Supplementary Information

Photo-catalyst-free Photomediated Pinacol Coupling of Ketones/Aldehydes by Formate at Room Temperature

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1.General Experimental Information

Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification. Both alkenes are purchased from Energy Chemical.

NMR spectra were obtained on a JNM-ECZ600R/S1 spectrometer. NMR data were obtained for ^{1}H at 400 MHz and 600 MHz, and for ^{13}C at 100 MHz. The ^{1}H NMR (400 MHz, 600 MHz) chemical shifts Chemical shifts were measured relative to $CDCl_3$ or DMSO-d_6 as the internal references ($CDCl_3$: δ = 7.26, DMSO-d_6: δ = 2.50). The ^{13}C NMR (100 MHz) chemical shifts were given using $CDCl_3$ as the internal references ($CDCl_3$: δ = 77.16). ESI HRMS was recorded on a Waters SYNAPT G2 and Water XEVO G2 Q-ToF. The 365nm light were obtained on PLH-18CU. TLC was performed on glass-backed silica plates. Column chromatography was performed on silica gel (300-400 mesh), eluting with petroleum ether and ethyl acetate. The yields are based on isolated compounds after purification.

2. General procedure for the synthesis of products

A 15 mL Schlenk tube equipped with a magnetic stirring bar was charged with ketone (0.1 mmol), HCOOK (0.2 mmol), EtOH (4 mL). The mixture was then stirred at room temperature under air or nitrogen atmosphere and irradiated with a 30 W of 365 nm LEDs light for 12 h (**Figure S1**). After completion of the reaction, the reaction mixture was diluted with EtOAc and then concentrated in vacuo, and the resulting residue was purified by column chromatography on silica gel or preparative TLC (EtOAc/PE, etc.) to afford the corresponding products.

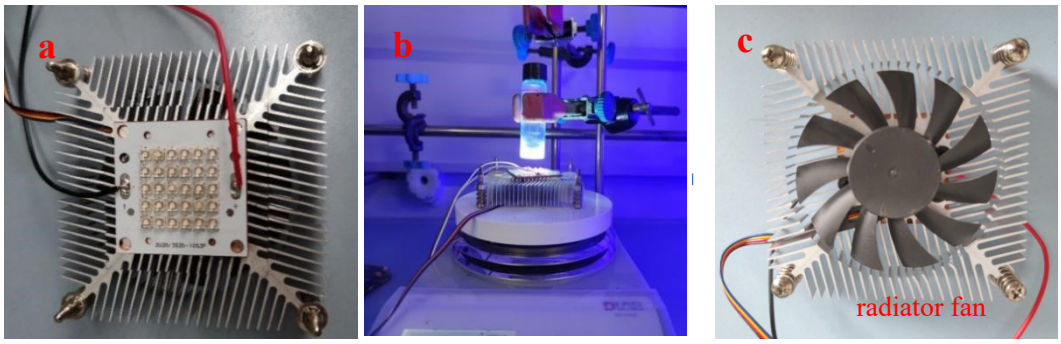


Figure S1 Reaction equipment **:** a. Assemble the lamp plate and heat sink. Use purchased 30 W UV LEDs with radiator. b. The distance between the lamp plate and the heat sink should be 0.5 to 1cm. c. The back of the radiator fan.

3. Procedure for gram scale reaction

The 250 mL quartz round bottom flask, charged with a magnetic stir bar, was vacuumed and backfilled with argon for three times. ketone (20 g), HCOOK (2 equiv), and EtOH (160 mL), were added into flask sequentially under the protection of Argon. Then the flask was sealed connected to balloon to release the gas generated during the reaction and stirred at room temperature under light (365 nm, 30 W) for 8-72 h (**Figure S2**). After completion, the reaction mixture was diluted with EtOAc and then concentrated in vacuo, and the resulting residue was purified by recrystallization from EtOAc to afford the pinacol product.

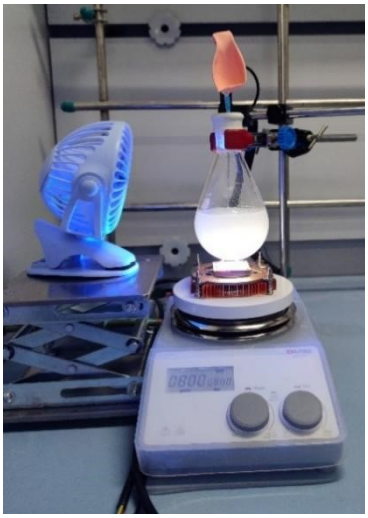


Figure S2 Gram scale reaction equipment.

4. Light source information.

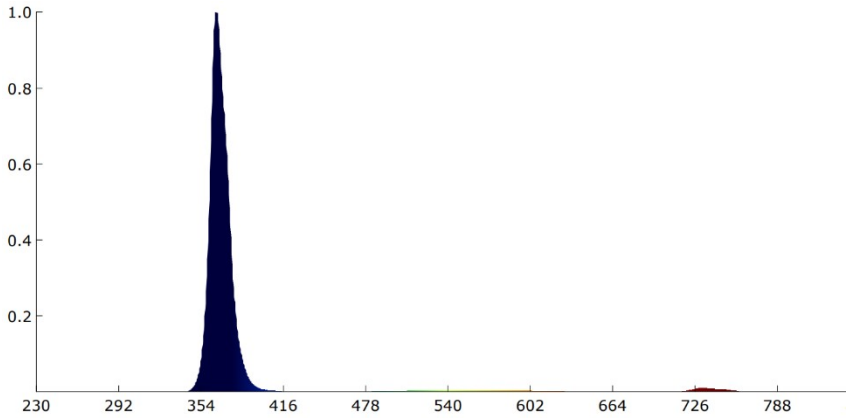
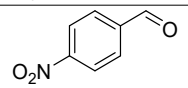
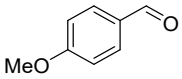
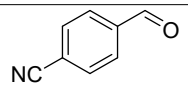
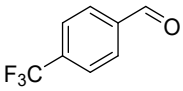
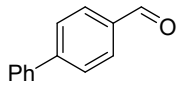
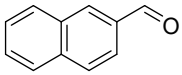
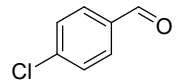
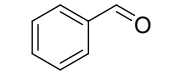
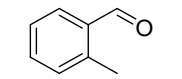
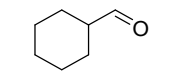
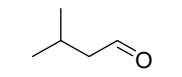
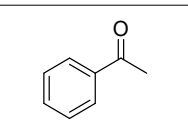
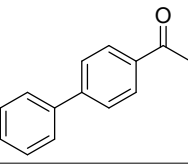
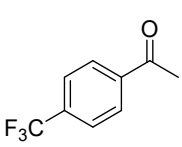
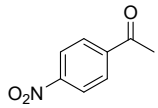
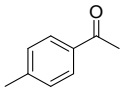
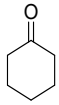


Figure S3 The UV spectrum used in this work (365 nm)

5. Reduction potential of aldehydes and ketones.

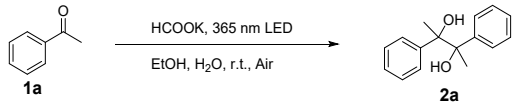
Table S1 Some reduction potential of aldehydes and ketones reported by previous works.

Aldehydes and ketones	Reduction potential	References
	-0.86 V	*Synlett* **2016**, 27, 714–723
	-2.06 V	*Synlett* **2016**, 27, 714–723
	-1.07 V	LangesChemistryHandbookVersion13 th
	-1.42 V	*Synlett* **2016**, 27, 714–723 *Chemical Society* **1986**, 108, 7727-7738.
	-1.66 V	*Synlett* **2016**, 27, 714–723
	-1.58 V	*Chemical Society* **1986**, 108, 7727-7738.
	-1.72 V	*Synlett* **2016**, 27, 714–723
	-1.73 V	*Synlett* **2016**, 27, 714–723
	-1.85 V	*Synlett* **2016**, 27, 714–723
	-1.82 V	*Chem. Sci*., 2022, 13,5973–5981
	-1.75 V	*Chemical Society* **1986**, 108, 7727-7738.
	-1.93 V	*Synlett* **2016**, 27, 714–723
	-0.94 V	LangesChemistryHandbookVersion13th
	-1.89 V	*Chem. Commun.,* 2010, 46, 2730–2732
	-2.11 V	*Chem. Commun.*, 2018, 54, 11017
	-1.94 V	*Synlett* **2016**, 27, 714–723
	-2.28 V	*Synlett* **2016**, 27, 714–723
	-2.24 V	*Synlett* **2016**, 27, 714–723
	-2.11 V	*Synlett* **2016**, 27, 714–723
	-1.85 V	*Chem. Sci*.,**2019**, 10,10937
	-2.1 V	*Nat. Commun.* **2021**, 12, 3306.
	-1.91 V	*Synlett* **2016**, 27, 714–723
	-1.74 V	*Synlett* **2016**, 27, 714–723
	-1.90 V	*Chemical Society* **1986**, 108, 7727-7738.

	-0.93 V	*Synlett* **2016**, 27, 714–723
	-2.16 V	*Synlett* **2016**, 27, 714–723
	-2.19 V	*Chemical Society* **1986**, 108, 7727-7738.
	-2.23 V	*Synlett* **2016**, 27, 714–723

6. The effect of water on the reaction.

Table S2 The effect of water on the reaction [a,b]



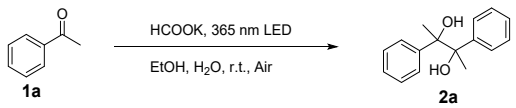
1a **2a**

Entry	H_2O	Volume	Yield (%)
1	1 eq	0.015 ul	99
2	2 eq	0.030 ul	99
3	4 eq	0.060 ul	99
4	8 eq	0.120 ul	99
5	10 eq	0.150 ul	99
6	20 eq	0.300 ul	97
7	40 eq	0.450 ul	96
8	100 eq	1.5 mL	95

General reaction conditions (unless otherwise stated)：[a] 0.1 mmol of **1a**, 0.2 mmol of HCOOK, 4 mL of EtOH, 30 W LEDs (365 nm), at air atmosphere and room temperature for 6 h.[b] Yields determined by NMR analysis.

7. The effect of the amount of HCOOK on the reaction

Table S3 The effect of the amount of HCOOK on the reaction [a,b]



1a **2a**

Entry	HCOOK	Yield (%)
1	1 eq	90
2	2 eq	99
3	4 eq	99
4	6 eq	99

General reaction conditions (unless otherwise stated)：[a] 0.1 mmol of **1a**, 0.2 mmol of HCOOK, 4 mL of EtOH, 30 W LEDs (365 nm), at air atmosphere and room temperature for 6 h. [b] Isolated Yields.

8. HR-Mass spectrum of mechanism study.

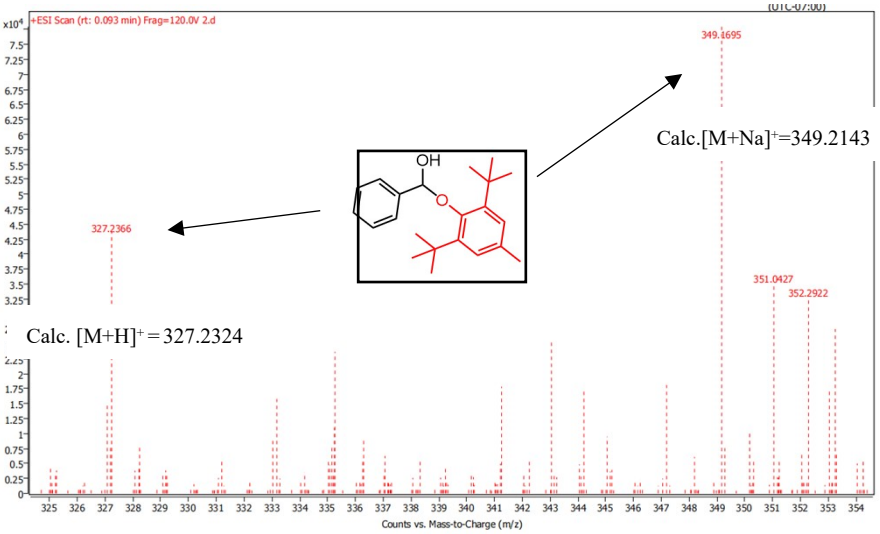
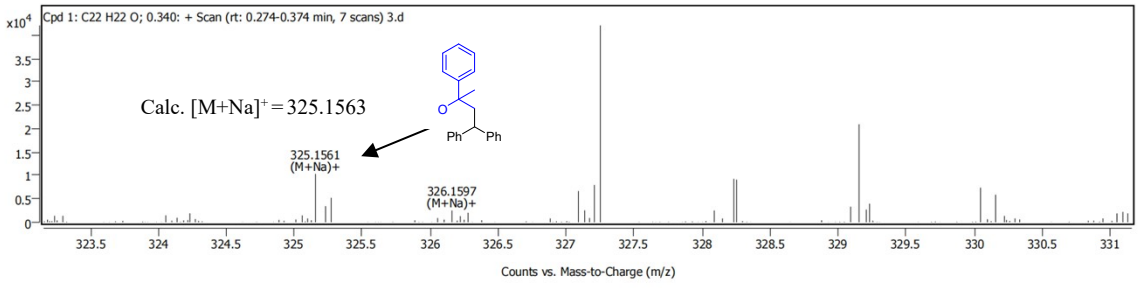


Figure S4. HR-Mass spectrum



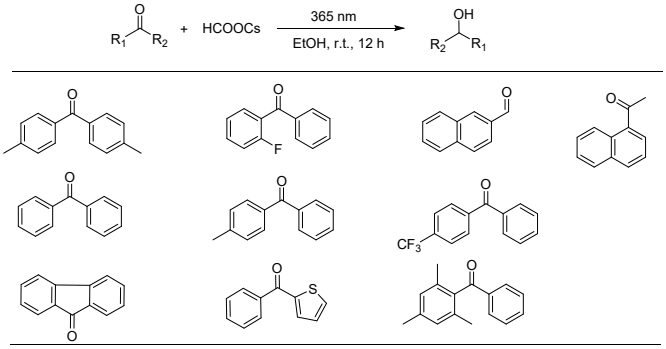
Spectrum Peaks

m/z	m/z (Calc)	Diff (ppm)	Abund	Height %	Height % (Calc)	Ion Species	Z
325.1561	325.1563	-0.50	10324	100.00	100.00	(M+Na)+	1
326.1597	326.1597	-0.03	2530	24.51	24.09	(M+Na)+	1

Figure S5. HR-Mass spectrum

9. Substrates of only reduced to alcohols.

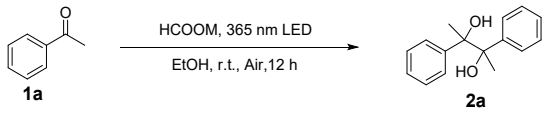
Table S4 Substrates of only reduced to alcohols



10. The study of selectivity.

General reaction conditions： 0.1 mmol of **1a**, 0.2 mmol of HCOOM, 4 mL of solvent, 30 W LEDs (365 nm), at air atmosphere for 12 h. Results were determined by NMR analysis.

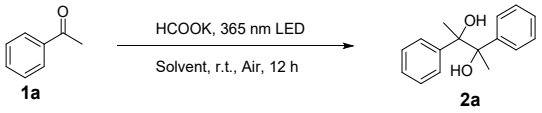
Table S5 The effect of HCOOM on the selectivity.



1a 2a

Entry	HCOOM	*meso:dl*	Yield (%)
1	$HCOONH_4$	1:1.22	60
2	HCOONa	1:1.16	97
3	HCOOH	1:1.24	90
4	$(HCOO)_2Ca$	1:1.13	95
5	HCOOK	1:1.18	99

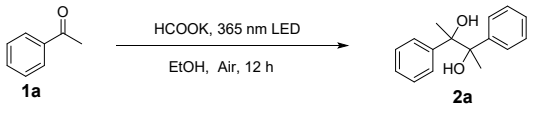
Table S6 The effect of solvent on the selectivity.



1a 2a

Entry	Sovent	*meso:dl*	Yield (%)
1	DMSO	1:1.45	99
2	MeOH	1:1.16	99
3	EtOH	1:1.18	99
4	iPrOH	1:1.12	99
5	EtOH/DMSO (1:1)	1:1.38	99
6	EtOH/H_2O (2:1)	1:1.30	90
7	EtOH/DCM (1:1)	1:1.07	88
8	EtOH/HFIP (1:1)	1:1.02	93
9	EtOH/DMF (1:1)	1:1.37	90

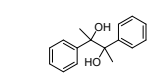
Table S7 The effect of temperature on the selectivity.



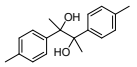
1a 2a

Entry	T(°C)	*meso:dl*	Yield (%)
1	-78	-	No reaction
2	-40	1:1.11	56
3	0	1:1.17	94
4	20	1:1.18	99
5	40	1:1.14	99
6	60	1:1.09	99

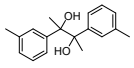
11. The selectivity of products.



2a, 99%
meso:dl=1:1.18



2b, 99%
meso:dl=1:1.89



2c, 99%
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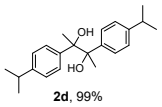
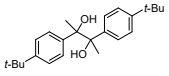


2d, 99%
meso:dl=1:1.55



2e, 99%
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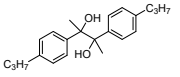
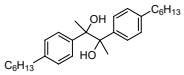


2f, 99%
meso:dl=1:1.51



2g, 99%
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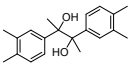

2h, 99%
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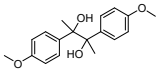
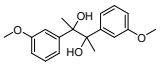


2i, 99%
meso:dl=1:1.53



2j, 99%
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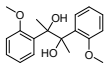
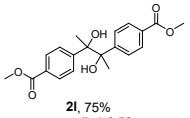
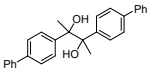


2k, 95%
dl



2l, 75%
meso:dl=1:6.58



2m, 99%
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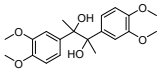

2n, 85%
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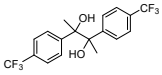

2o, 99%
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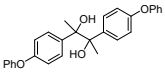
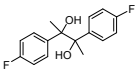
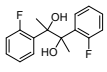


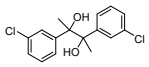
2p, 99%
meso:dl=1:1.4



2q, 75%
meso:dl=1:1.74



2r, 65%
meso:dl=1:1.33



2s, 78%
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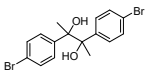
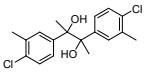
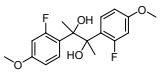


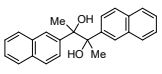
2t, 75%
meso:dl=1:1.15



2u, 65%
meso:dl=1:1.53



2v, 99%
meso:dl=1:1.23



2w, 70%
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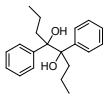
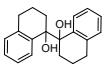
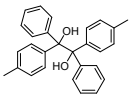


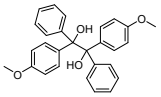
2x, 99%
meso:dl=1:1.5



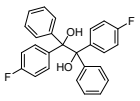
2y, 65%
dl



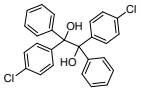
2a', 85%
meso:dl=1.11:1



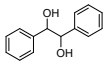
2b', 99%
meso:dl=1:1.01



2c', 99%
meso:dl=1.07:1



2e', 71%
meso:dl=1.12:1



4a, 99%
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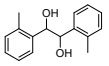
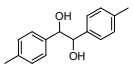


4b, 99%
meso:dl=1:2.14



4c, 99%
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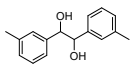
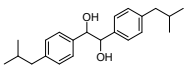
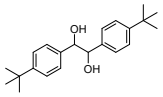


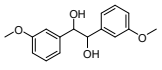
4d, 99%
meso:dl=1:1.15



4e, 99%
meso:dl=1:1.24



4f, 99%
meso:dl=1:1.24



4g, 99%
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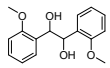
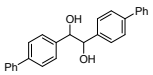
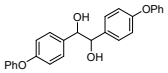


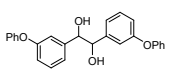
4h, 99%
meso:dl=1:1.32



4i, 99%
meso:dl=1:11



4j, 99%
meso:dl=1:1.32



4k, 99%
meso:dl=1:1.21

4l, 85%
meso:dl=1.28:1

4m, 99%
meso:dl=1:1.22

4n, 80%
meso:dl=1.16:1

4o, 99%
meso:dl=1:1

4p, 99%
meso:dl=1:2.06

4q, 99%
meso:dl=1.07:1

4r, 99%
meso:dl=1:1

4s, 99%
meso:dl=1:1.63

4t, 99%
meso:dl=1:2.34

4u, 99%
meso:dl=1:1.04

4v, 86%
meso:dl=1:4.72

4w, 84%
meso:dl=1:1.62

5a, 85%
meso:dl=1:1.17

5b, 82%
meso:dl=1.14:1

5c, 87%
meso:dl=1:1.67

5d, 80%
meso:dl=1:1.56

5e, 73%
meso:dl=1:1.34

5f, 81%
meso:dl=1:1.28

6a 45%
meso:dl=1:1.24

6b 52%
meso:dl=1:1.36

6c 61%
meso:dl=1:1.42

12. GC analyzes the gas of the reaction.

The template reaction stirred for 8 hours, then extract gas (1 mL) from reaction vial for GC analysis. Agilent 7890A (Thermo, USA), detector: TCD, temperature 150℃, column: HP-PLOT/Q 30 m X 0.32 mm X 20 um, inject temperature 150℃, Oven Column 70℃, He, 8min/L.

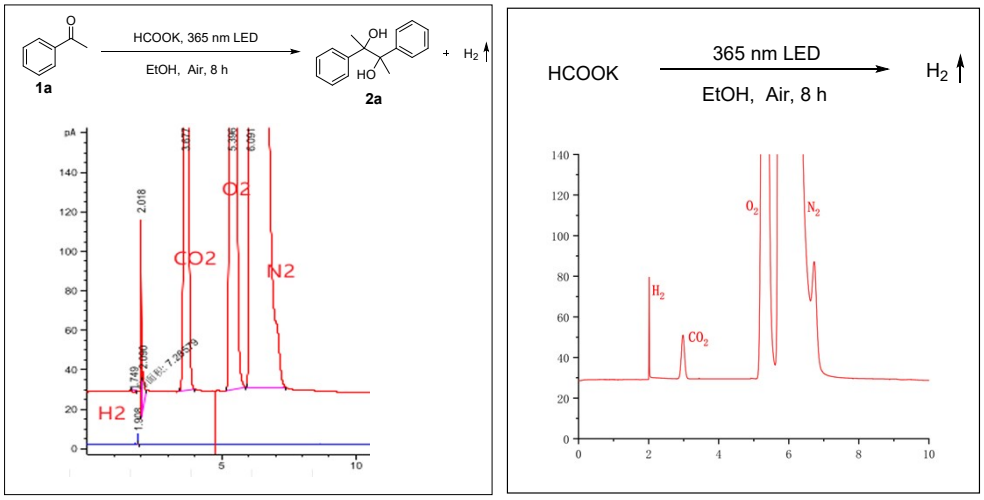
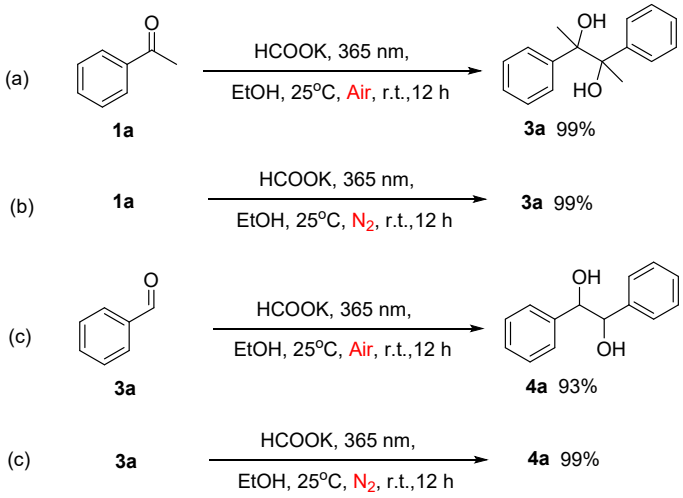


Figure S6. GC analyzes the gas of the reaction.

13. The effect of oxygen on the reaction

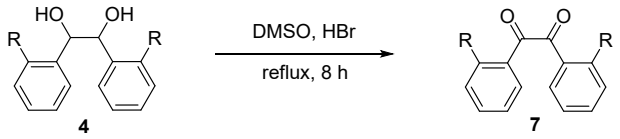
The reaction doesn't require oxygen. Oxygen is not a necessary condition for the reaction, and the reaction can proceed without the involvement of oxygen. Oxygen is not required for the production of carbon dioxide radical anion.



Scheme S1 The effect of oxygen on the reaction

14. Procedure for synthetic application.

Synthsis of 7a and 7h: The synthesis of **7a** and **7h** followed the procedure of previous work：Euro. J. Org. Chem. 2004, 3040



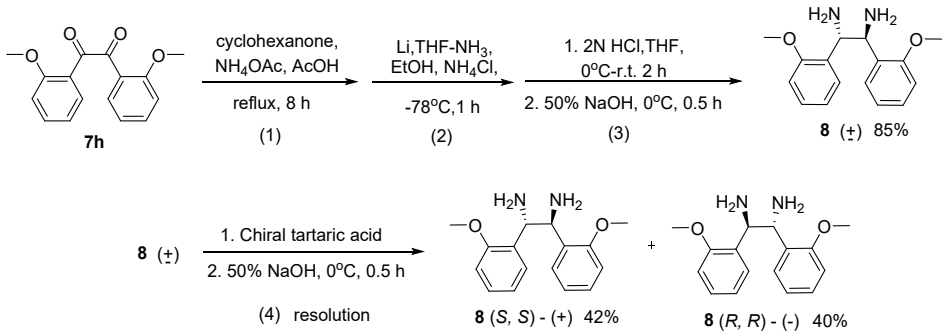
20 g of **4** was added to a 500-mL round-bottomed flask, and 250 mL of DMSO and 40 mL of HBr (40%) added. The mixture was headed to 120 °C. After the mixture was stirred for 3 h, the mixture was poured into 1 L of vigorously stirred water. The mixture was left overnight to cool to room temperature, the solid collected by filtration, washed 4 times with water, and dried under reduced pressure to afford **7** as a brown solid. This product was further purified by recrystallization from hexane/EtOAc. dried under reduced pressure to afford **7** as the white solid.

Benzil 7a, 18.8 g 92%, white solid, mp 105–106°C. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.00 (dt, J = 7.4, 1.3 Hz, 4H), 7.72 – 7.64 (m, 2H), 7.54 (td, J = 7.7, 1.7 Hz, 4H); ^{13}C NMR (100 MHz, DMSO):δ 194.70, 135.02, 133.15, 130.04, 129.16.

1,2-bis(2-methoxyphenyl)ethane-1,2-dione 7h, 19.3 g 95%, white solid, 131–132°C. ^{1}H NMR (400 MHz, DMSO-d_6): δ 8.10 (dd, J = 7.8, 1.8 Hz, 2H), 7.59 (ddd, J = 8.3, 7.3, 1.8 Hz, 2H), 7.14 (td, J = 7.5, 1.0 Hz, 2H), 6.97 (dd, J = 8.4, 1.0 Hz, 2H), 3.61 (s, 6H);^{13}C NMR (100 MHz, DMSO): δ 192.57, 160.48, 135.65, 130.55, 123.56, 121.46, 112.60, 55.98.

Synthsis of (±)-1,2-bis(2-methoxyphenyl)ethane-1,2-diamine:

The synthesis of **8** followed the procedure of previous works：*Org. Synth* **1993,** *71*, 22; *J. Am. Chem. Soc.* **2006,** *128*, 14212-14213.



(1) A 500 mL, three-necked, round-bottomed flask equipped with a mechanical stirrer and a reflux condenser is charged with 200 mL of glacial acetic acid, 20 g (74 mmol) of 7 h , 40 g of ammonium acetate and 80 mL (0.77 mol) of cyclohexanone . The mixture is stirred and heated at reflux temperature for 3 h and then, while hot, poured into 1 L of vigorously stirred water. The mixture is left overnight to cool to ambient temperature, the crystals are collected by filtration, washed 4 times with 150 mL of water, crushed in a mortar and dried under reduced pressure to

give a pale yellow solid. The solid was used directly in the next step without further purification.

(2) A 500 mL, four-necked, round-bottomed flask equipped with a mechanical stirrer, thermometer and dry ice condenser is charged with the solid product of last step 25 g (0.250 mol). The flask is flushed with argon, and 100 mL of tetrahydrofuran is added. The mixture is stirred until all solids dissolve, cooled to −78°C (dry ice/acetone bath) and treated with a stream of gaseous ammonia until the volume of liquid increases by about 300 mL. One of the side necks is then equipped with a solids addition funnel and 2.4 g (1.00 mol) of lithium is slowly introduced by cutting the wire with scissors in a gentle stream of argon. The rate of lithium addition is such that the temperature does not rise above −65°C. Following the addition of lithium, the mixture is stirred for 30 min and 10 mL of ethanol is slowly added. The mixture is stirred for an additional 20 min and 25 g of ammonium chloride is added. The cooling bath is removed, the mixture is allowed to warm to 0°C, 100 mL of water is carefully introduced, and the phases are separated. The aqueous phase is washed 3 times with 200 mL of ether and the combined organic extracts are washed with brine, dried over anhydrous sodium sulfate, filtered and concentrated with a rotary evaporator to about 100 mL.

(3) The solution is transferred to a 500 mL, one-necked, round-bottomed flask equipped with a mechanical stirrer, cooled to 0°C and treated with 100 mL of 2 N aqueous hydrochloric acid. The biphasic mixture is vigorously stirred at ambient temperature for 1 h, 150 mL of water is added and phases are separated. The organic phase is washed with 100 mL of water and the combined aqueous phases are extracted with 150 mL of dichloromethane. The aqueous solution is then carefully treated with 100 mL of 2 N aqueous sodium hydroxide and the mixture is extracted 3 times with 150 mL of methylene chloride. The combined organic extracts are washed with brine, dried over anhydrous sodium sulfate, and filtered. Removal of volatile material under reduced pressure (water aspirator) gives 17 g (yield of three steps 85%) of racemic diamine as a pale yellow solid. M.p: 85-87 °C; **^{1}H NMR (300 MHz, $CDCl_3$):** δ 7.22 (dd, *J* = 7.5, 1.8 Hz, 2H), 7.10 (td, *J* = 7.8, 1.8 Hz, 2H), 6.81 (td, *J* = 7.5, 1.2 Hz, 2H), 6.74 (dd, *J* = 8.2, 1.2 Hz, 2H), 4.45 (s, 2H), 3.76 (s, 6H); **^{13}C NMR (100 MHz, $CDCl_3$):** 156.85, 132.17, 128.00, 127.54, 120.22, 110.30, 55.39, 55.17.

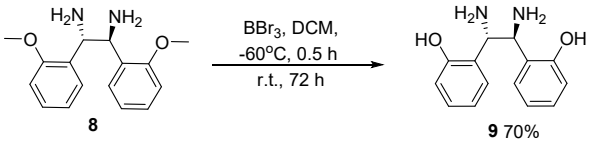
(4) **(1S,2S)-1,2-bis(2-methoxyphenyl)ethane-1,2-diamine:**

A 500 mL round-bottomed flask was charged with 24.3 g (0.09 mol) of (d,l)-8 and 150 mL ethanol. The mixture was heated to 70 °C, and a homogeneous solution of L-(+)-tartaric acid (13.4 g, 0.09 mol) in 150 mL ethanol was added. The tartrate salts precipitate immediately, and the mixture was cooled to ambient temperature. The solid were collected by filtration, washing twice with ethanol, and dried under reduced pressure. The tartrate salts were recrystallized twice using ethanol/water to give 16.9 g of colorless crystals. The salt was transferred to a 500 mL, round-bottomed flask and suspended in 150 mL water. After the mixture was cooled to 0-5 °C, under vigorously stirring, 15 mL of 50% aqueous NaOH was added dropwise followed by 150 mL dichloromethane, and stirring is continued for 1 h. The aqueous phase was extracted with CH_2Cl_2 (100 mL × 3). The combined organic phase was washed with brine and dried over $MgSO_4$. Removal of the volatile material under reduced pressure gave (S,S)-**8** as a yellowish solid (10.2 g, yield: 42%), $[\alpha]_D^{20}$ = -54.9 °(c = 0.5, $CHCl_3$).

(1R,2R)-1,2-bis(2-methoxyphenyl)ethane-1,2-diamine:

The filtrates from all crystallizations are combined and the solvent is evaporated under vacuum. The residual is transferred to a 500 mL, round-bottomed flask, and suspended in 150 mL of water, After the mixture was cooled to 0-5 °C, under vigorously stirring, 15 mL of 50% aqueous NaOH was added dropwise followed by 150 mL dichloromethane, and stirring is continued for 1 h. The aqueous phase was extracted with CH_2Cl_2 (50 mL × 3). The combined organic phase was washed with brine and dried over $MgSO_4$. Removal of the volatile material under reduced pressure gave enriched (R,R)-8 as yellowish solid. This material was treated in the same manner as described for the opposite enantiomer to give 9.7 g of white solid, yield: 40 %, $[\alpha]_D^{20}$ = +54.1° (c = 0.5, $CHCl_3$).

Synthesis of 2,2'-((1S,2S)-1,2-diaminoethane-1,2-diyl)diphenol 9



8 **9** 70%

A solution of **8** (5 g 13.4 mmol) in dry CH_2Cl_2 (50 mL) was cooled to -78°C and then BBr_3(5.2 mL, 52 mmol) was added. After the mixture was stirred for 30 min at -78°C, the cooling bath was removed and the stirring was continued for additional 24 h. The reaction was quenched by addition of water (10 mL), and CH_2Cl_2 was removed under the reduced pressure. The aqueous solution was neutralized by addition of aqueous $NaHCO_3$, and then extracted with EtOAc (50 mL × 3). The organic layer was washed with brine, and dried over Na_2SO_4. After removal of the solvent, the residue was purified by column chromatography to give 3.1 g of **9** as a light yellow solid: **70%, ^{1}H NMR (400 MHz, DMSO-d_6):** δ 6.98 (td, *J* = 7.6, 1.8 Hz, 2H), 6.81 (dd, *J* = 7.6, 1.7 Hz, 2H), 6.68 (dd, *J* = 8.0, 1.3 Hz, 2H), 6.55 (td, *J* = 7.4, 1.3 Hz, 2H), 6.02 (s, 4H), 4.12 (s, 2H), 3.42 (s, 2H); **^{13}C NMR (100 MHz, DMSO):** δ ^{13}C NMR (101 MHz, DMSO) δ 156.44, 128.95, 128.93, 127.69, 117.88, 116.33, 58.46.

15. Determination of the reaction quantum yield

Determination of the light intensity at 365 nm: According to the procedure work (*Chem. Sci*. **2015**, *6*, 5426-5434). *J. Am. Chem. Soc.* **2021,** *143*, 8987-8992. Hatchard, C. G.; Parker, C. A. Proc. Roy. Soc. (London) 1956, A235, 518–536. Pure Appl. Chem. 2004, 76, 2105–2146. Chemical Actinometry. Handbook of Photochemistry, 3rd Ed; Taylor & Francis Group, LLC. Boca Raton, FL, 2006, 601–616)

The photon flux of the LED was determined by standard ferrioxalate actinometry. A 0.15 M solution of ferrioxalate was prepared by dissolving potassium ferrioxalate hydrate (88 mg) in 30 mL of a 0.05 M H_2SO_4 solution. And A buffered solution of 1,10- phenanthroline was prepared by dissolving 1,10-phenanthroline (2 mg) and sodium acetate (11.25 g) in 50 mL of a 0.5 M solution H_2SO_4. Both solutions were stored in the dark. To determine the photon flux of the LEDs, the ferrioxalate solution (2.0 mL) was placed in a cuvette and irradiated for 30 s at λ_{max} = 365 nm. After

irradiation, the phenanthroline solution (0.35 mL) was added to the cuvette and the mixture and stired in the dark for 1 h to allow the ferrous ions to completely coordinate to the phenanthroline. The absorbance of the solution was measured at 510 nm. A nonirradiated sample was also prepared and the absorbance at 510 nm was measured. Conversion was calculated using eq 1.

$$mol\ Fe^{2+} = \frac{V \cdot \Delta A}{l \cdot \varepsilon} \quad (1)$$

where V is the total volume (0.00235 L) of the solution after addition of phenanthroline,
ΔA is the difference in absorbance at 510 nm between the irradiated and non-irradiated solutions,
l is the path length (1.00 cm),
and ε is the molar absorptivity of the ferrioxalate actinometer at 510 nm (11,100 L mol^{-1} cm^{-1}).
The photon flux can be calculated using eq 2.

$$photo\ flux = \frac{mol\ Fe^{2+}}{\Phi \cdot t \cdot f} = \quad (2)$$

where Φ is the quantum yield for the ferrioxalate actinometer (1.21 for a 0.006 M solution at λ = 365 nm), f (0.999) is the fraction of light absorbed at λ = 365 nm by the ferrioxalate actinometer. (Hatchard, C. G.; Parker, C. A. Proc. Roy. Soc. (London) 1956, A235, 518–536.)
t is the irradiation time (30 s).
The photon flux was calculated (average of three experiments) to be 6.94×10^{-8}einsteins s^{-1}

Determination of the reaction quantum yield:

The reaction was carried out in a reaction tube under standard conditions: acetophenone **1a** (0.1 mmol), potassium formate **2a** (0.2 mmol, 2 eq) and 2 mL EtOH were added to a reactor containing a magnetic stirrer. The mixture was stirred under nitrogen atmosphere while irradiated by 365 LEDs for 30 min. The crude yield of the product **3a** was determined by ^{1}H NMR based on a 1,3,5-trimethoxybenzene standard and the final yield was 50% (average of three experiments).

The reaction quantum yield (Φ) was determined using eq 4. Where the photon flux is 6.94×10^{-8} einsteins s^{-1} (determined by actinometry as described above), **t** is the reaction time (1800 s) and **f** is the fraction of incident light absorbed by the reaction mixture, determined using eq 3. An absorption spectrum of the reaction mixture gave an absorbance value of 0.857 at 365 nm (A = 0.857 indicating that the fraction of light absorbed is f = 0.861).

$$f = 1 - 10^{-A(365\ nm)} \quad (3)$$

$$\Phi = \frac{Mol\ product}{flux \cdot t \cdot f} \quad (4)$$

The reaction quantum yield (Φ) was thus determined to be Φ = 0.469

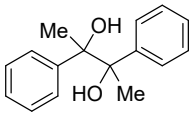
$$\Phi = \frac{Mol\ product}{flux \cdot t \cdot f} = (0.1\times10^{-3}\text{mol}\times0.5)/(6.94\times10^{-8}\text{einsteins } s^{-1}\times1800\text{s}\times0.861)=0.469$$

16. Compound Characterizations

The products **2a**[1], **2b**[2], **2c**[3], **2i**[4], **2j**[3], **2l**[5], **2m**[6], **2o**[7], **2p**[8], **2q**[8], **2r**[9], **2s**[3], **2t**[6], **2v**[8], **2w**[1], **2x**[9], **2y**[8], **2z**[8], **3a'**[10],

3b'[8],3c'[10], 4a[1], 4b[11], 4c[8], 4d[10], 4f[1], 4q[3], 4p[11], 4g[12], 4i[3], 4t[13], 4l[3], 4m[14], 4n[14], 4o[9], 4w[3], 5f[8], 5d[15], 5i[8], 6b[8], 6c[8] are consistent with published ones.

2,3-Diphenylbutane-2,3-diol (2a)



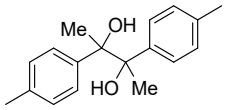
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.18

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.26 – 7.09 (m, 10H), 2.72 (s, 1H), 2.41 (s, 1H), 1.55 (s, 2H), 1.46 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.87, 143.50, 127.44, 127.28, 127.25, 127.16, 127.09, 127.07, 127.00, 126.91, 78.91, 78.66, 25.11, 24.94.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_2$ $[M+Na]^+$: 265.125, Found: 265.1195.

2,3-Di-*p*-tolylbutane-2,3-diol (3b)



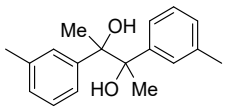
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.89

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.16 – 6.90 (m, 8H), 2.71 (s, 1H), 2.30 (s, 4H), 2.29 (s, 3H), 1.49 (s, 2H), 1.41 (d, J = 3.3 Hz, 4H)

^{13}C NMR (100 MHz, $CDCl_3$): δ 141.06, 140.71, 136.65, 136.50, 128.12, 127.96, 127.42, 126.99, 78.90, 78.65, 25.33, 25.15, 21.10, 21.06.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_2$ [$[M+Na]^+$: 293.1518, Found: 293.1513.

2,3-Di-*m*-tolylbutane-2,3-diol (2c)



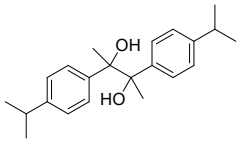
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.54.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.15 – 7.09 (m, 2H), 7.09 – 7.01 (m, 3H), 7.01 – 6.96 (m, 3H), 2.57 (s, 1H), 2.45 – 2.31 (m, 1H), 2.29 (s, 4H), 2.27 (s, 3H), 1.54 (s, 3H), 1.45 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.83, 143.51, 143.47, 136.80, 136.78, 136.76, 136.59, 136.58, 136.56, 128.39, 128.36, 128.34, 127.99, 127.95, 127.82, 127.69, 127.25, 127.09, 124.66, 124.62, 124.60, 124.17, 124.14, 79.00, 78.97, 78.77, 78.73, 25.20, 25.10, 21.70, 21.68.

HRMS (ESI, m/z): Calcd for $C_{18}H_{22}O_2$ [$[M+Na]^+$: 293.1518, Found: 293.1512.

2,3-Bis(4-isopropylphenyl)butane-2,3-diol (2d):



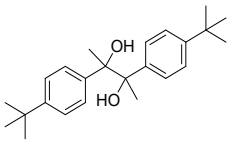
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* =1:1.55.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24 – 6.90 (m, 8H), 2.81 (dq, *J* = 13.4, 6.8 Hz, 2H), 2.50 (s, 1H), 2.11 (s, 1H), 1.44 (s, 2H), 1.38 (s, 4H), 1.16 (dd, *J* = 7.1, 5.3 Hz, 12H);

^{13}C NMR (100 MHz, $CDCl_3$): δ 147.63, 147.53, 141.44, 141.10, 127.40, 126.99, 125.42, 125.31, 78.88, 78.60, 33.75, 33.73, 25.28, 25.21, 24.16, 24.13, 24.08.

HRMS (ESI, m/z) : Calcd for $C_{22}H_{30}O_2$ $[M+Na]^+$: 349.2144, Found: 349.2134.

2,3-Bis(4-(tert-butyl)phenyl)butane-2,3-diol (2e)



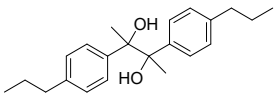
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.64.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.12 (m, 8H), 2.62 (s, 1H), 2.19 (s, 1H), 1.51 (s, 2H), 1.46 (s, 4H), 1.31 (d, *J* = 6.1 Hz, 18H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 149.90, 149.79, 141.07, 140.74, 127.11, 126.70, 124.28, 124.20, 78.79, 78.51, 34.50, 34.46, 31.52, 31.49, 25.24.

HRMS (ESI, m/z): Calcd for $C_{24}H_{34}O_2$ $[M+Na]^+$:377.2457, Found: 377.2455.

2,3-Bis(4-propylphenyl)butane-2,3-diol (2f)



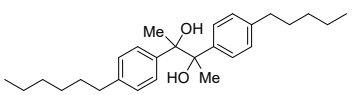
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.51.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.17 – 7.08 (m, 4H), 7.07 – 6.98 (m, 4H), 2.56 (q, *J* = 7.1 Hz, 4H), 1.63 (qd, *J* = 7.6, 6.2 Hz, 4H), 1.55 (s, 2H), 1.47 (s, 4H), 0.93 (td, *J* = 7.4, 5.7 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 141.49, 141.33, 141.25, 140.95, 128.80, 128.61, 128.50, 128.32, 127.50, 127.36, 127.34, 126.90, 78.96, 78.73, 38.16, 37.70, 37.64, 26.64, 25.21, 25.15, 24.59, 24.52, 24.34, 14.04, 13.96, 13.88.

HRMS (ESI, m/z) : Calcd for $C_{22}H_{30}O_2Na$ $[M+Na]^+$: 349.2144, Found: 349.2134.

2-(4-Hexylphenyl)-3-(4-pentylphenyl)butane-2,3-diol (2g)



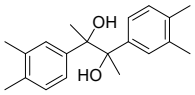
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.48.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.10 (dd, *J* = 12.7, 8.1 Hz, 4H), 7.06 – 6.96 (m, 4H), 2.57 (q, *J* = 7.2 Hz, 5H), 2.29 (d, *J* = 6.6 Hz, 1H), 1.58 (dq, *J* = 12.9, 6.1, 5.4 Hz, 5H), 1.53 (s, 2H), 1.46 (s, 3H), 1.39 – 1.24 (m, 13H), 1.08 – 0.68 (m, 7H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 141.73, 141.69, 141.57, 141.54, 141.23, 140.94, 128.63, 127.42,

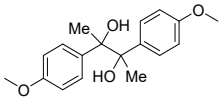
127.36, 127.28, 126.96, 126.92, 78.96, 78.73, 35.64, 35.59, 31.91, 31.89, 31.53, 31.50, 31.47, 29.15, 29.08, 25.19, 25.13, 25.11, 22.79, 14.25.
HRMS (ESI, m/z) : Calcd for $C_{27}H_{40}O_2Na$ $[M+Na]^+$: 419.2926, Found:419.2916.

2,3-Bis(3,4-dimethylphenyl)butane-2,3-diol (2h)



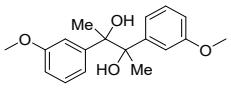
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.54.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.16 – 7.02 (m, 5H), 6.99 (dd, *J* = 7.9, 2.1 Hz, 1H), 2.67 (s, 1H), 2.29 (d, *J* = 5.0 Hz, 6H), 2.26 (d, *J* = 5.4 Hz, 6H), 1.56 (s, 2H), 1.49 (s, 4H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 141.47, 141.12, 135.37, 135.23, 135.15, 135.12, 128.81, 128.72, 128.52, 128.42, 124.99, 124.50, 78.83, 78.57, 25.37, 25.26, 20.01, 19.98, 19.43, 19.39.
HRMS (ESI, m/z) : Calcd for $C_{20}H_{26}O_2Na$ $[M+Na]^+$: 321.1831, Found: 321.1822.

2,3-Bis(4-methoxyphenyl)butane-2,3-diol (2i)



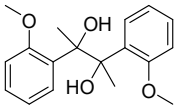
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.53.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.20 – 7.08 (m, 4H), 6.86 – 6.71 (m, 4H), 3.83 (s, 4H), 3.81 (s, 2H), 2.61 (s, 1H), 2.33 (s, 1H), 1.53 (d, *J* = 36.0 Hz, 6H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 158.66, 158.56, 136.22, 135.89, 128.68, 128.25, 112.68, 112.53, 78.83, 78.61, 77.48, 77.36, 77.16, 76.84, 55.32, 25.29, 25.13.
HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_4Na$ $[M+Na]^+$: 325.1416, Found:325.1410.

2,3-Bis(3-methoxyphenyl)butane-2,3-diol (2j)



The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.12.
^{1}H NMR (400 MHz, $CDCl_3$):δ 7.13 (t, *J* = 8.1 Hz, 2H), 6.85 (dt, *J* = 7.9, 1.3 Hz, 1H), 6.77 (d, *J* = 7.6 Hz, 5H), 3.69 (s, 4H), 3.65 (s, 3H), 2.88 (d, *J* = 1.1 Hz, 2H), 1.54 (s, 3H), 1.47 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 158.83, 158.64, 145.68, 145.29, 128.22, 128.06, 120.09, 119.51, 113.51, 113.13, 112.70, 112.58, 78.91, 78.90, 78.66, 55.19, 55.18, 25.13, 24.99.
HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_4Na$ $[M+Na]^+$: 325.1416, Found:325.1410.

2,3-Bis(2-methoxyphenyl)butane-2,3-diol (2k)



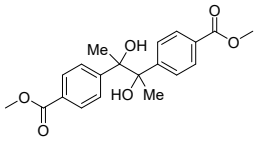
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (95% yield). *dl*

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.08 (ddd, *J* = 8.7, 7.3, 1.7 Hz, 2H), 6.98 – 6.86 (m, 2H), 6.74 (td, *J* = 7.6, 1.2 Hz, 2H), 6.65 (dd, *J* = 8.3, 1.2 Hz, 2H), 5.41 (s, 2H), 3.40 (s, 6H), 1.57 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 158.03, 132.23, 129.93, 128.39, 120.35, 111.35, 82.54,55.49, 24.63.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_4Na$ $[M+Na]^+$: 325.1416, Found:325.1413.

Dimethyl 4,4'-(2,3-dihydroxybutane-2,3-diyl)dibenzoate (2l)



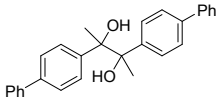
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (75% yield). *meso: dl* = 1:6.58

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.94 – 7.81 (m, 4H), 7.28 – 7.15 (m, 4H), 3.92 (s, 5H), 3.91 (s, 1H), 2.66 (s, 2H), 1.60 (s, 1H), 1.53 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 167.12, 148.50, 129.17, 128.70, 128.60, 127.57, 127.22, 78.98, 52.25, 24.89.

HRMS (ESI, m/z) : Calcd for $C_{20}H_{22}O_6Na$ $[M+Na]^+$: 381.1314, Found: 381.1311.

2,3-Di([1,1'-biphenyl]-4-yl)butane-2,3-diol (2m)



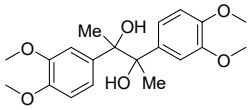
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1.05:1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 7.76 – 7.53 (m, 8H), 7.53 – 7.38 (m, 6H), 7.38 – 7.20 (m, 4H), 5.10 (s, 1H), 5.00 (s, 1H), 1.57 (s, 3H), 1.38 (s, 3H).

^{13}C NMR (100 MHz, DMSO-d_6): δ146.57, 140.14, 138.44, 128.84, 127.15, 126.51, 126.29, 125.87, 67.78, 25.82.

HRMS (ESI, m/z) : Calcd for $C_{28}H_{26}O_2$ Na $[M+Na]^+$: 417.1831, Found:417.1830.

2,3-Bis(3,4-dimethoxyphenyl)butane-2,3-diol (2n)



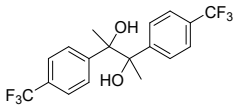
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (85% yield). *meso: dl* = 1:2.14.

^{1}H NMR (400 MHz, $CDCl_3$): δ 6.84 – 6.61 (m, 6H), 3.84 (dd, *J* = 4.6, 1.2 Hz, 6H), 3.71 (dd, *J* = 16.4, 1.3 Hz, 6H), 2.49 (s, 2H), 1.58 (d, *J* = 1.2 Hz, 2H), 1.48 (d, *J* = 1.3 Hz, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 148.00, 147.49, 136.26, 119.95, 111.38, 109.72, 78.89, 55.89, 55.78, 55.75, 24.99.

HRMS (ESI, m/z) : Calcd for $C_{20}H_{26}O_6Na$ $[M+Na]^+$: 385.1627, Found: 385.1620.

2,3-Bis(4-(trifluoromethyl)phenyl)butane-2,3-diol (2o)



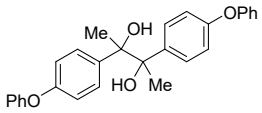
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. colorless oil (99% yield). *meso: dl* =1:1.47.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (dd, *J* = 8.6, 2.5 Hz, 4H), 7.40 (d, *J* = 8.5 Hz, 2H), 7.27 (d, *J* = 8.1 Hz, 2H), 2.77 (s, 1H), 2.40 (s, 1H), 1.55 (s, 3H), 1.50 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 147.85, 147.29, 147.27, 130.17, 129.85, 129.65, 129.53, 129.33, 129.20, 127.89, 127.61, 125.67 (d, *J*= 4 Hz), 124.33 (m, *J* = 80 Hz), 122.96 (d, *J*= 4 Hz), 122.94, 78.75, 78.43, 25.24, 24.86.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{16}F_6O_2Na$ $[M+Na]^+$: 401.0952, Found: 401.0922.

2,3-Bis(4-phenoxyphenyl)butane-2,3-diol (2p)



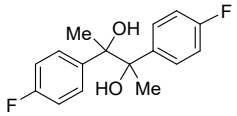
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. colorless oil (99% yield). *meso: dl* = 1:1.4.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.27 (m, 4H), 7.20 – 7.12 (m, 4H), 7.11 – 7.04 (m, 2H), 7.02 – 6.94 (m, 4H), 6.91 – 6.81 (m, 4H), 2.62 (s, 1H), 2.44 (s, 1H), 1.59 (s, 2H), 1.50 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 157.38, 157.21, 156.37, 156.15, 138.88, 138.46, 129.85, 129.82, 128.92, 128.53, 123.39, 123.27, 118.99, 118.96, 118.93, 118.79, 117.72, 117.44, 117.39, 78.81, 78.60, 25.16, 25.06.

HRMS (ESI, m/z) : Calcd for $C_{28}H_{26}O_4Na$ $[M+Na]^+$: 449.1729, Found: 449.1720.

2,3-Bis(4-fluorophenyl)butane-2,3-diol (2q)



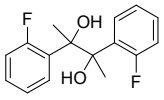
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. white solid (75% yield). *meso: dl* = 1:1.94.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.16 (dd, *J* = 8.7, 5.5 Hz, 2H), 7.11 (dd, *J* = 8.4, 5.5 Hz, 2H), 6.90 (dt, *J* = 11.9, 8.7 Hz, 4H), 2.57 (s, 2H), 1.56 (s, 2H), 1.47 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 162.11 (dd, *J*= 245 Hz), 139.62 (d, *J*= 3 Hz), 139.24 (d, *J*=3 Hz), 129.21 (d, *J*= 8 Hz), 128.82 (d, *J*= 8 Hz), 114.07 (dd, *J*= 28 Hz), 78.73, 78.47, 25.29, 25.02.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{16}F_2O_2Na$ [M+Na]+: 301.1016, Found: 301.1011.

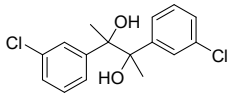
2,3-Bis(2-fluorophenyl)butane-2,3-diol (2r)



The title compound was synthesized according to the general procedure. The product was purified

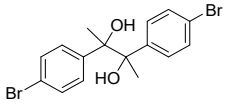
by flash column chromatography. White solid (65% yield). *meso: dl* = 1:1.33.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.45 (td, *J* = 8.1, 1.9 Hz, 1H), 7.30 – 7.05 (m, 4H), 7.00 – 6.91 (m, 2H), 6.86 (ddd, *J* = 13.1, 8.1, 1.3 Hz, 1H), 3.27 – 3.11 (m, 1H), 3.08 (s, 1H), 1.76 (d, *J* = 2.2 Hz, 3H), 1.64 (t, *J* = 2.2 Hz, 4H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 160.72 (dd, *J*= 251 Hz), 130.36, 130.32, 130.21, 130.11, 130.07, 129.45 (dd, *J*= 9 Hz), 123.74 (d, *J*= 3 Hz), 123.37 (d, *J*= 3 Hz), 116.46, 116.21, 115.96, 79.86 (d, *J*= 4 Hz), 79.74 (d, *J*= 4 Hz) 24.60, 24.58, 24.54, 24.52, 24.17, 24.15, 24.10, 24.08.
HRMS (ESI, m/z) **:** Calcd for $C_{16}H_{16}F_2O_2Na$ $[M+Na]^+$: 301.1016, Found: 301.1011.

2,3-Bis(3-chlorophenyl)butane-2,3-diol (2s)



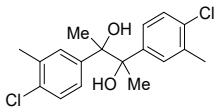
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. colorless oil (78% yield). *meso: dl* = 1:1.26.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (t, *J* = 1.8 Hz, 1H), 7.26 (dddt, *J* = 7.6, 5.9, 3.8, 1.6 Hz, 3H), 7.23 – 7.10 (m, 3H), 7.01 (dt, *J* = 7.9, 1.5 Hz, 1H), 2.34 (s, 2H), 1.56 (s, 3H), 1.50 (s, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 145.99, 145.43, 133.64, 133.55, 128.65, 128.52, 127.81, 127.56, 127.51, 127.31, 125.68, 125.33, 78.66, 78.34, 25.23, 24.89.
HRMS (ESI, m/z) : Calcd for $C_{16}H_{16}Cl_2O_2Na$ $[M+Na]^+$: 333.0425, Found: 333.0422.

2,3-bis(4-bromophenyl)butane-2,3-diol (2t)



The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. colorless oil (75% yield). *meso: dl* = 1:1.15.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.28 (dt, *J* = 9.1, 2.3 Hz, 5H), 7.17 (ddd, *J* = 6.0, 4.3, 2.1 Hz, 5H), 7.14 – 7.08 (m, 2H), 7.04 (d, *J* = 8.4 Hz, 2H), 6.97 – 6.92 (m, 2H), 2.21 (s, 4H), 1.59 – 1.20 (m, 12H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 143.92, 143.56, 142.91, 142.44, 130.51, 130.43, 130.35, 130.29, 129.40, 129.34, 129.01, 127.57, 127.50, 127.45, 127.41, 127.39, 127.29, 127.24, 127.20, 127.06, 127.04, 121.59, 121.39, 79.01, 78.75, 78.63, 78.36, 25.25, 25.20, 25.09, 24.85.
HRMS (ESI, m/z) : Calcd for $C_{16}H_{16}Br_2O_2Na$ $[M+Na]^+$: 422.9395, Found: 422.9350.

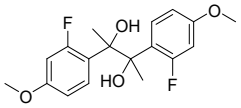
2,3-Bis(4-chloro-3-methylphenyl)butane-2,3-diol (2u)



The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (65% yield). *meso: dl* =1:1.53.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.27 – 7.11 (m, 2H), 7.11 – 6.96 (m, 3H), 6.92 (dd, *J* = 8.4, 2.4 Hz, 1H), 2.59 (s, 1H), 2.32 (s, 3H), 2.30 (d, *J* = 6.2 Hz, 3H), 1.56 – 1.50 (m, 2H), 1.48 – 1.42 (m, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 142.39, 141.92, 134.80, 134.68, 133.39, 133.23, 130.21, 129.87,

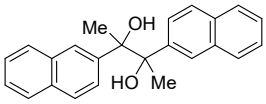
127.96, 127.82, 126.43, 126.01, 25.26, 25.00, 20.28, 20.25.
HRMS (ESI, m/z) : Calcd for $C_{18}H_{20}Cl_2O_2Na$ $[M+Na]^+$: 361.0738, Found: 361.0730.

2,3-Bis(2-fluoro-4-methoxyphenyl)butane-2,3-diol (2v)



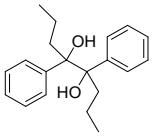
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.23.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (t, *J* = 9.2 Hz, 1H), 6.93 (t, *J* = 9.2 Hz, 1H), 6.57 (dd, *J* = 8.9, 2.6 Hz, 1H), 6.43 (dt, *J* = 12.0, 2.7 Hz, 2H), 6.34 (dd, *J* = 14.5, 2.6 Hz, 1H), 3.71 (d, *J* = 0.9 Hz, 3H), 3.67 (d, *J* = 0.9 Hz, 3H), 2.95 (s, 2H), 1.63 (d, *J* = 2.3 Hz, 3H), 1.55 – 1.47 (m, 3H).
^{13}C NMR (100 MHz, $CDCl_3$): δ 160.46 (m, *J*= 244 Hz), 160.25 (t, *J*= 12 Hz), 130.79 (d, *J*= 6 Hz), 130.59 (d, *J*= 6 Hz), 122.35 (d, *J*= 4 Hz), 122.25 (d, *J*= 3 Hz), 109.43 (d, *J*= 3 Hz), 109.10 (d, *J*= 3 Hz), 109.09, 102.16, 101.87, 101.58, 79.57 (d, *J*= 4 Hz), 79.46 (d, *J*= 5 Hz), 55.61, 55.57, 24.62, 24.59, 24.55, 24.53, 24.19, 24.13.
HRMS (ESI, m/z) : Calcd for $C_{18}H_{20}F_2O_4Na$ $[M+Na]^+$: 361.1228, Found: 361.1220.

2,3-Di(naphthalen-2-yl)butane-2,3-diol (2w)



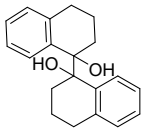
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (70% yield). *meso: dl* = 1:1.76;
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.85 (d, *J* = 1.9 Hz, 1H), 7.83 – 7.73 (m, 3H), 7.72 – 7.69 (m, 2H), 7.66 (dd, *J* = 8.7, 4.3 Hz, 2H), 7.50 – 7.36 (m, 5H), 7.27 (dd, *J* = 8.7, 1.9 Hz, 1H), 2.91 – 2.64 (m, 1H), 2.37 (s, 1H), 1.68 (s, 2H), 1.62 (s, 4H).
^{13}C NMR (100 MHz, $CDCl_3$): 141.66, 141.14, 132.81, 132.68, 132.60, 132.51, 128.46, 128.44, 127.50, 126.85, 126.60, 126.11, 126.03, 126.02, 125.94, 125.65, 79.39, 79.03, 25.72, 25.42.
HRMS (ESI, m/z) : Calcd for $C_{24}H_{22}O_2Na$ $[M+Na]^+$: 365.1518, Found: 365.1515.

4,5-Diphenyloctane-4,5-diol (2x)



The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.5.
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.22 (h, *J* = 10.1, 6.9 Hz, 10H), 2.60 (s, 1H), 2.24 (dq, *J* = 7.7, 4.0 Hz, 1H), 2.01 (ddd, *J* = 14.9, 9.4, 3.7 Hz, 1H), 1.63 (dtt, *J* = 21.2, 13.3, 3.6 Hz, 2H), 1.25 – 1.03 (m, 2H), 0.94 – 0.59 (m, 8H)。
^{13}C NMR (100 MHz, $CDCl_3$): δ 141.89, 141.00, 128.31, 127.63, 127.44, 127.23, 126.95, 126.76, 81.83, 37.95, 37.49, 17.01, 16.84, 14.66, 14.64.
HRMS (ESI, m/z) : Calcd for $C_{20}H_{26}O_2Na$ $[M+Na]^+$: 321.1831, Found:321.1830.

3,3',4,4'-Tetrahydro-[1,1'-binaphthalene]-1,1'(2H,2'H)-diol (2y)



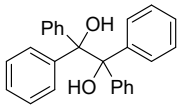
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (65% yield). *dl*.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.17 (dd, *J* = 7.6, 1.8 Hz, 2H), 7.26 – 7.15 (m, 4H), 7.08 (d, *J* = 7.4 Hz, 2H), 3.21 (s, 2H), 2.72 (q, *J* = 3.0 Hz, 1H), 2.68 (q, *J* = 3.1 Hz, 1H), 2.53 (ddd, *J* = 16.3, 11.3, 5.5 Hz, 2H), 1.64 (tdd, *J* = 14.3, 6.4, 3.6 Hz, 5H), 1.57 (q, *J* = 3.8, 3.1 Hz, 1H), 1.26 (ddd, *J* = 14.5, 12.1, 5.0 Hz, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 140.68, 138.52, 129.21, 129.19, 129.00, 127.35, 126.53, 36.59, 31.29, 20.22.

