



Chiral Phosphoric Acids

Sold in Collaboration with Daicel



Hotline/QQ: 400 666 7788

Chiral Phosphoric Acids

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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 and

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 chiral phosphoric acids which are sold in collaboration with Daicel.

About Daicel Chiral Technologies, Inc.

Chiral Technologies, the global leader in enantioselective chromatography, serves pharmaceutical and other life science industries and offers the largest portfolio of chiral stationary phases (CSPs) and analytical and preparative chiral columns for the separation of racemic mixtures into single enantiomers. The company also provides analytical method development and custom separation services. The North and Latin American markets are served through Chiral Technologies, Inc. (West Chester, PA), the European market through Chiral Technologies Europe SAS (Illkirch, France), and the Asian market through Daicel Chiral Technologies India and Daicel Chiral Technologies China, all wholly owned subsidiaries of Daicel.

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



CHIRAL.PHOS. 08/18
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Glossary of Terms

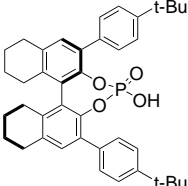
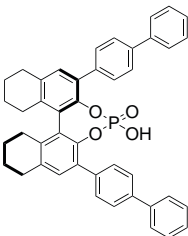
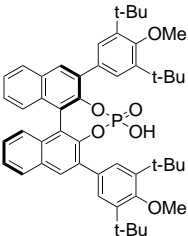
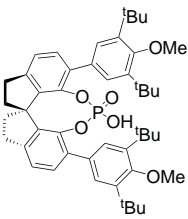
| | | |
|-----------------------------|-------|---|
| [α]_D | | Specific rotation |
| AAS | | Atomic Absorption Standard |
| ACS | | Conforms to American Chemical Society specifications |
| air sensitive | ..... | Product may chemically react with atmospheric oxygen or carbon dioxide at ambient conditions. 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 |
| powdr. | ..... | 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 |

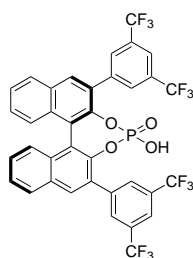
Chiral Phosphoric Acids

PHOSPHORUS (Compounds)

| | | | |
|---------|--|---|------|
| 15-0392 | (11bR)-2,6-Bis[4-(tert-butyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (1569807-27-7) $C_{40}H_{48}O_4P$; FW: 620.8; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0568 | (11bS)-2,6-Bis[4-(tert-butyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% $C_{40}H_{48}O_4P$; FW: 620.8; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0418 | (11bR)-2,6-Bis[(1,1'-biphenyl)-4-yl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (861909-35-5) $C_{44}H_{37}O_4P$; FW: 660.7; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0422 | (11bS)-2,6-Bis[(1,1'-biphenyl)-4-yl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) $C_{44}H_{37}O_4P$; FW: 660.7; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0554 | (11bR)-2,6-Bis[3,5-bis(1,1-dimethylethyl)-4-methoxyphenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (957790-93-1) $C_{60}H_{57}O_6P$; FW: 785.0; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0352 | (11bS)-2,6-Bis[3,5-bis(1,1-dimethylethyl)-4-methoxyphenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) $C_{60}H_{57}O_6P$; FW: 785.0; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0532 | (11aR)-3,7-Bis[3,5-bis(tert-butyl)-4-methoxyphenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{47}H_{59}O_6P$; FW: 750.9; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0534 | (11aS)-3,7-Bis[3,5-bis(tert-butyl)-4-methoxyphenyl]-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{47}H_{59}O_6P$; FW: 750.9; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |

PHOSPHORUS (Compounds)

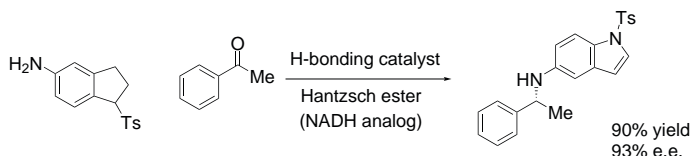
15-1366 (11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d':1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-62-1)
 $C_{36}H_{17}F_{12}O_4P$; FW: 772.5; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.



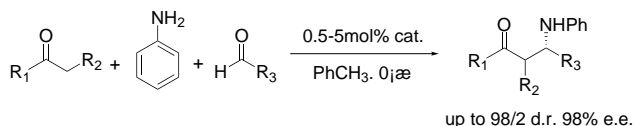
100mg

Technical Notes:

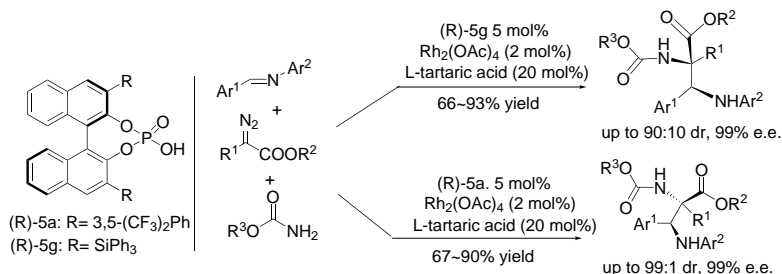
- Reductive Amination Reaction:** The first enantioselective organocatalytic reductive amination reaction has been accomplished.
- Mannich Reaction:** In the presence of a catalytic amt. of the phosphoric acid, anti-selective Mannich reactions of cyclic ketones with a wide scope of aldimines were obtained.
- The diastereoselectively switchable enantioselective trapping of protic carbamate ammonium ylides with imines is reported. The $Rh_2(OAc)_4$ and chiral Brønsted acid cocatalyzed three-component Mannich-type reaction of a diazo compound, a carbamate, and an imine provides rapid and efficient access to both syn- and anti- α -substituted α,β -diamino acid derivatives.
- Protonation:** A catalytic asymmetric protonation of ketene dithioacetals is described. Various racemic α -aryl hydrocoumarin derivatives are transformed into enantioenriched dithioacetal-protected hydrocoumarins in the presence of a chiral Brønsted acid catalyst.
- Povarov Cyclization:** Tetrahydroquinolines containing two quaternary stereogenic centers were synthesized with excellent ee and dr via a four-component cyclization reaction catalyzed by a chiral phosphoric acid.
- Pictet-Spengler Reaction:** β -Carbolines could be synthesized with good enantioselectivity by the Pictet-Spengler reaction catalyzed by a chiral binol-derived Brønsted acid.
- In the glycosylation of racemic alcohols with 1 to give the corresponding glycoside with good to excellent α/β -stereo- and diastereoselectivity in high yield.



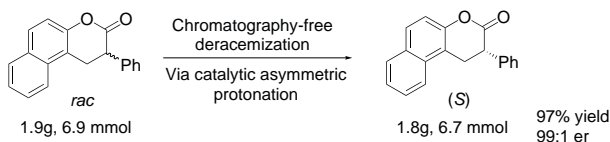
Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)



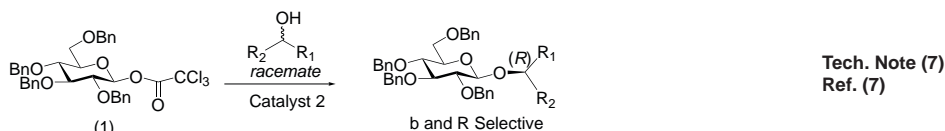
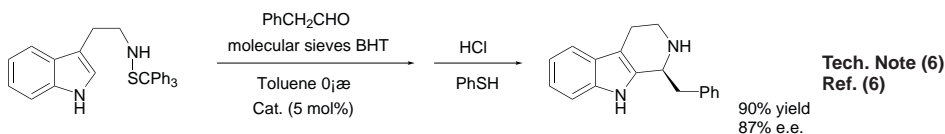
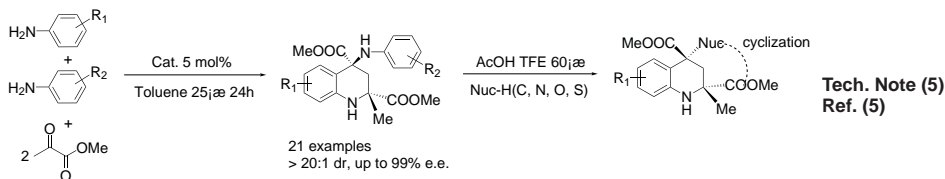
Tech. Note (3)
Ref. (3)



Tech. Note (4)
Ref. (4)

PHOSPHORUS (Compounds)

15-1366 (11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-62-1)



References:

1. *J. Am. Chem. Soc.*, **2006**, 128, 84-86.
2. *J. Am. Chem. Soc.*, **2007**, 129, 3790-3791.
3. *J. Am. Chem. Soc.*, **2011**, 133, 8428-8431.
4. *J. Am. Chem. Soc.*, **2012**, 134, 18245-18248.
5. *J. Am. Chem. Soc.*, **2013**, 135, 8193-8196.
6. *Angew. Chem. Int. Ed.*, **2007**, 46, 7485-7487.
7. *Angew. Chem. Int. Ed.*, **2013**, 52, 12131-12134.

