Supporting Information

For

Photoinduced Catalytical Reduction of Carbonyl Compounds by Water as Hydrogen Source

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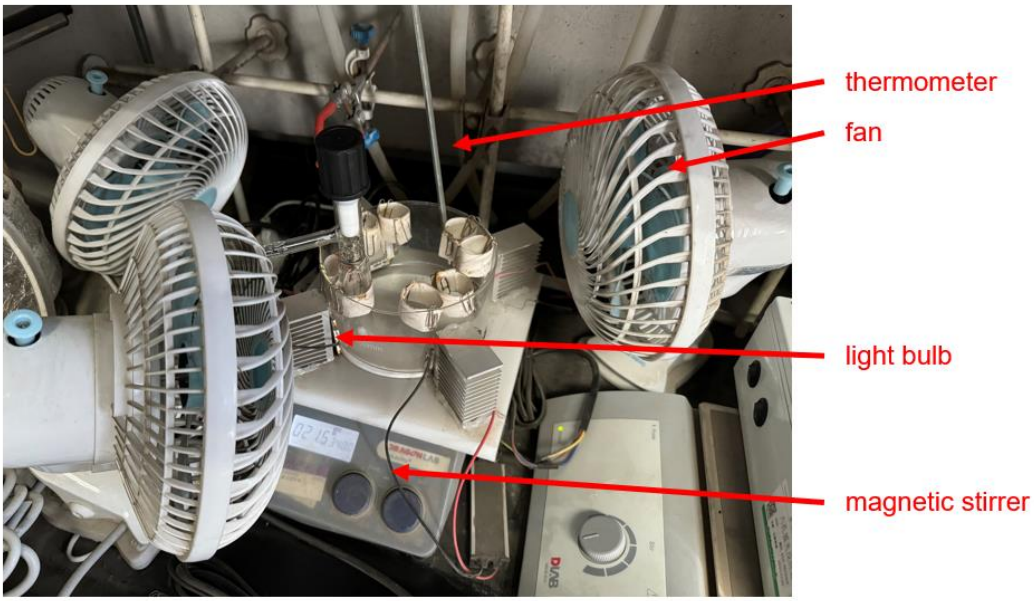
List of the Contents

1. General Information

Unless otherwise noted, all the reactions were carried out in oven-dried sealed tube with Teflon-lined-septum under N_2 atmosphere. Materials were obtained from commercial sources and used as received, or synthesized according to previous literatures. Super dry acetonitrile with molecular sieves was use in the reaction. ^{1}H NMR, ^{13}C NMR, and ^{19}F NMR spectra were recorded on 400 MHz at ambient temperature with $CDCl_3$ as the solvent. Chemical shifts (δ) were given in ppm, referenced to the residual proton resonance of $CDCl_3$ (7.26), to the carbon resonance of $CDCl_3$ (77.16). Coupling constants (*J*) were given in Hertz (Hz). The term m, q, t, d, and s referred to multiplet, quartet, triplet, doublet, and singlet. The reaction progress was monitored by GC-MS if applicable. Column chromatography was performed with silica gel (200-300 meshes). Thin layer chromatography (TLC) was visualized using UV light. HRMS(EI^+) analysis was performed on a Shimadzu GCMS-FT/TOF spectrometer.

The photoreactor used in this research was built by our group, which was made up of 4 blue LED bulbs (30 W for each) with 3 cooler fans to keep room temperature. Spectral distribution: 425 nm. In the reaction, each Schlenk tube is mainly irradiated by one of the light bulbs. The approximate distance of the tube to the closest light bulb is 2 cm. A magnetic stirrer is placed under the photoreactor to keep the reaction being stirred.



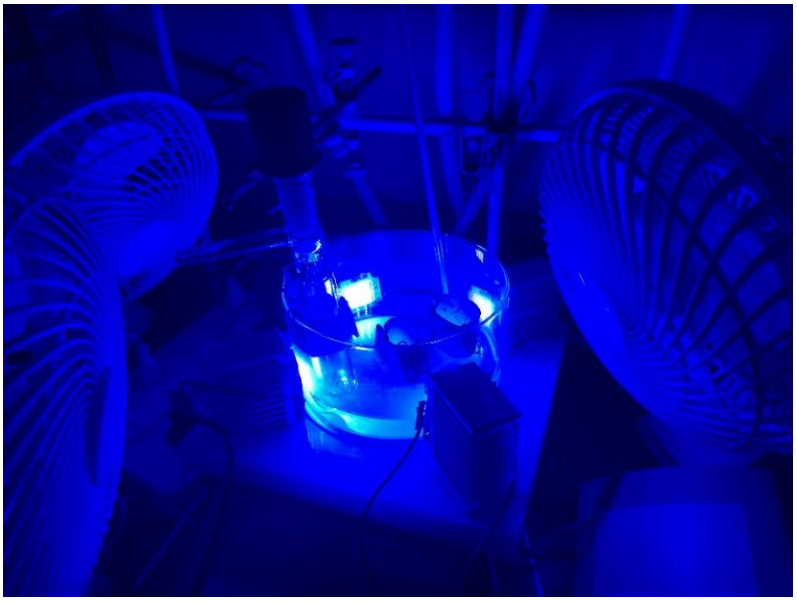
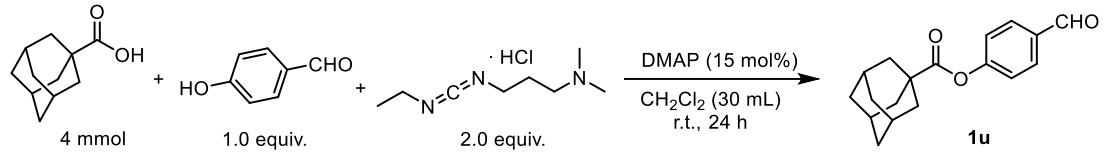


Fig. S1 Photos of the photoreactor

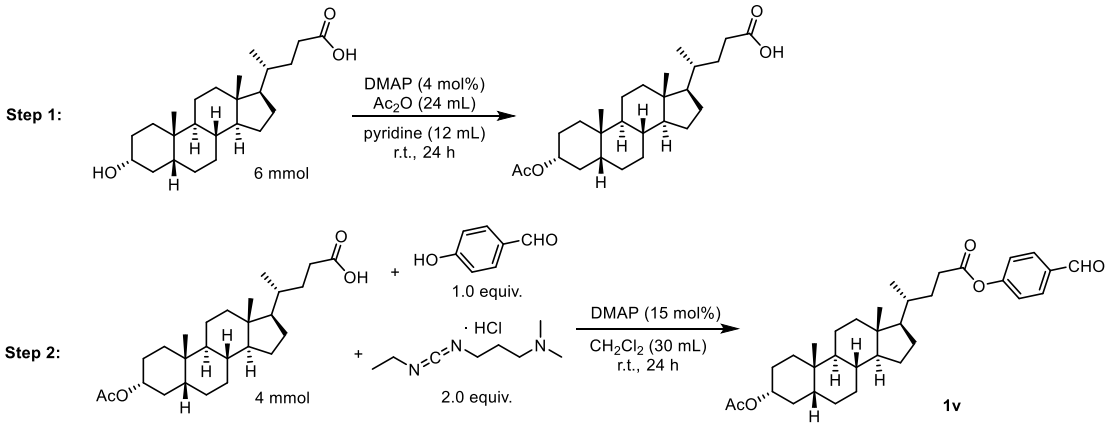
2. General Procedures for Synthesis of Substrates 1:[1]

*General procedures for synthesis of substrates **1u**:*



To a stirred of solution of adamantane acid (4.00 mmol, 1.00 equiv.) and EDC·HCl (1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride) (6.00 mmol, 2.00 equiv.) in CH_2Cl_2 (30 mL) were added DMAP (4-dimethylaminepyridine) (0.60 mmol, 0.15 equiv) and 4-hydroxybenzaldehyde (4.00 mmol, 1.00 equiv). The reaction mixture was stirred at 23 °C for 24 h, then concentrated *in vacuo.* The residue was purified by chromatography on silica gel to give products **1u**, which were identified by ^{1}H and ^{13}C NMR.

*General procedures for synthesis of substrates **1v**:*

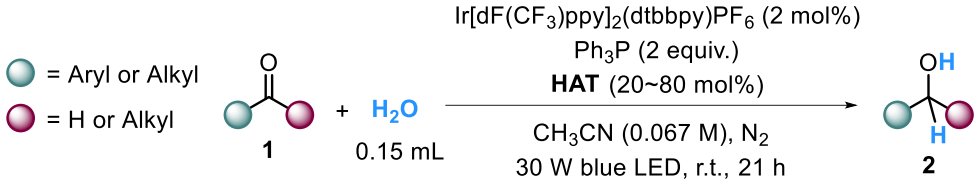


Step 1: To a solution of lithocholic acid (6.00 mmol) in pyridine (12 mL) was added acetic anhydride (24 mL) and DMAP (4-dimethylaminepyridine) (0.16 mmol). The reaction mixture was stirred at 23 °C for 24 h. The reaction was quenched with saturated $CuSO_4$ solution (120 mL) and extracted with ethyl acetate (180 mL). The organics was washed with H_2O (120 mL) and brine (120 mL), dried over Na_2SO_4, and concentrated *in vacuo.* The residue was purified by chromatography on silica gel.

Step 2: To a stirred of solution of acetate protected lithocholic acid (4.00 mmol, 1.00 equiv.) and EDC·HCl (6.00 mmol, 2.00 equiv.) in CH_2Cl_2 (30 mL) were added

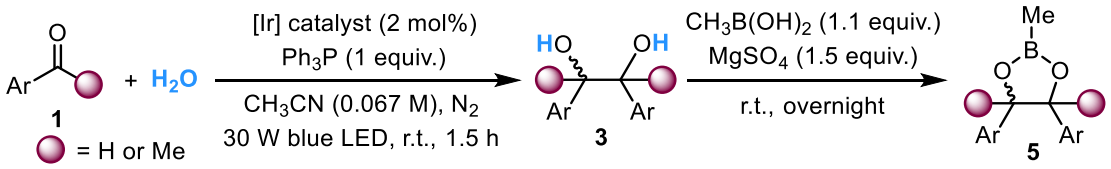
DMAP (4-dimethylaminepyridine) (0.60 mmol, 0.15 equiv.) and 4-hydroxybenzaldehyde (4.00 mmol, 1.00 equiv.). The reaction mixture was stirred at 23 °C for 24 h, then concentrated *in vacuo.* The residue was purified by chromatography on silica gel to give product **1v**, which was identified by ^{1}H and ^{13}C NMR.

3. General Procedures for Synthesis of Products 2 - 4:



General procedures for synthesis of products ***2*** *and* ***4*** *(alcohols from unimolecular reduction and amines):* A sealed tube equipped with a stirrer bar was charged with $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (4.4 mg, 2.0 mol%), PPh_3 (104.9 mg, 2.0 equiv.), substrate **1** (0.2 mmol, for solid substrates), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), 4-*tert*-butylthiophenol (6.7 – 26.6 mg, 20 – 80 mol%), H_2O (0.15 mL), and substrate **1** (0.2 mmol, for liquid substrates) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 21 hours, after which the reaction was concentrated *in vacuo*. The residue was purified by chromatography on silica gel to give products **2** and **4**, which were identified by ^1H, ^{13}C, and ^{19}F NMR.

General procedures for the gram-scale synthesis of products ***2a****:* A sealed tube equipped with a stirrer bar was charged with $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (0.176 g, 2.0 mol%), PPh_3 (4.196 g, 2.0 equiv.), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (120 mL), 4-*tert*-butylthiophenol (1.064 g, 80 mol%), H_2O (6.0 mL), and substrate **1a** (8 mmol, 0.960 g) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 21 hours, after which the reaction was concentrated *in vacuo*. The residue was purified by chromatography on silica gel to give products **2a** (0.899 g, 92%), which was identified by ^1H and ^{13}C NMR.



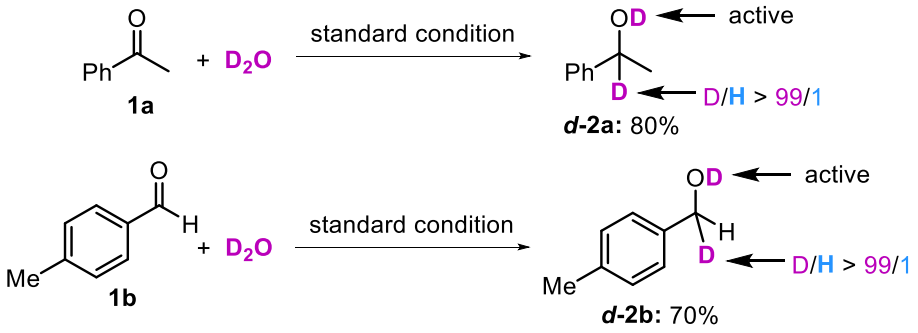
General procedures for synthesis of products ***3*** *(pinacols):* A sealed tube equipped with a stirrer bar was charged with $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (4.4 mg, 2.0 mol%), PPh_3 (52.5 mg, 1.0 equiv.), substrate **1** (0.2 mmol, for solid substrates), then degassed

and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), H_2O (0.15 mL), and substrate **1** (0.2 mmol, for liquid substrates) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 1.5 hours, after which the reaction was concentrated *in vacuo*. The residue was purified by chromatography on silica gel to give product **3**, which was identified by ^1H and ^{13}C NMR.

*General procedures for synthesis of products **5** (borate esters):* A sealed tube equipped with a stirrer bar was charged with $Ir[dF(CF_3)ppy]_2(dtbbpy)PF_6$ (4.4 mg, 2.0 mol%), PPh_3 (52.5 mg, 1.0 equiv.), substrate **1** (0.2 mmol, for solid substrates), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), H_2O (0.15 mL), and substrate **1** (0.2 mmol, for liquid substrates) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 1.5 hours, after which $CH_3B(OH)_2$ (13.2 mg, 1.1 equiv.), $MgSO_4$ (36.1 mg, 1.5 equiv.) were added, then stirred overnight. The residue was concentrated in vacuo and purified by chromatography on silica gel to give products **5**, which were identified by ^1H and ^{13}C NMR.

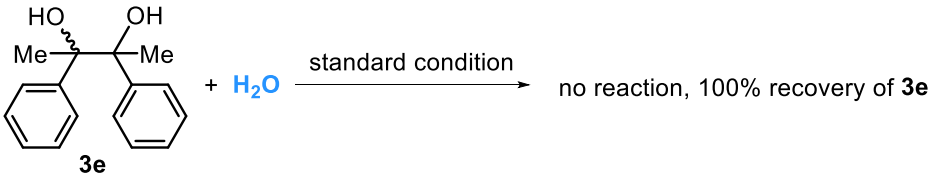
4. General Procedures for Mechanism Studies

4.1 Deuterium-labelled experiments



A sealed tube equipped with a stirrer bar was charged with Ir[dF(CF_3)ppy]$_2$(dtbbpy)PF_6 (4.4 mg, 2.0 mol%), PPh_3 (104.9 mg, 2.0 equiv.), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), 4-*tert*-butylthiophenol (6.7 – 26.6 mg, 20 – 80 mol%), H_2O (0.15 mL), and substrate **1a** or **1b** (0.2 mmol) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 21 hours, after which the reaction was concentrated *in vacuo*. The residue was tested by ^{1}H NMR to determine the deuterium ratio.

4.2 Intermediate study



A sealed tube equipped with a stirrer bar was charged with Ir[dF(CF_3)ppy]$_2$(dtbbpy)PF_6 (4.4 mg, 2.0 mol%), PPh_3 (104.9 mg, 2.0 equiv.), pinacol **3e** (0.2 mmol), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), 4-*tert*-butylthiophenol (26.6 mg, 80 mol%), H_2O (0.15 mL) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 21 hours, after which the reaction was concentrated in vacuo. The residue was tested by ^{1}H NMR to determine the result.

5. Stern-Volmer Fluorescence Quenching Experiments

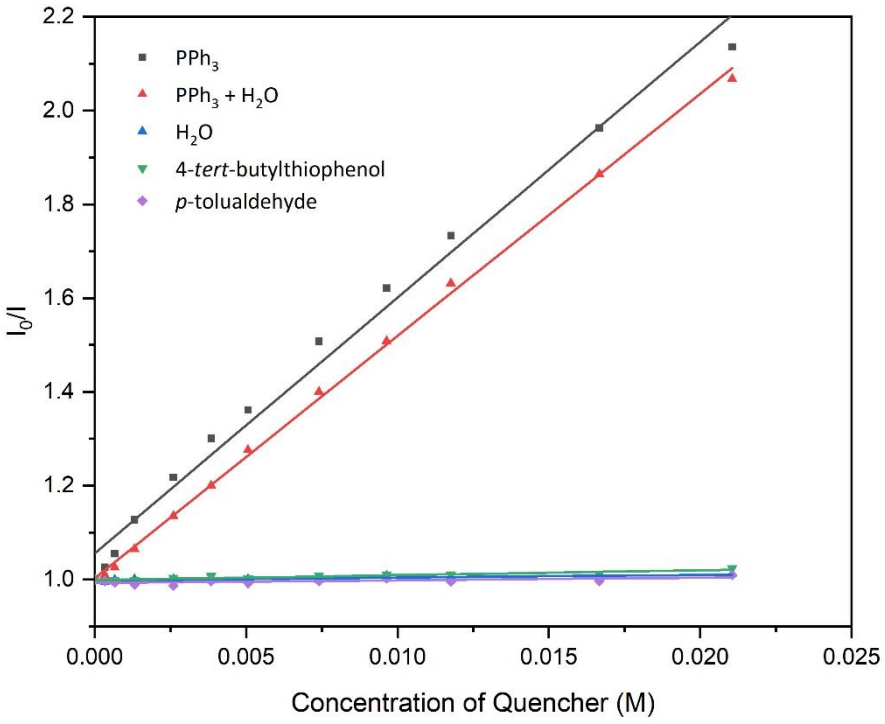


Fig. S2 Fluorescence quenching experiment between photocatalyst and substrate

Fluorescence quenching experiments were measured on an Ahilent Technologies Cary Eclipse Fluoresence Spectrophotometer. The complex Ir[dF(CF_3)ppy]$_2$(dtbbpy) was excited at 375 nm and the emission spectrum max = 475 nm was recorded. Gradient dilution to get 1.0 x 10^{-5} M Ir[dF(CF_3)ppy]$_2$(dtbbpy) solution in CH_3CN, 0.1 M *p*-tolualdehyde (**2b**) solution in CH_3CN, 0.1 M 4-*tert*-butylthiophenyl (**1a**) solution in CH_3CN, 0.1 M PPh_3 (**3a**) solution in CH_3CN, 0.1 M H_2O (**3a**) solution in CH_3CN, and 0.1 M PPh_3 + 0.1 M H_2O solution in CH_3CN. 3.0 mL 1.0 x 10^{-5} M Ir[dF(CF_3)ppy]$_2$(dtbbpy) solution in CH_3CN and a stirrer bar were added into the 4.0 mL quartz cuvette covered with Teflon cap. 10 μL of the above solutions were added each time, separately. Then, the emission spectrum of the solution was collected at each addition.

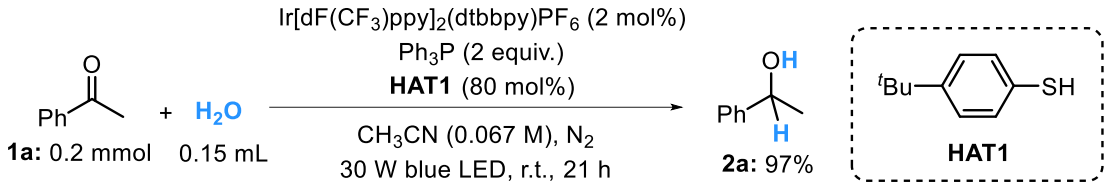
Quenching effects of various quenchers under different concentration were shown in Fig S1. Linear fit based on the Stern-Volmer equation was performed to calculate the Stern-Volmer constant (listed in Table S1).

$$\frac{I_0}{I} = 1 + K_{sv} \cdot [Q], \quad Q \text{ represents quencher}$$

Table S1 Stern-Volmer constant of various quenchers

Quencher	Ph_3P	$Ph_3P + H_2O$	H_2O	4-*tert*-butylthiophenol	*p*-tolualdehyde
K_{sv} (M^{-1})	54.6	51.7	0.583	1.05	0.563

6. Experiments for The Recovery of PPh_3, $POPh_3$, and Thiophenol



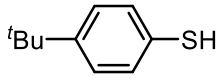
Agents	PPh_3	**HAT1**	$POPh_3$
Additive Amount	2.00 equiv.	0.80 equiv.	-
Theoretically Remaining Amount	1.03 equiv.	0.80 equiv.	0.97 equiv.
Experimentally Recovered Amount	0.60 equiv.	0.56 equiv.	1.35 equiv.
Recovery Yield	58%	70%	140%

$$Recovery\ rate = \frac{Theoratical\ Remaing}{Experimentally\ Recovered\ Amount}$$

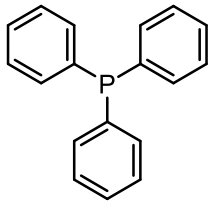
A sealed tube equipped with a stirrer bar was charged with Ir[dF(CF_3)ppy]$_2$(dtbbpy)PF_6 (4.4 mg, 2.0 mol%), PPh_3 (104.9 mg, 2.0 equiv.), then degassed and refilled with N_2 for 3 times. After that, anhydrous CH_3CN (3 mL), 4-*tert*-butylthiophenol (26.6 mg, 80 mol%), H_2O (0.15 mL), and substrate **1a** (0.2 mmol, for liquid substrates) were added under N_2. The reaction mixture was irradiated by 30 W blue LEDs at room temperature for 21 hours, after which the reaction was concentrated in vacuo. The residue was purified by chromatography on silica gel to recover PPh_3, **HAT1**, and $POPh_3$, which were identified by ^1H and ^{13}C NMR.

PPh_3 could be recovered at a 58% yield (31.5 mg), while $POPh_3$ was recovered at a 140% yield (75.1 mg), among them, the excess 40% of $POPh_3$ was from the oxidation of PPh_3 by air at the work-up stage. The total recovery rate of phosphorus species was (58% + 140%) / 2 = 99%, indicating that PPh_3 and $POPh_3$ were quantificationally recyclable from the reaction.

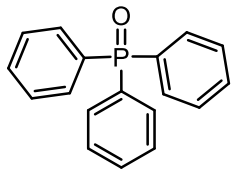
HAT1 could be recovered at a 70% yield, while about 30% of the **HAT1** was converted into diaryl disulfide through radical coupling reaction of the thiophenol radical as a side-reaction.



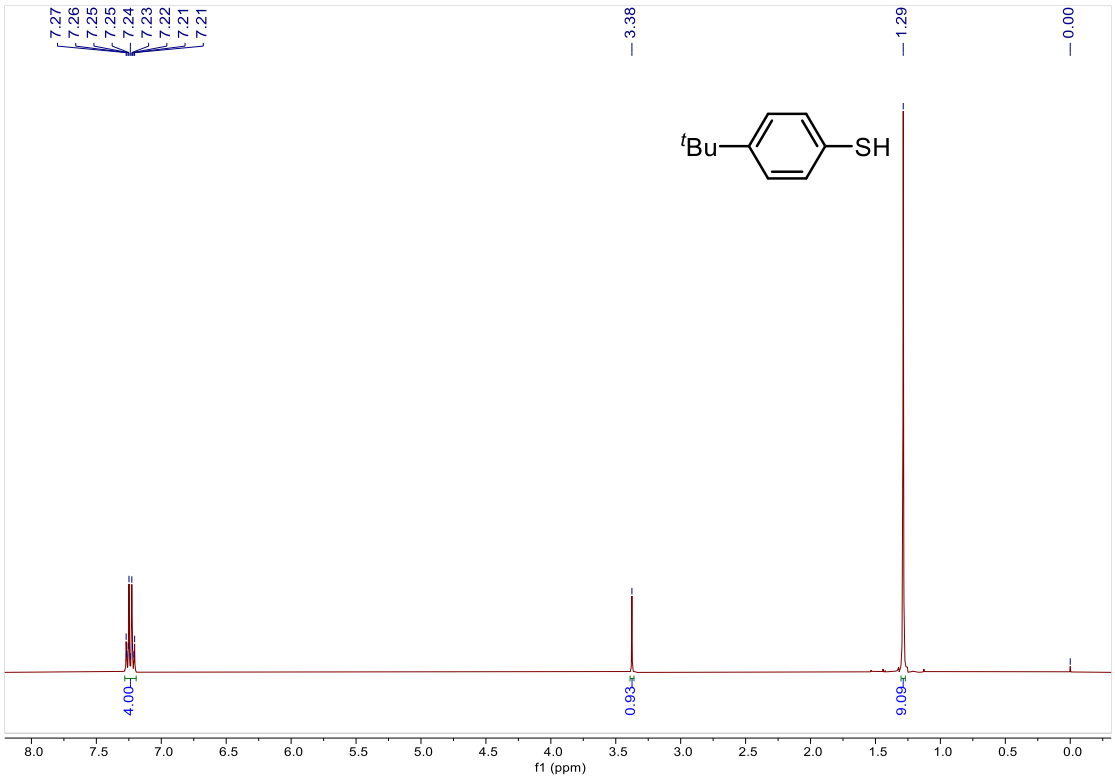
4-*Tert*-butylthiophenol (HAT1): colorless oil (18.6 mg, 0.56 equiv.). Eluent for the flash chromatography with silica gel: hexane / EA: 60/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.27 – 7.21 (m, 4H), 3.38 (s, 1H), 1.29 (s, 9H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 149.1, 129.7, 127.0, 126.3, 34.5, 31.4. The spectroscopic data corresponds to the reported data.[2]



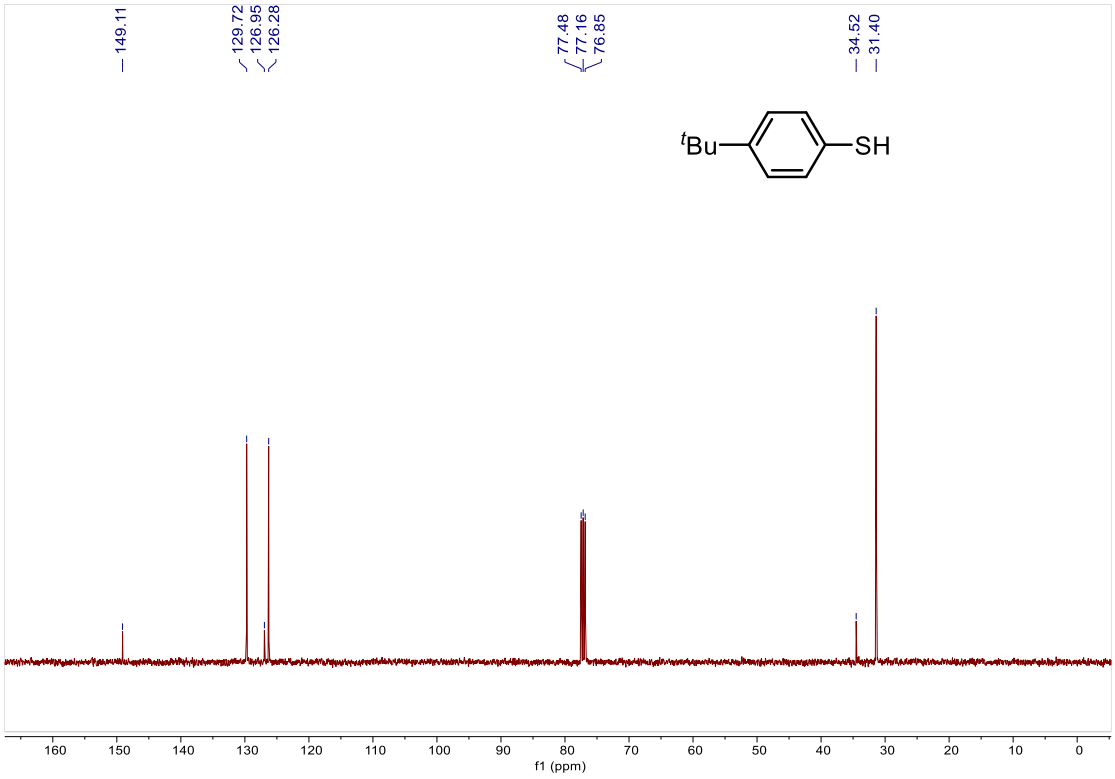
Triphenylphosphine (PPh_3): white solid (31.5 mg, 0.60 equiv.). Eluent for the flash chromatography with silica gel: hexane / EA: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.32 – 7.29 (m, 15H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 137.3 (d, *J* = 11.1 Hz), 133.9 (d, *J* = 20.2 Hz), 128.8, 128.6 (d, *J* = 7.1 Hz). The spectroscopic data corresponds to the reported data.[3]



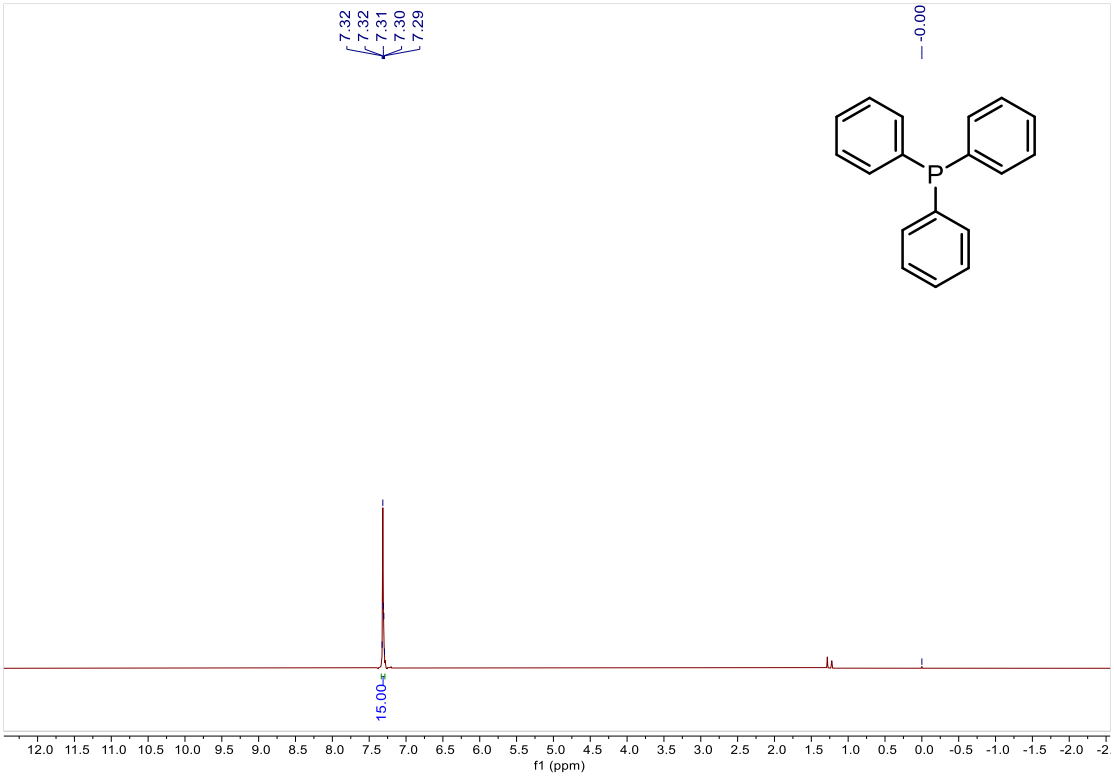
Triphenylphosphine oxide ($POPh_3$): white solid (75.1 mg, 1.35 equiv.). Eluent for the flash chromatography with silica gel: CH_2Cl_2 / MeOH: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.70 – 7.64 (m, 6H), 7.53 – 7.49 (m, 3H), 7.45 – 7.41 (m, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 132.9, 131.9 (d, *J* = 10.1 Hz), 131.8 (d, *J* = 3.0 Hz), 128.4 (d, *J* = 13.1 Hz). The spectroscopic data corresponds to the reported data.[4]



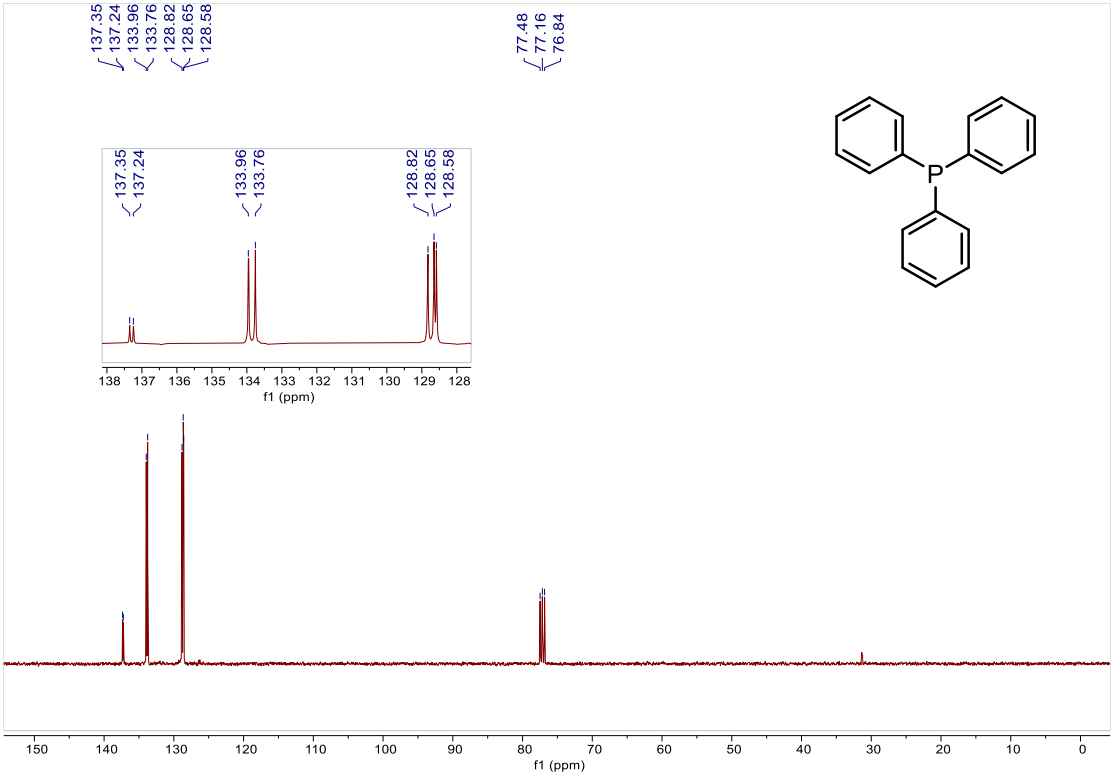
^{1}H NMR for compound **HAT1**



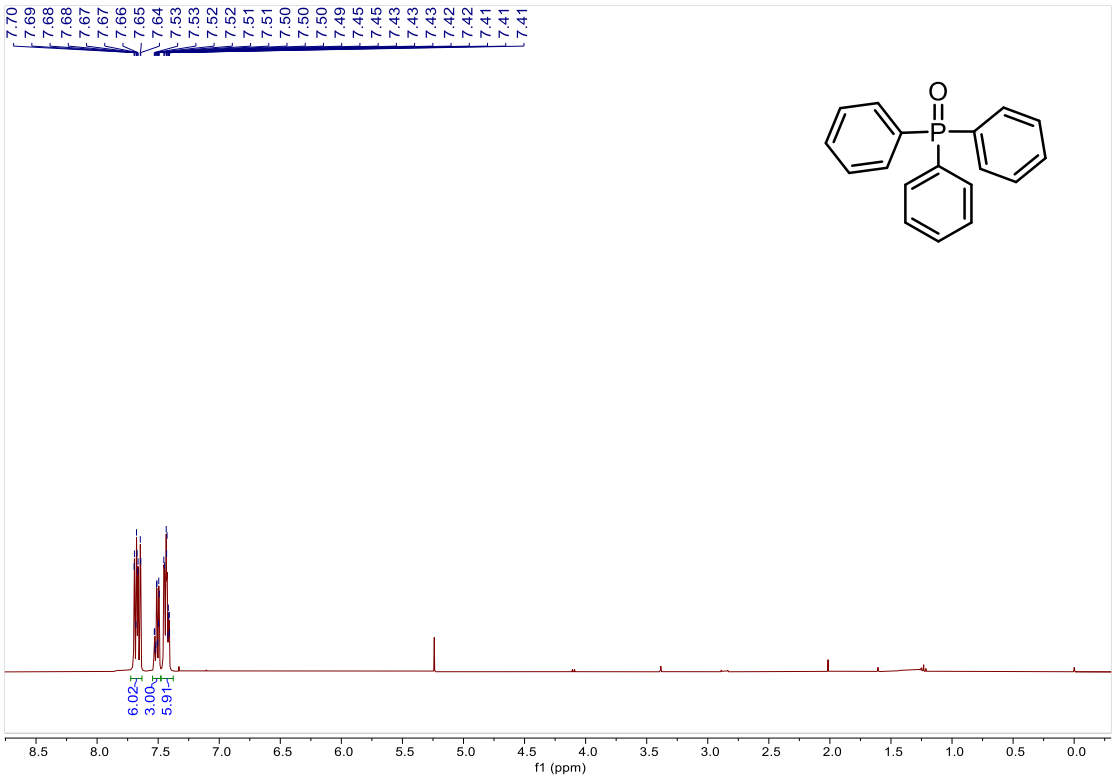
^{13}C{^{1}H} NMR for compound **HAT1**



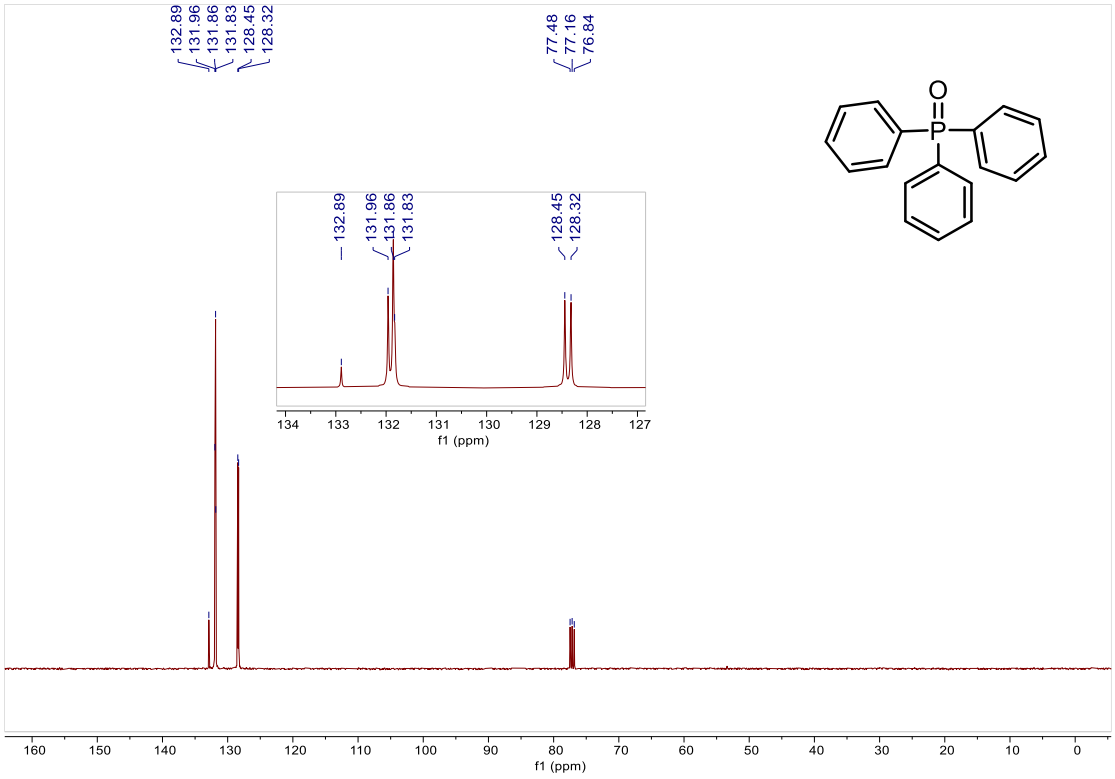
^{1}H NMR for compound **PPh$_3$**



^{13}C{^{1}H} NMR for compound **PPh$_3$**

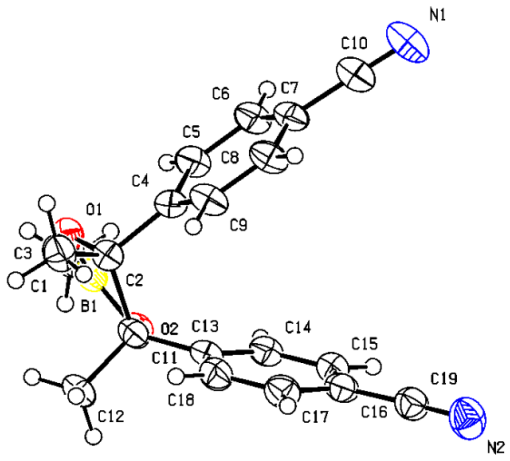


^{1}H NMR for compound **POPh$_3$**



^{13}C{^{1}H} NMR for compound **POPh$_3$**

7. X-Ray Crystallography of the *meso* Isomer of 5d



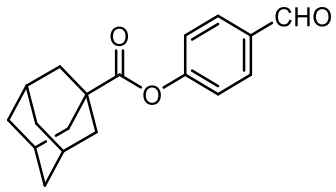
*ORTEP diagram of **5d (*meso*)** with the thermal ellipsoids shown at the 30% probability level. All hydrogen atoms have been omitted for clarity.

Crystal data and structure refinement for 5d (*meso*)

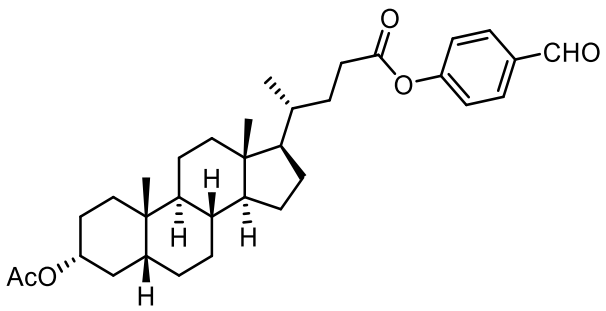
Empirical formula	$C_{38}H_{34}B_2N_4O_4$
Formula weight	632.31
Temperature/K	169.98(10)
Crystal system	triclinic
Space group	P-1
a/Å	8.1573(4)
b/Å	9.2437(8)
c/Å	24.5989(10)
α/°	86.636(5)
β/°	89.592(4)
γ/°	66.992(6)
Volume/Å^3	1704.1(2)
Z	2
ρ_{calc} g/cm^3	1.232
μ/mm^{-1}	0.637
F(000)	664.0
Crystal size/mm^3	0.18 × 0.15 × 0.1
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	3.598 to 172.506
Index ranges	$-9 \le h \le 10$, $-11 \le k \le 11$, $-30 \le l \le 30$
Reflections collected	18711
Independent reflections	6844 [R_{int} = 0.0636, R_{sigma} = 0.0571]
Data/restraints/parameters	6844/0/439
Goodness-of-fit on F^2	1.097
Final R indexes [I>=2σ (I)]	R_1 = 0.0891, wR_2 = 0.2375
Final R indexes [all data]	R_1 = 0.1099, wR_2 = 0.2502
Largest diff. peak/hole / e Å^{-3}	0.41/-0.41

CCDC Number: 2328828

8. Spectra Data for Synthesized Substrates



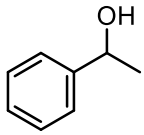
4-Formylphenyl adamantane-1-carboxylate (1u): ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 9.99 (s, 1H), 7.91 (d, *J* = 8.5 Hz, 2H), 7.23 (d, *J* = 8.5 Hz, 2H), 2.10 (s, 3H), 2.06 (s, 6H), 1.81 – 1.74 (m, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 191.1, 175.6, 156.1, 133.9, 131.3, 122.5, 41.3, 38.8, 36.5, 27.9. The spectroscopic data corresponds to the reported data.[1]



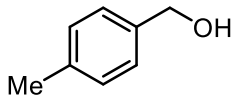
4-Formylphenyl (*R*)-4-((3*R*,5*R*,8*R*,9*S*,10*S*,13*R*,14*S*,17*R*)-3-acetoxy-10,13-dimethylhexadecahydro-1H-cyclopenta[a]phenanthren-17-yl)pentanoate (1v): ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 9.98 (s, 1H), 7.91 (d, *J* = 8.3 Hz, 2H), 7.27 (d, *J* = 8.7 Hz, 2H), 4.71 (dq, *J* = 11.5, 5.7 Hz, 1H), 2.64 (ddd, *J* = 15.1, 9.9, 5.0 Hz, 1H), 2.55 – 2.46 (m, 1H), 2.03 (s, 3H), 1.97 – 1.79 (m, 6H), 1.56 – 1.37 (m, 11H), 1.28 – 1.06 (m, 9H), 0.99 (d, *J* = 6.4 Hz, 3H), 0.93 (s, 3H), 0.67 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 190.9, 172.0, 170.6, 155.5, 133.9, 131.2, 122.4, 74.4, 56.5, 56.0, 42.8, 41.9, 40.4, 40.2, 35.8, 35.4, 35.0, 34.6, 32.2, 31.4, 28.3, 27.0, 26.6, 26.3, 24.2, 23.4, 21.5, 20.8, 18.3, 12.1. The spectroscopic data corresponds to the reported data.[1]

9. Spectral Data for All Products

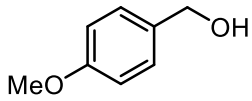
For products with diastereoisomers, **3a-3c**, **3f** were isolated and characterized as the mixture of the *dl* and *meso* isomer, while the *dl* and *meso* isomer of **3d**, **3e**, **5a-5d** were isolated and characterized separately.



