Supporting Information

Visible-light induced three component radical cascade 1,2-dialkylation of alkenes to access alcohols

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1. General information

^{1}H NMR spectra were recorded on a Bruker AVANCE III 800 spectrometer with 800 MHz frequencies, and ^{13}C NMR spectra were recorded on a Bruker AVANCE III 800 spectrometer with 200 MHz frequencies. The chemical shifts of ^{1}H NMR spectra in $CDCl_3$ were determined with $Si(CH_3)_4$ as the internal standard (δ = 0.0 ppm). The chemical shifts in ^{13}C NMR spectra were determined based on the chemical shift of $CDCl_3$ (δ = 77.0 ppm). Multiplicities are given as s (singlet), d (doublet), t (triplet), dd (doublet of doublet), td (triplet of doublet) or m (multiplet). Deuterated solvents were purchased from Cambridge Isotope Laboratories. HRMS spectra were measured using a Q-TOF instrument equipped with an ESI source.

A 40 W Kessil blue LED lamp (440 nm) was used as the light source. The distance of the tube from the light source is 4–5 cm.

Unless otherwise noted, the chemicals are either commercially available or known compounds that can be prepared following reported procedures. All the solvents are anhydrous or of analytical grade and are used without further purification. Analytical TLC was performed with silica gel GF254 plates, and 200–300 mesh silica gel was employed for column chromatography.

2. General procedure for the synthesis of 4

Procedure A: **1** and **2** are solid.

Cs_2CO_3 (0.4 mmol, 2.0 equiv.), 4CzIPN (5.0 mol%), vinylarenes **1** (0.3 mmol, 1.5 equiv.), APEs **2** (0.2 mmol, 1.0 equiv.) and aldehyde **3** (0.3 mmol, 1.5equiv.) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M,

2 mL), extracted into EtOAc (3×10 mL) and washed with water and brine (20 mL). Then organic phase was combined, dried with Na_2SO_4, filtered, and concentrated in vacuo. And the residue was purified with chromatography column on silica gel (eluting with PE /EA) to afford products **4**.

Procedure B: **1** and **2** are liquid.

Cs_2CO_3 (0.4 mmol, 2.0 equiv.) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Vinylarenes **1** (0.3 mmol, 1.5 equiv.), APEs **2** (0.2 mmol, 1.0 equiv.) and aldehyde **3** (0.3 mmol, 1.5 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2 mL), extracted into EtOAc (3×10 mL) and washed with water and brine (20 mL). Then the organic phase was combined, dried with Na_2SO_4, filtered, and concentrated in vacuo. And the residue was purified with chromatography column on silica gel (eluting with PE/EA) to afford products **4**.

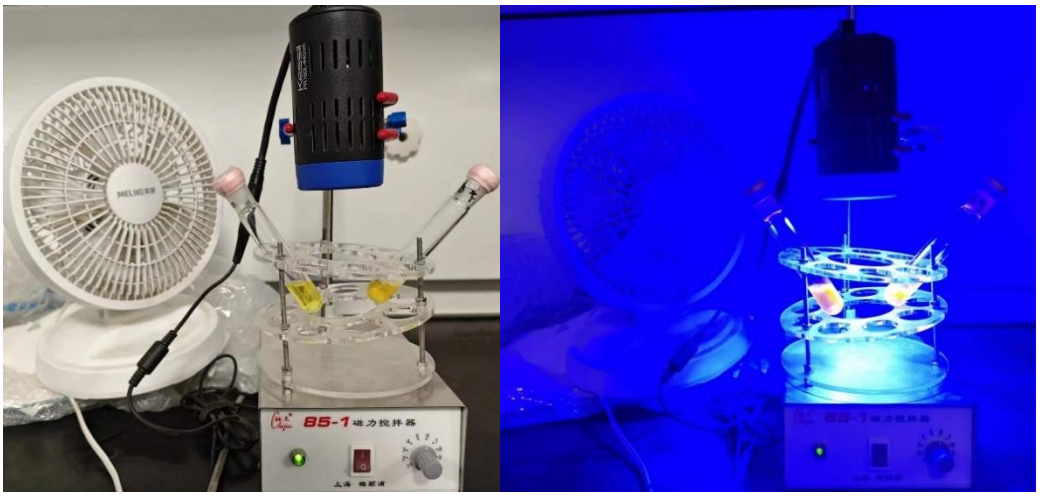
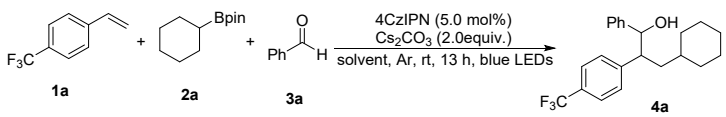


Figure S1. Reaction setup

3. Optimization of the reaction conditions

Table S1. Screen of solvent

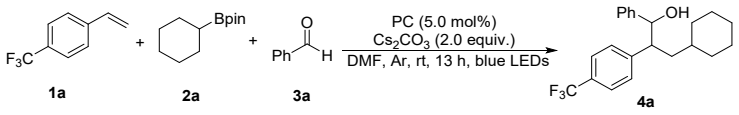


1a 2a 3a 4a

entry	Solvent	yield (%)
1	DMF	81%
2	DCE	43%
3	DCM	37%
4	1,4-dioxane	39%
5	DMA	62%
6	MeOH	trace
7	NMP	65%
8	THF	38%
9	DMSO	69%

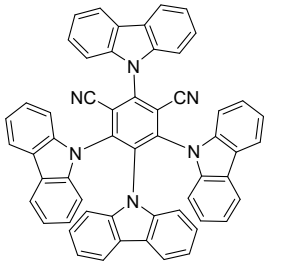
Reaction conditions: **1a** (1.5 equiv., 0.3 mmol), **2a** (0.2 mmol), **3a** (1.5 equiv., 0.3 mmol), 4CzIPN (5.0 mol%), Cs_2CO_3 (2.0 equiv., 0.4 mmol), solvent (2.0 mL), 40W kessil blue LED (440 nm, 75% intensity), room temperature, 13 h, under an argon atmosphere. Isolated yield.

Table S2. Screen of photocatalyst

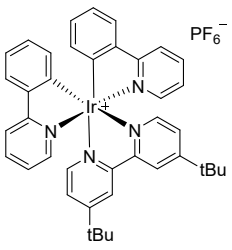


entry	Photocatalyst	yield (%)
1	PC-1	81%
2	PC-2	75%
3	PC-3	20%
4	PC-4	22%
5	PC-5	48%
6	PC-6	NR

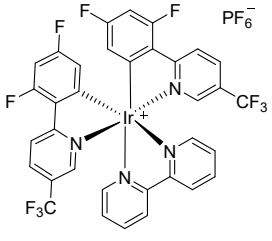
Reaction conditions: **1a** (1.5 equiv., 0.3 mmol), **2a** (0.2 mmol), **3a** (1.5 equiv., 0.3 mmol), PC (5.0 mol%), Cs_2CO_3 (2.0 equiv., 0.4 mmol), DMF (2.0 mL), 40W kessil blue LED (440 nm, 75% intensity), room temperature, 13 h, under an argon atmosphere. isolated yield.



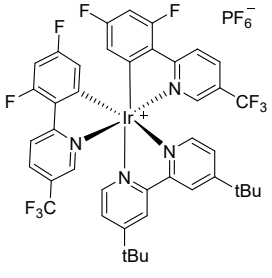
PC-1, 81%



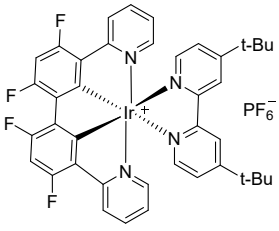
PC-2, 75%



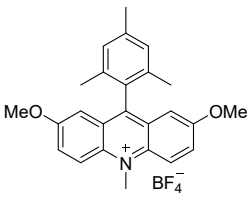
PC-3, 20%



PC-4, 22%

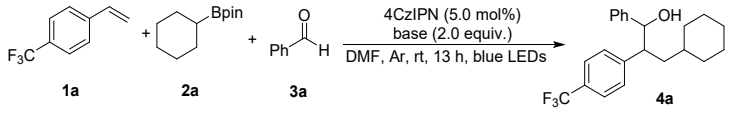


PC-5, 48%



PC-6, NR

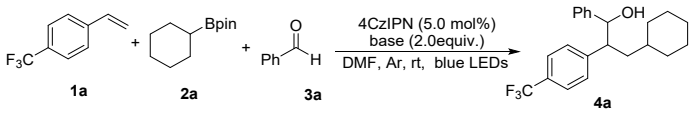
Table S3. Screen of base



entry	Base	yield (%)
1	NaOMe	61%
2	NaOH	76%
3	K_3PO_4	72%
4	DMAP (30 mol%)	trace
5	PPh_3 (30 mol%)	trace
6	DABCO (30 mol%)	ND
7	^{t}BuOK	ND
8	^{t}BuONa	ND
9	Cs_2CO_3	81%
10	K_2CO_3	33%
11	Na_2CO_3	42%
12	$NaHCO_3$	69%
13	CH_3COONa	32%
14	morpholine	43%
15	Pyrrolidine	trace
16	2,6-Lutidine	69%
17	none	15%

Reaction conditions: **1a** (1.5 equiv., 0.3 mmol), **2a** (0.2 mmol), **3a** (1.5 equiv., 0.3 mmol), 4CzIPN (5.0 mol%), base (2.0 equiv., 0.4 mmol), DMF (2.0 mL), 40W kessil blue LED (440 nm, 75% intensity), room temperature, 13 h, under an argon atmosphere. isolated yield.

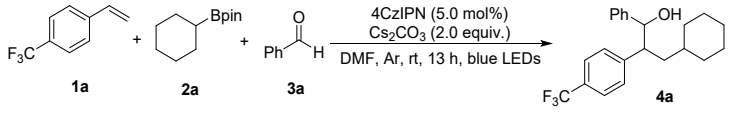
Table S4. Screen of reaction time



entry	Time	yield (%)
1	6 h	53%
2	10 h	70%
3	13 h	81%
4	15 h	63%

Reaction conditions: **1a** (1.5 equiv., 0.3 mmol), **2a** (0.2 mmol), **3a** (1.5 equiv., 0.3 mmol), 4CzIPN (5.0 mol%), Cs_2CO_3 (2.0 equiv., 0.4 mmol), DMF (2.0 mL), 40W kessil blue LED (440 nm, 75% intensity), room temperature, under an argon atmosphere. isolated yield.

Table S5. Screen of wavelength and power

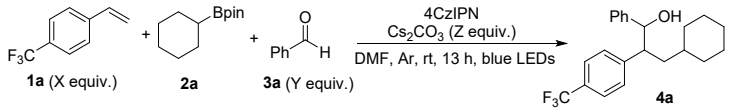


entry	wavelength and power	yield (%)
1	427 nm	40%

2	440 nm	81%
3	456 nm	44%
4	25%	47%
5	50%	71%
6	75%	81%
7	100%	72%

Reaction conditions: **1a** (1.5 equiv., 0.3 mmol), **2a** (0.2 mmol), **3a** (1.5 equiv., 0.3 mmol), 4CzIPN (5.0 mol%), Cs_2CO_3 (2.0 equiv., 0.4 mmol), DMF (2.0 mL), 40W kessil blue LED (440 nm, 75% intensity), room temperature, 13 h, under an argon atmosphere. isolated yield.

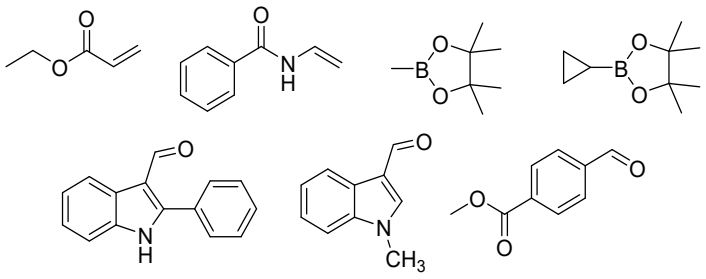
Table S6. Screen of ratio



entry	variation	yield (%)
1	**1** (1.0 equiv.)	64%
2	**1** (1.5 equiv.)	81%
3	**1** (2.0 equiv.)	77%
4	**3** (1.0 equiv.)	66%
5	**3** (1.5 equiv.)	81%
6	**3** (2.0 equiv.)	56%
7	4CzIPN (1.0 mol%)	58%
8	4CzIPN (2.0 mol%)	68%
9	4CzIPN (5.0 mol%)	81%
10	DMF (0.5 mL)	67%
11	DMF (1.0 mL)	60%
12	DMF (1.5 mL)	64%
13	DMF (2.0 mL)	81%
14	Cs_2CO_3 (1.0 equiv.)	59%
15	Cs_2CO_3 (1.5 equiv.)	58%
16	Cs_2CO_3 (2.0 equiv.)	81%
17	Cs_2CO_3 (2.5 equiv.)	64%
18	Cs_2CO_3 (3.0 equiv.)	62%

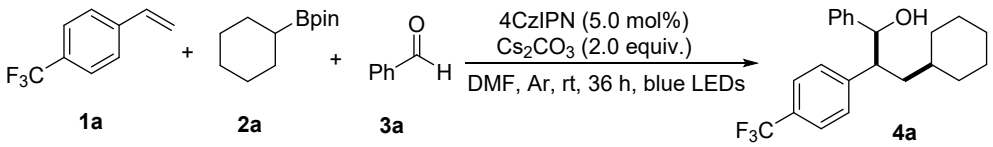
Reaction conditions: **1a** (X equiv.), **2a** (0.2 mmol), **3a** (Y equiv.), 4CzIPN, Cs_2CO_3 (Z equiv.), DMF, 40W kessil blue LED (440 nm, 75% intensity), room temperature, 13 h，under an argon atmosphere. isolated yield.

Table S7. Unsuccessful substrates



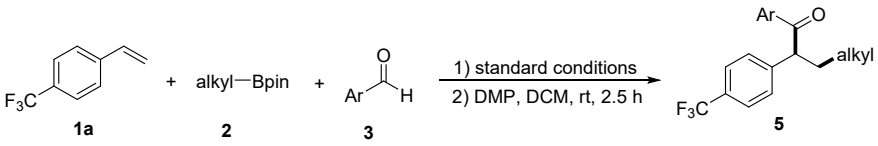
4. Scale-up reaction and synthetic applications

4.1 Gram-scale experiment:



Cs_2CO_3 (12.0 mmol, 2.0 equiv.) and 4CzIPN (5.0 mol%) were added into a 100 mL oven-dried glass flask equipped with a magnetic stirring bar and rubber stopper, the flask was evacuated and backfilled with argon (repeated three times). Vinyl arenes **1a** (9.0 mmol, 1.5 equiv.), cyclohexylboronic acid pinacol ester **2a** (6.0 mmol, 1.0 equiv.) and benzaldehyde **3a** (9.0 mmol, 1.5 equiv.) were added into the flask. Then, DMF (30 mL) was added to the flask, and the reaction mixture was irradiated with 2 ☋ 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 36 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 15 mL), extracted into EtOAc (3×20 mL) and washed with water and brine (20 mL). Then the organic phase was combined, dried with Na_2SO_4, filtered, and concentrated in vacuo. And the residue was purified with chromatography column on silica gel (eluting with PE /EA) to afford products **4** in 72% yield (1.56g).

4.2 Three-component 1,2-alkylbenzoylation for the synthesis of 5:



Cs_2CO_3 (0.4 mmol, 2.0 equiv.) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Vinylarenes **1** (0.3 mmol, 1.5 equiv.), APEs **2** (0.2 mmol, 1.0 equiv.) and aldehyde **3** (0.3 mmol, 1.5 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2 mL) and extracted into EtOAc (3×10 mL). The organic layer was washed with saturated brine and dried over Na_2SO_4. The solvent was removed

under reduced pressure. Then DCM (2 mL) and DMP (1.2 equiv., 0.24 mmol) were added in turn under N_2 flow. The mixture was allowed to react at room temperature for approximately 2.5 h. After completion, the mixture was evaporated to dryness under reduced pressure and then the resulting residue was purified by column chromatography on silica gel to afford the desired product **5**.

5. Cyclic voltammetry measurements

Determination of the potential of substrates was performed by cyclic voltammetry using a CHI760E potentiostation. Cyclic voltammetry (CV) measurement was conducted in a 40 mL glass vial fitted with a glassy carbon working electrode (3 mm in diameter), a saturated calomel reference electrode, and a platinum wire counter electrode.

DMF (40 mL) containing nBu$_4$NBF$_4$ (4.0 mmol), CyBpin (0.032 mmol) and Cs_2CO_3 (2.0 equiv., 0.064 mmol) were poured into the electrochemical cell and stirred for 5 min. The scan rate is 100 mV/s, ranging from 0 V to 2.0 V.

Table S8. Information about cyclic voltammetry experiments

CV plotting convention	**Solvent**	**Electrolyte**
IUPAC	DMF	0.1 M n-Bu$_4$NBF$_4$
Working electrode	**Counter electrode**	**Reference electrode**
glassy carbon electrode	platinum electrode	saturated calomel electrode
Analyte (0.1M)		
CyBpin + Cs_2CO_3		
Starting point	**Direction of scan**	**Solvent deoxygenation**
0 (V)	positive	blow nitrogen to solvent
Polishing method		
8-shaped grinding on sandpaper with polishing powder and water		
Polishing material		
mixture of cerium oxide, alumina, iron oxide, silicon oxide, zirconium oxide, chromium oxide		

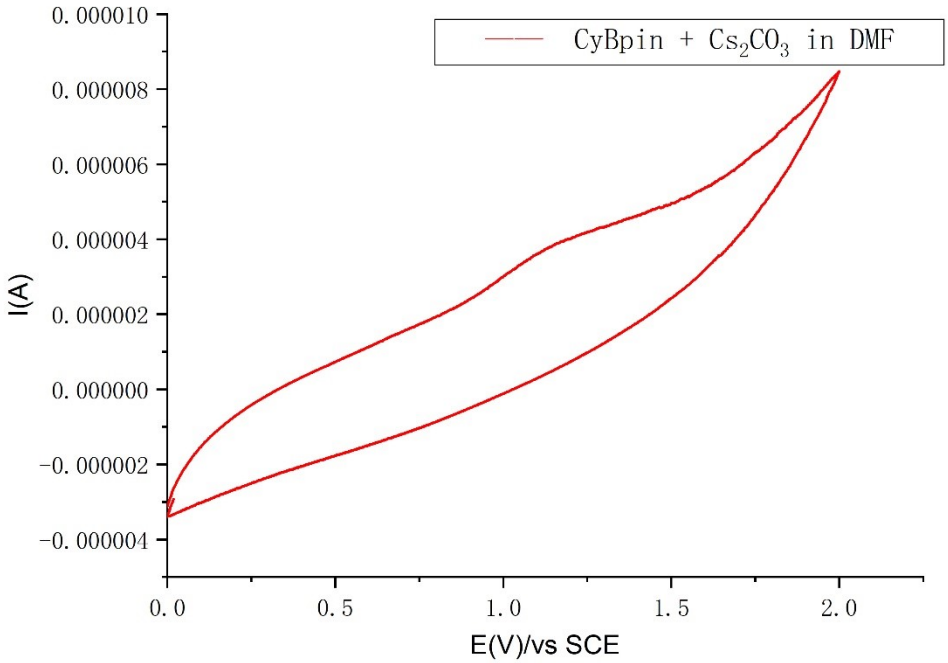
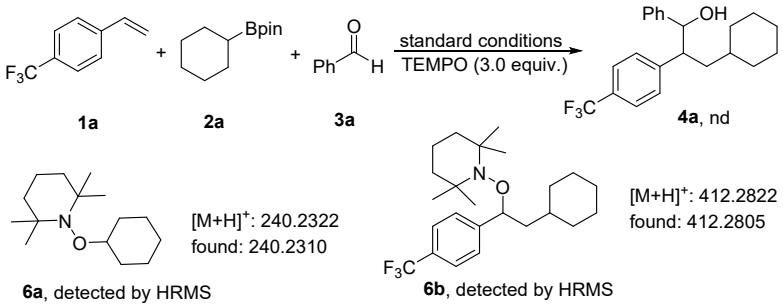


Figure S2. Cyclic voltammogram of Cs_2CO_3+CyBpin (0.8 mM) in DMF, $E_{1/2}^{red}$ = +1.18 V vs SCE.

6. Mechanism studies

6.1 TEMPO trapping experiment



Cs_2CO_3 (0.4 mmol, 2.0 equiv.), TEMPO (3.0 equiv., 0.6 mmol) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Styrene **1a** (0.3 mmol, 1.5 equiv.), APEs **2a** (0.2 mmol, 1.0 equiv.) and aldehyde **3a** (0.3 mmol, 1.5 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2 mL), extracted into EtOAc (2 mL). TLC analysis indicates that no reaction took place, and TEMPO-coupled

product **6a** and **6b** were detected by HRMS, respectively. **6a** (HRMS-ESI (m/z) [M + H]$^+$ calcd for $C_{15}H_{30}NO^+$: 240.2322; found, 240.2310.), **6b** (HRMS-ESI (m/z) [M + H]$^+$ calcd for $C_{24}H_{37}F_3NO^+$: 412.2822; found, 412.2805.).

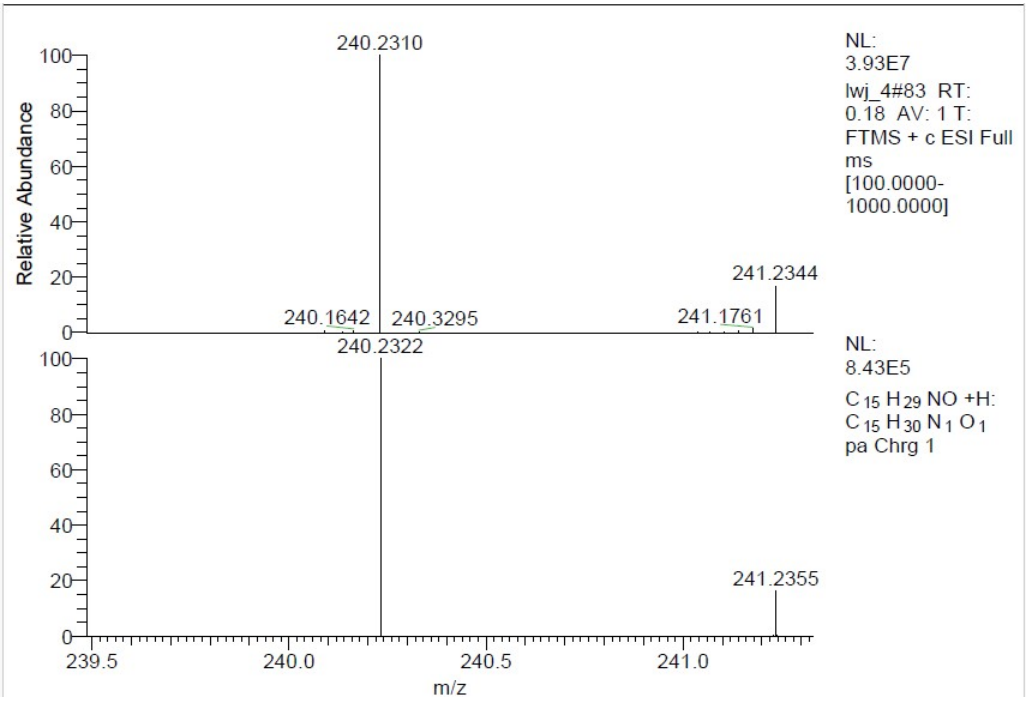


Figure S3. HRMS data of **6a**.

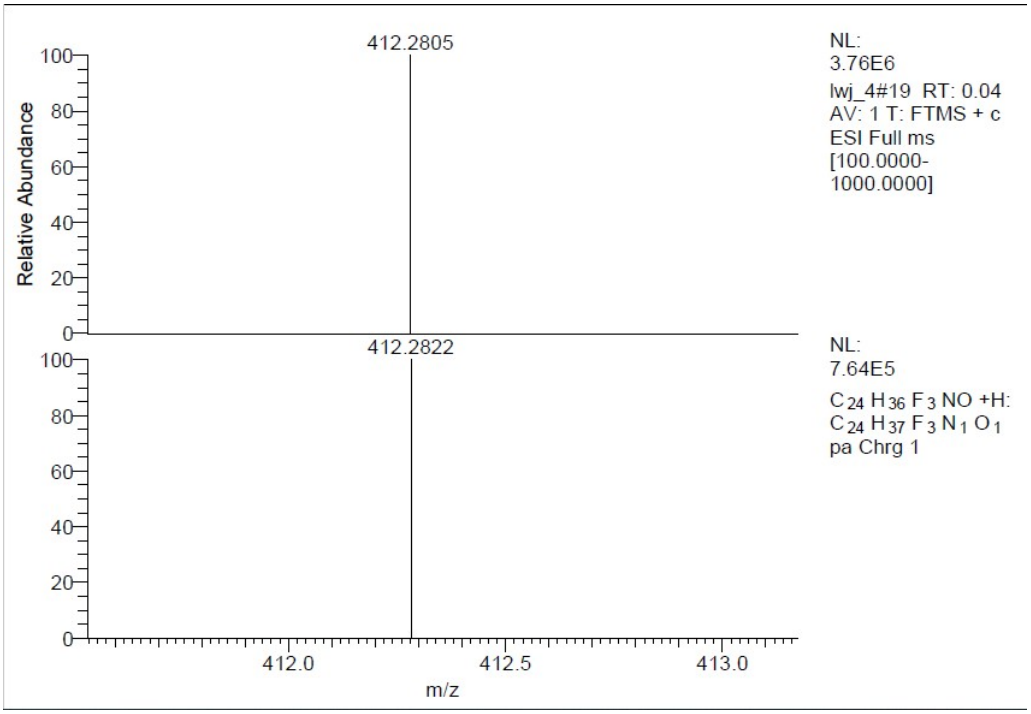
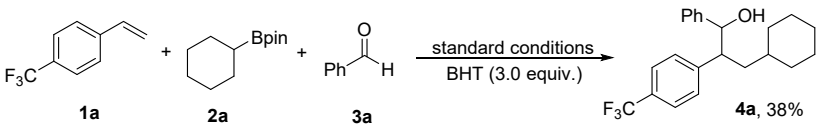


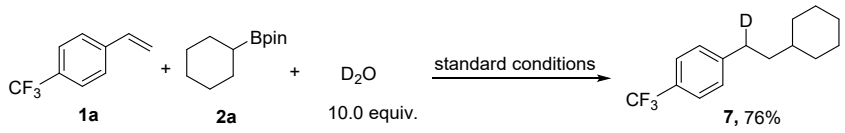
Figure S4. HRMS data of **6b**.

6.2 BHT trapping experiment

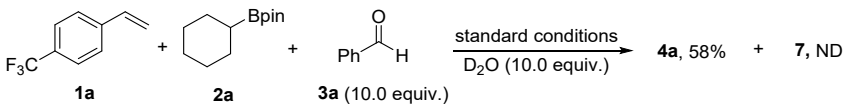


Cs_2CO_3 (0.4 mmol, 2.0 equiv.), BHT (3.0 equiv., 0.6 mmol) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Styrene **1a** (0.3 mmol, 1.5 equiv.), APEs **2a** (0.2 mmol, 1.0 equiv.) and aldehyde **3a** (0.3 mmol, 1.5 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2.0 mL), extracted into EtOAc (2.0 mL). The target product **4a** was obtained in 38% yield.

6.3 Isotope–labelling study



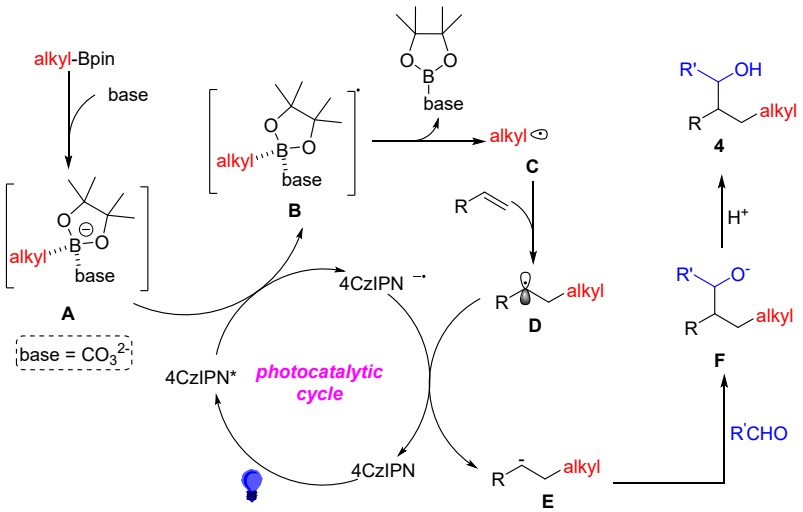
Cs_2CO_3 (0.4 mmol, 2.0 equiv.) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube was evacuated and backfilled with argon (repeated three times). Styrene **1a** (0.3 mmol, 1.5 equiv.), APEs **2a** (0.2 mmol, 1.0 equiv.) and D_2O (2.0 mmol, 10.0 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2.0 mL), extracted into EtOAc (2.0 mL). The α-D-substituted product **7** was purified with chromatographycolumn on silica gel (PE/EA = 50:1 – 200:1) and afforded as a colorless oil in 76% yield (39.5 mg).



Cs_2CO_3 (0.4 mmol, 2.0 equiv.) and 4CzIPN (5.0 mol%) were added into a 15 mL oven-dried glass tube equipped with a magnetic stirring bar and rubber stopper, the tube

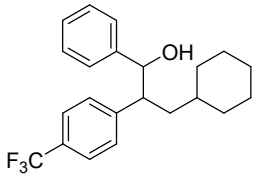
was evacuated and backfilled with argon (repeated three times). Styrene **1a** (0.3 mmol, 1.5 equiv.), APEs **2a** (0.2 mmol, 1.0 equiv.), D_2O (2.0 mmol, 10.0 equiv.) and aldehyde **3a** (2.0 mmol, 10.0 equiv.) were added into the tube. Then, DMF (2.0 mL) was added to the tube, and the reaction mixture was irradiated with a 40 W kessil blue LED lamp (440 nm, 75% intensity) at ambient temperature for 13 h. After completion of the reaction, the reaction mixture was treated with HCl (1 M, 2.0 mL), extracted into EtOAc (2.0 mL). The target product **4a** was obtained in 58% yield.

7. Proposed mechanism via RRPCO process

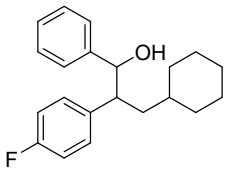


Initially, a Lewis base-APE adduct **A** was generated from Alk-Bpin via the Lewis base (Cs_2CO_3) activation. Subsequently, single-electron transfer (SET) between the excited photocatalyst 4CzIPN* and **A** produced an anionic catalyst radical and alkyl radical **B**. The latter undergoes fragmentation to give the alky radical **C**, which is subsequently trapped by alkene to deliver the radical intermediate **D**. Then, the SET reduction by anionic catalyst radical converts **D** to carbanion **E**, Meanwhile, the reduced anionic catalyst radical of 4CzIPN returned to the ground state to furnish the catalytic cycle. Finally, the carbanion **E** reacts with aldehydes via nucleophilic attack and protonation process to afford the final product **4**.

8. Characterization data of compounds 4

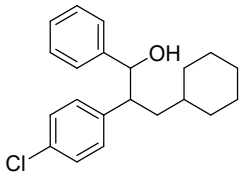


3-Cyclohexyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4a**) The resultant residue was purified by flash silica gel column chromatography to afford **4a** as yellow oil (58.7 mg, 81%, *dr* = 1.7 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.54 (d, J = 8.0 Hz, 3H), 7.41 (d, J = 8.0 Hz, 1H), 7.30-7.27 (m, 6H), 7.25-7.24 (m, 1H), 7.20-7.19 (m, 3H), 7.18-7.15 (m, 2H), 7.09 (d, J = 8.0 Hz, 1H), 7.02-7.01 (m, 1H), 4.65-4.63 (m, 2H), 3.11-3.08 (m, 1H), 3.06-3.03 (m, 1H), 2.16 (s, 1H), 1.90 (s, 1H), 1.75-1.71 (m, 1H), 1.70-1.65 (m, 3H), 1.59-1.56 (m, 3H), 1.55-1.50 (m, 5H), 1.43 (d, J = 12.8 Hz, 1H), 1.23-1.20 (m, 1H), 1.07-0.96 (m, 7H), 0.87-0.82 (m, 2H), 0.80-0.74 (m, 2H), 0.66-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.1, 146.0, 142.57, 142.46, 129.2, 128.8 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.3, 128.0, 127.9, 126.7, 126.3, 125.2 (q, J = 3.6 Hz), 124.8 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 78.8, 78.5, 39.6, 37.4, 34.6, 34.5, 34.4, 34.3, 31.94, 31.88, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) [M + Na]$^{+}$ calcd for $C_{22}H_{25}F_3ONa^{+}$: 385.1750; found, 385.1744.

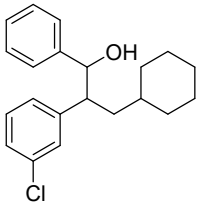


3-Cyclohexyl-2-(4-fluorophenyl)-1-phenylpropan-1-ol (**4b**) The resultant residue was purified by flash silica gel column chromatography to afford **4b** as yellow oil (40.6 mg, 65%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.32 (m, 2H), 7.29-7.26 (m, 1H), 7.24 (m, 2H), 7.22-7.20 (m, 2H), 7.18-7.15 (m, 3H), 7.06 (m, 2H), 7.02-6.99 (m, 2H), 6.96-6.94 (m, 2H), 6.89-6.86 (m, 2H), 4.69 (d, J = 6.4 Hz, 1H), 4.65 (d, J = 8.0 Hz, 1H), 3.07-3.04 (m, 1H), 3.00-2.97 (m, 1H), 1.91 (s, 1H), 1.74-1.64 (m, 5H), 1.60-1.57 (m, 2H), 1.55-1.50 (m, 6H), 1.44-1.41 (m, 1H), 1.20-1.17 (m, 1H), 1.10-1.03 (m, 3H), 1.02-0.89 (m, 6H), 0.80-0.74 (m, 2H), 0.65-0.60 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 161.7 (d, J = 243 Hz), 161.4 (d, J = 243 Hz), 142.73, 142.68, 137.1 (d, J = 3.4

Hz), 137.0 (d, J = 3.3 Hz), 130.2 (d, J = 7.4 Hz), 130.1 (d, J = 7.4 Hz), 128.3, 127.9, 127.8, 127.3, 126.8, 126.4, 115.3 (d, J = 21 Hz), 114.8 (d, J = 21 Hz), 79.0, 78.9, 50.2, 49.7, 39.7, 37.7, 34.6, 34.5, 34.4, 34.3, 32.0, 31.9, 26.5, 26.4, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{25}FONa^+$: 335.1782; found, 335.1782.

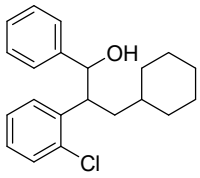


2-(4-Chlorophenyl)-3-cyclohexyl-1-phenylpropan-1-ol (**4c**) The resultant residue was purified by flash silica gel column chromatography to afford **4c** as yellow oil (51.9 mg, 79%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.34-7.32 (m, 1H), 7.31-7.27 (m, 4H), 7.24 (t, J = 1.2 Hz, 1H), 7.23-7.21 (m, 2H), 7.20-7.17 (m, 2H), 7.16-7.13 (m, 4H), 7.07 (m, 2H), 6.93 (m, 2H), 4.69-4.64 (m, 2H), 3.07-3.02 (m, 1H), 3.00-2.95 (m, 1H), 1.91 (d, J = 3.6 Hz, 1H), 1.74 (d, J = 3.2 Hz, 1H), 1.71-1.64 (m, 4H), 1.58-1.49 (m, 8H), 1.44-1.40 (m, 1H), 1.22-1.15 (m, 1H), 1.10-0.93 (m, 7H), 0.87-0.82 (m, 2H), 0.80-0.70 (m, 2H), 0.66-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.6, 140.1, 140.0, 132.4, 131.9, 130.2, 128.6, 128.3, 128.1, 128.0, 127.8, 127.4, 126.8, 126.4, 78.9, 78.7, 39.6, 37.6, 34.6, 34.5, 34.41, 34.36, 31.9, 31.8, 26.5, 26.4, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{25}ClONa^+$: 351.1486; found, 351.1483.

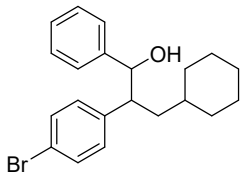


2-(3-Chlorophenyl)-3-cyclohexyl-1-phenylpropan-1-ol (**4d**) The resultant residue was purified by flash silica gel column chromatography to afford **4d** as green oil (54.6 mg, 83%, *dr* = 1.3 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.35-7.32 (m, 3H), 7.31-7.24 (m, 5H), 7.22-7.19 (m, 4H), 7.18-7.14 (m, 2H), 7.11-7.10 (m, 2H), 7.04-7.03 (m, 2H), 4.74 (d, J = 6.4 Hz, 1H), 4.64 (d, J = 8.0 Hz, 1H), 3.08-3.05 (m, 1H), 3.01-2.98 (m, 1H), 1.93 (s, 1H), 1.78 (s, 1H), 1.74-1.71 (m, 2H), 1.68-1.65 (m, 2H), 1.58-1.55 (m, 3H), 1.54-1.49 (m, 5H), 1.42-1.39 (m, 1H), 1.15-1.12 (m, 1H), 1.07-1.05 (m, 2H), 1.01-0.96 (m, 4H), 0.93-0.85 (m, 3H), 0.78-0.72 (m, 2H), 0.62-0.57 (m, 1H); ^{13}C NMR

(CDCl3, 200 MHz) δ: 143.9, 142.5, 134.3, 133.8, 129.6, 129.2, 128.8, 128.7, 128.3, 128.0, 127.9, 127.4, 127.2, 127.1, 126.9, 126.8, 126.5, 126.3, 78.9, 78.6, 50.7, 50.3, 39.6, 37.2, 34.6, 34.5, 34.4, 34.3, 32.0, 31.9, 26.5, 26.4, 26.2, 26.1, 25.95, 25.87; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{25}ClONa^+$: 351.1486; found, 351.1487.

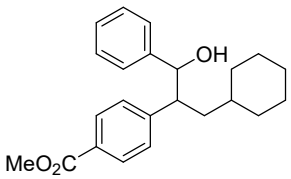


2-(2-Chlorophenyl)-3-cyclohexyl-1-phenylpropan-1-ol (**4e**) The resultant residue was purified by flash silica gel column chromatography to afford **4e** as yellow oil (51.4 mg, 78%, *dr* = 1.4 : 1); ^{1}H NMR (CDCl3, 800 MHz) δ: 7.35-7.33 (m, 2H), 7.31-7.23 (m, 12H), 7.19 (t, *J* = 7.2 Hz, 2H), 7.15 (t, *J* = 8.0 Hz, 1H), 7.10 (t, *J* = 8.0 Hz, 1H), 4.80 (s, 1H), 4.66 (d, *J* = 7.2 Hz, 1H), 3.82-3.73 (m, 2H), 1.92 (s, 1H), 1.81-1.76 (m, 3H), 1.68 (d, *J* = 13.6 Hz, 1H), 1.56-1.48 (m, 9H), 1.44-1.42 (m, 1H), 1.31-1.27 (m, 1H), 1.08-0.94 (m, 6H), 0.93-0.83 (m, 3H), 0.81-0.76 (m, 1H), 0.68-0.62 (m, 2H); ^{13}C NMR (CDCl3, 200 MHz) δ: 142.8, 142.7, 139.7, 139.5, 136.1, 134.8, 129.7, 129.5, 129.3, 128.5, 128.3, 128.0, 127.8, 127.6, 127.5, 127.2, 127.0, 126.9, 126.6, 126.1, 79.2, 45.2, 39.7, 35.5, 34.7, 34.7, 34.6, 34.4, 32.3, 32.1, 26.6, 26.5, 26.3, 26.2, 26.01, 26.00; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{25}ClONa^+$: 351.1486; found, 351.1484.

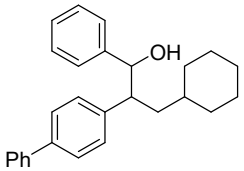


2-(4-Bromophenyl)-3-cyclohexyl-1-phenylpropan-1-ol (**4f**) The resultant residue was purified by flash silica gel column chromatography to afford **4f** as green oil (38.1 mg, 51%, *dr* = 1 : 1); ^{1}H NMR (CDCl3, 400 MHz) δ: 7.43 (m, 2H), 7.34-7.29 (m, 5H), 7.25-7.22 (m, 3H), 7.20-7.18 (m, 2H),7.09-7.06 (m, 4H), 6.88 (m, 2H), 4.69 (dd, *J* = 6.8, 3.2 Hz, 1H), 4.65 (dd, *J* = 7.6, 2.4 Hz, 1H), 3.06-3.01 (m, 1H), 3.00-2.94 (m, 1H), 1.90 (d, *J* = 6.4 Hz, 1H), 1.73 (d, *J* = 4.8 Hz, 1H), 1.71-1.63 (m, 4H), 1.50-1.55 (m, 3H), 1.54-1.48 (m, 4H), 1.45-1.40 (m, 1H), 1.22-1.15 (m, 1H), 1.10-1.04 (m, 3H), 1.03-0.91 (m, 5H), 0.87-0.82 (m, 2H), 0.79-0.71 (m, 2H), 0.67-0.57 (m, 1H); ^{13}C NMR

(CDCl$_3$, 200 MHz) δ: 142.60, 142.58, 140.63, 140.61, 131.5, 131.1, 130.58, 130.56, 128.3, 128.0, 127.8, 127.4, 126.8, 126.4, 120.5, 120.0, 78.9, 78.6, 50.4, 49.9, 39.6, 37.5, 34.6, 34.5, 34.39, 34.36, 31.9, 31.8, 26.4, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z) [M + Na]$^+$ calcd for $C_{21}H_{25}BrONa^+$: 395.0981; found, 395.0978.

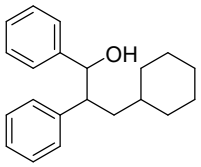


Methyl 4-(3-cyclohexyl-1-hydroxy-1-phenylpropan-2-yl)benzoate (**4g**) The resultant residue was purified by flash silica gel column chromatography to afford **4g** as green oil (63.4 mg, 90%, *dr* = 1 : 1); ^{1}H NMR (CDCl$_3$, 800 MHz) δ: 7.98 (d, *J* = 8.0 Hz, 2H), 7.84 (dd, *J* = 8.0 Hz, 2H), 7.32-7.31 (m, 2H), 7.29-7.27 (m, 3H), 7.25-7.24 (m, 2H), 7.20-7.15 (m, 3H), 7.08-7.06 (m, 4H), 4.72 (t, *J* = 7.2 Hz, 2H), 3.91 (s, 3H), 3.87 (s, 3H), 3.14-3.12 (m, 1H), 3.09-3.06 (m, 1H), 2.03-2.00 (s, 1H), 1.81-1.76 (m, 2H), 1.77-1.71 (m, 1H), 1.70-1.66 (m, 2H), 1.62-1.57 (m, 3H), 1.55-1.50 (m, 5H), 1.43-1.41 (m, 1H), 1.23-1.20 (m, 1H), 1.08-1.04 (m, 2H), 1.01-0.92 (m, 5H), 0.86- 0.83(m, 2H), 0.80-0.75 (m, 2H), 0.65-0.60 (m, 1H); ^{13}C NMR (CDCl$_3$, 200 MHz) δ: 167.13, 167.10, 147.39, 147.36, 129.6, 129.3, 128.90, 128.89, 128.6, 128.3, 128.1, 128.0, 127.8, 127.4, 126.8, 126.4, 78.9, 78.6, 52.0, 51.9, 50.9, 50.7, 39.6, 37.7, 34.65, 34.60, 34.5, 34.3, 32.0, 31.9, 26.5, 26.4, 26.2, 26.1, 25.95, 25.87; HRMS-ESI (m/z) [M + Na]$^+$ calcd for $C_{23}H_{28}O_3Na^+$: 375.1931; found, 375.1927.

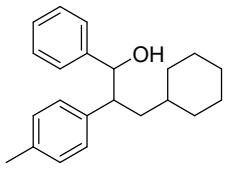


2-([1,1'-Biphenyl]-4-yl)-3-cyclohexyl-1-phenylpropan-1-ol (**4h**) The resultant residue was purified by flash silica gel column chromatography to afford **4h** as green oil (61.5 mg, 83%, *dr* = 1 : 1); ^{1}H NMR (CDCl$_3$, 800 MHz) δ: 7.62-7.61 (m, 2H), 7.58-7.56 (m, 4H), 7.46-7.40 (m, 6H), 7.36-7.29 (m, 9H), 7.23-7.21 (m, 2H), 7.19-7.17 (m, 1H), 7.15-7.13 (m, 2H), 7.11 (dd, *J* = 5.6Hz, 2H), 4.78 (d, *J* = 6.4 Hz, 1H), 4.68 (d, *J* = 8.8 Hz, 1H), 3.14-3.11 (m, 1H), 3.06-3.03 (m, 1H), 1.95 (s, 1H), 1.82 (s, 1H), 1.77-1.71

(m, 3H), 1.68-1.65 (m, 1H), 1.60-1.57 (m, 3H), 1.56-1.53 (m, 5H), 1.46-1.43 (m, 1H), 1.18-1.15 (m, 1H), 1.10-1.06 (m, 2H), 1.05-0.98 (m, 5H), 0.94-0.90 (m, 2H), 0.81-0.75 (m, 2H), 0.64-0.59 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.8, 142.7, 140.83, 140.81, 140.8, 140.7, 139.6, 139.0, 129.22, 129.17, 128.73, 128.68, 128.3, 127.9, 127.8, 127.22, 127.16, 127.14, 127.03, 127.01, 127.0, 126.9, 126.4, 79.2, 78.7, 50.7, 50.0, 39.6, 37.0, 34.7, 34.5, 34.41, 34.39, 32.0, 31.9, 26.6, 26.5, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{27}H_{30}ONa^+$: 393.2189; found, 393.2184.

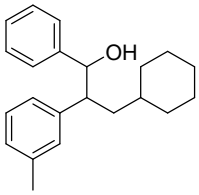


3-Cyclohexyl-1,2-diphenylpropan-1-ol (**4i**) The resultant residue was purified by flash silica gel column chromatography to afford **4i** as green oil (46.5 mg, 79%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.34-7.32 (m, 2H), 7.29-7.27 (m, 1H), 7.26-7.24 (m, 3H), 7.23-7.21 (m, 5H), 7.20-7.18 (m, 1H), 7.13-7.08 (m, 6H), 7.03 (t, J = 2.4 Hz, 1H), 6.88 (dt, J = 7.2, 1.6 Hz, 1H), 4.71 (dd, J = 2.4, 6.4 Hz, 1H), 4.65 (dd, J = 1.6, 8.0 Hz, 1H), 3.05-3.02 (m, 1H), 2.99-2.96 (m, 1H), 1.93 (d, J = 4.0 Hz, 1H), 1.76 (d, J = 3.2 Hz, 1H), 1.70-1.65 (m, 5H), 1.60-1.57 (m, 2H), 1.55-1.51 (m, 5H), 1.44-1.42 (m, 1H), 1.18-1.14 (m, 1H), 1.10-1.05 (m, 3H), 1.02-0.96 (m, 4H), 0.91-0.87 (m, 2H), 0.79-0.74 (m, 2H), 0.64-0.59 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.9, 142.7, 141.6, 141.5, 128.82, 128.80, 128.6, 128.3, 128.1, 127.8, 127.1, 127.0, 126.8, 126.4, 126.3, 79.22, 79.21, 78.8, 51.1, 50.4, 39.6, 37.1, 34.6, 34.5, 34.4, 32.0, 31.8, 26.6, 26.5, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{26}ONa^+$: 317.1876; found, 317.1873.

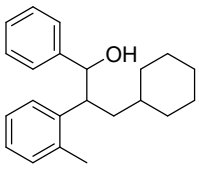


3-Cyclohexyl-1-phenyl-2-(p-tolyl)propan-1-ol (**4j**) The resultant residue was purified by flash silica gel column chromatography to afford **4j** as yellow oil (50.0 mg, 81%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.34-7.30 (m, 4H), 7.29-7.27 (m, 1H), 7.23-7.21

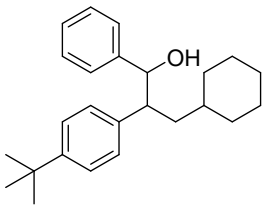
(m, 2H), 7.18-7.16 (m, 1H), 7.15-7.11 (m, 6H), 7.01 (d, J = 7.2 Hz, 2H), 6.93 (d, J = 8.0 Hz, 2H), 4.71 (d, J = 6.4 Hz, 1H), 4.60 (d, J = 8.8 Hz, 1H), 3.05-3.02 (m, 1H), 2.96-2.93 (m, 1H), 2.34 (s, 3H), 2.28 (s, 3H), 1.94 (d, J = 4.8 Hz, 1H), 1.80 (s, 1H), 1.70-1.66 (m, 3H), 1.61-1.59 (m, 1H), 1.58-1.56 (m, 2H), 1.53-1.48 (m, 6H), 1.41-1.39 (m, 1H), 1.11-1.09 (m, 1H), 1.07-1.04 (m, 2H), 1.02-0.96 (m, 5H), 0.89-0.86 (m, 2H), 0.77-0.69 (m, 2H), 0.60-0.55 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.9, 142.8, 138.5, 138.3, 136.3, 135.6, 129.3, 128.8, 128.61, 125.58, 128.2, 127.7, 127.6, 127.0, 126.9, 126.4, 79.2, 78.6, 50.6, 49.8, 39.6, 36.9, 34.6, 34.44, 34.38, 34.32, 31.9, 31.7, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8, 21.1, 21.0; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{28}ONa^+$: 331.2032; found, 331.2027.



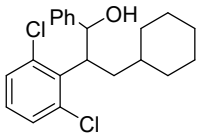
3-Cyclohexyl-1-phenyl-2-(m-tolyl)propan-1-ol (**4k**) The resultant residue was purified by flash silica gel column chromatography to afford **4k** as yellow oil (44.7 mg, 72%, dr = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.35-7.31 (m, 4H), 7.29-7.27 (m, 1H), 7.24-7.21 (m, 3H), 7.19-7.16 (m, 1H), 7.13-7.12 (m, 2H), 7.10 (t, J = 8.8 Hz, 1H), 7.08-7.05 (m, 3H), 6.97 (d, J = 7.2 Hz, 1H), 6.85 (d, J = 7.2 Hz, 2H), 4.74 (d, J = 5.6 Hz, 1H), 4.61 (d, J = 8.8 Hz, 1H), 3.05-3.02 (m, 1H), 2.96-2.93 (m, 1H), 2.36 (s, 3H), 2.27 (s, 3H), 1.93 (s, 1H), 1.79 (s, 1H), 1.72-1.67 (m, 3H), 1.60-1.55 (m, 4H), 1.53-1.48 (m, 6H), 1.42-1.39 (m, 1H), 1.10-1.04 (m, 4H), 1.00-0.97 (m, 3H), 0.91-0.86 (m, 2H), 0.77-0.69 (m, 2H), 0.60-0.54 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.9, 142.7, 141.6, 141.5, 138.1, 137.5, 129.6, 129.4, 128.4, 128.2, 127.9, 127.74, 127.68, 127.65, 127.07, 127.05, 127.0, 126.3, 125.77, 125.76, 79.3, 78.6, 51.0, 50.2, 34.6, 34.5, 34.4, 34.3, 32.0, 31.8, 26.6, 26.5, 26.2, 26.1, 25.9, 25.8, 21.5, 21.4; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{28}ONa^+$: 331.2032; found, 331.2026.