HRMS (ESI, m/z) : Calcd for $C_{20}H_{22}O_2Na$ $[M+Na]^+$: 317.1518, Found:317.1510.

1,1,2,2-Tetraphenylethane-1,2-diol (2z):



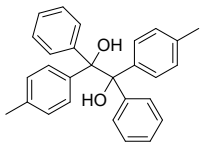
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 – 7.31 (m, 10H), 7.23 (qd, *J* = 4.2, 1.7 Hz, 10H), 3.11 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.32, 128.75, 127.41, 127.07, 83.17.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{22}O_2Na$ $[M+Na]^+$: 389.1518, Found:389.1511.

1,2-Diphenyl-1,2-di-p-tolylethane-1,2-diol (2a')



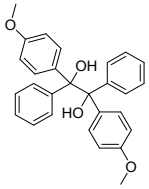
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (85% yield). *meso: dl* = 1.11:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.29 (m, 4H), 7.22 – 7.11 (m, 10H), 6.98 (t, *J* = 7.8 Hz, 4H), 3.02 (s, 2H), 2.30 (s, 3H), 2.28 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.64, 141.41, 136.72, 136.62, 130.46, 128.78, 128.73, 128.67, 128.63, 128.62, 128.36, 128.19, 128.16, 127.36, 127.34, 126.94, 126.87, 83.09, 21.11.

HRMS (ESI, m/z) : Calcd for $C_{28}H_{26}O_2Na$ $[M+Na]^+$: 417.1831, Found: 417.1830.

1,2-Bis(4-methoxyphenyl)-1,2-diphenylethane-1,2-diol (2b')



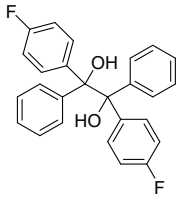
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.01.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (ddt, *J* = 5.8, 2.5, 1.4 Hz, 4H), 7.19 – 7.11 (m, 10H), 6.68 (dd, *J* = 9.0, 7.5 Hz, 4H), 3.73 (s, 3H), 3.72 (s, 3H), 2.97 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ δ 158.41, 158.35, 144.68, 136.52, 130.02, 129.96, 128.72, 128.65, 128.49, 128.00, 127.47, 127.31, 126.89, 126.83, 126.50, 113.95, 112.64, 82.99, 75.84, 55.33, 55.19, 55.17.

HRMS (ESI, m/z) : Calcd for $C_{28}H_{26}O_4Na$ $[M+Na]^+$: 449.1729, Found:449.1722.

1,2-Bis(4-fluorophenyl)-1,2-diphenylethane-1,2-diol (2c')



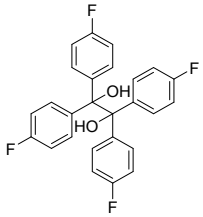
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1.07:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 – 7.32 (m, 2H), 7.32 – 7.09 (m, 12H), 6.84 (td, *J* = 8.8, 2.1 Hz, 4H), 2.96 (s, 1H), 2.94 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 163.19, 160.73, 139.81 (d, *J*= 3 Hz), 130.43 (d, *J*= 8 Hz), 130.39, 128.37, 128.29, 115.67, 115.46, 114.56, 114.35, 82.73.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{20}F_2O_2Na$ $[M+Na]^+$: 425.1329, Found: 425.1321.

1,1,2,2-Tetrakis(4-fluorophenyl)ethane-1,2-diol (2d')



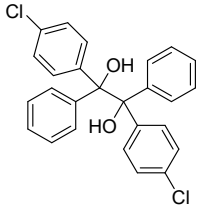
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.24 (m, 8H), 6.95 – 6.84 (m, 8H), 2.90 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.04, 143.82, 130.60 (d, *J*= 9 Hz), 128.53 (d, *J*= 6 Hz), 127.65, 127.51, 127.39, 114.32, 114.11, 82.94.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{18}F_4O_2Na$ $[M+Na]^+$: 461.1141, Found: 461.1131.

1,2-Bis(4-chlorophenyl)-1,2-diphenylethane-1,2-diol (2e')



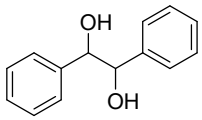
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (71% yield). *meso: dl* = 1.12:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.45 – 7.37 (m, 2H), 7.33 – 7.24 (m, 5H), 7.24 – 7.11 (m, 11H), 2.99 (s, 1H), 2.96 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.68, 143.38, 142.88, 142.85, 133.18, 132.99, 130.32, 130.29, 130.25, 128.80, 128.74, 128.64, 128.53, 128.50, 128.43, 127.76, 127.70, 127.66, 127.62, 127.56, 127.52, 82.92, 82.88.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{20}Cl_2O_2Na$ $[M+Na]^+$: 457.0738, Found: 457.0735.

1,2-Diphenylethane-1,2-diol (4a)



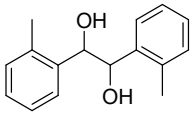
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.17.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.18 (hept, *J* = 3.3 Hz, 3H), 7.14 – 7.03 (m, 5H), 6.98 (qd, *J* = 3.6, 1.9 Hz, 2H), 4.68 (s, 1H), 4.53 (d, *J* = 1.6 Hz, 1H), 3.40 – 2.99 (m, 1H), 2.76 – 2.27 (m, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 140.00, 139.83, 128.51, 128.23, 128.17, 128.08, 128.07, 127.95, 127.21, 127.08, 79.17, 78.09.

HRMS (ESI, m/z) : Calcd for $C_{14}H_{14}O_2Na$ $[M+Na]^+$: 237.0892, Found:237.0890.

1,2-Bi-*o*-tolylethane-1,2-diol (4b)



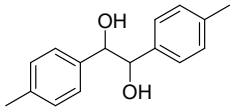
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:2.14.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (dd, *J* = 7.8, 1.5 Hz, 2H), 7.24 – 7.18 (m, 1H), 7.13 – 7.05 (m, 4H), 7.02 (td, *J* = 7.5, 1.5 Hz, 2H), 6.98 (dd, *J* = 5.2, 3.7 Hz, 1H), 6.85 – 6.80 (m, 2H), 5.07 (s, 1H), 4.84 (s, 2H), 3.01 (s, 2H), 2.05 (s, 3H), 1.56 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 138.15, 138.10, 136.14, 135.96, 130.20, 130.06, 127.74, 127.72, 127.32, 126.86, 126.06, 125.96, 74.66, 73.27, 19.17, 18.79.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_2Na$ $[M+Na]^+$:265.1204, Found:265.1201.

1,2-Di-*p*-tolylethane-1,2-diol (4c)



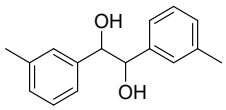
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.2.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.13 – 7.00 (m, 4H), 6.97 – 6.91 (m, 4H), 4.64 (s, 1H), 4.55 (s, 1H), 2.56 – 2.28 (m, 1H), 2.26 (s, 3H), 2.21 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 137.90, 137.58, 137.16, 137.14, 129.10, 128.94, 127.18, 126.99, 78.90, 78.16, 21.29, 21.26.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_2Na$ $[M+Na]^+$: 265.1204, Found:265.1201.

1,2-Di-*m*-tolylethane-1,2-diol (4d):



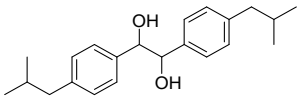
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.15.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.11 (t, *J* = 7.5 Hz, 1H), 7.06 – 6.91 (m, 5H), 6.86 (d, *J* = 2.0 Hz, 1H), 6.78 (dt, *J* = 7.6, 1.6 Hz, 1H), 4.59 (s, 1H), 4.51 (s, 1H), 2.82 (s, 2H), 2.23 (s, 3H), 2.18 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 140.14, 140.10, 137.84, 129.04, 128.72, 128.69, 128.31, 128.12, 128.09, 127.96, 127.65, 124.41, 124.16, 78.94, 78.35, 78.32, 21.56, 21.51.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_2Na$ $[M+Na]^+$: 265.1205, Found: 265.1201.

1,2-Bis(4-isobutylphenyl)ethane-1,2-diol (4e):



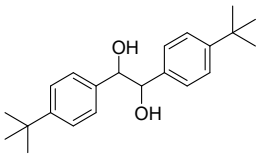
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.24.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.05 (d, *J* = 8.2 Hz, 2H), 6.99 (d, *J* = 8.1 Hz, 2H), 6.90 (s, 4H), 4.66 (s, 1H), 4.54 (s, 1H), 2.91 (s, 1H), 2.37 (d, *J* = 7.2 Hz, 2H), 2.33 (dd, *J* = 7.2, 1.5 Hz, 2H), 2.29 – 2.09 (m, 1H), 1.74 (dhept, *J* = 16.5, 6.8 Hz, 2H), 0.84 – 0.75 (m, 12H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 141.70, 141.39, 137.41, 137.29, 129.10, 128.90, 126.98, 126.78, 79.20, 78.14, 45.25, 45.19, 30.33, 30.31, 22.45, 22.42, 22.34.

HRMS (ESI, m/z) : Calcd for $C_{22}H_{30}O_2Na$ $[M+Na]^+$: 349.2144, Found: 349.2141.-

1,2-Bis(4-(tert-butyl)phenyl)ethane-1,2-diol (4f)



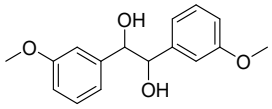
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.24.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.26 (m, 2H), 7.19 (dq, *J* = 8.7, 2.0 Hz, 4H), 7.03 (dd, *J* = 8.3, 1.8 Hz, 2H), 4.61 (d, *J* = 2.1 Hz, 2H), 2.59 (s, 2H), 1.24 (s, 9H), 1.21 (s, 9H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 151.32, 150.86, 137.44, 130.18, 127.04, 126.60, 125.55, 125.47, 125.19, 78.35, 78.19, 34.70, 34.62, 31.48, 31.46.

HRMS (ESI, m/z) : Calcd for $C_{22}H_{30}O_2Na$ $[M+Na]^+$: 349.2144, Found: 349.2141.

1,2-Bis(3-methoxyphenyl)ethane-1,2-diol (4g)



The title compound was synthesized according to the general procedure. The product was purified

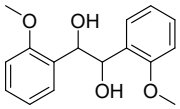
by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.15.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.10 (td, *J* = 7.9, 1.6 Hz, 1H), 7.03 (td, *J* = 7.9, 1.4 Hz, 1H), 6.74 – 6.68 (m, 2H), 6.68 – 6.62 (m, 2H), 6.61 – 6.53 (m, 2H), 4.65 (d, *J* = 1.3 Hz, 1H), 4.52 – 4.45 (m, 1H), 3.59 (dt, *J* = 9.0, 1.2 Hz, 6H), 2.83 – 2.71 (m, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 159.53, 159.42, 141.70, 141.52, 129.23, 129.17, 119.57, 119.40, 113.96, 113.94, 113.70, 112.46, 112.39, 78.91, 77.96, 55.30, 55.26, 55.25.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_4Na$ $[M+Na]^+$: 297.1103, Found: 297.1101.

1,2-bis(2-methoxyphenyl)ethane-1,2-diol (4h)



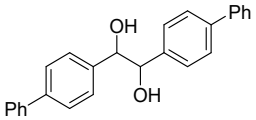
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* =1:1.32.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.26 – 7.14 (m, 4H), 6.89 (dtd, *J* = 11.6, 7.5, 1.1 Hz, 2H), 6.79 (ddd, *J* = 19.2, 8.6, 1.2 Hz, 2H), 5.29 (s, 1H), 5.07 (s, 1H), 3.68 (s, 3H), 3.66 (s, 3H), 3.55 (s, 1H), 3.20 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 156.97, 156.92, 128.66, 128.56, 128.50, 128.44, 128.27, 128.24, 120.46, 110.25, 110.22, 74.35, 73.42, 73.41, 55.27, 55.23.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_4Na$ $[M+Na]^+$: 297.1103, Found: 297.1101.

1,2-Di([1,1'-biphenyl]-4-yl)ethane-1,2-diol (4i)



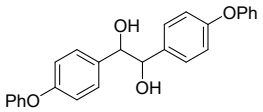
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (85% yield). *meso: dl* =1:11.

^{1}H NMR (400 MHz, DMSO-d_6): δ 7.68 – 7.60 (m, 8H), 7.58 – 7.49 (m, 8H), 7.44 (t, *J* = 7.7 Hz, 8H), 7.37 – 7.31 (m, 4H), 7.31 – 7.17 (m, 8H), 5.41 (s, 4H), 4.71 (d, *J* = 2.1 Hz, 4H).

^{13}C NMR (100 MHz, DMSO-d_6): δ 141.81, 139.99, 138.43, 128.89, 127.83, 127.23, 126.48, 125.59, 77.08.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{22}O_2Na$ $[M+Na]^+$: 389.1517, Found:389.1520.

1,2-Bis(4-phenoxyphenyl)ethane-1,2-diol (4j)



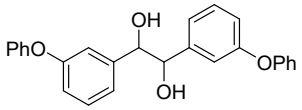
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* =1:1.32.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.23 (ddd, *J* = 8.5, 7.4, 6.0 Hz, 4H), 7.12 (d, *J* = 8.6 Hz, 2H), 7.03 – 6.97 (m, 4H), 6.94 – 6.83 (m, 6H), 6.81 – 6.77 (m, 2H), 4.71 (s, 1H), 4.56 (s, 1H), 2.96 (s, 1H), 2.34 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 157.23, 157.19, 157.02, 134.84, 134.65, 129.90, 129.87, 128.67, 128.55, 123.50, 123.43, 119.03, 118.91, 118.66, 118.64, 78.93, 27.05.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{22}O_4Na$ $[M+Na]^+$: 421.1416, Found: 421.1414.

1,2-Bis(3-phenoxyphenyl)ethane-1,2-diol (4k)



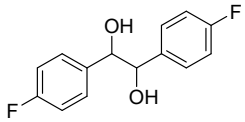
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* =1:1.21.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.23 – 7.10 (m, 6H), 6.98 (td, *J* = 7.3, 1.3 Hz, 2H), 6.89 – 6.68 (m, 9H), 6.63 (t, *J* = 1.9 Hz, 1H), 4.73 (s, 1H), 4.49 (d, *J* = 1.8 Hz, 1H), 2.97 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 157.19, 157.16, 157.12, 157.04, 141.86, 141.58, 130.07, 129.86, 129.74, 129.57, 123.34, 123.33, 121.94, 119.30, 118.87, 118.77, 118.60, 117.80, 117.60, 79.10, 77.51.

HRMS (ESI, m/z) : Calcd for $C_{26}H_{22}O_4Na$ $[M+Na]^+$: 421.1416, Found: 421.1414.

1,2-Bis(4-fluorophenyl)ethane-1,2-diol (4l)



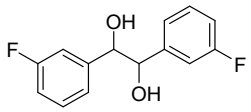
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (85% yield). *meso: dl* = 1.28:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 – 7.21 (m, 2H), 7.14 – 7.03 (m, 4H), 7.03 – 6.95 (m, 2H), 5.46 (dd, *J* = 2.7, 1.4 Hz, 1H), 5.32 (dd, *J* = 3.1, 1.5 Hz, 1H), 4.65 – 4.60 (m, 1H), 4.58 (dd, *J* = 3.2, 1.3 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 165.95 (m, *J*= 240 Hz), 144.35 (d, *J*= 3 Hz), 143.47 (d, *J*= 3 Hz), 134.22 (dd, *J*= 13 Hz), 119.26 (d, *J*= 2 Hz), 119.05 (d, *J*= 2 Hz) , 81.87, 81.42.

HRMS (ESI, m/z) : Calcd for $C_{14}H_{12}F_2O_2Na$ $[M+Na]^+$: 273.0703, Found: 273.0701.

1,2-Bis(3-fluorophenyl)ethane-1,2-diol (4m)



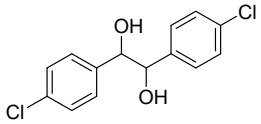
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.22.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.23 (dtd, *J* = 21.8, 7.4, 5.5 Hz, 2H), 7.04 – 6.86 (m, 5H), 6.85 – 6.79 (m, 1H), 4.85 (q, *J* = 2.1 Hz, 1H), 4.66 (q, *J* = 2.7 Hz, 1H), 2.68 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 164.04, 161.60, 142.31 (d, *J*= 7 Hz), 142.16 (d, *J*= 7 Hz), 129.81 (t, *J*= 8 Hz) , 122.75 (d, *J*= 3 Hz), 115.27, 115.24, 115.06, 115.03, 114.01 (d, *J*= 10 Hz), 78.53.

HRMS (ESI, m/z) : Calcd for $C_{14}H_{12}F_2O_2Na$ $[M+Na]^+$: 273.0703, Found: 273.0701.

1,2-Bis(4-chlorophenyl)ethane-1,2-diol (4n)



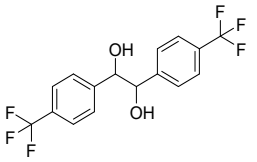
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (80% yield). *meso: dl* = 1.16:1.

^{1}H NMR (400 MHz, DMSO-d_6): δ 7.38 – 7.30 (m, 2H), 7.30 – 7.24 (m, 4H), 7.17 – 7.12 (m, 2H), 5.58 – 5.52 (m, 1H), 5.47 – 5.40 (m, 1H), 4.68 (d, *J* = 2.6 Hz, 1H), 4.61 (d, *J* = 3.5 Hz, 1H).

^{13}C NMR (100 MHz, DMSO-d_6): δ 141.90, 141.06, 131.25, 129.14, 128.94, 127.28, 127.23, 76.38, 76.15.

HRMS (ESI, m/z) : Calcd for $C_{14}H_{12}Cl_2O_2Na$ $[M+Na]^+$: 305.0112, Found:305.0109.

1,2-Bis(4-(trifluoromethyl)phenyl)ethane-1,2-diol (4o)



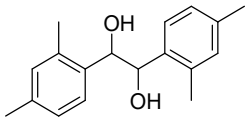
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.43 (t, *J* = 9.0 Hz, 4H), 7.30 – 7.04 (m, 4H), 4.85 (s, 1H), 4.63 (s, 1H), 3.05 (s, 1H), 2.51 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.46, 143.30, 130.47 (m, *J*= 53 Hz), 127.45 (d, *J*= 6 Hz), 125.50, 125.44, 125.42, 125.38, 125.34, 125.30, 125.27, 125.23, 125.20, 125.16, 122.80, 122.73, 78.52, 77.48, 77.32, 77.16, 76.84.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{12}F_6O_2Na$ $[M+Na]^+$: 373.0639, Found:373.0639.

1,2-Bis(2,4-dimethylphenyl)ethane-1,2-diol (4p)



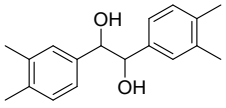
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* =1:2.06.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (d, *J* = 7.9 Hz, 4H), 7.31 – 7.23 (m, 2H), 7.09 – 6.98 (m, 6H), 6.95 (d, *J* = 1.9 Hz, 2H), 6.83 – 6.73 (m, 4H), 5.13 (s, 2H), 4.93 (s, 4H), 2.33 (s, 6H), 2.28 (s, 12H), 2.20 (s, 6H), 1.71 (s, 12H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 137.45, 137.31, 136.22, 135.79, 135.56, 135.30, 131.04, 127.20, 126.99, 126.76, 126.69, 74.55, 73.68, 21.16, 21.11, 19.29, 18.92.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_2Na$ $[M+Na]^+$: 293.1517, Found:293.1522.

1,2-Bis(3,4-dimethylphenyl)ethane-1,2-diol (4q)



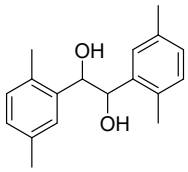
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1.07:1.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.03 – 6.97 (m, 2H), 6.95 (d, *J* = 7.8 Hz, 1H), 6.89 – 6.83 (m, 2H), 6.74 (dd, *J* = 7.7, 2.0 Hz, 1H), 4.52 (s, 1H), 4.51 (d, *J* = 1.9 Hz, 1H), 2.54 (s, 2H), 2.16 (s, 6H), 2.11 (s, 4H), 2.10 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 137.90, 137.80, 136.75, 136.69, 136.42, 136.13, 129.77, 129.48, 128.49, 128.09, 124.80, 124.47, 78.51, 78.31, 19.91, 19.86, 19.61, 19.56.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_2Na$ $[M+Na]^+$: 293.11517, Found: 293.1522.

1,2-Bis(2,5-dimethylphenyl)ethane-1,2-diol (4r):



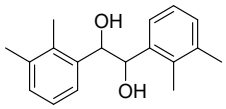
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). *meso: dl* = 1:1.

^{1}H NMR (400 MHz, $CDCl_3$): 7.35 (d, *J* = 1.9 Hz, 1H), 7.10 (s, 1H), 6.92 (d, *J* = 1.2 Hz, 2H), 6.85 (dd, *J* = 7.7, 1.9 Hz, 1H), 6.74 (d, *J* = 7.7 Hz, 1H), 5.03 (s, 1H), 4.86 (s, 1H), 2.24 (s, 3H), 2.22 (s, 3H), 2.12 (s, 3H), 1.60 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 138.26, 137.91, 135.73, 135.39, 133.38, 132.72, 130.25, 130.20, 128.68, 128.54, 127.73, 127.31, 74.49, 73.91, 21.23, 21.18, 18.97, 18.45.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_2Na$ $[M+Na]^+$: 293.1517, Found:293.1522.

1,2-Bis(2,3-dimethylphenyl)ethane-1,2-diol (4s):



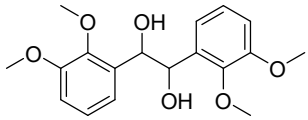
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). ***meso: dl*** = 1:1.63.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.14 (dd, *J* = 9.9, 5.5 Hz, 1H), 7.07 – 6.97 (m, 3H), 6.94 (dd, *J* = 7.6, 1.5 Hz, 1H), 5.14 (s, 1H), 4.91 (d, *J* = 1.2 Hz, 1H), 3.00 (s, 2H), 2.17 (s, 2H), 2.01 (d, *J* = 6.3 Hz, 6H), 1.45 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 138.36, 138.05, 136.69, 136.64, 135.01, 134.66, 129.50, 129.28, 128.67, 125.66, 125.50, 125.29, 125.02, 124.54, 74.91, 74.06, 27.04, 20.87, 20.74, 14.85, 14.35.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_2Na$ $[M+Na]^+$: 293.1517, Found:293.1522.

1,2-Bis(2,3-dimethoxyphenyl)ethane-1,2-diol (4t)



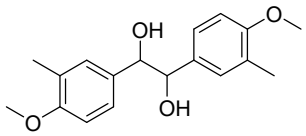
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (99% yield). ***meso: dl*** =1:2.34.

^{1}H NMR (400 MHz, $CDCl_3$): δ 6.93 – 6.85 (m, 2H), 6.80 (dt, *J* = 7.9, 2.4 Hz, 2H), 6.73 (ddt, *J* = 10.2, 8.1, 1.8 Hz, 2H), 5.07 (s, 1H), 5.02 (s, 1H), 3.80 – 3.70 (m, 8H), 3.70 – 3.65 (m, 4H), 3.20 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 152.43, 146.92, 146.71, 134.42, 133.97, 133.94, 124.11, 124.09, 124.00, 120.23, 120.18, 112.03, 111.98, 73.89, 73.86, 73.78, 60.92, 60.90, 60.78, 55.86, 55.81.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_6Na$ $[M+Na]^+$: 357.1314, Found:357.1312.

1,2-Bis(4-methoxy-3-methylphenyl)ethane-1,2-diol (4u)



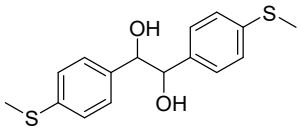
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (80% yield). *meso: dl* = 1:1.04.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.15 (d, *J* = 6.8 Hz, 2H), 6.98 (d, *J* = 2.2 Hz, 1H), 6.91 (dd, *J* = 8.3, 2.2 Hz, 1H), 6.86 – 6.76 (m, 1H), 6.69 (d, *J* = 8.3 Hz, 1H), 4.63 (s, 1H), 4.61 (s, 1H), 3.85 (s, 3H), 3.81 (s, 3H), 2.92 (s, 1H), 2.24 (s, 3H), 2.18 (s, 3H), 2.08 (s, 1H);

^{13}C NMR (100 MHz, $CDCl_3$): δ δ 157.48, 157.30, 131.48, 129.26, 127.47, 125.63, 110.38, 109.61, 78.63, 77.48, 77.16, 76.84, 55.49, 55.45, 16.43, 16.35.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{22}O_4Na$ $[M+Na]^+$: 325.1415, Found: 325.1442.

1,2-bis(4-(methylthio)phenyl)ethane-1,2-diol (4v)



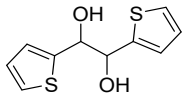
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (86% yield). *meso: dl* =1:4.72.

^{1}H NMR (400 MHz, DMSO-d_6): δ 7.18 (q, *J* = 8.4 Hz, 2H), 7.12 – 6.97 (m, 6H), 5.34 (s, 1H), 4.57 (s, 2H), 3.39 (s, 1H), 2.44 (d, *J* = 12.3 Hz, 6H).

^{13}C NMR (100 MHz, DMSO-d_6): δ 140.06, 139.06, 136.06, 135.91, 127.99, 127.92, 127.84, 125.20, 125.14, 125.07, 77.03, 76.57, 14.98, 14.82.

HRMS (ESI, m/z) **:** Calcd for $C_{16}H_{18}O_2S_2Na$ $[M+Na]^+$: 329.0646, Found: 329.0645.

1,2-Di(thiophen-2-yl)ethane-1,2-diol (4w)



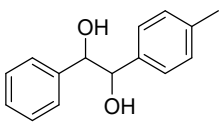
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (84% yield). *meso: dl* =1:1.62.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.21 (dd, *J* = 5.0, 1.3 Hz, 1H), 7.19 – 7.16 (m, 2H), 6.95 (dd, *J* = 3.6, 1.2 Hz, 1H), 6.90 (dd, *J* = 5.0, 3.5 Hz, 1H), 6.83 (dd, *J* = 5.1, 3.5 Hz, 2H), 6.75 (dd, *J* = 3.6, 1.2 Hz, 2H), 5.05 (s, 1H), 4.97 (s, 2H), 3.02 (s, 1H), 2.50 (s, 1H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.04, 142.67, 126.78, 126.75, 126.16, 125.99, 125.79, 125.55, 75.09, 74.57.

HRMS (ESI, m/z) : Calcd for $C_{10}H_{10}O_2S_2Na$ $[M+Na]^+$: 249.0020, Found:249.001.

1-Phenyl-2-(p-tolyl)ethane-1,2-diol (5a)



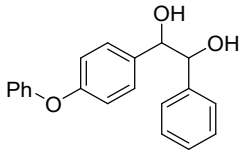
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (85% yield). *meso: dl* =1:1.17.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (td, *J* = 5.1, 2.1 Hz, 2H), 7.28 – 7.18 (m, 5H), 7.18 – 7.09 (m, 6H), 7.08 – 6.99 (m, 5H), 4.83 – 4.70 (m, 2H), 4.64 (dt, *J* = 8.9, 3.1 Hz, 2H), 2.83 (s, 4H), 2.37 (d, *J* = 2.2 Hz, 3H), 2.33 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 140.12, 140.02, 139.82, 137.73, 137.71, 137.44, 137.12, 137.03, 136.84, 128.97, 128.93, 128.84, 128.19, 128.16, 128.11, 127.99, 127.88, 127.83, 127.22, 127.19, 127.16, 127.12, 127.08, 127.00, 126.97, 79.12, 79.04, 78.91, 78.82, 78.03, 78.00, 77.98, 21.24, 21.22.

HRMS (ESI, m/z) : Calcd for $C_{15}H_{16}O_2Na$ $[M+Na]^+$: 251.1048, Found: 251.1032.

1-(4-phenoxyphenyl)-2-phenylethane-1,2-diol (5b)



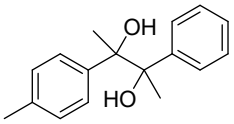
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (82% yield). *meso: dl*=1.14:1

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.13 (d, *J* = 15.6 Hz, 4H), 7.07 – 7.00 (m, 2H), 6.96 (d, *J* = 8.6 Hz, 3H), 6.85 (t, *J* = 10.2 Hz, 3H), 6.79 – 6.66 (m, 3H), 4.66 – 4.61 (m, 1H), 4.45 (d, *J* = 5.5 Hz, 1H), 3.63 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 157.14, 156.95, 156.84, 139.71, 134.81, 134.52, 129.80, 129.77, 128.63, 128.54, 128.12, 127.94, 127.17, 127.09, 123.38, 123.34, 118.90, 118.83, 118.79, 118.52, 118.45, 79.24, 78.81, 78.71, 77.97, 77.92, 77.49, 77.42.

HRMS (ESI, m/z) : Calcd for $C_{20}H_{18}O_3Na$ ~~$C_{21}H_{20}O_2Na$~~ $[M+Na]^+$: 329.1154, Found: 329.1146.

2-phenyl-3-(p-tolyl)butane-2,3-diol (5c)



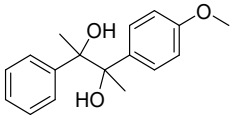
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (87% yield). *meso: dl* =1:1.67.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.10 (dddd, *J* = 12.5, 9.2, 4.9, 2.6 Hz, 5H), 7.04 – 6.98 (m, 1H), 6.97 – 6.89 (m, 3H), 2.68 (s, 1H), 2.38 (s, 1H), 2.21 (d, *J* = 5.8 Hz, 3H), 1.50 – 1.39 (m, 3H), 1.39 – 1.25 (m, 5H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 143.90, 143.54, 140.99, 140.64, 136.51, 136.44, 136.35, 136.29, 127.96, 127.83, 127.81, 127.47, 127.39, 127.19, 127.08, 127.07, 127.03, 126.98, 126.96, 126.94, 126.82, 126.77, 78.91, 78.88, 78.83, 78.80, 78.65, 78.61, 26.96, 25.13, 25.11, 25.02, 25.00, 24.94, 24.89, 24.87, 24.81, 21.01, 20.98.

HRMS (ESI, m/z) : Calcd for $C_{17}H_{20}O_2Na$ $[M+Na]^+$: 279.1361, Found:279.1353.

2-(4-methoxyphenyl)-3-phenylbutane-2,3-diol (5d)



The title compound was synthesized according to the general procedure. The product was purified

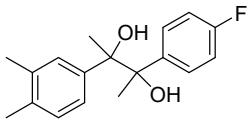
by flash column chromatography. Colorless oil (80% yield). *meso: dl* =1:1.56.

^{1}H NMR (400 MHz, $CDCl_3$)：δ 7.28 – 7.04 (m, 14H), 6.76 (dd, *J* = 8.9, 6.9 Hz, 4H), 3.79 (d, *J* = 6.7 Hz, 6H), 2.57 (d, *J* = 12.5 Hz, 2H), 2.27 (d, *J* = 9.9 Hz, 1H), 1.56 (d, *J* = 7.4 Hz, 5H), 1.48 (d, *J* = 11.1 Hz, 7H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 158.74, 158.65, 144.05, 143.70, 136.09, 135.74, 128.72, 128.25, 127.48, 127.40, 127.27, 127.12, 127.08, 126.97, 112.74, 112.58, 79.14, 78.83, 78.72, 78.54, 55.35, 25.36, 25.23, 25.15, 25.10.

HRMS (ESI, m/z) : Calcd for $C_{17}H_{20}O_3Na$ $[M+Na]^+$: 295.1310, Found:295.1301.

2-(3,4-dimethylphenyl)-3-(4-fluorophenyl)butane-2,3-diol (5e)



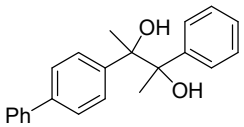
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (73% yield). *meso: dl* =1:1.34.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.16 – 6.96 (m, 2H), 6.92 (q, *J* = 5.9, 4.9 Hz, 2H), 6.82 (dddd, *J* = 19.5, 8.8, 6.8, 4.2 Hz, 3H), 2.33 (s, 2H), 2.16 – 2.13 (m, 3H), 2.11 (t, *J* = 4.4 Hz, 3H), 1.51 – 1.39 (m, 3H), 1.36 (d, *J* = 9.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 163.24, 163.20, 163.14, 163.09, 160.80, 160.77, 160.70, 160.65, 141.37, 141.17, 141.02, 140.83, 139.82, 139.60, 139.36, 139.21, 135.42, 135.37, 135.27, 135.23, 135.16, 135.07, 135.04, 129.30, 129.22, 129.17, 129.09, 128.84, 128.75, 128.72, 128.70, 128.62, 128.60, 128.56, 128.44, 128.36, 128.29, 124.91, 124.79, 124.43, 124.39, 114.04, 113.98, 113.88, 113.83, 113.78, 113.67, 113.58, 78.79, 78.63, 78.58, 78.54, 25.25, 25.20, 25.16, 25.11, 25.05, 24.91, 24.84, 19.91, 19.89, 19.34, 19.29.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{21}FO_2Na$ $[M+Na]^+$: 311.1424, Found:311.1422.

2-([1,1'-biphenyl]-4-yl)-3-phenylbutane-2,3-diol (5f)



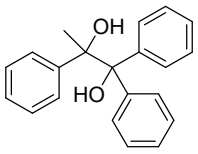
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (81% yield). *meso: dl* =1:1.28.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (d, J = 7.0 Hz, 2H), 7.37 – 7.23 (m, 4H), 7.23 – 7.14 (m, 2H), 7.14 – 6.97 (m, 6H), 2.69 (s, 1H), 2.45 (s, 1H), 1.54 – 1.25 (m, 6H).

^{13}C NMR (150 MHz, $CDCl_3$) δ 143.93, 143.56, 143.08, 142.69, 140.82, 140.78, 139.82, 139.75, 139.68, 128.88, 128.86, 128.03, 127.98, 127.62, 127.56, 127.53, 127.49, 127.43, 127.39, 127.37, 127.35, 127.30, 127.24, 127.20, 127.15, 127.13, 127.10, 127.05, 126.99, 126.04, 126.00, 125.98, 125.91, 125.86, 79.02, 78.99, 78.96, 78.92, 78.77, 78.74, 78.70, 78.67, 25.34, 25.26, 25.25, 25.20, 25.14, 25.08, 25.03.

HRMS (ESI, m/z) : Calcd for $C_{22}H_{22}O_2Na$ $[M+Na]^+$: 341.1517, Found: 341.1524.

1,1,2-Triphenylpropane-1,2-diol (5g)



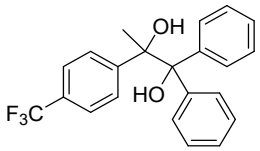
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (75% yield).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.52 (dt, *J* = 7.7, 2.7 Hz, 2H), 7.40 (dq, *J* = 7.2, 2.9, 2.5 Hz, 2H), 7.19 (ddt, *J* = 8.8, 6.7, 1.8 Hz, 1H), 7.12 (dq, *J* = 6.9, 2.5, 2.0 Hz, 3H), 7.04 (tq, *J* = 5.2, 2.9 Hz, 7H), 2.82 (d, *J* = 11.4 Hz, 1H), 2.57 – 2.33 (m, 1H), 1.56 (t, *J* = 2.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.62, 143.96, 143.86, 143.82, 128.73, 128.54, 128.47, 128.34, 128.27, 127.68, 127.61, 127.57, 127.46, 127.42, 127.35, 127.20, 127.09, 127.05, 127.01, 126.94, 126.65, 82.18, 80.42, 26.84.

HRMS (ESI, m/z) : Calcd for $C_{21}H_{20}O_2Na$ $[M+Na]^+$: 327.1361, Found: 327.1365.

1,1-Diphenyl-2-(4-(trifluoromethyl)phenyl)propane-1,2-diol (5h)



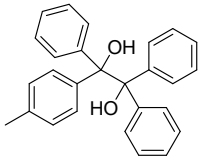
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (80% yield).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.47 (m, 2H), 7.46 – 7.37 (m, 2H), 7.36 – 7.28 (m, 4H), 7.21 – 7.17 (m, 3H), 7.09 (td, *J* = 5.2, 2.0 Hz, 3H), 2.73 (s, 1H), 2.46 (d, *J* = 12.1 Hz, 1H), 1.62 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 149.10, 144.32, 143.80, 143.58, 128.76, 128.32, 128.29, 127.94, 127.81, 127.72, 127.49, 127.42, 127.41, 127.09, 124.14 (m, *J*= 4 Hz) , 82.49, 80.19, 27.13.

HRMS (ESI, m/z**) :** Calcd for $C_{22}H_{19}F_3O_2Na$ $[M+Na]^+$: 395.1235, Found:395.1233.

1,1,2-triphenyl-2-(p-tolyl)ethane-1,2-diol (5i)



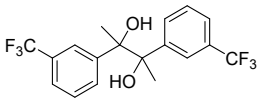
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid 83% yield). *dl : meso* = 1:0

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.21 (dq, *J* = 7.1, 3.3 Hz, 6H), 7.05 (ddq, *J* = 7.4, 4.9, 2.7 Hz, 11H), 6.87 (dt, *J* = 5.8, 2.9 Hz, 2H), 2.92 (s, 2H), 2.17 (p, *J* = 2.6 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.60, 144.53, 144.43, 144.40, 144.33, 141.32, 136.74, 136.68, 136.59, 128.75, 128.73, 128.65, 128.62, 128.19, 128.15, 127.41, 127.36, 127.32, 127.07, 127.02, 126.96, 126.92, 126.85, 83.17, 83.07, 21.10.

HRMS (ESI, m/z) : Calcd for $C_{27}H_{24}O_2Na$ $[M+Na]^+$: 403.1675, Found: 403.1648

2,3-bis(3-(trifluoromethyl)phenyl)butane-2,3-diol (6a)



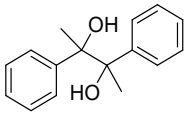
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. Colorless oil (45% yield). *meso: dl* =1:1.24.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 – 7.45 (m, 3H), 7.44 – 7.30 (m, 5H), 2.46 (s, 2H), 1.64 (s, 3H), 1.57 (d, *J* = 1.5 Hz, 4H).

^{13}C NMR (100 MHz, $CDCl_3$): δ 144.55, 144.15, 130.59, 130.19, 129.88 (d, *J*= 3 Hz) , 129.56 (d, *J*= 3 Hz), 127.72, 127.67, 125.50, 125.48, 124.12, 124.08, 123.95, 123.91, 123.88, 122.79, 122.77, 78.55, 78.34, 24.87, 24.58.

HRMS (ESI, m/z) : Calcd for $C_{18}H_{16}F_6O_2Na$ $[M+Na]^+$: 401.0952, Found: 401.0951.

2,3-diphenylbutane-2,3-diol (6b)



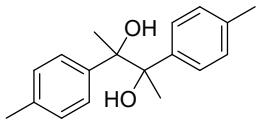
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (52% yield). *meso: dl* =1:1.36.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.15 (m, 10H), 2.80 – 2.28 (m, 2H), 1.62 (s, 2H), 1.54 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$): δ 143.79, 143.43, 127.36, 127.21, 127.17, 127.08, 127.02, 126.99, 126.92, 126.83, 78.83, 78.59, 25.03, 24.86.

HRMS (ESI, m/z) : Calcd for $C_{16}H_{18}O_2Na$ $[M+Na]^+$: 265.1205, Found: 265.1195.

2,3-di-p-tolylbutane-2,3-diol (6c)



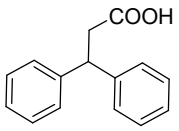
The title compound was synthesized according to the general procedure. The product was purified by flash column chromatography. White solid (61% yield). *meso: dl* =1:1.42.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.26 – 7.16 (m, 2H), 7.15 – 7.07 (m, 6H), 2.76 – 2.46 (m, 2H), 2.36 (d, *J* = 4.8 Hz, 6H), 1.57 (s, 3H), 1.50 (s, 4H).

^{13}C NMR (100 MHz, $CDCl_3$):δ 141.07, 140.72, 136.55, 136.40, 128.05, 127.89, 127.41, 126.99, 78.87, 78.63, 25.26, 25.07, 21.05, 21.02.

HRMS (ESI, m/z): Calcd for $C_{18}H_{22}O_2Na$ $[M+Na]^+$: 293.1518, Found: 293.1513.

3,3-diphenylpropanoic acid （11）



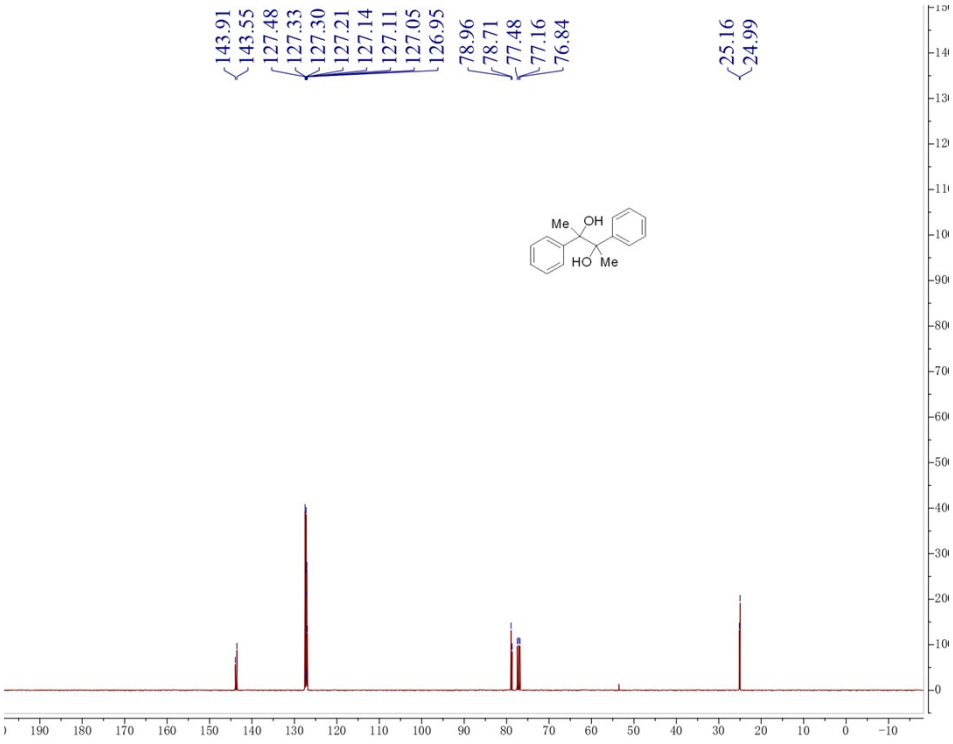
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.23 – 7.10 (m, 10H), 4.46 (t, *J* = 4.1 Hz, 1H), 3.02 (d, *J* = 3.0 Hz, 2H).

^{13}C NMR (150 MHz, $CDCl_3$): δ 177.53, 143.39, 128.77, 127.76, 126.78, 46.78, 40.52.

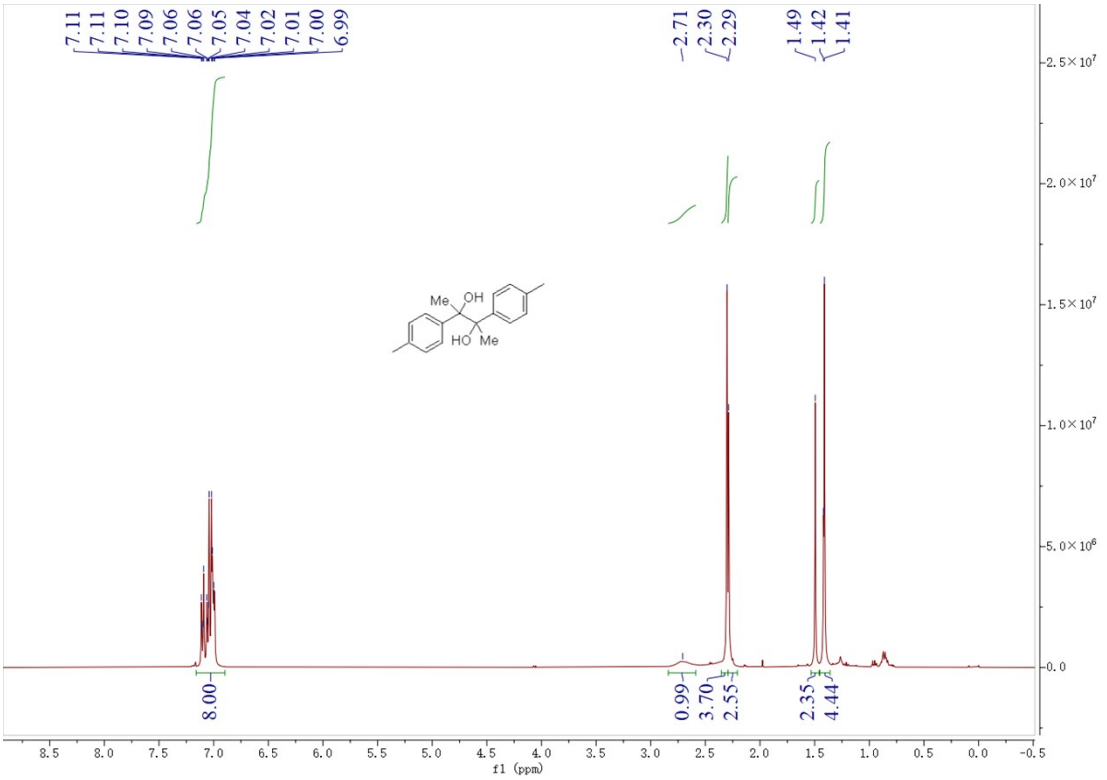
17. NMR Spectra

^{1}H NMR spectrum of compound 2a (400 MHz, $CDCl_3$)

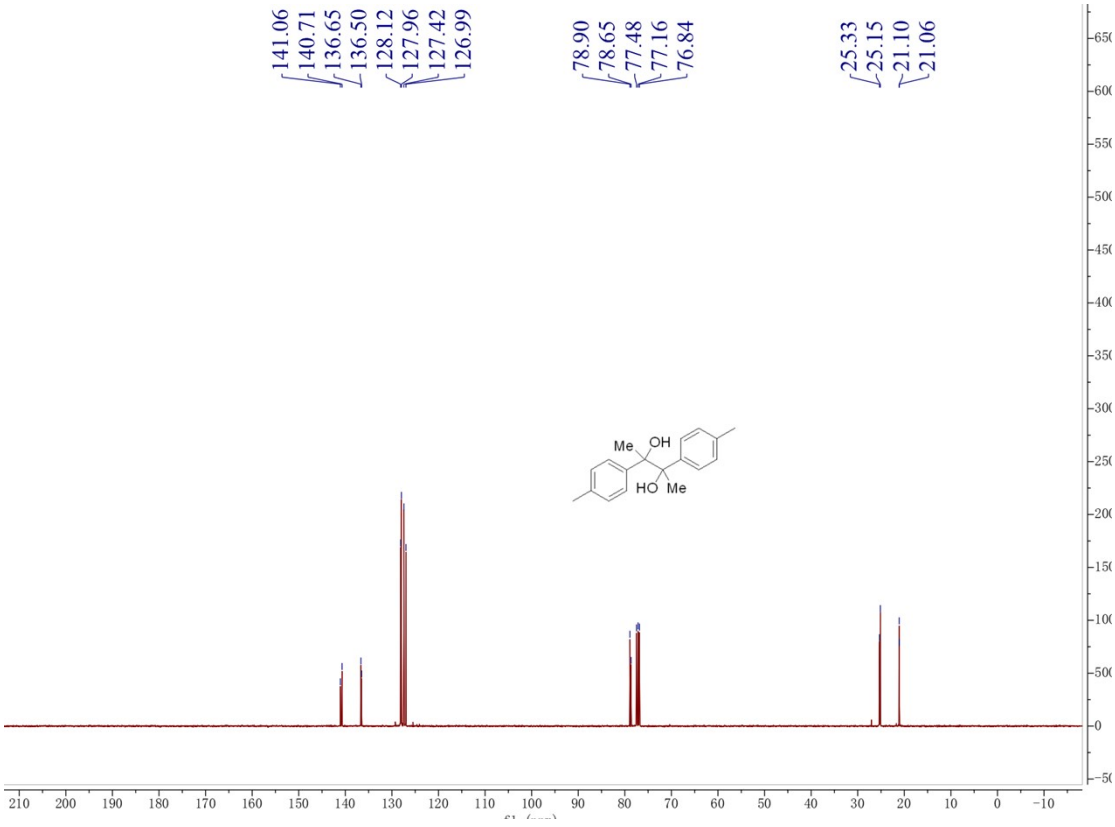
^{13}C NMR spectrum of compound 2a (100 MHz, $CDCl_3$)



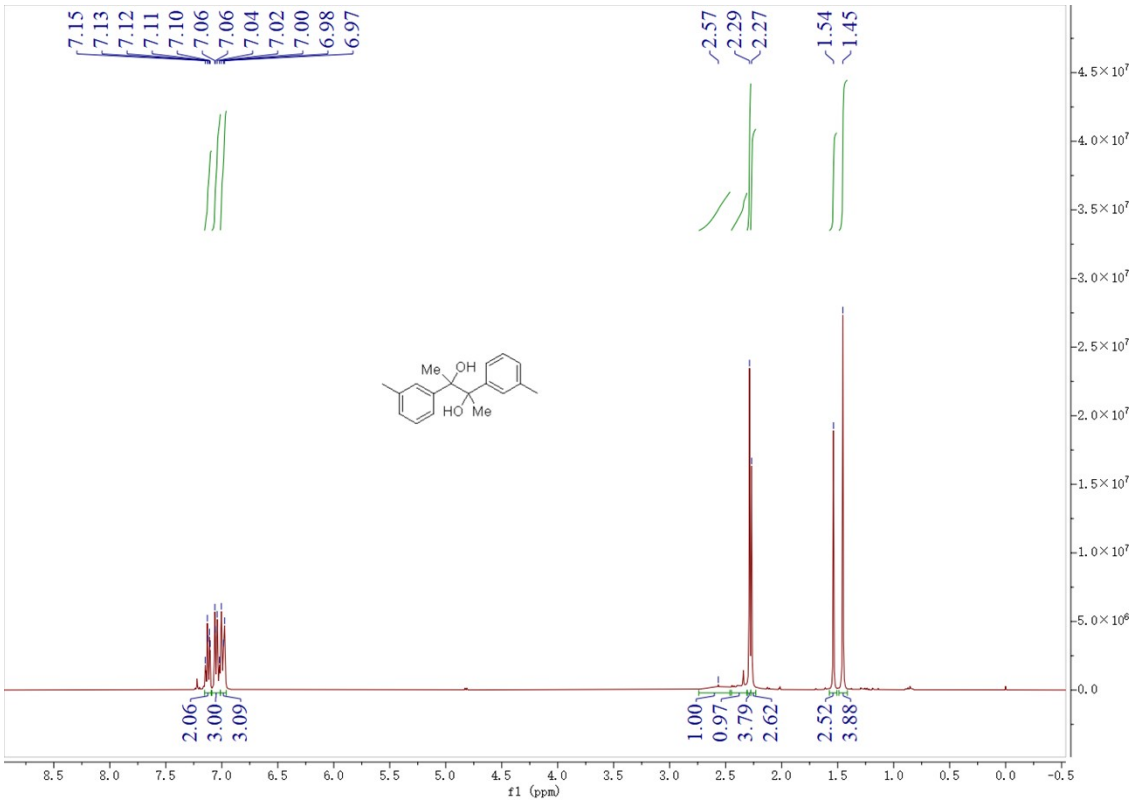
^{1}H NMR spectrum of compound 2b (400 MHz, $CDCl_3$)



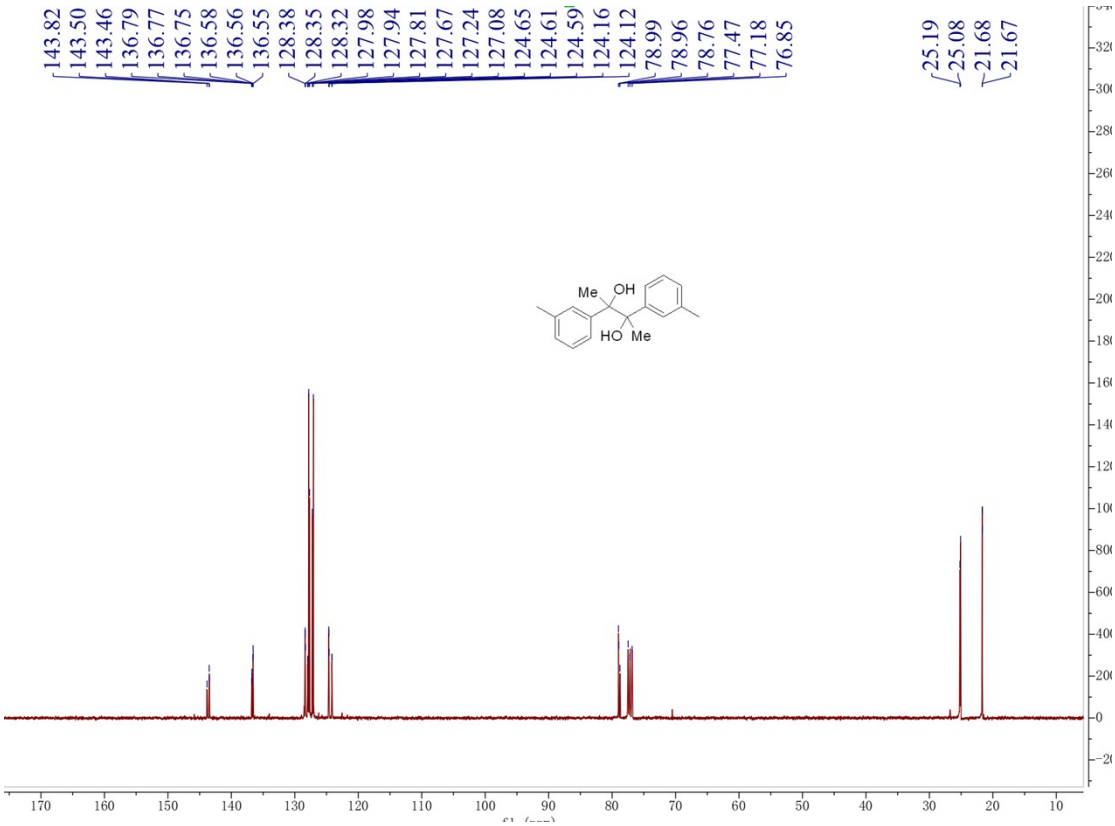
^{13}C NMR spectrum of compound 2b (100 MHz, $CDCl_3$)



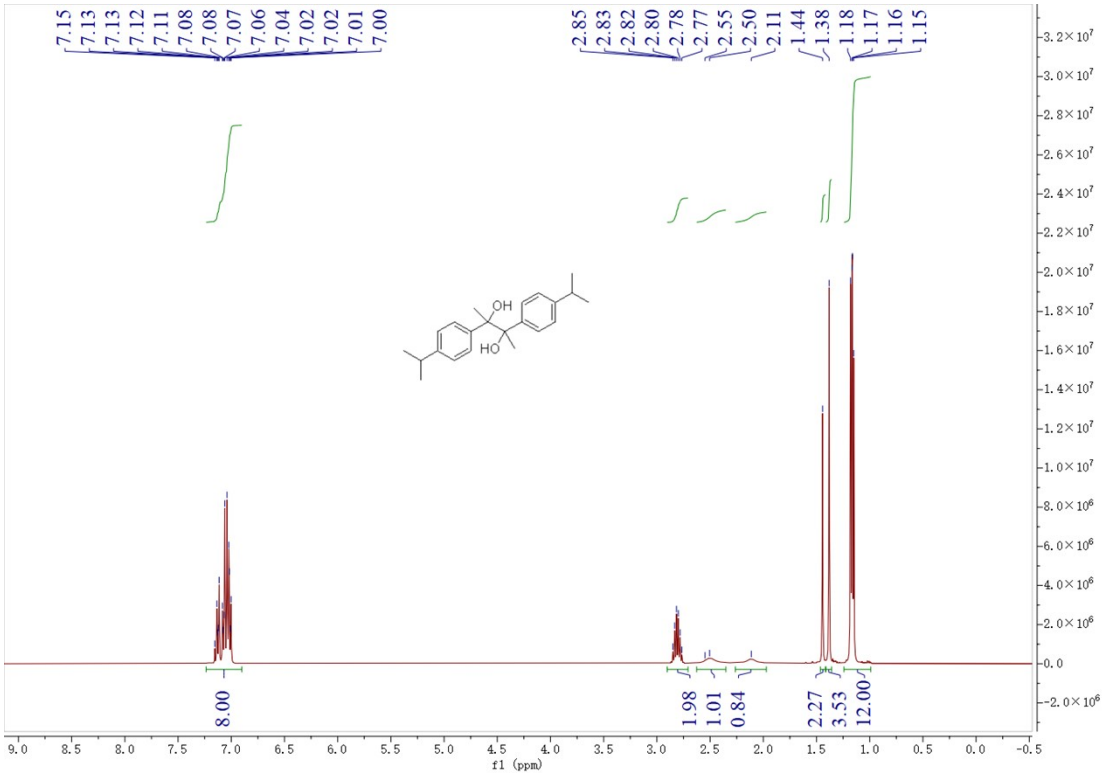
^{1}H NMR spectrum of compound 2c (400 MHz, $CDCl_3$)



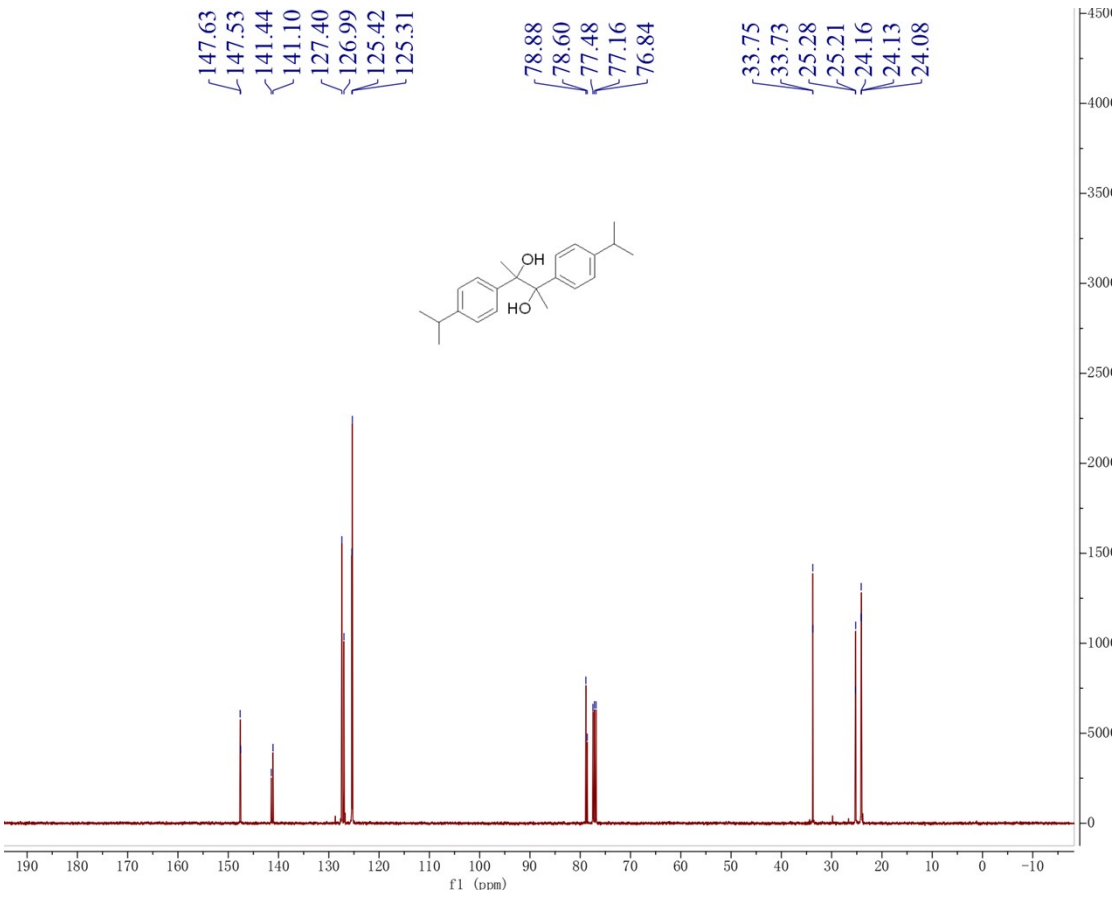
^{13}C NMR spectrum of compound 2c (100 MHz, $CDCl_3$)



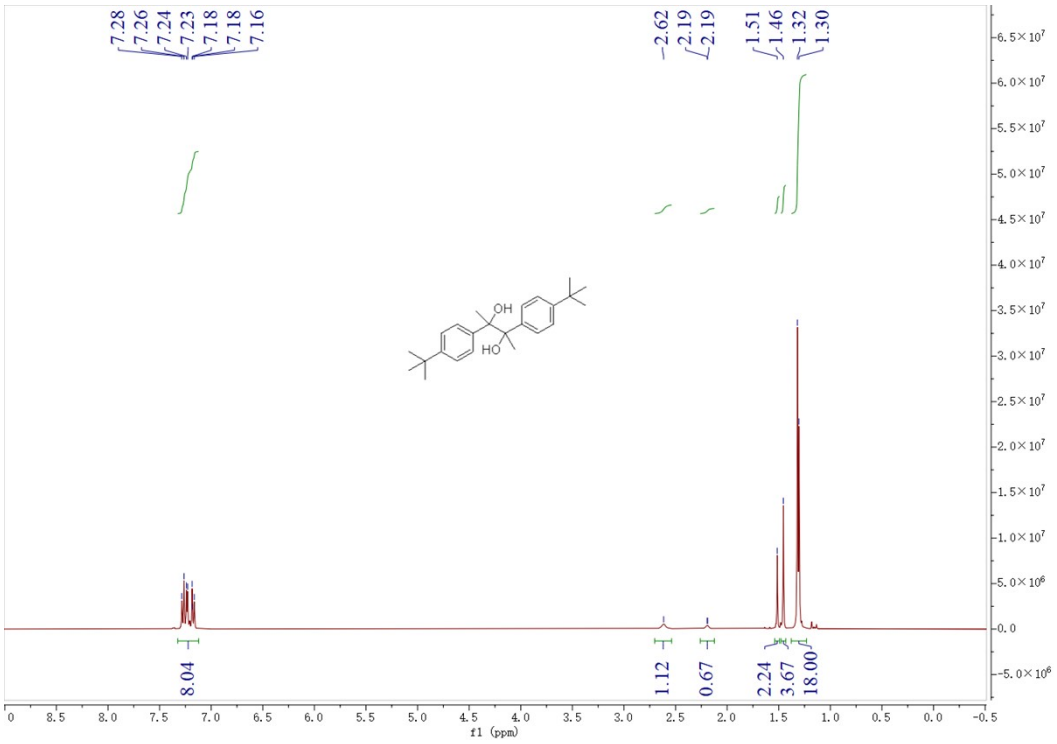
^{1}H NMR spectrum of compound 2d (400 MHz, $CDCl_3$)



