Acid			100mg
A2286	(1*S*,3*R*)-3-Aminocyclohexanecarboxylic Acid			200mg
A1438	(*S*)-(-)-4-Amino-2-hydroxybutyric Acid		5g	25g
A1043	L-Azetidine-2-carboxylic Acid		100mg	1g
B1121	(+)-*cis*-2-Benzamidocyclohexanecarboxylic Acid			5g
B1120	(-)-*cis*-2-Benzamidocyclohexanecarboxylic Acid			5g
B4142	(*S*)-Benzylsuccinic Acid		5g	25g
B4005	(*R*)-2-Bromo-3-methylbutyric Acid			5g
B1756	(*R*)-(+)-2-Bromopropionic Acid		5g	25g
B1757	(*S*)-(-)-2-Bromopropionic Acid		5g	25g
B3538	(1*R*,3*S*)-3-(*tert*-Butoxycarbonylamino)cyclohexanecarboxylic Acid			1g
B3539	(1*S*,3*R*)-3-(*tert*-Butoxycarbonylamino)cyclohexanecarboxylic Acid			1g
B4202	(*S*)-1-(*tert*-Butoxycarbonyl)-4,4-difluoro-2-pyrrolidinecarboxylic Acid		200mg	1g
B3177	(2*S*,4*R*)-1-(*tert*-Butoxycarbonyl)-4-fluoro-2-pyrrolidinecarboxylic Acid		200mg	1g
B3178	(2*S*,4*S*)-1-(*tert*-Butoxycarbonyl)-4-fluoro-2-pyrrolidinecarboxylic Acid		200mg	1g
B1635	*trans*-*N*-(*tert*-Butoxycarbonyl)-4-hydroxy-L-proline			5g
B4141	*N*-(*tert*-Butoxycarbonyl)-4-oxo-L-proline		1g	5g
B3700	(*S*)-1-(*tert*-Butoxycarbonyl)-2-piperidinecarboxylic Acid		1g	5g
B4083	*N*-(*tert*-Butoxycarbonyl)-L-pyroglutamic Acid		5g	25g
C1584	(3*S*)-2-Carbobenzoxy-1,2,3,4-tetrahydroisoquinoline-3-carboxylic Acid			5g
C1612	3-Chloro-L-alanine Hydrochloride		1g	5g
C2109	(*R*)-2-Chlorobutyric Acid		1g	5g
C1377	(*S*)-2-Chlorobutyric Acid		1g	5g
C1663	2-Chloro-D-mandelic Acid		1g	5g
C2738	2-Chloro-L-mandelic Acid		5g	25g
C1365	(*S*)-2-Chloro-3-methylbutyric Acid		1g	5g
C1372	(2*S*,3*S*)-2-Chloro-3-methylvaleric Acid		1g	5g
C1371	(*S*)-2-Chloro-4-methylvaleric Acid		1g	5g
C1655	(*R*)-(+)-2-Chloropropionic Acid	1g	5g	25g
C1373	(*S*)-(-)-2-Chloropropionic Acid	1g	5g	25g
C1953	(1*R*,2*R*)-1,2-Cyclohexanedicarboxylic Acid		1g	5g
C1954	(1*S*,2*S*)-1,2-Cyclohexanedicarboxylic Acid		1g	5g
C2569	L-2-Cyclohexylglycine		1g	5g
D3825	3,4-Dehydro-L-proline		100mg	1g
D2636	(+)-Diacetyl-D-tartaric Acid			5g
D1386	(-)-Diacetyl-L-tartaric Acid			25g
D0083	(*S*)-(+)-2,4-Diaminobutyric Acid Dihydrochloride			1g
D1573	(*R*)-(-)-2,3-Diaminopropionic Acid Hydrochloride		100mg	1g
D1377	(*S*)-(+)-2,3-Diaminopropionic Acid Hydrochloride		100mg	1g
D3490	(+)-Di-*p*-anisoyl-D-tartaric Acid			25g
D3491	(-)-Di-*p*-anisoyl-L-tartaric Acid			25g
D1398	(+)-Dibenzoyl-D-tartaric Acid Monohydrate		25g	500g
D3826	(+)-Dibenzoyl-D-tartaric Acid		25g	250g
D1354	(-)-Dibenzoyl-L-tartaric Acid Monohydrate		25g	500g
D3492	(-)-Dibenzoyl-L-tartaric Acid		25g	250g
D2539	D-(-)-2-(2,5-Dihydrophenyl)glycine		5g	25g
D4375	(*S*)-(-)-6,7-Dimethoxy-1,2,3,4-tetrahydroisoquinoline-3-carboxylic Acid Hydrochloride		1g	5g
D3677	(*S*)-(+)-2,2-Dimethylcyclopropanecarboxylic Acid		1g	5g

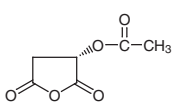
Product No.	Product Name			Unit Size
D2702	(+)-Dipivaloyl-D-tartaric Acid		1g	5g
D2686	(-)-Dipivaloyl-L-tartaric Acid		5g	25g
D1417	(+)-Di-*p*-toluoyl-D-tartaric Acid		25g	250g
D1387	(-)-Di-*p*-toluoyl-L-tartaric Acid		25g	250g
E0993	(*R*)-(-)-α-[[(4-Ethyl-2,3-dioxo-1-piperazinyl)carbonyl]amino]benzeneacetic Acid		1g	5g
E0994	(*R*)-(-)-α-[[(4-Ethyl-2,3-dioxo-1-piperazinyl)carbonyl]amino]-4-hydroxybenzeneacetic Acid		1g	5g
F0818	*trans*-4-Fluoro-L-proline			50mg
F0721	*O*-Formyl-D-mandeloyl Chloride			25g
G0265	(*S*)-(-)-2-Guanidinoglutaric Acid			100mg
H1224	D-Homoserine		1g	5g
H0937	(*R*)-(+)-2-(4-Hydroxyphenoxy)propionic Acid			5g
H1339	(*S*)-2-Hydroxy-4-phenylbutyric Acid		1g	5g
H0758	4-Hydroxy-D-(-)-2-phenylglycine		25g	500g
H0933	(*S*)-(+)-2-Hydroxy-4-phthalimidobutyric Acid			5g
I0589	(*R*)-(+)-Indoline-2-carboxylic Acid			1g
I0395	(*S*)-(-)-Indoline-2-carboxylic Acid		1g	5g
L0026	L-Leucic Acid	1g	5g	25g
L0144	Lithium L-Lactate			25g
M0021	D-(+)-Malic Acid		5g	25g
M0022	L-(-)-Malic Acid	25g	100g	500g
M0662	D-(-)-Mandelic Acid	25g	100g	500g
M0661	L-(+)-Mandelic Acid		25g	250g
M1366	(*R*)-(-)-2-Methoxy-2-(1-naphthyl)propionic Acid			100mg
M1021	(*S*)-(+)-2-(6-Methoxy-2-naphthyl)propionic Acid		25g	500g
M0830	(*R*)-(-)-α-Methoxyphenylacetic Acid	100mg	1g	5g
M0829	(*S*)-(+)-α-Methoxyphenylacetic Acid		1g	5g
M1228	(*R*)-(-)-2-Methylglutaric Acid			5g
M1229	(*S*)-(+)-2-Methylglutaric Acid			5g
M1226	(*R*)-(+)-Methylsuccinic Acid		5g	25g
M1227	(*S*)-(-)-Methylsuccinic Acid			5g
N0327	D-Norleucine		1g	10g
N0303	L-Norleucine	100mg	1g	5g
N0673	D-Norvaline	1g	5g	25g
N0686	L-Norvaline		1g	5g
O0370	(2*S*,3a*S*,7a*S*)-Octahydro-1*H*-indole-2-carboxylic Acid		1g	5g
O0089	L-Ornithine Dihydrochloride		1g	5g
O0064	L-Ornithine Monohydrochloride		25g	250g
O0281	(*R*)-(-)-5-Oxotetrahydrofuran-2-carboxylic Acid		1g	5g
O0276	(*S*)-(+)-5-Oxotetrahydrofuran-2-carboxylic Acid		1g	5g
P0820	D-2-Phenylglycine		25g	500g
P1288	L-2-Phenylglycine		25g	100g
P1981	D-(+)-3-Phenyllactic Acid		1g	5g
P1168	L-(-)-3-Phenyllactic Acid		1g	5g
P1219	(*R*)-(-)-2-Phenylpropionic Acid		1g	5g
P0936	(*S*)-(+)-Phenylsuccinic Acid			1g
P1830	D-Pipecolic Acid		5g	25g
P1404	L-Pipecolic Acid		1g	5g
N0654	(*R*)-(-)-3-Piperidinecarboxylic Acid		1g	5g
N0678	(*S*)-(+)-3-Piperidinecarboxylic Acid		1g	5g
Q0009	D-(-)-Quinic Acid		5g	25g
T0026	D-(-)-Tartaric Acid		25g	500g
T0025	L-(+)-Tartaric Acid		25g	500g
T1740	(*R*)-(+)-Tetrahydrofuran-2-carboxylic Acid		5g	25g
T1741	(*S*)-(-)-Tetrahydrofuran-2-carboxylic Acid	1g	5g	25g
T1515	(*S*)-(-)-1,2,3,4-Tetrahydroisoquinoline-3-carboxylic Acid		5g	25g
T0219	L-Thioproline		25g	500g
T1900	(*R*)-3,3,3-Trifluoro-2-hydroxy-2-methylpropionic Acid			1g
T1901	(*S*)-3,3,3-Trifluoro-2-hydroxy-2-methylpropionic Acid			1g

Esters

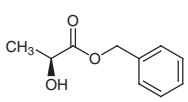
A2124

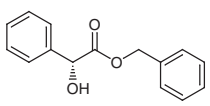
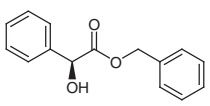
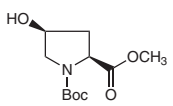
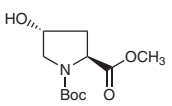
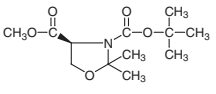
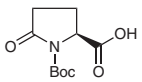
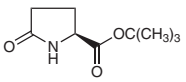
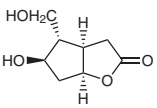
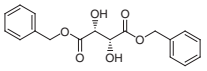
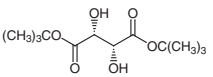
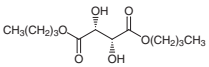
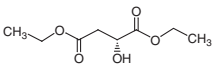
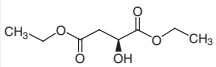
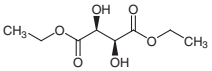
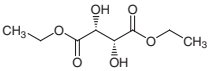
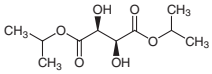
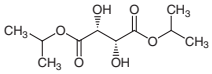
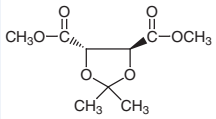
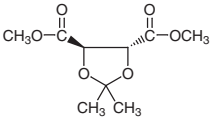
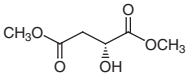
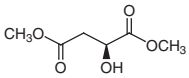
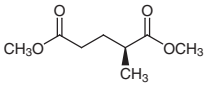
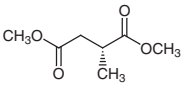
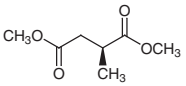
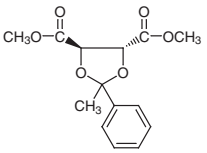
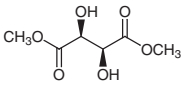
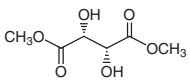
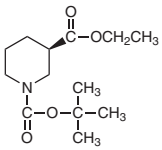
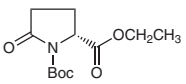
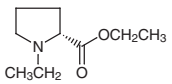
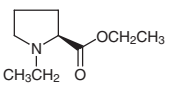
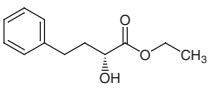
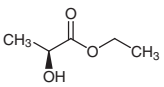
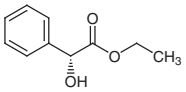
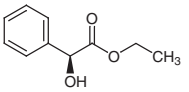
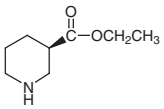
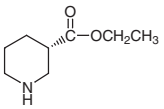
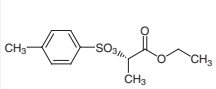
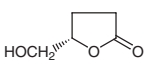
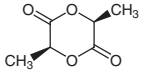


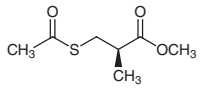
A1101

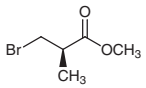


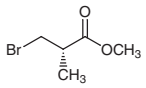
L0161

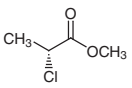


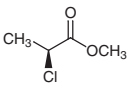
M1354 	M1355 	B3987 	B3843 	B1755 
B4083 	B4026 	H1418 	T1671 	D3898 
T0005 	M1351 	M1348 	T1195 	T0003 
T1387 	T0621 	I0474 	I0447 	M1347 
M1343 	M1230 	M1231 	M1232 	P1189 
T1659 	T0006 	E0948 	E0940 	E0469 
E0450 	H0904 	L0162 	M1344 	M1273 
N0655 	N0679 	T1241 	H0958 	L0115 

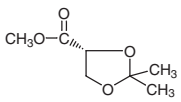
A1383


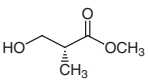
B2139


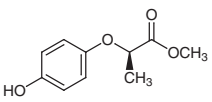
B2140


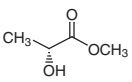
C1633


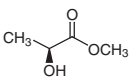
C1634


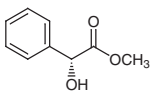
D2562


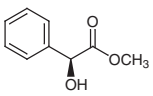
H0703


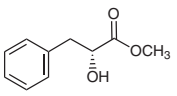
H0956


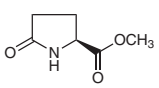
L0136


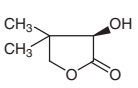
L0163


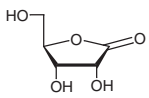
M1349


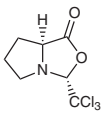
M1350


M2350


M2198


P0011


R0063


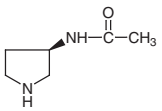
T2902


Product No.	Product Name	Unit Size	
A2124	(+)-*O*-Acetyl-D-malic Anhydride	1g	5g
A1101	(-)-*O*-Acetyl-L-malic Anhydride	5g	25g
L0161	Benzyl (*S*)-(-)-Lactate	5g	25g
M1354	Benzyl D-(-)-Mandelate	5g	25g
M1355	Benzyl L-(+)-Mandelate	5g	25g
B3987	*N*-(*tert*-Butoxycarbonyl)-*cis*-4-hydroxy-L-proline Methyl Ester	1g	5g
B3843	*N*-(*tert*-Butoxycarbonyl)-*trans*-4-hydroxy-L-proline Methyl Ester	1g	5g
B1755	(*S*)-(-)-3-*tert*-Butoxycarbonyl-4-methoxycarbonyl-2,2-dimethyl-1,3-oxazolidine	1g	5g 25g
B4083	*N*-(*tert*-Butoxycarbonyl)-L-pyroglutamic Acid	5g	25g
B4026	*tert*-Butyl L-Pyroglutamate	1g	5g
H1418	(-)-Corey Lactone	200mg	1g
T1671	Dibenzyl L-Tartrate		25g
D3898	Di-*tert*-butyl L-(+)-Tartrate		1g
T0005	Dibutyl L-(+)-Tartrate	25g	500g
M1351	Diethyl D-(+)-Malate	5g	25g
M1348	Diethyl L-(-)-Malate	5g	25g
T1195	Diethyl D-(-)-Tartrate	25g	250g
T0003	Diethyl L-(+)-Tartrate	25g	500g
T1387	Diisopropyl D-(-)-Tartrate	25g	250g
T0621	Diisopropyl L-(+)-Tartrate	25g	500g
I0474	Dimethyl (+)-2,3-*O*-Isopropylidene-D-tartrate		5g
I0447	Dimethyl (-)-2,3-*O*-Isopropylidene-L-tartrate	5g	25g
M1347	Dimethyl D-(+)-Malate	5g	25g
M1343	Dimethyl L-(-)-Malate	5g	25g
M1230	Dimethyl (*S*)-(+)-2-Methylglutarate		5g
M1231	Dimethyl (*R*)-(+)-Methylsuccinate		5g
M1232	Dimethyl (*S*)-(-)-Methylsuccinate		5g
P1189	Dimethyl (2*R*,3*R*)-2,3-*O*-(1-Phenylethylidene)-L-tartrate		5g
T1659	Dimethyl D-(-)-Tartrate	5g	25g
T0006	Dimethyl L-(+)-Tartrate		25g
E0948	Ethyl (*R*)-1-(*tert*-Butoxycarbonyl)-3-piperidinecarboxylate		5g
E0940	Ethyl *N*-(*tert*-Butoxycarbonyl)-D-pyroglutamate	1g	5g

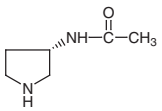
Product No.	Product Name	Unit Size	
E0469	Ethyl (*R*)-(+)-1-Ethyl-2-pyrrolidinecarboxylate	1g	5g
E0450	Ethyl (*S*)-(-)-1-Ethyl-2-pyrrolidinecarboxylate	1g	5g
H0904	Ethyl (*R*)-2-Hydroxy-4-phenylbutyrate		5g
L0162	Ethyl L-(-)-Lactate	25g	500g
M1344	Ethyl D-(-)-Mandelate	5g	25g
M1273	Ethyl L-(+)-Mandelate	5g	25g
N0655	Ethyl (*R*)-(-)-3-Piperidinecarboxylate	5g	25g
N0679	Ethyl (*S*)-(+)-3-Piperidinecarboxylate	5g	25g
T1241	Ethyl L-(-)-*O*-Tosyllactate	1g	25g
H0958	(*S*)-(+)-γ-Hydroxymethyl-γ-butyrolactone	1g	5g
L0115	L-(-)-Lactide	25g	250g
A1383	Methyl (*R*)-(+)-3-(Acetylthio)-2-methylpropionate		5mL
B2139	Methyl (*R*)-(+)-3-Bromoisobutyrate	1g	5g
B2140	Methyl (*S*)-(-)-3-Bromoisobutyrate	1g	5g
C1633	Methyl (*R*)-(+)-2-Chloropropionate		5g
C1634	Methyl (*S*)-(-)-2-Chloropropionate		5g
D2562	Methyl (*R*)-(+)-2,2-Dimethyl-1,3-dioxolane-4-carboxylate	5g	25g
H0703	Methyl (*R*)-(-)-3-Hydroxyisobutyrate	5g	25g
H0956	Methyl (*R*)-(+)-2-(4-Hydroxyphenoxy)propionate		25g
L0136	Methyl D-(+)-Lactate	5g	25g
L0163	Methyl L-(-)-Lactate	25g	500g
M1349	Methyl D-(-)-Mandelate	1g	5g
M1350	Methyl L-(+)-Mandelate	1g	5g
M2350	Methyl D-3-Phenyllactate	1g	5g
M2198	Methyl L-Pyroglutamate	25g	100g
P0011	D-(-)-Pantolactone	25g	500g
R0063	D-(+)-Ribono-1,4-lactone	1g	5g
T2902	(2*R*,5*S*)-2-Trichloromethyl-3-oxa-1-azabicyclo[3.3.0]octan-4-one		1g

Amides

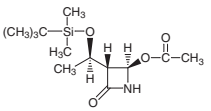
A1169



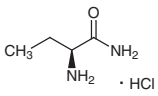
A1170



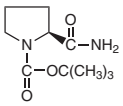
A1124



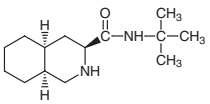
A2252



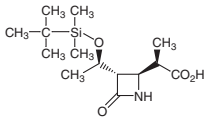
B3756



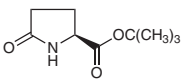
B3410



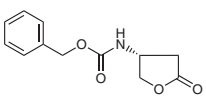
B1776



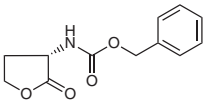
B4026



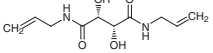
C2678



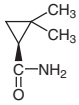
C2699



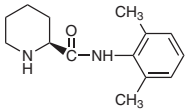
D1539



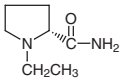
D3676



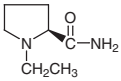
D4347



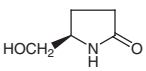
E0468



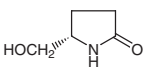
E0452



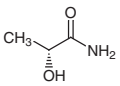
H1241



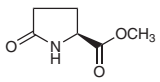
H0867



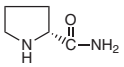
L0167



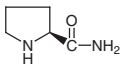
M2198



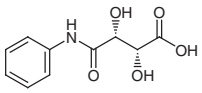
P2083



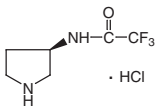
P1382



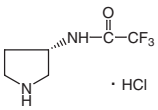
T1702



T1369



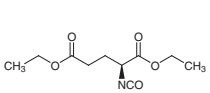
T1366



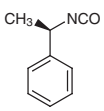
Product No.	Product Name	Unit Size	
A1169	(3*R*)-(+)-3-Acetamidopyrrolidine		5g
A1170	(3*S*)-(-)-3-Acetamidopyrrolidine		5g
A1124	(3*R*,4*R*)-4-Acetoxy-3-[(*R*)-(*tert*-butyldimethylsilyloxy)ethyl]-2-azetidinone	5g	25g
A2252	(*S*)-2-Aminobutyramide Hydrochloride	5g	25g
B3756	*N*-(*tert*-Butoxycarbonyl)-L-prolinamide	1g	5g
B3410	(*S*)-*N*-*tert*-Butyldecahydroisoquinoline-3-carboxamide	5g	25g
B1776	(3*S*,4*S*)-3-[(*R*)-1-(*tert*-Butyldimethylsilyloxy)ethyl]-4-[(*R*)-1-carboxyethyl]-2-azetidinone		1g
B4026	*tert*-Butyl L-Pyroglutamate	1g	5g
C2678	(*R*)-β-(Carbobenzoxyamino)-γ-butyrolactone		1g
C2699	*N*-Carbobenzoxy-L-homoserine Lactone	1g	5g
D1539	(+)-*N*,*N*'-Diallyl-L-tartardiamide		25g
D3676	(*S*)-(+)-2,2-Dimethylcyclopropanecarboxamide	5g	25g
D4347	(*S*)-*N*-(2,6-Dimethylphenyl)piperidine-2-carboxamide		5g
E0468	(*R*)-(+)-1-Ethyl-2-pyrrolidinecarboxamide	1g	5g
E0452	(*S*)-(-)-1-Ethyl-2-pyrrolidinecarboxamide	1g	5g
H1241	(*R*)-5-(Hydroxymethyl)-2-pyrrolidinone	1g	5g
H0867	(*S*)-5-(Hydroxymethyl)-2-pyrrolidinone	1g	5g
L0167	(*R*)-(+)-Lactamide	5g	25g
M2198	Methyl L-Pyroglutamate	25g	100g
P2083	D-Prolinamide	1g	5g
P1382	L-Prolinamide	5g	25g
T1702	(2*R*,3*R*)-Tartranilic Acid	1g	5g
T1369	(3*R*)-(+)-3-(Trifluoroacetamido)pyrrolidine Hydrochloride	1g	25g
T1366	(3*S*)-(-)-3-(Trifluoroacetamido)pyrrolidine Hydrochloride	1g	25g

Isocyanates

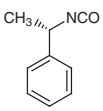
I0468



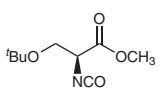
I0334



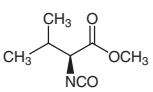
I0335



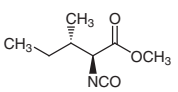
I0473



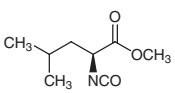
I0466



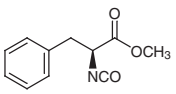
I0471

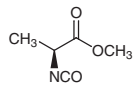
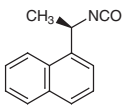
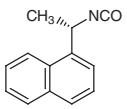


I0467



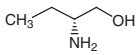
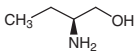
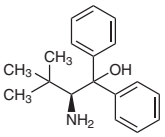
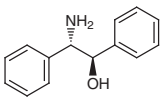
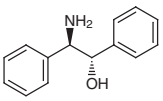
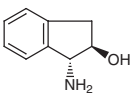
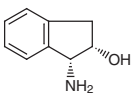
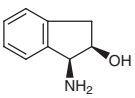
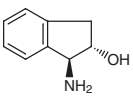
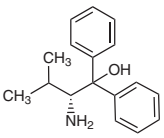
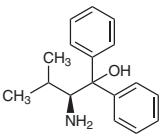
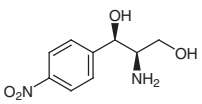
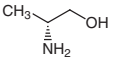
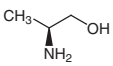
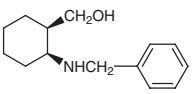
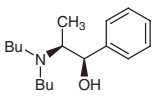
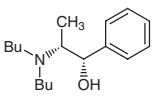
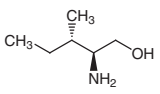
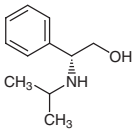
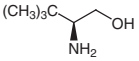
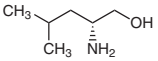
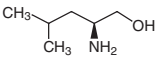
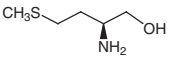
I0472

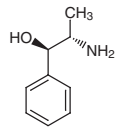
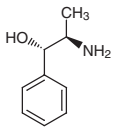
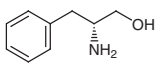
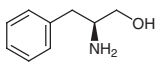
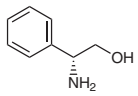
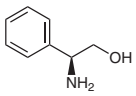
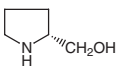
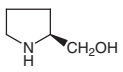
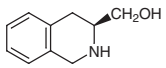
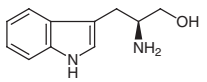
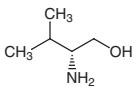
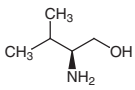


I0465	I0336	I0398
		

Product No.	Product Name	Unit Size		
I0468	Diethyl (*S*)-(-)-2-Isocyanatoglutarate		1g	5g
I0334	(*R*)-(+)-α-Methylbenzyl Isocyanate	1g	5g	25g
I0335	(*S*)-(-)-α-Methylbenzyl Isocyanate		1g	5g
I0473	Methyl (*S*)-(+)-2-Isocyanato-3-*tert*-butoxypropionate			1g
I0466	Methyl (*S*)-(-)-2-Isocyanato-3-methylbutyrate		1g	5g
I0471	Methyl (2*S*,3*S*)-2-Isocyanato-3-methylvalerate			5g
I0467	Methyl (*S*)-(-)-2-Isocyanato-4-methylvalerate		5g	25g
I0472	Methyl (*S*)-2-Isocyanato-3-phenylpropionate			5g
I0465	Methyl (*S*)-(-)-2-Isocyanatopropionate		1g	5g
I0336	(*R*)-(-)-1-(1-Naphthyl)ethyl Isocyanate		1g	5g
I0398	(*S*)-(+)-1-(1-Naphthyl)ethyl Isocyanate		1g	5g

Amino Alcohols

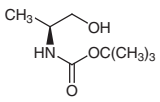
		A0972	A0973	A2503
				
A1230	A1231	A2306	A1623	A1624
				
A2307	A2533	A2504	A1017	A2002
				
A1085	B1119	D2128	D2129	I0462
				
I0476	L0160	L0236	L0137	M0929
				

N0608 	N0631 	P1289 	P1028 	P1201 
P1294 	P1274 	P1087 	T1755 	T1537 
V0077 	V0058 			

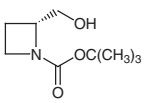
Product No.	Product Name			Unit Size
A0972	(*R*)-(-)-2-Amino-1-butanol			5mL
A0973	(*S*)-(+)-2-Amino-1-butanol		1mL	5mL
A2503	(*S*)-(-)-2-Amino-3,3-dimethyl-1,1-diphenyl-1-butanol		1g	5g
A1230	(1*R*,2*S*)-(-)-2-Amino-1,2-diphenylethanol		1g	5g
A1231	(1*S*,2*R*)-(+)-2-Amino-1,2-diphenylethanol		1g	5g
A2306	(1*R*,2*R*)-(-)-1-Amino-2-indanol		1g	5g
A1623	(1*R*,2*S*)-(+)-1-Amino-2-indanol		1g	5g
A1624	(1*S*,2*R*)-(-)-1-Amino-2-indanol		1g	5g
A2307	(1*S*,2*S*)-(+)-1-Amino-2-indanol		1g	5g
A2533	(*R*)-(+)-2-Amino-3-methyl-1,1-diphenyl-1-butanol			1g
A2504	(*S*)-(-)-2-Amino-3-methyl-1,1-diphenyl-1-butanol		1g	5g
A1017	D-(-)-*threo*-2-Amino-1-(4-nitrophenyl)-1,3-propanediol		25g	500g
A2002	(*R*)-(-)-2-Amino-1-propanol		5mL	25mL
A1085	(*S*)-(+)-2-Amino-1-propanol	1mL	5mL	25mL
B1119	(+)-*cis*-2-Benzylaminocyclohexanemethanol		1g	5g
D2128	(1*R*,2*S*)-2-(Dibutylamino)-1-phenyl-1-propanol		1g	5g
D2129	(1*S*,2*R*)-2-(Dibutylamino)-1-phenyl-1-propanol		1g	5g
I0462	L-Isoleucinol		1g	5g
I0476	(*R*)-2-Isopropylamino-2-phenylethanol		5g	25g
L0160	L-*tert*-Leucinol		1g	5g
L0236	D-(-)-Leucinol		1g	5g
L0137	L-(+)-Leucinol		5mL	25mL
M0929	L-(-)-Methioninol		100mg	1g
N0608	(1*R*,2*S*)-(-)-Norephedrine			25g
N0631	(1*S*,2*R*)-(+)-Norephedrine			25g
P1289	D-Phenylalaninol		5g	25g
P1028	L-Phenylalaninol		5g	25g
P1201	(*R*)-(-)-2-Phenylglycinol		5g	25g
P1294	(*S*)-(+)-2-Phenylglycinol		5g	25g
P1274	D-Prolinol	1g	5g	25g
P1087	L-Prolinol		5g	25g
T1755	(*S*)-1,2,3,4-Tetrahydroisoquinoline-3-methanol			1g
T1537	L-(-)-Tryptophanol			1g
V0077	D-Valinol		1g	5g
V0058	L-Valinol		5g	25g

N-Protected Amino Alcohols

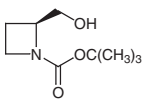
B1953



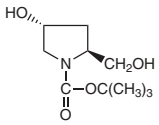
B2174



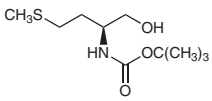
B2123



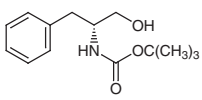
B3662



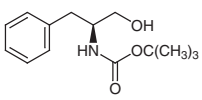
B4283



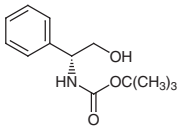
B1966



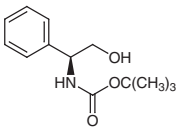
B2604



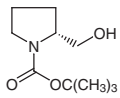
B3270



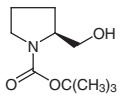
B3272



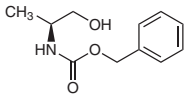
B3076



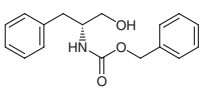
B3077



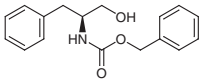
C2629



C1609



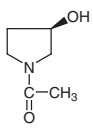
C1610



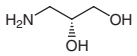
Product No.	Product Name	Unit Size	
B1953	*N*-(*tert*-Butoxycarbonyl)-L-alaninol	1g	5g
B2174	(*R*)-1-(*tert*-Butoxycarbonyl)-2-azetidinemethanol	100mg	1g
B2123	(*S*)-1-(*tert*-Butoxycarbonyl)-2-azetidinemethanol	100mg	1g
B3662	(2*S*,4*R*)-1-(*tert*-Butoxycarbonyl)-4-hydroxy-2-(hydroxymethyl)pyrrolidine	1g	5g
B4283	*N*-(*tert*-Butoxycarbonyl)-L-methioninol	1g	5g
B1966	*N*-(*tert*-Butoxycarbonyl)-D-phenylalaninol	1g	5g
B2604	*N*-(*tert*-Butoxycarbonyl)-L-phenylalaninol		5g
B3270	*N*-(*tert*-Butoxycarbonyl)-D-2-phenylglycinol	1g	5g
B3272	*N*-(*tert*-Butoxycarbonyl)-L-2-phenylglycinol	1g	5g
B3076	*N*-(*tert*-Butoxycarbonyl)-D-prolinol	1g	5g
B3077	*N*-(*tert*-Butoxycarbonyl)-L-prolinol	5g	25g
C2629	*N*-Carbobenzoxy-L-alaninol	1g	5g
C1609	*N*-Carbobenzoxy-D-phenylalaninol	1g	5g
C1610	*N*-Carbobenzoxy-L-phenylalaninol	1g	5g

Simple Alcohols

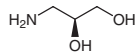
A2049



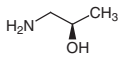
A1979



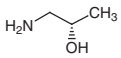
A1980



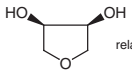
A0974



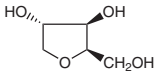
A0975



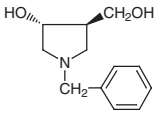
A1839

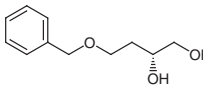
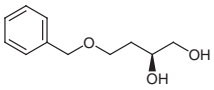
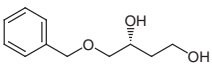
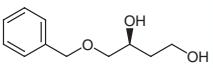
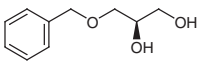
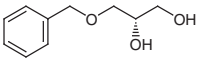
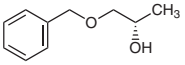
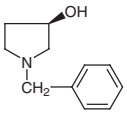
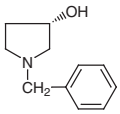
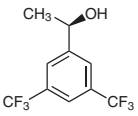
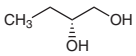
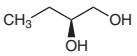
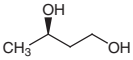
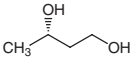
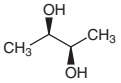
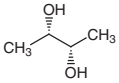
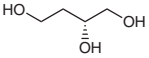
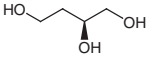
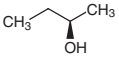
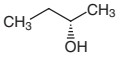
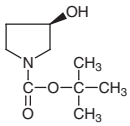
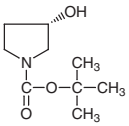
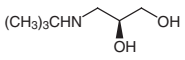
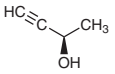
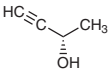
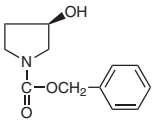
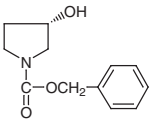
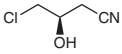
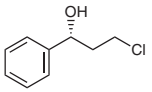
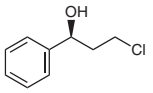
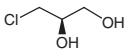
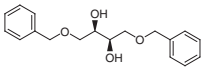
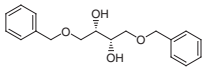
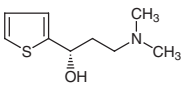
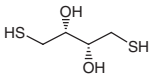
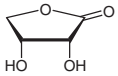
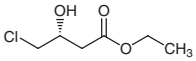
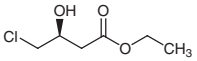
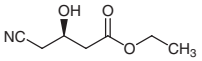
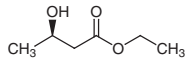


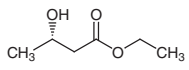
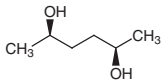
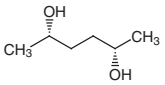
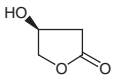
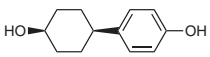
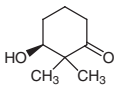
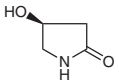
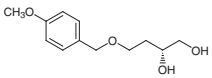
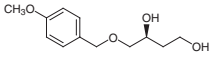
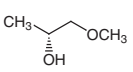
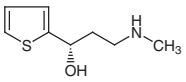
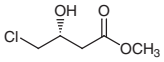
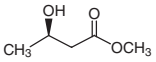
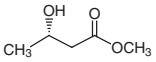
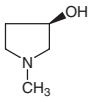
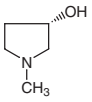
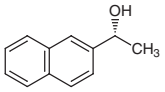
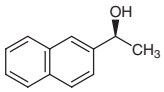
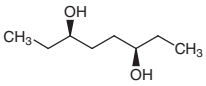
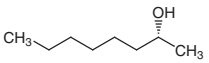
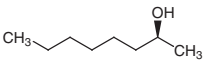
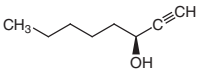
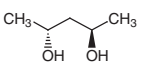
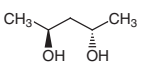
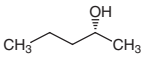
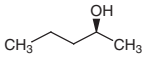
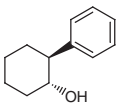
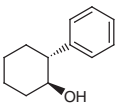
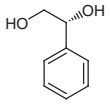
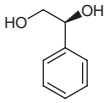
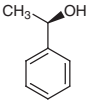
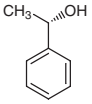
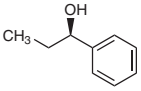
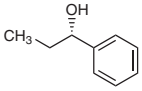
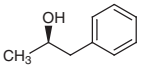
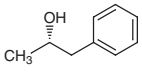
A2635

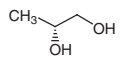
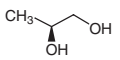
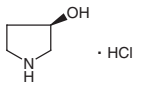
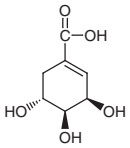
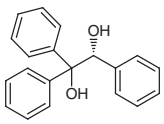
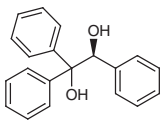


H1200



B2899 	B2900 	B2901 	B2902 	B2141 
B2142 	B4117 	B1532 	B1533 	B4131 
B4118 	B4119 	B1159 	B1160 	B1161 
B1343 	B3137 	B2404 	B0926 	B0925 
B3054 	B3055 	B1987 	B2909 	B2910 
C2585 	C2453 	C2763 	C2423 	C2424 
M0967 	D2239 	D2240 	D4010 	D1589 
E0455 	C1733 	C1717 	C1474 	H1029 

H0975 	H1032 	H0969 	H0950 	H0951 
H0939 	H1384 	H0887 	H1368 	H1332 
T1716 	M1788 	M1790 	M2166 	M2157 
M1483 	H0705 	H0704 	M1937 	M1938 
N0784 	N0785 	O0293 	O0145 	O0144 
O0235 	P1411 	P1412 	P0744 	P0743 
T1490 	T1491 	P1150 	P1151 	P0795 
P0796 	P1930 	P1931 	P1417 	P1780 

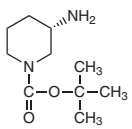
P1152	P1129	P1608	P1667	P1140
				
S0038	T2359	T2360	T1499	T1482
				

Product No.	Product Name	Unit Size		
A2049	(*R*)-1-Acetyl-3-pyrrolidinol			1g
A1979	(*R*)-3-Amino-1,2-propanediol		1g	5g
A1980	(*S*)-3-Amino-1,2-propanediol		1g	5g
A0974	(*R*)-(-)-1-Amino-2-propanol	1g	5g	25g
A0975	(*S*)-(+)-1-Amino-2-propanol		1g	5g
A1839	1,4-Anhydroerythritol			5g
A2635	1,4-Anhydro-D-xylitol		20mg	100mg
H1200	(3*R*,4*R*)-1-Benzyl-4-hydroxy-3-pyrrolidinemethanol			200mg
B2899	(*R*)-4-Benzyloxy-1,2-butanediol		200mg	1g
B2900	(*S*)-4-Benzyloxy-1,2-butanediol		200mg	1g
B2901	(*R*)-4-Benzyloxy-1,3-butanediol			1g
B2902	(*S*)-4-Benzyloxy-1,3-butanediol			1g
B2141	(*R*)-(+)-3-Benzyloxy-1,2-propanediol		100mg	1g
B2142	(*S*)-(-)-3-Benzyloxy-1,2-propanediol		100mg	1g
B4117	(*S*)-(+)-1-Benzyloxy-2-propanol		1g	5g
B1532	(*R*)-1-Benzyl-3-pyrrolidinol		1g	5g
B1533	(*S*)-1-Benzyl-3-pyrrolidinol		5g	25g
B4131	(*R*)-1-[3,5-Bis(trifluoromethyl)phenyl]ethanol		5g	25g
B4118	(*R*)-1,2-Butanediol		1g	5g
B4119	(*S*)-1,2-Butanediol		1g	5g
B1159	(*R*)-(-)-1,3-Butanediol		1g	5g
B1160	(*S*)-(+)-1,3-Butanediol		1g	5g
B1161	(*R*,*R*)-(-)-2,3-Butanediol		1g	5g
B1343	(*S*,*S*)-(+)-2,3-Butanediol		100mg	1g
B3137	(*R*)-1,2,4-Butanetriol		1g	5g
B2404	(*S*)-1,2,4-Butanetriol		5g	25g
B0926	(*R*)-(-)-2-Butanol		1mL	5mL
B0925	(*S*)-(+)-2-Butanol		1mL	5mL
B3054	(*R*)-1-(*tert*-Butoxycarbonyl)-3-pyrrolidinol		1g	5g
B3055	(*S*)-1-(*tert*-Butoxycarbonyl)-3-pyrrolidinol		1g	5g
B1987	(*S*)-(-)-3-*tert*-Butylamino-1,2-propanediol			5g
B2909	(*R*)-(+)-3-Butyn-2-ol		1g	5g
B2910	(*S*)-(-)-3-Butyn-2-ol			1g
C2585	(*R*)-1-Carbobenzoxy-3-pyrrolidinol		1g	5g
C2453	(*S*)-1-Carbobenzoxy-3-pyrrolidinol		1g	5g
C2763	(*R*)-(+)-4-Chloro-3-hydroxybutyronitrile		1g	5g
C2423	(*R*)-(+)-3-Chloro-1-phenyl-1-propanol			1g
C2424	(*S*)-(-)-3-Chloro-1-phenyl-1-propanol			1g
M0967	(*R*)-(-)-3-Chloro-1,2-propanediol		10g	25g
D2239	(+)-1,4-Di-*O*-benzyl-D-threitol			1g
D2240	(-)-1,4-Di-*O*-benzyl-L-threitol			1g
D4010	(*S*)-3-(Dimethylamino)-1-(2-thienyl)-1-propanol		1g	5g
D1589	L-Dithiothreitol		1g	5g
E0455	D-Erythronolactone	1g	5g	25g
C1733	Ethyl (*R*)-4-Chloro-3-hydroxybutyrate		5g	25g
C1717	Ethyl (*S*)-4-Chloro-3-hydroxybutyrate		5g	25g
C1474	Ethyl (*R*)-(-)-4-Cyano-3-hydroxybutyrate	1g	5g	25g
H1029	Ethyl (*R*)-(-)-3-Hydroxybutyrate		1g	5g
H0975	Ethyl (*S*)-(+)-3-Hydroxybutyrate		5g	25g
H1032	(2*R*,5*R*)-2,5-Hexanediol			1g

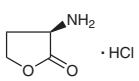
Product No.	Product Name	Unit Size		
H0969	(2*S*,5*S*)-2,5-Hexanediol		1g	5g
H0950	(*R*)-(+)-α-Hydroxy-γ-butyrolactone		100mg	1g
H0951	(*S*)-(-)-α-Hydroxy-γ-butyrolactone			100mg
H0939	(*S*)-3-Hydroxy-γ-butyrolactone		1g	5g
H1384	4-(*cis*-4-Hydroxycyclohexyl)phenol			1g
H0887	(*S*)-(+)-3-Hydroxy-2,2-dimethylcyclohexanone			100mg
H1368	(*S*)-(-)-4-Hydroxy-2-pyrrolidone			1g
H1332	(*R*)-3-Hydroxytetrahydrofuran		1g	5g
T1716	(*S*)-3-Hydroxytetrahydrofuran		1g	5g
M1788	(*R*)-4-(4-Methoxybenzyloxy)-1,2-butanediol			500mg
M1790	(*S*)-4-(4-Methoxybenzyloxy)-1,3-butanediol			500mg
M2166	(*R*)-(-)-1-Methoxy-2-propanol		5g	25g
M2157	(*S*)-3-(Methylamino)-1-(2-thienyl)-1-propanol		5g	25g
M1483	Methyl (*R*)-4-Chloro-3-hydroxybutyrate			5g
H0705	Methyl (*R*)-(-)-3-Hydroxybutyrate		10mL	25mL
H0704	Methyl (*S*)-(+)-3-Hydroxybutyrate		5mL	25mL
M1937	(*R*)-1-Methyl-3-pyrrolidinol		1g	5g
M1938	(*S*)-1-Methyl-3-pyrrolidinol		1g	5g
N0784	(*R*)-(+)-1-(2-Naphthyl)ethanol			1g
N0785	(*S*)-(-)-1-(2-Naphthyl)ethanol			1g
O0293	(3*R*,6*R*)-3,6-Octanediol			500mg
O0145	(*R*)-(-)-2-Octanol		5mL	25mL
O0144	(*S*)-(+)-2-Octanol		5mL	25mL
O0235	(*S*)-1-Octyn-3-ol		1g	5g
P1411	(2*R*,4*R*)-(-)-2,4-Pentanediol			1g
P1412	(2*S*,4*S*)-(+)-2,4-Pentanediol			1g
P0744	(*R*)-(-)-2-Pentanol		1mL	5mL
P0743	(*S*)-(+)-2-Pentanol		1mL	5mL
T1490	(1*R*,2*S*)-(-)-*trans*-2-Phenyl-1-cyclohexanol		100mg	1g
T1491	(1*S*,2*R*)-(+)-*trans*-2-Phenyl-1-cyclohexanol		100mg	1g
P1150	(*R*)-(-)-1-Phenylethane-1,2-diol	1g	5g	25g
P1151	(*S*)-(+)-1-Phenylethane-1,2-diol		1g	5g
P0795	(*R*)-(+)-1-Phenylethyl Alcohol	1g	5g	25g
P0796	(*S*)-(-)-1-Phenylethyl Alcohol	1g	5g	25g
P1930	(*R*)-(+)-1-Phenyl-1-propanol			1g
P1931	(*S*)-(-)-1-Phenyl-1-propanol			1g
P1417	(*R*)-1-Phenyl-2-propanol			1mL
P1780	(*S*)-1-Phenyl-2-propanol			1mL
P1152	(*R*)-(-)-1,2-Propanediol		5g	25g
P1129	(*S*)-(+)-1,2-Propanediol			5g
P1608	(*R*)-3-Pyrrolidinol		1g	5g
P1667	(*S*)-3-Pyrrolidinol	1g	5g	25g
P1140	(*R*)-(-)-3-Pyrrolidinol Hydrochloride		5g	25g
S0038	Shikimic Acid	100mg	1g	5g
T2359	(*R*)-(-)-1,2,3,4-Tetrahydro-1-naphthol		100mg	1g
T2360	(*S*)-(+)-1,2,3,4-Tetrahydro-1-naphthol		100mg	1g
T1499	(*R*)-(+)-1,1,2-Triphenyl-1,2-ethanediol		1g	5g
T1482	(*S*)-(-)-1,1,2-Triphenyl-1,2-ethanediol			1g

Amines

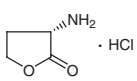
A2335



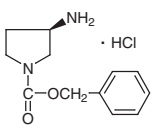
A2512



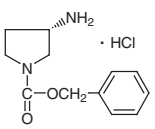
A1445



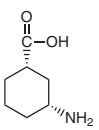
A2323



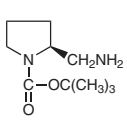
A2324



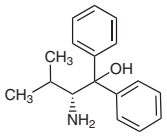
A2286

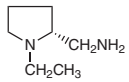
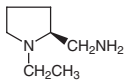
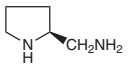
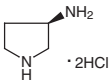
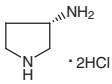
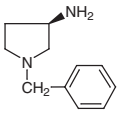
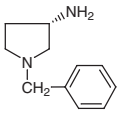
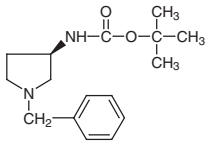
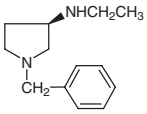
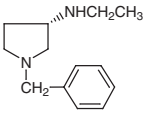
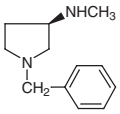
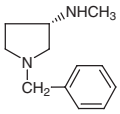
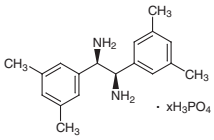
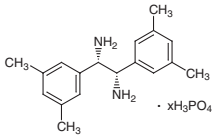
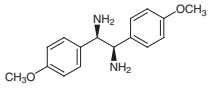
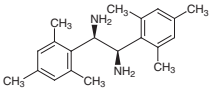
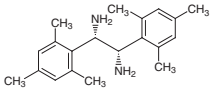
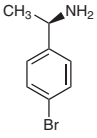
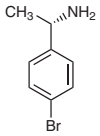
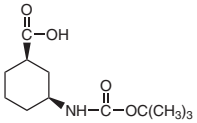
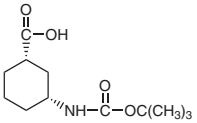
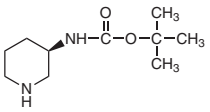
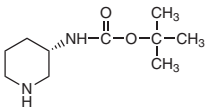
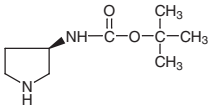
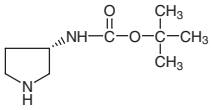
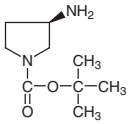
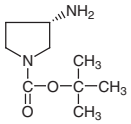
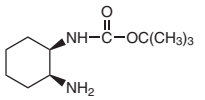
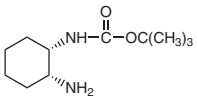
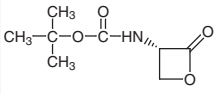
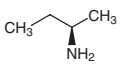
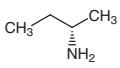
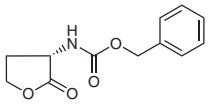
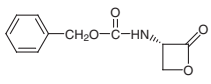
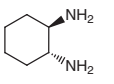
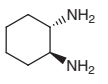
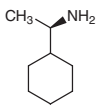
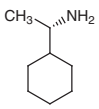


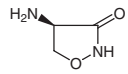
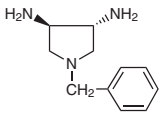
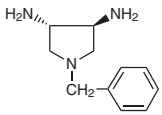
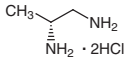
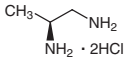
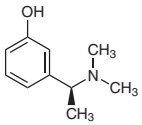
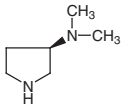
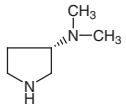
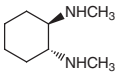
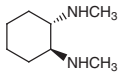
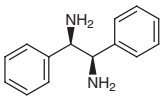
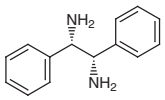
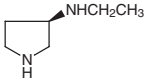
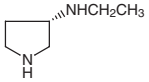
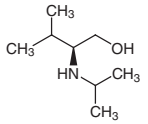
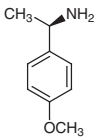
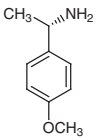
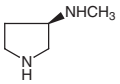
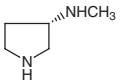
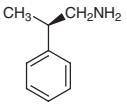
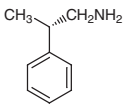
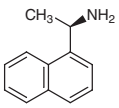
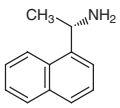
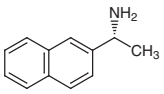
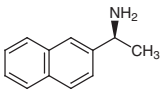
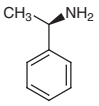
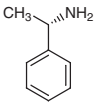
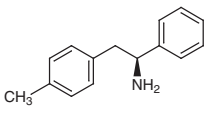
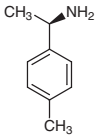
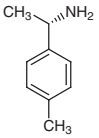
A2473



A2533



A1342 	A1301 	A2206 	A1167 	A1168 
A1053 	A1054 	A1173 	A1174 	B1932 
B1580 	B1581 	B1582 	B1583 	B2775 
B2776 	B3225 	B2316 	B2317 	B3672 
B3674 	B3538 	B3539 	B3591 	B3660 
A1171 	A1172 	B2920 	B2921 	B3478 
B3483 	B1995 	B2917 	B2918 	C2699 
C1575 	C1447 	C1448 	C1541 	C1531 

C1189 	D4035 	D4036 	D2827 	D2828 
D4258 	D2149 	D2193 	D2459 	D2460 
D2176 	D2175 	E0433 	E0434 	I0480 
M1511 	M1512 	M1107 	M1108 	M1746 
M1747 	N0482 	N0481 	N0724 	N0726 
P0794 	P0793 	P1118 	T2926 	T2878 
T1380 	T1381 			

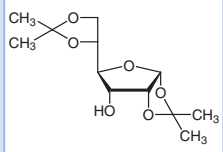
Product No.	Product Name	Unit Size
A2335	(*S*)-3-Amino-1-*tert*-butoxycarbonylpiperidine	1g
A2512	(*R*)-(+)-α-Amino-γ-butyrolactone Hydrochloride	1g 5g
A1445	(*S*)-(-)-α-Amino-γ-butyrolactone Hydrochloride	1g
A2323	(*R*)-3-Amino-1-carbobenzoxypyrrolidine Hydrochloride	1g 5g
A2324	(*S*)-3-Amino-1-carbobenzoxypyrrolidine Hydrochloride	1g 5g
A2286	(1*S*,3*R*)-3-Aminocyclohexanecarboxylic Acid	200mg

Product No.	Product Name	Unit Size		
A2473	(*S*)-2-(Aminomethyl)-1-(*tert*-butoxycarbonyl)pyrrolidine			1g
A2533	(*R*)-(+)-2-Amino-3-methyl-1,1-diphenyl-1-butanol			1g
A1342	(*R*)-(+)-2-Aminomethyl-1-ethylpyrrolidine			1g
A1301	(*S*)-(-)-2-Aminomethyl-1-ethylpyrrolidine		1g	5g
A2206	(*S*)-2-(Aminomethyl)pyrrolidine		200mg	1g
A1167	(3*R*)-(+)-3-Aminopyrrolidine		5g	25g
A1168	(3*S*)-(-)-3-Aminopyrrolidine		5g	25g
A1053	(3*R*)-(-)-3-Aminopyrrolidine Dihydrochloride		5g	25g
A1054	(3*S*)-(+)-3-Aminopyrrolidine Dihydrochloride		5g	25g
A1173	(3*R*)-(-)-1-Benzyl-3-aminopyrrolidine		10g	25g
A1174	(3*S*)-(+)-1-Benzyl-3-aminopyrrolidine		10g	25g
B1932	(3*R*)-(+)-1-Benzyl-3-(*tert*-butoxycarbonylamino)pyrrolidine			5g
B1580	(3*R*)-(-)-1-Benzyl-3-(ethylamino)pyrrolidine			5g
B1581	(3*S*)-(+)-1-Benzyl-3-(ethylamino)pyrrolidine			5g
B1582	(3*R*)-(-)-1-Benzyl-3-(methylamino)pyrrolidine		5g	25g
B1583	(3*S*)-(+)-1-Benzyl-3-(methylamino)pyrrolidine		5g	25g
B2775	(1*R*,2*R*)-1,2-Bis(3,5-dimethylphenyl)-1,2-ethylenediamine Phosphate			100mg
B2776	(1*S*,2*S*)-1,2-Bis(3,5-dimethylphenyl)-1,2-ethylenediamine Phosphate			100mg
B3225	(1*R*,2*R*)-1,2-Bis(4-methoxyphenyl)ethylenediamine		Price on request	
B2316	(1*R*,2*R*)-1,2-Bis(2,4,6-trimethylphenyl)ethylenediamine		100mg	500mg
B2317	(1*S*,2*S*)-1,2-Bis(2,4,6-trimethylphenyl)ethylenediamine		100mg	500mg
B3672	(*R*)-(+)-1-(4-Bromophenyl)ethylamine		1g	5g
B3674	(*S*)-(-)-1-(4-Bromophenyl)ethylamine		5g	25g
B3538	(1*R*,3*S*)-3-(*tert*-Butoxycarbonylamino)cyclohexanecarboxylic Acid			1g
B3539	(1*S*,3*R*)-3-(*tert*-Butoxycarbonylamino)cyclohexanecarboxylic Acid			1g
B3591	(*R*)-3-(*tert*-Butoxycarbonylamino)piperidine		1g	5g
B3660	(*S*)-3-(*tert*-Butoxycarbonylamino)piperidine		1g	5g
A1171	(3*R*)-(+)-3-(*tert*-Butoxycarbonylamino)pyrrolidine		5g	25g
A1172	(3*S*)-(-)-3-(*tert*-Butoxycarbonylamino)pyrrolidine		5g	25g
B2920	(3*R*)-(+)-1-(*tert*-Butoxycarbonyl)-3-aminopyrrolidine		1g	5g
B2921	(3*S*)-(-)-1-(*tert*-Butoxycarbonyl)-3-aminopyrrolidine		1g	5g
B3478	(1*R*,2*S*)-*N*'-(*tert*-Butoxycarbonyl)-1,2-cyclohexanediamine		1g	5g
B3483	(1*S*,2*R*)-*N*'-(*tert*-Butoxycarbonyl)-1,2-cyclohexanediamine		1g	5g
B1995	*N*-(*tert*-Butoxycarbonyl)-L-serine β-Lactone		1g	5g
B2917	(*R*)-(-)-*sec*-Butylamine		100mg	1g
B2918	(*S*)-(+)-*sec*-Butylamine			1g
C2699	*N*-Carbobenzoxy-L-homoserine Lactone		1g	5g
C1575	*N*-Carbobenzoxy-L-serine β-Lactone			1g
C1447	(1*R*,2*R*)-(-)-1,2-Cyclohexanediamine		5g	25g
C1448	(1*S*,2*S*)-(+)-1,2-Cyclohexanediamine		5g	25g
C1541	(*R*)-(-)-1-Cyclohexylethylamine		5g	25g
C1531	(*S*)-(+)-1-Cyclohexylethylamine		5g	25g
C1189	D-(+)-Cycloserine		1g	5g
D4035	(3*R*,4*R*)-(-)-3,4-Diamino-1-benzylpyrrolidine			50mg
D4036	(3*S*,4*S*)-(+)-3,4-Diamino-1-benzylpyrrolidine			50mg
D2827	(*R*)-1,2-Diaminopropane Dihydrochloride			1g
D2828	(*S*)-1,2-Diaminopropane Dihydrochloride			1g
D4258	(*S*)-3-[1-(Dimethylamino)ethyl]phenol		1g	5g
D2149	(3*R*)-(+)-3-(Dimethylamino)pyrrolidine		1g	5g
D2193	(3*S*)-(-)-3-(Dimethylamino)pyrrolidine		1g	5g
D2459	(1*R*,2*R*)-(-)-*N*,*N*'-Dimethylcyclohexane-1,2-diamine		100mg	1g
D2460	(1*S*,2*S*)-(+)-*N*,*N*'-Dimethylcyclohexane-1,2-diamine	100mg	1g	5g
D2176	(1*R*,2*R*)-(+)-1,2-Diphenylethylenediamine		1g	5g
D2175	(1*S*,2*S*)-(-)-1,2-Diphenylethylenediamine		1g	5g
E0433	(3*R*)-(+)-3-(Ethylamino)pyrrolidine			1g
E0434	(3*S*)-(-)-3-(Ethylamino)pyrrolidine			1g
I0480	(*S*)-2-Isopropylamino-3-methyl-1-butanol			5g
M1511	(*R*)-(+)-1-(4-Methoxyphenyl)ethylamine		5g	25g
M1512	(*S*)-(-)-1-(4-Methoxyphenyl)ethylamine		5g	25g
M1107	(3*R*)-(+)-3-(Methylamino)pyrrolidine		1g	5g
M1108	(3*S*)-(-)-3-(Methylamino)pyrrolidine		1g	5g
M1746	(*R*)-(+)-β-Methylphenethylamine		5g	25g
M1747	(*S*)-(-)-β-Methylphenethylamine		5g	25g
N0482	(*R*)-(+)-1-(1-Naphthyl)ethylamine		1g	5g
N0481	(*S*)-(-)-1-(1-Naphthyl)ethylamine		1g	5g
N0724	(*R*)-1-(2-Naphthyl)ethylamine		1g	5g
N0726	(*S*)-1-(2-Naphthyl)ethylamine		1g	5g
P0794	(*R*)-(+)-1-Phenylethylamine	25mL	100mL	500mL

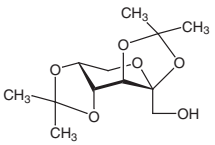
Product No.	Product Name	Unit Size		
P0793	(*S*)-(-)-1-Phenylethylamine	25mL	100mL	500mL
P1118	(*S*)-1-Phenyl-2-(*p*-tolyl)ethylamine		5g	25g
T2926	(*R*)-(-)-1,2,3,4-Tetrahydro-1-naphthylamine		5g	25g
T2878	(*S*)-(+)-1,2,3,4-Tetrahydro-1-naphthylamine		5g	25g
T1380	(*R*)-(+)-1-(*p*-Tolyl)ethylamine			1mL
T1381	(*S*)-(-)-1-(*p*-Tolyl)ethylamine		1mL	5mL

Isopropylidene Sugars

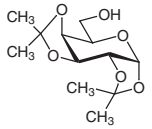
D2265



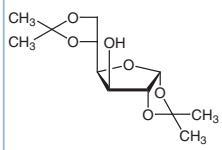
D3758



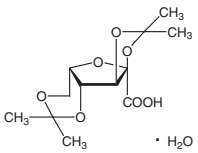
D2555



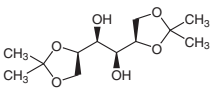
D1949



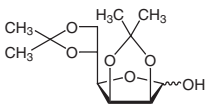
D2191



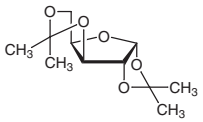
D2024



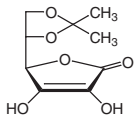
D2447



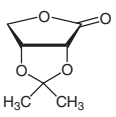
D2616



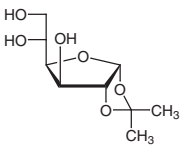
I0507



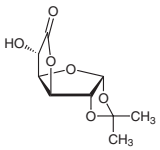
I0454



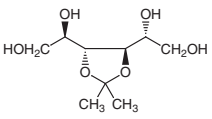
I0400



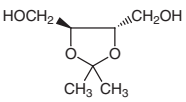
I0688



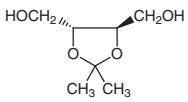
I0489



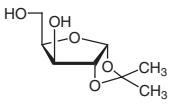
I0376



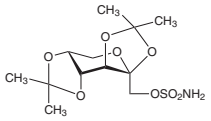
I0375



I0721



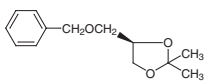
T2755



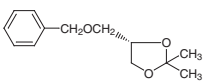
Product No.	Product Name	Unit Size	
D2265	1,2:5,6-Di-*O*-isopropylidene-*α*-D-allofuranose	1g	5g
D3758	2,3:4,5-Di-*O*-isopropylidene-*β*-D-fructopyranose	5g	25g
D2555	1,2:3,4-Di-*O*-isopropylidene-*α*-D-galactopyranose	5g	25g
D1949	1,2:5,6-Di-*O*-isopropylidene-*α*-D-glucofuranose	10g	25g
D2191	(-)-2,3:4,6-Di-*O*-isopropylidene-2-keto-L-gulonic Acid Monohydrate		5g
D2024	1,2:5,6-Di-*O*-isopropylidene-D-mannitol	5g	25g
D2447	2,3:5,6-Di-*O*-isopropylidene-D-mannofuranose		5g
D2616	1,2:3,5-Di-*O*-isopropylidene-*α*-D-xylofuranose		5g
I0507	(+)-5,6-*O*-Isopropylidene-L-ascorbic Acid	5g	25g
I0454	2,3-*O*-Isopropylidene-D-erythronolactone		1g
I0400	1,2-*O*-Isopropylidene-*α*-D-glucofuranose		25g
I0688	1,2-*O*-Isopropylidene-*α*-D-glucurono-6,3-lactone		1g
I0489	3,4-*O*-Isopropylidene-D-mannitol	1g	5g
I0376	(+)-2,3-*O*-Isopropylidene-L-threitol	1g	5g
I0375	(-)-2,3-*O*-Isopropylidene-D-threitol	1g	5g
I0721	1,2-*O*-Isopropylidene-*α*-D-xylofuranose	5g	25g
T2755	Topiramate	1g	5g

Protected 1,2/1,3-Diols

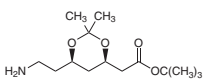
B2136



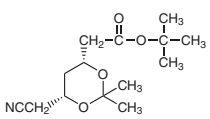
B2137



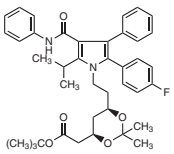
B3702



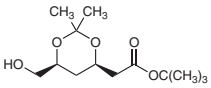
B3642



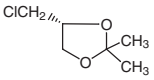
B3690



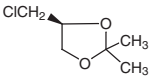
B4214



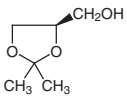
C2265



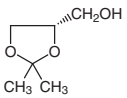
C1796



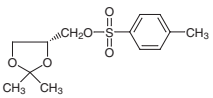
D1705



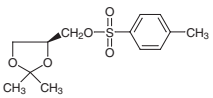
D1691



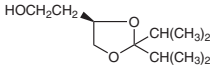
D2549



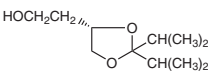
D2550



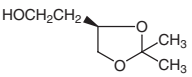
D4076



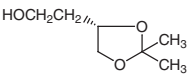
D4077



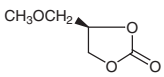
H1188



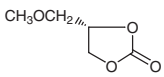
H1189



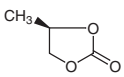
M1451



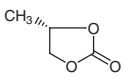
M1456



P1485



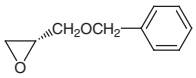
P1486



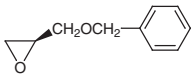
Product No.	Product Name			Unit Size
B2136	(*R*)-4-Benzyloxymethyl-2,2-dimethyl-1,3-dioxolane			1g
B2137	(*S*)-4-Benzyloxymethyl-2,2-dimethyl-1,3-dioxolane			1g
B3702	*tert*-Butyl 2-[(4*R*,6*R*)-6-(2-Aminoethyl)-2,2-dimethyl-1,3-dioxan-4-yl]acetate		1g	5g
B3642	*tert*-Butyl (4*R*,6*R*)-6-Cyanomethyl-2,2-dimethyl-1,3-dioxane-4-acetate			5g
B3690	*tert*-Butyl (4*R*,6*R*)-2-[6-[2-[2-(4-Fluorophenyl)-5-isopropyl-3-phenyl-4-(phenylcarbamoyl)pyrrol-1-yl]ethyl]-2,2-dimethyl-1,3-dioxan-4-yl]acetate		1g	5g
B4214	*tert*-Butyl (4*R*,6*S*)-6-(Hydroxymethyl)-2,2-dimethyl-1,3-dioxane-4-acetate		5g	25g
C2265	(*R*)-4-Chloromethyl-2,2-dimethyl-1,3-dioxolane		5g	25g
C1796	(*S*)-4-Chloromethyl-2,2-dimethyl-1,3-dioxolane		1g	5g
D1705	(*R*)-(-)-2,2-Dimethyl-1,3-dioxolane-4-methanol	1g	5g	25g
D1691	(*S*)-(+)-2,2-Dimethyl-1,3-dioxolane-4-methanol	1g	5g	25g
D2549	(*R*)-(-)-2,2-Dimethyl-1,3-dioxolan-4-ylmethyl *p*-Toluenesulfonate			1g
D2550	(*S*)-(+)-2,2-Dimethyl-1,3-dioxolan-4-ylmethyl *p*-Toluenesulfonate		1g	5g
D4076	(*R*)-4-(2-Hydroxyethyl)-2,2-diisopropyl-1,3-dioxolane			1g
D4077	(*S*)-4-(2-Hydroxyethyl)-2,2-diisopropyl-1,3-dioxolane			1g
H1188	(*R*)-4-(2-Hydroxyethyl)-2,2-dimethyl-1,3-dioxolane			1g
H1189	(*S*)-4-(2-Hydroxyethyl)-2,2-dimethyl-1,3-dioxolane			1g
M1451	(*R*)-(+)-4-(Methoxymethyl)-1,3-dioxolan-2-one		5g	25g
M1456	(*S*)-(-)-4-(Methoxymethyl)-1,3-dioxolan-2-one		5g	25g
P1485	(*R*)-Propylene Carbonate		5g	25g
P1486	(*S*)-Propylene Carbonate		5g	25g

Glycidyl Compounds

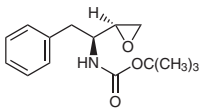
B2238



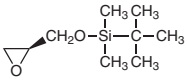
B2239



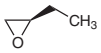
E0893



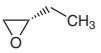
B4111



B3832



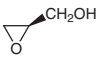
B3833



E0581

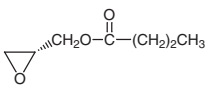
E0533

G0363

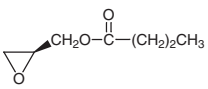


G0364

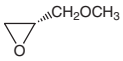
G0282



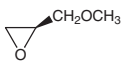
G0283



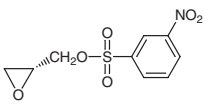
G0280



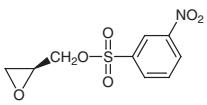
G0281



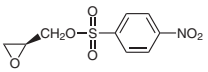
G0286



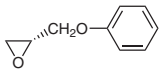
G0287



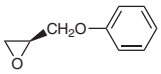
G0411



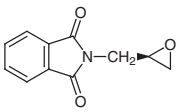
G0409



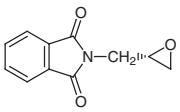
G0410



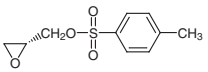
G0327



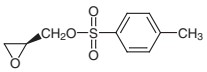
G0328



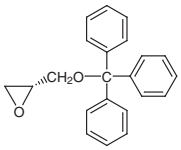
T1611



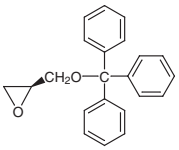
T1612



G0284



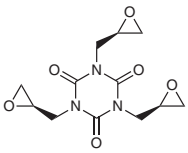
G0285



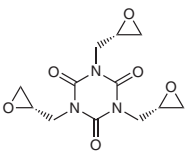
P1396

P0951

I0580



I0581

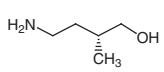


Product No.	Product Name	Unit Size		
B2238	Benzyl (*R*)-(-)-Glycidyl Ether	1g	5g	25g
B2239	Benzyl (*S*)-(+)-Glycidyl Ether	1g	5g	25g
E0893	(2*S*,3*S*)-3-(*tert*-Butoxycarbonylamino)-1,2-epoxy-4-phenylbutane		5g	25g
B4111	*tert*-Butyldimethylsilyl (*S*)-Glycidyl Ether			5mL
B3832	(*R*)-(+)-Butylene Oxide		5mL	25mL
B3833	(*S*)-(-)-Butylene Oxide		5mL	25mL

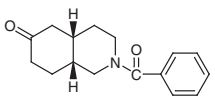
Product No.	Product Name	Unit Size	
E0581	(*R*)-Epichlorohydrin	5g	25g
E0533	(*S*)-Epichlorohydrin	5g	25g
G0363	(*R*)-(+)-Glycidol	5g	25g
G0364	(*S*)-(-)-Glycidol	5g	25g
G0282	(*R*)-Glycidyl Butyrate	5g	25g
G0283	(*S*)-Glycidyl Butyrate	5g	25g
G0280	(*R*)-Glycidyl Methyl Ether	5g	25g
G0281	(*S*)-Glycidyl Methyl Ether	5g	25g
G0286	(*R*)-Glycidyl 3-Nitrobenzenesulfonate	5g	25g
G0287	(*S*)-Glycidyl 3-Nitrobenzenesulfonate	5g	25g
G0411	(*S*)-Glycidyl 4-Nitrobenzenesulfonate		5g
G0409	(*R*)-Glycidyl Phenyl Ether		1g
G0410	(*S*)-Glycidyl Phenyl Ether	1g	5g
G0327	(*R*)-*N*-Glycidylphthalimide	5g	25g
G0328	(*S*)-*N*-Glycidylphthalimide	5g	25g
T1611	(2*R*)-(-)-Glycidyl *p*-Toluenesulfonate	5g	25g
T1612	(2*S*)-(+)-Glycidyl *p*-Toluenesulfonate	5g	25g
G0284	(*R*)-Glycidyl Trityl Ether	5g	25g
G0285	(*S*)-Glycidyl Trityl Ether	5g	25g
P1396	(*R*)-(+)-Propylene Oxide	5mL	25mL
P0951	(*S*)-(-)-Propylene Oxide	1mL	5mL	25mL
I0580	(*R*,*R*,*R*)-Triglycidyl Isocyanurate		1g
I0581	(*S*,*S*,*S*)-Triglycidyl Isocyanurate		1g

Others

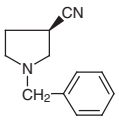
A1576



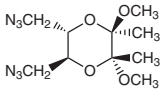
B2420



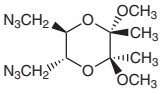
B3299



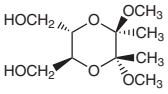
B3693



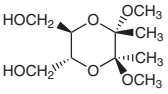
B3694



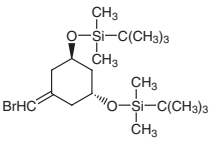
B3695



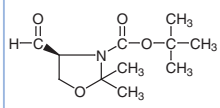
B3696



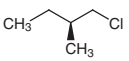
B2779



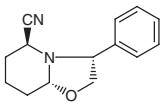
B1759



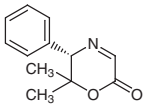
C1188



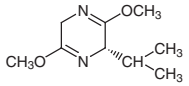
C1363



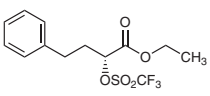
D3259



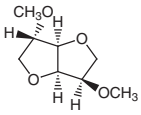
D3257



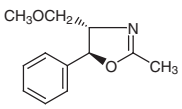
E0879



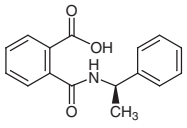
I0390



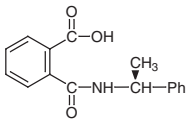
M0803



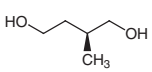
M1622



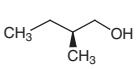
M0824



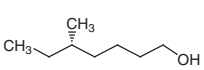
M1234



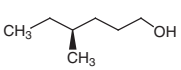
M0170



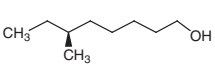
M0965

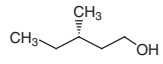


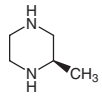
M0964

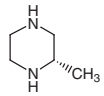


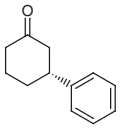
M0966

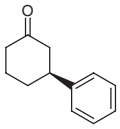


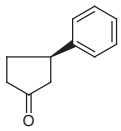
M0963


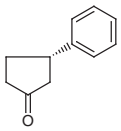
M2091


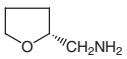
M1424


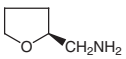
P1499


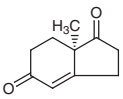
P1500


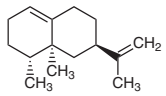
P1504


P1509


T2551


T2552


T2636


V0117


Product No.	Product Name	Unit Size	
A1576	(*R*)-4-Amino-2-methyl-1-butanol	1g	5g
B2420	(4a*S*,8a*R*)-2-Benzoyloctahydro-6(2*H*)-isoquinolinone		50mg
B3299	(*R*)-1-Benzyl-3-pyrrolidinecarbonitrile	1g	5g
B3693	(2*R*,3*R*,5*S*,6*S*)-5,6-Bis(azidomethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		100mg
B3694	(2*S*,3*S*,5*R*,6*R*)-5,6-Bis(azidomethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		100mg
B3695	(2*R*,3*R*,5*S*,6*S*)-5,6-Bis(hydroxymethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		200mg
B3696	(2*S*,3*S*,5*R*,6*R*)-5,6-Bis(hydroxymethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		200mg
B2779	(1*R*,3*R*)-5-(Bromomethylene)-1,3-bis(*tert*-butyldimethylsilyloxy)cyclohexane		100mg
B1759	(*S*)-(-)-3-(*tert*-Butoxycarbonyl)-4-formyl-2,2-dimethyl-1,3-oxazolidine	1g	5g
C1188	(*S*)-(+)-1-Chloro-2-methylbutane	10mL	25mL
C1363	(-)-2-Cyano-6-phenyloxazolopiperidine		1g
D3259	(5*S*)-5,6-Dihydro-6,6-dimethyl-5-phenyl-2*H*-1,4-oxazin-2-one		1g
D3257	(2*S*)-2,5-Dihydro-2-isopropyl-3,6-dimethoxypyrazine		1g
E0879	Ethyl (*R*)-4-Phenyl-2-(trifluoromethanesulfonyloxy)butyrate		1g
I0390	Isosorbide Dimethyl Ether		25g
M0803	(4*S*,5*S*)-(-)-4-Methoxymethyl-2-methyl-5-phenyl-2-oxazoline		1g
M1622	(*R*)-(+)-*N*-(α-Methylbenzyl)phthalamic Acid	1g	5g
M0824	(*S*)-(-)-*N*-(α-Methylbenzyl)phthalamic Acid		1g
M1234	(*S*)-(-)-2-Methyl-1,4-butanediol		5g
M0170	(*S*)-(-)-2-Methyl-1-butanol		25mL
M0965	(*S*)-(+)-5-Methyl-1-heptanol		1mL
M0964	(*S*)-(+)-4-Methyl-1-hexanol	1mL	5mL
M0966	(*S*)-(+)-6-Methyl-1-octanol	1mL	5mL
M0963	(*S*)-(+)-3-Methyl-1-pentanol	1mL	5mL
M2091	(*R*)-(-)-2-Methylpiperazine	5g	25g
M1424	(*S*)-(+)-2-Methylpiperazine	1g	5g
P1499	(*R*)-3-Phenylcyclohexanone	100mg	1g
P1500	(*S*)-3-Phenylcyclohexanone	100mg	1g
P1504	(*R*)-3-Phenylcyclopentanone	100mg	1g
P1509	(*S*)-3-Phenylcyclopentanone	100mg	1g
T2551	(*R*)-(-)-Tetrahydrofurfurylamine	200mg	1g	5g
T2552	(*S*)-(+)-Tetrahydrofurfurylamine	200mg	1g
T2636	(*R*)-(-)-2,3,7,7a-Tetrahydro-7a-methyl-1*H*-indene-1,5(6*H*)-dione		1g
V0117	Valencene		5g

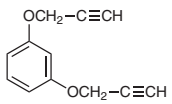
Terminal Acetylenes

Hydrocarbons		B3242 $HC{\equiv}C{-}CH_2CH_2Br$	C1195 $CH_3{-}\underset{\displaystyle Cl}{\underset{|}{CH}}{-}C{\equiv}CH$	C1493 $HC{\equiv}C{-}(CH_2)_4Cl$
C1522 $HC{\equiv}C{-}CH_2CH_2CH_2Cl$	C1984 	D1724 $CH_3(CH_2)_3{-}C{\equiv}C{-}CH_2CH_2{-}C{\equiv}CH$	D1326 $HC{\equiv}C{-}(CH_2)_6{-}C{\equiv}CH$	D0037 $CH_3(CH_2)_7{-}C{\equiv}CH$
B1114 $CH_3{-}\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}{-}C{\equiv}CH$	D0997 $CH_3(CH_2)_9{-}C{\equiv}CH$	H0440 $CH_3(CH_2)_{14}{-}C{\equiv}CH$	H0483 $HC{\equiv}C{-}(CH_2)_3{-}C{\equiv}CH$	H0048 $CH_3(CH_2)_4{-}C{\equiv}CH$
H0433 $CH_3(CH_2)_{13}{-}C{\equiv}CH$	H0140 $CH_3(CH_2)_3{-}C{\equiv}CH$	M0271 $CH_3{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH_2CH_2{-}C{\equiv}CH$	M0269 $CH_3{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}{-}CH_2{-}C{\equiv}CH$	N0406 $HC{\equiv}C{-}(CH_2)_5{-}C{\equiv}CH$
N0301 $CH_3(CH_2)_6{-}C{\equiv}CH$	O0128 $CH_3(CH_2)_{15}{-}C{\equiv}CH$	O0147 $HC{\equiv}C{-}(CH_2)_4{-}C{\equiv}CH$	O0050 $CH_3(CH_2)_5{-}C{\equiv}CH$	P0356 $CH_3(CH_2)_{12}{-}C{\equiv}CH$
P0068 $CH_3CH_2CH_2{-}C{\equiv}CH$	P1272 P0484 $HC{\equiv}C{-}CH_2Br$	P1273 P0810 $HC{\equiv}C{-}CH_2Cl$	P1881 $CH_3{-}C{\equiv}CH$	T0761 $CH_3(CH_2)_{11}{-}C{\equiv}CH$
U0033 $CH_3(CH_2)_8{-}C{\equiv}CH$				