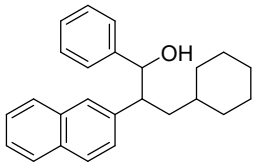
3-Cyclohexyl-1-phenyl-2-(o-tolyl)propan-1-ol (**4l**) The resultant residue was purified by flash silica gel column chromatography to afford **4l** as yellow oil (42.8 mg, 69%, *dr* = 1.3 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.32 (t, J = 8.0 Hz, 3H), 7.28-7.26 (m, 3H), 7.22-7.20 (m, 4H), 7.18-7.14 (m, 6H), 7.06 (td, J = 8.0, 1.6 Hz, 1H), 7.03-7.02 (m, 1H), 4.70 (d, J = 6.4 Hz, 1H), 4.60 (d, J = 8.0 Hz, 1H), 3.38-3.36 (m, 1H), 3.35-3.32 (m, 1H), 2.27 (s, 3H), 2.10 (s, 3H), 1.95 (s, 1H), 1.80-1.76 (m, 2H), 1.67-1.62 (m, 3H), 1.57-1.55 (m, 3H), 1.53-1.49 (m, 5H), 1.43-1.41 (m, 1H), 1.23-1.20 (m, 1H), 1.07-1.02 (m, 3H), 1.00-0.95 (m, 4H), 0.89-0.85 (m, 2H), 0.78-0.71 (m, 2H), 0.64-0.60 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 143.1, 142.9, 140.3, 139.9, 138.1, 136.7, 130.3, 128.2, 127.74, 127.72, 127.69, 127.66, 127.15, 127.13, 127.11, 127.0, 126.9, 126.5, 126.4, 126.2, 126.0, 125.9, 125.7, 78.8, 78.0, 44.9, 40.1, 37.0, 34.7, 34.6, 34.4, 32.5, 32.4, 26.5, 26.4, 26.2, 26.1, 26.0, 25.9, 20.1, 19.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{28}ONa^+$: 331.2032; found, 331.2029.



2-(4-(Tert-butyl)phenyl)-3-cyclohexyl-1-phenylpropan-1-ol (**4m**) The resultant residue was purified by flash silica gel column chromatography to afford **4m** as yellow solid (44.2 mg, 63%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.36-7.31 (m, 5H), 7.29-7.27 (m, 1H), 7.24-7.22 (m, 5H), 7.19-7.16 (m, 3H), 7.14 (d, J = 7.2Hz, 2H), 7.00 (d, J = 8.8 Hz, 2H), 4.76 (d, J = 3.2 Hz, 1H), 4.59 (d, J = 8.8Hz, 1H), 3.06-3.04 (m, 1H), 2.97-2.94 (m, 1H), 1.90 (d, J = 3.2 Hz, 1H), 1.79 (s, 1H), 1.73-1.66 (m, 3H), 1.58-1.55 (m, 1H), 1.54-1.48 (m, 8H), 1.43-1.40 (m, 1H), 1.33 (s, 8H), 1.29 (s, 10H), 1.11-1.05 (m, 3H), 1.04-0.98 (m, 5H), 0.89-0.86 (m, 2H), 0.77-0.72 (m, 1H), 0.70-0.65 (m, 1H), 0.59-0.54 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 149.6, 149.1, 142.9, 142.8, 138.5, 138.2, 128.31, 128.29, 128.24, 127.8, 127.7, 127.1, 126.9, 126.3, 125.5, 125.0, 79.3, 78.5, 50.6, 49.6, 39.6, 36.2, 34.6, 34.43, 34.40, 34.38, 34.33, 34.27, 32.0, 31.8, 31.38, 31.37, 26.6, 26.5, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{25}H_{34}ONa^+$: 373.2502; found, 373.2497.

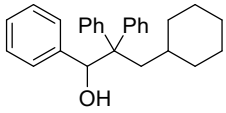


3-Cyclohexyl-2-(2,6-dichlorophenyl)-1-phenylpropan-1-ol (**4n**) The resultant residue was purified by flash silica gel column chromatography to afford **4n** as green oil (53.0 mg, 73%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.49-7.48 (m, 2H), 7.41-7.38 (m, 3H), 7.34-7.32 (m, 1H), 7.31 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.26-7.25 (m, 2H), 7.14-7.11 (m, 4H), 7.10-7.08 (m, 1H), 7.01 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.88 (t, *J* = 8.0 Hz, 1H), 5.37 (d, *J* = 9.6 Hz, 1H), 5.28 (d, *J* = 10.4 Hz, 1H), 4.12 (td, *J* = 10.4, 4.0 Hz, 1H), 4.02 (td, *J* = 10.4, 4.0 Hz, 1H), 2.31-2.27 (m, 1H), 2.06-2.03 (m, 2H), 2.00-1.97 (m, 2H), 1.71 (s, 1H), 1.68-1.66 (m, 1H), 1.63-1.61 (m, 2H), 1.59-1.56 (m, 2H), 1.51-1.47 (m, 3H), 1.44-1.42 (m, 1H), 1.15-1.09 (m, 3H), 1.00-0.99 (m, 3H), 0.97-0.91 (m, 4H), 0.73-0.69 (m, 2H), 0.51-0.46 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 143.6, 143.0, 138.4, 137.6, 137.5, 137.1, 134.8, 134.7, 130.2, 129.7, 128.6, 128.5, 128.3, 128.1, 128.0, 127.8, 127.7, 127.5, 127.2, 126.1, 75.9, 75.5, 48.0, 47.9, 36.3, 35.7, 34.4, 34.1, 33.1, 32.5, 26.56, 26.55, 26.38, 26.37, 26.2, 26.1, 25.9; HRMS-ESI (m/z) [M + Na]$^{+}$ calcd for $C_{21}H_{24}Cl_2ONa^{+}$: 385.1096; found, 385.1092.

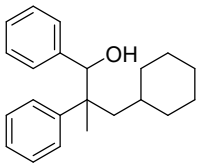


3-Cyclohexyl-2-(naphthalen-2-yl)-1-phenylpropan-1-ol (**4o**) The resultant residue was purified by flash silica gel column chromatography to afford **4o** as green oil (51.0 mg, 74%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.84-7.82 (m, 3H), 7.78-7.77 (m, 1H), 7.73 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.71-7.69 (m, 2H), 7.50-7.45 (m, 3H), 7.44-7.39 (m, 3H), 7.35-7.34 (m, 4H), 7.31-7.28 (m, 1H), 7.20-7.18 (m, 3H), 7.16-7.13 (m, 3H), 4.84 (dd, *J* = 6.4 Hz, 1H), 4.74 (dd, *J* = 8.0 Hz, 1H), 3.27-3.24 (m, 1H), 3.19-3.16 (m, 1H), 1.97 (s, 1H), 1.86-1.81 (m, 2H), 1.76-1.71 (m, 3H), 1.68-1.64 (m, 1H), 1.57-1.46 (m, 7H), 1.43-1.41 (m, 1H), 1.21-1.17 (m, 1H), 1.01-0.92 (m, 7H), 0.90-0.86 (m, 2H), 0.80-0.74 (m, 2H), 0.65-0.60 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 142.8, 142.7, 139.2, 139.0, 133.5, 133.3, 132.6, 132.3, 128.4, 128.3, 128.1, 127.9, 127.8, 127.7,

127.6, 127.59, 127.53, 127.47, 127.3, 127.2, 127.2, 126.41, 126.40, 126.3, 126.0, 125.7, 125.6, 125.3, 79.1, 78.7, 51.3, 50.5, 39.5, 37.2, 34.7, 34.5, 34.44, 34.42, 32.0, 31.8, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{25}H_{28}ONa^+$: 367.2032; found, 367.2025.

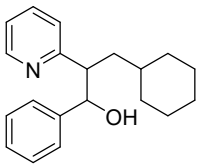


3-Cyclohexyl-1,2,2-triphenylpropan-1-ol (**4p**) The resultant residue was purified by flash silica gel column chromatography to afford **4p** as yellow oil (43.7 mg, 59%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.40 (d, J = 7.2 Hz, 2H), 7.31 (t, J = 8.0 Hz, 2H), 7.27 (t, J = 7.2 Hz, 1H), 7.25-7.24 (m, 1H), 7.23-7.21 (m, 2H), 7.16 (m, J = 8.0 Hz, 1H), 7.12 (d, J = 7.2 Hz, 2H), 7.07 (t, J = 8.0 Hz, 2H), 6.58 (d, J = 7.2 Hz, 2H), 5.59 (s, 1H), 2.19 (t, J = 3.2 Hz, 1H), 1.82 (dd, J = 4.8, 6.4 Hz, 1H), 1.59 (dd, J = 4.8, 14.4 Hz, 1H), 1.45-1.38 (m, 3H), 1.24-1.21 (m, 1H), 1.03-1.01 (m, 1H), 0.99-0.91 (m, 3H), 0.75-0.72 (m, 1H), 0.71-0.66 (m, 1H), 0.61-0.56 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.0, 141.7, 140.4, 130.91, 130.90, 129.3, 128.5, 128.0, 127.5, 127.0, 126.8, 126.4, 126.3, 78.3, 57.2, 45.7, 35.1, 35.0, 33.7, 26.5, 26.4, 26.3; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{27}H_{30}ONa^+$: 393.2189; found, 393.2182.

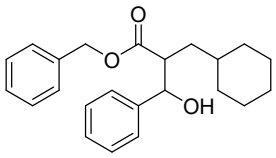


3-Cyclohexyl-2-methyl-1,2-diphenylpropan-1-ol (**4q**) The resultant residue was purified by flash silica gel column chromatography to afford **4q** as yellow oil (44.4 mg, 72%, dr = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.42-7.40 (m, 2H), 7.36-7.31 (m, 2H), 7.26-7.23 (m, 6H), 7.21-7.17 (m, 3H), 7.16-7.11 (m, 5H), 6.88-6.85 (m, 2H), 4.68 (d, J = 2.4 Hz, 1H), 4.64 (d, J = 2.8 Hz, 1H), 2.00-1.95 (m, 2H), 1.89 (d, J = 2.6 Hz, 1H), 1.72-1.67 (m, 2H), 1.60 (d, J = 2.8 Hz, 1H), 1.55-1.44 (m, 7H), 1.35 (s, 3H), 1.28-1.27 (m, 4H), 1.19-1.13 (m, 2H), 1.11-0.98 (m, 7H), 0.97-0.93 (m, 2H), 0.87-0.78 (m, 2H), 0.74-0.64 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 144.5, 144.3, 141.0, 140.6, 128.2, 128.1, 127.9, 127.69, 127.68, 127.65, 127.39, 127.36, 127.0, 127.0, 126.3, 126.1,

82.83, 82.78, 47.2, 47.1, 45.9, 43.9, 35.9, 35.8, 35.3, 35.1, 34.1, 34.0, 26.5, 26.41, 26.39, 26.36, 26.3, 26.2, 19.4, 18.4; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{28}ONa^+$: 331.2032; found, 331.2030.

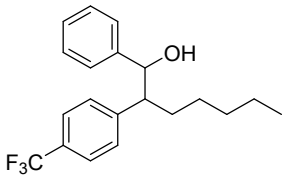


3-Cyclohexyl-1-phenyl-2-(pyridin-2-yl)propan-1-ol (**4r**) The resultant residue was purified by flash silica gel column chromatography to afford **4r** as white solid (28.4 mg, 48%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 8.57-8.56 (m, 2H), 7.62 (td, J = 8.0, 2.4 Hz, 2H), 7.35-7.34 (m, 4H), 7.32-7.30 (m, 4H), 7.22 (t, J = 7.2 Hz, 2H), 7.20-7.18 (m, 2H), 7.08 (d, J = 7.2 Hz, 2H), 5.66 (s, 2H), 5.11 (d, J = 3.2 Hz, 2H), 3.11 (t, J = 3.2 Hz, 1H), 3.10 (t, J = 3.2 Hz, 1H), 1.79-1.75 (m, 2H), 1.67-1.65 (m, 2H), 1.57-1.50 (m, 6H), 1.41-1.39 (m, 2H), 1.38-1.35 (m, 2H), 1.02-0.98 (m, 6H), 0.80-0.76 (m, 4H), 0.60-0.55 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 164.1, 148.8, 142.6, 136.6, 127.9, 126.7, 126.0, 123.6, 121.7, 75.9, 49.7, 35.2, 34.6, 34.4, 32.1, 26.5, 26.2, 26.0; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{20}H_{25}NONa^+$: 318.1828; found, 318.1824.

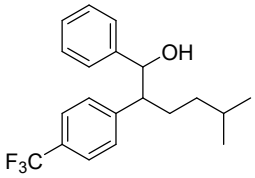


Benzyl 2-(cyclohexylmethyl)-3-hydroxy-3-phenylpropanoate (**4s**) The resultant residue was purified by flash silica gel column chromatography to afford **4s** as yellow oil (36.6 mg, 52%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.34-7.28 (m, 15H), 7.27-7.25 (m, 3H), 7.20-7.19 (m, 2H), 5.18 (d, J = 12.0 Hz, 1H), 5.06 (m, 2H), 4.97 (d, J = 12.0 Hz, 1H), 4.91 (d, J = 12.0 Hz, 1H), 4.76 (d, J = 8.0 Hz, 1H), 2.96-2.93 (m, 1H), 2.89-2.87 (m, 1H), 2.82-2.81 (m, 1H), 2.73 (t, J = 3.2 Hz, 1H), 1.75-1.69 (m, 3H), 1.63-1.58 (m, 6H), 1.54-1.51 (m, 2H), 1.47-1.44 (m, 1H), 1.12-1.01 (m, 10H), 0.89-0.82 (m, 1H), 0.81-0.76 (m, 1H), 0.69-0.62 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 175.4, 175.0, 142.1, 141.5, 135.8, 135.6, 128.48, 128.47, 128.3, 128.24, 128.22, 128.21, 128.16, 127.9, 127.7, 126.33, 126.32, 126.1, 75.8, 74.5, 66.3, 50.50, 50.48, 37.3, 35.6, 35.3, 34.8, 34.0, 33.8, 32.2, 32.1, 26.4, 26.3, 26.2, 26.1, 26.0, 25.9; HRMS-ESI (m/z)

[M + Na]$^+$ calcd for $C_{23}H_{28}O_3Na^+$: 375.1931; found, 375.1924.

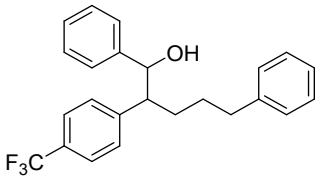


1-Phenyl-2-(4-(trifluoromethyl)phenyl)heptan-1-ol (**4aa**) The resultant residue was purified by flash silica gel column chromatography to afford **4aa** as yellow oil(19.4 mg, 29%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.35-7.32 (m, 4H), 7.31-7.27 (m, 1H), 7.27 (d, J = 7.2 Hz, 2H), 7.23-7.21 (m, 2H), 7.20-7.18 (m, 1H), 7.13 (d, J = 8.0 Hz, 2H), 7.10 (d, J = 7.2 Hz, 2H), 4.78-4.76 (m, 2H), 3.00-2.97 (m, 1H), 2.93-2.90 (m, 1H), 2.00-1.95 (m, 1H), 1.92 (d, J = 3.2 Hz, 1H), 1.76-1.71 (m, 2H), 1.61-1.57 (m, 1H), 1.46-1.42 (m, 1H), 1.25-1.21 (m, 2H), 1.20-1.17 (m, 2H), 1.15-1.10 (m, 3H), 1.09-1.05 (m, 3H), 1.02-0.98 (m, 2H), 0.81-0.79 (m, 3H), 0.77-0.75 (m, 3H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.0, 145.9, 142.6, 142.5, 129.1, 128.9 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.4, 128.1, 127.9, 127.5, 126.7, 126.4, 126.3, 125.2 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 124.28 (q, J = 270 Hz), 124.26 (q, J = 270 Hz), 78.5, 78.3, 53.9, 53.6, 31.9, 31.8, 31.6, 29.9, 27.1, 26.9, 22.44, 22.36, 14.0, 13.9; HRMS-ESI (m/z) [M + Na]$^+$ calcd for $C_{20}H_{23}F_3ONa^+$: 359.1593; found, 359.1590.

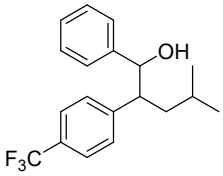


5-Methyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)hexan-1-ol (**4ab**) The resultant residue was purified by flash silica gel column chromatography to afford **4ab** as yellow oil (20.2 mg, 30%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.56 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.34-7.31 (m, 4H), 7.30-7.28 (m, 1H), 7.26 (d, J = 7.2 Hz, 2H), 7.23-7.21 (m, 2H), 7.20-7.18 (m, 1H), 7.12 (d, J = 7.2 Hz, 2H), 7.09 (d, J = 6.4 Hz, 2H), 4.79-4.77 (m, 2H), 2.96-2.94 (m, 1H), 2.90-2.88 (m, 1H), 2.04-1.99 (m, 1H), 1.93 (d, J = 3.2 Hz, 1H), 1.76-1.70 (m, 2H), 1.62-1.57 (m, 1H), 1.50-1.46 (m, 2H), 1.40-1.35 (m, 1H), 1.03-0.99 (m, 1H), 0.97-0.91 (m, 2H), 0.85-0.82 (m, 1H), 0.80 (dd,

J = 6.4, 9.6 Hz, 6H), 0.71 (dd, J = 6.4, 16 Hz, 6H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.0, 142.6, 142.5, 129.14, 129.12, 128.9 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.4, 128.1, 127.9, 127.5, 126.7, 126.4, 125.2 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 124.29 (q, J = 270 Hz), 124.26 (q, J = 270 Hz), 78.45, 78.39, 54.1, 53.9, 36.6, 36.4, 29.8, 28.0, 27.8, 27.7, 22.8, 22.8, 22.1, 21.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{20}H_{23}F_3ONa^+$: 359.1593; found, 359.1601.

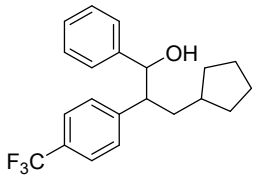


1,5-Diphenyl-2-(4-(trifluoromethyl)phenyl)pentan-1-ol (**4ac**) The resultant residue was purified by flash silica gel column chromatography to afford **4ac** as yellow oil (35.5 mg, 46%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.55 (d, J = 7.2 Hz, 2H), 7.42 (d, J = 8.0 Hz, 2H), 7.33 (t, J = 7.2 Hz, 2H), 7.30 (t, J = 7.2 Hz, 3H), 7.25-7.24 (m, 2H), 7.23-7.18 (m, 7H), 7.15-7.11 (m, 2H), 7.10-7.07 (m, 4H), 7.04 (d, J = 7.2 Hz, 2H), 6.09 (d, J = 8.0 Hz, 2H), 4.76-4.75 (m, 2H), 3.02-2.99 (m, 1H), 2.96-2.93 (m, 1H), 2.61-2.57 (m, 1H), 2.52-2.48 (m, 2H), 2.41-2.37 (m, 1H), 2.08-2.03 (m, 1H), 1.92 (s, 1H), 1.82-1.77 (m, 1H), 1.75 (s, 1H), 1.68-1.63 (m, 1H), 1.53-1.50 (m, 1H), 1.43-1.39 (m, 2H), 1.36-1.31 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.7, 145.6, 142.50, 142.46, 142.2, 142.0, 129.13, 129.09, 129.0 (q, J = 32 Hz), 128.6 (q, J = 32 Hz), 128.4, 128.3, 128.23, 128.21, 128.1, 128.0, 127.6, 126.7, 126.4, 125.7, 125.3 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 124.24 (q, J = 270 Hz), 124.22 (q, J = 270 Hz), 78.4, 78.3, 53.7, 53.5, 35.8, 35.6, 31.6, 29.6, 29.3, 29.0; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{24}H_{23}F_3ONa^+$: 407.1593; found, 407.1596.

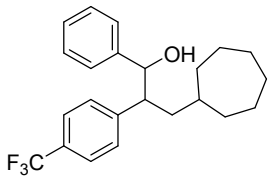


4-Methyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)pentan-1-ol (**4ad**) The resultant residue was purified by flash silica gel column chromatography to afford **4ad** as yellow solid (47.1 mg, 73%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz,

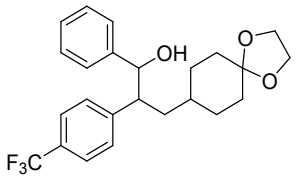
2H), 7.43 (d, J = 8.0 Hz, 2H), 7.34-7.32 (m, 4H), 7.30-7.28 (m, 1H), 7.26-7.25 (m, 2H), 7.23-7.20 (m, 2H), 7.20-7.18 (m, 1H), 7.13 (d, J = 8.0 Hz, 2H), 7.09-7.07 (m, 2H), 4.74-4.72 (m, 2H), 3.11-3.08 (m, 1H), 3.05-3.02 (m, 1H), 1.96 (s, 1H), 1.80-1.76 (m, 2H), 1.71-1.68 (m, 1H), 1.67-1.63 (m, 1H), 1.55 (s, 1H), 1.28-1.22 (m, 2H), 1.19-1.14 (m, 2H), 0.83 (d, J = 6.4 Hz, 3H), 0.77 (d, J = 6.4 Hz, 3H), 0.74 (d, J = 6.4 Hz, 2H), 0.71 (d, J = 6.4 Hz, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.9, 145.8, 142.5, 142.4, 129.19, 129.18, 128.9 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.4, 128.0, 127.9, 127.5, 126.7, 126.4, 125.2 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 124.27 (q, J = 270 Hz), 124.25 (q, J = 270 Hz), 78.8, 78.6, 51.6, 51.3, 41.0, 39.0, 25.2, 25.1, 24.0, 23.7, 21.0, 20.9; HRMS-ESI (m/z) $[M + H]^+$ calcd for $C_{19}H_{22}F_3O^+$: 323.1617; found, 323.1627.



3-Cyclopentyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4ae**) The resultant residue was purified by flash silica gel column chromatography to afford **4ae** as yellow oil (34.8 mg, 50%, *dr* = 1 :1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.35-7.32 (m, 4H), 7.29 (t, J = 8.0 Hz, 1H), 7.26 (d, J = 8.0 Hz, 2H), 7.22-7.17 (m, 3H), 7.14 (d, J = 8.0 Hz, 2H), 7.08 (d, J = 7.2 Hz, 2H), 4.75-4.73 (m, 2H), 3.06-3.03 (m, 1H), 3.00-2.97 (m, 1H), 1.98 (s, 1H), 1.94-1.91 (m, 1H), 1.85-1.77 (m, 3H), 1.65-1.61 (m, 2H), 1.59-1.57 (m, 1H), 1.55-1.50 (m, 3H), 1.48-1.42 (m, 3H), 1.39-1.32 (m, 5H), 1.30-1.26 (m, 1H), 1.06-1.00 (m, 2H), 0.93-0.87 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.1, 146.0, 142.6, 142.5, 129.19, 129.17, 128.8 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.4, 128.0, 127.9, 127.5, 126.7, 126.4, 125.2 (q, J = 3.8 Hz), 124.8 (q, J = 3.6 Hz), 124.28 (q, J = 270 Hz), 124.26 (q, J = 270 Hz), 78.7, 78.4, 53.0, 52.7, 38.4, 37.4, 37.3, 36.4, 33.6, 33.3, 31.58, 31.57, 25.02, 24.99, 24.94, 24.91; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{23}F_3ONa^+$: 371.1593; found, 371.1591.

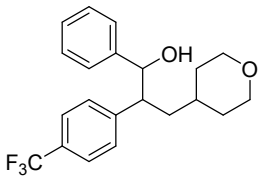


3-Cycloheptyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4af**) The resultant residue was purified by flash silica gel column chromatography to afford **4af** as yellow oil (50.4 mg, 67%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.56 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.35-7.28 (m, 5H), 7.25 (d, J = 2.0 Hz, 1H), 7.24-7.23 (m, 1H), 7.21-7.17 (m, 3H), 7.12 (d, J = 8.0 Hz, 2H), 7.09-7.06 (m, 2H), 4.74-4.71 (m, 2H), 3.12-3.07 (m, 1H), 3.06-3.00 (m, 1H), 1.94 (d, J = 3.2 Hz, 1H), 1.87-1.81 (m, 1H), 1.75-1.68 (m, 2H), 1.66-1.50 (m, 8H), 1.48-1.38 (m, 10H), 1.36-1.30 (m, 4H), 1.12-1.02 (m, 4H), 0.99-0.93 (m, 1H), 0.89-0.83 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.1, 146.0, 142.6, 142.5, 129.18, 129,16, 128.8 (q, J = 32 Hz), 128.5 (q, J = 32 Hz), 128.4, 128.0, 127.9, 127.5, 126.7, 126.3, 125.2 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 130.53 (q, J = 270 Hz), 130.51 (q, J = 270 Hz), 78.8, 78.6, 51.4, 51.1, 40.1, 37.9, 36.1, 36.0, 35.9, 35.8, 32.64, 32.60, 28.6, 28.45, 28.41, 28.3, 26.2, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{27}F_3ONa^+$: 399.1906; found, 399.1902.

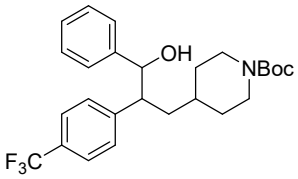


1-Phenyl-3-(1,4-dioxaspiro[4.5]decan-8-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4ag**) The resultant residue was purified by flash silica gel column chromatography to afford **4ag** as colorless oil (60.0 mg, 71%, *dr* = 1.9 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.58 (d, J = 8.0 Hz, 2H), 7.46 (d, J = 8.0 Hz, 4H), 7.35-7.31 (m, 4H), 7.29-7.28 (m, 1H), 7.25 (d, J = 8.0 Hz, 2H), 7.22 (t, J = 7.2 Hz, 4H), 7.19 (t, J = 7.2 Hz, 2H), 7.16 (d, J = 7.2 Hz, 4H), 7.09 (d, J = 7.2 Hz, 4H), 4.74 (d, J = 6.4 Hz, 2H), 4.70 (d, J = 7.2 Hz, 1H), 3.87-3.84 (m, 12H), 3.11-3.08 (m, 2H), 3.06-3.03 (m, 1H), 1.81-1.75 (m, 5H), 1.69-1.66 (m, 3H), 1.64-1.60 (m, 5H), 1.60-1.58 (m, 2H), 1.53-1.51 (m, 2H), 1.44 (d, J = 13.6 Hz, 1H), 1.37-1.32 (m, 3H), 1.31-1.27 (m, 5H), 1.24-1.20 (m, 3H), 1.14-1.07 (m, 3H), 1.02-0.94 (m, 3H), 0.92-0.87 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.9,

142.5, 142.4, 133.5, 130.1, 129.15, 129.10, 128.7 (q, J = 32 Hz), 128.48, 128.46, 128.1, 127.5, 126.7, 126.3, 125.3 (q, J = 3.8 Hz), 125.0 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 108.97, 108.91, 78.9, 78.4, 64.15, 64.13, 51.2, 50.9, 38.5, 35.9, 34.3, 34.2, 34.08, 34.02, 33.3, 33.1, 31.4, 31.2, 28.7, 28.6; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{24}H_{27}F_3O_3Na^+$: 443.1805; found, 443.1800.

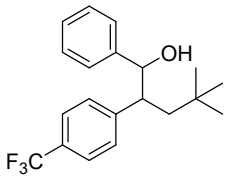


1-Phenyl-3-(tetrahydro-2H-pyran-4-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4ah**) The resultant residue was purified by flash silica gel column chromatography to afford **4ah** as yellow oil (56.8 mg, 78%, *dr* = 1.4 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.46 (d, J = 8.0 Hz, 2H), 7.34-7.29 (m, 4H), 7.24-7.19 (m, 6H), 7.13 (d, J = 8.0 Hz, 2H), 7.09-7.07 (m, 2H), 4.75-4.73 (m, 2H), 3.85-3.81 (m, 3H), 3.80-3.77 (m, 1H), 3.22-3.17 (m, 2H), 3.16-3.11 (m, 4H), 3.08-3.05 (m, 1H), 2.03 (s, 1H), 1.86-1.79 (m, 3H), 1.71-1.67 (m, 1H), 1.55-1.51 (m, 2H), 1.40-1.38 (m, 1H), 1.33-1.25 (m, 3H), 1.18-1.15 (m, 2H), 1.13-1.08 (m, 1H), 1.06-1.01 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.5, 142.4, 129.14, 129.12, 128.7 (q, J = 32 Hz), 128.4, 128.09, 128.06, 127.6, 126.6, 126.3, 125.3 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.2 (q, J = 270 Hz), 124.0 (q, J = 270 Hz), 78.7, 78.5, 67.8, 67.71, 67.68, 67.6, 50.3, 50.1, 39.1, 37.0, 34.0, 33.8, 32.1, 31.94, 31.91, 31.87; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{21}H_{23}F_3O_2Na^+$: 387.1542; found, 387.1545.

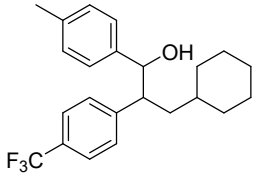


***Tert*-butyl4-(3-hydroxy-3-phenyl-2-(4-(trifluoromethyl)phenyl)propyl)piperidine-1-carboxylate** (**4ai**) The resultant residue was purified by flash silica gel column chromatography to afford **4ai** as black oil (80.8 mg, 87%, *dr* = 2.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 1H), 7.45 (d, J = 8.0 Hz, 3H), 7.33-7.31 (m, 2H), 7.30-7.27 (m, 1H), 7.23-7.20 (m, 4H),

7.19-7.17 (m, 1H), 7.14 (d, J = 8.0 Hz, 3H), 7.08-7.07 (m, 3H), 4.72 (t, J = 6.4 Hz, 2H), 3.93 (s, 4H), 3.11-3.08 (m, 1H), 3.07-3.04 (m, 1H), 2.44-2.28 (m, 6H), 1.81-1.79 (m, 3H), 1.69-1.66 (m, 1H), 1.58 (d, J = 12.8 Hz, 2H), 1.41 (s, 12H), 1.39 (s, 6H), 1.28-1.25 (m, 1H), 1.09-1.06 (m, 3H), 1.02-0.93 (m, 3H), 0.82-0.81 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 154.7, 154.6, 145.7, 145.6, 142.5, 142.4, 129.1, 129.0, 128.6 (q, J = 32 Hz), 128.4, 128.01, 127.97, 127.5, 126.6, 126.2, 125.3 (q, J = 3.0 Hz), 125.0 (q, J = 3.0 Hz), 124.19 (q, J = 270 Hz), 124.17 (q, J = 270 Hz), 148.3, 142.0, 127.2, 126.5, 125.2, 121.9, 79.20, 79.19, 78.6, 78.3, 75.0, 50.5, 50.4, 44.1, 43.2, 38.7, 36.4, 33.2, 33.1, 32.9, 30.8, 28.37, 28.35, 24.7; HRMS-ESI (m/z) [M + Na]$^+$ calcd for $C_{26}H_{32}F_3NO_3Na^+$: 486.2226; found, 486.2223.

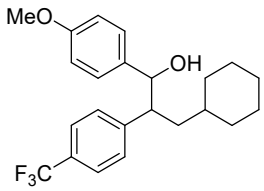


4,4-Dimethyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)pentan-1-ol (**4aj**) The resultant residue was purified by flash silica gel column chromatography to afford **4aj** as yellow oil (57.9 mg, 86%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.53 (d, J = 8.0 Hz, 2H), 7.43 (d, J = 8.0 Hz, 2H), 7.34 (d, J = 8.0 Hz, 2H), 7.32-7.30 (m, 2H), 7.28-7.26 (m, 1H), 7.23-7.21 (m, 4H), 7.20-7.17 (m, 3H), 7.11-7.10 (m, 2H), 4.69-4.67 (m, 2H), 3.09-3.05 (m, 2H), 1.97-1.95 (m, 2H), 1.79-1.74 (m, 3H), 1.54-1.52 (m, 1H), 0.69 (s, 10H), 0.64 (s, 8H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 148.0, 147.5, 142.5, 142.4, 129.6, 129.4, 128.7 (q, J = 32 Hz), 128.4 (q, J = 32 Hz), 128.3, 128.0, 127.9, 127.4, 126.9, 126.3, 125.0 (q, J = 3.6 Hz), 124.8 (q, J = 3.6 Hz), 124.28 (q, J = 270 Hz), 124.26 (q, J = 270 Hz), 79.5, 78.9, 50.5, 50.4, 45.5, 42.9, 31.1, 31.0, 30.0, 29.9; HRMS-ESI (m/z) [M + Na]$^+$ calcd for $C_{20}H_{23}F_3ONa^+$: 359.1593; found, 359.1593.

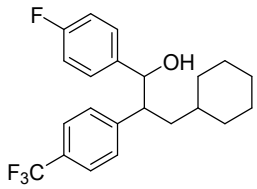


3-Cyclohexyl-1-(p-tolyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4ba**) The resultant residue was purified by flash silica gel column chromatography to afford **4ba**

as yellow oil (52.5 mg, 70%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.44 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 8.0 Hz, 2H), 7.13-7.12 (m, 6H), 7.01 (d, J = 8.0 Hz, 2H), 6.95 (d, J = 8.0 Hz, 2H), 4.69 (d, J = 6.4 Hz, 1H), 4.66 (d, J = 8.0 Hz, 1H), 3.14-3.11 (m, 1H), 3.08-3.05 (m, 1H), 2.34 (s, 3H), 2.28 (s, 3H), 1.92 (s, 1H), 1.74-1.67 (m, 5H), 1.60-1.50 (m, 9H), 1.43-1.41 (m, 1H), 1.23-1.88 (m, 1H), 1.09-1.05 (m, 2H), 1.04-0.96 (m, 4H), 0.94-0.89 (m, 2H), 0.81-0.75 (m, 2H), 0.66-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.3, 146.1, 139.6, 139.4, 137.6, 137.1, 129.2, 129.12, 129.07, 128.71 (q, J = 32 Hz), 128.70, 128.4 (q, J = 32 Hz), 126.7, 126.3, 125.2 (q, J = 3.6 Hz), 124.8 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 78.7, 78.4, 50.6, 50.2, 39.7, 37.6, 34.6, 34.5, 34.38, 34.37, 32.0, 31.9, 26.5, 26.4, 26.2, 26.1, 25.93, 25.86, 21.1, 21.0; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{27}F_3ONa^+$: 399.1906; found, 399.1907.

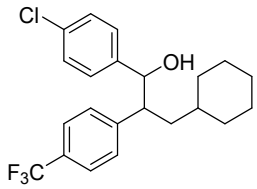


3-Cyclohexyl-1-(4-methoxyphenyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bb**) The resultant residue was purified by flash silica gel column chromatography to afford **4bb** as yellow oil (63.5 mg, 81%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.43 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 8.0 Hz, 2H), 7.17 (dt, J = 8.8, 3.2 Hz, 2H), 7.10 (d, J = 8.0 Hz, 2H), 6.98-6.96 (m, 2H), 6.87-6.85 (m, 2H), 6.74-6.72 (m, 2H), 4.67 (d, J = 6.4 Hz, 1H), 4.65 (d, J = 8.0 Hz, 1H), 3.81 (s, 3H), 3.75 (s, 3H), 3.13-3.10 (m, 1H), 3.06-3.03 (m, 1H), 1.93 (s, 1H), 1.77-1.74 (m, 1H), 1.72-1.66 (m, 4H), 1.62-1.50 (m, 9H), 1.43-1.40 (m, 1H), 1.21-1.18 (m, 1H), 1.09-1.06 (m, 2H), 1.03-0.96 (m, 4H), 0.94-0.90 (m, 2H), 0.81-0.76 (m, 2H), 0.66-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 159.2, 158.8, 146.3, 146.0, 134.7, 134.6, 129.2, 129.1, 128.8 (q, J = 32 Hz), 128.4 (q, J = 32 Hz), 127.9, 127.5, 125.2 (q, J = 3.6 Hz), 124.8 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 113.7, 113.3, 78.5, 78.2, 55.2, 55.1, 39.7, 37.8, 34.6, 34.5, 34.4, 34.3, 32.0, 31.8, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{27}F_3O_2Na^+$: 415.1855; found, 415.1856.



3-Cyclohexyl-1-(4-fluorophenyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bc**)

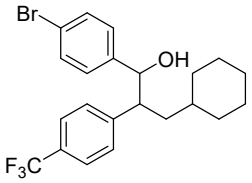
The resultant residue was purified by flash silica gel column chromatography to afford **4bc** as yellow oil (51.0 mg, 67%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 8.0 Hz, 2H), 7.31 (d, *J* = 8.0 Hz, 2H), 7.22-7.20 (m, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 7.04-7.00 (m, 4H), 6.89 (t, *J* = 8.8 Hz, 2H), 4.71-4.70 (m, 2H), 3.11-3.08 (m, 1H), 3.04-3.01 (m, 1H), 1.98 (s, 1H), 1.77 (s, 1H), 1.74-1.65 (m, 4H), 1.61-1.51 (m, 9H), 1.45-1.42 (m, 1H), 1.27-1.89 (m, 1H), 1.09-0.97 (m, 6H), 0.94-0.90 (m, 2H), 0.82-0.75 (m, 2H), 0.66-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 162.3 (d, *J* = 244 Hz), 162.0 (d, *J* = 244 Hz), 145.72, 145.67, 138.3 (d, *J* = 3.4 Hz), 138.2 (d, *J* = 3.0 Hz), 129.2, 129.1, 129.0 (q, *J* = 32 Hz), 128.6 (q, *J* = 32 Hz), 128.33, 128.29, 128.0, 127.9, 125.3 (q, *J* = 3.6 Hz), 124.9 (q, *J* = 3.6 Hz), 124.2 (q, *J* = 270 Hz), 124.0 (q, *J* = 270 Hz), 115.2 (d, *J* = 21 Hz), 114.8 (d, *J* = 21 Hz), 78.1, 77.9, 50.9, 50.5, 39.6, 37.5, 34.6, 34.5, 34.4, 34.3, 32.0, 31.9, 26.5, 26.4, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}F_4ONa^+$: 403.1655; found, 403.1652.



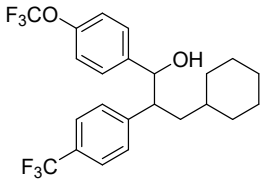
1-(4-Chlorophenyl)-3-cyclohexyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bd**)

The resultant residue was purified by flash silica gel column chromatography to afford **4bd** as yellow oil (63.3 mg, 80%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.56 (d, *J* = 8.0 Hz, 2H), 7.46 (d, *J* = 8.0 Hz, 2H), 7.30-7.28 (m, 4H), 7.18 (d, *J* = 8.0 Hz, 4H), 7.11 (d, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 8.0 Hz, 2H), 4.69-4.67 (m, 2H), 3.10 (m, 1H), 3.03-3.00 (m, 1H), 2.05 (s, 1H), 1.83 (s, 1H), 1.70-1.65 (m, 4H), 1.61-1.49 (m, 9H), 1.45-1.43 (m, 1H), 1.23-1.21 (m, 1H), 1.09-1.05 (m, 2H), 1.05-0.96 (m, 4H), 0.94-0.91 (m, 2H), 0.82-0.73 (m, 2H), 0.68-0.61 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.53, 145.48, 141.0, 140.9, 133.5, 133.1, 129.2, 129.1, 128.8 (q, *J* = 32 Hz), 128.5, 128.14,

128.07, 127.7, 125.3 (q, J = 3.8 Hz), 125.0 (q, J = 3.8 Hz), 124.2 (q, J = 270 Hz), 78.1, 77.8, 50.7, 50.4, 39.5, 37.3, 34.6, 34.5, 34.4, 34.3, 31.92, 31.89, 26.5, 26.4, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}ClF_3ONa^+$: 419.1360; found, 419.1346.

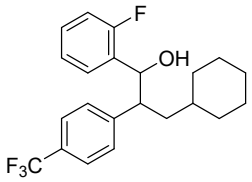


1-(4-Bromophenyl)-3-cyclohexyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4be**) The resultant residue was purified by flash silica gel column chromatography to afford **4be** as yellow oil (59.8 mg, 67%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ:7.57 (d, J = 8.0 Hz, 2H), 7.48 (d, J = 8.0 Hz, 2H), 7.45 (d, J = 8.0 Hz, 2H), 7.34 (d, J = 8.8 Hz, 2H), 7.30 (d, J = 7.2 Hz, 2H), 7.13-7.11 (m, 4H), 6.95 (d, J = 8.8 Hz, 2H), 4.71-4.68 (m, 2H), 3,11-3.08 (m, 1H), 3.03-3.00 (m, 1H), 1.96 (s, 1H), 1.77 (s, 1H), 1.79-1.65 (m, 4H), 1.61-1.50 (m, 9H), 1.45-1.43 (m, 1H), 1.24-1.20 (m, 1H), 1.10-1.05 (m, 2H), 1.05-0.96 (m, 4H), 0.95-0.89 (m, 2H), 0.83-0.73 (m, 2H), 0.67-0.62 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.5, 145.4, 141.5, 141.4, 131.4, 131.1, 129.2, 129.1, 129.0 (q, J = 32 Hz), 128.7 (q, J = 32 Hz), 128.4, 128.1, 125.3 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.42 (q, J = 270 Hz), 124.41 (q, J = 270 Hz), 121.7, 121.2, 78.1, 77.8, 50.6, 50.3, 39.5, 37.3, 34.6, 34.5, 34.4, 34.3, 31.91, 31.88, 26.44, 26.37, 26.37, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}BrF_3ONa^+$: 463.0855; found, 463.0858.

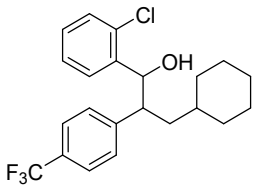


3-Cyclohexyl-1-(4-(trifluoromethoxy)phenyl)-2-(4-(trifluoromethyl)phenyl)-propan-1-ol (**4bf**) The resultant residue was purified by flash silica gel column chromatography to afford **4bf** as yellow oil (49.0 mg, 55%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.46 (d, J = 8.0 Hz, 2H), 7.3 (d, J = 8.0 Hz, 2H), 7.27-7.25 (m, 2H), 7.17 (d, J = 8.8 Hz, 2H), 7.13-7.10 (m, 4H), 7.06 (d, J =

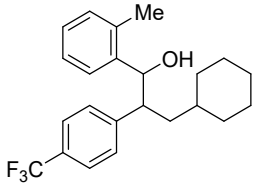
8.0 Hz, 2H), 4.75 (t, J = 8.0 Hz, 2H), 3.11-3.09 (m, 1H), 3.05-3.02 (m, 1H), 1.99 (s, 1H), 1.78 (s, 1H), 1.73-1.70 (m, 2H), 1.69-1.64 (m, 2H), 1.61-1.51 (m, 9H), 1.46-1.44 (m, 1H), 1.25-1.21 (m, 1H), 1.09-1.05 (m, 2H), 1.05-0.97 (m, 4H), 0.95-0.90 (m, 2H), 0.82-0.74 (m, 2H), 0.68-0.63 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 148.7, 148.4, 145.5, 145.4, 141.2, 141.1, 129.2, 129.1, 128.8 (q, J = 32 Hz), 128.1, 127.8, 125.3 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.22 (q, J = 270 Hz), 124.19 (q, J = 270 Hz), 120.8, 120.5, 120.44 (q, J = 270 Hz), 120.40 (q, J = 270 Hz), 78.0, 77.8, 50.8, 50.5, 39.5, 37.3, 34.6, 34.5, 34.4, 34.3, 31.93, 31.92, 26.4, 26.3, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{24}F_6O_2Na^+$: 469.1573; found, 469.1570.



3-Cyclohexyl-1-(2-fluorophenyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bg**) The resultant residue was purified by flash silica gel column chromatography to afford **4bg** as yellow oil (57.5 mg, 76%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.54 (d, J = 8.0 Hz, 2H), 7.46 (d, J = 8.0 Hz, 2H), 7.30 (d, J = 8.0 Hz, 2H), 7.25-7.20 (m, 4H), 7.19-7.15 (m, 2H), 7.07-7.02 (m, 3H), 6.91-6.89 (m, 1H), 5.12 (d, J = 7.2 Hz, 1H), 5.02 (d, J = 5.6 Hz, 1H), 3.22-3.20 (m, 1H), 3.14-3.11 (m, 1H), 2.04 (s, 1H), 1.83 (s, 1H), 1.77-1.73 (m, 1H), 1.72-1.66 (m, 4H), 1.60-1.56 (m, 4H), 1.72-1.66 (m, 4H), 1.34-1.29 (m, 1H), 1.09-0.97 (m, 6H), 0.94-0.87 (m, 3H), 0.84-0.78 (m, 1H), 0.76-0.65 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 159.7 (d, J = 244 Hz), 159.5 (d, J = 244 Hz), 146.0, 145.6, 129.8 (d, J = 12.6 Hz), 129.64 (q, J = 12.6 Hz), 129.2, 127.09 (d, J = 8.2 Hz), 129.0, 128.93 (d, J = 8.4 Hz), 128.6 (q, J = 32 Hz), 128.17 (d, J = 4.2 Hz), 127.77 (d, J = 4.2 Hz), 125.1 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 124.2 (d, J = 3.4 Hz), 123.9 (d, J = 3.4 Hz), 115.2 (d, J = 7.2 Hz), 115.1 (d, J = 7.2 Hz), 72.7, 71.7, 49.8, 49.2, 39.4, 36.9, 34.59, 34.56, 34.4, 34.2, 32.0, 31.9, 26.5, 26.4, 26.2, 26.1, 25.90, 25.88; HRMS-ESI (m/z) $[M + H]^+$ calcd for $C_{22}H_{25}F_4O^+$: 381.1836; found, 381.1833.

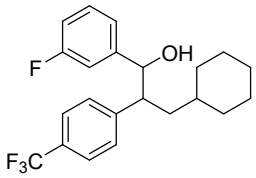


1-(2-Chlorophenyl)-3-cyclohexyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bh**) The resultant residue was purified by flash silica gel column chromatography to afford **4bh** as yellow oil (58.8 mg, 74%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.53 (d, *J* = 8.0 Hz, 2H), 7.50-7.48 (m, 3H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.33 (dd, *J* = 0.8, 8.0 Hz, 1H), 7.28 (dd, *J* = 0.8, 8.0 Hz, 1H), 7.25 (td, *J* = 1.6, 8.0 Hz, 1H), 7.22 (d, *J* = 8.0 Hz, 2H), 7.16 (qd, *J* = 1.6, 8.0 Hz, 2H), 7.11 (td, *J* = 0.8, 8.0 Hz, 1H), 7.04 (dd, *J* = 1.6, 8.0 Hz, 1H), 5.30 (d, *J* = 5.6 Hz, 1H), 5.13 (d, *J* = 4.8 Hz, 1H), 3.31-3.28 (m, 1H), 3.20-3.18 (m, 1H), 2.00 (s, 1H), 1.88 (s, 1H), 185-1.80 (m, 2H), 1.61-1.57 (m, 6H), 1.53-1.49 (m, 4H), 145-1.42 (m, 1H), 1.10-0.94 (m, 7H), 0.90-0.83 (m, 3H), 0.77-0.72 (m, 1H), 0.63-0.58 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.8, 145.1, 140.2, 140.0, 132.1, 131.7, 129.5, 129.4, 129.2, 128.9, 128.8 (q, *J* = 31 Hz), 128.7 (q, *J* = 32 Hz), 128.6, 128.5, 128.4, 127.8, 126.8, 126.6, 125.1 (q, *J* = 3.6 Hz), 124.9 (q, *J* = 3.6 Hz), 124.3 (q, *J* = 270 Hz), 74.8, 73.8, 48.9, 47.39, 47.38, 39.6, 35.01, 34.99, 34.60, 34.57, 34.5, 34.2, 32.2, 31.7, 26.5, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}ClF_3ONa^+$: 419.1360; found, 419.1357.



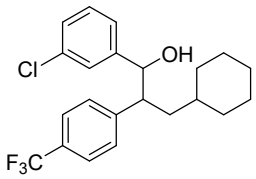
3-Cyclohexyl-1-(o-tolyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bi**) The resultant residue was purified by flash silica gel column chromatography to afford **4bi** as yellow oil (51.9 mg, 69%, *dr* = 1.5 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.56 (d, *J* = 8.0 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 2H), 7.43 (d, *J* = 1.6 Hz, 1H), 7.31 (d, *J* = 8.0 Hz, 2H), 7.24 (d, *J* = 8.0 Hz, 2H), 7.20-7.10 (m, 6H), 7.01 (d, *J* = 8.0 Hz, 1H), 5.03 (d, *J* = 7.2 Hz, 1H), 4.95 (d, *J* = 5.6 Hz, 1H), 3.15-3.11 (m, 2H), 2.39 (s, 3H), 2.11 (s, 3H), 1.85-1.81 (m, 1H), 1.79-1.75 (m, 2H), 1.71-1.66 (m, 2H), 1.64-1.61 (m, 2H), 1.60-1.57 (m, 3H), 1.56-1.51 (m, 4H), 1.46-1.43 (m, 1H), 1.29-1.25 (m, 1H), 1.08-1.00 (m, 4H), 0.99-

0.94 (m, 2H), 0.93-0.86 (m, 3H), 0.83-0.78 (m, 1H), 0.73-0.64 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.6, 145.0, 141.1, 140.7, 135.0, 134.4, 130.4, 130.3, 129.3, 128.9, 128.5 (q, J = 32 Hz), 127.5, 127.3, 126.3, 126.2, 126.1, 125.0, 125.1 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.30 (q, J = 270 Hz), 124.26 (q, J = 270 Hz), 74.6, 74.4, 49.9, 48.9, 39.4, 36.4, 34.7, 34.5, 34.4, 31.9, 31.8, 26.5, 26.4, 26.2, 26.1, 25.89, 25.86, 19.5, 19.1; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{27}F_3ONa^+$: 399.1906; found, 399.1905.

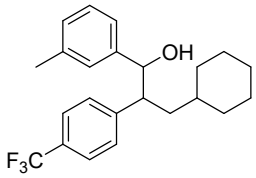


3-Cyclohexyl-1-(3-fluorophenyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (4bj)

The resultant residue was purified by flash silica gel column chromatography to afford **4bf** as yellow oil (36.0 mg, 47%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.47 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 8.0 Hz, 2H), 7.29-7.27 (m, 1H), 7.18-7.14 (m, 3H), 7.01 (d, J = 7.2 Hz, 1H), 6.99-6.96 (m, 2H), 6.89-6.86 (m, 2H), 6.82 (d, J = 8.0 Hz, 1H), 4.72 (t, J = 8.0 Hz, 2H), 3.12-3.09 (m, 1H), 3.05-3.02 (m, 1H), 2.01 (s, 1H), 1.82 (s, 1H), 1.75-1.71 (m, 1H), 1.71-1.66 (m, 3H), 1.63-1.49 (m, 9H), 1.46-1.44 (m, 1H), 1.25-1.22 (m, 1H), 1.08-1.05 (m, 2H), 1.05-0.96 (m, 4H), 0.94-0.89 (m, 2H), 0.83-0.79 (m, 1H), 0.78-0.72 (m, 1H), 0.69-0.62 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 162.8 (d, J = 244 Hz), 162.6 (d, J = 244 Hz), 145.7, 145.5, 145.2 (d, J = 6.4 Hz), 129.8 (d, J = 8.2 Hz), 129.5 (d, J = 8.0 Hz), 129.2, 129.1, 129.0 (q, J = 32 Hz), 128.7 (q, J = 32 Hz), 125.3 (q, J = 3.6 Hz), 125.0 (q, J = 3.6 Hz), 124.24 (q, J = 270 Hz), 124.22 (q, J = 270 Hz), 122.4 (d, J = 2.8 Hz), 122.0 (d, J = 3.2 Hz), 114.7 (d, J = 20.8 Hz), 114.3 (d, J = 21 Hz), 113.6 (d, J = 21.8 Hz), 113.2 (d, J = 22 Hz), 78.1, 77.9, 50.7, 50.4, 39.6, 37.1, 34.6, 34.5, 34.4, 34.3, 31.91, 31.90, 26.5, 26.4, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}F_4ONa^+$: 403.1655; found, 403.1655.

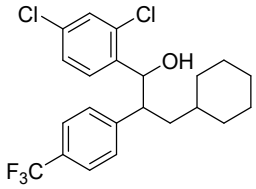


1-(3-Chlorophenyl)-3-cyclohexyl-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bk**) The resultant residue was purified by flash silica gel column chromatography to afford **4bg** as yellow oil (47.7 mg, 60%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, *J* = 8.0 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 7.26-7.23 (m, 3H), 7.17-7.12 (m, 5H), 7.10-7.08 (m, 1H), 6.91-6.90 (d, *J* = 8.0 Hz, 1H), 4.68 (t, *J* = 6.4 Hz, 2H), 3.10-3.08 (m, 1H), 3.04-3.02 (m, 1H), 2.03 (s, 1H), 1.82 (s, 1H), 1.72-1.66 (m, 4H), 1.61-1.50 (m, 9H), 1.46-1.44 (m, 1H), 1.24-1.22 (m, 1H), 1.08-1.03 (m, 4H), 1.00-0.97 (m, 2H), 0.94-0.90 (m, 2H), 0.83-0.80 (m, 1H), 0.77-0.73 (m, 1H), 0.86-0.63 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.6, 145.4, 144.64, 144.61, 134.3, 134.1, 129.6, 129.23, 129.17, 129.1, 128.7 (q, *J* = 32 Hz), 128.0, 127.6, 126.9, 126.4, 126.3, 125.3 (q, *J* = 3.6 Hz), 125.0 (q, *J* = 3.6 Hz), 124.9, 124.5, 124.2 (q, *J* = 270 Hz), 78.1, 77.9, 50.7, 50.4, 39.5, 37.1, 34.6, 34.5, 34.4, 34.3, 31.9, 26.5, 26.4, 26.1, 26.0, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{24}ClF_3ONa^+$: 419.1360; found, 419.1358.

