Supporting Information *for*

Hetero-bifunctional catalyst manipulates carbonyl and alkynyl reductions of conjugated alkynones in an aqueous medium

Yanchao Su, Fengwei Chang, Ronghua Jin, Rui Liu and Guohua Liu[*]

Key Laboratory of Resource Chemistry of Ministry of Education, Shanghai Key Laboratory of Rare Earth Functional Materials, Shanghai Normal University, Shanghai 200234, P. R. China.

CONTENTS

Experimental

1). General

All experiments, which are sensitive to moisture or air, were carried out under an Ar atmosphere using the standard Schlenk techniques. Tetraethoxysilane (TEOS), 1,4-bis(triethyoxysilyl)ethane, cetyltrimethylammonium bromide (CTAB), fluorocarbon surfactant (FC-4: $[C_3F_7O(CF(CF_3)CF_2O)_2CF(CF_3)CONH(CH_2)_3N^+(C_2H_5)_2CH_3]I^-$), 4-(2-(trimethoxysilyl)ethyl)benzene-1-sulfonyl chloride, Triethylenediamine (DABCO), 4-(methylphenylsulfonyl)-1,2-diphenylethylenediamine [(S,S)-TsDPEN], $(MesityleneRuCl_2)_2$ were purchased from Sigma-Aldrich Company Ltd and used as received.

2). Characterization

Ru and Pd loading amounts in the catalysts were analyzed using an inductively coupled plasma optical emission spectrometer (ICP, Varian VISTA-MPX). Fourier transform infrared (FT-IR) spectra were collected on a Nicolet Magna 550 spectrometer using KBr method. Scanning electron microscopy (SEM) images were obtained using a JEOL JSM-6380LV microscope operating at 20 kV. Transmission electron microscopy (TEM) images were performed on a JEOL JEM2010 electron microscope at an acceleration voltage of 220 kV. X-ray photoelectron spectroscopy (XPS) measurements were performed on a Perkin-Elmer PHI 5000C ESCA system. A 200 μm diameter spot size was scanned using a monochromatized Aluminum *Kα* X-ray source (1486.6.6 eV) at 40 W and 15 kV with 58.7 eV pass energies. All the binding energies were calibrated by using the contaminant carbon (C_{1s} = 284.6 eV) as a reference. Nitrogen adsorption isotherms were measured at 77 K with a Quantachrome Nova 4000 analyzer. The samples were measured after being outgassed at 423 K overnight. Pore size distributions were calculated by using the BJH model. The specific surface areas (S_{BET}) of samples were determined from the linear parts of BET plots (p/p_0 = 0.05-1.00). Solid state NMR experiments were explored on a Bruker AVANCE spectrometer at a magnetic field strength of 9.4 T with ^1H frequency of 400.1 MHz, ^{13}C frequency of 100.5 MHz, and ^{29}Si frequency of 79.4 MHz with 4 mm rotor at two spinning frequency of 5.5 kHz and 8.0 kHz, TPPM decoupling is applied in the during acquisition period. ^1H cross polarization in all solid state NMR experiments was employed using a contact time of 2 ms and the pulse lengths of 4μs.

Figure S1. FT-IR spectra of **4** and catalyst **5.**

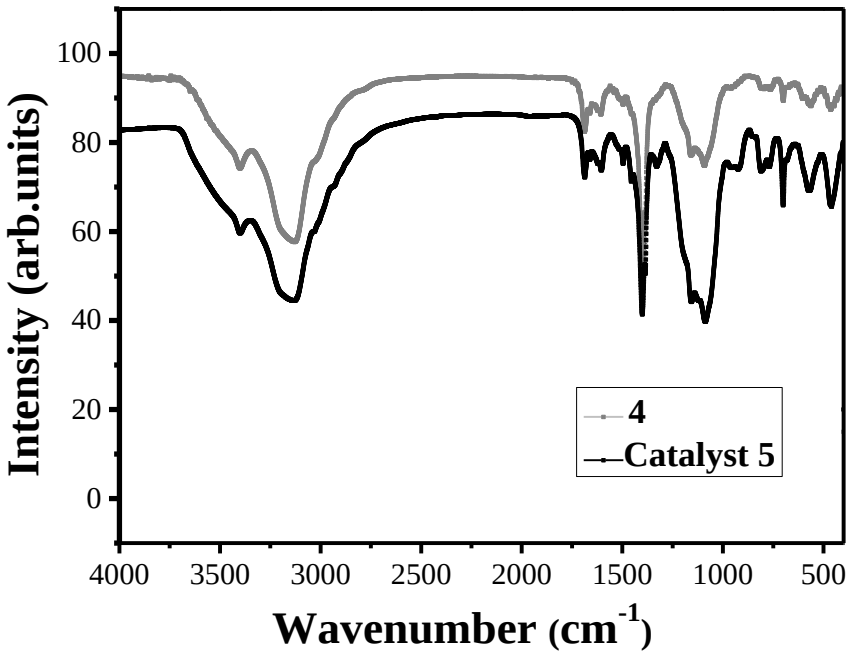


Figure S2. Small-angle powder XRD patterns of **4** and catalyst **5.**

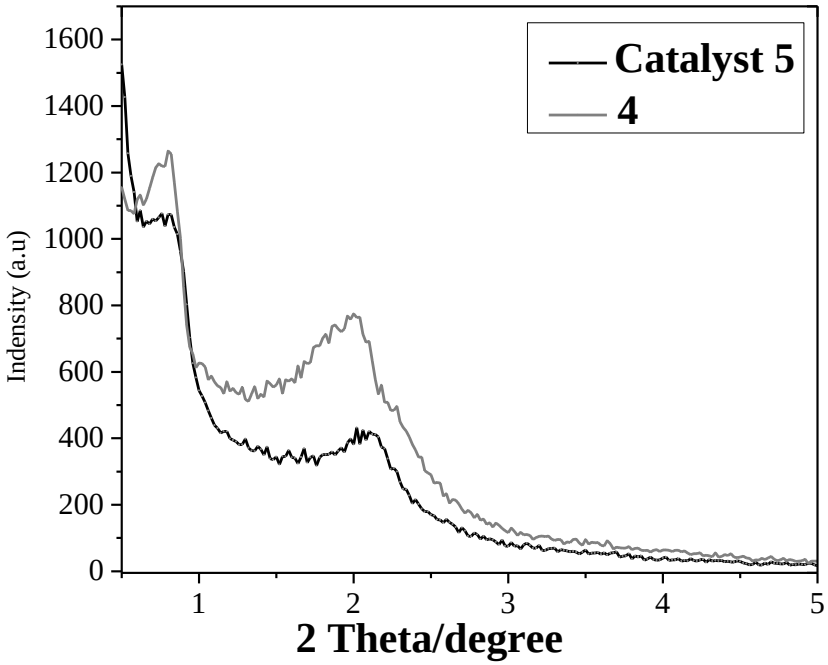
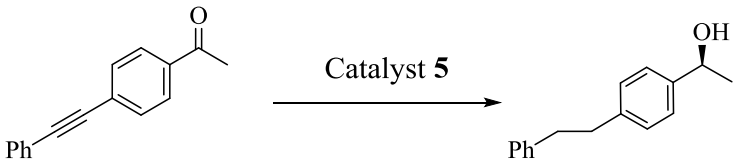


Table S1. Optimizing reaction conditions for the **5**-catalysed enantioselective cascade reactions of (4–(phenylethynyl)phenyl)ethanone.

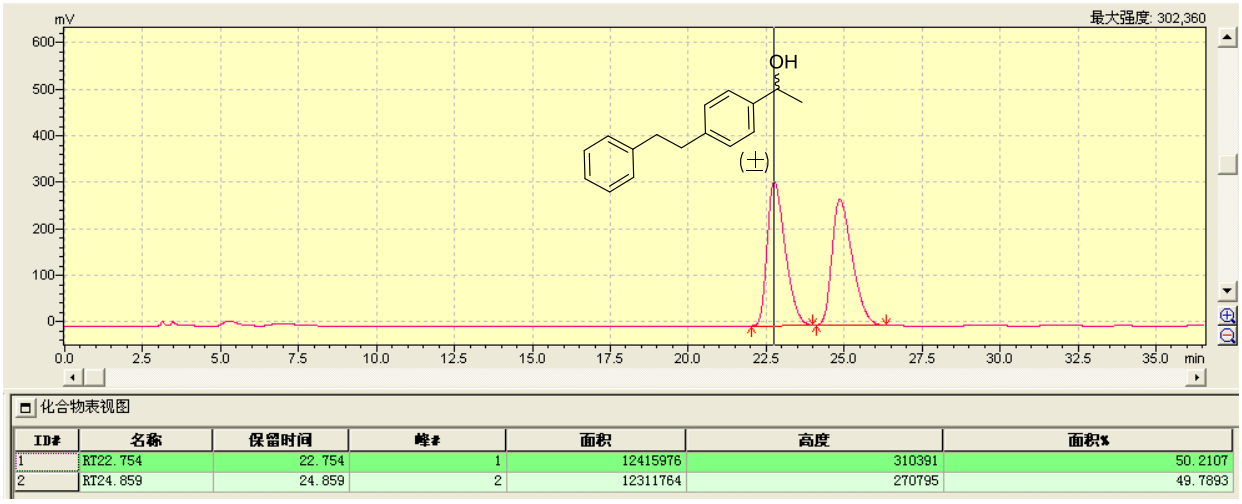


Entry	Ru-loading	H-resource	Solvent	℃	Time (h)	Yield (%)	*ee* (%)
1	2.0 mol%	HCOOH	/	60	8	/	/
2	2.0 mol%	^{i}PrOH	/	60	8	/	/
3	2.0 mol%	HCOOH/NEt_3	/	60	8	14	65
4	2.0 mol%	HCOONa	H_2O/ ^{i}PrOH (1:3)	50	6	34	94
5	2.0 mol%	HCOONa	H_2O/ ^{i}PrOH (1:3)	60	3	95	97
6	2.0 mol%	HCOONa	H_2O/ ^{i}PrOH (1:3)	70	1.5	97	92
7	2.0 mol%	HCOONa	H_2O/ ^{i}PrOH (1:2)	60	4	92	92
8	2.0 mol%	HCOONa	H_2O/ ^{i}PrOH (1:4)	60	2	98	93
9	2.0 mol%	HCOONa	H_2O/EtOH (1:3)	60	5	96	90
10	2.0 mol%	HCOONa	H_2O/MeOH (1:3)	60	5	97	89
11	1.75 mol%	HCOONa	H_2O/ ^{i}PrOH (1:3)	60	3	91	97
12	2.25 mol%	HCOONa	H_2O/ ^{i}PrOH (1:3)	60	3	96	96

Reaction conditions: Catalyst **5** (4.38 mol% of Pd based on ICP analysis), HCO_2Na (1.0 mmol), alkynone (0.10 mmol), and 2.0 mL of solvent were added sequentially to a 10.0 mL round−bottom flask. Yields were determined by ^{1}H–NMR analysis and *ee* values were determined by chiral HPLC analysis.

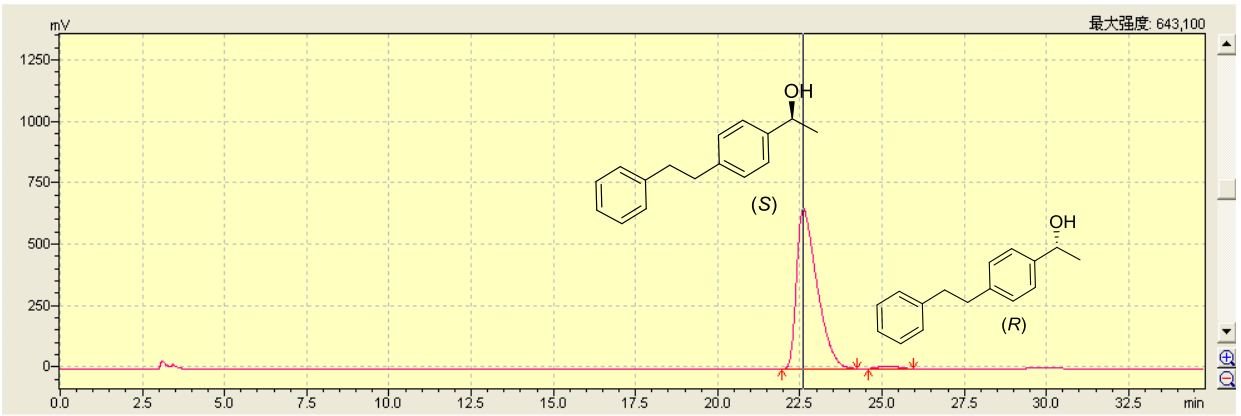
Figure 3. The HPLC analysis for chiral products. (Table 1 in manuscript: The selective ATH/reduction one–pot enantioselective cascade reductions of conjugated alkynones.)

7a. (*S*)-1-(4-phenethylphenyl)ethan-1-ol: (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃). [Literature (Chem. Eur. J. **2010**, 16, 6748): HPLC: Chiracel AD-H, eluent: n-hexane/2-propanol = 95/5, flow rate = 0.7 mL/min, detected at 254 nm, Retention time: 10.98 min (S), 12.16 min (R).]



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.754	22.754	1	12415976	310391	50.2107
2	RT24.859	24.859	2	12311764	270795	49.7893



化合物表视图

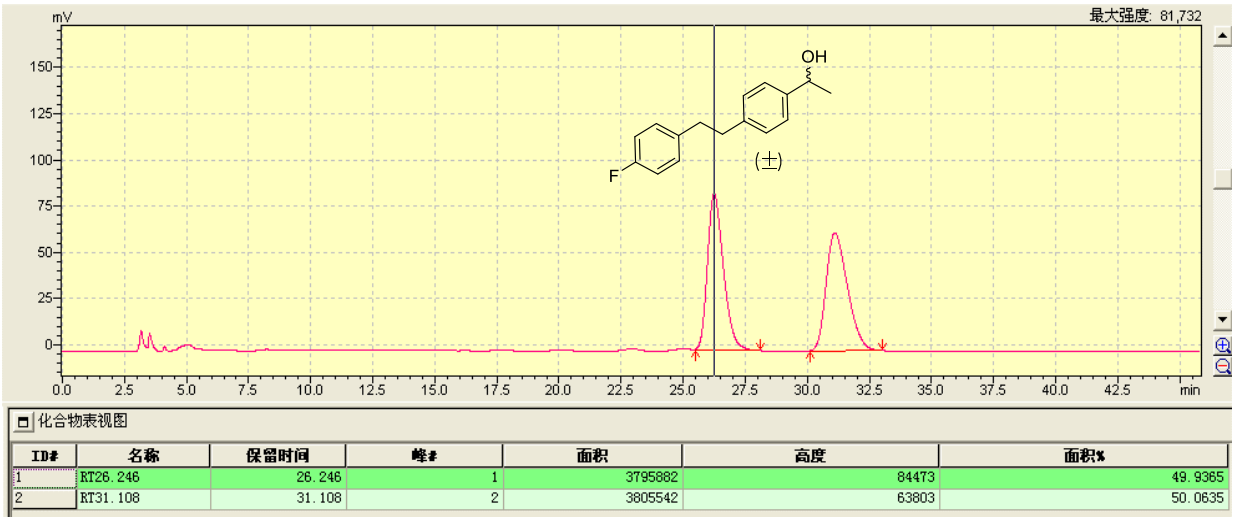
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

Translation of Chinese to English is as follows:

Name	ReTime [min]	Peak	Area	Heigh	Area%

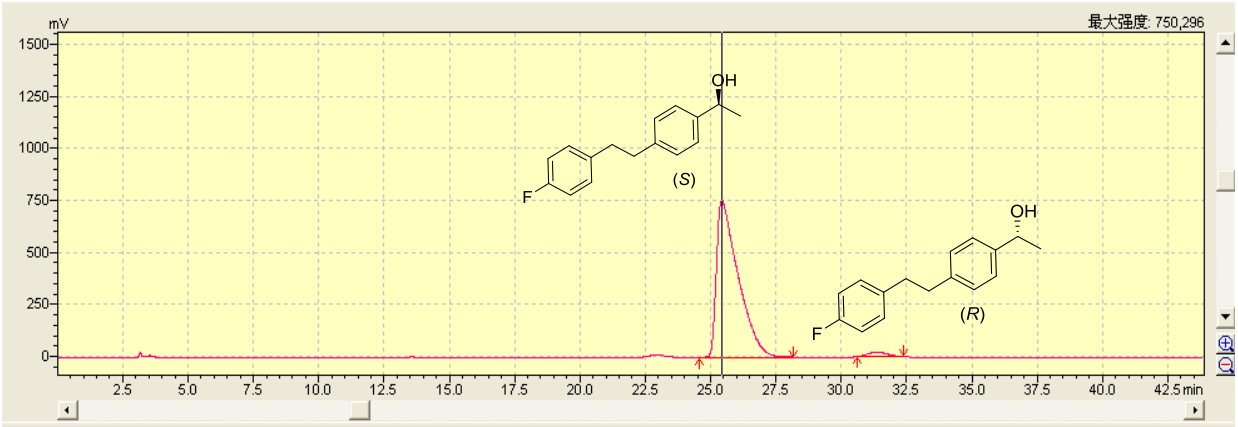
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7b. (*S*)-1-(4-(4-fluorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

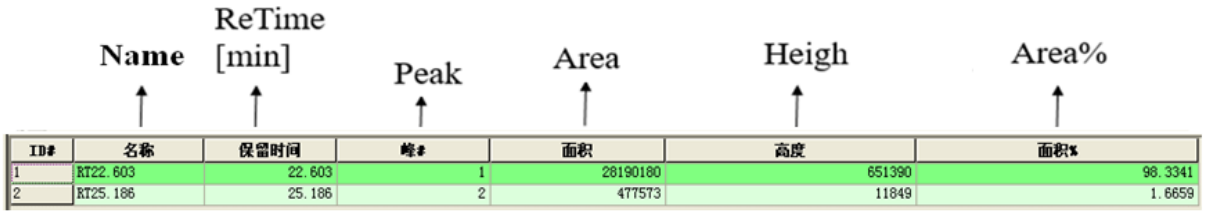
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT26.246	26.246	1	3795882	84473	49.9365
2	RT31.108	31.108	2	3805542	63803	50.0635



化合物表视图

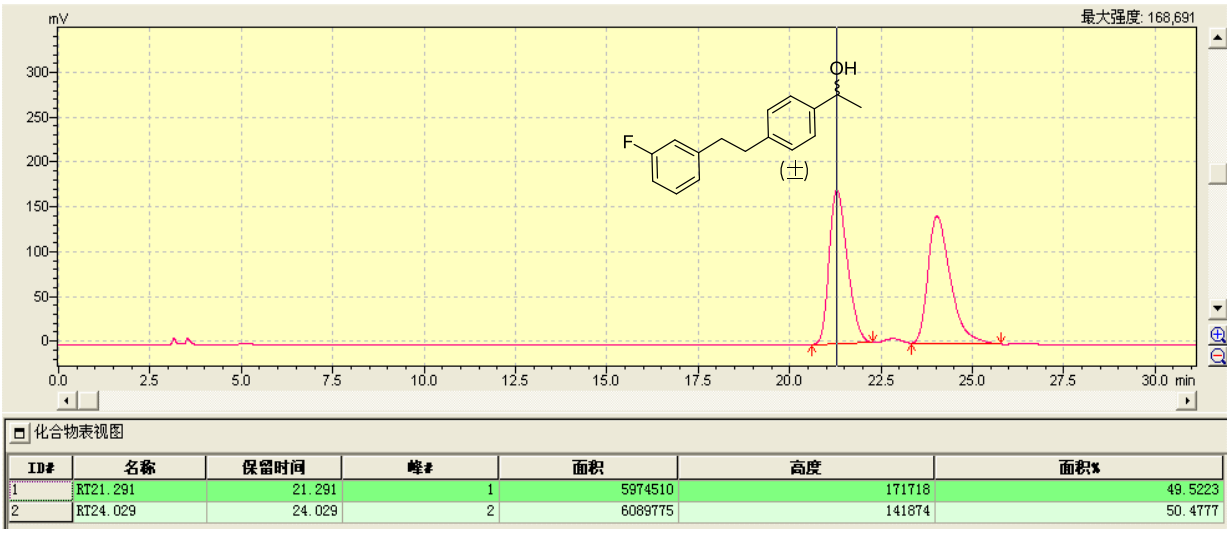
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT25.427	25.427	1	43276171	753757	97.3216
2	RT31.359	31.359	2	1190987	22033	2.6784

Translation of Chinese to English is as follows:



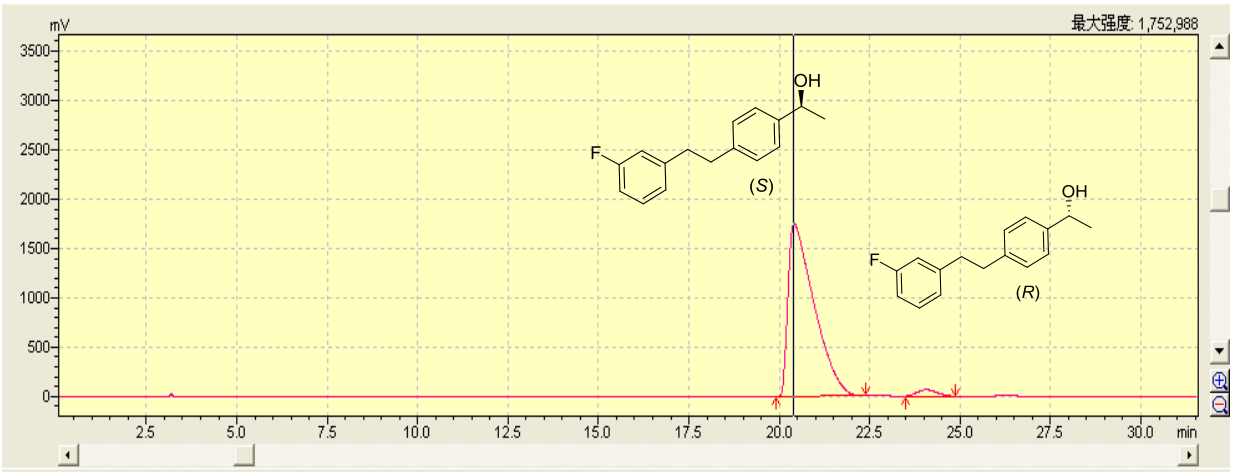
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7c. (*S*)-1-(4-(3-fluorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT21.291	21.291	1	5974510	171718	49.5223
2	RT24.029	24.029	2	6089775	141874	50.4777



化合物表视图

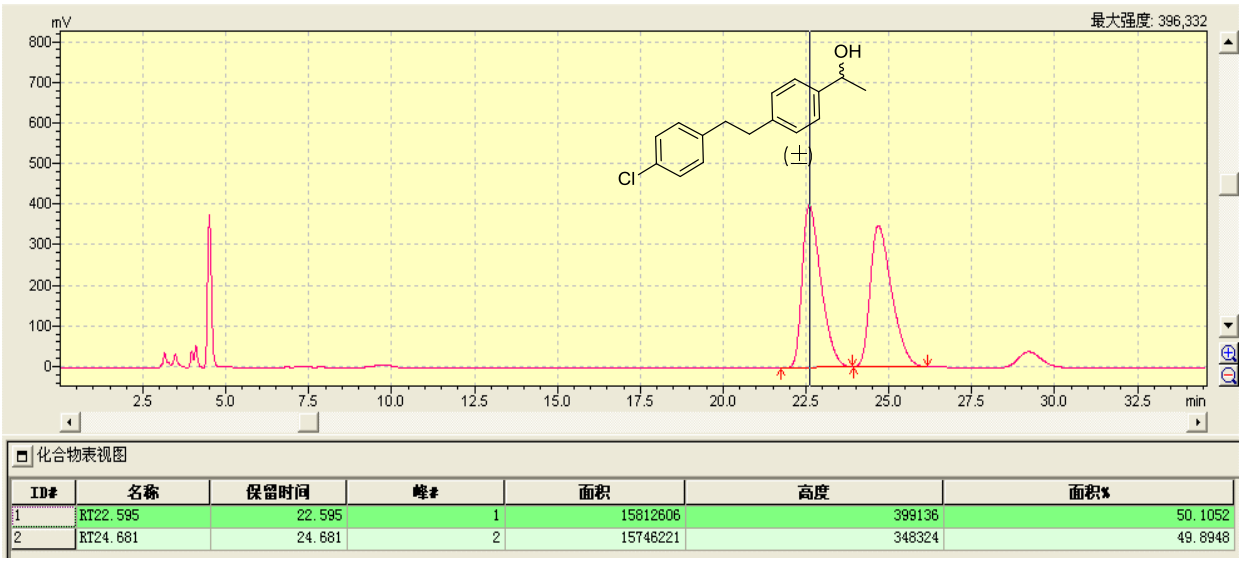
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT20.405	20.405	1	87766682	1753759	97.1648
2	RT24.053	24.053	2	2560975	65791	2.8352

<u>Translation of Chinese to English is as follows:</u>

Name ReTime [min] Peak Area Heigh Area%

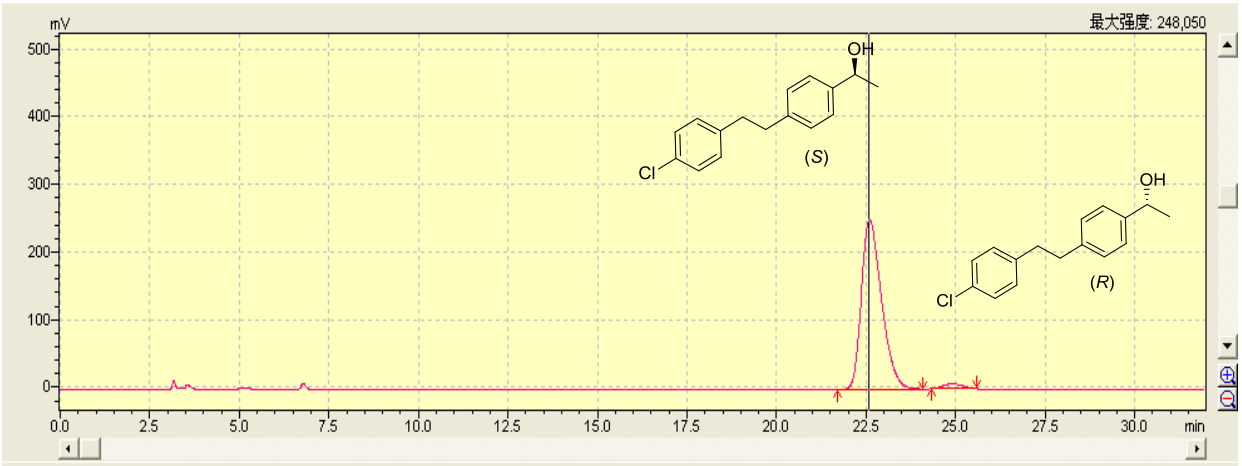
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7d. (*S*)-1-(4-(4-chlorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.595	22.595	1	15812606	399136	50.1052
2	RT24.681	24.681	2	15746221	348324	49.8948