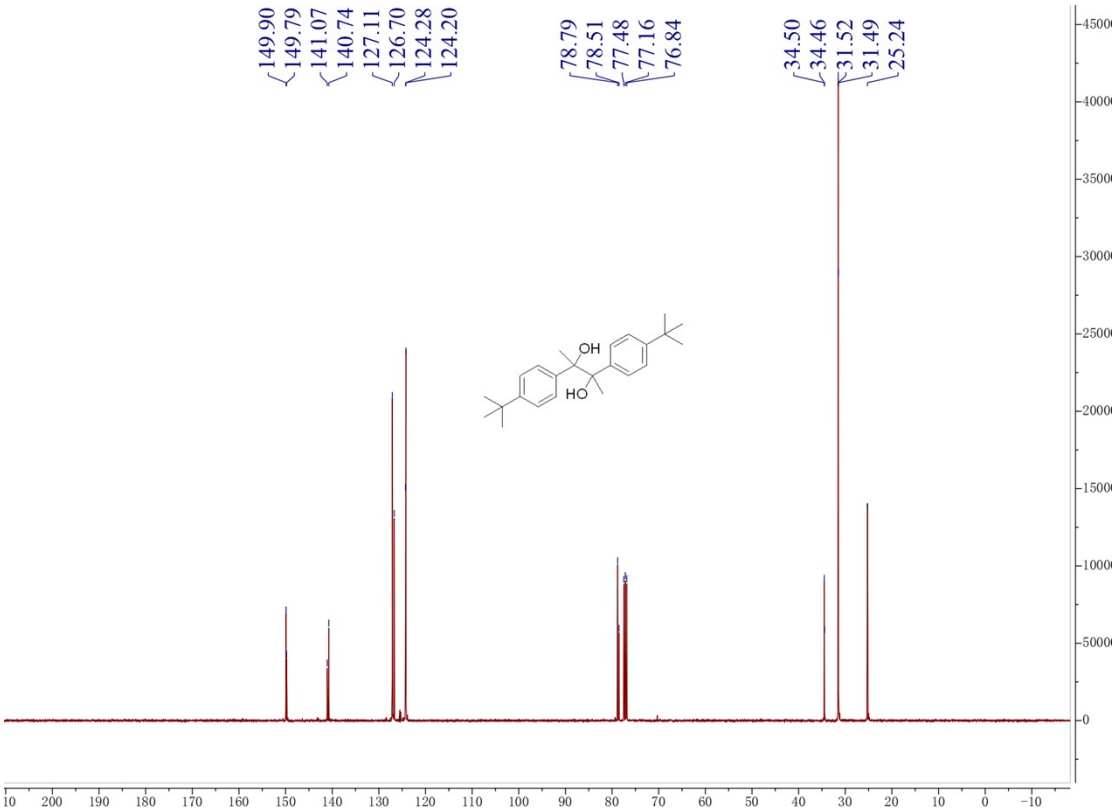
^{13}C NMR spectrum of compound 2d (100 MHz, $CDCl_3$)



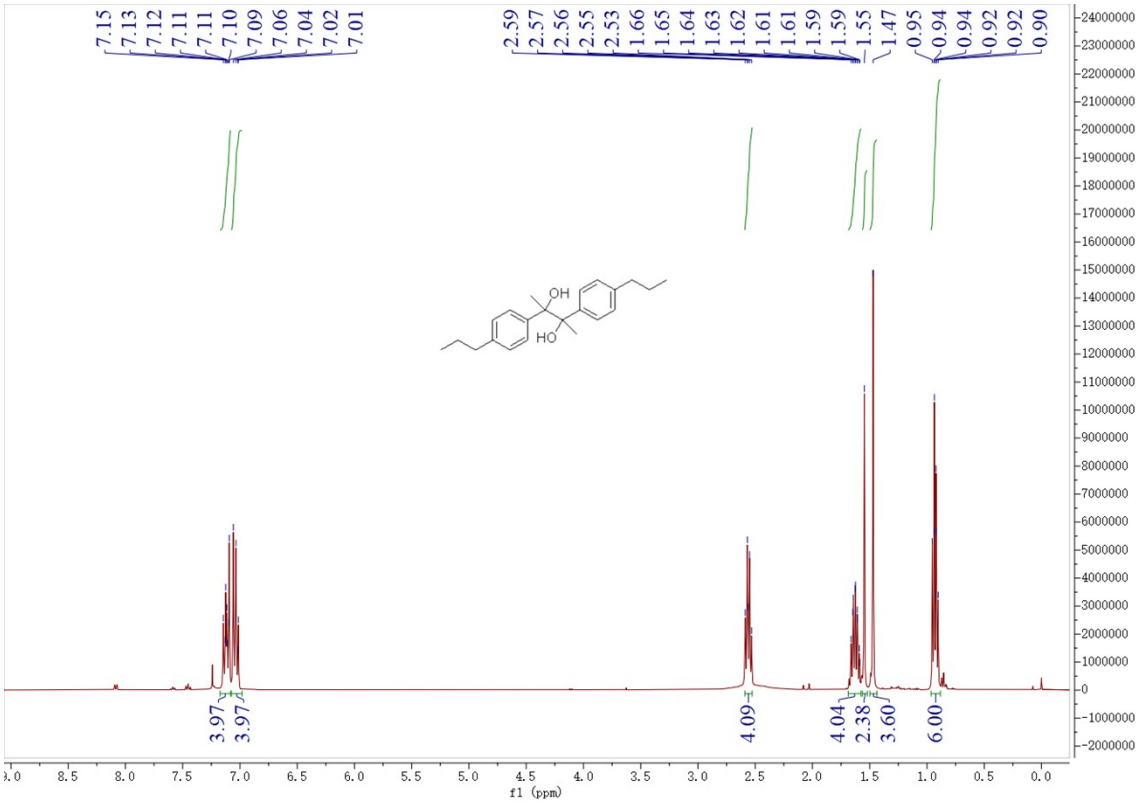
^{1}H NMR spectrum of compound 2e (400 MHz, $CDCl_3$)



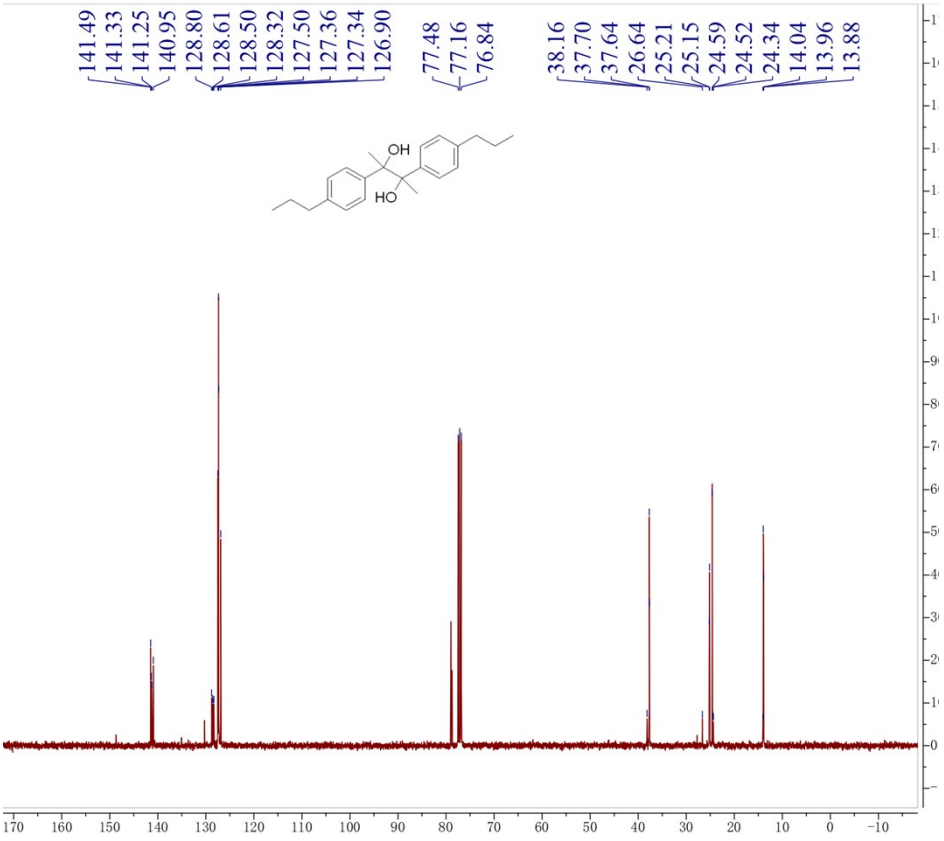
^{13}C NMR spectrum of compound 2e (100 MHz, $CDCl_3$)



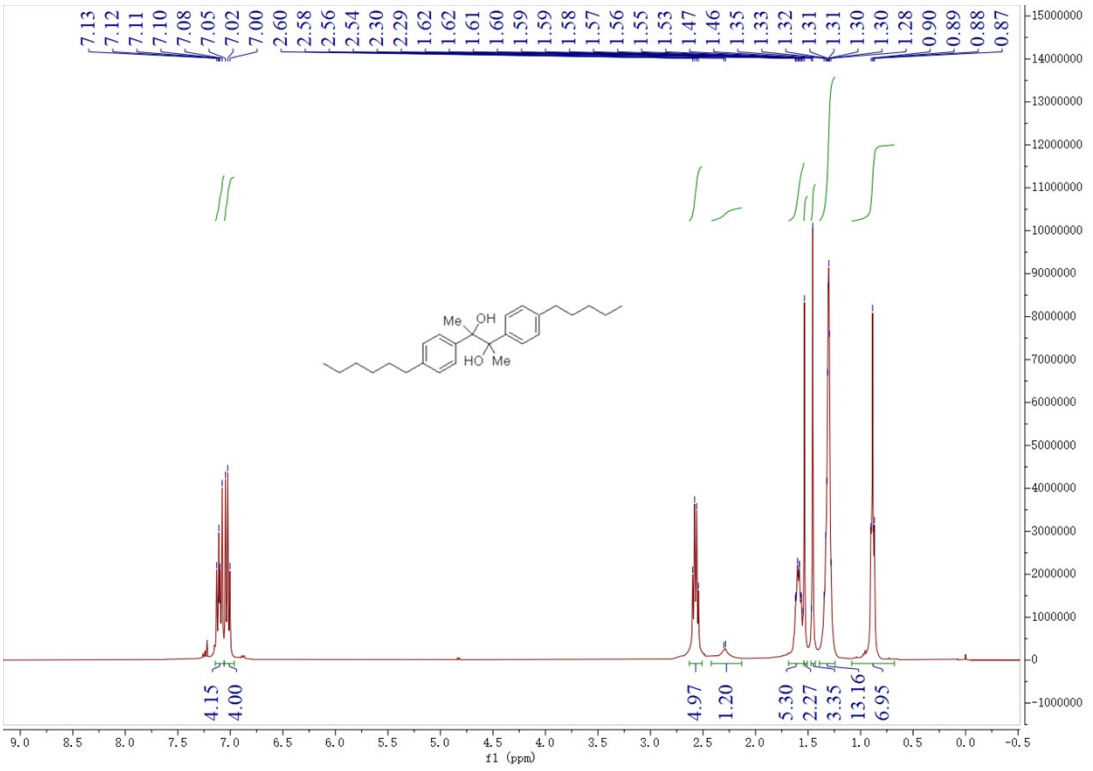
^{1}H NMR spectrum of compound 2f (400 MHz, $CDCl_3$)



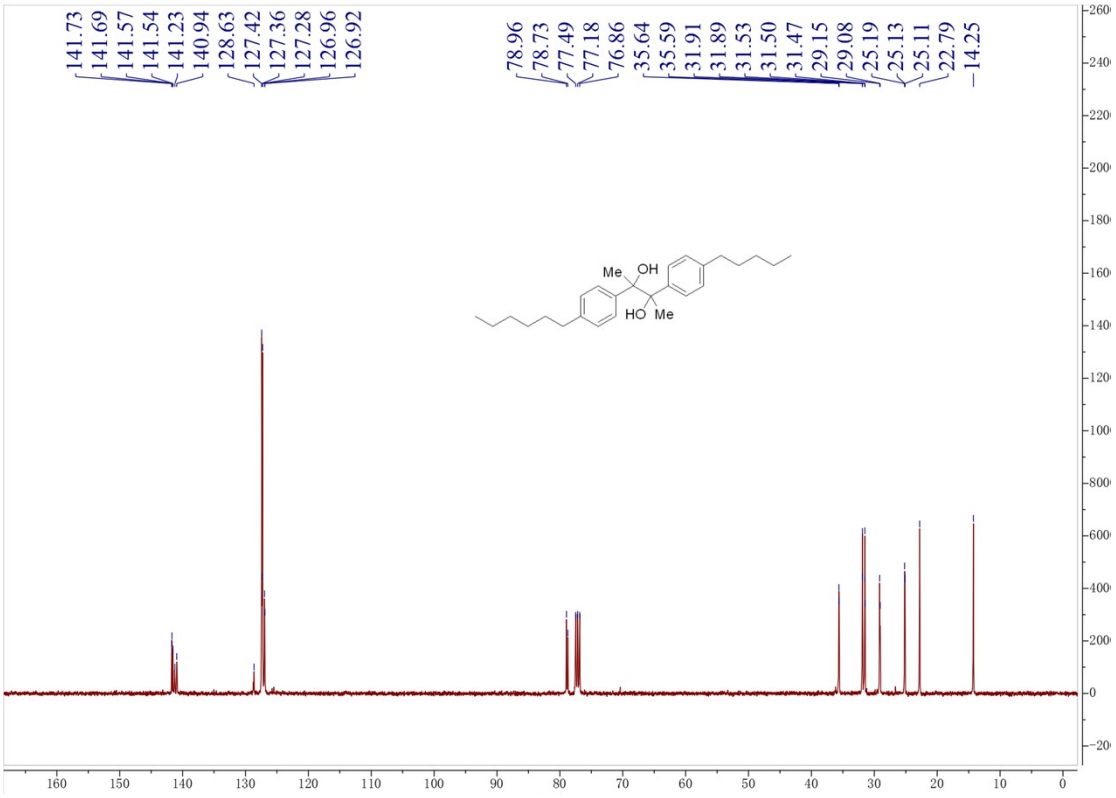
^{13}C NMR spectrum of compound 2f (100 MHz, $CDCl_3$)



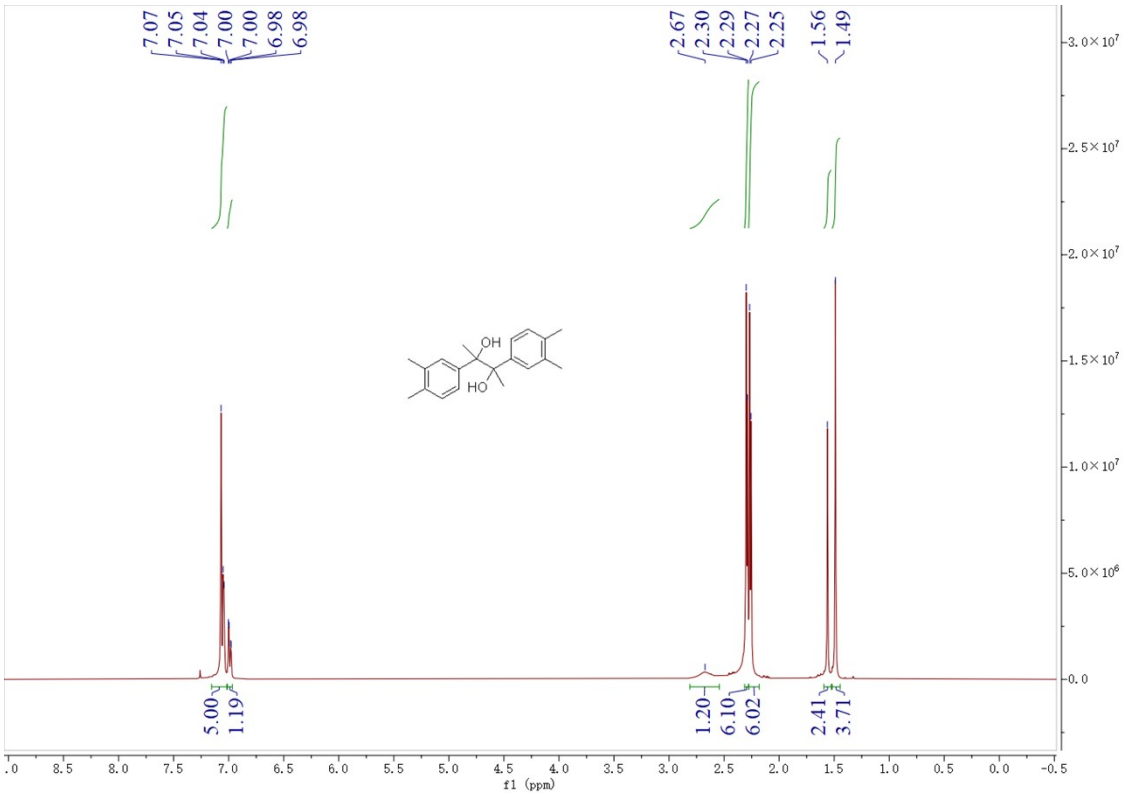
^{1}H NMR spectrum of compound 2g (400 MHz, $CDCl_3$)



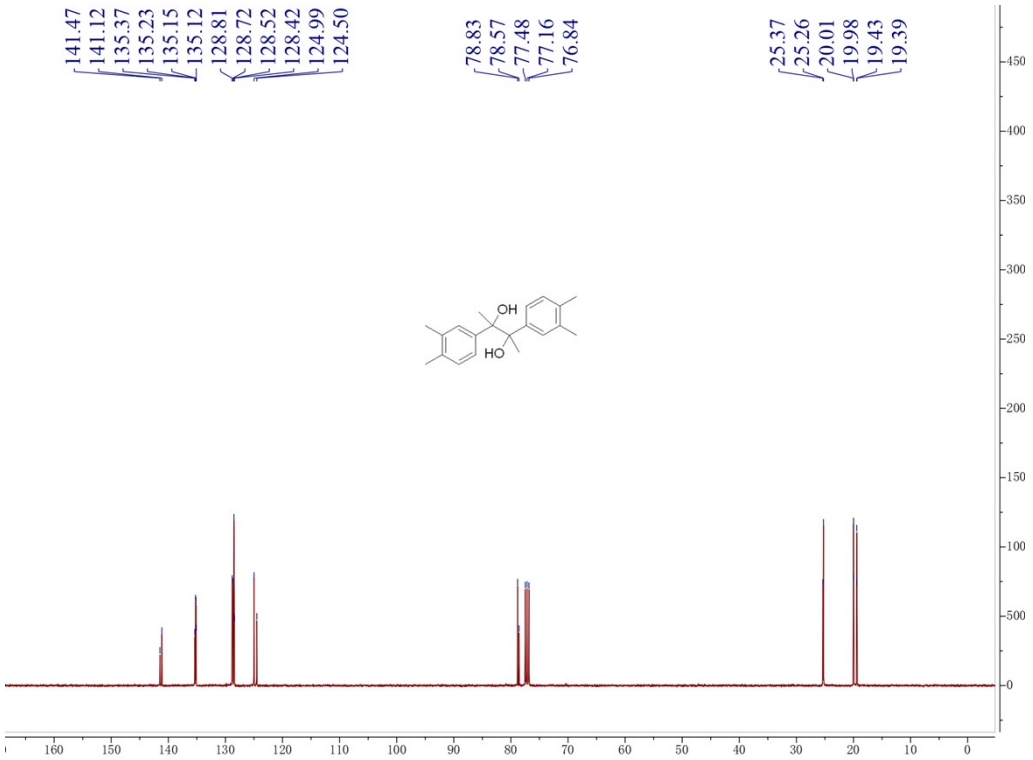
^{13}C NMR spectrum of compound 2g (100 MHz, $CDCl_3$)



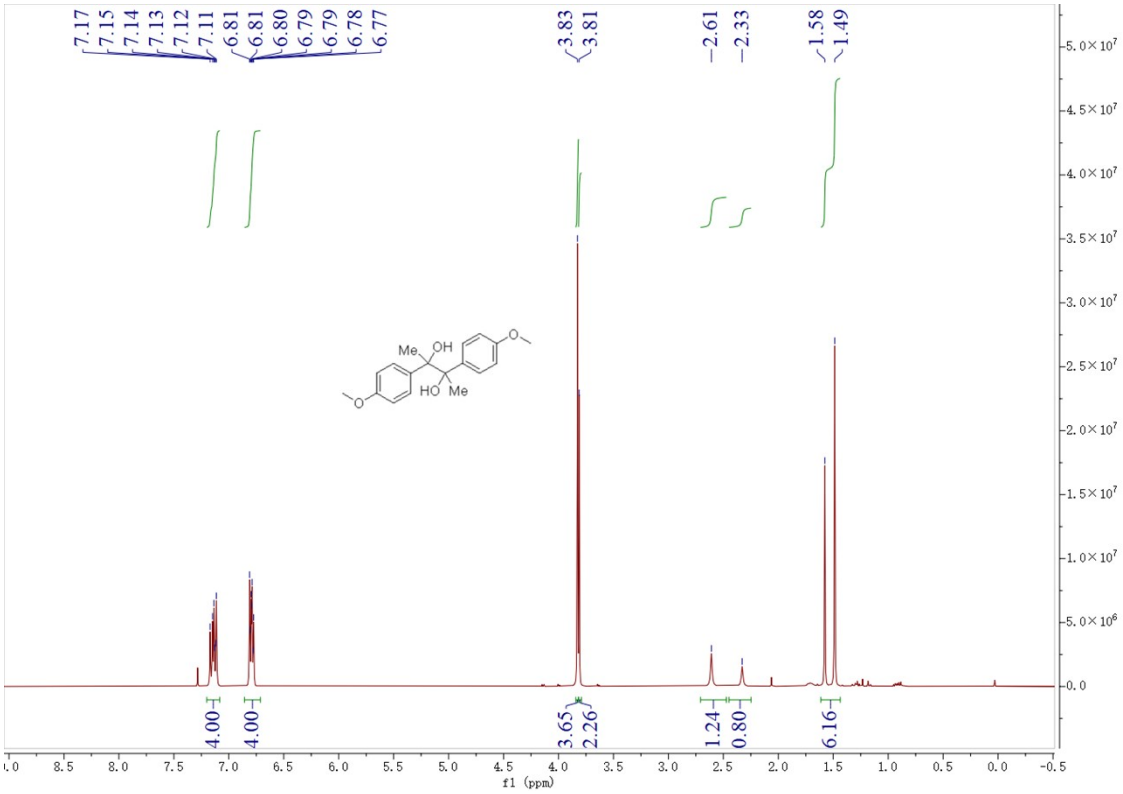
^{1}H NMR spectrum of compound 2h (400 MHz, $CDCl_3$)



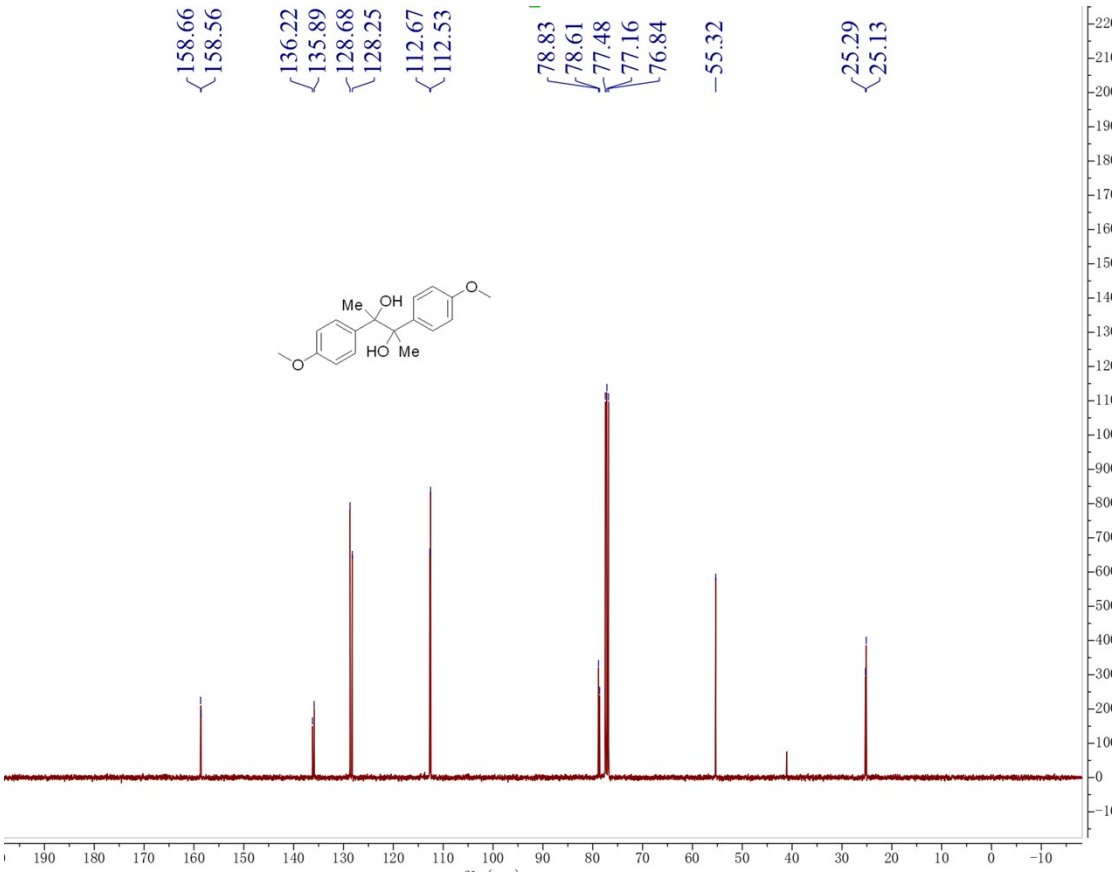
^{13}C NMR spectrum of compound 2h (100 MHz, $CDCl_3$)



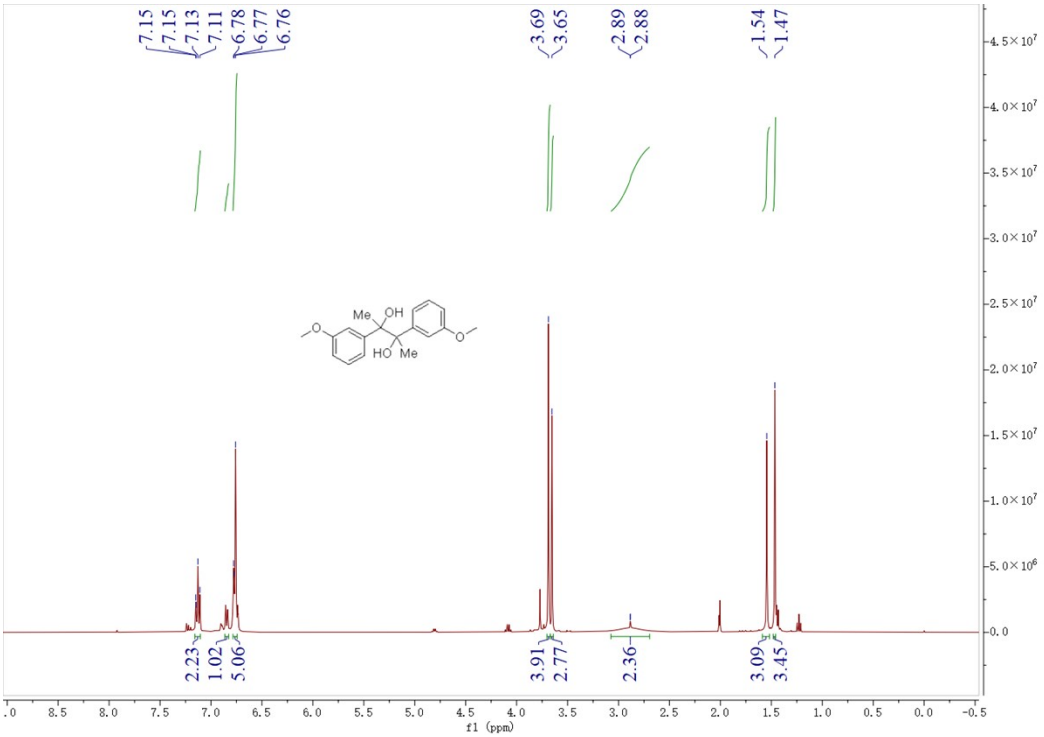
^{1}H NMR spectrum of compound 2i (400 MHz, $CDCl_3$)



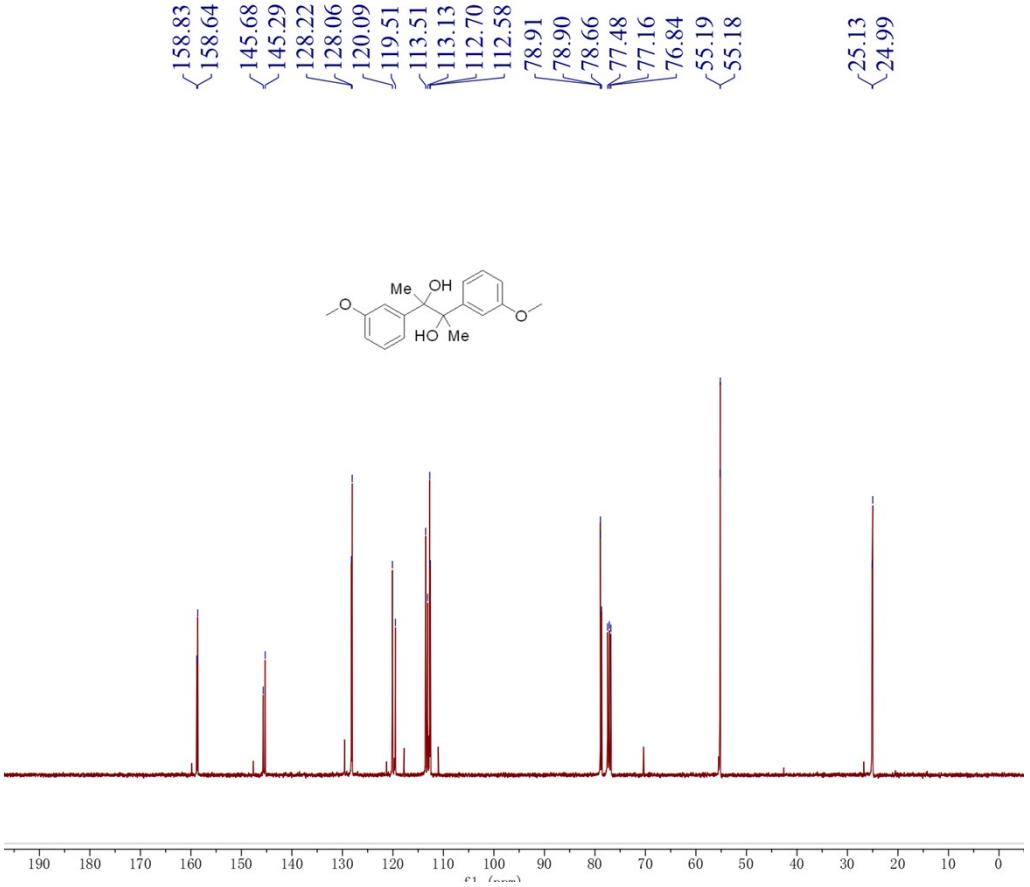
^{13}C NMR spectrum of compound 2i (100 MHz, $CDCl_3$)



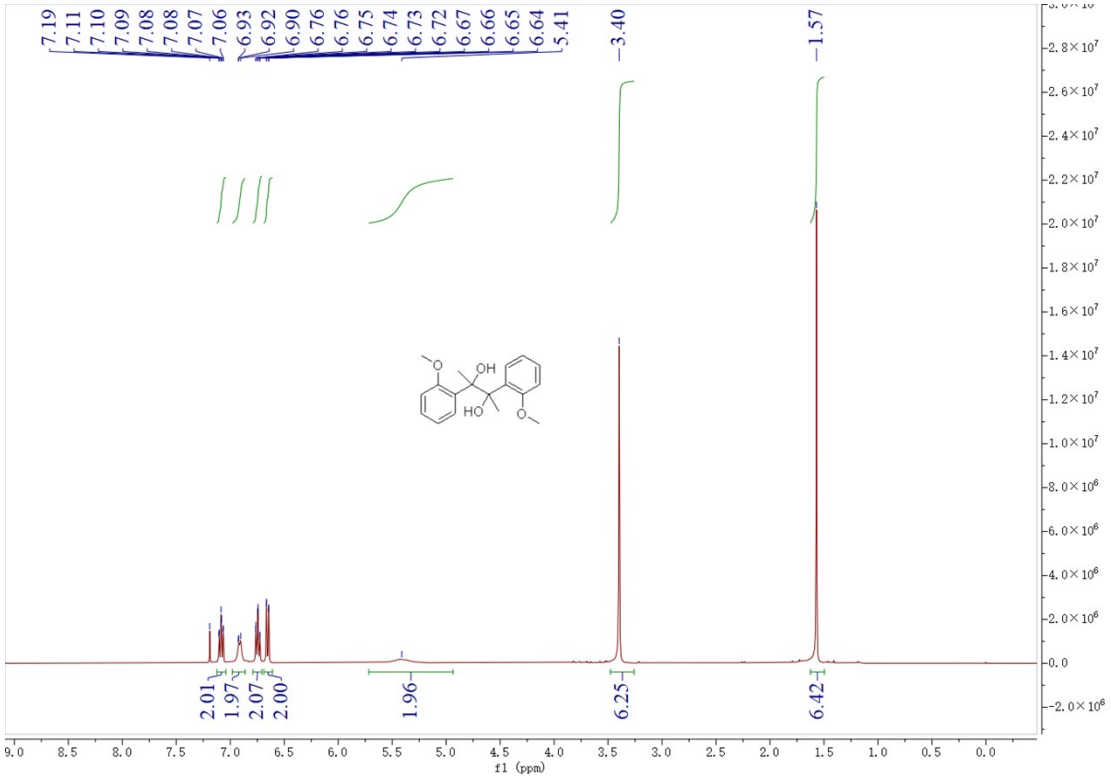
^{1}H NMR spectrum of compound 2j (400 MHz, $CDCl_3$)



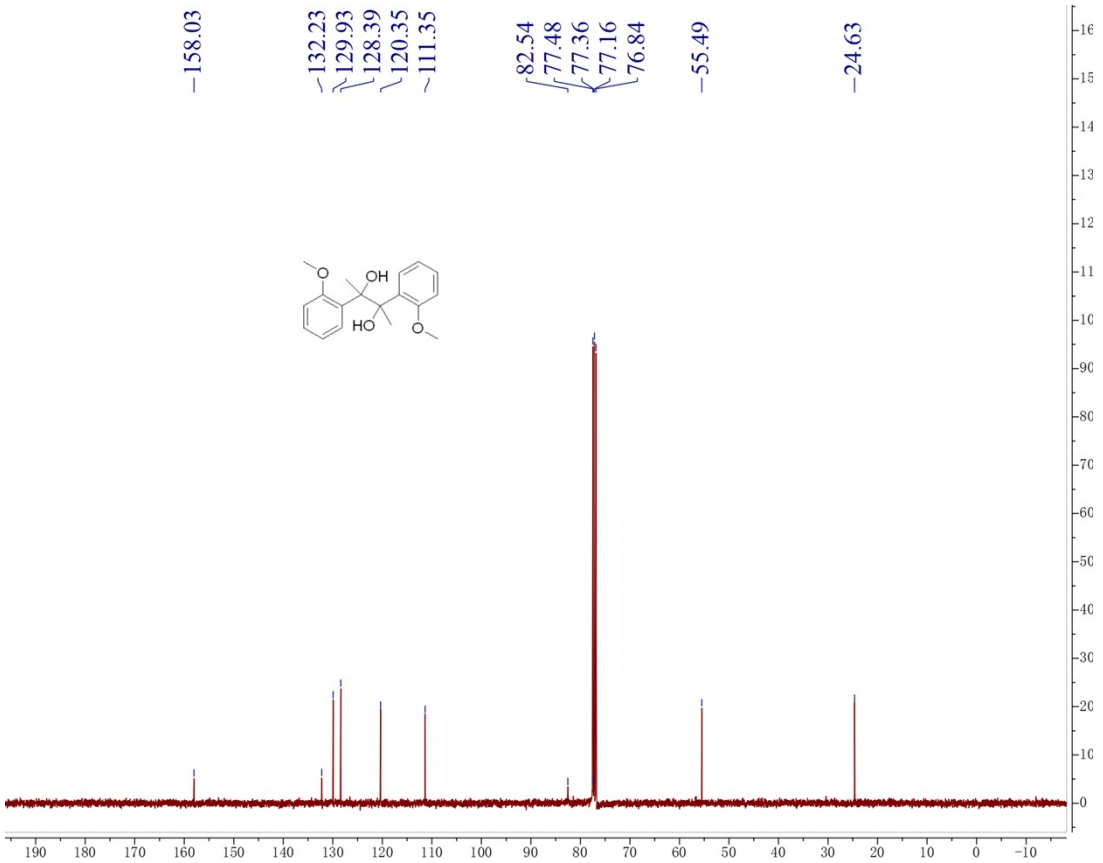
^{13}C NMR spectrum of compound 2j (100 MHz, $CDCl_3$)



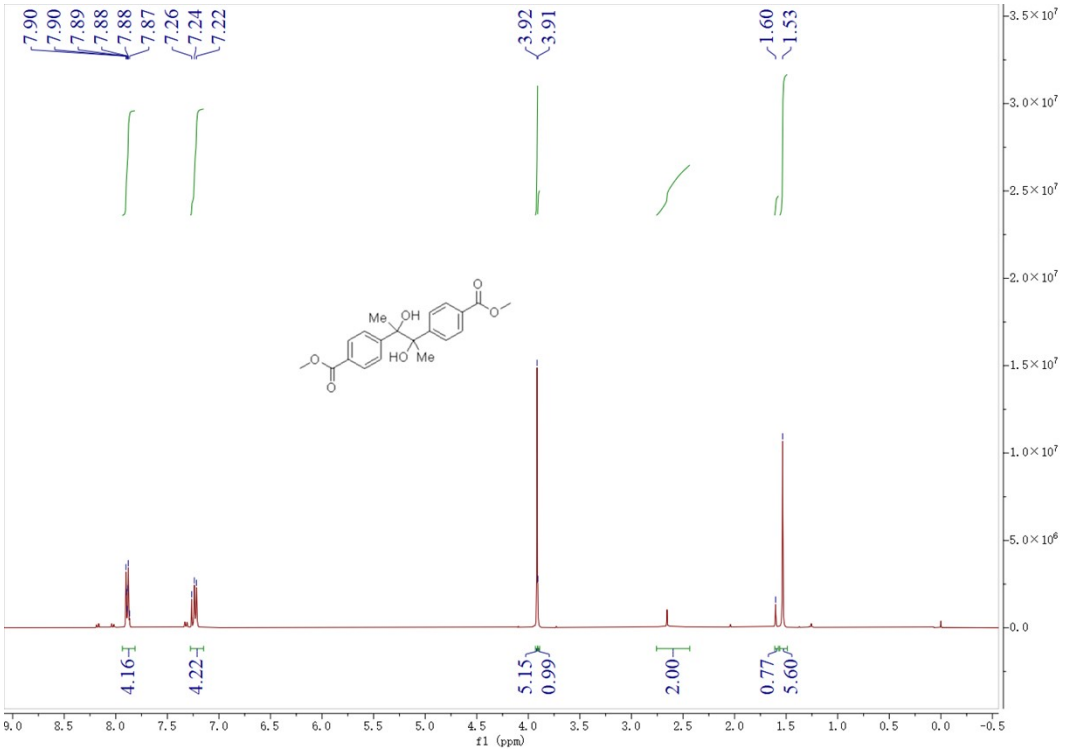
^{1}H NMR spectrum of compound 2k (400 MHz, $CDCl_3$)



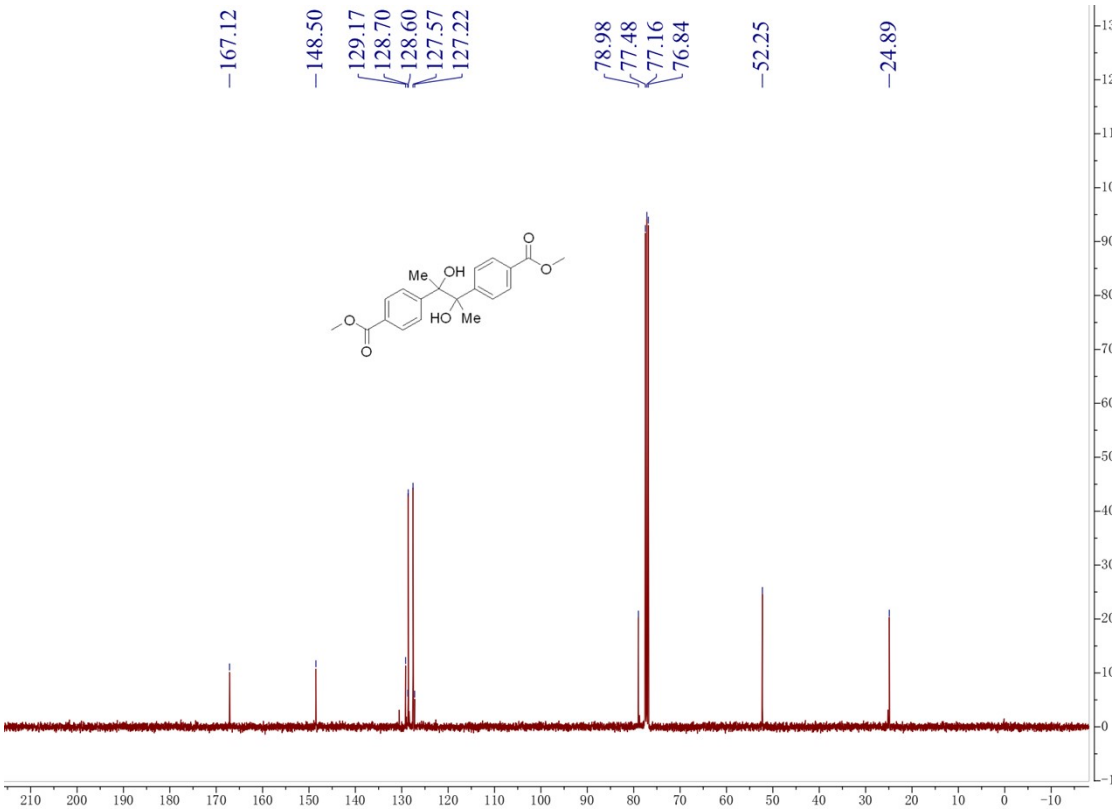
^{13}C NMR spectrum of compound 2k (100 MHz, $CDCl_3$)



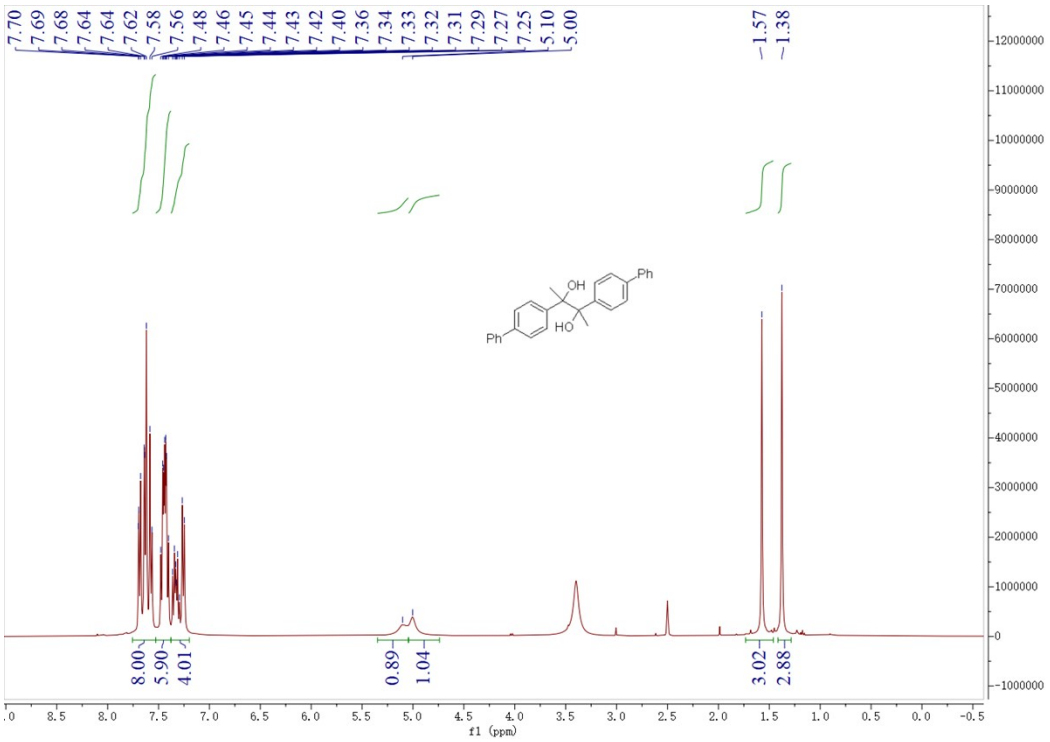
^{1}H NMR spectrum of compound 2l (400 MHz, $CDCl_3$)



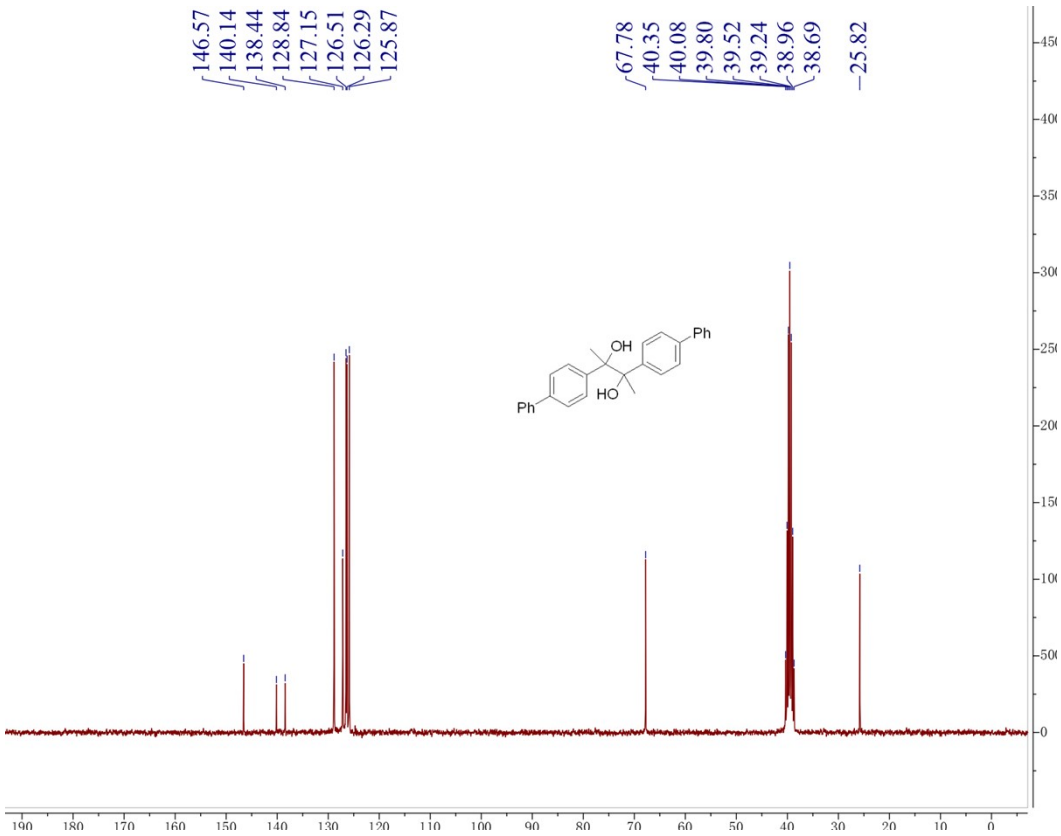
^{13}C NMR spectrum of compound 2l (100 MHz, $CDCl_3$)



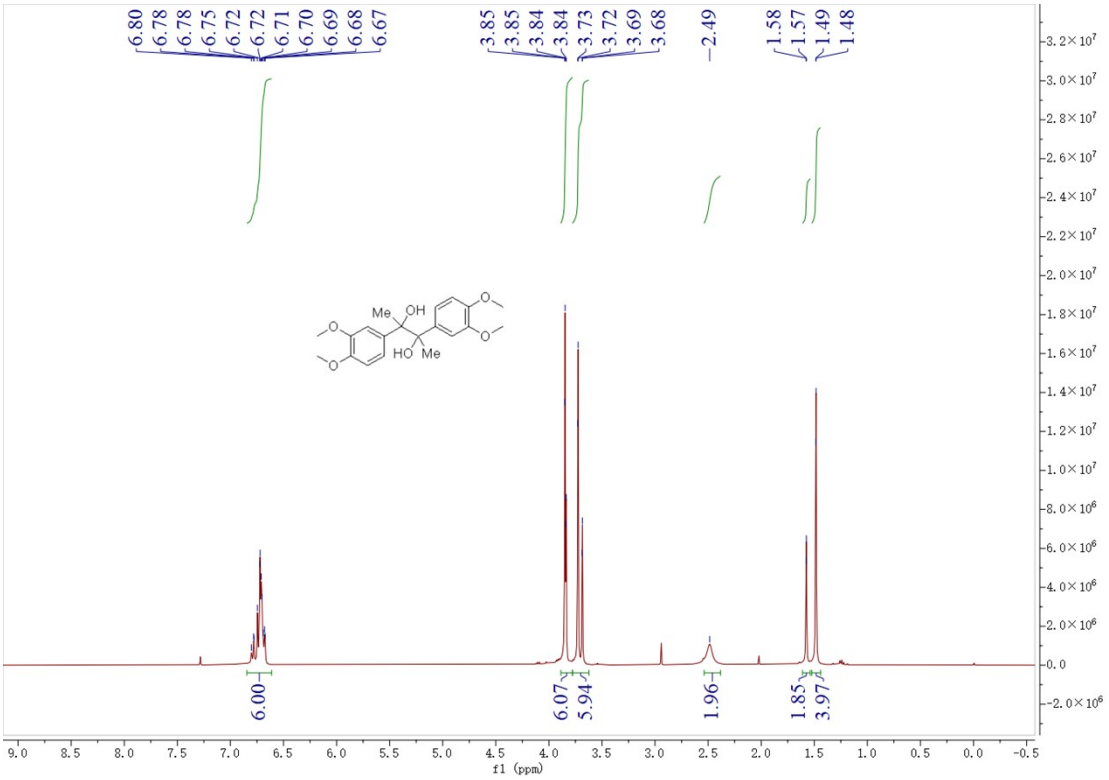
^{1}H NMR spectrum of compound 2m (400 MHz, DMSO-d_6)



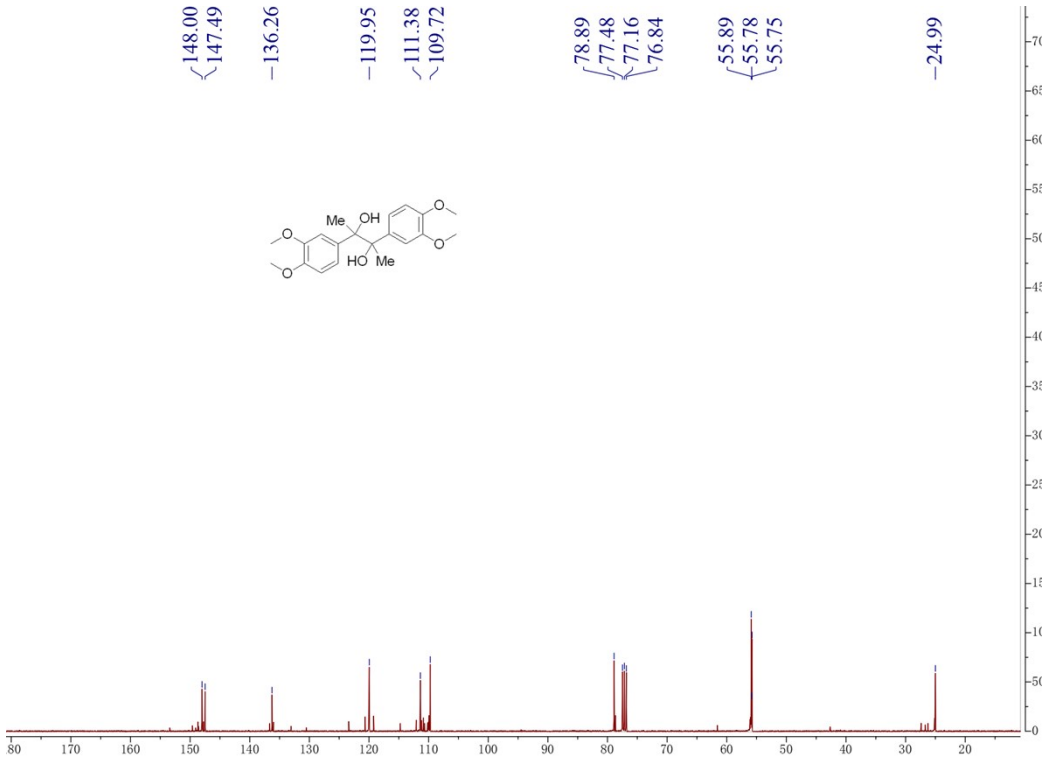
^{13}C NMR spectrum of compound 2m (100 MHz, DMSO-d_6)



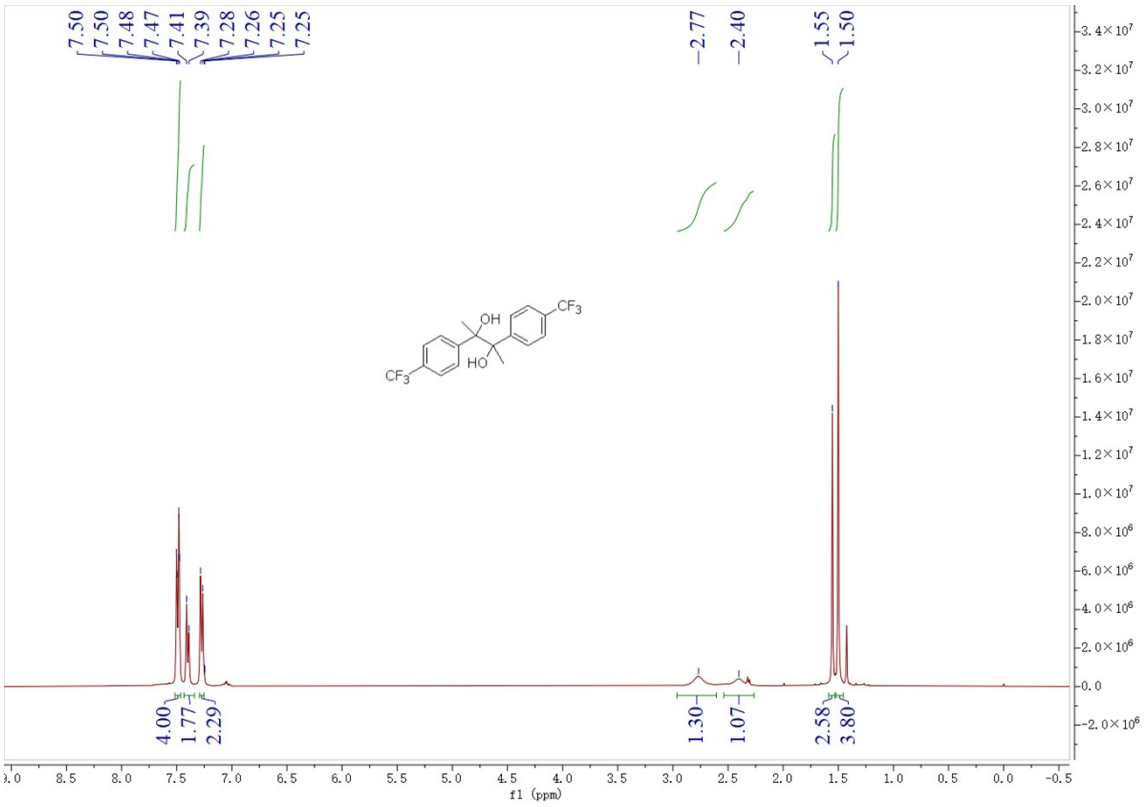
^{1}H NMR spectrum of compound 2n (400 MHz, $CDCl_3$)



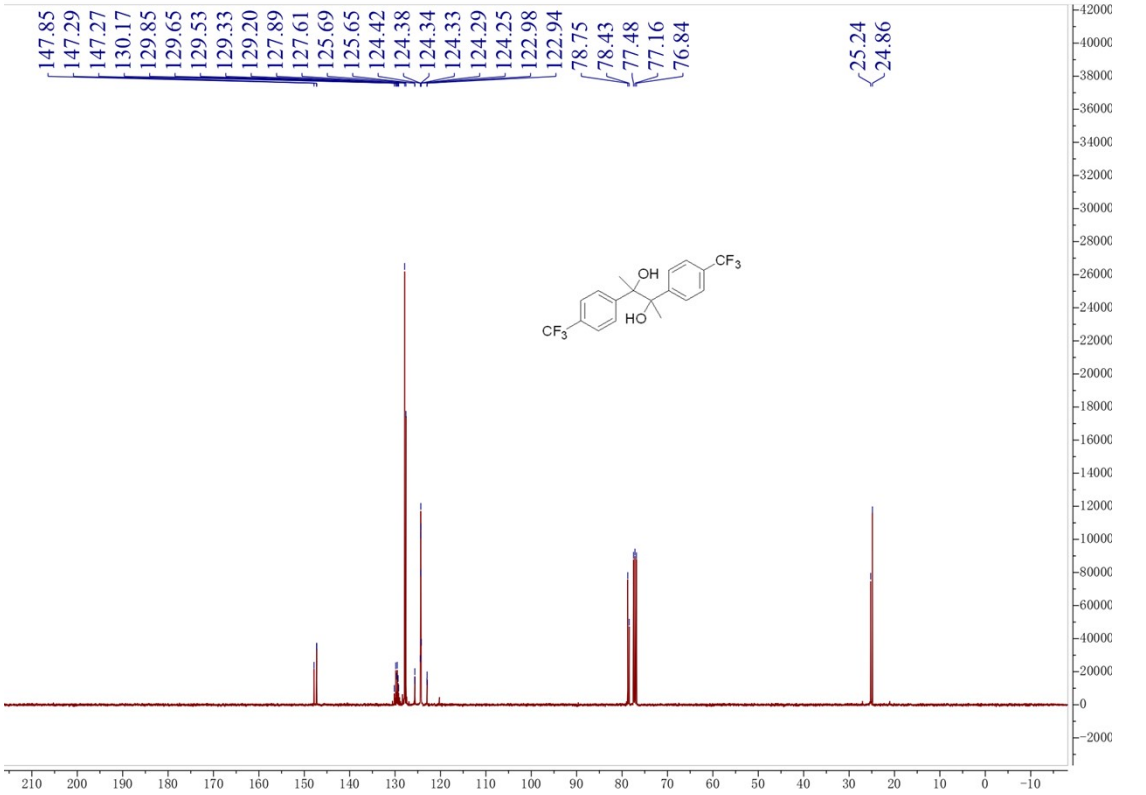
^{13}C NMR spectrum of compound 2n (100 MHz, $CDCl_3$)



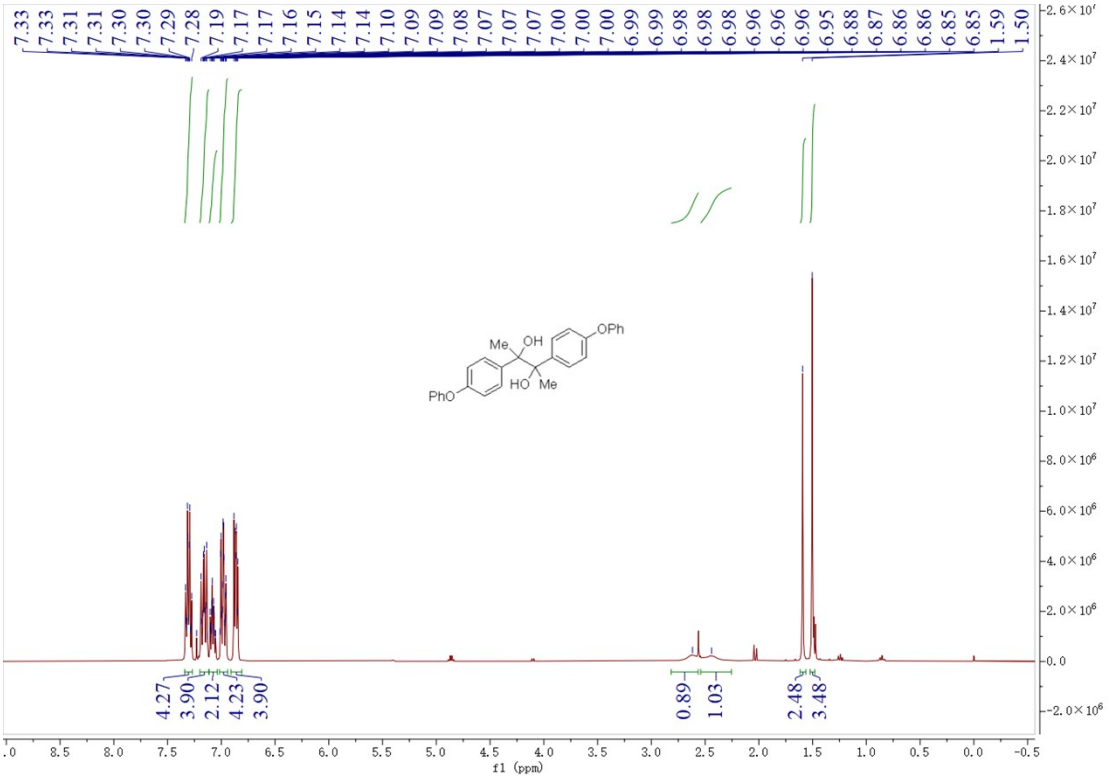
^{1}H NMR spectrum of compound 2o (400 MHz, $CDCl_3$)



