Supporting Information for

One-pot Relay Reduction-Isomerization of β-Trifluoromethylated-α,β-Unsaturated Ketones to chiral β-Trifluoromethylated Saturated Ketones Over Combined Catalysts in Aqueous Medium

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Experimental

1. General

All experiments, which are sensitive to moisture or air, were carried out under an Ar atmosphere using the standard Schlenk techniques. (*R,R*)-1,2-diphenylenediamine, $[RuCl_2(p\text{-Cymene})]_2$,1,2-bis(triethoxysilyl)ethylane, surfactant P123 $(CH_2\text{-}CH_2O)_{20}(CH_2(CH_3)CH_2O)_{70}(CH_2CH_2O)_{20}$) and tetraethoxysilane (TEOS) were purchased from Sigma-Aldrich Company Ltd. Compounds *(R,R)*-4-(trimethoxysilyl)ethyl)phenylsulfonyl-1,2-diphenylethylenediaminewas synthesized according to the reported literatures [*J. Mater. Chem.***2010,** *20,* 1970]

2. Preparation of ArDPEN-PMO (2). In a typical synthesis, 2.0 g of structure-directing agent, pluronic P123, was fully dissolved in a mixture of 80 mL hydrochloric acid (0.2 N) and 6.0 g KCl and the mixture was stirred at room temperature for 1.0 h. Then, 3.36 mL (9.10 mmol) of 1,2-bis(triethoxysilyl)ethane was added as the silica precursor at 40 ºC. After pre-hydrolysis period of 40 min., 0.24 g (0.48 mmol) of *(R,R)*-DPEN-$SO_2Ph(CH_2)_2Si(OMe)_3$ was added. The reaction mixture was stirred at 40 ºC for 24 h and aged at 100 ºC for 24 h. The resulting solid was filtered and rinsed with excess ethanol before being dried overnight on a filter. The surfactant template was removed by refluxing in acidic ethanol (400 mL per gram) for 24 h. The solid was filtered and rinsed with ethanol again, and dried at 60 ºC under reduced pressure overnight to afford **2** (1.36 g)in the form of a white powder.IR (KBr) cm^{-1}: 3443.5 (s), 2978.5 (w), 2928.8 (w), 1627.2 (m), 1460.2 (w), 1416.5 (w), 1382.7 (w), 1273.4 (m),1164.1 (s), 1096.5 (s), 1028.9 (s), 919.7 (m), 766.7 (m), 699.1 (m), 438.8 (m);^{13}C CP MAS NMR (161.9 MHz): 150.0, 137.5, 128.7 (*C*of Ph and Ar), 76.1−69.2 (*C*of −N*C*HPh−),59.4 (O-*C*H_2CH_3), 28.8 (*C*of −*C*H_2Ar), 16.3(O-CH_2*C*H_3), 5.2(*C*of −*C*H_2Si) ppm; ^{29}Si MAS/NMR (79.4 MHz): T^1 (δ = −49.1 ppm), T^2 (δ = −57.6ppm), T^3 (δ = −65.0 ppm).

3. General procedure for the reuse experimentsusing 4,4,4-trifluoro-1,3-diphenylbut-2-enone as a substrate.

The catalyst **3**(291.0 mg, 0.030 mmol of Ru based on ICP analysis), 4,4,4-trifluoro-1,3-diphenylbut-2-enone (1.50 mmol),HCO_2Na (2.04 g, 30.0 mmol), 20.0 mL of waterwere addedsequentially to a 50.0 mL round−bottom flask.The mixture was then stirred at room temperature (20 °C) for 17 h.After completion of the reaction, the catalyst was separated by centrifugation (10,000 rpm). The collected solids was transfered to a fresh50.0 mL round−bottom flask and 4,4,4-trifluoro-1,3-diphenylbut-2-enone (1.50 mmol),HCO_2Na (2.04 g, 30.0 mmol) and 20.0 mL of waterwere addedagain for next recycle. The aqueous solution was extracted with ethyl ether (3 × 3.0 mL). The combined ethyl ether extracts were washed with $NaHCO_3$ and brine, and then dehydrated with Na_2SO_4. After evaporation of ethyl ether, the residue was purified by silica gel flash column chromatography to afford the desired products.

Figure S1. FT-IR spectra of **2** and catalyst **3.**

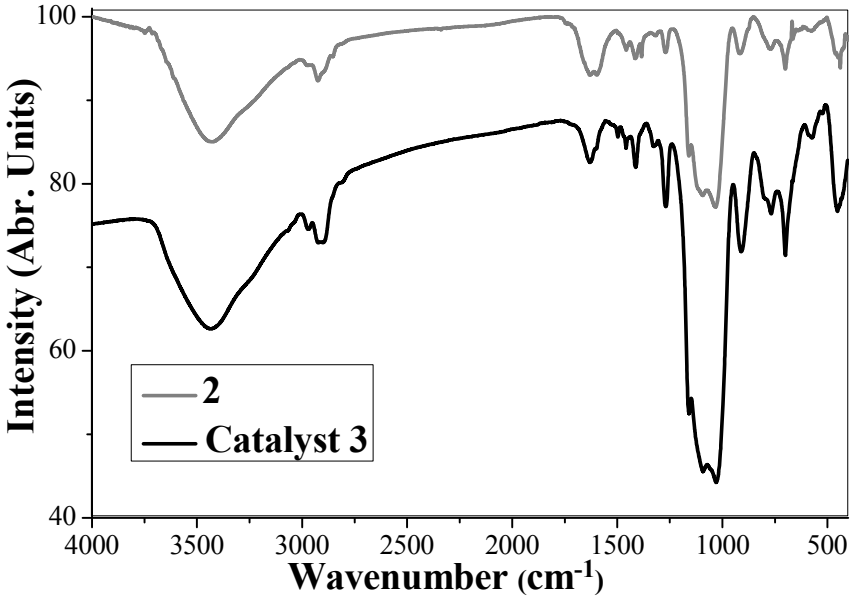


Figure S2. XPS spectrum of $[RuCl_2(p\text{-cymene})]_2$.

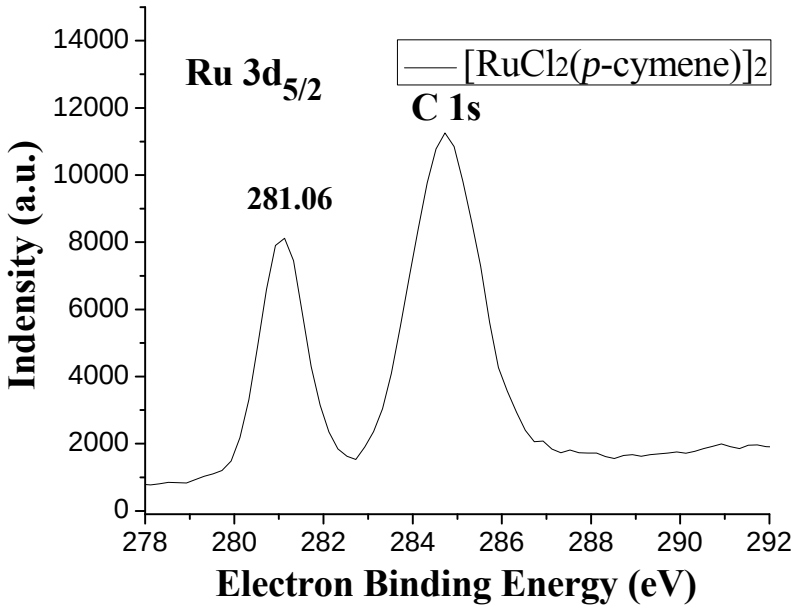
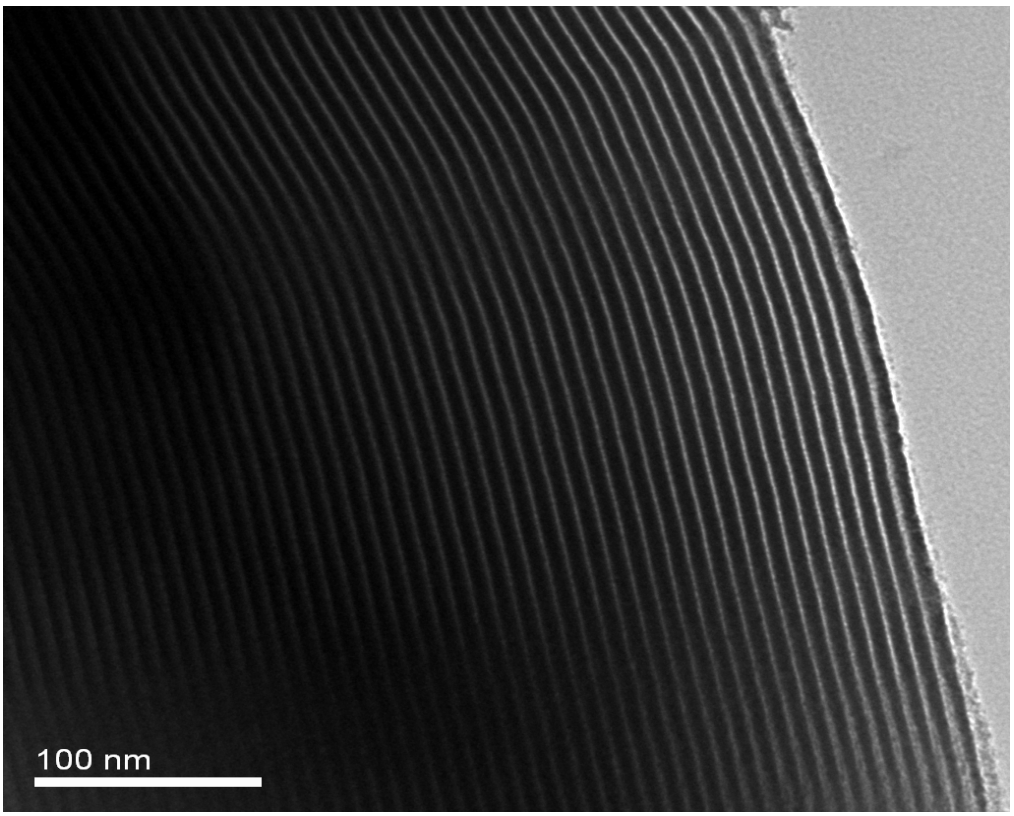


Figure S3. TEM images of catalyst **3** viewed along [100] (a) and [001] (b) directions.

(a) [100] direction.



(b) [001] direction.

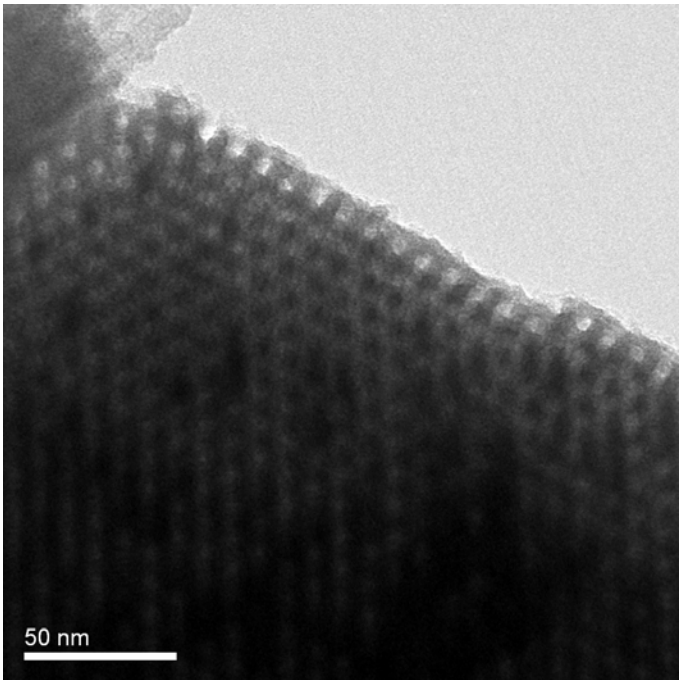
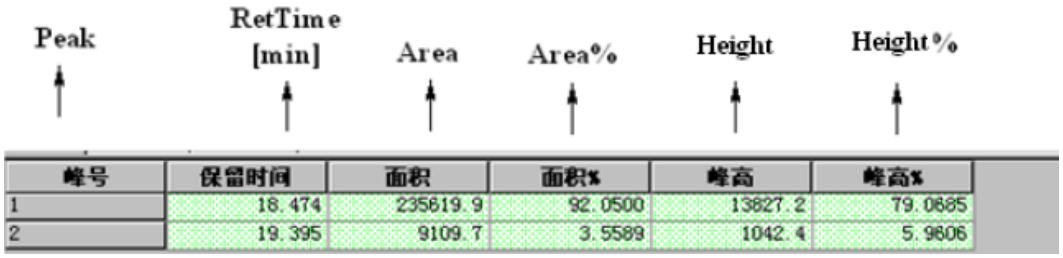


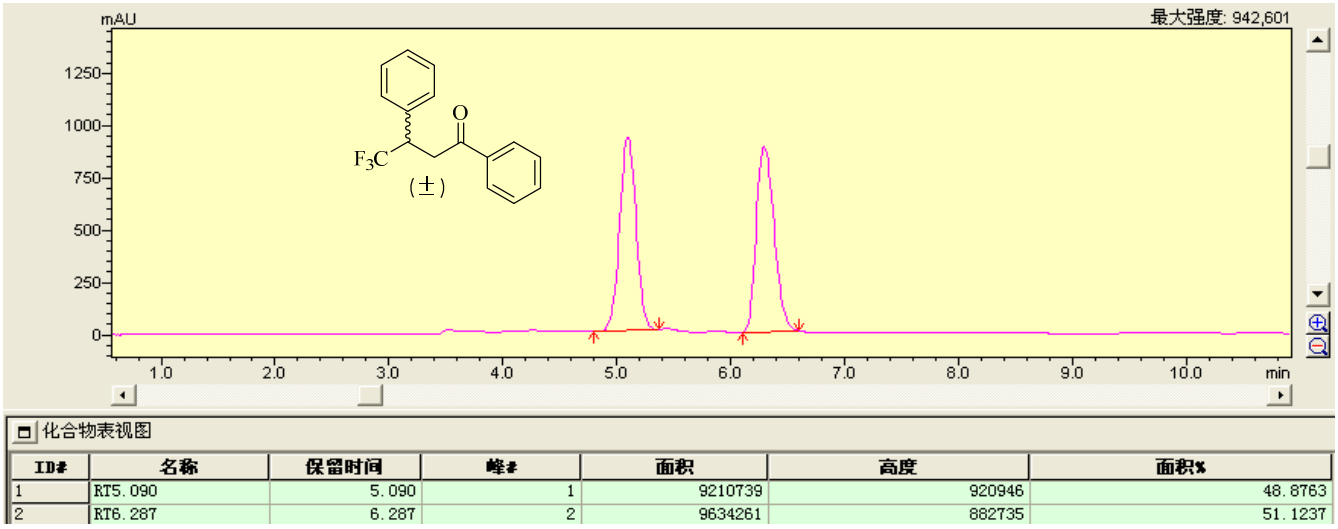
Figure S4. One-pot enantioselective reduction-isomerizationof β-trifluoromethylated-α,β-unsaturated ketones to chiral β-trifluoromethylated saturated ketones. [The products were analyzed by a HPLC with a UV-Vis detector using a Daicel OD-H or OJ-H chiralcel column (Φ0.46×25 cm)].

Translation of Chinese to English is as follows:



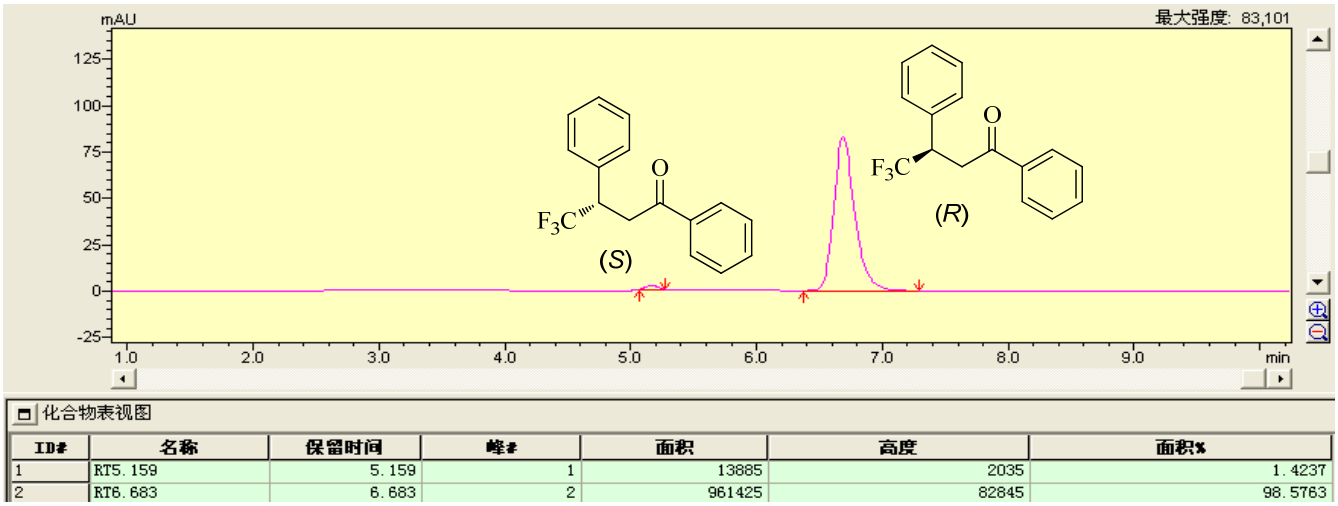
峰号	保留时间	面积	面积%	峰高	峰高%
1	18.474	235819.9	92.0500	13827.2	79.0685
2	19.395	9109.7	3.5589	1042.4	5.9606

***6a*: (*R*)-4,4,4-trifluoro-1,3-diphenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

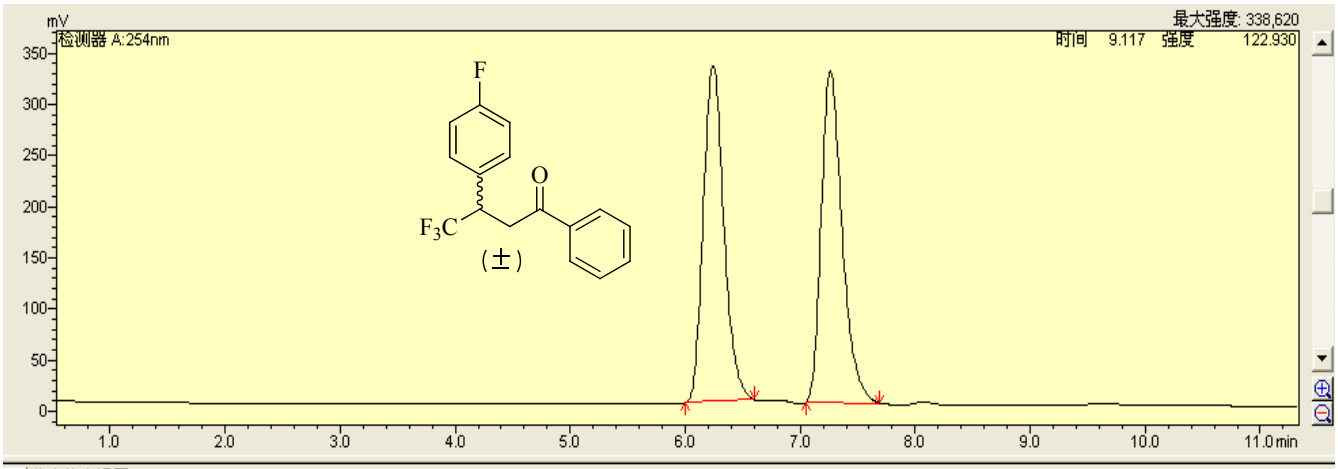
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.090	5.090	1	9210739	920946	48.8763
2	RT6.287	6.287	2	9634261	882735	51.1237



化合物表视图

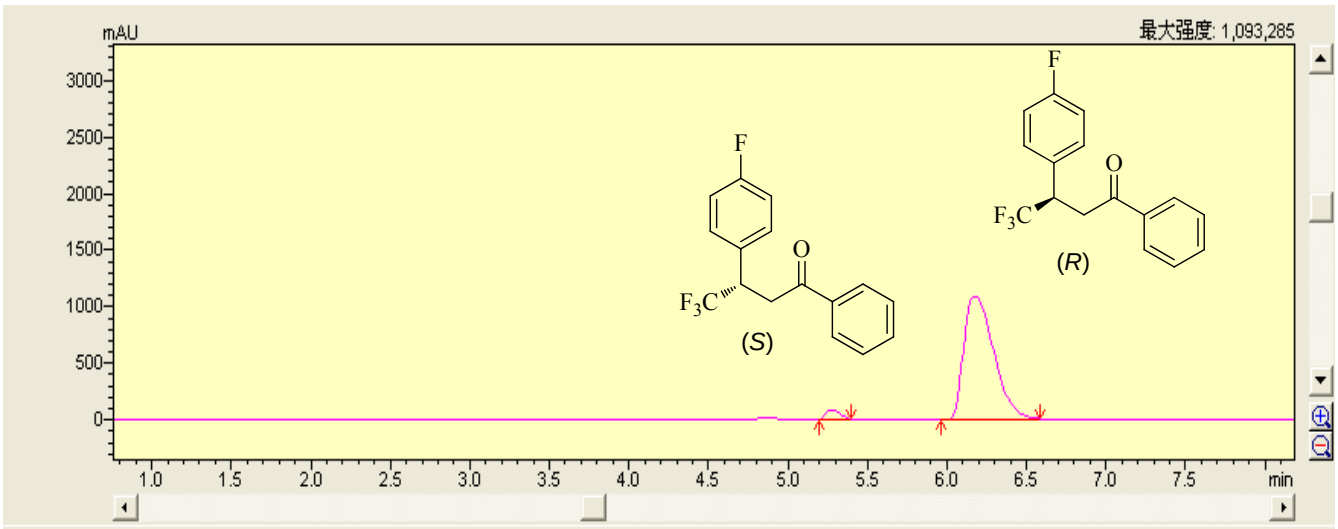
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.159	5.159	1	13885	2035	1.4237
2	RT6.683	6.683	2	961425	82845	98.5763

***6b*: (*R*)-4,4,4-trifluoro-3-(4-fluorophenyl)-1-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

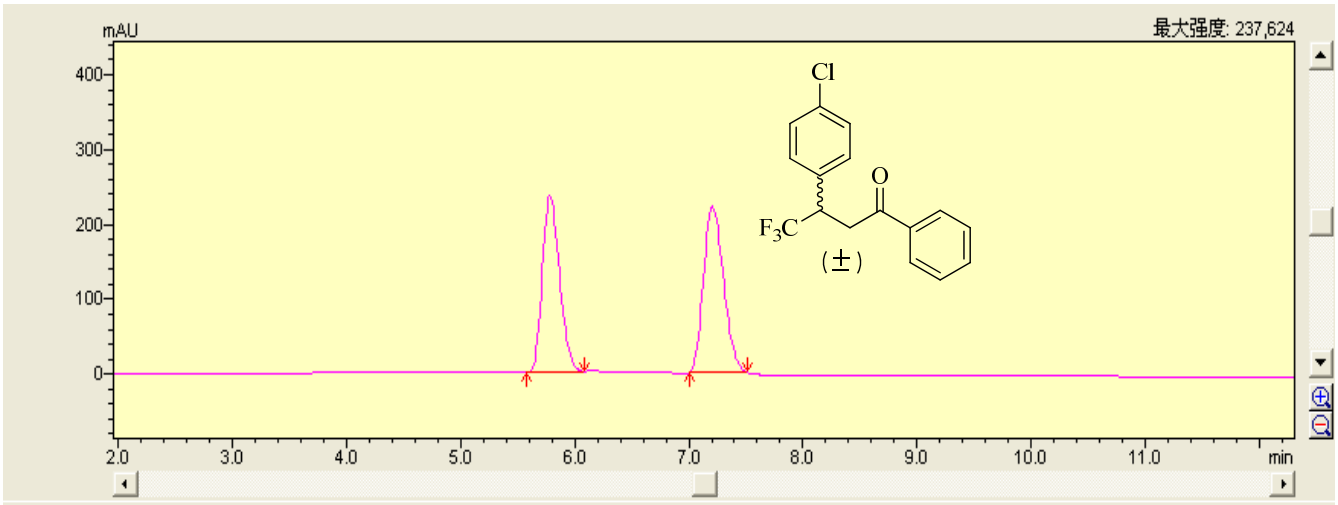
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT6.239	6.239	1	4109344	329250	6.000	6.600	49.9892
2	RT7.258	7.258	2	4111122	325309	7.050	7.692	50.0108



化合物表视图

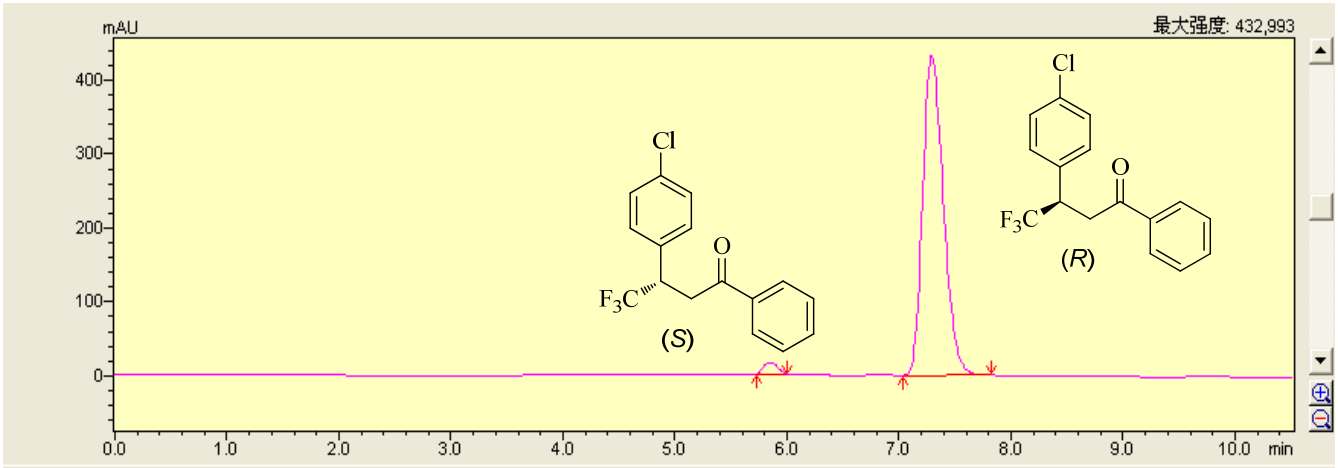
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.274	5.274	1	603547	90936	4.0210
2	RT6.169	6.169	2	14406285	1090385	95.9790

***6c*:** **(*R*)-3-(4-chlorophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

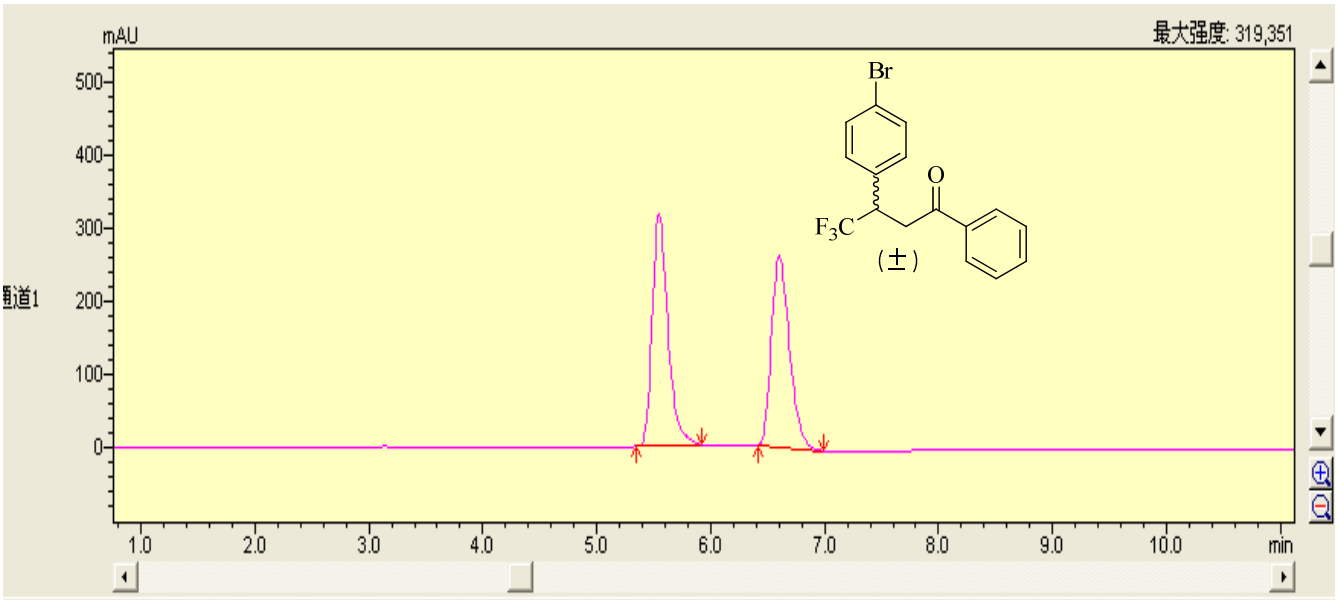
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.779	5.779	1	2466855	234754	47.4753
2	RT7.201	7.201	2	2729226	221803	52.5247



化合物表视图

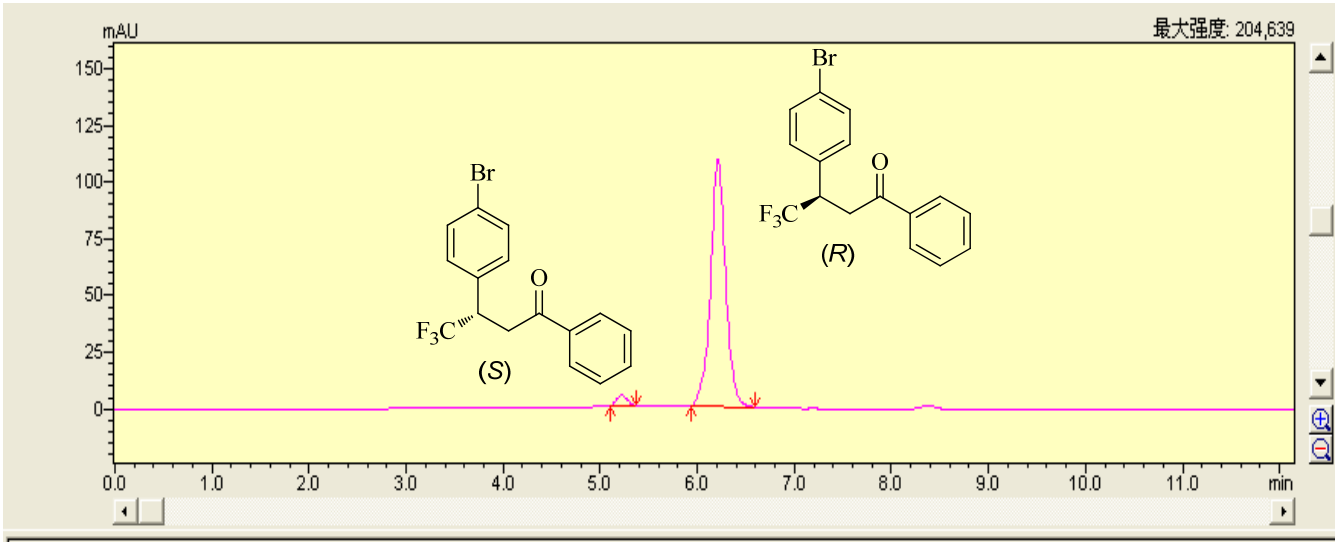
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.843	5.843	1	140278	16126	2.4569
2	RT7.285	7.285	2	5569253	432370	97.5431

***6d*:** **(*R*)-3-(4-bromophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

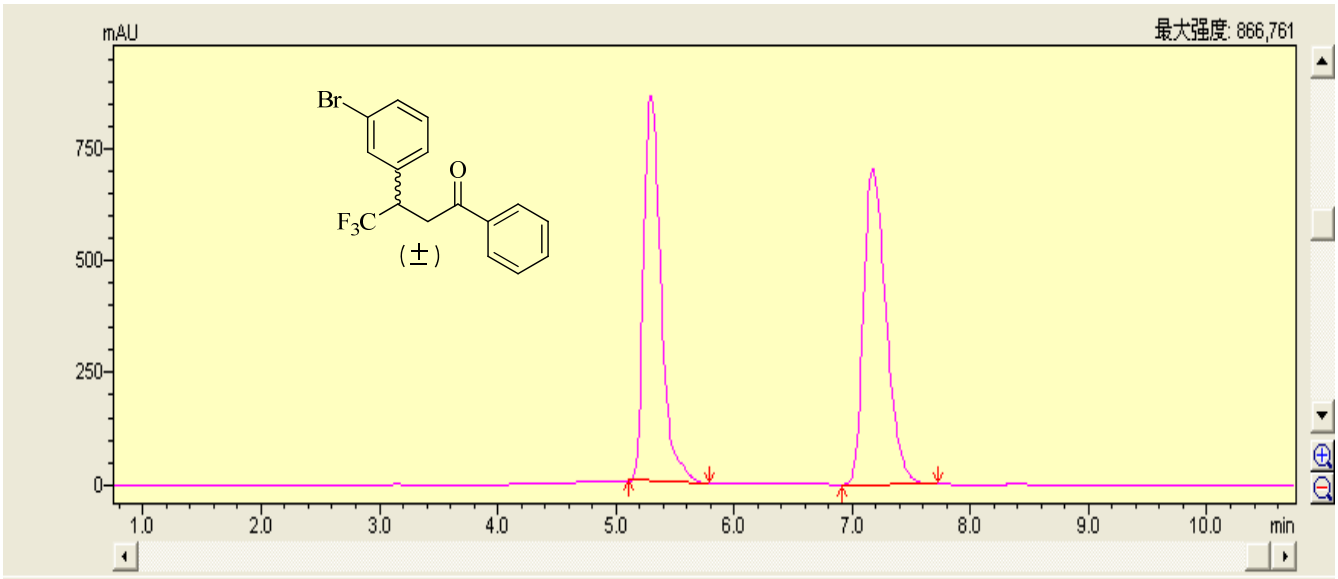
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.542	5.542	1	3045726	317042	51.3297
2	RT6.596	6.596	2	2887927	261999	48.6703



化合物表视图

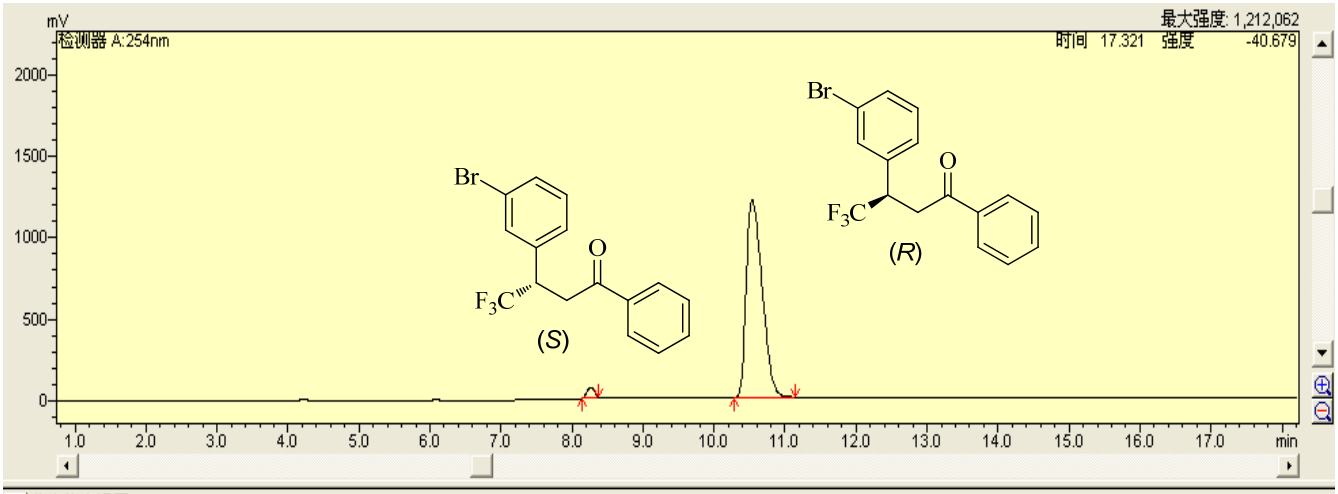
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.214	5.214	1	37443	4701	3.0455
2	RT6.208	6.208	2	1192002	108971	96.9545

***6e*: (*R*)-3-(3-bromophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one (4e):** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

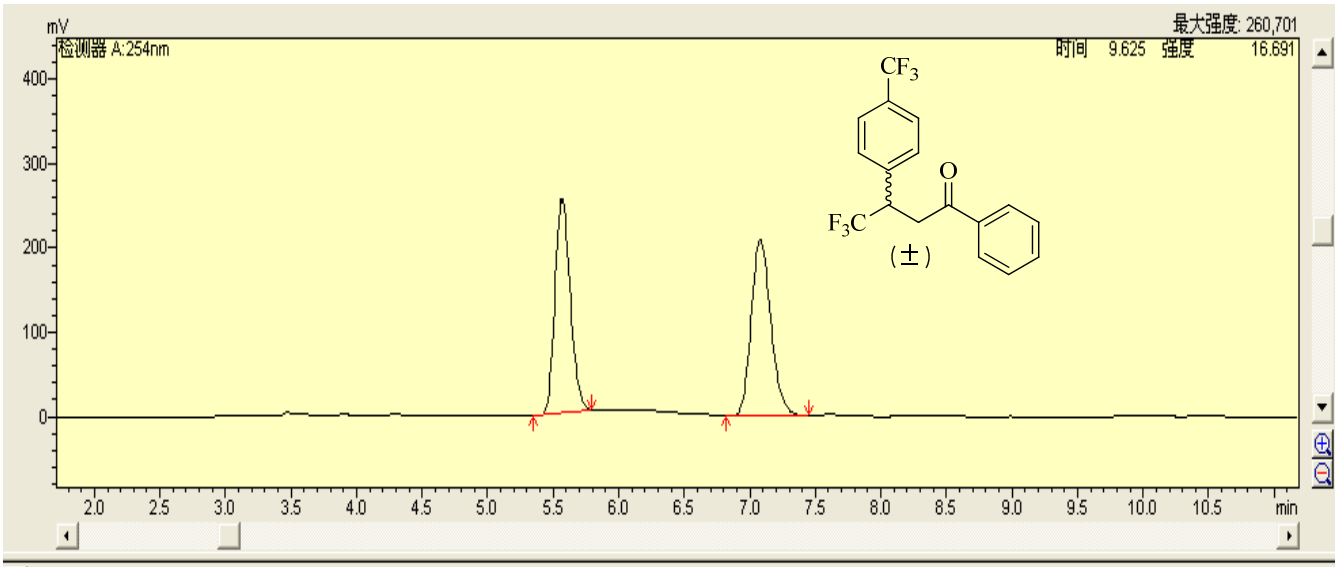
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.291	5.291	1	8829128	858716	48.4409
2	RT7.169	7.169	2	9397485	704283	51.5591



化合物表视图

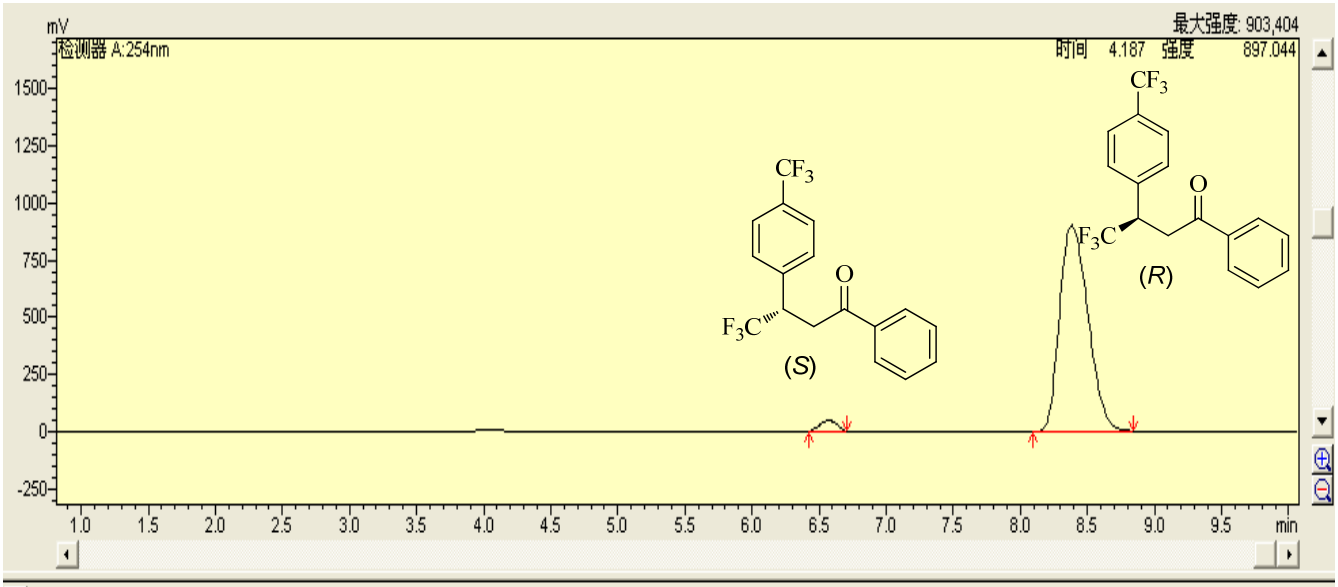
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT8.259	8.259	1	478433	64044	8.150	8.375	2.4757
2	RT10.535	10.535	2	18843229	1210519	10.292	11.142	97.5079

***6f*: (*R*)-4,4,4-trifluoro-1-phenyl-3-(4-(trifluoromethyl)phenyl)butan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

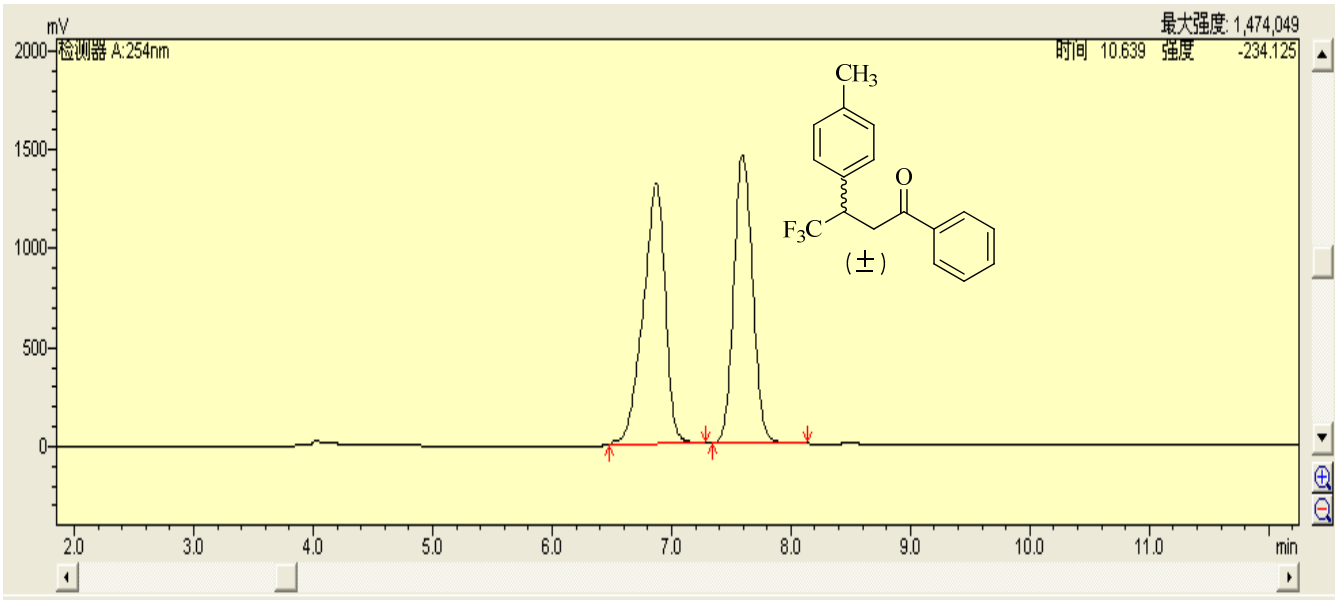
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT5.563	5.563	1	2076063	256119	5.350	5.792	48.6209
2	RT7.076	7.076	2	2193838	209054	6.817	7.450	51.3791



化合物表视图

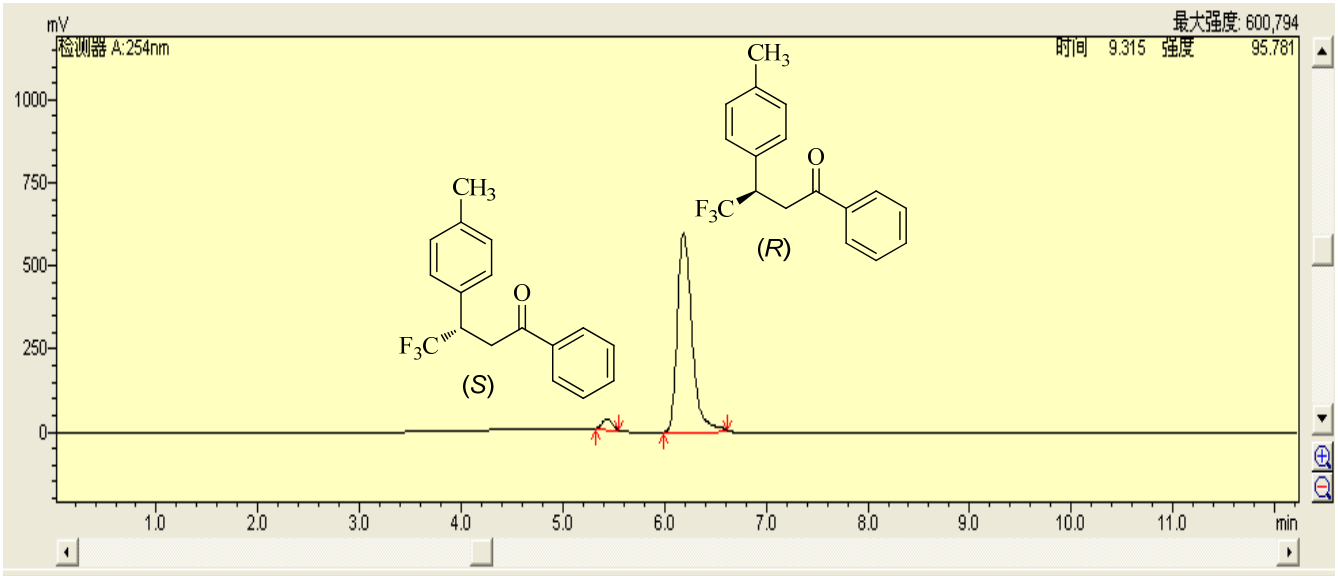
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT6.569	6.569	1	467978	50469	6.425	6.708	3.4055
2	RT8.378	8.378	2	13273929	901659	8.092	8.842	96.5945

***6q*: (*R*)-4,4,4-trifluoro-1-phenyl-3-(p-tolyl)butan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

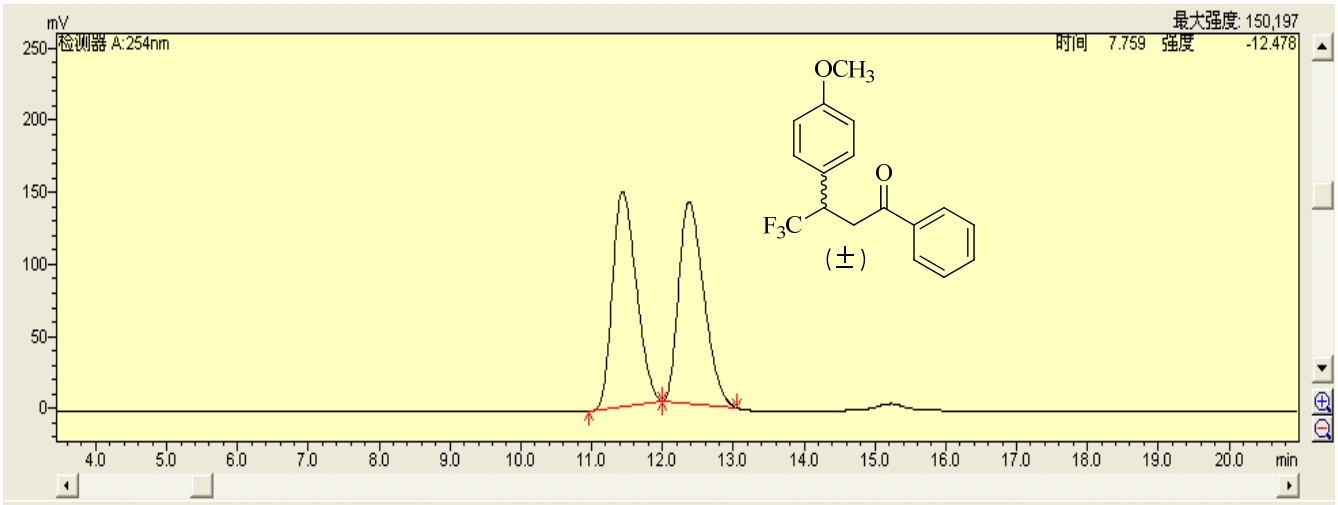
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT6.868	6.868	1	17063840	1315622	6.475	7.283	51.5677
2	RT7.591	7.591	2	16026354	1456893	7.342	8.133	48.4323



化合物表视图

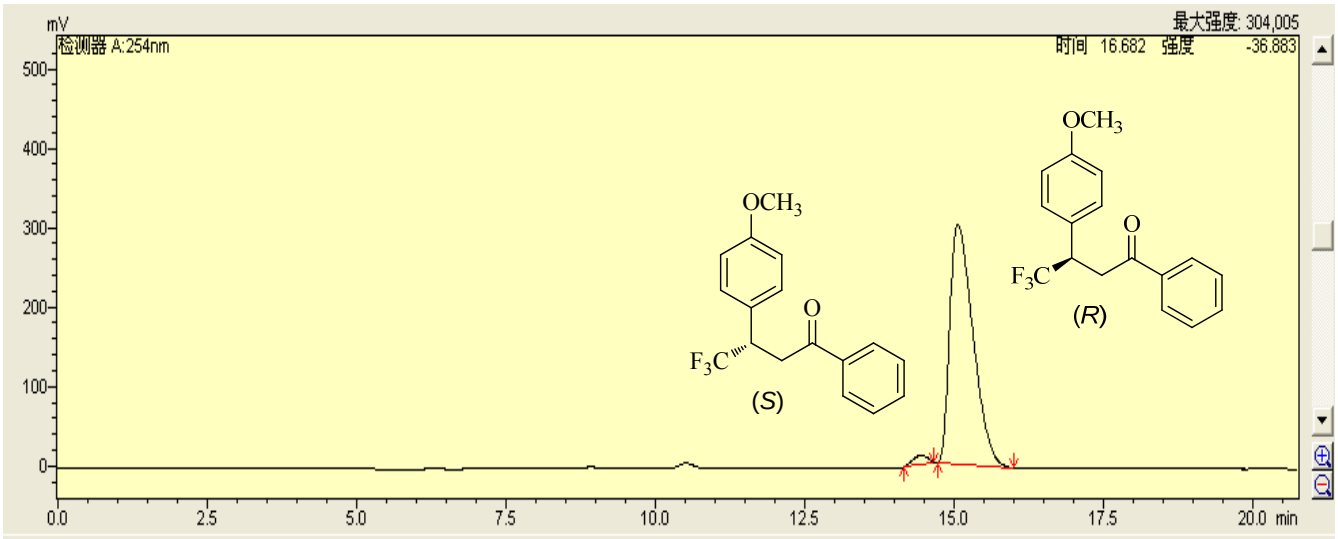
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT5.429	5.429	1	212087	31109	5.325	5.550	3.3128
2	RT6.183	6.183	2	6189997	601280	5.983	7.083	96.6872

***6h*: (*R*)-4,4,4-trifluoro-3-(4-methoxyphenyl)-1-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

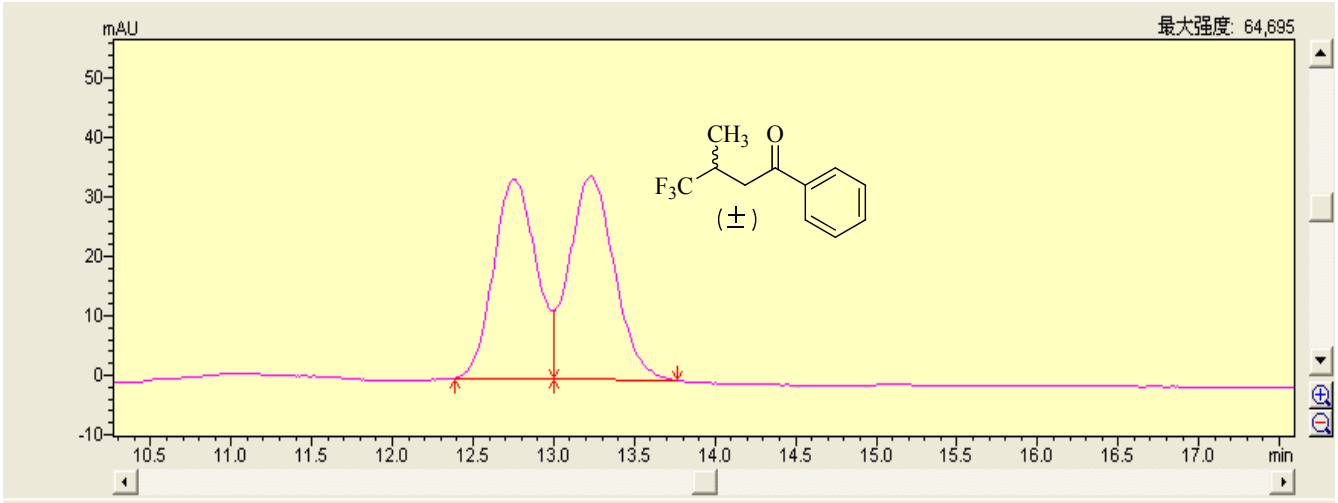
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT11.435	11.435	1	3493547	148969	10.967	11.992	50.1926
2	RT12.372	12.372	2	3466734	140004	11.992	13.050	49.8074



化合物表视图

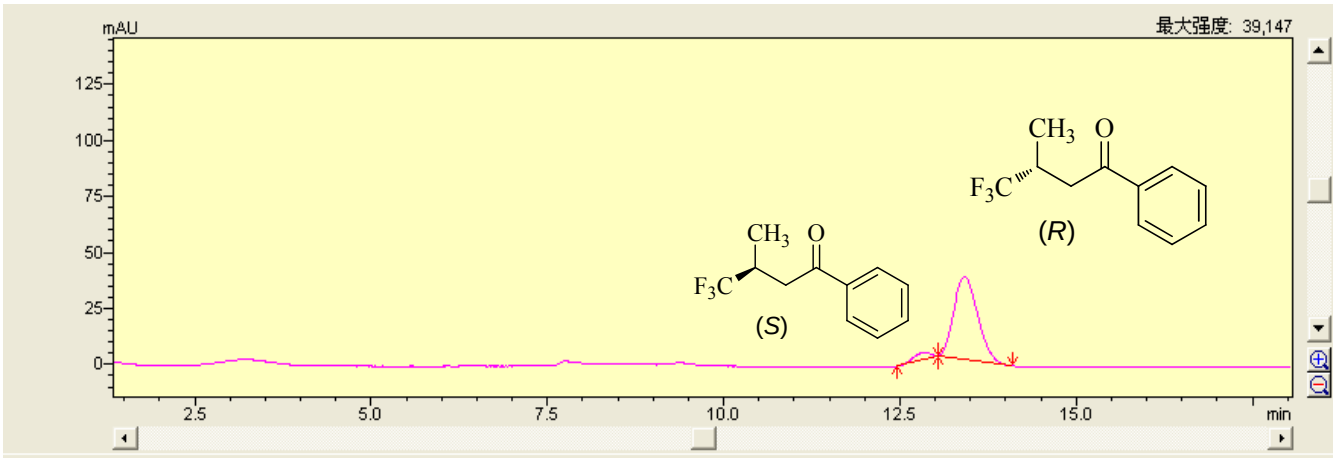
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT14.437	14.437	1	193889	11304	14.158	14.658	2.3220
2	RT15.062	15.062	2	8156293	301374	14.733	16.008	97.6780

***6i*: (*R*)-4,4,4-trifluoro-3-methyl-1-phenylbutan-1-one** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 99/1, flow rate =0.5 mL/min, 25 ºC).



