DIRECT DETERMINATION OF THE ABSOLUTE CONFIGURATIONS OF CHIRAL CYANOHYDRINS USING BIS(ZINC PORPHYRIN) AS A CD-SENSITIVE BIDENTATE HOST

Satoshi Hayashi, Shiori Takeda, Masahiro Noji,* and Toshikatsu Takanami*

Meiji Pharmaceutical University, 2-522-1, Noshio, Kiyose, Tokyo 204-8588,
e-mail: mnoji@my-pharm.ac.jp; and takanami@my-phram.ac.jp

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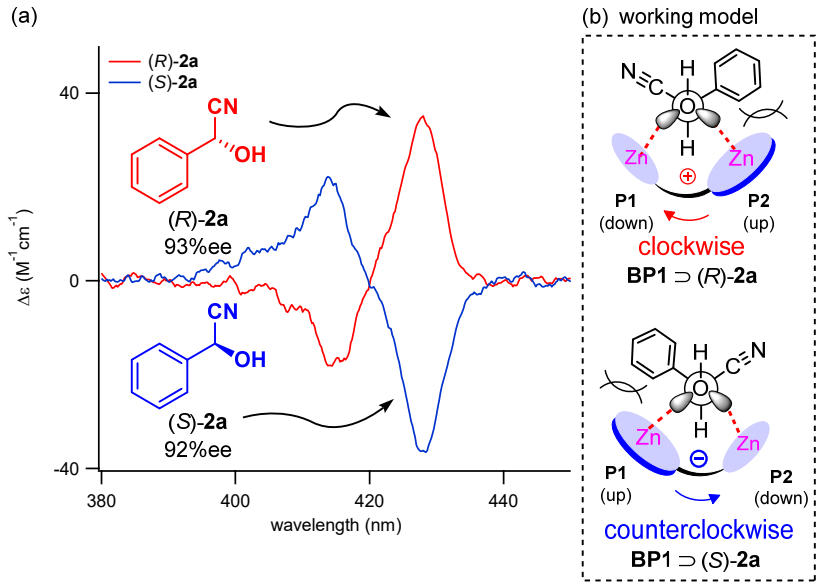


Figure S1. (a) ECCD spectra of **2a** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)- and (*S*)-**2a** (dashed box).

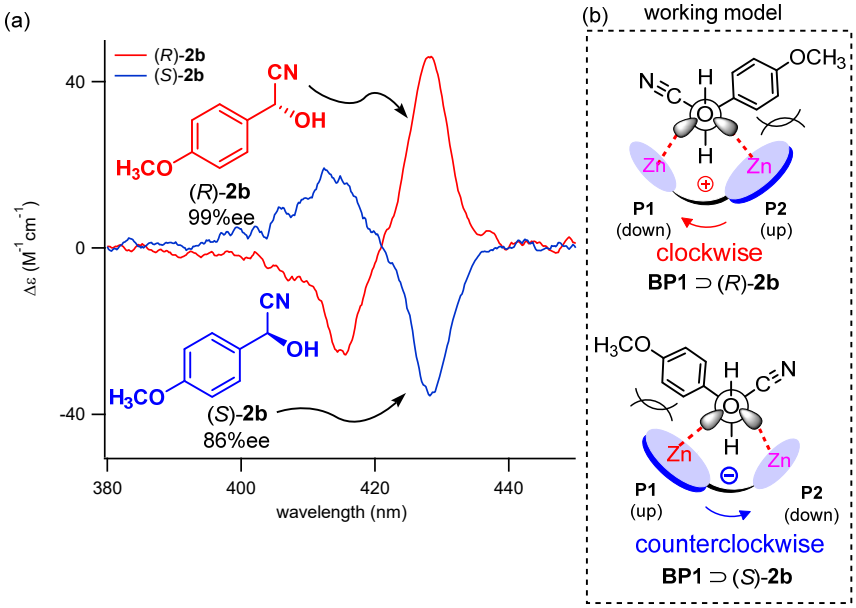


Figure S2. (a) ECCD spectra of **2b** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)- and (*S*)-**2b** (dashed box).

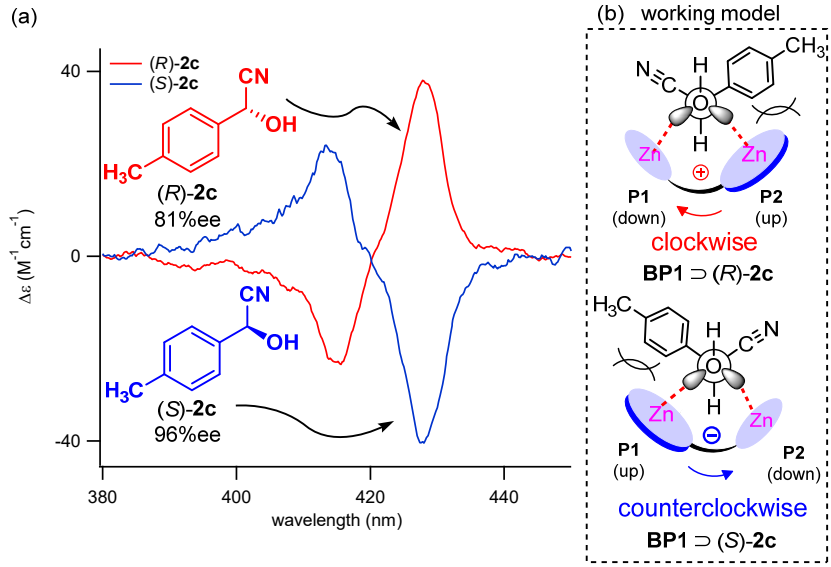


Figure S3. (a) ECCD spectra of **2c** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)- and (*S*)-**2c** (dashed box).