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.593	22.593	1	9802180	250791	97.3129
2	RT24.910	24.910	2	270671	7181	2.6871

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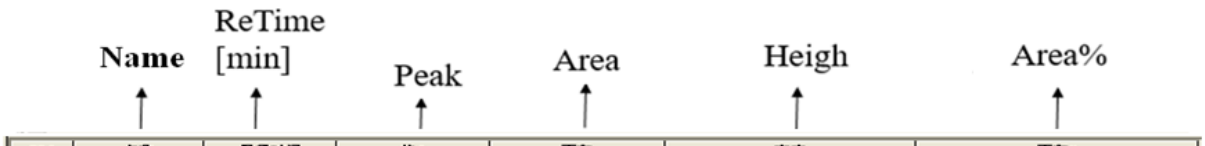
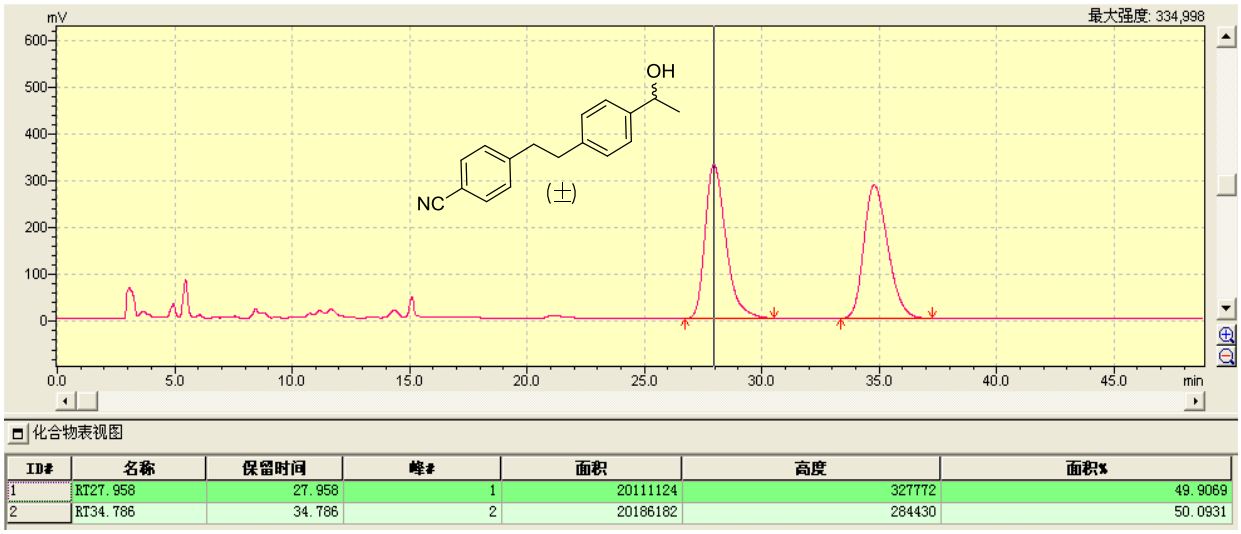


ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7e. (*S*)-4-(4-(1-hydroxyethyl)phenethyl)benzonitrile: (HPLC: Chiracel OD-H, detected at 215 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
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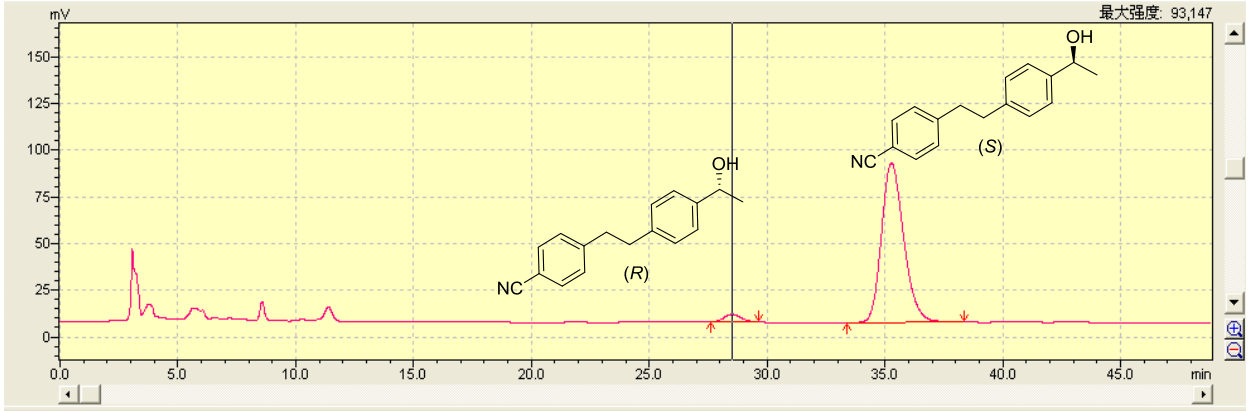
2	RT34.786	34.786	2	20186182	284430	50.0931



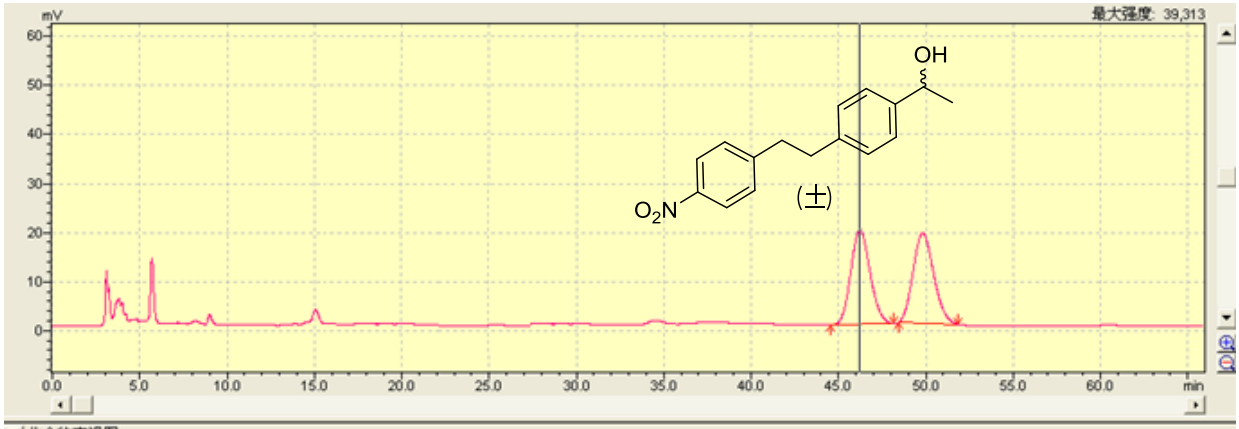
化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT28.510	28.510	1	213425	4145	3.6659
2	RT35.273	35.273	2	5608544	85384	96.3341

Translation of Chinese to English is as follows:

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7f. (*S*)-1-(4-(4-nitrophenethyl)phenyl)ethan-1-ol: (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 96/4, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

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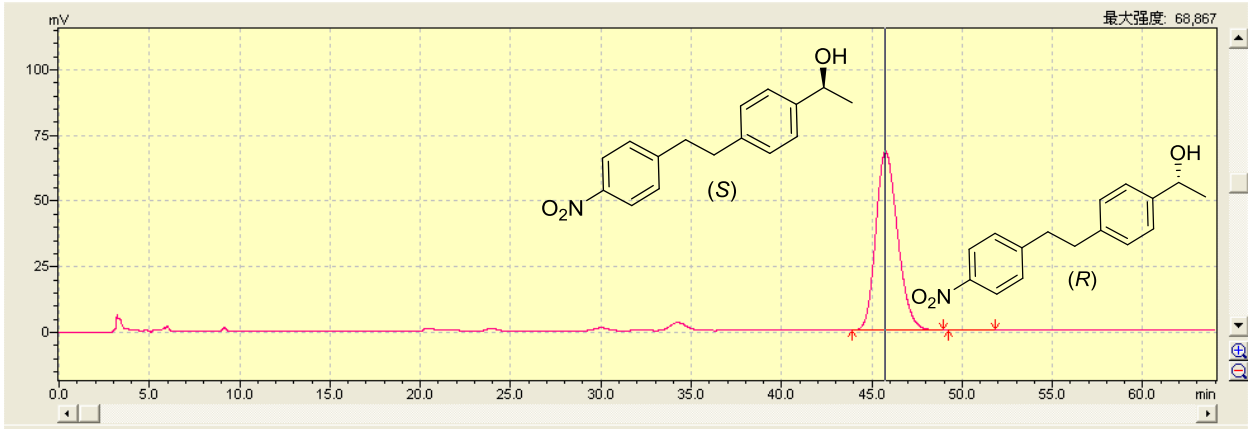
1	RT46.227	46.227	1	1484934	19292	49.4202
2	RT49.826	49.826	2	1519776	18378	50.5798



化合物表视图

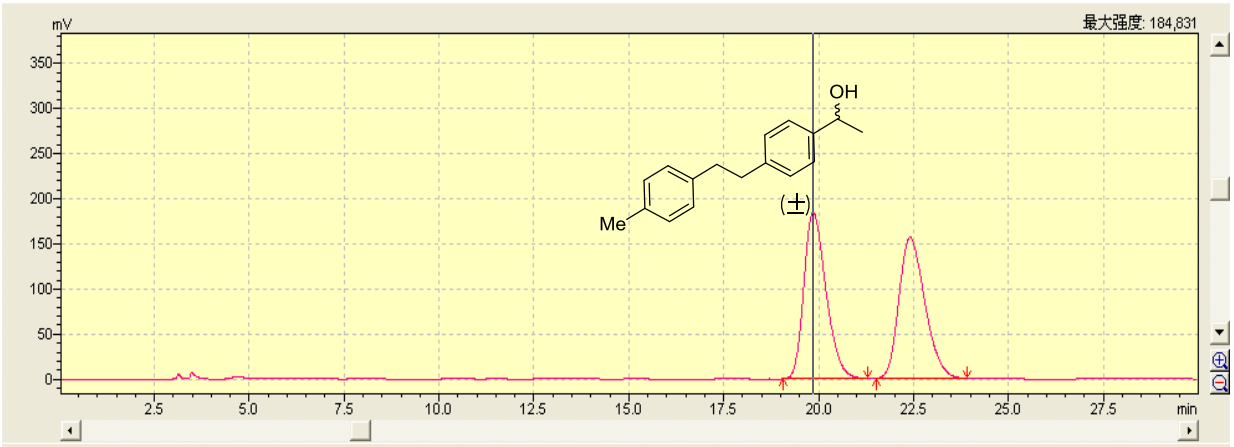
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT45.752	45.752	1	5691276	67936	99.9812
2	RT49.269	49.269	2	1069	2	0.0188

<u>Translation of Chinese to English is as follows:</u>

Name ReTime [min] Peak Area Heigh Area%

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7g. (*S*)-1-(4-(4-methylphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
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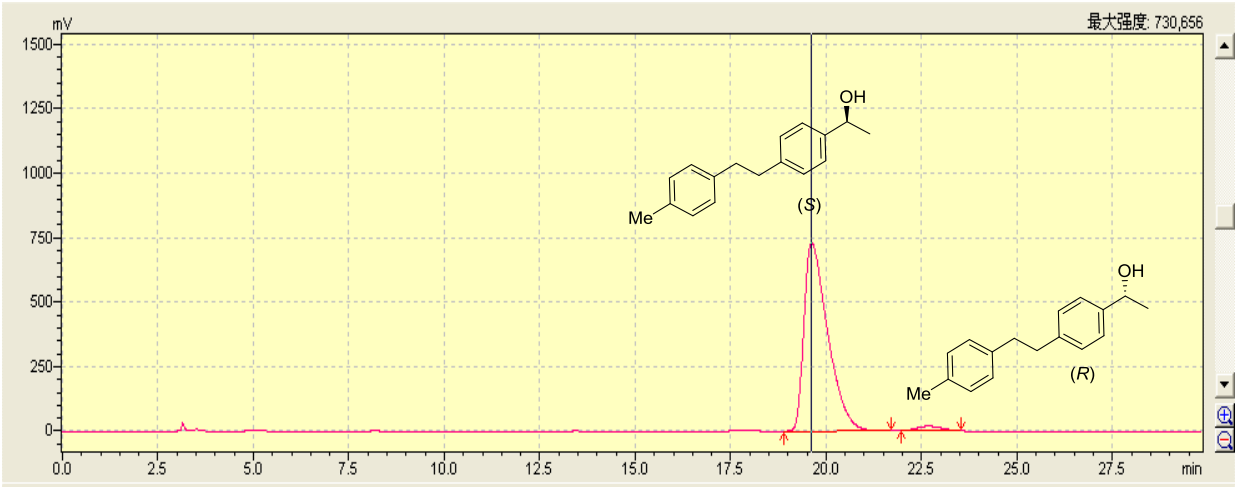
2	RT22.405	22.405	2	7433020	156503	49.8287



化合物表视图

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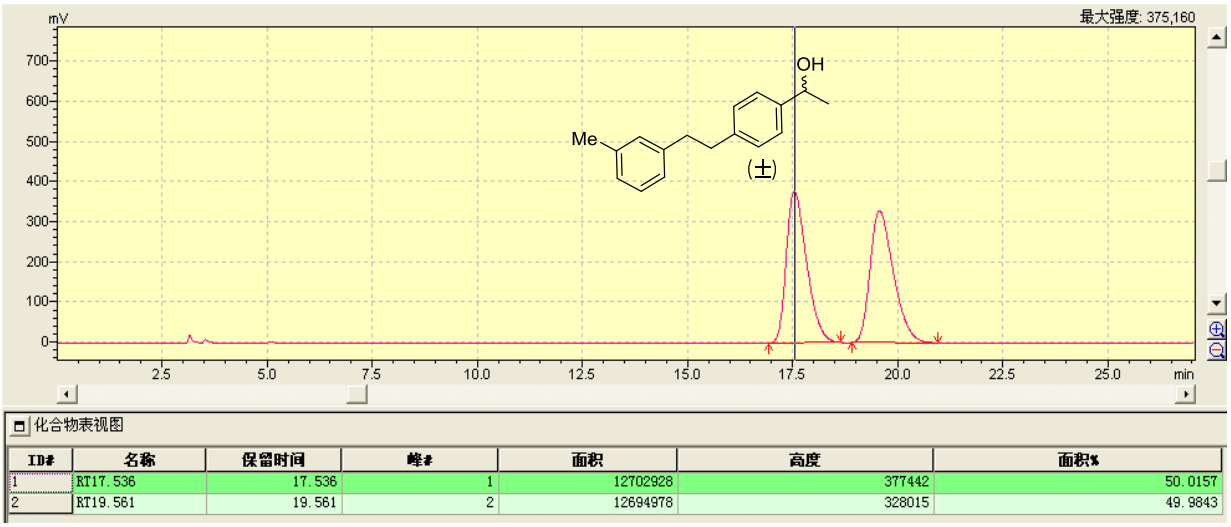
1	RT19.621	19.621	1	31608873	730931	97.4627
2	RT22.678	22.678	2	822890	17989	2.5373

Translation of Chinese to English is as follows:

Name ReTime [min] Peak Area Heigh Area%

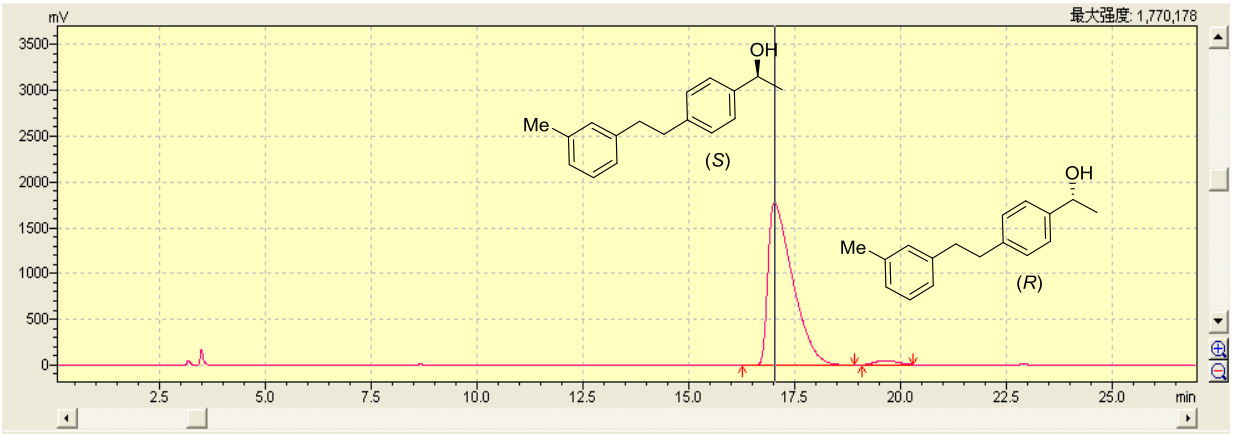
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7h. (*S*)-1-(4-(3-methylphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

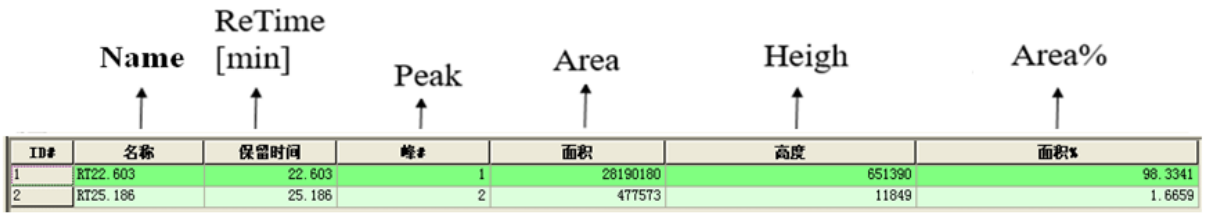
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT17.536	17.536	1	12702928	377442	50.0157
2	RT19.561	19.561	2	12694978	328015	49.9843



化合物表视图

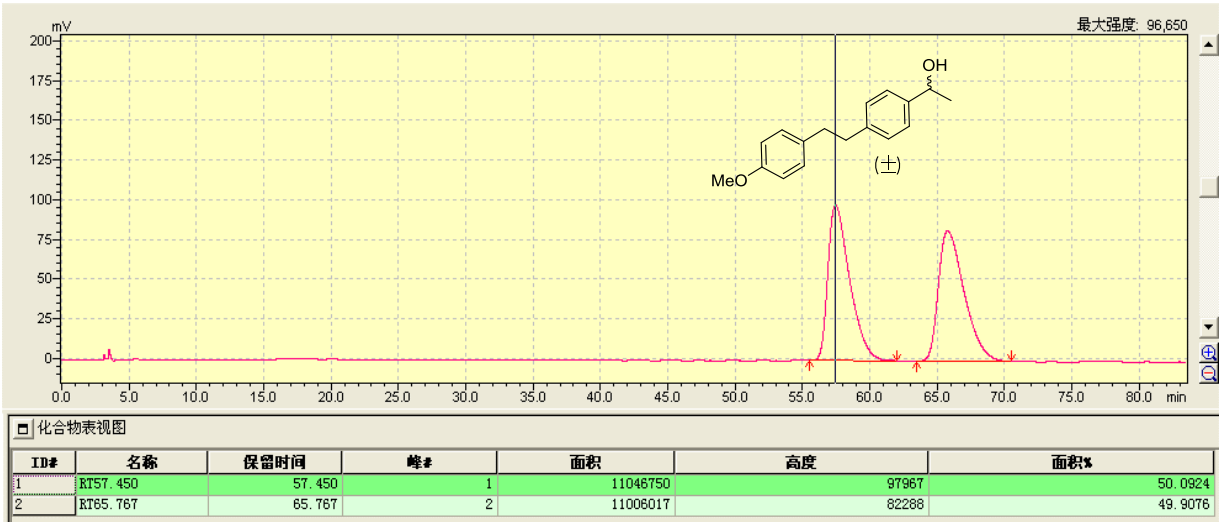
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT17.020	17.020	1	71818712	1772058	97.6740
2	RT19.645	19.645	2	1710291	47080	2.3260

<u>Translation of Chinese to English is as follows:</u>



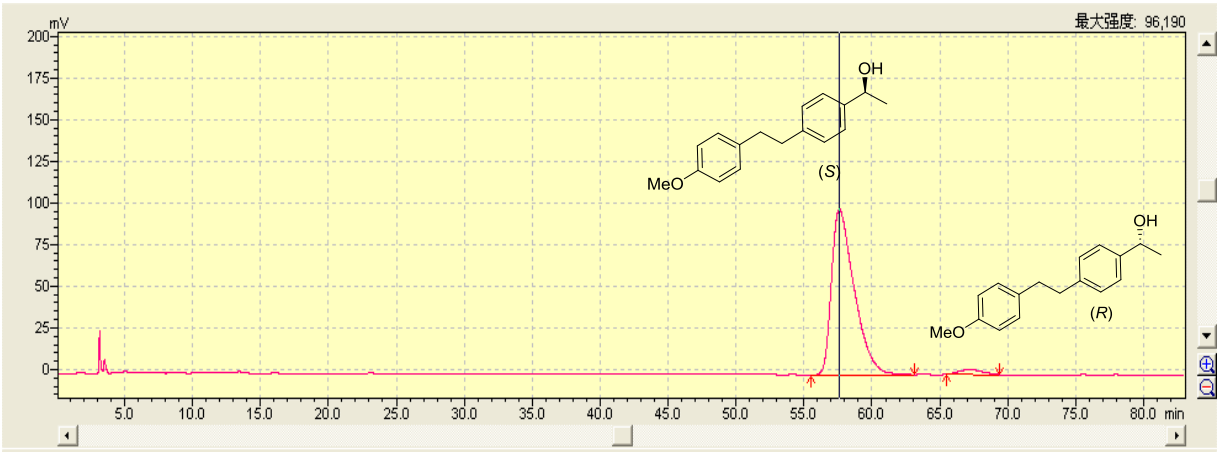
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7i. (*S*)-1-(4-(4-methoxyphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT57.450	57.450	1	11046750	97967	50.0924
2	RT65.767	65.767	2	11006017	82288	49.9076



化合物表视图

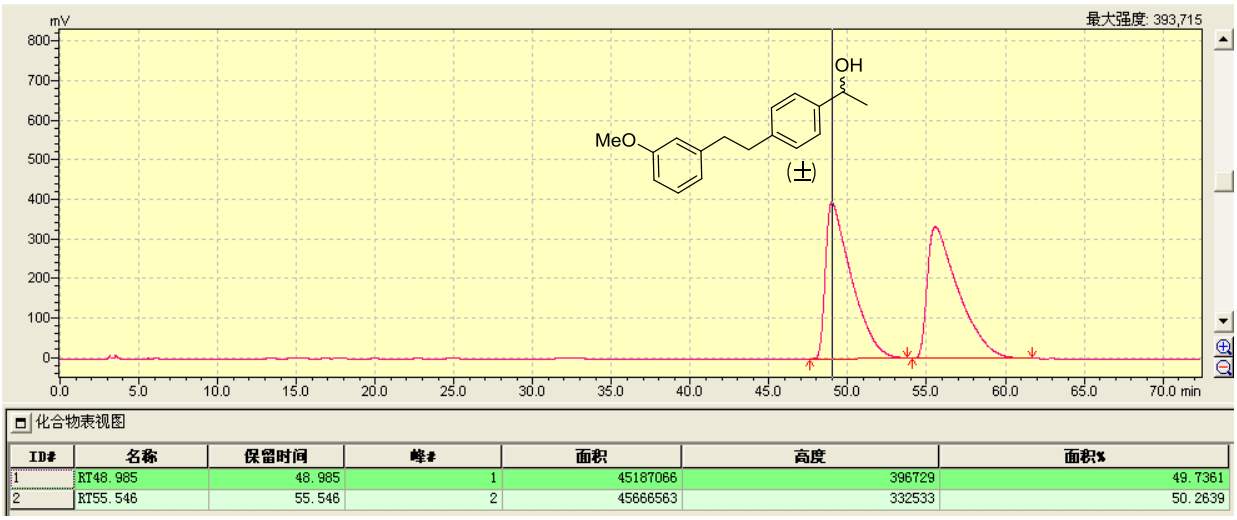
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT57.604	57.604	1	11550085	99432	97.0203
2	RT67.169	67.169	2	354727	2981	2.9797

Translation of Chinese to English is as follows:

Name ReTime [min] Peak Area Heigh Area%

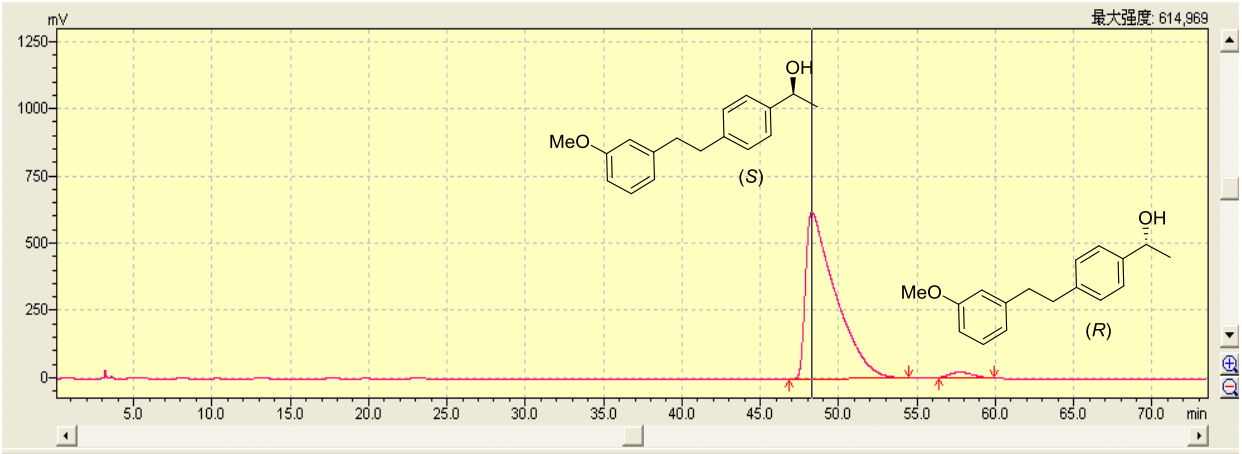
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7j. (*S*)-1-(4-(3-methoxyphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OB-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT48.985	48.985	1	45187066	396729	49.7361
2	RT55.546	55.546	2	45666563	332533	50.2639