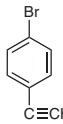
Product No.	Product Name			Unit Size
B3242	4-Bromo-1-butyne			5g
C1195	3-Chloro-1-butyne		1g	5g
C1493	6-Chloro-1-hexyne		5mL	25mL
C1522	5-Chloro-1-pentyne		5mL	25mL
C1984	Cyclopropylacetylene		5g	25g
D1724	1,5-Decadiyne		1mL	5mL
D1326	1,9-Decadiyne			5mL
D0037	1-Decyne		5mL	25mL
B1114	3,3-Dimethyl-1-butyne		10mL	100mL
D0997	1-Dodecyne		5mL	25mL
H0440	1-Heptadecyne			1g
H0483	1,6-Heptadiyne			5mL
H0048	1-Heptyne			25mL
H0433	1-Hexadecyne			5mL
H0140	1-Hexyne		25mL	250mL
M0271	5-Methyl-1-hexyne			5mL
M0269	4-Methyl-1-pentyne			5mL
N0406	1,8-Nonadiyne			5mL
N0301	1-Nonyne			5mL
O0128	1-Octadecyne			5mL
O0147	1,7-Octadiyne		5mL	25mL
O0050	1-Octyne		25mL	250mL
P0356	1-Pentadecyne			5mL
P0068	1-Pentyne			25mL
P1272	Propargyl Bromide (80% in Toluene, *ca.* 9.2mol/L) (stabilized with MgO)	25g	100g	500g
P0484	Propargyl Bromide (stabilized with MgO)	25g	100g	500g
P1273	Propargyl Chloride (70% in Toluene, *ca.* 9.2mol/L)		25g	250g
P0810	Propargyl Chloride			25mL
P1881	Propyne (*ca.* 3-4% in Heptane)			200g
T0761	1-Tetradecyne		5mL	25mL
U0033	1-Undecyne			5mL

Hydrocarbons having Benzene Ring

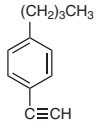
B4521



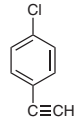
B3701



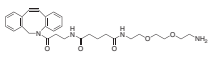
B2301



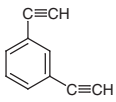
C2670



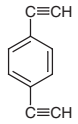
A2607



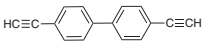
D2496



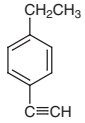
D2151



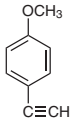
D4233



E0749



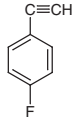
E0603



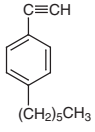
E0196

E0654

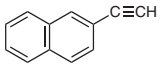
F0470



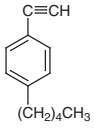
E0564



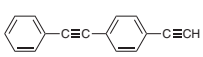
E0933



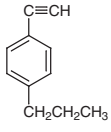
E0563

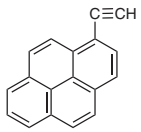


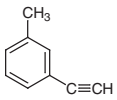
E0967

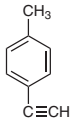


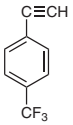
E0750

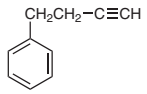


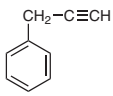
E0939


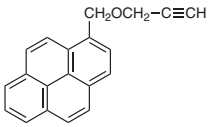
E0665


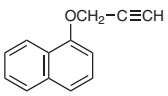
E0655


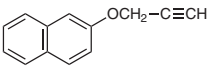
E0626


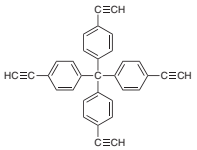
P0358


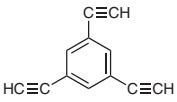
P1956


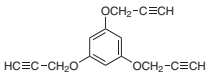
P2226


P2227


P2190


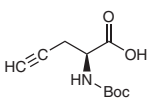
T3151


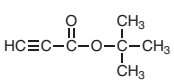
T2760


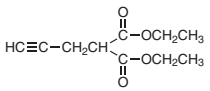
T3135


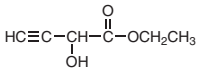
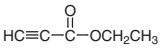
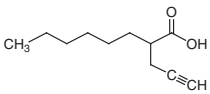
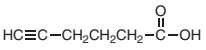
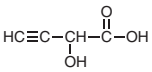
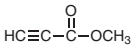
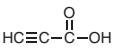
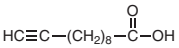
Product No.	Product Name	Unit Size		
B4521	1,3-Bis(2-propynyloxy)benzene		200mg	1g
B3701	1-Bromo-4-ethynylbenzene		1g	5g
B2301	1-Butyl-4-ethynylbenzene		5g	25g
C2670	1-Chloro-4-ethynylbenzene		1g	5g
A2607	9,15-Diaza-18-DBCO-3,6-dioxa-10,14,18-trioxooctadecylamine			25mg
D2496	1,3-Diethynylbenzene		1g	5g
D2151	1,4-Diethynylbenzene		1g	5g
D4233	4,4'-Diethynylbiphenyl		200mg	1g
E0749	1-Ethyl-4-ethynylbenzene		5g	25g
E0603	4-Ethynylanisole		1g	5g
E0196	Ethynylbenzene	25mL	100mL	500mL
E0654	1-Ethynyl-2-fluorobenzene			5g
F0470	1-Ethynyl-4-fluorobenzene		1g	5g
E0564	1-Ethynyl-4-hexylbenzene		5g	25g
E0933	2-Ethynylnaphthalene			100mg
E0563	1-Ethynyl-4-pentylbenzene		5g	25g
E0967	1-Ethynyl-4-(phenylethynyl)benzene		200mg	1g
E0750	1-Ethynyl-4-propylbenzene		5g	25g
E0939	1-Ethynylpyrene		200mg	1g
E0665	3-Ethynyltoluene	1g	5g	25g
E0655	4-Ethynyltoluene		5g	25g
E0626	1-Ethynyl-4-(trifluoromethyl)benzene		1g	5g
P0358	4-Phenyl-1-butyne			5mL
P1956	3-Phenyl-1-propyne (stabilized with BHT)		1g	5g
P2226	1-[(2-Propynyloxy)methyl]pyrene		200mg	1g
P2227	1-(2-Propynyloxy)naphthalene		1g	5g
P2190	2-(2-Propynyloxy)naphthalene		200mg	1g
T3151	Tetrakis(4-ethynylphenyl)methane		100mg	1g
T2760	1,3,5-Triethynylbenzene		1g	5g
T3135	1,3,5-Tris(2-propynyloxy)benzene		200mg	1g

Carboxylic Acids & Their Derivatives

B4007


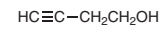
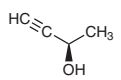
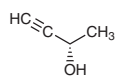
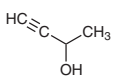
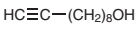
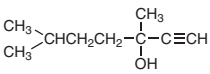
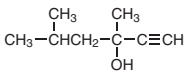
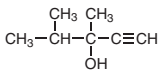
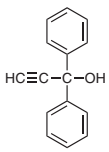
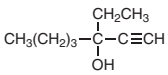
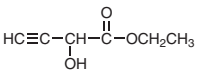
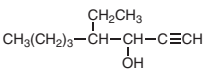
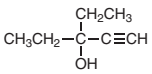
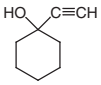
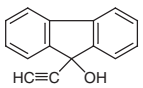
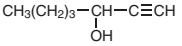
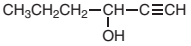
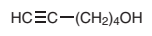
P1038


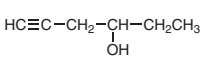
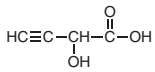
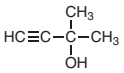
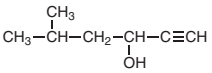
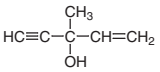
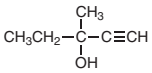
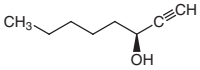
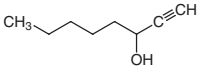
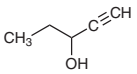
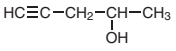
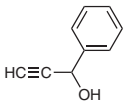
D4616


H0823 	P0529 	H0964 	H0882 	H0905 
P0528 	P0497 	U0054 		

Product No.	Product Name	Unit Size	
B4007	*N*-(*tert*-Butoxycarbonyl)-L-propargylglycine		1g
P1038	*tert*-Butyl Propiolate	5g	25g
D4616	Diethyl 2-Propynylmalonate	1g	5g
H0823	Ethyl 2-Hydroxy-3-butynoate		1g
P0529	Ethyl Propiolate	5mL	25mL
H0964	2-Hexyl-4-pentynoic Acid	5g	25g
H0882	5-Hexynoic Acid	5g	25g
H0905	2-Hydroxy-3-butynoic Acid	100mg	1g
P0528	Methyl Propiolate	5mL	25mL
P0497	Propiolic Acid	5g	25g
U0054	10-Undecynoic Acid	1g	5g

Alcohols

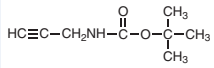
		B0799 	B2909 	B2910 
B0750 B1001 	D3710 	D1266 	D0737 	D1276 
D2495 	E0272 	H0823 	E0270 	E0273 
E0297 	E0548 	H0455 	H0141 	H0687 

H0462 	H0905 	M0180 	M0961 	M1312 
M0396 	M0860	O0235 	O0196 	P0069 
P0817	P0818 	P0220 	P0536	U0055

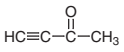
Product No.	Product Name	Unit Size	
B0799	3-Butyn-1-ol	5mL	25mL
B2909	(*R*)-(+)-3-Butyn-2-ol	1g	5g
B2910	(*S*)-(-)-3-Butyn-2-ol		1g
B0750	3-Butyn-2-ol (55% in Water, *ca.* 7.5mol/L)	25mL	500mL
B1001	3-Butyn-2-ol	5mL	25mL
D3710	9-Decyn-1-ol		5g
D1266	3,6-Dimethyl-1-heptyn-3-ol		5mL
D0737	3,5-Dimethyl-1-hexyn-3-ol	25mL	500mL
D1276	3,4-Dimethyl-1-pentyn-3-ol		10mL
D2495	1,1-Diphenyl-2-propyn-1-ol	5g	25g
E0272	3-Ethyl-1-heptyn-3-ol		5mL
H0823	Ethyl 2-Hydroxy-3-butynoate		1g
E0270	4-Ethyl-1-octyn-3-ol	25mL	500mL
E0273	3-Ethyl-1-pentyn-3-ol	5mL	25mL
E0297	1-Ethynyl-1-cyclohexanol	25g	500g
E0548	9-Ethynyl-9-fluorenol		5g
H0455	1-Heptyn-3-ol	1mL	5mL
H0141	1-Hexyn-3-ol	5mL	25mL
H0687	5-Hexyn-1-ol	5mL	25mL
H0462	5-Hexyn-3-ol		5mL
H0905	2-Hydroxy-3-butynoic Acid	100mg	1g
M0180	2-Methyl-3-butyn-2-ol	25mL	500mL
M0961	5-Methyl-1-hexyn-3-ol		5mL
M1312	3-Methyl-1-penten-4-yn-3-ol	5mL	25mL
M0396	3-Methyl-1-pentyn-3-ol		25mL
M0860	Methyl Propargyl Ether	5mL	25mL
O0235	(*S*)-1-Octyn-3-ol	1g	5g
O0196	1-Octyn-3-ol	25mL	250mL
P0069	1-Pentyn-3-ol		10g
P0817	4-Pentyn-1-ol	5mL	25mL
P0818	4-Pentyn-2-ol		5mL
P0220	1-Phenyl-2-propyn-1-ol	5g	25g
P0536	2-Propyn-1-ol	25mL	100mL 500mL
U0055	10-Undecyn-1-ol		5g

Other Functionalized Terminal Acetylenes

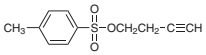
B4472



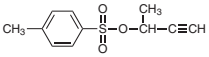
B2393



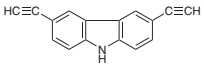
T2046



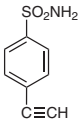
T1224



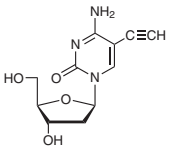
D4275



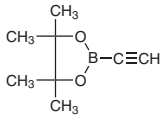
E1130



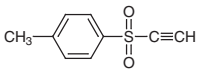
E1093



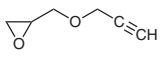
E1074



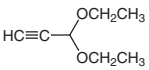
E0466



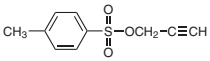
G0445



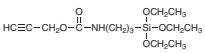
P1173



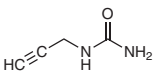
T1455



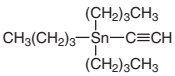
P2258



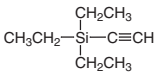
P2171



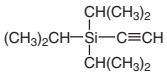
T1750



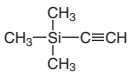
T2387



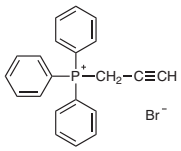
T1683



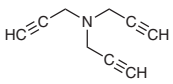
T1239



P1438



T2992

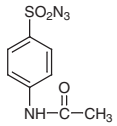


Product No.	Product Name	Unit Size		
B4472	*N*-(*tert*-Butoxycarbonyl)propargylamine		1g	5g
B2393	3-Butyn-2-one			5g
T2046	3-Butynyl *p*-Toluenesulfonate			5g
T1224	1-Butyn-3-yl *p*-Toluenesulfonate			5g
D4275	3,6-Diethynylcarbazole		200mg	1g
E1130	4-Ethynylbenzenesulfonamide		200mg	1g
E1093	5-Ethynyl-2'-deoxycytidine		50mg	200mg
E1074	2-Ethynyl-4,4,5,5-tetramethyl-1,3,2-dioxaborolane		200mg	1g
E0466	Ethynyl *p*-Tolyl Sulfone		1g	5g
G0445	Glycidyl Propargyl Ether		1g	5g
P1173	Propargylaldehyde Diethyl Acetal		5mL	25mL
T1455	Propargyl *p*-Toluenesulfonate			5g
P2258	2-Propynyl [3-(Triethoxysilyl)propyl]carbamate		1g	5g
P2171	2-Propynylurea		200mg	1g
T1750	Tributylethynyltin		1g	5g
T2387	Triethylsilylacetylene		1g	5g
T1683	Triisopropylsilylacetylene		5mL	25mL
T1239	Trimethylsilylacetylene	5mL	25mL	250mL
P1438	Triphenylpropargylphosphonium Bromide		5g	25g
T2992	Tripropargylamine		1g	5g

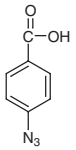
Azide Compounds

Organic Azides

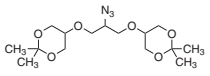
A1786



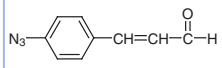
A0930



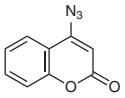
A2474



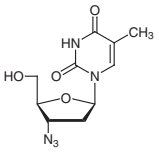
A0971



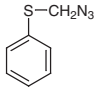
A2758



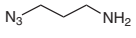
A2052



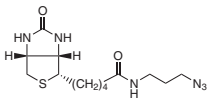
A1341



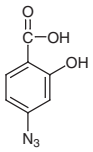
A2738



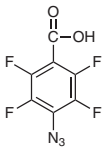
A2524



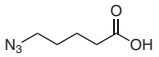
A2290



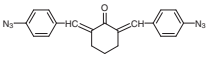
A2674



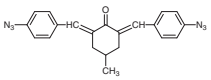
A2729



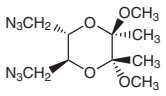
B1110



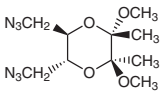
B1111



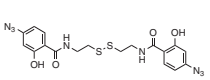
B3693



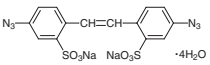
B3694



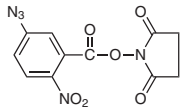
B3790



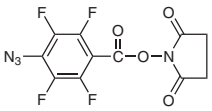
D1606



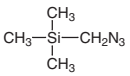
S0860



S0952



T1184

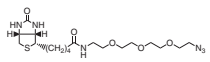


Product No.	Product Name	Unit Size	
A1786	4-Acetamidobenzenesulfonyl Azide	5g	25g
A0930	4-Azidobenzoic Acid	5g	25g
A2474	2-Azido-1,3-bis[(2,2-dimethyl-1,3-dioxan-5-yl)oxy]propane		100mg
A0971	4-Azidocinnamaldehyde		5g
A2758	4-Azidocoumarin		200mg
A2052	3'-Azido-3'-deoxythymidine	1g	5g
A1341	Azidomethyl Phenyl Sulfide		5g
A2738	3-Azidopropylamine		100mg
A2524	*N*-(3-Azidopropyl)biotinamide		100mg
A2290	4-Azidosalicylic Acid	100mg	1g
A2674	4-Azido-2,3,5,6-tetrafluorobenzoic Acid		1g
A2729	5-Azidovaleric Acid		200mg
B1110	2,6-Bis(4-azidobenzylidene)cyclohexanone (wetted with *ca.* 30% Water, containing 25g on a dry weight basis)		25g
B1111	2,6-Bis(4-azidobenzylidene)-4-methylcyclohexanone (wetted with *ca.* 30% Water, containing 25g on a dry weight basis)	Price on request	

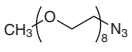
Product No.	Product Name	Unit Size	
B3693	(2*R*,3*R*,5*S*,6*S*)-5,6-Bis(azidomethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		100mg
B3694	(2*S*,3*S*,5*R*,6*R*)-5,6-Bis(azidomethyl)-2,3-dimethoxy-2,3-dimethyl-1,4-dioxane		100mg
B3790	Bis[2-(4-azidosalicylamido)ethyl] Disulfide		10mg
D1606	Disodium 4,4'-Diazidostilbene-2,2'-disulfonate Tetrahydrate		25g
D2580	Dodecylbenzenesulfonyl Azide (soft type) (mixture)		25g
S0860	*N*-Succinimidyl 5-Azido-2-nitrobenzoate		10mg
S0952	*N*-Succinimidyl 4-Azido-2,3,5,6-tetrafluorobenzoate	200mg	1g
T1184	Trimethylsilylmethyl Azide	1g	5g

PEG Azides

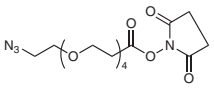
A2523



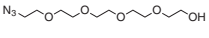
A2727



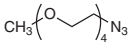
A2388



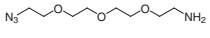
A2500



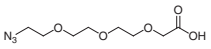
A2728



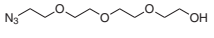
A2363



A2293



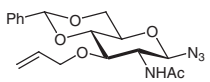
A2294



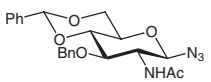
Product No.	Product Name	Unit Size	
A2523	*N*-[2-[2-[2-(2-Azidoethoxy)ethoxy]ethoxy]ethyl]biotinamide		100mg
A2727	25-Azido-2,5,8,11,14,17,20,23-octaoxapentacosane	25mg	100mg
A2388	Azido-PEG$_4$-NHS Ester		25mg
A2500	14-Azido-3,6,9,12-tetraoxatetradecanol		100mg
A2728	13-Azido-2,5,8,11-tetraoxatridecane	25mg	100mg
A2363	11-Azido-3,6,9-trioxaundecan-1-amine	1g	5g
A2293	11-Azido-3,6,9-trioxaundecanoic Acid		1g
A2294	11-Azido-3,6,9-trioxaundecanol		Price on request

Sugar Azides

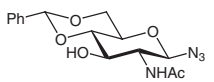
A1812



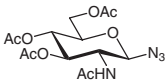
A1813



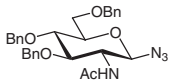
A1811



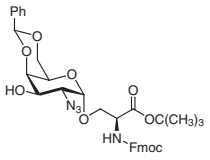
A1616



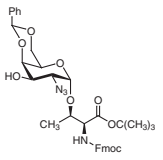
A1678



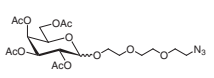
A1833



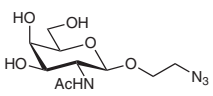
A1832



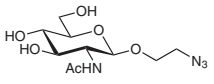
G0257



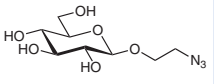
A2627



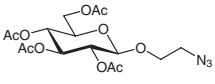
A2172



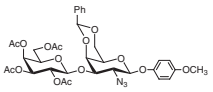
A2267



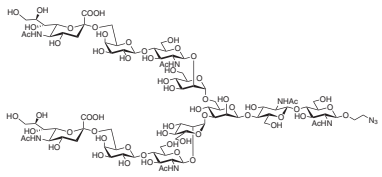
A2377



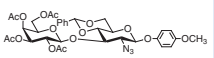
G0330



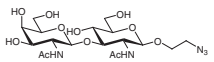
D4217



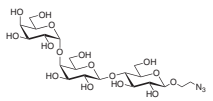
G0309



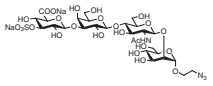
G0373



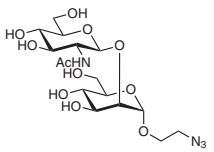
G0403



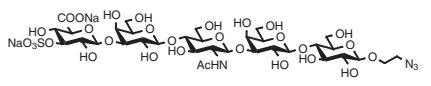
G0372



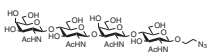
G0337



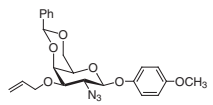
H1333



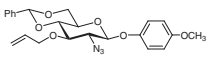
L0237



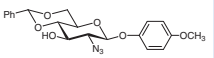
M1643



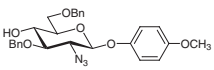
M1638



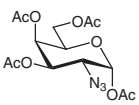
M1637



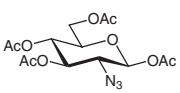
M1617



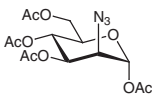
T1731



T2196



T1733



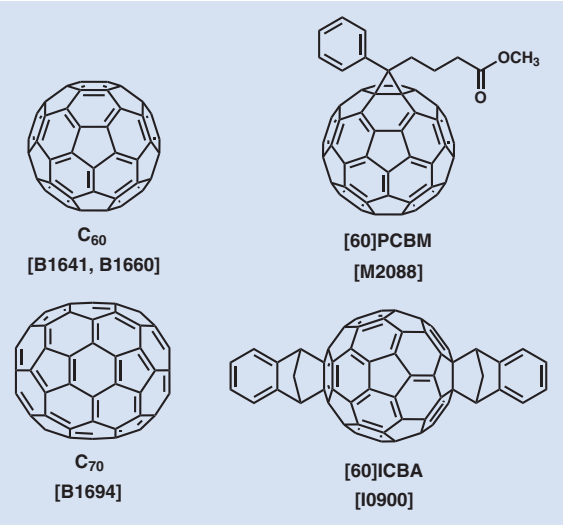
Product No.	Product Name	Unit Size
A1812	2-Acetamido-3-*O*-allyl-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranosyl Azide	1g
A1813	2-Acetamido-3-*O*-benzyl-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranosyl Azide	1g
A1811	2-Acetamido-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranosyl Azide	1g 5g
A1616	2-Acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-β-D-glucopyranosyl Azide	1g 5g
A1678	2-Acetamido-3,4,6-tri-*O*-benzyl-2-deoxy-β-D-glucopyranosyl Azide	1g 5g
A1833	*O*-(2-Azido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranosyl)-*N*-[(9*H*-fluoren-9-ylmethoxy)carbonyl]-L-serine *tert*-Butyl Ester	100mg
A1832	*O*-(2-Azido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranosyl)-*N*-[(9*H*-fluoren-9-ylmethoxy)carbonyl]-L-threonine *tert*-Butyl Ester	100mg
G0257	2-[2-(2-Azidoethoxy)ethoxy]ethyl 2,3,4,6-Tetra-*O*-acetyl-D-galactopyranoside	1g 5g
A2627	2-Azidoethyl 2-Acetamido-2-deoxy-β-D-galactopyranoside	Price on request
A2172	2-Azidoethyl 2-Acetamido-2-deoxy-β-D-glucopyranoside	500mg
A2267	2-Azidoethyl β-D-Glucopyranoside	1g
A2377	2-Azidoethyl 2,3,4,6-Tetra-*O*-acetyl-β-D-glucopyranoside	1g 5g
D4217	Disialylnonasaccharide β-Ethylazide	Price on request
G0330	Gal[2346Ac]β(1-3)GalN$_3$[46Bzd]-β-MP	1g 5g
G0309	Gal[2346Ac]β(1-3)GlcN$_3$[46Bzd]-β-MP	1g 5g
G0373	GalNAcβ(1-3)GlcNAcβ-Ethylazide	Price on request
G0403	Gb$_3$-β-ethylazide	Price on request
G0372	GlcA[3S]β(1-3)Galβ(1-4)GlcNAcβ(1-2)Manα-Ethylazide	Price on request
G0337	GlcNAcβ(1-2)Manα-1-Ethylazide	100mg
H1333	HNK-1 Ethylazide	Price on request
L0237	LacDiNAc Dimer Ethylazide	Price on request
M1643	4-Methoxyphenyl 3-*O*-Allyl-2-azido-4,6-*O*-benzylidene-2-deoxy-β-D-galactopyranoside	1g

Product No.	Product Name	Unit Size
M1638	4-Methoxyphenyl 3-*O*-Allyl-2-azido-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranoside	1g
M1637	4-Methoxyphenyl 2-Azido-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranoside	1g 5g
M1617	4-Methoxyphenyl 2-Azido-3,6-di-*O*-benzyl-2-deoxy-β-D-glucopyranoside	1g
T1731	1,3,4,6-Tetra-*O*-acetyl-2-azido-2-deoxy-α-D-galactopyranose	100mg
T2196	1,3,4,6-Tetra-*O*-acetyl-2-azido-2-deoxy-β-D-glucopyranose	200mg 1g
T1733	1,3,4,6-Tetra-*O*-acetyl-2-azido-2-deoxy-α-D-mannopyranose	100mg

Fullerenes

Fullerene is a spherical carbon compound and is an allotrope of carbon such as diamond, graphite and carbon nanotubes. Fullerenes of C_{60}, C_{70} and C_{84} are well known. They are isolable carbon compounds in a sole molecular species. Among them, the C_{60} is a representative species. Kroto, Smalley and Curl *et al*. first observed the C_{60} in which the 60 carbon atoms consist of 12 five-membered rings and 20 six-membered rings.[1] Kroto, Smalley and Curl won their joint Nobel prizes in chemistry in 1996 for their contributions. Osawa predicted existence of fullerene in 1970, earlier than the first observation of fullerene.[2]

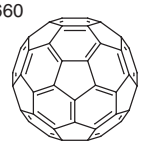
The most specific feature of fullerene is that it is an excellent electron acceptor. Any fullerenes are n-type semiconductors, which are suitable for organic electronic materials with electron carriers. Rubidium- and cesium-doped fullerenes can be superconductors with electron carriers. These superconducting transitions occur at more than 30 K.[3,4]



Addition reactions and other chemical modifications of fullerenes easily produce fullerene derivatives. Precise structure analyses of these derivatives are possible because they are molecular species. Non-derivatized fullerenes are poorly soluble in similarity to the other nanocarbon materials. However, we can introduce soluble functional groups to form solution-processible electronic materials. Phenyl-C_{61}-butyric acid methyl ester ([60]PCBM) and indene-C_{60} bisadduct (ICBA) are useful organic semiconductors for fabricating a solution-processible electronic device.[5,6] These fullerene derivatives are n-type organic semiconductors for organic photovoltaics (OPV) by mixing with a p-type conjugated polymer.[7] An application of a fullerene derivative for organic transistors was also reported.[8] A complexation of C_{60} with tetrakis(dimethylamino)ethylene (TDAE) gives a charge transfer complex (TDAE-C_{60}), which is an organic magnet at low temperature.[9]

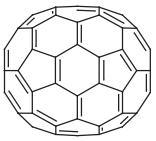
Although a chemical modification of the outer surface of fullerene provides PCBM or ICBA, we can introduce a small component to the inner side of fullerene. For instance, fullerenes can encapsulate a metal atom on the inner side, when the fullerenes are produced in the presence of the metal. This is the so-called metal-encapsulated fullerene described as M@C_{60}. The encapsulation modifies the electronic state[10] and chemical reactivity of fullerene.[11] On the other hand, water-encapsulated fullerene (H_2O@C_{60}) was also reported. A publication described that an organic synthetic procedure gave open-caged C_{60} which could then encapsulate one water molecule. A following chemical modification could close the cage to from water-encapsulated fullerene H_2O@C_{60}.[12]

B1641
B1660

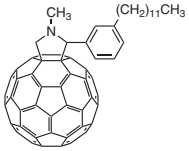


B1642

B1694

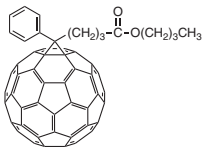


C2415

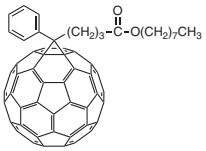


I0900

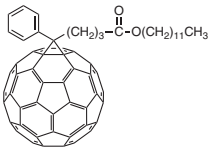
P2013



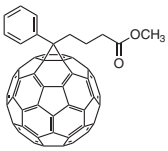
P2014



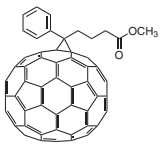
P2015



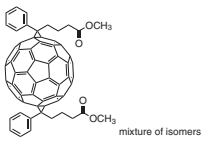
M2088



M2550



B4576



Product No.	Product Name	Unit Size	
B1641	Fullerene C_{60} (pure)	100mg	1g
B1660	Fullerene C_{60}	100mg	1g
B1642	Fullerene Extract, C_{60} (contains *ca.* 20% C_{70})	100mg	1g
B1694	Fullerene C_{70}		100mg
C2415	$C_{60}MC_{12}$		100mg
I0900	ICBA		50mg
P2013	[60]PCB-C_4 ([6,6]-Phenyl-C_{61}-butyric Acid Butyl Ester)		100mg
P2014	[60]PCB-C_8 ([6,6]-Phenyl-C_{61}-butyric Acid *n*-Octyl Ester)		100mg
P2015	[60]PCB-C_{12} ([6,6]-Phenyl-C_{61}-butyric Acid Dodecyl Ester)		100mg
M2088	[60]PCBM (Methyl [6,6]-Phenyl-C_{61}-butyrate)		100mg
M2550	[70]PCBM (Methyl [6,6]-Phenyl-C_{71}-butyrate) (mixture of isomers)		50mg
B4576	Bis-PCBM (mixture of isomers)		50mg

References

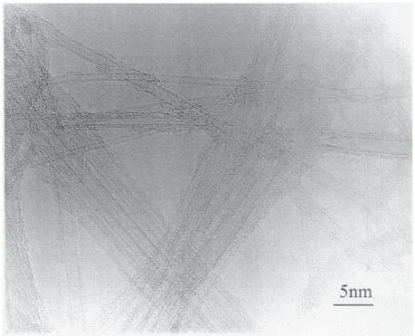
1) H. W. Kroto, J. R. Heath, S. C. O' Brien, R. F. Curl, R. E. Smalley, *Nature* **1985**, *318*, 162.
2) E. Osawa, *Kagaku* **1970**, *25*, 854.
3) K. Tanigaki, T. W. Ebbesen, S. Saito, J. Mizuki, J. S. Tsai, Y. Kubo, S. Kuroshima, *Nature* **1991**, *352*, 222.
4) A. Y. Ganin, Y. Takabayashi, Y. Z. Khimyak, S. Margadonna, A. Tamai, M. J. Rosseinsky, K. Prassides, *Nat. Mater.* **2008**, *7*, 367.
5) J. C. Hummelen, B. W. Knight, F. LePeq, F. Wudl, J. Yao, C. L. Wilkins, *J. Org. Chem.* **1995**, *60*, 532.
6) Y. He, H.-Y. Chen, J. Hou, Y. Li, *J. Am. Chem. Soc.* **2010**, *132*, 1377.
7) Review: S. Günes, H. Neugebauer, N. S. Sariciftci, *Chem. Rev.* **2007**, *107*, 1324.
8) T.-W. Lee, Y. Byun, B.-W. Koo, I.-N. Kang, Y.-Y. Lyu, C. H. Lee, L. Pu, S. Y. Lee, *Adv. Mater.* **2005**, *17*, 2180.
9) B. Narymbetov, A. Omerzu, V. V. Kabanov, M. Tokumoto, H. Kobayashi, D. Mihailovic, *Nature* **2000**, *407*, 883.
10) Y. Matsuo, H. Okada, M. Maruyama, H. Sato, H. Tobita, Y. Ono, K. Omote, K. Kawachi, Y. Kasama, *Org. Lett.* **2012**, *14*, 3784.
11) H. Kawakami, H. Okada, Y. Matsuo, *Org. Lett.* **2013**, *15*, 4466.
12) K. Kurotobi, Y. Murata, *Science* **2011**, *333*, 613.

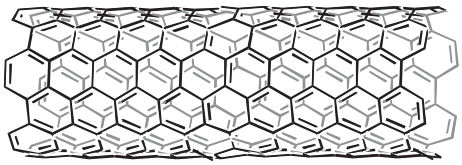
Carbon Nanotubes

A carbon nanotube (CNT) has a cylindrical structure with a nanoscale diameter that is like a rolled graphene sheet. Iijima first observed a CNT in 1991.[1] A CNT consists of only sp^2 carbons similar to fullerenes. There are diverse CNTs on the basis of their length, diameter of the nanotube, state of chirality, and number of the layer. The variety of these structures provides various band structures and metallic and semiconducting properties.[2,3] A normal synthetic procedure gives a mixture of semiconducting CNTs in 2/3 and metallic CNTs in 1/3, because rolling a carbon sheet occurs randomly. Since we need to obtain the semiconducting CNT in pure form in order to utilize the semiconductivity, improved synthetic procedure and efficient purification of CNT are further required.[4-7]

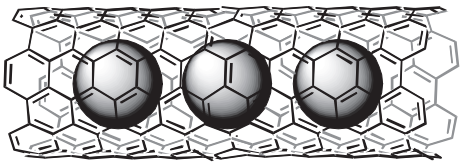
Moreover, CNTs have high physical durability, high electrical and thermal conductivity, and are light and flexible. On the basis of such excellent characteristics, CNTs are expected to be field-effect transistor (FET) materials, nanoscale wire materials, electron emission sources, optical communication switches, chemical sensors, high strength composites, and thermal devices.[8-10]

CNTs can enclose nanoscale molecules and atoms in the internal space, because of the cylindrical structure. For instance, there is a fullerene-enclosed CNT, the so-called 'peapod'.[11] In addition, CNTs can enclose metal, water, and molecular oxygen. Properties of the enclosed water in the CNT are different from those of bulk water.[12,13] An organic dye (eg. squarylium) can be easily enclosed within the internal space of CNTs in solution. In this case, the enclosed squarylium dye absorbs light and then an energy transfer (sensitization) to the outer CNT occurs.[14] Hydrogen storage using CNTs is expected to be used in the development of a fuel cell.[15]

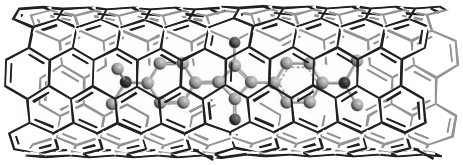




Single-WalledCarbonNanotube (SWCNT)



C_{60}Peapod



Squarylium@CNT

Product No.	Product Name	Unit Size
C3133	Carbon Nanotube Single-walled (>85%) below 3nm(Average diam.), over 5μm(Average length)	200mg
C2143	Carbon Nanotube Double-walled (>50%) below 5nm(diam.), 5-15μm(length)	200mg
C2149	Carbon Nanotube Multi-walled below 10nm(diam.), 1-2μm(length)	Price on request
C2148	Carbon Nanotube Multi-walled below 10nm(diam.), 5-15μm(length)	1g
C2150	Carbon Nanotube Multi-walled 10-20nm(diam.), 5-15μm(length)	1g 5g
C2153	Carbon Nanotube Multi-walled 10-30nm(diam.), 1-2μm(length)	1g
C2152	Carbon Nanotube Multi-walled 10-30nm(diam.), 5-15μm(length)	1g
C2155	Carbon Nanotube Multi-walled 20-40nm(diam.), 1-2μm(length)	1g
C2154	Carbon Nanotube Multi-walled 20-40nm(diam.), 5-15μm(length)	1g 5g
C2157	Carbon Nanotube Multi-walled 40-60nm(diam.), 1-2μm(length)	1g
C2156	Carbon Nanotube Multi-walled 40-60nm(diam.), 5-15μm(length)	1g 5g
C2159	Carbon Nanotube Multi-walled 60-100nm(diam.), 1-2μm(length)	1g
C2158	Carbon Nanotube Multi-walled 60-100nm(diam.), 5-15μm(length)	1g 5g
C2151	Carbon Nanotube Aligned Multi-walled 10-20nm(diam.), 5-15μm(length)	1g
C2147	Carbon Nanotube Bundled Multi-walled below 10nm(diam.), 5-15μm(length) (allowable temperature limit : 620℃)	200mg
C2146	Carbon Nanotube Herringbone 10-20nm(diam.), 5-15μm(length)	200mg

References

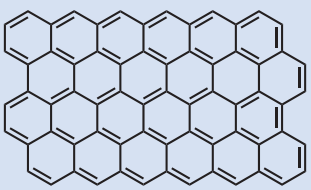
1) S. Iijima, *Nature* **1991**, *354*, 56.
2) J. Kim, A. J. Page, S. Irle, K. Morokuma, *J. Am. Chem. Soc*. **2012**, *134*, 9311.
3) Review: Y. Miyato, *J. MMIJ* **2011**, *127*, 61.
4) M. Kawai, H. Kyakuno, T. Suzuki, T. Igarashi, H. Suzuki, T. Okazaki, H. Kataura, Y. Maniwa, K. Yanagi, *J. Am. Chem. Soc*. **2012**, *134*, 9545.
5) I. Ibrahim, A. Bachmatiuk, J. H. Warner, B. Büchner, G. Cuniberti, M. H. Rümmeli, *Small* **2012**, *8*, 1973.
6) B. Liu, W. Ren, S. Li, C. Liu, H.-M. Cheng, *Chem. Commun*. **2012**, *48*, 2409.
7) H. Liu, D. Nishide, T. Tanaka, H. Kataura, *Nat. Commun*. **2011**, *2*, 1313/1.
8) Review: K. Balasubramanian, E. J. H. Lee, R. T. Weitz, M. Burghard, K. Kern, *Phys. Status Solidi A* **2008**, *205*, 633.
9) J. Park, Y. Kim, G.-T. Kim, J. S. Ha, *Adv. Funct. Mater*. **2011**, *21*, 4159.
10) N. J. Kybert, M. B. Lerner, J. S. Yodh, G. Preti, A. T. C. Johnson, *ACS Nano* **2013**, *7*, 2800.
11) J. H. Warner, A. A. R. Watt, L. Ge, K. Porfyrakis, T. Akachi, H. Okimoto, Y. Ito, A. Ardavan, B. Montanari, J. H. Jefferson, N. M. Harrison, H. Shinohara, G. A. D. Briggs, *Nano Lett*. **2008**, *8*, 1005.
12) H. Kyakuno, K. Matsuda, H. Yahiro, Y. Inami, T. Fukuoka, Y. Miyata, K. Yanagi, Y. Maniwa, H. Kataura, T. Saito, M. Yumura, S. Iijima, *J. Chem. Phys*. **2011**, *134*, 244501.
13) J. M. H. Kroes, F. Pietrucci, A. Curioni, R. Jaafar, O. Gröning, W. Andreoni, *J. Phys. Chem. C* **2013**, *117*, 1948.
14) K. Yanagi, K. Iakoubovskii, H. Matsui, H. Matsuzaki, H. Okamoto, Y. Miyata, Y. Maniwa, S. Kazaoui, N. Minami, H. Kataura *J. Am. Chem. Soc*. **2007**, *129*, 4992.
15) E. Tylianakis, G. K. Dimitrakakis, F. J. Martin-Martinez, S. Melchor, J. A. Dobado, E. Klontzas, G. E. Froudakis, Int. *J. Hydrogen Engergy* **2014**, *39*, 9825.

Graphene & Graphene Oxide

Graphene, which is one of the nanocarbon materials, consists of all six-membered rings with sp^2 carbons having a two-dimensional sheet structure. Graphene has been known for long time, since graphite is formed by combination of graphenes with van der Waals force. However, details of the properties were unclear until late years, because an isolation procedure of graphene from graphite was not well developed for long time. Geim and Novoselov *et al*. in 2004 successfully isolated a thin-flake graphene by a simple procedure. They used a tape to peel off a graphene layer from highly oriented pyrolytic graphite (HOPG) and then the peeled graphene layer is stuck on a substrate. After this observation,[1] studies of graphene have proved the particular characteristics of electronic, mechanical, and chemical properties. Geim and Novoselov won their joint Nobel prizes in physics in 2010 for their contributions.

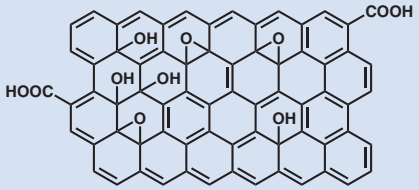
The most characteristic feature of graphene is its electrical property. The electron mobility in the graphene layer is 100 times greater than that of silicon.[2] Accordingly, we can expect to develop a transistor with high-mobility and low-power consumption. Graphene may be promising for a next generation channel material that is useful for LSI (large-scale integration). In addition, the physical strength of graphene is 100 times greater than that of iron. The current density tolerance is much better than that of copper, thus it is expected to be an electrical wire transporting large currents.[3]

Electrons in the graphene behave as massless Dirac fermions as similar to neutrinos,[4] and demonstrate a quantum Hall effect at room temperature.[5] Graphene is an ideal material for spintronics, since there are small spin orbit interactions and the negligible nuclear magnetic moment of carbon. Hybridization of graphene and a ferromagnetic material is developed for the application of an information processor using the electron spin (spintronics device).[6]



Graphene

[G0438, G0441, G0442]



Graphene oxide

[G0443, G0444]

The fabrication procedure for graphene is peeling off the layer from HOPG, a chemical vapor deposition (CVD)[7] as well as reduction of a graphene oxide (GO).[8] There are various synthetic methods of making GO, and the properties and applications depend on the degree of oxidation. GO disperses in water and several polar solvents, because the structure of GO normally includes hydroxyl, epoxy, and carboxyl groups on the graphene sheet. Accordingly, a GO thin film can be fabricated on a substrate by a solution-process. The reduction of GO provides a reduced graphene oxide (rGO), but it is not a perfect graphene. The rGO contains a few oxygen components and defects on the graphene structure. Although GO is an insulator because there are sp^3 carbon atoms, rGO is conductive. Therefore the rGO is expected to be an electrode material. A water dispersion of GO is used as a lubricant to reduce friction on metal surfaces.[9] GO-supported metal catalysts were developed for a cross-coupling reaction and hydrogenation.[10,11] We can introduce several functional groups on GO because there are oxygen-based groups. These GO derivatives may be useful for luminescent materials and biosensors.[12,13]

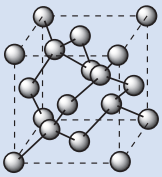
Product No.	Product Name	Unit Size	
G0441	Graphene Nanoplatelets 6-8nm(thick), 5μm(wide)	5g	25g
G0442	Graphene Nanoplatelets 6-8nm(thick), 15μm(wide)	5g	25g
G0438	Graphene Nanoplatelets 6-8nm(thick), 25μm(wide)	5g	25g
G0443	Graphene Oxide		100mg
G0444	Graphene Oxide (10mg/mL, Dispersion in Water)	5mL	25mL

References

1) K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, Y. Zhang, S. V. Dubonos, I. V. Grigorieva, A. A. Firsov, *Science* **2004**, *306*, 666.
2) K. I. Bolotin, K. J. Sikes, Z. Jiang, M. Klima, G. Fudenberg, J. Hone, P. Kim, H. L. Stormer, *Solid State Commun*. **2008**, *146*, 351.
3) A. K. Geim, *Science* **2009**, *324*, 1530.
4) K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, M. I. Katsnelson, I. V. Grigorieva, S. V. Dubonos, A. A. Firsov, *Nature* **2005**, *438*, 197.
5) Y. Zhang, Y.-W. Tan, H. L. Stormer, P. Kim, *Nature* **2005**, *438*, 201.
6) D. Pesin, A. H. MacDonald, *Nat. Mater*. **2012**, *11*, 409.
7) X. Zhang, L. Wang, J. Xin, B. I. Yakobson, F. Ding, *J. Am. Chem. Soc*. **2014**, *136*, 3040.
8) C. K. Chua, M. Pumera, *Chem. Soc. Rev*. **2014**, *43*, 291.
9) H. Kinoshita, Y. Nishina, A. A. Alias, M. Fujii, *Carbon* **2014**, *66*, 720.
10) S. Yamamoto, H. Kinoshita, H. Hashimoto, Y. Nishina, *Nanoscale* **2014**, *6*, 6501.
11) N. Morimoto, S. Yamamoto, Y. Takeuchi, Y. Nishina, *RSC Adv*. **2013**, *3*, 15608.
12) K. Furukawa, Y. Ueno, E. Tamechika, H. Hibino, *J. Mater. Chem. B* **2013**, *1*, 1119.
13) G. Gou, R. Ren, S. Li, S. Guo, Z. Dong, M. Xie, J. Ma, *New J. Chem*. **2013**, *37*, 3861.

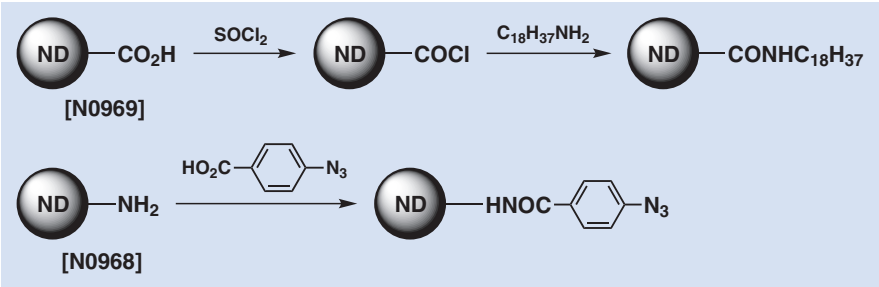
Nanodiamonds

Diamond, an allotrope of carbon, has excellent hardness, coefficient of friction, thermal conductivity, insulation characteristics, and refractive index. Large and highly pure diamond is good for use as jewelry. Furthermore, the major industrial application of diamond is for cutting and polishing tools, because it is the hardest of natural products. However, diamond is not workable enough because of its hardness so there is a limitation for industrial use of a large diamond. Nanodiamond (ND) is a nanoparticle having the crystal structure of diamond, and it has excellent properties of normal diamond. ND is artificially synthesized and is useful for polishing tools and additives of engine oil.



Nanodiamond (ND)

We can modify the surface of ND by introducing carboxyl and amino groups. These groups are further converted by a chemical modification to functionalize the ND particle.[1-3] Non-modified ND can be dispersed in water, but coheres in organic solvents. On the other hand, a functionalized ND particle with alkyl groups can be dispersed in organic solvents. We can modify a glass surface with ND that is functionalized with a silane coupling reagent.[4]



An application of ND is extended for biology and medical use[5,6] because it is a harmless nanoparticle in-vivo. Since a diamond with a complex defect (NV) containing nitrogen (N) and vacancy (V) shows fluorescence,[7] we can monitor movements and structural changes of a biological molecule on a microscope using the NV diamond as a fluorescent labeling reagent.[8-10] We can easily detect fluorescent behavior in a complex atmosphere in-vivo, because ND is chemically stable. A publication described that functionalization of ND also showed fluorescent behavior without NV defects.[11] Protein- and biotin-supported ND were reported in order to enhance affinity toward a biological molecule.[12,13] These modified NDs are expected to be used for a drug delivery system.

Product No.	Product Name	Unit Size
N0962	Nanodiamond (particle size : <10nm)	1g 5g
N0968	Nanodiamond (particle size : <10nm) (Amine-modified)	1g
N0969	Nanodiamond (particle size : <10nm) (Carboxyl-modified)	1g

References

1) B. T. Branson, P. S. Beauchamp, J. C. Beam, C. M. Lukehart, J. L. Davidson, *ACS Nano* **2013**, *7*, 3183.
2) V. N. Mochalin, Y. Gogotsi, *J. Am. Chem. Soc.* **2009**, *131*, 4594.
3) A. Barras, S. Szunerits, L. Marcon, N. Monfilliette-Dupont, R. Boukherroub, *Langmuir* **2010**, *26*, 13168.
4) Y. Liu, V. N. Khabashesku, N. J. Halas, *J. Am. Chem. Soc.* **2005**, *127*, 3712.
5) Review: V. K. A. Sreenivasan, A. V. Zvyagin, E. M. Goldys, *J. Phys.: Condens. Matter* **2013**, *25*, 194101.
6) Review: A. Krueger, *Chem. Eur. J.* **2008**, *14*, 1382.

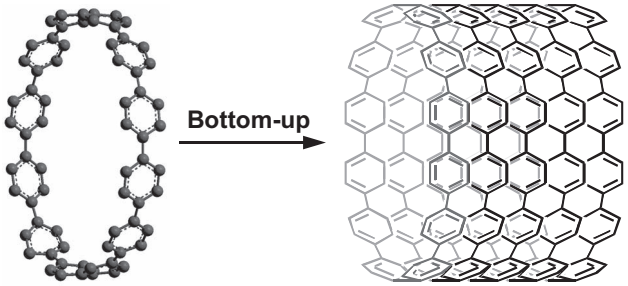
7) Review: A. Krueger, *J. Mater. Chem.* **2011**, *21*, 12571.
8) S.-J. Yu, M.-W. Kang, H.-C. Chang, K.-M. Chen, Y.-C. Yu, *J. Am. Chem. Soc.* **2005**, *127*, 17604.
9) T.-J. Wu, Y.-K. Tzeng, W.-W. Chang, C.-A. Cheng, Y. Kuo, C.-H. Chien, H.-C. Chang, J. Yu, *Nat. Nanotechnol.* **2013**, *8*, 682.
10) L. P. McGuinness, Y. Yan, A. Stacey, D. A. Simpson, L. T. Hall, D. Maclaurin, S. Prawer, P. Mulvaney, J. Wrachtrup, F. Caruso, R. E. Scholten, L. C. L. Hollenberg, *Nat. Nanotechnol.* **2011**, *6*, 358.
11) V. N. Mochalin, O. Shenderova, D. Ho, Y. Gogotsi, *Nat. Nanotechnol.* **2012**, *7*, 11.
12) L.-C. L. Huang, H.-C. Chang, *Langmuir* **2004**, *20*, 5879.
13) A. Krueger, J. Stegk, Y. Liang, L. Lu, G. Jarre, *Langmuir* **2008**, *24*, 4200.

Nanocarbon Unit Structures

(1) Cycloparaphenylenes (CPP)

Carbon nanotubes (CNT) have advanced chemistry, material science, life science and other research fields. CNTs can be prepared by physical methods such as arc discharge, laser furnace, and chemical vapor deposition techniques. One disadvantage of these physical methods is forming several kinds of CNTs with various diameters, thus uniform CNTs do not form.

Cycloparaphenylenes (CPP), the so-called carbon nanoring, have a cyclic structure formed by linkages of *para*-substituted benzenes. The CPP attracted researchers in fundamental chemistry and material science, because it is a unit structure of CNT. In fact, Itami *et al*. successfully synthesized uniform CNTs by a bottom-up procedure starting from CPP as a template compound.[1)]



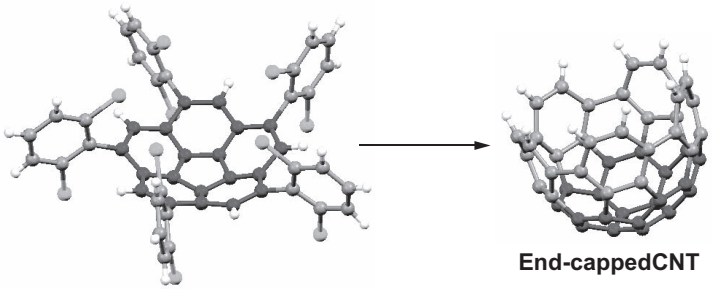
[C2449]

Recently, this research was extended to synthesize a CPP of smaller diameters having a large distortion. Yamago[2)] and Jasti[3)] groups independently reported synthesis of the [5]CPP, which has been the smallest CPP so far. We can expect to synthesize the smallest diameter CNTs from [5]CPP. In addition, the electronic and physical properties of [5]CPP may be interesting, because [5]CPP is a unit structure of C_{60} fullerene, too. CPPs of a specified diameter make an inclusion complex with a fullerene.[4)]

(2) Corannulene and truxene

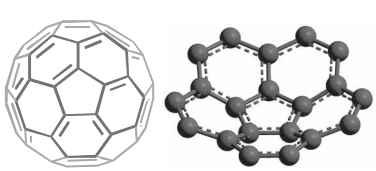
Corannulene, the so-called [5]circulene, is one of the polycyclic aromatic compounds. It has a condensed structure of five benzene rings. The corannulene was first synthesized in 1960s,[5)] and after that the bowl-type structure was observed.[6)] The corannulene is attractive as a nanocarbon material, because it is a unit structure of C_{60} fullerene.

Scott *et al*. synthesized a polyarene compound by a flash vacuum pyrolysis (FVP) starting from corannulene. This polyarene compound e corresponds to an end-capped CNT. An extension of the end-capped CNT may chemically produce a normal CNT.[7)] Itami and Scott *et al*. synthesized a grossly warped nanographene compound from corannulene.[8)]

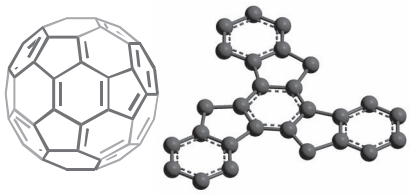


$(C_6H_3Cl_2)_5$-Corannulene **End-cappedCNT**

Truxene has star-shaped and rigid planar structures. Truxene is also a unit structure of C_{60} fullerene. Truxene derivatives are useful for OLED materials because they easily form an amorphous structure.[9] A chemical synthesis for C_{60} fullerene was carried out starting from truxene. Otero *et al*. synthesized a polyarene compound formulated as $C_{60}H_{30}$ by three step reactions, and a thermal treatment of the polyarene on platinum surface gave C_{60} fullerene all.[10]



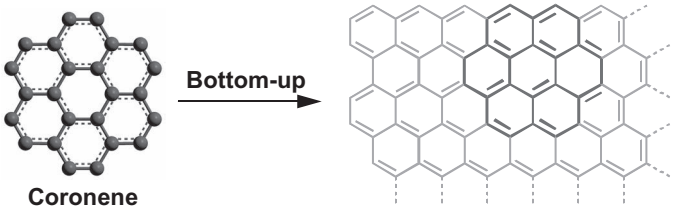
Corannulene
[C2572]



Truxene
[T2752]

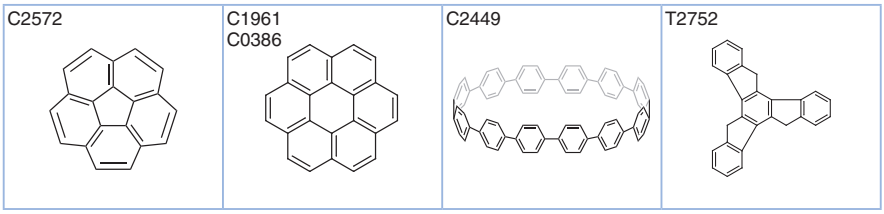
(3) Coronene

Coronene, the so-called [6]circulene, is another polycyclic aromatic compound. It has a condensed structure of six benzene rings. The coronene is a molecular compound in nanoscale, known as a representative nanographene compound that is smaller than graphene. The coronene can be an organic transistor material[11] because it is a nanographene compound with a band gap, which is different from graphene. Furthermore, a bottom-up procedure of coronene fabricated a graphene nanostructure.[12] After Kubozono *et al*. observed superconductivity from an alkali-doped picene,[13] studies on organic superconductors of polycyclic aromatic compounds recently received much attention.[14,15] An alkali-doped coronene also showed superconductivity.[16]



Coronene
[C0386,C1961]

Graphene



Product No.	Product Name	Unit Size	
C2572	Corannulene	20mg	100mg
C1961	Coronene (purified by sublimation)		100mg
C0386	Coronene	1g	5g
C2449	[12]Cycloparaphenylene		10mg
T2752	Truxene	100mg	1g

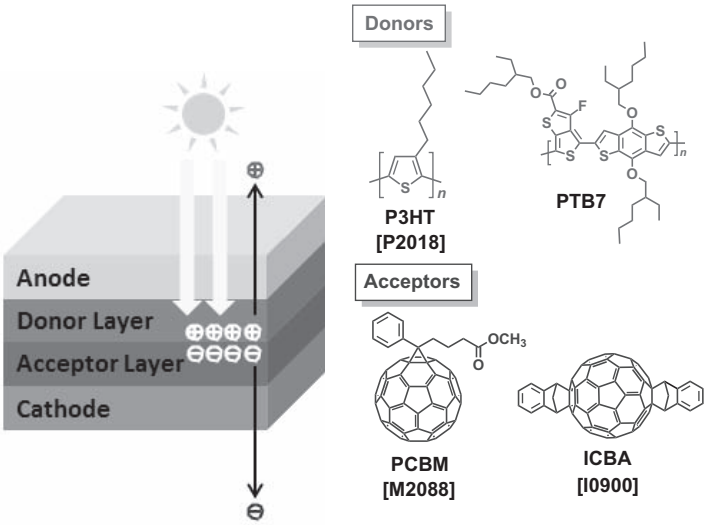
References

1) H. Omachi, T. Nakayama, E. Takahashi, Y. Segawa, K. Itami, *Nat. Chem.* **2013**, *5*, 572.
2) E. Kayahara, V. K. Patel, S. Yamago, *J. Am. Chem. Soc.* **2014**, *136*, 2284.
3) P. J. Evans, E. R. Darzi, R. Jasti, *Nat. Chem.* **2014**, *6*, 404.
4) T. Iwamoto, Y. Watanabe, T. Sadahiro, T. Haino, S. Yamago, *Angew. Chem. Int. Ed.* **2011**, *50*, 8342.
5) W. E. Barth, R. G. Lawton, *J. Am. Chem. Soc.* **1966**, *88*, 380.
6) J. C. Hanson, C. E. Nordman, *Acta Cryst.* **1976**, *B32*, 1147.
7) L. T. Scott, E. A. Jackson, Q. Zhang, B. D. Steinberg, M. Bancu, B. Li, *J. Am. Chem. Soc.* **2012**, *134*, 107.

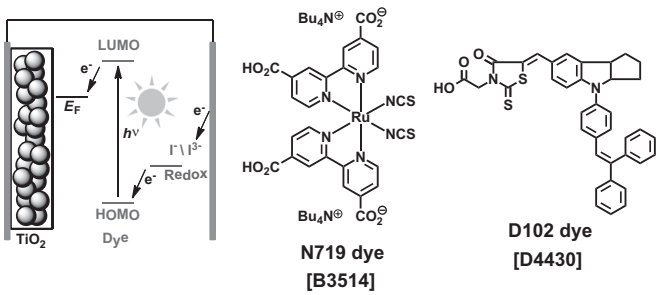
8) K. Kawasumi, Q. Zhang, Y. Segawa, L. T. Scott, K. Itami, *Nat. Chem.* **2013**, *5*, 739.
9) Z. Yang, B. Xu, J. He, L. Xue, Q. Guo, H. Xia, W. Tian, *Org. Electron*. **2009**, *10*, 954.
10) G. Otero, G. Biddau, C. Sánchez-Sánchez, R. Caillard, M. F. López, C. Rogero, F. J. Palomares, N. Cabello, M. A. Basanta, J. Ortega, J. Méndez, A. M. Echavarren, R. Pérez, B. Gómez-Lor, J. A. Martín-Gago, *Nature* **2008**, *454*, 865.
11) I. Diez-Perez, Z. Li, J. Hihath, J. Li, C. Zhang, X. Yang, L. Zang, Y. Dai, X. Feng, K. Muellen, N. Tao, *Nat. Commun*. **2010**, *1*, 1.
12) X. Wan, K. Chen, D. Liu, J. Chen, Q. Miao, J. Xu, *Chem. Mater*. **2012**, *24*, 3906.
13) R. Mitsuhashi, Y. Suzuki, Y. Yamanari, H. Mitamura, T. Kambe, N. Ikeda, H. Okamoto, A. Fujiwara, M. Yamaji, N. Kawasaki, Y. Maniwa, Y. Kubozono, *Nature* **2010**, *464*, 76.
14) X. F. Wang, R. H. Liu, Z. Gui, Y. L. Xie, Y. J. Yan, J. J. Ying, X. G. Luo, X. H. Chen, *Nat. Commun*. **2011**, *2*, 1513/1.
15) M. Xue, T. Cao, D. Wang, Y. Wu, H. Yang, X. Dong, J. He, F. Li, G. F. Chen, *Sci. Rep*. **2012**, *2*, srep00389.
16) Y. Kubozono, H. Mitamura, X. Lee, X. He, Y. Yamanari, H. Takahashi, Y. Suzuki, Y. Kaji, R. Eguchi, K. Akaike, T. Kambe, H. Okamoto, A. Fujiwara, T. Kato, T. Kosugi, H. Aoki, *Phys. Chem. Chem. Phys*. **2011**, *13*, 16476.

Reagents for Solar Cell Research

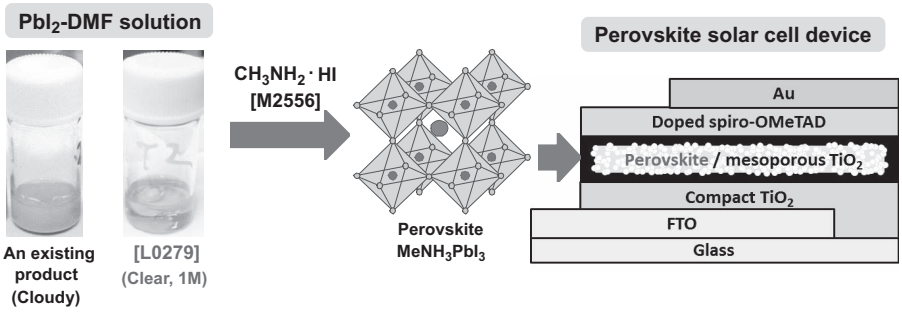
A prototype of organic photovoltaics (OPV) was reported by Tang *et al*. in 1986.[1] In order to fabricate an OPV device, we can use highly productive methods such as printing and roll-to-roll methods. The OPV device usually requires a bulk heterojunction (BHJ) which can be fabricated by mixing an electron-donor (p-type semiconductor) and electron-acceptor (n-type semiconductor).[2] The former material involves a π-conjugated polymer and a small molecule semiconductor, and the latter material is normally a fullerene derivative. PCBM, that is a solubility-enhanced fullerene, efficiently provides a bulk heterojunction.[3] ICBM gives a high open-circuit voltage because it has a higher energy LUMO than that of PCBM.[4] A C_{70} derivative usually gives higher cell efficiency compared with that of the corresponding C_{60} one, because the C_{70} derivative absorbs light better than the C_{60}.[5] We can introduce an acceptor component into the structure of a p-type semiconducting polymer to form a donor-acceptor (DA-type) polymer, that shows light absorption in the long wavelength area based on a charge transfer.[6] Raw materials for π-conjugated polymers are listed in the section of 'Building Blocks for Semiconducting Polymer'.

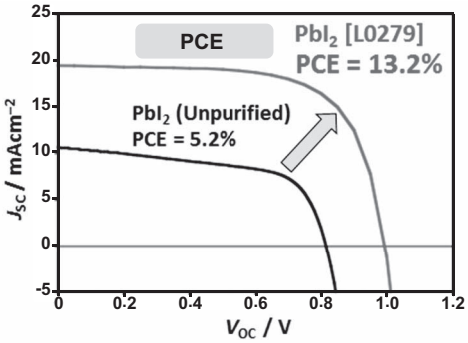


Grätzel *et al*. first developed a dye-sensitized solar cell (DSSC) in 1991.[7] The DSSC is a liquid-type device that involves nanoporous titanium oxide (TiO_2) as a semiconducting electrode, organic dye-sensitizer and electrolyte solution containing a redox component. This is expected to be a low cost solar cell, because there is a simpler device structure compared with the other solar cells.[8] The DSSC is usable under conditions with weak light. Thus, it is expected that the DSSC may be installed in a room. A ruthenium complex with a bipyridine ligand is one of popular organic dyes for the solar cell.[9] In the polypyridine ligand of the ruthenium complex, we can introduce some carboxyl or phosphonic acid groups forming a linkage with TiO_2. In addition, metal-free organic dyes (eg. D-102, D-131 and D-358) were also developed, because they do not contain any expensive ruthenium atoms.[10,11] Several examples of DSSC with all solid systems are reported as well.[12]



A perovskite solar cell, that was first reported by Miyasaka *et al*. in 2009, has recently received much attention.[13] The organic-inorganic perovskite, RNH_3PbX_3 (X = Cl, Br, I), can function as a light absorption layer. Power conversion efficiency (PCE) of the perovskite solar cell is getting >15%, better than those of OPV and DSSC.[14,15] A device of the perovskite solar cell is solution-processible enabling fabrication at low cost. The organic-inorganic perovskites RNH_3PbX_3 are easily prepared from HX salts of organic amines and lead halides. A modification of the halide X in the $(MeNH_3)PbX_3$ can control the range of absorption wavelength. The perovskite compound with X = Br is useful for light absorption in shorter wavelengths and the compound with X = I is relatively useful for that in longer wavelengths. Wakamiya *et al*. reported that use of highly dried lead(II) iodide is a key to fabricate efficient perovskite solar cell devices (PCE > 10%) with high reproducibility.[16,17]

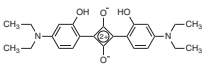




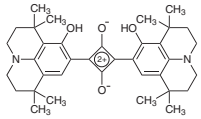
Organic Photovoltaics (OPV)

p-Type Semiconductors

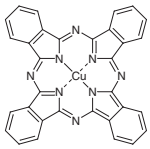
B4342



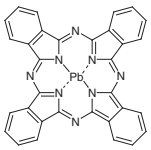
B4649



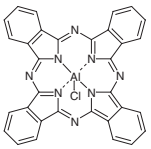
P1005
P1006



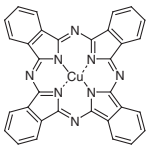
P0766



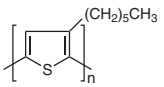
C1167



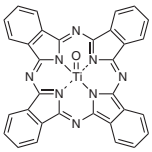
P1628



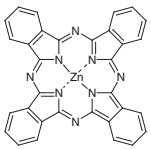
P2018



T2272



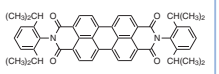
P0767



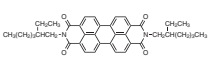
Product No.	Product Name	Unit Size		
B4342	2,4-Bis[4-(diethylamino)-2-hydroxyphenyl]squaraine		1g	5g
B4649	2,4-Bis[8-hydroxy-1,1,7,7-tetramethyljulolidin-9-yl]squaraine		1g	5g
P1005	Copper(II) Phthalocyanine (*α*-form)		25g	250g
P1006	Copper(II) Phthalocyanine (*β*-form)		25g	500g
P0766	Lead(II) Phthalocyanine		1g	25g
C1167	Phthalocyanine Chloroaluminum			1g
P1628	Pigment Blue 15 (purified by sublimation)			1g
P2018	Poly(3-hexylthiophene-2,5-diyl) (regioregular)		200mg	1g
T2272	Titanyl Phthalocyanine (purified by sublimation)		200mg	1g
P0767	Zinc Phthalocyanine	1g	10g	25g

n-Type Semiconductors

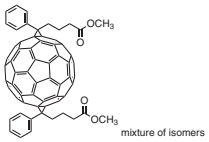
B4268



B4343

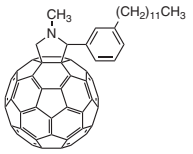


B4576

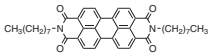


mixture of isomers

C2415

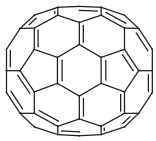


D4175



B1641

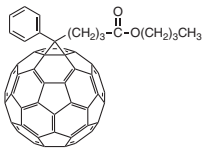
B1694



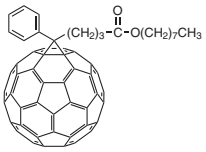
H1194

I0900

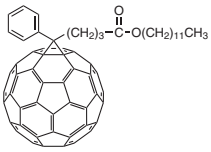
P2013



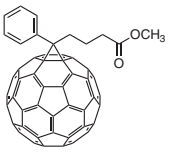
P2014



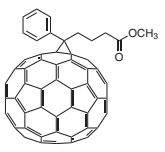
P2015



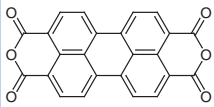
M2088



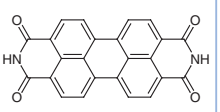
M2550



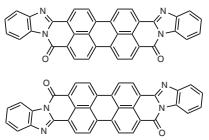
P0972



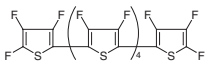
P0984



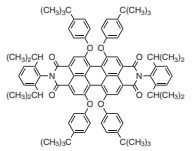
P2119



T2206



T3061

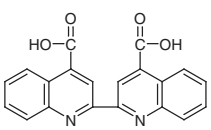


Product No.	Product Name	Unit Size	
B4268	*N,N'*-Bis(2,6-diisopropylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide	1g	5g
B4343	*N,N'*-Bis(2-ethylhexyl)-3,4,9,10-perylenetetracarboxylic Diimide		200mg
B4576	Bis-PCBM (mixture of isomers)		50mg
C2415	$C_{60}MC_{12}$		100mg
D4175	*N,N'*-Di-*n*-octyl-3,4,9,10-perylenetetracarboxylic Diimide		1g
B1641	Fullerene C_{60} (pure)	100mg	1g
B1694	Fullerene C_{70}		100mg
H1194	1,2,3,4,8,9,10,11,15,16,17,18,22,23,24,25-Hexadecafluorophthalocyanine Copper(II) (purified by sublimation)	100mg	1g
I0900	ICBA		50mg
P2013	[60]PCB-C_4 ([6,6]-Phenyl-C_{61}-butyric Acid Butyl Ester)		100mg
P2014	[60]PCB-C_8 ([6,6]-Phenyl-C_{61}-butyric Acid *n*-Octyl Ester)		100mg
P2015	[60]PCB-C_{12} ([6,6]-Phenyl-C_{61}-butyric Acid Dodecyl Ester)		100mg
M2088	[60]PCBM (Methyl [6,6]-Phenyl-C_{61}-butyrate)		100mg
M2550	[70]PCBM (Methyl [6,6]-Phenyl-C_{71}-butyrate) (mixture of isomers)		50mg

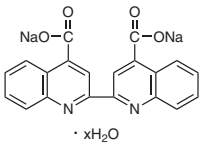
Product No.	Product Name	Unit Size		
P0972	3,4,9,10-Perylenetetracarboxylic Dianhydride	25g	100g	500g
P0984	3,4,9,10-Perylenetetracarboxylic Diimide			25g
P2119	PTCBI (*cis*- and *trans*- mixture)			200mg
T2206	Tetradecafluoro-α-sexithiophene (purified by sublimation)			50mg
T3061	1,6,7,12-Tetrakis(4-*tert*-butylphenoxy)-*N*,*N*'-bis(2,6-diisopropylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide			200mg

Dye-Sensitized Solar Cell (DSSC)

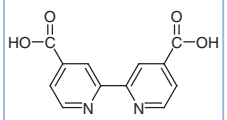
B3509



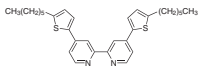
B4509



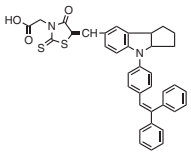
B1876



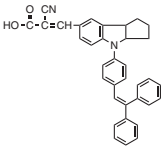
B4420



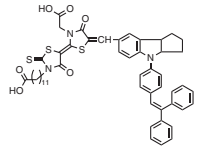
D4430



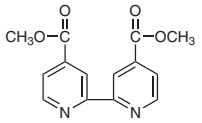
D4431



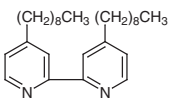
D4432



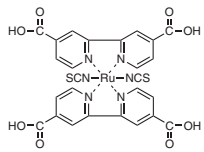
D4635



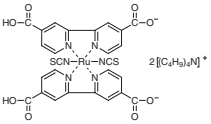
D3917



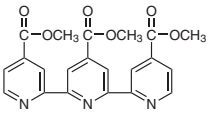
B4372



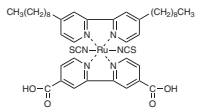
B3514



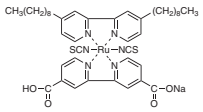
T2959



B4373



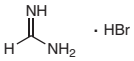
B4432



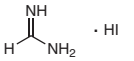
Product No.	Product Name	Unit Size	
B3509	2,2'-Bicinchoninic Acid	1g	5g
B4509	Bicinchoninic Acid Disodium Salt Hydrate	1g	5g
B1876	2,2'-Bipyridine-4,4'-dicarboxylic Acid	100mg	1g
B4420	4,4'-Bis(5-hexyl-2-thienyl)-2,2'-bipyridyl		200mg
D4430	D 102		50mg
D4431	D 131		50mg
D4432	D 358		50mg
D4635	Dimethyl 2,2'-Bipyridine-4,4'-dicarboxylate	1g	5g
D3917	4,4'-Dinonyl-2,2'-bipyridyl	1g	5g
B4372	N3 Dye		200mg
B3514	N719 Dye		100mg
T2959	Trimethyl 2,2':6',2''-Terpyridine-4,4',4''-tricarboxylate		200mg
B4373	Z907 Dye		200mg
B4432	Z907 Dye Sodium Salt		200mg

Perovskite Solar Cell

F0973



F0974



L0279

PbI_2

M2589

CH_3NH_2 · HBr

M2556

CH_3NH_2 · HI

Product No.	Product Name	Unit Size		
F0973	Formamidine Hydrobromide		1g	5g
F0974	Formamidine Hydroiodide		1g	5g
L0279	Lead(II) Iodide [for Perovskite precursor]		1g	5g
M2589	Methylamine Hydrobromide		1g	5g
M2556	Methylamine Hydroiodide	1g	5g	25g

References

1) C. W. Tang, *Appl. Phys. Lett*. **1986**, *48*, 183.
2) C. J. Brabec, G. Zerza, G. Cerullo, S. De Silvestri, S. Luzzatti, J. C. Hummelen, N. S. Sariciftci, *Chem. Phys. Lett*. **2001**, *340*, 232.
3) J. C. Hummelen, B. W. Knight, F. LePeq, F. Wudl, J. Yao, C. L. Wilkins, *J. Org. Chem*. **1995**, *60*, 532.
4) Y. He, H.-Y. Chen, J. Hou, Y. Li, *J. Am. Chem. Soc*. **2010**, *132*, 1377.
5) M. M. Wienk, J. M. Kroon, W. J. H. Verhees, J. Knol, J. C. Hummelen, P. A. van Hal, R. A. J. Janssen, *Angew. Chem., Int. Ed*. **2003**, *42*, 3371.
6) S. H. Park, A. Roy, S. Beaupré, S. Cho, N. Coates, J. S. Moon, D. Moses, M. Leclerc, K. Lee, A. J. Heeger, *Nat. Photonics* **2009**, *3*, 297.
7) B. O'Regan, M. Grätzel, *Nature* **1991**, *353*, 737.
8) M. K. Nazeeruddin, P. Pechy, M.Grätzel, *Chem. Commum*. **1997**, 1705.
9) Review: M. Grätzel, *Inorg. Chem*. **2005**, *44*, 6841.
10) W. H. Howie, F. Claeyssens, H. Miura, L. M. Peter, *J. Am. Chem. Soc*. **2008**, *130*, 1367.
11) R. Yoneya Ogura, S. Nakane, M. Morooka, M. Orihashi, Y. Suzuki, K. Noda, *Appl. Phys. Lett*. **2009**, *94*, 073308/1.
12) L. Schmidt-Mende, U. Bach, R. Humphry-Baker, T. Horiuchi, H. Miura, S. Ito, S. Uchida, M. Grätzel, *Adv. Mater*. **2005**, *17*, 813.
13) A. Kojima, K. Teshima, Y. Shirai, T. Miyasaka, *J. Am. Chem. Soc*. **2009**, *131*, 6050.
14) J. Burschka, N. Pellet, S.-J. Moon, R. Humphry-Baker, P. Gao, M. K. Nazeeruddin, M. Grätzel, *Nature* **2013**, *499*, 316.
15) M. Liu, M. B. Johnston, H. J. Snaith, *Nature* **2013**, *501*, 395.
16) A. Wakamiya, M. Endo, T. Sasamori, N. Tokitoh, Y. Ogomi, S. Hayase, Y. Murata, *Chem. Lett*. **2014**, *43*, 711.
17) Y. Yamada, T. Nakamura, M. Endo, A. Wakamiya, Y. Kanemitsu, *J. Am. Chem. Soc*. **2014**, *136*, 11610.

Reagents for Secondary Battery

Secondary batteries are rechargeable. There are small types of secondary batteries obtained from nickel-cadmium, nickel-hydrogen, and lithium ion sources. It is known that lead-acid batteries are relatively large. Secondary batteries are useful for automobiles, airplanes, agricultural equipment, electric vehicles, computers, mobile phones and so on. Among them, the lithium ion batteries are mainly used for various applications, and they are manufactured by lithium cobalt oxide (anode), graphite (cathode), and a liquid electrolyte with organic components.[1] The lithium ion batteries provide high voltage and energy density, because the lithium ion supplied from the lithium cobalt oxide is a carrier doing the charge/discharge of the battery. A memory effect hardly occurs. A package of the lithium ion batteries can be compact. A further development of a better secondary battery is also in progress toward a low-carbon society as well as energy security.

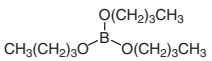
In order to improve security of the lithium ion batteries, it is expected to use an ionic liquid electrolyte,[2] phosphate-based organic solvent,[3] organic solid electrolyte, and inorganic solid electrolyte, since an organic electrolyte solution is more or less flammable. An electrolyte solution requires a fluorine-containing flame retardant as an additive.[4] A selection of electrolyte is important for input-output characteristics, lifetime, security and voltage of a secondary battery. It is also expected that the electrolyte shows high lithium ion conductivity, electrical and chemical stabilities, and a low environmental load.