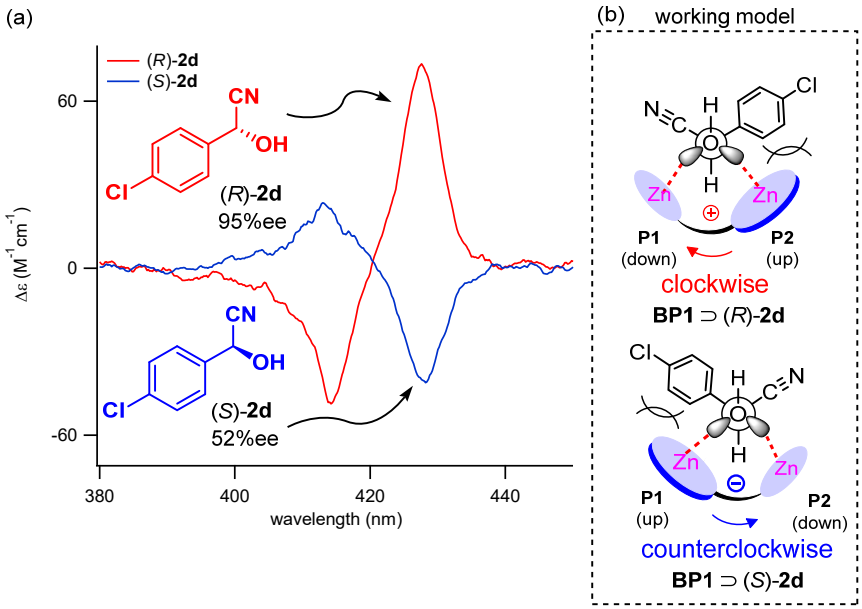


Figure S4. (a) ECCD spectra of **2d** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)- and (*S*)-**2d** (dashed box).

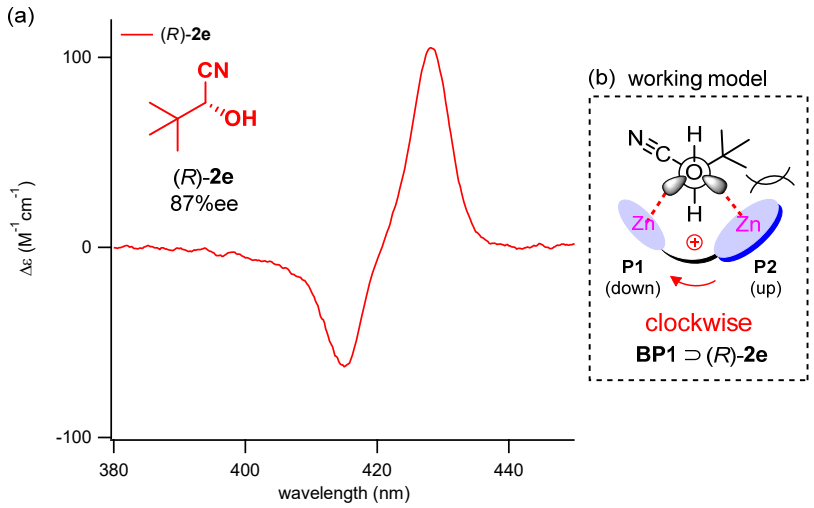


Figure S5. (a) ECCD spectrum of (*R*)-**2e** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)-**2e** (dashed box).

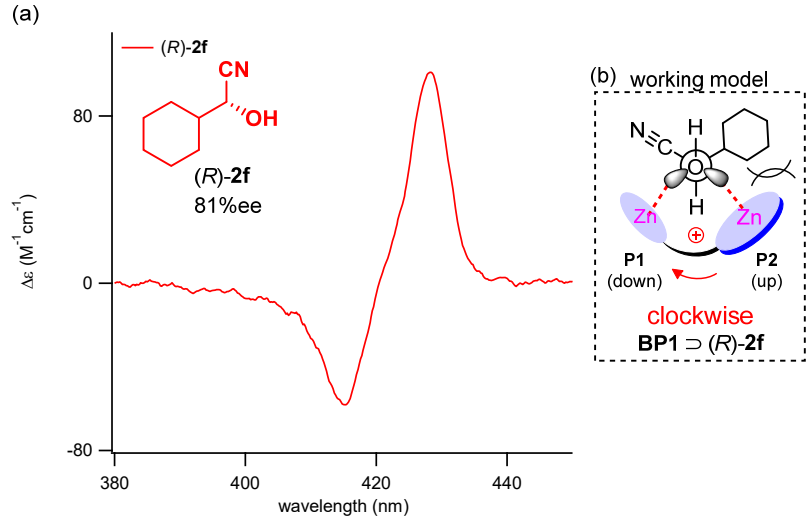


Figure S6. (a) ECCD spectrum of (*R*)-**2f** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)-**2g** (dashed box).