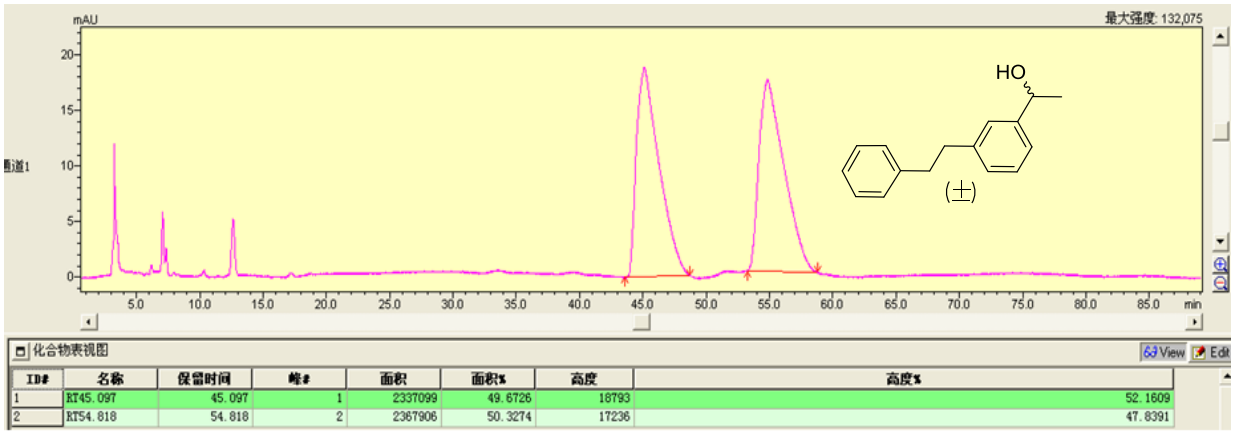
化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT48.286	48.286	1	82186647	618477	97.3337
2	RT57.761	57.761	2	2251374	21873	2.6663

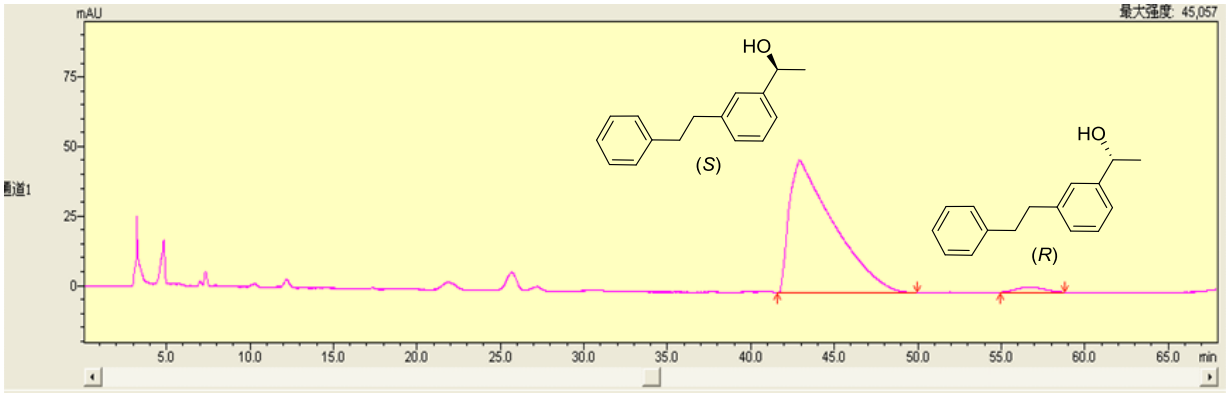
Translation of Chinese to English is as follows:

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7k. (*S*)-1-(3-phenethylphenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).

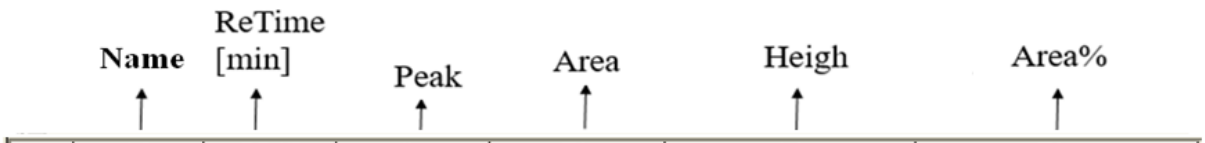


ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT45.097	45.097	1	2337099	49.6726	18793	52.1609
2	RT54.818	54.818	2	2367906	50.3274	17236	47.8391



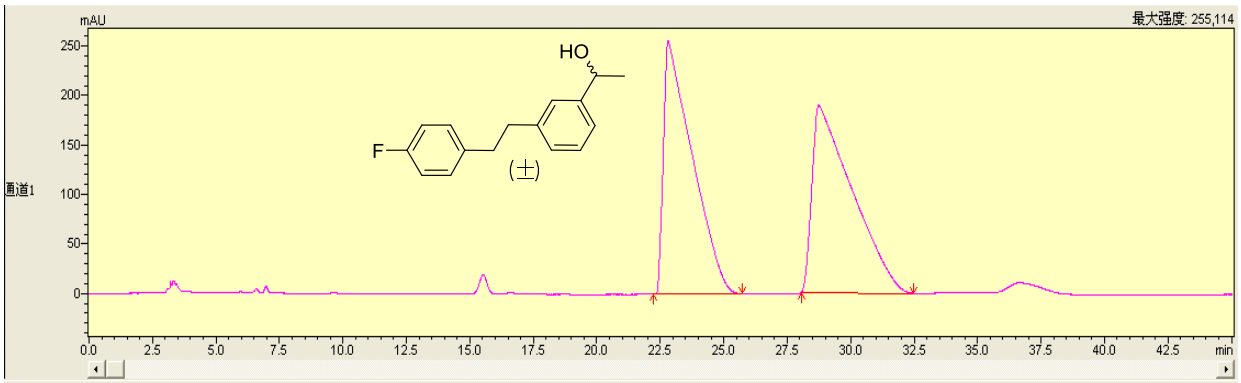
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT42.917	42.917	1	8757084	97.6557	47474	96.2324
2	RT56.703	56.703	2	210218	2.3443	1859	3.7676

Translation of Chinese to English is as follows:



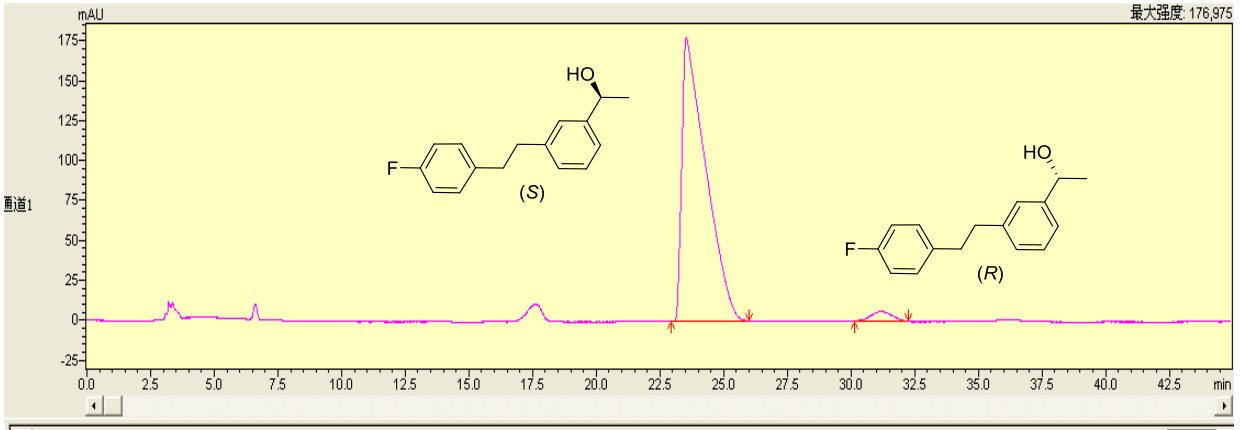
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7l. (*S*)-1-(3-(4-fluorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT22.801	22.801	1	20067322	49.1541	255697	57.4696
2	RT28.742	28.742	2	20758012	50.8459	189229	42.5304



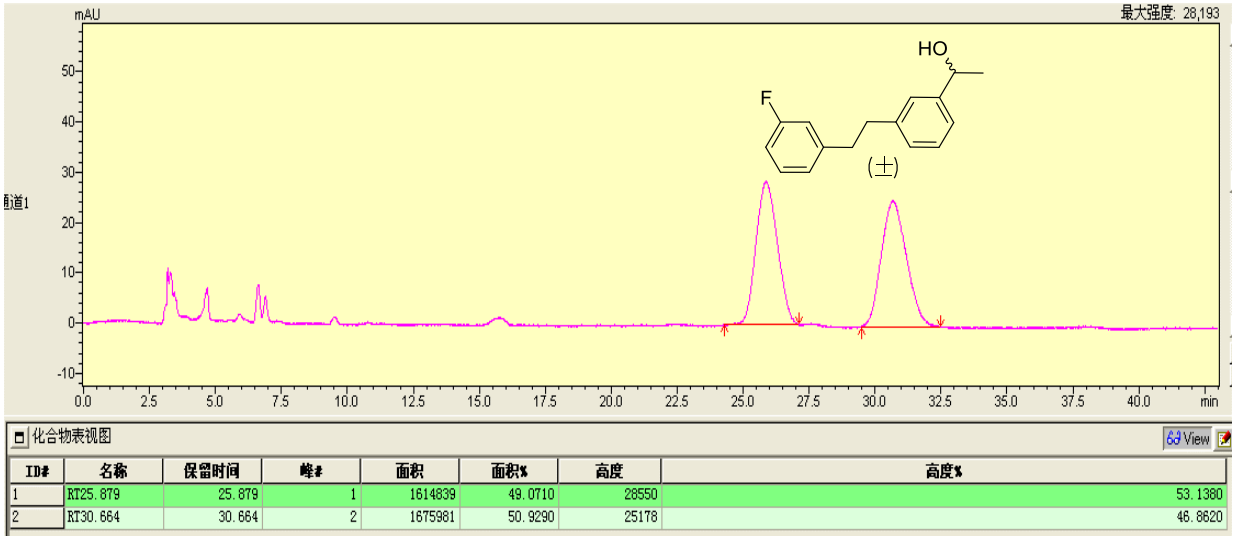
化合物表视图

ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT23.532	23.532	1	11625319	97.0557	177790	96.7489
2	RT31.184	31.184	2	352670	2.9443	5974	3.2511

Translation of Chinese to English is as follows:

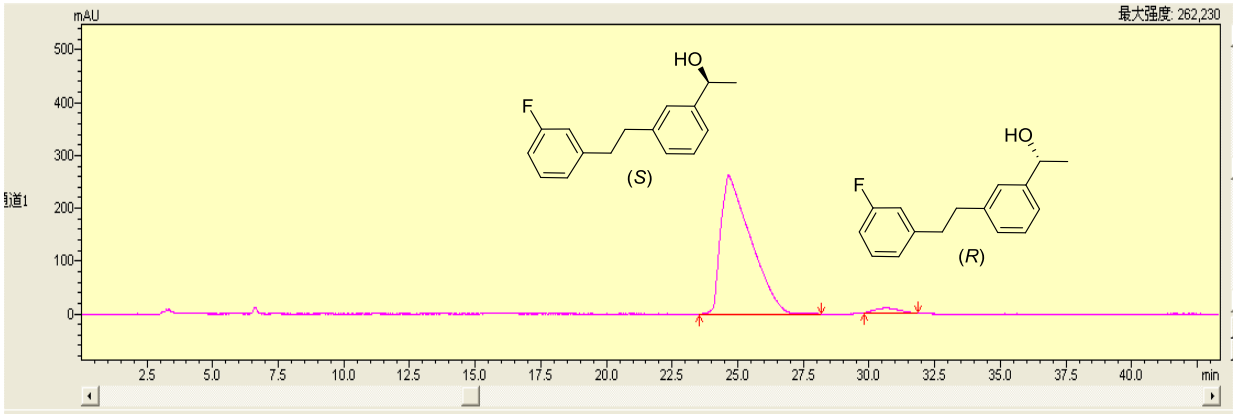
ID#	Name 名称	ReTime [min] 保留时间	Peak 峰#	Area 面积	Heigh 高度	Area% 面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7m. (*S*)-1-(3-(3-fluorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT25.879	25.879	1	1614839	49.0710	28550	53.1380
2	RT30.664	30.664	2	1675981	50.9290	25178	46.8620



化合物表视图

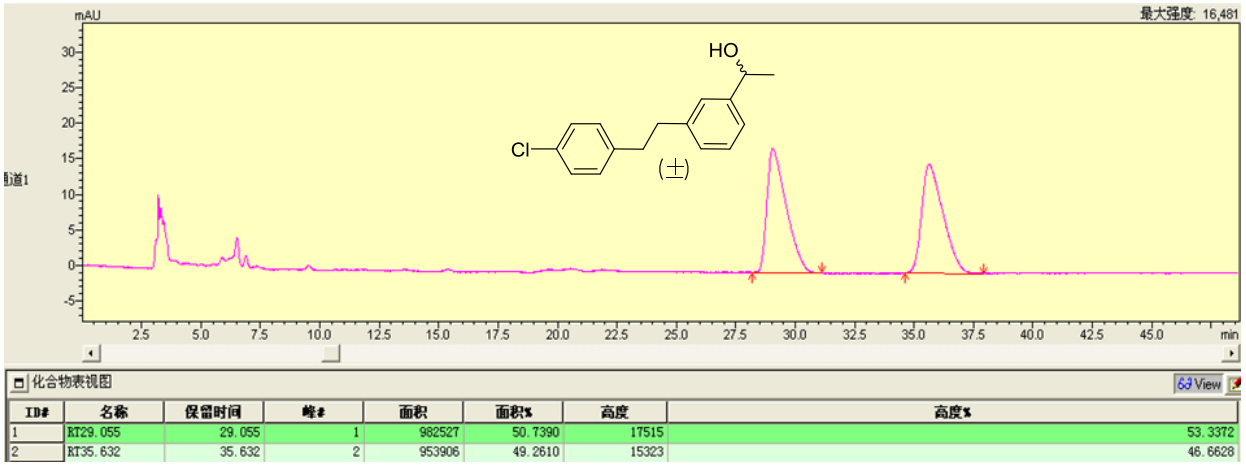
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT24.649	24.649	1	20775650	97.2308	262240	96.5753
2	RT30.650	30.650	2	591700	2.7692	9299	3.4247

Translation of Chinese to English is as follows:

Name ReTime [min] Peak Area Heigh Area%

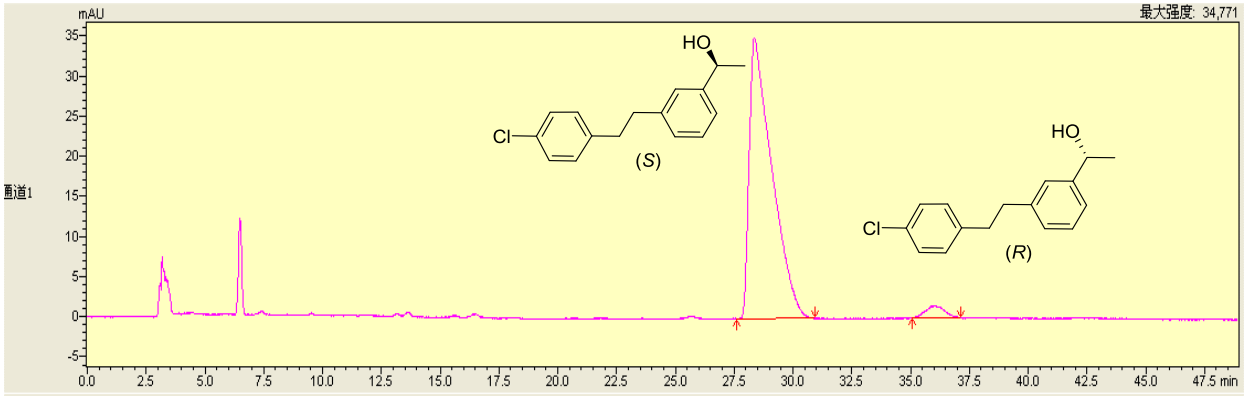
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7n. (*S*)-1-(3-(4-chlorophenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

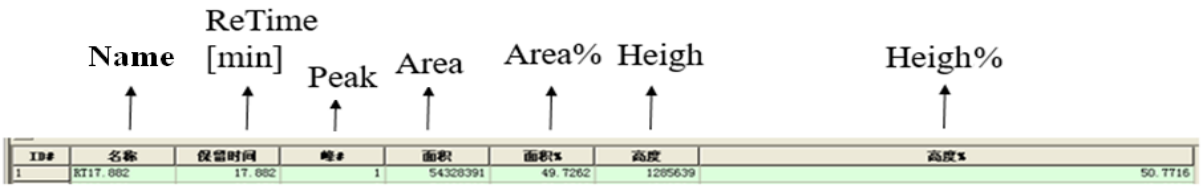
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT29.055	29.055	1	982527	50.7390	17515	53.3372
2	RT35.632	35.632	2	953906	49.2610	15323	46.6628



化合物表视图

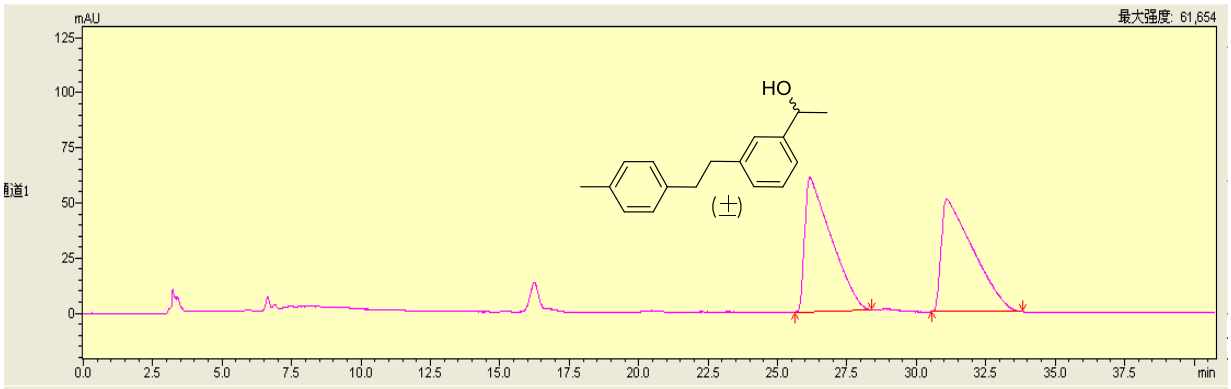
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT28.355	28.355	1	2341117	96.5461	35013	95.9052
2	RT35.945	35.945	2	83752	3.4539	1495	4.0948

<u>Translation of Chinese to English is as follows:</u>



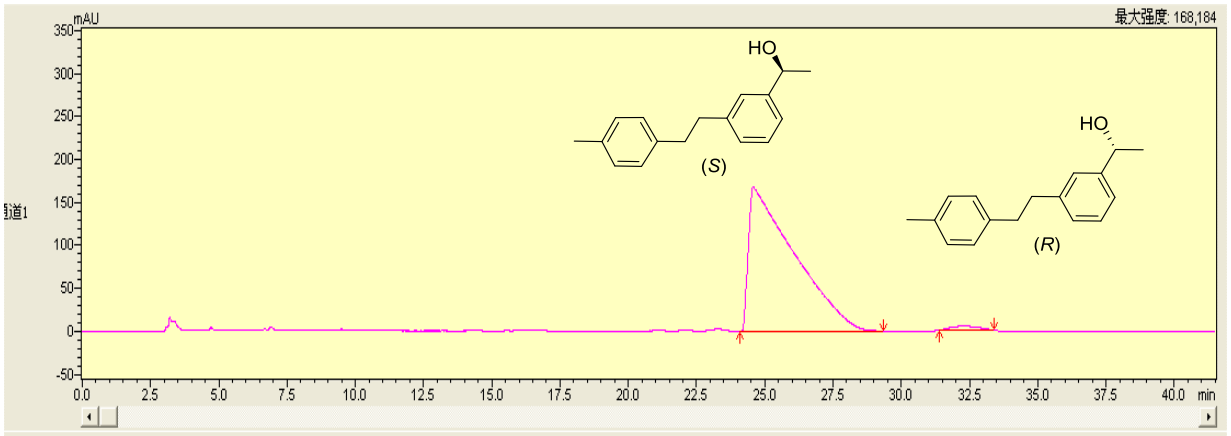
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT17.882	17.882	1	54328391	49.7262	1285639	50.7716

7o. (*S*)-1-(3-(4-methylphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

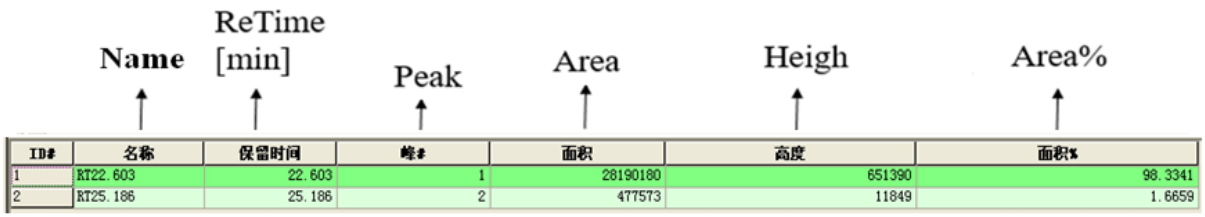
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT26.153	26.153	1	4037389	49.7484	60907	54.3578
2	RT31.087	31.087	2	4078228	50.2516	51141	45.6422



化合物表视图

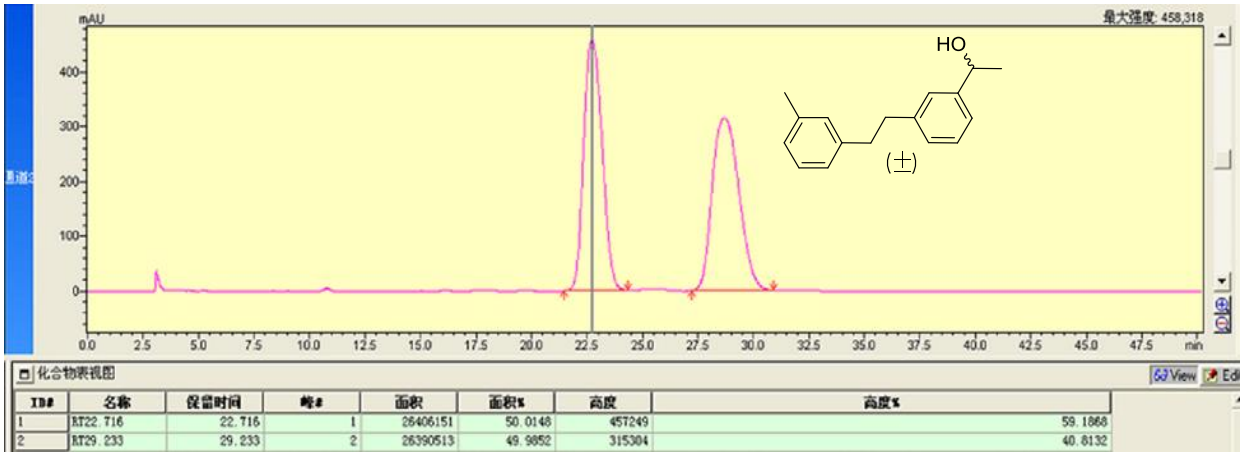
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT24.561	24.561	1	19539109	98.1976	168006	97.1913
2	RT32.242	32.242	2	358638	1.8024	4855	2.8087

Translation of Chinese to English is as follows:



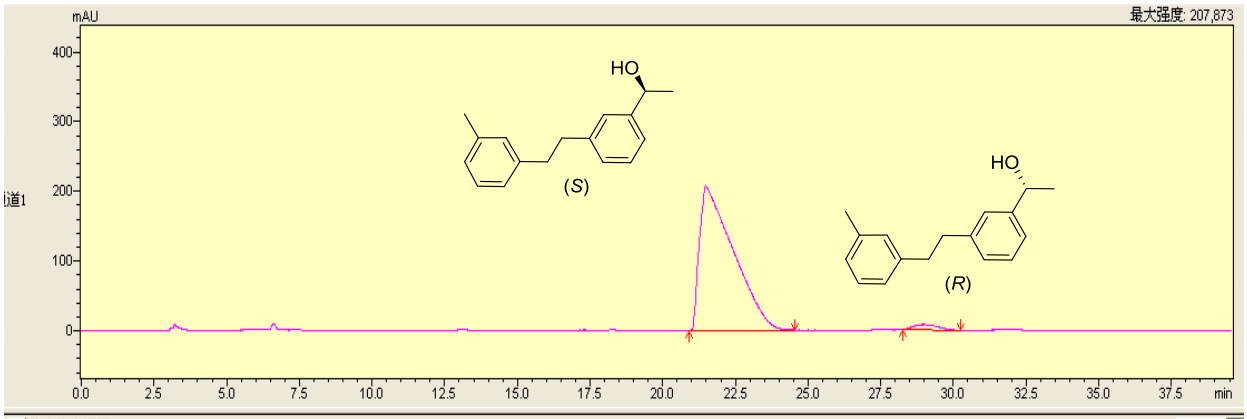
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7p. (*S*)-1-(3-(3-methylphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

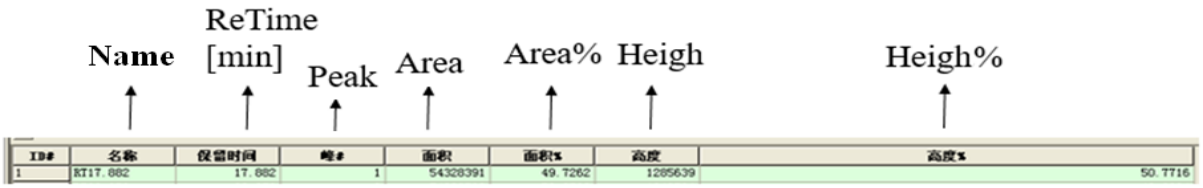
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT22.716	22.716	1	26406151	50.0148	457249	59.1868
2	RT29.233	29.233	2	26390513	49.9852	315304	40.8132



