Supporting Information for Alkyl Bistriflimidate-Mediated Electrochemical Deaminative Functionalization

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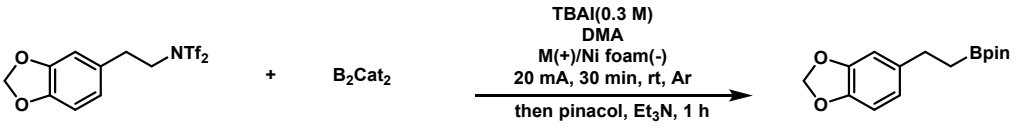
General Information

All reactions were performed in flame-dried glassware with magnetic stirring bar and sealed with a rubber septum. The solvents were distilled by standard methods. Reagents were obtained from commercial suppliers and used without further purification unlessotherwise noted. Silica gel column chromatography was carried out using silica Gel 60 (230–400 mesh). Analytical thin layer chromatography (TLC) was done using silica Gel (silica gel 60 F254). TLC plates were analyzed by an exposure to ultraviolet (UV) light. NMR experiments were measured on a Bruker AVANCE III-400 or 500 spectrometer and carried out indeuterochloroform ($CDCl_3$) ^{1}H NMR and ^{13}C NMR spectra were recorded at 400 MHz or 500 MHz and 100 MHz or 125 MHz spectrometers respectively. ^{19}F NMR spectra were recorded at 376 MHz or 470 MHz spectrometers. Chemical shifts are reported as δ valuesrelative to chloroform (δ 7.26 for ^{1}H NMR), chloroform (δ 77.16 for ^{13}C NMR). The following abbreviations are used for the multiplicities: s: singlet, d: doublet, dd: doublet of doublet, t: triplet, q: quadruplet, m: multiplet, br: broad signal for proton spectra; Coupling constants (J) are reported in Hertz (Hz). Infrared spectra were obtained on agilent Cary630. HRMS were recorded on a Bruker microTOF-Q111. GC-MS spectra were performed on Shimadzu QP2010 (EI Source). The EPR experiments are conducted on a Bruker ESR5000 electron paramagnetic resonance spectrometer. Unless otherwise noted, all reagents were weighed and handled in air, and all reactions were underargon.

Optimizations of the Reaction Conditions

Table S1. Optimization of electrode

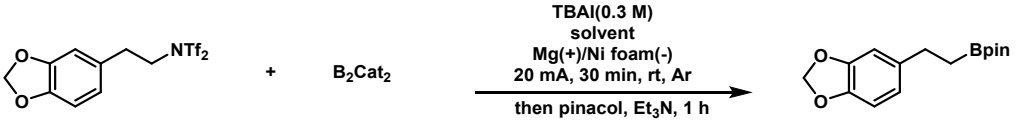


1 **2**

Entry	M	Yield [%][b]
1	Fe	69
2	Zn	57
3	C	n.d.
4	Al	16
5	Mg	88

[a]Reaction conditions: **1** (0.3 mmol), **2** (1.2 mmol), TBAI (0.3 M), DMA (3 mL), r.t., Ar, 30 min.[b]Determined by GC using Dodecane as internal standard.

Table S2. Optimization of solvent

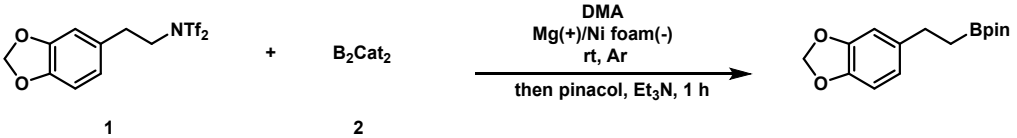


1 **2**

Entry	solvent	Yield [%][b]
1	DMA	88
2	DMF	37
3	DMSO	n.d.
4	MeCN	n.d.

[a]Reaction conditions: **1** (0.3 mmol), **2** (1.2 mmol), solvent (3 mL), r.t., Ar, 30 min.[b]Determined by GC using Dodecane as internal standard.

Table S3. Optimization of current and time

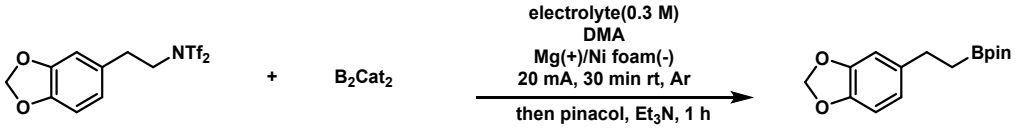


1 **2**

Entry	current	time	Yield [%][b]
1	30 mA	20 min	65
2	20 mA	30 min	88
3	10 mA	1 h	50
4	5 mA	2 h	43

[a]Reaction conditions: **1** (0.3 mmol), **2** (1.2 mmol), TBAI (0.3 M), DMA (3 mL), r.t., Ar, 30 min.[b]Determined by GC using Dodecane as internal standard.

Table S3. Optimization of electrolyte



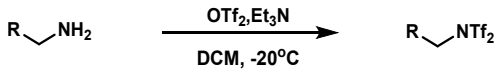
1 **2**

Entry	electrolyte	Yield [%][b]
1	TBAI	88
2	TBAB	76
3	NaI	85
4	^{n}BuNPF$_6$	n.d.

[a]Reaction conditions: **1** (0.3 mmol), **2** (1.2 mmol), DMA (3 mL), r.t., Ar, 30 min.[b]Determined by GC using Dodecane as internal standard.

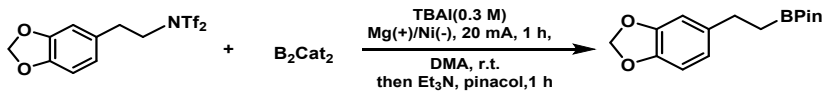
Experimental Procedure

General Procedure for the synthesis of the starting material (From primary alkyl amines)



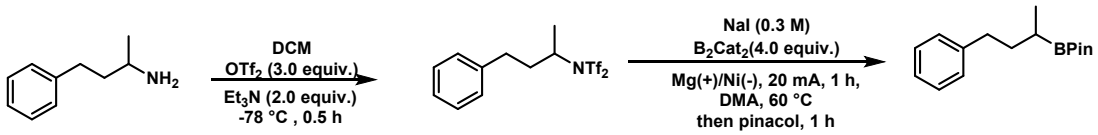
An oven dried round-bottom flask equipped with a stir bar was charged with amine (5.0 mmol, 1.0 equiv), CH_2Cl_2 (20 ml, 0.25M) and Et_3N (2.1 mL, 15 mmol, 3.0 equiv). The flask was cooled to -20 °C, and trifluoromethanesulfonic anhydride (1.7 mL, 2.8 g, 5.0 mmol, 2.0 equiv) was added dropwise. The reaction was stirred vigorously at -20 °C for 1 h and allowed to gradually warm up to room temperature. The reaction was then quenched with 20 mL H_2O. The reaction mixture was partitioned between H_2O and CH_2Cl_2 and layers were separated. The aqueous layer was extracted with CH_2Cl_2 (20 ml × 3). The organic layers were combined, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The reaction mixture was applied directly to a flash silica column for purification.

General Procedure for the synthesis of the product 3-32



TBAI (332 mg, 0.9 mmol), B_2cat_2 (477 mg, 2.0 mmol), alkyl bistriflimidate (0.5 mmol) and DMA (5 ml) in a tube and place in a glove box. Magnesium plate (52.5 × 8 × 2 mm) was used as the anode, foamed nickel electrode (52.5 × 8 × 2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA. Afterwards, a solution of pinacol (2.0 mmol, 4.0 equiv., 236 mg) in triethylamine (1.0 mL) was added to the electrolyzer cell and the reaction mixture kept stirring at room temperature for 1 h. The mixture was then quenched with ethyl acetate, dried onto silica gel, and purified by rapid column chromatography.

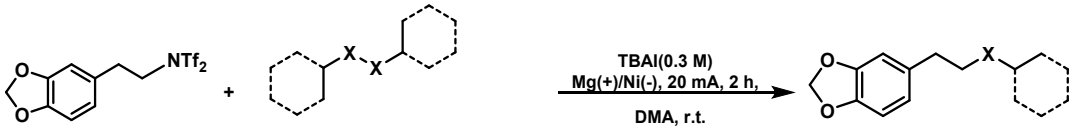
General Procedure for the synthesis of the product 33-36



An oven dried tube flask equipped with a stir bar placed in a glove box was charged with amine (0.5 mmol, 1.0 equiv), CH_2Cl_2 (1 ml, 0.5 M) and Et_3N (0.28 mL, 1 mmol, 2.0 equiv). The flask was cooled to -78 °C, and trifluoromethanesulfonic anhydride (0.26 mL, 0.42 g, 1.5 mmol, 3.0 equiv) was added dropwise. The reaction was stirred vigorously at -78 °C for 0.5 h. Then NaI (135 mg, 0.9 mmol), B_2cat_2 (477 mg, 2.0 mmol), and DMAc (3 ml) in the tube and place in a glove box. Magnesium plate (52.5 × 8 × 2 mm) was used as the anode, foamed nickel electrode (52.5 × 8 × 2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA at 60 °C. Afterwards, a solution of pinacol (2.0 mmol, 4.0 equiv., 236 mg) in triethylamine (1.0 mL) was added to the electrolyzer cell

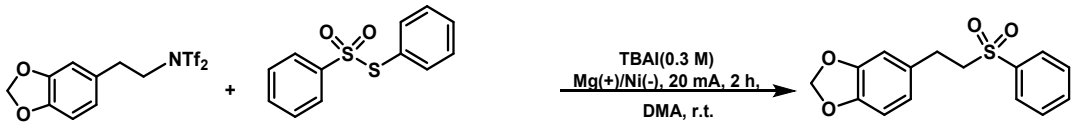
and the reaction mixture kept stirring at room temperature for 1 h. The mixture was then quenched with ethyl acetate, dried onto silica gel, and purified by rapid column chromatography.

General Procedure for the synthesis of the product 37-39,41-44



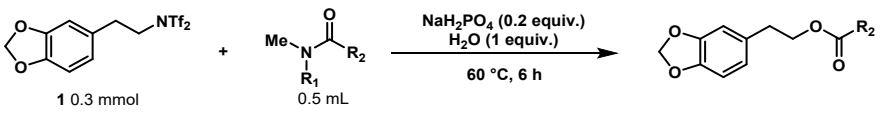
TBAI (332 mg, 0.9 mmol), disulfides (0.5 mmol), alkyl bistriflimidate (0.2 mmol) and DMAc (3 ml) in a tube and place in a glove box. Magnesium plate (52.5 × 8 × 2 mm) was used as the anode, foamed nickel electrode (52.5 × 8 × 2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA. The mixture was then quenched with ethyl acetate, dried onto silica gel, and purified by rapid column chromatography.

General Procedure for the synthesis of the product 40



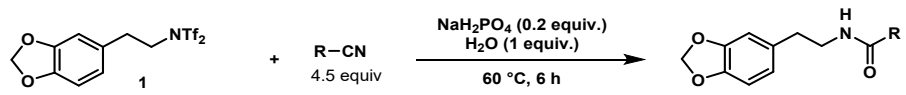
TBAI (332 mg, 0.9 mmol), benzenethiosulfonic acid s-phenyl ester (0.5 mmol), alkyl bistriflimidate (0.2 mmol) and DMAc (3 ml) in a tube and place in a glove box. Magnesium plate (52.5 × 8 × 2 mm) was used as the anode, foamed nickel electrode (52.5 × 8 × 2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA. The mixture was then quenched with ethyl acetate, dried onto silica gel, and purified by rapid column chromatography.

General Procedure for the synthesis of the product 45-48



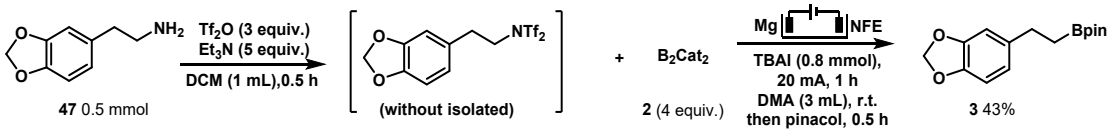
An oven dried round-bottom flask equipped with a stir bar was charged with alkyl bistriflimidate (0.2 mmol, 1.0 equiv), H_2O (0.2 mmol, 1.0 equiv), NaH_2PO_4 (0.04 mmol, 0.2 equiv) and amide (0.5 ml). The reaction was stirred at 60 °C for 6 h. The reaction was then quenched with 20 mL H_2O. The reaction mixture was partitioned between H_2O and CH_2Cl_2 and layers were separated. The aqueous layer was extracted with CH_2Cl_2 (20 ml × 3). The organic layers were combined, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The reaction mixture was applied directly to a flash silica column for purification.

General Procedure for the synthesis of the product 49-56



An oven dried round-bottom flask equipped with a stir bar was charged with alkyl bistriflimidate (0.2 mmol, 1.0 equiv), H_2O (0.2 mmol, 1.0 equiv), NaH_2PO_4 (0.04 mmol, 0.2 equiv) and nitrlie (0.9 mmol, 4.5 equiv). The reaction was stirred at 60 °C for 6 h. The reaction was then quenched with 20 mL H_2O. The reaction mixture was partitioned between H_2O and CH_2Cl_2 and layers were separated. The aqueous layer was extracted with CH_2Cl_2 (20 ml × 3). The organic layers were combined, dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The reaction mixture was applied directly to a flash silica column for purification.

One pot synthesis of products



An oven dried round-bottom flask equipped with a stir bar was charged with amine (0.5 mmol, 1.0 equiv.), CH_2Cl_2 (1 ml, 0.5 M) and Et_3N (2.5 mmol, 5.0 equiv.). The flask was cooled to -20 °C, and trifluoromethanesulfonic anhydride (1.5 mmol, 3.0 equiv.) was added dropwise. The reaction was stirred vigorously at -20 °C for 0.5 h and allowed to gradually warm up to room temperature. Then added TBAI (0.9 mmol), B_2cat_2 (2.0 mmol, 4 equiv.) and DMAc (3 ml) in the tube and place in a glove box. Magnesium plate (15 mm × 15 mm × 0.5 mm) was used as the anode, carbon cloth electrode (15 mm × 15 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA. Afterwards, a solution of pinacol (2.0 mmol, 4.0 equiv., 236 mg) in triethylamine (1.0 mL) was added to the electrolyzer cell and the reaction mixture kept stirring at room temperature for 1 h. The crude yields were determined by GC using dodecane as internal standard.

Graphical Guide for Borylation of Alkyl bistriflimidate

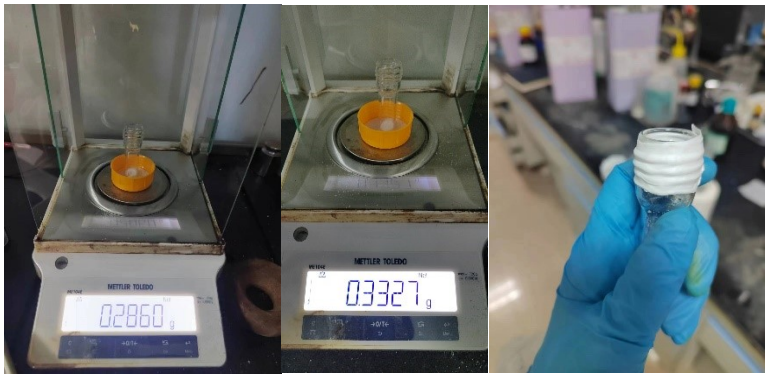
1. Materials used set-up.

Supplementary Figure 1: A electrochemical reaction bottle

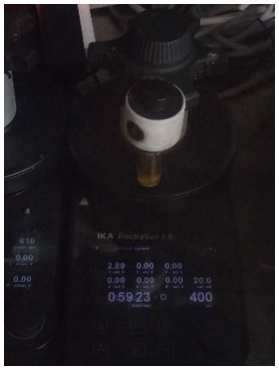
2. Reagents used for borylation: TBAI, B_2Cat_2, DMA, Pinacol, Et_3N and the Substrate.

Supplementary Figure 2: Electrochemical reaction reagents

3.TBAI (0.9 mmol, 332.0 mg) and B_2Cat_2 (1.2 mmol, 4 equiv., 286.0 mg) were added to a vessel equipped with a Teflon-coated magnetic stir bar. The vessel was wraped with teflon tape.



Supplementary Figure 3



4. the vessel was moved to the glove box. Alkyl bistriflimidate and DMA (3 ml) was added to the reaction mixture. The reaction mixture was connected to a potentiostat with the current kept at 20 mA.

Supplementary Figure 4: Duing reaction

Procedure for continuous-flow reactor

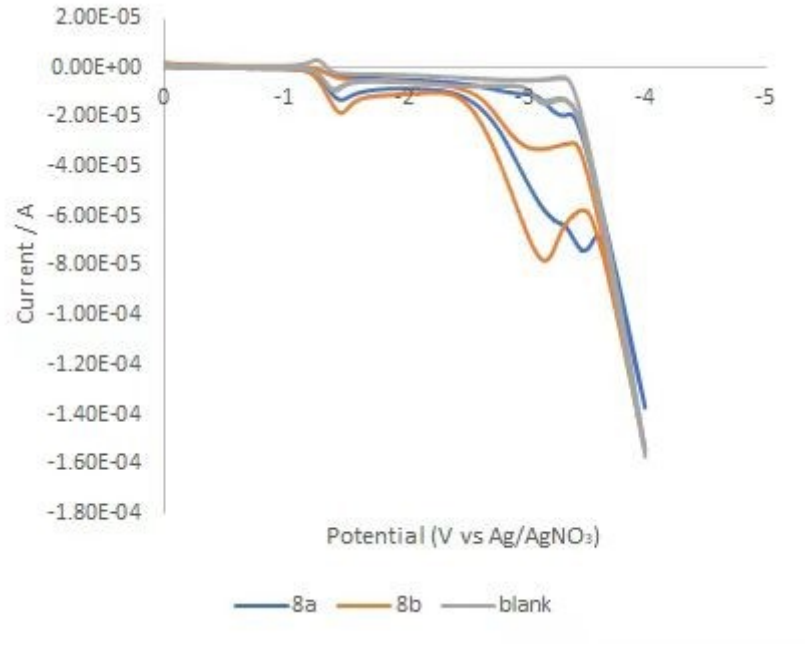
Supplementary Figure 5: Electrochemical Continuous-Flow System

First, the flow electrochemistry device was assembled and installed, with the anode being an Fe electrode, the cathode a nickel electrode, and a cell volume of 3 mL. Second, **1** (0.1 M), **2** (0.4 M), TBAI (0.3 M) were dissolved in DMA (30 mL). n-dodecane as internal standard. The reaction mixture was pumped into the flow cell via a syringe and electrolyzed at a constant current of 20 mA at room temperature. The flow rate was 0.0125 mL/min and residence time was 4 h. Then added triethylamine (0.8 M) and pinacol (0.8 M) and stired at room temperature for one hour. The out flow of the reaction mixture was collected and monitored by GCMS.

Procedure for cyclic voltammetry (CV)

Cyclic voltammetry was performed in a three-electrode cell connected to a schlenk line under nitrogen at room temperature. The working electrode was a steady glassy carbon disk electrode, the counter electrode a platinum wire. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution.

$^{n}Bu_4NClO_4$ (0.4 mmol) and a solvent (DMA, 10 mL) were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.025 V/s, ranging from -0.5 V to -4 V. (2) alkyl bistriflimidate (1 mM) and a mixed solvent (DMA, 10 mL) containing $^{n}Bu_4NClO_4$ (0.4 mmol) were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.025 V/s, ranging from -0.5 V to -4 V. (3) Alkyl iodide (1 mM) and a mixed solvent (DMA, 10 mL) containing $^{n}Bu_4NClO_4$ (0.4 mmol) were poured into the electrochemical cell in cyclic voltammetry experiments. The scan rate was 0.025 V/s, ranging from -0.5 V to -4 V. (Supplementary Figure 6).



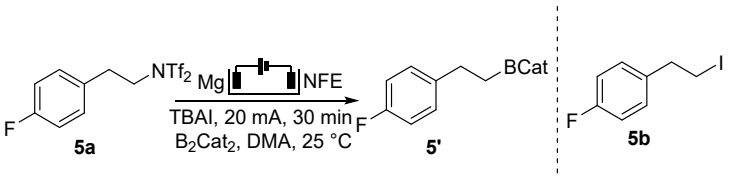
Supplementary Figure 6: Cyclic voltammetry

Scale Up Experiments

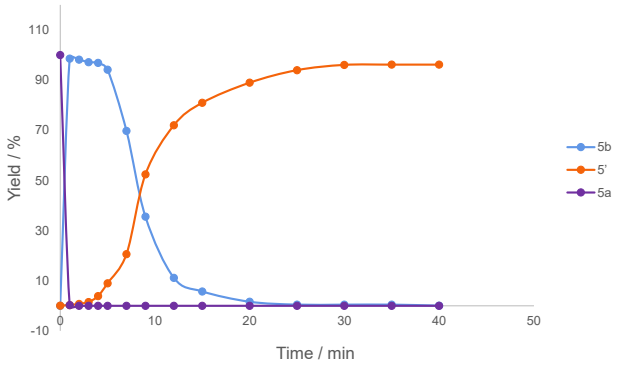
Supplementary Figure 7: Scale Up Experiments

TBAI (3.32 g, 9 mmol), B_2Cat_2 (2.86 g, 12 mmol), **1** (1.28 g, 3 mmol) and DMAc (30 ml) in a tube. Magnesium plate (35 mm × 40 mm × 0.2 mm) was used as the anode, carbon cloth electrode (35 mm × 40 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 100 mA until the alkyl bistriflimidate was consumed. Then added triethylamine (2.42 g, 24 mmol) and pinacol (2.83 g, 24 mmol) and stired at room temperature for one hour. The mixture was then quenched with ethyl acetate, dried onto silica gel, and purified by rapid column chromatography.

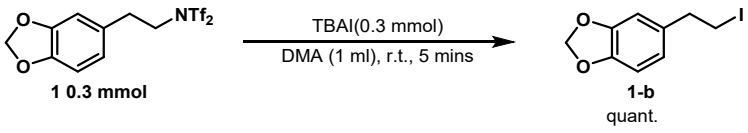
Intermediate verification experiments



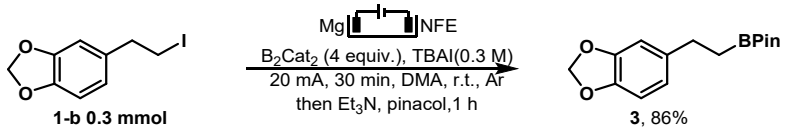
TBAI (332 mg, 0.9 mmol), B_2Cat_2 (286 mg, 1.2 mmol), **5a** (121 mg, 0.3 mmol), internal standard trifluorotoluene (0.5 mmol) and DMAc (3 ml) in a tube and placed in a glove box. Magnesium plate (52.5×8×2 mm) was used as the anode, foamed nickel electrode (52.5×8×2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA. Samples of the reaction mixture were taken in small amounts for yield analysis every minute during the first 10 minutes and then every 5 minutes thereafter. The results are as follows.



Supplementary Figure 8: Reaction progress

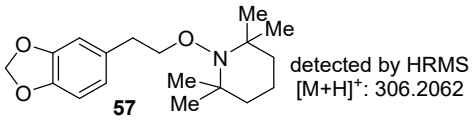


TBAI (110 mg, 0.3 mmol), **1** (128 mg, 0.3 mmol), and DMAc (1 ml) in a tube. After stirring the reaction mixture for five minutes, we monitored the disappearance of starting material **1** by TLC. Then, 20 mL of EA was added for extraction, followed by washing with water, resulting in the equivalent conversion to **1-b** without the need for further separation steps. Compound **1-b**: **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 6.75 (m, 1H), 6.70 – 6.54 (m, 2H), 5.94 (s, 2H), 3.38 – 3.16 (m, 2H), 3.08 (t, J = 7.7 Hz, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 147.9 , 146.5 , 134.6 , 121.5 , 108.8 , 108.5 , 101.1 , 40.2 , 6.2 .

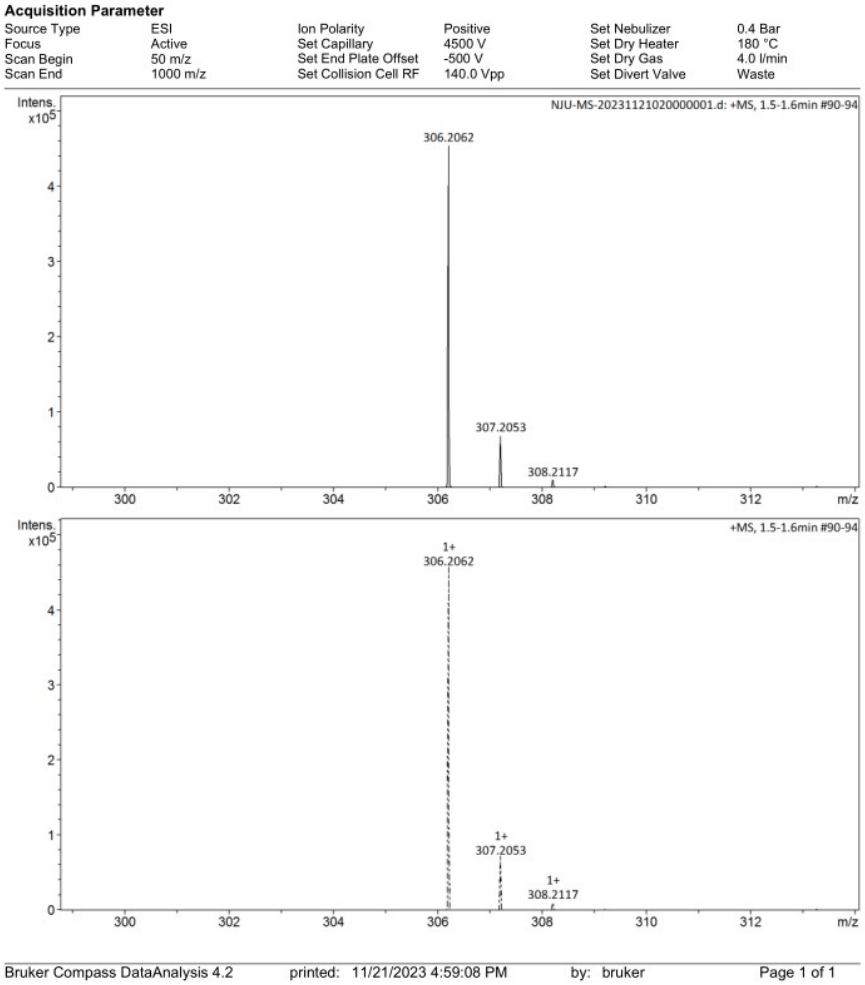


TBAI (332 mg, 0.9 mmol), B_2Cat_2 (286 mg, 1.2 mmol), **1-b** (83 mg, 0.3 mmol), and DMAc (3 ml) in a tube and placed in a glove box. Magnesium plate (52.5×8×2 mm) was used as the anode, foamed nickel electrode (52.5×8×2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA, 30 min. Afterwards, a solution of pinacol (2.0 mmol, 4.0 equiv., 236 mg) in triethylamine (1.0 mL) was added to the electrolyzer cell and the reaction mixture kept stirring at room temperature for 1 h. The yield was determined by GC using dodecane as internal standard.

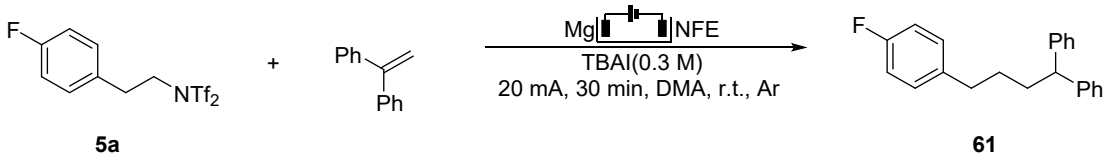
Radical capture experiments



TBAI (332 mg, 0.9 mmol), B_2Cat_2 (286 mg, 1.2 mmol), **1** (128 mg, 0.3 mmol), TEMPO (140 mg, 0.9 mmol), and DMAc (3 ml) in a tube and placed in a glove box. Magnesium plate (52.5×8×2 mm) was used as the anode, foamed nickel electrode (52.5×8×2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA, 30 min. Afterwards, a solution of pinacol (2.0 mmol, 4.0 equiv., 236 mg) in triethylamine (1.0 mL) was added to the electrolyzer cell and the reaction mixture kept stirring at room temperature for 1 h. The yield was determined by GC using dodecane as internal standard. And the alkyl-TEMPO adduct **57** was detected by HRMS.

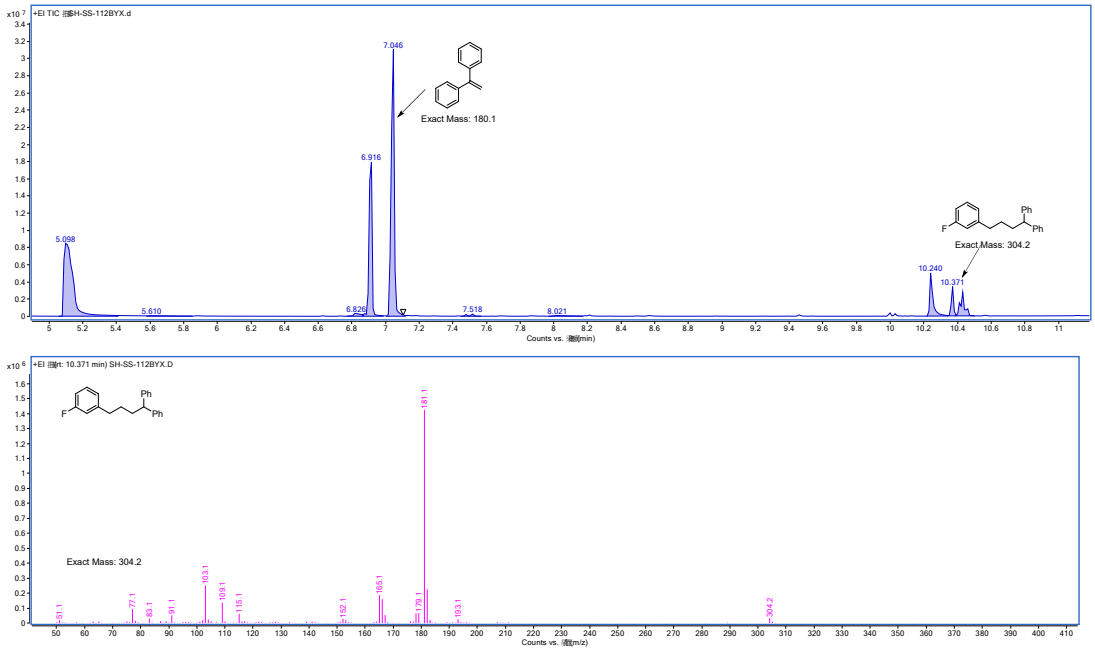


Supplementary Figure 9: HRMS date of **57**

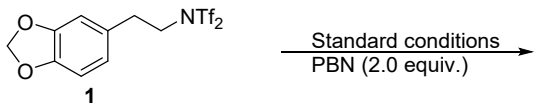


5a **61**

TBAI (332 mg, 0.9 mmol), 1,1-diphenylethylene (0.6 mmol), **5a** (0.3 mmol) and DMAc (3 ml) in a tube and placed in a glove box. Magnesium plate (52.5×8×2 mm) was used as the anode, foamed nickel electrode (52.5×8×2 mm) was used as the cathode and then the reaction mixture was electrolyzed at a constant current of 20 mA, 30 min. Afterwards, the radical adducts **61** were detectable by GC-MS.



EPR experiments:



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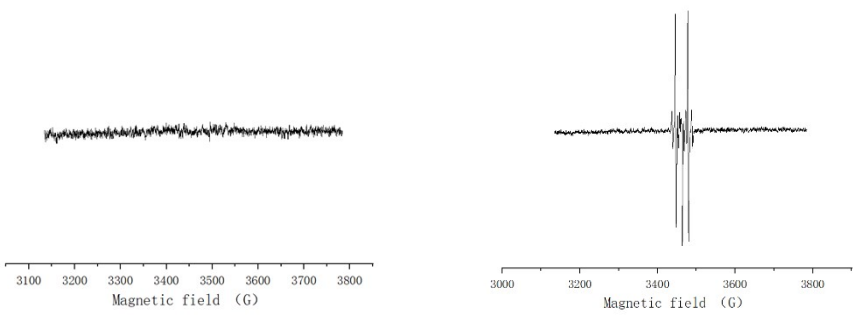
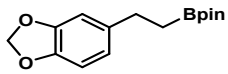


background(**left**). standard conditions + PBN (**right**)

Overview: the radical trapping agent TEMPO was added under the standard conditions and the alkyl radical was captured by HRMS, the radical trapping agent 1,1-diphenylethylene was added under the standard conditions and the alkyl radical was captured by GC-MS. In addition, a positive EPR signal was observed. Those support radical progress.

Characterization Data

Compound 3



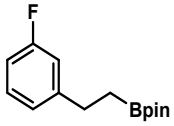
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 108 mg (78%). Physical State: colorless oil. R_f= 0.35 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-d) δ 6.70 (m, 3H), 5.90 (s, 2H), 3.19 – 2.39 (m, 2H), 1.22 (s, 12H), 1.09 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 147.4, 145.3, 138.4, 120.6, 108.6, 108.0, 100.6, 83.1, 29.8, 24.8. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 4



0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 94 mg (75%). Physical State: colorless oil. R_f= 0.35 (Hexane: ethyl acetate=20:1).

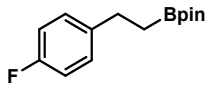
^{1}H NMR (400 MHz, Chloroform-d) δ 7.28 – 7.14 (m, 1H), 7.02 – 6.88 (m, 2H), 6.89 – 6.79 (m, 1H), 2.74 (t, *J* = 8.1 Hz, 2H), 1.22 (s, 12H), 1.17 – 1.08 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 161.2 (d, *J* = 242.6 Hz), 147.2 (d, *J* = 7.0 Hz), 129.7 (d, *J* = 8.4 Hz), 123.8 (d, *J* = 2.8 Hz), 115.0 (d, *J* = 20.9 Hz), 112.5 (d, *J* = 21.0 Hz), 83.4, 29.9, 24.9. The signal of the α-B-carbon was not observed.

^{19}F NMR (376 MHz, Chloroform-d) δ -114.26.

All data matched that reported in the literature[1]

Compound 5



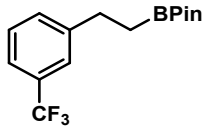
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 91.1 mg (73%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.18 – 7.13 (m, 2H), 6.97 – 6.89 (m, 2H), 2.72 (t, *J* = 8.1 Hz, 2H), 1.21 (s, 12H), 1.16 – 1.07 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.24 (d, *J* = 242.6 Hz), 140.4 (d, *J* = 3.1 Hz), 129.8 (d, *J* = 7.7 Hz), 115.3 (d, *J* = 21.0 Hz), 83.6, 29.6, 25.3. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 6



0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 105 mg (70%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

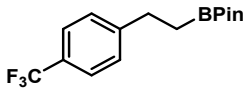
^{1}H NMR (400 MHz, Chloroform-d) δ 7.49 (s, 1H), 7.44 – 7.34 (m, 3H), 2.81 (t, *J* = 7.9 Hz, 2H), 1.20 (s, 12H), 1.16 (t, *J* = 7.9 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-d) δ 145.4 , 131.7 , 130.5 (q, *J* = 31.7 Hz), 128.7 , 127.5 (d, *J* = 266.0 Hz).125.0 (q, *J* = 3.9 Hz), 122.6 (q, *J* = 4.1 Hz), 83.4, 30.0, 24.9. The signal of the α-B-carbon was not observed.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.60.

All data matched that reported in the literature[7]

Compound 7



0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 90 mg (60%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1).

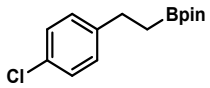
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.51 (d, *J* = 8.0 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 2.80 (t, *J* = 8.1 Hz, 2H), 1.22 (s, 12H), 1.15 (t, *J* = 8.1 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.6, 128.5, 128.1 (q, *J* = 32 Hz), 125.2 (q, *J* = 270 Hz), 124.6 (q, *J* = 8.1 Hz, 2H), 83.4, 30.0, 24.9. The signal of the α-B-carbon was not observed.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.27.

All data matched that reported in the literature[1]

Compound 8



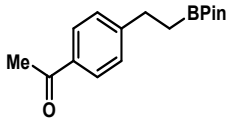
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 89.1 mg (67%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.21 (d, *J* = 8.4 Hz, 2H), 7.13 (d, *J* = 8.4 Hz, 2H), 2.71 (t, *J* = 8.1 Hz, 2H), 1.21 (s, 12H), 1.15 – 1.07 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.9, 131.3, 129.5, 128.3, 83.3, 29.5, 25.0. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[2]

Compound 9



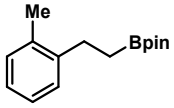
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=15:1) afforded 91.8 mg (67%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=15:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.89 – 7.82 (m, 2H), 7.37 – 7.25 (m, 2H), 2.79 (t, *J* = 8.1 Hz, 2H), 2.56 (s, 3H), 1.21 (s, 12H), 1.14 (t, *J* = 8.1 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 198.1, 150.4, 135.0, 128.6, 128.3, 83.4, 30.2, 26.7, 25.0. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 10



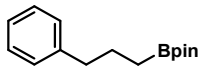
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 92 mg (75%). Physical State: colorless oil. R_f= 0.40 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.09 (s, 4H), 2.76 – 2.67 (m, 2H), 2.30 (s, 3H), 1.22 (s, 12H), 1.14 – 1.05 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.6, 135.9, 130.1, 128.2, 125.9, 125.8, 83.0, 27.3, 24.9, 19.4. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[2]

Compound 11



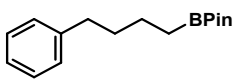
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 86 mg (70%). Physical State: colorless oil. R_f= 0.40 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.32 – 7.03 (m, 5H), 2.70 – 2.43 (m, 2H), 1.84 – 1.61 (m, 2H), 1.23 (s, 12H), 0.81 (t, *J* = 7.9 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.8, 128.7, 128.3, 125.7, 83.0, 38.7, 26.2, 25.0, 11.0.

All data matched that reported in the literature[2]

Compound 12



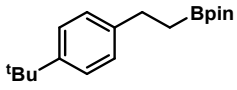
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 90 mg (71%). Physical State: colorless oil. R_f= 0.40 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.43 – 7.03 (m, 5H), 2.72 – 2.35 (m, 2H), 1.76 – 1.53 (m, 2H), 1.53 – 1.37 (m, 2H), 1.24 (s, 12H), 0.88 – 0.79 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 143.1, 128.5, 128.3 0, 125.6 0, 83.0 0, 35.9 0, 34.3 0, 29.9 0, 25.0, 23.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[2]

Compound 13



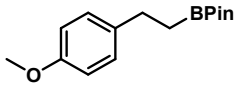
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 108.1 mg (75%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.43 – 7.28 (m, 2H), 7.28 – 7.13 (m, 2H), 2.86 – 2.69 (m, 2H), 1.36 (s, 9H), 1.27 (s, 12H), 1.23 – 1.13 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.3, 141.4, 127.8, 125.2, 83.1, 34.4, 31.6, 29.5, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 14



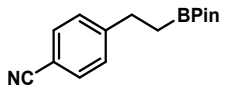
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 92 mg (71%). Physical State: white solid. R_f= 0.5 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.13 (m, 2H), 6.86 – 6.75 (m, 2H), 3.77 (s, 3H), 2.71 – 2.67 (m, 2H), 1.22 (s, 12H), 1.11 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 157.7, 136.7, 129.0, 113.7, 83.2, 55.4, 29.2, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 15



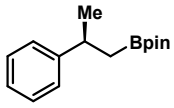
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 88 mg (69%). Physical State: white solid. R_f= 0.55 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.54 (d, J = 8.3 Hz, 2H), 7.34 – 7.26 (m, 2H), 2.79 (t, J = 8.0 Hz, 2H), 1.20 (s, 12H), 1.13 (t, J = 8.1 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 150.2, 132.2, 128.9, 119.3, 109.5 , 83.4, 30.3, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[3]

Compound 16



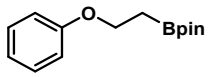
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 80 mg (65%). Physical State: white solid. R_f= 0.55 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.28 – 7.21 (m, 4H), 7.17 – 7.11 (m, 1H), 3.06 – 2.98 (m, 1H), 1.27 (d, *J* = 6.9 Hz,3H), 1.15 (s, 14H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 149.4, 128.3, 126.8, 125.8, 83.1, 35.9, 25.0, 24.9, 24.8, 21.3.

All data matched that reported in the literature[8]

Compound 17



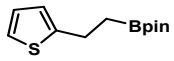
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 82.3 mg (67%). Physical State: colorless oil. R_f= 0.55 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.30 – 7.21 (m, 2H), 7.08 – 6.86 (m,3H), 4.11 (t, *J* = 7.8 Hz, 2H), 1.37 (t, *J* = 7.8 Hz,2H), 1.26 (s, 12H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.2, 129.4, 120.5, 114.8, 83.5, 64.9, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[5]

Compound 18



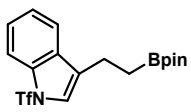
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 90 mg (76%). Physical State: colorless oil. R_f= 0.40 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.08 – 7.06 (m, 1H), 6.90 – 6.88 (m, 1H), 6.80 – 6.79 (m, 1H), 2.94 – 2.98 (m, 2H), 1.20 (s, 12H), 0.85 – 0.89 (m, 2H)

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.9, 126.7, 123.5, 122.7, 83.4, 29.8, 24.9, 14.3.

All data matched that reported in the literature[2]

Compound 19



0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=10:1) afforded 135 mg (67%). Physical State: white solid. R_f= 0.40 (Hexane: ethyl acetate=10:1).

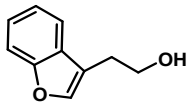
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.91 – 7.84 (m, 1H), 7.65 – 7.57 (m, 1H), 7.37 (ddd, *J* = 7.0, 5.2, 1.6 Hz, 2H), 7.16 (d, *J* = 1.4 Hz, 1H), 2.88 – 2.79 (m, 2H), 1.27 – 1.20 (m, 14H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 135.9, 131.4, 128.0, 125.8, 124.6, 122.1, 120.2, 119.8 (q, *J* = 324.1 Hz), 113.9, 83.5, 24.9, 19.3. The signal of the α-B-carbon was not observed.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -75.19.

HRMS(ESI) m/z: calced for $C_{17}H_{22}BF_3NO_4S^+$ $[M+H]^+$: 404.1309, found: 404.1310.

Compound 20



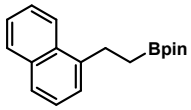
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 78 mg (58%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.58 – 7.54 (m, 1H), 7.52 – 7.45 (m, 2H), 7.33 – 7.21 (m, 2H), 3.91 (t, *J* = 6.4 Hz, 2H), 2.95 – 2.88 (m, 2H), 1.73 (s, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 155.8, 142.6, 128.4, 124.8, 122.9, 120.0, 117.2, 112.0, 62.2, 27.5.

All data matched that reported in the literature[21]

Compound 21



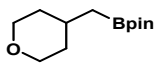
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 96 mg (68%). Physical State: white solid. R_f= 0.55 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.14 – 8.05 (m, 1H), 7.88 – 7.81 (m, 1H), 7.73 – 7.65 (m, 1H), 7.55 – 7.42 (m, 2H), 7.39 (d, *J* = 6.2 Hz, 2H), 3.27 – 3.18 (m, 2H), 1.35 – 1.26 (m, 2H), 1.25 (s, 12H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 140.6, 133.9, 131.9, 128.8, 126.4, 125.7, 125.7, 125.5, 125.1, 124.1, 83.3, 27.1, 25.0. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[2]

Compound 22



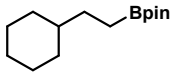
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 73.5 mg (65%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 3.91 – 3.82 (m, 2H), 3.38 – 3.34 (m, 2H), 1.71 – 1.67 (m,1H), 1.60 – 1.55 (m, 2H), 1.31 – 1.25 (m, 2H), 1.22 (s, 12H), 0.76 (d, *J* = 7.1 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.1, 68.3, 35.5, 31.5, 25.0. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[6]

Compound 23



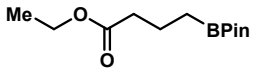
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 56 mg (47%). Physical State: colorless oil. R_f= 0.35 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 1.74 – 1.56 (m, 5H), 1.26 – 1.23 (m, 15H), 0.94 – 0.81 (m, 5H), 0.71 (d, *J* = 7.2 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 82.9, 36.1, 34.4, 29.9, 26.7, 26.5, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[4]

Compound 24



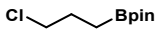
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 66.6 mg (55%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 4.08 (q, *J* = 7.1 Hz, 2H), 2.28 (t, *J* = 7.6 Hz, 2H), 1.81 – 1.57 (m, 2H), 1.22 (t, *J* = 7.1 Hz, 3H), 1.21 (s, 12H), 0.78 (t, *J* = 7.9 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 173.8, 83.1, 60.2, 36.7, 24.9, 19.8, 14.4, 10.8.

All data matched that reported in the literature[4]

Compound 25



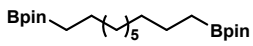
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 51.1 mg (71%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*)δ 3.53 (t, J = 6.8 Hz, 2H), 1.90 – 1.86 (m, 2H), 1.24 (s, 12H), 0.91 (t, J = 7.8 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.3, 47.3, 27.5, 25.0. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[7]

Compound 26



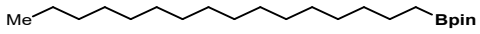
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 157.6 mg (80%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1).

^{1}H NMR (400 MHz, Chloroform-*d*)δ 1.37 (m, 4H), 1.24 – 1.20 (m, 36H), 0.74 (t, *J* = 7.8 Hz, 4H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.0, 32.6, 29.8, 29.6, 25.0, 24.2. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[10]

Compound 27



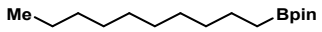
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 111 mg (63%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 1.39 (t, *J* = 7.6 Hz, 2H), 1.28 – 1.24 (m, 38H), 0.88 (t, *J* = 6.8 Hz, 3H), 0.76 (t, *J* = 7.8 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 82.8, 32.6, 32.1, 29.9, 29.8, 29.82 29.7, 29.6, 29.5, 25.0, 24.2, 22.9, 14.3, 11.3. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[9]

Compound 28



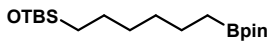
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 95.2 mg (71%). Physical State: colorless oil. R_f= 0.55 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 1.40 – 1.33 (m, 2H), 1.31 – 1.17 (m, 26H), 0.85 (t, *J* = 6.8 Hz, 3H), 0.73 (t, *J* = 7.7 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 82.9, 32.56, 32.1, 29.8, 29.7, 29.5, 29.5, 24.9, 24.1, 22.8, 14.2. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[10]

Compound 29



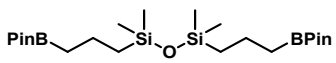
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 116.2 mg (68%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 3.58 (t, *J* = 6.7 Hz, 2H), 1.53 – 1.45 (m, 2H), 1.43 – 1.36 (m, 2H), 1.29 (p, *J* = 3.8 Hz, 4H), 1.23 (s, 12H), 0.88 (s, 9H), 0.76 (t, *J* = 7.7 Hz, 2H), 0.03 (s, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.0, 63.5, 33.0, 32.4, 25.8, 25.0, 24.1, 18.5, -5.1. The signal of the α-B-carbon was not observed.

HRMS(ESI) m/z: calced for $C_{18}H_{40}BO_3Si^+$ $[M+H]^+$: 343.2834, found: 343.2836.

Compound 30



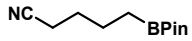
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 176 mg (75%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 1.50 – 1.37 (m, 4H), 1.24 (s, 24H), 0.82 (t, *J* = 7.6 Hz, 4H), 0.54 (m, 4H), 0.02 (s, 12H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.0, 25.0, 21.8, 18.1, 0.6. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[3]

Compound 31



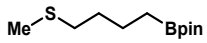
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 63 mg (55%). Physical State: colorless oil. R_f= 0.45 (Hexane: ethyl acetate=20:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 2.29 (t, *J* = 7.1 Hz, 2H), 1.68 – 1.58 (m, 2H), 1.57 – 1.46 (m, 2H), 1.20 (s, 12H), 0.76 (t, *J* = 7.7 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 119.6, 82.9, 27.5, 24.5, 23.0, 16.6. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[4]

Compound 32



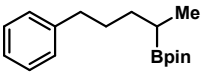
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 78 mg (68%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 2.54 – 2.39 (m, 2H), 2.07 (s, 3H), 1.80 – 1.63 (m, 2H), 1.24 – 1.23(m, 14H), 0.86 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 83.2, 36.7, 29.8, 24.9, 23.8, 15.5. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[1]

Compound 33



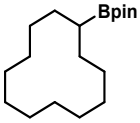
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 61.7 mg (45%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.31 – 7.08 (m, 5H), 2.62 – 2.57 (m, 2H), 1.84 – 1.71 (m, 1H), 1.61 – 1.53 (m, 1H), 1.23 (s, 12H), 1.07 – 0.99 (m, 4H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 143.2, 128.6, 128.3, 125.6, 83.0, 35.5, 29.9, 24.9, 15.6. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[3]

Compound 34



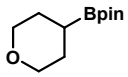
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 56 mg (38%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (500 MHz, Chloroform-*d*) δ 1.45 – 1.35 (m, 10H), 1.34 – 1.26 (m, 12H), 1.23 (s, 12H), 0.92 – 0.85 (m, 1H).

^{13}C NMR (126 MHz, Chloroform-*d*) δ 29.9, 25.1, 24.9, 24.4, 24.3, 23.6, 23.6, 23.5. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[3]

Compound 35



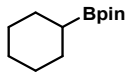
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 43.5 mg (41%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (500 MHz, Chloroform-*d*) δ 3.82 (m, 2H), 3.52 – 3.41 (m, 2H), 1.68 – 1.53 (m, 5H), 1.24 (s, 12H).

^{13}C NMR (126 MHz, Chloroform-*d*) δ 83.3, 69.0, 27.8, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[2]

Compound 36



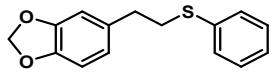
0.5 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 39 mg (38%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 1.69 – 1.62 (m, 4H), 1.60 – 1.53 (m, 6H), 1.22 (s, 12H), 1.03 – 0.91 (m, 1H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 82.9, 28.1, 27.3, 26.9, 24.9. The signal of the α-B-carbon was not observed.

All data matched that reported in the literature[3]

Compound 37



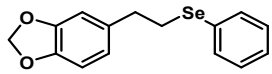
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 48 mg (92%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.36 – 7.32 (m, 2H), 7.30 – 7.25 (m, 2H), 7.20 – 7.14 (m, 1H), 6.72 (d, *J* = 7.9 Hz, 1H), 6.67 (d, *J* = 1.7 Hz, 1H), 6.62 (m, 1H), 5.90 (s, 2H), 3.14 – 3.08 (m, 2H), 2.87 – 2.78 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.8, 146.2, 136.4, 134.1, 129.3, 129.3, 126.1, 121.5, 109.1, 108.4, 101.0, 35.5 (2C).

All data matched that reported in the literature [11]

Compound 38



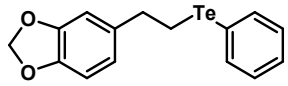
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 57.5 mg (94%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.62 – 7.48 (m, 2H), 7.38 – 7.19 (m, 3H), 6.86 – 6.52 (m, 3H), 5.94 (s, 2H), 3.19 – 3.07 (m, 2H), 3.00 – 2.83 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.8, 146.2, 135.0, 132.7, 130.3, 129.2, 127.0, 121.4, 109.0, 108.3, 101.0, 36.4, 29.1.