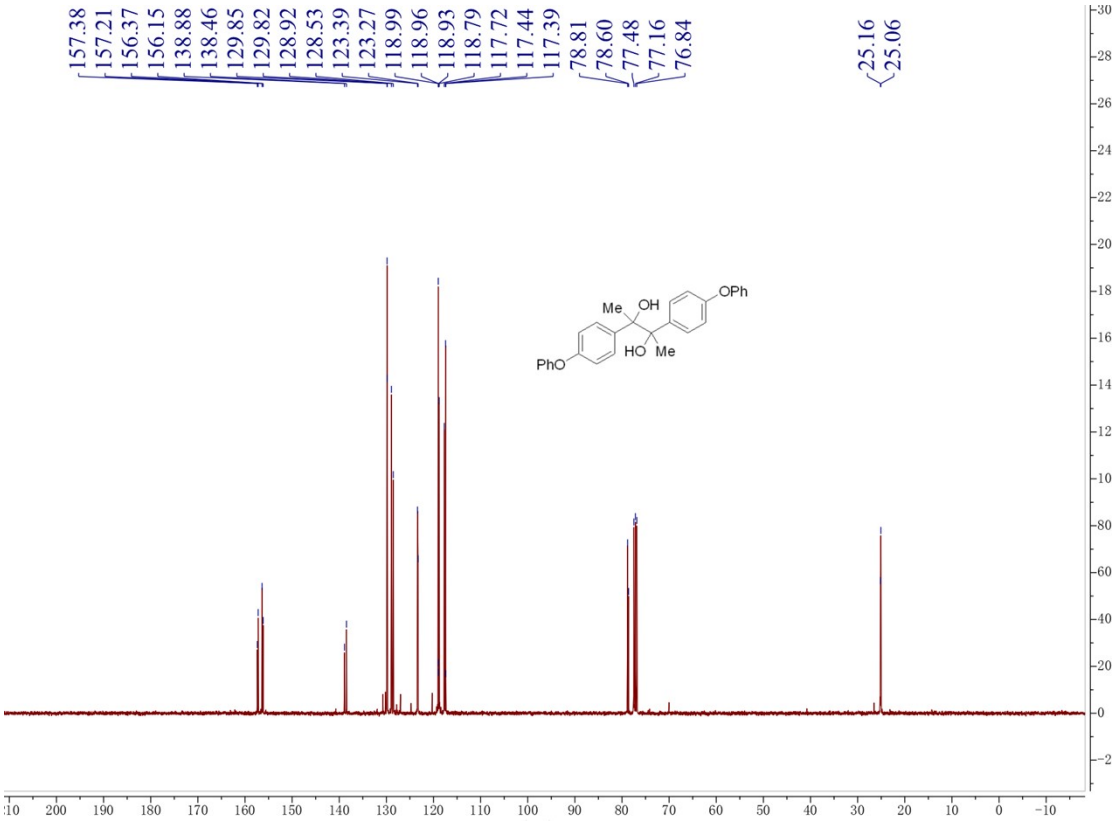
^{13}C NMR spectrum of compound 2o (100 MHz, $CDCl_3$)



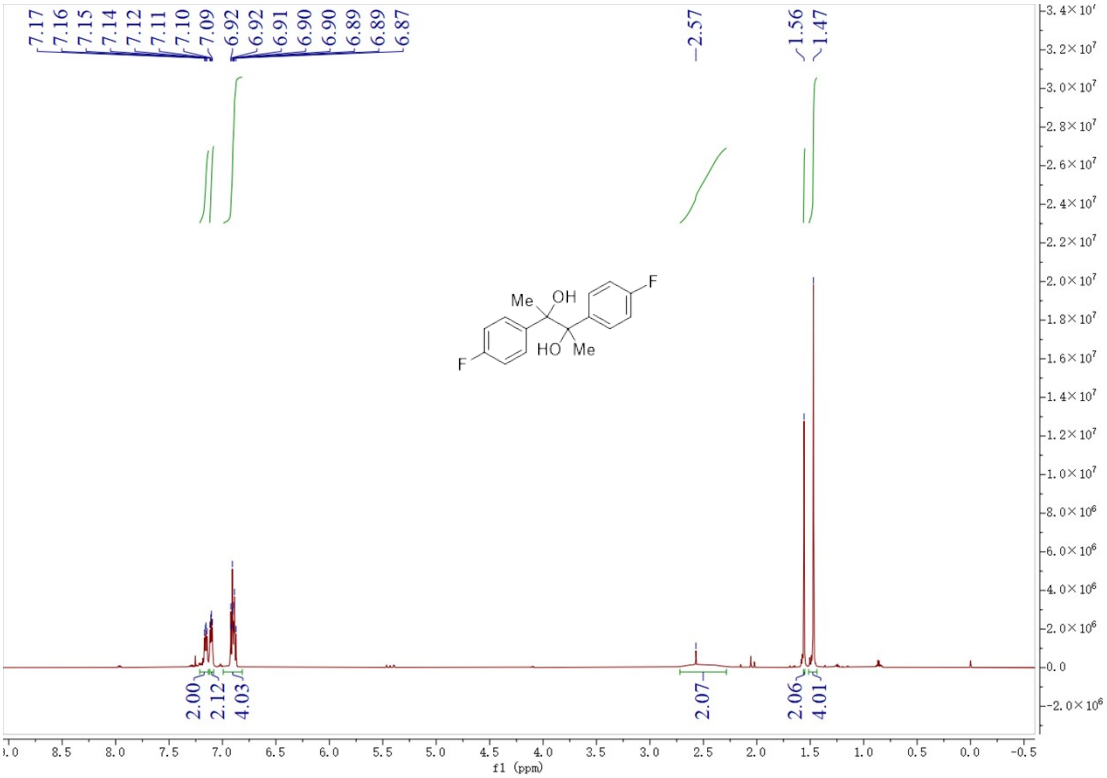
^{1}H NMR spectrum of compound 2p (400 MHz, $CDCl_3$)



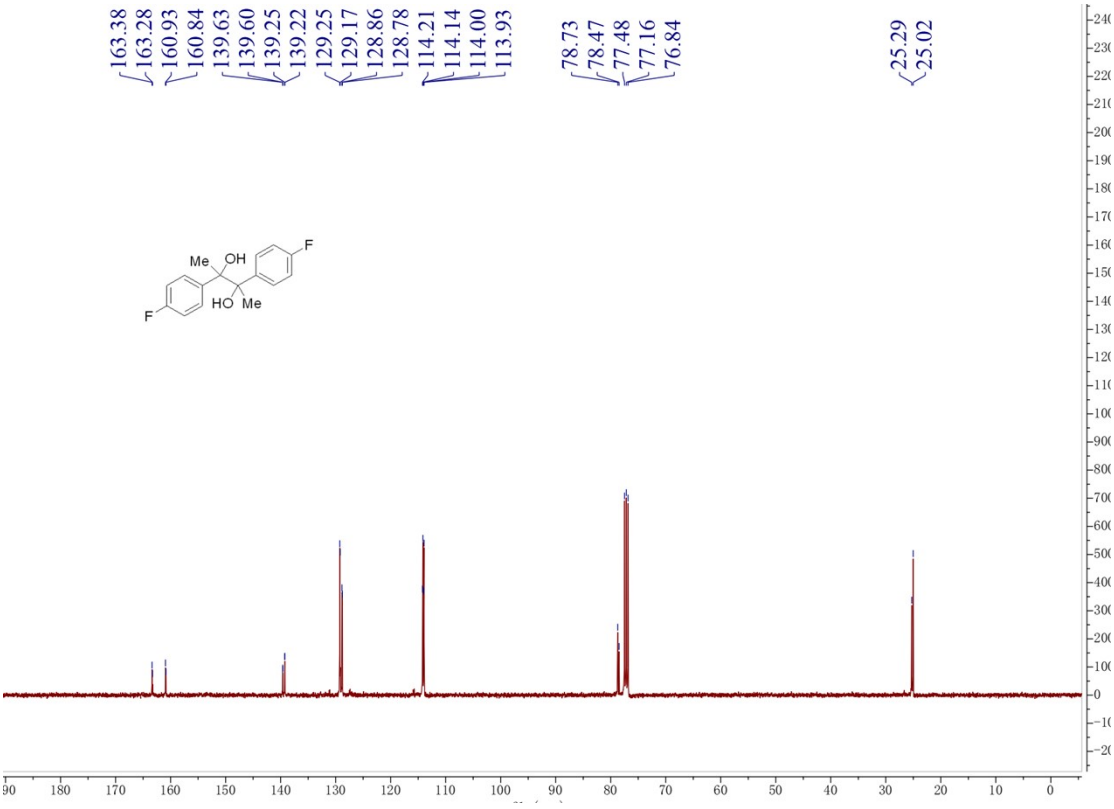
^{13}C NMR spectrum of compound 2p (100 MHz, $CDCl_3$)



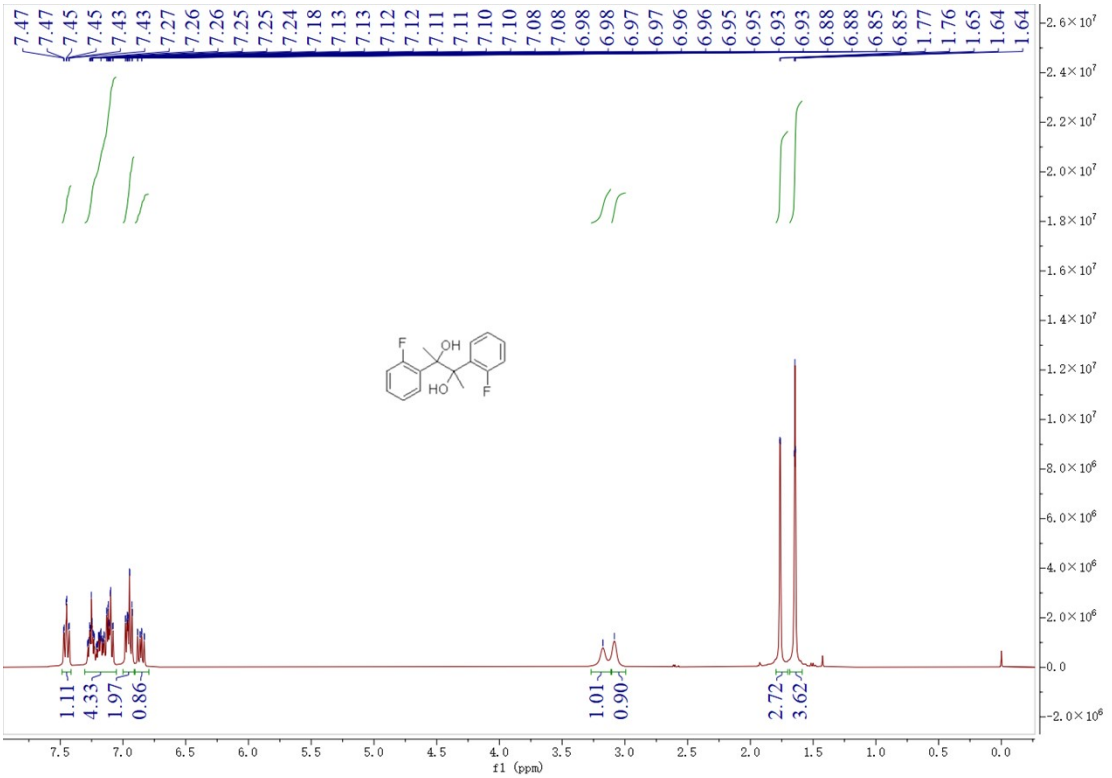
^{1}H NMR spectrum of compound 2q (400 MHz, $CDCl_3$)



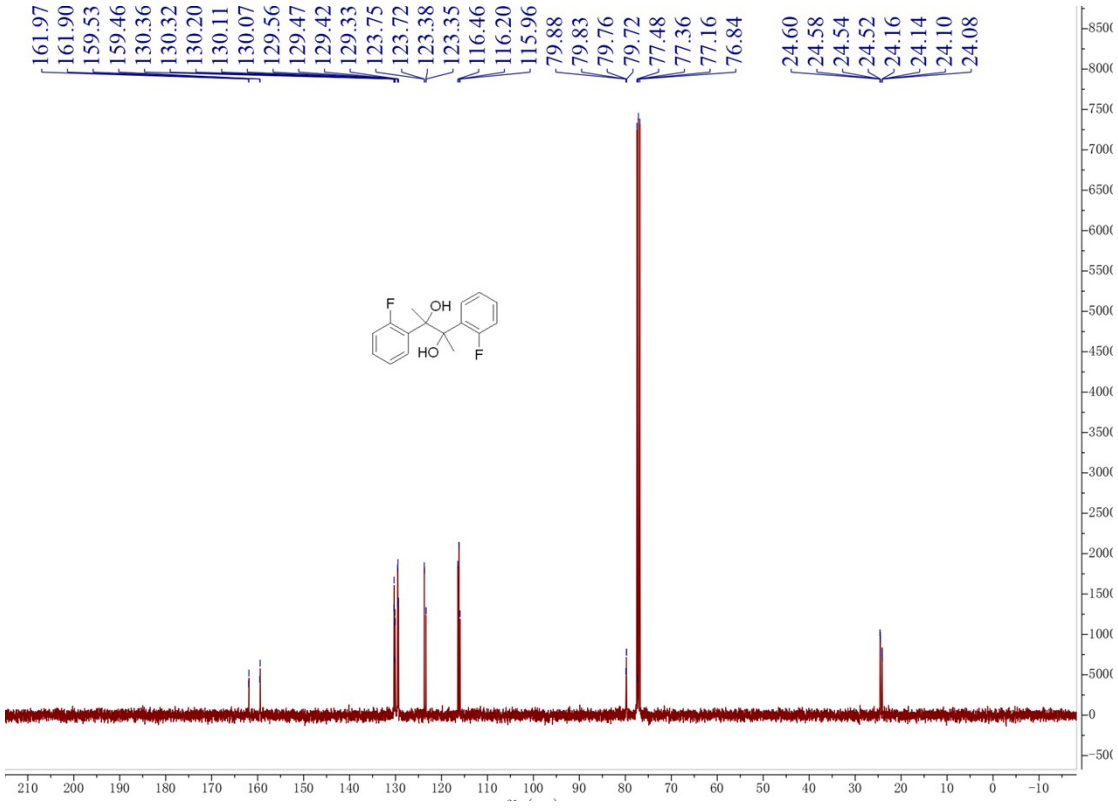
^{13}C NMR spectrum of compound 2q (100 MHz, $CDCl_3$)



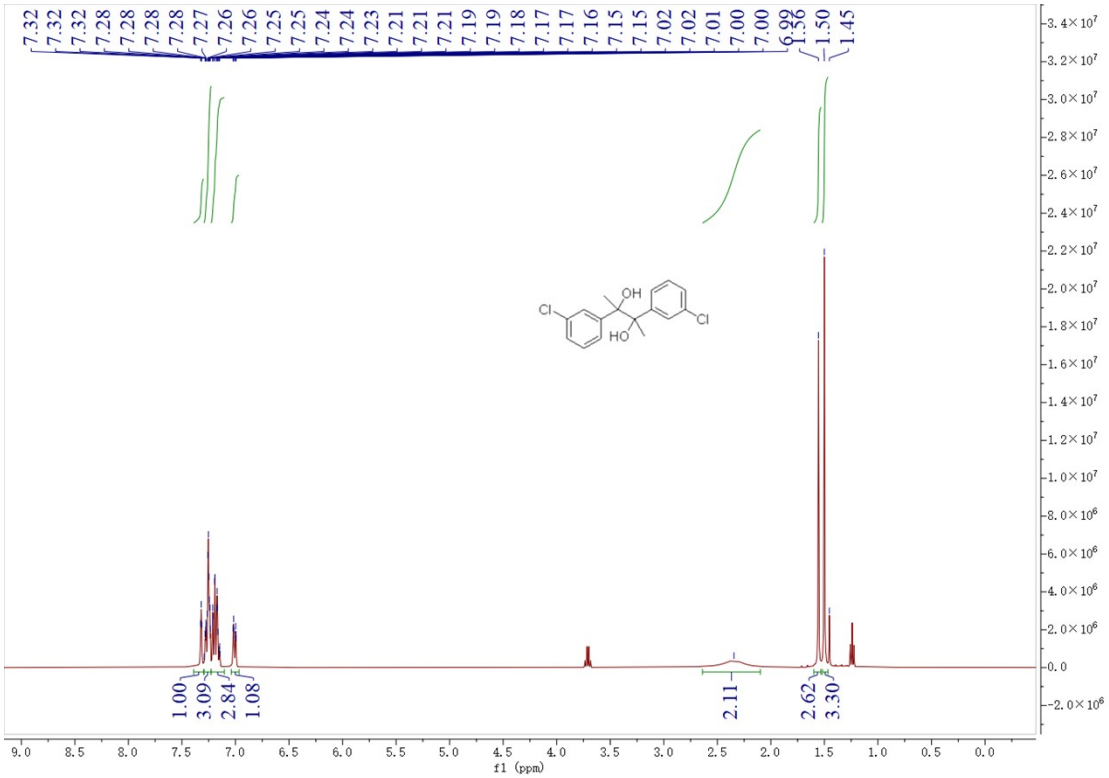
^{1}H NMR spectrum of compound 2r (400 MHz, $CDCl_3$)



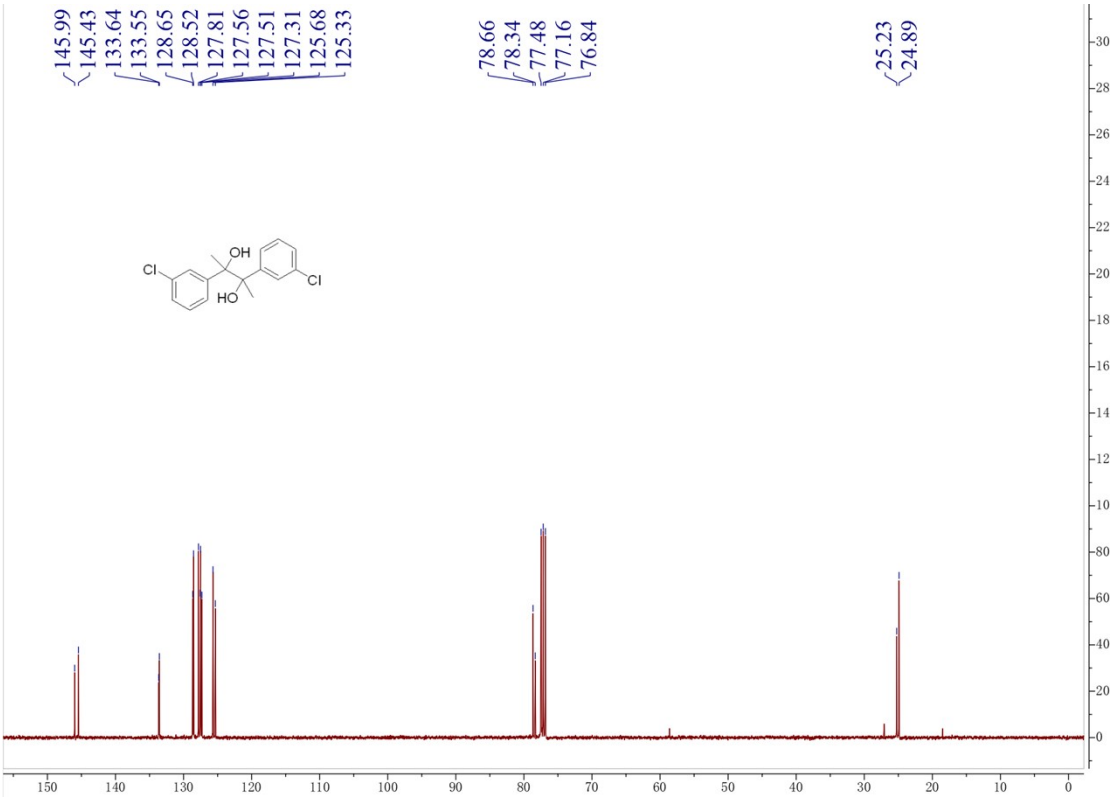
^{13}C NMR spectrum of compound 2r (100 MHz, $CDCl_3$)



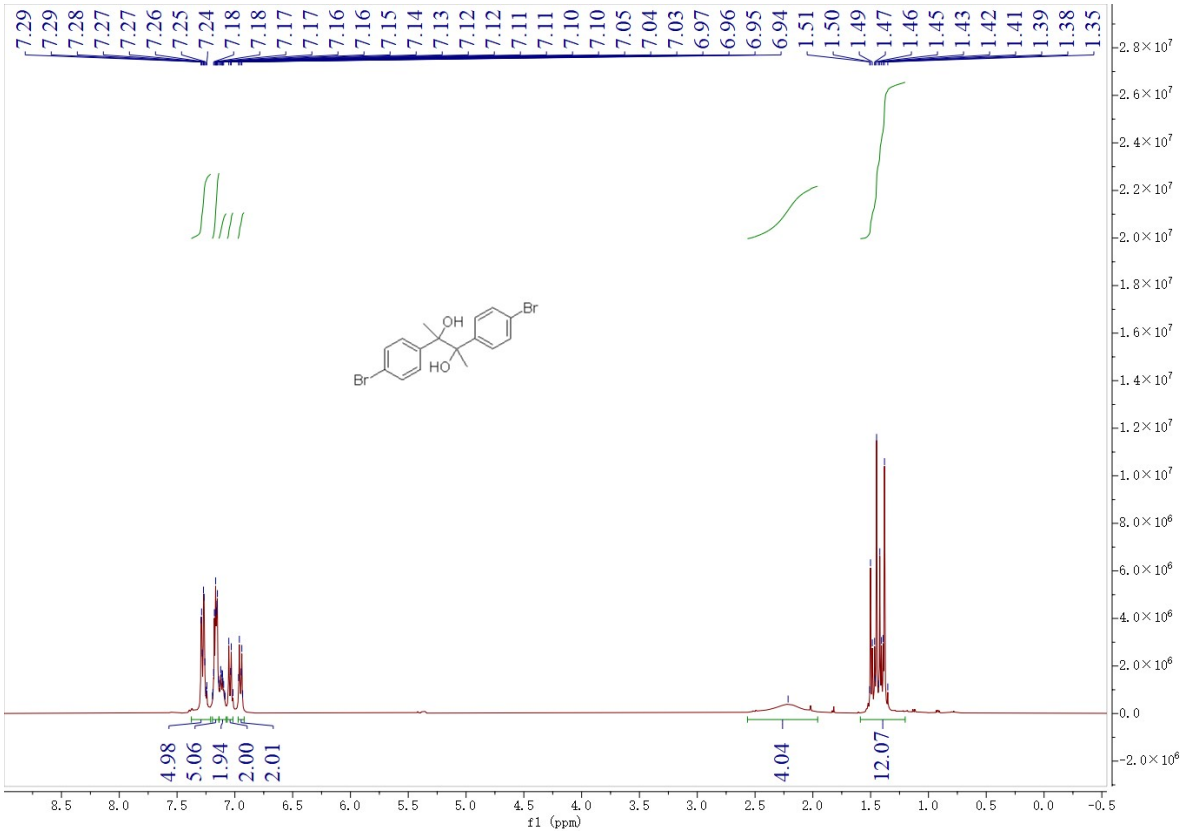
^{1}H NMR spectrum of compound 2s (400 MHz, $CDCl_3$)



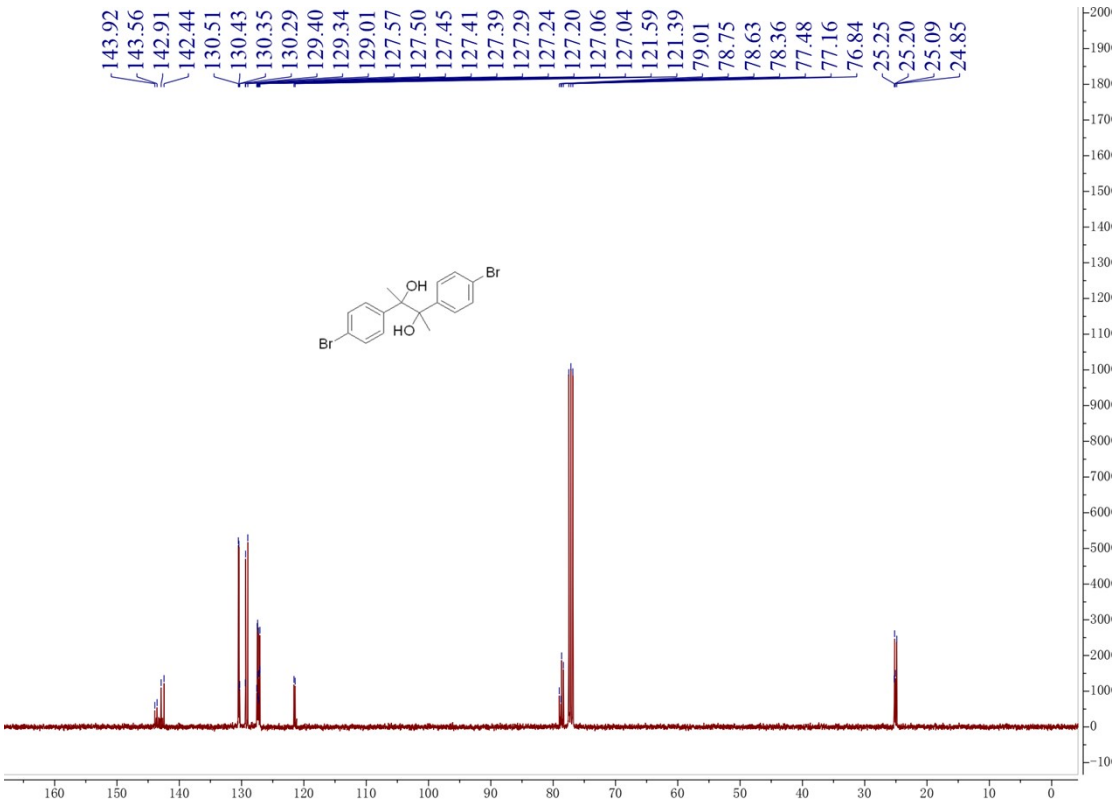
^{13}C NMR spectrum of compound 2s (100 MHz, $CDCl_3$)



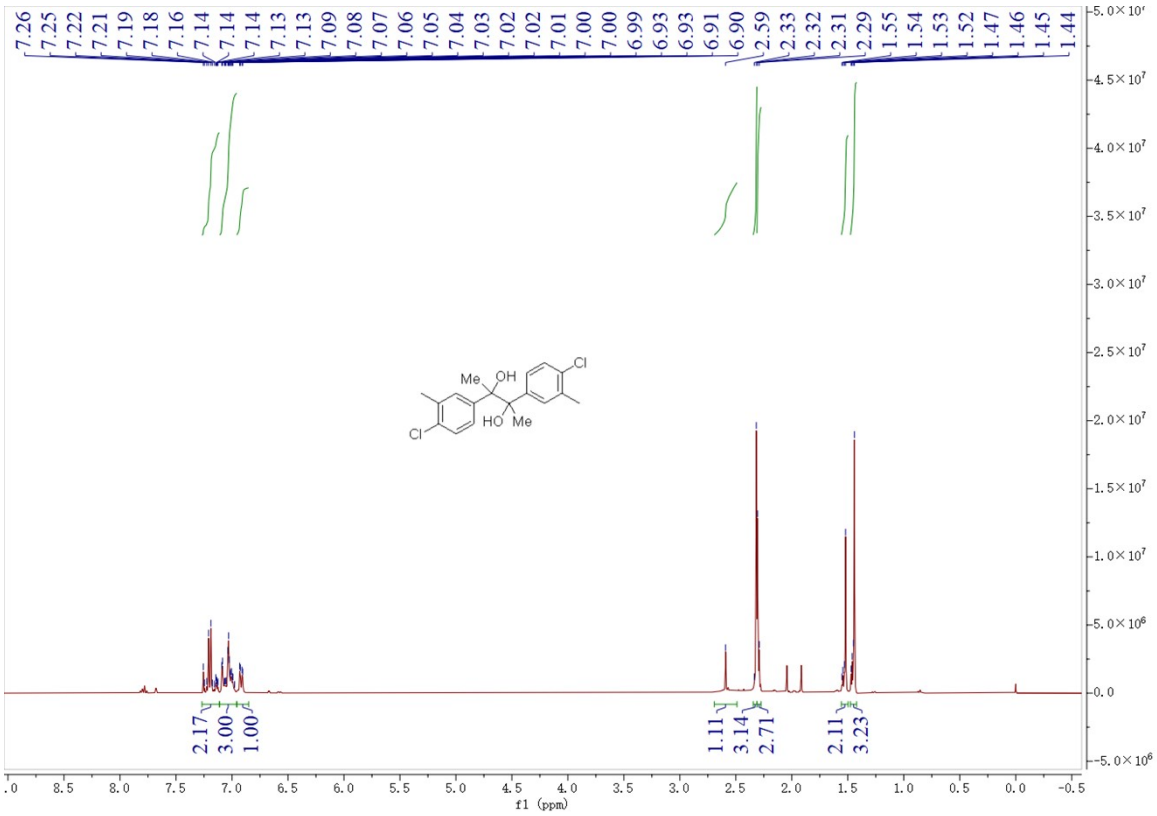
^{1}H NMR spectrum of compound 2t (400 MHz, $CDCl_3$)



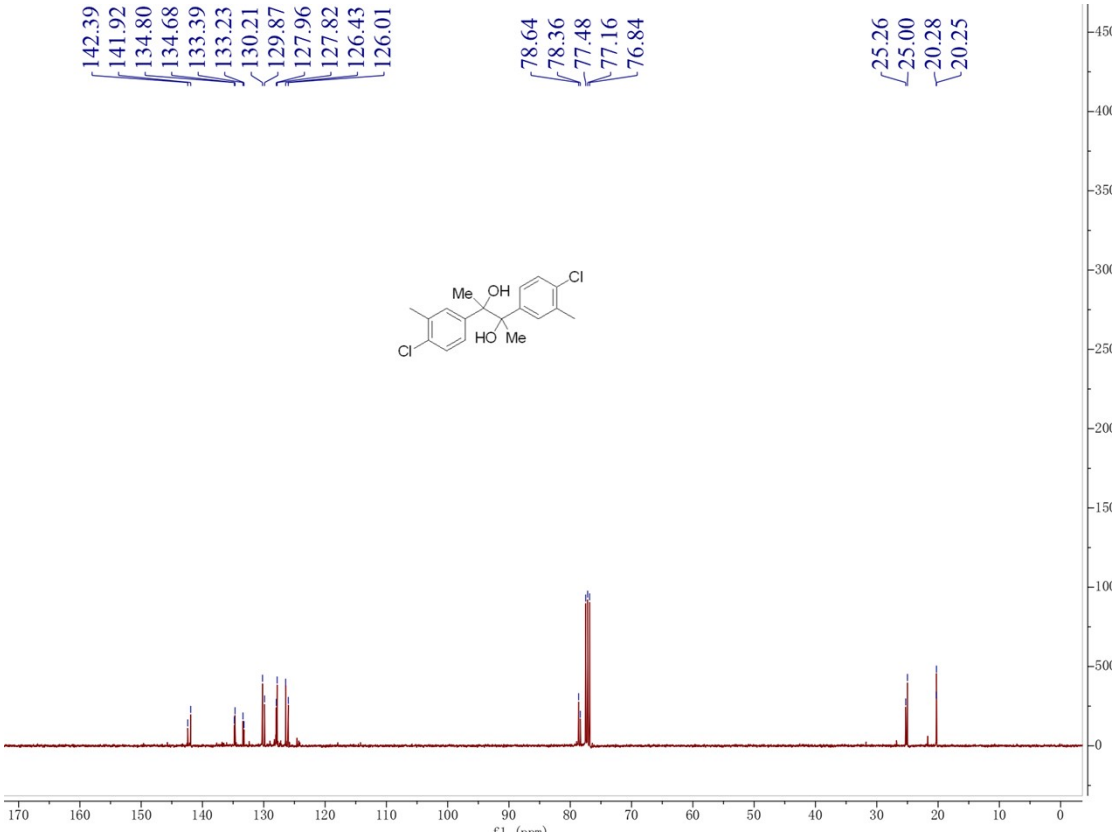
^{13}C NMR spectrum of compound 2t (100 MHz, $CDCl_3$)



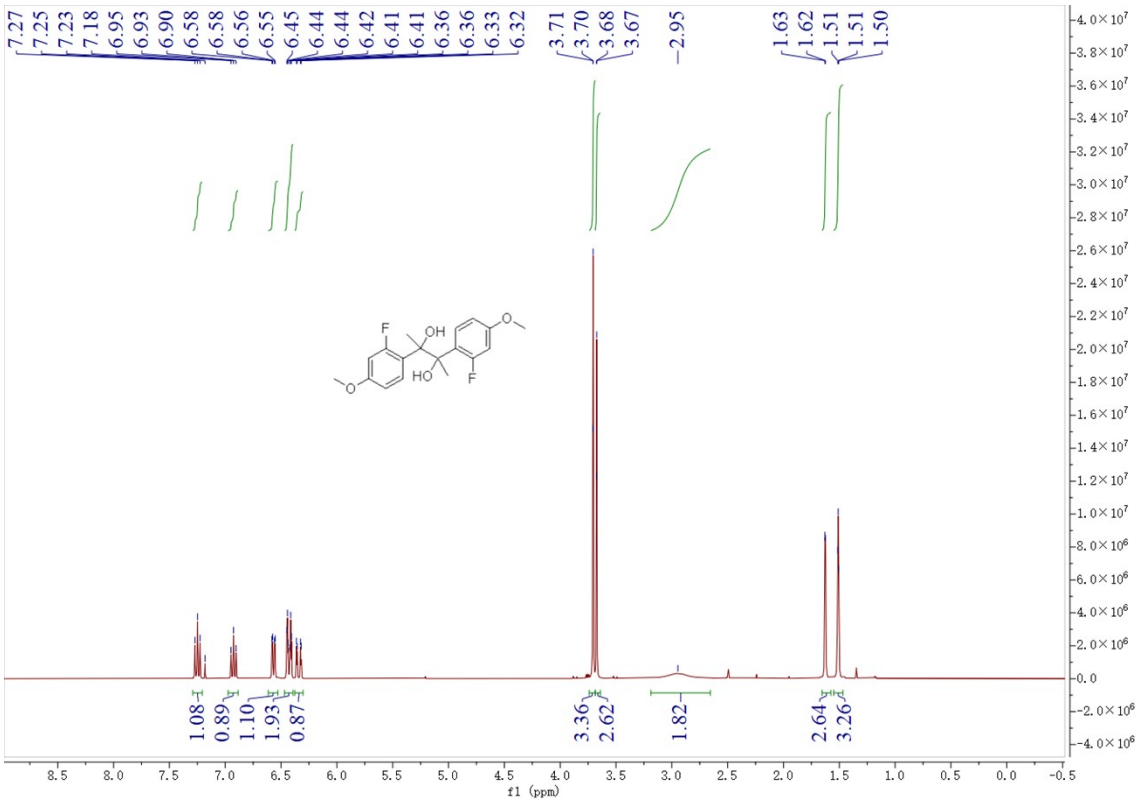
^{1}H NMR spectrum of compound 2u (400 MHz, $CDCl_3$)



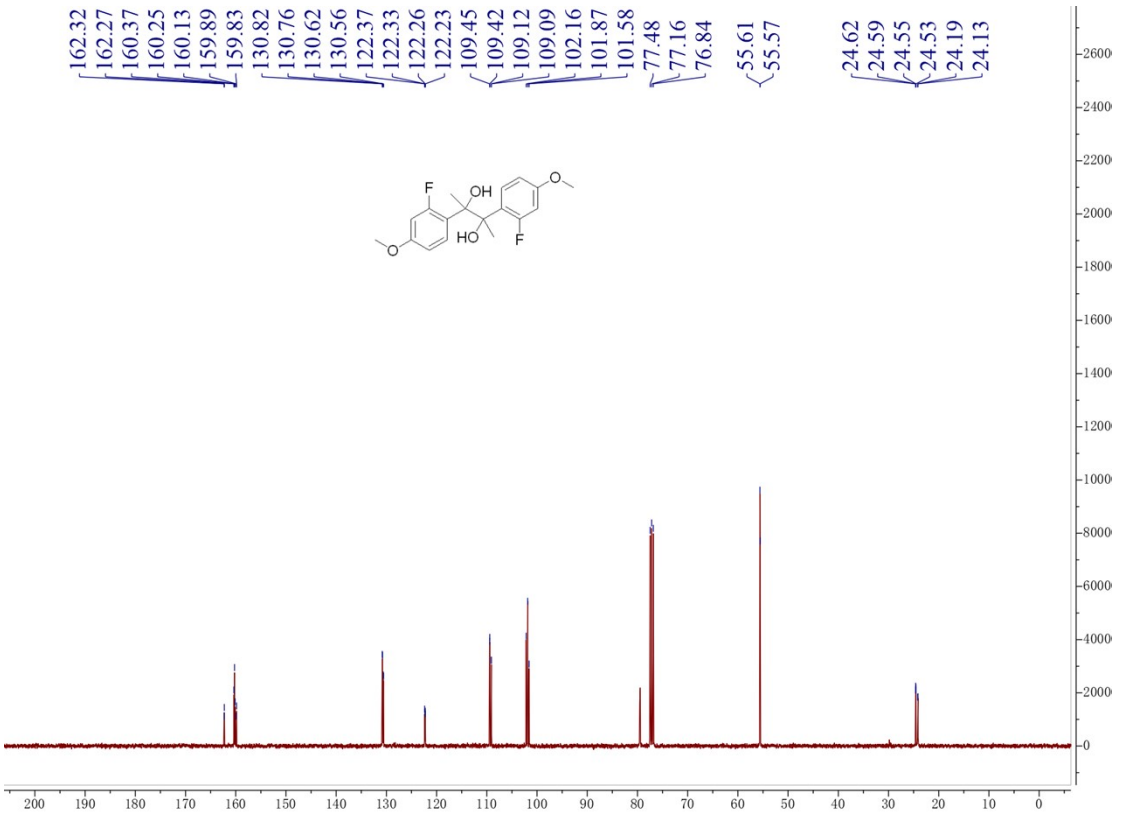
^{13}C NMR spectrum of compound 2u (100 MHz, $CDCl_3$)



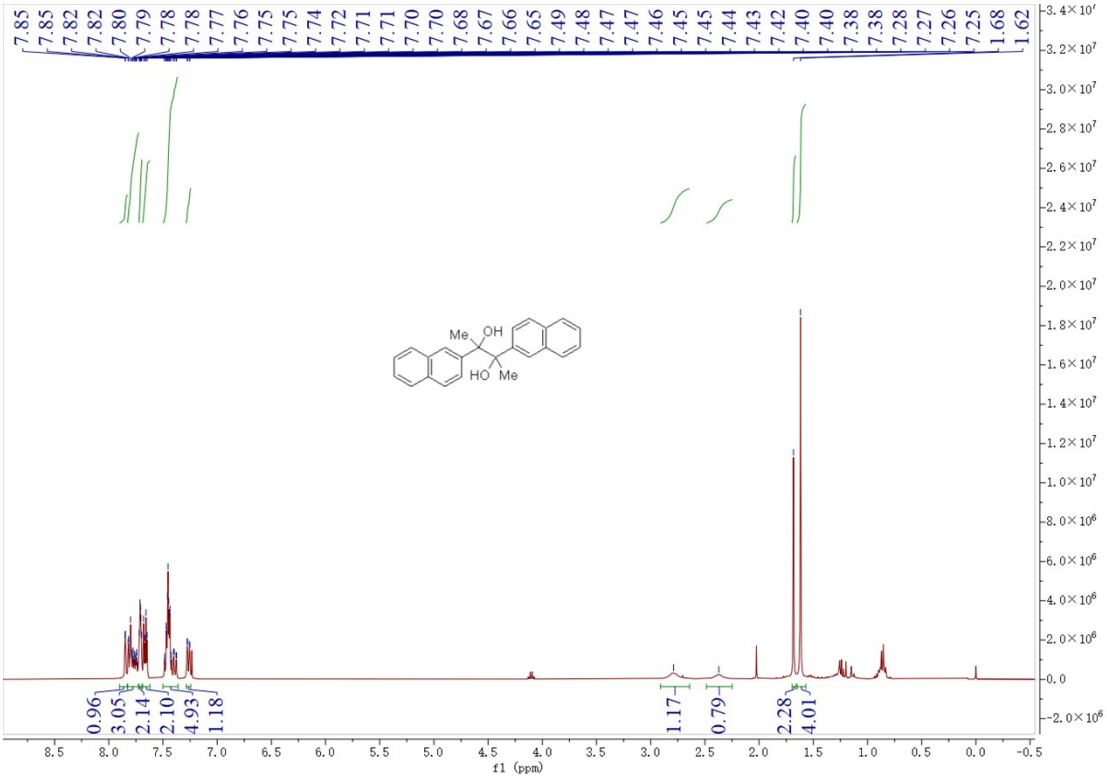
^{1}H NMR spectrum of compound 2v (400 MHz, $CDCl_3$)



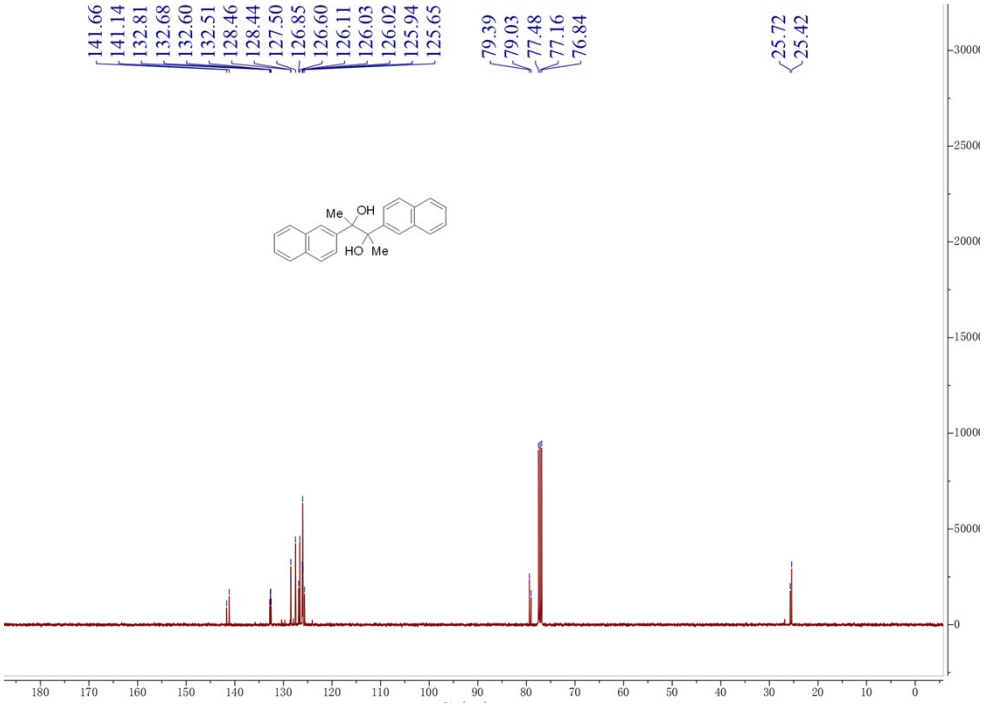
^{13}C NMR spectrum of compound 2v (100 MHz, $CDCl_3$)



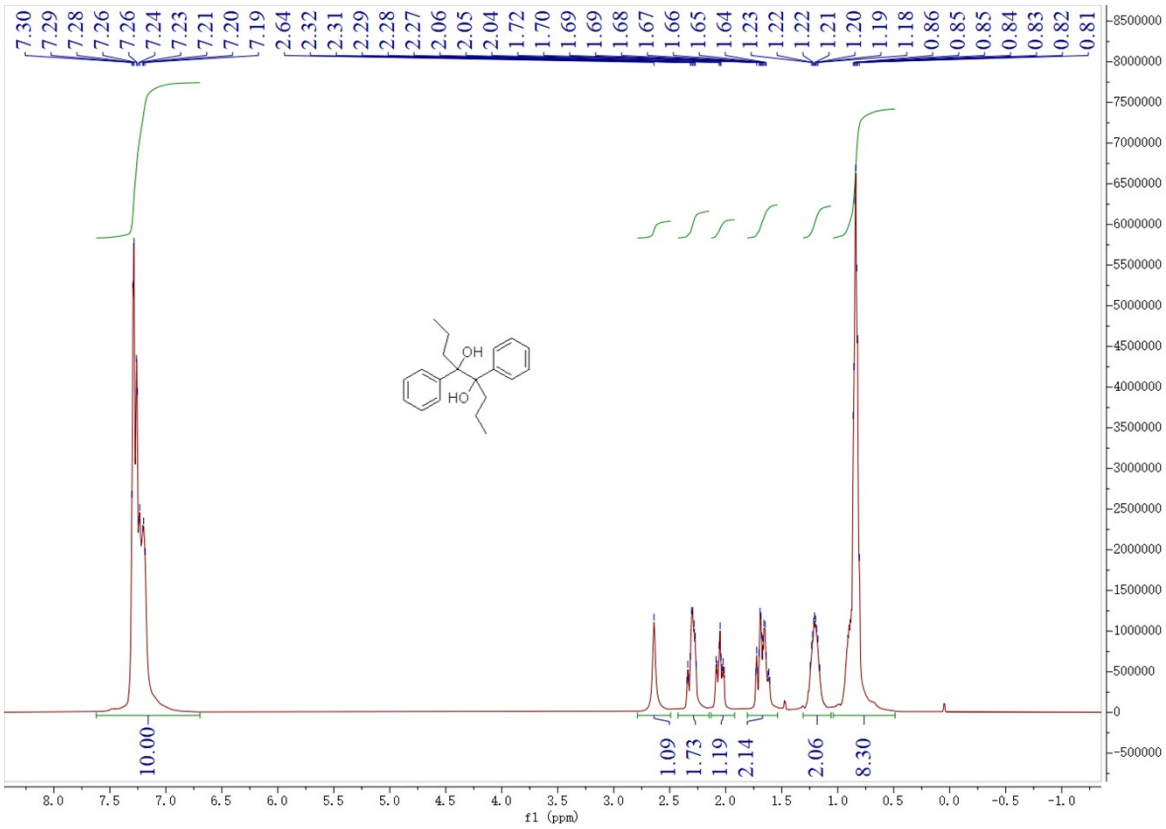
^{1}H NMR spectrum of compound 2w (400 MHz, $CDCl_3$)



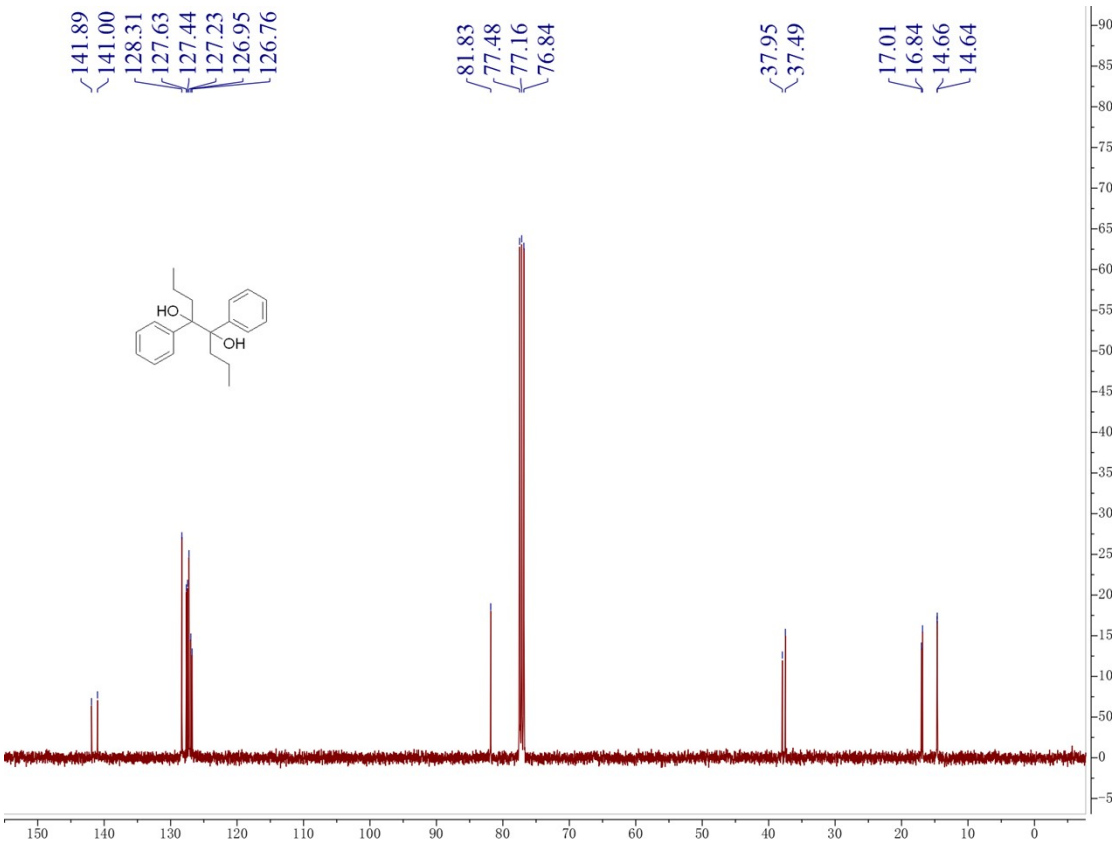
^{13}C NMR spectrum of compound 2w (100 MHz, $CDCl_3$)



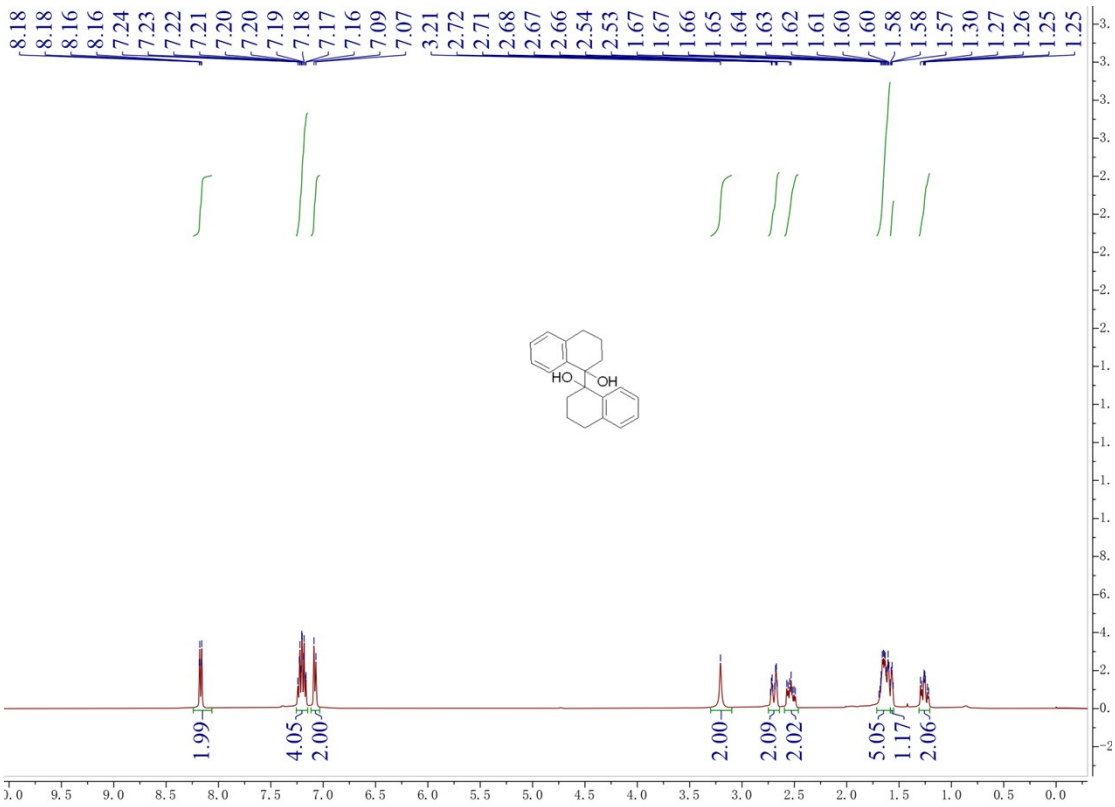
^{1}H NMR spectrum of compound 2x (400 MHz, $CDCl_3$)



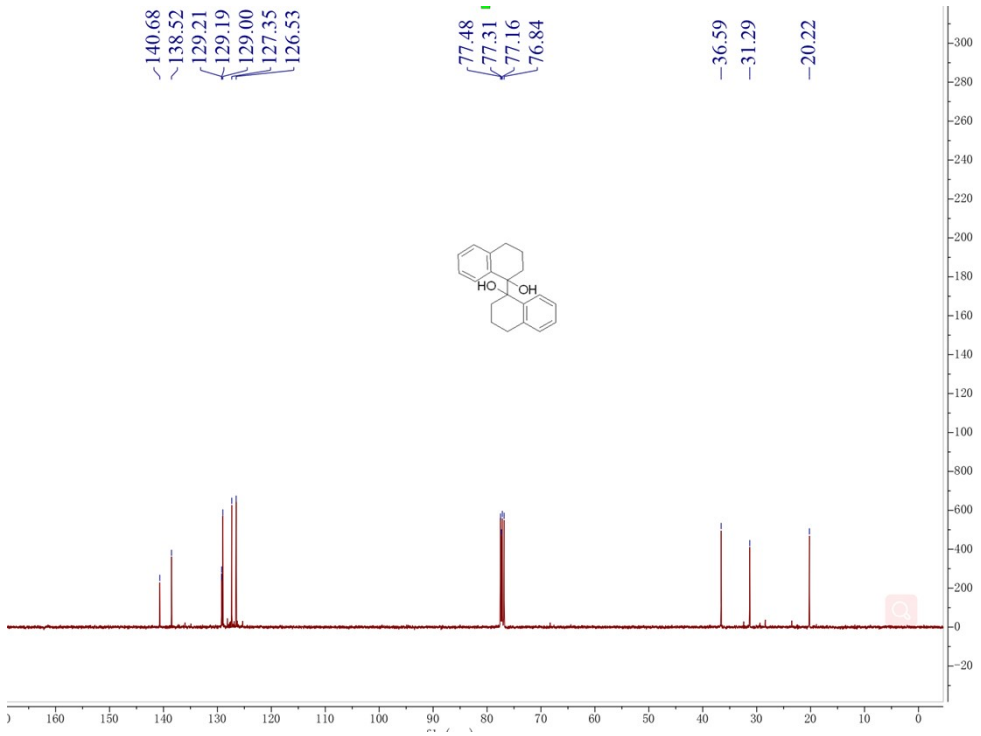
^{13}C NMR spectrum of compound 2x (100 MHz, $CDCl_3$)



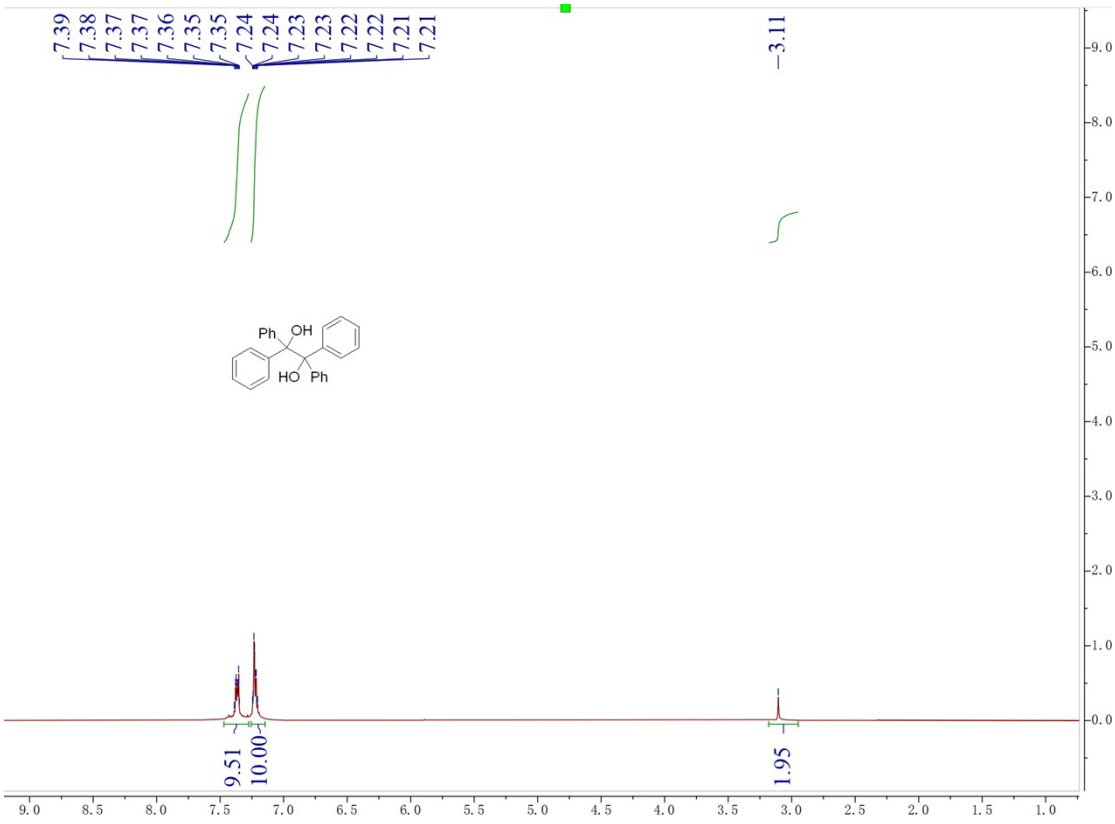
^{1}H NMR spectrum of compound 2y (400 MHz, $CDCl_3$)



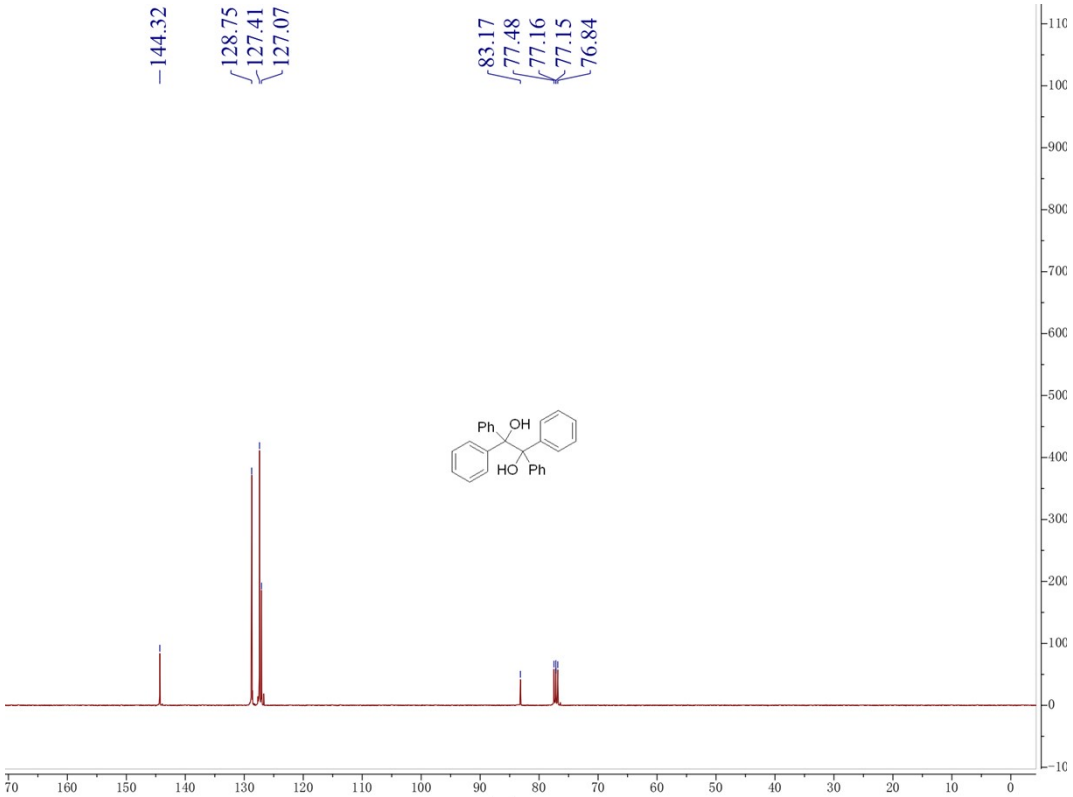
^{13}C NMR spectrum of compound 2y (100 MHz, $CDCl_3$)



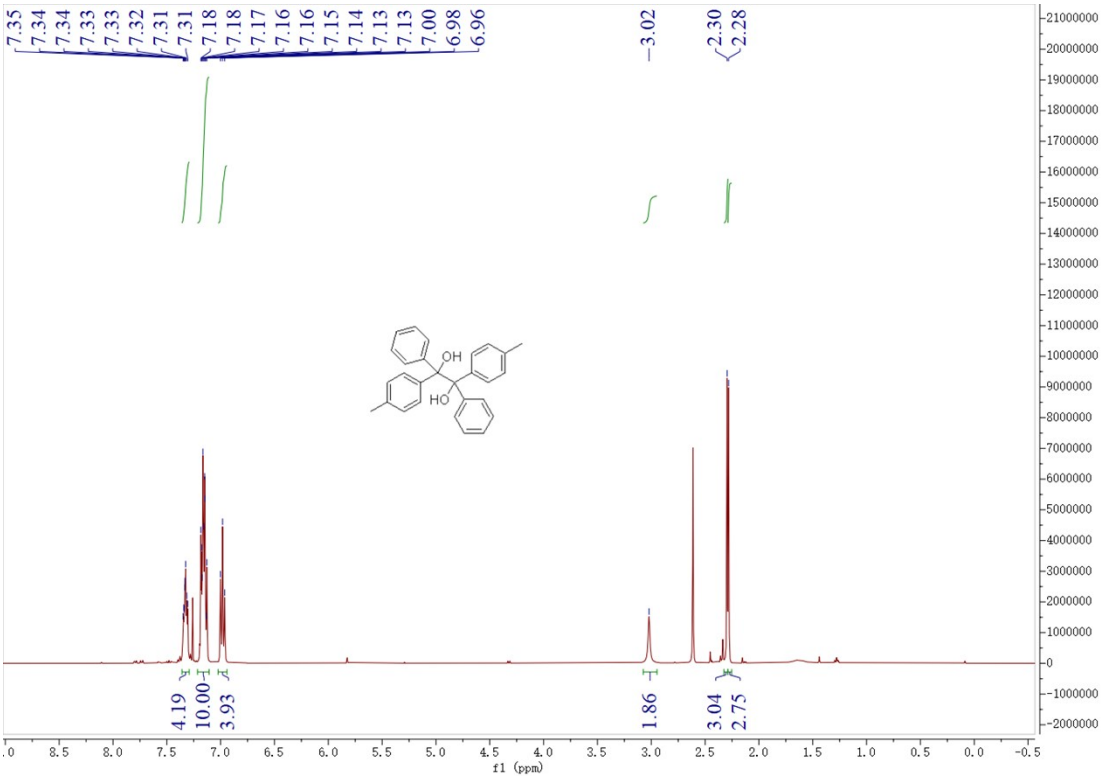
^{1}H NMR spectrum of compound 2z (400 MHz, $CDCl_3$)



