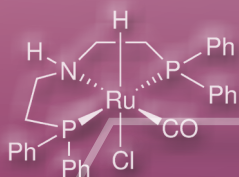


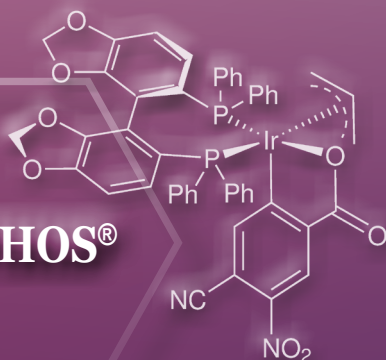


Catalysts & Ligands

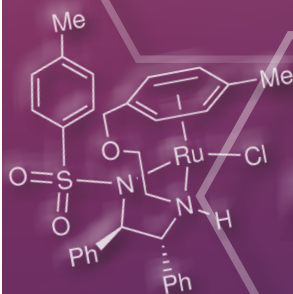
Products Sold in Collaboration
with Takasago



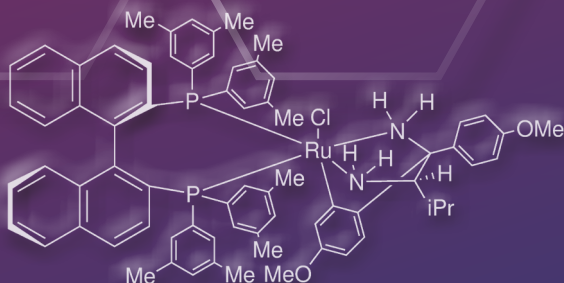
Ru-MACHO®



SEGPHOS®



DENE



RUCY®



Catalysts & Ligands

Products Sold in Collaboration with Takasago



Strem Chemicals is an ISO certified, employee-owned company that manufactures and markets specialty chemicals of high purity. We have been providing fine chemicals for research and commercial production for over fifty years. At Strem, we offer a wide variety of catalysts, ligands, nanomaterials and CVD/ALD precursors. Most of our products are of high purity, typically at 99%, while some are as high as 99.9999% metals purity. We continually seek to provide new technologies from around the globe to

add to our product line. We look forward to further advancements in order to best serve our customers' needs with the quality and service they can trust from Strem.

We have licensing agreements with industry and academia, which allow easier access to patent-protected products for our customers. This booklet is comprised of our products which are sold in collaboration with Takasago International Corporation.

About Takasago International Corporation

Takasago International Corporation was founded in Japan in 1920. For more than 95 years, Takasago has developed flavors and fragrances for some of the world's most successful food, beverage, fine fragrance, household and personal care products. Takasago is a leading global company especially in the Asian region.

Takasago has vigorously pursued pharmaceutical intermediaries, functional materials, and other fine chemicals. Asymmetric synthesis, cultivated in their aroma ingredients development work, is a key technology of these products. By utilizing technology and their global network, they develop high-quality and innovative products that contribute to cultural and social progress.

Our other booklets, which focus on applications and product classes, are available in print per request and also on our website. Below is a list of current booklet titles that are available. Please also check our Product Resources section online to find additional literature offerings, such as the Strem Chemiker, our technical publication, and product literature sheets.

- Biocatalysts
- Buchwald Ligands and Precatalysts
- Carbon-Based Nanomaterials & Elemental Forms
- Catalysts & Ligands Manufactured Under License of Takasago Patent
- Gold Elements & Compounds
- Heterogeneous Catalysts
- High Purity Chiral Reagents - Sold in Collaboration with Daicel
- Kits
- Materials for Energy Applications
- Metal Catalysts for Organic Synthesis
- Metal Organic Frameworks and Ligands for MOF Synthesis
- MOCVD, CVD & ALD Precursors
- Nanomaterials
- New Products
- Other Ligands
- Phosphorous Ligands and Compounds
- Photocatalysts
- PURATREM: High Purity Inorganics

Ephraim S. Honig, Ph.D., M.B.A.
Chief Executive Officer



TAKASAGO 09/18
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Glossary of Terms

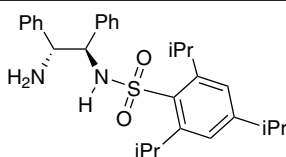
[α]_D		Specific rotation
AAS		Atomic Absorption Standard
ACS		Conforms to American Chemical Society specifications
air sensitive	.....	Product may chemically react with atmospheric oxygen or carbon dioxide at ambient conditions. Handle and store under an inert atmosphere of nitrogen or argon.
amp	.....	Ampouled
b.p.	.....	Boiling point in °C at 760mm, unless otherwise noted
d.	.....	Density
dec.	.....	Decomposes
elec. gr.	.....	Electronic Grade, suitable for electronic applications
f.p.	.....	Flash point in °F
gran.	.....	Granular
heat sensitive	.....	Product may chemically degrade if stored for prolonged periods of time at ambient temperatures or higher. Store at 5°C or lower.
hydrate	.....	Unspecified water content which may vary slightly from lot to lot
hygroscopic	.....	Product may absorb water if exposed to the atmosphere for prolonged periods of time (dependent on humidity and temperature). Handle and store under an inert atmosphere of nitrogen or argon.
light sensitive	.....	Product may chemically degrade if exposed to light
liq.	.....	Liquid
m.p.	.....	Melting point in °C
moisture sensitive	.....	Product may chemically react with water. Handle and store under an inert atmosphere of nitrogen or argon.
NMR grade	.....	Suitable as a Nuclear Magnetic Resonance reference standard
optical grade	.....	For optical applications
pwdr.	.....	Powder
primary standard	.....	Used to prepare reference standards and standardize volumetric solutions
PURATREM	.....	Product has a minimum purity of 99.99% (metals basis)
purified	.....	A grade higher than technical, often used where there are no official standards
P. Vol.	.....	Pore volume
pyrophoric	.....	Product may spontaneously ignite if exposed to air at ambient conditions
reagent	.....	High purity material, generally used in the laboratory for detecting, measuring, examining or analyzing other substances
REO	.....	Rare Earth Oxides. Purity of a specific rare-earth metal expressed as a percentage of total rare-earths oxides.
SA	.....	Surface area
store cold	.....	Product should be stored at -18°C or 4°C, unless otherwise noted (see product details)
subl.	.....	Sublimes
superconductor grade	.....	A high purity, analyzed grade, suitable for preparing superconductors
tech. gr.	.....	Technical grade for general industrial use
TLC	.....	Suitable for Thin Layer Chromatography
v.p.	.....	Vapor pressure mm of Hg
xtl.	.....	Crystalline

About Purity

Chemical purity	.....	is reported after the chemical name, e.g. Ruthenium carbonyl, 99%
Metals purity	.....	is reported in parentheses with the respective element, e.g. Gallium (III) bromide, anhydrous, granular (99.999%-Ga) PURATREM where 100% minus the metal purity is equal to the maximum allowable percentage of trace metal impurity

NITROGEN (Compounds)

07-2345 N-[(1R,2R)-2-Amino-1,2-diphenylethyl]-2,4,6-tris(1-methylethyl)benzenesulfonamide, 98% (R,R)-TIPSDPEN (852212-92-1)
C₂₉H₃₈N₂O₂S; FW: 478.69; white to tan powdr.
Note: Sold in collaboration with Takasago.



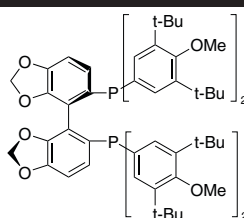
1g
5g

07-2346 N-[(1S,2S)-2-Amino-1,2-diphenylethyl]-2,4,6-tris(1-methylethyl)benzenesulfonamide, 98% (S,S)-TIPSDPEN (247923-41-7)
C₂₉H₃₈N₂O₂S; FW: 478.69; white solid
Note: Sold in collaboration with Takasago.

1g
5g

PHOSPHORUS (Compounds)

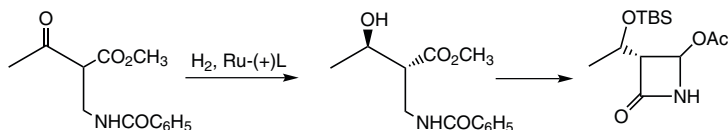
15-0066 (R)-(-)-5,5'-Bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPPOS® (566940-03-2)
C₇₄H₁₀₀O₈P₂; FW: 1179.53; off-white powdr.; m.p. 126-128°
Note: Sold in collaboration with Takasago.
Takasago SEGPPOS® Ligand Kit component.



250mg
1g
5g

Technical Notes:

1. Biaryl bisphosphine ligand with narrow dihedral angle. The DTBM SEGPPOS® ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity through dynamic kinetic resolution in the asymmetric hydrogenation of α-substituted-β-ketoesters useful in the synthesis of carbapenem antibiotics.¹
2. With rhodium, preferential enantioselective hydrogenation of more reactive olefin of extended enone structure.²
3. Rhodium catalyzed chemo-, regio, and enantioselective [2 + 2 + 2] cycloaddition of alkynes with isocyanates.³
4. With copper, enantioselective cross Aldol-type reaction of acetonitrile.⁴
5. With copper, enantioselective vinylsilane alkenylation of aldehydes.⁵
6. Gold carbene mediated stereoselective cyclopropanation of propargyl esters.⁶
7. With copper, enantioselective 1,2-reduction of ketones, and 1,4-reduction of α,β-unsaturated esters.⁷
8. With copper, catalytic enantioselective Mannich-type reaction.⁸
9. Enantioselective fluorination of β-keto esters, tert-butoxycarbonyl lactones and lactams with Sodeka's Pd-aqua complex and a fluorinating reagent.⁹
10. Rh-catalyzed intramolecular olefin or carbonyl hydroacylation.¹⁰
11. Pd-catalyzed γ-arylation of β,γ-unsaturated ketones.
12. Involved in numerous conjugate alkynylation, and ring-opening alkynylation of azabenzonornbornadienes.¹²
13. Involved in asymmetric hydroamination of bicyclic alkenes/dienes, 1,3a diamination of conjugated dienes,^{13a} and hydroalkoxylation/hydrosulfenylation of allenes.^{13c}
14. Used in cycloaddition reactions such as 1,3-dipolar cycloaddition of azomethine ylides,^{14a} and Au-catalyzed [2+2] cycloaddition of allenes.^{14b}
15. Asymmetric conjugate addition of nitroalkanes to α,β-unsaturated thioamides.¹⁵
16. Asymmetric synthesis of isothiazoles through Cu catalyzed conjugate addition of allyl cyanide to α,β-unsaturated thioamides.¹⁶
17. Asymmetric Ag-catalyzed cycloadditions.¹⁷
18. Rhodium-catalyzed C-C bond cleavage to generate acyclic, asymmetric quaternary centers.¹⁸
19. Iridium-catalyzed intermolecular hydroamidation of olefins.^{19,20}
20. Palladium-Catalyzed Asymmetric Hydrogenation of α-Acyloxy-1-arylethanones

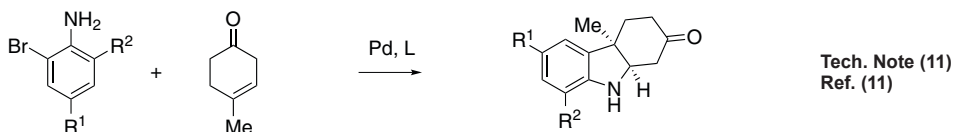
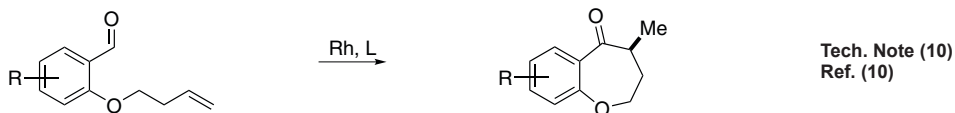
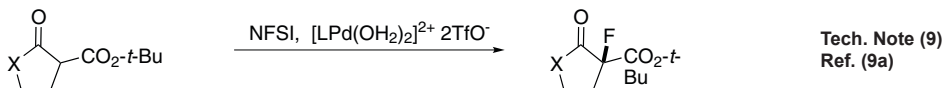
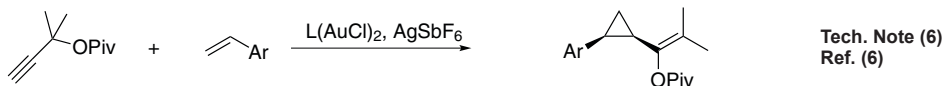
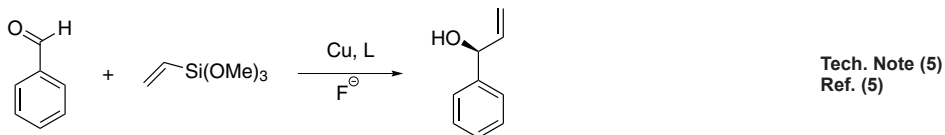
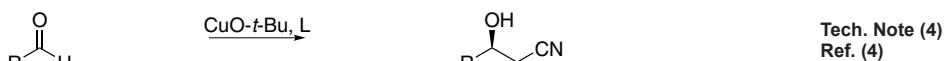
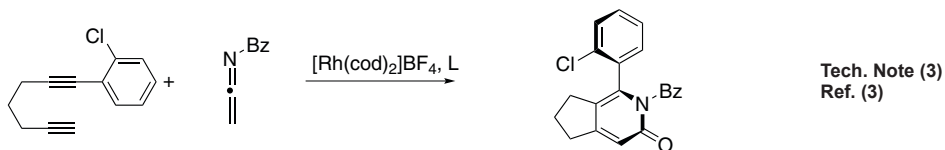
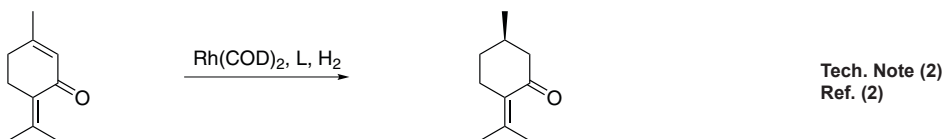


Tech. Note (1)
Ref. (1)

PHOSPHORUS (Compounds)

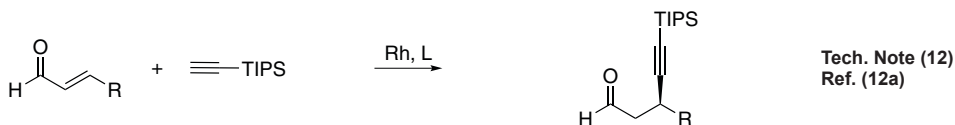
15-0066
(continued)

(R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%
(R)-(-)-DTBM-SEGPHOS® (566940-03-2)



PHOSPHORUS (Compounds)

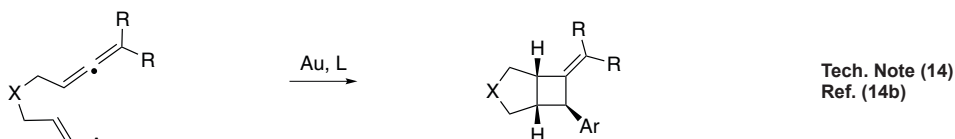
15-0066 (R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%
(continued) (R)-(-)-DTBM-SEGPHOS® (566940-03-2)



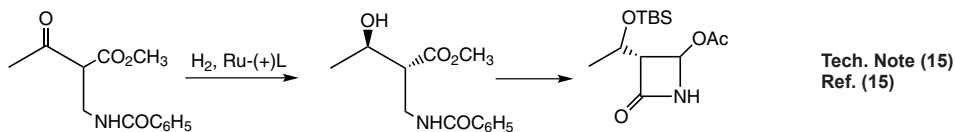
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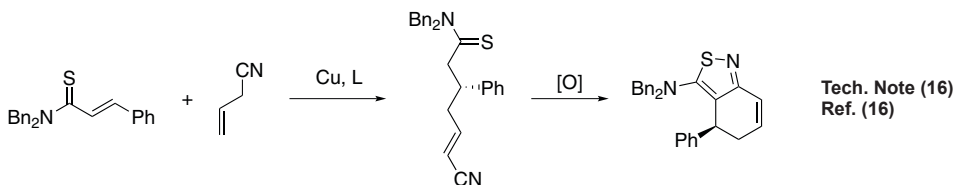
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Ref. (13a)



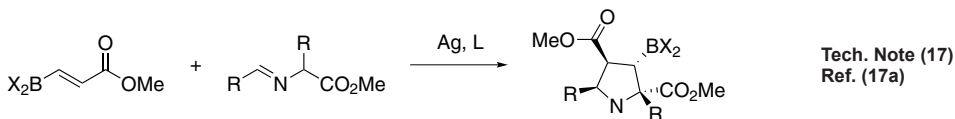
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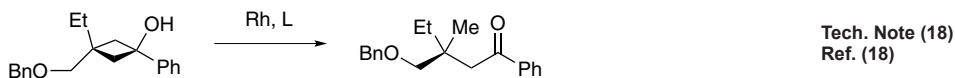
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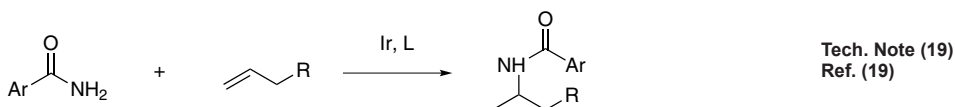
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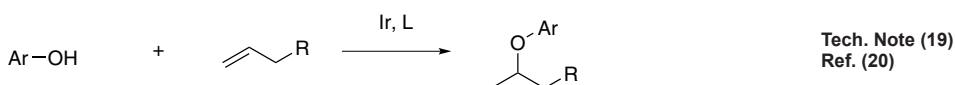
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Tech. Note (18)
Ref. (18)



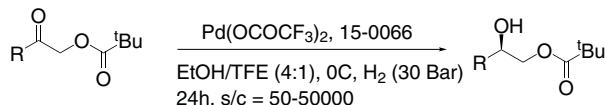
Tech. Note (19)
Ref. (19)



Tech. Note (19)
Ref. (20)

PHOSPHORUS (Compounds)

15-0066 (R)-(-)-5,5'-Bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%
(continued) (R)-(-)-DTBM-SEGPPOS® (566940-03-2)



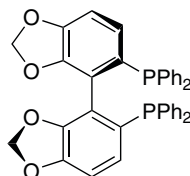
Tech. Note (20)
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2. *Chem. Eur. J.* **2008**, 14, 2060
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9. (a) *J. Am. Chem. Soc.*, **2002**, 124, 14530. (b) *J. Org. Chem.*, **2007**, 72, 246.
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12. (a) *Angew. Chem. Int. Ed.*, **2009**, 48, 8057. (b) *Org. Lett.*, **2008**, 10, 4057.
13. (a) *J. Am. Chem. Soc.*, **2008**, 130, 12220. (b) *Org. Lett.*, **2008**, 10, 4231. (c) *Chem. Commun.*, **2009**, 3528.
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15. *Org. Lett.*, **2012**, 14, 110.
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17. (a) *J. Org. Chem.*, **2011**, 76, 1945. (b) *J. Am. Chem. Soc.*, **2010**, 132, 3263.
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19. *J. Am. Chem. Soc.*, **2012**, 134, 11960.
20. *J. Am. Chem. Soc.*, **2013**, 135, 9303.
21. *J. Am. Chem. Soc.*, **2013**, 135, 15746.

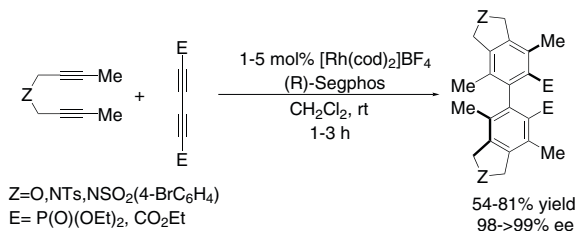
15-0067	(S)-(+)-5,5'-Bis[di(3,5-di- <i>t</i> -butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPPOS® (210169-40-7) C ₇₄ H ₁₀₀ O ₈ P ₂ ; FW: 1179.53; off-white powdr.; m.p. 126-128° Note: Sold in collaboration with Takasago. Takasago SEGPPOS® Ligand Kit component.	250mg 1g 5g
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15-0136	(R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-SEGPPOS® (244261-66-3) C ₃₈ H ₂₈ O ₄ P ₂ ; FW: 610.57; off-white powdr.; m.p. 168-172° Note: Sold in collaboration with Takasago. Takasago SEGPPOS® Ligand Kit component.	250mg 1g 5g
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Technical Notes:

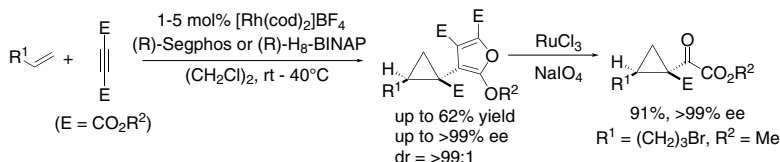
1. Ligand for the practical enantioselective synthesis of axially chiral biaryl diphosphonates and dicarboxylates.
2. Ligand in the Rhodium-catalyzed - highly enantio- and diastereoselective cotrimerization of alkenes and dialkyl acetylene dicarboxylates leading to furylcyclopropanes.
3. Ligand present in the Rhodium-catalyzed asymmetric hydroarylation of 3-pyrroline.
4. Ligand for the dynamic kinetic resolution in the Rh-catalyzed asymmetric arylation of phospholene oxides.



