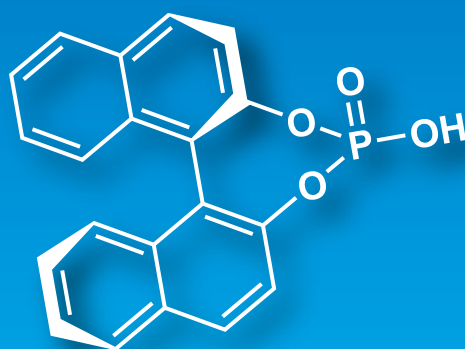
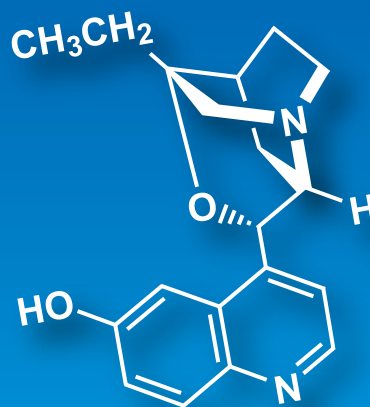
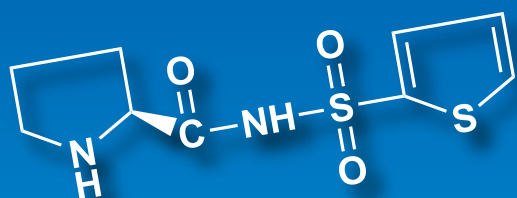


Asymmetric Organocatalysts



Prolines and Their Analogs

Amino Acids

Cinchona Alkaloids

Chiral Imidazolidinones

Chiral Oxazaborolidines

Chiral Isothioureas

Chiral Diols

Chiral Phosphoric Acids

Chiral Sulfonic Acids

Chiral Amines

Chiral Ammonium Salts

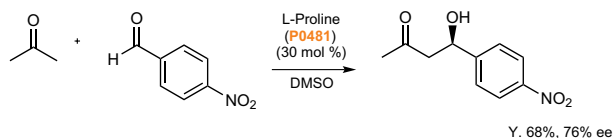
Chiral *N*-Heterocyclic Carbenes (NHC)

Others

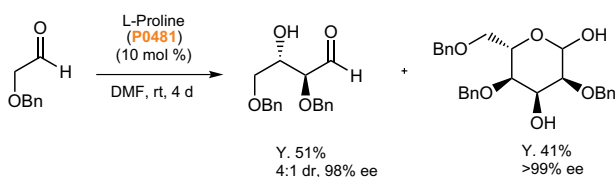


Asymmetric Organocatalysts

Asymmetric organocatalysis has emerged as a powerful synthetic tool that is complementary to metal-catalyzed reactions. Pioneering work in this area dates back to the 1970s in which Eder *et al.* and Hajos *et al.* separately reported an intramolecular asymmetric aldol reaction which employed L-proline (**P0481**) as catalyst.^{1,2} This reaction was considered to be a special case at that time. Later in 2000, List *et al.* reported an L-proline-catalyzed intermolecular asymmetric aldol reaction.³ The same year, MacMillan *et al.* documented the first highly enantioselective amine-catalyzed Diels-Alder reaction.⁴ These reports received a great deal of attention and the research in the area of asymmetric organocatalysts has since thrived.⁵



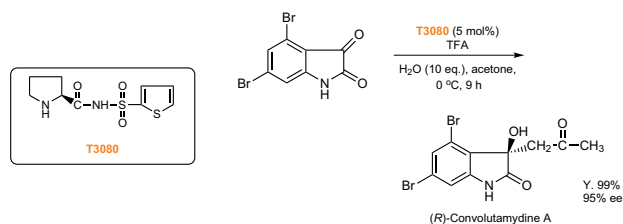
Later, the significance of these proline-catalyzed reactions was luminously demonstrated by MacMillan for the application to carbohydrate synthesis.⁶ Córdova *et al.* reported a proline-catalyzed asymmetric conversion of protected glycol aldehydes into hexoses in one step.⁷