15-1367 (11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (878111-17-2)

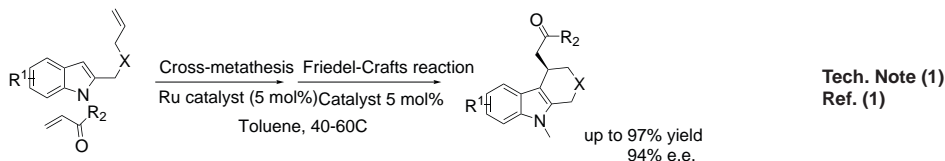
100mg

C₃₈H₁₇F₁₂O₄P; FW: 772.5; white to light yellow powdr.

Note: Sold in collaboration with Daicel for research purposes only.

Technical Note:

1. **Friedel-Crafts Alkylation:** Chiral phosphoric acids were used as catalysts for the Friedel-Crafts alkylations of indolyl enones while both a ruthenium complex and chiral phosphoric acids were used as catalysts for sequential olefin cross-metathesis and Friedel-Crafts alkylations of allyloxymethyl or allylaminomethyl indoles and enones.

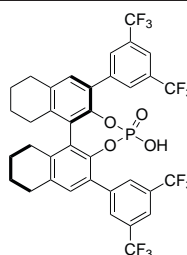


References:

1. *Angew. Chem. Int. Ed.*, **2009**, 48, 7428-7431.

PHOSPHORUS (Compounds)

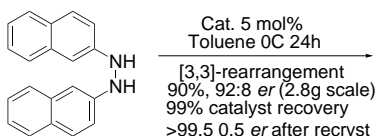
15-1376 (11bR)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (1011465-24-9)
 $C_{36}H_{28}F_{12}O_4P$; FW: 780.5; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.



25mg
100mg

Technical Notes:

- The preparation of binaphthol monophosphoric acid derivatives.
- Sigmatropic Rearrangements:** Used in the organocatalytic aryl-aryl bond-forming process for the regio- and atroposelective synthesis of 2,2'-diamino-1,1'-binaphthalenes (BINAMs). In the presence of catalytic amounts of axially chiral phosphoric acids, achiral N,N'-binaphthyl hydrazines undergo a facile [3,3]-sigmatropic rearrangement to afford enantiomerically enriched BINAM derivatives in good to excellent yield.



Tech. Note (2)
Ref. (1)

References:

- JP 4725757, EP 1038877, US 6274745, 2000-3-21.
- J. Am. Chem. Soc.*, **2013**, *135*, 7414-7417.

15-1377 (11bS)-2,6-Bis[3,5-bis(trifluoromethyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)
 $C_{36}H_{28}F_{12}O_4P$; FW: 780.5; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

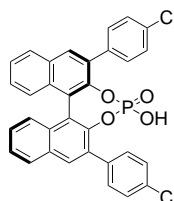
25mg
100mg

Technical Note:

- See 15-1376 (page 4)

15-0368 (11bR)-2,6-Bis(4-chlorophenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (922711-71-5)
 $C_{32}H_{19}Cl_2O_4P$; FW: 569.4; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW



50mg

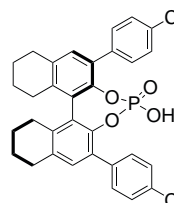
15-0372 (11bS)-2,6-Bis(4-chlorophenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee)
 $C_{32}H_{19}Cl_2O_4P$; FW: 569.4; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW

50mg

15-0384 (11bR)-2,6-Bis(4-chlorophenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (915038-16-3)
 $C_{32}H_{27}Cl_2O_4P$; FW: 577.4; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW



50mg

15-0386 (11bS)-2,6-Bis(4-chlorophenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee)
 $C_{32}H_{27}Cl_2O_4P$; FW: 577.4; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW

50mg

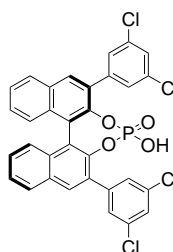
PHOSPHORUS (Compounds)

15-0362

NEW

(11bR)-2,6-Bis(3,5-dichlorophenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95% (99% ee) (1191451-24-7)

C₃₂H₁₇Cl₄O₄P; FW: 638.3; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.



50mg

15-0366

NEW

(11bS)-2,6-Bis(3,5-dichlorophenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (1374030-20-2)

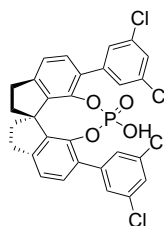
C₃₂H₁₇Cl₄O₄P; FW: 638.3; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.

15-0514

NEW

(11aR)-3,7-Bis(3,5-dichlorophenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee)

C₂₉H₁₉Cl₄O₄P; FW: 604.2; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.



50mg

15-0516

NEW

(11aS)-3,7-Bis(3,5-dichlorophenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee)

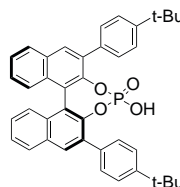
C₂₉H₁₉Cl₄O₄P; FW: 604.2; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.

15-0342

NEW

(11bS)-2,6-Bis[4-(1,1-dimethylethyl)phenyl]-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (1217901-32-0)

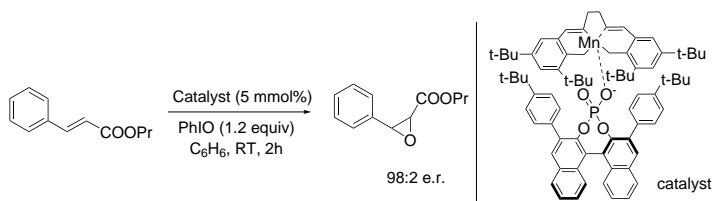
C₄₀H₃₇O₄P; FW: 612.7; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.



50mg

Technical Note:

1. **Epoxidation:** A highly active and enantioselective ion-pair epoxidation catalyst, consisting of an achiral Mn-salen complex and a chiral phosphate counteranion, mediates the epoxidization of a wide range of alkenes with high yields and enantioselectivities.



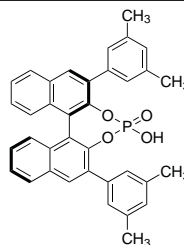
Tech. Note (1)
Ref. (1)

References:

1. *Angew. Chem. Int. Ed.*, **2010**, 49, 628-631.

PHOSPHORUS (Compounds)

15-1368 (11bR)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee) (861909-53-7)
 $C_{36}H_{29}O_4P$; FW: 556.6; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.



100mg

Technical Note:

1. Catalyst for the enantioselective cyanosilylation of aromatic ketones using chiral lithium salts of (R)-BINOL- or (S)-BINAM-derived phosphoric acid compounds.