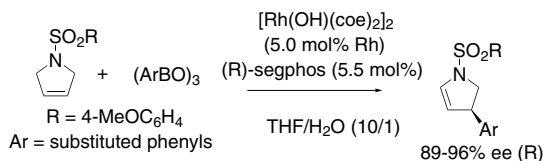
Tech. Note (1)
Ref. (1)

PHOSPHORUS (Compounds)

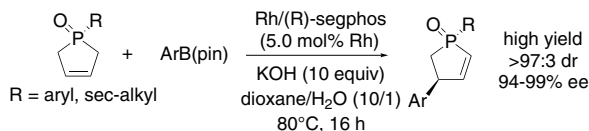
15-0136 (R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-SEGPHOS®
(continued) (244261-66-3)



Tech. Note (2)
Ref. (2)



Tech. Note (3)
Ref. (3)



Tech. Note (4)
Ref. (4)

References:

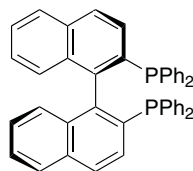
1. *Org. Lett.*, **2008**, *10*, 2849.
2. *Org. Lett.*, **2008**, *10*, 2825.
3. *J. Am. Chem. Soc.*, **2013**, *135*, 10990.
4. *J. Am. Chem. Soc.*, **2017**, *139*, 8122.

15-0137	(S)-(-)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-SEGPHOS® (210169-54-3)	250mg
	$C_{38}H_{28}O_4P_2$; FW: 610.57; off-white powdr.; m.p. 168-172°	1g
	Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ligand Kit component.	5g

Technical Note:

1. See 15-0136 (page 4)

15-0150	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)	250mg
	$C_{44}H_{32}P_2$; FW: 622.70; white to off-white powdr.;	1g
	m.p. 240.5-242°	5g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.	



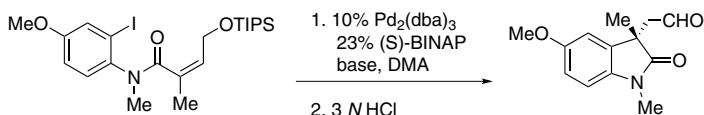
Technical Notes:

1. (R)-BINAP or (R)-Tol-BINAP can be combined with dichloro(1,5-cyclooctadiene)ruthenium to form precursors to NOYORI CATALYST SYSTEMS. These systems exhibit very high catalytic activity and enantioselectivity in the hydrogenation of a wide range of substrates. NOYORI CATALYST SYSTEMS have been shown to effect highly enantioselective hydrogenation of functionalized ketones where the substituents are dialkylamino, hydroxy, silyloxy, carbonyl, ester, amide or thioester.
2. Useful ligand in asymmetric Heck processes.
3. Ligand employed in palladium-catalyzed asymmetric arylation of ketones.
4. Ligand employed in rhodium-catalyzed 1,4-additions to enones.
5. Ligand employed in palladium-catalyzed hydroamination of styrene derivatives.
6. Ligand employed in silver-catalyzed asymmetric Sakurai-Hosomi allylation and Mukaiyama aldol reaction.
7. Ligand employed in rhodium-catalyzed kinetic resolution of enynes.
8. Ligand employed in asymmetric rhodium-catalyzed hydroboration of cyclopropenes.
9. Ligand employed in silver-catalyzed α-hydroxylation of stannyl enol ethers.
10. Ligand employed in palladium-catalyzed synthesis of chiral allenes.
11. Ligand for palladium-catalyzed enantioselective hetero Michael addition to form β-amino acid derivatives.
12. Ligand employed in rhodium-catalyzed asymmetric rearrangement of alkynyl alkenyl carbinols.
13. Ligand employed in rhodium-catalyzed 1,2-addition of aluminium organyl compounds to cyclic enones.

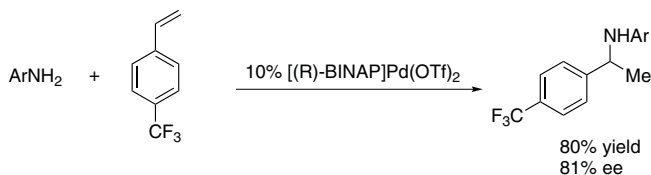
PHOSPHORUS (Compounds)

15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)
(continued)

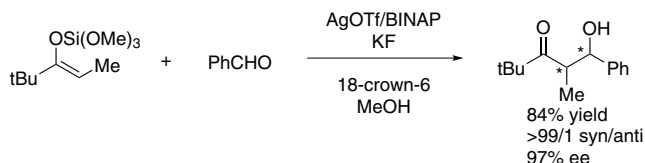
14. Ligand employed in iridium-catalyzed transfer hydrogenative allylation of benzylic alcohols.
15. Ligand employed in rhodium-catalyzed asymmetric C-Si bond formation by conjugate silyl transfer using a Si-B linkage.
16. Ligand employed in the iridium-catalyzed asymmetric cyclopropane-mediated carbonyl allylation of primary alcohols.
17. Ligand employed in the nickel-catalyzed asymmetric α -arylation of tetralones.
18. Ligand employed in the copper-catalyzed asymmetric propargylation of ketones.
19. Ligand employed in the cobalt-catalyzed asymmetric reductive coupling of alkynes with alkenes.
20. Ligand employed in the rhodium-catalyzed asymmetric 1,4-addition of arylalanes on trisubstituted enones.
21. Ruthenium-catalyzed asymmetric hydrocyanation of imines.
22. Palladium-catalyzed asymmetric intermolecular cyclization.



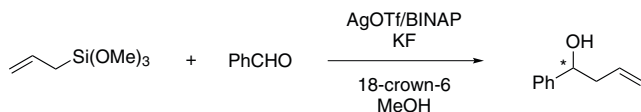
Tech. Note (2)
Ref. (5)



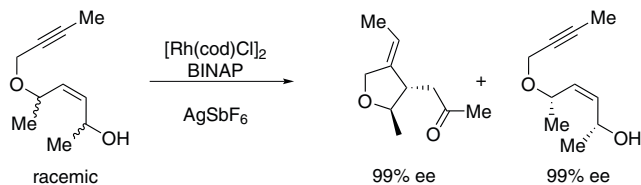
Tech. Note (5)
Ref. (9)



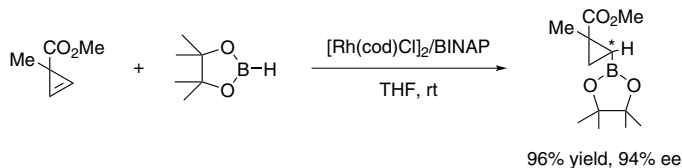
Tech. Note (6)
Ref. (10)



Tech. Note (6)
Ref. (10)



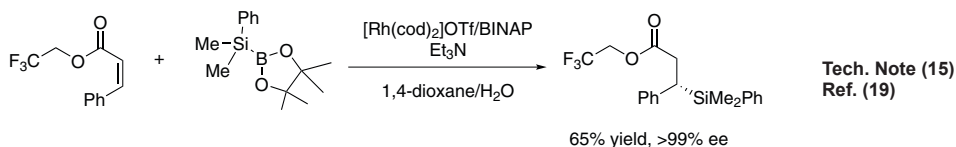
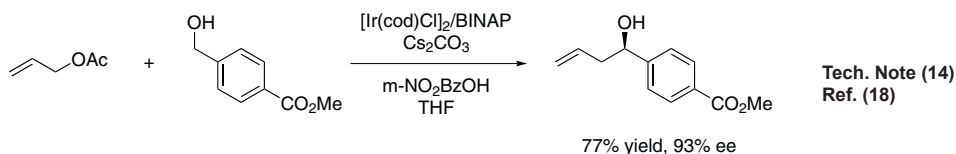
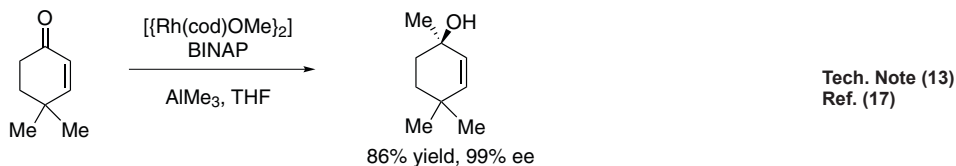
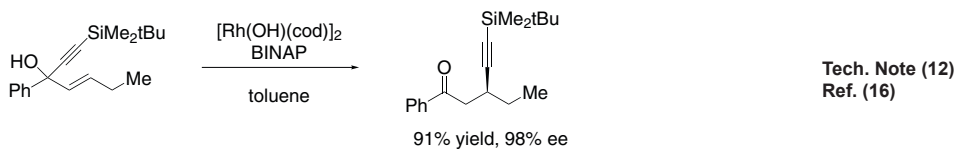
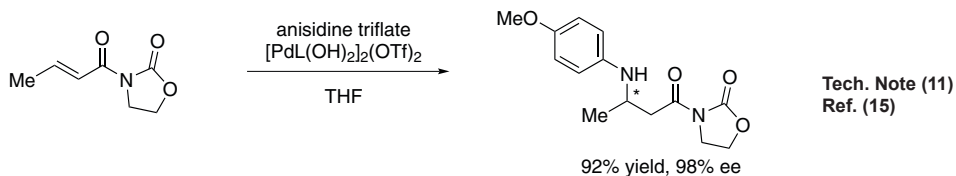
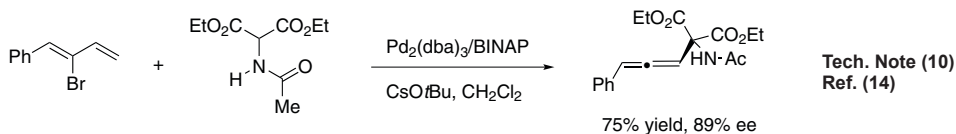
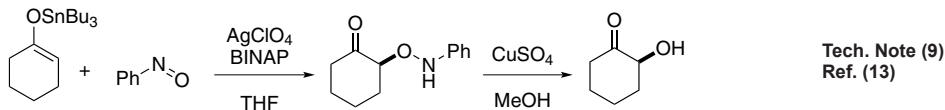
Tech. Note (7)
Ref. (11)



Tech. Note (8)
Ref. (12)

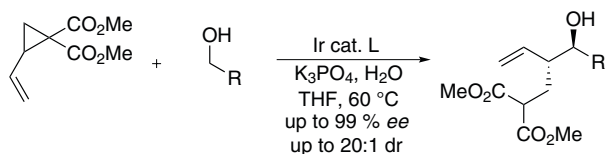
PHOSPHORUS (Compounds)

15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)
(continued)

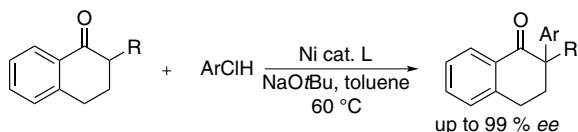


PHOSPHORUS (Compounds)

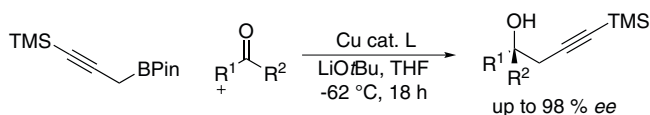
15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)
(continued)



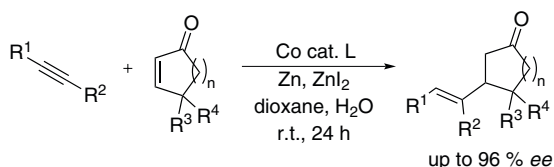
Tech. Note (16)
Ref. (20)



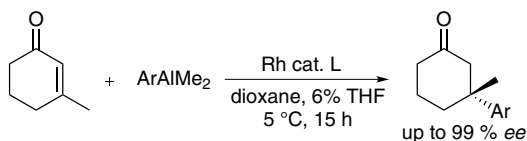
Tech. Note (17)
Ref. (21)



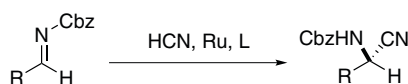
Tech. Note (18)
Ref. (22)



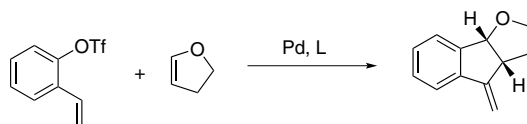
Tech. Note (19)
Ref. (23)



Tech. Note (20)
Ref. (24)



Tech. Note (21)
Ref. (25)



Tech. Note (22)
Ref. (26)

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1. CHEMTECH, **1992**, 360.
2. Asymmetric Catalysis in Organic Synthesis, **1993**, 61.
3. J. Am. Chem. Soc., **1988**, 110, 629.
4. Science, **1990**, 248, 1194.
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9. J. Am. Chem. Soc., **2000**, 122, 9546.
10. J. Org. Chem., **2003**, 68, 5593.
11. J. Am. Chem. Soc., **2003**, 125, 11472.
12. J. Am. Chem. Soc., **2003**, 125, 7198.

PHOSPHORUS (Compounds)

15-0150 (R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)
(continued)

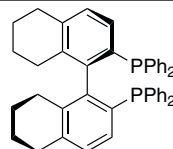
13. *J. Am. Chem. Soc.*, **2003**, 125, 6038.
14. *J. Am. Chem. Soc.*, **2001**, 123, 2089.
15. (a) JP4446465B2, (b) *Org. Lett.* **2004**, 6, 1861.
16. *J. Am. Chem. Soc.*, **2007**, 129, 14158.
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18. *J. Am. Chem. Soc.*, **2008**, 130, 14891.
19. *Angew. Chem. Int. Ed.*, **2008**, 47, 3818.
20. *J. Am. Chem. Soc.*, **2011**, 133, 18618.
21. *J. Am. Chem. Soc.*, **2011**, 133, 16330.
22. *J. Am. Chem. Soc.*, **2011**, 133, 10332.
23. *J. Am. Chem. Soc.*, **2011**, 133, 6942.
24. *Angew. Chem. Int. Ed.*, **2010**, 49, 7769.
25. *Org. Lett.*, **2012**, 14, 882.
26. *Angew. Chem., Int. Ed.*, **2013**, 52, 8676.

15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP (76189-56-5) C ₄₄ H ₃₂ P ₂ ; FW: 622.70; white to off-white powdr.; m.p. 241-242°	250mg 1g 5g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.	

Technical Note:

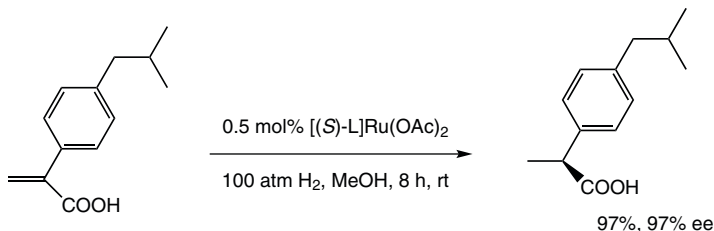
1. See 15-0150 (page 5)

15-2972	(R)-(+)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (R)-(+)-H₈-BINAP (139139-86-9) C ₄₄ H ₄₀ P ₂ ; FW: 630.74; off-white powdr.; m.p. 207-208°	50mg 250mg
	Note: Sold in collaboration with Takasago.	



Technical Notes:

1. Biaryl biphosphine ligand. The H8-BINAP ligand, as the ruthenium complex, catalyzes hydrogenation of unsaturated carboxylic acids to a higher ee than does BINAP. (Ref. 1,2)
2. The ruthenium catalyzed hydrogenation of aryl propenoic acid to produce the drug Ibuprofen.
3. Rhodium catalyzed asymmetric regioselective 1,4-addition of arylboronic acids to 3-substituted maleimides.
4. Ligand for palladium-catalyzed enantioselective hydrogenation of substituted indoles.
5. Rhodium-catalyzed enantioselective cyclization of γ -alkynylaldehydes with acyl phosphonates.
6. Enantioselective synthesis of axially chiral 1-arylisoquinolines by Rh-catalyzed [2+2+2] cycloaddition.
7. Enantioselective synthesis of 2,3-disubstituted indolines through Bronsted acid/Pd-complex-promoted tandem reactions.
8. Dehydration triggered asymmetric hydrogenation of 3-(α -hydroxyalkyl)indoles
9. Iridium-catalyzed [2+2+2] cycloaddition of α,ω -diynes with arylisocyanates
10. Asymmetric hydrogenation of 3-(toluenesulfonamidoalkyl)-indoles
11. Asymmetric Rh(I)-catalyzed intramolecular [3+2] cycloaddition of 1-yne-vinylcyclopropanes for bicyclo[3.3.0] compounds with a chiral quaternary carbon stereocenter.
12. Enantioselective intermolecular [2+2+2] cycloadditions of ene-allenes with allenates.
13. Rh-catalyzed one-pot intermolecular [2+2+2] trimerization/asymmetric intramolecular [4+2] cycloaddition of two aryl ethynyl ethers and 5-alkynals.
14. Rh-catalyzed regio-, diastereo-, and enantioselective [2+2+2] cycloaddition of 1,6-enynes with acrylamides.

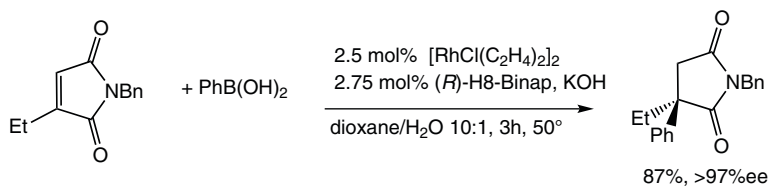


Tech. Note (1,2)
Ref. (1,2)

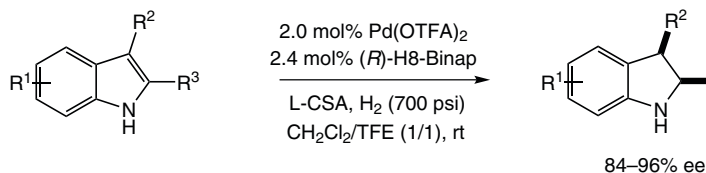
PHOSPHORUS (Compounds)

15-2972
(continued)

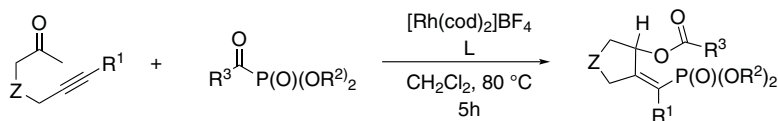
(R)-(+)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl
(R)-(+)-H₈-BINAP (139139-86-9)



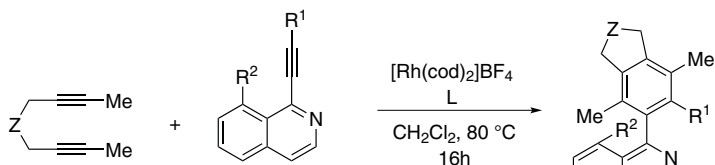
Tech. Note (3)
Ref. (3)



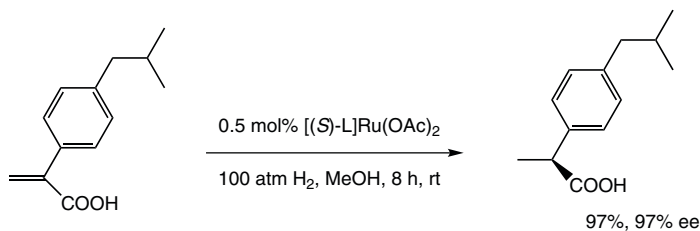
Tech. Note (4)
Ref. (4)



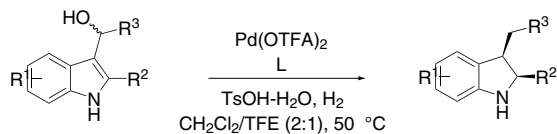
Tech. Note (5)
Ref. (5)



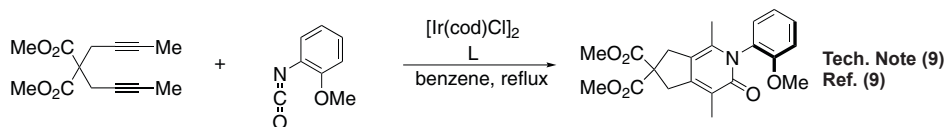
Tech. Note (6)
Ref. (6)



Tech. Note (7)
Ref. (7)

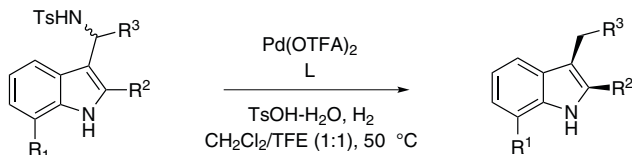


Tech. Note (8)
Ref. (8)

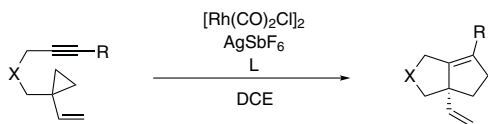


PHOSPHORUS (Compounds)

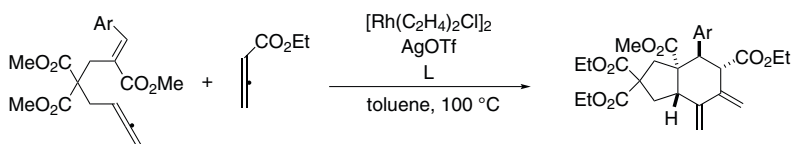
15-2972 (R)-(+)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl
(continued) (R)-(+)-H₈-BINAP (139139-86-9)



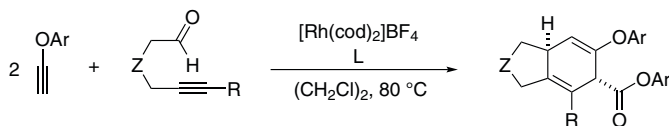
Tech. Note (10)
Ref. (10)



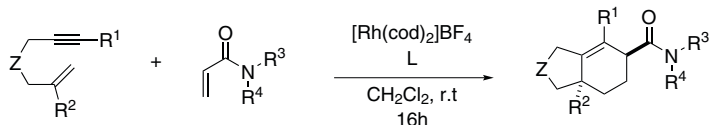
Tech. Note (11)
Ref. (11)



Tech. Note (12)
Ref. (12)



Tech. Note (13)
Ref. (13)



Tech. Note (14)
Ref. (14)

References:

1. *J. Org. Chem.*, **1996**, 61, 5510.
2. *Topics Organometal. Chem.* **2004**, 6, 63 (review).
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11. *J. Am. Chem. Soc.*, **2012**, 134, 398.
12. *Org. Lett.*, **2012**, 14, 6096.
13. *Org. Lett.*, **2012**, 14, 5856.
14. *Angew. Chem. Int. Ed.*, **2012**, 51, 13031.