化合物表视图

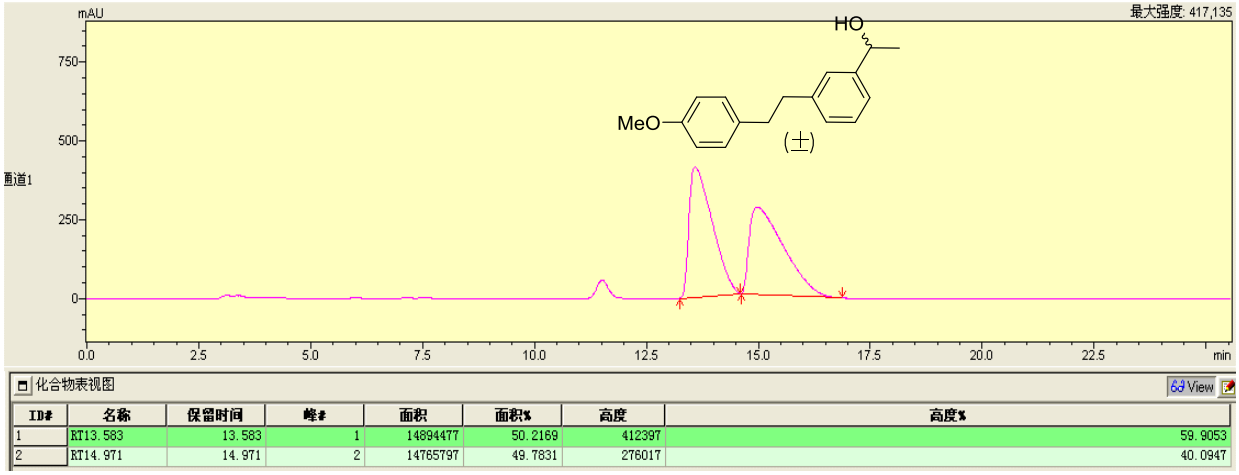
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT21.484	21.484	1	16737547	97.4847	207120	96.4883
2	RT28.957	28.957	2	431861	2.5153	7538	3.5117

Translation of Chinese to English is as follows:



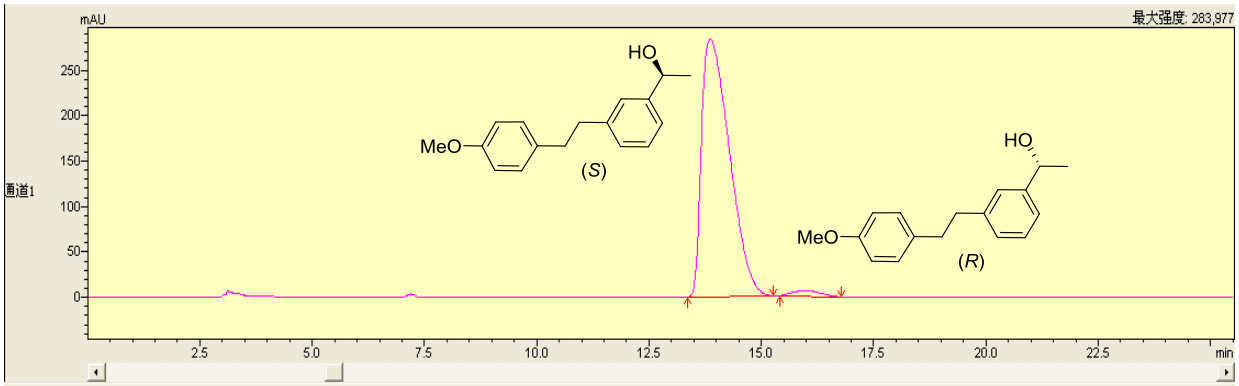
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT17.882	17.882	1	54328391	49.7262	1285639	50.7716

7q. (*S*)-1-(3-(4-methoxyphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel AS-H, detected at 254 nm, eluent: n-hexane/2-propanol = 96/4, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图 View

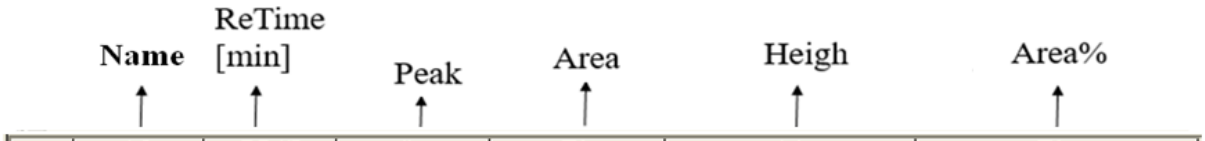
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT13.583	13.583	1	14894477	50.2169	412397	59.9053
2	RT14.971	14.971	2	14765797	49.7831	276017	40.0947



化合物表视图 View

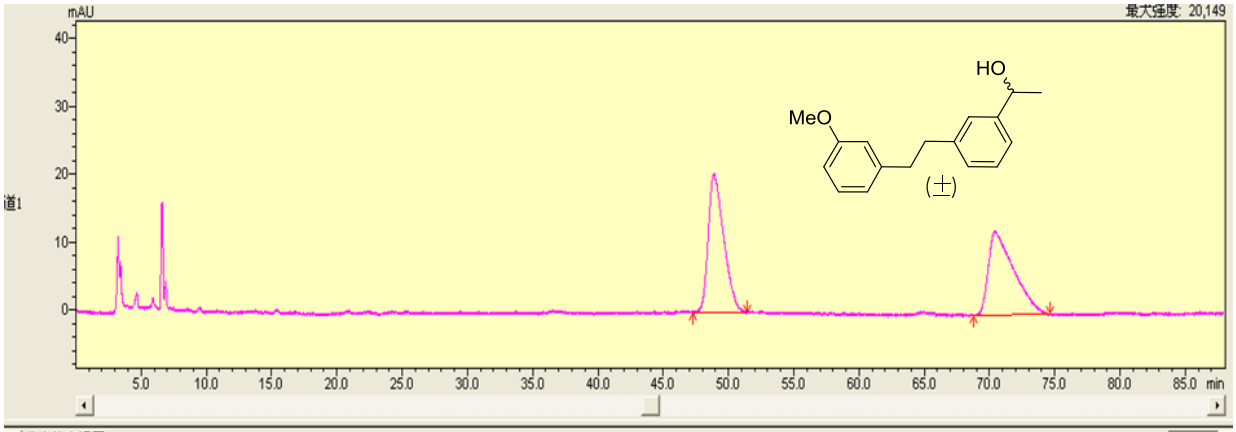
ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT13.855	13.855	1	12284358	97.8538	283423	97.8738
2	RT16.030	16.030	2	269433	2.1462	6157	2.1262

Translation of Chinese to English is as follows:



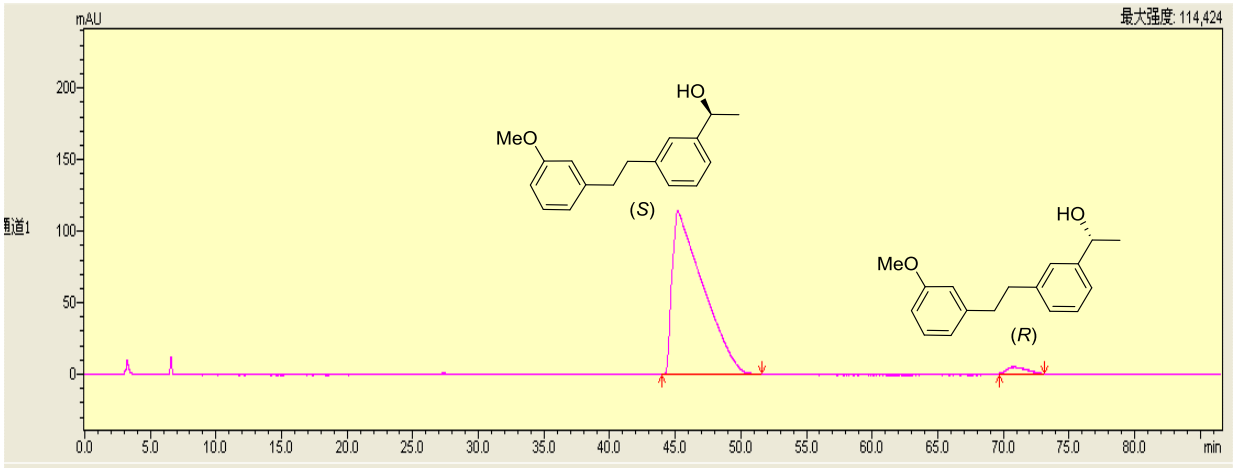
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7r. (*S*)-1-(3-(3-methoxyphenethyl)phenyl)ethan-1-ol**:** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT48.900	48.900	1	1686491	50.6123	20468	62.3137
2	RT70.434	70.434	2	1645686	49.3877	12378	37.6863



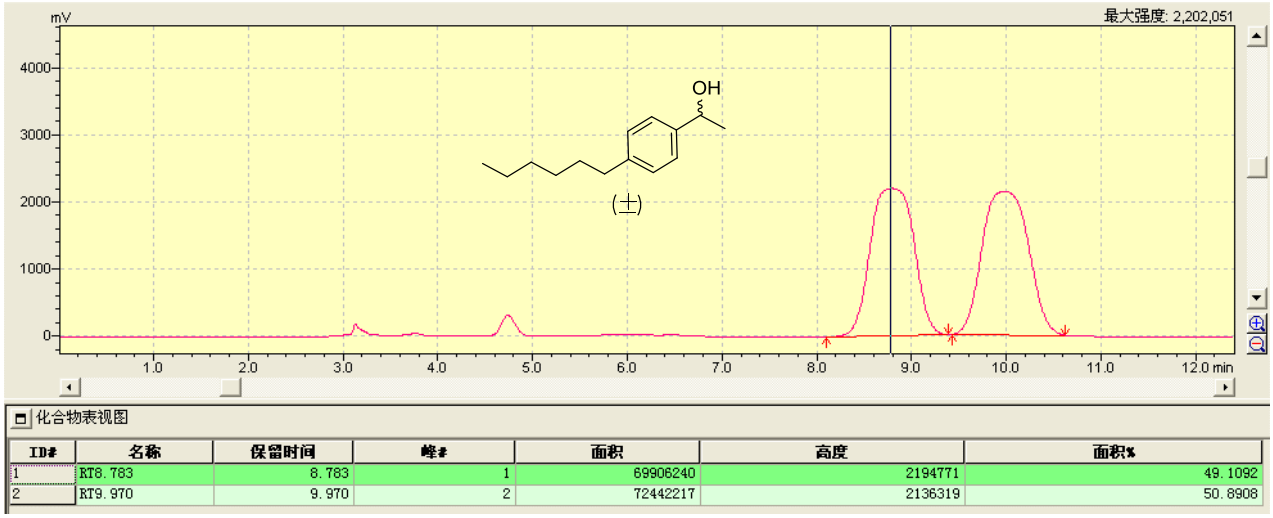
化合物表视图

ID#	名称	保留时间	峰#	面积	面积%	高度	高度%
1	RT45.174	45.174	1	18592140	97.4761	114232	96.0079
2	RT70.851	70.851	2	481393	2.5239	4750	3.9921

<u>Translation of Chinese to English is as follows:</u>

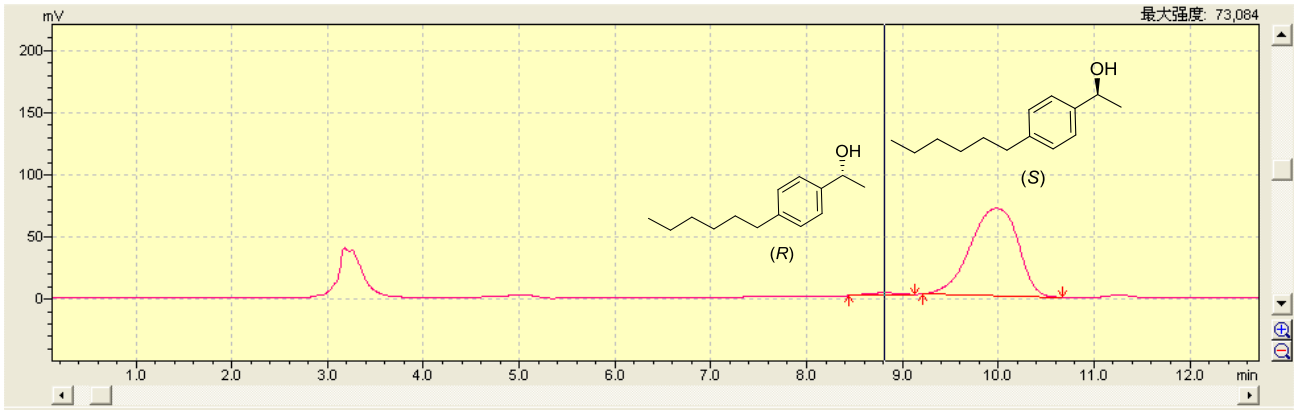
ID#	Name 名称	ReTime [min] 保留时间	Peak 峰#	Area 面积	Heigh 高度	Area% 面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7s. (*S*)-1-(4-hexylphenyl)ethan-1-ol: (HPLC: Chiracel OD-H, detected at 215 nm, eluent: n-hexane/2-propanol = 98/2, flow rate = 1.0 mL/min, 25 ℃).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.783	8.783	1	69906240	2194771	49.1092
2	RT9.970	9.970	2	72442217	2136319	50.8908



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.812	8.812	1	41305	1643	1.6714
2	RT9.978	9.978	2	2429989	70179	98.3286

Translation of Chinese to English is as follows:

Name ReTime [min] Peak Area Heigh Area%

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

7t. (1*S*,1'*S*)-1,1'-(ethane-1,2-diylbis(4,1-phenylene))bis(ethan-1-ol): (HPLC: Chiracel OB-H, detected at 254 nm, eluent: n-hexane/2-propanol = 96/4, flow rate = 1.0 mL/min, 25 ℃).

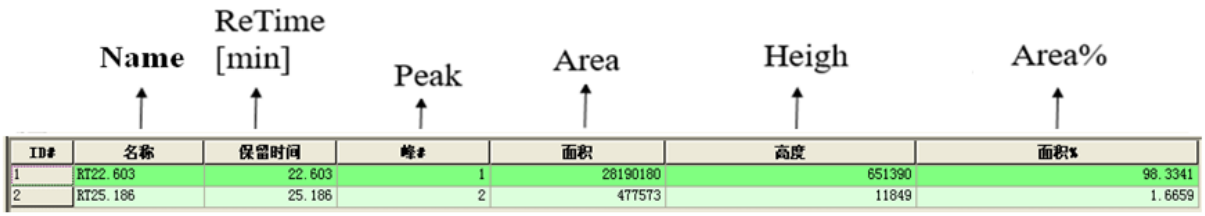
化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT51.280	51.280	1	7776005	60930	25.7769
2	RT56.662	56.662	2	14840821	101967	49.1963
3	RT62.668	62.668	3	7549735	40009	25.0268

化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT49.828	49.828	1	51551312	288051	95.3505
2	RT59.410	59.410	2	2410416	15177	4.4584
3	RT65.846	65.846	3	103334	657	0.1911

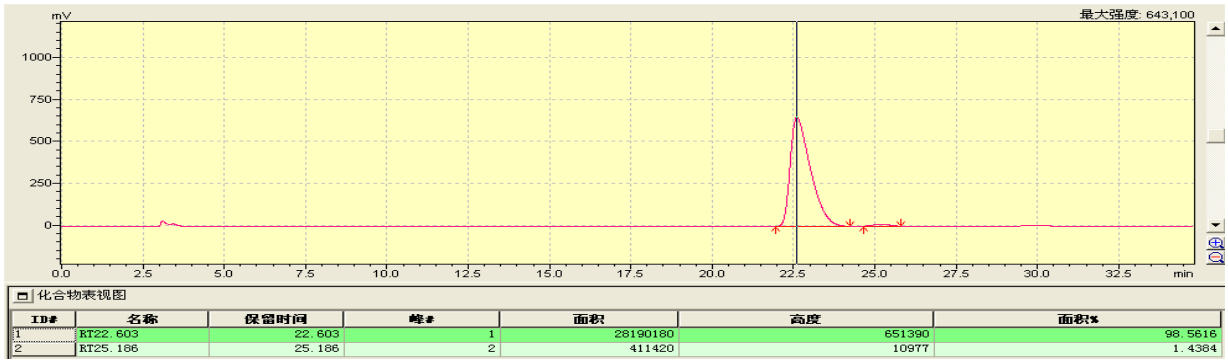
<u>Translation of Chinese to English is as follows:</u>



ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

Figure 4. Reusability of catalyst **5** for the enantioselective cascade reductions of conjugated alkynones.

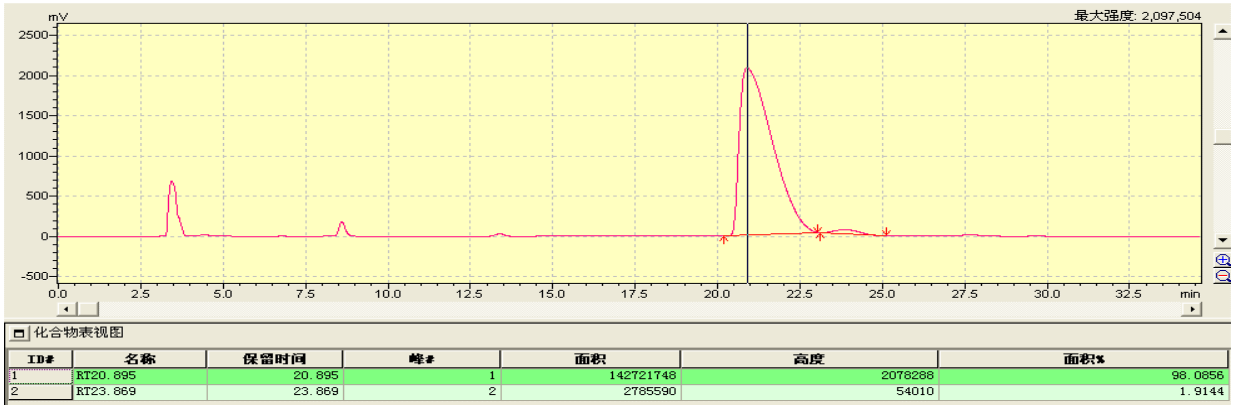
Recycle 1



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.5616
2	RT25.186	25.186	2	411420	10977	1.4384

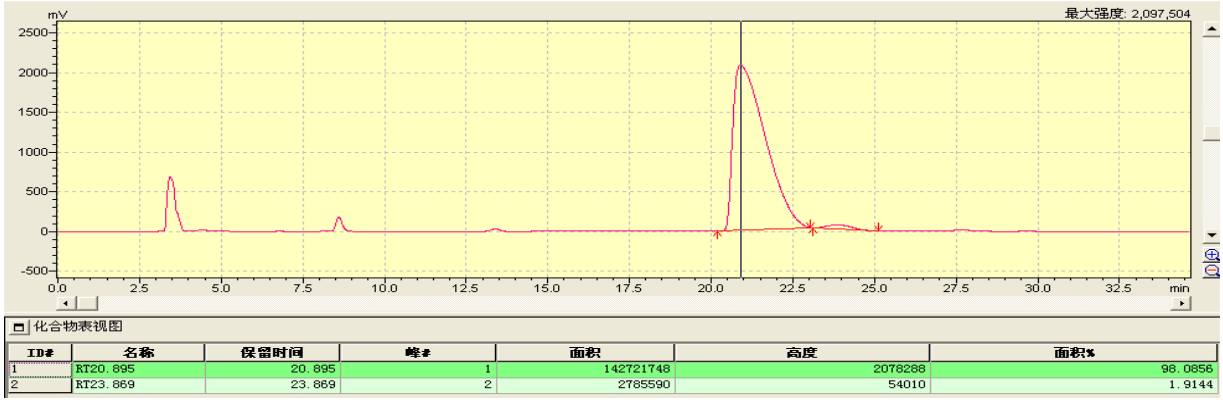
Recycle 2



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT20.895	20.895	1	142721748	2078288	98.0856
2	RT23.869	23.869	2	2785590	54010	1.9144

Recycle 3



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT20.895	20.895	1	142721748	2078288	98.0856
2	RT23.869	23.869	2	2785590	54010	1.9144

<u>Translation of Chinese to English is as follows:</u>

Name ReTime [min] Peak Area Heigh Area%

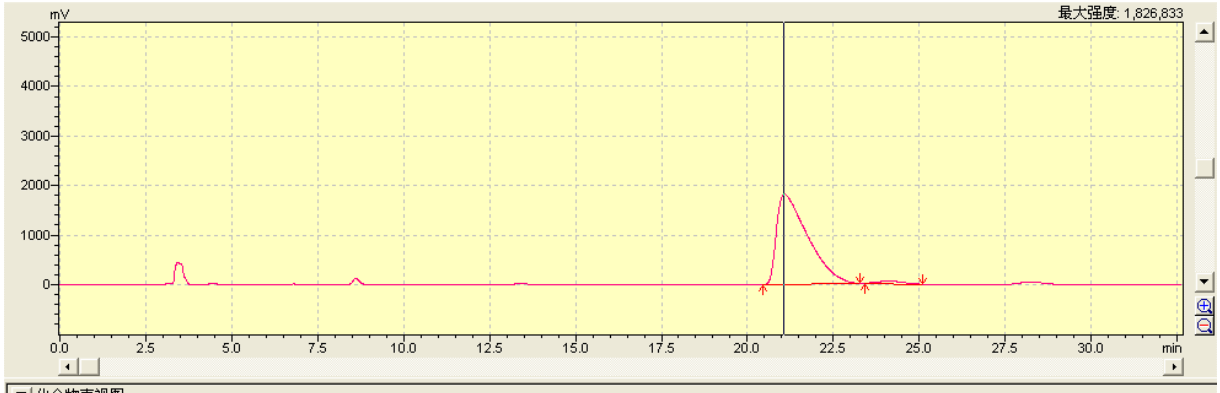
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

Recycle 4

化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT21.451	21.451	1	87456800	1567139	97.8983
2	RT24.419	24.419	2	1877553	42425	2.1017

Recycle 5



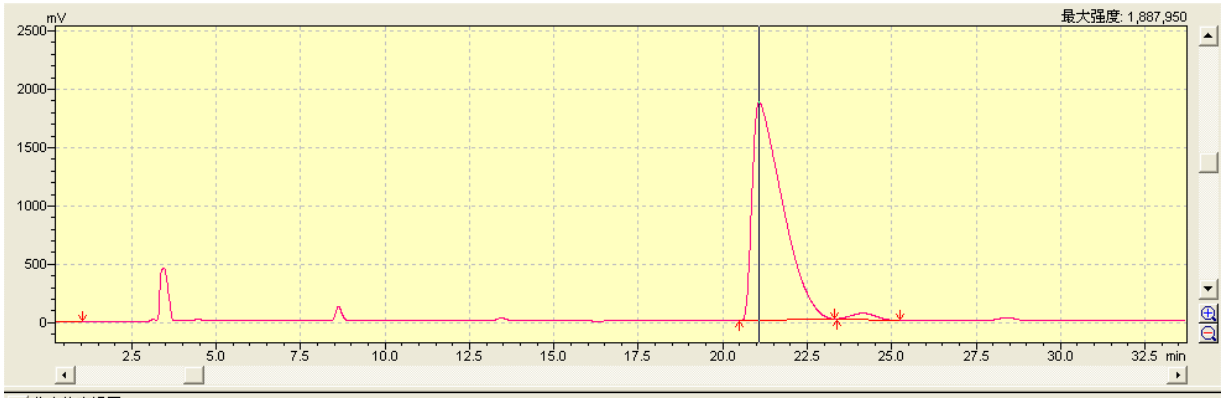
化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT21.072	21.072	1	114090223	1819929	97.7488
2	RT24.112	24.112	2	2627491	50982	2.2512

<u>Translation of Chinese to English is as follows:</u>

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

Recycle 6



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT21.076	21.076	2	116302884	1869305	97.6541
2	RT24.146	24.146	3	2785411	54968	2.3388

Recycle 7

化合物表视图

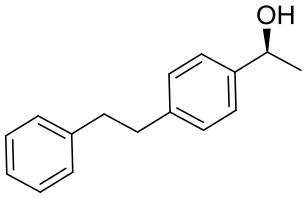
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT21.974	21.974	1	37018407	763087	96.7776
2	RT24.720	24.720	2	1232593	27875	3.2224

Translation of Chinese to English is as follows:

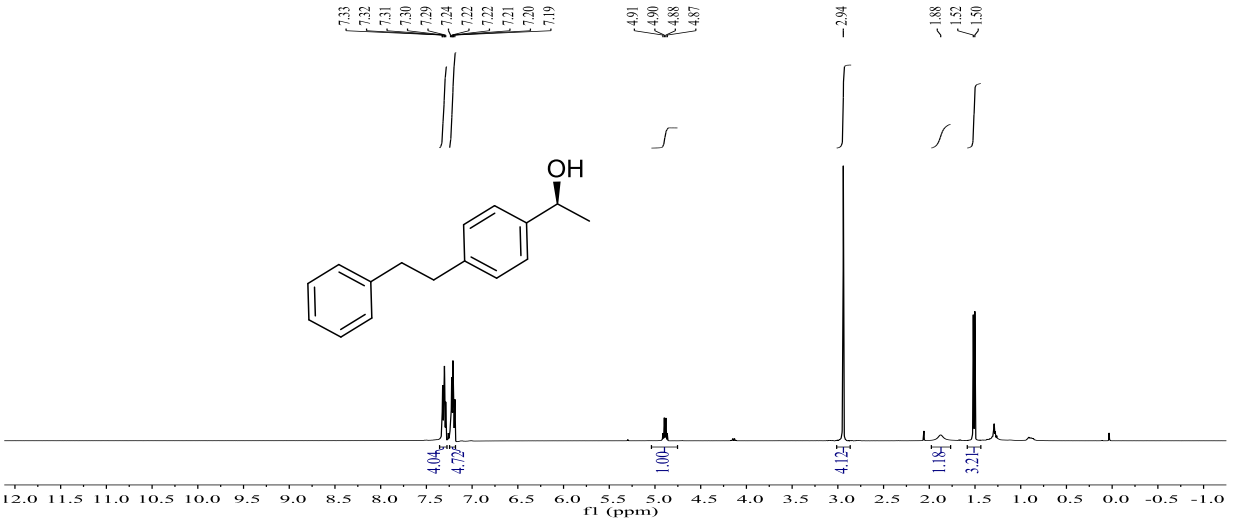
ID#	Name	ReTime [min]	Peak	Area	Heigh	Area%
1	RT22.603	22.603	1	28190180	651390	98.3341
2	RT25.186	25.186	2	477573	11849	1.6659

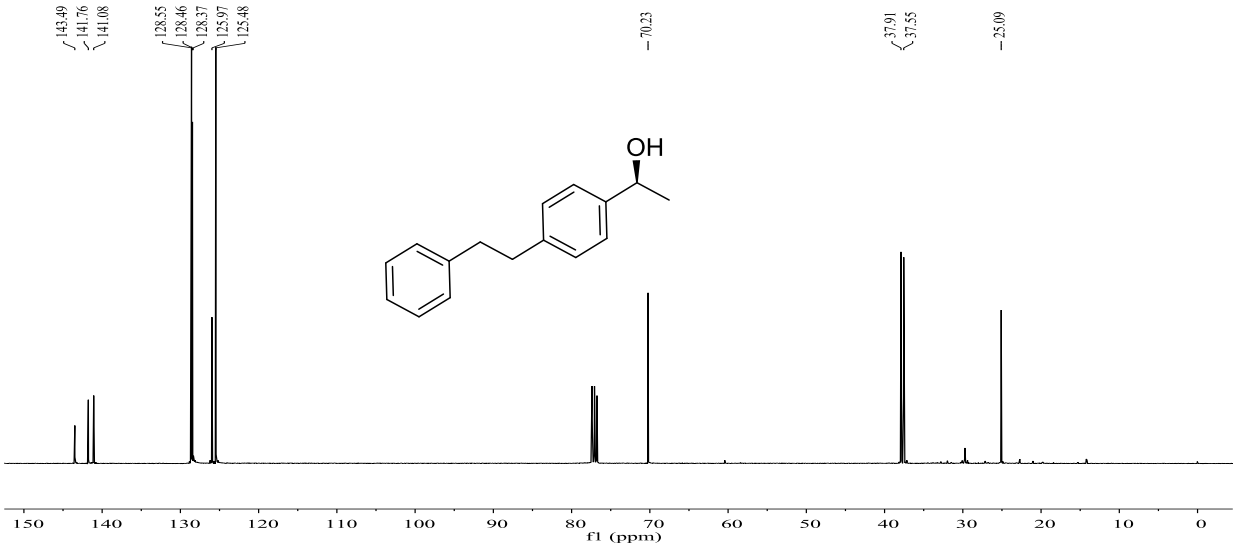
Figure 5. The characterizations of chiral products (**Table 1 in manuscript**).