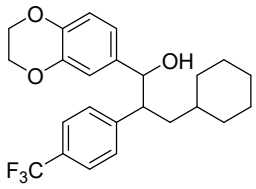


3-Cyclohexyl-1-(m-tolyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bl**) The resultant residue was purified by flash silica gel column chromatography to afford **4bl** as yellow oil (52.3 mg, 69%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.56 (d, *J* = 8.0 Hz, 2H), 7.44 (d, *J* = 8.0 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 7.21 (t, *J* = 8.0 Hz, 1H), 7.13 (d, *J* = 8.0 Hz, 2H), 7.10-7.08 (m, 2H), 7.03 (d, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 7.2 Hz, 1H), 6.86 (d, *J* = 8.0 Hz, 1H), 6.84 (s, 1H), 4.68-4.65 (m, 2H), 3.13-3.11 (m, 1H), 3.09-3.05 (m, 1H), 2.33 (s, 3H), 2.24 (s, 3H), 1.95 (s, 1H), 1.76-1.66 (m, 5H), 1.60-1.51 (m, 9H), 1.45-1.42 (m, 1H), 1.24-1.21 (m, 1H), 1.10-1.06 (m, 2H), 1.05-0.96 (m, 4H), 0.95-0.89 (m, 2H), 0.82-0.75 (m, 2H), 0.67-0.62 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.2, 146.1, 142.5, 142.41, 142.39, 138.0, 137.6, 129.2, 129.1, 128.8 (q, *J* = 32 Hz), 128.6, 128.4 (q, *J* = 32 Hz), 128.25, 128.16, 127.9, 127.4, 127.0, 125.2 (q, *J* = 3.6 Hz), 124.8 (q, *J* = 3.6 Hz), 124.3 (q, *J* = 270 Hz), 123.8, 123.4, 78.9, 78.6, 50.6, 50.4, 39.6, 37.4, 34.61, 34.58, 34.4, 34.3, 32.0, 31.8, 26.5, 26.4, 26.2, 26.1, 25.93, 25.86, 21.4,

21.3; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{23}H_{27}F_3ONa^+$: 399.1906; found, 399.1902.

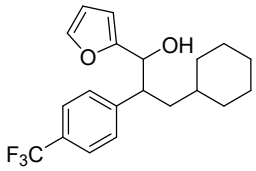


3-Cyclohexyl-1-(2,4-dichlorophenyl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bm**) The resultant residue was purified by flash silica gel column chromatography to afford **4bm** as yellow oil (51.0 mg, 59%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.55 (d, J = 8.0 Hz, 2H), 7.50 (d, J = 8.0 Hz, 2H), 7.45 (d, J = 8.0 Hz, 1H), 7.38 (d, J = 8.0 Hz, 2H), 7.36 (d, J = 2.4 Hz, 1H), 7.31 (d, J = 1.6 Hz, 1H), 7.25 (dd, J = 2.4, 8.0 Hz, 1H), 7.21 (d, J = 8.0 Hz, 2H), 7.09 (dd, J = 2.4, 8.0 Hz, 1H), 6.98 (d, J = 8.0 Hz, 1H), 5.26-5.25 (m, 1H), 5.11-5.10 (m, 1H), 3.25 (td, J = 12.0, 4.0 Hz, 1H), 3.15-3.12 (m, 1H), 1.95 (d, J = 4.0 Hz, 1H), 1.86 (d, J = 4.0 Hz, 1H), 1.85-1.81 (m, 2H), 1.71-1.69 (m, 1H), 1.62-1.54 (m, 7H), 1.52-1.49 (m, 2H), 1.45-1.41 (m, 2H), 1.11-1.01 (m, 5H), 1.01-1.97 (m, 2H), 0.89-0.85 (m, 3H), 0.75 (qd, J = 4.0, 12.0 Hz, 1H), 0.63-0.58 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.3, 144.6, 138.9, 138.7, 133.59, 133.56, 132.6, 132.3, 129.5, 129.4, 129.2, 129.0 (q, J = 32 Hz), 128.89, 128.87 (q, J = 32 Hz), 128.8, 127.1, 127.0, 125.2 (q, J = 3.6 Hz), 124.9 (q, J = 3.6 Hz), 124.2 (q, J = 270 Hz), 74.3, 73.3, 48.8, 47.3, 39.6, 34.9, 34.61, 34.56, 34.3, 34.2, 32.2, 31.8, 26.44, 26.43, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{23}Cl_2F_3ONa^+$: 453.0970; found, 453.0965.

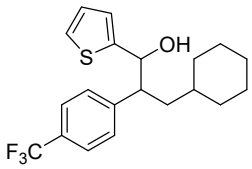


3-Cyclohexyl-1-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bn**) The resultant residue was purified by flash silica gel column chromatography to afford **4bn** as yellow oil (61.1 mg, 73%, *dr* = 1.3 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, J = 8.0 Hz, 2H), 7.45 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 8.0 Hz, 2H), 6.82-6.81 (m, 2H), 6.73 (dd, J = 8.0, 2.4 Hz, 1H), 6.67 (d, J = 8.0 Hz, 1H), 6.65 (d, J = 2.4 Hz, 1H), 6.51 (dd, J = 8.0,

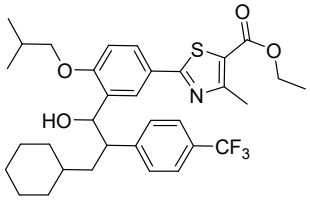
1.6 Hz, 1H), 4.61 (d, *J* = 6.4 Hz, 1H), 4.56 (d, *J* = 8.0 Hz, 1H), 4.25 (s, 4H), 4.20-4.19 (m, 4H), 3.10-3.07 (m, 1H), 3.04-3.01 (m, 1H), 1.93 (s, 1H), 1.75-1.72 (m, 2H), 1.71-1.67 (m, 4H), 1.61-1.57 (m, 4H), 1.55-1.50 (m, 6H), 1.43-1.40 (m, 1H), 1.22-1.18 (m, 1H), 1.08-1.06 (m, 3H), 0.94-0.87 (m, 3H), 0.83-0.76 (m, 3H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.3, 146.1, 143.4, 143.2, 143.1, 142.7, 136.0, 129.1, 129.0, 128.7 (q, *J* = 32 Hz), 128.4 (q, *J* = 32 Hz), 125.2 (q, *J* = 3.6 Hz), 124.8 (q, *J* = 3.6 Hz), 124.3 (q, *J* = 270 Hz), 119.8, 119.4, 117.1, 116.7, 115.6, 115.2, 78.5, 78.0, 64.3, 64.25, 64.24, 50.6, 50.2, 39.7, 37.5, 34.6, 34.5, 34.4, 31.9, 31.8, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{24}H_{27}F_3O_3Na^+$: 443.1805; found, 443.1797.



3-Cyclohexyl-1-(furan-2-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bo**) The resultant residue was purified by flash silica gel column chromatography to afford **4bo** as yellow oil (41.9 mg, 59%, *dr* = 1.2 : 1); ^1H NMR ($CDCl_3$, 800 MHz) δ: 7.57 (d, *J* = 8.0 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.39 (d, *J* = 1.6 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.28 (d, *J* = 1.6 Hz, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 6.32 (dd, *J* = 1.6, 3.2 Hz, 1H), 6.21 (dd, *J* = 1.6, 3.2 Hz, 1H), 6.18 (d, *J* = 3.2 Hz, 1H), 5.98 (d, *J* = 3.2 Hz, 1H), 4.76 (d, *J* = 8.0 Hz, 1H), 4.73 (d, *J* = 7.2 Hz, 1H), 3.32-3.29 (m, 2H), 2.06 (s, 1H), 1.80-1.69 (m, 5H), 1.64-1.51 (m, 9H), 1.49-1.46 (m, 1H), 1.30-1.27 (m, 1H), 1.10-1.02 (m, 6H), 0.98-0.92 (m, 2H), 0.86-0.80 (m, 2H), 0.77-0.72 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 154.8, 145.8, 145.7, 142.0, 141.6, 129.1 (q, *J* = 32 Hz), 129.0, 128.8, 128.6 (q, *J* = 32 Hz), 125.3 (q, *J* = 3.6 Hz), 125.0 (q, *J* = 3.6 Hz), 124.9, 124.26 (q, *J* = 270 Hz), 124.25 (q, *J* = 270 Hz), 110.2, 110.1, 107.5, 106.9, 72.4, 72.0, 48.2, 48.1, 39.6, 37.9, 34.6, 34.5, 34.4, 34.3, 32.04, 32.01, 26.48, 26.47, 26.4, 26.14, 26.06, 25.92, 25.87; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{20}H_{23}F_3O_2Na^+$: 375.1542; found, 375.1539.

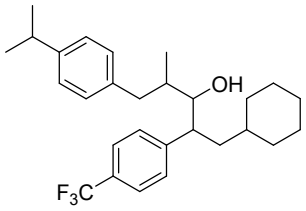


3-Cyclohexyl-1-(thiophen-2-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-ol (**4bp**) The resultant residue was purified by flash silica gel column chromatography to afford **4bp** as yellow oil (51.8 mg, 70%, *dr* = 1.1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.59 (d, *J* = 8.0 Hz, 2H), 7.48 (d, *J* = 8.0 Hz, 2H), 7.37 (d, *J* = 8.0 Hz, 2H), 7.27 (d, *J* = 0.8, 4.8 Hz, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.15 (d, *J* = 5.6 Hz, 1H), 6.96-6.94 (m, 2H), 6.84-6.83 (m, 1H), 6.66 (d, *J* = 4.0 Hz, 1H), 5.00 (d, *J* = 8.0 Hz, 2H), 3.18-3.16 (m, 1H), 3.13-3.10 (m, 1H), 2.15 (s, 1H), 1.91 (s, 1H), 1.85-1.82 (m, 1H), 1.77-1.72 (m, 3H), 1.64-1.57 (m, 5H), 1.56-1.51 (m, 3H), 1.45-1.43 (m, 1H), 1.33-1.30 (m, 1H), 1.11-1.08 (m, 2H), 1.06-1.00 (m, 4H), 0.97-0.92 (m, 2H), 0.88-0.81 (m, 3H), 0.74-0.69 (m, 1H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 146.6, 146.3, 145.9, 145.8, 129.05, 129.03 (q, *J* = 32 Hz), 129.02, 128.7 (q, *J* = 32 Hz), 126.46, 126.43, 125.4 (q, *J* = 3.6 Hz), 125.2, 125.1, 125.0 (q, *J* = 3.6 Hz), 124.4, 124.3 (q, *J* = 270 Hz), 124.2, 74.8, 74.5, 51.4, 50.9, 39.9, 37.9, 34.59, 34.57, 34.4, 32.0, 31.8, 26.5, 26.4, 26.2, 26.1, 25.9, 25.8; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{20}H_{23}F_3OSNa^+$: 391.1314; found, 391.1312.

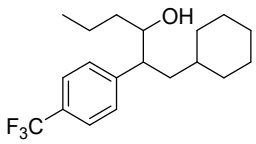


Ethyl-2-(3-(3-cyclohexyl-1-hydroxy-2-(4-(trifluoromethyl)phenyl)propyl)-4-isobutoxyphenyl)-4-methylthiazole-5-carboxylate (**4bq**) The resultant residue was purified by flash silica gel column chromatography to afford **4bq** as yellow oil (72.3 mg, 60%, *dr* = 3 : 1); ^{1}H NMR ($CDCl_3$, 400 MHz) δ: 7.86-7.80 (m, 2H), 7.58-7.45 (m, 6H), 7.24 (d, *J* = 8.0 Hz, 4H), 6.84 (d, *J* = 8.8 Hz, 2H), 5.17 (d, *J* = 6.4 Hz, 1H), 4.98 (d, *J* = 6.0 Hz, 1H), 4.37-4.29 (m, 4H), 3.86-3.82 (m, 2H), 3.79-3.67 (m, 3H), 3.35-3.30 (m, 1H), 3.20-3.15 (m, 1H), 2.74 (d, *J* = 2.0 Hz, 6H), 2.38 (s, 1H), 2.16-2.09 (m, 2H), 1.83-1.76 (m, 2H), 1.72-1.67 (m, 3H), 1.59-1.53 (m, 8H), 1.46-1.43 (m, 1H), 1.40-1.36 (m, 6H), 1.11-1.05 (m, 12H), 1.03-0.98 (m, 7H), 0.89-0.82 (m, 3H), 0.76-0.67 (m, 2H);

^{13}C NMR ($CDCl_3$, 100 MHz) δ: 169.8, 162.4, 160.9, 158.0, 145.7, 131.6, 131.1, 129.3, 129.0, 128.8, 127.0, 126.9, 126.7, 125.3, 124.9 (q, J = 3.7 Hz), 120.8, 111.3, 74.7, 73.1, 61.1, 49.0, 48.4, 39.8, 34.6, 34.3, 32.2, 31.9, 29.7, 28.4, 26.5, 26.1, 25.9, 19.5, 19.45, 19.44, 17.51, 17.49, 14.34, 14.32; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{33}H_{40}F_3NO_4SNa^+$: 626.2522; found, 626.2513.

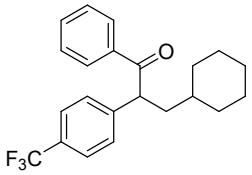


1-Cyclohexyl-5-(4-isopropylphenyl)-4-methyl-2-(4-(trifluoromethyl)phenyl)pentan-3-ol (**4br**) The resultant residue was purified by flash silica gel column chromatography to afford **4br** as yellow oil (29.0 mg, 32%, *dr* = 1 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.59 (d, J = 8.0 Hz, 2H), 7.50 (d, J = 8.0 Hz, 2H), 7.32 (d, J = 8.0 Hz, 2H), 7.11 (d, J = 8.0 Hz, 2H), 7.09 (d, J = 8.0 Hz, 4H), 6.92 (d, J = 8.0 Hz, 2H), 6.90 (d, J = 8.0 Hz, 2H), 3.53 (dd, J = 2.4, 9.6 Hz, 1H), 3.51 (t, J = 5.6 Hz, 1H), 3.04-3.01 (m, 1H), 2.97 (dd, J = 4.0, 15.6 Hz, 1H), 2.89-2.83 (m, 3H), 2.59-2.57 (m, 1H), 2.47-2.44 (m, 1H), 2.23-2.20 (m, 1H), 1.83-1.79 (m, 2H), 1.78-1.76 (m, 1H), 1.71-1.69 (m, 2H), 1.68-1.65 (m, 1H), 1.64-1.62 (m, 2H), 1.60-1.66 (m, 6H), 1.53-1.49 (m, 2H), 1.47-1.42 (m, 2H), 1.41-1.39 (m, 1H), 1.24 (d, J = 7.2 Hz, 7H), 1.22 (d, J = 6.4 Hz, 5H), 1.11-1.04 (m, 4H), 1.04-0.99 (m, 2H), 0.95-0.88 (m, 3H), 0.85-0.80 (m, 8H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 147.6, 147.4, 146.4, 146.3, 138.2, 137.7, 129.1, 128.9, 128.8, 128.7, 128.4, 126.3, 126.2, 125.4 (q, J = 3.6 Hz), 125.3 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 80.4, 46.7, 45.8, 40.4, 40.2, 37.8, 37.5, 36.8, 36.4, 34.8, 34.7, 34.6, 34.5, 33.6, 32.03, 31.97, 26.52, 26.51, 26.2, 26.18, 26.14, 25.9, 24.04, 24.03, 24.02, 17.0, 12.3; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{28}H_{37}F_3ONa^+$: 469.2689; found, 469.2686.

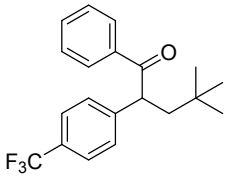


1-Cyclohexyl-2-(4-(trifluoromethyl)phenyl)hexan-3-ol (**4bs**) The resultant residue was purified by flash silica gel column chromatography to afford **4bs** as yellow solid

(27.0 mg, 41%, *dr* = 1.2 : 1); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.57-7.55 (m, 4H), 7.34 (d, J = 8.0 Hz, 2H), 7.29 (d, J = 8.0 Hz, 2H), 3.73-3.71 (m, 1H), 3.65-3.63 (m, 1H), 2.83-2.77 (m, 2H), 1.77-1.74 (m, 2H), 1.73-1.66 (m, 3H), 1.65-1.56 (m, 7H), 155-1.51 (m, 3H), 1.50-1.46 (m, 2H), 1.45-1.40 (m, 2H), 1.38-1.33 (m, 1H), 1.31-1.26 (m, 2H), 1.26-1.19 (m, 3H), 1.12-1.07 (m, 4H), 1.06-1.00 (m, 2H), 0.96-0.89 (m, 6H), 0.86-0.81 (m, 5H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 147.1, 146.1, 129.3, 128.9, 128.68 (q, J = 32 Hz), 128.57 (q, J = 32 Hz), 125.3 (q, J = 3.6 Hz), 125.1 (q, J = 3.6 Hz), 124.3 (q, J = 270 Hz), 75.6, 74.9, 49.0, 48.5, 39.9, 37.9, 37.5, 36.9, 34.68, 34.65, 34.63, 34.4, 32.4, 32.1, 26.5, 26.2, 26.1, 25.98, 25.96, 19.1, 19.0, 14.0, 13.9; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{19}H_{27}F_3ONa^+$: 351.1906; found, 351.1910.

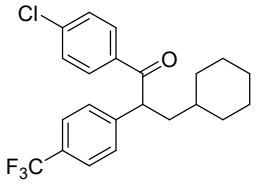


3-Cyclohexyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)propan-1-one (**5a**) The resultant residue was purified by flash silica gel column chromatography to afford **5a** as colorless oil (56.9 mg, 79%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.96 (d, J = 8.0 Hz, 2H), 7.55 (d, J = 8.0 Hz, 2H), 7.52 (t, J = 8.0 Hz, 1H), 7.44-7.41 (m, 4H), 4.80 (t, J = 7.2 Hz, 1H), 2.15-2.11 (m, 1H), 1.82 (d, J = 12.4 Hz, 1H), 1.73-1.61 (m, 5H), 1.19-1.11 (m, 4H), 0.97-0.91 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 198.9, 143.5, 136.2, 132.7, 128.8 (q, J = 32 Hz), 128.3, 128.2, 128.1, 125.4 (q, J = 3.8 Hz), 123.7 (q, J = 270 Hz), 49.8, 41.3, 34.9, 33.1, 32.7, 26.0, 25.7, 25.6; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{23}F_3ONa^+$: 383.1593; found, 383,1590.

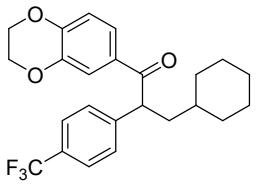


4,4-Dimethyl-1-phenyl-2-(4-(trifluoromethyl)phenyl)pentan-1-one (**5b**) The resultant residue was purified by flash silica gel column chromatography to afford **5b** as colorless solid (53.5 mg, 80%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.99 (d, J = 8.0 Hz, 2H), 7.53-7.51 (m, 3H), 7.46-7.43 (m, 4H), 4.80 (dd, J = 3.2, 8.8 Hz, 1H), 2.64-2.61 (.,

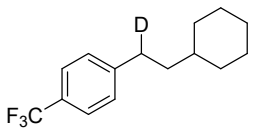
1H), 1.58 (dd, J = 4.0, 13.6 Hz, 1H), 0.89 (s, 9H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 198.7, 144.4, 136.0, 132.5, 128.5 (q, J = 32 Hz), 128.1, 127.9, 127.8, 125.2 (q, J = 3.6 Hz), 123.5 (q, J = 270 Hz), 48.7, 47.0, 30.7, 29.2; HRMS-ESI (m/z) $[M + H]^+$ calcd for $C_{20}H_{21}F_3O^+$: 357.1437; found, 357.1434.



1-(4-Chlorophenyl)-3-cyclohexyl-2-(4-(trifluoromethyl)phenyl)propan-1-one (**5c**) The resultant residue was purified by flash silica gel column chromatography to afford **5c** as colorless oil (63.9 mg, 81%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.89 (d, J = 8.8 Hz, 2H), 7.55 (d, J = 8.0 Hz, 2H), 7.41 (d, J = 8.0 Hz, 2H), 7.39 (d, J = 8.8 Hz, 2H), 4.73 (t, J = 7.2 Hz, 1H), 2.13-2.10 (m, 1H), 1.82-1.79 (m, 1H), 1.72-1.67 (m, 2H), 1.66-1.59 (m, 3H), 1.19-1.11 (m, 4H), 0.97-0.90 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 197.6, 143.1, 139.1, 134.3, 129.4, 128.8 (q, J = 32 Hz), 128.5, 127.9, 125.3 (q, J = 3.6 Hz), 123.5 (q, J = 270 Hz), 49.7, 41.0, 34.7, 32.9, 32.5, 25.8, 25.5, 25.4; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{22}H_{22}ClF_3ONa^+$: 417.1203; found, 417.1194.



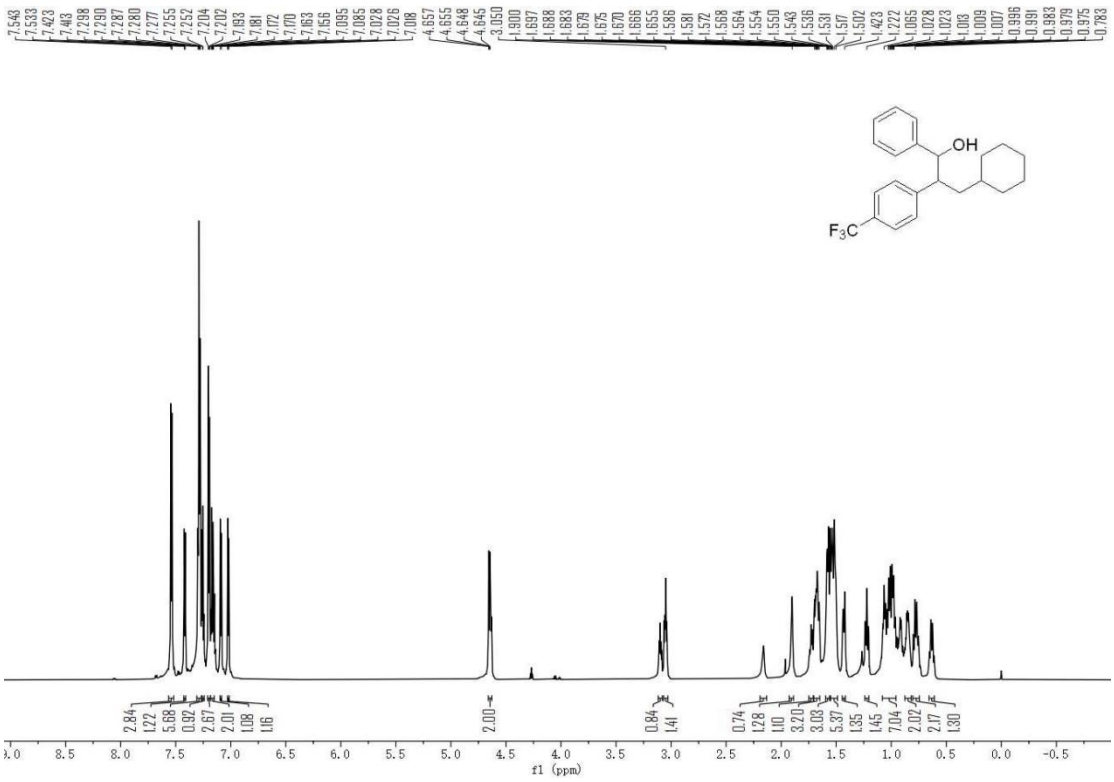
3-Cyclohexyl-1-(2,3-dihydrobenzo[b][1,4]dioxin-6-yl)-2-(4-(trifluoromethyl)phenyl)propan-1-one (**5d**) The resultant residue was purified by flash silica gel column chromatography to afford **5d** as colorless oil (69.5 mg, 83%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.54-7.51 (m, 4H), 7.43 (dd, J = 8.0 Hz, 2H), 6.87 (d, J = 9.6 Hz, 1H), 4.72 (t, J = 7.2 Hz, 1H), 4.28-4.27 (m, 2H), 4.25-4.24 (m, 2H), 2.13-2.09 (m, 1H), 1.81-1.79 (m, 1H), 1.69-1.59 (m, 5H), 1.18-1.10 (m, 4H), 0.96-0.89 (m, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 197.7, 148.2, 144.3, 143.4, 130.3, 129.1 (q, J = 32 Hz), 128.5, 125.7 (q, J = 3.8 Hz), 124.2 (q, J = 270 Hz), 122.7, 118.1, 117.3, 64.7, 64.1, 49.8, 41.7, 35.3, 33.5, 33.2, 26.4, 26.1, 26.0; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{24}H_{25}F_3O_3Na^+$: 441.1648; found, 441.1641.



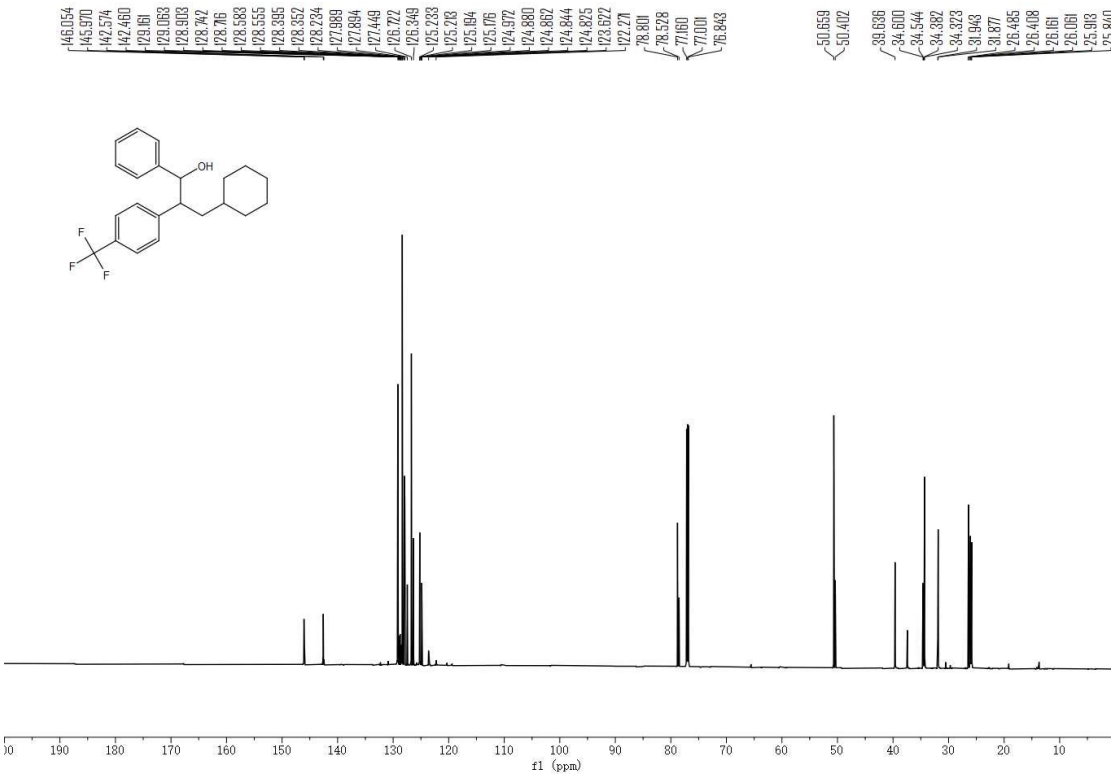
1-(2-Cyclohexylethyl-1-d)-4-(trifluoromethyl)benzene (**7**) The resultant residue was purified by flash silica gel column chromatography to afford **7** as colorless oil (39.5 mg, 76%); ^{1}H NMR ($CDCl_3$, 800 MHz) δ: 7.51 (d, J = 8.0 Hz, 2H), 7.27 (d, J = 8.0 Hz, 2H), 2.67-2.63 (m, 1H), 1.76 (d, J = 9.6 Hz, 2H), 1.72-1.69 (m, 2H) 1.67-1.64 (m, 1H), 1.50 (t, J = 8.0 Hz, 2H), 1.28-1.24 (m, 1H), 1.23-1.19 (m, 2H), 1.18-1.13 (m, 1H), 0.93 (qd, J = 4.0, 12.0 Hz, 2H); ^{13}C NMR ($CDCl_3$, 200 MHz) δ: 145.73, 145.70, 126.9, 126.3 (q, J = 32.2 Hz), 123.5 (q, J = 4.2 Hz), 122.8 (q, J = 270 Hz), 37.4, 37.3, 35.62, 35.60, 31.6, 31.2, 31.1, 31.0, 24.9, 24.6; HRMS-ESI (m/z) $[M + Na]^+$ calcd for $C_{15}H_{18}DF_3Na^+$: 280.1394; found, 280.1396.

9. Copies of NMR spectra

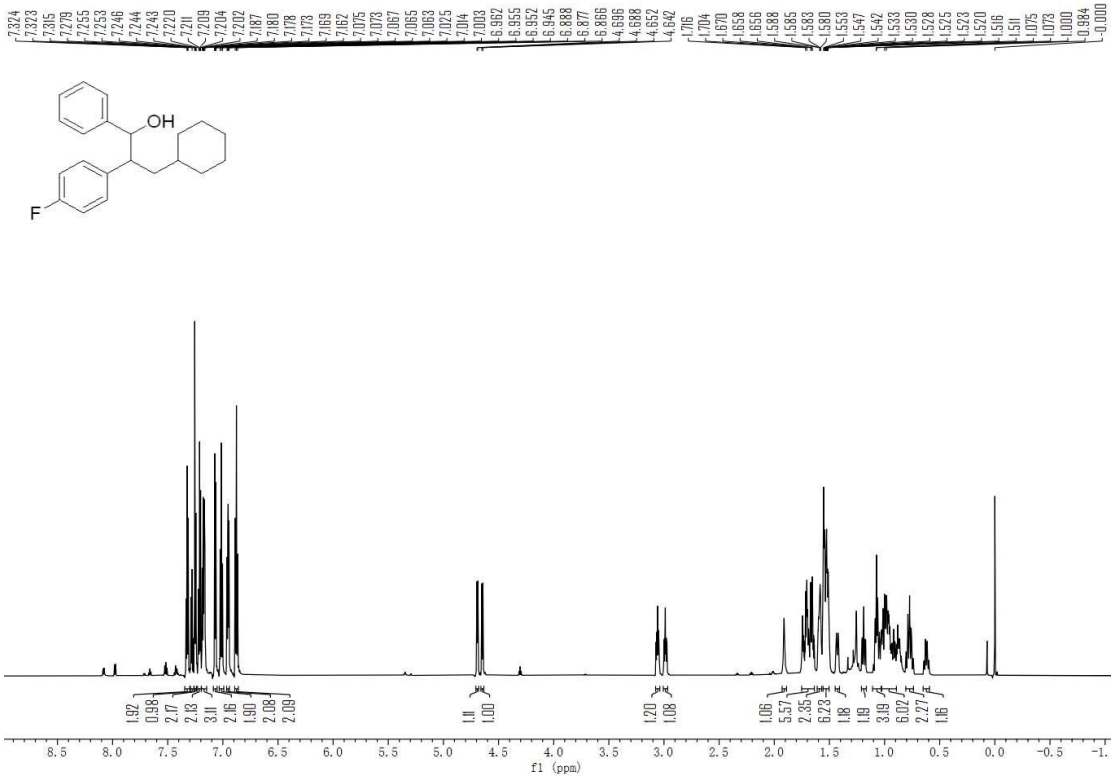
4a; ^{1}H NMR (800 Hz, $CDCl_3$)



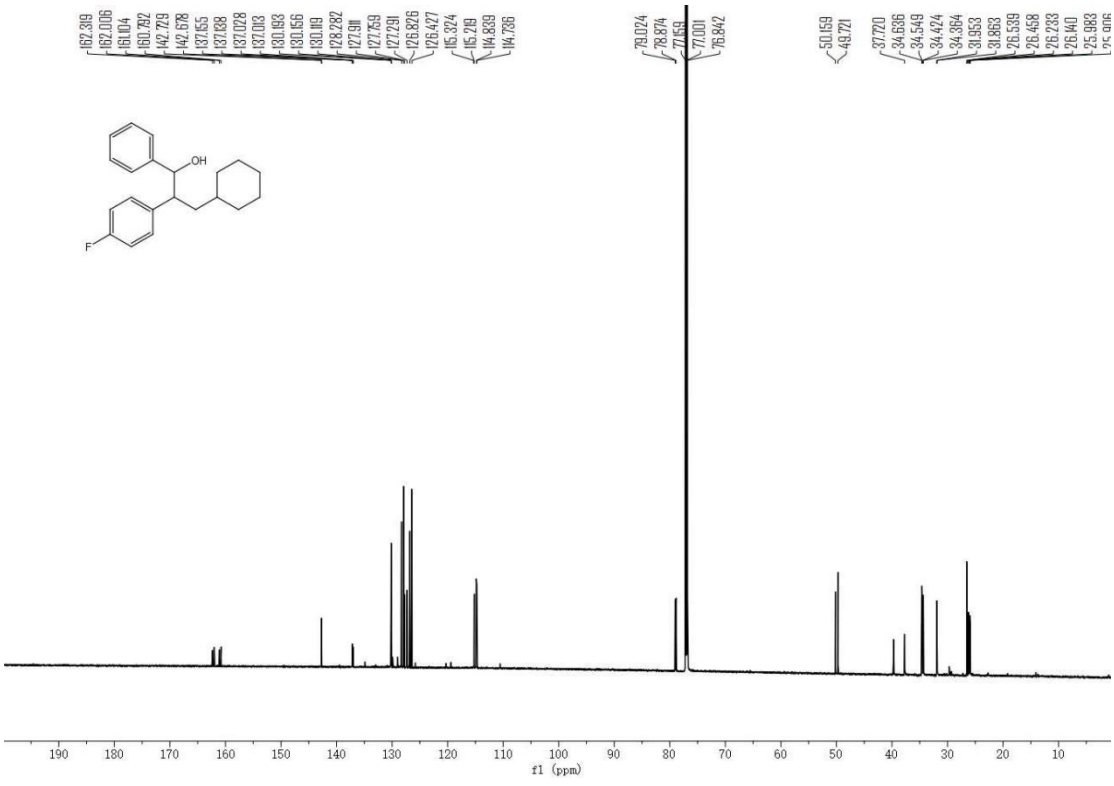
4a; ^{13}C NMR (200 Hz, $CDCl_3$)



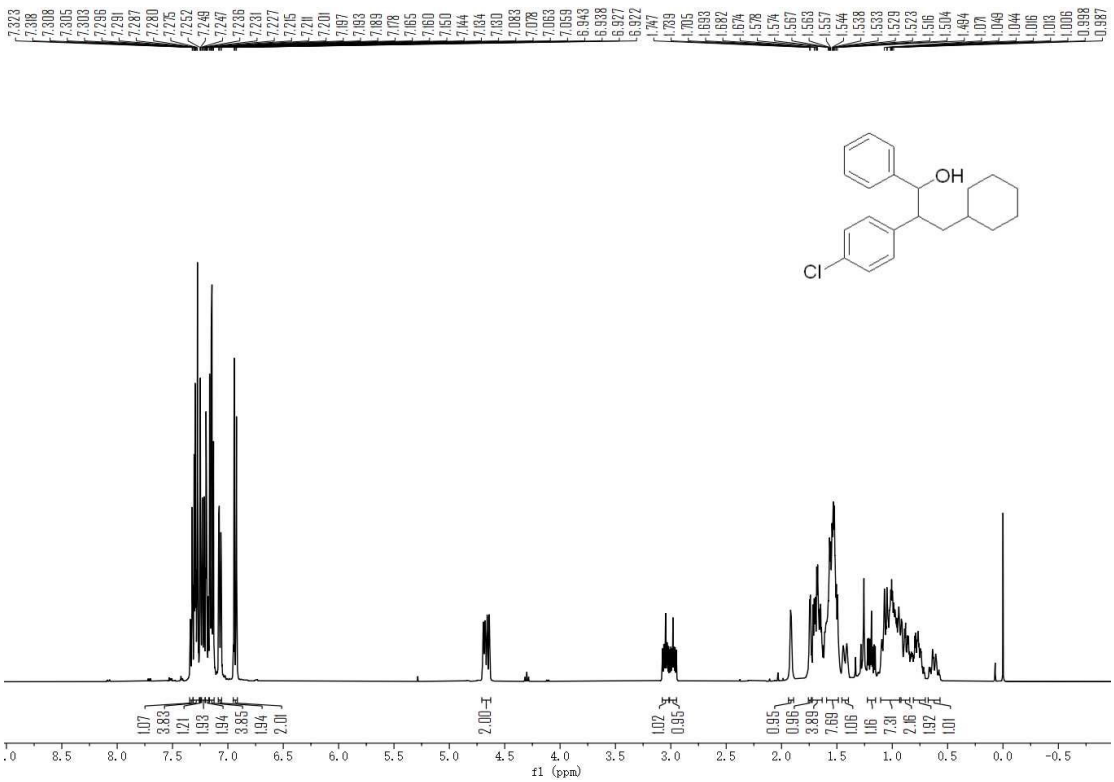
4b; ^{1}H NMR (800 Hz, $CDCl_3$)



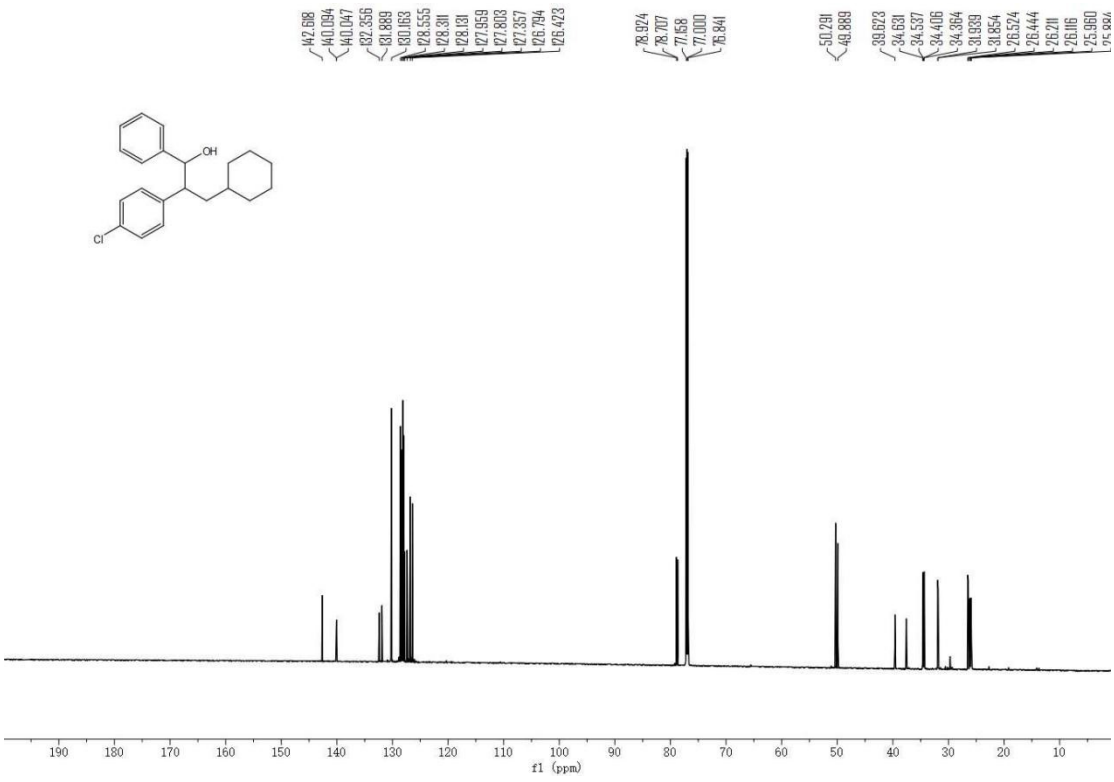
4b; ^{13}C NMR (200 Hz, $CDCl_3$)



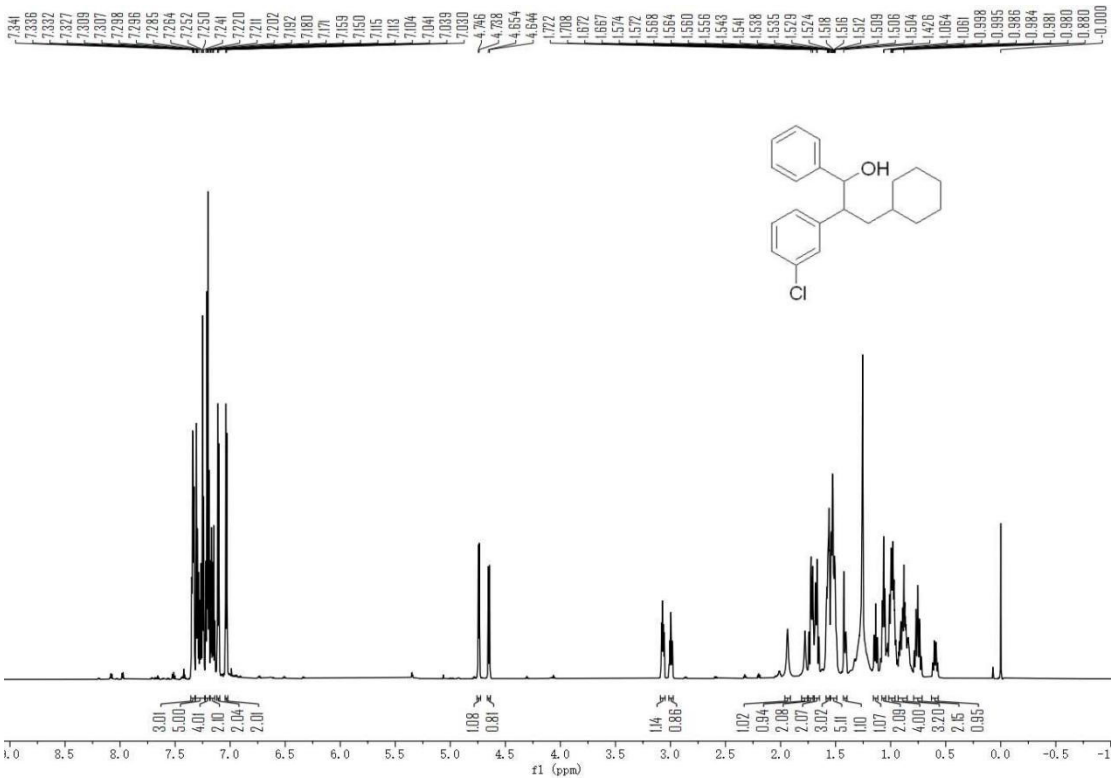
4c; ^{1}H NMR (400 Hz, $CDCl_3$)



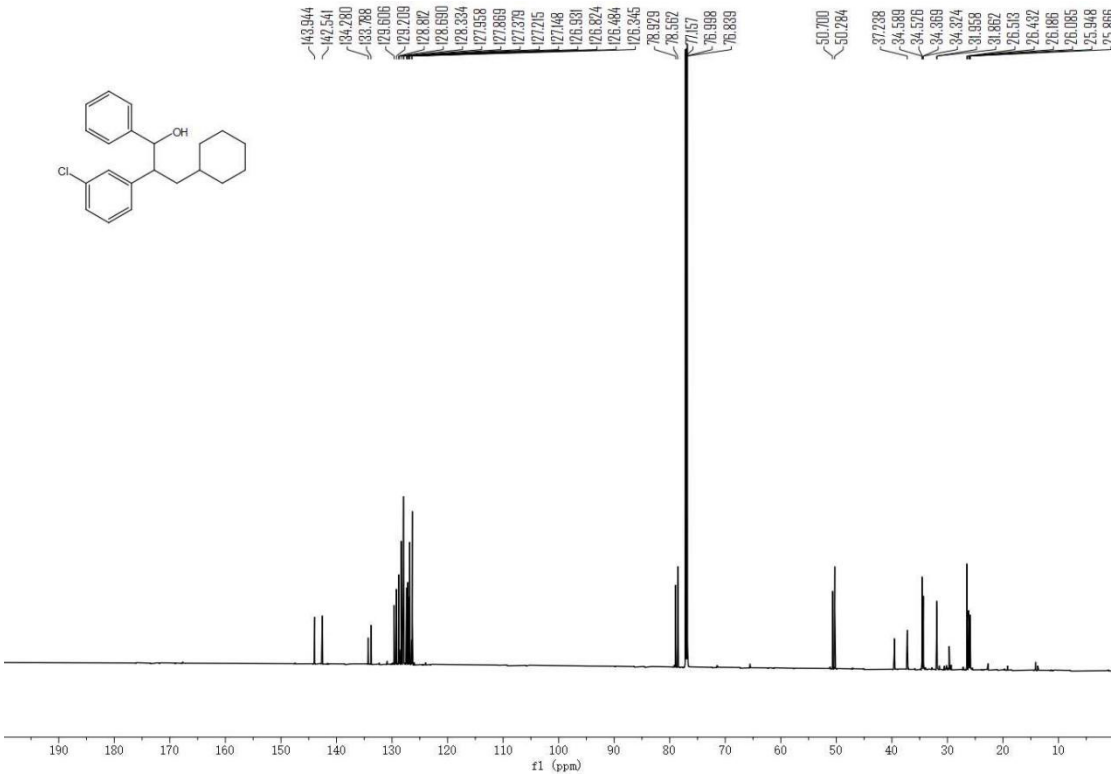
4c; ^{13}C NMR (200 Hz, $CDCl_3$)



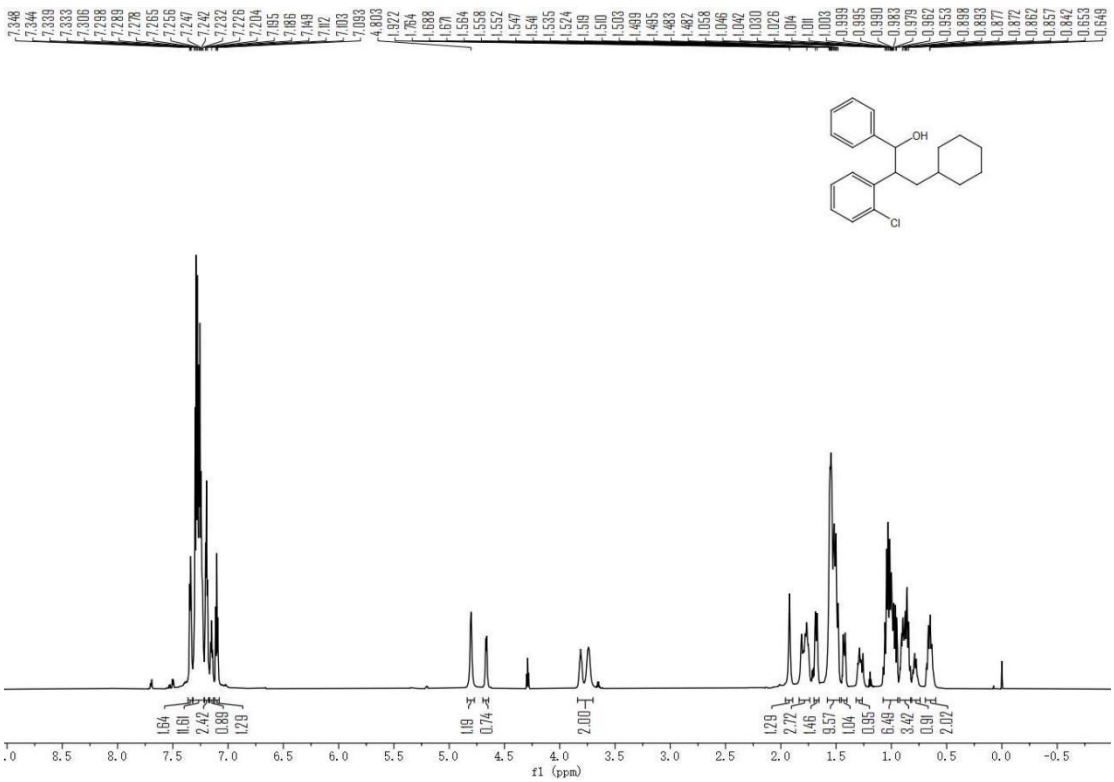
4d; ^{1}H NMR (800 Hz, $CDCl_3$)



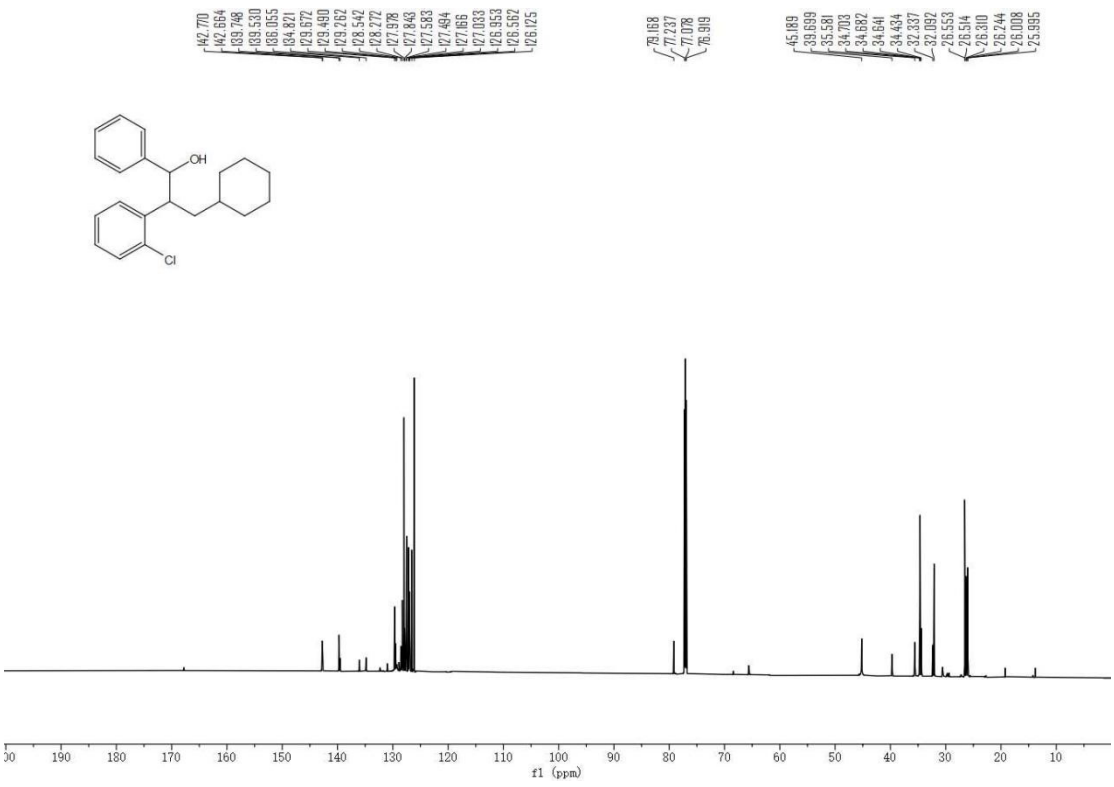
4d; ^{13}C NMR (200 Hz, $CDCl_3$)