HRMS(ESI) m/z: calced for $C_{15}H_{15}O_2S^+$ $[M+H]^+$: 307.0232, found: 307.0233.

Compound 39



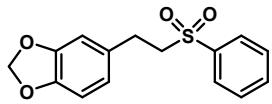
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 65 mg (91%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.84 – 7.49 (m, 2H), 7.30 – 7.07 (m, 3H), 6.81 – 6.39 (m, 3H), 5.90 (s, 2H), 3.14 – 3.03 (m, 2H), 3.06 – 2.96 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.4, 145.8, 138.2, 136.3, 129.0, 127.4, 120.8, 111.5, 108.4, 108.0, 100.6, 37.7, 9.4.

HRMS(ESI) m/z: calced for $C_{15}H_{15}O_2Te^+$ $[M+H]^+$: 357.0129, found: 357.01130.

Compound 40



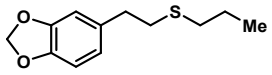
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 34.8 mg (61%). Physical State: colorless oil. Rf= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 7.82 (m, 2H), 7.82 – 7.60 (m, 1H), 7.61 – 7.49 (m, 2H), 6.71– 6.66 (m, 1H), 6.60 – 6.49 (m, 2H), 5.89 (s, 2H), 3.38 – 3.23 (m, 2H), 3.06 – 2.85 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.0, 146.6, 139.1, 133.9, 131.2, 129.4, 128.1, 121.4, 108.8, 108.5, 101.1, 57.8, 28.6.

HRMS(ESI) m/z: calced for $C_{15}H_{15}O_4S^+$ $[M+H]^+$: 291.0686, found: 291.0688.

Compound 41



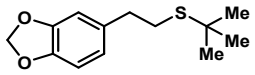
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 41.6 mg (93%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 6.75 – 6.63 (m, 3H), 5.92 (s, 2H), 2.82 – 2.78 (m, 2H), 2.74 – 2.70 (m, 2H), 2.53 – 2.46 (m, 2H), 1.62 (m, 2H), 0.99 (t, *J* = 7.2 Hz, 3H)

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.7, 146.1, 134.7, 121.4, 109.0, 108.3, 101.0, 36.2, 34.5, 34.0, 23.1, 13.6.

HRMS(ESI) m/z: calced for $C_{12}H_{17}O_2S^+$ $[M+H]^+$: 225.0944, found: 225.0943.

Compound 42



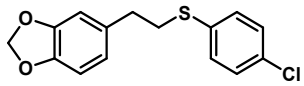
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 42mg (93%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 6.77 – 6.56 (m, 3H), 5.92 (s, 2H), 2.92 – 2.54 (m, 4H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 148.0, 146.4, 135.2, 121.7, 109.3, 108.6, 101.3, 42.6, 36.5 , 31.4, 30.7.

HRMS(ESI) m/z: calced for $C_{13}H_{19}O_2S^+$ $[M+H]^+$: 239.1100, found: 239.1101.

Compound 43



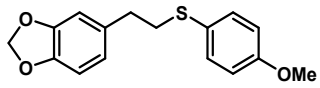
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 54 mg (91%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.26 (s, 4H), 6.96 – 6.49 (m, 3H), 5.92 (s, 2H), 3.10 (m, 2H), 2.83 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 133.4, 130.3, 128.8, 121.2, 108.6, 108.0, 100.7, 35.3, 35.0.

All data matched that reported in the literature[11]

Compound 44



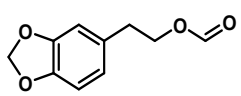
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 52 mg (90%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=20:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.41 – 7.30 (m, 2H), 6.92 – 6.82 (m, 2H), 6.77 – 6.57 (m, 3H), 5.92 (s, 2H), 3.81 (s, 3H), 3.07 – 2.96 (m, 2H), 2.86 – 2.70 (m, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.0, 147.7, 146.1, 134.3, 133.3, 126.4, 121.5, 114.7, 109.1, 108.3, 101.0, 55.4, 37.6, 35.7.

HRMS(ESI) m/z: calced for $C_{16}H_{17}O_3S^+$ $[M+H]^+$: 289.0893, found: 289.0892.

Compound 45



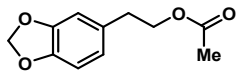
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 33.3 mg (86%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.04 (s, 1H), 6.98 – 6.58 (m, 3H), 5.93 (s, 2H), 4.87 – 3.96 (m, 2H), 2.89 (t, *J* = 7.0 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.1, 147.9, 146.5, 131.2, 122.0, 109.4, 108.5, 101.1, 64.7, 34.8.

HRMS(ESI) m/z: calced for $C_{10}H_{10}NaO_4^+$ $[M+Na]^+$: 217.0471, found: 217.0469.

Compound 46



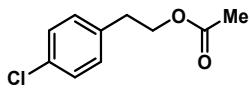
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 37.4 mg (90%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1)

^{1}H NMR (500 MHz, Chloroform-*d*) δ 6.79 – 6.51 (m, 3H), 5.91 (s, 2H), 4.21 (t, *J* = 7.0 Hz, 2H), 2.83 (t, *J* = 7.0 Hz, 2H), 2.03 (s, 3H).

^{13}C NMR (126 MHz, Chloroform-*d*) δ 170.8, 147.5, 146.0, 131.4, 121.6, 109.1, 108.1, 100.8, 64.9, 34.6, 20.8.

HRMS(ESI) m/z: calced for $C_{11}H_{12}NaO_4^+$ $[M+Na]^+$: 231.0628, found: 231.0630.

Compound 47



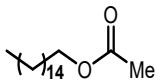
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 31 mg (78%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.31 – 7.24 (m, 2H), 7.19 – 7.11 (m, 2H), 4.25 (t, *J* = 6.9 Hz, 2H), 2.90 (t, *J* = 7.0 Hz, 2H), 2.03 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 171.4, 136.8, 132.9, 130.7, 129.1, 65.0, 34.9, 21.4.

HRMS(ESI) m/z: calced for $C_{10}H_{11}ClNaO_2^+$ $[M+Na]^+$: 221.0340, found: 221.0339.

Compound 48



0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 37.5 mg (66%). Physical

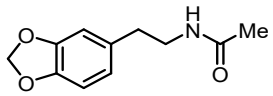
State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=10:1)

^{1}H NMR (500 MHz, Chloroform-*d*) δ 4.05 (s, 2H), 2.04 (s, 3H), 1.76 – 1.53 (m, 2H), 1.33 – 1.26 (m, 26H), 0.88 (t, *J* = 6.9 Hz, 3H).

^{13}C NMR (126 MHz, Chloroform-*d*) δ 171.2, 64.6, 31.8, 29.59, 29.59, 29.57, 29.56, 29.56, 29.54, 29.47, 29.42, 29.3, 29.2, 28.5, 25.8, 22.6, 20.9, 14.0.

HRMS(ESI) m/z: calced for $C_{17}H_{14}F_3NNaO_3^+$ $[M+Na]^+$: 307.2608, found: 307.2606.

Compound 49



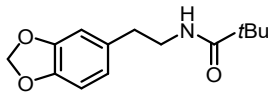
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 33.5 mg (81%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=5:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 6.84 – 6.52 (m, 3H), 5.94 (s, 2H), 5.45 (s, 1H), 3.57 – 3.28 (m, 2H), 2.72 (t, *J* = 6.9 Hz, 2H), 1.94 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 170.5, 148.3, 146.7, 133.0, 122.1, 109.5, 108.8, 101.4, 41.3, 35.9, 23.8.

All data matched that reported in the literature [14]

Compound 50



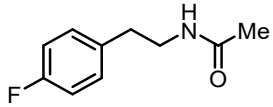
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 43 mg (86%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=5:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 6.93 – 6.45 (m, 3H), 5.93 (s, 2H), 5.71 (s, 1H), 3.61 – 3.17 (m, 2H), 2.72 (t, *J* = 6.9 Hz, 2H), 1.15 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 178.8, 148.2, 146.6, 133.2, 122.1, 109.5, 108.7, 101.3, 41.2, 39.1, 35.8, 28.0.

All data matched that reported in the literature [15]

Compound 51



0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 26.8 mg (74%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=4:1)

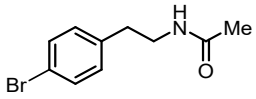
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 – 7.11 (m, 2H), 7.00 – 6.94 (m, 2H), 5.86 (s, 1H), 3.46 (m, 2H), 2.77 (t, *J* = 7.1 Hz, 2H), 2.06 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 171.0, 161.7 (d, *J* = 244.6 Hz), 134.5 (d, *J* = 3.3 Hz), 130.2 (d, *J* = 8.0 Hz), 115.5 (d, *J* = 21.2 Hz), 41.0, 34.8, 23.2.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -116.60.

All data matched that reported in the literature[15]

Compound 52



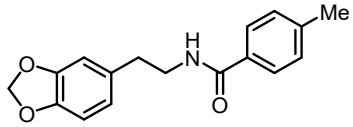
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 38.6 mg (80%). Physical State: colorless oil. R_f= 0.30 (Hexane: ethyl acetate=4:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.61 – 7.33 (m, 2H), 7.20 – 6.82 (m, 2H), 5.72 (s, 1H), 3.45 m, 2H), 2.75 (t, *J* = 7.0 Hz, 2H), 1.92 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 170.0, 137.7, 131.4, 130.2, 120.1, 40.3, 34.9, 23.0.

All data matched that reported in the literature[17]

Compound 53



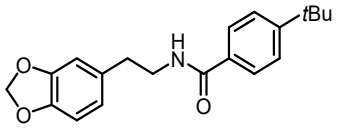
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 45 mg (80%). Physical State: colorless oil. R_f= 0.50 (Hexane: ethyl acetate=4:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.70 – 7.56 (m, 2H), 7.20 (d, *J* = 7.9 Hz, 2H), 6.82 – 6.56 (m, 3H), 6.18 (s, 1H), 5.93 (s, 2H), 3.69 – 3.60 (m, 2H), 2.83 (t, *J* = 6.9 Hz, 2H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.5, 148.0, 146.4, 141.9, 132.8, 131.9, 129.3, 126.9, 121.8, 109.2, 108.5, 101.0, 41.4, 35.6, 21.5.

All data matched that reported in the literature[18]

Compound 54



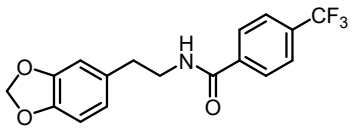
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 56 mg (76%). Physical State: colorless oil. R_f= 0.50 (Hexane: ethyl acetate=4:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.69 – 7.58 (m, 2H), 7.53 – 7.36 (m, 2H), 6.83 – 6.57 (m, 3H), 6.10 (s, 1H), 5.94 (s, 2H), 3.66 (t, *J* = 6.6 Hz, 2H), 2.84 (t, *J* = 6.8 Hz, 2H), 1.32 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.5, 155.0, 148.1, 146.4, 132.8, 131.9, 126.8, 125.7, 121.9, 109.2, 108.6, 101.1, 41.3, 39.0, 35.6, 31.3.

All data matched that reported in the literature[18]

Compound 55



0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 44.5 mg (66%). Physical State: colorless oil. R_f= 0.50 (Hexane: ethyl acetate=4:1)

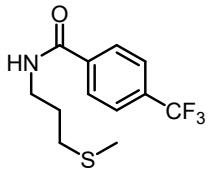
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.83 – 7.76 (m, 2H), 7.67 (d, *J* = 8.1 Hz, 2H), 6.80 – 6.59 (m, 3H), 6.18 (s, 1H), 5.94 (s, 2H), 3.77 – 3.51 (m, 2H), 2.86 (t, *J* = 6.8 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.2, 148.0, 146.4, 138.0, 133.2 (q, *J* = 32.6 Hz), 132.3, 127.3, 125.7 (q, *J* = 3.7 Hz), 123.6 (q, *J* = 272.5 Hz), 121.7, 109.0, 108.5, 101.0, 41.4, 35.3, 29.7.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.98.

HRMS(ESI) m/z: calced for $C_{17}H_{15}F_3NO_3^+$ $[M+H]^+$: 338.0999, found: 338.1001.

Compound 56



0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=20:1) afforded 45.4 mg (82%). Physical State: colorless oil. R_f= 0.50 (Hexane: ethyl acetate=4:1)

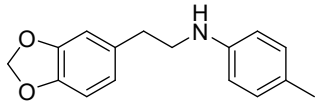
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.96 – 7.79 (m, 2H), 7.73 – 7.60 (m, 2H), 6.76 (s, 1H), 3.79 – 3.53 (m, 2H), 2.61 (t, *J* = 6.9 Hz, 2H), 2.11 (s, 3H), 1.94 (t, *J* = 6.8 Hz, 2H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.1, 137.6, 133.0 (q, *J* = 32.9 Hz), 127.2, 125.4 (q, *J* = 3.8 Hz), 123.7 (q, *J* = 272.5 Hz), 39.4, 31.9, 28.0, 15.3.

^{19}F NMR (376 MHz, Chloroform-*d*) δ -62.97.

HRMS(ESI) m/z: calced for $C_{12}H_{15}F_3NOS^+$ $[M+H]^+$: 278.0821, found: 278.0820.

Compound 58



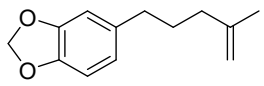
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=10:1) afforded 20.4 mg (40%). Physical State: colorless oil. R_f= 0.70 (Hexane: ethyl acetate=5:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.00 (d, *J* = 8.2 Hz, 2H), 6.76 (d, *J* = 7.8 Hz, 1H), 6.72 (d, *J* = 1.5 Hz, 1H), 6.67 (dd, *J* = 7.9, 1.6 Hz, 1H), 6.59 – 6.52 (m, 2H), 5.94 (s, 2H), 3.33 (t, *J* = 6.9 Hz, 2H), 2.83 (t, *J* = 6.9 H, 2H), 2.25 (s, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.9, 146.2, 145.8, 133.3, 129.9, 126.9, 121.8, 113.4, 109.2, 108.5, 101.0, 45.8, 35.4, 20.5.

All data matched that reported in the literature[22]

Compound 59



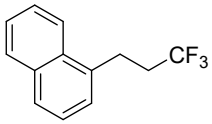
0.2 mmol scale. Purification by flash column chromatography (Hexane: ethyl acetate=10:1) afforded 12.2 mg (30%). Physical State: colorless oil. R_f= 0.70 (Hexane: ethyl acetate=10:1)

^{1}H NMR (400 MHz, Chloroform-*d*) δ 6.72 (d, *J* = 7.9 Hz, 1H), 6.68 (d, *J* = 1.7 Hz, 1H), 6.63 (dd, *J* = 7.9, 1.7 Hz, 1H), 5.92 (s, 2H), 4.77 – 4.65 (m, 2H), 2.55 – 2.50 (m, 2H), 2.03 (t, *J* = 7.6 Hz, 2H), 1.76 – 1.67 (m, 5H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 147.64, 145.80, 145.63, 136.58, 121.26, 110.16, 109.04, 108.21, 100.86, 37.34, 35.35, 29.74, 22.56.

All data matched that reported in the literature[18]

Compound 60



0.2 mmol scale. Purification by flash column chromatography (Hexane) afforded 22.5 mg (49%). Physical State: colorless oil. R_f= 0.60 (Hexane)

^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.01 – 7.96 (m, 1H), 7.89 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.78 (d, *J* = 8.2 Hz, 1H), 7.57 (ddd, *J* = 8.4, 6.7, 1.5 Hz, 1H), 7.52 (ddd, *J* = 8.0, 6.7, 1.3 Hz, 1H), 7.43 (dd, *J* = 8.2, 7.0 Hz, 1H), 7.36 (dd, *J* = 7.0, 1.1 Hz, 1H), 3.38 – 3.32 (m, 2H), 2.59 – 2.46 (m, 2H).

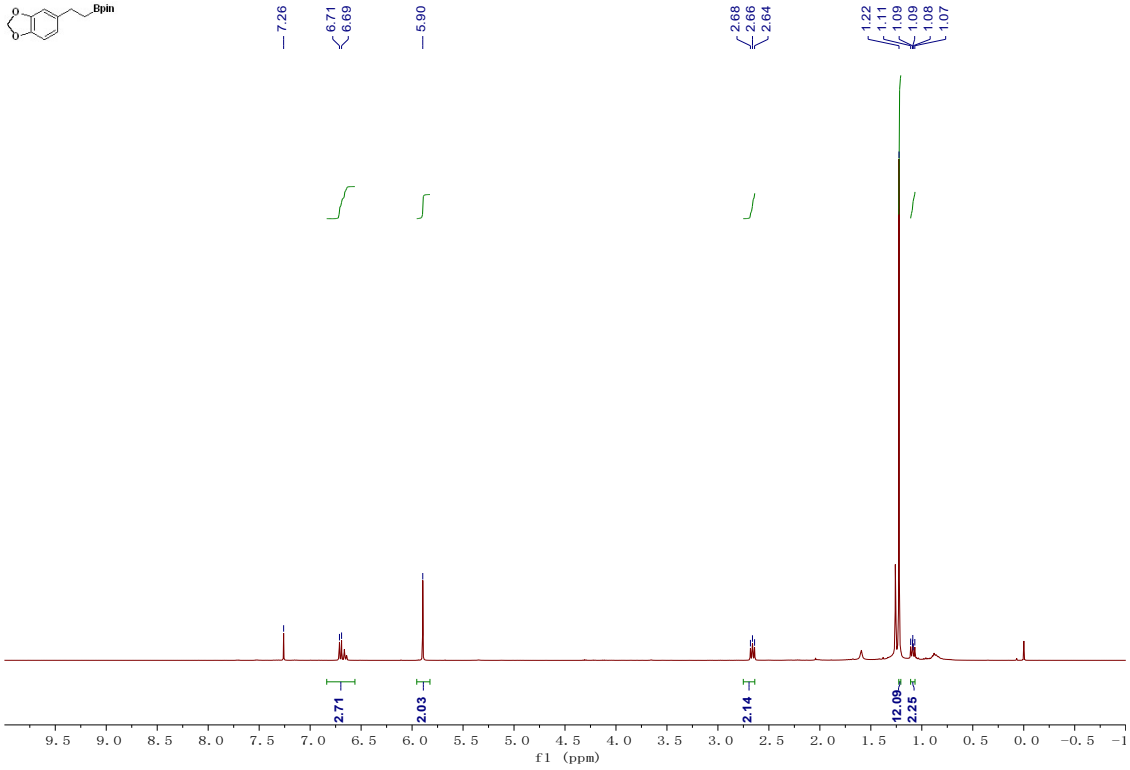
^{13}C NMR (126 MHz, Chloroform-*d*) δ 34.9 (q, *J* = 28.3 Hz), 25.4 (d, *J* = 3.5 Hz). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 135.0, 134.0, 131.4, 129.1, 127.6, 126.9 (q, *J* = 276.8 Hz), 126.4, 126.2, 125.8, 125.6, 123.0, 34.9 (q, *J* = 28.3 Hz), 25.4 (d, *J* = 3.5 Hz).

^{19}F NMR (471 MHz, Chloroform-*d*) δ -66.73.

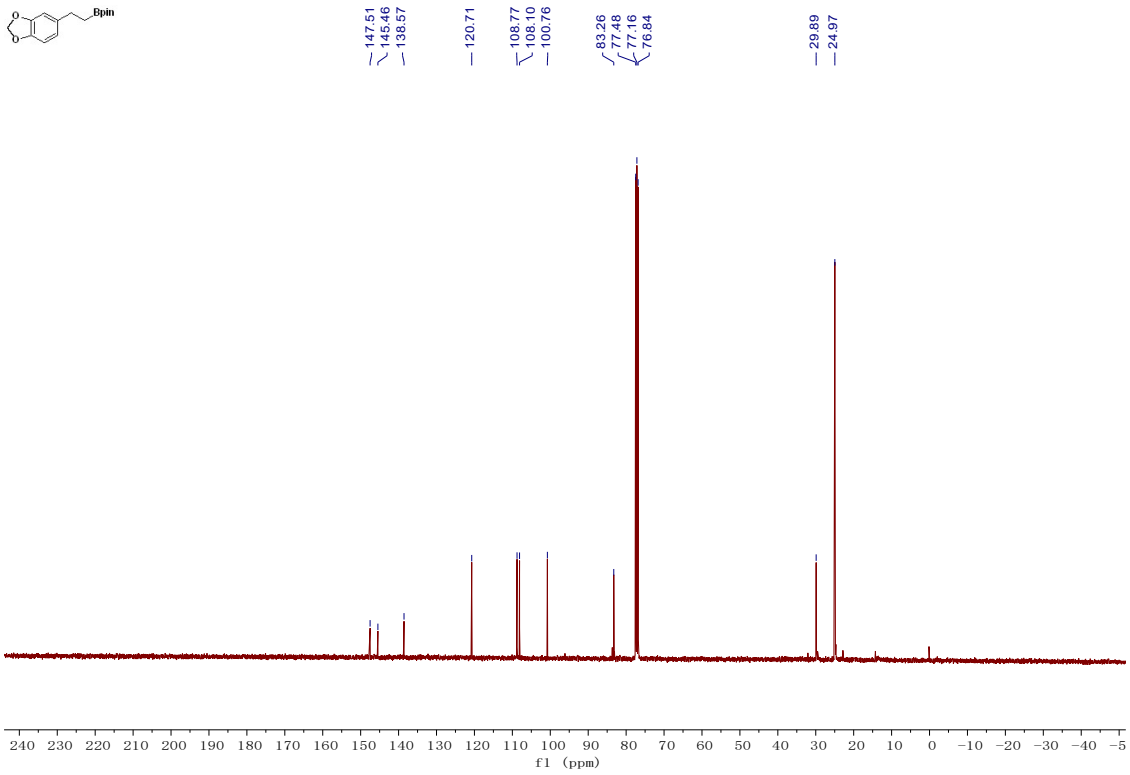
All data matched that reported in the literature[23]