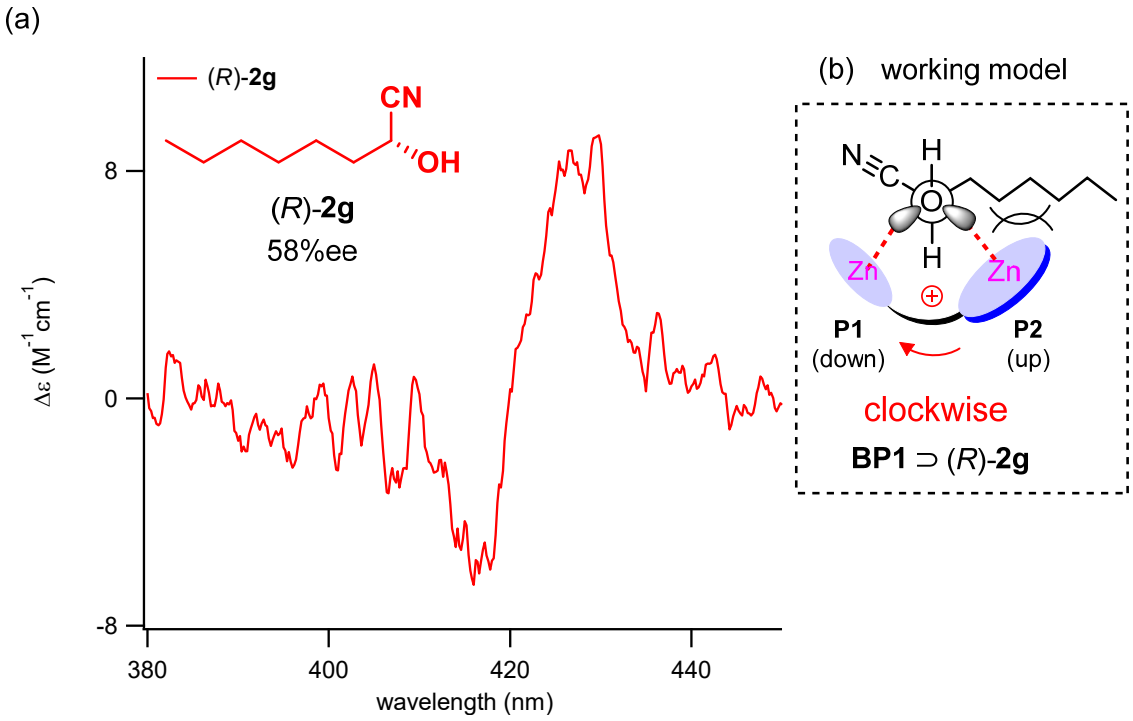


Figure S7. (a) ECCD spectrum of (*R*)-**2g** (7.5×10^{-6} M) in the presence of **BP1** (1.5×10^{-6} M) in 5% CH_2Cl_2/*n*-hexane at 0 °C. (b) The proposed working model for assigning the absolute configuration of the chiral guest (*R*)-**2g** (dashed box).

2 Correlation Between the Amplitude of ECCD Signal and ee of Cyanohydrins

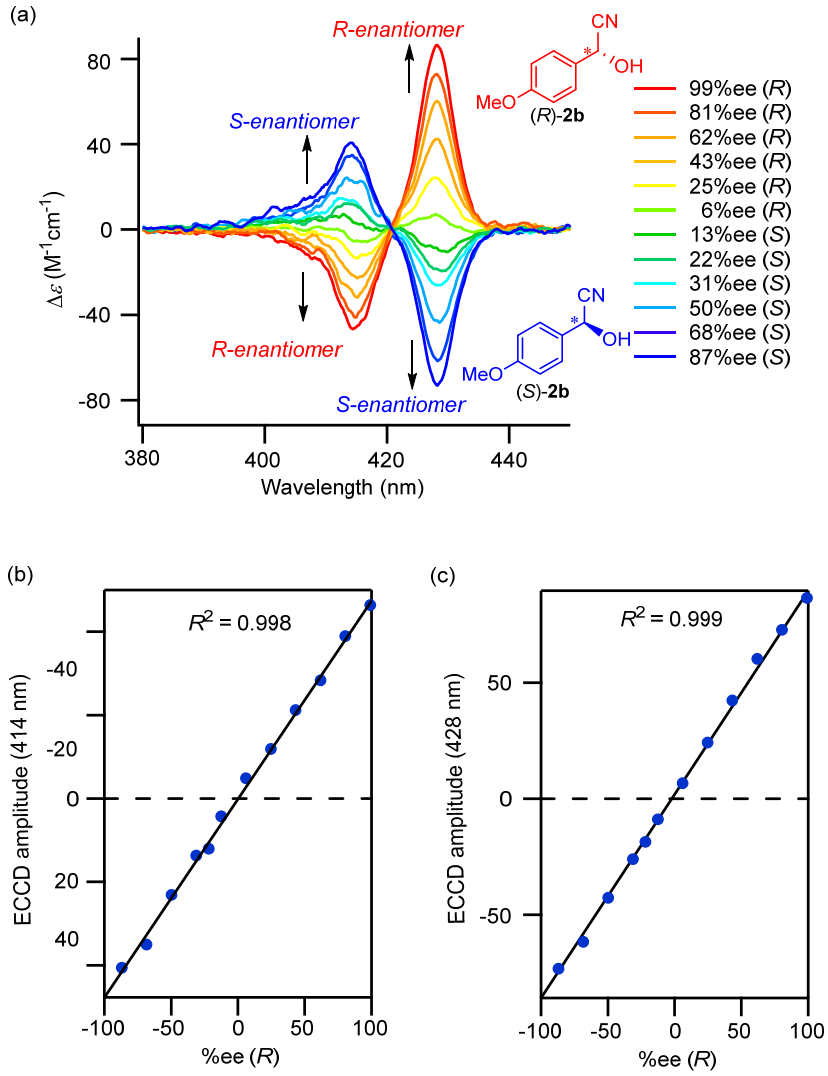
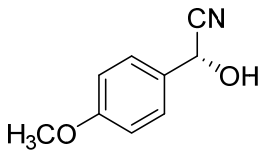


Figure S8. (a) ECCD spectra of **BP1** (1.5×10^{-6} M) complexed with **2b** (10 equiv) at different enantio excess (ECCD spectra were recorded in 5% CH_2Cl_2/*n*-hexane at 0 °C). (b) Plot of ECCD amplitude ($\Delta\varepsilon_{(415\ nm)}$) versus % ee of (*R*)-**2b** in complex with **BP1**. (c) Plot of ECCD amplitude ($\Delta\varepsilon_{(428\ nm)}$) versus % ee of (*R*)-**2b** in complex with **BP1**.