A next generation secondary battery with high energy density must be developed well. Among them, we may expect practical use of a secondary battery based on a multivalent ion carrier that can transport multi-electrons. A magnesium-based secondary battery has a theoretically high energy density. Furthermore, it is expected that we can use abundant magnesium for the battery and it is secure to use.[5]

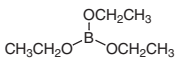
Solvents for Battery

Boric Acid Esters

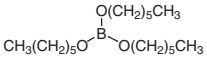
B0518



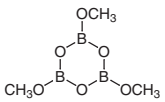
B0520



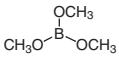
B2094



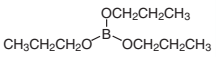
T1581



B0522



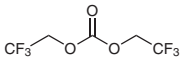
B0134



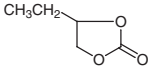
Product No.	Product Name	Unit Size		
B0518	Tributyl Borate	25mL	100mL	500mL
B0520	Triethyl Borate	25mL	100mL	500mL
B2094	Trihexyl Borate			25g
T1581	2,4,6-Trimethoxyboroxin		25g	100g
B0522	Trimethyl Borate	25mL	100mL	500mL
B0134	Tripropyl Borate		25mL	500mL

Carbonates

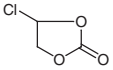
B4703



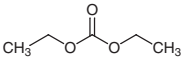
B3321



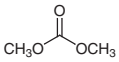
C1858



C0041

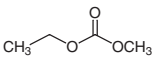


C0053

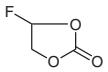


E0076

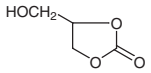
C1342



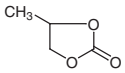
F0731



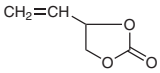
G0279



P0525



V0114



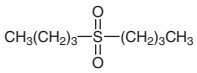
V0015

Product No.	Product Name	Unit Size		
B4703	Bis(2,2,2-trifluoroethyl) Carbonate		5g	25g
B3321	1,2-Butylene Carbonate		25g	500g
C1858	4-Chloro-1,3-dioxolan-2-one		5g	25g
C0041	Diethyl Carbonate		25g	500g
C0053	Dimethyl Carbonate	25mL	100mL	500mL
E0076	Ethylene Carbonate		25g	500g
C1342	Ethyl Methyl Carbonate		10mL	25mL
F0731	4-Fluoro-1,3-dioxolan-2-one		5g	25g
G0279	Glycerol 1,2-Carbonate		25g	500g
P0525	Propylene Carbonate		25g	500g
V0114	4-Vinyl-1,3-dioxolan-2-one			25g
V0015	Vinylene Carbonate (stabilized with BHT)		5g	25g

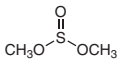
Sulfonyls & Related Compounds

B0136

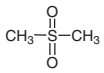
D1172



D0264



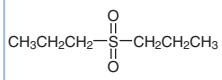
M1239



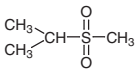
D2830

D2977

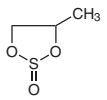
D1171



I0484



M2471



M0436

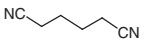
P0324

T0115

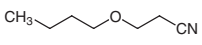
Product No.	Product Name	Unit Size		
B0136	1,4-Butanesultone		25g	250g
D1172	Dibutyl Sulfone			25g
D0264	Dimethyl Sulfite		25g	500g
M1239	Dimethyl Sulfone		25g	500g
D2830	1,3,2-Dioxathiolane 2,2-Dioxide		5g	25g
D2977	1,3,2-Dioxathiolane 2-Oxide		5g	25g
D1171	Dipropyl Sulfone			25g
I0484	Isopropyl Methyl Sulfone		5g	25g
M2471	4-Methyl-1,3,2-dioxathiolane 2-Oxide (mixture of isomers)		5g	25g
M0436	3-Methylsulfolane		25g	250g
P0324	1,3-Propanesultone	25g	100g	500g
T0115	Tetrahydrothiophene 1,1-Dioxide		25g	500g

Nitriles

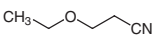
A0168



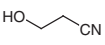
B0959



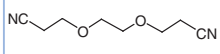
E0299



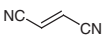
C0450



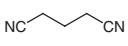
E0108



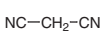
F0072



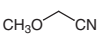
G0072



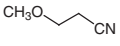
M0033



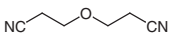
M0103



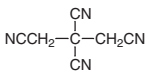
M0653



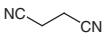
B0475



P1751



S0109



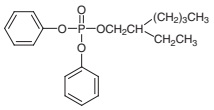
T0077

Product No.	Product Name	Unit Size		
A0168	Adiponitrile		25mL	500mL
B0959	3-Butoxypropionitrile			25mL
E0299	3-Ethoxypropionitrile		25mL	500mL
C0450	Ethylene Cyanohydrin		25mL	500mL
E0108	Ethylene Glycol Bis(propionitrile) Ether		25g	100g
F0072	Fumaronitrile		5g	25g
G0072	Glutaronitrile		25g	250g
M0033	Malononitrile	25g	100g	500g
M0103	Methoxyacetonitrile		5mL	25mL
M0653	3-Methoxypropionitrile		25mL	500mL
B0475	3,3'-Oxydipropionitrile		25mL	500mL
P1751	1,2,2,3-Propanetetracarbonitrile		1g	5g
S0109	Succinonitrile		25g	500g
T0077	Tetracyanoethylene		5g	25g

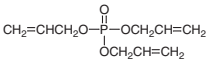
Additives for Battery

Phosphates

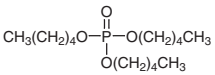
P1021



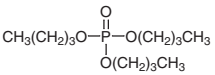
P0264



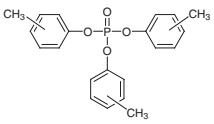
P0265



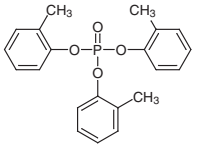
P0266



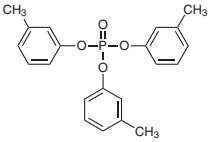
P0273



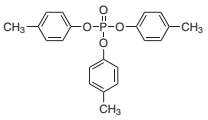
P1331



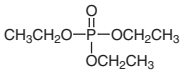
P1472



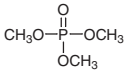
T2209



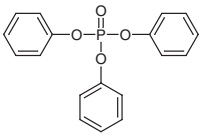
P0270



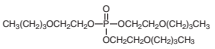
P0271



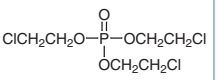
P0272



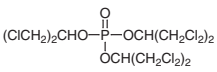
P0683



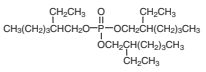
P0268



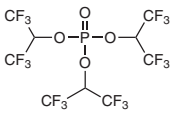
P0269



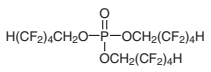
P1022



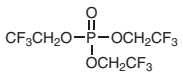
T3041



P1134



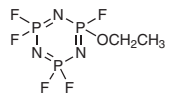
T3203



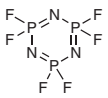
Product No.	Product Name	Unit Size	
P0259	Cresyl Diphenyl Phosphate (so called) (mixture of analogue)	25mL	500mL
P1021	2-Ethylhexyl Diphenyl Phosphate	25g	500g
P0264	Triallyl Phosphate		25mL
P0265	Triamyl Phosphate		25mL
P0266	Tributyl Phosphate	25g	500g
P0273	Tricresyl Phosphate (mixture of isomers)	25g	500g
P1331	Tri-*o*-cresyl Phosphate	5g	25g
P1472	Tri-*m*-cresyl Phosphate		5g
T2209	Tri-*p*-cresyl Phosphate	5g	25g
P0270	Triethyl Phosphate	25g	500g
P0271	Trimethyl Phosphate	25g	500g
P0272	Triphenyl Phosphate	25g	500g
P0683	Tris(2-butoxyethyl) Phosphate	25g	500g
P0268	Tris(2-chloroethyl) Phosphate		25g
P0269	Tris(1,3-dichloro-2-propyl) Phosphate	25g	500g
P1022	Tris(2-ethylhexyl) Phosphate	25mL	500mL
T3041	Tris(1,1,1,3,3,3-hexafluoro-2-propyl) Phosphate	1g	5g
P1134	Tris(1*H*,1*H*,5*H*-octafluoropentyl) Phosphate		10g
T3203	Tris(2,2,2-trifluoroethyl) Phosphate	5g	25g

Phosphazenes

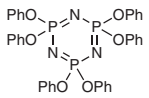
E1140



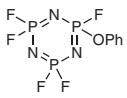
H1429



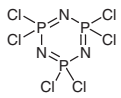
H1356



P2286



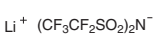
C0584



Product No.	Product Name	Unit Size	
E1140	Ethoxy(pentafluoro)cyclotriphosphazene	1g	5g
H1429	Hexafluorocyclotriphosphazene	5g	25g
H1356	Hexaphenoxycyclotriphosphazene	5g	25g
P2286	Pentafluoro(phenoxy)cyclotriphosphazene	1g	5g
C0584	Phosphonitrilic Chloride Trimer	25g	250g

Lithium Electrolytes

L0267

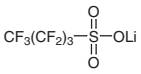


B2542

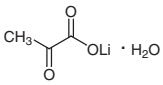
L0224

L0146

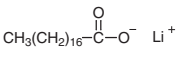
N0710



P0659



S0237



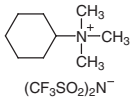
L0133

T1548

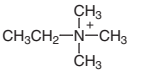
Product No.	Product Name	Unit Size	
L0267	Lithium Bis(pentafluoroethanesulfonyl)imide		1g
B2542	Lithium Bis(trifluoromethanesulfonyl)imide	25g	250g
L0224	Lithium Carbonate	25g	500g
L0146	Lithium Hexafluorophosphate	25g	100g
N0710	Lithium Nonafluoro-1-butanesulfonate		25g
P0659	Lithium Pyruvate Monohydrate		25g
S0237	Lithium Stearate	25g	500g
L0133	Lithium Tetrafluoroborate		25g
T1548	Lithium Trifluoromethanesulfonate		25g

Other Solid Electrolytes

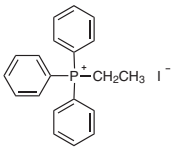
C1966



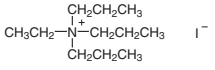
E0190



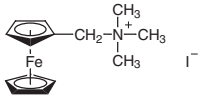
E0549



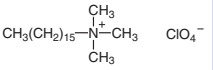
E0191



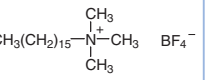
F0167



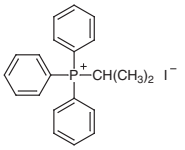
H0735



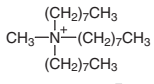
H0734



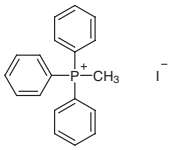
I0552



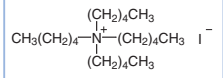
M1660



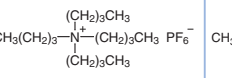
M0253



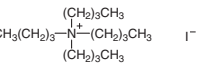
T1011



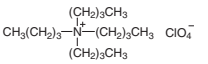
T1279



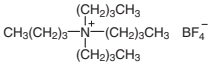
T0057



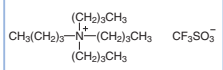
T0836



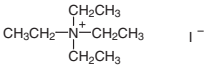
T0914
T2648



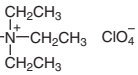
T1568



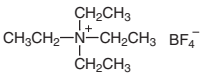
T0097



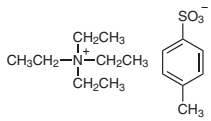
T0839



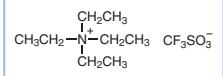
T0983



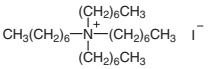
T0937



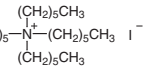
T1745



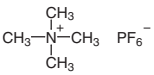
T1396



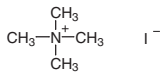
T1010



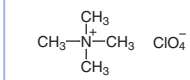
T1296



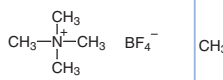
T0139



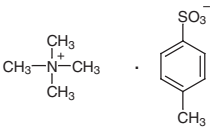
T0841



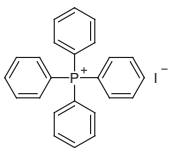
T0842



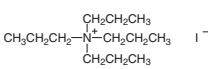
T0843



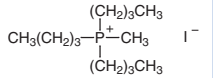
T1450



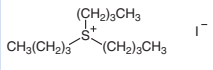
T0172



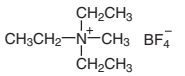
M1455



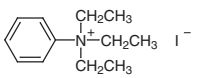
T1564



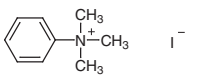
T2198



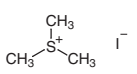
P0242



P0246



T1056



Product No.	Product Name			Unit Size
C1966	Cyclohexyltrimethylammonium Bis(trifluoromethanesulfonyl)imide			5g
E0190	Ethyltrimethylammonium Iodide			25g
E0549	Ethyltriphenylphosphonium Iodide		25g	250g
E0191	Ethyltripropylammonium Iodide			25g
F0167	(Ferrocenylmethyl)trimethylammonium Iodide			5g
H0735	Hexadecyltrimethylammonium Perchlorate		1g	5g
H0734	Hexadecyltrimethylammonium Tetrafluoroborate		1g	5g
I0552	Isopropyltriphenylphosphonium Iodide		5g	25g
M1660	Methyltri-*n*-octylammonium Bis(trifluoromethanesulfonyl)imide			5g
M0253	Methyltriphenylphosphonium Iodide	25g	100g	500g
T1011	Tetraamylammonium Iodide		5g	25g
T1279	Tetrabutylammonium Hexafluorophosphate		25g	250g
T0057	Tetrabutylammonium Iodide	25g	100g	500g
T0836	Tetrabutylammonium Perchlorate	25g	100g	500g
T0914	Tetrabutylammonium Tetrafluoroborate	25g	100g	500g
T2648	Tetrabutylammonium Tetrafluoroborate			25g
T1568	Tetrabutylammonium Trifluoromethanesulfonate		10g	25g
T0097	Tetraethylammonium Iodide		25g	500g
T0839	Tetraethylammonium Perchlorate			25g
T0983	Tetraethylammonium Tetrafluoroborate			25g
T0937	Tetraethylammonium *p*-Toluenesulfonate		25g	500g
T1745	Tetraethylammonium Trifluoromethanesulfonate		5g	25g
T1396	Tetraheptylammonium Iodide			25g
T1010	Tetrahexylammonium Iodide		5g	25g
T1296	Tetramethylammonium Hexafluorophosphate			25g
T0139	Tetramethylammonium Iodide	25g	100g	500g
T0841	Tetramethylammonium Perchlorate			25g
T0842	Tetramethylammonium Tetrafluoroborate		25g	500g
T0843	Tetramethylammonium *p*-Toluenesulfonate			25g
T1450	Tetraphenylphosphonium Iodide		10g	25g
T0172	Tetrapropylammonium Iodide		25g	500g
M1455	Tributylmethylphosphonium Iodide			25g
T1564	Tributylsulfonium Iodide			1g
T2198	Triethylmethylammonium Tetrafluoroborate			25g
P0242	Triethylphenylammonium Iodide			25g
P0246	Trimethylphenylammonium Iodide		25g	500g
T1056	Trimethylsulfonium Iodide		25g	500g

Ionic Liquids (see p.130)

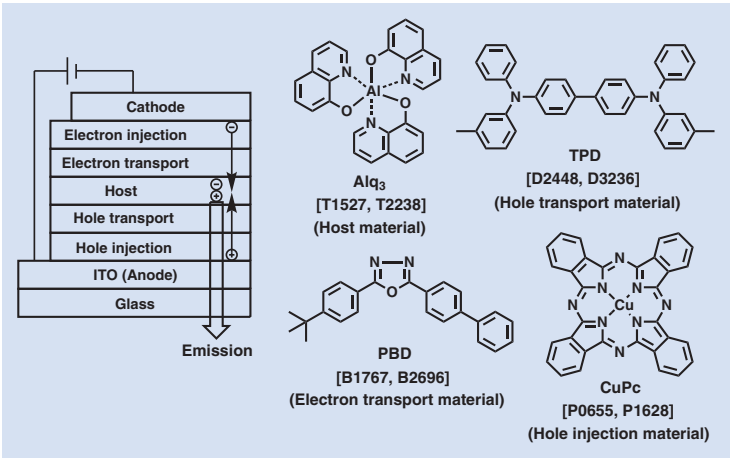
References

1) Review: M. V. Reddy, G. V. Subba Rao, B. V. R. Chowdari, *Chem. Rev*. **2013**, *113*, 5364.
2) M. Montanino, M. Moreno, M. Carewska, G. Maresca, E. Simonetti, R. Lo Presti, F. Alessandrini, G. B. Appetecchi, *J. Power Sources* **2014**, *269*, 608.
3) H. Jia, J. Wang, F. Lin, C. W. Monroe, J. Yang, Y. NuLi, *Chem. Commun*. **2014**, *50*, 7011.
4) Z. Zeng, X. Jiang, B. Wu, L. Xiao, X. Ai, H. Yang, Y. Cao, *Electrochim. Acta* **2014**, *129*, 300.
5) Y. Orikasa, T. Masese, Y. Koyama, T. Mori, M. Hattori, K. Yamamoto, T. Okado, Z.-D. Huang, T. Minato, C. Tassel, J. Kim, Y. Kobayashi, T. Abe, H. Kageyama, Y. Uchimoto, *Sci. Rep*. **2014**, *4*, 5622.

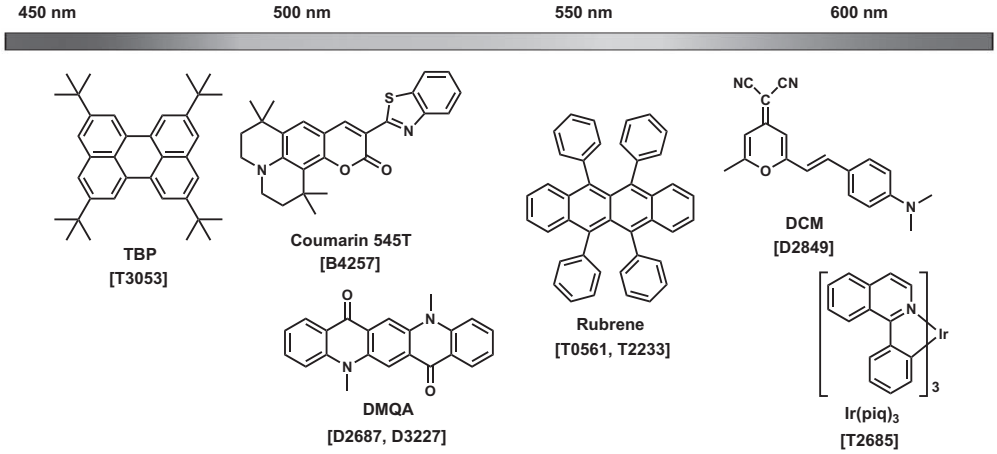
OLED Materials

Organic light-emitting diode (OLED) devices have received much attention, because they are expected to be a next generation display and light source, thanks to lightweight and flexible organic materials. The OLED was focused on practical use, after Tang *et al*. first observed the OLED device by use of a two layered organic thin film.[1] Adachi *et al*. further reported a three layered device, in which a host layer is sandwiched by hole transport and electron transport layers. In addition, they reported a two layered system, in which one layer has roles of host and electron transport properties.[2,3] A five layered system including electron injection and hole injection layers has been also studied in order to improve the efficiency of carrier injection. One can control RGB colors of emission by selection of a dopant into a host layer. A suitable combination of the dopant can give a white colored device.[4,5] An application using the white organic light-emitting device (WOLED) is an OLED light panel.[6]

An amorphous material is useful for an OLED device, because it is transparent, homogeneous, isotropic and easily processible. A practical OLED device further requires excellent heat-resistance and durability. Many hole transport materials based on triphenylamine derivatives (TPD) are widely usable, because they are heat-resistant and amorphous.[7,8] In addition to the TPDs, oxadiazole derivatives (PBD) having an electron transport property,[9] Alq_3 as a host material,[1] and blue emissive distylyl derivatives[10] are fundamental materials for amorphous OLED devices.



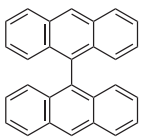
OLED Dopants



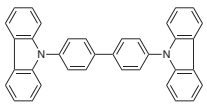
A conventional fluorescent material provides only 25% of a singlet exciton but loses 75% of the triplet one by a nonradiative deactivation, although it has a high current density. On the other hand, a phosphorescent material may provide 100% EL quantum efficiency through an intersystem crossing from singlet to triplet excited states. The phosphorescent $Ir(ppy)_3$ and its analogues have been reported so far.[11] Recently, metal-free materials exhibiting thermally activated delayed fluorescence (TADF) were investigated as well. Adachi *et al*. reported more than 25% quantum efficiency by use of fluorescent materials having a low energy gap between singlet and triplet excited states, because an inverted energy transfer occurs from the triplet to the singlet state.[12,13]

Host Materials

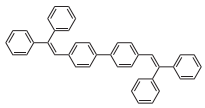
B4095



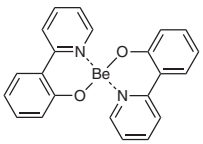
B4219
B2713



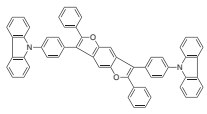
B2737



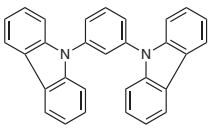
B4720



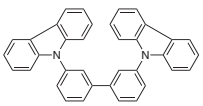
C2780



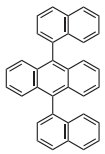
D4087



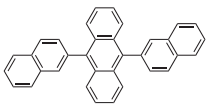
D4772



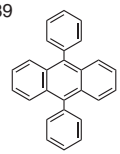
D3975



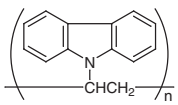
D4127



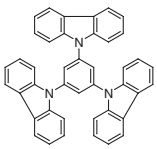
D4401
D1689



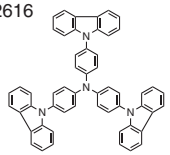
P0656



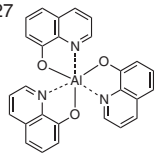
T1934



T2274
T2616



T2238
T1527

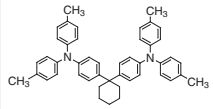


Product No.	Product Name	Unit Size	
B4095	9,9'-Bianthracene	1g	5g
B4219	4,4'-Bis(9*H*-carbazol-9-yl)biphenyl (purified by sublimation)		1g
B2713	4,4'-Bis(9*H*-carbazol-9-yl)biphenyl	1g	5g
B2737	4,4'-Bis(2,2-diphenylvinyl)biphenyl	5g	25g
B4720	Bis[2-(2-pyridinyl)phenolato]beryllium(II)		200mg
C2780	CZBDF		200mg
D4087	1,3-Di-9-carbazolylbenzene (purified by sublimation)		1g
D4772	3,3'-Di(9*H*-carbazol-9-yl)-1,1'-biphenyl		200mg
D3975	9,10-Di(1-naphthyl)anthracene	1g	5g
D4127	9,10-Di(2-naphthyl)anthracene	1g	5g
D4401	9,10-Diphenylanthracene (purified by sublimation)		1g
D1689	9,10-Diphenylanthracene	1g	25g
P0656	Poly(*N*-vinylcarbazole)	5g	25g
T1934	1,3,5-Tri(9*H*-carbazol-9-yl)benzene (purified by sublimation)	1g	5g

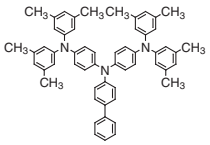
Product No.	Product Name	Unit Size	
T2274	4,4',4"-Tri-9-carbazolyltriphenylamine (purified by sublimation)	200mg	1g
T2616	4,4',4"-Tri-9-carbazolyltriphenylamine	1g	5g
T2238	Tris(8-quinolinolato)aluminum (purified by sublimation)		5g
T1527	Tris(8-quinolinolato)aluminum	25g	250g

Hole Transport Materials

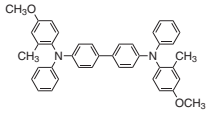
B3146
B2079



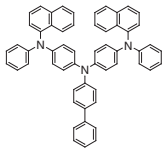
B2269



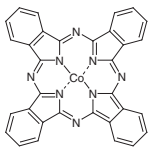
B4470



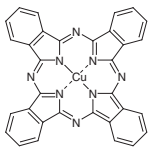
B2305



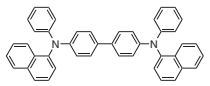
P0887



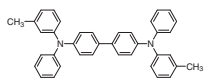
P1005
P1006



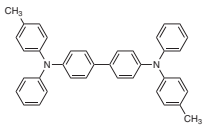
D3970



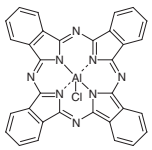
D3236
D2448



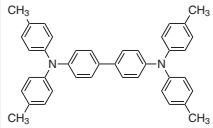
D4834



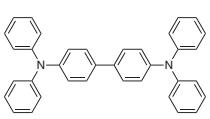
C1167



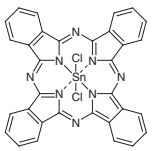
T2269



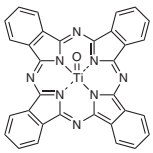
T1812



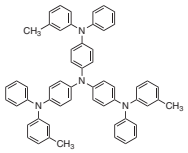
P0997



T2272



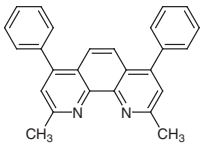
T2251



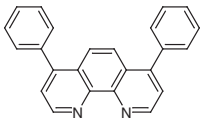
Product No.	Product Name	Unit Size	
B3146	1,1-Bis[4-[*N*,*N*-di(*p*-tolyl)amino]phenyl]cyclohexane (purified by sublimation)		1g
B2079	1,1-Bis[4-[*N*,*N*-di(*p*-tolyl)amino]phenyl]cyclohexane	1g	5g
B2269	4,4'-Bis[di(3,5-xylyl)amino]-4"-phenyltriphenylamine	100mg	1g
B4470	*N*,*N*'-Bis(4-methoxy-2-methylphenyl)-*N*,*N*'-diphenylbenzidine	5g	25g
B2305	4,4'-Bis[*N*-(1-naphthyl)-*N*-phenylamino]-4"-phenyltriphenylamine		100mg
P0887	Cobalt(II) Phthalocyanine		25g
P1005	Copper(II) Phthalocyanine (*α*-form)	25g	250g
P1006	Copper(II) Phthalocyanine (*β*-form)	25g	500g
D3970	*N*,*N*'-Di-1-naphthyl-*N*,*N*'-diphenylbenzidine (purified by sublimation)	1g	5g
D3236	*N*,*N*'-Diphenyl-*N*,*N*'-di(*m*-tolyl)benzidine (purified by sublimation)	1g	5g
D2448	*N*,*N*'-Diphenyl-*N*,*N*'-di(*m*-tolyl)benzidine	1g	5g
D4834	*N*,*N*'-Diphenyl-*N*,*N*'-di(*p*-tolyl)benzidine	200mg	1g
C1167	Phthalocyanine Chloroaluminum		1g
T2269	*N*,*N*,*N*',*N*'-Tetrakis(*p*-tolyl)benzidine		5g
T1812	*N*,*N*,*N*',*N*'-Tetraphenylbenzidine	5g	25g
P0997	Tin(IV) Phthalocyanine Dichloride		1g
T2272	Titanyl Phthalocyanine (purified by sublimation)	200mg	1g
T2251	4,4',4"-Tris[phenyl(*m*-tolyl)amino]triphenylamine		100mg

Electron Transport Materials

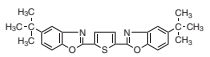
B2694
D0711



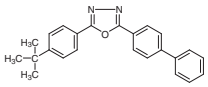
B2695
D0905



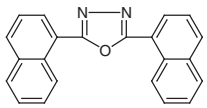
B4221
B1554



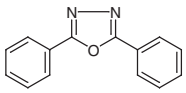
B2696
B1767



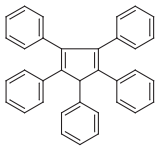
D2757



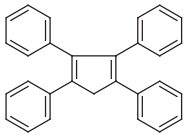
D1429



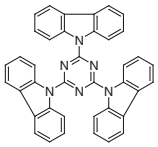
P1633



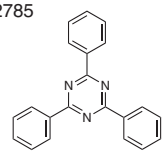
T1333



T2700



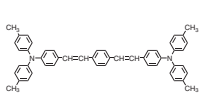
T3268
T2785



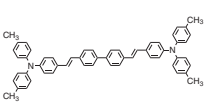
Product No.	Product Name	Unit Size	
B2694	Bathocuproine (purified by sublimation)	1g	5g
D0711	Bathocuproine	1g	5g
B2695	Bathophenanthroline (purified by sublimation)		1g
D0905	Bathophenanthroline	1g	5g
B4221	2,5-Bis(5-*tert*-butyl-2-benzoxazolyl)thiophene (purified by sublimation)	1g	5g
B1554	2,5-Bis(5-*tert*-butyl-2-benzoxazolyl)thiophene	5g	25g
B2696	2-(4-*tert*-Butylphenyl)-5-(4-biphenylyl)-1,3,4-oxadiazole (purified by sublimation)	1g	5g
B1767	2-(4-*tert*-Butylphenyl)-5-(4-biphenylyl)-1,3,4-oxadiazole	5g	25g
D2757	2,5-Di(1-naphthyl)-1,3,4-oxadiazole		5g
D1429	2,5-Diphenyl-1,3,4-oxadiazole		10g
P1633	1,2,3,4,5-Pentaphenyl-1,3-cyclopentadiene	100mg	1g
T1333	1,2,3,4-Tetraphenyl-1,3-cyclopentadiene	1g	5g
T2700	2,4,6-Tri(9*H*-carbazol-9-yl)-1,3,5-triazine (purified by sublimation)	1g	5g
T3268	2,4,6-Triphenyl-1,3,5-triazine (purified by sublimation)		1g
T2785	2,4,6-Triphenyl-1,3,5-triazine	1g	5g

Blue Dopants

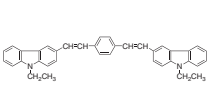
B2080



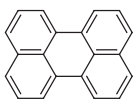
B4682



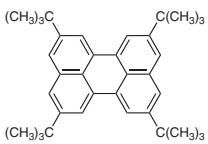
B4792



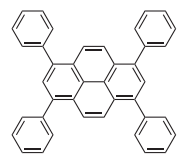
P1629
P0078



T3053



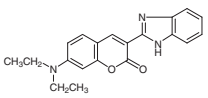
T3042



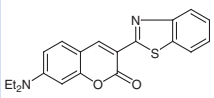
Product No.	Product Name	Unit Size	
B2080	1,4-Bis[4-(di-*p*-tolylamino)styryl]benzene		1g
B4682	4,4'-Bis[4-(di-*p*-tolylamino)styryl]biphenyl		200mg
B4792	1,4-Bis[2-(9-ethylcarbazol-3-yl)vinyl]benzene		200mg
P1629	Perylene (purified by sublimation)		1g
P0078	Perylene	5g	25g
T3053	2,5,8,11-Tetra-*tert*-butylperylene		100mg
T3042	1,3,6,8-Tetraphenylpyrene	50mg	200mg

Green Dopants

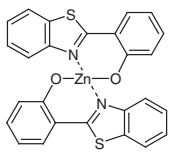
B2111



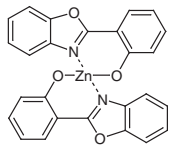
B2088



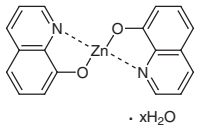
B2077



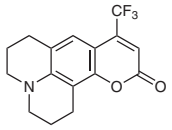
B2078



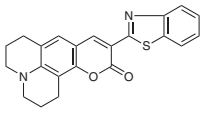
B1678



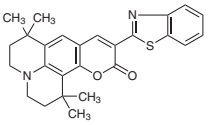
C2858



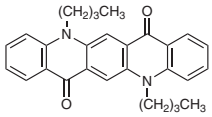
C2900



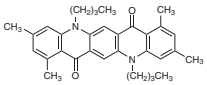
B4257



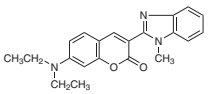
D4780



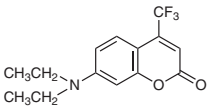
D4697



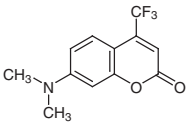
C2837



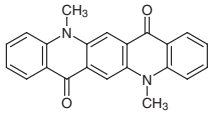
D4466



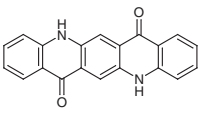
D3356



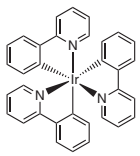
D3227
D2687



Q0083
Q0057



T1946

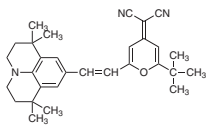


Product No.	Product Name	Unit Size	
B2111	3-(2-Benzimidazolyl)-7-(diethylamino)coumarin	100mg	1g
B2088	3-(2-Benzothiazolyl)-7-(diethylamino)coumarin	1g	5g
B2077	Bis[2-(2-benzothiazolyl)phenolato]zinc(II)	1g	5g
B2078	Bis[2-(2-benzoxazolyl)phenolato]zinc(II)		5g
B1678	Bis(8-quinolinolato)zinc(II) Hydrate	5g	25g
C2858	Coumarin 153	200mg	1g
C2900	Coumarin 545		200mg
B4257	Coumarin 545T		200mg
D4780	*N,N'*-Dibutylquinacridone	200mg	1g
D4697	5,12-Dibutyl-1,3,8,10-tetramethylquinacridone (This product is only available in Japan.)	200mg	1g
C2837	7-(Diethylamino)-3-(1-methyl-2-benzimidazolyl)coumarin	200mg	1g
D4466	7-(Diethylamino)-4-(trifluoromethyl)coumarin		200mg
D3356	7-(Dimethylamino)-4-(trifluoromethyl)coumarin	5g	25g
D3227	*N,N'*-Dimethylquinacridone (purified by sublimation)		1g

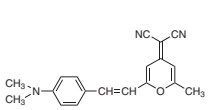
Product No.	Product Name	Unit Size
D2687	*N*,*N*'-Dimethylquinacridone	1g 5g
Q0083	Quinacridone (purified by sublimation)	1g
Q0057	Quinacridone	25g
T1946	Tris(2-phenylpyridinato)iridium(III) (purified by sublimation)	200mg

Red Dopants

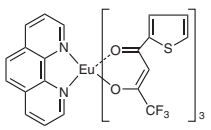
D4700



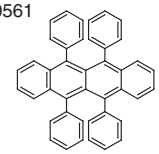
D2849



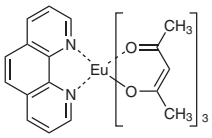
P1766



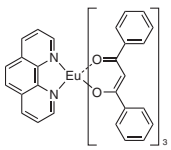
T2233
T0561



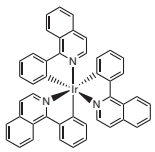
T3206



T1735



T2685



Product No.	Product Name	Unit Size
D4700	DCJTB	200mg
D2849	4-(Dicyanomethylene)-2-methyl-6-(4-dimethylaminostyryl)-4*H*-pyran	500mg
P1766	(1,10-Phenanthroline)tris[4,4,4-trifluoro-1-(2-thienyl)-1,3-butanedionato]europium(III)	1g
T2233	5,6,11,12-Tetraphenylnaphthacene (purified by sublimation)	250mg 1g
T0561	5,6,11,12-Tetraphenylnaphthacene	100mg 1g
T3206	Tris(acetylacetonato)(1,10-phenanthroline)europium(III)	200mg
T1735	Tris(1,3-diphenyl-1,3-propanedionato)(1,10-phenanthroline)europium(III)	1g 5g
T2685	Tris[1-phenylisoquinoline-C^2,*N*]iridium(III) (purified by sublimation)	100mg

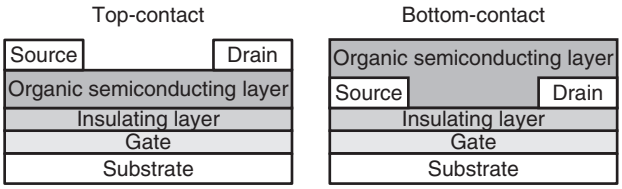
References

1) C. W. Tang, S. A. VanSlyke, *Appl. Phys. Lett.* **1987**, *51*, 913.
2) C. Adachi, S. Tokito, T. Tsutsui, S. Saito, *Jpn. J. Appl. Phys.* **1988**, *27*, L269.
3) C. Adachi, S. Tokito, T. Tsutsui, S. Saito, *Jpn. J. Appl. Phys.* **1988**, *27*, L713.
4) Review: B. Luessem, M. Riede, K. Leo, *Phys. Org. Semicon. (2nd Edition)* **2012**, 427.
5) Review: C. Adachi, T. Oyamada, T. Matsushima, *Mol. Electron. Bioelectron.* **2007**, *18*, 25.
6) Review: H. Sasabe, J. Kido, *J. Mater. Chem. C* **2013**, *1*, 1699.
7) Y. Shirota, K. Okumoto, H. Inada, *Synth. Met.* **2000**, *111-112*, 387.
8) X. Zhou, J. Blochwitz, M. Pfeiffer, A. Nollau, T. Fritz, K. Leo, *Adv. Funct. Mater.* **2001**, *11*, 310.
9) M. Era, C. Adachi, T. Tsutsui, S. Saito, *Chem. Phys. Lett.* **1991**, *178*, 488.
10) C. Hosokawa, H. Higashi, H. Nakamura, T. Kusumoto, *Appl, Phys. Lett.* **1995**, *67*, 3853.
11) C. Adachi, M. A. Baldo, S. R. Forrest, M. E. Thompson, *Appl. Phys. Lett.* **2000**, *77*, 904.
12) H. Uoyama, K. Goushi, K. Shizu, H. Nomura, C. Adachi, *Nature* **2012**, *492*, 234.
13) Q. Zhang, B. Li, S. Huang, H. Nomura, H. Tanaka, C. Adachi, *Nat. Photonics* **2014**, *8*, 326.

Organic Transistor Materials

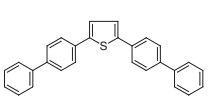
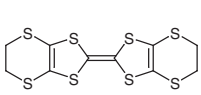
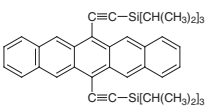
Light and flexible organic semiconductor materials are promising for foldable electronic circuits[1] and implantable biometric sensors,[2] although such electronic devices are hardly obtained from silicon-based semiconductors. We have developed a printed electronics giving large scale and highly precise devices on flexible substrates (eg. paper and film) by a printing method thanks to solubility of organic materials. The printing method is an efficient technology for mass production and low cost production of a semiconducting device.[3] Further advantage using an organic material is that one can precisely control electrical properties and processing characteristics by chemical modification of the material, because organic materials are structurally diverse.

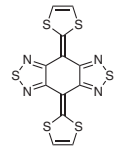
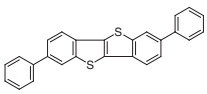
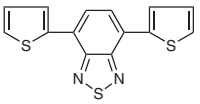
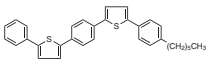
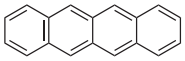
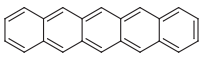
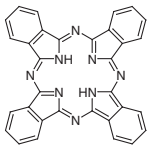
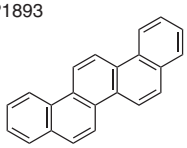
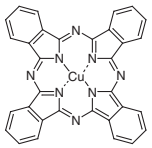
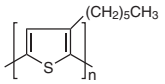
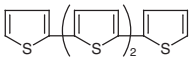
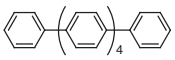
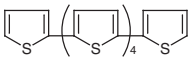
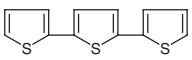
One functional parameter for evaluation of an organic semiconductor is mobility (μ) that shows how fast holes or electrons move in the semiconducting layer. We need an organic material with high mobility for highly drivable electronic circuits. The mobility can be measured from an organic field-effect transistor (OFET). There are TOF and TRMC methods for the measurement. The OFET can be fabricated by an organic semiconductor layer, insulating layer, source, drain and gate electrodes. In addition to the mobility value, we can determine fundamental OFET characteristics such as minimum drive voltage and drive stability. There are several types of OFET device structures with top-contact and bottom-contact systems. Furthermore, there is also a vertical transistor in which a carrier is movable vertically.



There are p-type organic semiconductors with hole carriers, n-type organic semiconductors with electron carriers and ambipolar organic semiconductors with both hole and electron carriers. Among them, there are small molecule p-type organic semiconductors; rubrene and pentacene as acene series, dinaphthothienothiophene (DNTT) and benzothienobenzothiophene (BTBT) as heteroacene series, oligothiophene series and porphyrin series. A category of n-type small molecule semiconductor involves perylene tetracarboxydiimide (PTCDI) and tetracyanoquinodimethane (TCNQ), and fullerenes. A polymer-based organic transistor also has been developed by using polythiophene, polyfluorene, and a donor-acceptor type polymer. A mobility value obtained from a solution-processed OFET has been normally lower than that obtained from a vapor deposited one, thus solubility is incompatible with mobility so far. However, an excellent solution-processible device was recently developed by soluble organic materials with high mobility.[4-7] Further synthetic and process developments of organic materials may provide an efficient solution-processible device.

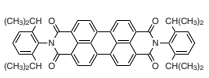
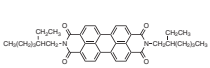
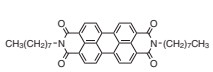
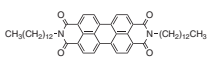
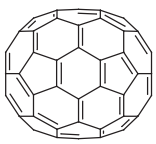
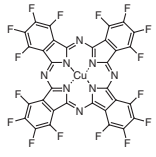
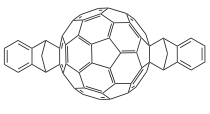
One characteristic of organic semiconductors is flexibility. Liquid crystal organic semiconductors also receive attention, because they are more flexible than the usual crystalline and amorphous organic semiconductors.[8,9] The liquid crystal organic semiconductor shows carrier mobility and self-assembly, in which the liquid crystal molecule spontaneously undergoes an orientation. Moreover, one can control the molecular orientation by applying an electrical field, thanks to flexibility of the liquid crystal molecule.

p-Type Semiconductors	B3441 	B1200 	B3562 

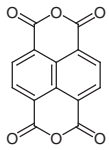
B3612 	D3526 	D4487 	H1448 	N0951 N0001 
P0030 	P1795 	P2207 P1893 	P1628 	P2018 
Q0078 	S0220 	S0504 	T1196 	T2233 

Product No.	Product Name			Unit Size
B3441	2,5-Bis(4-biphenylyl)thiophene		1g	5g
B1200	Bis(ethylenedithio)tetrathiafulvalene	100mg	1g	5g
B3562	6,13-Bis(triisopropylsilylethynyl)pentacene (This product is unavailable in the U.S.)			100mg
B3612	BTQBT (purified by sublimation)			100mg
D3526	2,7-Diphenyl[1]benzothieno[3,2-*b*][1]benzothiophene			100mg
D4487	4,7-Di(2-thienyl)-2,1,3-benzothiadiazole		200mg	1g
H1448	4"-Hexyl-1,4-bis(5-phenyl-2-thienyl)benzene (purified by sublimation)			50mg
N0951	Naphthacene (purified by sublimation)		200mg	1g
N0001	Naphthacene	100mg	1g	5g
P0030	Pentacene (purified by sublimation)		100mg	1g
P1795	Phthalocyanine (purified by sublimation)			1g
P2207	Picene (purified by sublimation) (>99.9%)			100mg
P1893	Picene (purified by sublimation)		100mg	1g
P1628	Pigment Blue 15 (purified by sublimation)			1g
P2018	Poly(3-hexylthiophene-2,5-diyl) (regioregular)		200mg	1g
Q0078	*α*-Quaterthiophene			100mg
S0220	*p*-Sexiphenyl		100mg	1g
S0504	*α*-Sexithiophene (purified by sublimation)		100mg	1g
T1196	2,2':5',2"-Terthiophene (purified by sublimation)		1g	5g
T2233	5,6,11,12-Tetraphenylnaphthacene (purified by sublimation)		250mg	1g

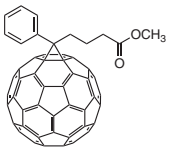
n-Type Semiconductors

	B4268 	B4343 	D4175 	
D3947 	B1641 	B1694 	H1194 	I0900 

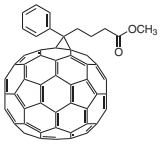
N0755
N0369



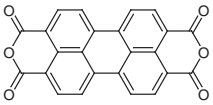
M2088



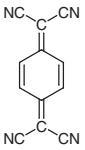
M2550



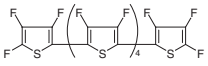
P0972



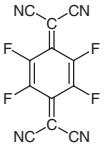
T0078



T2206



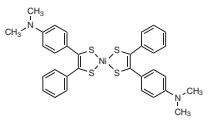
T1131



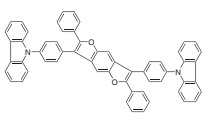
Product No.	Product Name			Unit Size
B4268	*N,N'*-Bis(2,6-diisopropylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide		1g	5g
B4343	*N,N'*-Bis(2-ethylhexyl)-3,4,9,10-perylenetetracarboxylic Diimide			200mg
D4175	*N,N'*-Di-*n*-octyl-3,4,9,10-perylenetetracarboxylic Diimide			1g
D3947	*N,N'*-Ditridecyl-3,4,9,10-perylenetetracarboxylic Diimide		200mg	1g
B1641	Fullerene C_{60} (pure)		100mg	1g
B1694	Fullerene C_{70}			100mg
H1194	1,2,3,4,8,9,10,11,15,16,17,18,22,23,24,25-Hexadecafluorophthalocyanine Copper(II) (purified by sublimation)		100mg	1g
I0900	ICBA			50mg
N0755	Naphthalene-1,4,5,8-tetracarboxylic Dianhydride (purified by sublimation)		1g	5g
N0369	Naphthalene-1,4,5,8-tetracarboxylic Dianhydride	10g	25g	250g
M2088	[60]PCBM (Methyl [6,6]-Phenyl-C_{61}-butyrate)			100mg
M2550	[70]PCBM (Methyl [6,6]-Phenyl-C_{71}-butyrate) (mixture of isomers)			50mg
P0972	3,4,9,10-Perylenetetracarboxylic Dianhydride	25g	100g	500g
T0078	7,7,8,8-Tetracyanoquinodimethane		5g	25g
T2206	Tetradecafluoro-*α*-sexithiophene (purified by sublimation)			50mg
T1131	Tetrafluorotetracyanoquinodimethane (purified by sublimation)		100mg	1g

Ambipolar Semiconductors

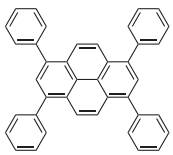
B4361



C2780



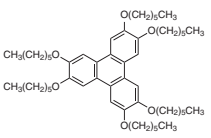
T3042



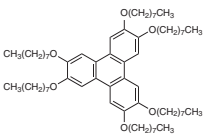
Product No.	Product Name		Unit Size
B4361	Bis(4-dimethylaminodithiobenzil)nickel(II)		1g
C2780	CZBDF		200mg
T3042	1,3,6,8-Tetraphenylpyrene	50mg	200mg

Liquid Crystal Semiconductors

H1449



H1450



Product No.	Product Name	Unit Size	
H1449	2,3,6,7,10,11-Hexakis(hexyloxy)triphenylene	200mg	1g
H1450	2,3,6,7,10,11-Hexakis[(*n*-octyl)oxy]triphenylene	200mg	1g

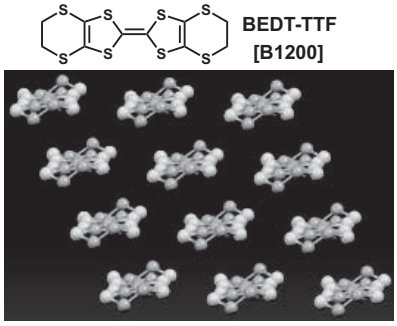
References

1) M. Kaltenbrunner, T. Sekitani, J. Reeder, T. Yokota, K. Kuribara, T. Tokuhara, M. Drack, R. Schwödiauer, I. Graz, S. Bauer-Gogonea, S. Bauer, T. Someya, *Nature* **2013**, *499*, 458.
2) K. Kuribara, H. Wang, N. Uchiyama, K. Fukuda, T. Yokota, U. Zschieschang, C. Jaye, D. Fischer, H. Klauk, T. Yamamoto, K. Takimiya, M. Ikeda, H. Kuwabara, T. Sekitani, Y.-L. Loo, T. Someya, *Nat. Commun.* **2012**, *3*, 723.
3) K. Suganuma, in *Introduction to Printed Electronics*, Springer, New York, **2014**, *124*, 148.
4) T. Okamoto, C. Mitsui, M. Yamagishi, K. Nakahara, J. Soeda, Y. Hirose, K. Miwa, H. Sato, A. Yamano, T. Matsushita, T. Uemura, J. Takeya, *Adv. Mater.* **2013**, *25*, 6392.
5) H. Ebata, T. Izawa, E. Miyazaki, K. Takimiya, M. Ikeda, H. Kuwabara, T. Yui, *J. Am. Chem. Soc.* **2007**, *129*, 15732.
6) G. Kim, S.-J. Kang, G. K. Dutta, Y.-K. Han, T. J. Shin, Y.-Y. Noh, C. Yang, *J. Am. Chem. Soc.* **2014**, *136*, 9477.
7) H. Minemawari, T. Yamada, H. Matsui, J. Tsutsumi, S. Haas, R. Chiba, R. Kumai, T. Hasegawa, *Nature* **2011**, *475*, 364.
8) Review: E.-K. Fleischmann, R. Zentel, *Angew. Chem. Int. Ed.* **2013**, *52*, 8810.
9) M. A. Alam, J. Motoyanagi, Y. Yamamoto, T. Fukushima, J. Kim, K. Kato, M. Takata, A. Saeki, S. Seki, S. Tagawa, T. Aida, *J. Am. Chem. Soc.* **2009**, *131*, 17722.

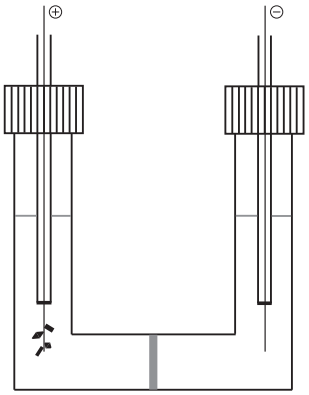
Molecular Conductors

A molecular conductor is an electrical conductor based on a molecular component. A chemical modification of the molecule can control the electronic structure and physical properties. We can synthesize an opened-shell molecular conductor by chemical or electrochemical doping of a carrier, although an organic molecule is usually an insulator with a closed-shell structure. The first example of an organic conductor was observed from a bromine-doped perylene.[1] After this observation, a molecular conductor based on tetrathiafulvalene (TTF) was reported in the 1970s,[2] and the first case of an organic molecular superconductor was observed from the organic salt of tetraselenafulvalene, $(TMTSF)_2X$ in the 1980s.[3] These TTF and TMTSF salts form a one-dimensional or pseudo one-dimensional molecular arrangement. On the other hand, bis(ethylenedithio)tetrathiafulvalene (BEDT-TTF) favors forming a two-dimensional molecular arrangement, which is a relatively stable molecular metal toward temperature.[4-6]

Conducting salts of TTF derivatives can be normally obtained by an electrochemical oxidation (elec trocrystallization).[7] These TTF derivatives can function as donor molecules with a hole carrier. Metal dithiolene complexes ($M(dmit)_2$), 7,7,8,8-Tetracyanoquinodimethane (TCNQ) and fullerene (C_{60}) are acceptor molecules with an electron carrier. An $M(dmit)_2$ salt produced the first example of an acceptor-based organic superconductor.[8] Chemical modifications of the $M(dmit)_2$ salt produced plenty of those organic superconductors by changing the central metal atom and counter cation.[9]



Molecular arrangement of BEDT-TTF salt (β-form)

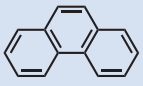


Electrocrystallization

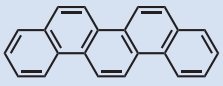
Several alkali-doped nanocarbon and nanographene compounds have shown superconductivity. It has well known that rubidium- and cesium-doped fullerenes have demonstrated superconductivity at more than 30 K.[10] Recently, superconductivity of Cs_3C_{60} at 38 K was reported.[11] Although the molecular conductors synthesized from TTF and $M(dmit)_2$ exhibit low-dimensional molecular arrangements, these fullerene salts can form three-dimensionality.[12] Kubozono *et al*. reported that an alkali-doped picene demonstrated superconductivity at 18 K.[13] This result indicates that one can observe superconductivity from a planar nanocarbon material as well. In addition to the picene-based superconductor, an alkali-doped phenanthrene (T_c = 5 K),[14] alkali-doped coronene (T_c = 15 K),[15] and alkali-doped 1,2:8,9-dibenzopentacene (T_c = 33 K)[16] have also shown superconductivity.

Superconducting materials by alkali metal doping

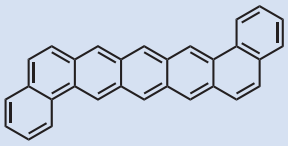
C_{60}
[B1660, B1641]



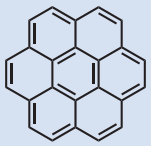
Phenanthrene
[P0079]



Picene
[P1893]



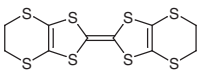
1,2:8,9-Dibenzopentacene
[D1311]



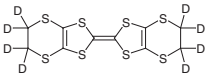
Coronene
[C0386, C1961]

Donor Molecules

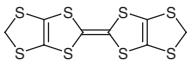
B1200



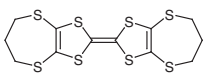
B1299



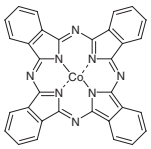
B1218



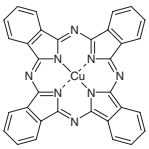
B1244



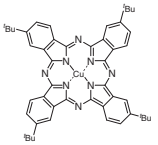
P0887



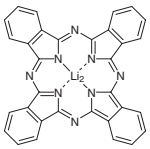
P1005
P1006



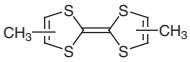
T1256



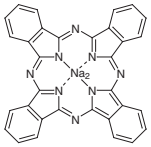
P1049



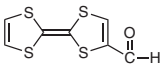
D2067



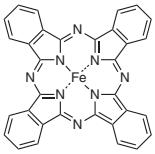
P0973



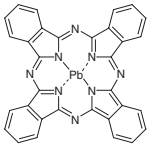
F0285



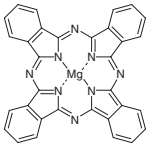
I0783
P0774



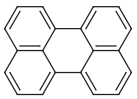
P0766



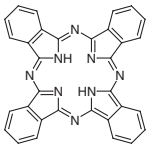
P1018



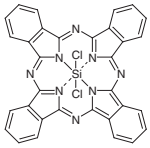
P1629
P0078



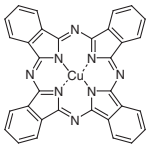
P1795
P0355



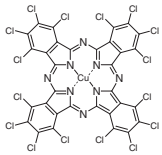
P0996



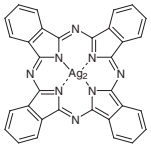
P1628
P0655



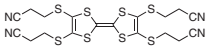
P0660



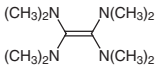
S0363



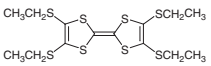
T2806



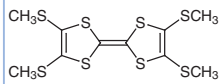
T1221



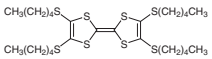
T1571



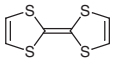
T1119



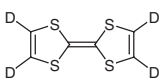
T1205



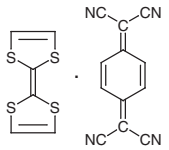
T0980



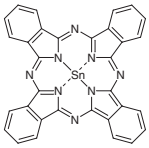
T1377



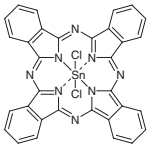
T2468



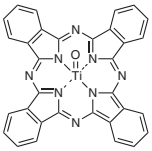
P1024



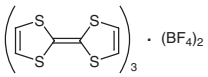
P0997



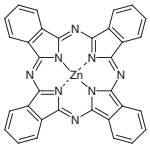
T2272



T1282



P0767



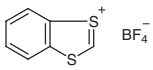
Product No.	Product Name		Unit Size	
B1200	Bis(ethylenedithio)tetrathiafulvalene	100mg	1g	5g
B1299	Bis(ethylenedithio)tetrathiafulvalene-d_8			100mg
B1218	Bis(methylenedithio)tetrathiafulvalene			100mg
B1244	Bis(trimethylenedithio)tetrathiafulvalene			100mg
P0887	Cobalt(II) Phthalocyanine			25g
P1005	Copper(II) Phthalocyanine (*α*-form)		25g	250g

Product No.	Product Name	Unit Size		
P1006	Copper(II) Phthalocyanine (β-form)		25g	500g
T1256	Copper(II) 2,9,16,23-Tetra-*tert*-butylphthalocyanine			100mg
P1049	Dilithium Phthalocyanine			1g
D2067	Dimethyltetrathiafulvalene		100mg	1g
P0973	Disodium Phthalocyanine		1g	5g
F0285	Formyltetrathiafulvalene			1g
I0783	Iron(II) Phthalocyanine (purified by sublimation)		200mg	1g
P0774	Iron(II) Phthalocyanine			25g
P0766	Lead(II) Phthalocyanine		1g	25g
P1018	Magnesium(II) Phthalocyanine			1g
P1629	Perylene (purified by sublimation)			1g
P0078	Perylene		5g	25g
P1795	Phthalocyanine (purified by sublimation)			1g
P0355	Phthalocyanine			25g
P0996	Phthalocyanine Silicon Dichloride		Price on request	
P1628	Pigment Blue 15 (purified by sublimation)			1g
P0655	Pigment Blue 15			25g
P0660	Pigment Green 7			25g
S0363	Silver(I) Phthalocyanine		Price on request	
T2806	2,3,6,7-Tetrakis(2-cyanoethylthio)tetrathiafulvalene		100mg	1g
T1221	Tetrakis(dimethylamino)ethylene		5g	25g
T1571	Tetrakis(ethylthio)tetrathiafulvalene			100mg
T1119	Tetrakis(methylthio)tetrathiafulvalene			100mg
T1205	Tetrakis(pentylthio)tetrathiafulvalene			100mg
T0980	Tetrathiafulvalene	1g	5g	25g
T1377	Tetrathiafulvalene-d_4			100mg
T2468	Tetrathiafulvalene - 7,7,8,8-Tetracyanoquinodimethane Complex			1g
P1024	Tin(II) Phthalocyanine		1g	5g
P0997	Tin(IV) Phthalocyanine Dichloride			1g
T2272	Titanyl Phthalocyanine (purified by sublimation)		200mg	1g
T1282	Tris(tetrathiafulvalene) Bis(tetrafluoroborate) Complex			1g
P0767	Zinc Phthalocyanine	1g	10g	25g

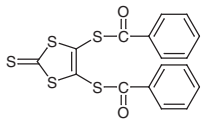
TTF Precursors

B1322

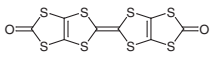
B1151



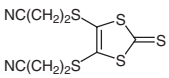
B1199



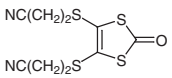
B1272



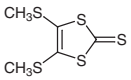
B2228



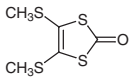
B2233



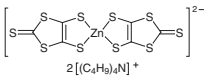
B1778



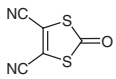
B1777



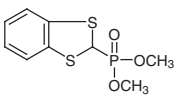
B1221



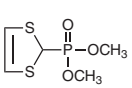
D3252



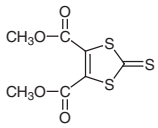
D3992



D3981

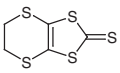


D2127

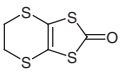


D2133

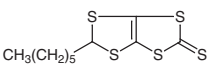
E0429



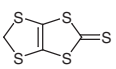
E0460



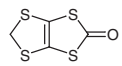
H1163



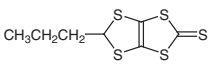
M1112



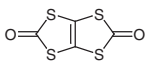
M1154



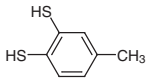
P1635



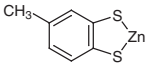
T1132



T0266



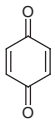
T0279



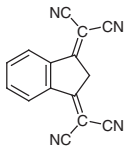
Product No.	Product Name	Unit Size		
B1322	1,2-Benzenedithiol		1g	5g
B1151	1,3-Benzodithiolylium Tetrafluoroborate			5g
B1199	4,5-Bis(benzoylthio)-1,3-dithiole-2-thione		1g	5g
B1272	Bis(carbonyldithio)tetrathiafulvalene			1g
B2228	4,5-Bis(2-cyanoethylthio)-1,3-dithiole-2-thione			1g
B2233	4,5-Bis(2-cyanoethylthio)-1,3-dithiol-2-one			1g
B1778	4,5-Bis(methylthio)-1,3-dithiole-2-thione			1g
B1777	4,5-Bis(methylthio)-1,3-dithiol-2-one			1g
B1221	Bis(tetrabutylammonium) Bis(1,3-dithiole-2-thione-4,5-dithiolato)zinc Complex		5g	25g
D3252	4,5-Dicyano-1,3-dithiol-2-one			1g
D3992	Dimethyl 1,3-Benzodithiol-2-ylphosphonate			1g
D3981	Dimethyl 2-(1,3-Dithiole)phosphonate		1g	5g
D2127	Dimethyl 1,3-Dithiole-2-thione-4,5-dicarboxylate			10g
D2133	1,3-Dithiole-2-thione			5g
E0429	4,5-Ethylenedithio-1,3-dithiole-2-thione		5g	25g
E0460	4,5-Ethylenedithio-1,3-dithiol-2-one		1g	5g
H1163	5-Hexyl-1,3-dithiolo[4,5-*d*][1,3]dithiole-2-thione			1g
M1112	4,5-Methylenedithio-1,3-dithiole-2-thione			1g
M1154	4,5-Methylenedithio-1,3-dithiol-2-one			100mg
P1635	5-Propyl-1,3-dithiolo[4,5-*d*][1,3]dithiole-2-thione		250mg	1g
T1132	1,3,4,6-Tetrathiapentalene-2,5-dione	1g	5g	25g
T0266	Toluene-3,4-dithiol	1g	5g	25g
T0279	(Toluene-3,4-dithiolato)zinc(II)		1g	5g

Acceptor Molecules

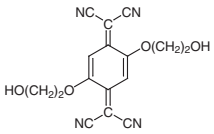
B0089



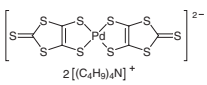
B1416



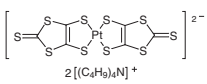
B2309



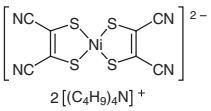
B1437



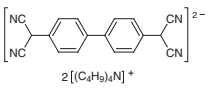
B1438



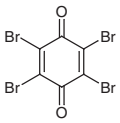
B1371



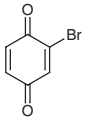
B1466



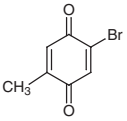
T0617



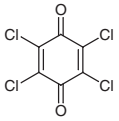
B1601



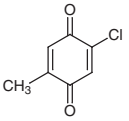
B1595



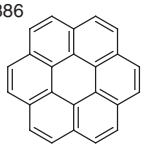
T0061



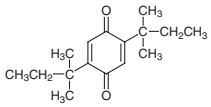
C1336



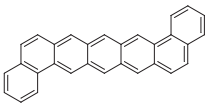
C1961
C0386



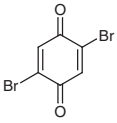
D2152



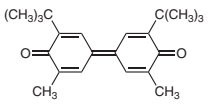
D1311



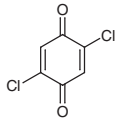
D2249



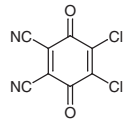
D4407



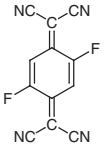
D0343



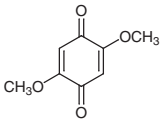
D1070



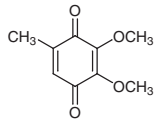
D3200



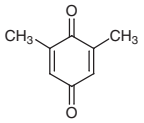
D2250



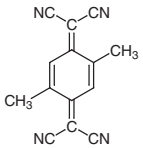
D1956



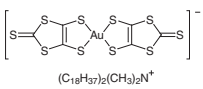
D2234



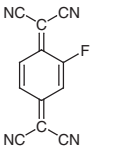
D2021



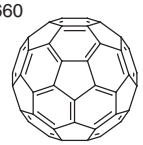
D2134



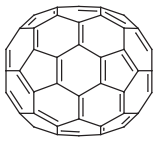
F0509



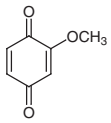
B1641
B1660



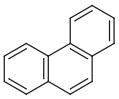
B1694



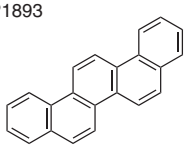
M1045



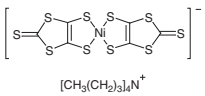
P0331
P0079



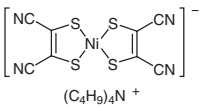
P2207
P1893



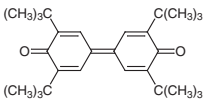
T1272



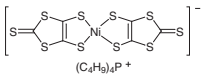
T1415



T1503

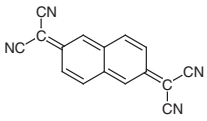


T1416

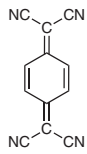


T0077

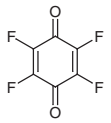
T1246



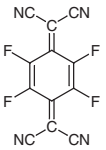
T3034
T0078



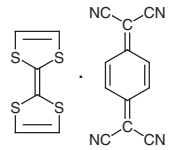
T0790



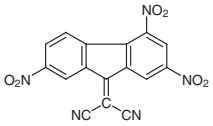
T1131



T2468



T0875



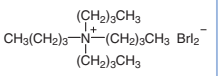
Product No.	Product Name			Unit Size
B0089	1,4-Benzoquinone	25g	100g	500g
B1416	1,3-Bis(dicyanomethylidene)indan			5g
B2309	2,5-Bis(2-hydroxyethoxy)-7,7,8,8-tetracyanoquinodimethane			Price on request
B1437	Bis(tetrabutylammonium) Bis(1,3-dithiole-2-thione-4,5-dithiolato)palladium(II)		100mg	1g
B1438	Bis(tetrabutylammonium) Bis(1,3-dithiole-2-thione-4,5-dithiolato)platinum(II)			100mg
B1371	Bis(tetrabutylammonium) Bis(maleonitriledithiolato)nickel(II) Complex			1g
B1466	Bis(tetrabutylammonium) Tetracyanodiphenoquinodimethanide			100mg
T0617	Bromanil		5g	25g
B1601	2-Bromo-1,4-benzoquinone		1g	5g
B1595	2-Bromo-5-methyl-1,4-benzoquinone			5g
T0061	Chloranil		25g	500g
C1336	2-Chloro-5-methyl-1,4-benzoquinone			5g
C1961	Coronene (purified by sublimation)			100mg
C0386	Coronene		1g	5g
D2152	2,5-Di-*tert*-amylbenzoquinone			5g
D1311	1,2:8,9-Dibenzopentacene			100mg
D2249	2,5-Dibromo-1,4-benzoquinone		1g	5g
D4407	3,3'-Di-*tert*-butyl-5,5'-dimethyldiphenoquinone			1g
D0343	2,5-Dichloro-1,4-benzoquinone		1g	5g
D1070	2,3-Dichloro-5,6-dicyano-1,4-benzoquinone		25g	250g
D3200	2,5-Difluoro-7,7,8,8-tetracyanoquinodimethane			100mg
D2250	2,5-Dimethoxy-1,4-benzoquinone		5g	25g
D1956	2,3-Dimethoxy-5-methyl-1,4-benzoquinone		1g	5g
D2234	2,6-Dimethyl-1,4-benzoquinone	1g	5g	25g

Product No.	Product Name	Unit Size	
D2021	2,5-Dimethyl-7,7,8,8-tetracyanoquinodimethane	100mg	500mg
D2134	Dioctadecyldimethylammonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)aurate(III)		100mg
F0509	2-Fluoro-7,7,8,8-tetracyanoquinodimethane		100mg
B1641	Fullerene C_{60} (pure)	100mg	1g
B1660	Fullerene C_{60}	100mg	1g
B1694	Fullerene C_{70}		100mg
M1045	Methoxybenzoquinone	1g	5g
P0331	Phenanthrene Zone Refined (number of passes:30)		1sample
P0079	Phenanthrene	25g	500g
P2207	Picene (purified by sublimation) (>99.9%)		100mg
P1893	Picene (purified by sublimation)	100mg	1g
T1272	Tetrabutylammonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)nickel(III) Complex		100mg
T1415	Tetrabutylammonium Bis(maleonitriledithiolato)nickel(III) Complex		1g
T1503	3,3',5,5'-Tetra-*tert*-butyl-4,4'-diphenoquinone		1g
T1416	Tetrabutylphosphonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)nickel(III) Complex		1g
T0077	Tetracyanoethylene	5g	25g
T1246	11,11,12,12-Tetracyanonaphtho-2,6-quinodimethane		100mg
T3034	7,7,8,8-Tetracyanoquinodimethane (purified by sublimation)	1g	5g
T0078	7,7,8,8-Tetracyanoquinodimethane	5g	25g
T0790	Tetrafluoro-1,4-benzoquinone	1g	5g
T1131	Tetrafluorotetracyanoquinodimethane (purified by sublimation)	100mg	1g
T2468	Tetrathiafulvalene - 7,7,8,8-Tetracyanoquinodimethane Complex		1g
T0875	2,4,7-Trinitro-9-fluorenylidenemalononitrile	1g	5g

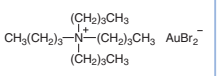
Supporting Electrolytes for Electrocrystallization

S0838

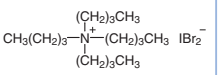
T1270



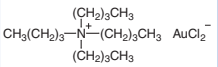
T1261



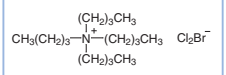
T1269



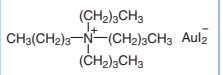
T1273



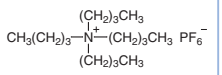
T1186



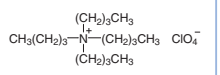
T1357



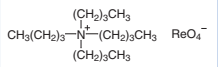
T1279



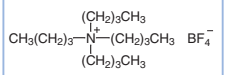
T0836



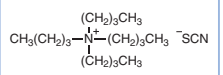
T1803



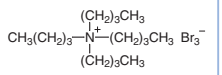
T2648
T0914



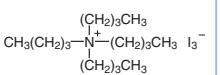
T1278



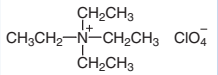
T1284



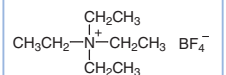
T1271



T0839



T0983



Product No.	Product Name	Unit Size	
S0838	Sodium Dicyanamide	25g	100g
T1270	Tetrabutylammonium Bromodiiodide		1g
T1261	Tetrabutylammonium Dibromoaurate		1g
T1269	Tetrabutylammonium Dibromoiodide	1g	10g
T1273	Tetrabutylammonium Dichloroaurate		100mg
T1186	Tetrabutylammonium Dichlorobromide		25g

Product No.	Product Name			Unit Size
T1357	Tetrabutylammonium Diiodoaurate		100mg	1g
T1279	Tetrabutylammonium Hexafluorophosphate		25g	250g
T0836	Tetrabutylammonium Perchlorate	25g	100g	500g
T1803	Tetrabutylammonium Perrhenate		1g	5g
T2648	Tetrabutylammonium Tetrafluoroborate			25g
T0914	Tetrabutylammonium Tetrafluoroborate	25g	100g	500g
T1278	Tetrabutylammonium Thiocyanate		25g	250g
T1284	Tetrabutylammonium Tribromide	25g	100g	500g
T1271	Tetrabutylammonium Triiodide		5g	25g
T0839	Tetraethylammonium Perchlorate			25g
T0983	Tetraethylammonium Tetrafluoroborate			25g

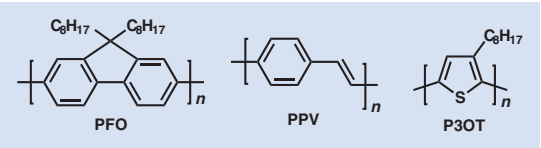
References

1) H. Akamatu, H. Inokuchi, Y. Matsunaga, *Nature* **1954**, *173*, 168.
2) F. Wudl, D. Wobschall, E. J. Hufnagel, *J. Am. Chem. Soc*. **1972**, *94*, 670.
3) D. Jérome, A. Mazaud, M. Ribault, K. Bechgaard, *J. Phys. Lett*. **1980**, *41*, 95.
4) T. Mori, *Chem. Rev*. **2004**, *104*, 4947.
5) R. P. Shibaeva, E. B. Yagubskii, *Chem. Rev*. **2004**, *104*, 5347.
6) H. Mori, *Int. J. Mod. Phys. B* **1994**, *8*, 1.
7) P. Batail, K. Boubekeur, M. Fourmigué, J.-C. P. Gabriel, *Chem. Mater*. **1998**, *10*, 3005.
8) L. Brossard, M. Ribault, M. Bousseau, L. Valade, P. Cassoux, *C. R. Acad. Sci., Ser. II* **1986**, *302*, 205.
9) R. Kato, *Chem. Rev*. **2004**, *104*, 5319.
10) K. Tanigaki, T. W. Ebbesen, S. Saito, J. Mizuki, J. S. Tsai, Y. Kubo, S. Kuroshima, *Nature* **1991**, *352*, 222.
11) A. Y. Ganin, Y. Takabayashi, Y. Z. Khimyak, S. Margadonna, A. Tamai, M. J. Rosseinsky, K. Prassides, *Nat. Mater*. **2008**, *7*, 367.
12) Y. Takabayashi, A. Y. Ganin, P. Jeglič, D. Arčon, T. Takano, Y. Iwasa, Y. Ohishi, M. Takata, N. Takeshita, K. Prassides, M. J. Rosseinsky, *Science* **2009**, *323*, 1585.
13) R. Mitsuhashi, Y. Suzuki, Y. Yamanari, H. Mitamura, T. Kambe, N. Ikeda, H. Okamoto, A. Fujiwara, M. Yamaji, N. Kawasaki, Y. Maniwa, Y. Kubozono, *Nature* **2010**, *464*, 76.
14) X. F. Wang, R. H. Liu, Z. Gui, Y. L. Xie, Y. J. Yan, J. J. Ying, X. G. Luo, X. H. Chen, *Nat. Commun*. **2011**, *2*, 1513.
15) Y. Kubozono, H. Mitamura, X. Lee, X. He, Y. Yamanari, Y. Takahashi, Y. Suzuki, Y. Kaji, R. Eguchi, K. Akaike, T. Kambe, H. Okamoto, A. Fujiwara, T. Kato, T. Kosugi, H. Aoki, *Phys. Chem. Chem. Phys*. **2011**, *13*, 16476.
16) M. Xue, T. Cao, D. Wang, Y. Wu, H. Yang, X. Dong, J. He, F. Li, G. F. Chen, *Sci. Rep*. **2012**, *2*, srep00389.

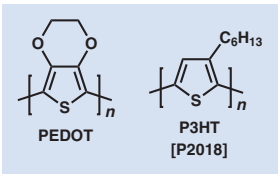
Building Blocks for Semiconducting Polymer

Polyacetylenes exhibit semiconducting-insulating properties by a lack of free electrons (carriers), although there are conducting pathways through π-conjugations. Shirakawa, MacDiarmid and Heeger *et al*. in 1977 observed that polyacetylenes show high electrical conduction comparable with a metal when the insulating polyacetylenes obtain carriers by a bromine doping.[1] After their observation, studies of conducting polymers were dramatically enhanced, and some of the representative polymers were practical for electronic equipment.

In 1990s, an organic light-emitting diode (OLED) of polyphenylene vinylene (PPV) was reported and then semiconducting polymers attracted us in this research area.[2] The PPV is one of the light-emitting polymers (LEP) and the functionality is due to the semiconducting property of a π-conjugated polymer without a chemical doping. A chemical modification of a π-conjugated polymer can create various colored emissions. For instance, polyfluorenes (PFO),[3] PPVs[4] and regiorandom poly(3-octylthiophene) (P3OT)[5] exhibit blue, green and red emissions, respectively.