NMR Spectra

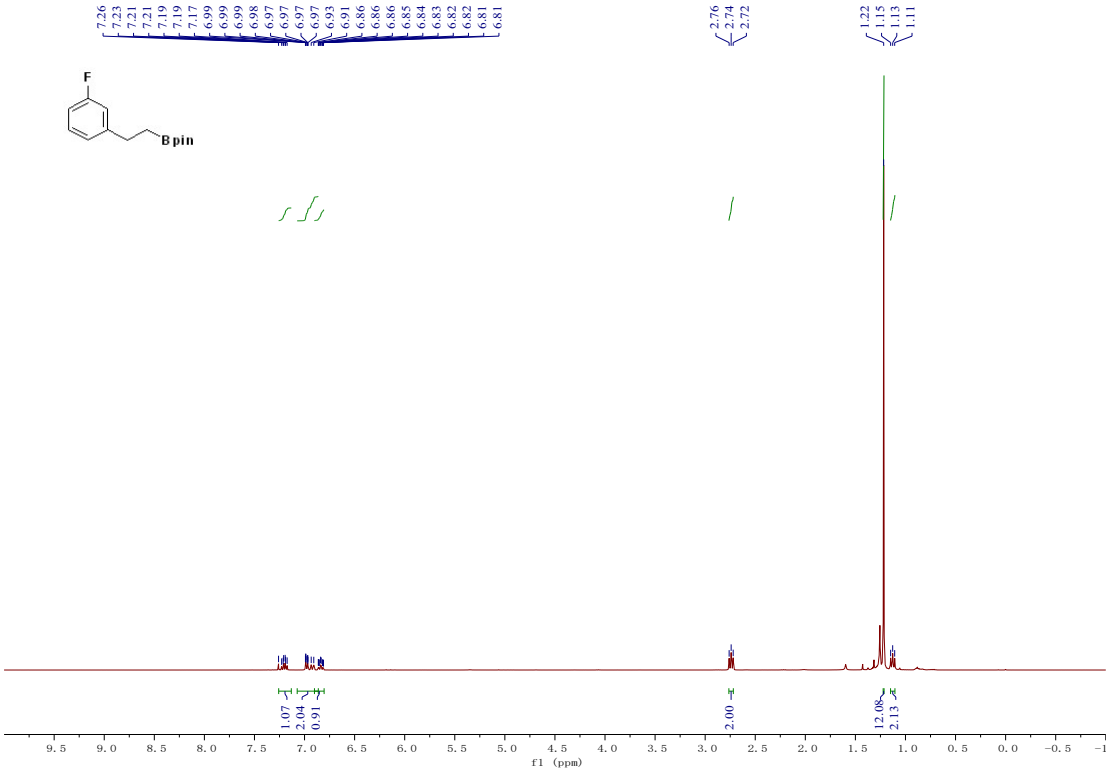
Compound **3** ^{1}H NMR



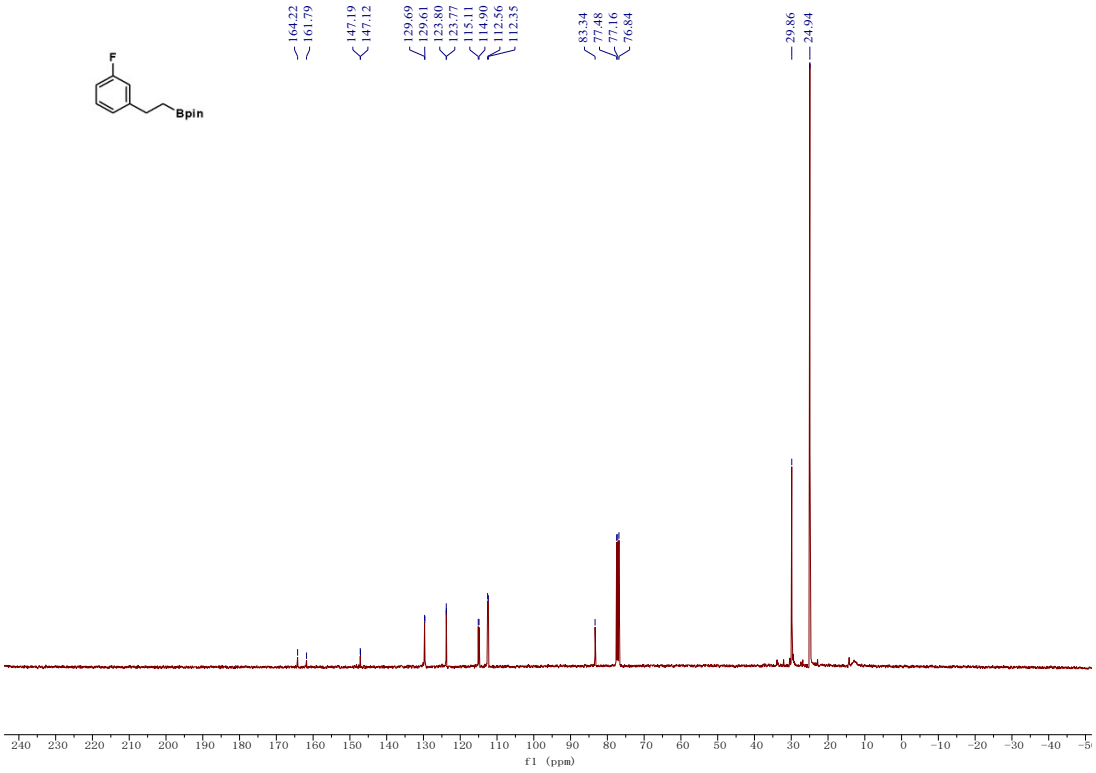
Compound **4** ^{13}C NMR



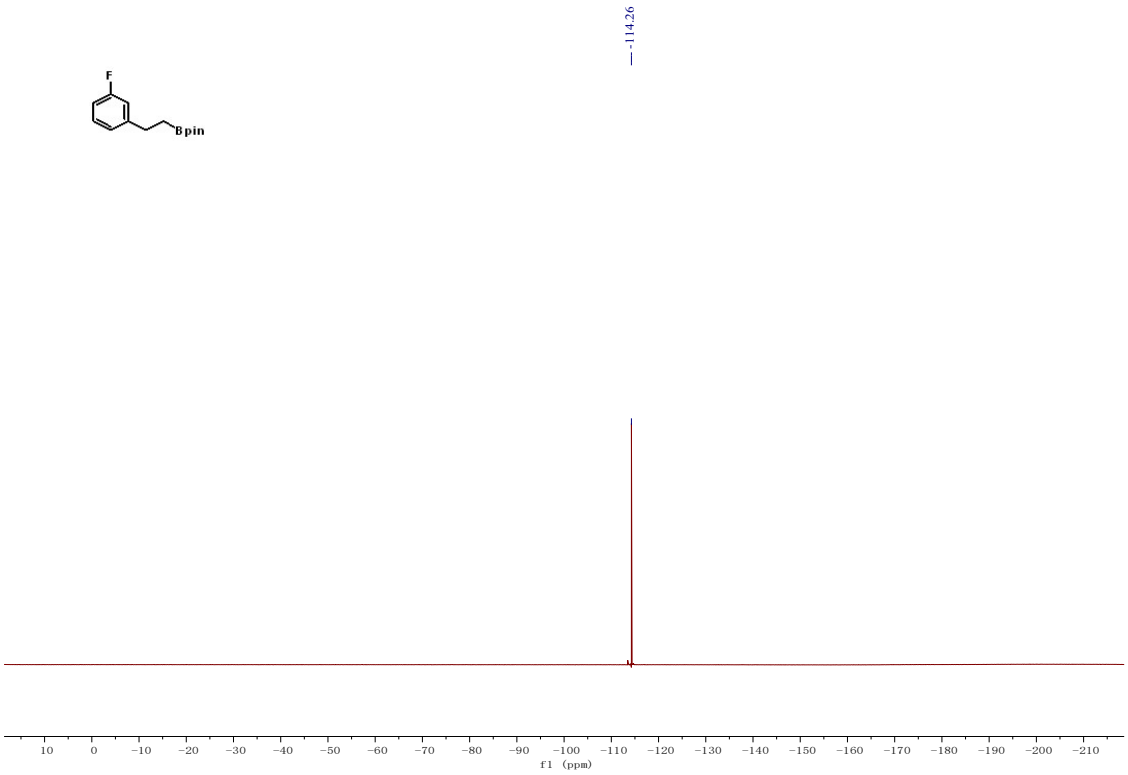
Compound **4** ^{1}H NMR



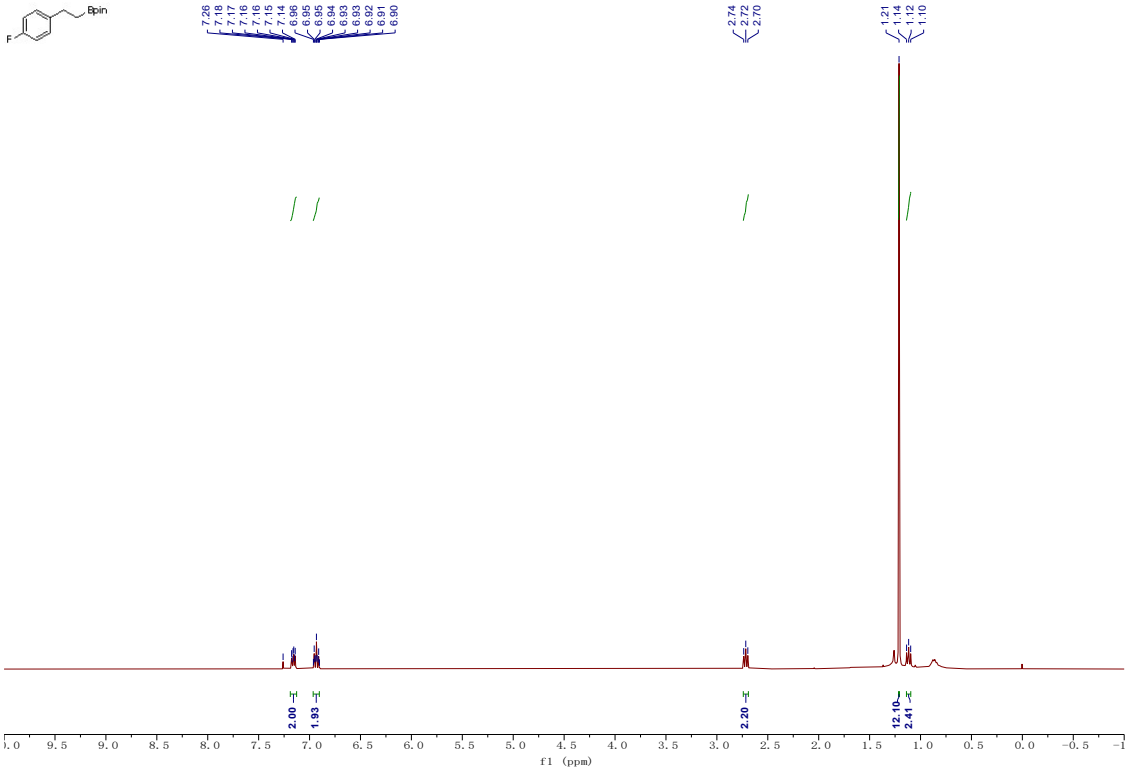
Compound **4** ^{13}C NMR



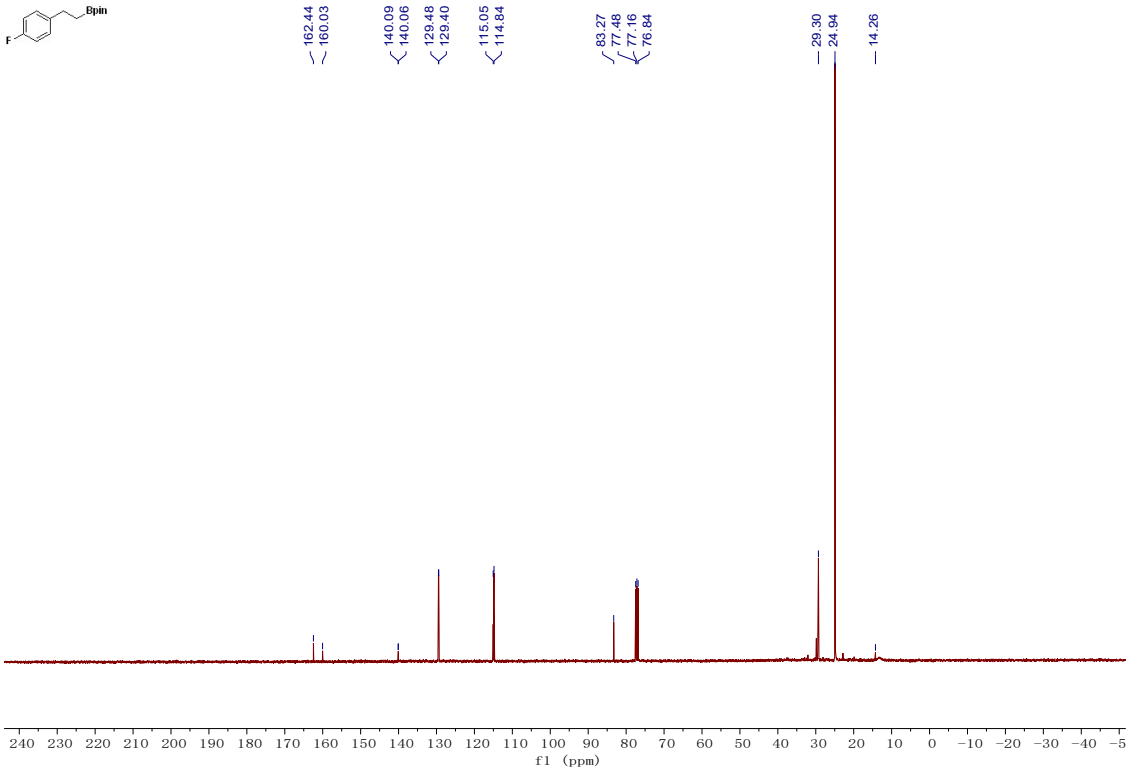
Compound **4** ^{19}F NMR



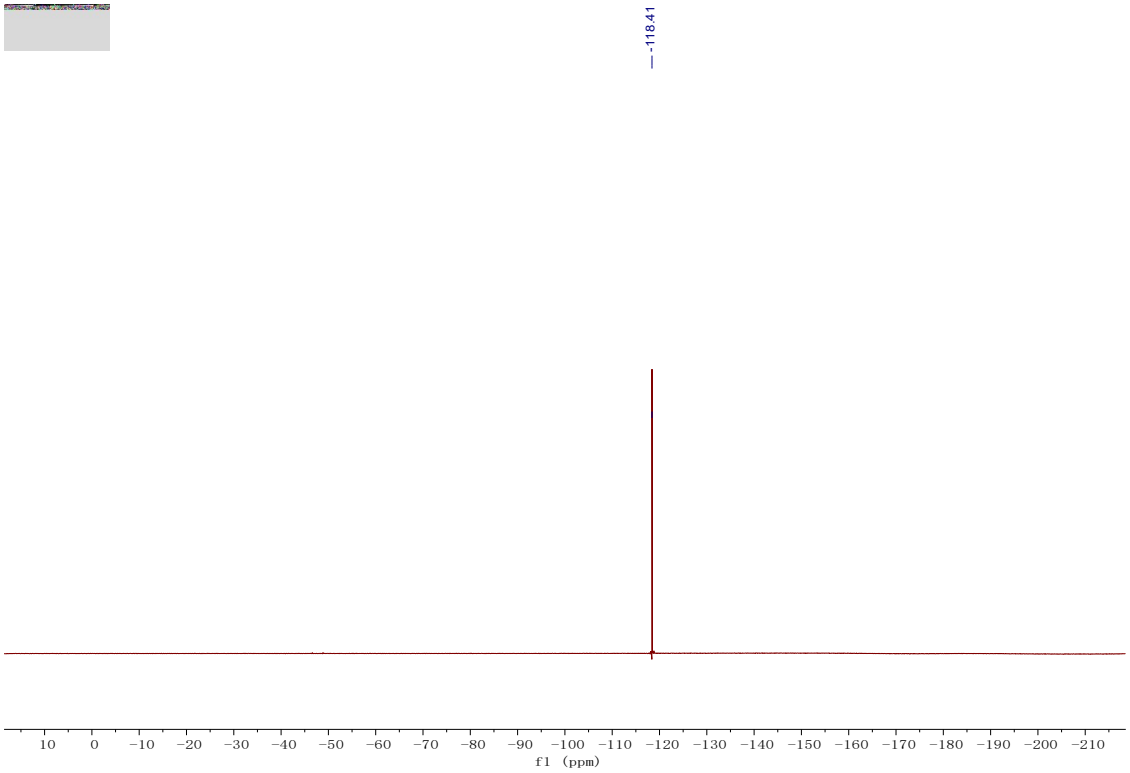
Compound **5** ^{1}H NMR



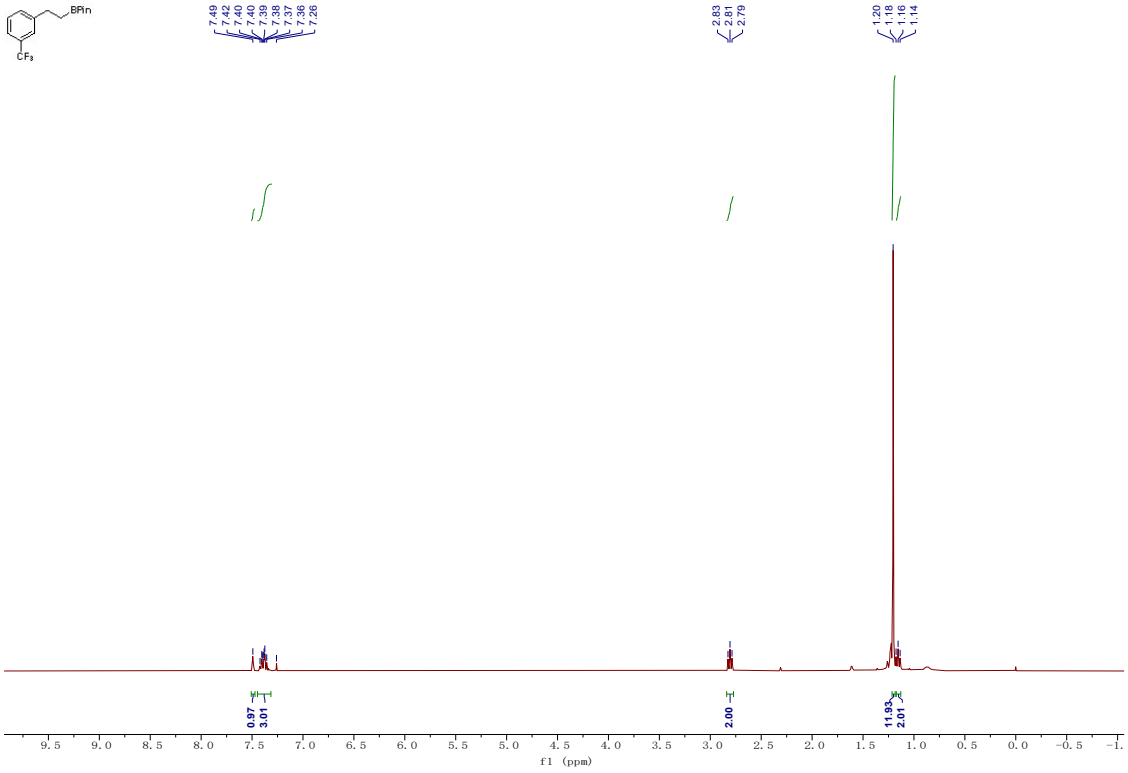
Compound **5** ^{13}C NMR



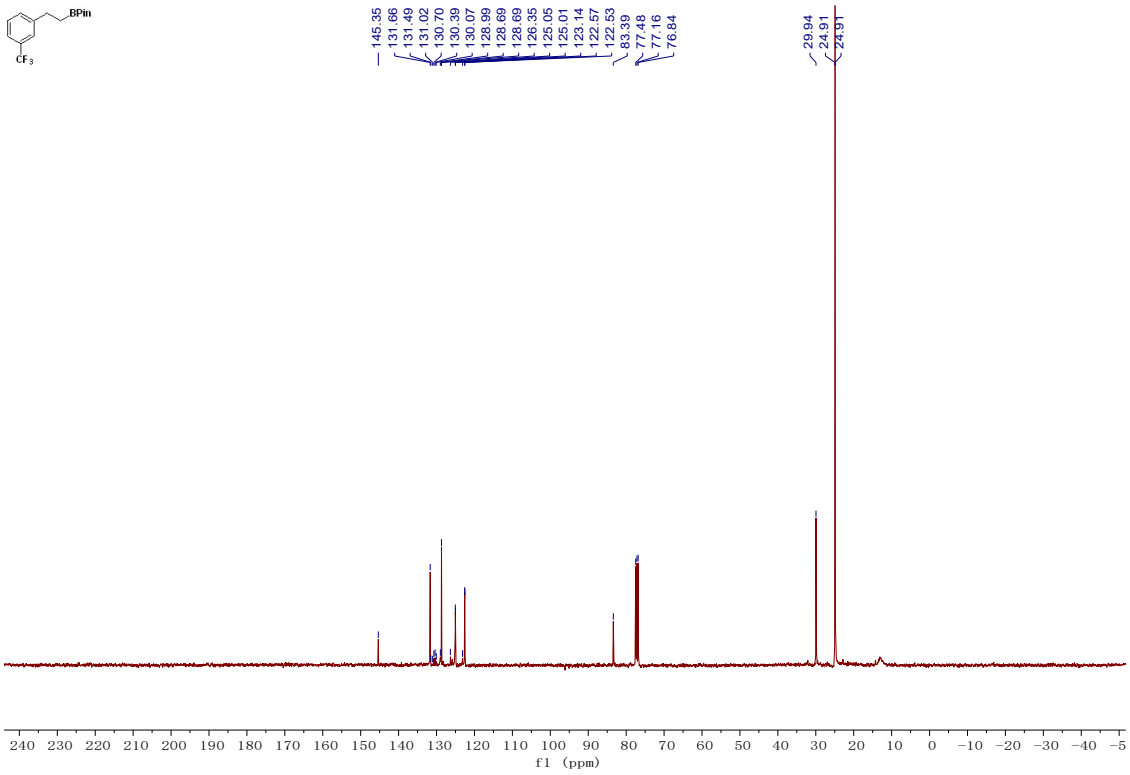
Compound **5** ^{19}F NMR



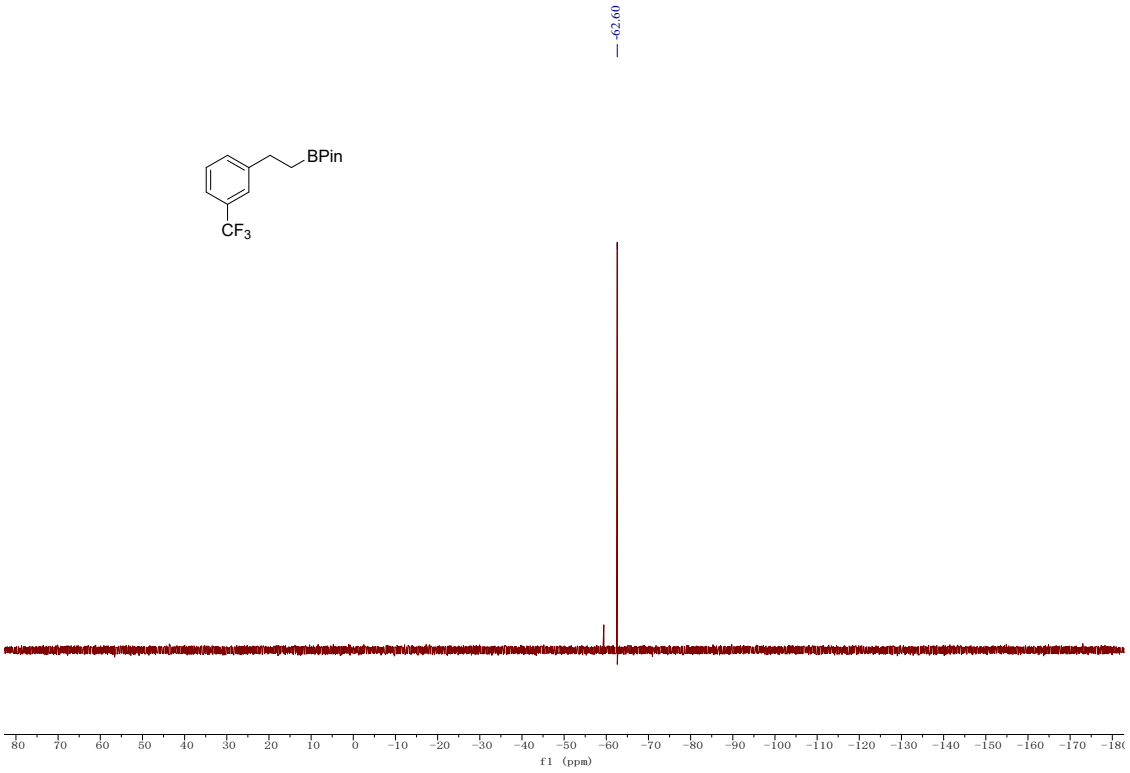
Compound **6** ^{1}H NMR



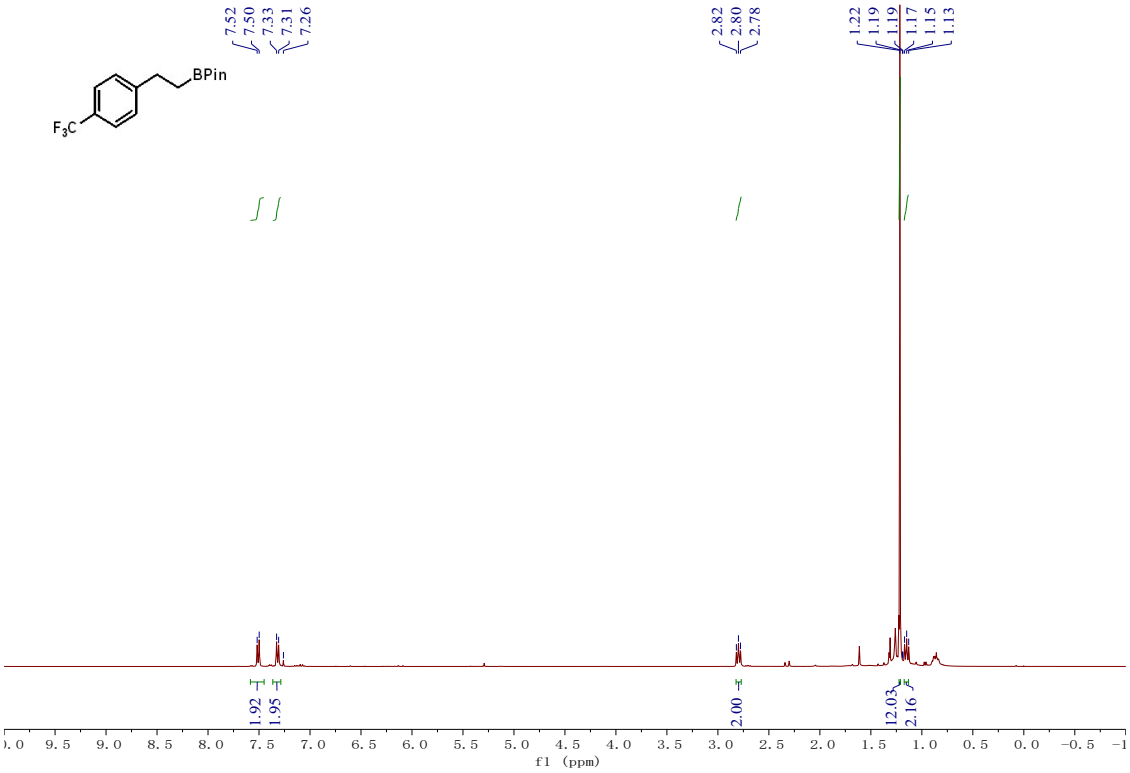
Compound **6** ^{13}C NMR



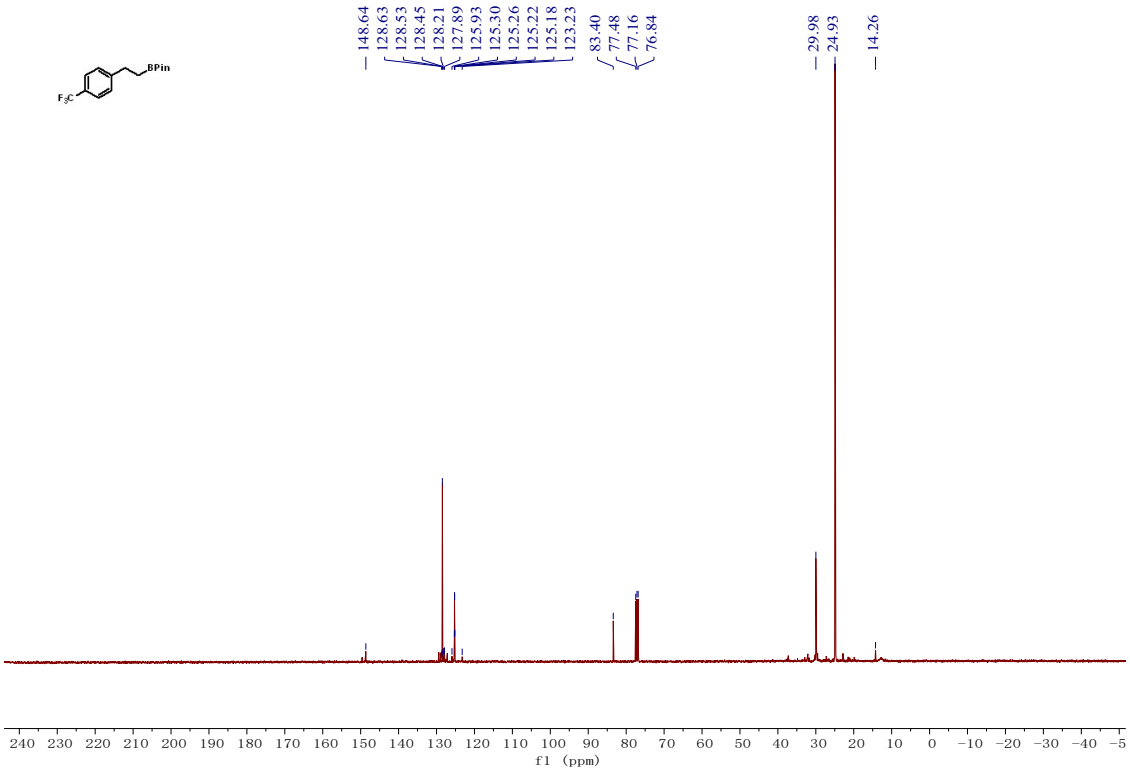
Compound **6** ^{19}F NMR



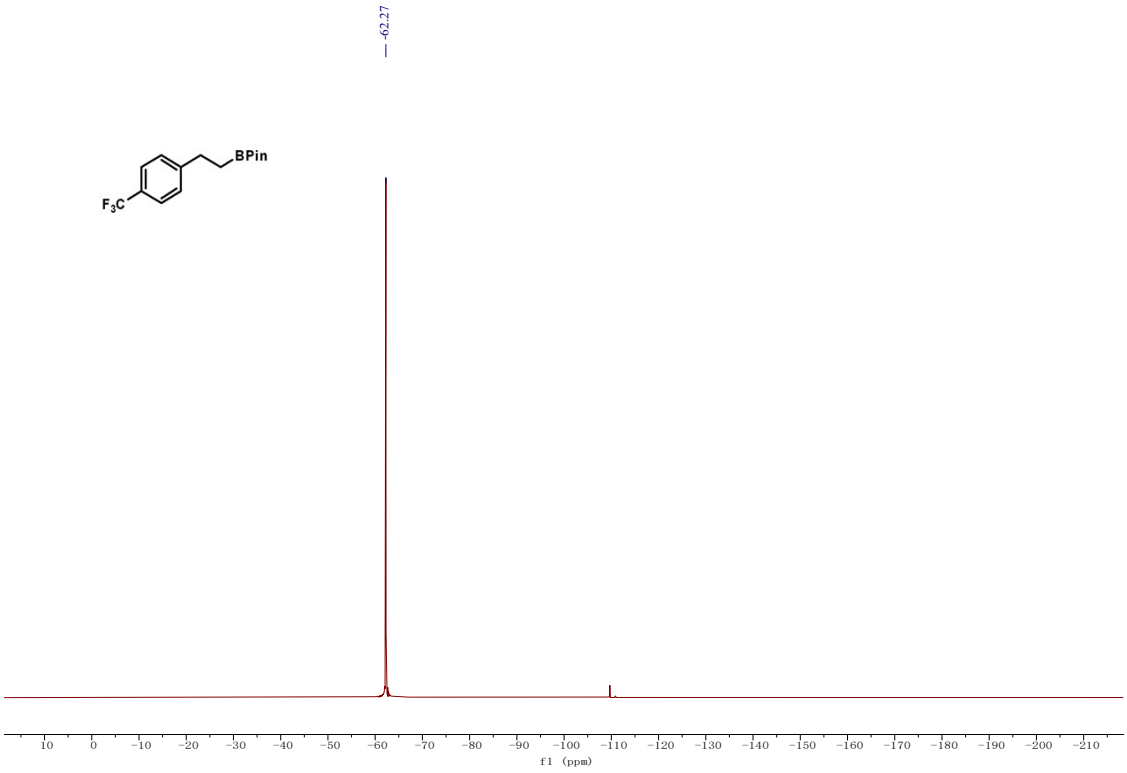
Compound **7** ^{1}H NMR



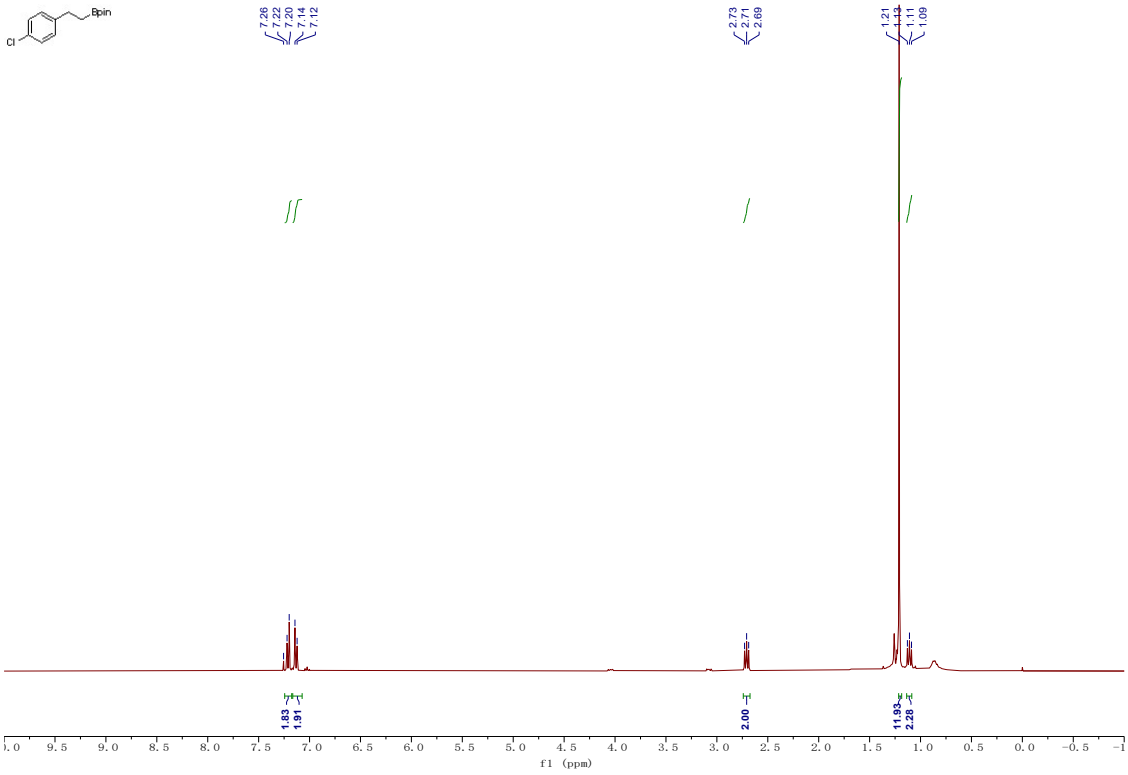
Compound **7** ^{13}C NMR



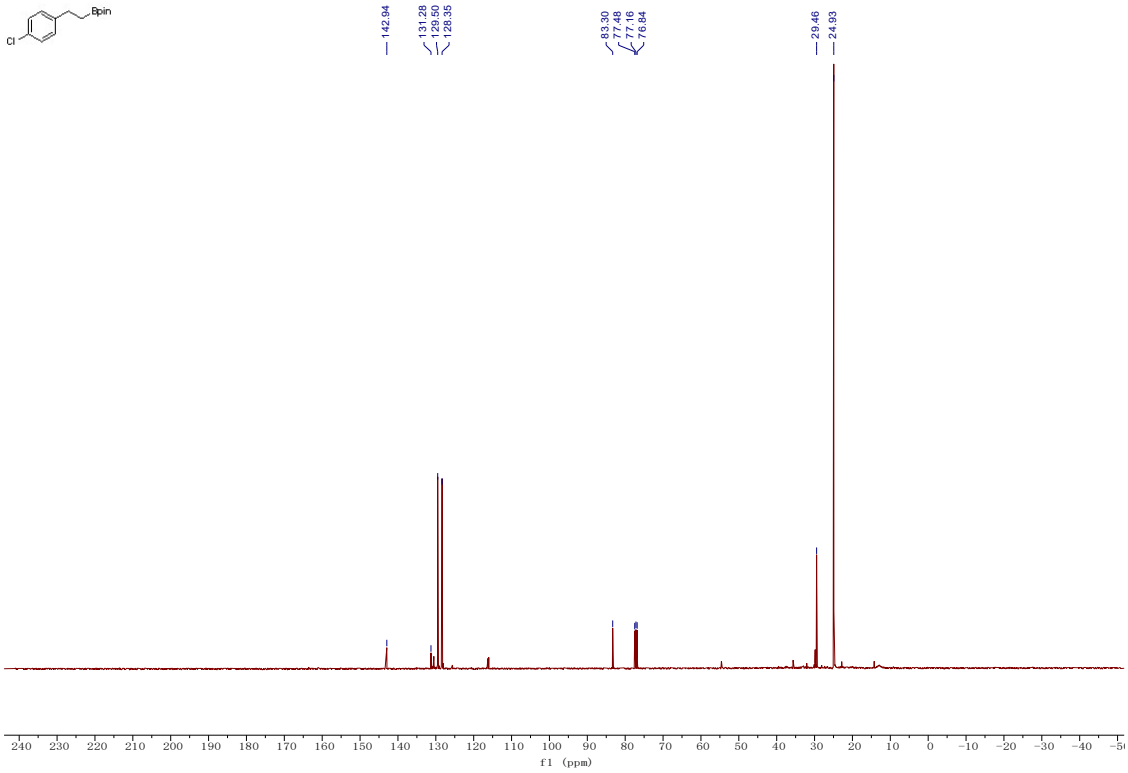
Compound **7** ^{19}F NMR



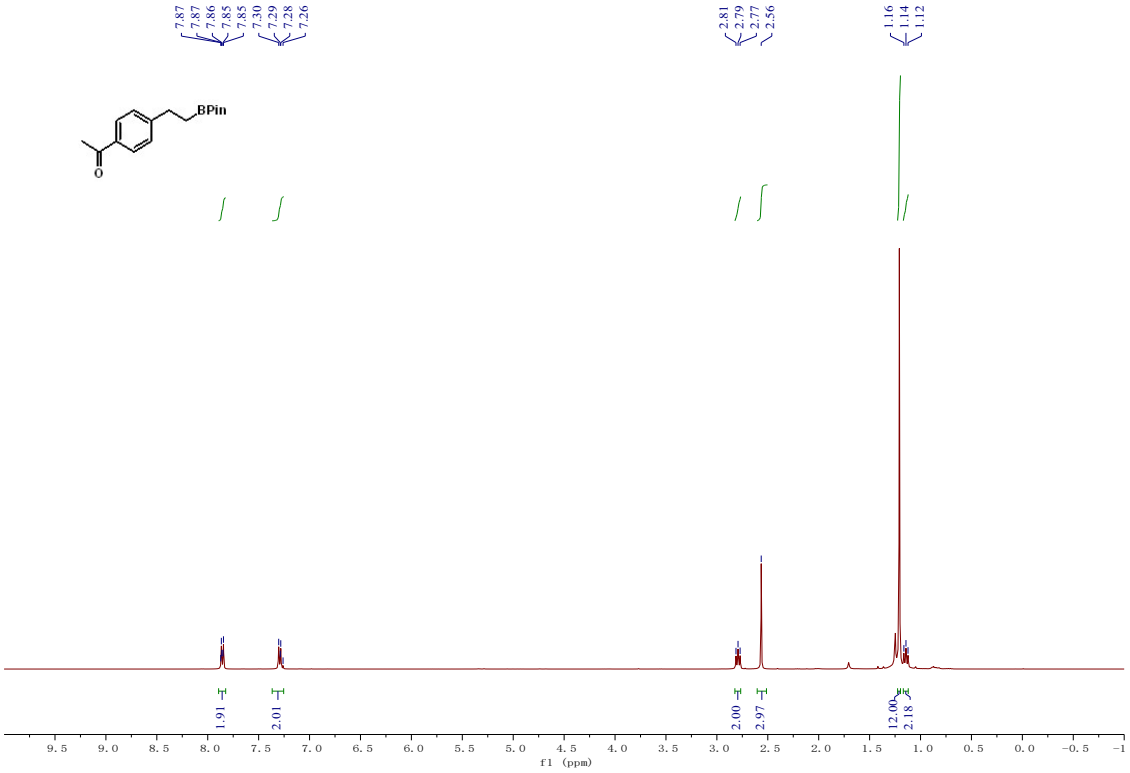
Compound **8** ^{1}H NMR



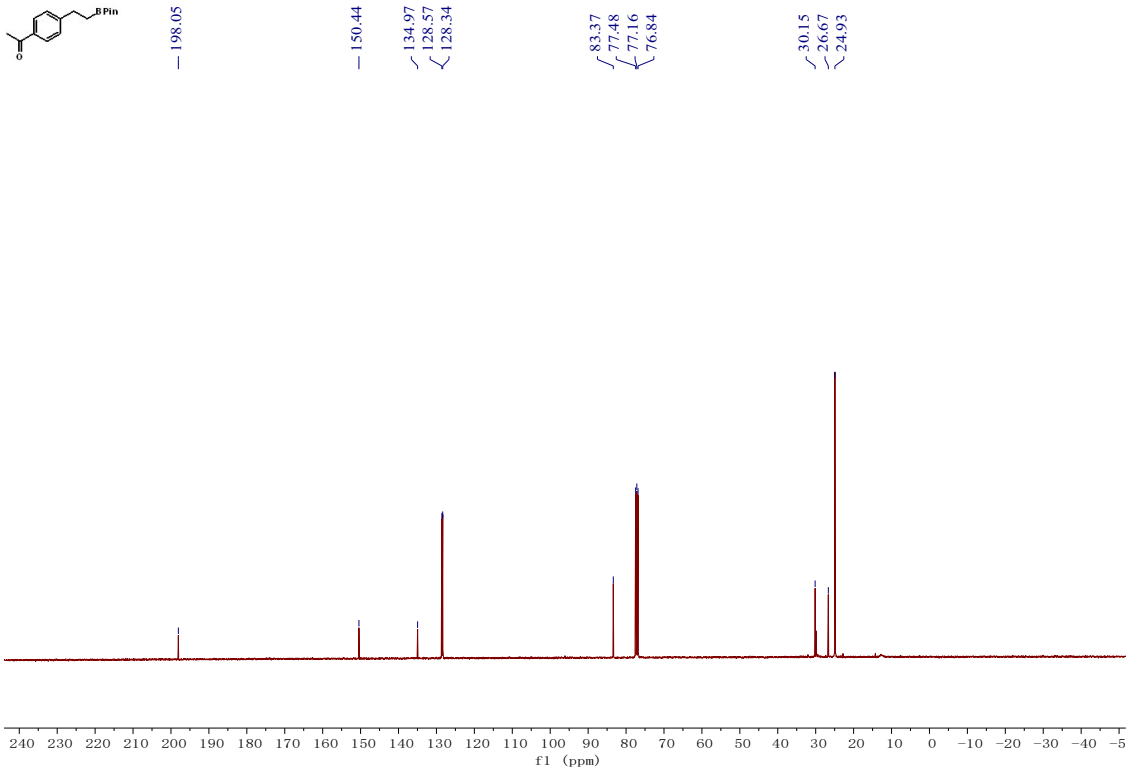
Compound **8** ^{13}C NMR



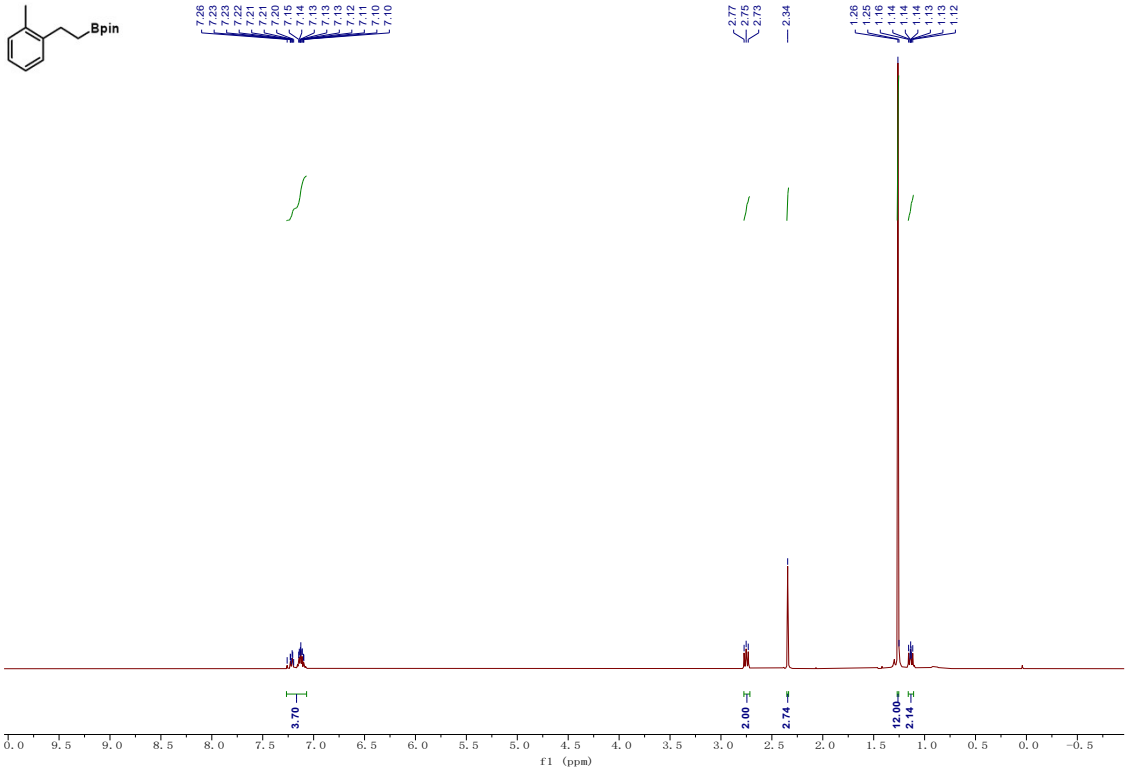
Compound **9** ^{1}H NMR



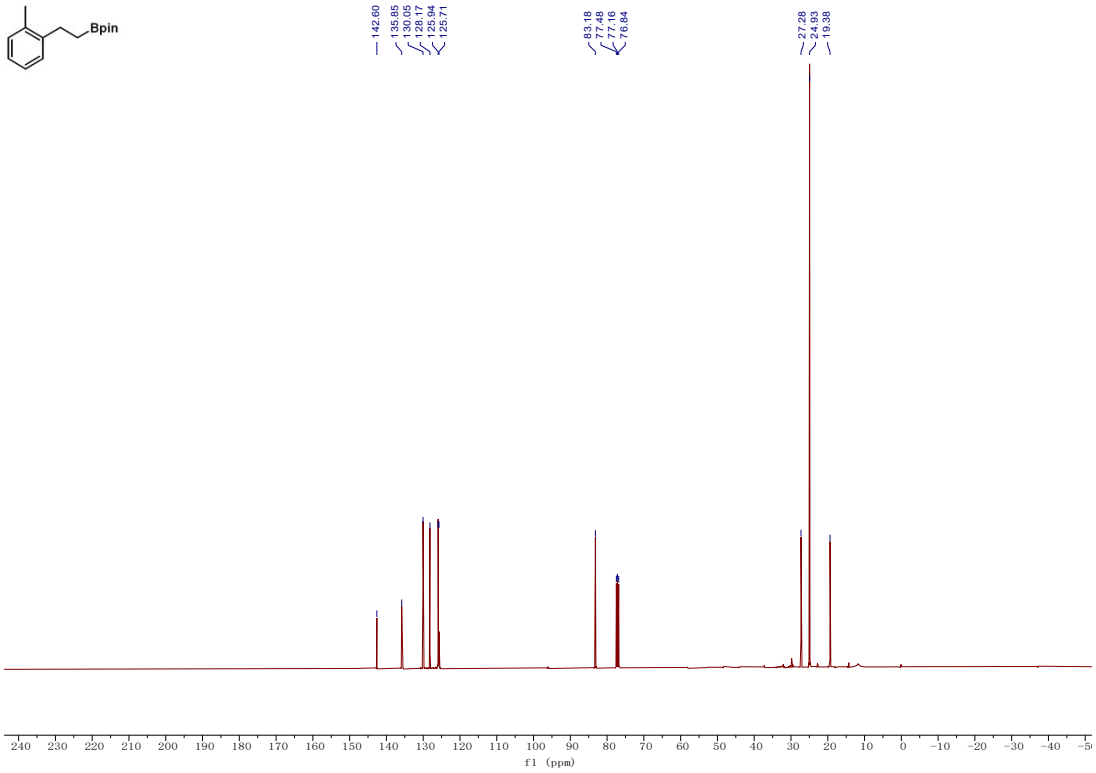
Compound **9** ^{13}C NMR



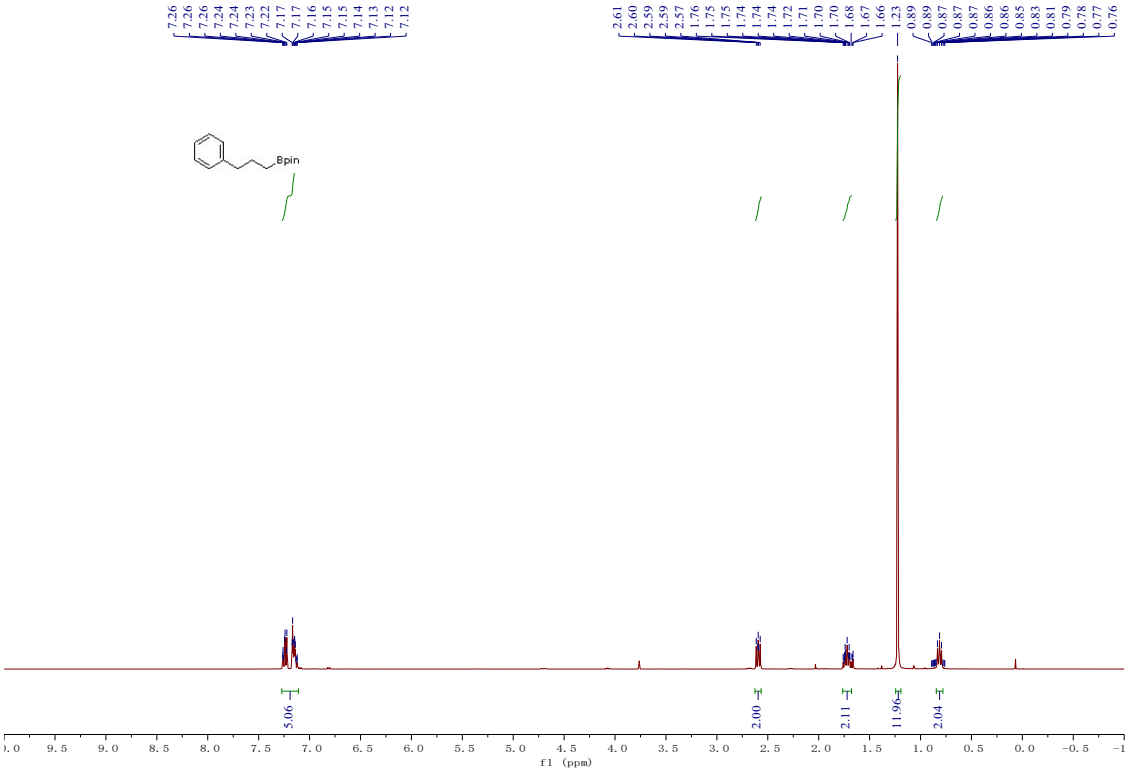
Compound **10** ^{1}H NMR



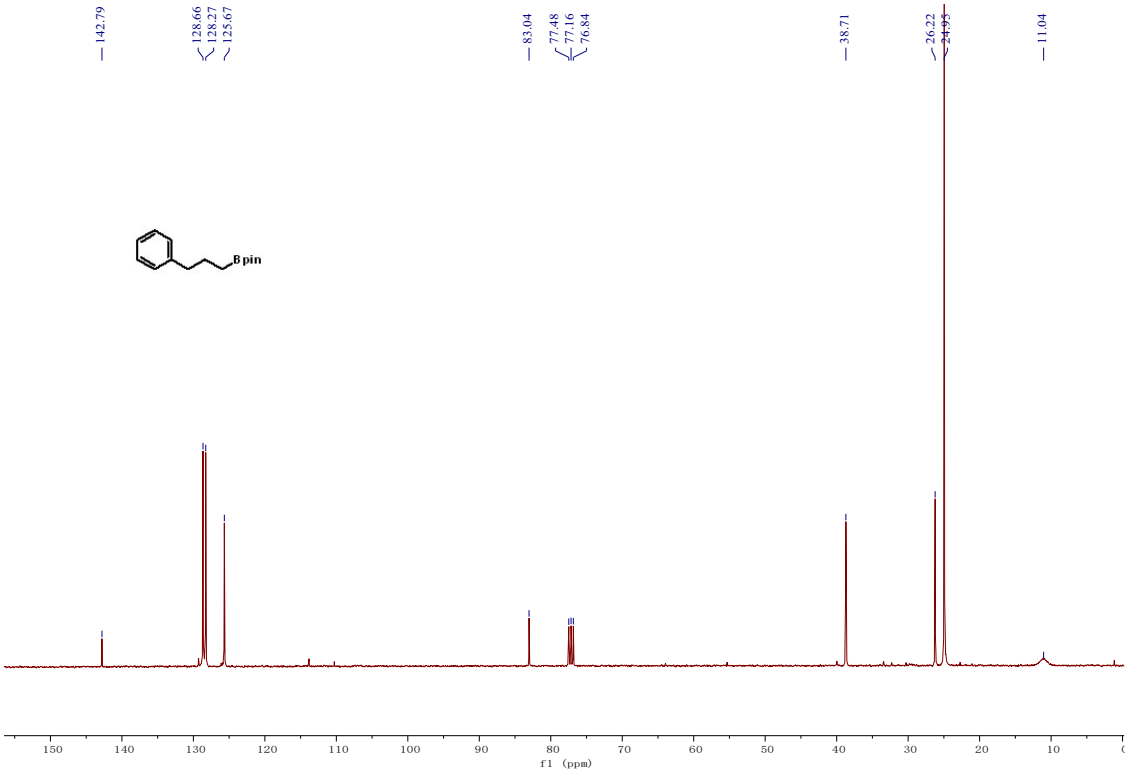
Compound **10** ^{13}C NMR



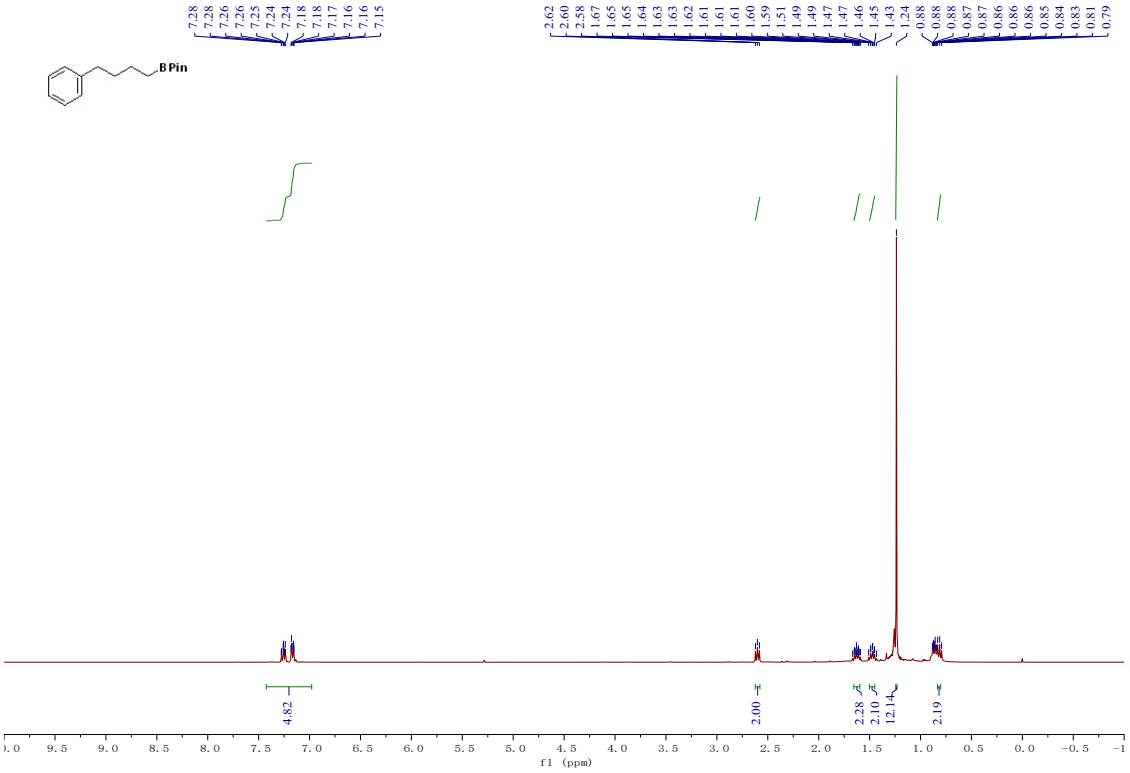
Compound **11** ^{1}H NMR



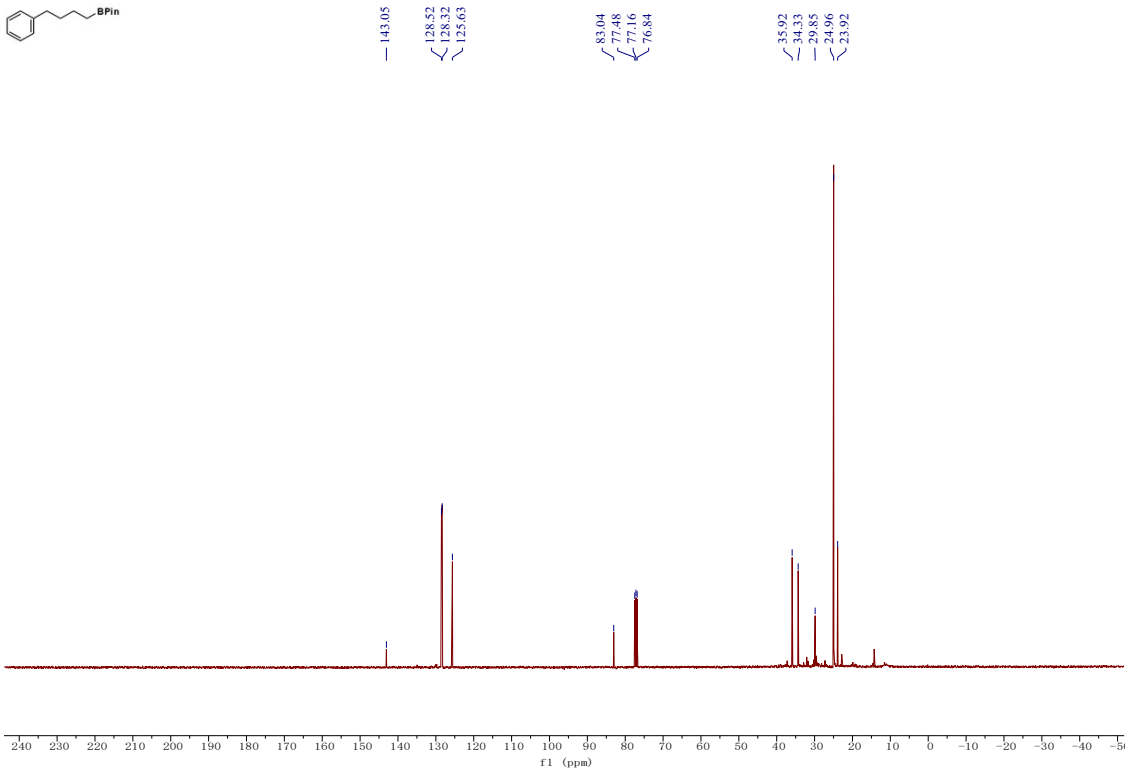
Compound **11** ^{13}C NMR



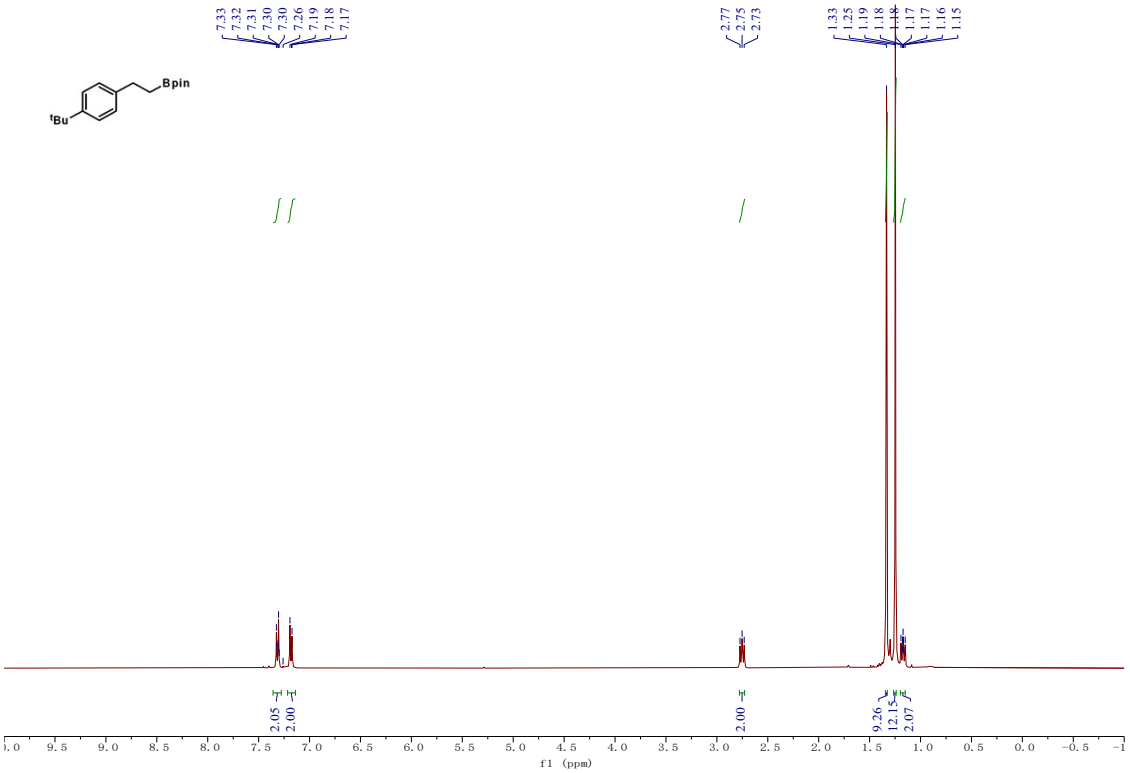
Compound **12** ^{1}H NMR



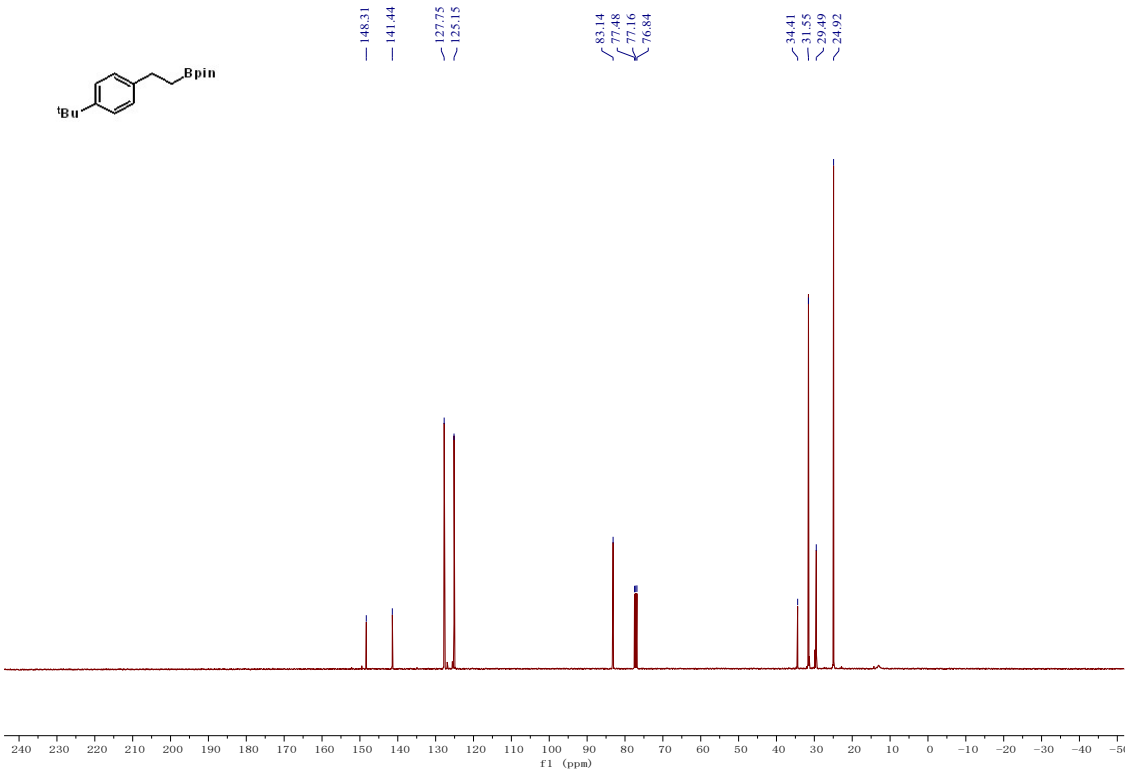
Compound **12** ^{13}C NMR



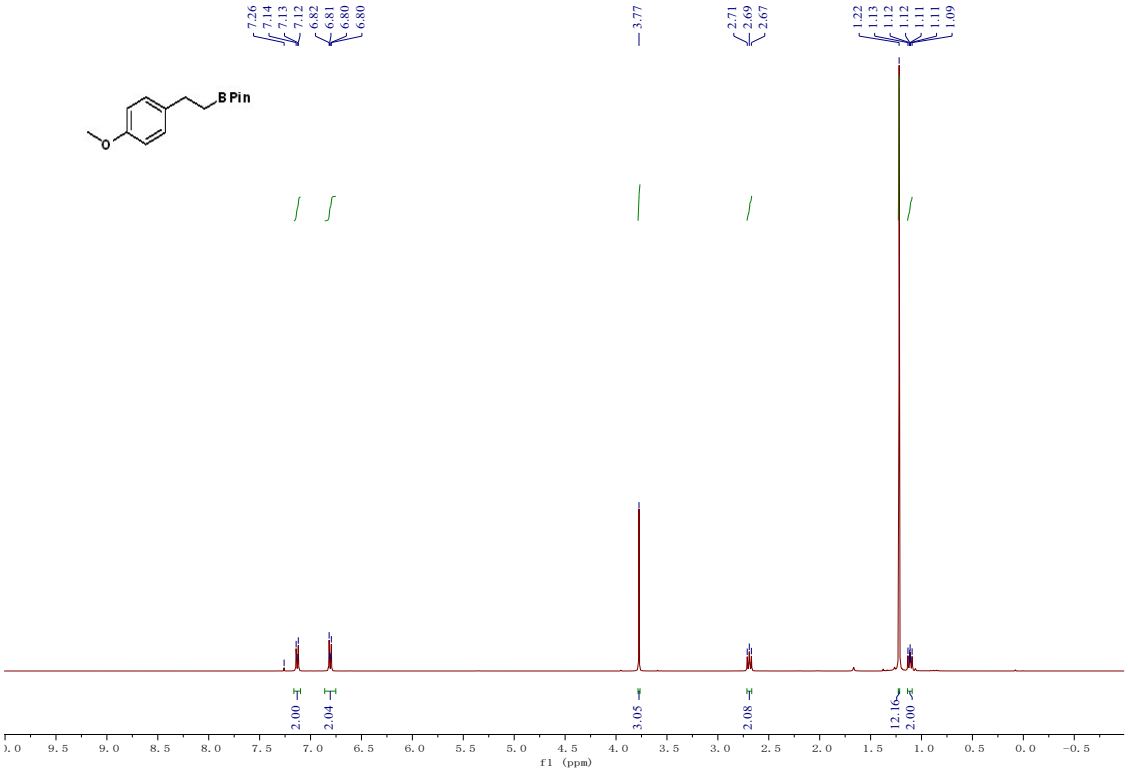
Compound **13** ^{1}H NMR



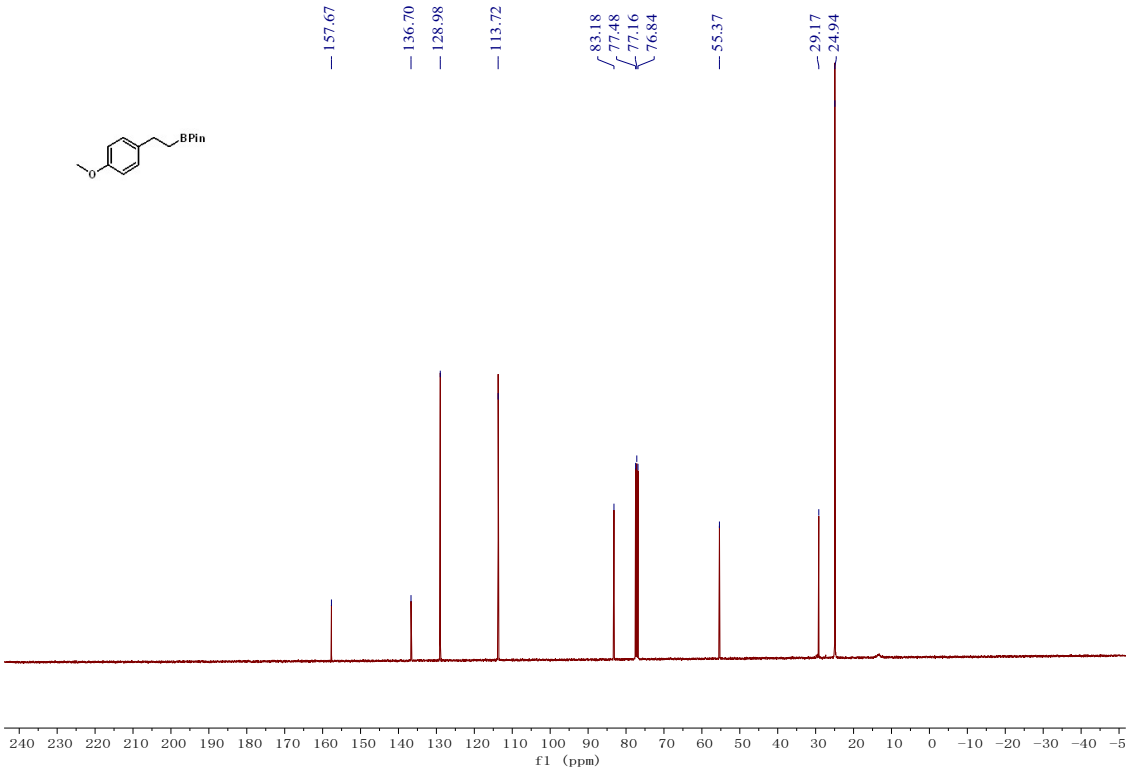
Compound **13** ^{13}C NMR



