Ms No. JA981869

Supporting Information

Revised 9-9-98

Materials and methods.

All reagents were used as supplied commercially unless otherwise noted. THF and diethyl ether were distilled from sodium under N_2 before use. CH_2Cl_2 was distilled under N_2 from P_2O_5. CH_3CN was dried with P_2O_5 and distilled from K_2CO_3. 2,2'-dimethoxy-1,1'-binaphthyl-3,3'-dicarboxylic acid was prepared according to literature method.[†] ^1H NMR spectra were performed on a Varian XL-400 or XL-500 Spectrometer in the solvent specified, referenced to the residual proton signals. Routine mass spectra were obtained from the University of California, San Francisco Mass Spectrometry Facility. UV-visible spectra were recorded on a Hewlett-Packard 8452 Diode Array Spectrometer. Epoxide formation in olefin epoxidations was analyzed on a Hewlett-Packard 5890 Gas Chromatograph equipped with a DB-5 capillary column (0.32 mm × 25 M, i.d., 0.25 μm, J&W Scientific). Enantiomeric excesses were determined by chiral GLC with a Cyclodex-B-PH chiral capillary column (0.26mm × 30 M, i.d., 0.25 μm, J&W Scientific).

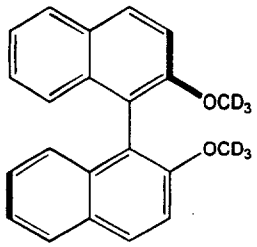
General Procedure for Asymmetric Olefin Epoxidation.

Catalyst **1** (1 μmol), dodecane (25 μL, as a GC standard) and an olefin (1.0 mmol) were dissolved in freshly distilled CH_2Cl_2 (2 mL) in a Shlenk tube. The mixture was deaerated by evacuation and refilling N_2 for several times. With stirring and under a N_2 flow, PhIO (0.10 mmol) was added in one portion. The reaction mixture was stirred at rt and monitored by GC periodically. Each aliquot (ca. 10 μL) was passed through a short pad of silica gel (0.5 cm) and eluted with CH_2Cl_2 (200 μL). The elute was collected and injected on GC for analysis. At the end of the reaction, CH_2Cl_2 was removed under reduced pressure and the reaction mixture was loaded on a short silica gel column (1 × 5 cm). PhI and unreacted olefins were eluted with pentane. Epoxides were eluted with 20% ether/pentane. The ee's of the epoxides were determined by GC on a Cyclodex-B chiral stationary phase column. The GC conditions are as follows: (epoxide, oven temperature,

[†] Naruta, Y.; Tani, F.; Ishibara, N.; Maruyama, K. *J. Am. Chem. Soc.* **1991**, *113*, 6865.

retention time with the absolute configuration): (styrene oxide, 95°C, 14.3 min (R), 14.7 min (S); pentafluorostyrene oxide, 70°C, 32.3 min (R), 32.9 min (S); *m*-chlorostyrene oxide, 95C, 44.2 min (R), 44.7 min (S); *o*-nitrostyrene oxide, 125°C, 41.4 min (R), 41.9 min (S); *m*-nitrostyrene oxide, 120°C, 107.7 min (R), 109.0 min (S); 1,2-dihydronaphthalene oxide, 95°C, 31.3 min (1S, 2R), 32.7 min (1R, 2S); *cis*-β-methylstyrene oxide, 105°C, 13.6 min (1R, 2S), 14.1 min (1S, 2R); *t*-butyloxirane, 25°C, 15.6 min, 15.9 min; trimethylsilyloxirane, 35°C, 12.2 min, 12.6 min.

Preparation of (R)-binaphthyl di-CD_3 ether



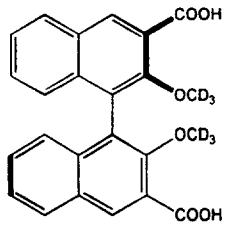
(R)-(+)-2,2'-Binaphthol (572 mg, 2.0 mmol) and CD_3I (870 mg, 6.0 mmol) were dissolved in anhydrous MeCN (20 mL, dried and distilled from K_2CO_3). To the solution was added in one portion dry Cs_2CO_3 (1.96 g, 6.0 mmol). The mixture was stirred at room temperature under an atmosphere of N_2 for 24h. Ether (100 mL) was added and the mixture was washed with saturated NaCl solution (20 mL × 3). The ether layer was separated and dried over $MgSO_4$. After evaporation of the solvent, the crude product was purified by passing through a short silica gel column (eluent: CH_2Cl_2/hexane = 1/1). Yield 627 mg (98%).

^{1}H NMR (400 MHz/$CDCl_3$) 7.97(d, J = 8.9 Hz, 2H), 7.86(d, J = 8.1 Hz, 2H), 7.45(d, J = 8.9 Hz, 2H), 7.31(dd, J = 8.1, 7.0 Hz, 2H), 7.20(dd, J = 8.3, 7.0 Hz, 2H), 7.10(d, J = 8.3 Hz, 2H).

^{13}C NMR (400 MHz/$CDCl_3$) 154.93, 133.97, 129.38, 129.16, 127.91, 126.30, 125.22, 123.49, 119.52, 114.18.

MS: m/e = 323.2 $(M+H)^+$ for $C_{22}H_{12}D_6O_2$ (LSIMS$^+$).

Preparation of CD_3O-substituted binaphthyl diacid



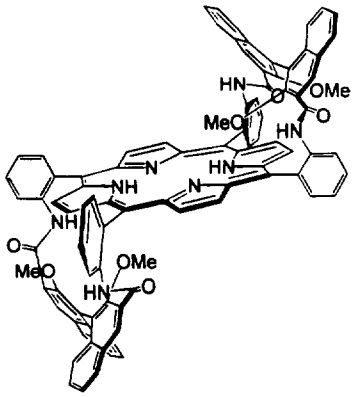
A 200 mL three-necked flask was fitted with a reflux condenser, a N_2 inlet and gas outlet (on top of the condenser) connected to a bubbler. The system was flushed with dry N_2 and the walls of the glassware were dried with a small flame. Under a N_2 flow, the flask was charged with di-CD_3 ether (500 mg, 1.56 mmol), TMEDA (N, N, N', N'-tetramethylethylenediamine, 1.0 mL) and diethyl ether freshly distilled from sodium (100 mL). The mixture was cooled to 0°C by an ice-water bath. With stirring, n-BuLi (2.5M in hexane, 2.5 mL, ca. 6.2 mmol) was slowly added via a syringe. After the addition was complete, the mixture was warmed to room temperature and refluxed for 24h. This mixture was cooled to 0°C again and CO_2 (dried by passing through concentrated H_2SO_4) was bubbled through the solution for 1h. After stirring for another hour, ether was removed by rotary evaporation, water (100 mL) was added and the resulting mixture was washed with benzene (30 mL × 2) (The benzene layer may contain unreacted starting material if the metalation is not complete). The aqueous layer was then acidified with 5M HCl solution and extracted with $CHCl_3$ (50 mL × 3). The $CHCl_3$ extractions were combined and dried with Na_2SO_4. Removal of the solvent gave the crude product which was recrystallized from hot benzene. Yield 414 mg (65%).