References:

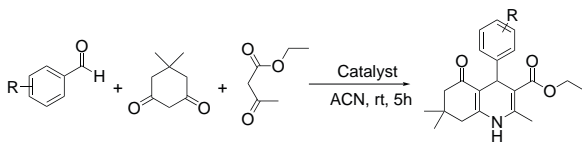
1. *Angew. Chem. Int. Ed.*, **2009**, 48, 7428-7431.

15-1369 (11bS)-2,6-Bis(3,5-dimethylphenyl)-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee) (1170736-59-0)
 $C_{36}H_{29}O_4P$; FW: 556.6; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

100mg

Technical Note:

1. **Hantzsch Reaction:** The four-component Hantzsch reaction provides access to pharmaceutically important dihydropyridines.



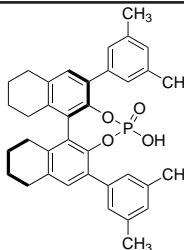
69–94%
up to 94%
e.e.

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

References:

1. *Org. Lett.*, **2009**, 11, 2957-2959.

15-1373 (11bR)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee) (1065214-95-0)
 $C_{36}H_{37}O_4P$; FW: 564.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.



25mg
100mg

Technical Note:

1. The preparation of binaphthol monophosphoric acid derivatives.

References:

1. JP 4725757, EP 1038877, US 6274745, 2000-3-21.

15-1374 (11bS)-2,6-Bis(3,5-dimethylphenyl)-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee)
 $C_{36}H_{37}O_4P$; FW: 564.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
100mg

Technical Note:

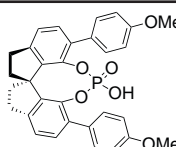
1. The preparation of binaphthol monophosphoric acid derivatives.

References:

1. JP 4725757, EP 1038877, US 6274745, 2000-3-21.

15-0494 (11aR)-3,7-Bis(4-methoxyphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee)
 $C_{31}H_{27}O_6P$; FW: 526.5; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW



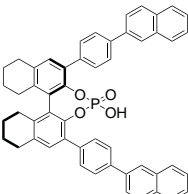
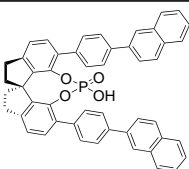
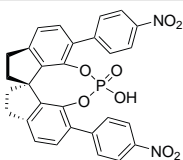
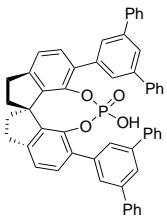
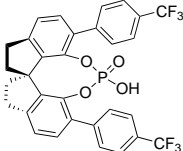
50mg

15-0508 (11aS)-3,7-Bis(4-methoxyphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee)
 $C_{31}H_{27}O_6P$; FW: 526.5; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

NEW

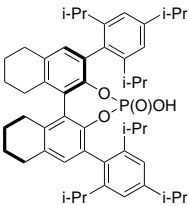
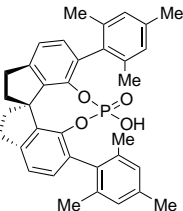
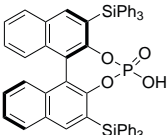
50mg

PHOSPHORUS (Compounds)

| | | | |
|-----------------------|--|---|------|
| 15-0388 NEW | (11bR)-2,6-Bis[4-(2-naphthalenyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) $C_{62}H_{44}O_4P$; FW: 760.9; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0390 NEW | (11bS)-2,6-Bis[4-(2-naphthalenyl)phenyl]-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) $C_{62}H_{44}O_4P$; FW: 760.9; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0546 NEW | (11aR)-3,7-Bis[4-(2-naphthalenyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{49}H_{36}O_4P$; FW: 718.8; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0548 NEW | (11aS)-3,7-Bis[4-(2-naphthalenyl)phenyl]-10,11,12,13-tetrahydro-5-hydroxy-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{48}H_{36}O_4P$; FW: 718.8; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0576 NEW | (11aR)-3,7-Bis(4-nitrophenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 95% (99% ee) (1352810-37-7) $C_{29}H_{21}N_2O_8P$; FW: 556.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0512 NEW | (11aS)-3,7-Bis(4-nitrophenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) (1412439-84-9) $C_{29}H_{21}N_2O_8P$; FW: 556.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0526 NEW | (11aR)-3,7-Bis[(1,1':3',1''-terphenyl]-5'-yl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) (1352810-38-8) $C_{53}H_{38}O_4P$; FW: 770.8; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0530 NEW | (11aS)-3,7-Bis[(1,1':3',1''-terphenyl]-5'-yl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{53}H_{38}O_4P$; FW: 770.8; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0484 NEW | (11aR)-3,7-Bis(4-(trifluoromethyl)phenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) $C_{31}H_{21}F_6O_4P$; FW: 602.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |

Chiral Phosphoric Acids

PHOSPHORUS (Compounds)

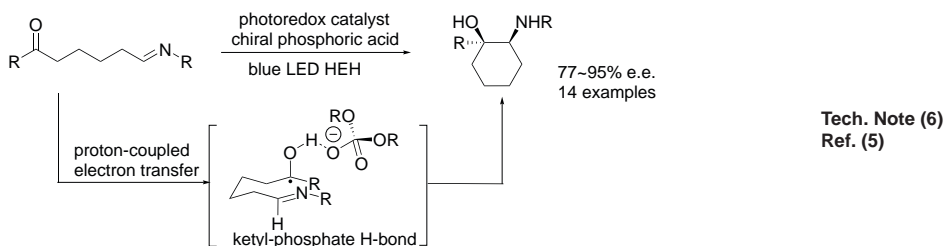
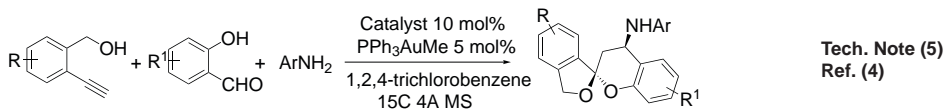
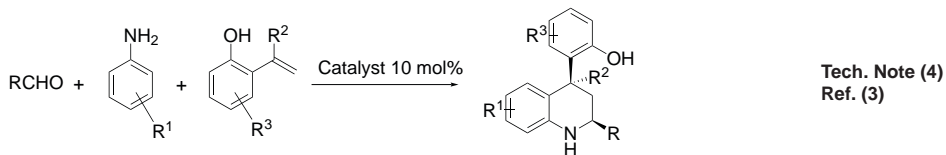
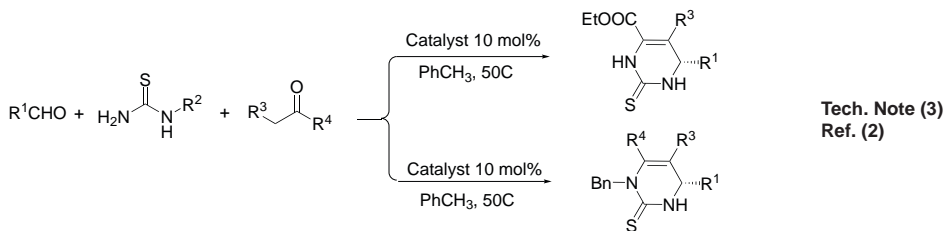
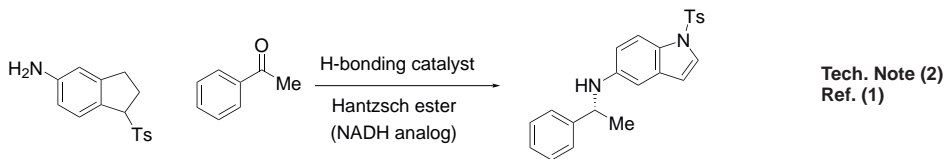
| | | |
|------------|---|--|
| 15-0492 | (11aS)-3,7-Bis(4-(trifluoromethyl)phenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) | 50mg |
| NEW | $C_{21}H_{21}F_3O_4P$; FW: 602.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | |
| 15-1395 | (R)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) (929294-27-9) | 25mg 100mg |
| | $C_{60}H_{66}O_4P$; FW: 761; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  |
| 15-1394 | (S)-3,3'-Bis(2,4,6-triisopropylphenyl)-5,5',6,6',7,7',8,8'-octahydro-1,1'-binaphthyl-2,2'-diyl Hydrogenphosphate, 98%, (99% ee) (878111-20-7) | 25mg 100mg |
| | $C_{60}H_{66}O_4P$; FW: 761; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | |
| 15-0538 | (11aR)-3,7-Bis(2,4,6-trimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) (1801196-27-9) | 50mg |
| NEW | $C_{35}H_{35}O_4P$; FW: 550.6; white to brown powdr. Note: Sold in collaboration with Daicel for research purposes only. |  |
| 15-0544 | (11aS)-3,7-Bis(2,4,6-trimethylphenyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) | 50mg |
| NEW | $C_{35}H_{35}O_4P$; FW: 550.6; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | |
| 15-0340 | (R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(R)-TIPSY] (791616-55-2) | 10mg 100mg |
| | $C_{66}H_{44}O_4PSi_2$; FW: 865.07; white to light yellow powdr.; m.p. 329-335° Note: Sold in collaboration with Daicel for research purposes only. |  |