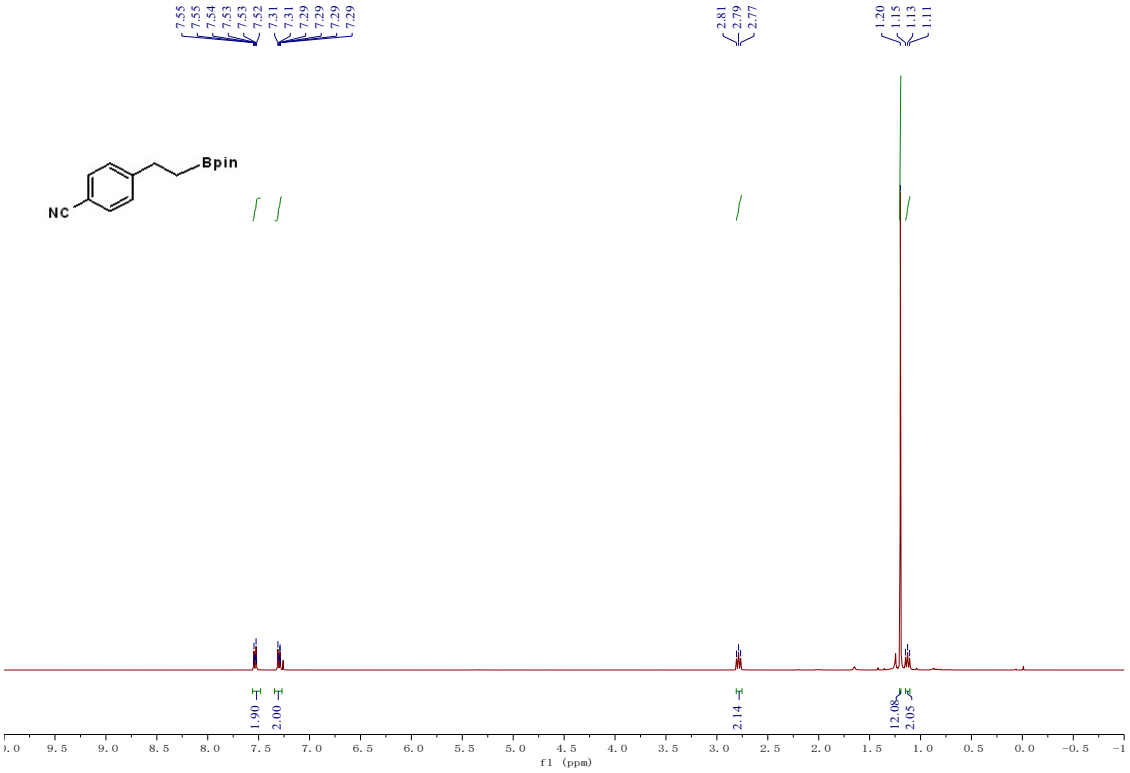
Compound **14** ^{1}H NMR



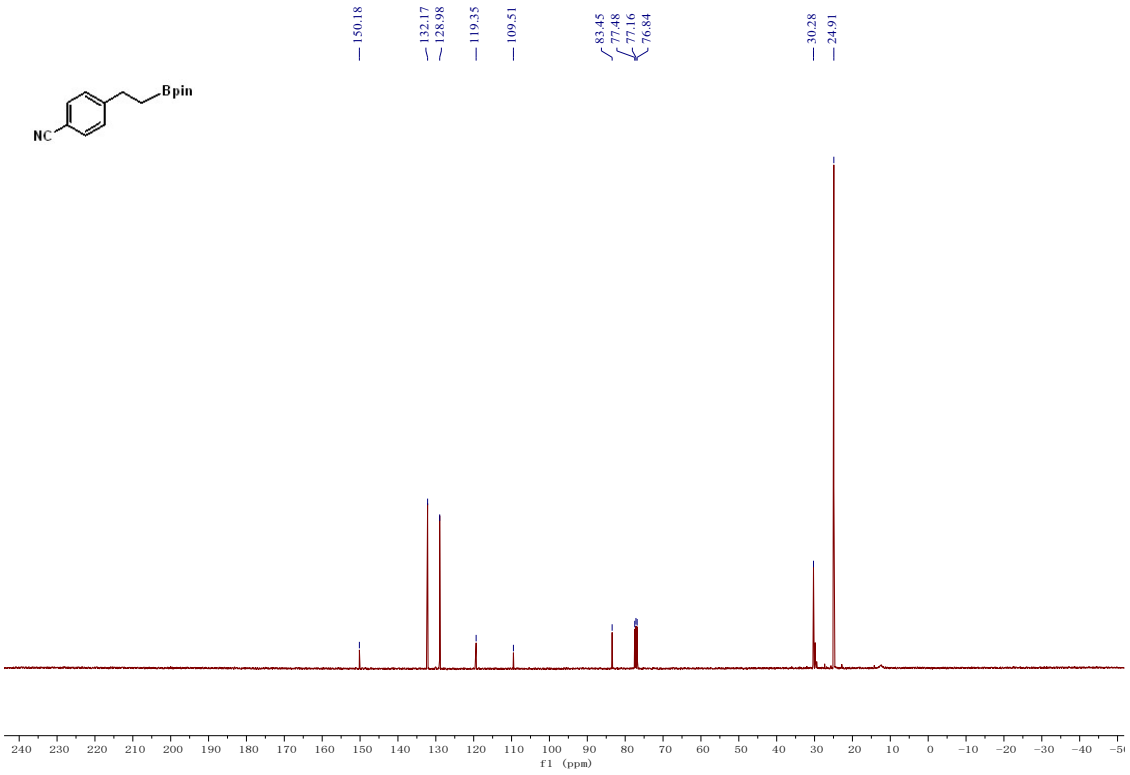
Compound **14** ^{13}C NMR



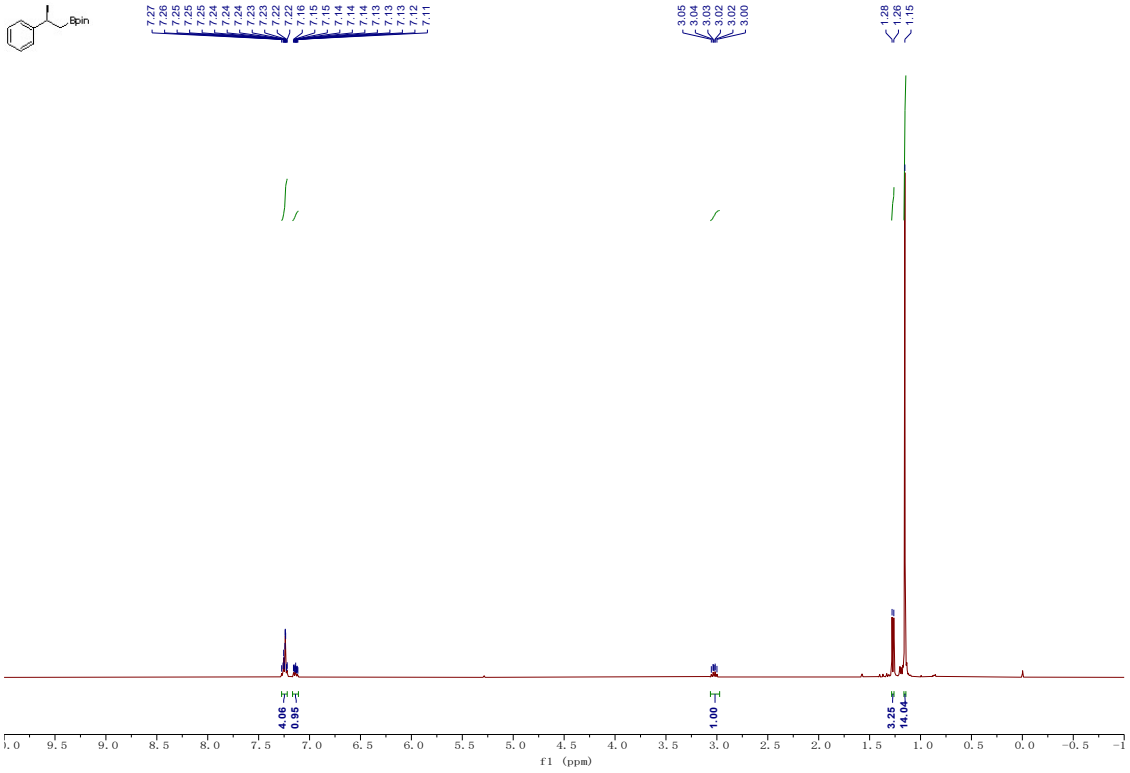
Compound **15** ^{1}H NMR



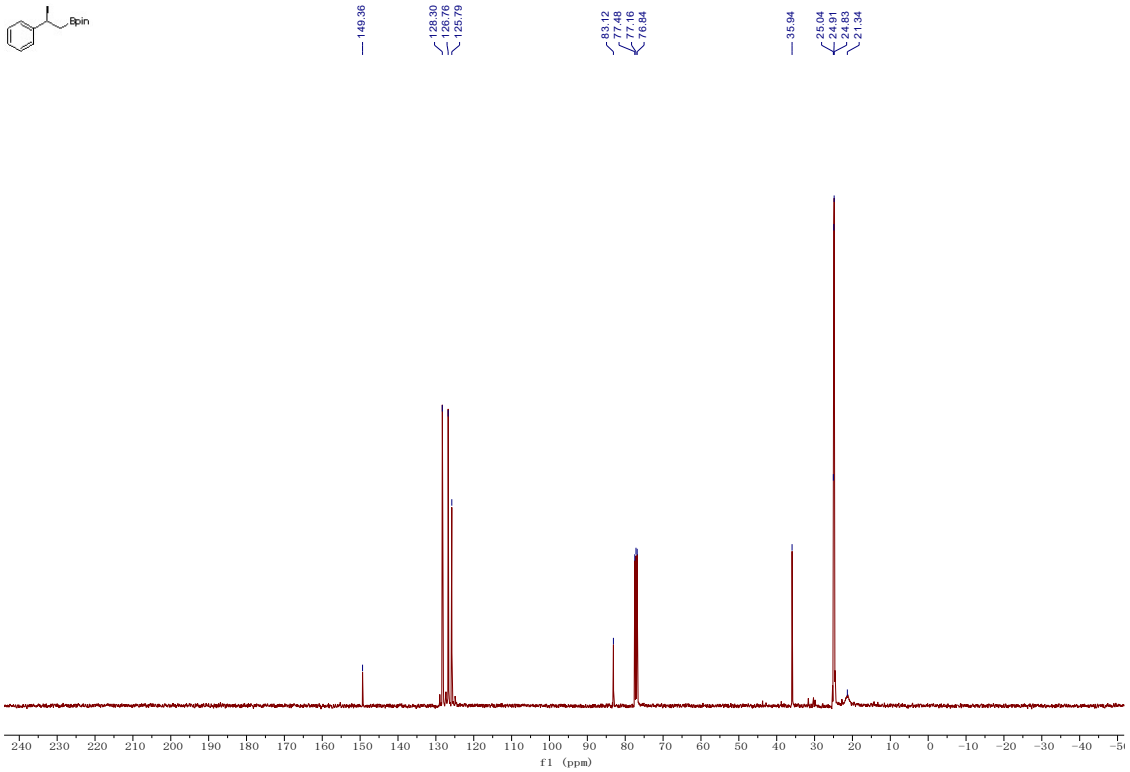
Compound **15** ^{13}C NMR



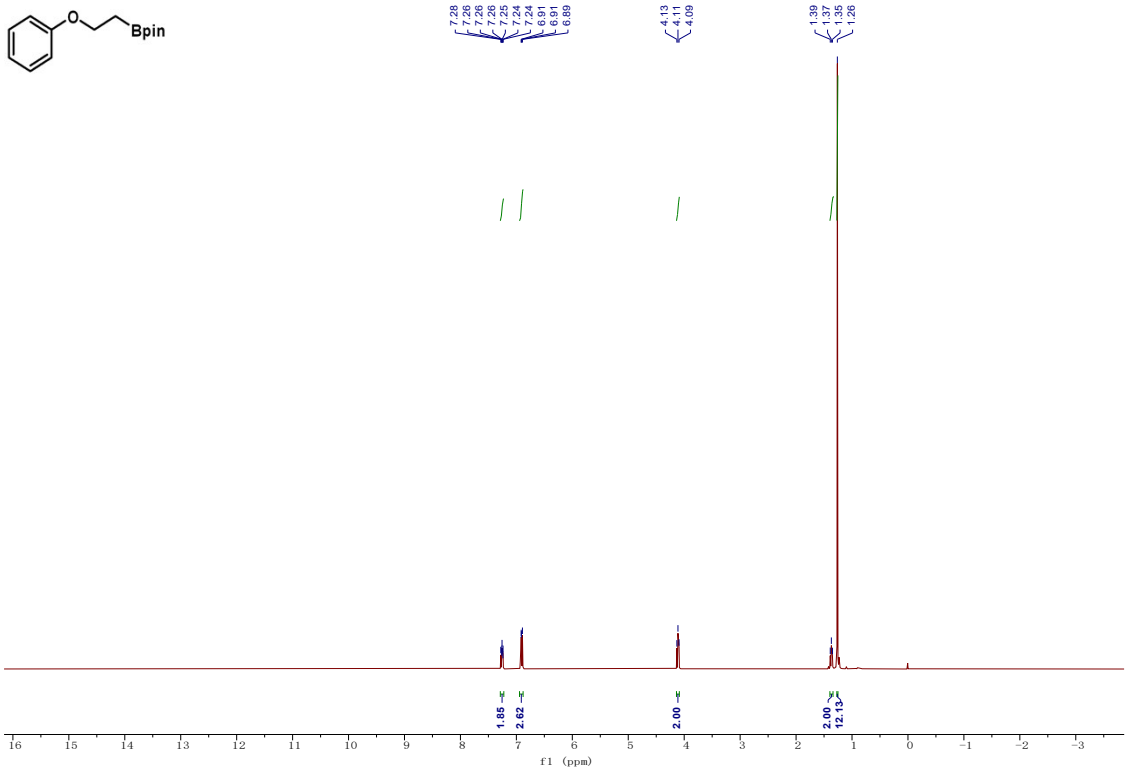
Compound **16** ^{1}H NMR



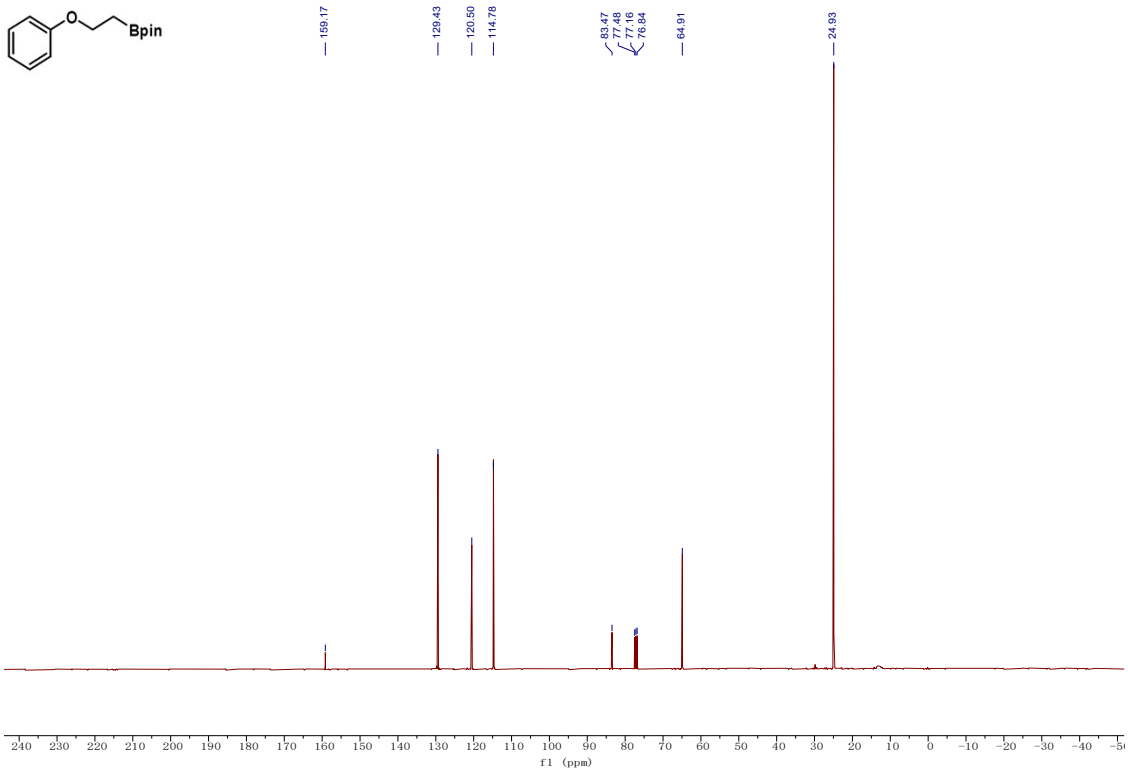
Compound **16** ^{13}C NMR



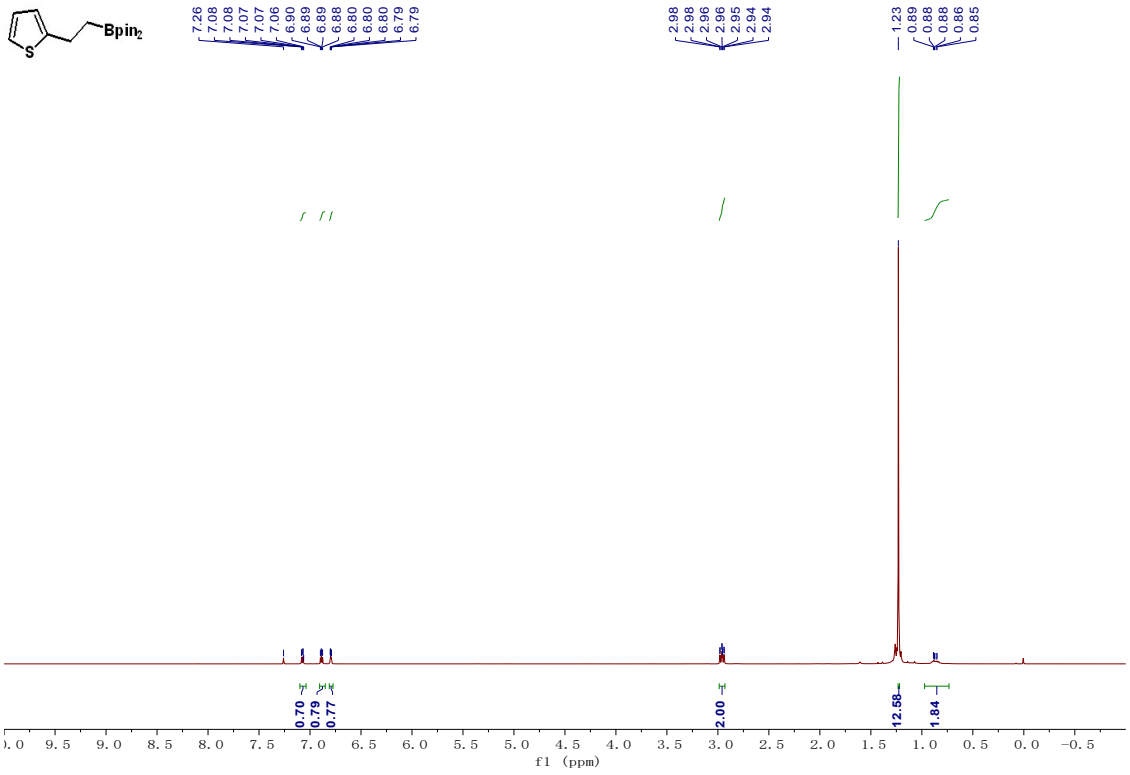
Compound **17** ^{1}H NMR



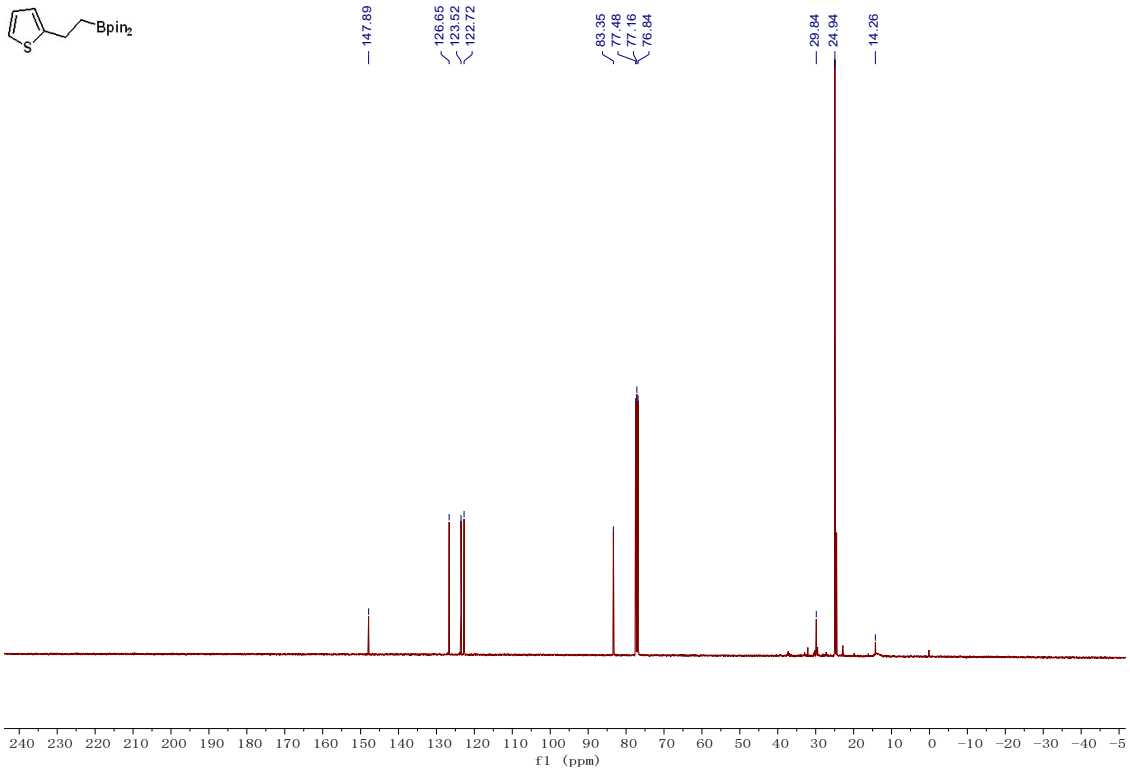
Compound **17** ^{13}C NMR



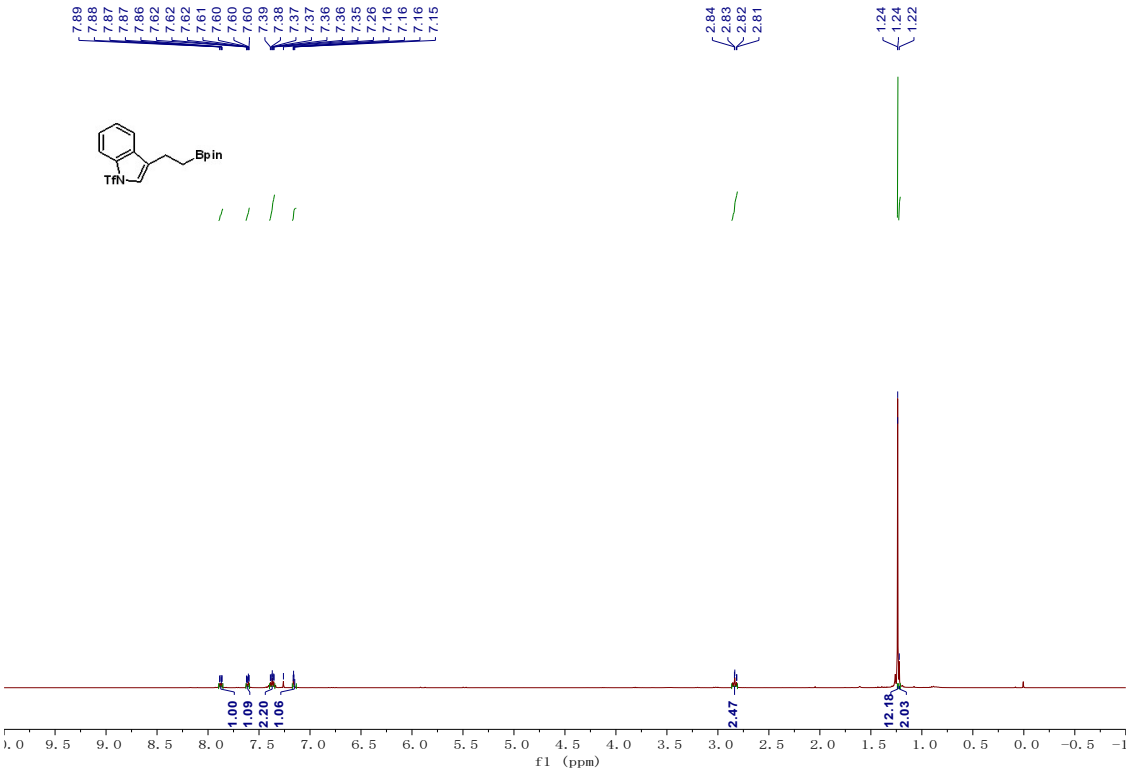
Compound **18** ^{1}H NMR



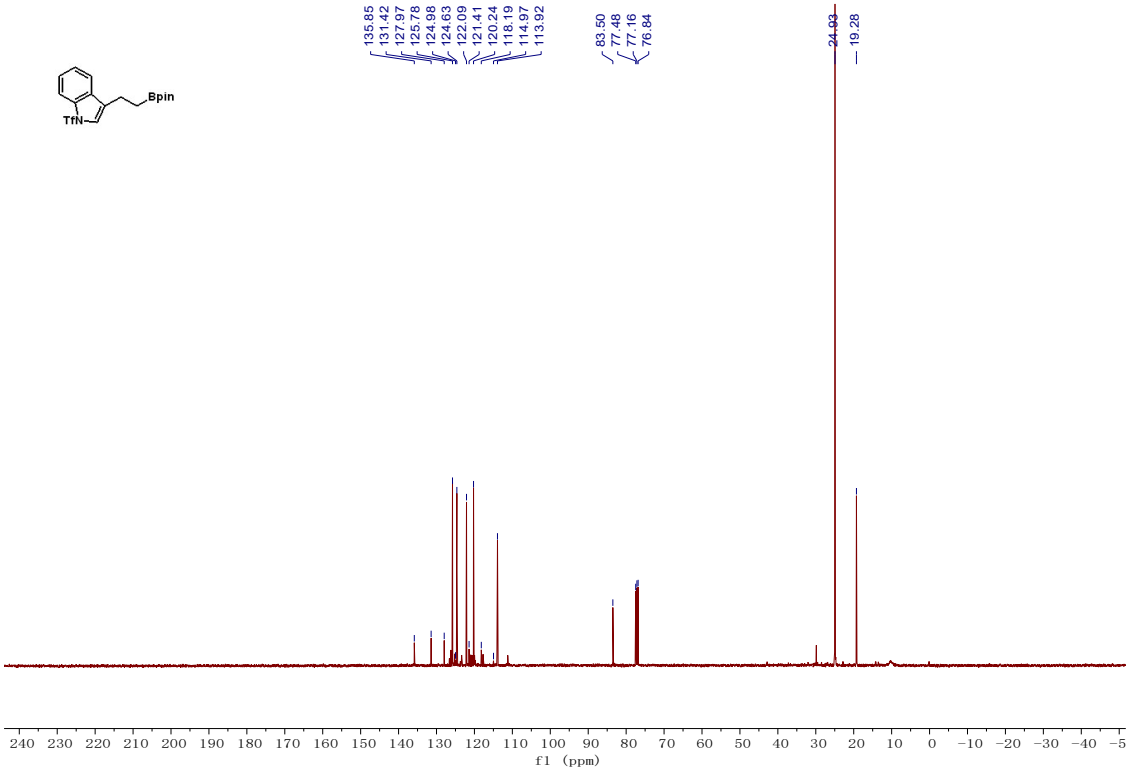
Compound **18** ^{13}C NMR



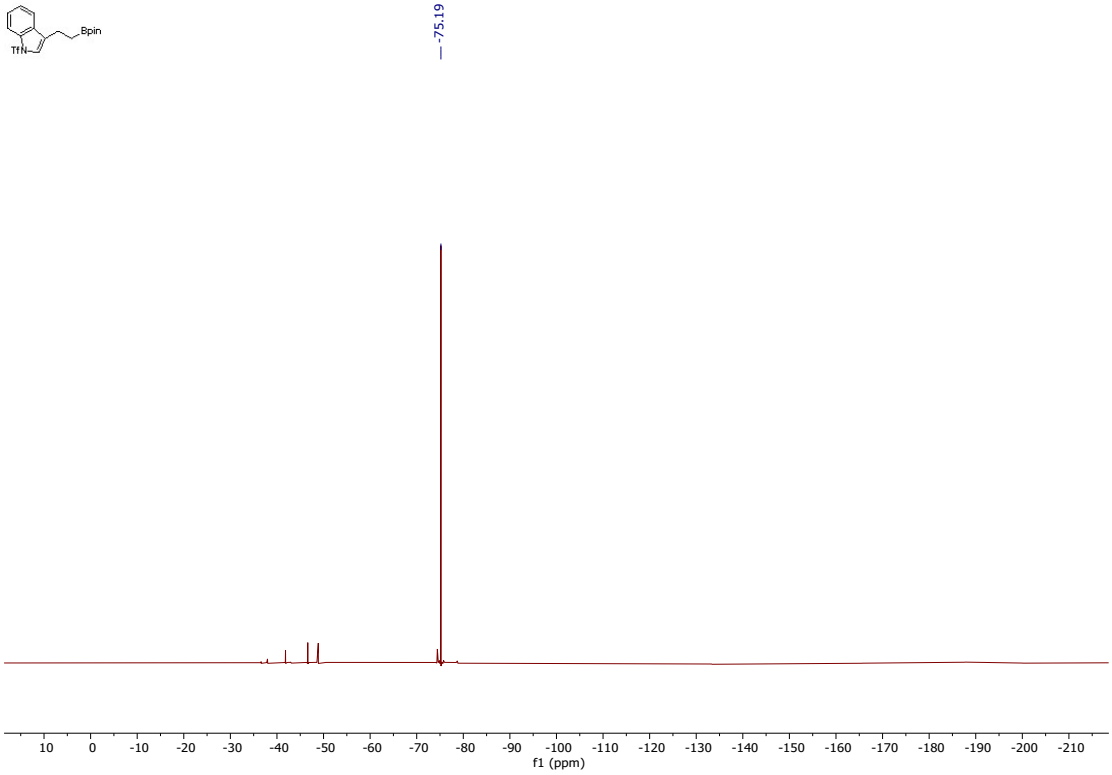
Compound **19** ^{1}H NMR



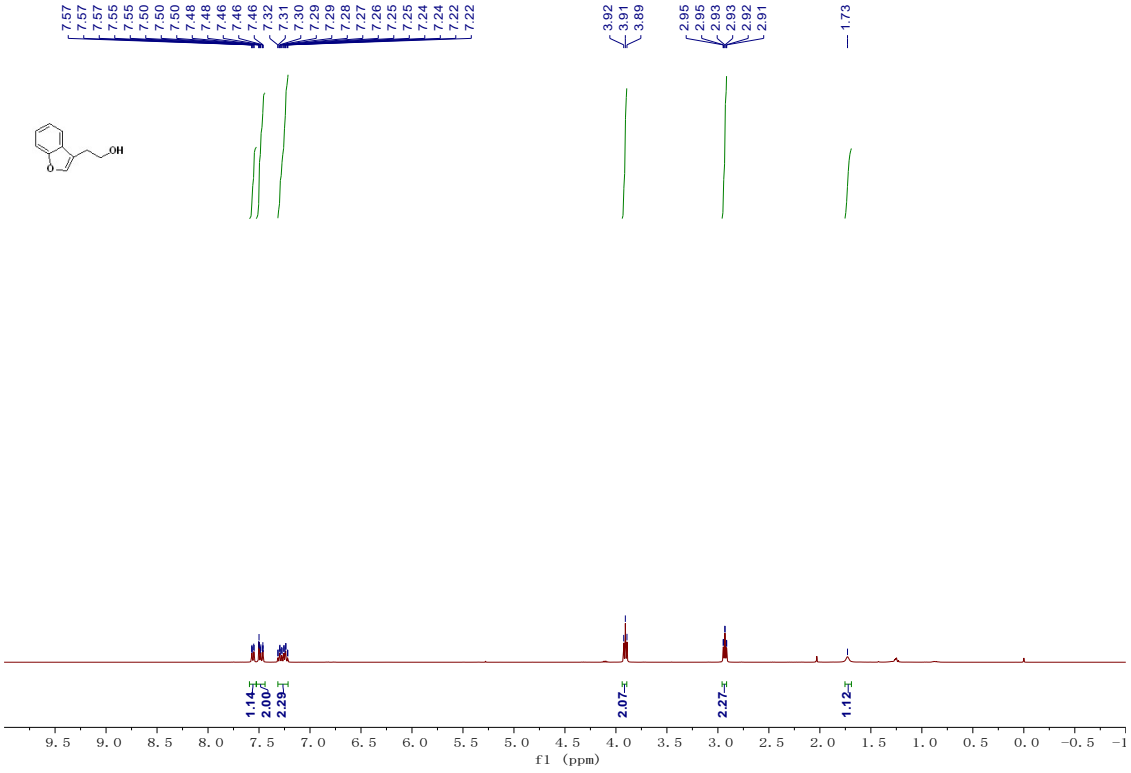
Compound **19** ^{13}C NMR



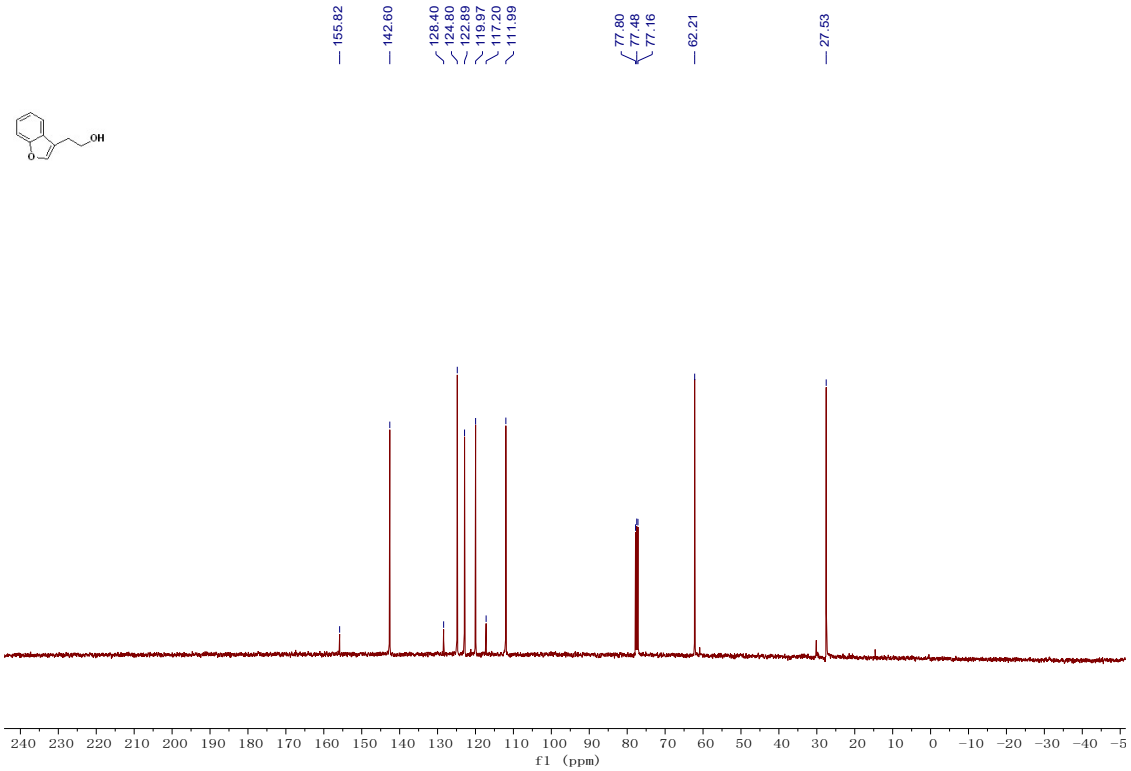
Compound **19** ^{19}F NMR



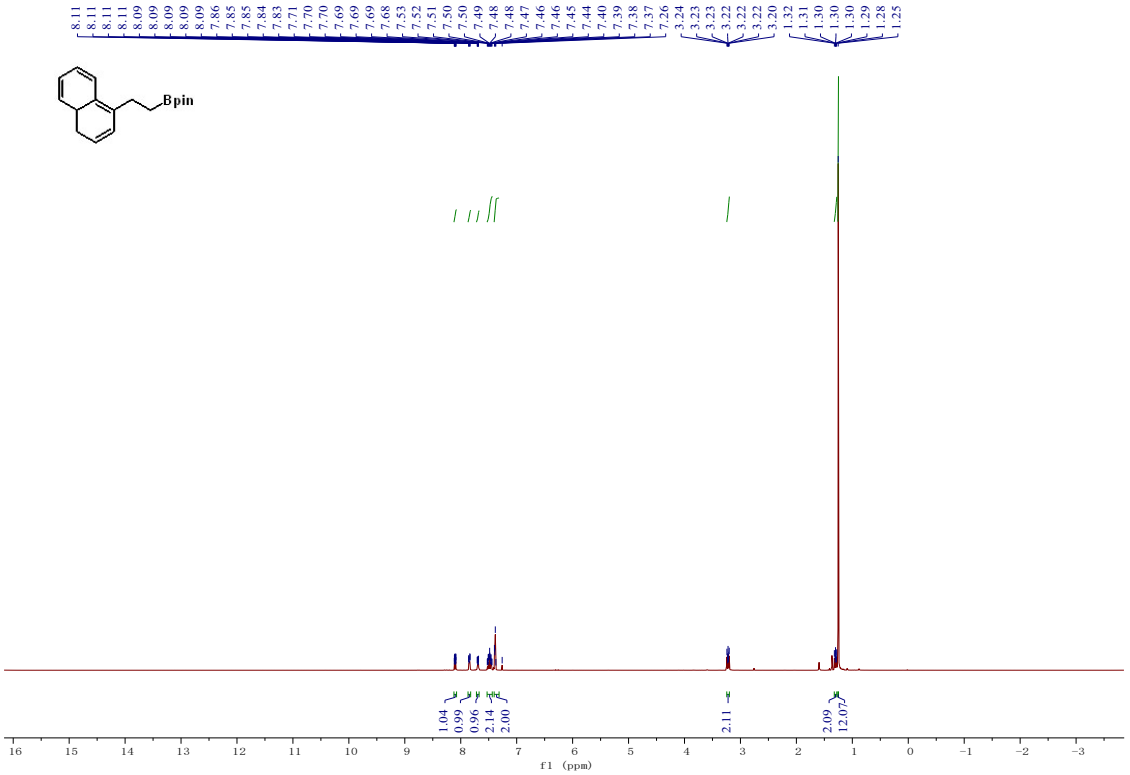
Compound **20** ^{1}H NMR



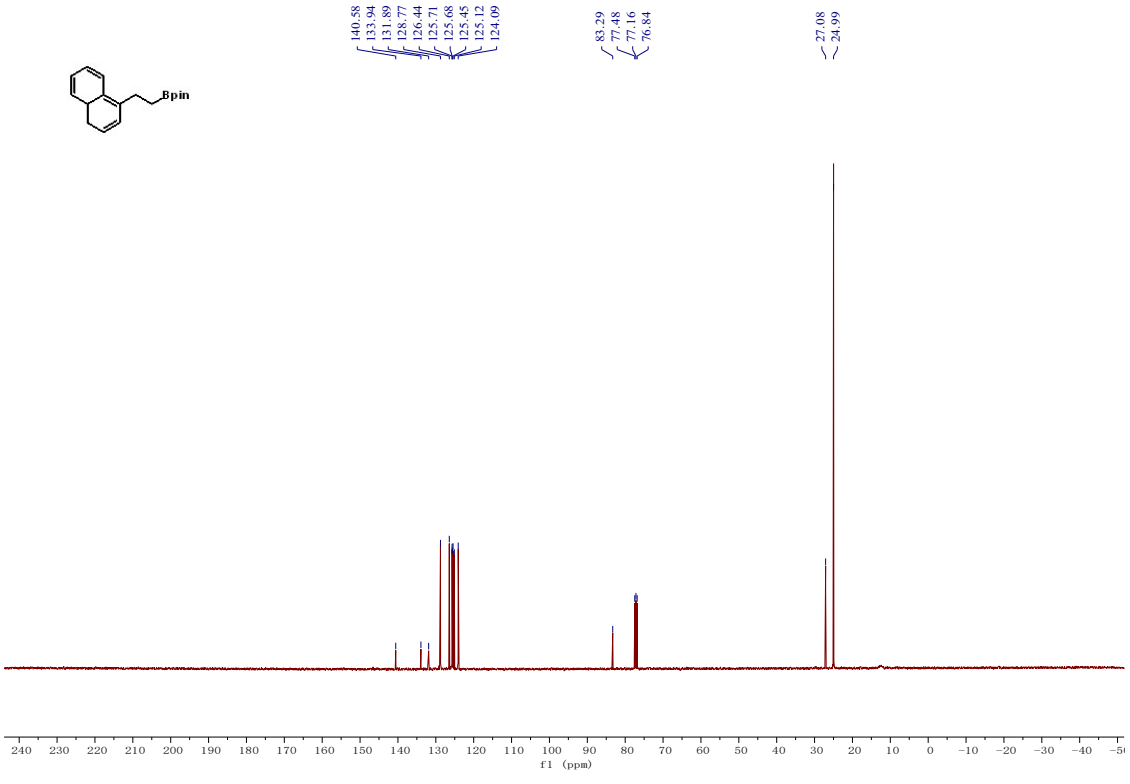
Compound **20** ^{13}C NMR



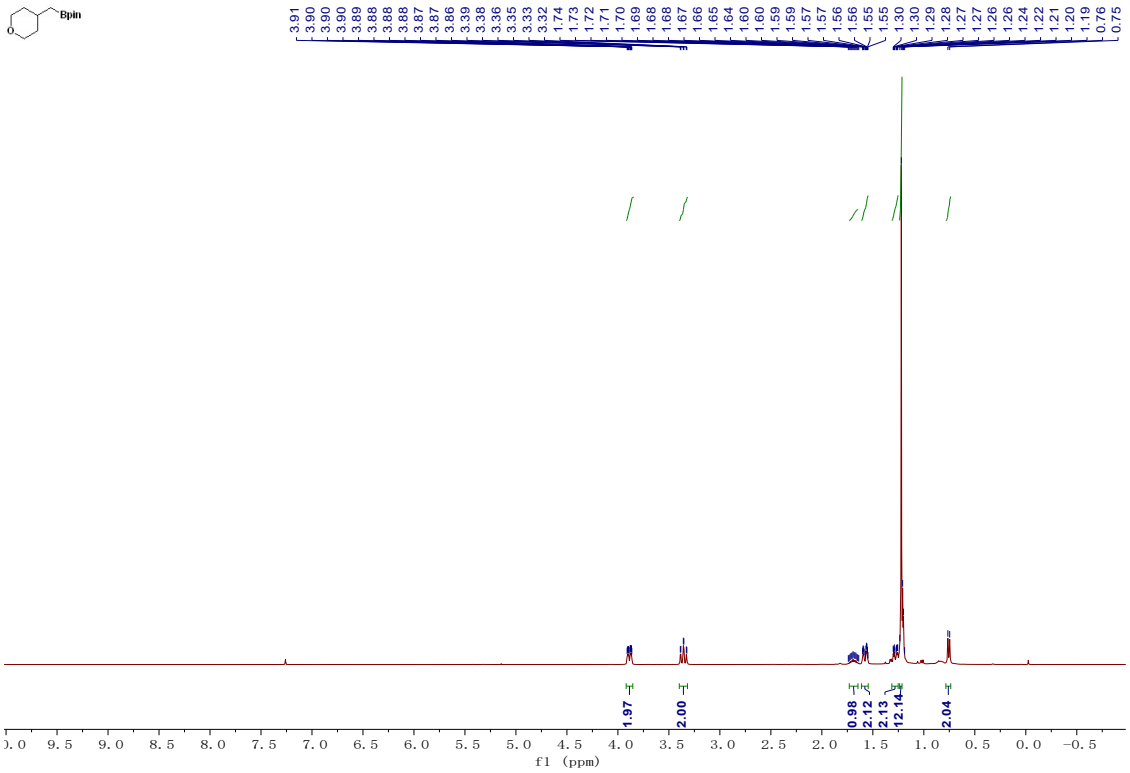
Compound **21** ^{1}H NMR



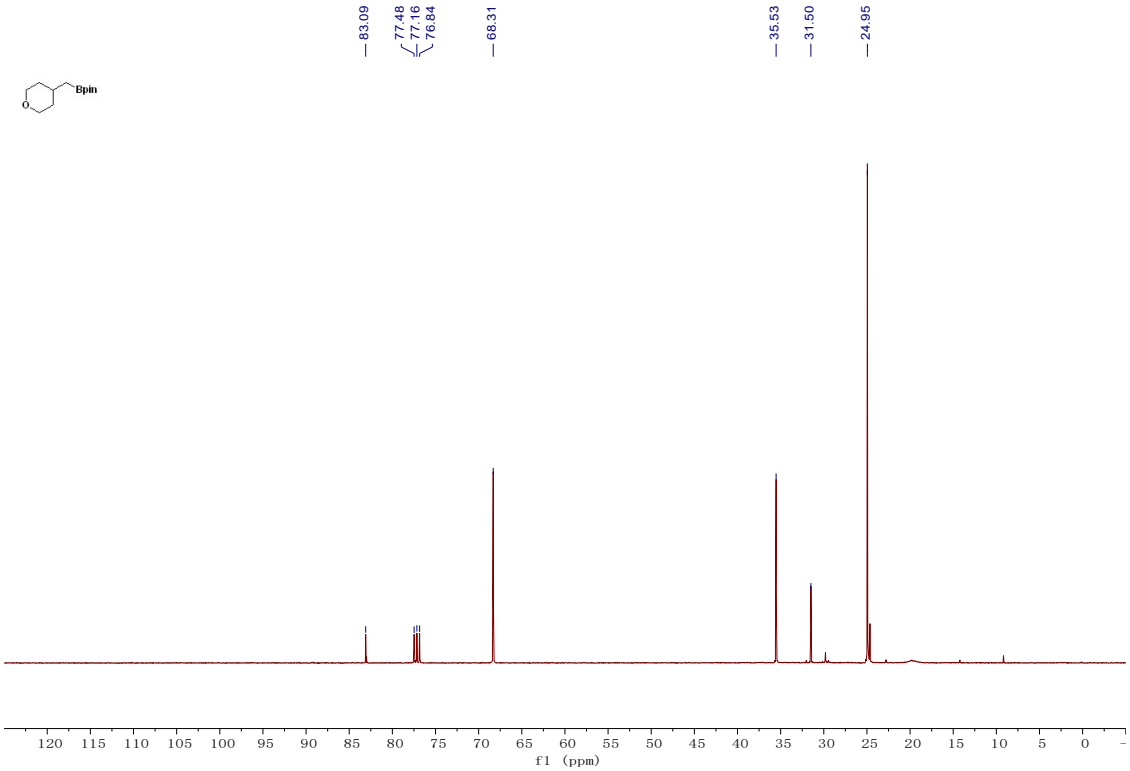
Compound **21** ^{13}C NMR



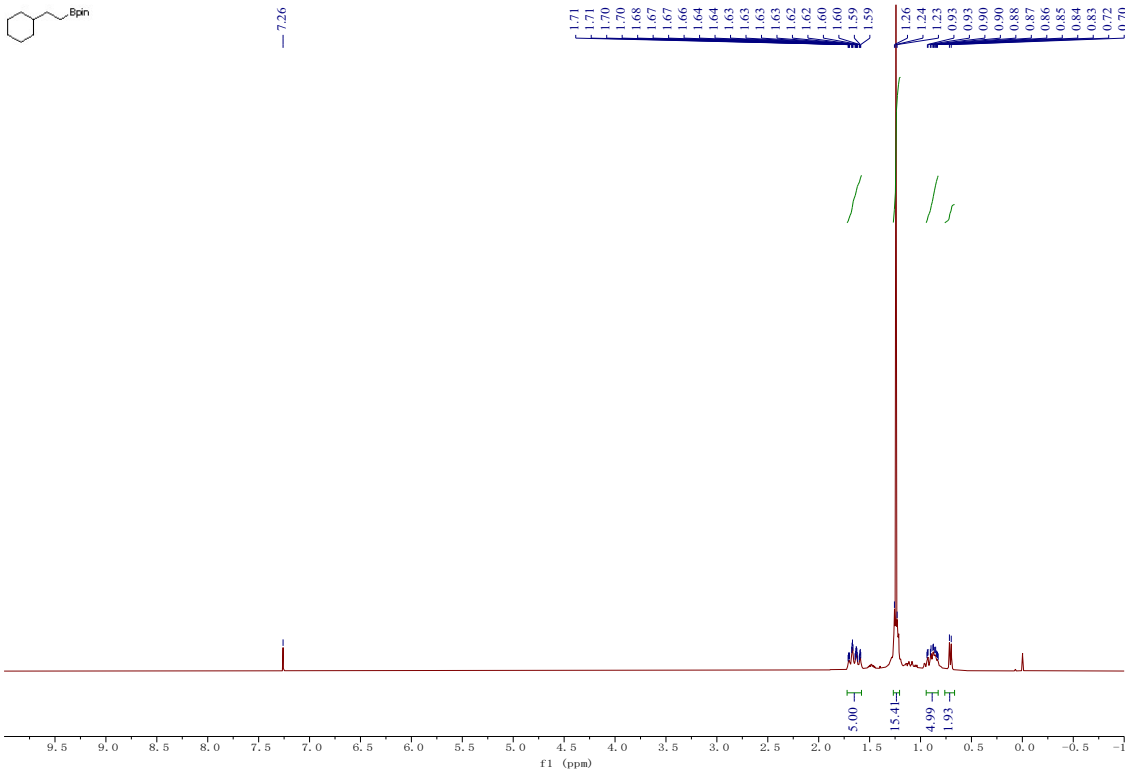
Compound **22** ^{1}H NMR



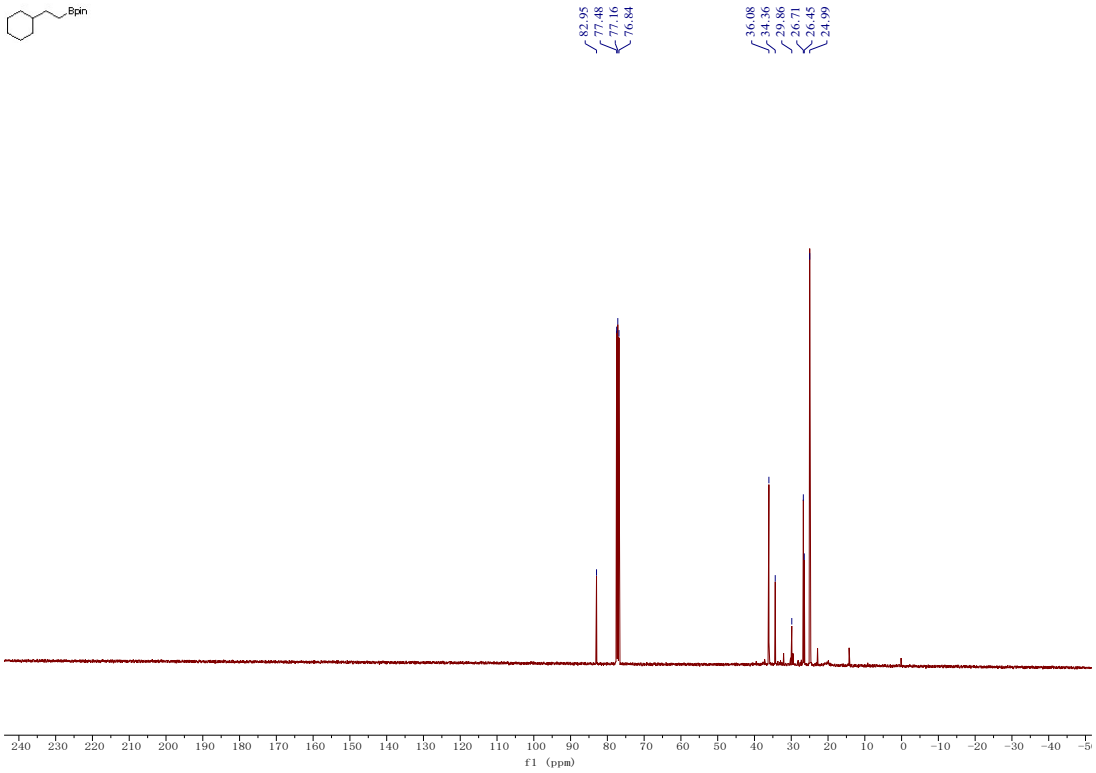
Compound **22** ^{13}C NMR



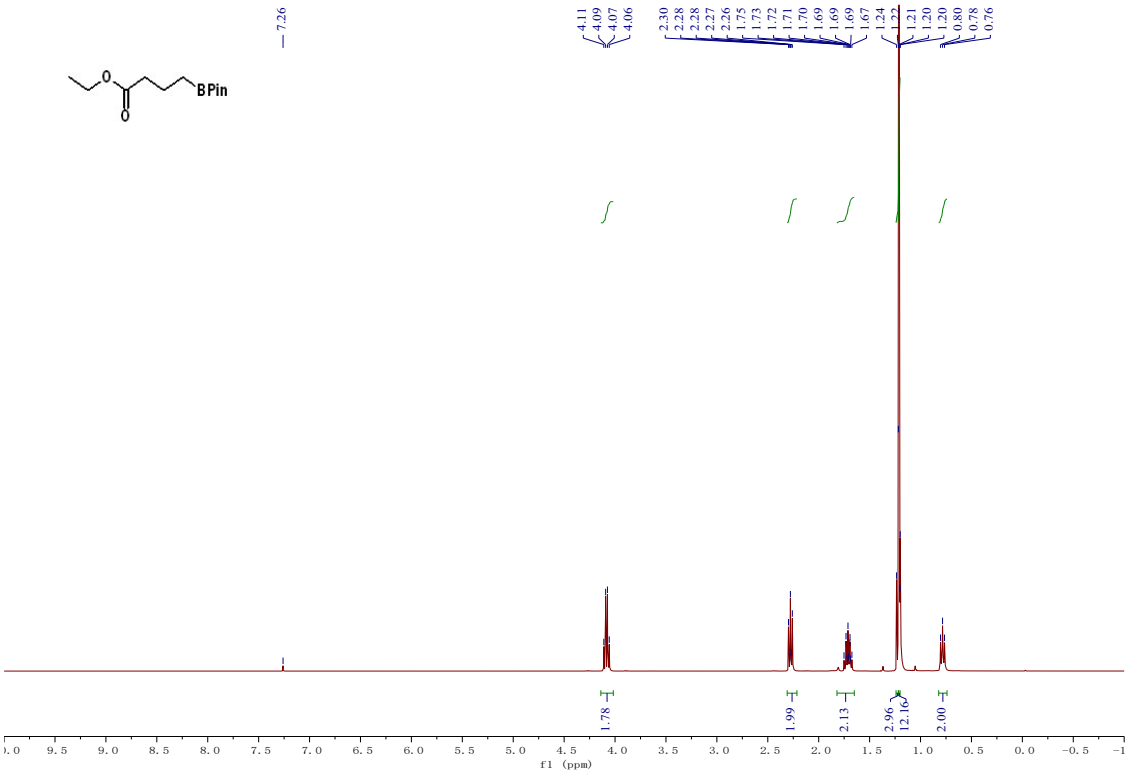
Compound **23** ^{1}H NMR



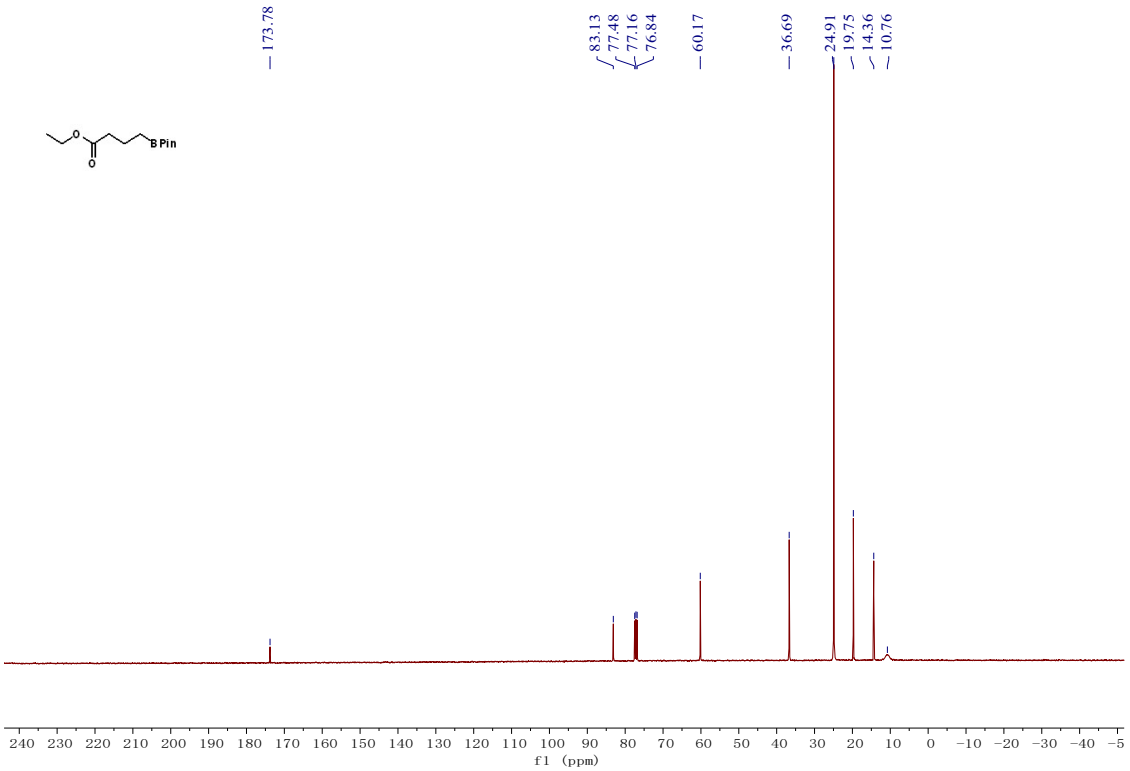
Compound **23** ^{13}C NMR



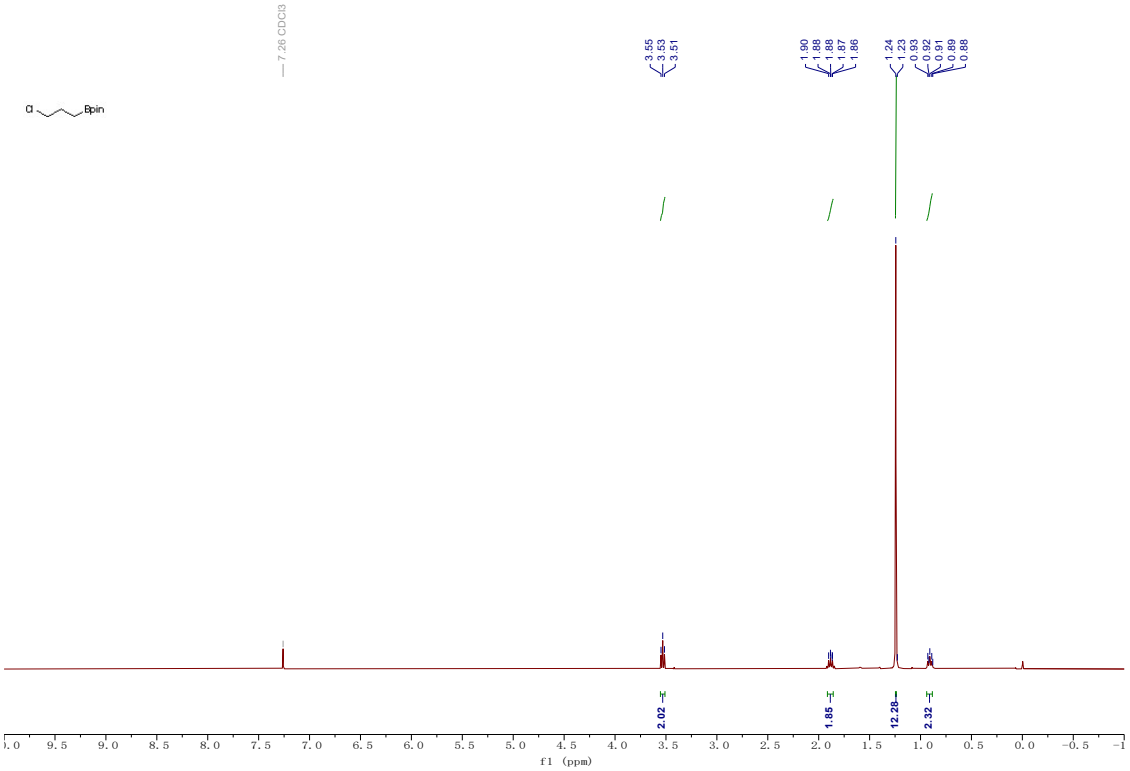
Compound **24** ^{1}H NMR



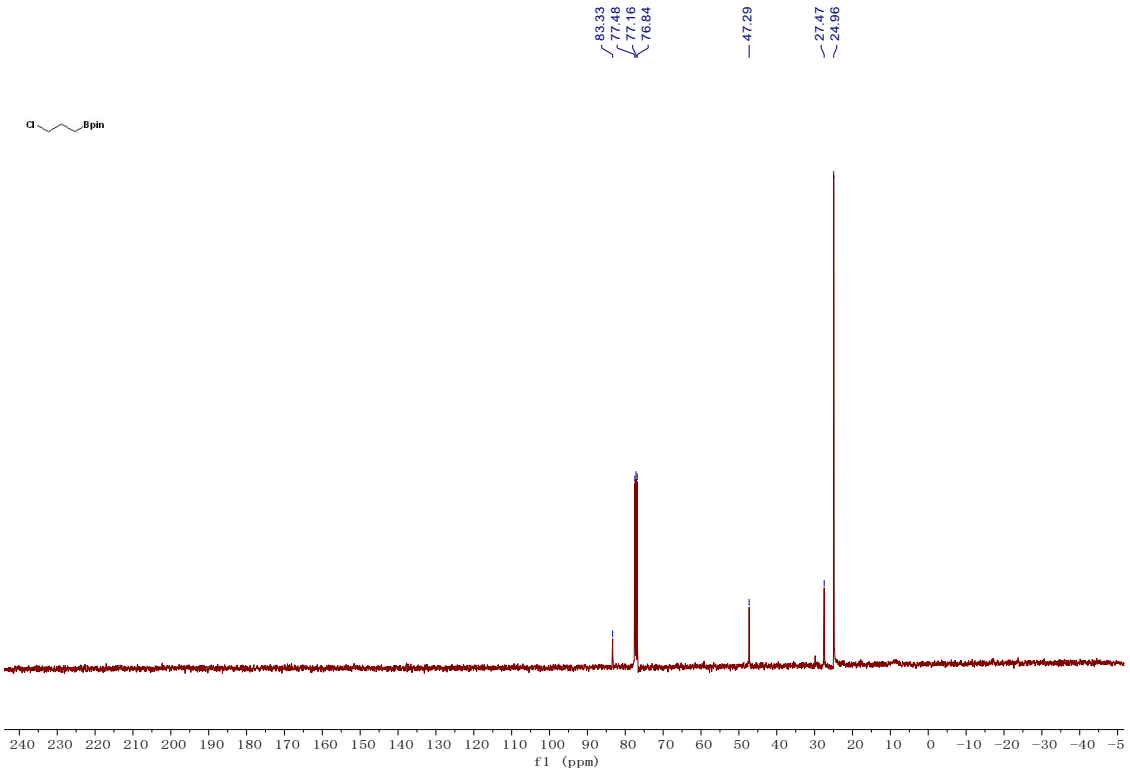
Compound **24** ^{13}C NMR



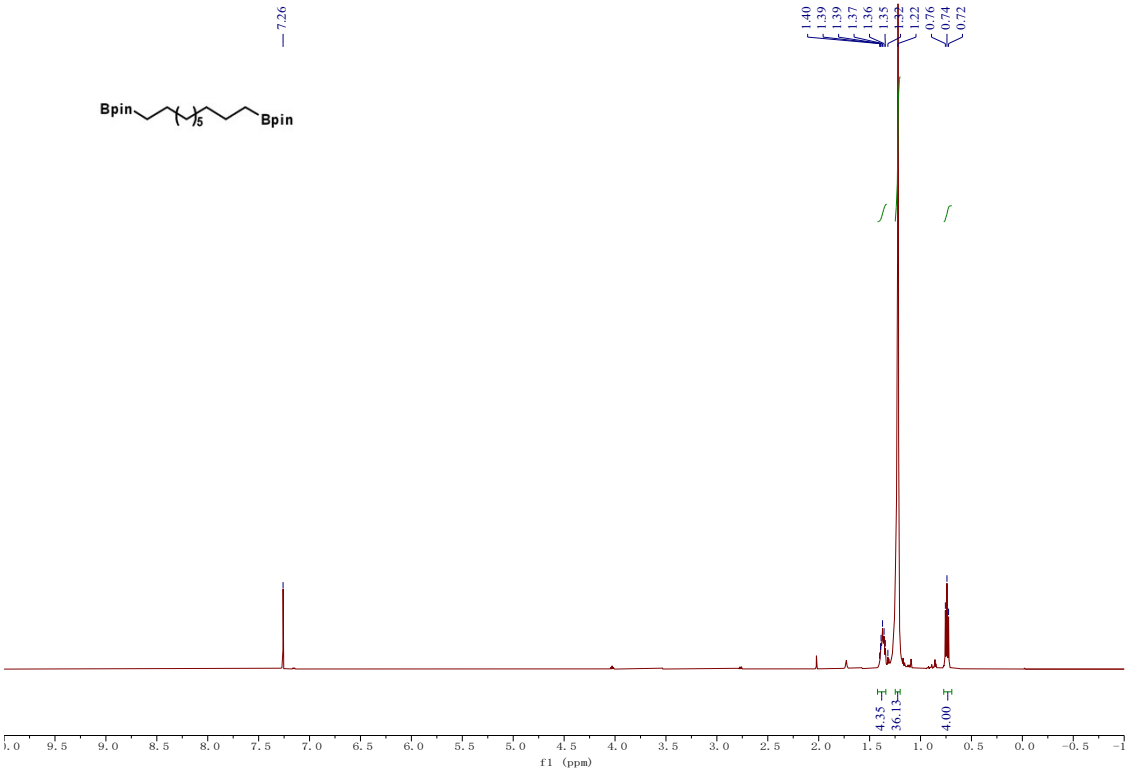
Compound **25** ^{1}H NMR



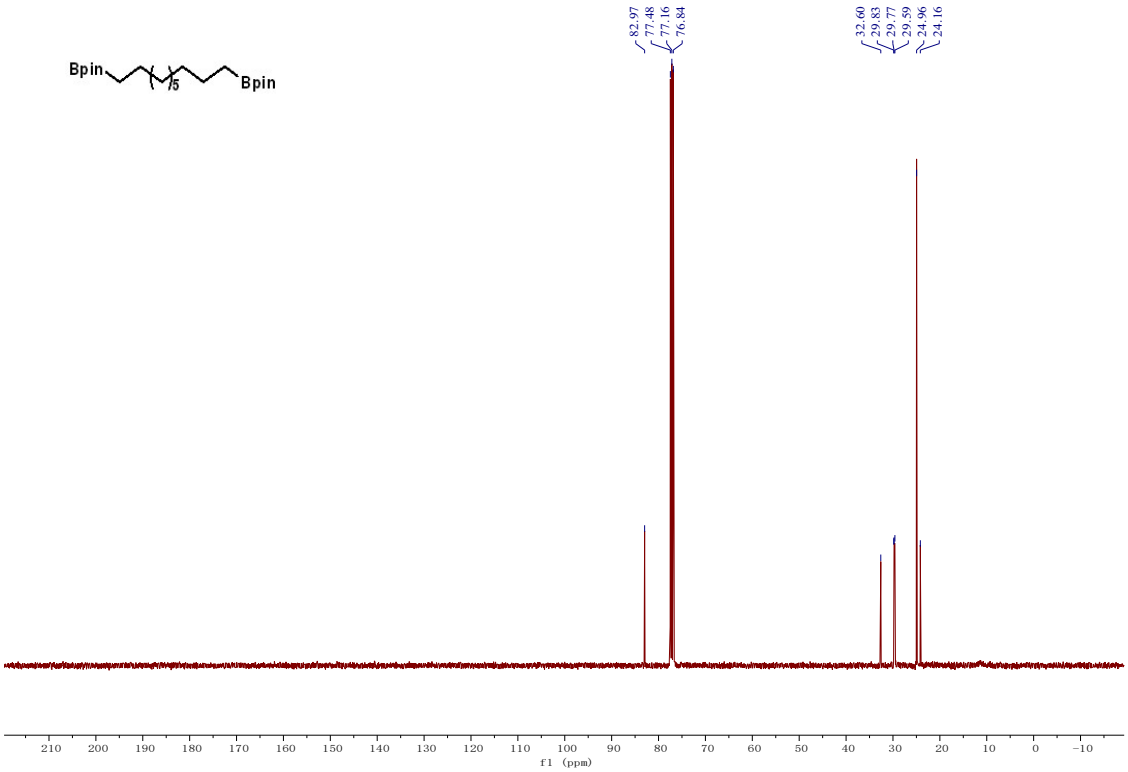
Compound **25** ^{13}C NMR



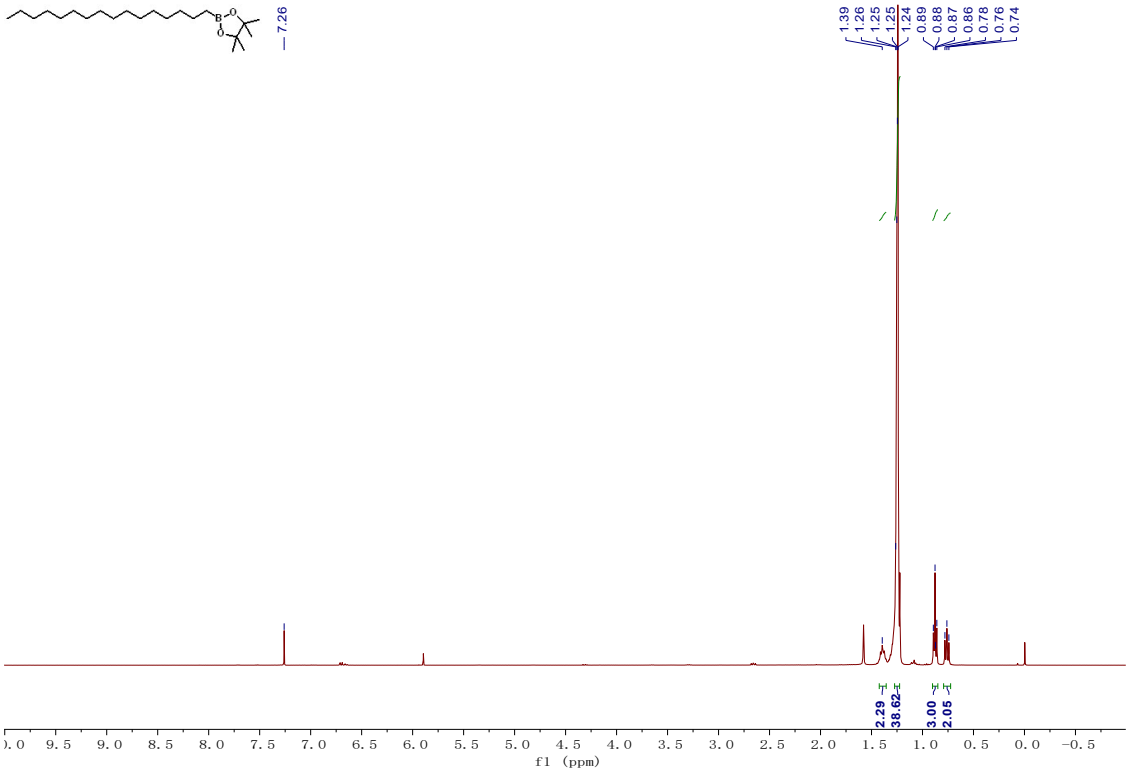
Compound **26** ^{1}H NMR



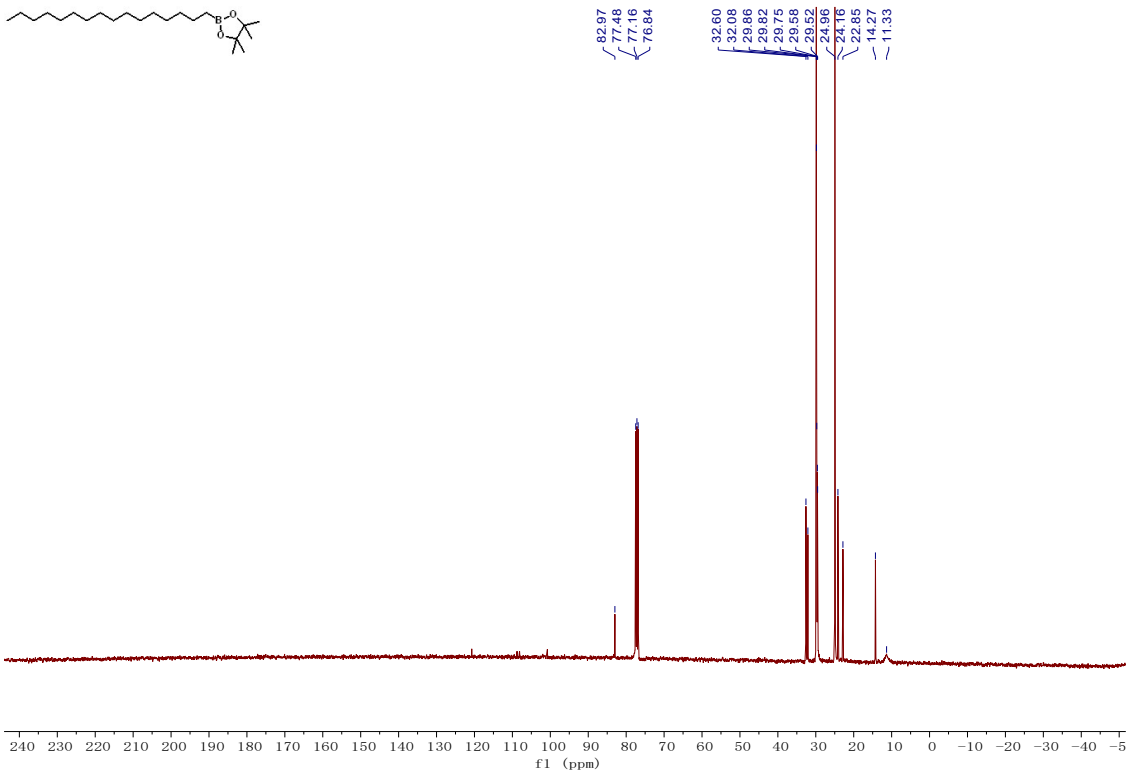