^{1}H NMR (400 MHz/$CDCl_3$) 8.95(s, 2H), 8.07(d, J = 7.5 Hz, 2H), 7.54(t, J = 7.5 Hz, 2H), 7.45(t, J = 7.5 Hz, 2H), 7.15(d, J = 7.5 Hz, 2H).

^{13}C NMR (400 MHz/$CDCl_3$) 166.52, 153.89, 143.80, 136.38, 136.14, 130.04, 129.95, 126.57, 125.31, 124.42, 121.36.

MS (m/e): 409.1 $(M+H)^+$ for $C_{24}H_{12}D_6O_6$ (LSIMS$^+$).

Preparation of αααβ bis-binaphthyl-strapped free base porphyrin



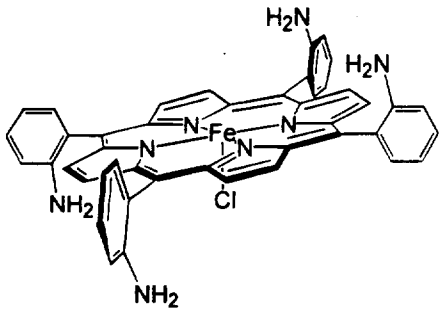
Binaphthyl diacid chloride was freshly prepared by refluxing 2,2'-dimethoxy-1,1'-binaphthyl-3,3'-dicarboxylic acid (45 mg, 0.11 mmol) with $SOCl_2$ for 8h and dried *in vacuo*. αααβ-TAPP (tetrakis(*o*-aminophenyl)porphine) (34 mg, 0.05 mmol) and N, N-diethylaniline (45 mg, 0.30 mmol) were dissolved in anhydrous THF (25 mL, freshly distilled from sodium). Under a flow of dry N_2, the solution was cooled to 0°C with an ice-water bath and a solution of the diacid chloride in THF (10 mL) was added by syringe pump over 1h. The mixture was allowed to stir at room temperature overnight. THF was removed by rotary evaporation and the residue was taken up in CH_2Cl_2 (100 mL) and washed with water (20 mL). After dried with Na_2SO_4, the solution was reduced to dryness and the residue was subject to column chromatography on silica gel (eluent: CH_3OH/CH_2Cl_2 = 1/99) to give bis-binaphthyl-strapped porphyrin (42 mg, 60%).

^1H NMR (400 MHz/$CDCl_3$) 11.85(s, 2H), 9.11(d, J = 8.0 Hz, 2H), 8.86-8.85(m, 6H), 8.69(s, 4H), 8.40(d, J = 8.0 Hz, 2H), 8.33(d, J = 6.7 Hz, 2H), 7.99(s, 2H), 7.95-7.85(m, 4H), 7.82(t, J = 6.7 Hz, 2H), 7.69(t, J = 6.7 Hz, 2H), 7.64(s, 2H), 7.34-7.20(m, 8H), 7.06(t, J = 6.6 Hz, 2H), 6.93(t, J = 6.6 Hz, 2H), 6.74(t, J = 6.7 Hz, 2H), 6.51(d, J = 6.6 Hz, 2H), 6.37(d, J = 6.7 Hz, 2H), 2.96(s, 6H), -0.65(s, 6H), -2.93(s, 2H).

MS: m/e = 1407.5 $(M+H)^+$ for $C_{92}H_{62}N_8O_8$ ($LSIMS^+$).

UV-vis (CH_2Cl_2): 418(soret), 510 nm.

Preparation of Fe(αααβ-TAPP)Cl

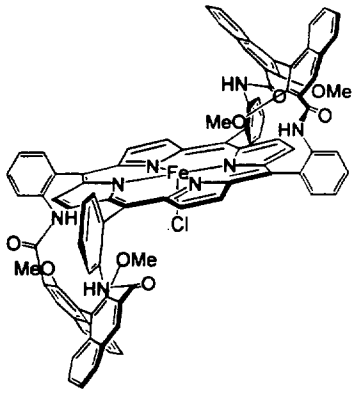


A mixture αααββ-TAPP (67.4 mg, 0.10 mmol), $FeBr_2$ (200 mg, 0.93 mmol), 2,6-lutidine (0.20 mL) in benzene-THF solution (1:1, 50 mL) was stirred for 24h at room temperature in a dry box. The metalation was complete as indicated by UV-visible spectroscopy. This mixture was brought out and stirred under air for 3h. The solvents were removed under vacuum and the residue was dissolved in CH_2Cl_2 (200 mL) and filtered to remove iron salt. The CH_2Cl_2 layer was washed with aqueous NH_4Cl solution, dried over $MgSO_4$ and concentrated to give Fe(αααββ-TAPP)Cl. The yield is quantitative.

MS: m/e = 728.2 $(M\text{-}Cl)^+$ for $C_{44}H_{32}ClFeN_8$ ($LSIMS^+$).

UV-vis (CH_2Cl_2): 370, 416, 510, 580 nm.

Preparation of αααββ bis-binaphthyl-strapped Fe porphyrin (1)



Binaphthyl diacid chloride was freshly prepared by refluxing the diacid (45 mg, 0.11 mmol) with $SOCl_2$ for 8h and dried *in vacuo*. Fe(αααββ-TAPP)Cl (35 mg, 0.05 mmol) and N, N-diethylaniline (45 mg, 0.30 mmol) were dissolved in anhydrous THF (25 mL, freshly distilled from sodium). Under a flow of dry N_2, the solution was cooled to 0°C with an ice-water bath and a solution of the diacid chloride in THF (10 mL) was added by syringe pump over 1h. The mixture was allowed to stir at room temperature overnight.

THF was removed by rotary evaporation and the residue was taken up in CH_2Cl_2 (100 mL) and washed with water (20 mL). After dried with Na_2SO_4, the solution was reduced to dryness and the residue was subject to column chromatography on silica gel (eluent: CH_3OH/CH_2Cl_2 = 5/95). The fraction was washed with 10% aqueous HCl and dried to give bis-binaphthyl-strapped Fe porphyrin **1** (40 mg, 53%).

MS m/e = 1461.4 $(M\text{-}Cl)^+$ for $C_{92}H_{60}ClFeN_8O_8$ ($LSIMS^+$).

UV-vis (CH_2Cl_2): 346, 420, 504, 566 nm.

Catalyst **1a** was synthesized following the same procedure using CD_3O-substituted binaphthyl diacid.

MS m/e = 1473.4 $(M\text{-}Cl)^+$ for $C_{92}H_{48}ClD_{12}FeN_8O_8$ ($LSIMS^+$).

UV-vis (CH_2Cl_2): 345, 420, 504, 564 nm.