Technical Notes:

- See 15-1366. Catalyst used in:
- Reductive Amination:** The development of a new chiral phosphoric acid catalyst has provided a convenient strategy for the enantioselective construction of protected primary amines and provided a highly stereoselective method for the reductive amination of heterocyclic amines.
- Biginelli and Biginelli-like Reaction:** Organocatalytic enantioselective Biginelli and Biginelli-like reactions by chiral phosphoric acids derived from 3,3'-disubstituted binaphthols
- Povarov Reaction:** An organocatalytic asymmetric three-component Povarov reaction involving 2-hydroxystyrenes to give cis-disubstituted tetrahydroquinolines in high stereoselectivities of up to >99:1 dr and 97% ee.
- Cascade Spirocyclization:** The gold/chiral Brønsted acid relay catalysis enabled a highly stereoselective three-component reaction of salicylaldehydes, anilines, and alkynols to give aromatic spiroacetals in high yields and stereoselectivities.
- aza-Pinacol Cyclization:** The first highly enantioselective catalytic protocol for the reductive coupling of ketones and hydrazones is reported.

PHOSPHORUS (Compounds)

15-0340 (R)-(-)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98%
(continued) [(R)-TiPSY] (791616-55-2)



References:

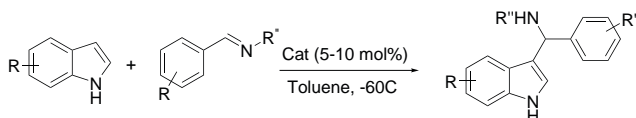
1. *J. Am. Chem. Soc.* **2006**, 128, 84-86
2. *J. Am. Chem. Soc.* **2009**, 131, 15301-15310.
3. *J. Am. Chem. Soc.* **2012**, 77, 6970-6979.
4. *Org. Lett.*, **2013**, 15, 460-463.
5. *J. Am. Chem. Soc.* **2013**, 135, 17735-17738.

PHOSPHORUS (Compounds)

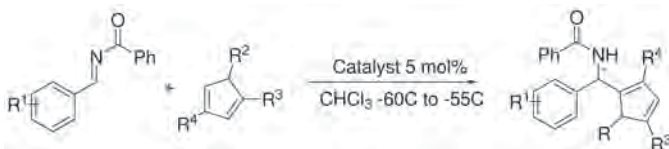
| | | |
|----------------|---|---------------|
| 15-0341 | (S)-(+)-3,3'-Bis(triphenylsilyl)-1,1'-binaphthyl-2,2'-diyl hydrogen phosphate, min. 98% [(S)-TIPSY] (929097-92-7) C ₅₆ H ₄₁ O ₄ PSi ₂ ; FW: 865.07; white to light-yellow solid; m.p. 329-335° Note: Sold in collaboration with Daicel for research purposes only. | 10mg 100mg |
|----------------|---|---------------|

Technical Notes:

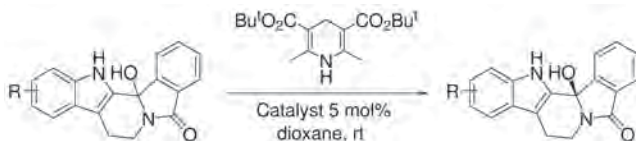
- Friedel-Crafts Reaction:** Catalyst for the highly enantioselective Friedel-Crafts reactions of indoles with imines.
- Catalyst used in the highly enantioselective Friedel-Crafts reaction of pyrrole derivatives with N-acyl imines.
- Transfer Hydrogenation:** Chiral phosphoric acid catalyzed enantioselective transfer hydrogenation of hydroxylactams to provide enantioenriched tetrahydro-β-carbolines in dioxane at room temperature (up to 94% yield, 90% ee).
- Multicomponent Reaction:** Catalyzed by [Rh₂(OAc)₄] and a chiral phosphoric acid, an enantioselective symmetric three-component reaction of diazo compounds with imines and water is reported to give β-amino-α-hydroxy acid derivatives.



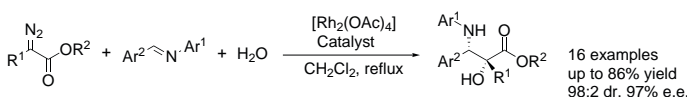
Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)



Tech. Note (3)
Ref. (3)

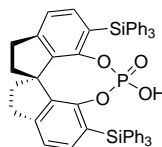


Tech. Note (4)
Ref. (4)

References:

- J. Am. Chem. Soc.* **2007**, 129, 1484-1485.
- Org. Lett.*, **2007**, 9, 4065-4068.
- Org. Lett.*, **2013**, 15, 2688-2691.
- ChemCatChem*, **2011**, 3, 653-656.

| | | |
|------------------------------|--|------|
| 15-0520 NEW | (11aR)-3,7-Bis(triphenylsilyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) (1372719-94-2) C ₅₃ H ₄₃ O ₄ PSi ₂ ; FW: 831.1; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|------------------------------|--|------|



| | | |
|------------------------------|---|------|
| 15-0524 NEW | (11aS)-3,7-Bis(triphenylsilyl)-10,11,12,13-tetrahydro-5-hydroxy-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) C ₅₃ H ₄₃ O ₄ PSi ₂ ; FW: 831.1; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|------------------------------|---|------|

PHOSPHORUS (Compounds)

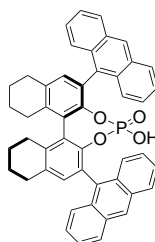
15-0378

NEW

(11bR)-2,6-Di-9-anthracenyl-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95% (99% ee) (1011465-29-4)

$C_{48}H_{37}O_4P$; FW: 708.8; white to yellow powdr.

Note: Sold in collaboration with Daicel for research purposes only.



50mg

15-0382

NEW

(11bS)-2,6-Di-9-anthracenyl-8,9,10,11,12,13,14,15-octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee)

$C_{48}H_{37}O_4P$; FW: 708.8; white to light yellow powdr.

Note: Sold in collaboration with Daicel for research purposes only.

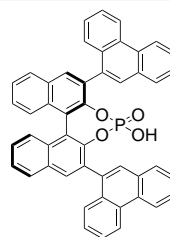
15-0552

NEW

(11bR)-2,6-Di-9-phenanthrenyl-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, (864943-22-6)

$C_{48}H_{29}O_4P$; FW: 700.7; white to light yellow powdr.

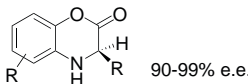
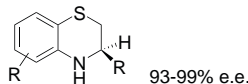
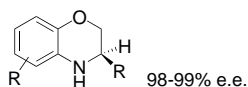
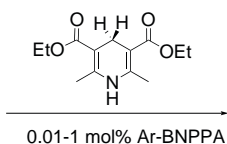
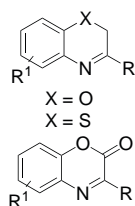
Note: Sold in collaboration with Daicel for research purposes only.