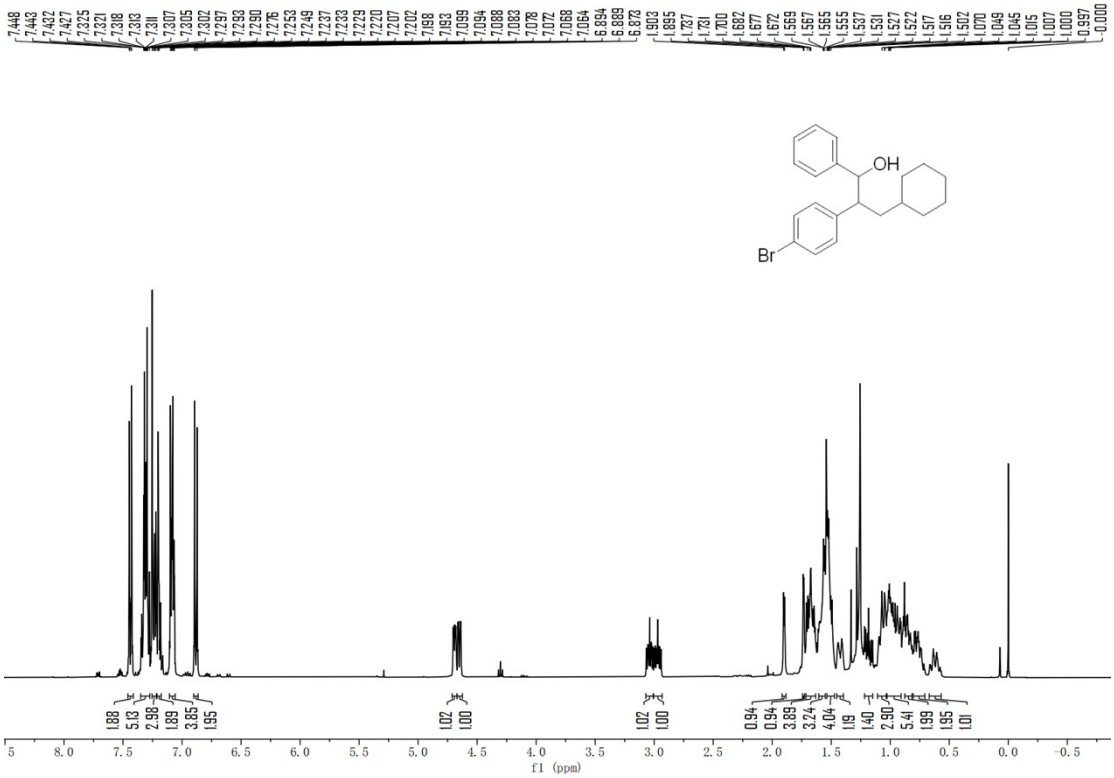
4e; ^{1}H NMR (800 Hz, $CDCl_3$)



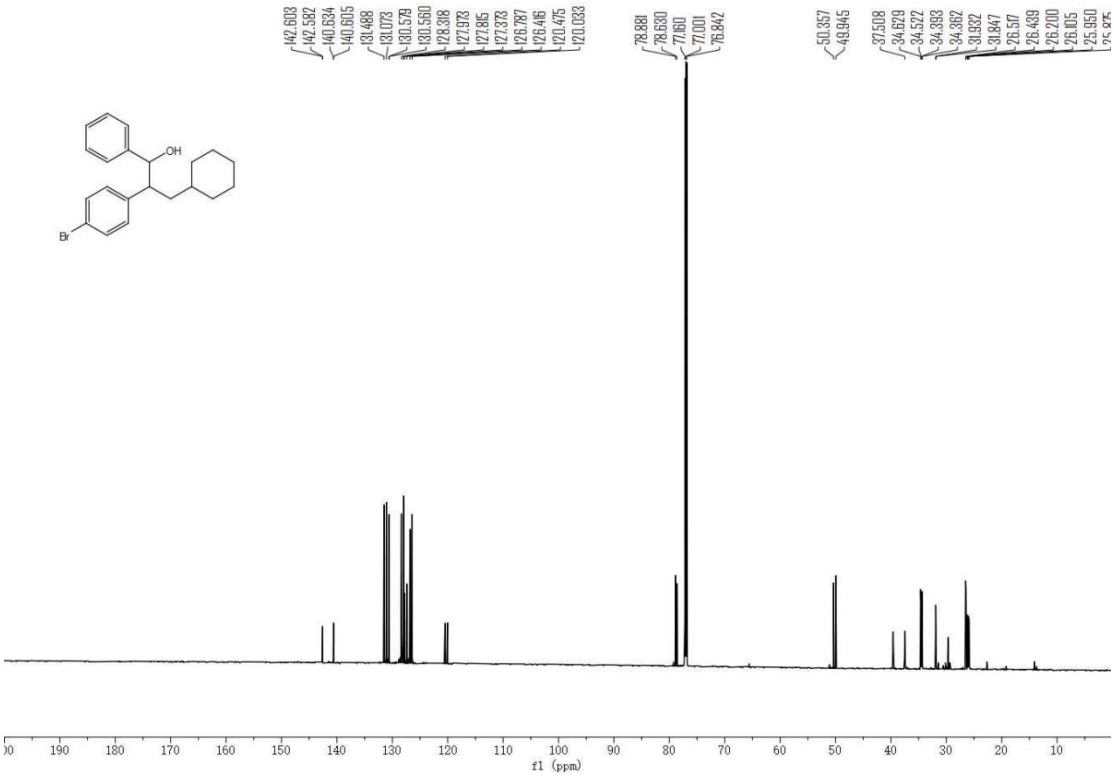
4e; ^{13}C NMR (200 Hz, $CDCl_3$)



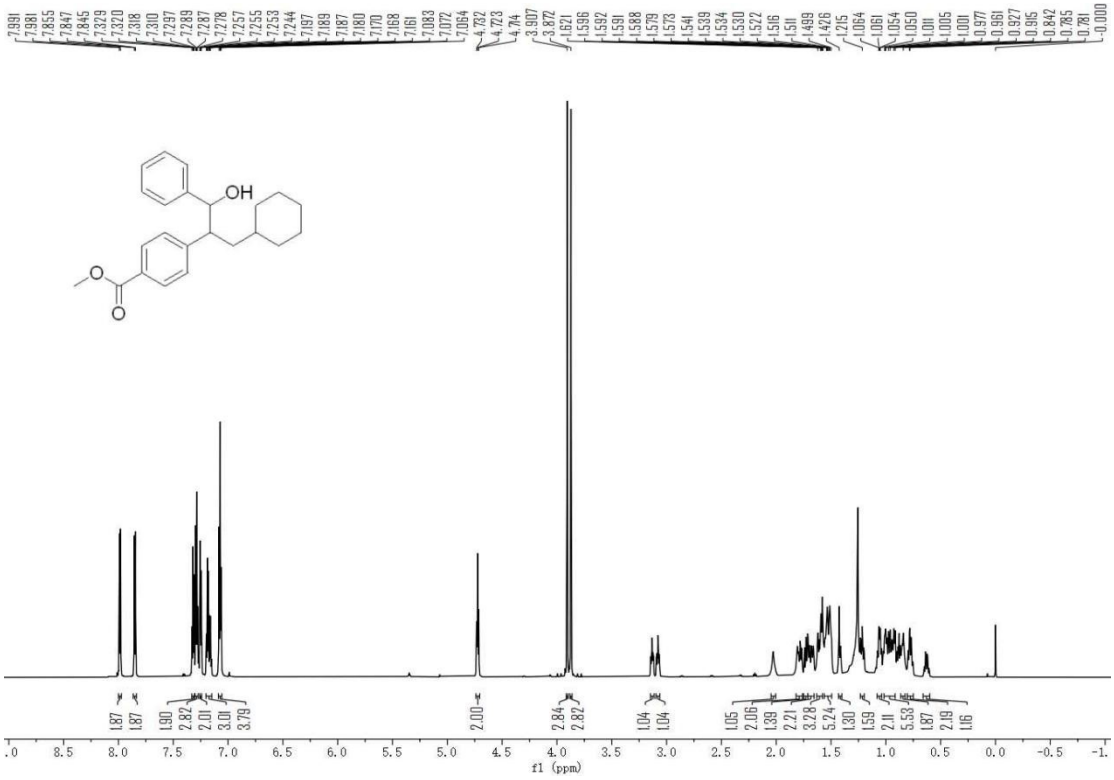
4f; ^{1}H NMR (400 Hz, $CDCl_3$)



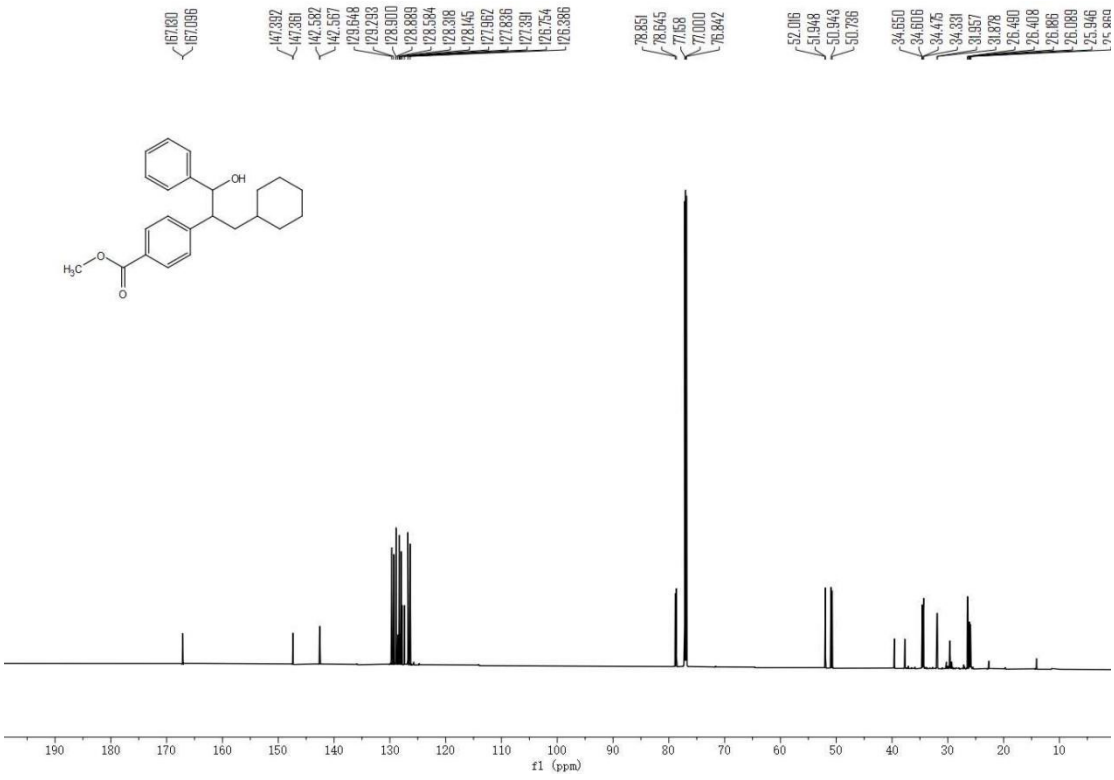
4f; ^{13}C NMR (200 Hz, $CDCl_3$)



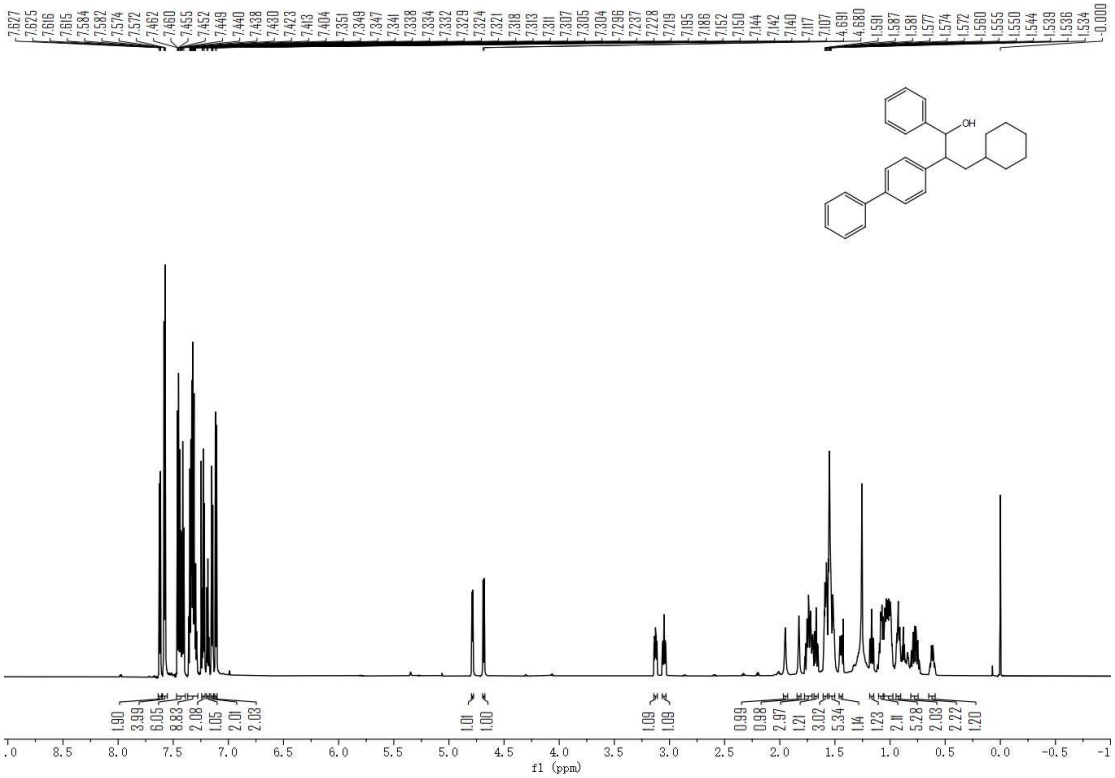
4g; ^{1}H NMR (800 Hz, $CDCl_3$)



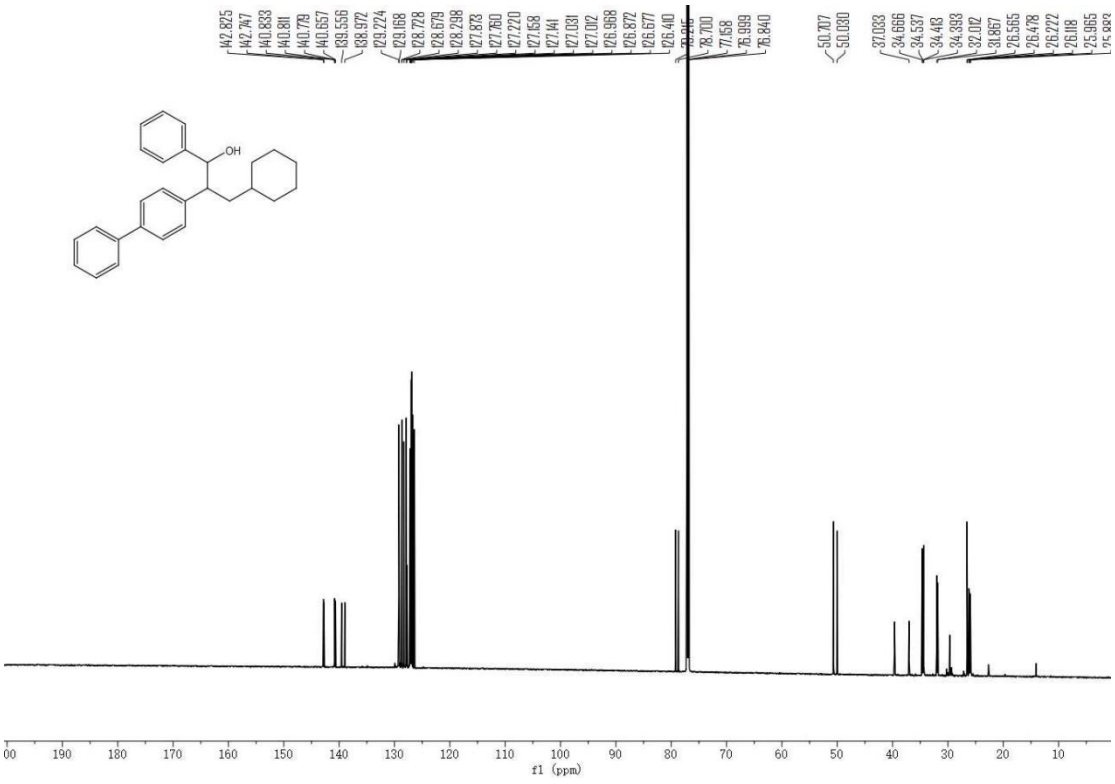
4g; ^{13}C NMR (200 Hz, $CDCl_3$)



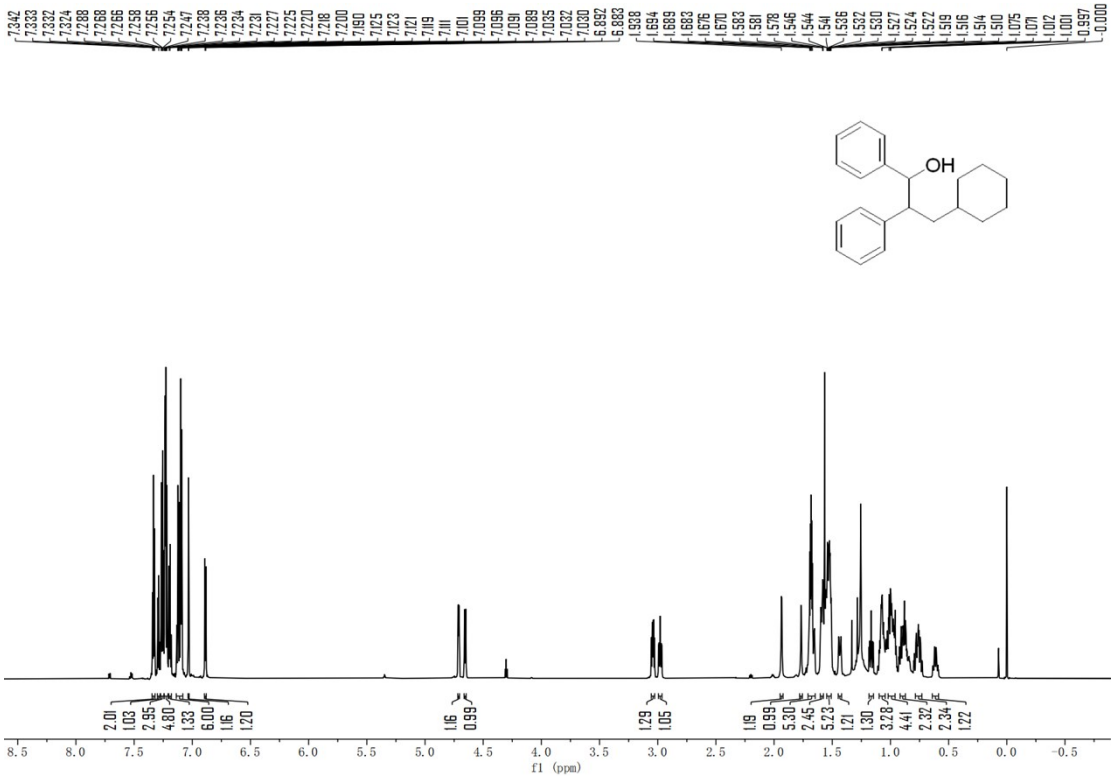
4h; ^{1}H NMR (800 Hz, $CDCl_3$)



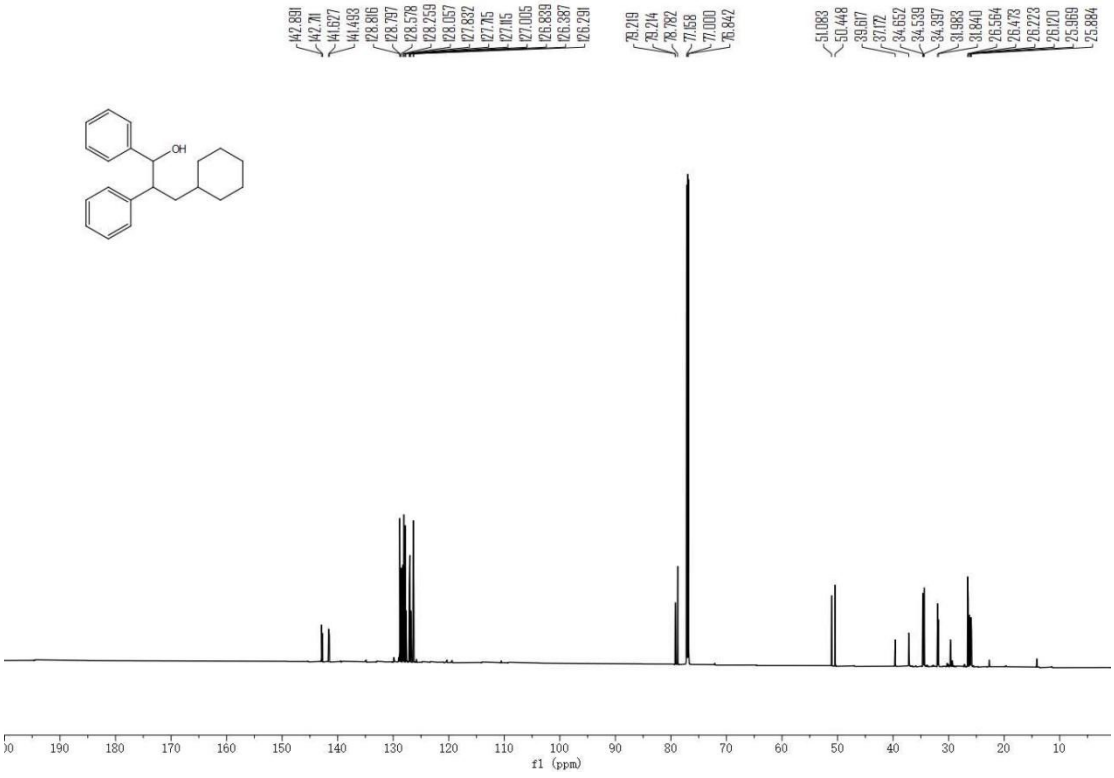
4h; ^{13}C NMR (200 Hz, $CDCl_3$)



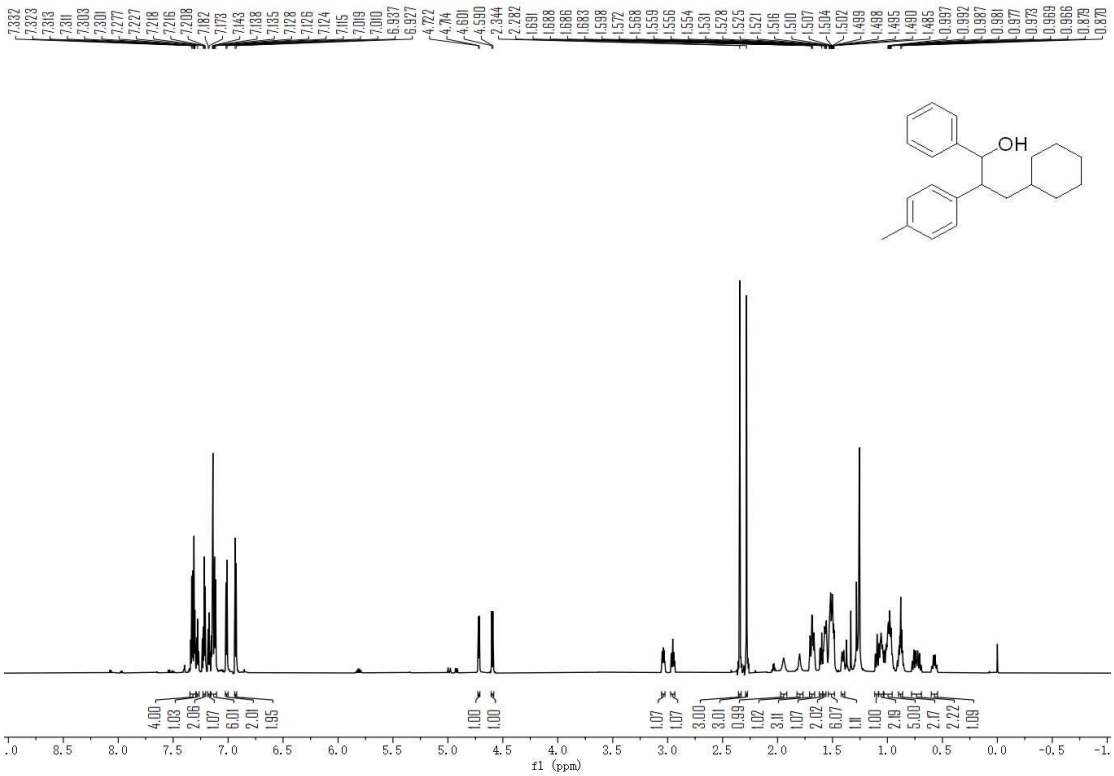
4i; ^{1}H NMR (800 Hz, $CDCl_3$)



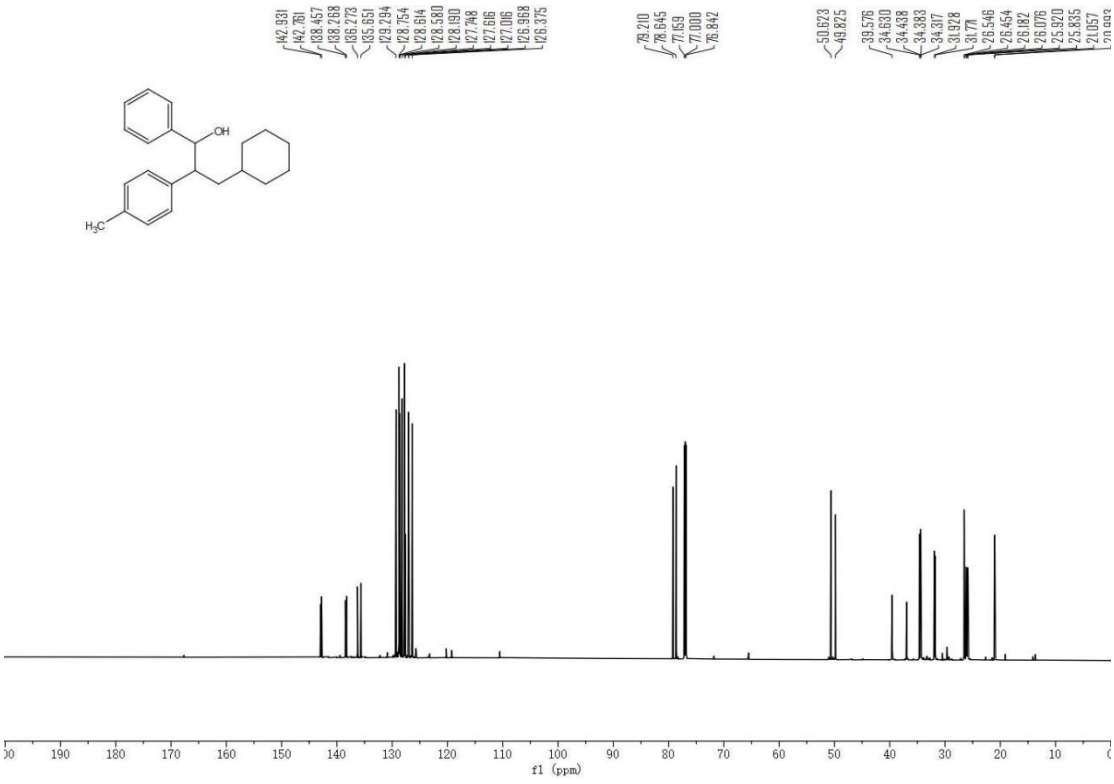
4i; ^{13}C NMR (200 Hz, $CDCl_3$)



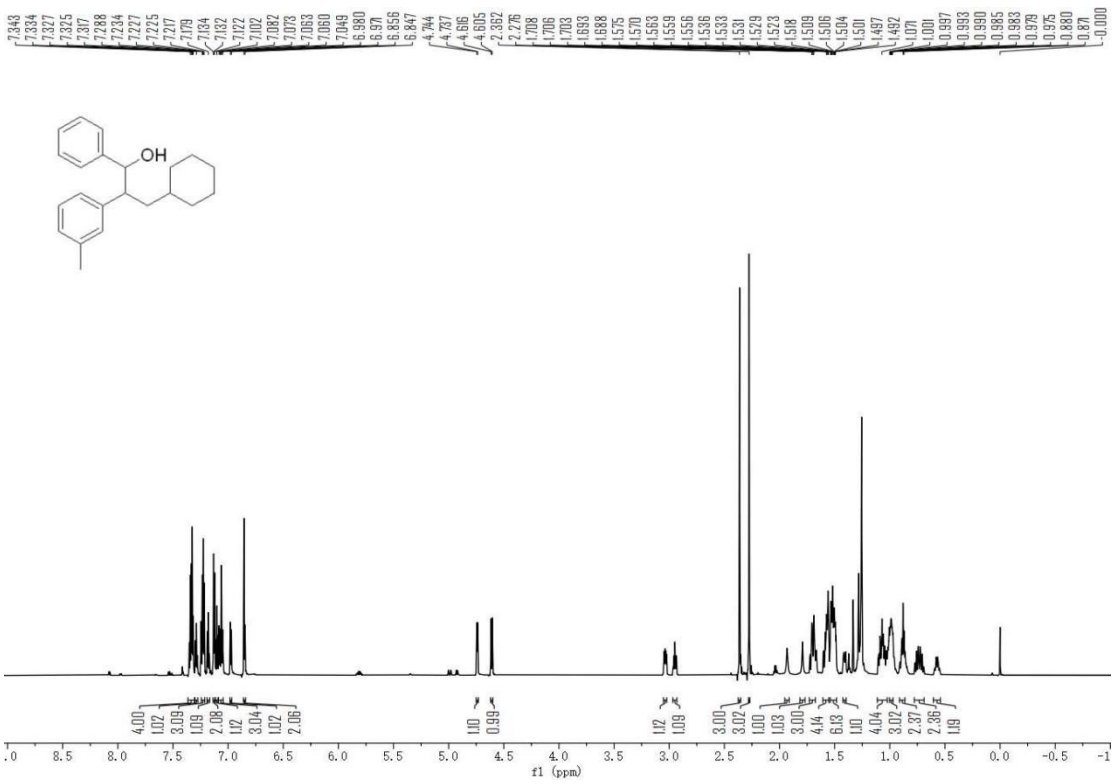
4j; ^{1}H NMR (800 Hz, $CDCl_3$)



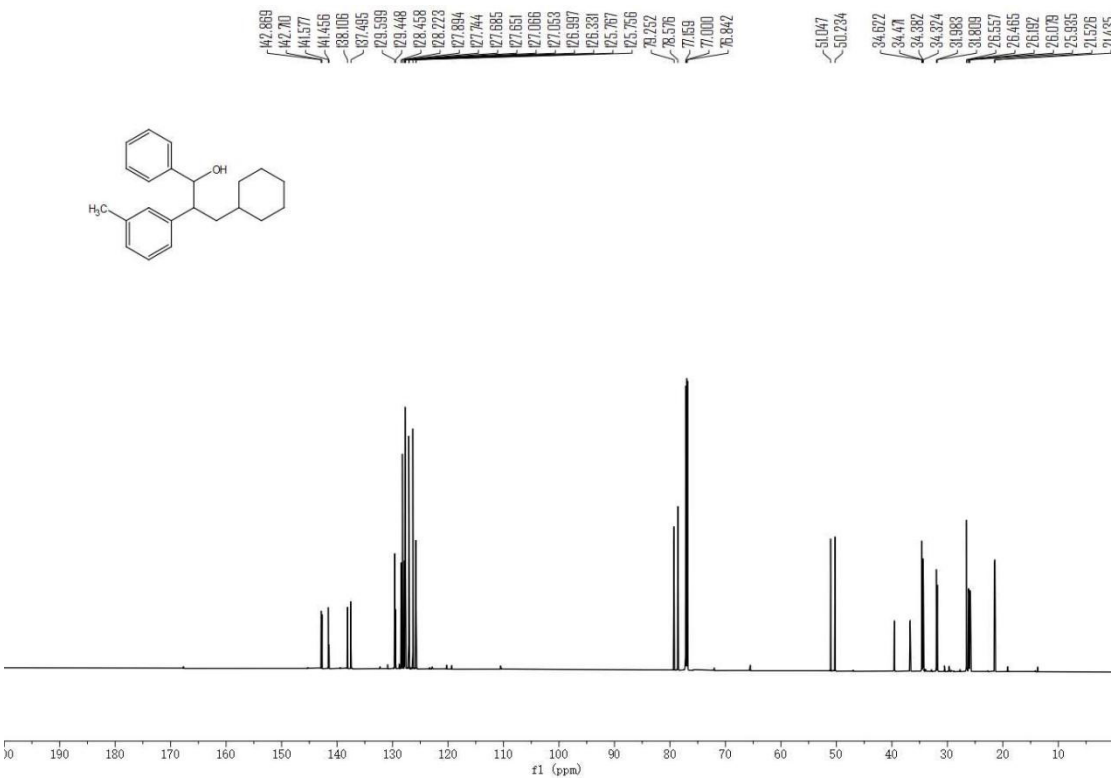
4j; ^{13}C NMR (200 Hz, $CDCl_3$)



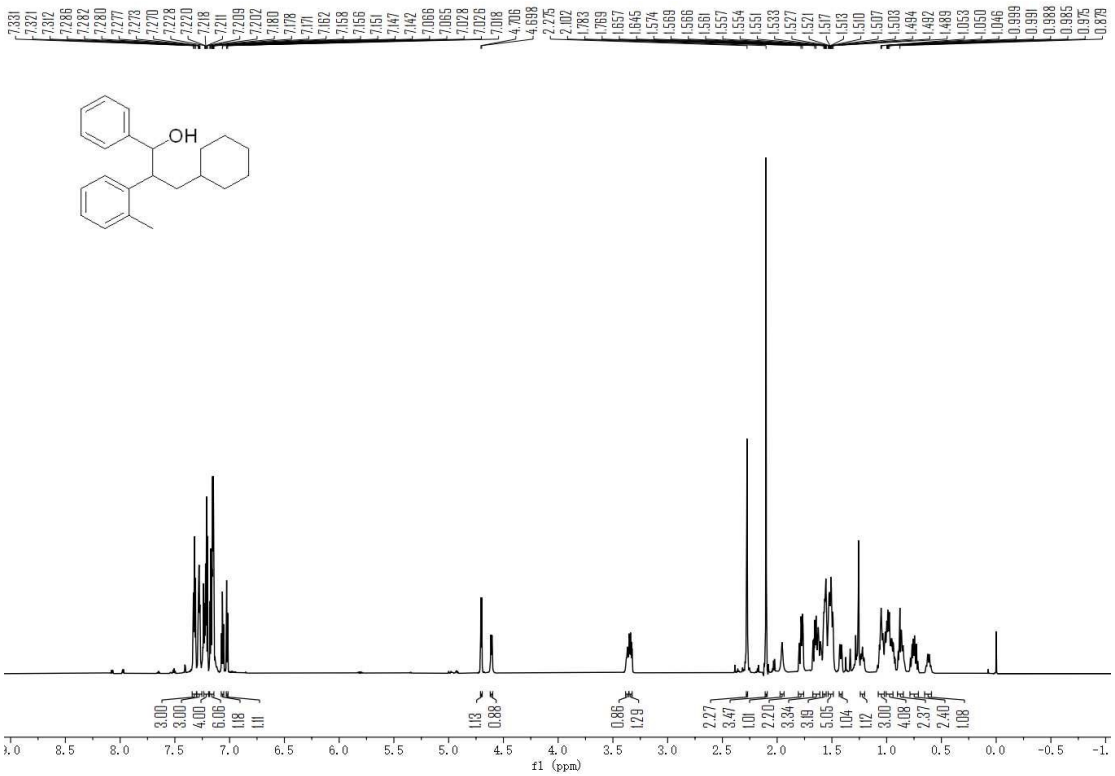
4k; ^{1}H NMR (800 Hz, $CDCl_3$)



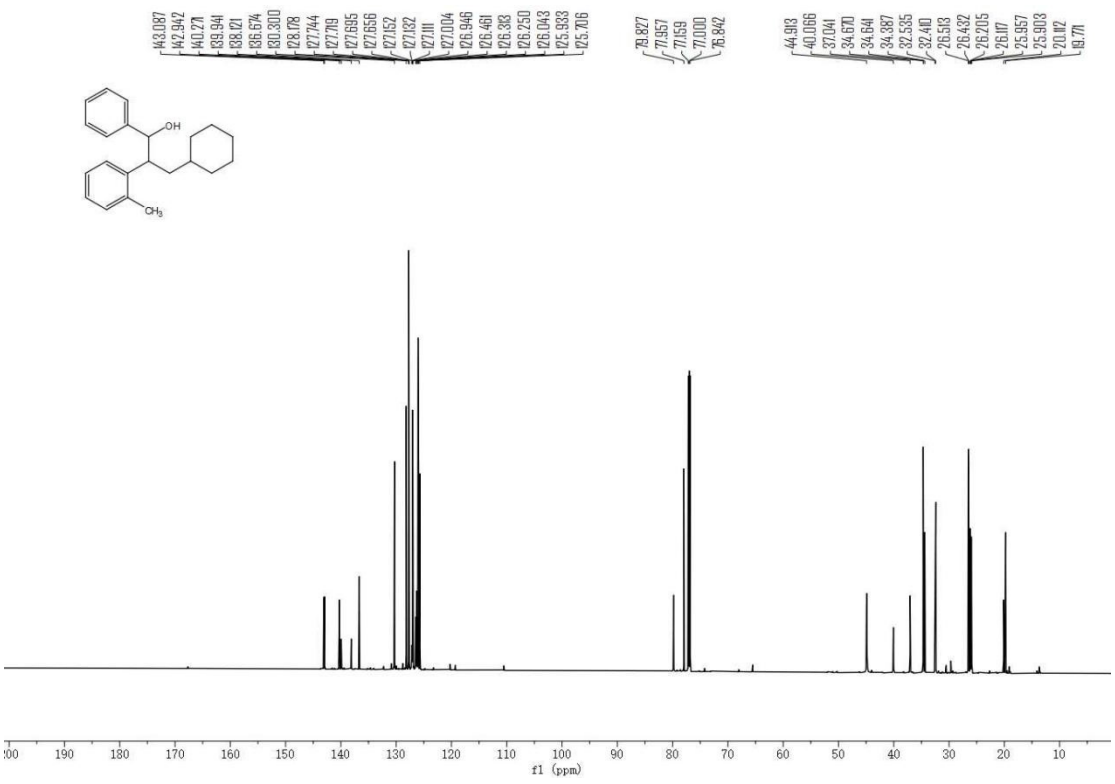
4k; ^{13}C NMR (200 Hz, $CDCl_3$)



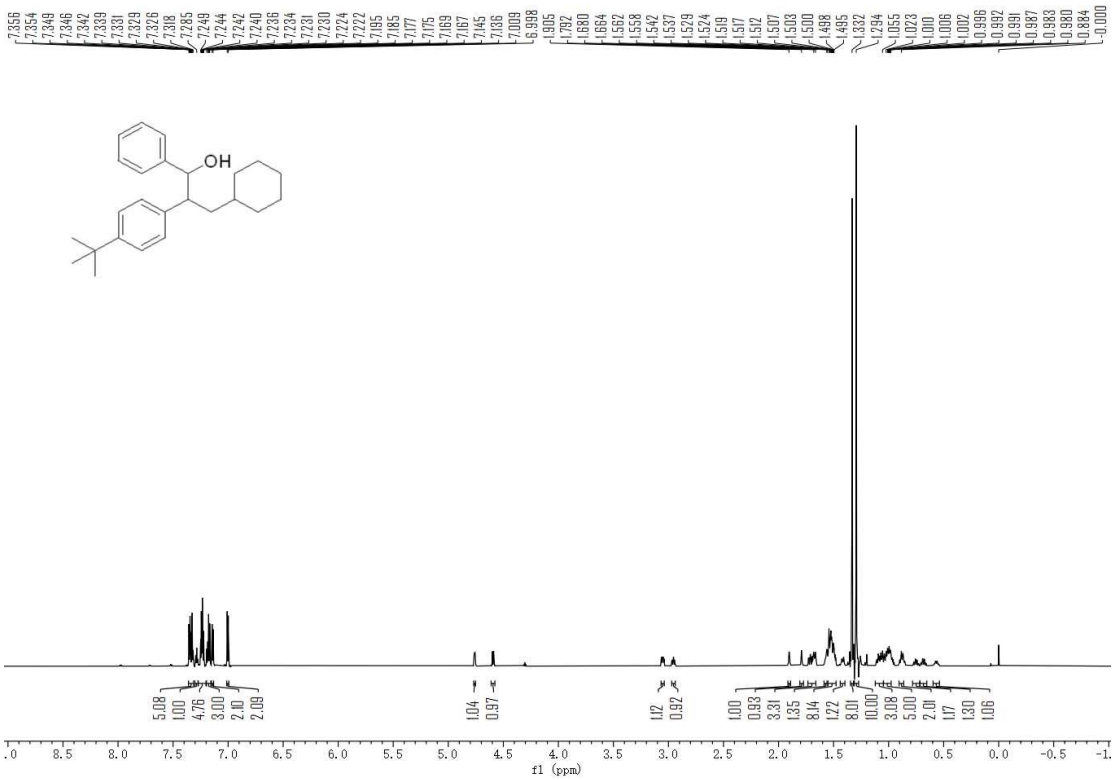
4l; ^{1}H NMR (800 Hz, $CDCl_3$)



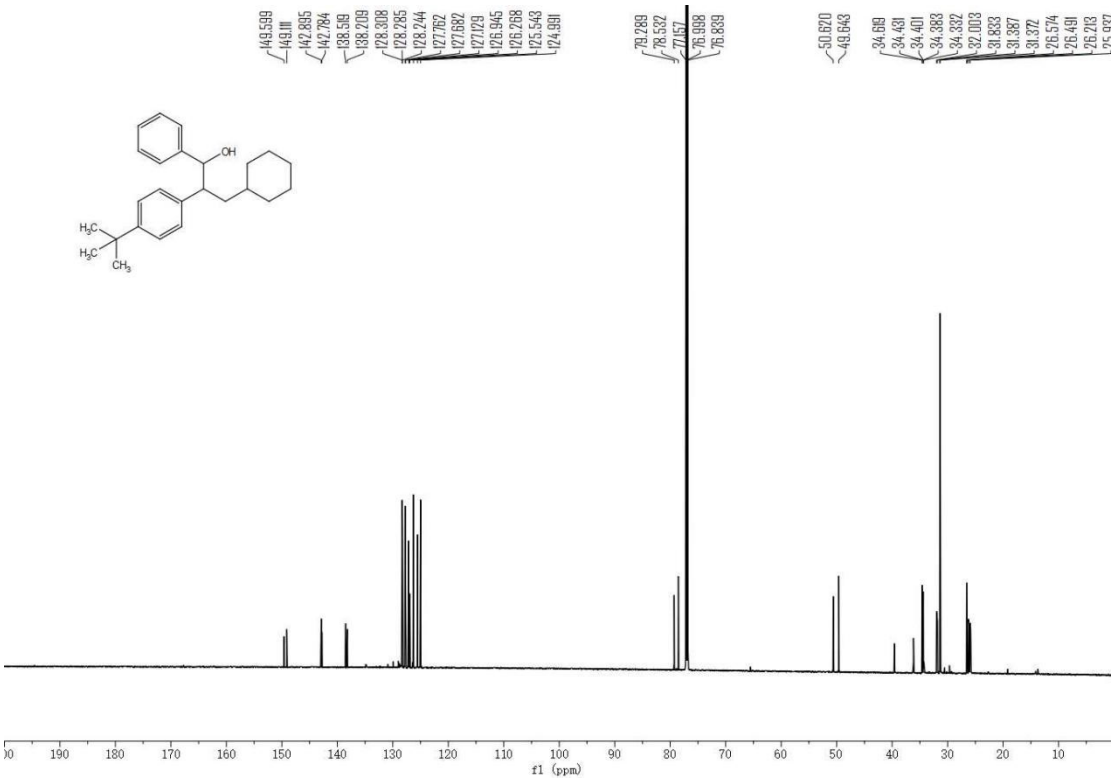
4l; ^{13}C NMR (200 Hz, $CDCl_3$)



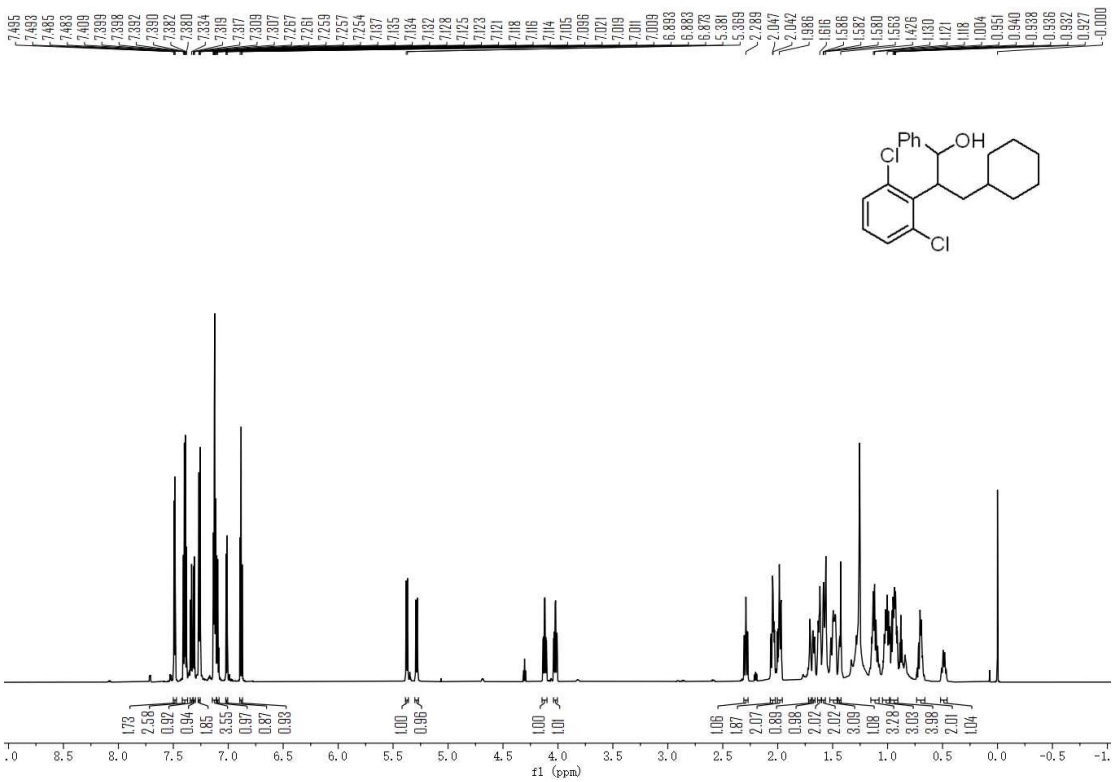
4m; ^{1}H NMR (800 Hz, $CDCl_3$)



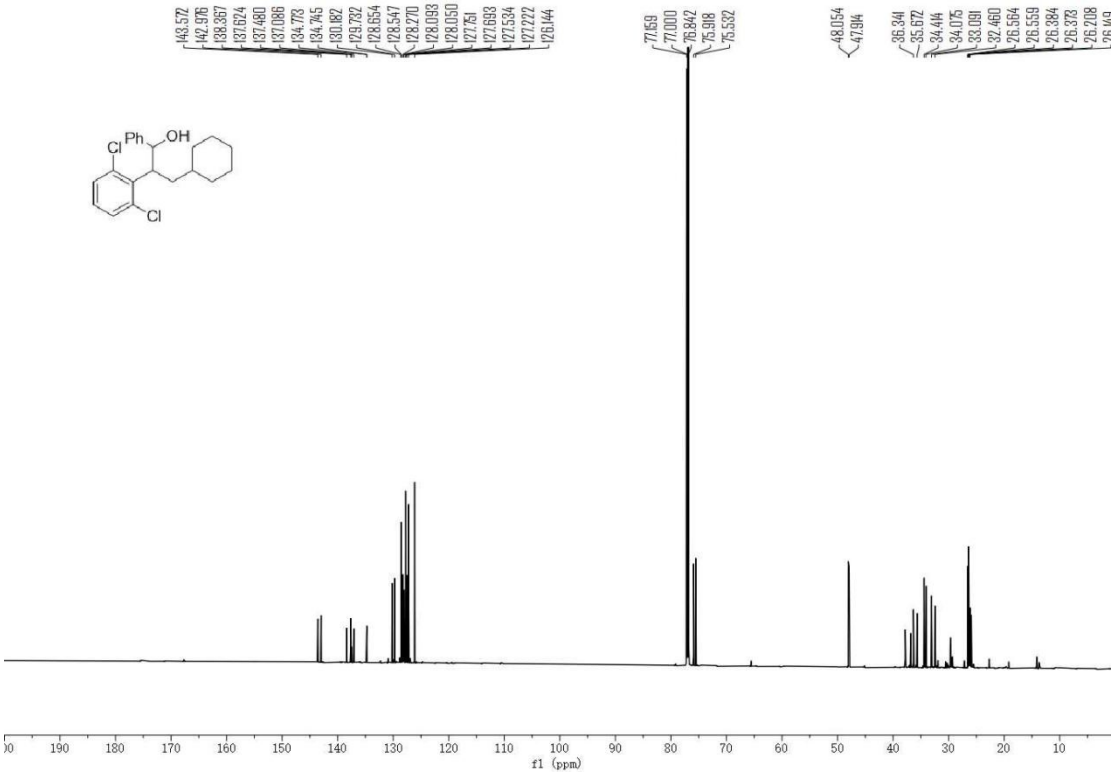
4m; ^{13}C NMR (200 Hz, $CDCl_3$)



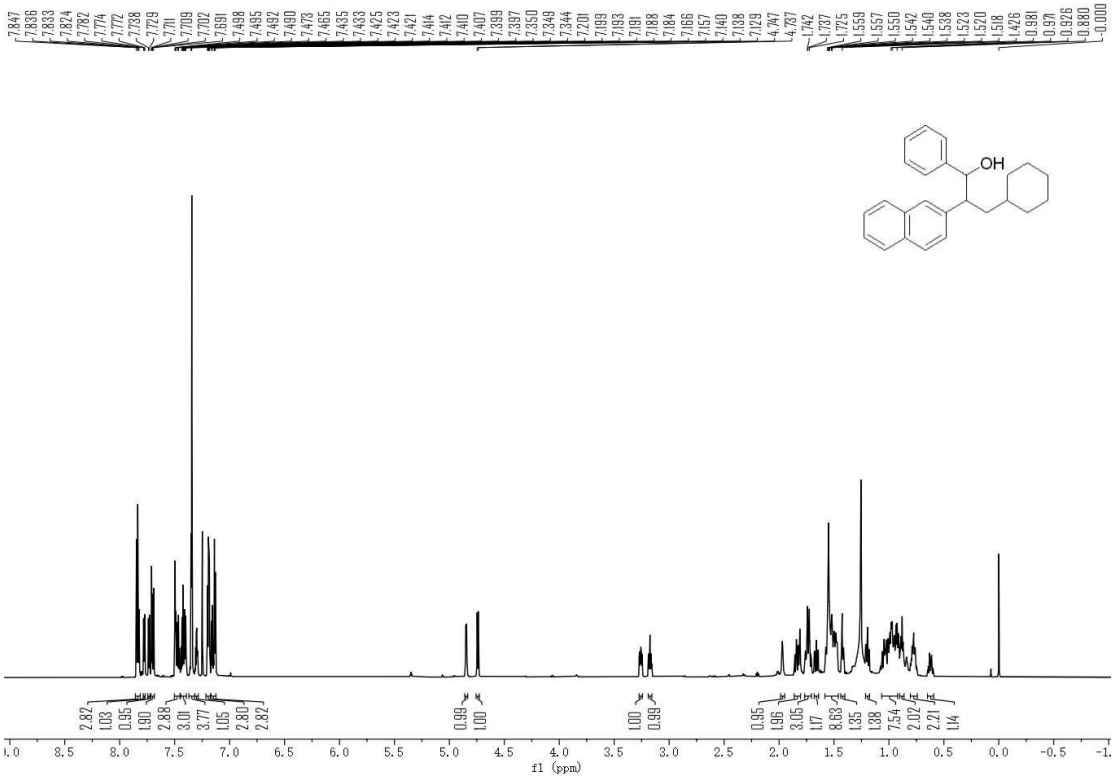
4n; ^{1}H NMR (800 Hz, $CDCl_3$)