Compound **26** ^{13}C NMR



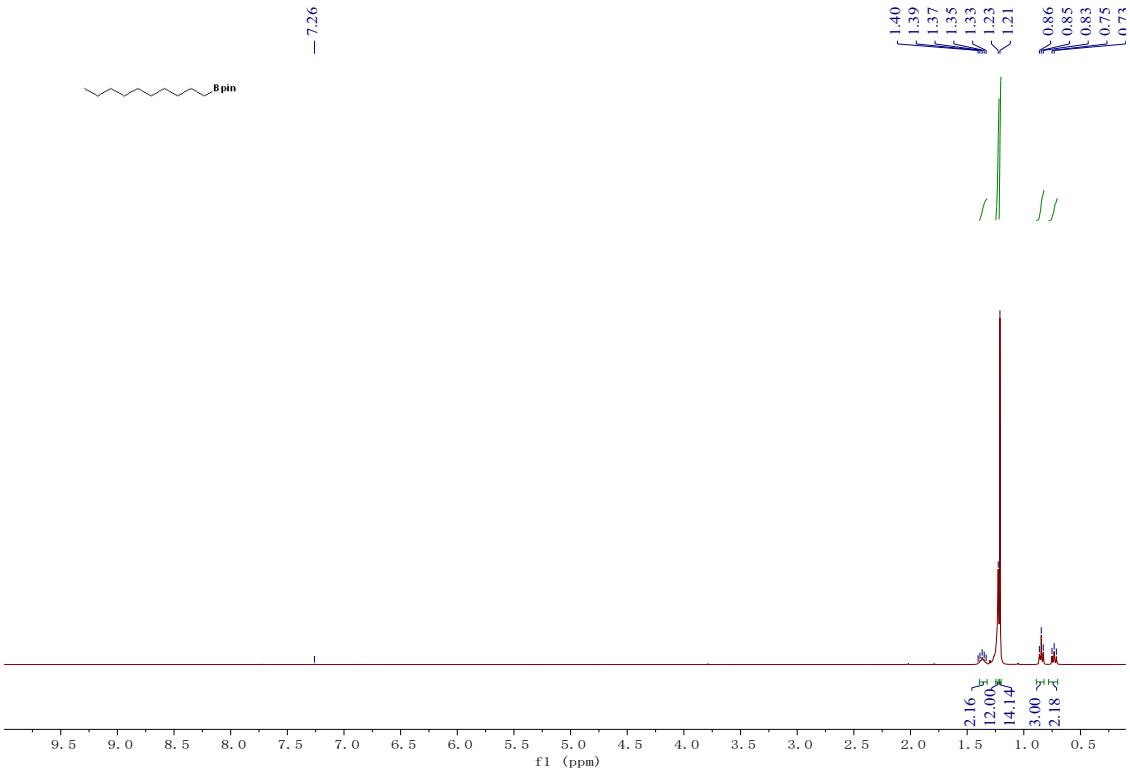
Compound **27** ^{1}H NMR



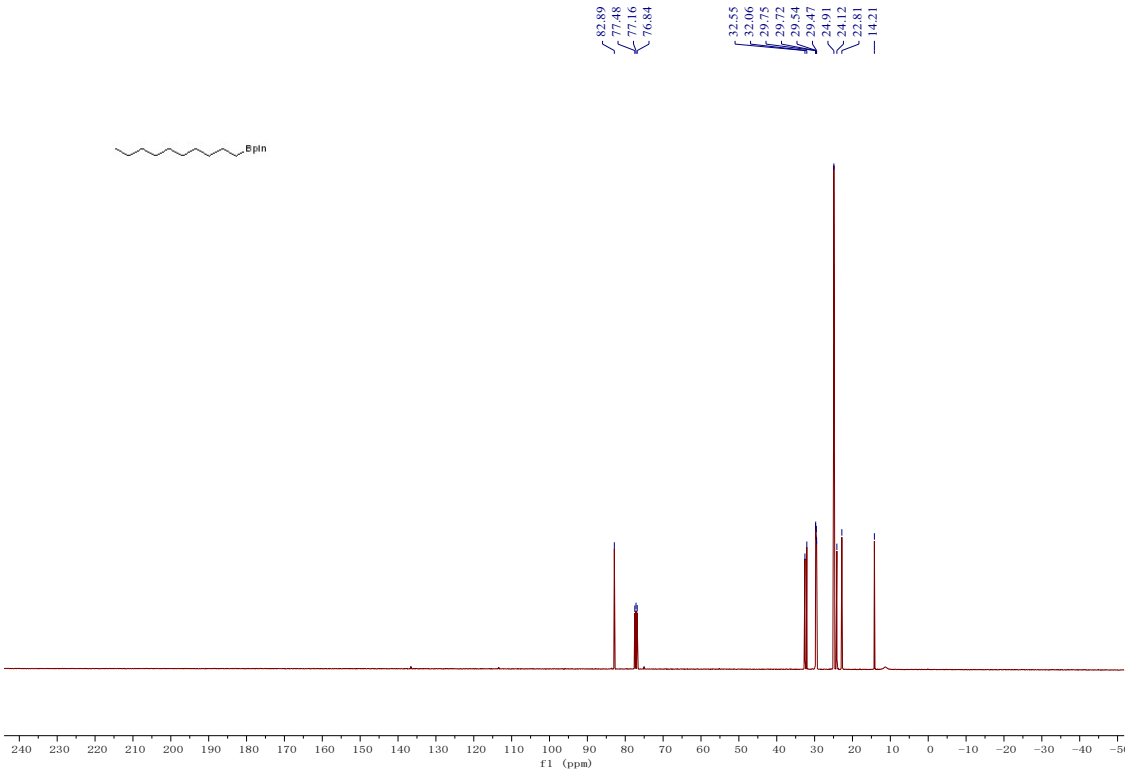
Compound **27** ^{13}C NMR



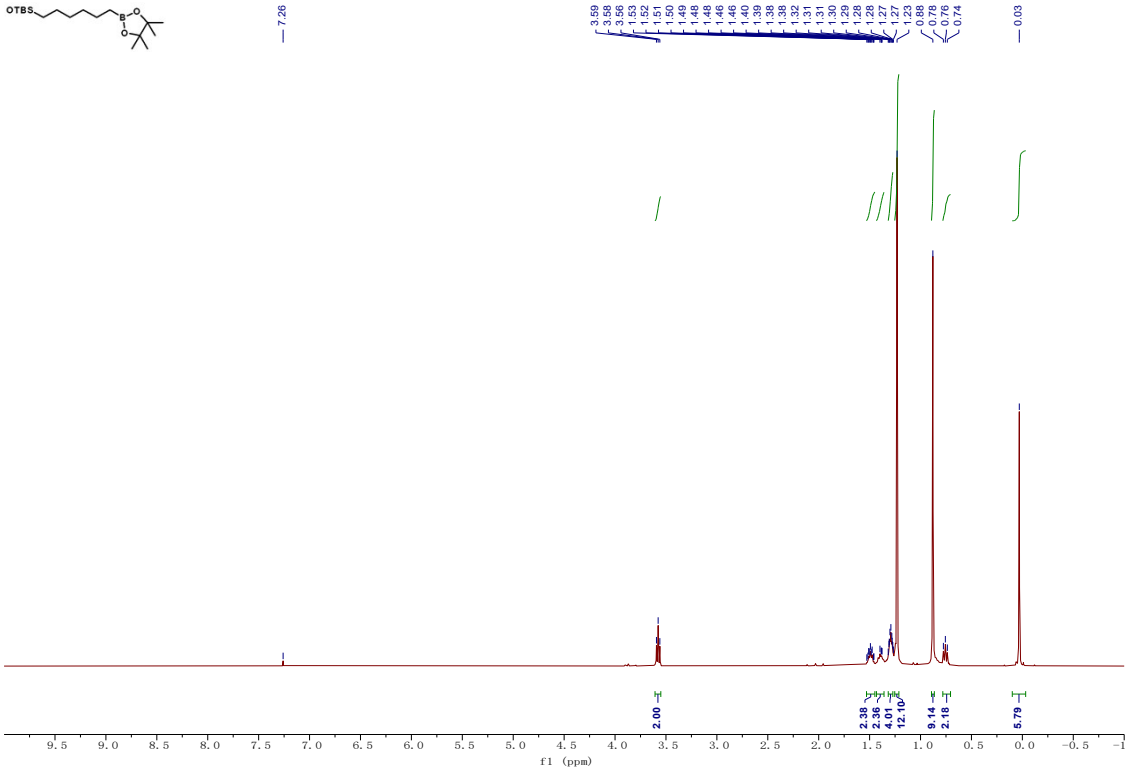
Compound **28** ^{1}H NMR



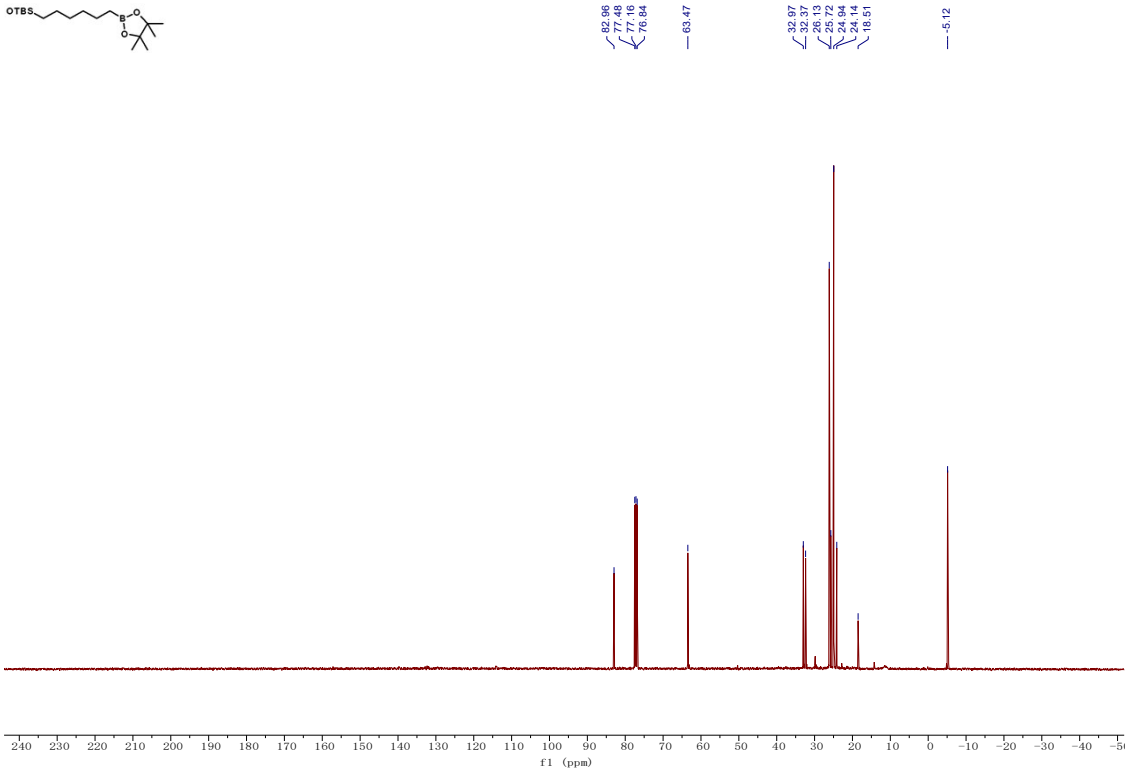
Compound **28** ^{13}C NMR



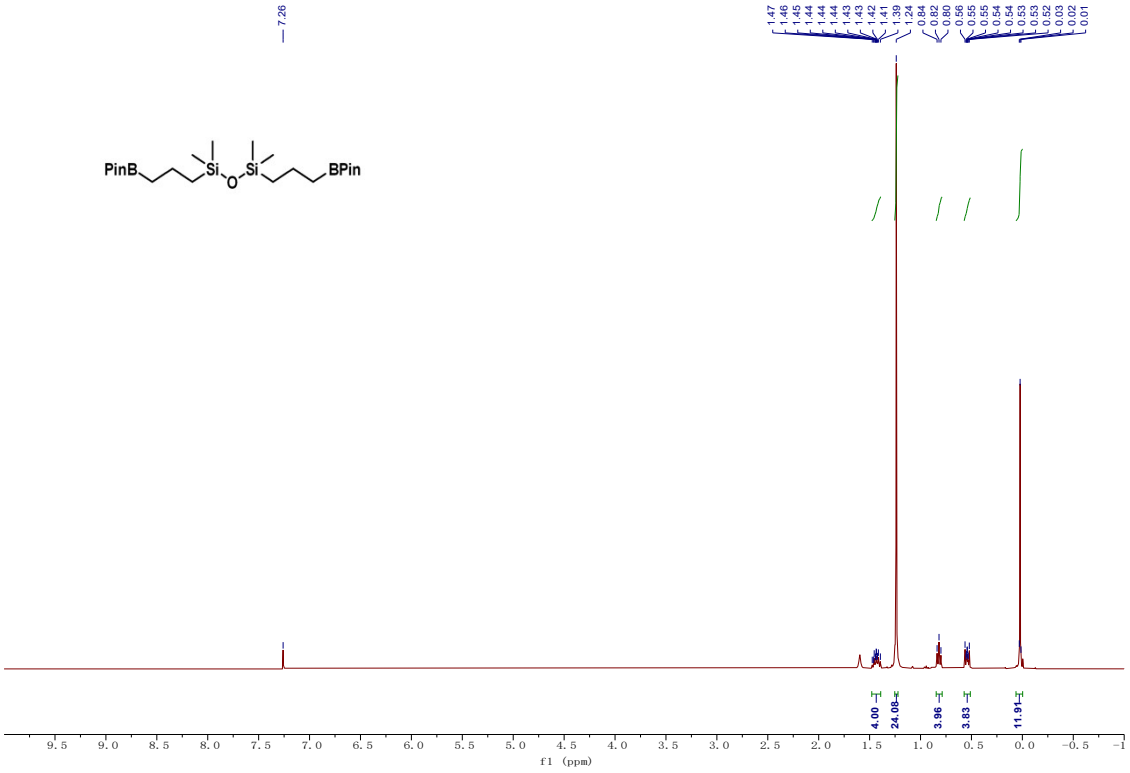
Compound **29** ^{1}H NMR



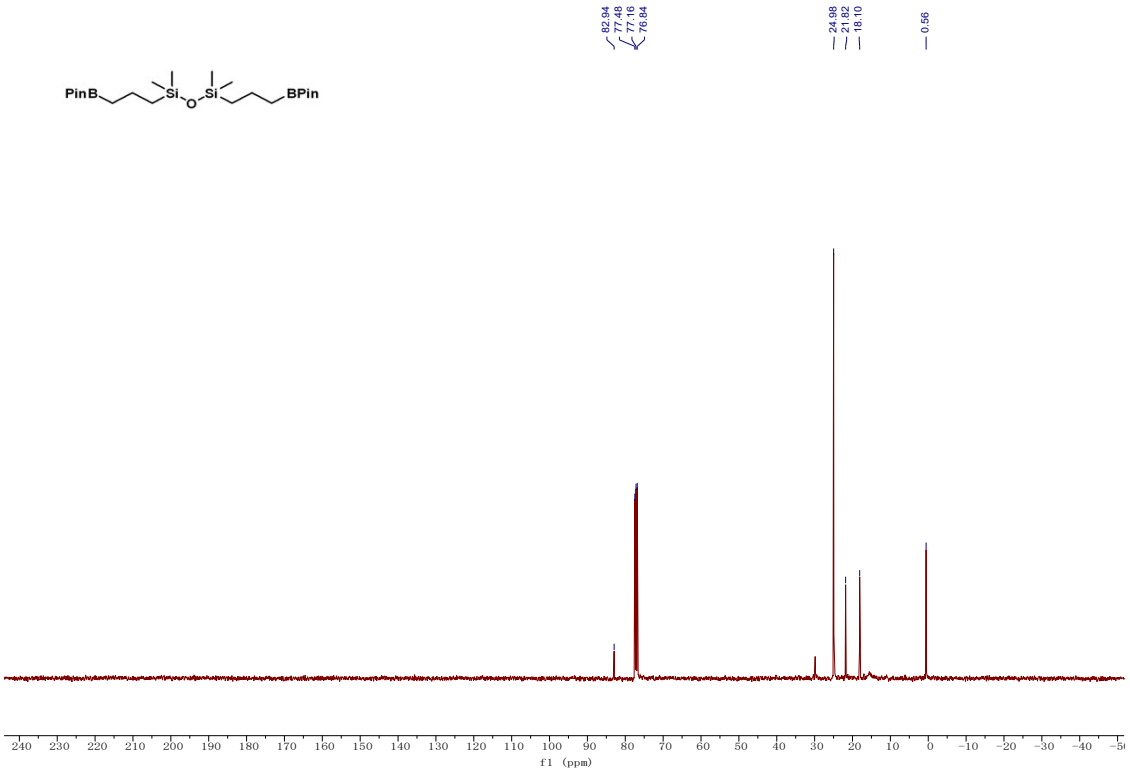
Compound **29** ^{13}C NMR



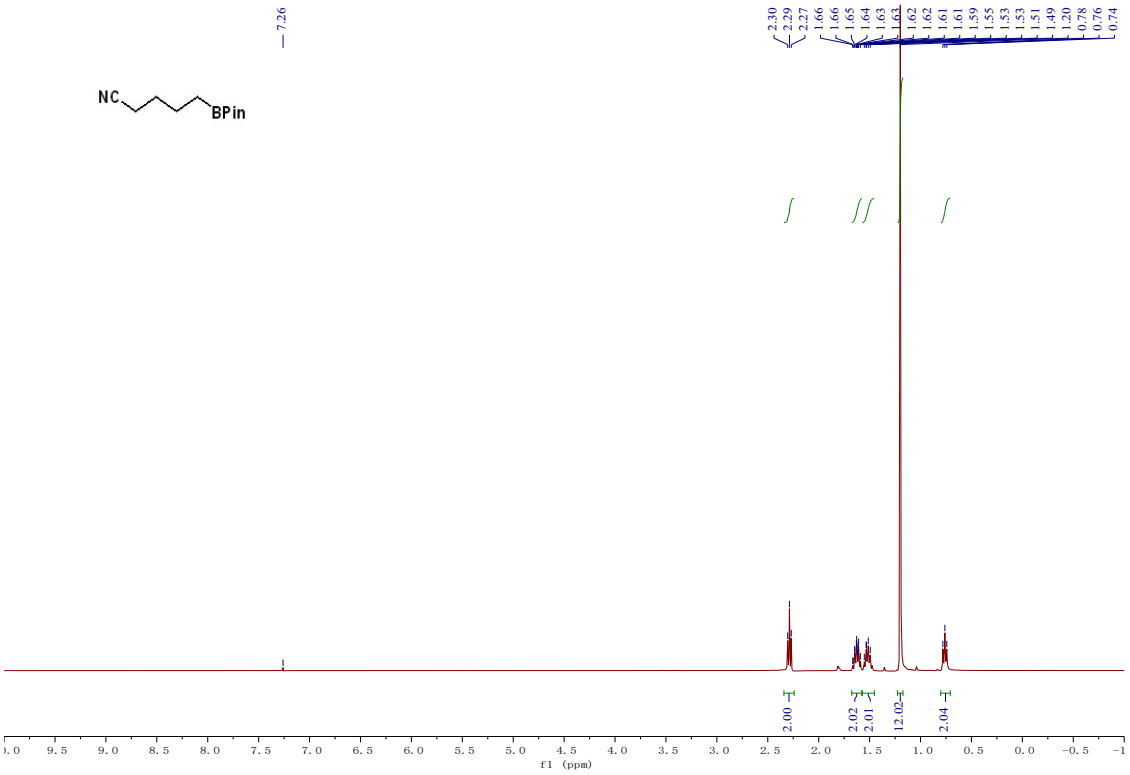
Compound **30** ^{1}H NMR



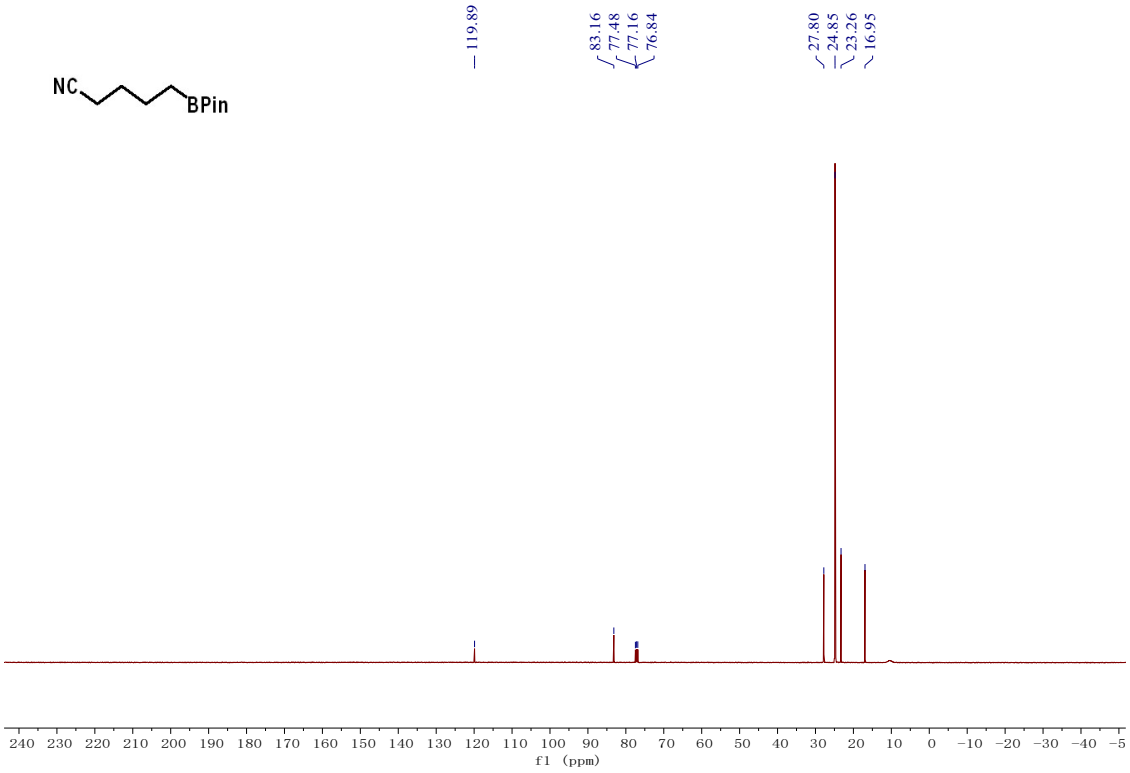
Compound **30** ^{13}C NMR



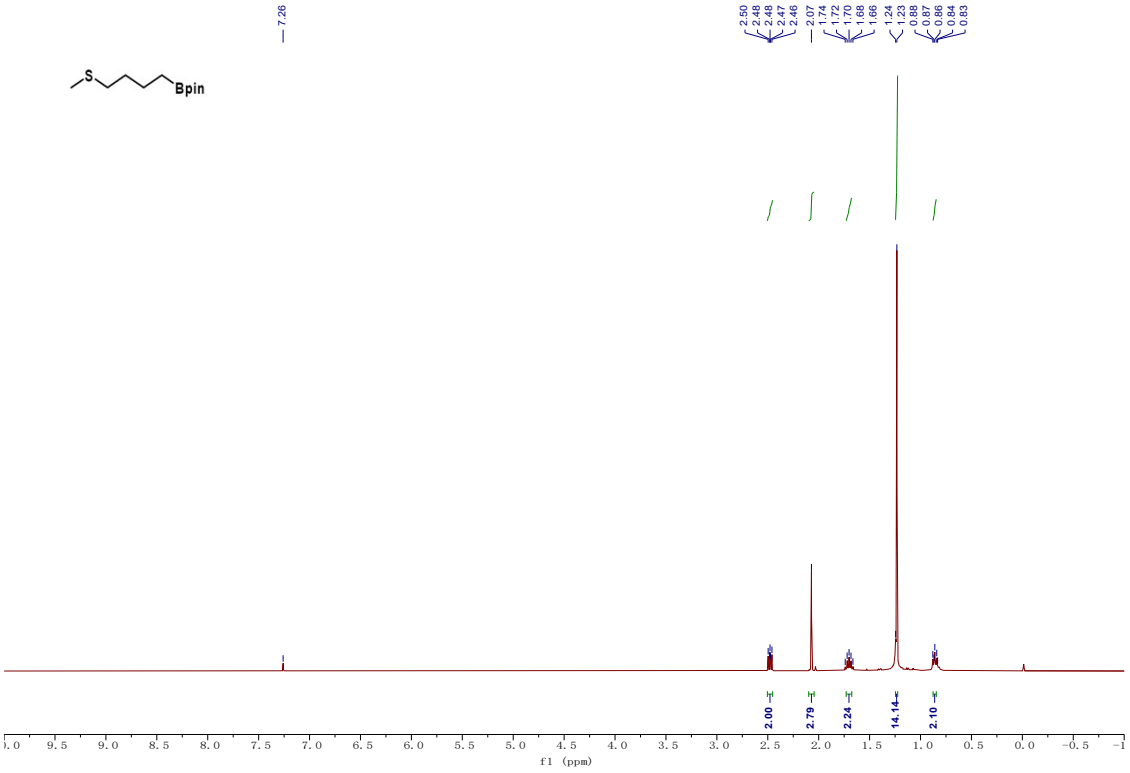
Compound **31** ^{1}H NMR



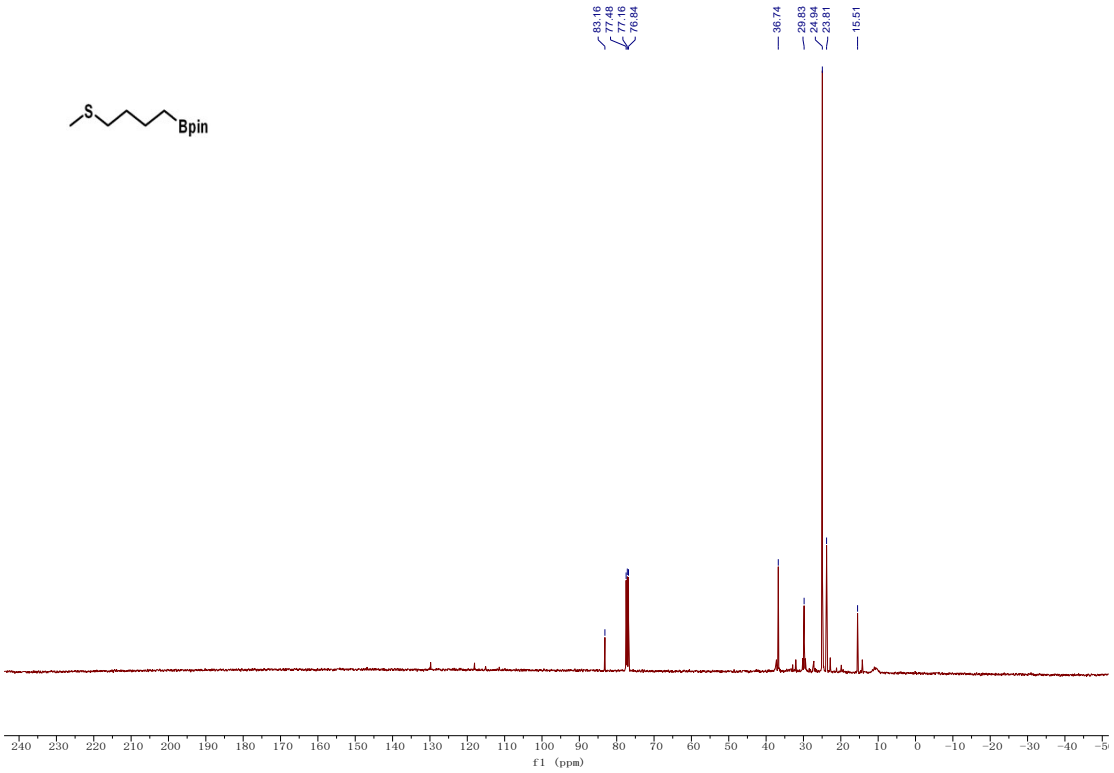
Compound **31** ^{13}C NMR



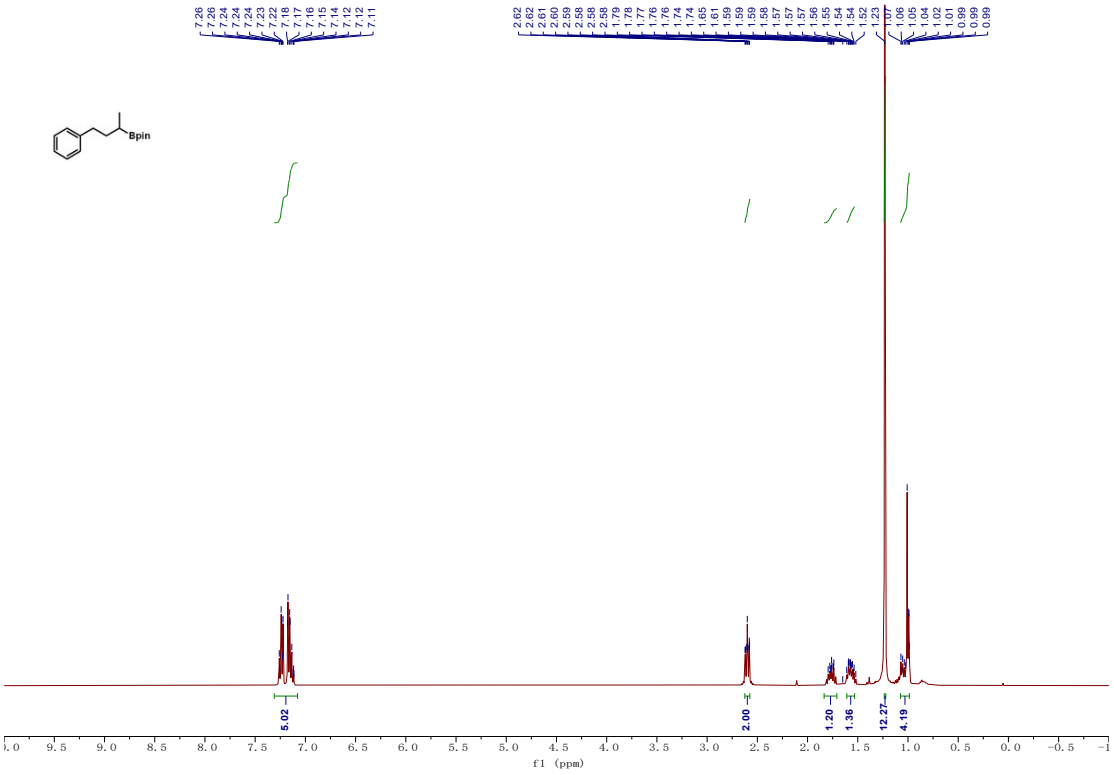
Compound **32** ^{1}H NMR



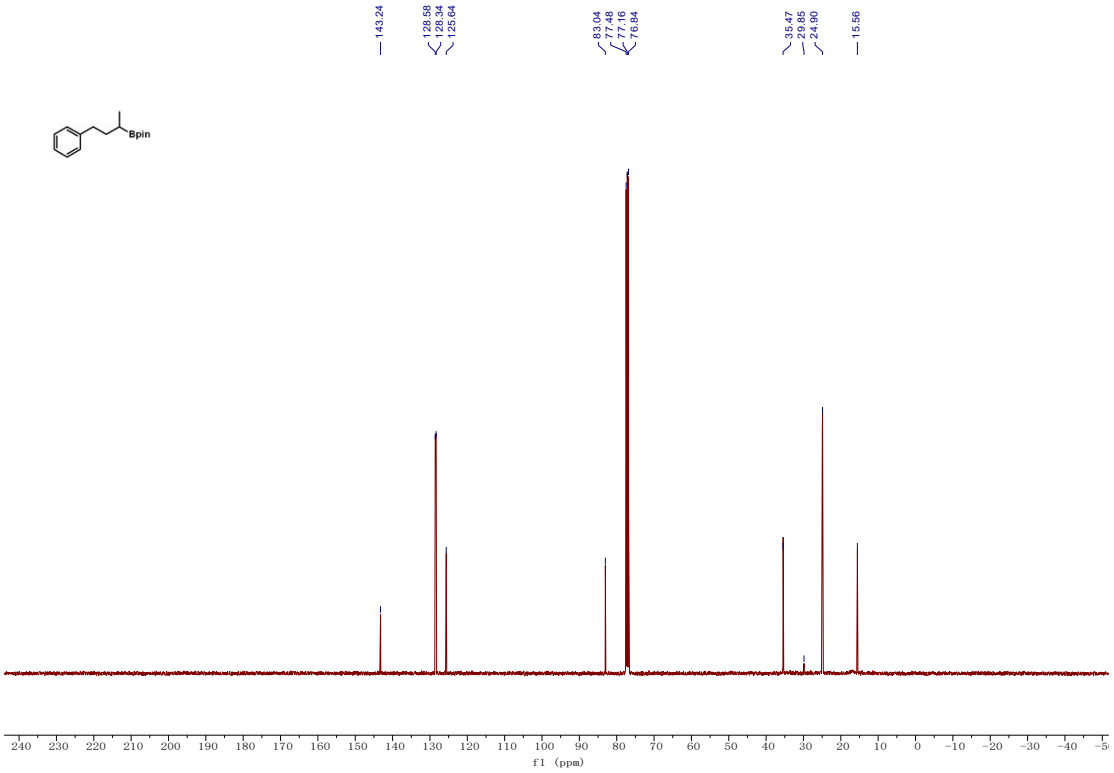
Compound **32** ^{13}C NMR



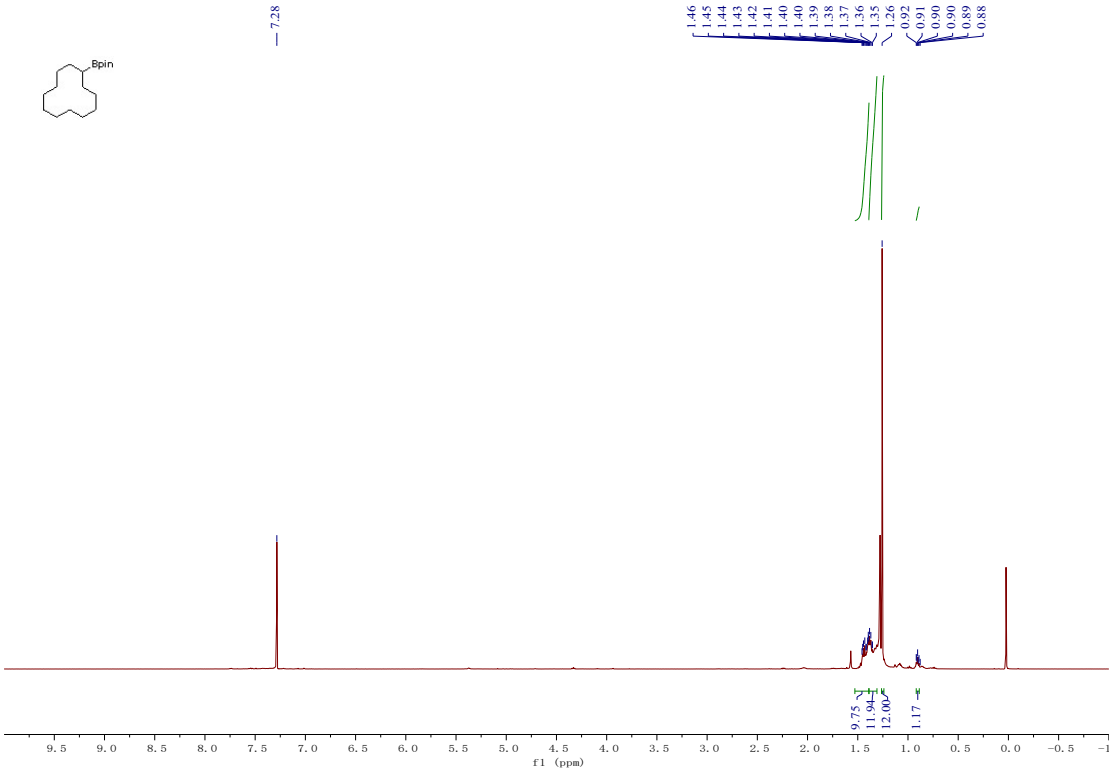
Compound **33** ^{1}H NMR



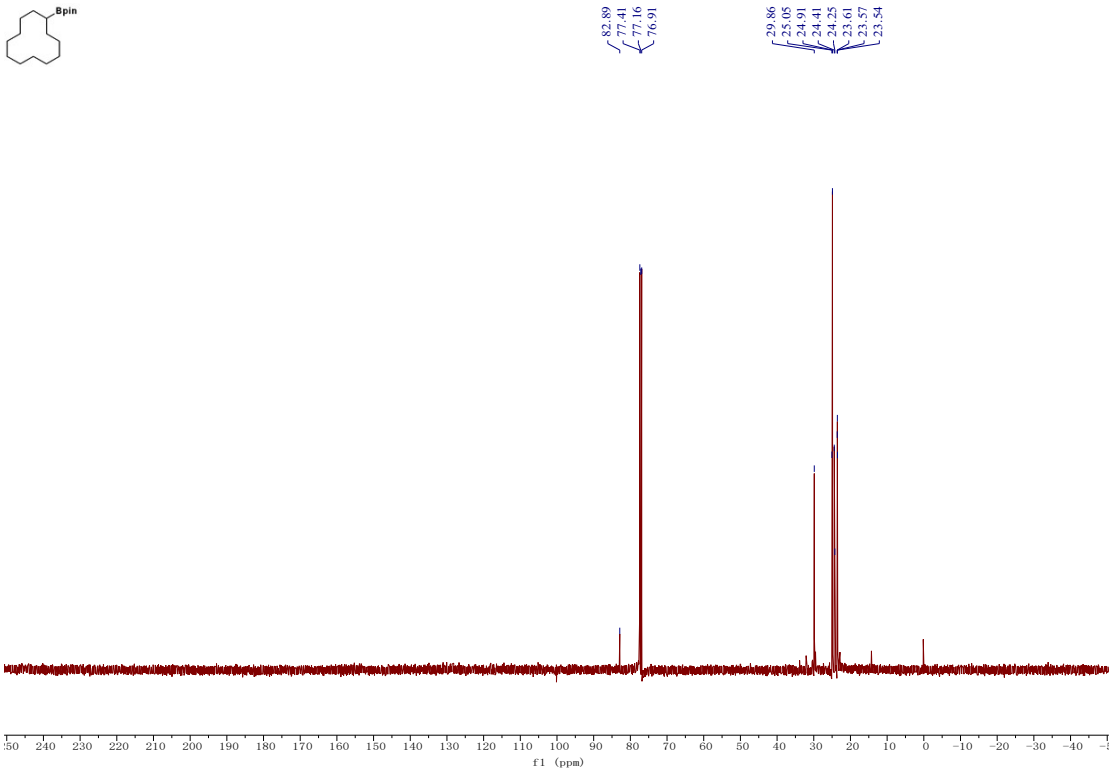
Compound **33** ^{13}C NMR



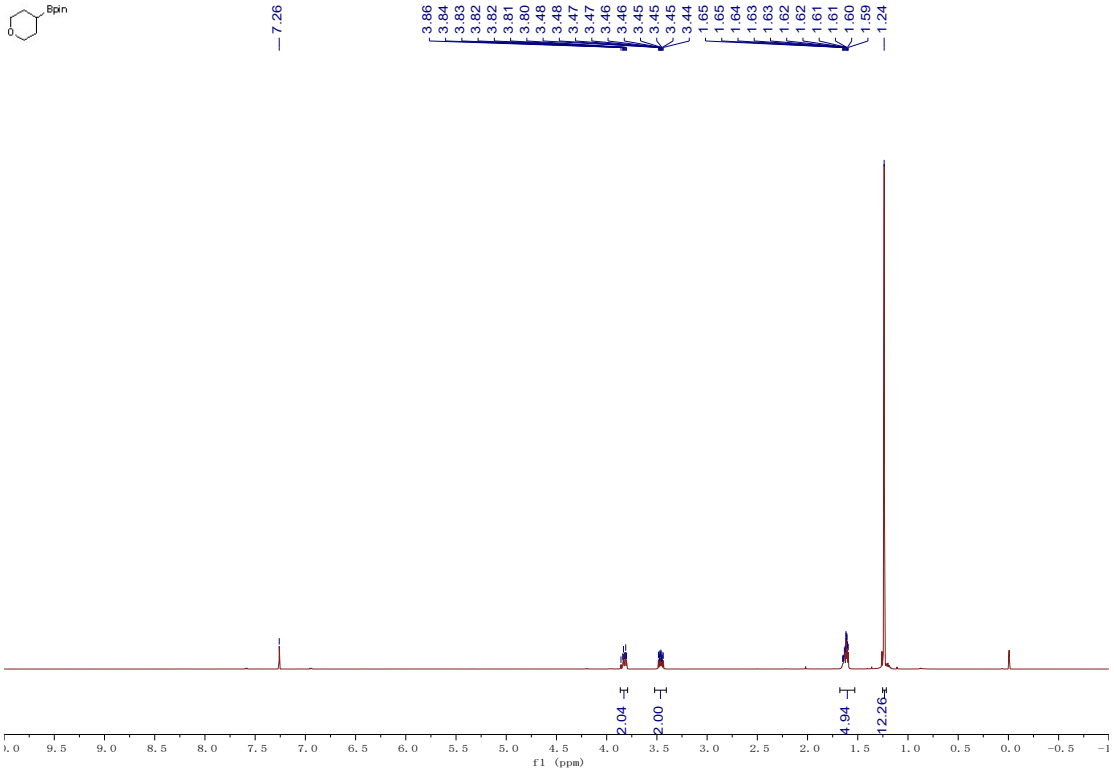
Compound **34** ^{1}H NMR



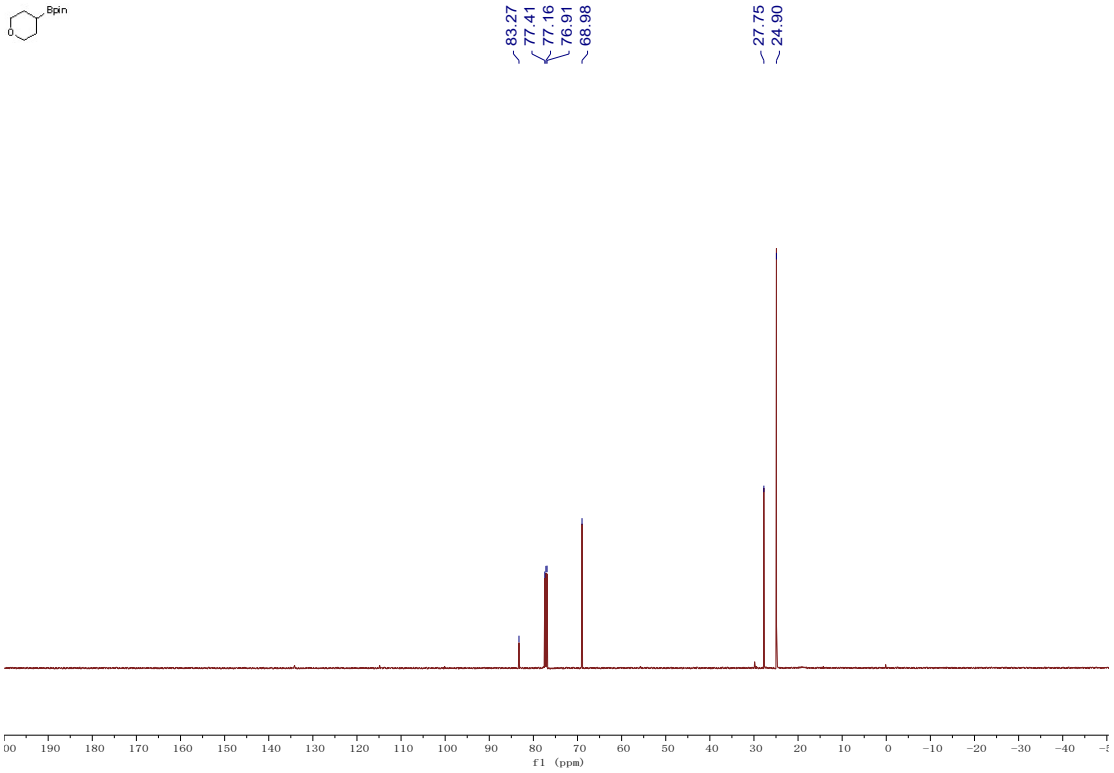
Compound **34** ^{13}C NMR



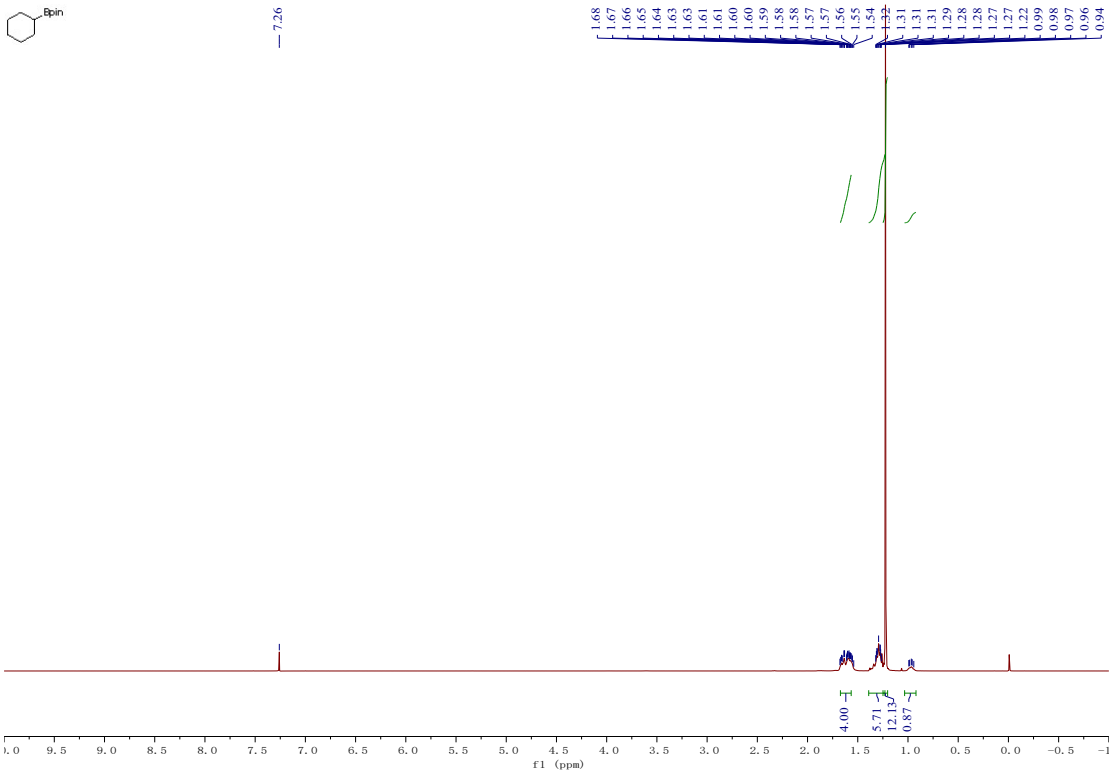
Compound **35** ^{1}H NMR



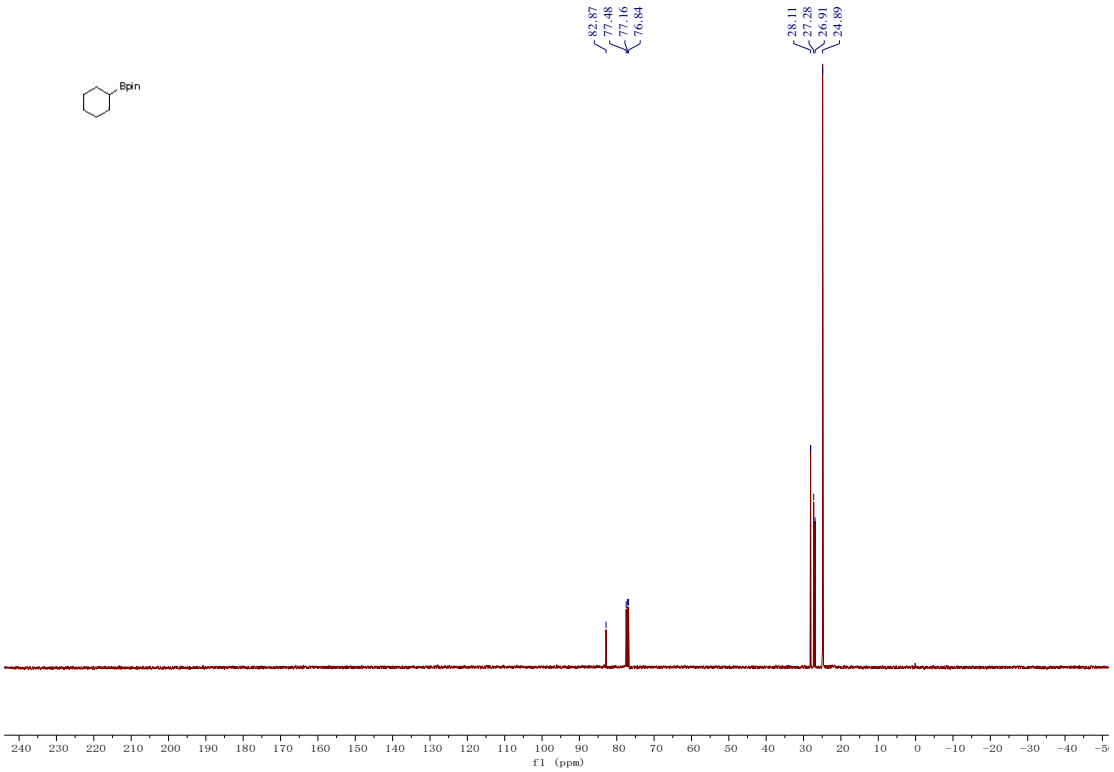
Compound **35** ^{13}C NMR



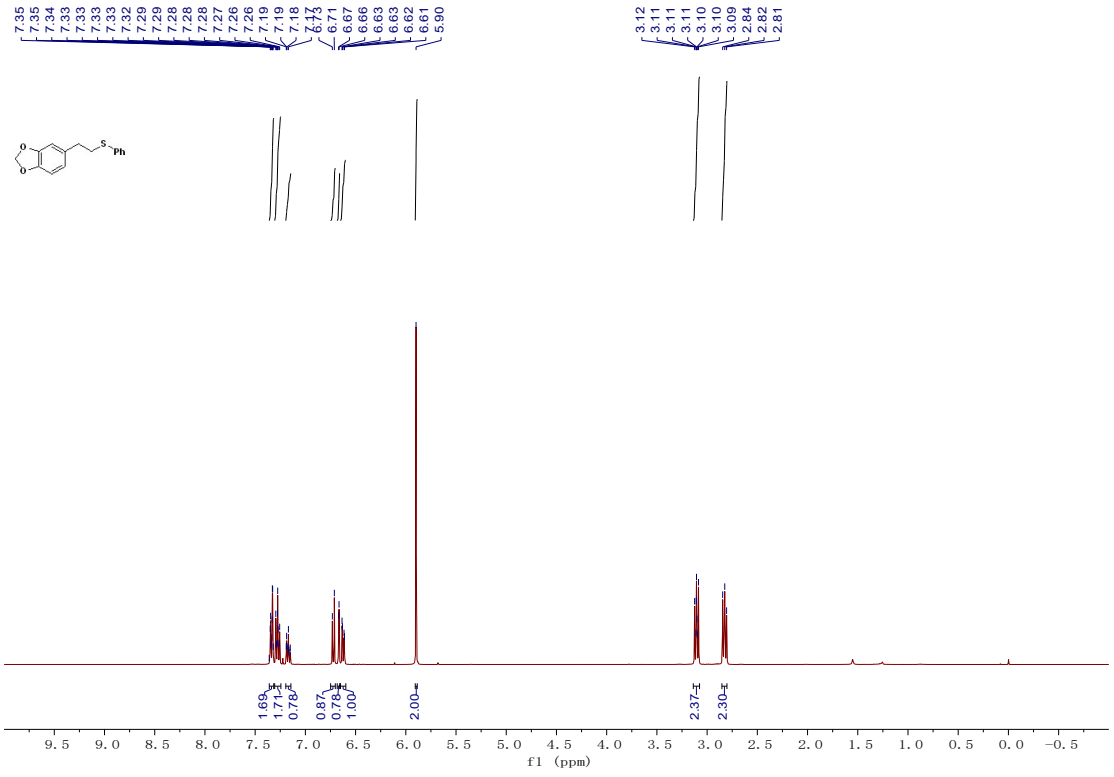
Compound **36** ^{1}H NMR



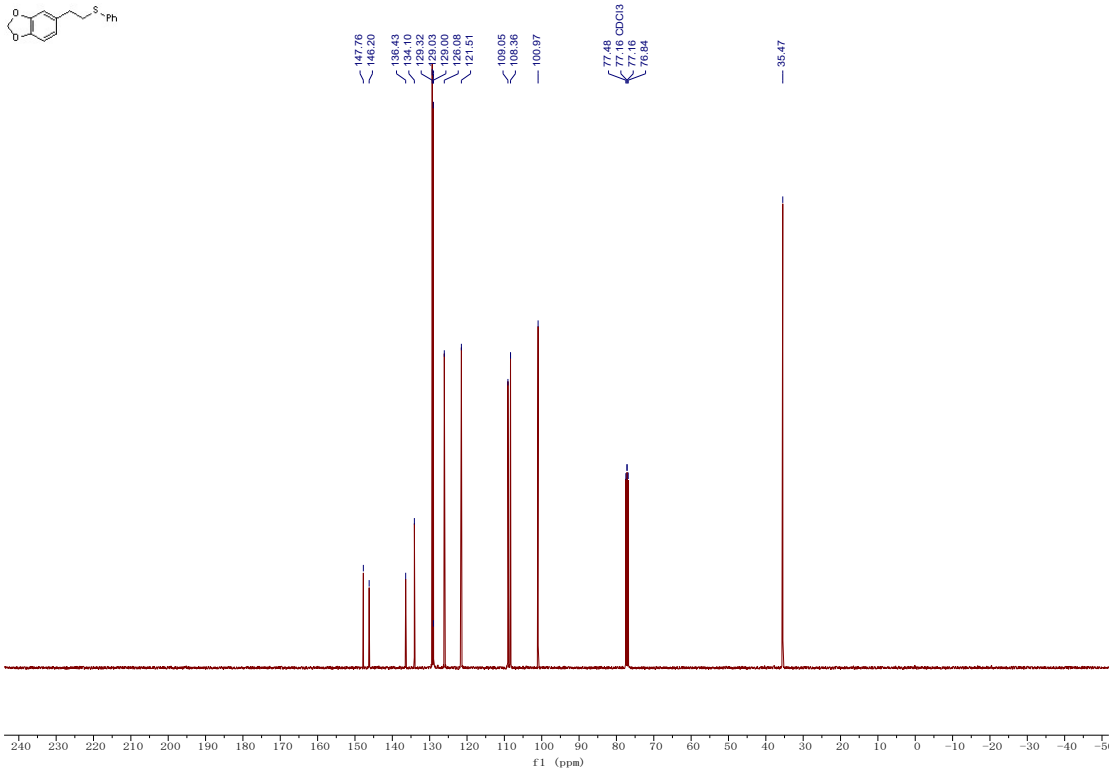
Compound **36** ^{13}C NMR



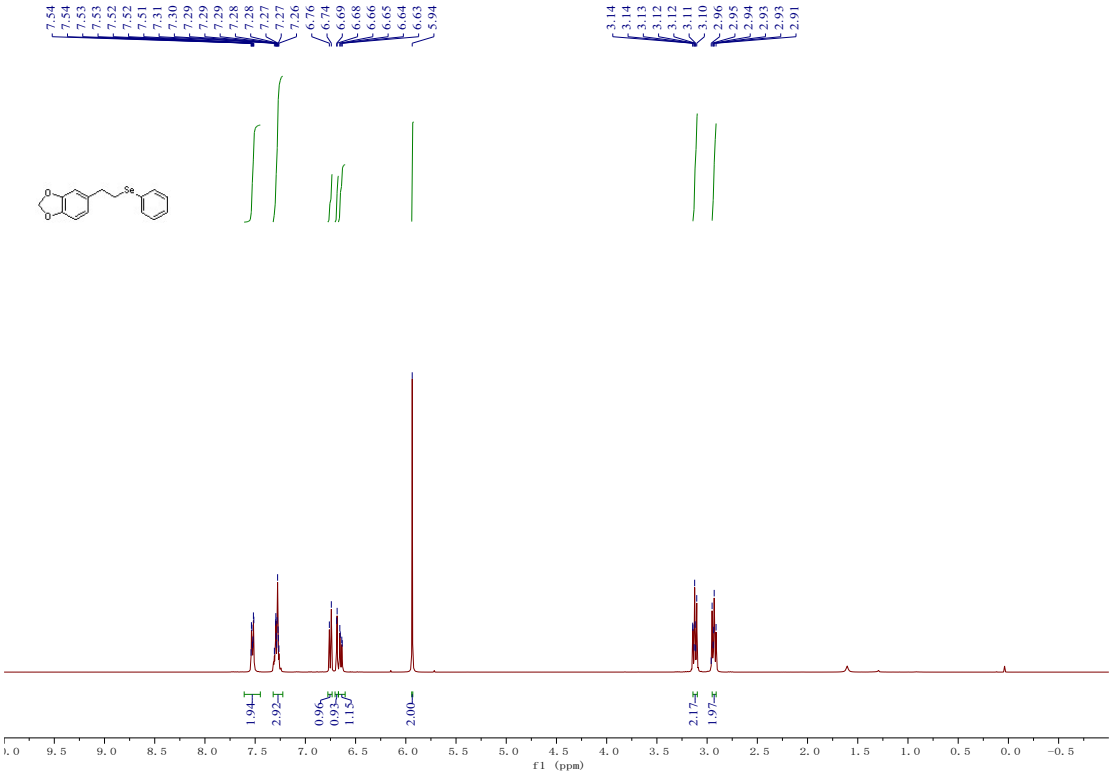
Compound **37** ^{1}H NMR



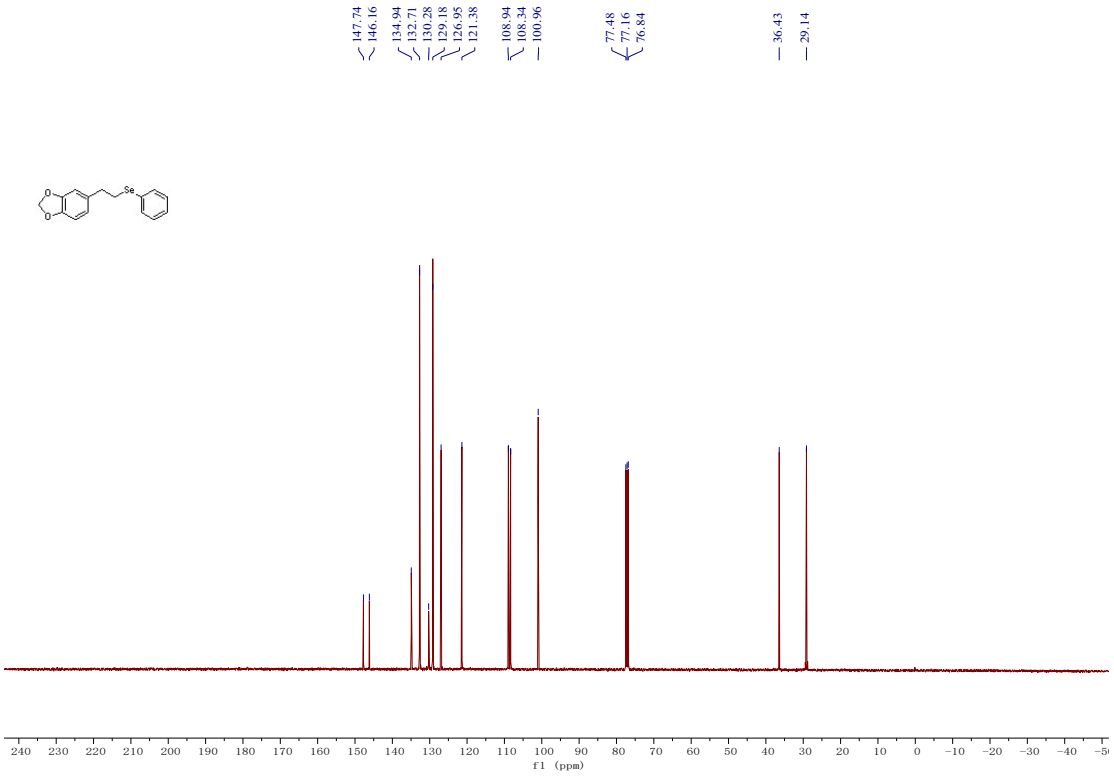
Compound **37** ^{13}C NMR



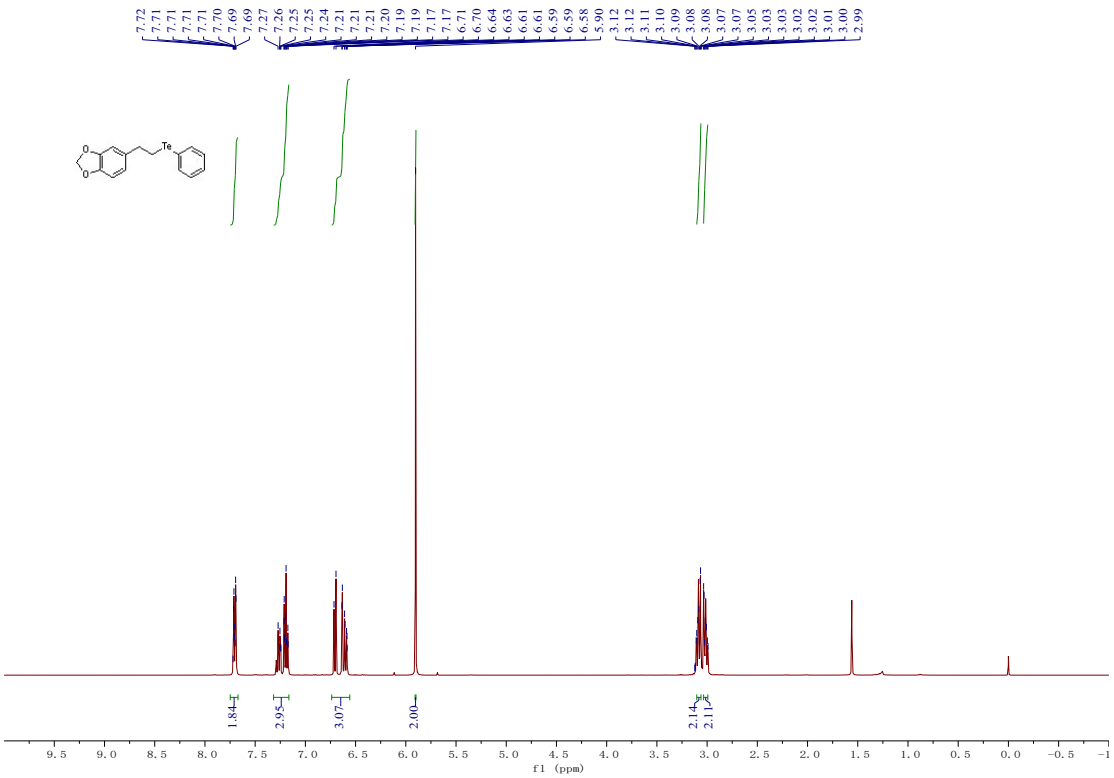
Compound **38** ^{1}H NMR



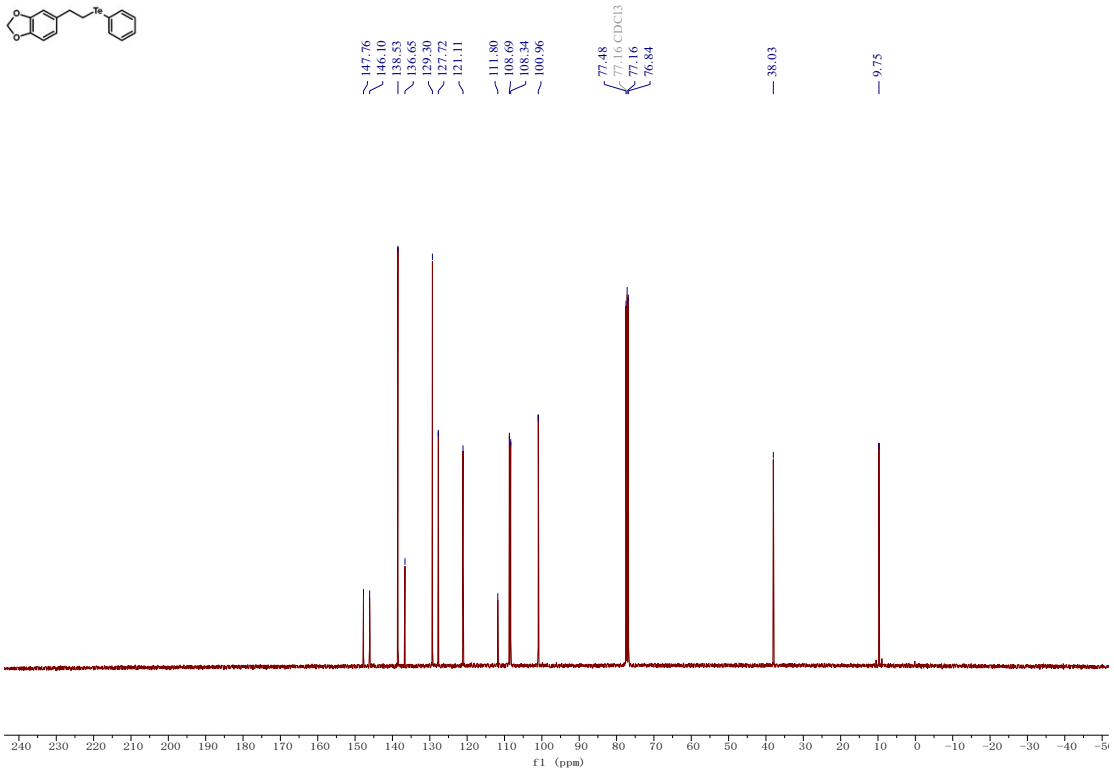
Compound **38** ^{13}C NMR



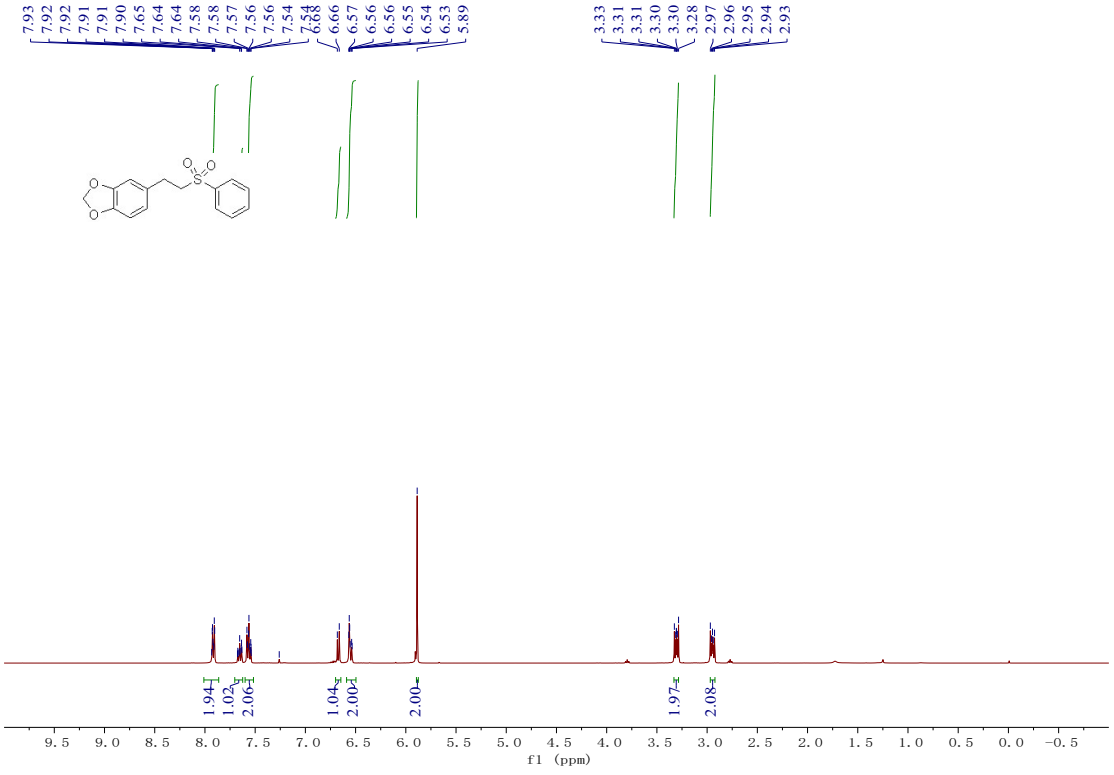
Compound **39** ^{1}H NMR



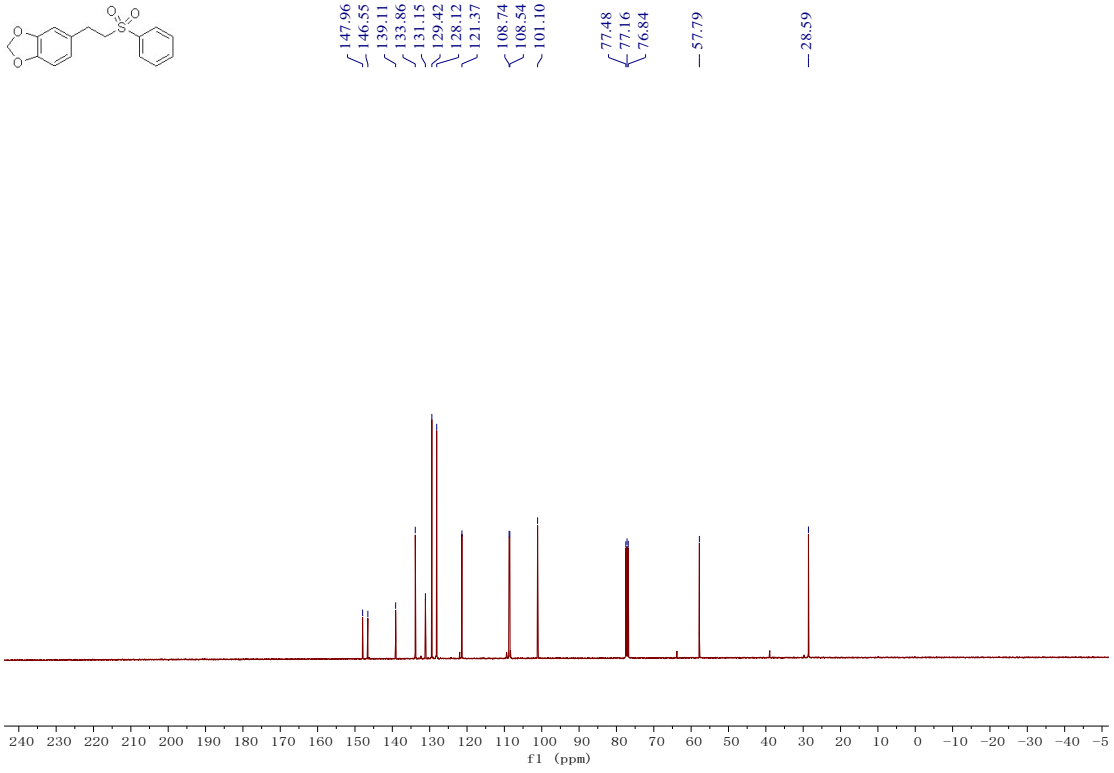