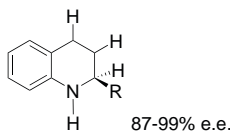
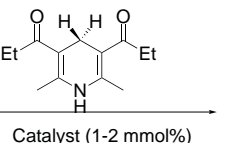
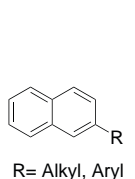
50mg

Technical Notes:

- Hydrogenation:** A highly efficient transfer hydrogenation of benzoxazines, benzothiazines, and benzoxazinones with as low as 0.01 mol% BINOL phosphate catalyst furnishes the dihydro-2H-benzoxazines, -benzothiazines, and -benzoxazinones
- A Brønsted acid catalyzed cascade transfer hydrogenation provides direct access to 2-aryl- and 2-alkyl-substituted tetrahydroquinolines with excellent enantioselectivities under mild conditions and using very low amounts of catalyst.
- Three-Component Reaction:** An asymmetric three-component reaction of diazo compounds and alcohols with imines catalyzed cooperatively by a rhodium complex and a chiral Brønsted acid provides a general and efficient entry to β -amino- α -hydroxyl acid derivatives.
- Diels-Alder Reaction:** A mild, enantioselective Diels-Alder reaction, catalyzed by a chiral magnesium phosphate species, has been developed for the synthesis of various chiral spirooxindoles.



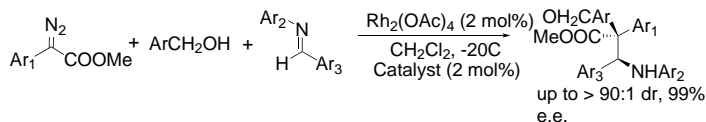
Tech. Note (1)
Ref. (1)



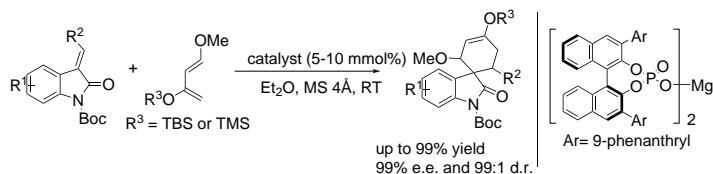
Tech. Note (2)
Ref. (2)

PHOSPHORUS (Compounds)

15-0552 (11bR)-2,6-Di-9-phenanthrenyl-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, (864943-22-6)



Tech. Note (3)
Ref. (3)



Tech. Note (4)
Ref. (4)

References:

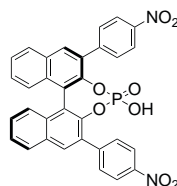
1. *Angew. Chem. Int. Ed.*, **2006**, 45, 6751-6755.
2. *Angew. Chem. Int. Ed.*, **2006**, 45, 3683-3686.
3. *J. Am. Chem. Soc.*, **2008**, 130, 7782-7783.
4. *Angew. Chem. Int. Ed.*, **2013**, 52, 4628-4632.

15-0344 (11bR)-4-Hydroxy-2,6-bis(4-nitrophenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)

NEW

$\text{C}_{32}\text{H}_{18}\text{N}_2\text{O}_8\text{P}$; FW: 590.5; white to yellow pwr.

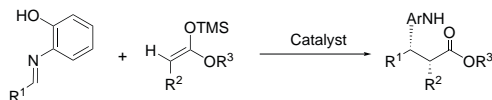
Note: Sold in collaboration with Daicel for research purposes only.



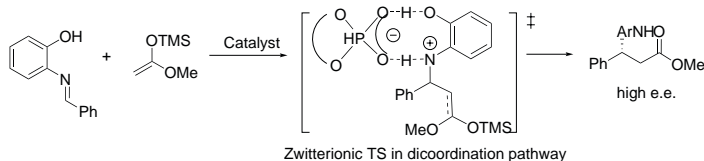
50mg

Technical Notes:

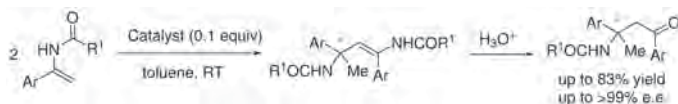
1. **Mannich Reaction:** The Mannich-type reaction of ketene silyl acetals with aldimines proceeded highly enantioselectively to afford the syn isomer of β -aminoesters **3** with up to 96% ee under the influence of the catalyst.
2. Mannich-type reaction of ketene silyl acetals with aldimines proceeded catalytically by means of a phosphoric acid diester with good diastereoselectivity and high enantioselectivity (up to 96% ee). The highest enantioselectivity was achieved by the phosphoric acid diester bearing 4-nitrophenyl groups on the 3,3'-positions of BINOL.
3. **Self-Coupling Reaction:** The enantioselective BINOL-phosphate catalyzed formation of a quaternary carbon center, bearing a N-atom has been achieved through the self-coupling reaction of enamides
4. **Hydrocyanation:** A first organocatalytic enantioselective route was developed for the conversion of readily prepared and air stable aliphatic hydrazones to synthetically valuable α -hydrazinonitriles.
5. See 15-1386.



Tech. Note (1)
Ref. (1)

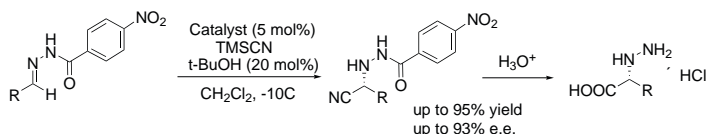


Tech. Note (2)
Ref. (2)



Tech. Note (3)
Ref. (3)

PHOSPHORUS (Compounds)

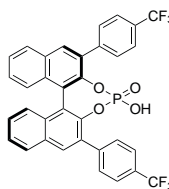
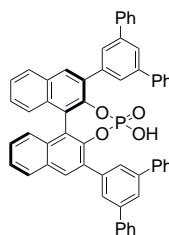


Tech. Note (4)
Ref. (4)

References:

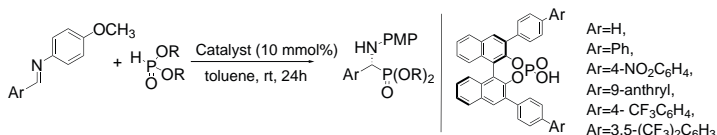
1. *Angew. Chem. Int. Ed.*, **2004**, 43, 1566-1568.
2. *J. Am. Chem. Soc.*, **2007**, 129, 6756-6764.
3. *Chem. Commun.*, **2008**, (38), 4637-4639
4. *Org. Lett.*, **2010**, 12, 188-191.

| | | |
|----------------|--|-------|
| 15-0346 | (11bS)-4-Hydroxy-2,6-bis(4-nitrophenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (878111-16-1) $\text{C}_{32}\text{H}_{19}\text{N}_2\text{O}_8\text{P}$; FW: 590.5; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
| 15-0348 | (11bR)-4-Hydroxy-2,6-bis([1,1':3',1''-terphenyl]-5'-yl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (361342-55-4) $\text{C}_{66}\text{H}_{37}\text{O}_4\text{P}$; FW: 804.9; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
| 15-1392 | (11bR)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee) (791616-59-6) $\text{C}_{34}\text{H}_{19}\text{F}_6\text{O}_4\text{P}$; FW: 636.5; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 100mg |



Technical Note:

1. **Hydrophosphonylation:** Catalyst for the highly enantioselective hydrophosphonylation reaction of diisopropyl phosphite with aldimine to give α -amino.