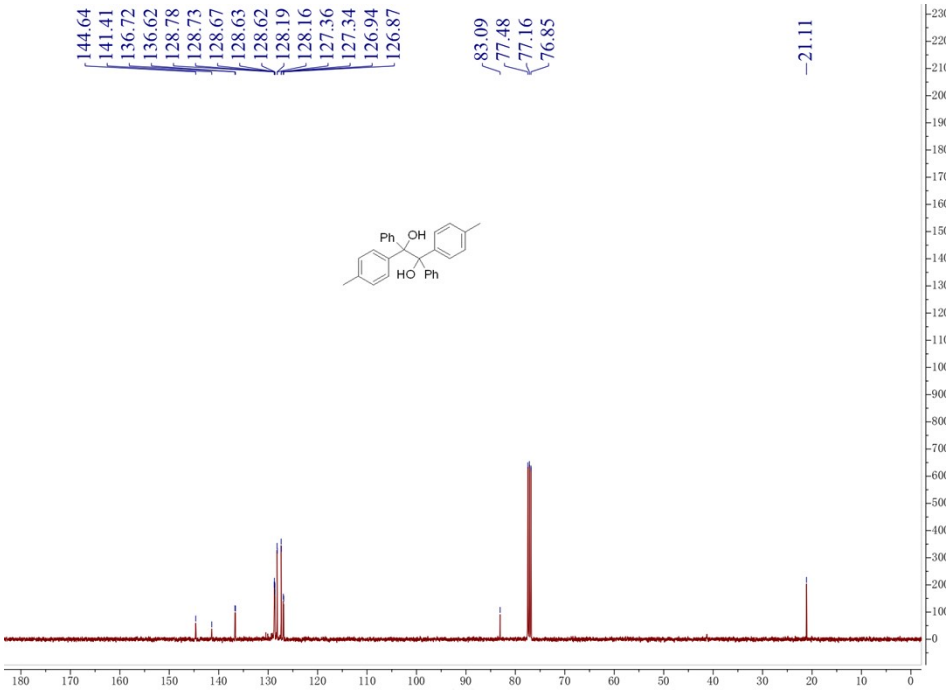
^{13}C NMR spectrum of compound 2z (100 MHz, $CDCl_3$)



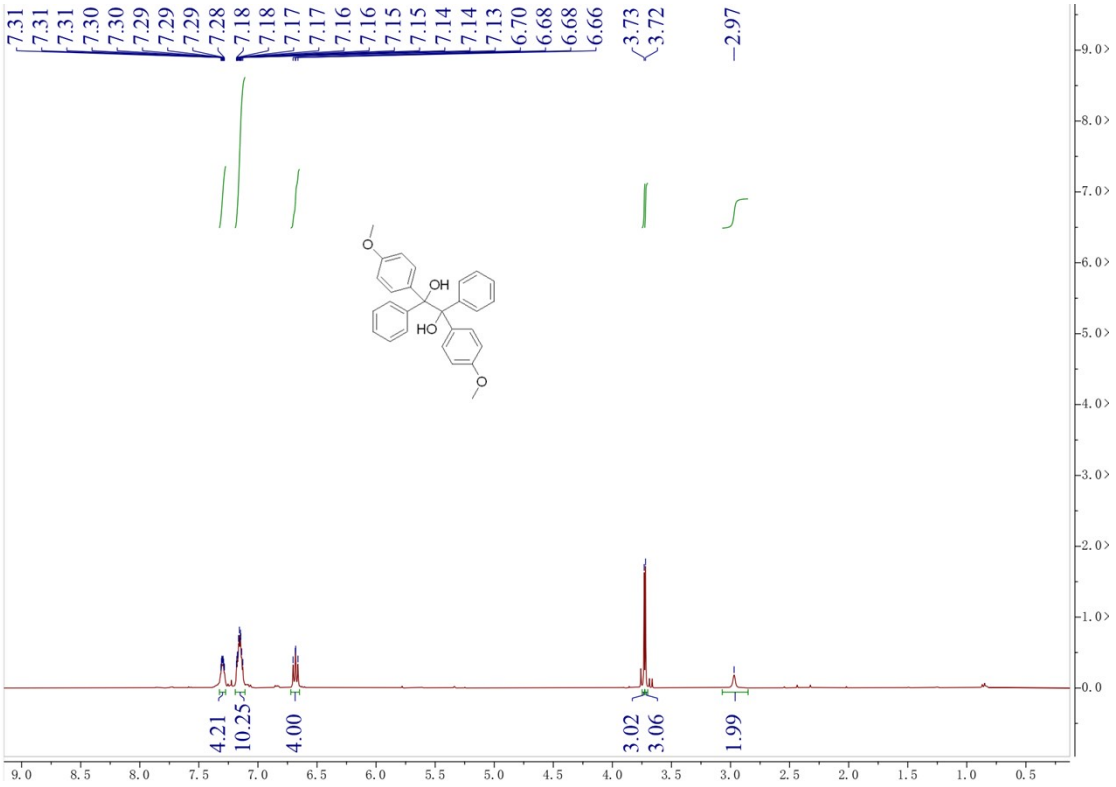
^{1}H NMR spectrum of compound 2a' (400 MHz, $CDCl_3$)



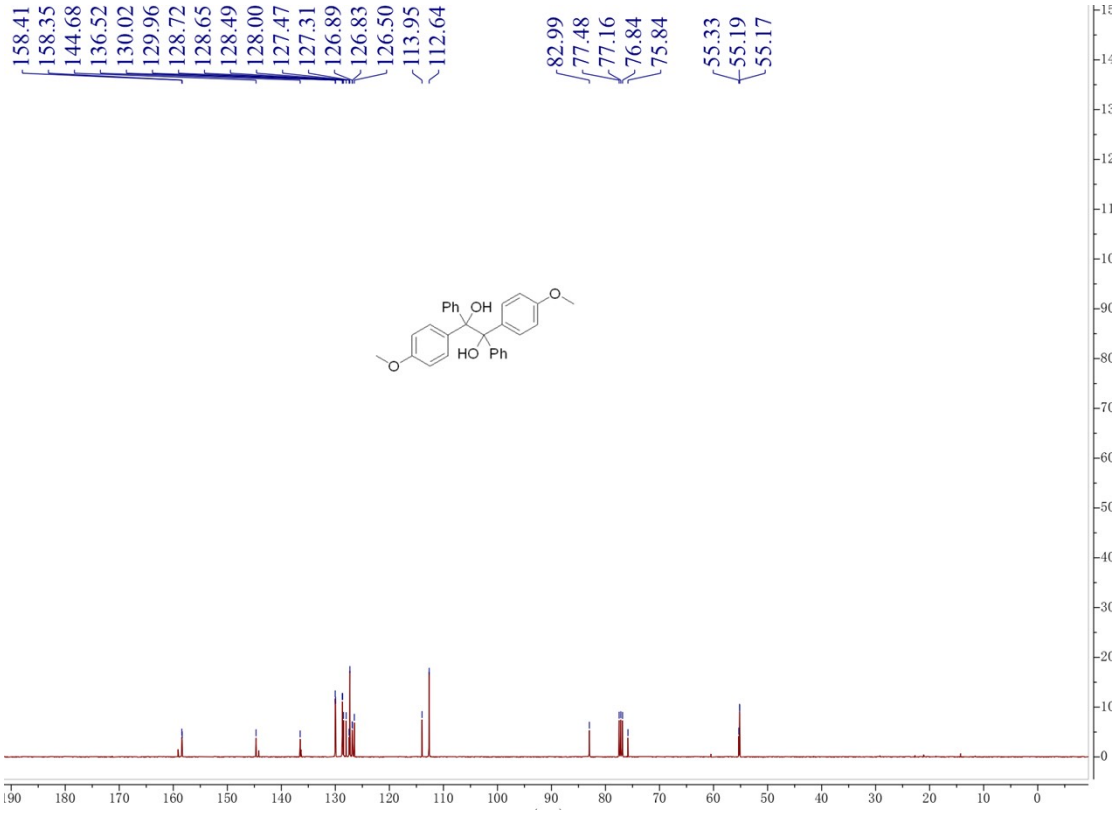
^{13}C NMR spectrum of compound 2a' (100 MHz, $CDCl_3$)



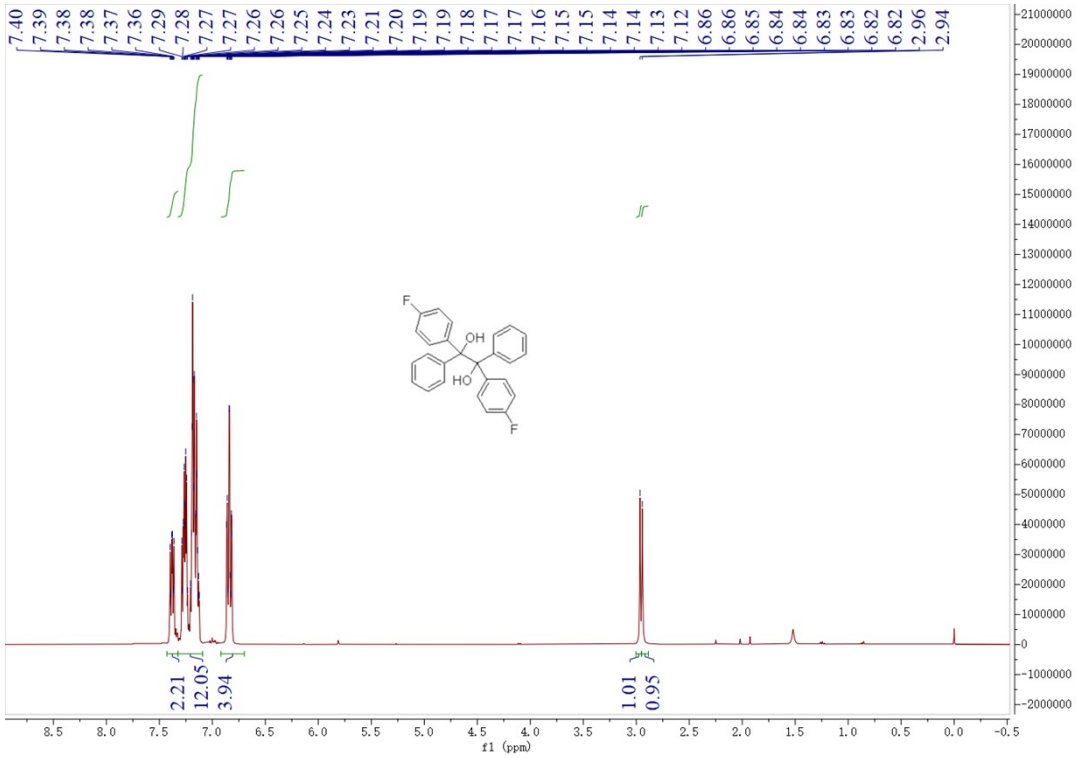
^{1}H NMR spectrum of compound 2b' (400 MHz, $CDCl_3$)



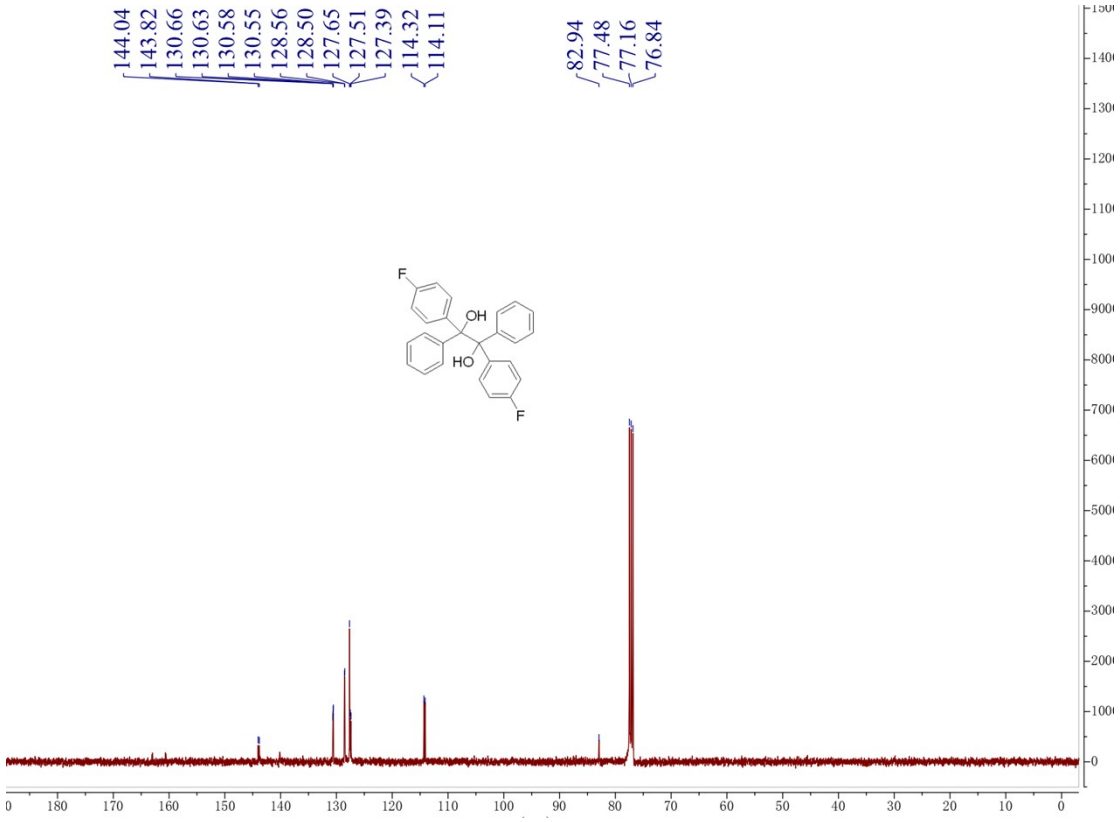
^{13}C NMR spectrum of compound 2b' (100 MHz, $CDCl_3$)



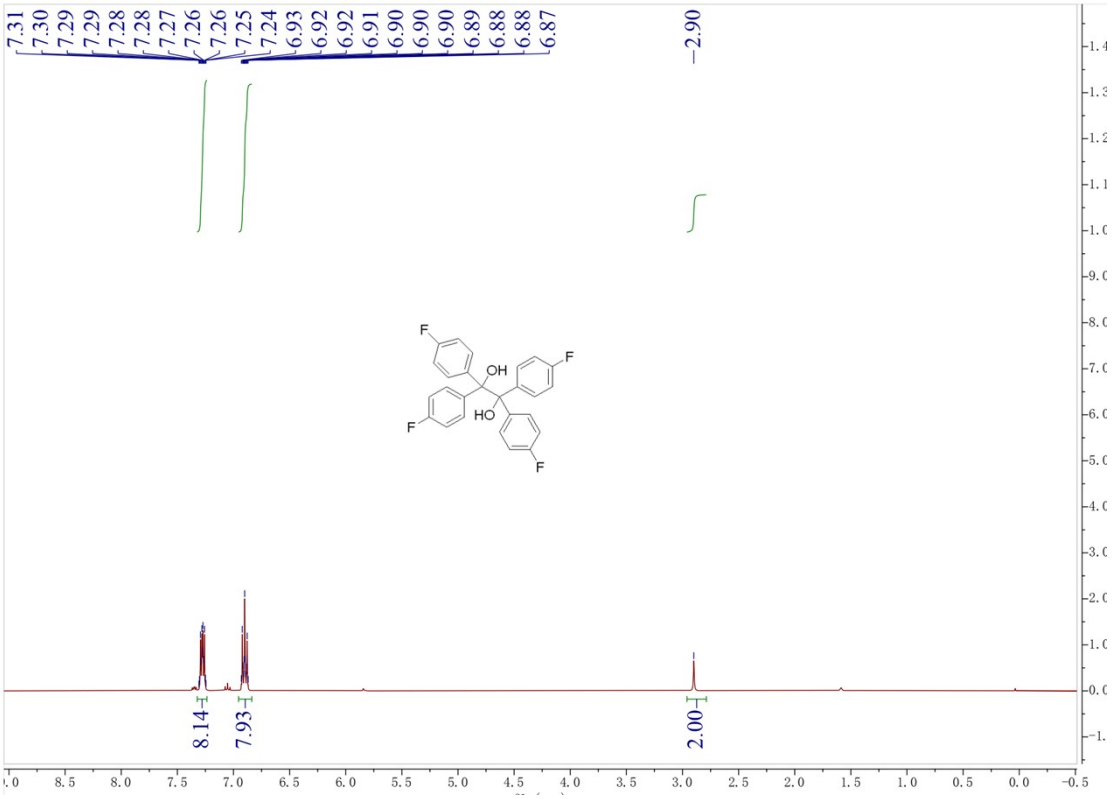
^{1}H NMR spectrum of compound 2c' (400 MHz, $CDCl_3$)



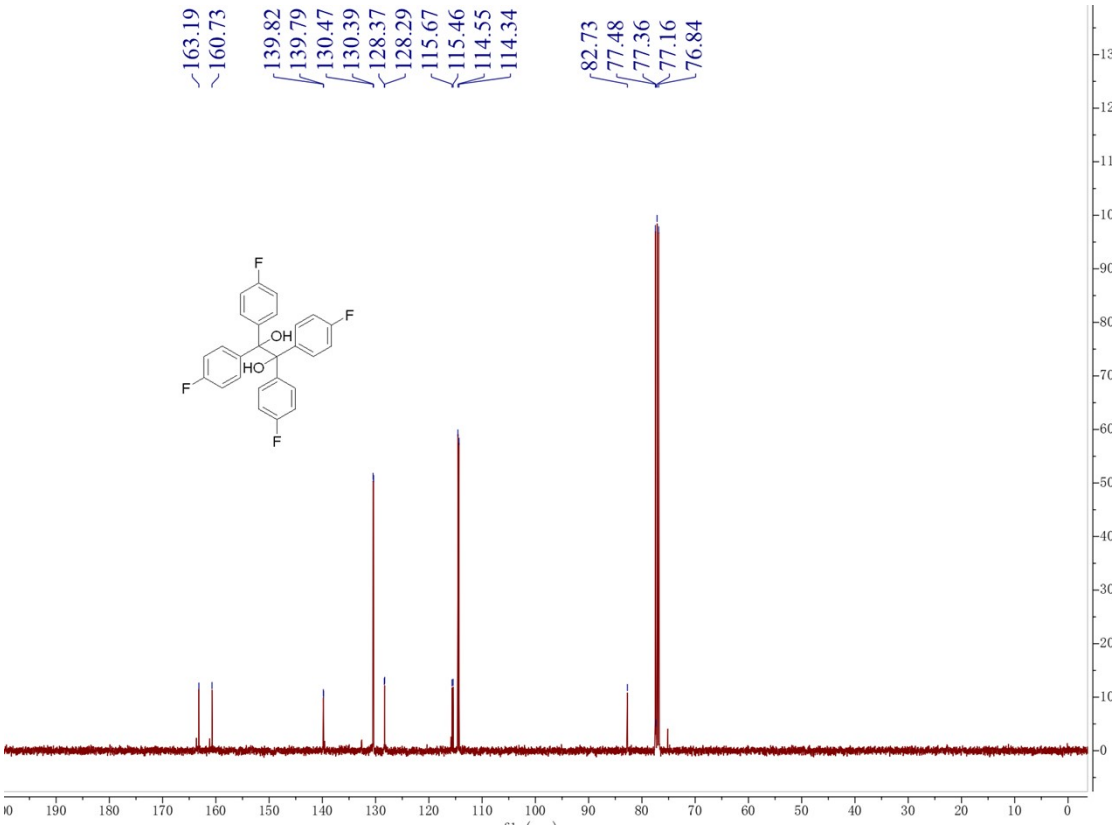
^{13}C NMR spectrum of compound 2c' (100 MHz, $CDCl_3$)



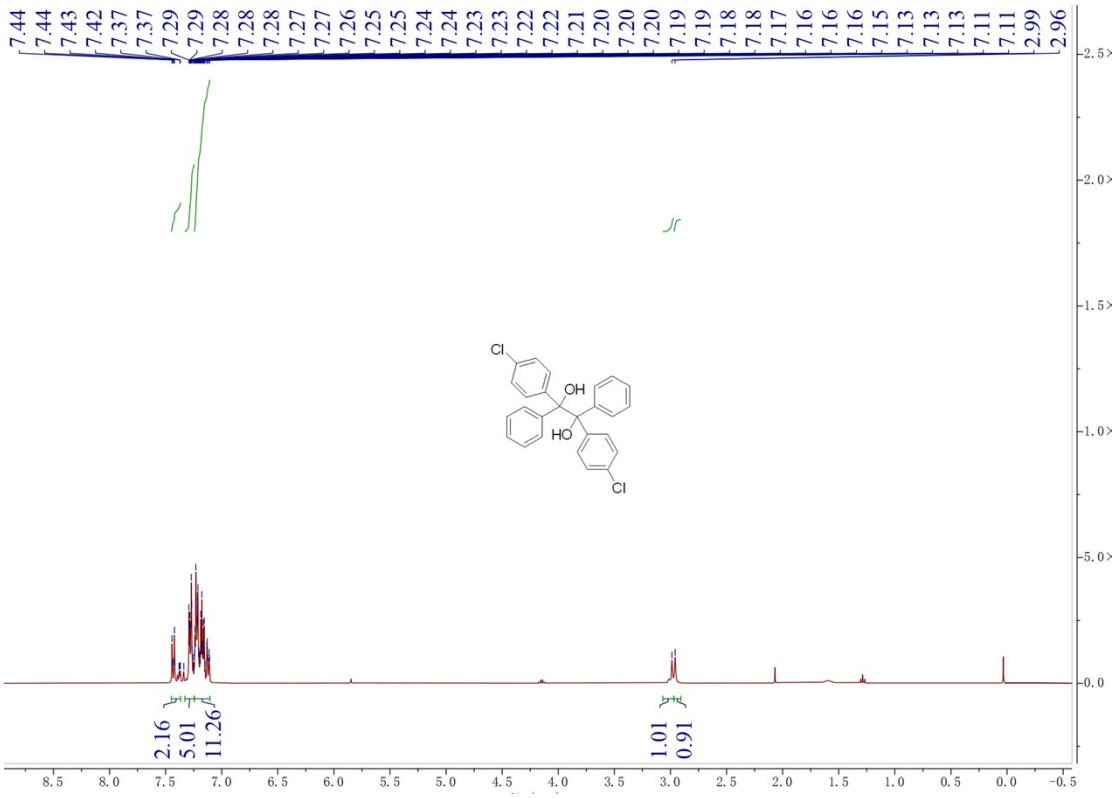
^{1}H NMR spectrum of compound 2d' (400 MHz, $CDCl_3$)



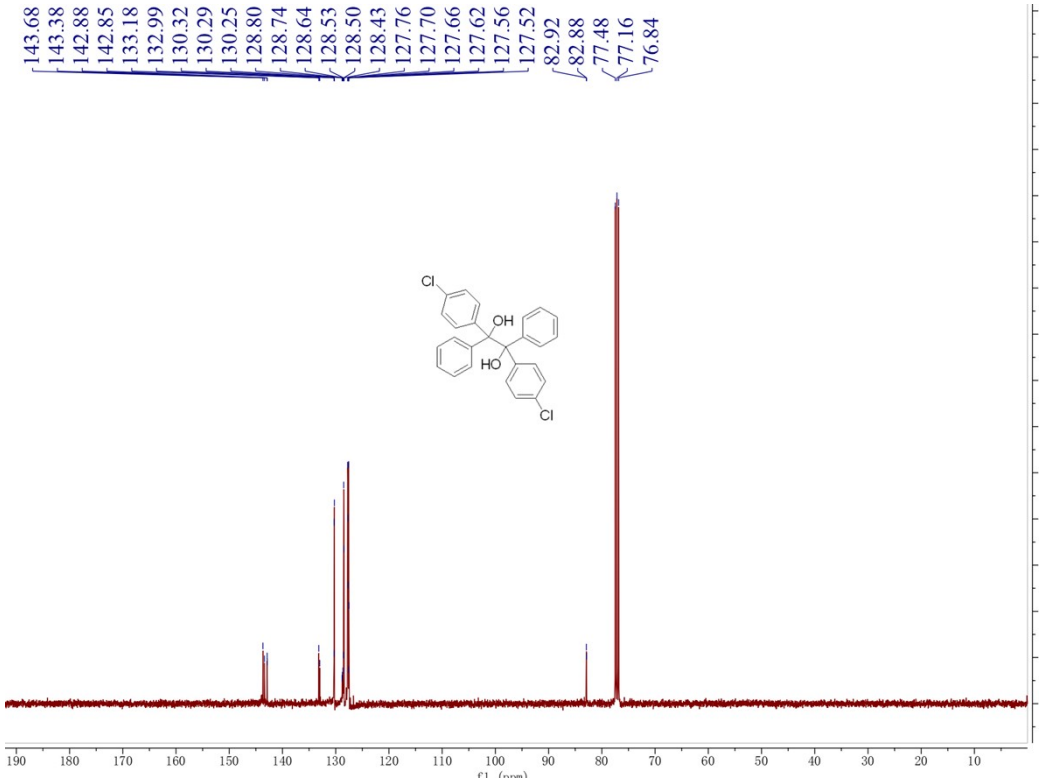
^{13}C NMR spectrum of compound 2d' (100 MHz, $CDCl_3$)



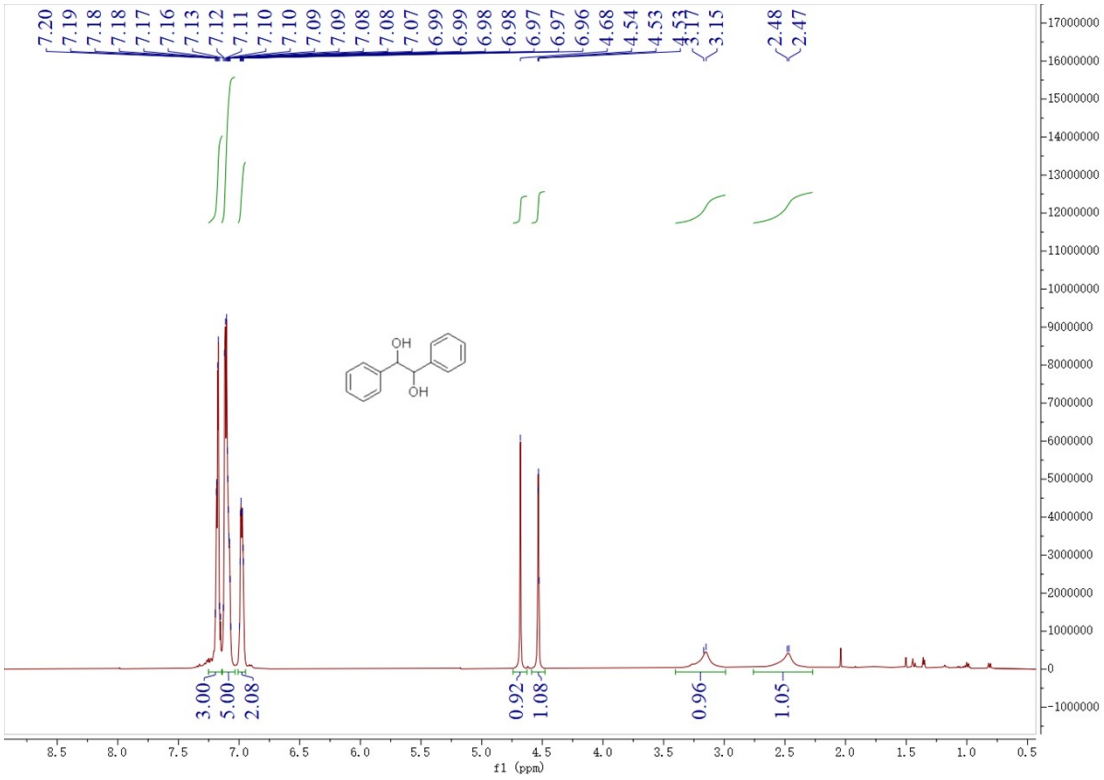
^{1}H NMR spectrum of compound 2e' (400 MHz, $CDCl_3$)



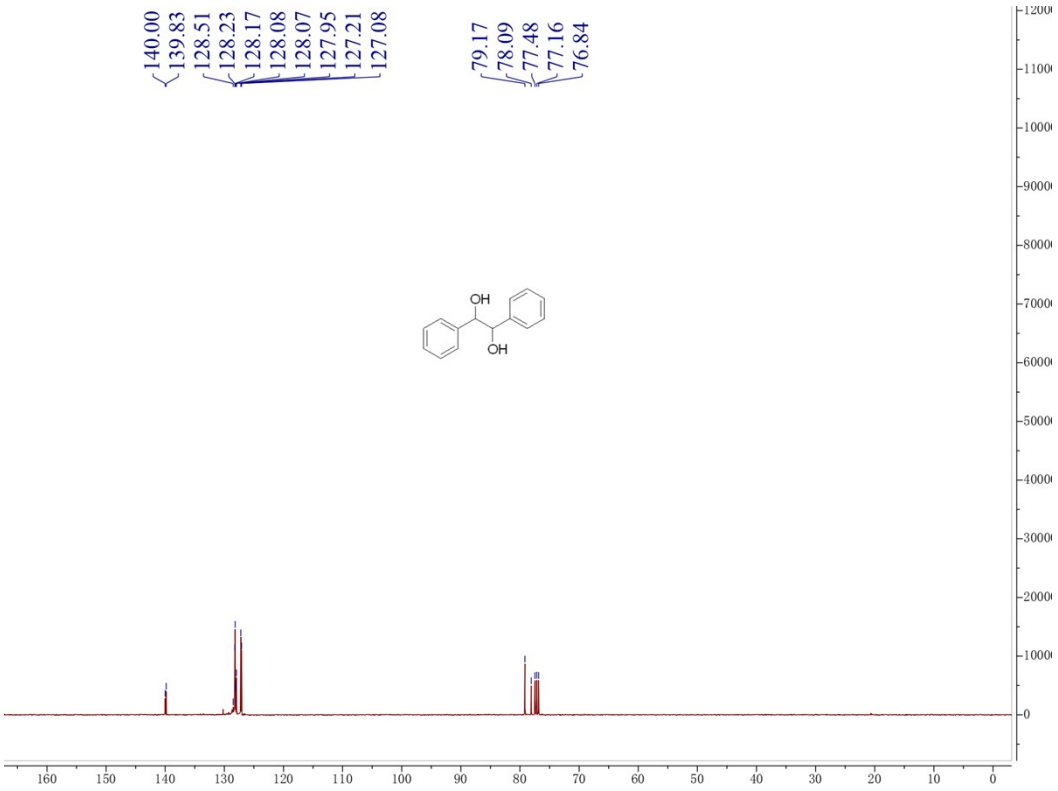
^{13}C NMR spectrum of compound 2e' (100 MHz, $CDCl_3$)



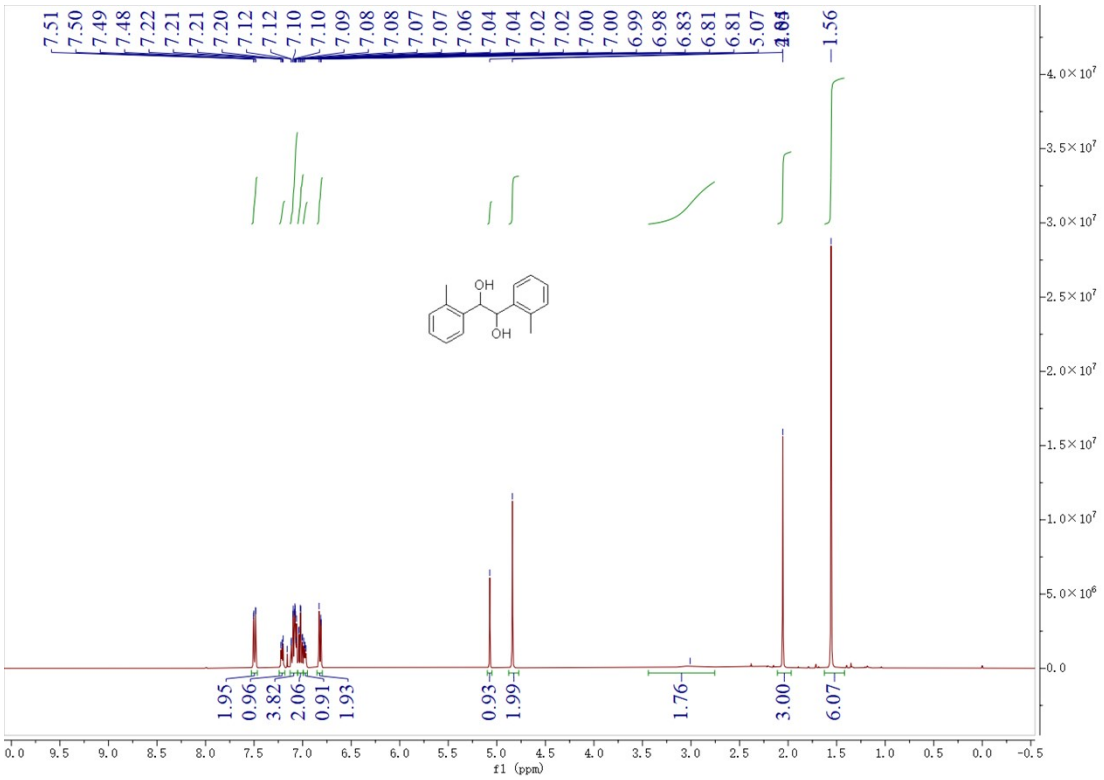
^{1}H NMR spectrum of compound 4a (400 MHz, $CDCl_3$)



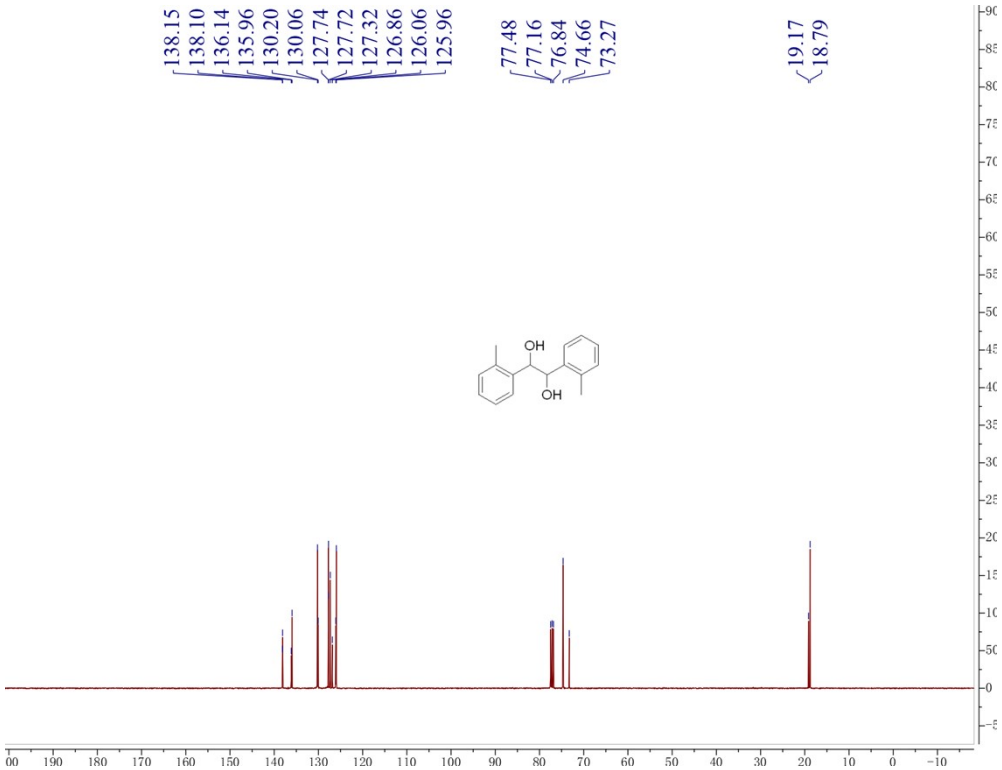
^{13}C NMR spectrum of compound 4a (100 MHz, $CDCl_3$)



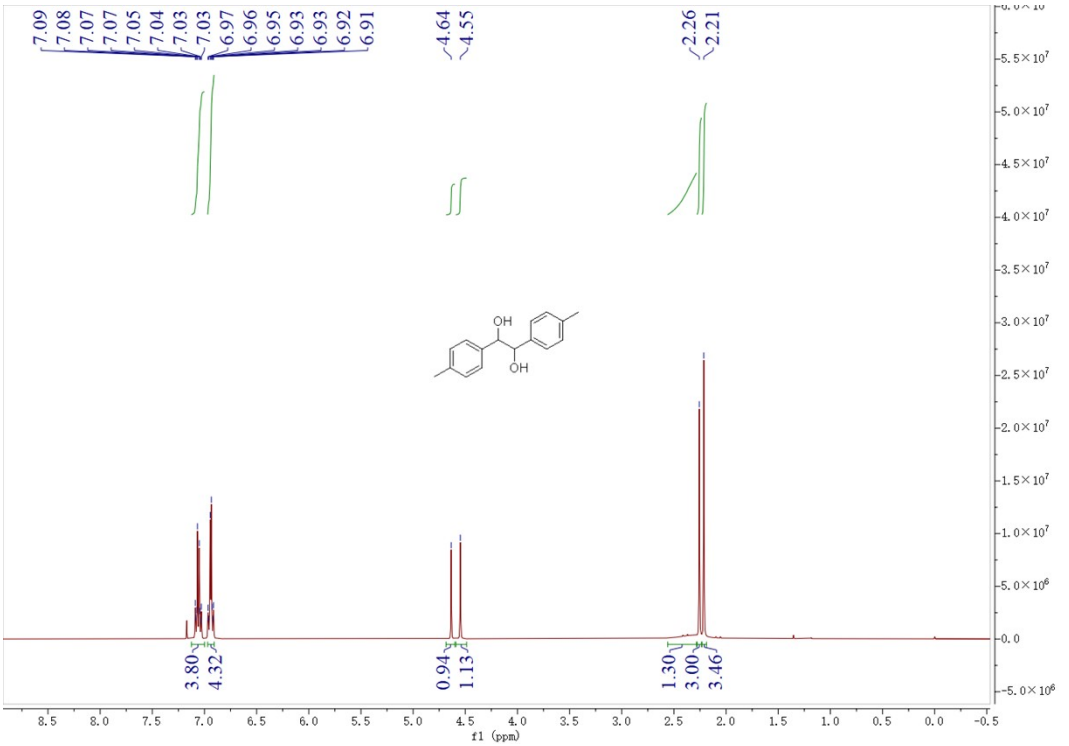
^{1}H NMR spectrum of compound 4b (400 MHz, $CDCl_3$)



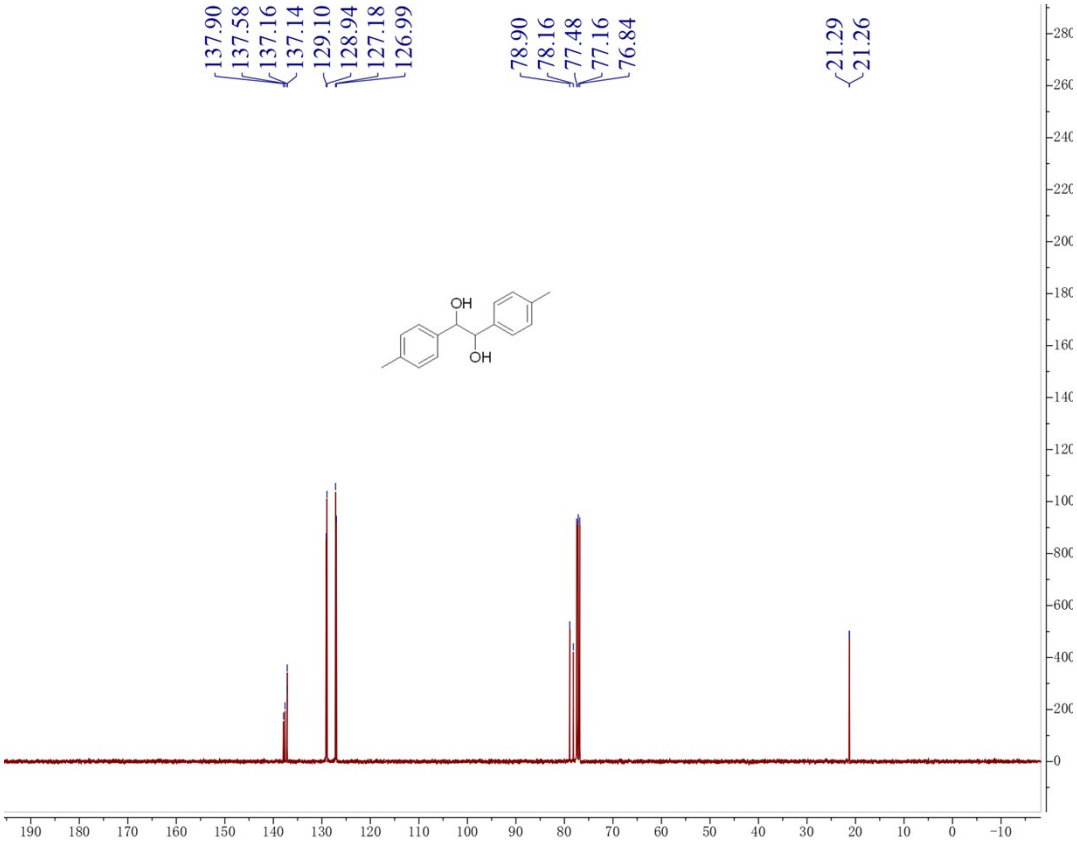
^{13}C NMR spectrum of compound 4b (100 MHz, $CDCl_3$)



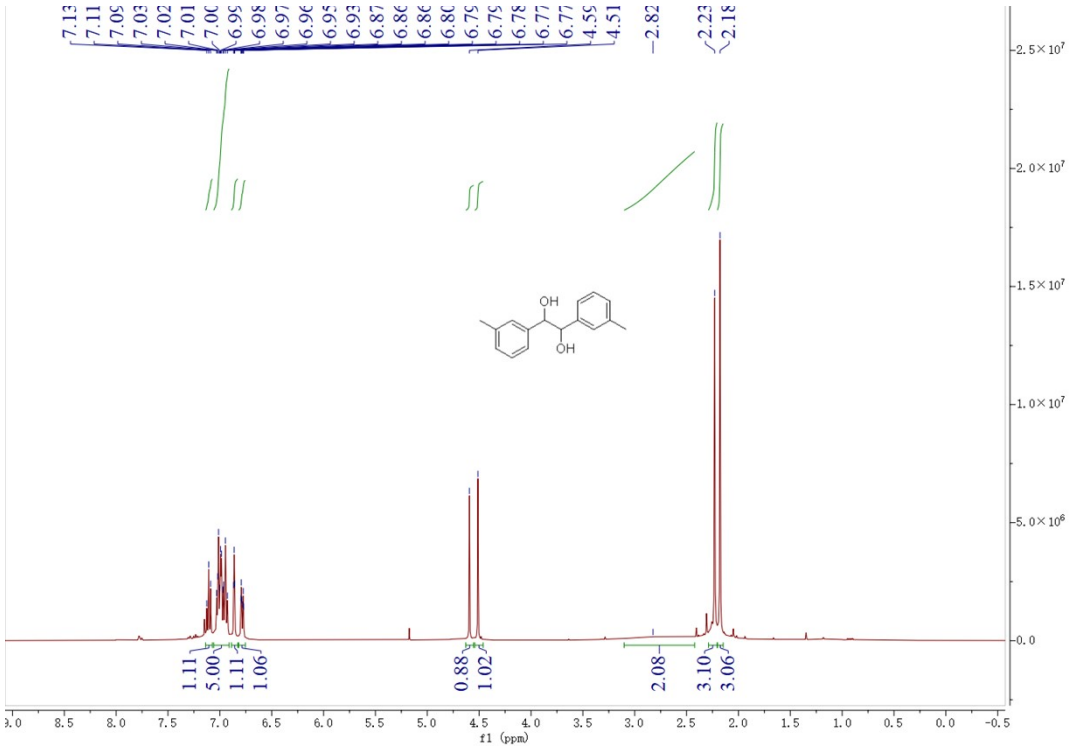
^{1}H NMR spectrum of compound 4c (400 MHz, $CDCl_3$)



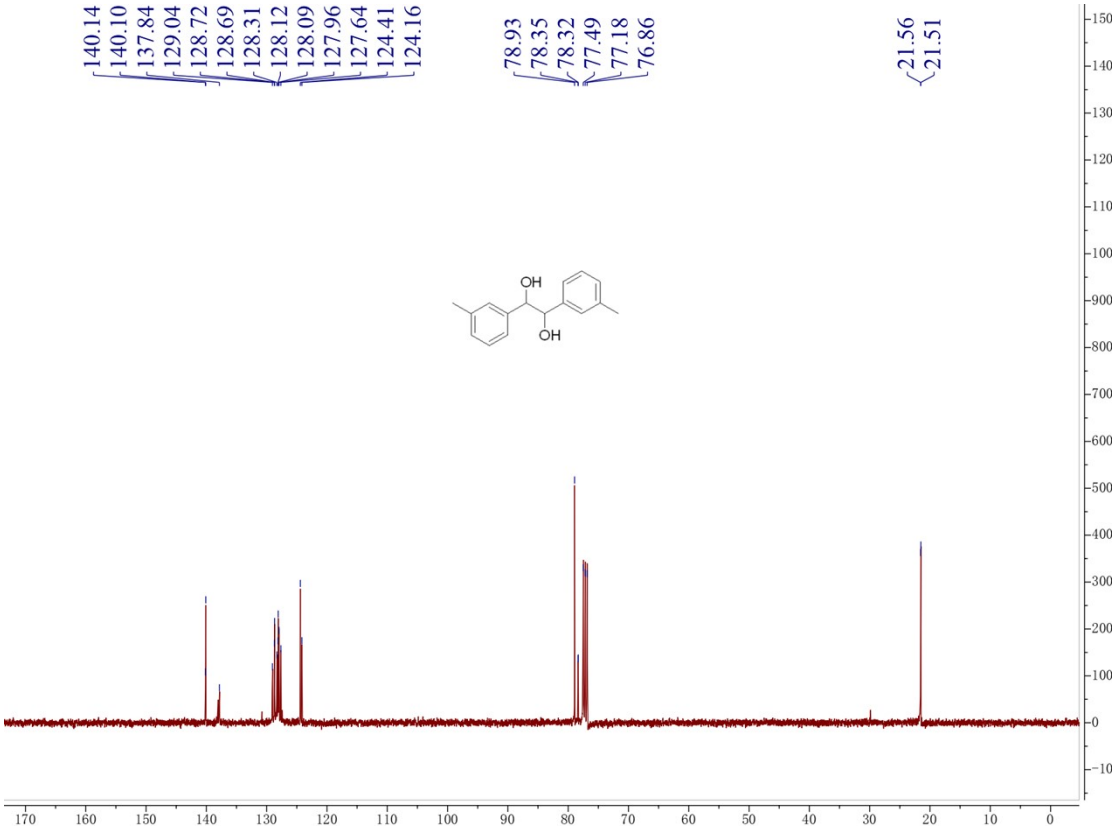
^{13}C NMR spectrum of compound 4c (100 MHz, $CDCl_3$)



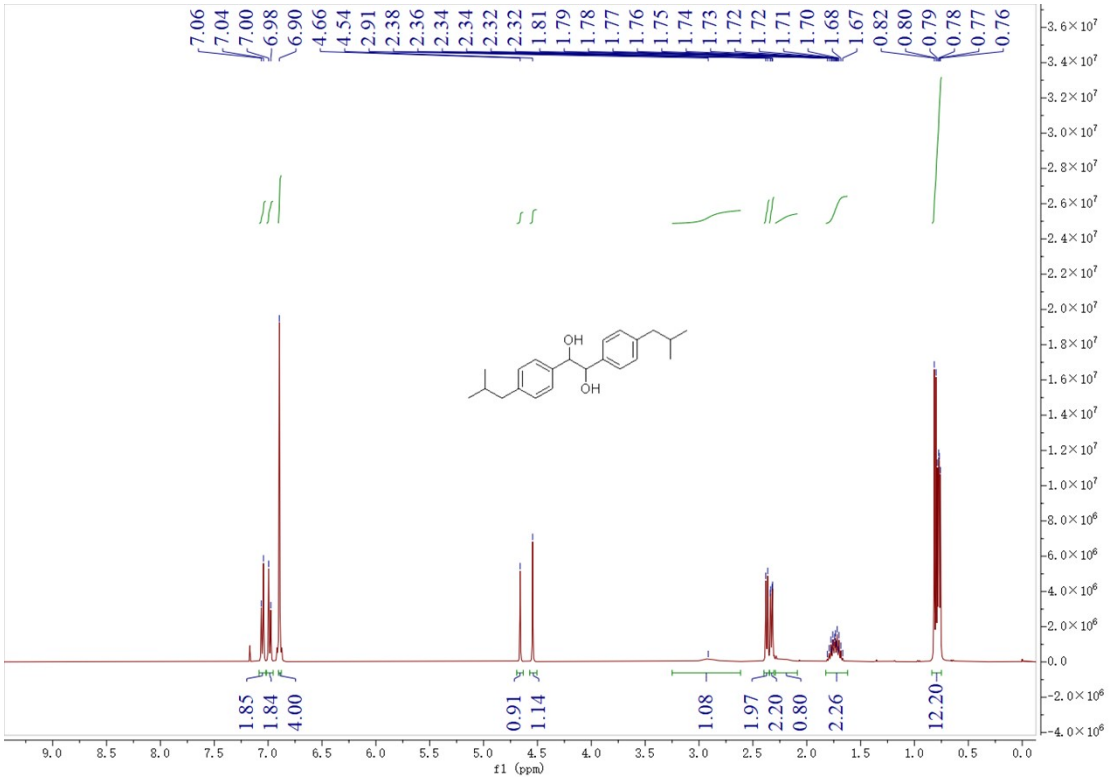
^{1}H NMR spectrum of compound 4d(400 MHz, $CDCl_3$)



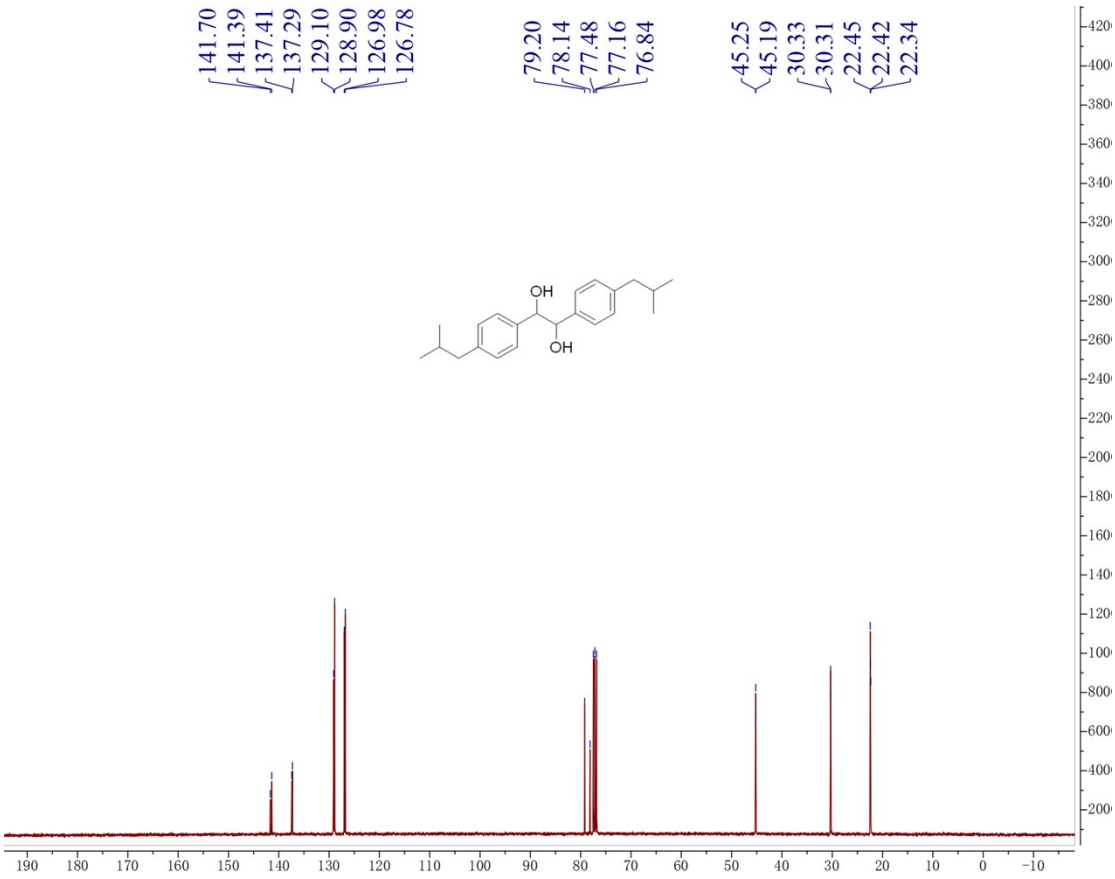
^{13}C NMR spectrum of compound 4d (100 MHz, $CDCl_3$)



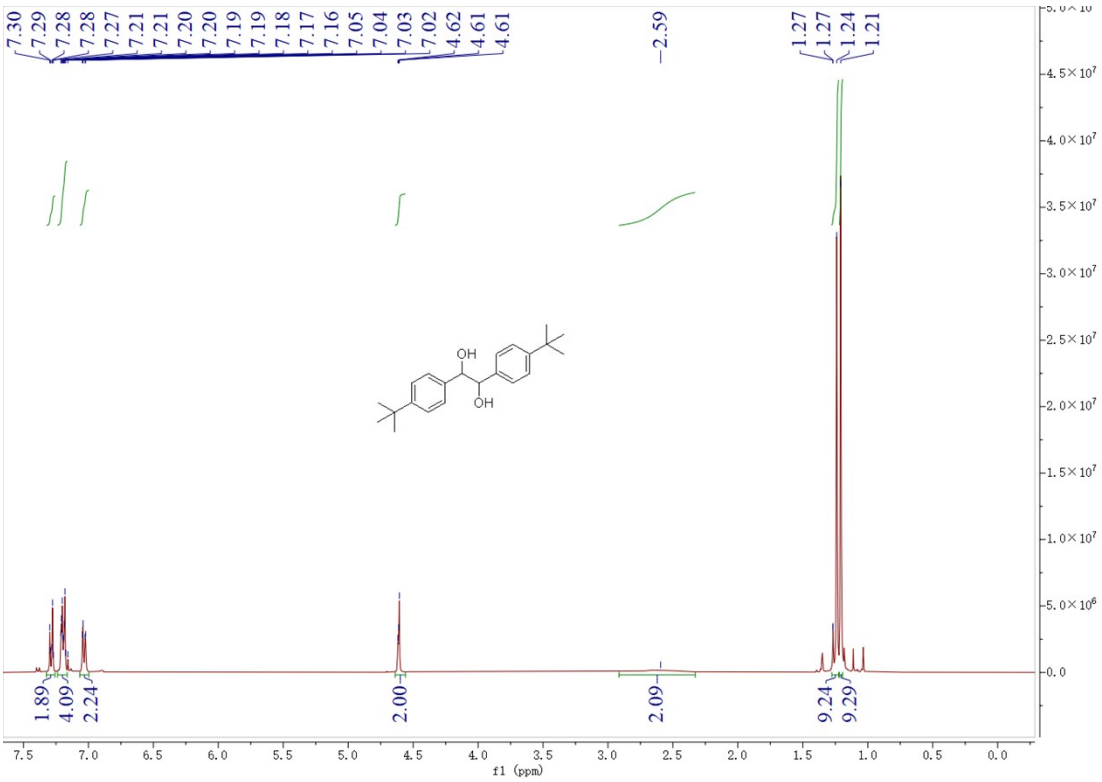
^{1}H NMR spectrum of compound 4e (400 MHz, $CDCl_3$)



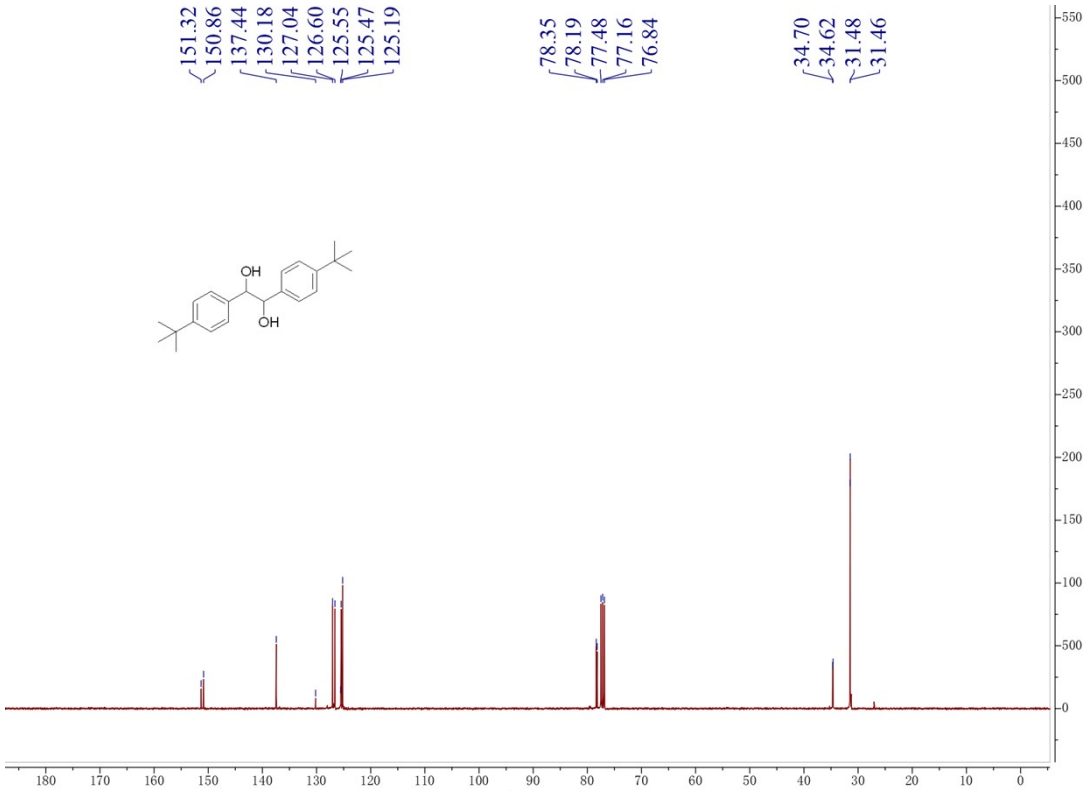
^{13}C NMR spectrum of compound 4e (100 MHz, $CDCl_3$)



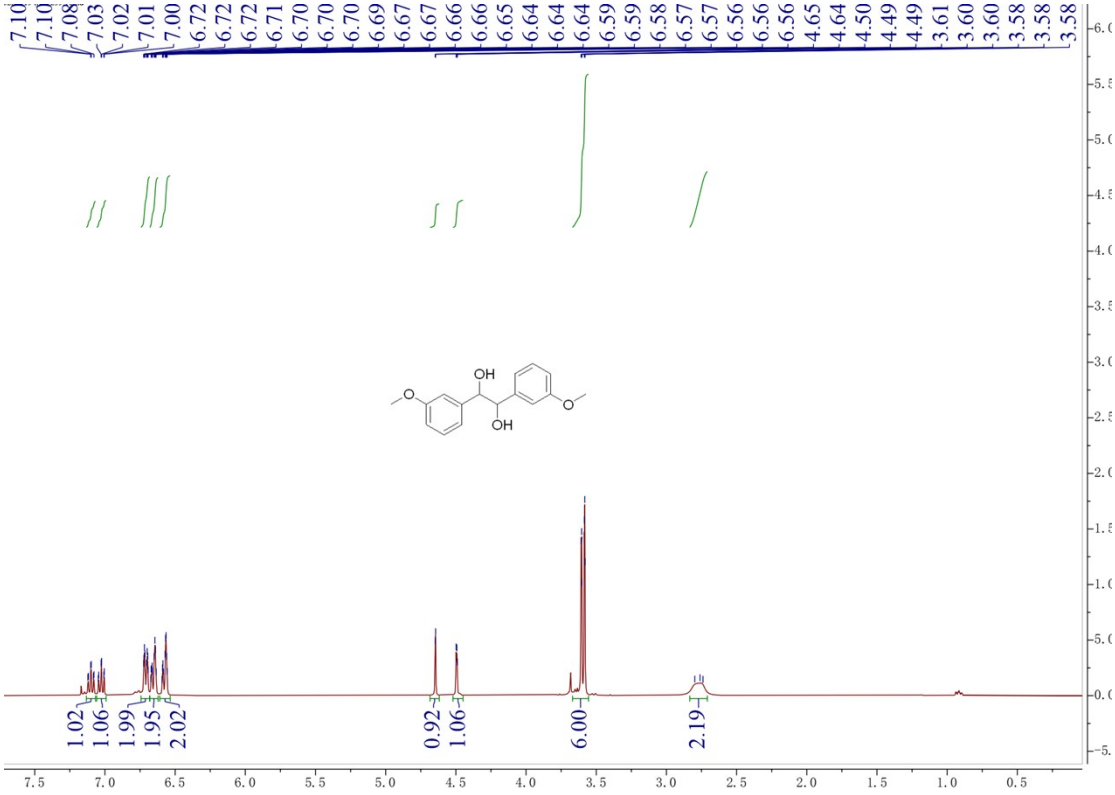
^{1}H NMR spectrum of compound 4f (400 MHz, $CDCl_3$)



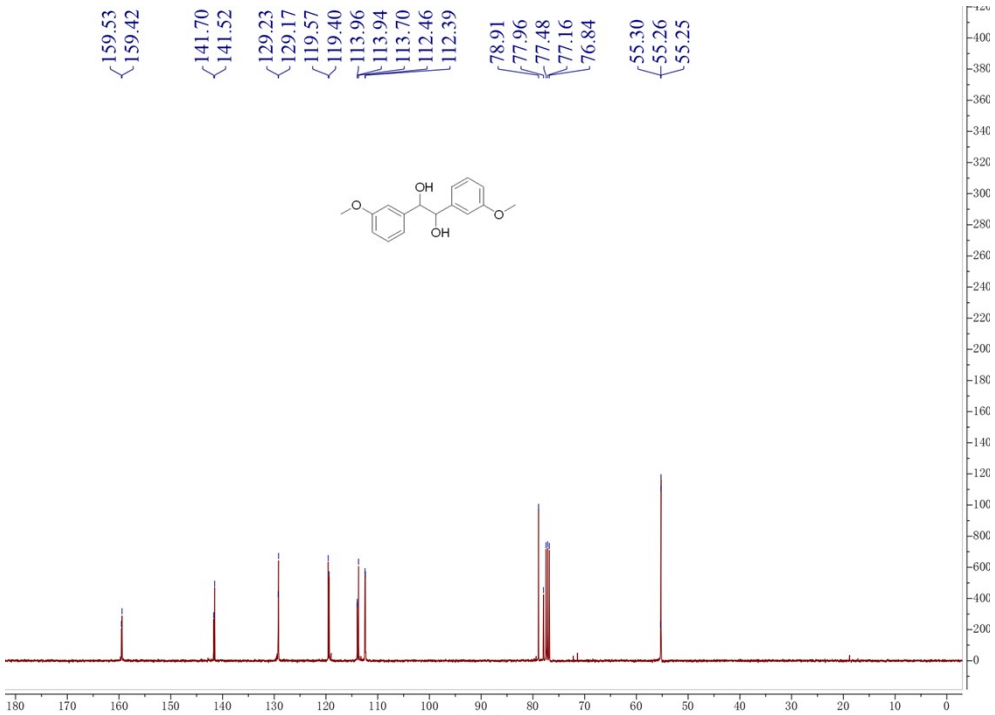
^{13}C NMR spectrum of compound 4f (100 MHz, $CDCl_3$)