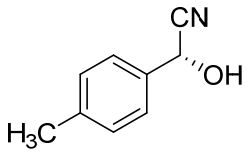
3 Optical Purity Determination of Chiral Cyanohydrins

Determination of the optical purity of (R)-2b



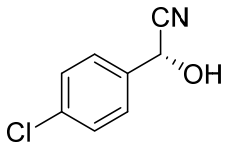
(*R*)-2-Hydroxy-2-(4-methoxypheny)lacetonitrle (*R*)-**2b**: White solid; 99%ee; $[\alpha]_D^{20}$ +47.5° (*c* 1.0, $CHCl_3$), lit.[1b] $[\alpha]_D^{26}$ +40.7° (*c* 0.90, $CHCl_3$) for *R* enantiomer in 96% ee.

Determination of the optical purity of (R)-2c



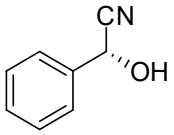
(*R*)-2-Hydroxy-2-(*p*-tolyl)acetonitrle (*R*)-**2c**: colorless oil; 81%ee; $[\alpha]_D^{20}$ -39° (*c* 1.0, $CHCl_3$), lit.[1b] $[\alpha]_D^{26}$ +46.5° (*c* 1.40, $CHCl_3$) for *R* enantiomer in 97% ee.

Determination of the optical purity of (R)-2d



(*R*)-2-hydroxy-2-(4-chlorophenyl)acetonitrle (*R*)-**2d**: colorless oil; 95%ee; $[\alpha]_D^{20}$ +39° (*c* 1.0, $CHCl_3$), lit.[1b] $[\alpha]_D^{27}$ +39.7° (*c* 0.70, $CHCl_3$) for *R* enantiomer in 97% ee.

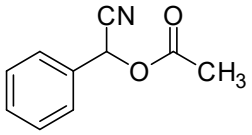
Determination of the optical purity of (R)-2a

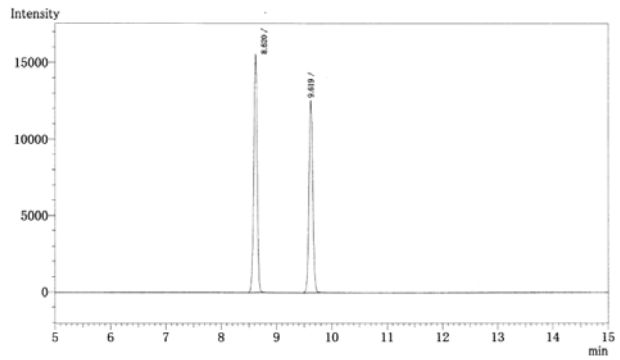


(*R*)-2-hydroxy-2-phenylacetonitrle [(*R*)-**2a**] [1a]: Pale yellow oil; 93%ee; $[\alpha]_D^{25}$ +41.6° (*c* 1.65, $CHCl_3$), [lit.[1a] $[\alpha]_D^{24}$ -45.4° (*c* 1.40, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding acetate.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 20 cm/s; injection temperature, 200 °C; column temperature, 150 °C, 40 min; detector temperature, 250 °C. Retention time: 8.6 min (*R*), 9.6 min (*S*).

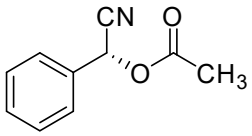
Racemic cyano(phenyl)methyl acetate (Derived from **2a**)

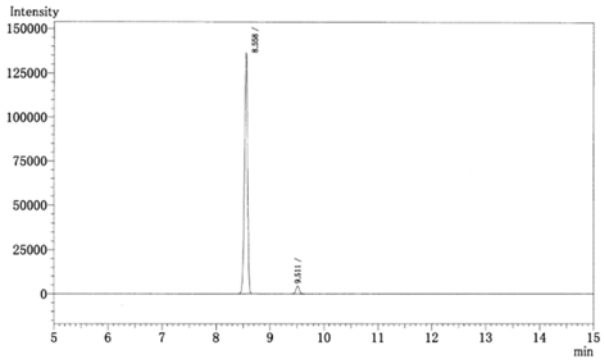




Peak No.	Rt (min)	Area	Area %
1	8.620	68090	53.282
2	9.616	59702	46.718
Total		127792	100.000

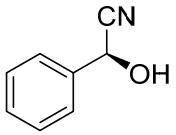
(*R*)-Cyano(phenyl)methyl acetate (Derived from (*R*)-**2a**)





Peak No.	Rt (min)	Area	Area %
1	8.558	552524	96.664
2	9.511	19069	3.336
Total		571593	100.000

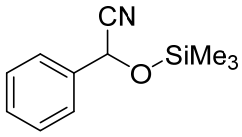
Determination of the optical purity of (S)-2a