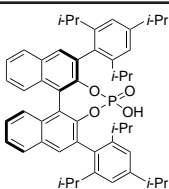


Tech. Note (1)
Ref. (1)

References:

1. *Tetrahedron Lett.*, **2009**, 65, 4950-4956.

| | | |
|----------------|---|-------|
| 15-1393 | (11bS)-4-Hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95%, (99% ee) (1264573-23-0) $\text{C}_{34}\text{H}_{19}\text{F}_6\text{O}_4\text{P}$; FW: 636.5; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 100mg |
| 15-1381 | (11bR)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-63-2) $\text{C}_{66}\text{H}_{57}\text{O}_4\text{P}$; FW: 753.0; white to light yellow powd. Note: Sold in collaboration with Daicel for research purposes only. | 100mg |



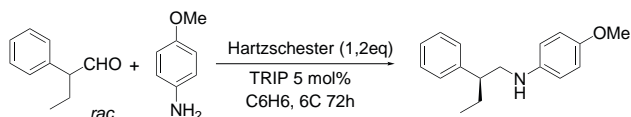
Technical Notes:

1. **Reductive Amination:** Catalyst for the organocatalytic asymmetric reductive amination of aldehydes. Treating racemic α -branched aldehydes with p-anisidine and a Hantzsch ester in the presence of catalyst, TRIP, gave β -branched secondary amines.
2. **α -Allylation:** Highly enantioselective Pd/chiral acid-catalyzed α -allylation of α -branched aldehydes with an allyl amine as the allylating species, that creates all-carbon quaternary stereogenic centers in high yields and enantioselectivities.

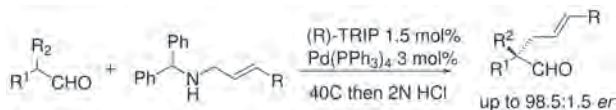
PHOSPHORUS (Compounds)

15-1381 (11bR)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-63-2)

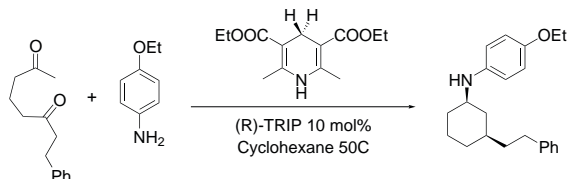
- Hydrogenation:** A achiral amine in combination with a catalytic amount of a chiral Brønsted acid can accomplish an aldol addition-dehydration-conjugate reduction-reductive amination to provide potential intermediates of pharmaceutically active compounds in good yields and excellent enantioselectivities.
- Friedel-Crafts Reaction:** The first enantioselective catalysis of the Friedel-Crafts reaction via activation of electron-rich multiple bonds by a chiral Brønsted acid.
- Allylboration:** A new high-yielding and highly enantioselective chiral Brønsted acid-catalyzed allylboration of aldehydes.
- Aza-Darzens Reaction:** Aza-Darzens reaction of ethyl diazoacetate with aldimines, derived from phenyl glyoxal, furnished cis-aziridine carboxylates with excellent enantioselectivities by means of a chiral phosphoric acid.
- Intramolecular Aldol Condensation:** Transformation applicable to a wide variety of substrates to give chiral cyclohexenones in high yields and with excellent enantioselectivity.



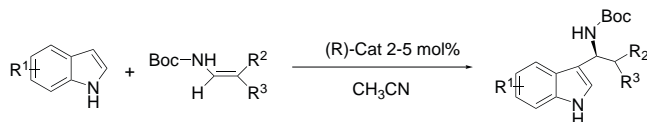
Tech. Note (1)
Ref. (1)



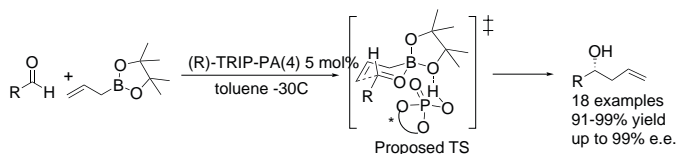
Tech. Note (2)
Ref. (2)



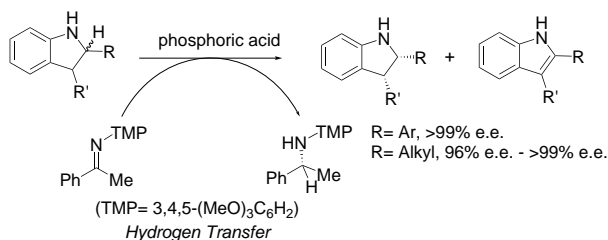
Tech. Note (3)
Ref. (3)



Tech. Note (4)
Ref. (4)

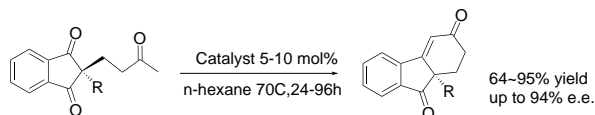


Tech. Note (5)
Ref. (5)



Tech. Note (6)
Ref. (6)

PHOSPHORUS (Compounds)



Tech. Note (7)
Ref. (7)

References:

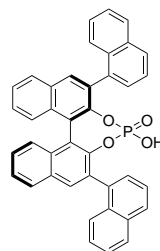
1. *J. Am. Chem. Soc.*, **2006**, 128, 13074-13075.
2. *J. Am. Chem. Soc.*, **2007**, 129, 11336-11337.
3. *J. Am. Chem. Soc.*, **2007**, 129, 7498-7499.
4. *J. Am. Chem. Soc.*, **2007**, 129, 292-293.
5. *J. Am. Chem. Soc.*, **2010**, 132, 11884-11886.
6. *J. Am. Chem. Soc.*, **2013**, 135, 11740-11743.
7. *Angew. Chem. Int. Ed.*, **2009**, 48, 9652-9654.

15-1382 (11bS)-4-Hydroxy-2,6-bis[2,4,6-tris(1-methylethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (874948-63-7)
C₅₀H₅₇O₄P; FW: 753.0; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.

100mg

15-1388 (11bR)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (864943-23-7)
C₄₀H₂₈O₄P; FW: 600.6; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.

100mg

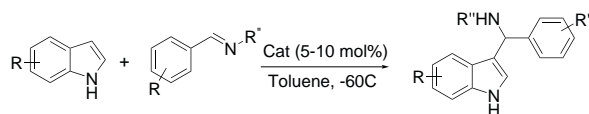


15-1389 (11bS)-4-Hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (929097-93-8)
C₄₀H₂₈O₄P; FW: 600.6; white to light yellow powdr.
Note: Sold in collaboration with Daicel for research purposes only.

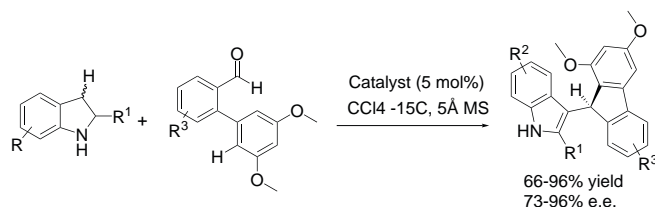
25mg
100mg

Technical Notes:

1. **Friedel-Crafts Reaction:** Catalyst for the Highly enantioselective Friedel-Crafts reactions of indoles with imines.
2. Chiral phosphoric acid catalyzed tandem double Friedel-Crafts reactions between indoles and 2-formylbiphenyls were realized under mild conditions.



Tech. Note (1)
Ref. (1)



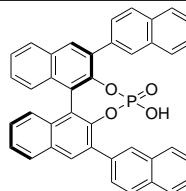
Tech. Note (2)
Ref. (2)

References:

1. *J. Am. Chem. Soc.*, **2007**, 129, 1484-1485.
2. *Chem. Eur. J.*, **2009**, 15, 8709-8712.

PHOSPHORUS (Compounds)

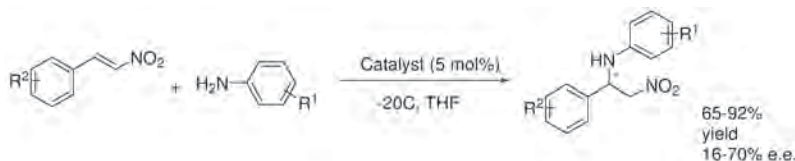
15-1390 (11bR)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-56-3)
 $C_{40}H_{25}O_4P$; FW: 600.6; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.