化合物表视图

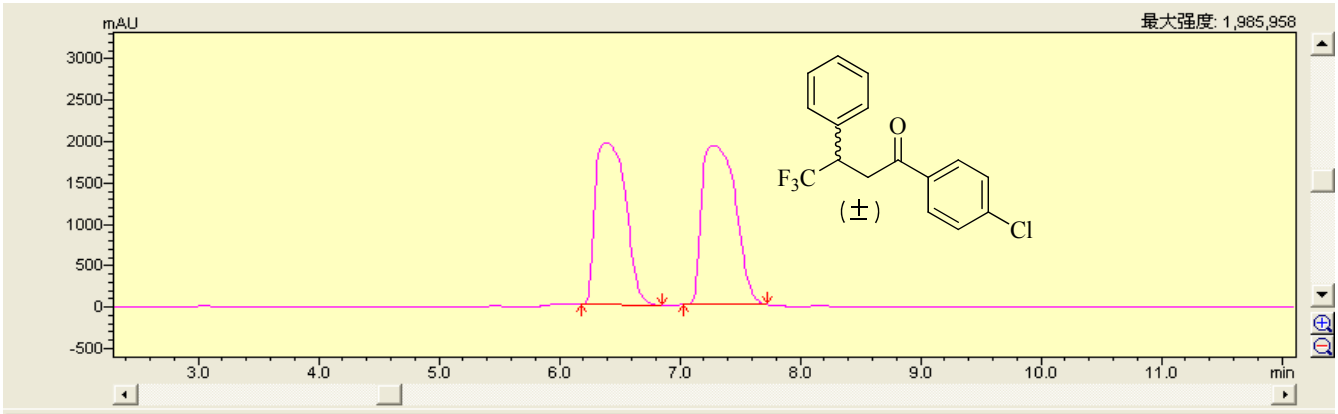
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.748	12.748	1	626503	33748	48.4713
2	RT13.224	13.224	2	666021	34355	51.5287



化合物表视图

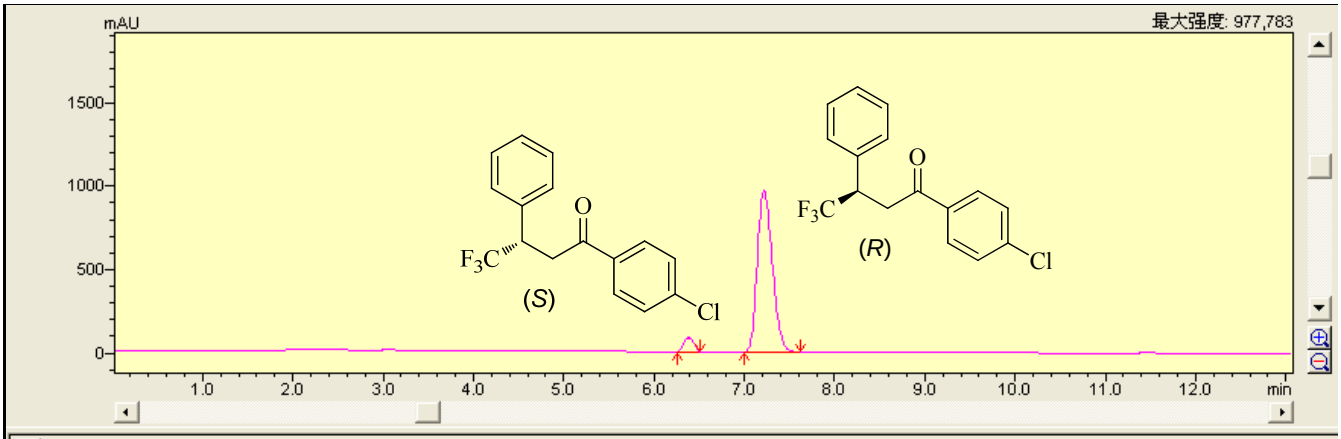
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.836	12.836	1	52566	3127	5.6229
2	RT13.416	13.416	2	882278	36954	94.3771

***6j*: (*R*)-1-(4-chlorophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC)



化合物表视图

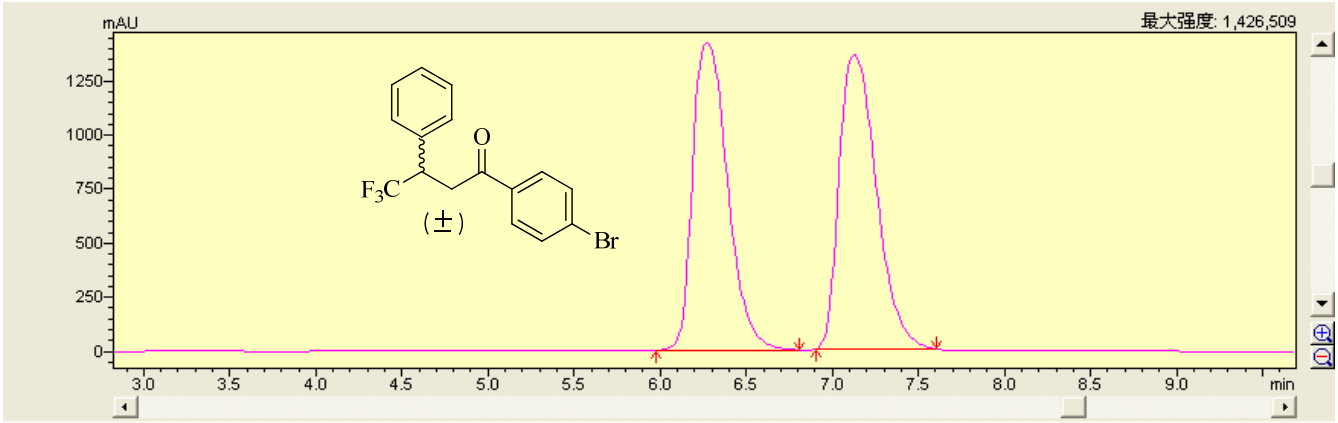
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.379	6.379	1	34389626	1955223	47.7477
2	RT7.269	7.269	2	37634041	1925668	52.2523



化合物表视图

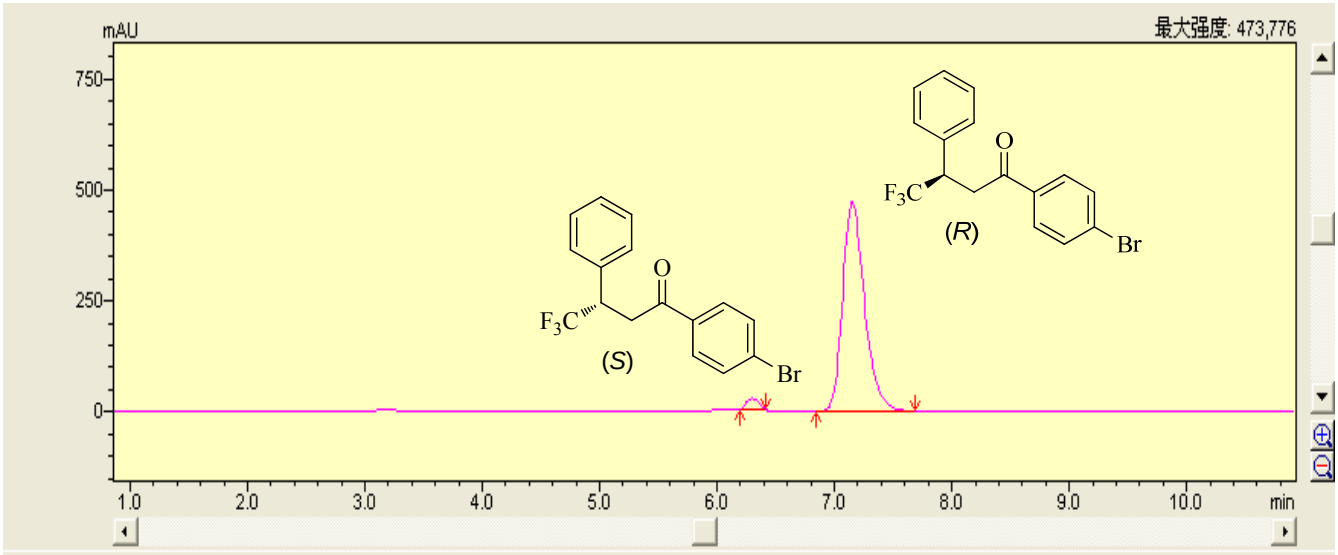
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.379	6.379	1	733342	89125	6.1112
2	RT7.214	7.214	2	11266591	974494	93.8888

***6k*: (*R*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

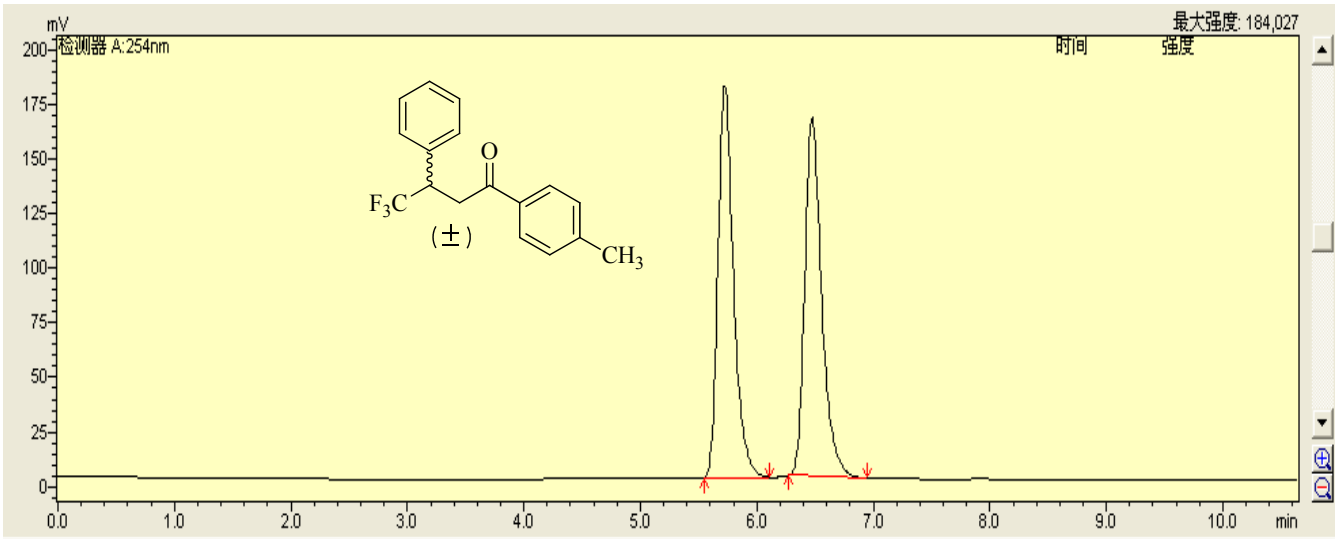
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.267	6.267	1	20149016	1421975	49.4362
2	RT7.123	7.123	2	20608609	1362230	50.5638



化合物表视图

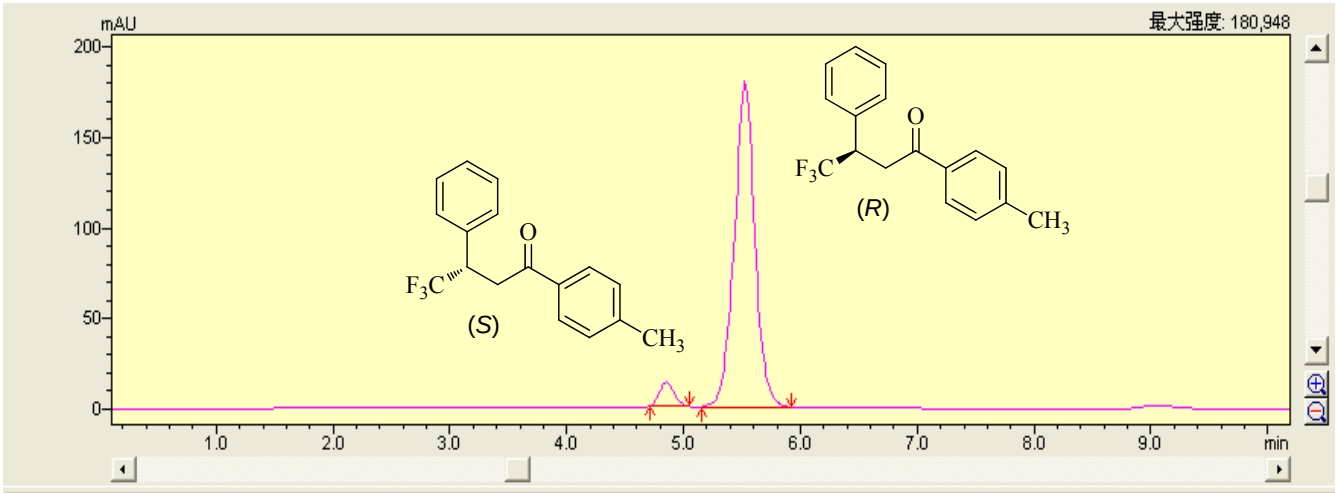
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.294	6.294	1	187476	24887	2.9784
2	RT7.147	7.147	2	6106985	471540	97.0216

***6l*: (*R*)-4,4,4-trifluoro-3-phenyl-1-(p-tolyl)butan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

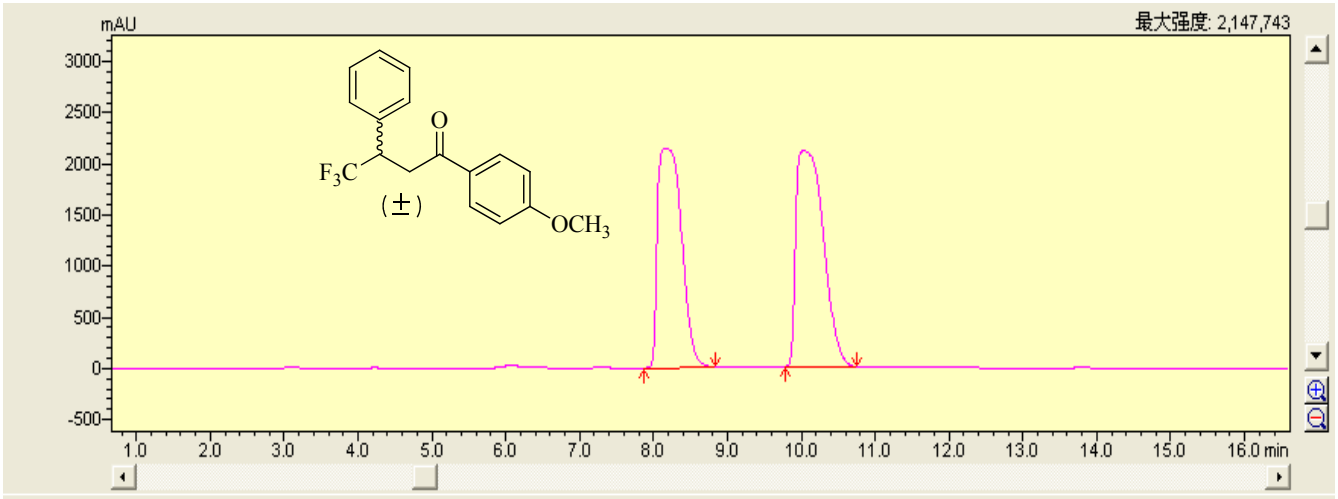
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT5.720	5.720	1	1668097	179755	5.550	6.108	50.1558
2	RT6.470	6.470	2	1657733	164193	6.275	6.942	49.8442



化合物表视图

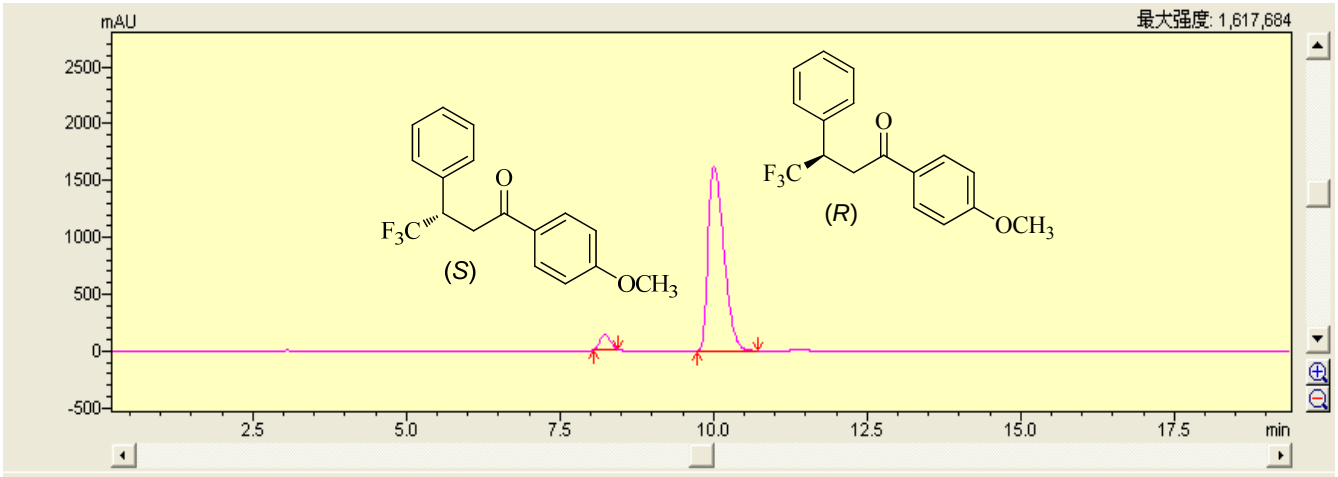
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT4.848	4.848	1	114319	13156	4.9328
2	RT5.521	5.521	2	2203206	179808	95.0672

***6m*: (*R*)-4,4,4-trifluoro-1-(4-methoxyphenyl)-3-phenylbutan-1-one (4m):** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

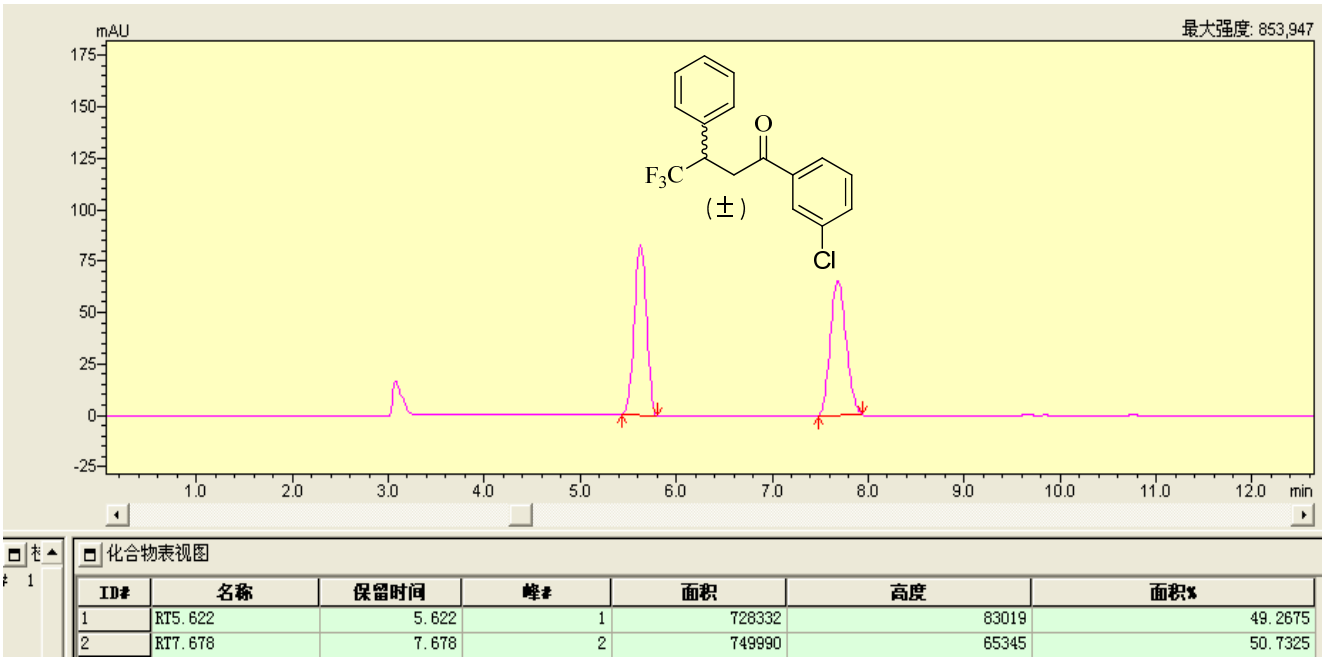
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.163	8.163	1	48015696	2140694	46.7337
2	RT10.018	10.018	2	54727510	2110129	53.2663



化合物表视图

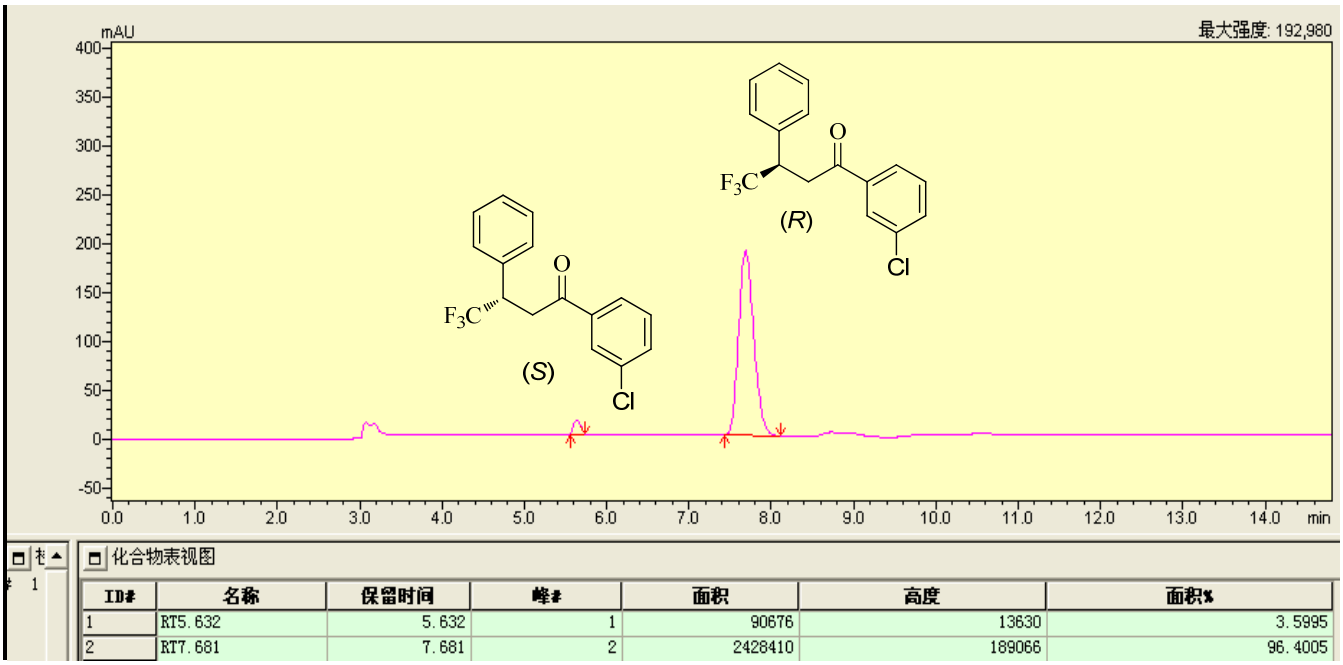
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.226	8.226	1	1495050	127899	4.9308
2	RT10.006	10.006	2	28825325	1613219	95.0692

***6n*: (*R*)-1-(3-chlorophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ºC)



化合物表视图

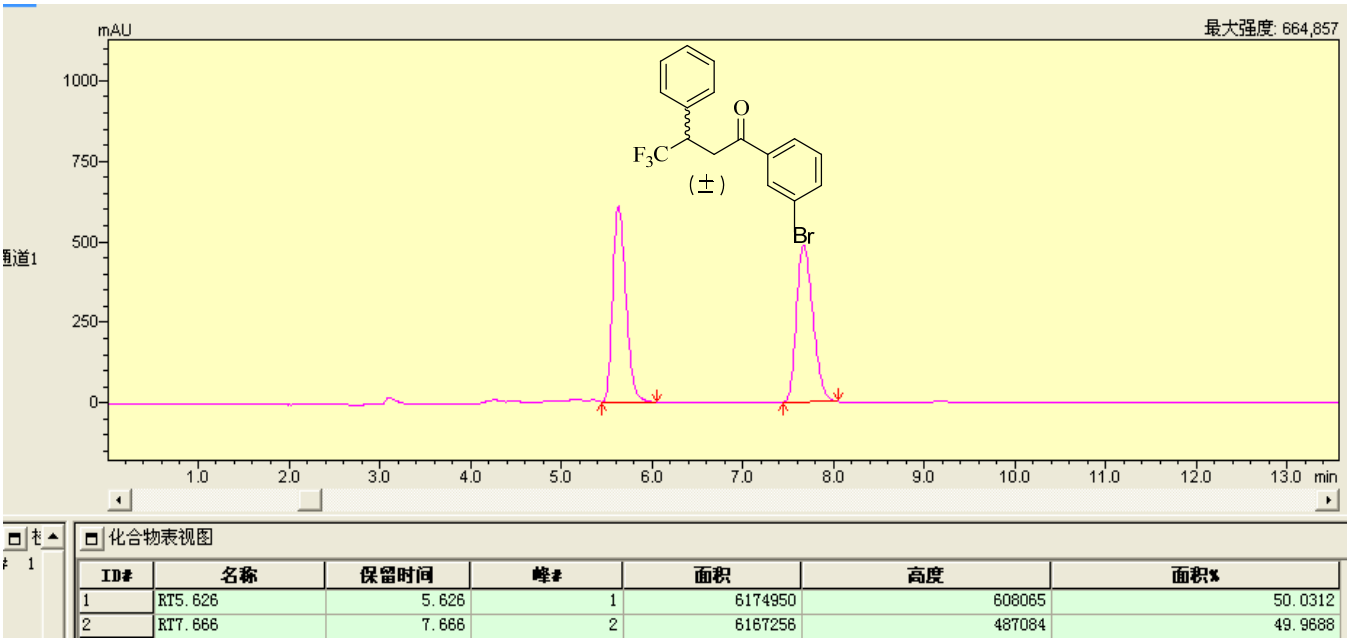
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.622	5.622	1	728332	83019	49.2675
2	RT7.678	7.678	2	749990	65345	50.7325



化合物表视图

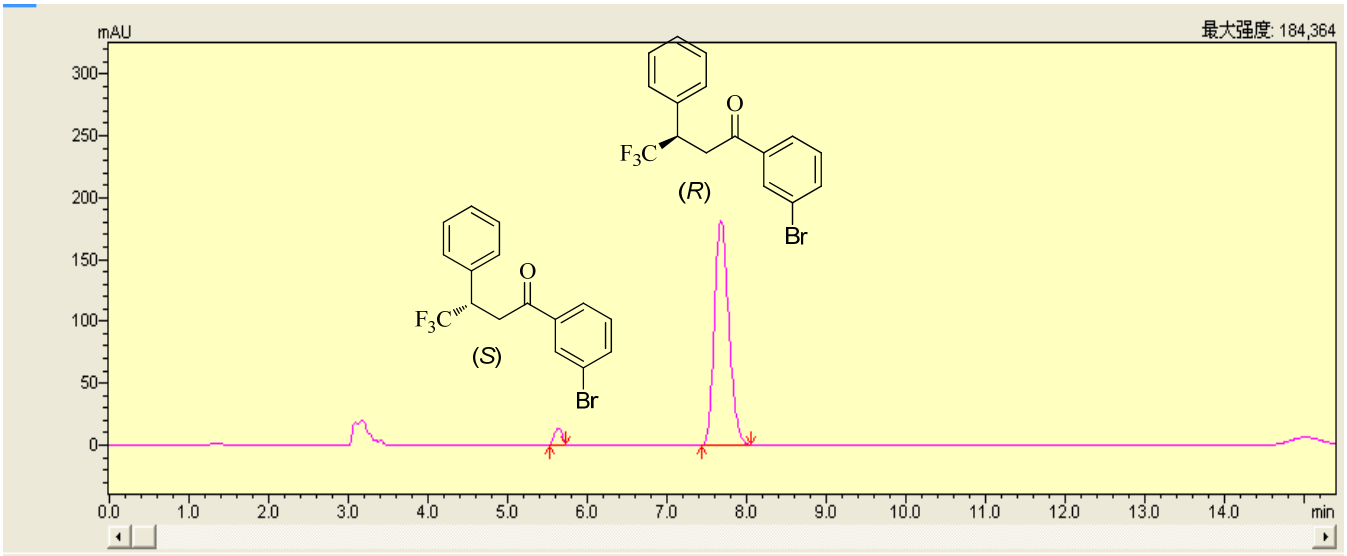
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.632	5.632	1	90676	13630	3.5995
2	RT7.681	7.681	2	2428410	189066	96.4005

6o: **(*R*)-1-(3-bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

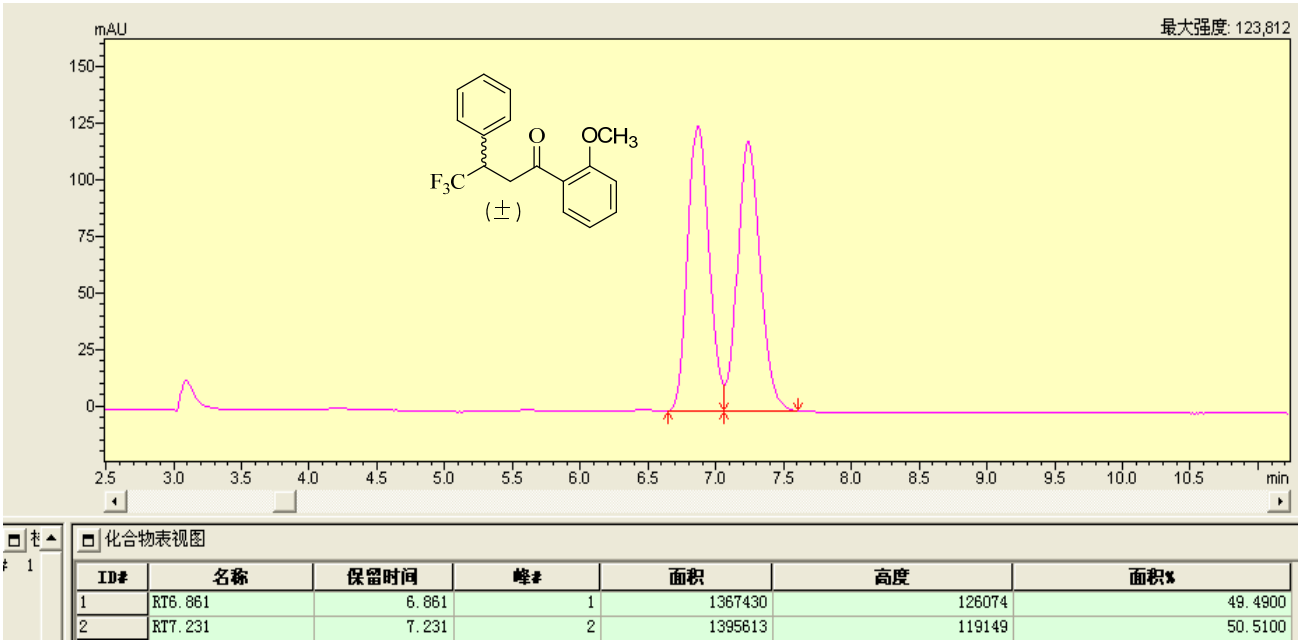
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.626	5.626	1	6174950	608065	50.0312
2	RT7.666	7.666	2	6167256	487084	49.9688



化合物表视图

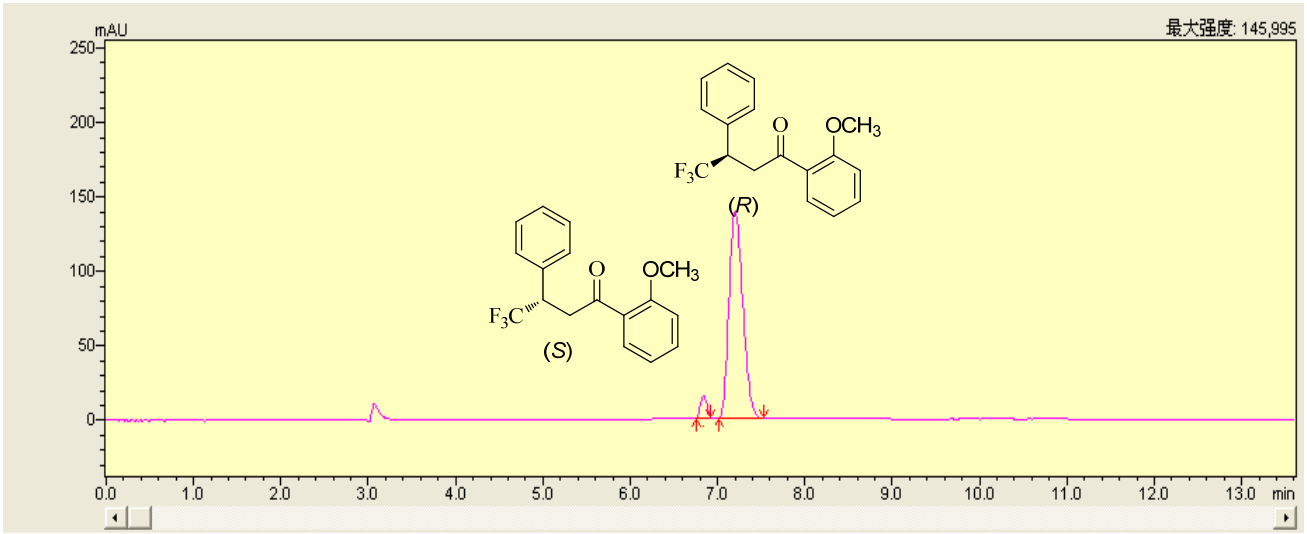
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.632	5.632	1	88115	14039	3.6770
2	RT7.673	7.673	2	2308271	181983	96.3230

***6p*: (*R*)-4,4,4-trifluoro-1-(2-methoxyphenyl)-3-phenylbutan-1-one** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

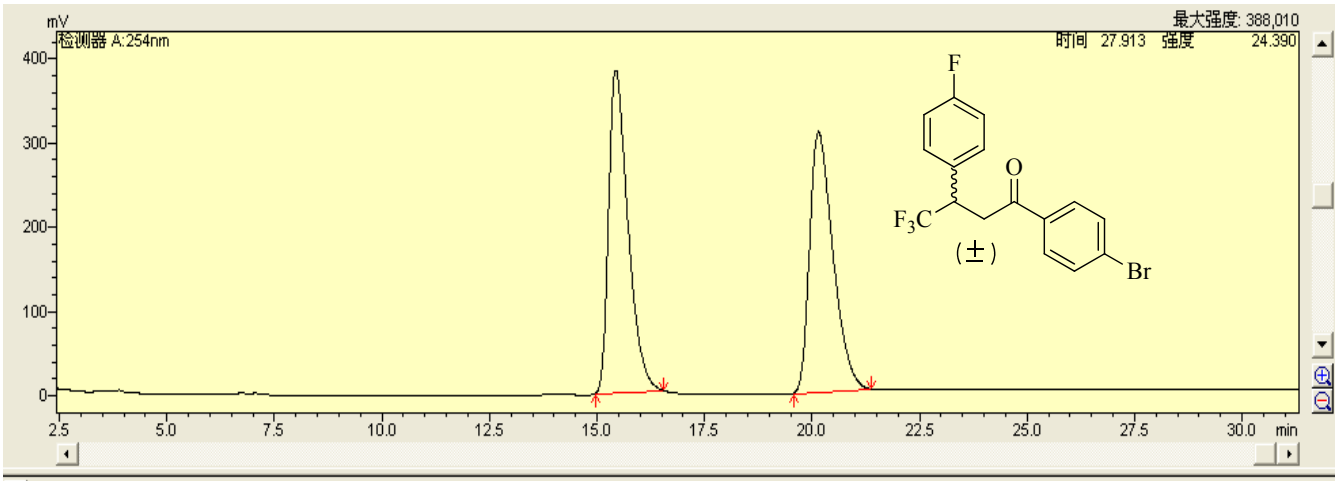
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.861	6.861	1	1367430	126074	49.4900
2	RT7.231	7.231	2	1395613	119149	50.5100



化合物表视图

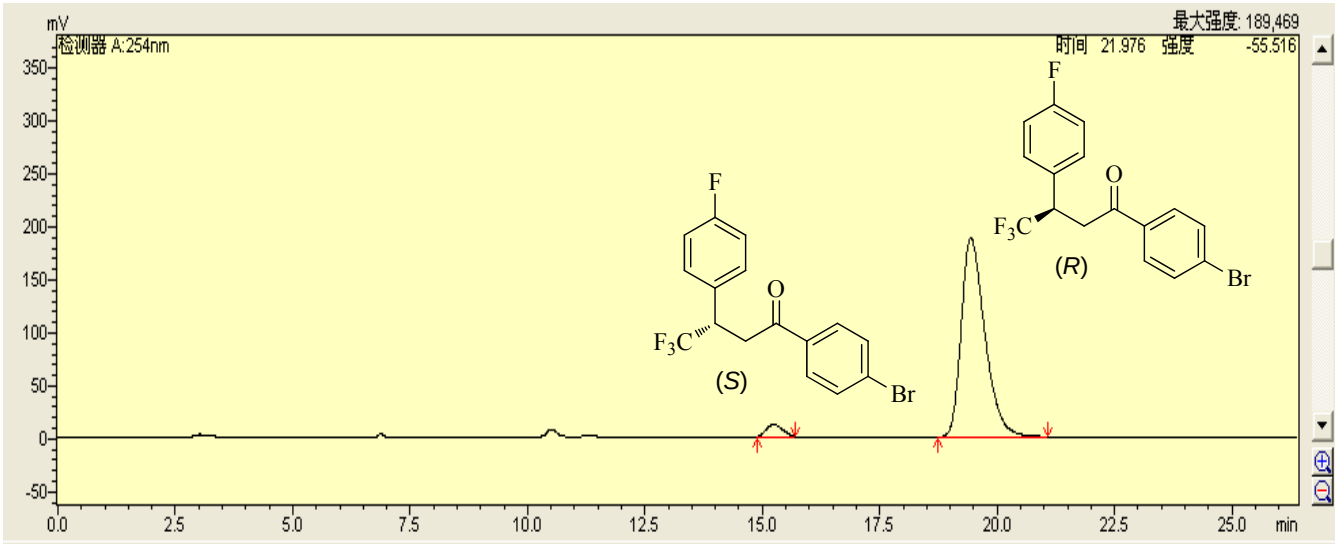
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.836	6.836	1	64522	13274	3.9446
2	RT7.195	7.195	2	1571162	141122	96.0554

***6q*: (*R*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-(4-fluorophenyl)butan-1-one** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.5 mL/min, 25 ºC).



化合物表视图

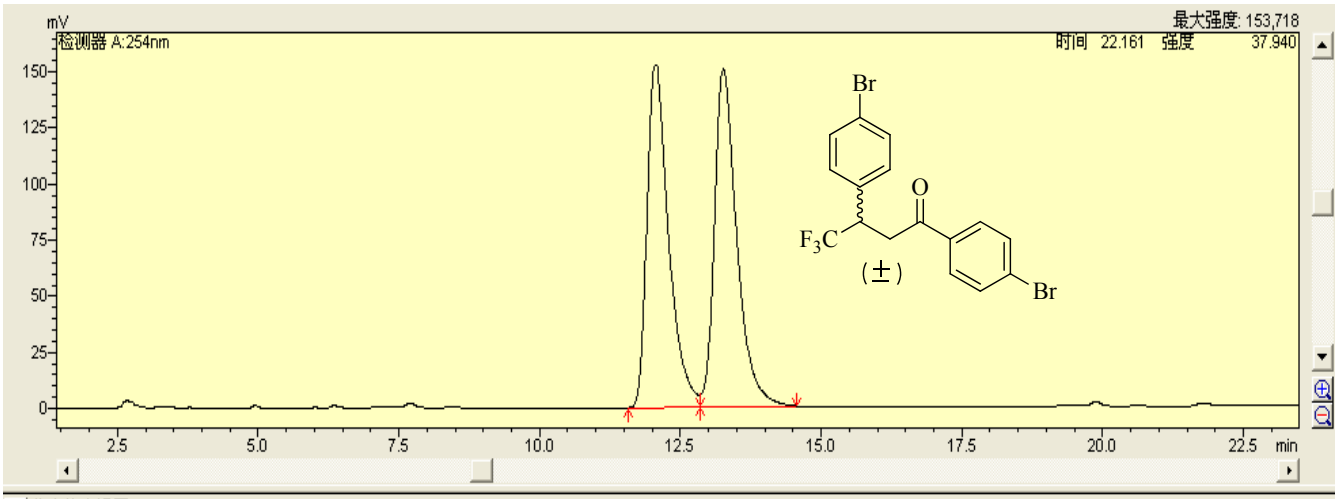
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT15.433	15.433	1	12016481	384356	14.967	16.558	50.6332
2	RT20.148	20.148	2	11715949	309185	19.575	21.383	49.3668



化合物表视图

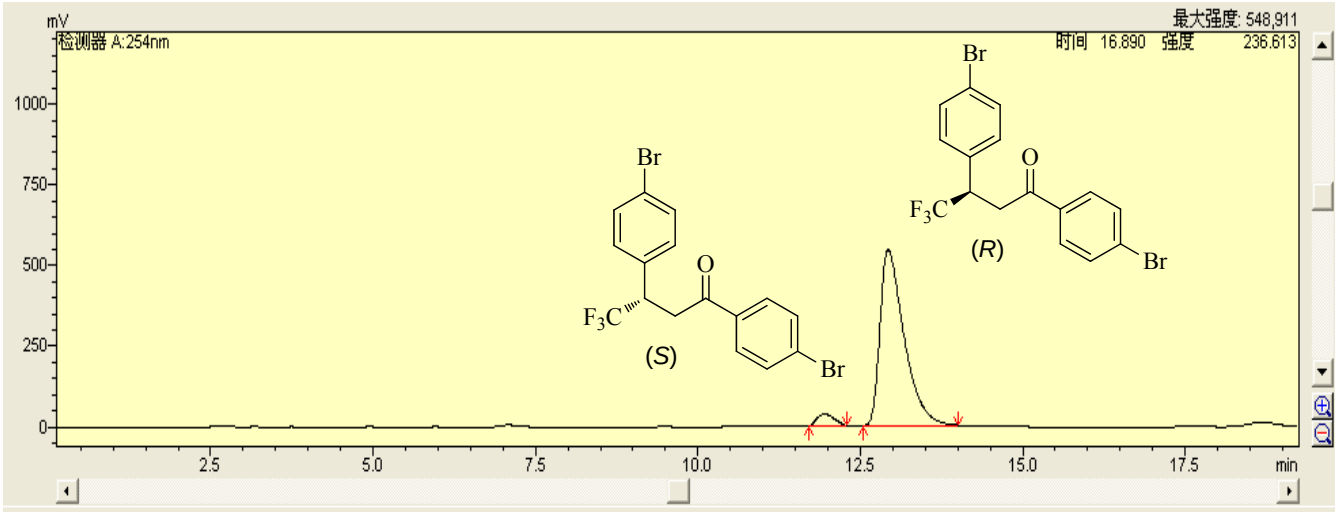
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT15.244	15.244	1	297211	11815	14.883	15.700	4.3042
2	RT19.438	19.438	2	6608002	187855	18.750	21.083	95.6958

***6r*: (*R*)-1,3-bis(4-bromophenyl)-4,4,4-trifluorobutan-1-one (4o):** (HPLC: Chiracel OJ-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.5 mL/min, 25 ºC).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT12.050	12.050	1	4079839	153213	11.567	12.842	49.4717
2	RT13.260	13.260	2	4166980	150572	12.842	14.575	50.5283

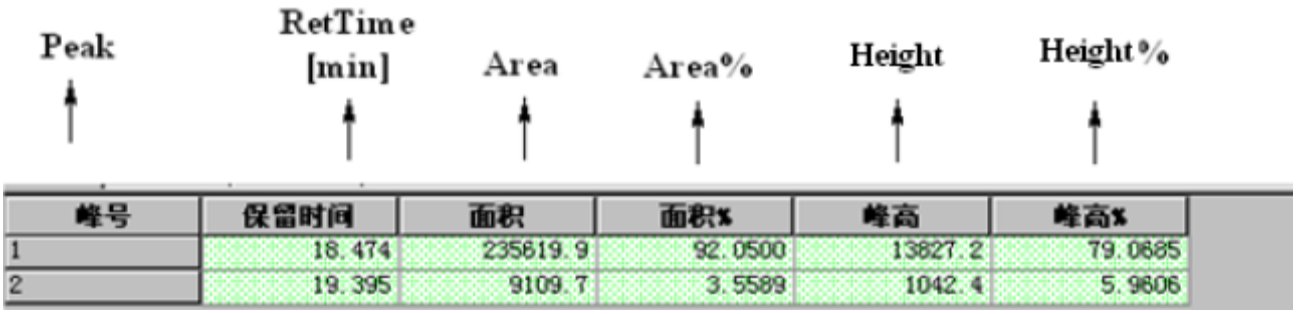


化合物表视图

ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT11.949	11.949	1	744067	38768	11.717	12.300	4.9570
2	RT12.928	12.928	2	14266521	545199	12.542	14.325	95.0430

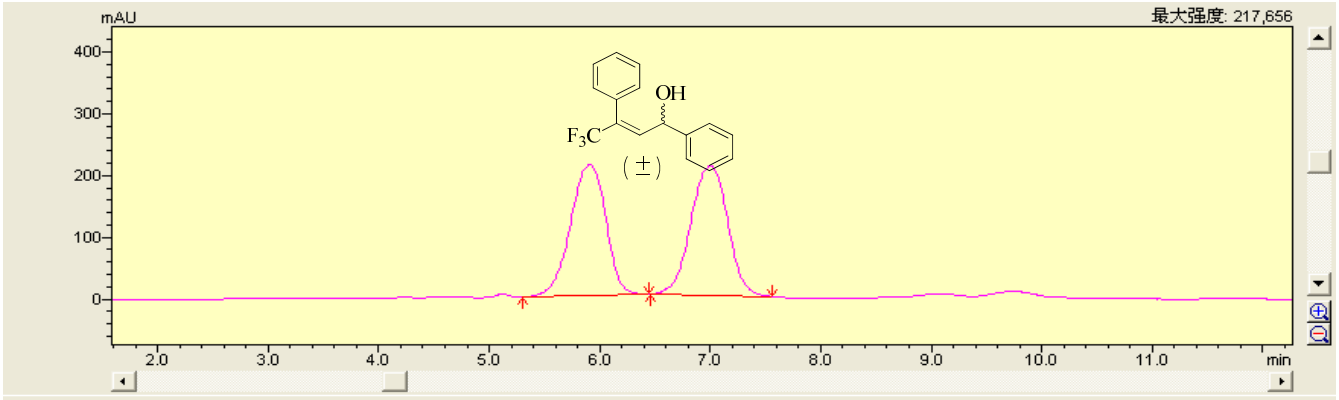
Figure S5. Enantioselectivereductions of β-trifluoromethylated-α,β-unsaturated ketones to chiral chiral β-trifluoromethylated alcohols. [The products were analyzed by a HPLC with a UV-Vis detector using a Daicel OD-H or AD-H chiralcel column (Φ0.46×25 cm). Please see literatures (Catal. Sci. Technol. 2015, **5**, 1750;Angew. Chem. Int. Ed. **2012**, 51, 6467).