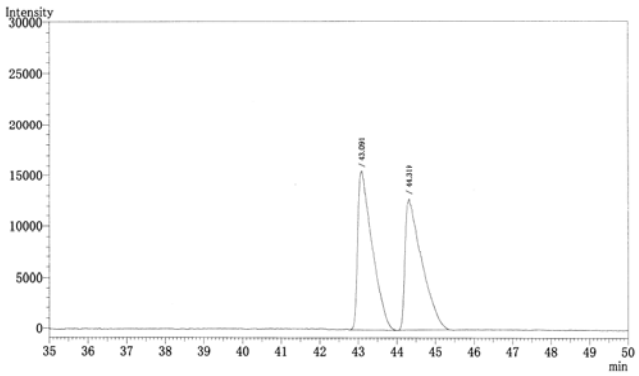


(*S*)-2-hydroxy-2-phenylacetonitrle [(*S*)-**2a**][1b] Pale yellow oil; 92%ee; $[\alpha]_D^{27}$ -36.7° (*c* 1.07, $CHCl_3$), [lit.[2a] $[\alpha]_D^{22}$ -41.9° (*c* 0.50, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding silyl ether.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 25 cm/s; injection temperature, 220 °C; column temperature, 100 °C, 50 min; detector temperature, 250 °C. Retention time: 43.1 min (*S*), 44.3 min (*R*).

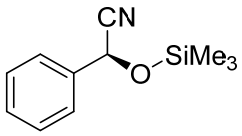
Racemic 2-phenyl-2-((trimethylsilyl)oxy)acetonitrile (Precursor of **2a**)

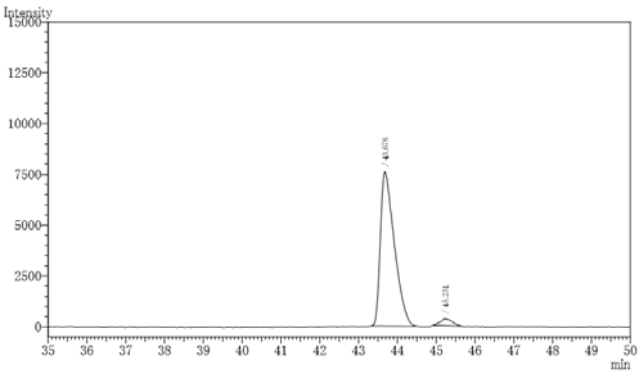




Peak No.	Rt (min)	Area	Area %
1	43.091	404445	51.061
2	44.319	387637	48.939
Total		792082	100.000

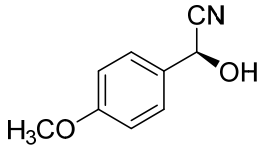
(*S*)-2-Phenyl-2-((trimethylsilyl)oxy)acetonitrile (Precursor of (*S*)-**2a**)





Peak No.	Rt (min)	Area	Area %
1	43.678	189944	96.222
2	45.231	7458	3.778
Total		197402	100.000

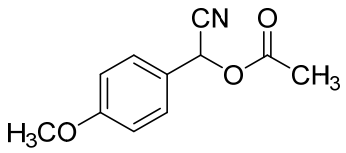
Determination of the optical purity of (S)-2b

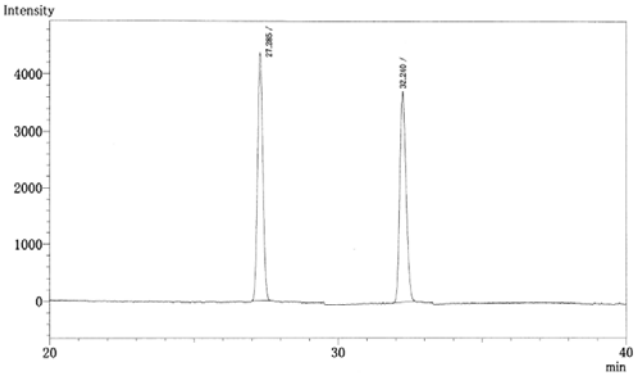


(*S*)-2-hydroxy-2-(4-methoxypheny)lacetonitrle [(*S*)-**2b**] [1a]: White solid; 86%ee; $[\alpha]_D^{27}$ -40.4° (*c* 0.63, $CHCl_3$), [lit.[2a] $[\alpha]_D^{20}$ -43.6° (*c* 1.25, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding acetate.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 20 cm/s; injection temperature, 200 °C; column temperature, 150 °C, 60 min; detector temperature, 250 °C. Retention time: 27.3 min (*R*), 32.2 min (*S*).

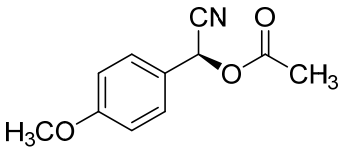
Racemic cyano(4-methoxyphenyl)methyl acetate (Derived from **2b**)

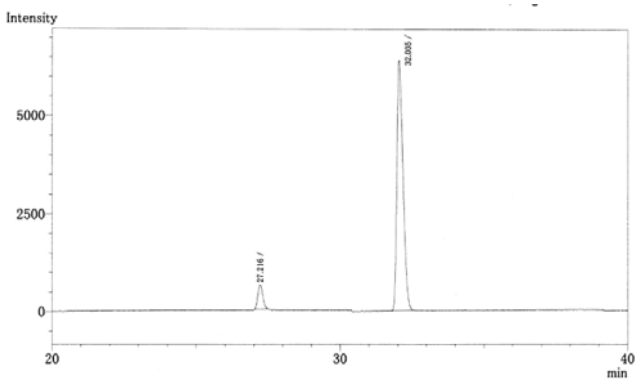




Peak No.	Rt (min)	Area	Area %
1	27.285	56362	50.017
2	32.240	56323	49.983
Total		112685	100.000