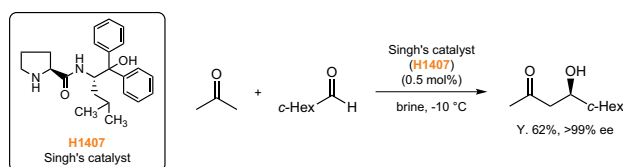
Compared with conventional transition metal complex catalysts, asymmetric organocatalysts offer several advantages including operational simplicity, their availability, and low toxicity which confer a direct benefit in the production of pharmaceuticals and contribution to green chemistry.

In the initial spectacular advances in asymmetric organocatalysis, proline and its analogues have been predominantly employed. Generally organocatalytic aldol reactions with ketones as acceptors require high catalyst loadings, however a recent development in this area enables the reaction with a lower catalyst loading. Nakamura *et al.* reported the enantioselective synthesis of (*R*)-convolutamyndine by using 5 mol% of newly developed novel *N*-heteroaryl-sulfonylprolinamide (**T3080**).⁸ In this reaction, amounts of the catalyst can be reduced to 0.5 mol% with retention of the

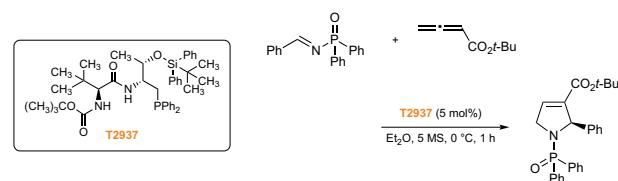
enantioselectivity even though the time takes longer to complete the reaction.



Singh *et al.* also developed a new class of proline-based organocatalysts and reported asymmetric direct aldol reactions with excellent enantioselectivities (>99% ee). A variety of ketones and aldehydes could be employed using 0.5 mol% of catalyst (**H1407**).⁹

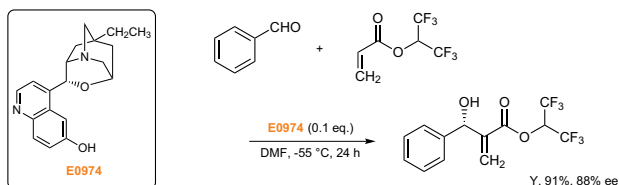


Due to the various advantages including ready availability and versatility, the asymmetric reactions using other amino acids as organocatalysts were also intensively studied. More recently, the group of Lu explored the possibility of deriving a wide array of novel multifunctional organocatalysts from amino acid structural scaffolds.¹⁰ The new catalyst, dipeptide-derived phosphine (**T2937**), was proven to promote enantioselective [3+2] cycloadditions of allenes to acrylates or acrylamides.

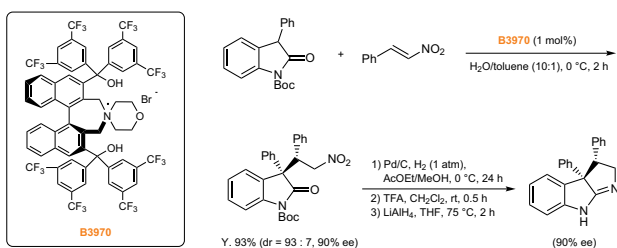


Cinchona alkaloids and their derivatives have been intensively used as chiral ligands for metal-catalyzed reactions or as organocatalysts as demonstrated in Sharpless asymmetric dihydroxylation with an OsO₄-cinchona alkaloids complex.¹¹ It is considered as one of the most privileged chiral inducers. Cinchona alkaloids-derived catalysts could be effectively applied for nearly all classes of organic reactions. The quinuclidinyl moiety as a tertiary amine could serve as an