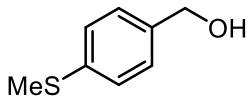
1-Phenylethanol (2a): colorless oil (24.2 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.37 – 7.32 (m, 4H), 7.28 – 7.23 (m, 1H), 4.86 (q, *J* = 6.4 Hz, 1H), 2.09 (s, 1H), 1.47 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 145.9, 128.6, 127.6, 125.5, 70.5, 25.2. The spectroscopic data corresponds to the reported data.[5]



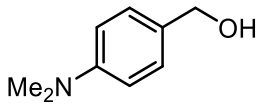
4-Methylbenzyl alcohol (2b): colorless oil (23.7 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / ethyl acetate (EA): 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.23 (d, *J* = 7.8 Hz, 2H), 7.15 (d, *J* = 7.8 Hz, 2H), 4.60 (s, 2H), 2.34 (s, 3H), 1.96 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.0, 137.4, 129.3, 127.2, 65.3, 21.2. The spectroscopic data corresponds to the reported data.[5]



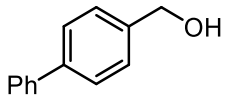
4-Methoxybenzyl alcohol (2c): colorless oil (25.9 mg, 95%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.30 – 7.25 (m, 2H), 6.91 – 6.85 (m, 2H), 4.59 (s, 2H), 3.80 (s, 3H), 1.85 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 159.3, 133.2, 128.8, 114.0, 65.1, 55.4. The spectroscopic data corresponds to the reported data.[5]



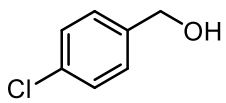
4-(Methylthio)benzyl alcohol (2d): light yellow solid (30.5 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.29 – 7.23 (m, 4H), 4.63 (s, 2H), 2.48 (s, 3H), 1.83 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 137.9, 137.9, 127.8, 126.9, 65.0, 16.1. The spectroscopic data corresponds to the reported data.[6]



***N,N*-dimethyl-4-hydroxymethylaniline (2e):** colorless oil (29.9 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 – 7.19 (m, 2H), 6.74 – 6.68 (m, 2H), 4.53 (s, 2H), 2.93 (s, 6H), 1.82 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 150.4, 129.0, 128.7, 112.7, 65.4, 40.8. The spectroscopic data corresponds to the reported data.[6]

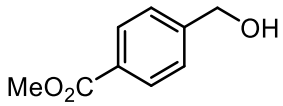


Biphenyl-4-yl methanol (2f): white solid (24.0 mg, 65%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.57 (m, 4H), 7.47 – 7.41 (m, 4H), 7.37 – 7.32 (m, 1H), 4.73 (d, *J* = 4.6 Hz, 2H), 1.75 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 141.0, 140.8, 140.0, 128.9, 127.6, 127.5, 127.5, 127.2, 65.2. The spectroscopic data corresponds to the reported data.[7]

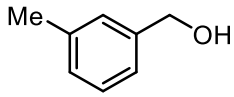


4-Chlorobenzyl alcohol (2g): colorless oil (15.1 mg, 53%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.35 – 7.26 (m, 4H), 4.66 (s, 2H), 1.75 (s, 1H). ^{13}C NMR (101

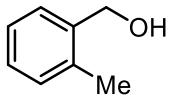
MHz, CHLOROFORM-D) δ 139.4, 133.5, 128.8, 128.4, 64.7. The spectroscopic data corresponds to the reported data.[7]



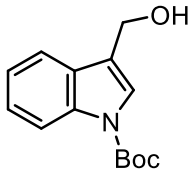
4-(Methoxycarbonyl)benzyl alcohol (2h): white solid (7.0 mg, 21%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.03 (d, *J* = 8.3 Hz, 2H), 7.43 (d, *J* = 8.3 Hz, 2H), 4.77 (s, 2H), 3.92 (s, 3H), 1.87 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 167.1, 146.1, 130.0, 129.5, 126.6, 64.9, 52.3. The spectroscopic data corresponds to the reported data.[7]



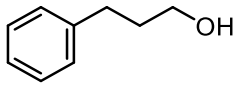
3-Methylbenzyl alcohol (2i): colorless oil (22.7 mg, 93%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 (t, *J* = 7.6 Hz, 1H), 7.20 – 7.07 (m, 3H), 4.63 (s, 2H), 2.35 (s, 3H), 1.84 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 140.9, 138.4, 128.6, 128.5, 127.9, 124.2, 65.5, 21.5. The spectroscopic data corresponds to the reported data.[5]



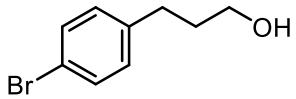
2-Methylbenzyl alcohol (2j): colorless oil (22.5 mg, 92%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.37 – 7.31 (m, 1H), 7.24 – 7.14 (m, 3H), 4.67 (s, 2H), 2.35 (s, 3H), 1.72 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.8, 136.2, 130.4, 127.9, 127.6, 126.2, 63.6, 18.8. The spectroscopic data corresponds to the reported data.[5]



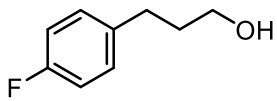
***Tert*-butyl 3-hydroxymethylindole-1-carboxylate (2k):** colorless oil (28.5 mg, 58%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.14 (d, *J* = 7.8 Hz, 1H), 7.64 (d, *J* = 7.8 Hz, 1H), 7.57 (s, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 7.26 (t, *J* = 7.8 Hz, 1H), 4.83 (s, 2H), 1.66 (s, 9H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 149.8, 135.9, 129.3, 124.8, 123.9, 122.8, 120.6, 119.4, 115.4, 83.9, 57.3, 28.3. The spectroscopic data corresponds to the reported data.[8]



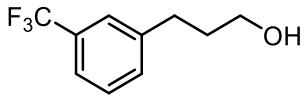
3-Phenyl-1-propanol (2l): colorless oil (25.9 mg, 95%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.32 – 7.26 (m, 2H), 7.21 – 7.17 (m, 3H), 3.67 (t, *J* = 6.4 Hz, 2H), 2.71 (t, *J* = 7.6 Hz, 2H), 1.89 (tt, *J* = 7.6, 6.4 Hz, 2H), 1.40 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 142.0, 128.5, 128.5, 126.0, 62.4, 34.4, 32.2. The spectroscopic data corresponds to the reported data.[5]



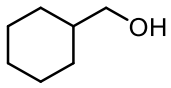
3-(4-Bromophenyl)propan-1-ol (2m): colorless oil (40.4 mg, 94%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.42 – 7.37 (m, 2H), 7.07 (d, *J* = 8.3 Hz, 2H), 3.65 (t, *J* = 6.4 Hz, 2H), 2.70 – 2.62 (m, 2H), 1.89 – 1.81 (m, 2H), 1.56 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 140.9, 131.6, 130.3, 119.7, 62.1, 34.1, 31.5. The spectroscopic data corresponds to the reported data.[9]



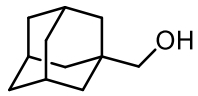
3-(4-fluorophenyl)propan-1-ol (2n): colorless oil (27.8 mg, 90%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.16 – 7.11 (m, 2H), 7.02 – 6.91 (m, 2H), 3.65 (t, *J* = 6.4 Hz, 2H), 2.72 – 2.63 (m, 2H), 1.90 – 1.81 (m, 2H), 1.75 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 161.3 (d, *J* = 243.4 Hz), 137.5 (d, *J* = 4.0 Hz), 129.8 (d, *J* = 8.1 Hz), 115.2 (d, *J* = 21.2 Hz), 62.09, 34.38, 31.29. ^{19}F NMR (376 MHz, CHLOROFORM-*D*) δ -117.5 – -117.7 (m). The spectroscopic data corresponds to the reported data.[10]



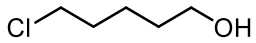
3-[3-(trifluoromethyl)phenyl]propan-1-ol (2o): colorless oil (32.7 mg, 80%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.46 – 7.44 (m, 2H), 7.42 – 7.38 (m, 2H), 3.68 (t, *J* = 6.4 Hz, 2H), 2.81 – 2.74 (m, 2H), 1.95 – 1.86 (m, 2H), 1.55 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 142.9, 132.0, 130.8 (q, *J* = 32.3 Hz), 128.9 (q, *J* = 8.1 Hz), 125.2 (q, *J* = 3.5 Hz), 124.4 (q, *J* = 273.7 Hz), 122.9 (q, *J* = 3.6 Hz), 62.0, 34.1, 32.0. ^{19}F NMR (376 MHz, CHLOROFORM-*D*) δ -62.4. The spectroscopic data corresponds to the reported data.[11]



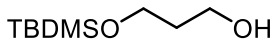
Cyclohexylmethyl alcohol (2p): colorless oil (17.8 mg, 78%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 3.44 (d, *J* = 6.4 Hz, 2H), 1.76 – 1.72 (m, 4H), 1.71 – 1.65 (m, 1H), 1.52 – 1.43 (m, 1H), 1.40 (s, 1H), 1.30 – 1.14 (m, 3H), 0.93 (qd, *J* = 12.8, 3.4 Hz, 2H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 68.9, 40.6, 29.7, 26.7, 26.0. The spectroscopic data corresponds to the reported data.[12]



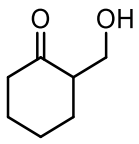
1-Adamantanemethanol (2q): white solid (32.9 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 3.19 (s, 2H), 1.99 (s, 3H), 1.73 (d, *J* = 12.4 Hz, 3H), 1.65 (d, *J* = 11.5 Hz, 3H), 1.51 (d, *J* = 2.8 Hz, 7H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 73.9, 39.1, 37.3, 34.6, 28.3. The spectroscopic data corresponds to the reported data.[6]



5-Chloro-1-pentanol (2r): colorless oil (22.8 mg, 93%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 3.66 (t, *J* = 6.2 Hz, 2H), 3.55 (t, *J* = 6.6 Hz, 2H), 1.82 (dt, *J* = 14.2, 6.9 Hz, 2H), 1.64 – 1.48 (m, 5H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 62.7, 45.1, 32.4, 32.0, 23.2. The spectroscopic data corresponds to the reported data.[13]

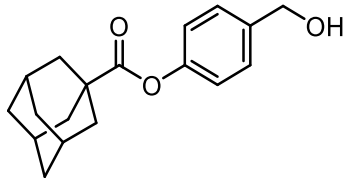


3-(*t*-Butyldimethylsilyloxy)propanol (2t): colorless oil (37.3 mg, 98%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 3.84 (t, *J* = 5.7 Hz, 2H), 3.80 (t, *J* = 5.3 Hz, 2H), 2.76 (s, 1H), 1.78 (tt, *J* = 5.7, 5.3 Hz, 2H), 0.90 (s, 9H), 0.08 (s, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 63.0, 62.5, 34.3, 26.0, 18.3, -5.4. The spectroscopic data corresponds to the reported data.[14]

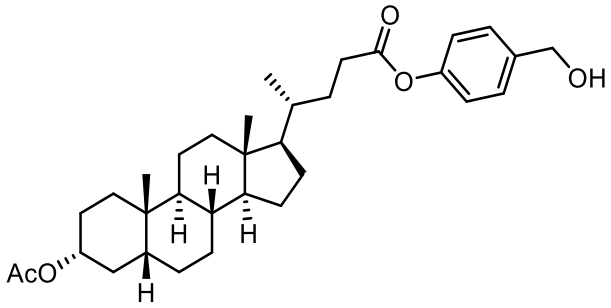


2-(Hydroxymethyl)cyclohexanone (2t): Colorless oil (21.0 mg, 82%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 3.80 – 3.69 (m, 1H), 3.67 – 3.55 (m, 1H), 2.70 (s, 1H), 2.52 (ddt, *J* = 11.9, 6.4, 4.6 Hz, 1H), 2.46 – 2.24 (m, 2H), 2.15 – 1.99 (m, 2H), 1.97 – 1.88 (m,

1H), 1.76 – 1.60 (m, 2H), 1.48 (qd, *J* = 12.8, 3.7 Hz, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 215.0, 62.9, 52.4, 42.3, 30.2, 27.6, 24.8. The spectroscopic data corresponds to the reported data.[15]

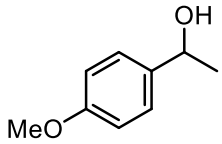


4-(Hydroxymethyl)phenyl adamantane-1-carboxylate (2u): white solid (55.6 mg, 97%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.33 (d, *J* = 8.7 Hz, 2H), 7.01 (d, *J* = 8.3 Hz, 2H), 4.63 (s, 2H), 2.20 – 2.05 (m, 10H), 1.80 – 1.73 (m, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 176.5, 150.6, 138.3, 128.1, 121.7, 64.8, 41.1, 38.8, 36.5, 28.0. The spectroscopic data corresponds to the reported data.[16]

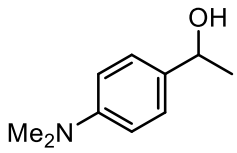


4-(Hydroxymethyl)phenyl (*R*)-4-((3*R*,5*R*,8*R*,9*S*,10*S*,13*R*,14*S*,17*R*)-3-acetoxy-10,13-dimethylhexadecahydro-1H-cyclopenta[a]phenanthren-17-yl)pentanoate (2v): white solid (73.5mg, 70%). Melting point: 138.4 – 140.9 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.35 (d, *J* = 8.3 Hz, 2H), 7.04 (d, *J* = 8.3 Hz, 2H), 4.71 (td, *J* = 11.5, 5.7 Hz, 1H), 4.64 (s, 2H), 2.60 (ddd, *J* = 15.1, 9.6, 4.8 Hz, 1H), 2.51 – 2.43 (m, 1H), 2.02 (s, 3H), 2.00 – 1.74 (m, 6H), 1.68 (d, *J* = 10.1 Hz, 1H), 1.61 – 1.37 (m, 10H), 1.35 – 1.02 (m, 10H), 0.98 (d, *J* = 6.4 Hz, 3H), 0.93 (s, 3H), 0.67 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 173.0, 170.8, 150.1, 138.6, 128.1, 121.7, 74.5, 64.6, 56.6, 56.0, 42.8, 41.9, 40.5, 40.2, 35.8, 35.4, 35.1, 34.6, 32.3, 31.4, 31.0, 28.3, 27.1,

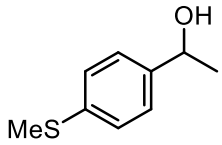
26.7, 26.4, 24.2, 23.4, 21.6, 20.9, 18.4, 12.1. HRMS (EI+) calculated *m/z* for $C_{33}H_{48}O_5^+$ $[M]^+$: 524.3496, found 524.3498.



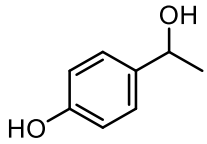
1-(4-Methoxyphenyl)ethanol (2w): colorless oil (30.1 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.31 – 7.26 (m, 2H), 6.90 – 6.84 (m, 2H), 4.83 (q, *J* = 6.4 Hz, 1H), 3.79 (s, 3H), 1.97 (s, 1H), 1.46 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 159.1, 138.2, 126.8, 114.0, 70.0, 55.4, 25.1. The spectroscopic data corresponds to the reported data.[5]



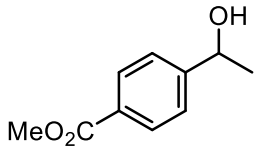
1-[4-(*N*,*N*-dimethylamino)phenyl]ethanol (2x): colorless oil (26.8 mg, 81%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 (d, *J* = 8.7 Hz, 2H), 6.72 (d, *J* = 8.7 Hz, 2H), 4.81 (q, *J* = 6.4 Hz, 1H), 2.93 (s, 6H), 1.79 (s, 1H), 1.47 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 150.3, 133.9, 126.6, 112.7, 70.2, 40.8, 24.8. The spectroscopic data corresponds to the reported data.[17]



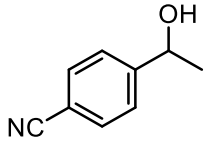
1-(4-(Methylthio)phenyl)ethanol (2y): white solid (33.3 mg, 99%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.27 (d, *J* = 8.3 Hz, 2H), 7.23 (d, *J* = 8.3 Hz, 2H), 4.83 (q, *J* = 6.4 Hz, 1H), 2.47 (s, 3H), 2.08 (s, 1H), 1.46 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 142.9, 137.4, 126.9, 126.1, 70.1, 25.2, 16.1. The spectroscopic data corresponds to the reported data.[18]



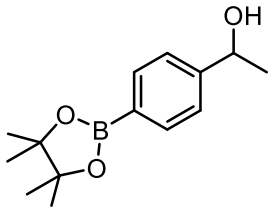
1-(4-Hydroxyphenyl)ethanol (2z): white solid (27.1 mg, 98%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, METHANOL-D_4) δ 7.23 – 7.13 (m, 2H), 6.76 – 6.72 (m, 2H), 4.77 – 4.70 (m, 1H), 1.43 – 1.39 (m, 3H). ^{13}C NMR (101 MHz, METHANOL-D_4) δ 157.6, 138.3, 127.8, 115.9, 70.6, 25.4. The spectroscopic data corresponds to the reported data.[19]



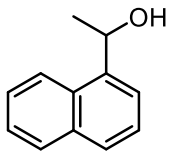
Methyl 4-(1-hydroxy ethyl)benzoate (2aa): colorless oil (22.3 mg, 62%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.03 – 7.97 (m, 2H), 7.43 (d, J = 8.3 Hz, 2H), 4.95 (q, J = 6.4 Hz, 1H), 3.90 (s, 3H), 2.16 (s, 1H), 1.50 (d, J = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 167.1, 151.1, 130.0, 129.3, 125.4, 70.1, 52.2, 25.4. The spectroscopic data corresponds to the reported data.[20]



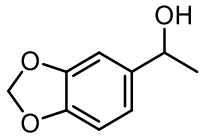
4-(1-Hydroxyethyl)benzonitrile (2ab): colorless oil (15.6 mg, 53%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.63 (d, J = 8.3 Hz, 2H), 7.49 (d, J = 8.3 Hz, 2H), 4.96 (q, J = 6.4 Hz, 1H), 2.07 (s, 1H), 1.50 (d, J = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 151.2, 132.5, 126.2, 119.0, 111.2, 69.8, 25.5. The spectroscopic data corresponds to the reported data.[18]



1-(4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)ethanol (2ac): white solid (25.3 mg, 51%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.80 (d, *J* = 8.3 Hz, 2H), 7.38 (d, *J* = 7.8 Hz, 2H), 4.91 (q, *J* = 6.4 Hz, 1H), 1.93 (s, 1H), 1.49 (d, *J* = 6.4 Hz, 3H), 1.34 (s, 12H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 149.1, 135.2, 124.8, 83.9, 70.5, 25.3, 25.0. The spectroscopic data corresponds to the reported data.[21]

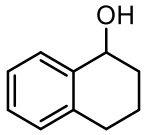


1-(1-Naphthyl)ethanol (2ad): colorless oil (11.4 mg, 33%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.12 (d, *J* = 8.3 Hz, 1H), 7.90 – 7.85 (m, 1H), 7.78 (d, *J* = 8.3 Hz, 1H), 7.68 (d, *J* = 7.3 Hz, 1H), 7.55 – 7.45 (m, 3H), 5.68 (q, *J* = 6.4 Hz, 1H), 1.97 (s, 1H), 1.67 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 141.5, 133.9, 130.4, 129.5, 129.0, 128.0, 126.2, 125.7, 123.3, 122.1, 67.2, 24.5. The spectroscopic data corresponds to the reported data.[22]

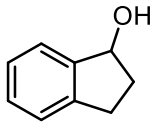


1-Benzo[1,3]dioxol-5-yl-ethanol (2ae): colorless oil (31.6 mg, 95%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 6.86 (s, 1H), 6.81 – 6.73 (m, 2H), 5.92 (s, 2H), 4.78 (q, *J* = 6.4 Hz, 1H), 2.20 (s, 1H), 1.43 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-

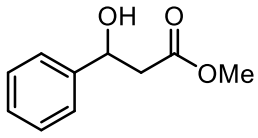
D) δ 147.8, 146.8, 140.1, 118.8, 108.1, 106.1, 101.0, 70.2, 25.2. The spectroscopic data corresponds to the reported data.[23]



1,2,3,4-Tetrahydro-1-naphthol (2af): colorless oil (24.3 mg, 82%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.43 – 7.39 (m, 1H), 7.21 – 7.18 (m, 2H), 7.11 – 7.08 (m, 1H), 4.75 (s, 1H), 2.81 (dt, *J* = 16.0, 5.0 Hz, 1H), 2.75 – 2.67 (m, 1H), 2.00 – 1.86 (m, 4H), 1.81 – 1.73 (m, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.9, 137.2, 129.1, 128.8, 127.7, 126.3, 68.2, 32.3, 29.3, 18.9. The spectroscopic data corresponds to the reported data.[18]

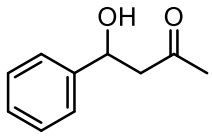


1-Indanol (2ag): colorless oil (24.7 mg, 92%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.40 (d, *J* = 6.0 Hz, 1H), 7.24 7.20 (m, 3H), 5.21 (t, *J* = 5.5 Hz, 1H), 3.04 (ddd, *J* = 16.0, 8.7, 4.8 Hz, 1H), 2.80 (dt, *J* = 15.6, 7.3 Hz, 1H), 2.46 (dtd, *J* = 13.3, 7.6, 5.0 Hz, 1H), 2.01 (s, 1H), 1.97 – 1.86 (m, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 145.1, 143.4, 128.4, 126.8, 125.0, 124.3, 76.5, 36.0, 29.9. The spectroscopic data corresponds to the reported data.[18]

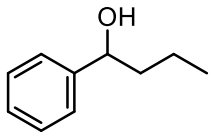


Methyl 3-hydroxy-3-phenylpropionate (2ah): colorless oil (31.0 mg, 86%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.37 – 7.25 (m, 5H), 5.14 – 5.10 (m, 1H), 3.70 (s, 3H), 3.32 (s,

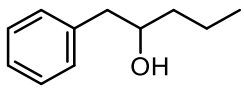
1H), 2.79 – 2.67 (m, 2H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 172.9, 142.6, 128.6, 127.9, 125.7, 70.4, 52.0, 43.3. The spectroscopic data corresponds to the reported data.[24]



1-Hydroxy-1-phenyl-3-butanone (2ai): colorless oil (23.0 mg, 70%). Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.35 (d, *J* = 4.6 Hz, 4H), 7.30 – 7.25 (m, 1H), 5.14 (dd, *J* = 8.9, 3.0 Hz, 1H), 3.35 (s, 1H), 2.88 (dd, *J* = 17.4, 9.2 Hz, 1H), 2.80 (dd, *J* = 17.4, 3.2 Hz, 1H), 2.18 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 209.2, 142.8, 128.6, 127.8, 125.7, 69.9, 52.1, 30.9. The spectroscopic data corresponds to the reported data.[25]

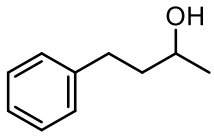


1-Phenyl-1-butanol (2aj): colorless oil (29.4 mg, 98%). Eluent for the flash chromatography with silica gel: hexane / EA: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.35 – 7.31 (m, 4H), 7.28 – 7.24 (m, 1H), 4.64 (t, *J* = 6.6 Hz, 1H), 2.02 (s, 1H), 1.77 (dtd, *J* = 10.1, 7.8, 5.0 Hz, 1H), 1.66 (ddt, *J* = 13.3, 10.1, 5.5 Hz, 1H), 1.48 – 1.36 (m, 1H), 1.34 – 1.24 (m, 1H), 0.92 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 145.0, 128.5, 127.6, 126.0, 74.5, 41.3, 19.1, 14.1. The spectroscopic data corresponds to the reported data.[26]

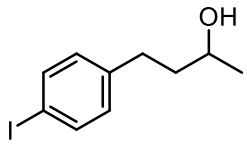


1-Phenyl-2-pentanol (2ak): colorless oil (15.8 mg, 48%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.34 – 7.29 (m, 2H), 7.26 – 7.20 (m, 3H), 3.91 – 3.75 (m, 1H),

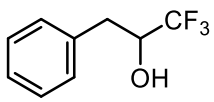
2.83 (dd, *J* = 13.5, 4.4 Hz, 1H), 2.64 (dd, *J* = 13.5, 8.5 Hz, 1H), 1.54 – 1.47 (m, 4H), 1.41 – 1.37 (m, 1H), 0.94 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.8, 129.6, 128.7, 126.6, 72.6, 44.2, 39.1, 19.1, 14.2. The spectroscopic data corresponds to the reported data.[27]



1-Phenyl-3-butanol (2al): colorless oil (15.0 mg, 50%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.31 – 7.25 (m, 2H), 7.21 – 7.16 (m, 3H), 3.86 – 3.78 (m, 1H), 2.80 – 2.62 (m, 2H), 1.77 (ddt, *J* = 9.2, 7.3, 5.3 Hz, 2H), 1.53 (s, 1H), 1.22 (d, *J* = 6.0 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 142.2, 128.5, 128.5, 125.9, 67.6, 41.0, 32.2, 23.7. The spectroscopic data corresponds to the reported data.[18]

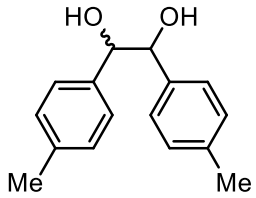


4-(4-Iodophenyl)-2-butanol (2am): colorless oil (11.6 mg, 21%). Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.64 – 7.54 (m, 2H), 7.03 – 6.88 (m, 2H), 3.81 (dq, *J* = 12.4, 6.0 Hz, 1H), 2.75 – 2.57 (m, 2H), 1.77 – 1.68 (m, 2H), 1.22 (d, *J* = 6.4 Hz, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 141.8, 137.6, 130.7, 90.9, 67.4, 40.7, 31.7, 23.9. HRMS (EI+) calculated *m/z* for $C_{10}H_{13}IO^{+}$ $[M]^{+}$: 276.0006, found 276.0009.

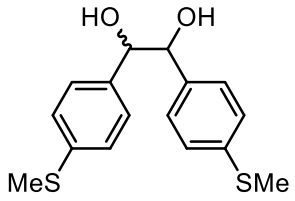


1,1,1-Trifluoro-3-phenylpropan-2-ol (2an): colorless oil (34.6 mg, 91%). Eluent for the flash chromatography with silica gel: hexane / EA: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.36 – 7.24 (m, 5H), 4.18 – 4.08 (m, 1H), 3.05 (dd, *J* = 14.2, 2.8 Hz, 1H), 2.84 (dd, *J* = 14.2, 10.1 Hz, 1H), 2.15 (d, *J* = 5.0 Hz, 1H). ^{13}C NMR (101 MHz,

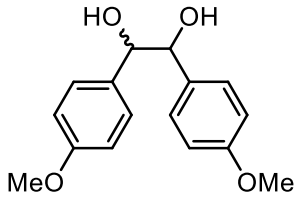
CHLOROFORM-D) δ 135.8, 129.6, 128.9, 127.4, 125.0 (q, *J* = 282.8 Hz), 71.6 (q, *J* = 31.3 Hz), 36.2. The spectroscopic data corresponds to the reported data.[28]



1,2-Bis(4-methylphenyl)-1,2-ethanediol (*dl* and *meso*) (3a): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 – 7.13 (m, 8H), 7.06 – 6.99 (m, 8H), 4.72 (s, 2H), 4.64 (s, 2H), 2.86 (s, 2H), 2.34 (s, 6H), 2.29 (s, 6H), 2.16 (s, 2H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 137.9, 137.6, 137.1, 129.1, 128.9, 127.2, 127.0, 78.9, 78.2, 21.3, 21.3. The spectroscopic data corresponds to the reported data.[29]

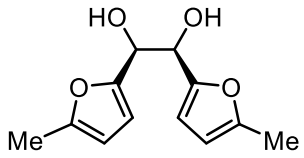


1,2-Bis(4-(methylthio)phenyl)-1,2-ethanediol (*dl* and *meso*) (3b): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.11 (d, *J* = 8.3 Hz, 4H), 7.03 (d, *J* = 8.7 Hz, 4H), 4.62 (s, 2H), 2.89 (s, 2H), 2.45 (s, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.3, 136.6, 127.6, 126.2, 78.8, 15.8. **(*R*,*S*)-287a** was assigned, while **(*R*,*R*)/(*S*,*S*)-287a** was not assigned due to the weak signal caused by extremely low soluability. The spectroscopic data corresponds to the reported data.[30]

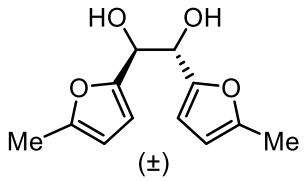


1,2-Bis(4-methoxyphenyl)-1,2-ethanediol (*dl* and *meso*) (3c): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz,

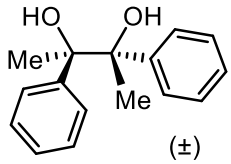
CHLOROFORM-D) δ 7.18 (d, *J* = 8.7 Hz, 1H), 7.02 (d, *J* = 8.7 Hz, 4H), 6.84 (d, *J* = 8.7 Hz, 1H), 6.75 (d, *J* = 8.7 Hz, 4H), 4.72 (s, 2H), 4.60 (s, 2H), 3.79 (s, 6H), 3.75 (s, 6H), 2.94 (s, 2H).[13]C NMR (101 MHz, CHLOROFORM-D) δ 159.5, 159.3, 132.2, 132.2, 128.5, 128.3, 113.8, 113.6, 78.9, 77.9, 55.4, 55.3. The spectroscopic data corresponds to the reported data.[31]



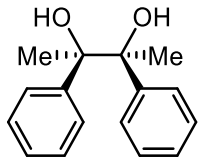
(*R*,*S*)-1,2-bis(5-methylfuran-2-yl)-1,2-ethanediol (*dl*-3d): Colorless oil. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. [1]H NMR (400 MHz, CHLOROFORM-D) δ 6.21 (d, *J* = 3.2 Hz, 2H), 5.93 (d, *J* = 2.8 Hz, 2H), 4.91 (s, 2H), 2.32 (s, 2H), 2.29 (s, 6H). [13]C NMR (101 MHz, CHLOROFORM-D) δ 152.6, 151.0, 109.7, 106.5, 70.0, 13.7. The spectroscopic data corresponds to the reported data.[30]



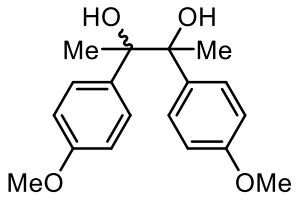
(*R*,*R*)/(*S*,*S*)-1,2-bis(5-methylfuran-2-yl)-1,2-ethanediol (*meso*-3d): Colorless oil. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. [1]H NMR (400 MHz, CHLOROFORM-D) δ 6.13 (d, *J* = 2.8 Hz, 2H), 5.87 (d, *J* = 2.8 Hz, 2H), 4.92 (s, 2H), 2.81 (s, 2H), 2.26 (s, 6H). [13]C NMR (101 MHz, CHLOROFORM-D) δ 152.3, 150.9, 109.0, 106.4, 69.9, 13.7. The spectroscopic data corresponds to the reported data.[30]



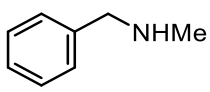
(*R,R)*/(*S,S*)-2,3-diphenylbutane-2,3-diol (*dl*-3e): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 – 7.23 (m, 6H), 7.21 – 7.18 (m, 4H), 2.59 (s, 2H), 1.50 (s, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 143.6, 127.5, 127.3, 127.2, 79.0, 25.1. The spectroscopic data corresponds to the reported data.[29]



(*R,S*)-2,3-diphenylbutane-2,3-diol (*meso*-3e): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.25 – 7.21 (m, 10H), 2.25 (s, 2H), 1.58 (s, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 143.9, 127.4, 127.0, 127.0, 78.7, 25.3. The spectroscopic data corresponds to the reported data.[29]

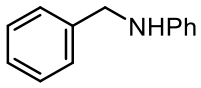


1,2-Bis(4-methoxyphenyl)butane-2,3-ethanediol (*dl* and *meso*) (3f): White solid. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.14 – 7.07 (m, 8H), 6.79 – 6.73 (m, 8H), 3.79 (s, 6H), 3.78 (s, 6H), 2.56 (s, 2H), 2.28 (s, 2H), 1.54 (s, 6H), 1.45 (s, 6H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 158.7, 158.6, 136.2, 135.8, 128.7, 128.2, 112.7, 112.5, 78.8, 78.6, 55.3, 55.3, 25.3, 25.1. The spectroscopic data corresponds to the reported data.[32]

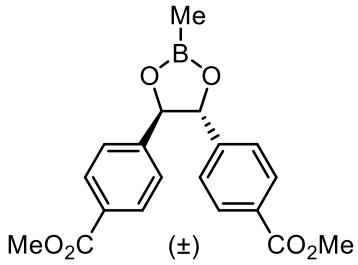


***N*-Methylbenzylamine (4a):** white solid (10.2 mg, 42%). Eluent for the flash chromatography with silica gel: CH_2Cl_2 / MeOH: 20/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.35 – 7.29 (m, 4H), 7.27 – 7.22 (m, 1H), 3.74 (s, 2H), 2.45 (s,

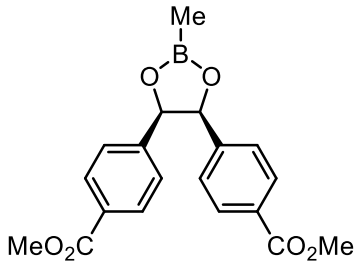
3H), 1.41 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 140.3, 128.5, 128.3, 127.0, 56.2, 36.2. The spectroscopic data corresponds to the reported data.[33]



***N*-Benzylaniline (4b):** white solid (33.7 mg, 92%). Eluent for the flash chromatography with silica gel: hexane / EA: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.34 (q, *J* = 8.0 Hz, 4H), 7.26 (t, *J* = 6.6 Hz, 1H), 7.16 (t, *J* = 7.6 Hz, 2H), 6.74 – 6.68 (m, 1H), 6.62 (d, *J* = 8.3 Hz, 2H), 4.31 (s, 2H), 4.00 (s, 1H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 148.2, 139.6, 129.4, 128.8, 127.6, 127.3, 117.7, 112.9, 48.4. The spectroscopic data corresponds to the reported data.[34]

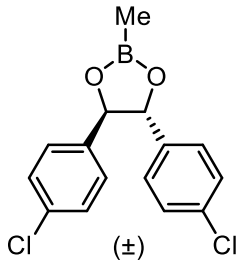


(*R,R)*/(*S,S*) dimethyl 4,4'-(2-methyl-1,3,2-dioxaborolane-4,5-diyl)dibenzoate (*dl*-5a): White solid. Melting point: 109.6 – 111.5 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.07 (d, *J* = 8.3 Hz, 4H), 7.35 (d, *J* = 8.3 Hz, 4H), 5.15 (s, 2H), 3.93 (s, 6H), 0.57 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 166.8, 144.9, 130.4, 130.3, 125.8, 85.9, 52.4. HRMS (EI+) calculated *m/z* for $C_{19}H_{19}BO_6^+$ $[M]^+$: 354.1269, found 354.1267.

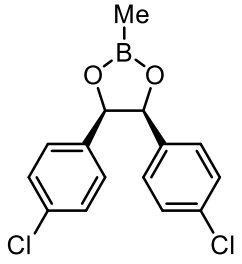


(*R,S*) dimethyl 4,4'-(2-methyl-1,3,2-dioxaborolane-4,5-diyl)dibenzoate (*meso*-5a): White solid. Melting point: 223.9 – 225.2 ℃. Eluent for the flash chromatography with

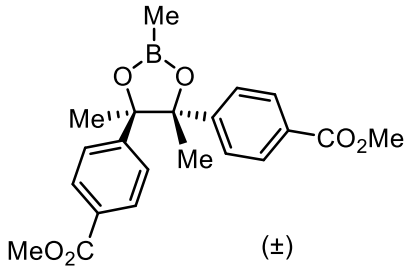
silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.74 (d, *J* = 8.3 Hz, 4H), 6.98 (d, *J* = 8.3 Hz, 4H), 5.80 (s, 2H), 3.84 (s, 6H), 0.63 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 166.7, 142.4, 129.5, 129.3, 126.3, 82.4, 52.2. HRMS (EI+) calculated *m/z* for $C_{19}H_{19}BO_6^+$ $[M]^+$: 354.1269, found 354.1267.



(*R,R)*/(*S,S*)-4,5-bis(4-chlorophenyl)-2-methyl-1,3,2-dioxaborolane (*dl*-5b): Light yellow oil. Eluent for the flash chromatography with silica gel: hexane / EA: 15/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.36 (d, *J* = 8.3 Hz, 4H), 7.20 (d, *J* = 8.3 Hz, 4H), 5.05 (s, 2H), 0.53 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 138.5, 134.5, 129.2, 127.3, 85.8. HRMS (EI+) calculated *m/z* for $C_{15}H_{13}BCl_2O_2^+$ $[M]^+$: 306.0380, found 306.0377.

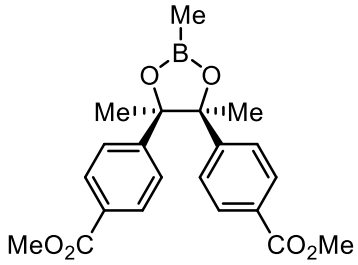


(*R,S*)-4,5-bis(4-chlorophenyl)-2-methyl-1,3,2-dioxaborolane (*meso*-5b): White solid. Melting point: 89.1 – 91.4 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.10 – 7.06 (m, 4H), 6.85 – 6.80 (m, 4H), 5.68 (s, 2H), 0.59 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 128.5, 128.5, 128.2, 127.7, 82.1. HRMS (EI+) calculated *m/z* for $C_{15}H_{13}BCl_2O_2^+$ $[M]^+$: 306.0380, found 306.0377.

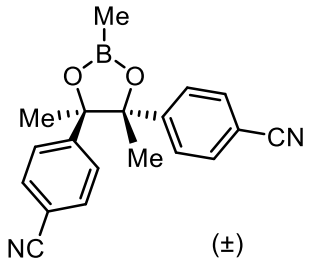


(±)

(*R,R)*/(*S,S*) dimethyl 4,4'-(2,4,5-trimethyl-1,3,2-dioxaborolane-4,5-diyl)dibenzoate (*dl*-5c): White solid. Melting point: 152.0 – 153.9 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 10/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 8.08 (d, *J* = 8.7 Hz, 4H), 7.53 (d, *J* = 8.3 Hz, 4H), 3.95 (s, 6H), 1.15 (s, 6H), 0.55 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 166.9, 147.5, 129.6, 125.8, 87.8, 52.3, 27.5. HRMS (EI+) calculated *m/z* for $C_{21}H_{23}BO_6^+$ $[M]^+$: 382.1582, found 382.1585.

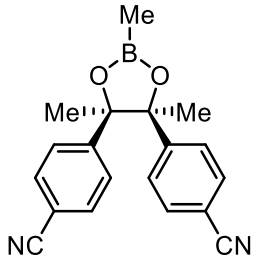


(*R,S*) dimethyl 4,4'-(2,4,5-trimethyl-1,3,2-dioxaborolane-4,5-diyl)dibenzoate (*meso*-5c): White solid. Melting point: 103.2 – 105.4 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.68 (d, *J* = 8.3 Hz, 4H), 6.99 (d, *J* = 8.3 Hz, 4H), 3.85 (s, 6H), 1.83 (s, 6H), 0.64 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 166.7, 147.5, 128.9, 128.7, 125.5, 88.6, 52.1, 25.0. HRMS (EI+) calculated *m/z* for $C_{21}H_{23}BO_6^+$ $[M]^+$: 382.1582, found 382.1585.



(±)

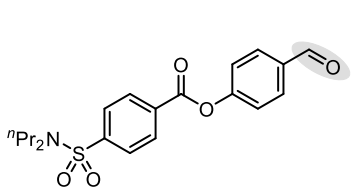
(*R*,*R*)/(*S*,*S*)-4,4'-(2,4,5-trimethyl-1,3,2-dioxaborolane-4,5-diyl)dibenzonitrile (*dl*-5d): White solid. Melting point: 212.0 – 213.4 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 5/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.73 (d, *J* = 7.3 Hz, 4H), 7.57 (d, *J* = 7.8 Hz, 4H), 1.14 (s, 6H), 0.55 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 147.5, 132.3, 126.5, 118.6, 112.0, 87.5, 27.4. HRMS (EI+) calculated *m/z* for $C_{19}H_{17}BN_2O_2^+$ $[M]^+$: 316.1378, found 316.1380.



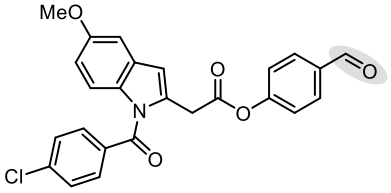
(*R*,*S*)-4,4'-(2,4,5-trimethyl-1,3,2-dioxaborolane-4,5-diyl)dibenzonitrile (*meso*-5d): White solid. Melting point: 141.7 – 143.2 ℃. Eluent for the flash chromatography with silica gel: hexane / EA: 2/1. ^{1}H NMR (400 MHz, CHLOROFORM-D) δ 7.37 – 7.32 (m, 4H), 7.04 – 7.00 (m, 4H), 1.82 (s, 6H), 0.63 (s, 3H). ^{13}C NMR (101 MHz, CHLOROFORM-D) δ 147.6, 131.6, 126.3, 118.4, 111.2, 88.4, 24.8. HRMS (EI+) calculated *m/z* for $C_{19}H_{17}BN_2O_2^+$ $[M]^+$: 316.1378, found 316.1380.

10. Scope of Unsuccessful Derivatized Examples

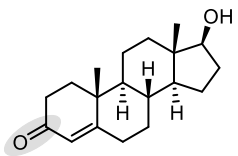
The following bioactive compounds or drugs did not proceed well in the hydrogenated reaction for different reasons. The probenecid derivative suffered from competitive reductive coupling and reduction of the sulfonyl group, and the indomethacin derivative was interrupted by the dearomatized hydrogenation of the indole motif, while testosterone resulted in hydrogenation of the C=C double bond.



from probenecid



from indomethacin



testosterone

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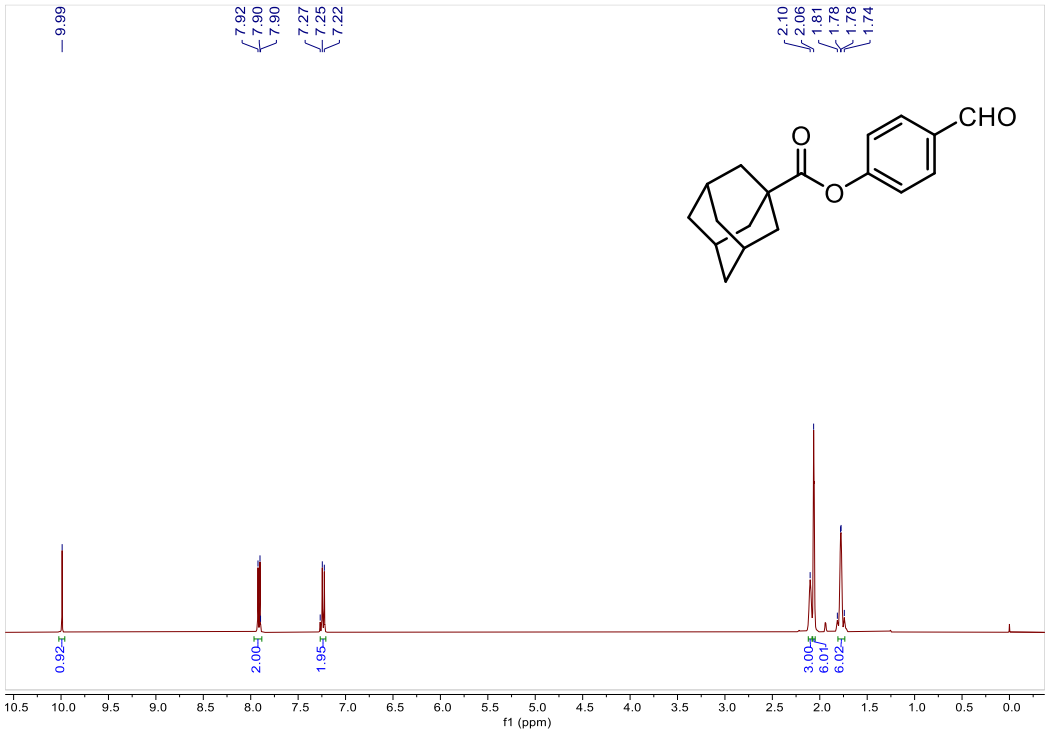
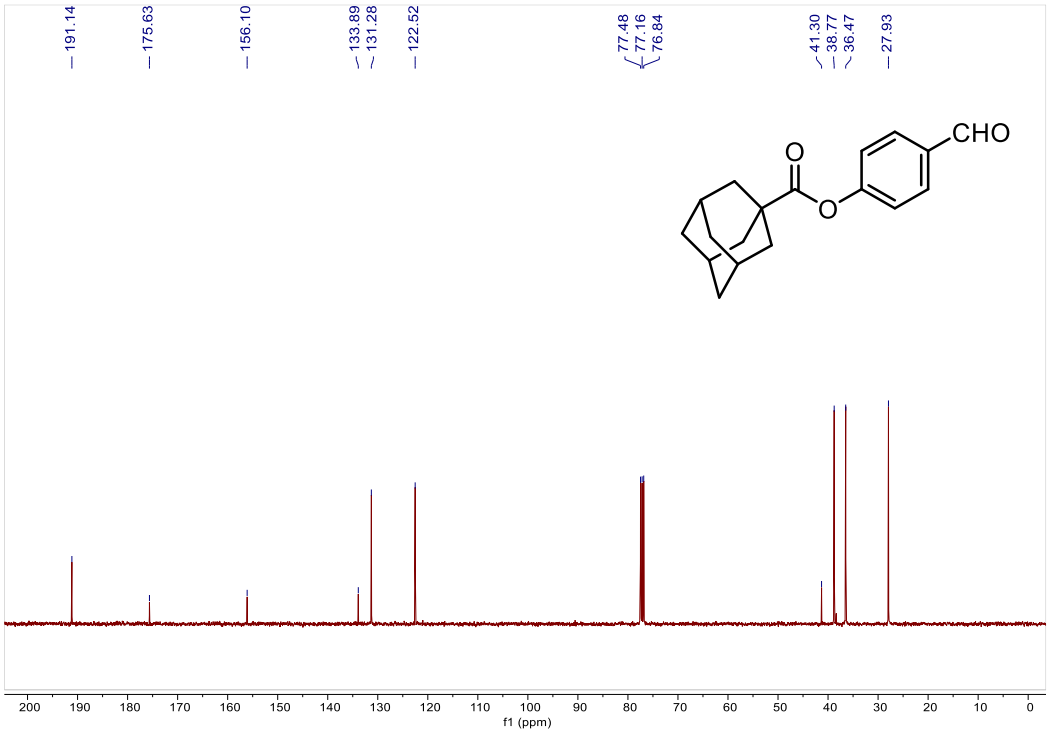
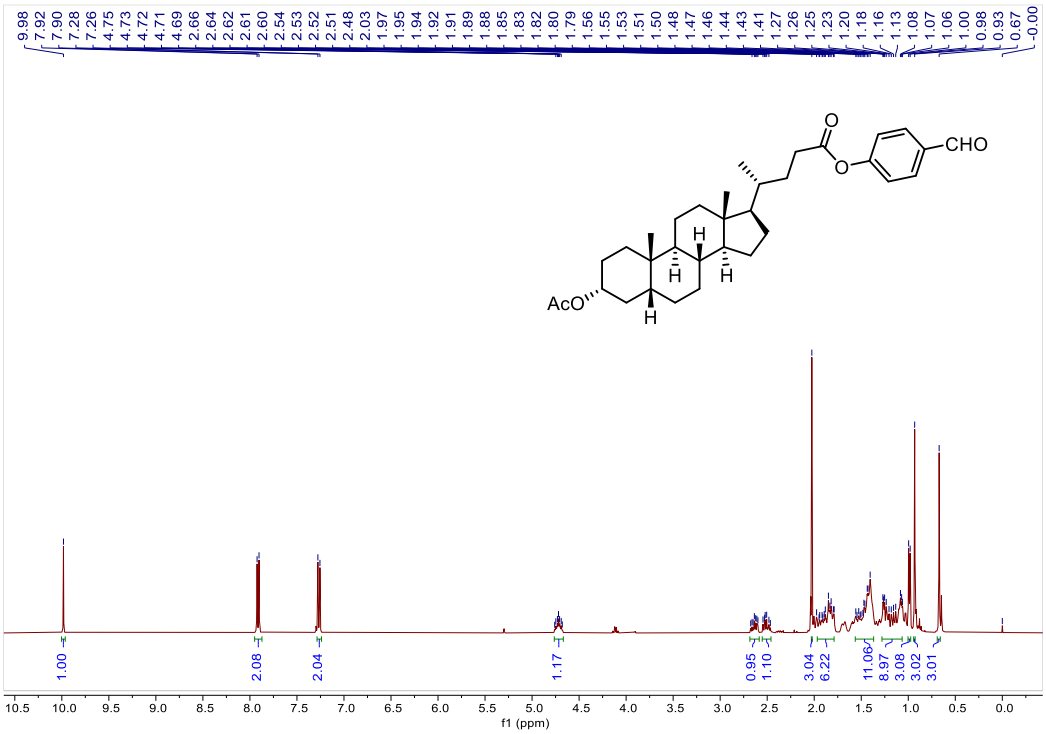
12. Copies of ^{1}H, $^{13}C\{^{1}H\}$, ^{19}F NMR Spectra for Synthesized Compounds



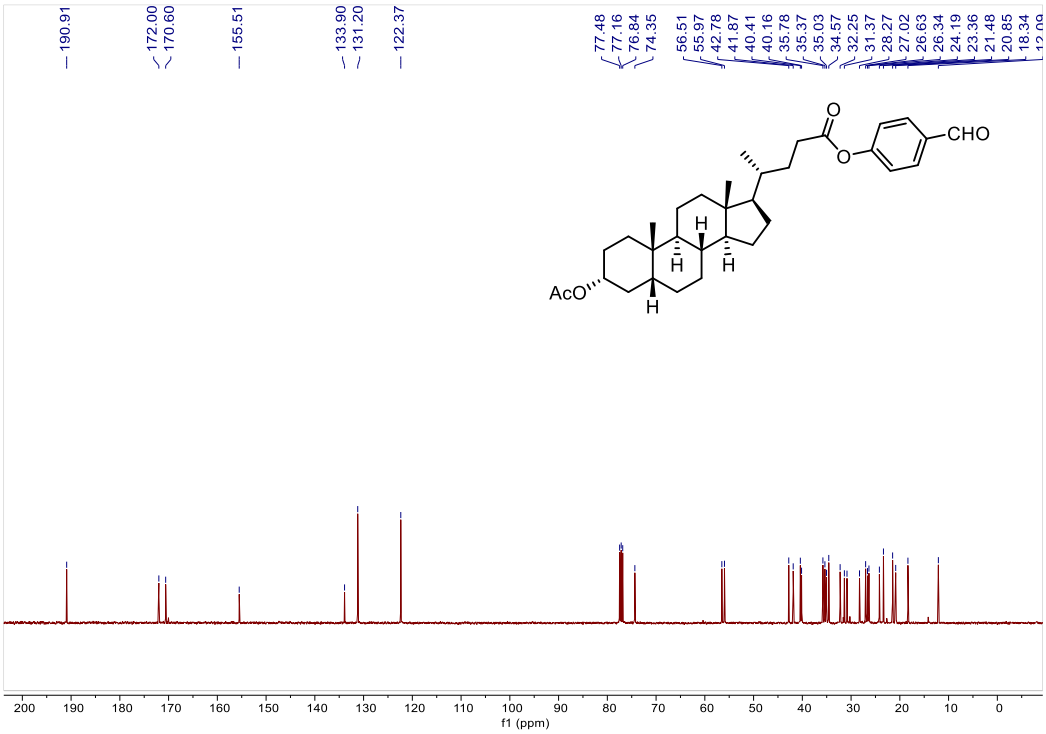
^{1}H NMR for compound **1u**



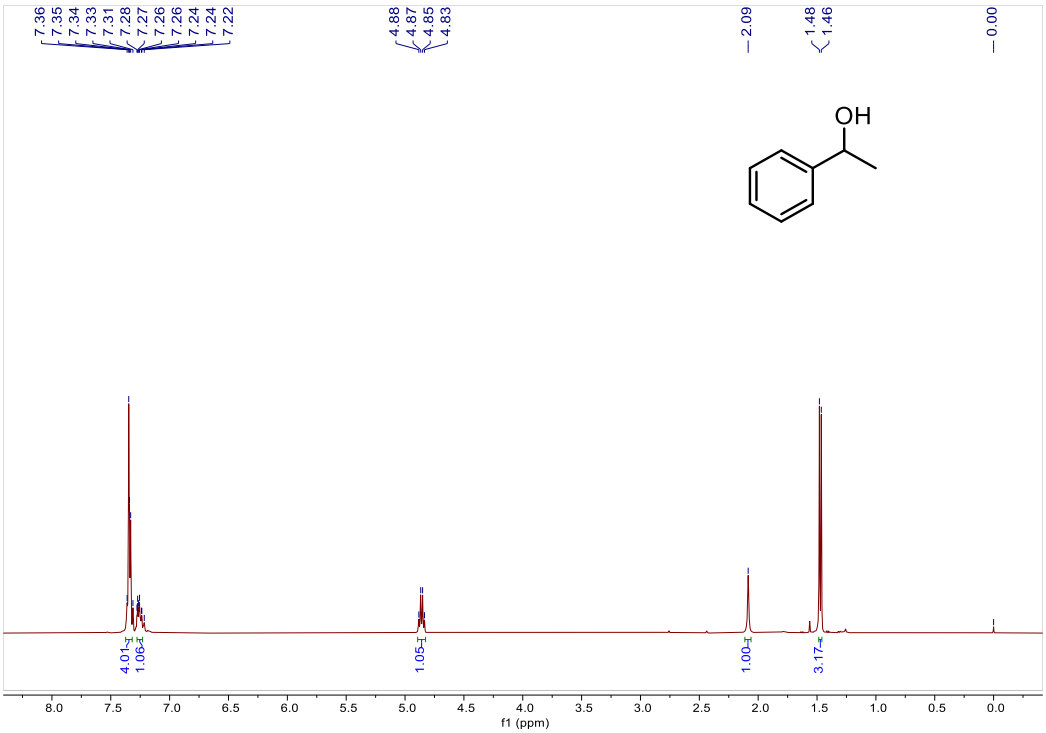
$^{13}C\{^{1}H\}$ NMR for compound **1u**