7a. (*S*)-1-(4-phenethylphenyl)ethan-1-ol. White solid, 99% yield, 97% *ee*. $[\alpha]_D^{25}$ = -25.891 (c 0.216. $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.31 (dd, *J* = 7.6, 5.7 Hz, 4H), 7.21 (dt, *J* = 8.2, 5.5 Hz, 5H), 4.89 (q, *J* = 6.4 Hz, 1H), 2.94 (s, 4H), 1.88 (brs, 1H), 1.51 (d, *J* = 6.6z Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$): δ 143.5, 141.8, 141.0, 128.6, 128.5, 128.4, 126.0, 125.5, 70.2, 37.9, 37.6, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{18}ONa^+$: 249.1250; found: 249.1251. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).



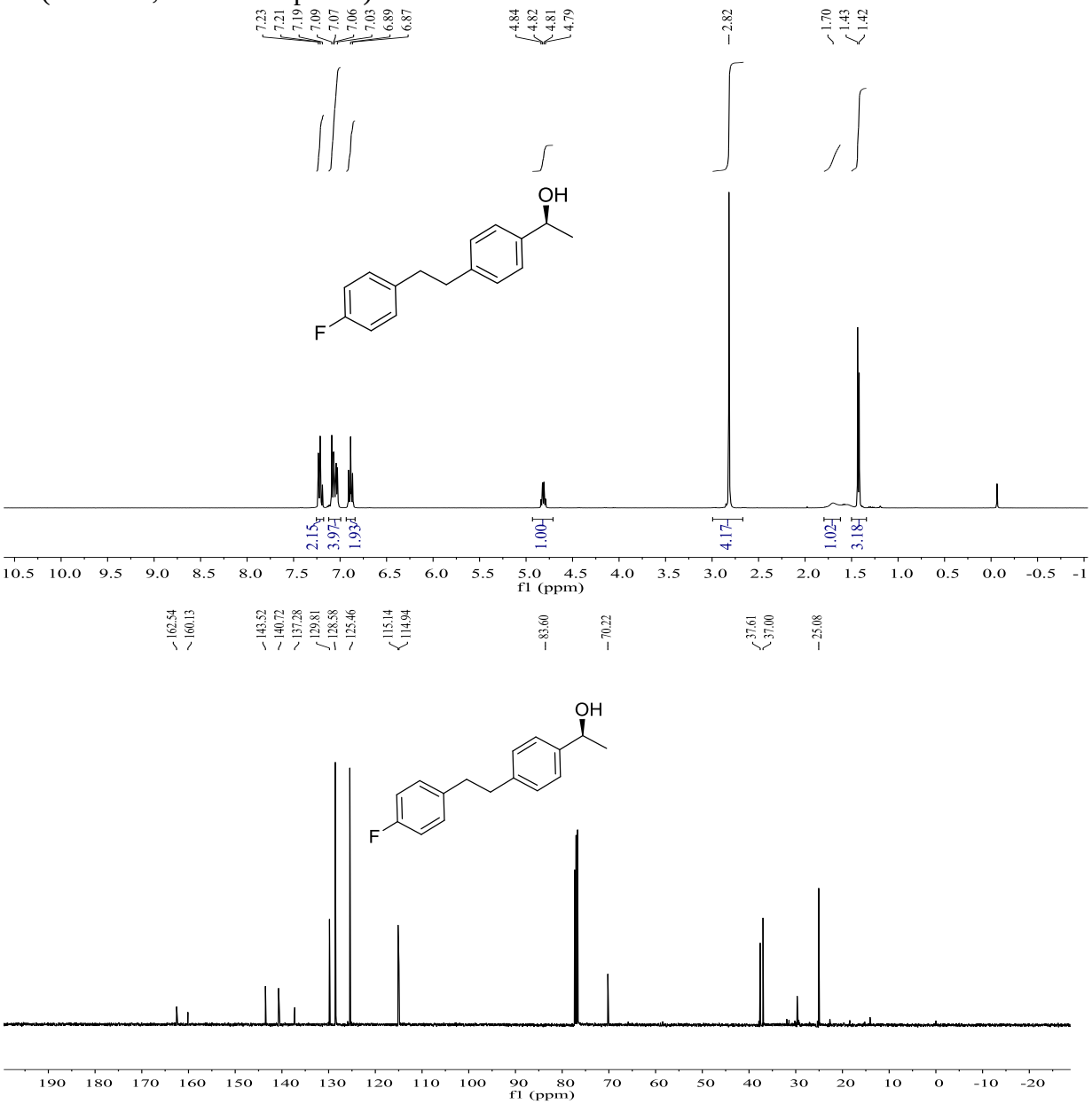
7a (^1H NMR, ^{13}C NMR spectra)**.**



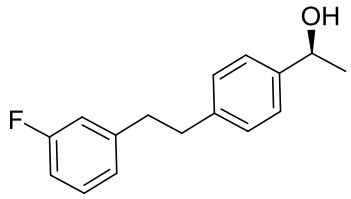


7b. (*S*)-1-(4-(4-fluorophenethyl)phenyl)ethan-1-ol. White solid, 93% yield, 95% *ee*. $[\alpha]_D^{25}$ = -29.648 (c 0.256, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.21 (t, *J* = 8.8 Hz, 2H), 7.12 – 6.99 (m, 4H), 6.88 (d, *J* = 8.6 Hz, 2H), 4.82 (q, *J* = 6.5 Hz, 1H), 2.82 (s, 4H), 1.70 (brs, 1H), 1.43 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 161.3 (d, *J* = 243 Hz), 143.5, 140.7, 137.3, 129.8, 128.6, 125.5, 114.9, 70.2, 37.6, 37.0, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}FONa^+$: 267.1156; found: 267.1156. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

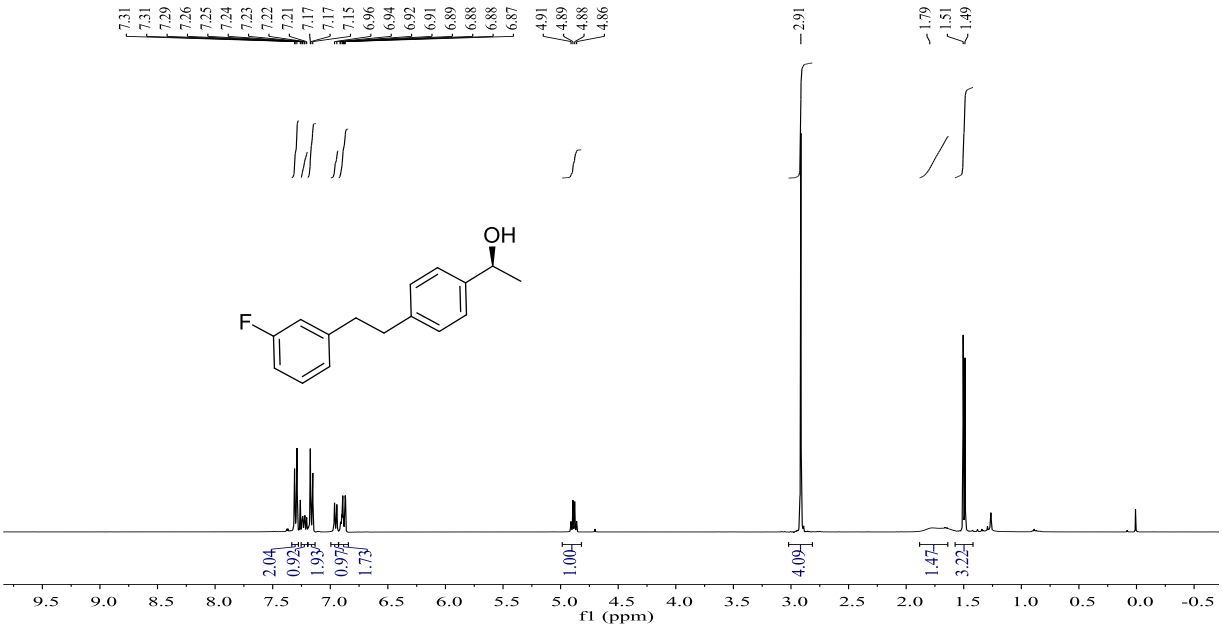
7b (^1H NMR, ^{13}C NMR spectra)**.**

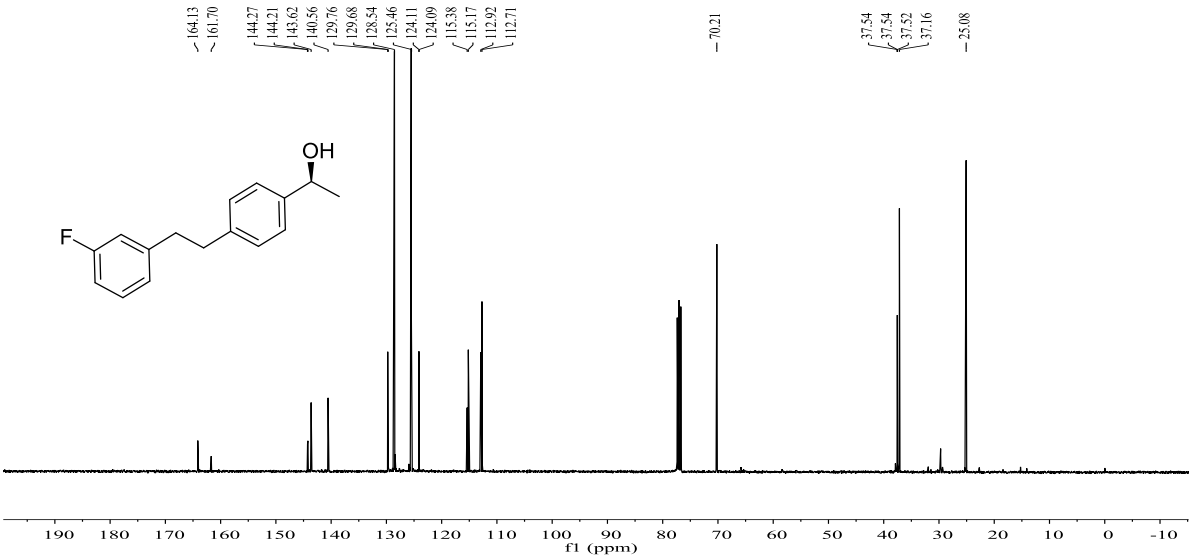


7c. (*S*)-1-(4-(3-fluorophenethyl)phenyl)ethan-1-ol. Yellow liquid, 92% yield, 94% ee. $[\alpha]_D^{25}$ = -28.785 (c 0.378, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.2 Hz, 2H), 7.25 – 7.20 (m, 1H), 7.16 (d, *J* = 8.2 Hz, 2H), 6.94 (d, *J* = 7.7 Hz, 1H), 6.93 – 6.87f (m, 2H), 4.89 (q, *J* = 6.5 Hz, 1H), 2.91 (s, 4H), 1.79 (brs, 1H), 1.50 (d, *J* = 6.2 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 162.9 (d, *J* = 245 Hz), 144.2 (d, *J* = 6.5 Hz), 143.6, 140.6, 129.8 (d, *J* = 8.7 Hz), 128.5, 125.5, 124.1 (d, *J* = 2.3 Hz), 115.3 (d, *J* = 20.9 Hz), 112.8 (d, *J* = 21.5 Hz), 70.2, 37.6, 37.5, 37.2, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}FONa^+$: 267.1156; found: 267.1158. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

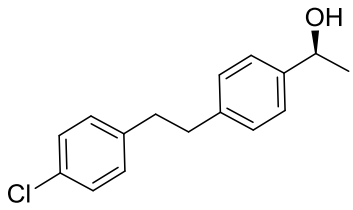


7c (^1H NMR, ^{13}C NMR spectra)**.** (*S*)-1-(4-(3-fluorophenethyl)phenyl)ethan-1-ol.

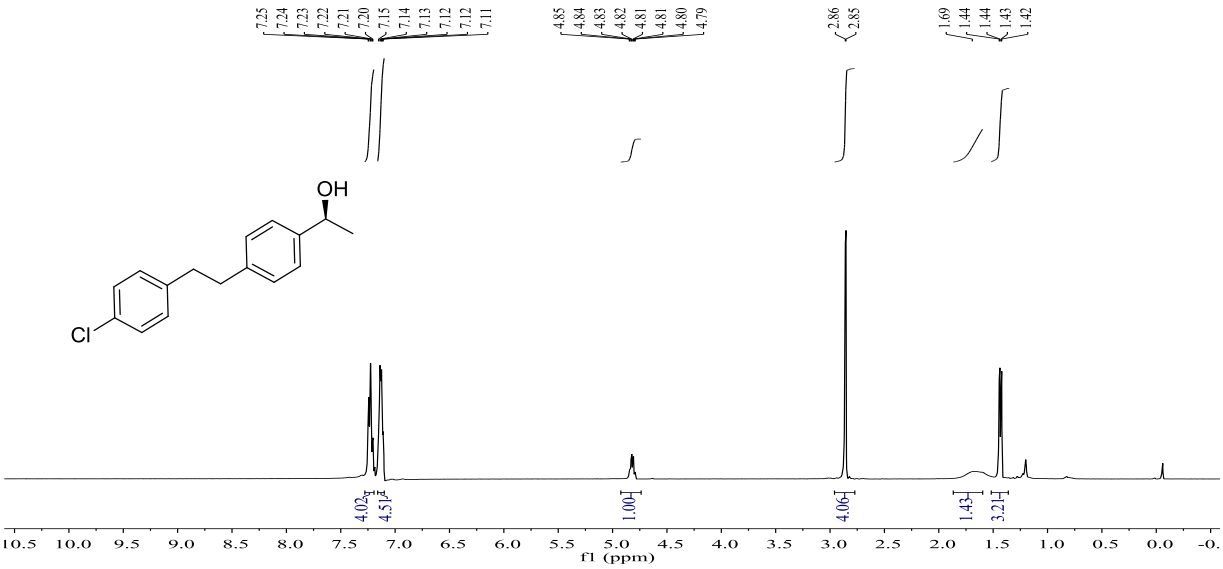


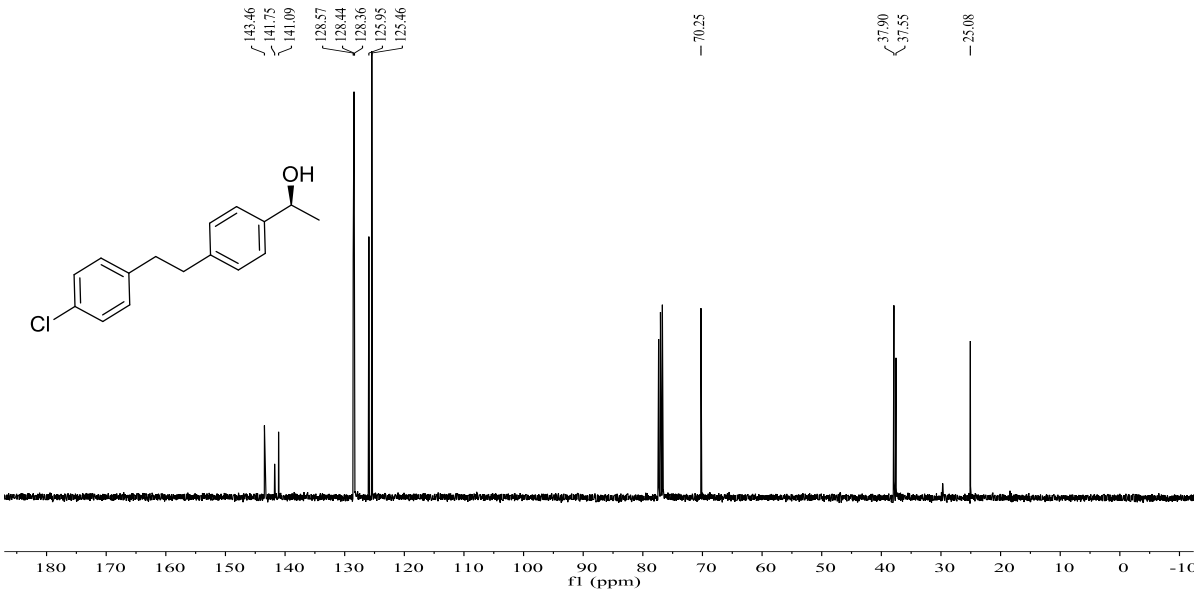


7d. (*S*)-1-(4-(4-chlorophenethyl)phenyl)ethan-1-ol. White solid, 94% yield, 95% ee. $[\alpha]_D^{25}$ = -33.289 (c 0.216, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ7.25 – 7.20 (m, 4H), 7.16 – 7.10 (m, 4H), 4.82 (qd, *J* = 6.4, 2.2 Hz, 1H), 2.86– 2.85 (d, *J* = 2.5 Hz, 4H), 1.69 (brs, 1H), 1.43 (dd, *J* = 6.7, 2.4 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 143.5, 141.8, 141.1, 128.6, 128.5, 128.4, 126.0, 125.5, 70.3, 37.9, 37.6, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}ClONa^+$: 283.0860; found: 283.0861. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

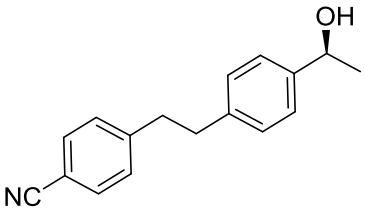


7d (^1H NMR, ^{13}C NMR spectra)**.**

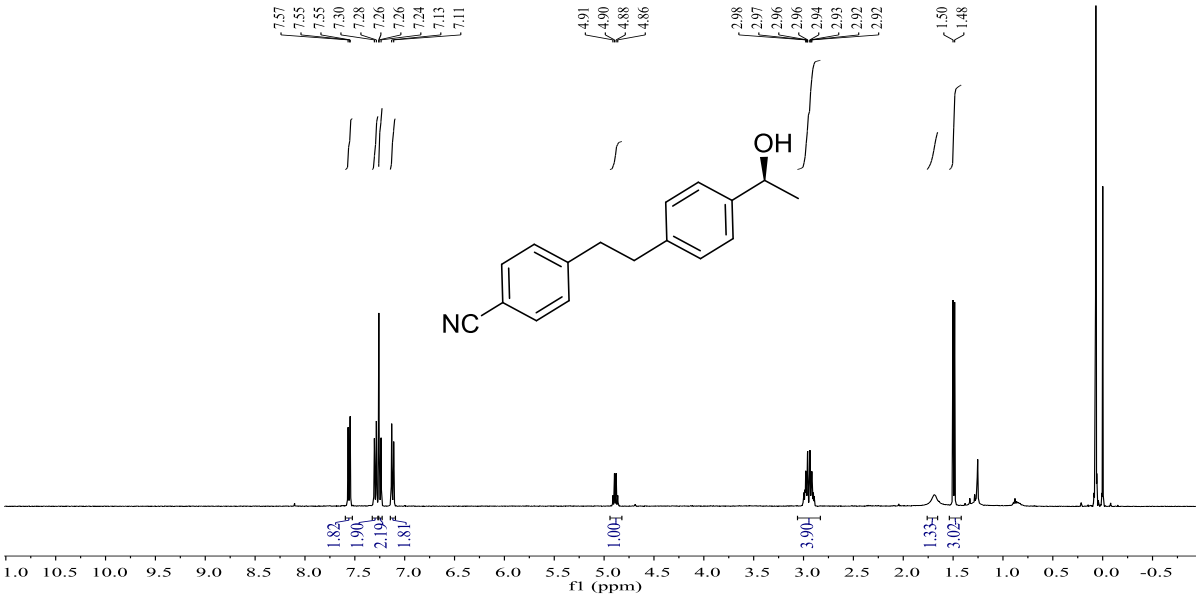


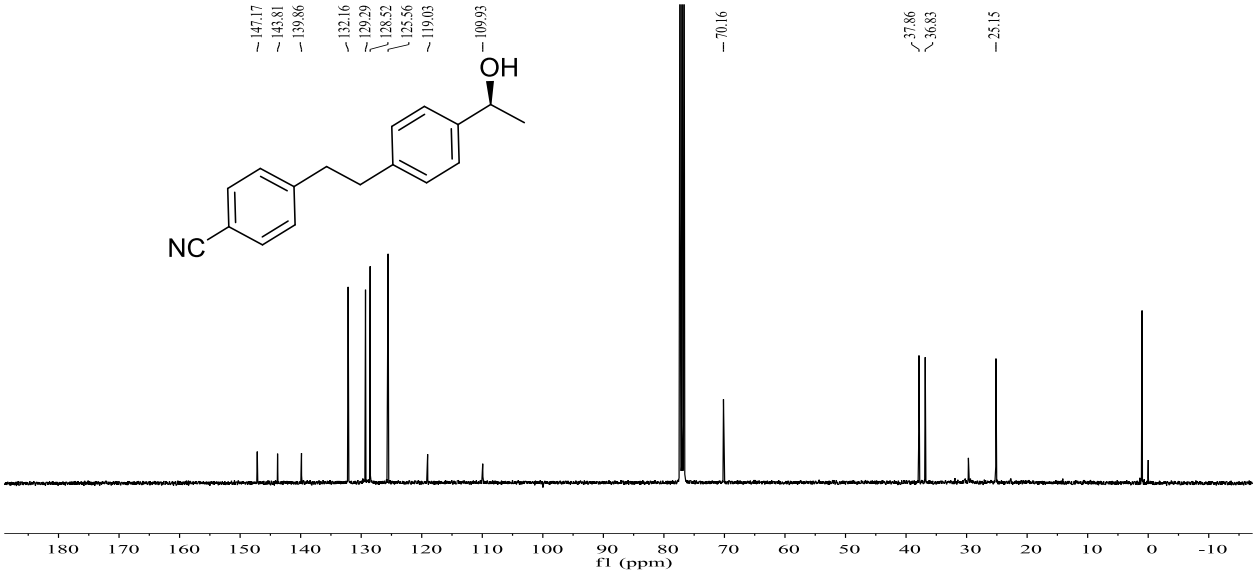


7e. (S)-4-(4-(1-hydroxyethyl)phenethyl)benzonitrile. White solid, 91% yield, 94% ee. $[\alpha]_D^{25}$ = -7.467 (c 0.214, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.56 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 7.25 (d, *J* = 8.0 Hz, 2H), 7.12 (d, *J* = 8.1 Hz, 2H), 4.89 (q, *J* = 6.5 Hz, 1H), 3.06 – 2.83 (m, 4H), 1.69 (brs, 1H), 1.49 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 147.2, 143.8, 139.9, 132.2, 129.3, 128.5, 125.6, 119.0, 109.0, 70.2, 37.9, 36.8, 25.2. HRMS (ESI): m/z $[M+NH_4]^+$ calculated for $C_{17}H_{21}N_2O^+$: 269.1650; found: 269.1648. HPLC (Chiralpak OD-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 95/5, flow rate: 1.0 mL/min, 25 ℃).