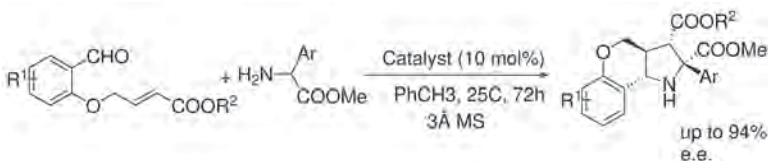
100mg

Technical Notes:

- aza-Michael Addition:** Catalyst for the enantioselective aza-Michael addition of aromatic amines to nitroolefins.
- Cycloaddition:** A chiral phosphoric acid-catalyzed intramolecular 1,3-dipolar cycloaddition of 4-(2-formylphenoxy)butenoates with amino esters provides hexahydromeno[4,3-b]pyrrolidine derivatives in high enantioselectivity (up to 94% ee).



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

References:

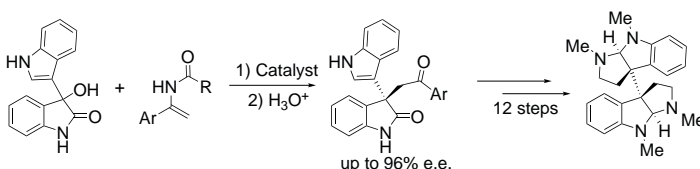
- Chinese J Catal*, **2011**, 32, 1573-1576.
- Org. Biomol. Chem.*, **2010**, 8, 2016-2019.

15-1391 (11bS)-4-Hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (874948-60-4)
 $C_{40}H_{25}O_4P$; FW: 600.6; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
 100mg

Technical Note:

- Nucleophilic Substitution:** Catalyst for the nucleophilic substitution involving 3-hydroxyoxindoles giving 3,3'-disubstituted oxindoles with concomitant generation of an all-carbon quaternary stereogenic center in high yield and excellent enantioselectivity.



Tech. Note (1)
Ref. (1)

References:

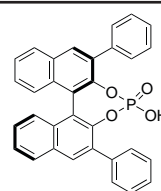
- Angew. Chem. Int. Ed.*, **2012**, 51, 1046-1050.

15-1386 (11bR)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (695162-86-8)
 $C_{32}H_{21}O_4P$; FW: 500.5; white to light yellow powdr.
 Note: Sold in collaboration with Daicel for research purposes only.

100mg

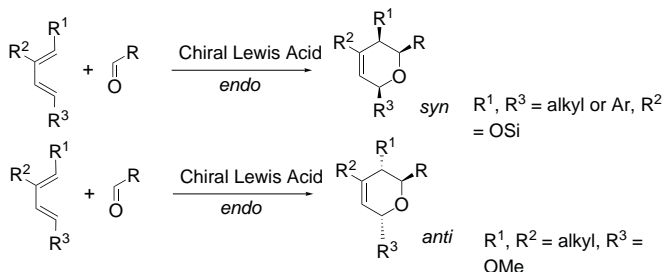
Technical Notes:

- Diels-Alder Reaction:** A highly enantioselective anti-diastereoselective hetero-Diels-Alder reaction between a glyoxylate and siloxy- or methoxydienes using a chiral phosphoric acid catalyst that possesses less bulky phenyl groups at the 3 and 3' positions of binaphthyl has been developed.
- Kinetic Resolution:** In the presence of 10 mol% of a chiral phosphoric acid, a variety of racemic N-benzylic sulfonamides having N-(3-indolyl)methyl groups smoothly undergo kinetic resolution with benzyl thiol at 0 °C or at room temperature and the remaining sulfonamides are recovered in moderate to excellent yields and with excellent ee.

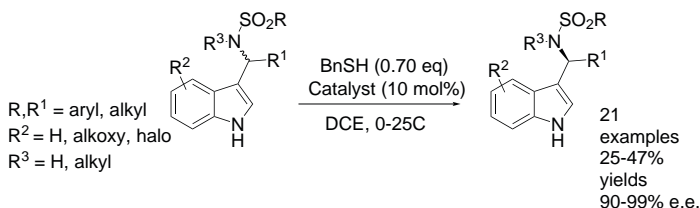


PHOSPHORUS (Compounds)

15-1386 (11bR)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (695162-86-8)



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

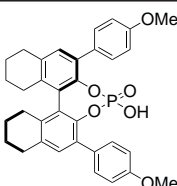
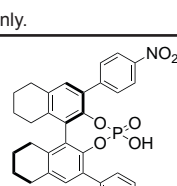
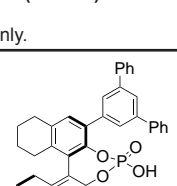
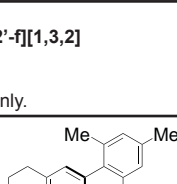
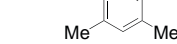
References:

1. *J. Am. Chem. Soc.*, **2009**, 131, 12882-12883.
2. *Chem. Commun.*, **2012**, 48, 898-900.

| | | |
|-----------------------|--|----------|
| 15-1387 | (11bS)-4-Hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (874948-59-1) $C_{32}H_{21}O_4P$; FW: 500.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | 100mg |
| 15-0404 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (791616-70-1) $C_{34}H_{27}F_6O_4P$; FW: 644.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
| 15-0406 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis[4-(trifluoromethyl)phenyl]-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) $C_{34}H_{27}F_6O_4P$; FW: 644.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
| 15-0436 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(3,5-di-tert-butyl-4-methoxyphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) $C_{50}H_{65}O_6P$; FW: 793.0; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |

Chiral Phosphoric Acids

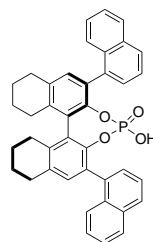
PHOSPHORUS (Compounds)

| | | | |
|-----------------------|---|---|------|
| 15-0438 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(3,5-di-tert-butyl-4-methoxyphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) C ₅₀ H ₆₅ O ₆ P; FW: 793.0; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0408 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(4-methoxyphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) (1011465-27-2) C ₃₄ H ₃₃ O ₆ P; FW: 568.6; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0412 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(4-methoxyphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) C ₃₄ H ₃₃ O ₆ P; FW: 568.6; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0414 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(4-nitrophenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) (791616-68-7) C ₃₂ H ₂₇ N ₂ O ₈ P; FW: 598.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0416 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(4-nitrophenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) C ₃₂ H ₂₇ N ₂ O ₈ P; FW: 598.5; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0394 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis([1,1':3',1''-terphenyl]-5'-yl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) (1569807-15-3) C ₆₆ H ₄₅ O ₆ P; FW: 812.9; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0396 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis([1,1':3',1''-terphenyl]-5'-yl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) (1496637-09-2) C ₆₆ H ₄₅ O ₆ P; FW: 812.9; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |
| 15-0424 NEW | (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(2,4,6-trimethylphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) (1011465-23-8) C ₃₈ H ₄₁ O ₆ P; FW: 592.7; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. |  | 50mg |
| 15-0434 NEW | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-bis(2,4,6-trimethylphenyl)-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98% (99% ee) C ₃₈ H ₄₁ O ₆ P; FW: 592.7; white to light yellow powdr. Note: Sold in collaboration with Daicel for research purposes only. | | 50mg |

PHOSPHORUS (Compounds)

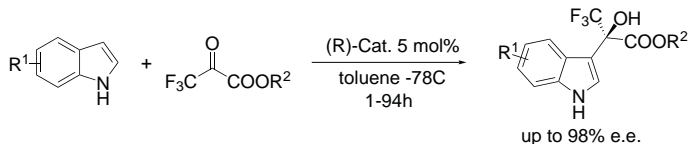
15-1383 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (1242066-20-1)
 $C_{40}H_{33}O_4P$; FW: 608.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
100mg

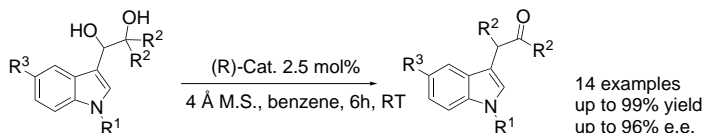


Technical Notes:

- Friedel-Crafts Alkylation:** Chiral phosphoric acid catalyzed Friedel-Crafts alkylation of indoles with 3,3,3-trifluoropropylate gave the corresponding adducts in excellent yields with high enantioselectivities.
- Pinacol Rearrangement:** It has been found that indolyl diols can be treated with chiral phosphoric acids to effect a regio- and enantioselective pinacol rearrangement with high efficiency.