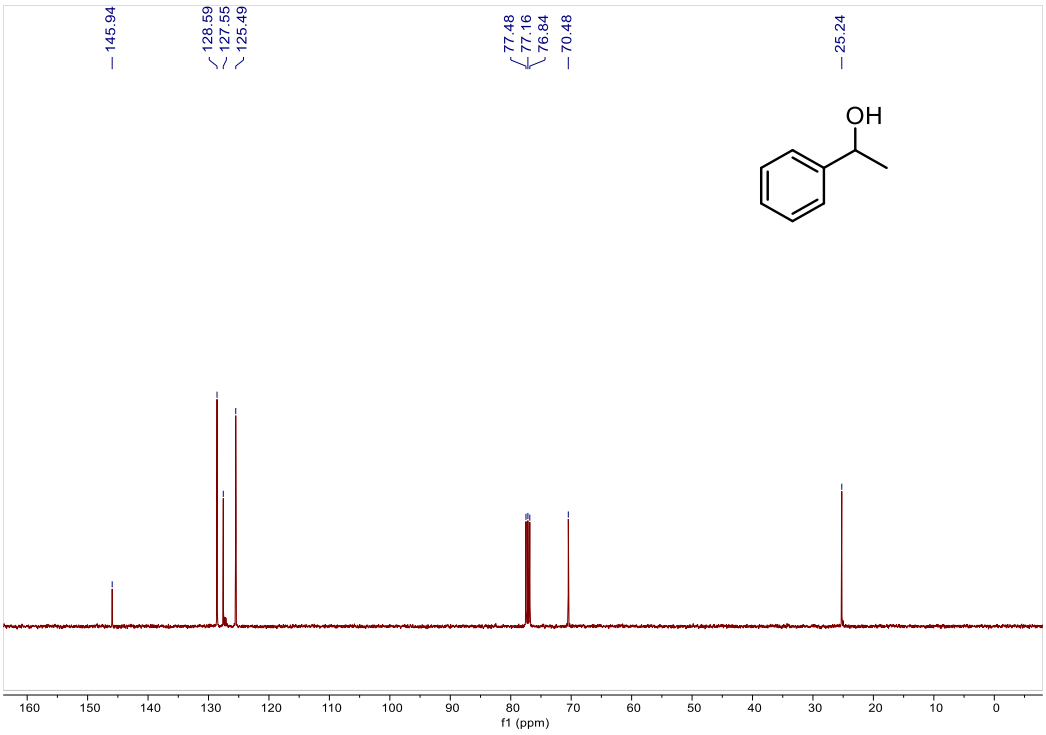
^{1}H NMR for compound **1v**



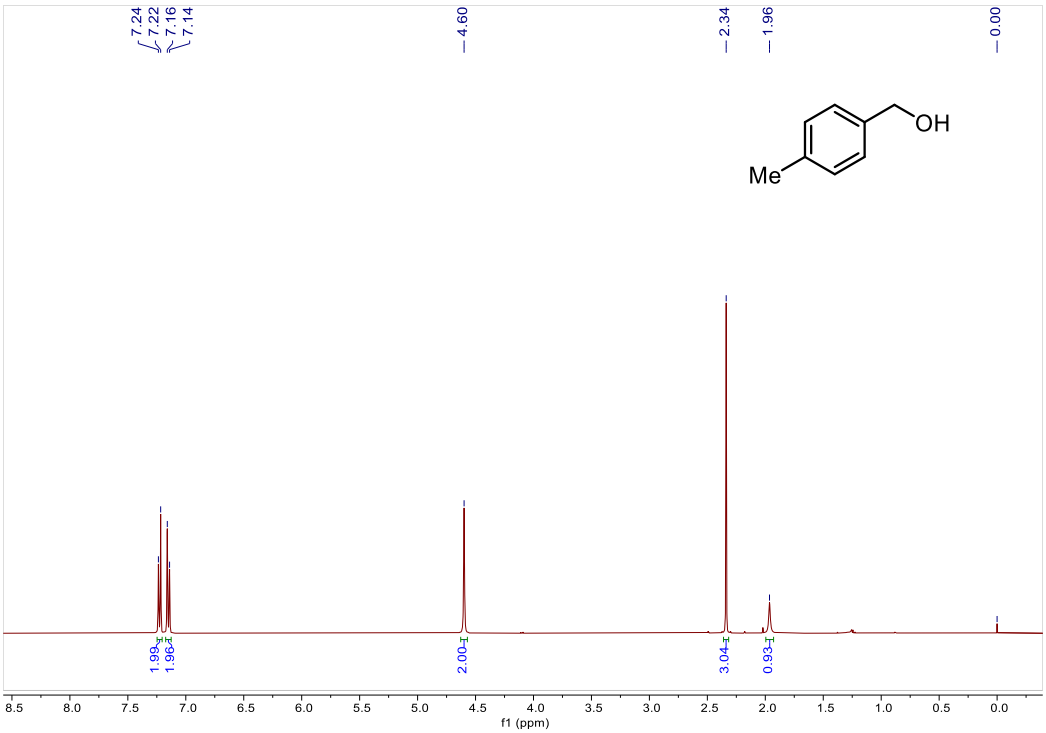
^{13}C{^{1}H} NMR for compound **1v**



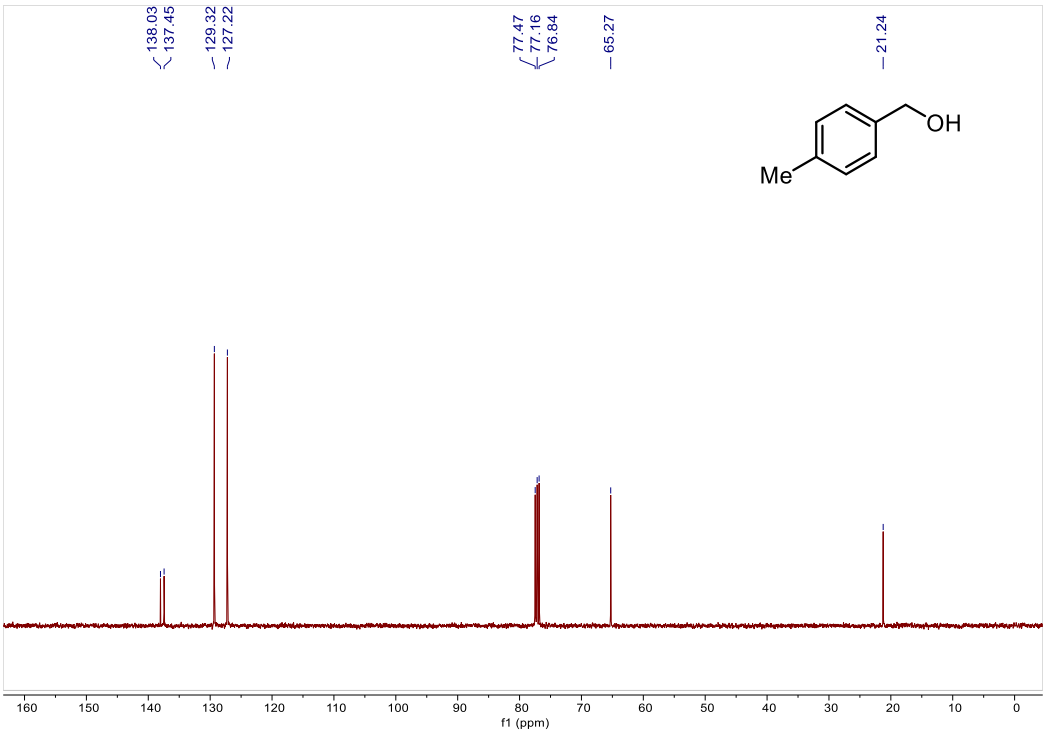
^{1}H NMR for compound **2a**



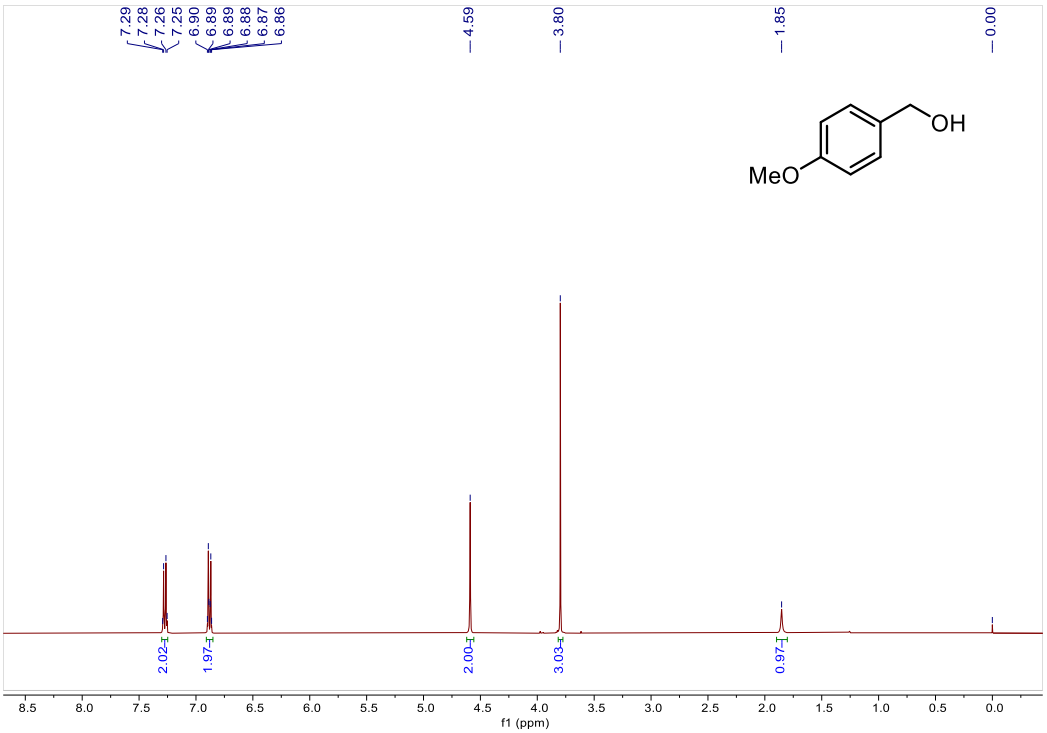
^{13}C{^{1}H} NMR for compound **2a**



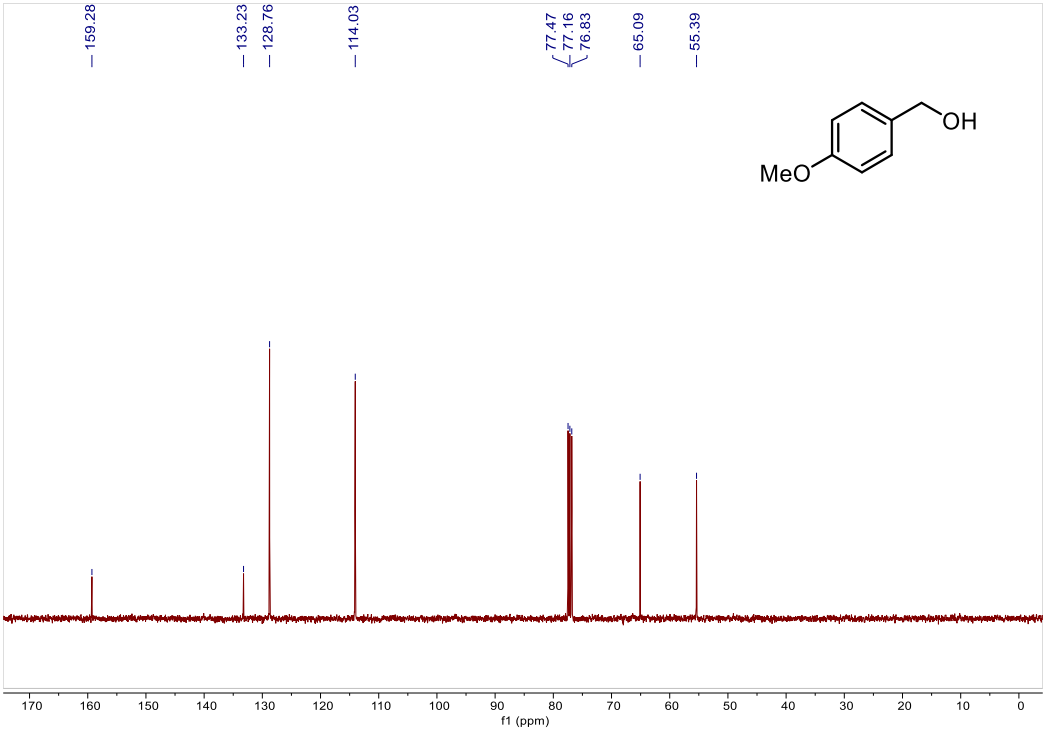
^{1}H NMR for compound **2b**



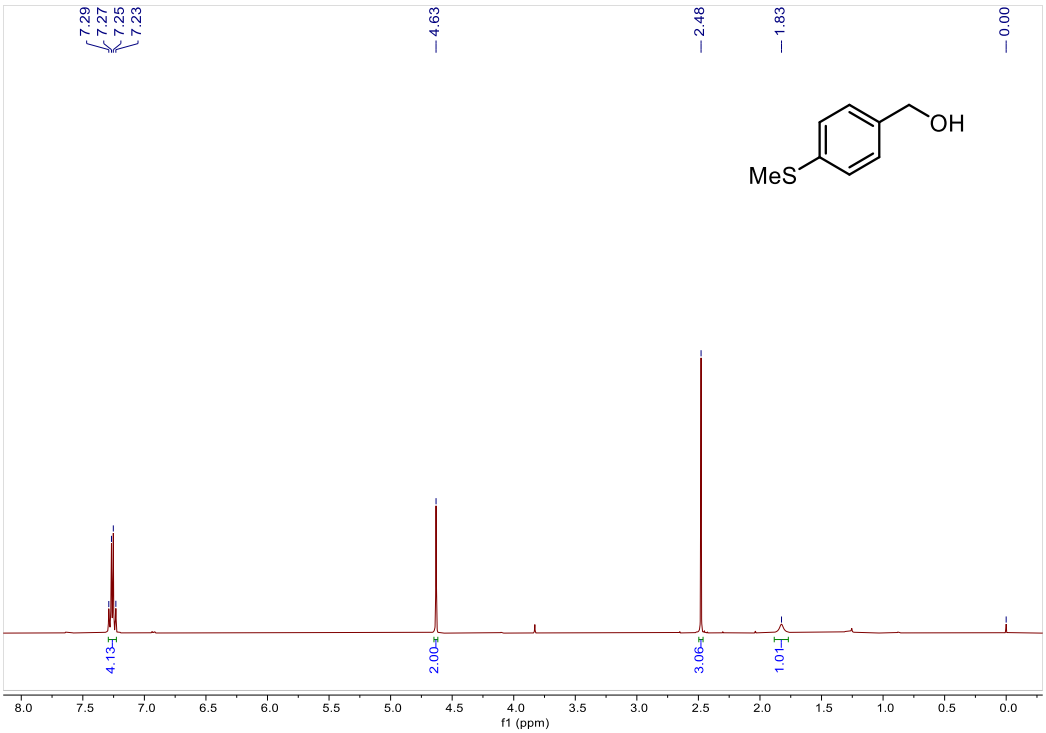
^{13}C{^{1}H} NMR for compound **2b**



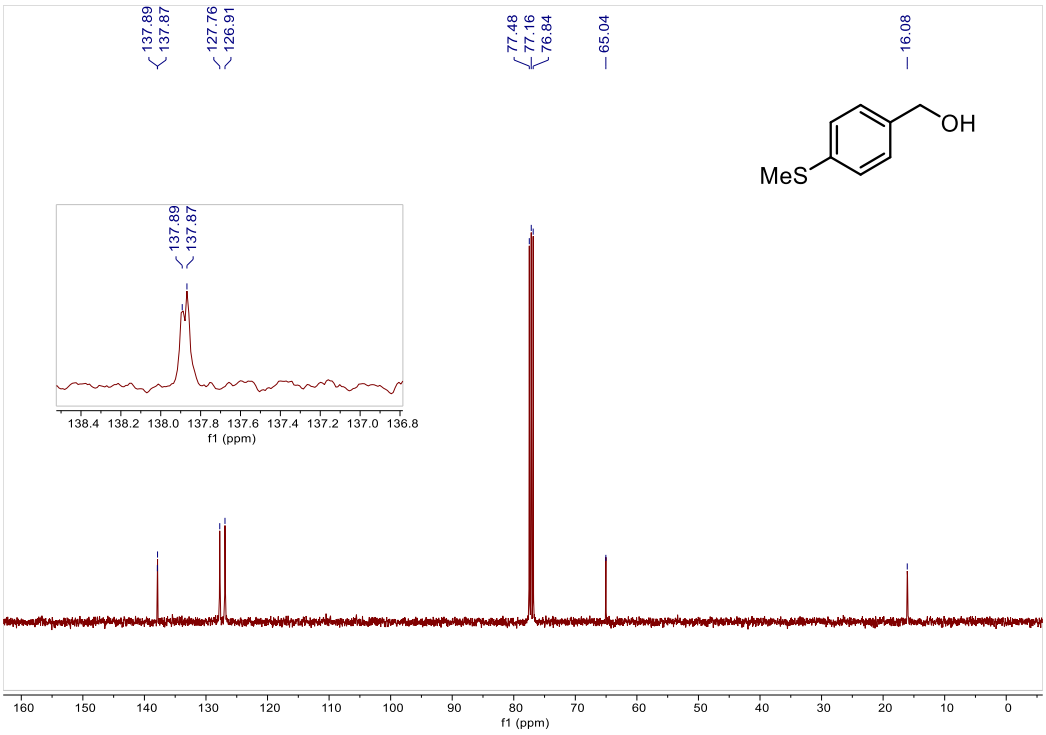
^{1}H NMR for compound **2c**



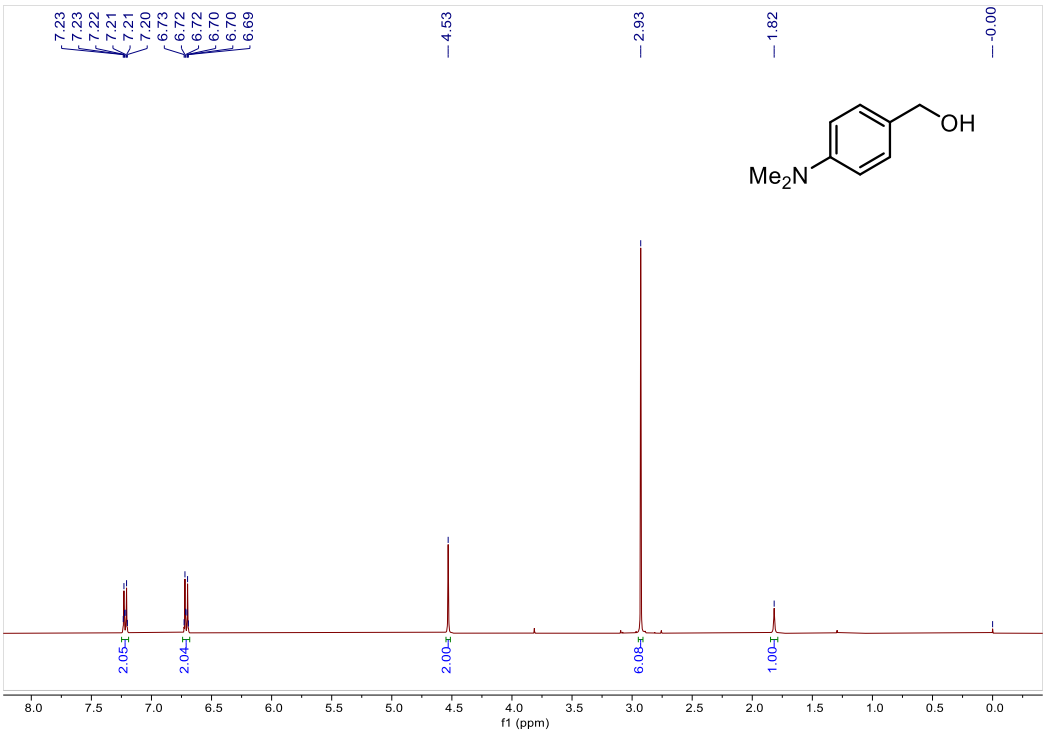
^{13}C{^{1}H} NMR for compound **2c**



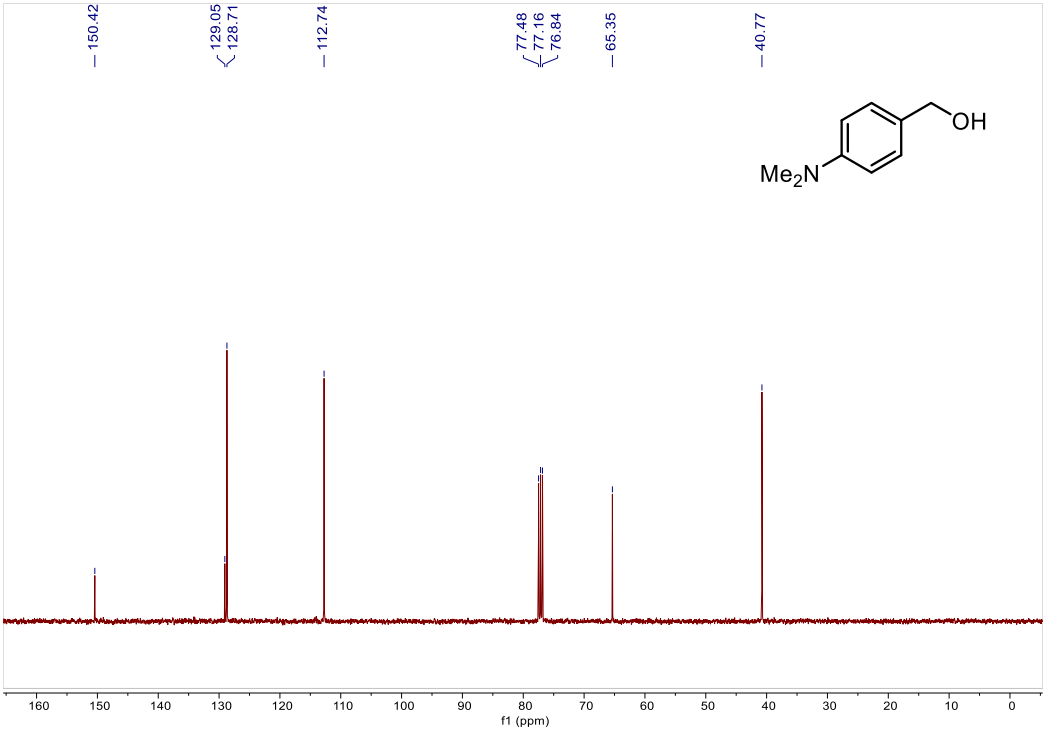
^{1}H NMR for compound **2d**



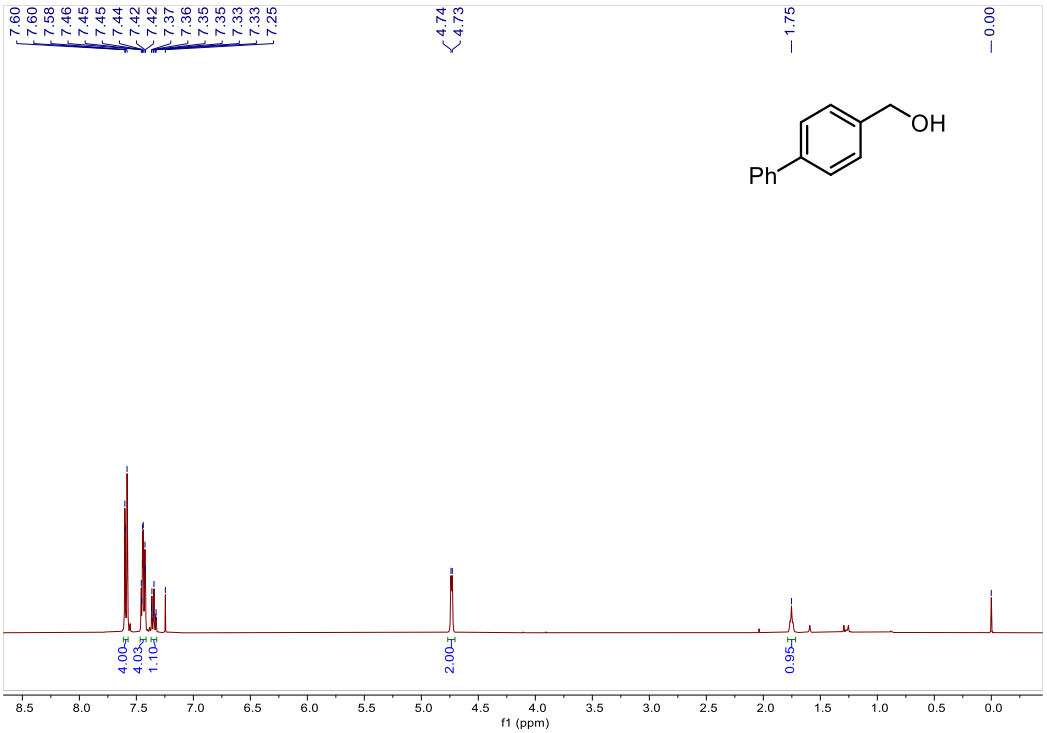
^{13}C{^{1}H} NMR for compound **2d**



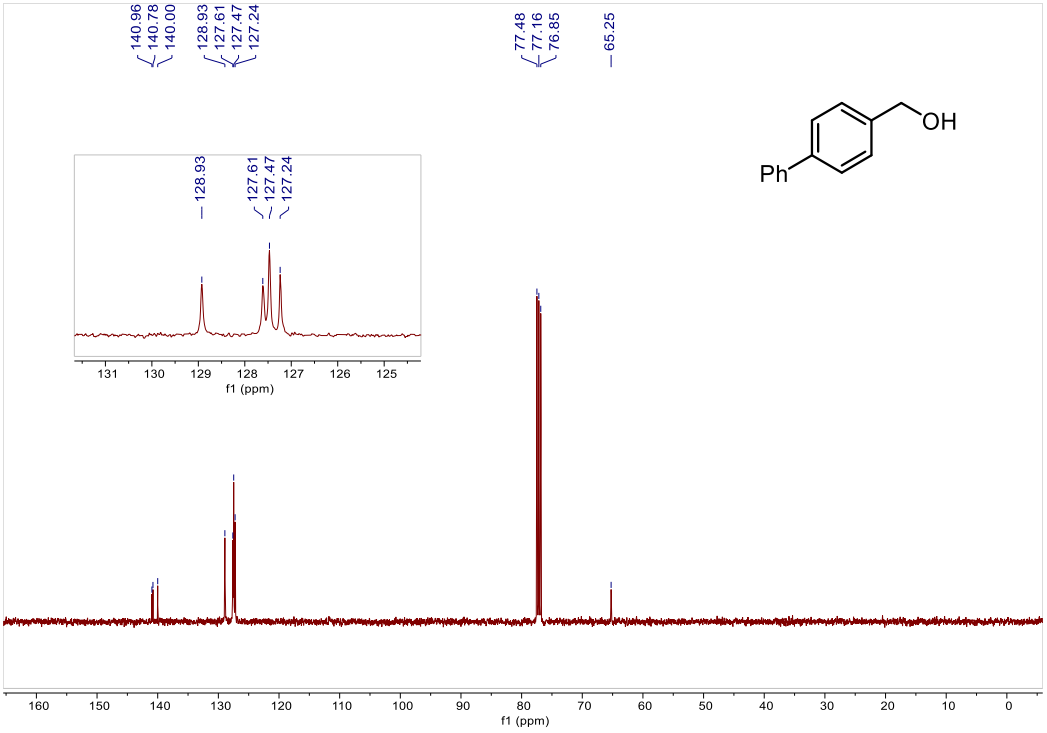
^{1}H NMR for compound **2e**



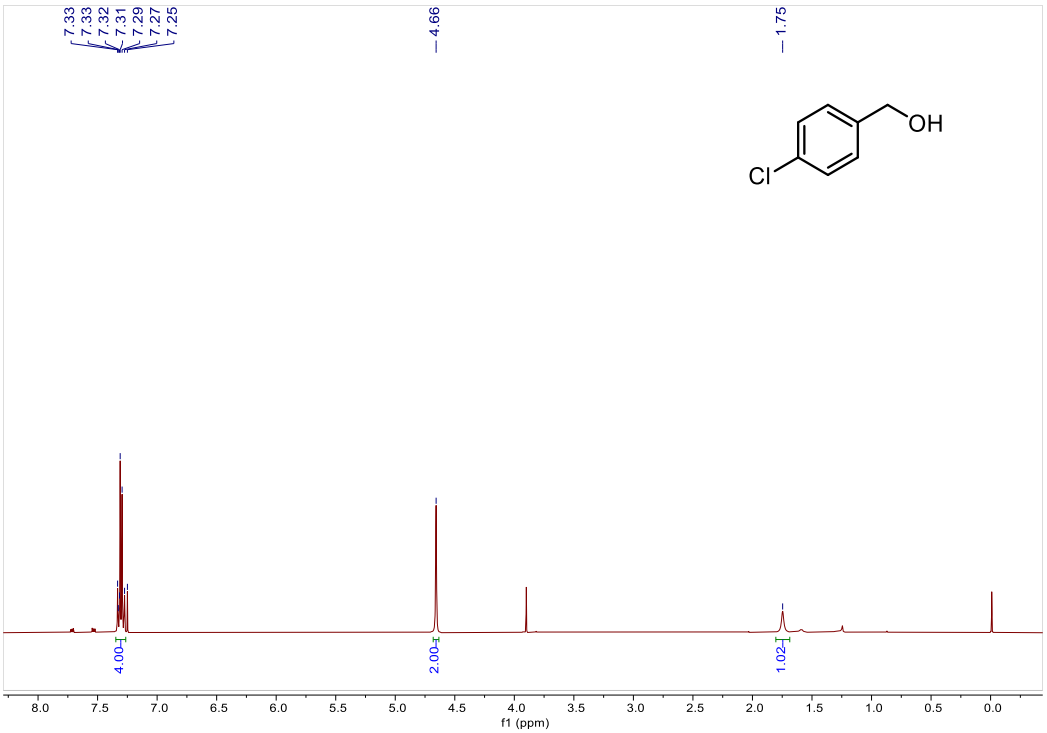
^{13}C{^{1}H} NMR for compound **2e**



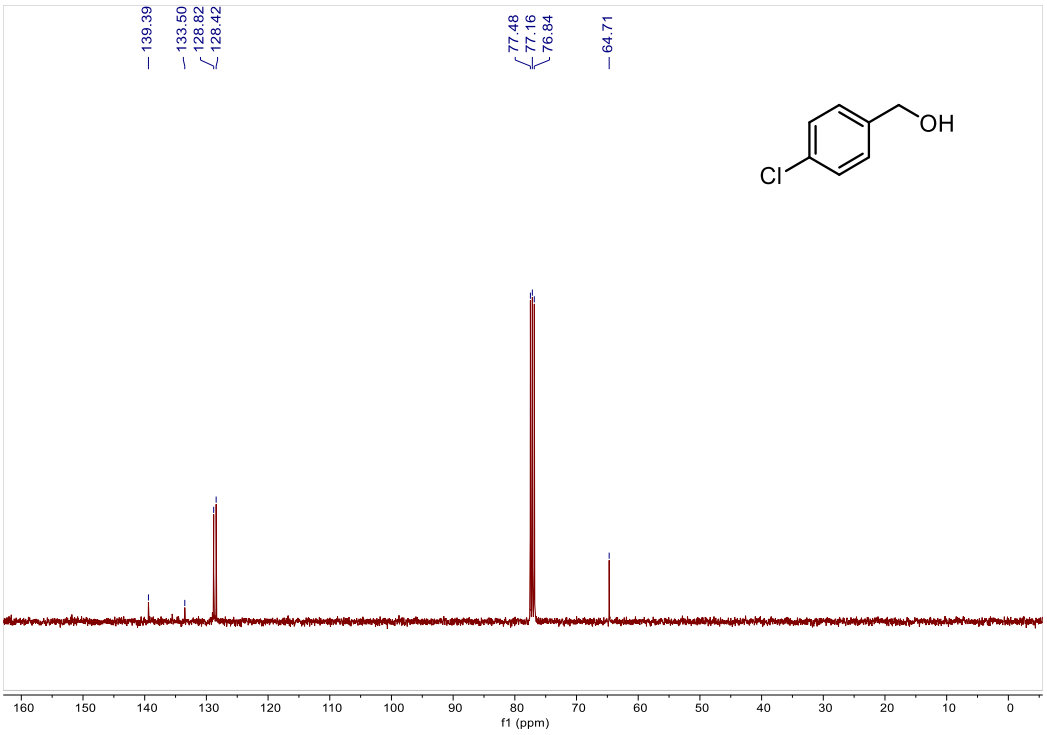
^{1}H NMR for compound **2f**



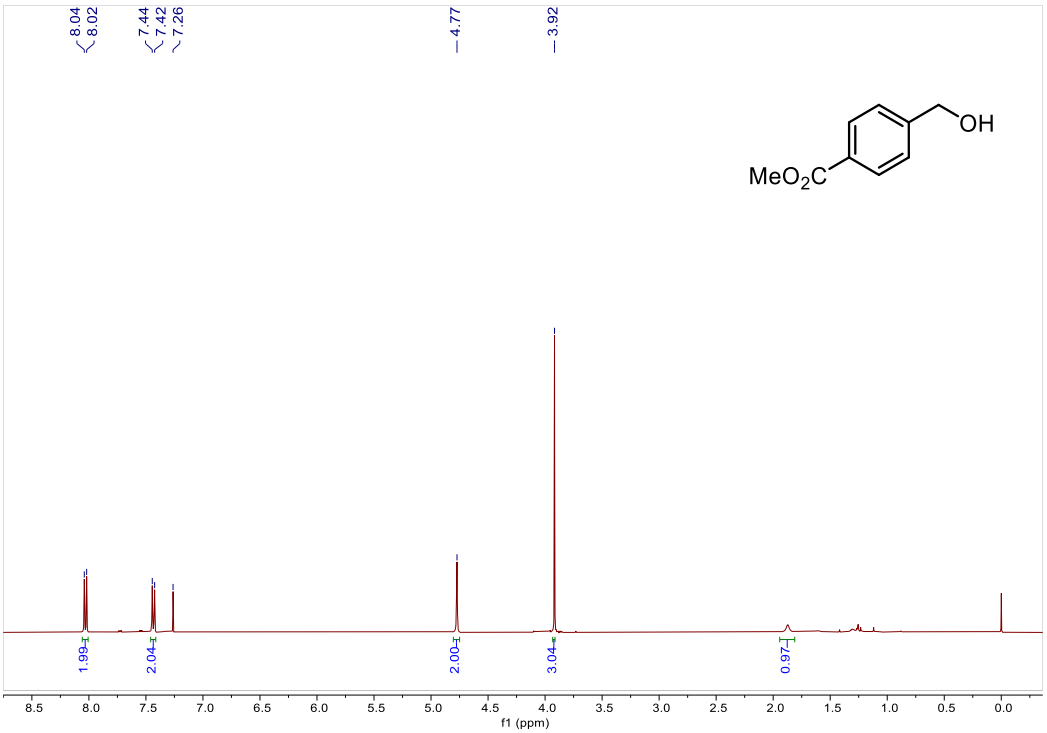
^{13}C{^{1}H} NMR for compound **2f**



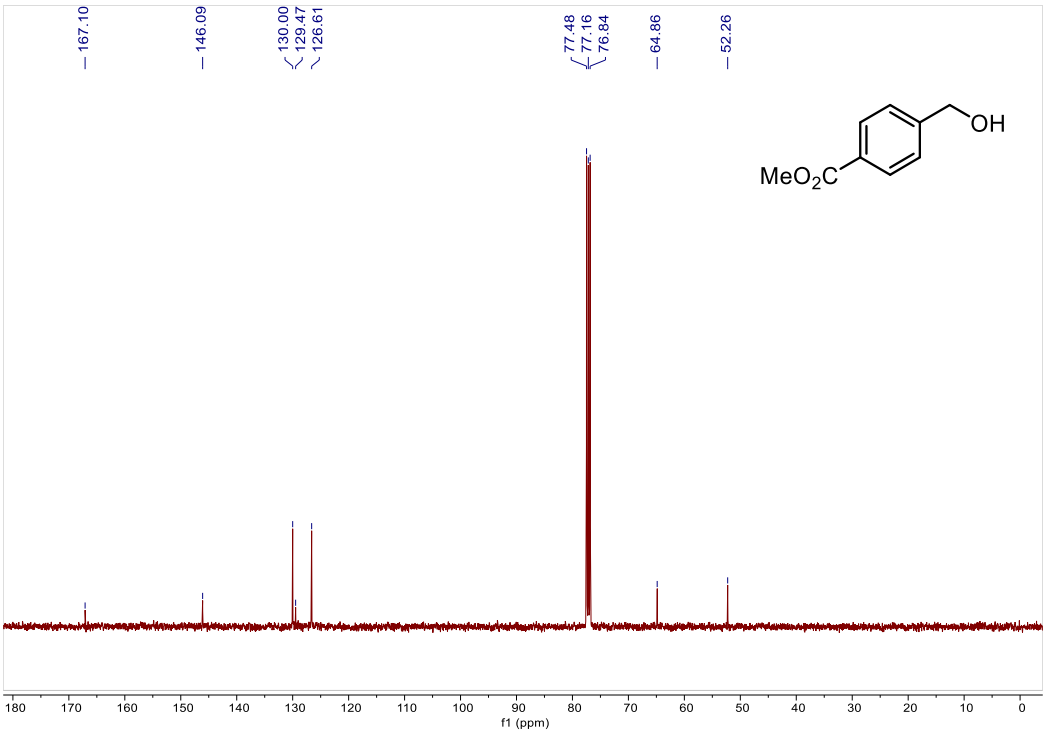
^{1}H NMR for compound **2g**



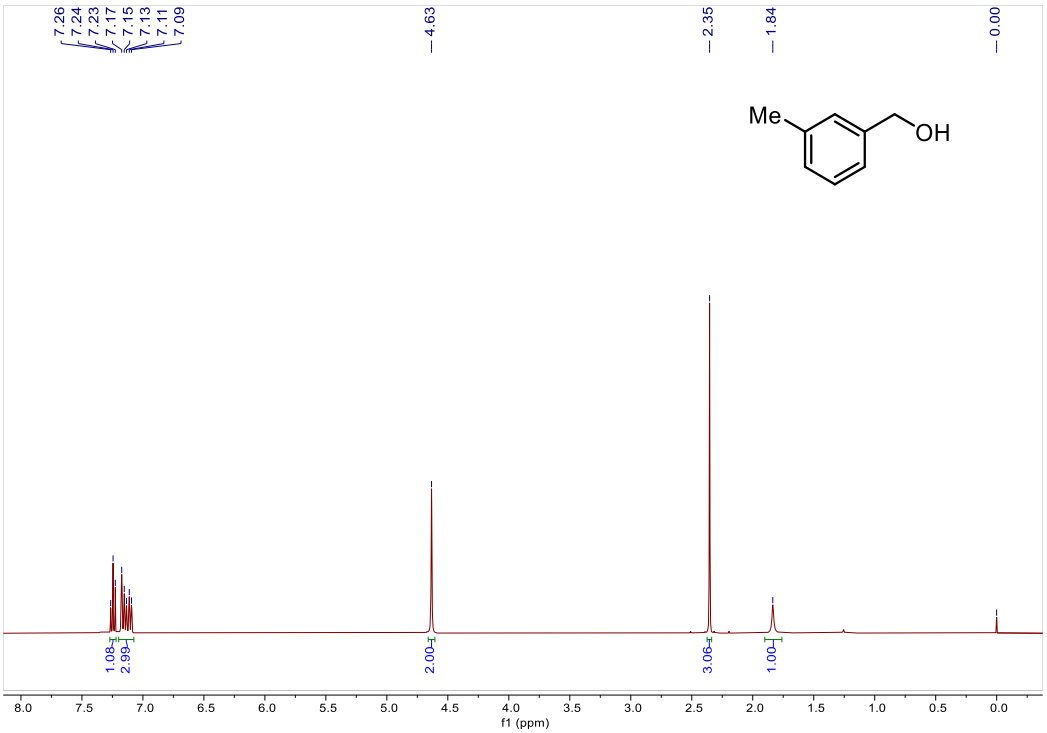
^{13}C{^{1}H} NMR for compound **2g**



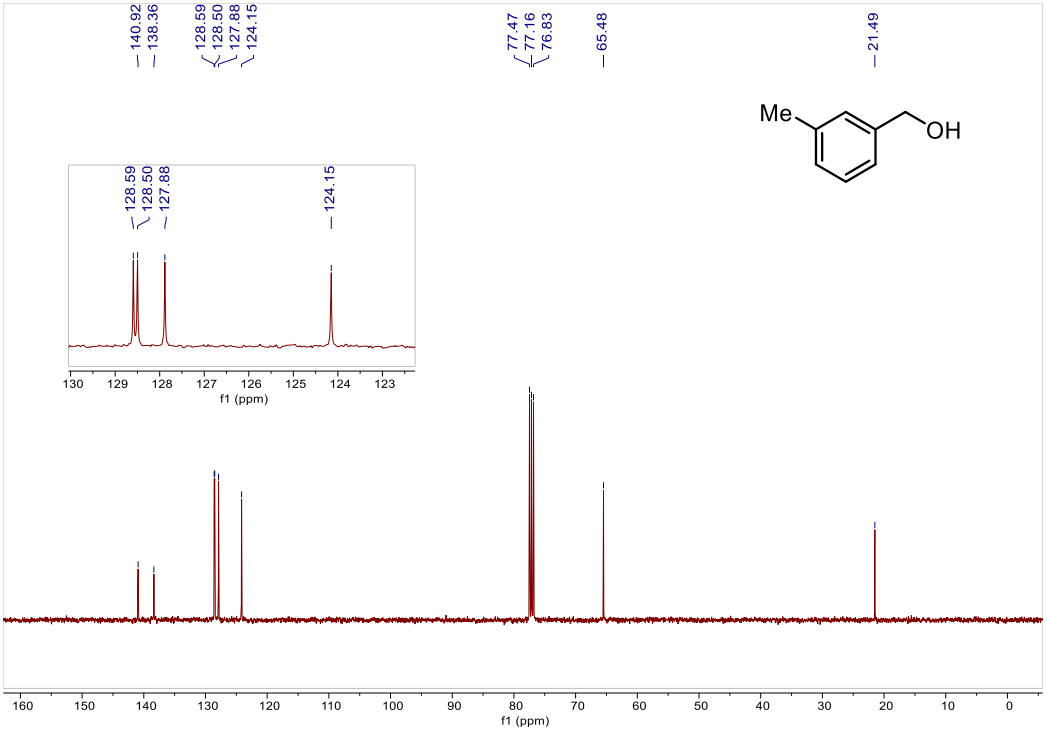
^{1}H NMR for compound **2h**



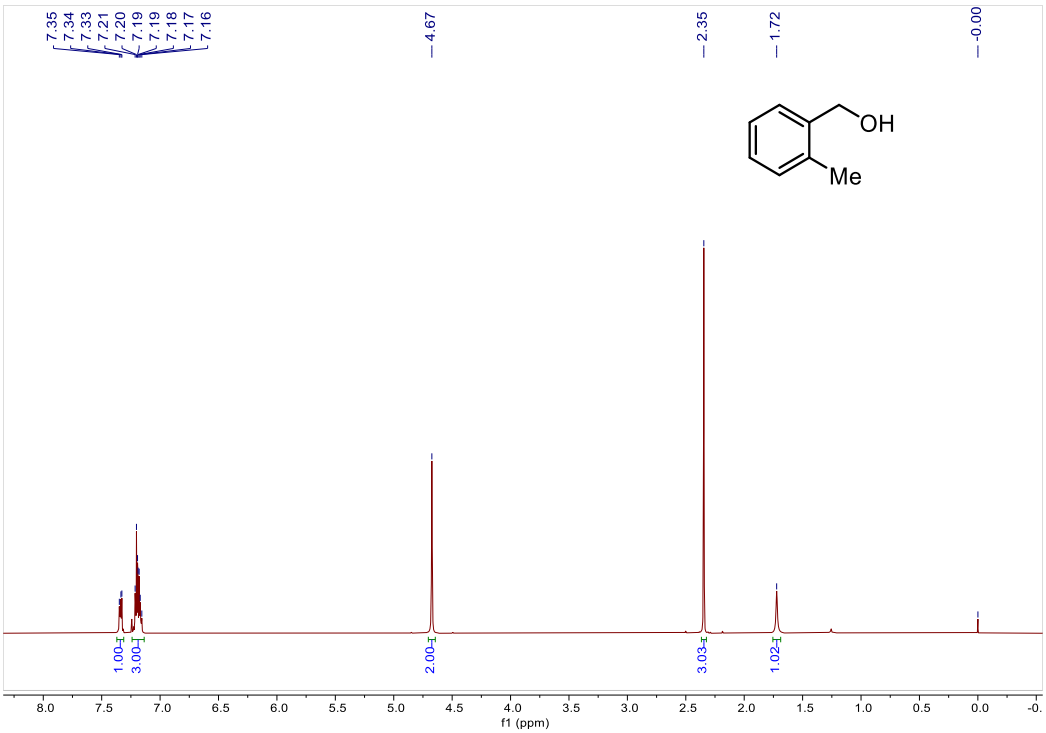
^{13}C{^{1}H} NMR for compound **2h**



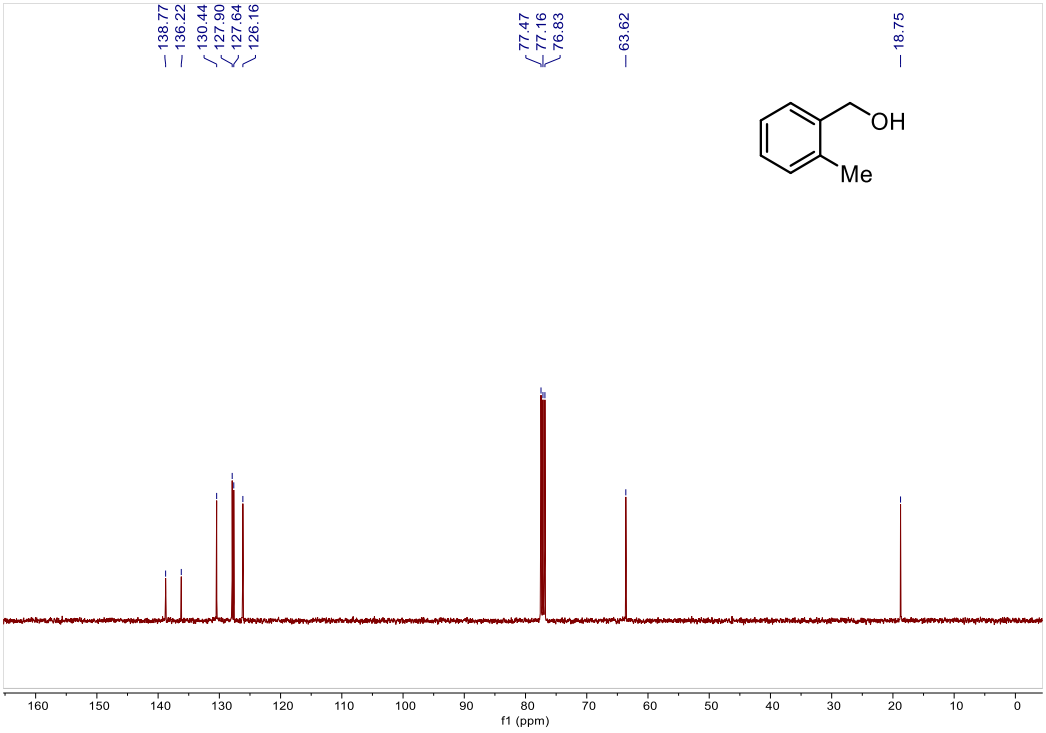
^{1}H NMR for compound **2i**



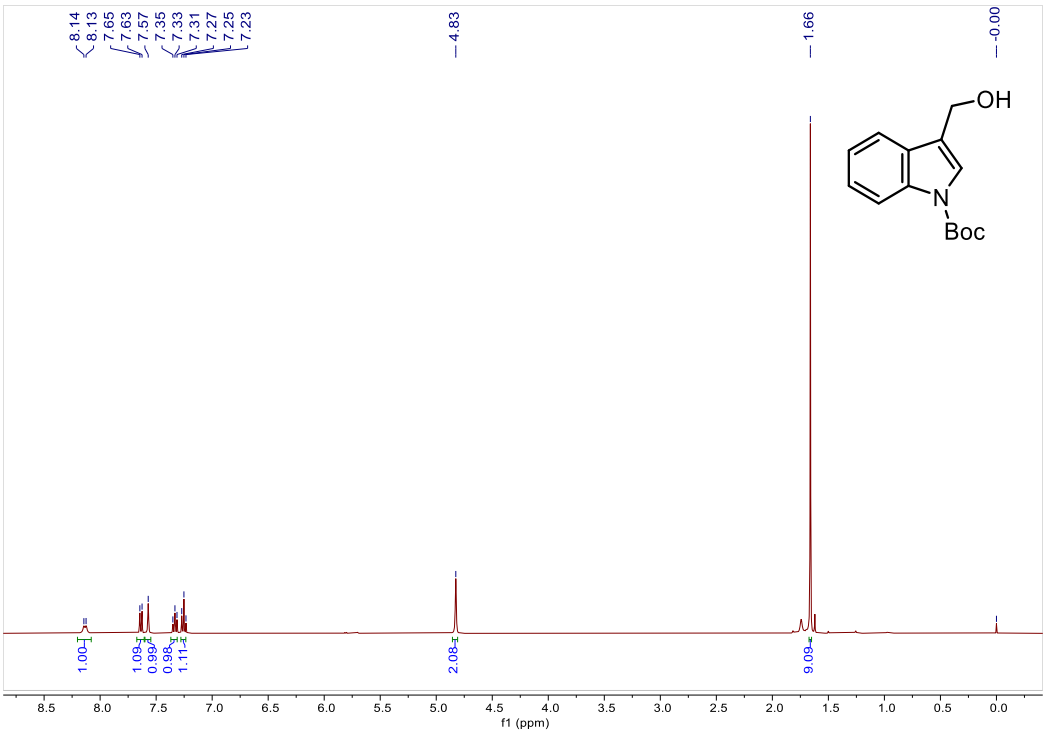
^{13}C{^{1}H} NMR for compound **2i**



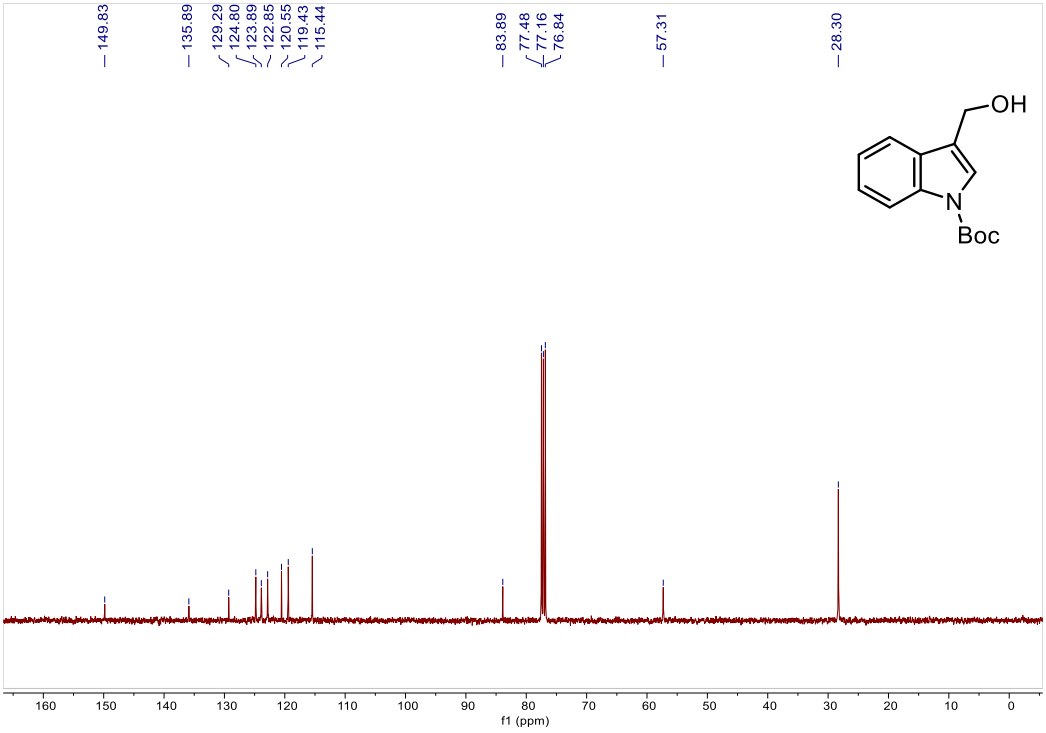
^{1}H NMR for compound **2j**



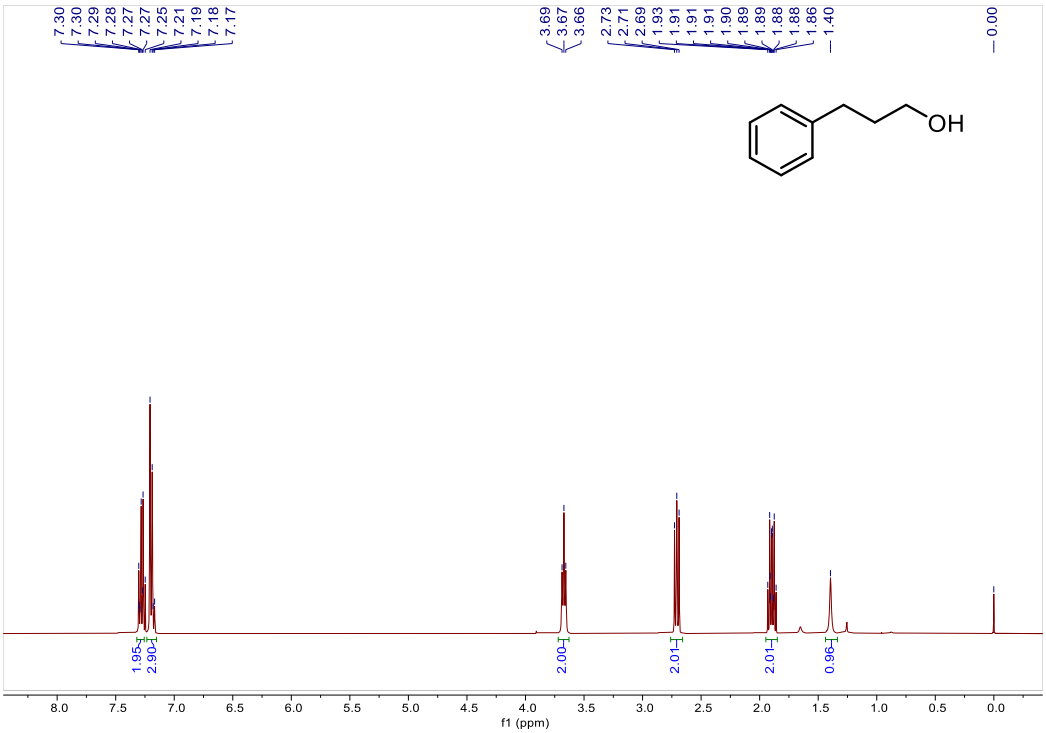
^{13}C{^{1}H} NMR for compound **2j**



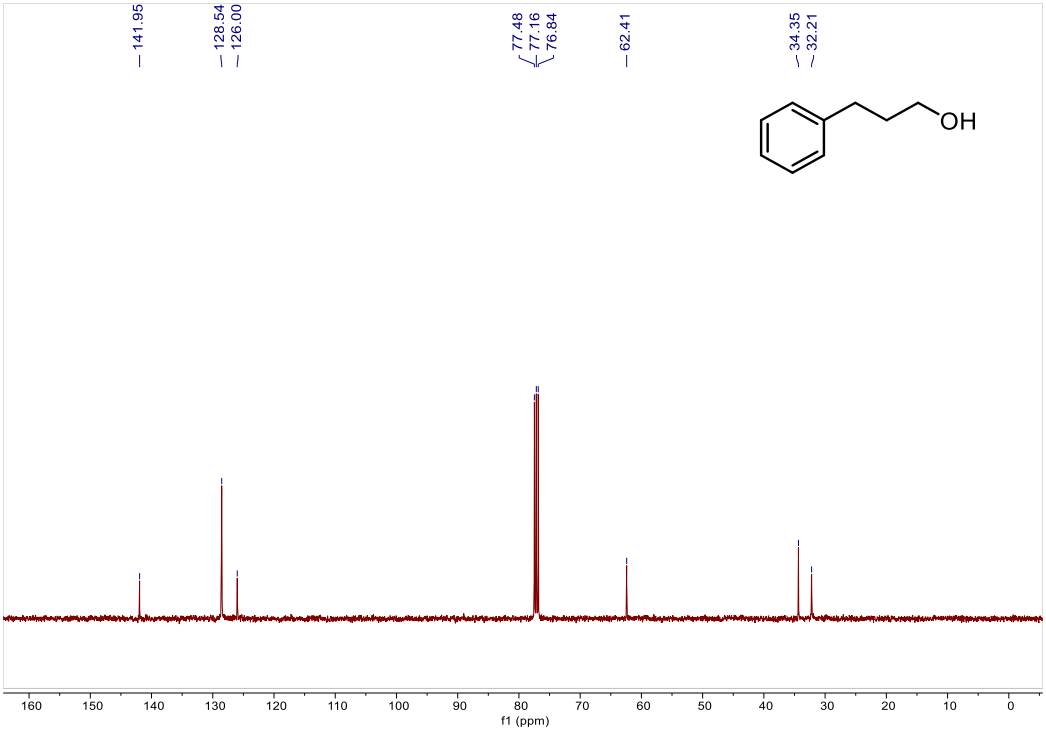
^{1}H NMR for compound **2k**