Compound **39** ^{13}C NMR



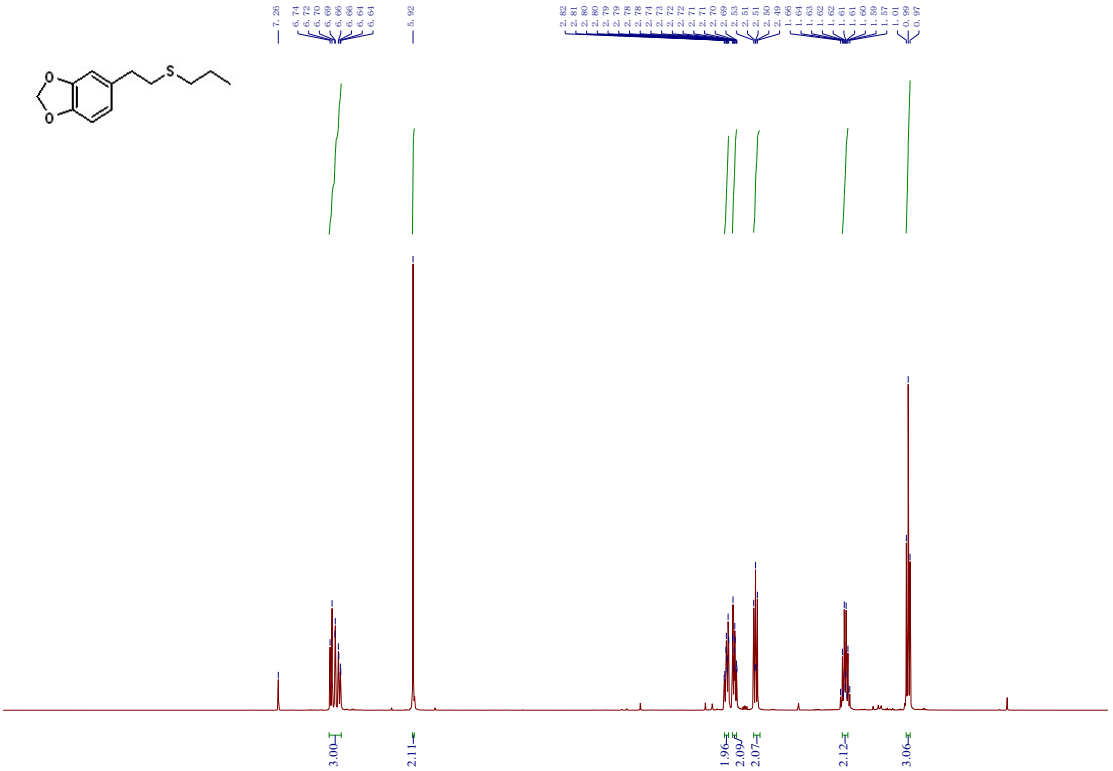
Compound **40** ^{1}H NMR



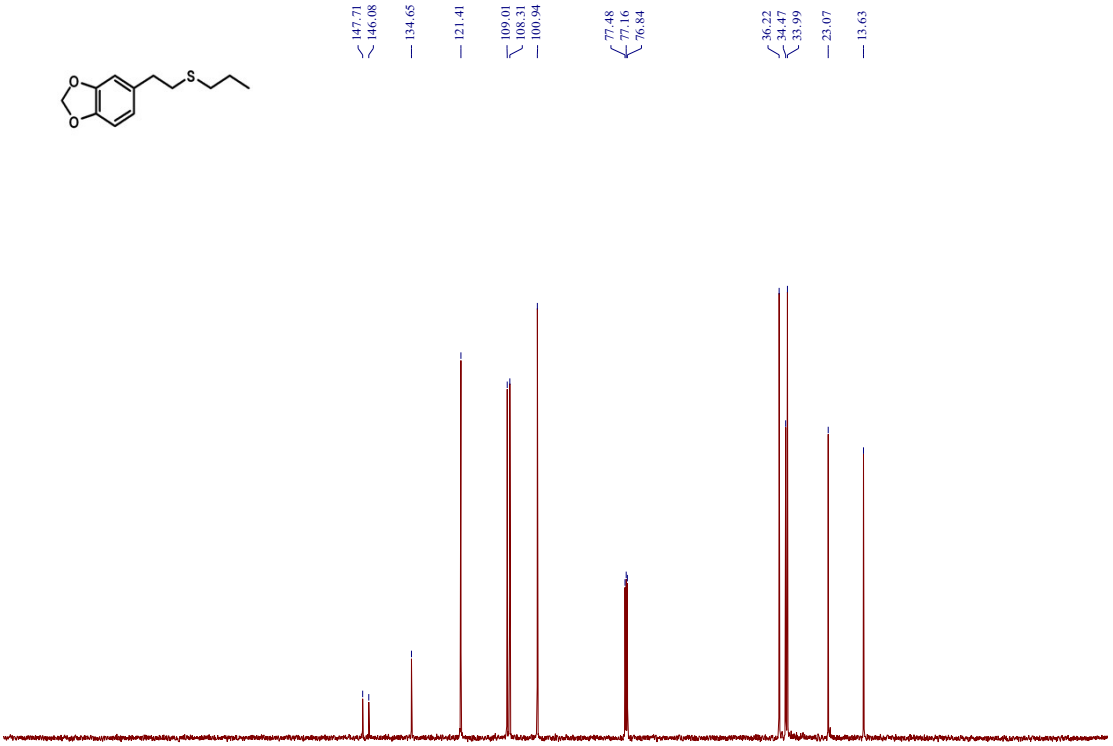
Compound **40** ^{13}C NMR



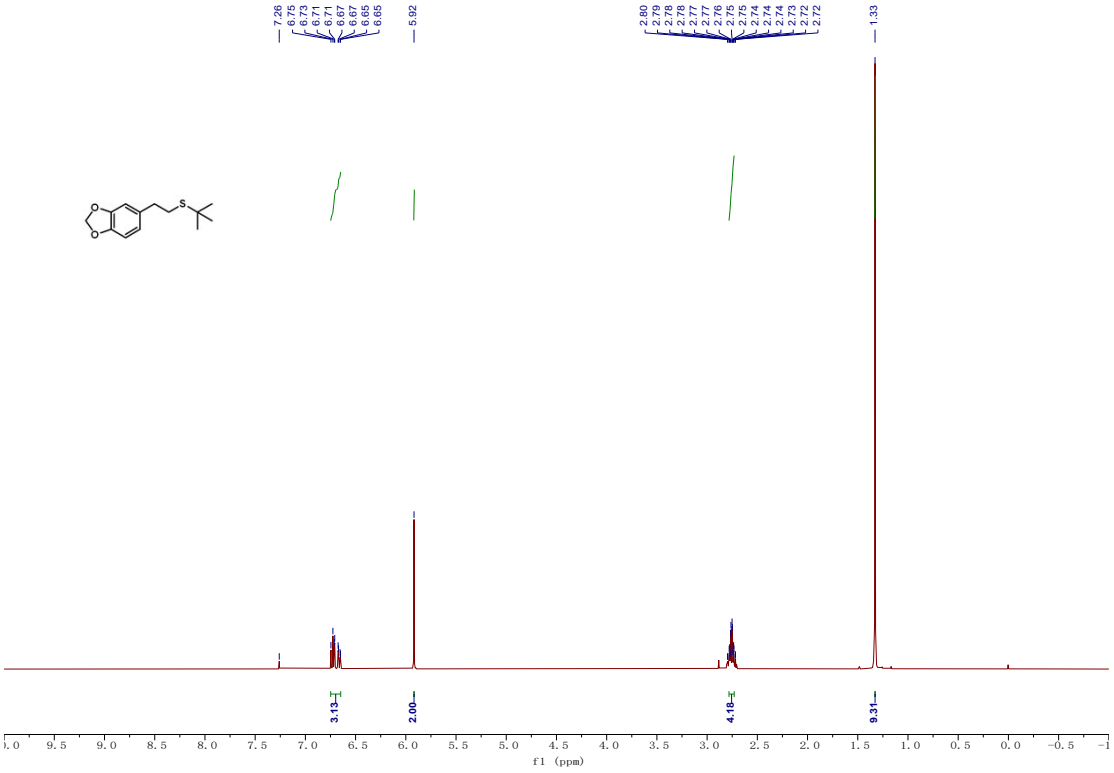
Compound **41** ^{1}H NMR



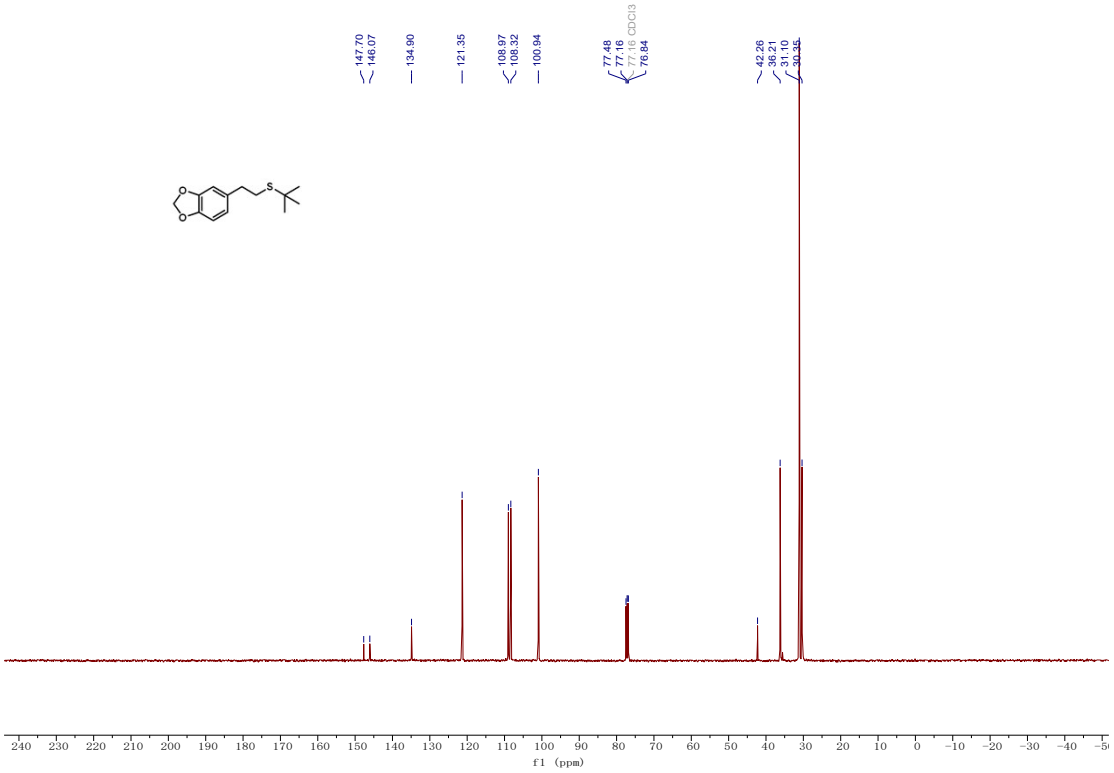
Compound **41** ^{13}C NMR



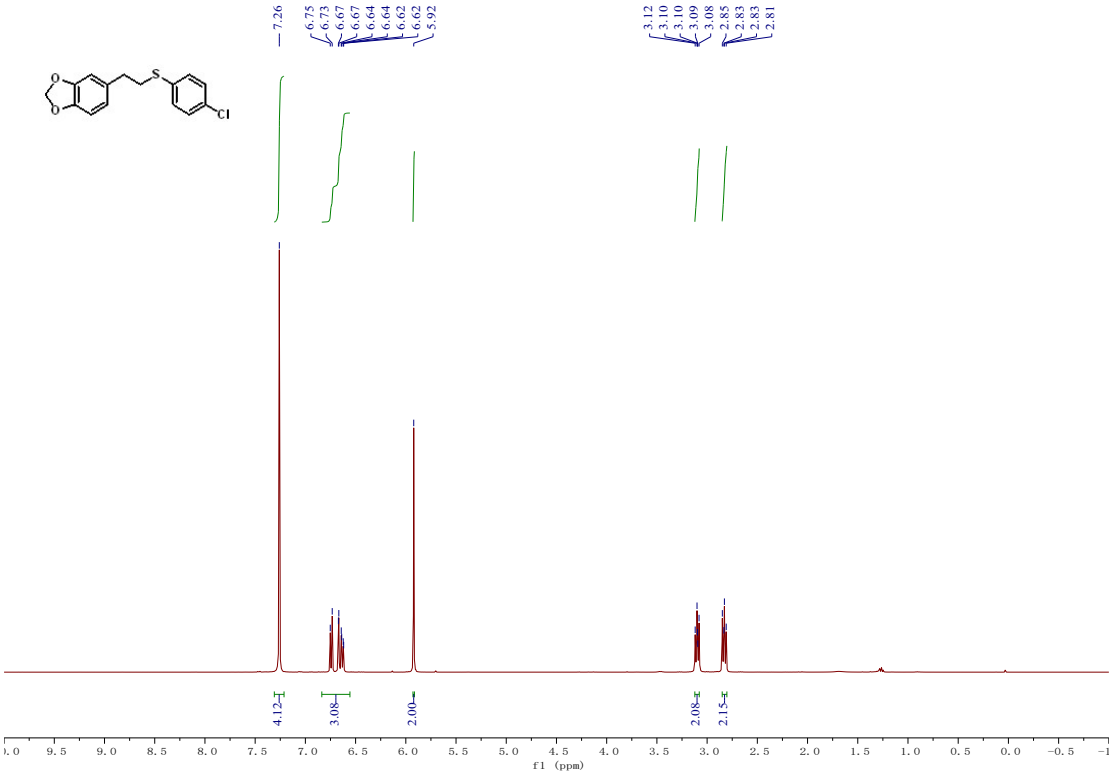
Compound **42** ^{1}H NMR



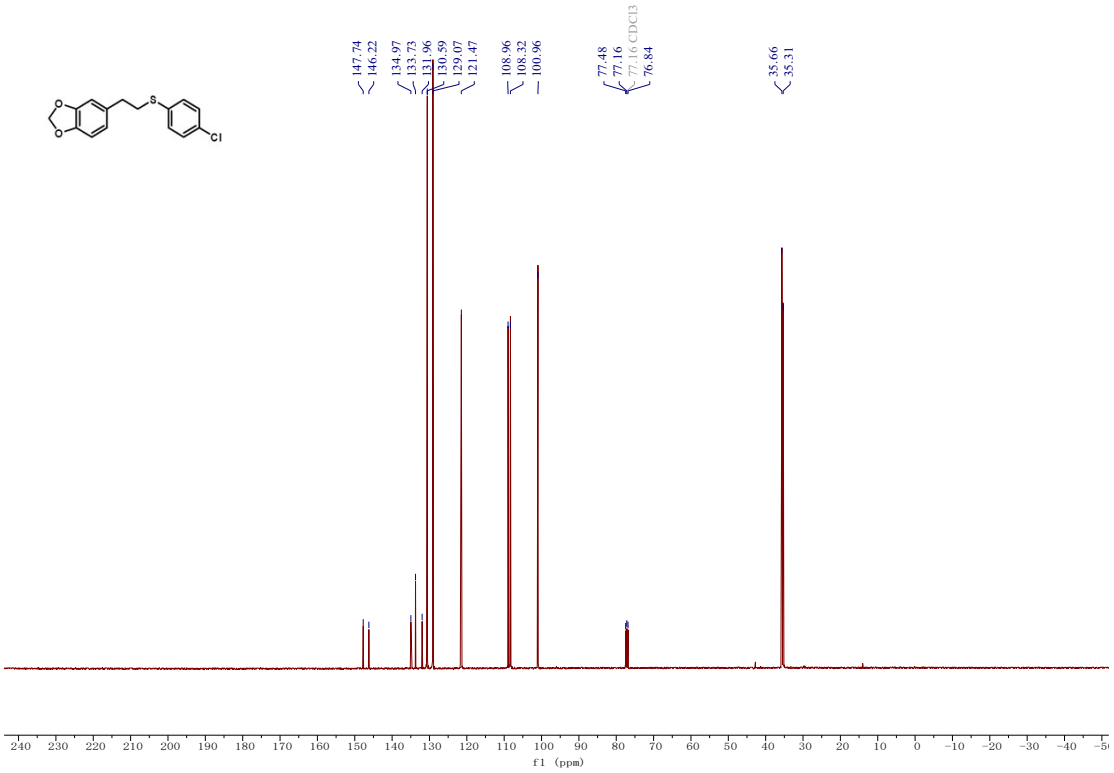
Compound **42** ^{13}C NMR



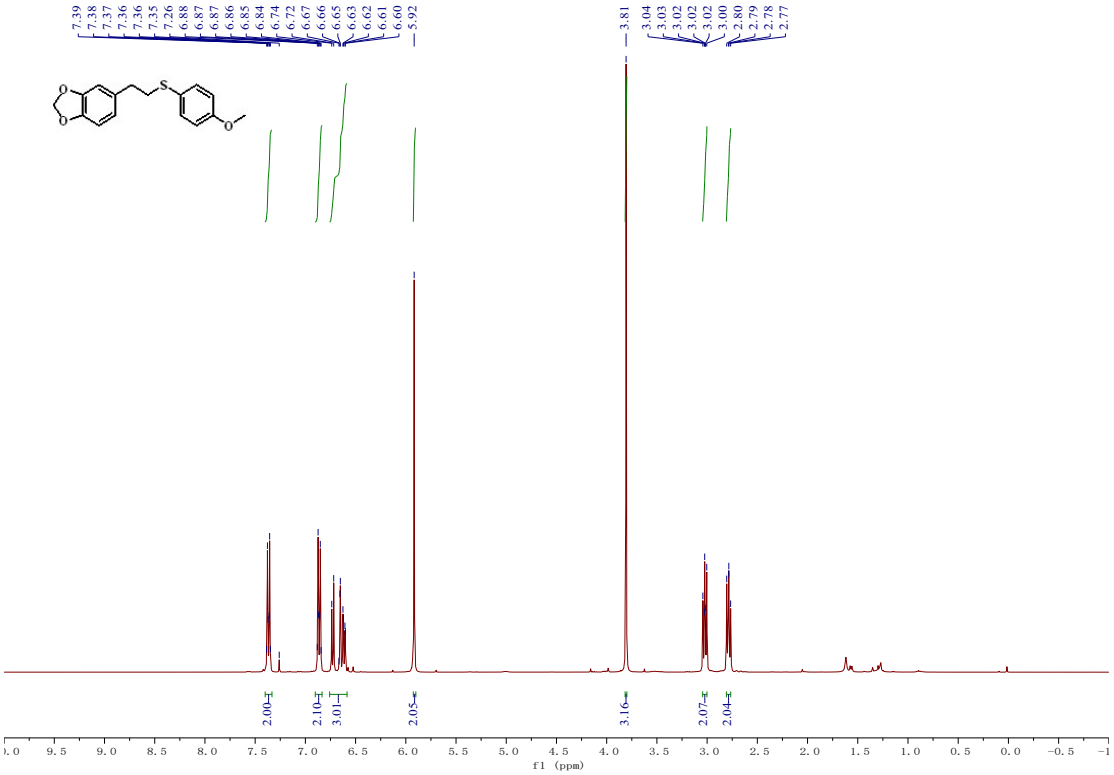
Compound **43** ^{1}H NMR



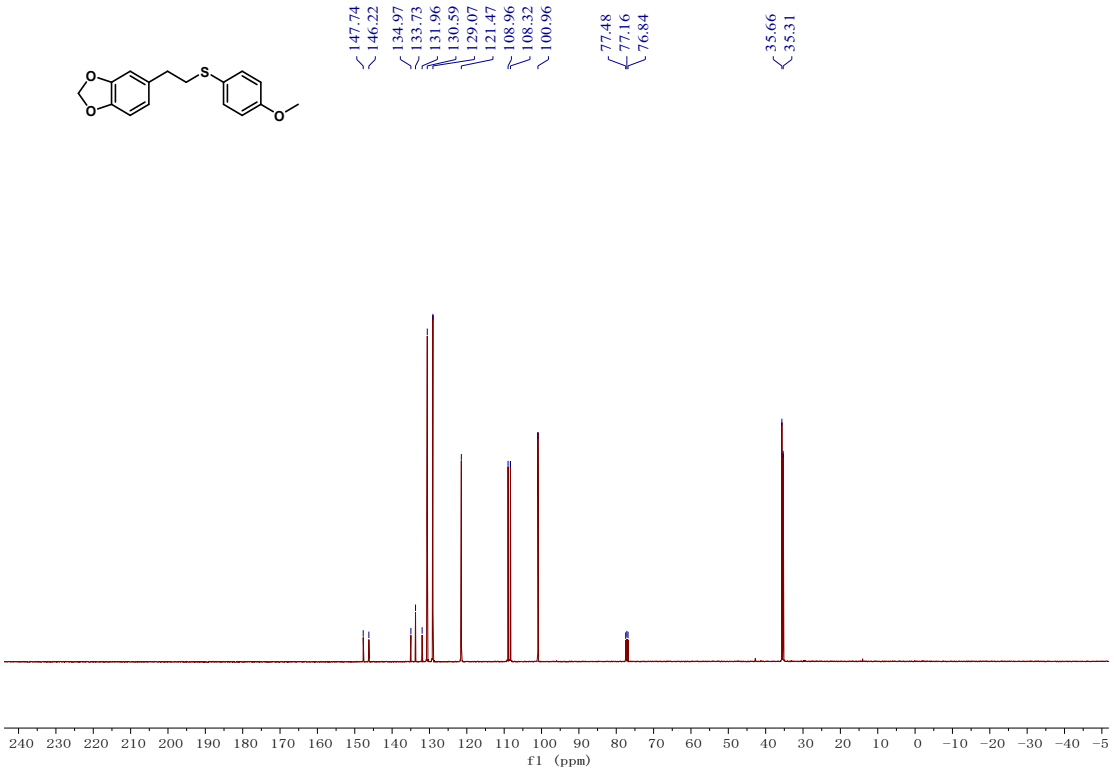
Compound **43** ^{13}C NMR



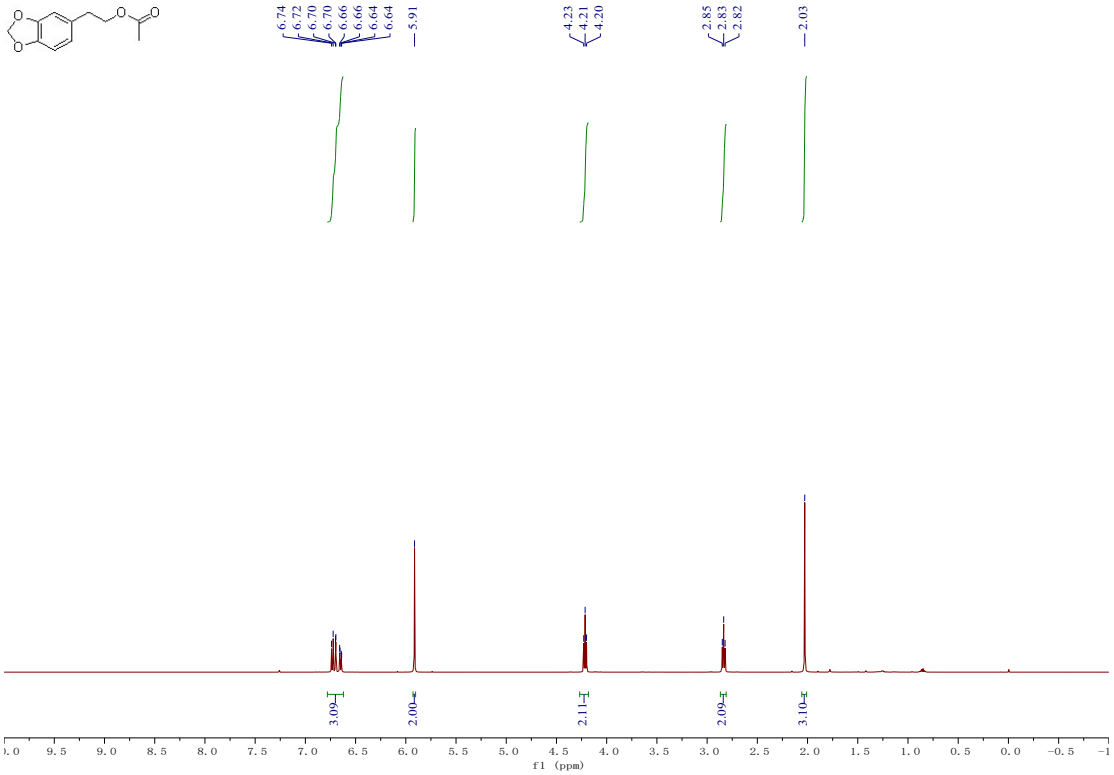
Compound **44** ^{1}H NMR



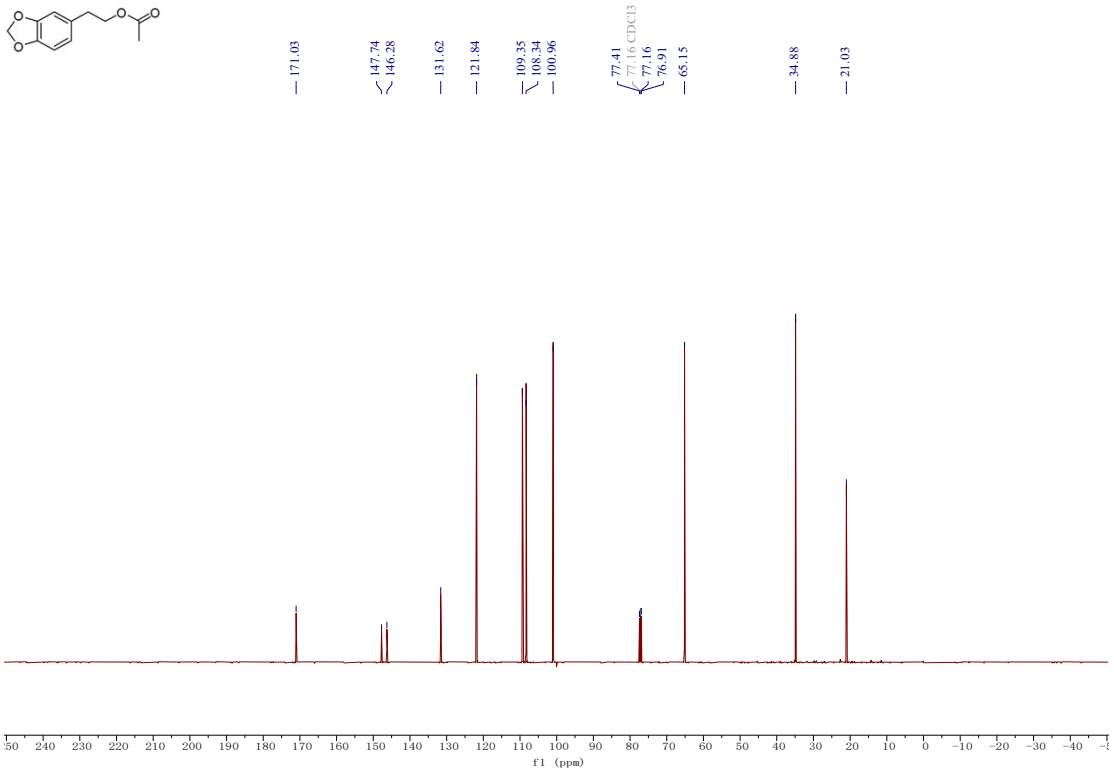
Compound **44** ^{13}C NMR



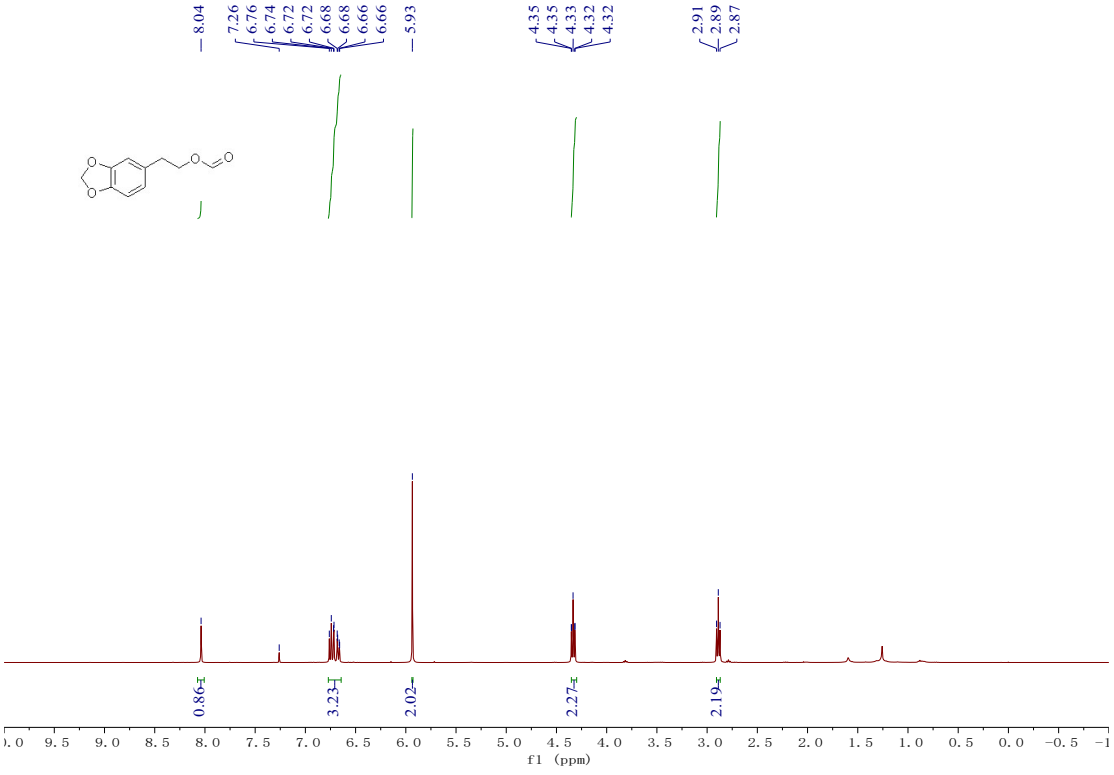
Compound **45** ^{1}H NMR



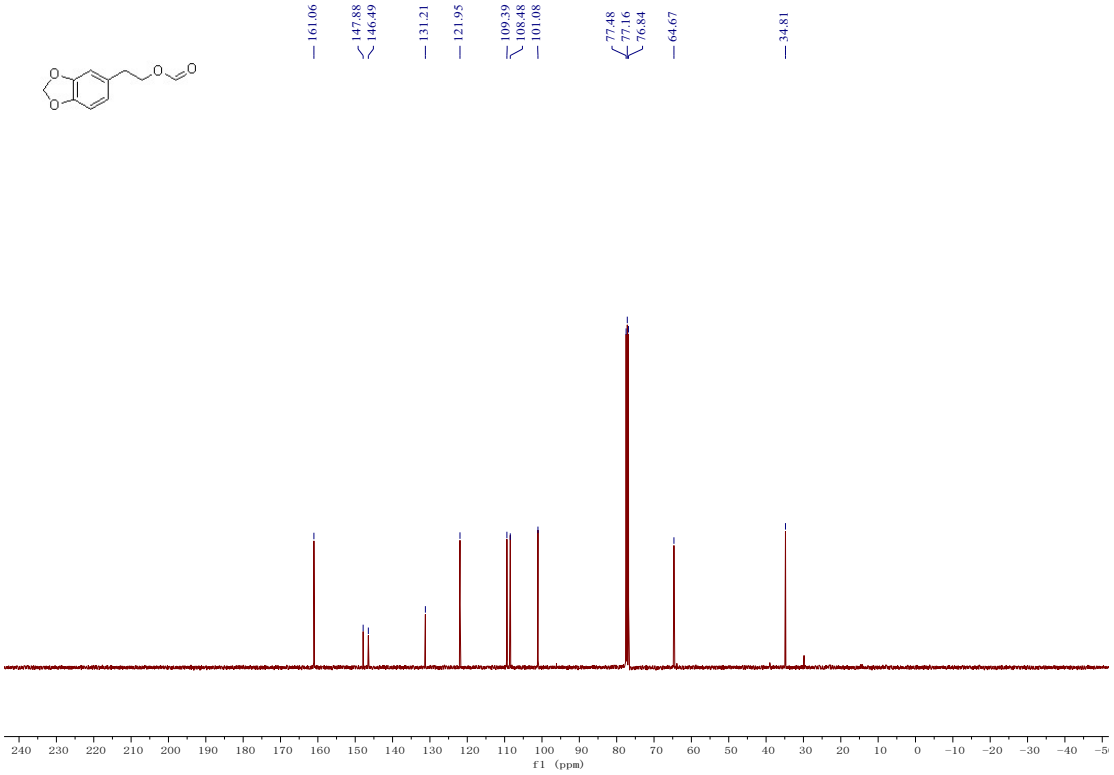
Compound **45** ^{13}C NMR



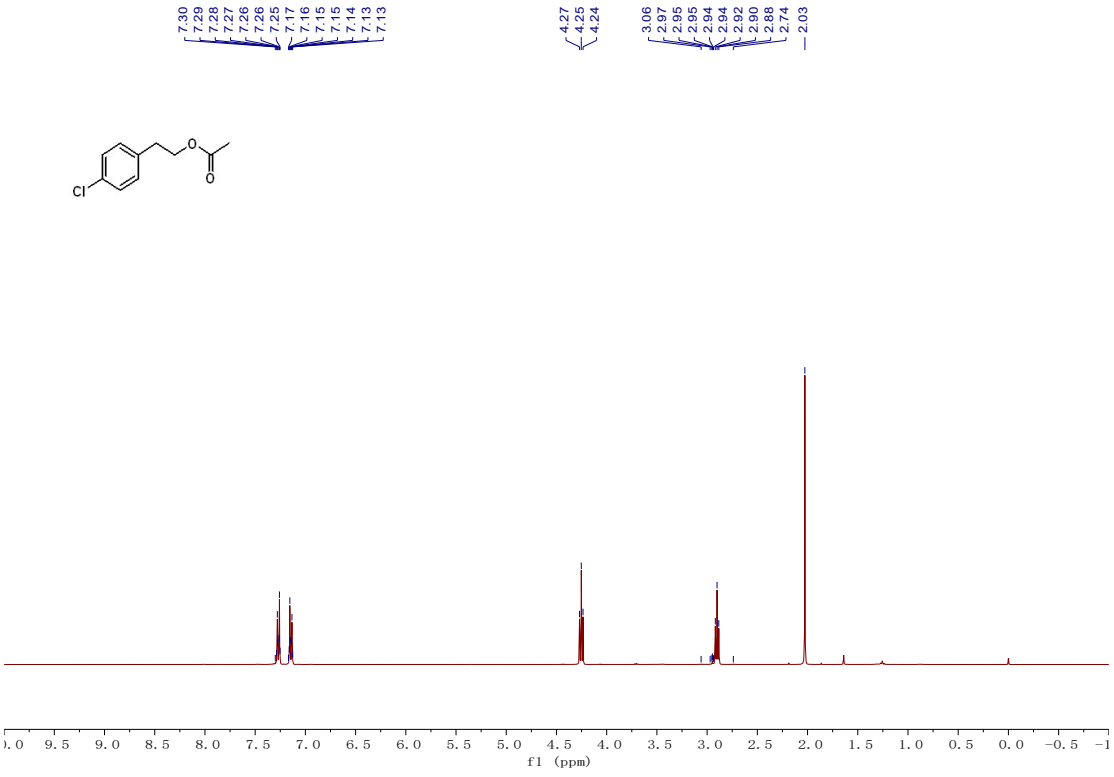
Compound **46** ^{1}H NMR



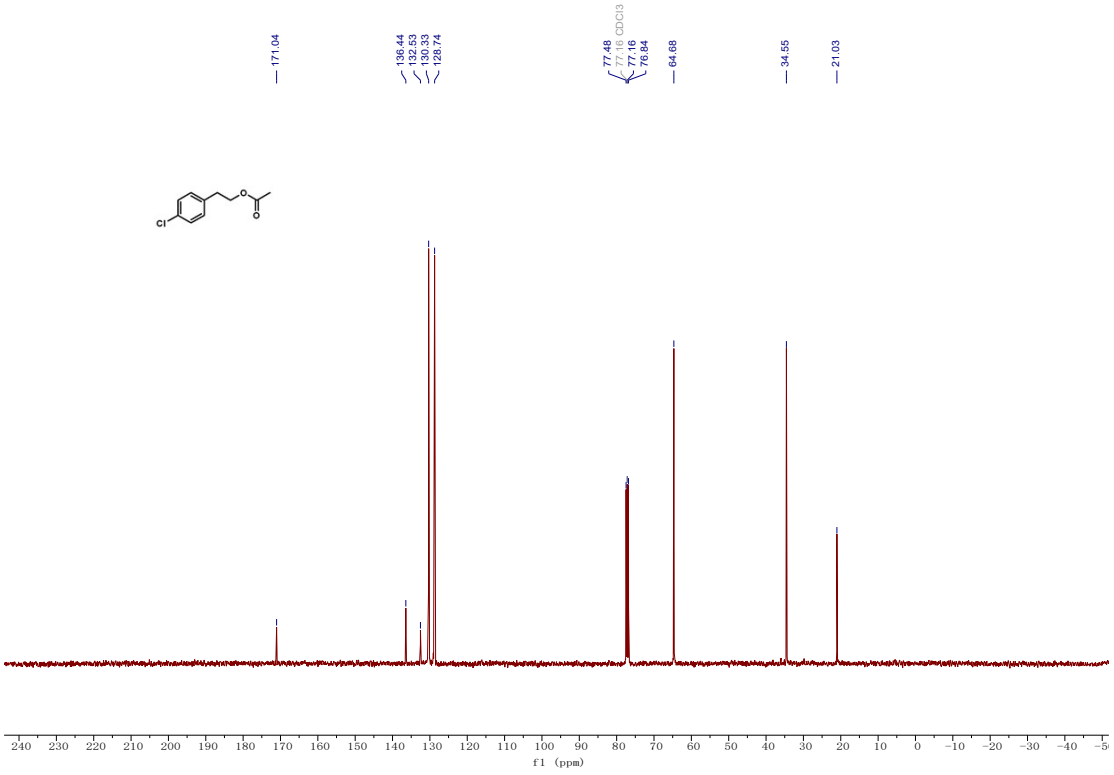
Compound **46** ^{13}C NMR



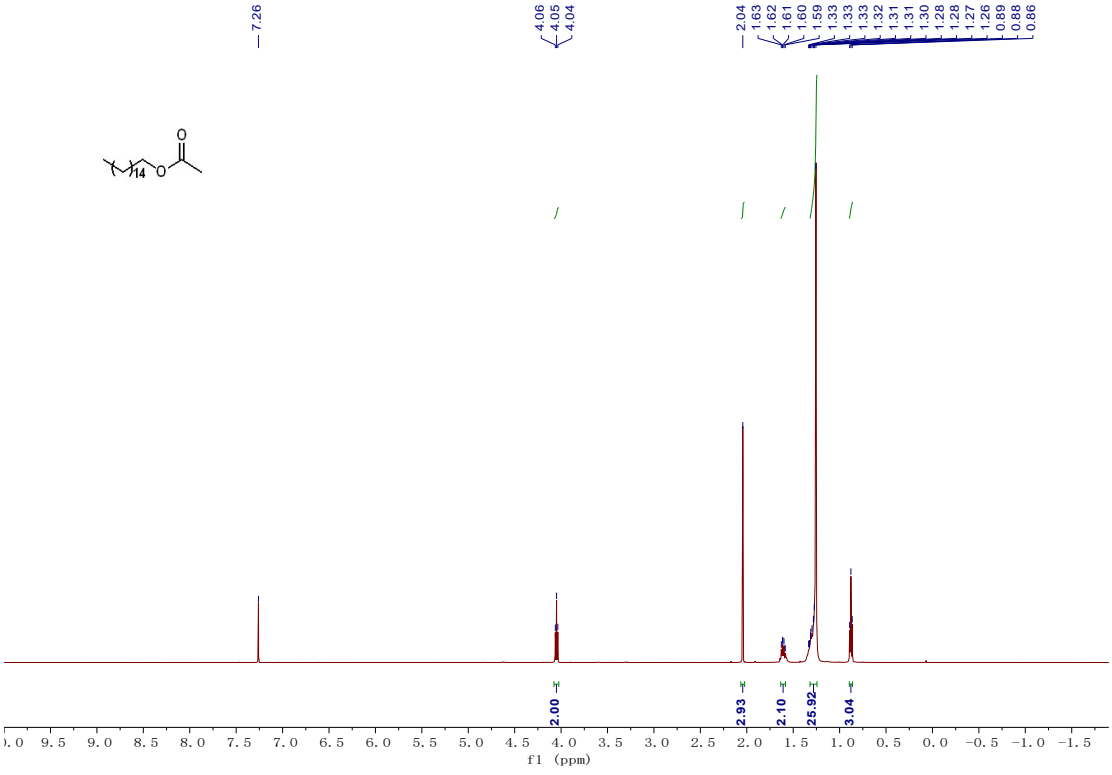
Compound **47** ^{1}H NMR



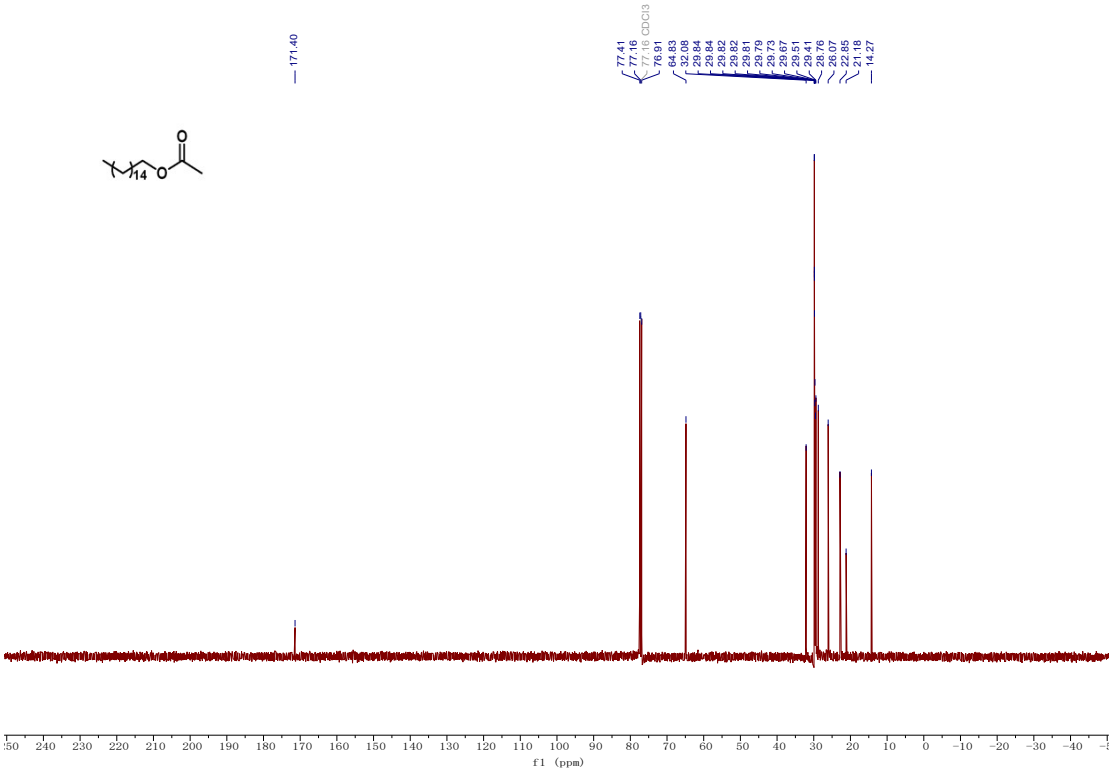
Compound **47** ^{13}C NMR



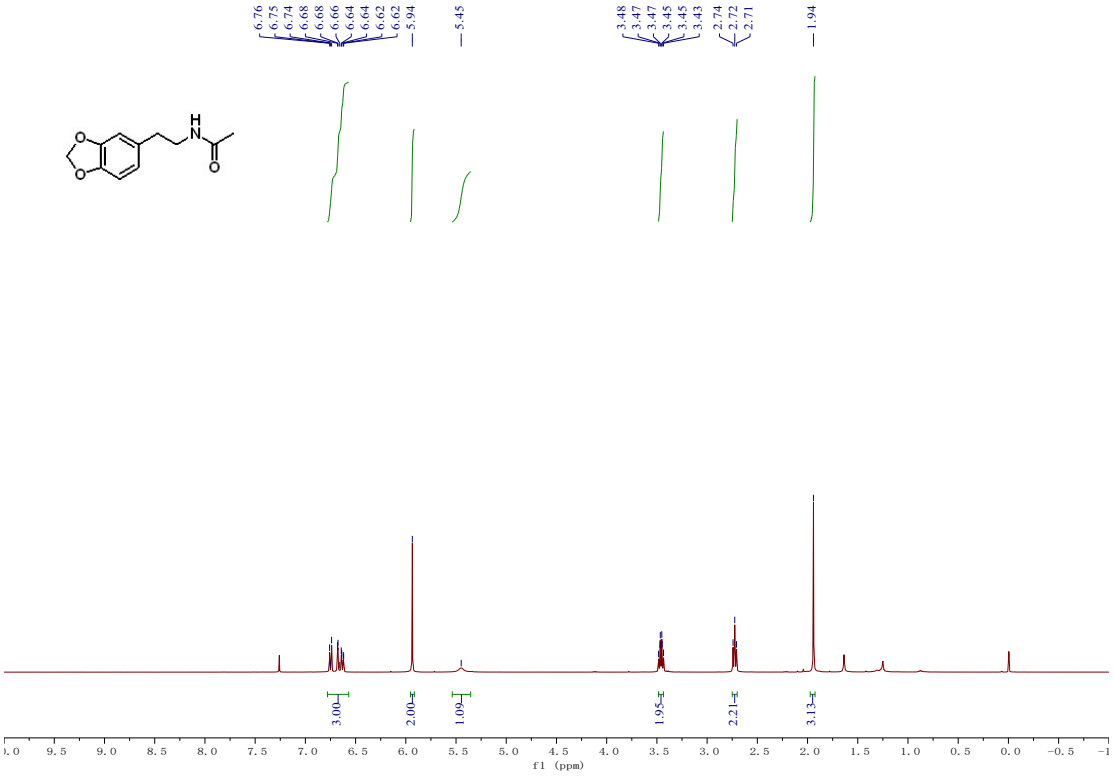
Compound **48** ^{1}H NMR



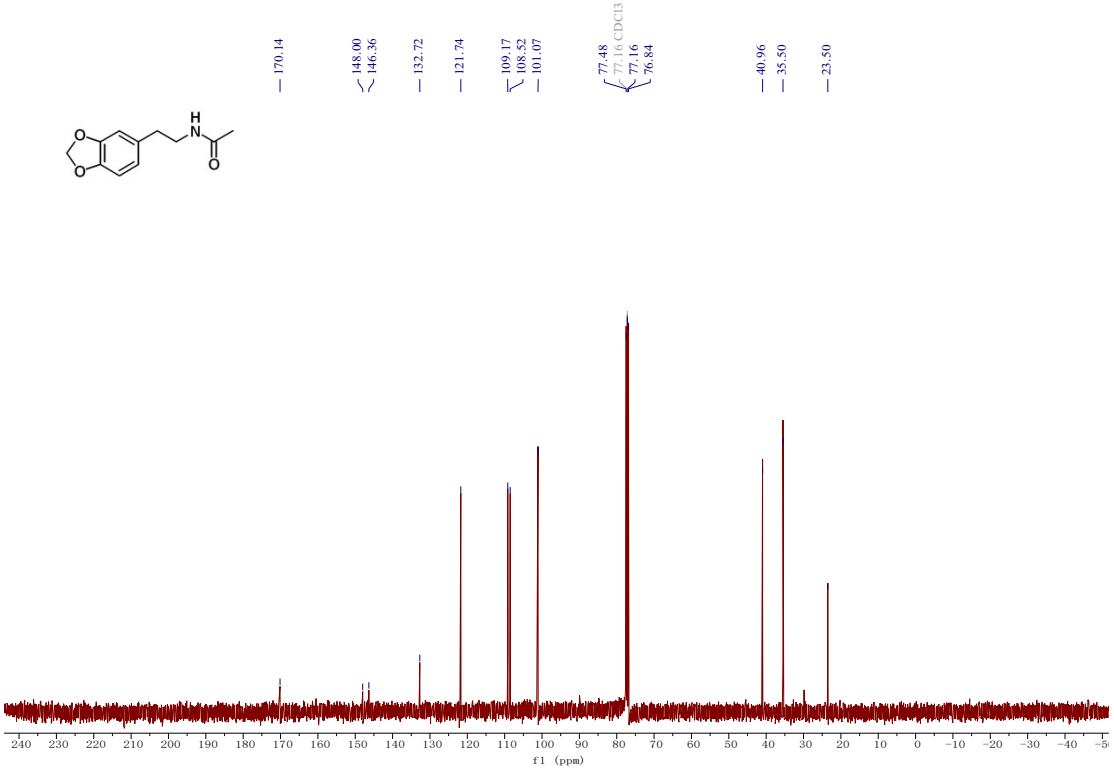
Compound **48** ^{13}C NMR



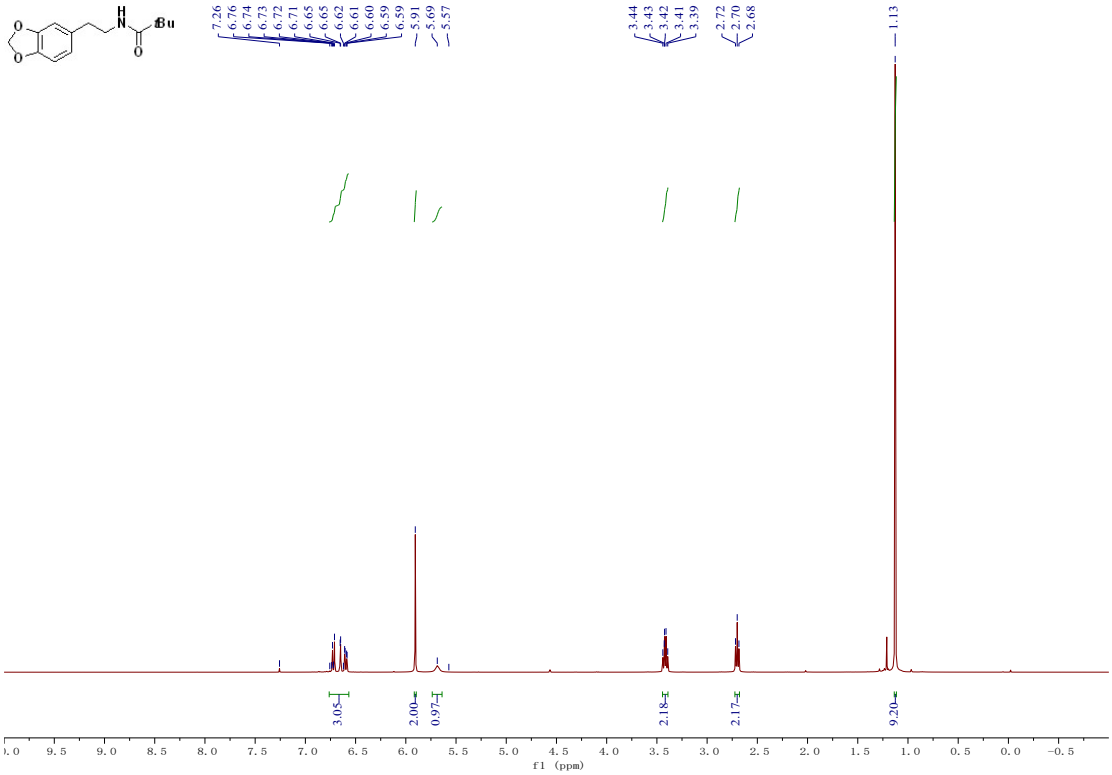
Compound **49** ^{1}H NMR



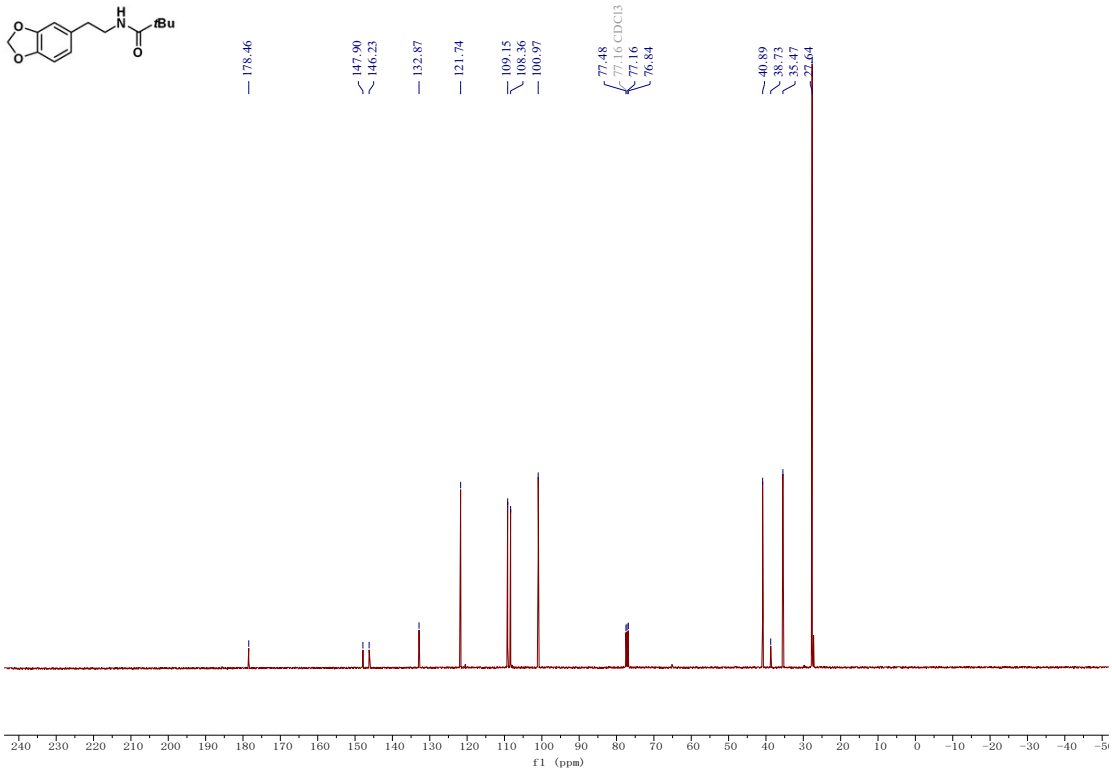
Compound **49** ^{13}C NMR



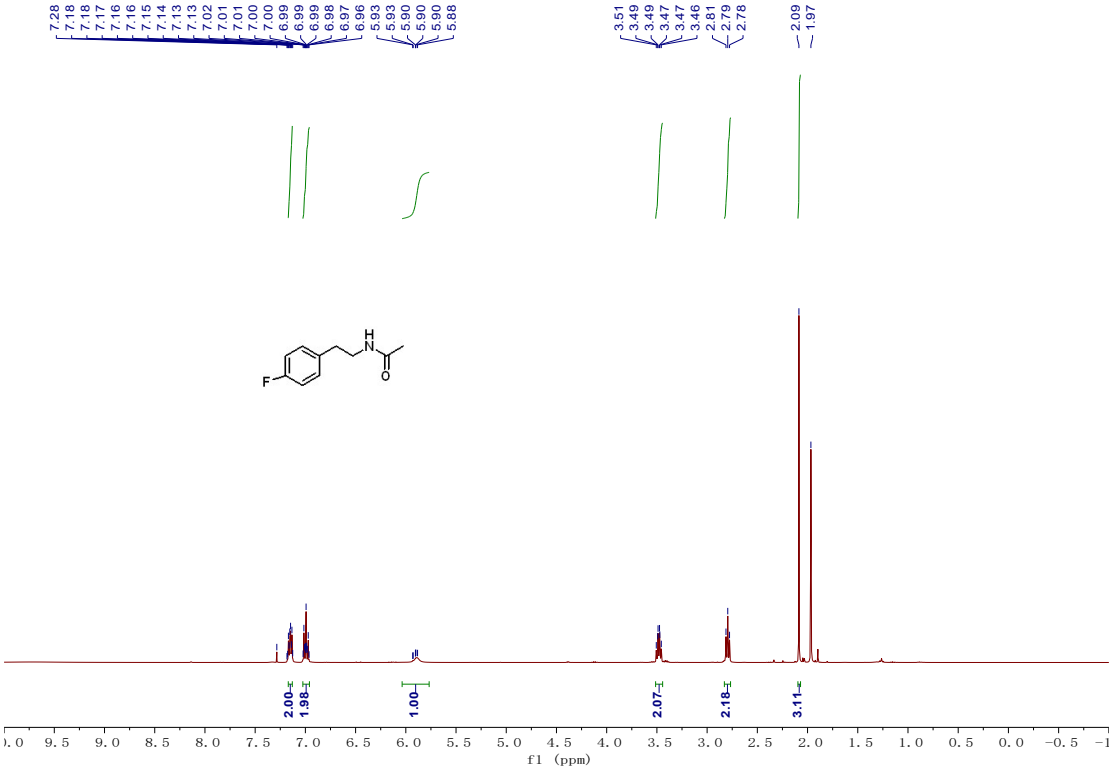
Compound **50** ^{1}H NMR



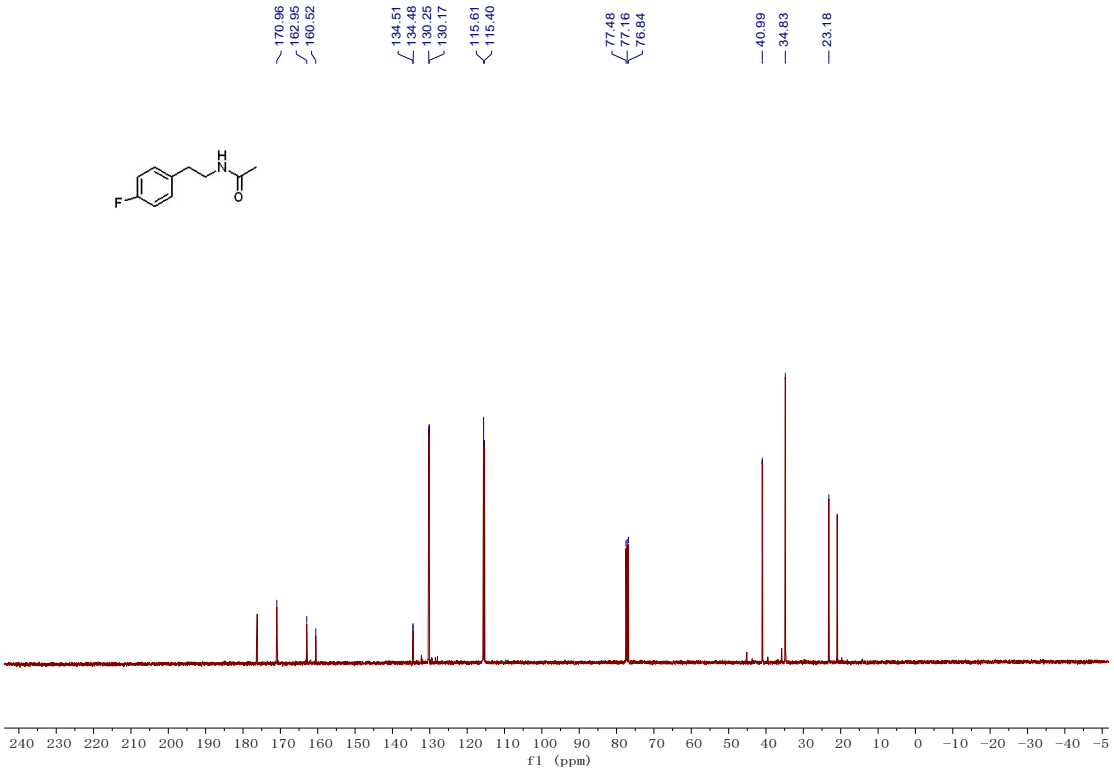
Compound **50** ^{13}C NMR



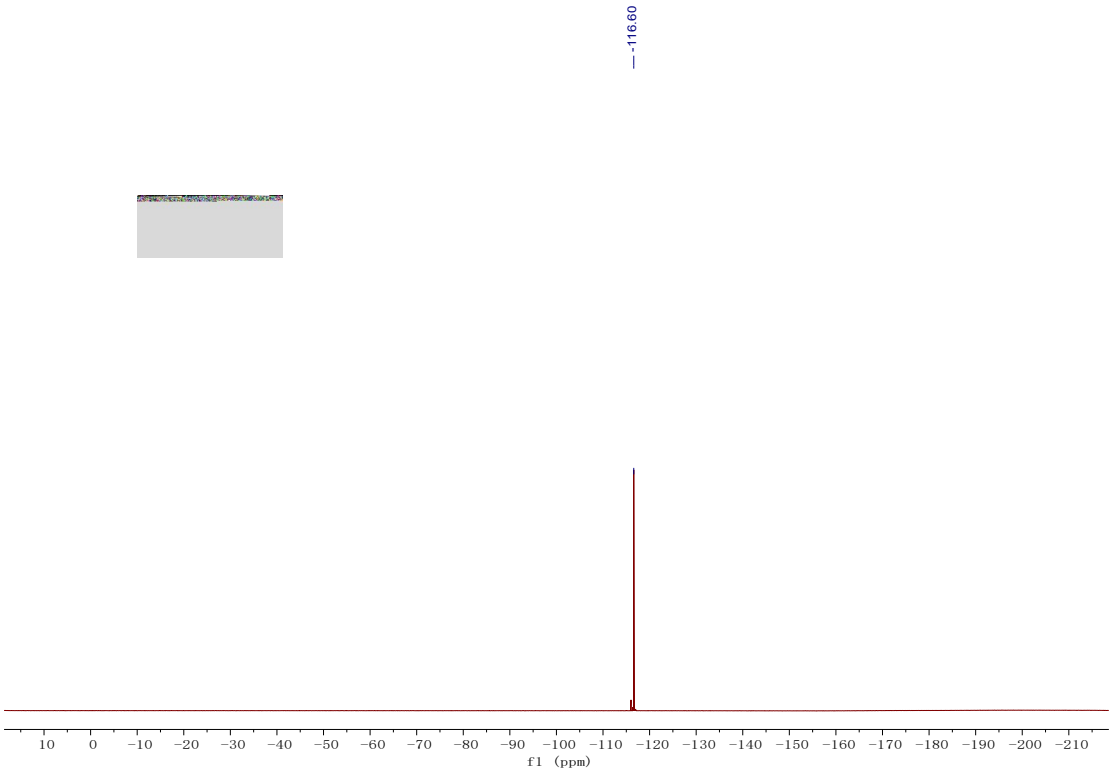
Compound **51** ^{1}H NMR



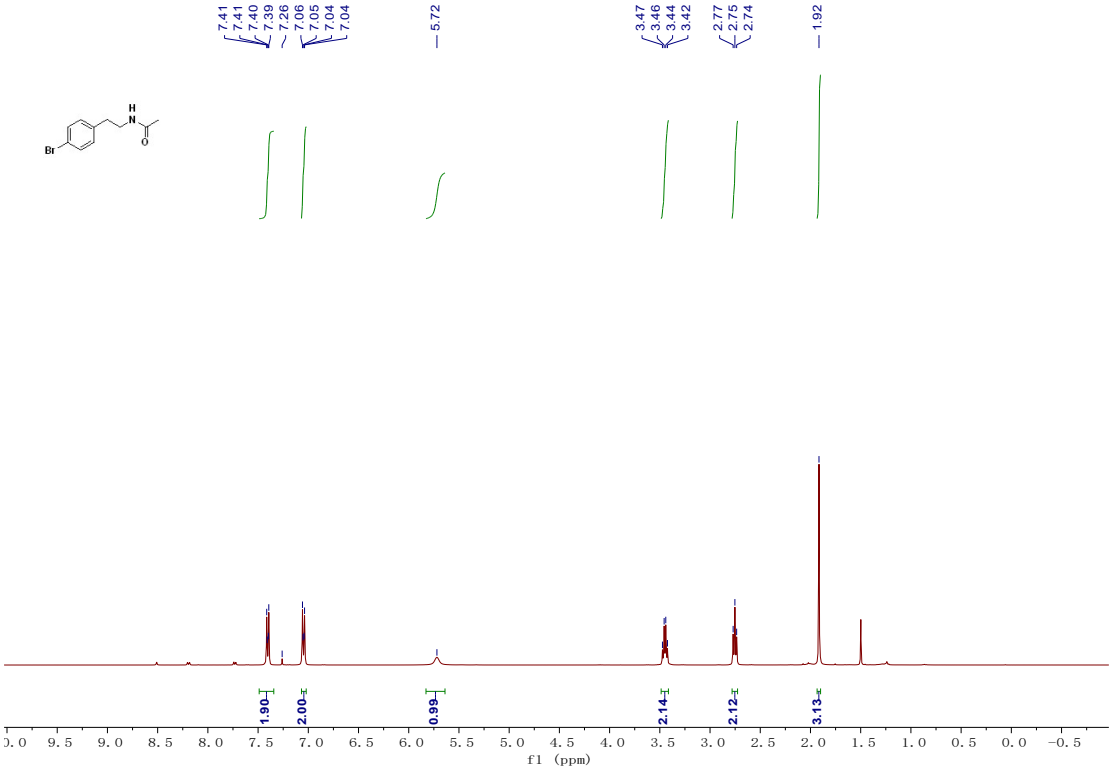
Compound **51** ^{13}C NMR



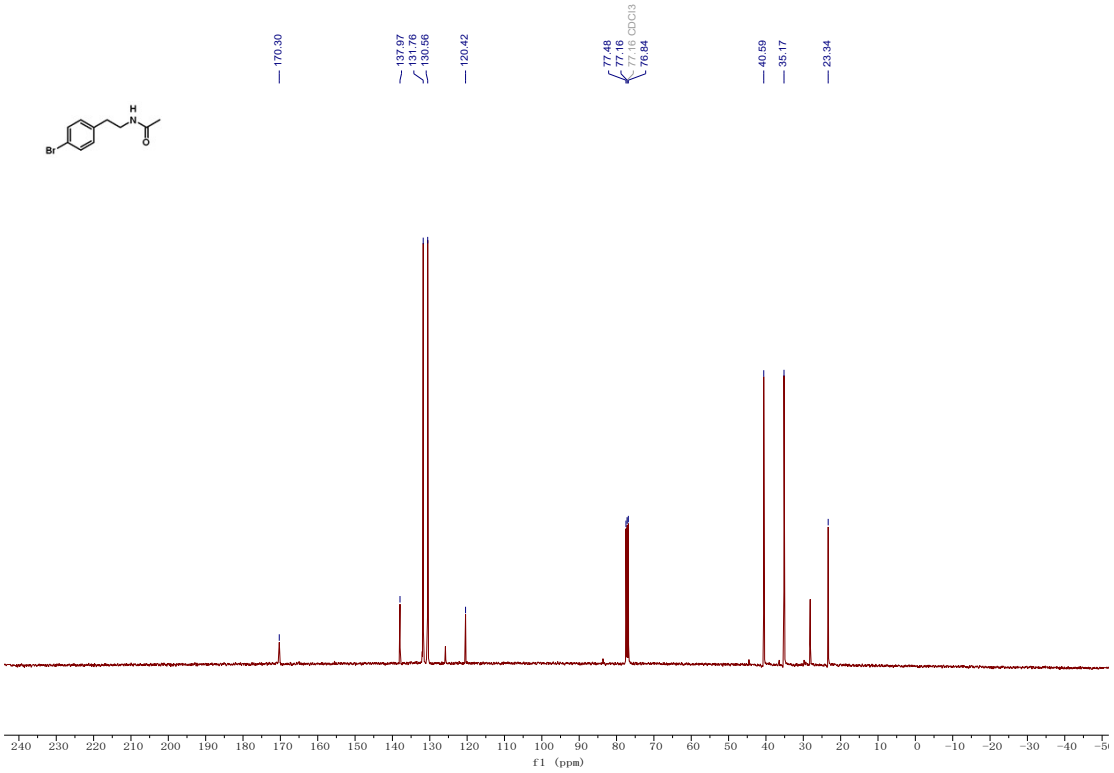
Compound **51** ^{19}F NMR



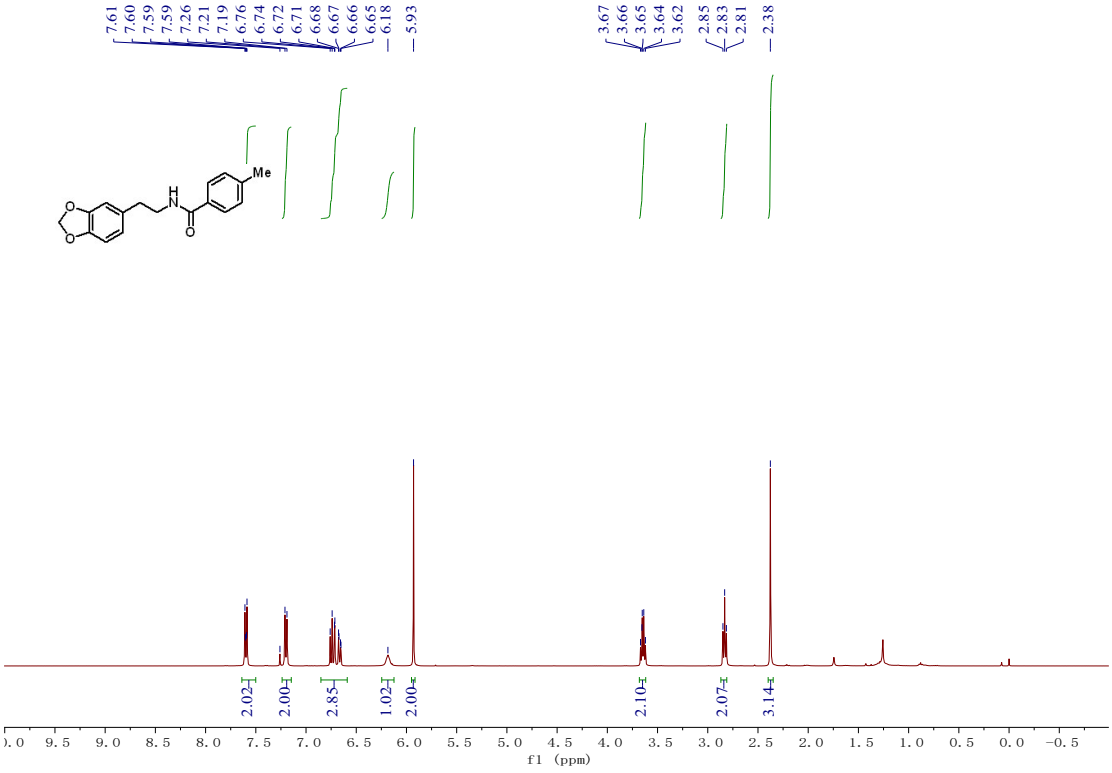
Compound **52** ^{1}H NMR