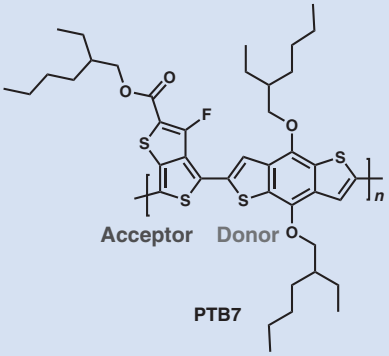


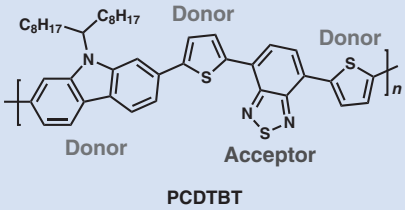
Recent research on organic electronics developed sulfur-containing polymers such as polythiophene. Poly(3,4-ethylenedioxythiophene) (PEDOT) is useful for a capacitor, organic transistor, hole transport material for an OLED device, and secondary battery as well as for an actuator, sensor and thermoelectric conversion element.[6,7] PEDOT/PSS that is mixture of PEDOT and polystyrene sulfonate (PSS), is widely used as a hole transport material for organic photovoltaics (OPV).[8] Poly(3-hexyl)thiophene (P3HT) can be blended with fullerene derivatives (eg. PCBM) to form an efficient bulk heterojunction. The polymer for the OPV device works as a p-type semiconductor with light absorption.[9]

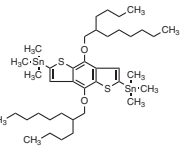
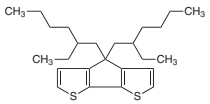
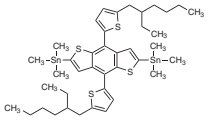
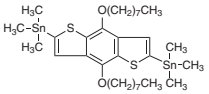
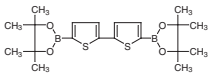
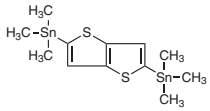
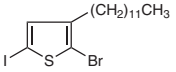
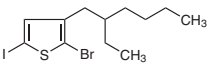
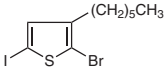
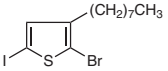
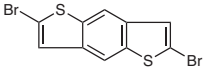
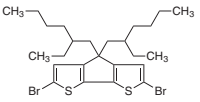
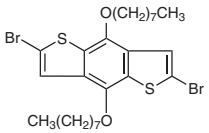
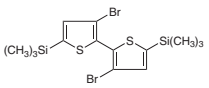
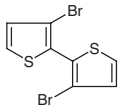
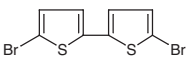
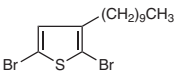
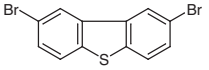
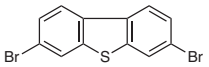
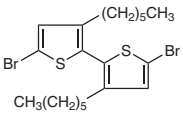
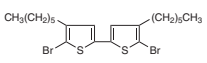
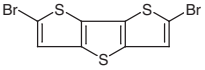


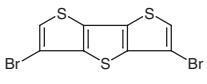
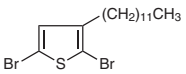
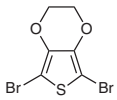
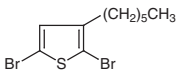
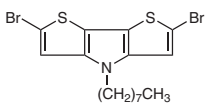
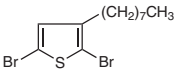
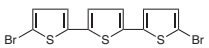
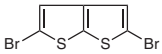
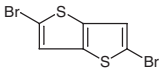
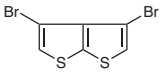
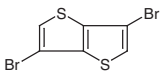
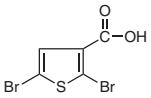
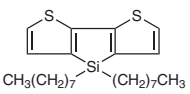
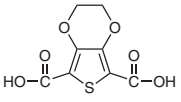
On the other hand, some thiophene-based polymers exhibit a high energy level of the highest occupied molecular orbital (HOMO), because they are electron-rich. One problem of the thiophene-based polymers is their sensitivity for electrochemical oxidation. In order to solve the problem, one can combine an electron-rich monomer (donor) and an electron-deficient monomer (acceptor) to decrease the HOMO energy level and then stable donor-acceptor (DA type) polymers can be produced.[10-12] The DA type polymer usually shows a low band gap state which can absorb light of long wavelength. Furthermore, several DA type polymers are ambipolar enabling both p- and n-dopes.[13,14]

Low Band Gap Polymers





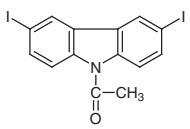
Donor Raw Materials		Thiophenes		
B4685 		B4102 		
B4437 	B4378 	B3363 	B4536 	B4586 
B4585 	B3865 	B4584 	D3954 	D4568 
D4621 	D3941 	D3798 	D2755 	D4572 
D2245 	D4274 	D4183 	D4184 	D3799 

D3800 	D4031 	D4056 	D3896 	D4714 
D4053 	D4050 	D4032 	D3678 	D4033 
D3679 	D4582 	D4564 	E0741 	E0743 

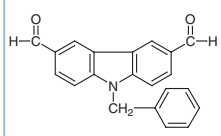
Product No.	Product Name			Unit Size
B4685	4,8-Bis(2-butyl-*n*-octyloxy)-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene			200mg
B4102	4,4-Bis(2-ethylhexyl)-4*H*-cyclopenta[2,1-*b*:3,4-*b*']dithiophene		1g	5g
B4437	4,8-Bis[5-(2-ethylhexyl)thiophen-2-yl]-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene			200mg
B4378	4,8-Bis(*n*-octyloxy)-2,6-bis(trimethylstannyl)benzo[1,2-*b*:4,5-*b*']dithiophene			200mg
B3363	5,5'-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene			5g
B4536	2,5-Bis(trimethylstannyl)thieno[3,2-*b*]thiophene		200mg	1g
B4586	2-Bromo-3-dodecyl-5-iodothiophene (stabilized with Copper chip)			1g
B4585	2-Bromo-3-(2-ethylhexyl)-5-iodothiophene (stabilized with Copper chip)		1g	5g
B3865	2-Bromo-3-hexyl-5-iodothiophene (stabilized with Copper chip)		1g	5g
B4584	2-Bromo-5-iodo-3-*n*-octylthiophene (stabilized with Copper chip)			1g
D3954	2,6-Dibromobenzo[1,2-*b*:4,5-*b*']dithiophene		1g	5g
D4568	2,6-Dibromo-4,4-bis(2-ethylhexyl)-4*H*-cyclopenta[2,1-*b*:3,4-*b*']dithiophene			200mg
D4621	2,6-Dibromo-4,8-bis(*n*-octyloxy)benzo[1,2-*b*:4,5-*b*']dithiophene			200mg
D3941	3,3'-Dibromo-5,5'-bis(trimethylsilyl)-2,2'-bithiophene		1g	5g
D3798	3,3'-Dibromo-2,2'-bithiophene	1g	5g	25g
D2755	5,5'-Dibromo-2,2'-bithiophene		1g	5g
D4572	2,5-Dibromo-3-decylthiophene		5g	25g
D2245	2,8-Dibromodibenzothiophene	1g	5g	25g
D4274	3,7-Dibromodibenzo[*b*,*d*]thiophene			200mg
D4183	5,5'-Dibromo-3,3'-dihexyl-2,2'-bithiophene		1g	5g
D4184	5,5'-Dibromo-4,4'-dihexyl-2,2'-bithiophene		200mg	1g
D3799	2,6-Dibromodithieno[3,2-*b*:2',3'-*d*]thiophene		200mg	1g
D3800	3,5-Dibromodithieno[3,2-*b*:2',3'-*d*]thiophene		200mg	1g
D4031	2,5-Dibromo-3-dodecylthiophene			5g
D4056	2,5-Dibromo-3,4-ethylenedioxythiophene		1g	5g
D3896	2,5-Dibromo-3-hexylthiophene		5g	25g
D4714	2,6-Dibromo-4-*n*-octyldithieno[3,2-*b*:2',3'-*d*]pyrrole			200mg
D4053	2,5-Dibromo-3-*n*-octylthiophene			5g
D4050	5,5''-Dibromo-2,2':5',2''-terthiophene		1g	5g
D4032	2,5-Dibromothieno[2,3-*b*]thiophene			1g
D3678	2,5-Dibromothieno[3,2-*b*]thiophene	200mg	1g	5g
D4033	3,4-Dibromothieno[2,3-*b*]thiophene			1g
D3679	3,6-Dibromothieno[3,2-*b*]thiophene		200mg	1g
D4582	2,5-Dibromothiophene-3-carboxylic Acid		1g	5g
D4564	4,4-Di-*n*-octyldithieno[3,2-*b*:2,3-*d*']silole			200mg
E0741	3,4-Ethylenedioxythiophene		5g	25g
E0743	3,4-Ethylenedioxythiophene-2,5-dicarboxylic Acid		1g	5g

Carbazoles

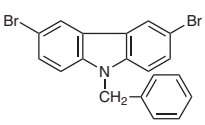
A2051



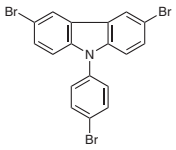
B2805



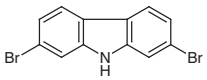
B4348



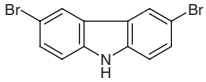
D4563



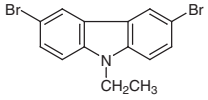
D3932



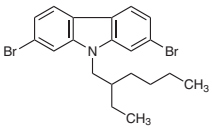
D2983



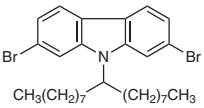
D2982



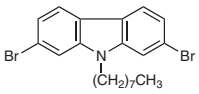
D4735



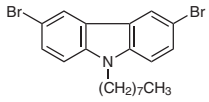
D4490



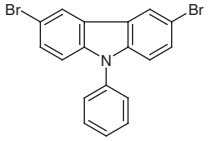
D3935



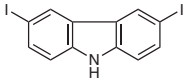
D4482



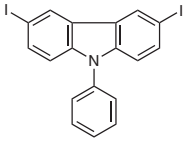
D2981



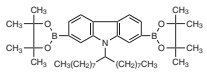
D4548



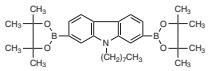
D4543



O0428



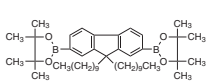
O0439



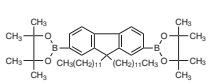
Product No.	Product Name	Unit Size		
A2051	9-Acetyl-3,6-diiodocarbazole		1g	5g
B2805	9-Benzylcarbazole-3,6-dicarboxaldehyde			100mg
B4348	9-Benzyl-3,6-dibromocarbazole			1g
D4563	3,6-Dibromo-9-(4-bromophenyl)carbazole		200mg	1g
D3932	2,7-Dibromocarbazole		1g	5g
D2983	3,6-Dibromocarbazole	1g	5g	25g
D2982	3,6-Dibromo-9-ethylcarbazole		1g	5g
D4735	2,7-Dibromo-9-(2-ethylhexyl)carbazole			200mg
D4490	2,7-Dibromo-9-(9-heptadecyl)carbazole		200mg	1g
D3935	2,7-Dibromo-9-*n*-octylcarbazole			200mg
D4482	3,6-Dibromo-9-*n*-octylcarbazole		200mg	1g
D2981	3,6-Dibromo-9-phenylcarbazole		1g	5g
D4548	3,6-Diiodocarbazole		5g	25g
D4543	3,6-Diiodo-9-phenylcarbazole		1g	5g
O0428	9-(9-Heptadecanyl)-2,7-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)carbazole		200mg	1g
O0439	9-*n*-Octyl-2,7-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)carbazole			200mg

Fluorenes

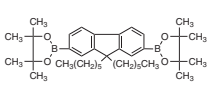
B4588



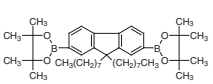
B4624



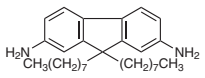
B4029



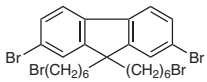
B3582



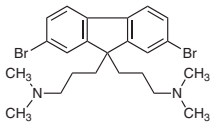
D4719



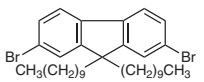
B3552



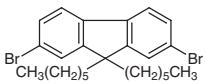
D4550



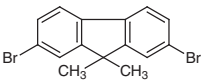
D4561



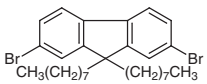
D3933



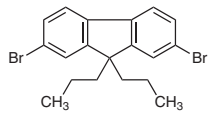
D3859



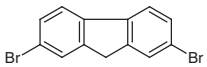
D3934



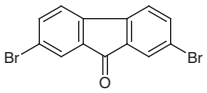
D4569



D3556

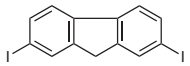


D3557

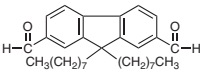


D3781

D4504



D4671

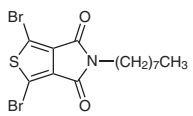


Product No.	Product Name	Unit Size		
B4588	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-didecylfluorene			1g
B4624	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-didodecylfluorene			1g
B4029	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-dihexylfluorene			1g
B3582	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9-di-*n*-octylfluorene			1g
D4719	2,7-Diamino-9,9-di-*n*-octylfluorene		200mg	1g
B3552	2,7-Dibromo-9,9-bis(6-bromohexyl)fluorene		1g	5g
D4550	2,7-Dibromo-9,9-bis[3-(dimethylamino)propyl]fluorene		200mg	1g
D4561	2,7-Dibromo-9,9-didecylfluorene		5g	25g
D3933	2,7-Dibromo-9,9-dihexylfluorene		5g	25g
D3859	2,7-Dibromo-9,9-dimethylfluorene		5g	25g
D3934	2,7-Dibromo-9,9-di-*n*-octylfluorene		5g	25g
D4569	2,7-Dibromo-9,9-dipropylfluorene		1g	5g
D3556	2,7-Dibromofluorene	5g	25g	100g
D3557	2,7-Dibromo-9-fluorenone		5g	25g
D3781	2,7-Dibromo-9,9'-spirobi[9*H*-fluorene]			1g
D4504	2,7-Diiodofluorene		1g	5g
D4671	9,9-Di-*n*-octylfluorene-2,7-dicarboxaldehyde			1g

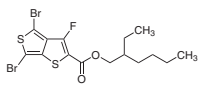
Acceptor Raw Materials

Thiophenes

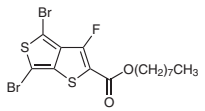
D4219



E1040



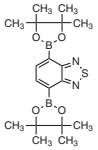
O0436



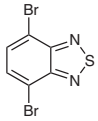
Product No.	Product Name	Unit Size
D4219	2,5-Dibromo-*N*-*n*-octyl-3,4-thiophenedicarboximide	200mg
E1040	2-Ethylhexyl 4,6-Dibromo-3-fluorothieno[3,4-*b*]thiophene-2-carboxylate	100mg
O0436	*n*-Octyl 4,6-Dibromo-3-fluorothieno[3,4-*b*]thiophene-2-carboxylate	100mg

Benzothiadiazoles

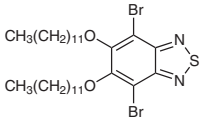
B3573



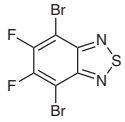
D3842



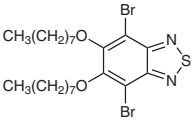
D4622



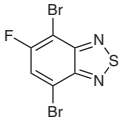
D4734



D4529



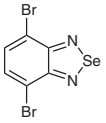
D4750



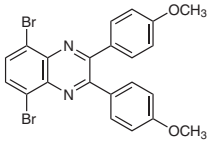
Product No.	Product Name	Unit Size
B3573	4,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,1,3-benzothiadiazole	1g
D3842	4,7-Dibromo-2,1,3-benzothiadiazole	1g 5g 25g
D4622	4,7-Dibromo-5,6-bis(dodecyloxy)-2,1,3-benzothiadiazole	200mg
D4734	4,7-Dibromo-5,6-difluoro-2,1,3-benzothiadiazole	200mg
D4529	4,7-Dibromo-5,6-di-*n*-octyloxy-2,1,3-benzothiadiazole	200mg
D4750	4,7-Dibromo-5-fluoro-2,1,3-benzothiadiazole	200mg 1g

Others

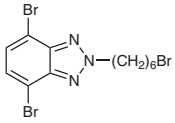
D3944



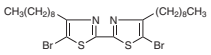
D4653



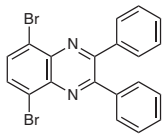
D4514



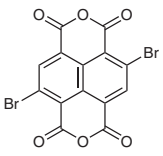
D4558



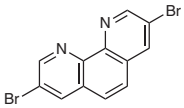
D4461



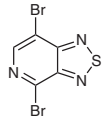
D4339



D3209



D4442

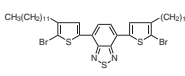


Product No.	Product Name	Unit Size
D3944	4,7-Dibromo-2,1,3-benzoselenadiazole	1g
D4653	5,8-Dibromo-2,3-bis(4-methoxyphenyl)quinoxaline	200mg
D4514	4,7-Dibromo-2-(6-bromohexyl)benzotriazole	200mg
D4558	5,5'-Dibromo-4,4'-dinonyl-2,2'-bithiazole	200mg
D4461	5,8-Dibromo-2,3-diphenylquinoxaline	200mg
D4339	2,6-Dibromonaphthalene-1,4,5,8-tetracarboxylic Dianhydride	1g 5g

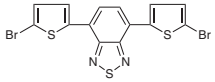
Product No.	Product Name	Unit Size	
D3209	3,8-Dibromo-1,10-phenanthroline	200mg	1g
D4442	4,7-Dibromo[1,2,5]thiadiazolo[3,4-*c*]pyridine	200mg	1g

DA-Type Monomers

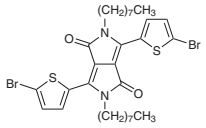
B4719



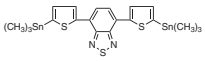
B3886



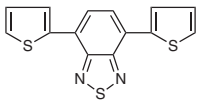
B4419



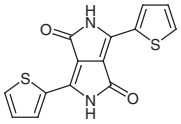
B4453



D4487



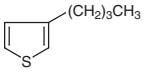
D3969



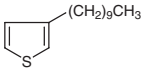
Product No.	Product Name	Unit Size	
B4719	4,7-Bis(5-bromo-4-dodecyl-2-thienyl)-2,1,3-benzothiadiazole		200mg
B3886	4,7-Bis(5-bromo-2-thienyl)-2,1,3-benzothiadiazole	100mg	1g
B4419	3,6-Bis(5-bromo-2-thienyl)-2,5-di-*n*-octylpyrrolo[3,4-*c*]pyrrole-1,4-dione		200mg
B4453	4,7-Bis(5-trimethylstannyl-2-thienyl)-2,1,3-benzothiadiazole		200mg
D4487	4,7-Di(2-thienyl)-2,1,3-benzothiadiazole	200mg	1g
D3969	3,6-Di(2-thienyl)-2,5-dihydropyrrolo[3,4-*c*]pyrrole-1,4-dione	1g	5g

Raw Materials for Oxidative Polymerization, Thiophenes

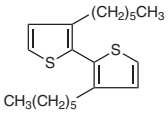
B1458



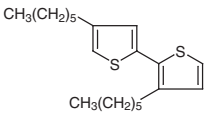
D2098



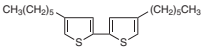
D4180



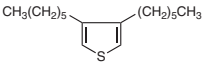
D3928



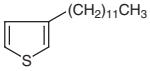
D4182



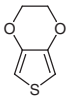
D4202



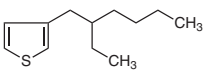
D2016



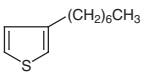
E0741



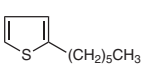
E0973



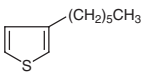
H0722



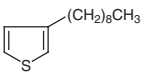
H1350



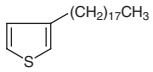
H0756



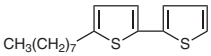
N0533



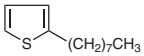
O0245



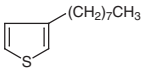
O0383



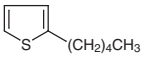
O0376



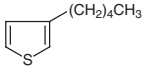
O0213



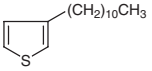
P1835



P1127



U0056



Product No.	Product Name	Unit Size		
B1458	3-Butylthiophene		1g	5g
D2098	3-Decylthiophene		1g	5g
D4180	3,3'-Dihexyl-2,2'-bithiophene		1g	5g
D3928	3,4'-Dihexyl-2,2'-bithiophene		1g	5g
D4182	4,4'-Dihexyl-2,2'-bithiophene		200mg	1g
D4202	3,4-Dihexylthiophene		1g	5g
D2016	3-Dodecylthiophene	1g	5g	25g
E0741	3,4-Ethylenedioxythiophene		5g	25g
E0973	3-(2-Ethylhexyl)thiophene		200mg	1g
H0722	3-Heptylthiophene		1g	5g
H1350	2-Hexylthiophene		5g	25g
H0756	3-Hexylthiophene	1g	5g	25g
N0533	3-Nonylthiophene		1g	5g
O0245	3-Octadecylthiophene		1g	5g
O0383	5-*n*-Octyl-2,2'-bithiophene			1g
O0376	2-*n*-Octylthiophene			5g
O0213	3-*n*-Octylthiophene	1g	5g	25g
P1835	2-Pentylthiophene			5g
P1127	3-Pentylthiophene		1g	5g
U0056	3-Undecylthiophene		1g	5g

References

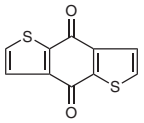
1) H. Shirakawa, E. J. Louis, A. G. MacDiarmid, C. K. Chiang, A. J. Heeger, *J. Chem. Soc., Chem. Comm.* **1977**, 578.
2) J. H. Burroughes, D. D. C. Bradley, A. R. Brown, R. N. Marks, K. Mackay, R. H. Friend, P. L. Burns, A. B. Holmes, *Nature* **1990**, *347*, 539.
3) A. W. Grice, D. D. C. Bradley, M. T. Bernius, M. Inbasekaran, W. W. Wu, E. P. Woo, *Appl. Phys. Lett.* **1998**, *73*, 629.
4) Review: A. B. Holmes, D. D. C. Bradley, A. R. Brown, P. L. Burn, J. H. Burroughes, R. H. Friend, N. C. Greenham, R. W. Gymer, D. A. Halliday, R. W. Jackson, A. Kraft, J. H. F. Martens, K. Pichler, I. D. W. Samuel, *Synth. Met.* **1993**, *57*, 4031.
5) D. Braun, G. Gustafsson, D. McBranch, A. J. Heeger, *J. Appl. Phys.* **1992**, *72*, 564.
6) Review: L. Groenendaal, F. Jonas, D. Freitag, H. Pielartzik, J. R. Reynolds, *Adv. Mater.* **2000**, *12*, 481.
7) A. Elschner, S. Kirchmeyer, W. Lovenich, U. Merker, K. Reuter, in *PEDOT: Principles and Applications of an Intrinsically Conductive Polymer*, CRC Press, **2010**.
8) Review: C. Winder, N. S. Sariciftci, *J. Mater. Chem.* **2004**, *14*, 1077.
9) Review: M. T. Dang, L. Hirsch, G. Wantz, *Adv. Mater.* **2011**, *23*, 3597.
10) Y. Liang, Z. Xu, J. Xia, S.-T. Tsai, Y. Wu, G. Li, C. Ray, L. Yu, *Adv. Mater.* **2010**, *22*, E135.
11) N. Blouin, A. Michaud, M. Leclerc, *Adv. Mater.* **2007**, *19*, 2295.
12) P. M. Beaujuge, W. Pisula, H. N. Tsao, S. Ellinger, K. Müllen, J. R. Reynolds, *J. Am. Chem. Soc.* **2009**, *131*, 7514.
13) H. Ito, T. Iwata, S. Watanabe, S. Kuroda, *Appl. Phys. Express* **2013**, *6*, 051601.
14) S. Cho, J. H. Seo, G.-H. Kim, J. Y. Kim, H. Y. Woo, *J. Mater. Chem.* **2012**, *22*, 21238.

Building Blocks for Small Molecule Semiconductor

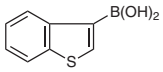
Several features of small molecule organic semiconductors are that they are isolable in a chemically pure form, it is possible to determine structures by a single crystal structure analysis, it is possible to fabricate a thin-layer and to purify it by vacuum deposition. In comparison with inorganic materials, organic materials are structurally diverse based on the carbon-centered geometry. Therefore, we can precisely control physical properties such as photo absorption, emission properties, energy level and solubility by applying organic synthesis. Several conventional coupling reactions can enable expansion of π-conjugated structures. In particular, palladium- and copper-catalyzed cross-coupling reactions can systematically and rapidly produce various organic compounds to develop new materials. The following lists plenty of 'Building Blocks for Small Molecule Semiconductors' bearing halogen, boronic acid (ester), a stannyl group, amino group, or formyl group.

Thiophenes

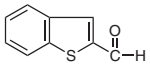
B3793



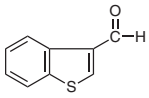
B4774



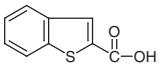
B3777



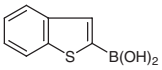
B4086



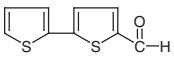
B2033



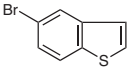
B2893



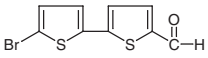
B1838



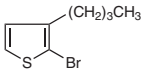
B3762



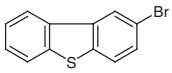
B1874



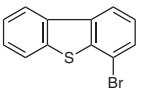
B4511



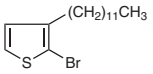
B3525



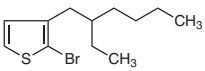
B4449



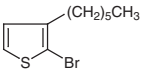
B3691



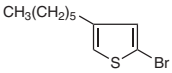
B4783



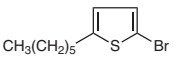
B3507



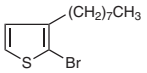
B3985



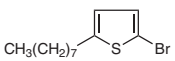
B3812



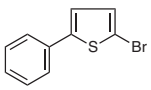
B3733



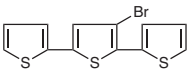
B3738



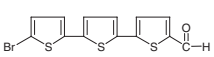
B3663



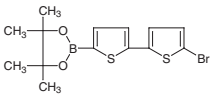
B4050



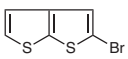
B2058



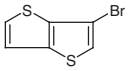
B3200



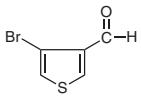
B3692



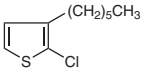
B3226



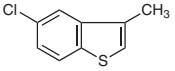
B4126



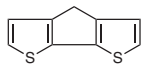
C2613



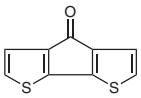
C2457



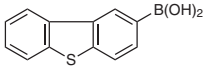
C3021



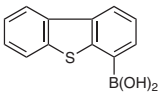
C2715



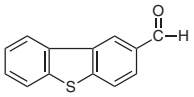
D4373



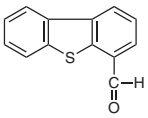
D4057



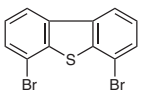
D4777



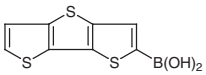
D4767



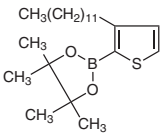
D4822



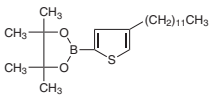
D3823



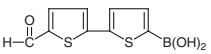
D4290



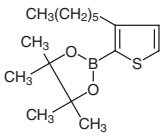
D4291



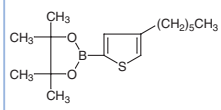
F0548



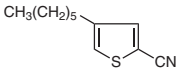
H1298



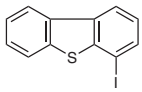
H1294



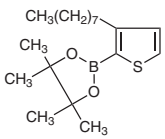
H1503



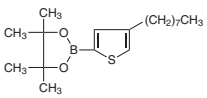
I0947



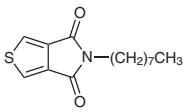
O0410



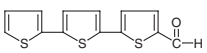
O0411



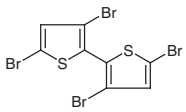
O0394



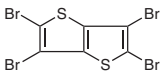
T1805



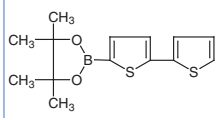
T2699



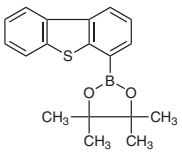
T2772



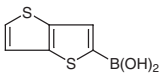
T2518



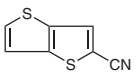
T3236



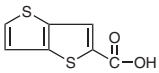
T2621



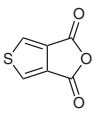
T3221



T3156



T2897

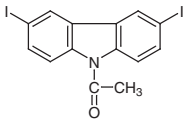


Product No.	Product Name	Unit Size		
B3793	Benzo[1,2-*b*:4,5-*b*']dithiophene-4,8-dione		1g	5g
B4774	Benzo[*b*]thiophene-3-boronic Acid (contains varying amounts of Anhydride)		1g	5g
B3777	Benzo[*b*]thiophene-2-carboxaldehyde			5g
B4086	Benzo[*b*]thiophene-3-carboxaldehyde		1g	5g
B2033	Benzo[*b*]thiophene-2-carboxylic Acid			1g
B2893	Benzo[*b*]thiophene-2-ylboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
B1838	2,2'-Bithiophene-5-carboxaldehyde	1g	5g	25g
B3762	5-Bromobenzo[*b*]thiophene		1g	5g
B1874	5-Bromo-2,2'-bithiophene-5'-carboxaldehyde		1g	5g
B4511	2-Bromo-3-butylthiophene		5g	25g
B3525	2-Bromodibenzothiophene		5g	25g
B4449	4-Bromodibenzothiophene		1g	5g
B3691	2-Bromo-3-dodecylthiophene			5g
B4783	2-Bromo-3-(2-ethylhexyl)thiophene		1g	5g

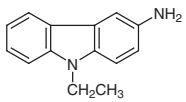
Product No.	Product Name			Unit Size
B3507	2-Bromo-3-hexylthiophene		5g	25g
B3985	2-Bromo-4-hexylthiophene			1g
B3812	2-Bromo-5-hexylthiophene			5g
B3733	2-Bromo-3-*n*-octylthiophene			5g
B3738	2-Bromo-5-*n*-octylthiophene		5g	25g
B3663	2-Bromo-5-phenylthiophene		1g	5g
B4050	3'-Bromo-2,2':5',2''-terthiophene		1g	5g
B2058	5''-Bromo-2,2':5',2''-terthiophene-5-carboxaldehyde	100mg	1g	5g
B3200	5-Bromo-5'-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene			1g
B3692	2-Bromothieno[2,3-*b*]thiophene			1g
B3226	3-Bromothieno[3,2-*b*]thiophene		200mg	1g
B4126	4-Bromothiophene-3-carboxaldehyde		200mg	1g
C2613	2-Chloro-3-hexylthiophene			5g
C2457	5-Chloro-3-methylbenzo[*b*]thiophene		5g	25g
C3021	4*H*-Cyclopenta[2,1-*b*:3,4-*b* ']dithiophene		200mg	1g
C2715	4*H*-Cyclopenta[1,2-*b*:5,4-*b* ']dithiophen-4-one			200mg
D4373	Dibenzothiophene-2-boronic Acid (contains varying amounts of Anhydride)		1g	5g
D4057	Dibenzothiophene-4-boronic Acid (contains varying amounts of Anhydride)		1g	5g
D4777	Dibenzothiophene-2-carboxaldehyde		1g	5g
D4767	Dibenzothiophene-4-carboxaldehyde		1g	5g
D4822	4,6-Dibromodibenzothiophene		200mg	1g
D3823	Dithieno[3,2-*b*:2',3'-*d*]thiophene-2-boronic Acid (contains varying amounts of Anhydride)		200mg	1g
D4290	3-Dodecyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
D4291	4-Dodecyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
F0548	5'-Formyl-2,2'-bithiophene-5-boronic Acid (contains varying amounts of Anhydride)			1g
H1298	3-Hexyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene	1g	5g	25g
H1294	4-Hexyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene			5g
H1503	4-Hexylthiophene-2-carbonitrile			200mg
I0947	4-Iododibenzothiophene		1g	5g
O0410	3-*n*-Octyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
O0411	4-*n*-Octyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)thiophene		1g	5g
O0394	*N*-*n*-Octyl-3,4-thiophenedicarboximide		200mg	1g
T1805	2,2':5',2''-Terthiophene-5-carboxaldehyde			1g
T2699	3,3',5,5'-Tetrabromo-2,2'-bithiophene	1g	5g	25g
T2772	2,3,5,6-Tetrabromothieno[3,2-*b*]thiophene			1g
T2518	5-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)-2,2'-bithiophene	1g	5g	25g
T3236	4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)dibenzothiophene		1g	5g
T2621	Thieno[3,2-*b*]thiophene-2-boronic Acid (contains varying amounts of Anhydride)			1g
T3221	Thieno[3,2-*b*]thiophene-2-carbonitrile		200mg	1g
T3156	Thieno[3,2-*b*]thiophene-2-carboxylic Acid		200mg	1g
T2897	3,4-Thiophenedicarboxylic Anhydride			1g

Carbazoles

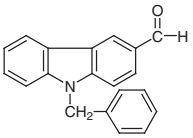
A2051



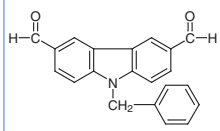
A1508



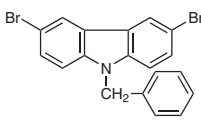
B2804



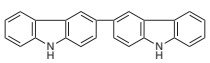
B2805



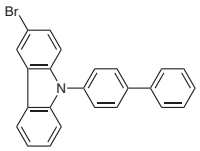
B4348



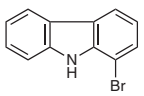
B4646



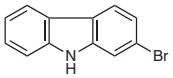
B4538



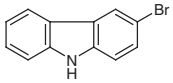
B4816



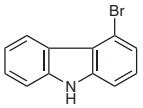
B4381



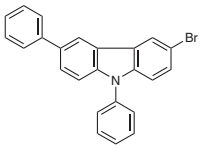
B3458



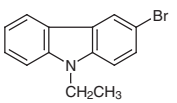
B4752

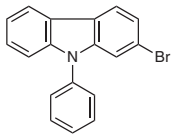
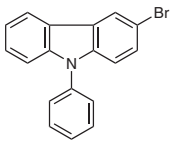
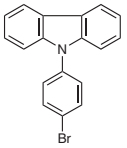
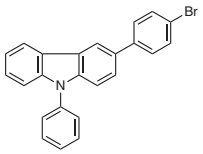
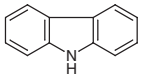
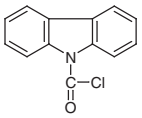
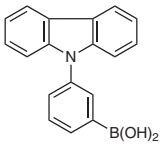
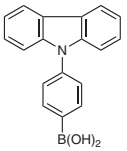
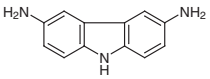
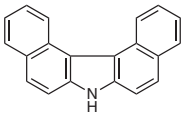
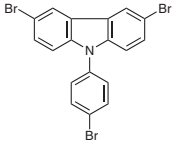
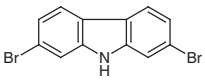
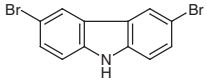
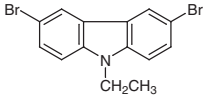
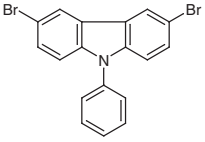
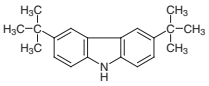
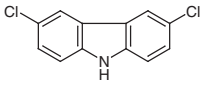
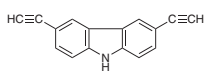
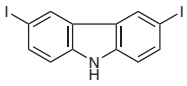
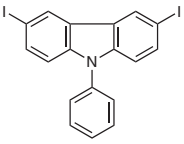
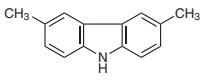
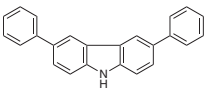
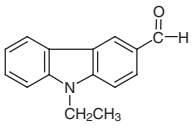
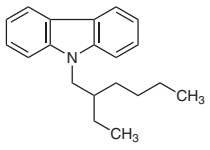
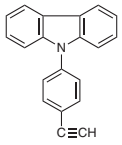
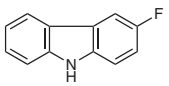
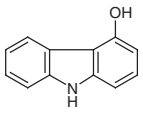
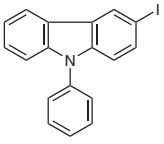
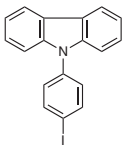
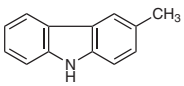
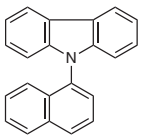
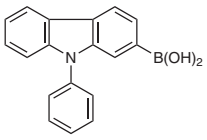
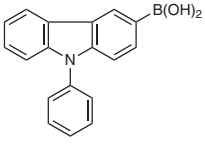
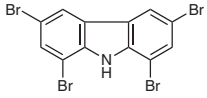
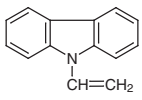


B4795



B3459



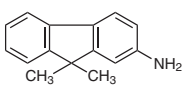
B4439 	B3908 	B3554 	B4452 	C0032 
C1031 	C2967 	C2926 	D2116 	D4473 
D4563 	D3932 	D2983 	D2982 	D2981 
D3952 	D3751 	D4275 	D4548 	D4543 
D4512 	D4433 	E0359 	E0972 	E1055 
F0965 	H1014 	I0913 	I0961 	M2561 
N1012 	P2169 	P2001 	T2932 	V0021 

Product No.	Product Name	Unit Size	
A2051	9-Acetyl-3,6-diiodocarbazole	1g	5g
A1508	3-Amino-9-ethylcarbazole		5g
B2804	9-Benzylcarbazole-3-carboxaldehyde	1g	5g
B2805	9-Benzylcarbazole-3,6-dicarboxaldehyde		100mg
B4348	9-Benzyl-3,6-dibromocarbazole		1g
B4646	3,3'-Bicarbazole	200mg	1g

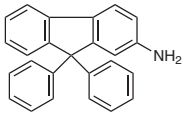
Product No.	Product Name	Unit Size		
B4538	9-(4-Biphenylyl)-3-bromocarbazole		5g	25g
B4816	1-Bromocarbazole		200mg	1g
B4381	2-Bromocarbazole			5g
B3458	3-Bromocarbazole			5g
B4752	4-Bromocarbazole		200mg	1g
B4795	3-Bromo-6,9-diphenylcarbazole		1g	5g
B3459	3-Bromo-9-ethylcarbazole		1g	5g
B4439	2-Bromo-9-phenylcarbazole		1g	5g
B3908	3-Bromo-9-phenylcarbazole		1g	5g
B3554	9-(4-Bromophenyl)carbazole		1g	5g
B4452	3-(4-Bromophenyl)-9-phenylcarbazole		1g	5g
C0032	Carbazole	25g	100g	500g
C1031	Carbazole-9-carbonyl Chloride	1g	5g	25g
C2967	3-(9*H*-Carbazol-9-yl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
C2926	4-(9*H*-Carbazol-9-yl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
D2116	3,6-Diaminocarbazole		1g	5g
D4473	7*H*-Dibenzo[*c*,*g*]carbazole			200mg
D4563	3,6-Dibromo-9-(4-bromophenyl)carbazole		200mg	1g
D3932	2,7-Dibromocarbazole		1g	5g
D2983	3,6-Dibromocarbazole	1g	5g	25g
D2982	3,6-Dibromo-9-ethylcarbazole		1g	5g
D2981	3,6-Dibromo-9-phenylcarbazole		1g	5g
D3952	3,6-Di-*tert*-butylcarbazole		1g	5g
D3751	3,6-Dichlorocarbazole		1g	5g
D4275	3,6-Diethynylcarbazole		200mg	1g
D4548	3,6-Diiodocarbazole		5g	25g
D4543	3,6-Diiodo-9-phenylcarbazole		1g	5g
D4512	3,6-Dimethylcarbazole			1g
D4433	3,6-Diphenylcarbazole		1g	5g
E0359	*N*-Ethylcarbazole-3-carboxaldehyde			25g
E0972	9-(2-Ethylhexyl)carbazole		1g	5g
E1055	9-(4-Ethynylphenyl)carbazole		1g	5g
F0965	3-Fluorocarbazole			1g
H1014	4-Hydroxycarbazole	1g	5g	25g
I0913	3-Iodo-9-phenylcarbazole		1g	5g
I0961	9-(4-Iodophenyl)carbazole		1g	5g
M2561	3-Methyl-9*H*-carbazole			1g
N1012	9-(1-Naphthyl)carbazole		1g	5g
P2169	9-Phenylcarbazole-2-boronic Acid (contains varying amounts of Anhydride)		200mg	1g
P2001	9-Phenylcarbazole-3-boronic Acid (contains varying amounts of Anhydride)		5g	25g
T2932	1,3,6,8-Tetrabromocarbazole		200mg	1g
V0021	9-Vinylcarbazole			25g

Fluorenes & Fluorenones

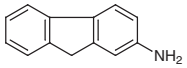
A2634



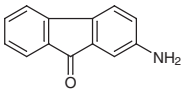
A2779



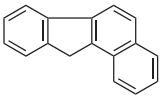
A0621



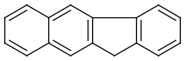
A1040



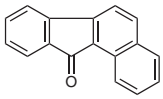
B3931



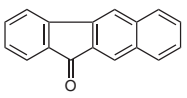
B0059

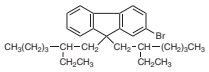
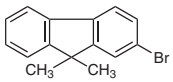
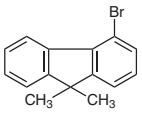
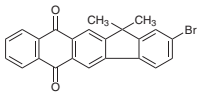
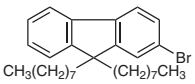
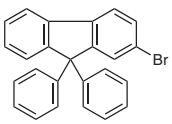
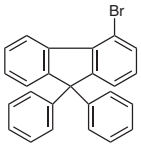
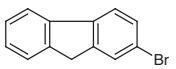
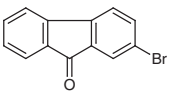
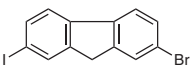
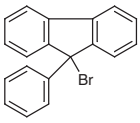
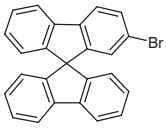
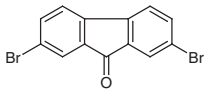
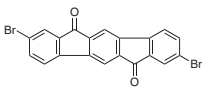
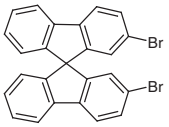
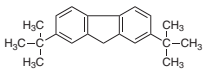
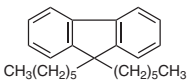
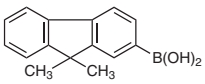
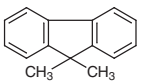
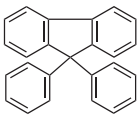
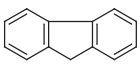
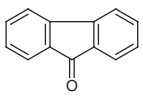
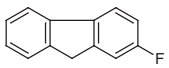
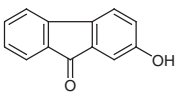
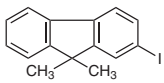
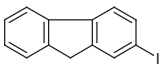
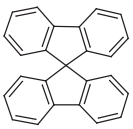
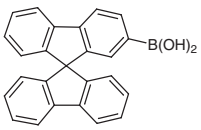


B3933



B3932



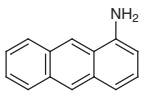
B4441 	B3894 	B4661 	B4668 	B4366 
B4450 	B4776 	B3069 	B3109 	B4431 
B1702 	B3560 	D3557 	D4573 	D3872 
D4084 	D4327 	D3974 	D3235 	D3586 
F0017 	F0021 	F0228 	H0329 	I0875 
I0793 	S0800 	S0831 		

Product No.	Product Name	Unit Size	
A2634	2-Amino-9,9-dimethylfluorene	200mg	1g
A2779	2-Amino-9,9-diphenylfluorene	1g	5g
A0621	2-Aminofluorene	5g	25g
A1040	2-Amino-9-fluorenone	1g	5g
B3931	1,2-Benzofluorene	200mg	1g
B0059	2,3-Benzofluorene	100mg	1g
B3933	11*H*-Benzo[*a*]fluoren-11-one		1g
B3932	11*H*-Benzo[*b*]fluoren-11-one		5g
B4441	2-Bromo-9,9-bis(2-ethylhexyl)fluorene		1g
B3894	2-Bromo-9,9-dimethylfluorene	5g	25g
B4661	4-Bromo-9,9-dimethylfluorene	200mg	1g
B4668	2-Bromo-13,13-dimethyl-6*H*-indeno[1,2-*b*]anthracene-6,11(13*H*)-dione		1g
B4366	2-Bromo-9,9-di-*n*-octylfluorene		1g
B4450	2-Bromo-9,9-diphenylfluorene	1g	5g

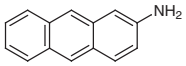
Product No.	Product Name	Unit Size		
B4776	4-Bromo-9,9-diphenylfluorene		1g	5g
B3069	2-Bromofluorene	5g	25g	100g
B3109	2-Bromo-9-fluorenone		5g	25g
B4431	2-Bromo-7-iodofluorene		5g	25g
B1702	9-Bromo-9-phenylfluorene		5g	25g
B3560	2-Bromo-9,9'-spirobi[9*H*-fluorene]			5g
D3557	2,7-Dibromo-9-fluorenone		5g	25g
D4573	2,8-Dibromoindeno[1,2-*b*]fluorene-6,12-dione			1g
D3872	2,2'-Dibromo-9,9'-spirobi[9*H*-fluorene]			1g
D4084	2,7-Di-*tert*-butylfluorene		5g	25g
D4327	9,9-Dihexylfluorene		1g	5g
D3974	9,9-Dimethylfluoren-2-boronic Acid (contains varying amounts of Anhydride)		1g	5g
D3235	9,9-Dimethylfluorene			5g
D3586	9,9-Diphenylfluorene		5g	25g
F0017	Fluorene		25g	500g
F0021	9-Fluorenone		25g	500g
F0228	2-Fluorofluorene		5g	25g
H0329	2-Hydroxy-9-fluorenone			1g
I0875	2-Iodo-9,9-dimethylfluorene		5g	25g
I0793	2-Iodofluorene		5g	25g
S0800	9,9'-Spirobi[9*H*-fluorene]		1g	5g
S0831	9,9'-Spirobi[9*H*-fluorene]-2-boronic Acid		1g	5g

Anthracenes & Anthraquinones

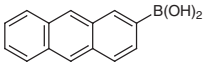
A1709



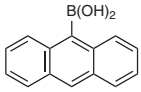
A1687



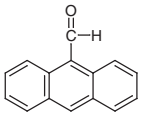
A1843



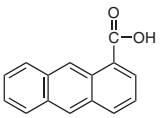
A2328



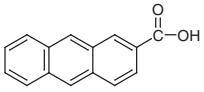
A0779



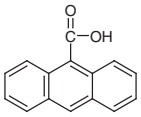
A1220



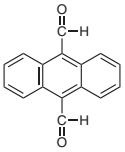
A1150



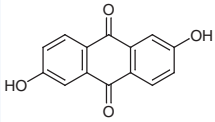
A0690



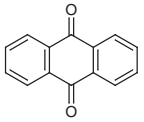
A2664



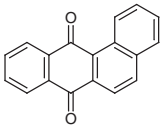
A1894



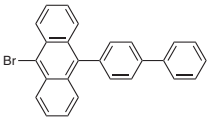
A0502



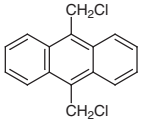
B0018



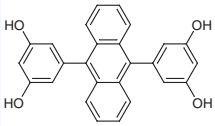
B4569



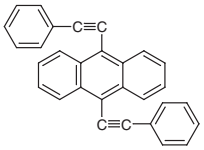
B1327



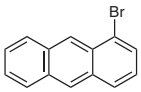
B2109



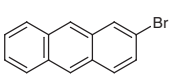
P1137



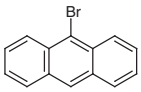
B3475
B2615



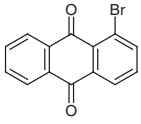
B2616



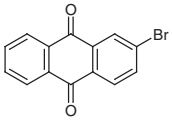
B2871
B0872



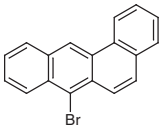
B2688



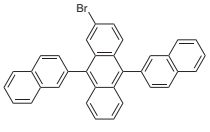
B2689



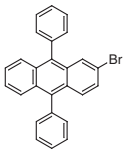
B1603



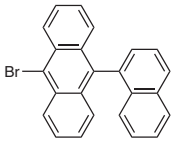
B4321



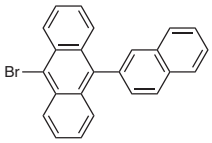
B3442



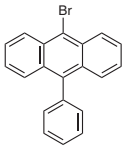
B4451



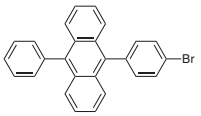
B4426



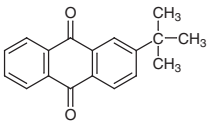
B3977



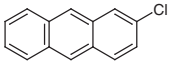
B4475



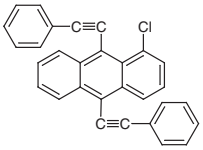
B0816



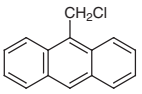
C1962



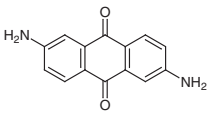
C1289



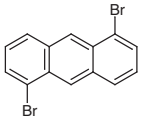
C1046



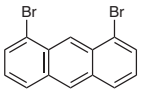
D3180



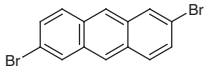
D3183



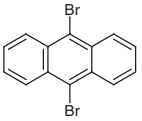
D4230



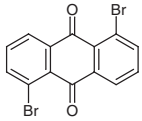
D3171



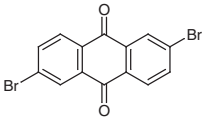
D0166



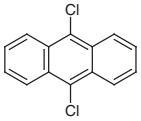
D3181



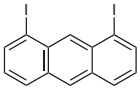
D3182



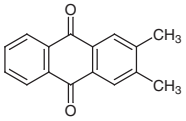
D0327



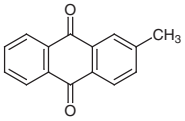
D4151



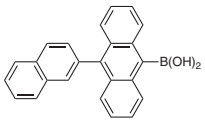
D2980



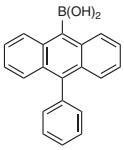
M0156



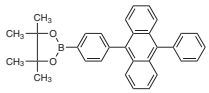
N0929



P1984



T3276

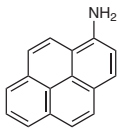


Product No.	Product Name	Unit Size		
A1709	1-Aminoanthracene			1g
A1687	2-Aminoanthracene			1g
A1843	2-Anthraceneboronic Acid (contains varying amounts of Anhydride)		250mg	1g
A2328	9-Anthraceneboronic Acid (contains varying amounts of Anhydride)		1g	5g
A0779	9-Anthracenecarboxaldehyde		25g	100g
A1220	1-Anthracenecarboxylic Acid			1g
A1150	2-Anthracenecarboxylic Acid		1g	5g
A0690	9-Anthracenecarboxylic Acid		5g	25g
A2664	Anthracene-9,10-dicarboxaldehyde		1g	5g
A1894	Anthraflavic Acid		1g	5g
A0502	Anthraquinone		25g	500g
B0018	1,2-Benzanthraquinone		5g	25g
B4569	9-(4-Biphenylyl)-10-bromoanthracene		1g	5g
B1327	9,10-Bis(chloromethyl)anthracene		5g	25g
B2109	9,10-Bis(3,5-dihydroxyphenyl)anthracene		100mg	1g
P1137	9,10-Bis(phenylethynyl)anthracene		1g	5g
B3475	1-Bromoanthracene (purified by sublimation)			1g
B2615	1-Bromoanthracene		100mg	500mg
B2616	2-Bromoanthracene		1g	5g
B2871	9-Bromoanthracene	5g	25g	100g
B0872	9-Bromoanthracene		5g	25g
B2688	1-Bromoanthraquinone		1g	5g
B2689	2-Bromoanthraquinone	1g	5g	25g
B1603	7-Bromobenz[*a*]anthracene		1g	5g

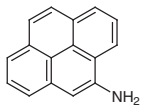
Product No.	Product Name	Unit Size		
B4321	2-Bromo-9,10-di(2-naphthyl)anthracene		1g	5g
B3442	2-Bromo-9,10-diphenylanthracene			1g
B4451	9-Bromo-10-(1-naphthyl)anthracene		1g	5g
B4426	9-Bromo-10-(2-naphthyl)anthracene		1g	5g
B3977	9-Bromo-10-phenylanthracene		1g	5g
B4475	9-(4-Bromophenyl)-10-phenylanthracene		200mg	1g
B0816	2-*tert*-Butylanthraquinone		25g	500g
C1962	2-Chloroanthracene			1g
C1289	1-Chloro-9,10-bis(phenylethynyl)anthracene		1g	10g
C1046	9-Chloromethylanthracene	1g	5g	25g
D3180	2,6-Diaminoanthraquinone		25g	250g
D3183	1,5-Dibromoanthracene			1g
D4230	1,8-Dibromoanthracene		1g	5g
D3171	2,6-Dibromoanthracene		1g	5g
D0166	9,10-Dibromoanthracene	25g	100g	500g
D3181	1,5-Dibromoanthraquinone			1g
D3182	2,6-Dibromoanthraquinone		1g	5g
D0327	9,10-Dichloroanthracene		1g	10g
D4151	1,8-Diiodoanthracene		1g	5g
D2980	2,3-Dimethylanthraquinone		1g	5g
M0156	2-Methylanthraquinone		25g	500g
N0929	10-(2-Naphthyl)anthracene-9-boronic Acid (contains varying amounts of Anhydride)			1g
P1984	10-Phenyl-9-anthraceneboronic Acid (contains varying amounts of Anhydride)			1g
T3276	4,4,5,5-Tetramethyl-2-[4-(10-phenylanthracen-9-yl)phenyl]-1,3,2-dioxaborolane		200mg	1g

Pyrenes

A0632

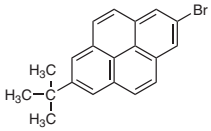


A2180

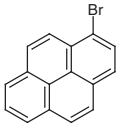


B3956

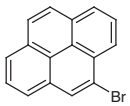
B3957



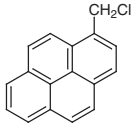
B1495



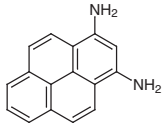
B2807



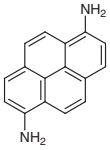
C1637



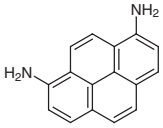
D2167



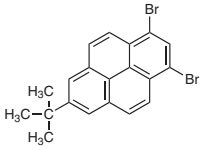
D2160



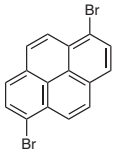
D2168



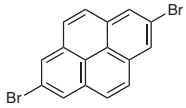
D4187



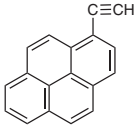
D3167



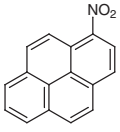
D3169



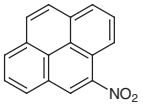
E0939



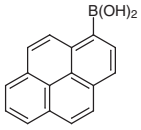
N0419



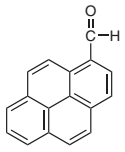
N0838



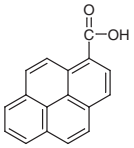
P1625



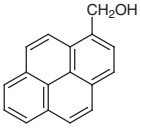
P1448



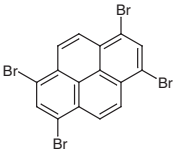
P1687



P1221



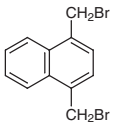
T2716



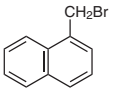
Product No.	Product Name	Unit Size		
A0632	1-Aminopyrene	1g	5g	25g
A2180	4-Aminopyrene			1g
B3956	2,7-Bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)pyrene		1g	5g
B3957	2-Bromo-7-*tert*-butylpyrene		1g	5g
B1495	1-Bromopyrene		5g	25g
B2807	4-Bromopyrene		1g	5g
C1637	1-Chloromethylpyrene			1g
D2167	1,3-Diaminopyrene			100mg
D2160	1,6-Diaminopyrene			100mg
D2168	1,8-Diaminopyrene			100mg
D4187	1,3-Dibromo-7-*tert*-butylpyrene		1g	5g
D3167	1,6-Dibromopyrene		1g	5g
D3169	2,7-Dibromopyrene			1g
E0939	1-Ethynylpyrene		200mg	1g
N0419	1-Nitropyrene		5g	25g
N0838	4-Nitropyrene			1g
P1625	1-Pyreneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
P1448	1-Pyrenecarboxaldehyde		1g	5g
P1687	1-Pyrenecarboxylic Acid		1g	5g
P1221	1-Pyrenemethanol		1g	5g
T2716	1,3,6,8-Tetrabromopyrene			5g

Naphthalenes

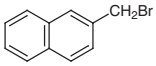
B1919



B4563

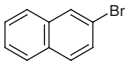


B1524

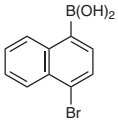


B0618

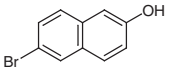
B0619



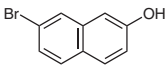
B4463



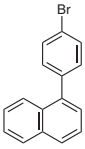
B0621



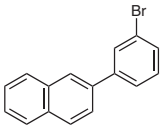
B4580



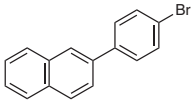
B3978



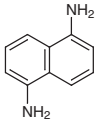
B4568



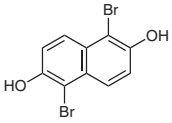
B4159



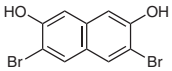
D0101



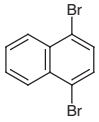
D4668



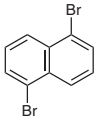
D4669



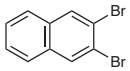
D2359



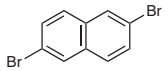
D4660



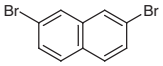
D4597



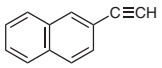
D4154



D3624

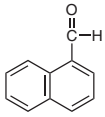


E0933

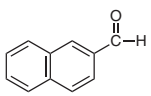


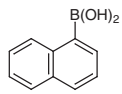
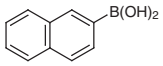
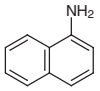
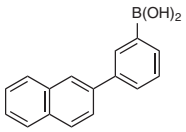
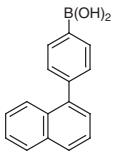
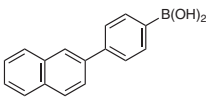
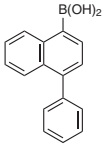
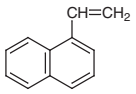
I0266

N0002

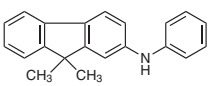
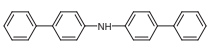
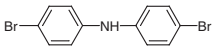


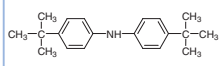
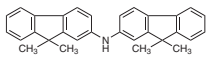
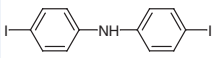
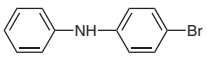
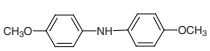
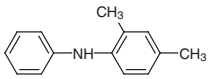
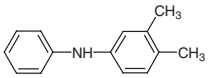
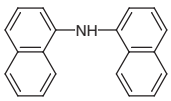
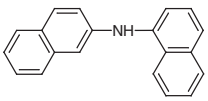
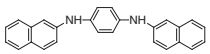
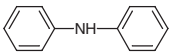
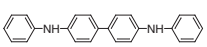
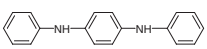
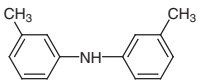
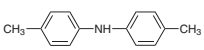
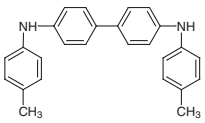
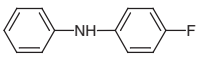
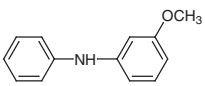
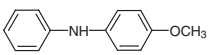
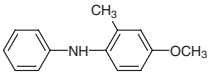
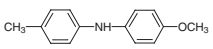
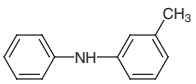
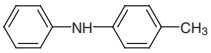
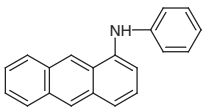
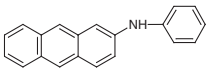
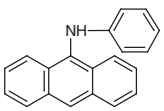
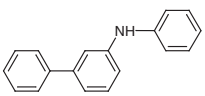
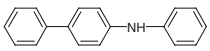
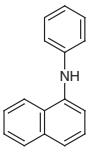
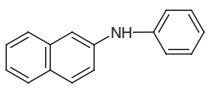
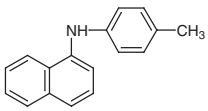
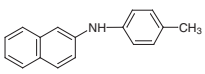
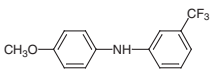
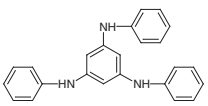
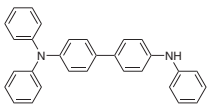
N0003



N0630	N0649	N0052	N1009	N0798
				
N0946	**N0212**	**P2290**	**V0040**	
				

Product No.	Product Name			Unit Size
B1919	1,4-Bis(bromomethyl)naphthalene (contains *ca.* 23% isomer)		1g	5g
B4563	1-(Bromomethyl)naphthalene		5g	25g
B1524	2-(Bromomethyl)naphthalene		5g	25g
B0618	1-Bromonaphthalene	25g	100g	500g
B0619	2-Bromonaphthalene		5g	25g
B4463	4-Bromo-1-naphthaleneboronic Acid (contains varying amounts of Anhydride)			1g
B0621	6-Bromo-2-naphthol		25g	100g
B4580	7-Bromo-2-naphthol		1g	5g
B3978	1-(4-Bromophenyl)naphthalene		1g	5g
B4568	2-(3-Bromophenyl)naphthalene		1g	5g
B4159	2-(4-Bromophenyl)naphthalene			1g
D0101	1,5-Diaminonaphthalene	25g	100g	500g
D4668	1,5-Dibromo-2,6-dihydroxynaphthalene		5g	25g
D4669	3,6-Dibromo-2,7-dihydroxynaphthalene		1g	5g
D2359	1,4-Dibromonaphthalene		5g	25g
D4660	1,5-Dibromonaphthalene			1g
D4597	2,3-Dibromonaphthalene		200mg	1g
D4154	2,6-Dibromonaphthalene			1g
D3624	2,7-Dibromonaphthalene		5g	25g
E0933	2-Ethynylnaphthalene			100mg
I0266	1-Iodonaphthalene			25g
N0002	1-Naphthaldehyde		25mL	500mL
N0003	2-Naphthaldehyde		5g	25g
N0630	1-Naphthaleneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
N0649	2-Naphthaleneboronic Acid (contains varying amounts of Anhydride)	1g	5g	25g
N0052	1-Naphthylamine		25g	100g
N1009	3-(2-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0798	4-(1-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		1g	5g
N0946	4-(2-Naphthyl)phenylboronic Acid (contains varying amounts of Anhydride)		200mg	1g
N0212	1-Nitronaphthalene		25g	500g
P2290	4-Phenylnaphthalene-1-boronic Acid (contains varying amounts of Anhydride)		1g	5g
V0040	1-Vinylnaphthalene (stabilized with TBC)			5g

Secondary Arylamines	A2741	B2429	B2684
			

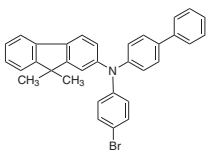
B2803 	B4664 	B2685 	B3949 	D0632 
D3398 	D3845 	D2986 	D2988 	D0812 
D0872 	D0878 	D0609 	D1512 	D0950 
D3567 	F0630 	M1135 	M2069 	M1286 
M2070 	M1258 	M1173 	P1494 	P1495 
P1496 	P1497 	P1498 	P0197 	P0198 
T2201 	T2065 	T1326 	T1831 	T2891 

Product No.	Product Name	Unit Size	
A2741	2-Anilino-9,9-dimethylfluorene	1g	5g
B2429	Bis(4-biphenylyl)amine	1g	5g
B2684	Bis(4-bromophenyl)amine	1g	5g
B2803	Bis(4-*tert*-butylphenyl)amine	25g	500g
B4664	Bis(9,9-dimethyl-9*H*-fluoren-2-yl)amine	1g	5g
B2685	Bis(4-iodophenyl)amine	1g	5g

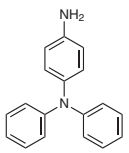
Product No.	Product Name	Unit Size	
B3949	4-Bromodiphenylamine	5g	25g
D0632	4,4'-Dimethoxydiphenylamine	1g	5g
D3398	2,4-Dimethyldiphenylamine		25g
D3845	3,4-Dimethyldiphenylamine		25g
D2986	1,1'-Dinaphthylamine		1g
D2988	1,2'-Dinaphthylamine (purified by sublimation)	1g	5g
D0812	*N*,*N*'-Di-2-naphthyl-1,4-phenylenediamine	25g	500g
D0872	Diphenylamine	25g	500g
D0878	*N*,*N*'-Diphenylbenzidine	5g	25g
D0609	*N*,*N*'-Diphenyl-1,4-phenylenediamine	25g	500g
D1512	*m*,*m*'-Ditolylamine	5g	25g
D0950	*p*,*p*'-Ditolylamine	5g	25g
D3567	*N*,*N*'-Di-*p*-tolylbenzidine	1g	5g
F0630	4-Fluorodiphenylamine	1g	5g
M1135	3-Methoxydiphenylamine	25g	500g
M2069	4-Methoxydiphenylamine	5g	25g
M1286	4-Methoxy-2-methyldiphenylamine	25g	500g
M2070	4-Methoxy-4'-methyldiphenylamine	5g	25g
M1258	3-Methyldiphenylamine		25g
M1173	4-Methyldiphenylamine	1g	5g
P1494	*N*-Phenyl-1-anthramine		500mg
P1495	*N*-Phenyl-2-anthramine		1g
P1496	*N*-Phenyl-9-anthramine	1g	5g
P1497	*N*-Phenyl-3-biphenylamine		500mg
P1498	*N*-Phenyl-4-biphenylamine		500mg
P0197	*N*-Phenyl-1-naphthylamine	25g	500g
P0198	*N*-Phenyl-2-naphthylamine	25g	500g
T2201	*N*-(*p*-Tolyl)-1-naphthylamine		500mg
T2065	*N*-(*p*-Tolyl)-2-naphthylamine		500mg
T1326	3-Trifluoromethyl-4'-methoxydiphenylamine	1g	5g
T1831	*N*,*N*',*N*''-Triphenyl-1,3,5-benzenetriamine	5g	25g
T2891	*N*,*N*,*N*'-Triphenylbenzidine	1g	5g

Tertiary Arylamines

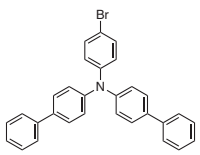
A2858



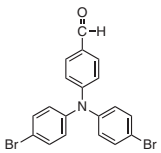
A2624



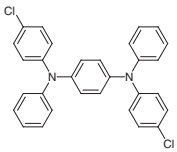
B4550



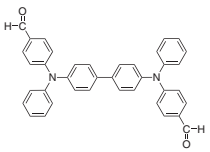
B3991



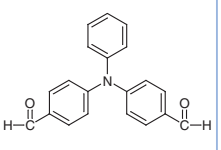
B1336



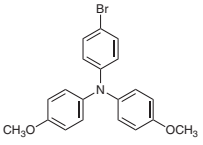
B4793



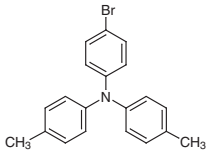
B2843



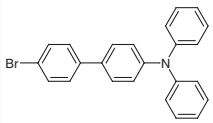
B4667



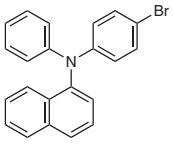
B3089



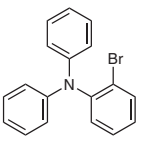
B2844



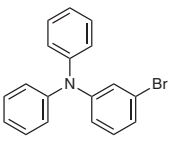
B4299



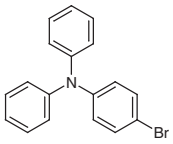
B4008



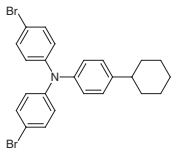
B4036



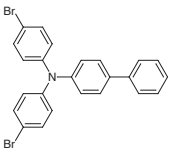
B2633



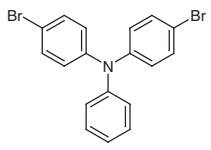
D3302



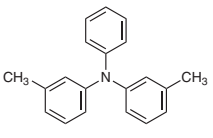
D3303

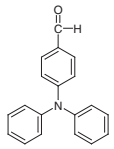


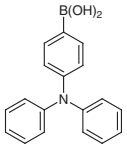
D1910

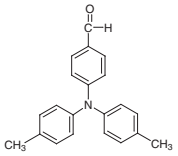


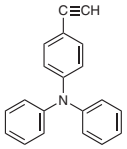
D4755

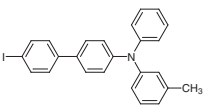


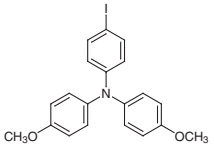
D2172


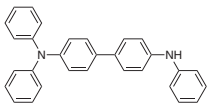
D3537


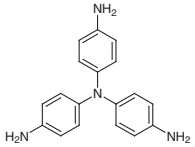
D2737


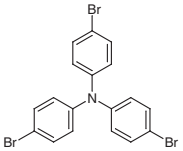
E0894


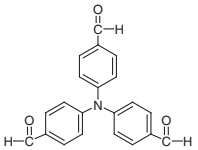
I0490


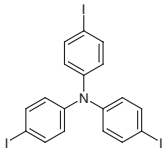
I0776


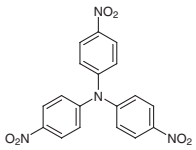
T2891


T2332


T1361


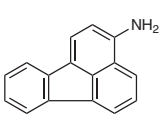
T2310


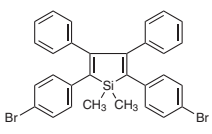
T1724


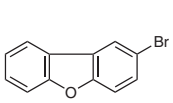
T2333


Product No.	Product Name	Unit Size	
A2858	2-Amino-*N*-[(1,1'-biphenyl)-4-yl]-*N*-(4-bromophenyl)-9,9-dimethylfluorene	1g	5g
A2624	4-Aminotriphenylamine		200mg
B4550	*N*,*N*-Bis(4-biphenylyl)-*N*-(4-bromophenyl)amine	5g	25g
B3991	4-[*N*,*N*-Bis(4-bromophenyl)amino]benzaldehyde		200mg
B1336	*N*,*N*'-Bis(4-chlorophenyl)-*N*,*N*'-diphenyl-1,4-phenylenediamine		1g
B4793	*N*,*N*'-Bis(4-formylphenyl)-*N*,*N*'-diphenylbenzidine	200mg	1g
B2843	Bis(4-formylphenyl)phenylamine (purified by sublimation)		1g
B4667	4-Bromo-4',4''-dimethoxytriphenylamine	1g	5g
B3089	4-Bromo-4',4''-dimethyltriphenylamine	1g	5g
B2844	4-Bromo-4'-(diphenylamino)biphenyl	250mg	1g
B4299	*N*-(4-Bromophenyl)-*N*-phenyl-1-naphthylamine	200mg	1g
B4008	2-Bromotriphenylamine		5g
B4036	3-Bromotriphenylamine	1g	5g
B2633	4-Bromotriphenylamine	5g	25g
D3302	4,4'-Dibromo-4''-cyclohexyltriphenylamine		1g
D3303	4,4'-Dibromo-4''-phenyltriphenylamine		1g
D1910	4,4'-Dibromotriphenylamine	1g	5g
D4755	3,3'-Dimethyltriphenylamine	1g	5g
D2172	4-(*N*,*N*-Diphenylamino)benzaldehyde	5g	25g
D3537	4-(Diphenylamino)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g
D2737	4-(Di-*p*-tolylamino)benzaldehyde	1g	5g
E0894	4-Ethynyltriphenylamine		1g
I0490	*N*-(4'-Iodobiphenyl-4-yl)-*N*-(*m*-tolyl)aniline		1g
I0776	4-Iodo-4',4''-dimethoxytriphenylamine	1g	5g
T2891	*N*,*N*,*N*'-Triphenylbenzidine	1g	5g
T2332	Tris(4-aminophenyl)amine	1g	5g
T1361	Tris(4-bromophenyl)amine		25g
T2310	Tris(4-formylphenyl)amine		500mg
T1724	Tris(4-iodophenyl)amine	5g	25g
T2333	Tris(4-nitrophenyl)amine	1g	25g

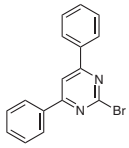
Others

A2789


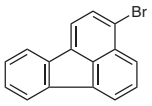
B4547


B4459


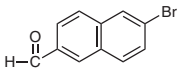
B4662



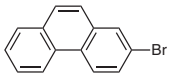
B4599



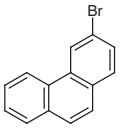
B4686



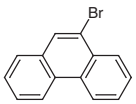
B4671



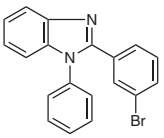
B2387



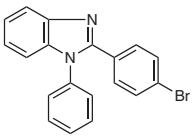
B0838



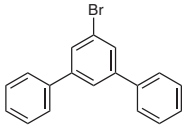
B4794



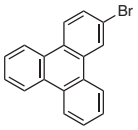
B4479



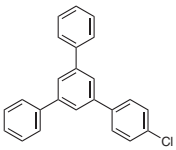
B4308



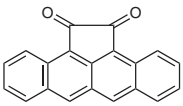
B4442



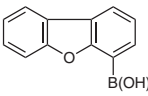
C3008



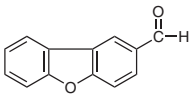
C2669



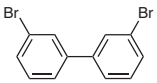
D4567



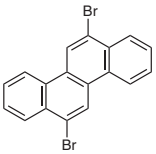
D4759



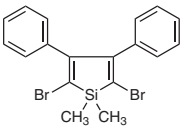
D3166



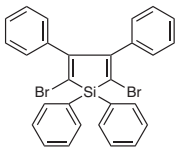
D4236



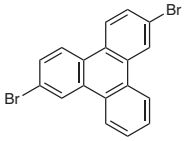
D4631



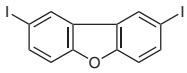
D4310



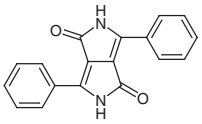
D4801



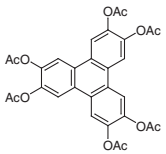
D4835



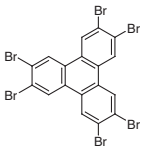
D3743



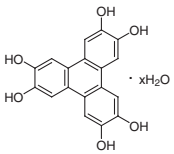
H0923



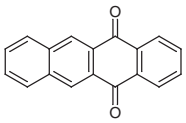
H1201



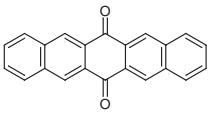
H0907



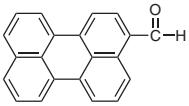
N0603



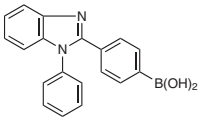
P1685



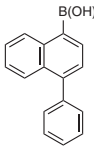
P2110



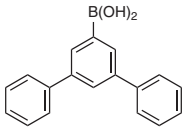
P2158



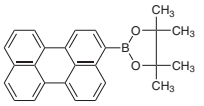
P2290



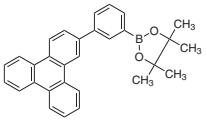
T2792



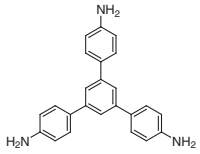
T3089



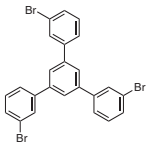
T3261



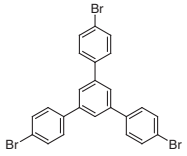
T2728



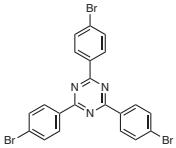
T3073



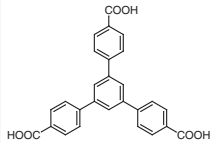
T2644



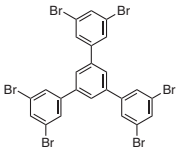
T3178



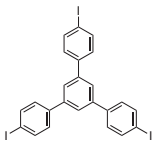
T2647



T3213



T3084

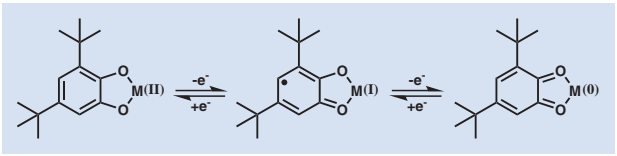


Product No.	Product Name	Unit Size	
A2789	3-Aminofluoranthene	1g	5g
B4547	2,5-Bis(4-bromophenyl)-1,1-dimethyl-3,4-diphenylsilole	1g	5g
B4459	2-Bromodibenzofuran	1g	5g
B4662	2-Bromo-4,6-diphenylpyrimidine	200mg	1g
B4599	3-Bromofluoranthene	1g	5g
B4686	6-Bromo-2-naphthaldehyde		1g
B4671	2-Bromophenanthrene	200mg	1g
B2387	3-Bromophenanthrene		100mg
B0838	9-Bromophenanthrene	25g	250g
B4794	2-(3-Bromophenyl)-1-phenylbenzimidazole	1g	5g
B4479	2-(4-Bromophenyl)-1-phenylbenzimidazole	1g	5g
B4308	5'-Bromo-*m*-terphenyl	5g	25g
B4442	2-Bromotriphenylene	1g	5g
C3008	4-Chloro-5'-phenyl-1,1':3',1''-terphenyl	200mg	1g
C2669	Cyclopenta[*fg*]tetracene-1,2-dione	200mg	1g
D4567	Dibenzofuran-4-boronic Acid (contains varying amounts of Anhydride)	1g	5g
D4759	Dibenzofuran-2-carboxaldehyde	1g	5g
D3166	3,3'-Dibromobiphenyl	5g	25g
D4236	6,12-Dibromochrysene	200mg	1g
D4631	2,5-Dibromo-1,1-dimethyl-3,4-diphenylsilole	1g	5g
D4310	2,5-Dibromo-1,1,3,4-tetraphenylsilole	1g	5g
D4801	2,7-Dibromotriphenylene	200mg	1g
D4835	2,8-Diiododibenzofuran	200mg	1g
D3743	3,6-Diphenyl-2,5-dihydropyrrolo[3,4-*c*]pyrrole-1,4-dione	5g	25g
H0923	2,3,6,7,10,11-Hexaacetoxytriphenylene		100mg
H1201	2,3,6,7,10,11-Hexabromotriphenylene	100mg	1g
H0907	2,3,6,7,10,11-Hexahydroxytriphenylene Hydrate	1g	5g
N0603	5,12-Naphthacenequinone	10g	25g
P1685	6,13-Pentacenedione	5g	25g
P2110	3-Perylenecarboxaldehyde	1g	5g
P2158	4-(1-Phenyl-1*H*-benzimidazol-2-yl)phenylboronic Acid (contains varying amounts of Anhydride)	1g	5g
P2290	4-Phenylnaphthalene-1-boronic Acid (contains varying amounts of Anhydride)	1g	5g
T2792	5'-*m*-Terphenylboronic Acid (contains varying amounts of Anhydride)		1g
T3089	4,4,5,5-Tetramethyl-2-(3-perylenyl)-1,3,2-dioxaborolane	200mg	1g
T3261	4,4,5,5-Tetramethyl-2-[3-(triphenylen-2-yl)phenyl]-1,3,2-dioxaborolane	200mg	1g
T2728	1,3,5-Tris(4-aminophenyl)benzene		5g
T3073	1,3,5-Tris(3-bromophenyl)benzene	1g	5g
T2644	1,3,5-Tris(4-bromophenyl)benzene	1g	5g
T3178	2,4,6-Tris(4-bromophenyl)-1,3,5-triazine		200mg
T2647	1,3,5-Tris(4-carboxyphenyl)benzene	1g	5g
T3213	1,3,5-Tris(3,5-dibromophenyl)benzene	200mg	1g
T3084	1,3,5-Tris(4-iodophenyl)benzene	1g	5g

Ligands for Functional Metal Complex

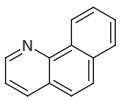
Optically and electronically functional metal complexes exhibiting light absorption, emission, and magnetism have been well known. Such functional metal complexes show absorption (emission) by a charge transfer, electrical conduction, and magnetic properties based on d- or f-electrons of the metal center. Coordination modes of metal complexes are diverse from two-coordinate to eight-coordinate, and thus many coordination geometries are known. Here we list ligands to synthesize the functional metal complexes that are useful for electronics and dye-sensitizers. In particular, these ligands undergo more than bidentate chelation with a metal center forming a rigid structure.

Many transition metals can be redox centers in the metal complex, because they can have several oxidation states. On the other hand, there are 'redox active ligands' that can function as redox centers. One can observe a variety of oxidation states in the transition metal complexes bearing a redox active ligand, because the redox center involves both of the metal and the coordinating ligand. In addition, a redox active ligand may interexchange electrons with a metal center. A typical example is valence tautomerism.[1,2] The water oxidation catalyst developed by Tanaka *et al*. also requires a redox active ligand.[3,4] Physical properties of a metal complex involving a redox active ligand are sometimes due to the π-electrons of the ligand. The metal complexes with a redox active dithiolene ligand have been studied on conductivity and magnetism based on the π-conjugated structure.[5]

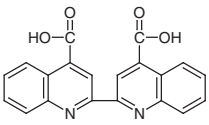


Phenylpyridines

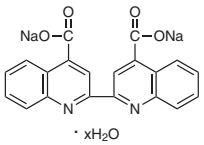
B0088



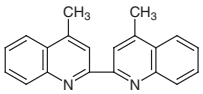
B3509



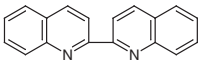
B4509



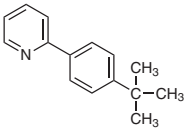
B0841



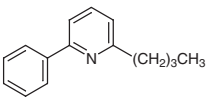
B0470



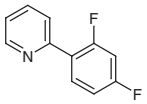
B4092



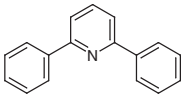
B3314



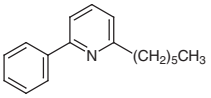
D3413



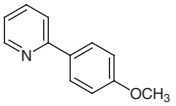
D1922



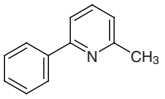
H1265



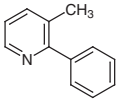
M2101



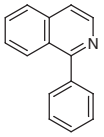
M2001



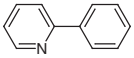
M0932



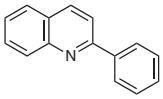
P1731



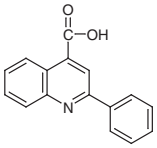
P1039



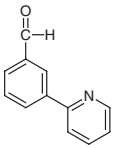
P2057



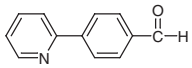
P1301



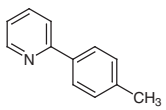
P1889



P1671



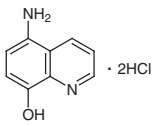
T1228



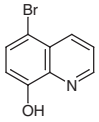
Product No.	Product Name	Unit Size	
B0088	Benzo[*h*]quinoline	5g	25g
B3509	2,2'-Bicinchoninic Acid	1g	5g
B4509	Bicinchoninic Acid Disodium Salt Hydrate	1g	5g
B0841	2,2'-Bi-4-lepidine		100mg
B0470	2,2'-Biquinoline	1g	5g
B4092	2-(4-*tert*-Butylphenyl)pyridine	200mg	1g
B3314	2-Butyl-6-phenylpyridine		1g
D3413	2-(2,4-Difluorophenyl)pyridine	1g	5g
D1922	2,6-Diphenylpyridine	5g	25g
H1265	2-Hexyl-6-phenylpyridine		1g
M2101	2-(4-Methoxyphenyl)pyridine	1g	5g 25g
M2001	2-Methyl-6-phenylpyridine	1g	5g
M0932	3-Methyl-2-phenylpyridine	5g	25g
P1731	1-Phenylisoquinoline	1g	5g
P1039	2-Phenylpyridine	5g	25g
P2057	2-Phenylquinoline	1g	5g
P1301	2-Phenylquinoline-4-carboxylic Acid		25g
P1889	3-(2-Pyridyl)benzaldehyde		1g
P1671	4-(2-Pyridyl)benzaldehyde	1g	5g
T1228	2-(*p*-Tolyl)pyridine	5g	25g

Quinolinols

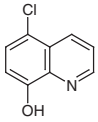
A1005



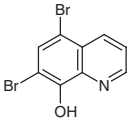
B3324



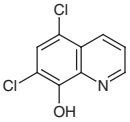
C0645



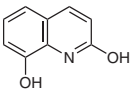
D0208



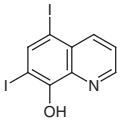
D0412



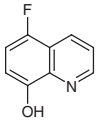
D3819



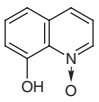
D1736



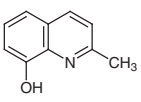
F0038



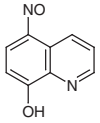
H1272



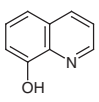
M0420



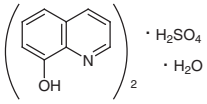
N0270



H0305



Q0017

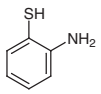


Product No.	Product Name	Unit Size	
A1005	5-Amino-8-hydroxyquinoline Dihydrochloride	5g	25g
B3324	5-Bromo-8-hydroxyquinoline	5g	25g
C0645	5-Chloro-8-hydroxyquinoline	25g	250g
D0208	5,7-Dibromo-8-hydroxyquinoline		25g
D0412	5,7-Dichloro-8-hydroxyquinoline	5g	25g
D3819	2,8-Dihydroxyquinoline	5g	25g

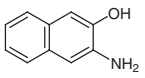
Product No.	Product Name	Unit Size		
D1736	5,7-Diiodo-8-hydroxyquinoline			25g
F0038	5-Fluoro-8-quinolinol		1g	5g
H1272	8-Hydroxyquinoline *N*-Oxide		5g	25g
M0420	2-Methyl-8-quinolinol	25g	100g	500g
N0270	5-Nitroso-8-hydroxyquinoline			25g
H0305	8-Quinolinol		25g	500g
Q0017	8-Quinolinol Sulfate Monohydrate		25g	500g

Redox Active Ligands

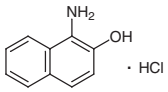
A0267



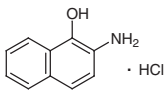
A1593



A0364



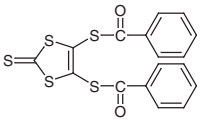
A0365



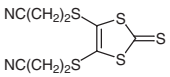
A0335

B1322

B1199

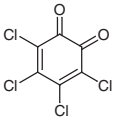


B2228

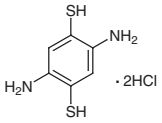


P0317

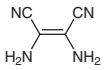
T0970



D2022

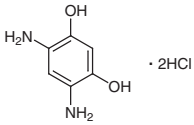


D1335

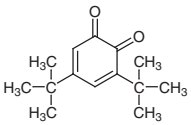


D1045

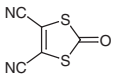
D1888



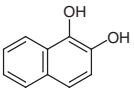
D2430



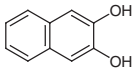
D3252



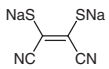
D2299



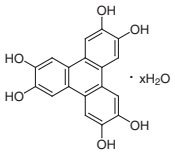
D0593



D1930

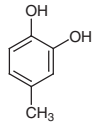


H0907

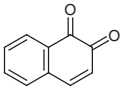


H1177

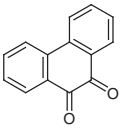
M0413



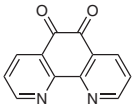
N0041



P0080

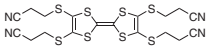


P1973

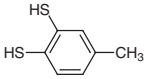


P0168

T2806



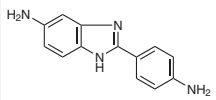
T0266



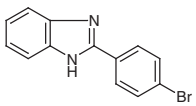
Product No.	Product Name	Unit Size		
A0267	2-Aminobenzenethiol	25mL	100mL	500mL
A1593	3-Amino-2-naphthol			5g
A0364	1-Amino-2-naphthol Hydrochloride			25g
A0365	2-Amino-1-naphthol Hydrochloride		1g	5g
A0335	2-Aminophenol	25g	100g	500g
B1322	1,2-Benzenedithiol		1g	5g
B1199	4,5-Bis(benzoylthio)-1,3-dithiole-2-thione		1g	5g
B2228	4,5-Bis(2-cyanoethylthio)-1,3-dithiole-2-thione			1g
P0317	Catechol		25g	100g
T0970	*o*-Chloranil		5g	25g
D2022	2,5-Diamino-1,4-benzenedithiol Dihydrochloride		5g	25g
D1335	Diaminomaleonitrile	25g	100g	500g
D1045	2,3-Diaminonaphthalene		1g	5g
D1888	4,6-Diaminoresorcinol Dihydrochloride		5g	25g
D2430	3,5-Di-*tert*-butyl-1,2-benzoquinone		5g	25g
D3252	4,5-Dicyano-1,3-dithiol-2-one			1g
D2299	1,2-Dihydroxynaphthalene		1g	5g
D0593	2,3-Dihydroxynaphthalene		25g	250g
D1930	Disodium Dimercaptomaleonitrile		1g	5g
H0907	2,3,6,7,10,11-Hexahydroxytriphenylene Hydrate		1g	5g
H1177	2-Hydroxybenzenethiol		5g	25g
M0413	4-Methylcatechol		25g	500g
N0041	1,2-Naphthoquinone		5g	25g
P0080	9,10-Phenanthrenequinone		5g	25g
P1973	1,10-Phenanthroline-5,6-dione		1g	5g
P0168	1,2-Phenylenediamine	25g	100g	500g
T2806	2,3,6,7-Tetrakis(2-cyanoethylthio)tetrathiafulvalene		100mg	1g
T0266	Toluene-3,4-dithiol	1g	5g	25g

Other Ligands

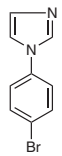
A2759



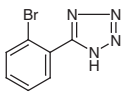
B2812



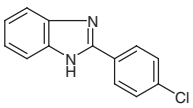
B4101



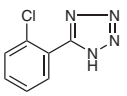
B2577



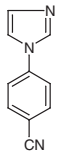
C2027



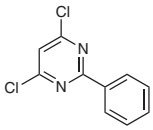
C2811



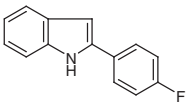
C2045



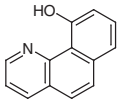
F0851



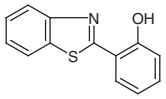
F0427



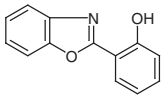
H0738



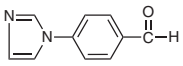
H0973



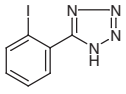
H0291



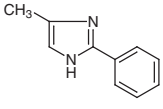
I0818



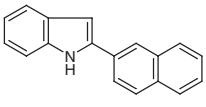
I0735



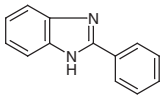
M0669



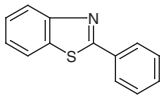
N0859



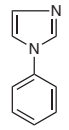
P1105



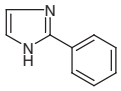
P1130



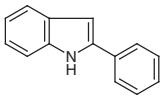
P2030



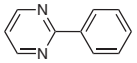
P0684



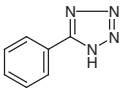
P0188



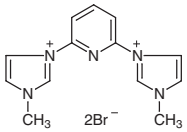
P1945



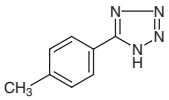
P1109



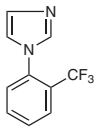
P1816



T2486



T2982



Product No.	Product Name	Unit Size		
A2759	5-Amino-2-(4-aminophenyl)benzimidazole		1g	5g
B2812	2-(4-Bromophenyl)benzimidazole		1g	5g
B4101	1-(4-Bromophenyl)imidazole		1g	5g
B2577	5-(2-Bromophenyl)-1*H*-tetrazole		5g	25g
C2027	2-(4-Chlorophenyl)benzimidazole		1g	5g
C2811	5-(2-Chlorophenyl)-1*H*-tetrazole		1g	5g
C2045	1-(4-Cyanophenyl)imidazole			5g
F0851	Fenclorim		1g	5g
F0427	2-(4-Fluorophenyl)indole			25g
H0738	10-Hydroxybenzo[*h*]quinoline		1g	5g
H0973	2-(2-Hydroxyphenyl)benzothiazole		5g	25g
H0291	2-(2-Hydroxyphenyl)benzoxazole		1g	25g
I0818	4-(1-Imidazolyl)benzaldehyde		1g	5g
I0735	5-(2-Iodophenyl)-1*H*-tetrazole			5g
M0669	4-Methyl-2-phenylimidazole		25g	500g
N0859	2-(2-Naphthyl)indole		1g	5g
P1105	2-Phenylbenzimidazole			25g
P1130	2-Phenylbenzothiazole			5g
P2030	1-Phenylimidazole		1g	5g
P0684	2-Phenylimidazole			100g
P0188	2-Phenylindole		25g	250g
P1945	2-Phenylpyrimidine		200mg	1g
P1109	5-Phenyltetrazole	25g	100g	500g
P1816	1,1'-(2,6-Pyridinediyl)bis(3-methylimidazolium) Dibromide		1g	5g
T2486	5-(*p*-Tolyl)-1*H*-tetrazole		5g	25g
T2982	1-[2-(Trifluoromethyl)phenyl]imidazole			1g

Bipyridine & Terpyridine (see also p.98)

Phenanthroline (see also p.100)

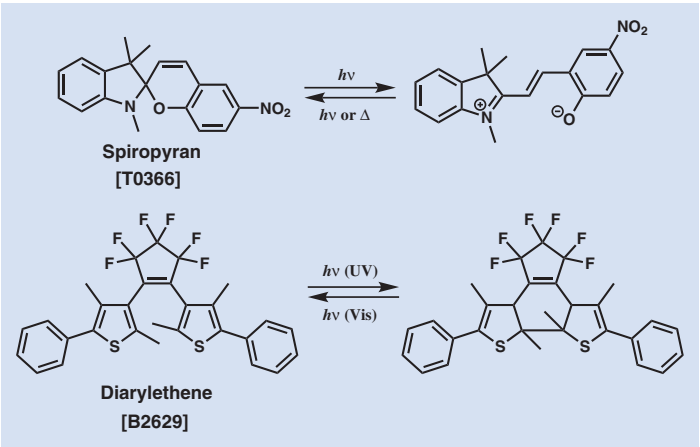
References

1) Review: T. Tezgerevska, K. G. Alley, C. Boskovic, *Coord. Chem. Rev*. **2014**, *268*, 23.
2) C. G. Pierpont, O.-S. Jung, *Inorg. Chem*. **1995**, *34*, 4281.
3) T. Wada, K. Tsuge, K. Tanaka, *Angew. Chem. Int. Ed*. **2000**, *39*, 1479.
4) T. Wada, K. Tsuge, K. Tanaka, *Inorg. Chem*. **2001**, *40*, 329.
5) Review: R. Kato, *Chem. Rev*. **2004**, *104*, 5319.