Translation of Chinese to English is as follows:



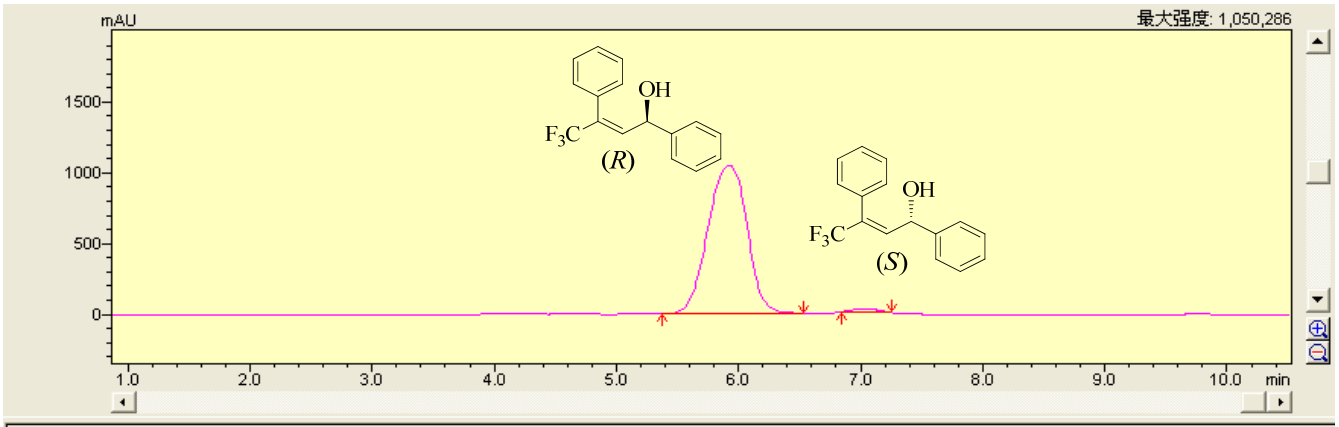
峰号	保留时间	面积	面积%	峰高	峰高%
1	18.474	235619.9	92.0500	13827.2	79.0685
2	19.395	9109.7	3.5589	1042.4	5.9606

***5a*: (*R*,*E*)-4,4,4-trifluoro-1,3-diphenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

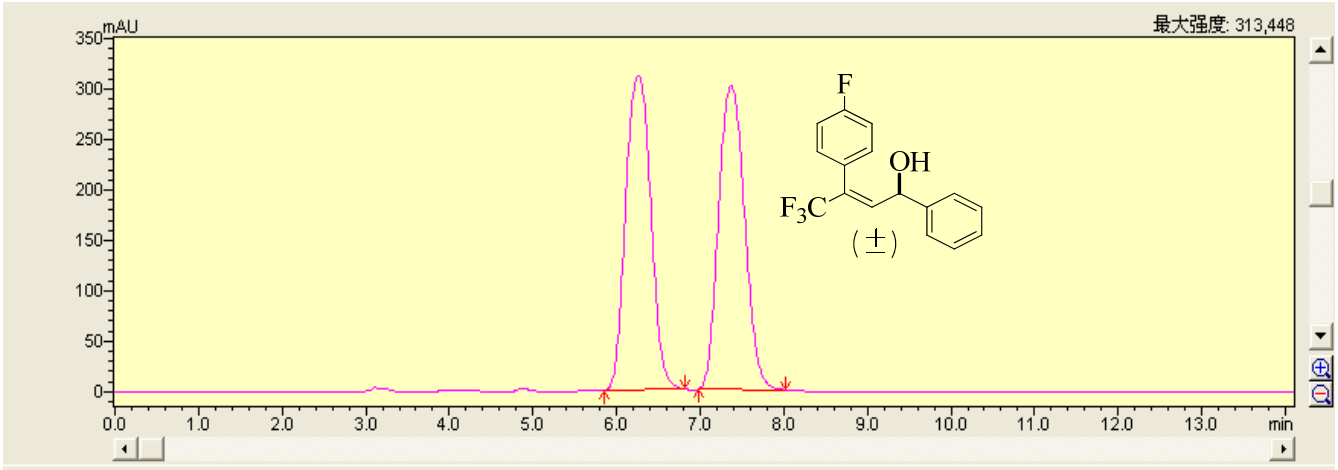
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.904	5.904	1	4698382	211753	49.2228
2	RT6.995	6.995	2	4846753	209191	50.7772



化合物表视图

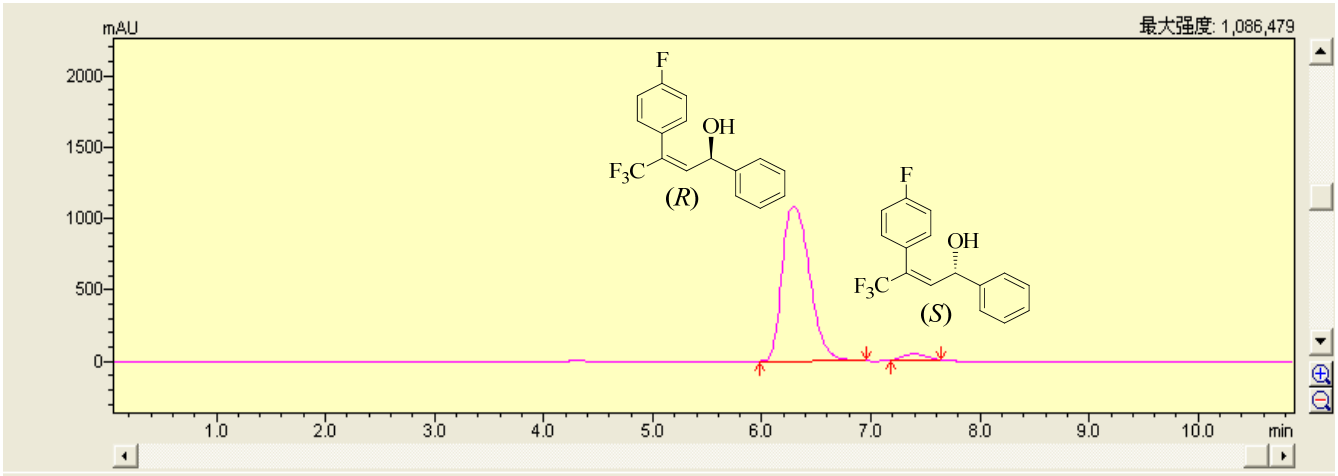
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.917	5.917	1	23384162	1045374	98.5174
2	RT7.027	7.027	2	351920	23303	1.4826

***5b*: (*R*,*E*)-4,4,4-trifluoro-3-(4-fluorophenyl)-1-phenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

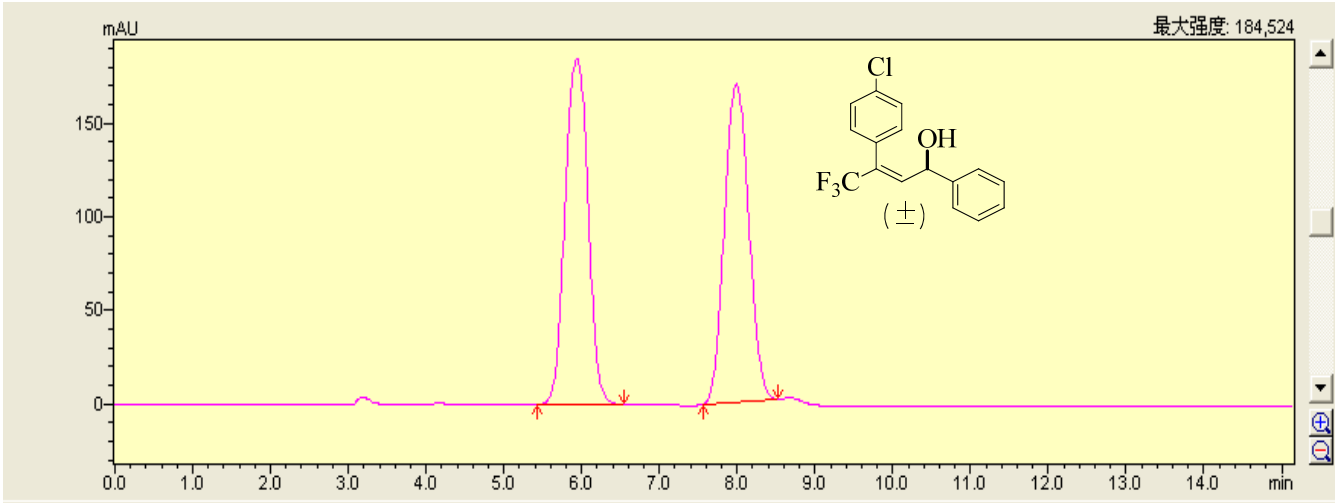
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.256	6.256	1	6537111	311739	49.9540
2	RT7.366	7.366	2	6549160	301751	50.0460



化合物表视图

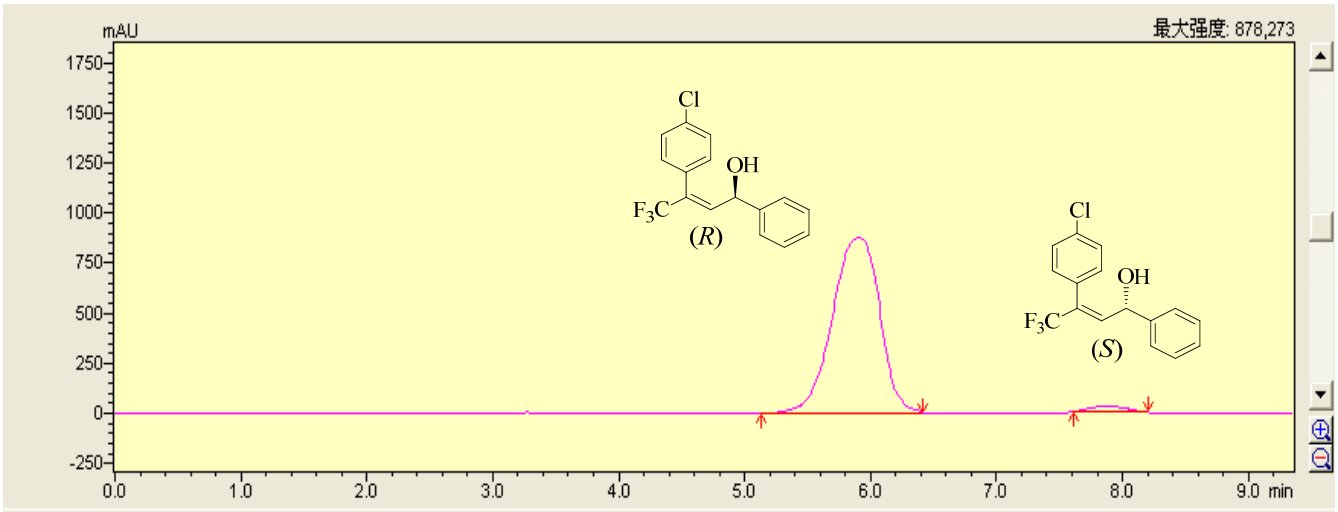
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.286	6.286	1	19066024	1083360	96.7244
2	RT7.394	7.394	2	645675	43155	3.2756

***5c*: (*R*,*E*)-3-(4-chlorophenyl)-4,4,4-trifluoro-1-phenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

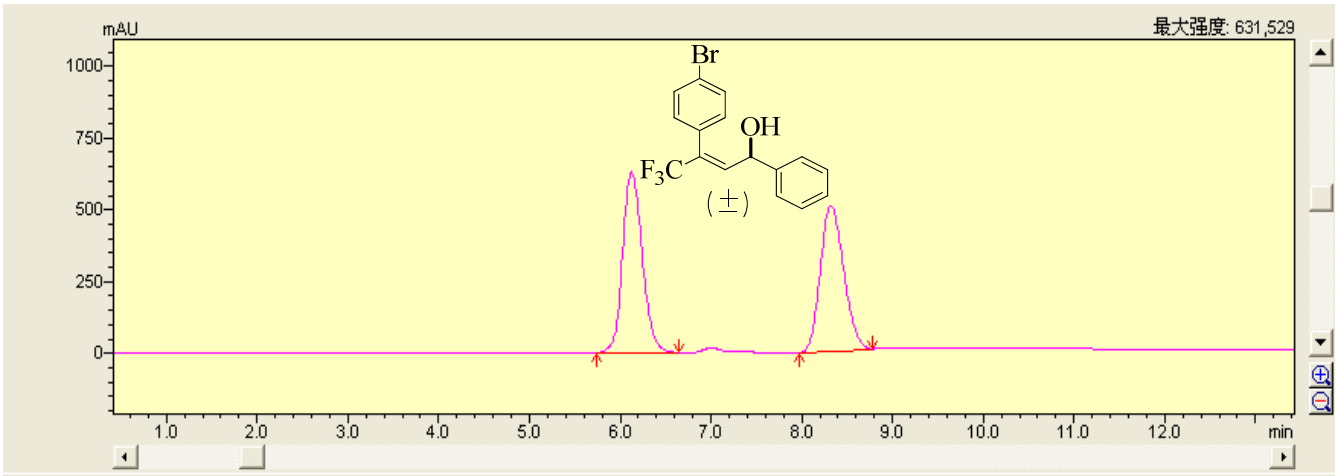
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.936	5.936	1	3822012	185032	50.7906
2	RT7.985	7.985	2	3703022	170076	49.2094



化合物表视图

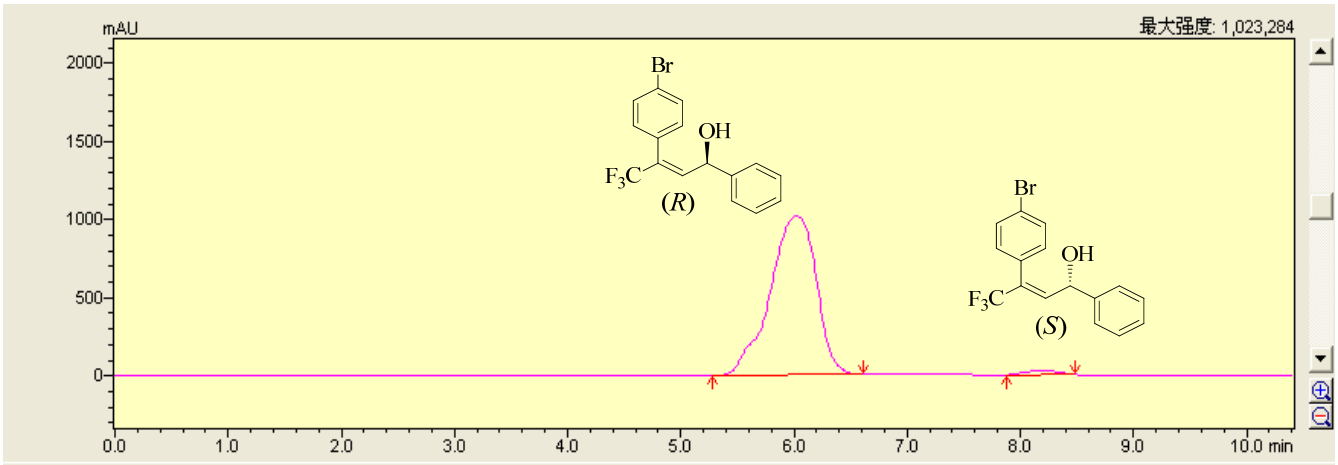
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.900	5.900	1	22937359	877564	97.5224
2	RT7.880	7.880	2	582729	28561	2.4776

***5d*: (*R*,*E*)-3-(4-bromophenyl)-4,4,4-trifluoro-1-phenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

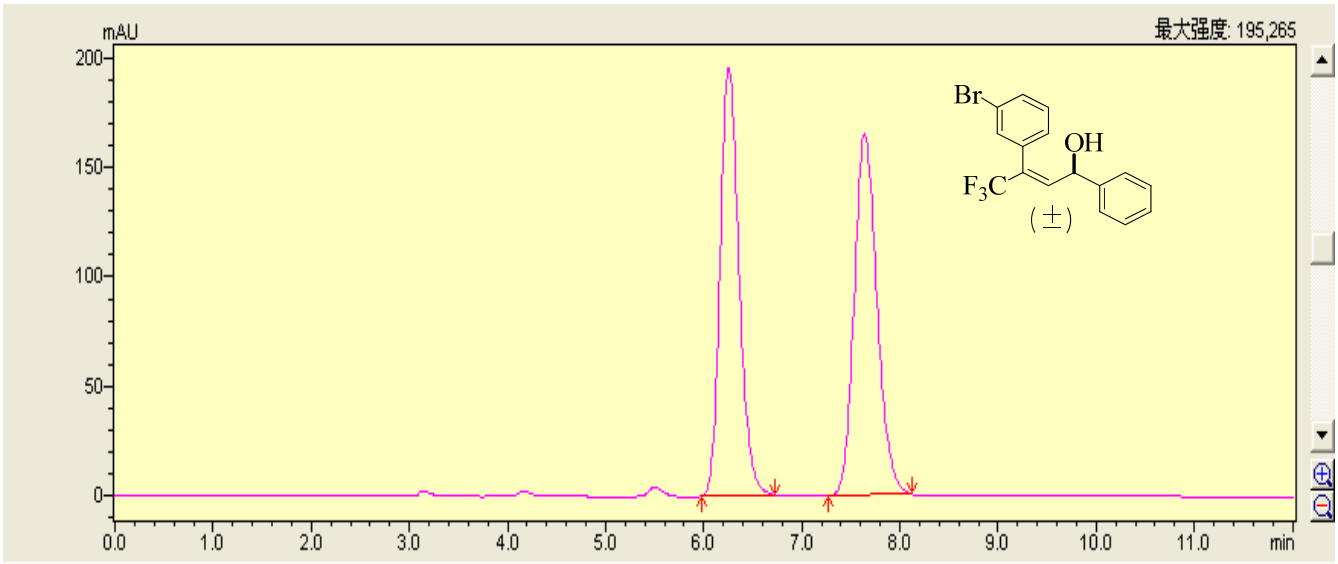
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.120	6.120	1	9507347	630078	51.1364
2	RT8.318	8.318	2	9084769	506122	48.8636



化合物表视图

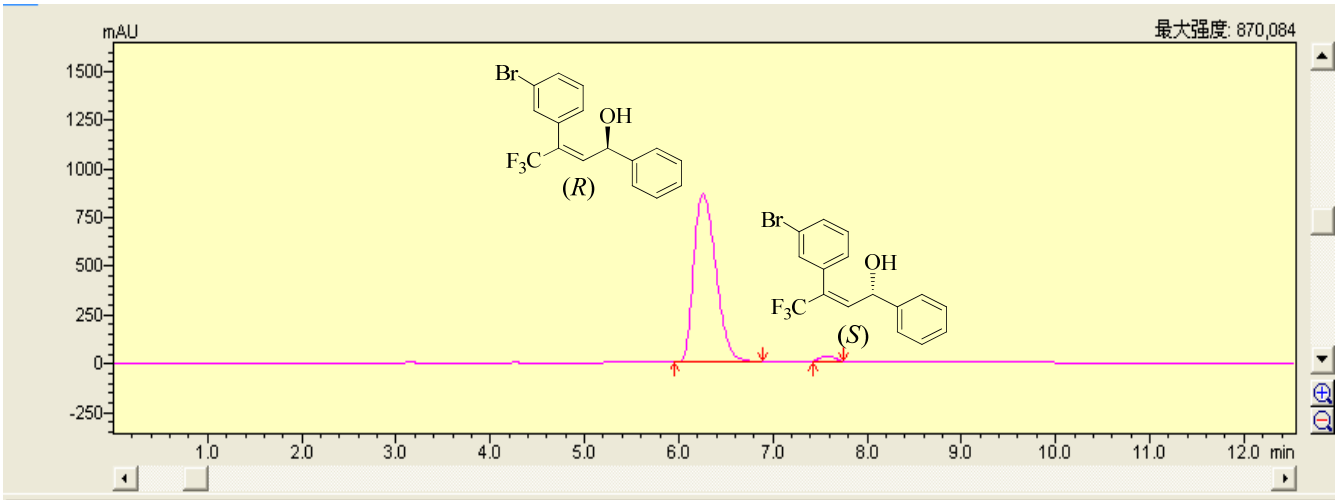
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.020	6.020	1	28875165	1016742	98.1326
2	RT8.198	8.198	2	549472	26324	1.8674

***5e*: (*R*,*E*)-3-(3-bromophenyl)-4,4,4-trifluoro-1-phenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

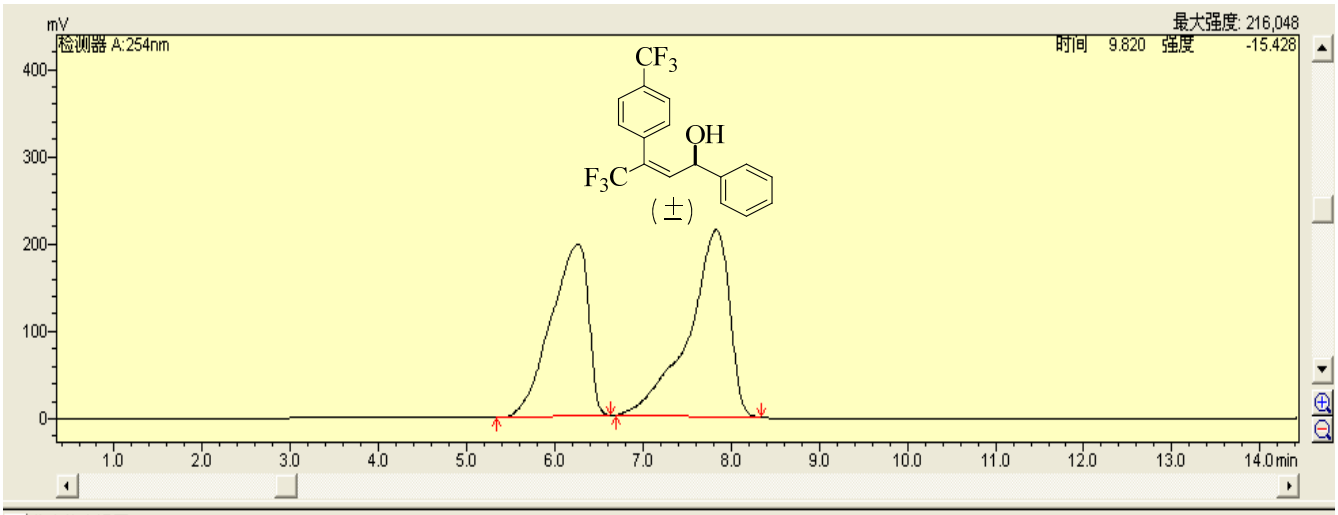
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.249	6.249	1	2608825	194979	49.5177
2	RT7.636	7.636	2	2659641	165182	50.4823



化合物表视图

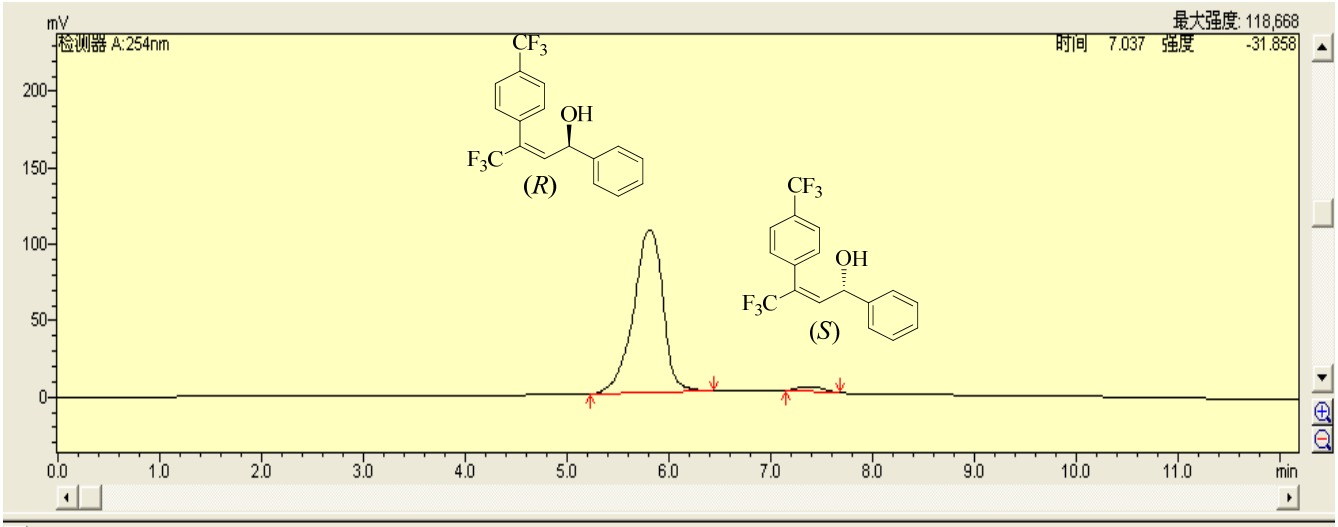
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.254	6.254	1	14089515	862581	97.6531
2	RT7.568	7.568	2	338617	28410	2.3469

***5f*: (*R,E*)-4,4,4-trifluoro-1-phenyl-3-(4-(trifluoromethyl)phenyl)but-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

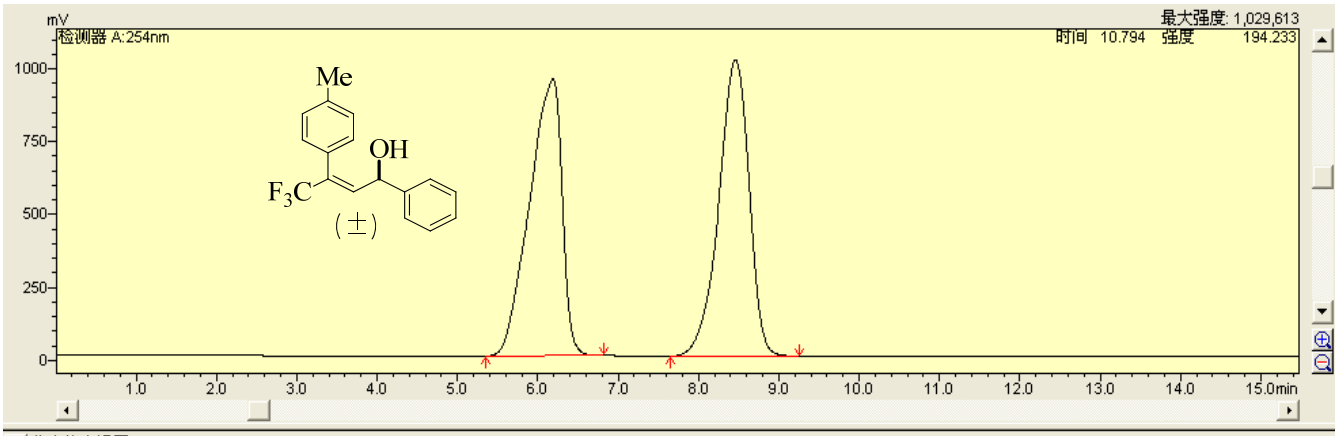
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT6.261	6.261	1	5842032	197596	5.333	6.625	45.7465
2	RT7.826	7.826	2	6928428	213650	6.700	8.342	54.2535



化合物表视图

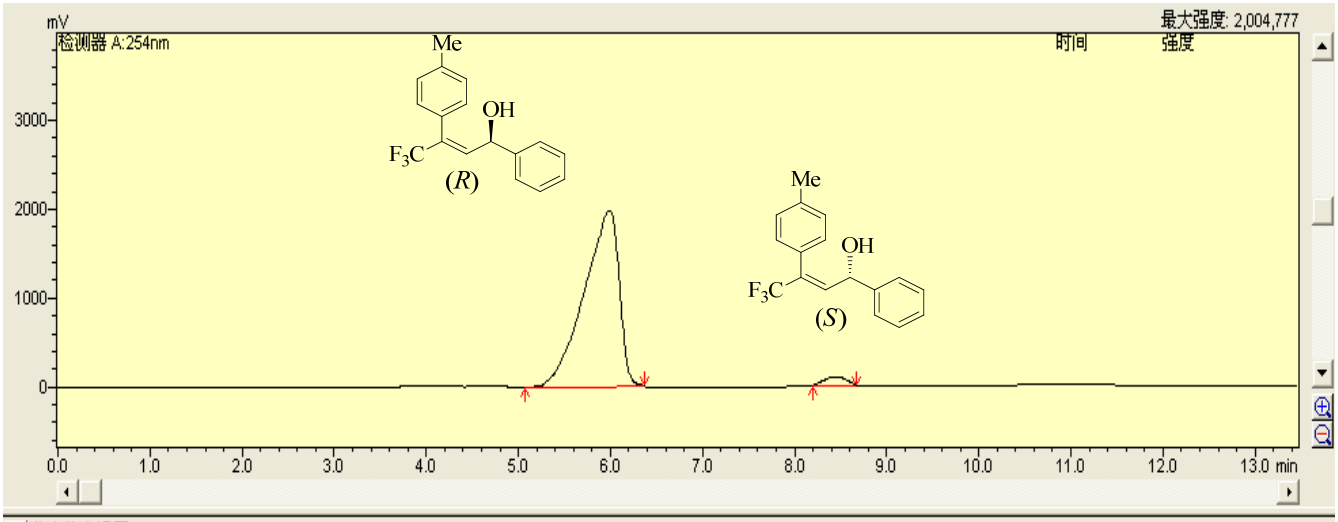
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT5.802	5.802	1	2168805	106949	5.225	6.433	97.6351
2	RT7.353	7.353	2	52532	2984	7.150	7.675	2.3649

***5q*: (*R*,*E*)-4,4,4-trifluoro-1-phenyl-3-(p-tolyl)but-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

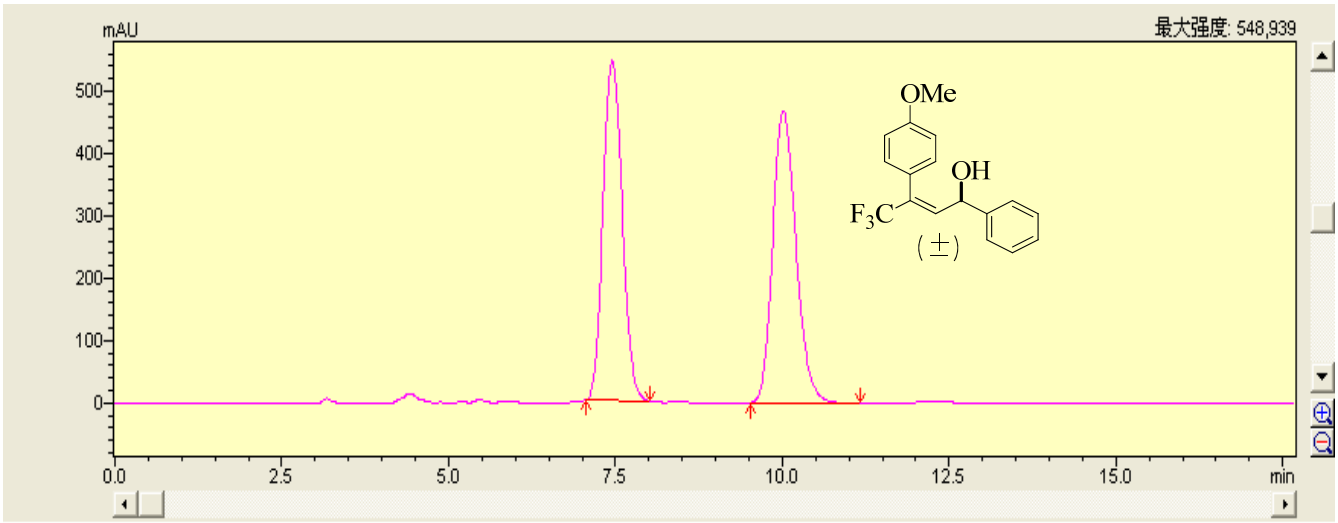
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT6.184	6.184	1	26496852	947606	5.358	6.817	49.8643
2	RT8.458	8.458	2	26641100	1015514	7.658	9.258	50.1357



化合物表视图

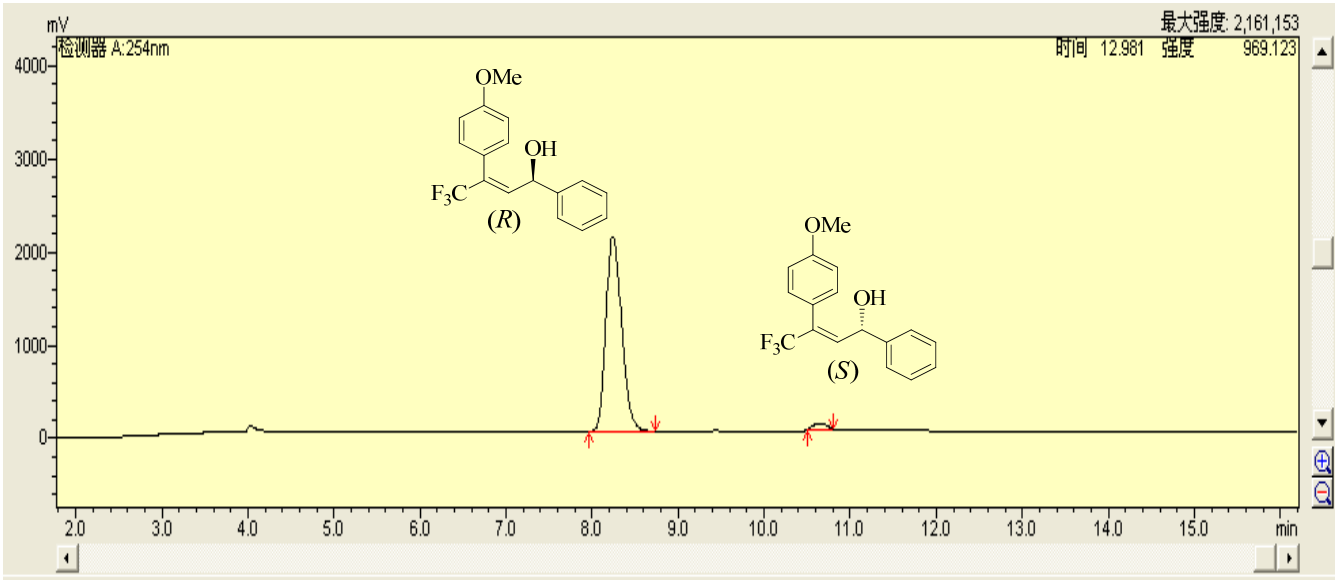
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT5.983	5.983	1	52634419	2002900	5.067	7.058	97.0536
2	RT8.444	8.444	2	1597920	94120	8.200	8.675	2.9464

***5h*: (*R*,*E*)-4,4,4-trifluoro-3-(4-methoxyphenyl)-1-phenylbut-2-en-1-ol:** (HPLC: ChiracelOD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

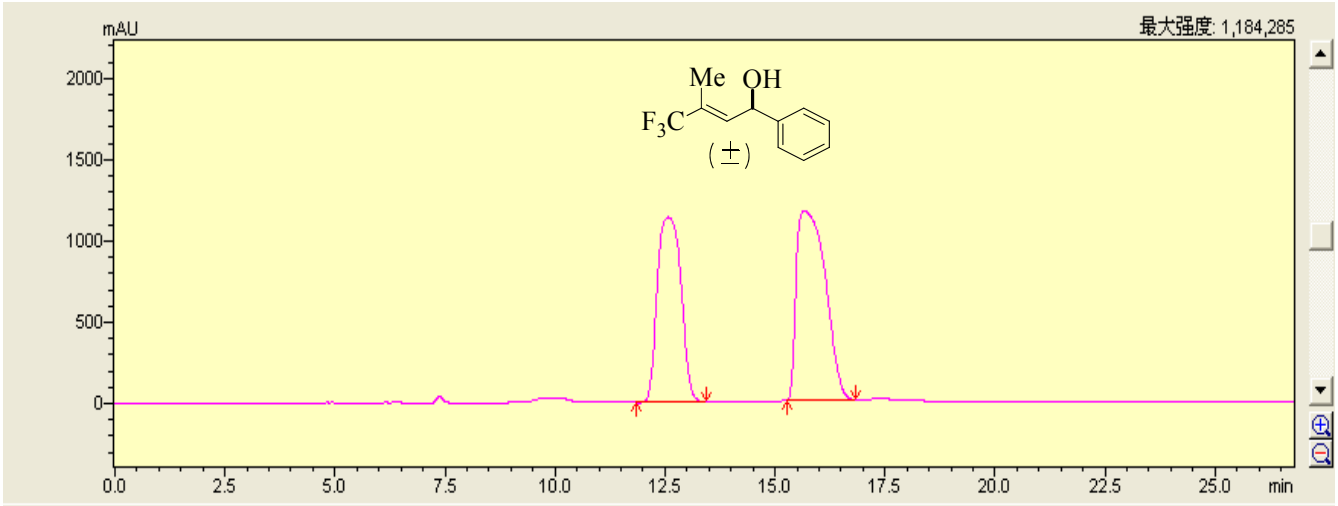
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT7.446	7.446	1	10947383	544989	49.1061
2	RT10.010	10.010	2	11345948	468662	50.8939



化合物表视图

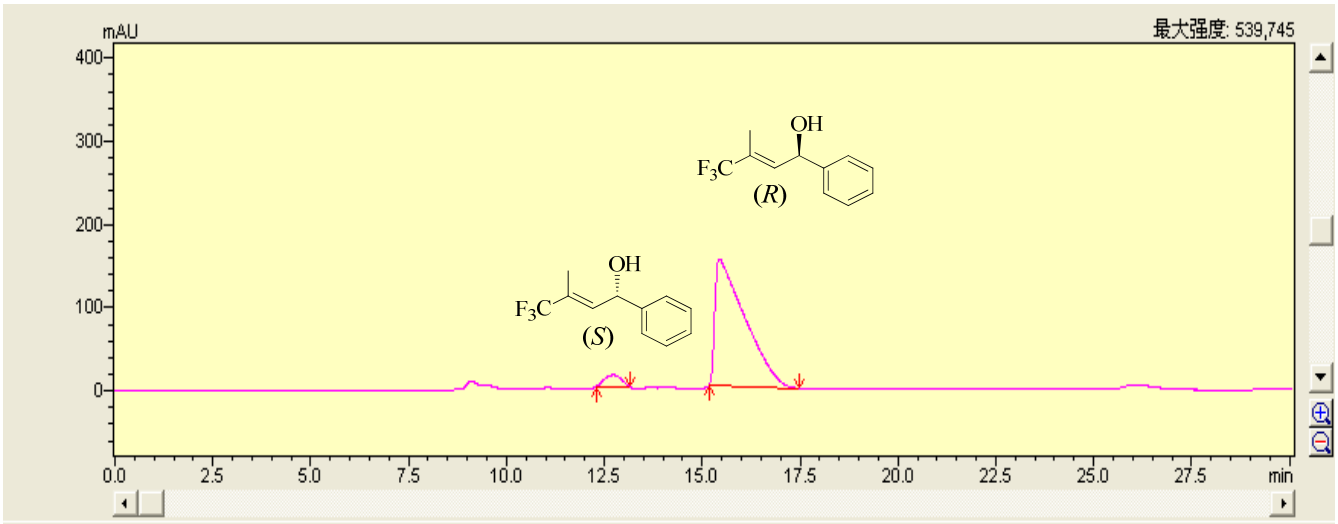
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT8.238	8.238	1	26847808	2087487	7.958	8.742	97.4219
2	RT10.642	10.642	2	710481	65836	10.508	10.808	2.5781

***5i*: (*R,E*)-4,4,4-trifluoro-3-methyl-1-phenylbut-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

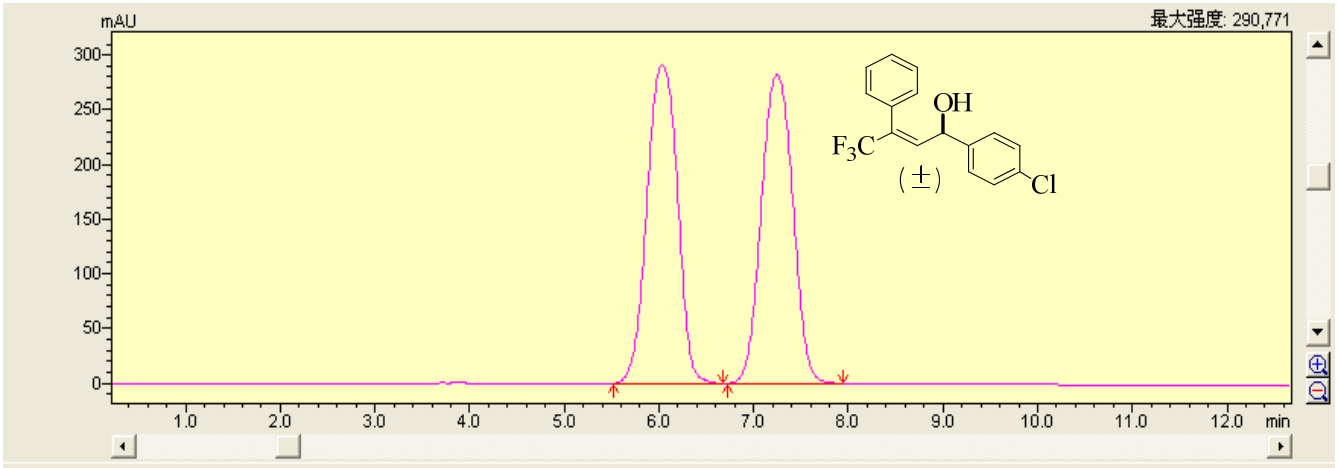
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.568	12.568	1	42503140	1137240	44.2880
2	RT15.656	15.656	2	53466750	1165269	55.7120



化合物表视图

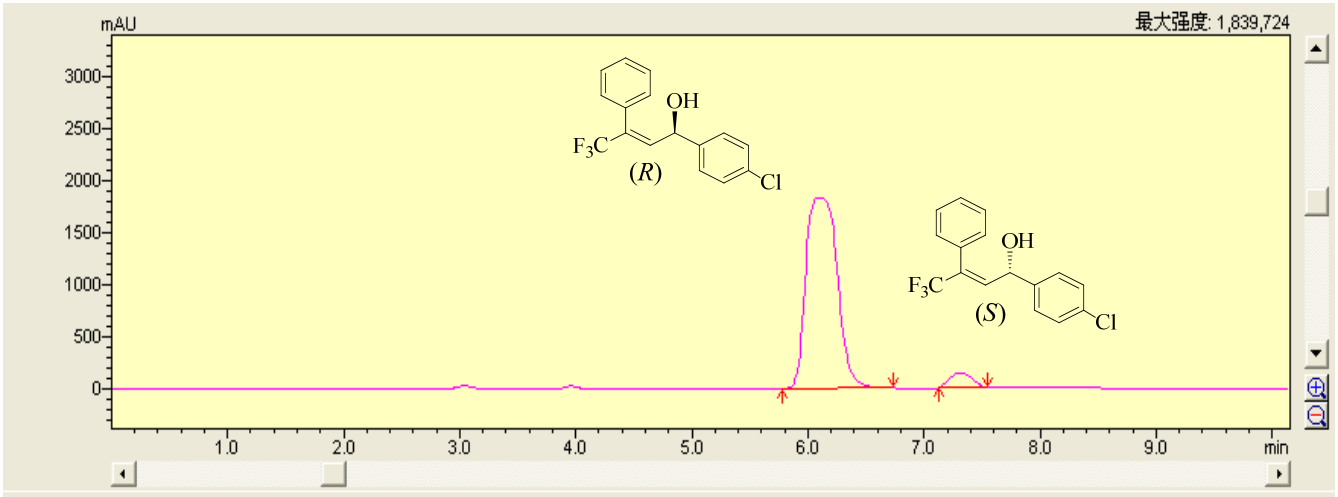
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.733	12.733	1	424879	14054	4.9603
2	RT15.432	15.432	2	8140711	152912	95.0397

***5j*: (*R,E*)-1-(4-chlorophenyl)-4,4,4-trifluoro-3-phenylbut-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

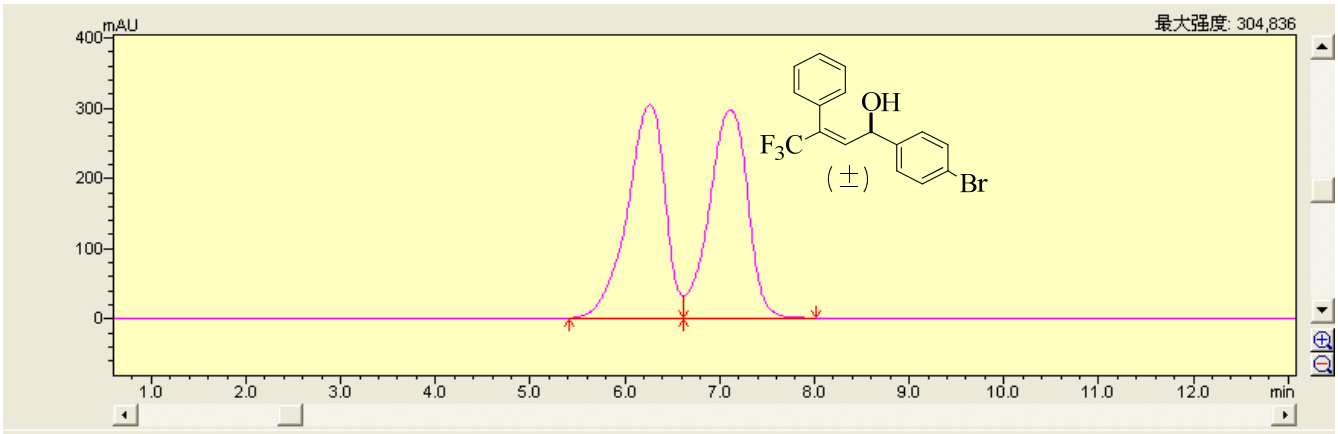
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.029	6.029	1	6519192	291200	50.0147
2	RT7.241	7.241	2	6515357	282304	49.9853



化合物表视图

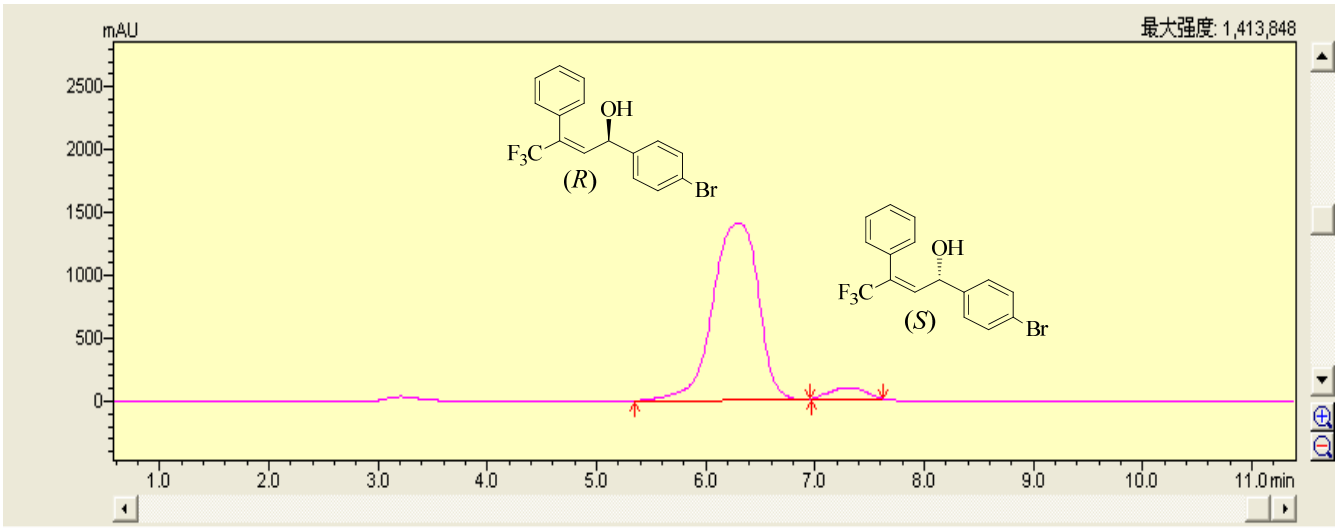
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.113	6.113	1	34275419	1835932	95.4399
2	RT7.310	7.310	2	1637679	131274	4.5601

***5k*: (*R*,*E*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-phenylbut-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

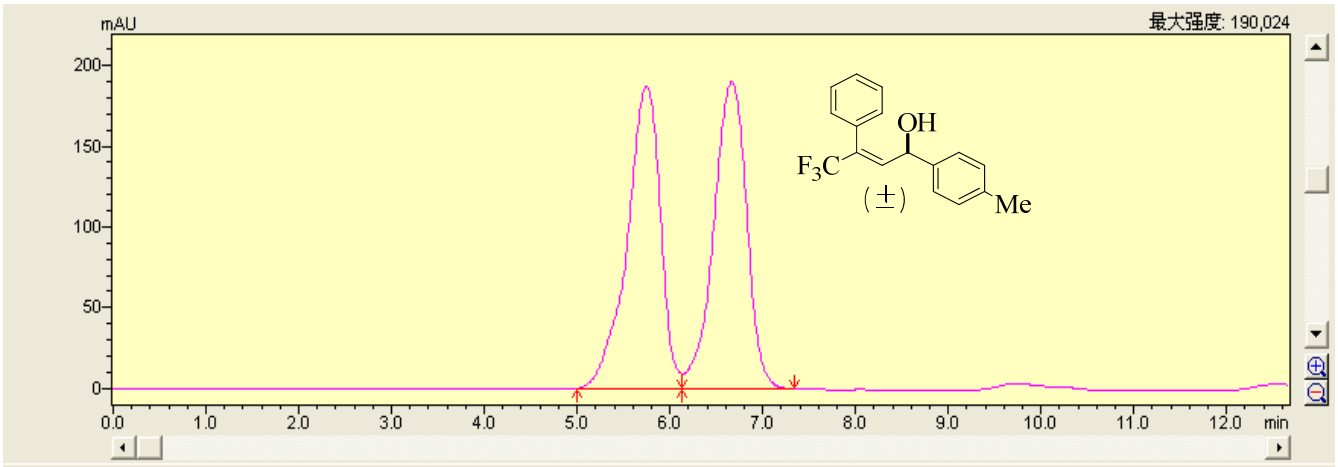
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.257	6.257	1	8444646	303803	50.2763
2	RT7.107	7.107	2	8351825	296608	49.7237



化合物表视图

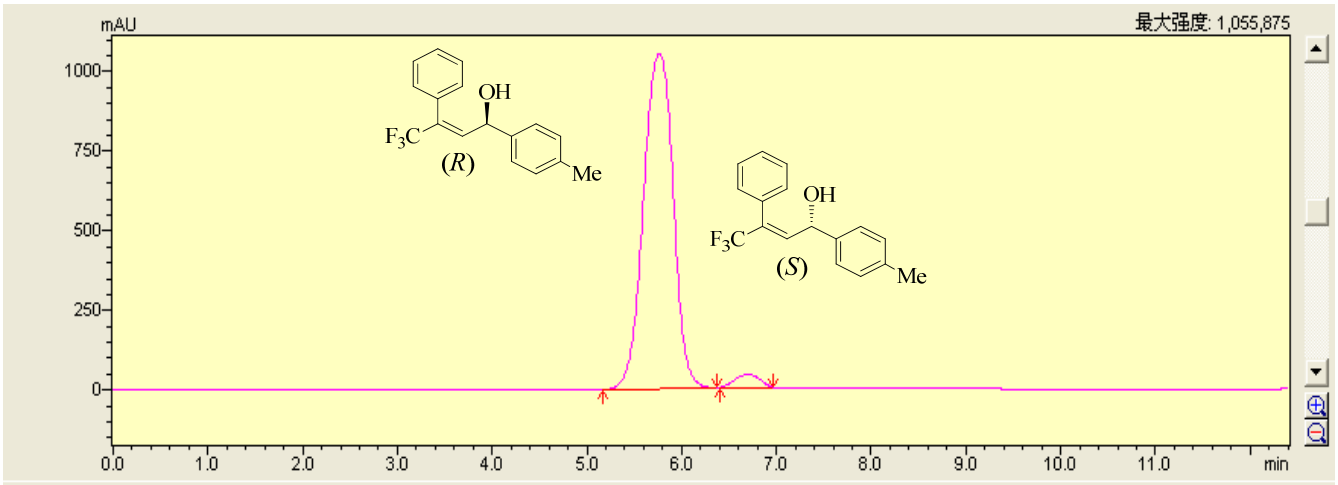
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.288	6.288	1	40500254	1399886	97.0170
2	RT7.299	7.299	2	1245257	67497	2.9830