Demetalation of 1. A mixture of **1** (10 mg) and $NaBH_4$ (38 mg) in CH_3OH (5 mL) was stirred at rt under N_2 for 1h. To the mixture was added deaerated HCl solution (6 N, 2 mL) with cooling. The demetalated porphyrin was taken up with CH_2Cl_2 (10 mL), washed with water (5 mL × 2) and dried with Na_2SO_4. Evaporation of the solvents gave the corresponding metal free porphyrin. The ^1H NMR and mass spectra are identical with the porphrin prepared from αααβ-TAPP and **4**.

Experiment procedure for determining the ee's at different turnover numbers.

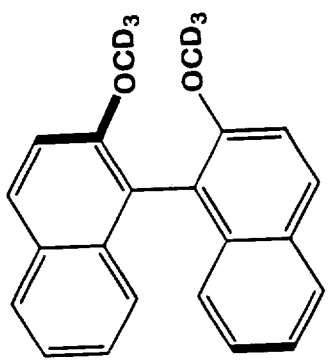
Catalyst **1** or **1a** (1 μmol), dodecane (25 μL, as a GC standard) and styrene (2.0 mL, ca. 17.5 mmol) and CH_2Cl_2 (2 mL) were mixed in a Shlenk tube. The mixture was deaerated by evacuation and refilling N_2 several times. With stirring and under a N_2 flow, PhIO was added in 10 μmol, 10 μmol, 100 μmol, 200 μmol, 400 μmol, 1000 μmol, 2000 μmol, 2000 μmol portions over time intervals during which the previous batch of oxidant was mostly consumed as indicated by the disappearance of solid PhIO. Small aliquots of the reaction mixture were taken periodically and subject to GC analysis as described in **General Procedure**. Ee's were plotted against the corresponding turnover numbers.

Styrene epoxidation catalyzed by 1 with different axial ligands.

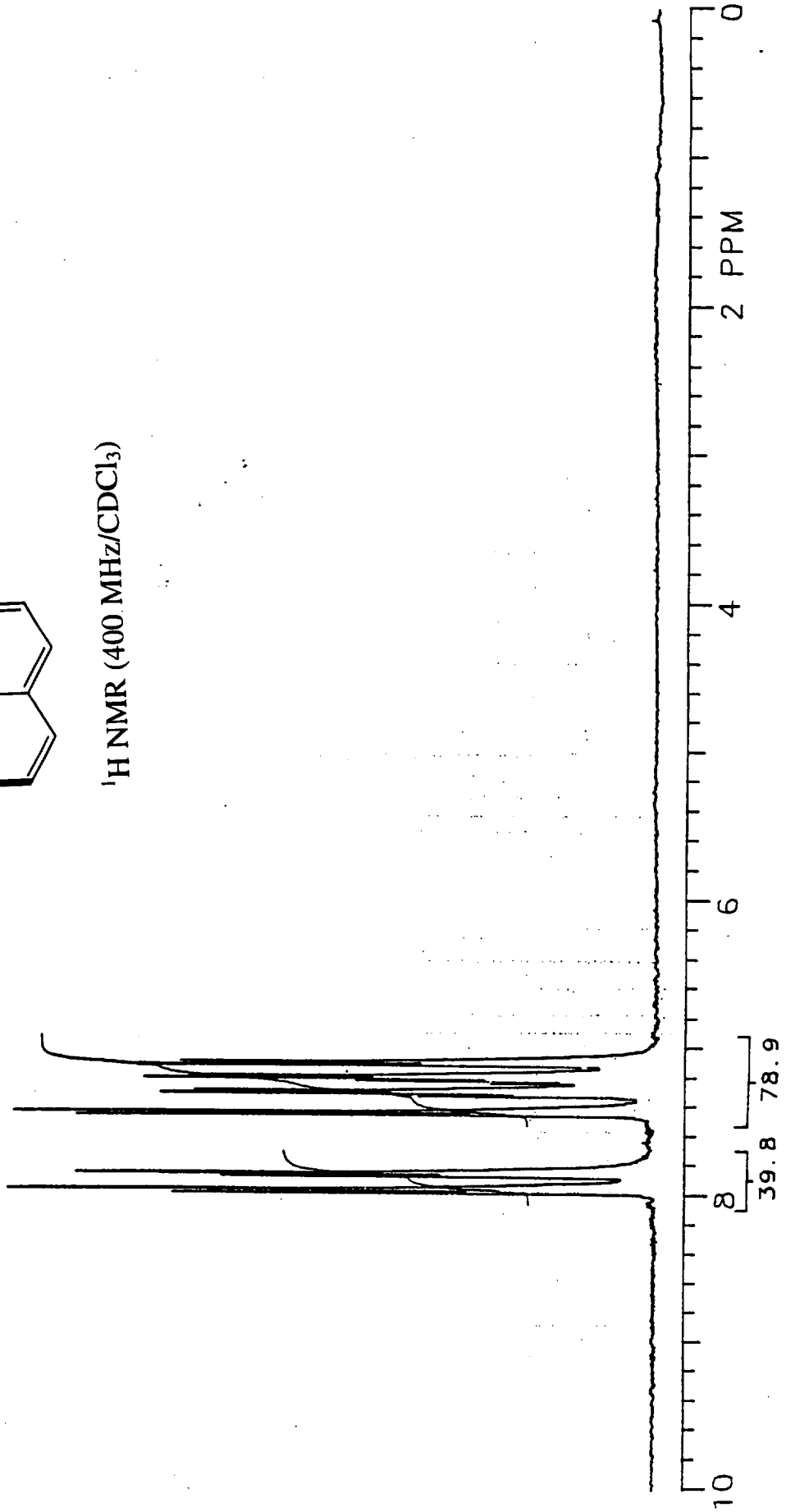
Catalyst **1** (1 μmol), dodecane (25 μL, as a GC standard), styrene (1.0 mmol) and an ligand (30 μmol) were dissolved in freshly distilled CH_2Cl_2 (2 mL) in a Shlenk tube. When weak field ligands such as DMSO and 2,6-difluoropyridine are used, $AgBF_4$ (5 μmol) was added and the mixture was stirred for 1h to remove choride ligand from the iron (aluminum foil was applied to protect the tube from light). The mixture was deaerated by evacuation and refilling N_2 several times. With stirring and under a N_2 flow, PhIO (0.10 mmol) was added. The reaction mixture was stirred at rt. The epoxidation products were analyzed by GC as described in **General Procedure**.

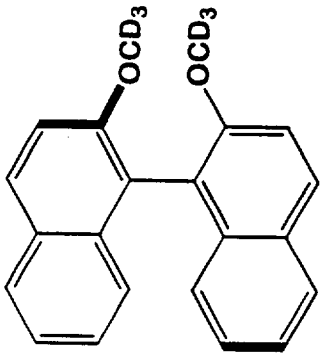
Epoxidation Reaction Using Olefin as the Limiting Reagent.

