Supporting Information

Base Promoted *gem*-Difluoroolefination of Alkyl Triflones

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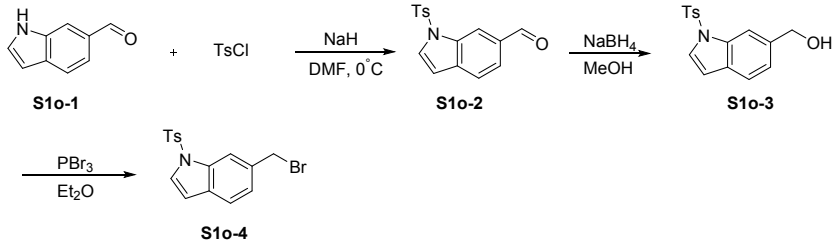
1. General

^{1}H NMR (400 MHz, 600 MHz),^{13}C NMR (100 MHz, 150 MHz) and ^{19}F NMR (376 MHz, 564 MHz) spectra were recorded on a Bruker NMR apparatus. The chemical shifts are reported in δ (ppm) values (^{1}H and ^{13}C NMR relative to $CHCl_3$, δ 7.26 ppm for ^{1}H NMR and δ 77.0 ppm for ^{13}C NMR). Or alternatively, ^{1}H NMR chemical shifts were referenced to tetramethylsilane signal (0 ppm). Multiplicities are recorded by s (singlet), d (doublet), t (triplet), q (quartet), p (pentet), m (multiplet) and br (broad). Coupling constants (*J*) are reported in Hertz (Hz). TLC was developed on silica gel 60 F254 glassplates. The products were purified using a commercial flash chromatography system or a regular glass column. The High-Resolution Mass measurements were conducted using an Agilent 7250 GC/Q-TOF equipment.

Commercial reagents and solvents were obtained from the commercial providers and used without further purification. Work-ups and purifications were performed using commercial reagent-grade solvents. Most benzyl bromides were commercially available from Sigma-Aldrich, TCI and Bidepharm. Starting materials **2d**[1] and **1ac**[2], **2ac**[2] are known compounds.

2. Synthesis of benzyl bromide

Procedure for the synthesis of S1o-4:



S1o-1 **S1o-2** **S1o-3** **S1o-4**

Procedure for the synthesis of S1o-2:

Under nitrogen atmosphere, to a solution of 1*H*-indole-6-carbaldehyde (**S1o-1**) (1.0 equiv) and TsCl (1.05 equiv) in dry DMF (0.2 M/L) was added NaH (1.2 equiv) slowly at 0 ºC. After stirring at 0 ºC to room temperature for 12 hours, the mixture was quenched by NH_4Cl (aq.) at 0 ºC. The mixture was extracted with EtOAc, combined organic layers were dried over Na_2SO_4 and evaporated under reduced pressure to afford residue, which was further purified by silica-gel column chromatography eluting with a mixture of EA and PE to give methyl 1-tosyl-1*H*-indole-6-carbaldehyde (**S1o-2**).

Procedure for the synthesis of S1o-3:

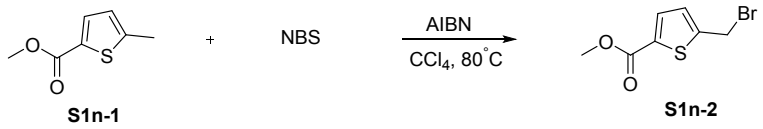
Under nitrogen atmosphere, to a solution of 1-tosyl-1*H*-indole-6-carbaldehyde (**S1o-2**) (1.0 equiv) in MeOH (0.1 M/L) was added $NaBH_4$ (1.0 equiv) slowly at 0 ºC. After stirring at room temperature for 1 h, water was added at 0 ºC. The mixture was extracted with EtOAc, combined organic layers were dried over Na_2SO_4 and evaporated under reduced pressure to afford methyl 6-hydroxymethyl-1-tosylindole (**S1o-3**), which was used in the next step without further purification.