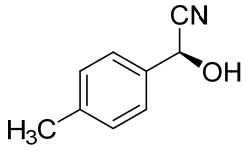
(*S*)-Cyano(4- methoxyphenyl)methyl acetate (Derived from (*S*)-**2b**)





Peak No.	Rt (min)	Area	Area %
1	27.216	7274	7.199
2	32.035	93761	92.801
Total		101035	100.000

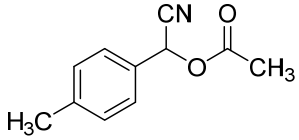
Determination of the optical purity of (S)-2c

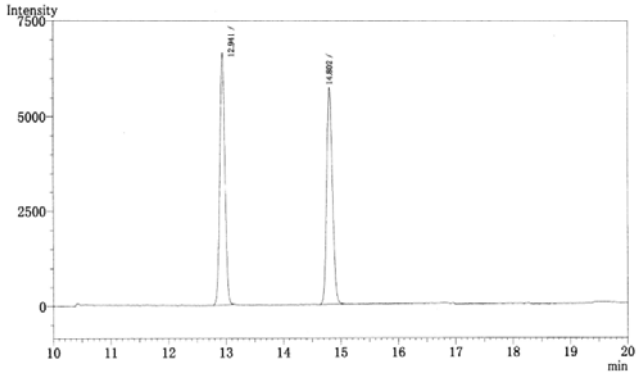


(*S*)-2-hydroxy-2-(*p*-tolyl)acetonitrle [(*S*)-**2c**][1a]; White solid; 96%ee; $[\alpha]_D^{26}$ -44.6° (*c* 0.49, $CHCl_3$), [lit.[2b] $[\alpha]_D^{20}$ -47.9° (*c* 1.02, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding acetate.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 20 cm/s; injection temperature, 200 °C; column temperature, 150 °C, 60 min; detector temperature, 250 °C. Retention time: 12.9 min (*R*), 14.8 min (*S*).

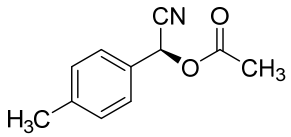
Racemic cyano(*p*-tolyl)methyl acetate (Derived from **2c**)

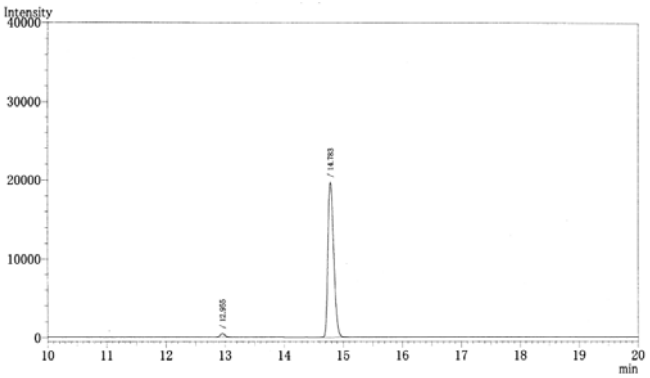




Peak No.	Rt (min)	Area	Area %
1	12.941	40754	50.036
2	14.802	40695	49.964
Total		81449	100.000

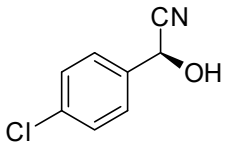
(*S*)-Cyano(*p*-tolyl)methyl acetate (Derived from (*S*)-**2c**)





Peak No.	Rt (min)	Area	Area %
1	12.955	2649	1.926
2	14.783	134875	98.074
Total		137524	100.000

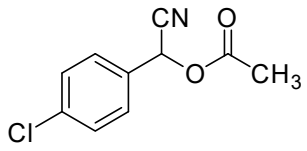
Determination of the optical purity of (S)-2d

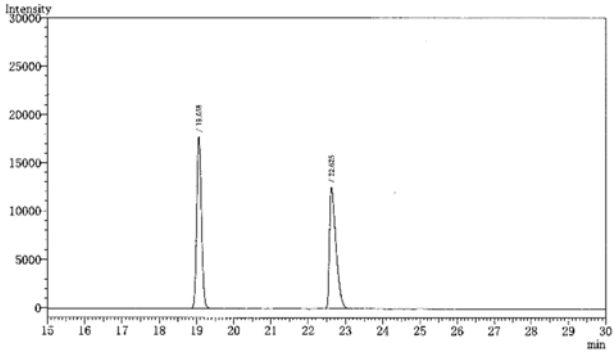


(*S*)-2-hydroxy-2-(4-chlorophenyl)acetonitrle (*S*)-**2d**[1a]: White solid; 52%ee; $[\alpha]_D^{25}$ -19.4° (*c* 0.92, $CHCl_3$), [lit.[2a] $[\alpha]_D^{20}$ -37.6° (*c* 1.47, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding acetate.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 20 cm/s; injection temperature, 200 °C; column temperature, 150 °C, 60 min; detector temperature, 250 °C. Retention time: 19.1 min (*R*), 22.6 min (*S*).