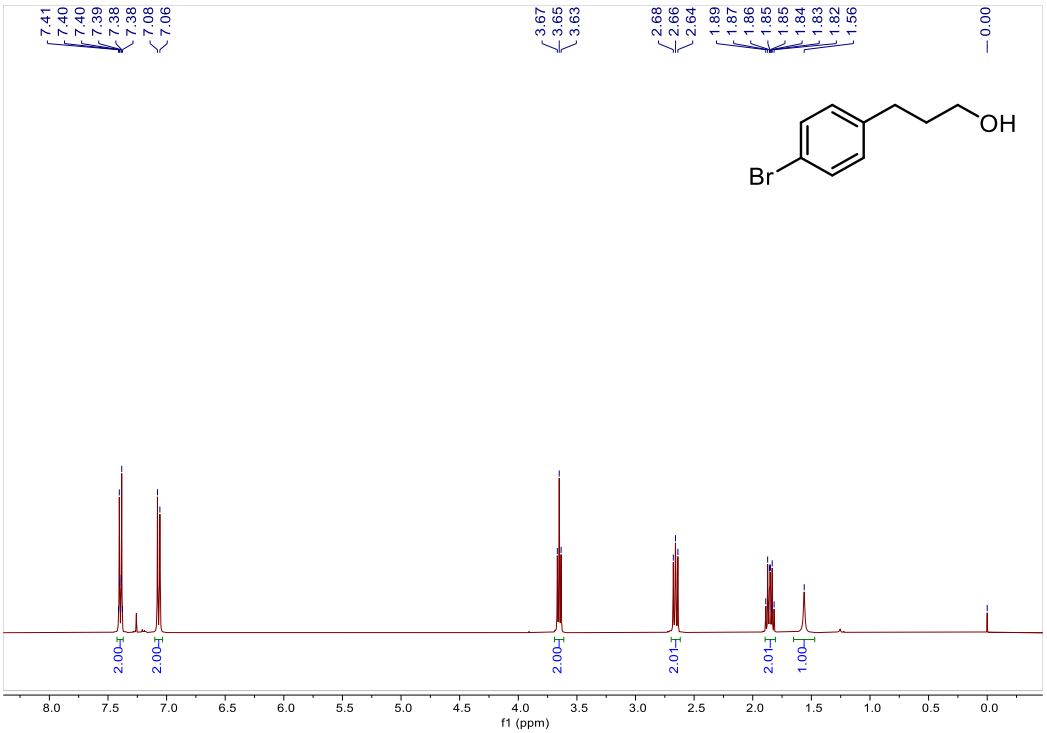
^{13}C{^{1}H} NMR for compound **2k**



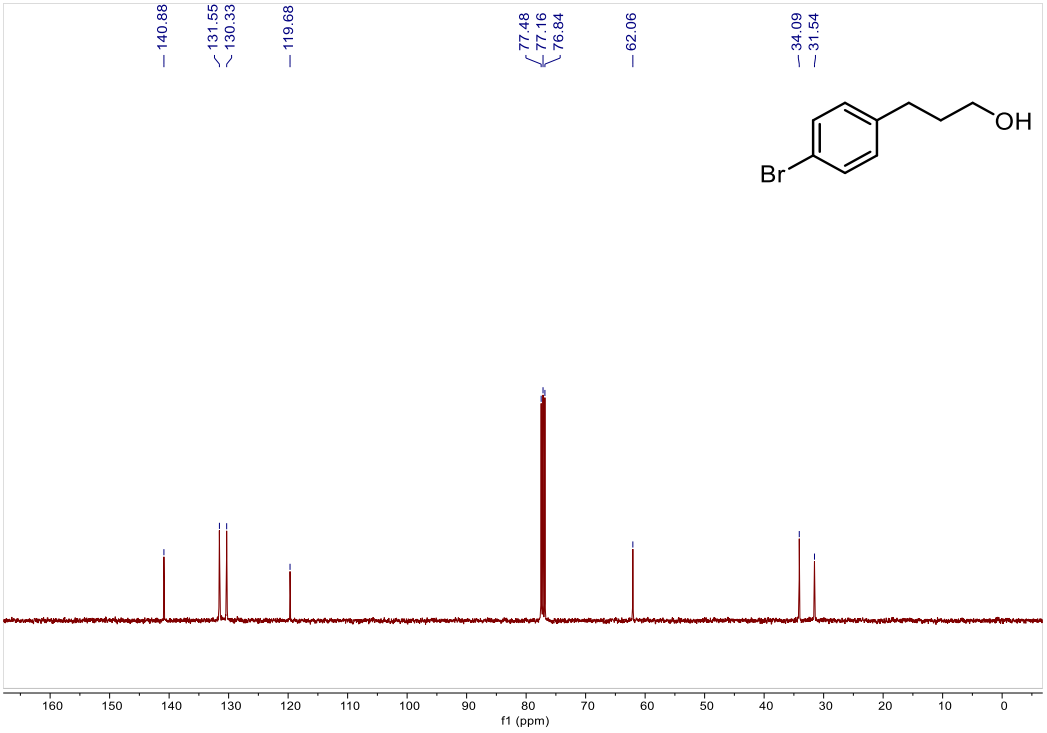
^{1}H NMR for compound **2l**



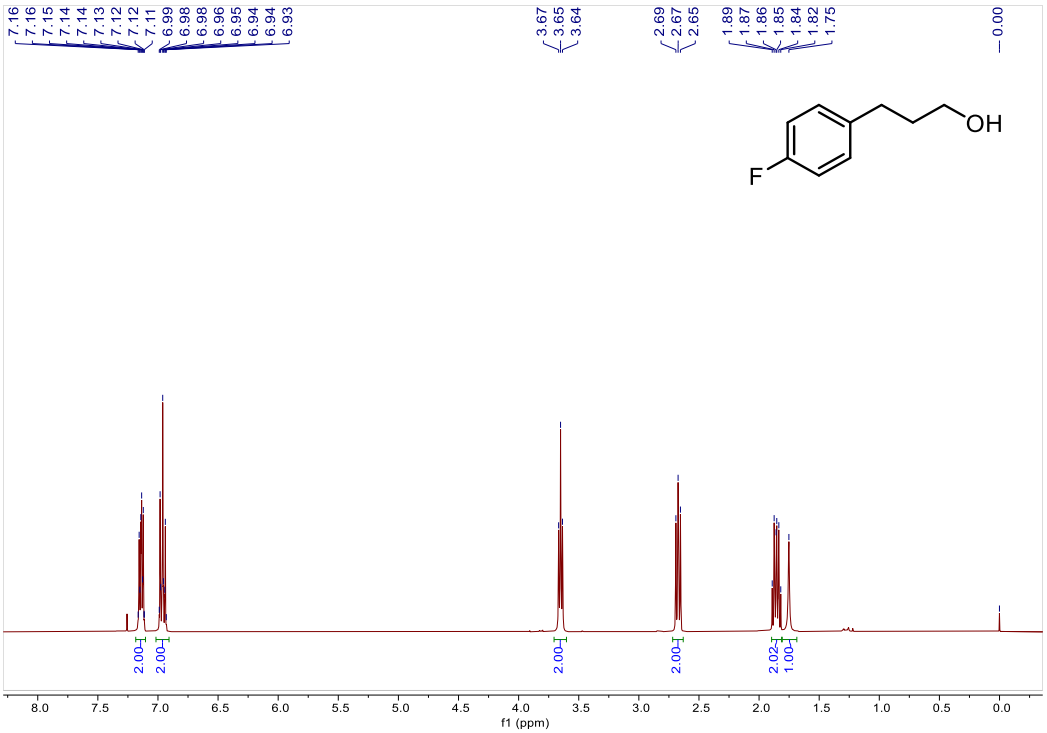
^{13}C{^{1}H} NMR for compound **2l**



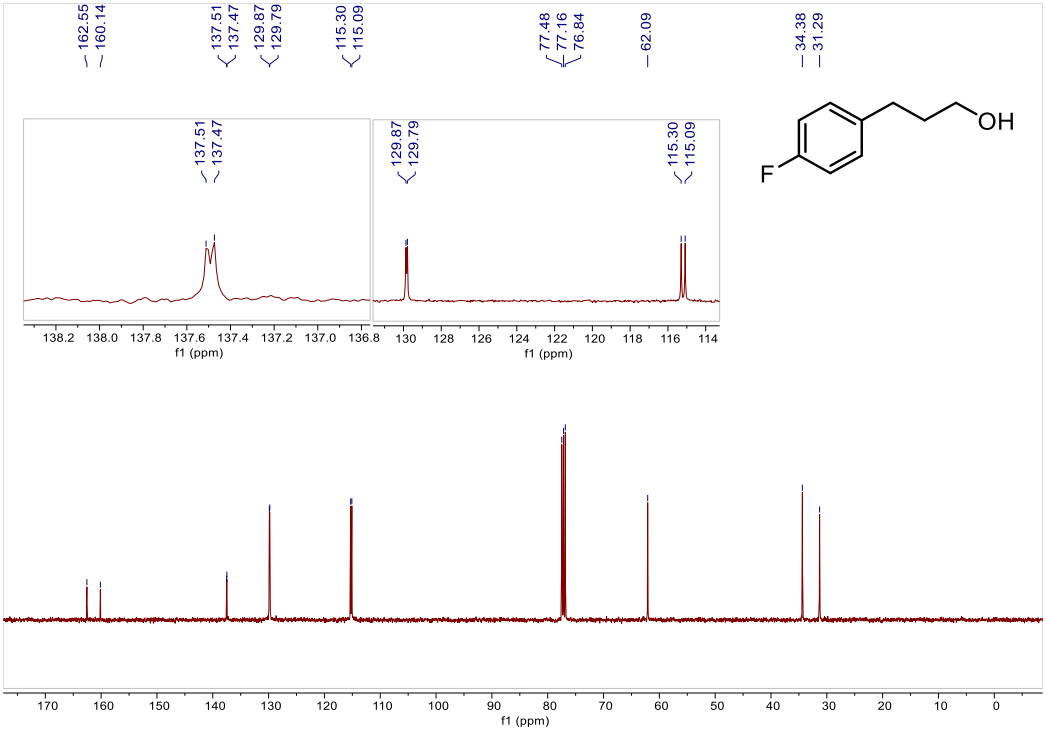
^{1}H NMR for compound **2m**



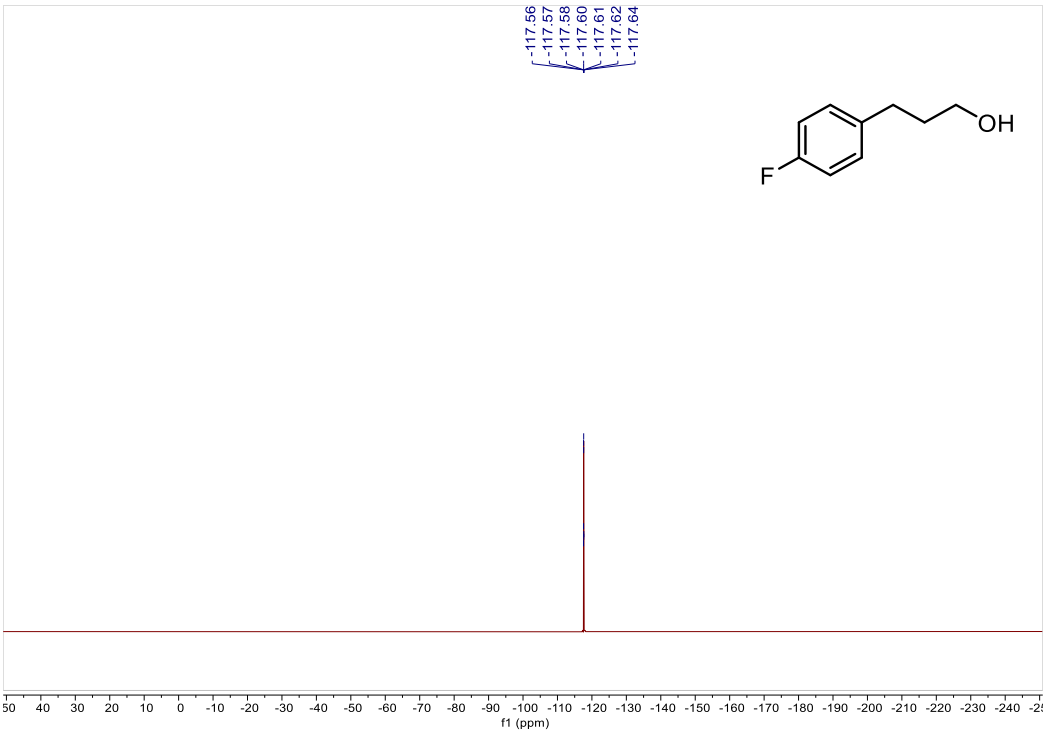
^{13}C{^{1}H} NMR for compound **2m**



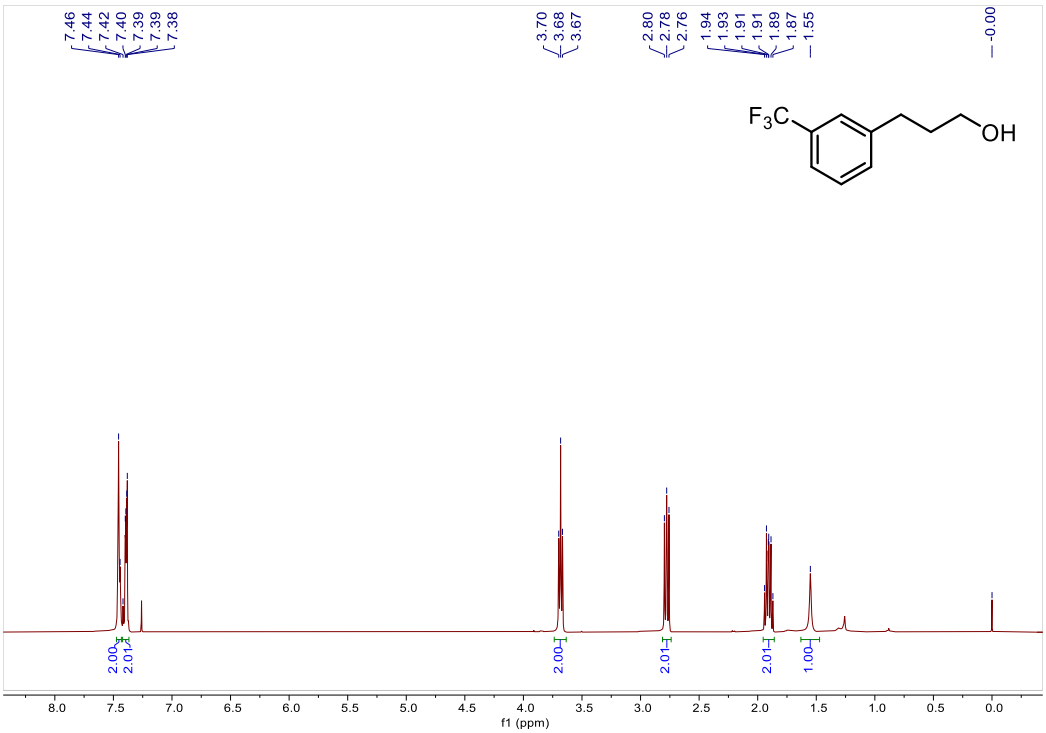
^{1}H NMR for compound **2n**



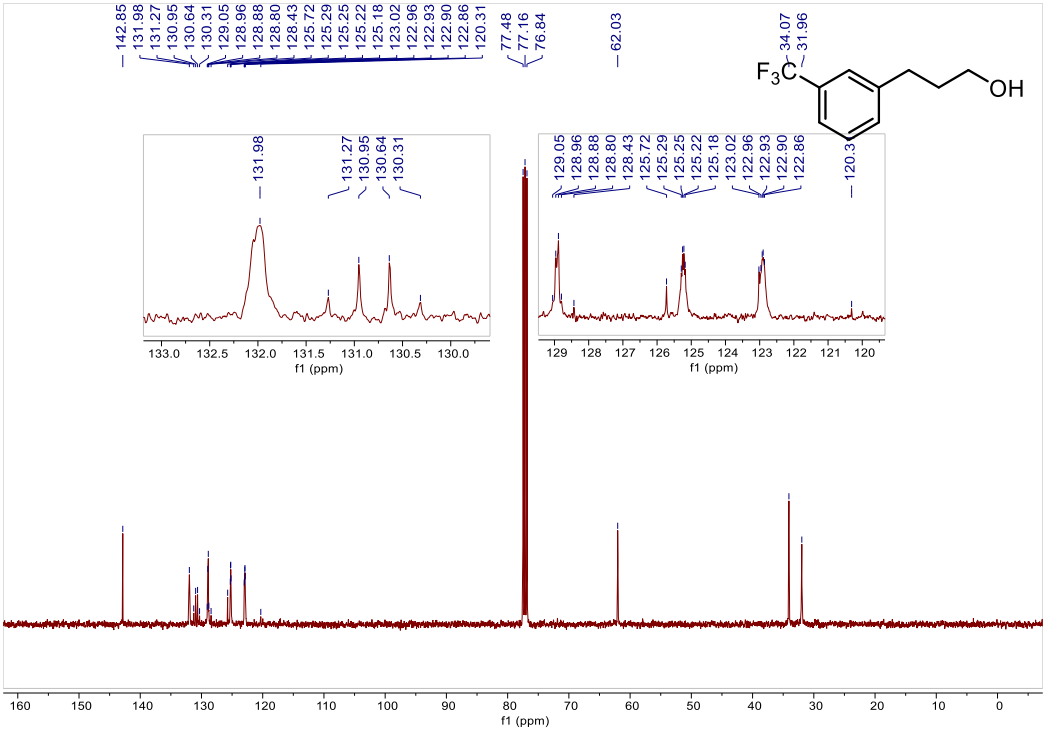
^{13}C{^{1}H} NMR for compound **2n**



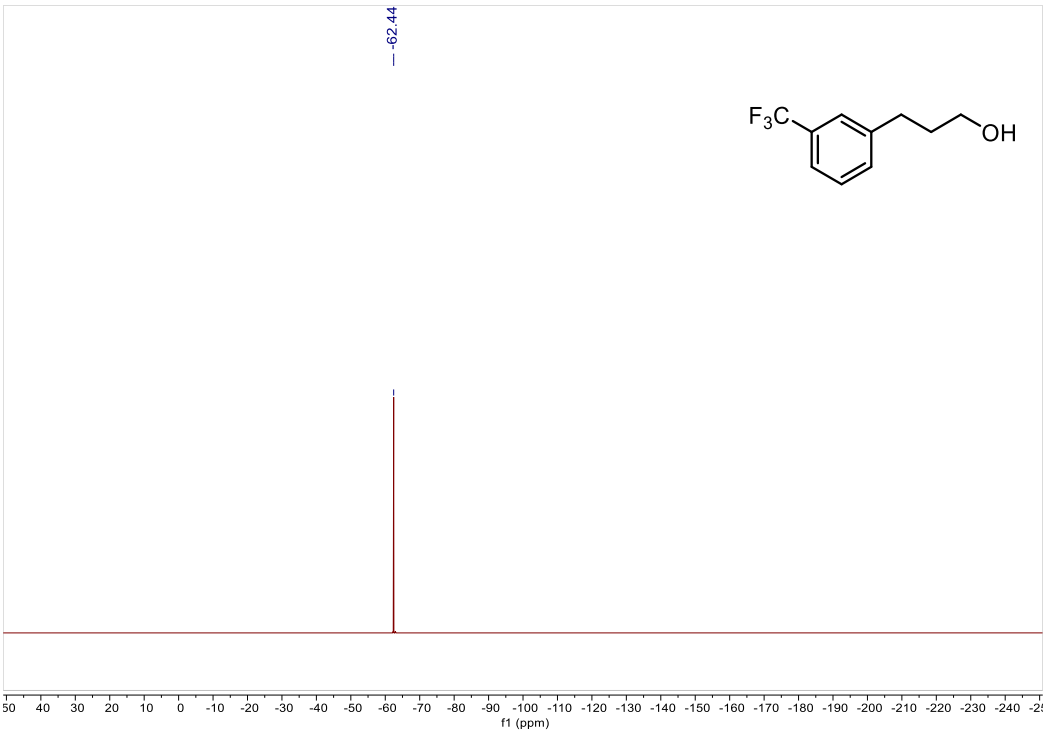
^{19}F NMR for compound **2n**



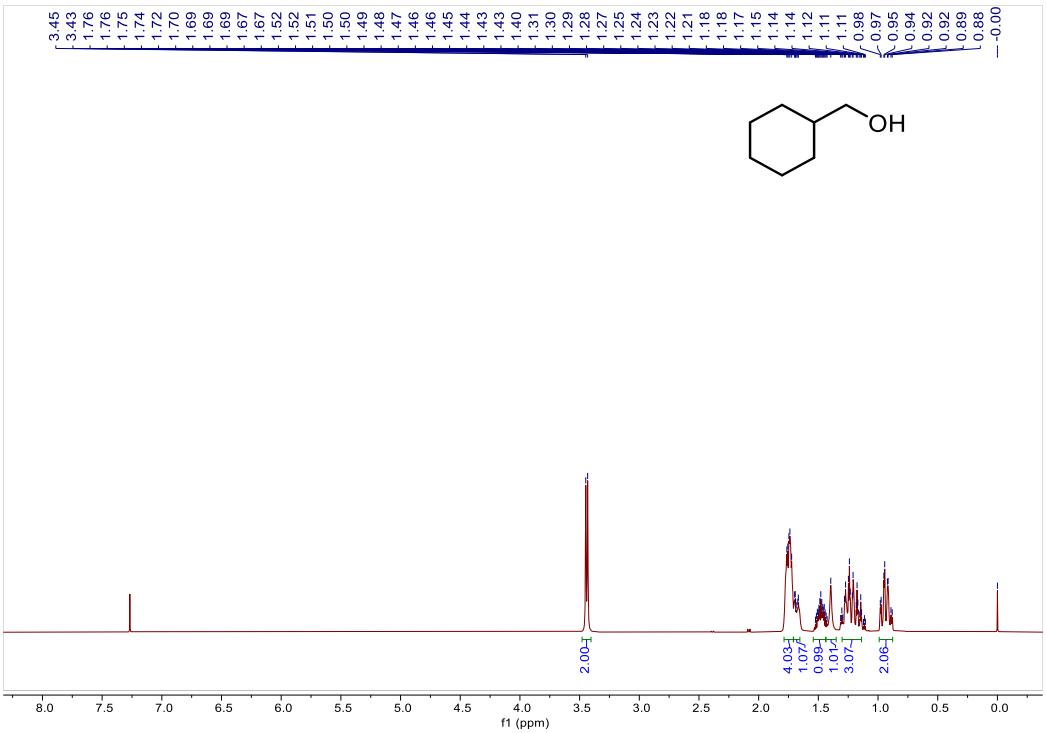
^{1}H NMR for compound **2o**



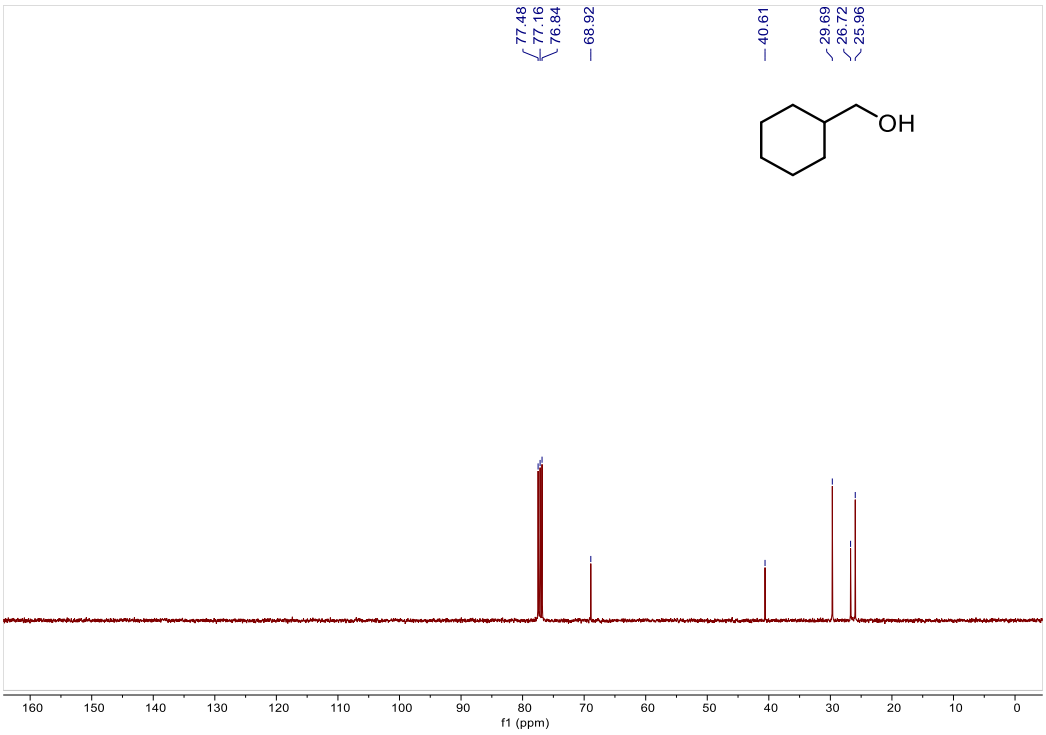
^{13}C{^{1}H} NMR for compound **2o**



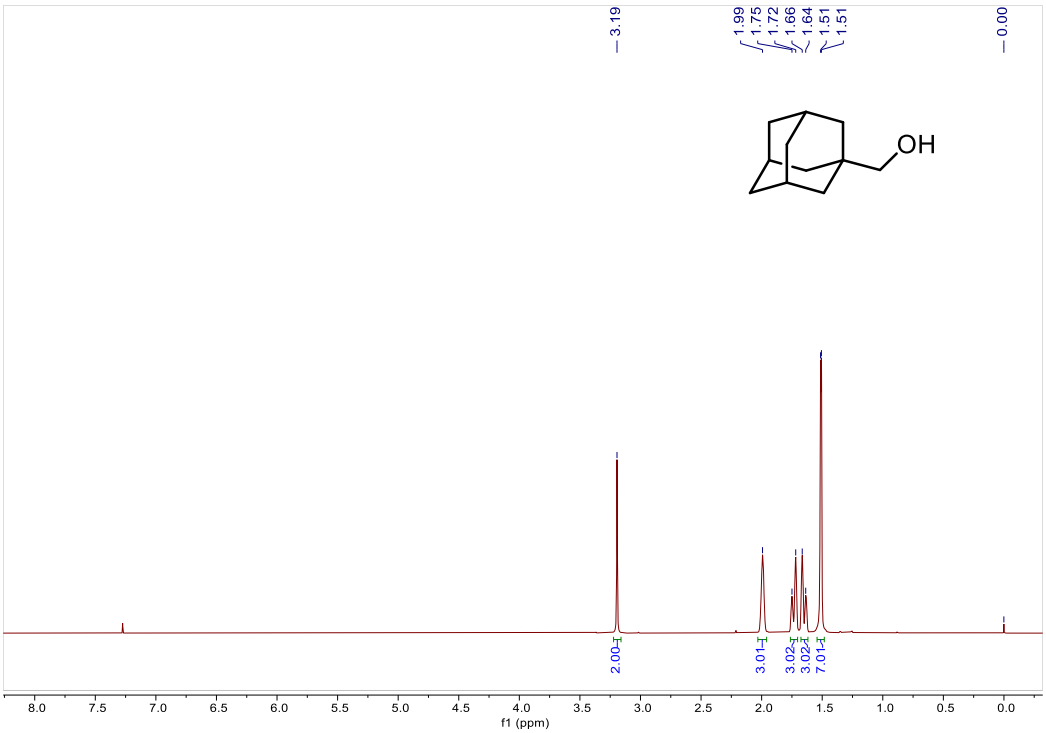
^{19}F NMR for compound **2o**



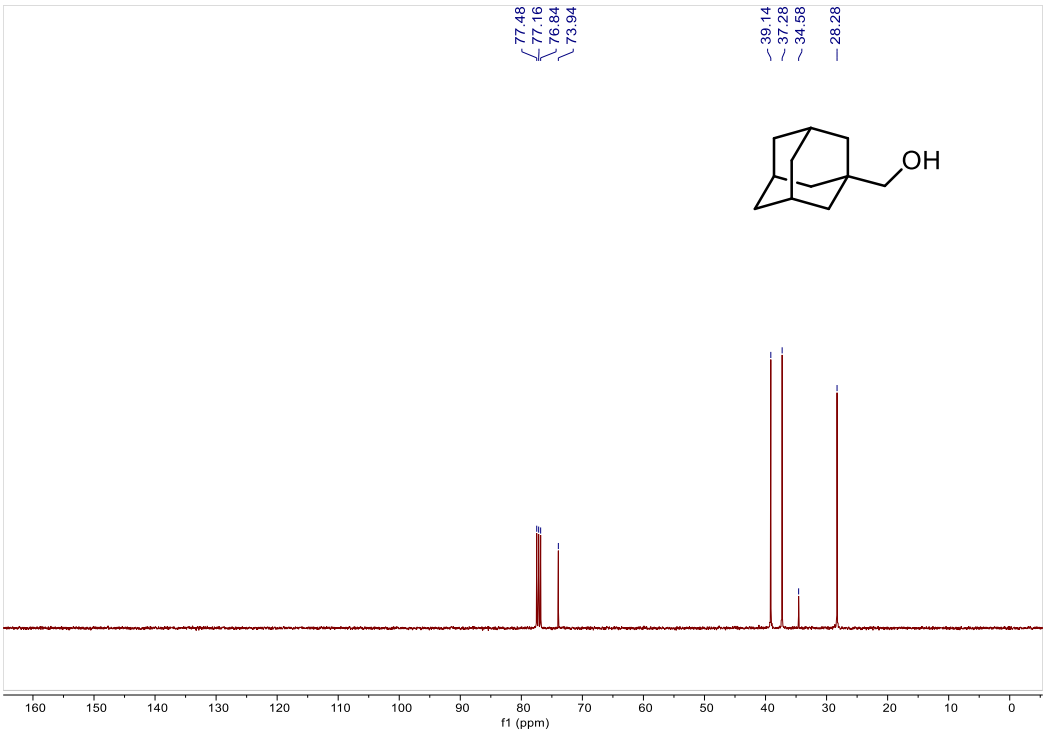
^{1}H NMR for compound **2p**



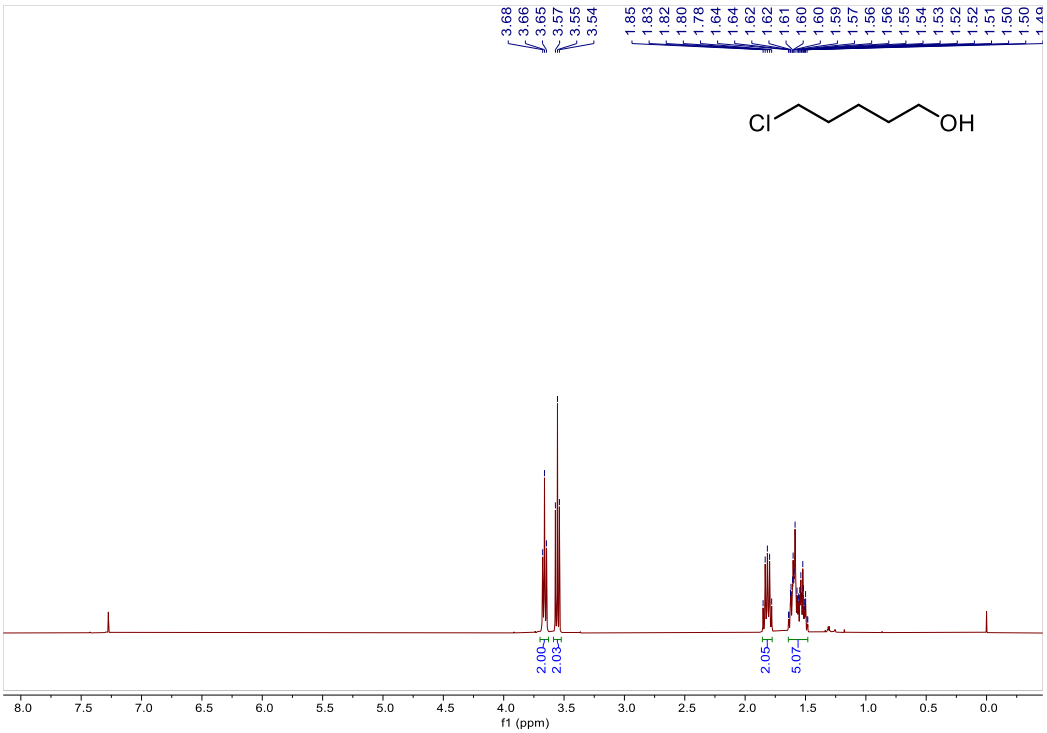
^{13}C{^{1}H} NMR for compound **2p**



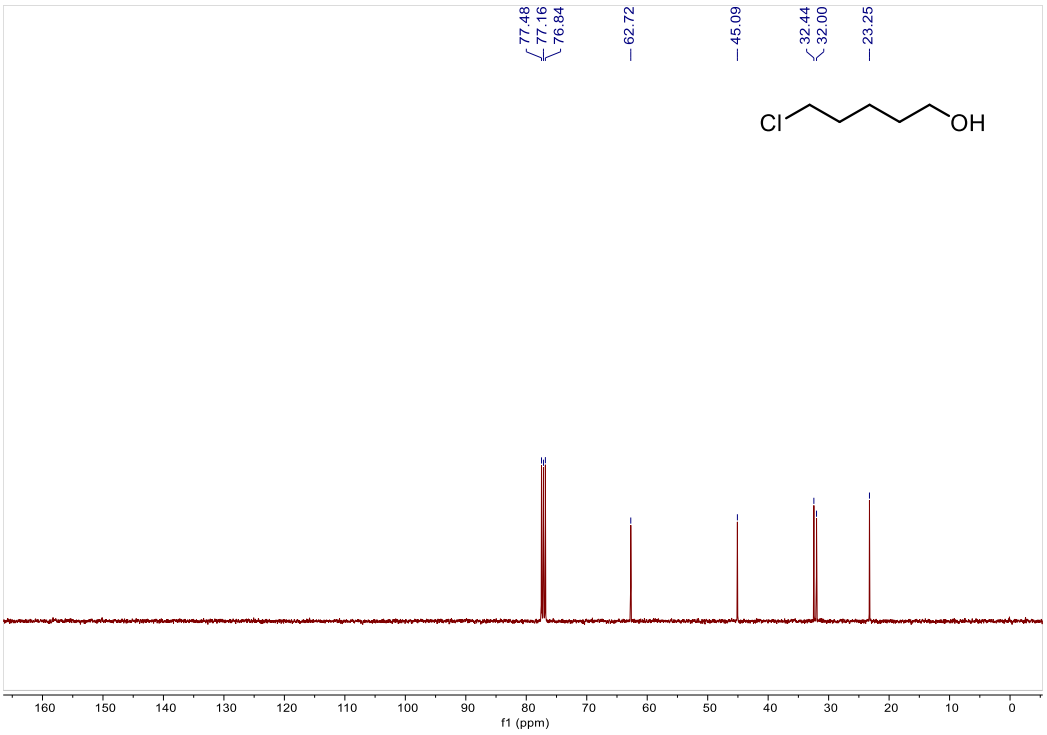
^{1}H NMR for compound **2q**



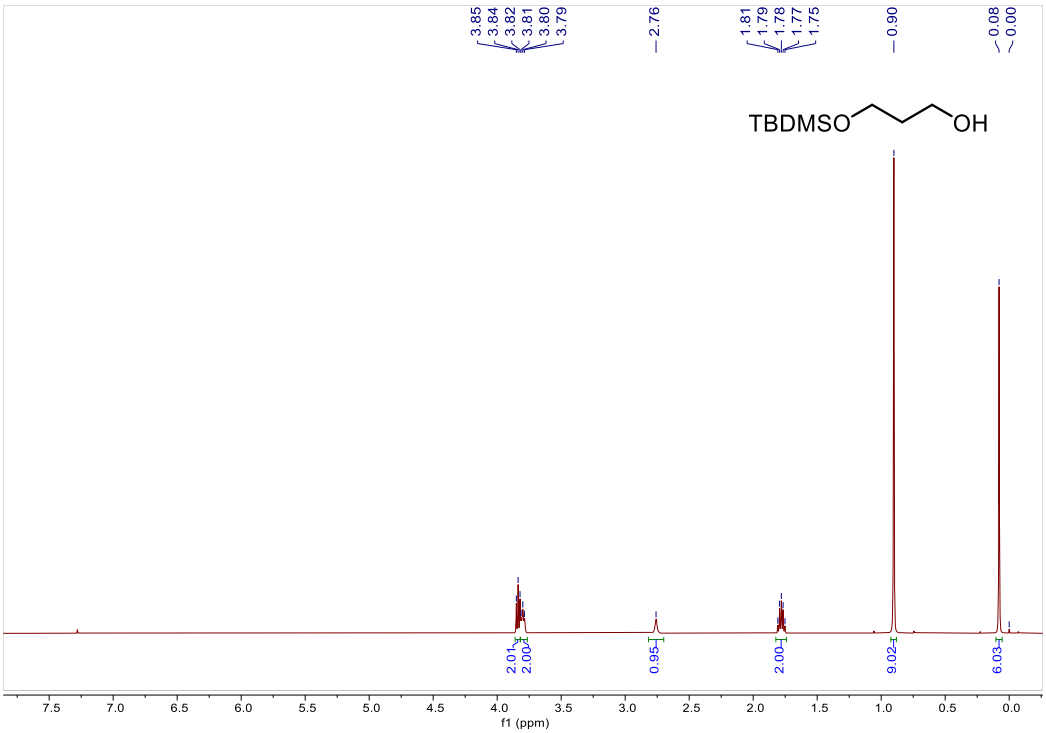
^{13}C{^{1}H} NMR for compound **2q**



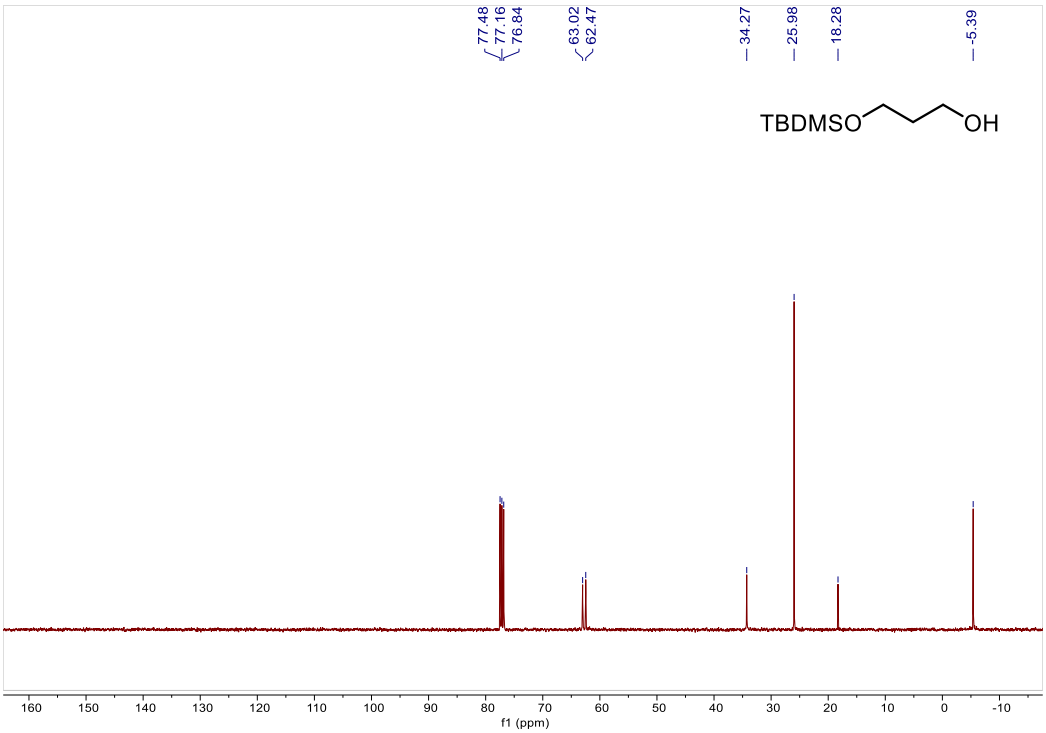
^{1}H NMR for compound **2r**



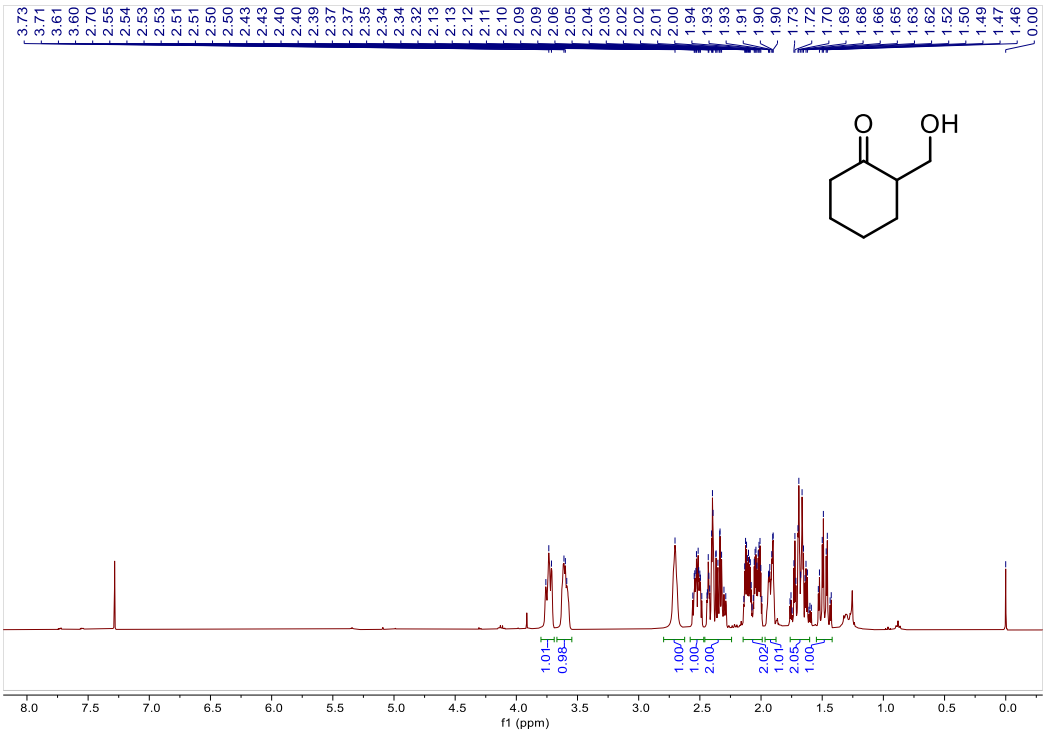
^{13}C{^{1}H} NMR for compound **2r**



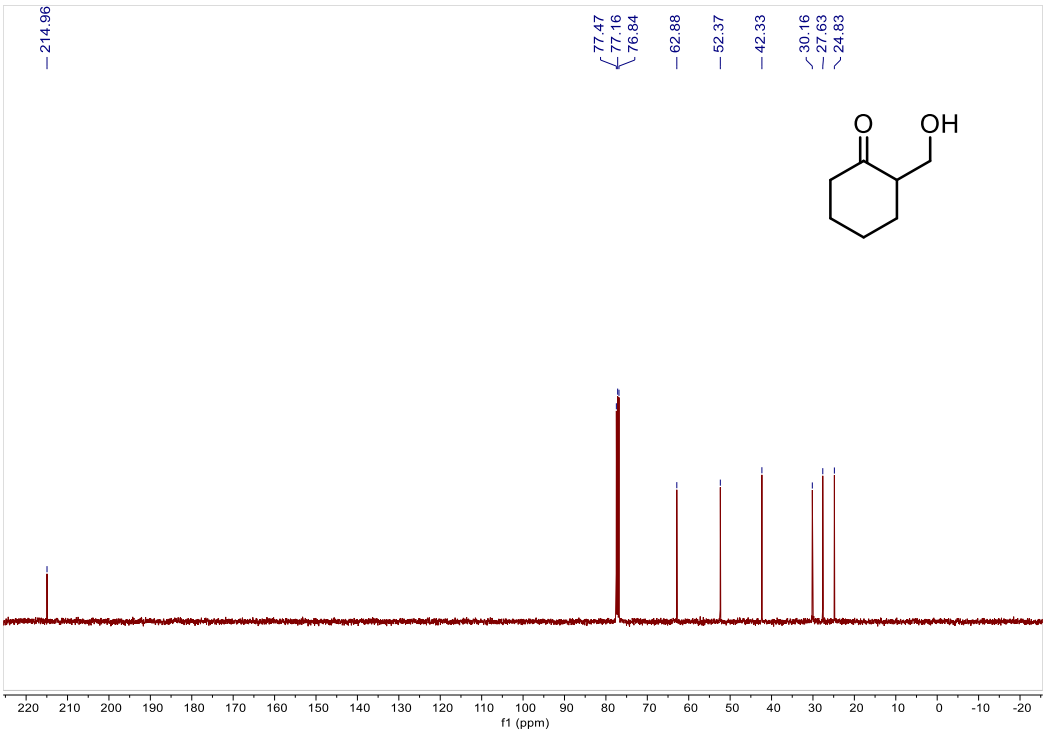
^{1}H NMR for compound **2s**



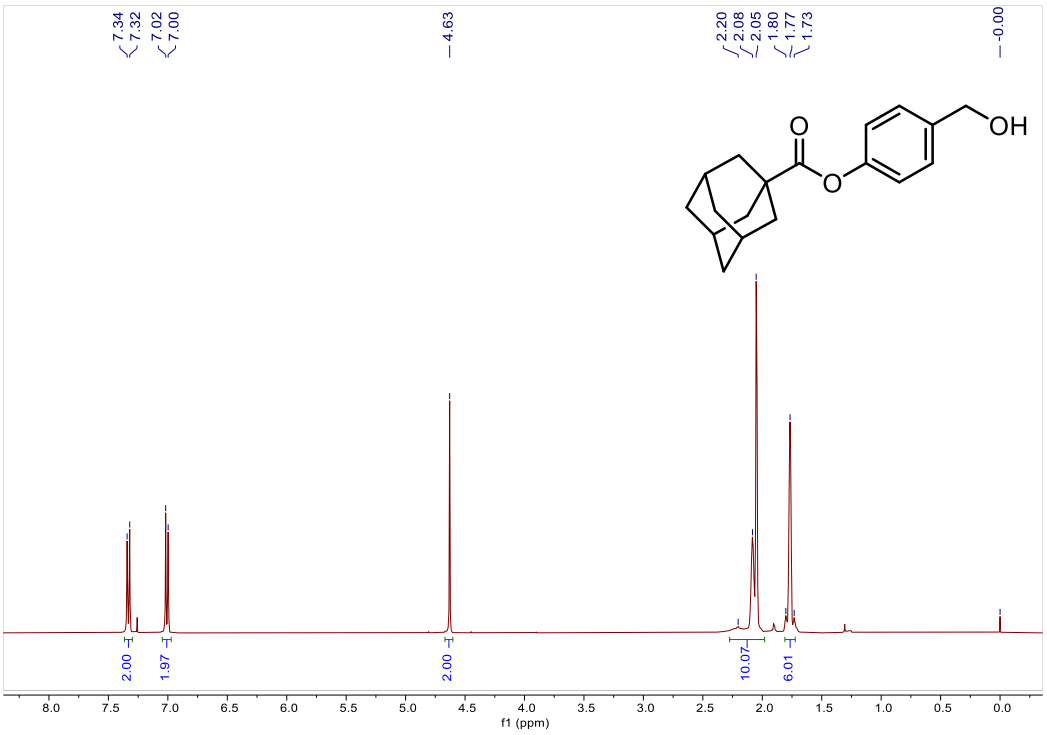
^{13}C{^{1}H} NMR for compound **2s**



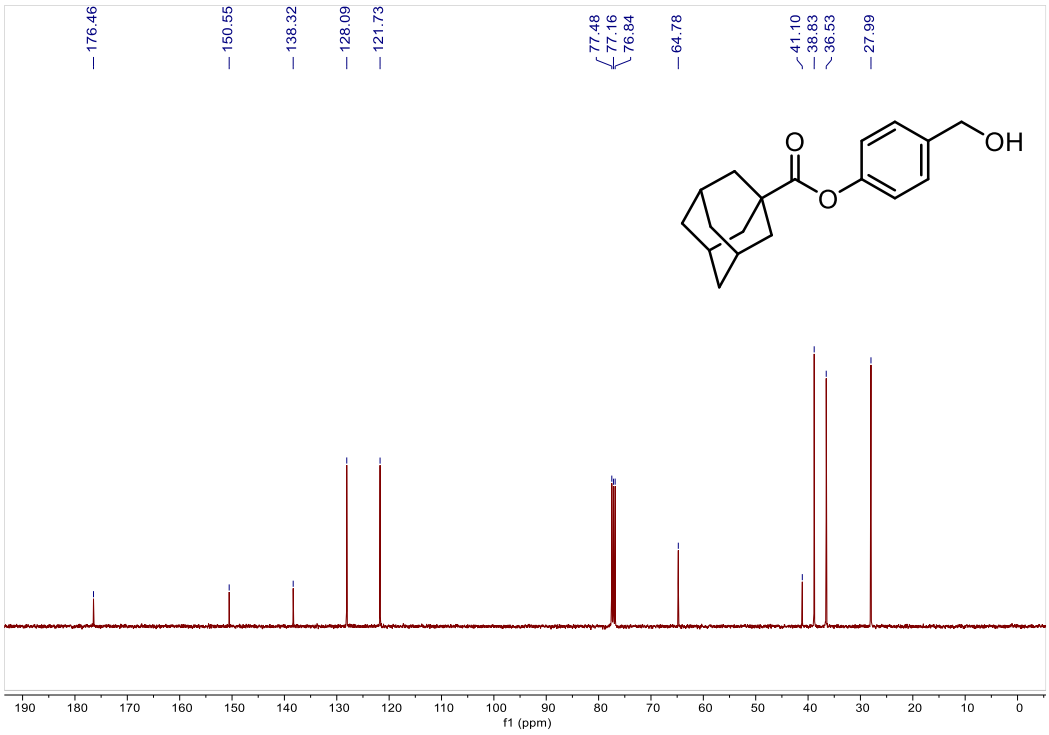
^{1}H NMR for compound **2t**



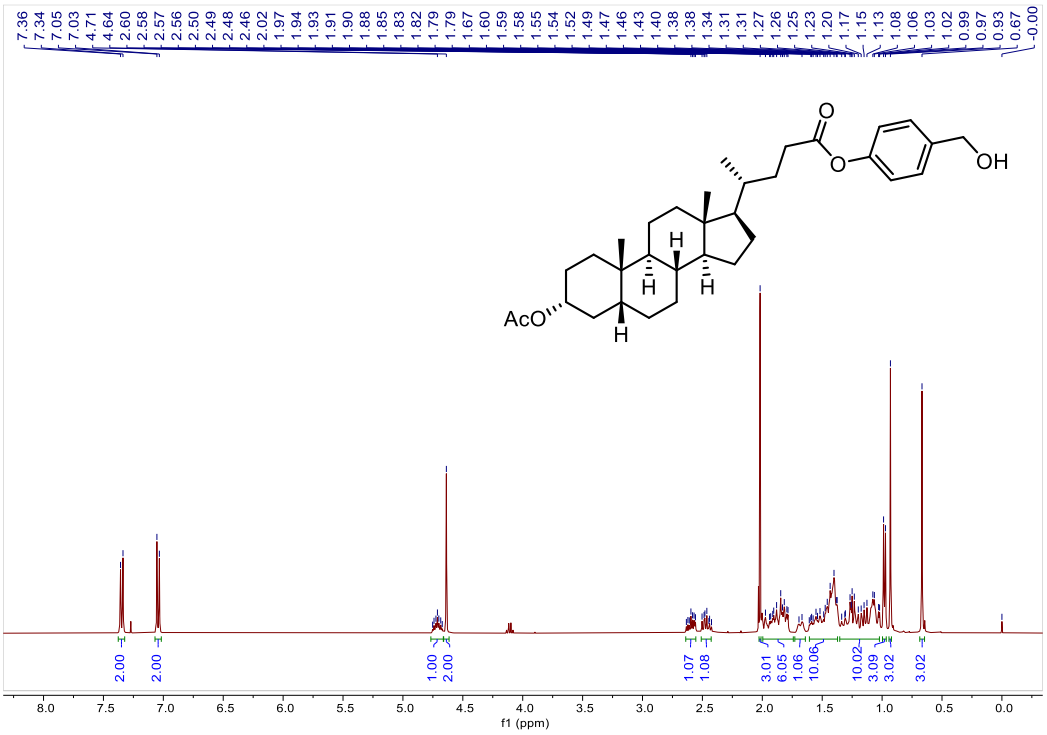
^{13}C{^{1}H} NMR for compound **2t**



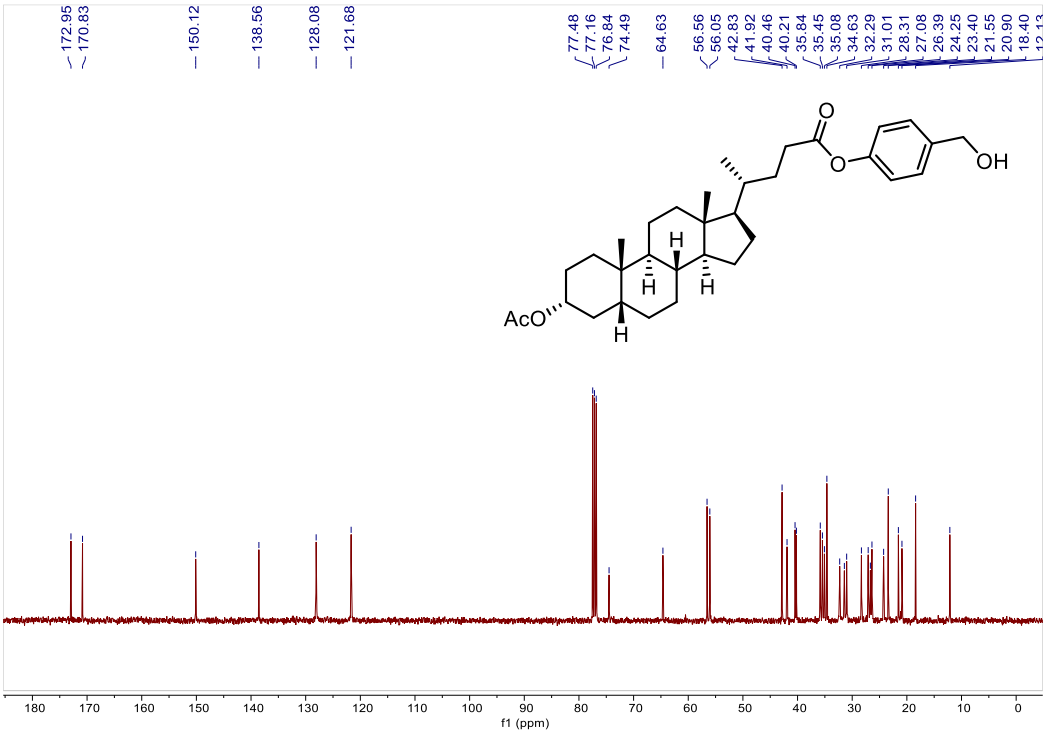
^{1}H NMR for compound **2u**



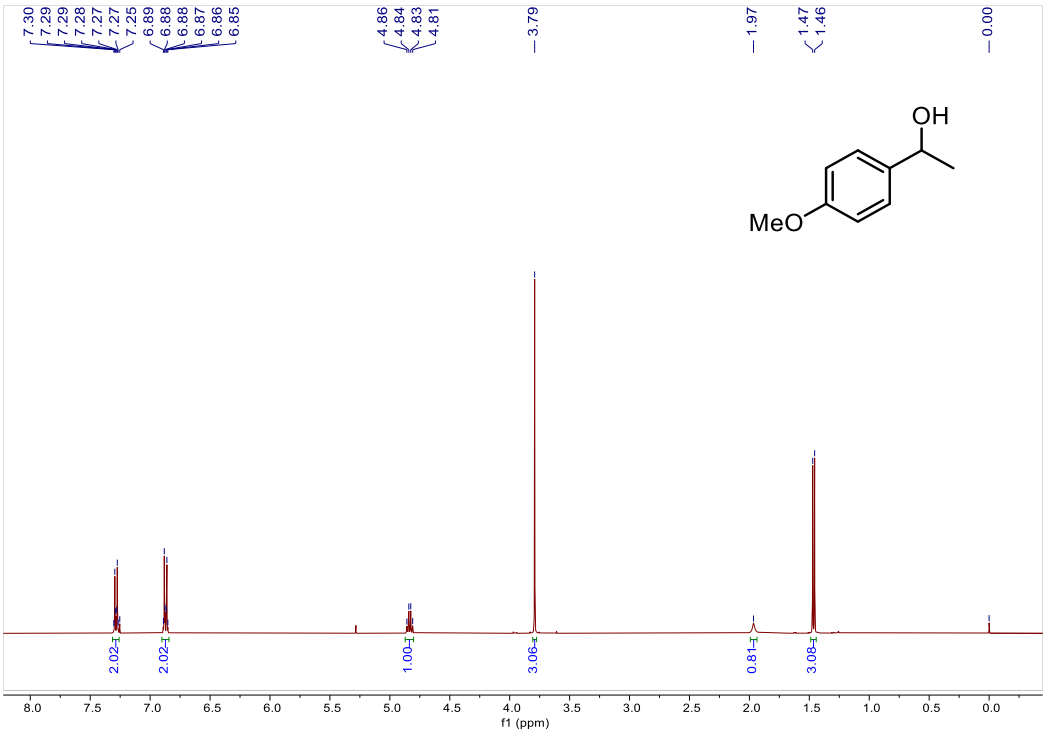