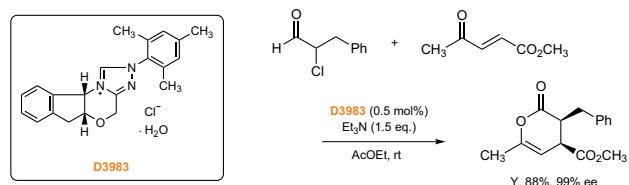
active center for Brønsted base catalysis, Lewis base catalysis, and nucleophilic catalysis. Upon alkylation of the quinuclidine nitrogen, the resulting ammonium salts could serve as phase transfer catalysts, another class of organic catalysis. Hatakeyama, Ishihara, *et al.* have developed α -isocupreine (α -ICPN, **E0974**), a pseudoenantiomer of β -isocupreidine (**10728**) and reported the application to an efficient asymmetric Morita-Baylis-Hillman (MBH) reaction.¹²⁾



Since the pioneering work on asymmetric synthesis of amino acids using *N*-benzyl cinchoninium halide as a chiral phase transfer catalyst in 1980s,¹³⁾ numerous cinchona alkaloids-derived chiral phase-transfer catalysts have been developed.¹⁴⁾ In the late 1990s, a totally new aspect on the design of chiral phase-transfer catalyst, based on the C_2 -symmetrical chiral binaphthyl moiety, has emerged.¹⁵⁾ The ongoing efforts towards the simplification of the catalyst have led to the novel catalyst which could be employed under even milder conditions with excellent enantioselectivities. Maruoka *et al.* reported an enantioselective conjugate addition of 3-substituted oxindoles to Michael acceptors under neutral conditions in a water-rich solvent in the presence of a newly developed morpholine-derived chiral phase-transfer catalyst (**B3970**) without base additives.¹⁶⁾



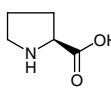
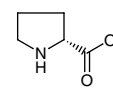
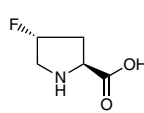
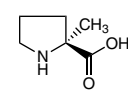
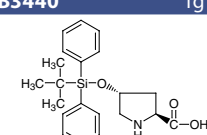
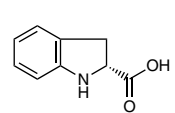
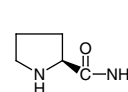
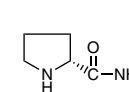
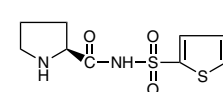
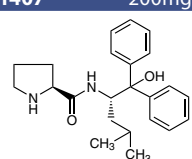
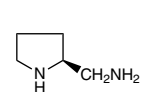
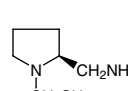
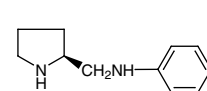
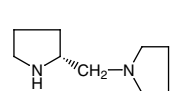
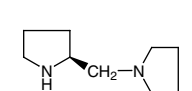
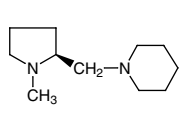
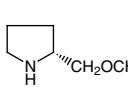
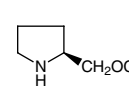
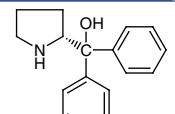
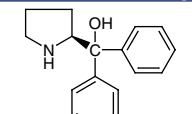
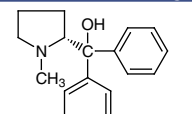
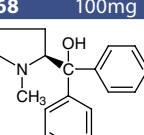
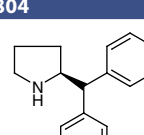
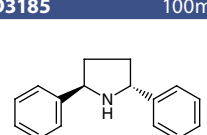
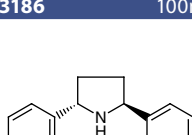
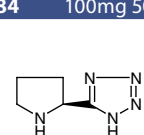