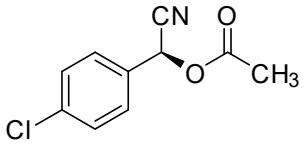
Racemic (4-chlorophenyl)(cyano)methyl acetate (Derived from **2d**)

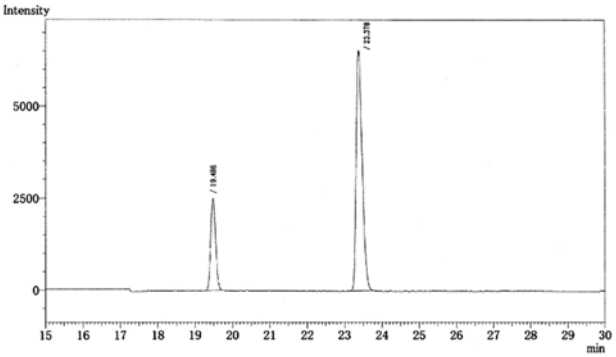




Peak No.	Rt (min)	Area	Area %
1	19.058	155642	50.931
2	22.625	19950	49.069
Total		305592	100.000

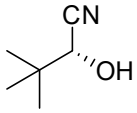
(*S*)-(4-Chlorophenyl)(cyano)methyl acetate (Derived from (*S*)-**2d**)





Peak No.	Rt (min)	Area	Area %
1	19.486	22651	23.895
2	23.378	72142	76.105
Total		94793	100.000

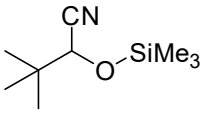
Determination of the optical purity of (R)-2e

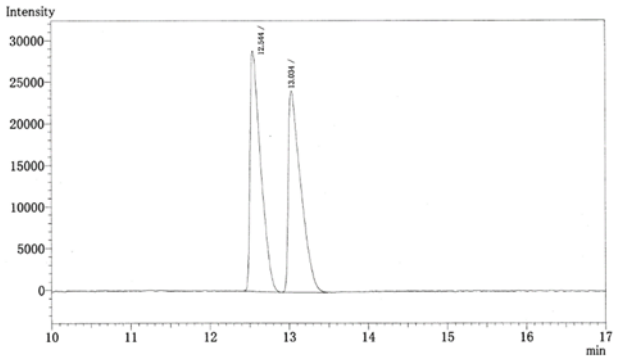


(*R*)-2-hydroxy-3,3-dimethylbutanenitrile (*R*)-**2e**[1b]:colorless oil; 87%ee; $[\alpha]_D^{25}$ +20.4° (*c* 0.11, $CHCl_3$), [lit.[1b] $[\alpha]_D^{26}$ +21.5° (*c* 0.70, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding silyl ether.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 30 cm/s; injection temperature, 220 °C; column temperature, 70 °C, 30 min; detector temperature, 250 °C. Retention time: 12.5 min (*R*), 13.0 min (*S*).

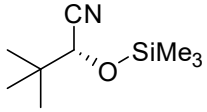
Racemic 3,3-dimethyl-2-((trimethylsilyl)oxy)butanenitrile (Precursor of **2e**)

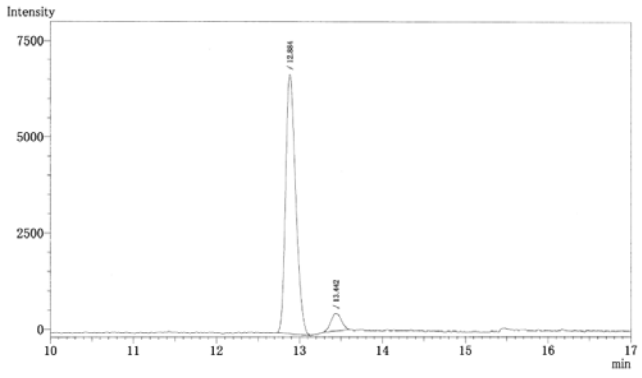




Peak No.	Rt (min)	Area	Area %
1	12.544	270801	50.665
2	13.034	263688	49.335
Total		534489	100.000

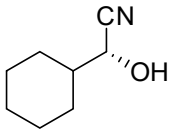
(*R*)-3,3-Dimethyl-2-((trimethylsilyl)oxy)butanenitrile (Precursor of (*R*)-**2e**)





Peak No.	Rt (min)	Area	Area %
1	12.884	56902	93.369
2	13.442	4041	6.631
Total		60943	100.000

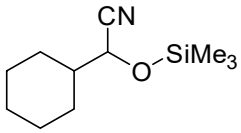
Determination of the optical purity of (R)-2f

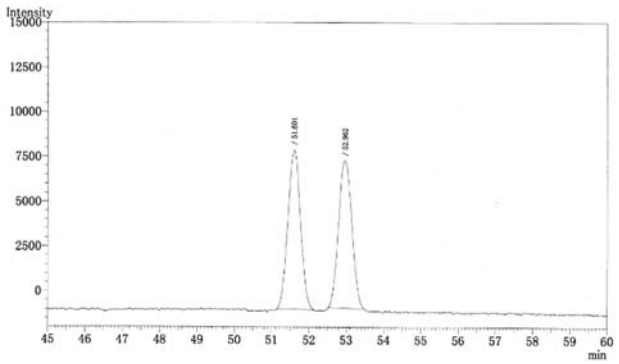


(*R*)-2-cyclohexyl-2-hydroxyacetonitrile (*R*)-**2f**[1b]: colorless oil; 81%ee; $[\alpha]_D^{25}$ +7.6° (*c* 0.77, $CHCl_3$), [lit.[1b] $[\alpha]_D^{26}$ +8.5° (*c* 1.30, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding silyl ether.