15-2973 (S)-(-)-2,2'-Bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl (S)-(-)-H₈-BINAP (139139-93-8)
C₄₄H₄₀P₂, FW: 630.74; off-white powdr.; m.p. 207-208°
Note: Sold in collaboration with Takasago.

50mg
250mg

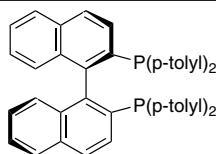
Technical Note:

1. See 15-2972 (page 9)

PHOSPHORUS (Compounds)

15-0152

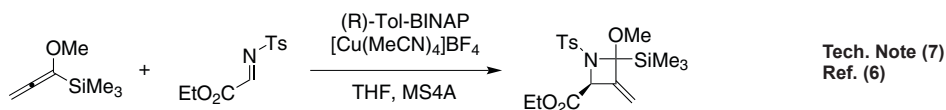
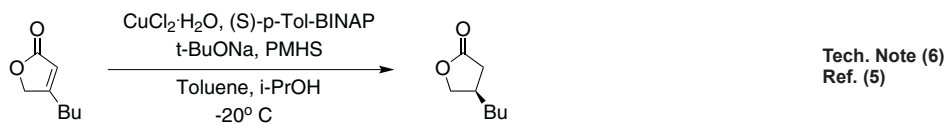
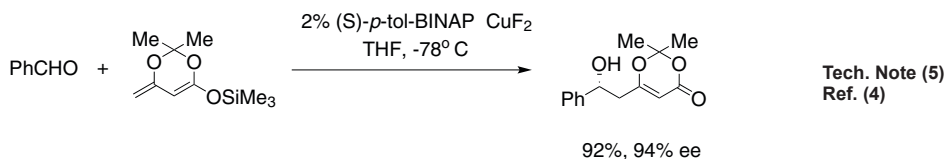
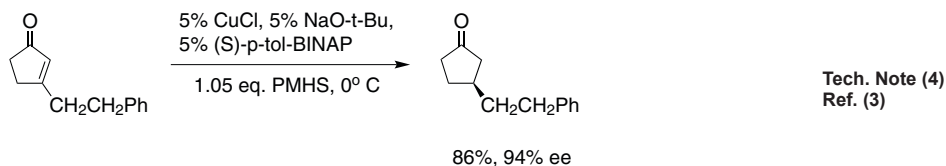
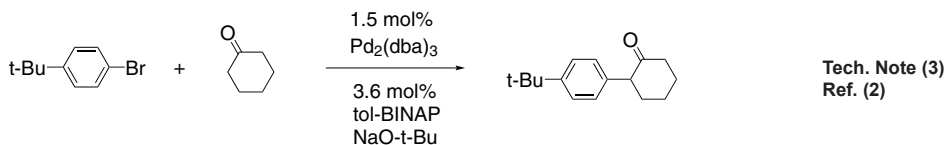
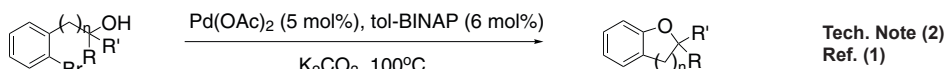
(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP (99646-28-3)
 $C_{48}H_{40}P_2$; FW: 678.79; white powdr.; m.p. 255-257°
 Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.



250mg
1g
5g

Technical Notes:

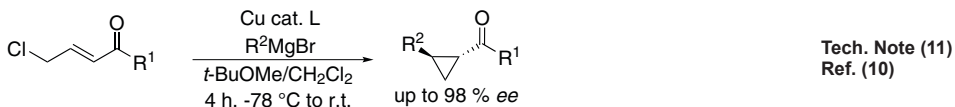
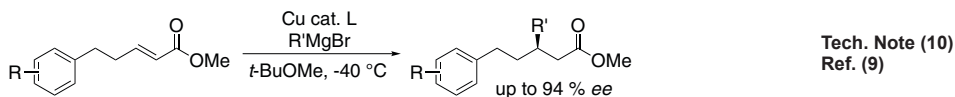
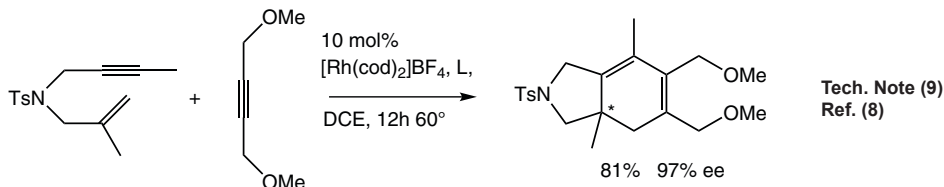
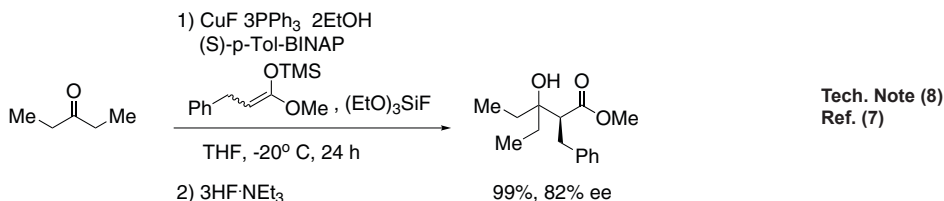
1. See 15-0150.
2. Useful ligand for palladium-catalyzed carbon-oxygen bond formation.
3. Ligand for palladium-catalyzed α -arylation of ketones.
4. Ligand for Cu-catalyzed asymmetric conjugate reduction.
5. Ligand for Cu-catalyzed asymmetric dienolate addition to aldehydes.
6. Enantioselective conjugate reduction of lactones and lactams.
7. Ligand used in the enantioselective cycloaddition of allenylsilanes with α -lmino esters.
8. Catalytic Aldol reaction to ketones.
9. Ligand with rhodium catalyses [2+2+2] cycloaddition reaction of alkenes and alkynes.
10. Ligand used in the copper-catalyzed asymmetric conjugate addition of alkyl Grignard reagents on α,β -unsaturated esters.
11. Ligand used in the copper-catalyzed asymmetric synthesis of cyclopropanes via tandem conjugate addition and intramolecular enolate trapping.



PHOSPHORUS (Compounds)

15-0152
(continued)

(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP (99646-28-3)



References:

1. *J. Am. Chem. Soc.*, **1996**, 118, 10333.
2. *J. Am. Chem. Soc.*, **1997**, 119, 11108.
3. *J. Am. Chem. Soc.*, **2000**, 122, 6797.
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8. *Org. Lett.*, **2005**, 7(22), 4955.
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15-0153 (S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP

(100165-88-6)

C₄₈H₄₀P₂; FW: 678.79; white powdr.; m.p. 255-257°

Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.

250mg

1g

5g

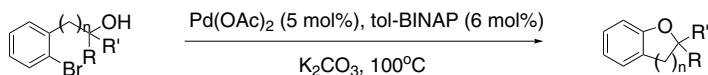
Technical Notes:

1. See 15-0150.
2. Useful ligand for palladium-catalyzed carbon-oxygen bond formation.
3. Ligand for palladium-catalyzed α-arylation of ketones.
4. Ligand for Cu-catalyzed asymmetric conjugate reduction.
5. Ligand for Cu-catalyzed asymmetric dienolate addition to aldehydes.
6. Enantioselective conjugate reduction of lactones and lactams.
7. Ligand used in the enantioselective cycloaddition of allenylsilanes with α-imino esters.
8. Catalytic Aldol reaction to ketones.
9. Ligand with rhodium catalyses [2+2+2] cycloaddition reaction of alkenes and alkynes.
10. Ligand used in the iridium-catalyzed enantioselective C-H bond activation of 2-(alkylamino)-pyridine with alkenes.
11. Iridium-catalyzed regio-, diastereo-, and enantioselective tert-(hydroxyl)-prenylation of alcohols.
12. Rhodium-catalyzed cross cyclotrimerization.

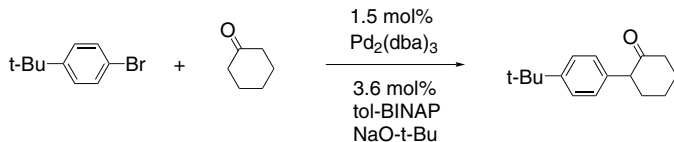
PHOSPHORUS (Compounds)

15-0153
(continued)

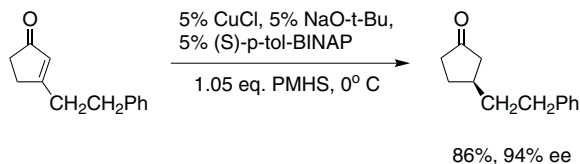
(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP (100165-88-6)



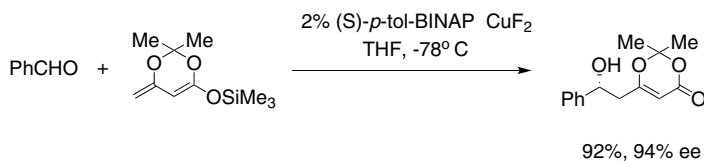
Tech. Note (2)
Ref. (1)



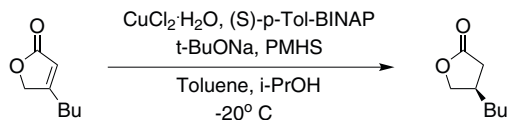
Tech. Note (3)
Ref. (2)



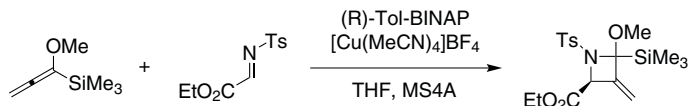
Tech. Note (4)
Ref. (3)



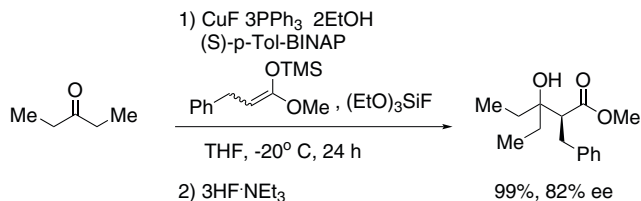
Tech. Note (5)
Ref. (4)



Tech. Note (6)
Ref. (5)



Tech. Note (7)
Ref. (6)



Tech. Note (8)
Ref. (7)

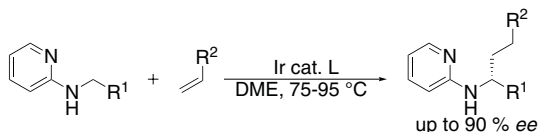


Tech. Note (9)
Ref. (8)

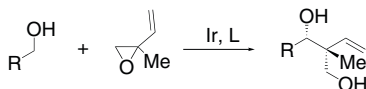
PHOSPHORUS (Compounds)

15-0153
(continued)

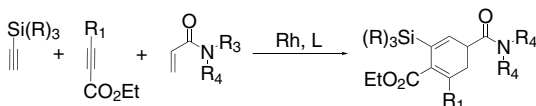
(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-ToIBINAP (100165-88-6)



Tech. Note (10)
Ref. (9)



Tech. Note (11)
Ref. (10)



Tech. Note (12)
Ref. (11)

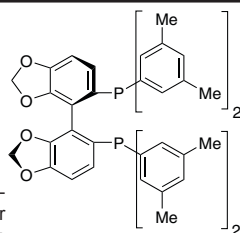
References:

1. *J. Am. Chem. Soc.*, **1996**, 118, 10333
2. *J. Am. Chem. Soc.*, **1997**, 119, 11108
3. *J. Am. Chem. Soc.*, **2000**, 122, 6797
4. *J. Am. Chem. Soc.*, **1998**, 120, 837
5. *J. Am. Chem. Soc.*, **2003**, 125, 11253
6. *Org. Lett.*, **2003**, 5, 20, 3691
7. *J. Am. Chem. Soc.*, **2003**, 125, 5644
8. *Org. Lett.*, **2005**, 7, 22, 4955
9. *Org. Lett.*, **2011**, 13, 4692
10. *J. Am. Chem. Soc.*, **2014**, 136, 8911
11. *Angew. Chem., Int. Ed.*, **2014**, 53, 2956

15-0478 (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPPOS®
(850253-53-1)

C₄₆H₄₄O₄P₂; FW: 722.79; off white to pale yellow powdr.; m.p. 256-261°

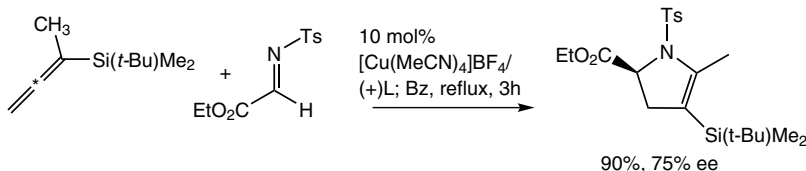
Note: Sold in collaboration with Takasago. Takasago SEGPPOS® Ligand Kit component.



250mg
1g
5g

Technical Notes:

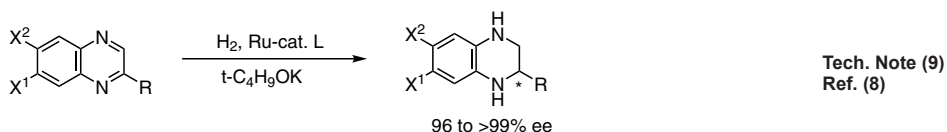
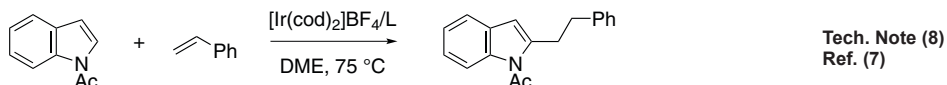
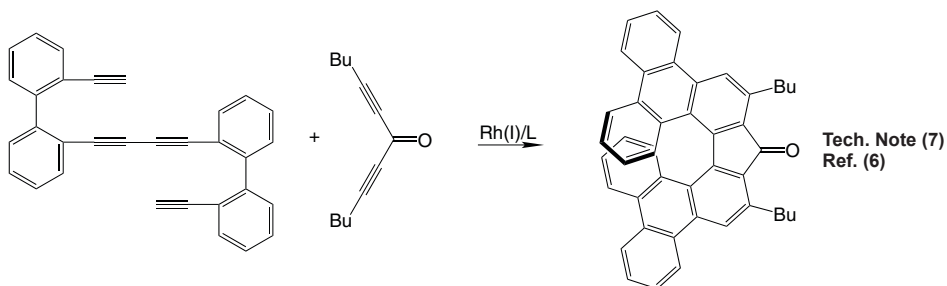
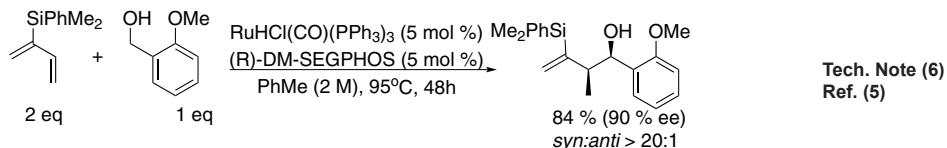
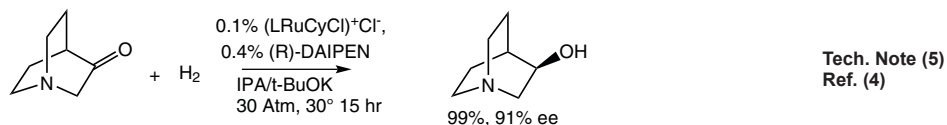
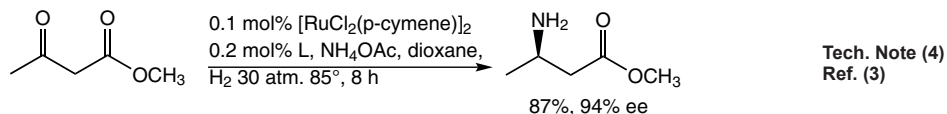
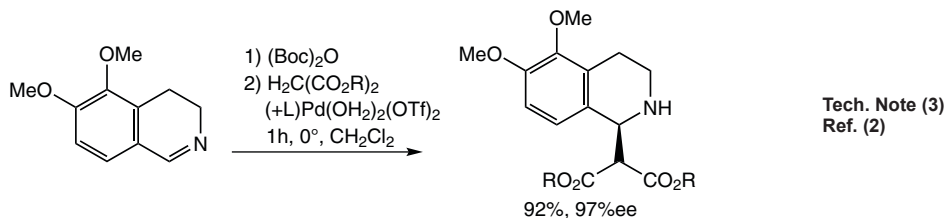
1. Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPPOS ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of α -substituted- β -ketoesters. See 15-0066.
2. Copper catalyzed enantioselective [3 + 2] cycloaddition as a route to γ -amino ketones and 3-pyrrolidinones.
3. Palladium catalyzed enantioselective addition of malonates to dihydroisoquinolines.
4. Ruthenium catalyzed enantioselective synthesis of β amino acids by hydrogenation.
5. Ruthenium catalyzed asymmetric hydrogenation of 3-quinuclidinone. See 44-0098 for Ru catalyst.
6. Diastereo- and enantioselective ruthenium-catalyzed hydrohydroxyalkylation of 2-silyl-butadienes.
7. Asymmetric [2+2+2] cycloaddition.
8. Linear selective C-H activation.
9. Ligand used in the asymmetric hydrogenation of quinoxalines, benzoxazines and Benzothiazine.



Tech. Note (2)
Ref. (1)

PHOSPHORUS (Compounds)

15-0478 (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%
(continued) (R)-(+)-DM-SEGPHOS® (850253-53-1)



PHOSPHORUS (Compounds)

15-0478 (R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%
(continued) (R)-(+)-DM-SEGPPOS® (850253-53-1)

References:

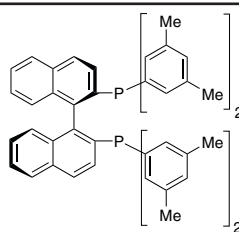
1. *Org. Lett.*, **2005**, 7, 1051.
2. *J. Am. Chem. Soc.*, **2006**, 128, 14010.
3. US.Pat. 7626034.
4. (a) US.Pat. 7462722. (b) *Org. Process Res. Dev.* **2011**, 15, 1130.
5. *J. Am. Chem. Soc.*, **2011**, 133, 10582.
6. *J. Am. Chem. Soc.*, **2012**, 134, 4080.
7. *J. Am. Chem. Soc.*, **2012**, 134, 17474.
8. *Adv. Synth. Catal.*, **2013**, 355, 2769.

15-0479	(S)-(-)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98%	250mg
	(S)-(-)-DM-SEGPPOS® (210169-57-6)	1g
	C ₄₆ H ₄₄ O ₄ P ₂ ; FW: 722.79; off-white to pale yellow powdr.; m.p. 256-261°	5g
	Note: Sold in collaboration with Takasago. Takasago SEGPPOS® Ligand Kit component.	

Technical Note:

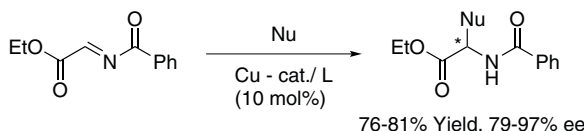
1. See 15-0478 (page 15)

15-0476	(R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP (137219-86-4)	250mg
	C ₅₂ H ₄₈ P ₂ ; FW: 734.90; white to pale yellow xtl.; m.p. 203-206°	1g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.	5g

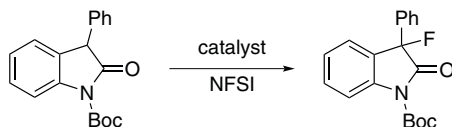


Technical Notes:

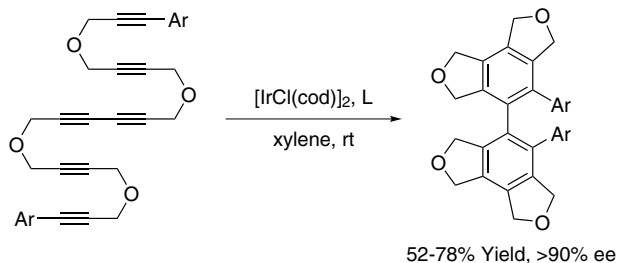
1. See 15-0150.
2. See 15-0477.
3. Ligand used in copper-catalyzed asymmetric Mannich-type reactions of N-acylimino esters.
4. Ligand used in the enantioselective fluorination of oxindoles.
5. Ligand used in [2+2+2] cycloaddition of tetraynes and hexaynes.
6. Ligand used in the asymmetric reduction of ketone via ruthenium-catalyzed asymmetric hydrogenation.
7. Asymmetric hydroboration of unsaturated imines.