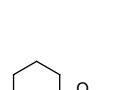
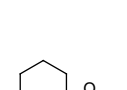
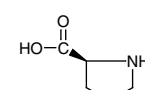
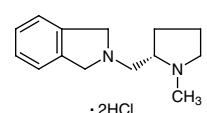
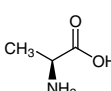
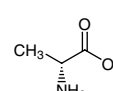
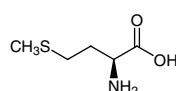
Nucleophilic carbene is an emerging class of asymmetric organocatalysis. Since the report of the first asymmetric intramolecular Stetter reaction by Enders *et al.*, there have been many reports on asymmetric carbon-carbon bond formation reactions *via* umpolung of aldehydes mediated by *N*-heterocyclic carbene (NHC) catalysts.¹⁷⁾ Bode *et al.* have reported highly enantioselective Diels–Alder reactions to afford dihydropyridinones using an NHC catalyst (**D3983**) generated *in situ*.¹⁸⁾



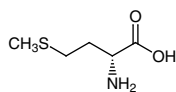
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Prolines and Their Analogs

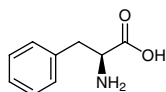
<h2>Prolines and Their Analogs</h2>		P0481 25g 250g  L-Proline [147-85-3]	P0994 5g 25g  D-Proline [344-25-2]	F0818 50mg  <i>trans</i> -4-Fluoro-L-proline [2507-61-1]
		M2077 1g 5g  α -Methyl-L-proline [42856-71-3]	B3440 1g 5g  <i>trans</i> -4-(<i>tert</i> -Butyldiphenylsilyloxy)-L-proline [259212-61-8]	I0589 1g  (<i>R</i>)-(+)-Indoline-2-carboxylic Acid [98167-06-7]
P1382 1g 5g 25g  L-Prolinamide [7531-52-4]	P2083 1g 5g  D-Prolinamide [62937-45-5]	T3080 100mg  <i>N</i> -(2-Thiophenesulfonyl)-L-prolinamide [1089663-51-3]	H1407 200mg 1g  Singh's Catalyst [910110-45-1]	A2206 200mg  (<i>S</i>)-2-(Aminomethyl)pyrrolidine [69500-64-7]
A1301 1g 5g  (<i>S</i>)-(-)-2-Aminomethyl-1-ethylpyrrolidine [22795-99-9]	A0945 1g 5g  (<i>S</i>)-(+)-2-(Anilinomethyl)pyrrolidine [64030-44-0]	P1925 1g  (<i>R</i>)-(-)-1-(2-Pyrrolidinylmethyl)pyrrolidine [60419-23-0]	P1241 1g 5g  (<i>S</i>)-(+)-1-(2-Pyrrolidinylmethyl)pyrrolidine [51207-66-0]	M1183 1g 5g  (<i>S</i>)-(-)-1-Methyl-2-(1-piperidinomethyl)pyrrolidine [84466-85-3]
M1169 1g 5g  (<i>R</i>)-2-(Methoxymethyl)pyrrolidine [84025-81-0]	M1161 1g 5g  (<i>S</i>)-2-(Methoxymethyl)pyrrolidine [63126-47-6]	D2365 1g 5g  (<i>R</i>)-(+)- α,α -Diphenyl-2-pyrrolidinemethanol [22348-32-9]	D2735 1g 5g  (<i>S</i>)-(-)- α,α -Diphenyl-2-pyrrolidinemethanol [112068-01-6]	H0784 1g 5g  (<i>R</i>)-(-)-2-[Hydroxy(diphenyl)methyl]-1-methylpyrrolidine [144119-12-0]
H0768 100mg 1g 5g  (<i>S</i>)-(+)-2-[Hydroxy(diphenyl)methyl]-1-methylpyrrolidine [110529-22-1]	D3804 1g  (<i>S</i>)-(-)-2-(Diphenylmethyl)pyrrolidine [119237-64-8]	D3185 100mg  (2 <i>R</i> ,5 <i>R</i>)-2,5-Diphenylpyrrolidine [155155-73-0]	D3186 100mg  (2 <i>S</i> ,5 <i>S</i>)-2,5-Diphenylpyrrolidine [295328-85-7]	P1784 100mg 500mg  (<i>S</i>)-5-(Pyrrolidin-2-yl)-1 <i>H</i> -tetrazole [33878-70-5]
A1043 100mg 1g  L-Azetidine-2-carboxylic Acid [2133-34-8]	P1830 5g 25g  D-Pipecolic Acid [1723-00-8]	P1404 1g 5g  L-Pipecolic Acid [3105-95-1]	T0219 25g 500g  L-Thioprolin [34592-47-7]	M1995 1g  (<i>S</i>)-2-[(1-Methyl-2-pyrrolidinyl)methyl]-isoindoline Dihydrochloride
<h2>Amino Acids</h2>		A0179 25g 250g  L-Alanine [56-41-7]	A0177 5g 25g  D-Alanine [338-69-2]	M0099 25g 100g 500g  L-Methionine [63-68-3]