***5l*: (*R,E*)-4,4,4-trifluoro-3-phenyl-1-(p-tolyl)but-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

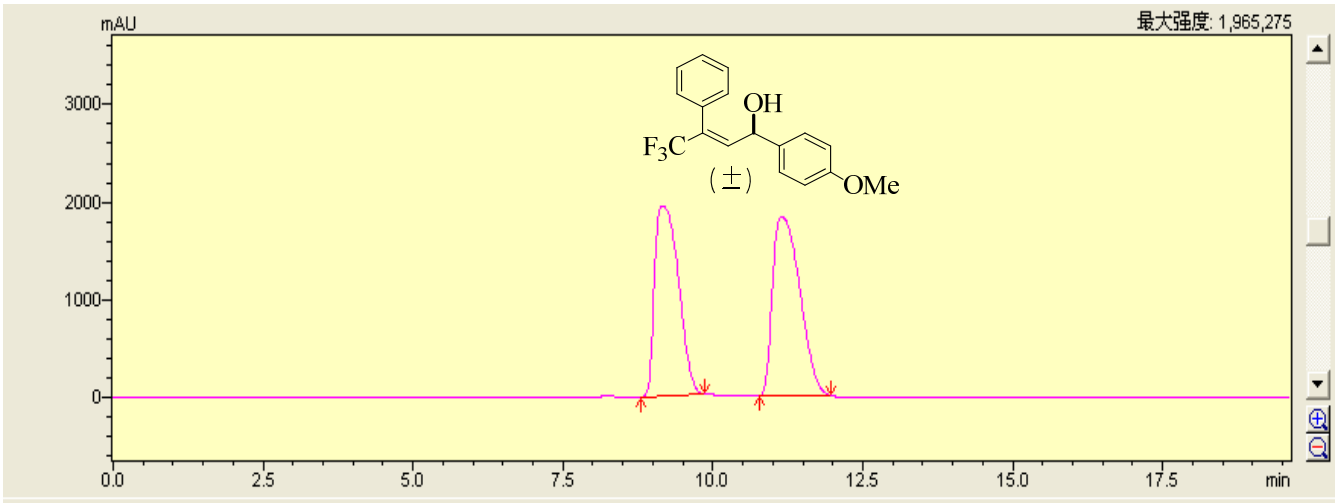
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.743	5.743	1	4688000	187926	49.8019
2	RT6.662	6.662	2	4725292	190637	50.1981



化合物表视图

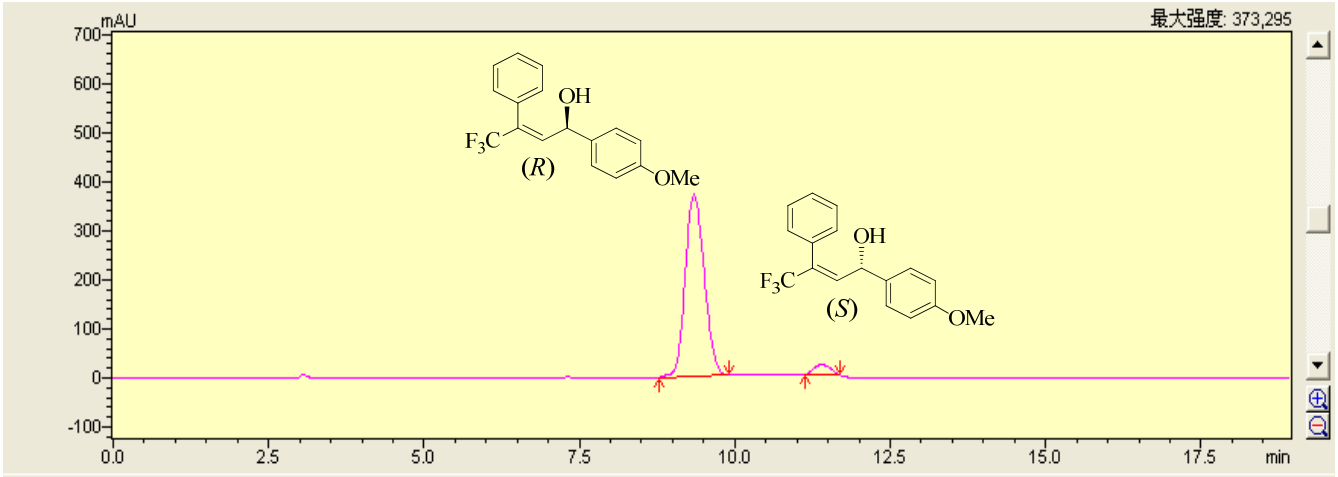
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.759	5.759	1	22945012	1051230	97.0651
2	RT6.695	6.695	2	693778	38988	2.9349

***5m*: (*R,E*)-4,4,4-trifluoro-1-(4-methoxyphenyl)-3-phenylbut-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

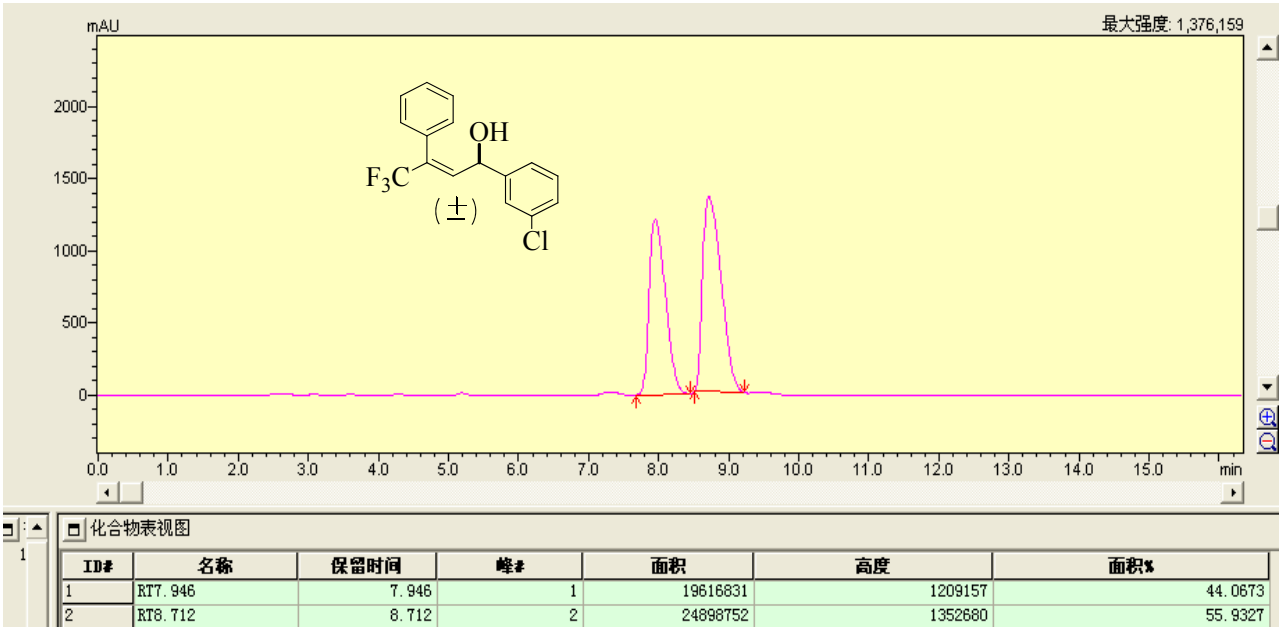
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT9.160	9.160	1	54204047	1951779	48.2621
2	RT11.144	11.144	2	58107807	1834026	51.7379



化合物表视图

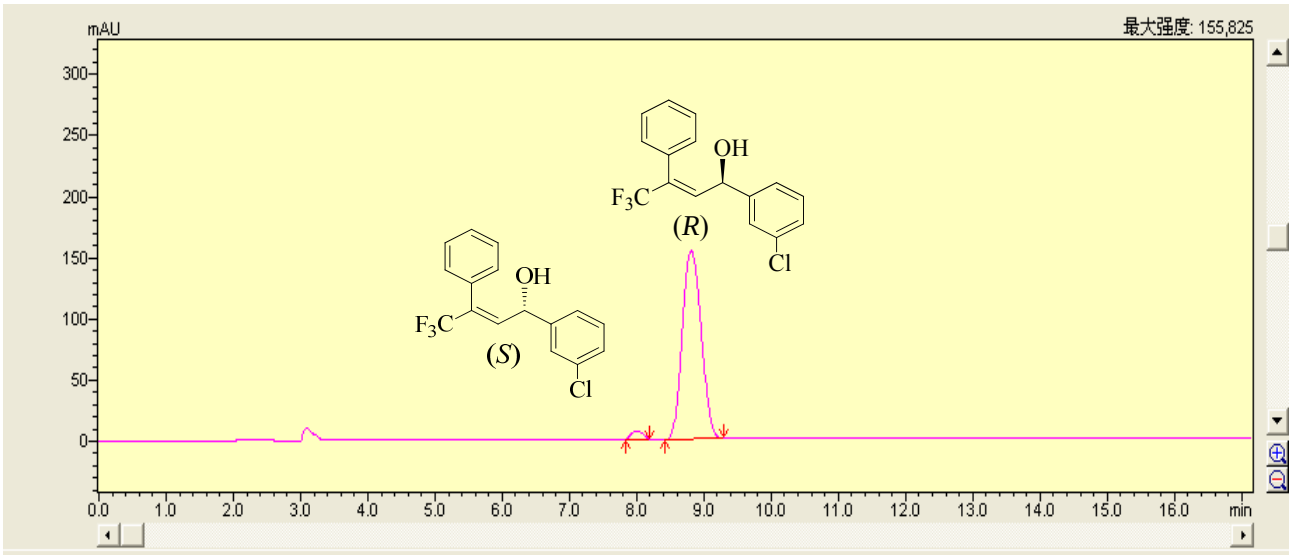
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT9.340	9.340	1	7883068	369793	94.9681
2	RT11.397	11.397	2	417688	21536	5.0319

***5n*: (*R*,*E*)-1-(3-chlorophenyl)-4,4,4-trifluoro-3-phenylbut-2-en-1-ol** (HPLC: Chiracel AD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

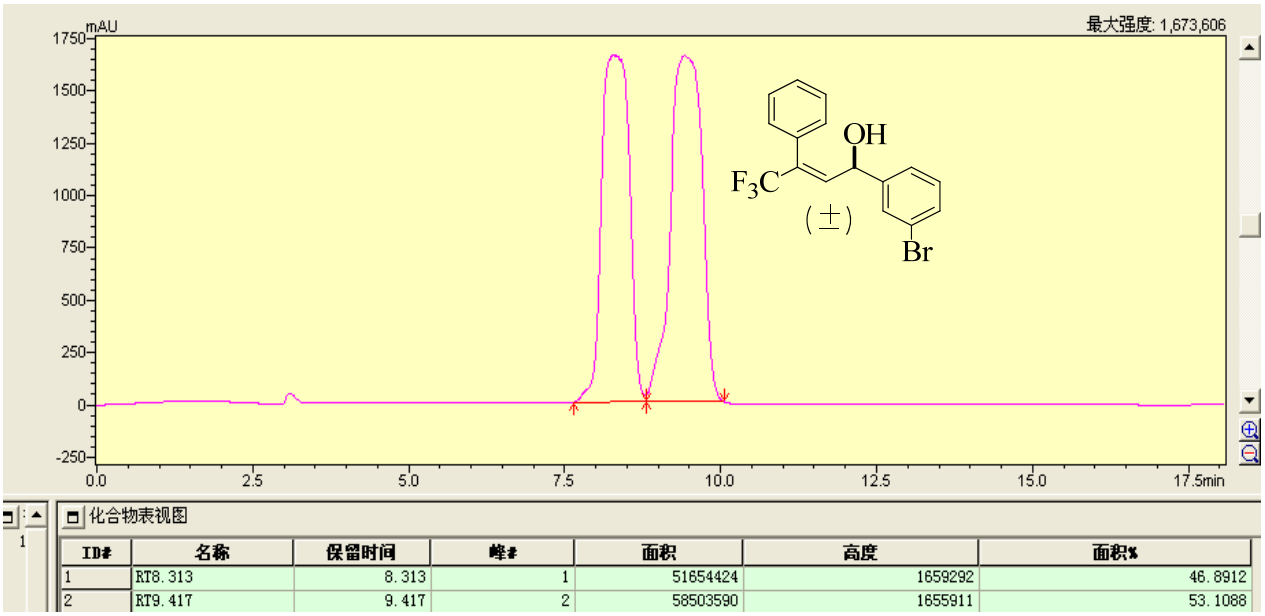
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT7.946	7.946	1	19616831	1209157	44.0673
2	RT8.712	8.712	2	24898752	1352680	55.9327



化合物表视图

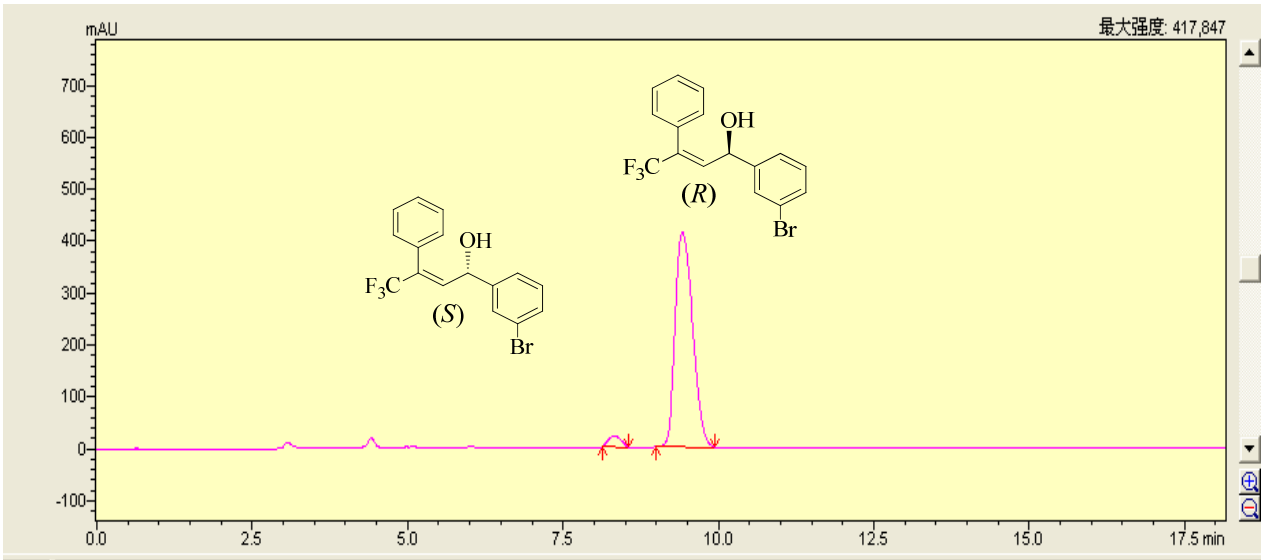
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.000	8.000	1	96883	7406	3.0720
2	RT8.805	8.805	2	3056803	154280	96.9280

5o: **(*R*,*E*)-1-(3-bromophenyl)-4,4,4-trifluoro-3-phenylbut-2-en-1-ol** (HPLC: Chiracel AD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

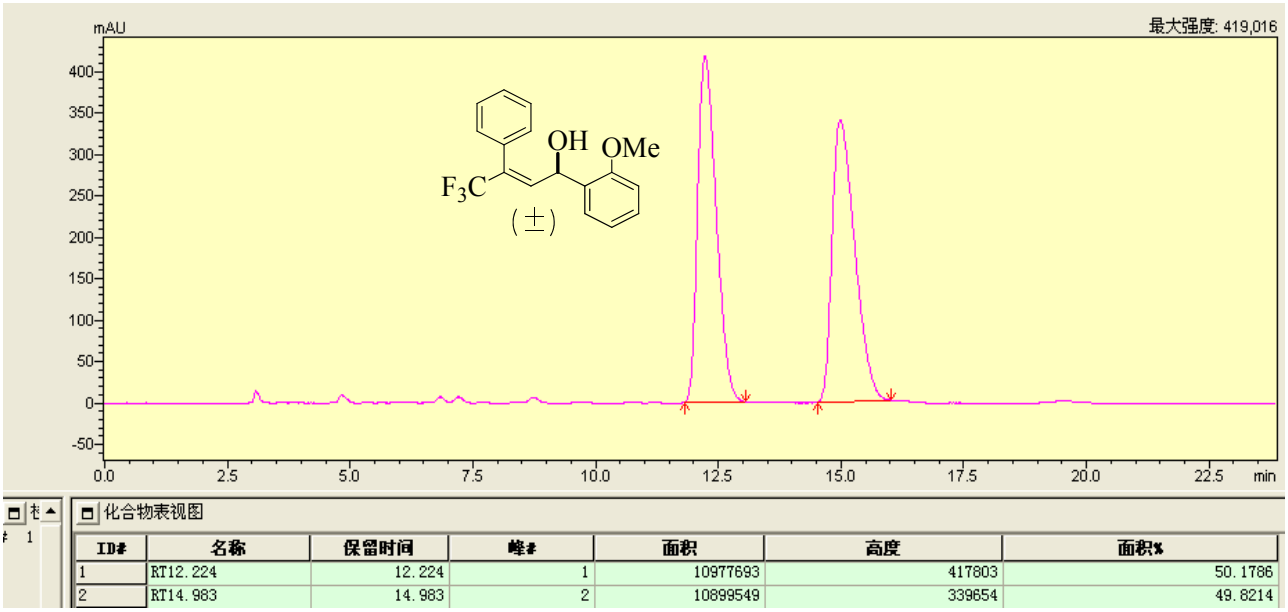
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.313	8.313	1	51654424	1659292	46.8912
2	RT9.417	9.417	2	58503590	1655911	53.1088



化合物表视图

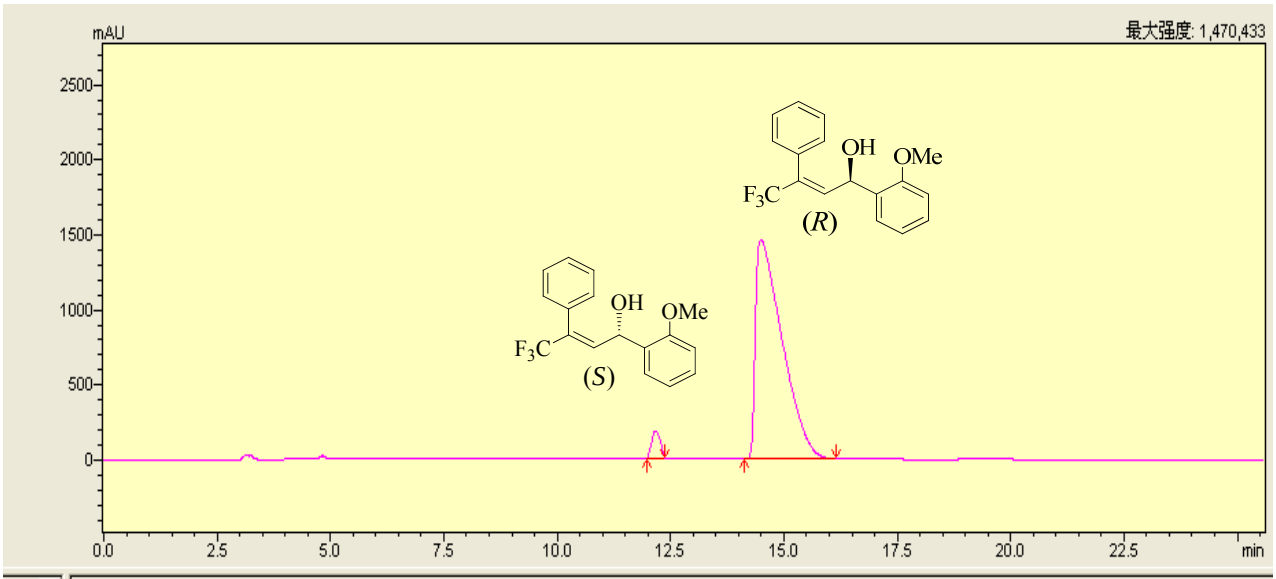
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT8.322	8.322	1	302343	20636	3.6011
2	RT9.416	9.416	2	8093399	414166	96.3989

5p: **(*R*,*E*)-4,4,4-trifluoro-1-(2-methoxyphenyl)-3-phenylbut-2-en-1-ol** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 97/3, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

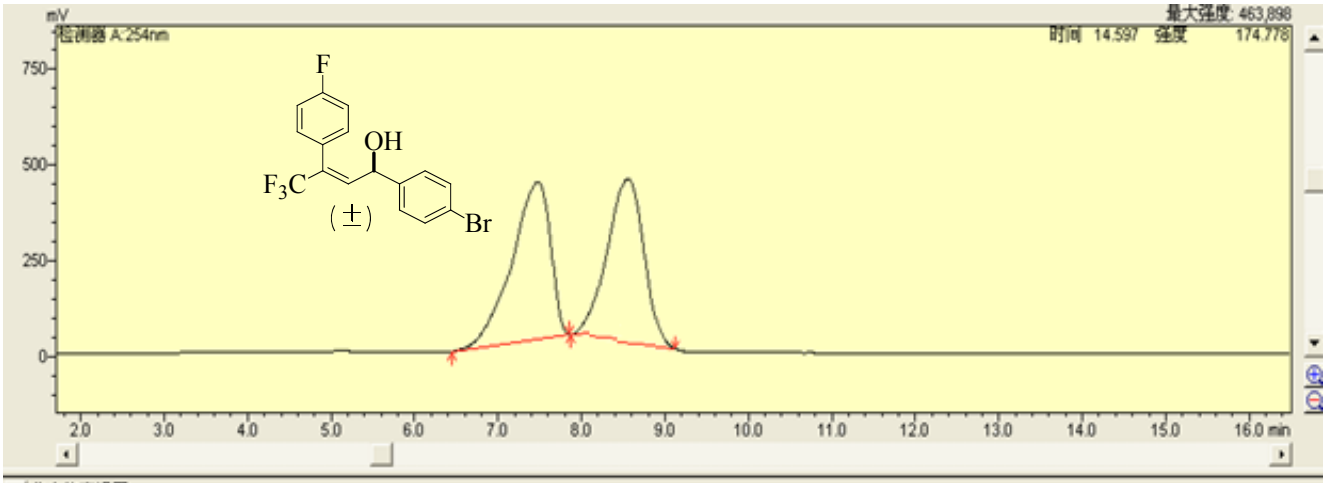
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.224	12.224	1	10977693	417803	50.1786
2	RT14.983	14.983	2	10899549	339654	49.8214



化合物表视图

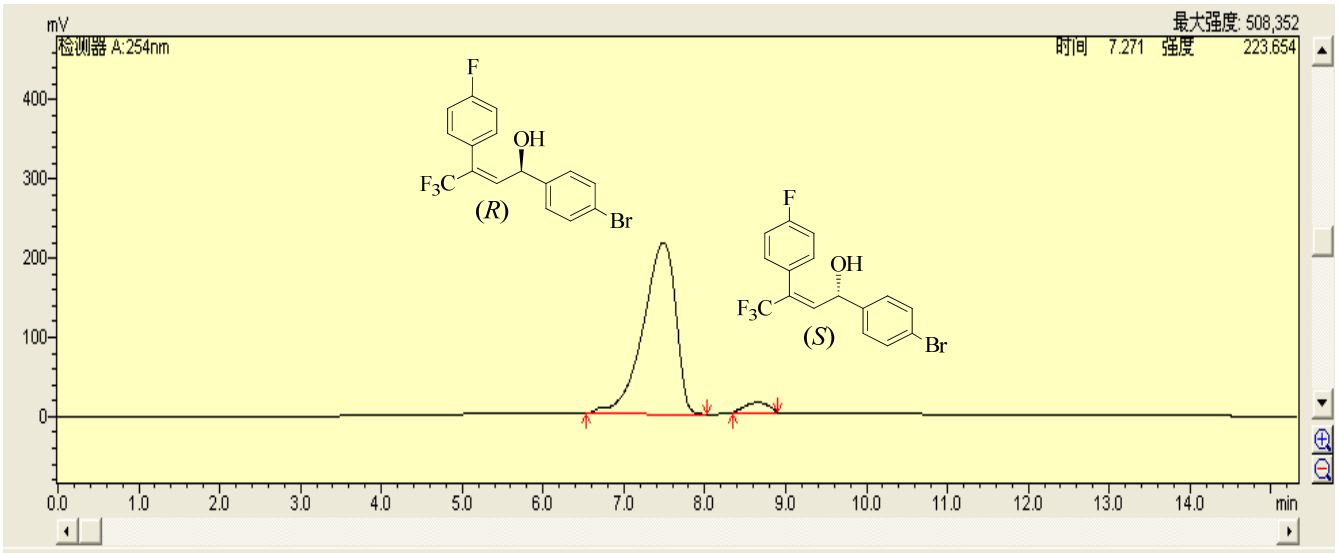
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT12.163	12.163	1	2372950	183944	3.8127
2	RT14.492	14.492	2	59865658	1464333	96.1873

***5q*: (*R*,*E*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-(4-fluorophenyl)but-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

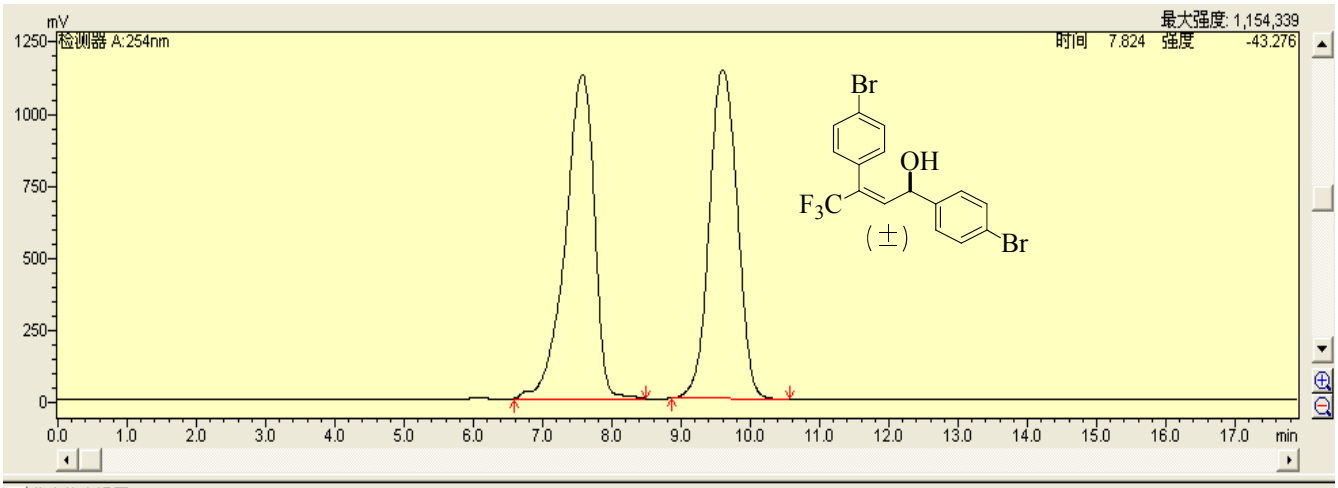
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT7.471	7.471	1	13250338	411542	6.450	7.858	53.6715
2	RT8.548	8.548	2	11437513	396518	7.875	8.983	46.3285



化合物表视图

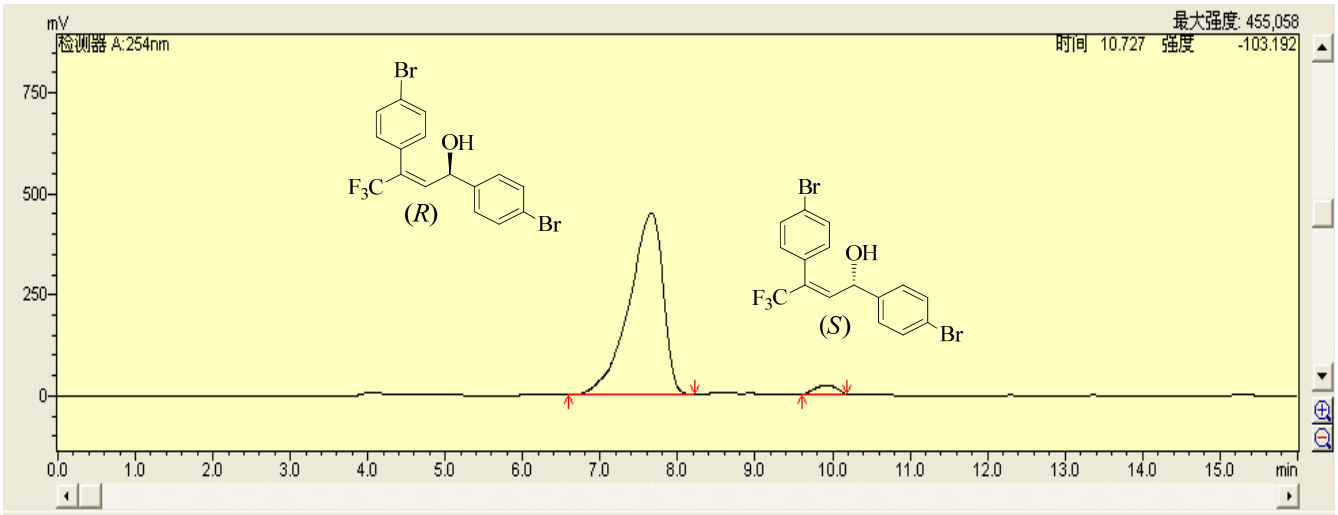
ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT7.481	7.481	1	6043868	216586	6.533	8.033	95.7932
2	RT8.648	8.648	2	265422	12728	8.342	8.908	4.2068

***5r*: (*R*,*E*)-1,3-bis(4-bromophenyl)-4,4,4-trifluorobut-2-en-1-ol:** (HPLC: Chiracel OD-H, detected at 254 nm, eluent: n-hexane/2-propanol = 95/5, flow rate = 1.0 mL/min, 25 ºC).



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT7.567	7.567	1	32764616	1121514	6.583	8.500	50.4942
2	RT9.596	9.596	2	32123250	1140394	8.858	10.575	49.5058

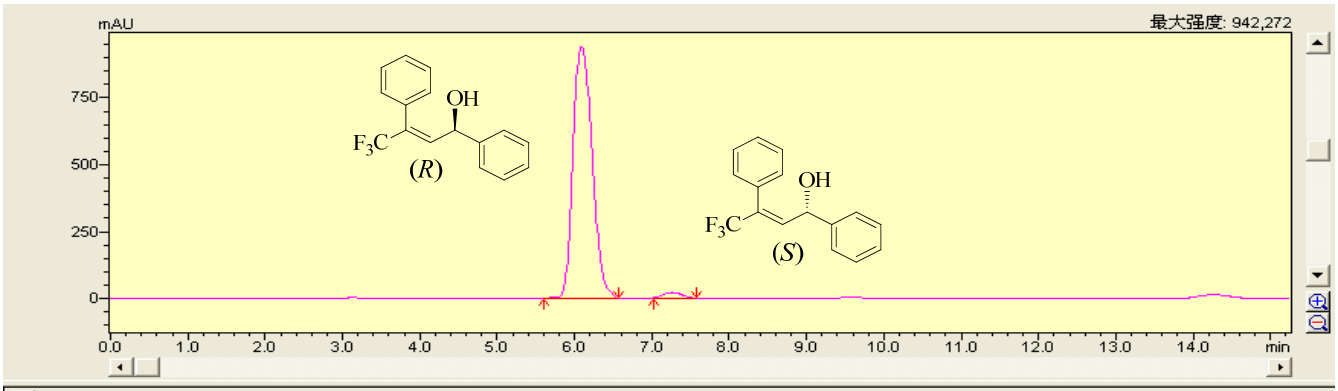


化合物表视图

ID#	名称	保留时间	峰#	面积	高度	峰开始	峰结束	面积%
1	RT7.656	7.656	1	13819245	452831	6.583	8.225	96.5597
2	RT9.916	9.916	2	492363	23710	9.608	10.192	3.4403

Figure S6. Reusability of catalyst **3** for enantioselective reductionof4,4,4-trifluoro-1,3-diphenylbut-2-enone to (*R*)-4,4,4-trifluoro-1,3-diphenylbut-2-enol.

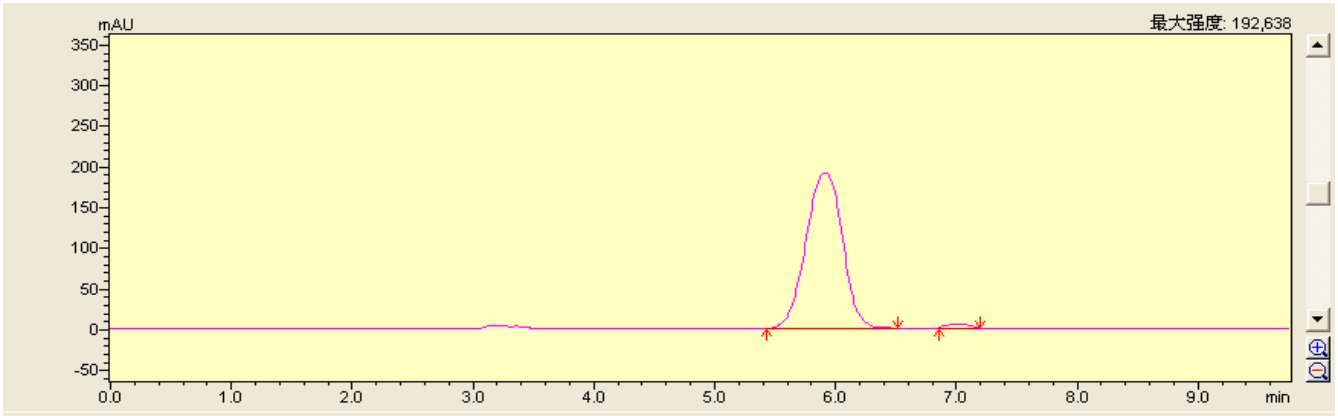
Recycle 2.



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.087	6.087	1	16506259	940359	97.9897
2	RT7.259	7.259	2	338628	20507	2.0103

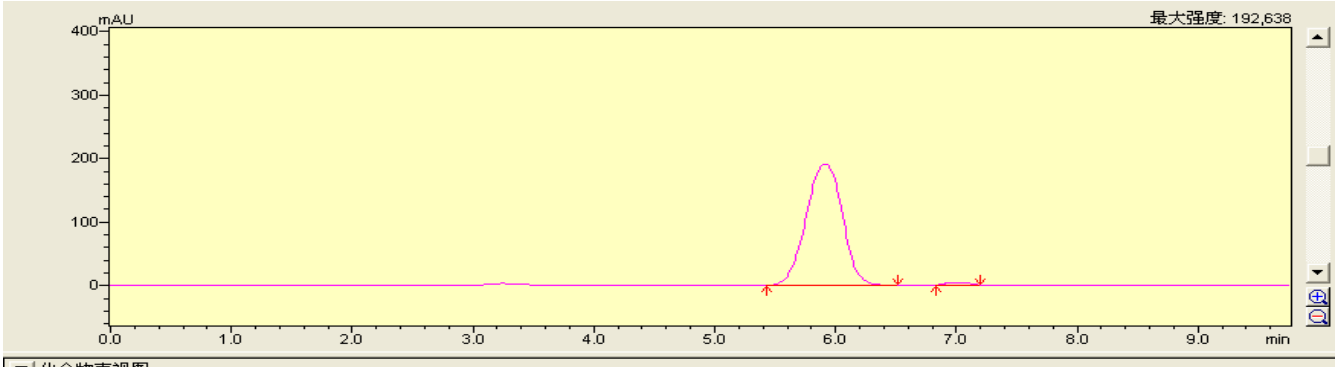
Recycle3



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.910	5.910	1	3994828	190348	98.4238
2	RT7.008	7.008	2	63973	4562	1.5762

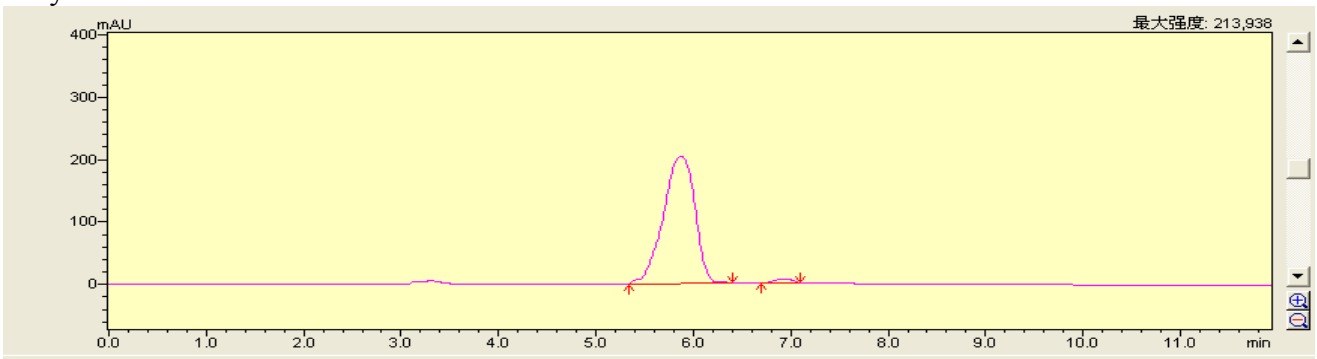
Recycle4



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.910	5.910	1	3994828	190348	98.4238
2	RT7.008	7.008	2	63973	4562	1.5762

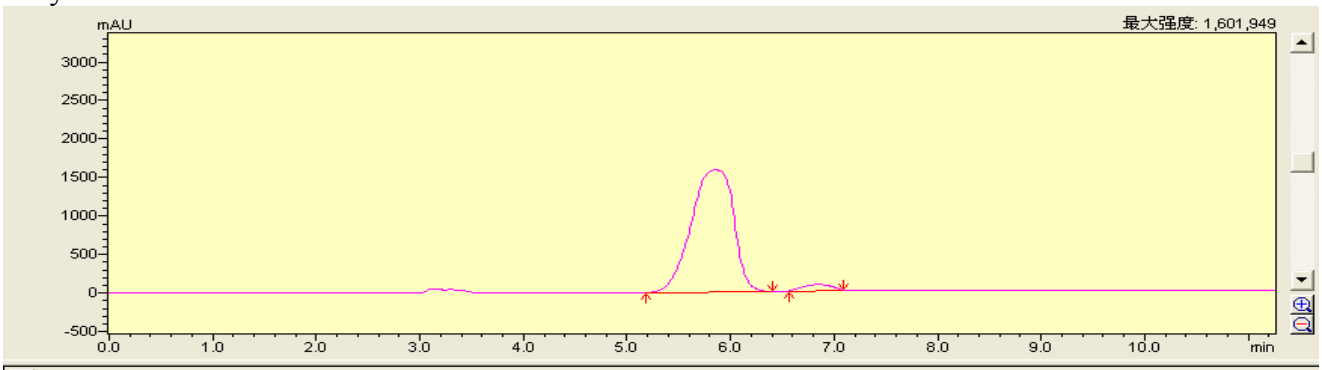
Recycle5



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.868	5.868	1	4634392	204964	97.9463
2	RT6.929	6.929	2	97173	6714	2.0537

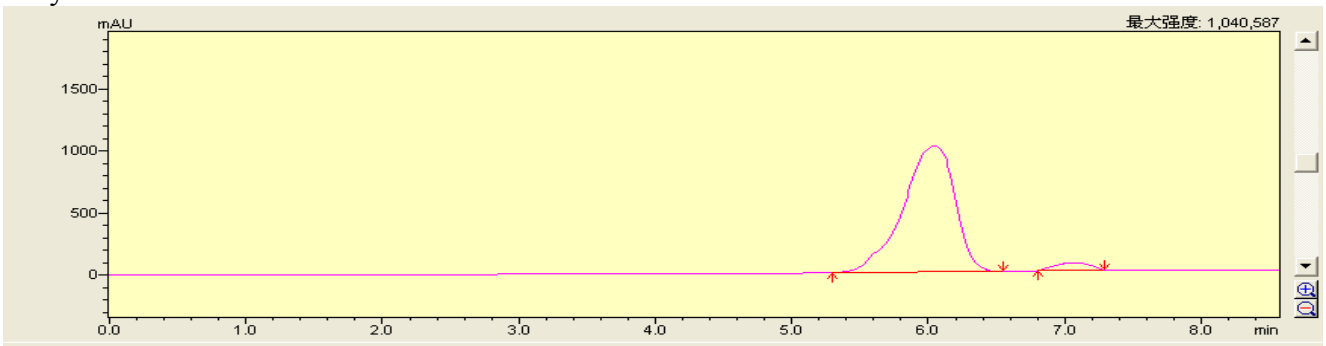
Recycle6



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT5.857	5.857	1	45216175	1589759	97.0642
2	RT6.852	6.852	2	1367587	75007	2.9358

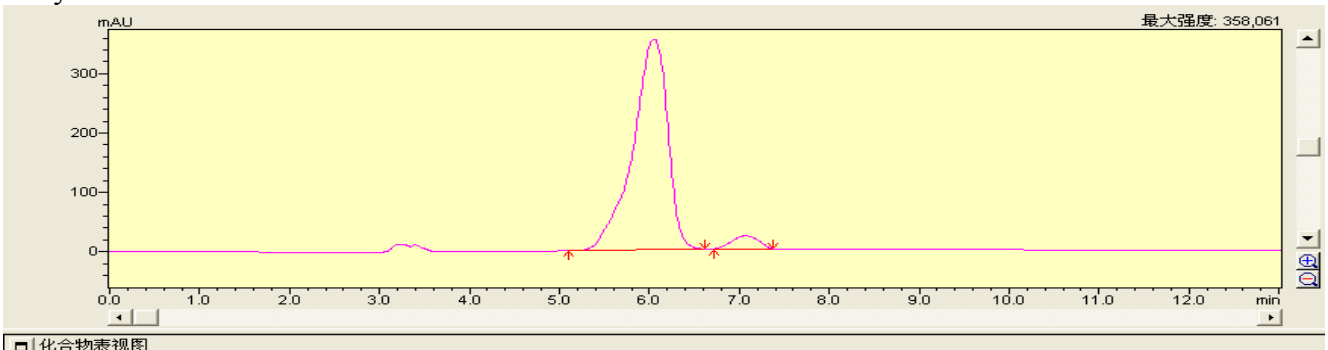
Recycle7



化合物表视图

ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.035	6.035	1	26816678	1015131	95.9206
2	RT7.064	7.064	2	1140475	62413	4.0794

Recycle8

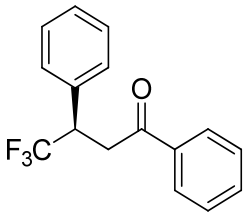


化合物表视图

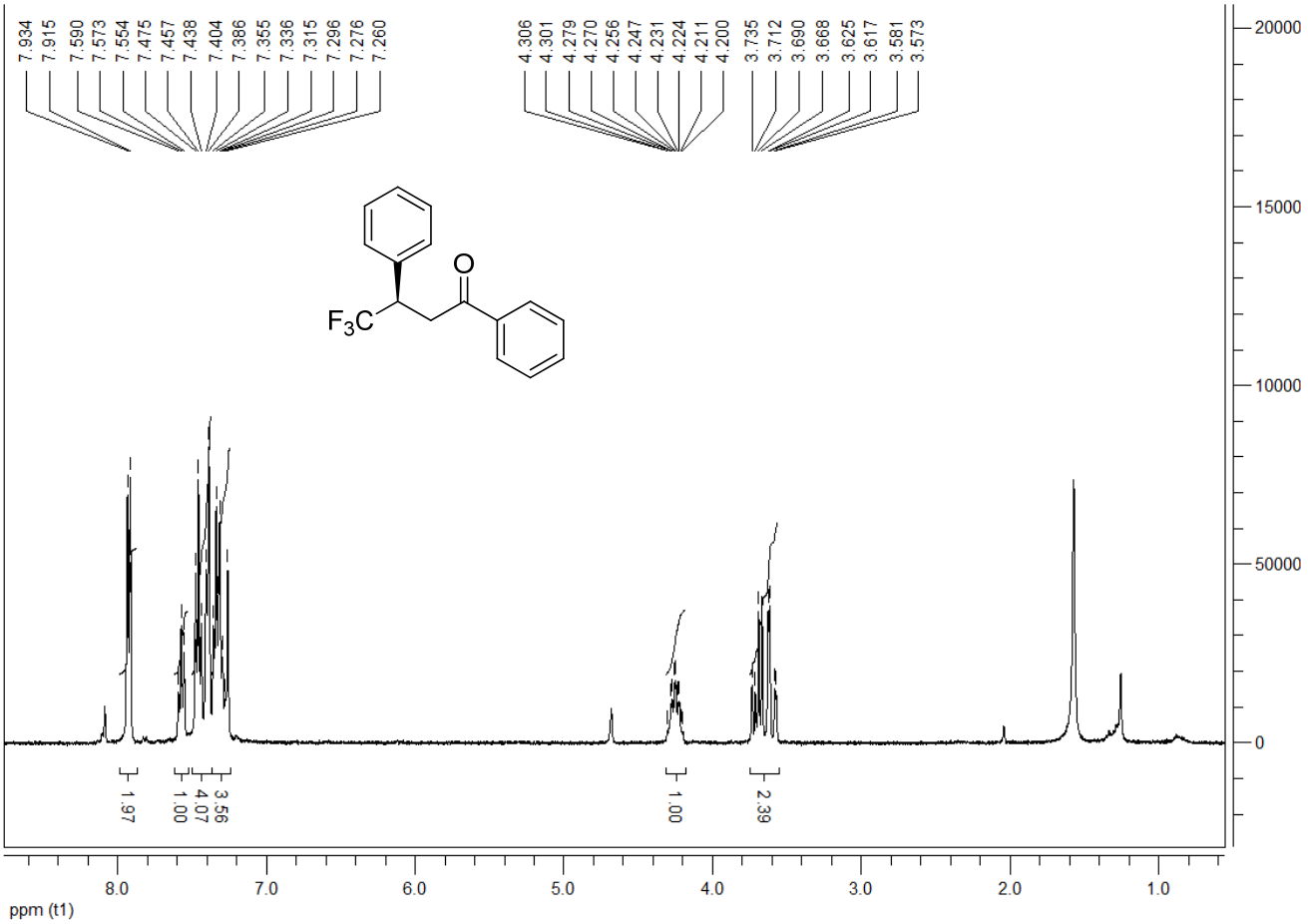
ID#	名称	保留时间	峰#	面积	高度	面积%
1	RT6.046	6.046	1	9597501	354196	95.2942
2	RT7.065	7.065	2	473943	22289	4.7058

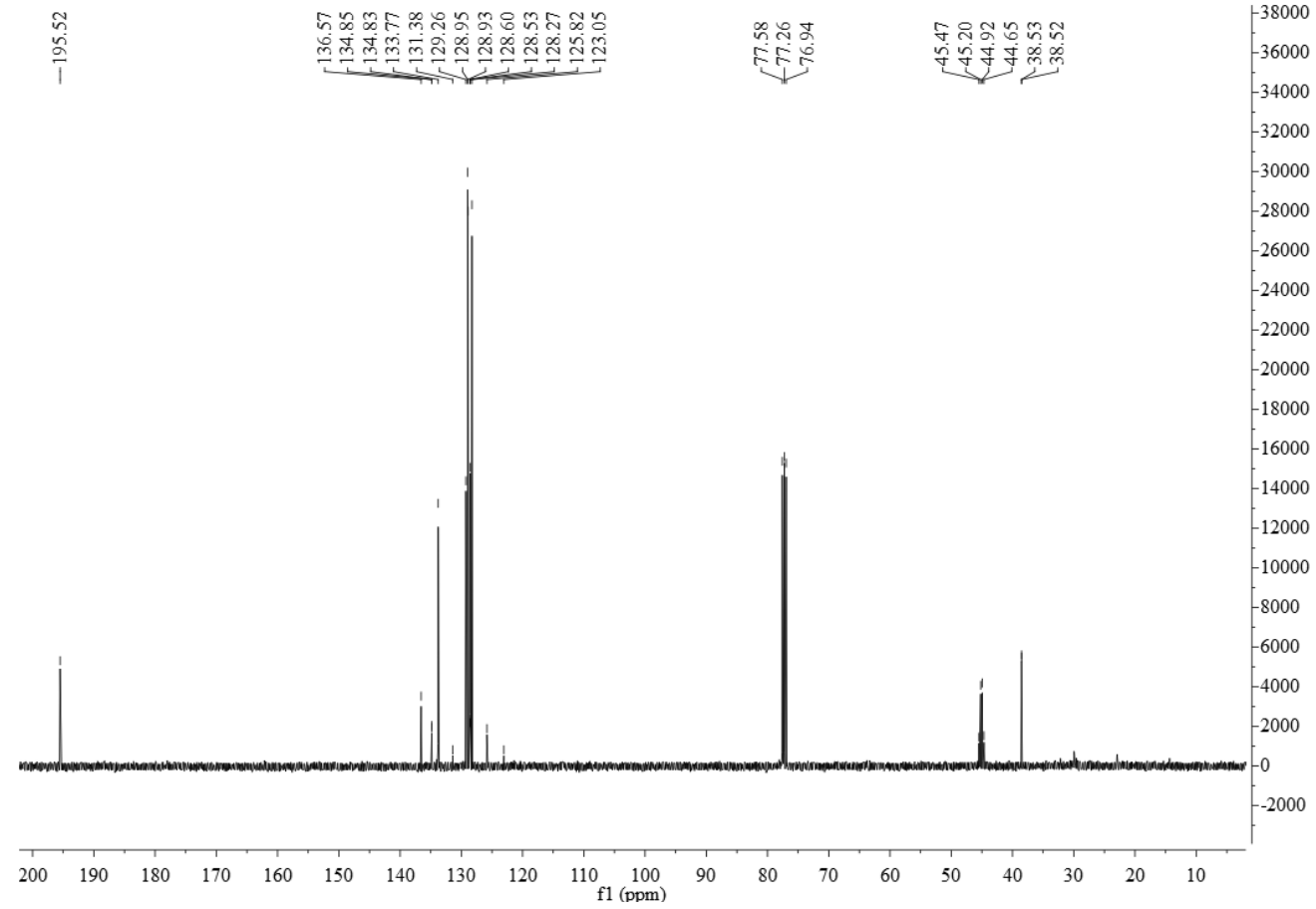
Figure S7. ^{1}H-NMR, ^{13}C-NMR and GC-MS of all chiral products.