Tech. Note (3)
Ref. (1)



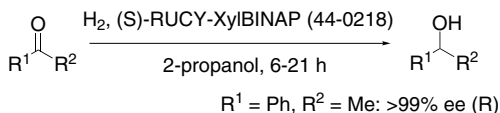
Tech. Note (4)
Ref. (2)



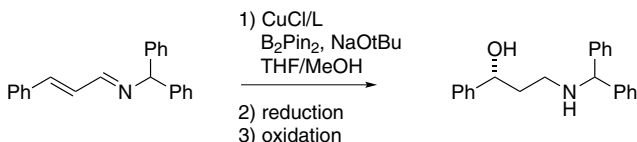
Tech. Note (5)
Ref. (3)

PHOSPHORUS (Compounds)

15-0476 (R)-(+)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP (137219-86-4)
(continued)



Tech. Note (6)
Ref. (4)



Tech. Note (7)
Ref. (5)

References:

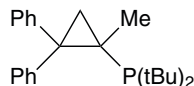
1. *J. Am. Chem. Soc.*, **2003**, 125, 2507.
2. *J. Am. Chem. Soc.*, **2005**, 127, 10164
3. *Tetrahedron*, **2008**, 64, 821.
4. *J. Am. Chem. Soc.*, **2011**, 133, 10696.
5. *Org. Lett.*, **2013**, 15, 4810.

15-0477	(S)-(-)-2,2'-Bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP	250mg
	(135139-00-3)	1g
	$\text{C}_{62}\text{H}_{48}\text{P}_2$; FW: 734.90; white to pale yellow xtl.; m.p. 203-206°	5g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ligand Kit component.	

Technical Note:

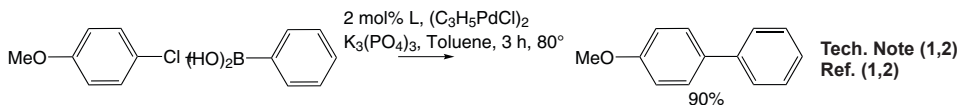
1. See 15-0476 (page 17)

15-1005	Di-t-butyl(2,2-diphenyl-1-methyl-1-cyclopropyl)phosphine cBRIDP (742103-27-1)	250mg
	$\text{C}_{24}\text{H}_{33}\text{P}$; FW: 352.49; white to pale yellow solid	1g
	air sensitive, (store cold)	5g
	Note: Sold in collaboration with Takasago. US7129367B2.	

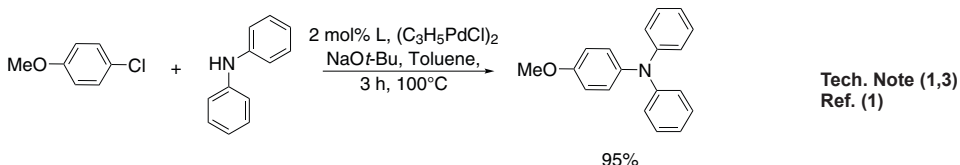


Technical Notes:

1. Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
2. Ligand used in the palladium catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
3. Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.



Tech. Note (1,2)
Ref. (1,2)

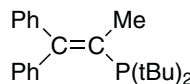


Tech. Note (1,3)
Ref. (1)

References:

1. *US Patent* 7129367.
2. *Synlett.*, **2008**, 12, 1809.

15-1065	Di-t-butyl(2,2-diphenyl-1-methylvinyl)phosphine, min. 98% vBRIDP (384842-25-5)	250mg
	$\text{C}_{23}\text{H}_{31}\text{P}$; FW: 338.47; white to pale yellow xtl.	1g
	air sensitive, (store cold)	5g
	Note: Sold in collaboration with Takasago. US6455720.	

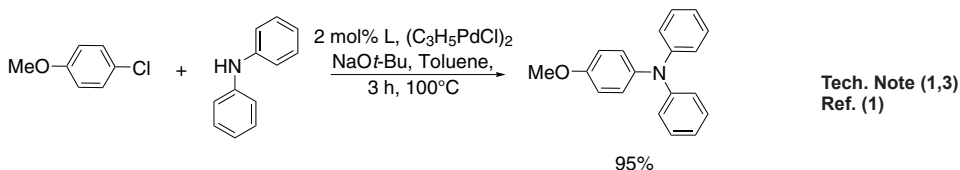
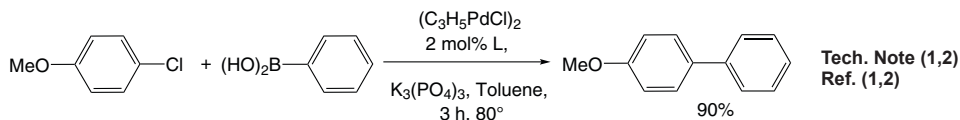


Technical Notes:

1. Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
2. Ligand used in the palladium-catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
3. Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.

PHOSPHORUS (Compounds)

15-1065 Di-*t*-butyl(2,2-diphenyl-1-methylvinyl)phosphine, min. 98% vBRIDP (384842-25-5)
(continued)



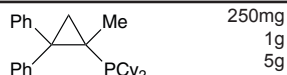
References:

1. *US Patent* 7129367.
2. *Synlett.*, **2008**, 12, 1809.

15-1007 Dicyclohexyl(2,2-diphenyl-1-methylcyclopropyl)phosphine **Cy-cBRIDP** (1023330-38-2)

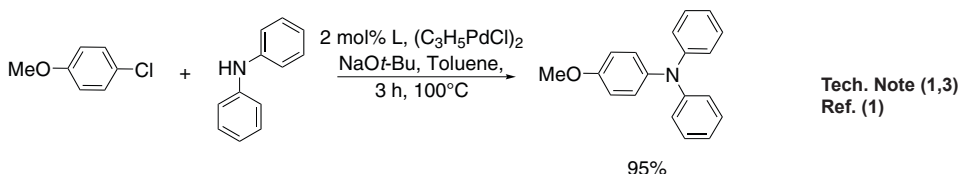
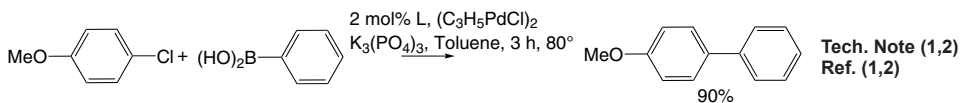
$C_{28}H_{37}P$; FW: 404.57; white to pale yellow solid
air sensitive, (store cold)

Note: Sold in collaboration with Takasago. US7129367B2.



Technical Notes:

1. Ligand effective for many classes of palladium-catalyzed coupling of aryl halides, including the Miyaura-Suzuki, Buchwald-Hartwig, Sonogashira, Heck, aryl etherification, and carbonylation reactions.
2. Ligand used in the palladium catalyzed Suzuki-Miyaura coupling of aryl boronic acids.
3. Ligand employed in the palladium-catalyzed Buchwald-Hartwig aryl amination reaction.



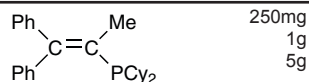
References:

1. *US Patent* 7129367.
2. *Synlett.*, **2008**, 12, 1809.

15-1062 Dicyclohexyl(2,2-diphenyl-1-methylvinyl)phosphine **Cy-vBRIDP** (384842-24-4)

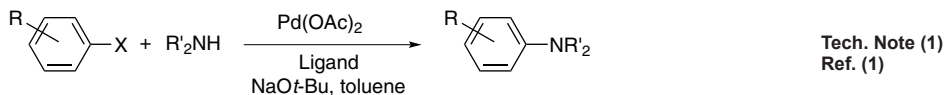
$C_{25}H_{35}P$; FW: 366.52; white to pale yellow solid
air sensitive, (store cold)

Note: Sold in collaboration with Takasago. US6455720.



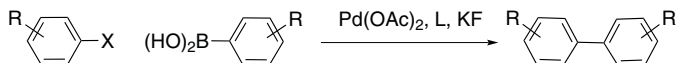
Technical Notes:

1. Ligand used in the Pd-catalyzed amination of aryl halides.
2. Ligand used for Suzuki-Miyaura coupling.



PHOSPHORUS (Compounds)

15-1062 (continued) (R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP (145964-33-6)

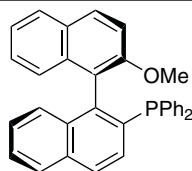


Tech. Note (2)
Ref. (2)

References:

1. *Adv. Synth. Catal.*, **2007**, 349, 2089.
2. *Synlett*, **2007**, 20, 3206.

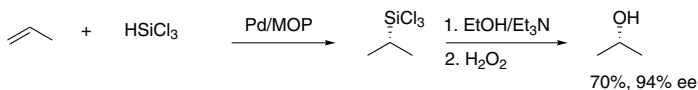
15-1775 (R)-(+)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (R)-MOP (145964-33-6)
C₃₃H₂₅OP; FW: 468.53; white powdr.; m.p. 177-179°
air sensitive
Note: Sold in collaboration with Takasago.



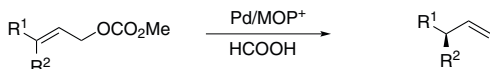
100mg
500mg

Technical Notes:

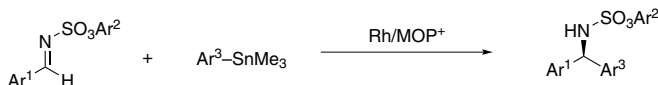
1. Efficient catalyst for the enantioselective hydrosilylation of 1-alkenes to optically active 2-alcohols.
2. Ligand for palladium-catalyzed asymmetric reduction of allylic esters.
3. Ligand for the rhodium-catalyzed asymmetric arylation of imines with organostannanes.
4. Ligand for the rhodium-catalyzed asymmetric addition of aryl- and alkenylboronic acids to Isatins.
5. Ligand for desymmetrization of malonamides via an enantioselective intramolecular Buchwald-Hartwig reaction.



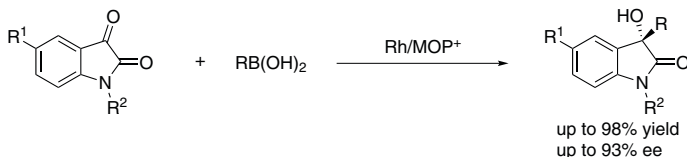
Tech. Note (1)
Ref. (1,2)



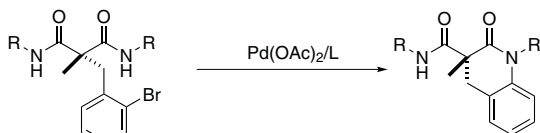
Tech. Note (2)
Ref. (3)



Tech. Note (3)
Ref. (4)



Tech. Note (4)
Ref. (5)



Tech. Note (5)
Ref. (6)

References:

1. *J. Am. Chem. Soc.*, **1991**, 113, 9887.
2. *Acc. Chem. Res.*, **2000**, 33, 354. (review)
3. *J. Am. Chem. Soc.*, **1994**, 116, 775.
4. *J. Am. Chem. Soc.*, **2000**, 122, 976.
5. *Angew. Chem. Int. Ed.*, **2006**, 45, 3353.
6. *Tetrahedron Lett.*, **2009**, 50, 4170

PHOSPHORUS (Compounds)

15-1776	(S)-(-)-2-(Diphenylphosphino)-2'-methoxy-1,1'-binaphthyl, 99% (S)-MOP (134484-36-9) $C_{33}H_{28}OP$; FW: 468.53; white powdr.; m.p. 175-179° <i>air sensitive</i> Note: Sold in collaboration with Takasago.	100mg 500mg
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Technical Note:

1. See 15-1775 (page 20)

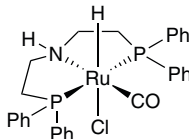
96-6950	Takasago BINAP Ligand Kit See page 44
96-6900	Takasago SEGPHOS® Ligand Kit See page 48

RHODIUM (Compounds)

45-0185	(2S,3S)-(+)-2,3-Bis(diphenylphosphino)bicyclo[2.2.1]hept-5-ene(1,5-cyclooctadiene)rhodium(I) tetrafluoroborate, min. 97% (S,S)-NORPHOS-Rh (78355-59-6) $[Rh(C_8H_{12})(C_{31}H_{28}P_2)] \cdot BF_4$; FW: 760.39; red-orange powdr. <i>air sensitive</i> Note: Sold in collaboration with Takasago.	100mg 500mg
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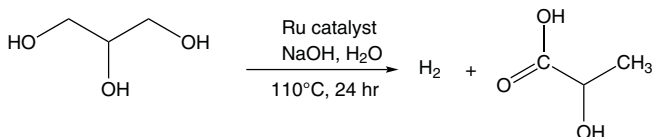
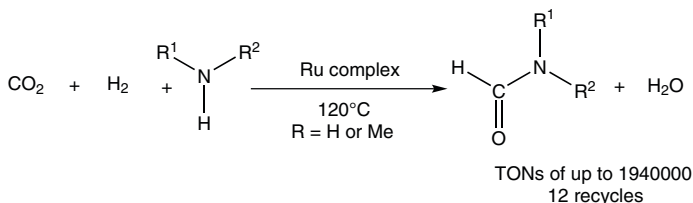
RUTHENIUM (Compounds)

44-0071	Carbonylchlorohydrido[bis(2-(diphenylphosphinoethyl) amino]ruthenium(II), min.98% Ru-MACHO® (1295649-40-9) $C_{29}H_{30}ClNOP_2Ru$; FW: 607.03; white to yellow powdr. <i>air sensitive</i> Note: Sold in collaboration with Takasago. US Patent 8471048	250mg 1g 5g
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Technical Notes:

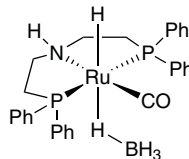
1. Highly efficient ruthenium-catalyzed N-formylation of amines with hydrogen and carbon dioxide.
2. Ruthenium-catalyzed hydrogen generation from glycerol and selective synthesis of lactic acid.
3. See 44-0074.



References:

1. *Angew. Chem., Int. Ed.*, **2015**, *54*, 6186
2. *Green Chem.*, **2015**, *17*, 193

44-0074	Carbonylhydrido(tetrahydroborato)[bis(2-diphenylphosphinoethyl) amino]ruthenium(II), min.98% Ru-MACHO™-BH (1295649-41-0) $C_{29}H_{34}BNOP_2Ru$; FW: 586.41; white to yellow powdr. <i>air sensitive</i> Note: Sold in collaboration with Takasago. US Patent 8471048.	250mg 1g 5g
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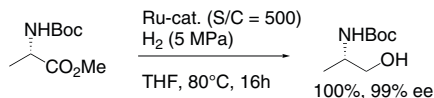


Technical Notes:

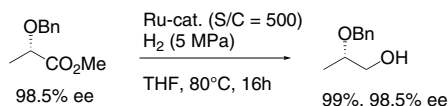
1. Catalyst used for hydrogenation of esters without addition of base.
2. See 44-0071.

RUTHENIUM (Compounds)

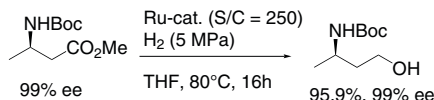
44-0074 (continued) Carbonylhydrido(tetrahydroborato)[bis(2-diphenylphosphinoethyl) amino]ruthenium(II), min. 98% Ru-MACHO™-BH (1295649-41-0)



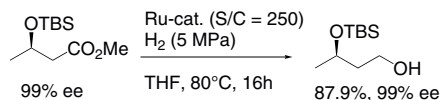
Tech. Note (1)
Ref. (1)



Tech. Note (1)
Ref. (1)



Tech. Note (1)
Ref. (1)

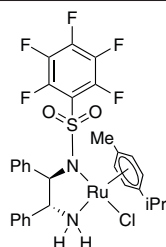


Tech. Note (1)
Ref. (1)

References:

- US. Pat. 8471048.

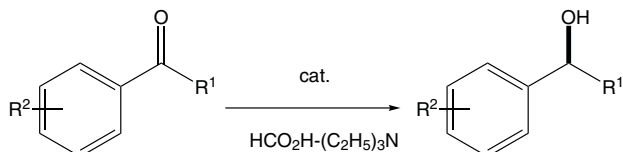
44-0156 Chloro{[(1R,2R)-(-)-2-amino-1,2-diphenylethyl](pentafluorophenylsulfonyl)amido}(p-cymene) ruthenium(II), min. 90% RuCl[(R,R)-Fsdpen](p-cymene) (1026995-71-0)
C₃₀H₂₈ClF₅N₂O₂RuS; FW: 712.14; orange to brown pwdr.
air sensitive
Note: Sold in collaboration with Takasago.



250mg
1g
5g

Technical Note:

- Catalyst used in the asymmetric transfer hydrogenation of ketones using formic acid-triethylamine mixture.



Tech. Note (1)
Ref. (1)

References:

- J. Am. Chem. Soc., 1996, 118, 2521.

44-0157 Chloro{[(1S,2S)-(+)-2-amino-1,2-diphenylethyl](pentafluorophenylsulfonyl)amido}(p-cymene)ruthenium(II), min. 90% RuCl[(S,S)-Fsdpen](p-cymene) (1026995-72-1)
C₃₀H₂₈ClF₅N₂O₂RuS; FW: 712.14; orange to brown pwdr.
air sensitive
Note: Sold in collaboration with Takasago. Takasago ATH Catalyst Kit component.

250mg
1g
5g

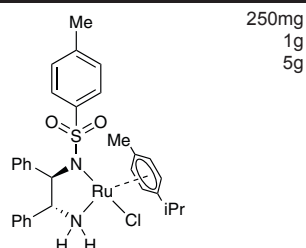
44-0149 Chloro{[(1S,2S)-(+)-2-amino-1,2-diphenylethyl](4-toluenesulfonyl)amido}(p-cymene)ruthenium(II), min. 90% RuCl[(S,S)-Tsdpen](p-cymene) (192139-90-5)
C₃₁H₃₅ClN₂O₂RuS; FW: 636.21; yellow to dark brown solid
air sensitive
Note: Sold in collaboration with Takasago. Takasago ATH Catalyst Kit component.

250mg
1g
5g

RUTHENIUM (Compounds)

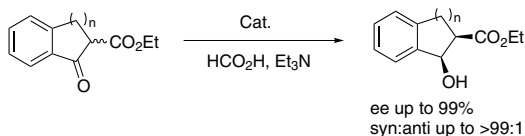
44-0148 Chloro[[[(1*R*,2*R*)-(-)-2-amino-1,2-diphenylethyl](4-toluenesulfonylamido)}(p-cymene)ruthenium(II)], min. 95% RuCl[[(*R*,*R*)-Tsdpen](p-cymene) (192139-92-7)
C₃₁H₃₅ClN₂O₂RuS; FW: 636.21; yellow to dark brown solid
air sensitive

Note: Sold in collaboration with Takasago. Takasago ATH Catalyst Kit component.

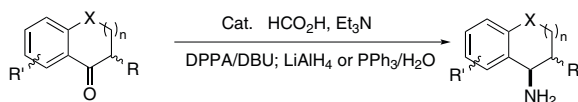


Technical Note:

1. This catalyst has shown to effect highly enantioselective hydrogenation of functionalized ketones where the substituents are dialkylamino, hydroxy, siloxy, carbonyl, ester, amide or thioester.

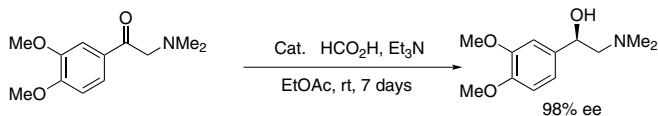


Tech. Note (1)
Ref. (1)

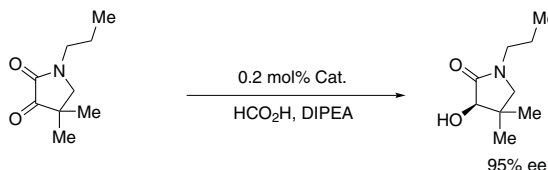


n = 0, 1; R = alkyl, F, OAc; X = CH₂, O

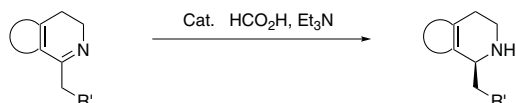
Tech. Note (1)
Ref. (2)



Tech. Note (1)
Ref. (3)



Tech. Note (1)
Ref. (4-6)



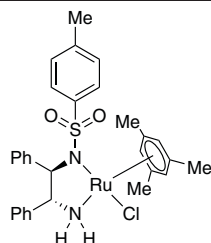
Tech. Note (1)
Ref. (7,8)

References:

1. *Tetrahedron*, **2007**, 63, 7532
2. *Tetrahedron*, **2007**, 63, 6755
3. *Tetrahedron: Asymmetry*, **2009**, 20, 1138
4. *J. Org. Chem.*, **2009**, 74, 1411
5. *Org. Lett.*, **2007**, 9, 2461
6. *Org. Lett.*, **2009**, 11, 935
7. *Angew. Chem. Int. Ed.*, **2009**, 48, 7616
8. *Bioorg. Med. Chem. Lett.*, **2008**, 18, 4110

RUTHENIUM (Compounds)

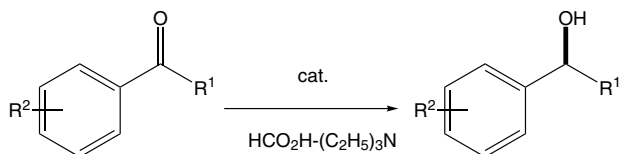
44-0154 Chloro[[[(1R,2R)-(-)-2-amino-1,2-diphenylethyl](4-toluenesulfonyl)amido](mesitylene)ruthenium(II)], min. 90% **RuCl[(R,R)-Tsdpen(mesitylene)] (174813-82-2)**
 $C_{30}H_{33}ClN_2O_2RuS$; FW: 622.18; orange powdr.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago ATH Catalyst Kit component.



250mg
1g
5g

Technical Note:

1. Catalyst used in the asymmetric transfer hydrogenation of ketones using formic acid-triethylamine mixture.

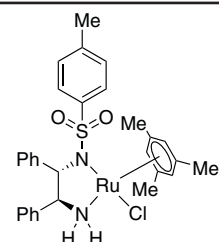


Tech. Note (1)
Ref. (1)

References:

1. *J. Am. Chem. Soc.*, **1996**, *118*, 2521.