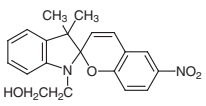
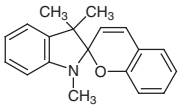
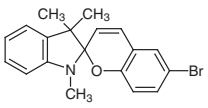
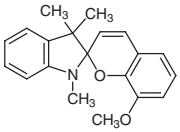
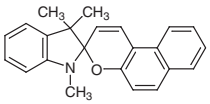
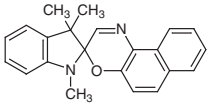
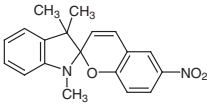
Photochromic Compounds

Chromism is a phenomenon that reversibly changes optical properties (eg. photo absorption and emission) by an external stimulus. A molecular structure changes in many cases while chromism occurs, and then refractive index, dielectricity, redox potentials, and melting point also change. Photochromism is a photo-induced chromism. Photochromic materials are further developed for a light-modulating materials, optical recording media, optical switches, and functional inks.

A structural isomerization during photochromism involves photo-induced geometrical isomerizations (eg. *cis-trans* isomerization) and photo-induced ring-opening and -closure reactions. Fischer *et al*. first reported the photochromic behavior of spiropyrans.[1] UV irradiation to a spiropyran undertakes a ring-opening of the spiro carbon. The structural change leads to a blue shift of photo absorption up to the visible region. Irie *et al*. first observed photochromism of diarylethenes.[2] The diarylethene also shows photo-induced ring-opening and -closure reactions. UV irradiation to the diarylethene undertakes a ring-closure (with coloration) whereas a spiropyran does a ring-opening (with coloration) by UV irradiation. The ring-opened spiropyran thermally closes the ring (T-type). On the other hand, the ring-closed diarylethene is thermally stable but opens to form the original compound by visible light irradiation (P-type). It is well known that diarylethene is a photochromic compound with high photo sensitivity and repetition durability.[3] A fulgide is also a P-type photochromic compound exhibiting a ring-closure by a photo irradiation.[4]



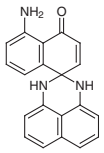
Hayashi and Maeda observed photochromism of an imidazole dimer, hexaarylbiimidazole (HABI).[5] A light irradiation to HABI undertakes dissociation of the dimer. The photochromic mechanism is different from those of the others doing photo isomerizations. A triphenylimidazolyl radical formed by the dissociation thermally recombines to reform the original HABI, thus this is a T-type photochromism. The triphenylimidazolyl radical is also useful as a photopolymerization initiator.[6]

Spiropyrans		H1042	T0344	T0370
				
T0416	T0423	T1259	T0366	
				

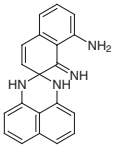
Product No.	Product Name	Unit Size	
H1042	1-(2-Hydroxyethyl)-3,3-dimethylindolino-6'-nitrobenzopyrylospiran	1g	5g
T0344	1,3,3-Trimethylindolinobenzopyrylospiran	1g	5g
T0370	1,3,3-Trimethylindolino-6'-bromobenzopyrylospiran		1g
T0416	1,3,3-Trimethylindolino-8'-methoxybenzopyrylospiran	1g	25g
T0423	1,3,3-Trimethylindolino-*β*-naphthopyrylospiran	1g	5g
T1259	1,3,3-Trimethylindolinonaphthospirooxazine		1g
T0366	1,3,3-Trimethylindolino-6'-nitrobenzopyrylospiran	1g	25g

Spiroperimidines

D3618



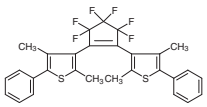
D3619



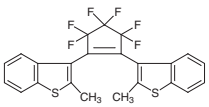
Product No.	Product Name	Unit Size
D3618	2,3-Dihydro-2-spiro-4'-[8'-aminonaphthalen-1'(4'*H*)-one]perimidine (contains *o*-form)	100mg
D3619	2,3-Dihydro-2-spiro-7'-[8'-imino-7',8'-dihydronaphthalen-1'-amine]perimidine	100mg

Diarylethenes

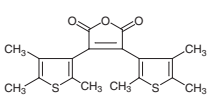
B2629



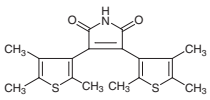
B2287



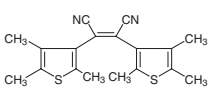
B1534



B1535



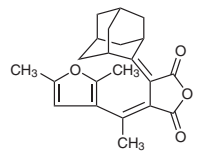
B1536



Product No.	Product Name	Unit Size	
B2629	1,2-Bis(2,4-dimethyl-5-phenyl-3-thienyl)-3,3,4,4,5,5-hexafluoro-1-cyclopentene	100mg	1g
B2287	1,2-Bis[2-methylbenzo[*b*]thiophen-3-yl]-3,3,4,4,5,5-hexafluoro-1-cyclopentene	100mg	1g
B1534	2,3-Bis(2,4,5-trimethyl-3-thienyl)maleic Anhydride	100mg	1g
B1535	2,3-Bis(2,4,5-trimethyl-3-thienyl)maleimide	100mg	1g
B1536	*cis*-1,2-Dicyano-1,2-bis(2,4,5-trimethyl-3-thienyl)ethene	1g	5g

Fulgide

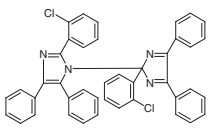
A2869



Product No.	Product Name	Unit Size	
A2869	Aberchrome 670	200mg	1g

Hexaarylbiimidazole

B1225



Product No.	Product Name	Unit Size
B1225	2,2'-Bis(2-chlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole	25g

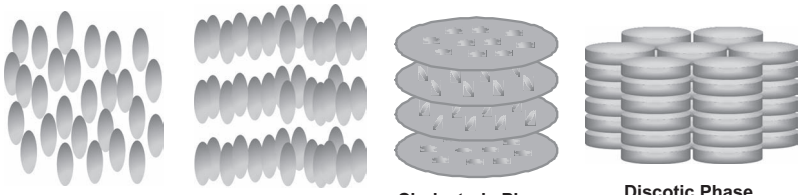
References

1) E. Fischer, Y. Hirshberg, *J. Chem. Soc*. **1952**, 4522.
2) Review: M. Irie, *Chem. Rev*. **2000**, *100*, 1685.
3) K. Matsuda, M. Irie, TCIMAIL **2003**, number *120*, 2.
4) J. Harada, R. Nakajima, K. Ogawa, *J. Am. Chem. Soc*. **2008**, *130*, 7085.
5) K. Maeda, T. Hayashi, *Bull. Chem. Soc. Jpn*. **1969**, *42*, 3509.
6) Review: B. M. Monroe, G. C. Weed, *Chem. Rev*. **1993**, *93*, 435.

Liquid Crystal Materials

Liquid crystals have properties between those of conventional liquid and those of solid crystal. For instance, a liquid crystal shows fluidity like a liquid, but it also demonstrates optical anisotropy like a crystal. Liquid crystal molecules are directionally oriented, but positionally not oriented. Small molecule-based and polymer-based liquid crystals are known. The structure of a liquid crystal involves rigid π-electron systems bearing flexible long alkyl chains. Many liquid crystal molecules are calamitic shaped with a group for polarization, but planar molecules are also known. We can control the temperature which shows a liquid crystal phase by modifying the length of alkyl chain. A practical liquid crystal has a mesophase around room temperature. In addition to an application for a liquid crystal display, liquid crystal materials are expected to be organic semiconductors. A semiconductor having a liquid crystal phase, the so-called liquid crystal semiconductor, spontaneously undergoes a molecular orientation and self-assembly.[1,2)]

The various liquid-crystal phases can be characterized by the type of ordering. Among them, there are mainly nematic, smectic, cholesteric, and discotic phases. We can introduce chirality into a liquid crystal molecule giving chiral nematic and chiral smectic phases.



(1) Nematic phase

Calamitic shaped molecules are oriented one-dimensionally. The individual molecule can be relatively movable along the long axis direction. This phase belongs to the most flexible liquid crystal with large fluidity and small viscosity. Calamitic shaped cyanobiphenyls with large dielectric anisotropy ($\Delta\varepsilon$) enable control of the molecular orientation by applying an electrical field. A liquid crystal display of a twisted nematic (TN) system[3)] is fabricated from a nematic liquid crystal.

(2) Smectic phase

There is a two-dimensional layered structure caused by more positional limitations compared with that of a nematic phase. A smectic phase is harder than a nematic phase, because the movable range of the unit molecules is relatively narrow. A nematic phase sometimes changes to a smectic phase by decreasing the temperature. Diversity of the layered structures demonstrates many kinds of smectic phases.

(3) Cholesteric phase (Chiral nematic phase)

This phase is usually observed from cholesterol derivatives. The unit molecules are oriented one-dimensionally similar to a normal nematic phase, but the molecular orientation shows a twisted helical arrangement between layers. This is due to an asymmetric carbon (chiral center) in the cholesterol molecule. Accordingly, a cholesteric phase is called a chiral nematic phase. This chiral phase exhibits optical rotation, selective optical scattering, circular polarization, and dichroism. Recently, a research development on a 'blue phase' received much attention.[4)] This phase is observed between temperatures of the cholesteric phase and an isotropic liquid. One difficulty is that we can find the blue phase in a narrow temperature range of 1-2 degrees. However, one can widen the temperature range more than several dozens of degrees, when a polymer slightly forms in the blue phase (polymer-stabilized blue phase).[5)]

(4) Discotic phase

Formation of a discotic phase requires a discotic aromatic molecule such as phthalocyanine,[6] triphenylene,[7] hexabenzocoronene[8] and so on, although nematic and smectic phases require calamitic molecules. A discotic molecule usually forms a one-dimensional columnar structure (columnar phase) by stacking the molecules. A research area on organic electronics focuses on the discotic phase, because electrical conduction may occur along the molecular stacking direction. On the other hand, a rare example was reported that a chemical modification of a discotic molecule provided a three-dimensionally stacked cubic phase,[9] whereas discotic molecules normally stack one-dimensionally.

Nematic & Smectic Liquid Crystals		Cyanobiphenyls & Analogs	A1828	A2568
H0812	C1606	C2618	C1550	C1551
C2910	C2911	D4534	D4535	P2150

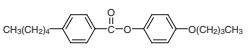
Product No.	Product Name	Unit Size	
A1828	4-(*trans*-4-Amylcyclohexyl)benzonitrile	5g	25g
A2568	4'-(*trans*-4-Amylcyclohexyl)biphenyl-4-carbonitrile	1g	5g
H0812	4-Cyano-4'-heptylbiphenyl	1g	5g
C1606	4-Cyano-4'-heptyloxybiphenyl		1g
C2618	4-Cyano-4'-*n*-octyloxybiphenyl	5g	25g
C1550	4-Cyano-4'-pentylbiphenyl	1g 5g	25g
C1551	4-Cyano-4'-pentyloxybiphenyl	1g	5g
C2910	4-Cyano-4'-pentyl-*p*-terphenyl	1g	5g
C2911	4-Cyano-4'-propoxy-1,1'-biphenyl	1g	5g
D4534	3,4-Difluoro-4'-(*trans*-4-pentylcyclohexyl)biphenyl	5g	25g
D4535	3,4-Difluoro-4'-(*trans*-4-propylcyclohexyl)biphenyl	5g	25g
P2150	(*R*)-1-Phenyl-1,2-ethanediyl Bis[4-(*trans*-4-pentylcyclohexyl)benzoate]	200mg	1g

Carbonates	A0608	E0257

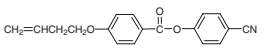
Product No.	Product Name	Unit Size
A0608	Amyl 4-(4-Ethoxyphenoxycarbonyl)phenyl Carbonate	1g
E0257	4-(4-Ethoxyphenoxycarbonyl)phenyl Ethyl Carbonate	1g

Phenyl Esters

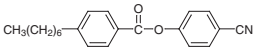
P0896



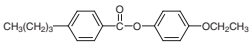
B1586



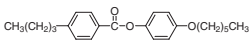
H0810



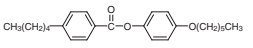
B0375



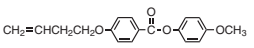
B1091



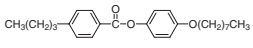
P0897



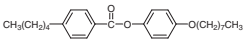
M2106



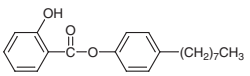
B1092



P0898



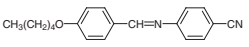
S0016



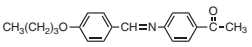
Product No.	Product Name	Unit Size
P0896	4-Butoxyphenyl 4-Pentylbenzoate	1g
B1586	4-Cyanophenyl 4-(3-Butenyloxy)benzoate	1g
H0810	4-Cyanophenyl 4-Heptylbenzoate	1g 5g
B0375	4-Ethoxyphenyl 4-Butylbenzoate	1g
B1091	4-(Hexyloxy)phenyl 4-Butylbenzoate	1g
P0897	4-Hexyloxyphenyl 4-Pentylbenzoate	1g
M2106	4-Methoxyphenyl 4-(3-Butenyloxy)benzoate	1g 5g
B1092	4-*n*-Octyloxyphenyl 4-Butylbenzoate	1g
P0898	4-*n*-Octyloxyphenyl 4-Pentylbenzoate	5g
S0016	4-Octylphenyl Salicylate	25g

Schiff Bases

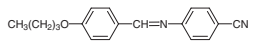
B0253



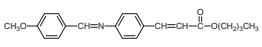
B0372



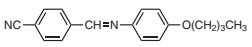
B0252



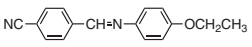
B0255



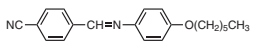
C0743



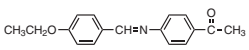
C0744



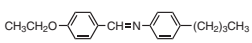
C0742



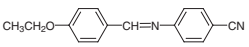
E0254



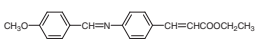
E0262



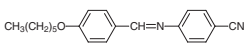
E0240



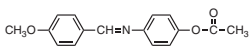
M0602



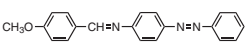
H0419



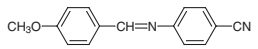
M0581



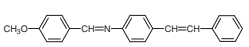
M0583



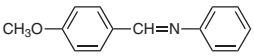
M0604



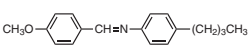
M0603



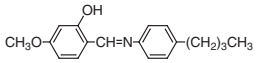
M0582



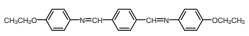
M0275



B0250



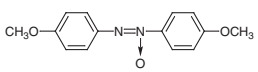
B0871



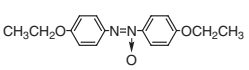
Product No.	Product Name	Unit Size
B0253	4'-(Amyloxy)benzylidene-4-cyanoaniline	1g
B0372	*N*-(4-Butoxybenzylidene)-4-acetylaniline	1g
B0252	4'-Butoxybenzylidene-4-cyanoaniline	1g
B0255	Butyl 4-[(4-Methoxybenzylidene)amino]cinnamate	1g
C0743	4'-Cyanobenzylidene-4-butoxyaniline	1g
C0744	4'-Cyanobenzylidene-4-ethoxyaniline	1g
C0742	4'-Cyanobenzylidene-4-hexyloxyaniline	Price on request
E0254	*N*-(4-Ethoxybenzylidene)-4-acetylaniline	1g
E0262	4'-Ethoxybenzylidene-4-butylaniline	25g 500g
E0240	4'-Ethoxybenzylidene-4-cyanoaniline	1g
M0602	Ethyl 4-[(4-Methoxybenzylidene)amino]cinnamate	1g
H0419	4'-Hexyloxybenzylidene-4-cyanoaniline	1g
M0581	*N*-(4-Methoxybenzylidene)-4-acetoxyaniline	25g
M0583	4-[(4-Methoxybenzylidene)amino]azobenzene	Price on request
M0604	4-[(4-Methoxybenzylidene)amino]benzonitrile	1g
M0603	4-[(Methoxybenzylidene)amino]stilbene	1g
M0582	*N*-(4-Methoxybenzylidene)aniline	5g 25g
M0275	*N*-(4-Methoxybenzylidene)-4-butylaniline	25g
B0250	*N*-(4-Methoxy-2-hydroxybenzylidene)-4-butylaniline	1g
B0871	Terephthalbis(*p*-phenetidine)	5g 25g

Azoxybenzenes

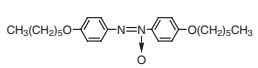
A0554



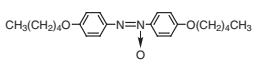
A0683



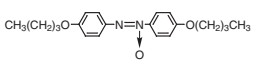
D1092



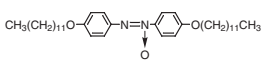
D1093



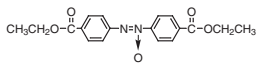
D1096



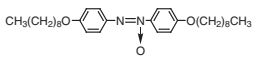
D0553



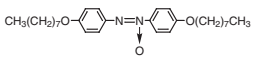
A1065



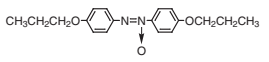
D1518



D1123



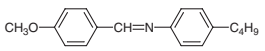
D1094



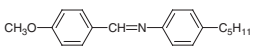
Product No.	Product Name	Unit Size	
A0554	4,4'-Azoxydianisole	5g	25g
A0683	4,4'-Azoxydiphenetole	1g	5g
D1092	4,4'-Bis(hexyloxy)azoxybenzene		1g
D1093	4,4'-Diamyloxyazoxybenzene		1g
D1096	4,4'-Dibutoxyazoxybenzene		1g
D0553	4,4'-Didodecyloxyazoxybenzene		5g
A1065	Diethyl Azoxybenzene-4,4'-dicarboxylate		1g
D1518	4,4'-Dinonyloxyazoxybenzene		100mg
D1123	4,4'-Di-*n*-octyloxyazoxybenzene	1g	5g
D1094	4,4'-Dipropoxyazoxybenzene		5g

Others

T0697



T0699

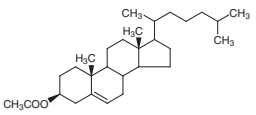


Product No.	Product Name	Unit Size
T0697	Liquid Crystal, TK-LQ 2040 Electric effect type, Mesomorphic range:20-40℃ [Nematic Liquid Crystal]	1g
T0699	Liquid Crystal, TK-LQ 3858 Electric effect type, Mesomorphic range:38-58℃ [Nematic Liquid Crystal]	1g

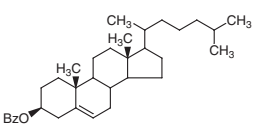
Cholesteric Liquid Crystals

Cholesteryl Compounds

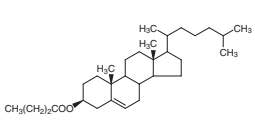
C0319



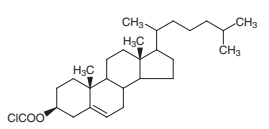
C0320



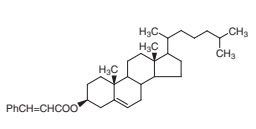
C0668



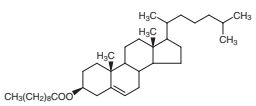
C0694



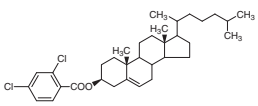
C0617



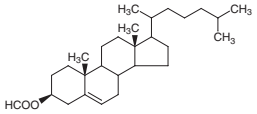
C0618



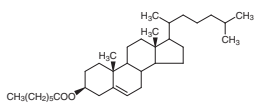
C1260



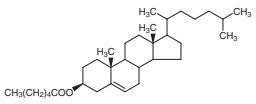
C0671



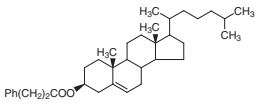
C0672



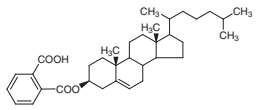
C0673



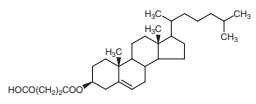
C0619



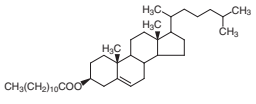
C0692



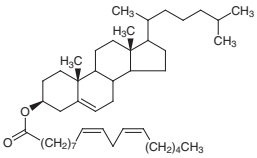
C0674



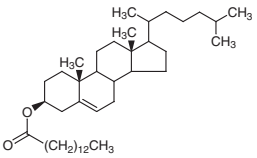
C0620



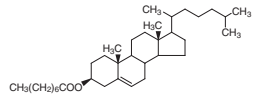
C0321



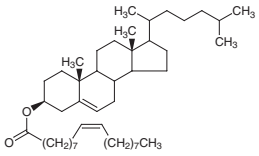
C0675



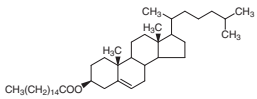
C0334



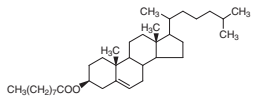
C0559



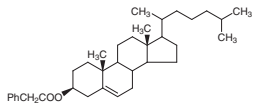
C0322



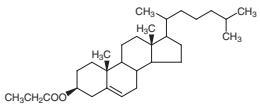
N0347



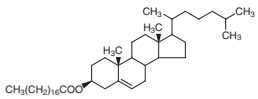
C0693



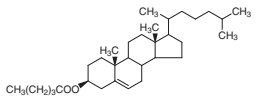
C0676



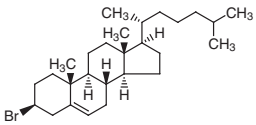
C0323



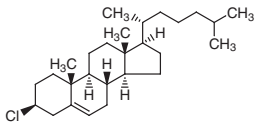
C0677



C0695



C0610

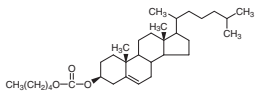


Product No.	Product Name	Unit Size	
C0319	Cholesterol Acetate	25g	500g
C0320	Cholesterol Benzoate		25g
C0668	Cholesterol Butyrate	25g	500g
C0694	Cholesterol Chloroformate		25g
C0617	Cholesterol *trans*-Cinnamate		25g
C0618	Cholesterol Decanoate		25g
C1260	Cholesterol 2,4-Dichlorobenzoate		25g
C0671	Cholesterol Formate		10g
C0672	Cholesterol Heptanoate		25g
C0673	Cholesterol Hexanoate		25g
C0619	Cholesterol Hydrocinnamate		10g
C0692	Cholesterol Hydrogen Phthalate		10g
C0674	Cholesterol Hydrogen Succinate		10g
C0620	Cholesterol Laurate		25g

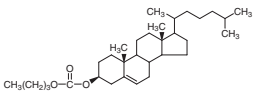
Product No.	Product Name	Unit Size		
C0321	Cholesterol Linoleate			25g
C0675	Cholesterol Myristate		10g	25g
C0334	Cholesterol *n*-Octanoate		5g	25g
C0559	Cholesterol Oleate	25g	100g	500g
C0322	Cholesterol Palmitate			25g
N0347	Cholesterol Pelargonate		25g	500g
C0693	Cholesterol Phenylacetate			10g
C0676	Cholesterol Propionate		10g	25g
C0323	Cholesterol Stearate		25g	500g
C0677	Cholesterol Valerate			10g
C0695	Cholesteryl Bromide from Beef Fat			10g
C0610	Cholesteryl Chloride from Beef Fat			25g

Cholesteryl Carbonates

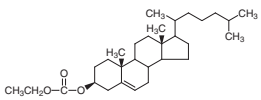
C0720



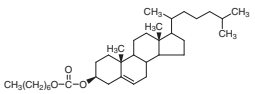
C0718



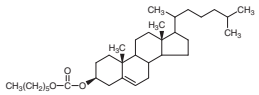
C0716



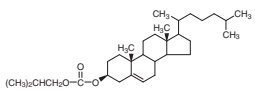
B0264



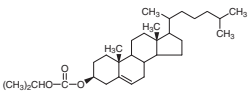
C0725



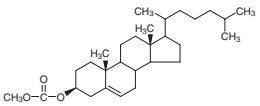
C0719



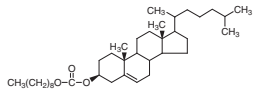
C0717



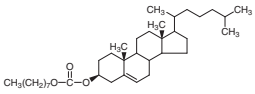
C0715



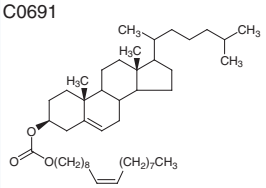
B0256



C0721



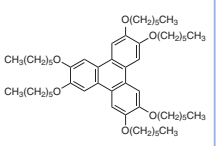
C0691



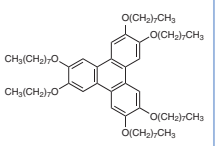
Product No.	Product Name	Unit Size	
C0720	Cholesterol Amyl Carbonate	1g	10g
C0718	Cholesterol Butyl Carbonate		10g
C0716	Cholesterol Ethyl Carbonate		10g
B0264	Cholesterol Heptyl Carbonate		10g
C0725	Cholesterol Hexyl Carbonate		10g
C0719	Cholesterol Isobutyl Carbonate		10g
C0717	Cholesterol Isopropyl Carbonate		10g
C0715	Cholesterol Methyl Carbonate		10g
B0256	Cholesterol Nonyl Carbonate	1g	10g
C0721	Cholesterol *n*-Octyl Carbonate		10g
C0691	Cholesterol Oleyl Carbonate	10g	25g

Discotic Liquid Crystals

H1449



H1450



Product No.	Product Name	Unit Size	
H1449	2,3,6,7,10,11-Hexakis(hexyloxy)triphenylene	200mg	1g
H1450	2,3,6,7,10,11-Hexakis[(*n*-octyl)oxy]triphenylene	200mg	1g

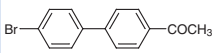
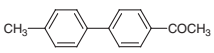
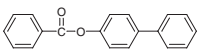
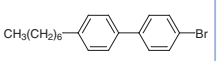
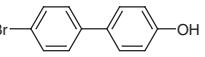
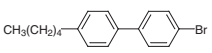
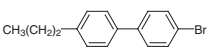
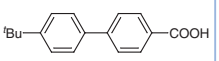
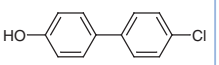
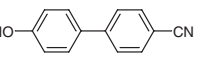
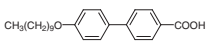
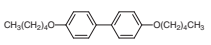
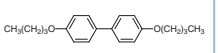
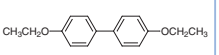
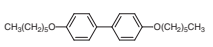
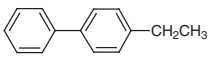
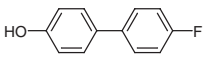
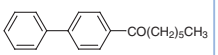
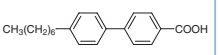
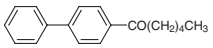
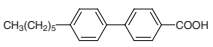
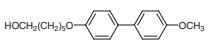
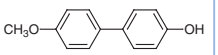
References

1) M. Funahashi, J. Hanna, *Mol. Cryst. Liq. Cryst*. **1997**, *304*, 429.
2) T. Yasuda, T. Shimizu, F. Liu, G. Ungar, T. Kato, *J. Am. Chem. Soc*. **2011**, *133*, 13437.
3) M. Schadt, W. Helfrich, *Appl. Phys. Lett*. **1971**, *18*, 127.
4) D. Coates, G. W. Gray, *Phys. Lett. A* **1973**, *45*, 115.
5) H. Kikuchi, M. Yokota, Y. Hisakado, H. Yang, T. Kajiyama, *Nat. Mater*. **2002**, *1*, 64.
6) E. Venuti, R. G. D. Valle, I. Bilotti, A. Brillante, M. Cavallini, A. Calo`, Y. H. Geerts, *J. Phys. Chem. C* **2011**, *115*, 12150.
7) S. K. Pal, S. Setia, B. S. Avinash, S. Kumar, *Liq. Cryst*. **2013**, *40*, 1769.
8) L. Piot, C. Marie, X. Feng, K. Müllen, D. Fichou, *Adv. Mater*. **2008**, *20*, 3854.
9) M. A. Alam, J. Motoyanagi, Y. Yamamoto, T. Fukushima, J. Kim, K. Kato, M. Takata, A. Saeki, S. Seki, S. Tagawa, T. Aida, *J. Am. Chem. Soc*. **2009**, *131*, 17722.

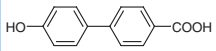
Building Blocks for Liquid Crystals

The first nematic liquid crystal materials, the Schiff base types, were sensitive to moisture, while the azoxybenzene types were sensitive to light. Therefore, research to improve the stability of liquid crystals to moisture and light had been undertaken. The chemically stable biphenylcarboxylates and cyanobiphenyls were developed one after another. The cyanobiphenyls were found to be exceptional in possessing the necessary properties of display material. They exhibited low viscosity and low voltage operation, leading to many reports on the cyanobiphenyls. The phenylcyclohexane-based liquid crystals also have low viscosity and high response speeds, thus drawing to attention their use as display material. Furthermore, these bicylic liquid crystals were modified by the addition of benzene and cyclohexane rings to produce tricyclic and tetracyclic liquid crystals. As a result, the upper range of temperature was increased. Further improvements in the various physical properties were made by introduction of fluorine and other functional groups to the liquid crystals. The optically active compounds are important components of chiral nematic liquid crystals, chiral smectic liquid crystals, and blue phase. Antiferroelectric liquid crystals of the chiral smectic liquid crystal type are undergoing vigorous synthetic studies to develop novel liquid crystal compounds. Larger high-resolution displays are the target for the next generation of liquid crystal materials.

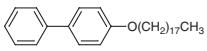
Following are listed building blocks for liquid crystals. These products enable you to develop new liquid crystal materials.

Biphenyls		A1410	A1322	B1866
				
B1304	H0690	B1305	B1306	B1986
				
C1239	H0523	D2041	D1090	D1082
				
D1127	D1089	E0463	F0704	H0708
				
H0709	H0710	H0711	H0767	H0819
				

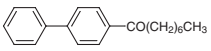
H0695



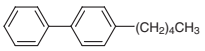
B1924



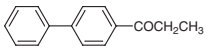
O0214



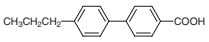
P1133



P1212



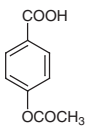
P1037



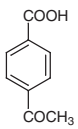
Product No.	Product Name	Unit Size	
A1410	4-Acetyl-4'-bromobiphenyl		25g
A1322	4-Acetyl-4'-methylbiphenyl		5g
B1866	4-Biphenyl Benzoate	5g	25g
B1304	4-Bromo-4'-heptylbiphenyl		5g
H0690	4-Bromo-4'-hydroxybiphenyl	5g	25g
B1305	4-Bromo-4'-pentylbiphenyl		5g
B1306	4-Bromo-4'-propylbiphenyl	5g	25g
B1986	4-(4-*tert*-Butylphenyl)benzoic Acid	1g	5g
C1239	4-Chloro-4'-hydroxybiphenyl	1g	5g
H0523	4-Cyano-4'-hydroxybiphenyl	5g	25g
D2041	4'-Decyloxybiphenyl-4-carboxylic Acid		1g
D1090	4,4'-Diamyloxybiphenyl		5g
D1082	4,4'-Dibutoxybiphenyl		25g
D1127	4,4'-Diethoxybiphenyl		5g
D1089	4,4'-Dihexyloxybiphenyl		5g
E0463	4-Ethylbiphenyl		25g
F0704	4-Fluoro-4'-hydroxybiphenyl	5g	25g
H0708	4-Heptanoylbiphenyl		25g
H0709	4-(4-Heptylphenyl)benzoic Acid		5g
H0710	4-Hexanoylbiphenyl		10g
H0711	4-(4-Hexylphenyl)benzoic Acid		5g
H0767	4-(6-Hydroxyhexyloxy)-4'-methoxybiphenyl		1g
H0819	4-Hydroxy-4'-methoxybiphenyl	1g	5g
H0695	4-(4-Hydroxyphenyl)benzoic Acid	5g	25g
B1924	4-Octadecyloxybiphenyl		25g
O0214	4-*n*-Octanoylbiphenyl		10g
P1133	4-Pentylbiphenyl	5mL	25mL
P1212	4-Propionylbiphenyl	5g	25g
P1037	4-(4-Propylphenyl)benzoic Acid		10g

Benzoic Acids

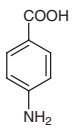
A0885



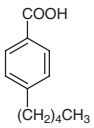
A1024



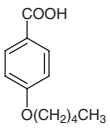
A0269



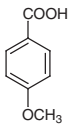
A0741



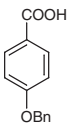
A0708



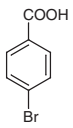
A0482



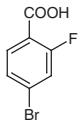
B1665



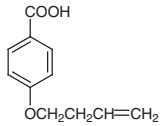
B0553



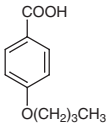
B1950



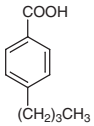
B1585



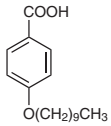
B0896



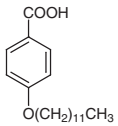
B0241



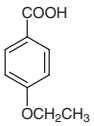
D4176



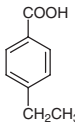
D2859



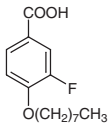
E0045



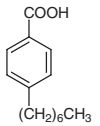
E0379



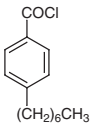
F0337



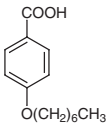
H0774



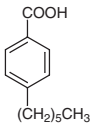
H0792



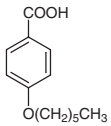
H0248



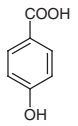
H0829



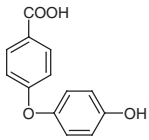
H0247



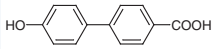
H0207



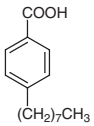
H0642



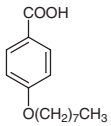
H0695



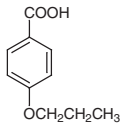
O0137



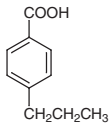
O0117



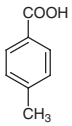
P0206



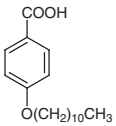
P0945



T0293



U0072



Product No.	Product Name			Unit Size
A0885	4-Acetoxybenzoic Acid		25g	500g
A1024	4-Acetylbenzoic Acid		1g	5g
A0269	4-Aminobenzoic Acid	25g	100g	500g
A0741	4-Amylbenzoic Acid	5g	25g	250g
A0708	4-Amyloxybenzoic Acid			25g
A0482	*p*-Anisic Acid		25g	500g
B1665	4-Benzyloxybenzoic Acid		5g	25g
B0553	4-Bromobenzoic Acid	25g	100g	500g
B1950	4-Bromo-2-fluorobenzoic Acid		5g	25g
B1585	4-(3-Butenyloxy)benzoic Acid			5g
B0896	4-Butoxybenzoic Acid			25g
B0241	4-Butylbenzoic Acid		5g	25g
D4176	4-(Decyloxy)benzoic Acid		5g	25g
D2859	4-(Dodecyloxy)benzoic Acid		5g	25g
E0045	4-Ethoxybenzoic Acid			25g
E0379	4-Ethylbenzoic Acid			25g
F0337	3-Fluoro-4-*n*-octyloxybenzoic Acid		1g	5g
H0774	4-Heptylbenzoic Acid			10g
H0792	4-Heptylbenzoyl Chloride		5g	25g
H0248	4-(Heptyloxy)benzoic Acid		25g	500g
H0829	4-Hexylbenzoic Acid			5g
H0247	4-(Hexyloxy)benzoic Acid		25g	500g
H0207	4-Hydroxybenzoic Acid	25g	100g	500g
H0642	4-(4-Hydroxyphenoxy)benzoic Acid		1g	5g

Product No.	Product Name			Unit Size
H0695	4-(4-Hydroxyphenyl)benzoic Acid		5g	25g
O0137	4-*n*-Octylbenzoic Acid	1g	5g	25g
O0117	4-*n*-Octyloxybenzoic Acid			25g
P0206	4-Propoxybenzoic Acid			25g
P0945	4-Propylbenzoic Acid		25g	500g
T0293	*p*-Toluic Acid		25g	500g
U0072	4-Undecyloxybenzoic Acid			5g

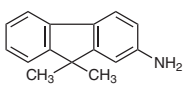
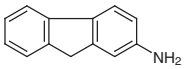
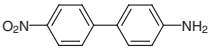
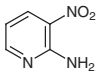
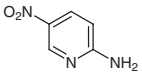
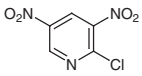
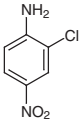
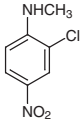
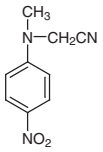
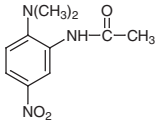
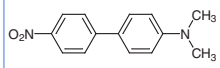
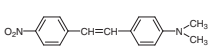
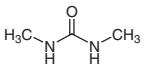
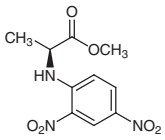
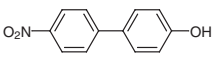
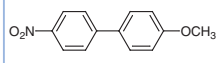
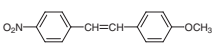
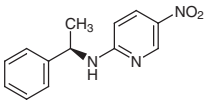
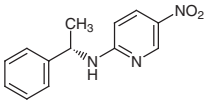
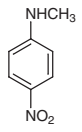
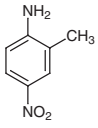
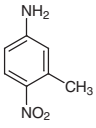
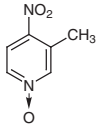
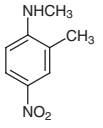
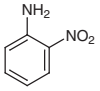
For others: See our website

References

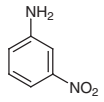
1) T. Kitamura, *Zairyo Kagaku* **1992**, *29*, 72.
2) H. Numata, *Kogyo Zairyo* **1998**, *46*, 40.
3) Y. Suzuki, *Kino Zairyo* **1995**, *15*, 8.
4) T. Inukai, K. Miyazawa, *Ekisho* **1997**, *1*, 9.
5) G. W. Gray, G. R. Luckhurst, in *The Molecular Physics of Liquid Crystal*, Academic Press, **1979**, pp.1-29, pp.263-284.
6) P. G. Gennes, J. Prost, in *The Physics of Liquid Crystals, Second Edition*, Oxford University Press, **1993**.

Organic Nonlinear Optical Materials

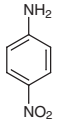
Advancements of lasers and optical fibers contributed to optical communications and optical disks for practical use. Further development of optical materials is urgently required. Nonlinear optical materials efficiently exhibit nonlinear optical phenomena, which are conversion of light wavelength, amplification of light, and conversion of the refractive index depending on optical intensity. Since a laser oscillation was reported from an inorganic compound in the 1960s, inorganic nonlinear optical materials have been well developed. In addition to these inorganic materials, organic nonlinear optical materials have also been studied. This is because organic materials show efficient nonlinear optical properties and rapid responsiveness based on highly movable π-electrons, thanks to delocalized electrons in organic materials. Nonlinear optical materials may be important for large-capacity communications, because further application of this material may provide a device in an all optical system. As one of the basic technologies of photonics, lightwave technology using organic nonlinear optical effects are important to develop. Further research on organic materials with excellent nonlinear optical properties and vigorous applied studies has been carried out.

A2634 	A0621 	A1251 	A0838 	A0794 
C0943 	C0214 	C1209 	C1349 	D2020 
D2263 	D2505 	D0289 	D2135 	H0747 
M0997 	M0999 	M0909 	M0985 	M1011 
N0529 	M1677 	N0527 	M0953 	N0118 

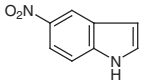
N0117



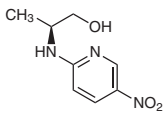
N0119



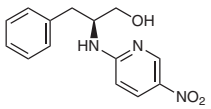
N0400



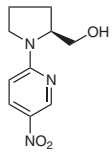
N0547



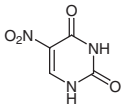
N0546



N0540



N0281



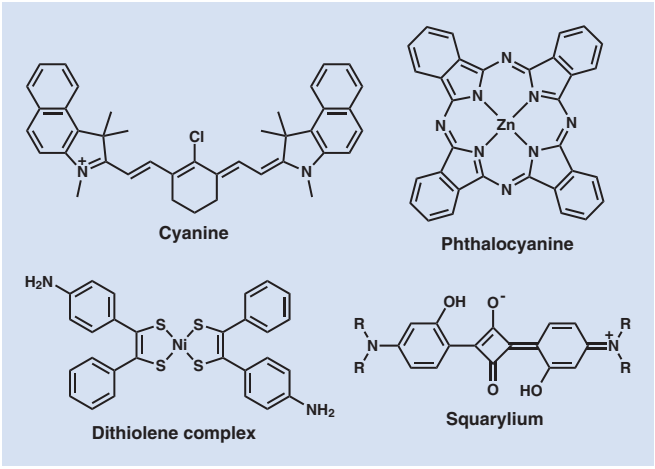
Product No.	Product Name	Unit Size		
A2634	2-Amino-9,9-dimethylfluorene		200mg	1g
A0621	2-Aminofluorene		5g	25g
A1251	4-Amino-4'-nitrobiphenyl		1g	5g
A0838	2-Amino-3-nitropyridine			5g
A0794	2-Amino-5-nitropyridine		25g	250g
C0943	2-Chloro-3,5-dinitropyridine		1g	5g
C0214	2-Chloro-4-nitroaniline			25g
C1209	2-Chloro-4-nitro-*N*-methylaniline		Price on request	
C1349	*N*-Cyanomethyl-*N*-methyl-4-nitroaniline			5g
D2020	2'-(*N*,*N*-Dimethylamino)-5'-nitroacetanilide			1g
D2263	4-Dimethylamino-4'-nitrobiphenyl		1g	5g
D2505	4-Dimethylamino-4'-nitrostilbene			5g
D0289	1,3-Dimethylurea		25g	500g
D2135	*N*-(2,4-Dinitrophenyl)-L-alanine Methyl Ester			1g
H0747	4-Hydroxy-4'-nitrobiphenyl	1g	5g	25g
M0997	4-Methoxy-4'-nitrobiphenyl		100mg	1g
M0999	4-Methoxy-4'-nitrostilbene			5g
M0909	(*R*)-(+)-2-(α-Methylbenzylamino)-5-nitropyridine			5g
M0985	(*S*)-(-)-2-(α-Methylbenzylamino)-5-nitropyridine		1g	5g
M1011	*N*-Methyl-4-nitroaniline		25g	500g
N0529	2-Methyl-4-nitroaniline			25g
M1677	3-Methyl-4-nitroaniline		5g	25g
N0527	3-Methyl-4-nitropyridine *N*-Oxide		5g	25g
M0953	*N*-Methyl-4-nitro-*o*-toluidine			5g
N0118	2-Nitroaniline		25g	500g
N0117	3-Nitroaniline		25g	500g
N0119	4-Nitroaniline		25g	500g
N0400	5-Nitroindole		5g	25g
N0547	(*S*)-(-)-*N*-(5-Nitro-2-pyridyl)alaninol			100mg
N0546	(*S*)-*N*-(5-Nitro-2-pyridyl)phenylalaninol			1g
N0540	(*S*)-(-)-*N*-(5-Nitro-2-pyridyl)prolinol		1g	5g
N0281	5-Nitrouracil		5g	25g

References

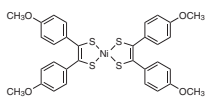
1) S. Miyata, *et al*., Preprints of IUPAC 32nd International Symposium on Macromolecules, Kyoto, **1988**, p.582.
2) D. S. Chemla, J. Zyss, in *Nonlinear Optical Properties of Organic Molecules and Crystals*, Academic Press, New York, **1987**.
3) L. M. Hayden, S. T. Kowel, M. P. Srinivasan, *Opt. Commun*. **1987**, *61*, 351.
4) C. Flytzanis, J. L. Oudar, in *Nonlinear Optics: Materials and Devices*, Springer, Berlin, **1986**.
5) P. N. Prasad, D. R. Ulrich, in *Nonlinear Optical and Electroactive Polymers*, Plenum, New York, **1988**.
6) D. R. Ulrich, J. Orenstein, A. J. Heeger, in *Nonlinear Optical Properties, of Polymers*, Material Research Society, Pittsbourgh, **1988**.

Materials for Near Infrared Absorption

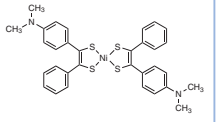
Near infrared dyes show light absorption in the near infrared area of 700-2000 nm. Their intense absorption normally originates from a charge transfer of an organic dye or metal complex. Materials of near infrared absorption involve cyanine dyes having an extended polymethine, phthalocyanine dyes with a metal center of aluminum or zinc, naphthalocyanine dyes, nickel dithiolene complexes with a square-planar geometry, squarylium dyes, quinone analogues, diimonium compounds and azo derivatives. Applications using these organic dyes include security markings, lithography, optical recording media and optical filters. A laser-induced process requires near infrared dyes having a sensitive absorption of longer than 700 nm, high solubility for appropriate organic solvents, and excellent heat-resistivity. In order to increase power conversion efficiency of an organic solar cell, efficient near infrared dyes are required, because sunlight includes near infrared light. Furthermore, near infrared dyes are expected to be biomaterials for chemotherapy and imaging deep-tissue in-vivo by using luminescent phenomena in the near infrared region.



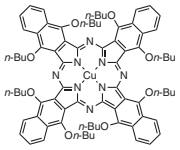
B4360



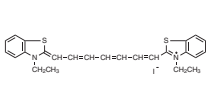
B4361



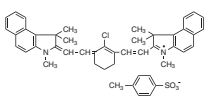
C3051



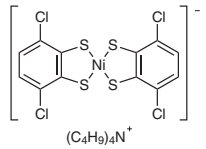
D4773



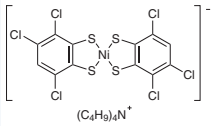
C2886



T3204



T3205

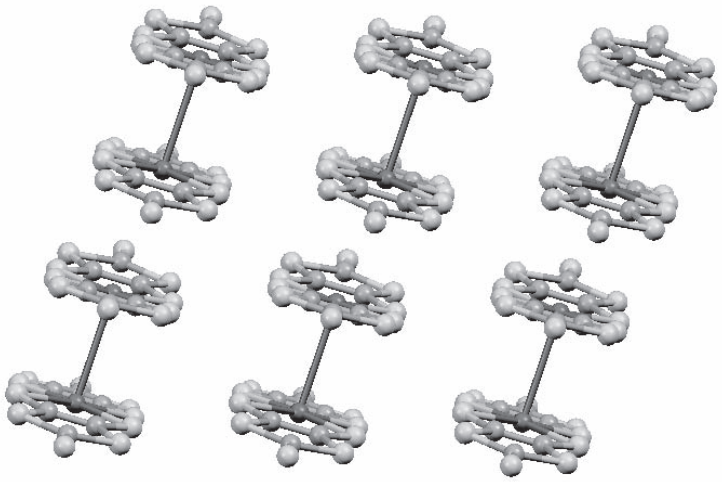


Product No.	Product Name		Unit Size
B4360	Bis[4,4'-dimethoxy(dithiobenzil)]nickel(II)		1g
B4361	Bis(4-dimethylaminodithiobenzil)nickel(II)		1g
C3051	Copper(II) 5,9,14,18,23,27,32,36-Octabutoxy-2,3-naphthalocyanine	200mg	1g
D4773	3,3'-Diethylthiatricarbocyanine Iodide	1g	5g
C2886	IR-813 *p*-Toluenesulfonate	1g	5g
T3204	Tetrabutylammonium Bis(3,6-dichloro-1,2-benzenedithiolato)nickelate		200mg
T3205	Tetrabutylammonium Bis(3,4,6-trichloro-1,2-benzenedithiolato)nickelate		200mg

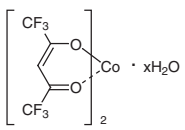
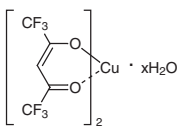
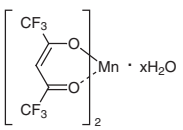
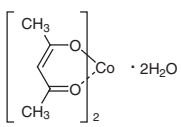
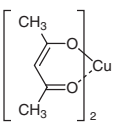
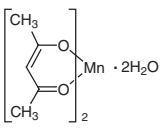
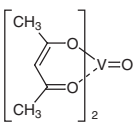
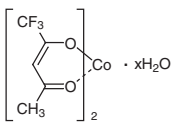
Magnetic Metal Complexes

Magnetism is mainly classified into five categories: paramagnetism in which unpaired electrons are randomly oriented, ferromagnetism in which unpaired electrons are oriented in the same direction, antiferromagnetism in which unpaired electrons are oriented in antiparallel direction, ferrimagnetism in which unpaired electrons with different magnetic moments are oriented in antiparallel direction, and diamagnetism without unpaired electrons. An application of ferromagnet for electronics is a magnetic disk that is further developed to enhance memory capacity. Many Prussian blue analogues formulated as $M_4[M(CN)_6]_3$ are ferromagnets and ferrimagnets.[1,2]

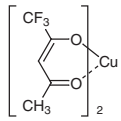
Although neodymium magnets and ferrite magnets are magnetic materials based on inorganic solids, magnetic materials using molecular metal complexes have been also developed. Since a molecular magnetic material has a molecular unit, one advantage is that a chemical modification of the unit molecule controls physical properties. Furthermore, a molecular material can fabricate a device at low cost. Miller *et al*. observed a ferromagnet of the charge transfer complex derived from metallocene and tetracyanoethylene (TCNE) or tetracyanoquinodimethane (TCNQ).[3,4] Single molecule magnets (SMM) in which a single molecule behaves as a magnet, were intensively investigated from 1993.[5,6] The SMM is a specified material obtained from a molecular compound, and the application may be high-density information media. Single-chain magnets (SCM) are obtained from a one-dimensional assembly of magnetic complexes.[7] Kato *et al*. reported that physical properties of the metal complex salt of the 1,2-dithiolene ligand formulated as (Cation)$[Pd(dmit)_2]_2$ in which the anion radical of the dimer $[Pd(dmit)_2]_2$ shows paramagnetism, antiferromagnetism, superconductivity and spin liquid state.[8]



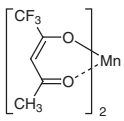
Triangular Lattice of Dimer $[Pd(dmit)_2]_2$

β-Diketonato Complexes		H0553	H0554	H0557
				
C0373 B2681	C0384	M0042	V0016	T0746
				

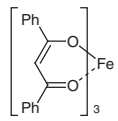
T0752



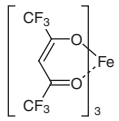
T0685



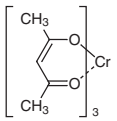
T1686



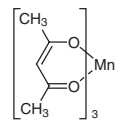
H0555



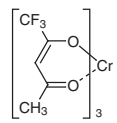
C0336



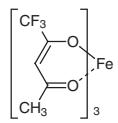
M0043



T0932



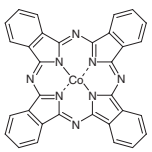
T0750



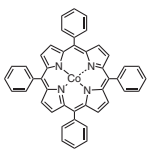
Product No.	Product Name	Unit Size	
H0553	Bis(hexafluoroacetylacetonato)cobalt(II) Hydrate		5g
H0554	Bis(hexafluoroacetylacetonato)copper(II) Hydrate	1g	5g
H0557	Bis(hexafluoroacetylacetonato)manganese(II) Hydrate	1g	5g
C0373	Bis(2,4-pentanedionato)cobalt(II) Dihydrate	25g	500g
B2681	Bis(2,4-pentanedionato)cobalt(II)		25g
C0384	Bis(2,4-pentanedionato)copper(II)	25g	250g
M0042	Bis(2,4-pentanedionato)manganese(II) Dihydrate	25g	500g
V0016	Bis(2,4-pentanedionato)vanadium(IV) Oxide		25g
T0746	Bis(trifluoro-2,4-pentanedionato)cobalt(II) Hydrate		5g
T0752	Bis(trifluoro-2,4-pentanedionato)copper(II)		5g
T0685	Bis(trifluoro-2,4-pentanedionato)manganese(II)		5g
T1686	Tris(dibenzoylmethanato) Iron	5g	25g
H0555	Tris(hexafluoroacetylacetonato)iron(III)		1g
C0336	Tris(2,4-pentanedionato)chromium(III)	25g	500g
M0043	Tris(2,4-pentanedionato)manganese(III)	25g 100g	500g
T0932	Tris(trifluoro-2,4-pentanedionato)chromium(III)		1g
T0750	Tris(trifluoro-2,4-pentanedionato)iron(III)		5g

Porphyrin & Phthalocyanine Complexes

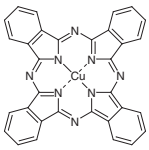
P0887



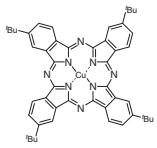
C2986



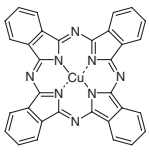
P1005
P1006



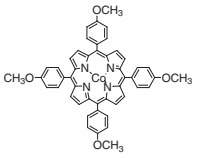
T1256



P1628



T1861

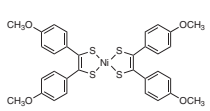


Product No.	Product Name	Unit Size	
P0887	Cobalt(II) Phthalocyanine		25g
C2986	Cobalt(II) Tetraphenylporphyrin	1g	5g
P1005	Copper(II) Phthalocyanine (*α*-form)	25g	250g
P1006	Copper(II) Phthalocyanine (*β*-form)	25g	500g
T1256	Copper(II) 2,9,16,23-Tetra-*tert*-butylphthalocyanine		100mg
P1628	Pigment Blue 15 (purified by sublimation)		1g

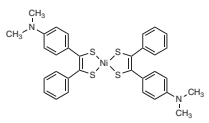
Product No.	Product Name	Unit Size	
T1861	[5,10,15,20-Tetrakis(4-methoxyphenyl)porphyrinato]cobalt(II)	1g	5g

Dithiolene Complexes

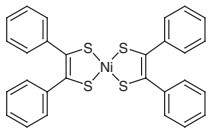
B4360



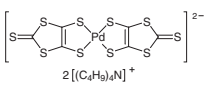
B4361



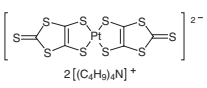
B1350



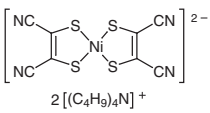
B1437



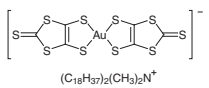
B1438



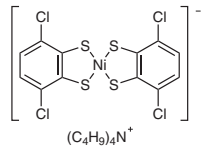
B1371



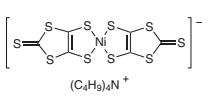
D2134



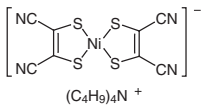
T3204



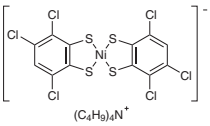
T1272



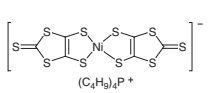
T1415



T3205



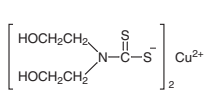
T1416



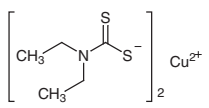
Product No.	Product Name	Unit Size	
B4360	Bis[4,4'-dimethoxy(dithiobenzil)]nickel(II)		1g
B4361	Bis(4-dimethylaminodithiobenzil)nickel(II)		1g
B1350	Bis(dithiobenzil)nickel(II)		1g
B1437	Bis(tetrabutylammonium) Bis(1,3-dithiole-2-thione-4,5-dithiolato)palladium(II)	100mg	1g
B1438	Bis(tetrabutylammonium) Bis(1,3-dithiole-2-thione-4,5-dithiolato)platinum(II)		100mg
B1371	Bis(tetrabutylammonium) Bis(maleonitriledithiolato)nickel(II) Complex		1g
D2134	Dioctadecyldimethylammonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)aurate(III)		100mg
T3204	Tetrabutylammonium Bis(3,6-dichloro-1,2-benzenedithiolato)nickelate		200mg
T1272	Tetrabutylammonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)nickel(III) Complex		100mg
T1415	Tetrabutylammonium Bis(maleonitriledithiolato)nickel(III) Complex		1g
T3205	Tetrabutylammonium Bis(3,4,6-trichloro-1,2-benzenedithiolato)nickelate		200mg
T1416	Tetrabutylphosphonium Bis(1,3-dithiole-2-thione-4,5-dithiolato)nickel(III) Complex		1g

Dithiocarbamato Complexes

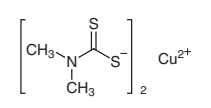
B0491



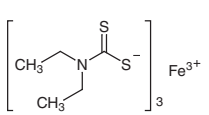
D0487



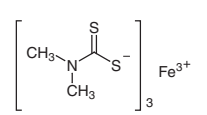
D1022



D0489



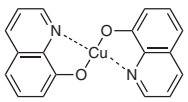
D1267



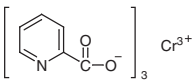
Product No.	Product Name	Unit Size	
B0491	Copper(II) Bis(2-hydroxyethyl)dithiocarbamate		25g
D0487	Copper Diethyldithiocarbamate		25g
D1022	Copper(II) Dimethyldithiocarbamate		25g
D0489	Iron(III) Diethyldithiocarbamate		25g
D1267	Iron(III) Dimethyldithiocarbamate	25g	500g

Other Complexes

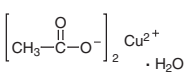
B3834
B1677



P1347



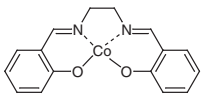
C2346



I0849

$Fe_4[Fe(CN)_6]_3$

S0318



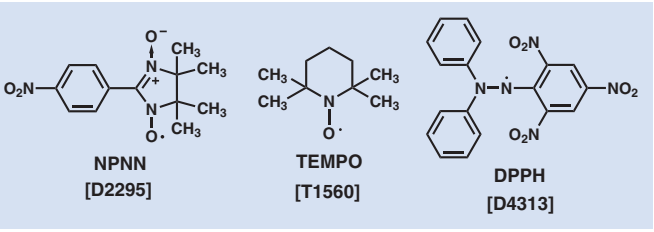
Product No.	Product Name	Unit Size		
B3834	Bis(8-quinolinolato)copper(II) (purified by sublimation)			1g
B1677	Bis(8-quinolinolato)copper(II)			25g
P1347	Chromium(III) Pyridine-2-carboxylate			25g
C2346	Copper(II) Acetate Monohydrate		25g	500g
I0849	Iron(III) Hexacyanoferrate(II)			25g
S0318	Salcomine [=*N,N'*-Bis(salicylidene)ethylenediiminocobalt(II)]	25g	100g	500g

References

1) S. Ohkoshi, H. Tokoro, T. Matsuda, H. Takahashi, H. Irie, K. Hashimoto, *Angew. Chem. Int. Ed.* **2007**, *46*, 3238.
2) W. Kosaka, K. Nomura, K. Hashimoto, S. Ohkoshi, *J. Am. Chem. Soc.* **2005**, *127*, 8590.
3) J. S. Miller, A. J. Epstein, *Angew. Chem. Int. Ed.* **1994**, *33*, 385.
4) J. S. Miller, D. A. Dixon, R. S. McLean, D. M. Groski, R. B. Flippen, J. M. Manriquez, G. T. Yee, K. S. Narayan, A. J. Epstein, *Adv. Mater.* **1991**, *3*, 309.
5) R. Sessoli, D. Gatteschi, A. Caneschi, M. A. Novak, *Nature* **1993**, *365*, 141.
6) T. Komeda, H. Isshiki, J. Liu, Y.-F. Zhang, N. Lorente, K. Katoh, B. K. Breedlove, M. Yamashita, *Nat. Commun.* **2011**, *2*, 1210.
7) R. Clérac, H. Miyasaka, M. Yamashita, C. Coulon, *J. Am. Chem. Soc.* **2002**, *124*, 12837.
8) Review: R. Kato, *Bull. Chem. Soc. Jpn.* **2014**, *87*, 355.

Organic Radicals

Ferromagnetic and ferrimagnetic properties of metal compounds are based on contributions of unpaired d- or f-electrons of transition or lanthanoid metals. On the other hand, magnetic properties of metal-free organic compounds are due to unpaired π-electrons. Normally, π-electrons are favorable to electrical conduction in material science, because they are movable by the π-conjugation effect, but they have received less attention for magnetic materials. However, diverse chemical modifications of an organic molecule have produced organic radical-based ferromagnets.[1,2] It is known that the charge transfer complex obtained from fullerene with tetrakis(dimethylamino)ethylene (TDAE) becomes an organic magnet.[3] In addition to using a π-conjugated organic radical, localized free radical species also provide organic magnets. 4-Nitrophenylnitronyl nitroxide (NPNN) was the first organic ferromagnet in a pure organic radical.[4] Nogami *et al.* reported that 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO) and its analogues became ferromagnets or antiferromagnets.[5,6] Furthermore, 1,1-diphenyl-2-picrylhydrazyl (DPPH) is an antiferromagnet at extremely low temperature.



NPNN
[D2295]

TEMPO
[T1560]

DPPH
[D4313]

A1348	A1343	C1428	C1406	C1432
C1782	D4313	D2399	G0020	H0865
H0878	I0487	I0908	I0486	M1531
M1197	D2295	O0266	A5440	T1560

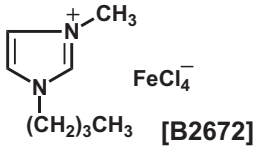
Product No.	Product Name	Unit Size	
A1348	4-Acetamido-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
A1343	4-Amino-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	1g	5g
C1428	4-Carboxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	100mg	1g
C1406	3-Carboxy-2,2,5,5-tetramethylpyrrolidine 1-Oxyl Free Radical		1g
C1432	4-(2-Chloroacetamido)-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	100mg	1g
C1782	4-Cyano-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical		1g
D4313	1,1-Diphenyl-2-picrylhydrazyl Free Radical	1g	5g
D2399	16-DOXYL-stearic Acid Free Radical	25mg	100mg
G0020	Galvinoxyl Free Radical	1g	5g
H0865	4-Hydroxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
H0878	4-Hydroxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Benzoate Free Radical	1g	5g
I0487	4-(2-Iodoacetamido)-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical		100mg
I0908	4-[2-[2-(4-Iodophenoxy)ethoxy]carbonyl]benzoyloxy-2,2,6,6-tetramethylpiperidin-1-oxyl		100mg
I0486	4-Isothiocyanato-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	100mg	1g
M1531	4-Methacryloyloxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	1g	5g
M1197	4-Methoxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	1g	5g
D2295	2-(4-Nitrophenyl)-4,4,5,5-tetramethylimidazoline-3-oxide-1-oxyl Free Radical		100mg
O0266	4-Oxo-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
A5440	PTIO (=2-Phenyl-4,4,5,5-tetramethylimidazoline-3-oxide-1-oxyl)	1g	5g
T1560	2,2,6,6-Tetramethylpiperidine 1-Oxyl Free Radical	5g	25g

References

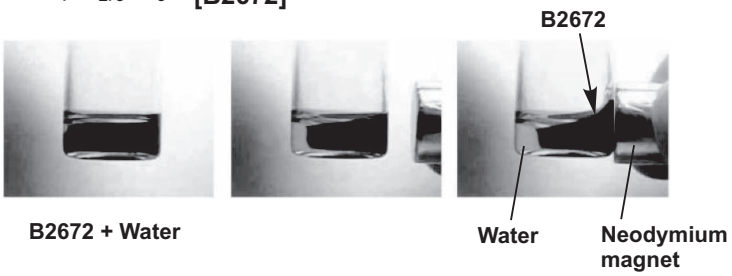
1) W. Fujita, K. Awaga, *J. Am. Chem. Soc.* **2001**, *123*, 3601.
2) W. Fujita, K. Awaga, *Chem. Phys. Lett.* **2002**, *357*, 385.
3) P. W. Stephens, D. Cox, J. W. Lauher, L. Mihaly, J. B. Wiley, P.-M. Allemand, A. Hirsch, K. Holczer, Q. Li, J. D. Thompson, F. Wudl, *Nature* **1992**, *355*, 331.
4) M. Kinoshita, P. Turek, M. Tamura, K. Nozawa, D. Shiomi, Y. Nakazawa, M. Ishikawa, M. Takahashi, K. Awaga, T. Inabe, Y. Maruyama, *Chem. Lett.* **1991**, *20*, 1225.
5) T. Nogami, K. Tomioka, T. Ishida, H. Yoshikawa, M. Yasui, F. Iwasaki, H. Iwamura, N. Takeda, M. Ishikawa, *Chem. Lett.* **1994**, *23*, 29.
6) T. Nogami, T. Ishida, M. Yasui, F. Iwasaki, N. Takeda, M. Ishikawa, T. Kawakami, K. Yamaguchi, *Bull. Chem. Soc. Jpn.* **1996**, *69*, 1841.

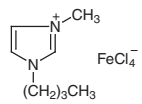
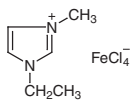
Magnetic Ionic Liquids

Ionic liquids consist of only ionic components, having high ionic conductivity suitable for a liquid electrolyte. An electrolyte for a secondary battery requires not only high ionic conductivity but also non-volatility, heat-resistivity, non-inflammability, and non-corrosiveness. Ionic liquids cover these conditions. The cationic component of ionic liquid involves alkyl-substituted imidazolium, pyrrolidinium, piperidinium, ammonium, phosphonium, sulfonium and the anionic component involves halide, BF_4, PF_6, thiocyanate, and di(sulfonyl)imide. Chemical modifications of the cation and anion control melting point, viscosity and ionic conductivity. Hamaguchi *et al*. observed magnetic ionic liquids by introducing $FeCl_4$ to the anion part to form 1-butyl-3-methylimidazolium tetrachloroferrate, (Bmim)$FeCl_4$.[1,2] A magnetic fluid is a liquid with magnetic properties. However, a conventional magnetic fluid contains volatile solvents. It causes a change of viscosity and phase separation by cohesion/precipitation. On the other hand, the magnetic ionic liquid is a highly stable and non-volatile liquid. Moreover, this magnetic ionic liquid responds to a magnetic field by a permanent magnet, because it shows large magnetic susceptibility at room temperature.



[B2672]



B2672	E0706
	

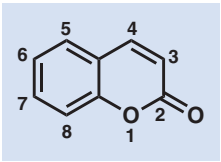
Product No.	Product Name	Unit Size	
B2672	1-Butyl-3-methylimidazolium Tetrachloroferrate	5g	25g
E0706	1-Ethyl-3-methylimidazolium Tetrachloroferrate		5g

References

1) S. Hayashi, H. Hamaguchi, *Chem. Lett*. **2004**, *33*, 1590.
2) K. Iwata, H. Okajima, S. Saha, H. Hamaguchi, *Acc. Chem. Res*. **2007**, *40*, 1174.

Coumarin Dyes

Coumarins are aromatic lactone compounds and many of them exist in natural plants. A coumarin compound with an electron-donating group on the 7-position shows strong light absorption and luminescence, whereas unsubstituted coumarin compounds are hardly luminescent. This is because intramolecular charge transfer occurs when electron-donating and -withdrawing groups coexist in the coumarin molecule. An introduction of a group on the 3- or 4-position largely controls the wavelength of light absorption and luminescence. Furthermore, an introduction of an electron-withdrawing group on these positions can enhance the intensity of luminescence. Such coumarin dyes are useful for laser dyes emitting blue-green light.

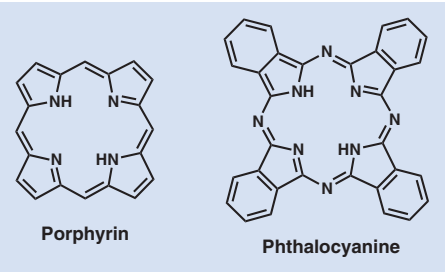


B2111	B2088	C2267	C2858	C2268
C3044	C3072	C3047	C2836	C3045
C3046	B4257	D3354	D4462	D4238
C2837	M0631	D4466	D3355	D3356
E1132	E1129	E0642	H1145	

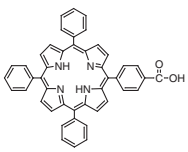
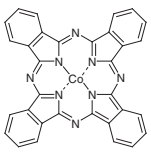
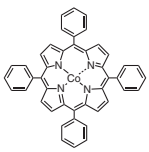
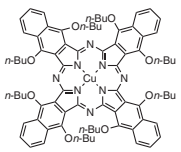
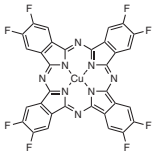
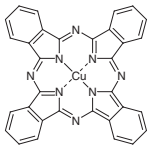
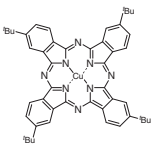
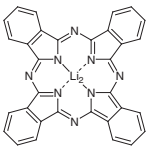
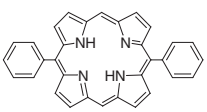
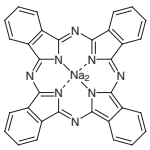
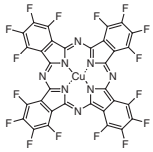
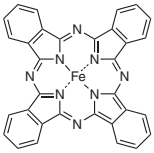
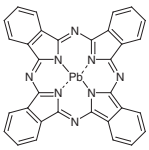
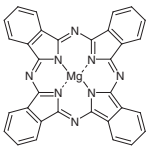
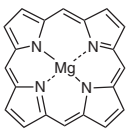
Product No.	Product Name	Unit Size	
B2111	3-(2-Benzimidazolyl)-7-(diethylamino)coumarin	100mg	1g
B2088	3-(2-Benzothiazolyl)-7-(diethylamino)coumarin	1g	5g
C2267	Coumarin 102		1g
C2858	Coumarin 153	200mg	1g
C2268	Coumarin 314		1g
C3044	Coumarin 498		200mg
C3072	Coumarin 510	200mg	1g
C3047	Coumarin 525		200mg
C2836	Coumarin 6H	200mg	1g
C3045	Coumarin 504T	200mg	1g
C3046	Coumarin 521T		200mg
B4257	Coumarin 545T		200mg
D3354	7-(Diethylamino)coumarin	200mg	1g
D4462	7-(Diethylamino)coumarin-3-carbonitrile	1g	5g
D4238	7-(Diethylamino)coumarin-3-carboxylic Acid		100mg
C2837	7-(Diethylamino)-3-(1-methyl-2-benzimidazolyl)coumarin	200mg	1g
M0631	7-Diethylamino-4-methylcoumarin	25g	500g
D4466	7-(Diethylamino)-4-(trifluoromethyl)coumarin		200mg
D3355	7-(Dimethylamino)-4-methylcoumarin	5g	25g
D3356	7-(Dimethylamino)-4-(trifluoromethyl)coumarin	5g	25g
E1132	7-(Ethylamino)-4,6-dimethylcoumarin	200mg	1g
E1129	7-(Ethylamino)-4-methylcoumarin		200mg
E0642	Ethyl 7-(Diethylamino)coumarin-3-carboxylate	1g	5g
H1145	Hexyl 7-(Diethylamino)coumarin-3-carboxylate	1g	5g

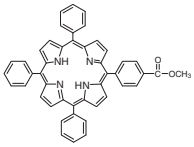
Porphyrin & Phthalocyanine Dyes

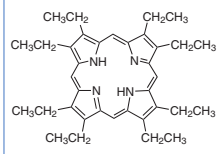
Porphyrin has a cyclic structure with four condensed pyrroles. The corresponding porphyrin metal complexes are important in-vivo, because they are included in chlorophyll functioning photo absorption and photo electron transfer for photosynthesis, and also included in heme (hemoglobin) transporting oxygen in blood. In addition, porphyrinato metal complexes are useful for photoelectron functional materials, metal complex catalysts and molecular electrical conductors. Chemical modifications of substituted groups, metal centers, and axial ligands on the porphyrinato metal complexes show various functionalities. Normal porphyrin complexes have sharp absorptions, the so-called Soret band, around 400-500 nm, and the Q band around 500-700 nm that is a relatively weak absorption. Molar absorption coefficients of the Soret band are up to order of 10^6 M/cm. The chlorophyll and porphyrinato zinc complexes hardly show energy relaxation of absorbed light, but easily show photoelectron transfer. Therefore, studies on porphyrinato metal complexes are performed for artificial photosynthesis (eg. reduction of carbon dioxide) and solar cell materials.

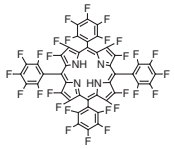


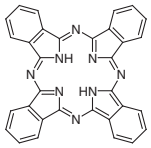
Phthalocyanine compounds do not exist in nature, although they have an analogue structure to porphyrin compounds. The phthalocyanato metal complexes are artificial dyes for painting of railway trains, and for organic photoconductors of electrophotography. There are applications of organic semiconductors as organic transistors and hole injection materials for organic light-emitting diodes (OLED). The phthalocyanato metal complexes show a more intense Q band absorption than that of the Soret band. Their absorption wavelengths are shifted to longer wavelengths than those of porphyrin compounds. Absorption wavelength is further shifted to the near infrared area by modification of the central metal and expansion of the π-conjugates. Introduction of an alkyl group provides soluble phthalocyanine and porphyrin compounds, although they are poorly soluble due to the large π-conjugated cycle.

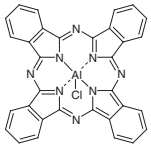
C1630 	P0887 	C2986 	C3051 	C2427 
P1005 P1006 	T1256 	P1049 	D2860 	P0973 
H1194 	I0783 P0774 	P0766 	P1018 	M2209 

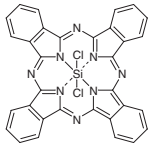
M1338


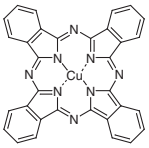
O0234


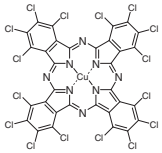
O0319


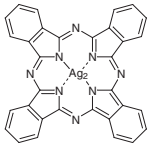
P1795
P0355


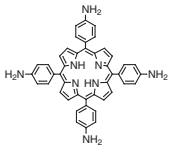
C1167


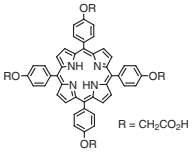
P0996


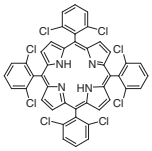
P1628
P0655


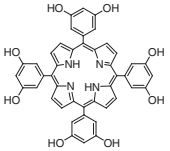
P0660


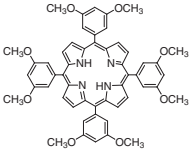
S0363


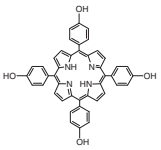
T1494


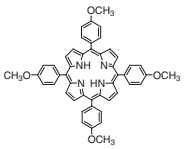
T1495


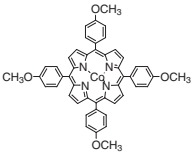
T1438


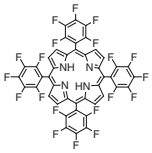
T1815


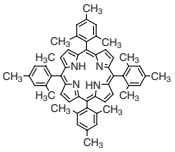
T1832


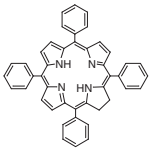
T1497


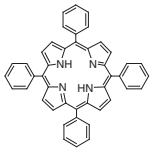
T1360


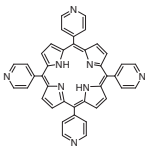
T1861


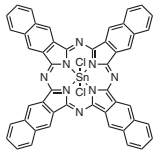
T1730


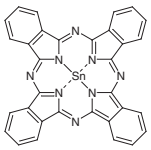
T1729


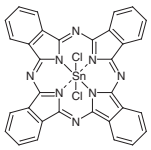
T1358


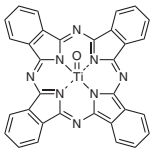
T1359


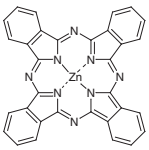
T2222


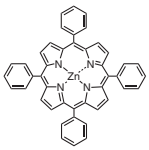
T2940


P1024


P0997


T2272


P0767


Z0036


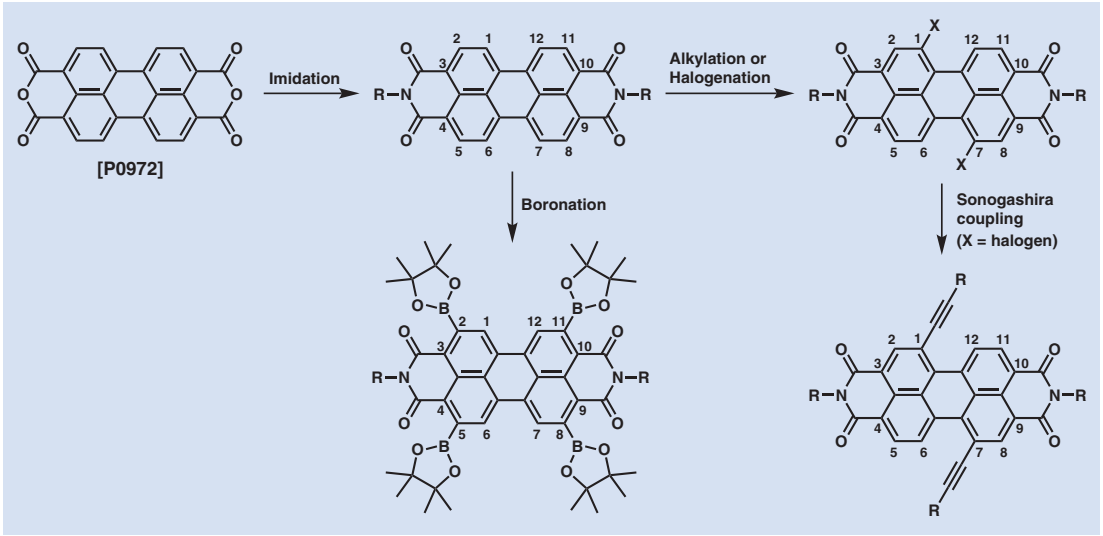
Product No.	Product Name	Unit Size	
C1630	5-(4-Carboxyphenyl)-10,15,20-triphenylporphyrin		100mg
P0887	Cobalt(II) Phthalocyanine		25g
C2986	Cobalt(II) Tetraphenylporphyrin	1g	5g
C3051	Copper(II) 5,9,14,18,23,27,32,36-Octabutoxy-2,3-naphthalocyanine	200mg	1g
C2427	Copper(II) 2,3,9,10,16,17,23,24-Octafluorophthalocyanine (purified by sublimation)	100mg	1g
P1005	Copper(II) Phthalocyanine (α-form)	25g	250g
P1006	Copper(II) Phthalocyanine (β-form)	25g	500g
T1256	Copper(II) 2,9,16,23-Tetra-*tert*-butylphthalocyanine		100mg
P1049	Dilithium Phthalocyanine		1g
D2860	5,15-Diphenylporphyrin		100mg
P0973	Disodium Phthalocyanine	1g	5g
H1194	1,2,3,4,8,9,10,11,15,16,17,18,22,23,24,25-Hexadecafluorophthalocyanine Copper(II) (purified by sublimation)	100mg	1g
I0783	Iron(II) Phthalocyanine (purified by sublimation)	200mg	1g
P0774	Iron(II) Phthalocyanine		25g

Product No.	Product Name	Unit Size	
P0766	Lead(II) Phthalocyanine	1g	25g
P1018	Magnesium(II) Phthalocyanine		1g
M2209	Magnesium Porphyrin		100mg
M1338	5-(4-Methoxycarbonylphenyl)-10,15,20-triphenylporphyrin	100mg	1g
O0234	2,3,7,8,12,13,17,18-Octaethylporphyrin	100mg	1g
O0319	2,3,7,8,12,13,17,18-Octafluoro-5,10,15,20-tetrakis(pentafluorophenyl)porphyrin		100mg
P1795	Phthalocyanine (purified by sublimation)		1g
P0355	Phthalocyanine		25g
C1167	Phthalocyanine Chloroaluminum		1g
P0996	Phthalocyanine Silicon Dichloride		Price on request
P1628	Pigment Blue 15 (purified by sublimation)		1g
P0655	Pigment Blue 15		25g
P0660	Pigment Green 7		25g
S0363	Silver(I) Phthalocyanine		Price on request
T1494	5,10,15,20-Tetrakis(4-aminophenyl)porphyrin		100mg
T1495	5,10,15,20-Tetrakis(4-carboxymethyloxyphenyl)porphyrin		100mg
T1438	5,10,15,20-Tetrakis(2,6-dichlorophenyl)porphyrin		100mg
T1815	5,10,15,20-Tetrakis(3,5-dihydroxyphenyl)porphyrin	100mg	1g
T1832	5,10,15,20-Tetrakis(3,5-dimethoxyphenyl)porphyrin		100mg
T1497	5,10,15,20-Tetrakis(4-hydroxyphenyl)porphyrin		100mg
T1360	5,10,15,20-Tetrakis(4-methoxyphenyl)porphyrin	100mg	1g
T1861	[5,10,15,20-Tetrakis(4-methoxyphenyl)porphyrinato]cobalt(II)	1g	5g
T1730	5,10,15,20-Tetrakis(pentafluorophenyl)porphyrin		100mg
T1729	5,10,15,20-Tetrakis(2,4,6-trimethylphenyl)porphyrin	100mg	1g
T1358	*meso*-Tetraphenylchlorin		100mg
T1359	Tetraphenylporphyrin (Chlorin free)		1g
T2222	5,10,15,20-Tetra(4-pyridyl)porphyrin		1g
T2940	Tin(IV) 2,3-Naphthalocyanine Dichloride	200mg	1g
P1024	Tin(II) Phthalocyanine	1g	5g
P0997	Tin(IV) Phthalocyanine Dichloride		1g
T2272	Titanyl Phthalocyanine (purified by sublimation)	200mg	1g
P0767	Zinc Phthalocyanine	1g 10g	25g
Z0036	Zinc(II) Tetraphenylporphyrin	1g	5g

Perylene Dyes

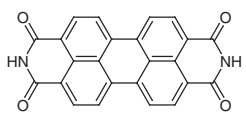
Perylene was a p-type organic semiconductor and it was known in the 1950s that the bromine-doped material showed electrical conductivity[1]. In contrast to that, perylenetetracarboxylic dianhydride and perylenetetracarboxylic diimide derivatives are n-type organic semiconductors. The latter perylenetetracarboxylic derivatives (PDI or PBI) are important semiconducting materials, because n-type ones are relatively less known than p-type ones. In fact, PTCBI (3,4,9,10-perylenetetracarboxylic bisbenzimidazole) was an n-type organic semiconductor for a prototype of organic photovoltaics.[2]

Applications in organic electronics using PDI derivatives are organic light-emitting diode (OLED) materials[3] and laser dyes[4] thanks to their high fluorescent quantum efficiency and photochemical stability. PDIs with electron mobility larger than 0.1 cm^2/Vs are also reported.[5,6] An introduction of an alkyl group on the imido moiety (NR) produces soluble PDI derivatives, although they are poorly soluble in general.[7] Recent research has proved direct alkylations at the meta positions (1,6,7,12-positions),[8,9] and direct boronations at the ortho positions (2,5,8,11-positions)[10] for PDIs. Halogenations at the meta positions are available, followed by various cross-coupling reactions[11] and polymerizations[12] providing PDI derivatives with diverse molecular structures and molecular weights.