^{13}C{^{1}H} NMR for compound **2u**



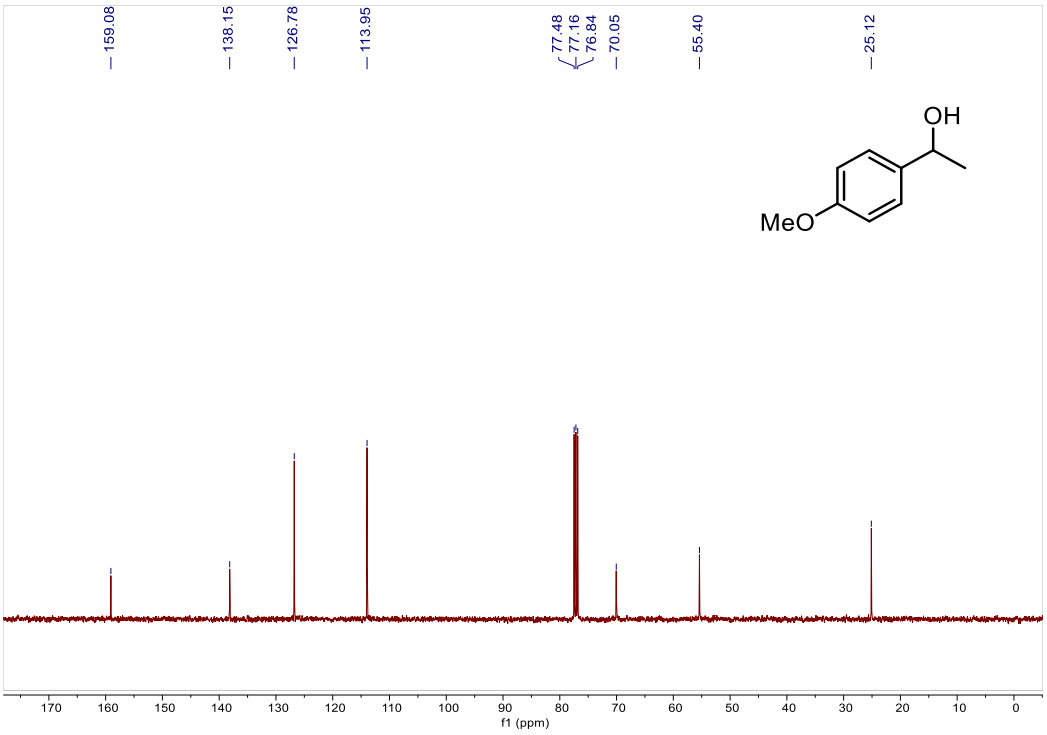
^{1}H NMR for compound **2v**



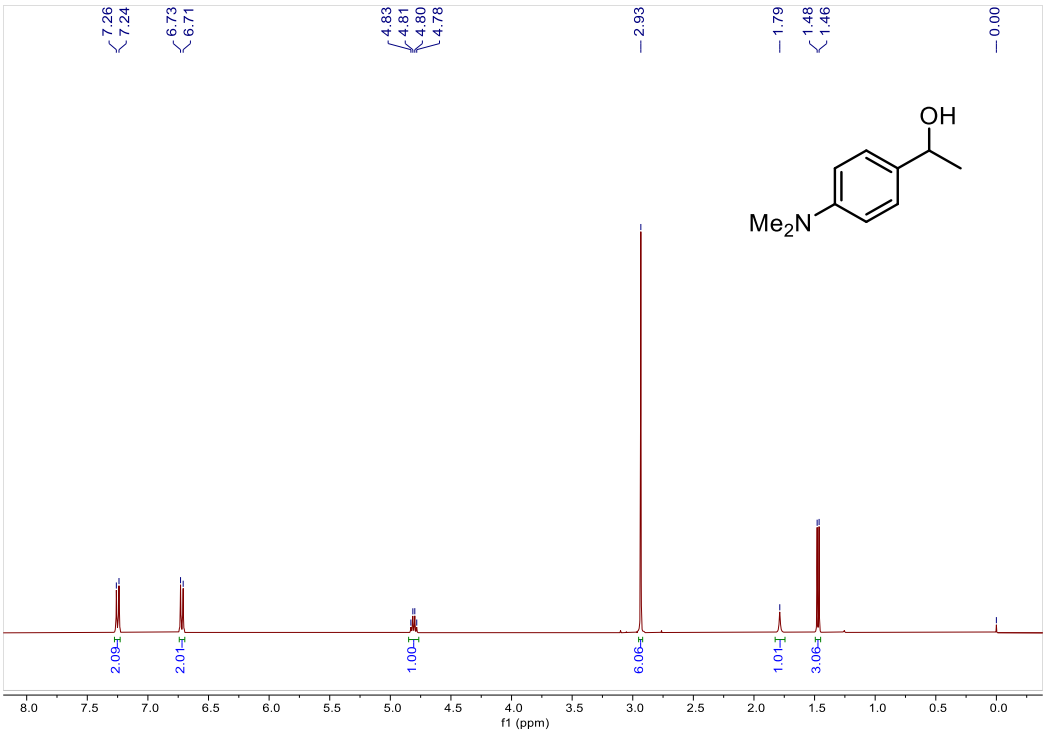
^{13}C{^{1}H} NMR for compound **2v**



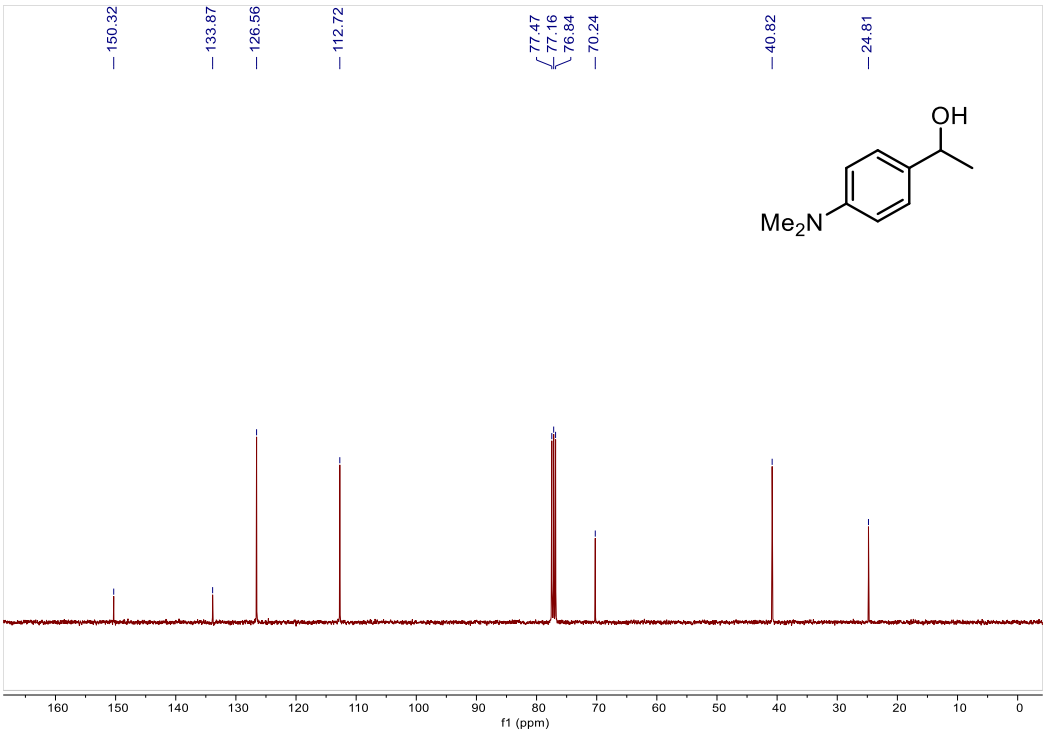
^{1}H NMR for compound **2w**



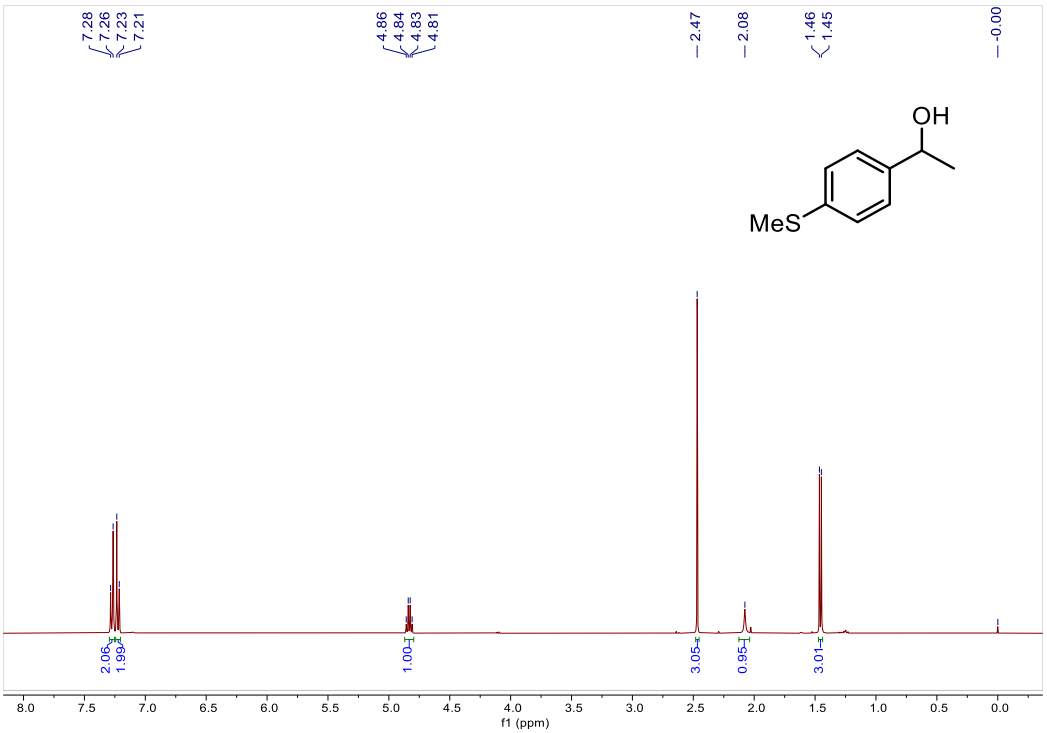
^{13}C{^{1}H} NMR for compound **2w**



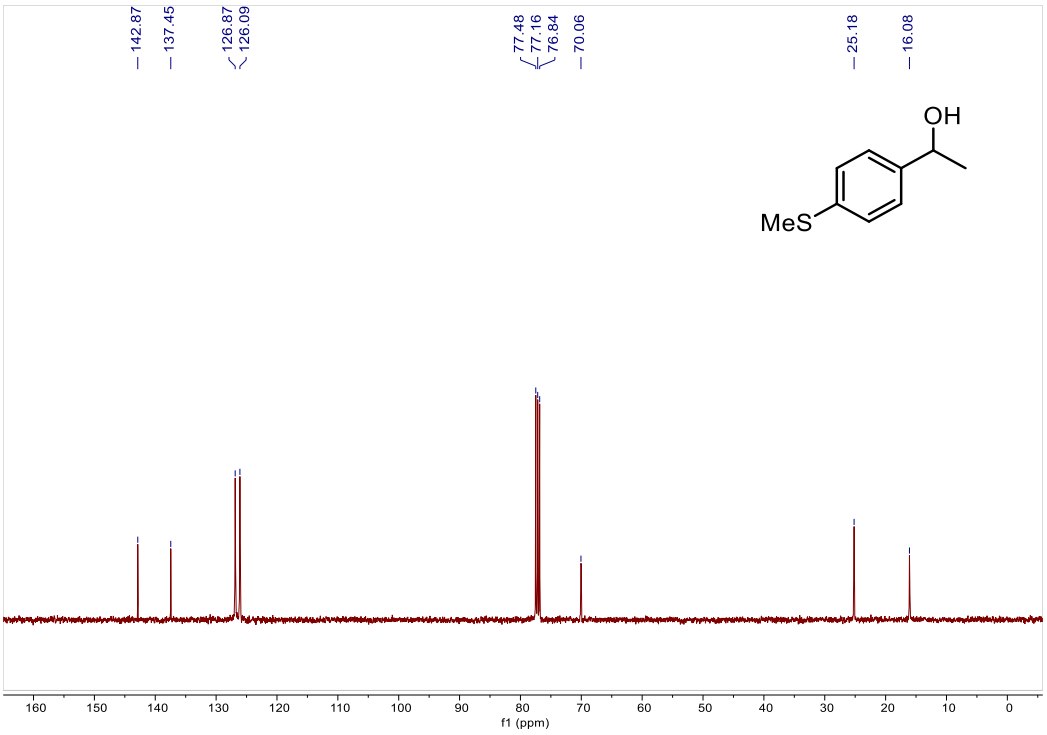
^{1}H NMR for compound **2x**



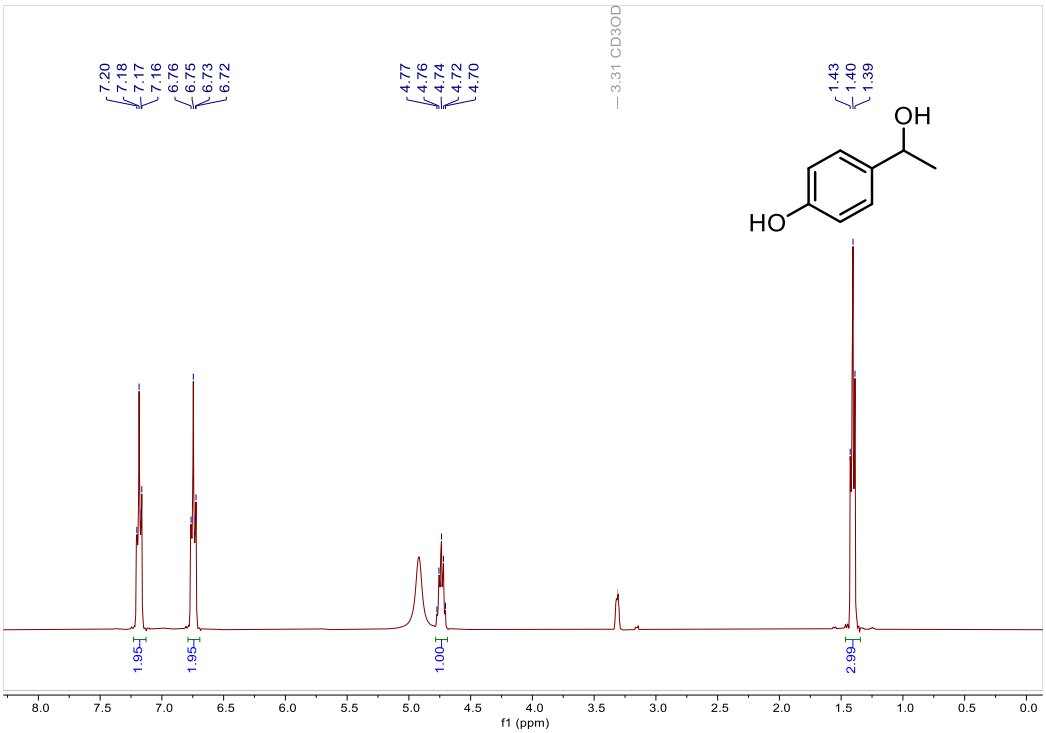
^{13}C{^{1}H} NMR for compound **2x**



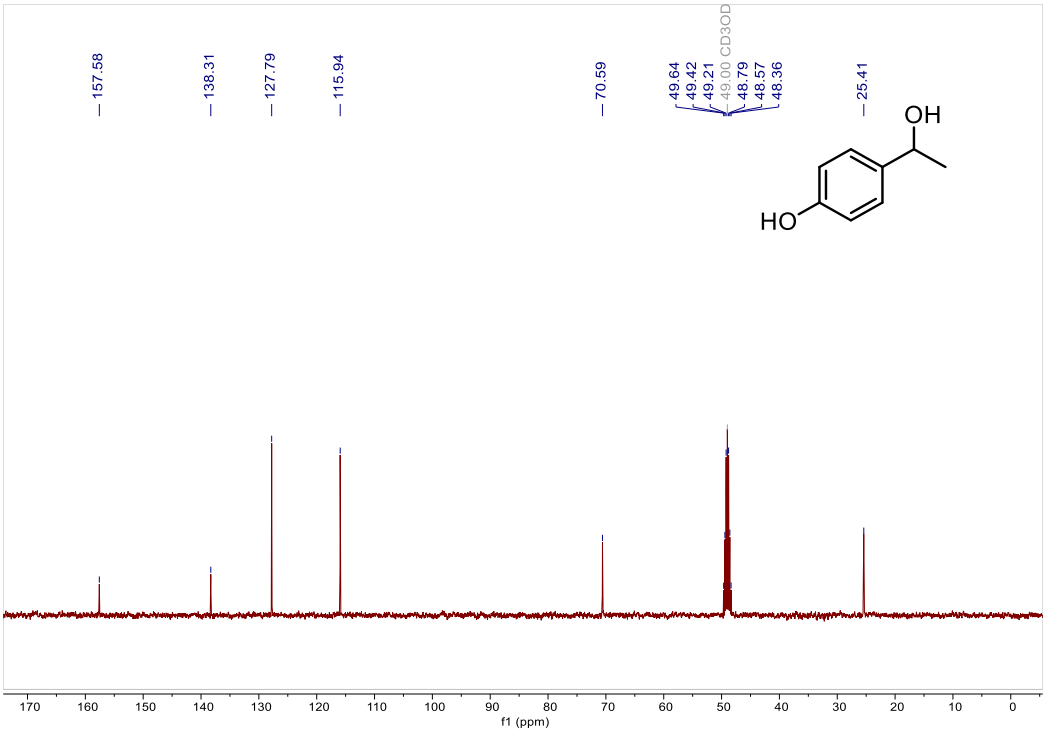
^{1}H NMR for compound **2y**



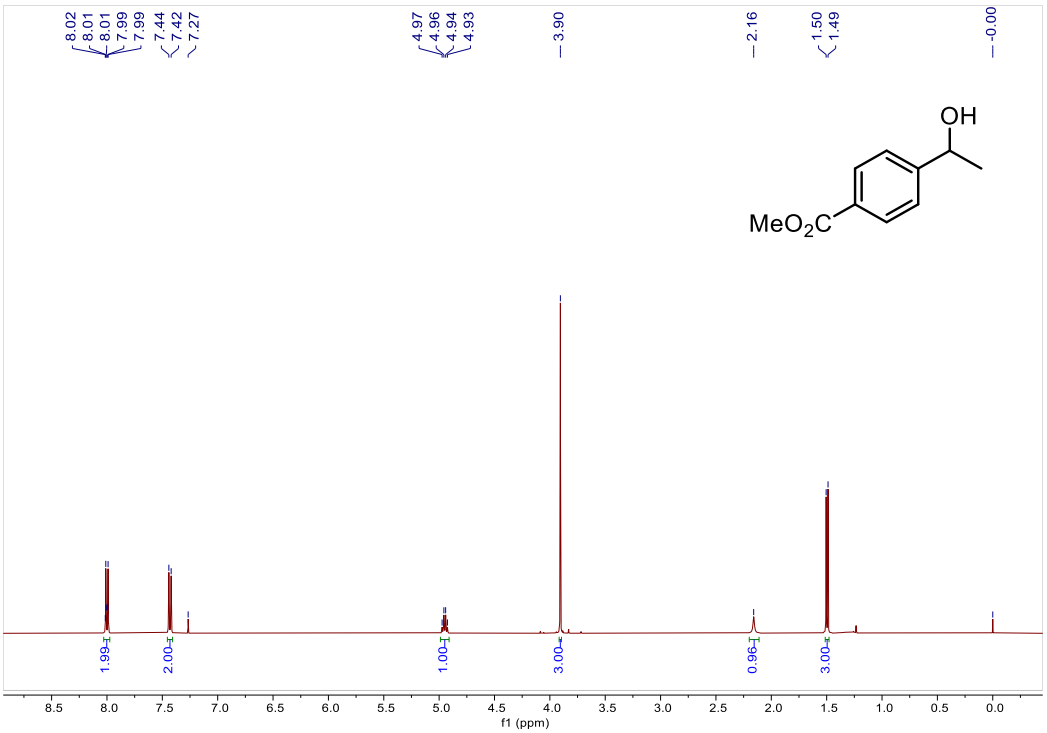
^{13}C{^{1}H} NMR for compound **2y**



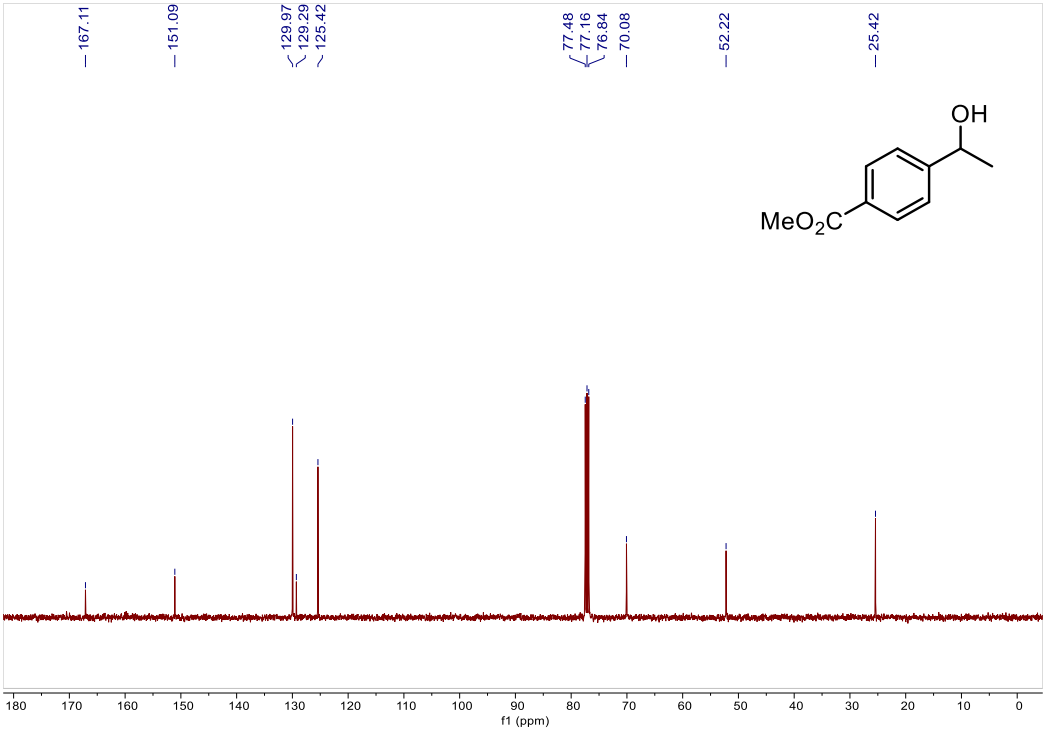
^{1}H NMR for compound **2z**



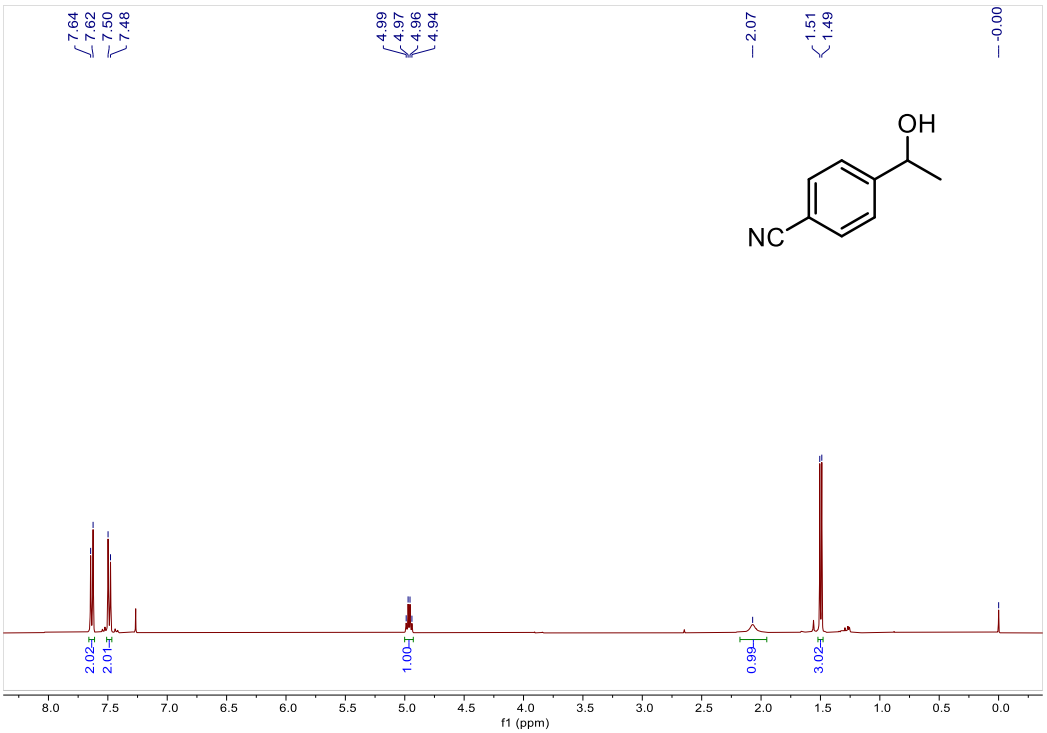
^{13}C{^{1}H} NMR for compound **2z**



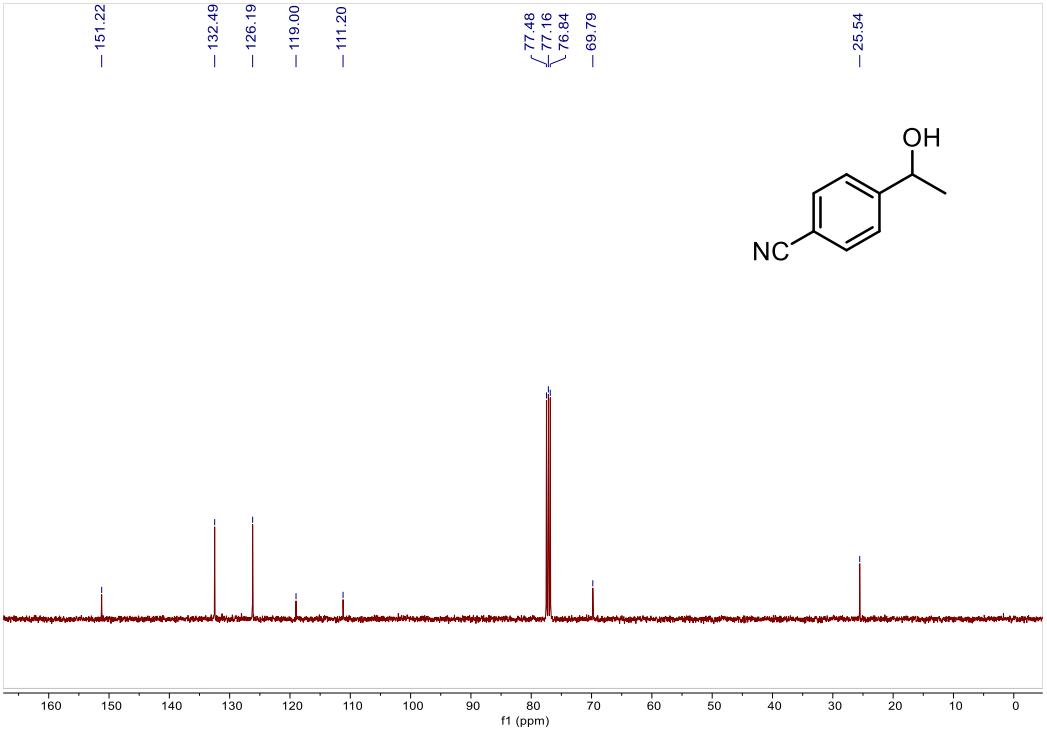
^{1}H NMR for compound **2aa**



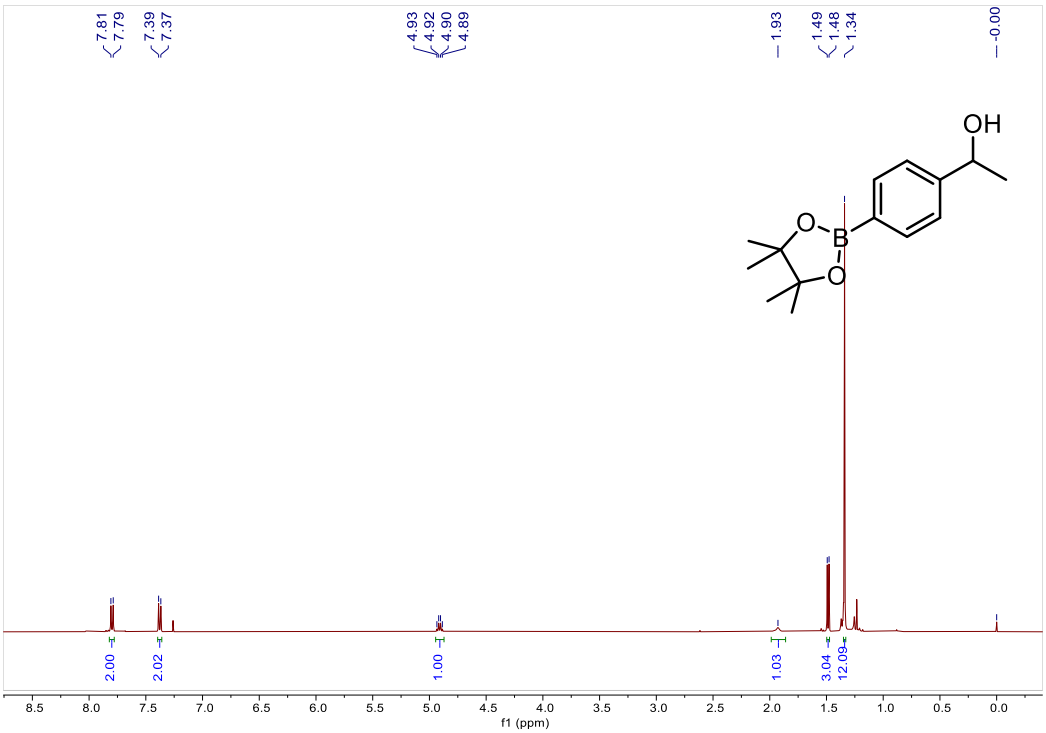
^{13}C{^{1}H} NMR for compound **2aa**



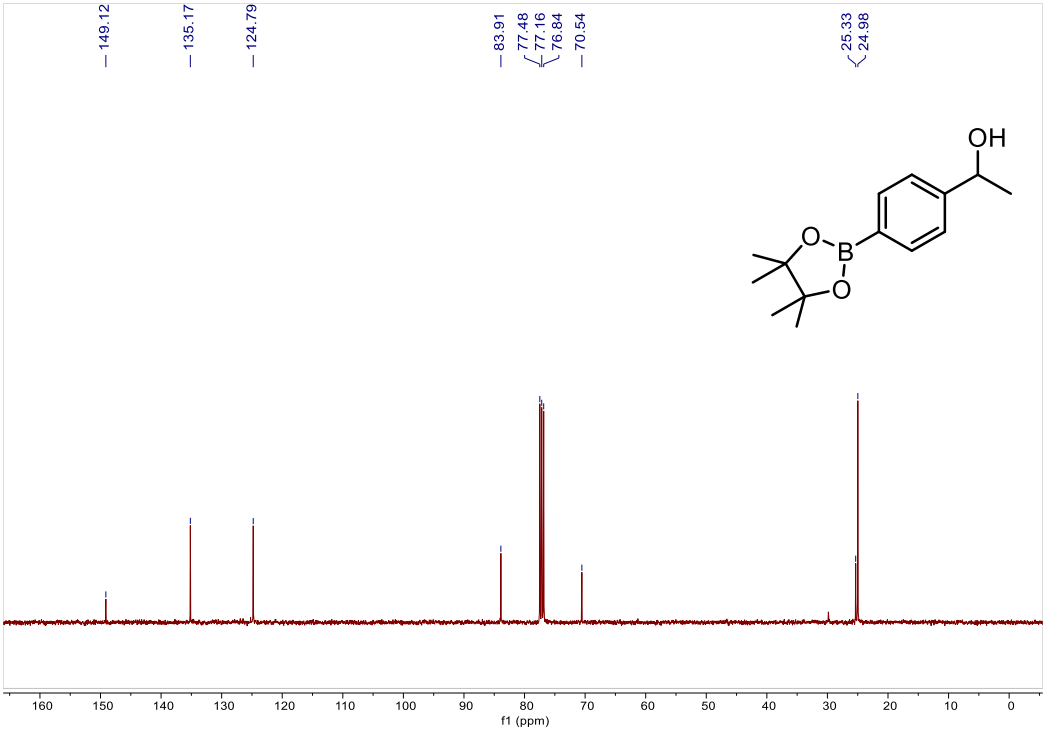
^{1}H NMR for compound **2ab**



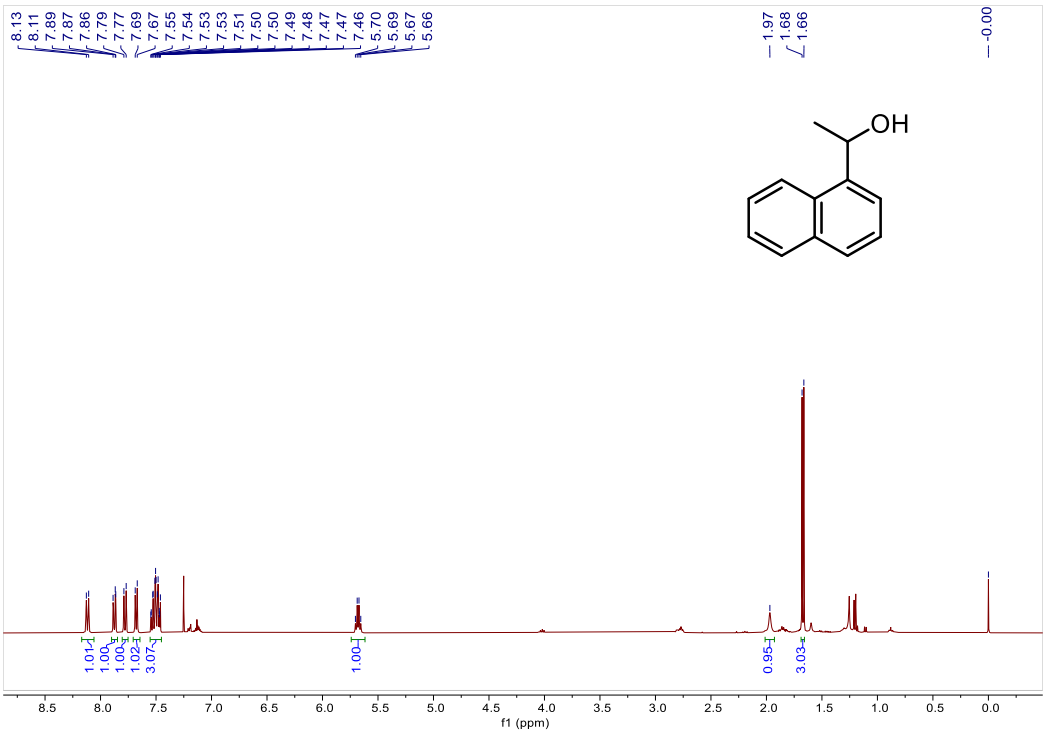
^{13}C{^{1}H} NMR for compound **2ab**



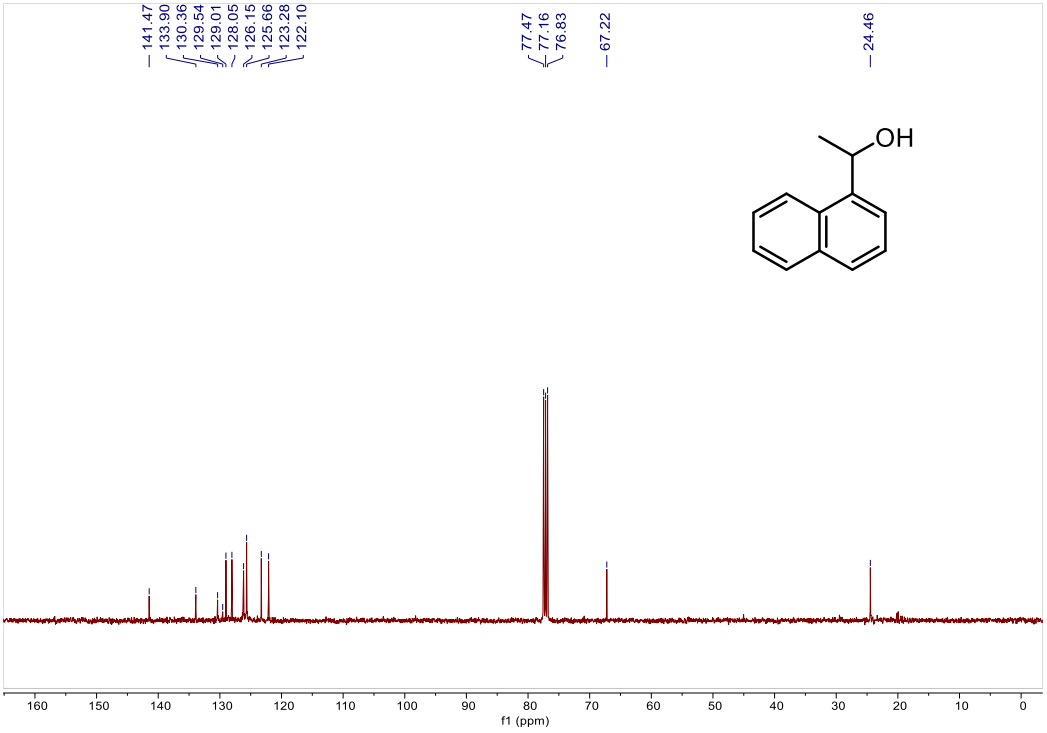
^{1}H NMR for compound **2ac**



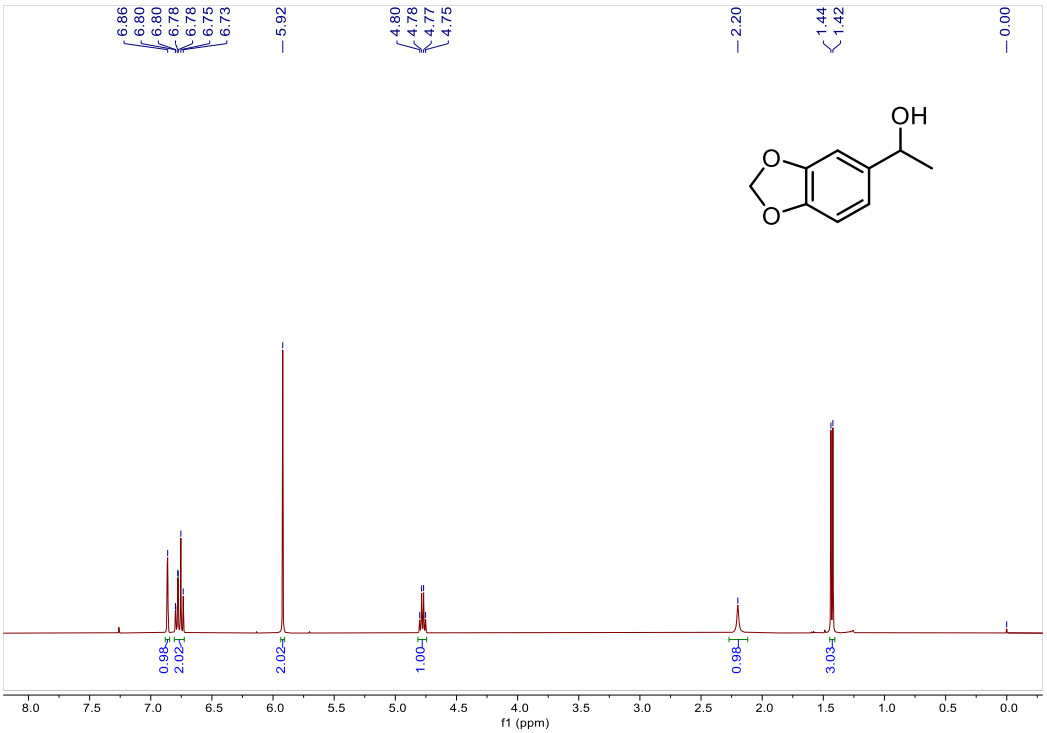
^{13}C{^{1}H} NMR for compound **2ac**



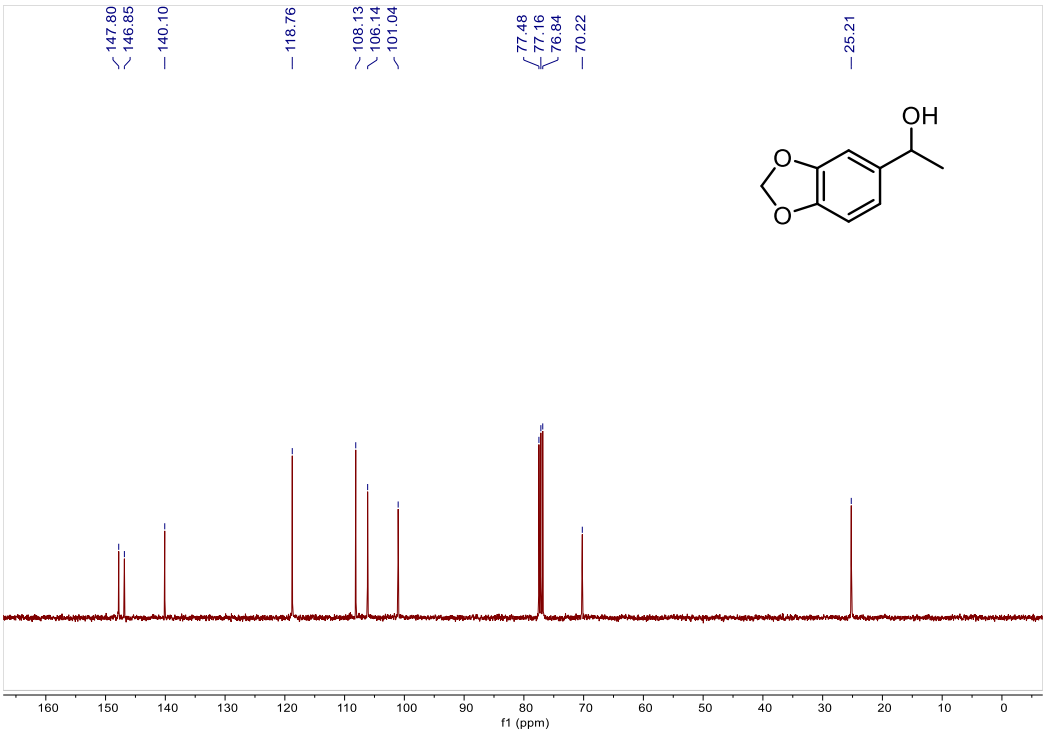
^{1}H NMR for compound **2ad**



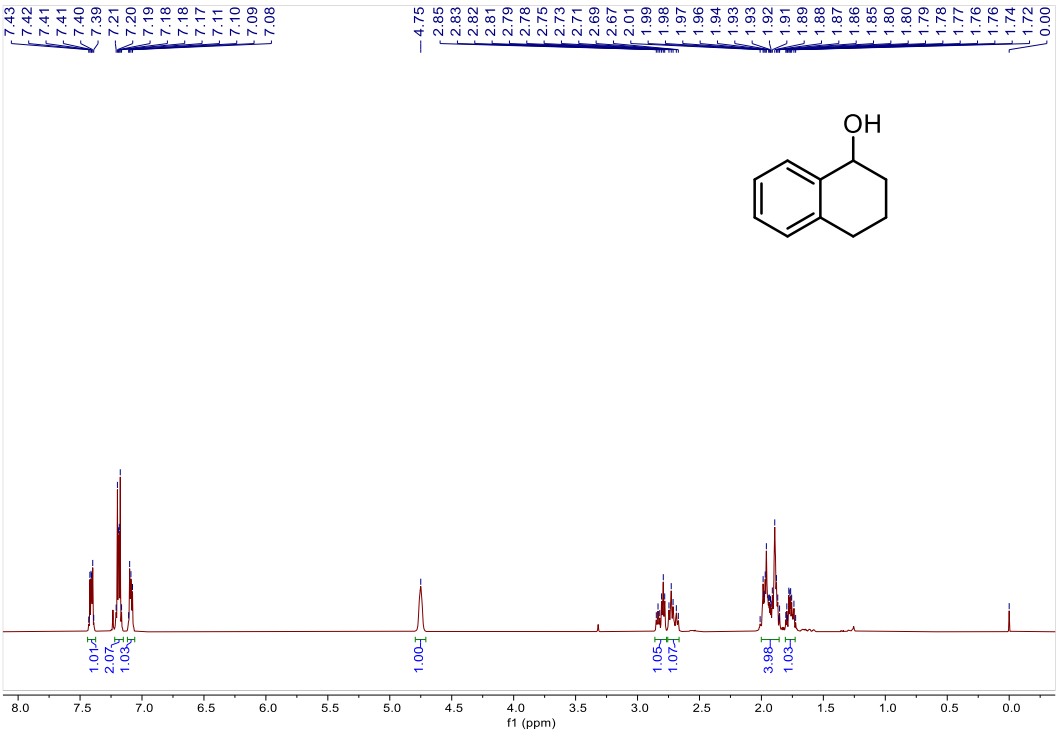
^{13}C{^{1}H} NMR for compound **2ad**



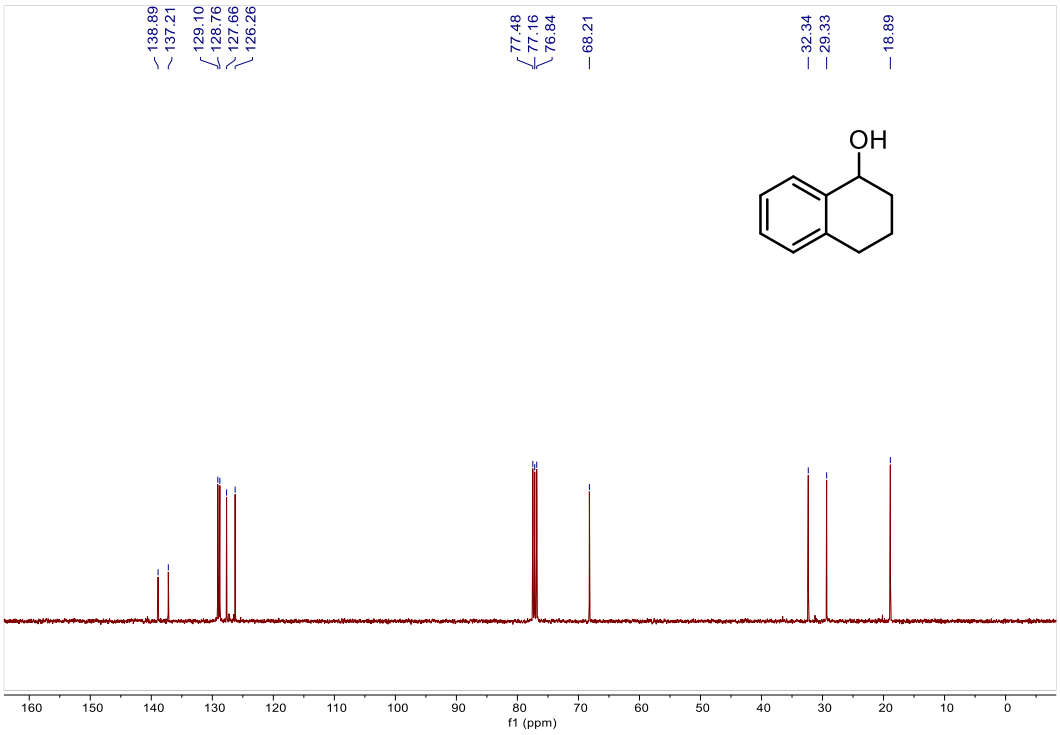
^{1}H NMR for compound **2ae**



^{13}C{^{1}H} NMR for compound **2ae**



^{1}H NMR for compound **2af**



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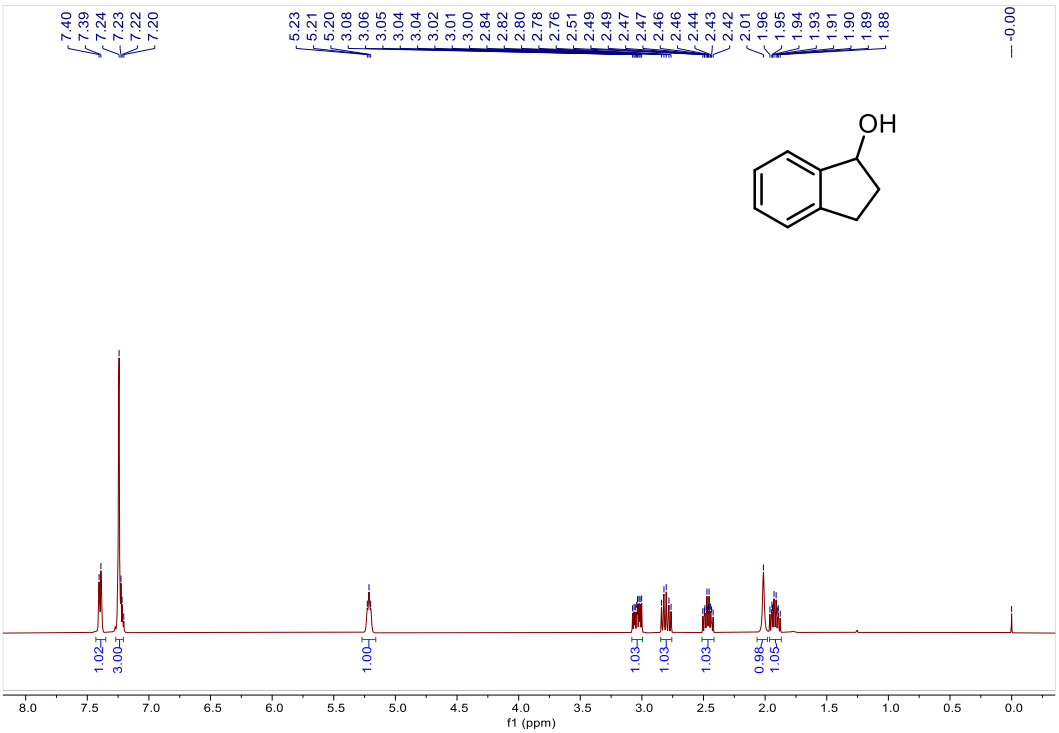
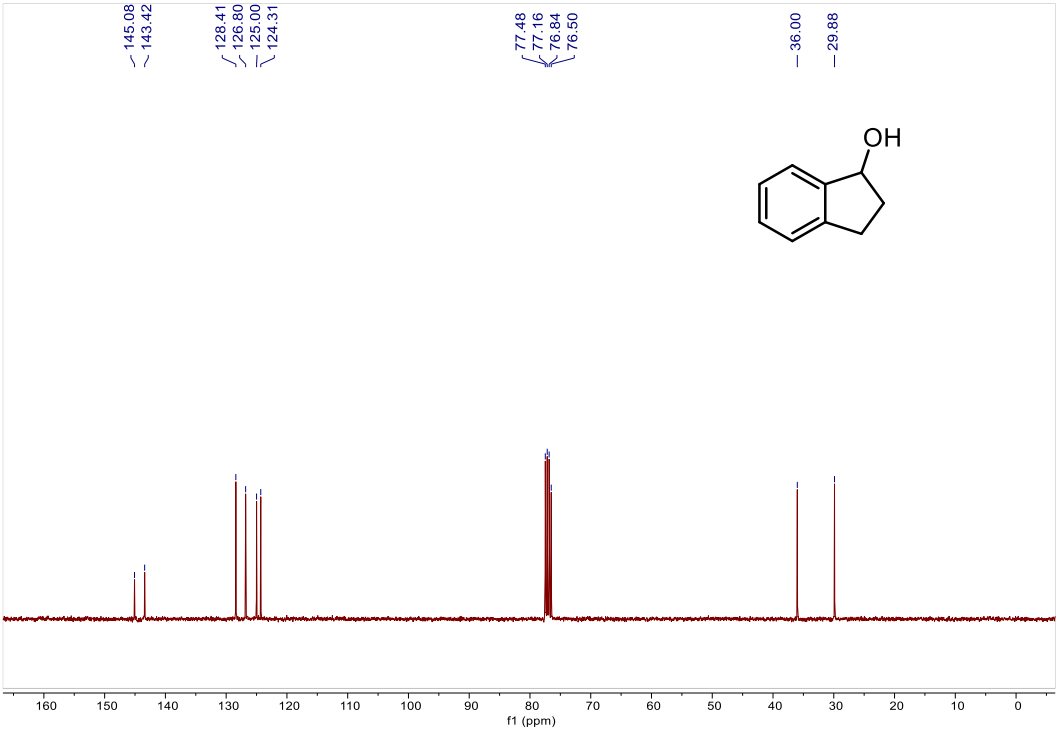
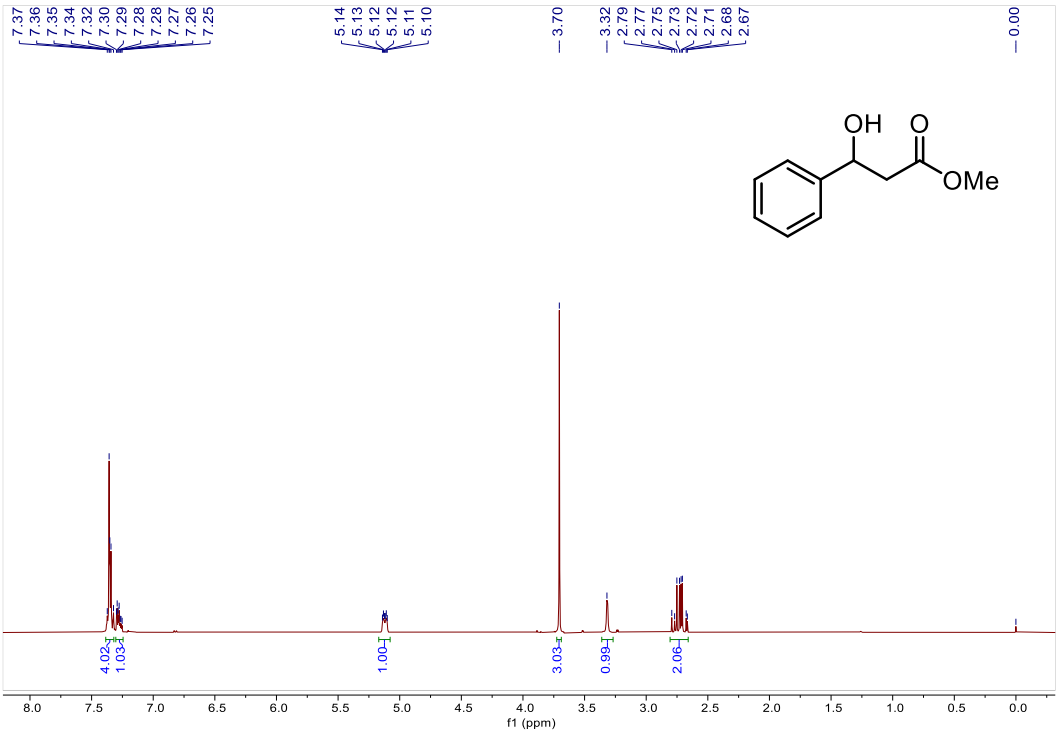