Tech. Note (1)
Ref. (1)



Tech. Note (2)
Ref. (2)

References:

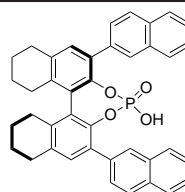
- Asian J. Chem.*, **2010**, 5, 470-472.
- Angew. Chem. Int. Ed.*, **2010**, 49, 9734-9736.

15-1384 (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)
 $C_{40}H_{33}O_4P$; FW: 608.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
100mg

15-1378 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (922711-75-9)
 $C_{40}H_{33}O_4P$; W: 608.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
100mg



Technical Notes:

- The preparation of binaphthol monophosphoric acid derivatives.
- Organocatalyst developed for the diastereo- and enantioselective 1,4-conjugate addn. of a variety of β -ketoesters to nitroolefins, employed in the addn. reaction, providing the corresponding nitroalkanes in high yield (up to 97%) with moderate diastereoselectivities (up to 2.6:1 dr) and enantioselectivities (up to 58% ee).

References:

- JP 4725757, EP 1038877, US 6274745, 2000-3-21.
- Lett. in Org. Chem.*, **2010**, 7, 219-225.

15-1379 (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-2-naphthalenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee)
 $C_{40}H_{33}O_4P$; FW: 608.7; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

25mg
100mg

Technical Note:

- The preparation of binaphthol monophosphoric acid derivatives.

References:

- JP 4725757, EP 1038877, US 6274745, 2000-3-21.

Chiral Phosphoric Acids

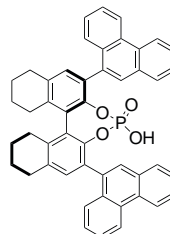
PHOSPHORUS (Compounds)

15-0376 (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-9-phenanthrenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 95% (99% ee) (1028416-47-8) 50mg
NEW
 $C_{48}H_{37}O_4P$; FW: 708.8; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

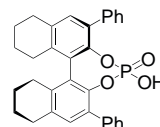
Technical Note:

1. See 15-0566 (page 20)

15-0566 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-9-phenanthrenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (934201-93-1) 50mg
NEW
 $C_{48}H_{37}O_4P$; FW: 708.8; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

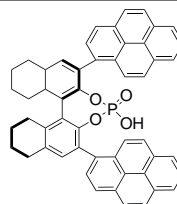


15-1396 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (791616-65-4) 100mg
 $C_{32}H_{29}O_4P$; FW: 508.5; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.



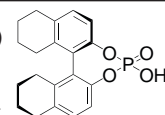
15-1397 (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-diphenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (945852-48-2) 100mg
 $C_{32}H_{29}O_4P$; FW: 508.5; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

15-0444 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-pyrenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) (1225195-02-7) 50mg
NEW
 $C_{52}H_{37}O_4P$; FW: 756.8; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.



15-0446 (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-2,6-di-1-pyrenyl-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98% (99% ee) 50mg
NEW
 $C_{52}H_{37}O_4P$; FW: 756.8; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.

15-1370 (11bR)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphepin, 98%, (99% ee) (297752-25-1) 100mg
 $C_{20}H_{21}O_4P$; FW: 356.4; white to light yellow pwdr.
 Note: Sold in collaboration with Daicel for research purposes only.



Technical Note:

1. The preparation of binaphthol monophosphoric acid derivatives.

References:

1. JP 4725757, EP 1038877, US 6274745, 2000-3-21.

Chiral Phosphoric Acids

PHOSPHORUS (Compounds)

| | | |
|---------|--|-------|
| 15-1371 | (11bS)-8,9,10,11,12,13,14,15-Octahydro-4-hydroxy-4-oxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin, 98%, (99% ee) (1193697-61-8) C ₂₀ H ₂₁ O ₄ P; FW: 356.4; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | 100mg |
|---------|--|-------|

Technical Note:

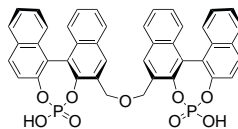
- The preparation of binaphthol monophosphoric acid derivatives.

References:

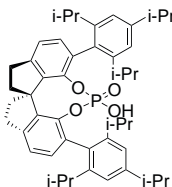
- JP 4725757, EP 1038877, US 6274745, 2000-3-21.

| | | |
|-----------------------|---|------|
| 15-0356 NEW | (11bS,11'bS)-2,2'-[Oxybis(methylene)]bis[4-hydroxy-4,4'-dioxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin], 95% (99% ee) (1447217-75-5) C ₄₂ H ₂₈ O ₉ P ₂ ; FW: 738.6; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|-----------------------|---|------|

| | | |
|-----------------------|---|------|
| 15-0354 NEW | (11bR,11'bR)-2,2'-[Oxybis(methylene)]bis[4-hydroxy-4,4'-dioxide-dinaphtho[2,1-d:1',2'-f][1,3,2]dioxaphosphopin], 98% (99% ee) (1022915-09-8) C ₄₂ H ₂₈ O ₉ P ₂ ; FW: 738.6; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|-----------------------|---|------|



| | | |
|-----------------------|--|------|
| 15-0574 NEW | (11aR)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-bis[2,4,6-trisopropylphenyl]-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 95% (99% ee) (1372719-95-3) C ₄₇ H ₅₉ O ₄ P; FW: 718.9; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|-----------------------|--|------|



| | | |
|-----------------------|--|------|
| 15-0464 NEW | (11aS)-10,11,12,13-Tetrahydro-5-hydroxy-3,7-bis[2,4,6-trisopropylphenyl]-5-oxide-diindeno[7,1-de:1',7'-fg][1,3,2]dioxaphosphocin, 98% (99% ee) (1258276-28-6) C ₄₇ H ₅₉ O ₄ P; FW: 718.9; white to light yellow pwdr. Note: Sold in collaboration with Daicel for research purposes only. | 50mg |
|-----------------------|--|------|

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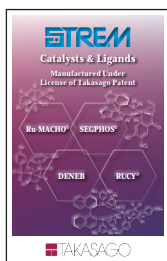
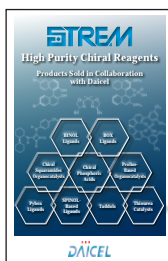
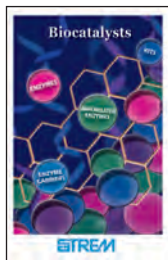
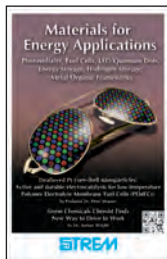
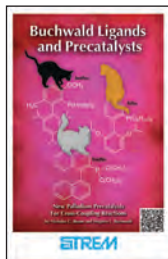
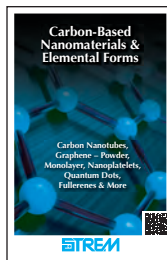
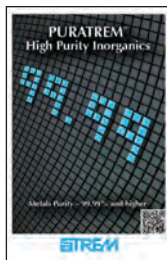
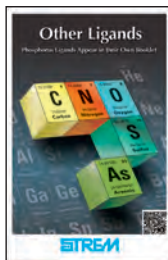
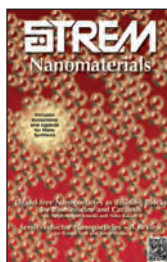
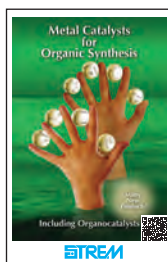


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