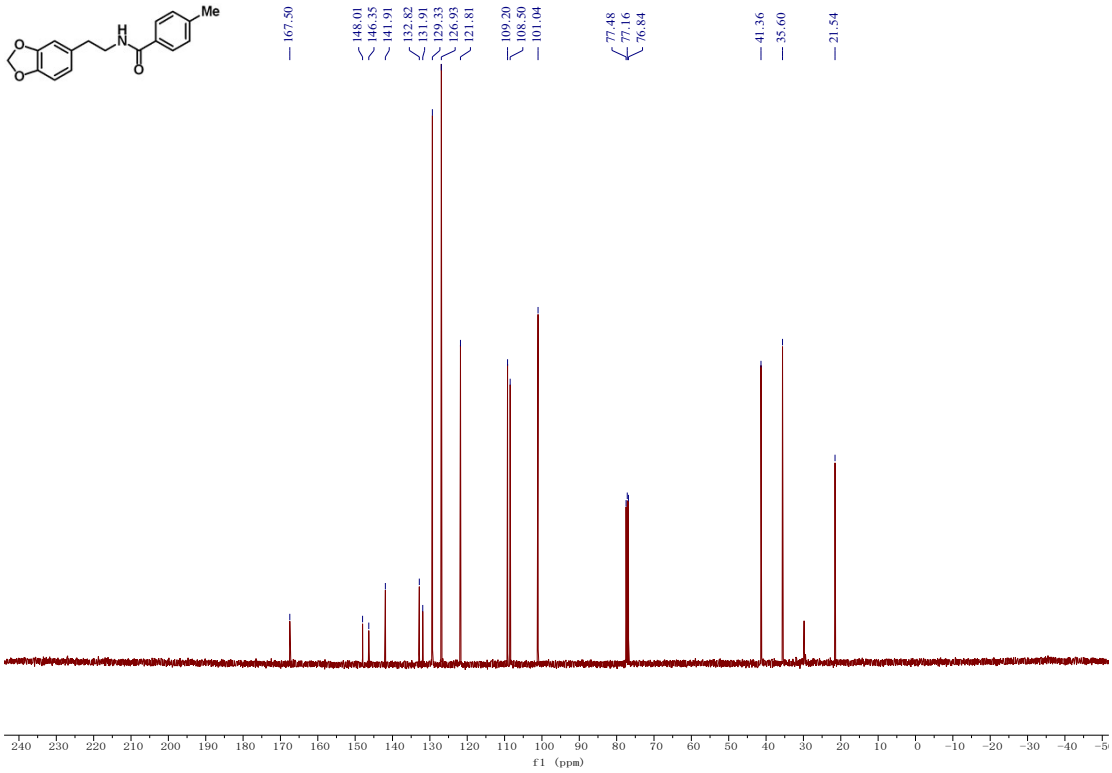
Compound **52** ^{13}C NMR



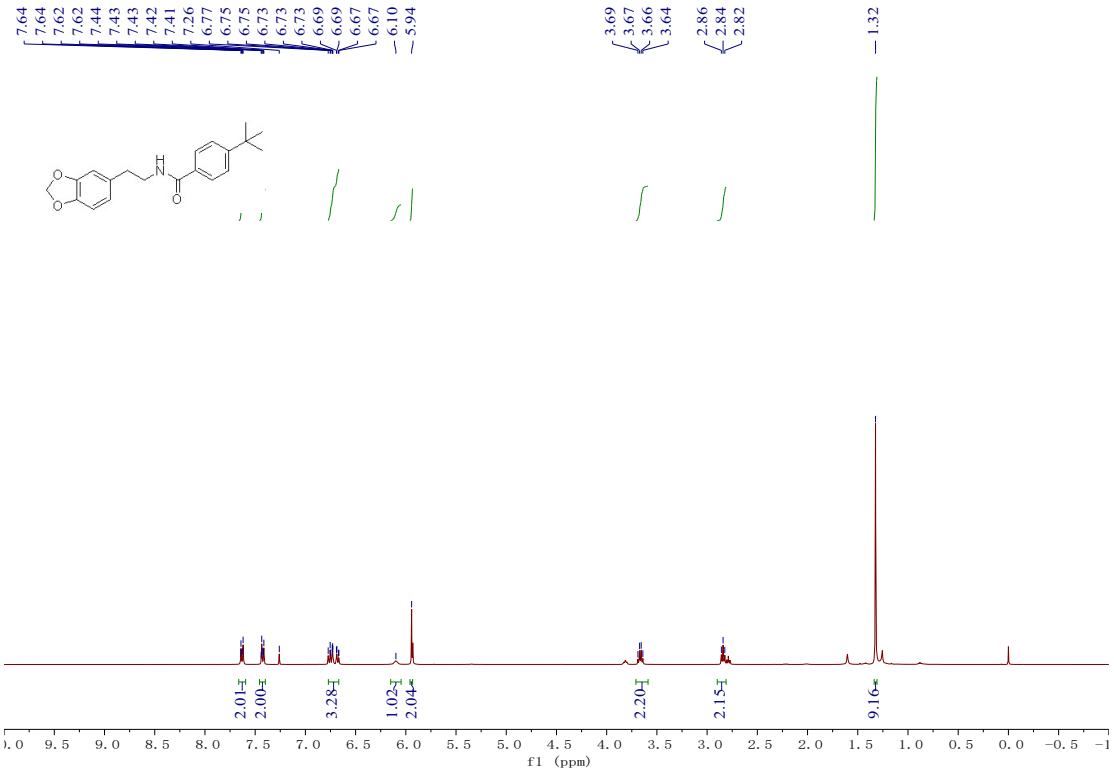
Compound **53** ^{1}H NMR



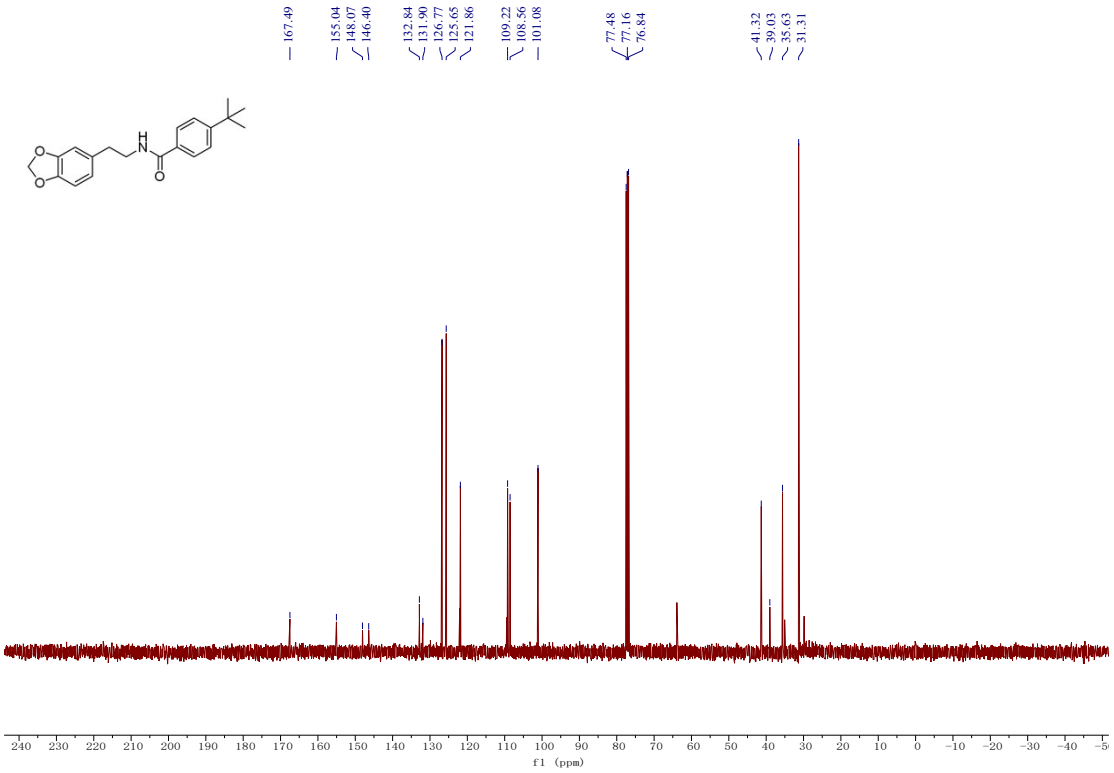
Compound **53** ^{13}C NMR



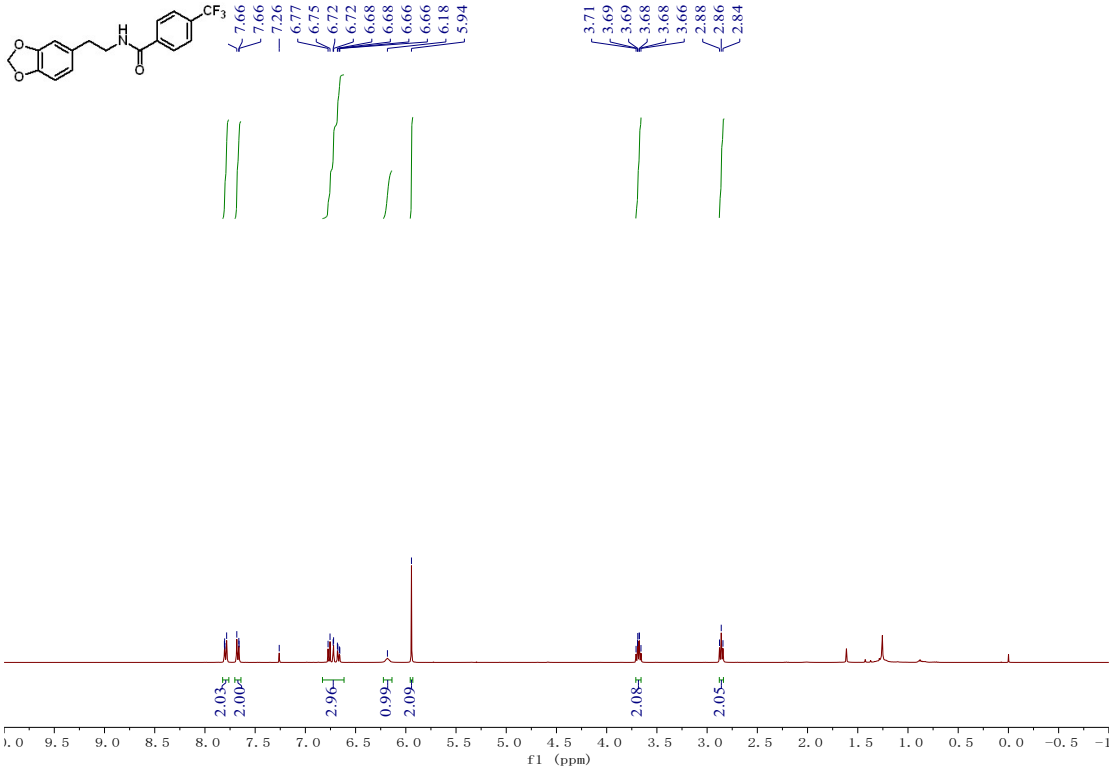
Compound **54** ^{1}H NMR



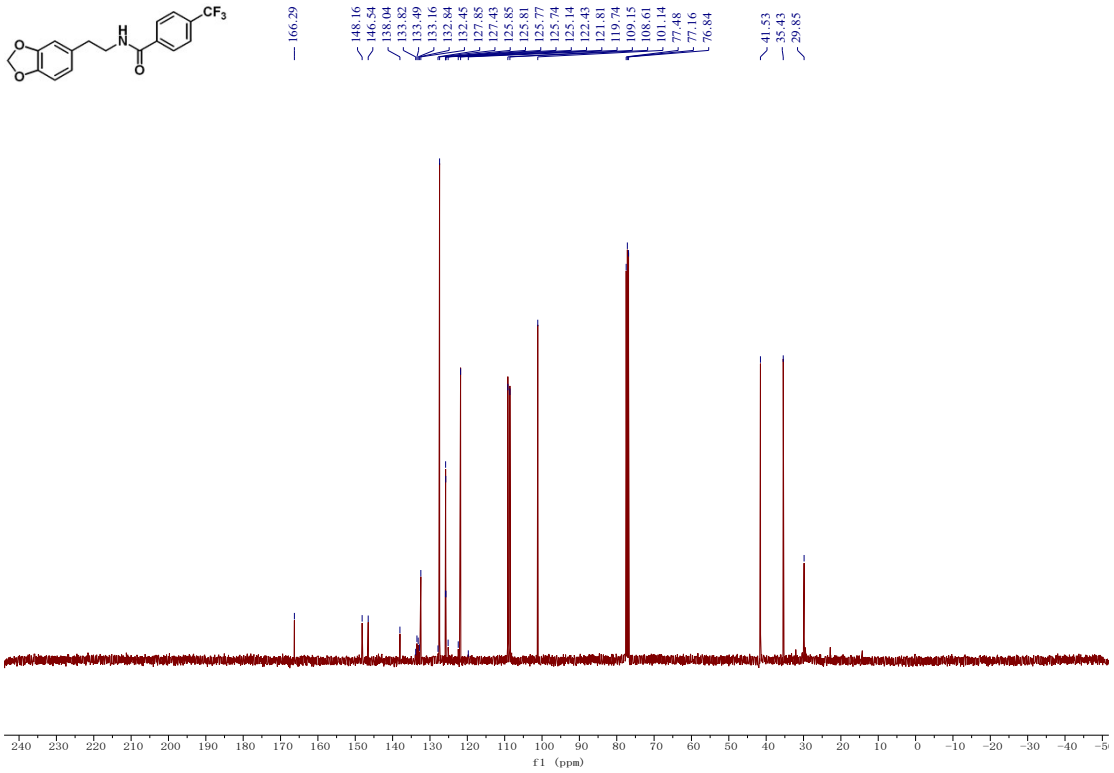
Compound **54** ^{13}C NMR



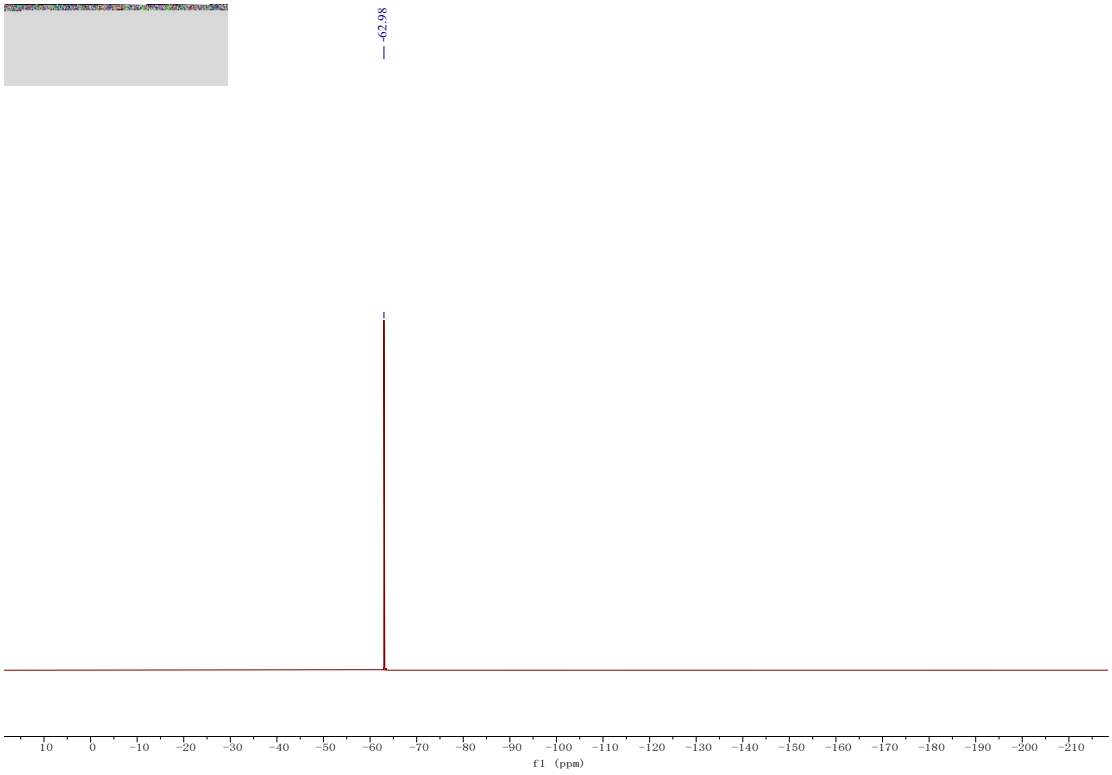
Compound **55** ^{1}H NMR



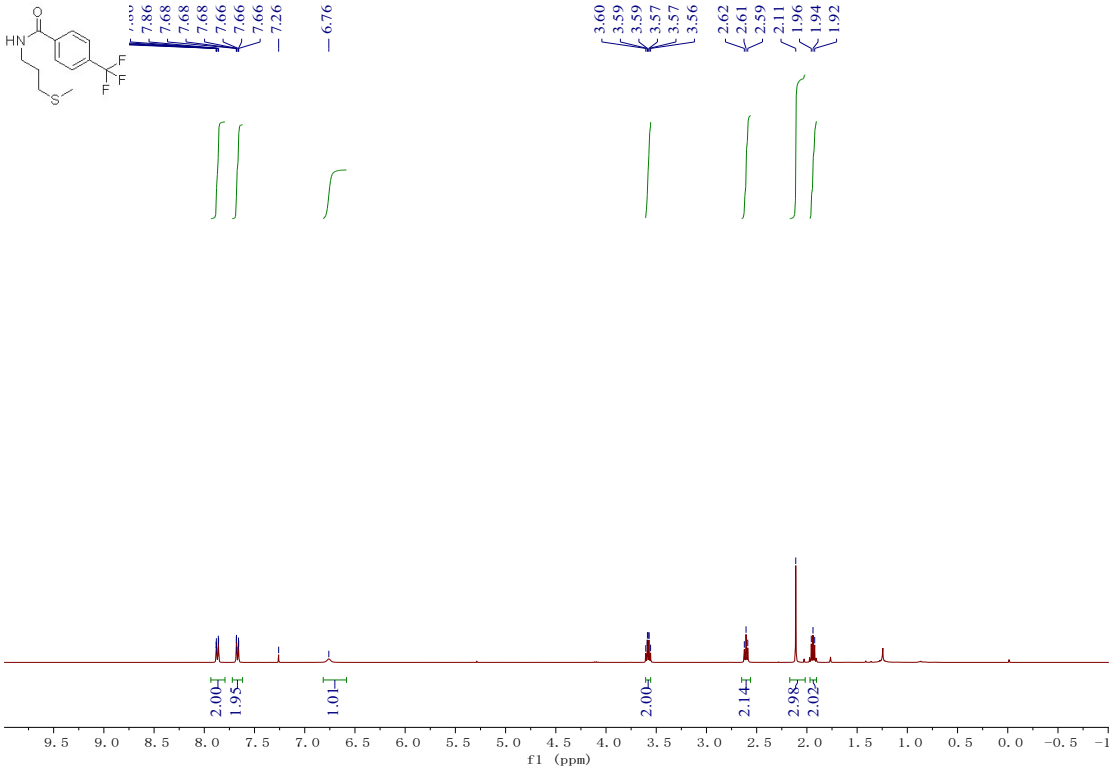
Compound **55** ^{13}C NMR



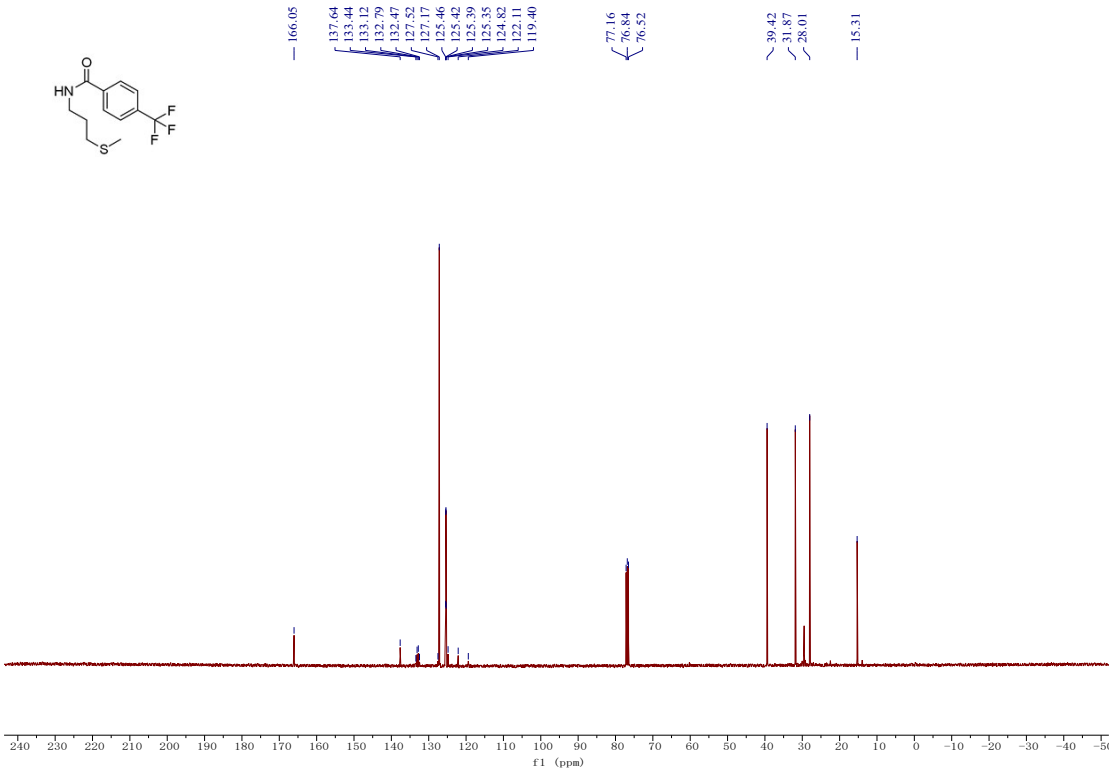
Compound **55** ^{19}F NMR



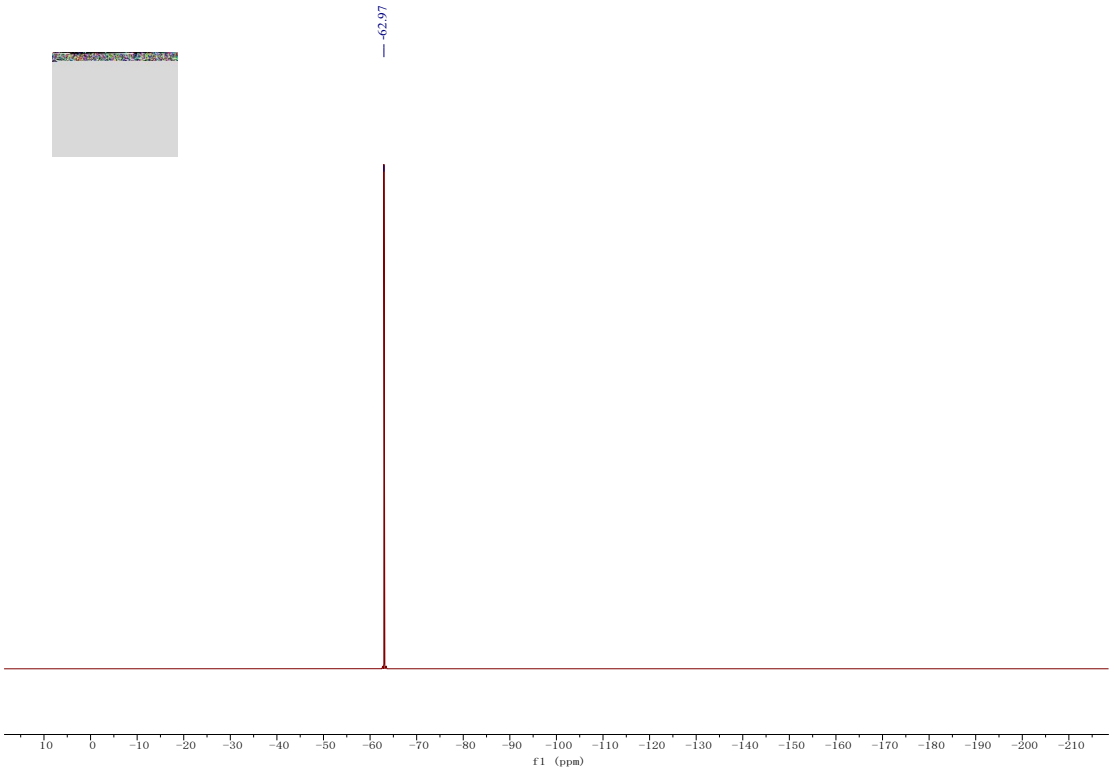
Compound **56** ^{1}H NMR



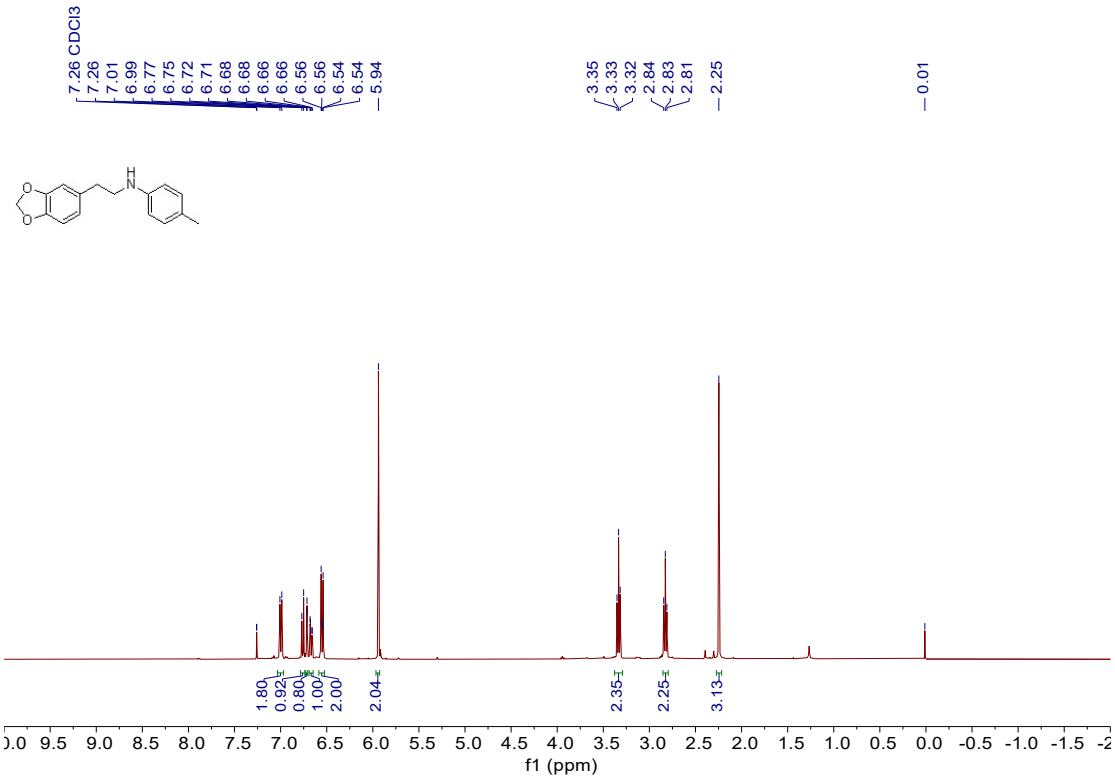
Compound **56** ^{13}C NMR



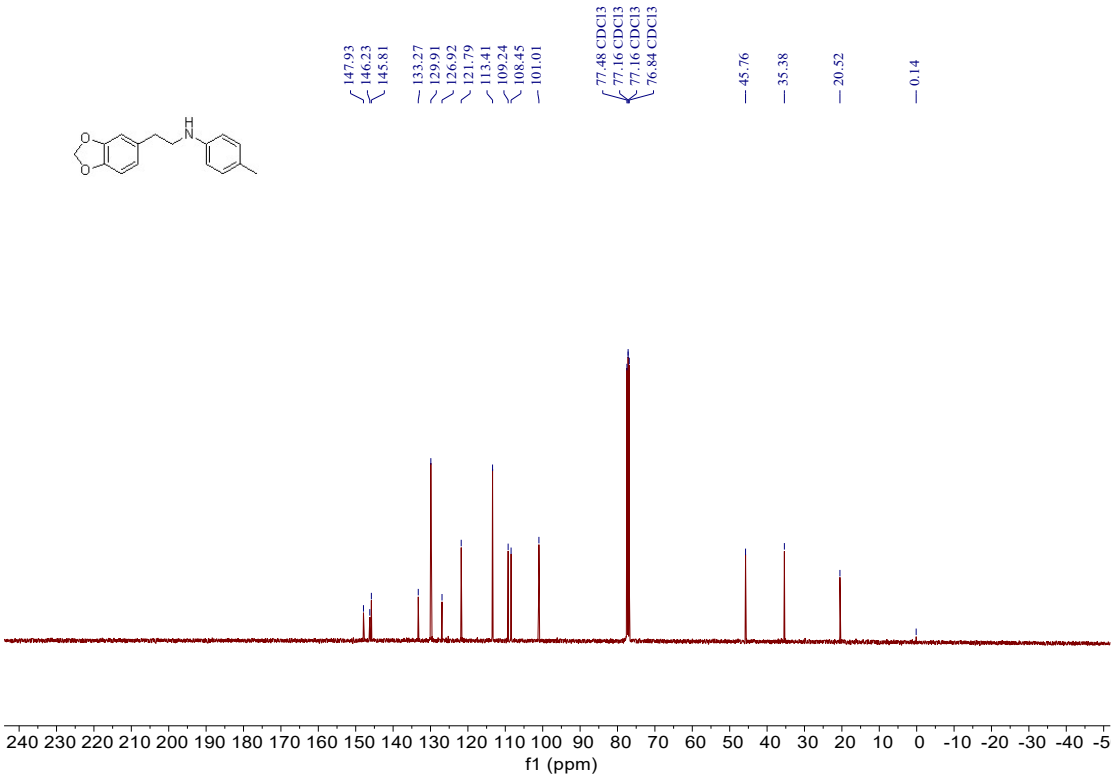
Compound **56** ^{19}F NMR



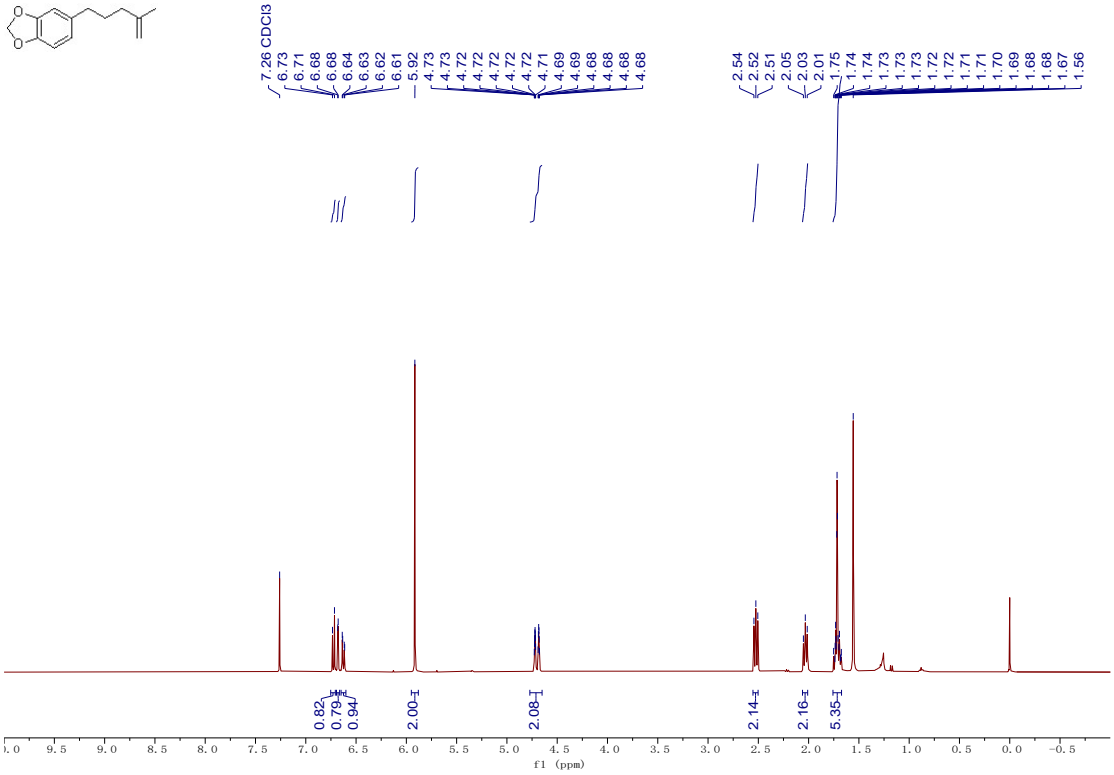
Compound **58** ^{1}H NMR



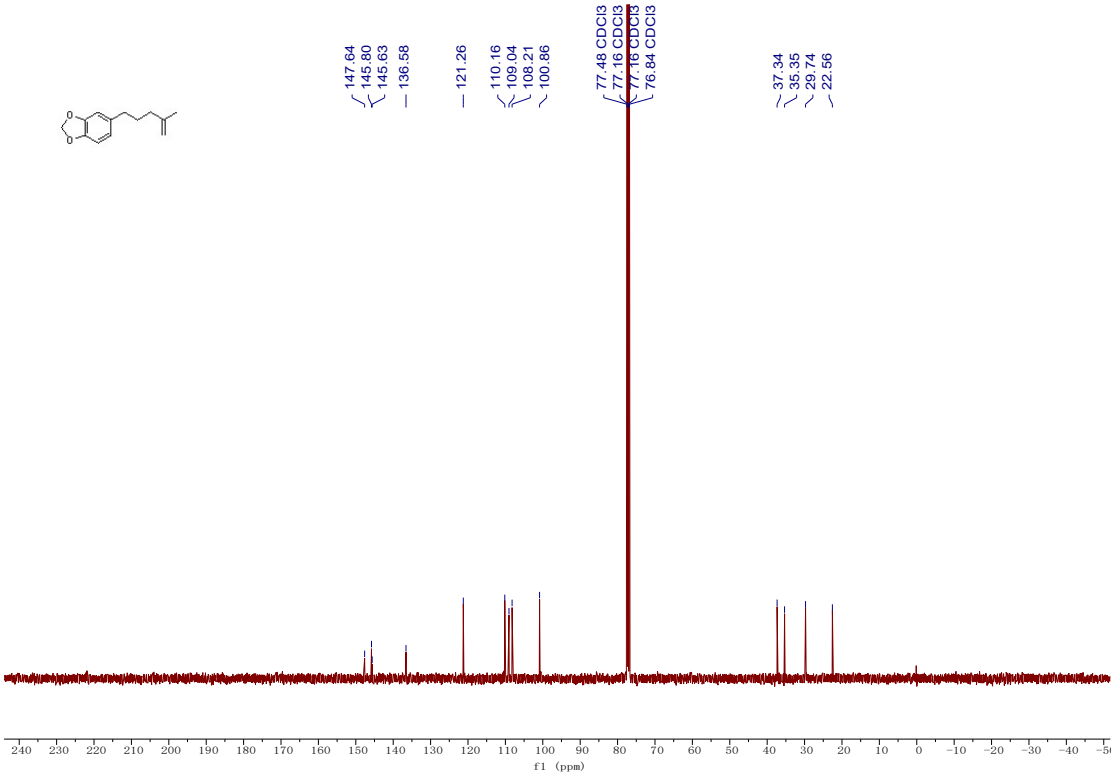
Compound **58** ^{13}C NMR



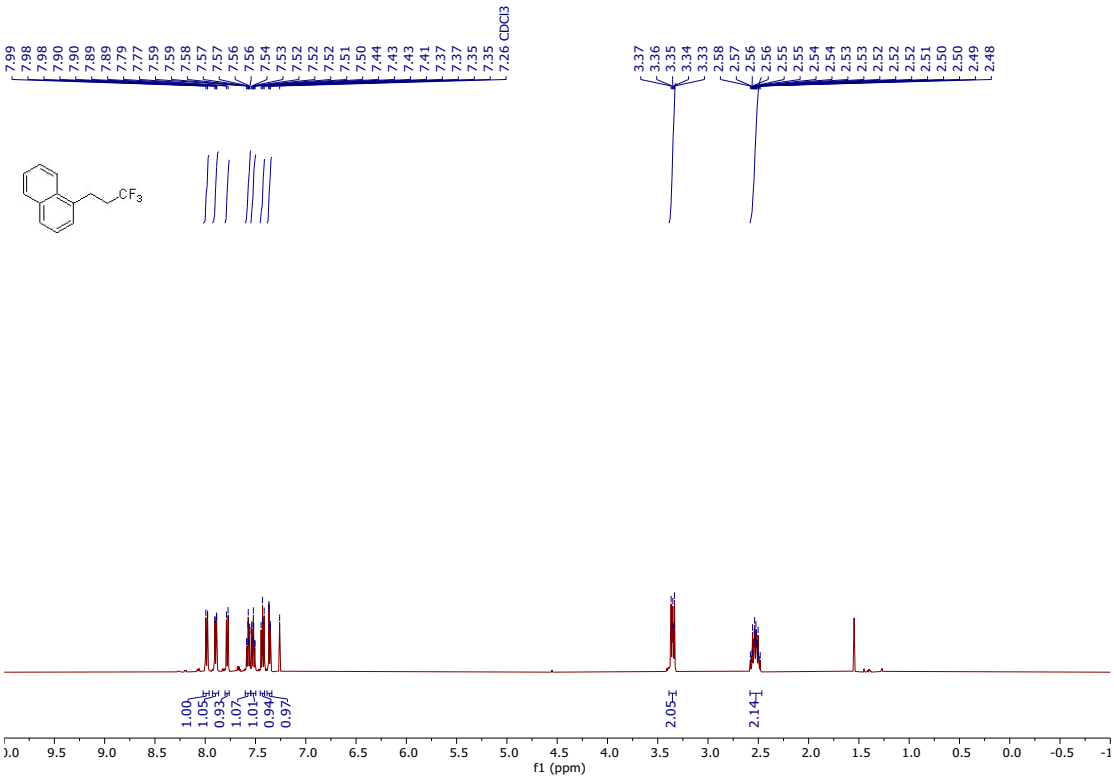
Compound **59** ^{1}H NMR



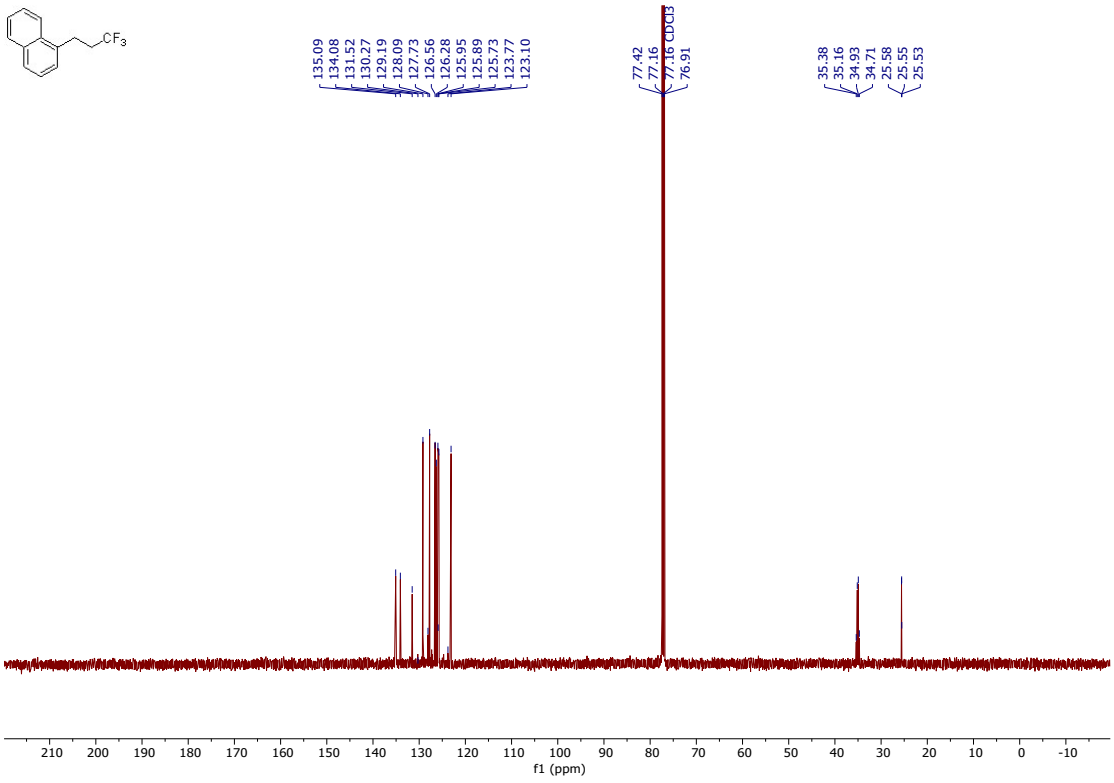
Compound **59** ^{13}C NMR



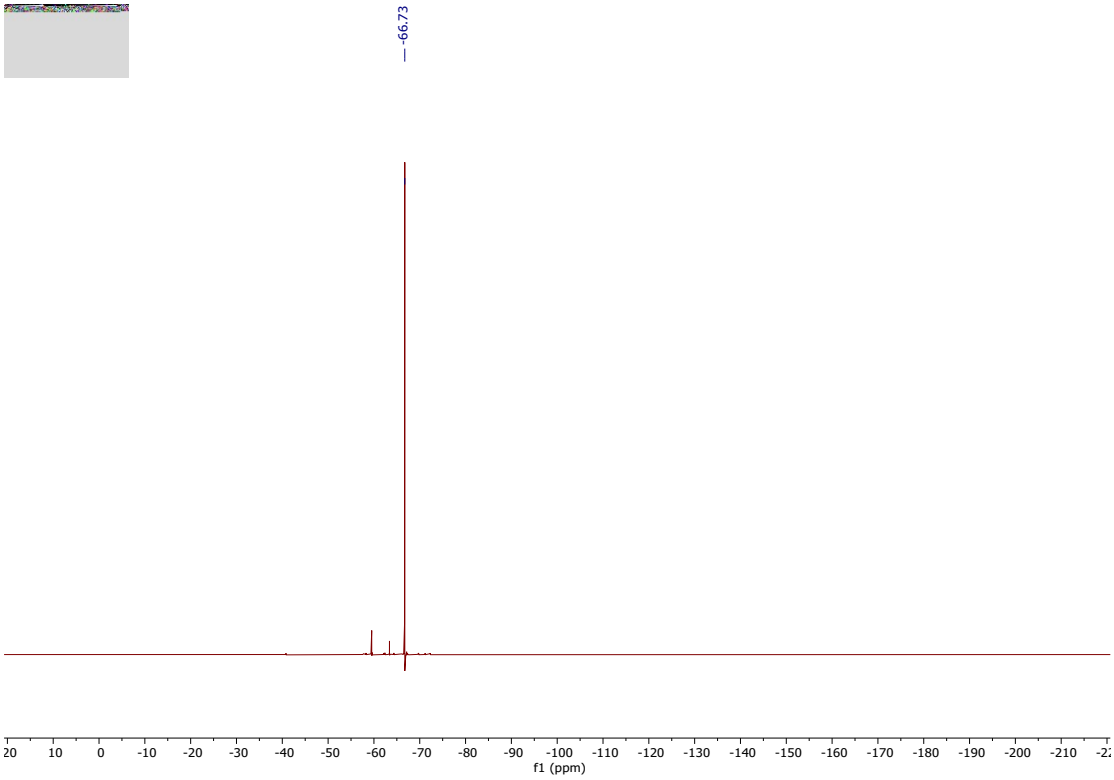
Compound **60** ^{1}H NMR



Compound **60** ^{13}C NMR



Compound **60** ^{19}F NMR



References

1. J.-F. Li, Z.-Z. Wei, Y.-Q. Wang, M. Ye, *Green Chem.* **2017**, *19*, 4498-4502.
2. Zhao, C. Li, M. Luo, X. Zeng, *Organometallics* **2021**, *40*, 2204-2208.
3. J. Wu, L. He, A. Noble, V. K. Aggarwal, *J. Am. Chem.Soc.* **2018**, *140*, 10700-10704.
4. A. Joshi-Pangu, X. Ma, M. Diane, S. Iqbal, R. J. Kribs, R. Huang, C.-Y. Wang, M. R. Biscoe, *J. Org. Chem.* **2012**, *77*, 6629-6633.
5. P. K. Verma, K. S. Prasad, D. Varghese, K. Geetharani, *Org. Lett.* **2020**, *22*, 1431-1436.
6. P. Guo, H. Jin, J. Han, L. Xu, P. Li, M. Zhan, *Org. Lett.* **2023**, *25*, 1268-1273.
7. J. Hu, G. Wang, S. Li, Z. Shi, *Angew.Chem.Int.Ed.* **2018**, *57*, 15227-15231.