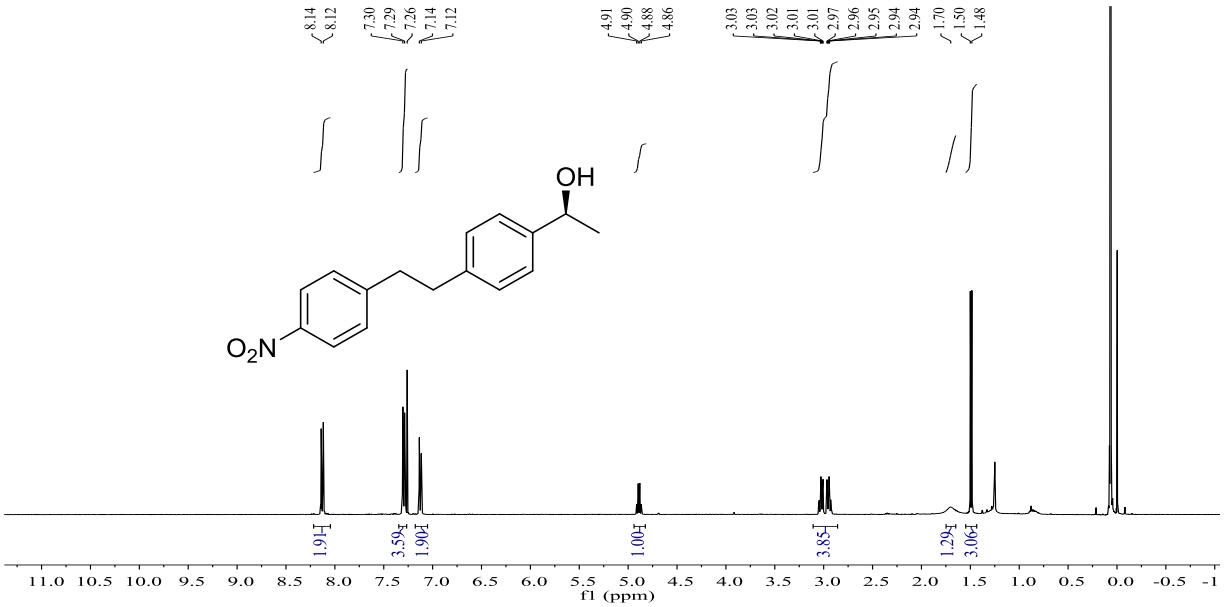
7e (^1H NMR, ^{13}C NMR spectra)**.**

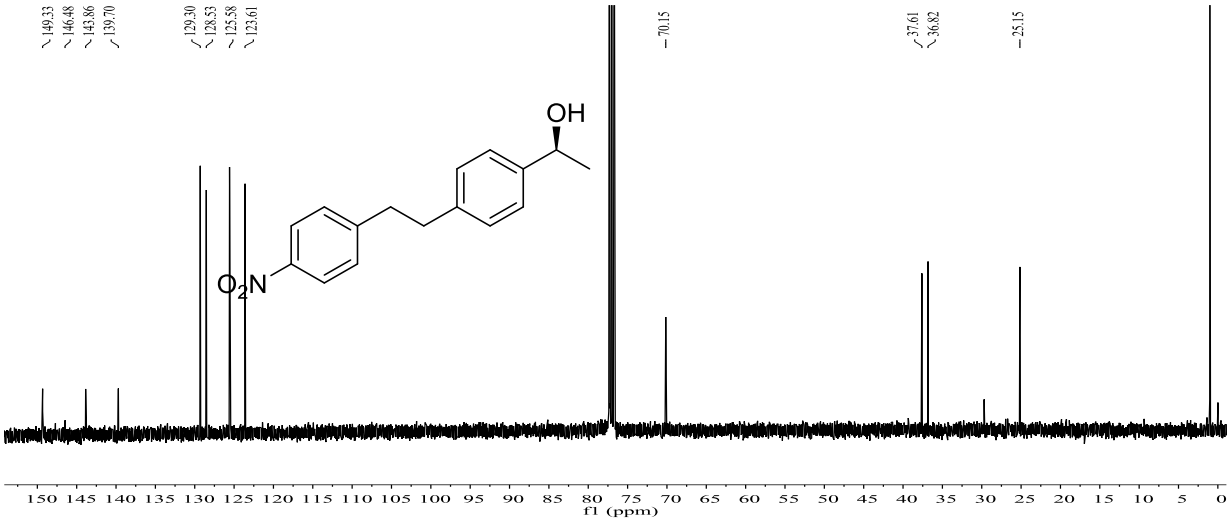




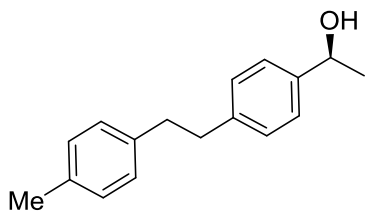
7f. (S)-1-(4-(4-nitrophenethyl)phenyl)ethan-1-ol. Brown solid, 83% yield, 99% ee.$[\alpha]_D^{25}$ = -4.781 (c 0.376, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.7 Hz, 2H), 7.30 (d, *J* = 7.2 Hz, 4H), 7.13 (d, *J* = 8.1 Hz, 2H), 4.89 (q, *J* = 6.5 Hz, 1H), 3.03 – 2.94 (m, 4H), 1.70 (s, 1H), 1.49 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 149.3, 146.5, 143.9, 139.7, 129.3, 128.5, 125.6, 123.6, 70.2, 37.6, 36.8, 25.2. HRMS (ESI): m/z $[M+NH_4]^+$ calculated for $C_{16}H_{21}N_2O_3^+$: 289.1548; found: 289.1547. HPLC (Chiralpak OD-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 96/4, flow rate: 1.0 mL/min, 25 ℃).

7f (^1H NMR, ^{13}C NMR spectra)**.**

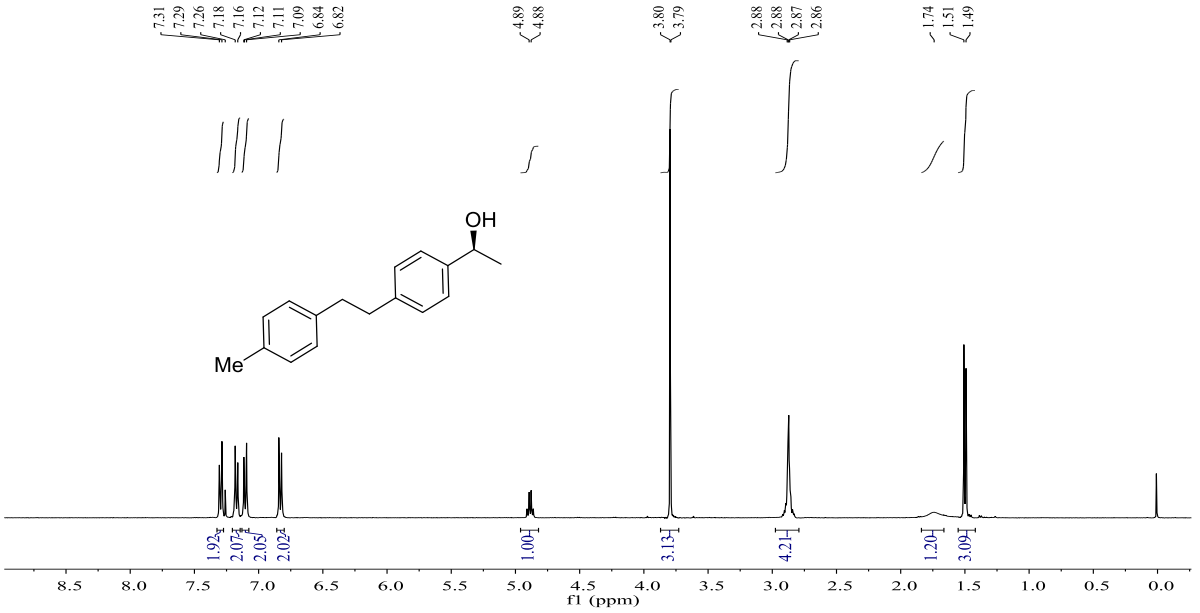


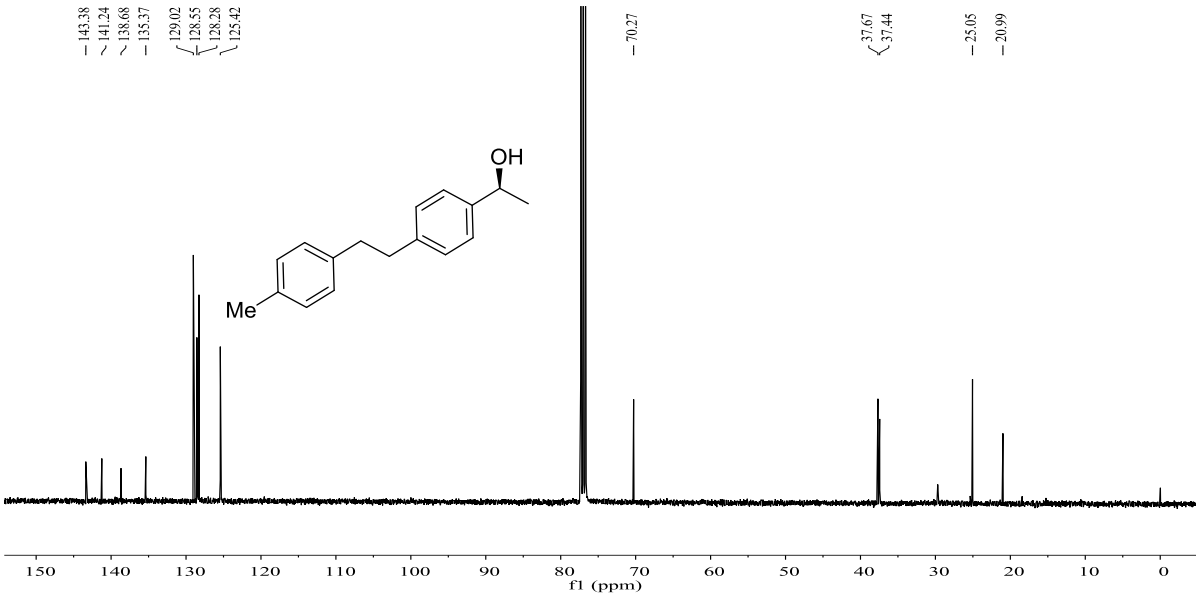


7g. (*S*)-1-(4-(4-methylphenethyl)phenyl)ethan-1-ol. White solid, 95% yield, 95% ee. $[\alpha]_D^{25}$ = -20.693 (c 0.222, $CHCl_3$). ^1H NMR (400 MHz, Chloroform-*d*) δ 7.30 (dc, *J* = 7.9 Hz, 2H), 7.17 (d, *J* = 7.9 Hz, 2H), 7.10 (d, *J* = 8.5 Hz, 2H), 6.83 (d, *J* = 8.5 Hz, 2H), 4.89 (d, *J* = 6.3 Hz, 1H), 3.80 (s, 3H), 2.87 (q, *J* = 2.9 Hz, 4H), 1.74 (brs, 1H), 1.50 (d, *J* = 6.7 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 143.4, 141.2, 138.7, 135.4, 129.0, 128.6, 128.3, 125.4, 70.3, 37.6, 37.4, 25.1, 21.0. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}ONa^+$: 263.1406; found: 263.1409. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

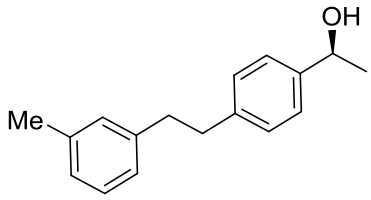


7g (^1H NMR, ^{13}C NMR spectra)**.**

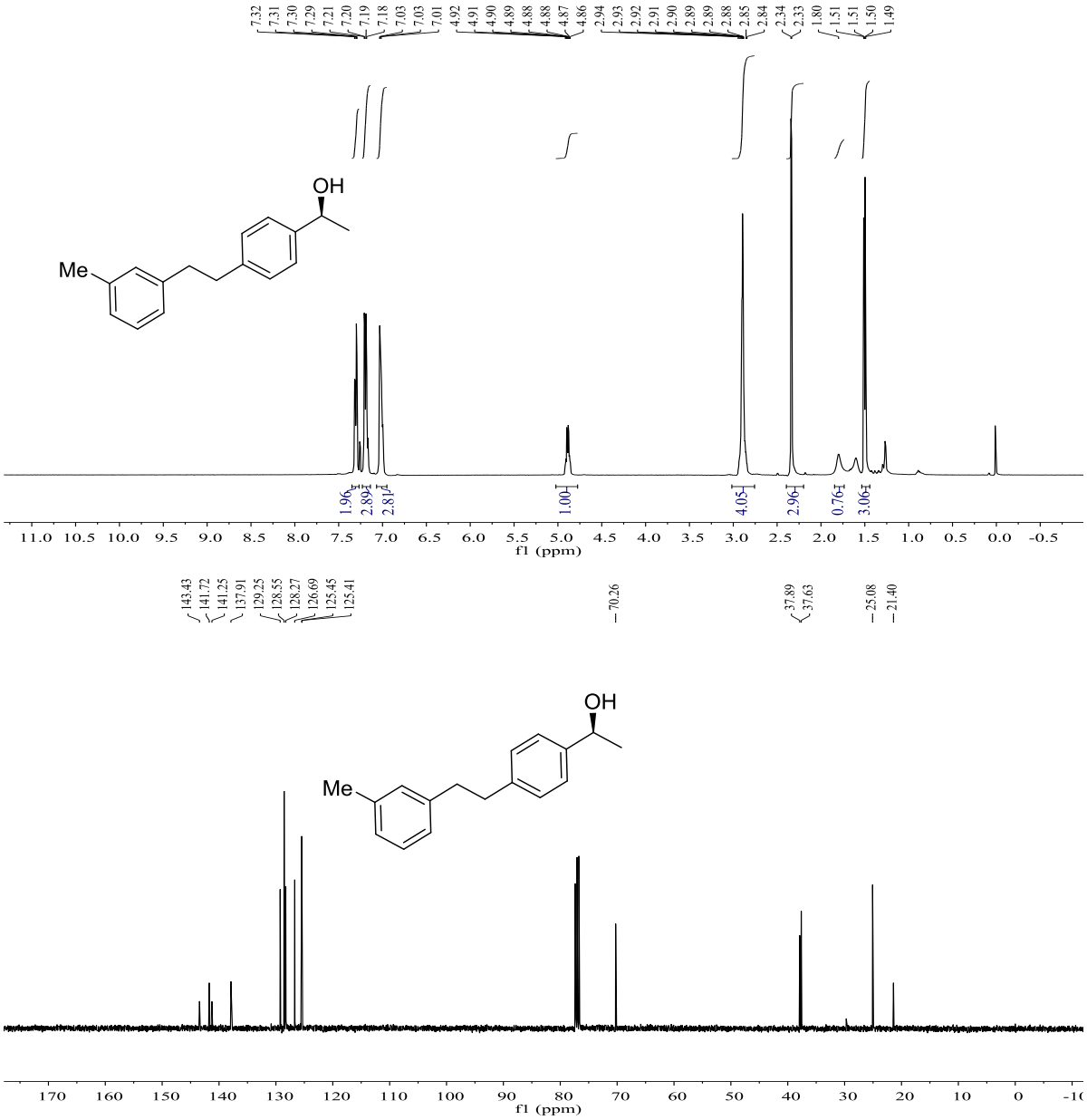




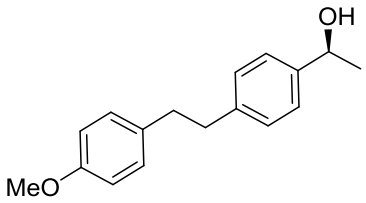
7h. (*S*)-1-(4-(3-methylphenethyl)phenyl)ethan-1-ol. White solid, 94% yield, 95% ee. $[\alpha]_D^{25}$ = -37.333 (c 0.214, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (dd, *J* = 8.3, 2.9 Hz, 2H), 7.20 (dd, *J* = 8.1, 2.8 Hz, 3H), 7.07 – 6.95 (m, 3H), 4.89 (qd, *J* = 6.5, 2.8 Hz, 1H), 2.90 (h, *J* = 3.4, 2.5 Hz, 4H), 2.34 (d, *J* = 3.1 Hz, 3H), 1.80 (brs, 1H), 1.53 – 1.44 (m, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 143.4, 141.7, 141.3, 137.9, 129.3, 128.6, 128.3, 126.7, 125.5, 125.4, 70.3, 37.9, 37.6, 25.1, 21.4. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}ONa^+$: 263.1406; found: 263.1407. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).



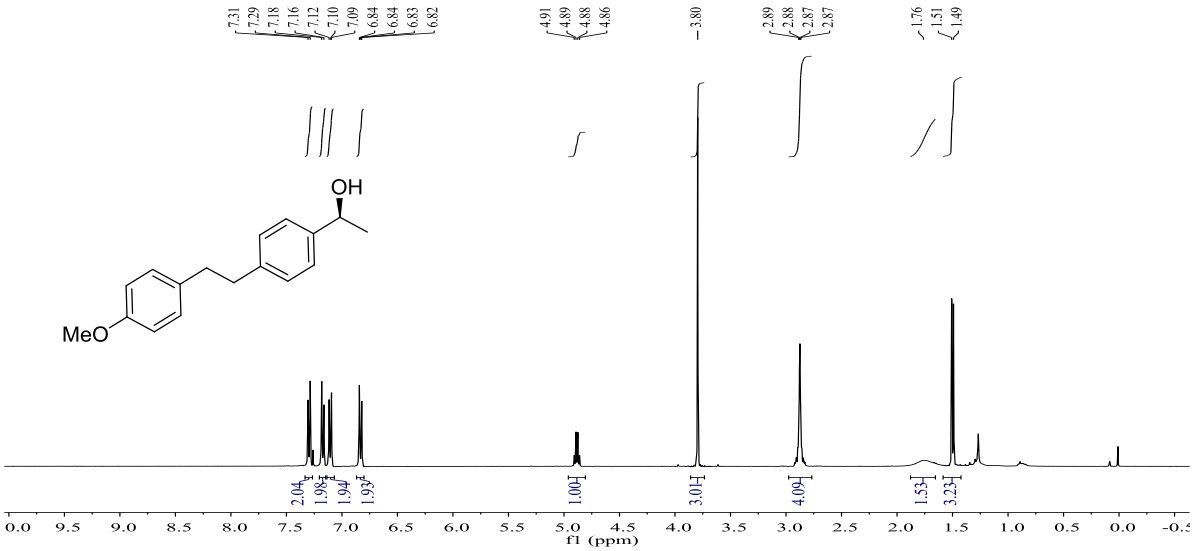
7h (^1H NMR, ^{13}C NMR spectra)**.**

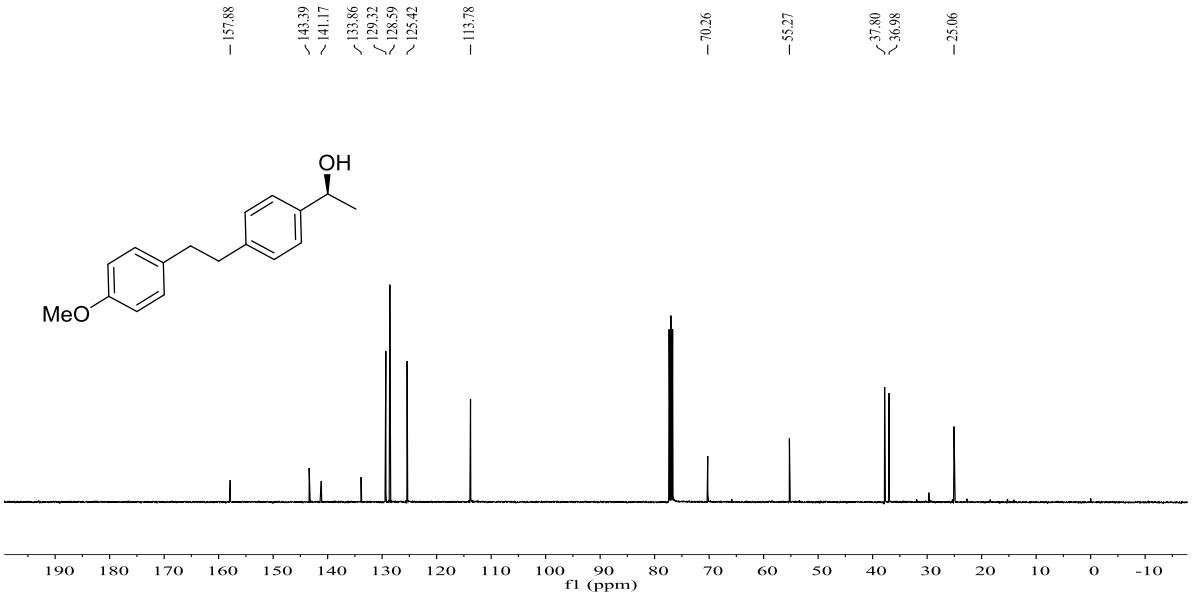


7i. (*S*)-1-(4-(4-methoxyphenethyl)phenyl)ethan-1-ol. White solid, 95% yield, 94% ee. $[\alpha]_D^{25}$ = -23.941 (c 0.292, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 7.9 Hz, 2H), 7.17 (d, *J* = 7.9 Hz, 2H), 7.11 (d, *J* = 8.3 Hz, 2H), 6.83 (d, *J* = 8.4 Hz, 2H), 4.88 (q, *J* = 6.4 Hz, 1H), 3.80 (s, 3H), 2.88 (q, *J* = 3.0 Hz, 4H), 1.76 (brs, 1H), 1.50 (d, *J* = 6.6 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 157.9, 143.4, 141.2, 133.9, 129.3, 128.6, 125.4, 113.8, 70.3, 55.3, 37.8, 37.0, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}O_2Na^+$: 279.1356; found: 279.1359. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

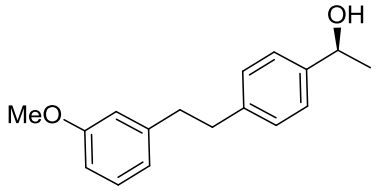


7i (^1H NMR, ^{13}C NMR spectra)**.**

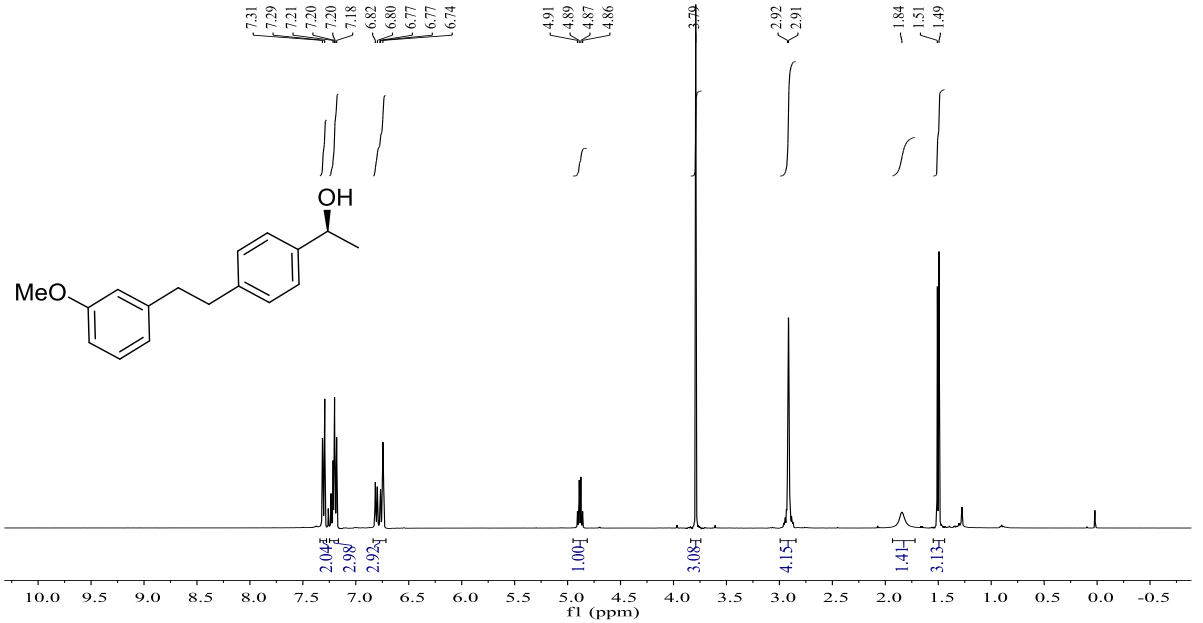


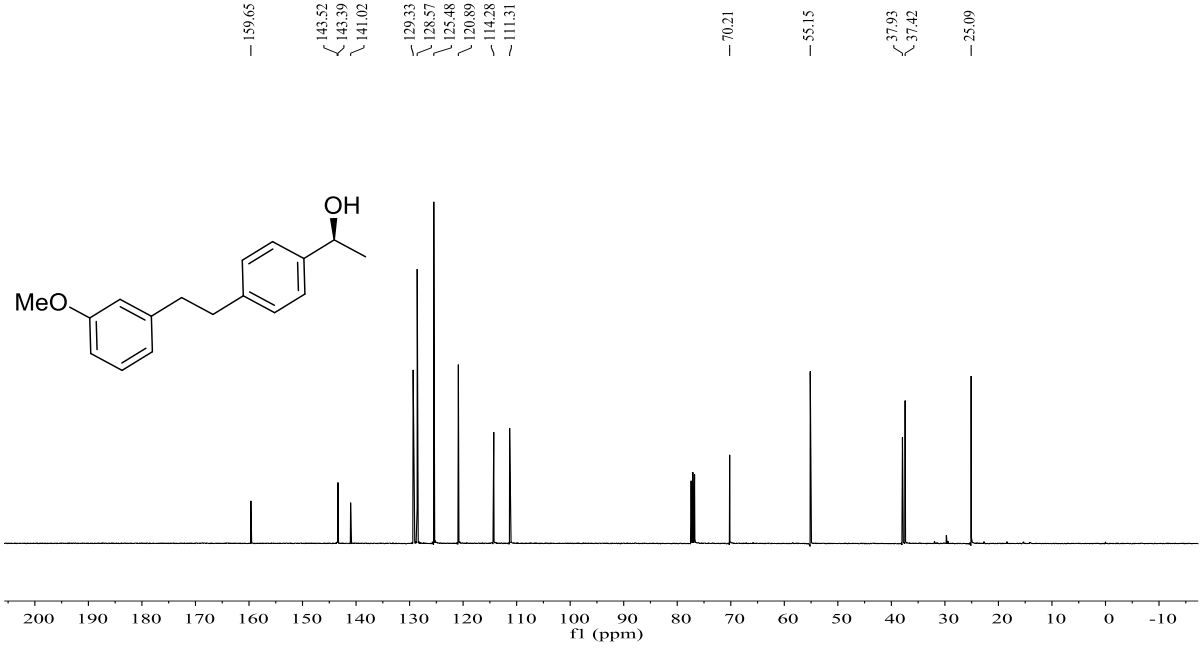


7j. (*S*)-1-(4-(3-methoxyphenethyl)phenyl)ethan-1-ol. White solid, 92% yield, 95% ee. $[\alpha]_D^{25}$ = -39.207 (c 0.270, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.2 Hz, 2H), 7.20 (dd, *J* = 7.8, 5.8 Hz, 3H), 6.84 – 6.72 (m, 3H), 4.88 (q, *J* = 6.5 Hz, 1H), 3.79 (s, 3H), 2.91 (s, 4H), 1.84 (brs, 1H), 1.50 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 159.7, 143.5, 143.4, 141.0, 129.3, 128.6, 125.5, 120.9, 114.28 , 111.3, 70.2, 55.2, 37.9, 37.4, 25.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}O_2Na^+$: 279.1356; found: 279.1361. HPLC (Chiralpak OB-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).