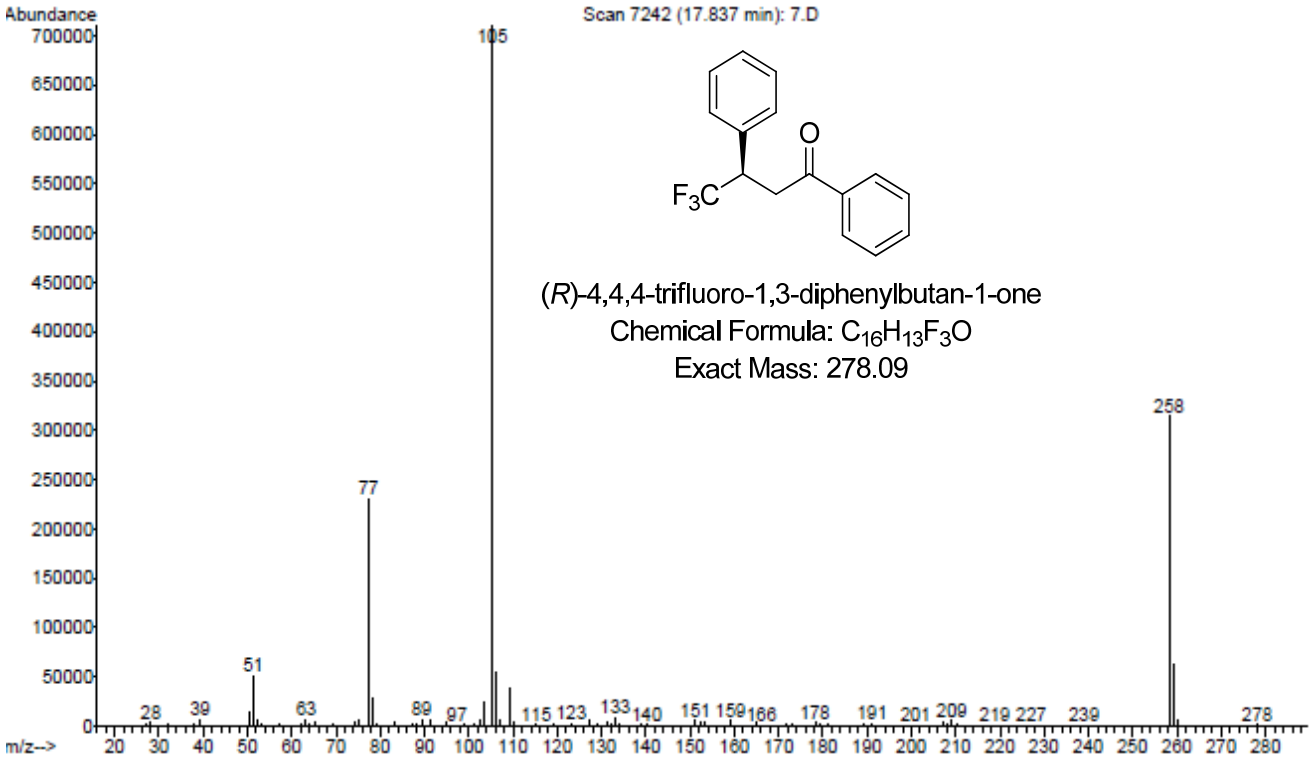
***6a*: (*R*)-4,4,4-Trifluoro-1,3-diphenylbutan-1-one**



Yield: 96% (97% ee, 100% es);^{1}H NMR (400 MHz, $CDCl_3$):δ 3.52 (dd, 1H, *J* = 18 Hz, *J* = 4.5 Hz), 3.64 (dd, 1H, *J* = 18 Hz, *J*= 4.5 Hz), 4.18-4.29 (m, 1H), 7.21-7.96 (m, 10H); ^{13}C NMR (100 MHz, $CDCl_3$):δ38.5 (q, *J* = 2 Hz), 44.9 (q, *J* = 27.7 Hz), 127.2 (q, *J* = 280 Hz), 128.3, 128.5,128.9, 129.0, 129.2, 133.8, 134.8 (q, *J* = 2 Hz), 136.5, 195.5;GC/MS (m/z): 278.09; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 5.1 min, t_2 = 6.6 min.

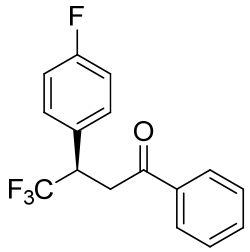




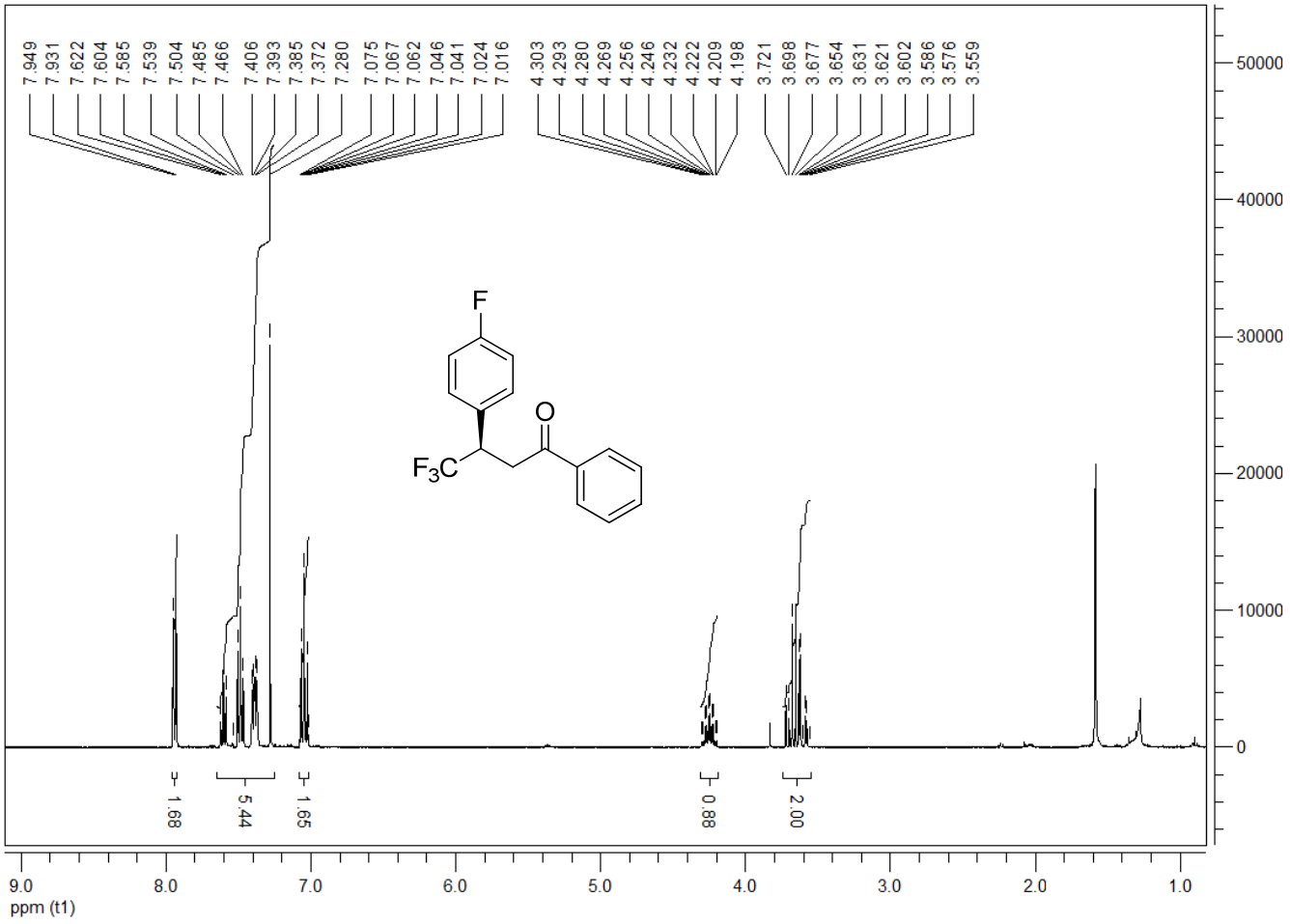


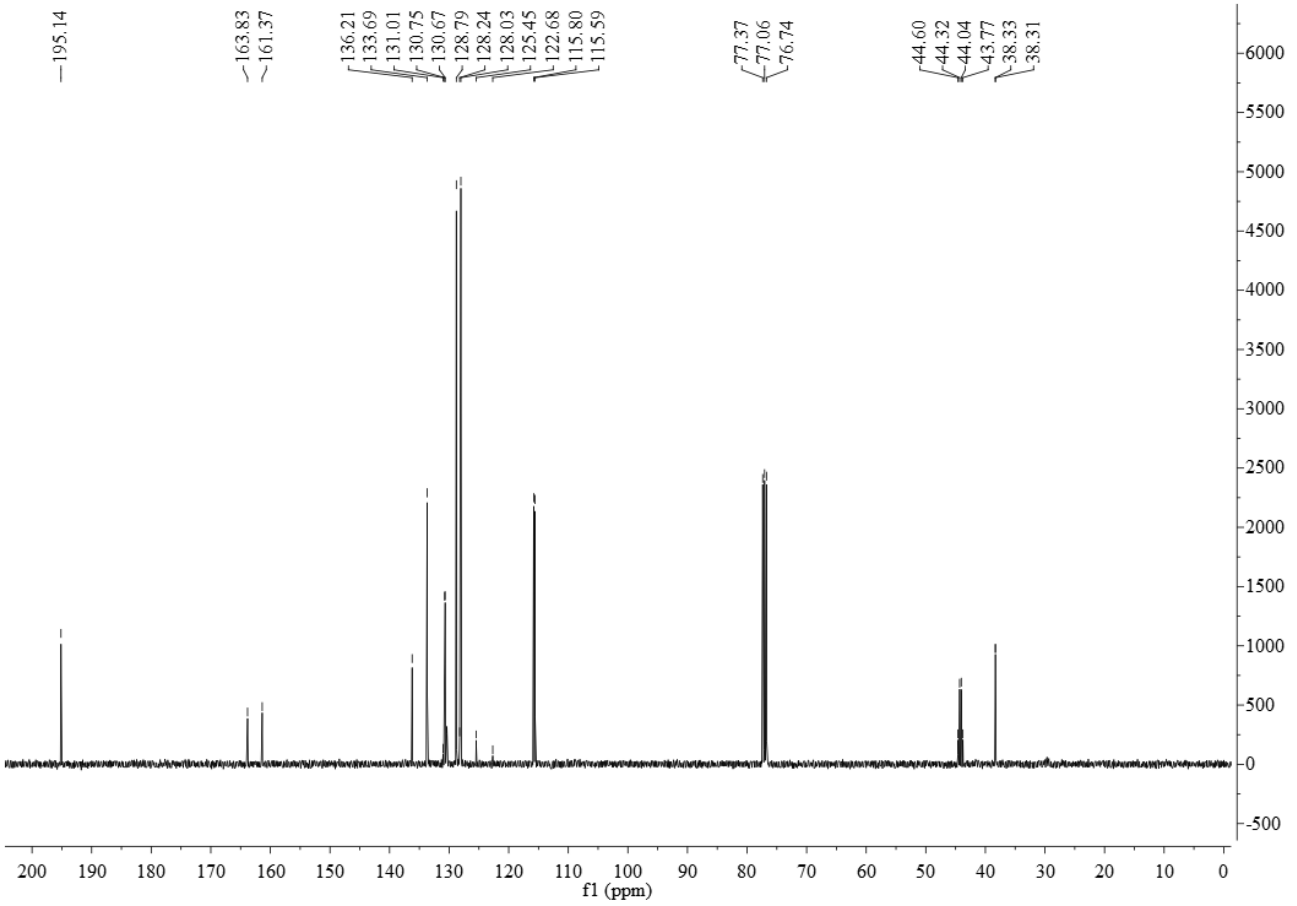
(*R*)-4,4,4-trifluoro-1,3-diphenylbutan-1-one
Chemical Formula: $C_{16}H_{13}F_3O$
Exact Mass: 278.09

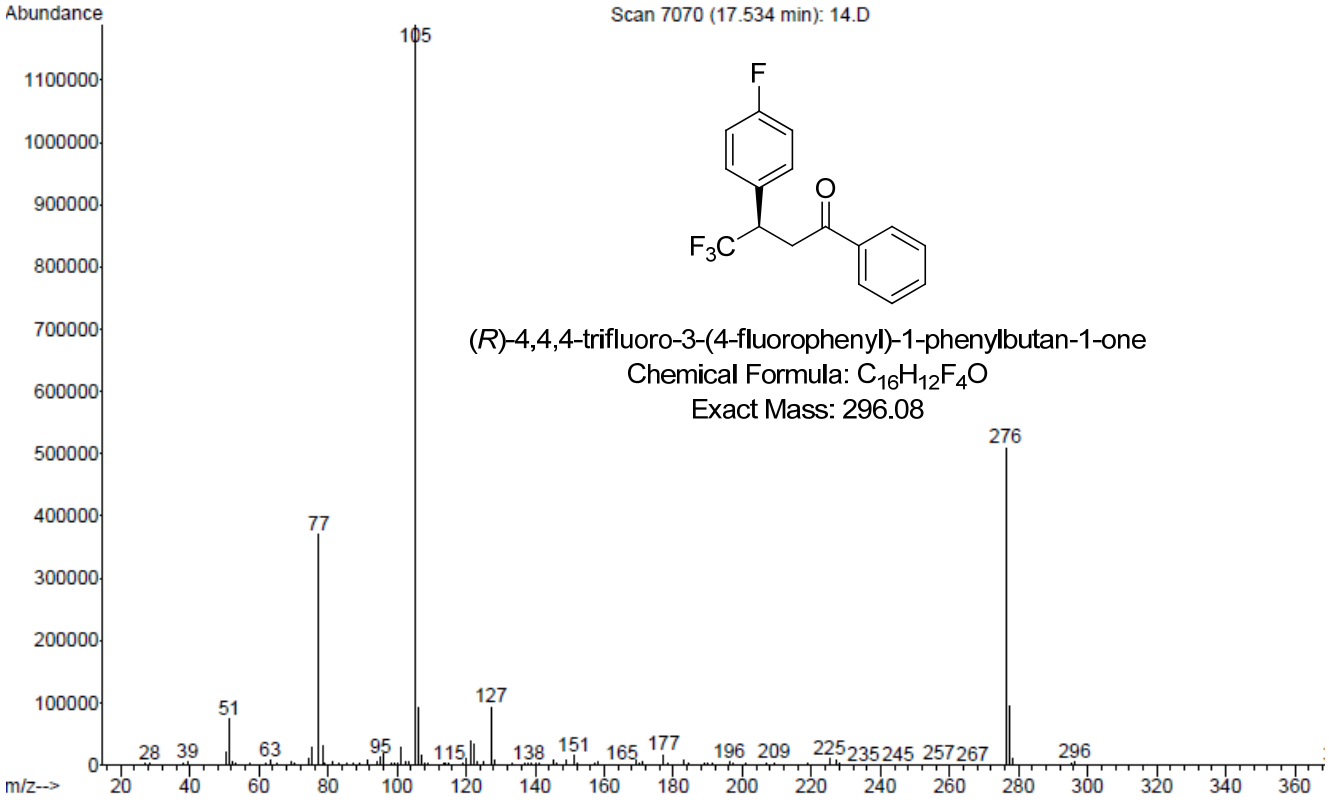
6b: (*R*)-4,4,4-Trifluoro-3-(4-fluorophenyl)-1-phenylbutan-1-one



Yield: 96% (92% ee, 98% es);^{1}H NMR (400 MHz, $CDCl_3$):δ 3.51 (dd, *J* = 3.99, 17.76 Hz, 1H),3.59 (dd, *J* = 9.40, 17.76 Hz, 1H), 4.22–4.30 (m, 1H), 7.04–7.13(m, 2H), 7.24–7.65 (m, 5H), 7.83–7.85 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$):δ 38.3(q, *J* = 2Hz), 44.2 (q, *J* = 28 Hz), 115.7 (d, *J* = 21 Hz), 126.3 (q, J = 278.4 Hz), 128.0, 128.8, 130.6, 130.7,133.7, 136.2, 162.6 (d, *J* = 246.1 Hz), 195.1;GC/MS (m/z): 296.08; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 °C) t_1 = 5.2 min, t_2 = 6.1 min.

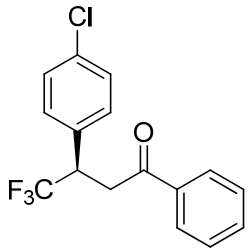




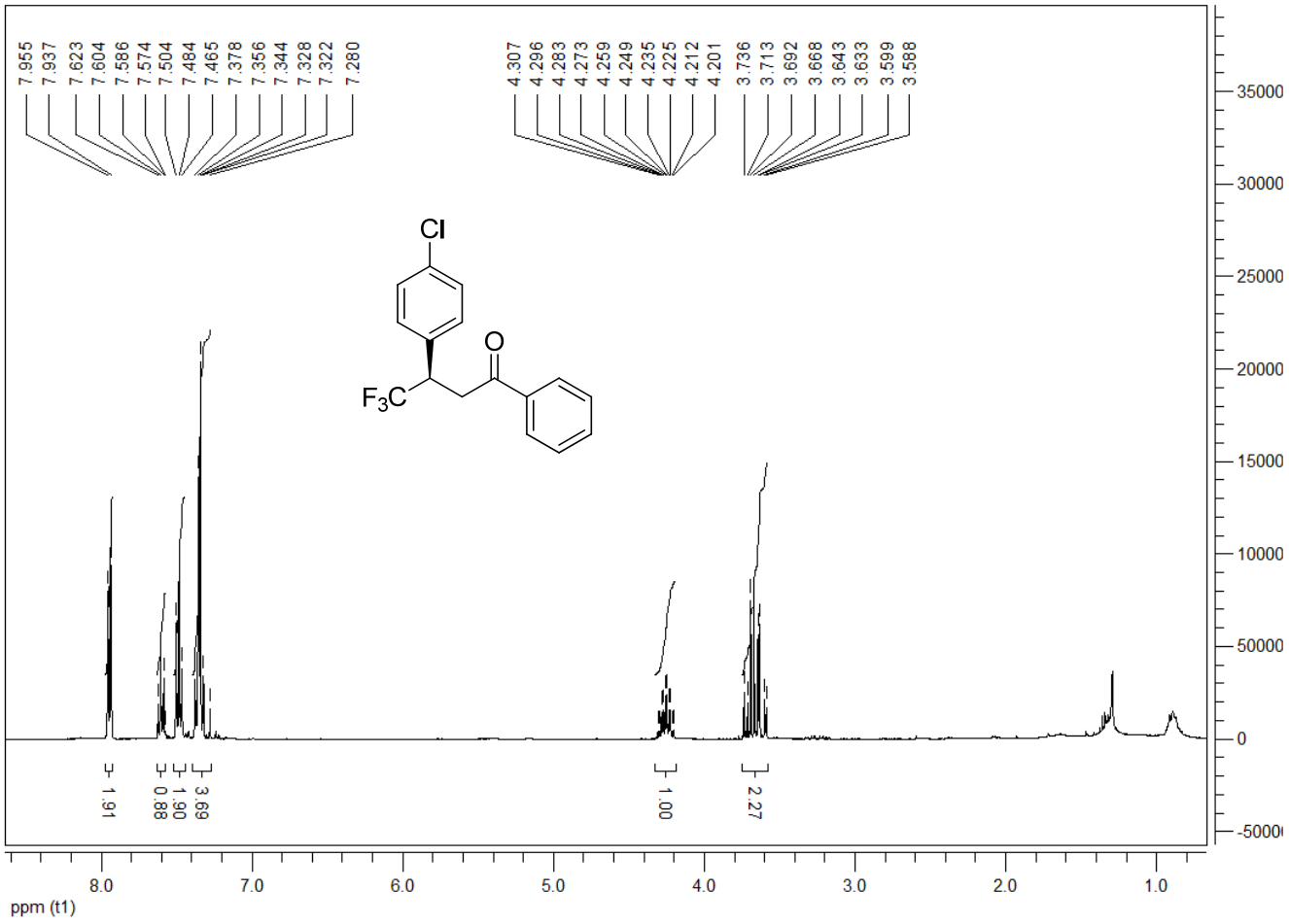


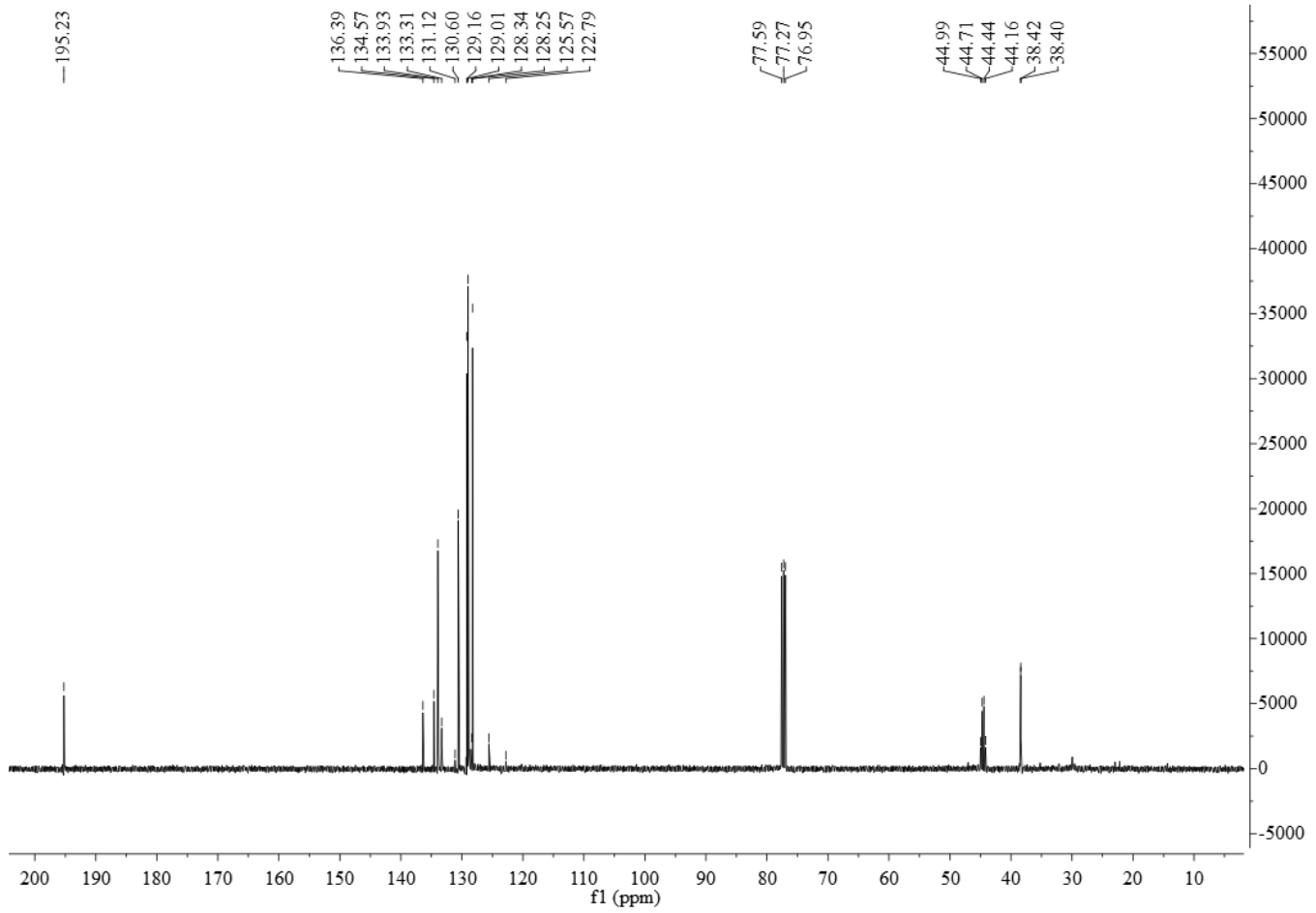
(*R*)-4,4,4-trifluoro-3-(4-fluorophenyl)-1-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}F_4O$
Exact Mass: 296.08

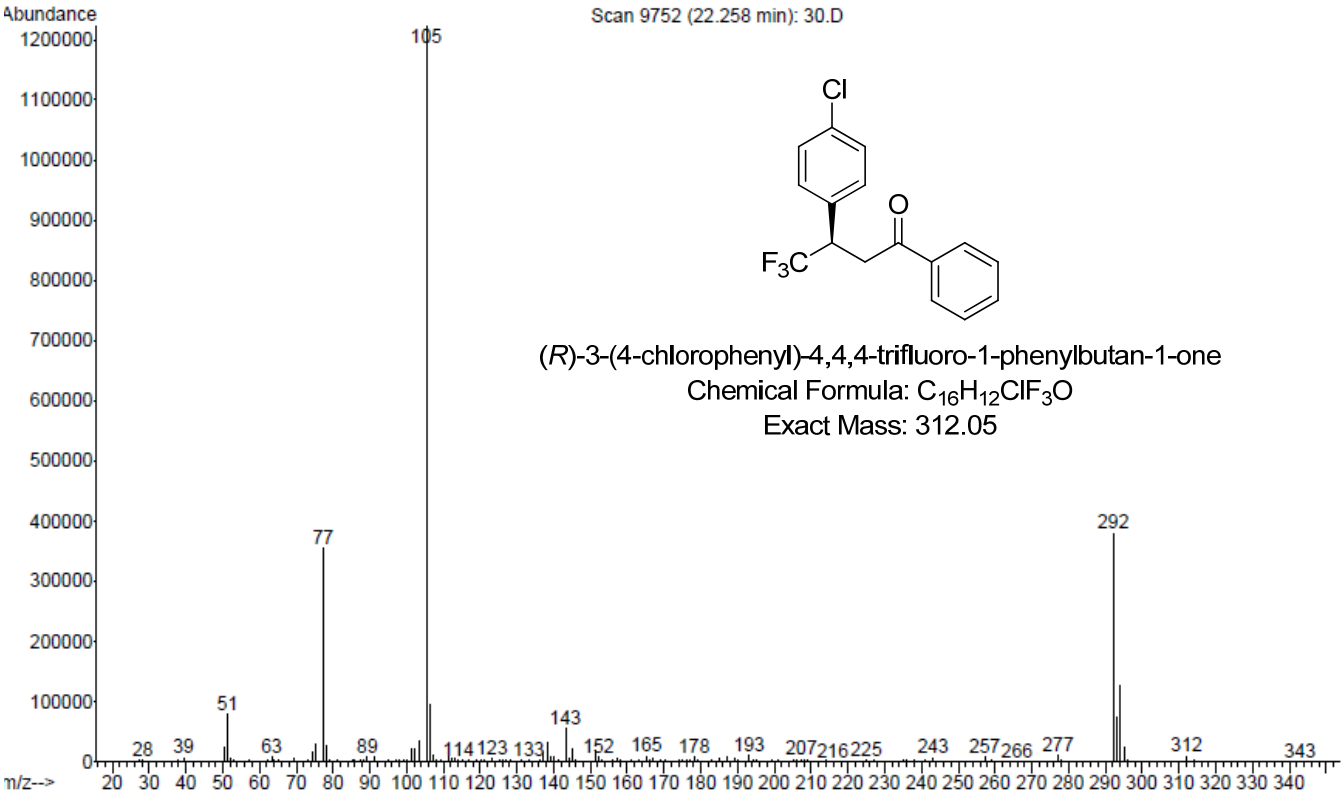
6c: (*R*)-3-(4-Chlorophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one



Yield: 97% (95% ee, 100% es);^{1}H NMR (400 MHz, $CDCl_3$): δ3.60 (dd, 1H, *J* = 17.9 Hz, *J* =4.3 Hz),3.68 (dd, 1H, *J* = 17.8 Hz, *J* = 9.1 Hz),4.21–4.33 (m, 1H), 7.30–7.36 (m, 4H),7.46 (t, 2H, *J* = 7.8 Hz),7.61 (t, 1H, *J* = 7.4 Hz),7.92 (d, 2H, *J*= 7.3 Hz);^{13}C NMR (100 MHz, $CDCl_3$): δ38.2(q, *J* = 2 Hz), 44.6 (q, *J* = 27 Hz),126.9 (q, *J* = 277.7 Hz), 128.3, 129.0, 129.2, 130.6,133.3 (q, *J* = 1.5Hz), 133.9, 134.6, 136.4,195.2;GC/MS (m/z): 312.05; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 5.8 min, t_2 = 7.2 min.

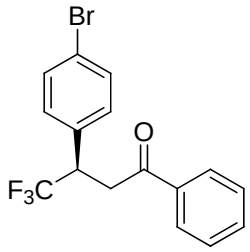




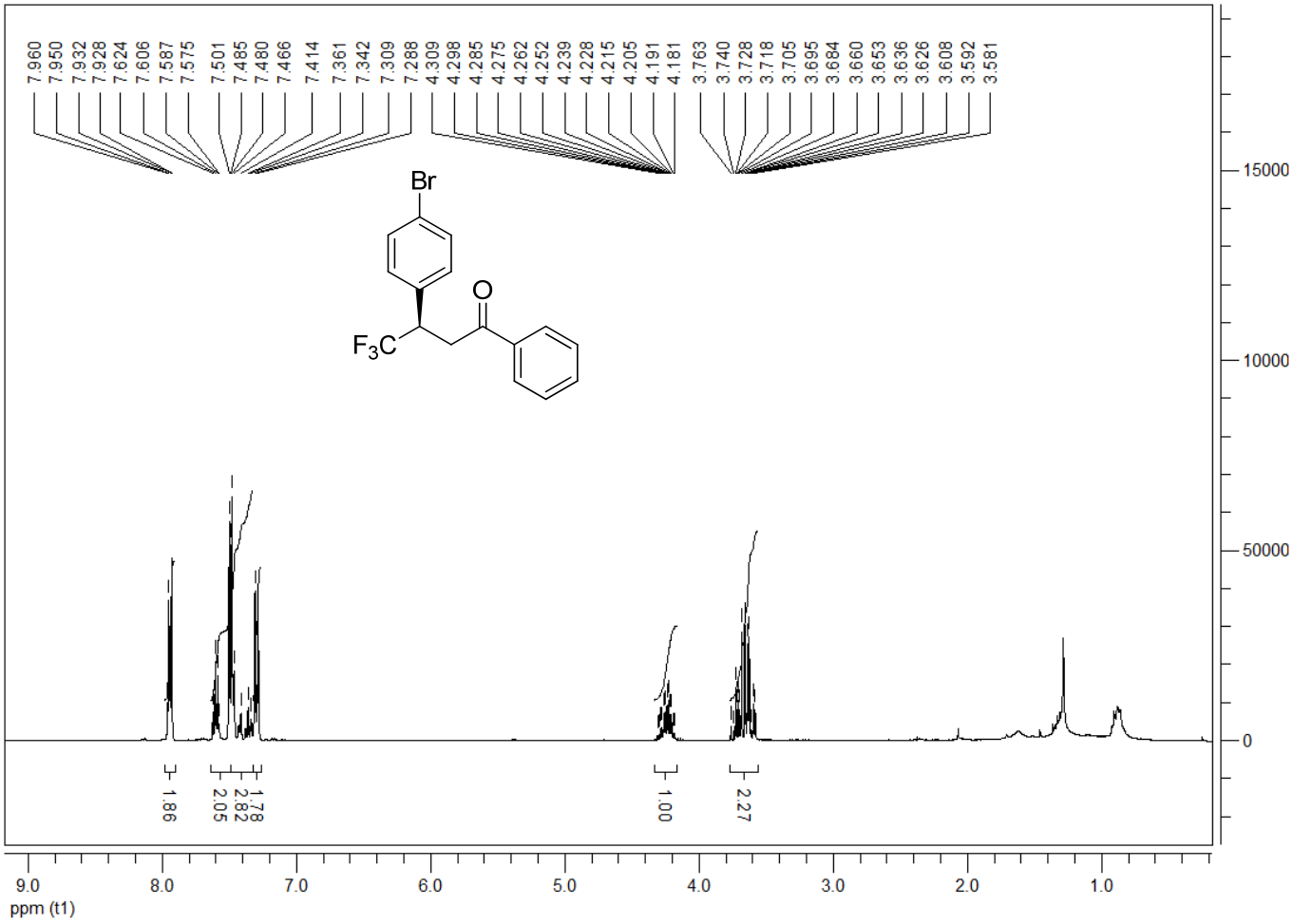


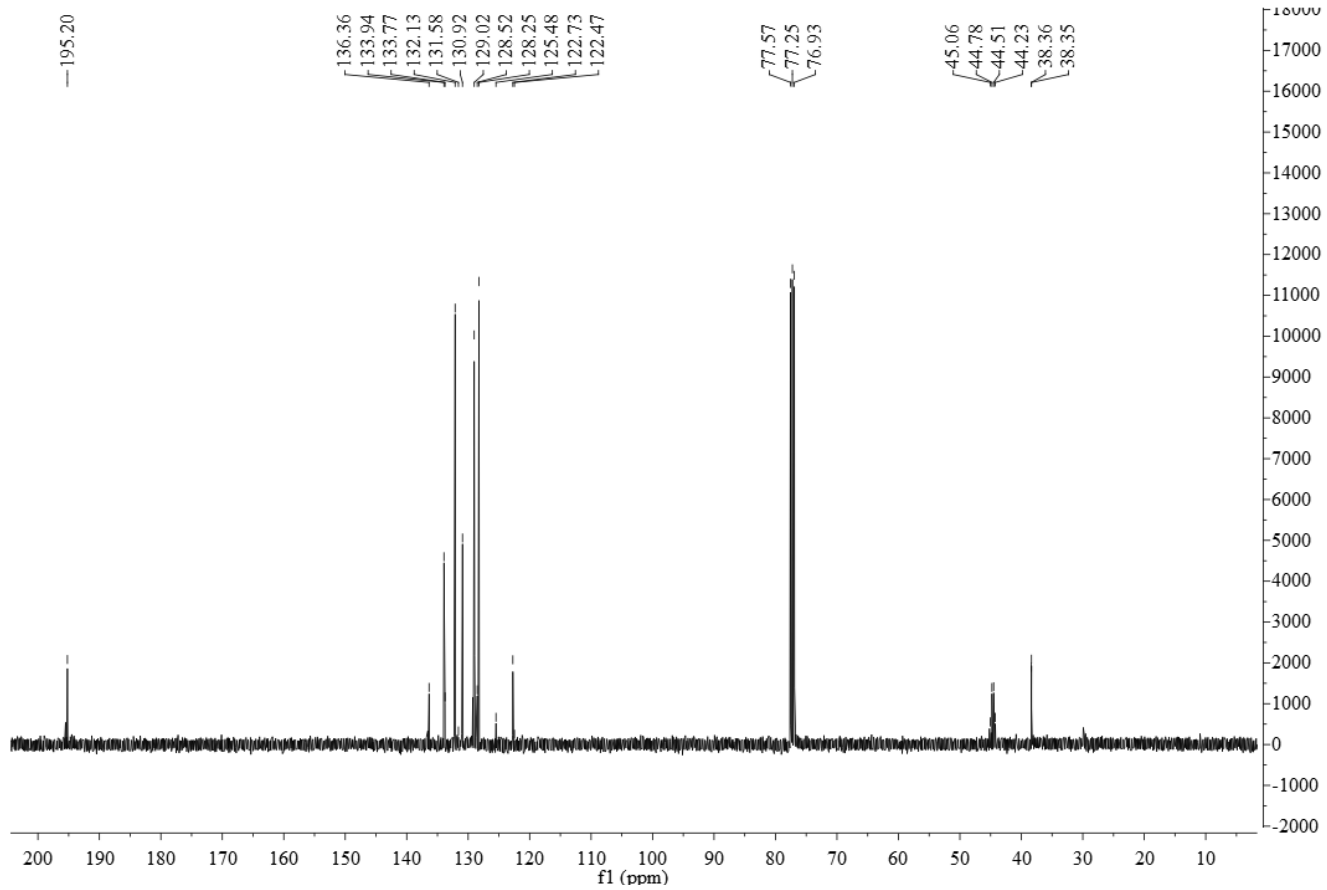
(*R*)-3-(4-chlorophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}ClF_3O$
Exact Mass: 312.05

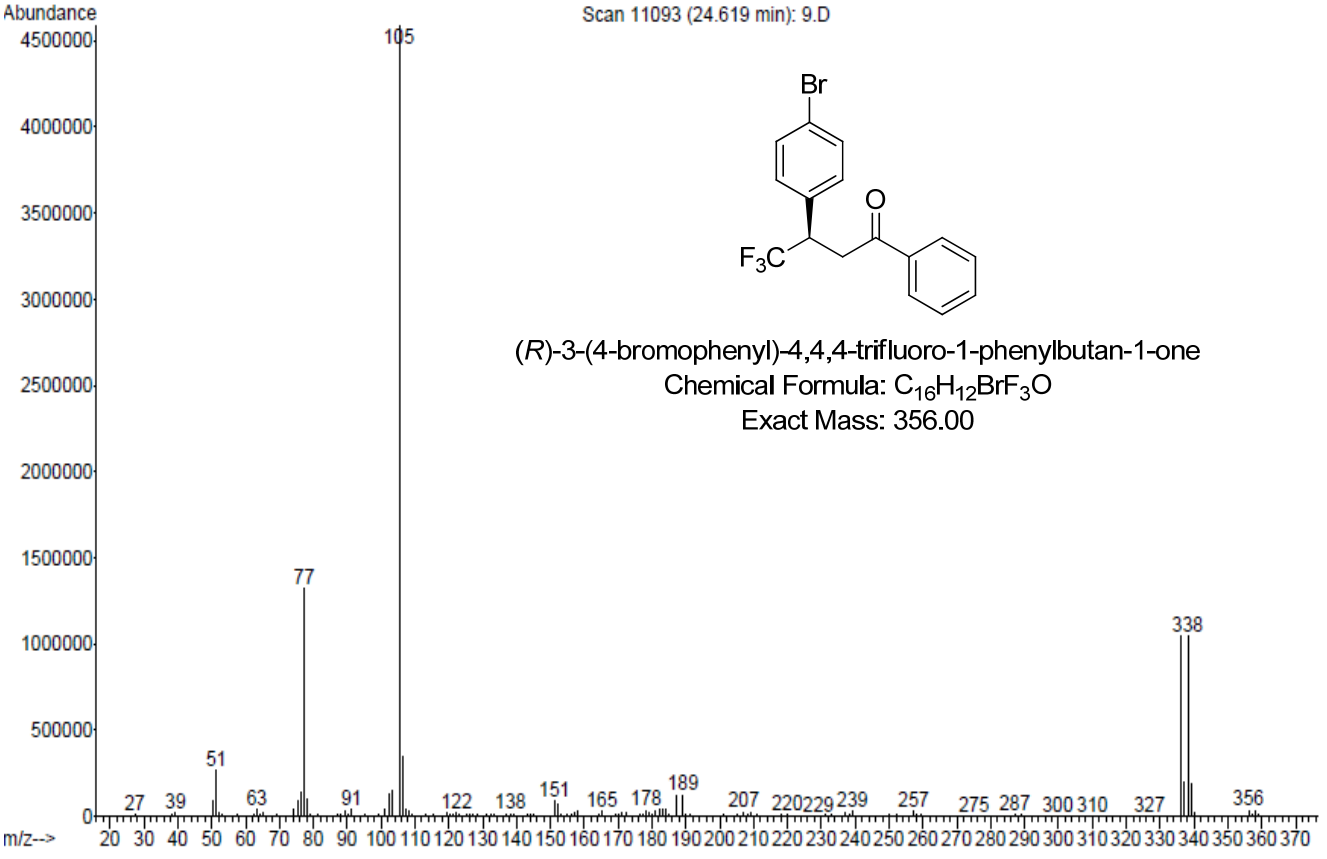
<u>*6d*</u>: (*R*)-3-(4-Bromoephenyl)-4,4,4-trifluoro-1-phenylbutan-1-one



Yield: 95% (94% ee, 98% es); ^{1}H NMR (400 MHz, $CDCl_3$):δ 3.58 (dd, 1H, *J* = 3 Hz, *J* = 18 Hz), 3.67 (dd, 1H, *J* = 9 Hz, *J* =18 Hz), 4.21 (m, 1H), 7.25-7.28 (m, 2H), 7.43-7.48 (m, 3H), 7.56-7.60(m, 2H), 7.90-7.93 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$):δ 38.2(q, *J* = 2Hz), 44.6 (q, *J* = 27 Hz),122.7, 126.9 (q, *J* = 279 Hz), 128.3, 129.0, 130.9, 132.1, 133.8, 133.9,136.4, 195.2; GC/MS (m/z): 356.00; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 5.2 min, t_2 = 6.2 min.

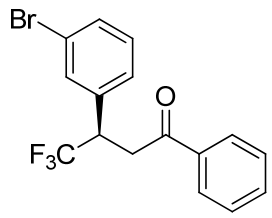




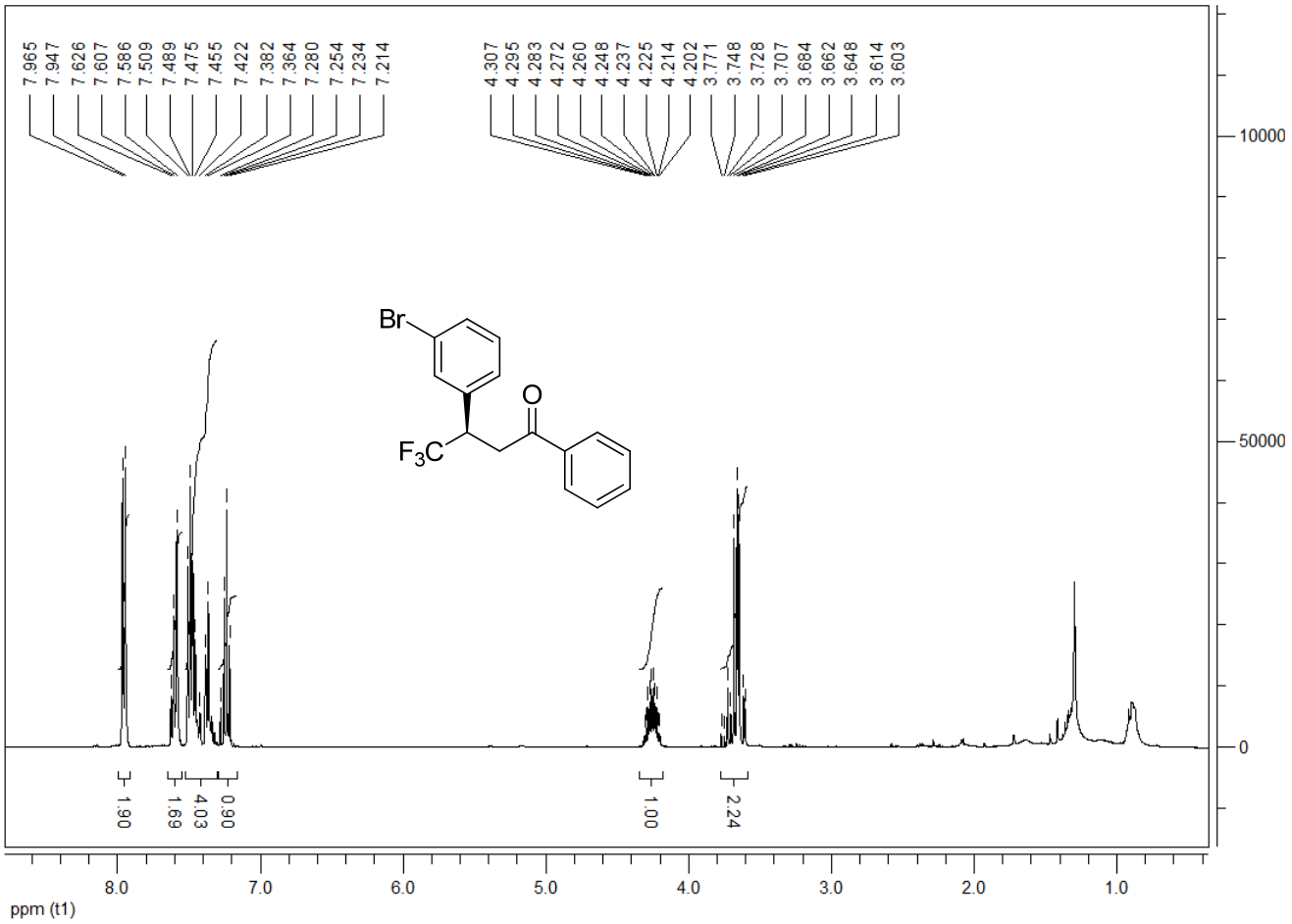


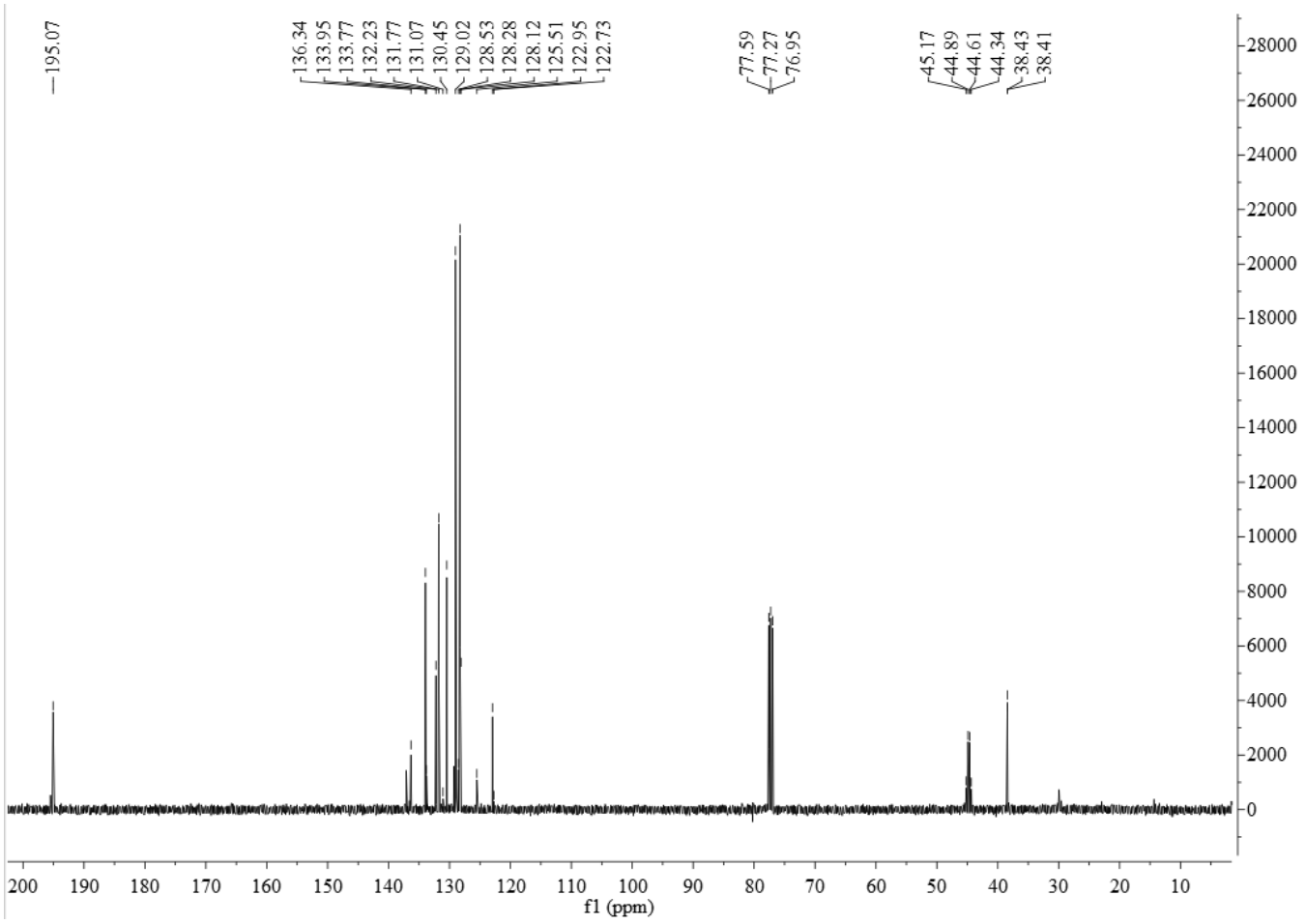
(*R*)-3-(4-bromophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}BrF_3O$
Exact Mass: 356.00

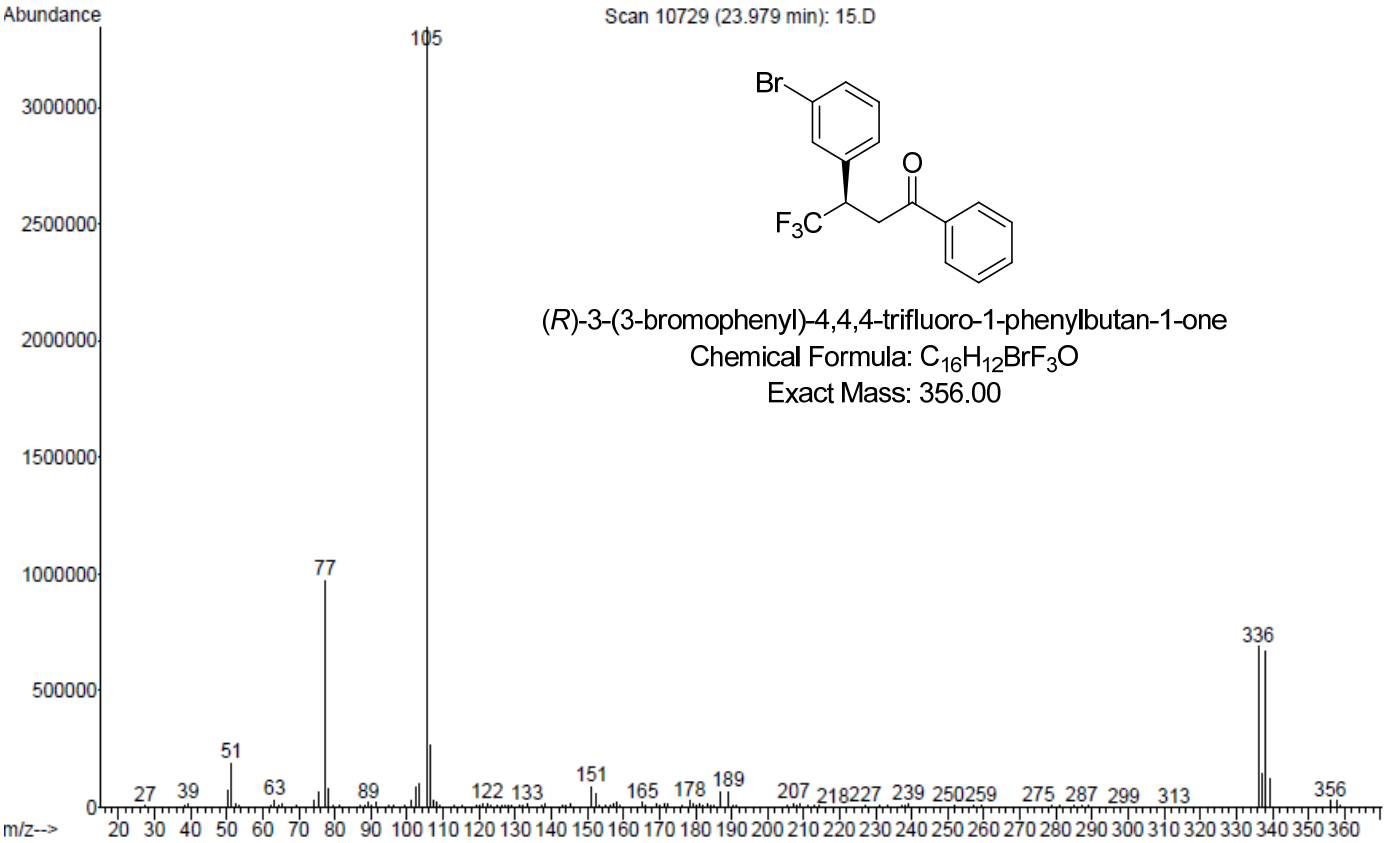
***6e*: (*R*)-3-(3-Bromoephenyl)-4,4,4-trifluoro-1-phenylbutan-1-one.**



Yield: 94% (95% ee, 100% es);^{1}H NMR (400 MHz, $CDCl_3$):δ 3.58 (dd, 1H, *J* = 3 Hz, *J* = 18 Hz), 3.67 (dd, 1H, *J* = 9 Hz, *J* =18 Hz), 4. 20 (m, 1H), 7.21-7.28 (m, 1H), 7.33-7.41 (m, 1H), 7.42-7.53(m, 3H), 7.56-7.65 (m, 2H),7.90-7.98 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$):δ 38.4(q, *J* = 2Hz), 44.7 (q, *J* = 27 Hz),122.9, 127.0 (q, *J* = 278 Hz),128.1,128.3, 129.0, 130.4, 131.7,132.2, 133.8, 133.9,136.3, 195.1; GC/MS (m/z): 356.00; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 8.2 min, t_2 = 10.5 min.