44-0155 Chloro[[[(1S,2S)-(+)-2-amino-1,2-diphenylethyl](4-toluenesulfonyl)amido](mesitylene)ruthenium(II)], min. 90% **RuCl[(S,S)-Tsdpen(mesitylene)] (174813-81-1)**
 $C_{30}H_{33}ClN_2O_2RuS$; FW: 622.18; yellow to dark brown solid
air sensitive
 Note: Sold in collaboration with Takasago. US7129367B2. Takasago ATH Catalyst Kit component.

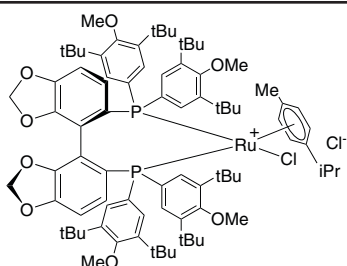


250mg
1g
5g

Technical Note:

1. See 44-0154 (page 24)

44-0102 Chloro{(R)-(-)-5,5'-bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole}(p-cymene)ruthenium(II) chloride [**RuCl(p-cymene)((R)-dtbm-segphos®)]Cl (944451-32-5)**
 $[C_{84}H_{114}ClO_8P_2Ru]^+Cl^-$; FW: 1485.72; yellow to dark brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.



250mg
1g
5g

Technical Note:

1. See 15-0066.

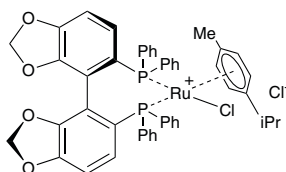
44-0103 Chloro{(S)-(+)-5,5'-bis[di(3,5-di-*t*-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole}(p-cymene)ruthenium(II) chloride [**RuCl(p-cymene)((S)-dtbm-segphos®)]Cl (944451-33-6)**
 $[C_{84}H_{114}ClO_8P_2Ru]^+Cl^-$; FW: 1485.72; orange to brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Note:

1. See 44-0102 (page 24)

RUTHENIUM (Compounds)

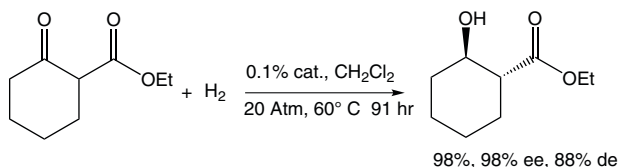
44-0096 Chloro[(R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-segphos®)]Cl (944451-28-9)
 $[C_{48}H_{42}ClO_4P_2Ru] \cdot Cl$; FW: 916.77;
 yellow powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago SEGPHOS® Ru Catalyst Kit component.



250mg
1g
5g

Technical Notes:

- Highly active highly enantioselective catalyst for hydrogenation of functionalized ketones. Slightly higher temperature is necessary to activate the cymene complexes. See 15-0136.
- Asymmetric hydrogenation of α -substituted- β -ketoesters accompanied by dynamic kinetic resolution.



Tech. Note (1)
Ref. (1)

References:

- U.S. Pat. 7038087.

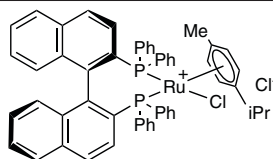
44-0097 Chloro[(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-segphos®)]Cl (944451-29-0)
 $[C_{48}H_{42}ClO_4P_2Ru] \cdot Cl$; FW: 916.77; ocher to dark brown powdr.;
 m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

250mg
1g
5g

Technical Note:

- See 44-0096 (page 25)

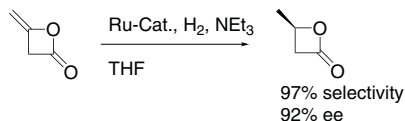
44-0084 Chloro[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-binap)]Cl (145926-28-9)
 $[C_{54}H_{46}ClP_2Ru] \cdot Cl$; FW: 928.87; orange powdr.;
 m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago BINAP Ru Cymene Catalyst Kit component.



250mg
1g
5g

Technical Note:

- An efficient catalytic asymmetric hydrogenation of diketene.



Tech. Note (1)
Ref. (1)

References:

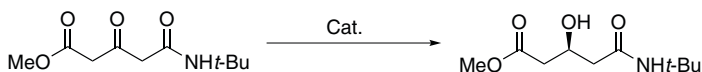
- J. Chem. Soc., Chem. Chem. Commun.* **1992**, 1725.

RUTHENIUM (Compounds)

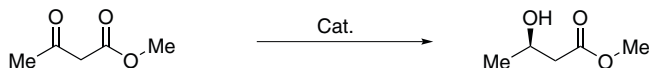
44-0086	Chloro[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-binap)]Cl <i>(130004-33-0)</i> $[C_{54}H_{46}ClP_2Ru]^+Cl^-$; FW: 928.87; orange powdr.; m.p. >100° dec. <i>air sensitive</i> Note: Sold in collaboration with Takasago. Takasago BINAP Ru Cymene Catalyst Kit component.	250mg 1g 5g
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Technical Notes:

- See 15-0151.
- This catalyst has shown to effect the highly enantioselective hydrogenation of functionalized ketones where the substituents are dialkylamino, hydroxy, siloxy, carbonyl, ester, amide or thioester.



Tech. Note (2)
Ref. (1)

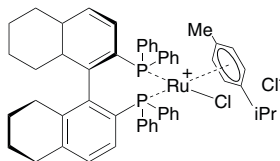


Tech. Note (2)
Ref. (2)

References:

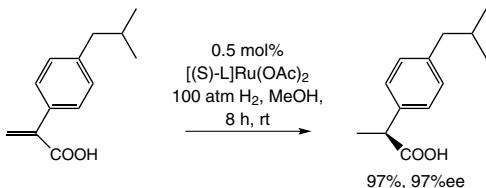
- Tetrahedron Lett.*, **2008**, 49, 4836
- Appl. Catal. A.*, **2009**, 366, 160

44-0094	Chloro[(R)-(+)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-H₈-binap)]Cl (944451-26-7) $[C_{54}H_{54}ClP_2Ru]^+Cl^-$; FW: 936.93; pale yellow powdr.; m.p. >100° dec. <i>air sensitive</i> Note: Sold in collaboration with Takasago.	50mg 250mg
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Technical Notes:

- Biaryl bisphosphine ligand. The H₈-BINAP ligand, as the ruthenium complex, catalyzes hydrogenation of unsaturated carboxylic acids to a higher ee than does BINAP. (Ref. 1,2)
- The ruthenium catalyzed hydrogenation of aryl propenoic acid to produce the drug Ibuprofen.



Tech. Note (1,2)
Ref. (1,2)

References:

- J. Org. Chem.*, **1996**, 61, 5510
- Topics Organometal. Chem.* **2004**, 6, 63, review

44-0095	Chloro[(S)-(-)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-H₈-binap)]Cl (944451-27-8) $[C_{54}H_{54}ClP_2Ru]^+Cl^-$; FW: 936.93; pale yellow powdr.; m.p. >100° dec. <i>air sensitive</i> Note: Sold in collaboration with Takasago.	50mg 250mg
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Technical Note:

- See 44-0094 (page 26)

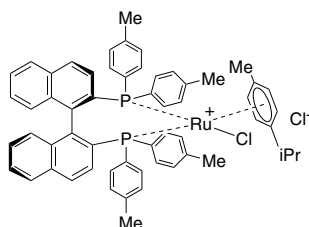
RUTHENIUM (Compounds)

44-0088 Chloro[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-tolbinap)]Cl

(131614-43-2)
[C₅₈H₅₄ClP₂Ru]·Cl; FW: 984.97; brown powdr.;
m.p. >100° dec.

air sensitive

Note: Sold in collaboration with Takasago.
Takasago BINAP Ru Cymene Catalyst Kit component.



250mg
1g
5g

Technical Note:

- See 15-0152 (page 12)

44-0089 Chloro[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-tolbinap)]Cl (228120-95-4)

[C₅₈H₅₄ClP₂Ru]·Cl; FW: 984.97; yellow to dark brown solid; m.p. >100° dec.
air sensitive

Note: Sold in collaboration with Takasago. Takasago BINAP Ru Cymene Catalyst Kit component.

250mg
1g
5g

Technical Note:

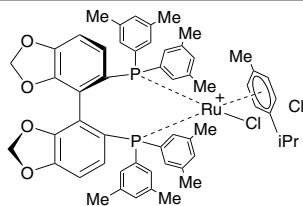
- See 15-0153 (page 13)

44-0098 Chloro[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-dm-segphos®)]Cl (944451-30-3)

[C₅₆H₅₈ClO₄P₂Ru]·Cl; FW: 1028.98;
orange to brown powdr.; m.p. >100° dec.

air sensitive

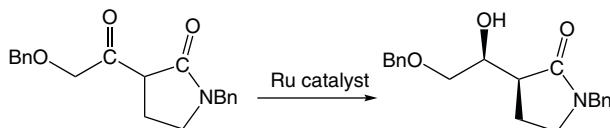
Note: Sold in collaboration with Takasago.
Takasago SEGPHOS® Ru Catalyst Kit component.



250mg
1g
5g

Technical Note:

- Ruthenium catalyst used for the asymmetric hydrogenation of β-ketoimides.



**Tech. Note (1)
Ref. (1)**

References:

- J. Org. Chem., 2012, 77, 4732

44-0099 Chloro[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-dm-segphos®)]Cl (944451-31-4)

[C₅₆H₅₈ClO₄P₂Ru]·Cl; FW: 1028.98; orange to brown powdr.; m.p. >100° dec.

air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

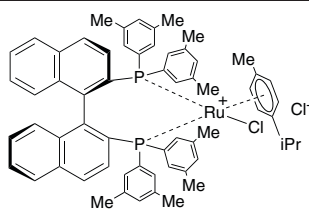
250mg
1g
5g

Technical Note:

- Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPHOS ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of α-substituted-β-ketoesters. See 15-0066.

RUTHENIUM (Compounds)

44-0092 Chloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}(p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-xybinap)]Cl (944451-24-5)
 $[C_{62}H_{62}ClIP_2Ru] \cdot Cl$; FW: 1041.08;
 orange to brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago BINAP Ru Cymene Catalyst Kit component.



250mg
1g
5g

Technical Note:

- See 15-0150.

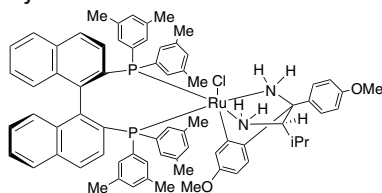
44-0093 Chloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}(p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-xybinap)]Cl (944451-25-6)
 $[C_{62}H_{62}ClIP_2Ru] \cdot Cl$; FW: 1041.08; orange to brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Cymene Catalyst Kit component.

250mg
1g
5g

Technical Note:

- See 44-0092 (page 28)

44-0217 Chloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2R)-(-)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) (R)-RUCY®XYBINAP (1384974-38-2)
 $C_{71}H_{73}ClN_2O_2P_2Ru$; FW: 1184.82;
 yellow to dark brown/green solid
air sensitive
 Note: Sold in collaboration with Takasago.
 US Patent 9079931. Takasago BINAP Ru Diamine Catalyst Kit component. Takasago ATH Catalyst Kit component.

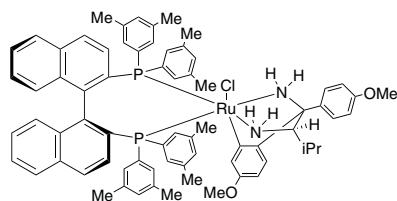


100mg
250mg
1g
5g

Technical Note:

- See 44-0218 (page 28)

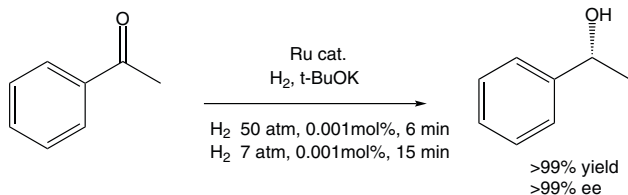
44-0218 Chloro{(S)-(-)-2,2'-bis[di(3,5-xylyl) phosphino]-1,1'-binaphthyl}[(2S)-(+)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) (S)-RUCY®XYBINAP (1312713-89-5)
 $C_{71}H_{73}ClN_2O_2P_2Ru$; FW: 1184.82;
 yellow to dark brown/green solid
air sensitive
 Note: Sold in collaboration with Takasago.
 US Patent 9079931. Takasago BINAP Ru Diamine Catalyst Kit component. Takasago ATH Catalyst Kit component.



250mg
1g
5g

Technical Note:

- Catalyst used for the rapid, and highly selective hydrogenation of ketones.



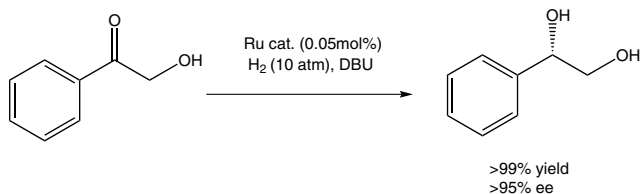
"trans-RuCl₂(xybinap)(daipen) 0.001 mol%, 240 min"

Tech. Note (1)
Ref. (1)

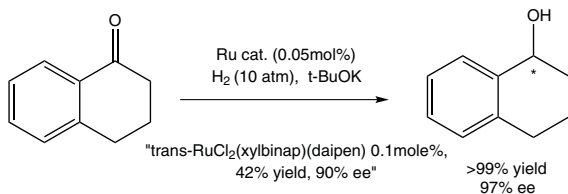
RUTHENIUM (Compounds)

44-0218
(continued)

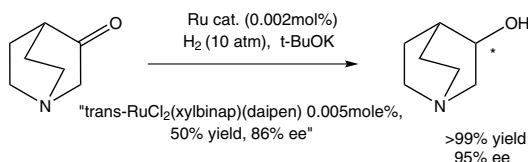
Chloro[(S)-(-)-2,2'-bis[di(3,5-xylyl) phosphino]-1,1'-binaphthyl][(2S)-(+)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II)
(S)-RUCY®XyIBINAP (1312713-89-5)



Tech. Note (1)
Ref. (1)



Tech. Note (1)
Ref. (1)



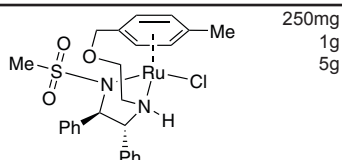
Tech. Note (1)
Ref. (1)

References:

- (a) *US. Pat.* **9079931**. (b) *J. Am. Chem. Soc.*, **2011**, 133, 10696.

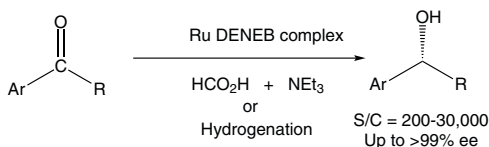
44-0255

Chloro[N-[(1R,2R)-2-[(S)-[2-[[1,2,3,4,5,6-η]-4-methylphenyl]methoxy]ethyl]amino]-1,2-diphenylethylmethanesulfonamidato]ruthenium(II)
(R,R)-Ms-DENEB® (1333981-86-4)
C₂₅H₂₉ClN₂O₃RuS; FW: 574.10; light to dark brown powdr.
Note: Sold in collaboration with Takasago. US. Patent 9217005. Takasago ATH Catalyst Kit component.

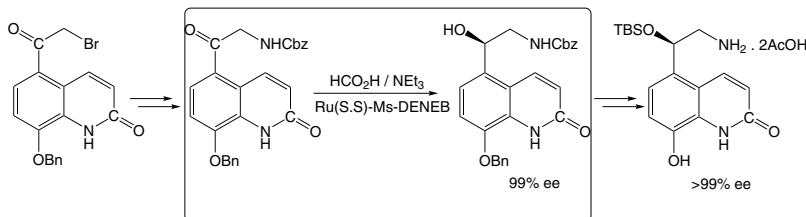


Technical Notes:

- Catalyst used for both hydrogenation and asymmetric transfer hydrogenation.
- Ruthenium catalyst used as a key intermediate in a synthesis of a receptor agonist.



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

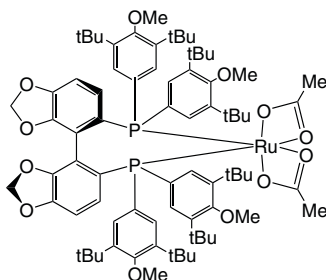
References:

- J. Am. Chem. Soc.*, **2011**, 133, 14960
- Org. Process Res. Dev.*, **2015**, 19, 315

RUTHENIUM (Compounds)

44-0256 Chloro{N-[(1S,2S)-2-[(R)-[2-[[1,2,3,4,5,6-η]-4-methylphenyl]methoxy]ethyl]amino]-1,2-diphenylethylmethanesulfonamidato}ruthenium(II) (S,S)-Ms-DENE[®] (1361318-83-3) 250mg
1g
5g
C₂₅H₂₉ClN₂O₃RuS; FW: 574.10; light to dark brown pwdr.
Note: Sold in collaboration with Takasago. US. Patent 9217005.
Takasago ATH Catalyst Kit component.

44-0180 Diacetato{(R)-(-)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole}ruthenium(II) Ru(OAc)₂[(R)-dtbm-segphos[®]] (1025477-38-6) 250mg
1g
5g
C₇₈H₁₀₆O₁₂P₂Ru; FW: 1398.69;
yellow to brownish-red to dark green solid
air sensitive
Note: Sold in collaboration with Takasago.
Takasago SEGPHOS[®] Ru Catalyst Kit component.

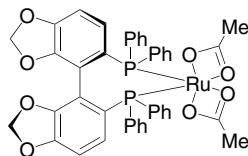


Technical Note:

1. Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPHOS ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of α-substituted-β-ketoesters. See 15-0066.

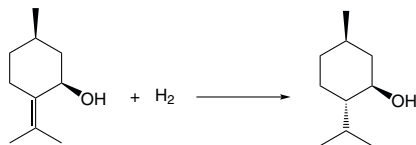
44-0181 Diacetato{(S)-(+)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole}ruthenium(II) Ru(OAc)₂[(S)-dtbm-segphos[®]] (1025476-84-9) 250mg
1g
5g
C₇₈H₁₀₆O₁₂P₂Ru; FW: 1398.69; yellow to brownish-red to dark green solid
air sensitive
Note: Sold in collaboration with Takasago. Takasago SEGPHOS[®] Ru Catalyst Kit component.

44-0168 Diacetato{(R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole}ruthenium(II) Ru(OAc)₂[(R)-segphos[®]] (944450-48-0) 250mg
1g
5g
C₄₂H₃₄O₆P₂Ru; FW: 829.73; dark yellow pwdr.;
m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago.
Takasago SEGPHOS[®] Ru Catalyst Kit component.



Technical Notes:

1. Highly active highly enantioselective catalyst for hydrogenation of functionalized ketones. The acetate salts are frequently used for hydrogenation of allyl alcohols, unsaturated carboxylic acids and reductive amination. See 15-0136.
2. Asymmetric hydrogenation of substituted allyl alcohols.



Tech. Note (1)
Ref. (1)

References:

1. U.S. Pat. 6342644.

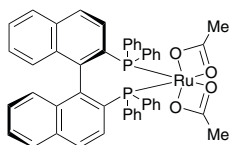
44-0169 Diacetato{(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole}ruthenium(II) Ru(OAc)₂[(S)-segphos[®]] (373650-12-5) 250mg
1g
5g
C₄₂H₃₄O₆P₂Ru; FW: 829.73; yellow to black solid; m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago. Takasago SEGPHOS[®] Ru Catalyst Kit component.

Technical Note:

1. See 44-0168 (page 30)

RUTHENIUM (Compounds)

44-0152 Diacetato[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II) $\text{Ru}(\text{OAc})_2[(\text{R})\text{-binap}]$ (325146-81-4)
 $\text{C}_{48}\text{H}_{38}\text{O}_4\text{P}_2\text{Ru}$; FW: 841.83; ocher to green powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 US. Patent 7626034. Takasago BINAP Ru Acetate Catalyst Kit component.



250mg
1g
5g

Technical Note:

1. Catalyst system that exhibits very high catalytic activity and enantioselectivity in the hydrogenation of a wide range of substrates.

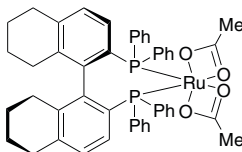
44-0153 Diacetato[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]ruthenium(II) $\text{Ru}(\text{OAc})_2[(\text{S})\text{-binap}]$ (261948-85-0)
 $\text{C}_{48}\text{H}_{38}\text{O}_4\text{P}_2\text{Ru}$; FW: 841.83; pale yellow powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Acetate Catalyst Kit component.

250mg
1g
5g

Technical Note:

1. See 44-0152 (page 31)

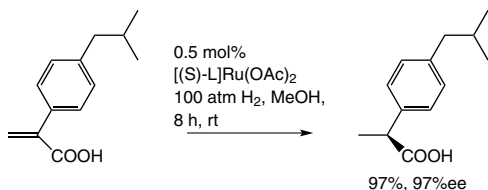
44-0166 Diacetato[(R)-(+)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl]ruthenium(II) $\text{Ru}(\text{OAc})_2[(\text{R})\text{-H}_8\text{-binap}]$ (374067-51-3)
 $\text{C}_{48}\text{H}_{46}\text{O}_4\text{P}_2\text{Ru}$; FW: 849.89; ocher to olive solid; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.



50mg
250mg

Technical Notes:

1. Biaryl bisphosphine ligand. The H8-BINAP ligand, as the ruthenium complex, catalyzes hydrogenation of unsaturated carboxylic acids to a higher ee than does BINAP. (Ref. 1,2)
2. The ruthenium catalyzed hydrogenation of aryl propenoic acid to produce the drug Ibuprofen.