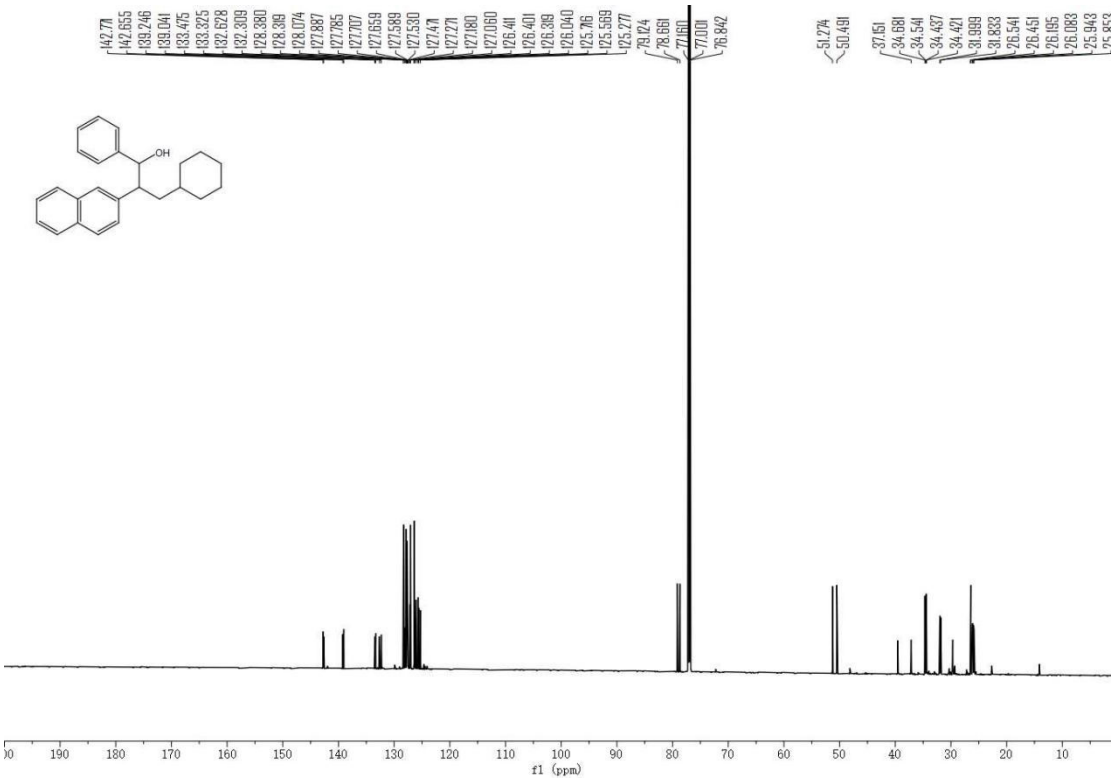
4n; ^{13}C NMR (200 Hz, $CDCl_3$)



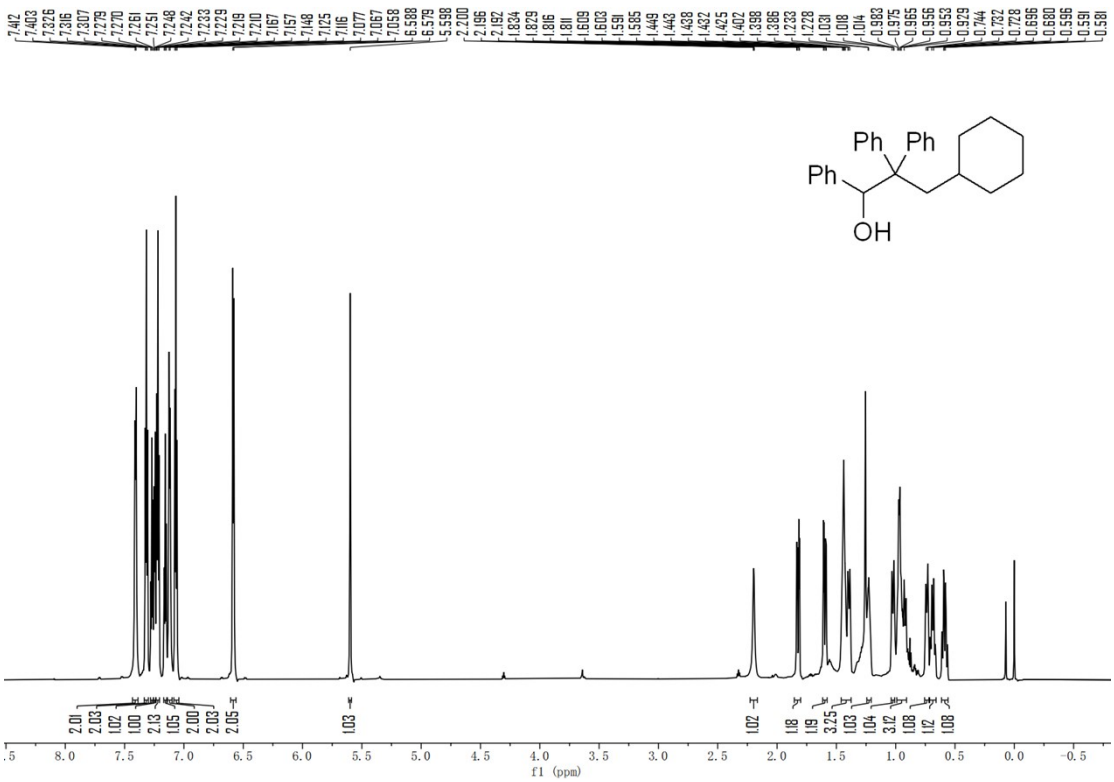
4o; ^{1}H NMR (800 Hz, $CDCl_3$)



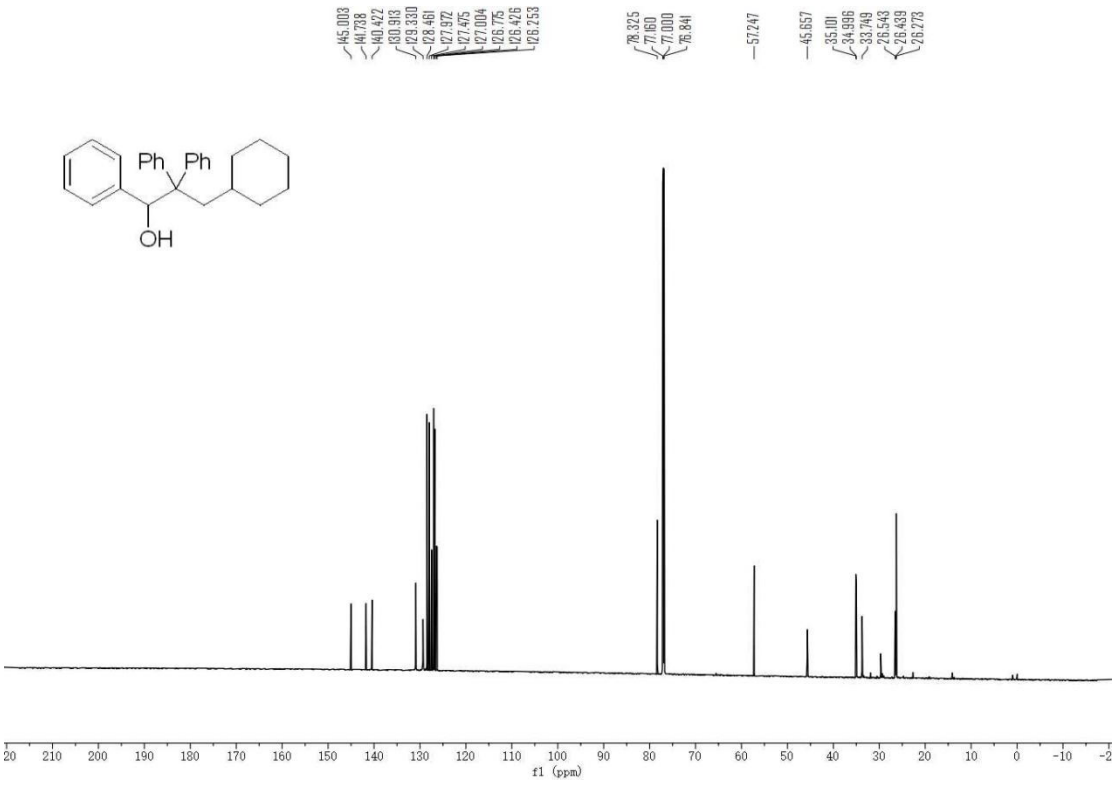
4o; ^{13}C NMR (200 Hz, $CDCl_3$)



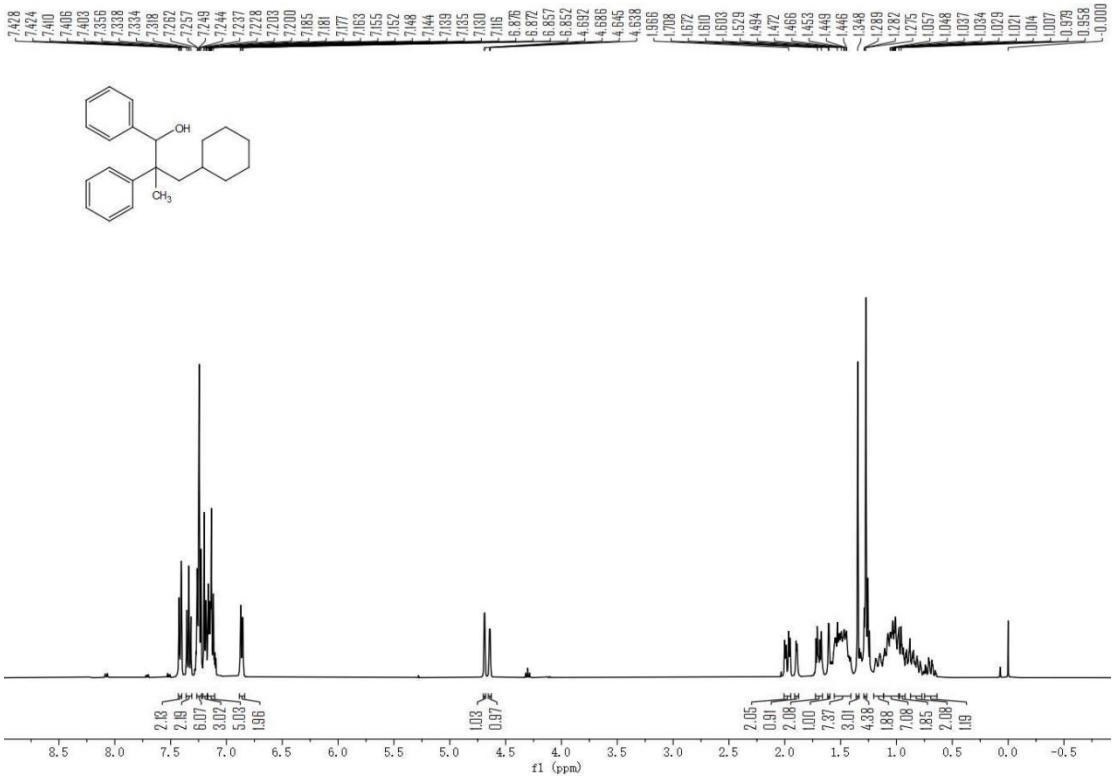
4p; ^{1}H NMR (800 Hz, $CDCl_3$)



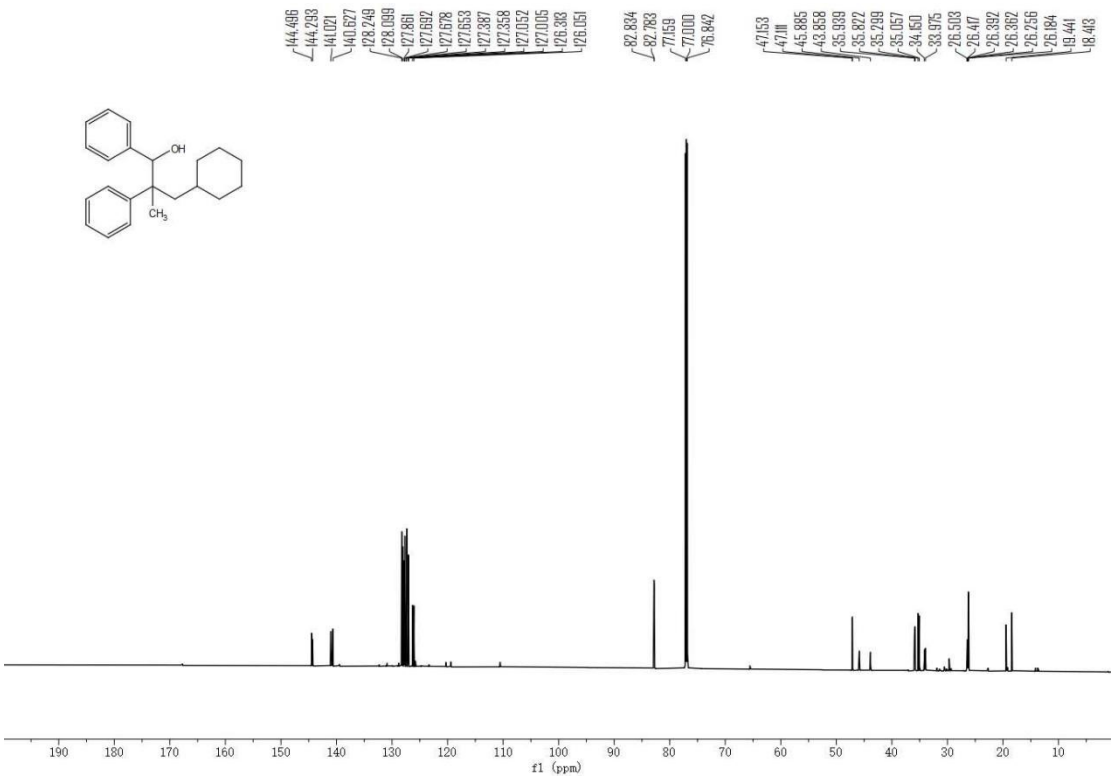
4p; ^{13}C NMR (200 Hz, $CDCl_3$)



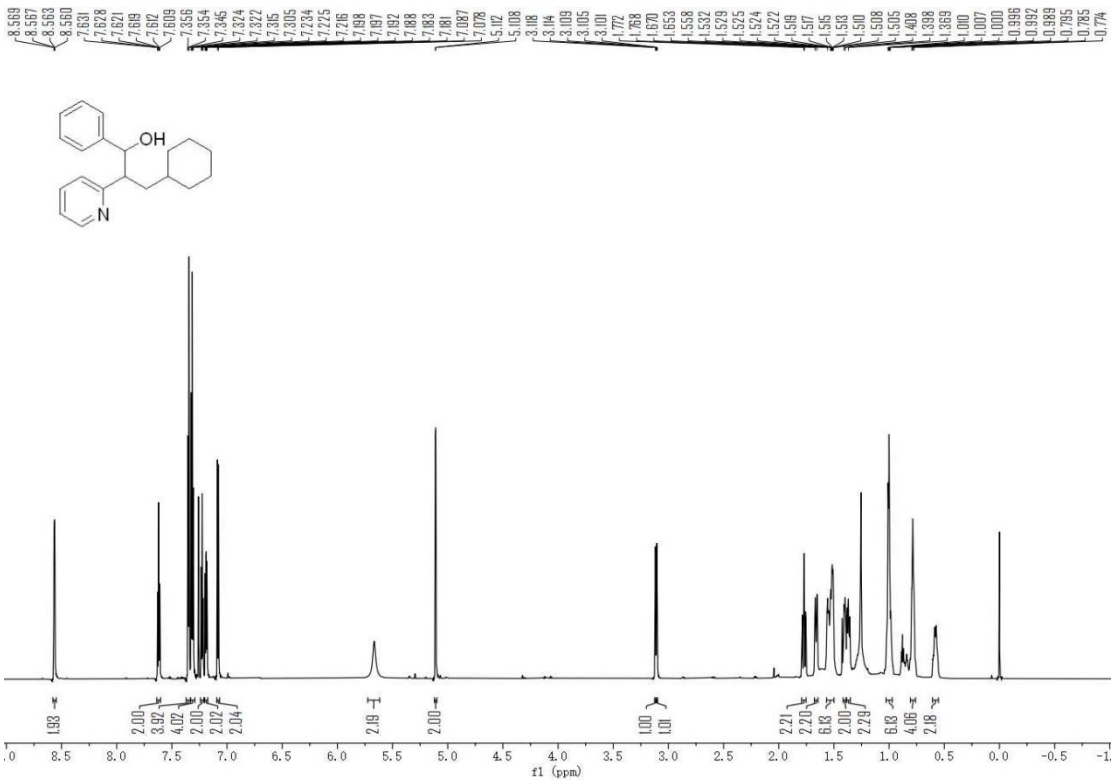
4q; ^{1}H NMR (400 Hz, $CDCl_3$)



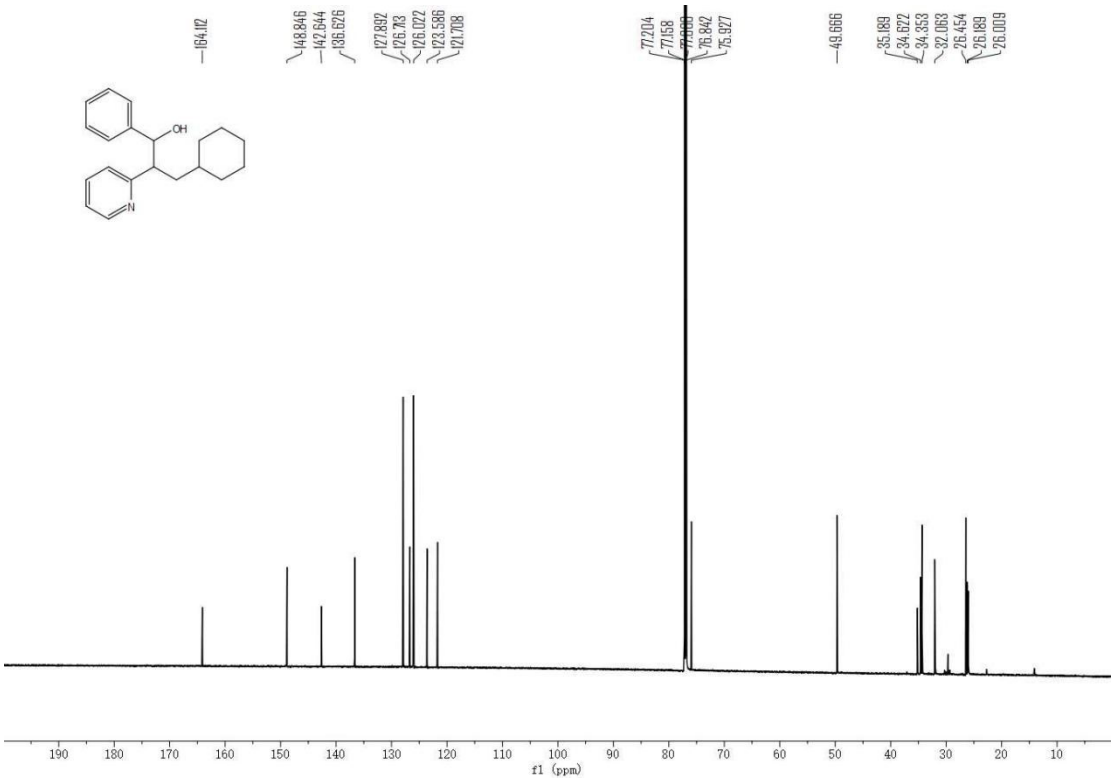
4q; ^{13}C NMR (200 Hz, $CDCl_3$)



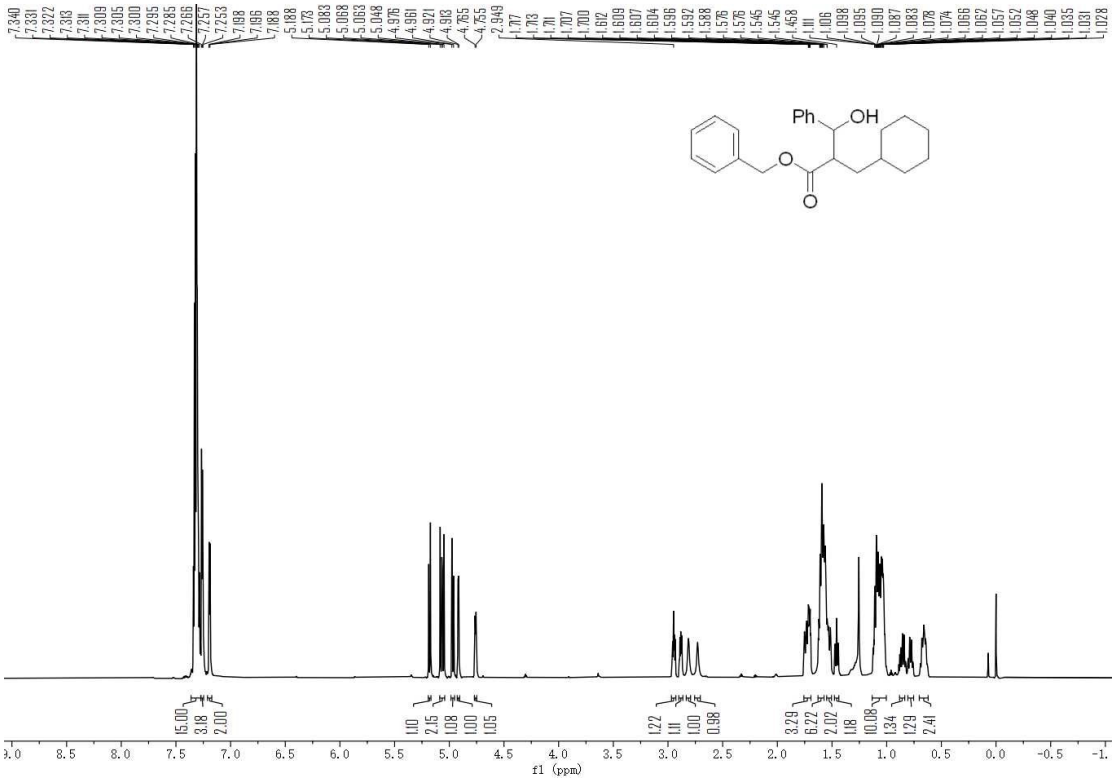
4r; ^{1}H NMR (800 Hz, $CDCl_3$)



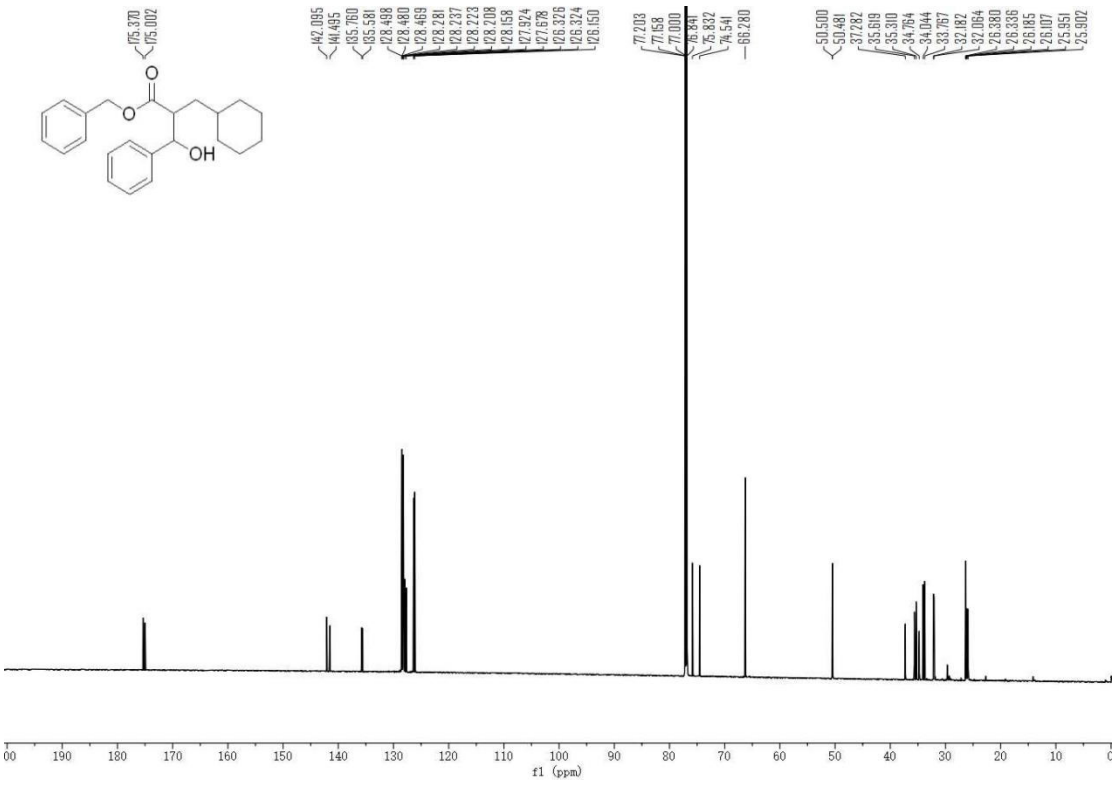
4r; ^{13}C NMR (200 Hz, $CDCl_3$)



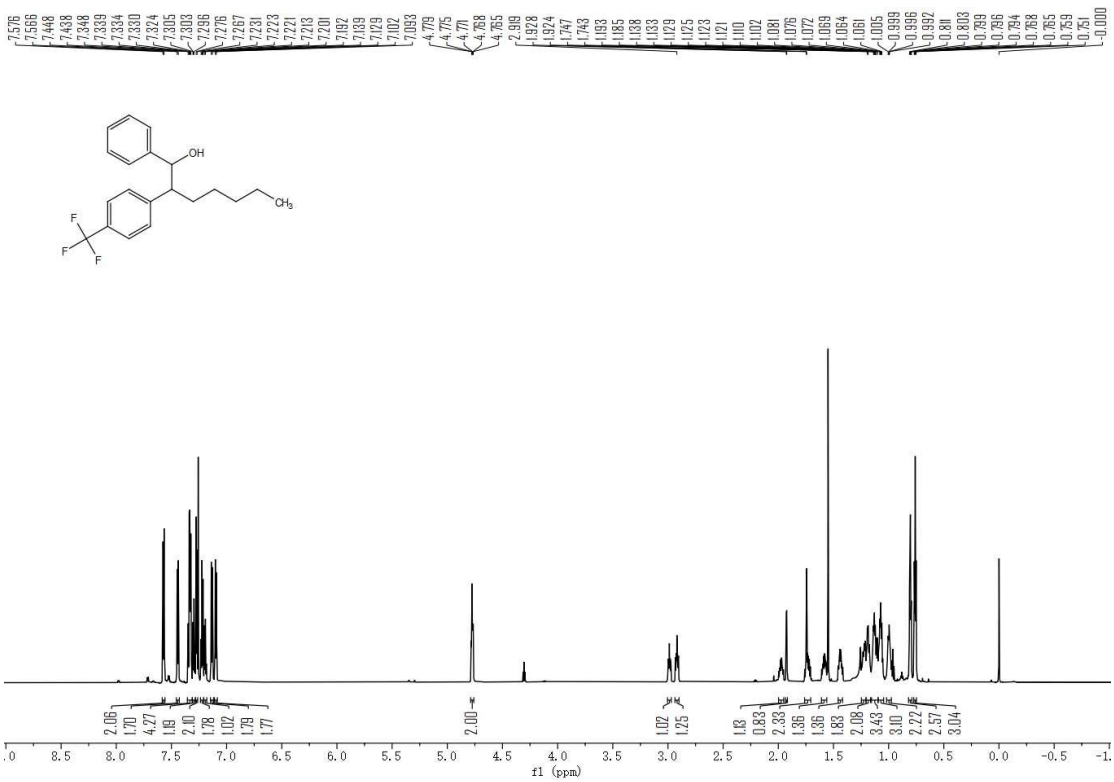
4s; ^{1}H NMR (800 Hz, $CDCl_3$)



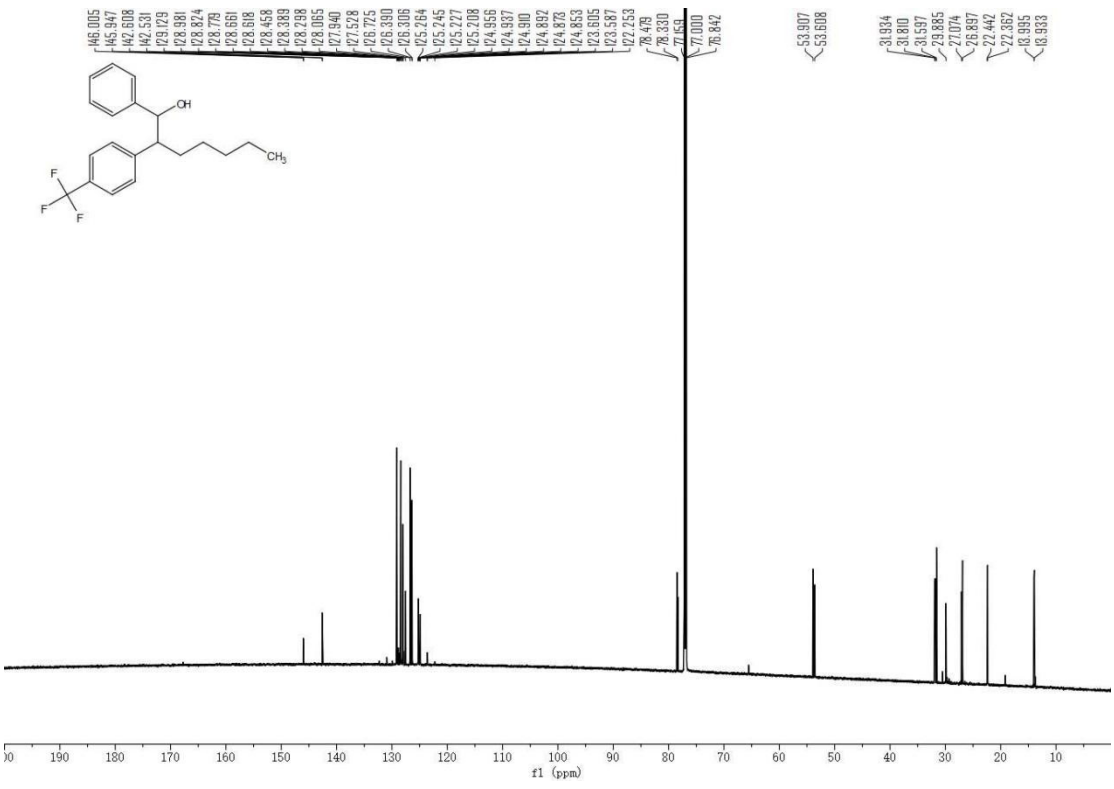
4s; ^{13}C NMR (200 Hz, $CDCl_3$)



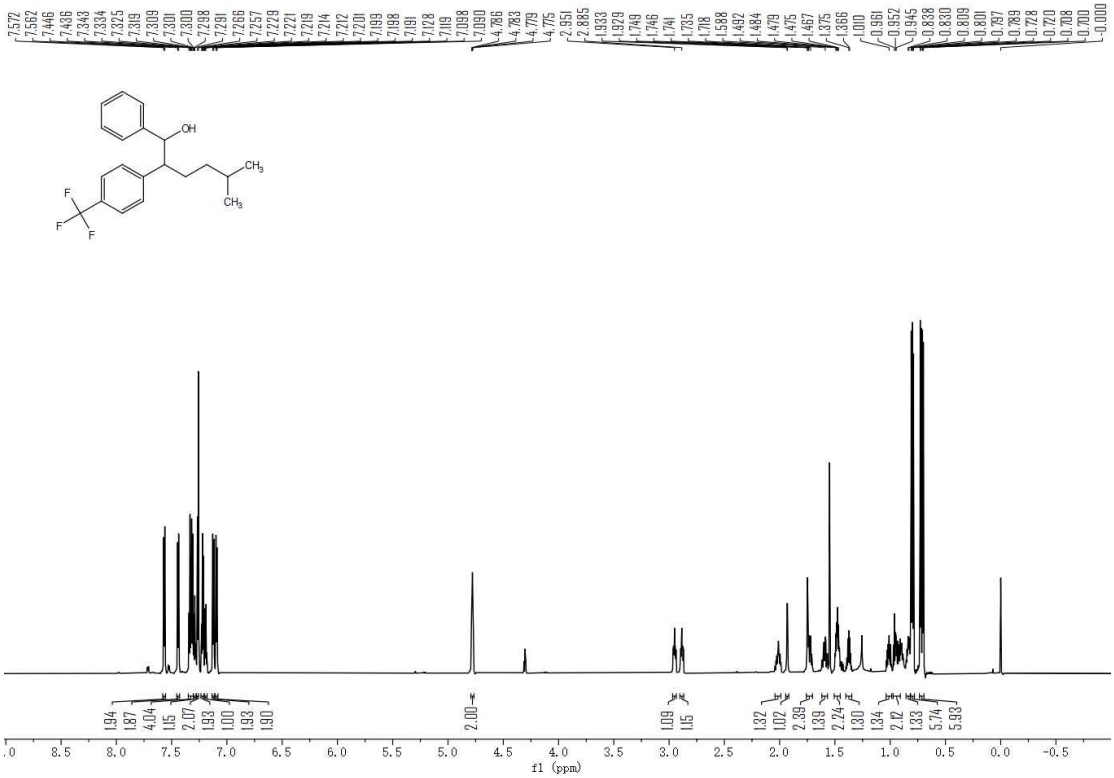
4aa; ^{1}H NMR (800 Hz, $CDCl_3$)



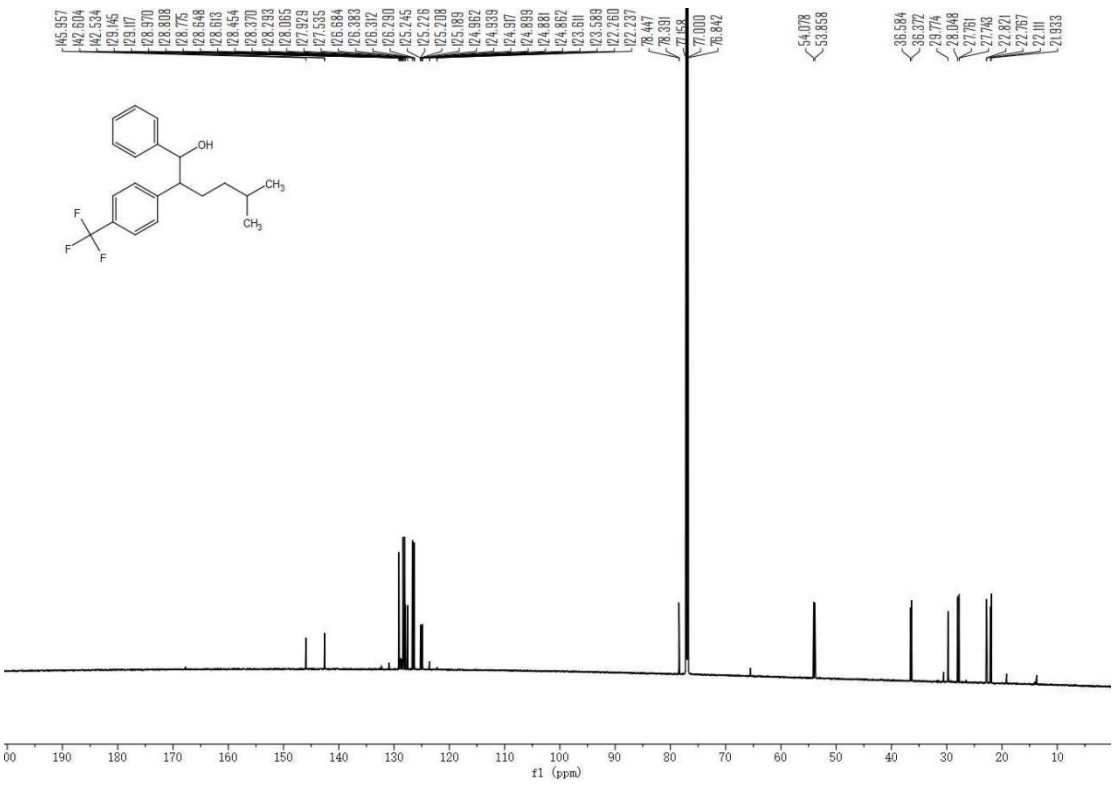
4aa; ^{13}C NMR (200 Hz, $CDCl_3$)



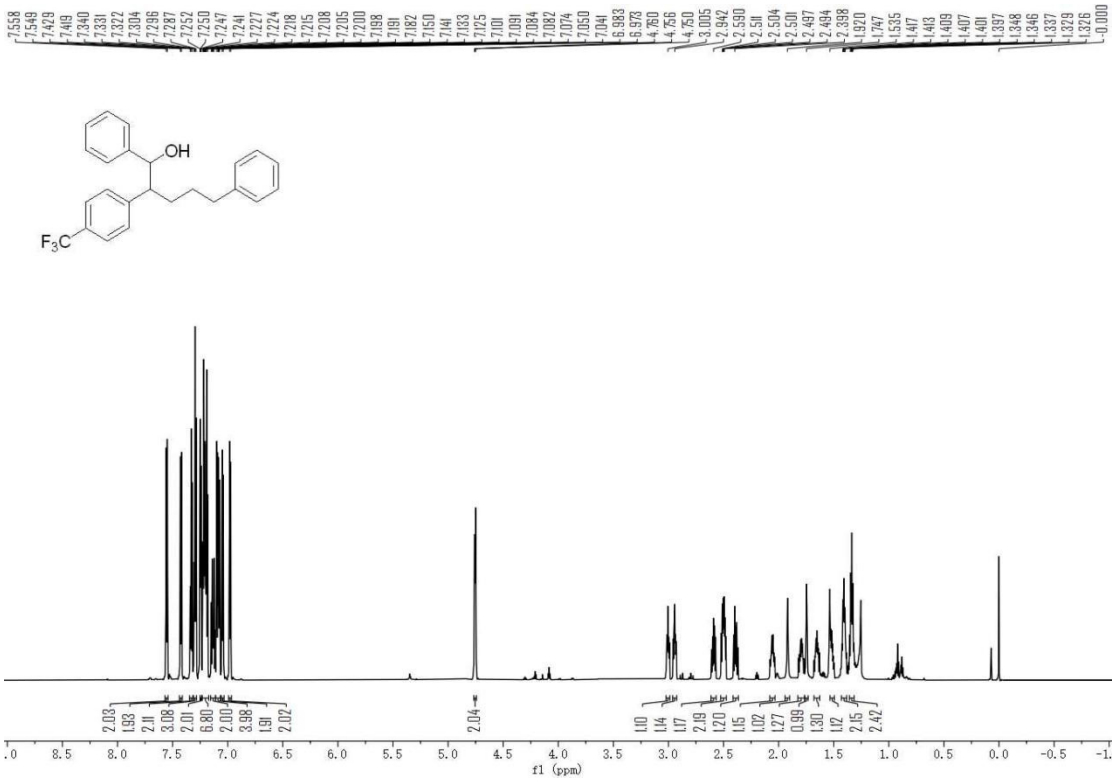
4ab; ^{1}H NMR (800 Hz, $CDCl_3$)



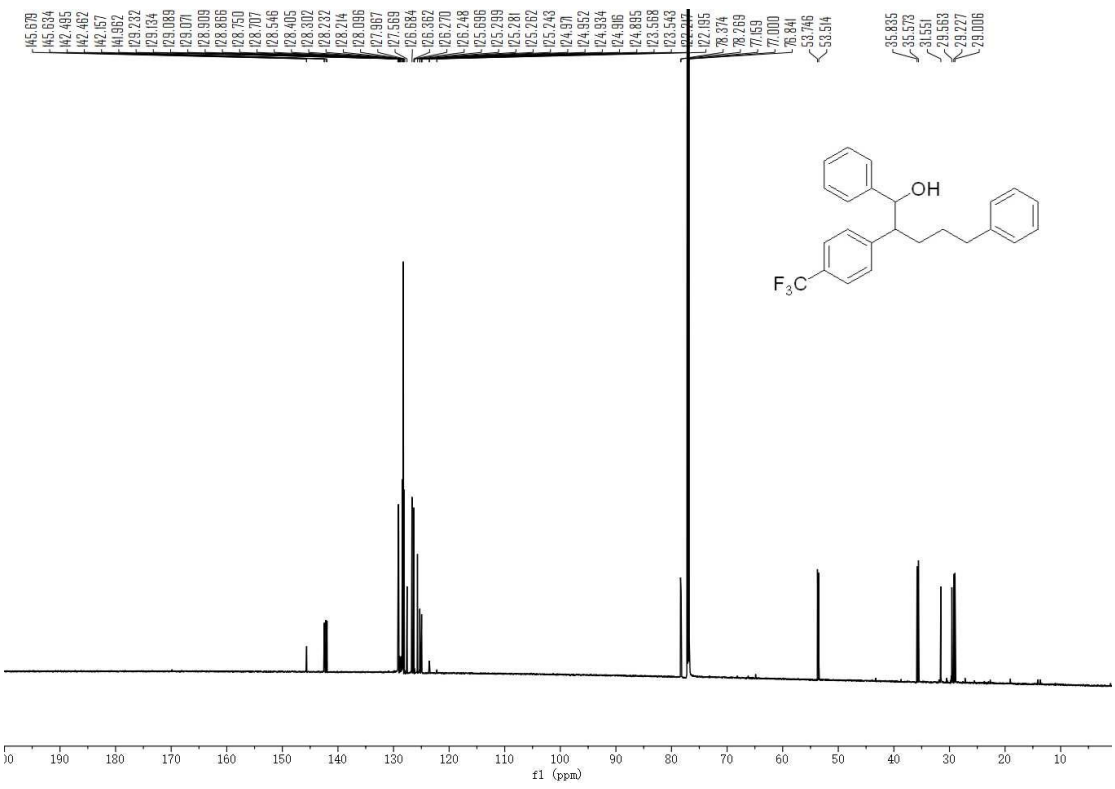
4ab; ^{13}C NMR (200 Hz, $CDCl_3$)



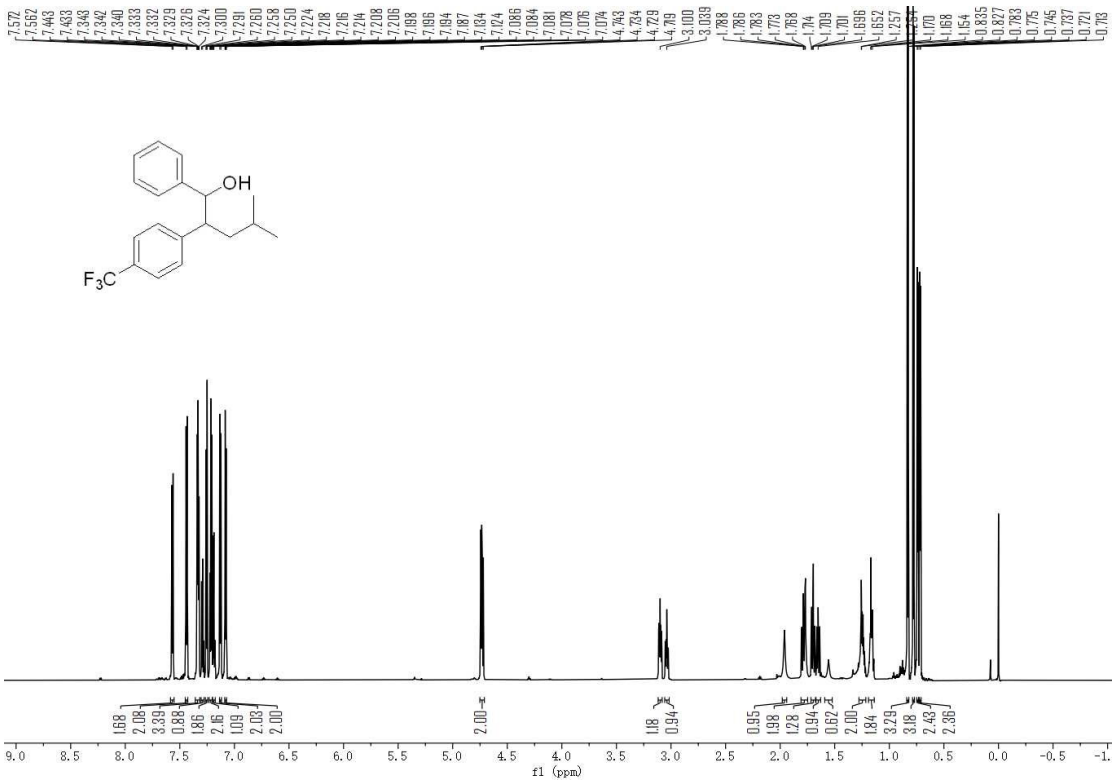
4ac; ^{1}H NMR (800 Hz, $CDCl_3$)



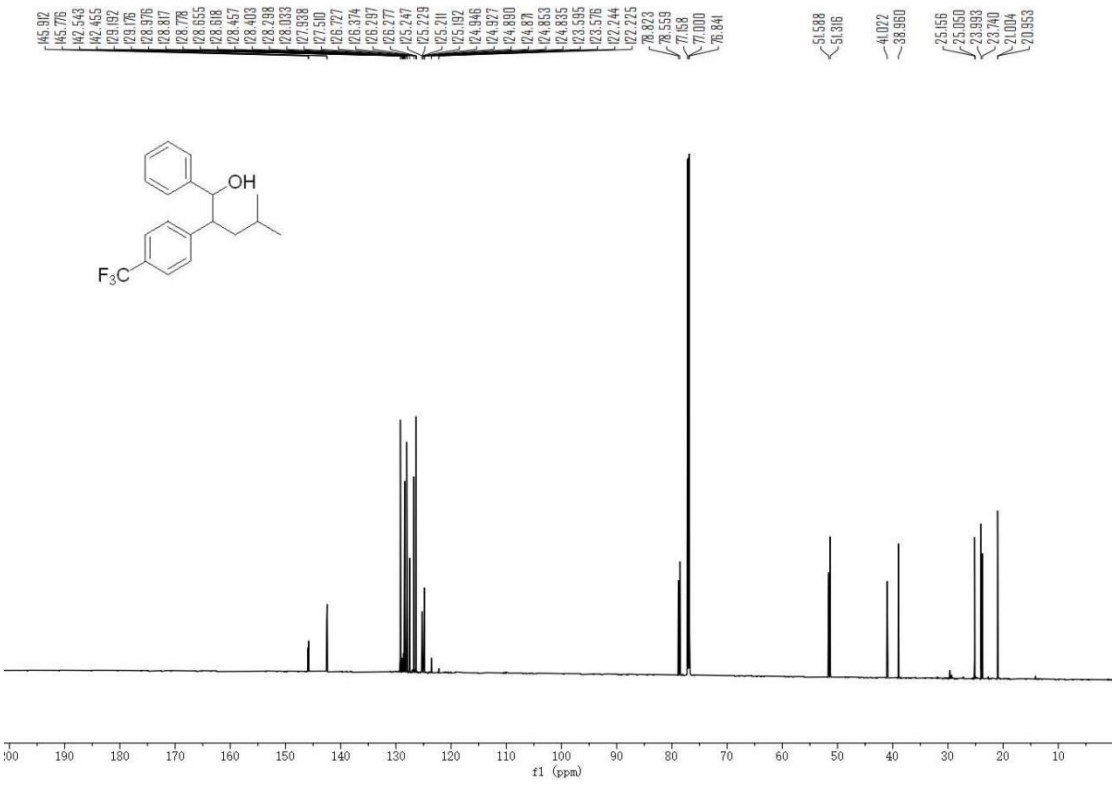
4ac; ^{13}C NMR (200 Hz, $CDCl_3$)



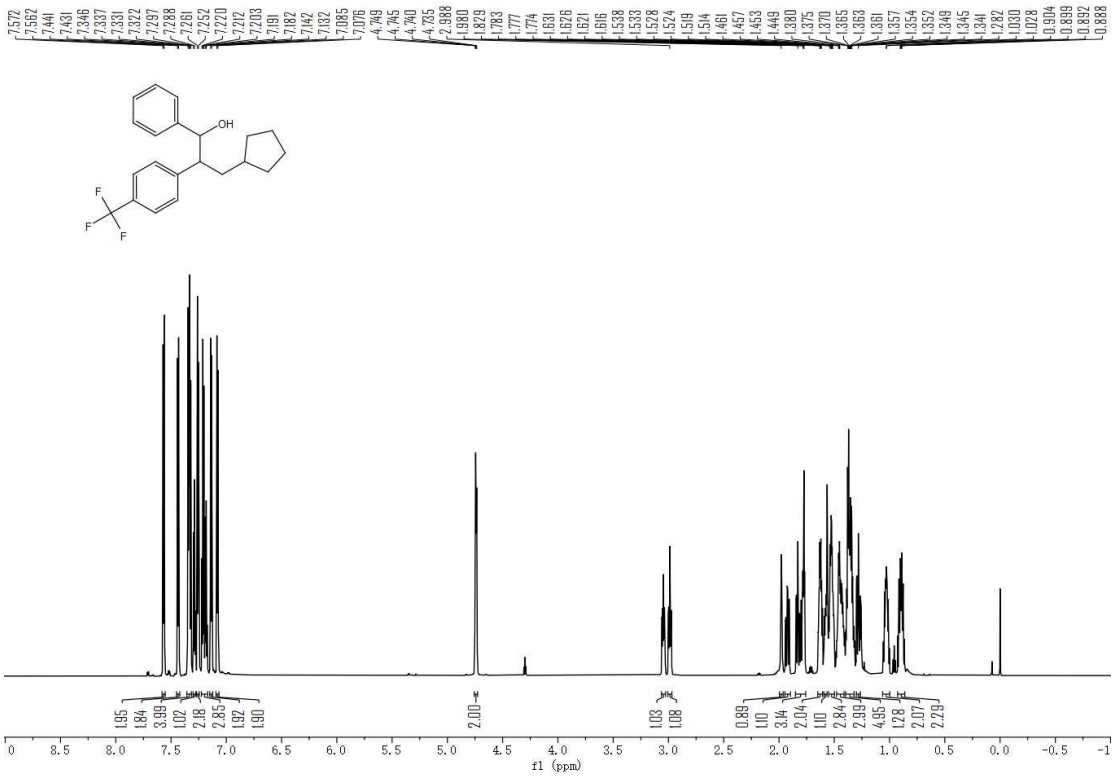
4ad; ^{1}H NMR (800 Hz, $CDCl_3$)



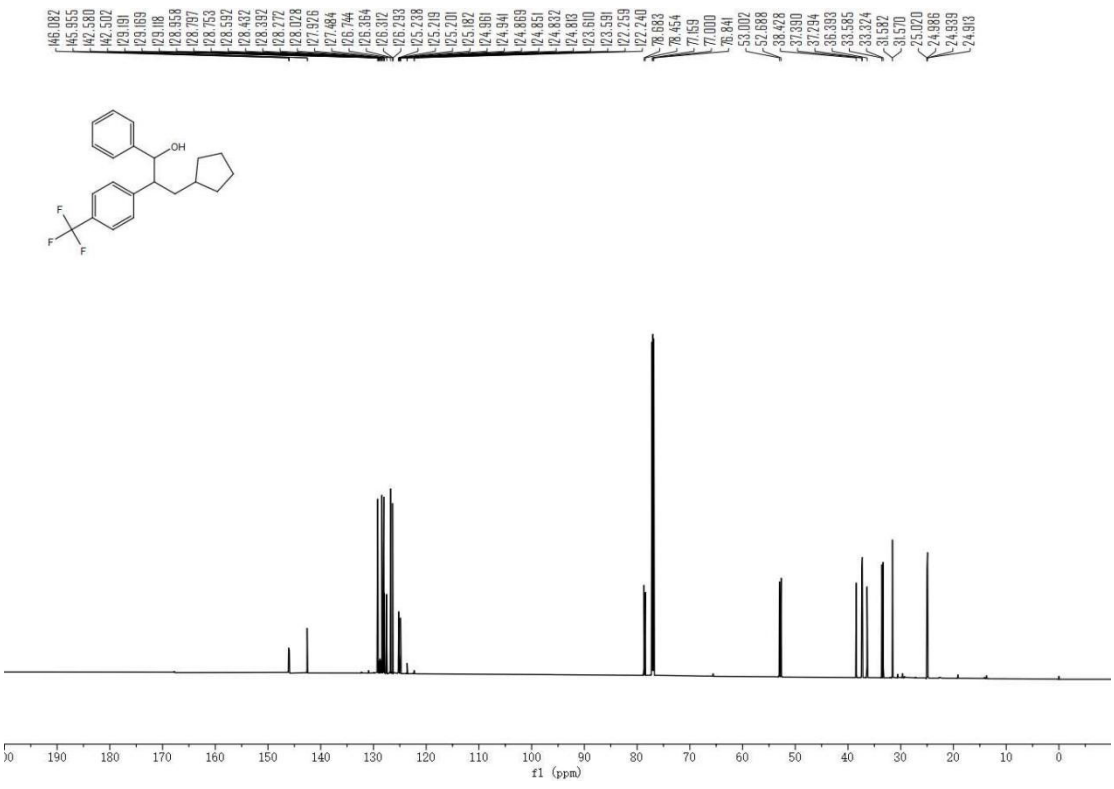
4ad; ^{13}C NMR (200 Hz, $CDCl_3$)