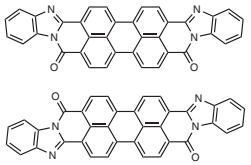


B4268	B4394	B4231	B4343
B2892	D4175	D3947	P0972

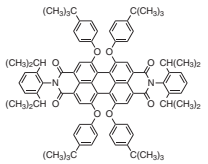
P0984



P2119



T3061



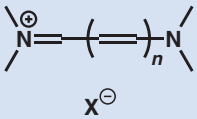
Product No.	Product Name			Unit Size
B4268	*N*,*N*'-Bis(2,6-diisopropylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide		1g	5g
B4394	*N*,*N*'-Bis(2,6-diisopropylphenyl)-1,6,7,12-tetraphenoxy-3,4,9,10-perylenetetracarboxylic Diimide		1g	5g
B4231	*N*,*N*'-Bis(3,5-dimethylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide		1g	5g
B4343	*N*,*N*'-Bis(2-ethylhexyl)-3,4,9,10-perylenetetracarboxylic Diimide			200mg
B2892	*N*,*N*'-Bis(4-methoxyphenyl)-3,4,9,10-perylenetetracarboxylic Diimide		1g	5g
D4175	*N*,*N*'-Di-*n*-octyl-3,4,9,10-perylenetetracarboxylic Diimide			1g
D3947	*N*,*N*'-Ditridecyl-3,4,9,10-perylenetetracarboxylic Diimide		200mg	1g
P0972	3,4,9,10-Perylenetetracarboxylic Dianhydride	25g	100g	500g
P0984	3,4,9,10-Perylenetetracarboxylic Diimide			25g
P2119	PTCBI (*cis*- and *trans*- mixture)			200mg
T3061	1,6,7,12-Tetrakis(4-*tert*-butylphenoxy)-*N*,*N*'-bis(2,6-diisopropylphenyl)-3,4,9,10-perylenetetracarboxylic Diimide			200mg

References

1) H. Akamasu, H. Inokuchi, Y. Matsunaga, *Nature* **1954**, *173*, 168.
2) C. W. Tang, *Appl. Phys. Lett*. **1986**, *48*, 183.
3) P. Ranke, I. Bleyl, J. Simmerer, D. Haarer, A. Bacher, H. W. Schmidt, *Appl. Phys. Lett*. **1997**, *71*, 1332.
4) M. G. Ramirez, M. Morales-Vidal, V. Navarro-Fuster, P. G. Boj, J. A. Quintana, J. M. Villalvilla, A. Retolaza, S. Merino, M. A. Diaz-Garcia, *J. Mater. Chem. C* **2013**, *1*, 1182.
5) P. R. L. Malenfant, C. D. Dimitrakopoulos, J. D. Gelorme, L. L. Kosbar, T. O. Graham, A. Curioni, W. Andreoni, *Appl. Phys. Lett*. **2002**, *80*, 2517.
6) R. J. Chesterfield, J. C. McKeen, C. R. Newman, P. C. Ewbank, D. A. da Silva Filho, J.-L. Brédas, L. L. Miller, K. R. Mann, C. D. Frisbie, *J. Phys. Chem. B* **2004**, *108*, 19281.
7) R. Narayan, P. Kumar, K. S. Narayan, S. K. Asha, *Adv. Funct. Mater*. **2013**, *23*, 2033.
8) W. Yue, Y. Li, W. Jiang, Y. Zhen, Z. Wang, *Org. Lett*. **2009**, *11*, 5430.
9) Y. Li, C. Li, W. Yue, W. Jiang, R. Kopecek, J. Qu, Z. Wang, *Org. Lett*. **2010**, *12*, 2374.
10) G. Battagliarin, C. Li, V. Enkelmann, K. Müllen, *Org. Lett*. **2011**, *13*, 3012.
11) J. Sun, F. Zhong, J. Zhao, *Dalton Trans*. **2013**, *42*, 9595.
12) X. Hu, L. Zuo, H. Pan, F. Hao, J. Pan, L. Fu, M. Shi, H. Chen, *Sol. Energy Mater. Sol. Cells* **2012**, *103*, 157.

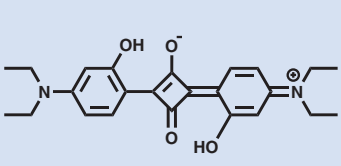
Cyanine & Squarylium Dyes

Cyanine dyes contain some *N*-heterocycles on both sides of the polymethine structure. The *N*-heterocycle on the one side is a cationic ammonium with an electron-withdrawing effect, and the other *N*-heterocycle is a tertiary amine with an electron-donating effect. Accordingly, cyanine dyes show the light absorption of a charge transfer through the central polymethine structure. An extension of the polymethine structure exhibits a red shift of absorption. The absorption of cyanine dyes shifts to longer wavelengths with every extension by the addition of two methine moieties (or by the addition of one *n* moiety).[1] There are cyanine dyes exhibiting near infrared absorption. The *N*-heterocycles contained in the cyanine dyes consist of indole, benzoxazole, benzothiazole, naphthothiazole, quinoline and so on. Proper selection of these *N*-heterocycles controls absorption wavelength. Increasing the number of aromatic rings shifts absorption to longer wavelengths. Counter anions consist of halides, sulfonate, perchlorate, tetrafluoroborate, hexafluoroantimonate and so on. Proper selection of these anions enhances solubility and durability.[2,3] Cyanine dyes are useful for silver photography, and optical recording media by laser sensitivity.[4] Water-soluble cyanine dyes are usable as fluorescent probes in biochemical research.[5]

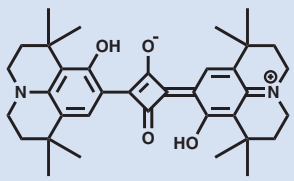


***n* = 1: cyanine**
***n* = 2: carbocyanine**
***n* = 3: dicarbocyanine**
***n* = 4: tricarbocyanine**

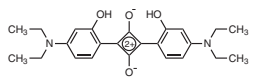
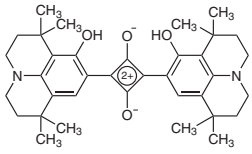
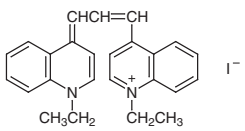
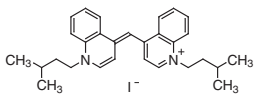
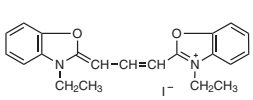
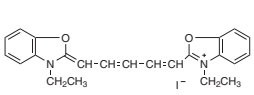
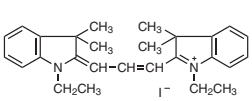
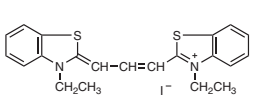
Squarylium dye (SQ), which is an analogue of cyanine dye, has a squaraine moiety in the center of the π-conjugate. The SQ dye has a zwitterion structure in which the cation and anion coexist in the molecule, although the cyanine dye has a separated cation component. The SQ was conventionally used as a charge generation material for an organic photo conductors.[6,7] Recently, SQ provided a sensitizer for organic solar cells originating from a strong absorption in near infrared area.[8,9] In addition, the SQ dye was applied to an organic light-emitting diode because it shows efficient red luminescence.[10]



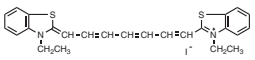
[B4342]



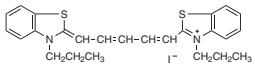
[B4649]

B4342 	B4649 
C0426 	C0436 
D4453 	D4457 
A2684 	D4454 

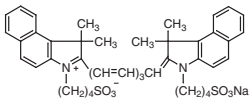
D4773



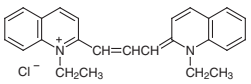
D4456



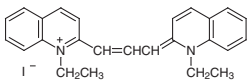
I0535



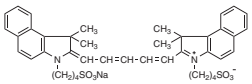
P0156



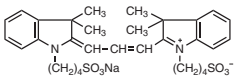
P0436



D4463



D4464



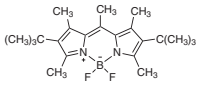
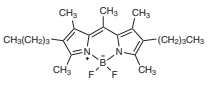
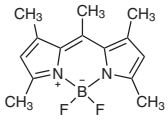
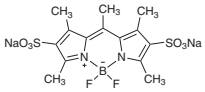
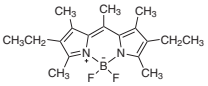
Product No.	Product Name	Unit Size	
B4342	2,4-Bis[4-(diethylamino)-2-hydroxyphenyl]squaraine	1g	5g
B4649	2,4-Bis[8-hydroxy-1,1,7,7-tetramethyljulolidin-9-*yl*]squaraine	1g	5g
C0426	Cryptocyanine	200mg	1g
C0436	Cyanine	1g	5g
D4453	3,3'-Diethyloxacarbocyanine Iodide	1g	5g
D4457	3,3'-Diethyloxadicarbocyanine Iodide		200mg
A2684	1,1'-Diethyl-3,3,3',3'-tetramethylindocarbocyanine Iodide	1g	5g
D4454	3,3'-Diethylthiacarbocyanine Iodide	1g	5g
D4773	3,3'-Diethylthiatricarbocyanine Iodide	1g	5g
D4456	3,3'-Dipropylthiadicarbocyanine Iodide	200mg	1g
I0535	Indocyanine Green	100mg	1g
P0156	Pinacyanol Chloride	100mg	1g
P0436	Pinacyanol Iodide	1g	5g
D4463	3,3,3',3'-Tetramethyl-1,1'-bis(4-sulfobutyl)benzoindodicarbocyanine Sodium Salt	1g	5g
D4464	3,3,3',3'-Tetramethyl-1,1'-bis(4-sulfobutyl)indocarbocyanine Sodium Salt	1g	5g

References

1) Y. Y. Davidson, B. M. Gunn, S. A. Soper, *Appl. Spectrosc*. **1996**, *50*, 211.
2) A. Mishra, R. K. Behera, P. K. Behera, B. K. Mishra, G. B. Behera, *Chem. Rev*. **2000**, *100*, 1973.
3) Review: Z. Zhu, *Dyes Pigments* **1995**, *27*, 77.
4) H. Oba, M. Abe, M. Umehara, T. Sato, Y. Ueda, M. Kunikane, *Appl. Opt*. **1986**, *25*, 4023.
5) X. H. Zhang, Q. Liu, H. J. Shi, L. Y. Wang, Y. L. Fu, X. C. Wei, L. F. Yang, *Dyes Pigments* **2014**, *100*, 232.
6) K.-Y. Law, F. C. Bailey, L. J. Bluett, *Can. J. Chem*. **1986**, *64*, 1607.
7) K.-Y. Law, F. C. Bailey, *Dyes Pigments* **1993**, *21*, 1.
8) A. Burke, L. Schmidt-Mende, S. Ito, M. Grätzel, *Chem. Commun*. **2007**, 234.
9) T. Maeda, Y. Hamamura, K. Miyanaga, N. Shima, S. Yagi, H. Nakazumi, *Org. Lett*. **2011**, *13*, 5994.
10) B. Zhang, W. Zhao, Y. Cao, X. Wang, Z. Zhang, X. Jiang, S. Xu, *Synth. Met*. **1997**, *91*, 237.

Dipyrromethene Dyes

Dipyrromethene is a unit structure of porphyrin and can coordinate to main group elements and transition metals as a monoanionic bidentate ligand to form complexes. Among them, a dipyrromethene-coordinated boron complex (boron dipyrromethene) shows a very small Stokes shift, high fluorescent quantum efficiency that is independent of solvent polarity, large molar absorption coefficient, and sharp excitation and emission spectra. It is expected that dipyrromethene dyes are alternative fluorescent dyes to fluorescein and rhodamine dyes. Applications of dipyrromethene dyes are fluorescent labeling reagents, laser dyes, and electronic materials. A chemical modification of boron dipyrromethene controls optical properties more easily than other fluorescent dyes.

B4400	B4489	D4341	D4593	E1065
				

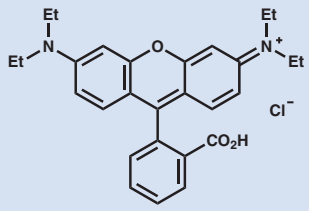
Product No.	Product Name	Unit Size
B4400	[[(4-*tert*-Butyl-3,5-dimethyl-1*H*-pyrrol-2-yl)(4-*tert*-butyl-3,5-dimethyl-2*H*-pyrrol-2-ylidene)methyl]-methane](difluoroborane)	200mg
B4489	[[(4-Butyl-3,5-dimethyl-1*H*-pyrrol-2-yl)(4-butyl-3,5-dimethyl-2*H*-pyrrol-2-ylidene)methyl]methane]-(difluoroborane)	200mg
D4341	[[(3,5-Dimethyl-1*H*-pyrrol-2-yl)(3,5-dimethyl-2*H*-pyrrol-2-ylidene)methyl]methane](difluoroborane)	1g
D4593	[[(3,5-Dimethyl-4-sulfo-1*H*-pyrrol-2-yl)(3,5-dimethyl-4-sulfo-2*H*-pyrrol-2-ylidene)methyl]methane]-(difluoroborane) Disodium Salt	200mg
E1065	[[(4-Ethyl-3,5-dimethyl-1*H*-pyrrol-2-yl)(4-ethyl-3,5-dimethyl-2*H*-pyrrol-2-ylidene)methyl]methane]-(difluoroborane)	200mg

Xanthene Dyes

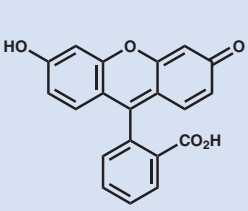
Both cationic and anionic xanthene dyes are known to be efficient fluorescent dyes. Functional groups on the xanthene moiety control their fluorescent colors. For instance, there are the cationic dyes of rhodamine B with a dialkylamino group as a red fluorescent dye, fluorescein as a green fluorescent dye, and the anionic dye of eosin (brominated fluorescein) as a red fluorescent dye. Applications of xanthene dyes involve optical materials and organic dyes for medical diagnosis research. Several characteristic features of xanthene dyes are large absorption and luminescence, excellent light resistance, low toxicity in-vivo, and relatively high solubility in water.

Since xanthene dyes have a sensitizing effect, their applications for dye sensitized solar cells (DSSC) have been reported.[1)] We can expect that the xanthene dyes fabricate DSSC devices at low cost, because they are metal-free, although the power conversion efficiency of xanthene dyes are lower than those of ruthenium-based dyes. Further research has been in progress with a combination of several xanthene dyes to increase power conversion efficiency.[2)]

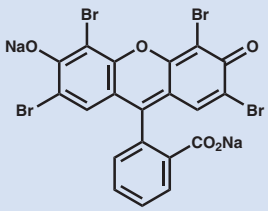
There is an application of xanthene derivatives for a laser dye. A dye laser requires coumarin and rhodamine dyes as an organic medium. They all oscillate in the visible area. Among these xanthene dyes, the rhodamine 6G is mainly used for a laser dye.[3)]



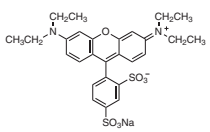
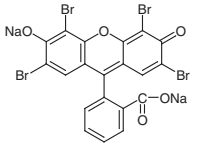
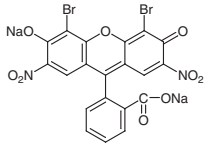
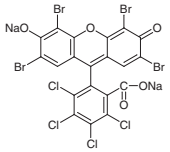
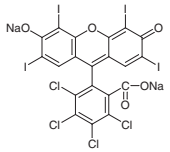
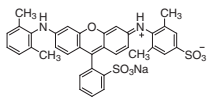
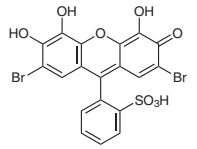
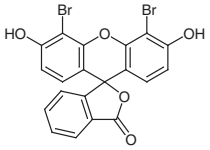
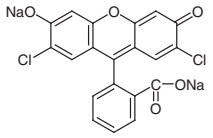
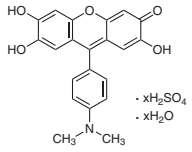
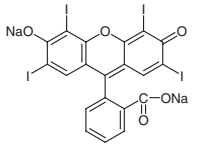
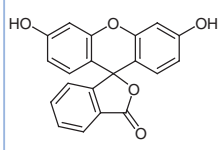
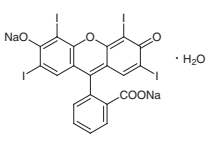
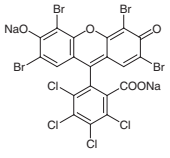
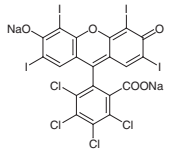
Rhodamine B
[R0040]



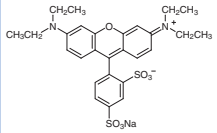
Fluorescein
[F0095]



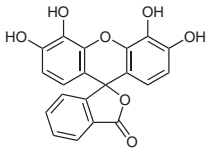
Eosine
[T0037]

A0600 	T0037 	E0204 	T0050 	R0041 
A1906 	D0207 	D1120 	D0424 	D1118 
T0557 	F0095 	F0139 	F0142 	F0001 

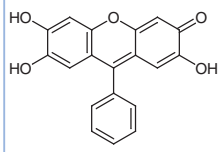
F0143



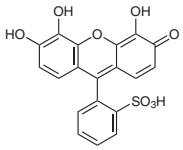
A0601



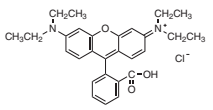
T0450



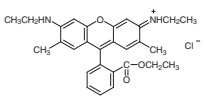
P0572



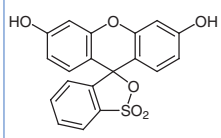
R0040



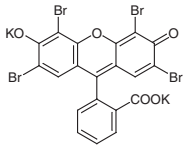
R0039



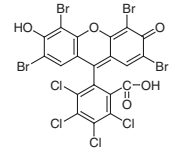
S0132



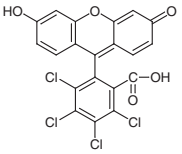
T0036



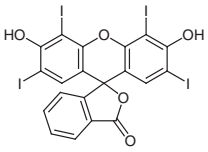
T0049



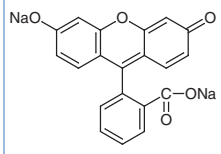
T0066



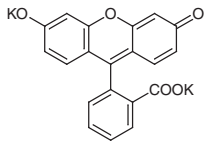
T0124



F0096



F0027



Product No.	Product Name	Unit Size		
A0600	Acid Red 52			25g
T0037	Acid Red 87			25g
E0204	Acid Red 91			25g
T0050	Acid Red 92			25g
R0041	Acid Red 94			25g
A1906	Acid Red 289			25g
D0207	Bromopyrogallol Red		1g	5g
D1120	Dibromofluorescein (contains Mono-, Tri- and Tetra-)			5g
D0424	2',7'-Dichlorofluorescein Sodium Salt		1g	25g
D1118	9-(4'-Dimethylaminophenyl)-2,6,7-trihydroxyfluorone Sulfate Hydrate			1g
T0557	Erythrosine B			25g
F0095	Fluorescein	25g	100g	500g
F0139	Food Red No. 3			25g
F0142	Food Red No. 104			25g
F0001	Food Red No. 105			25g
F0143	Food Red No. 106			25g
A0601	Gallein		1g	25g
T0450	Phenylfluorone			1g
P0572	Pyrogallol Red			1g
R0040	Rhodamine B		25g	250g
R0039	Rhodamine 6G			25g
S0132	Sulfonfluorescein		1g	5g
T0036	Tetrabromofluorescein Potassium Salt			25g
T0049	2',4',5',7'-Tetrabromo-3,4,5,6-tetrachlorofluorescein			25g
T0066	3,4,5,6-Tetrachlorofluorescein			1g
T0124	Tetraiodofluorescein			25g
F0096	Uranine		25g	500g
F0027	Uranine K			25g

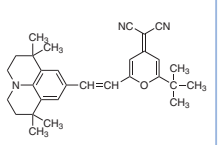
References

1) H. Tsubomura, M. Matsumura, Y. Nomura, T. Amamiya, *Nature* **1976**, *261*, 402.
2) S. Rani, P. K. Shishodia, R. M. Mehra, *J. Renew. Sust. Energ.* **2010**, *2*, 043103.
3) J. Loerke, F. Marlow, *Adv. Mater.* **2002**, *14*, 1745.

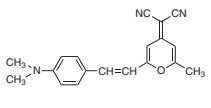
DCM Dyes

DCM dye consists of a pyranylidene malononitrile as an electron acceptor and a 4-aminostyryl group as an electron donor. Chemical modifications of the substituent on the pyran ring and amino group control the wavelengths of absorption and luminescence. The DCM dyes are useful for laser oscillation and a red dopant for an organic light-emitting diode device. This dye is a low band gap material with good efficiency and long lifetime.

D4700



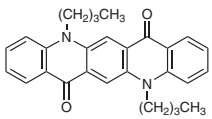
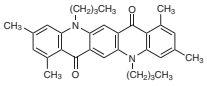
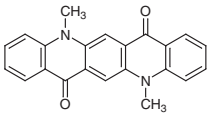
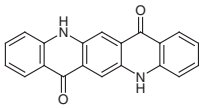
D2849



Product No.	Product Name	Unit Size
D4700	DCJTB	200mg
D2849	4-(Dicyanomethylene)-2-methyl-6-(4-dimethylaminostyryl)-4*H*-pyran	500mg

Quinacridone Dyes

Quinacridone dyes were originally used as red pigments having clear color and durability. They are useful for painting of automobiles, printing ink and coloring of plastics. In the research field of organic electronics, quinacridone dyes are applied to solar cells and organic light-emitting diodes (OLED). Quinacridones easily show intermolecular stacks in face-to-face mode and form strong intermolecular hydrogen bondings (NH•••O). Thus, these facts indicate that quenching of emission occurs under a concentrated condition. On the other hand, quinacridone dyes are strongly luminescent in solution, and are useful for luminescent dopant materials even if they are used in the solid state. In fact, they are green luminescent dopants for an OLED device. In order to decrease intermolecular hydrogen bonding, we can introduce a group on the nitrogen to avoid intermolecular quenching. Introduction of alkyl groups enhances solubility, because quinacridones usually are poorly soluble.

D4780	D4697	D3227 D2687	Q0083 Q0057
			

Product No.	Product Name	Unit Size	
D4780	*N,N'*-Dibutylquinacridone	200mg	1g
D4697	5,12-Dibutyl-1,3,8,10-tetramethylquinacridone (This product is only available in Japan.)	200mg	1g
D3227	*N,N'*-Dimethylquinacridone (purified by sublimation)		1g
D2687	*N,N'*-Dimethylquinacridone	1g	5g
Q0083	Quinacridone (purified by sublimation)		1g
Q0057	Quinacridone		25g

Metal-Organic Frameworks (MOFs / PCPs) & Related Ligands

Porous metal-organic frameworks (MOFs) (other name: porous coordination polymers (PCPs)) have attracted wide scientific attention for the potential application to gas storage, gas separation, catalysis and nanospace engineering.[1] MOFs (PCPs) are constructed mainly by coordination bonds between metal cations and multidentate ligands. Their specificities depend on the pore shape, size, and chemical environments of the voids or channels. Kitagawa *et al*. have reported the first utilization of a MOF as an electrocatalyst for oxidation of ethanol to aldehyde, for which the potential was comparable with Pt-based catalysts.[2]

Recently, Kaneko, Kanoh, Kondo, Kajiro, *et al*. have developed a quite unique Cu complex MOF $[Cu(bpy)(BF_4)_2(H_2O)_2]bpy$ (bpy = 4,4'-bipyridine),[3] named as *pre*-ELM-11 (ELM stands for Elastic Layer-Structured MOF). Upon heating and dehydration, *pre*-ELM-11 converts to an innovative and stable gas absorbent ELM-11 $[Cu(bpy)_2(BF_4)_2]$ (Figure 1). ELM-11 has structural flexibility, and its structural transformation occurs easier than traditional rigid MOFs. And the gate type adsorption isotherm on ELM-11, which has a predominantly rectangular shaped hysteresis, is quite unique (Figure 2).

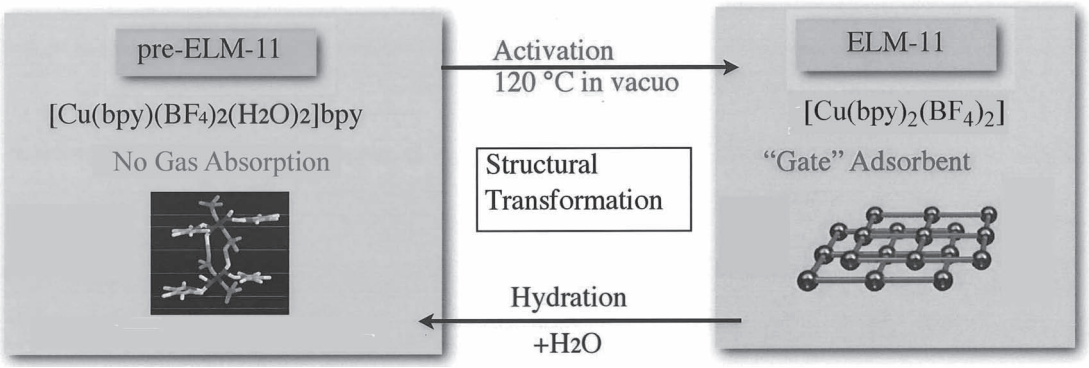


Figure 1. Structure Transformation between *pre*-ELM-11 and ELM-11

Pre-ELM-11 is easily converted to ELM-11 by an activation process (dehydration). Recommended conditions are 120℃ for 3 h in vacuo. ELM-11 is stable on drying at rt. ELM-11 rapidly absorbs moisture in atmospheric conditions and changes its structure to *pre*-ELM-11, but can be re-transformed.

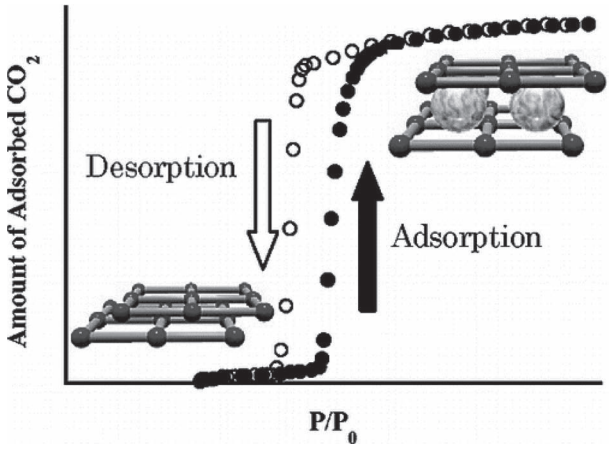
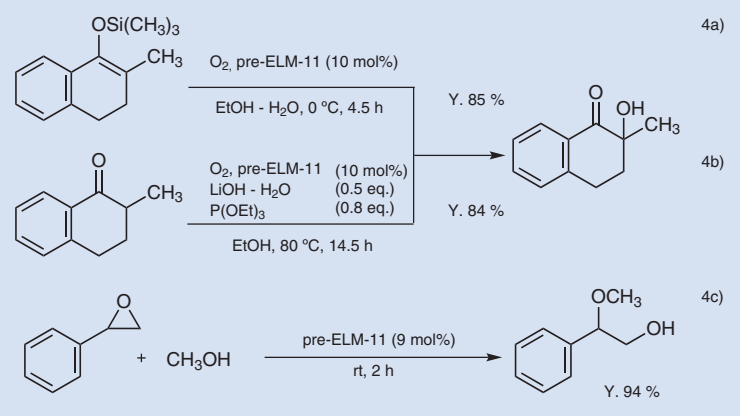


Figure 2. Schematic representation of the gate adsorption of CO_2[3a]

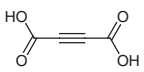
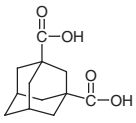
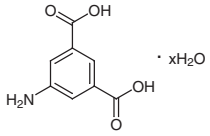
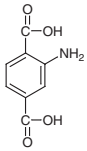
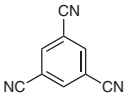
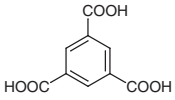
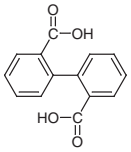
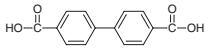
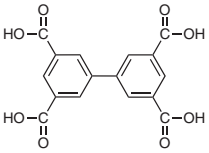
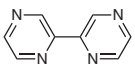
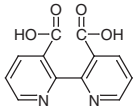
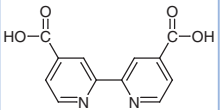
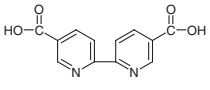
Pre-ELM-11 is also utilized as a catalyst in organic synthesis for molecular oxygen-derived oxidation and epoxide alcoholysis (Scheme).[4]

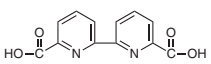
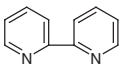
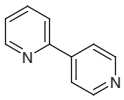
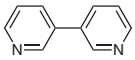
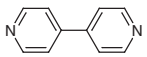
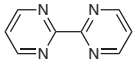
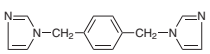
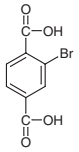
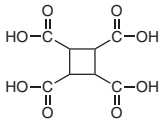
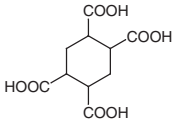
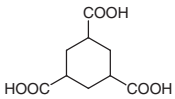
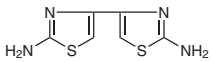
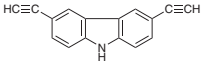
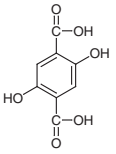
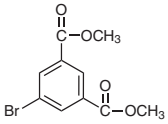
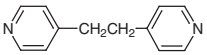
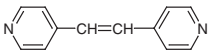
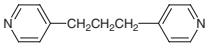
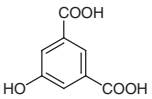
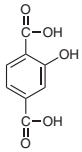
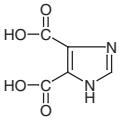
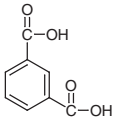
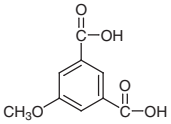
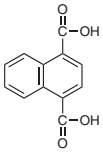
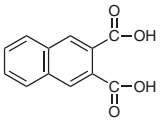
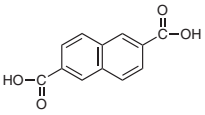
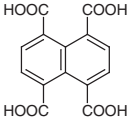
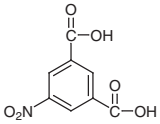
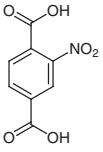
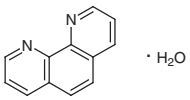
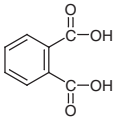
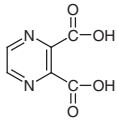
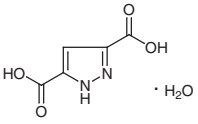
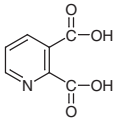
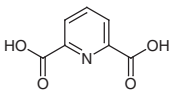
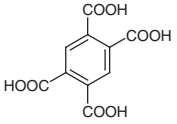


Scheme. Molecular oxygen-derived oxidation and epoxide alcoholysis using *pre*-ELM-11

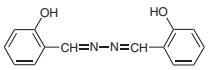
MOF/PCP	C2409
	$[Cu(bpy)(BF_4)_2(H_2O)_2]bpy$

Product No.	Product Name	Unit Size
C2409	*pre*-ELM-11	5g

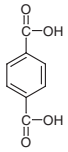
Ligands for MOF/PCP		A0088	A1358	A1290
				
A1291	B4294	B0043	D0864	B1191
				
B3792	B4297	B3622	B1876	B3502
				

B3533 	B0468 	B0863 	B3984 	B0469 
B2496 	B4023 	B1321 	C2502 	C2198 
C2029 	D4273 	D0134 	D4275 	D3899 
D4068 	D3752 	D0276 	D0938 	H0794 
H1385 	I0001 	I0003 	I0155 	M1835 
M0345 	N0606 	N0526 	N0377 	N0770 
N0520 	N0272 	P0221 	P0287 	P0544 
P0545 	P1048 	P0550 	P0554 	B0039 

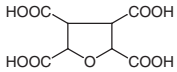
S0850



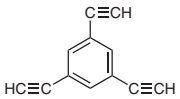
T0166



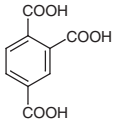
T0975



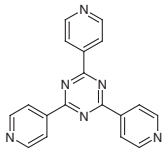
T2760



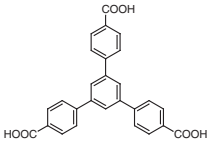
B0042



T1937



T2647



Product No.	Product Name	Unit Size		
A0088	Acetylenedicarboxylic Acid		5g	25g
A1358	1,3-Adamantanedicarboxylic Acid		5g	25g
A1290	5-Aminoisophthalic Acid Hydrate		25g	500g
A1291	2-Aminoterephthalic Acid			25g
B4294	1,3,5-Benzenetricarbonitrile		1g	5g
B0043	1,3,5-Benzenetricarboxylic Acid	25g	100g	500g
D0864	2,2'-Biphenyldicarboxylic Acid		25g	100g
B1191	4,4'-Biphenyldicarboxylic Acid		5g	25g
B3792	Biphenyl-3,3',5,5'-tetracarboxylic Acid			200mg
B4297	2,2'-Bipyrazine			100mg
B3622	2,2'-Bipyridine-3,3'-dicarboxylic Acid		1g	5g
B1876	2,2'-Bipyridine-4,4'-dicarboxylic Acid		100mg	1g
B3502	2,2'-Bipyridine-5,5'-dicarboxylic Acid			1g
B3533	2,2'-Bipyridine-6,6'-dicarboxylic Acid		1g	5g
B0468	2,2'-Bipyridyl	25g	100g	500g
B0863	2,4'-Bipyridyl		1g	5g
B3984	3,3'-Bipyridyl		1g	5g
B0469	4,4'-Bipyridyl		25g	100g
B2496	2,2'-Bipyrimidyl		200mg	1g
B4023	1,4-Bis[(1*H*-imidazol-1-yl)methyl]benzene			5g
B1321	Bromoterephthalic Acid		5g	25g
C2502	1,2,3,4-Cyclobutanetetracarboxylic Acid			1g
C2198	1,2,4,5-Cyclohexanetetracarboxylic Acid		5g	25g
C2029	1,3,5-Cyclohexanetricarboxylic Acid (*cis*- and *trans*- mixture)		5g	25g
D4273	2,2'-Diamino-4,4'-bithiazole		200mg	1g
D0134	1,4-Diazabicyclo[2.2.2]octane	25g	100g	500g
D4275	3,6-Diethynylcarbazole		200mg	1g
D3899	2,5-Dihydroxyterephthalic Acid		5g	25g
D4068	Dimethyl 5-Bromoisophthalate		1g	5g
D3752	1,2-Di(4-pyridyl)ethane		1g	5g
D0276	1,2-Di(4-pyridyl)ethylene		10g	25g
D0938	1,3-Di(4-pyridyl)propane		25g	500g
H0794	5-Hydroxyisophthalic Acid		25g	500g
H1385	2-Hydroxyterephthalic Acid		1g	5g
I0001	Imidazole	25g	100g	500g
I0003	1*H*-Imidazole-4,5-dicarboxylic Acid		5g	25g
I0155	Isophthalic Acid		25g	500g
M1835	5-Methoxyisophthalic Acid			5g
M0345	2-Methylimidazole	25g	100g	500g
N0606	1,4-Naphthalenedicarboxylic Acid			25g
N0526	2,3-Naphthalenedicarboxylic Acid		5g	25g
N0377	2,6-Naphthalenedicarboxylic Acid		25g	100g
N0770	1,4,5,8-Naphthalenetetracarboxylic Acid (contains Monoanhydride)		25g	250g
N0520	5-Nitroisophthalic Acid		25g	500g
N0272	Nitroterephthalic Acid			25g
P0221	1,10-Phenanthroline Monohydrate		1g	25g
P0287	Phthalic Acid		25g	500g
P0544	Pyrazine		25g	500g
P0545	2,3-Pyrazinedicarboxylic Acid			25g
P1048	3,5-Pyrazoledicarboxylic Acid Monohydrate		5g	25g

Product No.	Product Name		Unit Size	
P0550	2,3-Pyridinedicarboxylic Acid		25g	500g
P0554	2,6-Pyridinedicarboxylic Acid		25g	500g
B0039	Pyromellitic Acid		25g	500g
S0850	Salicylaldehyde Azine		5g	25g
T0166	Terephthalic Acid		25g	500g
T0975	Tetrahydrofuran-2,3,4,5-tetracarboxylic Acid		25g	500g
T2760	1,3,5-Triethynylbenzene		1g	5g
B0042	Trimellitic Acid	25g	100g	500g
T1937	2,4,6-Tri(4-pyridyl)-1,3,5-triazine (purified by sublimation)		1g	5g
T2647	1,3,5-Tris(4-carboxyphenyl)benzene		1g	5g

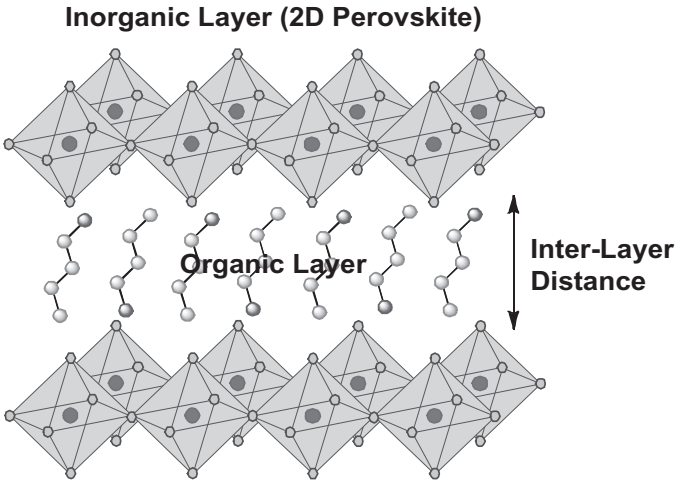
References

1) Reviews of metal-organic frameworks (MOFs / PCPs)
a) "Chemistry of Coordination Space", ed. by H. Nishihara, *Coord. Chem. Rev*. **2007**, *251*, 2489-2766.
b) M. P. Suh, Y. E. Cheon, E. Y. Lee, *Coord. Chem. Rev*. **2008**, *250*, 1007.
c) A. Corma, H. Garcia, F. X. L. Xamena, *Chem. Rev*. **2010**, *110*, 4606.
2) Electrocatalyst for ethanol oxidation
L. Yang, S. Kinoshita, T. Yamada, S. Kanda, H. Kitagawa, M. Tokunaga, T. Ishimoto, T. Ogura, R. Nagumo, A. Miyamoto, M. Koyama, *Angew. Chem. Int. Ed*. **2010**, *49*, 5348.
3) For gas storage and gas separation research of pre-ELM-11
a) D. Li, K. Kaneko, *Chem. Phys. Lett*. **2001**, *335*, 50.
b) A. Kondo, H. Noguchi, S. Ohnishi, H. Kajiro, A. Tohdoh, Y. Hattori, W.-C. Xu, H. Tanaka, H. Kanoh, K. Kaneko, *Nano Lett*. **2006**, *6*, 2581.
c) H. Noguchi, A. Kondo, Y. Hattori, H. Kajiro, H. Kanoh, K. Kaneko, *J. Phys. Chem. C* **2007**, *111*, 248.
d) H. Kanoh, A. Kondo, H. Noguchi, H. Kajiro, A. Tohdoh, Y. Hattori, W.-C. Xu, M. Inoue, T. Sugiura, K. Morita, H. Tanaka, T. Ohba, K. Kaneko, *J. Colloid Interface Sci*. **2009**, *334*, 1.
e) H. Kajiro, A. Kondo, K. Kaneko, H. Kanoh, *Int. J. Mol. Sci*. **2010**, *11*, 3803.
f) Nippon Steel Corporation, Nippon Steel Chemical Co., Ltd., Institute of Research and Innovation, Jpn. Kokai Tokkyo Koho 2005 162624; Nippon Steel Corporation, Nippon Steel Chemical Co., Ltd., Institute of Research and Innovation, Jpn. Kokai Tokkyo Koho 2005 162625; Nippon Steel Corporation, Institute of Research and Innovation, Jpn. Kokai Tokkyo Koho 2005 336129; Nippon Steel Corporation, Jpn. Kokai Tokkyo Koho 2005 232031.
4) For catalysis research of pre-ELM-11
a) T. Arai, H. Takasugi, T. Sato, H. Noguchi, H. Kanoh, K. Kaneko, A. Yanagisawa, *Chem. Lett*. **2005**, *34*, 1590.
b) T. Arai, T. Sato, H. Noguchi, H. Kanoh, K. Kaneko, A. Yanagisawa, *Chem. Lett*. **2006**, *35*, 1094.
c) D. Jiang, T. Mallat, F. Krumeich, A. Baiker, *J. Catal*. **2008**, *257*, 390.

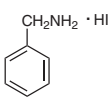
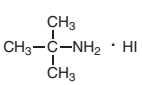
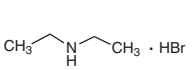
Organic-Inorganic Perovskite Precursors

'Perovskite' originates from the mineral name of calcium titanate ($CaTiO_3$) and the compounds with formula of ABO_3 generally belong to a perovskite-type compound, where the A is a divalent and B is a tetravalent metal ion. A perovskite with cubic or orthorhombic phases shows ferroelectricity, for instance, barium titanate ($BaTiO_3$) is a ferroelectric or piezoelectric material.[1] High temperature superconductive oxides with unit of a copper oxide are obtained from all perovskite compounds.[2] These perovskite compounds consist of metal ions and oxygen atoms, and are manufactured by a physical procedure (eg. sintering method).[3] Modification of the metal ion and a changing ratio of the metal ion components can drastically control physical properties of the perovskite. In addition to the oxide perovskites, halide-based perovskites are also well known.

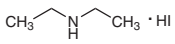
On the other hand, one can replace the cationic component with an organic ammonium. In this case, a chemical method can provide a perovskite compound. This perovskite compound is called an 'organic-inorganic perovskite compound', because it contains an organic component. A metal ion component usually involves tin or lead.[4,5] This perovskite compound has the general formula $[(RNH_3)_mMX_n]$, in which modifications of metal (M), halide (X) and organic groups (R) precisely control physical properties. Among them, the tin perovskite is relatively better for electrical conduction,[6] and the lead one is better for optical properties.[7] A chemical modification of the halide controls band gap.[8] Selection of organic ammonium halide, metal halide and their mixing ratio changes the component ratio of the halide. The organic groups are selected from methyl, long alkyls, phenyl, benzyl, phenethyl and so on. Diversity of these organic groups allows controlling the structure of a perovskite compound. For instance, a perovskite compound with R = methyl provides $[(MeNH_3)MX_3]$ having a three-dimensional cubic perovskite structure.[9] A perovskite compound with R = C_nH_{2n+1} ($n \geq 2$) provides a two-dimensional perovskite layer and the length of alkyl group can control the inter-layer distance.[10]



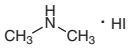
An application of organic-inorganic perovskite is a perovskite solar cell.[11] This solar cell can be usually fabricated by the three-dimensional cubic perovskite $[(MeNH_3)MX_3]$. Research on the perovskite solar cell recently received much attention. Power conversion efficiency of this solar cell is more than those of organic photovoltaics (OPV) and dye-sensitized solar cells (DSSC), and the device can be fabricated by solution-process at low cost.

A2778	B4566	B4434	B4433	D4667
				

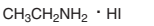
D4643



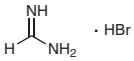
D4555



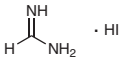
E1045



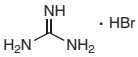
F0973



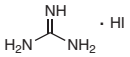
F0974



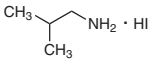
G0449



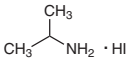
G0450



I0935

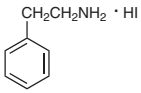


I0934

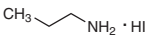


M2556

P2213



P2212



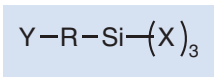
Product No.	Product Name		Unit Size	
A2778	Aniline Hydroiodide		1g	5g
B4566	Benzylamine Hydroiodide		1g	5g
B4434	*tert*-Butylamine Hydroiodide		1g	5g
B4433	Butylamine Hydroiodide		1g	5g
D4667	Diethylamine Hydrobromide		1g	5g
D4643	Diethylamine Hydroiodide		1g	5g
D4555	Dimethylamine Hydroiodide		1g	5g
E1045	Ethylamine Hydroiodide		1g	5g
F0973	Formamidine Hydrobromide		1g	5g
F0974	Formamidine Hydroiodide		1g	5g
G0449	Guanidine Hydrobromide		1g	5g
G0450	Guanidine Hydroiodide		1g	5g
I0935	Isobutylamine Hydroiodide		1g	5g
I0934	Isopropylamine Hydroiodide		1g	5g
M2556	Methylamine Hydroiodide	1g	5g	25g
P2213	2-Phenylethylamine Hydroiodide		1g	5g
P2212	Propylamine Hydroiodide		1g	5g

References

1) E. Sawaguchi, Y. Akishige, M. Kobayashi, *J. Phys. Soc. Jpn*. **1985**, *54*, 480.
2) Y. Tokura, H. Takagi, S. Uchida, *Nature* **1989**, *337*, 345.
3) F. S. Galasso, M. Kestigan, *Inorg. Synth*. **1973**, *14*, 142.
4) D. B. Mitzi, C. A. Feild, W. T. A. Harrison, A. M. Guloy, *Nature* **1994**, *369*, 467.
5) K. Liang, D. B. Mitzi, M. T. Prikas, *Chem. Mater*. **1998**, *10*, 403.
6) Y. Takahashi, R. Obara, Z.-Z. Lin, Y. Takahashi, T. Naito, T. Inabe, S. Ishibashi, K. Terakura, *Dalton Trans*. **2011**, *40*, 5563.
7) N. Pellet, P. Gao, G. Gregori, T.-Y. Yang, M. K. Nazeeruddin, J. Maier, M. Grätzel, *Angew. Chem. Int. Ed*. **2014**, *53*, 3151.
8) S. A. Kulkarni, T. Baikie, P. P. Boix, N. Yantara, N. Mathews, S. Mhaisalkar, *J. Mater. Chem. A* **2014**, *2*, 9221.
9) Y. Kawamura, H. Mashiyama, K. Hasebe, *J. Phys. Soc. Jpn*. **2002**, *71*, 1694.
10) T. Ishihara, J. Takahashi, T. Goto, *Phys. Rev. B* **1990**, *42*, 11099.
11) A. Kojima, K. Teshima, Y. Shirai, T. Miyasaka, *J. Am. Chem. Soc*. **2009**, *131*, 6050.

Silane Coupling Agents

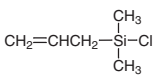
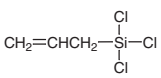
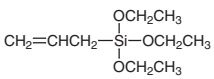
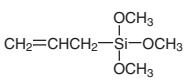
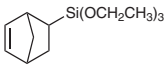
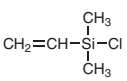
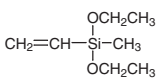
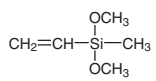
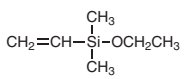
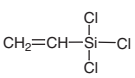
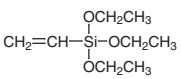
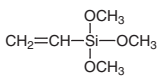
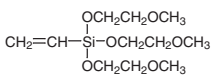
Silane coupling agents are organosilicon compounds having two functional groups with different reactivity. One of the two functional groups reacts with organic materials and the other reacts with inorganic materials. Their general structure is as follows:



Where Y denotes a functional group that links with organic materials, e.g. vinyl, epoxy, amino group and so on. X is a functional group that undergoes hydrolysis by water or moisture to form silanol. This silanol links with inorganic materials. Representative examples of X include chlorine, alkoxy, and acetoxy group.

Silane coupling agents are effective for the improved adhesion at the interface between the organic and inorganic materials and have been frequently utilized to enhance the strength and improve the performance of glass-fiber reinforced plastics. Recently, they have been used in the manufacture of inorganic-organic hybrid materials such as the laminating board for printed circuit boards, artificial marble, plastic magnets, and silica-immobilized bioactive compounds.

In addition to the original purpose of improving the adhesiveness of an interface, different applications are being explored. Examples include synthesis of moisture crosslinkable polymers using the reactivity of hydrolytic functional group, to give antistatic and antibacterial properties from surface treatment using silane coupling agents. It is expected that silane coupling agents will be applied in many fields.

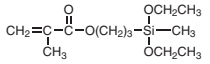
Olefinyl Silanes		A1275 	A1538 	A0785 
A1504 	B3214 	C1208 	D2318 	D3386 
V0046 	T0407 	V0044 	V0042 	V0048 

Product No.	Product Name	Unit Size	
A1275	Allylchlorodimethylsilane	10mL	25mL
A1538	Allyltrichlorosilane	5g	25g
A0785	Allyltriethoxysilane		10mL
A1504	Allyltrimethoxysilane	5mL	25mL
B3214	[Bicyclo[2.2.1]hept-5-en-2-yl]triethoxysilane (mixture of isomers)	1g	5g
C1208	Chlorodimethylvinylsilane	25mL	100mL

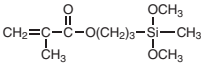
Product No.	Product Name			Unit Size
D2318	Diethoxymethylvinylsilane			25mL
D3386	Dimethoxymethylvinylsilane		25g	250g
V0046	Dimethylethoxyvinylsilane			25mL
T0407	Trichlorovinylsilane	25g	100g	500g
V0044	Triethoxyvinylsilane	25mL	100mL	500mL
V0042	Vinyltrimethoxysilane	25mL	100mL	500mL
V0048	Vinyltris(2-methoxyethoxy)silane		25mL	500mL

Acryloyloxyalkyl Silanes

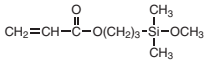
D4679



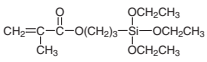
M1530



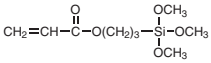
M2525



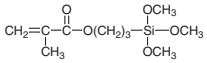
T2676



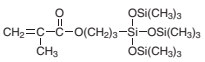
A1597



M0725



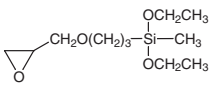
M1324



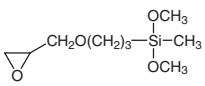
Product No.	Product Name			Unit Size
D4679	3-[Diethoxy(methyl)silyl]propyl Methacrylate			25mL
M1530	3-[Dimethoxy(methyl)silyl]propyl Methacrylate			25mL
M2525	3-(Methoxydimethylsilyl)propyl Acrylate (stabilized with MEHQ)			5g
T2676	3-(Triethoxysilyl)propyl Methacrylate (stabilized with HQ)			25g
A1597	3-(Trimethoxysilyl)propyl Acrylate (stabilized with BHT)			25g
M0725	3-(Trimethoxysilyl)propyl Methacrylate (stabilized with BHT)	25mL	100mL	500mL
M1324	3-[Tris(trimethylsilyloxy)silyl]propyl Methacrylate (stabilized with MEHQ)		25mL	100mL

Glycidyloxyalkyl Silanes

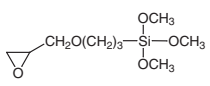
D2632



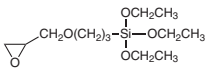
G0261



G0210



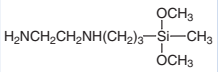
T2675



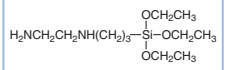
Product No.	Product Name	Unit Size		
D2632	Diethoxy(3-glycidyloxypropyl)methylsilane			25mL
G0261	3-Glycidyloxypropyl(dimethoxy)methylsilane		25g	500g
G0210	3-Glycidyloxypropyltrimethoxysilane	25g	100g	500g
T2675	Triethoxy(3-glycidyloxypropyl)silane			25g

Aminoalkyl Silanes

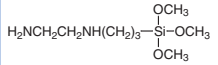
A0876



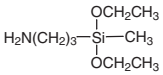
A1923



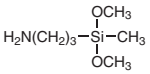
A0774



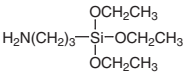
D1980



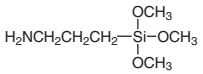
A2628



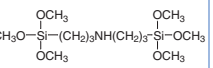
A0439



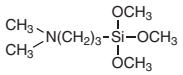
T1255



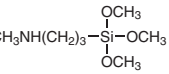
B2548



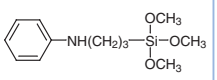
D4328



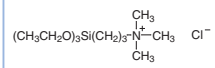
T2868



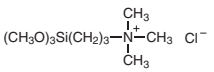
P1458



T2246



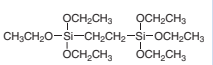
T2796



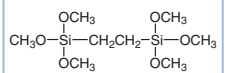
Product No.	Product Name			Unit Size
A0876	3-(2-Aminoethylamino)propyldimethoxymethylsilane		25mL	500mL
A1923	3-(2-Aminoethylamino)propyltriethoxysilane			25g
A0774	3-(2-Aminoethylamino)propyltrimethoxysilane	25g	100g	500g
D1980	3-Aminopropyldiethoxymethylsilane	25mL	100mL	500mL
A2628	3-Aminopropyldimethoxymethylsilane			25mL
A0439	3-Aminopropyltriethoxysilane	25g	100g	500g
T1255	3-Aminopropyltrimethoxysilane	25mL	100mL	500mL
B2548	Bis[3-(trimethoxysilyl)propyl]amine		25g	500g
D4328	[3-(*N*,*N*-Dimethylamino)propyl]trimethoxysilane		5mL	25mL
T2868	Trimethoxy[3-(methylamino)propyl]silane		25g	100g
P1458	Trimethoxy[3-(phenylamino)propyl]silane		25g	250g
T2246	Trimethyl[3-(triethoxysilyl)propyl]ammonium Chloride		5g	25g
T2796	Trimethyl[3-(trimethoxysilyl)propyl]ammonium Chloride (*ca.* 50% in Methanol)		10g	25g

Alkyl Silanes

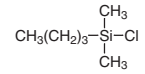
B4123



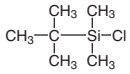
B2927



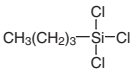
B2010



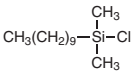
B0995



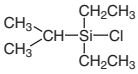
B0393



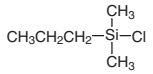
C1468

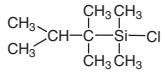
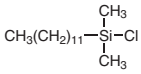
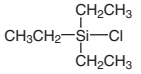
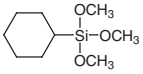
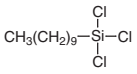
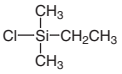
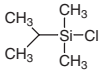
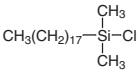
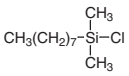
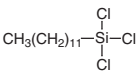
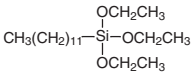
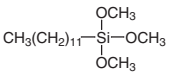
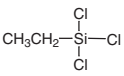
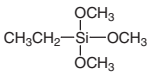
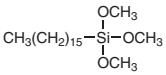
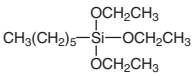
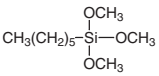
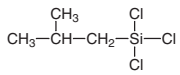
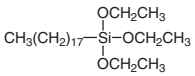
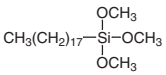
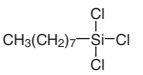
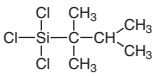
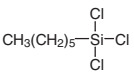
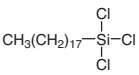
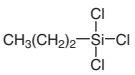
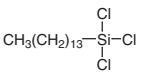
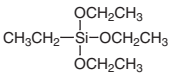
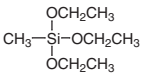
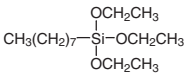
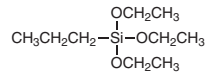
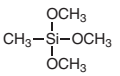
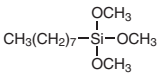
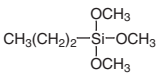


D2262



D1590

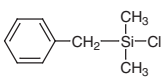


T2116 	C1469 	T0589 	C0306 	C0892 
C2280 	D1486 	D0135 	D1594 	D1560 
D1827 	D1509 	D1510 	D3383 	E0188 
E0789 	H1376 	H1158 	H0879 	I0452 
O0165 	O0256 	O0168 	T2517 	H0547 
M0450 	O0079 	P0371 	T0924 	E0189 
M0451 	O0171 	T2867 	T1078 	M0660 
T2875 	T1801 			

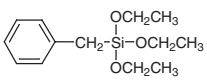
Product No.	Product Name	Unit Size		
B4123	1,2-Bis(triethoxysilyl)ethane			5mL
B2927	1,2-Bis(trimethoxysilyl)ethane		5g	25g
B2010	Butylchlorodimethylsilane			25mL
B0995	*tert*-Butyldimethylchlorosilane	5g	25g	100g
B0393	Butyltrichlorosilane			25g
C1468	Chloro(decyl)dimethylsilane			25mL
D2262	Chlorodiethylisopropylsilane		1g	5g
D1590	Chlorodimethylpropylsilane		5mL	25mL
T2116	Chloro(dimethyl)thexylsilane		5g	25g
C1469	Chloro(dodecyl)dimethylsilane			25mL
T0589	Chlorotriethylsilane	5g	25g	100g
C0306	Chlorotrimethylsilane	25mL	100mL	500mL
C0892	Cyclohexyltrichlorosilane		5g	25g
C2280	Cyclohexyltrimethoxysilane		5g	25g
D1486	Decyltrichlorosilane			25mL
D0135	Dimethylethylchlorosilane		5g	25g
D1594	Dimethylisopropylchlorosilane		5mL	25mL
D1560	Dimethyloctadecylchlorosilane			25mL
D1827	Dimethyl-*n*-octylchlorosilane		25mL	100mL
D1509	Dodecyltrichlorosilane			25mL
D1510	Dodecyltriethoxysilane			10mL
D3383	Dodecyltrimethoxysilane		25g	250g
E0188	Ethyltrichlorosilane		25g	500g
E0789	Ethyltrimethoxysilane			25g
H1376	Hexadecyltrimethoxysilane			25g
H1158	Hexyltriethoxysilane		25mL	500mL
H0879	Hexyltrimethoxysilane		25mL	500mL
I0452	Isobutyltrichlorosilane		25g	500g
O0165	Octadecyltriethoxysilane			25g
O0256	Octadecyltrimethoxysilane			25mL
O0168	*n*-Octyltrichlorosilane		25g	250g
T2517	Thexyltrichlorosilane		5g	25g
H0547	Trichlorohexylsilane			25mL
M0450	Trichloro(methyl)silane	25g	100g	500g
O0079	Trichlorooctadecylsilane			25g
P0371	Trichloro(propyl)silane			25g
T0924	Trichlorotetradecylsilane			10mL
E0189	Triethoxyethylsilane			25mL
M0451	Triethoxymethylsilane		25mL	500mL
O0171	Triethoxy-*n*-octylsilane		25mL	500mL
T2867	Triethoxy(propyl)silane		25g	100g
T1078	Triisopropylsilyl Chloride	5mL	25mL	250mL
M0660	Trimethoxy(methyl)silane		25mL	500mL
T2875	Trimethoxy-*n*-octylsilane			25mL
T1801	Trimethoxy(propyl)silane		25mL	500mL

Aryl Silanes, Arylalkyl Silanes

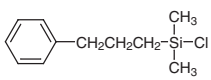
B2334



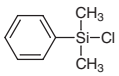
B3282



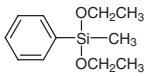
C1488



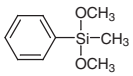
D1147



D3760

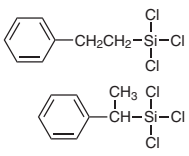


D2319

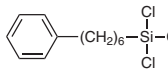


P0240

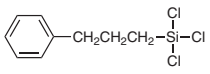
T2852



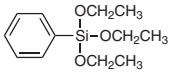
T2854



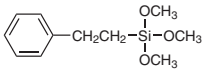
T2853



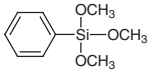
P0735



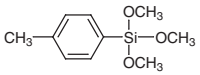
T2869



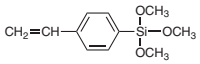
P0857



T2560



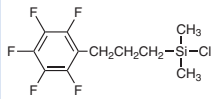
T3185



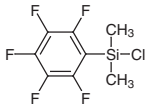
Product No.	Product Name			Unit Size
B2334	Benzylchlorodimethylsilane			5g
B3282	Benzyltriethoxysilane	1g	5g	25g
C1488	Chlorodimethyl(3-phenylpropyl)silane		5mL	25mL
D1147	Chlorodimethylphenylsilane			25mL
D3760	Diethoxy(methyl)phenylsilane			25g
D2319	Dimethoxymethylphenylsilane		25mL	100mL
P0240	Phenyltrichlorosilane		25g	500g
T2852	Trichloro(phenylethyl)silane (mixture of isomers)			25g
T2854	Trichloro(6-phenylhexyl)silane		5g	25g
T2853	Trichloro(3-phenylpropyl)silane		5g	25g
P0735	Triethoxyphenylsilane		25mL	500mL
T2869	Trimethoxy(2-phenylethyl)silane [contains *ca.* 25% Trimethoxy(1-phenylethyl)silane]		25g	100g
P0857	Trimethoxyphenylsilane	25mL	100mL	500mL
T2560	Trimethoxy(*p*-tolyl)silane			5g
T3185	Trimethoxy(4-vinylphenyl)silane		5g	25g

Fluoroalkyl Silanes, Fluoroaryl Silanes

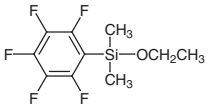
C2700



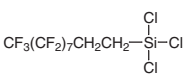
P0854



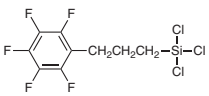
P1242



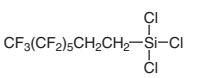
T2705



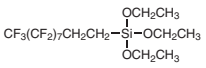
T3030



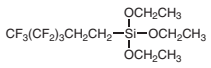
T2577



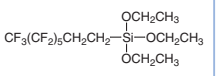
T2876



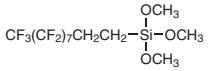
T2860



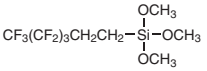
T1770



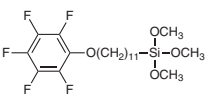
T2917



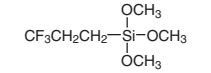
T2918



T3158



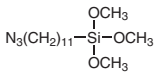
T2720



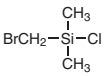
Product No.	Product Name	Unit Size	
C2700	Chlorodimethyl[3-(2,3,4,5,6-pentafluorophenyl)propyl]silane	5g	25g
P0854	Pentafluorophenyldimethylchlorosilane	1mL	5mL
P1242	Pentafluorophenylethoxydimethylsilane		1g
T2705	Trichloro(1*H*,1*H*,2*H*,2*H*-heptadecafluorodecyl)silane	5g	25g
T3030	Trichloro[3-(pentafluorophenyl)propyl]silane	1g	5g
T2577	Trichloro(1*H*,1*H*,2*H*,2*H*-tridecafluoro-*n*-octyl)silane		5g
T2876	Triethoxy-1*H*,1*H*,2*H*,2*H*-heptadecafluorodecylsilane		5g
T2860	Triethoxy(1*H*,1*H*,2*H*,2*H*-nonafluorohexyl)silane	5g	25g
T1770	Triethoxy-1*H*,1*H*,2*H*,2*H*-tridecafluoro-*n*-octylsilane	5g	25g
T2917	Trimethoxy(1*H*,1*H*,2*H*,2*H*-heptadecafluorodecyl)silane	5g	25g
T2918	Trimethoxy(1*H*,1*H*,2*H*,2*H*-nonafluorohexyl)silane	5g	25g
T3158	Trimethoxy(11-pentafluorophenoxyundecyl)silane (This product is only available in Japan.)		100mg
T2720	Trimethoxy(3,3,3-trifluoropropyl)silane	5g	25g

Other Silane Coupling Agents

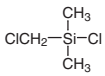
A2783



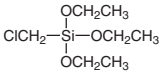
B0847



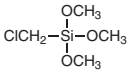
C0605



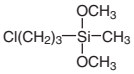
C1402



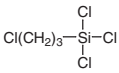
C3073



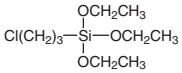
C1168



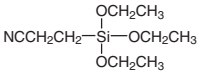
C0844



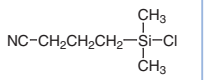
T1253



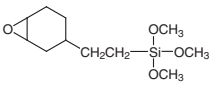
C1259



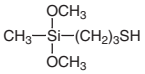
C1207



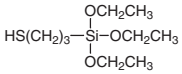
E0327



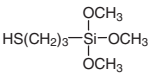
M1323



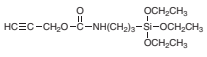
M1505



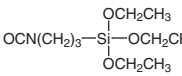
M0928



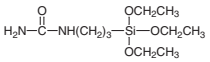
P2258



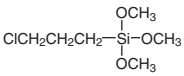
I0556



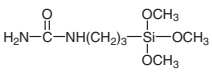
U0048



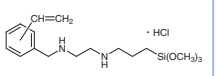
C0840



T1915



V0050



Product No.	Product Name	Unit Size	
A2783	(11-Azidoundecyl)trimethoxysilane		100mg
B0847	(Bromomethyl)chlorodimethylsilane		25g
C0605	Chloro(chloromethyl)dimethylsilane	25g	250g
C1402	(Chloromethyl)triethoxysilane		10g
C3073	(Chloromethyl)trimethoxysilane	5g	25g
C1168	3-Chloropropyldimethoxymethylsilane	5g	25g

Product No.	Product Name			Unit Size
C0844	3-Chloropropyltrichlorosilane			25g
T1253	3-Chloropropyltriethoxysilane		25mL	500mL
C1259	2-Cyanoethyltriethoxysilane		25mL	250mL
C1207	(3-Cyanopropyl)dimethylchlorosilane		5mL	25mL
E0327	2-(3,4-Epoxycyclohexyl)ethyltrimethoxysilane		25mL	500mL
M1323	3-Mercaptopropyl(dimethoxy)methylsilane			25mL
M1505	(3-Mercaptopropyl)triethoxysilane	25g	100g	500g
M0928	(3-Mercaptopropyl)trimethoxysilane	25mL	100mL	500mL
P2258	2-Propynyl [3-(Triethoxysilyl)propyl]carbamate		1g	5g
I0556	3-(Triethoxysilyl)propyl Isocyanate		25g	100g
U0048	1-[3-(Triethoxysilyl)propyl]urea (40-52% in Methanol)		25mL	500mL
C0840	3-Trimethoxysilylpropyl Chloride		25mL	500mL
T1915	1-[3-(Trimethoxysilyl)propyl]urea		25g	250g
V0050	*N*-[2-(*N*-Vinylbenzylamino)ethyl]-3-aminopropyltrimethoxysilane Hydrochloride (30-40% in Methanol)			25mL

References

1) E. P. Plueddemann, in *Silane Coupling Agents*, 2nd ed., Springer US, New York, **1991**.
2) K. L. Mittal, in *Silanes and Other Coupling Agents*, CRC Press, New York, **2009**, Vol. 5.

Self-Assembled Monolayer (SAM) Forming Agents

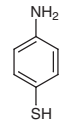
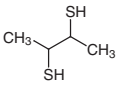
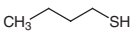
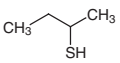
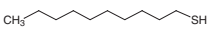
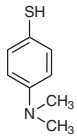
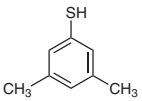
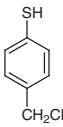
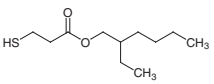
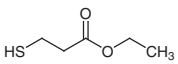
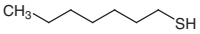
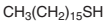
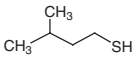
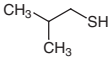
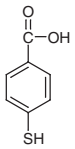
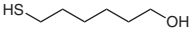
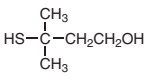
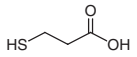
Self-assembly is the spontaneous gathering and regular arrangement of atoms, molecules and particles and is observed in various natural environments. There are many reports describing basic and applied research into artificial self-assembly, in particular "self-assembled monolayers (SAMs)" formed by the aggregation of organic molecules on a solid surface.

A family of organic silicon compounds, silane coupling agents, can form SAMs on glass, alumina and other inorganic oxide surfaces. Thiols (R-SH) are used to forms SAMs on the surface of metal nanoparticles and metal substrates because of their high affinity for gold, silver and other transition metals. Phosphonic acids ($R\text{-}PO_3H_2$) combine with the surfaces of many inorganic oxides to form stable SAMs.

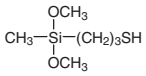
Reference

J. C. Love, L. A. Estroff, J. K. Kriebel, R. G. Nuzzo, G. M. Whitesides, *Chem. Rev.* **2005**, *105*, 1103.

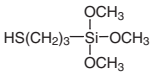
Silane Coupling Agents (see p.305)

Thiols		A0623	B0041	B2888
				
B0685	B0686	C0727	C0810	D0016
				
D4047	D4286	D0970	E0672	M1067
				
M1038	H0029	H0068	H0103	I0149
				
M0404	M1294	M2266	M2433	M0061
				

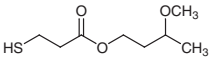
M1323



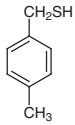
M0928



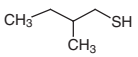
M1802



M0682

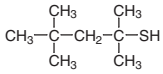


M1041



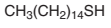
O0005

O0026

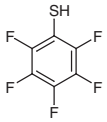


O0025

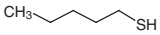
P0836



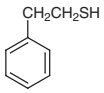
P0861



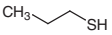
P0053



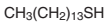
P1715



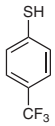
P0488



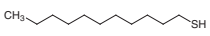
T0082



T2972



U0066

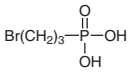


Product No.	Product Name	Unit Size		
A0623	4-Aminobenzenethiol			25g
B0041	Benzenethiol		25mL	500mL
B2888	2,3-Butanedithiol		5g	25g
B0685	1-Butanethiol		25mL	500mL
B0686	*sec*-Butyl Mercaptan		25mL	500mL
C0727	Cyclohexanethiol		25mL	500mL
C0810	Cyclopentanethiol		5mL	25mL
D0016	1-Decanethiol		25mL	500mL
D4047	4-(Dimethylamino)benzenethiol			1g
D4286	3,5-Dimethylbenzenethiol			5g
D0970	1-Dodecanethiol		25mL	500mL
E0672	4-Ethylbenzenethiol		5g	25g
M1067	2-Ethylhexyl 3-Mercaptopropionate		25mL	500mL
M1038	Ethyl 3-Mercaptopropionate		25g	500g
H0029	1-Heptanethiol		10g	25g
H0068	1-Hexadecanethiol		25mL	500mL
H0103	Hexyl Mercaptan		25mL	500mL
I0149	Isoamyl Mercaptan		25mL	250mL
M0404	Isobutyl Mercaptan		25mL	500mL
M1294	4-Mercaptobenzoic Acid		5g	25g
M2266	6-Mercapto-1-hexanol		5g	25g
M2433	3-Mercapto-3-methyl-1-butanol		5g	25g
M0061	3-Mercaptopropionic Acid	25g	100g	500g
M1323	3-Mercaptopropyl(dimethoxy)methylsilane			25mL
M0928	(3-Mercaptopropyl)trimethoxysilane	25mL	100mL	500mL
M1802	3-Methoxybutyl 3-Mercaptopropionate		25g	500g
M0682	4-Methylbenzyl Mercaptan		10mL	25mL
M1041	2-Methyl-1-butanethiol		5g	25g
O0005	1-Octadecanethiol		25g	400g
O0026	*tert*-Octanethiol			5mL
O0025	1-Octanethiol		25mL	500mL
P0836	1-Pentadecanethiol			10mL

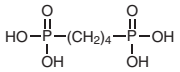
Product No.	Product Name	Unit Size	
P0861	Pentafluorobenzenethiol	5g	25g
P0053	1-Pentanethiol	25mL	500mL
P1715	2-Phenylethanethiol	5g	25g
P0488	1-Propanethiol	25mL	500mL
T0082	1-Tetradecanethiol		25mL
T2972	4-(Trifluoromethyl)benzenethiol	1g	5g
U0066	1-Undecanethiol		5mL

Phosphonic Acids

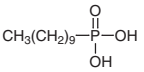
B1591



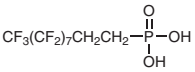
B4848



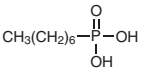
D3884



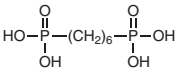
H1459



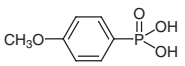
H1535



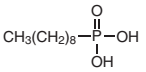
H1536



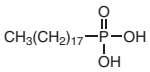
M1155



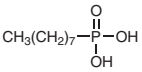
N1025



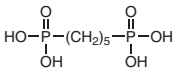
O0371



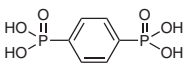
O0380



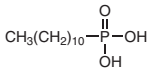
P2300



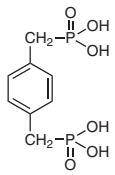
P2303



U0088



X0074



Product No.	Product Name	Unit Size	
B1591	(3-Bromopropyl)phosphonic Acid	1g	5g
B4848	1,4-Butylenediphosphonic Acid		1g
D3884	Decylphosphonic Acid	1g	5g
H1459	(1*H*,1*H*,2*H*,2*H*-Heptadecafluorodecyl)phosphonic Acid		200mg
H1535	Heptylphosphonic Acid	1g	5g
H1536	1,6-Hexylenediphosphonic Acid		1g
M1155	4-Methoxyphenylphosphonic Acid		1g
N1025	Nonylphosphonic Acid		1g
O0371	Octadecylphosphonic Acid	1g	5g
O0380	*n*-Octylphosphonic Acid	1g	5g
P2300	1,5-Pentylenediphosphonic Acid		1g
P2303	1,4-Phenylenediphosphonic Acid	200mg	1g
U0088	Undecylphosphonic Acid	1g	5g
X0074	*p*-Xylylenediphosphonic Acid	1g	5g

Polymers

Polyvinyl chloride and polyethylene polymers have long been the mainstay of industrial polymers but are now making way for new high performance polymers. Engineering plastics are polymers engineered to have various specific properties.

For example, some polymers are designed for thermal resistance, such as polyamide and polycarbonate, and are widely used. The thermal resistance of a polymer is determined by the softening point: an increase in the softening point increases the material strength. Engineering plastics such as polysulfone, polyether sulfone, polyarylate and polyimide have been developed to improve the softening point and material strength. The softening points of these polymers are all above 150 °C, and these polymers are incorporated into, for example, firefighter uniforms and bulletproof vests. R&D into engineering plastics continues to further improve their performance.

There has also been extensive research into adding new functions to polymers, such as electrical, optical, medical and biological properties. For example, copolymers obtained by the polymerization of fluorine-containing monomers and a variety of other monomers are used to make photoresists, optical fiber dressings, oxygen enrichment membranes, and membrane oxygenators. The maximum absorbance of polysilane is in the ultraviolet region, and it is photosensitive; therefore, polysilane can be used as a positive-type resist with excellent oxygen plasma resistance. Another polymer, polylactic acid (PLA), has been commercialized as an environmentally-friendly polymer that reduces the consumption of fossil fuel resources because it is made from biomass raw materials.

There are many broad applications of polymer materials, making R&D in this field highly promising. The page below describes natural polymers, semisynthetic polymers and synthetic polymers.