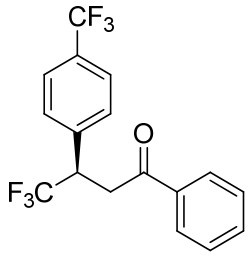




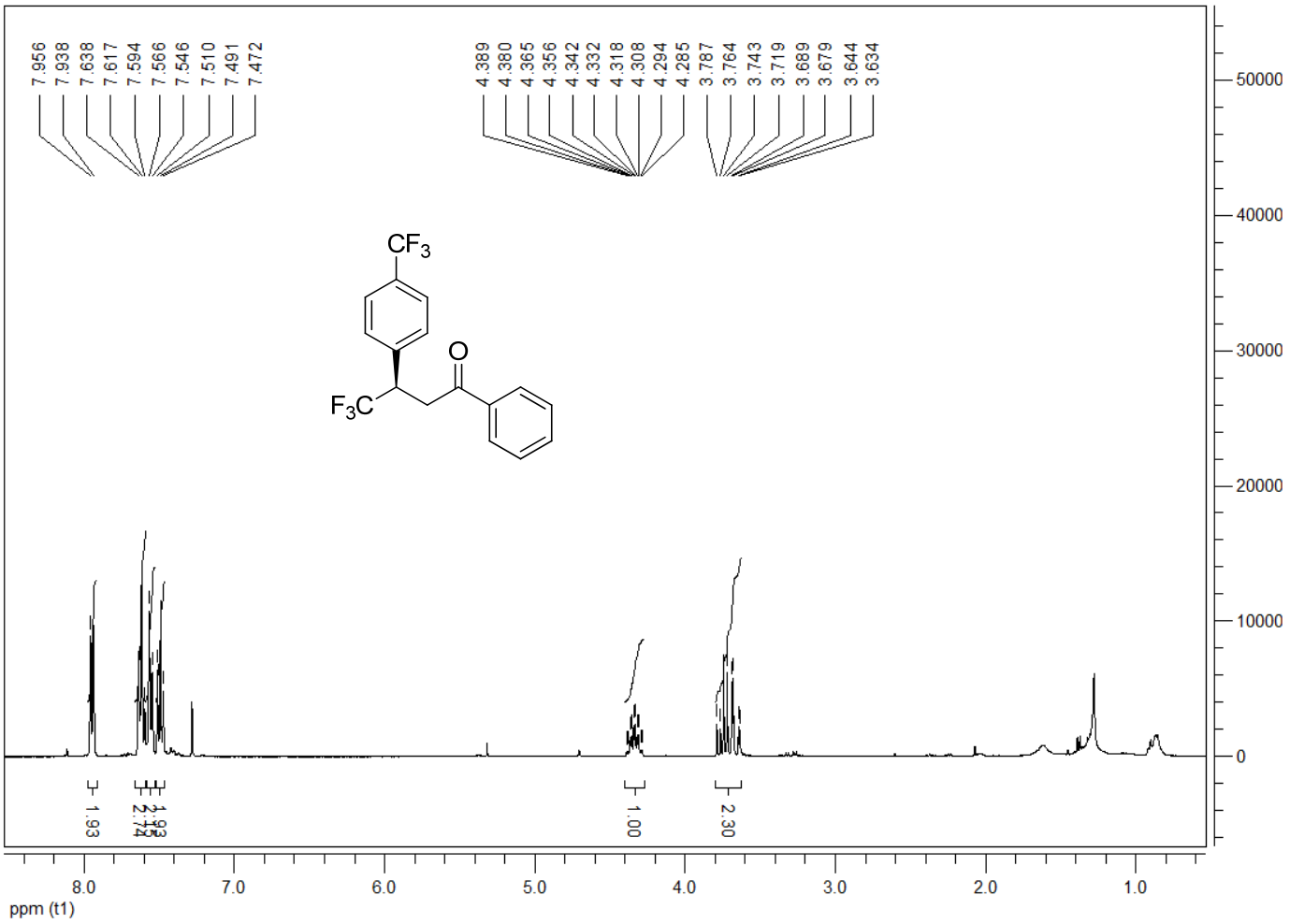


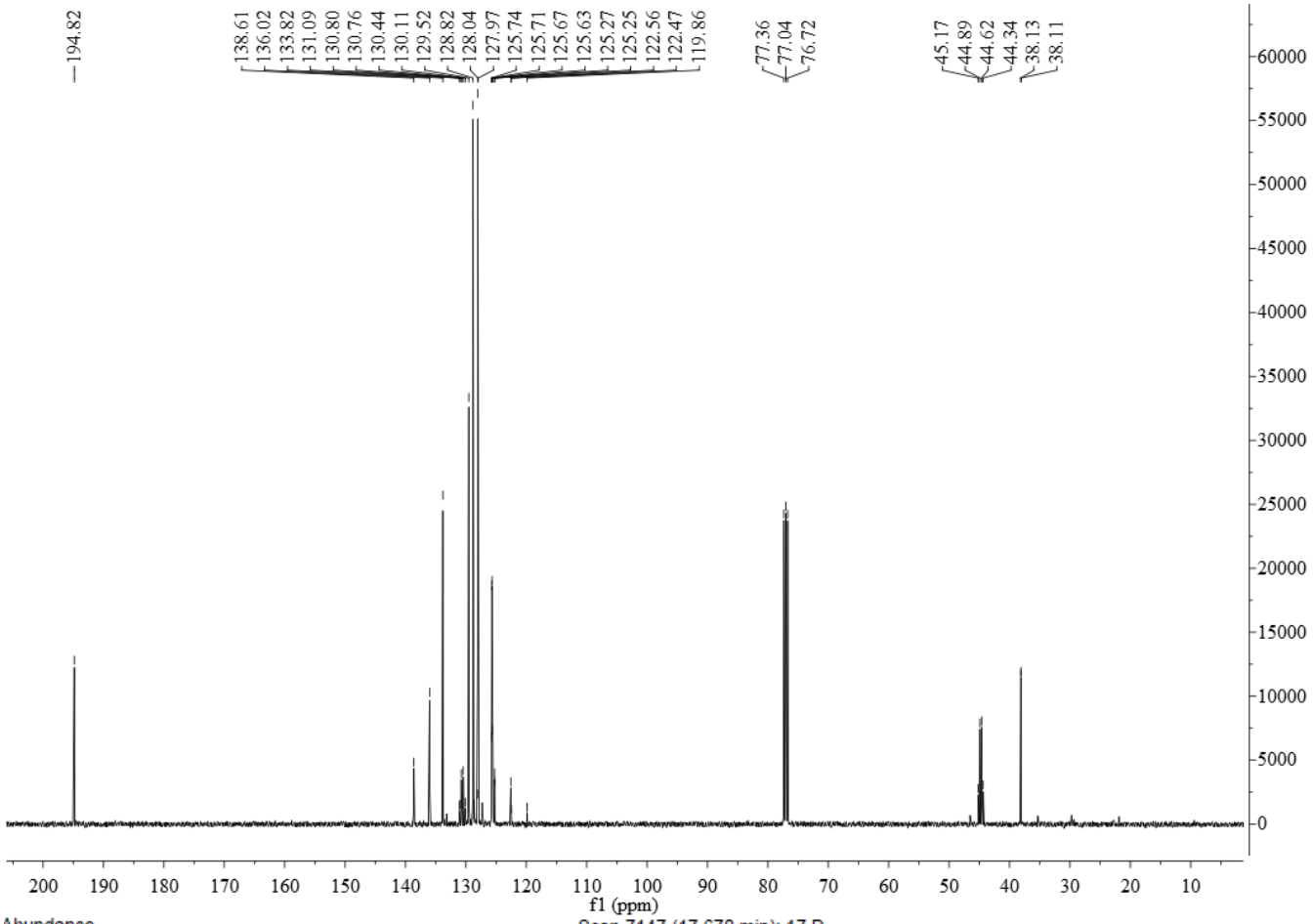
(*R*)-3-(3-bromophenyl)-4,4,4-trifluoro-1-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}BrF_3O$
Exact Mass: 356.00

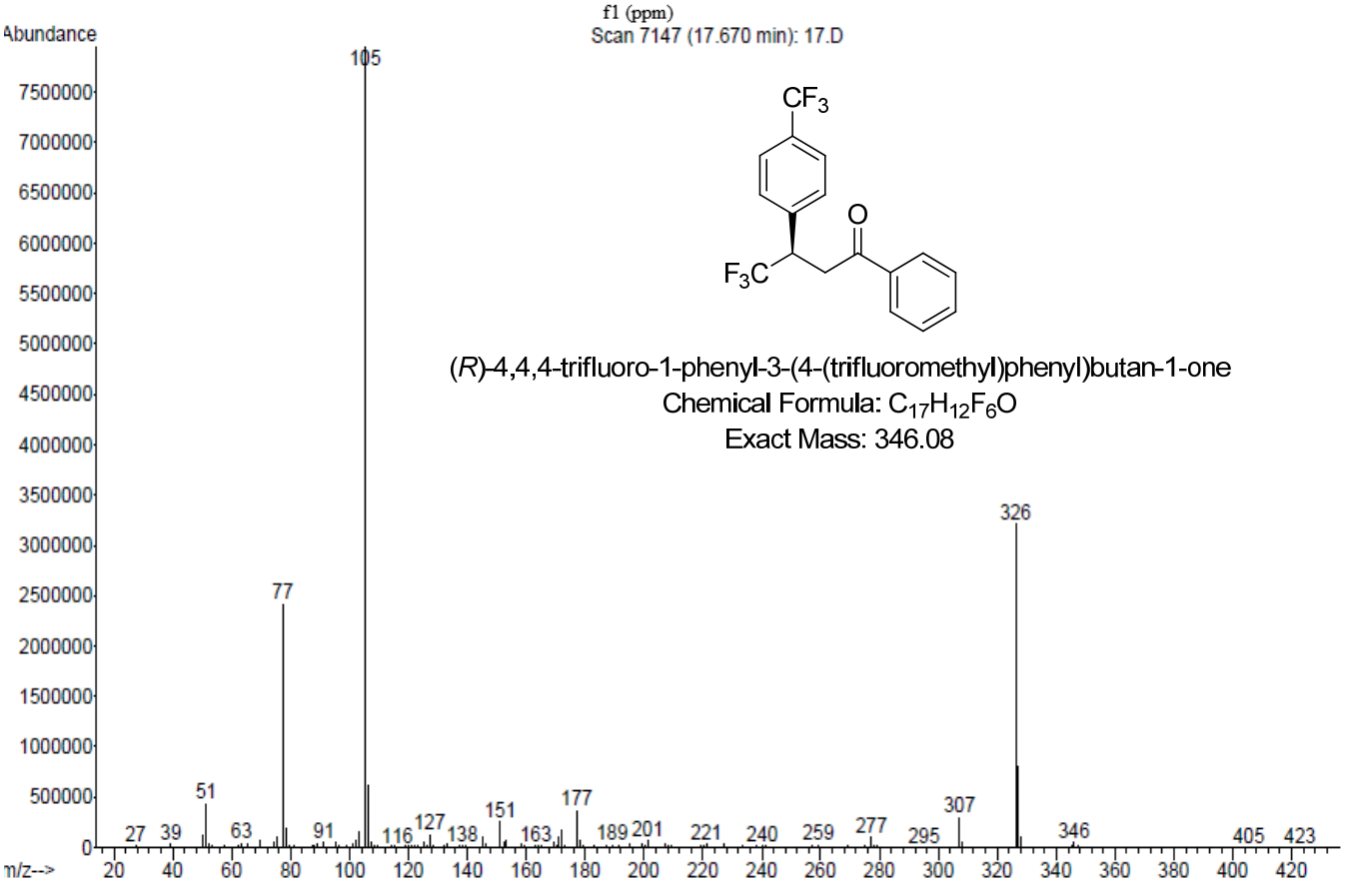
***6f*: (*R*)-4,4,4-Trifluoro-1-phenyl-3-(4'-(trifluoromethyl)phenyl)butan-1-one**



Yield: 97% (93% ee, 98% es);^{1}H NMR (400 MHz, $CDCl_3$): δ 3.64 (dd,1H,J = 3 Hz, J = 18 Hz), 3.74 (dd, 1H, J = 9 Hz, J = 18 Hz), 4.32(m,1H),7.45-7.62 (m, 7H), 7.91-7.94 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 38.1(q, *J* = 1.5 Hz), 44.7 (q, *J*= 28 Hz), 123.9 (q, *J* = 271 Hz), 125.7 (q, *J* = 4 Hz), 126.6 (q, *J* = 278Hz), 128.0, 128.8, 129.5, 130.6 (q, *J* = 32 Hz), 133.8, 136.0, 138.6, 194.8;GC/MS (m/z): 346.08; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 6.5 min, t_2 = 8.3 min

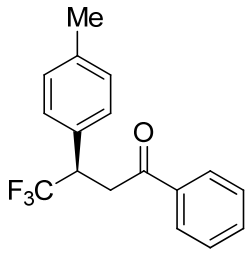




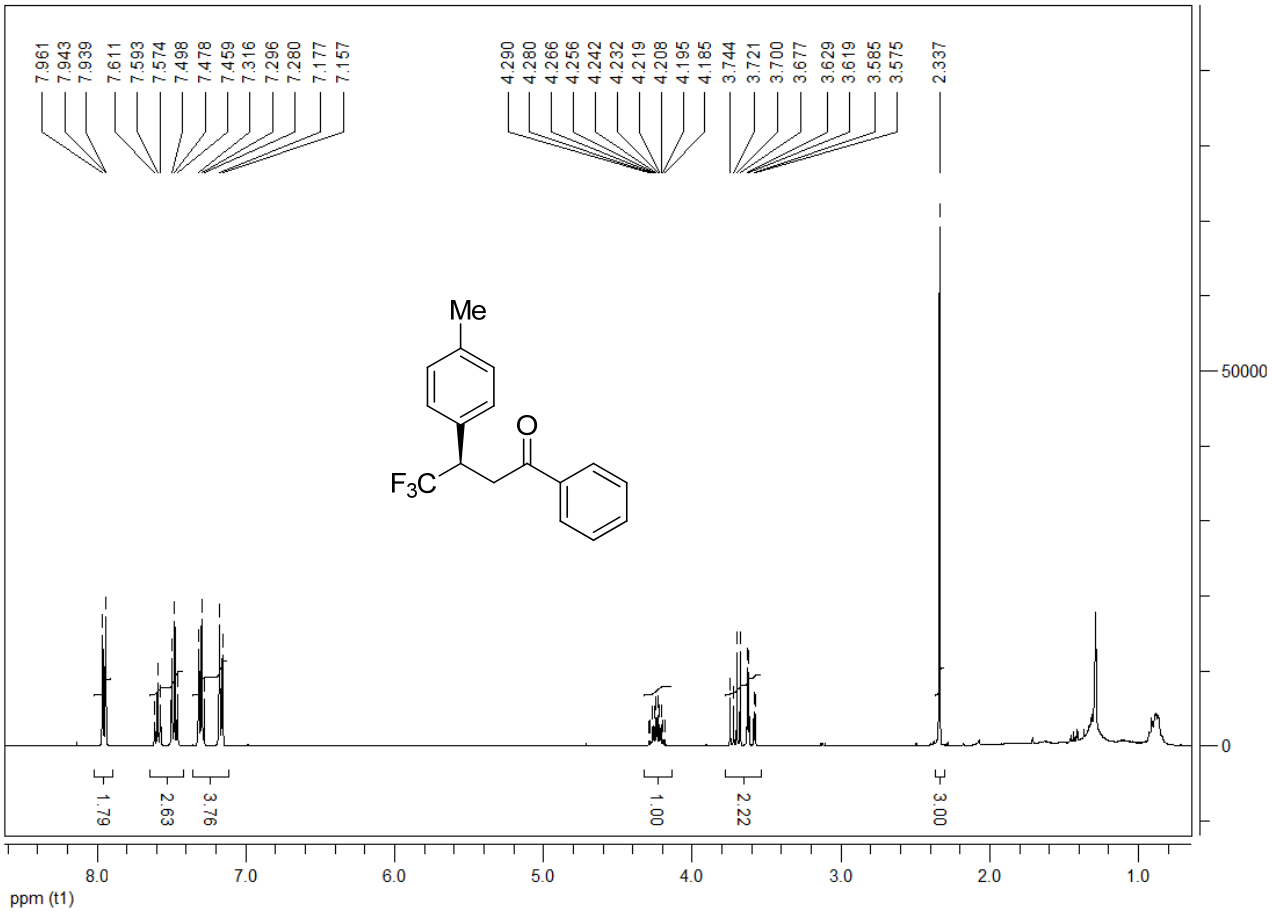


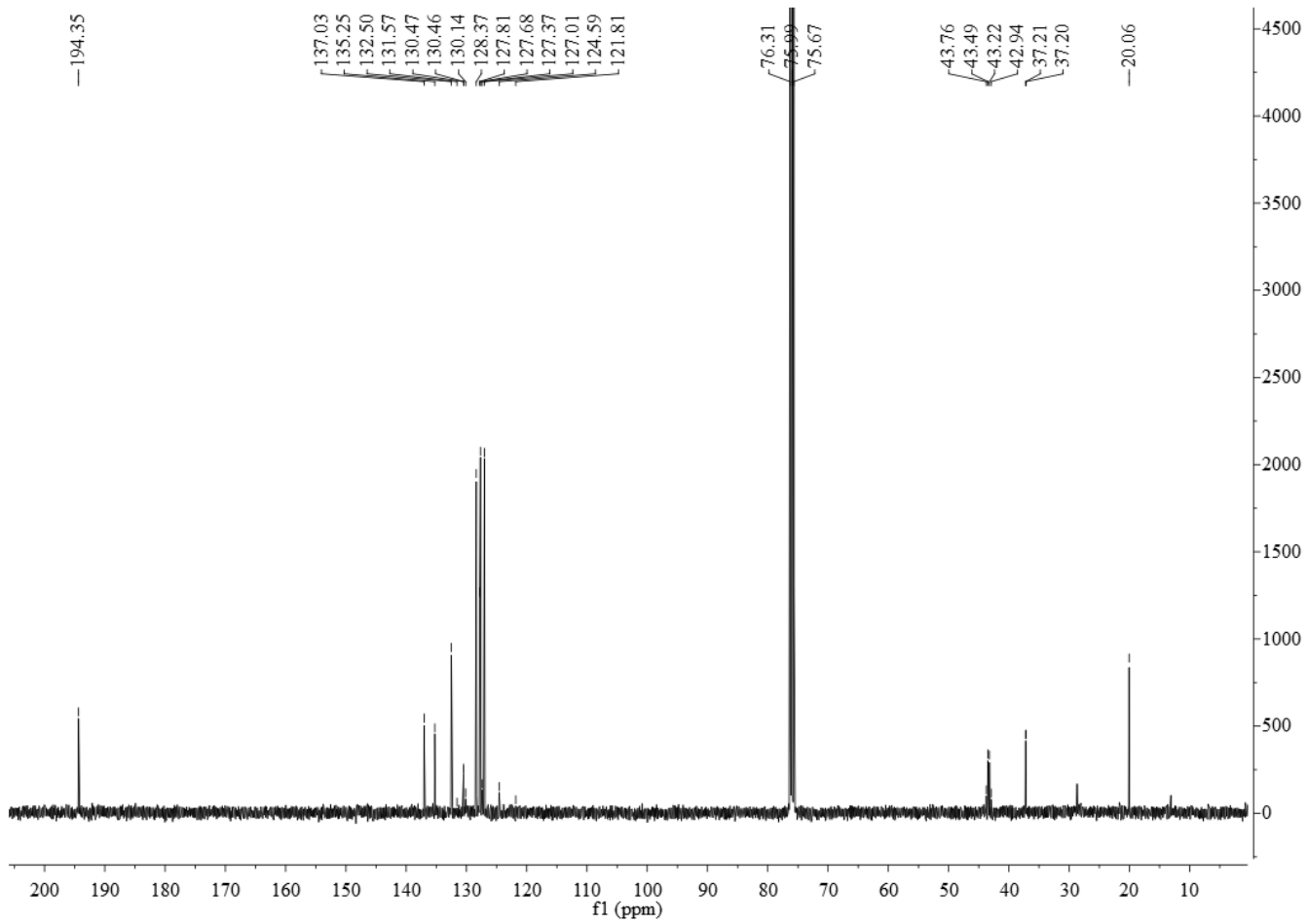
(*R*)-4,4,4-trifluoro-1-phenyl-3-(4-(trifluoromethyl)phenyl)butan-1-one
Chemical Formula: $C_{17}H_{12}F_6O$
Exact Mass: 346.08

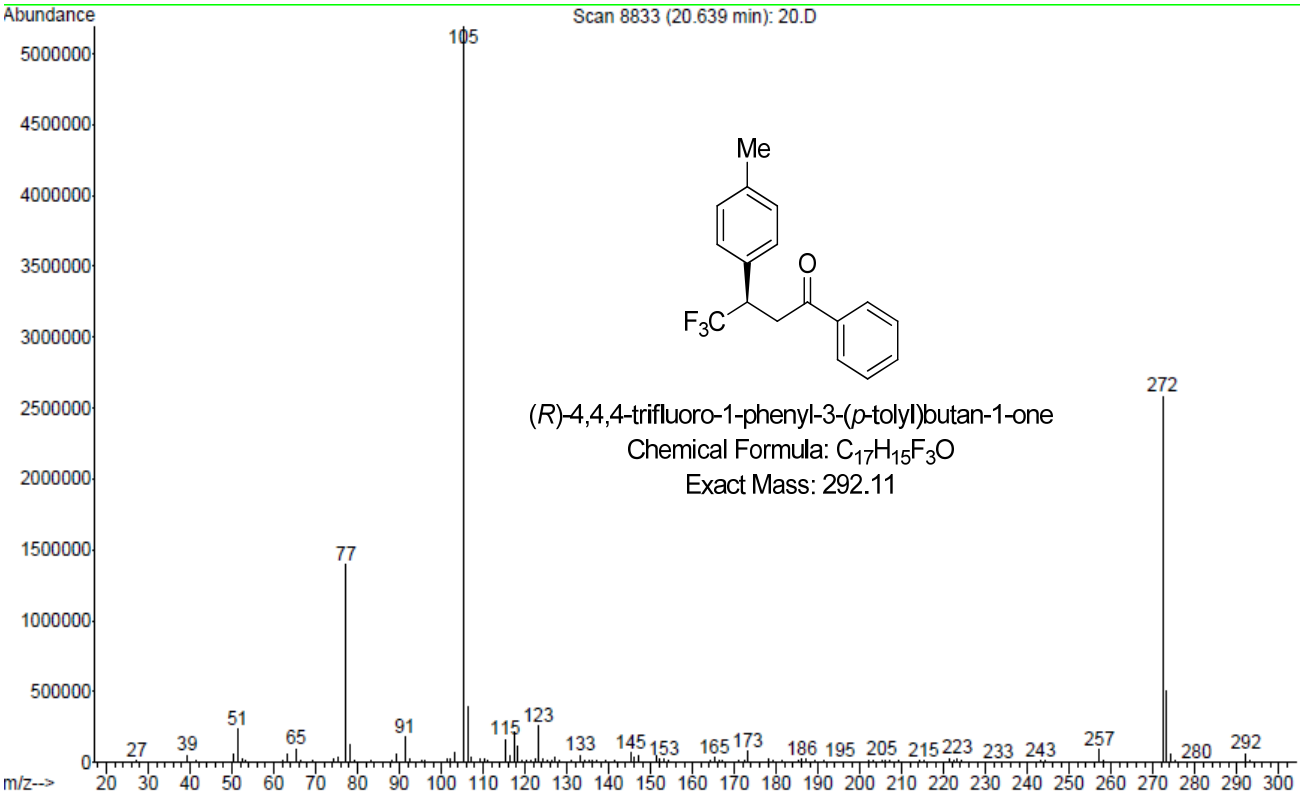
***6q*: (*R*)-4,4,4-trifluoro-1-phenyl-3-*p*-tolylbutan-1-one**



Yield: 96% (93% ee, 99% es);^{1}H NMR (400 MHz, $CDCl_3$): δ2.32 (s, 3H),3.59 (dd, 1H, *J* = 17.7 Hz, *J* = 3.9 Hz), 3.73 (dd, 1H, *J* = 17.8 Hz, *J* = 9.2 Hz), 4.19–4.25 (m, 1H),7.16 (d, 2H, *J* = 7.7 Hz), 7.30 (d, 2H, *J* = 7.7 Hz), 7.46 (t, 2H, *J* = 7.6 Hz), 7.58 (t, 1H, *J* = 7.2 Hz),7.94 (d, 2H, *J* =7.6 Hz);^{13}C NMR (100 MHz, $CDCl_3$):δ20.0, 37.2 (q, *J* = 1.5 Hz), 43.3 (q, *J* = 27 Hz),125.9 (q, *J* = 277 Hz),127.0, 127.6, 127.8, 128.3, 130.4 (q, *J* = 2 Hz), 131.5, 132.5, 135.2, 137.0,194.3;GC/MS (m/z): 292.11; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 5.4 min, t_2 = 6.1 min.

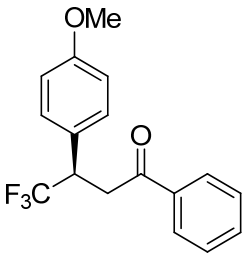




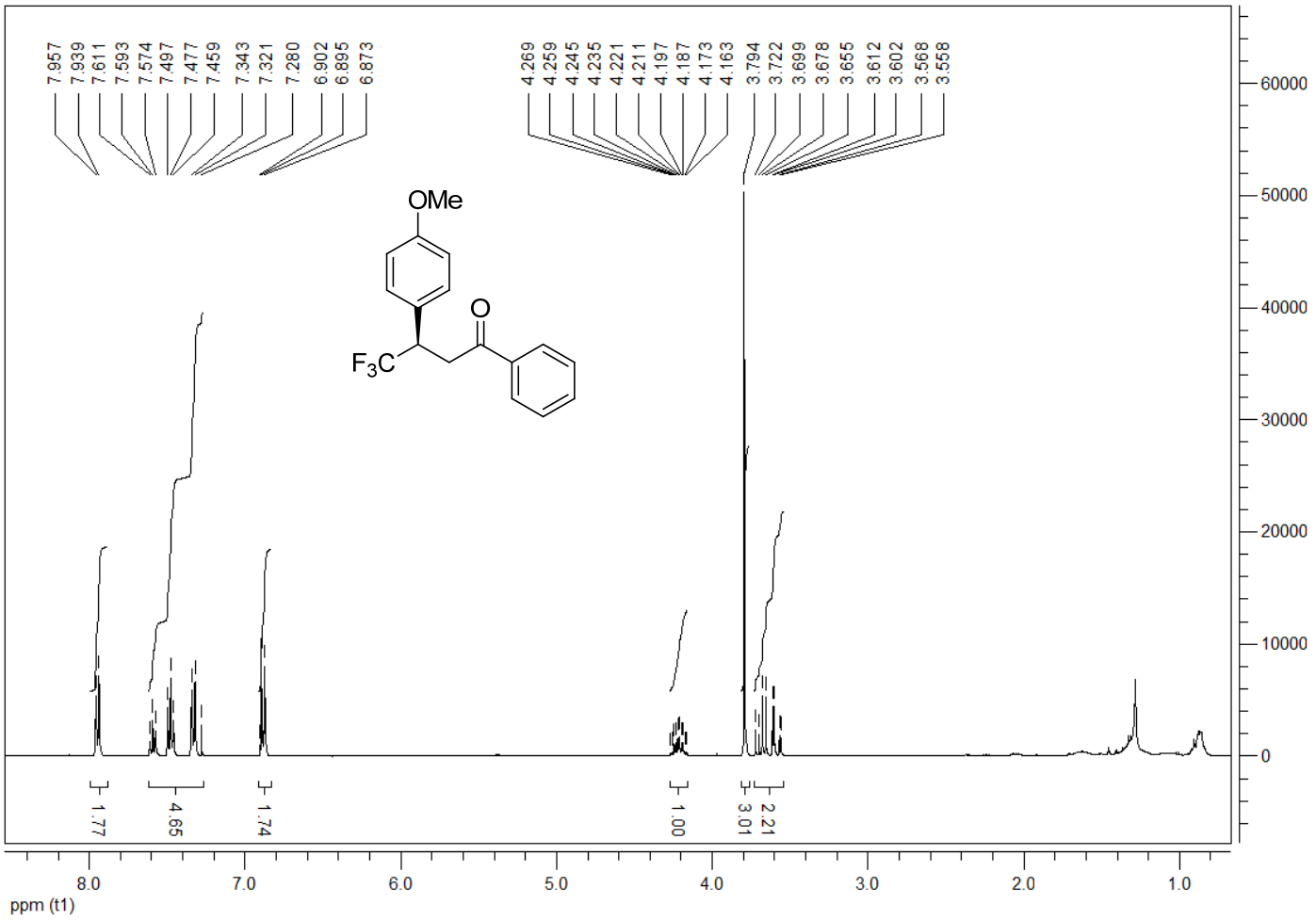


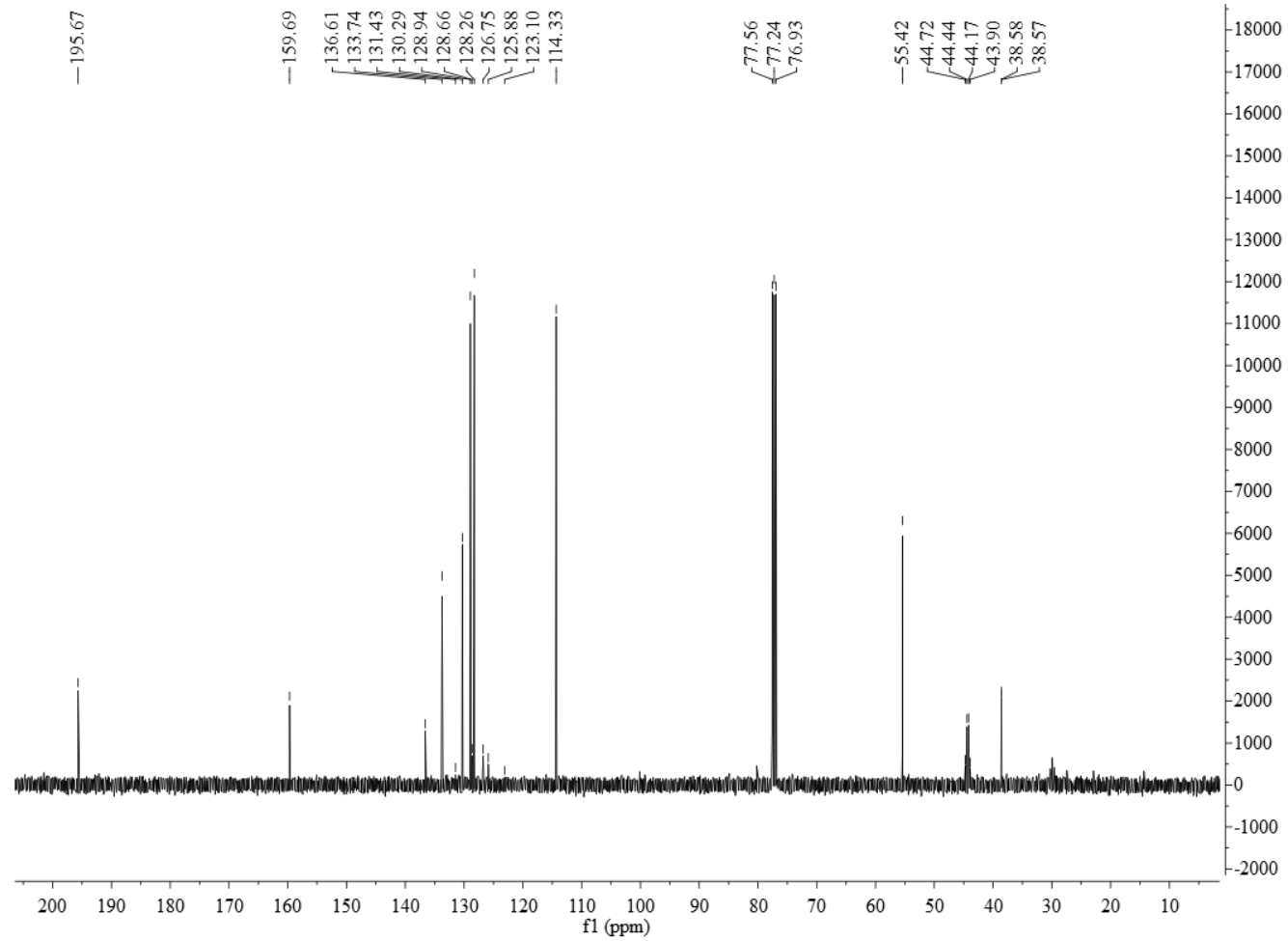
(*R*)-4,4,4-trifluoro-1-phenyl-3-(*p*-tolyl)butan-1-one
Chemical Formula: $C_{17}H_{15}F_3O$
Exact Mass: 292.11

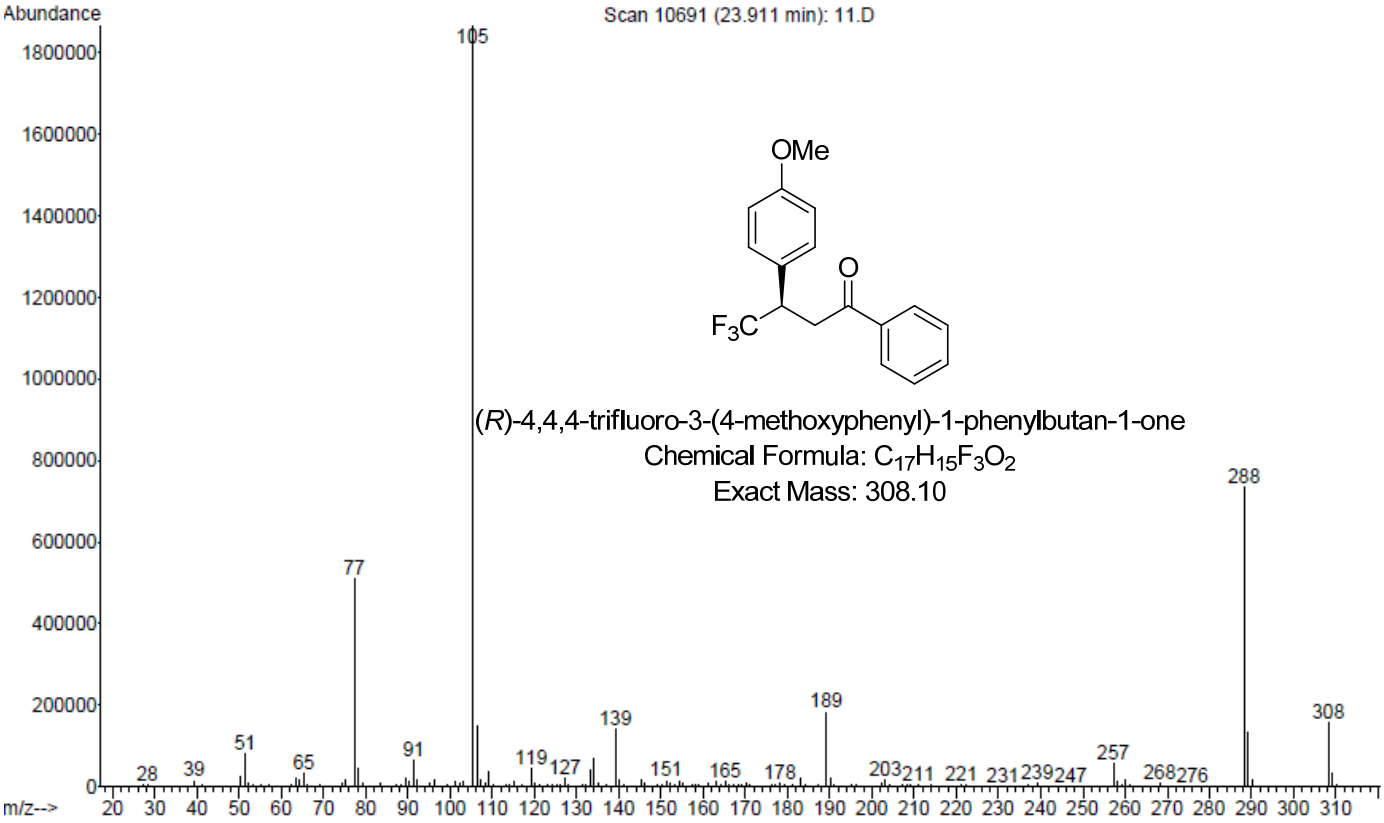
<u>*6h*</u>: (*R*)-4,4,4-Trifluoro-3-(4-methoxyphenyl)-1-phenylbutan-1-one



Yield: 92% (93% ee, 95% es);^{1}H NMR (400 MHz, $CDCl_3$):δ 3.56 (dd, 1H, *J*= 4 Hz, *J* = 18 Hz), 3.68 (dd, 1H, *J* = 9 Hz, *J* = 18 Hz), 3.77 (s, 3H), 4.12-4.27 (m, 1H), 6.85-6.89 (m, 2H), 7.30-7.33 (m, 2H), 7.43-7.48 (m, 2H),7.54-7.60 (m, 1H), 7.91-7.95 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$):δ 38.6 (q, *J* = 2Hz), 44.3 (q, *J* = 27 Hz), 55.4, 114.3, 126.7 (q, *J* = 2 Hz), 127.3 (q, *J* = 277Hz), 128.3, 128.9, 130.3, 133.7, 136.6, 159.7, 195.7;GC/MS (m/z): 308.10; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 14.4 min, t_2 =15.0 min.





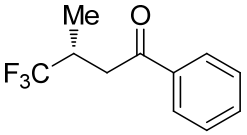


(*R*)-4,4,4-trifluoro-3-(4-methoxyphenyl)-1-phenylbutan-1-one

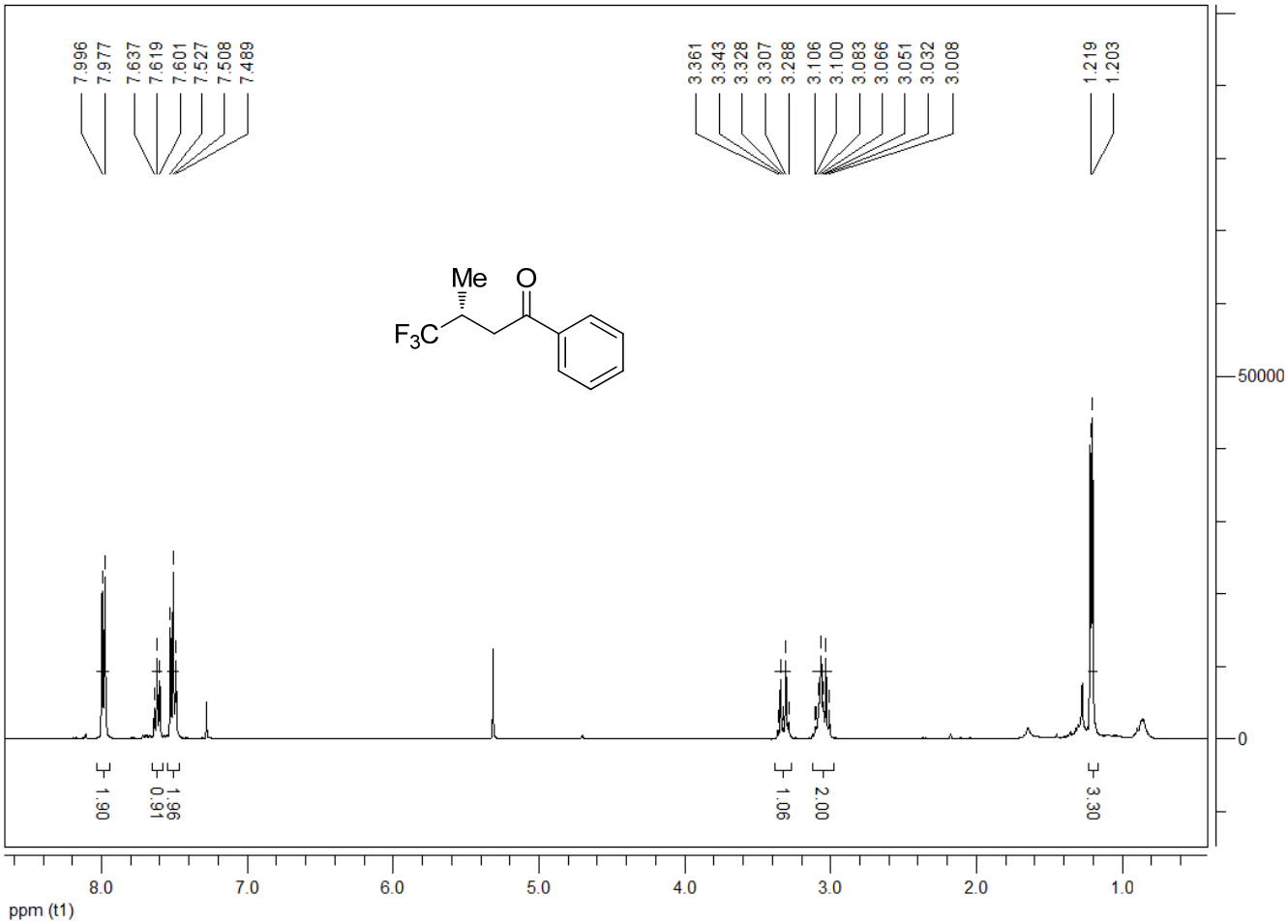
Chemical Formula: $C_{17}H_{15}F_3O_2$

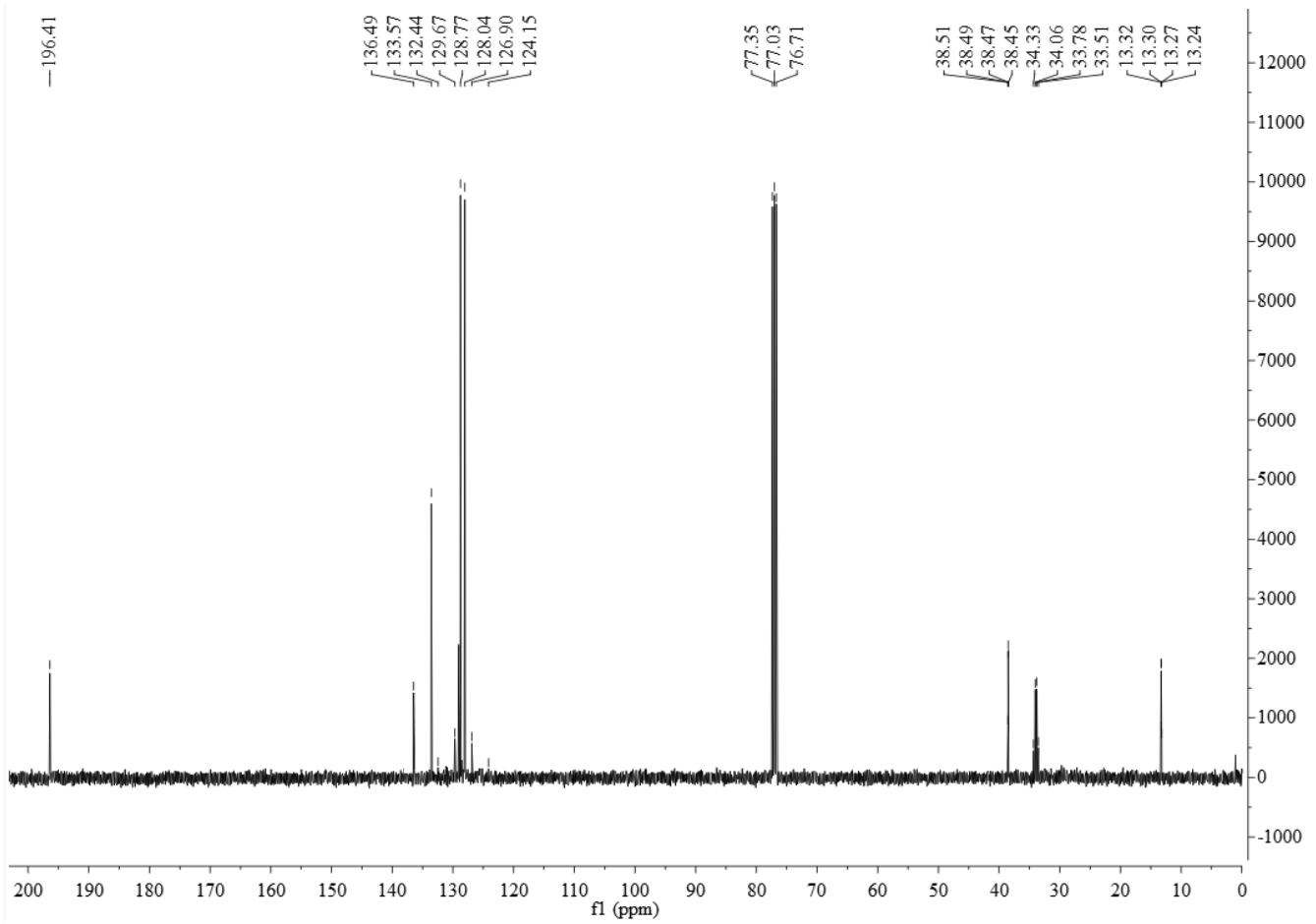
Exact Mass: 308.10

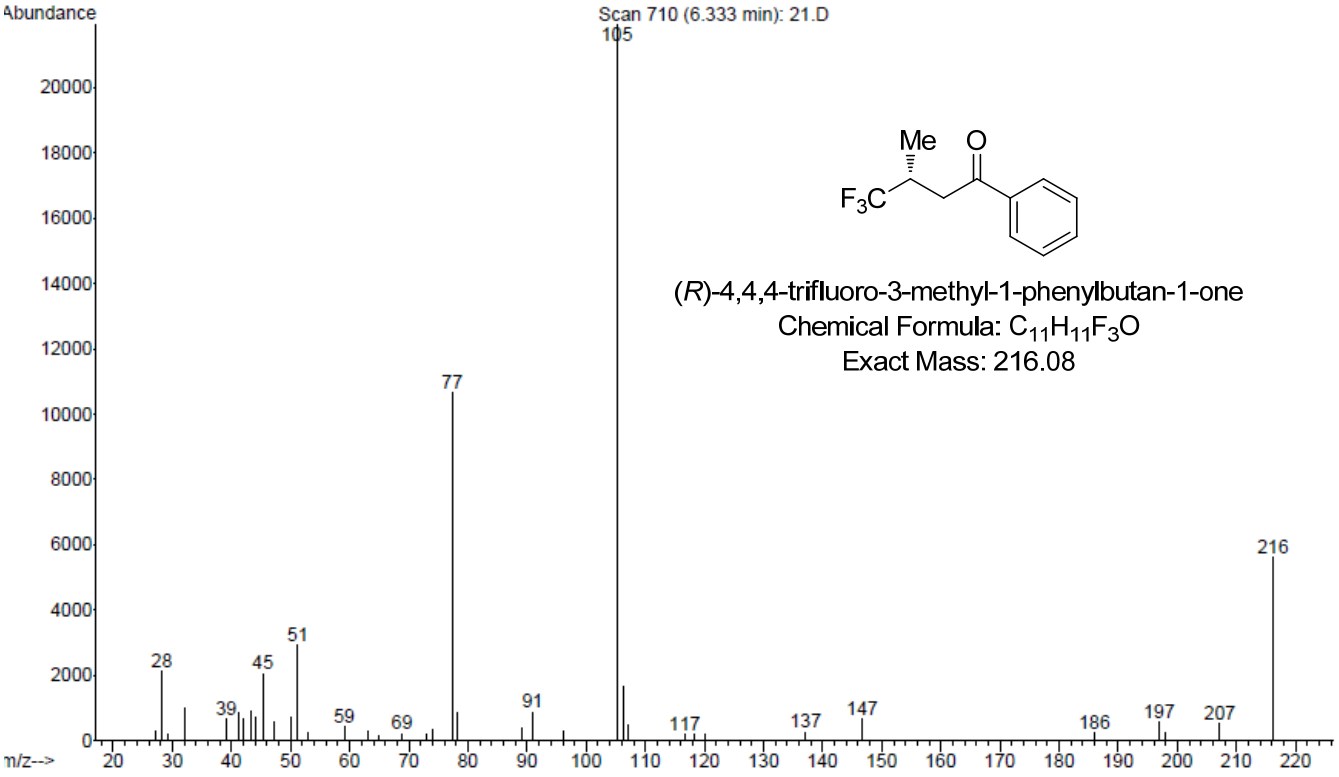
***6i*: (*R*)-4,4,4-Trifluoro-3-methyl-1-phenylbutan-1-one**



Yield: 97% (88% ee, 98% es);^{1}H NMR (400 MHz, $CDCl_3$):δ 1.19 (d, *J* = 6Hz, 3H), 2.98-3.06 (m, 2H), 3.26-3.35 (m, 1H), 7.49 (t, *J* =7 Hz, 2H), 7.60 (t, *J* = 7 Hz, 1H), 7.97 (d, *J* = 7 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$):δ 13.3(q, *J* = 2 Hz), 33.9 (q, *J* = 27 Hz), 38.5 (q, *J* = 2 Hz), 128.0, 128.3 (q, *J*= 276Hz),128.8, 133.6, 136.5, 196.4;GC/MS (m/z): 216.08; HPLC (OJ-H, elute: *n*-hexanes/*i*-PrOH = 99/1, detector: 254 nm, flow rate: 0.5 mL/min, 25 ^{o}C) t_1 = 12.8 min, t_2 =13.4 min.