**Tech. Note (1,2)
Ref. (1,2)**

References:

1. *J. Org. Chem.*, **1996**, 61, 5510
2. *Topics Organometal. Chem.* **2004**, 6, 63, review

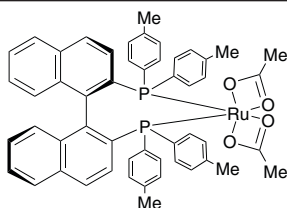
44-0167 Diacetato[(S)-(-)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl]ruthenium(II) $\text{Ru}(\text{OAc})_2[(\text{S})\text{-H}_8\text{-binap}]$ (142962-95-6)
 $\text{C}_{48}\text{H}_{46}\text{O}_4\text{P}_2\text{Ru}$; FW: 849.89; yellow to dark brown solid; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.

50mg
250mg

Technical Note:

1. See 44-0166 (page 31)

44-0162 Diacetato[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl]ruthenium(II) $\text{Ru}(\text{OAc})_2[(\text{R})\text{-tolbinap}]$ (116128-29-1)
 $\text{C}_{52}\text{H}_{46}\text{O}_4\text{P}_2\text{Ru}$; FW: 897.94; brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago BINAP Ru Acetate Catalyst Kit component.

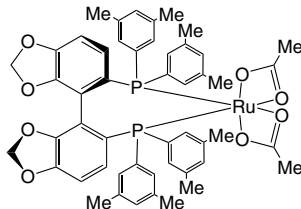


250mg
1g
5g

RUTHENIUM (Compounds)

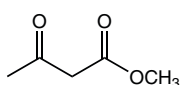
44-0163 **Diacetato{(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl} ruthenium(II) Ru(OAc)₂[(S)-tolbinap] (106681-15-6)** 250mg
 C₅₂H₄₆O₈P₂Ru; FW: 897.94; brown pwdr.; m.p. >100° dec. 1g
air sensitive 5g
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Acetate Catalyst Kit component.

44-0174 **Diacetato{(R)-(+)-5,5'-bis(di(3,5-xylyl)phosphino)-4,4'-bi-1,3-benzodioxole} ruthenium(II) Ru(OAc)₂[(R)-dm-segphos®] (944450-49-1)** 250mg
 C₅₀H₅₀O₈P₂Ru; FW: 941.95; 1g
 yellow to brownish-red to dark green solid; 5g
 m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago SEGPHOS® Ru Catalyst Kit component.

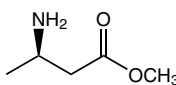


Technical Notes:

1. Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPHOS® ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of α -substituted- β -ketoesters. See 15-0066
2. Ruthenium catalyzed enantioselective synthesis of β amino acids by hydrogenation.



0.1 mol% Ruthenium complex
 0.2 mol% L, NH₄OAc, dioxane,
 H₂ 30 atm. 85° C, 8 hr



87%, 94% ee

Tech. Note (2)
Ref. (1)

References:

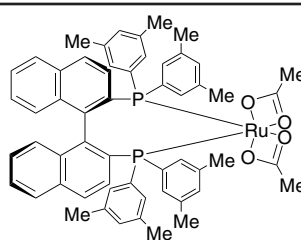
1. US. Pat. 7626034.

44-0176 **Diacetato{(S)-(-)-5,5'-bis(di(3,5-xylyl)phosphino)-4,4'-bi-1,3-benzodioxole} ruthenium(II) Ru(OAc)₂[(S)-dm-segphos®] (944450-50-4)** 250mg
 C₅₀H₅₀O₈P₂Ru; FW: 941.95; yellow to brownish-red to dark green solid; m.p. >100° dec. 1g
air sensitive 5g
 Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Note:

1. See 44-0174 (page 32)

44-0164 **Diacetato{(R)-(+)-2,2'-bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl}ruthenium(II) Ru(OAc)₂[(R)-xylinap] (374067-50-2)** 250mg
 C₅₆H₅₄O₈P₂Ru; FW: 954.04; dark brown pwdr.; 1g
 m.p. >100° dec. 5g
air sensitive
 Note: Sold in collaboration with Takasago.
 Takasago BINAP Ru Acetate Catalyst Kit component.



Technical Note:

1. Catalyst system used for asymmetric hydrogenation.

44-0165 **Diacetato{(S)-(-)-2,2'-bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl} ruthenium(II) Ru(OAc)₂[(S)-xylinap] (374067-49-9)** 250mg
 C₅₆H₅₄O₈P₂Ru; FW: 954.04; dark brown pwdr.; m.p. >100° dec. 1g
air sensitive 5g
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Acetate Catalyst Kit component.

Technical Note:

1. See 44-0164 (page 32)

RUTHENIUM (Compounds)

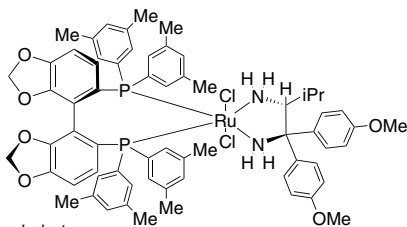
- 44-0214** Dichloro{(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole}[(2R)-(-)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) 250mg
1g
5g

RuCl₂[(R)-dm-segphos®][(R)-daipen]
(944450-43-5)

C₆₅H₇₀Cl₂N₂O₆P₂Ru; FW: 1209.18;
yellow powdr.

air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.



Technical Note:

1. Efficient catalyst for asymmetric hydrogenation of simple ketones.

- 44-0215** Dichloro{(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole}[(2S)-(+)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl₂[(S)-dm-segphos®][(S)-daipen] (944450-44-6) 250mg
1g
5g

C₆₅H₇₀Cl₂N₂O₆P₂Ru; FW: 1209.18; yellow powdr.

air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Note:

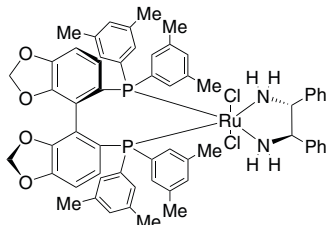
1. See 44-0214 (page 33)

- 44-0228** Dichloro{(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole}[(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) RuCl₂[(R)-dm-segphos®][(R,R)-dpem] (944450-45-7) 250mg
1g
5g

C₆₀H₆₀Cl₂N₂O₄P₂Ru; FW: 1075.04;
yellow powdr.

air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.



Technical Note:

1. Efficient catalyst for asymmetric hydrogenation of simple ketones.

- 44-0229** Dichloro{(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole}[(1S,2S)-(-)-1,2-diphenylethylenediamine]ruthenium(II) RuCl₂[(S)-dm-segphos®][(S,S)-dpem] (944450-46-8) 250mg
1g
5g

C₆₀H₆₀Cl₂N₂O₄P₂Ru; FW: 1075.04; yellow powdr.

air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Note:

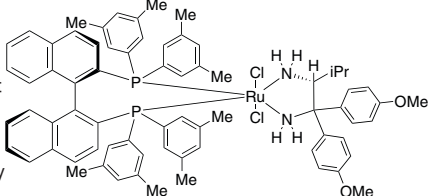
1. See 44-0228 (page 33)

- 44-0212** Dichloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2R)-(-)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl₂[(R)-xylbinap][(R)-daipen] (220114-32-9) 250mg
1g
5g

C₇₁H₇₄Cl₂N₂O₆P₂Ru; FW: 1221.28;
yellow to dark brown or green solid

air sensitive

Note: Sold in collaboration with Takasago. Takasago BINAP Ru Diamine Catalyst Kit component.



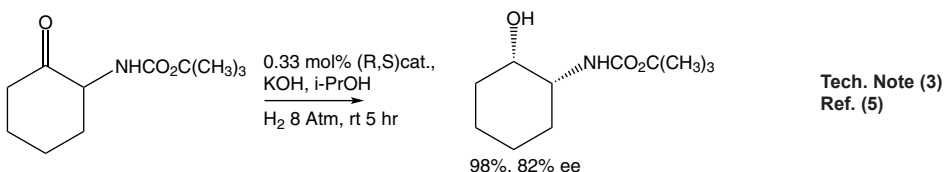
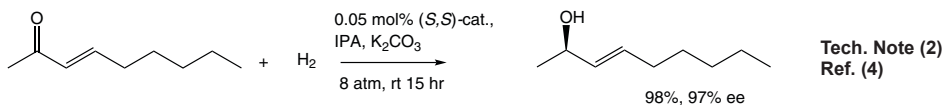
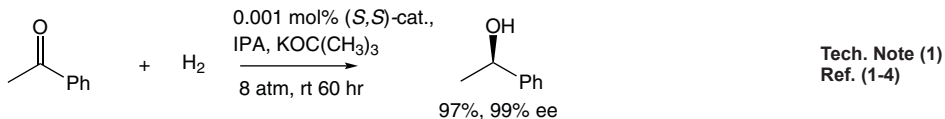
Technical Notes:

1. Highly active catalyst for hydrogenation of simple ketones giving high enantioselectivity when sterically unsymmetrical ketones such as acetophenone, heteroaryl ketones, benzophenones, cyclopropyl ketones, and cyclohexyl ketones are substrates. Ee's are enhanced with XylBINAP relative to BINAP. The otherwise poorly bonded ketone is held in the transition state by hydrogen bonding to the protic bidentate amine.
2. Carbonyl groups are selectively reduced even when olefins exist in the same molecule.

RUTHENIUM (Compounds)

44-0212 **Dichloro{[(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl][(2R)-(-)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl₂[(R)-xylbinap][(R)-daipen]** (220114-32-9)

3. In the presence of strong base, and catalyst, simple ketones, having substituents at the α -position, may be induced to undergo dynamic kinetic resolution during their hydrogenation to produce two chiral carbon centers in high yield.



References:

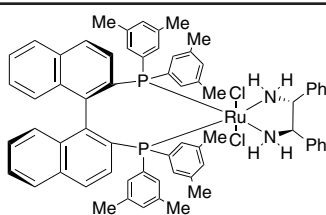
1. *Angew Chem. Int. Ed.*, **2001**, 40, 40, review, article
2. *Org. Lett.*, **2000**, 2, 1749
3. *Org. Lett.*, **2000**, 2, 659
4. *J. Am. Chem. Soc.*, **1998**, 120, 13529
5. *J. Am. Chem. Soc.*, **2000**, 122, 6510

44-0213	Dichloro{[(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl][(2S)-(+)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl₂[(S)-xylbinap][(S)-daipen] (220114-01-2)	250mg
	C ₇₁ H ₇₄ Cl ₂ N ₂ O ₂ P ₂ Ru; FW: 1221.28; orange powdr.	1g
	<i>air sensitive</i>	5g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ru Diamine Catalyst Kit component.	

Technical Note:

1. See 44-0212 (page 33)

44-0226	Dichloro{[(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl][(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) RuCl₂[(R)-xylbinap][(R,R)-dpem] (220114-38-5)	250mg
	C ₆₆ H ₆₄ Cl ₂ N ₂ P ₂ Ru; FW: 1119.15; yellow powdr.	1g
	<i>air sensitive</i>	5g
	Note: Sold in collaboration with Takasago. Takasago BINAP Ru Diamine Catalyst Kit component.	



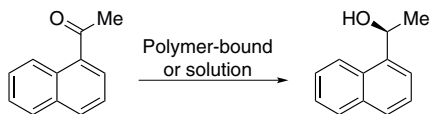
Technical Notes:

1. See 44-0210.
2. Sequential asymmetric hydrogenation reactions with solution or polymer-bound BINAP/Diamine complexes.
3. Asymmetric hydrogenation of imines.
4. Catalysts for deracemization of benzylic alcohols.

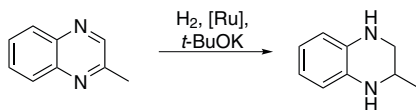
RUTHENIUM (Compounds)

44-0226
(continued)

Dichloro{[(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl]}[(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) $\text{RuCl}_2\{[(R)\text{-xylbinap}]\}[(R,R)\text{-dpem}]$ (220114-38-5)



Tech. Note (2)
Ref. (1,2)



Tech. Note (3)
Ref. (3)



Tech. Note (4)
Ref. (4)

References:

1. *Angew. Chem. Int. Ed.*, **2001**, 40, 40 (review)
2. *Adv. Synth. Catal.*, **2001**, 343, 369.
3. *Adv. Synth. Catal.*, **2003**, 345, 195.
4. *Chem. Commun.*, **2007**, 2608.

44-0224 Dichloro{[(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl]}[(1S,2S)-(-)-1,2-diphenylethylenediamine]ruthenium(II) $\text{RuCl}_2\{[(S)\text{-xylbinap}]\}[(S,S)\text{-dpem}]$ (220114-03-4)

250mg

1g

5g

$\text{C}_{86}\text{H}_{64}\text{Cl}_2\text{N}_2\text{P}_2\text{Ru}$; FW: 1119.15; yellow powdr.

air sensitive

Note: Sold in collaboration with Takasago. Takasago BINAP Ru Diamine Catalyst Kit component.

Technical Note:

1. See 44-0226 (page 34)

44-0520 Dimethylammonium dichlorotri(μ-chloro)bis{[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole]diruthenate(II) $[\text{NH}_2\text{Me}_2][\text{RuCl}[(R)\text{-dm-segphos}]]_2(\mu\text{-Cl})_3$ (935449-46-0)

250mg

1g

5g

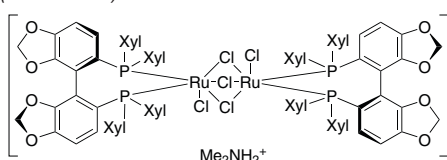
$(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{92}\text{H}_{88}\text{Cl}_5\text{O}_8\text{P}_4\text{Ru}_2]^-$;

FW: 1870.06; light brown powdr.;

m.p. >100° dec.

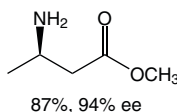
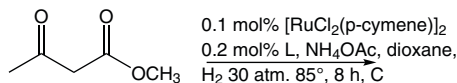
air sensitive

Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

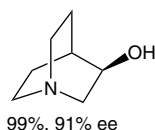
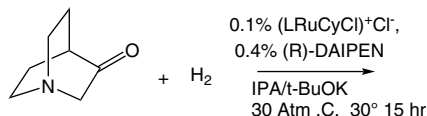


Technical Notes:

1. Biaryl bisphosphine ligand with narrow dihedral angle. The DM-SEGPHOS ligand, as the ruthenium complex, gives superior enantioselectivity and diastereoselectivity in the asymmetric hydrogenation of α-substituted-β-ketoesters. See 15-0066.
2. Ruthenium catalyzed enantioselective synthesis of β amino acids by hydrogenation.
3. Ruthenium catalyzed asymmetric hydrogenation of 3-quinuclidinone. See 44-0098 for Ru catalyst.



Tech. Note (2)
Ref. (1)



Tech. Note (3)
Ref. (2)

References:

1. U.S. Pat. 7626034.
2. U.S. Pat. 7462722.

RUTHENIUM (Compounds)

- 44-0521** Dimethylammonium dichlorotri(μ-chloro)bis((S)-(-)-5,5'-bis(di(3,5-xylyl)phosphino)-4,4'-bi-1,3-benzodioxole)diruthenate(II) [NH₂Me₂]₂[{RuCl((S)-dm-segphos®)}₂(μ-Cl)]₂ (944451-14-3) 250mg
1g
5g
(CH₃)₂NH₂⁺[C₉₂H₈₈Cl₅O₈P₄Ru₂]; FW: 1870.06; light brown powdr.;
m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

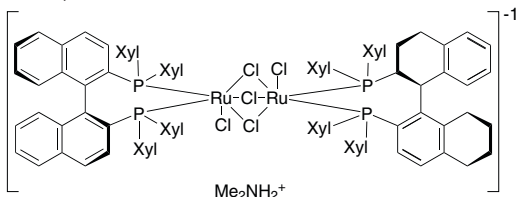
Technical Note:

1. See 44-0520 (page 35)

- 44-0514** Dimethylammonium dichlorotri(μ-chloro)bis((R)-(+)-2,2'-bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl)diruthenate(II) [NH₂Me₂]₂[{Ru-Cl((R)-xylbinap)}₂(μ-Cl)]₂ (944451-08-5) 250mg
1g
5g
(CH₃)₂NH₂⁺[C₁₀₄H₈₆Cl₅P₄Ru₂]; FW: 1894.26; red-brown powdr.;
m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.

Technical Note:

1. Catalyst system for asymmetric hydrogenation.



- 44-0515** Dimethylammonium dichlorotri(μ-chloro)bis((S)-(-)-2,2'-bis(di(3,5-xylyl)phosphino)-1,1'-binaphthyl)diruthenate(II) [NH₂Me₂]₂[{RuCl((S)-xylbinap)}₂(μ-Cl)]₂ (944451-10-9) 250mg
1g
5g
(CH₃)₂NH₂⁺[C₁₀₄H₈₆Cl₅P₄Ru₂]; FW: 1894.26; red-brown powdr.; m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.

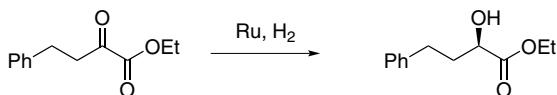
Technical Note:

1. See 44-0514 (page 36)

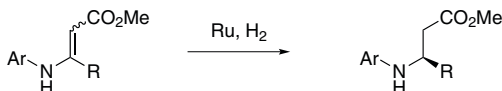
- 44-0518** Dimethylammonium dichlorotri(μ-chloro)bis((R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole)diruthenate(II) [NH₂Me₂]₂[{RuCl((R)-segphos®)}₂(μ-Cl)]₂ (346457-41-8) 250mg
1g
5g
(CH₃)₂NH₂⁺[C₇₆H₄₈Cl₅O₈P₄Ru₂]; FW: 1637.57; light brown powdr.;
m.p. >100° dec.
air sensitive
Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Notes:

1. Highly enantioselective, highly active catalyst for hydrogenation of functionalized ketones. The chlororuthenate salts show catalytic activity at relatively low temperature. See 15-0136 .
2. Catalyst for enantioselective hydrogenation of enamines.



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

References:

1. *Adv. Synth. Catal.*, **2001**, 343, 264
2. *U.S. Pat.* 8188307.

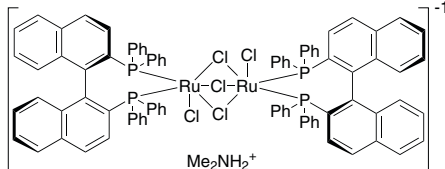
RUTHENIUM (Compounds)

- 44-0519** Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\{\text{RuCl}((\text{S})\text{-segphos})\}_2(\mu\text{-Cl})\}]$ (488809-34-3) 250mg
($(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{76}\text{H}_{48}\text{Cl}_5\text{O}_8\text{P}_4\text{Ru}_2]$; FW: 1637.57; light brown powdr.; m.p. >100° dec. 1g
air sensitive 5g
Note: Sold in collaboration with Takasago. Takasago SEGPHOS® Ru Catalyst Kit component.

Technical Note:

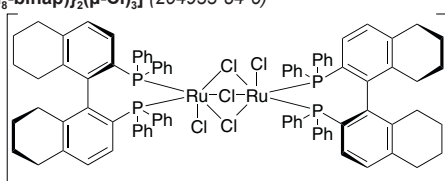
- See 44-0518 (page 36)

- 44-0510** Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\{\text{RuCl}((\text{R})\text{-binap})\}_2(\mu\text{-Cl})\}]$ (199684-47-4) 250mg
($(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{88}\text{H}_{64}\text{Cl}_5\text{P}_4\text{Ru}_2]$; FW: 1669.83; orange powdr.; m.p. >100° dec. 1g
air sensitive 5g
Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.



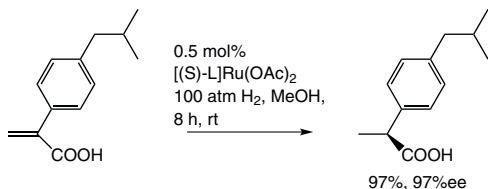
- 44-0511** Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\{\text{RuCl}((\text{S})\text{-binap})\}_2(\mu\text{-Cl})\}]$ (199541-17-8) 250mg
($(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{88}\text{H}_{64}\text{Cl}_5\text{P}_4\text{Ru}_2]$; FW: 1669.83; orange powdr.; m.p. >100° dec. 1g
air sensitive 5g
Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.

- 44-0516** Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\{\text{RuCl}((\text{R})\text{-H}_8\text{-binap})\}_2(\mu\text{-Cl})\}]$ (204933-84-6) 50mg
($(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{88}\text{H}_{60}\text{Cl}_5\text{P}_4\text{Ru}_2]$; FW: 1685.96; red-brown powdr.; m.p. >100° dec. 250mg
air sensitive
Note: Sold in collaboration with Takasago.



Technical Notes:

- Biaryl bisphosphine ligand. The H8-BINAP ligand, as the ruthenium complex, catalyzes hydrogenation of unsaturated carboxylic acids to a higher ee than does BINAP. (Ref. 1,2)
- The ruthenium catalyzed hydrogenation of aryl propenoic acid to produce the drug Ibuprofen.



Tech. Note (1,2)
Ref. (1,2)

References:

- J. Org. Chem.*, **1996**, 61, 5510
- Topics Organometal. Chem.* **2004**, 6, 63, review

RUTHENIUM (Compounds)

- 44-0517** Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(diphenylphosphino)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\text{RuCl}(\text{S})\text{-H}_8\text{-binap}\}_2(\mu\text{-Cl})_3]$ (944451-12-1) $(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{88}\text{H}_{80}\text{Cl}_5\text{P}_4\text{Ru}_2]^-$; FW: 1685.96; red-brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago.