Natural Polymers

Product No.	Product Name	Unit Size		
A0733	Alginic Acid		25g	500g
A0456	Amylopectin Hydrate (Amylose free), from Waxy Corn		25g	500g
A0847	Amylose (*Mw.=ca.* 15,000)			1g
A1328	(+)-Arabinogalactan from Larch Wood			25g
A0738	Calcium Alginate		25g	500g
C1805	*ι*-Carrageenan		25g	500g
C1804	*κ*-Carrageenan		25g	500g
C2871	*λ*-Carrageenan		1g	5g
C0072	Chitin		25g	250g
C2395	Chitosan (5-20mPa·s, 0.5% in 0.5% Acetic Acid at 20℃)		25g	500g
C2396	Chitosan (50-100mPa·s, 0.5% in 0.5% Acetic Acid at 20℃)		25g	100g
C0831	Chitosan (200-600mPa·s, 0.5% in 0.5% Acetic Acid at 20℃)		25g	500g
C0335	Chondroitin Sulfate Sodium Salt		25g	100g
D3672	Dermatan Sulfate Sodium Salt		20mg	100mg
D1448	Dextran 40 (*Mw.=ca.* 40,000)		25g	500g
D1449	Dextran 70 (*Mw.=ca.* 70,000)	25g	100g	500g
G0331	Glucan from Black Yeast		1g	5g
H0393	Heparin Sodium Salt from Hog intestine		100mg	1g
H0595	Hyaluronic Acid from Cockscomb			1g
I0041	Inulin		5g	25g
L0082	Lignin (Alkaline)		25g	500g
L0045	Lignin (Dealkaline)		25g	500g
P0024	Pectin from Citrus		25g	500g
H0652	Potassium Hyaluronate from Cockscomb			1g
H0603	Sodium Hyaluronate from Cockscomb		100mg	1g
L0098	Sodium Ligninsulfonate		25g	500g
X0048	Xanthan Gum		25g	500g
Z0008	Zymosan		100mg	1g

Semisynthetic Polymers

Product No.	Product Name	Unit Size		
C0045	Carboxymethyl Cellulose Sodium n≈500		25g	500g
C0603	Carboxymethyl Cellulose Sodium n≈1050		25g	500g
E0265	Ethyl Cellulose [9-11mPa·s, 5% in Toluene + Ethanol (80:20) at 25℃]		25g	500g
E0072	Ethyl Cellulose [18-22mPa·s, 5% in Toluene + Ethanol (80:20) at 25℃]		25g	500g
E0266	Ethyl Cellulose [45-55mPa·s, 5% in Toluene + Ethanol (80:20) at 25℃]		25g	500g
E0290	Ethyl Cellulose [90-110mPa·s, 5% in Toluene + Ethanol (80:20) at 25℃]		25g	500g
H0242	Hydroxyethyl Cellulose (200-300mPa·s, 2% in Water at 20℃)		25g	500g
H0418	Hydroxyethyl Cellulose (800-1,500mPa·s, 2% in Water at 20℃)		25g	500g
H0392	Hydroxyethyl Cellulose (4,500-6,500mPa·s, 2% in Water at 25℃)		25g	500g
H0473	Hydroxypropyl Cellulose (3-6mPa·s, 2% in Water at 20℃)		25g	500g
H0474	Hydroxypropyl Cellulose (6-10mPa·s, 2% in Water at 20℃)		25g	500g
H0386	Hydroxypropyl Cellulose (150-400mPa·s, 2% in Water at 20℃)		25g	500g
H0475	Hydroxypropyl Cellulose (1,000-4,000mPa·s, 2% in Water at 20℃)		25g	500g
M0290	Methyl Cellulose (13-18mPa·s, 2% in Water at 20℃)		25g	500g
M0291	Methyl Cellulose (20-30mPa·s, 2% in Water at 20℃)		25g	500g
M0292	Methyl Cellulose (80-120mPa·s, 2% in Water at 20℃)		25g	500g
M0293	Methyl Cellulose (350-550mPa·s, 2% in Water at 20℃)		25g	500g
M0294	Methyl Cellulose (1,000-1,800mPa·s, 2% in Water at 20℃)		25g	500g
M0185	Methyl Cellulose (3,500-5,600mPa·s, 2% in Water at 20℃)		25g	500g
M0295	Methyl Cellulose (7,000-10,000mPa·s, 2% in Water at 20℃)		25g	500g

Synthetic Polymers

Product No.	Product Name	Unit Size		
A0140	Acrylamide Polymer (*Mw.*=400,000-800,000) (containing small amounts of formalin as fungicide) (10% in Water)			500g
A0259	3-Aminobenzaldehyde Polymer			25g
A0260	4-Aminobenzaldehyde Polymer			25g
G0264	Ethyl Glyoxylate Polymer form (47% in Toluene)	25g	100g	500g
M0086	Isobutyl Methacrylate Polymer		25g	500g
M0088	Methyl Methacrylate Polymer		25g	500g
S0098	Poly(diethylene Glycol Succinate)			25g
P0840	Polyethylene Glycol 200		25g	500g
H0543	Polyethylene Glycol 300		25g	500g
N0443	Polyethylene Glycol 400		25g	500g
P1187	Polyethylene Glycol 600		25g	500g
P2034	Polyethylene Glycol 2,000		25g	500g
P0885	Polyethylene Glycol 4,000		25g	500g
P0903	Polyethylene Glycol 6,000		25g	500g
P2241	Polyethylene Glycol Dimethyl Ether (*Mw.*=*ca.* 240)		25g	500g
P0872	Polyethylene Glycol Monolaurate n≈10		25g	500g
P2183	Polyethylene Glycol Monomethyl Ether 400		100g	500g
P2184	Polyethylene Glycol Monomethyl Ether 550		100g	500g
P2185	Polyethylene Glycol Monomethyl Ether 1000		100g	500g
P2186	Polyethylene Glycol Monomethyl Ether 2000		100g	500g
P2187	Polyethylene Glycol Monomethyl Ether 4000		100g	500g
P0704	Polyethylene Glycol Mono-4-nonylphenyl Ether n≈2			25g
P0707	Polyethylene Glycol Mono-4-nonylphenyl Ether n≈10			25g
P0708	Polyethylene Glycol Mono-4-nonylphenyl Ether n≈15			25g
P0709	Polyethylene Glycol Mono-4-nonylphenyl Ether n≈18			25g
P0710	Polyethylene Glycol Mono-4-nonylphenyl Ether n≈20			25g
P0467	Poly(ethylene Glycol Succinate)			25g
P0381	Polyethyleneimine (*ca.* 30% in Water)		25g	500g
P2018	Poly(3-hexylthiophene-2,5-diyl) (regioregular)		200mg	1g
P0384	Poly(methyl Vinyl Ether) (30% in Water)		25g	500g
S0099	Poly(neopentyl Glycol Succinate)		5g	25g
P0966	Poly(perfluoropropylene Oxide)			10g
P0469	Poly(vinyl Alcohol) n=1750±50		25g	500g
P0804	Poly(vinyl Alcohol) n≈2,000 (degree's of saponification *ca.* 80mol%)		25g	500g
P0656	Poly(*N*-vinylcarbazole)		5g	25g
P0641	Polyvinylformal		25g	500g
P1007	Poly(vinyl Methyl Ether) (50% in Methanol)			500g
P0691	Polyvinylpyrrolidone (insoluble)			100g

Product No.	Product Name			Unit Size
P0471	Polyvinylpyrrolidone K 15 Viscosity Average Molecular Wt. 10,000	25g	100g	500g
P0472	Polyvinylpyrrolidone K 30 Viscosity Average Molecular Wt. 40,000		25g	500g
P0696	Polyvinylpyrrolidone K 60 Viscosity Average Molecular Wt. 160,000 (*ca.* 35% in Water)		25g	500g
P0473	Polyvinylpyrrolidone K 90 Viscosity Average Molecular Wt. 360,000		25g	500g
P0385	Poly(1-vinylpyrrolidone-*co*-Vinyl Acetate) (Copolymer, 3:7) (50% in Ethanol)		25g	500g
P0382	Poly(1-vinylpyrrolidone-*co*-Vinyl Acetate) (Copolymer, 7:3) (50% in Ethanol)		25g	500g

Monomers

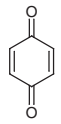
Monomers are the building blocks of polymers and are categorized below. Lists of categorized monomers also appear on our website.

- Ethylene Monomers
- Styrene Monomers
- Acrylate Monomers
- Methacrylate Monomers
- Acrylamide Monomers
- Methacrylamide Monomers
- Divinyl Monomers, Diallyl Monomers
- Cyclic Olefin Monomers
- Epoxide Monomers
- Diol Monomers
- Diamine Monomers
- Tetracarboxylic Dianhydride Monomers
- Dicarboxylic Acid Monomers
- Diacid Chloride Monomers
- Bismaleimide Monomers
- Isocyanate Monomers
- Thiol Monomers
- Lactone, Lactide Monomers
- etc.

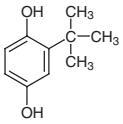
Polymerization Inhibitors

Monomers are often stabilized by the addition of inhibitors to prevent polymerization initiation by light, heat and air. For example, stable radical compounds which can trap free radicals are used to inhibit radical polymerization.

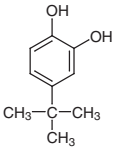
B0887



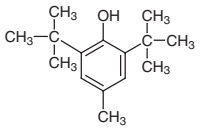
B0833



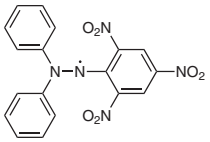
B0739



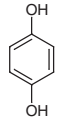
D0228



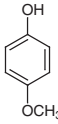
D4313



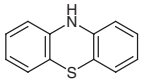
H0186



M0123



P0106



Product No.	Product Name	Unit Size		
B0887	1,4-Benzoquinone		25g	500g
B0833	*tert*-Butylhydroquinone		25g	500g
B0739	4-*tert*-Butylpyrocatechol		25g	500g
D0228	2,6-Di-*tert*-butyl-*p*-cresol		25g	500g
D4313	1,1-Diphenyl-2-picrylhydrazyl Free Radical		1g	5g
H0186	Hydroquinone		25g	500g
M0123	4-Methoxyphenol	25g	100g	500g
P0106	Phenothiazine		25g	500g

Polymerization Initiators

Initiators are often used in chain-growth polymerization such as radical polymerization to regulate initiation by heat or light.

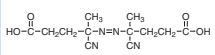
Thermal polymerization initiators are compounds that generate radicals or cations upon exposure to heat. For example, azo compounds such as 2,2'-azobis(isobutyronitrile) (AIBN) and organic peroxides such as benzoyl peroxide (BPO) are well-known thermal radical initiators, and benzenesulfonic acid esters and alkylsulfonium salts have been developed as thermal cation initiators.

Photopolymerization initiators are roughly categorized into three groups depending on the generated active species (radicals, cations, anions). Conventional photopolymerization initiators such as benzoin derivatives generate free radicals upon light irradiation. Photo-acid generators which produce cations (acid) upon light irradiation found practical use in the late 1990s. Photo-base generators, which produce anions (base) upon light irradiation, are of current research interest.

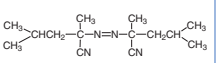
Thermal Polymerization Initiators

Thermal Radical Initiators

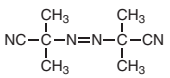
A1671



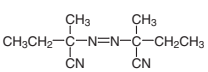
A0680



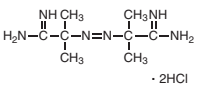
A0566



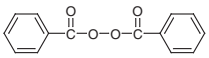
A1670



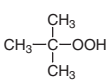
A2735



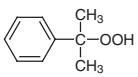
B3152



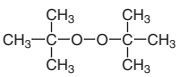
B3153



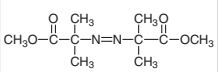
C2223



D3411



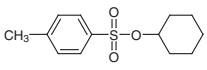
D3797



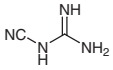
Product No.	Product Name	Unit Size	
A1671	4,4'-Azobis(4-cyanovaleric Acid) (contains *ca.* 20% Water)	25g	250g
A0680	2,2'-Azobis(2,4-dimethylvaleronitrile)	25g	500g
A0566	2,2'-Azobis(isobutyronitrile)	25g	500g
A1670	2,2'-Azobis(2-methylbutyronitrile)	25g	500g
A2735	2,2'-Azobis(2-methylpropionamidine) Dihydrochloride		25g
B3152	Benzoyl Peroxide (wetted with *ca.* 25% Water)		25g
B3153	*tert*-Butyl Hydroperoxide (70% in Water)		100g
C2223	Cumene Hydroperoxide (contains *ca.* 20% Aromatic Hydrocarbon)		100g
D3411	Di-*tert*-butyl Peroxide		100mL
D3797	Dimethyl 2,2'-Azobis(2-methylpropionate)		25g

Thermal Cationic Initiators

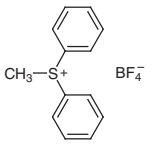
C2363



C0454



D2685

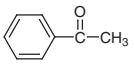


Product No.	Product Name	Unit Size	
C2363	Cyclohexyl *p*-Toluenesulfonate	5g	25g
C0454	Dicyandiamide	25g	500g
D2685	Diphenyl(methyl)sulfonium Tetrafluoroborate	1g	5g

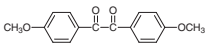
Photopolymerization Initiators

Photo-Radical Initiators

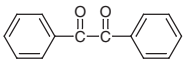
A0061



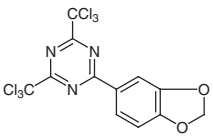
A1028



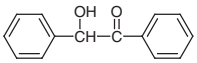
B0221
B0050



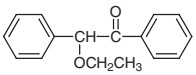
B3633



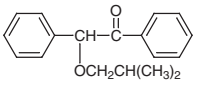
B0222
B0079



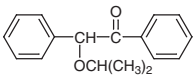
B1019



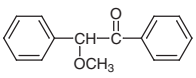
B1015



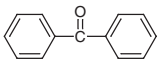
B0942



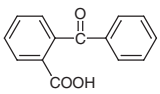
B0869



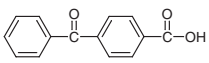
B0083



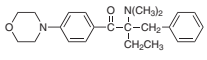
B0103



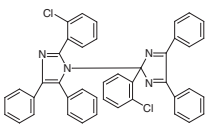
B1164



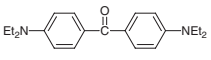
B3914



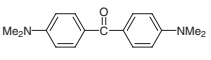
B1225



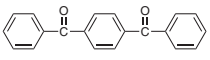
B0139



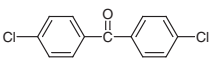
B0481



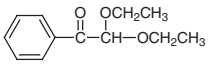
D4196



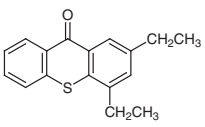
D1621



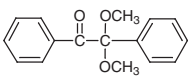
D1640



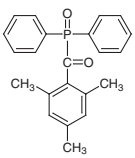
D2375



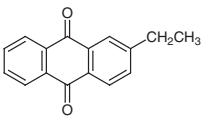
D1702



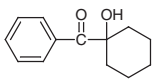
D3358



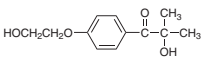
E0063



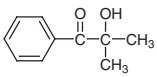
H0617



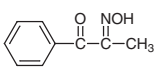
H1361

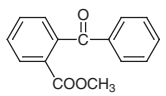
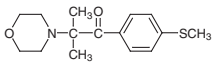
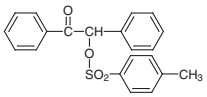


H0991



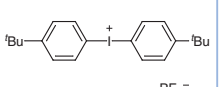
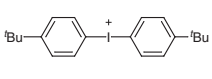
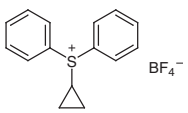
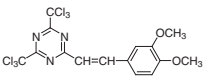
P0211

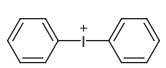
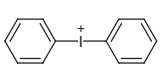
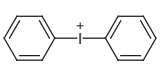
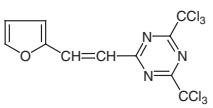
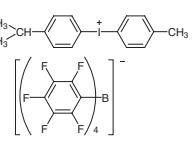


B1231	M2028	P1410
		

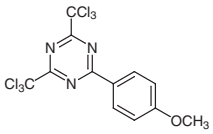
Product No.	Product Name			Unit Size
A0061	Acetophenone		25g	500g
A1028	*p*-Anisil			25g
B0221	Benzil Zone Refined (number of passes:22)			1sample
B0050	Benzil		25g	500g
B3633	2-(1,3-Benzodioxol-5-yl)-4,6-bis(trichloromethyl)-1,3,5-triazine			5g
B0222	Benzoin Zone Refined (number of passes:40)			1sample
B0079	Benzoin		25g	500g
B1019	Benzoin Ethyl Ether	25g	100g	500g
B1015	Benzoin Isobutyl Ether		25g	500g
B0942	Benzoin Isopropyl Ether		25g	500g
B0869	Benzoin Methyl Ether		25g	500g
B0083	Benzophenone		25g	500g
B0103	2-Benzoylbenzoic Acid		25g	500g
B1164	4-Benzoylbenzoic Acid		5g	25g
B3914	2-Benzyl-2-(dimethylamino)-4'-morpholinobutyrophenone		25g	100g
B1225	2,2'-Bis(2-chlorophenyl)-4,4',5,5'-tetraphenyl-1,2'-biimidazole			25g
B0139	4,4'-Bis(diethylamino)benzophenone		25g	500g
B0481	4,4'-Bis(dimethylamino)benzophenone		25g	500g
D4196	1,4-Dibenzoylbenzene			5g
D1621	4,4'-Dichlorobenzophenone		25g	500g
D1640	2,2-Diethoxyacetophenone		25g	500g
D2375	2,4-Diethylthioxanthen-9-one		25g	250g
D1702	2,2-Dimethoxy-2-phenylacetophenone	25g	100g	500g
D3358	Diphenyl(2,4,6-trimethylbenzoyl)phosphine Oxide			25g
E0063	2-Ethylanthraquinone		25g	500g
H0617	1-Hydroxycyclohexyl Phenyl Ketone		25g	500g
H1361	2-Hydroxy-4'-(2-hydroxyethoxy)-2-methylpropiophenone	5g	25g	100g
H0991	2-Hydroxy-2-methylpropiophenone	25g	100g	500g
P0211	2-Isonitrosopropiophenone			25g
B1231	Methyl 2-Benzoylbenzoate		25g	500g
M2028	2-Methyl-4'-(methylthio)-2-morpholinopropiophenone		25g	500g
P1410	2-Phenyl-2-(*p*-toluenesulfonyloxy)acetophenone			1g

Photo-Cationic Initiators

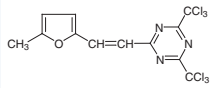
B2380	B2381	C1390	D2963
			

D2248	D2238	D2253	F0362	I0591
				

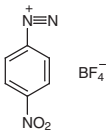
M1245



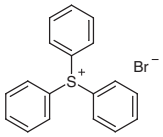
M1209



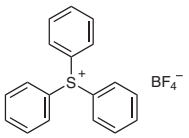
N0137



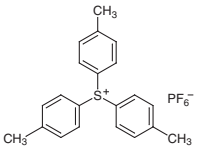
T1609



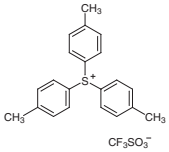
T1608



T2041



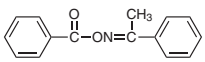
T2042



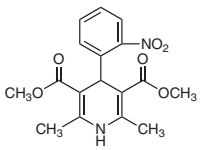
Product No.	Product Name		Unit Size	
B2380	Bis(4-*tert*-butylphenyl)iodonium Hexafluorophosphate		1g	5g
B2381	Bis(4-*tert*-butylphenyl)iodonium Trifluoromethanesulfonate			1g
C1390	Cyclopropyldiphenylsulfonium Tetrafluoroborate			1g
D2963	2-(3,4-Dimethoxystyryl)-4,6-bis(trichloromethyl)-1,3,5-triazine			5g
D2248	Diphenyliodonium Hexafluoroarsenate			1g
D2238	Diphenyliodonium Hexafluorophosphate	1g	5g	25g
D2253	Diphenyliodonium Trifluoromethanesulfonate		1g	5g
F0362	2-[2-(Furan-2-yl)vinyl]-4,6-bis(trichloromethyl)-1,3,5-triazine			5g
I0591	4-Isopropyl-4'-methyldiphenyliodonium Tetrakis(pentafluorophenyl)borate		5g	25g
M1245	2-(4-Methoxyphenyl)-4,6-bis(trichloromethyl)-1,3,5-triazine		5g	25g
M1209	2-[2-(5-Methylfuran-2-yl)vinyl]-4,6-bis(trichloromethyl)-1,3,5-triazine			5g
N0137	4-Nitrobenzenediazonium Tetrafluoroborate			25g
T1609	Triphenylsulfonium Bromide	100mg	1g	5g
T1608	Triphenylsulfonium Tetrafluoroborate		1g	5g
T2041	Tri-*p*-tolylsulfonium Hexafluorophosphate			1g
T2042	Tri-*p*-tolylsulfonium Trifluoromethanesulfonate		1g	5g

Photo-Anionic Initiators

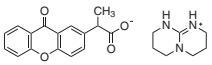
A2502



N0528



O0396



Product No.	Product Name	Unit Size	
A2502	Acetophenone *O*-Benzoyloxime	1g	5g
N0528	Nifedipine	10g	25g
O0396	2-(9-Oxoxanthen-2-yl)propionic Acid 1,5,7-Triazabicyclo[4.4.0]dec-5-ene Salt		1g

Polymerization Catalysts

The Zieglar-Natta catalyst discovered in 1953 made possible the synthesis of high-density polyethylene. Later, transition metal catalysts such as metallocene were developed for polyolefin synthesis. Transition metal carbene complexes were used as catalysts for ring-opening metathesis polymerization in Nobel Prize-winning work in 2005.

This section also includes catalysts for Kumada-Tamao-Corriu cross coupling for polymer synthesis.

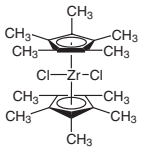
Olefin Polymerization Catalysts

Metallocene Catalysts

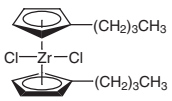
C1994

C1995

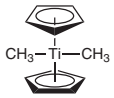
D3307



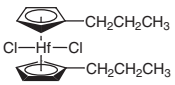
D3321



D4100

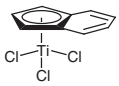


D3286

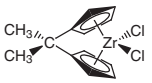


H0914

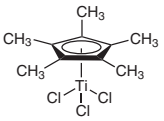
I0646



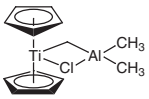
I0645



P1651



C1411



T0616

V0090

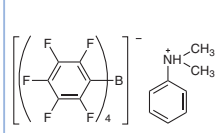
Z0010

Z0007

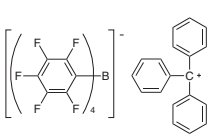
Product No.	Product Name	Unit Size		
C1994	Cyclopentadienyltitanium(IV) Trichloride		1g	5g
C1995	Cyclopentadienylzirconium(IV) Trichloride		1g	5g
D3307	Decamethylzirconocene Dichloride			1g
D3321	1,1'-Dibutylzirconocene Dichloride		1g	5g
D4100	Dimethyltitanocene (5% in Tetrahydrofuran/Toluene)			100g
D3286	1,1'-Dipropylhafnocene Dichloride			1g
H0914	Hafnocene Dichloride	1g	5g	25g
I0646	(Indenyl)titanium(IV) Trichloride			1g
I0645	1,1'-Isopropylidenezirconocene Dichloride			100mg
P1651	(Pentamethylcyclopentadienyl)titanium(IV) Trichloride			1g
C1411	Tebbe Reagent (*ca.* 0.5mol/L in Toluene)			25mL
T0616	Titanocene Dichloride		5g	25g
V0090	Vanadinocene Dichloride			1g
Z0010	Zirconocene Chloride Hydride	1g	5g	25g
Z0007	Zirconocene Dichloride		5g	25g

Olefin Polymerization Co-catalysts

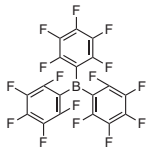
D4404



T2863



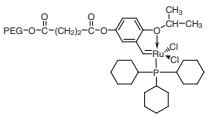
T2313



Product No.	Product Name	Unit Size	
D4404	*N*,*N*-Dimethylanilinium Tetrakis(pentafluorophenyl)borate	200mg	1g
T2863	Triphenylmethylium Tetrakis(pentafluorophenyl)borate	1g	5g
T2313	Tris(pentafluorophenyl)borane	1g	5g

Olefin Metathesis Catalysts

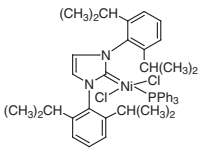
P1427



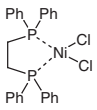
Product No.	Product Name	Unit Size
P1427	Polyethylene Glycol-bound Ruthenium Carbene Complex	100mg

Cross-coupling Polymerization Catalysts

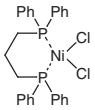
B3235



B2225

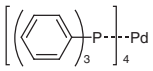


B1313



B3161

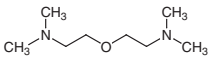
T1350



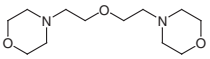
Product No.	Product Name	Unit Size		
B3235	[1,3-Bis(2,6-diisopropylphenyl)imidazol-2-ylidene]triphenylphosphine Nickel(II) Dichloride		200mg	1g
B2225	[1,2-Bis(diphenylphosphino)ethane]nickel(II) Dichloride	1g	5g	25g
B1313	[1,3-Bis(diphenylphosphino)propane]nickel(II) Dichloride		5g	25g
B3161	Bis(tri-*tert*-butylphosphine)palladium(0)		250mg	1g
T1350	Tetrakis(triphenylphosphine)palladium(0)	1g	5g	25g

Polyurethane Catalysts

B1291



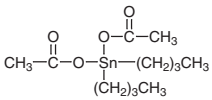
B1784



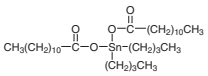
D1313

D0134

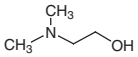
D0302



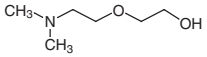
D0303



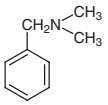
D0649



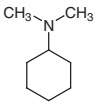
D1756



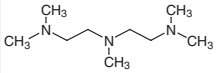
D0688



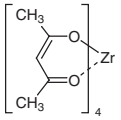
D0705



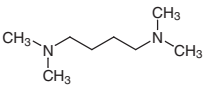
P0881



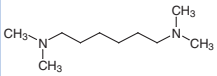
Z0006



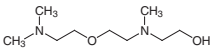
T1289



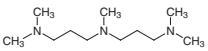
T0537



T1598



T1618



Product No.	Product Name	Unit Size		
B1291	Bis(2-dimethylaminoethyl) Ether		25mL	500mL
B1784	Bis(2-morpholinoethyl) Ether		25g	500g
D1313	1,5-Diazabicyclo[4.3.0]-5-nonene	10mL	25mL	250mL
D0134	1,4-Diazabicyclo[2.2.2]octane	25g	100g	500g
D0302	Dibutyltin Diacetate	25g	100g	500g
D0303	Dibutyltin Dilaurate	25g	100g	500g
D0649	2-(Dimethylamino)ethanol		25mL	500mL
D1756	2-[2-(Dimethylamino)ethoxy]ethanol		25mL	500mL
D0688	*N,N*-Dimethylbenzylamine		25mL	500mL
D0705	*N,N*-Dimethylcyclohexylamine		25mL	500mL
P0881	*N,N,N'*,*N"*,*N"*-Pentamethyldiethylenetriamine		25mL	500mL
Z0006	Tetrakis(2,4-pentanedionato)zirconium(IV)		25g	500g
T1289	*N,N,N'*,*N'*-Tetramethyl-1,4-diaminobutane			25mL
T0537	*N,N,N'*,*N'*-Tetramethyl-1,6-diaminohexane		25mL	500mL
T1598	*N,N,N'*-Trimethyl-*N'*-(2-hydroxyethyl)bis(2-aminoethyl) Ether		25mL	500mL
T1618	2,6,10-Trimethyl-2,6,10-triazaundecane		25mL	500mL

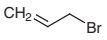
Precise Polymerization Reagents

In the radical, cationic or anionic polymerization of vinyl monomers, the chain propagation is often compromised by termination reaction, chain-transfer reaction, and other side reactions. There has been much research on living polymerization, which decreases termination reaction and maintains actively growing polymer chains, allowing control of the average molecular weight and thus synthesis of polymers with a narrow molecular weight distribution.

Atom Transfer Radical Polymerization (ATRP) Reagents

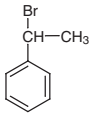
Initiators

B0643

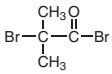


B1058

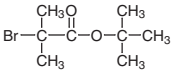
B0592



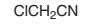
B0607



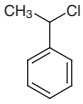
B3500



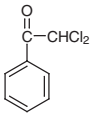
C0094



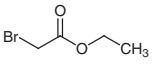
C0166



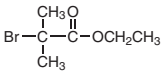
D1122



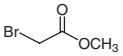
B0532



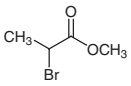
B0606



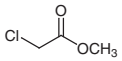
B0533



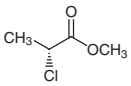
B1460



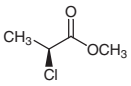
C0093



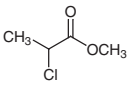
C1633



C1634



C0970

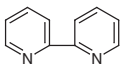


Product No.	Product Name	Unit Size		
B0643	Allyl Bromide		25g	500g
B1058	Bromoacetonitrile	25g	100g	500g
B0592	(1-Bromoethyl)benzene		25g	100g
B0607	2-Bromoisobutyryl Bromide		25g	500g
B3500	*tert*-Butyl 2-Bromoisobutyrate		25g	500g
C0094	Chloroacetonitrile	25g	100g	500g
C0166	(1-Chloroethyl)benzene		25mL	500mL
D1122	2,2-Dichloroacetophenone			25g
B0532	Ethyl Bromoacetate		25g	500g
B0606	Ethyl 2-Bromoisobutyrate	25g	100g	500g
B0533	Methyl Bromoacetate	25g	100g	500g
B1460	Methyl 2-Bromopropionate		25g	500g
C0093	Methyl Chloroacetate		25mL	500mL
C1633	Methyl (*R*)-(+)-2-Chloropropionate			5g

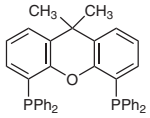
Product No.	Product Name	Unit Size	
C1634	Methyl (*S*)-(-)-2-Chloropropionate		5g
C0970	Methyl 2-Chloropropionate	25mL	500mL

Ligands

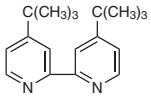
B0468



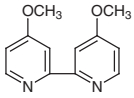
B2709



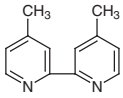
D3134



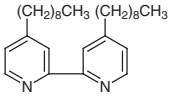
D3886



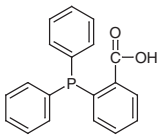
B0852



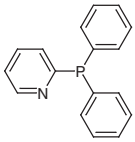
D3917



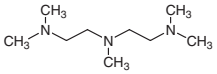
D3242



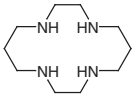
D2471



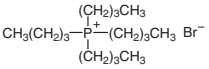
P0881



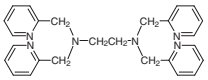
T1597



T1124



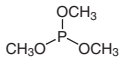
T1487



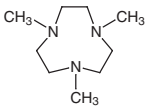
T1878

T0361

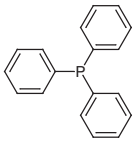
T0488



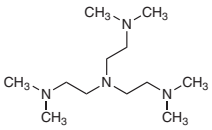
T1879



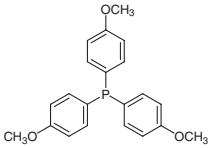
T0519



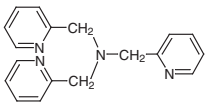
T2898



T0861



T2671

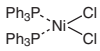


Product No.	Product Name			Unit Size
B0468	2,2'-Bipyridyl	25g	100g	500g
B2709	4,5-Bis(diphenylphosphino)-9,9-dimethylxanthene		1g	5g
D3134	4,4'-Di-*tert*-butyl-2,2'-bipyridyl		1g	5g
D3886	4,4'-Dimethoxy-2,2'-bipyridyl		1g	5g
B0852	4,4'-Dimethyl-2,2'-bipyridyl	1g	5g	25g
D3917	4,4'-Dinonyl-2,2'-bipyridyl		1g	5g
D3242	2-(Diphenylphosphino)benzoic Acid			1g
D2471	Diphenyl-2-pyridylphosphine		1g	5g
P0881	*N*,*N*,*N*',*N*'',*N*''-Pentamethyldiethylenetriamine		25mL	500mL
T1597	1,4,8,11-Tetraazacyclotetradecane		1g	5g
T1124	Tetrabutylphosphonium Bromide	25g	100g	500g
T1487	*N*,*N*,*N*',*N*'-Tetrakis(2-pyridylmethyl)ethylenediamine		1g	5g
T1878	1,4,7-Triazacyclononane	200mg	1g	5g
T0361	Tributylphosphine	25mL	100mL	500mL

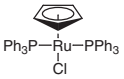
Product No.	Product Name	Unit Size	
T0488	Trimethyl Phosphite		25mL
T1879	1,4,7-Trimethyl-1,4,7-triazacyclononane (stabilized with $NaHCO_3$)	1g	5g
T0519	Triphenylphosphine	25g	500g
T2898	Tris[2-(dimethylamino)ethyl]amine	1g	5g
T0861	Tris(4-methoxyphenyl)phosphine	5g	25g
T2671	Tris(2-pyridylmethyl)amine	1g	5g

Transition Metal Complexes

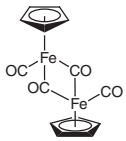
B1571



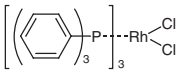
C2201



C1592



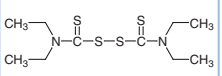
D1997



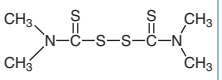
Product No.	Product Name	Unit Size	
B1571	Bis(triphenylphosphine)nickel(II) Dichloride	10g	100g
C2201	Cyclopentadienylbis(triphenylphosphine)ruthenium(II) Chloride	1g	5g
C1592	Cyclopentadienyliron Dicarbonyl Dimer		5g
D1997	Tris(triphenylphosphine)ruthenium(II) Dichloride	1g	5g

Reversible Addition Fragmentation Chain Transfer (RAFT) Polymerization Reagents

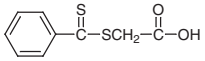
B0479



B0486



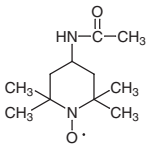
T2401



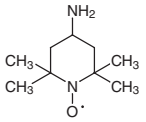
Product No.	Product Name	Unit Size	
B0479	Tetraethylthiuram Disulfide	25g	500g
B0486	Tetramethylthiuram Disulfide	25g	500g
T2401	*S*-(Thiobenzoyl)thioglycolic Acid	5g	25g

Nitroxide-Mediated Radical Polymerization (NMP) Reagents

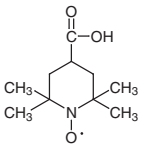
A1348



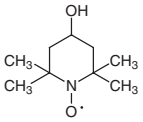
A1343



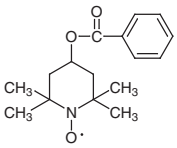
C1428



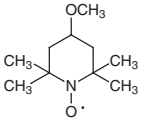
H0865



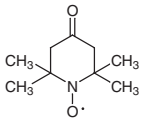
H0878



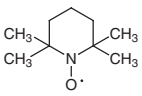
M1197



O0266



T1560

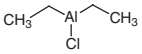


Product No.	Product Name	Unit Size	
A1348	4-Acetamido-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
A1343	4-Amino-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	1g	5g
C1428	4-Carboxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	100mg	1g
H0865	4-Hydroxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
H0878	4-Hydroxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Benzoate Free Radical	1g	5g
M1197	4-Methoxy-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	1g	5g

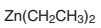
Product No.	Product Name	Unit Size	
O0266	4-Oxo-2,2,6,6-tetramethylpiperidine 1-Oxyl Free Radical	5g	25g
T1560	2,2,6,6-Tetramethylpiperidine 1-Oxyl Free Radical	5g	25g

Immortal Polymerization Reagents

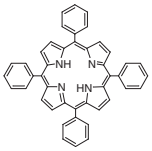
D1340



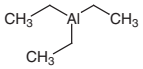
D3902
D3214



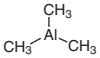
T1359



T0783
T0925



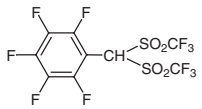
T0782
T1575



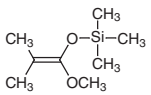
Product No.	Product Name	Unit Size	
D1340	Diethylaluminum Chloride (*ca.* 15% in Hexane, *ca.* 0.87mol/L)		100mL
D3902	Diethylzinc (*ca.* 15% in Toluene, *ca.* 1mol/L)		100mL
D3214	Diethylzinc (*ca.* 17% in Hexane, *ca.* 1mol/L)	100mL	500mL
T1359	Tetraphenylporphyrin (Chlorin free)		1g
T0783	Triethylaluminum (15% in Hexane, *ca.* 1.0mol/L)		100mL
T0925	Triethylaluminum (15% in Toluene, *ca.* 1.1mol/L)		100mL
T0782	Trimethylaluminum (15% in Hexane, *ca.* 1.4mol/L)		100mL
T1575	Trimethylaluminum (15% in Toluene, *ca.* 1.8mol/L)		100mL

Group Transfer Polymerization (GTP) Reagents

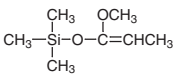
B2291



D1789

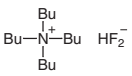


M1199

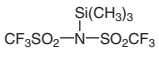


P1888

T1295



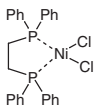
T2392



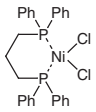
Product No.	Product Name	Unit Size	
B2291	1-[Bis(trifluoromethanesulfonyl)methyl]-2,3,4,5,6-pentafluorobenzene	100mg	1g
D1789	Dimethylketene Methyl Trimethylsilyl Acetal	5mL	25mL
M1199	1-Methoxy-1-trimethylsilyloxypropene	1g	5g
P1888	Potassium Hydrogenfluoride		500g
T1295	Tetrabutylammonium Bifluoride	5g	25g
T2392	*N*-(Trimethylsilyl)bis(trifluoromethanesulfonyl)imide	1g	5g

Catalyst-transfer Polycondensation Reagents

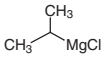
B2225



B1313



I0543
I0542



Product No.	Product Name			Unit Size
B2225	[1,2-Bis(diphenylphosphino)ethane]nickel(II) Dichloride	1g	5g	25g
B1313	[1,3-Bis(diphenylphosphino)propane]nickel(II) Dichloride		5g	25g
I0543	Isopropylmagnesium Chloride (*ca.* 11% in Tetrahydrofuran, *ca.* 1mol/L)			250g
I0542	Isopropylmagnesium Chloride (*ca.* 13% in Ethyl Ether, *ca.* 1mol/L)			250g

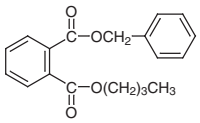
Resin Additives

The addition of additives makes synthetic resin, a polymer material, workable or stable. This section includes plasticizers which improve the workability of resin by increasing flexibility and stabilizers which protect against resin aging caused by radicals.

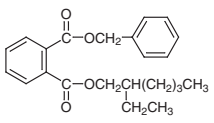
Plasticizers

Phthalates

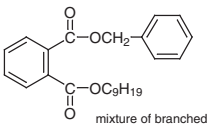
P0288



B2714

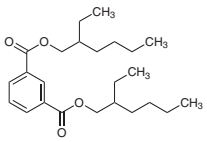


B2715

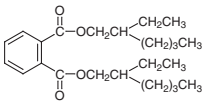


mixture of branched chain isomers

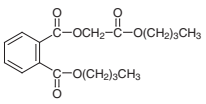
B4302



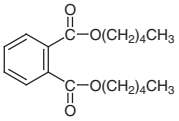
P0297



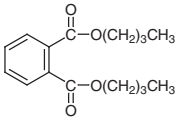
B0737



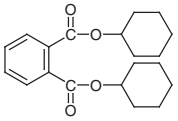
P0291



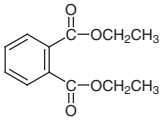
P0292



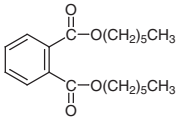
P0293



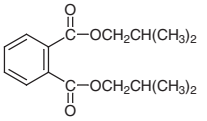
P0296



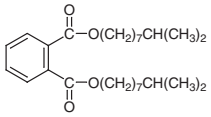
P1344



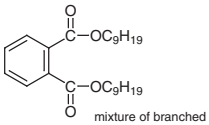
P0298



P0299

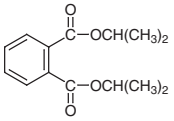


P0300

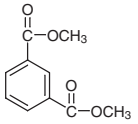


mixture of branched chain isomers

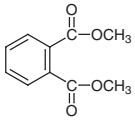
P0301



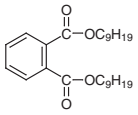
I0157



P0302

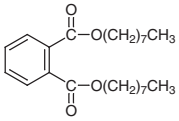


P0303

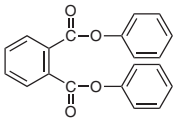


mixture of branched chain isomers

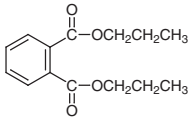
P0304



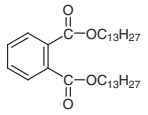
P0305



P0306

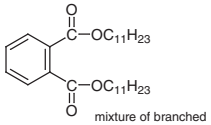


P0307



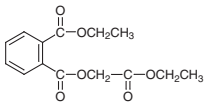
mixture of branched chain isomers

D3248

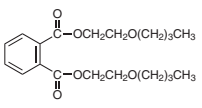


mixture of branched chain isomers

E0164



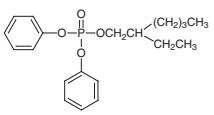
P0657



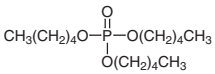
Product No.	Product Name	Unit Size		
P0288	Benzyl Butyl Phthalate		25g	500g
B2714	Benzyl 2-Ethylhexyl Phthalate			25g
B2715	Benzyl Isononyl Phthalate (mixture of branched chain isomers)			25g
B4302	Bis(2-ethylhexyl) Isophthalate		25g	500g
P0297	Bis(2-ethylhexyl) Phthalate		25g	500g
B0737	Butyl Phthalyl Butyl Glycolate		25g	500g
P0291	Diamyl Phthalate	25g	100g	500g
P0292	Dibutyl Phthalate		25mL	500mL
P0293	Dicyclohexyl Phthalate		25g	500g
P0296	Diethyl Phthalate		25mL	500mL
P1344	Dihexyl Phthalate		5g	25g
P0298	Diisobutyl Phthalate		25g	500g
P0299	Diisodecyl Phthalate (mixture of branched chain isomers)		25mL	500mL
P0300	Diisononyl Phthalate (mixture of branched chain isomers)			500g
P0301	Diisopropyl Phthalate		25mL	500mL
I0157	Dimethyl Isophthalate		25g	500g
P0302	Dimethyl Phthalate		25g	500g
P0303	Dinonyl Phthalate (mixture of isomers)		25mL	500mL
P0304	Di-*n*-octyl Phthalate		25mL	500mL
P0305	Diphenyl Phthalate		25g	500g
P0306	Dipropyl Phthalate	25mL	100mL	500mL
P0307	Ditridecyl Phthalate (mixture of branched chain isomers)		25g	500g
D3248	Diundecyl Phthalate (mixture of branched chain isomers)			500g
E0164	Ethyl Phthalyl Ethyl Glycolate		25g	500g
P0657	Phthalic Acid Bis(2-butoxyethyl) Ester			25g

Phosphates

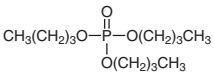
P1021



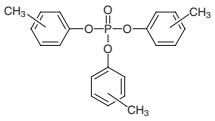
P0265



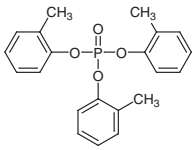
P0266



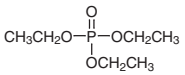
P0273



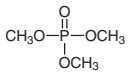
P1331



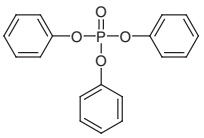
P0270



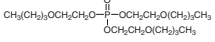
P0271



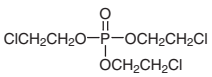
P0272



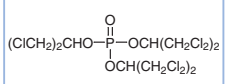
P0683



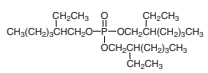
P0268



P0269



P1022

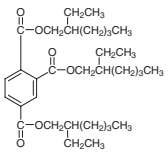


Product No.	Product Name	Unit Size	
P0259	Cresyl Diphenyl Phosphate (so called) (mixture of analogue)	25mL	500mL
P1021	2-Ethylhexyl Diphenyl Phosphate	25g	500g
P0265	Triamyl Phosphate		25mL
P0266	Tributyl Phosphate	25g	500g
P0273	Tricresyl Phosphate (mixture of isomers)	25g	500g
P1331	Tri-*o*-cresyl Phosphate	5g	25g

Product No.	Product Name	Unit Size	
P0270	Triethyl Phosphate	25g	500g
P0271	Trimethyl Phosphate	25g	500g
P0272	Triphenyl Phosphate	25g	500g
P0683	Tris(2-butoxyethyl) Phosphate	25g	500g
P0268	Tris(2-chloroethyl) Phosphate		25g
P0269	Tris(1,3-dichloro-2-propyl) Phosphate	25g	500g
P1022	Tris(2-ethylhexyl) Phosphate	25mL	500mL

Trimellitate

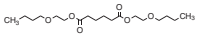
B0881



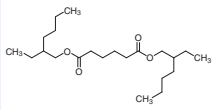
Product No.	Product Name	Unit Size	
B0881	Tris(2-ethylhexyl) Trimellitate	25mL	500mL

Fatty Acid Esters

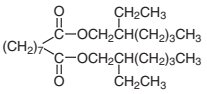
B2716



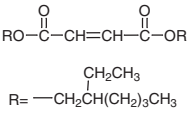
A0163



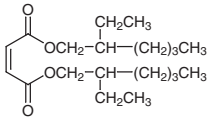
A0653
A1473



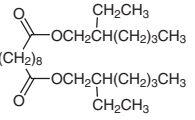
F0117



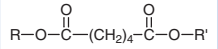
M0011



S0025

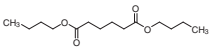


A1386

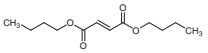


R, R'=*n*-C_6H_{13}, *n*-C_8H_{17}, *n*-$C_{10}H_{21}$

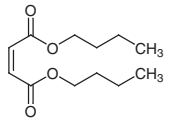
A0655



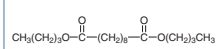
F0116



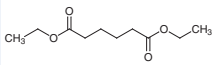
M0009



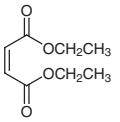
S0023



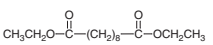
A0162



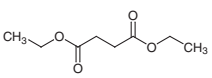
M0010



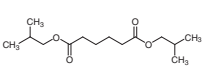
S0024



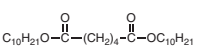
S0103



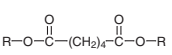
A0706



A0164

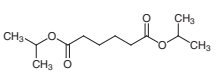


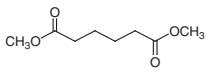
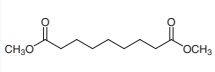
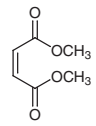
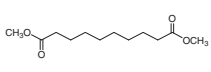
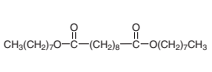
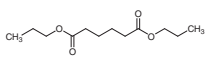
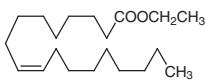
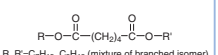
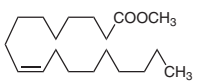
A1387



R=C_9H_{19} (mixture of branched isomers)

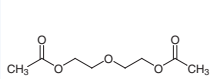
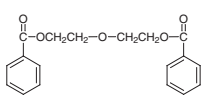
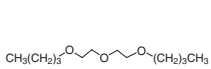
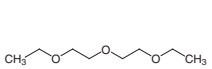
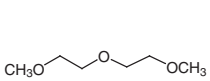
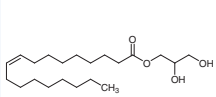
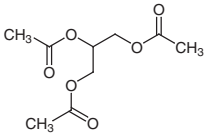
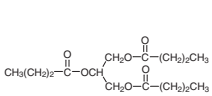
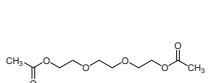
A0654



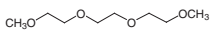
A0166 	A1308 	M0012 	S0027 	S0028 
A0931 	O0143 O0054 	A1388 	O0055 	

Product No.	Product Name	Unit Size	
B2716	Bis(2-butoxyethyl) Adipate	25g	500g
A0163	Bis(2-ethylhexyl) Adipate	25mL	500mL
A0653	Bis(2-ethylhexyl) Azelate	25mL	500mL
A1473	Bis(2-ethylhexyl) Azelate		25mL
F0117	Bis(2-ethylhexyl) Fumarate	25mL	500mL
M0011	Bis(2-ethylhexyl) Maleate	25mL	500mL
S0025	Bis(2-ethylhexyl) Sebacate	25mL	500mL
A1386	Di-*n*-alkyl Adipate	25mL	500mL
A0655	Dibutyl Adipate	25mL	500mL
F0116	Dibutyl Fumarate	25g	500g
M0009	Dibutyl Maleate	25g	500g
S0023	Dibutyl Sebacate	25mL	500mL
A0162	Diethyl Adipate	25mL	500mL
M0010	Diethyl Maleate	25mL	500mL
S0024	Diethyl Sebacate	25mL	500mL
S0103	Diethyl Succinate	25g	500g
A0706	Diisobutyl Adipate	25mL	500mL
A0164	Diisodecyl Adipate	25mL	500mL
A1387	Diisononyl Adipate (so called)	25mL	500mL
A0654	Diisopropyl Adipate	25mL	500mL
A0166	Dimethyl Adipate	25mL	500mL
A1308	Dimethyl Azelate		25mL
M0012	Dimethyl Maleate	25mL	500mL
S0027	Dimethyl Sebacate	25g	500g
S0028	Di-*n*-octyl Sebacate		25mL
A0931	Dipropyl Adipate		25mL
O0143	Ethyl Oleate	5mL	25mL
O0054	Ethyl Oleate	25mL	500mL
A1388	Heptylnonyl Adipate (so called)	25mL	500mL
O0055	Methyl Oleate	25mL	500mL

Polyalcohol Ethers, Esters

	D1230 	D1522 	B0828 	B0489 
B0498 	G0082 	G0086 	T0364 	T0923 

B0496

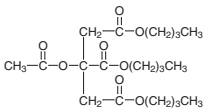


Product No.	Product Name	Unit Size	
D1230	Diethylene Glycol Diacetate	25mL	500mL
D1522	Diethylene Glycol Dibenzoate	25mL	500mL
B0828	Diethylene Glycol Dibutyl Ether	25mL	500mL
B0489	Diethylene Glycol Diethyl Ether	25mL	500mL
B0498	Diethylene Glycol Dimethyl Ether	25mL	500mL
G0082	Monoolein	25g	500g
G0086	Triacetin	25g	500g
T0364	Tributyrin	25mL	500mL
T0923	Triethylene Glycol Diacetate	25g	500g
B0496	Triethylene Glycol Dimethyl Ether (stabilized with BHT)	25g	500g

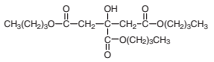
Hydroxycarboxylic Acid Esters

A0879

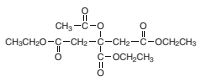
A0822



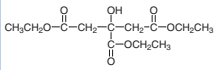
C0366



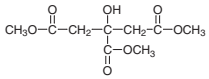
A0086



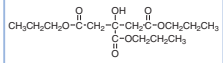
C0367



C0368



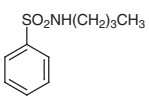
C0601



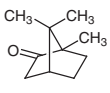
Product No.	Product Name	Unit Size	
A0879	Methyl *O*-Acetylricinoleate	25mL	500mL
A0822	Tributyl *O*-Acetylcitrate	25mL	500mL
C0366	Tributyl Citrate	25mL	500mL
A0086	Triethyl *O*-Acetylcitrate	25g	500g
C0367	Triethyl Citrate	25g	500g
C0368	Trimethyl Citrate		25g
C0601	Tripropyl Citrate		25g

Camphor, etc.

B0716

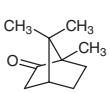


C0011

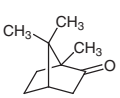


relative

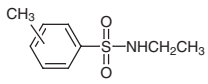
C0010



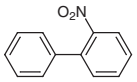
C1251



E0187



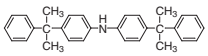
N0194



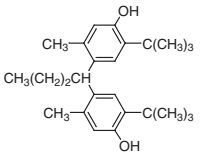
Product No.	Product Name	Unit Size	
B0716	*N*-Butylbenzenesulfonamide	25g	500g
C0011	(±)-Camphor	25g	500g
C0010	(+)-Camphor	25g	500g
C1251	(-)-Camphor		5g
E0187	*N*-Ethyltoluenesulfonamide (*o*- and *p*- mixture)	25g	500g
N0194	2-Nitrobiphenyl	25g	500g

Resin Stabilizers

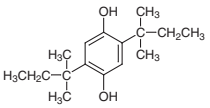
B1970



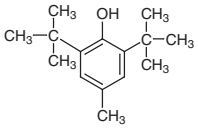
B0724



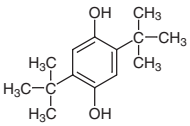
D0299



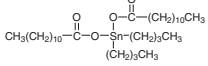
D0228



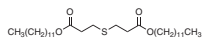
D0940



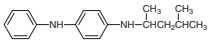
D0303



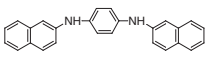
T0205



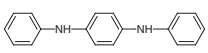
D3331



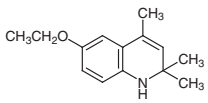
D0812



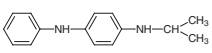
D0609



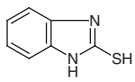
E0237



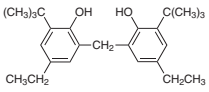
P0327



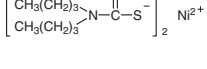
B0055



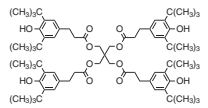
M0215



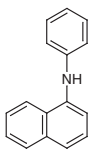
D1781



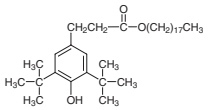
P0932



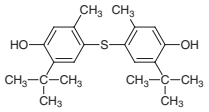
P0197



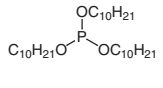
D1644



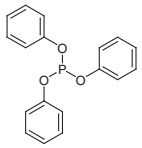
T0196



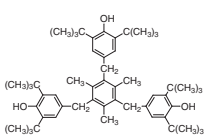
T0420



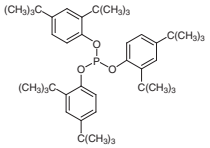
T0510



T0916



P1421

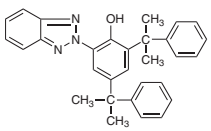


Product No.	Product Name	Unit Size		
B1970	4,4'-Bis(α,α-dimethylbenzyl)diphenylamine		25g	500g
B0724	4,4'-Butylidenebis(6-*tert*-butyl-*m*-cresol)		25g	500g
D0299	2,5-Di-*tert*-amylhydroquinone		25g	500g
D0228	2,6-Di-*tert*-butyl-*p*-cresol		25g	500g
D0940	2,5-Di-*tert*-butylhydroquinone		25g	500g
D0303	Dibutyltin Dilaurate	25g	100g	500g
D0304	Dibutyltin Maleate (so called)		25g	500g
T0205	Didodecyl 3,3'-Thiodipropionate		25g	500g
D3331	*N*-(1,3-Dimethylbutyl)-*N'*-phenyl-1,4-phenylenediamine		25g	500g
D0812	*N,N'*-Di-2-naphthyl-1,4-phenylenediamine		25g	500g
D0609	*N,N'*-Diphenyl-1,4-phenylenediamine		25g	500g
E0237	6-Ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline		25g	500g
P0327	4-Isopropylaminodiphenylamine		25g	500g
B0055	2-Mercaptobenzimidazole		25g	500g
M0215	2,2'-Methylenebis(6-*tert*-butyl-4-ethylphenol)		25g	500g
D1781	Nickel(II) Dibutyldithiocarbamate		25g	500g
P0932	Pentaerythritol Tetrakis[3-(3,5-di-*tert*-butyl-4-hydroxyphenyl)propionate]		25g	500g
P0197	*N*-Phenyl-1-naphthylamine		25g	500g
D1644	Stearyl 3-(3,5-Di-*tert*-butyl-4-hydroxyphenyl)propionate		25g	500g
T0196	4,4'-Thiobis(6-*tert*-butyl-*m*-cresol)		25g	500g
T0420	Triisodecyl Phosphite (mixture of isomers)		25mL	500mL
T0510	Triphenyl Phosphite		25g	500g
T0916	2,4,6-Tris(3',5'-di-*tert*-butyl-4'-hydroxybenzyl)mesitylene		25g	500g
P1421	Tris(2,4-di-*tert*-butylphenyl) Phosphite	25g	100g	500g

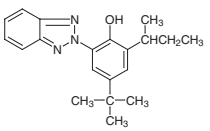
UV Absorbents

Benzotriazoles

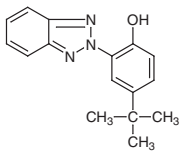
B3717



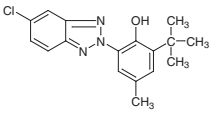
B3400



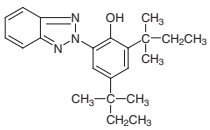
H0719



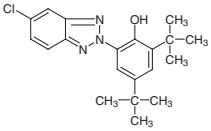
H0559



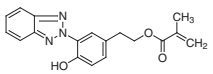
H0718



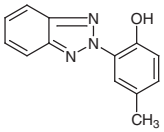
D1529



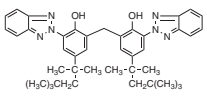
H1261



H0560



M1259

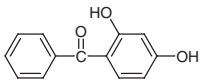


Product No.	Product Name	Unit Size	
B3717	2-(2*H*-Benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol	25g	250g
B3400	2-(3-*sec*-Butyl-5-*tert*-butyl-2-hydroxyphenyl)benzotriazole	Price on request	
H0719	2-(5-*tert*-Butyl-2-hydroxyphenyl)benzotriazole	25g	500g
H0559	2-(5-Chloro-2-benzotriazolyl)-6-*tert*-butyl-*p*-cresol	25g	500g
H0718	2-(3,5-Di-*tert*-amyl-2-hydroxyphenyl)benzotriazole	25g	500g
D1529	2-(3,5-Di-*tert*-butyl-2-hydroxyphenyl)-5-chlorobenzotriazole		25g

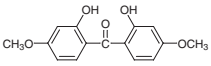
Product No.	Product Name	Unit Size	
H1261	2-[2-Hydroxy-5-[2-(methacryloyloxy)ethyl]phenyl]-2*H*-benzotriazole	25g	500g
H0560	2-(2-Hydroxy-5-methylphenyl)benzotriazole	25g	500g
H0716	2-(2-Hydroxy-5-*tert*-octylphenyl)benzotriazole	25g	500g
M1259	2,2'-Methylenebis[6-(benzotriazol-2-yl)-4-*tert*-octylphenol]	25g	500g

Benzophenones

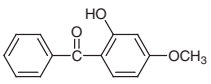
D0573



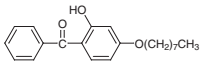
D0575



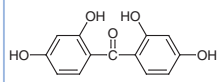
H0266



H0288



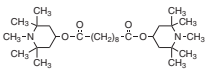
T0118



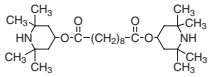
Product No.	Product Name	Unit Size	
D0573	2,4-Dihydroxybenzophenone	25g	500g
D0575	2,2'-Dihydroxy-4,4'-dimethoxybenzophenone		25g
H0266	2-Hydroxy-4-methoxybenzophenone	25g	500g
H0288	2-Hydroxy-4-*n*-octyloxybenzophenone	25g	500g
T0118	2,2',4,4'-Tetrahydroxybenzophenone		25g

Hindered Amines

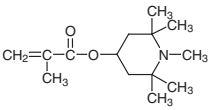
B3924



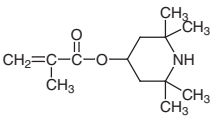
S0448



P1513



T2324



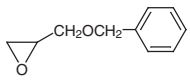
Product No.	Product Name		Unit Size	
B3924	Bis(1,2,2,6,6-pentamethyl-4-piperidyl) Sebacate		5g	25g
S0448	Bis(2,2,6,6-tetramethyl-4-piperidyl) Sebacate	5g	25g	250g
P1513	1,2,2,6,6-Pentamethyl-4-piperidyl Methacrylate (stabilized with MEHQ)		25g	500g
T2324	2,2,6,6-Tetramethyl-4-piperidyl Methacrylate		25g	500g

Photopolymer Research Reagents

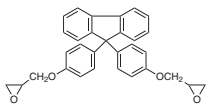
A photopolymer is a photosensitive, optically functional polymer material or resin whose properties, such as solubility, are altered by light irradiation. Photopolymers are widely used as photoresist materials during etching in the manufacture of printed circuits and semiconductor integrated circuits. In positive-type photoresist, photoacid generators (PAG) change the solubility of the photopolymer, whereas negative-type photoresist requires photopolymerization initiators for polymerization and curing. This section includes the monomers required to generate photopolymers.

Photopolymerization initiators are described on p. 322.

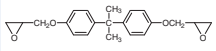
B2108



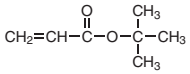
B4269



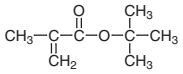
B1796



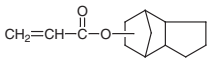
A1389



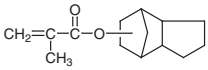
M0326



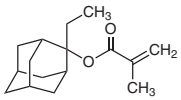
D3380



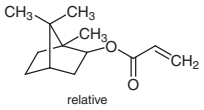
D3381



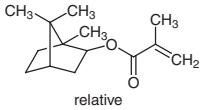
E0909



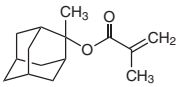
I0638



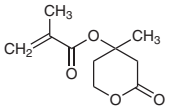
I0617



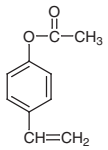
M2260



M2261



A1551



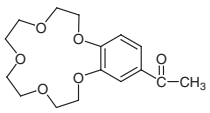
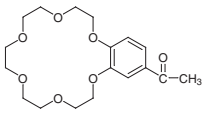
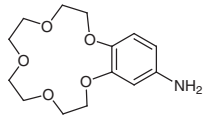
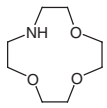
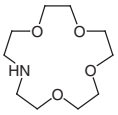
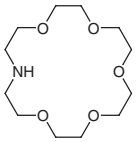
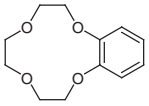
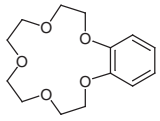
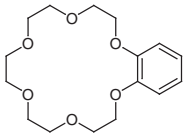
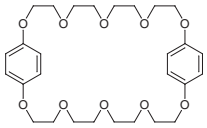
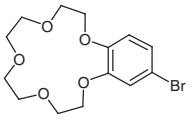
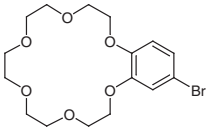
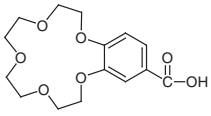
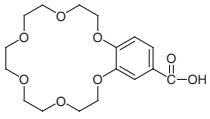
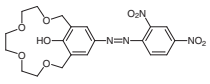
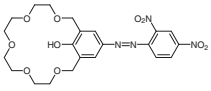
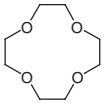
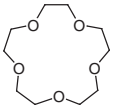
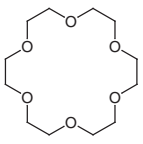
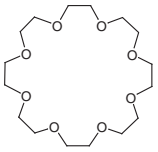
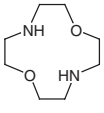
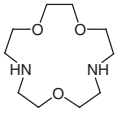
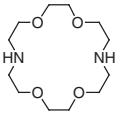
Product No.	Product Name	Unit Size	
B2108	Benzyl Glycidyl Ether	5g	25g
B4269	9,9-Bis(4-glycidyloxyphenyl)fluorene	5g	25g
B1796	2,2-Bis(4-glycidyloxyphenyl)propane	25g	500g
A1389	*tert*-Butyl Acrylate (stabilized with MEHQ)	25mL	500mL
M0326	*tert*-Butyl Methacrylate Monomer (stabilized with MEHQ)	25mL	500mL
D3380	Dicyclopentanyl Acrylate (stabilized with MEHQ)	25g	500g
D3381	Dicyclopentanyl Methacrylate (stabilized with MEHQ)	25g	500g
E0909	2-Ethyl-2-methacryloyloxyadamantane (stabilized with MEHQ)		5g
I0638	Isobornyl Acrylate (stabilized with MEHQ)	25g	500g
I0617	Isobornyl Methacrylate (stabilized with MEHQ)	25g	500g
M2260	2-Methacryloyloxy-2-methyladamantane (stabilized with MEHQ)		5g
M2261	Mevalonic Lactone Methacrylate (stabilized with MEHQ)		1g
A1551	4-Vinylphenyl Acetate (stabilized with TBC)	5g	25g

Macrocycles

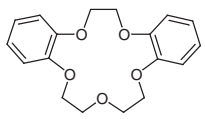
for Host-Guest Chemistry

Host-compounds recognize and incorporate specific molecules, atoms or ions (guests) into the molecules to form complexes. In the formation of these complexes, a variety of forces such as electrostatic interaction, hydrophobic interaction, hydrogen bonding, etc. are utilized to create high selectivity. Molecular sensors, synthetic enzymes, separation systems, etc. utilize the high guest selectivity of these host compounds. Synthesis of new host compounds with even higher selectivity are currently being developed.

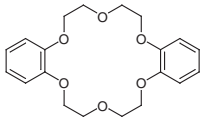
For example, Shinkai and co-workers have developed exciting purification techniques for fullerene C_{60} employing calixarene. According to these techniques, the stirring of crude fullerene and *tert*-butylcalix[8]arene in toluene causes only C_{60} to be incorporated in the calixarene to form and precipitate a complex. Filtration and subsequent stirring of the complex in chloroform cause it to decompose to yield C_{60} of high purity as a precipitate. This method has been reported to be an efficient purification technique in obtaining C_{60} compared with conventional column purification techniques.

Crown Ethers		A1603	A1604	A1404
				
A1552	A1323	A1324	B1249	B1154
				
B1539	B2245	B2189	B2181	C1713
				
C1714	C1942	C1943	C0858	C0859
				
C0860	C1736	D2743	D2744	D2323
				

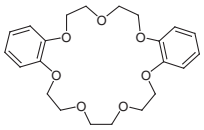
D2877



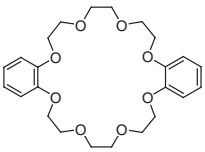
D1533



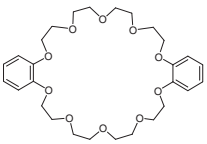
D2878



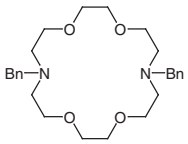
D1830



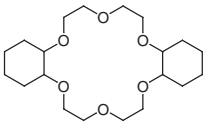
D2684



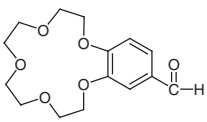
D2321



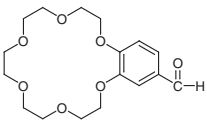
D1668



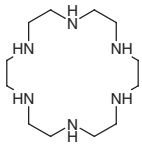
F0448



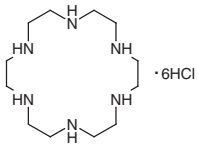
F0451



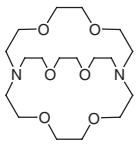
H1070



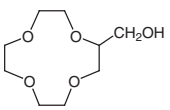
H1215



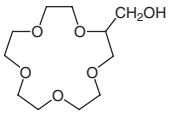
H0932



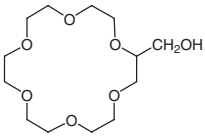
H0982



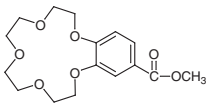
H0983



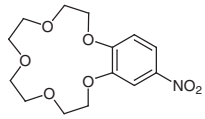
H0990



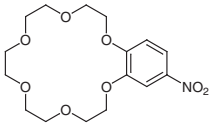
M1489



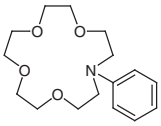
N0561



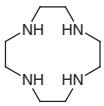
N0562



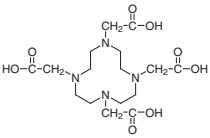
P1143



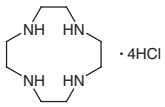
T1874



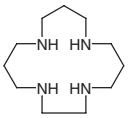
T1875



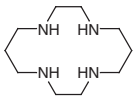
T1426



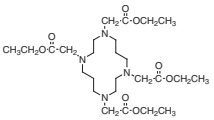
T1691



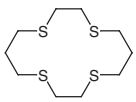
T1597



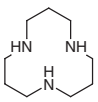
T2540



T1959

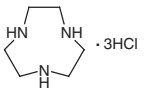


T1876

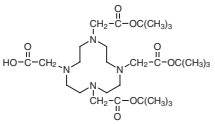


T1878

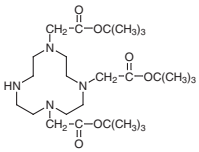
T1600



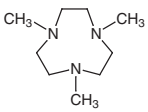
T2642



T2541



T1879



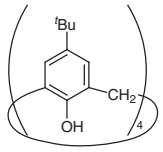
T1972

Product No.	Product Name	Unit Size	
A1603	4'-Acetylbenzo-15-crown 5-Ether		1g
A1604	4'-Acetylbenzo-18-crown 6-Ether		1g
A1404	4'-Aminobenzo-15-crown 5-Ether		1g
A1552	1-Aza-12-crown 4-Ether	250mg	1g
A1323	1-Aza-15-crown 5-Ether	1g	5g
A1324	1-Aza-18-crown 6-Ether	1g	5g

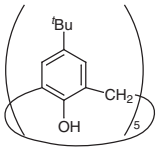
Product No.	Product Name	Unit Size		
B1249	Benzo-12-crown 4-Ether		1g	5g
B1154	Benzo-15-crown 5-Ether		1g	5g
B1539	Benzo-18-crown 6-Ether		1g	5g
B2245	Bis(1,4-phenylene)-34-crown 10-Ether			100mg
B2189	4'-Bromobenzo-15-crown 5-Ether		1g	5g
B2181	4'-Bromobenzo-18-crown 6-Ether		1g	5g
C1713	4'-Carboxybenzo-15-crown 5-Ether			1g
C1714	4'-Carboxybenzo-18-crown 6-Ether		100mg	1g
C1942	15-Crown-4 [4-(2,4-Dinitrophenylazo)phenol]			100mg
C1943	18-Crown-5 [4-(2,4-Dinitrophenylazo)phenol]			100mg
C0858	12-Crown 4-Ether		1mL	5mL
C0859	15-Crown 5-Ether		5mL	25mL
C0860	18-Crown 6-Ether	5g	25g	100g
C1736	24-Crown 8-Ether			1g
D2743	4,10-Diaza-12-crown 4-Ether			100mg
D2744	4,10-Diaza-15-crown 5-Ether			1g
D2323	4,13-Diaza-18-crown 6-Ether		1g	5g
D2877	Dibenzo-15-crown 5-Ether			1g
D1533	Dibenzo-18-crown 6-Ether		5g	25g
D2878	Dibenzo-21-crown 7-Ether			1g
D1830	Dibenzo-24-crown 8-Ether		1g	5g
D2684	Dibenzo-30-crown 10-Ether			1g
D2321	*N*,*N*'-Dibenzyl-4,13-diaza-18-crown 6-Ether		1g	5g
D1668	Dicyclohexano-18-crown 6-Ether		1g	5g
F0448	4'-Formylbenzo-15-crown 5-Ether		100mg	1g
F0451	4'-Formylbenzo-18-crown 6-Ether			500mg
H1070	1,4,7,10,13,16-Hexaazacyclooctadecane			100mg
H1215	1,4,7,10,13,16-Hexaazacyclooctadecane Hexahydrochloride			100mg
H0932	4,7,13,16,21,24-Hexaoxa-1,10-diazabicyclo[8.8.8]hexacosane		1g	5g
H0982	2-(Hydroxymethyl)-12-crown 4-Ether		1g	5g
H0983	2-(Hydroxymethyl)-15-crown 5-Ether	1g	5g	25g
H0990	2-(Hydroxymethyl)-18-crown 6-Ether		200mg	1g
M1489	4'-Methoxycarbonylbenzo-15-crown 5-Ether			1g
N0561	4'-Nitrobenzo-15-crown 5-Ether		1g	5g
N0562	4'-Nitrobenzo-18-crown 6-Ether		1g	5g
P1143	*N*-Phenylaza-15-crown 5-Ether		1g	5g
T1874	1,4,7,10-Tetraazacyclododecane		1g	5g
T1875	1,4,7,10-Tetraazacyclododecane-1,4,7,10-tetraacetic Acid		200mg	1g
T1426	1,4,7,10-Tetraazacyclododecane Tetrahydrochloride		1g	5g
T1691	1,4,8,12-Tetraazacyclopentadecane		1g	5g
T1597	1,4,8,11-Tetraazacyclotetradecane		1g	5g
T2540	Tetraethyl 1,4,8,11-Tetraazacyclotetradecane-1,4,8,11-tetraacetate			200mg
T1959	1,4,8,11-Tetrathiacyclotetradecane		200mg	1g
T1876	1,5,9-Triazacyclododecane			100mg
T1878	1,4,7-Triazacyclononane	200mg	1g	5g
T1600	1,4,7-Triazacyclononane Trihydrochloride		1g	5g
T2642	Tri-*tert*-butyl 1,4,7,10-Tetraazacyclododecane-1,4,7,10-tetraacetate		100mg	1g
T2541	Tri-*tert*-butyl 1,4,7,10-Tetraazacyclododecane-1,4,7-triacetate			200mg
T1879	1,4,7-Trimethyl-1,4,7-triazacyclononane (stabilized with $NaHCO_3$)		1g	5g
T1972	1,4,7-Trithiacyclononane			500mg

Calixarenes

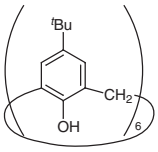
B1809



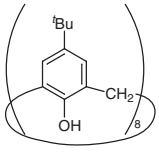
B2221



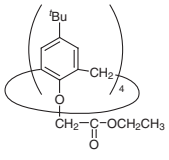
H0714



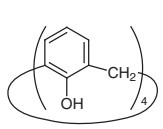
B1750



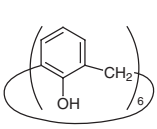
T2563



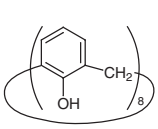
C1455



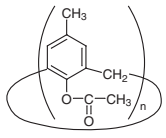
H0713



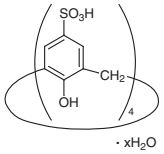
C1435



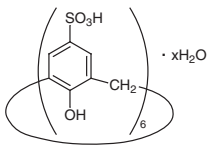
H0889



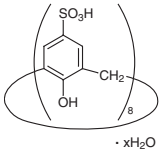
S0469



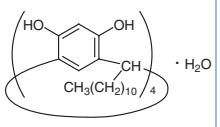
S0470



S0471



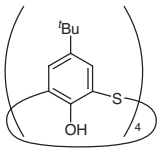
U0069



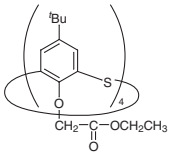
Product No.	Product Name			Unit Size
B1809	4-*tert*-Butylcalix[4]arene	1g	5g	25g
B2221	4-*tert*-Butylcalix[5]arene			100mg
H0714	4-*tert*-Butylcalix[6]arene (contains 5-10% Benzene)		5g	25g
B1750	4-*tert*-Butylcalix[8]arene		5g	25g
T2563	Tetraethyl 4-*tert*-Butylcalix[4]arene-*O*,*O*',*O*'',*O*'''-tetraacetate		200mg	1g
C1455	Calix[4]arene (contains *ca.* 8% Chloroform)		100mg	1g
H0713	Calix[6]arene		1g	5g
C1435	Calix[8]arene		1g	5g
H0889	4-Methyl-1-acetoxycalixarene [mixture of [6] and [8]] (contains 5-10% Acetone)		100mg	1g
S0469	4-Sulfocalix[4]arene Hydrate		1g	5g
S0470	4-Sulfocalix[6]arene Hydrate		1g	5g
S0471	4-Sulfocalix[8]arene Hydrate		1g	5g
U0069	*C*-Undecylcalix[4]resorcinarene Monohydrate			1g

Thiacalixarenes

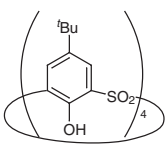
B2296



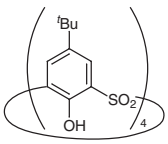
B2310



B2312



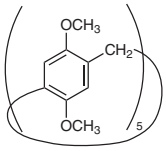
S0477



Product No.	Product Name		Unit Size
B2296	4-*tert*-Butylthiacalix[4]arene	1g	5g
B2310	4-*tert*-Butyl-1-(ethoxycarbonylmethoxy)thiacalix[4]arene	1g	5g
B2312	4-*tert*-Butylsulfonylcalix[4]arene	1g	5g
S0477	4-Sulfothiacalix[4]arene Sodium Salt	1g	5g

Pillararenes

D4471

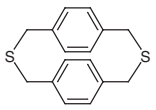


Product No.	Product Name	Unit Size
D4471	Dimethoxypillar[5]arene	100mg

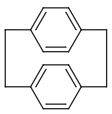
Cyclophanes

C1749

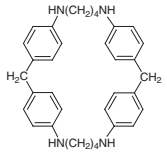
D2210



P1165



T1378



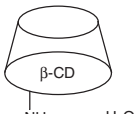
Product No.	Product Name	Unit Size
C1749	Cyclobis(paraquat-1,4-phenylene) Tetrakis(hexafluorophosphate)	100mg
D2210	2,11-Dithia[3.3]paracyclophane	100mg 500mg
P1165	[2.2]Paracyclophane	1g
T1378	1,6,20,25-Tetraaza[6.1.6.1]paracyclophane	100mg

Cyclodextrins

A2122

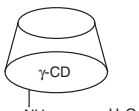
(2A*S*, 3A*S*)-α-CD

A1916



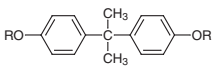
(2A*S*, 3A*S*)-β-CD

A2123



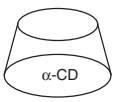
(2A*S*, 3A*S*)-γ-CD

B3026

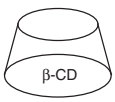


R = permethyl-α-CD

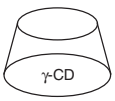
C0776



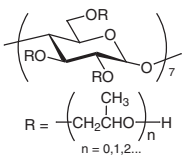
C0900
C0777



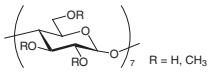
C0869



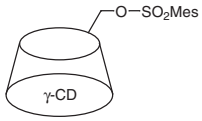
H0979



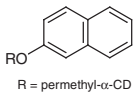
M1356



M1212

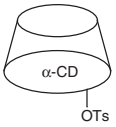


M1876

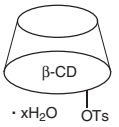


R = permethyl-α-CD

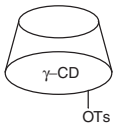
M1956



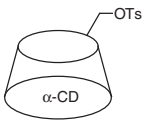
M1741



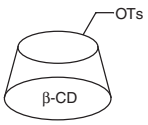
M1957



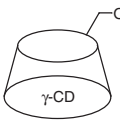
M1644



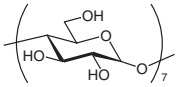
M1381



M1645

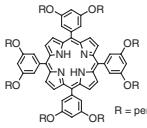


P0977

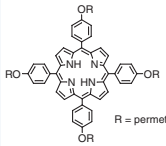


cross-linked by Epichlorohydrin

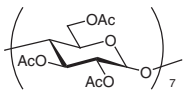
T2452



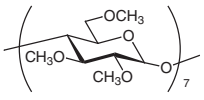
T2451



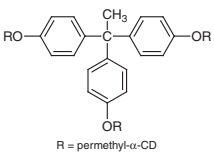
T1844



T1094



T2450



R = permethyl-α-CD

Product No.	Product Name	Unit Size		
A2122	3A-Amino-3A-deoxy-(2A*S*,3A*S*)-α-cyclodextrin Hydrate		200mg	1g
A1916	3A-Amino-3A-deoxy-(2A*S*,3A*S*)-β-cyclodextrin Hydrate		200mg	1g
A2123	3A-Amino-3A-deoxy-(2A*S*,3A*S*)-γ-cyclodextrin Hydrate			1g
B3026	2,2-Bis[4-(per-*O*-methyl-α-cyclodextrin-6-yloxy)phenyl]propane			10mg
C0776	α-Cyclodextrin	10g	25g	100g
C0900	β-Cyclodextrin	25g	100g	500g
C0777	β-Cyclodextrin			25g
C0869	γ-Cyclodextrin	5g	25g	100g
H0979	Hydroxypropyl-β-cyclodextrin		25g	100g
M1356	Methyl-β-cyclodextrin (mixture of several Methylated)		25g	250g
M1212	Mono-6-*O*-mesitylenesulfonyl-γ-cyclodextrin			1g
M1876	Mono-6-*O*-(2-naphthyl)-per-*O*-methyl-α-cyclodextrin			10mg
M1956	Mono-2-*O*-(*p*-toluenesulfonyl)-α-cyclodextrin			1g
M1741	Mono-2-*O*-(*p*-toluenesulfonyl)-β-cyclodextrin Hydrate			1g
M1957	Mono-2-*O*-(*p*-toluenesulfonyl)-γ-cyclodextrin			1g
M1644	Mono-6-*O*-(*p*-toluenesulfonyl)-α-cyclodextrin		200mg	1g
M1381	Mono-6-*O*-(*p*-toluenesulfonyl)-β-cyclodextrin			200mg
M1645	Mono-6-*O*-(*p*-toluenesulfonyl)-γ-cyclodextrin			200mg
P0977	Poly-β-cyclodextrin (Cross-linked by Epichlorohydrin)			1g
T2452	5,10,15,20-Tetrakis[3,5-bis(per-*O*-methyl-α-cyclodextrin-6-yloxy)phenyl]-21*H*,23*H*-porphine			10mg
T2451	5,10,15,20-Tetrakis[4-(per-*O*-methyl-α-cyclodextrin-6-yloxy)phenyl]-21*H*,23*H*-porphine			10mg
T1844	Triacetyl-β-cyclodextrin			25g
T1094	Trimethyl-β-cyclodextrin			1g
T2450	1,1,1-Tris[4-(per-*O*-methyl-α-cyclodextrin-6-yloxy)phenyl]ethane			10mg

References

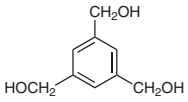
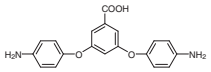
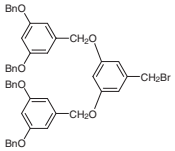
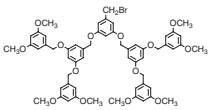
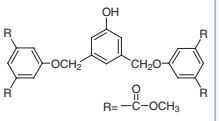
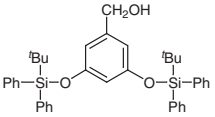
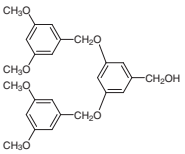
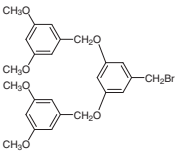
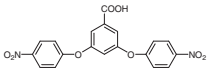
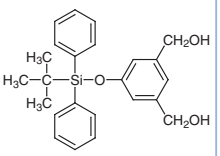
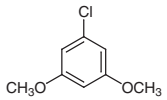
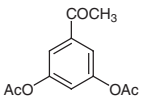
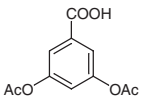
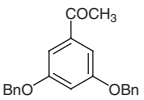
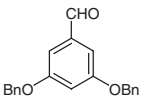
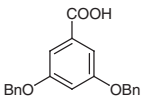
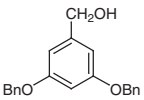
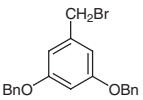
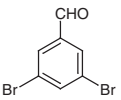
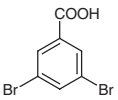
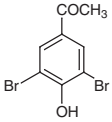
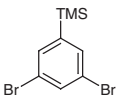
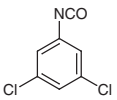
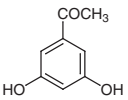
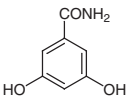
1) Calixarene
A. Ikeda, S. Shinkai, *Chem. Rev*. **1997**, *97*, 1713; M. Ayabe, S. Shinkai, *TCIMAIL* **2003**, number*118*, 2.
2) Cyclodextrin
K. Takahashi, *Chem. Rev*. **1998**, *98*, 2013.
3) Thiacalixarene
N. Morohashi, S. Miyano, *TCIMAIL* **2004**, number*122*, 2.