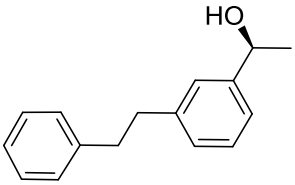


7j (^1H NMR, ^{13}C NMR spectra)**.**

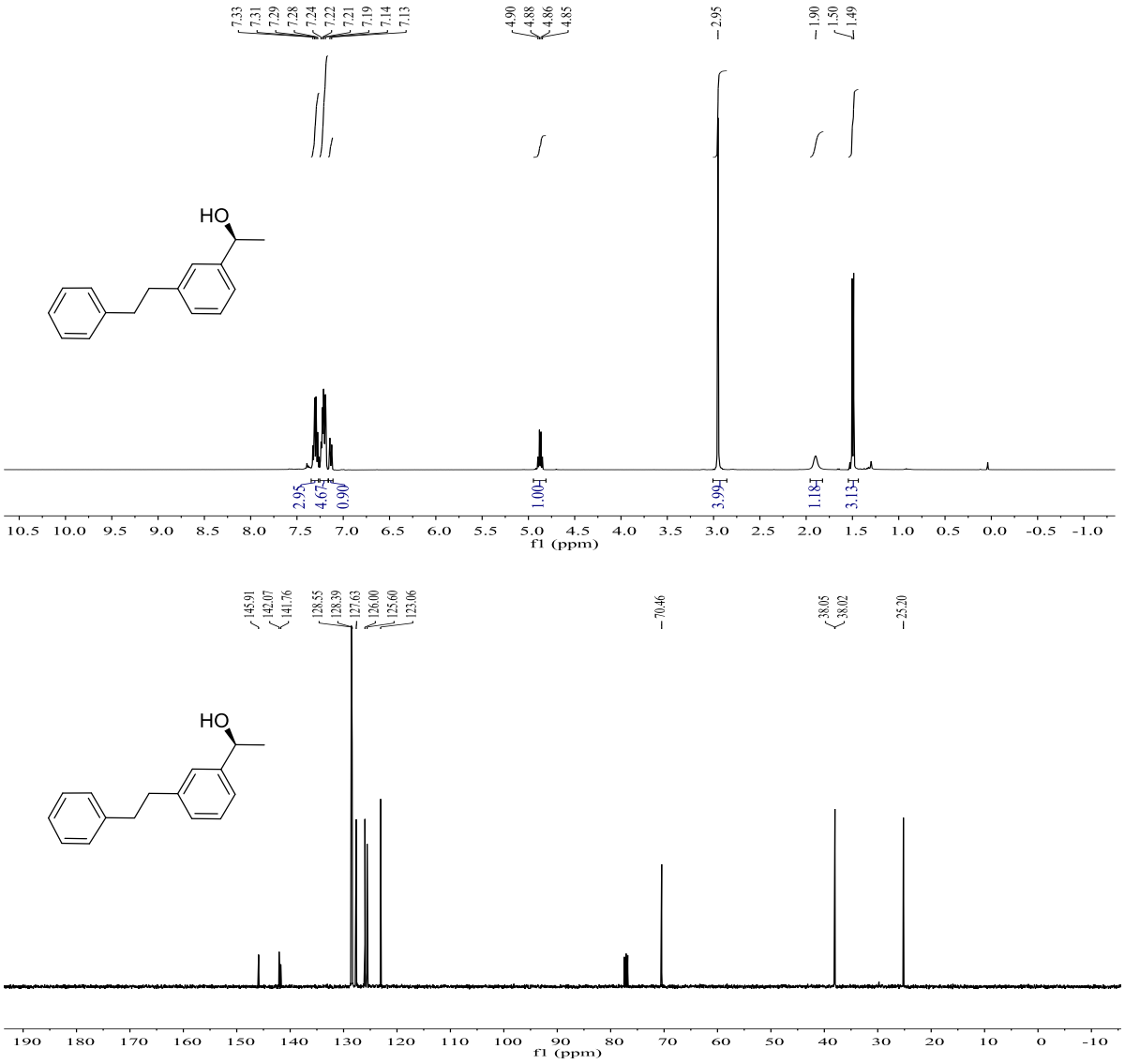




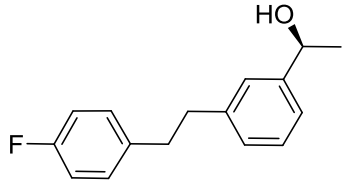
7k. (*S*)-1-(3-phenethylphenyl)ethan-1-ol. Yellow liquid, 93% yield, 95% ee. $[\alpha]_D^{25}$ = -21.766 (c 0.468, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (q, *J* = 7.3 Hz, 3H), 7.22 (dd, *J* = 11.5, 7.5 Hz, 5H), 7.13 (d, *J* = 7.5 Hz, 1H), 4.87 (q, *J* = 6.5 Hz, 1H), 2.95 (s, 4H), 1.90 (s, 1H), 1.50 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 145.9, 142.1, 141.8, 128.6, 128.4, 127.6, 126.0, 125.6, 123.1, 70.5, 38.1, 38.0, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{18}ONa^+$: 249.1250; found: 249.1252. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).



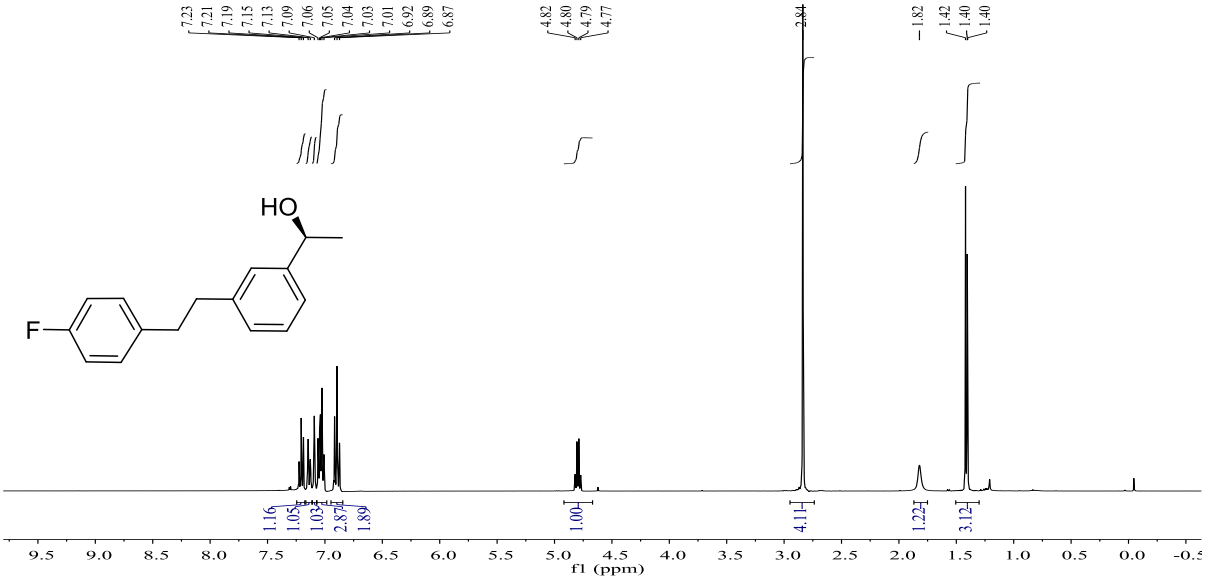
7k (^1H NMR, ^{13}C NMR spectra)**.**

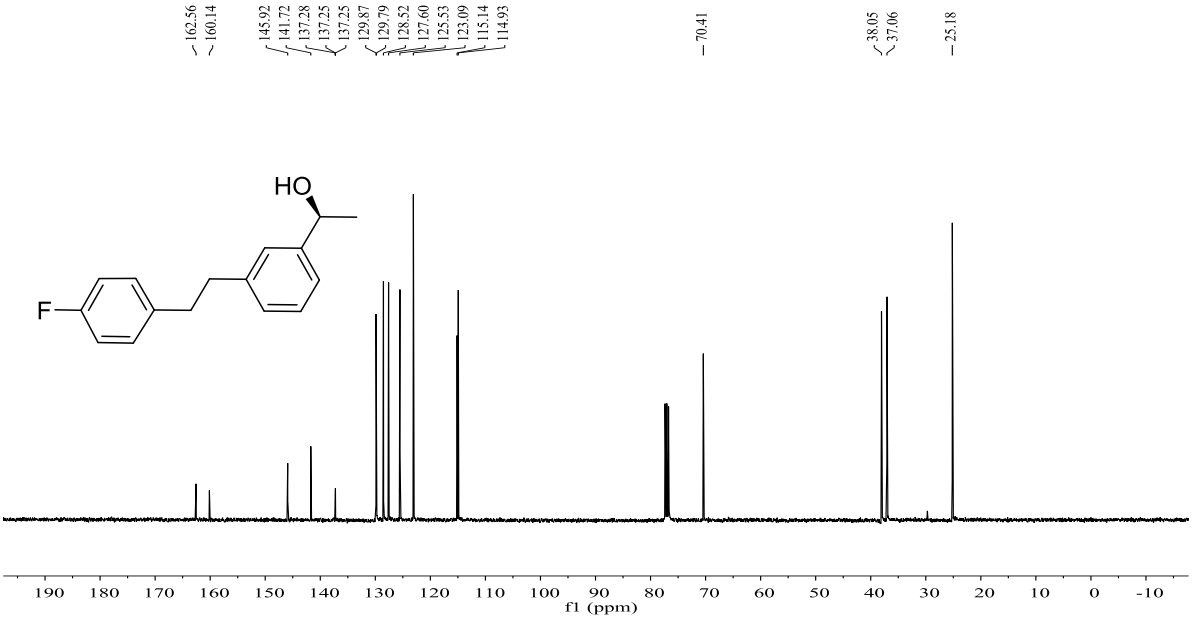


7l. (*S*)-1-(3-(4-fluorophenethyl)phenyl)ethan-1-ol. Yellow liquid, 91% yield, 94% ee. $[\alpha]_D^{25}$ = -33.116 (c 0.386, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ7.21 (t, *J* = 7.5 Hz, 1H), 7.14 (d, *J* = 7.6 Hz, 1H), 7.09 (s, 1H), 7.07 – 6.99 (m, 3H), 6.89 (t, *J* = 8.7 Hz, 2H), 4.80 (q, *J* = 6.4 Hz, 1H), 2.84 (s, 4H), 1.82 (brs, 1H), 1.41 (d, *J* = 6.2 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 161.4 (d, *J* = 245 Hz), 145.9, 141.7, 137.3 (d, *J* = 3.2 Hz), 129.8 (d, *J* = 7.4 Hz), 128.5, 127.6, 125.5, 123.1, 115.0 (d, *J* = 21.5 Hz), 70.4, 38.1, 37.1, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}FONa^+$: 267.1156; found: 267.1158. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3, flow rate: 1.0 mL/min, 25 ℃).

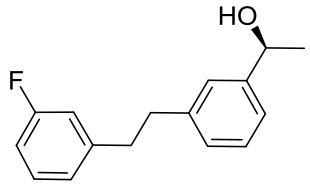


7l (^1H NMR, ^{13}C NMR spectra)**.**

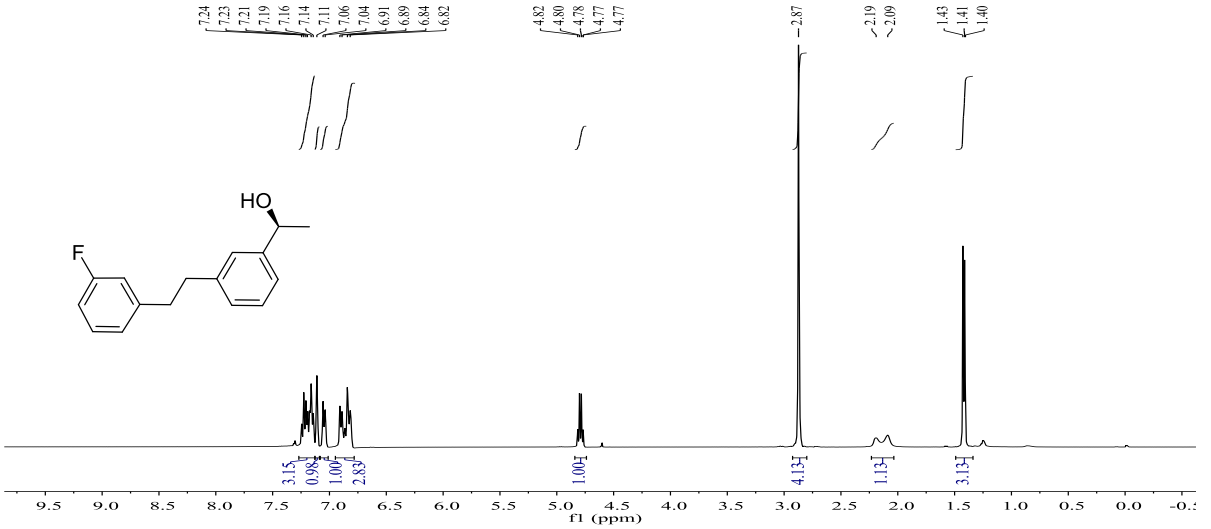


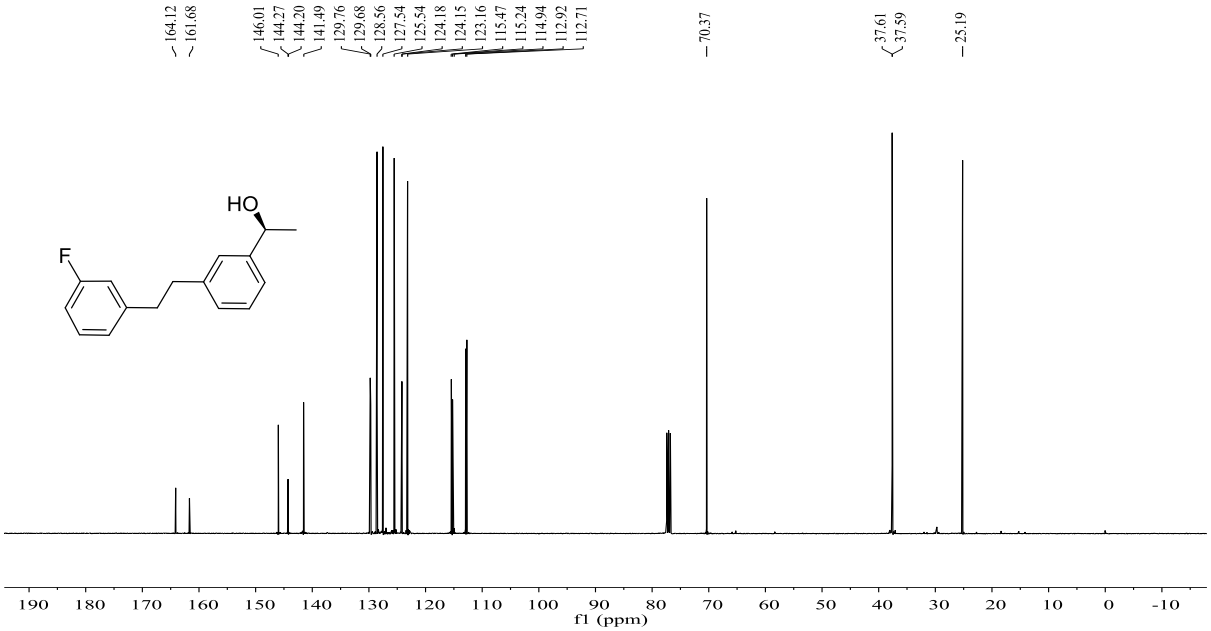


7m. (*S*)-1-(3-(3-fluorophenethyl)phenyl)ethan-1-ol. Yellow liquid, 90% yield, 94% ee. $[\alpha]_D^{25}$ = -22.323 (c 0.340, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.27 – 7.13 (m, 3H), 7.11 (s, 1H), 7.05 (d, *J* = 7.3 Hz, 1H), 6.91 – 6.82 (m, 3H), 4.79 (q, *J* = 6.4 Hz, 1H), 2.87 (s, 4H), 2.19 – 2.09 (m, 1H). 1.42 (d, *J* = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.9 (d, *J* = 245 Hz), 146.1, 144.2 (d, *J* = 7.2 Hz), 141.5, 129.7 (d, *J* = 8.4 Hz), 128.6, 127.5, 125.4, 124.2 (d, *J* = 2.7 Hz), 123.2, 115.3 (d, *J* = 21.1 Hz), 112.8 (d, *J* = 21.1 Hz), 70.4, 37.6, 37.6, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}FONa^+$: 267.1156; found: 267.1157. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3, flow rate: 1.0 mL/min, 25 ℃).

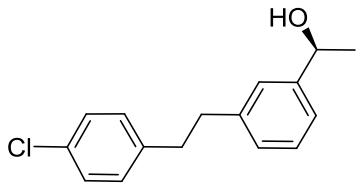


7m (^1H NMR, ^{13}C NMR spectra)**.**

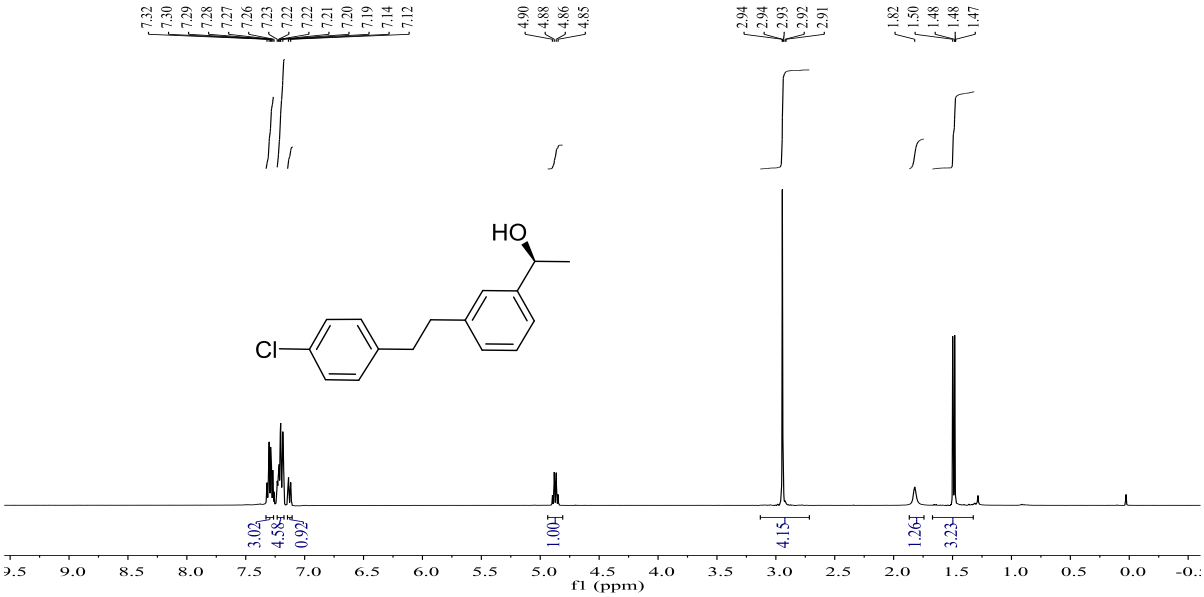


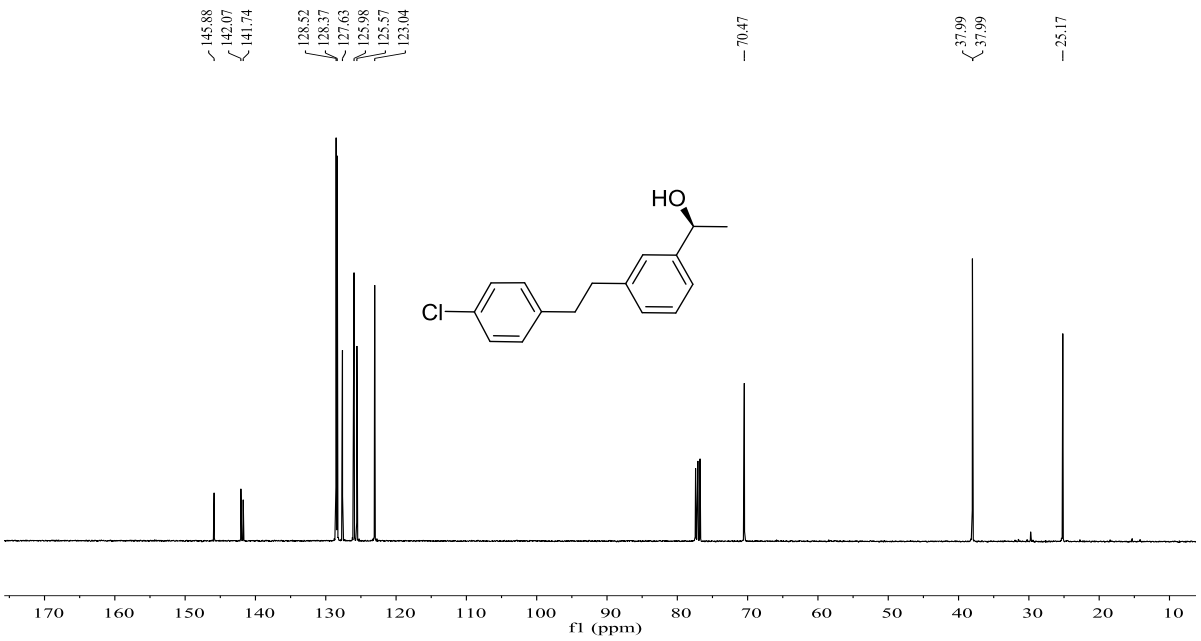


7n. (*S*)-1-(3-(4-chlorophenethyl)phenyl)ethan-1-ol. Yellow liquid, 91% yield, 93% ee. $[\alpha]_D^{25}$ = -23.839 (c 0.310, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.26 (m, 3H), 7.21 (dt, *J* = 8.3, 5.9 Hz, 4H), 7.13 (d, *J* = 7.4 Hz, 1H), 4.87 (q, *J* = 6.4 Hz, 1H), 3.13 – 2.72 (m, 4H), 1.82 (brs, 1H), 1.49 (d, *J* = 6.5 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 145.9, 142.1, 141.7, 128.5, 128.4, 127.6, 126.0, 125.6, 123.1, 70.5, 38.0, 37.9, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{16}H_{17}ClONa^+$: 283.0860; found: 283.0862. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3, flow rate: 1.0 mL/min, 25 ℃).

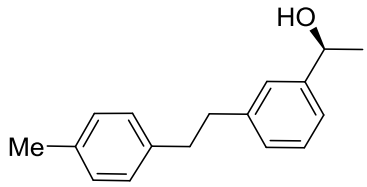


7n (^1H NMR, ^{13}C NMR spectra)**.**

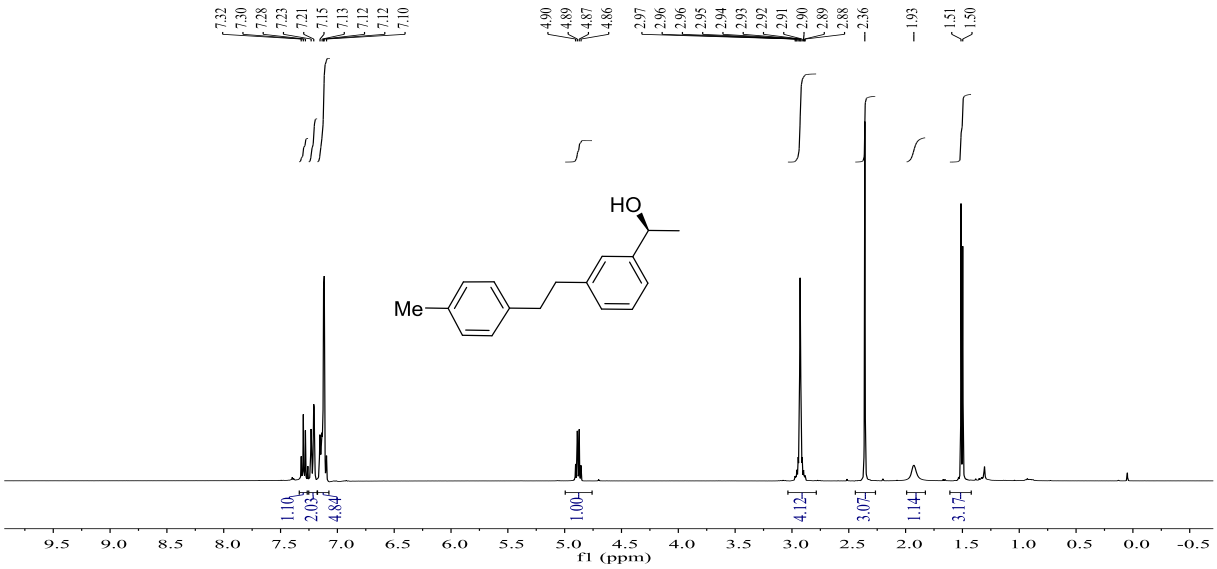


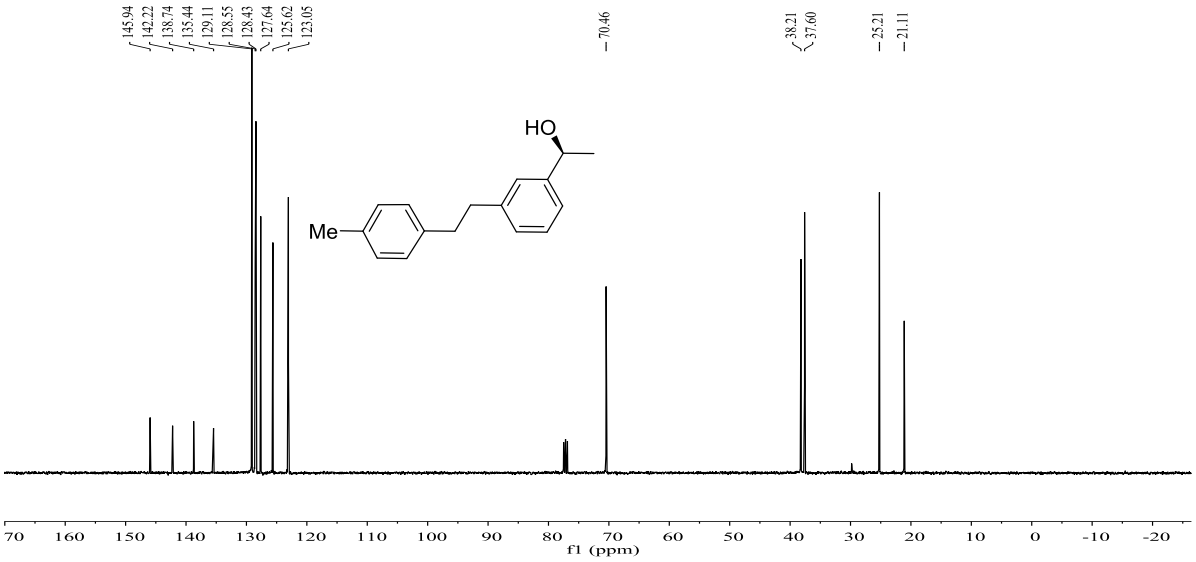


7o. (*S*)-1-(3-(4-methylphenethyl)phenyl)ethan-1-ol. Yellow liquid, 92% yield, 96% ee. $[\alpha]_D^{25}$ = -24.845 (c 0.410, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.30 (t, *J* = 7.5 Hz, 1H), 7.22 (d, *J* = 9.2 Hz, 2H), 7.15 – 7.10 (m, 5H), 4.88 (q, *J* = 6.4 Hz, 1H), 2.97 – 2.88 (m, 4H), 2.36 (s, 3H), 1.93 (s, 1H), 1.50 (d, *J* = 6.2 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 145.9, 142.2, 138.7, 135.4, 129.1, 128.6, 128.4, 127.6, 125.6, 123.1, 70.5, 38.2, 37.6, 25.2, 21.1. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}ONa^+$: 263.1406; found: 263.1414. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3, flow rate: 1.0 mL/min, 25 ℃).