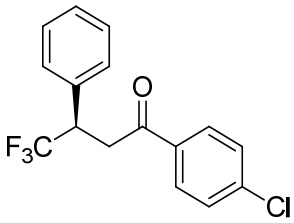




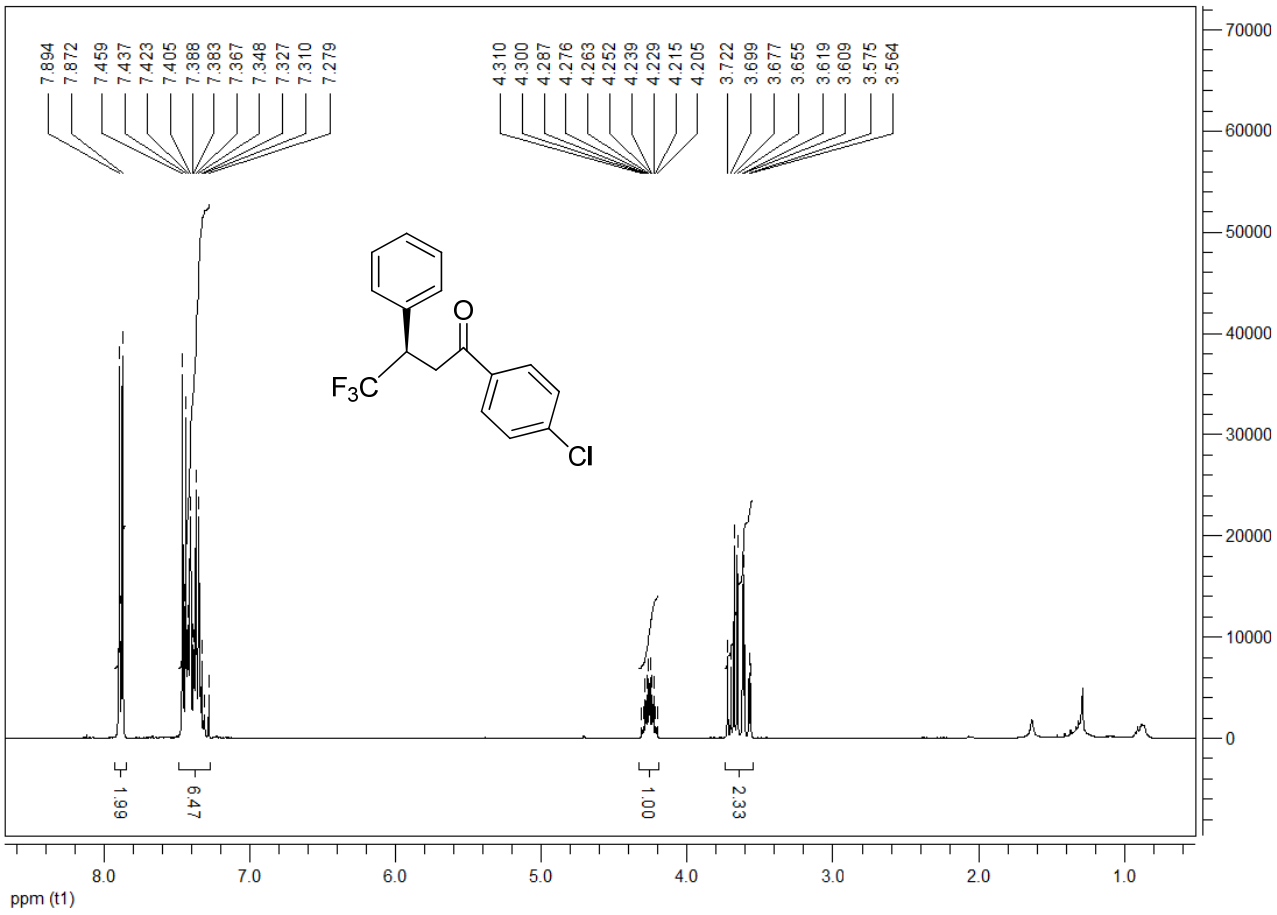


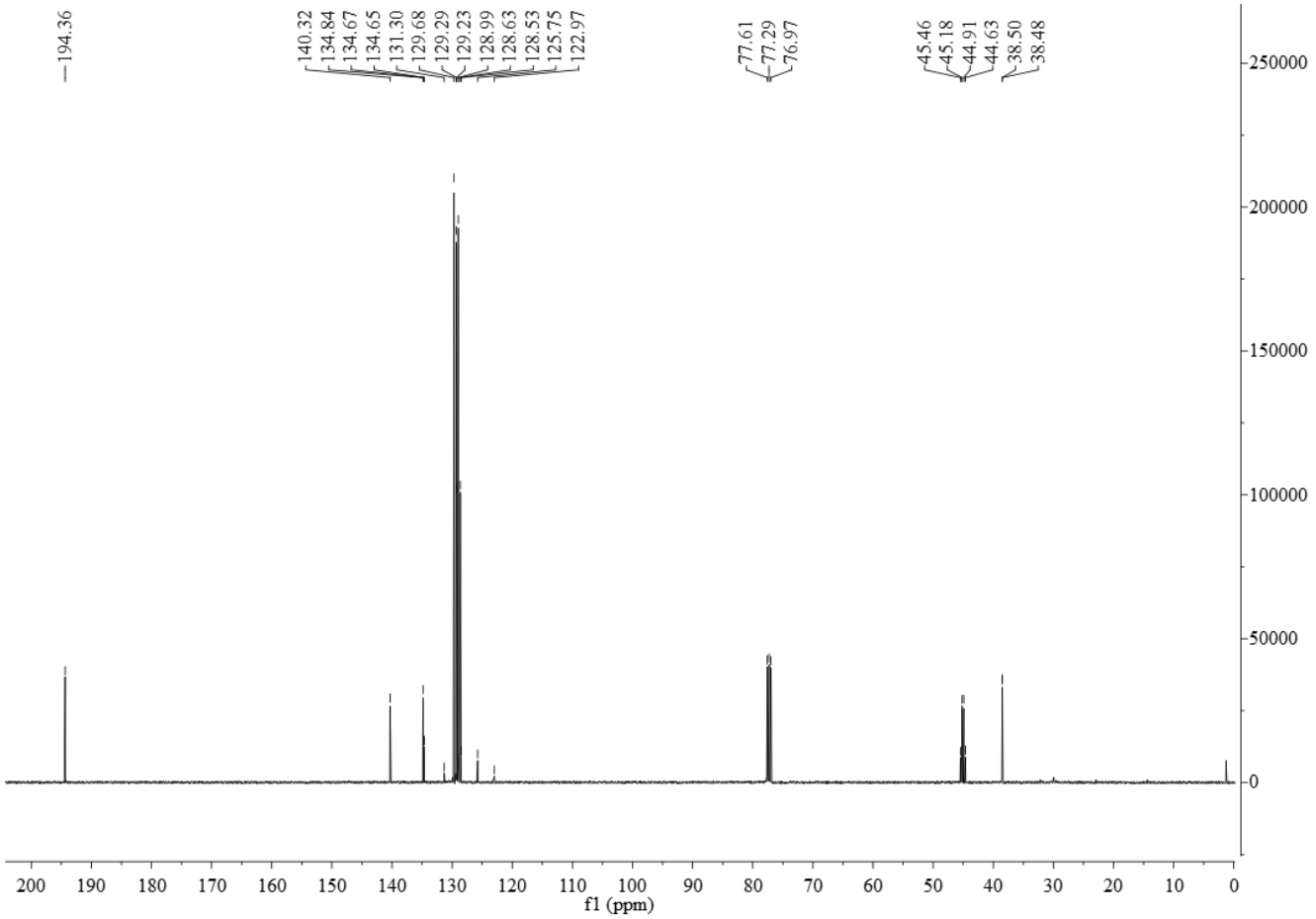
(*R*)-4,4,4-trifluoro-3-methyl-1-phenylbutan-1-one
Chemical Formula: $C_{11}H_{11}F_3O$
Exact Mass: 216.08

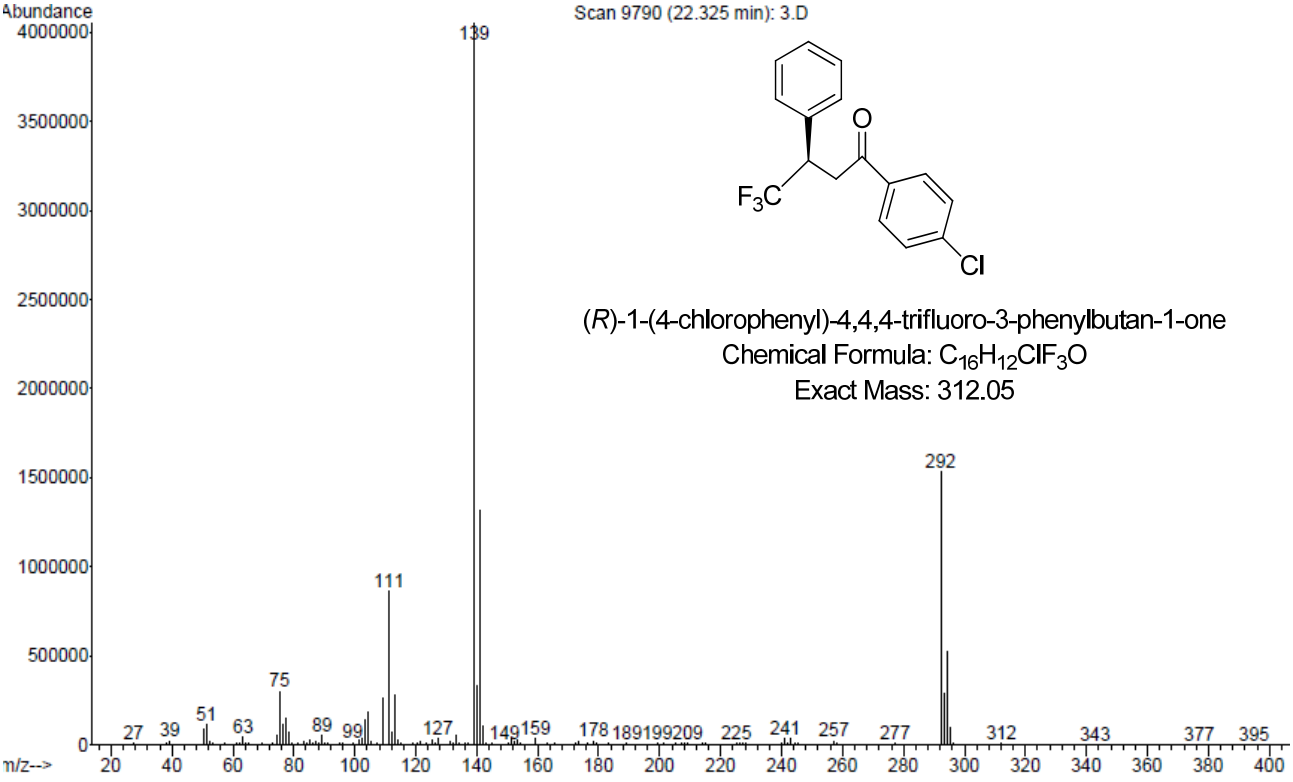
***6j*: (*R*)-1-(4-Chlorophenyl)-4,4,4-trifluoro-3-phenyl-1-butanone**



Yield: 96% (88% ee, 97% es);^{1}H NMR (400 MHz, $CDCl_3$): δ3.53 (dd, 1H, *J* = 17.8 Hz, *J* = 4.4 Hz), 3.64 (dd, 1H, *J* = 17.8 Hz, *J* = 8.8Hz), 4.12–4.26 (m, 1H), 7.28–7.40 (m, 7H),7.82 (d, 2H, *J* =8.6 Hz); ^{13}C NMR (100 MHz, $CDCl_3$): δ38.5 (q, *J* = 2 Hz) 45.0 (q, *J* = 27 Hz), 127.0 (q, *J*= 277.8 Hz), 128.6, 129.0, 129.2, 129.3, 129.7, 134.6 (q, *J* = 2 Hz), 134.8,140.3,194.3;GC/MS (m/z): 312.05; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 6.3 min, t_2 =7.2 min.



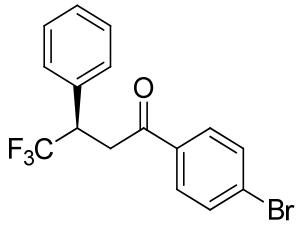




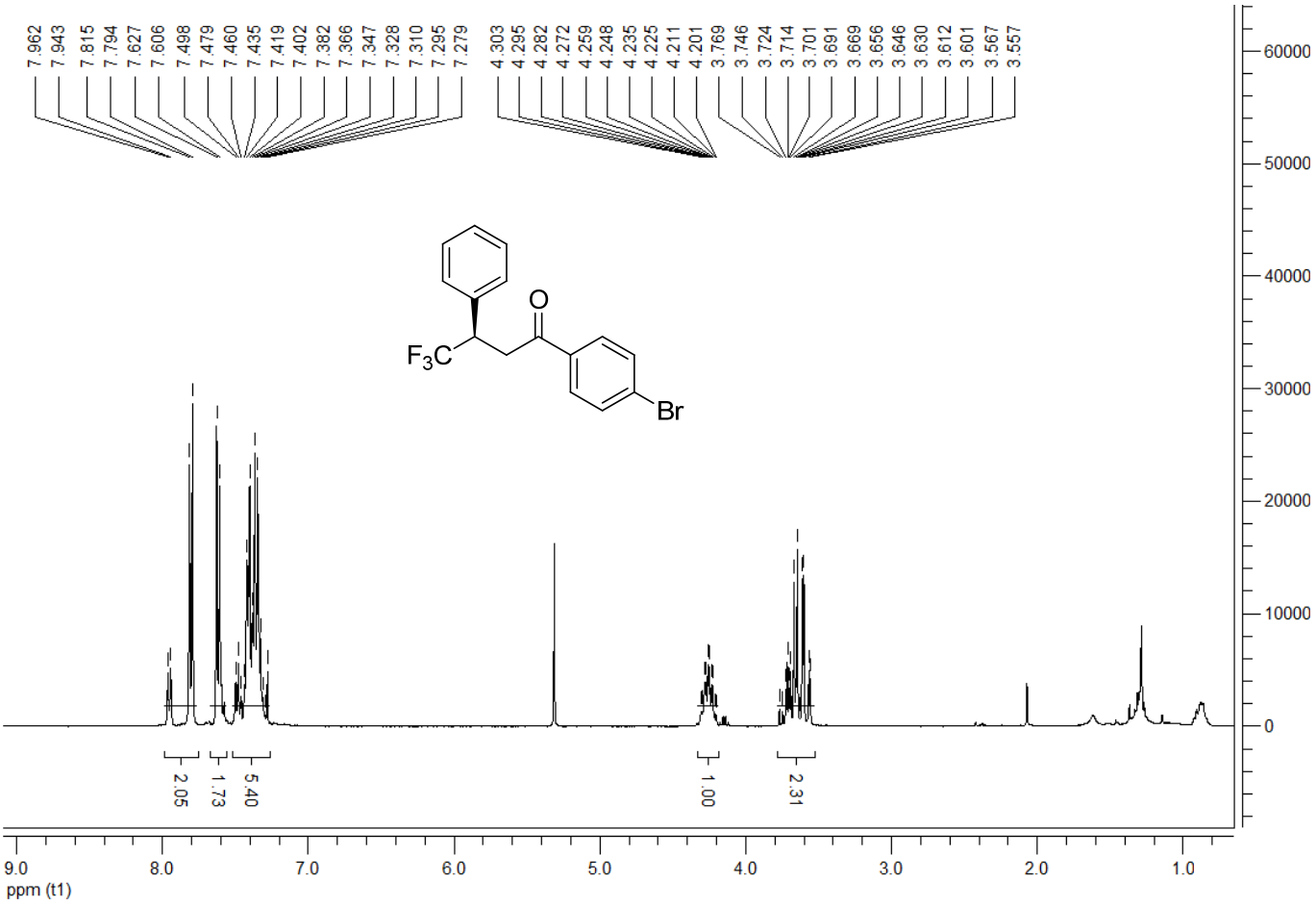
Scan 9790 (22.325 min): 3.D

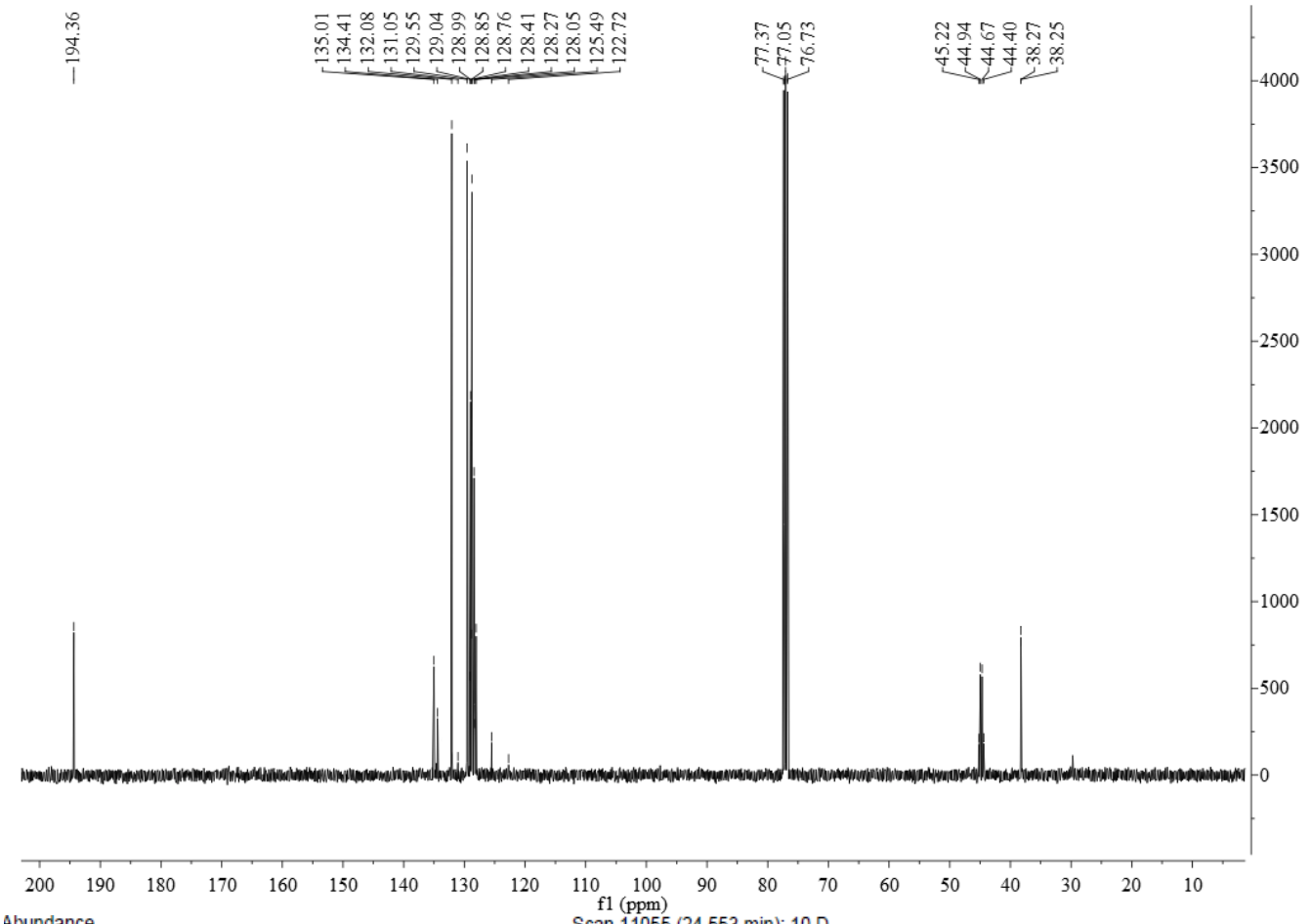
(*R*)-1-(4-chlorophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}ClF_3O$
Exact Mass: 312.05

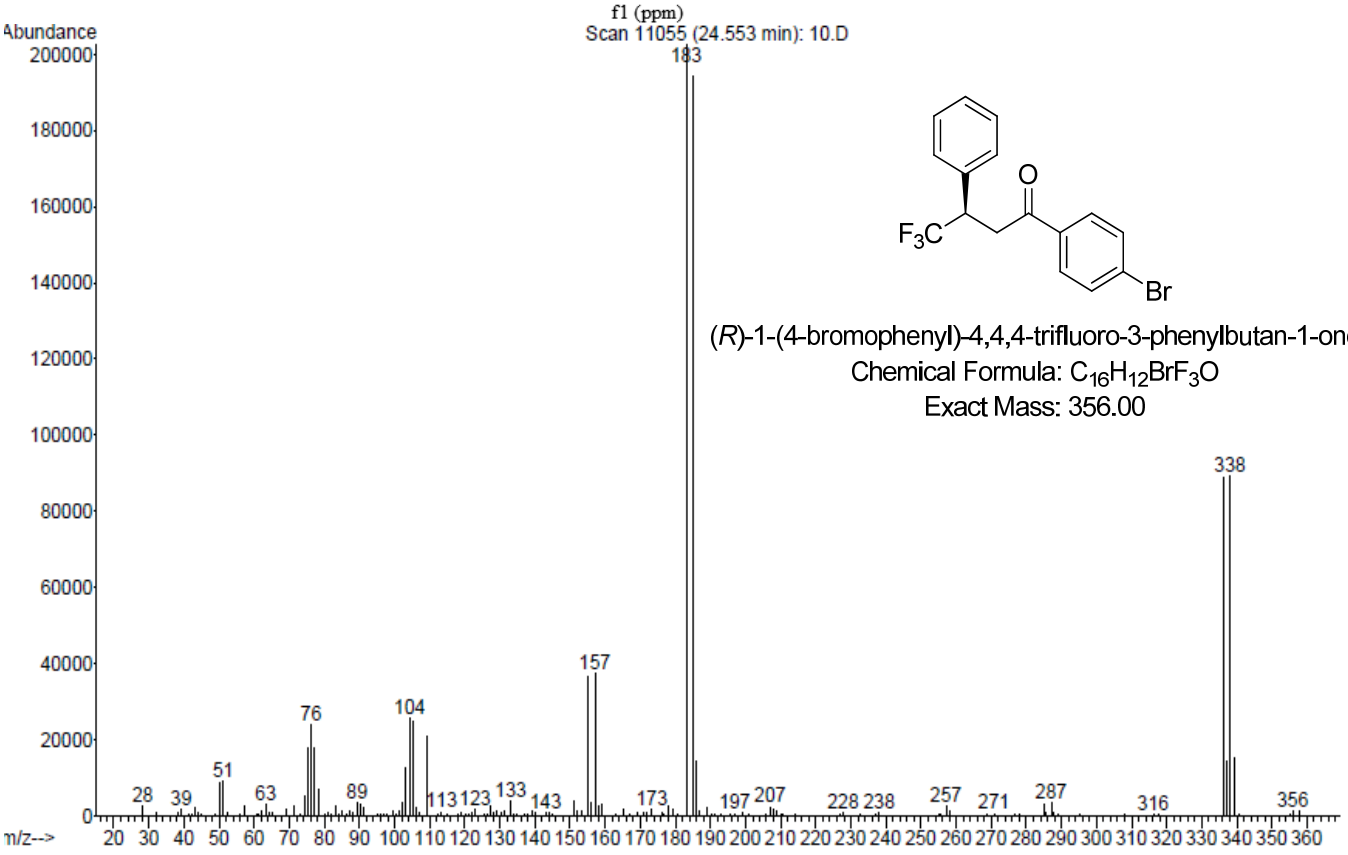
***6k*: (*R*)-1-(4-Bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one**



Yield: 95% (94% ee, 100% es);^{1}H NMR (400 MHz, $CDCl_3$):δ3.57 (dd, 1H, *J* = 17.7 Hz, *J* = 4.4 Hz), 3.66 (dd,1H, *J* = 17.7 Hz, *J* = 8.8 Hz), 4.16–4.30 (m, 1H), 7.30–7.40 (m, 5H), 7.60 (d, 2H, *J* = 8.5 Hz),7.78 (d, 2H, *J* =8.5 Hz);^{13}C NMR (100 MHz, $CDCl_3$): δ38.3 (q, *J* = 2 Hz), 44.8 (q, *J* = 27 Hz), 126.9 (q, *J* = 277.7 Hz), 128.4,128.8, 129.0, 129.1, 129.6, 132.1, 134.4 (q, *J*= 2 Hz),135.0, 194.4;GC/MS (m/z): 356.00; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 6.2 min, t_2 =7.1 min.

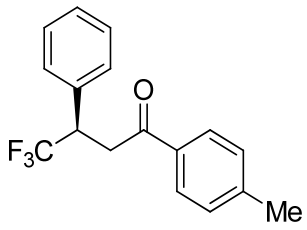




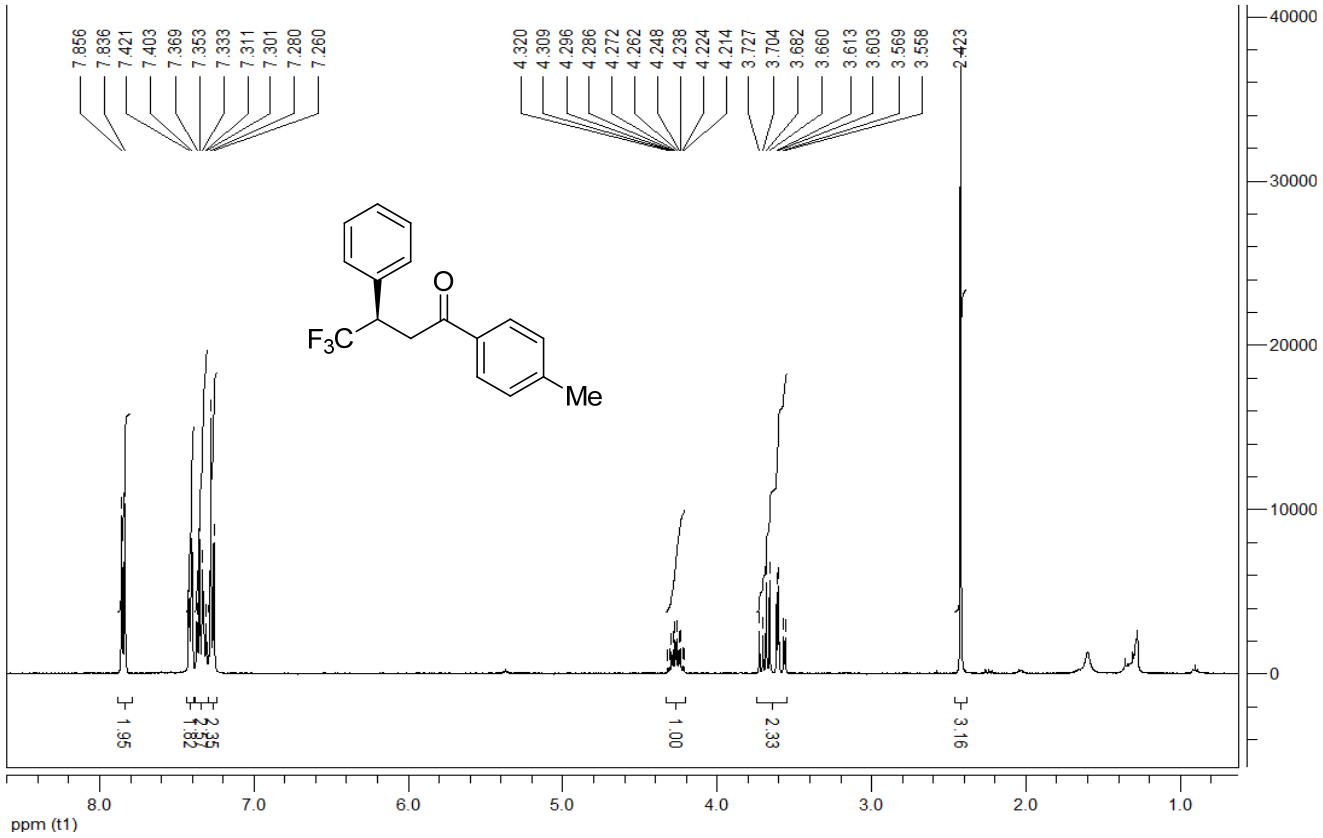


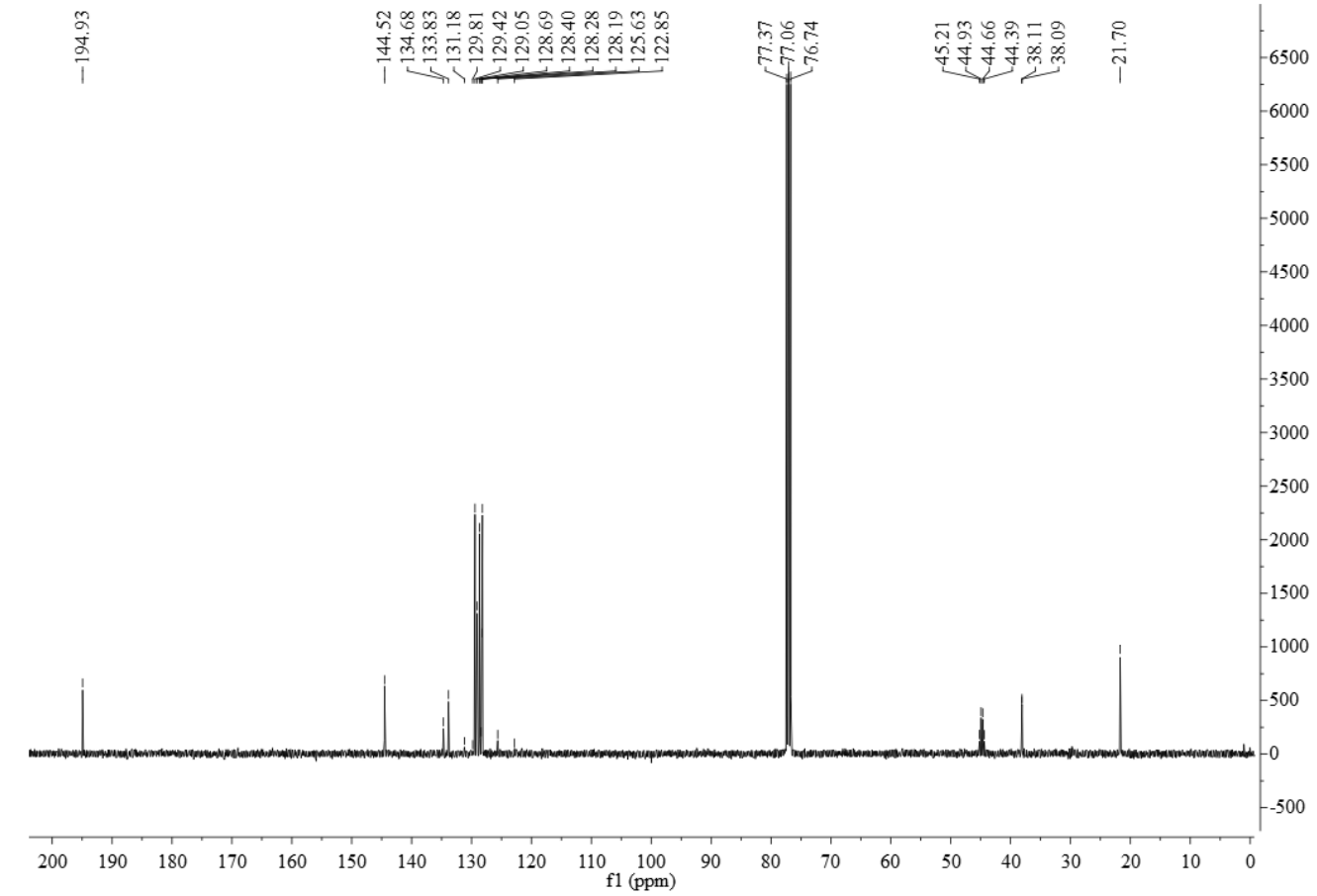
(*R*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}BrF_3O$
Exact Mass: 356.00

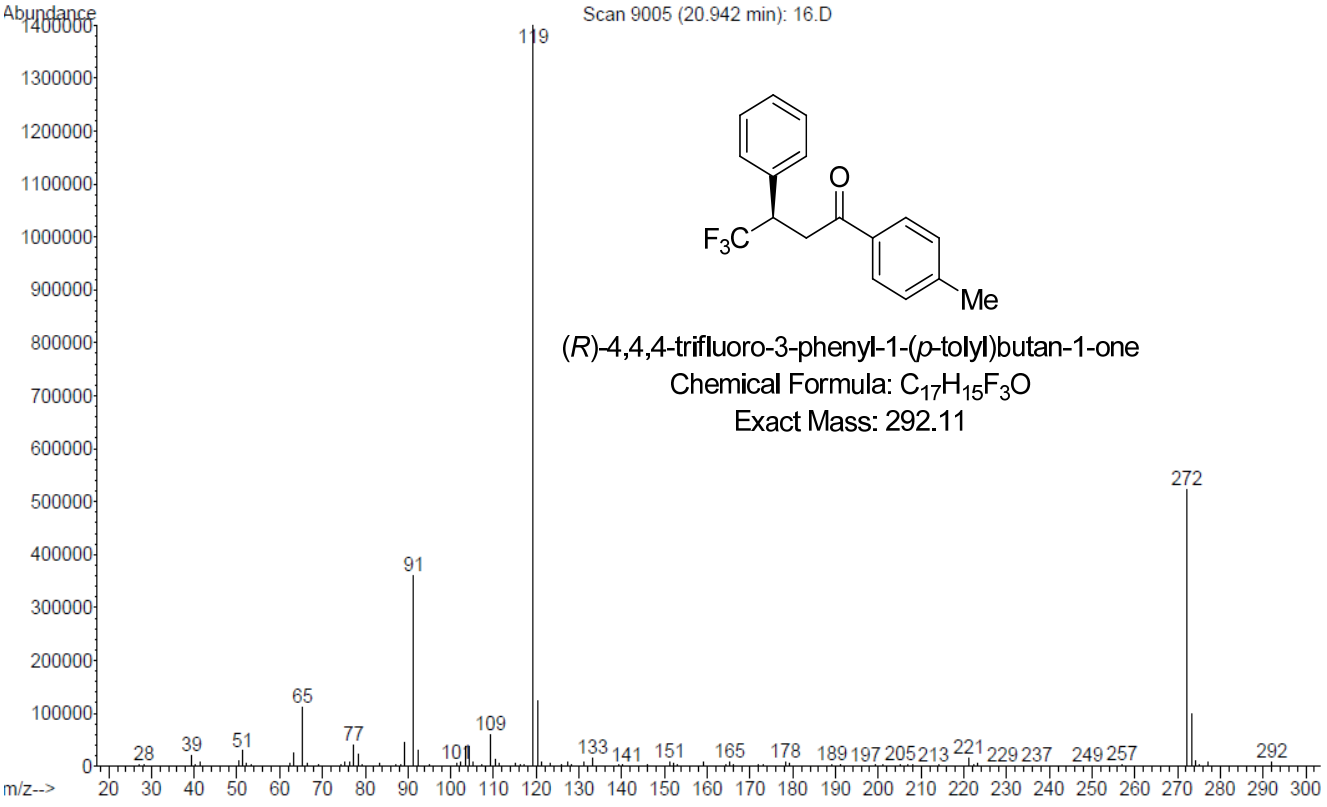
***6l*: (*R*)-4,4,4-Trifluoro-1-(4-methylphenyl)-3-phenyl-1-butanone**



Yield: 95% (90% ee, 95% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 2.40, (s, 3H), 3.53-3.60 (m,1H), 3.68 (ddd, *J* = 1.9, 8.9, 17.8 Hz, 1H), 4.21-4.28 (m, 1H), 7.24-7.38(m, 7H), 7.81-7.84(m, 2H);^{13}C NMR (100 MHz, $CDCl_3$): δ21.7, 38.1(q, *J* = 2 Hz), 44.8 (q, *J*= 27.7Hz), 127.0(q, *J*= 279.2 Hz), 128.2, 128.3, 128.7, 129.0, 129.4, 129.8, 133.8, 134.6, 144.5, 194.9; GC/MS (m/z): 292.11; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C) t_1 = 4.8 min, t_2 =5.5 min.

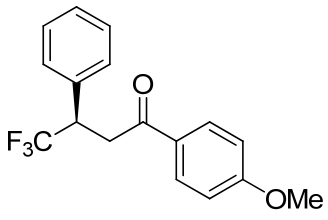




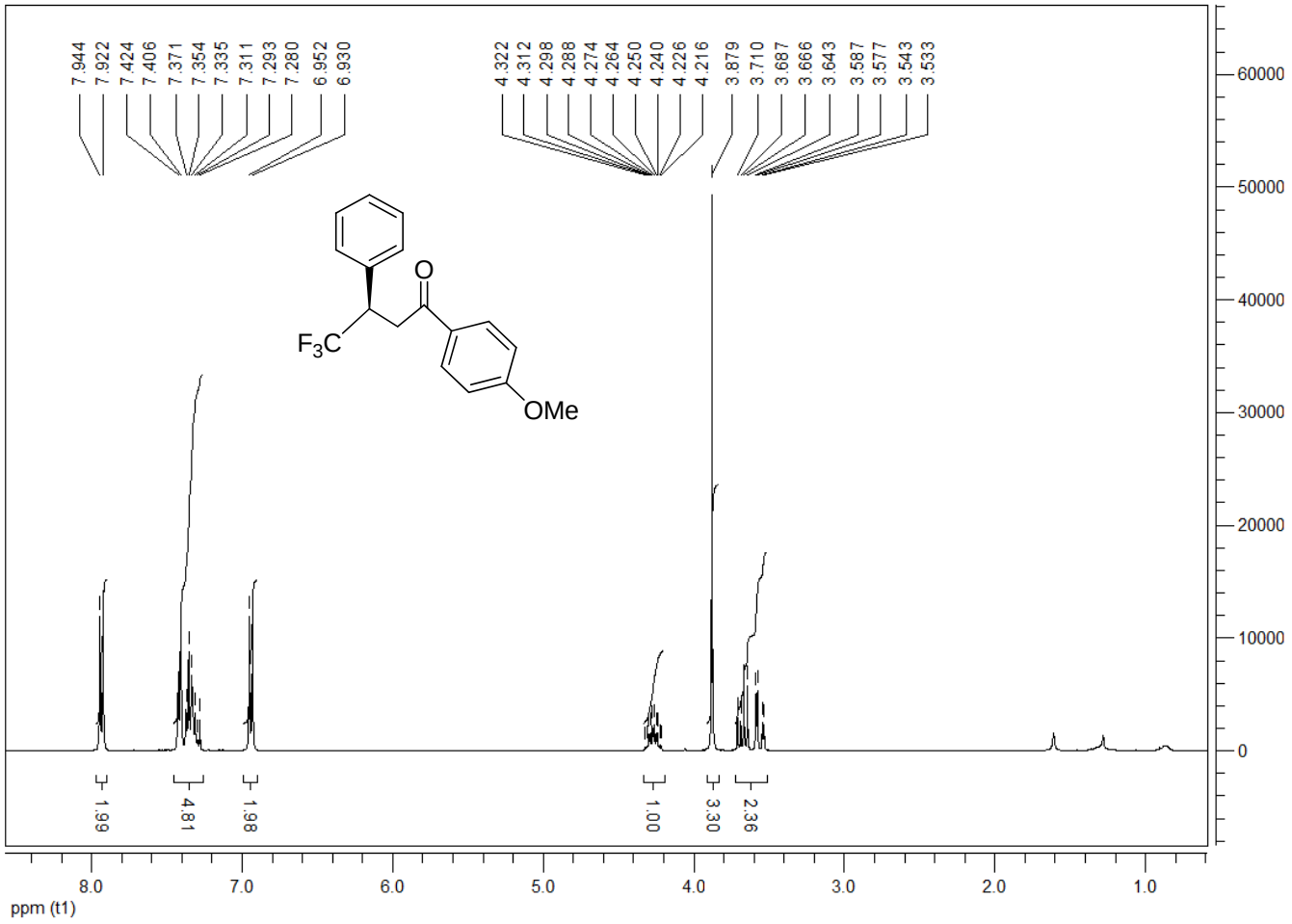


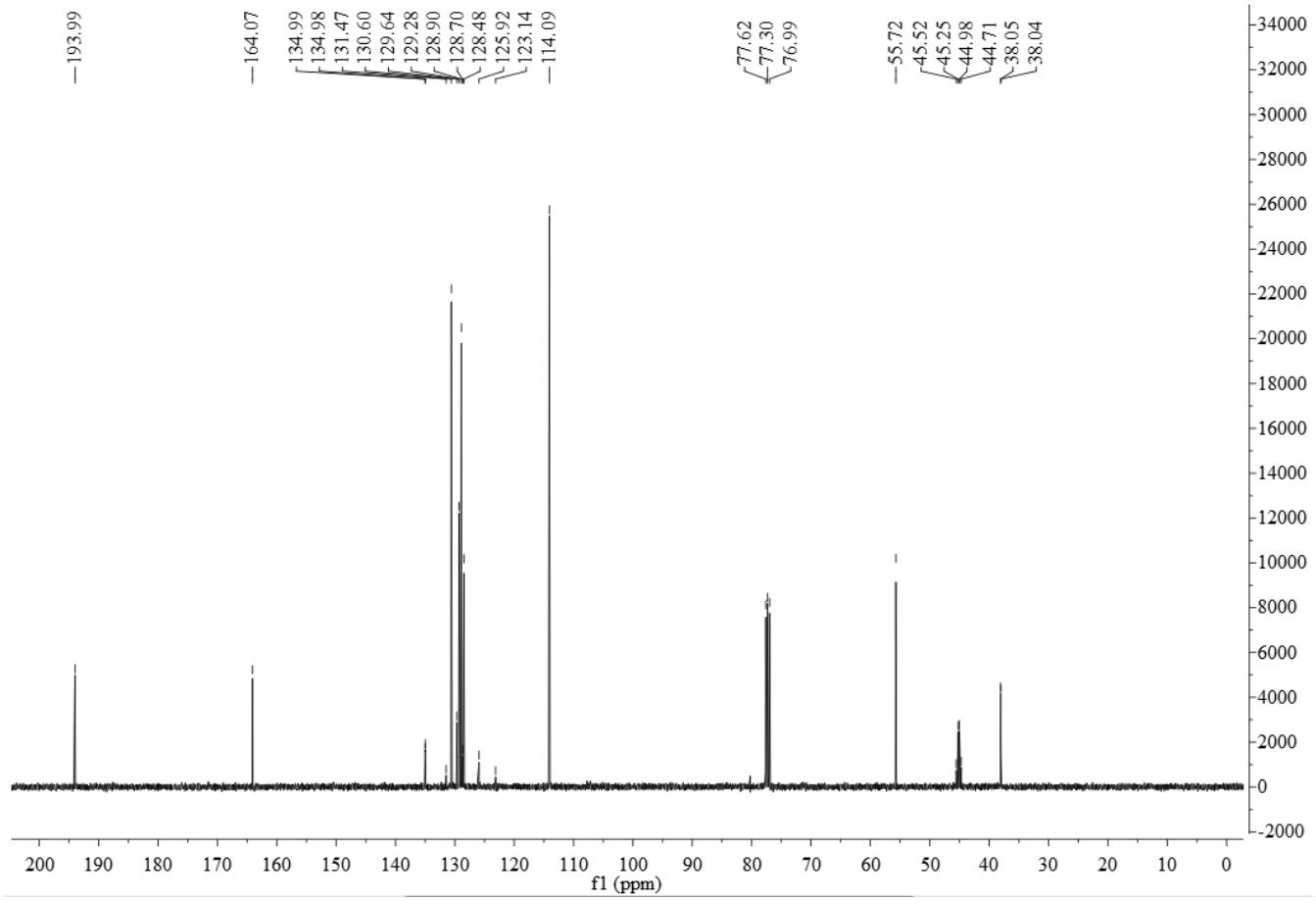
(*R*)-4,4,4-trifluoro-3-phenyl-1-(*p*-tolyl)butan-1-one
Chemical Formula: $C_{17}H_{15}F_3O$
Exact Mass: 292.11

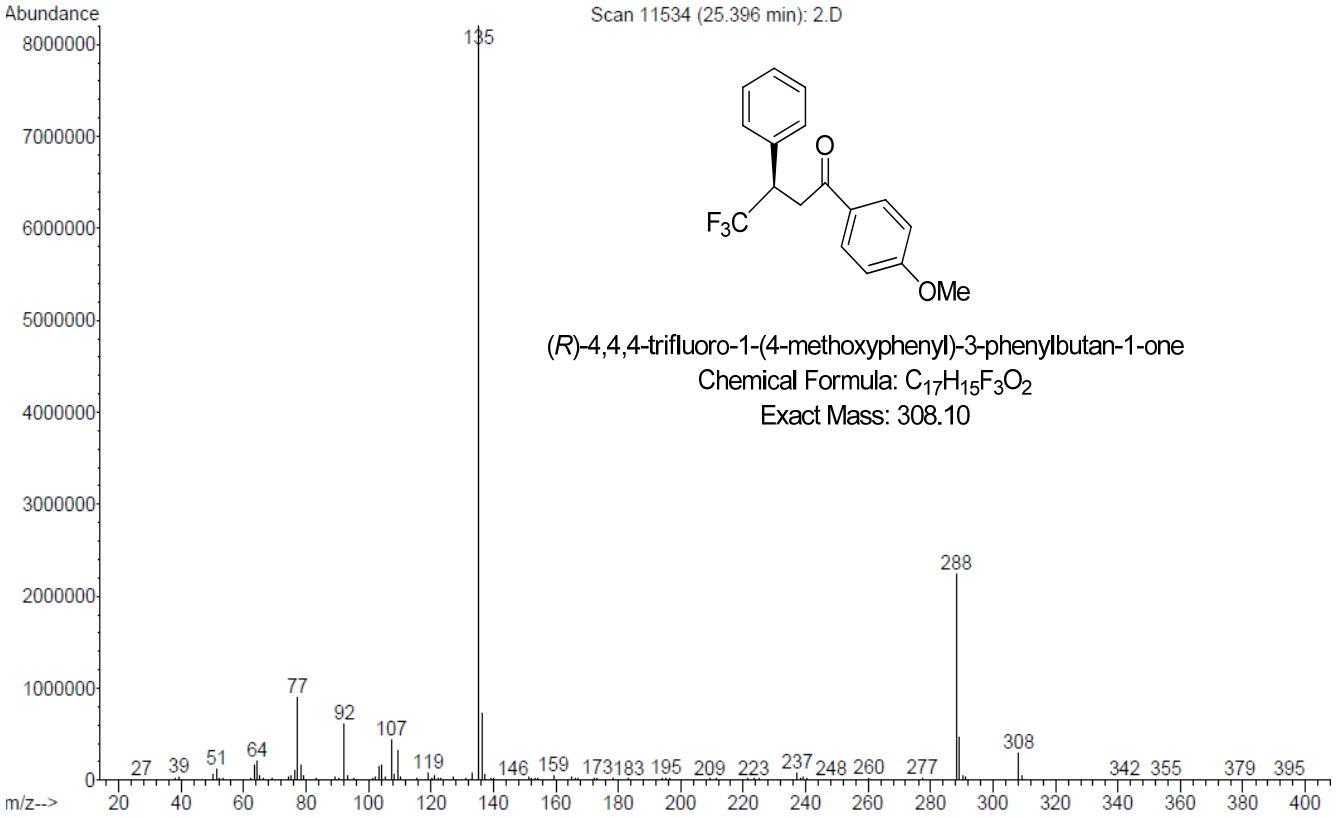
***6m*: (*R*)-4,4,4-Trifluoro-1-(4-methoxyphenyl)-3-phenyl-1-butanone**



Yield: 92% (90% ee, 100% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 3.53 (dd, *J* = 3.9, 17.4 Hz, 1H), 3.65 (dd, *J* = 9.0, 17.4 Hz, 1H), 3.85(s, 3H), 4.18-4.31 (m, 1H), 6.92 (d, *J* = 8.4 Hz, 2H), 7.29-7.40 (m, 5H), 7.91 (d, *J* = 8.7 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 38.0 (q, *J* = 1.5 Hz), 45.1 (q, *J* = 27.7 Hz), 55.7, 114.0, 127.3 (q, *J* = 278.2 Hz), 128.4, 128.9, 129.2, 129.6, 130.6, 135.0, 164.0, 194.0; GC/MS (m/z): 308.10; HPLC (OD-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.0 mL/min, 25 °C) t_1 = 8.2 min, t_2 =10.0 min.