Catalyst **1** (1 μmol) and an olefin (1.0 mmol) were dissolved in CH_2Cl_2 (2 mL) in a Shlenk tube. PhIO (264 mg, 1.2 mmol) was added to the solution in 10 portions at room temperature with stirring. Each subsequent portion was added when the previous batch of PhIO had been consumed as indicated by the disappearance of the solid oxidant. The reaction was monitored with GC until the substrate was completely consumed. The reaction mixture was concentrated and the residue was subject to column chromatography on silica gel to give the epoxide. The ee of the product was determined by GC as described in **General Procedure**.



^{1}H NMR (400 MHz/$CDCl_3$)

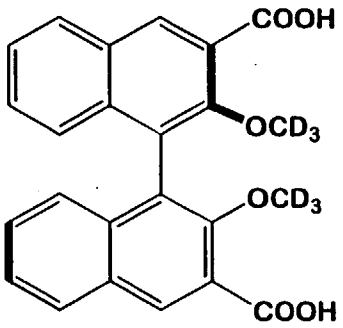




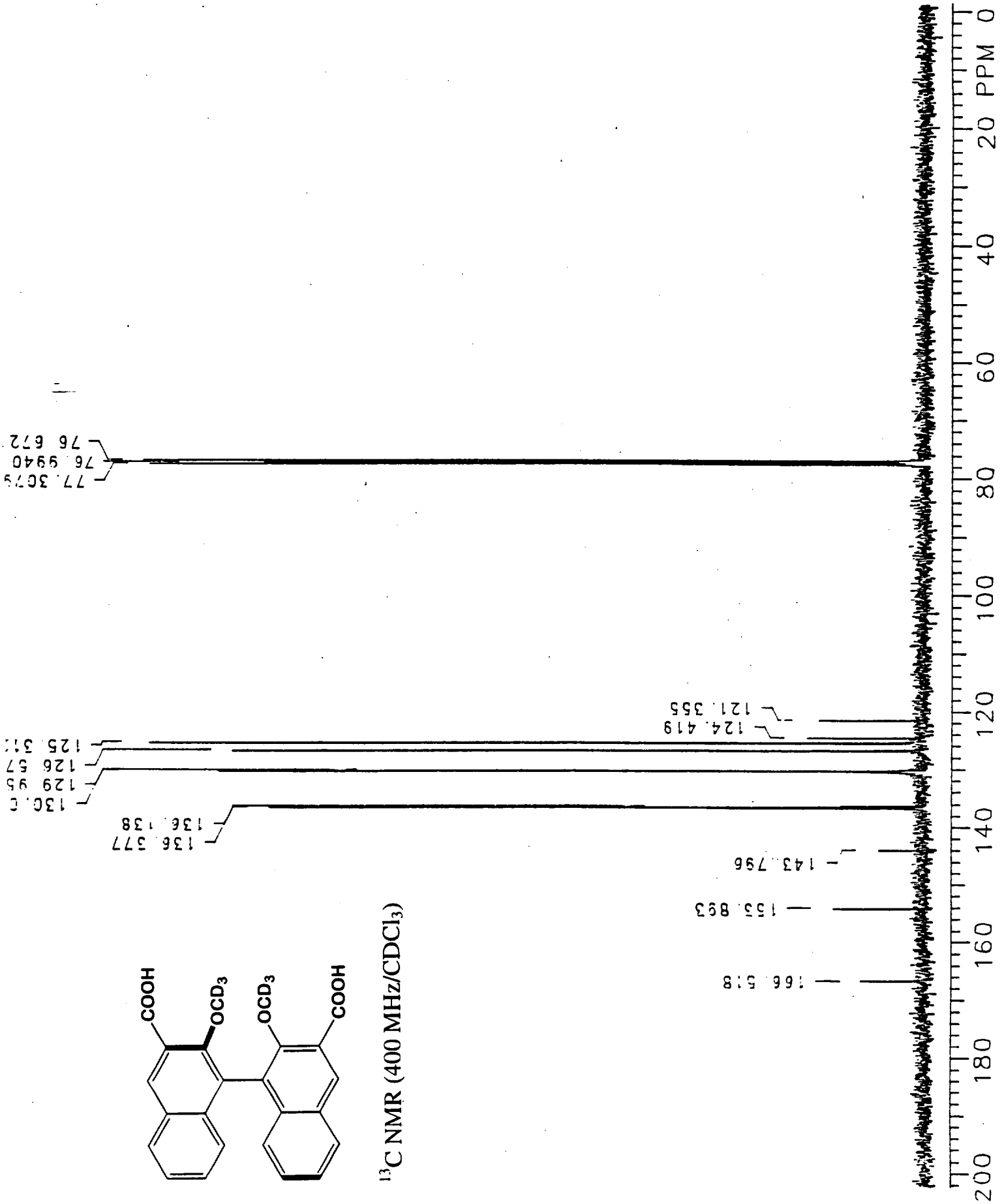
^{13}C NMR (400 MHz/$CDCl_3$)

3,3-DIACID
EXP1 PULSE SEQUENCE: STD1H
DATE 07-19-96
SOLVENT CDCL3
FILE CDCL3

OBSERVE PROTON
FREQUENCY 399.95 MHZ
SPECTRAL WIDTH 5000.0 HZ
ACQ. TIME 1.997 SEC
RELAXATION DELAY 1.0 MSEC
PULSE WIDTH 41 DEGREES
AMBIENT TEMPERATURE
NO. REPETITIONS 16
DOUBLE PRECISION ACQUISITION
DATA PROCESSING
LINE BROADENING 0.2 HZ
FT SIZE 32K

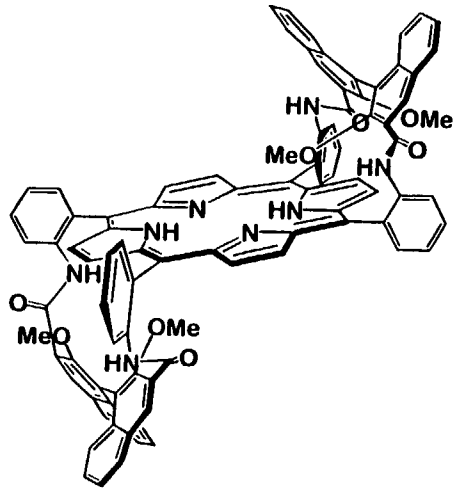


^{1}H NMR (400 MHz/$CDCl_3$)



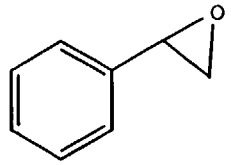
^{13}C NMR (400 MHz/$CDCl_3$)

aabb TAPP + binap diacid cl, frac 1
Solvent: CDCl3
Ambient temperature
INOVA-500 "ui500"
PULSE SEQUENCE
Pulse 45.0 degrees
Acq. time 1.998 sec
Width 8999.9 Hz
10000 repetitions
OBSERVE H1, 499.7485831 MHz
DATA PROCESSING
Line broadening 0.2 Hz
FT size 65536
Total time 5.6 hours