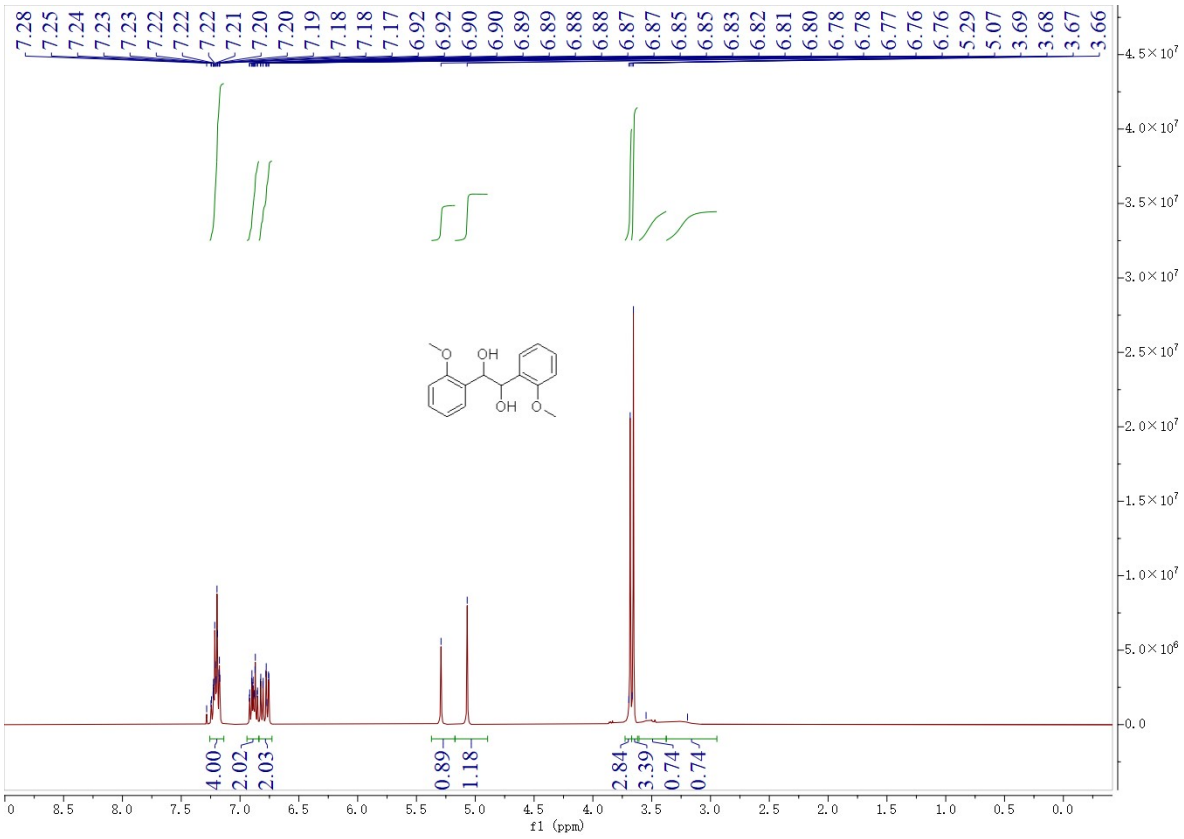
^{1}H NMR spectrum of compound 4g (400 MHz, $CDCl_3$)



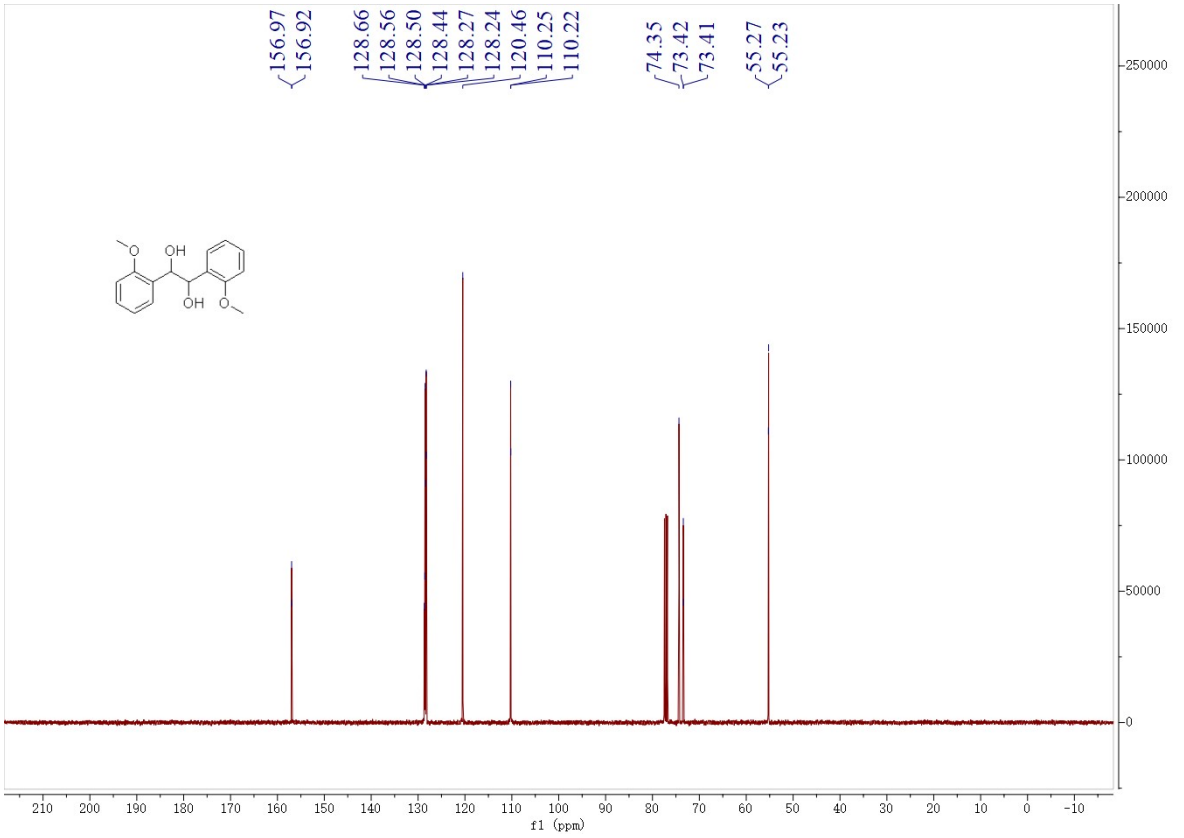
^{13}C NMR spectrum of compound 4g (100 MHz, $CDCl_3$)



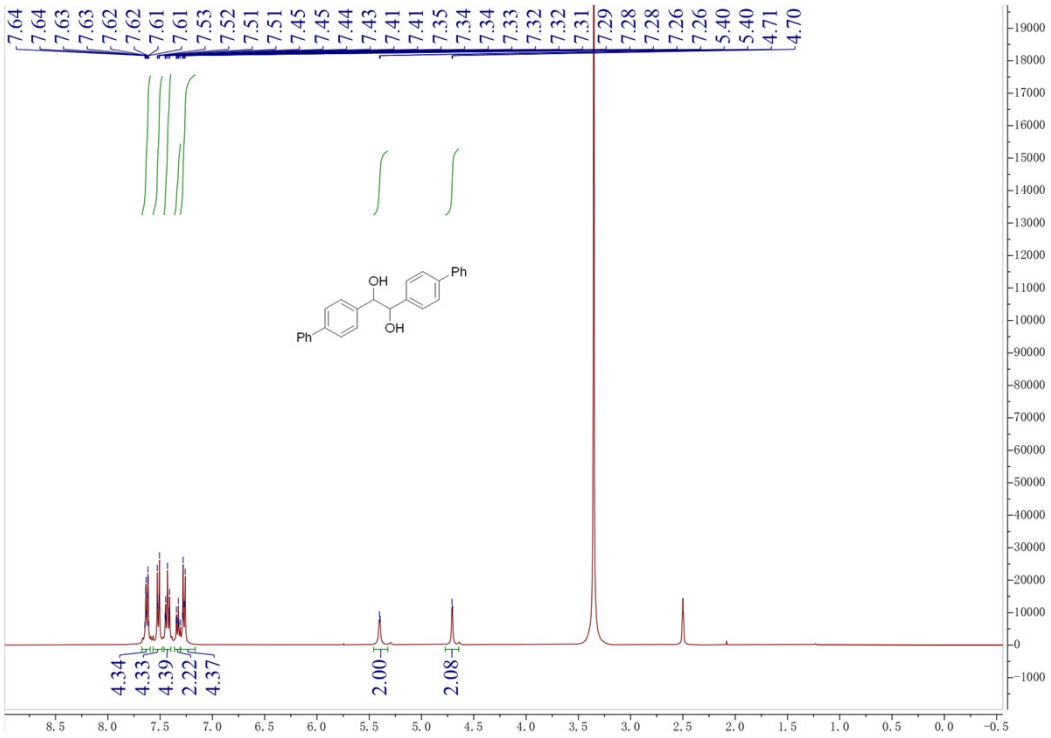
^{1}H NMR spectrum of compound 4h (400 MHz, $CDCl_3$)



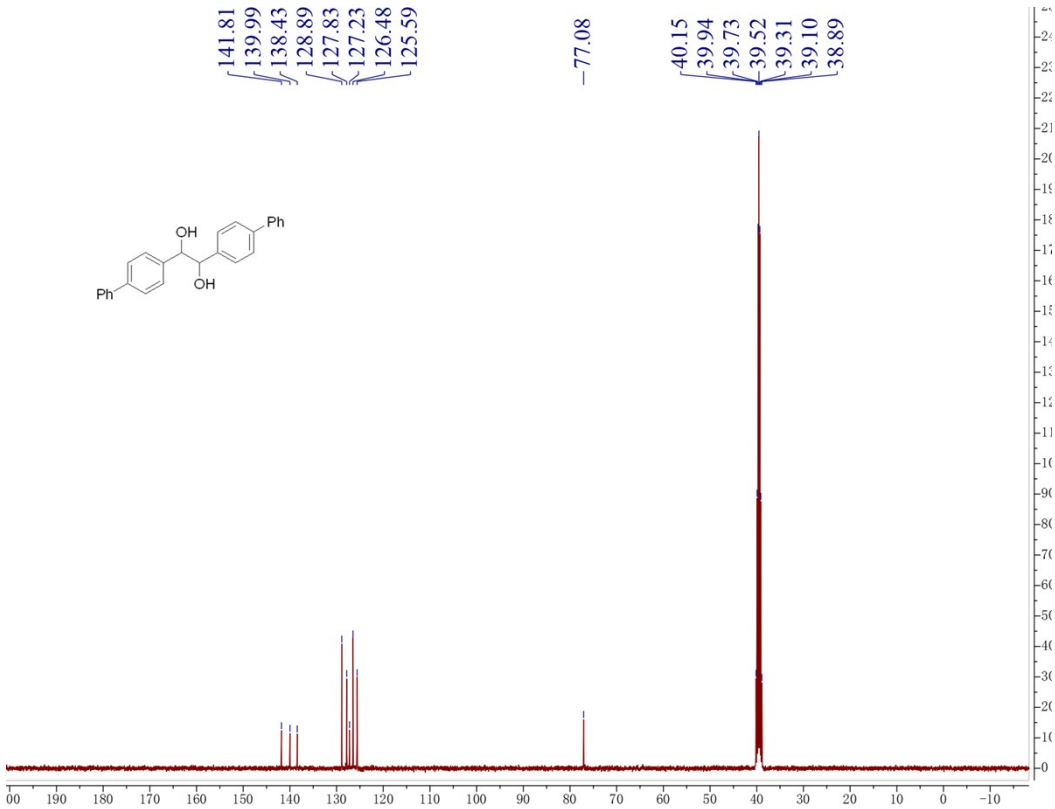
^{13}C NMR spectrum of compound 4h(100 MHz, $CDCl_3$)



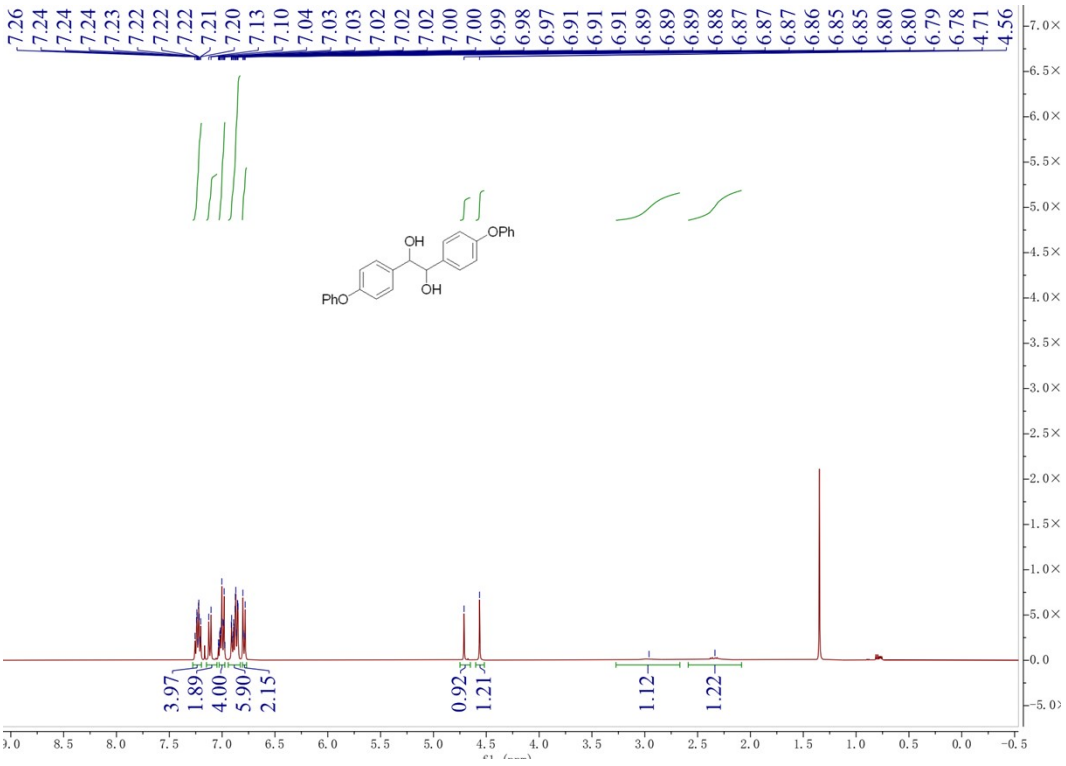
^{1}H NMR spectrum of compound 4i (400 MHz, DMSO-*d6*)



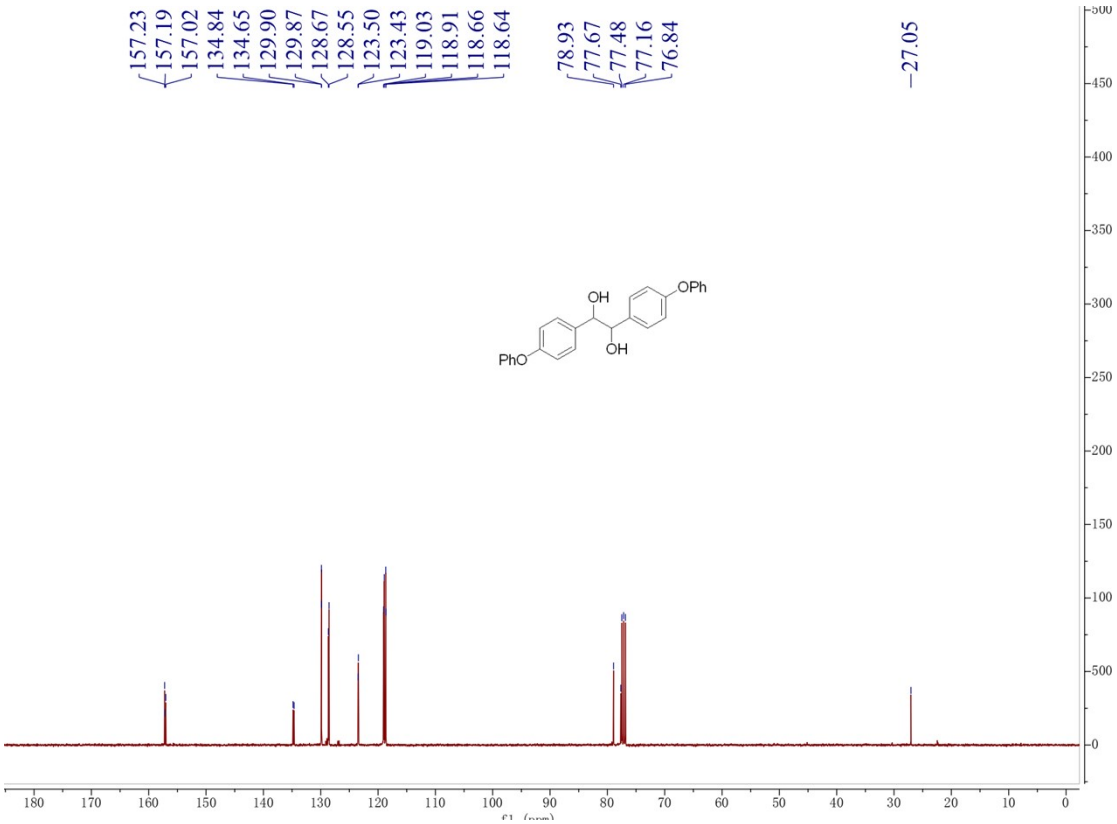
^{13}C NMR spectrum of compound 4i (100 MHz, DMSO)



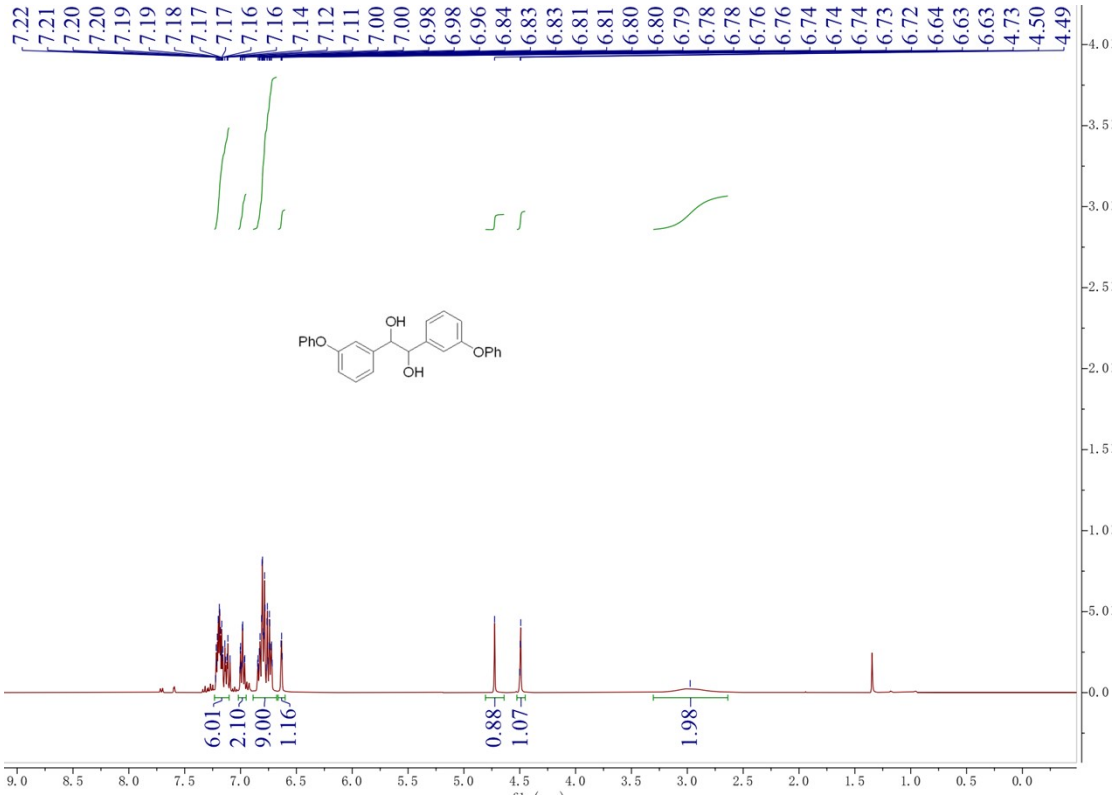
^{1}H NMR spectrum of compound 4j (400 MHz, $CDCl_3$)



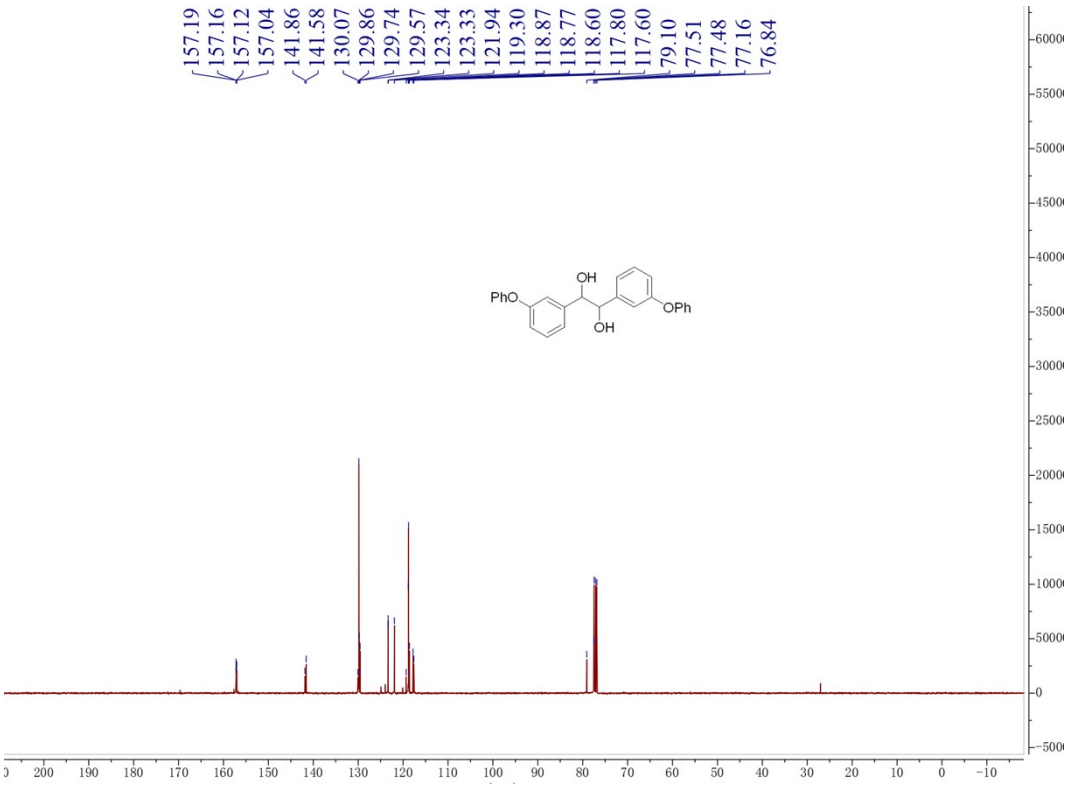
^{13}C NMR spectrum of compound 4j (100 MHz, $CDCl_3$)



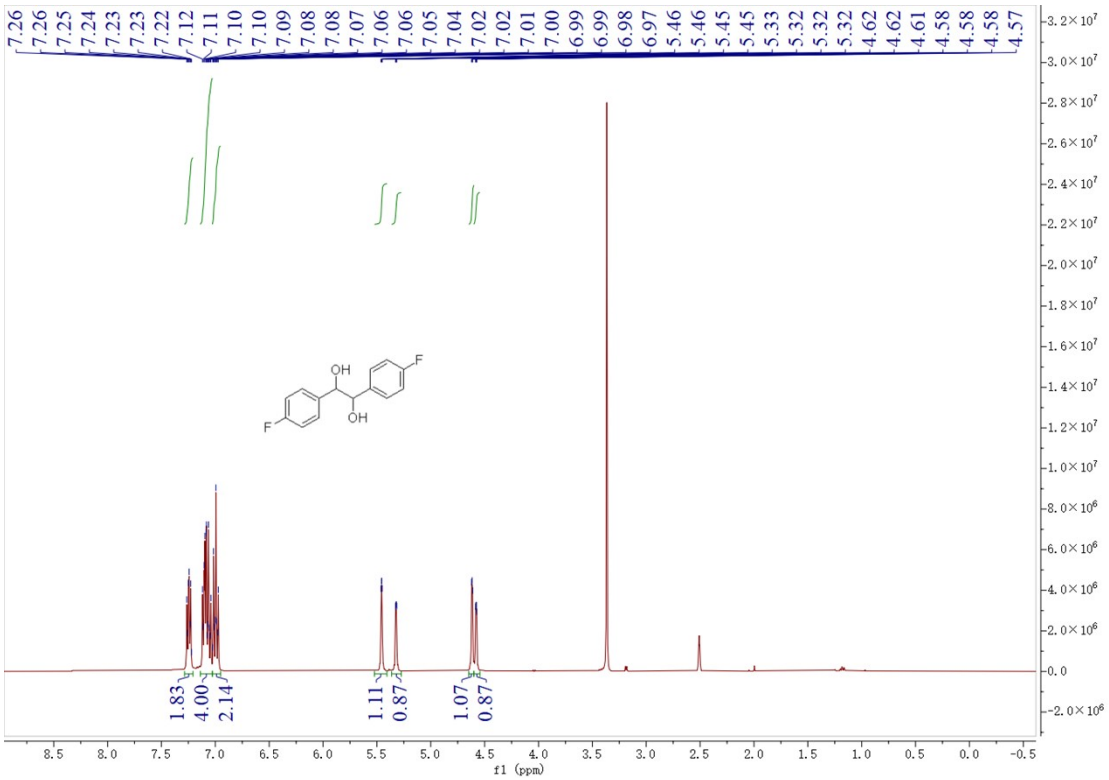
^{1}H NMR spectrum of compound 4k (400 MHz, $CDCl_3$)



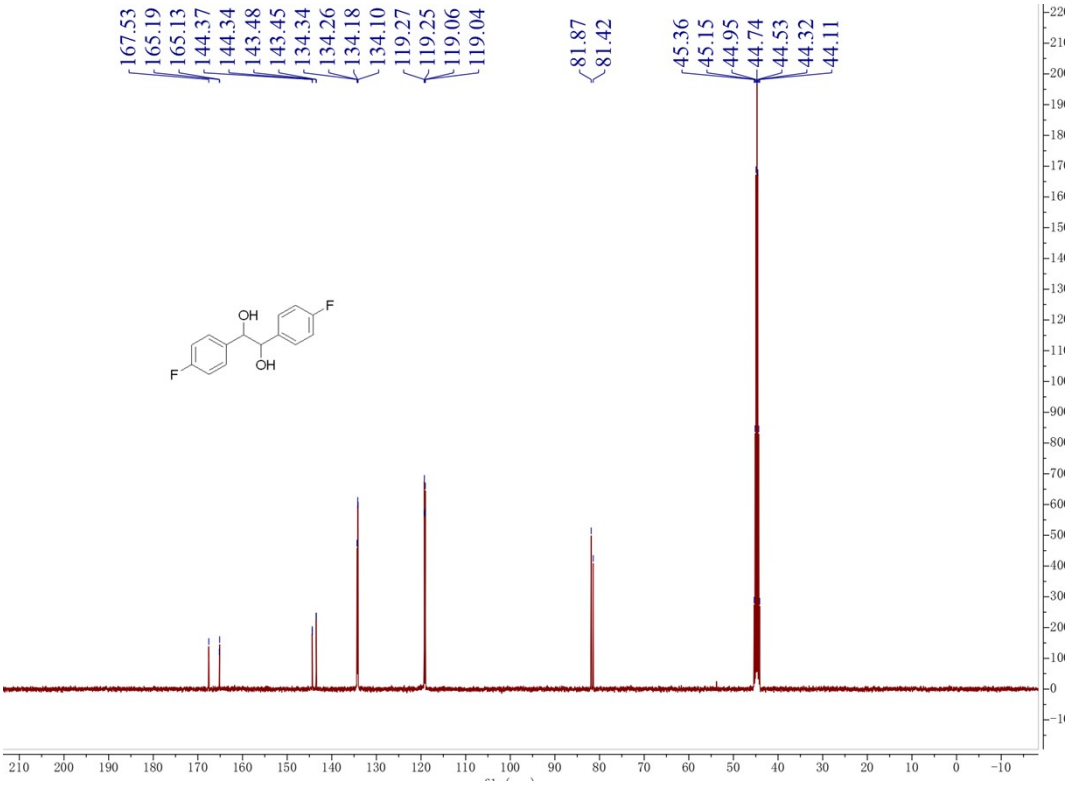
^{13}C NMR spectrum of compound 4k (100 MHz, $CDCl_3$)



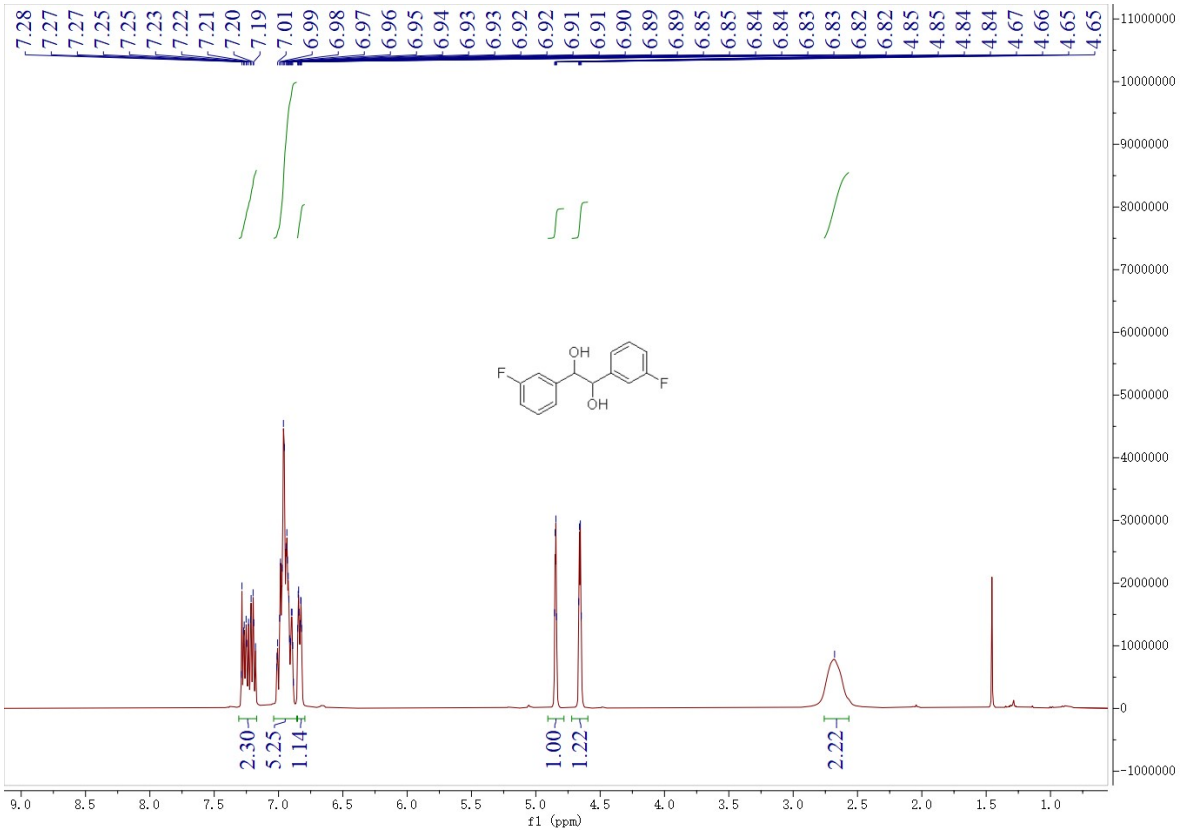
^{1}H NMR spectrum of compound 4l (400 MHz, DMSO-*d6*)



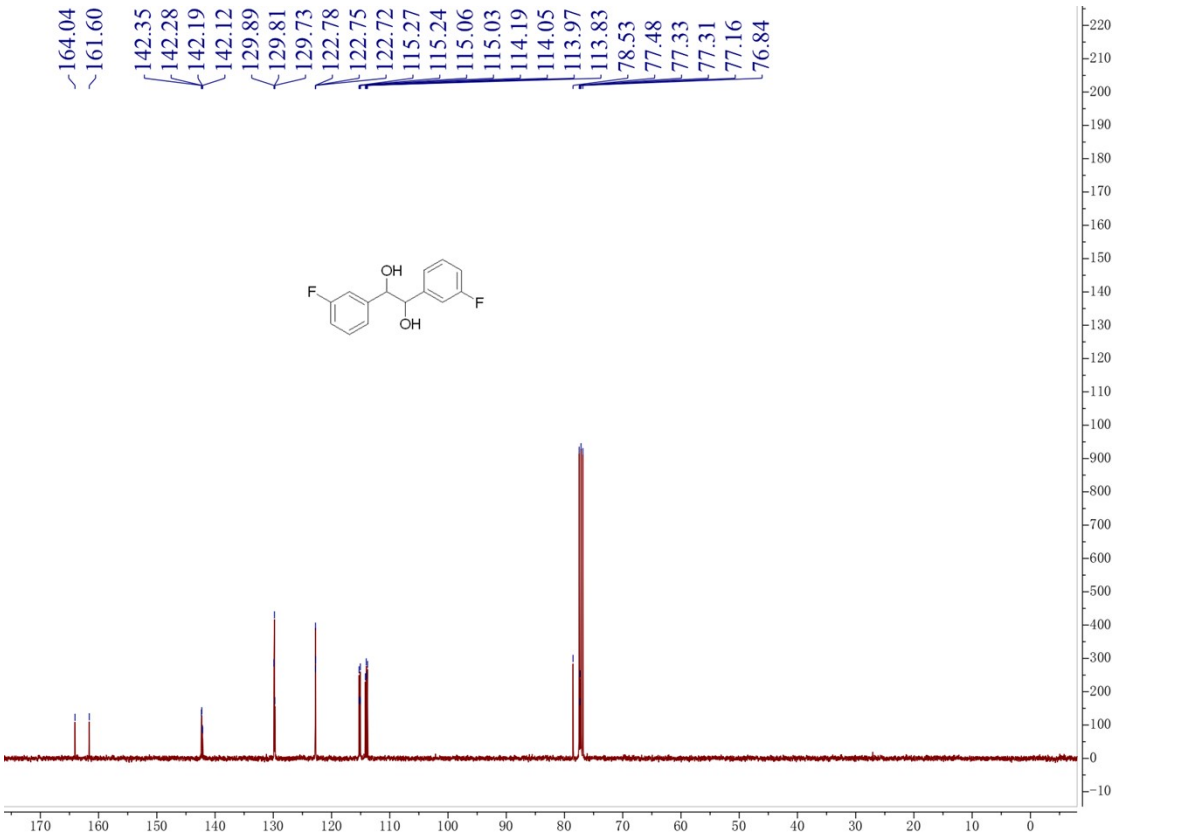
^{13}C NMR spectrum of compound 4l (100 MHz, $CDCl_3$)



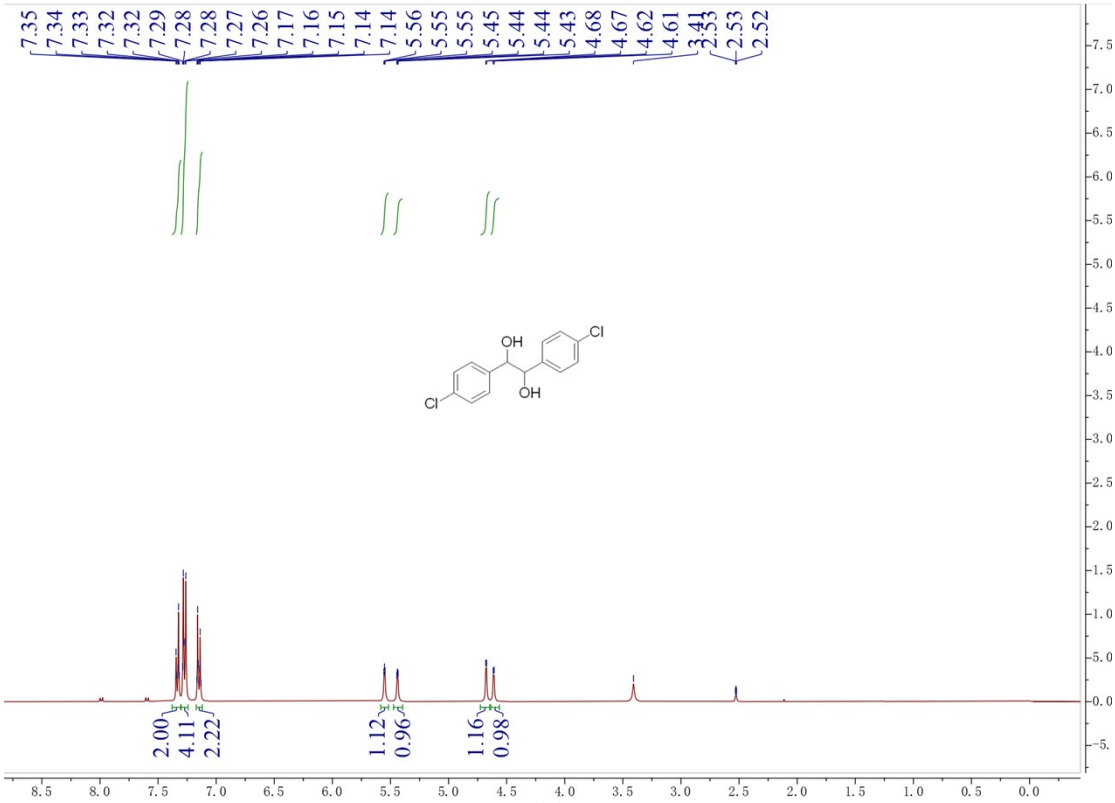
^{1}H NMR spectrum of compound 4m (400 MHz, $CDCl_3$)



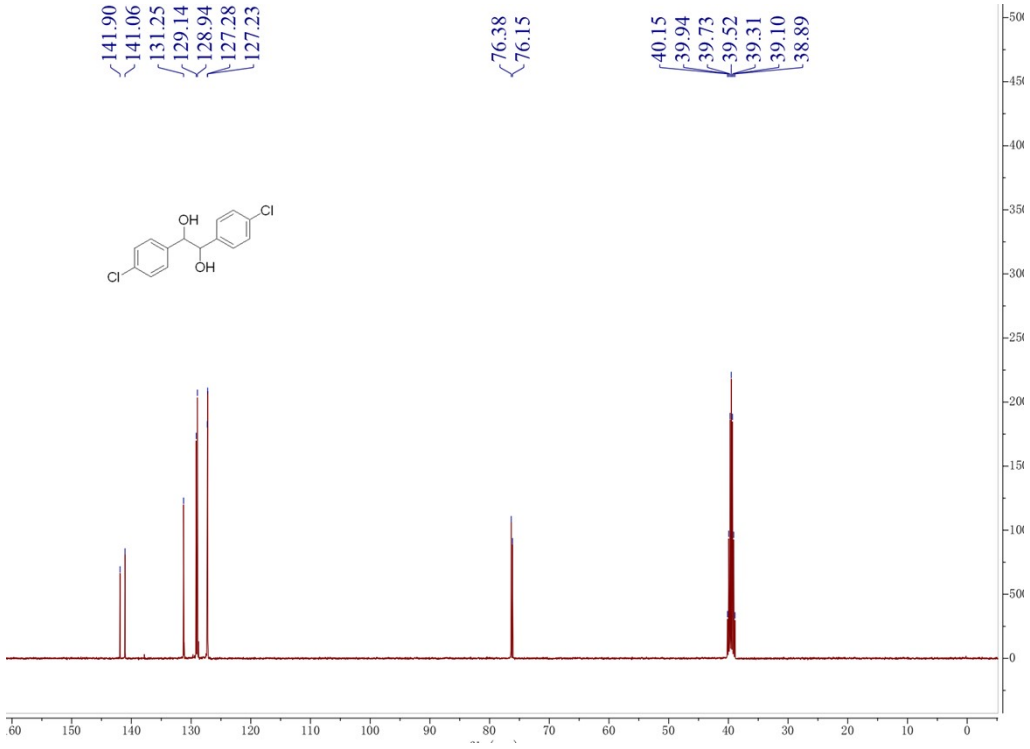
^{13}C NMR spectrum of compound 4m (100 MHz, $CDCl_3$)



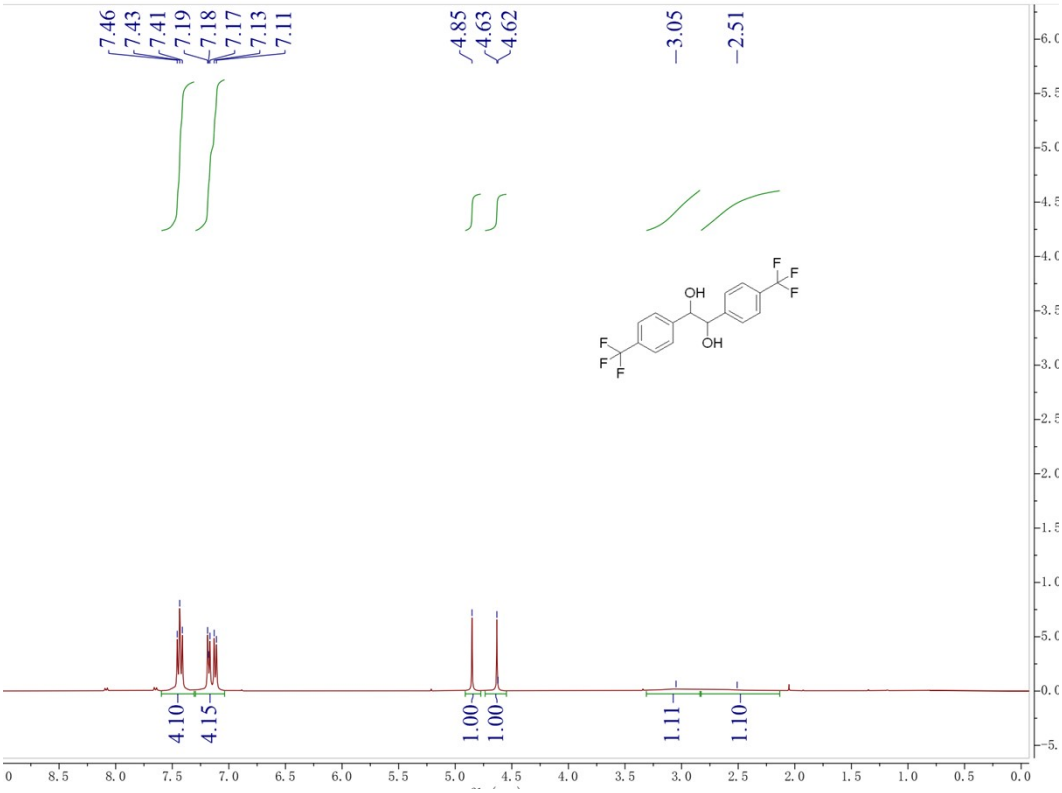
^{1}H NMR spectrum of compound 4n (400 MHz, DMSO-*d6*)



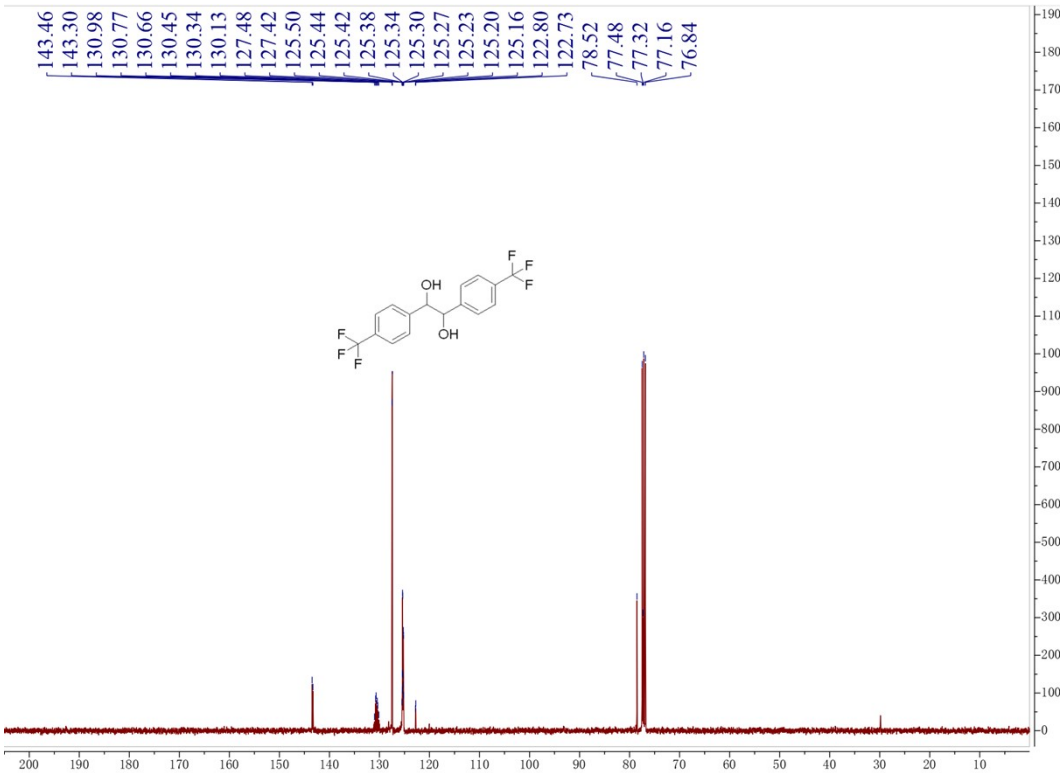
^{13}C NMR spectrum of compound 4n (100 MHz, DMSO-*d6*)



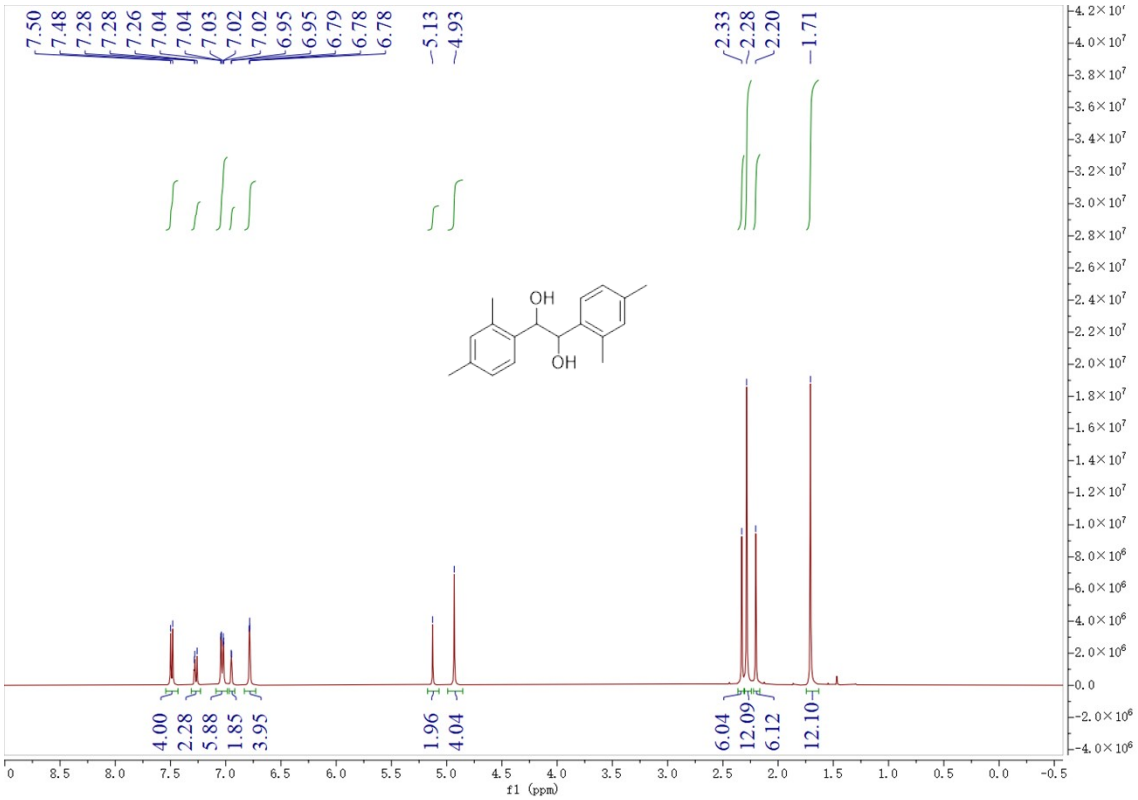
^{1}H NMR spectrum of compound 4o (400 MHz, $CDCl_3$)



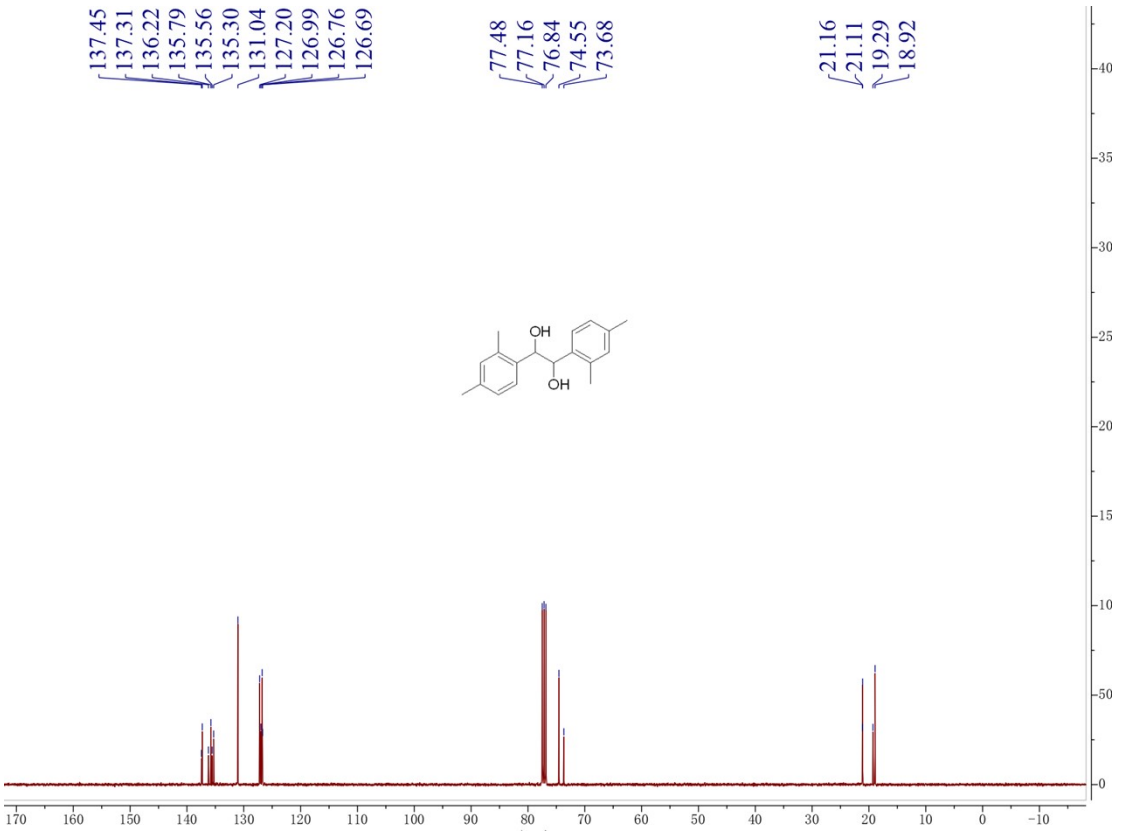
^{13}C NMR spectrum of compound 4o (100 MHz, $CDCl_3$)



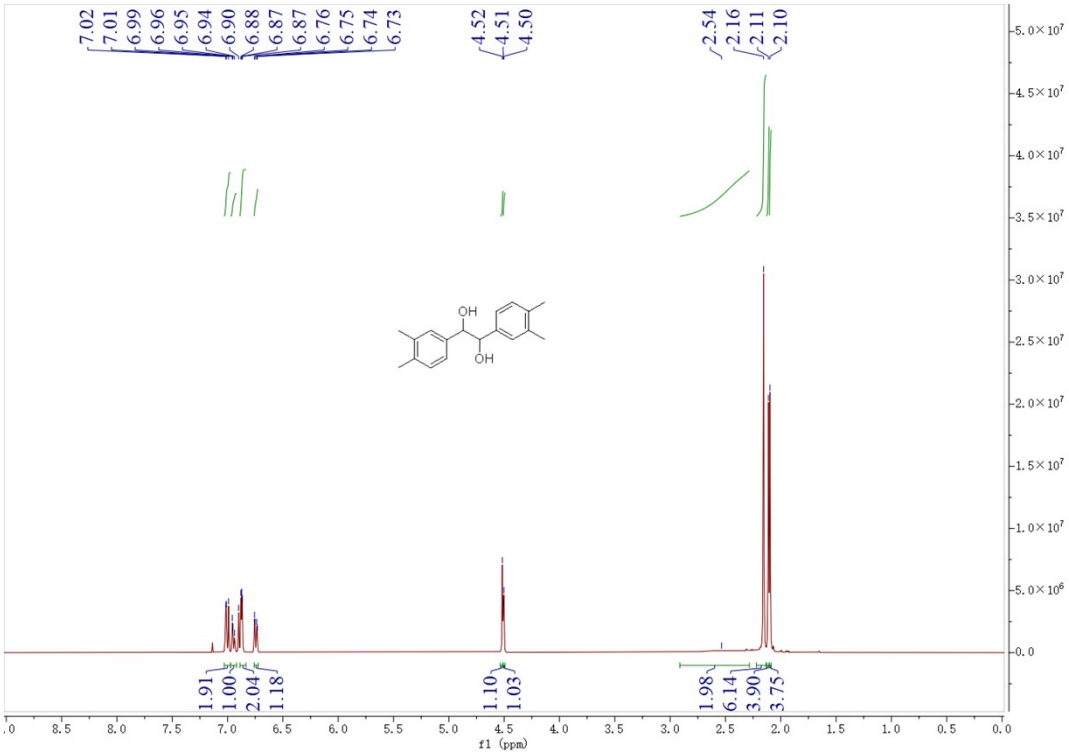
^{1}H NMR spectrum of compound 4p (400 MHz, $CDCl_3$)



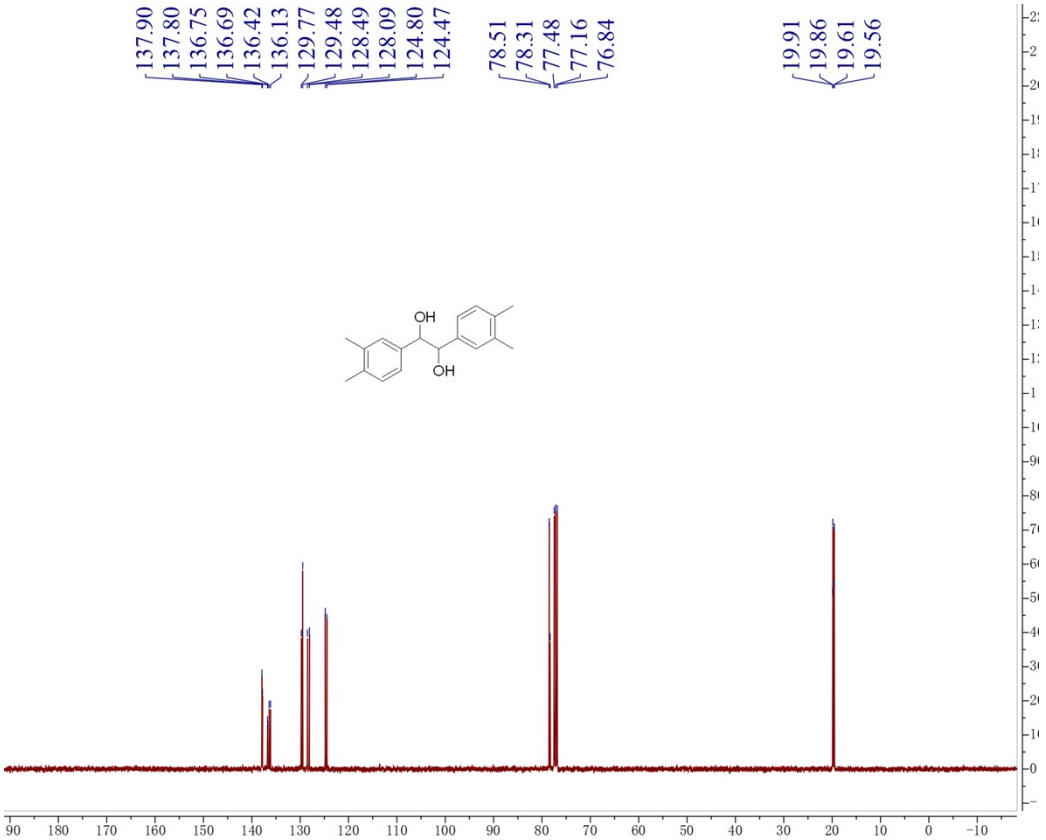
^{13}C NMR spectrum of compound 4p (100 MHz, $CDCl_3$)



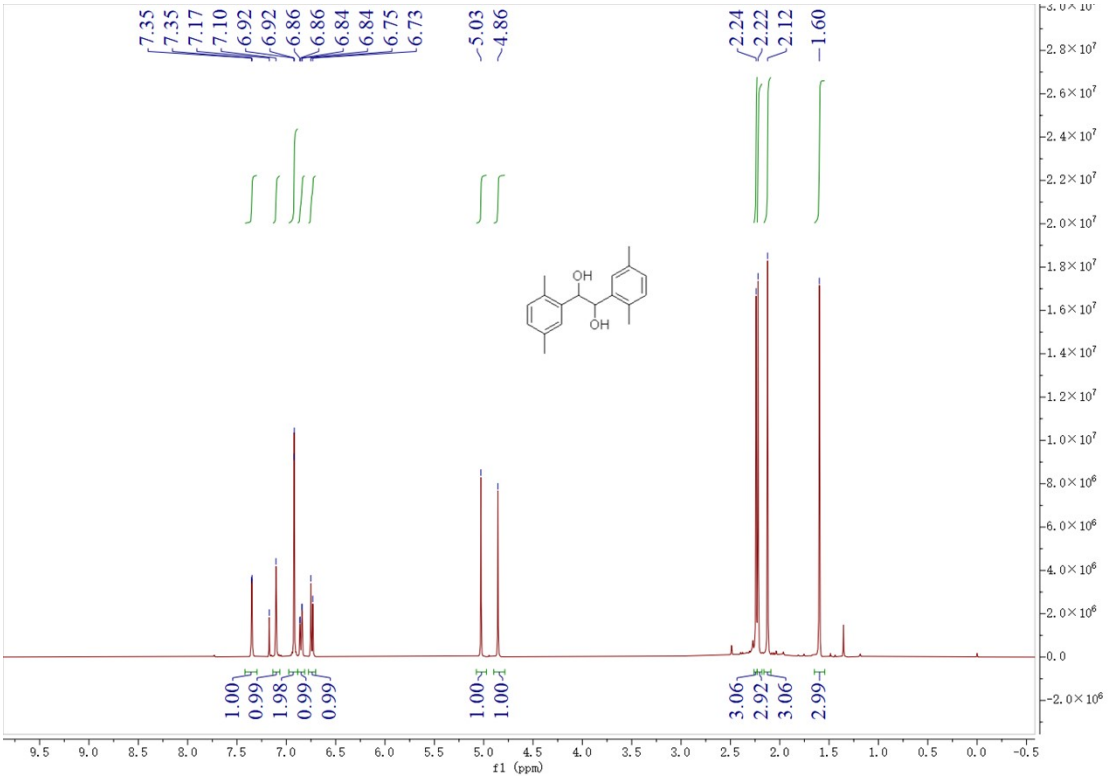
^{1}H NMR spectrum of compound 4q (400 MHz, $CDCl_3$)



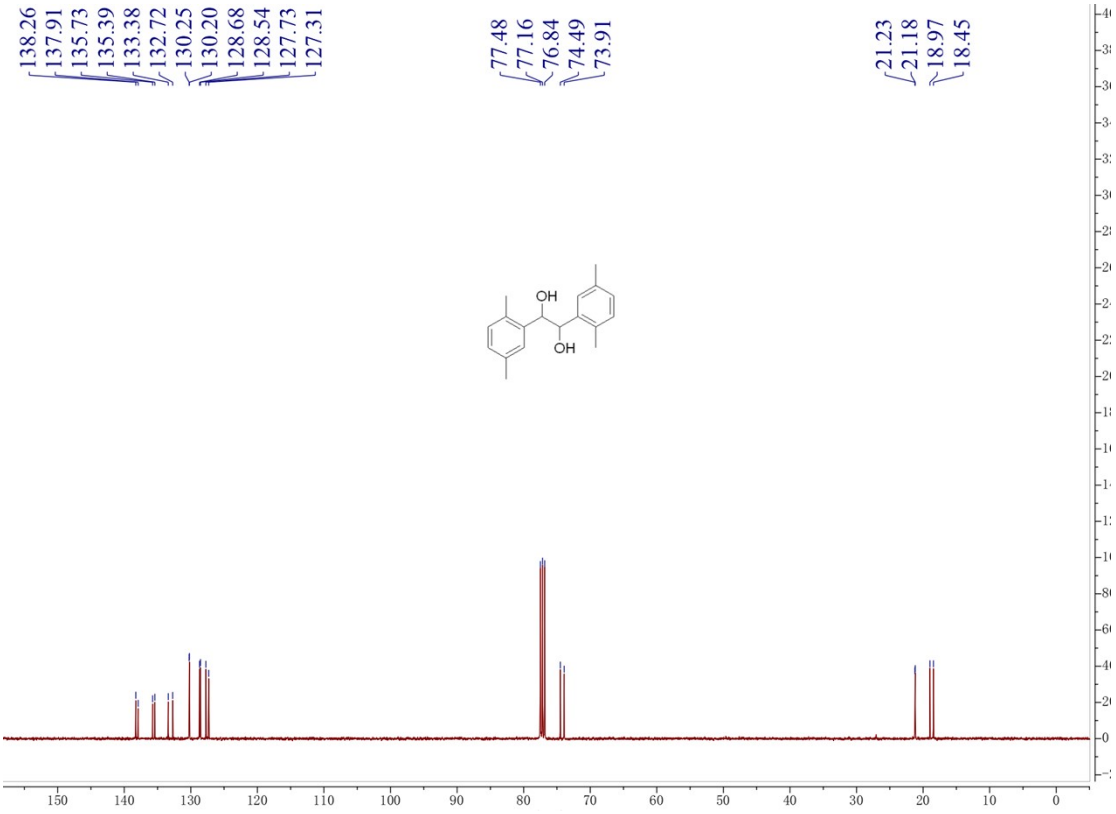
^{13}C NMR spectrum of compound 4q (100 MHz, $CDCl_3$)