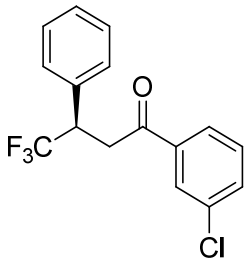




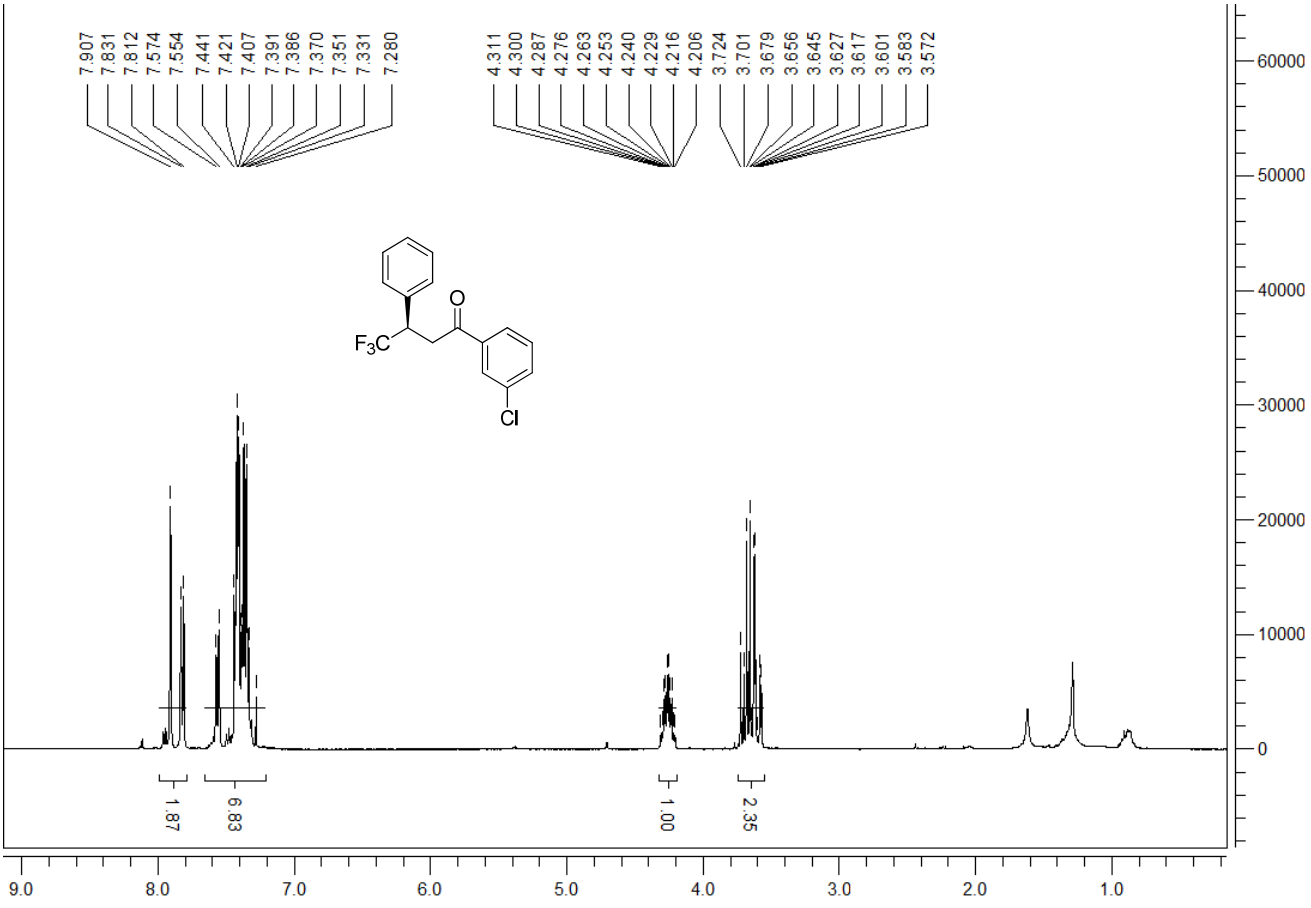


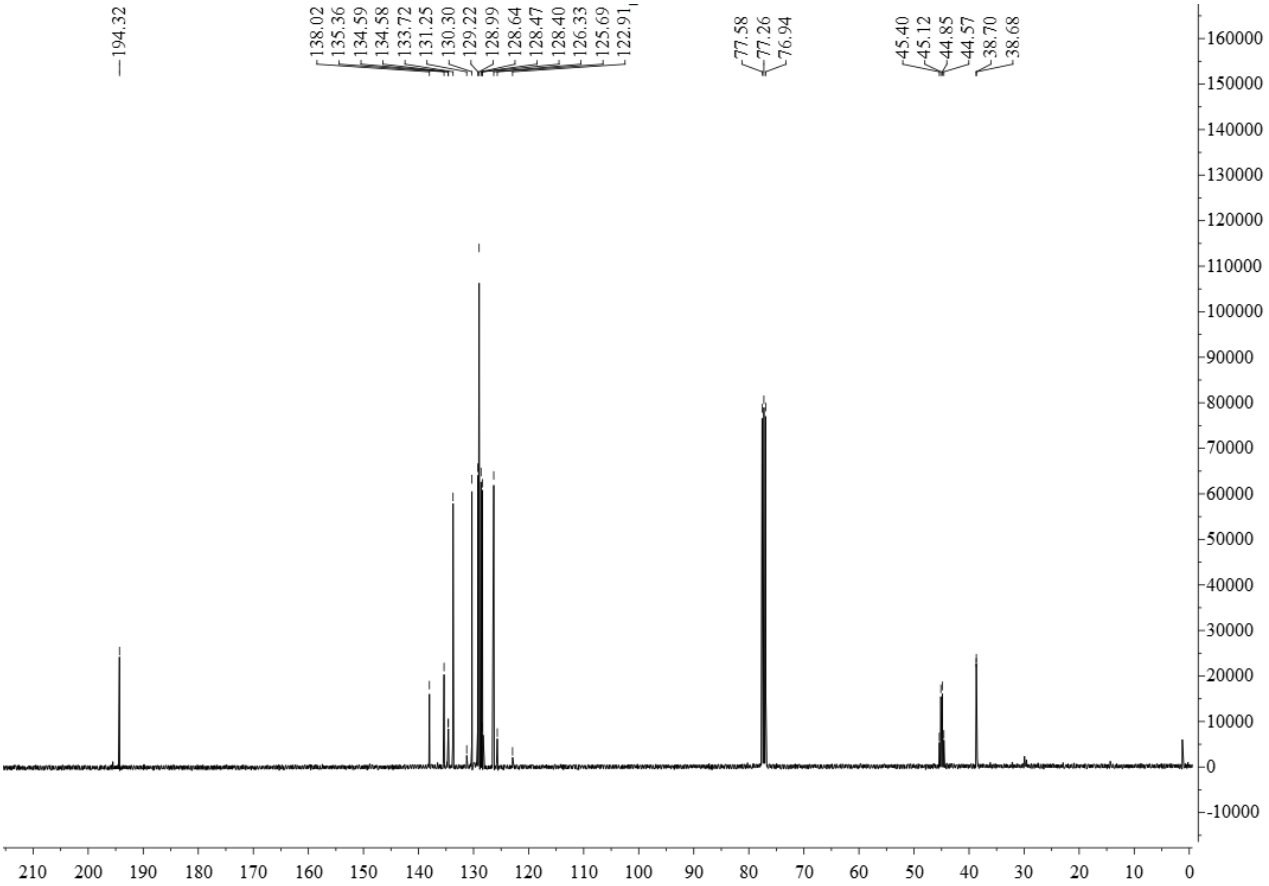
(*R*)-4,4,4-trifluoro-1-(4-methoxyphenyl)-3-phenylbutan-1-one
Chemical Formula: $C_{17}H_{15}F_3O_2$
Exact Mass: 308.10

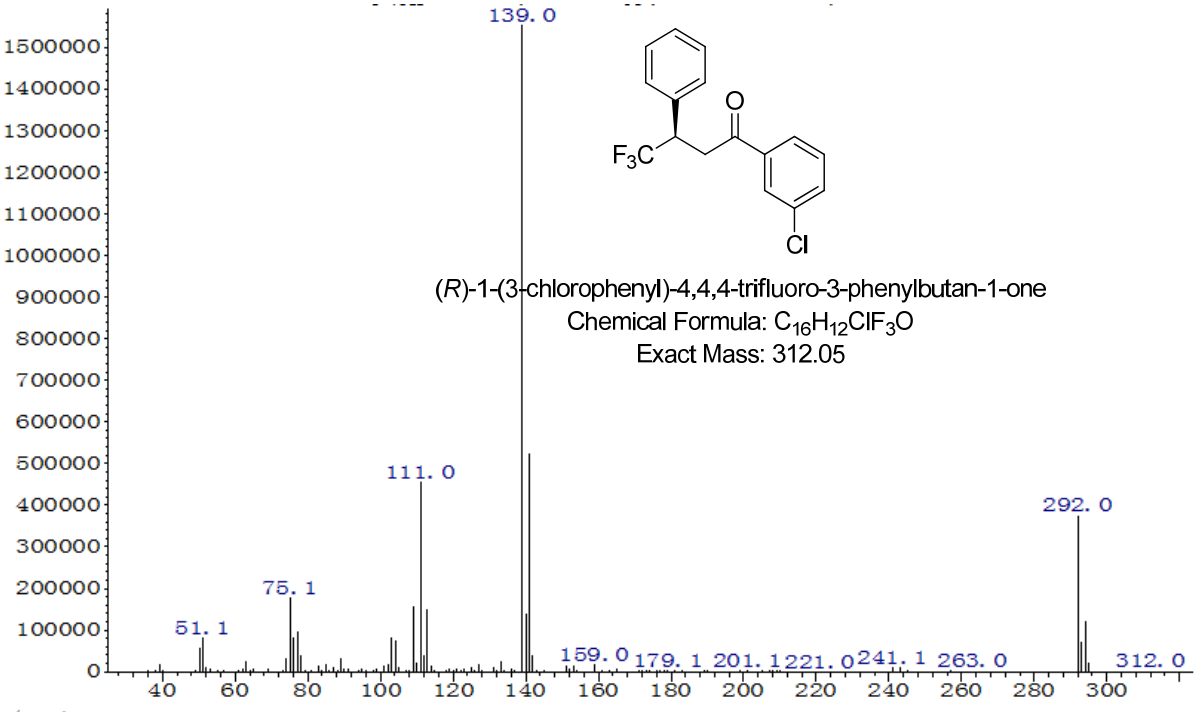
<u>*6n*</u>: (*R*)-1-(3-Chlorophenyl)-4,4,4-trifluoro-3-phenyl-1-butanone



Yield: 95% (93% ee, 99% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 3.58 (dd, 1H, *J* = 17.8 Hz, *J* = 4.4 Hz), 3.68 (dd, 1H, *J* = 17.8 Hz, *J* = 8.8Hz), 4.21–4.32 (m, 1H), 7.28–7.58 (m, 7H), 7.85 (d, 2H, *J* =8.6 Hz); ^{13}C NMR (100 MHz, $CDCl_3$): δ 38.7 (q, *J* = 2 Hz), 45.0 (q, J = 27 Hz), 126.3, 127.0 (q, J= 277.8 Hz), 128.4, 128.6, 129.2, 130.3, 133.7, 134.6 (q, J = 2 Hz), 135.4, 138.0, 194.3; GC/MS (m/z): 312; HPLC (OD-H, elute: Hexanes/i-PrOH = 97/3, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C), t_1 = 5.6 min, t_2 =7.6 min

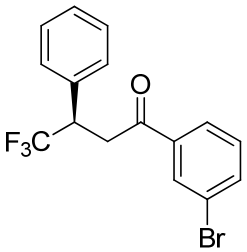




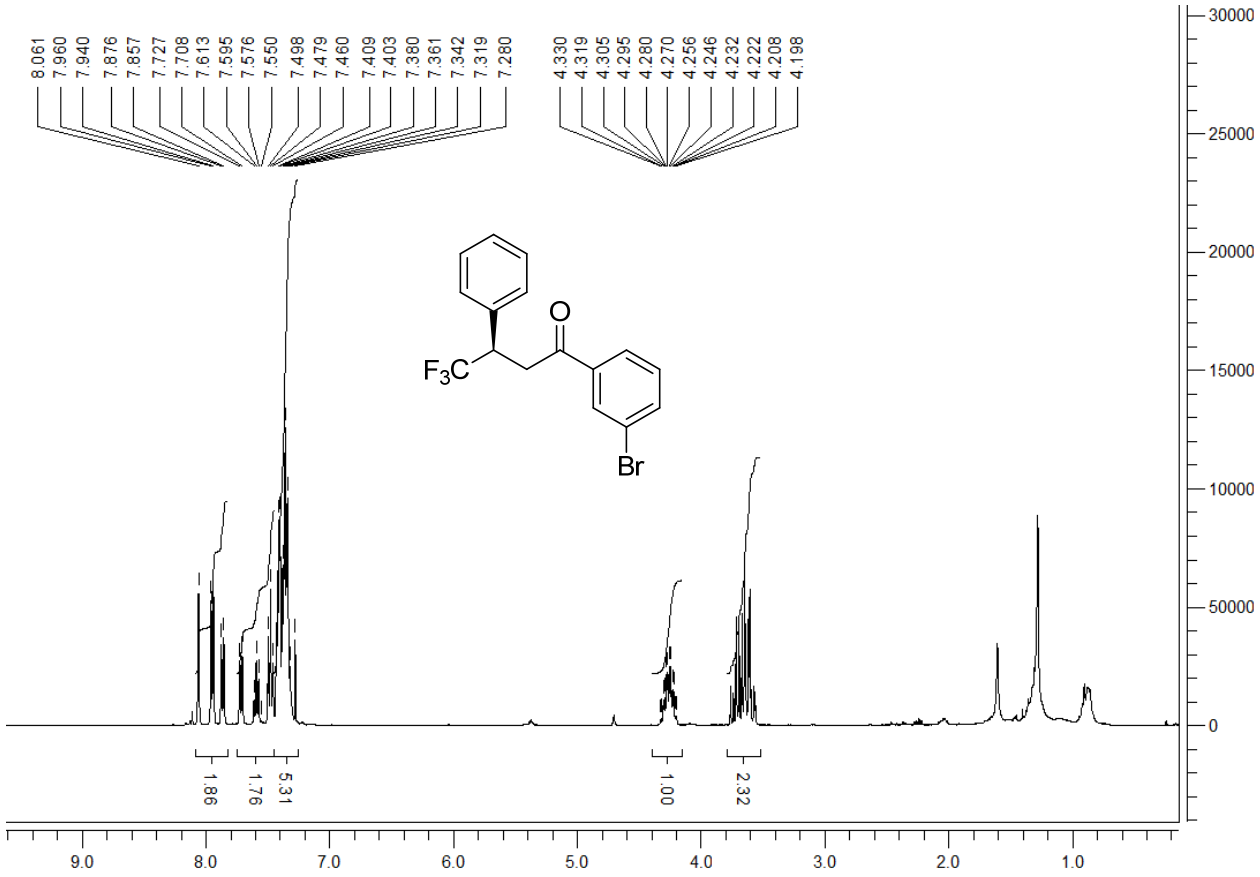


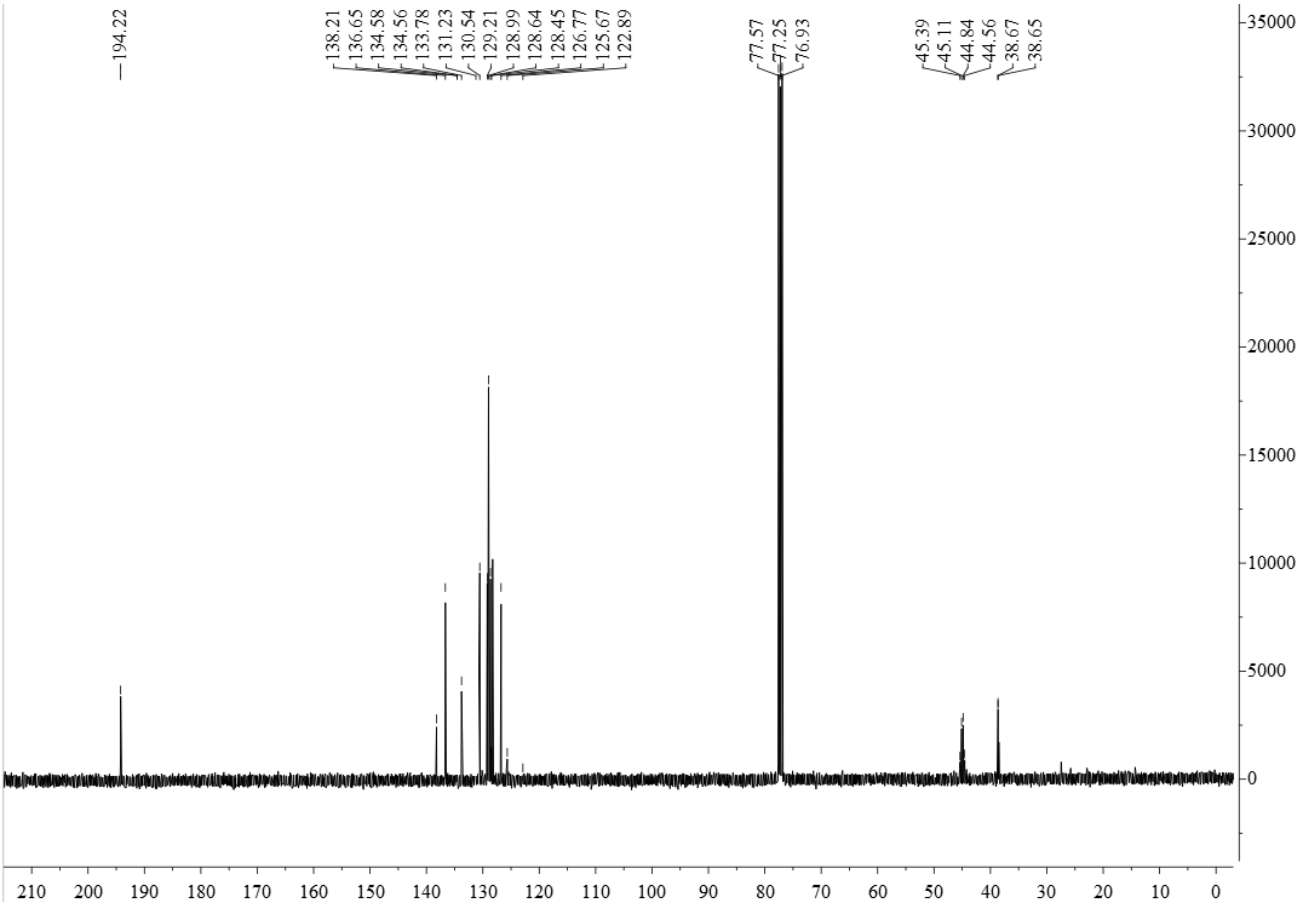
(*R*)-1-(3-chlorophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}ClF_3O$
Exact Mass: 312.05

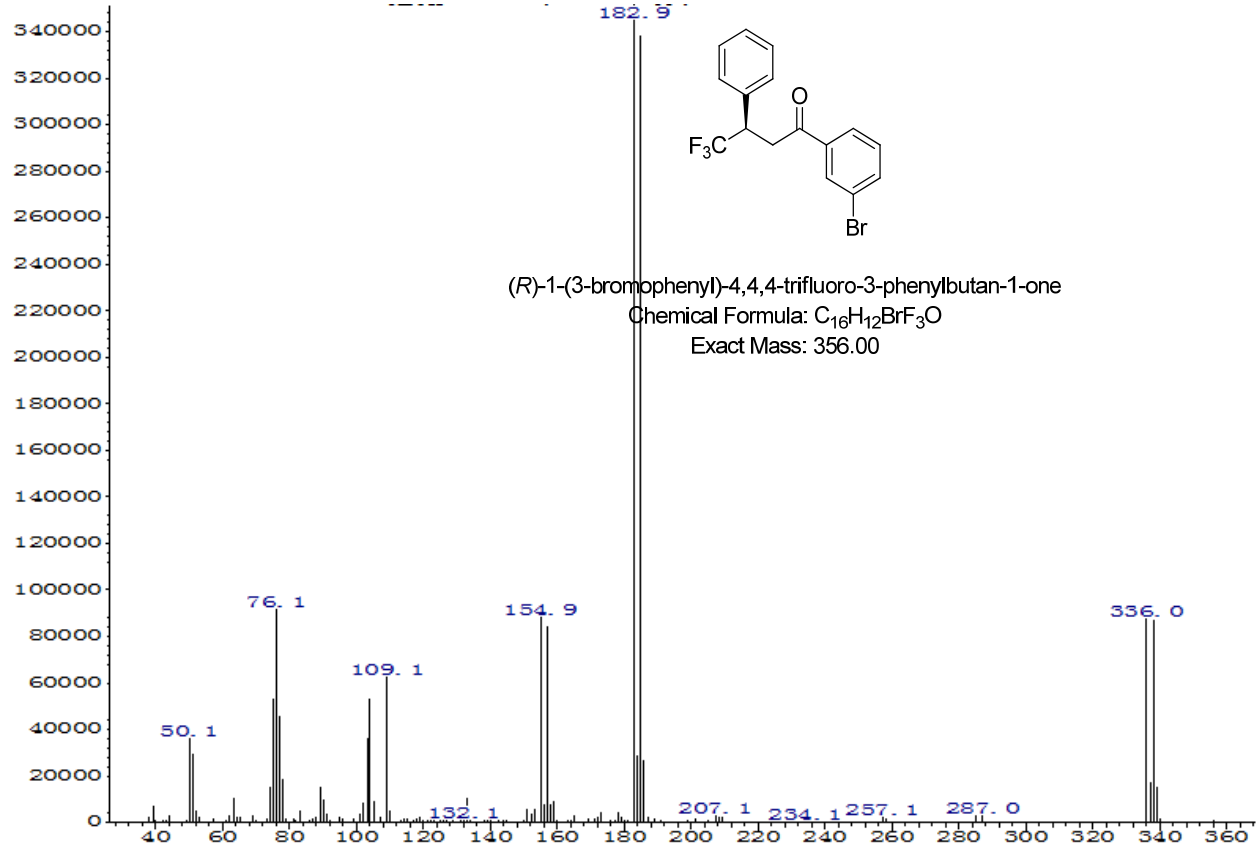
<u>*6o*:</u> (*R*)-1-(3-Bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one



Yield: 96% (93% ee, 100% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 3.57 (dd, 1H, *J* = 17.7 Hz, *J* = 4.4 Hz), 3.66 (dd, 1H, *J* = 17.7 Hz, *J* = 8.8 Hz), 7.27–7.42 (m, 5H),4.18–4.33 (m, 1H), 7.62 (d, 2H, *J* = 8.5 Hz), 7.88 (d, 2H, *J* = 8.5 Hz); ^{13}C NMR (100MHz, $CDCl_3$): δ 38.6 (q, *J* = 2 Hz), 45.0 (q, *J* = 27 Hz), 126.7, 127.0 (q, *J* = 277.9 Hz), 128.6, 128.9, 129.2, 130.5, 133.7, 134.6 (q, *J* = 2 Hz), 136.6, 138.2, 194.2; GC/MS (m/z): 356; HPLC (OD-H, elute: Hexanes/i-PrOH = 97/3, detector: 254 nm, flow rate: 1.0 mL/min, 25 °C), t_1 = 5.6 min, t_2 =7.6 min.

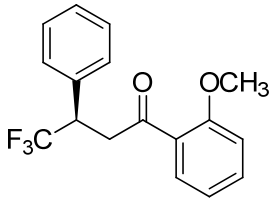




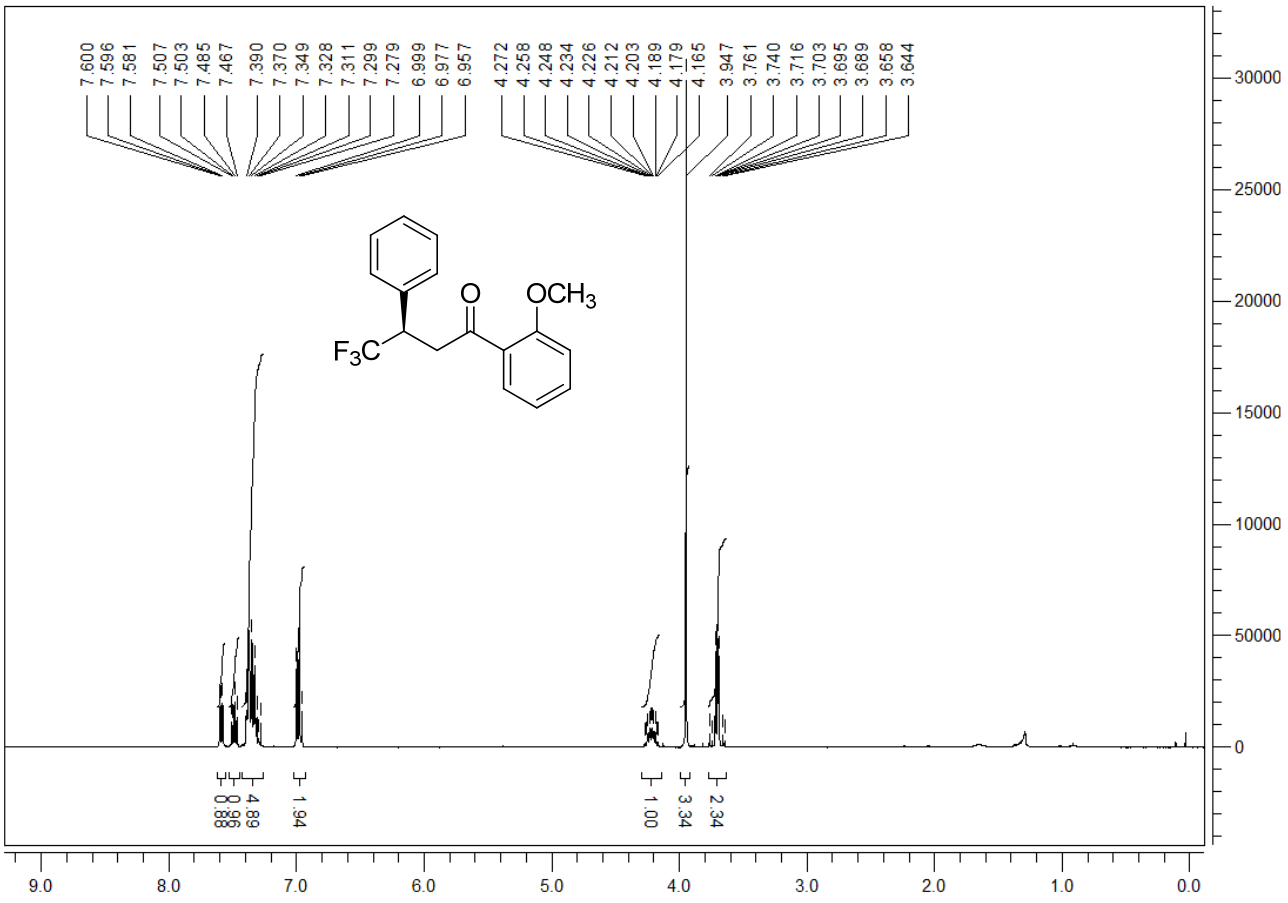


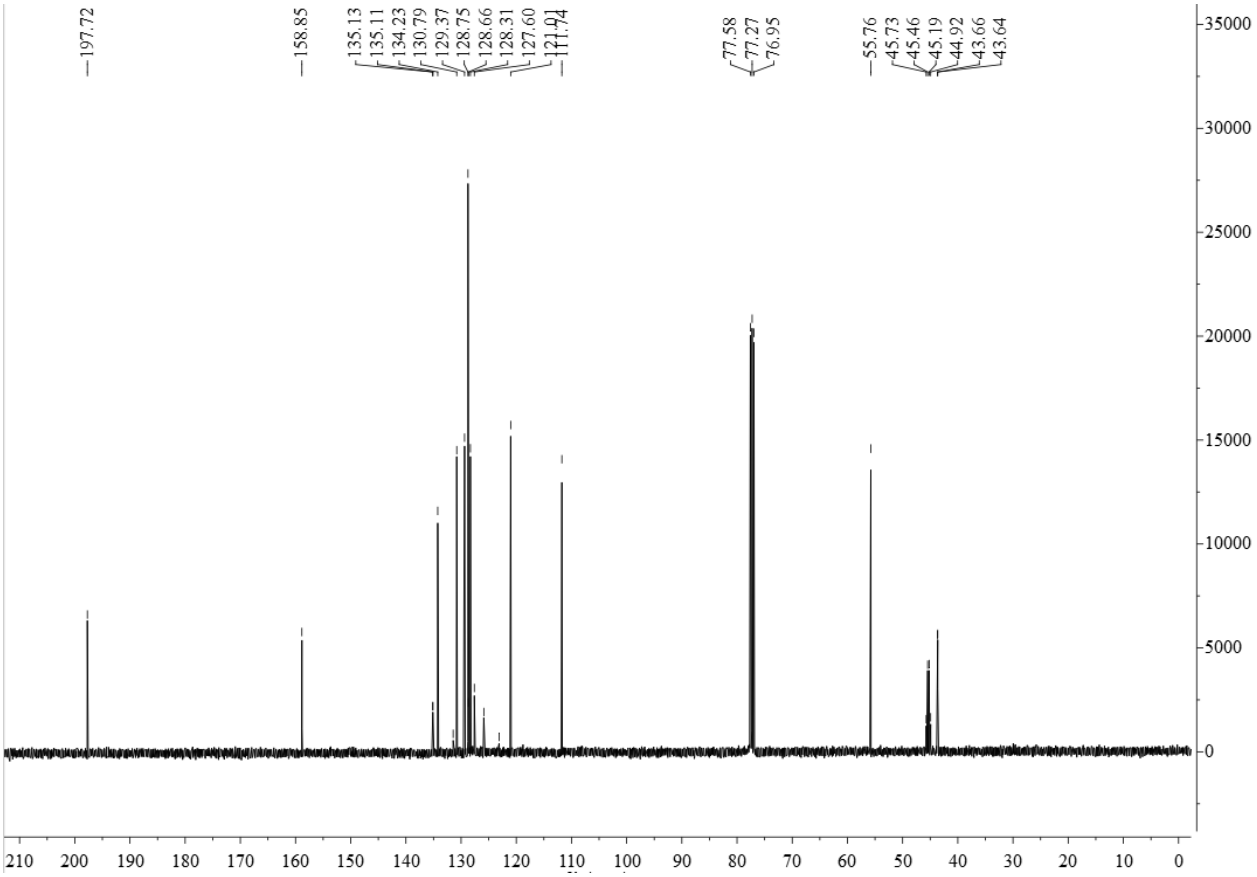
(*R*)-1-(3-bromophenyl)-4,4,4-trifluoro-3-phenylbutan-1-one
Chemical Formula: $C_{16}H_{12}BrF_3O$
Exact Mass: 356.00

<u>*6p*</u>: (*R*)-4,4,4-Trifluoro-1-(2-methoxyphenyl)-3-phenyl-1-butanone



Yield: 95% (92% ee, 100% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 3.63 (dd, 1H, *J* = 13.2 Hz, *J* = 1.0 Hz), 3.74 (dd, 1H, *J* = 17.9 Hz, *J* = 3.2 Hz), 3.95 (s, 3H), 4.16–4.28 (m, 1H), 6.94–7.10 (m, 2H), 7.57–7.61 (m, 1H), 7.28–7.40 (m, 5H), 7.45–7.51 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 43.6 (q, *J* = 2 Hz), 45.3 (q, *J*= 27 Hz), 55.7, 111.7, 121.0, 127.2 (q, *J* = 277.9 Hz), 127.6, 128.3, 128.7, 129.4, 130.8, 134.2, 135.1 (q, *J* = 1.5 Hz), 158.8, 197.7; GC/MS (m/z): 308; HPLC (OD-H, elute: Hexanes/i-PrOH = 97/3, detector: 254 nm, flow rate: 1.0 mL/min, 25 ^{o}C), t_1 = 6.8 min, t_2 =7.2 min

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135.13
135.11
134.23
130.79
129.37
128.75
128.66
128.31
127.60
121.91
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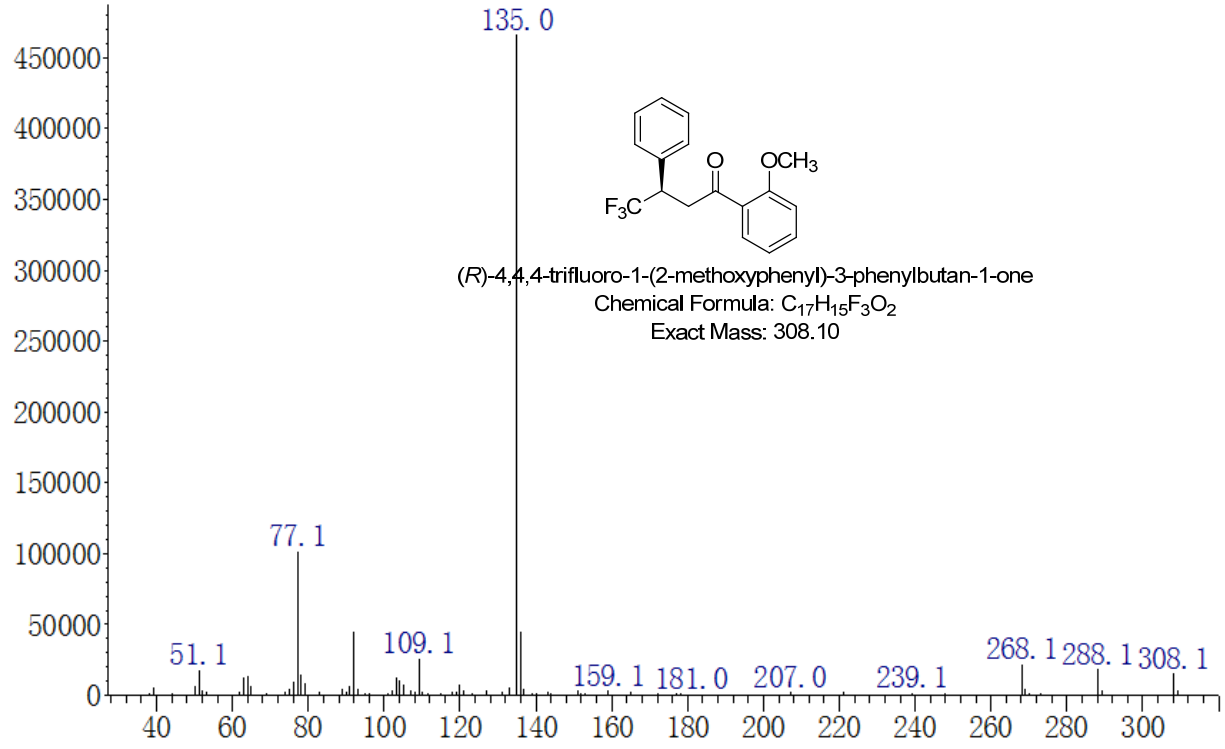
45.73
45.46
45.19
44.92
43.66
43.64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159.1
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239.1
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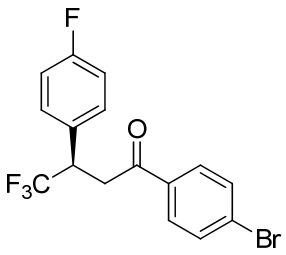
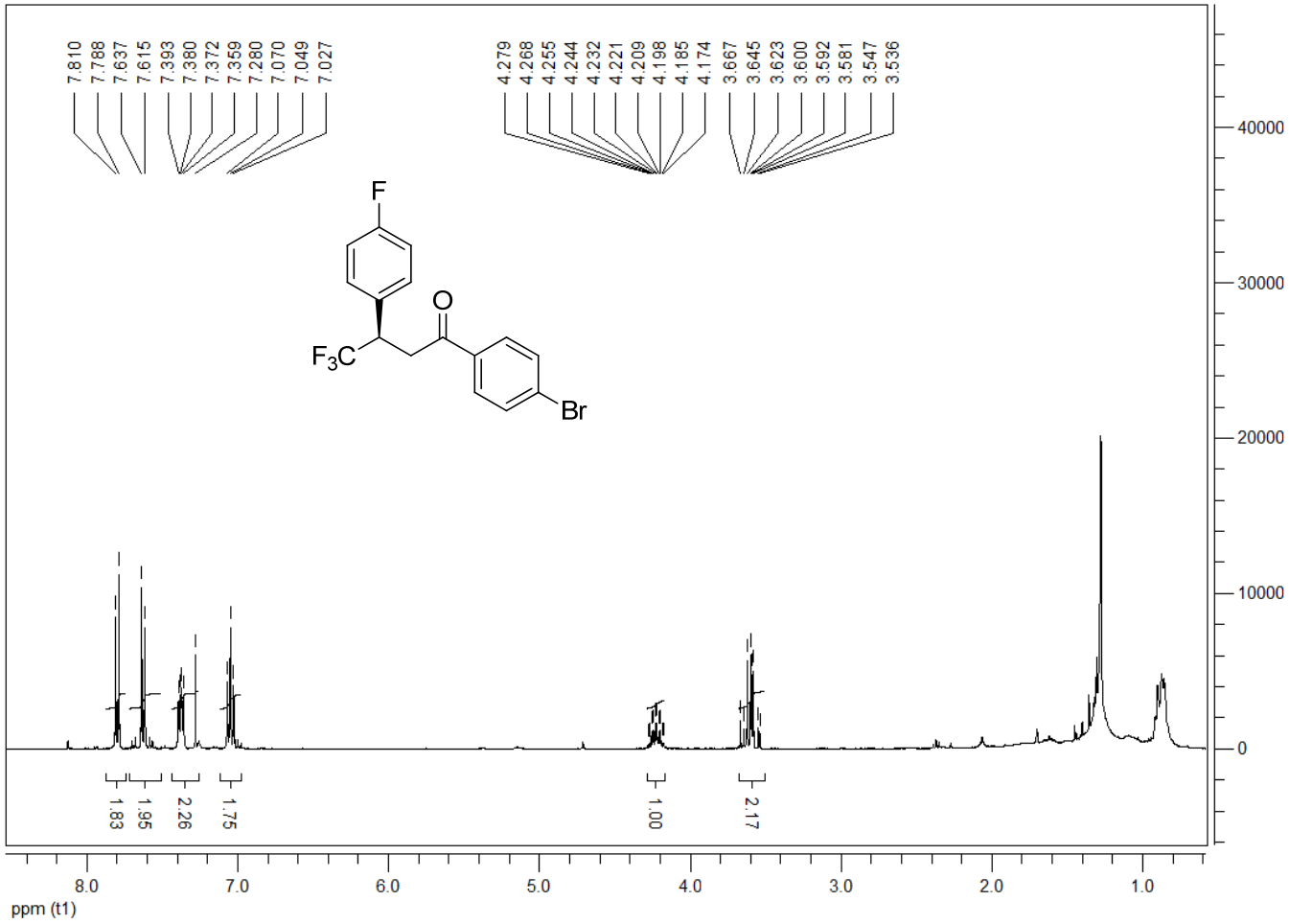
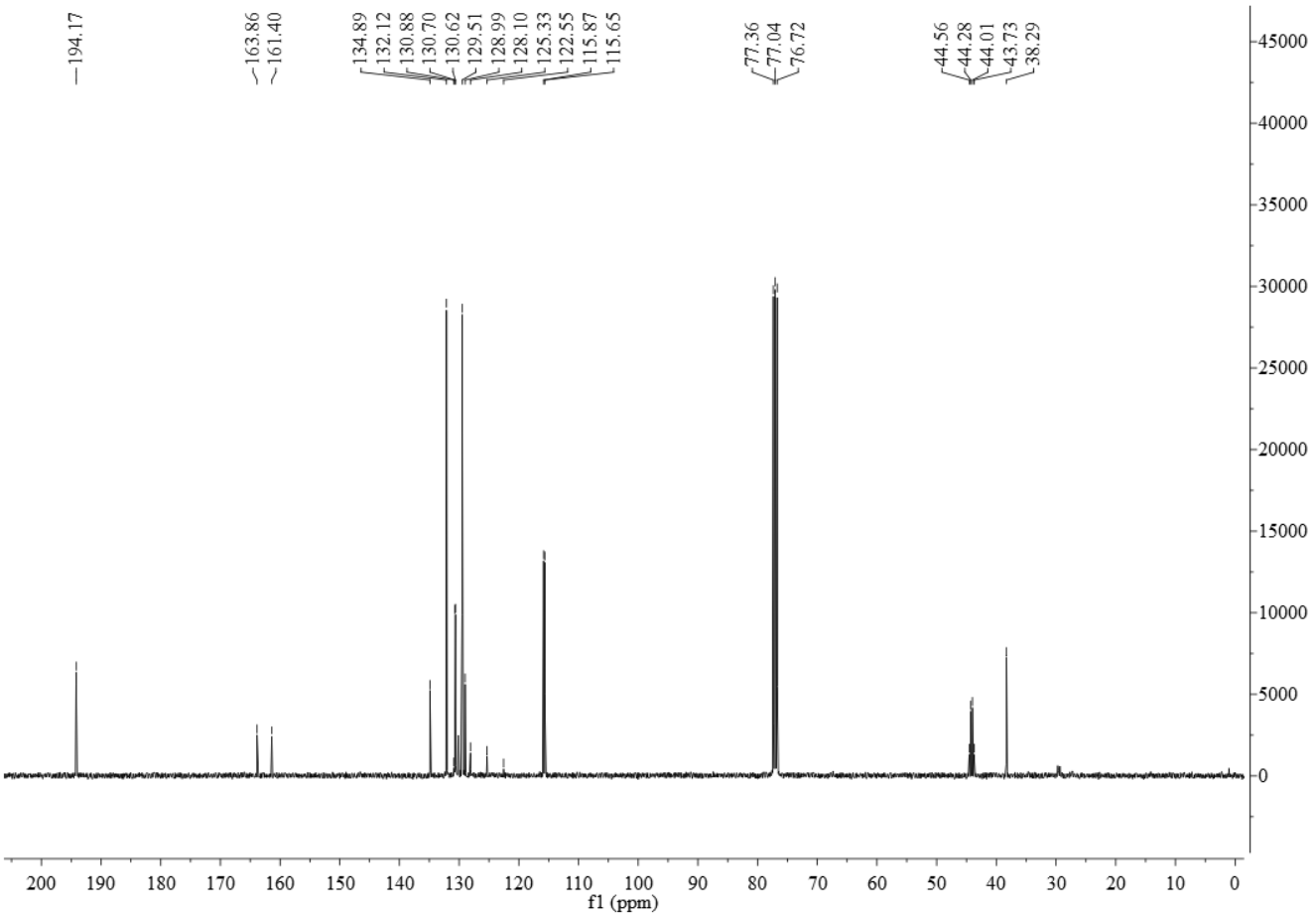
288.1
308.1
O
OCH3
F3C
(R)-4,4,4-trifluoro-1-(2-methoxyphenyl)-3-phenylbutan-1-one
Chemical Formula: C17H15F3O2
Exact Mass: 308.10

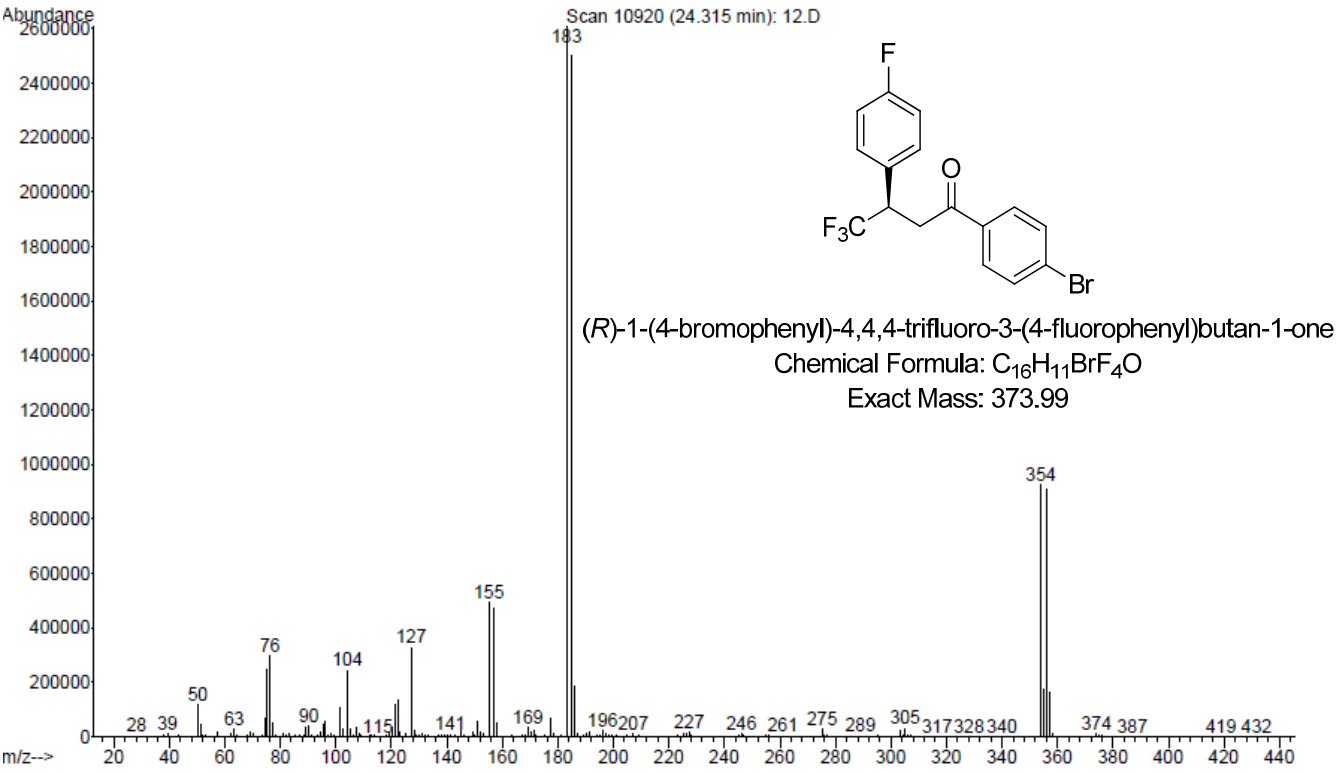
***6q*: (*R*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-(4-fluorophenyl)butan-1-one**



Yield: 95% (91% ee, 100% es); ^{1}H NMR (400 MHz, $CDCl_3$):δ3.52–3.67 (m, 2H), 4.21 (dd,*J*= 9.4, 4.4 Hz, 1H), 7.02–7.07 (m, 2H), 7.28–7.39 (m, 2H), 7.61–7.63(m, 2H), 7.78–7.81 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$):δ 38.3(q, *J* = 2Hz), 44.2 (q, *J* = 28 Hz),115.7 (d, *J* = 22 Hz),126.7 (q, *J* = 278 Hz), 129.0, 129.5,130.6, 130.7,132.1, 134.9, 162.6 (d, *J* = 246 Hz),194.2;GC/MS (m/z): 373.99; HPLC (OJ-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.5 mL/min, 25 °C) t_1 = 15.2 min, t_2=19.4min.

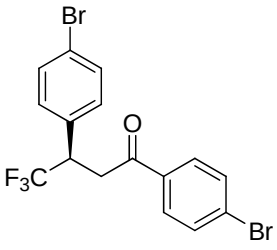




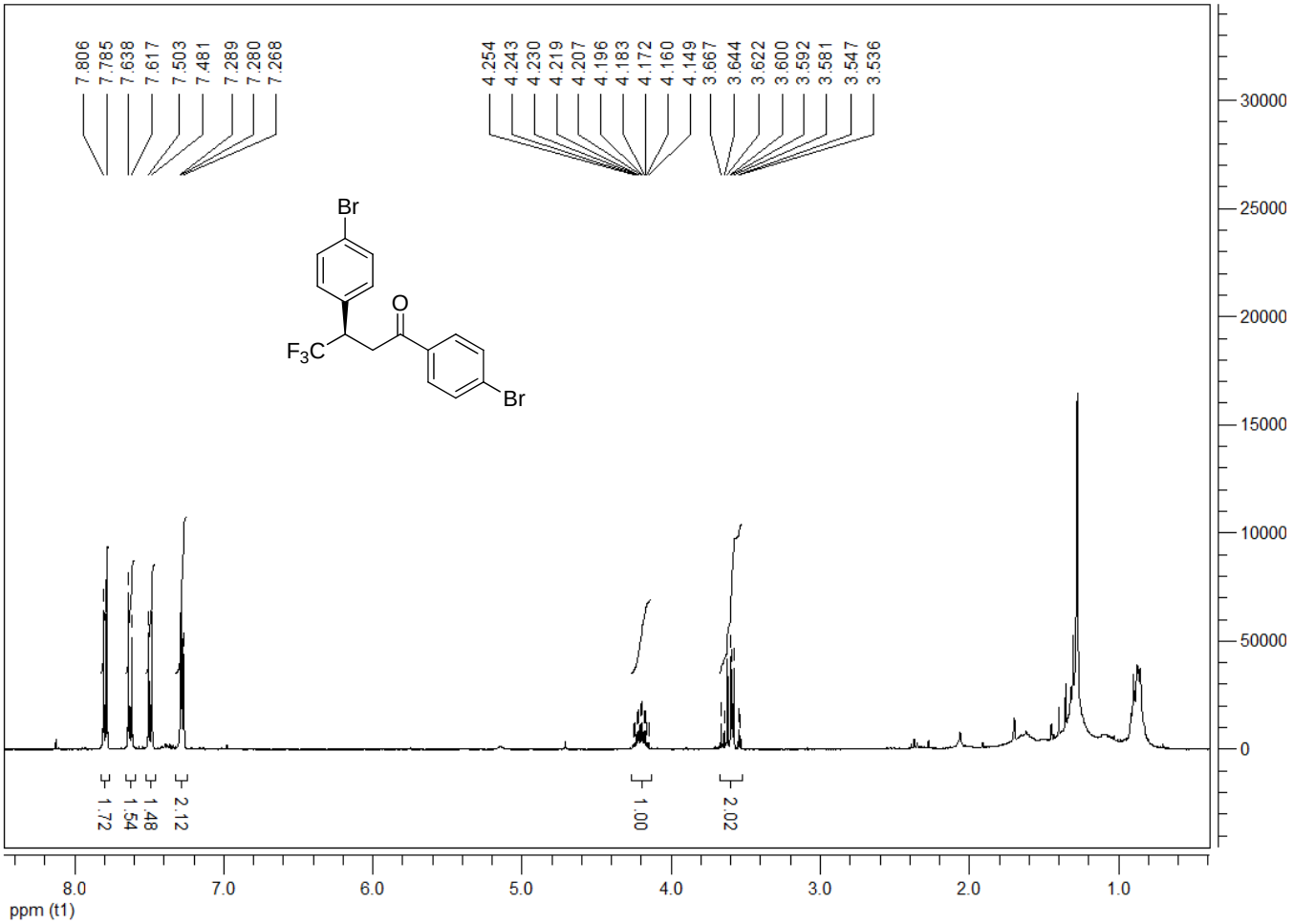


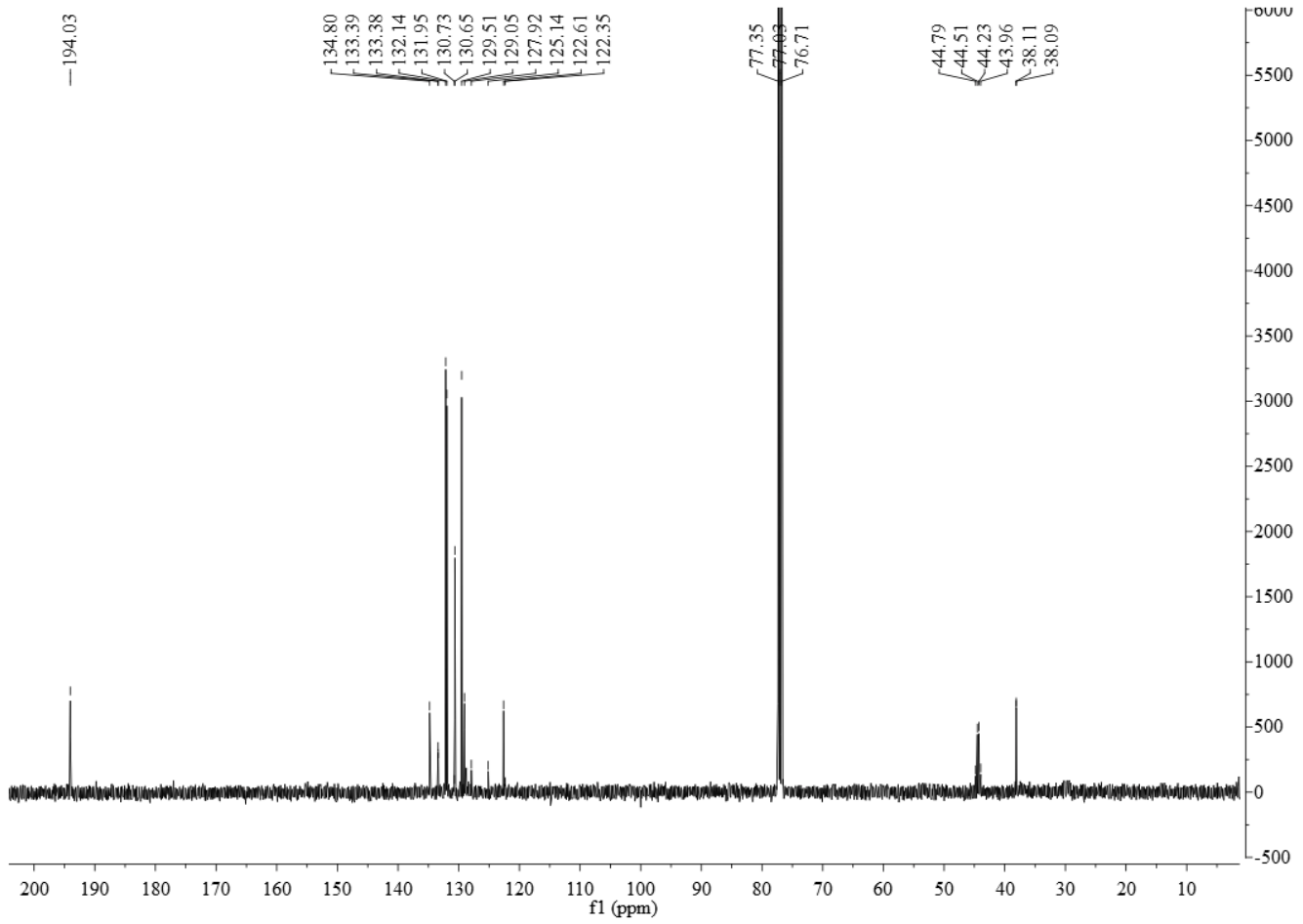
(*R*)-1-(4-bromophenyl)-4,4,4-trifluoro-3-(4-fluorophenyl)butan-1-one
Chemical Formula: $C_{16}H_{11}BrF_4O$
Exact Mass: 373.99

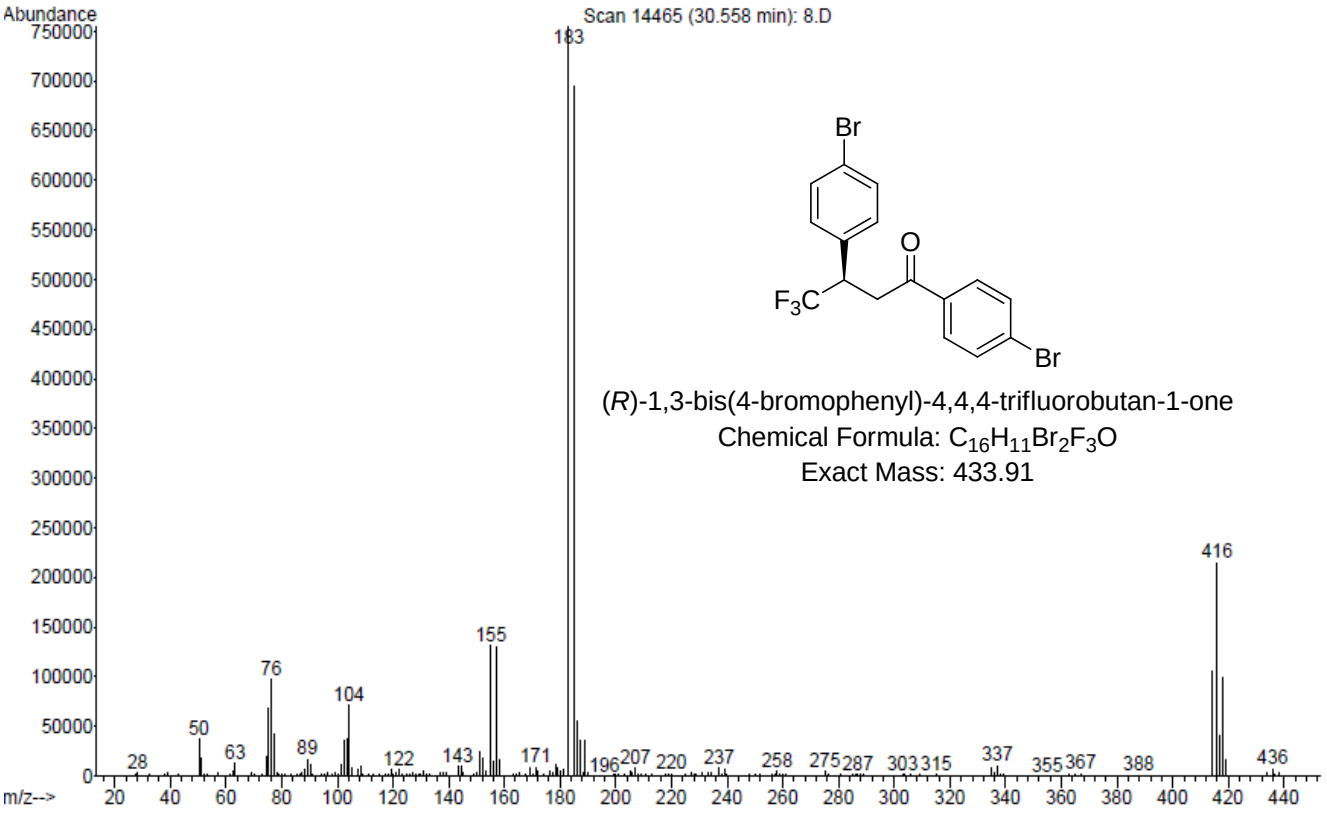
***6r*: (*R*)-4,4,4-Trifluoro-1,3-bis(4-bromophenyl)butan-1-one**



Yield: 94% (90% ee, 97% es); ^{1}H NMR (400 MHz, $CDCl_3$): δ 3.51–3.65 (m, 2H), 4.18 (dd,J = 9.4, 4.4 Hz, 1H), 7.23–7.29 (m, 2H), 7.44–7.49 (m, 2H), 7.57–7.62(m, 2H), 7.74–7.79 (m, 2H);^{13}C NMR (100 MHz, $CDCl_3$): δ= 38.1(q, *J*= 1.5 Hz), 44.4 (q, *J*= 27 Hz), 122.6, 126.5 (q, *J* = 279 Hz), 129.1, 129.5 (d, *J* = 2 Hz), 130.6,131.9, 132.1, 133.4 (d, *J*= 1.7 Hz), 134.8, 194.0; GC/MS (m/z): 433.91; HPLC (OJ-H, elute: *n*-hexanes/*i*-PrOH = 95/5, detector: 254 nm, flow rate: 1.5 mL/min, 25 ^{o}C) t_1 = 11.9 min, t_2 = 12.9 min.







(*R*)-1,3-bis(4-bromophenyl)-4,4,4-trifluorobutan-1-one
Chemical Formula: $C_{16}H_{11}Br_2F_3O$
Exact Mass: 433.91