M0102 5g 25g



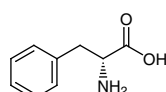
D-Methionine [348-67-4]

P0134 25g 250g



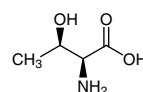
L-Phenylalanine [63-91-2]

P0135 5g 25g



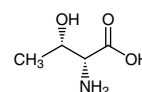
D-Phenylalanine [673-06-3]

T0230 25g 100g 500g



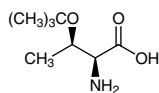
L-(-)-Threonine [72-19-5]

T0228 25g 100g 500g

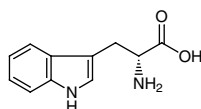


D-(+)-Threonine [632-20-2]

B3398 1g 5g

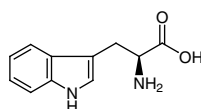
O-tert-Butyl-L-threonine
[4378-13-6]

T0539 5g 25g



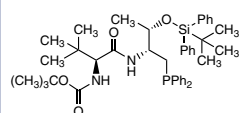
D-Tryptophan [153-94-6]

T0541 25g 100g



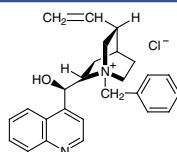
L-Tryptophan [73-22-3]

T2937 100mg

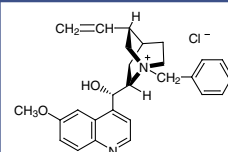
O-TBDPS-D-Thr-N-Boc-
L-tert-Leu-Diphenylphosphine
[1264520-63-9]

Cinchona Alkaloids

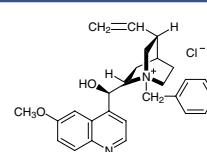
B1683 10g

N-Benzylcinchonidinium
Chloride [69257-04-1]

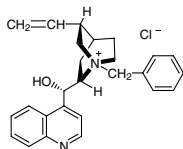
B1684 5g

N-Benzylquinidinium
Chloride [77481-82-4]

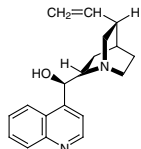
B1685 5g

N-Benzylquininium
Chloride [67174-25-8]

B1689 5g

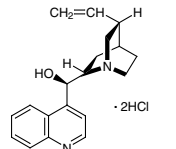
N-Benzylcinchoninium
Chloride [69221-14-3]

C0347 25g

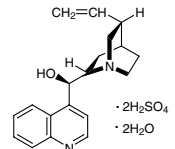


Cinchonidine [485-71-2]

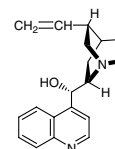
C0348 25g

Cinchonidine Dihydrochloride
[24302-67-8]

C0349 25g

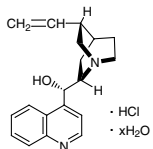
Cinchonidine Sulfate
Dihydrate [524-61-8]

C0350 25g 200g

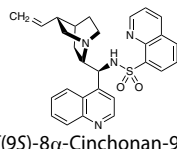


Cinchonine [118-10-5]