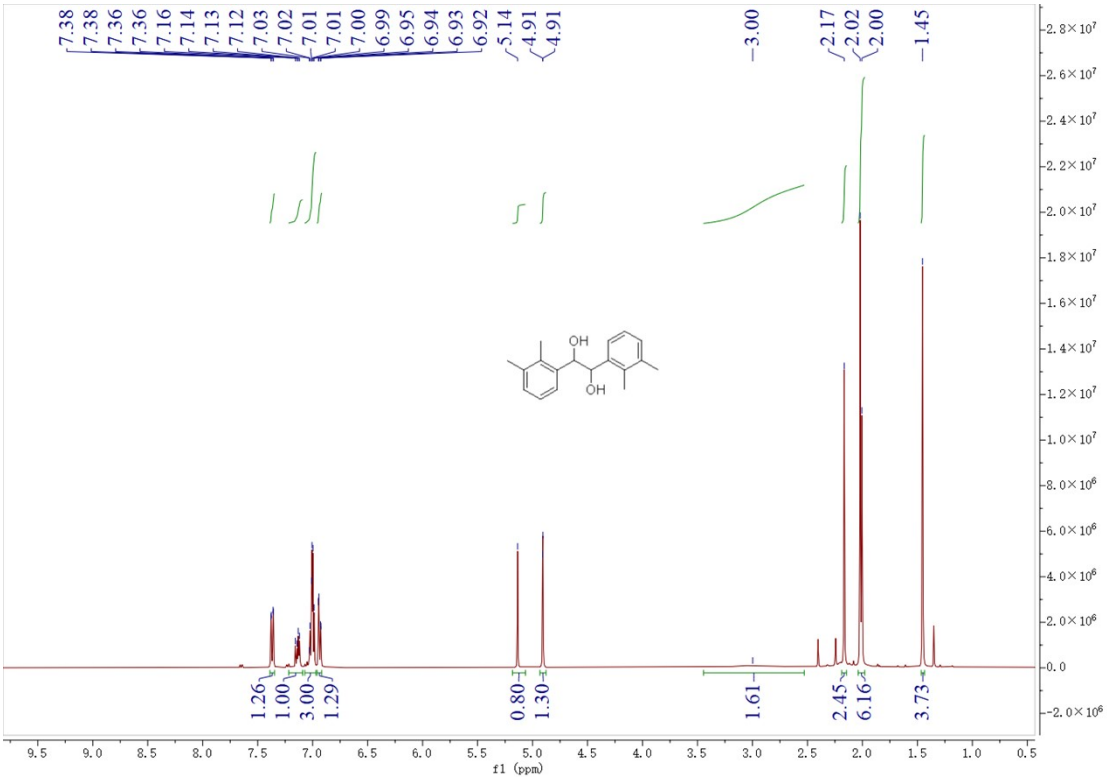
^{1}H NMR spectrum of compound 4r (400 MHz, $CDCl_3$)



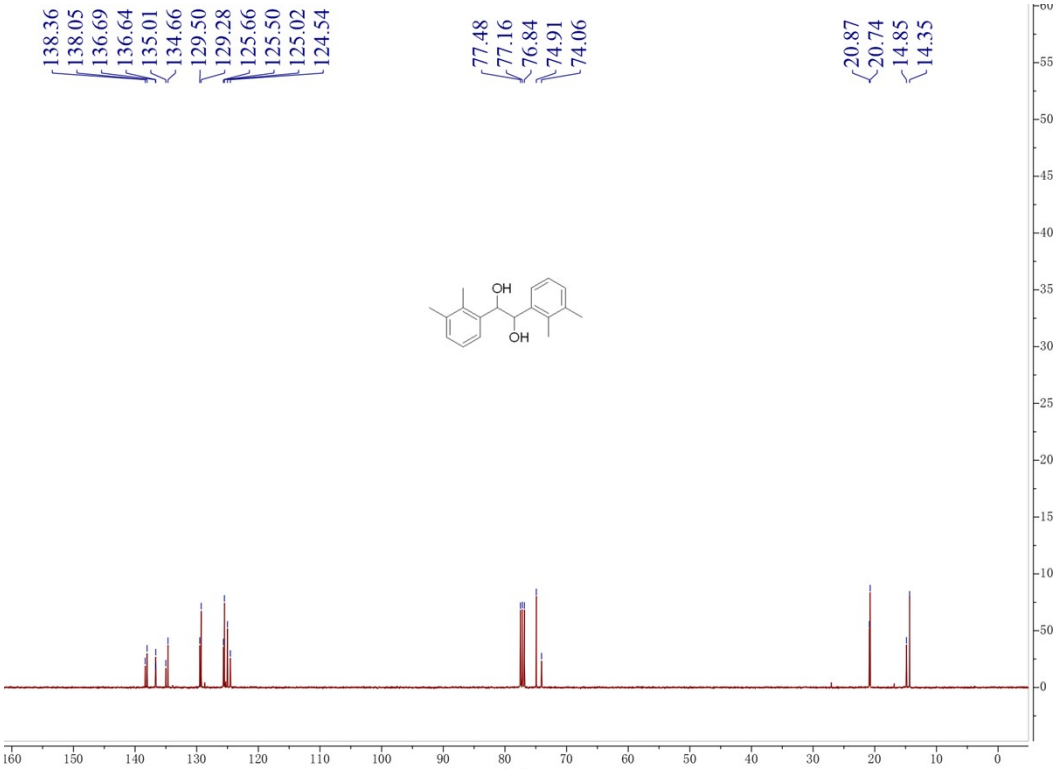
^{13}C NMR spectrum of compound 4r (100 MHz, $CDCl_3$)



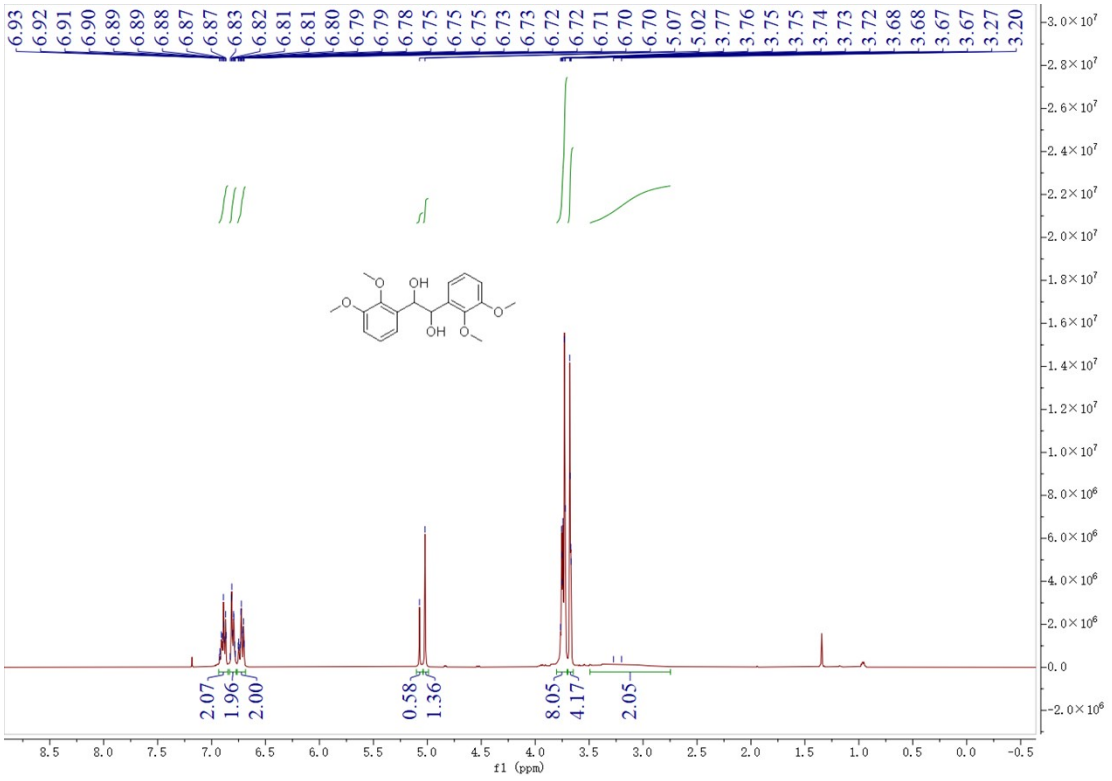
^{1}H NMR spectrum of compound 4s (400 MHz, $CDCl_3$)



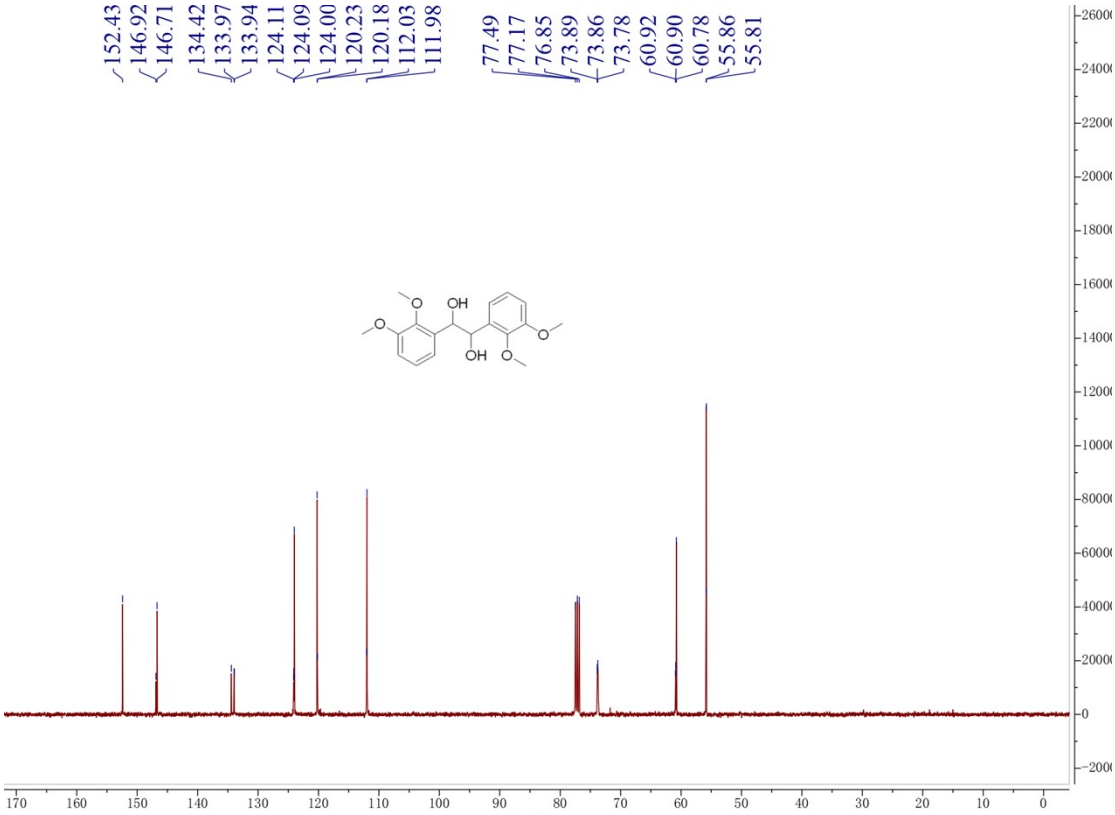
^{13}C NMR spectrum of compound 4s(100 MHz, $CDCl_3$)



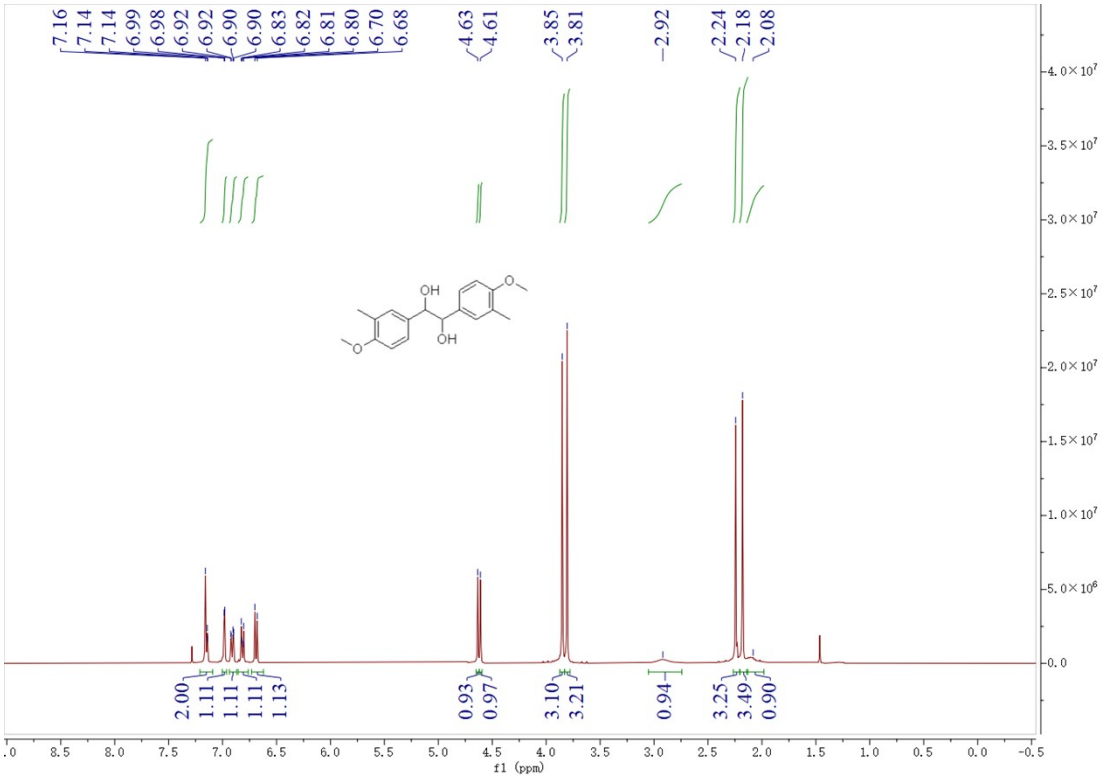
^{1}H NMR spectrum of compound 4t (400 MHz, $CDCl_3$)



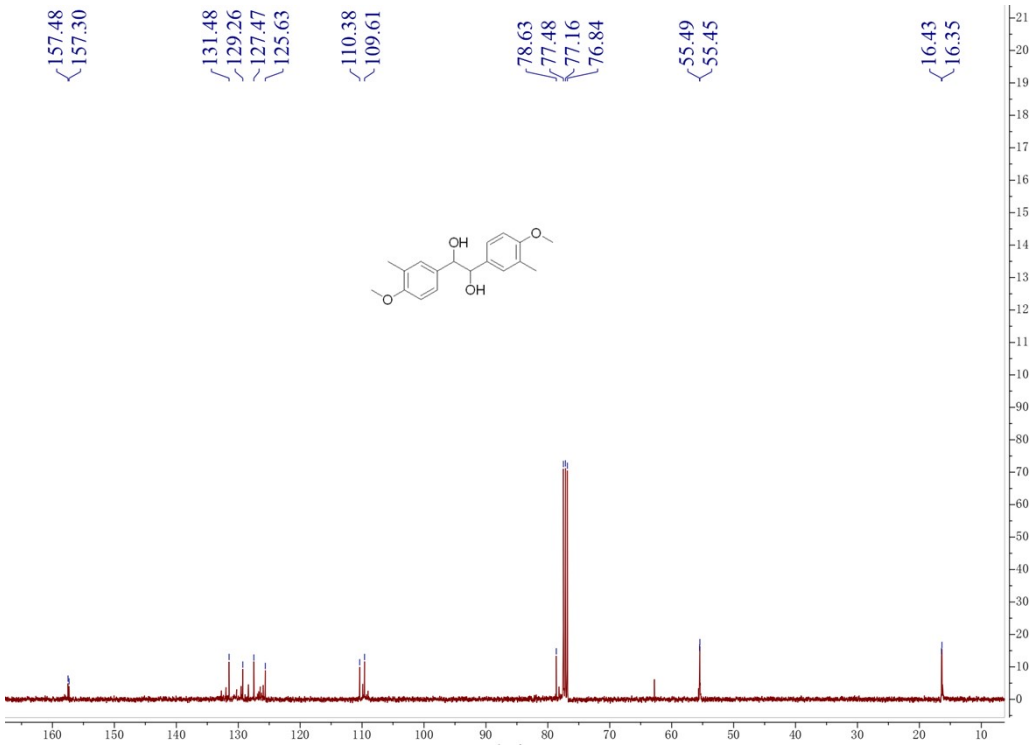
^{13}C NMR spectrum of compound 4t (100 MHz, $CDCl_3$)



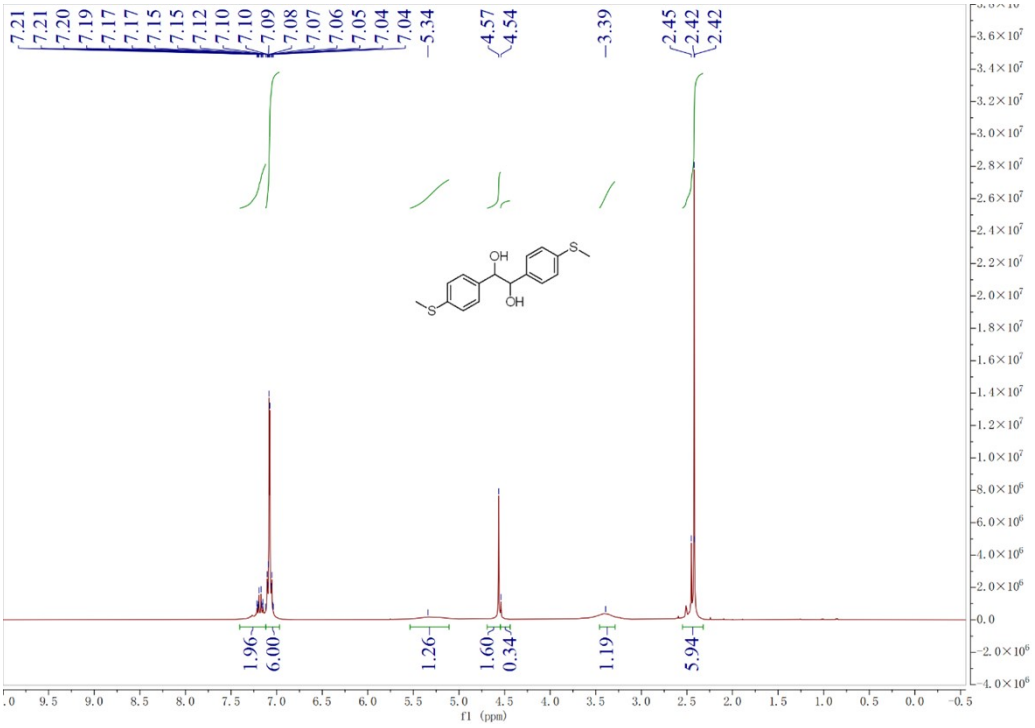
^{1}H NMR spectrum of compound 4u (400 MHz, $CDCl_3$)



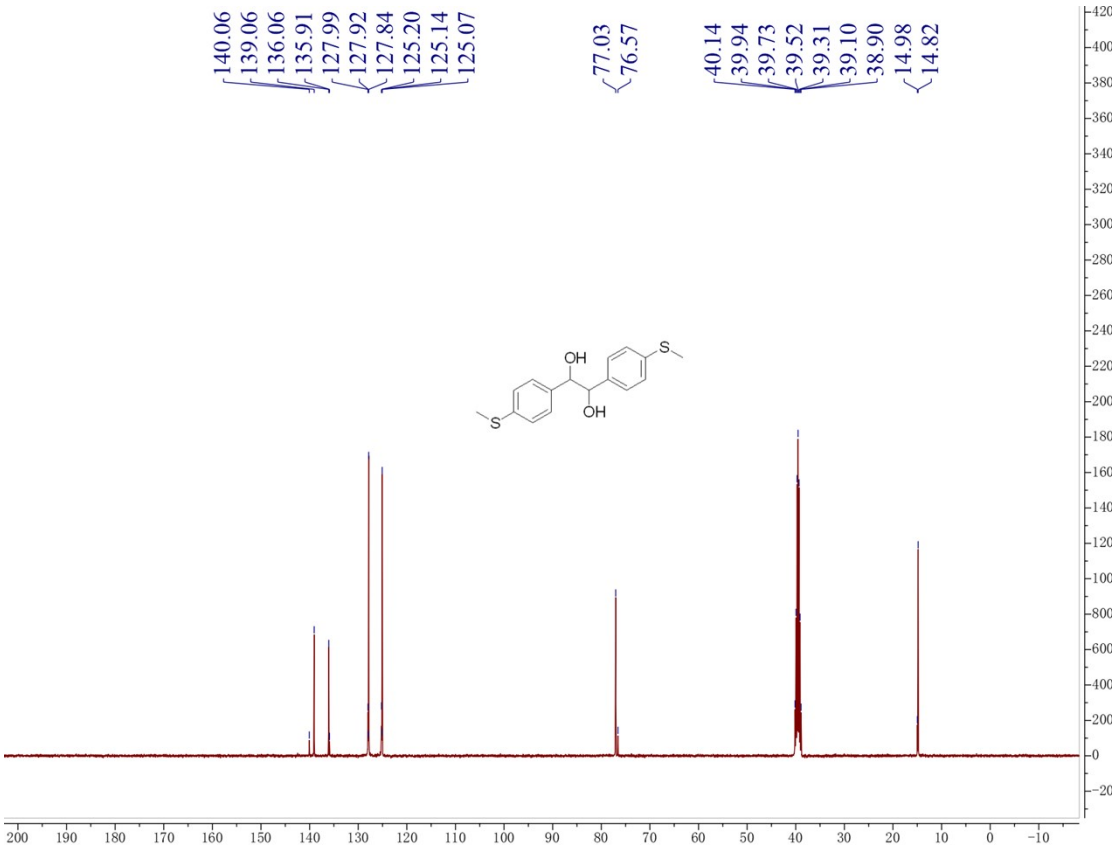
^{13}C NMR spectrum of compound 4u (100 MHz, $CDCl_3$)



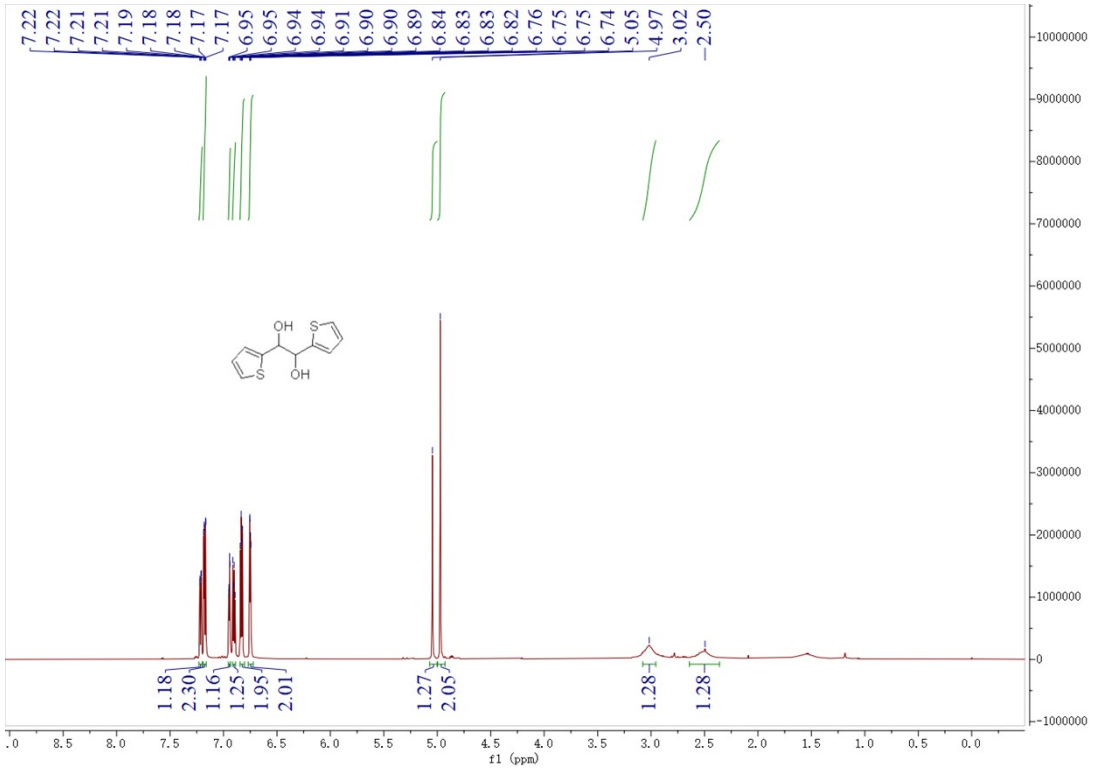
^{1}H NMR spectrum of compound 4v(400 MHz, DMSO-d_6)



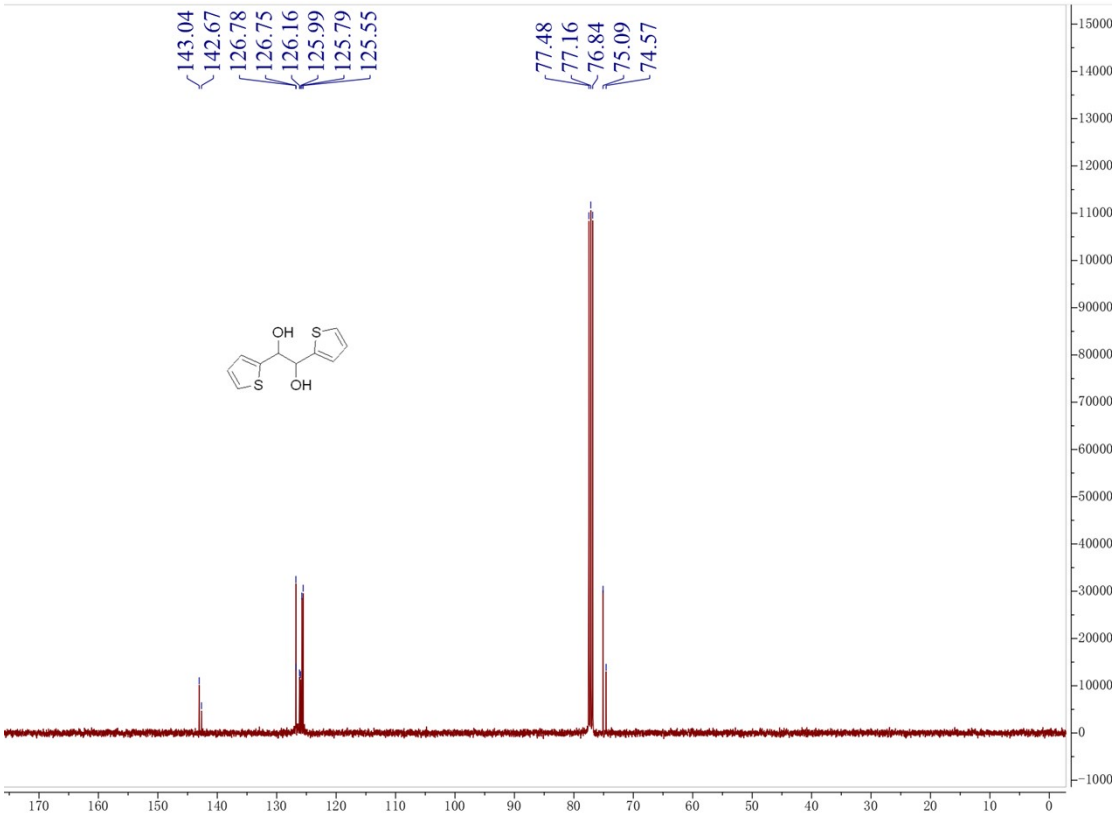
^{13}C NMR spectrum of compound 4v (100 MHz, DMSO-d_6)



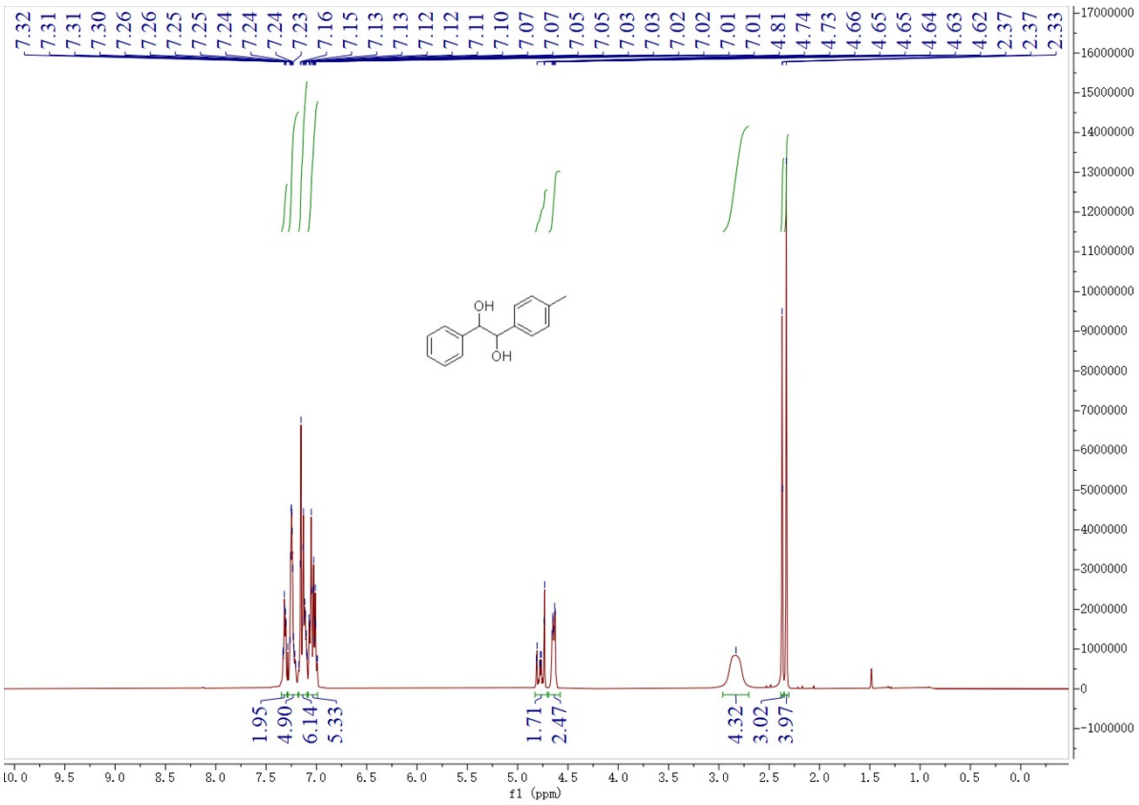
^{1}H NMR spectrum of compound 4w (400 MHz, $CDCl_3$)



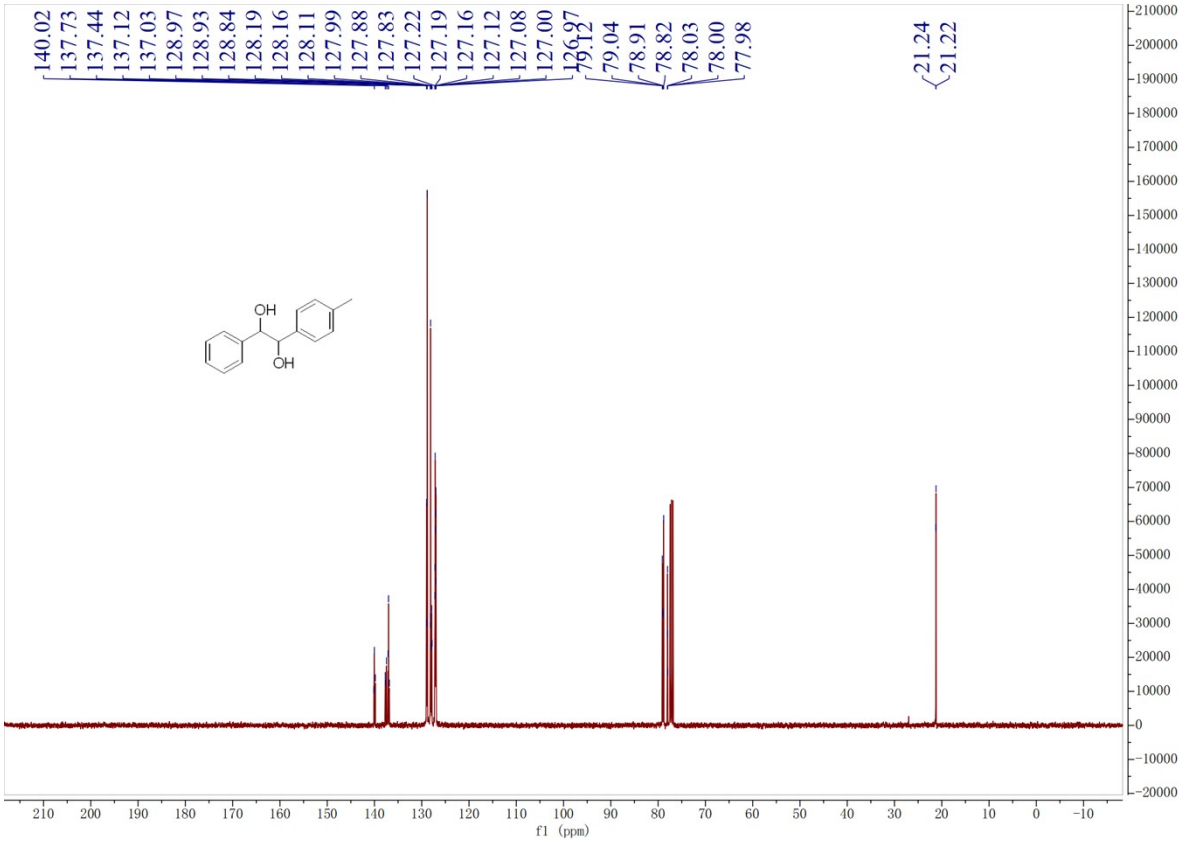
^{13}C NMR spectrum of compound 4w (100 MHz, $CDCl_3$)



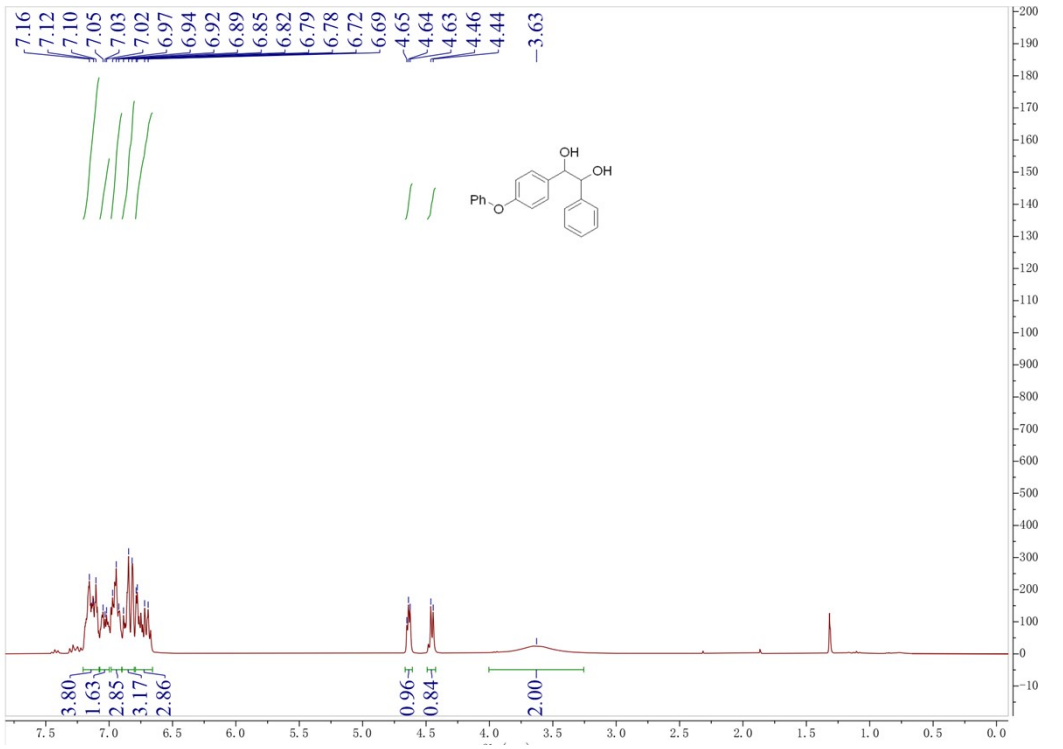
^{1}H NMR spectrum of compound 5a (400 MHz, $CDCl_3$)



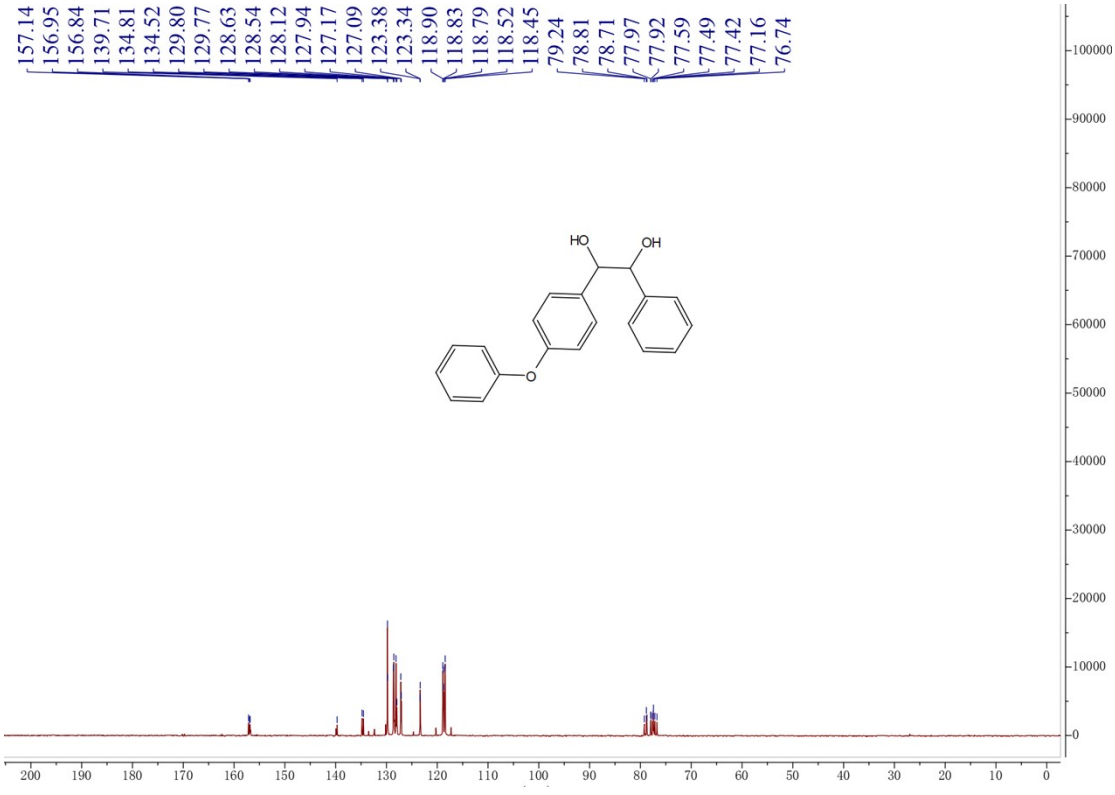
^{13}C NMR spectrum of compound 5a (100 MHz, $CDCl_3$)



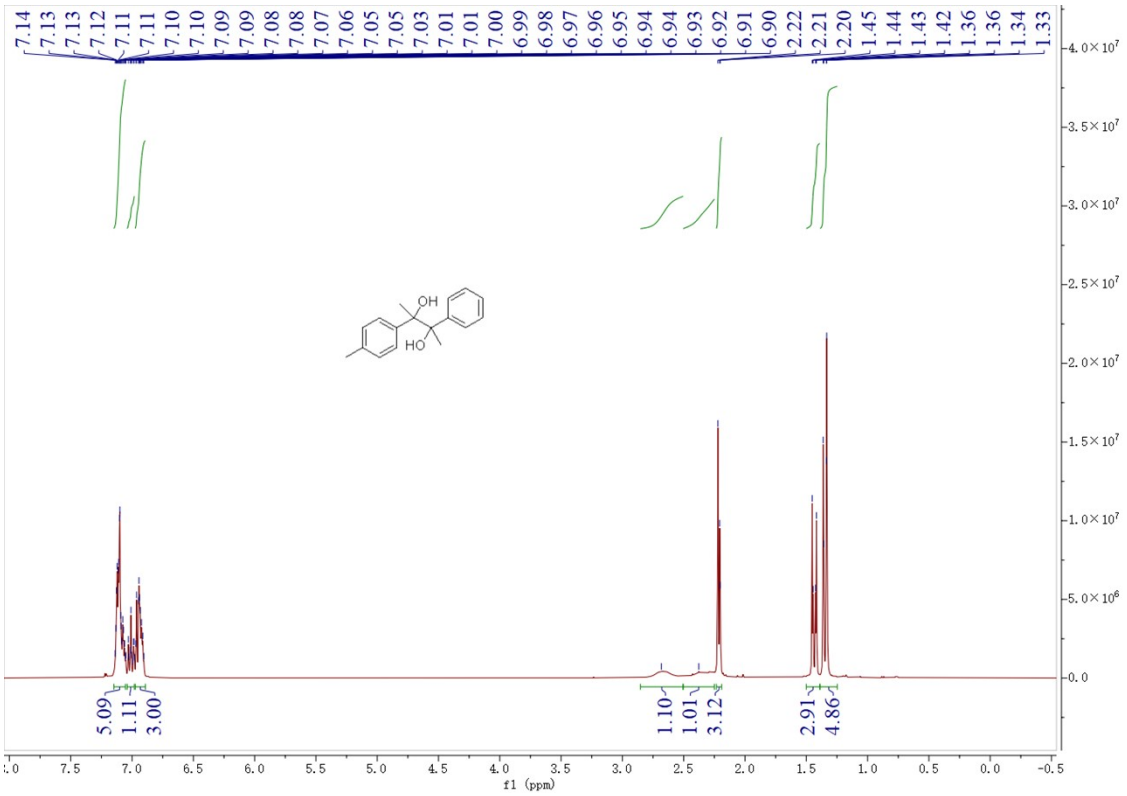
^{1}H NMR spectrum of compound 5b (300 MHz, $CDCl_3$)



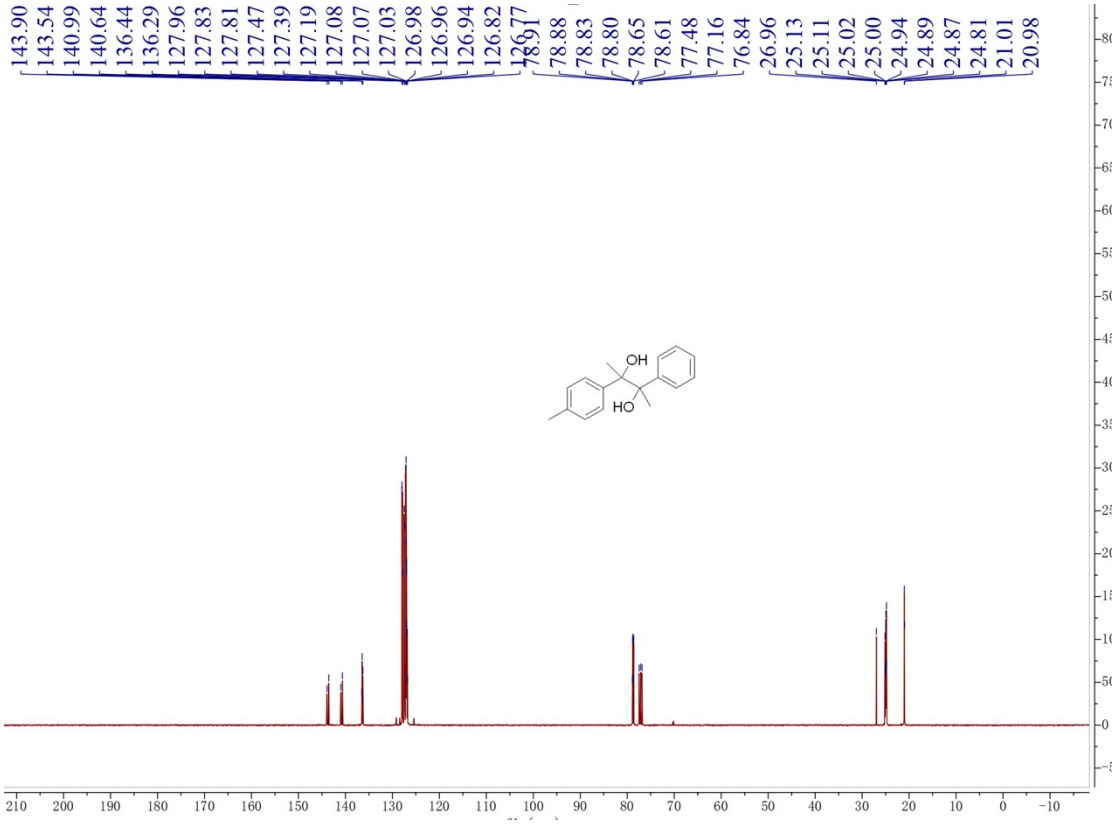
^{13}C NMR spectrum of compound 5b (75 MHz, $CDCl_3$)



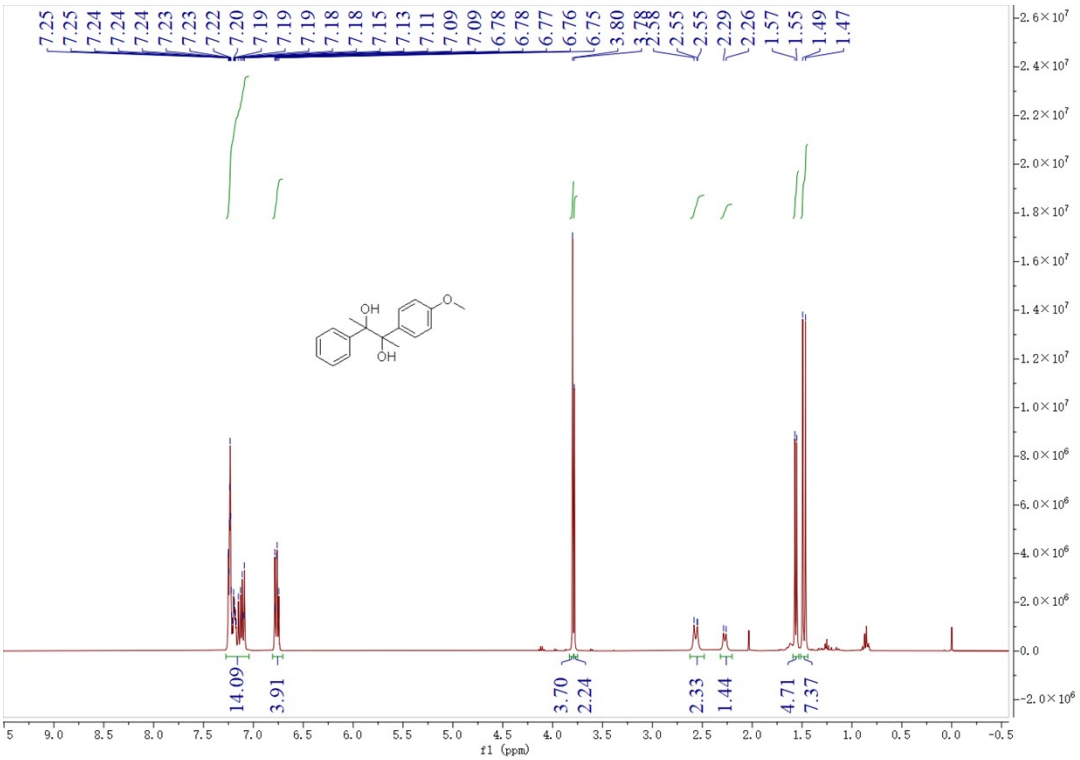
^{1}H NMR spectrum of compound 5c (400 MHz, $CDCl_3$)



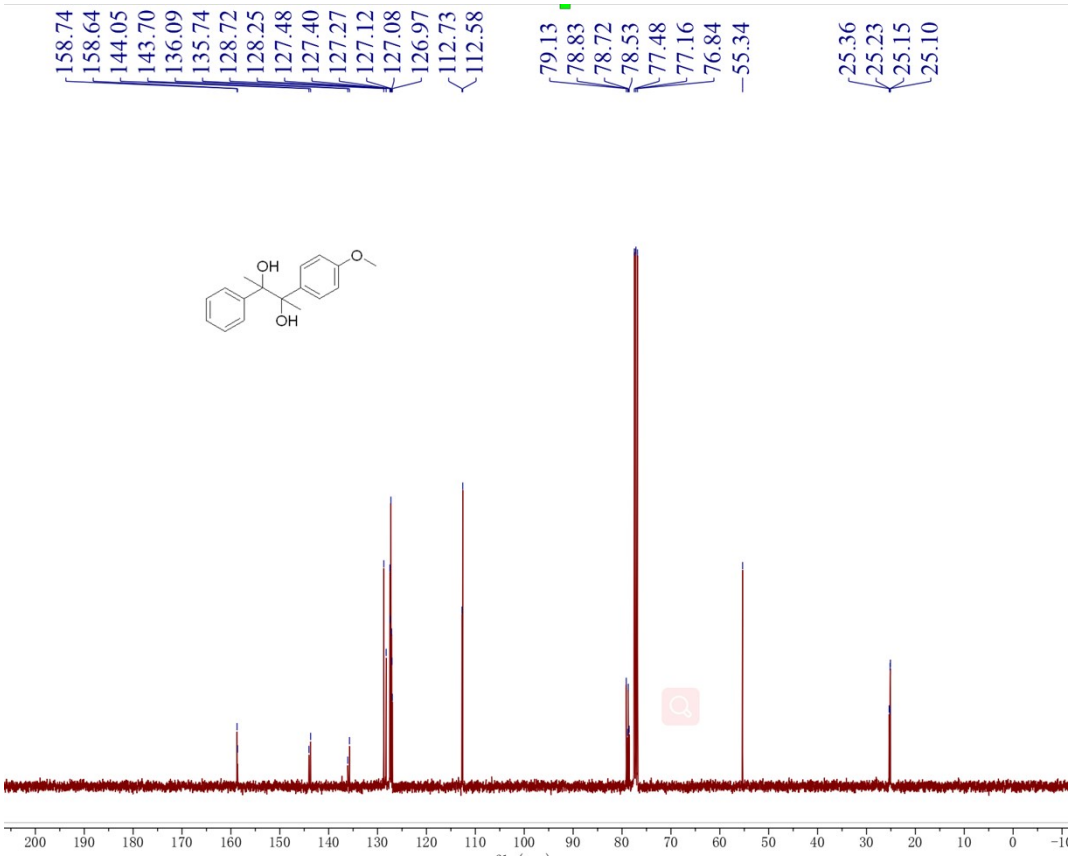
^{13}C NMR spectrum of compound 5c (100 MHz, $CDCl_3$)



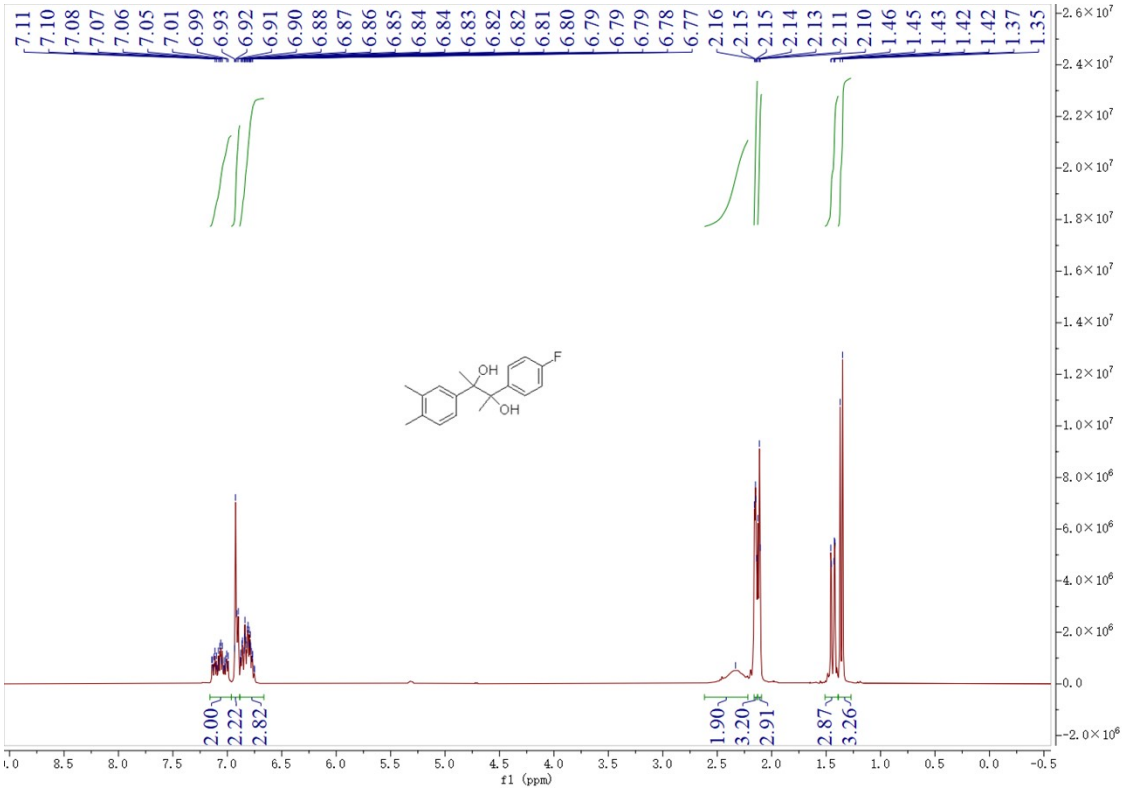
^{1}H NMR spectrum of compound 5d (400 MHz, $CDCl_3$)



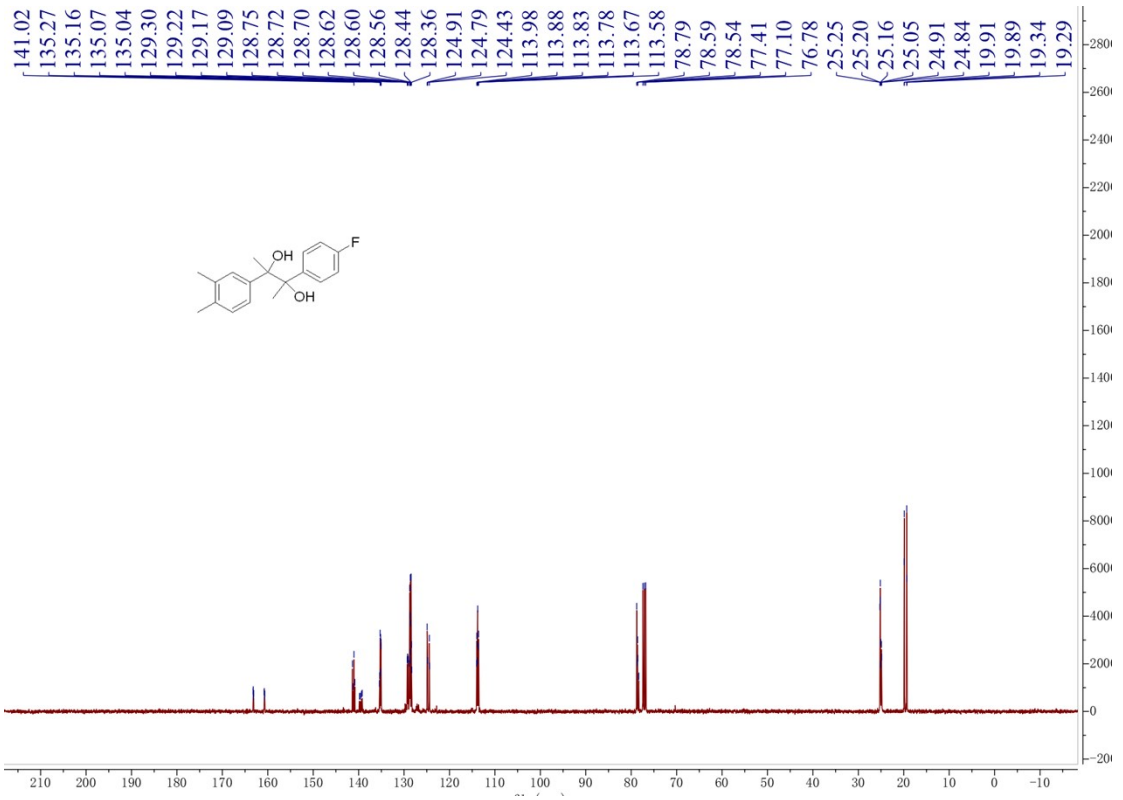
^{13}C NMR spectrum of compound 5d (100 MHz, $CDCl_3$)



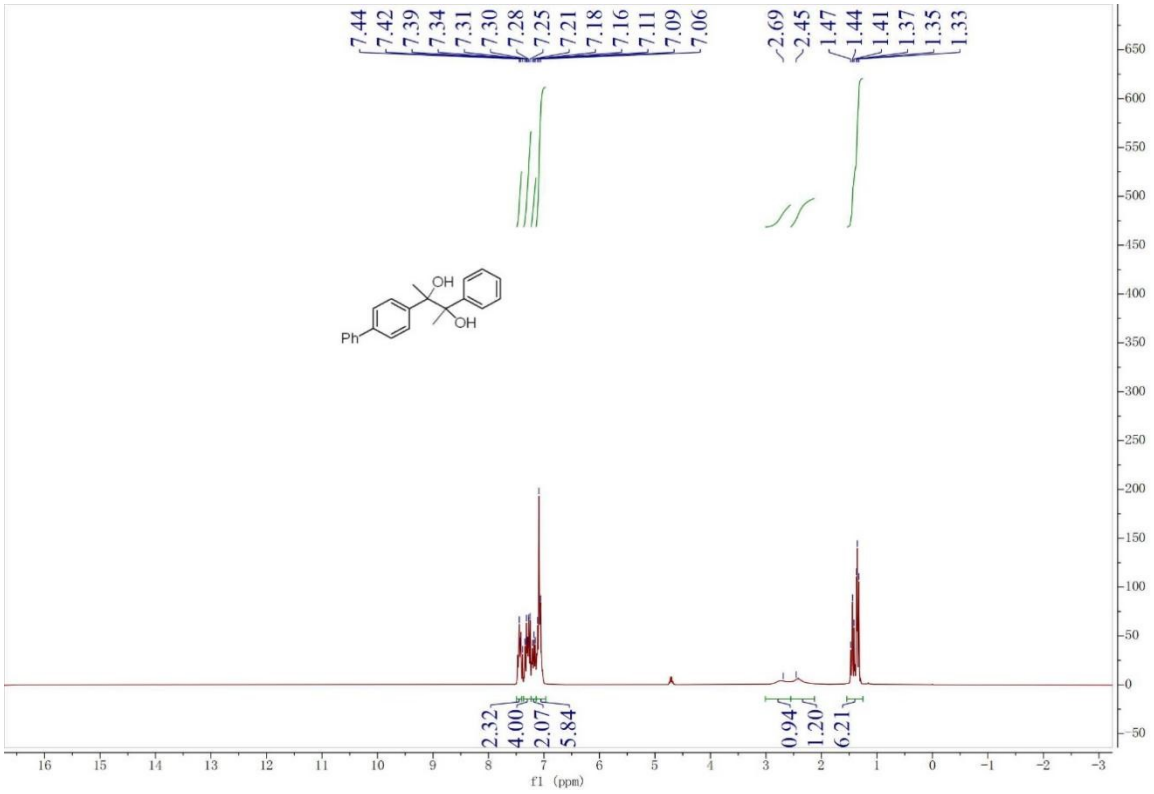
^{1}H NMR spectrum of compound 5e(400 MHz, $CDCl_3$)



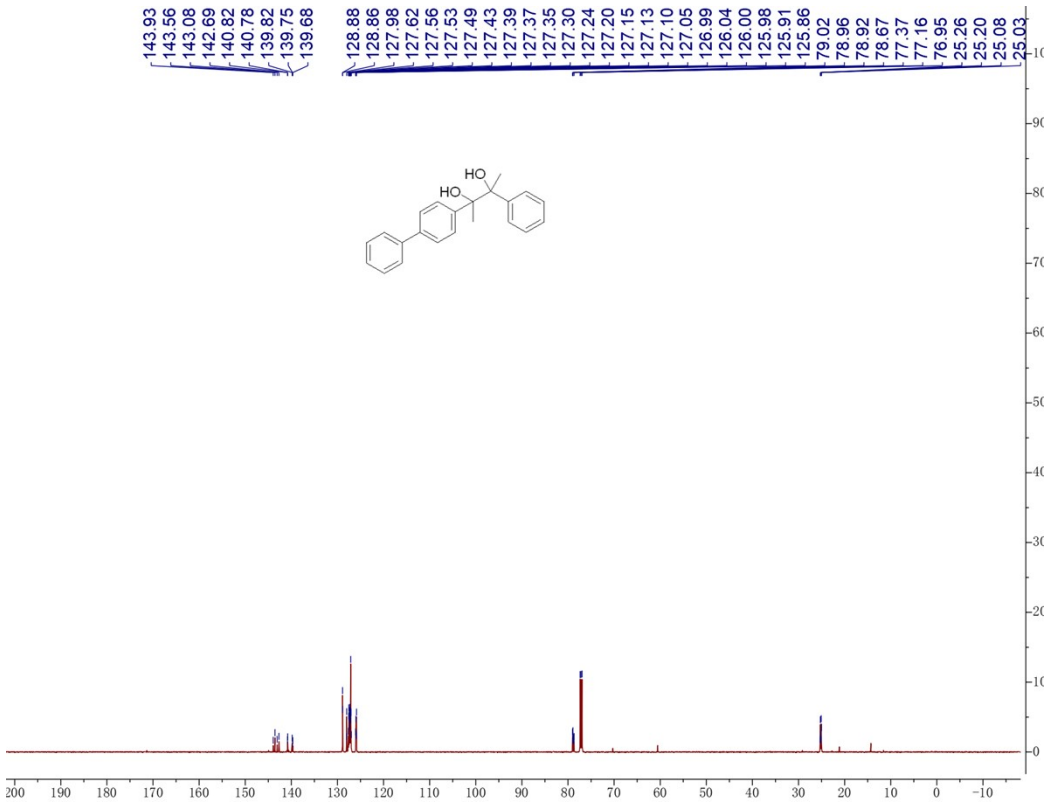
^{13}C NMR spectrum of compound 5e (100 MHz, $CDCl_3$)