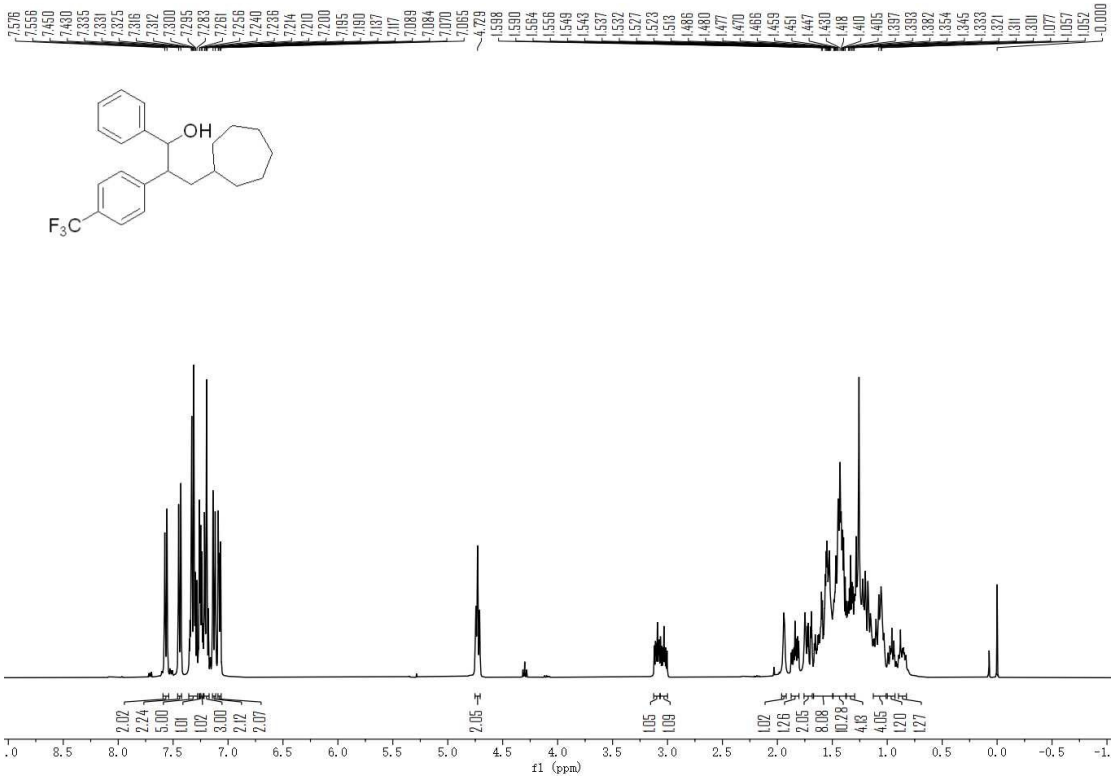
4ae; ^{1}H NMR (800 Hz, $CDCl_3$)



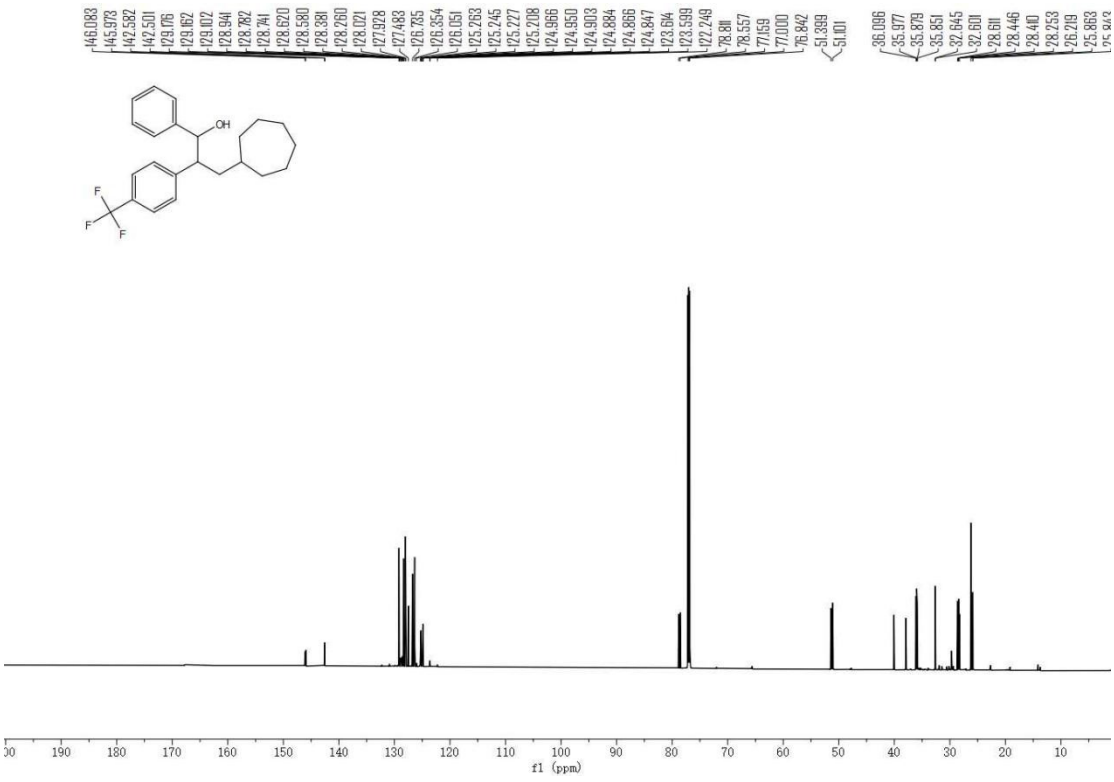
4ae; ^{13}C NMR (200 Hz, $CDCl_3$)



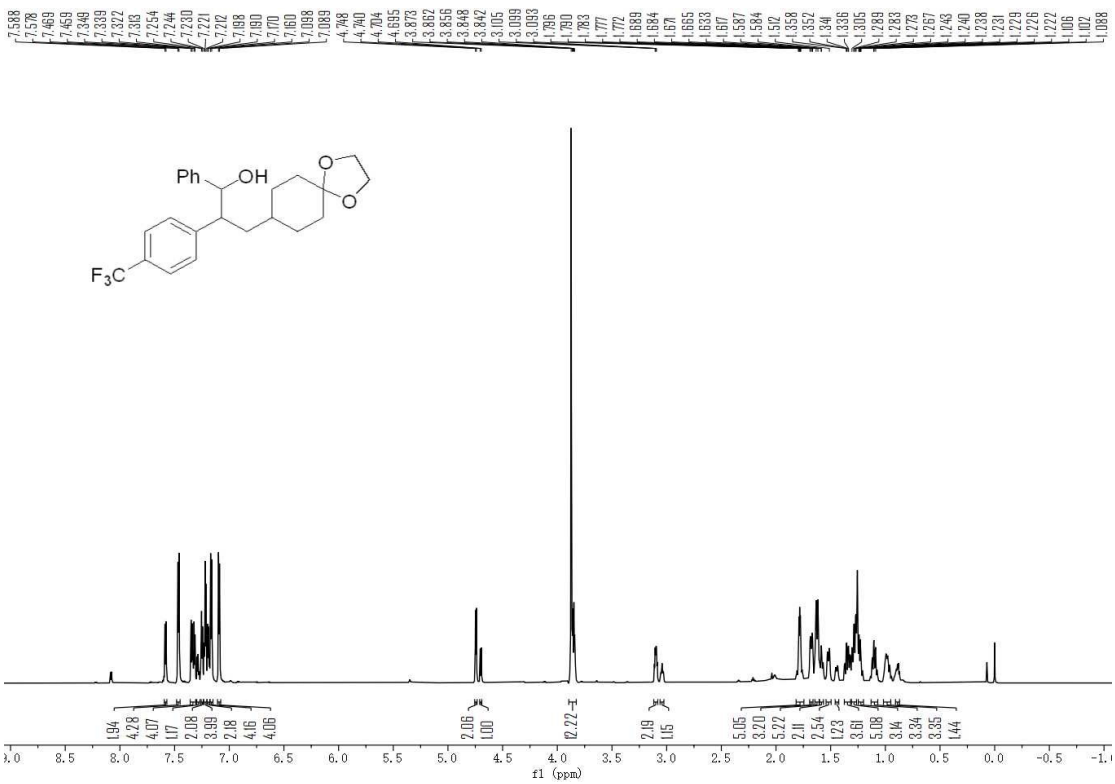
4af; ^{1}H NMR (400 Hz, $CDCl_3$)



4af; ^{13}C NMR (200 Hz, $CDCl_3$)



4ag; ^{1}H NMR (800 Hz, $CDCl_3$)



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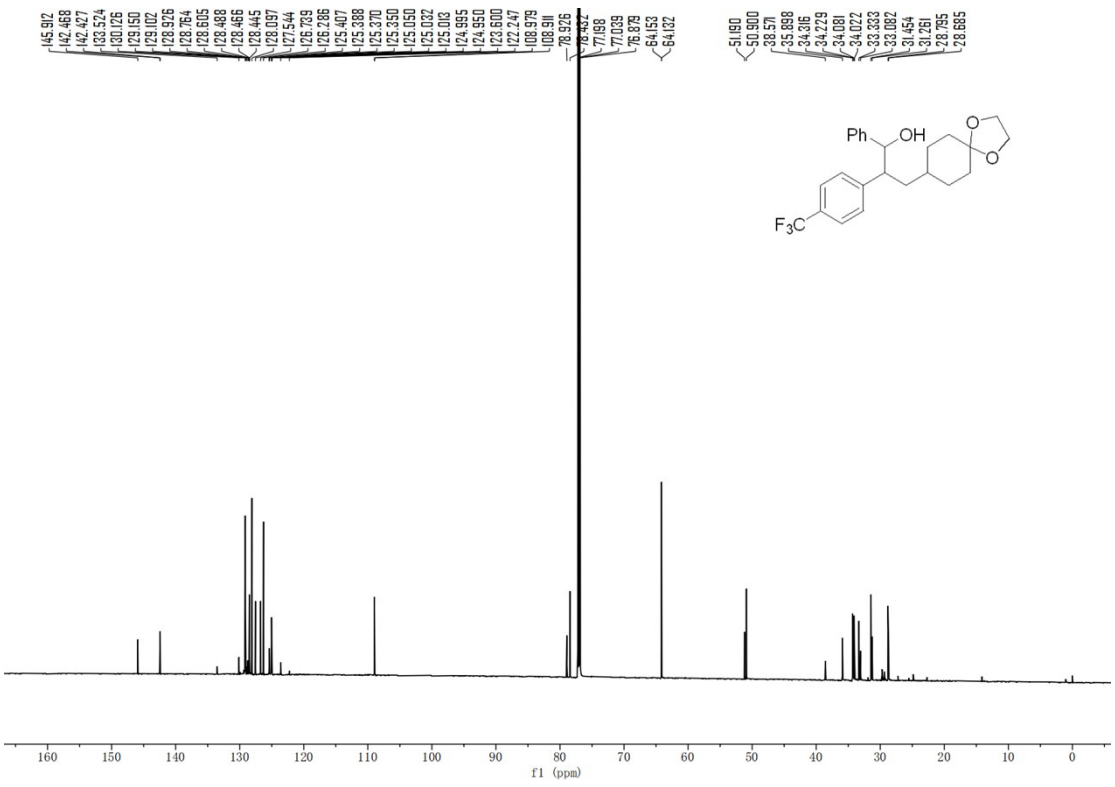

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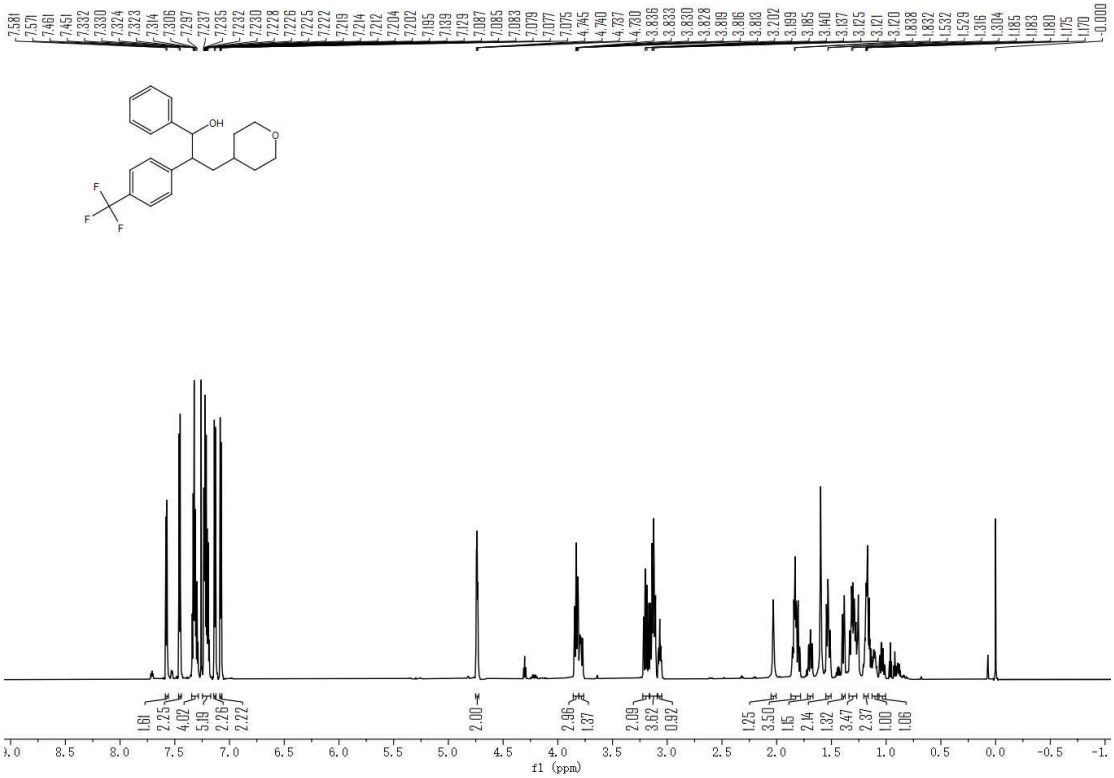

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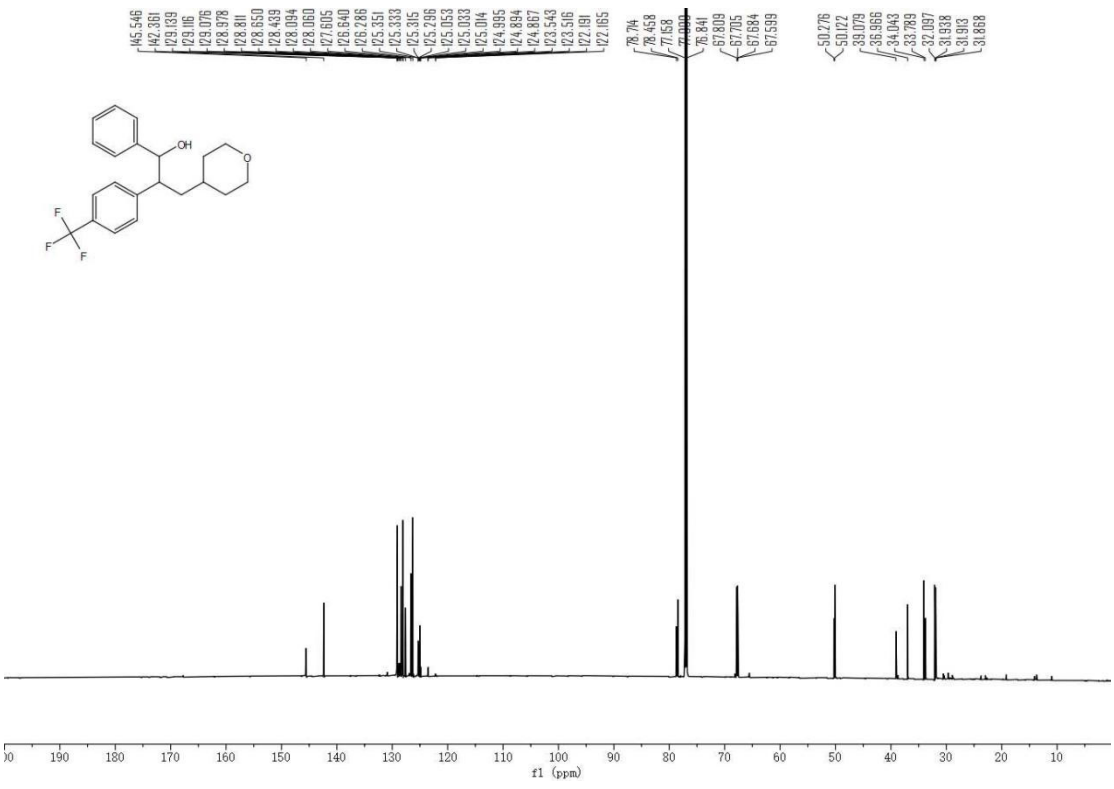

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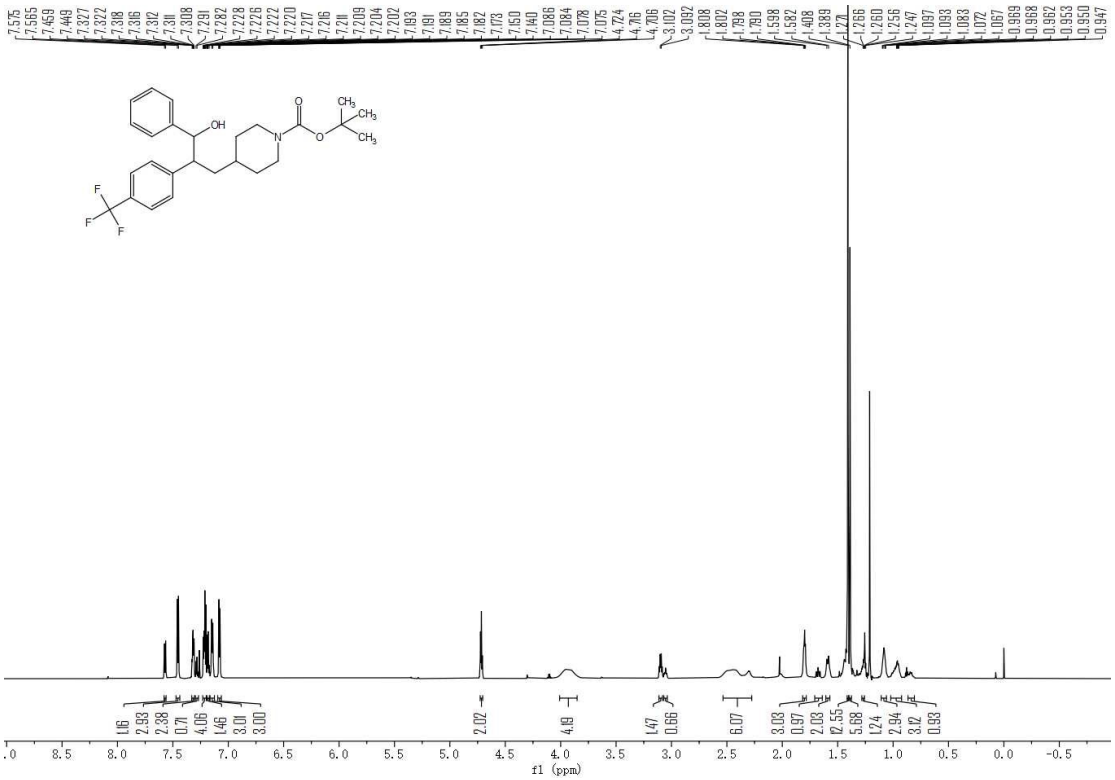

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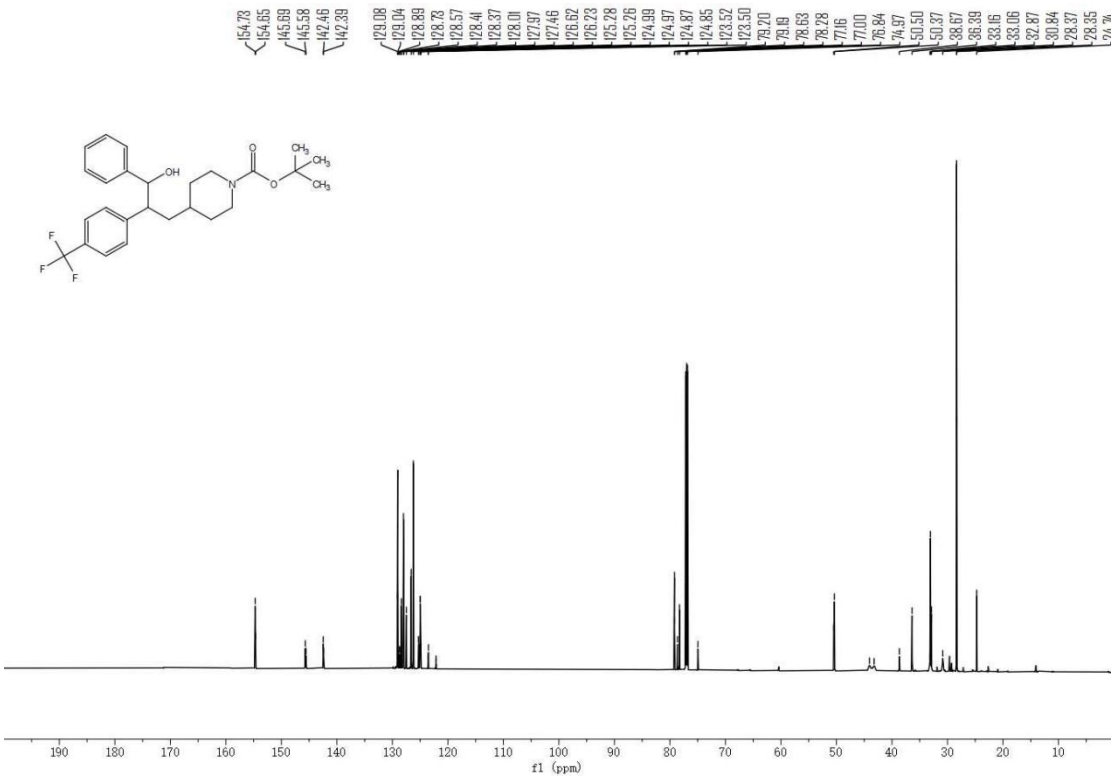

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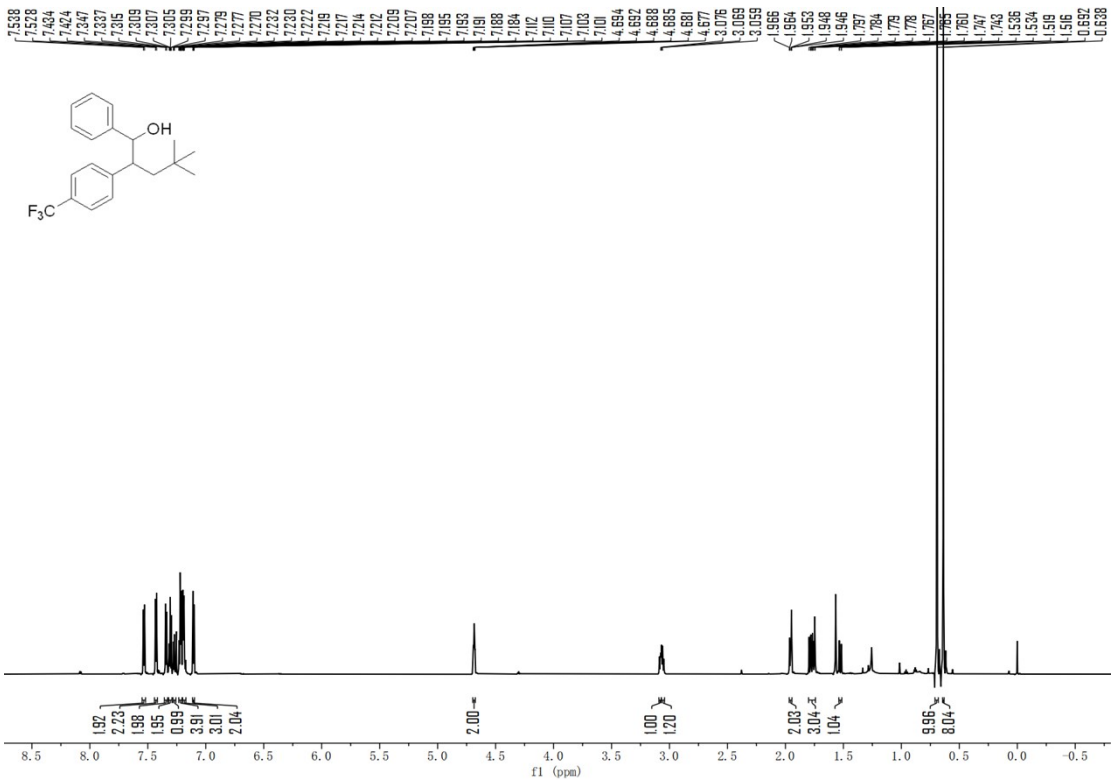

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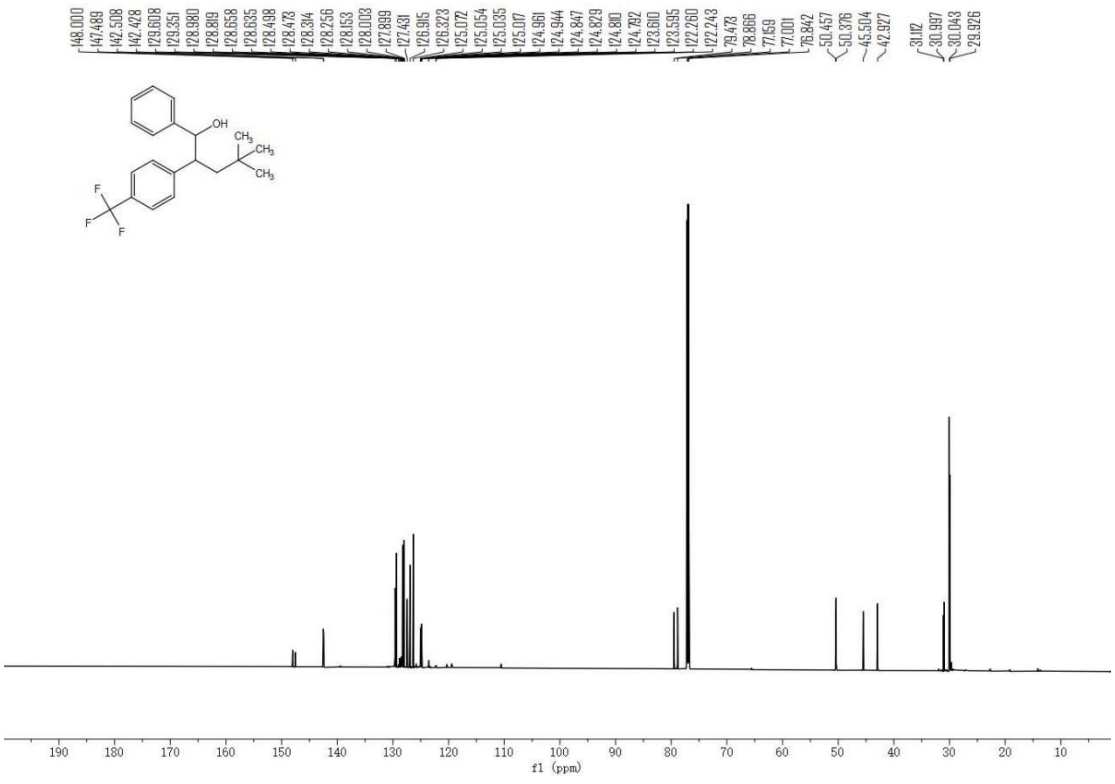

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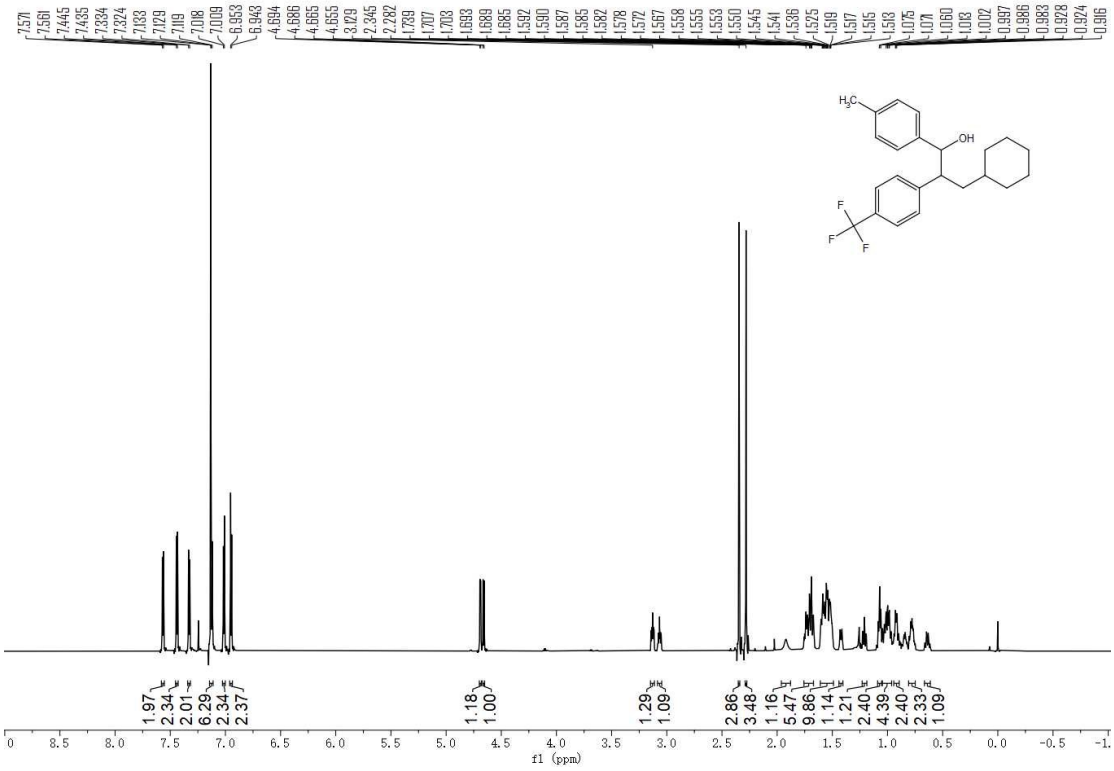

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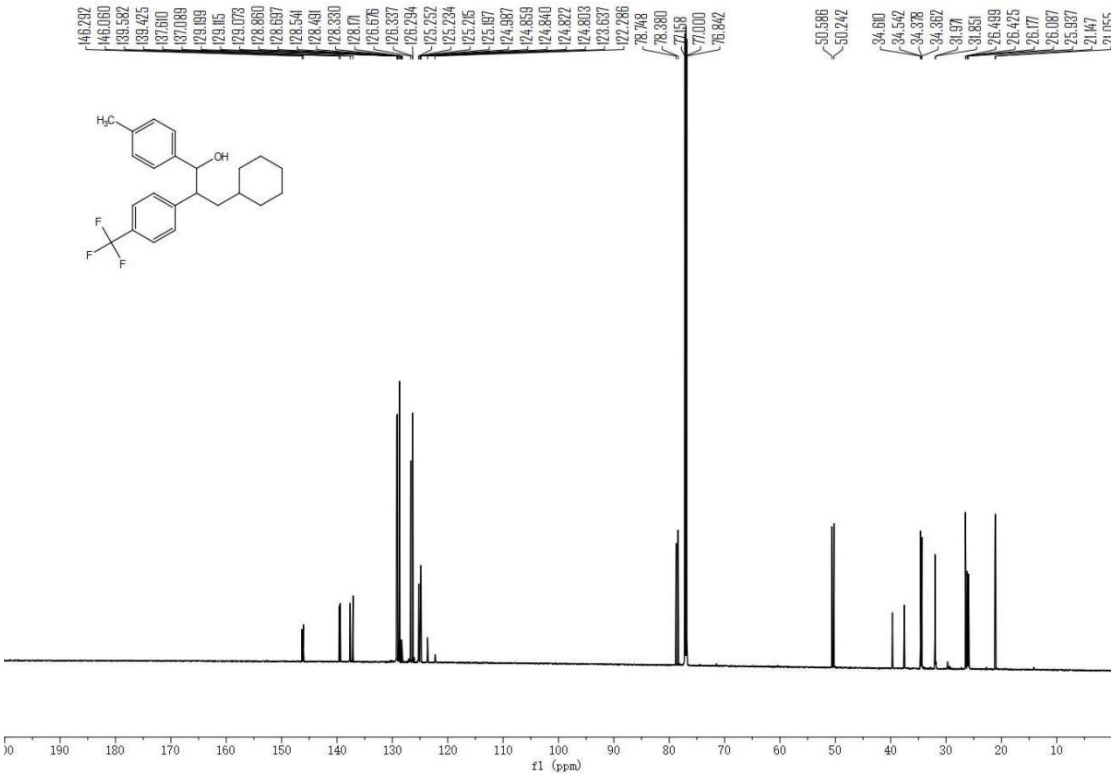

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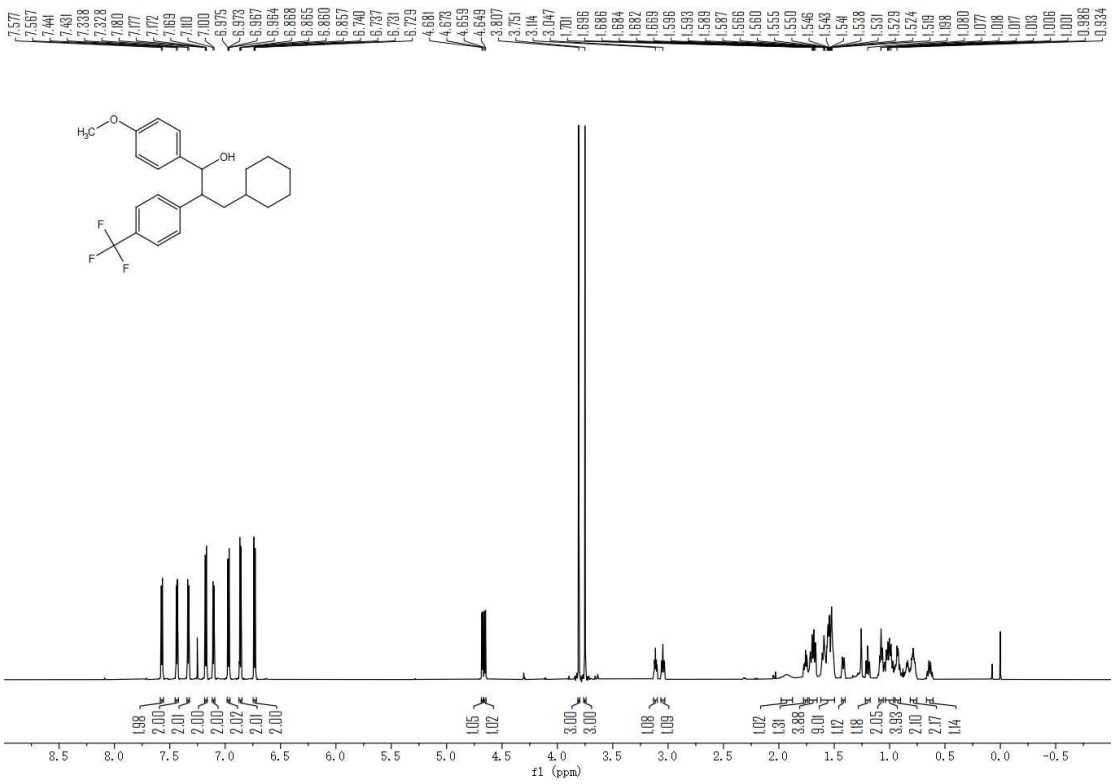

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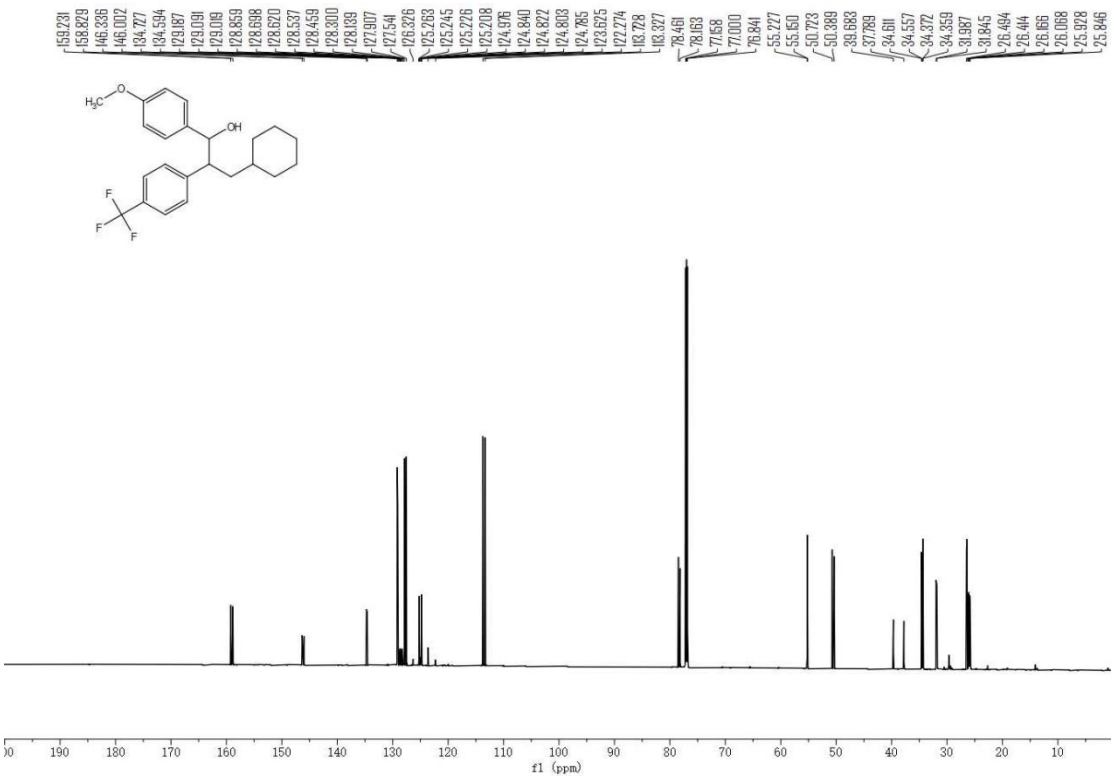

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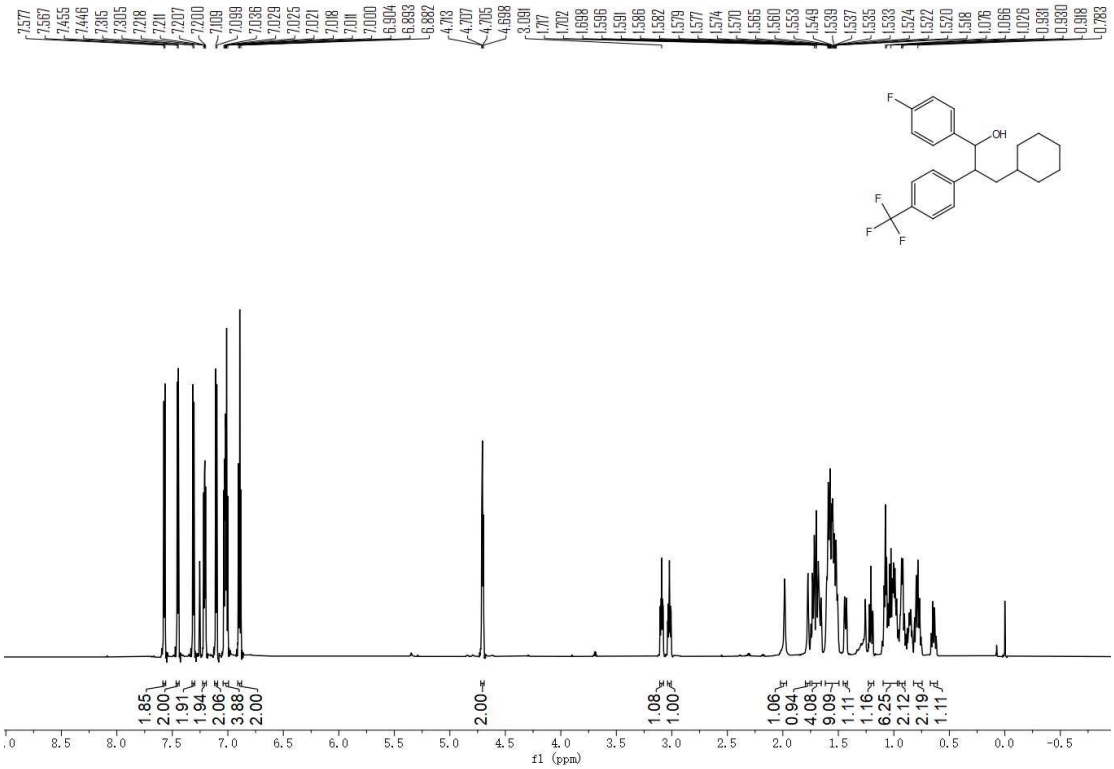

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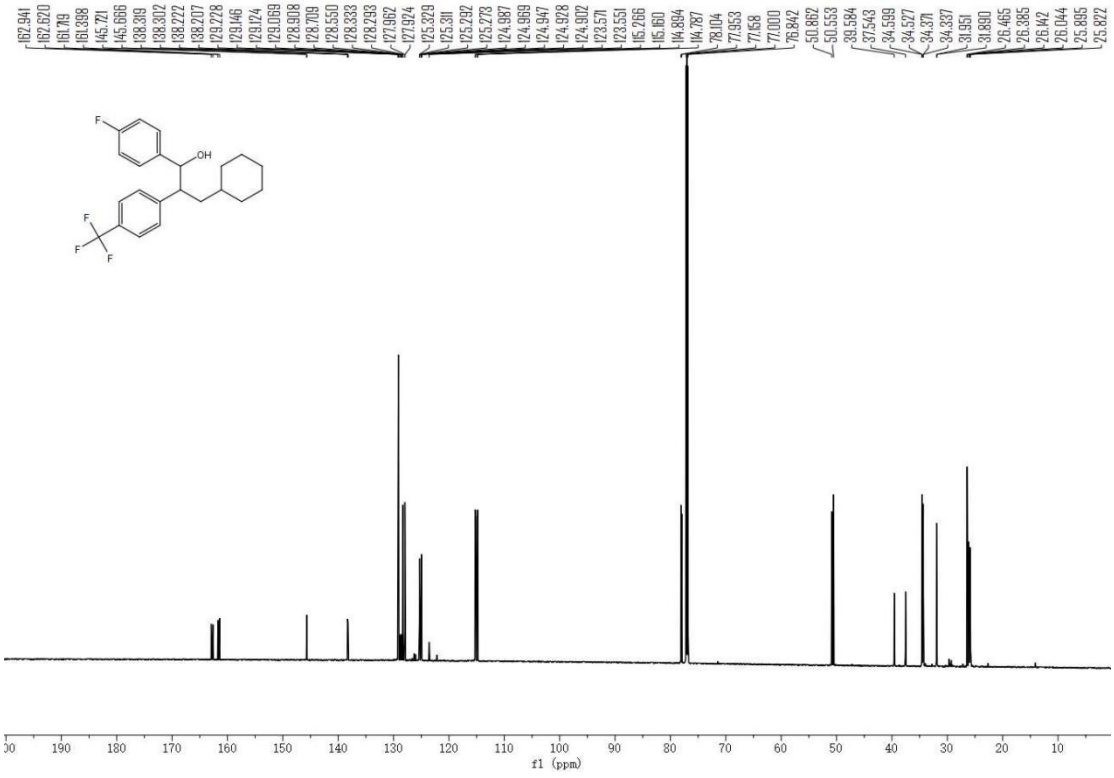

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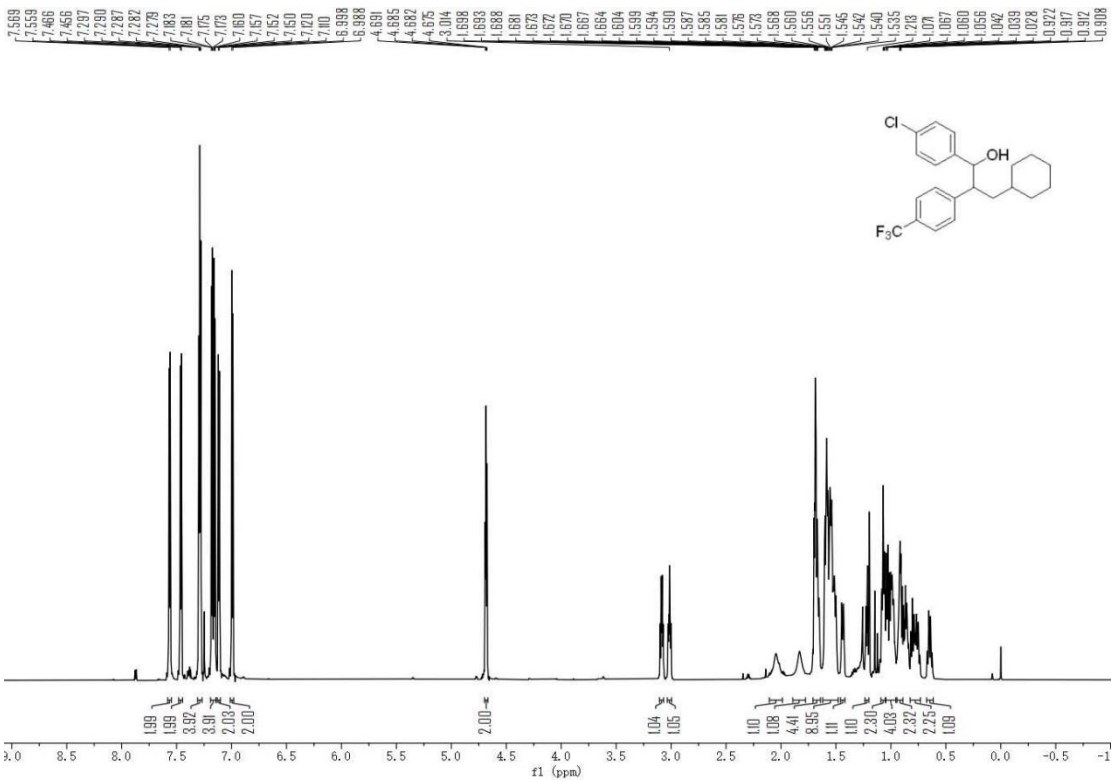

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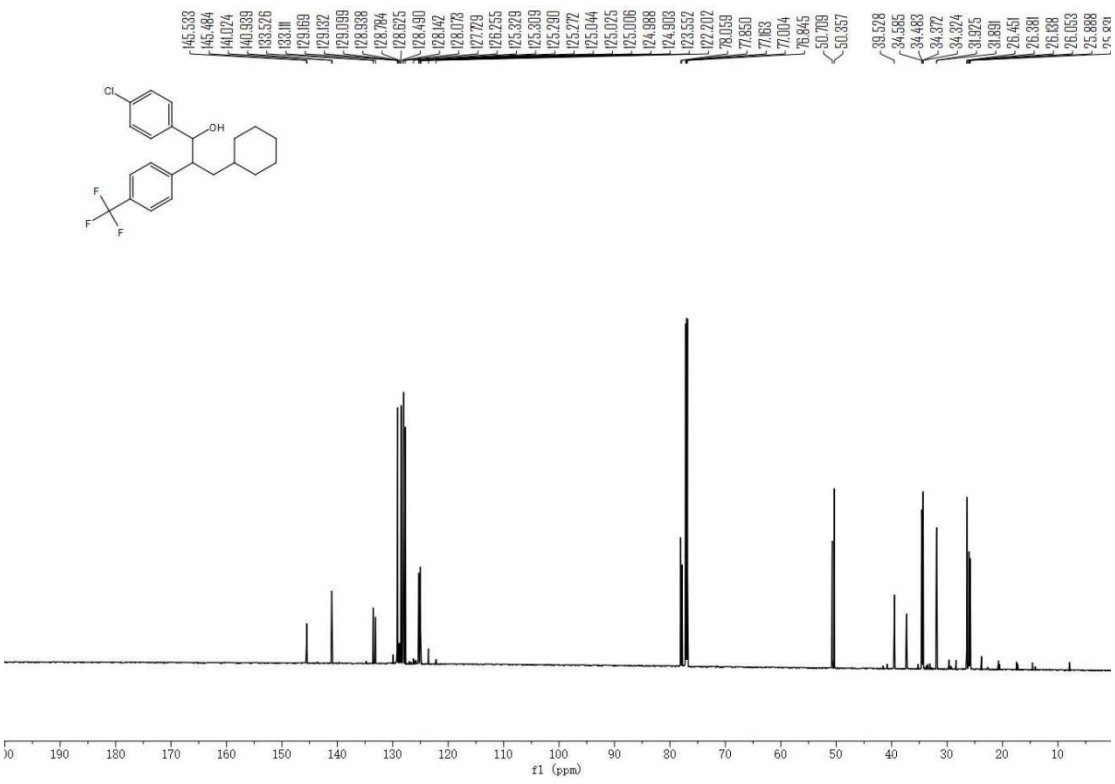

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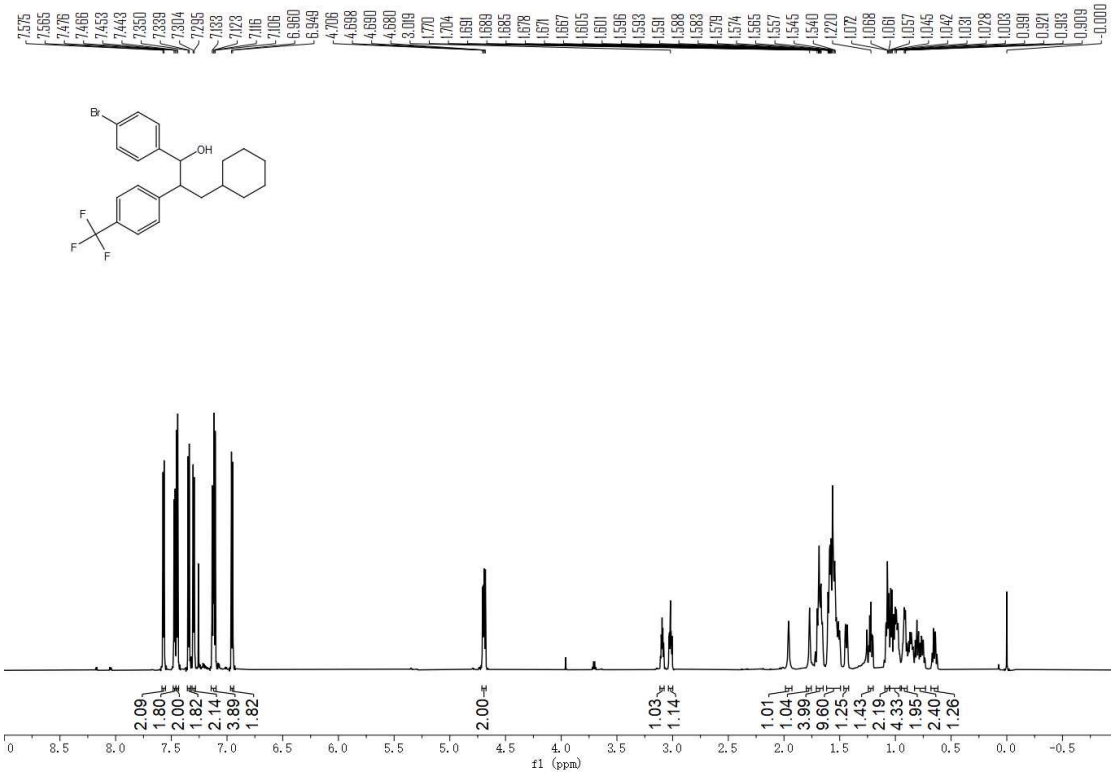