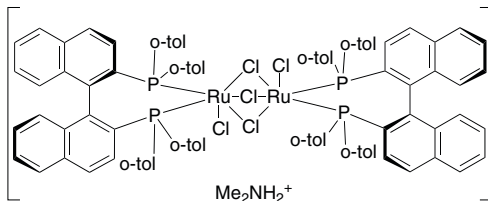
Technical Note:

1. Catalyst system for asymmetric hydrogenation.

References:

1. World Patent WO2003/0307676

- 44-0512** Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\text{RuCl}(\text{R})\text{-tolbinap}\}_2(\mu\text{-Cl})_3]$ (749935-02-2) $(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{96}\text{H}_{80}\text{Cl}_5\text{P}_4\text{Ru}_2]^-$; FW: 1782.05; brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.



Technical Note:

1. Catalyst system for asymmetric hydrogenation.

References:

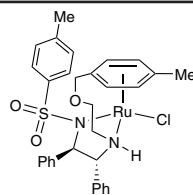
1. World Patent WO2004/074255

- 44-0513** Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl]diruthenate(II) $[\text{NH}_2\text{Me}_2][\{\text{RuCl}(\text{S})\text{-tolbinap}\}_2(\mu\text{-Cl})_3]$ (309735-86-2) $(\text{CH}_3)_2\text{NH}_2^+[\text{C}_{96}\text{H}_{80}\text{Cl}_5\text{P}_4\text{Ru}_2]^-$; FW: 1782.05; brown powdr.; m.p. >100° dec.
air sensitive
 Note: Sold in collaboration with Takasago. Takasago BINAP Ru Dimer Catalyst Kit component.

Technical Note:

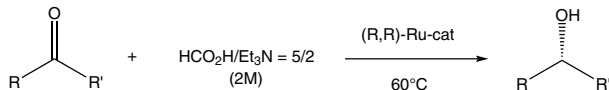
1. See 44-0512 (page 38)

- 44-0185** N-[(1R,2R)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethyl-amino)-ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (R,R)-Ts-DENEB® (1333981-84-2) $\text{C}_{34}\text{H}_{33}\text{ClN}_2\text{O}_3\text{RuS}$; FW: 650.19; gray to brown solid
 Note: Sold in collaboration with Takasago.
 US. Patent 9079931.

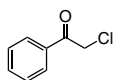


Technical Notes:

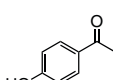
1. Catalyst used for asymmetric -transfer hydrogenation.
2. Catalyst used for asymmetric H_2 - hydrogenation.
3. Catalyst used for dynamic kinetic resolution.
4. Catalyst used for asymmetric transfer hydrogenation of unsymmetrical benzophenones.
5. Catalyst used for asymmetric transfer hydrogenation of Aryl N-Heteroaryl Ketones.
6. Catalyst used for asymmetric transfer hydrogenation of alpha-Substituted Ketone.



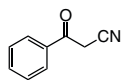
(S/C=30,000, 96h)
95% conv. 97% ee



(S/C=1,000, 5h)
>99% conv. 97% ee
(>95% select.)



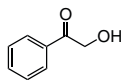
(S/C=500, 24h)
>99% conv. 95% ee



(S/C=1,000, 5h)
>99% conv. 95% ee



(S/C=1,000, 24h)
>99% conv. 93% ee



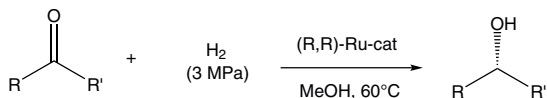
(S/C=1,000, 5h)
98% conv. 96% ee

**Tech. Note (1)
Ref. (1)**

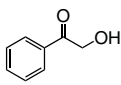
RUTHENIUM (Compounds)

44-0185
(continued)

N-[(1*R*,2*R*)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethylamino)-ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (*R,R*)-Ts-DENE[®] (1333981-84-2)

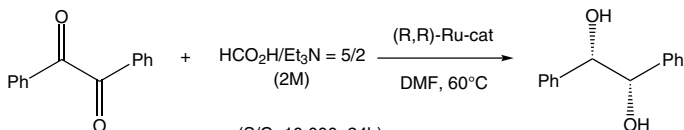


(S/C=1,000, 20h)
>99% conv. 99% ee



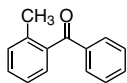
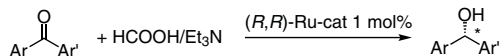
(S/C=5,000, 18h)
>99% conv. 93% ee

Tech. Note (2)
Ref. (1)

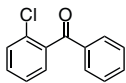


(S/C=10,000, 24h)
>99% conv. (dl:meso = 97.2:2.8)
>99% ee (dl)

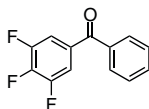
Tech. Note (3)
Ref. (1)



(60 °C, 18 h)
98% yield. 98% ee

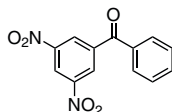


(40 °C, 17 h)
>99% yield. 98% ee

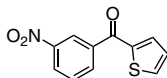


(30 °C, 16 h)
>99% yield. 95% ee

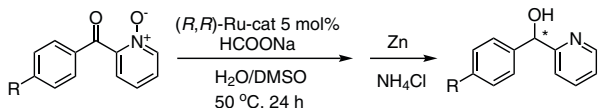
Tech. Note (4)
Ref. (2)



(30 °C, 26 h)
90% yield. >99% ee



(10 °C, 8 h)
96% yield. 98% ee

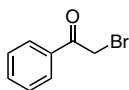
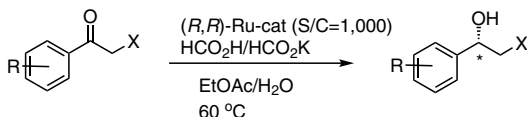


R=H : 86% yield. 97.8% ee
R=Cl : 92% yield. 99.8% ee

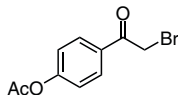
Tech. Note (5)
Ref. (3)

RUTHENIUM (Compounds)

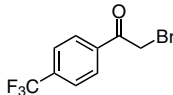
44-0185 N-[(1*R*,2*R*)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethylamino)-ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (*R,R*)-Ts-DENE[®] (1333981-84-2)
(continued)



(4 h)
93% yield, 96% ee



(6 h)
93% yield, 95% ee



(4 h)
94% yield, 94% ee

Tech. Note (6)
Ref. (4)

References:

1. *J. Am. Chem. Soc.*, **2011**, 133, 14960
2. *J. Am. Chem. Soc.* **2016**, 138, 10084.
3. *Org. Lett.* **2017**, 19, 2094.
4. *Adv. Synth. Catal.* **2017**, 360, 568

44-0186	N-[(1<i>S</i>,2<i>S</i>)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethylamino)-ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (<i>S,S</i>)-Ts-DENE[®] (1384974-37-1)	250mg 1g 5g
	C ₃₁ H ₃₃ ClN ₂ O ₃ RuS; FW: 650.19; gray to brown solid Note: Sold in collaboration with Takasago. US Pat. 9217005, US Pat. 9073827.	

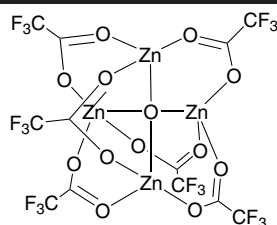
Technical Note:

1. See 44-0185 (page 38)

96-6955	Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit See page 42
96-6953	Takasago BINAP Ru Acetate Catalyst Kit See page 44
96-6951	Takasago BINAP Ru Cymene Catalyst Kit See page 45
96-6954	Takasago BINAP Ru Diamine Catalyst Kit See page 46
96-6952	Takasago BINAP Ru Dimer Catalyst Kit See page 47
96-6901	Takasago SEGPHOS[®] Ru Catalyst Kit See page 49

ZINC (Compounds)

30-4050 Oxo[hexa(trifluoroacetato)]tetrazinc trifluoroacetic acid adduct ZnTAC₂₄[™] (1299489-47-6)
Zn₄(CF₃COO)₆(O)(CF₃COOH)₂; FW: 955.65;
white solid
moisture sensitive
Note: Sold in collaboration with Takasago.
US. Pat. 7888513 and 8552204.



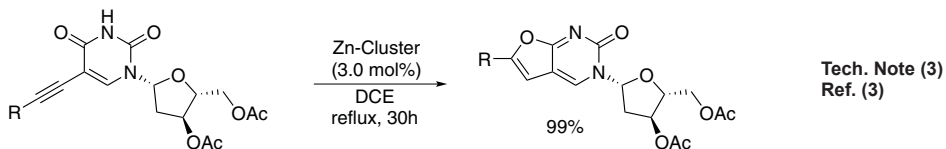
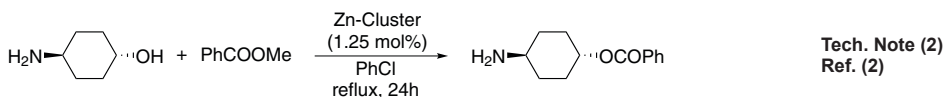
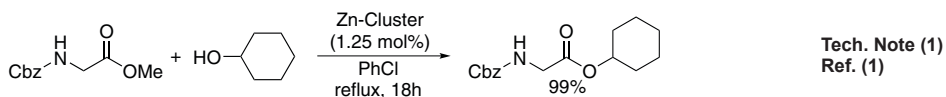
5g
25g

Technical Notes:

1. Zinc-catalyzed transesterification of various methyl esters under mild conditions
2. Zinc-catalyzed acylation of alcohols in the presence of amines
3. Zinc-catalyzed cycloisomerization. Synthesis of substituted furanes and furopyrimidine nucleosides

ZINC (Compounds)

30-4050 Oxo[hexa(trifluoroacetato)]tetrazinc trifluoroacetic acid adduct $\text{ZnTAC}_{24}^{\text{TM}}$ (1299489-47-6)
(continued)



References:

1. *J.Org. Chem.*, **2008**, 73, 5147
2. *J. Am. Chem. Soc.*, **2008**, 130, 2944
3. *J.Org. Chem.*, **2008**, 73, 5881

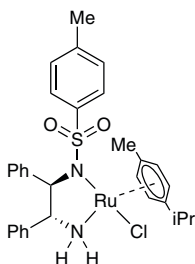
KITS - Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit

96-6955 Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit

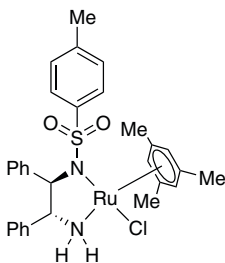
Sold in collaboration with Takasago.

Components also available for individual sale.

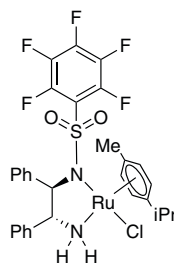
Contains the following:



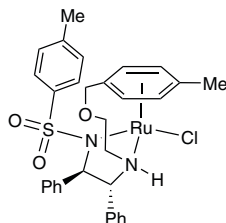
44-0148 250mg
RuCl[(R,R)-Tsdpen](p-cymene)
44-0149
RuCl[(S,S)-Tsdpen](p-cymene)



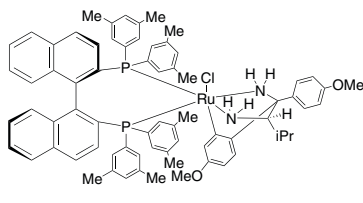
44-0154 250mg
RuCl[(R,R)-Tsdpen(mesitylene)]
44-0155
RuCl[(S,S)-Tsdpen(mesitylene)]



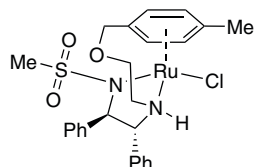
44-0156 250mg
RuCl[(R,R)-Fsdpen](p-cymene)
44-0157
RuCl[(S,S)-Fsdpen](p-cymene)



44-0185 250mg
(R,R)-Ts-DENEB™
44-0186
(S,S)-Ts-DENEB™



44-0217 250mg
(R)-RUCY™-XylBINAP
44-0218
(S)-RUCY™-XylBINAP



44-0255 250mg
Ru-(R,R)-Ms-DENEB
44-0256
Ru-(S,S)-Ms-DENEB

KITS - Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit

96-6955 (continued)	Takasago ATH (Asymmetric Transfer Hydrogenation) Catalyst Kit		
44-0148	Chloro{[(1R,2R)-(-)-2-amino-1,2-diphenylethyl] (4-toluenesulfonyl)amido}(p-cymene)ruthenium(II), min. 95% RuCl[(R,R)-Tsdpen](p-cymene) (192139-92-7)	250mg	See page 23
44-0149	Chloro{[(1S,2S)-(+)-2-amino-1,2-diphenylethyl] (4-toluenesulfonyl)amido}(p-cymene)ruthenium(II), min. 90% RuCl[(S,S)-Tsdpen](p-cymene) (192139-90-5)	250mg	See page 22
44-0154	Chloro{[(1R,2R)-(-)-2-amino-1,2-diphenylethyl] (4-toluenesulfonyl)amido}(mesitylene)ruthenium(II), min. 90% RuCl[(R,R)-Tsdpen](mesitylene) (174813-82-2)	250mg	See page 24
44-0155	Chloro{[(1S,2S)-(+)-2-amino-1,2-diphenylethyl] (4-toluenesulfonyl)amido}(mesitylene)ruthenium(II), min. 90% RuCl[(S,S)-Tsdpen](mesitylene) (174813-81-1)	250mg	See page 24
44-0156	Chloro{[(1R,2R)-(-)-2-amino-1,2-diphenylethyl](pentafluoro- phenylsulfonyl)amido}(p-cymene)ruthenium(II), min. 90% RuCl[(R,R)-Fsdpen](p-cymene) (1026995-71-0)	250mg	See page 22
44-0157	Chloro{[(1S,2S)-(+)-2-amino-1,2-diphenylethyl](pentafluoro- phenylsulfonyl)amido}(p-cymene)ruthenium(II), min. 90% RuCl[(S,S)-Fsdpen](p-cymene) (1026995-72-1)	250mg	See page 22
44-0185	N-[(1R,2R)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethylamino)- ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (R,R)-Ts-DENEB® (1333981-84-2)	250mg	See page 38
44-0186	N-[(1S,2S)-1,2-Diphenyl-2-(2-(4-methylbenzyloxy)ethylamino)- ethyl]-4-methylbenzene sulfonamide(chloro)ruthenium(II) (S,S)-Ts-DENEB® (1384974-37-1)	250mg	See page 40
44-0217	Chloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'- binaphthyl} [(2R)-(-)-1-(4-methoxyphenyl)-1'-(4-methoxy- phenyl)-kC)-3-methyl-1,2-butanediamine]ruthenium(II) (R)-RUCY®XylBINAP (1384974-38-2)	250mg	See page 28
44-0218	Chloro{(S)-(-)-2,2'-bis[di(3,5-xylyl) phosphino]-1,1'- binaphthyl}[(2S)- (+)-1-(4-methoxyphenyl)-1'-(4- methoxyphenyl)-kC)-3-methyl-1,2-butanediamine] ruthenium(II) (S)-RUCY®XylBINAP (1312713-89-5)	250mg	See page 28
44-0255	Chloro{N-[(1R,2R)-2-[(S)-[2-[[1,2,3,4,5,6-η]-4-methylphenyl] methoxy]ethyl]amino]-1,2-diphenylethylmethanesulfonamidato} ruthenium(II) (R,R)-Ms-DENEB® (1333981-86-4)	250mg	See page 29
44-0256	Chloro{N-[(1S,2S)-2-[(R)-[2-[[1,2,3,4,5,6-η]-4-methylphenyl] methoxy]ethyl]amino]-1,2-diphenylethylmethanesulfonamidato} ruthenium(II) (S,S)-Ms-DENEB® (1361318-83-3)	250mg	See page 30

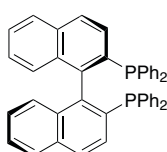
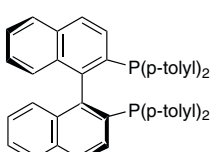
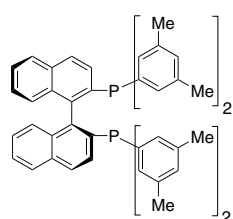
KITS - Takasago BINAP Ligand Kit

96-6950

Takasago BINAP Ligand Kit

Sold in collaboration with Takasago.

Components also available for individual sale. Contains the following:

 250mg 15-0150 (R)-(+)-BINAP 15-0151 (S)-(-)-BINAP	 250mg 15-0152 (R)-(+)-TolBINAP 15-0153 (S)-(-)-TolBINAP	 250mg 15-0476 (R)-(+)-XylBINAP 15-0477 (S)-(-)-XylBINAP
--	--	--

15-0150	(R)-(+)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-BINAP (76189-55-4)	250mg	See page 5
15-0151	(S)-(-)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-BINAP (76189-56-5)	250mg	See page 9
15-0152	(R)-(+)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (R)-(+)-TolBINAP (99646-28-3)	250mg	See page 12
15-0153	(S)-(-)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl, 98% (S)-(-)-TolBINAP (100165-88-6)	250mg	See page 13
15-0476	(R)-(+)-2,2'-Bis(di(3,5-xyl)phosphino)-1,1'-binaphthyl, 98% (R)-(+)-XylBINAP (137219-86-4)	250mg	See page 17
15-0477	(S)-(-)-2,2'-Bis(di(3,5-xyl)phosphino)-1,1'-binaphthyl, 98% (S)-(-)-XylBINAP (135139-00-3)	250mg	See page 18

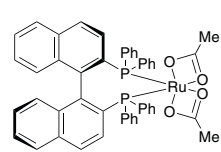
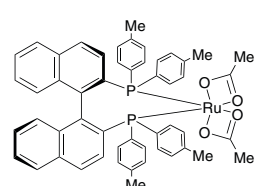
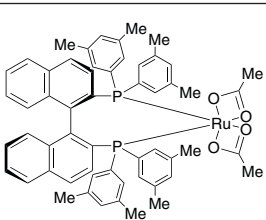
KITS - Takasago BINAP Ru Acetate Catalyst Kit

96-6953

Takasago BINAP Ru Acetate Catalyst Kit

Sold in collaboration with Takasago.

Components also available for individual sale. Contains the following:

 250mg 44-0152 Ru(OAc)₂[(R)-binap] 44-0153 Ru(OAc)₂[(S)-binap]	 250mg 44-0162 Ru(OAc)₂[(R)-tolbinap] 44-0163 Ru(OAc)₂[(S)-tolbinap]	 250mg 44-0164 Ru(OAc)₂[(R)-xylbinap] 44-0164 Ru(OAc)₂[(S)-xylbinap]
---	---	---

44-0152	Diacetato[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl] ruthenium(II) Ru(OAc) ₂ [(R)-binap] (325146-81-4)	250mg	See page 31
44-0153	Diacetato[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl] ruthenium(II) Ru(OAc) ₂ [(S)-binap] (261948-85-0)	250mg	See page 31
44-0162	Diacetato[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] ruthenium(II) Ru(OAc) ₂ [(R)-tolbinap] (116128-29-1)	250mg	See page 31
44-0163	Diacetato[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] ruthenium(II) Ru(OAc) ₂ [(S)-tolbinap] (106681-15-6)	250mg	See page 32
44-0164	Diacetato[(R)-(+)-2,2'-bis(di(3,5-xyl)phosphino)-1,1'-binaphthyl]ruthenium(II) Ru(OAc) ₂ [(R)-xylbinap] (374067-50-2)	250mg	See page 32
44-0165	Diacetato[(S)-(-)-2,2'-bis(di(3,5-xyl)phosphino)-1,1'-binaphthyl]ruthenium(II) Ru(OAc) ₂ [(S)-xylbinap] (374067-49-9)	250mg	See page 32

KITS - Takasago BINAP Ru Cymene Catalyst Kit

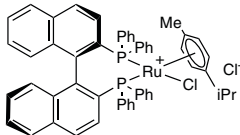
96-6951

Takasago BINAP Ru Cymene Catalyst Kit

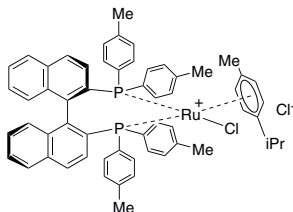
Sold in collaboration with Takasago.

Components also available for individual sale.