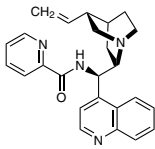
C0351 25g

Cinchonine Hydrochloride
Hydrate [5949-11-1]

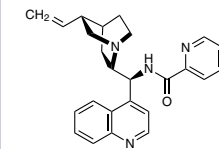
C2728 100mg

N-[(9S)-8α-(Cinchonan-9-yl)-
quinoline-8-sulfonamide
[1440939-88-7]

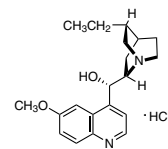
D4305 100mg

N-(9-Deoxy-epi-cinchonin-9-yl)-
picolinamide [1414851-55-0]

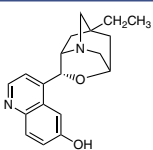
D4306 100mg

N-(9-Deoxy-epi-cinchonin-9-yl)-
picolinamide [1414851-57-2]

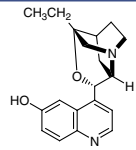
H0752 25g 250g

Hydroquinidine
Hydrochloride [1476-98-8]

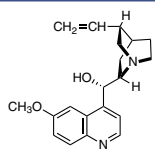
E0974 100mg

α-Isocupreine
[1476067-44-3]

I0728 1g

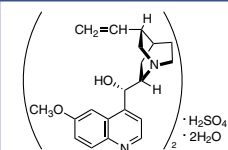
β-Isocupreidine
[253430-48-7]

Q0006 5g 25g

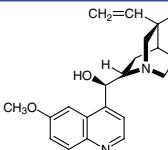


Quinidine [56-54-2]

Q0010 5g 25g

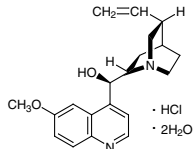
Quinidine Sulfate Dihydrate
[6591-63-5]

Q0028 25g 100g

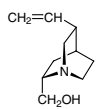


Quinine [130-95-0]

Q0030 25g

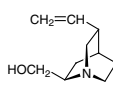
Quinine Hydrochloride
Dihydrate [6119-47-7]

Q0074 100mg 1g



Quincorine [207129-35-9]

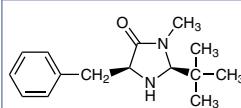
Q0076 100mg 1g



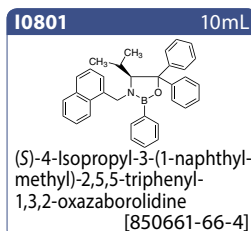
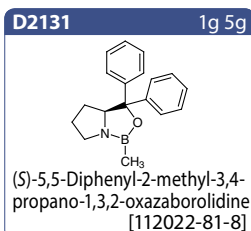
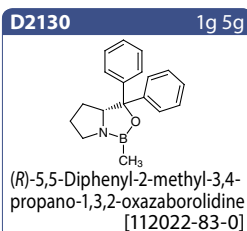
Quincoridine [207129-36-0]

Chiral Imidazolidinones

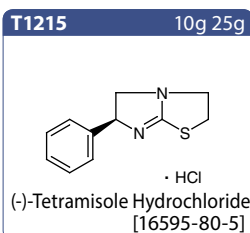
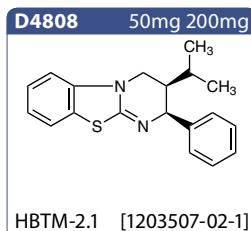
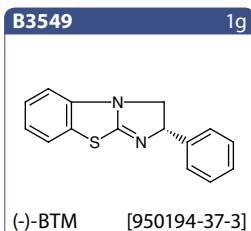
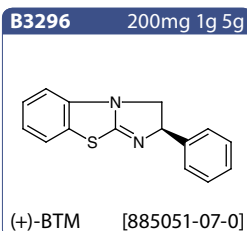
B4138 200mg 1g

(2S,5S)-(-)-2-tert-Butyl-3-
methyl-5-benzyl-
4-imidazolidinone
[346440-54-8]