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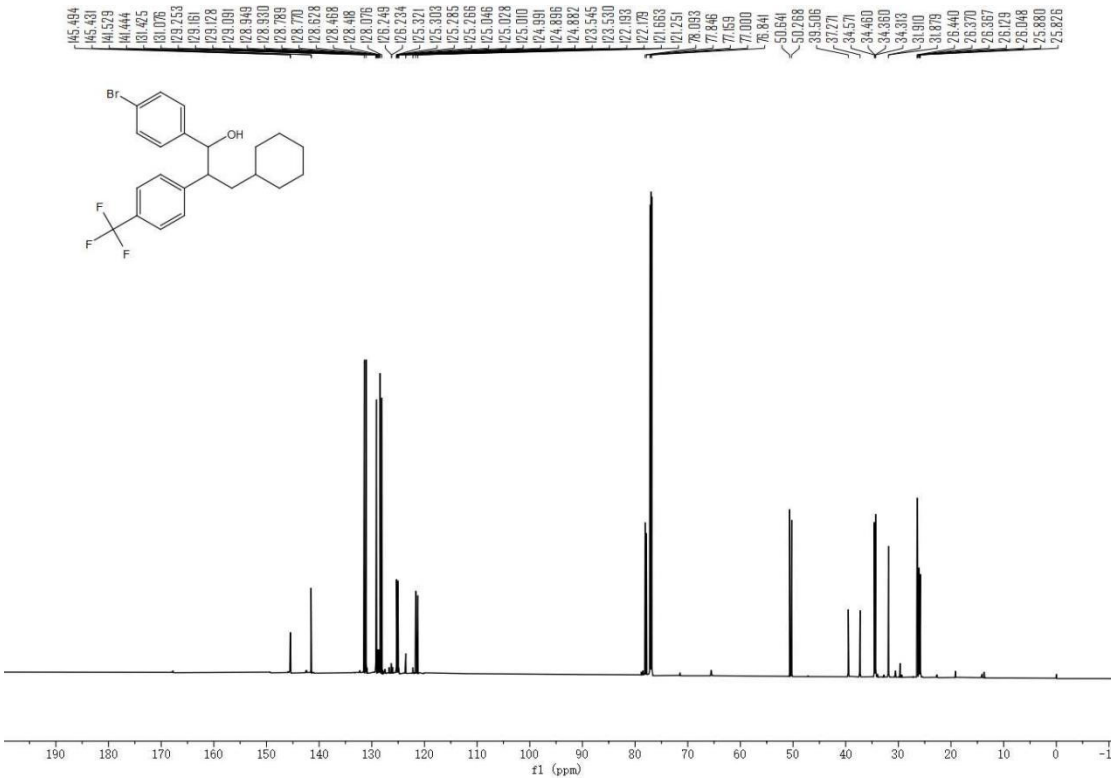
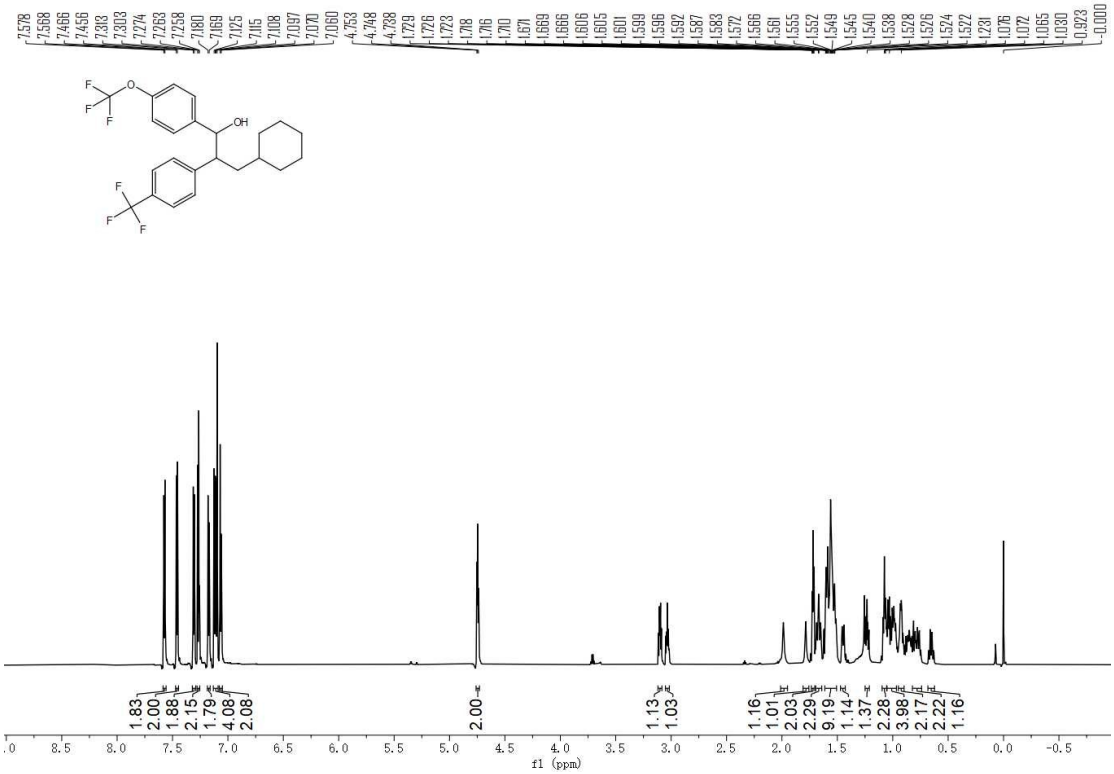
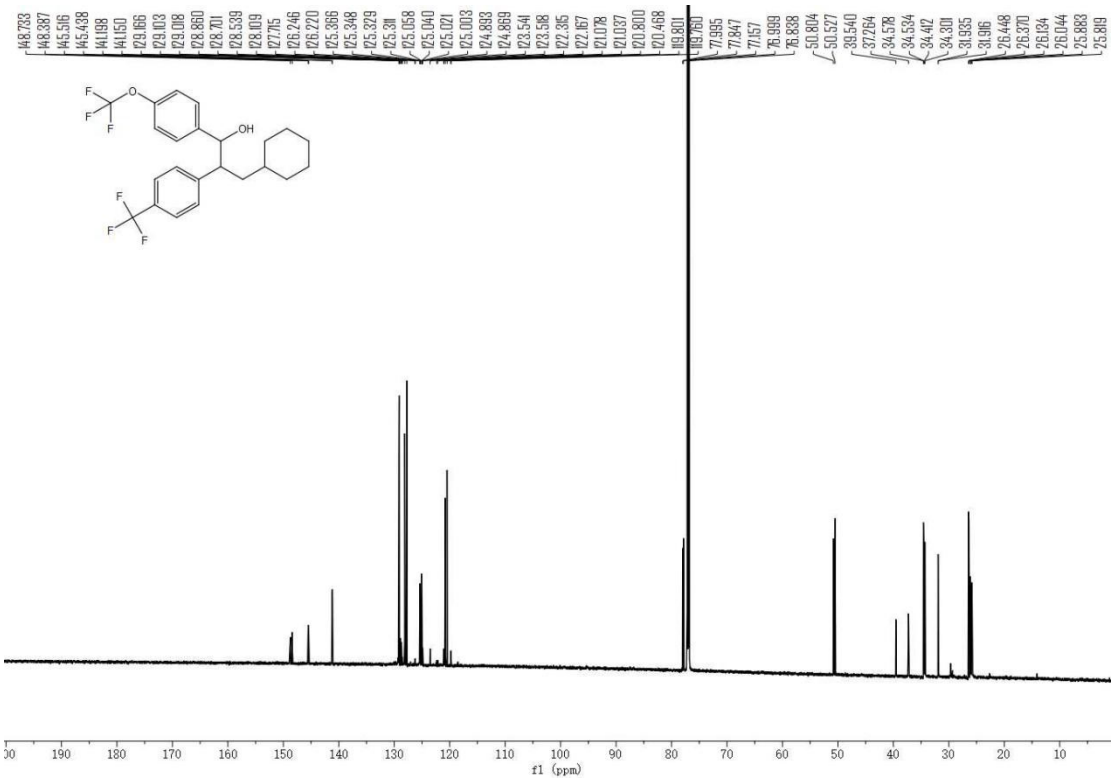


4bf; ^{1}H NMR (800 Hz, $CDCl_3$)



4bf; ^{13}C NMR (200 Hz, $CDCl_3$)



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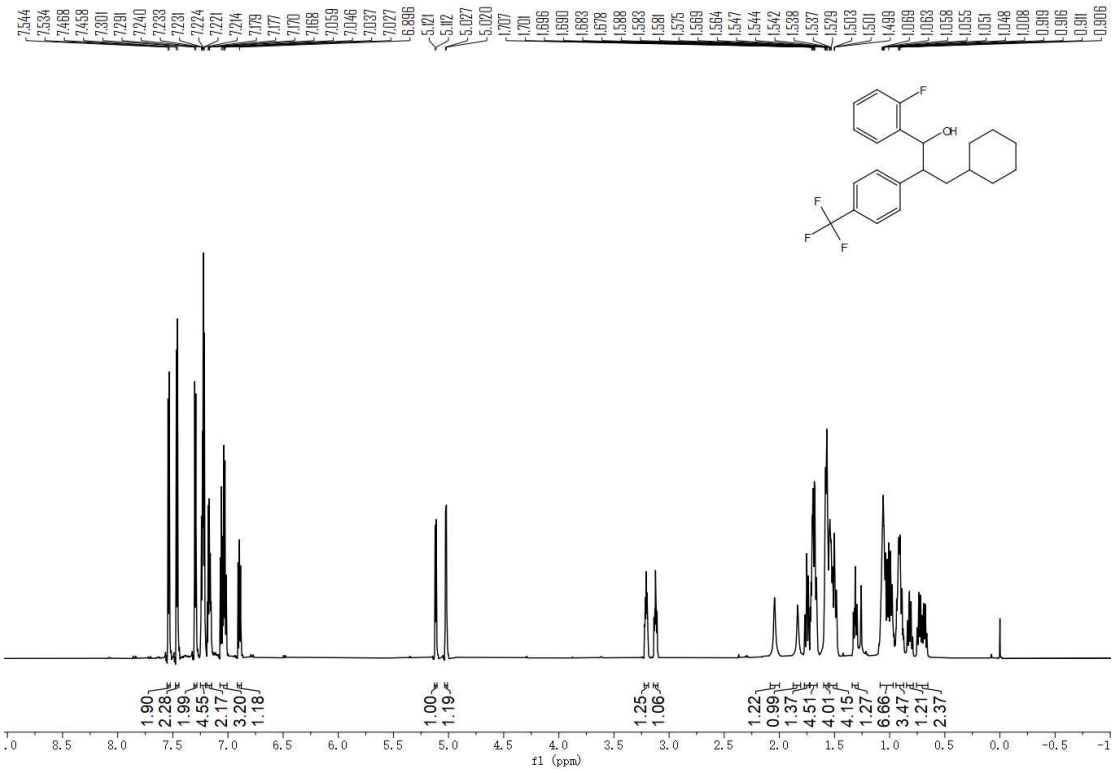
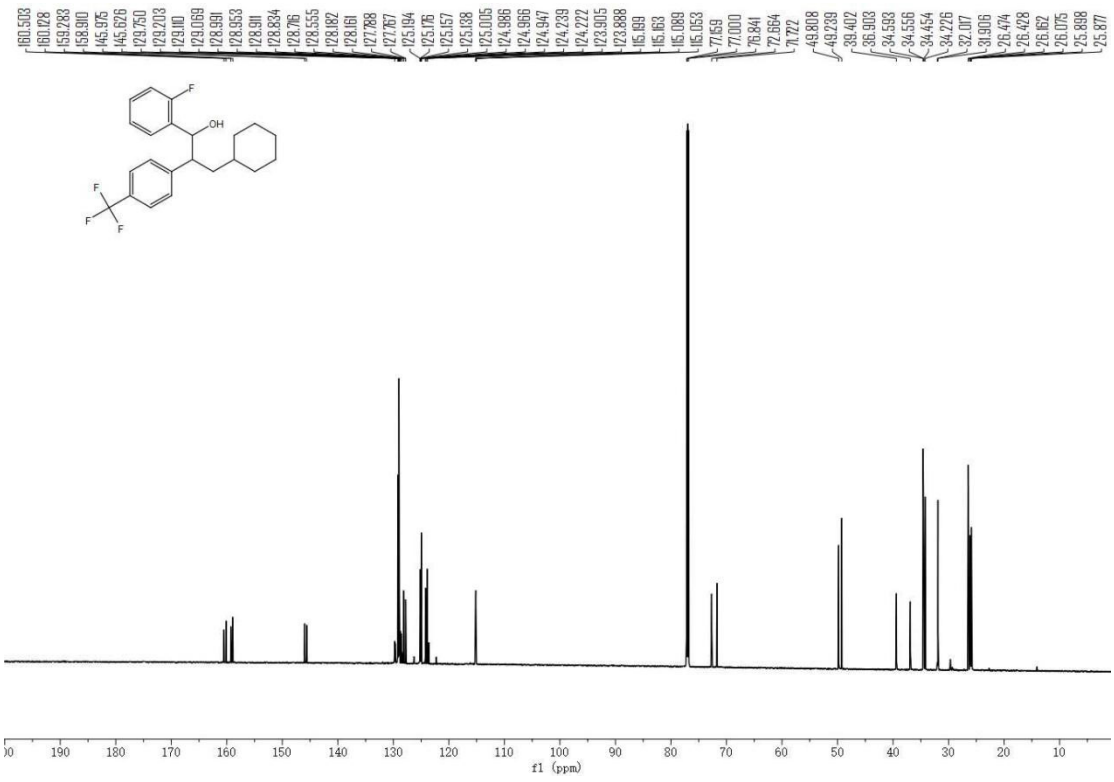


4bg; ^{13}C NMR (200 Hz, $CDCl_3$)



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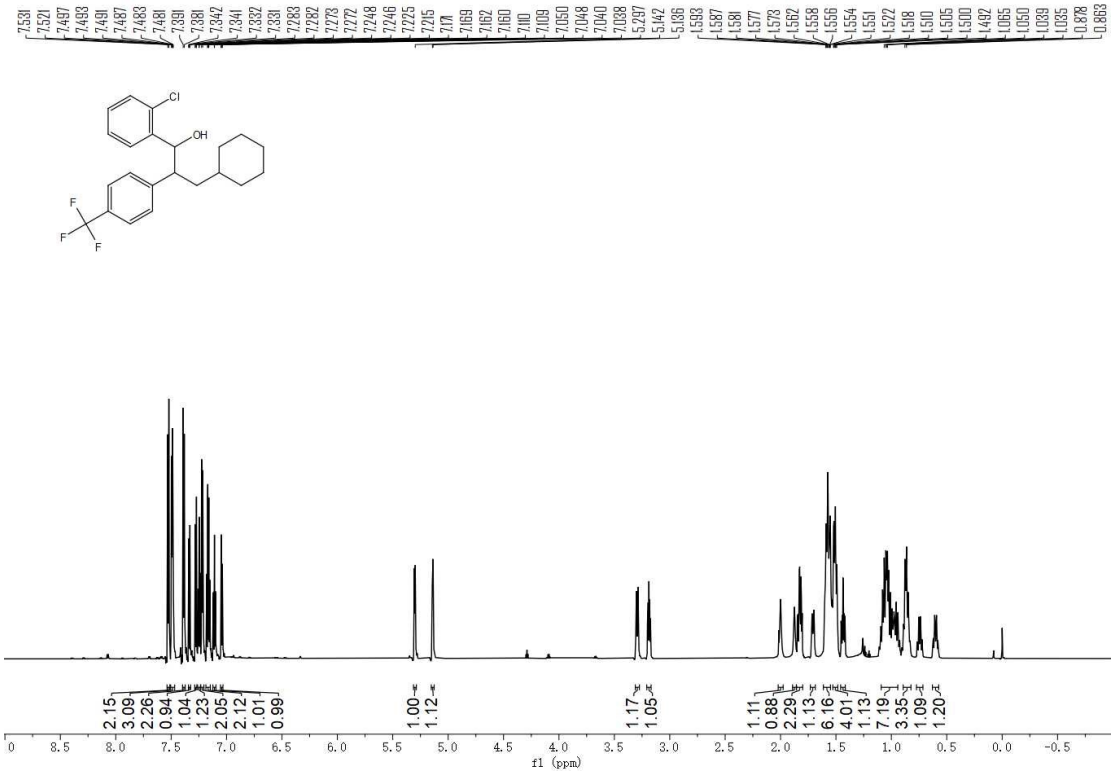

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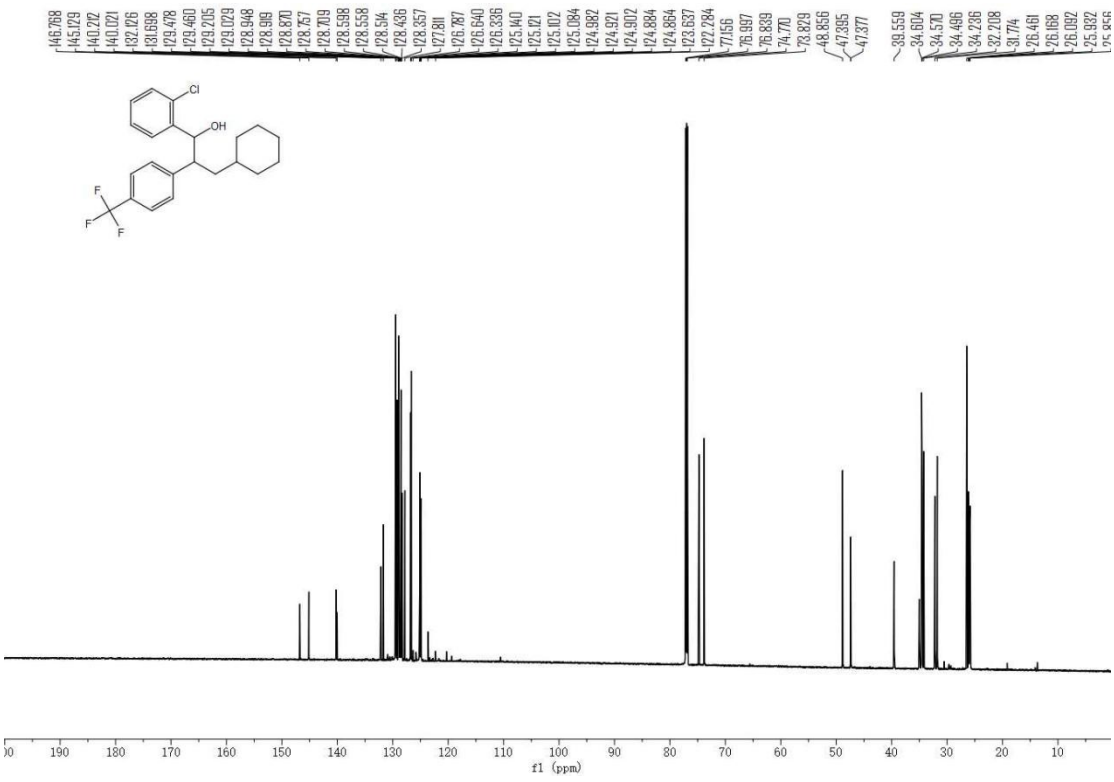

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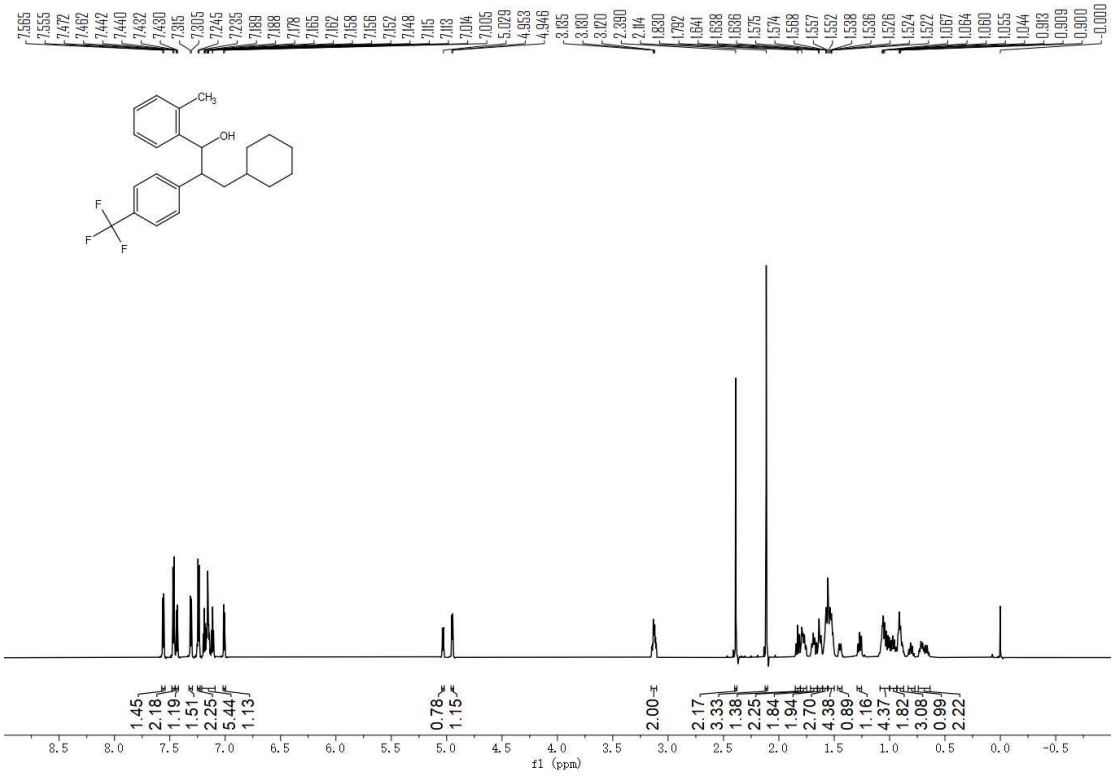

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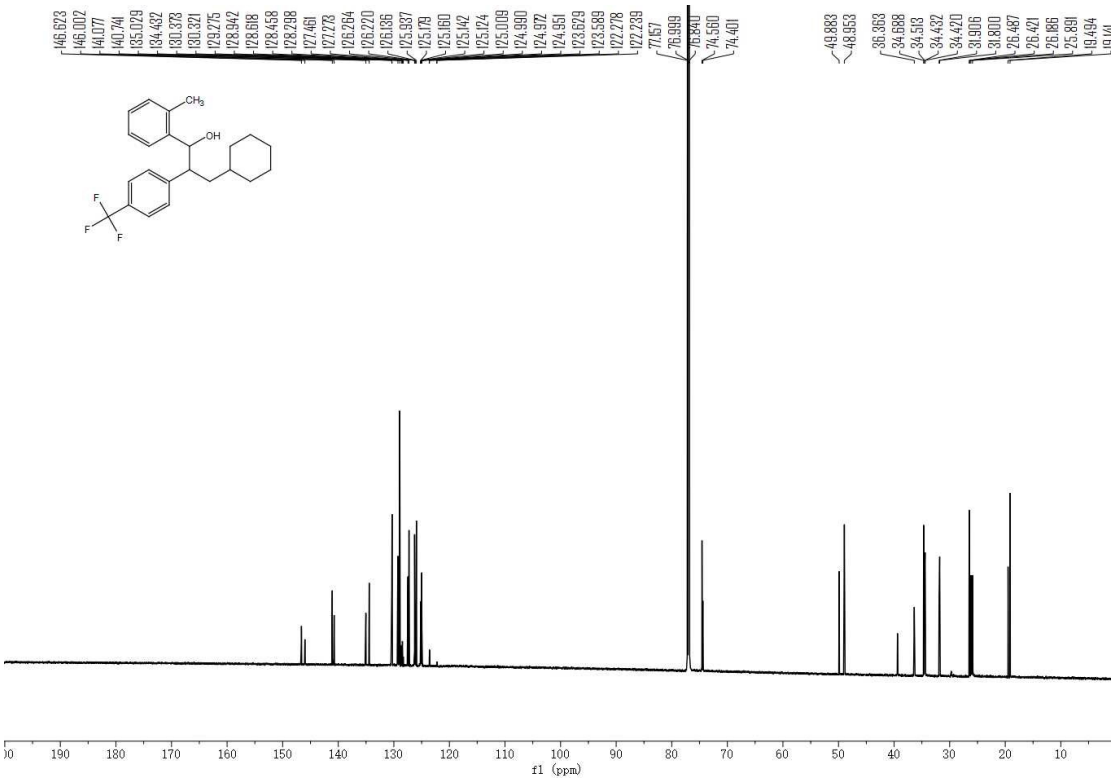

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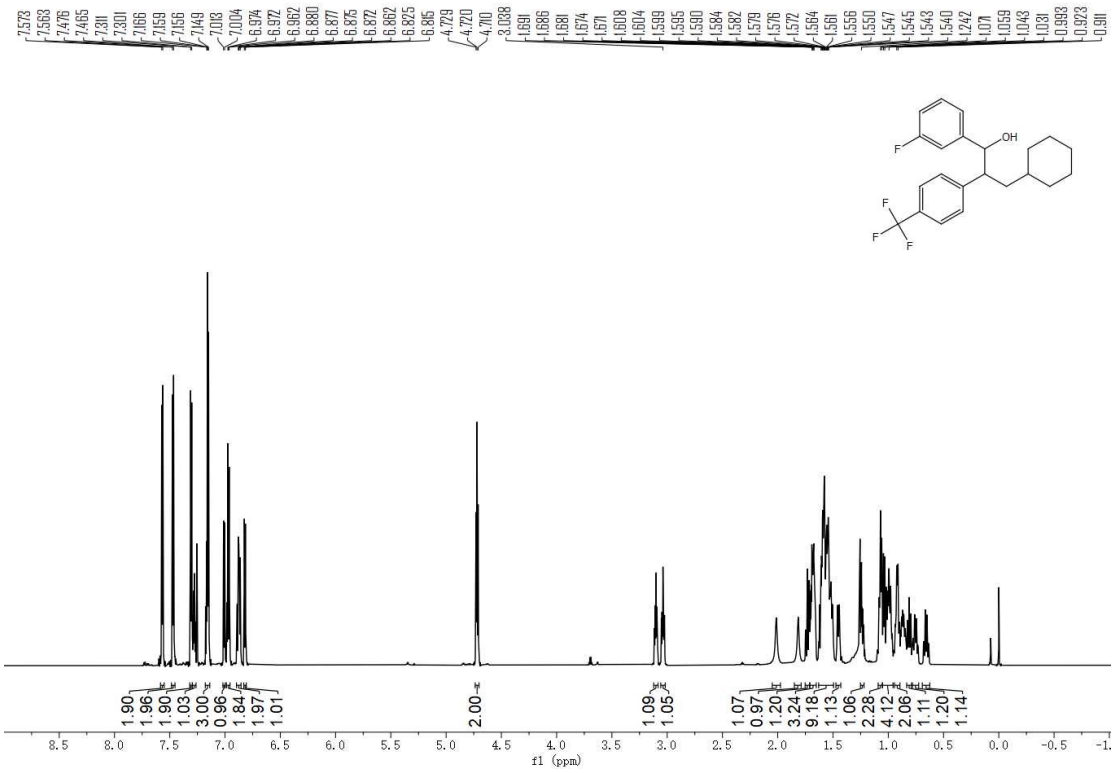

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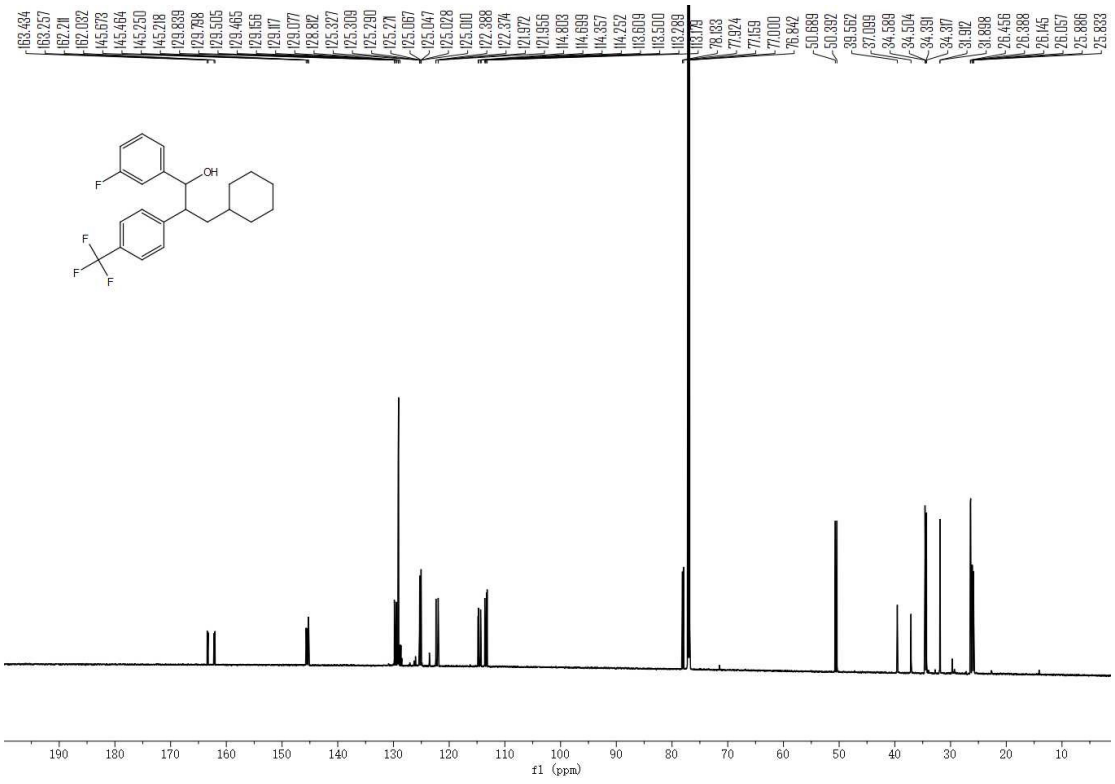

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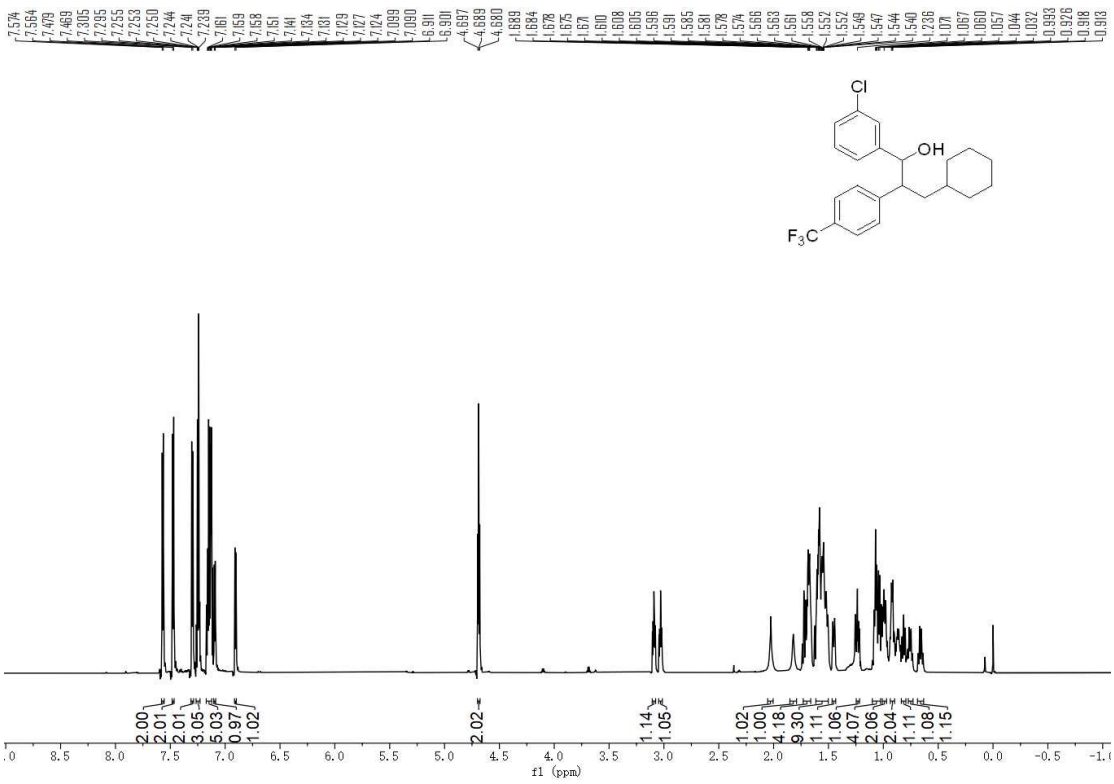

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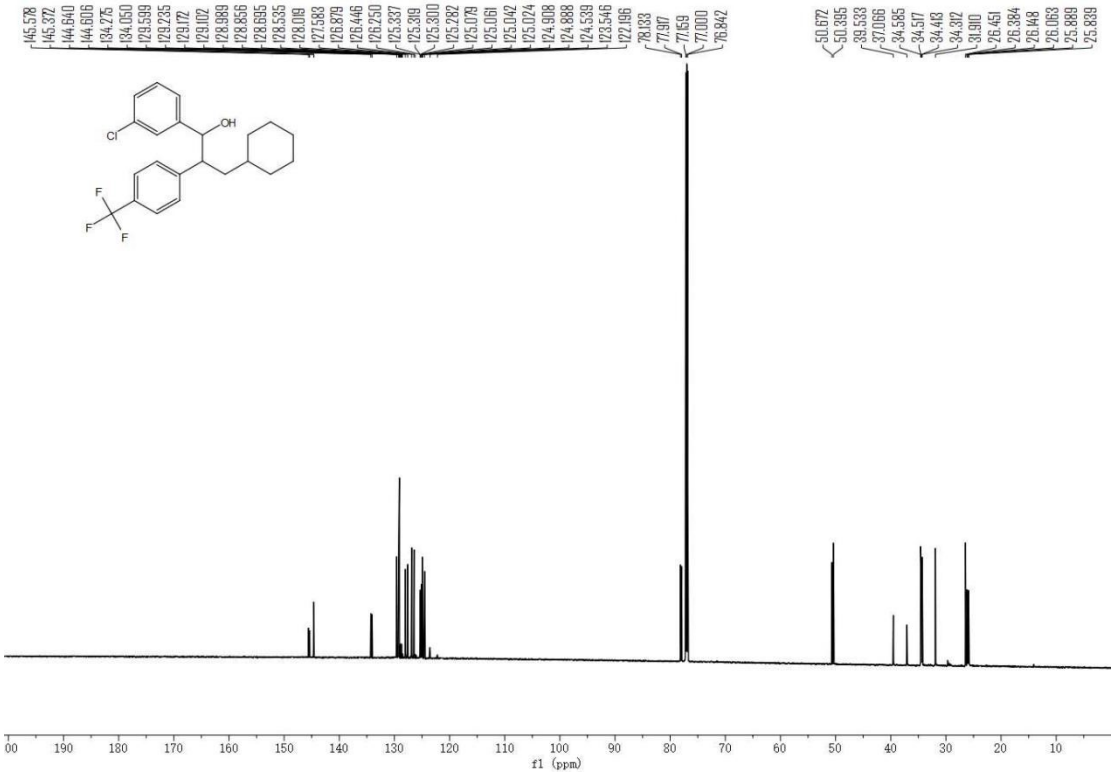

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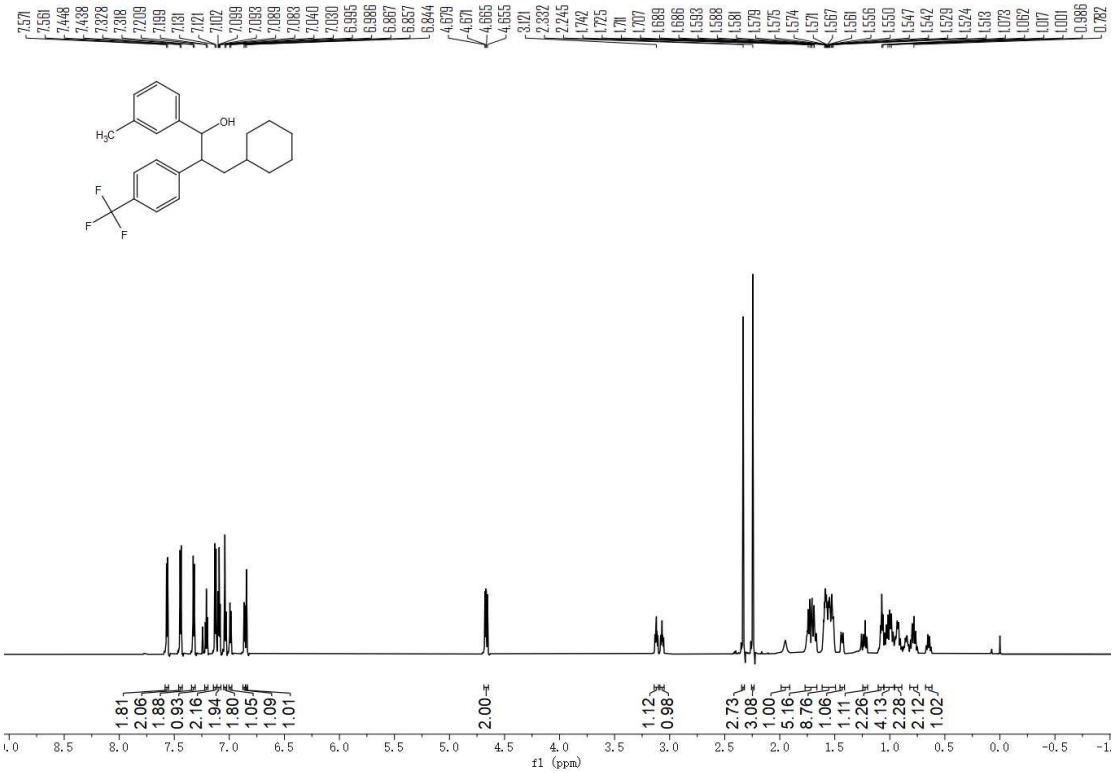

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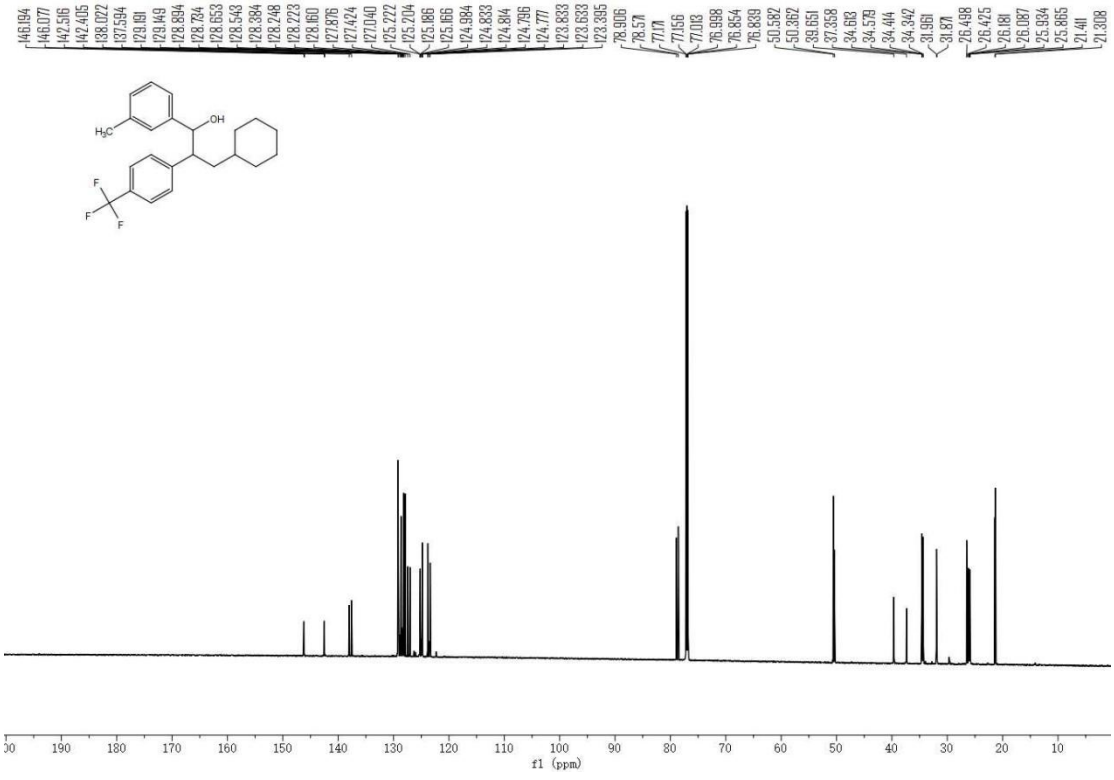

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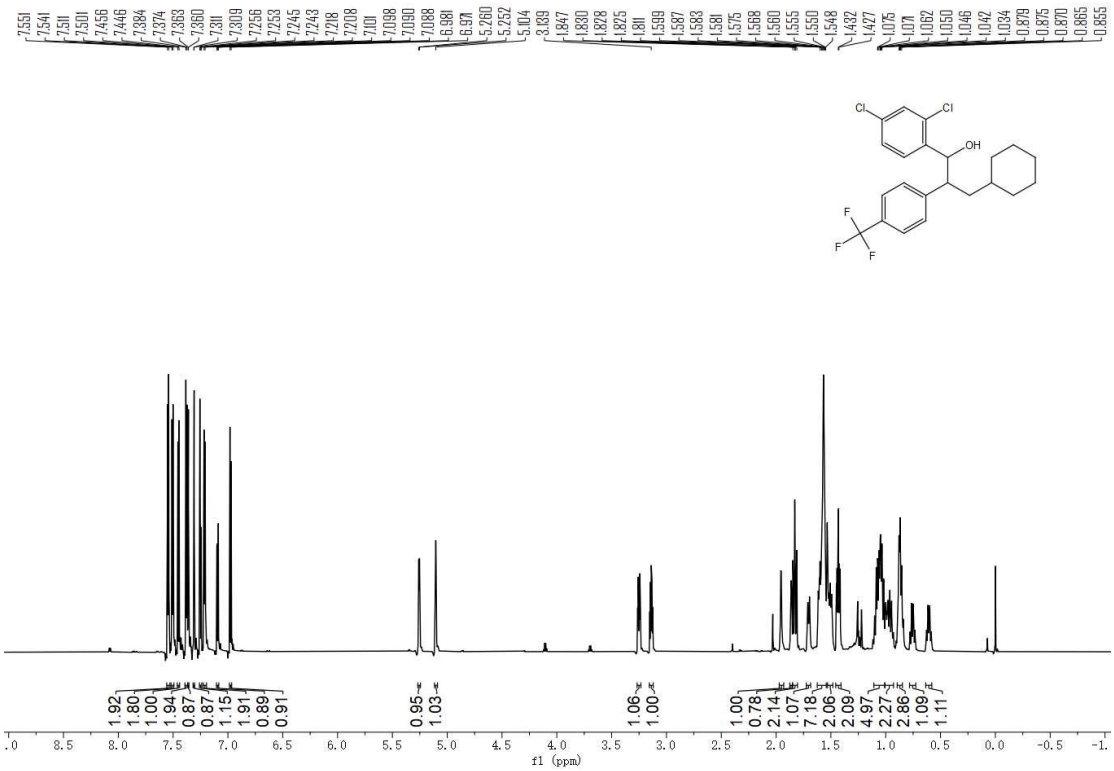

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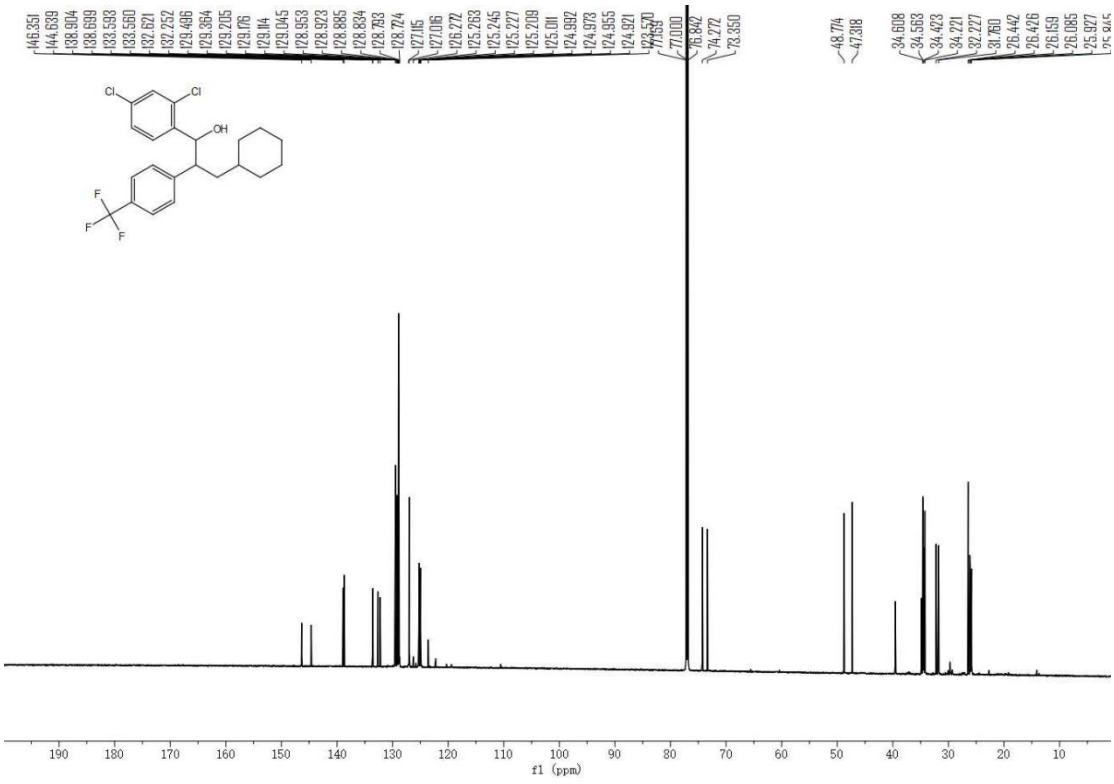

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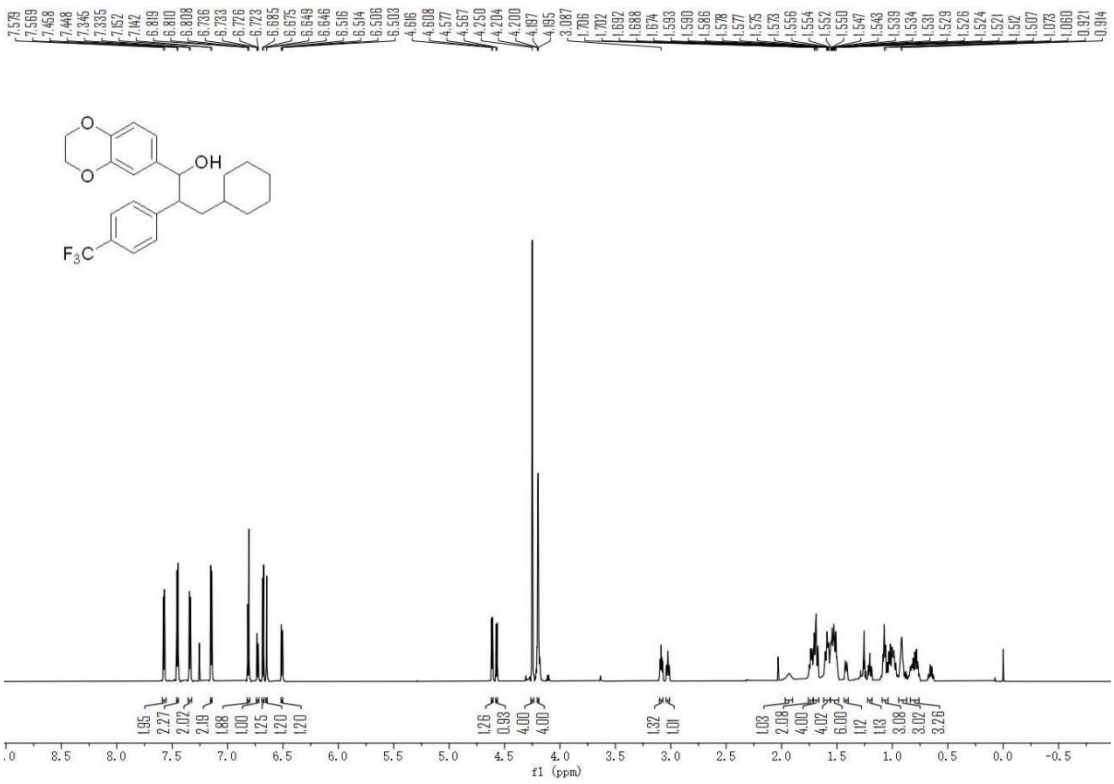