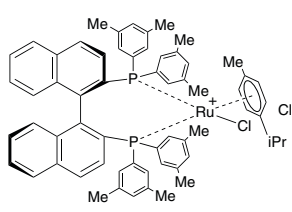
Contains the following:



44-0084 250mg
[RuCl(p-cymene)((R)-binap)]Cl
44-0086
[RuCl(p-cymene)((S)-binap)]Cl



44-0088 250mg
[RuCl(p-cymene)((R)-tolbinap)]Cl
44-0089
[RuCl(p-cymene)((S)-tolbinap)]Cl



44-0092 250mg
[RuCl(p-cymene)((R)-xylbinap)]Cl
44-0093
[RuCl(p-cymene)((S)-xylbinap)]Cl

44-0084	Chloro[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-binap)]Cl (145926-28-9)	250mg	See page 25
44-0086	Chloro[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-binap)]Cl (130004-33-0)	250mg	See page 26
44-0088	Chloro[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-tolbinap)]Cl (131614-43-2)	250mg	See page 27
44-0089	Chloro[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl] (p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-tolbinap)]Cl (228120-95-4)	250mg	See page 27
44-0092	Chloro[(R)-(+)-2,2'-bis[di(3,5-xyllyl)phosphino]-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-xylbinap)]Cl (944451-24-5)	250mg	See page 28
44-0093	Chloro[(S)-(-)-2,2'-bis[di(3,5-xyllyl)phosphino]-1,1'-binaphthyl](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-xylbinap)]Cl (944451-25-6)	250mg	See page 28

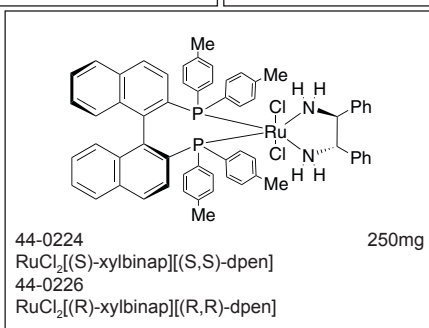
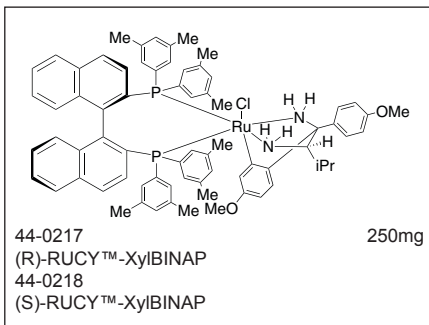
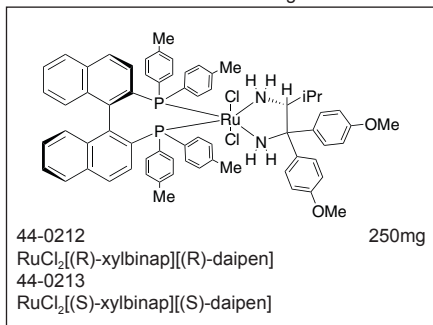
KITS - Takasago BINAP Ru Diamine Catalyst Kit

96-6954 Takasago BINAP Ru Diamine Catalyst Kit

Sold in collaboration with Takasago.

Components also available for individual sale.

Contains the following:



44-0212	Dichloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2R)-(-)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl ₂ [(R)-xylbinap][(R)-daipen] (220114-32-9)	250mg	See page 33
44-0213	Dichloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl}[(2S)-(+)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl ₂ [(S)-xylbinap][(S)-daipen] (220114-01-2)	250mg	See page 34
44-0217	Chloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl} [(2R)-(-)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) (R)-RUCY®XylBINAP (1384974-38-2)	250mg	See page 28
44-0218	Chloro{(S)-(-)-2,2'-bis[di(3,5-xylyl) phosphino]-1,1'-binaphthyl} [(2S)- (+)-1-(4-methoxyphenyl)-1'-(4-methoxyphenyl-kC)-3-methyl-1,2-butanediamine]ruthenium(II) (S)-RUCY®XylBINAP (1312713-89-5)	250mg	See page 28
44-0224	Dichloro{(S)-(-)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl} [(1S,2S)-(-)-1,2-diphenylethylenediamine]ruthenium(II) RuCl ₂ [(S)-xylbinap][(S,S)-dpen] (220114-03-4)	250mg	See page 35
44-0226	Dichloro{(R)-(+)-2,2'-bis[di(3,5-xylyl)phosphino]-1,1'-binaphthyl} [(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) RuCl ₂ [(R)-xylbinap][(R,R)-dpen] (220114-38-5)	250mg	See page 34

KITS - Takasago BINAP Ru Dimer Catalyst Kit

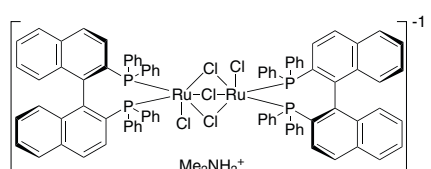
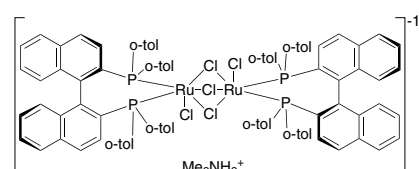
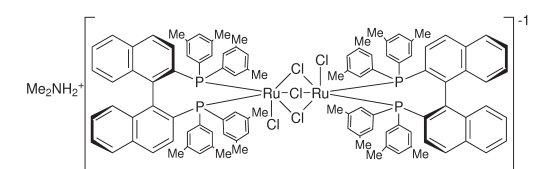
96-6952

Takasago BINAP Ru Dimer Catalyst Kit

Sold in collaboration with Takasago.

Components also available for individual sale.

Contains the following:

 250mg 44-0510 [NH₂Me₂][{RuCl((R)-binap)}₂(μ-Cl)₃] 44-0511 [NH₂Me₂][{RuCl((S)-binap)}₂(μ-Cl)₃]	 250mg 44-0512 [NH₂Me₂][{RuCl((R)-tolbinap)}₂(μ-Cl)₃] 44-0513 [NH₂Me₂][{RuCl((S)-tolbinap)}₂(μ-Cl)₃]
 250mg 44-0514 [NH₂Me₂][{RuCl((R)-xylbinap)}₂(μ-Cl)₃] 44-0515 [NH₂Me₂][{RuCl((S)-xylbinap)}₂(μ-Cl)₃]	

44-0510	Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((R)-binap)} ₂ (μ-Cl) ₃] (199684-47-4)	250mg	See page 37
44-0511	Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((S)-binap)} ₂ (μ-Cl) ₃] (199541-17-8)	250mg	See page 37
44-0512	Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((R)-tolbinap)} ₂ (μ-Cl) ₃] (749935-02-2)	250mg	See page 38
44-0513	Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(di-p-tolylphosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((S)-tolbinap)} ₂ (μ-Cl) ₃] (309735-86-2)	250mg	See page 38
44-0514	Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-2,2'-bis(di(3,5-xyllyl)phosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((R)-xylbinap)} ₂ (μ-Cl) ₃] (944451-08-5)	250mg	See page 36
44-0515	Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-2,2'-bis(di(3,5-xyllyl)phosphino)-1,1'-binaphthyl]diruthenate(II) [NH ₂ Me ₂][{RuCl((S)-xylbinap)} ₂ (μ-Cl) ₃] (944451-10-9)	250mg	See page 36

KITS - Takasago SEGPPOS® Ligand Kit

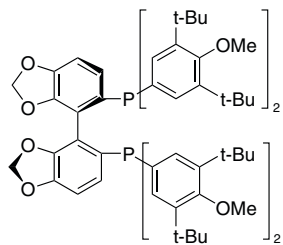
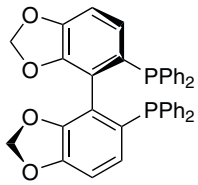
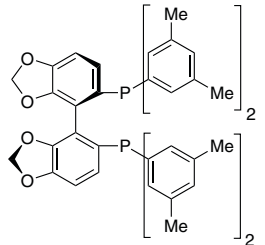
96-6900

Takasago SEGPPOS® Ligand Kit

Sold in collaboration with Takasago.

Components also available for individual sale.

Contains the following:

 250mg 15-0066 (R)-(-)-DTBM-SEGPPOS® 15-0067 (S)-(+)-DTBM-SEGPPOS®	 250mg 15-0136 (R)-(+)-SEGPPOS® 15-0137 (S)-(-)-SEGPPOS®	 250mg 15-0478 (R)-(+)-DM-SEGPPOS® 15-0479 (S)-(-)-DM-SEGPPOS®
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15-0066	(R)-(-)-5,5'-Bis[di(3,5-di- <i>t</i> -butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(-)-DTBM-SEGPPOS® (566940-03-2)	250mg	See page 1
15-0067	(S)-(+)-5,5'-Bis[di(3,5-di- <i>t</i> -butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(+)-DTBM-SEGPPOS® (210169-40-7)	250mg	See page 4
15-0136	(R)-(+)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-SEGPPOS® (244261-66-3)	250mg	See page 4
15-0137	(S)-(-)-5,5'-Bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-SEGPPOS® (210169-54-3)	250mg	See page 5
15-0478	(R)-(+)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (R)-(+)-DM-SEGPPOS® (850253-53-1)	250mg	See page 15
15-0479	(S)-(-)-5,5'-Bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole, min. 98% (S)-(-)-DM-SEGPPOS® (210169-57-6)	250mg	See page 17

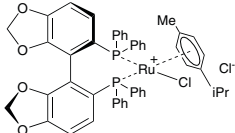
KITS - Takasago SEGPHOS® Ru Catalyst Kit

96-6901

Takasago SEGPHOS® Ru Catalyst Kit

Sold in collaboration with Takasago.

Components also available for individual sale. Contains the following:

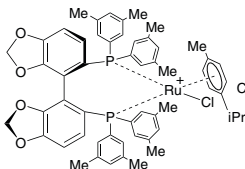


44-0096 250mg

[RuCl(p-cymene)((R)-s-segphos®)Cl]

44-0097

[RuCl(p-cymene)((S)-segphos®)Cl]

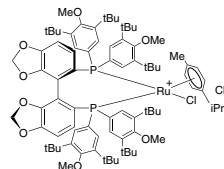


44-0098 250mg

[RuCl(p-cymene)((R)-dm-segphos®)Cl]

44-0099

[RuCl(p-cymene)((S)-dm-segphos®)Cl]

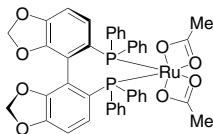


44-0102 250mg

[RuCl(p-cymene)((R)-dtbm-segphos®)Cl]

44-0103

[RuCl(p-cymene)((S)-dtbm-segphos®)Cl]

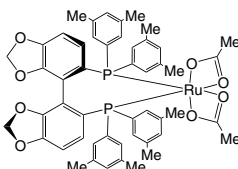


44-0168 250mg

Ru(OAc)₂[(R)-segphos®]

44-0169

Ru(OAc)₂[(S)-segphos®]

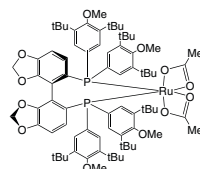


44-0174 250mg

Ru(OAc)₂[(R)-dm-segphos®]

44-0176

Ru(OAc)₂[(S)-dm-segphos®]

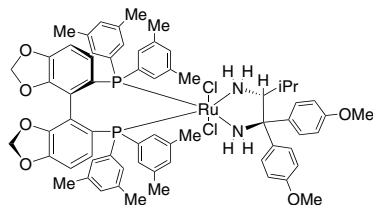


44-0180 250mg

Ru(OAc)₂[(R)-dtbm-segphos®]

44-0181

Ru(OAc)₂[(S)-dtbm-segphos®]

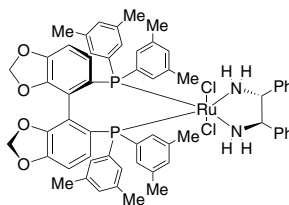


44-0214 250mg

RuCl₂[(R)-dm-segphos®][(R)-daipen]

44-0215

RuCl₂[(S)-dm-segphos®][(S)-daipen]

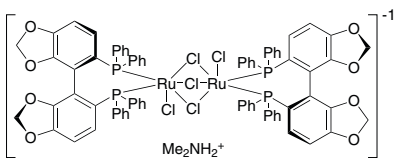


44-0228 250mg

RuCl₂[(R)-dm-segphos®][(R,R)-dpen]

44-0229

RuCl₂[(S)-dm-segphos®][(S,S)-dpen]

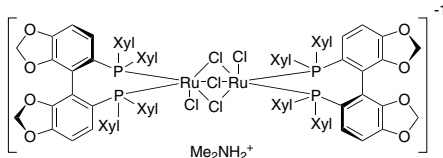


44-0518 250mg

[NH₂Me₂][RuCl₂[(R)-segphos®]₂(μ-Cl)₃]

44-0519

[NH₂Me₂][RuCl₂[(S)-segphos®]₂(μ-Cl)₃]



44-0520 250mg

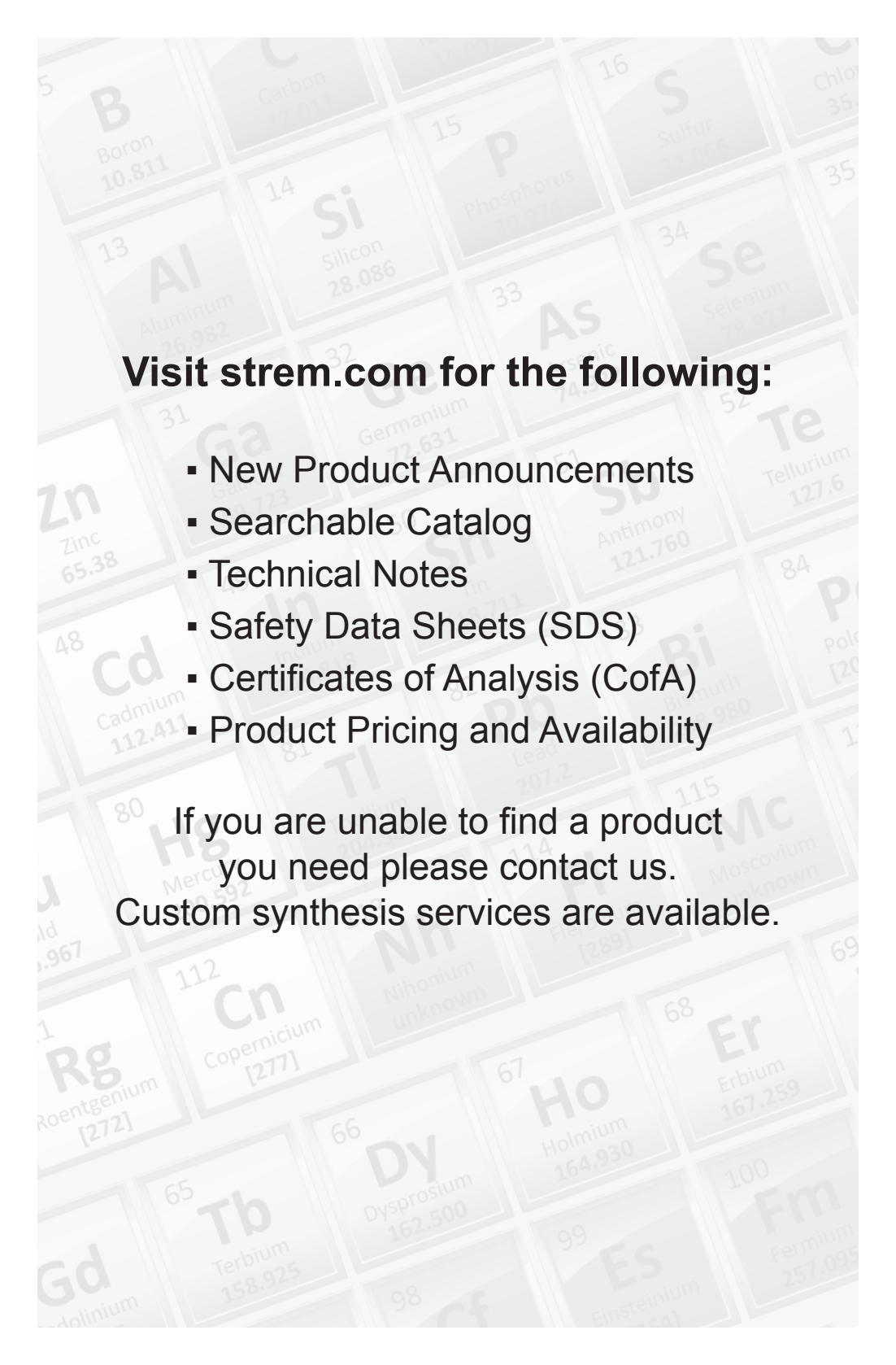
[NH₂Me₂][RuCl₂[(R)-dm-segphos®]₂(μ-Cl)₃]

44-0521

[NH₂Me₂][RuCl₂[(S)-dm-segphos®]₂(μ-Cl)₃]

KITS - Takasago SEGPPOS® Ru Catalyst Kit

44-0096	Chloro[(R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-segphos®)]Cl (944451-28-9)	250mg	See page 25
44-0097	Chloro[(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-segphos®)]Cl (944451-29-0)	250mg	See page 25
44-0098	Chloro[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-dm-segphos®)]Cl (944451-30-3)	250mg	See page 27
44-0099	Chloro[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-dm-segphos®)]Cl (944451-31-4)	250mg	See page 27
44-0102	Chloro[(R)-(-)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((R)-dtbm-segphos®)]Cl (944451-32-5)	250mg	See page 24
44-0103	Chloro[(S)-(+)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole](p-cymene)ruthenium(II) chloride [RuCl(p-cymene)((S)-dtbm-segphos®)]Cl (944451-33-6)	250mg	See page 24
44-0168	Diacetato[(R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(R)-segphos®] (944450-48-0)	250mg	See page 30
44-0169	Diacetato[(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(S)-segphos®] (373650-12-5)	250mg	See page 30
44-0174	Diacetato[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(R)-dm-segphos®] (944450-49-1)	250mg	See page 32
44-0176	Diacetato[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(S)-dm-segphos®] (944450-50-4)	250mg	See page 32
44-0180	Diacetato[(R)-(-)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(R)-dtbm-segphos®] (1025477-38-6)	250mg	See page 30
44-0181	Diacetato[(S)-(+)-5,5'-bis[di(3,5-di-t-butyl-4-methoxyphenyl)phosphino]-4,4'-bi-1,3-benzodioxole]ruthenium(II) Ru(OAc) ₂ [(S)-dtbm-segphos®] (1025476-84-9)	250mg	See page 30
44-0214	Dichloro[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole][(2R)-(-)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl ₂ [(R)-dm-segphos®] [(R)-daipen] (944450-43-5)	250mg	See page 33
44-0215	Dichloro[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole][(2S)-(+)-1,1-bis(4-methoxyphenyl)-3-methyl-1,2-butanediamine]ruthenium(II) RuCl ₂ [(S)-dm-segphos®] [(S)-daipen] (944450-44-6)	250mg	See page 33
44-0228	Dichloro[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole][(1R,2R)-(+)-1,2-diphenylethylenediamine]ruthenium(II) RuCl ₂ [(R)-dm-segphos®] [(R,R)-dpen] (944450-45-7)	250mg	See page 33
44-0229	Dichloro[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole][(1S,2S)-(-)-1,2-diphenylethylenediamine]ruthenium(II) RuCl ₂ [(S)-dm-segphos®] [(S,S)-dpen] (944450-46-8)	250mg	See page 33
44-0518	Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH ₂ Me ₂][(RuCl((R)-segphos®)) ₂ (μ-Cl) ₃] (346457-41-8)	250mg	See page 36
44-0519	Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-5,5'-bis(diphenylphosphino)-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH ₂ Me ₂][(RuCl((S)-segphos®)) ₂ (μ-Cl) ₃] (488809-34-3)	250mg	See page 37
44-0520	Dimethylammonium dichlorotri(μ-chloro)bis[(R)-(+)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH ₂ Me ₂][(RuCl((R)-dm-segphos®)) ₂ (μ-Cl) ₃] (935449-46-0)	250mg	See page 35
44-0521	Dimethylammonium dichlorotri(μ-chloro)bis[(S)-(-)-5,5'-bis[di(3,5-xylyl)phosphino]-4,4'-bi-1,3-benzodioxole]diruthenate(II) [NH ₂ Me ₂][(RuCl((S)-dm-segphos®)) ₂ (μ-Cl) ₃] (944451-14-3)	250mg	See page 36

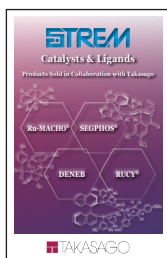
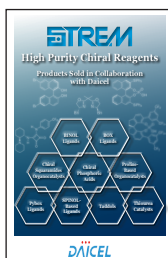
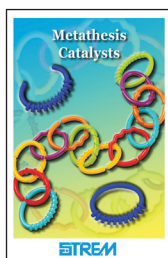
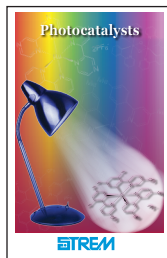
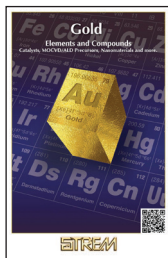
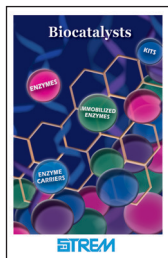
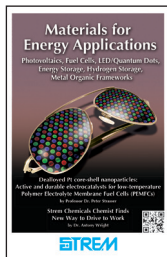
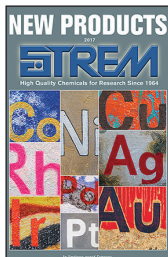
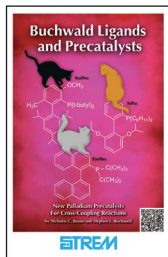
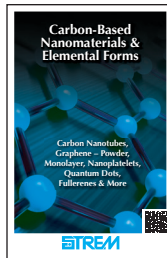
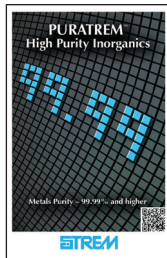
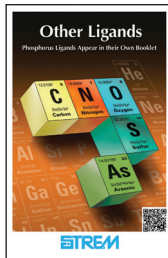
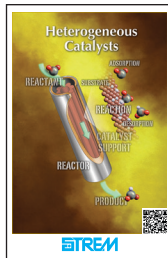
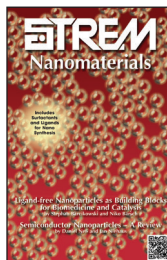
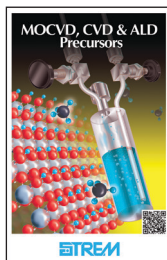
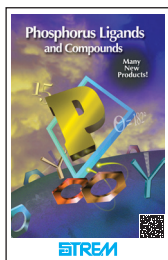
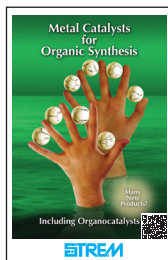
The background of the entire page is a faded, grayscale image of a periodic table of elements. The elements are arranged in their standard grid format, with symbols, atomic numbers, and names visible. The text is overlaid on this background.

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