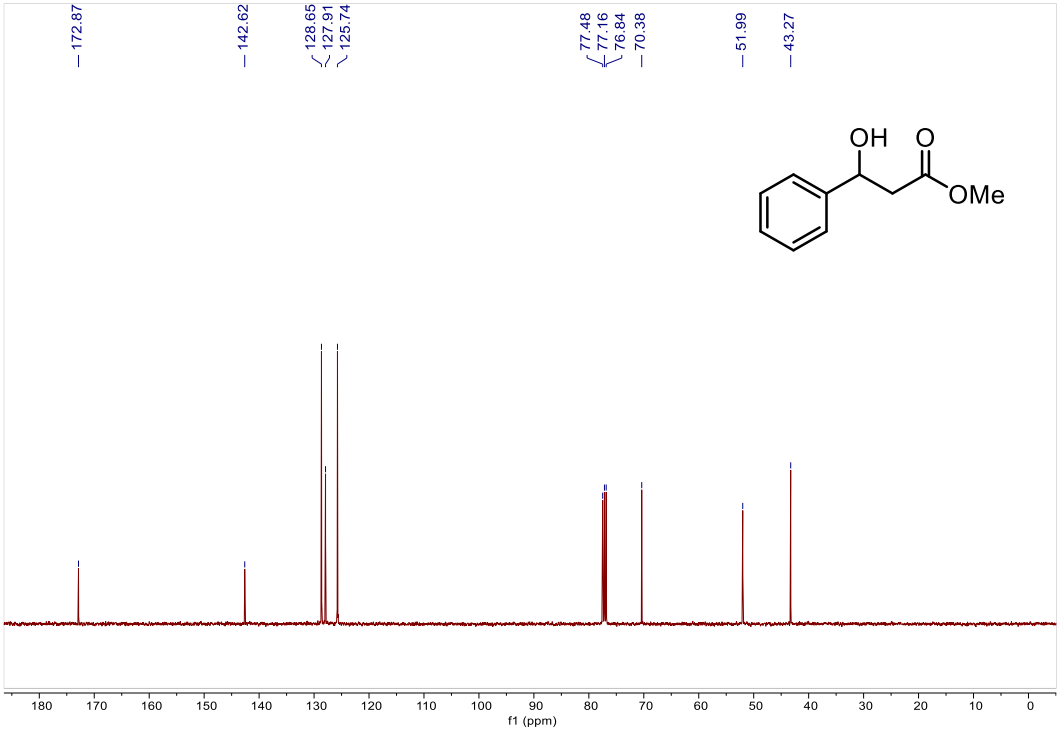
^{1}H NMR for compound **2ag**



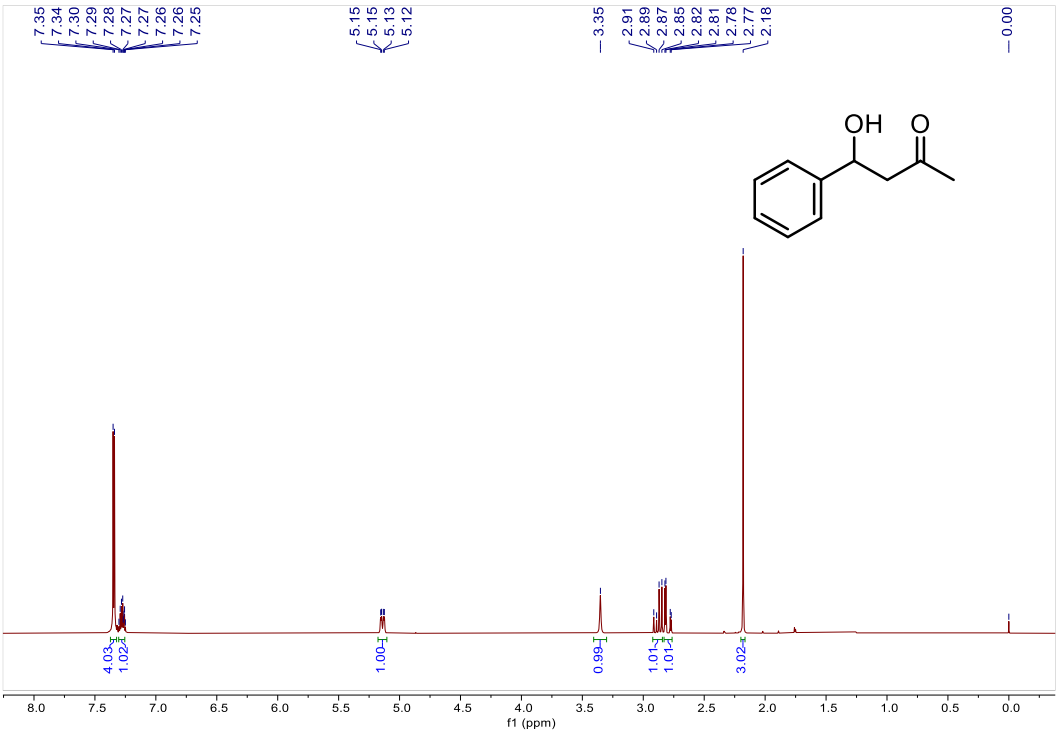
^{13}C{^{1}H} NMR for compound **2ag**



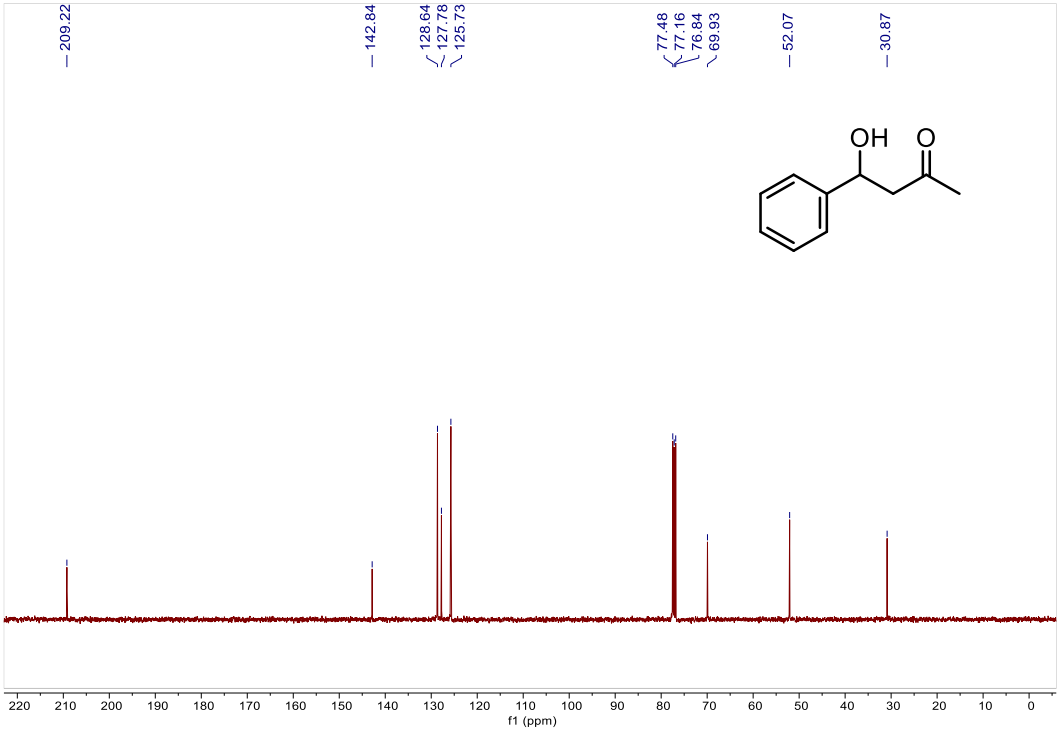
^{1}H NMR for compound **2ah**



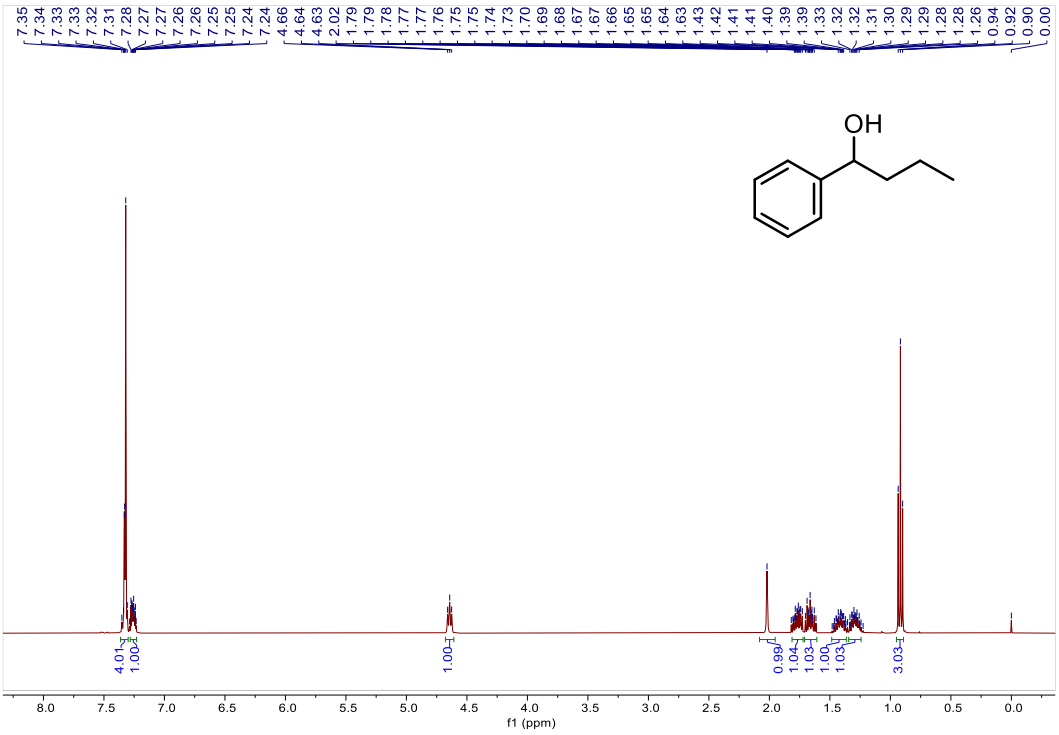
^{13}C{^{1}H} NMR for compound **2ah**



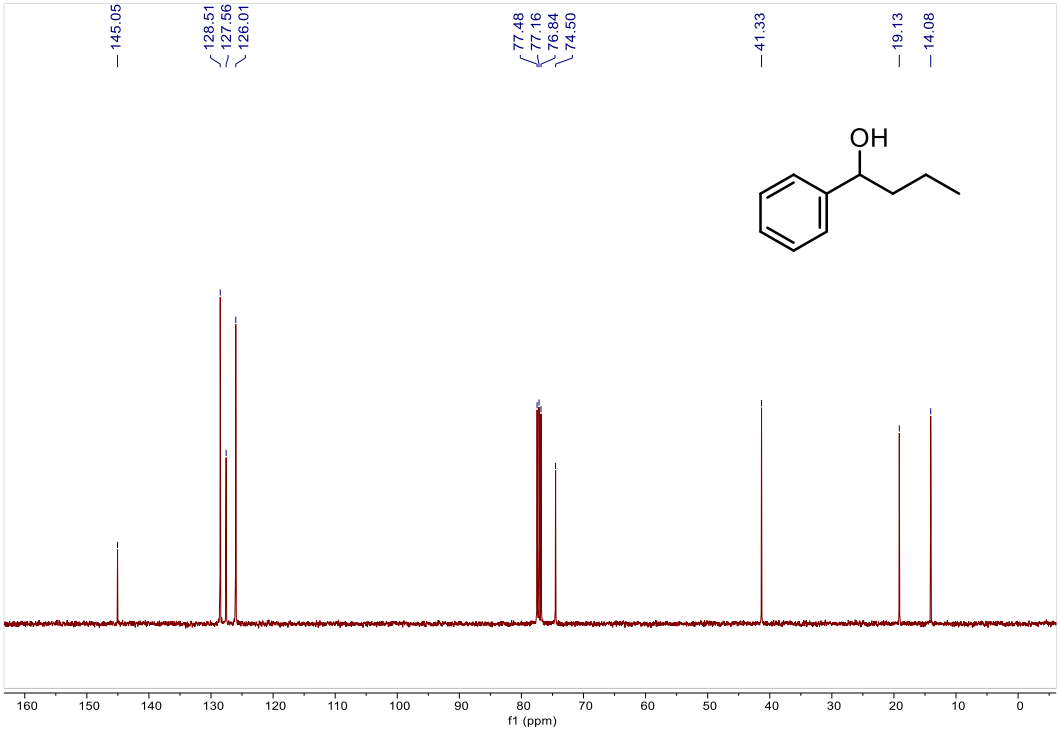
^{1}H NMR for compound **2ai**



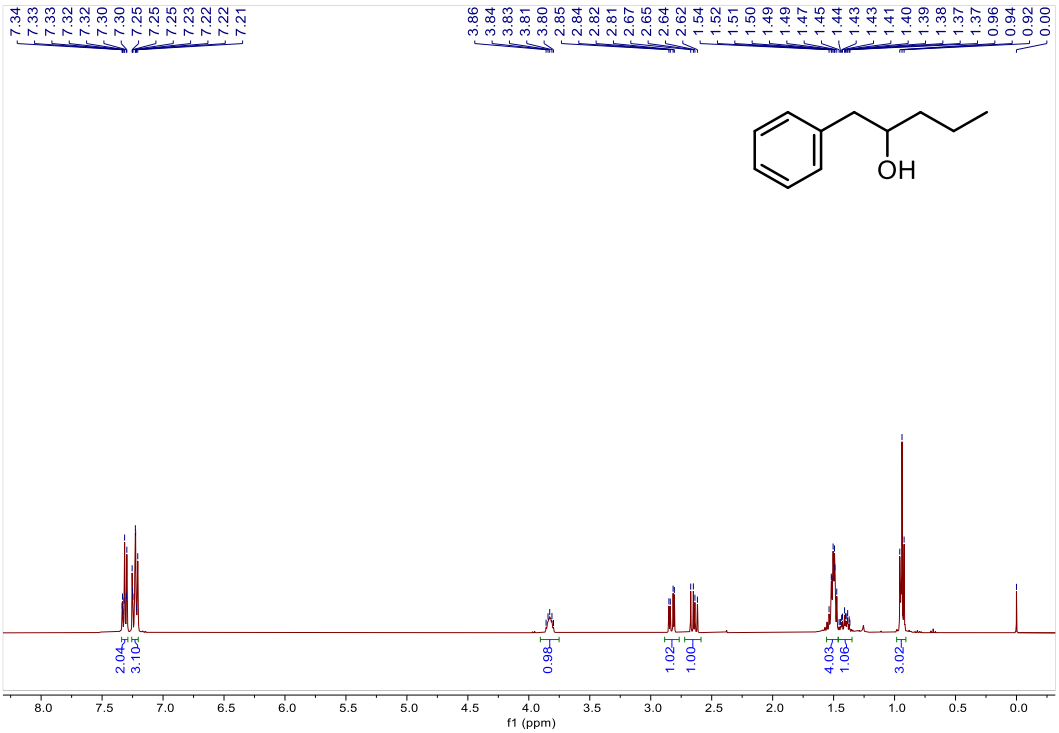
^{13}C{^{1}H} NMR for compound **2ai**



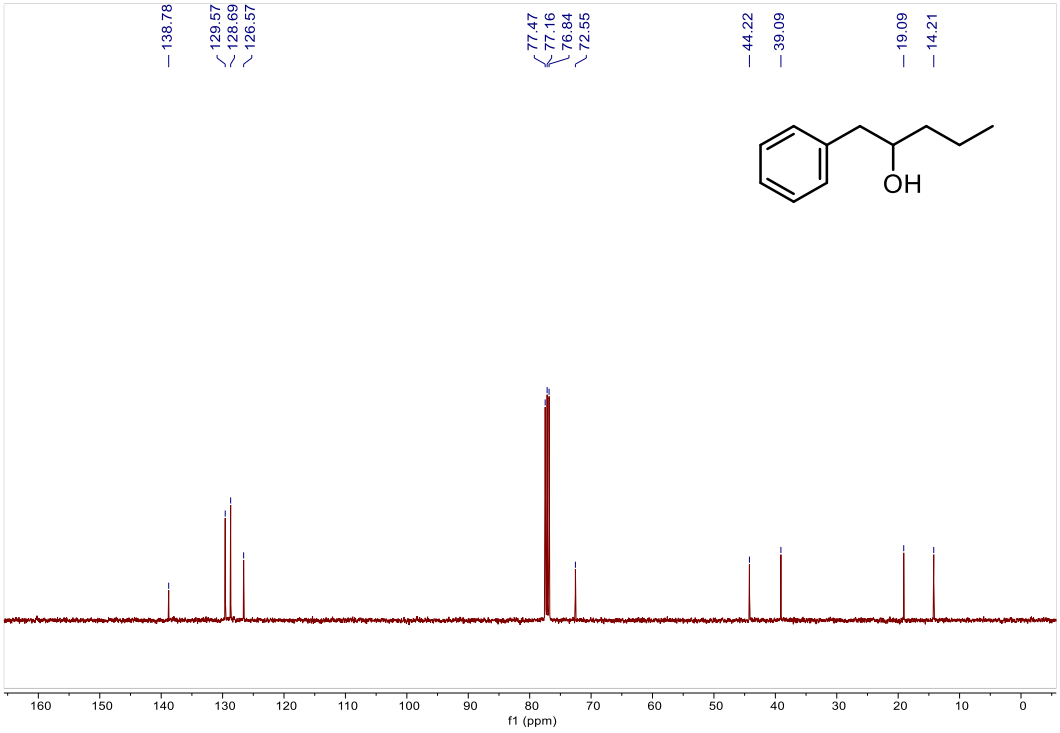
^{1}H NMR for compound **2aj**



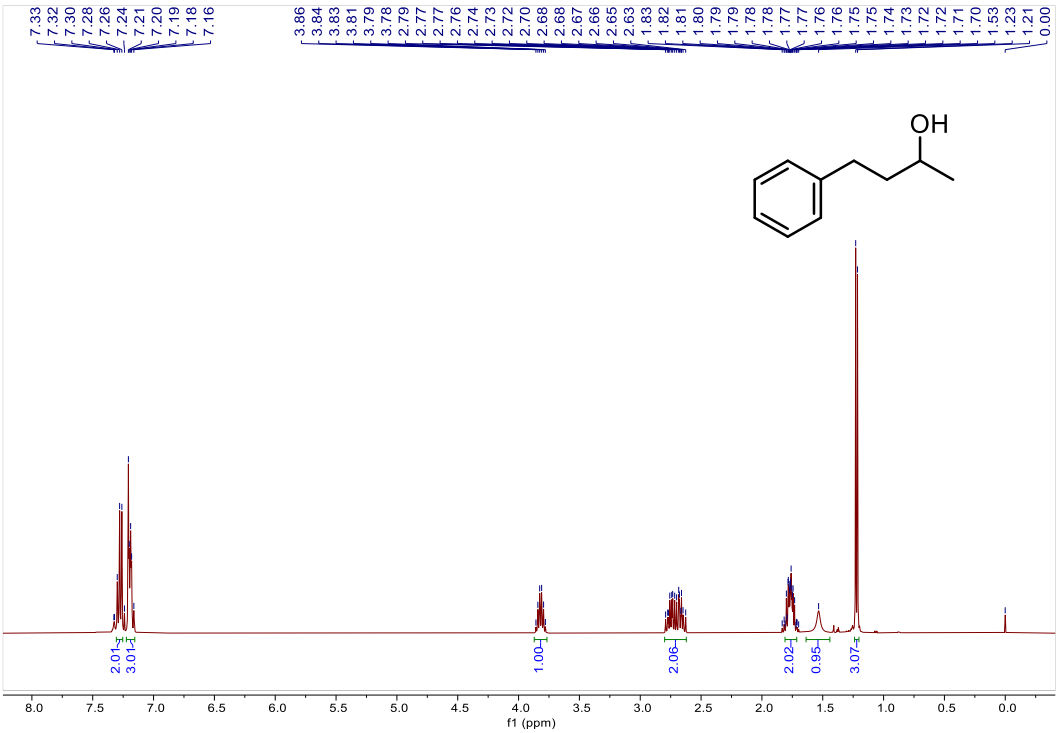
^{13}C{^{1}H} NMR for compound **2aj**



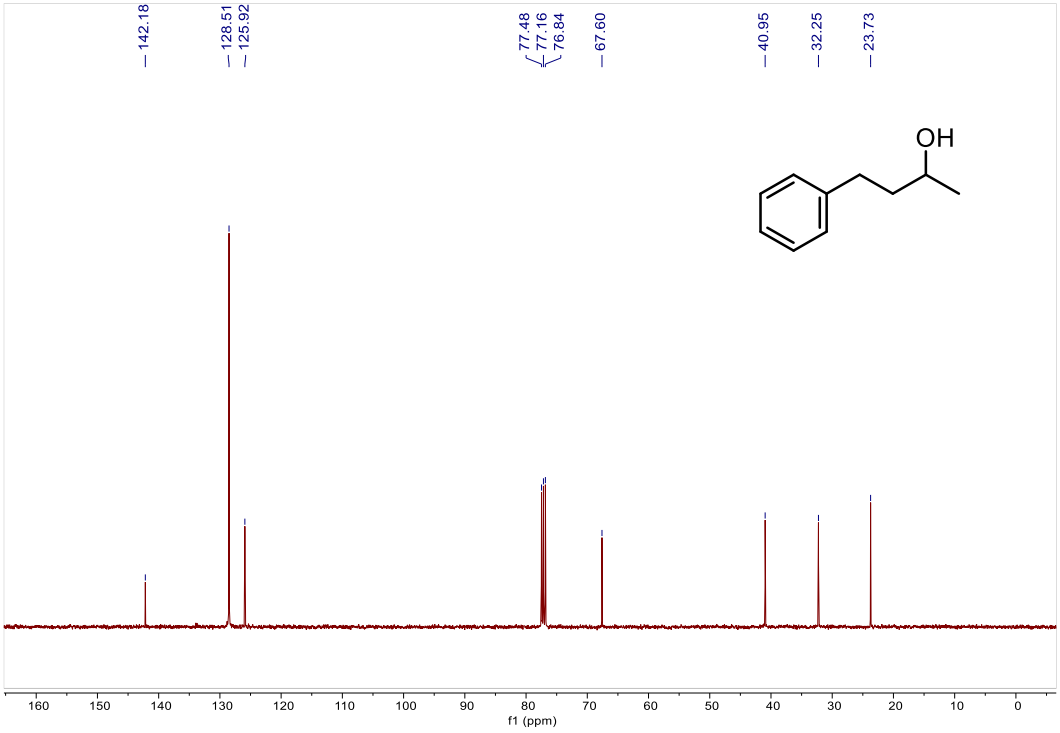
^{1}H NMR for compound **2ak**



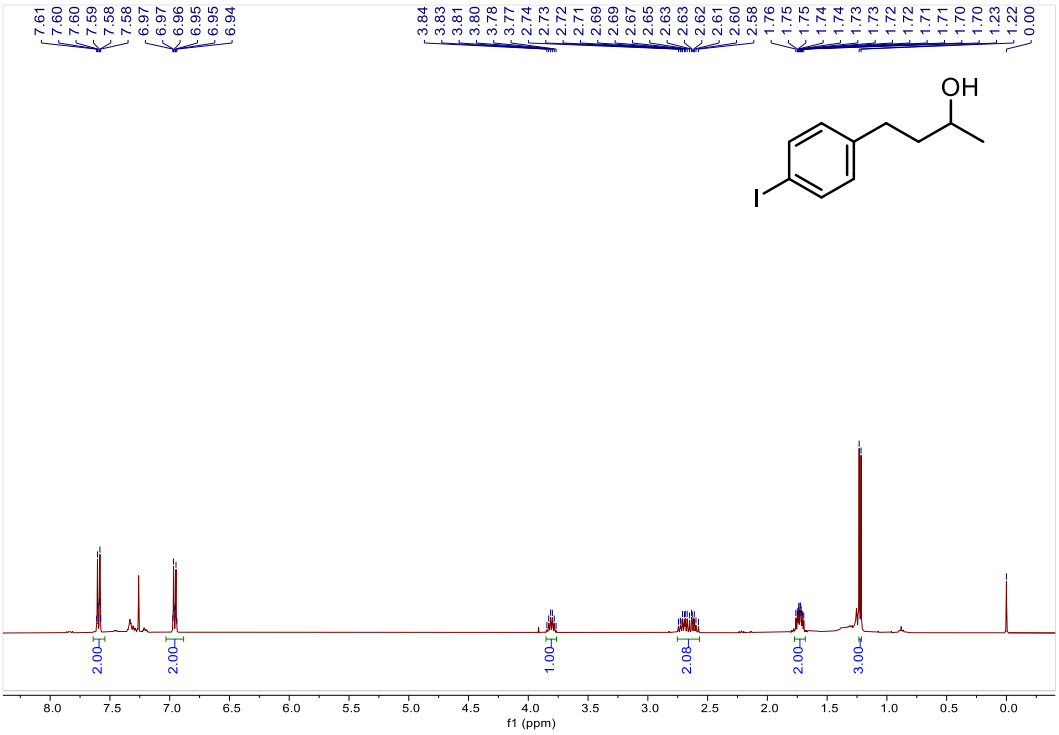
^{13}C{^{1}H} NMR for compound **2ak**



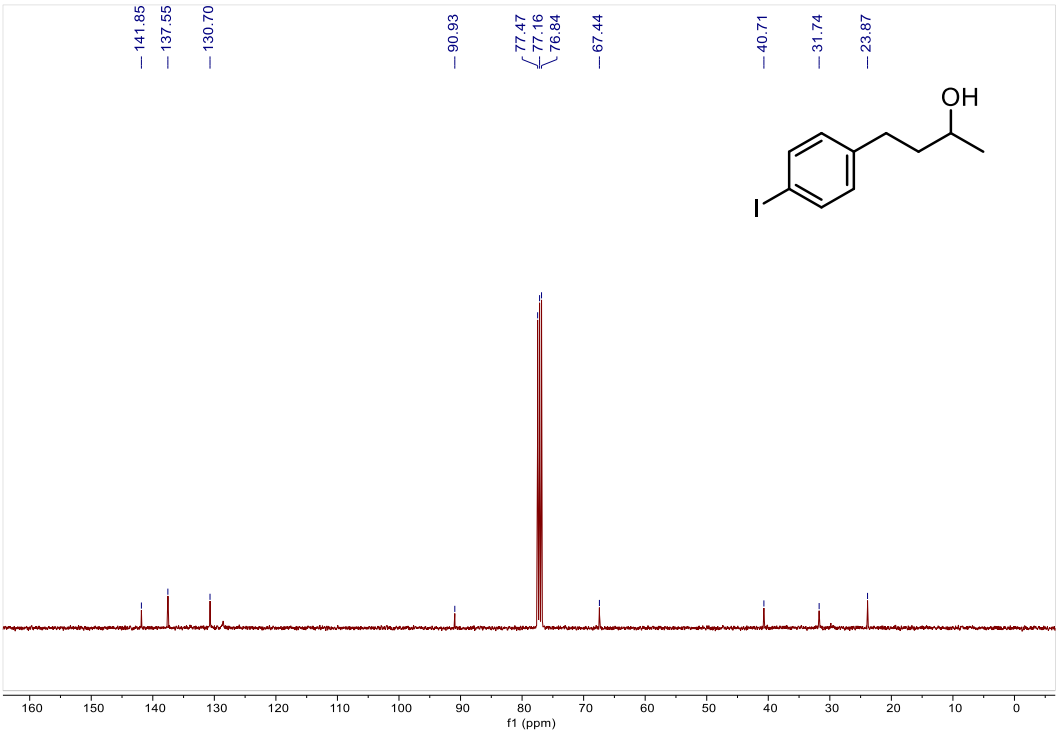
^{1}H NMR for compound **2al**



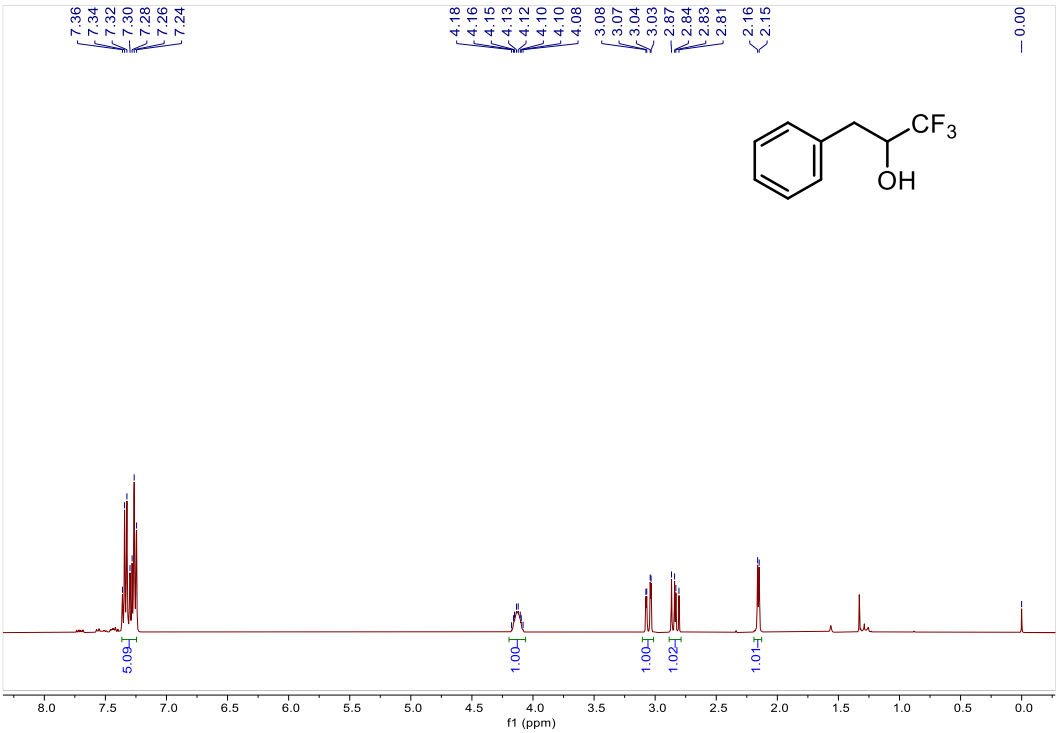
^{13}C{^{1}H} NMR for compound **2al**



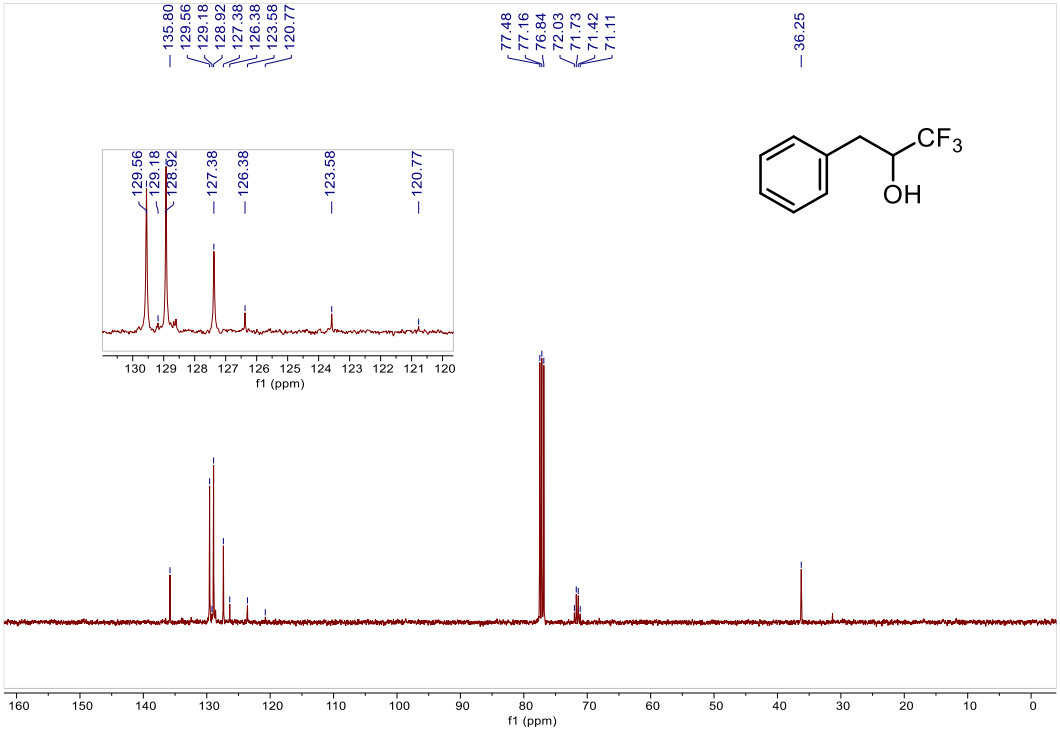
^{1}H NMR for compound **2am**



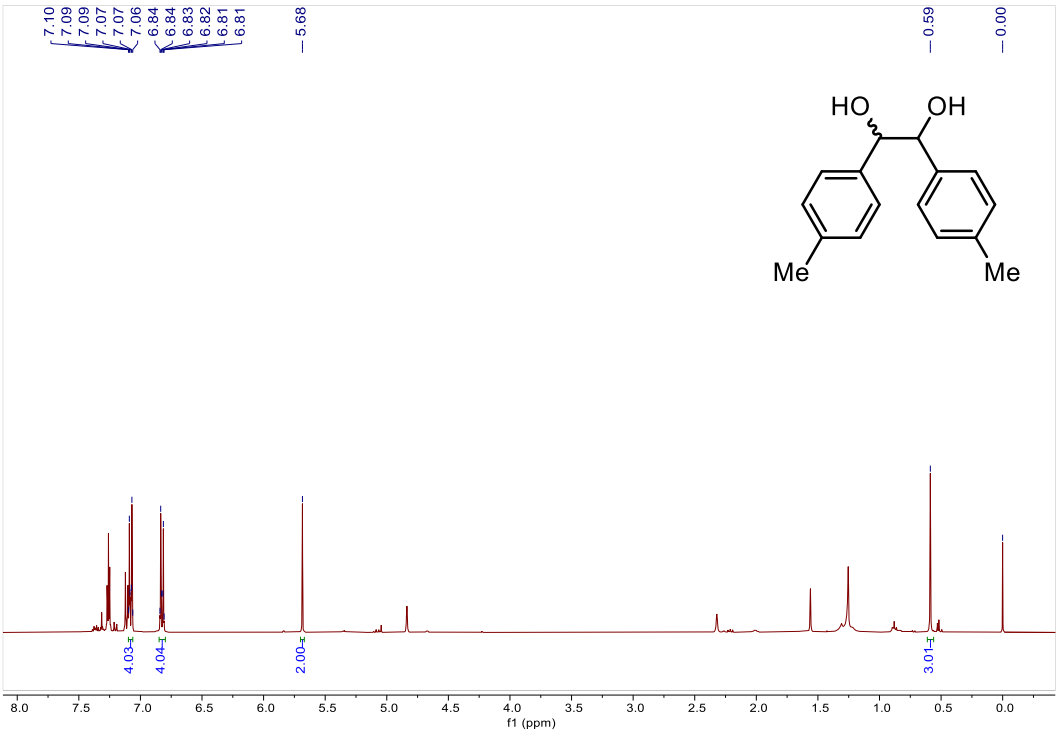
^{13}C{^{1}H} NMR for compound **2am**



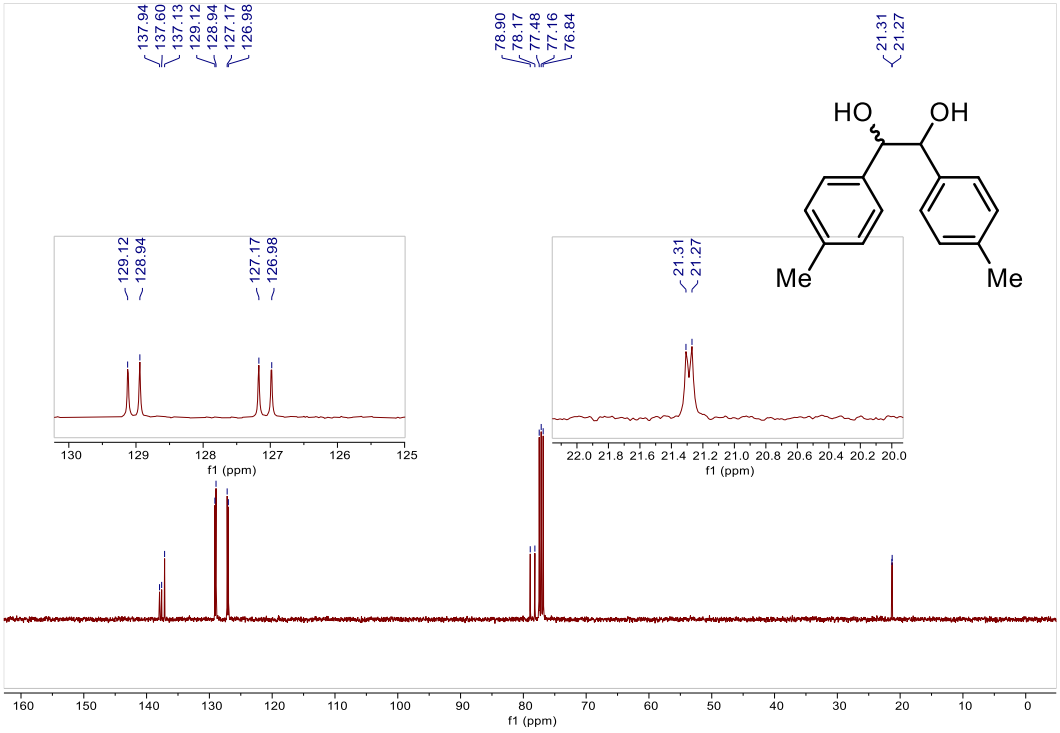
^{1}H NMR for compound **2an**



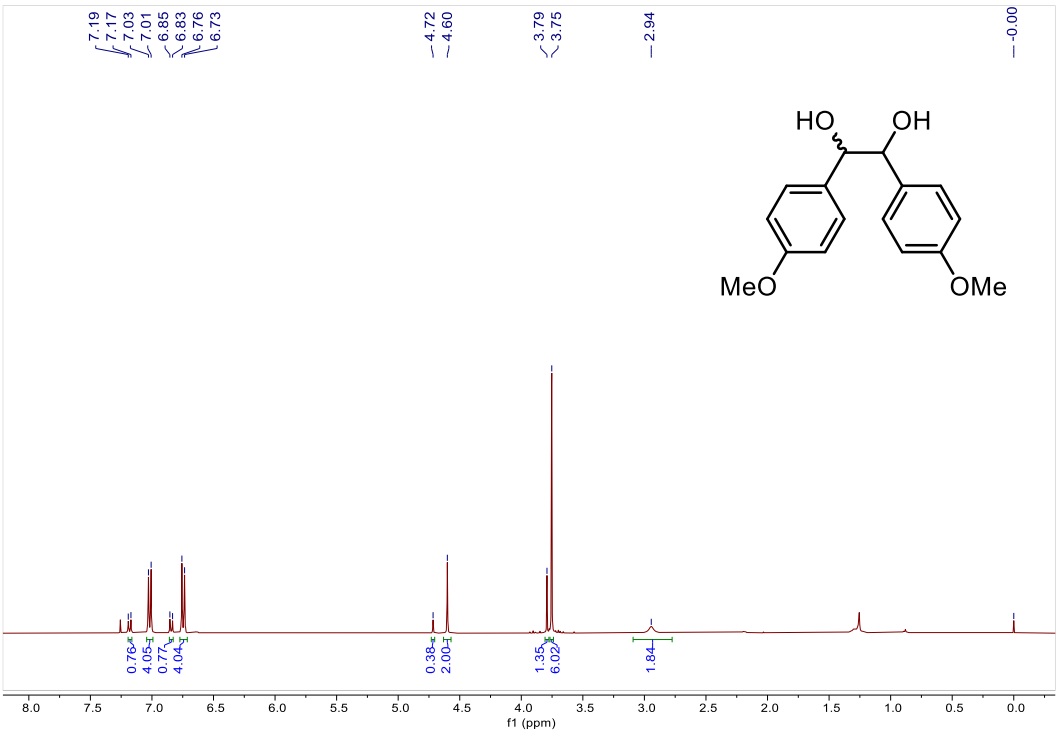
^{13}C{^{1}H} NMR for compound **2an**