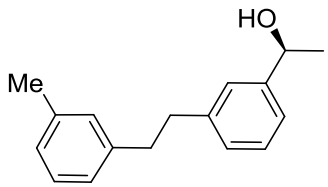


7o (^1H NMR, ^{13}C NMR spectra)**.**

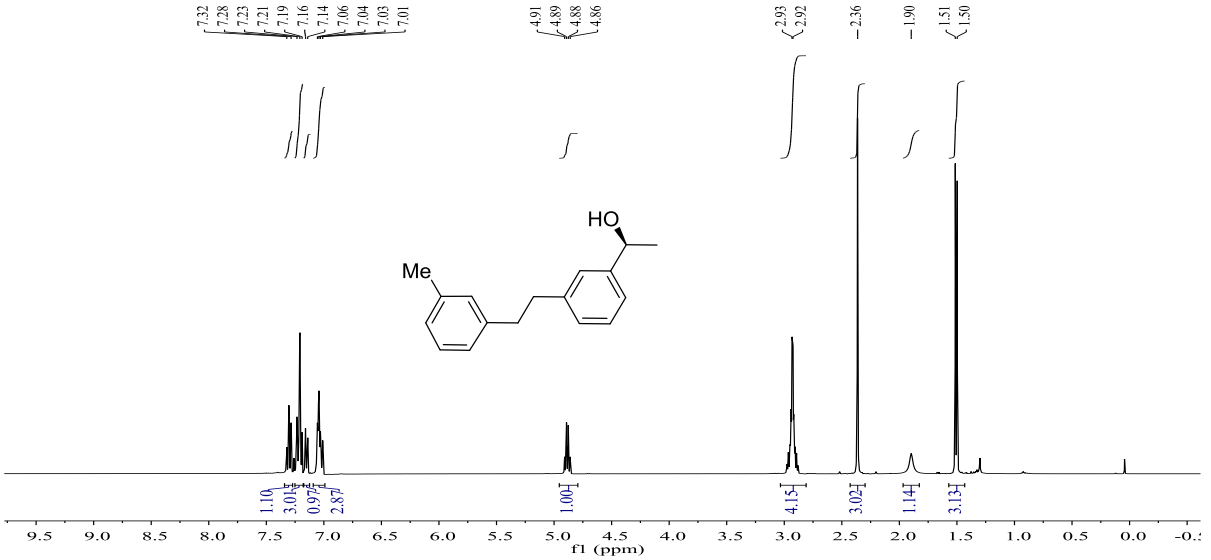


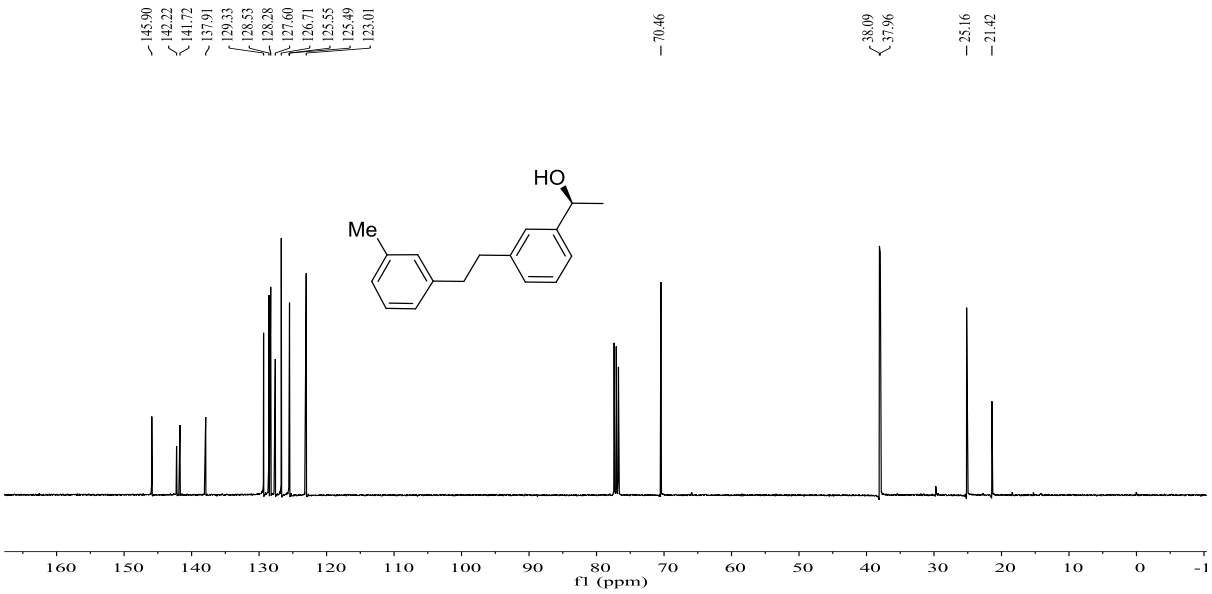


7p. (*S*)-1-(3-(3-methylphenethyl)phenyl)ethan-1-ol. Yellow liquid, 92% yield, 95% ee. $[\alpha]_D^{25}$ = -22.688 (c 0.493, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ7.30 (d, *J* = 14.9 Hz, 1H), 7.25 – 7.18 (m, 3H), 7.15 (d, *J* = 7.5 Hz, 1H), 7.09 – 7.01 (m, 3H), 4.88 (q, *J* = 6.6 Hz, 1H), 2.93 (d, *J* = 3.4 Hz, 4H), 2.36 (s, 3H), 1.90 (brs, 1H), 1.51 (d, *J* = 6.6 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 145.9, 142.2, 141.7, 137.9, 129.3, 128.5, 128.3, 127.6, 126.7, 125.6, 125.5, 123.0, 70.5, 38.1, 38.0 , 25.2, 21.4. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}ONa^+$: 263.1406; found: 263.1409. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3, flow rate: 1.0 mL/min, 25 ℃).

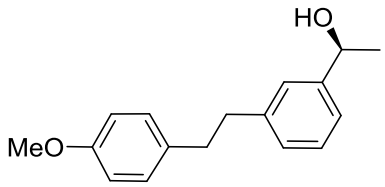


7p (^1H NMR, ^{13}C NMR spectra)**.**

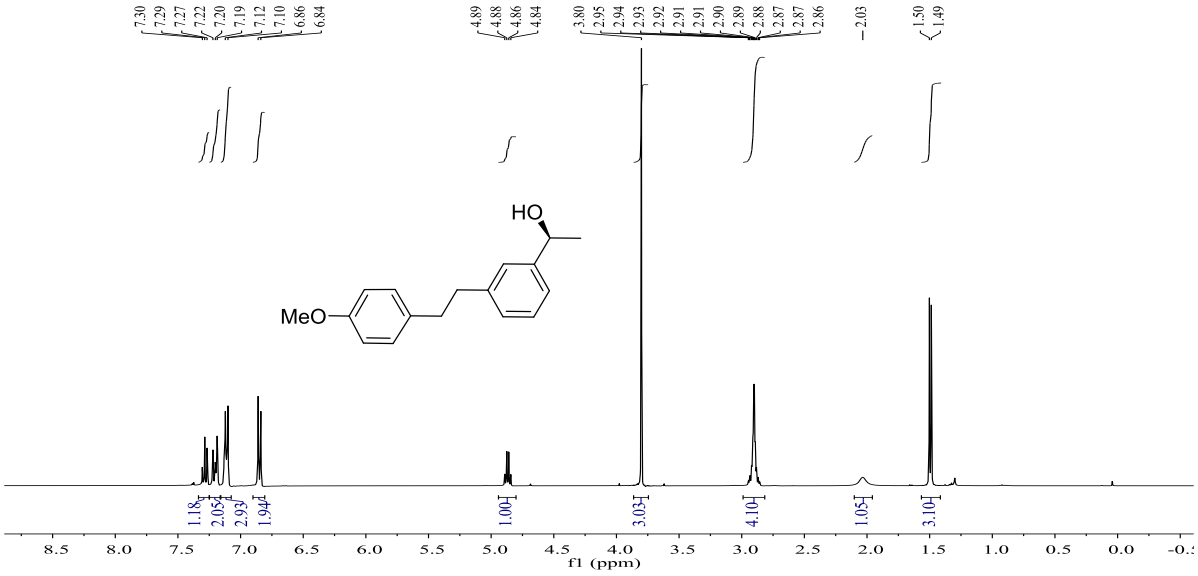


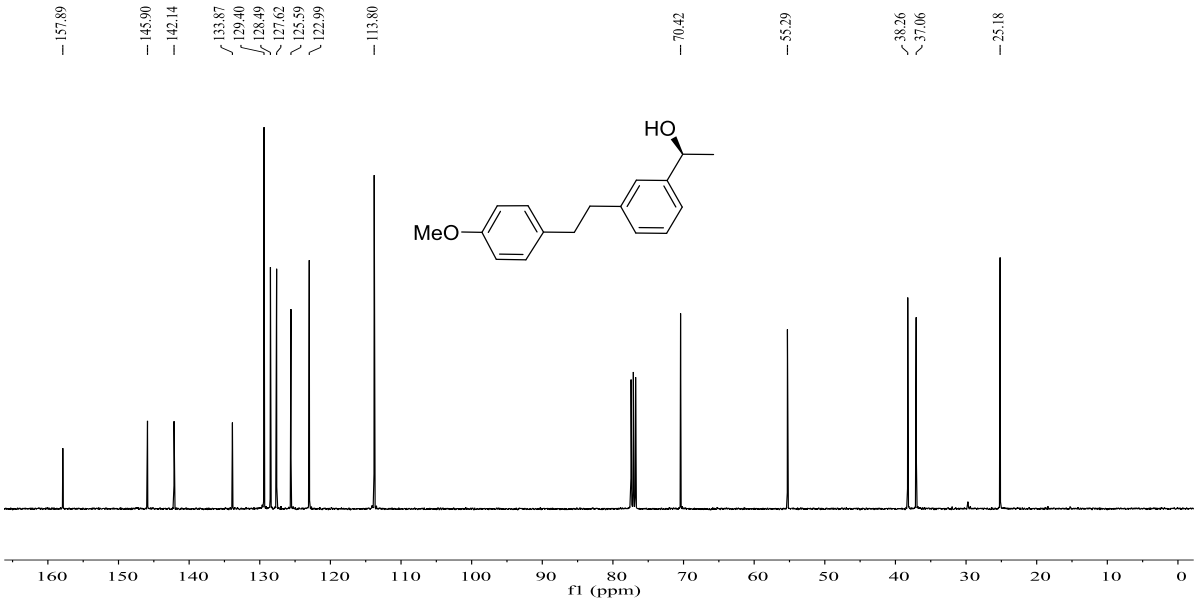


7q. (*S*)-1-(3-(4-methoxyphenethyl)phenyl)ethan-1-ol. Yellow liquid, 92% yield, 96% ee. $[\alpha]_D^{25}$ = -22.122 (c 0.316, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.29 (t, *J* = 7.5 Hz, 1H), 7.25 – 7.16 (m, 2H), 7.11 (d, *J* = 8.6 Hz, 3H), 6.85 (d, *J* = 8.5 Hz, 2H), 4.87 (q, *J* = 6.5 Hz, 1H), 3.80 (s, 3H), 2.95 – 2.86 (m, 4H), 2.03 (brs, 1H), 1.49 (d, *J* = 6.3 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 157.9, 145.9, 142.1, 133.9, 129.4, 128.5, 127.6, 125.6, 123.0, 113.8, 70.4, 55.3, 38.3, 37.1, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}O_2Na^+$: 279.1356; found: 279.1364. HPLC (Chiralpak AS-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 96/4, flow rate: 1.0 mL/min, 25 ℃).

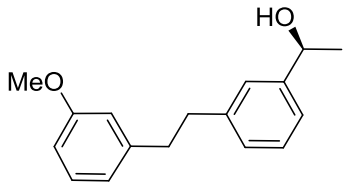


7q (^1H NMR, ^{13}C NMR spectra)**.**

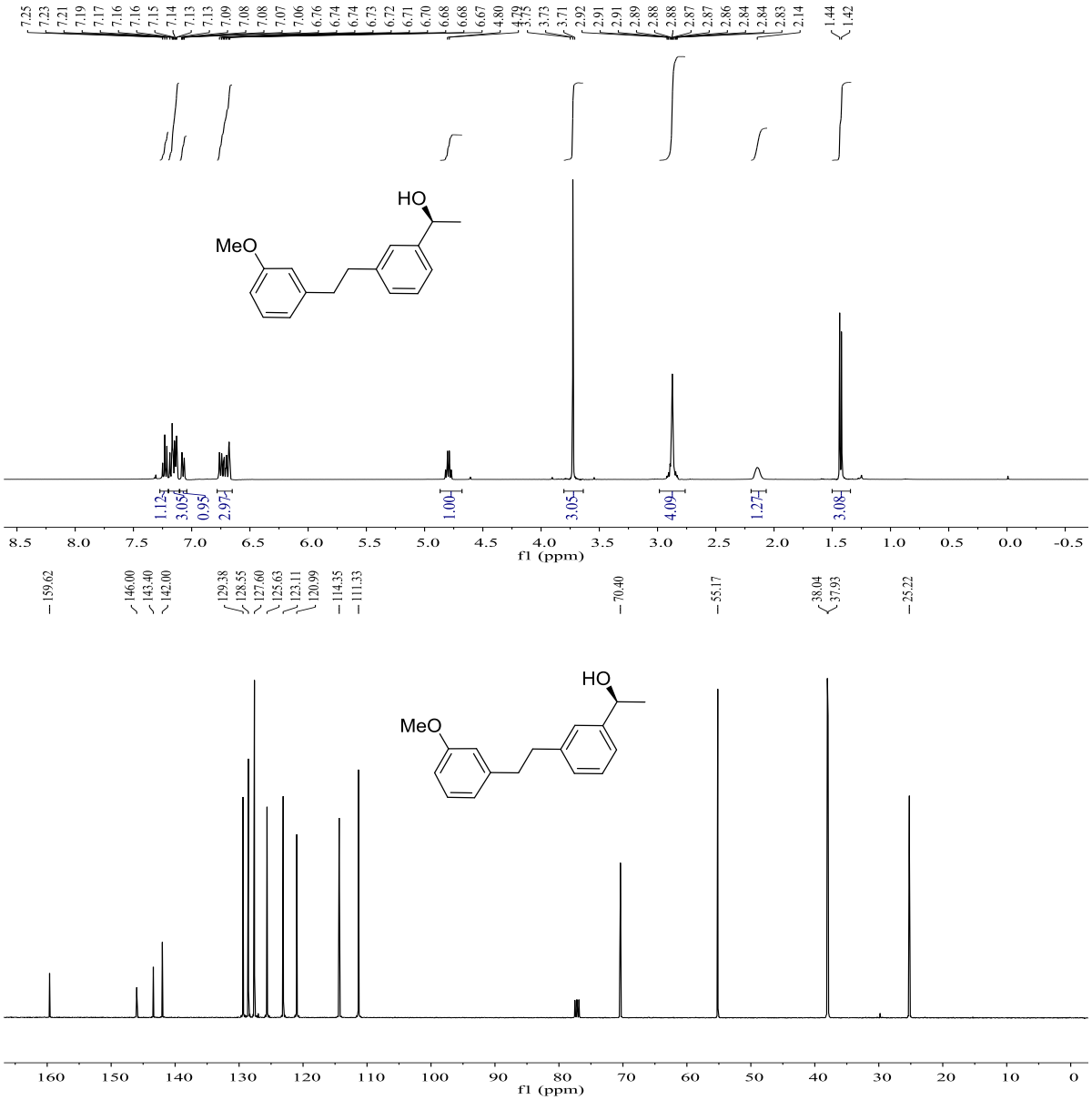




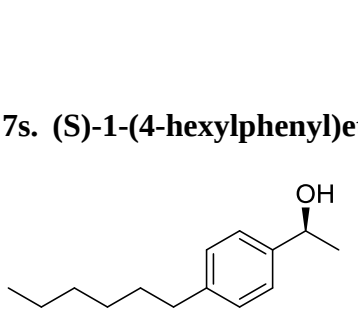
7r. (*S*)-1-(3-(3-methoxyphenethyl)phenyl)ethan-1-ol. Yellow liquid, 91% yield, 95% ee. $[\alpha]_D^{25}$ = -24.247 (c 0.486, $CHCl_3$). ^1H NMR (400 MHz, $CDCl_3$) δ 7.23 (t, *J* = 7.4 Hz, 1H), 7.20 – 7.11 (m, 3H), 7.10 – 7.04 (m, 1H), 6.78 – 6.65 (m, 3H), 4.80 (q, *J* = 6.5 Hz, 1H), 3.73 (s, 3H), 2.98 – 2.76 (m, 4H), 2.14 (brs, 1H), 1.43 (d, *J* = 6.2 Hz, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$) δ 159.6, 146.0, 143.4, 142.0, 129.4, 128.6, 127.6, 125.6, 123.1, 121.1, 114.4, 111.3, 70.4, 55.2, 38.0, 37.9, 25.2. HRMS (ESI): m/z $[M+Na]^+$ calculated for $C_{17}H_{20}O_2Na^+$: 279.1356; found: 279.1364. HPLC (Chiralpak OJ-H, detector: 254 nm, elute: Hexane/*i*-PrOH = 97/3 flow rate: 1.0 mL/min, 25 ℃).



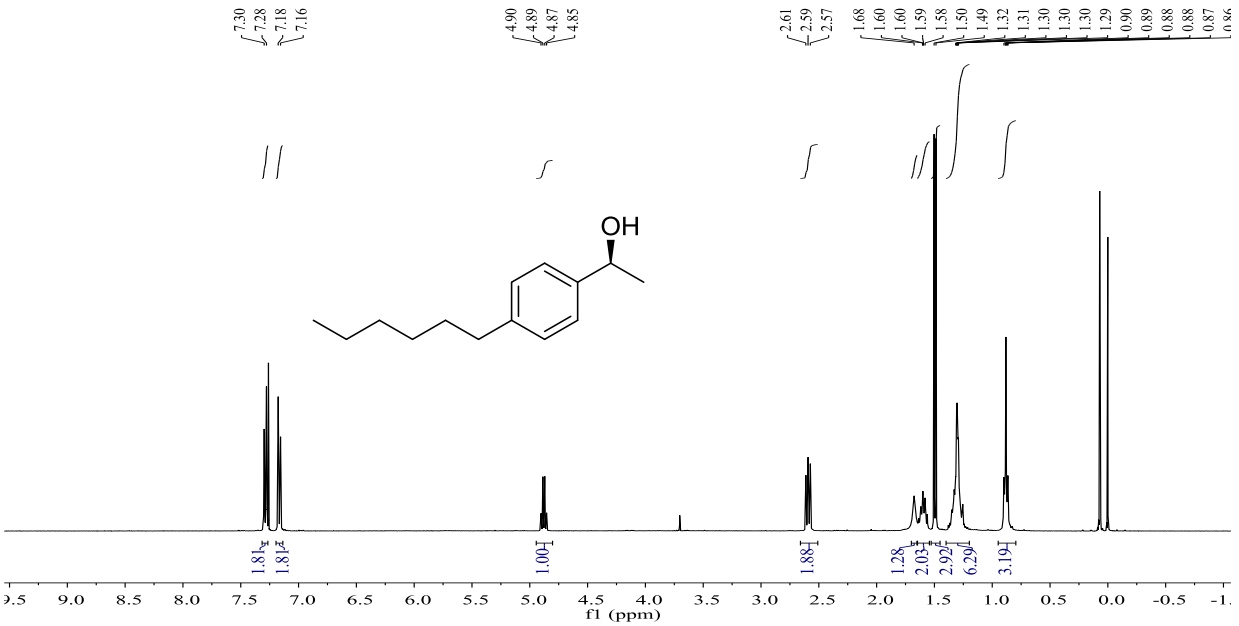
7r (^1H NMR, ^{13}C NMR spectra)**.**

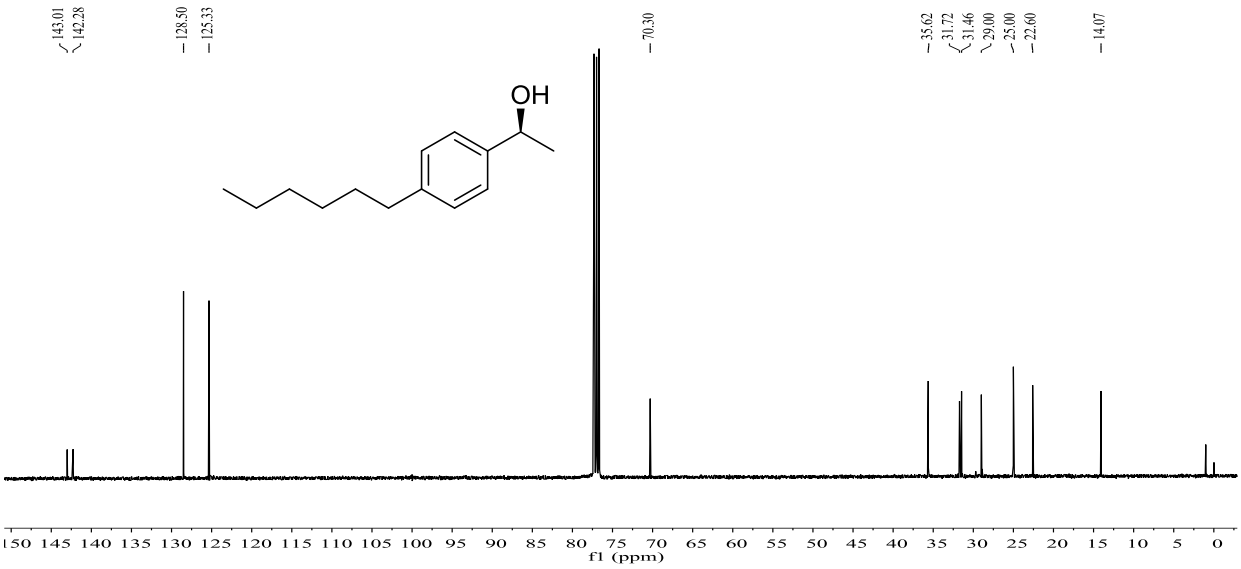


7s. (S)-1-(4-hexylphenyl)ethan-1-ol. Colorless liquid, 86% yield, 97% ee.$[\alpha]_D^{25}$ = -5.707 (c 0.350, $CHCl_3$). ^1H NMR (400 MHz, $CHCl_3$) δ 7.29 (d, *J* = 7.9 Hz, 2H), 7.17 (d, *J* = 8.1 Hz, 2H), 4.88 (q, *J* = 6.4 Hz, 1H), 2.66 – 2.57 (m, 2H), 1.68 (brs, 1H), 1.60 (ddd, *J* = 9.2, 4.6, 1.5 Hz, 2H), 1.49 (d, *J* = 6.4 Hz, 3H), 1.32 – 1.29 (m, 6H), 0.90 – 0.86 (m, 3H). $^{13}C\{^1H\}$ NMR (100 MHz, $CHCl_3$) δ 143.0, 142.3, 128.5, 125.3, 70.3, 35.6, 31.7, 31.5, 29.0, 25.0, 22.6, 14.1. HRMS (ESI): m/z $[M+NH_4]^+$ calculated for $C_{14}H_{26}NO^+$: 224.2011; found: 224.2009. HPLC (Chiralpak OD-H, detector: 215 nm, elute: Hexane/*i*-PrOH = 98/2, flow rate: 1.0 mL/min, 25 ℃).



7s. (^1H NMR, ^{13}C NMR spectra).





7t. (1S,1'S)-1,1'-(ethane-1,2-diylbis(4,1-phenylene))bis(ethan-1-ol). Colorless liquid, 86% yield, 99% ee, 21:1 dr.$[\alpha]_D^{25}$ = -9.939 (c 0.422, $CHCl_3$). ^1H NMR (400 MHz, $CHCl_3$) δ 7.30 (d, *J* = 8.0 Hz, 4H), 7.18 (d, *J* = 8.0 Hz, 4H), 4.93 – 4.85 (m, 2H), 2.89 (s, 4H), 1.77 (brs, 2H), 1.49 (d, *J* = 9.3 Hz, 6H). $^{13}C\{^1H\}$ NMR (101 MHz, Chloroform-d) δ 143.4, 141.0, 128.5, 125.5, 70.3, 37.5, 25.1. HRMS (ESI): m/z $[M+NH_4]^+$ calculated for $C_{18}H_{26}NO^+$: 288.1960; found: 288.1958. (HPLC: Chiracel OB-H, detected at 254 nm, eluent: n-hexane/2-propanol = 96/4, flow rate = 1.0 mL/min, 25 ℃).

7t. (^1H NMR, ^{13}C NMR spectra).