8. T. Zhang, K. Manna, W. Lin, *J. Am. Chem.Soc.* **2016**, *138*, 3241-3249.
9. J. Wang, M. Shang, H. Lundberg, K. S. Feu, S. J. Hecker, T. Qin, D. G. Blackmond, P. S. Baran, *ACS Cata.* **2018**, *8*, 9537-9542.
10. S. Li, C. Hu, X. Cui, J. Zhang, L. L. Liu, L. Wu, *Angew.Chem.Int.Ed.* **2021**, *60*, 26238-26245.
11. B. C. Ranu, T. Mandal, *Synlett* **2007**, *2007*, 0925-0928.
12. R. R. Bhandare and J. D. Canney, *Med. Chem.*, 2014, **10**, 361-375.
13. A. P. Bashall and J. F. Collins, *Tetrahedron. Lett.*, 1975, **16**, 3489-3490.
14. C. Pramthaisong, R. Worayuthakarn, V. Pharikronburee, T. Duangthongyou, R. Rattanakam, S. Ruchirawat, N. Thasana, *Org. Lett.* **2018**, *20*, 4015-4019.
15. B. Li, G. Zhou, D. Zhang, L. Yao, M. Li, G. Yang, S. Zhang, H. Nie, *Org. Lett.* **2024**, *26*, 2097-2102.
16. M. J. Harper, E. J. Emmett, J. F. Bower, C. A. Russell, *J. Am. Chem.Soc.* **2017**, 139, 12386-12389.
17. N. Goswami, S. K. Sinha, P. Mondal, S. Adhya, A. Datta, D. Maiti, *Chem.* **2023**, *9*, 989-1003.
18. H. Liu, L. Wang, Y. Li, J. Liu, M. An, S. Zhu, Y. Cao, Z. Jiang, M. Zhao, Z. Cai, L. Dai, T. Ni, W. Liu, S. Chen, C. Wei, C. Zang, S. Tian, J. Yang, C. Wu, D. Zhang, H. Liu, Y. Jiang, *ChemMedChem* **2014**, *9*, 207-216.
19. L. Quteishat, A. Panossian, F. Le Bideau, R. Alsalim, P. Retailleau, C. Troufflard, E. Rose, F. Dumas, *J. Organo. Chem.* **2015**, *776*, 35-42.
20. S. Shahane, F. Louafi, J. Moreau, J.-P. Hurvois, J.-L. Renaud, P. van de Weghe, T. Roisnel, *Eur.J. Org. Chem. 2008, 2008, 4622-4631.*
21. Q. Xie, C. Ni, R. Zhang, L. Li, J. Rong, J. Hu, *Angew.Chem.Int.Ed.* **2017**, *56*, 3206-3210.
22. Wang, Q.; Xu, J.; Xu, Z.; Wang, Z.; Tao, X.; Ni, S.; Pan, Y.; Wang, Y. *Green Chem.* **2023**, *25*, 7084-7091.
23. Yang, Y.-F.; Lin, J.-H.; Xiao, J.-C. *Org. Lett.* **2021**, *23*, 9277-9282.