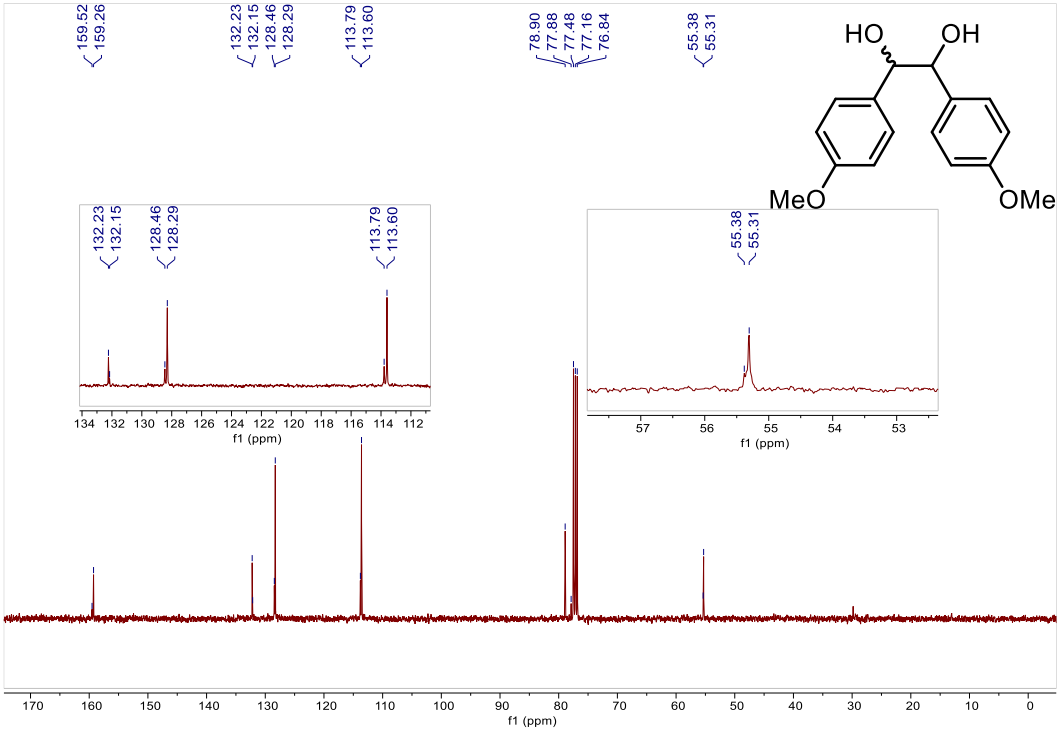
^{1}H NMR for compound **3a (*dl* and *meso*)**



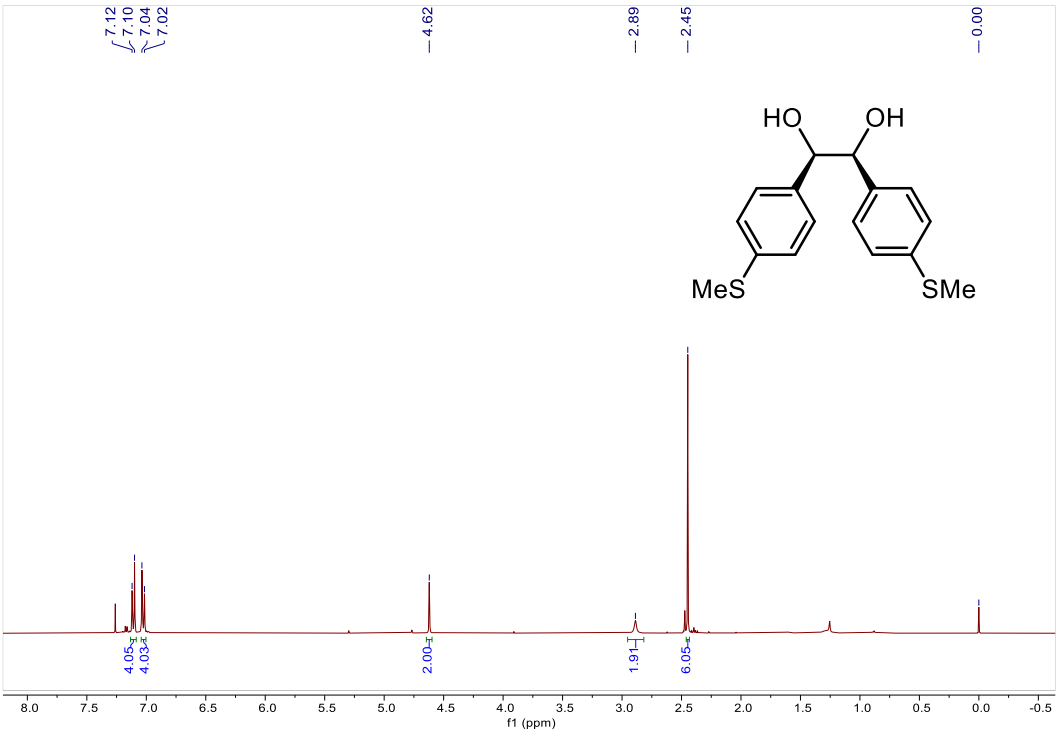
^{13}C{^{1}H} NMR for compound **3a (*dl* and *meso*)**



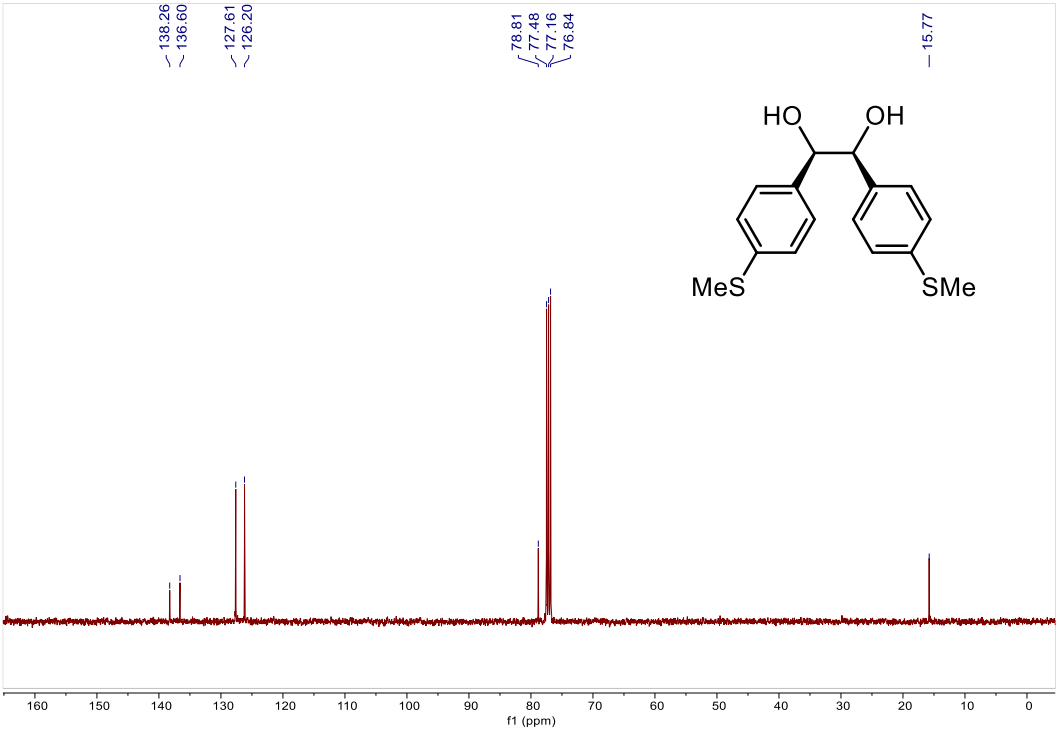
^{1}H NMR for compound **3b (*dl* and *meso*)**



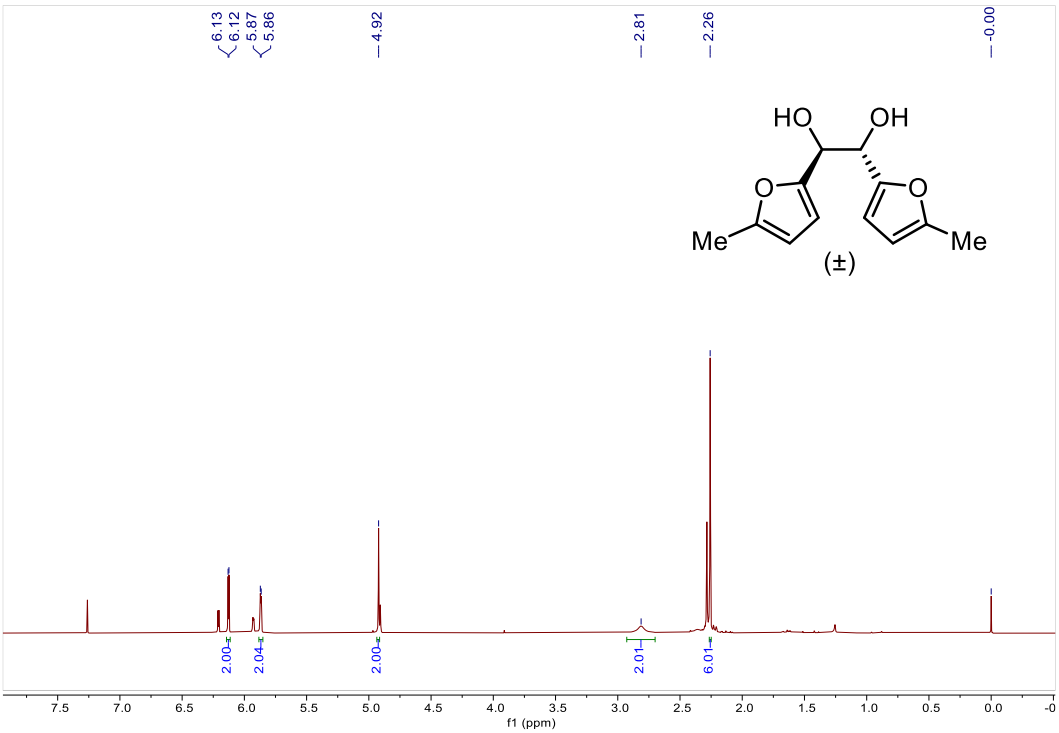
^{13}C{^{1}H} NMR for compound **3b (*dl* and *meso*)**



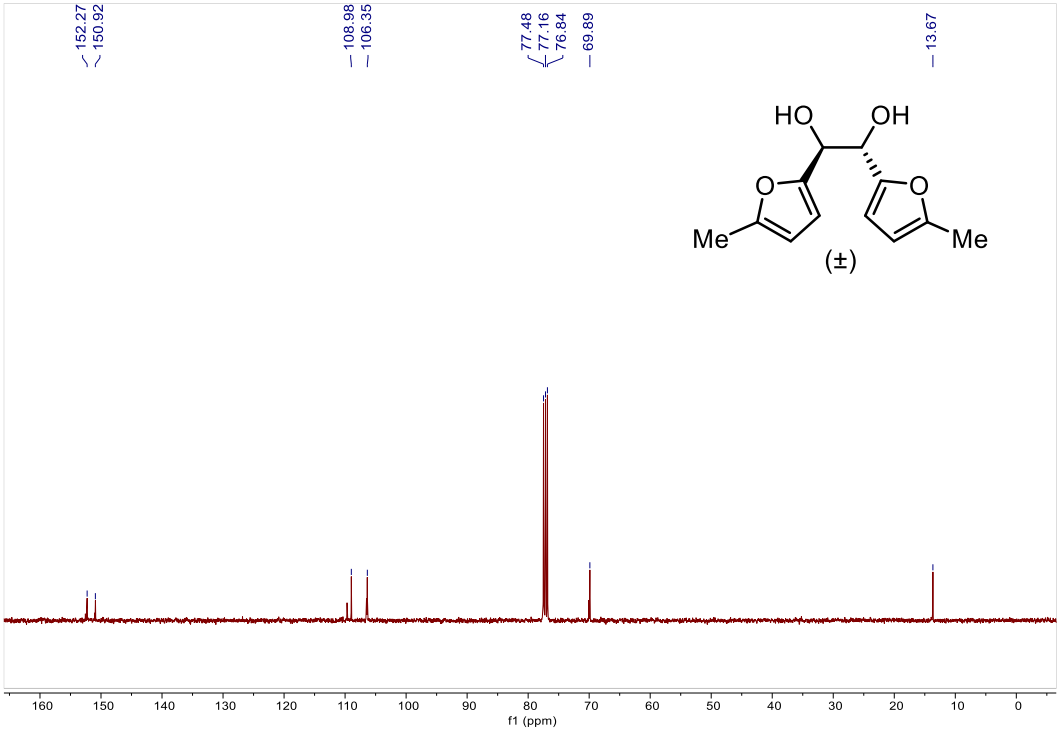
^{1}H NMR for compound ***meso*-3c**



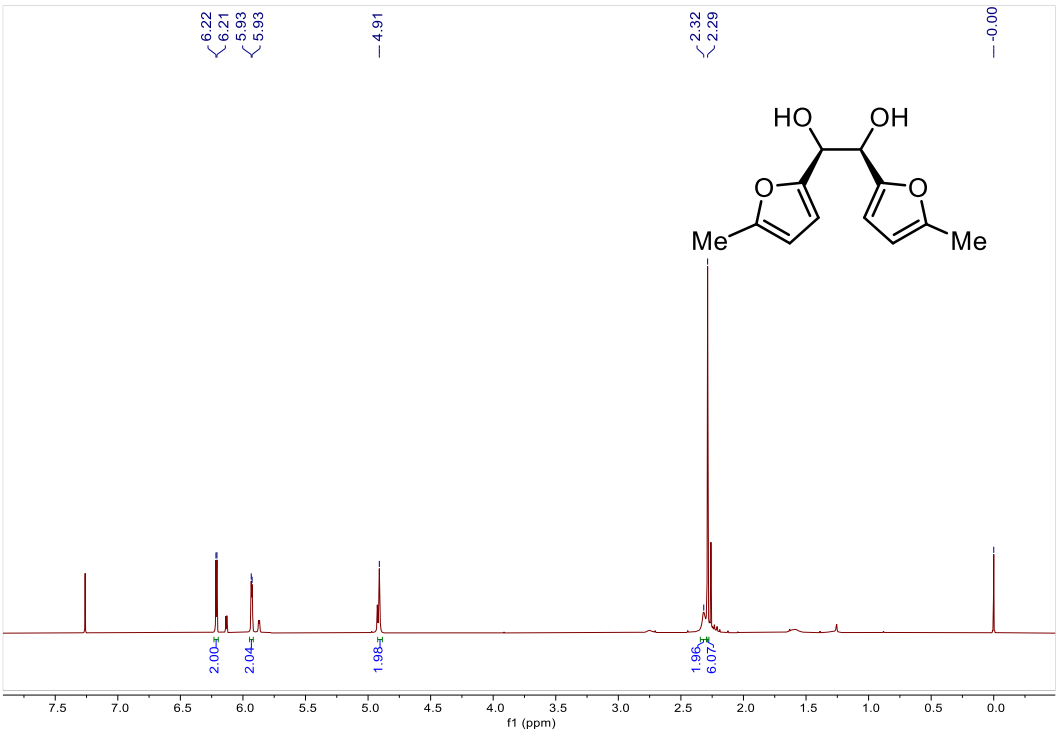
^{13}C{^{1}H} NMR for compound ***meso*-3c**



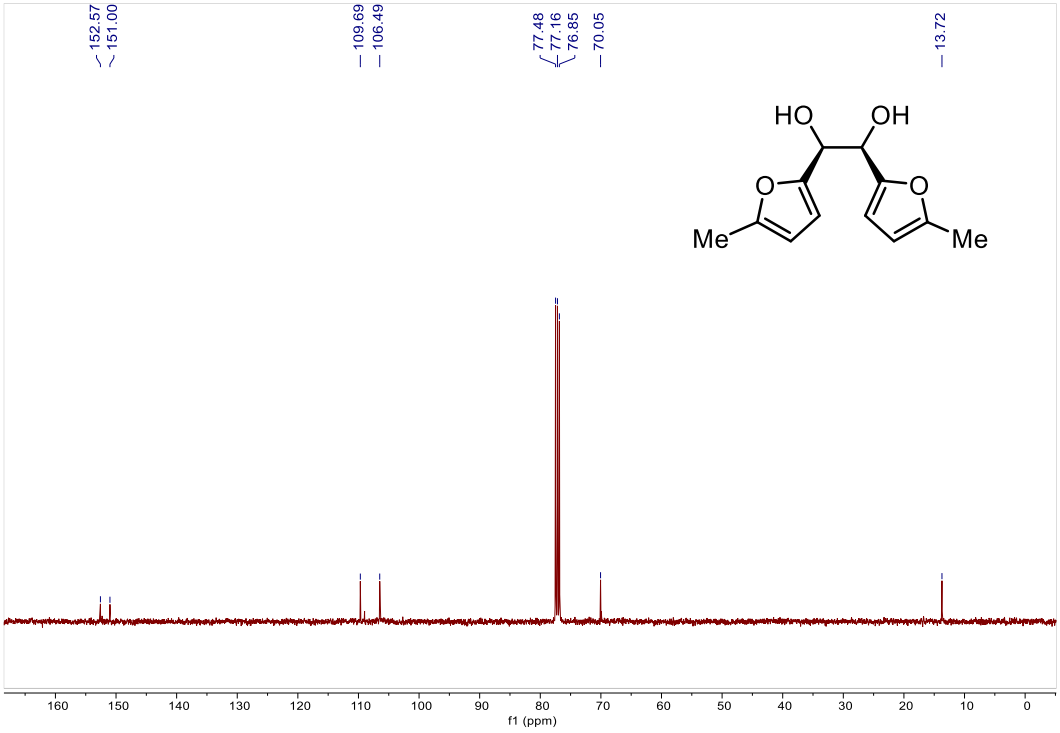
^{1}H NMR for compound ***dl*-3d**



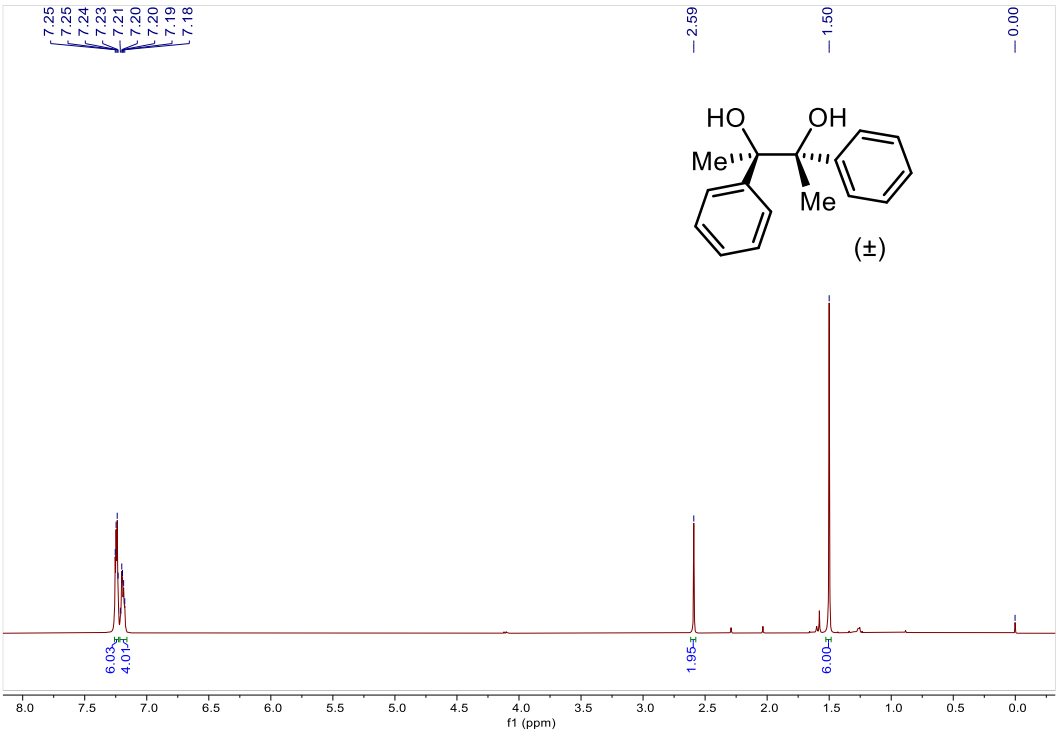
^{13}C{^{1}H} NMR for compound ***dl*-3d**



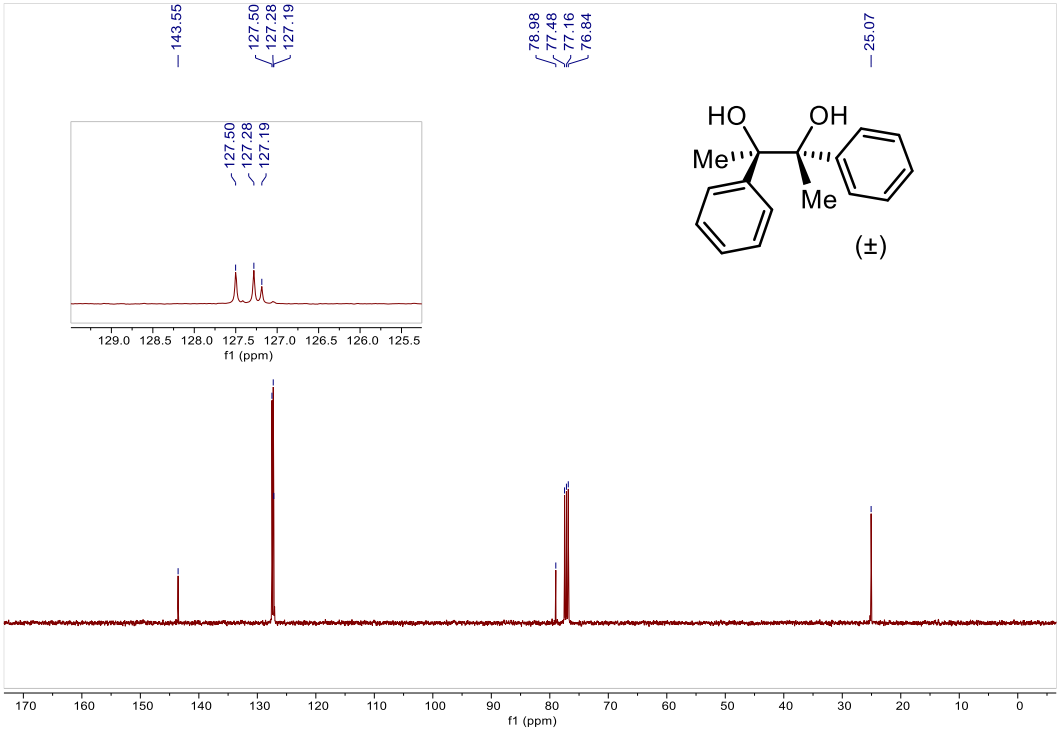
^{1}H NMR for compound ***meso*-3d**



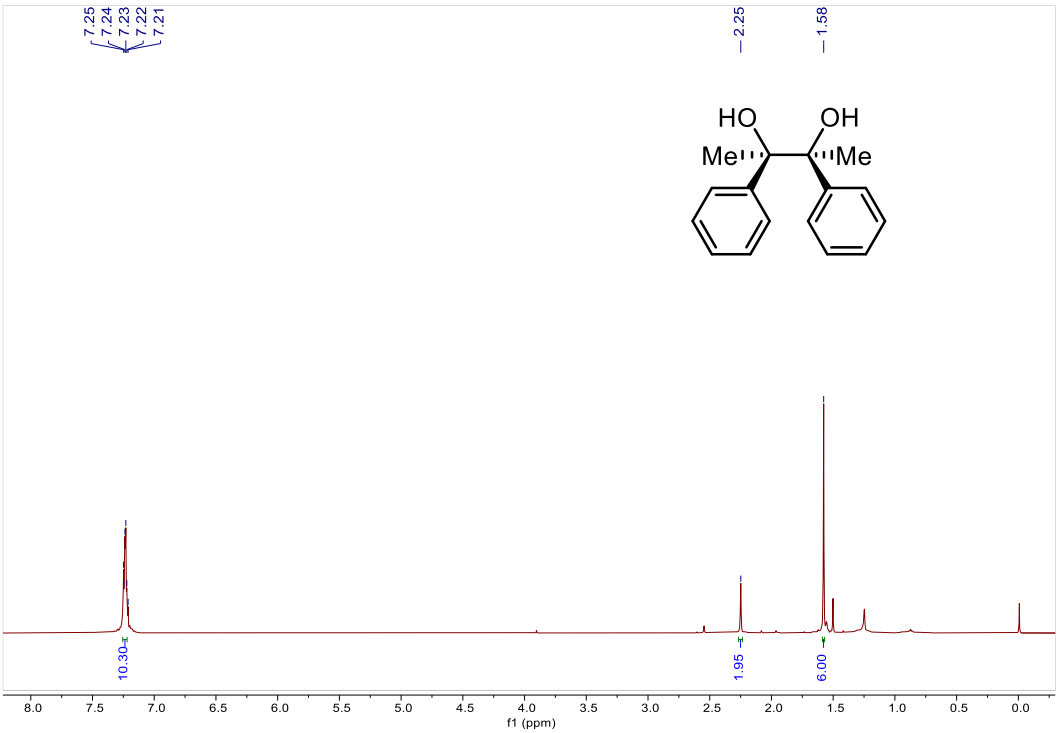
^{13}C{^{1}H} NMR for compound ***meso*-3d**



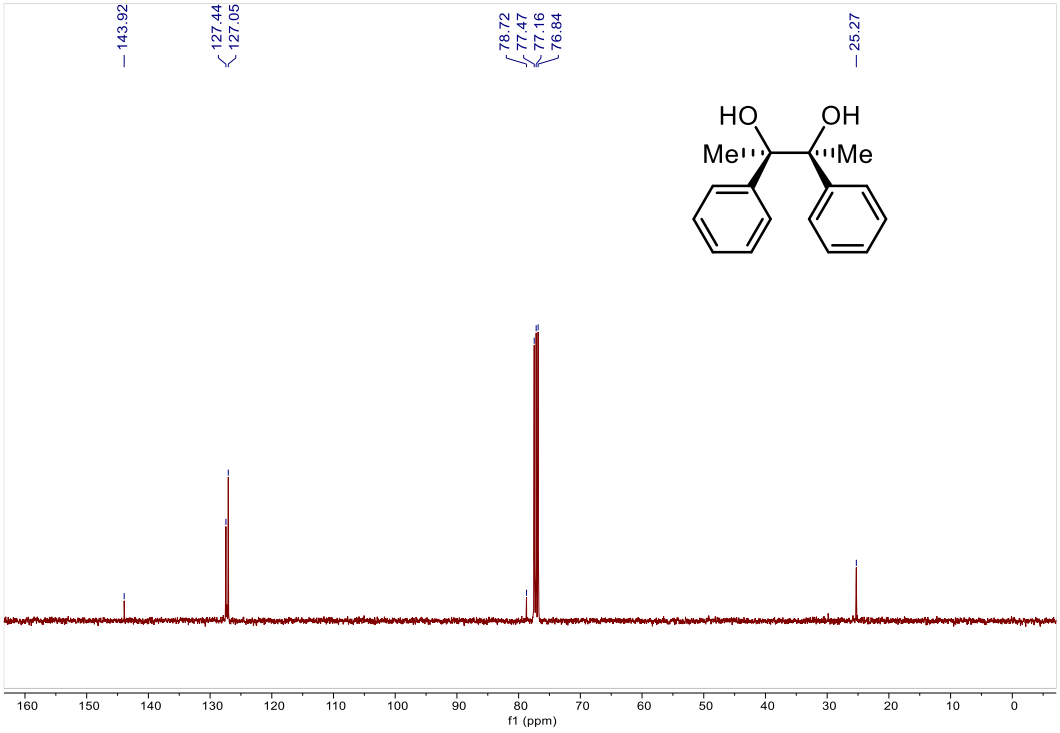
^{1}H NMR for compound ***dl*-3e**



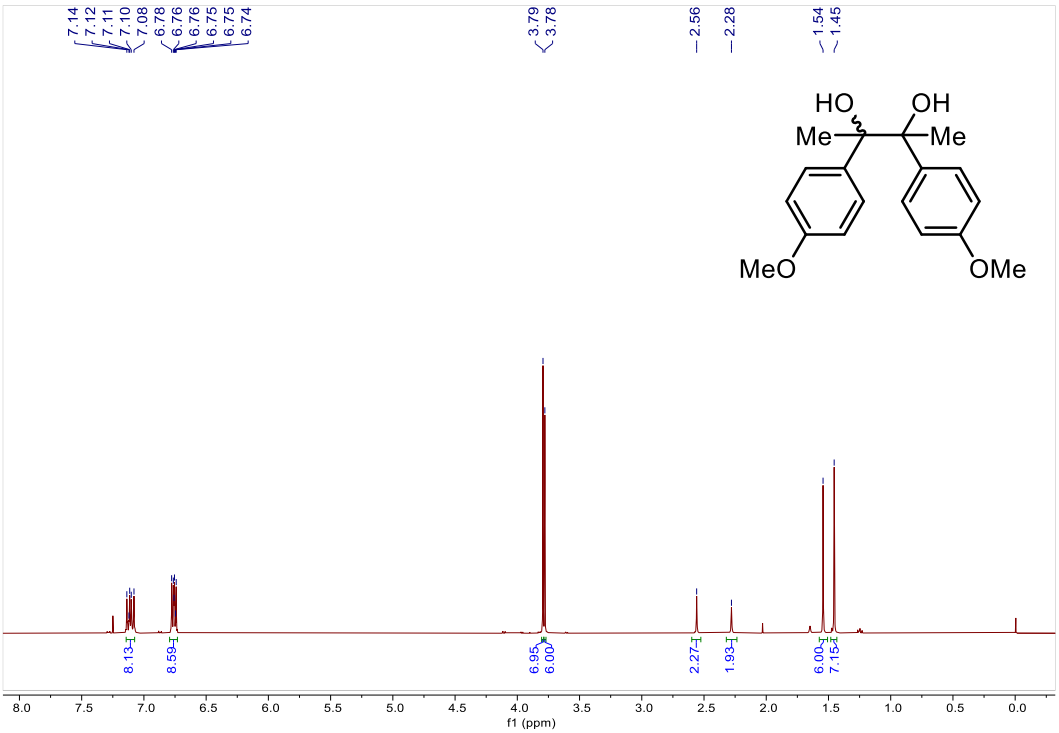
^{13}C{^{1}H} NMR for compound ***dl*-3e**



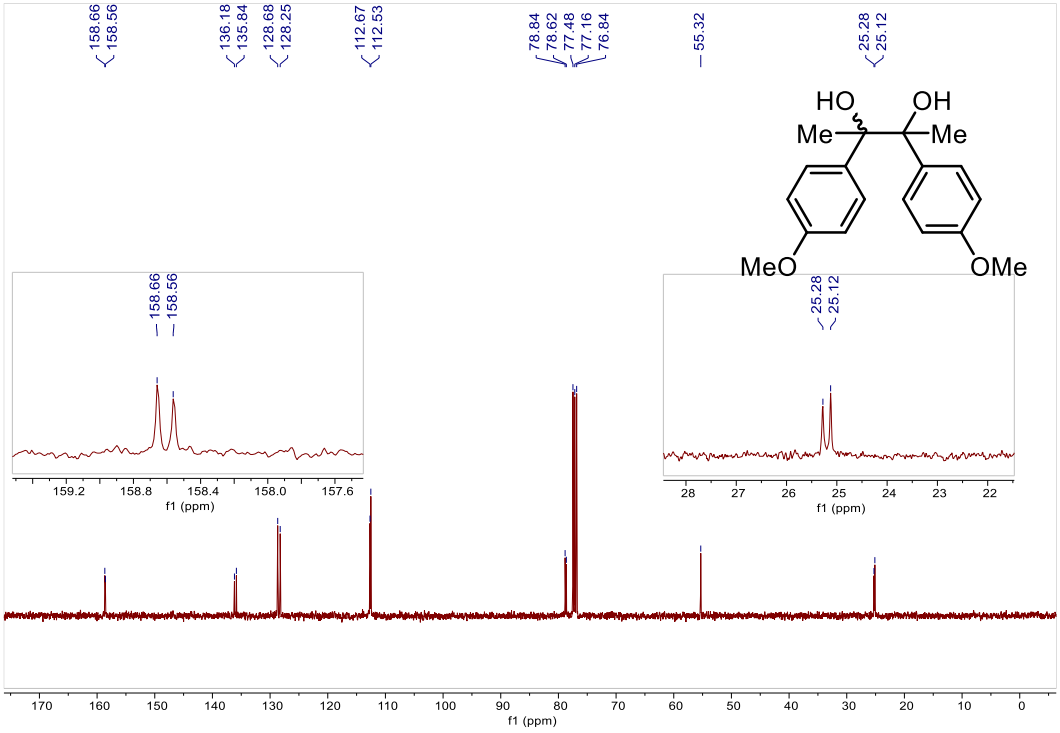
^{1}H NMR for compound ***meso*-3e**



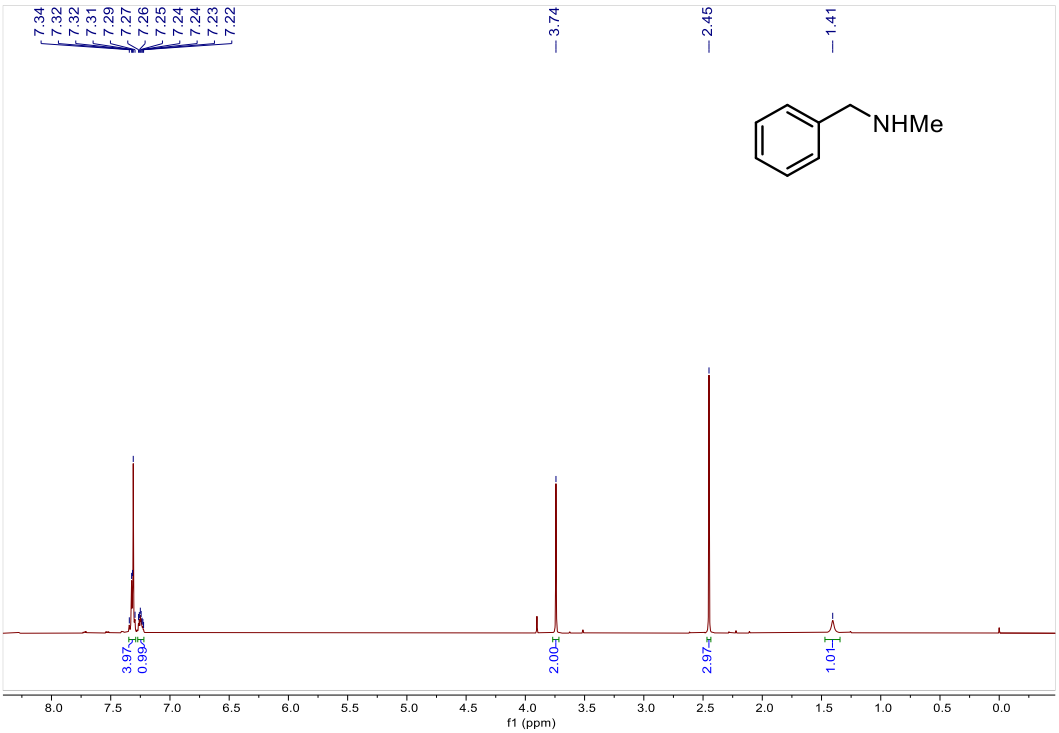
^{13}C{^{1}H} NMR for compound ***meso*-3e**