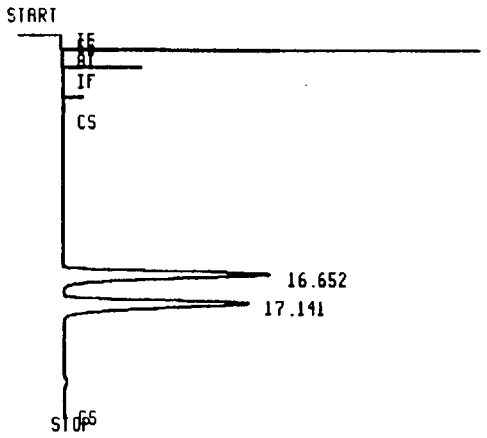


^{1}H NMR (500 MHz/$CDCl_3$)

GC Conditions: Column: Cyclodex-B-PH
J & W Scientific
Detection: FID



Racemate
Oven temperature: 90°C



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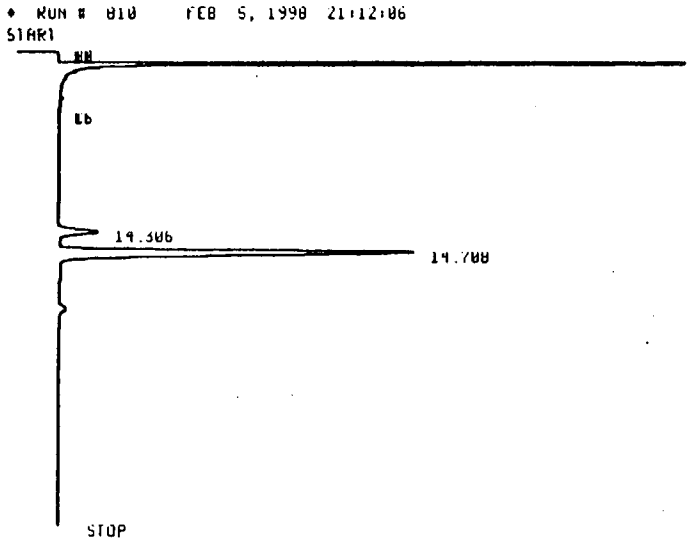
TOTAL AREA= 84663
MUL FACTOR=1.0000E+00

Reaction Product
Oven temperature: 95°C



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SIGNAL FILE: M:SIGNAL.BNC
AREA%

RT	AREA	TYPE	WIDTH	AREA%
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14.708	15750	PB	.115	91.50061

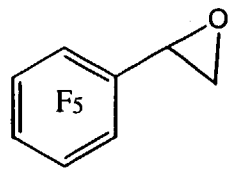
TOTAL AREA= 17213
MUL FACTOR=1.0000E+00

GC Conditions:

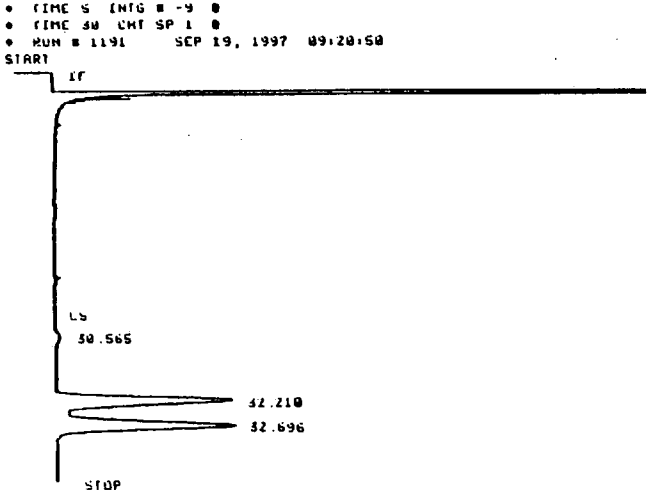
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 70°C

Detection: FID



Racemate



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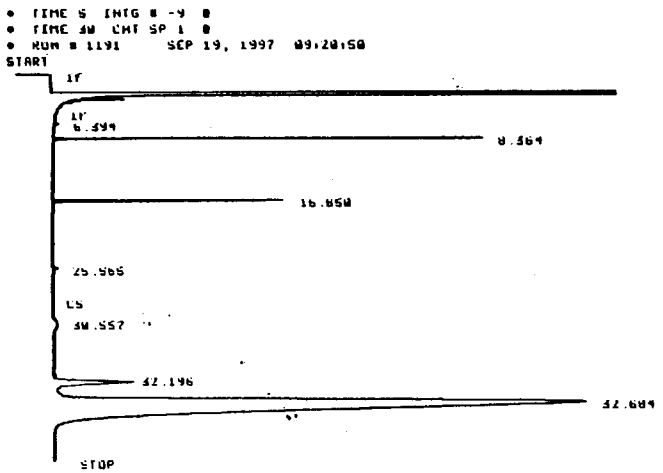
TOTAL AREA= 283820

Reaction Product



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SIGNAL FILE: M:SIGNAL.BNC
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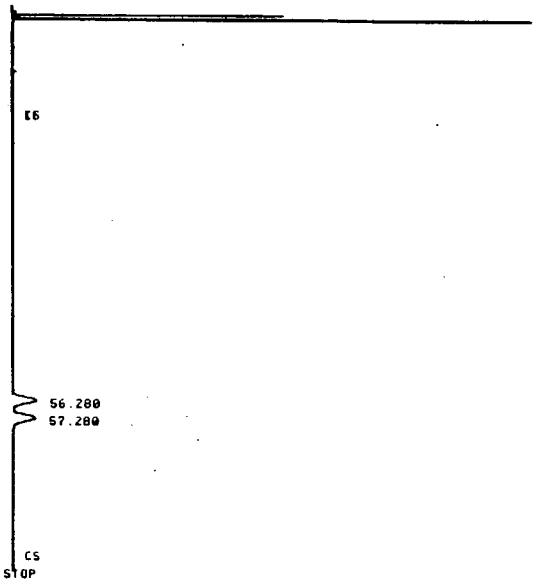
	16.650	26993	BB	.135	11.63592
	25.565	1308	PU	.251	.56384
	30.557	1447	PU	.301	.62376
/	32.196	21952	PU	.233	9.46486
}	32.684	164084	VB	.310	70.73239

TOTAL AREA= 231980

GC conditions: Column: Cyclodex-B-PH
J & W Scientific
Oven temperature: 90°C
Detection: FID

Racemate



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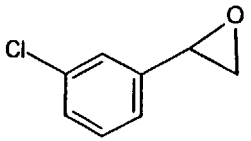
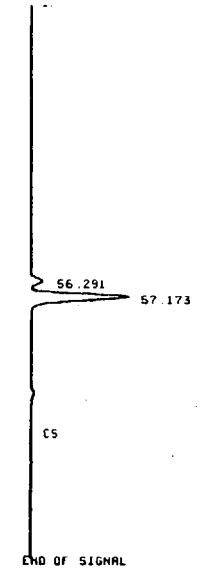