GC conditions: column, CYCLOSIL-B (0.25 mm × 25 m); carrier gas, N_2; flow rate, 20 cm/s; injection temperature, 220 °C; column temperature, 110 °C, 60 min; detector temperature, 250 °C. Retention time: 51.6 min (*S*), 53.0 min (*R*).

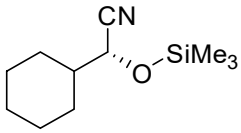
Racemic 2-cyclohexyl-2-((trimethylsilyl)oxy)acetonitrile (Precursor of **2f**)

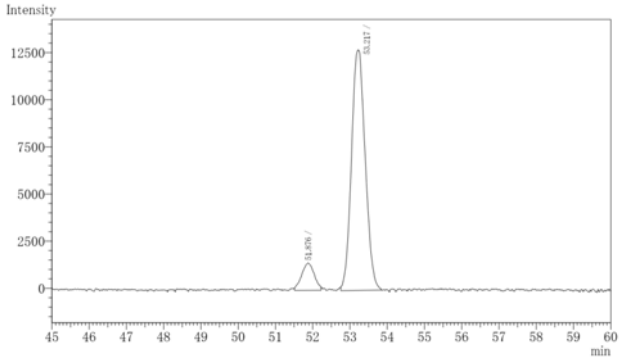




Peak No.	Rt (min)	Area	Area %
1	51.601	208288	50.580
2	52.962	203507	49.420
Total		411795	100.000

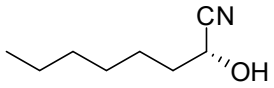
(*R*)-2-Cyclohexyl-2-((trimethylsilyl)oxy)acetonitrile (Precursor of (*R*)-**2f**)





Peak No.	Rt (min)	Area	Area %
1	51.876	34219	9.481
2	53.217	326692	90.519
Total		360911	100.000

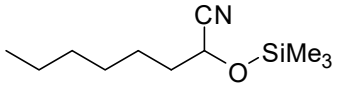
Determination of the optical purity of (R)-2g

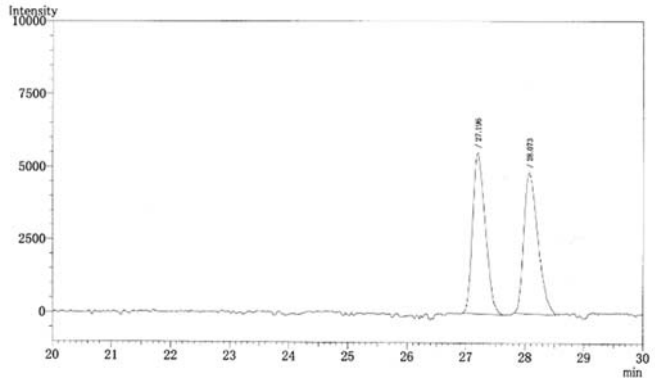


(*R*)-2-hydroxyoctanenitrile (*R*)-**2g**[1b]: colorless oil; 58%ee; $[\alpha]_D^{25}$ +6.8° (*c* 0.73, $CHCl_3$), [lit.[1b] $[\alpha]_D^{26}$ +9.7° (*c* 0.70, $CHCl_3$)]. The enantiomeric excess was determined by GC analysis after conversion to corresponding silyl ether.

GC conditions: column, CHIRASIL-DEX CB (0.25 mm × 25 m); carrier gas, N_2; flow rate, 25 cm/s; injection temperature, 220 °C; column temperature, 100 °C, 30 min; detector temperature, 250 °C. Retention time: 27.2 min (*R*), 28.1 min (*S*).

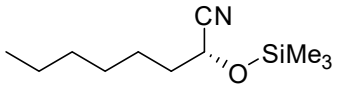
Racemic 2-((trimethylsilyl)oxy)octanenitrile (Precursor of **2g**)

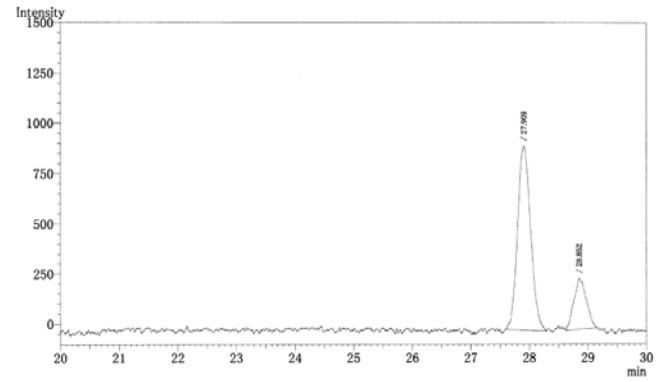




Peak No.	Rt (min)	Area	Area %
1	27.196	82181	50.667
2	28.073	80016	49.333
Total		162197	100.000

(*R*)-2-((trimethylsilyl)oxy)octanenitrile (Precursor of (*R*)-**2g**)





Peak No.	Rt (min)	Area	Area %
1	27.909	14284	79.239
2	28.852	3742	20.761
Total		18026	100.000

4 Reference

1 (a) M. Hatano, T. Ikeno, T. Miyamoto, and K. Ishihara, *J. Am. Chem. Soc*. 2005, **127**, 10776; (b) N. Kurono, K. Arai, M. Uemura, and T. Ohkuma, *Angew. Chem. Int. Ed*. 2008, **47**, 6643.

2 (a) Y. Sakai, J. Mitote, K. Matsumoto and T. Katsuki, *Chem. Commun*., 2010, **46**, 5787; (b) Z. Zeng, G. Zhao, Z. Zhou, and C. Tang, *Eur. J. Org. Chem.* 2008, 1615.