Building Blocks for Dendrimers

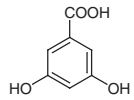
Dendrimers are a single dendritic polymer consisting of three layers, its core, dendron regularly branched from the core, and the exterior surface layer. The typical species become globular and their size is in a clear-cut nm scale, having physical properties different from conventional straight polymer. Since their report in 1984 by Tomalia and co-workers, dendrimers have received much attention in many areas.[1] Nowadays, applications of dendrimers are examined in chemical sensors, catalysts, electronics, photonics and medicines.[2, 3]

Functional elements and functional groups can be introduced into the core, dendron and surface layer. The synthetic technique is divided mainly into the divergent method, where synthesis proceeds from the center core toward the outside, and the convergent method, where synthesis proceeds from the exterior shell to the core.

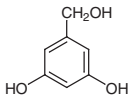
For the synthesis of the regularly branched portions, multifunctional compounds have been utilized. The 1,3,5-trisubstituted benzenes, shown below are useful building blocks for dendrimers. Please refer to our website for other building blocks. We provide the structure search on the website and you can search by the substructure.

B3586 	B2081 	B2118 	B2248 	B2865 
B2052 	B2246 	B2247 	B2120 	B2866 
C1258 	D1978 	D2844 	D2085 	D3184 
D2267 	D2651 	B2093 	D2832 	D2353 
D2824 	D2724 	I0302 	D1981 	D2875 

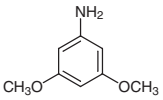
D0570
D2554



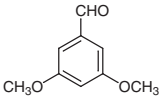
D2656



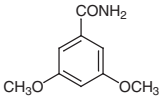
D1484



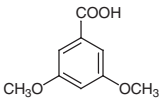
D1164



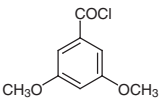
D1558



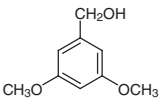
D1534



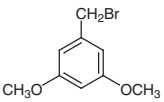
D2609



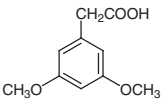
D2594



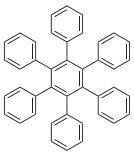
D2657



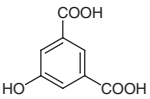
D2950



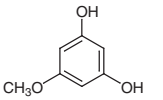
H1412



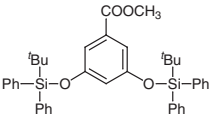
H0794



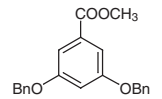
M1413



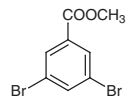
B2051



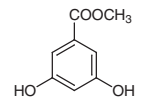
B2092



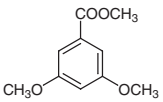
M1929



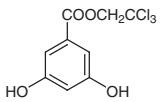
D2215



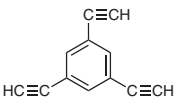
D1737



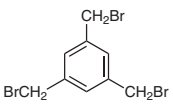
D2655



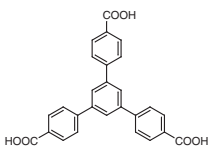
T2760



T2719



T2647



Product No.	Product Name	Unit Size	
B3586	1,3,5-Benzenetrimethanol	1g	5g
B2081	3,5-Bis(4-aminophenoxy)benzoic Acid	1g	5g
B2118	3,5-Bis[3,5-bis(benzyloxy)benzyloxy]benzyl Bromide	1g	5g
B2248	3,5-Bis[3,5-bis(3,5-dimethoxybenzyloxy)benzyloxy]benzyl Bromide		1g
B2865	3,5-Bis[3,5-bis(methoxycarbonyl)phenoxymethyl]phenol		200mg
B2052	3,5-Bis(*tert*-butyldiphenylsilyloxy)benzyl Alcohol		1g
B2246	3,5-Bis(3,5-dimethoxybenzyloxy)benzyl Alcohol	1g	5g
B2247	3,5-Bis(3,5-dimethoxybenzyloxy)benzyl Bromide	1g	5g
B2120	3,5-Bis(4-nitrophenoxy)benzoic Acid		5g
B2866	5-(*tert*-Butyldiphenylsilyloxy)-1,3-benzenedimethanol	1g	5g
C1258	1-Chloro-3,5-dimethoxybenzene	10g	25g
D1978	3',5'-Diacetoxyacetophenone	10g	25g
D2844	3,5-Diacetoxybenzoic Acid	1g	5g
D2085	3',5'-Dibenzyloxyacetophenone		10g
D3184	3,5-Dibenzyloxybenzaldehyde	1g	5g
D2267	3,5-Dibenzyloxybenzoic Acid	5g	25g
D2651	3,5-Dibenzyloxybenzyl Alcohol	5g	25g
B2093	3,5-Dibenzyloxybenzyl Bromide	5g	25g
D2832	3,5-Dibromobenzaldehyde	5g	25g
D2353	3,5-Dibromobenzoic Acid		10g
D2824	3',5'-Dibromo-4'-hydroxyacetophenone	5g	25g
D2724	3,5-Dibromo-1-trimethylsilylbenzene	5g	25g
I0302	3,5-Dichlorophenyl Isocyanate		10g
D1981	3',5'-Dihydroxyacetophenone	10g	25g

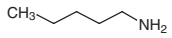
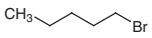
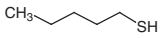
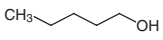
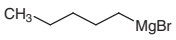
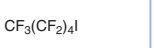
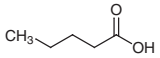
Product No.	Product Name	Unit Size	
D2875	3,5-Dihydroxybenzamide		5g
D0570	3,5-Dihydroxybenzoic Acid	25g	500g
D2554	3,5-Dihydroxybenzoic Acid	25g	500g
D2656	3,5-Dihydroxybenzyl Alcohol	5g	25g
D1484	3,5-Dimethoxyaniline	5g	25g
D1164	3,5-Dimethoxybenzaldehyde	5g	25g
D1558	3,5-Dimethoxybenzamide		5g
D1534	3,5-Dimethoxybenzoic Acid	25g	500g
D2609	3,5-Dimethoxybenzoyl Chloride	5g	25g
D2594	3,5-Dimethoxybenzyl Alcohol	5g	25g
D2657	3,5-Dimethoxybenzyl Bromide	5g	25g
D2950	3,5-Dimethoxyphenylacetic Acid	1g	5g
H1412	Hexaphenylbenzene	1g	5g
H0794	5-Hydroxyisophthalic Acid	25g	500g
M1413	5-Methoxyresorcinol		1g
B2051	Methyl 3,5-Bis(*tert*-butyldiphenylsilyloxy)benzoate (*ca.* 20% in Toluene, *ca.* 0.28mol/L)		25g
B2092	Methyl 3,5-Dibenzyloxybenzoate	5g	25g
M1929	Methyl 3,5-Dibromobenzoate	5g	25g
D2215	Methyl 3,5-Dihydroxybenzoate	25g	250g
D1737	Methyl 3,5-Dimethoxybenzoate		25g
D2655	2,2,2-Trichloroethyl 3,5-Dihydroxybenzoate (*ca.* 20% in Dichloromethane, *ca.* 1mol/L)	5g	25g
T2760	1,3,5-Triethynylbenzene	1g	5g
T2719	1,3,5-Tris(bromomethyl)benzene	1g	5g
T2647	1,3,5-Tris(4-carboxyphenyl)benzene	1g	5g

References

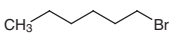
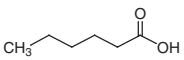
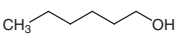
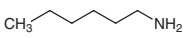
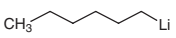
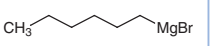
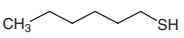
1) D. A. Tomalia, J. R. Dewald, M. R. Hall, S. J. Martin, P. B. Smith, Preprints of the 1st SPSJ International Polymer Conference, Society of Polymer Science Japan, Kyoto, **1984**, p 65; D. A. Tomalia, J. M. J. Fréchet, *J. Polym. Sci. Part A: Polym. Chem.* **2002**, *40*, 2719.
2) F. Vögtle, G. Richardt, N. Werner, in *Dendrimer Chemistry: Concepts, Syntheses, Properties, Applications*, Wiley-VCH, Weinheim, **2009**.
3) D. Astruc, E. Boisselier, C. Ornelas, *Chem. Rev.* **2010**, *110*, 1857.

Derivatizing Reagents for Solubility Improvement

Alkyl groups do not affect molecular electronic properties, because they do not strongly interact with π-conjugates. However, the effect of alkyl groups is large in the molecule-assembled solid state, modifying solubility and melting point when alkyl groups are introduced. In particular, organic devices require alkyl derivatizations to increase solubility, because solution-processible printing technologies are required for large scale manufacturing. In addition, introduction of a long alkyl chain to an organic molecule produces a liquid crystal material.

C5 Alkyl Groups		A0445	B0628	P0053
				
P0055	P1177	U0081	V0003	
				

Product No.	Product Name	Unit Size		
A0445	Amylamine	25mL	100mL	500mL
B0628	1-Bromopentane		25mL	500mL
P0053	1-Pentanethiol		25mL	500mL
P0055	1-Pentanol		25mL	500mL
P1177	Pentylmagnesium Bromide (18% in Tetrahydrofuran, *ca.* 1mol/L)			250g
U0081	Undecafluoropentyl Iodide		5g	25g
V0003	Valeric Acid		25mL	500mL

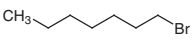
C6 Alkyl Groups		B0600	H0105	H0130
				
H0134	H0842	H0821	H0103	T2479
				

T1098

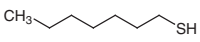
Product No.	Product Name	Unit Size		
B0600	1-Bromohexane		25g	500g
H0105	Hexanoic Acid		25mL	500mL
H0130	1-Hexanol		25mL	500mL
H0134	Hexylamine	25mL	100mL	500mL
H0842	Hexyllithium (30% in Hexane, *ca.* 2.3mol/L)			100mL
H0821	Hexylmagnesium Bromide (20% in Tetrahydrofuran, *ca.* 1mol/L)			250g
H0103	Hexyl Mercaptan		25mL	500mL
T2479	Tridecafluorohexyl Bromide		5g	25g
T1098	Tridecafluorohexyl Iodide		5g	25g

C7 Alkyl Groups

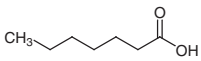
B0598



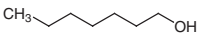
H0029



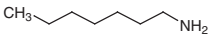
H0030



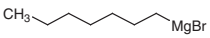
H0033



H0045



H0822



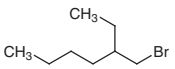
P1753

P1839

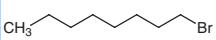
Product No.	Product Name	Unit Size	
B0598	1-Bromoheptane	25g	500g
H0029	1-Heptanethiol	10g	25g
H0030	Heptanoic Acid	25mL	500mL
H0033	1-Heptanol	25mL	500mL
H0045	Heptylamine	25mL	500mL
H0822	Heptylmagnesium Bromide (21% in Tetrahydrofuran, *ca.* 1mol/L)		250g
P1753	Pentadecafluoroheptyl Bromide		5g
P1839	Pentadecafluoroheptyl Iodide (stabilized with $Na_2S_2O_3$)	5g	25g

C8 Alkyl Groups

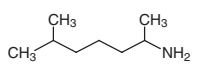
B0596



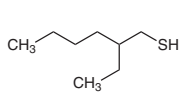
B0626



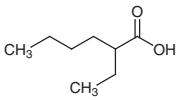
D1800



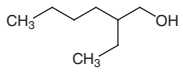
E1031



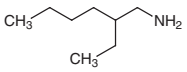
E0120



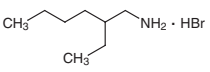
E0122



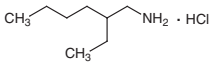
E0126



E0127



E0128

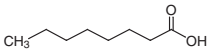


H0946

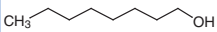
P1084

O0025

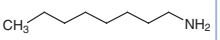
O0027



O0036



O0045

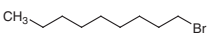


O0240

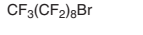
Product No.	Product Name	Unit Size		
B0596	1-Bromo-2-ethylhexane	25mL	100mL	500mL
B0626	1-Bromooctane		25mL	500mL
D1800	1,5-Dimethylhexylamine			25mL
E1031	2-Ethyl-1-hexanethiol		25g	100g
E0120	2-Ethylhexanoic Acid		25mL	500mL
E0122	2-Ethyl-1-hexanol		25mL	500mL
E0126	2-Ethylhexylamine	25mL	100mL	500mL
E0127	2-Ethylhexylamine Hydrobromide			25g
E0128	2-Ethylhexylamine Hydrochloride			25g
H0946	Heptadecafluoro-*n*-octyl Bromide		5g	25g
P1084	Heptadecafluoro-*n*-octyl Iodide			25g
O0025	1-Octanethiol		25mL	500mL
O0027	*n*-Octanoic Acid		25mL	500mL
O0036	1-Octanol		25mL	500mL
O0045	*n*-Octylamine		25mL	500mL
O0240	*n*-Octylmagnesium Bromide (*ca.* 22% in Tetrahydrofuran, *ca.* 1mol/L)			250g

C9 Alkyl Groups

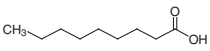
B0933



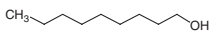
N0808



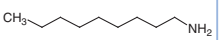
N0288
P0952



N0292



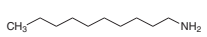
N0297



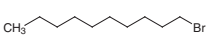
Product No.	Product Name	Unit Size	
B0933	1-Bromononane	25mL	500mL
N0808	Nonadecafluorononyl Bromide		5g
N0288	Nonanoic Acid	25mL	500mL
P0952	Nonanoic Acid	25mL	500mL
N0292	1-Nonanol	25mL	500mL
N0297	Nonylamine		25mL

C10 Alkyl Groups

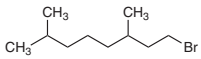
D0033



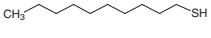
B0583



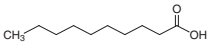
B4401



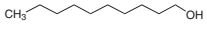
D0016



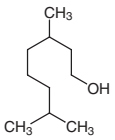
D0017



D0031



D1442

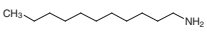


H0844

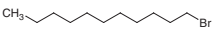
Product No.	Product Name	Unit Size		
D0033	1-Aminodecane	25mL	100mL	500mL
B0583	1-Bromodecane		25mL	500mL
B4401	1-Bromo-3,7-dimethyloctane		5g	25g
D0016	1-Decanethiol		25mL	500mL
D0017	Decanoic Acid		25g	400g
D0031	1-Decanol		25mL	500mL
D1442	3,7-Dimethyl-1-octanol		25mL	500mL
H0844	Heneicosafluorodecyl Iodide			5g

C11 Alkyl Groups

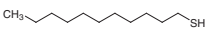
A0761



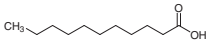
B0934



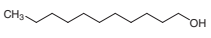
U0066



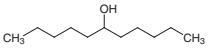
U0004



U0005

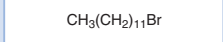


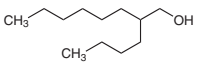
U0040

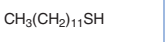


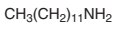
Product No.	Product Name	Unit Size	
A0761	1-Aminoundecane		10mL
B0934	1-Bromoundecane	25mL	500mL
U0066	1-Undecanethiol		5mL
U0004	Undecanoic Acid	25g	250g
U0005	1-Undecanol	25mL	500mL
U0040	6-Undecanol		5g

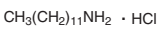
C12 Alkyl Groups

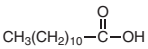
B0587


B3457


D0970


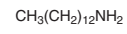
D0980


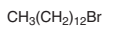
D1452


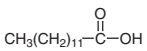
L0011


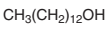
Product No.	Product Name	Unit Size	
B0587	1-Bromododecane	25mL	500mL
B3457	2-Butyl-1-*n*-octanol	25mL	500mL
D0970	1-Dodecanethiol	25mL	500mL
D0980	Dodecylamine	25g	400g
D1452	Dodecylamine Hydrochloride	25g	500g
L0011	Lauric Acid	25g	500g

C13 Alkyl Groups

A0762


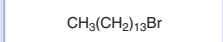
B0935


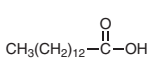
T0412


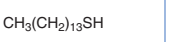
T0803


Product No.	Product Name	Unit Size	
A0762	1-Aminotridecane	10g	25g
B0935	1-Bromotridecane	5mL	25mL
T0412	Tridecanoic Acid	25g	500g
T0803	1-Tridecanol		25g

C14 Alkyl Groups

B0233


M0476


T0082


T0084	T0090

Product No.	Product Name	Unit Size	
B0233	1-Bromotetradecane	25mL	500mL
M0476	Myristic Acid	25g	500g
T0082	1-Tetradecanethiol		25mL
T0084	1-Tetradecanol	25mL	500mL
T0090	Tetradecylamine	25g	400g

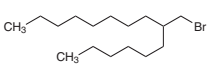
C15 Alkyl Groups

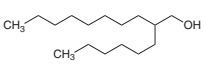
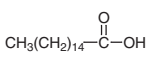
A0763	B0936	P0836

P0035	P0036	P1251
		

Product No.	Product Name	Unit Size		
A0763	1-Aminopentadecane			10g
B0936	1-Bromopentadecane		25mL	250mL
P0836	1-Pentadecanethiol			10mL
P0035	Pentadecanoic Acid	25g	100g	500g
P0036	1-Pentadecanol	25g	100g	500g
P1251	Pentadecylmagnesium Bromide (*ca.* 15% in Tetrahydrofuran, *ca.* 0.4mol/L)			250g

C16 Alkyl Groups

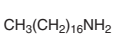
B0599	B4544	H0068
		

H0071	H0074	H1461	P1145 P0002
			

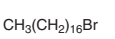
Product No.	Product Name	Unit Size	
B0599	1-Bromohexadecane	25g	500g
B4544	7-(Bromomethyl)pentadecane	5mL	25mL
H0068	1-Hexadecanethiol	25mL	500mL
H0071	1-Hexadecanol	25g	500g
H0074	Hexadecylamine	25g	500g
H1461	2-Hexyl-1-decanol	25mL	500mL
P1145	Palmitic Acid		5g
P0002	Palmitic Acid	25g	500g

C17 Alkyl Groups

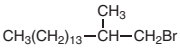
A0764



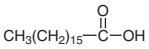
B0937



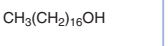
B1456



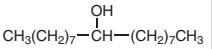
H0019



H0018



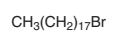
H1401



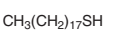
Product No.	Product Name			Unit Size
A0764	1-Aminoheptadecane			10g
B0937	1-Bromoheptadecane		5g	25g
B1456	1-Bromo-2-methylhexadecane			1g
H0019	Heptadecanoic Acid	25g	100g	500g
H0018	1-Heptadecanol		5g	25g
H1401	9-Heptadecanol			1g

C18 Alkyl Groups

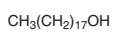
B0625



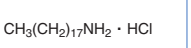
O0005



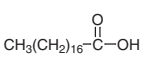
O0006



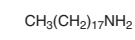
O0099



S0163



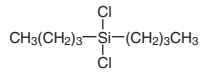
O0014



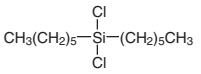
Product No.	Product Name	Unit Size	
B0625	1-Bromooctadecane	25g	500g
O0005	1-Octadecanethiol	25g	400g
O0006	1-Octadecanol	25g	500g
O0099	Octadecylamine Hydrochloride		25g
S0163	Stearic Acid	25g	500g
O0014	Stearylamine	25g	500g

Dialkyldichlorosilanes

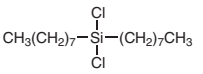
D2704



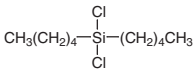
D2712



D4336



D2710



Product No.	Product Name	Unit Size	
D2704	Dibutyldichlorosilane	5g	25g
D2712	Dichlorodihexylsilane	5g	25g
D4336	Dichlorodi-*n*-octylsilane		1g
D2710	Dichlorodipentylsilane		5g

Abbreviations

Descriptors

o-	ortho
m-	meta
p-	para
n-	normal
prim-	primary
sec-	secondary
tert-	tertiary
α-	alpha
β-	beta
γ-	gamma
δ-	delta
ε-	epsilon
η-	eta
μ-	mu

τ-	tau(tele)
ω-	omega
B-	boron position
N-	nitrogen position
O-	oxygen position
P-	phosphorus position
S-	sulfur position
cis-	cis form
trans-	trans form
(*Z*)-	Z（zusammen）form
(*E*)-	E（entgegen）form
threo-	threo form
erythro-	erythro form
D-	D form

L-	L form
DL-	DL form
d- or (+)-	dextro rotation
l- or (−)-	levo rotation
dl- or (±)-	racemic mixture
(*R*)-	R（rectus）form
(*S*)-	S（sinister）form
meso-	meso form
syn-	syn form
anti-	anti form
asym-	asymmetric form
s- or sym-	symmetric form
active-	active form
leuco-	leuco form

Products / Ligands

acac	Acetylacetone
ADDP	1,1'-(Azodicarbonyl)dipiperidine
AIBN	2,2'-Azobis(isobutyronitrile)
BINAP	2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl
BINOL	Binaphthol
bipy	= bpy
BMS	Borane - Dimethyl Sulfide Complex
bpy	Bipyridine
BSA	*N*,*O*-Bis(trimethylsilyl)acetamide
CD	Cyclodextrin
CDI	*N*,*N*'-Carbonyldiimidazole
cod	Cyclooctadiene
cot	Cyclooctatetraene
CSA	Camphorsulfonic Acid
CSI	Chlorosulfonyl Isocyanate
DABCO	1,4-Diazabicyclo[2.2.2]octane
DAST	(Diethylamino)sulfur Trifluoride
dba	Dibenzylideneacetone
DBAD	Di-*tert*-butyl Azodicarboxylate
DBN	1,5-Diazabicyclo[4.3.0]non-5-ene
DBU	1,8-Diazabicyclo[5.4.0]-7-undecene
DCC	*N*,*N*'-Dicyclohexylcarbodiimide
DDQ	2,3-Dichloro-5,6-dicyano-1,4-benzoquinone
DEAD	Diethyl Azodicarboxylate
DET	Diethyl Tartrate
DHP	3,4-Dihydro-2*H*-pyran
DIAD	Diisopropyl Azodicarboxylate
DIBAL	= DIBAL-H
DIBAL-H	Diisobutylaluminum Hydride
DIEA	= DIPEA
DIPEA	*N*,*N*-Diisopropylethylamine
DIPT	Diisopropyl Tartrate
DMA	*N*,*N*-Dimethylacetamide
DMAP	4-Dimethylaminopyridine
DME	1,2-Dimethoxyethane
DMF	*N*,*N*-Dimethylformamide
dmit	4,5-Dimercapto-1,3-dithiole-2-thione
DMP	Dess-Martin Periodinane
DMPU	*N*,*N*'-Dimethylpropyleneurea
DMS	Dimethyl Sulfide
DMSO	Dimethyl Sulfoxide
DMTSF	Dimethyl(methylthio)sulfonium Tetrafluoroborate
DOXYL	4,4-Dimethyloxazolidine-1-oxyl
DPPA	Diphenylphosphoryl Azide

dppf	1,1'-Bis(diphenylphosphinoferrocene)
DTBP	Di-*tert*-butyl Peroxide
DVB	Divinylbenzene
EDAC	= EDCI
EDC	3-(3-Dimethylaminopropyl)-1-ethylcarbodiimide
EDC	= EDCI
EDCI	1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide
EDTA	Ethylenediaminetetraacetic Acid
FAMSO	Formaldehyde Dimethyl Dithioacetal *S*-Oxide
Fc	Ferrocene
HMDS	1,1,1,3,3,3-Hexamethyldisilazane
HMPA	Hexamethylphosphoric Triamide
HMPT	Hexamethylphosphorous Triamide
HOAt	1-Hydroxy-7-azabenzotriazole
HOBt	1-Hydroxybenzotriazole
HOSu	*N*-Hydroxysuccinimide
IBX	2-Iodoxybenzoic Acid
Im	Imidazole
Imid	= Im
LAH	Lithium Aluminum Hydride
LDA	Lithium Diisopropylamide
LHMDS	= LiHMDS
LiHMDS	Lithium Hexamethyldisilazide
LTA	Lead Tetraacetate
MCPBA	*m*-Chloroperoxybenzoic Acid
MEK	Methyl Ethyl Ketone
MTBE	Methyl *tert*-Butyl Ether
MVK	Methyl Vinyl Ketone
NaHDMS	Sodium Hexamethyldisilazide
nbd	2,5-Norbornadiene
NBS	*N*-Bromosuccinimide
NCS	*N*-Chlorosuccinimide
NHC	*N*-Heterocyclic Carbene
NIS	*N*-Iodosuccinimide
NMO	4-Methylmorpholine *N*-Oxide
NMP	*N*-Methyl-2-pyrrolidone
Norphos	2,3-Bis(diphenylphosphino)bicyclo[2.2.1]hept-5-ene
Pc	Phthalocyanine
PCC	Pyridinium Chlorochromate
PDC	Pyridinium Dichromate
PEG	Polyethylene Glycol
PG	Prostaglandin
phen	Phenanthroline

PPTS	Pyridinium *p*-Toluenesulfonate
PTSA	*p*-Toluenesulfonic Acid
py	Pyridine
Salen	*N*,*N*'-Bis(salicylidene)ethylenediamine
SDS	Sodium Dodecyl Sulfate
TBAB	Tetrabutylammonium Bromide
TBAD	= DBAD
TBAF	Tetrabutylammonium Fluoride
TBHP	*tert*-Butyl Hydroperoxide
TCNQ	7,7,8,8-Tetracyanoquinodimethane
TEMPO	2,2,6,6,-Tetramethylpiperidine 1-Oxyl

TFA	Trifluoroacetic Acid
TFAA	Trifluoroacetic Anhydride
THF	Tetrahydrofuran
THP	Tetrahydropyran
TMTSF	Tetramethyltetraselenafluvalene
TNBS	2,4,6-Trinitrobenzenesulfonic Acid
TPAP	Tetrapropylammonium Perruthenate
TPD	*N*,*N*'-Diphenyl-*N*,*N*'-di(*m*-tolyl)benzidine
TPDS	Tetraphenyldisilane
TPP	Tetraphenylporphyrin
TTF	Tetrathiafulvalene

Protecting Groups / Functional Groups

Ac	Acetyl-
Alloc	Allyloxycarbonyl-
Ar	Aryl-
Bn	Benzyl-
Boc	*tert*-Butoxycarbonyl-
BOM	Benzyloxycarbonyl-
BPS	= TBDPS
Bz	Benzoyl-
Cbz	Carbobenzoxy- (=Benzyloxycarbonyl-)
Chx	= Cy
Cp	Cyclopentadienyl-
Cy	Cyclohexyl-
DMTr	4,4'-Dimethoxytrityl-
Dnp	2,4-Dinitrophenyl-
Fmoc	(9*H*-Fluoren-9-ylmethoxy)carbonyl-
MEM	(2-Methoxyethoxy)methyl-
Mes	2,4,6-Trimethylphenyl- (=Mesityl-)
MMTr	4-Monomethoxytrityl-
MOM	Methoxymethyl-

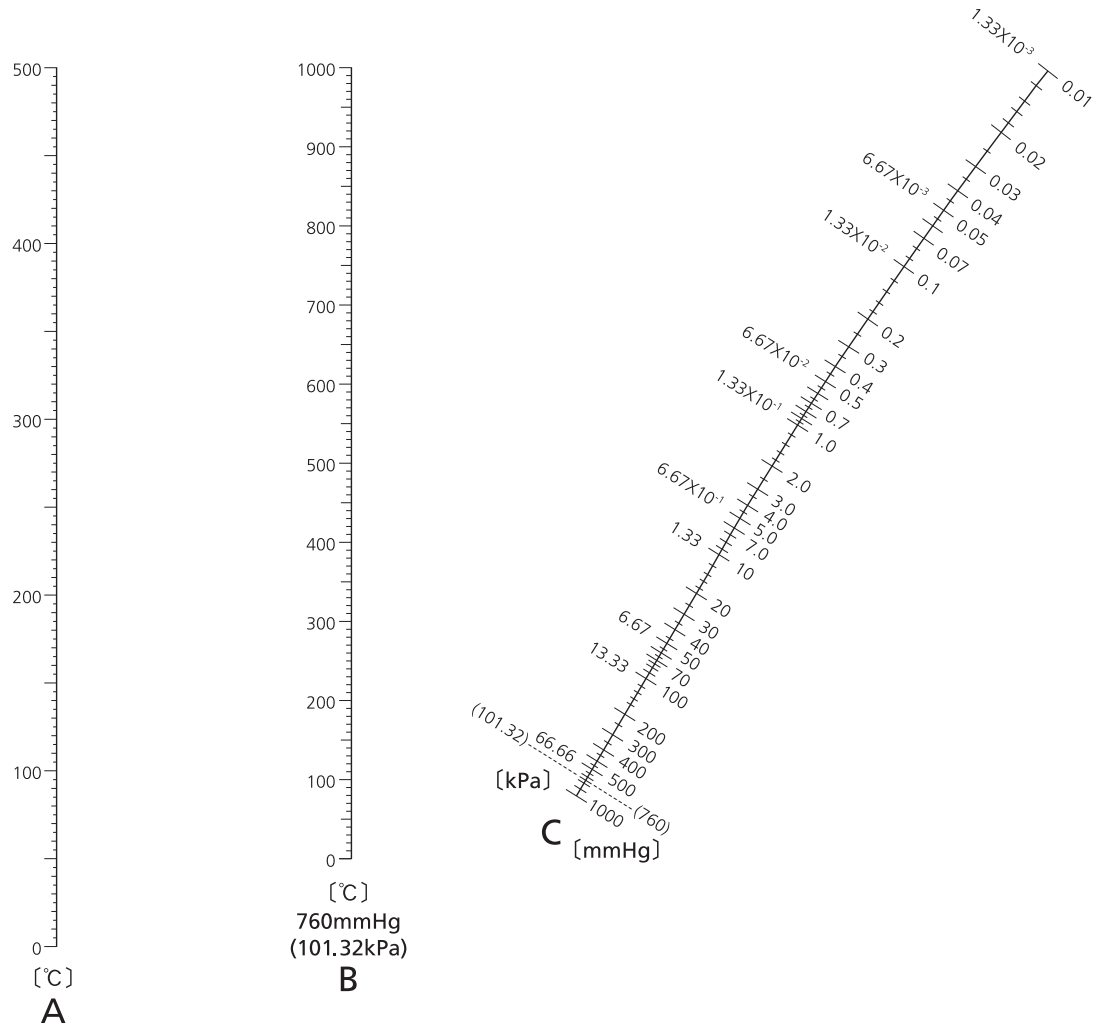
Ms	Methanesulfonyl-
Naph	= Np
Np	Naphthyl-
Nps	2-Nitrophenylsulfenyl-
Ns	Nitrobenzenesulfonyl
Piv	Pivaloyl-
PMB	*p*-Methoxybenzyl
SEM	2-(Trimethylsilyl)ethoxymethyl-
TBDMS	*tert*-Butyldimethylsilyl- (=TBS)
TBDPS	*tert*-Butyldiphenylsilyl-
TES	Triethylsilyl-
Tf	Trifluoromethanesulfonyl-
TIPS	Triisopropylsilyl-
TMS	Trimethylsilyl-
Tol	*p*-Tolyl-
Tr	Triphenylmethyl- (=Trityl-)
Ts	*p*-Toluenesulfonyl- (=Tosyl)
Z	=Cbz

Stabilizers

BHT	3,5-Di-*tert*-butyl-4-hydroxytoluene
HQ	Hydroquinone
MEHQ	Hydroquinone Monomethyl Ether (=4-Methoxyphenol)

ONP	*o*-Nitrophenol
TBC	4-*tert*-Butylcatechol
TBBP	3,3',5,5'-Tetra-*tert*-butyl-4,4'- dihydroxybiphenyl

Pressure-Temperature Nomograph



●How to calculate the bp under atmospheric pressure from bp under reduced pressure

① Connect a degree on the line C and its corresponding bp on the line A under reduced pressure using a straight line.

② An intersection found by step ① on the line B serves as an approximate bp in atmospheric pressure.

*This nomograph applies to nonassociated solvent.
Since the bp obtained from this nomograph is an approximate value, it is not an exact bp.

Reference :Science of Petroleum, Vol.II. p.1281 (1938).

The physical properties of the typical organic solvents [1)]

Organic Solvents	bp (°C)	mp (°C)	d (20/4°C)	Compatibility with Water (°C) (weight % of solvents)	Miscibility with Water[b)]
Methanol (MeOH)	64.5	-97.7	0.791	— a)	○
Ethanol (EtOH)	78.3	-114.5	0.789	78.2(96.0)	○
Propanol (*n*-PrOH)	97.2	-126.2	0.804	87.7(71.7)	○
Isopropyl Alcohol (*i*-PrOH)	82.2	-88.0	0.785	80.1(88.0)	○
Butanol (BuOH)	117.7	-88.6	0.810	92.7(57.5)	△
Isobutyl Alcohol (*i*-BuOH)	107.9	-108	0.802	89.8(67)	△
sec-Butyl Alcohol (*s*-BuOH)	99.5	-114.7	0.807	87.0(73.2)	△
tert-Butyl Alcohol (*t*-BuOH)	82.3	25.6	0.781	79.7(88.2)	○
Ethylene Glycol	197.5	-12.6	1.114	— a)	○
1,2-Dimethoxyethane (Glyme)	84.5	-69	0.869	77.4(89.9)	○
Diethyl Ether (Et_2O)	34.4	-116	0.714	34.2(98.7)	× c)
Diisopropyl Ether ($i\text{-}Pr_2O$)	68.5	-85.5	0.724	62.2(95.5)	×
Acetic Acid (AcOH)	117.9	16.7	1.050	— a)	○
Ethyl Acetate (AcOEt)	77.1	-83.6	0.901	70.4(91.5)	× c)
Acetic Anhydride (Ac_2O)	140.0	-73.1	1.083		
Tetrahydrofuran (THF)	66.0	-108.4	0.889	63.4(93.3)	○
1,4-Dioxane	101.3	11.8	1.034	87.8(82)	○
Acetone	56.1	-94.7	0.790	— a)	○
Ethyl Methyl Ketone	79.6	-86.7	0.805	73.4(88.7)	△
Carbon Tetrachloride (CCl_4)	76.6	-22.8	1.594	66(95.9)	×
Chloroform ($CHCl_3$)	61.2	-63.5	1.489	56.1(97.8)	×
Dichloromethane (CH_2Cl_2)	39.6	-94.9	1.326	38.1(98.5)	×
1,2-Dichloroethane ($ClCH_2CH_2Cl$)	83.5	-35.7	1.252	72(91.8)	×
Benzene (C_6H_6)	80.1	5.5	0.879	69.3(91.2)	×
Toluene	110.6	-95.0	0.867	85(79.8)	×
o-Xylene	144.4	-25.2	0.880	93.5(50.1)	×
Cyclohexane	80.7	6.7	0.779	69.0(91)	×
Pentane	36.1	-129.7	0.626	34.6(98.6)	×
Hexane	68.7	-95.3	0.659	61.6(94.4)	×
Heptane	98.4	-90.6	0.684		×
Acetonitrile (CH_3CN)	81.6	-43.8	0.782	76.7(84.2)	○
Nitromethane (CH_3NO_2)	101.2	-28.6	1.138	83.6(76.4)	×
Dimethylformamide (DMF)	153	-60.4	0.949	— a)	○
Hexamethylphosphoric Triamide (HMPA)	233	7.2	1.027		○
Triethylamine (Et_3N)	89.6	-114.7	0.728		○
Pyridine (Py)	115.3	-41.6	0.983	93.6(58.7)	○
Dimethyl Slufoxide (DMSO)	189.0	18.5	1.100	— a)	△
Carbon Disulfide (CS_2)	46.2	-111.6	1.263	42.6(97.2)	×

a) It doesn't form azeotropic mixture

b) ○ : freely miscible
△ : partially miscible
× : practically immiscible (solubility : less than 1%)

c) highly soluble in water

Example of combination of recrystallization solvents

The crystals are obtained from the solution of single or more than one solvent.
In the two solvent system, solvent A and B should be miscible : when solubility is A > B, it is desirable that the boiling point is A < B and the density is A > B.

Freezing mixtures [2)]

Freezing mixtures	Temp. (°C)	Freezing mixtures	Temp. (°C)
Ice	0	Chloroform / N_2	-63
Ethylene Glycol / CO_2	-15	Chloroform / CO_2	-63
Ice(100) / NH_4Cl (25)	-15	Ethanol / CO_2	-72
Ice(100) / NaCl(33)	-21	Ether / CO_2	-77
Carbon Tetrachloride / N_2	-23	Acetone / CO_2	-78
Carbon Tetrachloride / CO_2	-23	Methanol / N_2	-98
Ice(100) / EtOH (100)	-30	*n*-Pentane / N_2	-131
Acetonitrile / N_2	-41	N_2	-180
Ice(100) / $CaCl_2$ (150)	-49		

References

1) "Yuki Kagaku Jikken no Tebiki 1", editors : T. Goto, T. Shiba, T. Matsuura, Kagaku Dojin
2) "Shinhan Kiso Yuki Kagaku Jikken", K. Hata, K. Watanabe, Maruzen

Periodic Table of the Elements

ATOMIC NUMBER
SYMBOL
ATOMIC WEIGHT
i : ionic radius (Å) (coordination no:6)
a : atomic radius (Å)
v : van der waals radius (Å)
χ_P : electronegativity
Atomic Weights : 2009 IUPAC values

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008 v : 1.20 χ_P: 2.20																	2 **He** 4.002602 v : 1.40
3 **Li** 6.94 i : 0.76 (+) a : 1.57 v : 1.82 χ_P: 0.98	4 **Be** 9.012182 a : 1.12 χ_P: 1.57											5 **B** 10.81 a : 0.88 χ_P: 2.04	6 **C** 12.011 a : 0.77 v : 1.70 χ_P: 2.55	7 **N** 14.007 a : 0.74 v : 1.55 χ_P: 3.04	8 **O** 15.999 i : 1.40 (2-) a : 0.66 v : 1.52 χ_P: 3.44	9 **F** 18. 9984032 i : 1.33 (-) a : 0.64 v : 1.47 χ_P: 3.98	10 **Ne** 20.1797 v : 1.54
11 **Na** 22.98976928 i : 1.02 (+) a : 1.91 v : 2.27 χ_P: 0.93	12 **Mg** 24.3050 i : 0.72 (2+) a : 1.60 v : 1.73 χ_P: 1.31											13 **Al** 26. 9815386 i : 0.54 (3+) a : 1.43 χ_P: 1.61	14 **Si** 28.085 a : 1.17 v : 2.10 χ_P: 1.90	15 **P** 30.973762 a : 1.10 v : 1.80 χ_P: 2.19	16 **S** 32.06 i : 1.84 (2-) a : 1.04 v : 1.80 χ_P: 2.58	17 **Cl** 35.45 i : 1.81 (-) a : 0.99 v : 1.75 χ_P: 3.16	18 **Ar** 39.948 v : 1.88
19 **K** 39.0983 i : 1.38 (+) a : 2.35 v : 2.75 χ_P: 0.82	20 **Ca** 40.078 i : 1.00 (2+) a : 1.97 χ_P: 1.00	21 **Sc** 44.955912 a : 1.64 χ_P: 1.36	22 **Ti** 47.867 a : 1.47 χ_P: 1.54	23 **V** 50.9415 a : 1.35 χ_P: 1.63	24 **Cr** 51.9961 a : 1.29 χ_P: 1.66	25 **Mn** 54.938045 a : 1.37 χ_P: 1.55	26 **Fe** 55.845 a : 1.26 χ_P: 1.83	27 **Co** 58.933195 a : 1.25 χ_P: 1.88	28 **Ni** 58.6934 a : 1.25 v : 1.63 χ_P: 1.91	29 **Cu** 63.546 a : 1.28 v : 1.4 χ_P: 1.90	30 **Zn** 65.38 a : 1.37 v : 1.39 χ_P: 1.65	31 **Ga** 69.723 i : 0.62 (3+) a : 1.53 v : 1.87 χ_P: 1.81	32 **Ge** 72.63 a : 1.22 v : 2.10 χ_P: 2.01	33 **As** 74.92160 a : 1.21 v : 1.85 χ_P: 2.18	34 **Se** 78.96 i : 1.98 (2-) a : 1.17 v : 1.90 χ_P: 2.55	35 **Br** 79.904 i : 1.96 (-) a : 1.14 v : 1.85 χ_P: 2.96	36 **Kr** 83.798 v : 2.02 χ_P: 3.00
37 **Rb** 85.4678 i : 1.52 (+) a : 2.50 χ_P: 0.82	38 **Sr** 87.62 i : 1.18 (2+) a : 2.15 χ_P: 0.95	39 **Y** 88.90585 a : 1.82 χ_P: 1.22	40 **Zr** 91.224 a : 1.60 χ_P: 1.33	41 **Nb** 92.90638 a : 1.47 χ_P: 1.60	42 **Mo** 95.96 a : 1.40 χ_P: 2.16	43 **Tc** (98) a : 1.36 χ_P: 1.90	44 **Ru** 101.07 a : 1.34 χ_P: 2.20	45 **Rh** 102.90550 a : 1.34 χ_P: 2.28	46 **Pd** 106.42 a : 1.37 v : 1.63 χ_P: 2.20	47 **Ag** 107.8682 a : 1.44 v : 1.72 χ_P: 1.93	48 **Cd** 112.411 a : 1.52 v : 1.58 χ_P: 1.69	49 **In** 114.818 i : 0.80 (3+) a : 1.67 v : 1.93 χ_P: 1.78	50 **Sn** 118.710 i : 0.69 (4+) a : 1.58 v : 2.17 χ_P: 1.96	51 **Sb** 121.760 a : 1.41 χ_P: 2.05	52 **Te** 127.60 i : 2.21 (2-) a : 1.37 v : 2.06 χ_P: 2.10	53 **I** 126.90447 i : 2.20 (-) a : 1.33 v : 1.98 χ_P: 2.66	54 **Xe** 131.293 v : 2.16 χ_P: 2.60
55 **Cs** 132.9054519 i : 1.67 (+) a : 2.72 χ_P: 0.79	56 **Ba** 137.327 i : 1.35 (2+) a : 2.24 χ_P: 0.89	57 **La** • 138.90547 a : 1.88 χ_P: 1.10	72 **Hf** 178.49 a : 1.59 χ_P: 1.30	73 **Ta** 180.94788 a : 1.47 χ_P: 1.50	74 **W** 183.84 a : 1.41 χ_P: 2.36	75 **Re** 186.207 a : 1.37 χ_P: 1.90	76 **Os** 190.23 a : 1.35 χ_P: 2.20	77 **Ir** 192.217 a : 1.36 χ_P: 2.20	78 **Pt** 195.084 a : 1.39 v : 1.75 χ_P: 2.28	79 **Au** 196.966569 a : 1.44 v : 1.66 χ_P: 2.54	80 **Hg** 200.59 a : 1.55 v : 1.55 χ_P: 2.00	81 **Tl** 204.38 i : 0.89 (3+) a : 1.71 v : 1.96 χ_P: 2.04	82 **Pb** 207.2 a : 1.75 v : 2.02 χ_P: 2.33	83 **Bi** 208.98040 a : 1.82 χ_P: 2.02	84 **Po** (209) χ_P: 2.00	85 **At** (210) χ_P: 2.20	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** ▲ (227)	104 **Rf** (265)	105 **Db** (268)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (280)	112 **Cn** (285)	113 **Uut** (284)	114 **Uuq** (289)	115 **Uup** (288)	116 **Uuh** (293)	117 **Uus** (294)	118 **Uuo** (294)

• Lanthanoids	58 **Ce** 140.116	59 **Pr** 140.90765	60 **Nd** 144.242	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.964	64 **Gd** 157.25	65 **Tb** 158.92535	66 **Dy** 162.500	67 **Ho** 164.93032	68 **Er** 167.259	69 **Tm** 168.93421	70 **Yb** 173.054	71 **Lu** 174.9668
▲ Actinoids	90 **Th** 232.03806	91 **Pa** 231.03588	92 **U** 238.02891	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

References : Inorganic Chemistry, Third Edition (D. F. Shriver, P. W. Atkins), Tokyo Kagaku Dojin, **2001**; Kagaku Binran Kisohen Revised Fifth Edition, Maruzen, **2004**
Atomic weights of the elements 2009. *Pure Appl. Chem.* **2011**, *83*, 359.

INDEX

S : Reagent Guide Synthetic Organic Chemistry & Materials Chemistry
B : Reagent Guide Bioscience & Analytical Science
HP : Please visit our website.

[D]

[Z]

TCI International Offices

NORTH, CENTRAL and SOUTH AMERICA

TCI AMERICA
9211 N. Harborgate Street, Portland, OR 97203, USA
Tel: 800-423-8616 / 503-283-1681
Fax: 888-520-1075 / 503-283-1987
E-mail: Sales-US@TCIchemicals.com

[East Coast Sales Office]
1 Broadway, 14th Floor, Cambridge, MA 02142, USA

[Philadelphia Sales & Distribution Center]
121 Domorah Drive, Montgomeryville, PA 18936, USA

EUROPE

TCI EUROPE N.V.
Boerenveldseweg 6 - Haven 1063
2070 Zwijndrecht
Belgium
Tel: +32 (0)3 735 07 00
Fax: +32 (0)3 735 07 01
E-mail: Sales-EU@TCIchemicals.com

TCI Deutschland GmbH
Mergenthalerallee 79-81
D-65760 Eschborn
Germany
Tel: +49 (0) 6196 640 53 00
Fax: +49 (0) 6196 640 53 01
E-mail: Sales-DE@TCIchemicals.com

Tokyo Chemical Industry UK Ltd.
The Magdalen Centre
Robert Robinson Avenue
The Oxford Science Park
Oxford OX4 4GA
U.K.
Tel: +44 1865 78 45 60
Fax: +44 1865 78 45 61
E-mail: Sales-UK@TCIchemicals.com

ASIA PACIFIC REGIONS

TOKYO CHEMICAL INDUSTRY CO., LTD.
4-10-2 Nihonbashi-honcho, Chuo-ku, Tokyo 103-0023, Japan
Tel: +81-3-5640-8878
Fax: +81-3-5640-8902
E-mail: globalbusiness@TCIchemicals.com

CHINA

梯希爱（上海）化成工业发展有限公司
上海化学工业区普工路 96 号 邮编 201507
Tel: 800-988-0390 / 021-6712-1386
Fax: 021-6712-1385
E-mail: Sales-CN@TCIchemicals.com

梯希爱（上海）化成工业发展有限公司北京分公司
北京市海淀区中关村南大街 2 号 B 座 17 层 2002D 邮编 100086

INDIA

TCI Chemicals (India) Pvt. Ltd.
Plot No. B-28, Phase II, 5th Cross Street, MEPZ-SEZ, Tambaram,
Chennai-600045, Tamilnadu, India
Toll Free: 1800 425 7889
Tel: +91-(0)44-2262 0909
Fax: +91-(0)44-2262 8902
E-mail: Sales-IN@TCIchemicals.com

TCI Distributors

NORTH, CENTRAL and SOUTH AMERICA

VWR International LLC	URL: www.vwr.com
Spectrum Chemical Manufacturing Corp.	URL: www.spectrumchemical.com
Thermo Fisher Scientific Inc.	URL: www.fishersci.com

EUROPE

CROATIA

KUNA CORPORATION d.o.o.

Mokrice 179A
49243 Oroslavje
Hrvatska, Croatia
Tel/Fax: +385 49249019
E-mail: kuna@kuna-corporation.hr
URL: www.kuna-corporation.hr

CZECH REPUBLIC / SLOVAKIA

BDL Czech Republic s.r.o

Náměstí Českého ráje 2
511 01 Turnov
Czech Republic
Tel: +420 481 540 792
Fax: +420 481 541 032
E-mail: info@bdl-cee.com
URL: www.bdl-cee.com

ISRAEL

Beith Dekel Ltd

16 Ha'tidhar st. Ra'anana 43665
Israel
Tel: +972 9 7611800
Fax: +972 9 7420073
E-mail: info@bdl.co.il
URL: www.bdl.co.il

HUNGARY

MOLAR CHEMICALS KFT

Árpád u. 1
2314 HALÁSZTELEK
Hungary
Tel: +36 1 3066476
Fax: +36 1 3050298
E-mail: ertekesites@molar.hu
URL: www.molar.hu

ITALY

Zentek SRL

via Tadino 55
20124 Milano Italy
Tel: +39 02 295 29165
Fax: +39 02 295 29155
E-mail: info@zentek.it
URL: www.zentek.it

LATVIA / LITHUANIA / ESTONIA

HPLC Solutions

Antonijas street 22-1
Riga, Latvia
LV-1010
Tel: +371 2251444
Fax: +371 67142225
E-mail: info@hplc.lv
URL: www.chromsword.com

POLAND	
TriMen Chemicals S.A.	Al. Pilsudskiego 141 92-318 LODZ Poland Tel: +48 733-874-636 (733-TRIMEN) Fax: +48 42 250 30 31 E-mail: sprzedaz@trimen.pl URL: www.trimen.pl
ROMANIA	
SC Nordic Chemicals SRL	Valea Seaca Street, no. 7A 400227 CLUJ NAPOCA Romania Tel: +40 264 274187 Fax: +40 264 274185 E-mail: nordic.romania@yahoo.ro URL: www.reactivi.eu/
RUSSIA	
OOO "Fizlabpribor"	Varshavskoye Shosse 125G, building 5, office 325 117587, Moscow Tel: +7 495 740 54 06 Fax: +7 495 280 13 48 E-mail: info@fizlabpribor.ru URL: www.fizlabpribor.ru
SPAIN / PORTUGAL	
CYMIT QUIMICA, S.L.	Santander, 42-48 Nave 2, 08020 Barcelona Spain Tel: +34 93 2412927 Fax: +34 93 4144979 E-mail: info@cymitquimica.com URL: www.cymitquimica.com
SWEDEN	
Chemtronica AB	Box 12852 112 98 Stockholm Sweden Tel: +46-86657094 Fax: +46-86650773 E-mail: sales@chemtronica.se URL: www.chemtronica.se
TURKEY	
VWR International Laboratuvar Teknolojileri Ltd. Şti.	Orta Mah. Cemal Gürsel Cad. Ördekçioğlu İş Mrk. No. 32/1 34896 Pendik/Istanbul Turkey Tel: +90 2165982900 Fax: +90 2165982907 E-mail: info@tr.vwr.com URL: www.pro-lab.com.tr

for HPLC Columns Located in GERMANY	
dichrom GmbH	Graewenkolkstr. 66 D-45770 Marl Germany Tel: +49 2365699260 Fax: +49 23656992611 E-mail: info@dichrom.com URL: www.dichrom.com/index.shtml
Located in Latvia ChromSword Group	Antonijas Street 22-1 Riga, Latvia LV-1010 Tel: +371 2251444 Fax: +371 6714225 E-mail: tci@chromsword.com URL: www.chromsword.com
Located in the United Kingdom Greyhound Chromatography and Allied Chemicals	6 Kelvin Park Birkenhead Merseyside CH41 1LT United Kingdom Tel: +44 0151649 Fax: +44 0151649001 E-mail: sales@greyhoundchrom.com URL: www.greyhoundchrom.com/default.aspx

ASIA PACIFIC REGIONS

AUSTRALIA	
Chem-Supply Pty Ltd.	38-50 Bedford Street Gillman, South Australia 5013, Australia Tel: +61 8 8440 2000 Fax: +61 8 8440 2001 E-mail: info@chemsupply.com.au
Thermo Fisher Scientific Australia Pty Ltd.	5 Caribbean Drive, Scoresby, VIC, 3179 Australia Tel: 1300 735 292 Fax: 1800-067-639 E-mail: AUinfo@thermofisher.com
HONG KONG	
Advanced Technology and Industrial Co., Ltd.	Unit 1B, Cheong Shing Industrial Building, 17 Walnut St., Tai Kok Tsui, Kln., Hong Kong Tel: +852-23902293 Fax: +852-27898314 E-mail: sales@advtechind.com
INDONESIA	
PT. Dipa Puspa Labsains	Jl. Kebon Jeruk Raya 66, Jakarta 11530, Indonesia Tel: +62-(0)21-5350535 Fax: +62-(0)21-5481322 E-mail: info@dipa.co.id
PT. Surya Buana Nusantara	Jl. Budi Mulia No.5-11/5, Gunung Sahari-Ancol, Jakarta 14420, Indonesia Tel: +62-(0)-21-6406225 Fax: +62-(0)-21-6458467 E-mail: sales@suryabuana.com

KOREA	
Sejin Chemical Industry Co. (Exclusive Distributor)	A-1811, Woolimblue9 Business Center, 240-21, Yeomchang-dong, Gangseo-gu, Seoul 157-779, Korea Tel: 080-747-0691, +82-(0)2-2093-2480 Fax: +82-(0)2-2093-2481 E-mail: sales@sejinci.co.kr
MALAYSIA	
Acumen Scientific Sdn. Bhd.	Plot No. 256, Tingkat Perusahaan 5, Kawasan Perindustrian Perai 2, 13600 Perai, Pulau Pinang, Malaysia Tel: +60-(0)4-398 1609 Fax: +60-(0)4-399 1609 E-mail: inquiry@acumen.com.my
Segar Alatan Sains (M) Sdn. Bhd.	No.8, Jalan Putra Mahkota 7/8D, Putra Heights, 47650 Subang Jaya, Selangor, Malaysia Tel: +60-(0)3-5192 5500 Fax: +60-(0)3-5192 5511 E-mail: sales@segarasia.com
NEW ZEALAND	
VWR International LP trading as Global Science	241 Bush Road, Albany, Auckland 0632, New Zealand Tel: +64-(0)9-443-5867 Fax: +64 (0)9-444-7314 E-mail: sales@globalscience.co.nz
PHILIPPINES	
Theo-Pam Trading Corp.	2825 Park Avenue, San Rafael, Pasay City 1302 Philippines Tel: +63-(0)2-8314808 Fax: +63-(0)2-8314040 E-mail: inquiry@theopam.com.ph
SINGAPORE	
Tee Hai Chem Pte. Ltd.	Tampines LogisPark, 25 Greenwich Drive, Singapore 533973 Tel: +65-68625655 Fax: +65-68625855 E-mail: sales@teehaichem.com.sg
TAIWAN	
Echo Chemical Co., Ltd.	No.16, Gongyeh Road, Lu-Chu Li, 351, Toufen, Miaoli, Taiwan, R.O.C. Tel: +886-(0)37-629988 Fax: +886-(0)37-621090 E-mail: sales@echochemical.com
KM3 SCIENTIFIC CORPORATION	7F.-7, No.5, Sec. 3, New Taipei Blvd., Xinzhuang Dist., New Taipei City 24250, Taiwan, R.O.C Tel: +886-(0)2-8522-8321 Fax: +886-(0)2-8522-8331 E-mail: km3.sci@msa.hinet.net
THAILAND	
Chemical Express Co., Ltd.	111/5 Moo.5 Srinakarin Road, Bang Muang, Muang, Samutprakarn 10270, Thailand Tel: +66-(0)2-740-4271-6 Fax: +66-(0)2-740-4277-8 E-mail: chemex@loxinfo.co.th

VIETNAM

INTECOM Co., Ltd
A1A2 Minh Khai, Hoang Cau, Dongda district, Hanoi, Vietnam
Tel: +84 4 - 3513 54 23 / 24
Fax: +84 4 - 3511 9826
E-mail: quang.tn@intecomvn.com

AFRICA

EGYPT

Nano Tech for life science and trade
5, Amer St. Mesaha, Dokki, Giza 12311, Egypt
Tel: + 2-(0)2 37618866
Fax: +2 -(0)2 37620792
E-mail: info@nanotech-eg.net

CHINA

北京百灵威科技有限公司

百灵威（北京）
北京市朝阳区北辰西路 69 号峻峰华亭 A 座 5 层
邮编：100029
电话：400-666-7788 / +86 10 8284 8833
传真：010-8284 9933
邮件：jkinfo@jkchemical.com
jkinfo@jk-scientific.com

百灵威（上海）
上海市浦东区世纪大道 1777 号东方希望大厦 10 楼 H 座
邮编：200122
电话：+86 21 6163 8833
传真：+86 21 6163 8800
邮件：jksh@jkchemical.com
jksh@jk-scientific.com

百灵威（广州）
广东省广州市天河区珠江新城华夏路 28 号富力盈信大厦 1012 室
邮编：510623
电话：+86 20 3888 9733
传真：+86 20 3888 8569
邮件：jkgz@jkchemical.com
jkgz@jk-scientific.com

国药集团化学试剂有限公司

区域销售总部 - 本部
上海四川中路 660 号
邮编：200002
电话：021-63213696
传真：021-64372447
邮件：liucheng@sinopharm.com

区域销售总部 - 浙江终端
上海四川中路 660 号
邮编：200002
电话：021-53215998
传真：021-63295918
邮件：chenhong3@sinopharm.com

区域销售总部 - 江浙皖分销
上海四川中路 660 号
邮编：200002
电话：021-63391142
传真：021-63295918
邮件：liujian10@sinopharm.com

区域销售总部 - 华南大区
上海四川中路 660 号
邮编：200002
电话：021-53215989
传真：021-63216489
邮件：huangguoxu@sinopharm.com

区域销售总部 - 华中西南大区
上海四川中路 660 号
邮编：200002
电话：021-53215988
传真：021-63295918
邮件：huanghuiping@sinopharm.com

区域销售总部 - 闽赣湘
上海四川中路 660 号
邮编：200002
电话：021-63237985
传真：021-63216489
邮件：yinshanqing@sinopharm.com

区域销售总部 - 江苏终端
上海四川中路 660 号
邮编：200002
电话：021-53215628
传真：021-63295918
邮件：zhengxuejiao@sinopharm.com

山东分公司
济南历城区花园路 184 号青苹果时代公寓 102 室
邮编：250100
电话：18853180207
传真：0531-83175931
邮件：zhanghongxi@sinopharm.com

国药集团化学试剂北京有限公司

营业总部

北京市西城区太平街 8 号院 6 号楼商铺
邮编：100050
电话：010-58329221
传真：010-58329201
邮件：chiweidan@sinopharm.com

海淀营业部

海淀区中关村北大街 172 号
邮编：100080
电话：010-62559318 010-62551704
传真：010-62559444
邮件：chiweidan@sinopharm.com

国药集团化学试剂沈阳有限公司

沈阳市和平区市府大路 106 号
邮编：110002
电话：024-23465502
传真：024-23464297
邮件：Gyhs2011@163.com

国药集团化学试剂苏州有限公司

苏州市水潭巷 15 号
邮编：215003
电话：0512-86660525
传真：0512-65119183
邮件：zhafengyi@sinopharm.com

国药集团化学试剂成都有限公司

成都市东三环路二段华冠路 168 号
邮编：610052
电话：028-84216090、84216064
传真：028-84216092
邮件：yuduo@sinopharm.com

国药集团化学试剂陕西有限公司

西安市和平路 99 号金鑫国际 204 室
邮编：710001
电话：029-87206415
传真：029-87441568
邮件：sj_sxcgb@sinopharm.com

国药集团化学试剂合肥有限公司

合肥市巢湖路 89 号添锦公寓商业 04
邮编：230031
电话：0551-64661037
传真：0551-64661037
邮件：hfreagent@126.com

萨恩化学技术（上海）有限公司

上海市浦东新区张江高科毕升路 289 号 4 号楼
邮编：201204
电话：400-005-6266
传真：021-58436166-800
邮件：service@energy-chemical.com

上海正晃商贸有限公司

上海市徐汇区广元西路 315 号联峰汇 3 楼 C 室
邮编：200030
电话：021-60905268
传真：021-60905269
邮件：seiko.cn@seikonet.co.jp

广州市亿之伦贸易有限公司

广州办公室

广州市海珠区新港西路 3 号西楼 802 房
邮编：510260
电话：020-83488003
传真：020-83505374
邮件：yesgz@189.cn

上海办公室

上海市虹口区东宝兴路 258 弄 3 号 1002 室
邮编：200080
电话：021-63065836
传真：021-63072663
邮件：shyrhg@126.com

斯百全化学（上海）有限公司

上海市松江区申港路 3802 弄 A20
邮编：201611
电话：86-21-67601398
传真：86-21-57711696
邮件：Sales@spectrumchina.net

中久科技（上海）有限公司

中国上海东明路 2100 号 219 室
邮编：200123
电话：021-58986888
传真：021-58558801
邮件：Info_china@vwr.com

INDIA

Telangana	
Strides Enterprises	Plot-No: 31&32, Door-No: F2, Sai Kalyan Appts, RKH Colony, A.S. Rao Nagar, ECILl, Hyderabad – 500062 Telangana State, INDIA. Mobile: +91 9000249563 E-mail: stridesent@gmail.com, info@stridesenterprises.com. URL: www.stridesenterprises.com
Orbit Scientific Products	I Floor, Mathru Krupa Building, Plot No.15, Sanjeevaiah Housing, Chandulal Bowli, Tarband, Secunderabad-500009, Andhra Pradesh, INDIA. Mobile: 9502783838 Phone: 91-40-65133545 E-mail: sales@osp-india.com
Goa	
Shree Chemicals	Flat no 102, Block B, Situated on the 1st Floor in Building Known as "Jewel Countryside".Tal:Sirsaim.Bardez. Goa - 403502 Mobile: 09922111663/09922111794 Phone: 020-26452262/26444440 E-mail: info@shreechemicalspune.com
Scitech Scientifics	GS-3, Goa Housing Board Comm. Complex, Patrakar Colony, Next to Bank of Maharashtra, Porvorim, Goa - 403 521. Mobile: +91 98920 03110 Phone: 91 832 645 2855 E-mail: scitechgoa@gmail.com
Gujarat	
Datt Chemicals	F-107, Shopper's Point, Parimal Chowk, Waghawadi Road, Bhavnagar - 364002. Mobile: 09879210340 E-mail: dattchem@gmail.com
Sterling Biologicals.	225-226, Shukan mall, Near CIMS Hospital, Sola-science City road, Sola, Ahmedabad-380060, Gujarat. Mobile: 09879106739 & 09879106729 Phone: 079-27710026. E-mail: sterlingbiologicals@hotmail.com & sbio2012@hotmail.com
Matrix Trade link Pvt Ltd	312 & 314 Shail, Opp Madhusudan House, Off C G Road, Navrangpura, Ahmedabad - 380 006, Gujarat. Mobile: +91-98250-65410 & 91-93761-40576 Phone: 079-30086050/30086060 E-mail: matrixentp@gmail.com
Chemical Centre	Office no.114, Plot No.10, Brij Industries, Opp. Shree Saibaba Mandir, GIDC, Makarpura, Vadodara - 10, Gujarat. Phone: 022-2203 1616 , 22051616 , 22051564 E-mail: sales@chemicalcentre.net
Aum Chemicals	No. 10, Pushpam Bunglow, B/H, Jivraj Park Society, Ahmedabad-390051, Gujarat. Mobile: 09898207003 E-mail: aum_chemicals@yahoo.co.in
Shreejala Chemicals	Parijat, Plot No. 2601/14/4, Near Asian Paint Chockdi, G.I.D.C Estate, Ankleshwar, Gujarat - 393002 Mobile: 09427114814

Karnataka	
Scientific & Allied Products	#306 Saraswathi Niwas 5 Main channel Road, Saraswathipuram, Ulsoor, Bangalore-560008 Mobile: 9845122597/984561712 Phone: 08025513531 E-mail: scientificalliedproducts@gmail.com
Syneric Consultant & Distributors Pvt Ltd	1st Floor, No. 44(S), 1st Stage, 2nd Phase, Vijayanagar, Chandra Layout, Bangalore – 560040. India Mobile: +91 9686098580 Phone: 080-23185115 E-mail: mktg@syneric.in
Ace Rasayan	18/8, 5th Main Road, Gandhinagar, Bangalore-560009 Mobile: 9845066361 Phone: 080 22268521 / 22250078 E-mail: Bangalore@acerasayan.com
Kerala	
Globe Scientific	TC 28/1288-1 Sreekandeswaram, Fort PO, Thiruvananthapuram - 695023 Phone: 0471-2465482 E-mail: globescientific@gmail.com
Chemical House	41/1834 B, Vee Kay Tower, T.A.B Road, Ernakulam North, Kochi-18, Kerala. Mobile: 9539015353 E-mail: info@chemicalhouse.in
Madhya Pradesh	
Effective Enterprises	CM-67, BDA Duplex, Opp. NABARD Complex, Sector-C', Shahpura, Bhopal, Madhya Pradesh-462016 Mobile: 9827225325 Phone: 0755-2460129 E-mail: effectiveenterprises12@gmail.com
S.K traders	48, Jaora Compound, Opp. Dental College, Indore-452001, Madhya pradesh Mobile: 9826026006 Phone: 0731-6638000, 001, 002-(99 Lines) E-mail: sktindore@gmail.com
Maharashtra	
Shah Enterprises	12, Mukti Chaitanya Society, 3rd floor 236. Samuel Street, Masjid(W), Mumbai 400003. Phone: +91-22-23449076 Fax: +91-22-23450708 E-mail: sales@shahentp.in
Jignesh Agency Pvt. Ltd.	14/15 Atlanta Estate, Hanuman Tekdi Road, Vitbhati, Near Virwani Indl Estate, Goregaon (East). Mumbai-400063 Maharashtra India Mobile: 09320179914 Phone: +91 22 29277421 / 6116 / 6117 Ext:28 E-mail: sales@japl.org
Universal Trading Corporation	Kamal Heritage, Tapodham Parisar, Near Jijai Garden, Warje, Pune- 411 058. E-mail: univ24@gmail.com Mobile: 9890 184185

Naresh Enterprises	Survey. No. 220/5/1A, Behind Hotel Le Royale, Maan Road, Phase I, Hinjewadi, Pune-411057 Mobile: 9850050004 Phone: 020-20271271 E-mail: nareshent.pune@gmail.com
Ameya Enterprises	Shop No. 1, Tathawade Chowk, Near Nirmitee Electricals, Pune, Maharashtra-411033 Mobile: 09552317771 Phone: 020 – 22934633 E-mail: vinayakpune@gmail.com
P. P. Enterprises	Plot No. 100 B1, "Shivresidency" Behind Ramayana Culture Hall, Ulka Nagri, Garkheda Parisar, Aurangabad - 431005 (Maharashtra). Mobile: 9272379222,8275319324 Phone: 02402355411 E-mail: ppenterprisesabd@gmail.com, ppenterprisesabd@yahoo.com
Chemical Centre	Bhavani Bhavan, Gr. Flr, 18/20, Popatwadi, Kalbadevi Road, Mumbai, Maharashtra-400002 Phone: 022-2203 1616 , 22051616 , 22051564 E-mail: sales@chemicalcentre.net
Liberty Associates	8, Morghade Lay-out, Pawansut Nagar, Ramna Maroti, Nagpur-440009, Maharashtra. Mobile: 9423402989/ 9561962762 E-mail: libertynagpur@gmail.com
National Chemical Co.	A-401-Cosmos Park, M.G.Road, Borivali (East), Mumbai-400 066, Maharashtra, India. Phone: 91 022 2687 1818 / 81 Fax: 91 022 26871819 E-mail: bijdeep@gmail.com
Punjab	
Klorofil Scientific	Shop No. 3/3, Raghuvanshi Complex, Sector 45-A, Chandigarh - 160047 Mobile: 9316801030 E-mail: klorofil@outlook.com
DP Traders & Services	SCF.37, 1st Floor, Phase-5, Mohali - 160059, Punjab, India. Mobile: 09814431423 E-mail: pathak56@gmail.com
Himachal Pradesh	
Tech chem Solutions	32, Housing Board Colony, Daundhi (Bagla), PO Nagchala, Distt-Mandi, Himachal Pradesh-175021 Mobile: 91-86794-46162 E-mail: sumanto@techchemsolutions.com
Rajasthan	
Sarthak Sales	C-26, Moorti Kala Colony Gopalpura By Pass, Jaipur- 302018 Mobile: 8875088882 E-mail: sarthaksales@hotmail.com
Bionic Corporation	B-33, Lalkothi Shopping Center, Near Rajasthan Hospital, Lalkothi, Tonk road, Jaipur, Rajasthan Pin-302015, Mobile: 91 9509676725 E-mail: corpbionic@gmail.com

Tamil Nadu	
Dhanush Agencies	3, Ambigapathi Towers TT Nagar, Sekkalai Road Karakudi - 630001 Tamil Nadu. Mobile: 9489 506050 Phone: (4565) 234660 E-mail: dhanushagencies@gmail.com
Sudagar Biological & Chemicals	No.37/30, E.K.Guru Street, Near Vepery High Road State Bank, Periamet, Chennai - 600003. Tamil nadu. Mobile: +9195000 17900/ 9197899 73038/ 9190030 45679 Phone: 044-25383734 / 25361862 / 25382774 E-mail: sbcbiotn@gmail.com
Eswarr Scientific & Co.	No.46, 4th Cross, RMS Colony, Karumandapam, Trichy-620001. Tamilnadu. Mobile: 9790092600, 9443704605 Phone: 0431-2481415 E-mail: esc1265@gmail.com
West Bengal	
Lab Solution	26 A, Ram Ratan Bose Lane, (Near Shyambazar CESC), Kolkata - 700004, West Bengal. Mobile: 09830132339 E-mail: labsolution2010@gmail.com
Eastern Chemical Trading Corporation	15/8, Haridevpur Road, Kolkata - 700 082. Mobile: 9088810750 E-mail: prajitghosh123@gmail.com
Jharkhand	
Sam Air Products & Equipments	Katras road, Godhar, kusunda Dhanbad, Jharkhand -828116 Mobile: 8102149279 E-mail: samairproduct@gmail.com
Delhi	
Shiva Chemical Company	71/7, A-8 , Rama Road Industrial Area New Delhi-110015 Mobile: 9811039454 Phone: 011-25171484 E-mail: bch@vsnl.net
Vinay Brothers	203, Express Tower, Naniwala bagh, Azadpur New Delhi-110033 Mobile: 09711896574 Phone: 011-23619905 E-mail: vinaybros@gmail.com
Global Lab Solutions	D-29, 3rd Floor, Acharya Niketan Above of Vijya Bank, Mayur Vihar, Phase 1, Delhi – 110091, INDIA Mobile: +91-9999070903 Phone: +91-11-6537522 E-mail: gls@globallab.in, accounts@globallab.in

Assam	
Friends Associate	(A House Of Scientific Materials) M.G. Road (Na-Ali), Near Moktab School, Jorhat-785001, Assam. Mobile: 09435091248, 9957179056 Phone: 0376 2321413(O), 2322410(R) E-mail: ms.friendsassociate@rediffmail.com
Valency Scientific	No. 18, Jilika Path, Shankardev Nagar, Panjabari - 781037, Guwahati, Assam. Mobile: 9859929886 E-mail: valencyscientific@yahoo.in
Uttar Pradesh	
Hind Associates	SCO-25, Huda Market, Sector-7, Old Railway Station Road, Gurgaon, Haryana-122001 Mobile: 09810649003 Phone: 0124-2222717 E-mail: hindassociate@yahoo.co.in
Uma Scientific Traders	No: 31, Shahganj Leader Road, Allahabad-211 003 (U.P), India. Mobile: 09935624902 E-mail: umascientificalld@gmail.com
Ravindra Chemical & Apparatus	9/140, Bagh Muzafaar Khan , Agra - 282 002, India. Mobile: 09412263858 Phone: 0562-2524919 E-mail: info@ravindrachemicals.com
Vidya Scientific Corporation	H.No. 73/74, Bannu Bal Nagar, Delapeer, Bareilly(U.P), India. Mobile: 08430049767 E-mail: vidyascientific@gmail.com
Chemicals & Instruments	466/5, Shastri Nagar, Kanpur - 208005, India. Mobile: 9919534665 Phone: 0512-2540320 E-mail: chemkanpur@gmail.com
Haryana	
Hind Associates	SCO-25, Huda Market, Sector-7, Old Railway Station Road, Gurgaon Haryana-122001 Mobile: 09810649003 Phone: 0124-2222717 E-mail: hindassociate@yahoo.co.in
Shree Vaishno Devi Chemicals	443, Loha Mandi, Hisar (Haryana), India. Mobile: 09416342503, 09996742503 E-mail: svdc73@yahoo.com
Uttarakhand	
H.V.Technologies	B-7, Phase II, Behind FCI Godown, Transport Nagar, Dehradun 248 002, Uttarakhand, India. Uttarakhand, India. Mobile: 7500464464 Phone: 0135- 264 1535, 264 5523 Fax: 0135- 264 1965
Odisha	
Ravi Sales	Plot No. D-108, Koel Nagar, Raurkela, Odisha -769014 Mobile: 9040716712 E-mail: ravisales.rkl@gmail.com
Sam Air Products & Equipments	Katras road, Godhar, kusunda Dhanbad, Jharkhand -828116 Mobile: 8102149279 E-mail: samairproduct@gmail.com

Reagent Guide
8th Edition

Synthetic Organic Chemistry & Materials Chemistry

Not for Sale

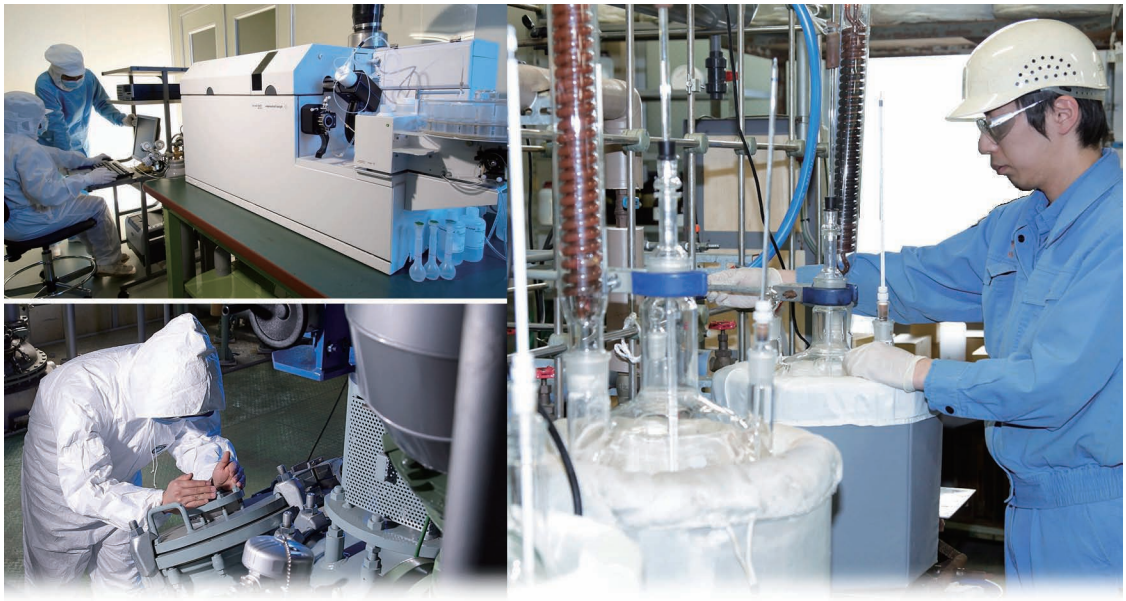
First Edition : June 2015

Publisher TOKYO CHEMICAL INDUSTRY CO., LTD.
Global Business Department
4-10-2, Nihonbashi-Honcho, Chuo-Ku, Tokyo 103-0023, Japan

Editor TOKYO CHEMICAL INDUSTRY CO., LTD.
Technical Information Management Department

T257150618
Printed in Japan

Bulk and Custom Manufacturing Services



High Quality | **Reliable Delivery**

Milligrams to Tons | **Confidential**

TCI's Advantages

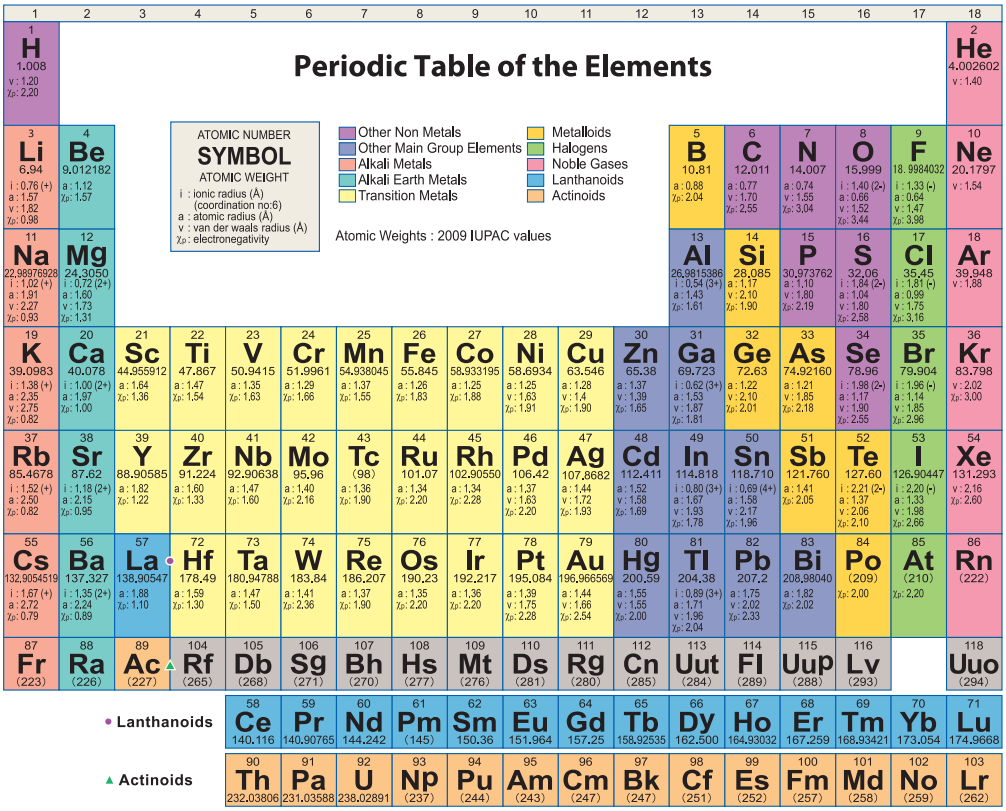
- **Technologies**
  We will help you find the best solution with over 60 years of experience in organic synthesis. TCI's technical know-how provides a flexible design with the most efficient synthetic route.
- **Facilities**
  TCI conducts multiple-step reactions and processes using over 300 types of manufacturing equipment.

Product Line-Up

- Organic Intermediates
- High Purity Electronic Materials (Trace Metals)
- Cosmetic Materials
- Building Blocks (Heterocyclic, Chiral, etc.)
- Functional Materials
- Pharmaceutical Intermediates
- Oligosaccharides
- Chemical Library

For more information about our products or services, please contact your local TCI office.
Business names and contact addresses are listed on page 376.

TCI



TOKYO CHEMICAL INDUSTRY

Ordering and Customer Service

TCI AMERICA
Tel: 800-423-8616 / 503-283-1681
Fax: 888-520-1075 / 503-283-1987
E-mail: Sales-US@TCIchemicals.com

East Coast Office
Tel: 800-423-8616
Fax: 888-520-1075
E-mail: Sales-US@TCIchemicals.com

TCI EUROPE N.V.
Tel: +32 (0)3 735 07 00
Fax: +32 (0)3 735 07 01
E-mail: Sales-EU@TCIchemicals.com

TCI Deutschland GmbH
Tel: +49 (0)6196 64053-00
Fax: +49 (0)6196 64053-01
E-mail: Sales-DE@TCIchemicals.com

Tokyo Chemical Industry UK Ltd.
Tel: +44 (0)1865 784560
Fax: +44 (0)1865 784561
E-mail: Sales-UK@TCIchemicals.com

梯希爱(上海)化成工业发展有限公司
Tel: 800-988-0390 / 021-6712-1386
Fax: 021-6712-1385
E-mail: Sales-CN@TCIchemicals.com

TCI Chemicals (India) Pvt. Ltd.
Tel: 1800 425 7889 / 044-2262 0909
Fax: 044-2262 8902
E-mail: Sales-IN@TCIchemicals.com

TOKYO CHEMICAL INDUSTRY CO., LTD.
Tel: +81 (0)3-5640-8878
Fax: +81 (0)3-5640-8902
E-mail: globalbusiness@TCIchemicals.com

U3001-15SE1