Reaction Mixture



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SIGNAL FILE: M:SIGNAL.BNA
AREAX

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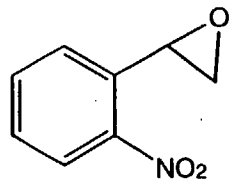
MUL FACTOR=1.0000E+00

GC Conditions:

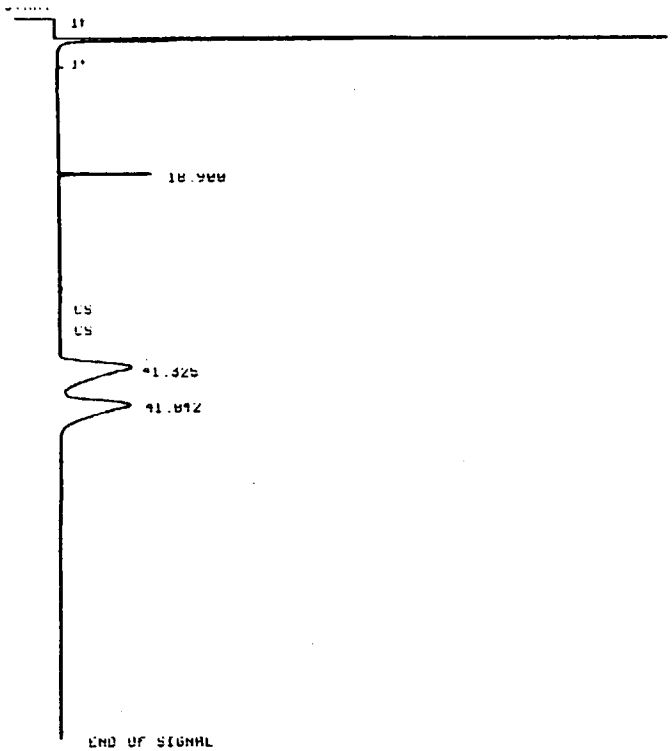
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 125°C

Detection: FID



Racemate



Closing signal file M:SIGNAL .BNN

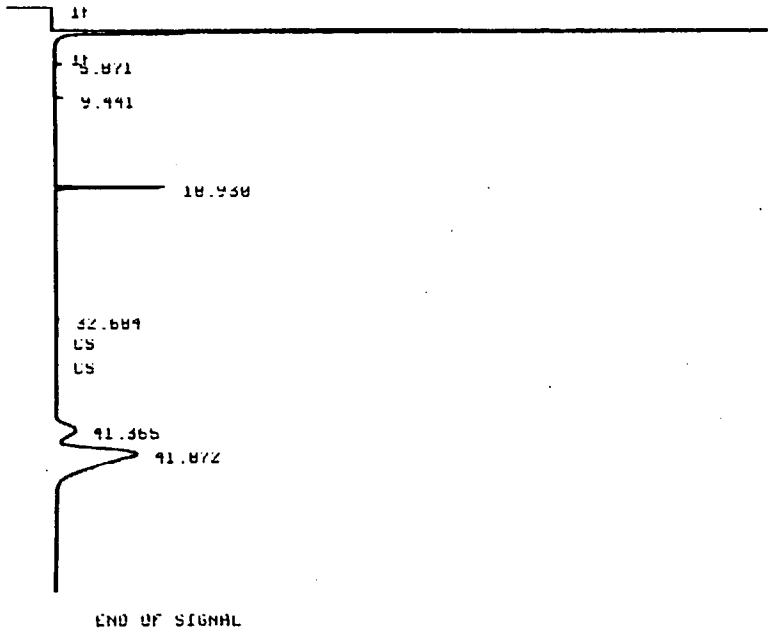
RUN# 222 OCT 25, 1997 14:35:36

SIGNAL FILE: M:SIGNAL.BNN
AREAX

	RT	AREA	TYPE	WIDTH	AREAX
	18.900	6201	PB	.153	3.57323
{	41.325	83702	PV	.289	48.27821
{	41.892	83557	VB	.401	48.14856

TOTAL AREA= 173540
MUL FACTOR=1.0000E+00

Reaction Product



Closing signal file M:SIGNAL .BNN

RUN# 222 OCT 25, 1997 14:35:36

SIGNAL FILE: M:SIGNAL.BNN
AREAX

	RT	AREA	TYPE	WIDTH	AREAX
	5.871	1071	BB	.053	.68911
	9.491	1899	PB	.070	1.21300
	18.930	46201	PB	.153	29.51123
	32.684	2294	PB	.281	1.43337
{	41.365	23530	PV	.289	15.02995
{	41.872	81609	VB	.401	52.12033

TOTAL AREA= 156554
MUL FACTOR=1.0000E+00

GC conditions: Column: Cyclodex-B-PH
J & W Scientific
Oven temperature: 110°C
Detection: FID