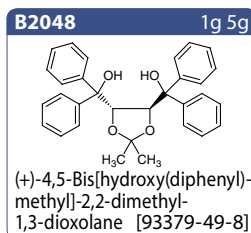
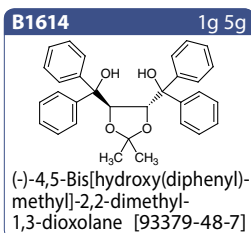
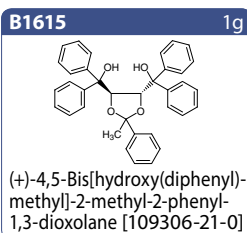
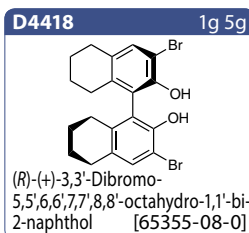
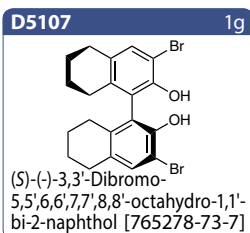
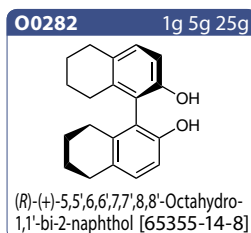
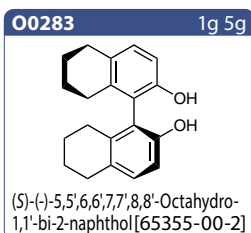
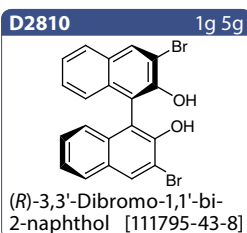
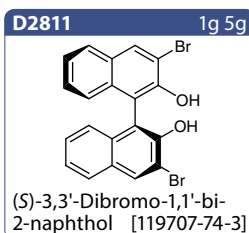
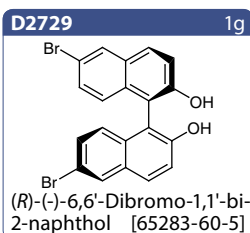
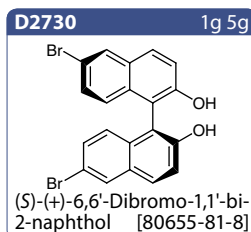
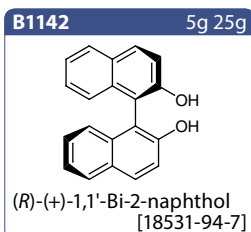
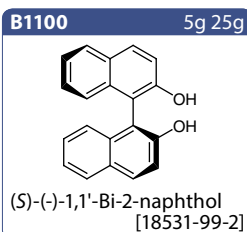
Chiral Oxazaborolidines



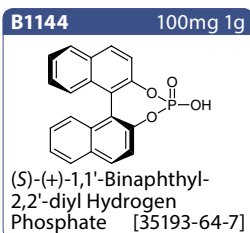
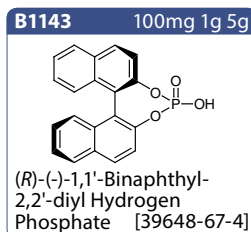
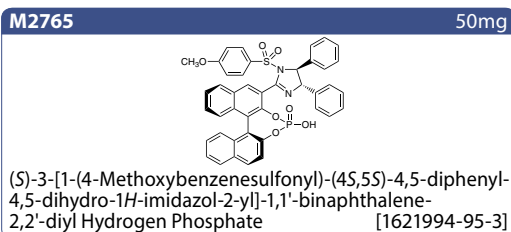
Chiral Isothioureas



Chiral Diols

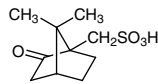


Chiral Phosphoric Acids



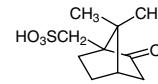
Chiral Sulfonic Acids

C0015 25g 100g 500g



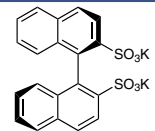
(+)-10-Camphorsulfonic Acid
[3144-16-9]