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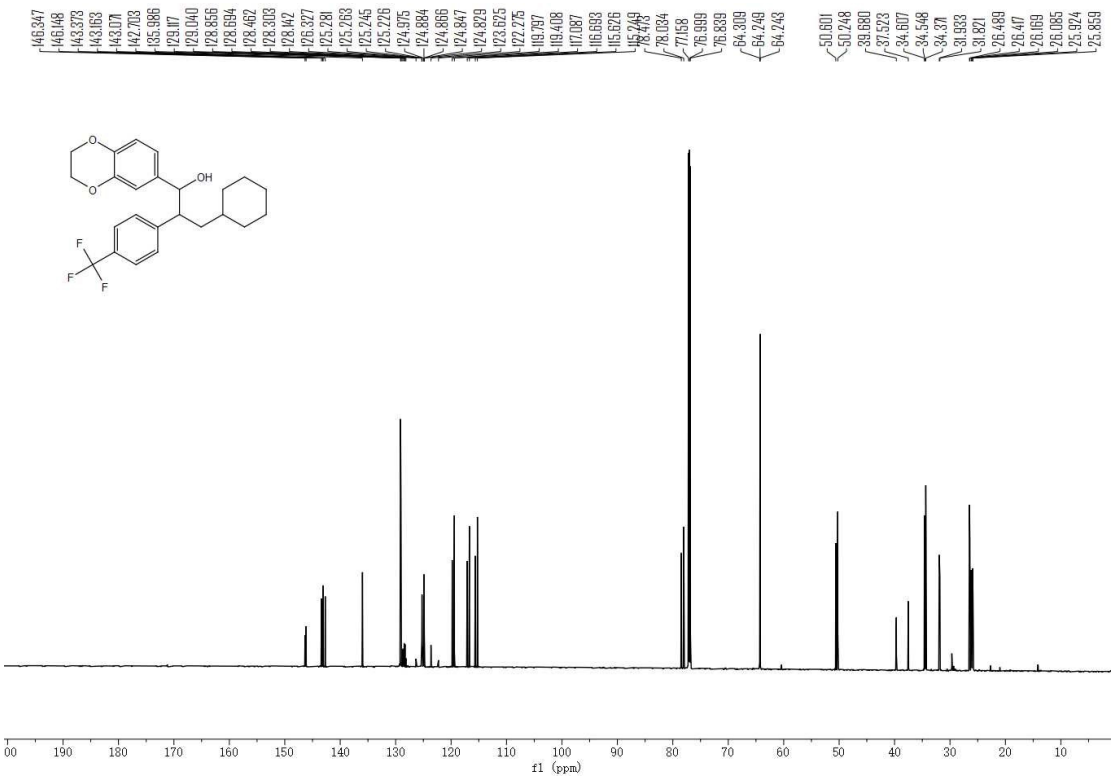
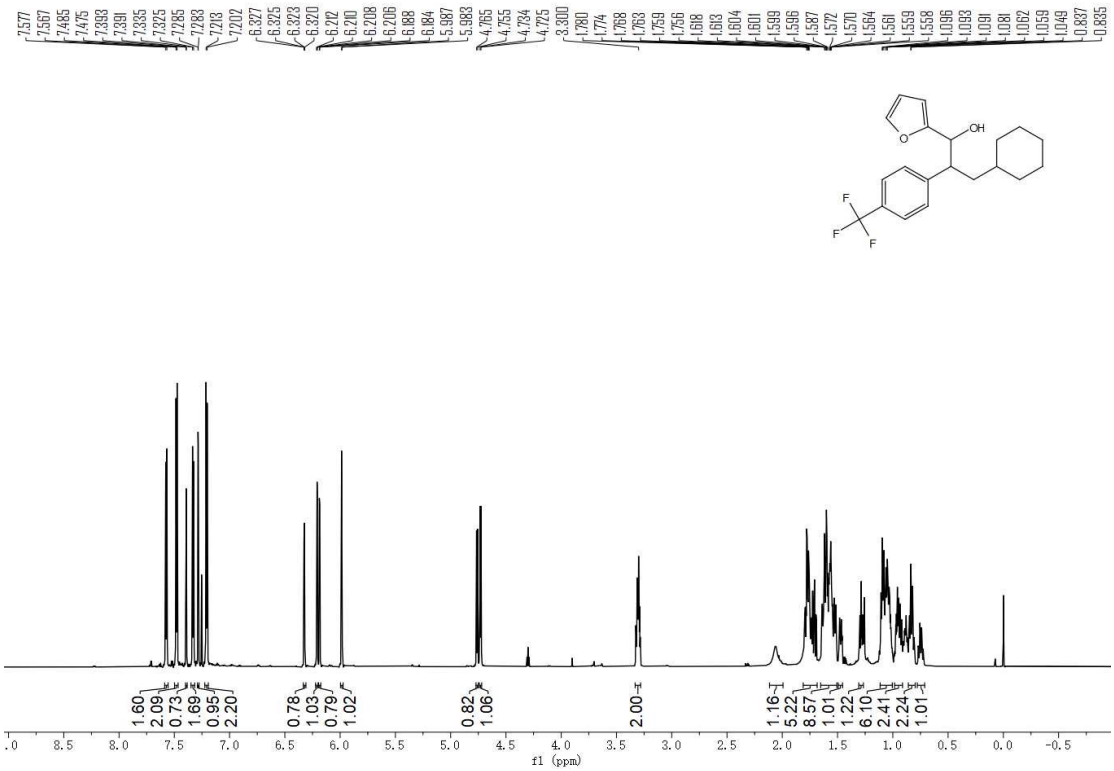
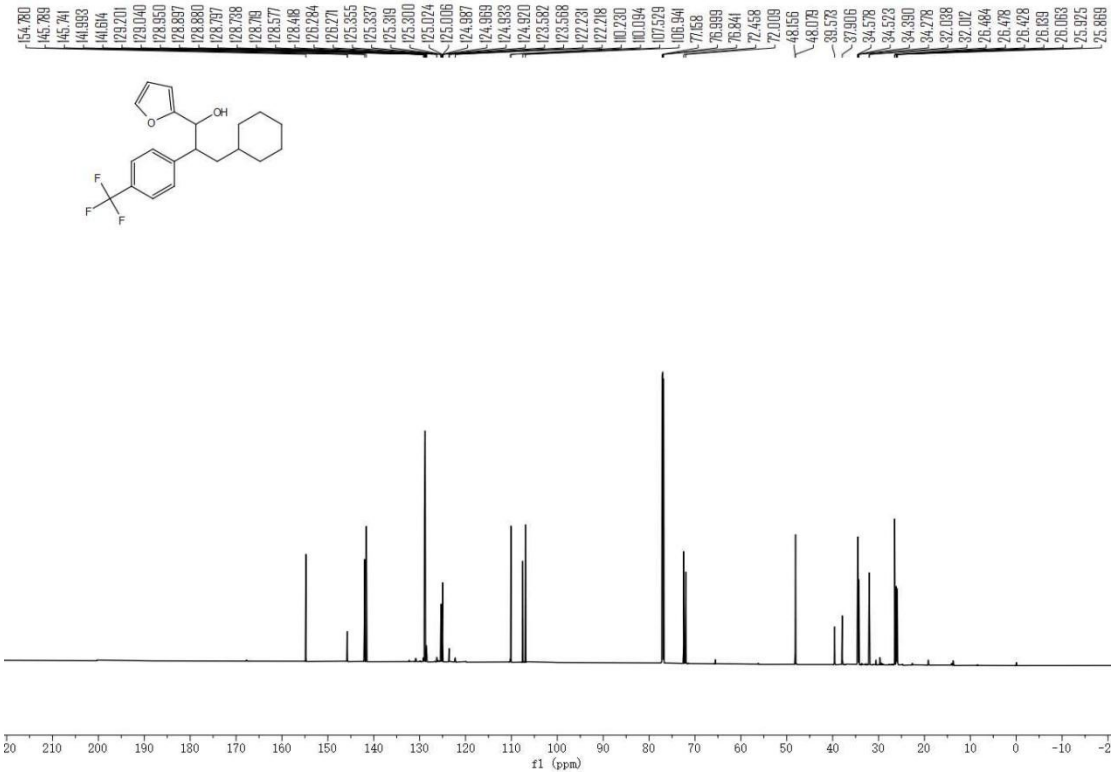


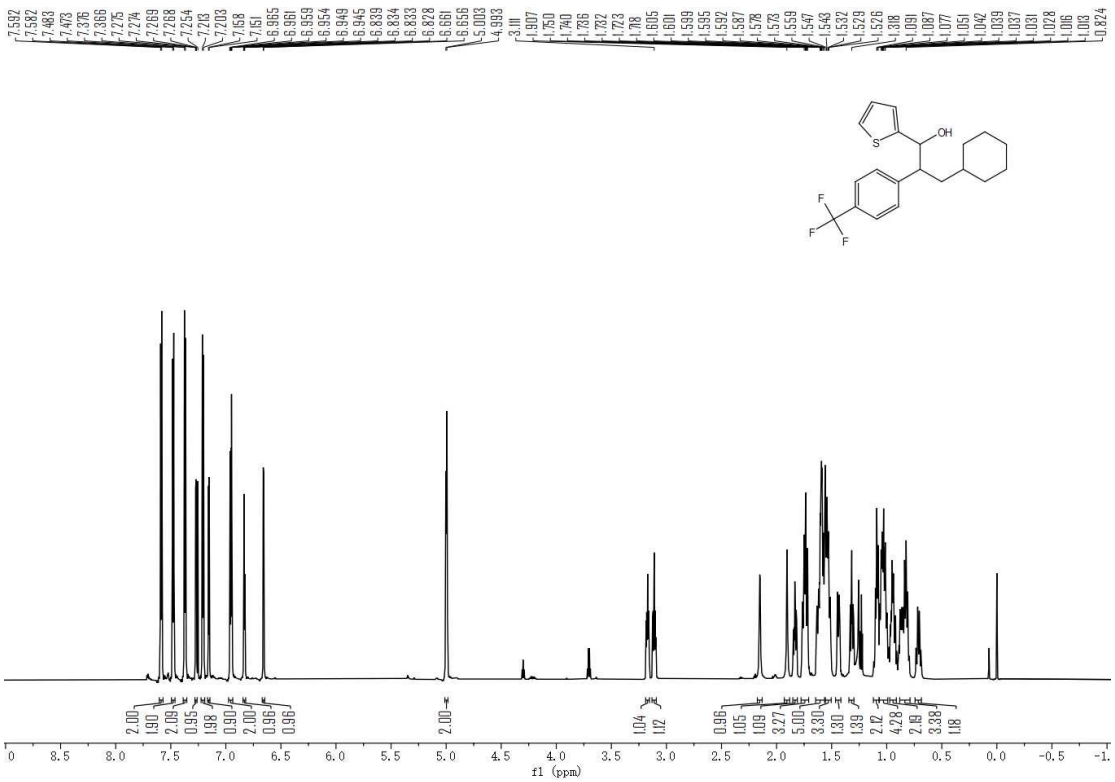
4bo; ^{1}H NMR (800 Hz, $CDCl_3$)



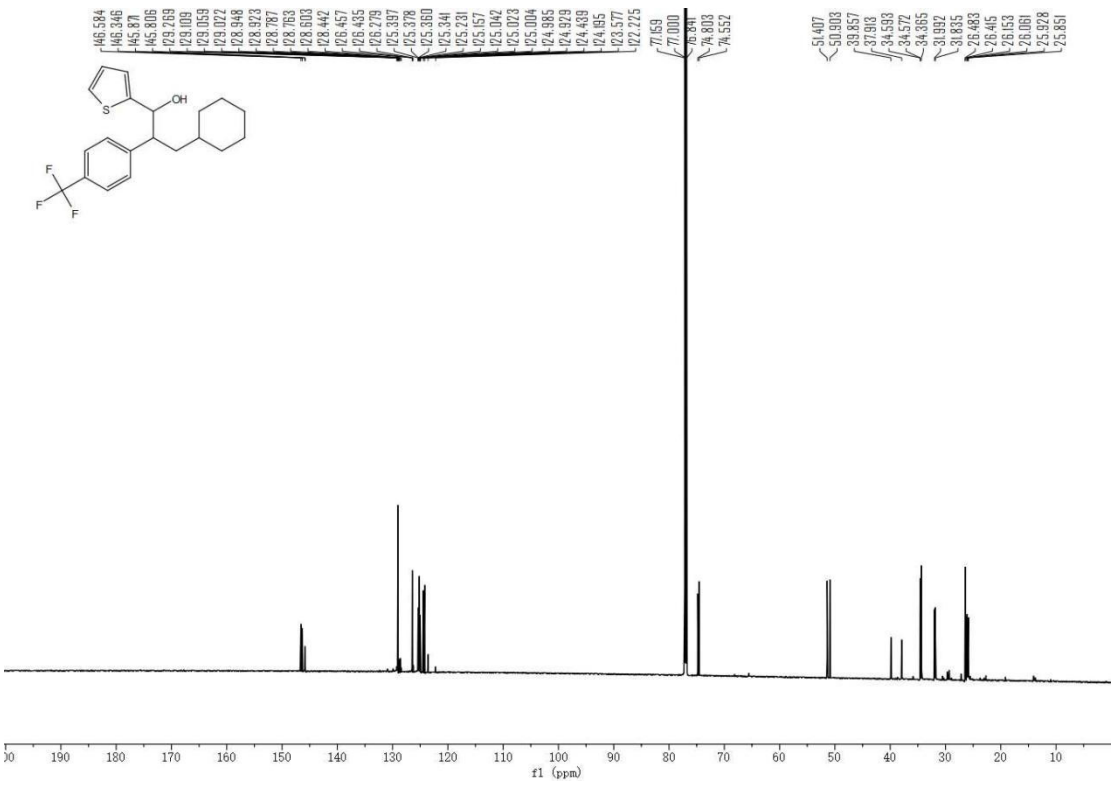
4bo; ^{13}C NMR (200 Hz, $CDCl_3$)



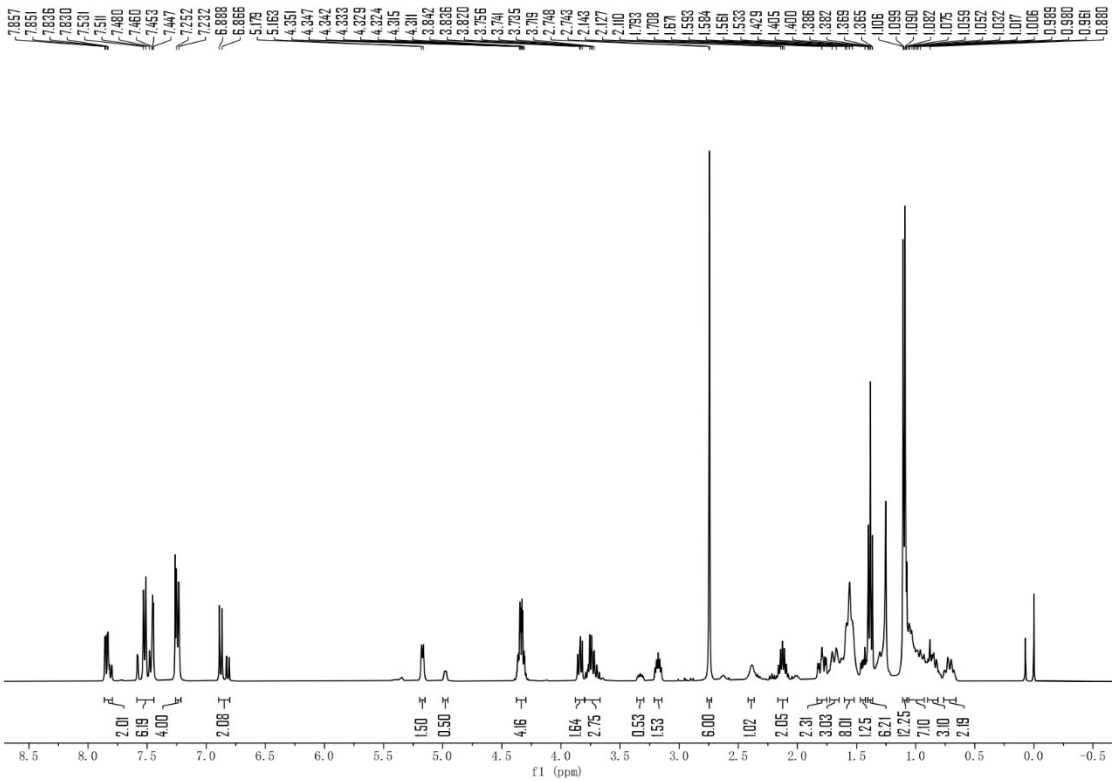
4bp; ^{1}H NMR (800 Hz, $CDCl_3$)



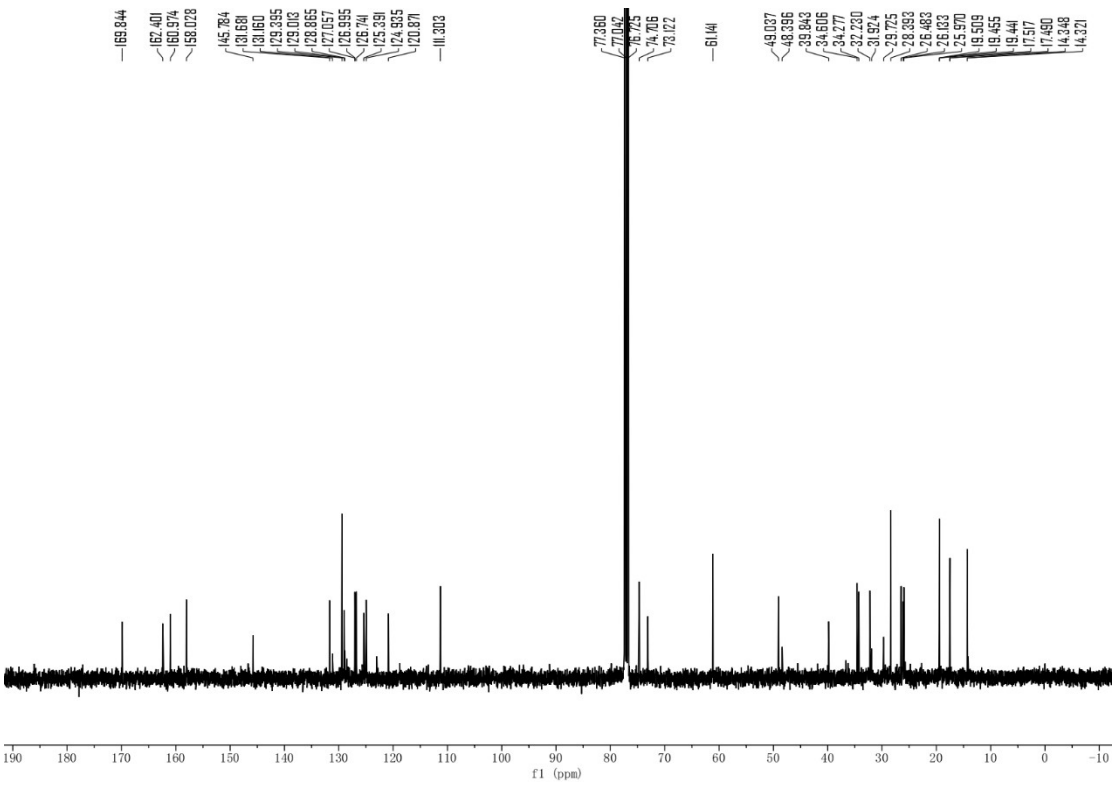
4bp; ^{13}C NMR (200 Hz, $CDCl_3$)



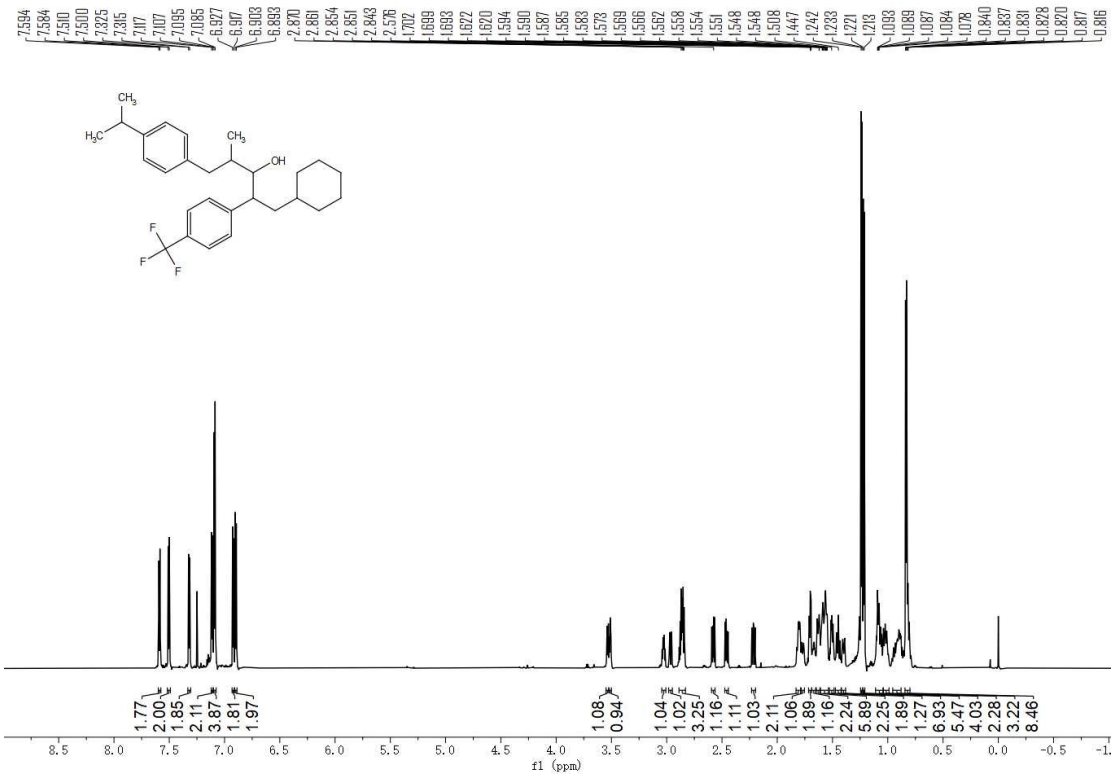
4bq; ^{1}H NMR (400 Hz, $CDCl_3$)



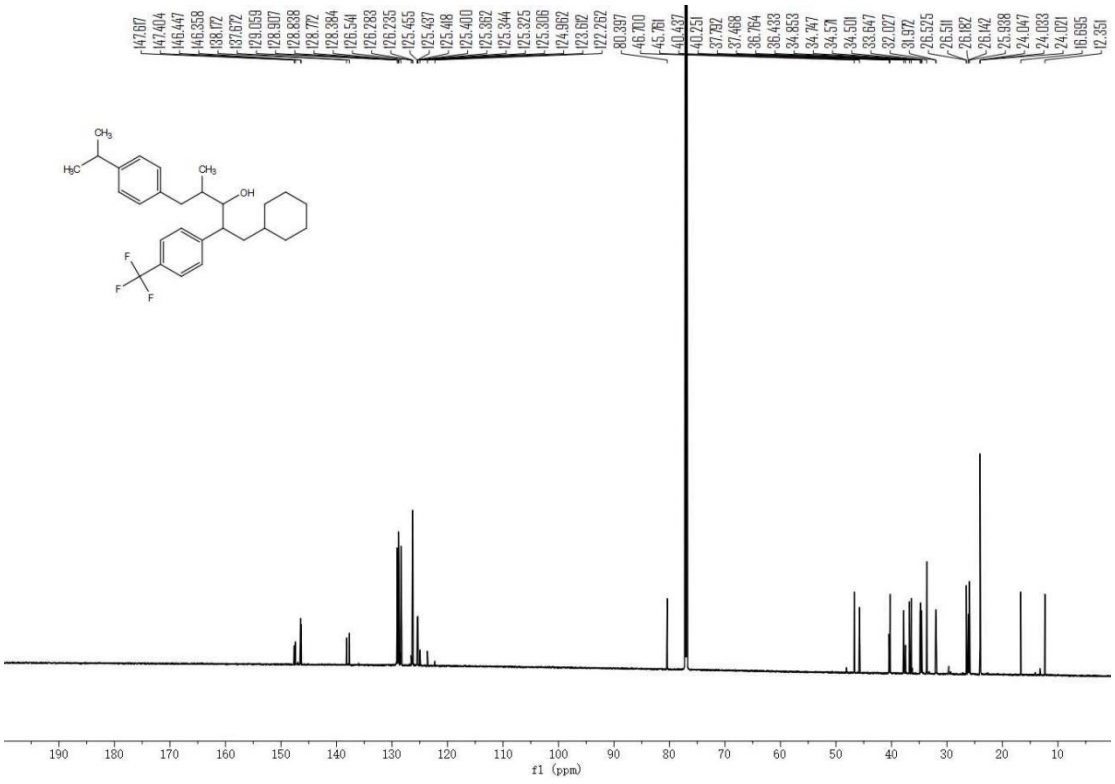
4bq; ^{13}C NMR (100 Hz, $CDCl_3$)



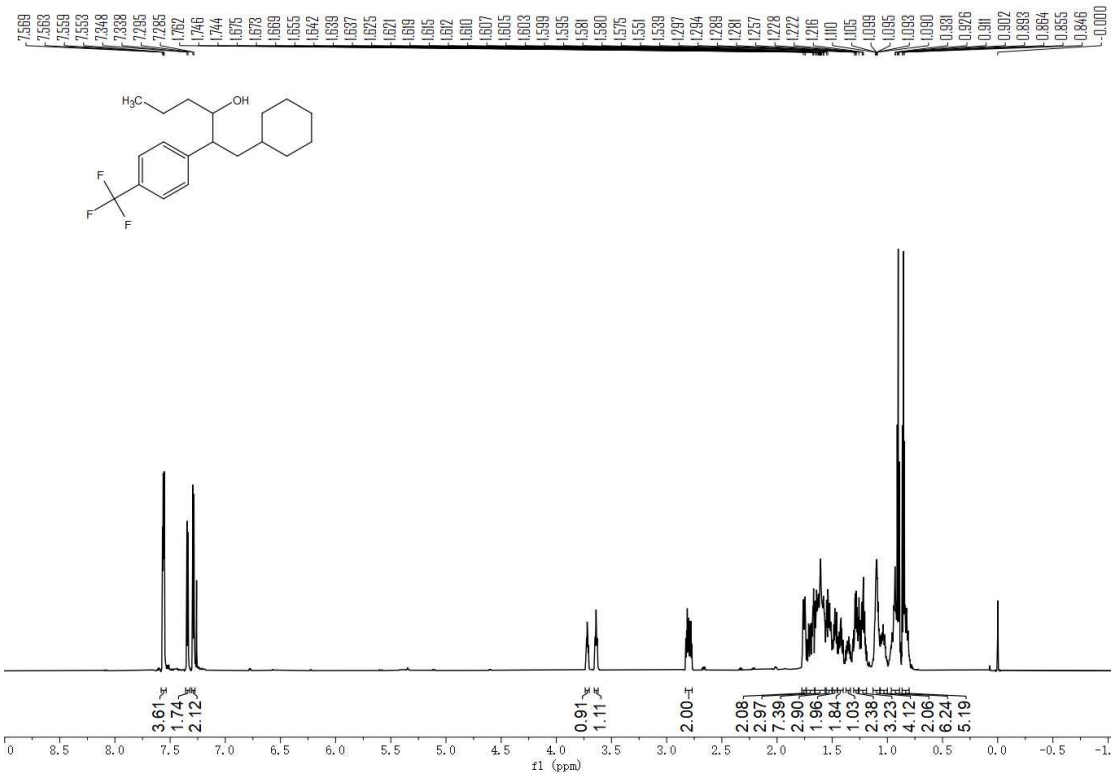
4br; ^{1}H NMR (800 Hz, $CDCl_3$)



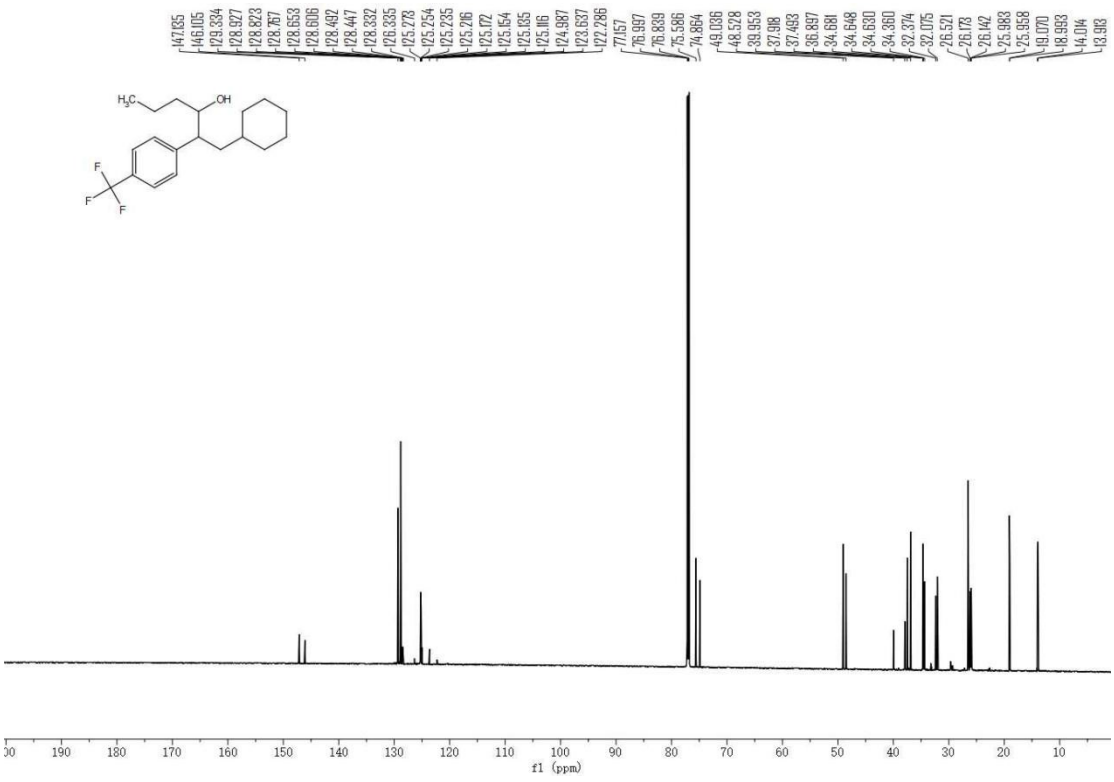
4br; ^{13}C NMR (200 Hz, $CDCl_3$)



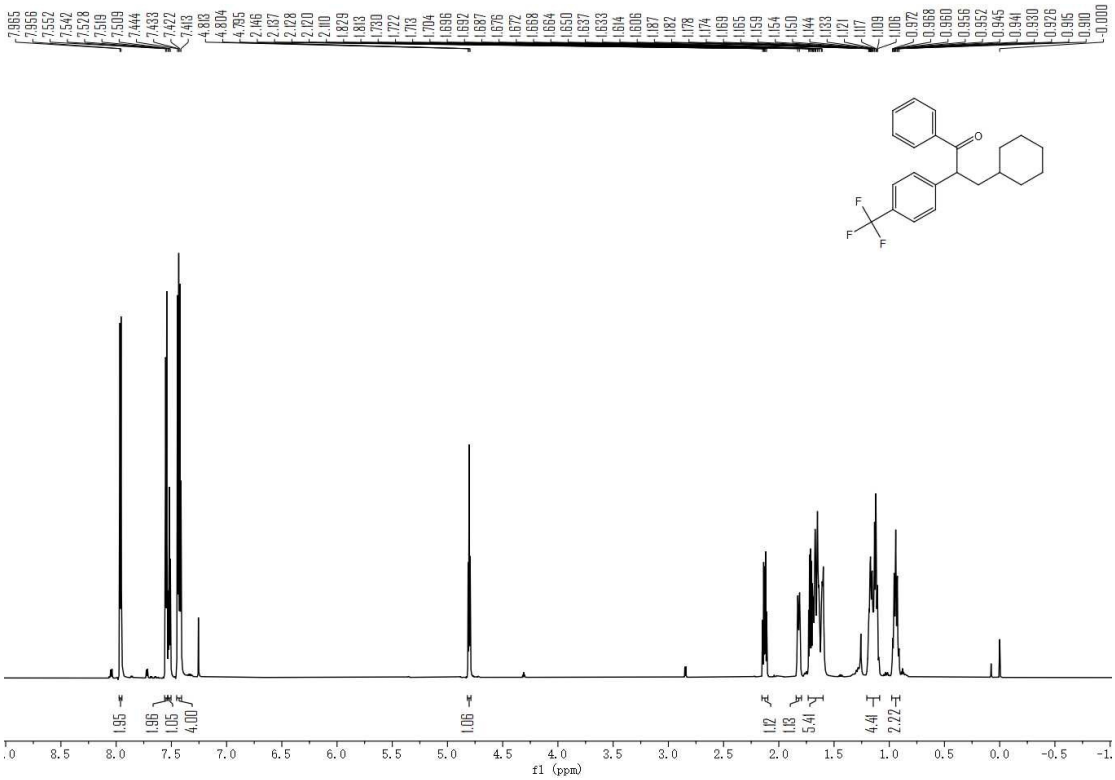
4bs; ^{1}H NMR (800 Hz, $CDCl_3$)



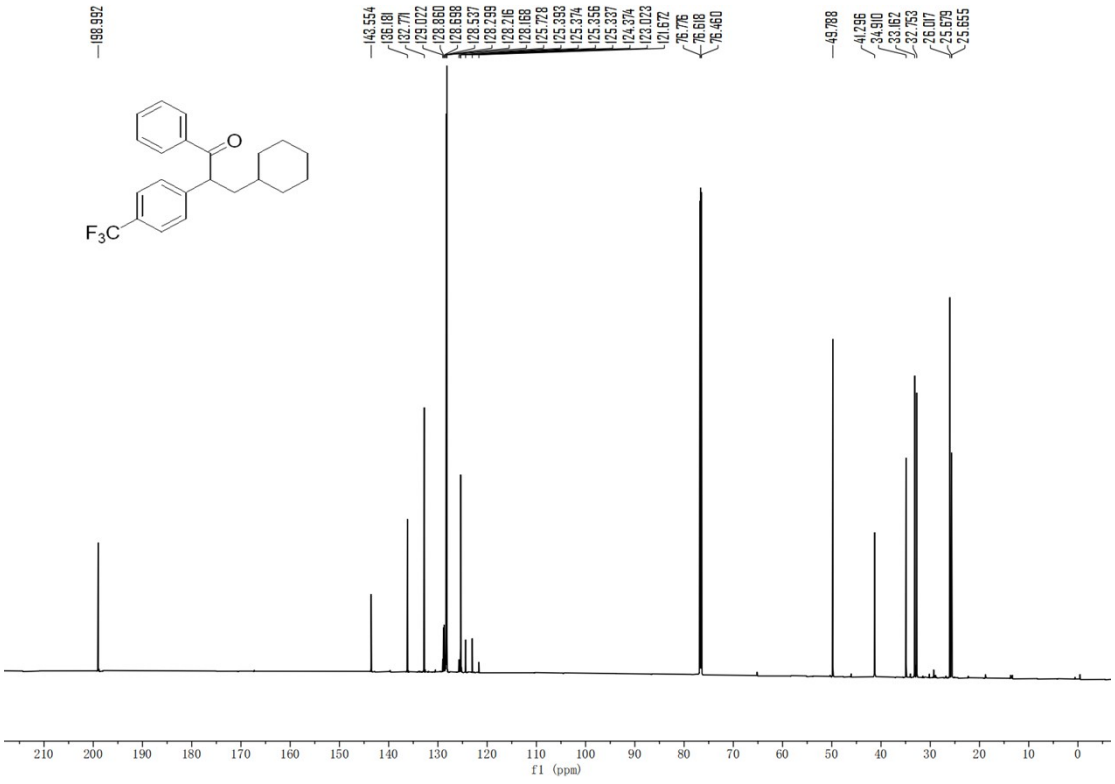
4bs; ^{13}C NMR (200 Hz, $CDCl_3$)



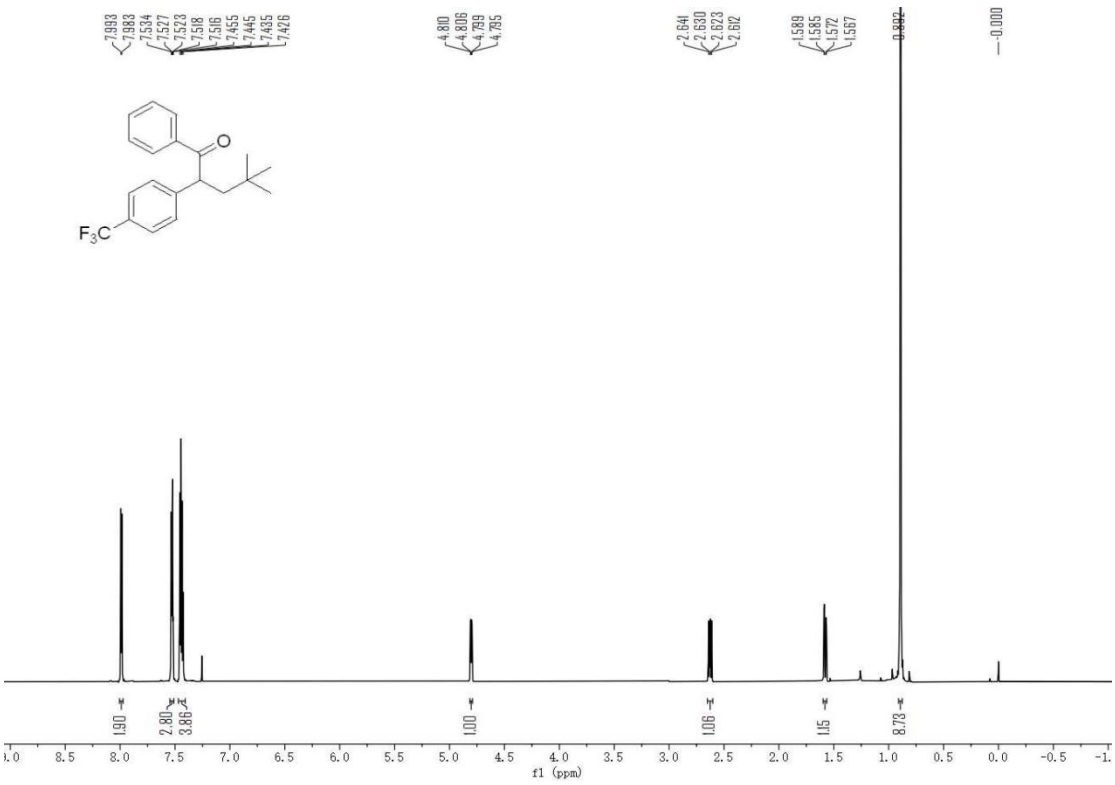
5a; ^{1}H NMR (800 Hz, $CDCl_3$)



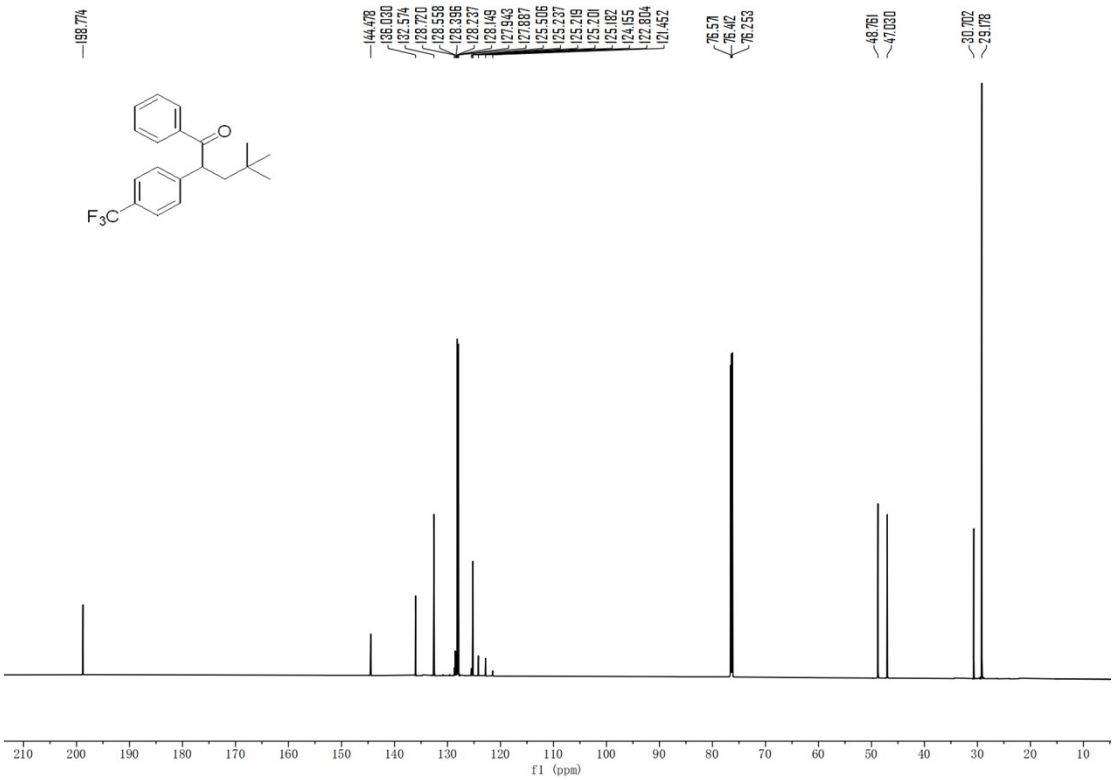
5a; ^{13}C NMR (200 Hz, $CDCl_3$)



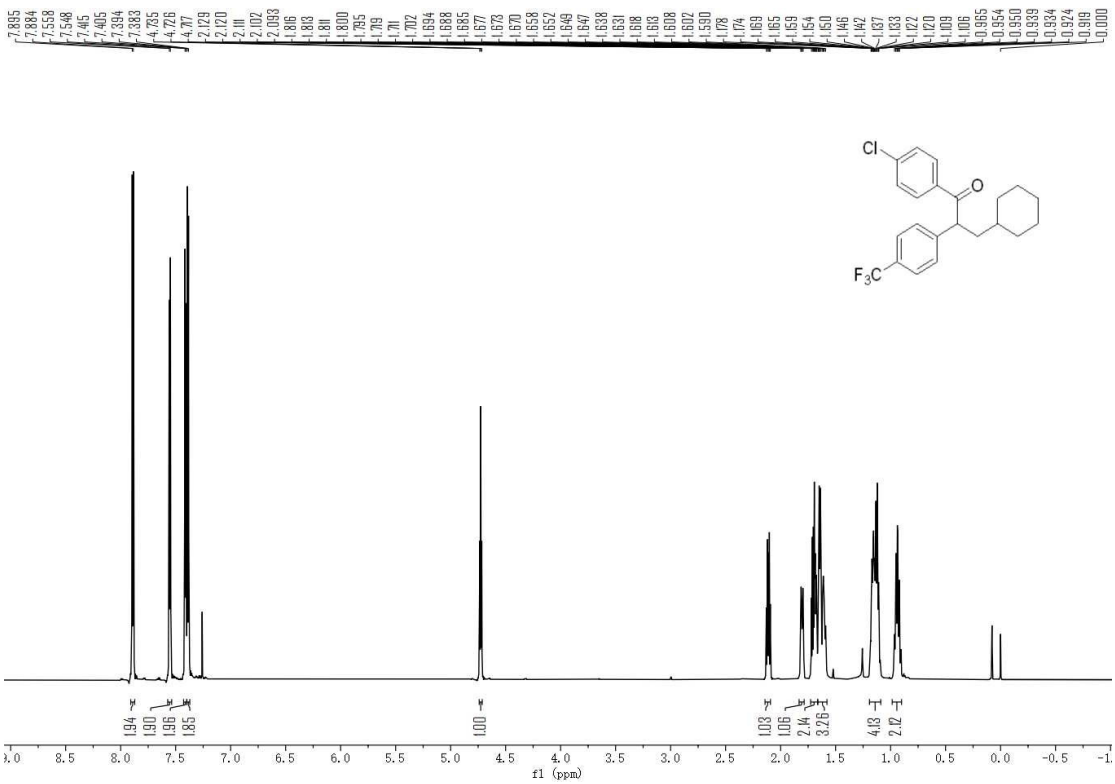
5b; ^{1}H NMR (800 Hz, $CDCl_3$)



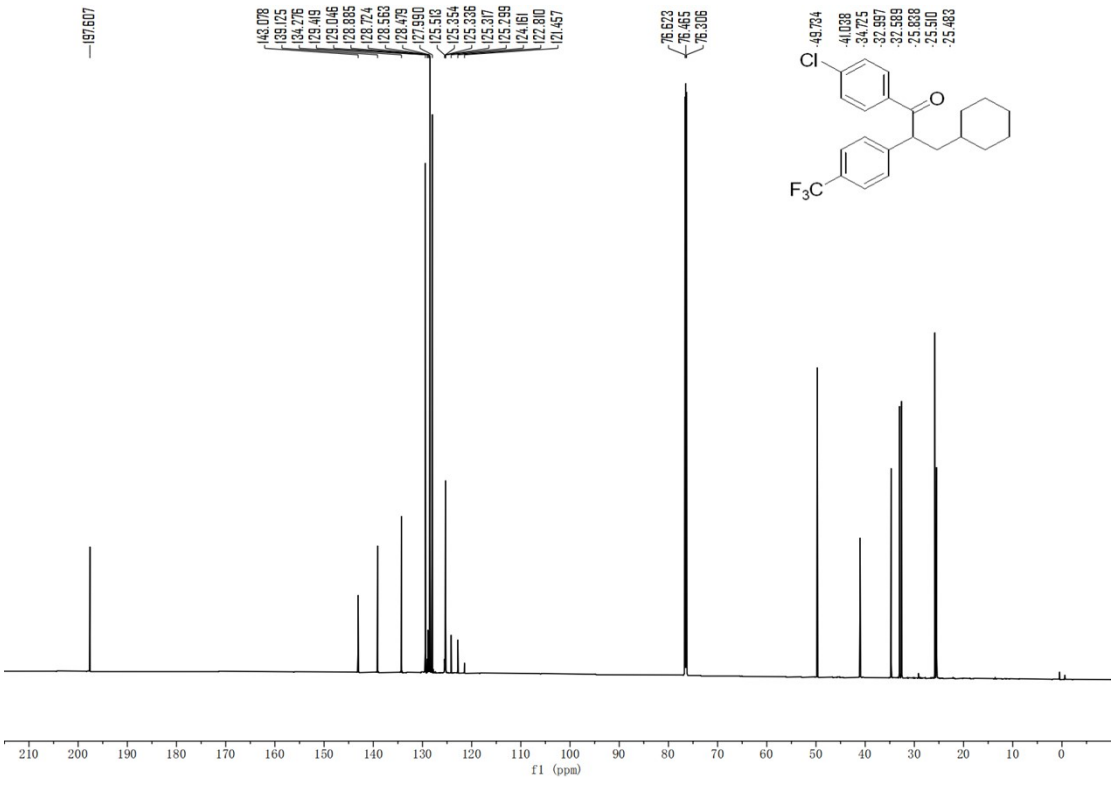
5b; ^{13}C NMR (200 Hz, $CDCl_3$)



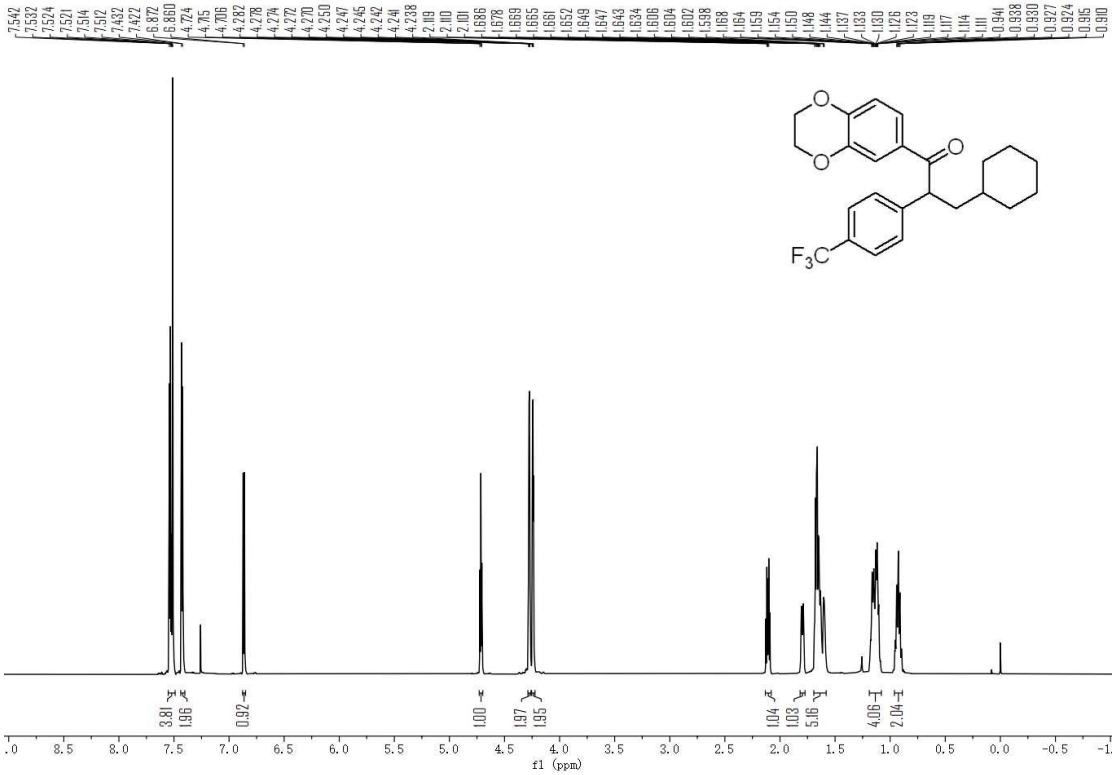
5c; ^{1}H NMR (800 Hz, $CDCl_3$)



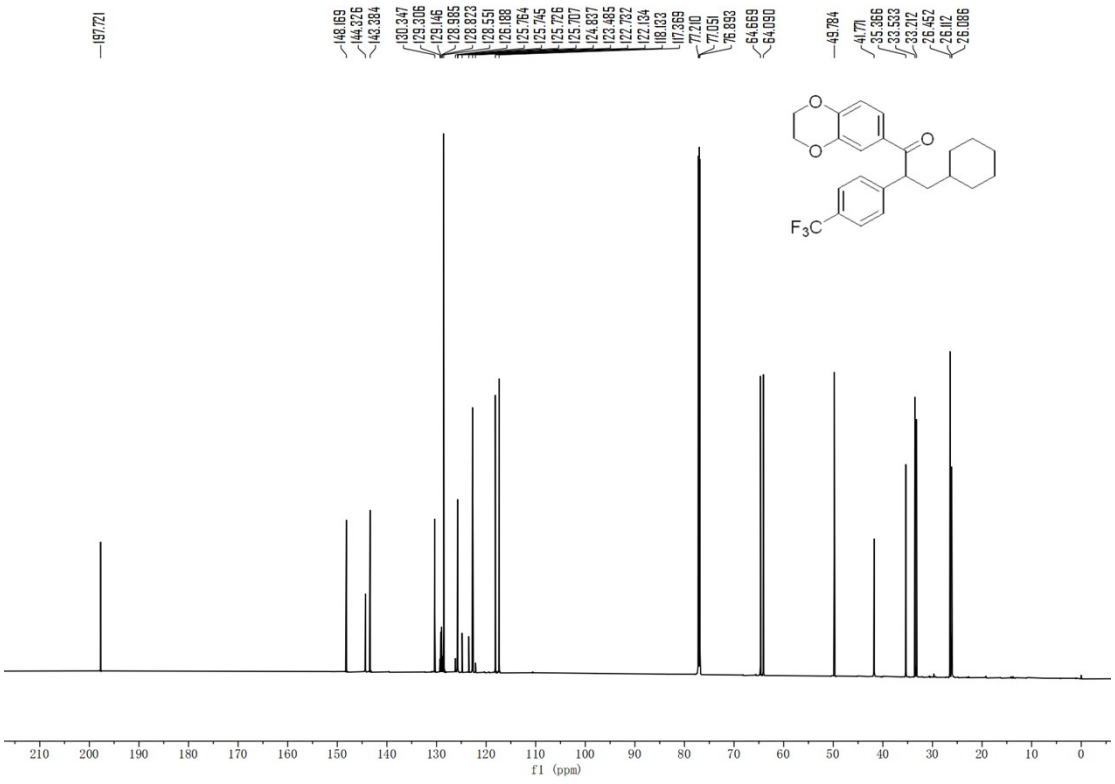
5c; ^{13}C NMR (200 Hz, $CDCl_3$)



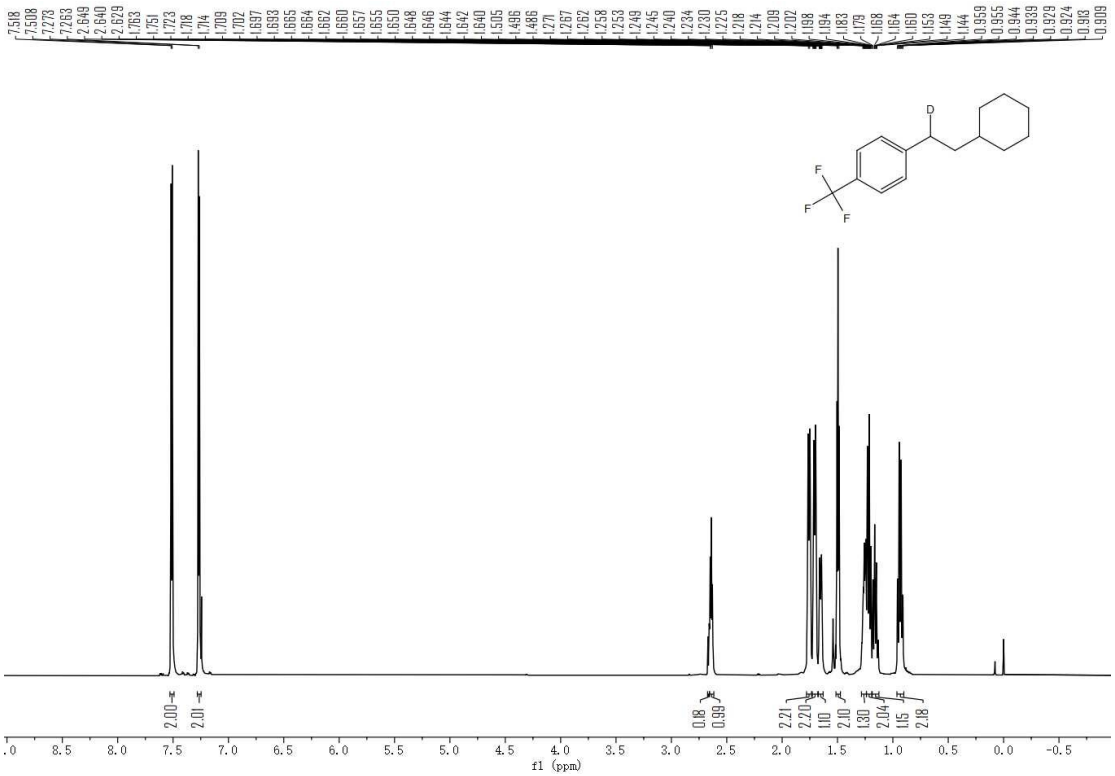
5d; ^{1}H NMR (800 Hz, $CDCl_3$)



5d; ^{13}C NMR (200 Hz, $CDCl_3$)



7; ^{1}H NMR (800 Hz, $CDCl_3$)



7; ^{13}C NMR (200 Hz, $CDCl_3$)