Racemate

END OF SIGNAL

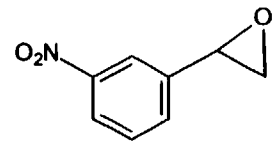
Closing signal file M:SIGNAL .BNA

RUN# 1746 SEP 1, 1998 16:22:41

SIGNAL FILE: M:SIGNAL.BNA
AREAX

RT	AREA	TYPE	WIDTH	AREAX
152.075	5449	PU	1.160	49.89786
154.370	5473	VP	1.237	50.10216

TOTAL AREA= 10922
MUL FACTOR=1.0000E+00



Reaction Mixture

END OF SIGNAL

Closing signal file M:SIGNAL .BNA

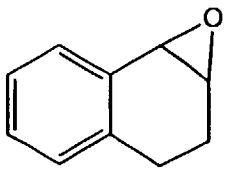
RUN# 1747 SEP 1, 1998 19:22:22

SIGNAL FILE: M:SIGNAL.BNA
AREAX

RT	AREA	TYPE	WIDTH	AREAX
152.054	12467	PU	1.167	13.88523
154.352	77319	VP	1.247	86.11476

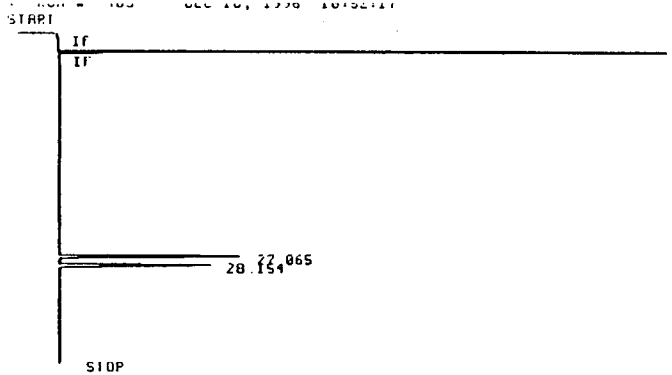
TOTAL AREA= 89786
MUL FACTOR=1.0000E+00

GC Conditions: Column: Cyclodex-B-PH
J & W Scientific
Detection: FID



Racemate

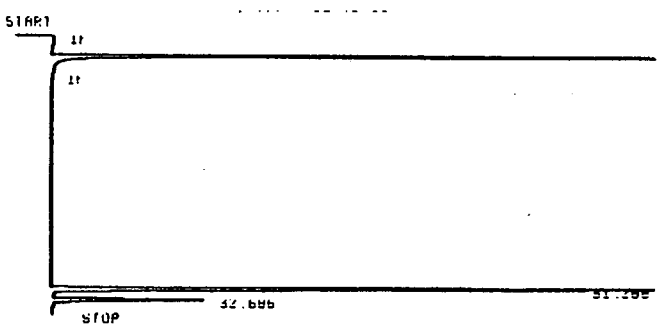
Oven temperature: 100°C




```
Closing signal file M:SIGNAL   .BNC

RUN#   403          DEC 18, 1996  10:52:17

SIGNAL FILE: M:SIGNAL.BNC
AREA%
      RT       AREA TYPE  WIDTH      AREA%
  27.065      59576   PB    .209   49.86774
  28.154      59892   PB    .225   50.13225

TOTAL AREA= 119468
MUL FACTOR=1.0000E+00
```

Reaction Product

Oven temperature: 95°C



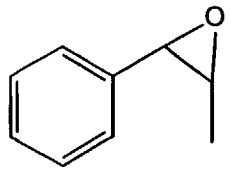

```
Closing signal file M:SIGNAL   .BNC

RUN#   202          OCT 24, 1997  12:40:38

SIGNAL FILE: M:SIGNAL.BNC
AREA%
      RT       AREA TYPE  WIDTH      AREA%
  31.289     117600   PB    .278   77.49434
  32.686      34153   BB    .278   22.50565

TOTAL AREA= 151753
MUL FACTOR=1.0000E+00
```

GC Conditions:

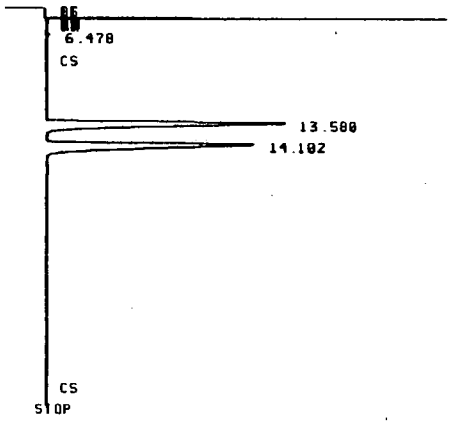
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 95°C

Detection: FID



Racemate



Closing signal file M:SIGNAL .BNC

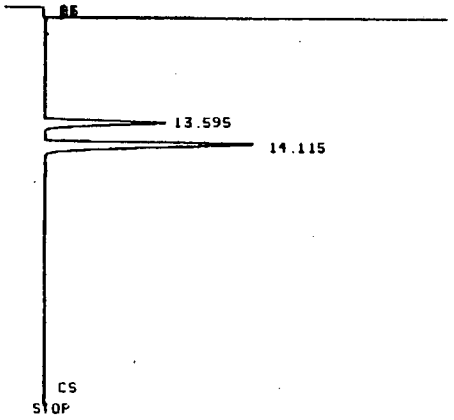
RUN# 871 AUG 11, 1997 21:50:20

SIGNAL FILE: M:SIGNAL.BNC
AREAX

	RT	AREA	TYPE	WIDTH	AREAX
	6.478	1244	BB	.059	.66404
{	13.580	92084	PB	.121	49.58070
{	14.102	93211	BB	.139	49.75526

TOTAL AREA= 187339
MUL FACTOR=1.0000E+00

Reaction Product



Closing signal file M:SIGNAL .BNC

RUN# 871 AUG 11, 1997 21:50:20

SIGNAL FILE: M:SIGNAL.BNC
AREAX

RT	AREA	TYPE	WIDTH	AREAX
13.595	32026	PB	.121	25.49983
14.115	93567	BB	.139	74.50017

TOTAL AREA= 125593
MUL FACTOR=1.0000E+00

Reaction Product + Eu(hfc)$_3$

There is no peak corresponding to the minor isomer. Assuming a 5% detection limit for NMR spectrometer, the minor isomer should be ≤5%, and the ee ≥ 90%.

^{1}H NMR (400 MHz/$CDCl_3$)

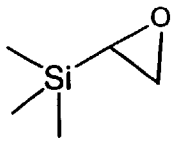
Racemate + Eu(hfc)$_3$

GC Conditions:

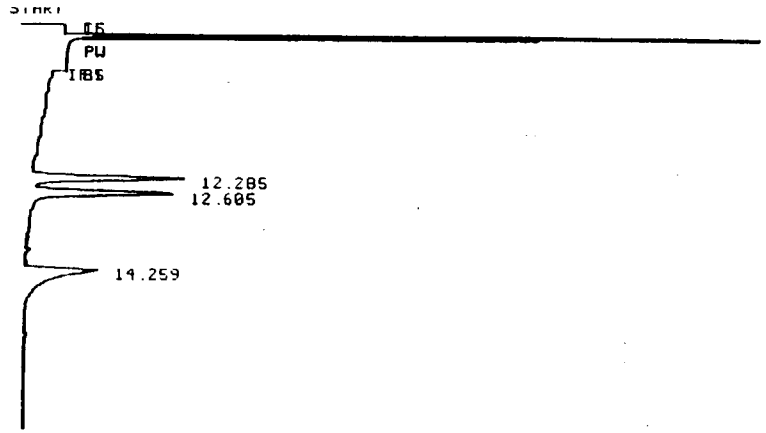
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 35°C

Detection: FID



Racemate



END OF SIGNAL

Closing signal file M:SIGNAL .BNA

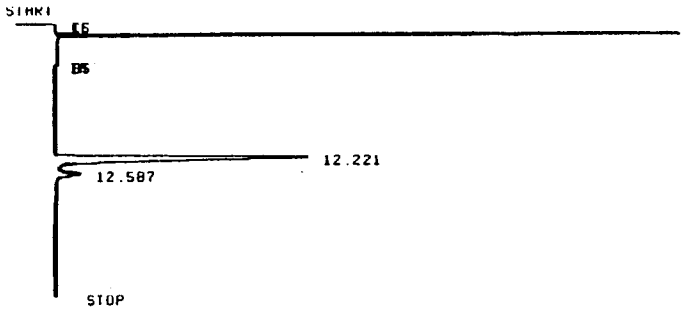
RUN# 276 MAR 22, 1998 17:20:13

SIGNAL FILE: M:SIGNAL.BNA
AREA%

	RT	AREA	TYPE	WIDTH	AREA%
{	12.285	1501	PU	.113	28.80446
{	12.605	1493	VB	.118	28.65894
	14.259	1792	PB	.260	34.38880
	23.165	425	PP	.208	8.15582