C0972 25g 100g 500g



(-)-10-Camphorsulfonic Acid
[35963-20-3]

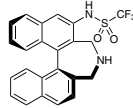
D4445 100mg



Dipotassium (R)-1,1'-Binaphthyl-2,2'-disulfonate
[1092934-19-4]

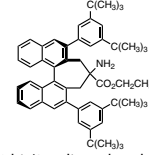
Chiral Amines

D4663 20mg



N-[(11bS)-4,5-Dihydro-3H-dinaphtho[2,1-c:1',2'-e]azepin-2-yl]trifluoromethanesulfonamide [871915-77-4]

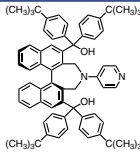
E1267



Ethyl (11bR)-4-Amino-2,6-bis(3,5-di-tert-butylphenyl)-4,5-dihydro-3H-cyclohepta[1,2-a:7,6-a']dinaphthalene-4-carboxylate [1678540-23-2]

P2380

50mg

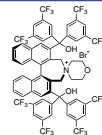


(S)-[4-(Pyridin-4-yl)-4,5-dihydro-3H-dinaphtho[2,1-c:1',2'-e]azepine-2,6-diyl]bis[bis[4-(tert-butyl)phenyl]methanol] [1883396-49-3]

Chiral Ammonium Salts

B3970

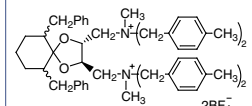
50mg



(11bS)-2,6-Bis[bis[3,5-bis(trifluoromethyl)phenyl]-hydroxymethyl]-3,5-dihydrospiro[4H-dinaphth[2,1-c:1',2'-e]azepine-4,4'-morpholinium] Bromide [1197922-04-5]

D3475

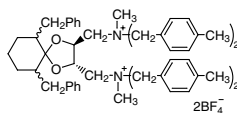
200mg 1g



(R,R)-TaDiAS-2nd

D3476

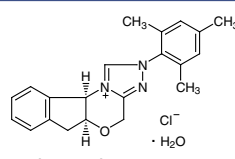
200mg 1g



(S,S)-TaDiAS-2nd

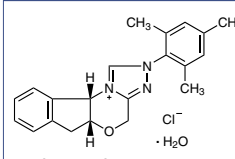
Chiral N-Heterocyclic Carbenes (NHC)

D3984 100mg



Bode Catalyst 1
Monohydrate [919102-70-8]

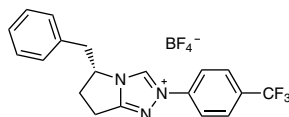
D3983 100mg



Bode Catalyst 2
Monohydrate [903571-02-8]

B3592

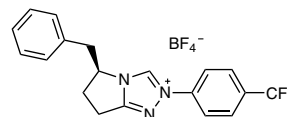
200mg 1g



(R)-Benzyl-2-[4-(trifluoromethyl)phenyl]-6,7-dihydro-5H-pyrrolo[2,1-c][1,2,4]triazolium Tetrafluoroborate [862095-77-0]

B3593

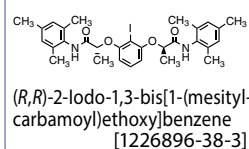
200mg 1g



(S)-Benzyl-2-[4-(trifluoromethyl)phenyl]-6,7-dihydro-5H-pyrrolo[2,1-c][1,2,4]triazolium Tetrafluoroborate

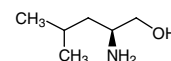
Others

I0807 200mg



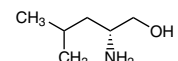
(R,R)-2-Iodo-1,3-bis[1-(mesityl-carbamoyl)ethoxy]benzene [1226896-38-3]

L0137 5mL 25mL



L-(+)-Leucinol [7533-40-6]

L0236 1g 5g



D-(-)-Leucinol [53448-09-2]

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TOKYO CHEMICAL INDUSTRY CO., LTD.

Tel : +81 (0)3-5640-8878
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