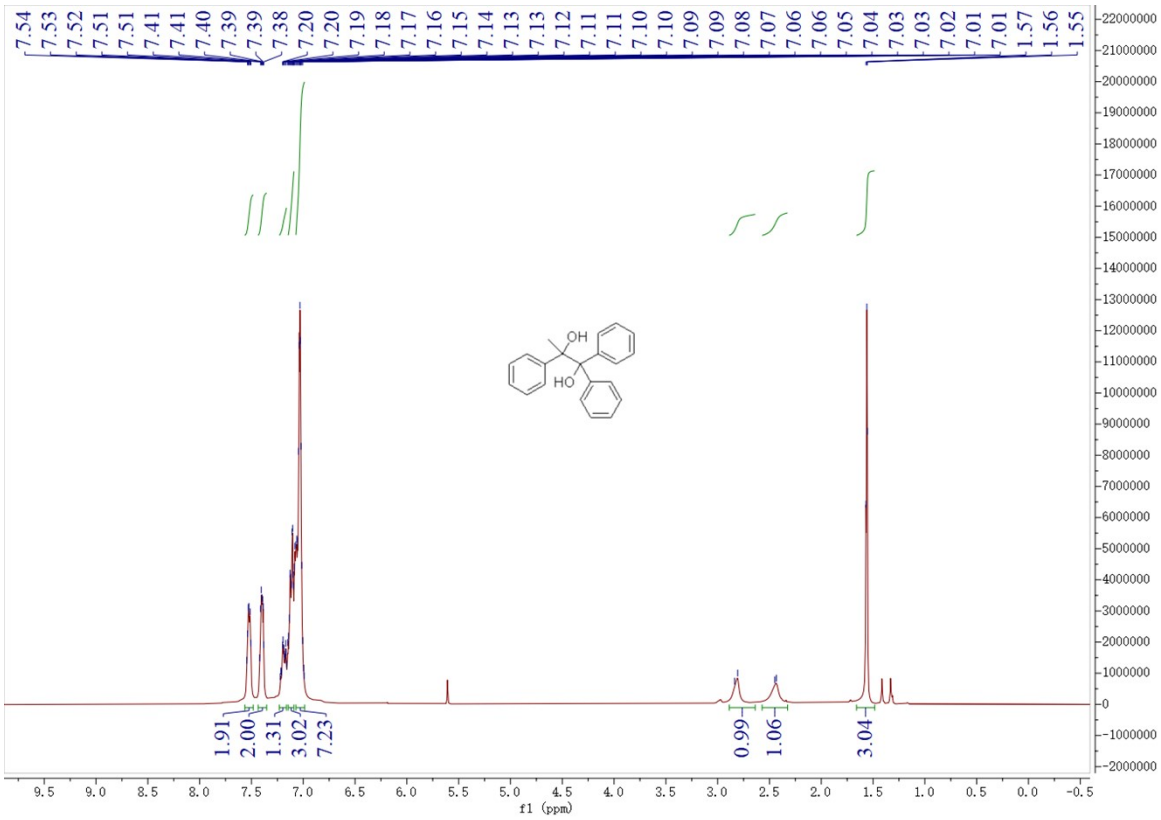
^{1}H NMR spectrum of compound 5f(400 MHz, $CDCl_3$)



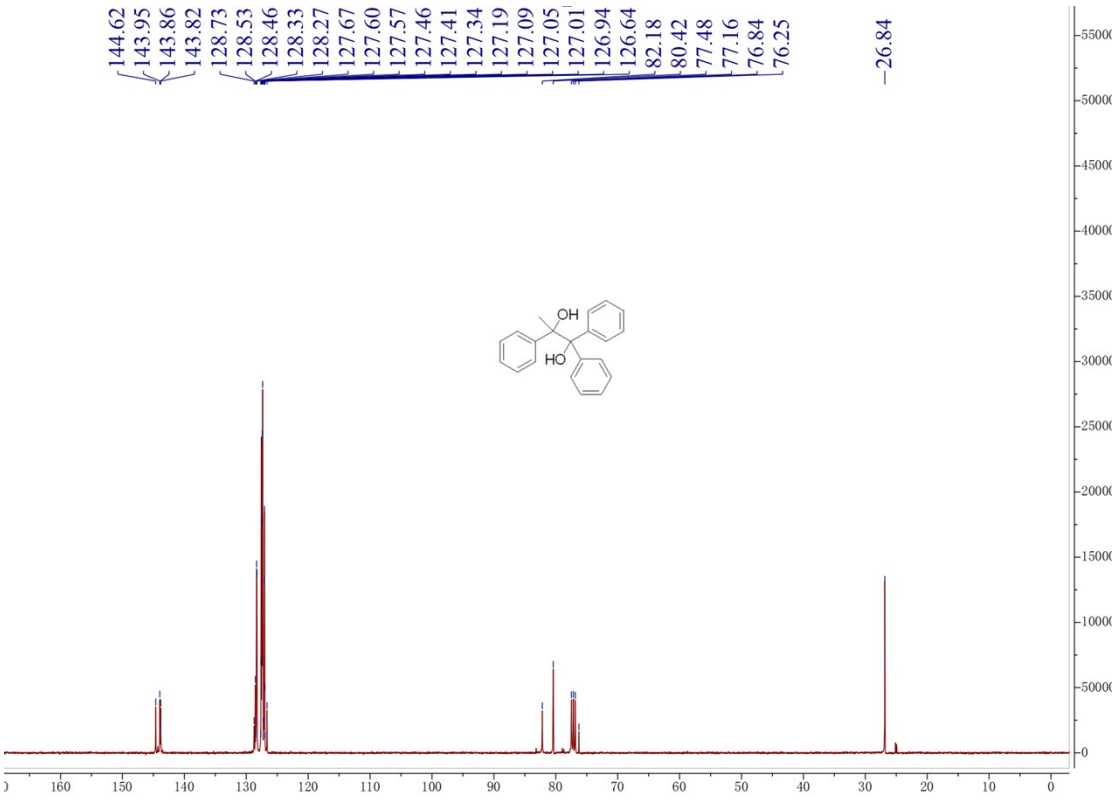
^{13}C NMR spectrum of compound 5f (150 MHz, $CDCl_3$)



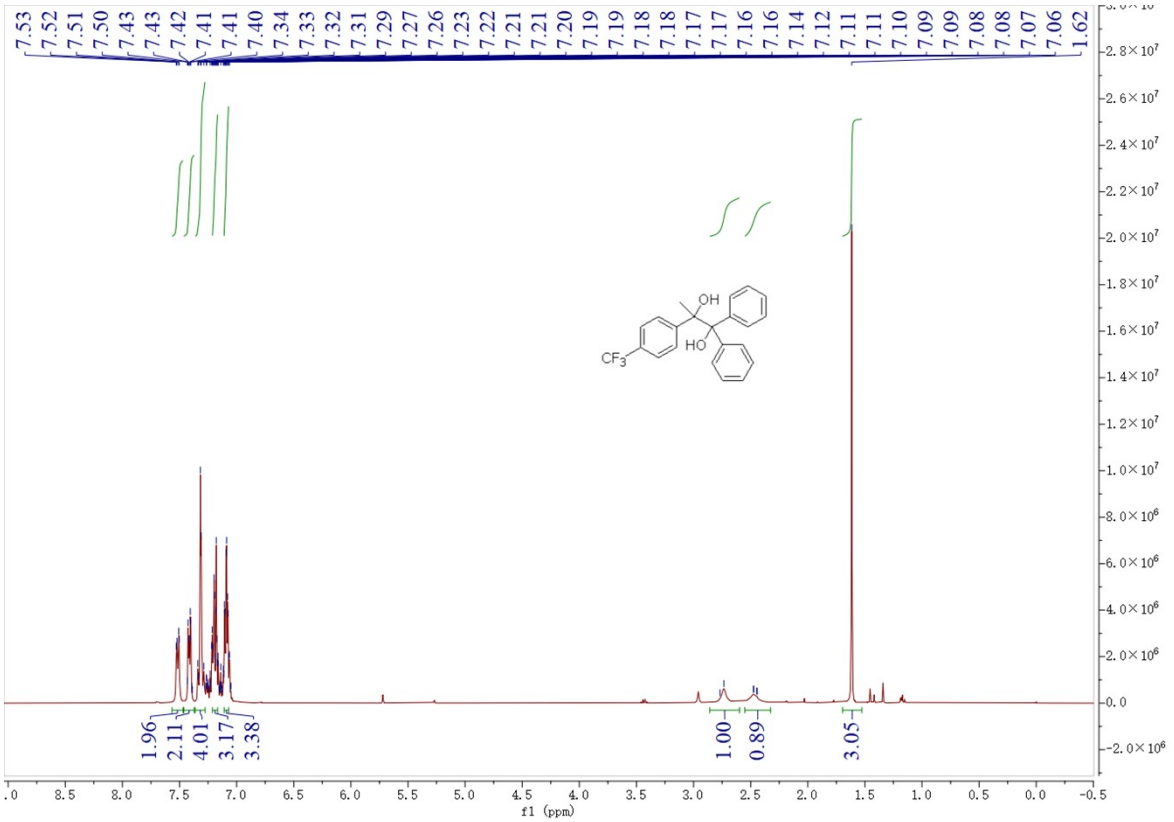
^{1}H NMR spectrum of compound 5g (400 MHz, $CDCl_3$)



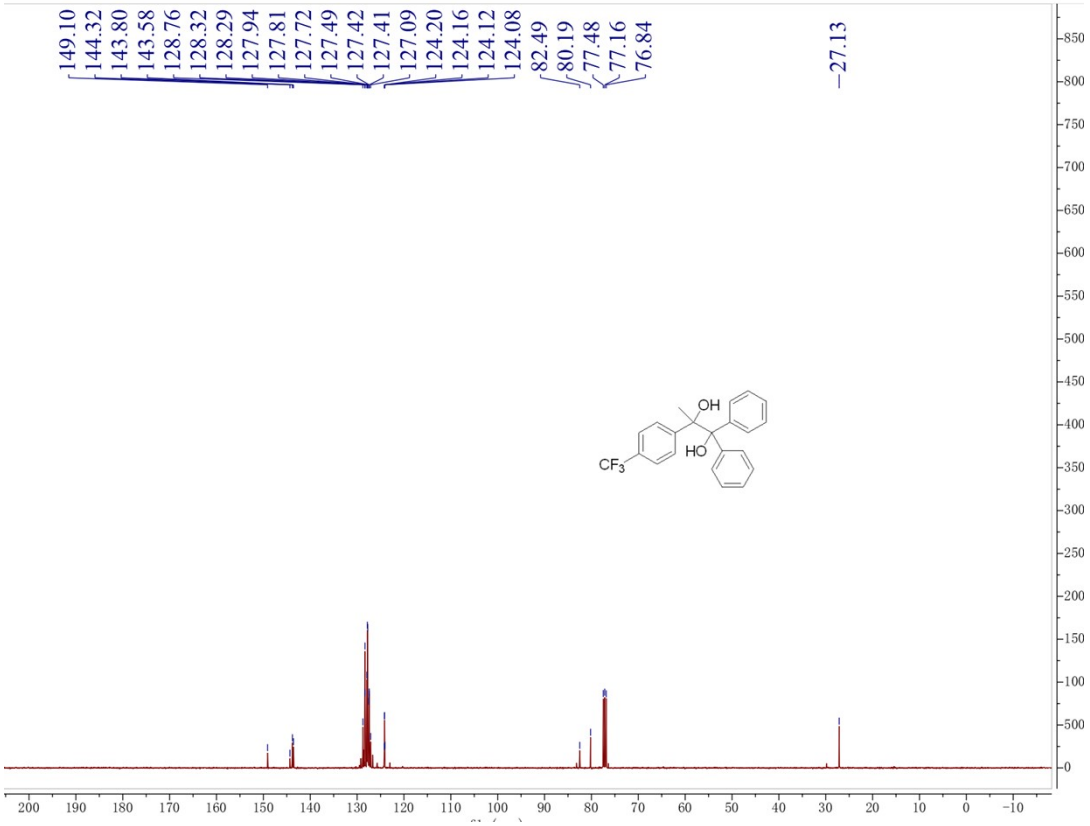
^{13}C NMR spectrum of compound 5g (100 MHz, $CDCl_3$)



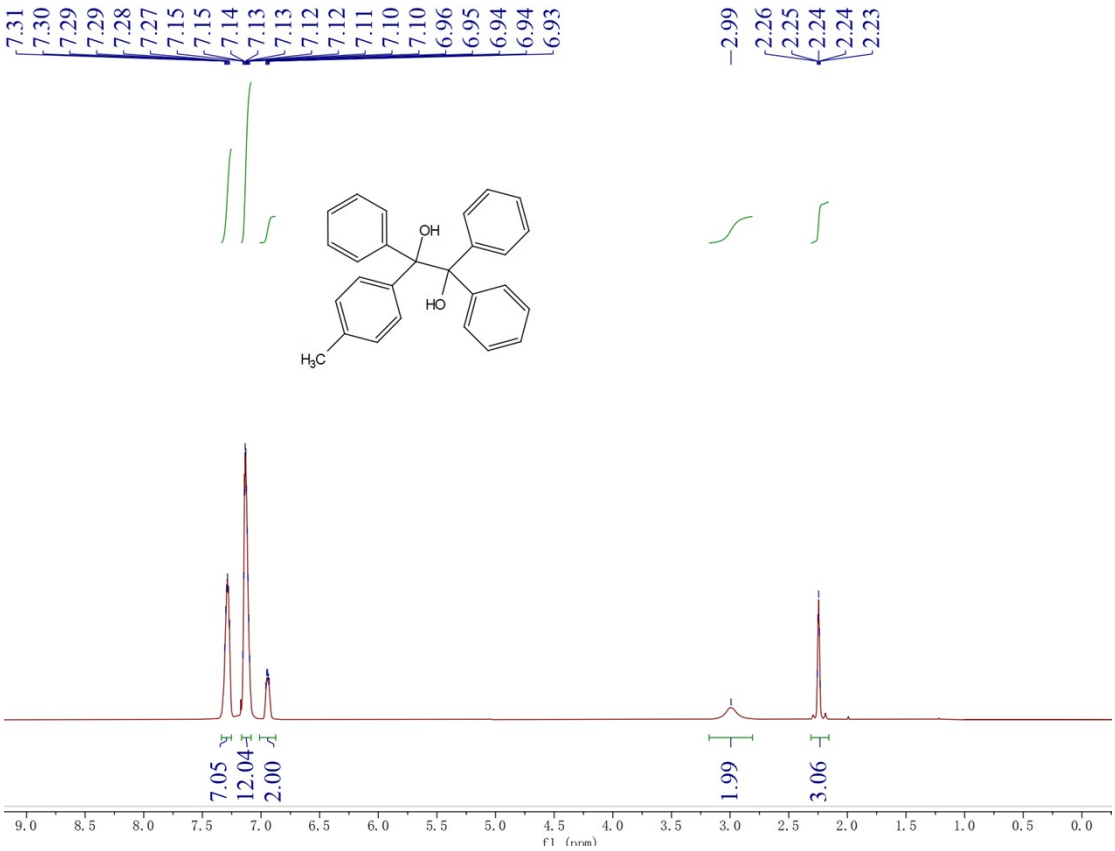
^{1}H NMR spectrum of compound 5h (400 MHz, $CDCl_3$)



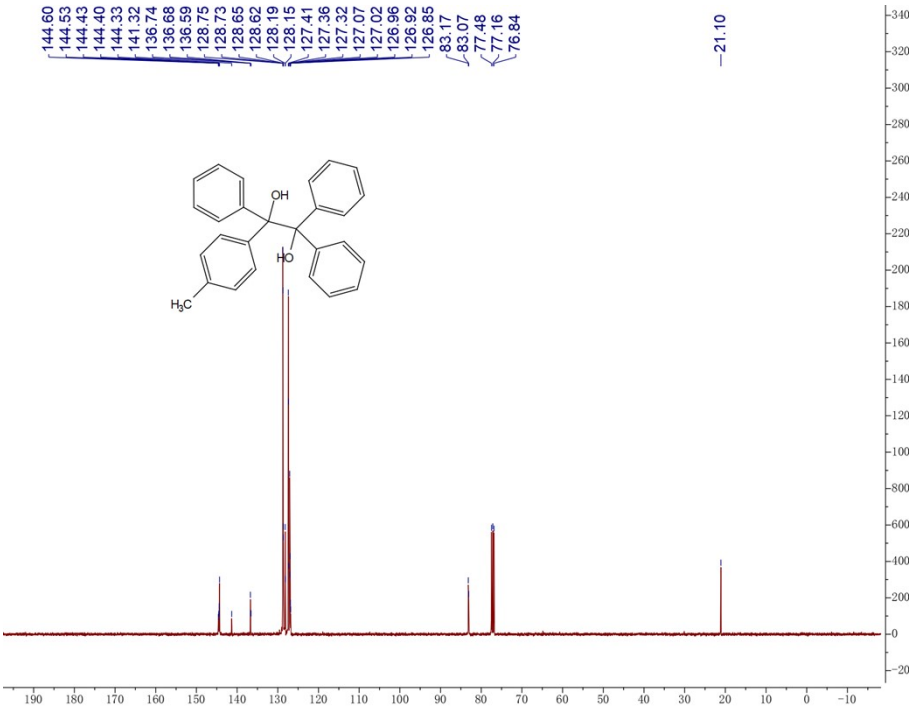
^{13}C NMR spectrum of compound 5h (100 MHz, $CDCl_3$)



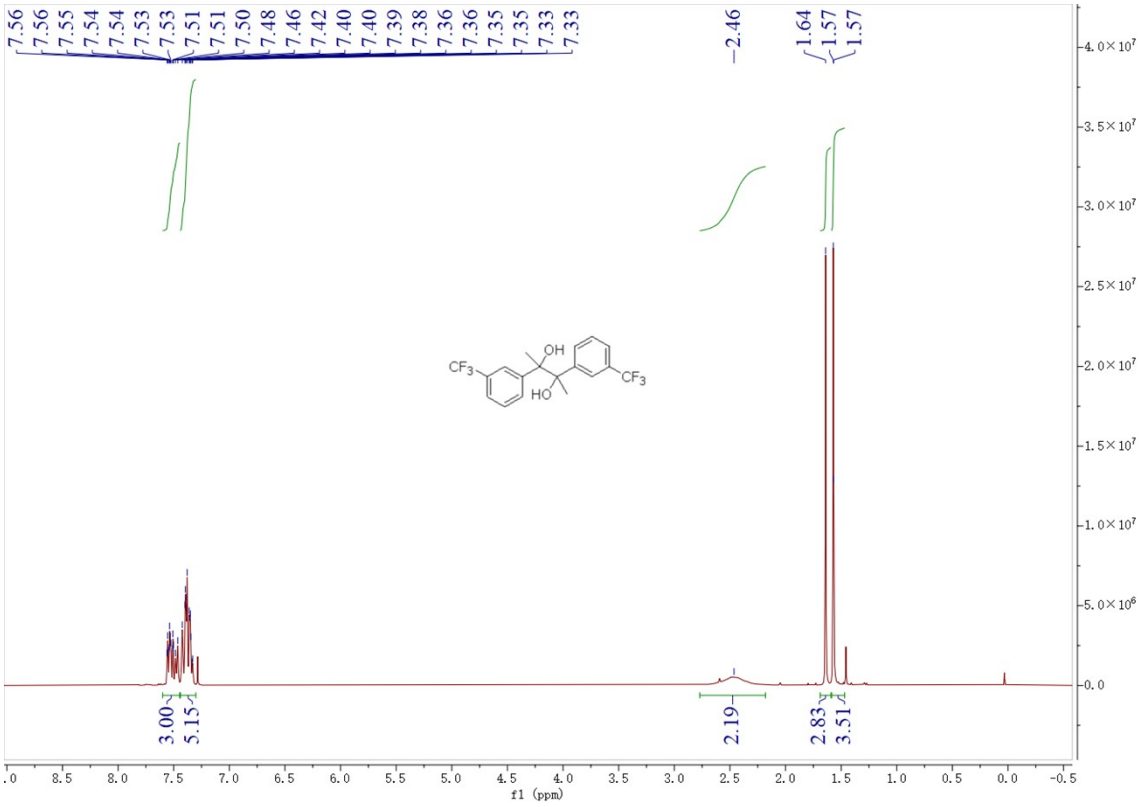
^{1}H NMR spectrum of compound 5i (400 MHz, $CDCl_3$)



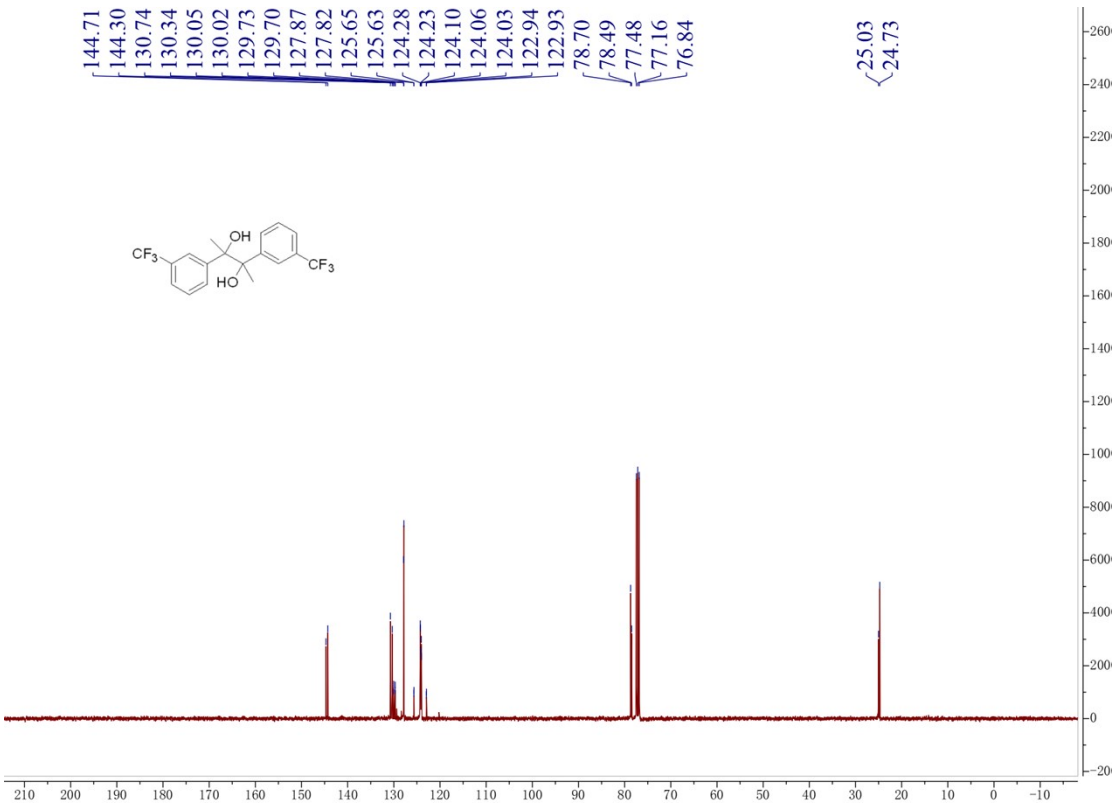
^{13}C NMR spectrum of compound 5i (100 MHz, $CDCl_3$)



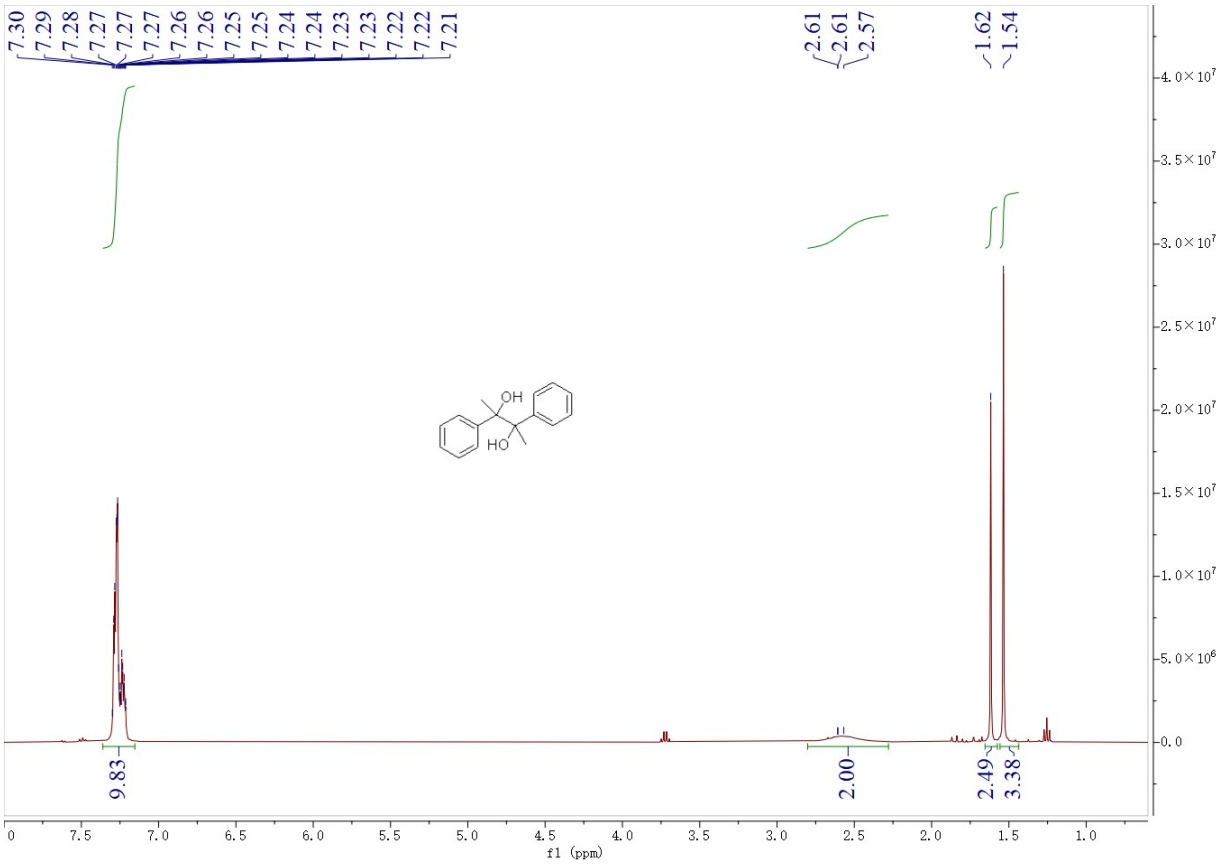
^{1}H NMR spectrum of compound 6a (400 MHz, $CDCl_3$)



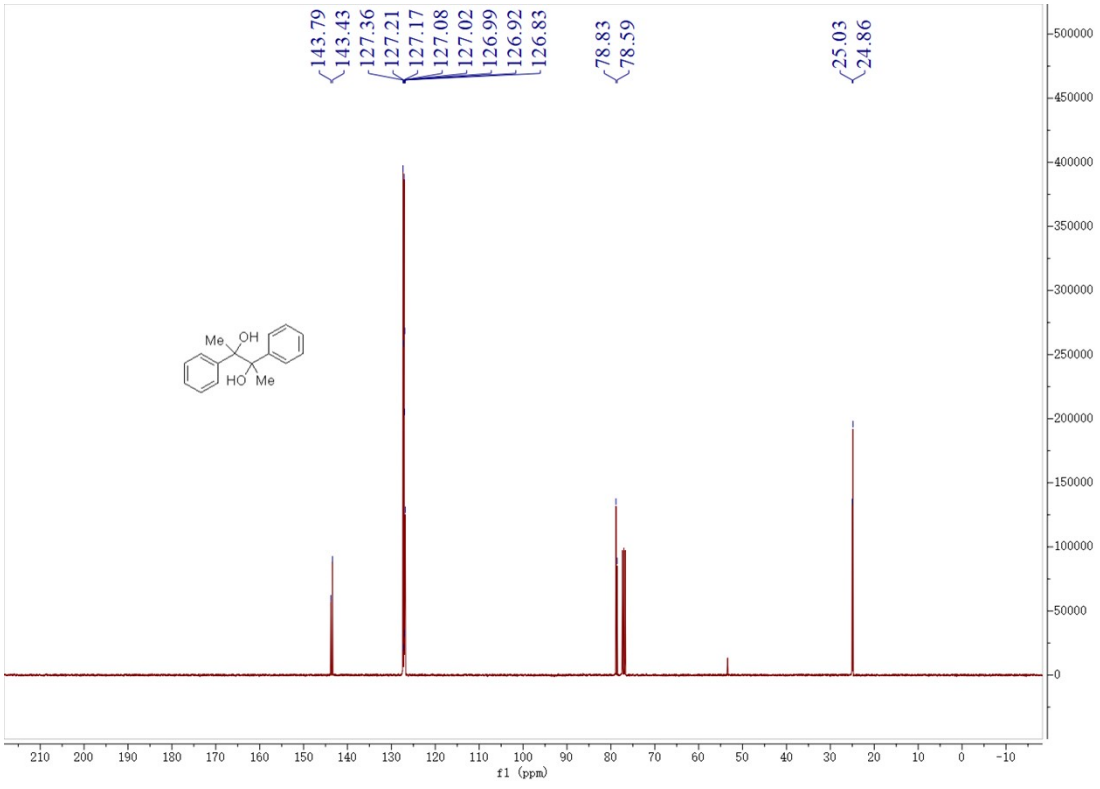
^{13}C NMR spectrum of compound 6a (100 MHz, $CDCl_3$)



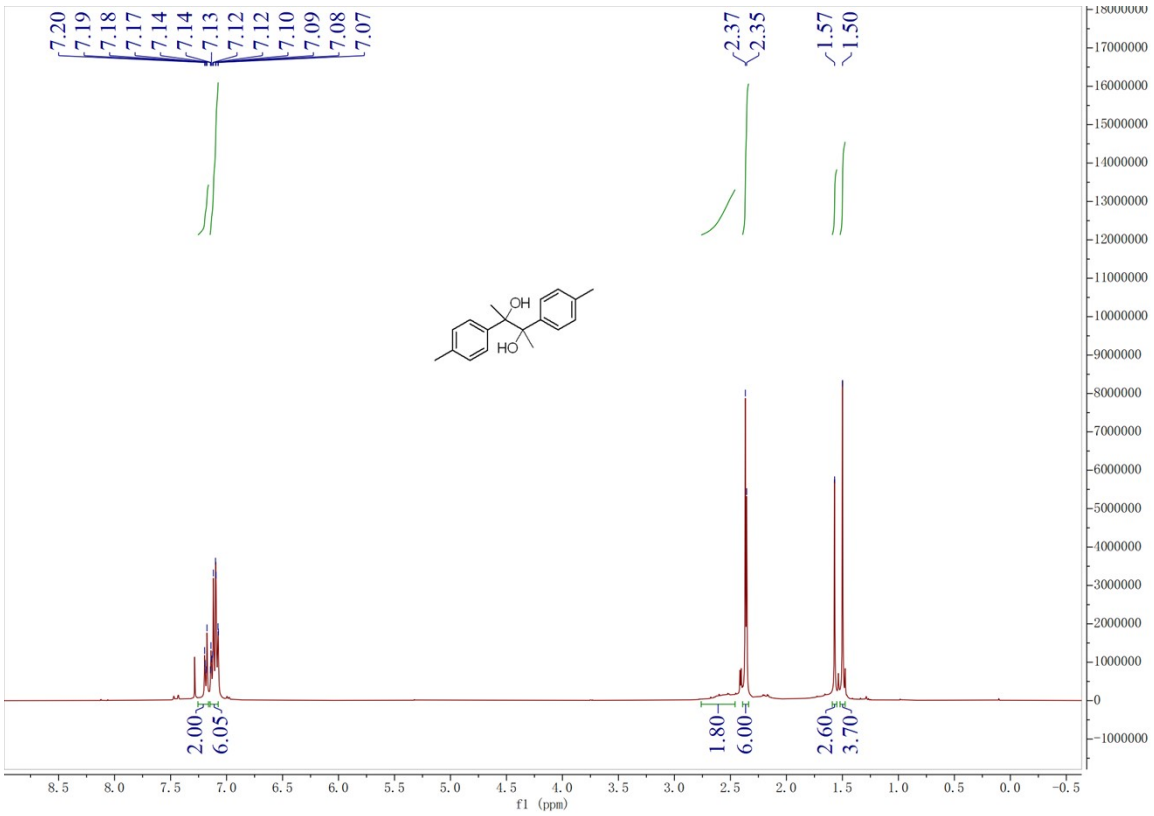
^{1}H NMR spectrum of compound 6b (400 MHz, $CDCl_3$)



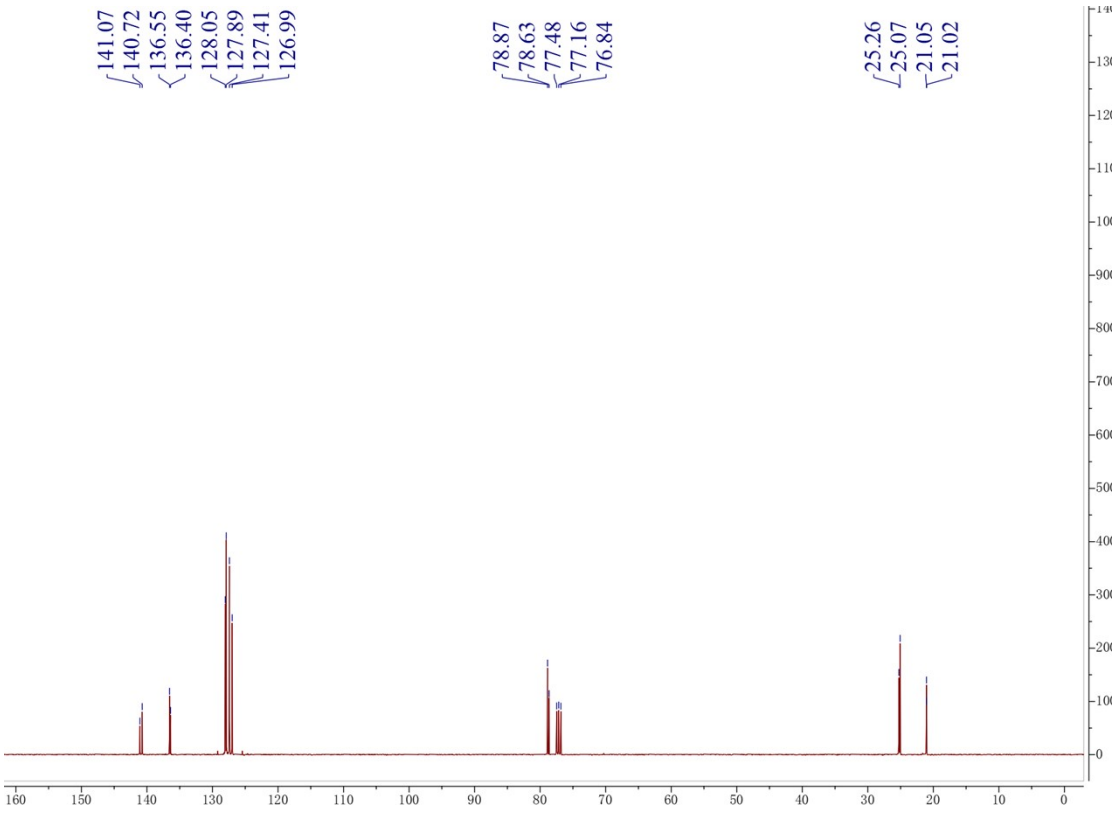
^{13}C NMR spectrum of compound 6b (100 MHz, $CDCl_3$)



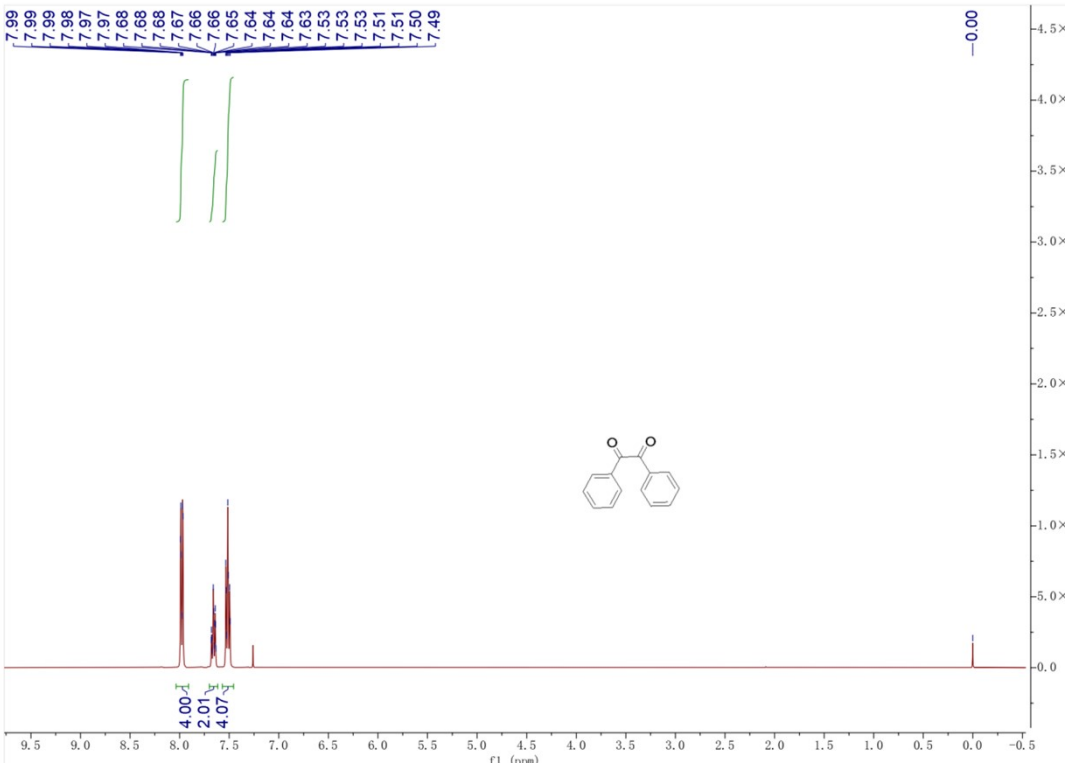
^{1}H NMR spectrum of compound 6c (400 MHz, $CDCl_3$)



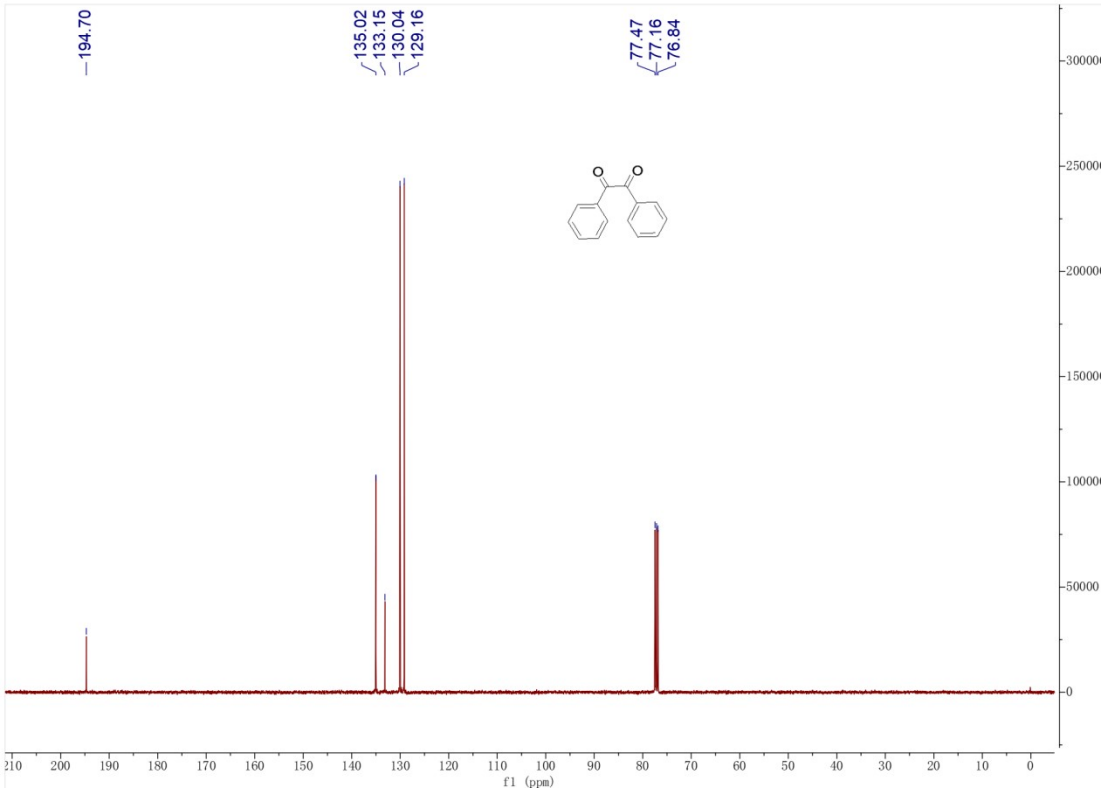
^{13}C NMR spectrum of compound 6c (100 MHz, $CDCl_3$)



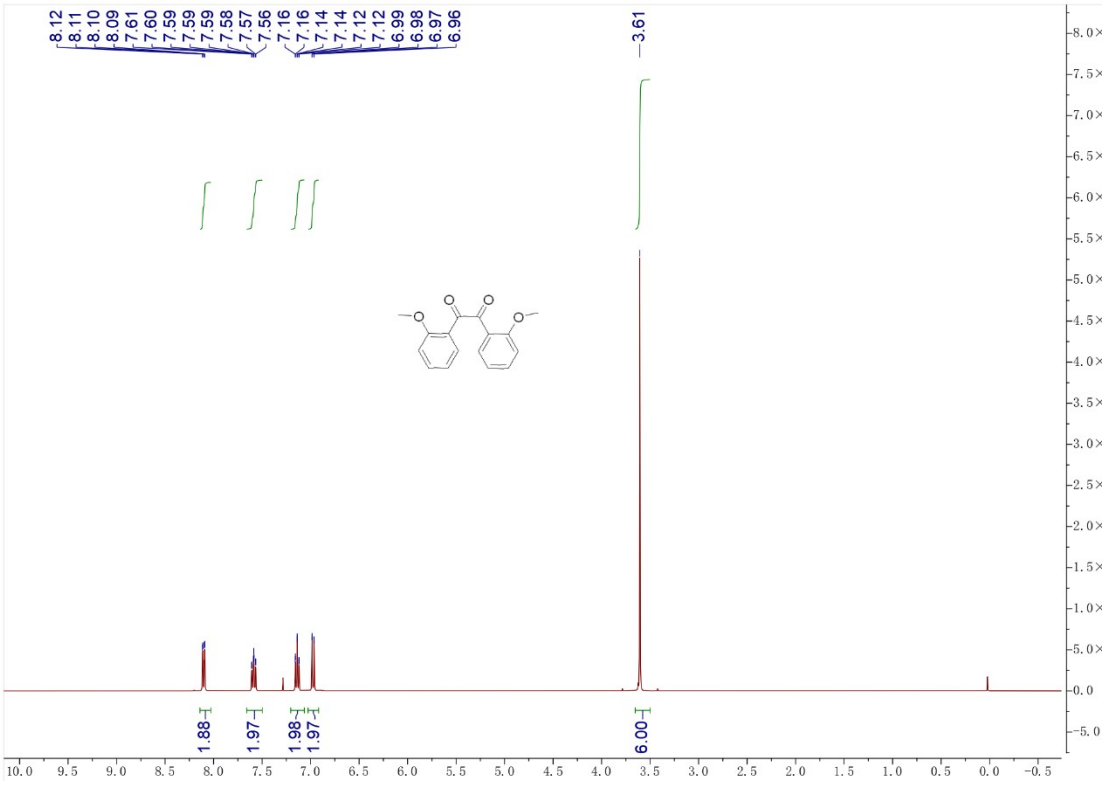
^{1}H NMR spectrum of compound7a (400 MHz, $CDCl_3$)



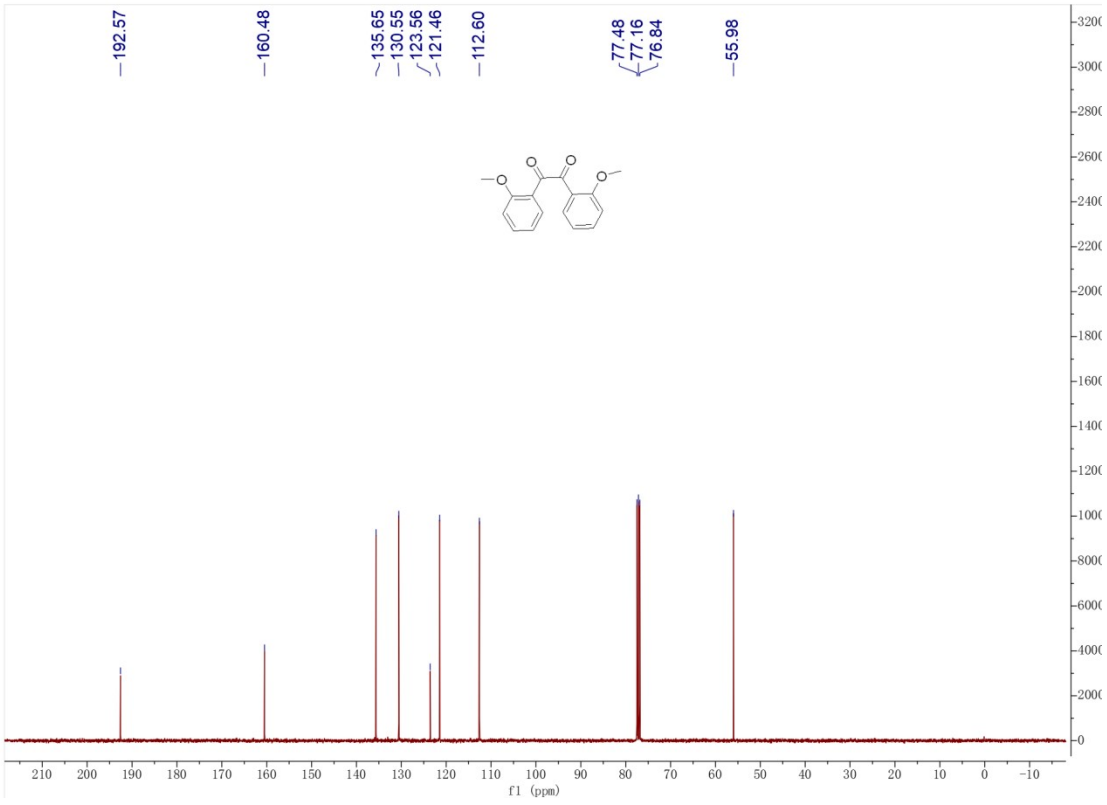
^{13}C NMR spectrum of compound 7a (100 MHz, $CDCl_3$)



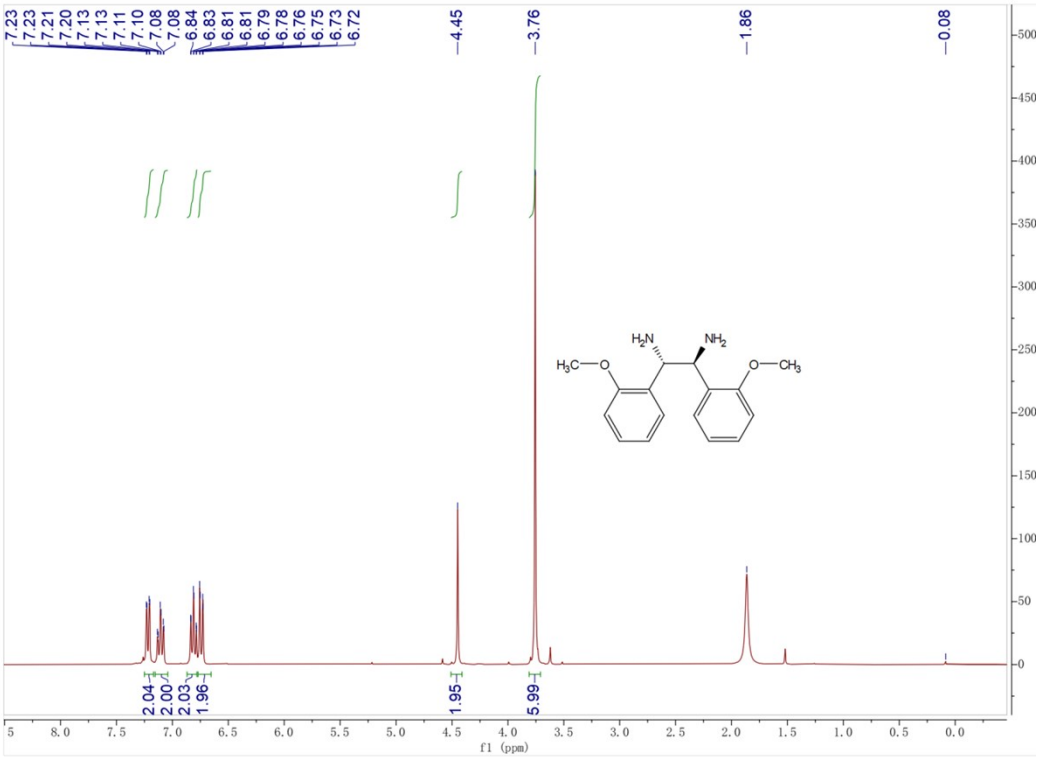
^{1}H NMR spectrum of compound 7b (400 MHz, $CDCl_3$)



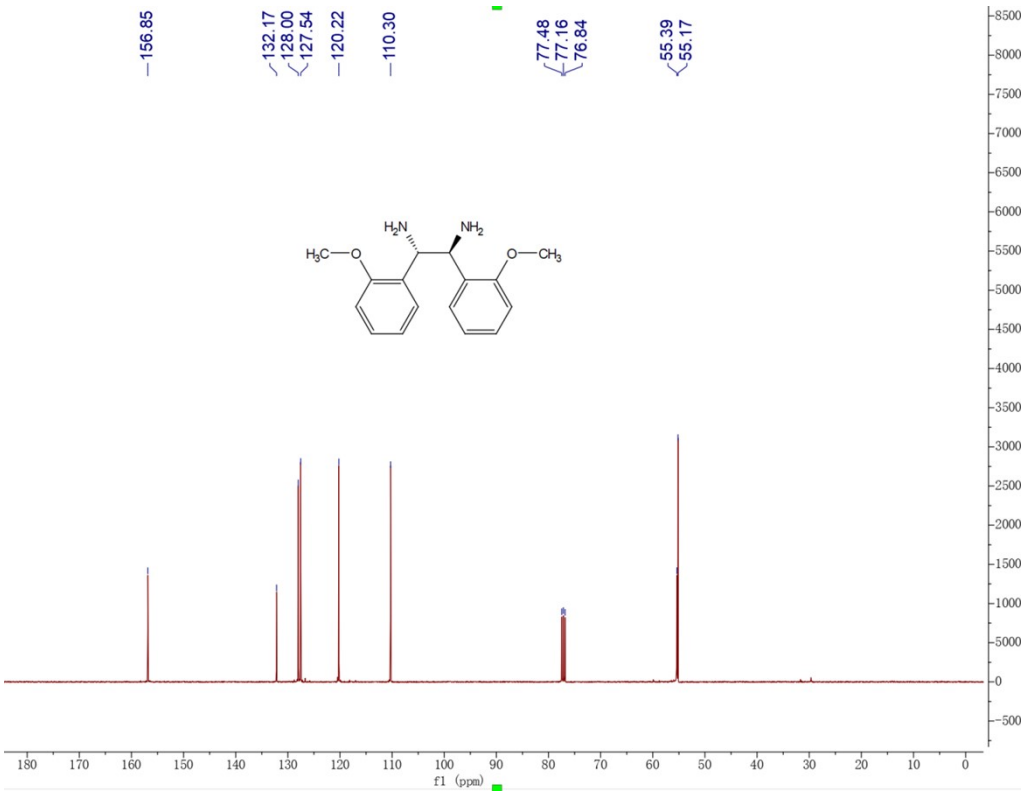
^{13}C NMR spectrum of compound 7b (100 MHz, $CDCl_3$)



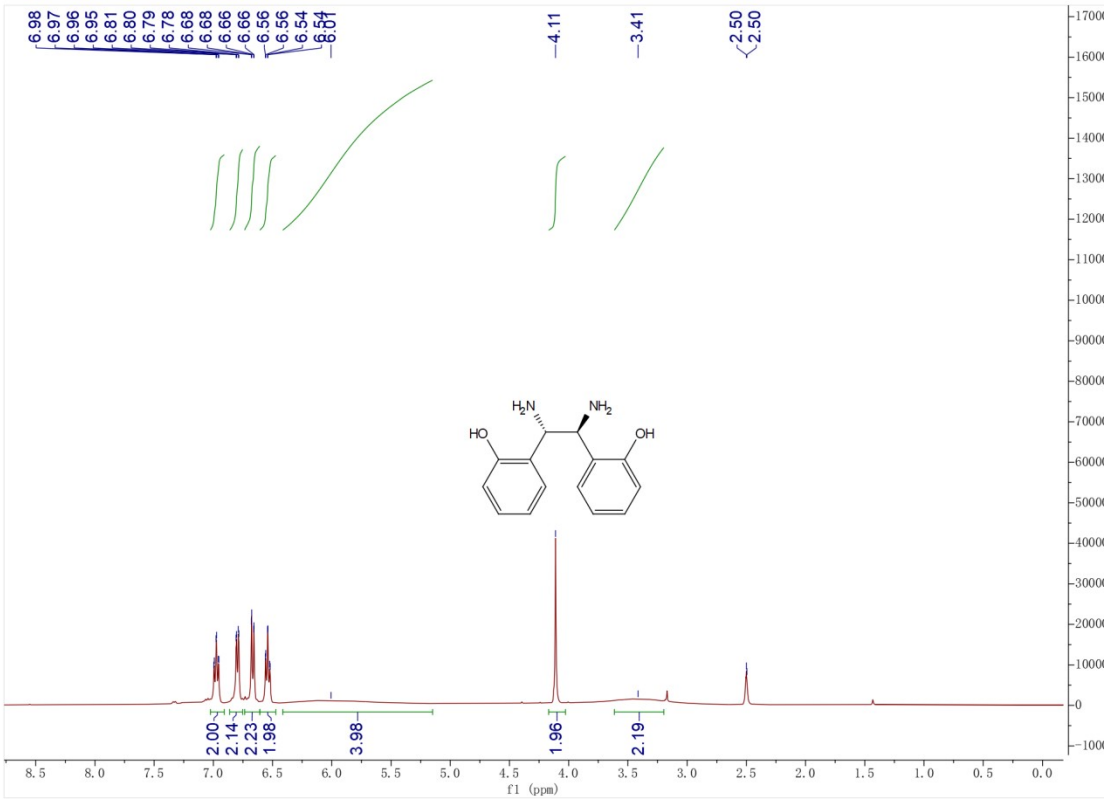
^{1}H NMR spectrum of compound 8 (300 MHz, $CDCl_3$)



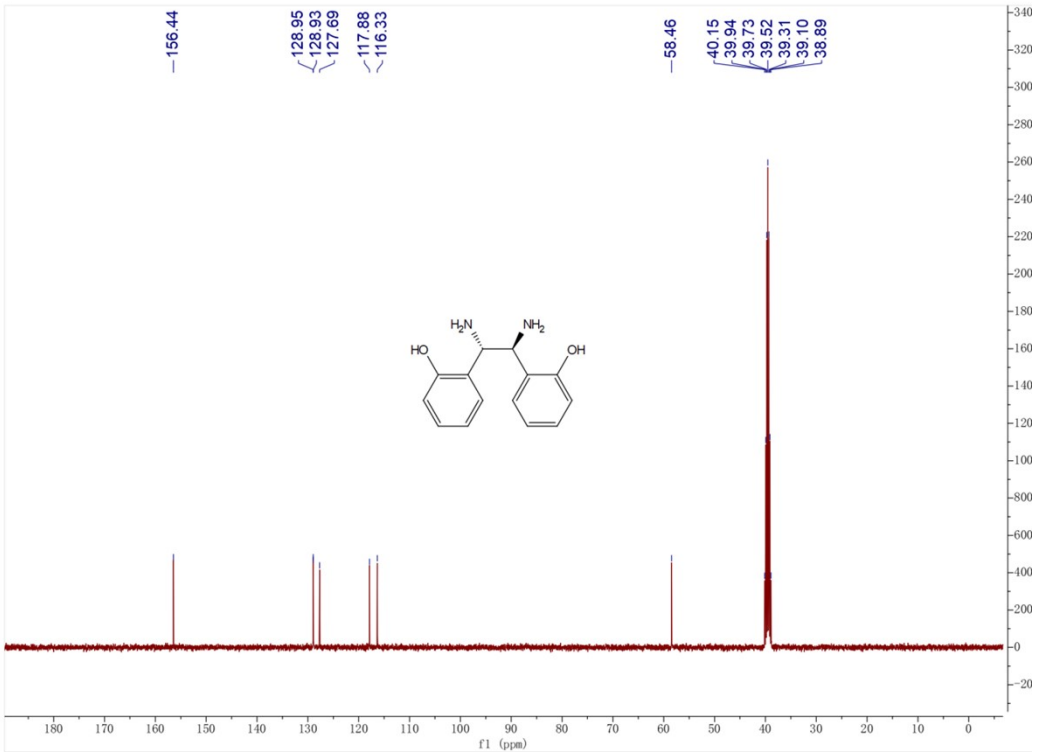
^{13}C NMR spectrum of compound 8 (100 MHz, $CDCl_3$)



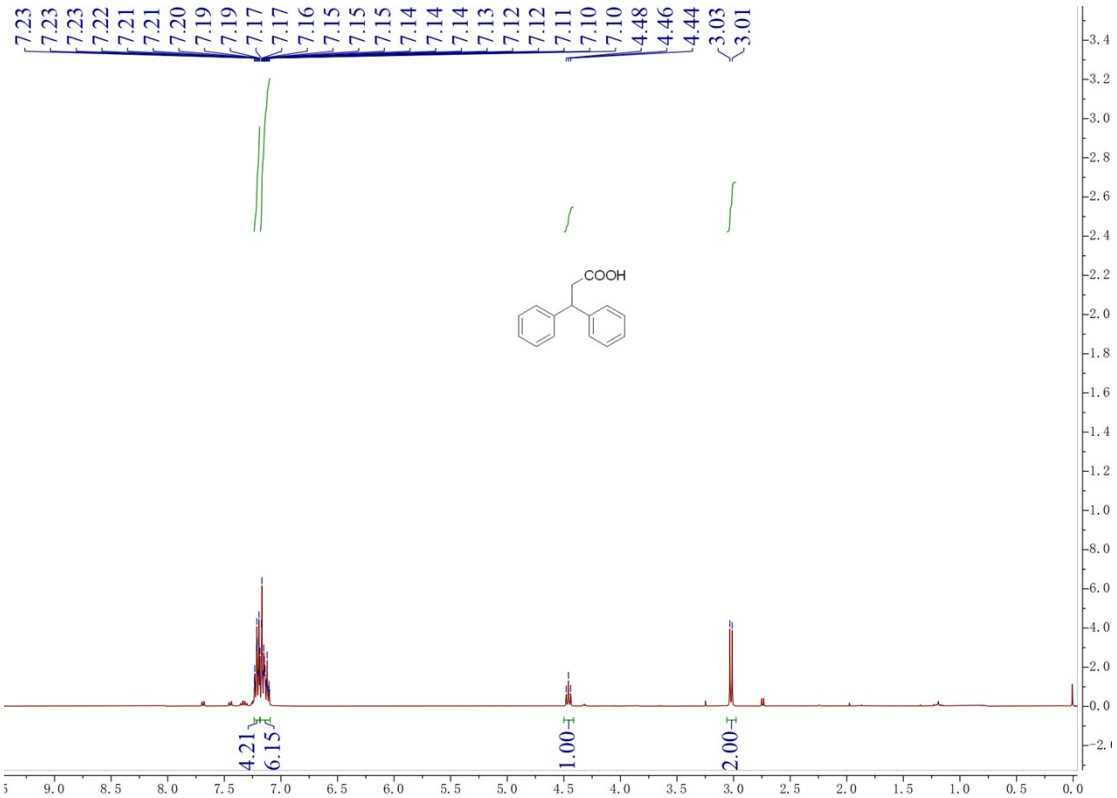
^{1}H NMR spectrum of compound 9 (400 MHz, $CDCl_3$)



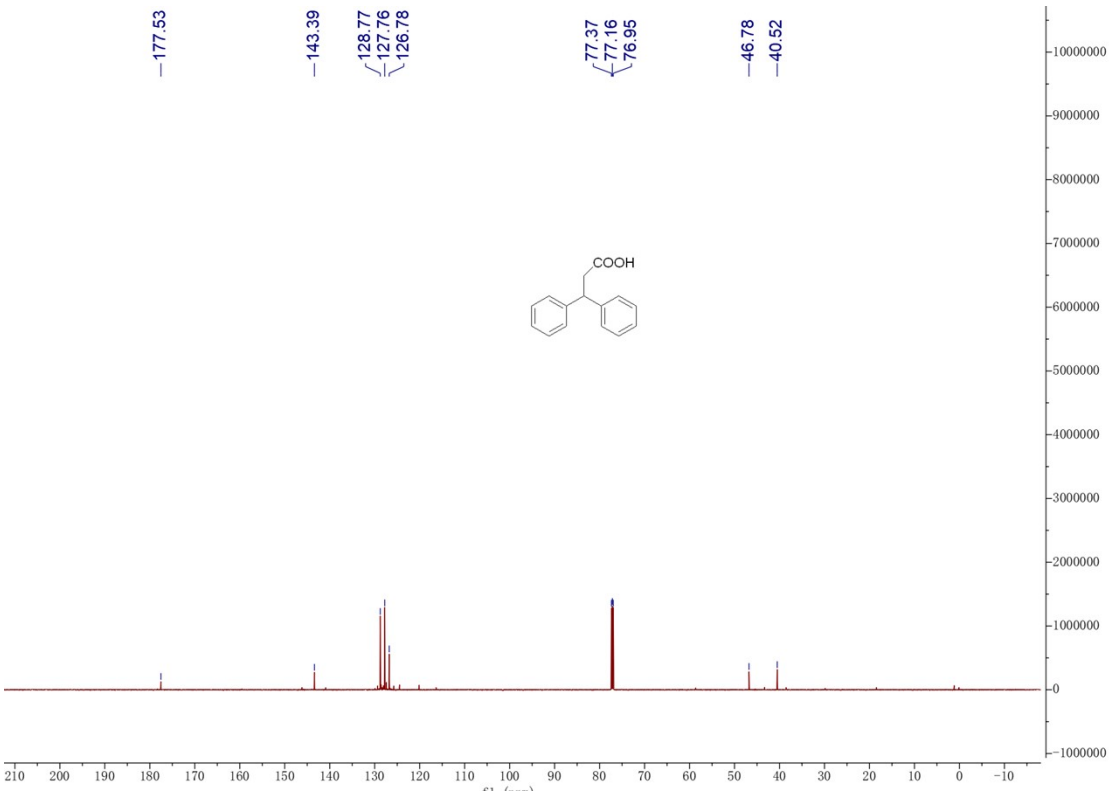
^{13}C NMR spectrum of compound 9 (100 MHz, $CDCl_3$)



^{1}H NMR spectrum of compound 11 (400 MHz, $CDCl_3$)



^{13}C NMR spectrum of compound 11 (150 MHz, $CDCl_3$)



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