TOTAL AREA= 5211
MUL FACTOR=1.0000E+00

Reaction Product



Closing signal file M:SIGNAL .BNC

RUN# 280 MAR 22, 1998 22:33:21

SIGNAL FILE: M:SIGNAL.BNC
AREA%

RT	AREA	TYPE	WIDTH	AREA%
12.221	11277	VV	.116	90.96554
12.587	1120	VP	.113	9.03444

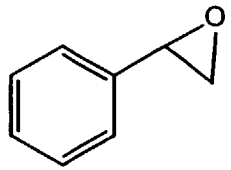
TOTAL AREA= 12397
MUL FACTOR=1.0000E+00

GC Conditions:

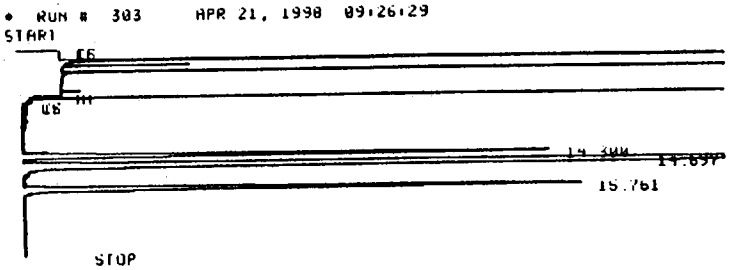
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 95°C

Detection: FID



Reaction Product using pyridine as the ligand



Closing signal file M:SIGNAL .BNC

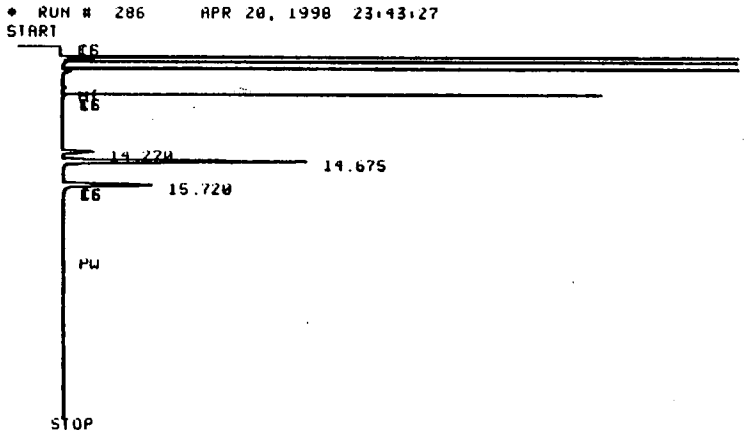
RUN# 303 APR 21, 1998 09:26:29

SIGNAL FILE: M:SIGNAL.BNC
AREA%

	RT	AREA	TYPE	WIDTH	AREA%
{	14.300	2626	BP	.110	10.60582
{	14.697	18906	PB	.119	76.35702
	15.761	3228	BB	.127	13.03716

TOTAL AREA= 24760
MUL FACTOR=1.0000E+00

Reaction Product using 2,6-difluoropyridine as the ligand



Closing signal file M:SIGNAL .BNC

RUN# 286 APR 20, 1998 23:43:27

SIGNAL FILE: M:SIGNAL.BNC
AREA%

	RT	AREA	TYPE	WIDTH	AREA%
{	14.270	1290	PP	.114	8.43192
{	14.675	10031	PB	.116	65.56637
	15.720	3978	PB	.124	26.00171

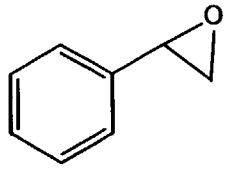
TOTAL AREA= 15299
MUL FACTOR=1.0000E+00

GC Conditions:

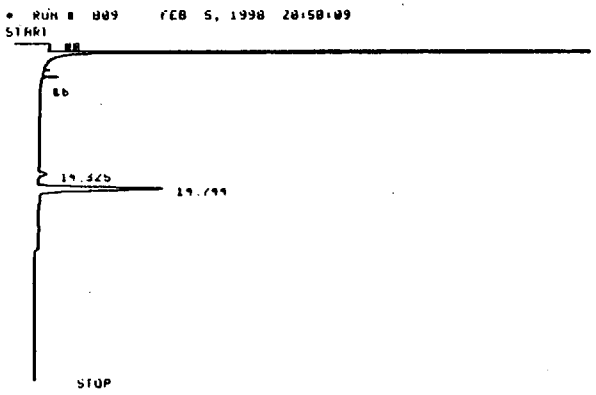
Column: Cyclodex-B-PH
J & W Scientific

Oven temperature: 95°C

Detection: FID



Reaction Product using DMSO as the ligand



Closing signal file M:SIGNAL .BNC

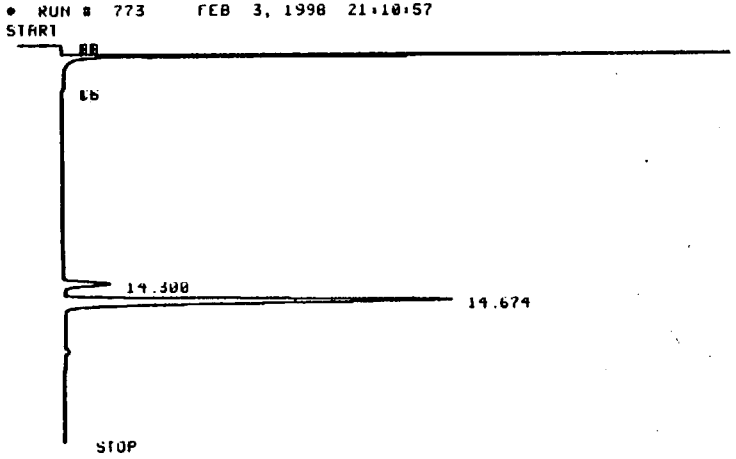
RUN# 889 FEB 5, 1998 20:50:09

SIGNAL FILE: M:SIGNAL.BNC
AREAX

RT	AREA	TYPE	WIDTH	AREAX
14.325	502	BP	.110	6.19983
14.799	7595	PB	.119	93.80017

TOTAL AREA= 8097
MUL FACTOR=1.0000E+00

Reaction Product using Br^- as the ligand



Closing signal file M:SIGNAL .BNC

RUN# 773 FEB 3, 1998 21:10:57

SIGNAL FILE: M:SIGNAL.BNC
AREAX

RT	AREA	TYPE	WIDTH	AREAX
14.300	3656	BP	.108	9.87334
14.674	33373	PB	.119	90.12666

TOTAL AREA= 37029
MUL FACTOR=1.0000E+00