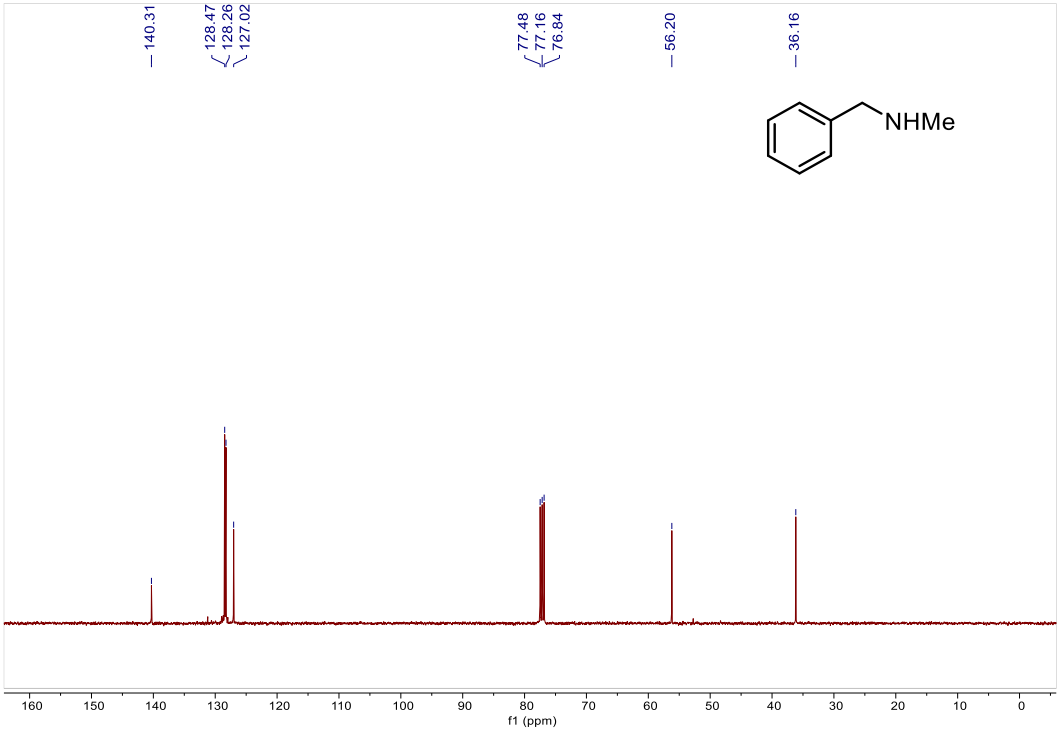
^{1}H NMR for compound **3f (*dl* and *meso*)**



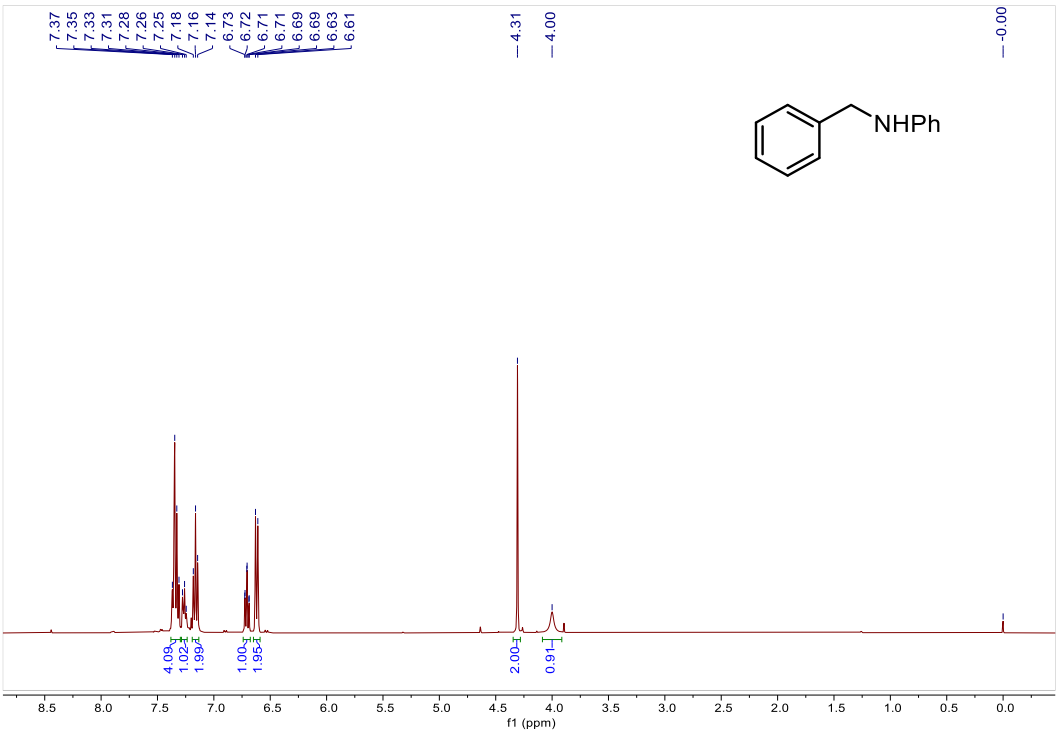
^{13}C{^{1}H} NMR for compound **3f (*dl* and *meso*)**



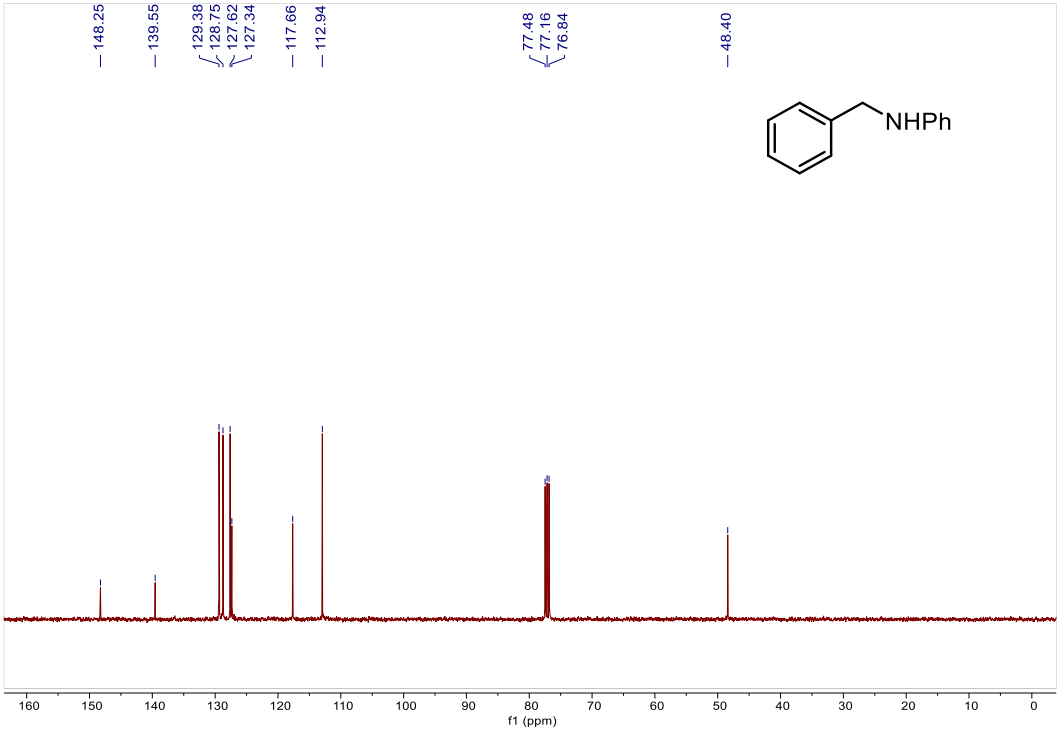
^{1}H NMR for compound **4a**



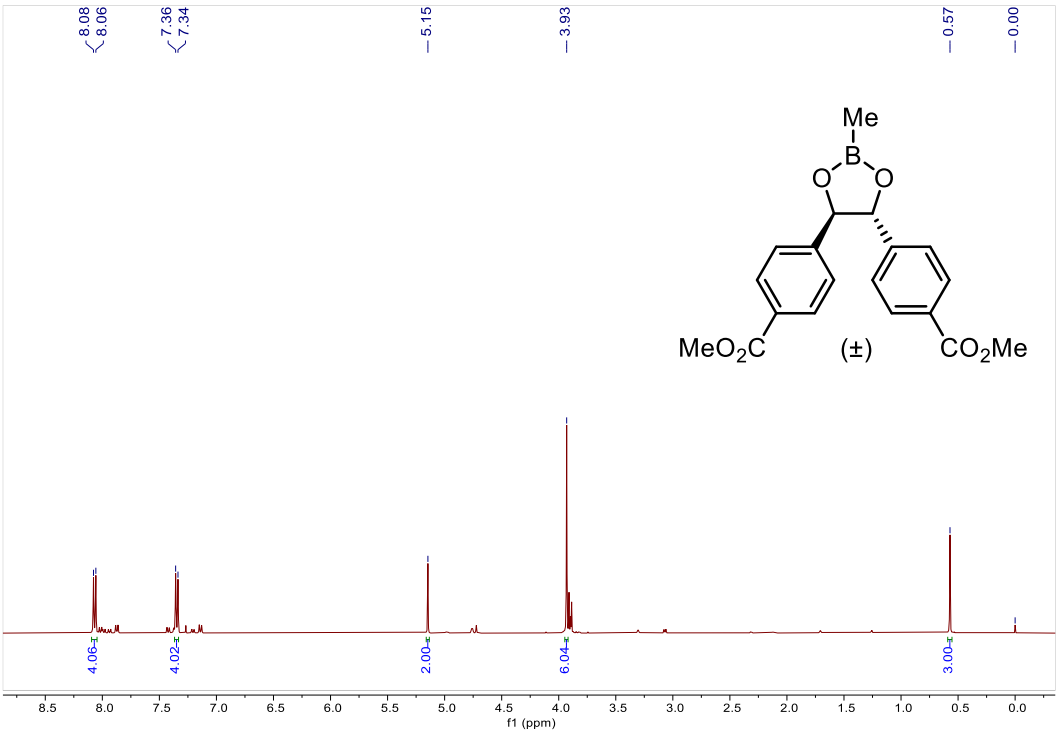
^{13}C{^{1}H} NMR for compound **4a**



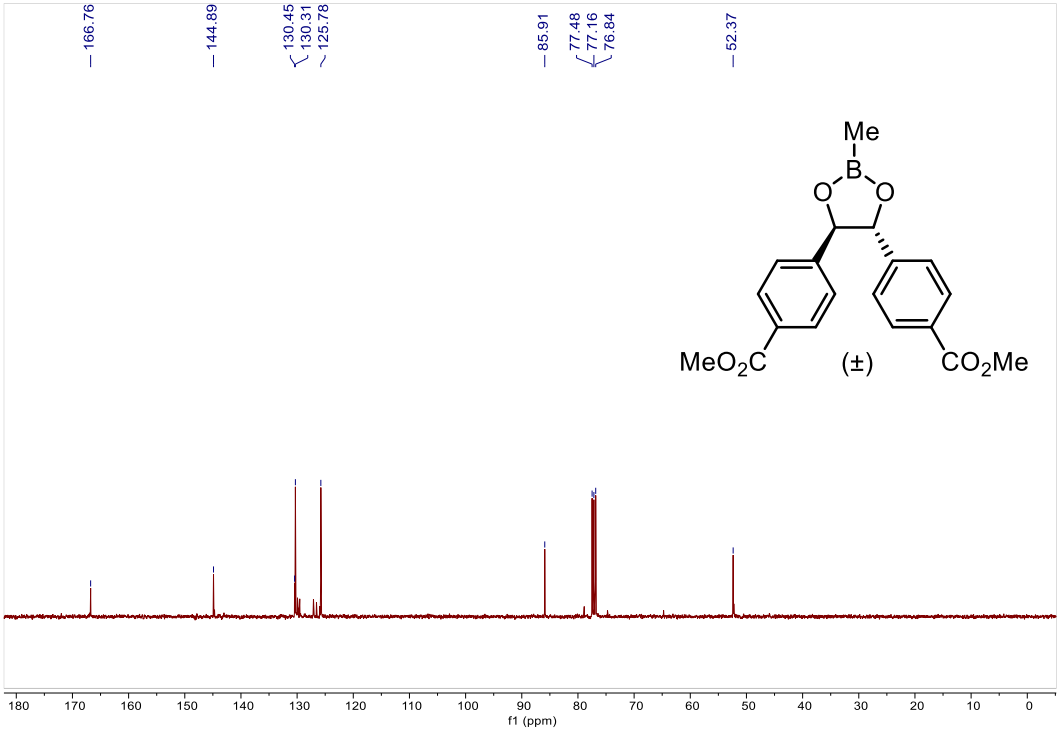
^{1}H NMR for compound **4b**



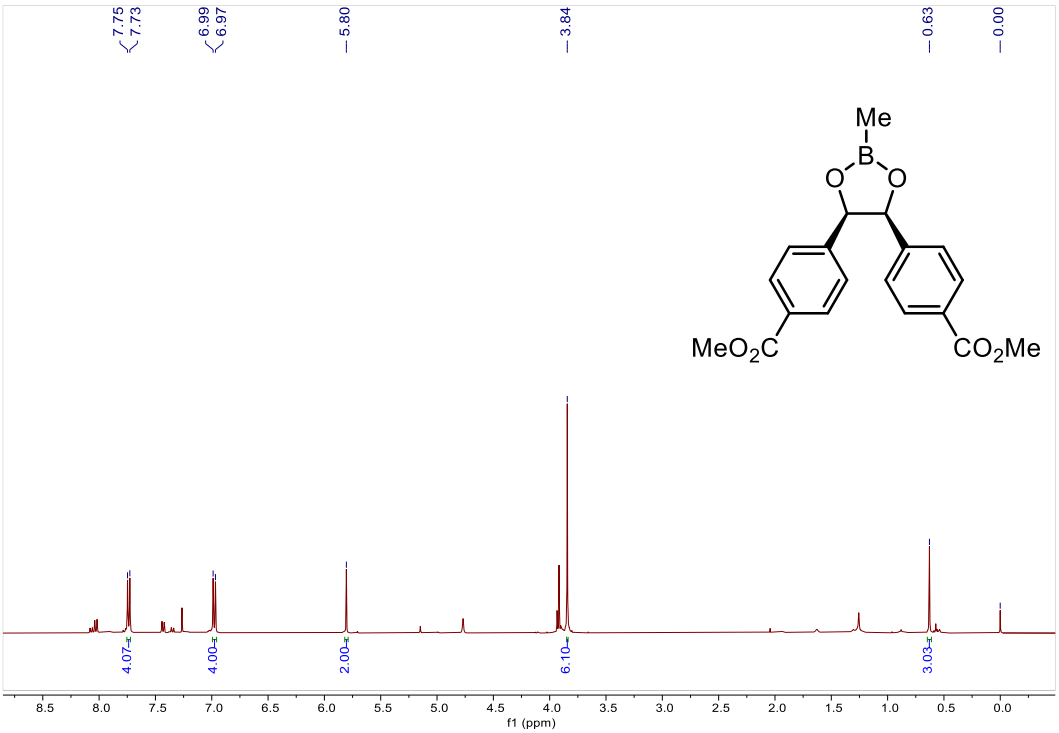
^{13}C{^{1}H} NMR for compound **4b**



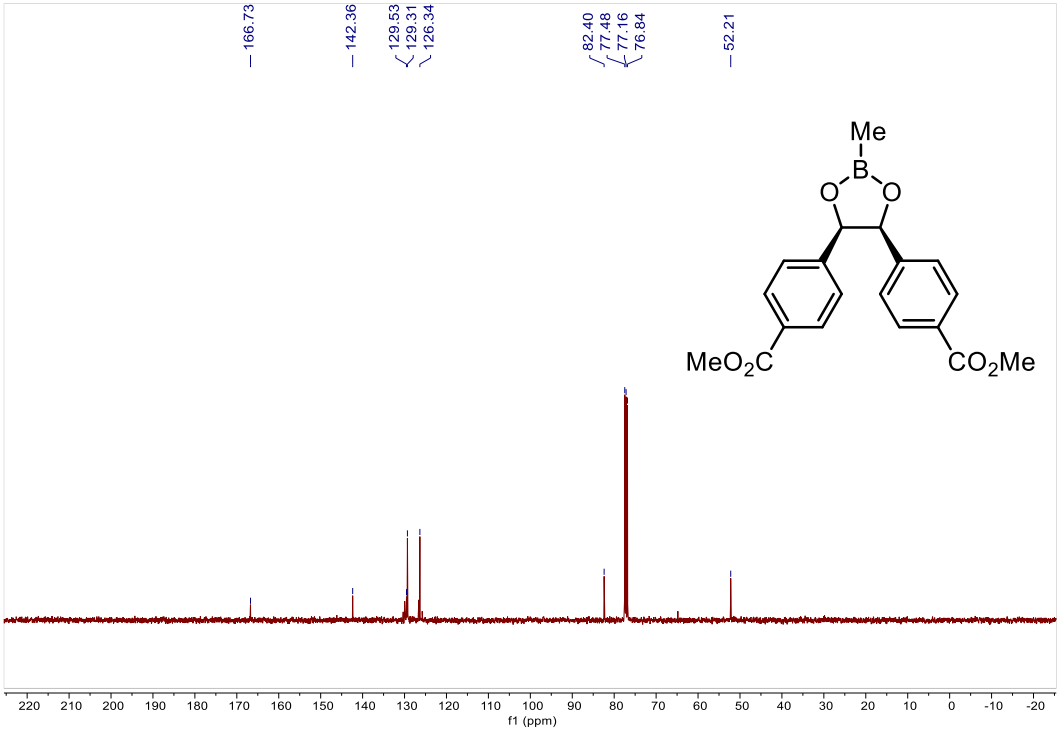
^{1}H NMR for compound ***dl*-5a**



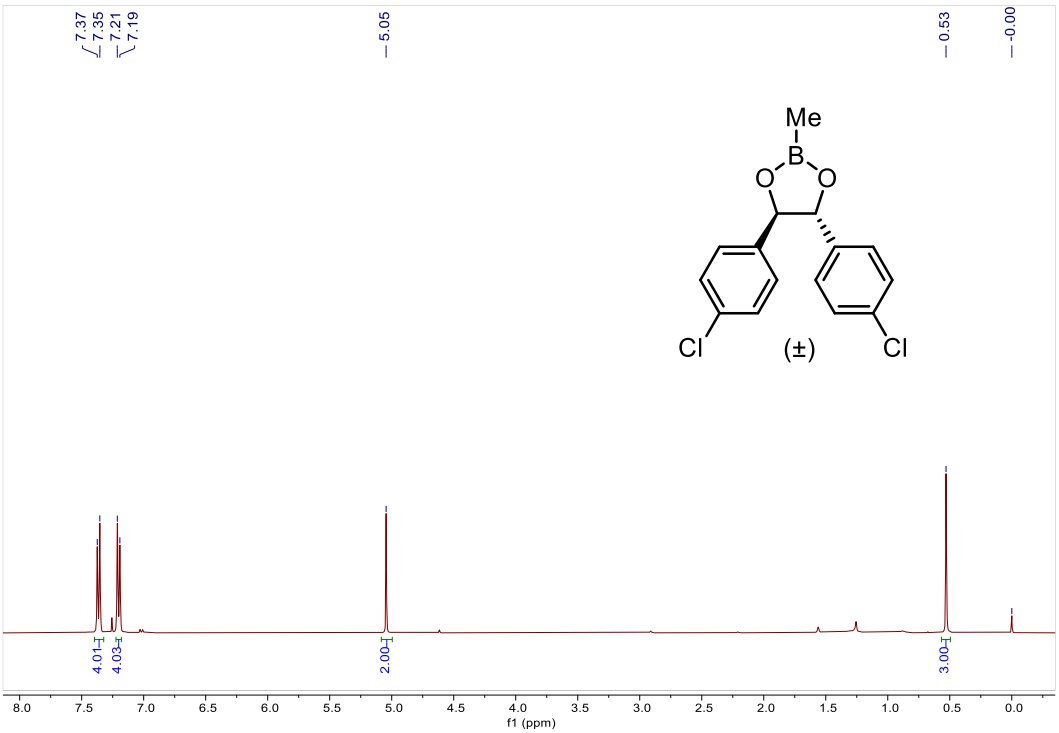
^{13}C{^{1}H} NMR for compound ***dl*-5a**



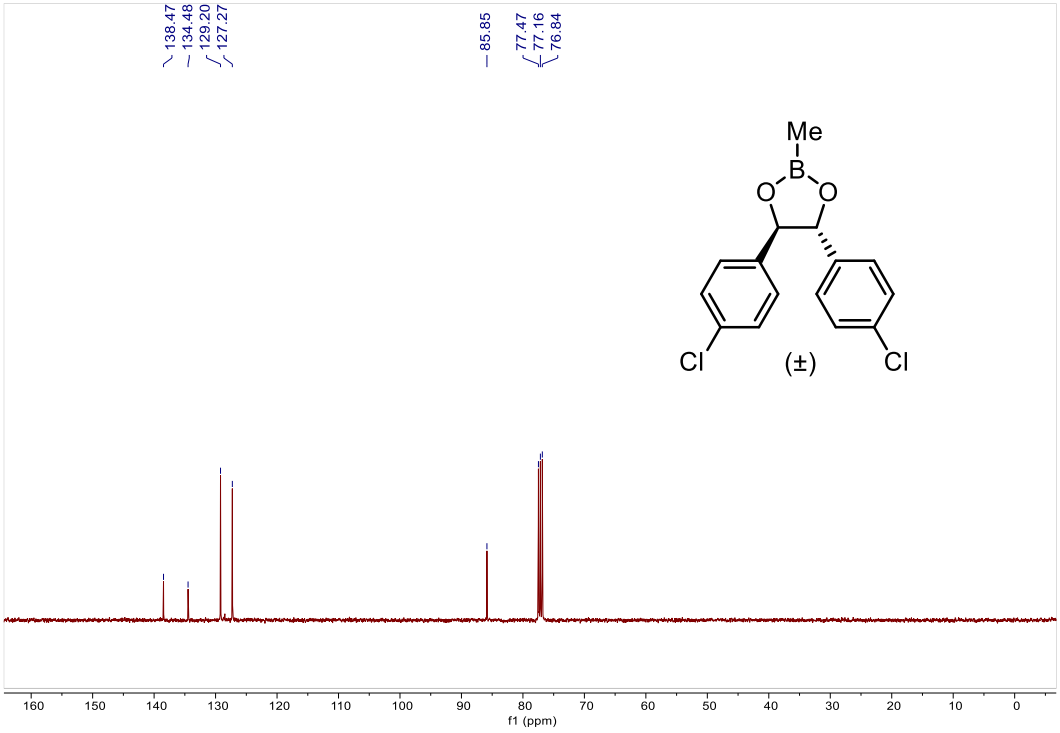
^{1}H NMR for compound ***meso*-5a**



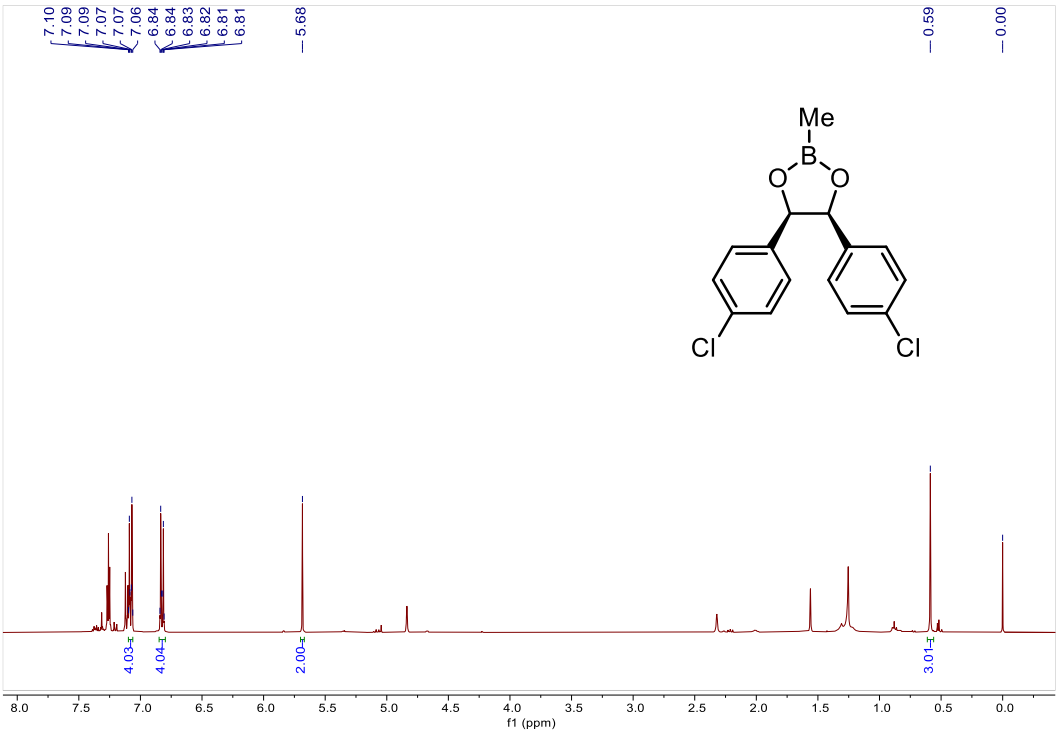
^{13}C{^{1}H} NMR for compound ***meso*-5a**



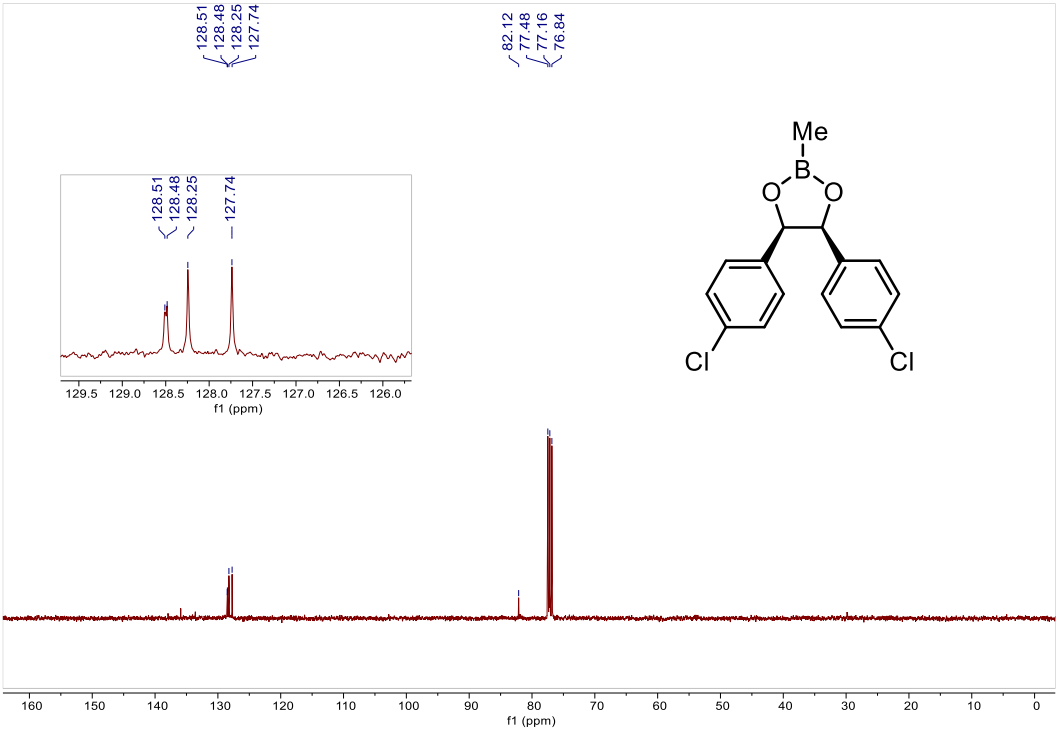
^{1}H NMR for compound ***dl*-5b**



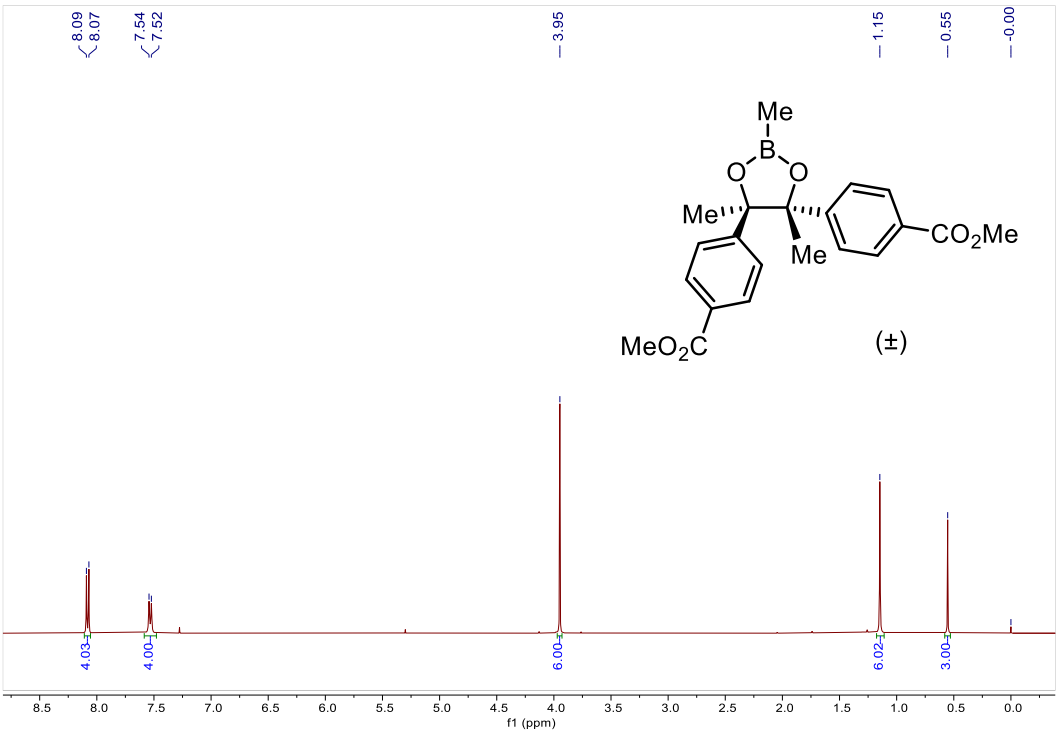
^{13}C{^{1}H} NMR for compound ***dl*-5b**



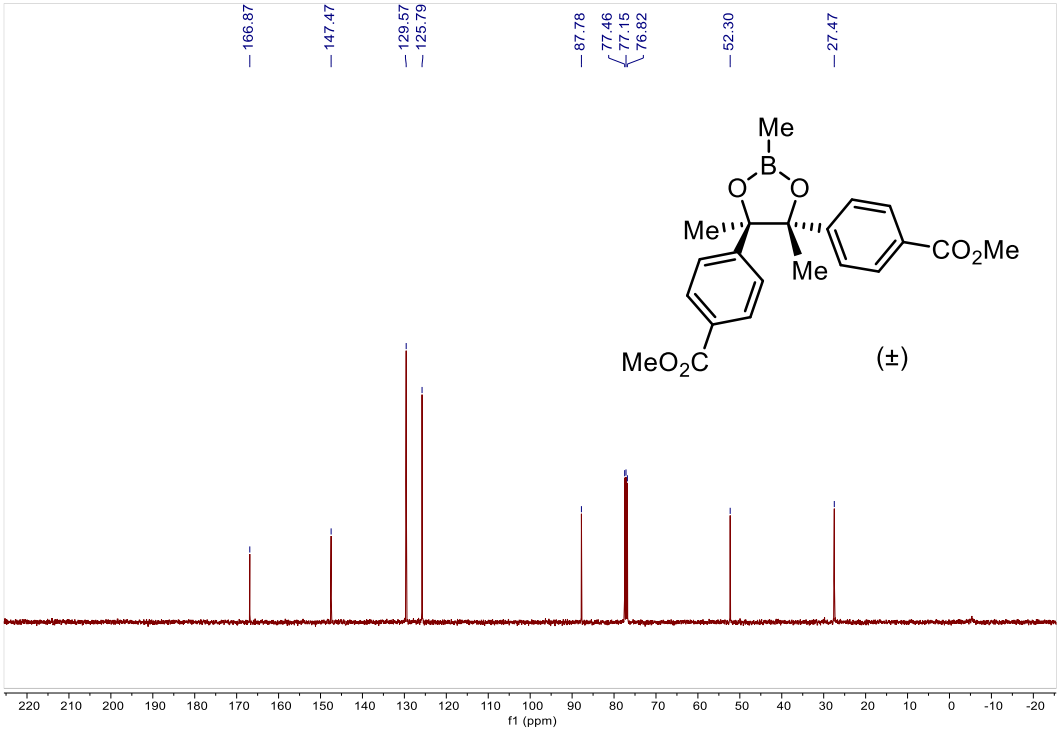
^{1}H NMR for compound ***meso*-5b**



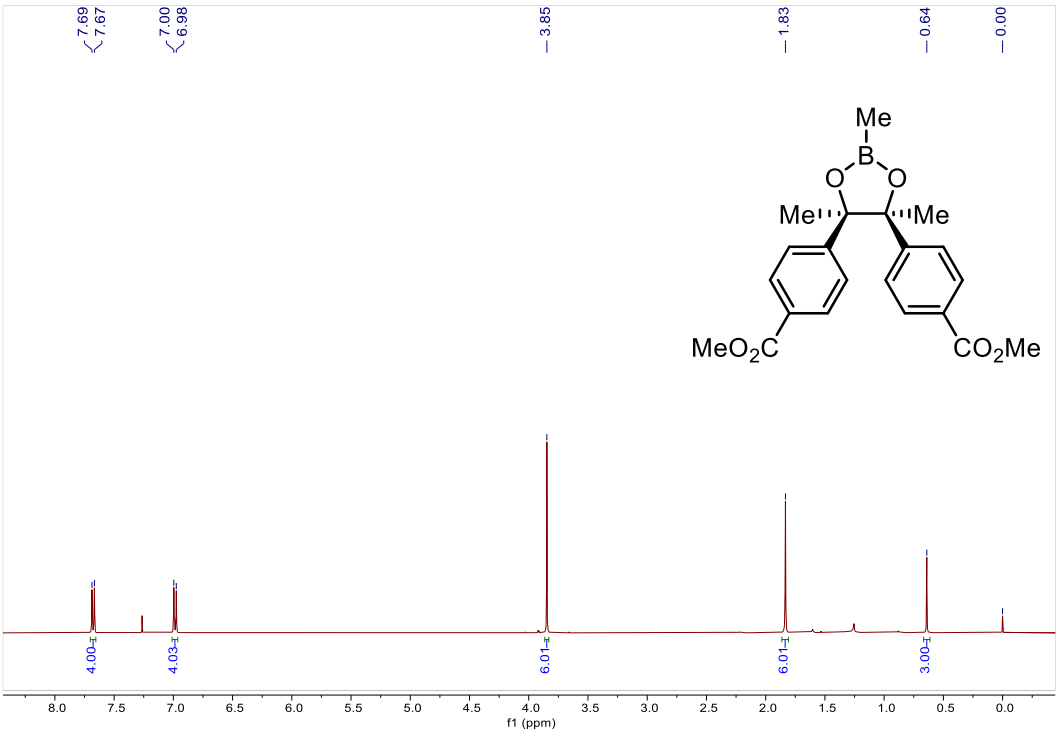
^{13}C{^{1}H} NMR for compound ***meso*-5b**



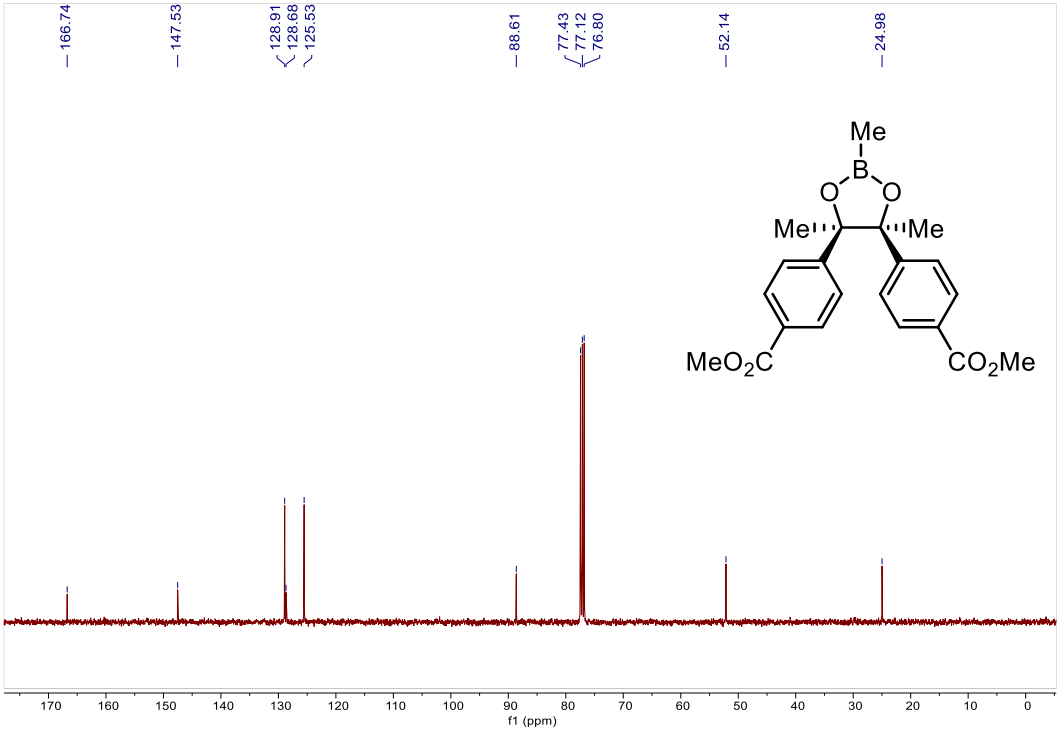
^{1}H NMR for compound ***dl*-5c**



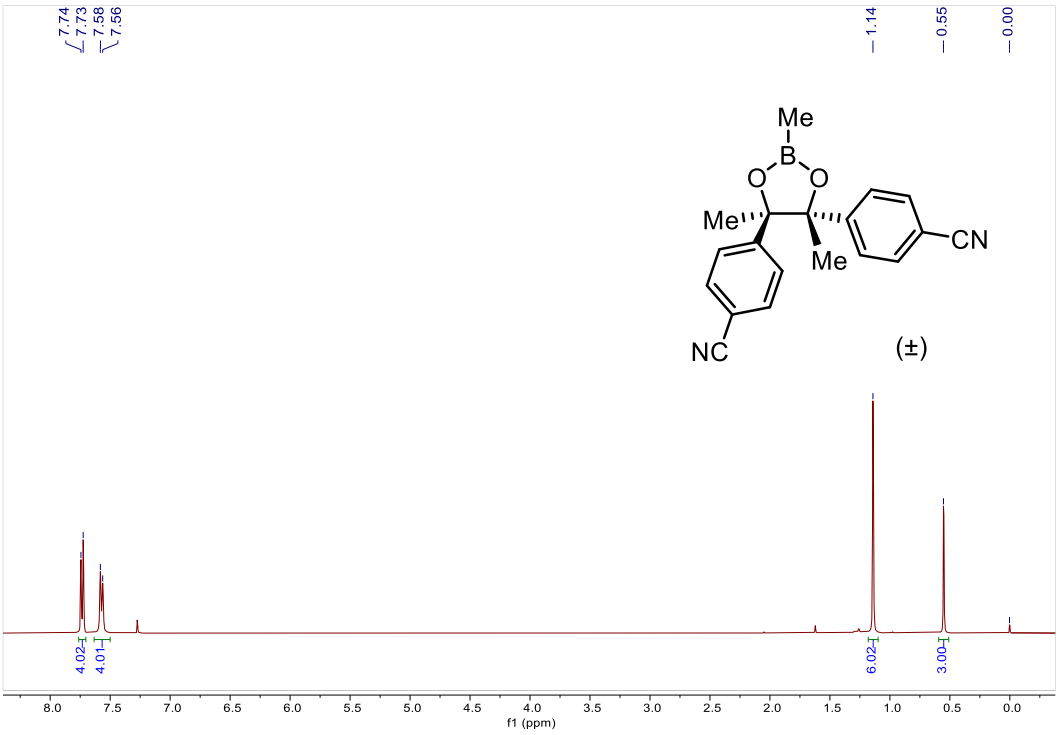
^{13}C{^{1}H} NMR for compound ***dl*-5c**



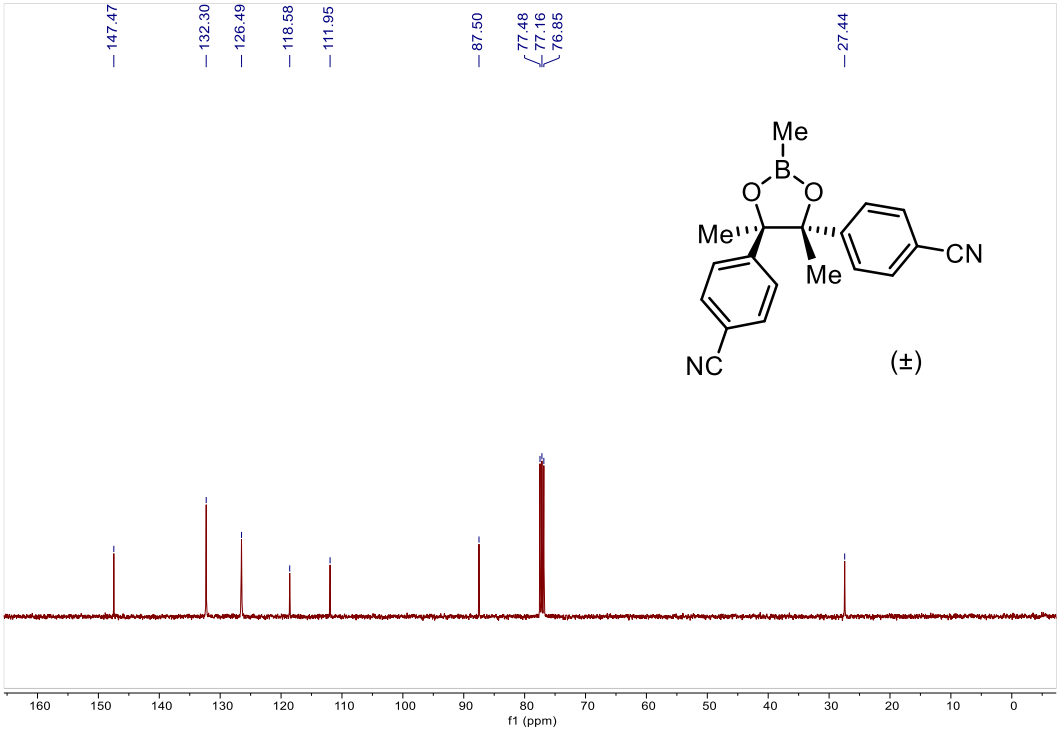
^{1}H NMR for compound ***meso*-5c**



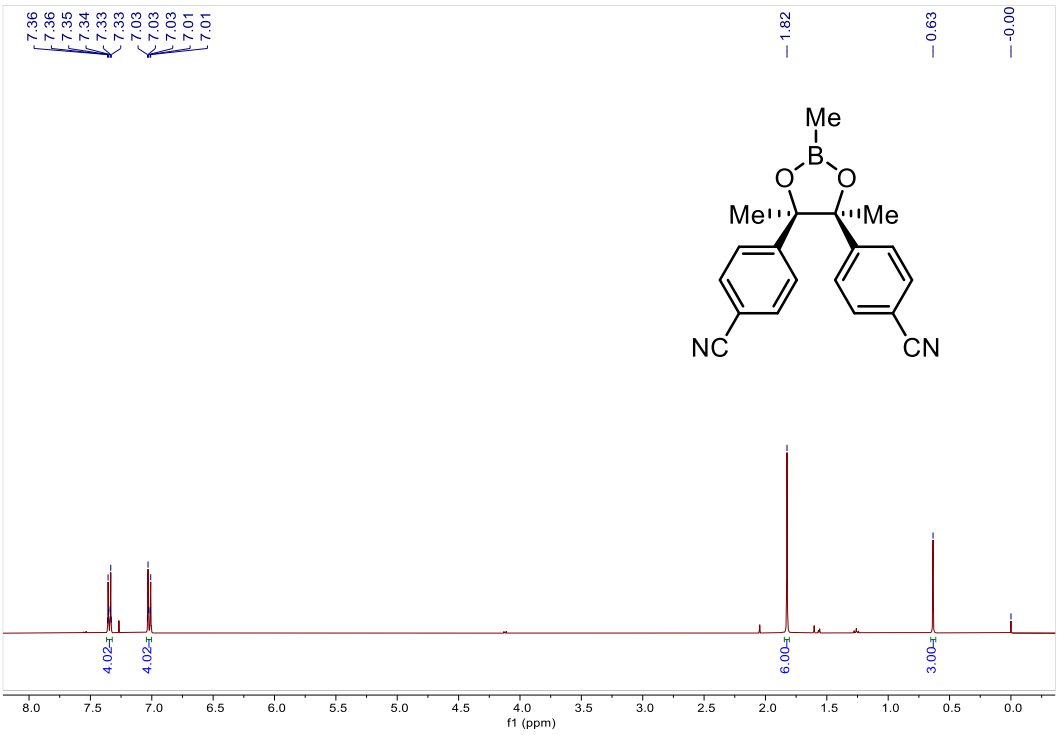
^{13}C{^{1}H} NMR for compound ***meso*-5c**



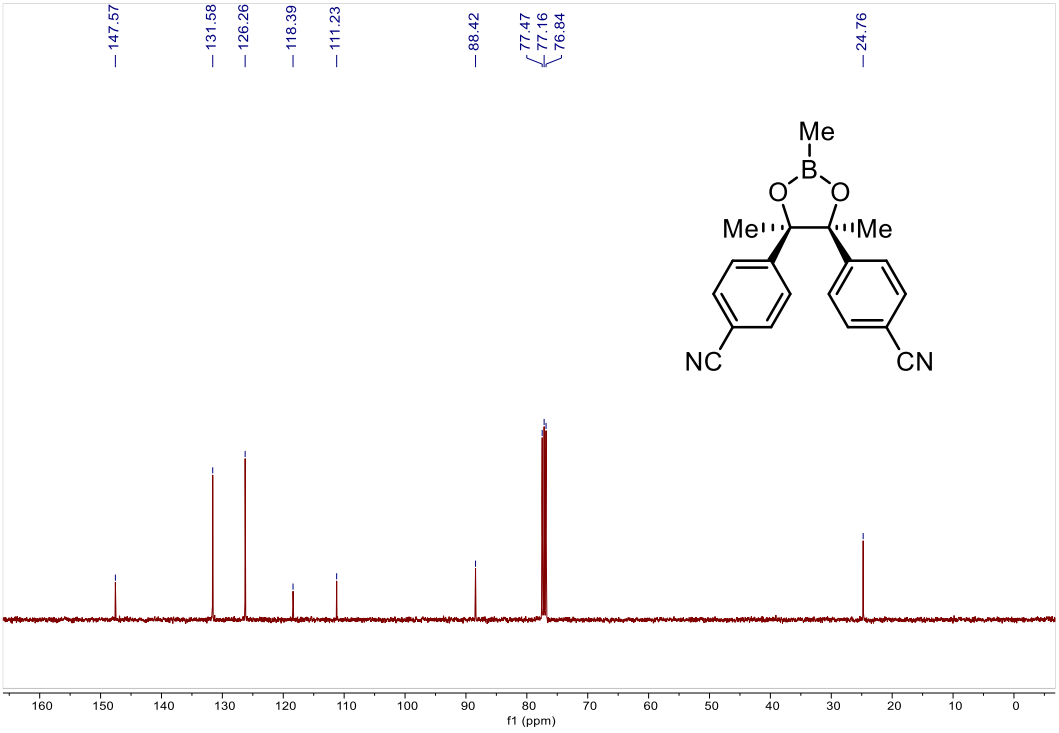
^{1}H NMR for compound ***dl*-5d**



^{13}C{^{1}H} NMR for compound ***dl*-5d**



^{1}H NMR for compound ***meso*-5d**



^{13}C{^{1}H} NMR for compound ***meso*-5d**