Procedure for the synthesis of S1o-4:

Under nitrogen atmosphere, to a solution of 6-hydroxymethyl-1-tosylindole (**S1o-3**) (1.0 equiv) in dry Et_2O (0.1 M/L) was added PBr_3 (1.0 equiv) slowly at 0 ºC. After stirring at room temperature for 2 h, water and saturated $NaHCO_3$ (aq.) were added at 0 ºC. The mixture was extracted with Et_2O, combined

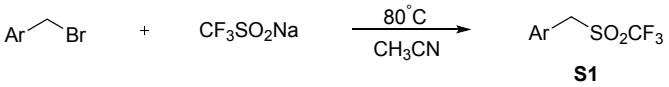
organic layer were dried over Na_2SO_4 and evaporated under reduced pressure to afford methyl 6-bromomethyl-1-tosylindole (**S1o-4**), which was used without further purification.

Procedure for the synthesis of S1n-2



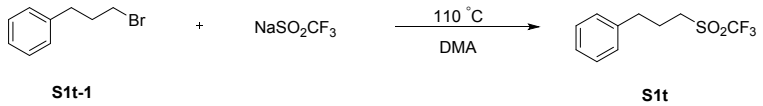
To a solution of methyl 5-methylthiophene-2-carboxylate (**S1n-1**) (1.0 equiv) in carbon tetrachloride (0.2 M/L) at room temperature was added NBS (1.2 equiv) and AIBN (10 mol%). The resulting mixture was heated to 80 °C and stirred at this temperature for 12 h under a nitrogen atmosphere. The mixture was filtered, and the filtrate was concentrated in a vacuum to give the crude product methyl 5-(bromomethyl)thiophene-2-carboxylate (**S1n-2**) as a yellow oil. The product was used in the next step without further purification.

3. General procedure for the synthesis of S1



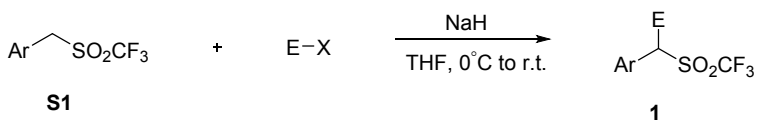
Under a nitrogen atmosphere, a mixture of benzyl bromide **1** (1.0 equiv.) and $NaSO_2CF_3$ **2** (2.0 equiv.) in acetonitrile (0.2 M/L) was heated at 80 °C for about 12 to 24 h. After completed the reaction was monitored by TLC and GC-MS, the reaction mixture was cooled down to room temperature; the reaction mixture was concentrated in a vacuum to give a residue. The residue was washed with dichloromethane and filtered through Celite to give the crude product. The crude product was purified by silica gel chromatography eluted with PE: EtOAc = 20:1 or recrystallization from a mixture of hexane and dichloromethane to give product **S1**.

Procedure for the synthesis of S1t



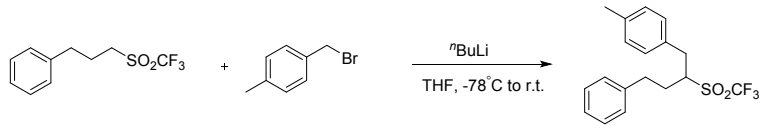
Under a nitrogen atmosphere, a mixture of (3-bromopropyl)benzene **1** (1.0 equiv.) and $NaSO_2CF_3$ **2** (2.0 equiv.) in DMA (0.2 M/L) was heated at 110 °C for 3 days. After completed the reaction was monitored by TLC and GC-MS, the reaction mixture was cooled down to room temperature; the reaction mixture was concentrated in a vacuum to give a residue. The residue was washed with dichloromethane and filtered through Celite to give the crude product. The crude product was purified recrystallization from a mixture of hexane and dichloromethane to give the product (3-((trifluoromethyl)sulfonyl)propyl)benzene **S1t**.

4. General procedure for the synthesis of 1



To a solution of S**1** (1.0 equiv.) in THF (0.2 M/L) was added NaH (1.1 equiv.) under nitrogen atmosphere at 0 °C. The mixture was stirred at 0 °C for 10 minutes, and then benzyl bromide or alkyl iodide in THF was added via syringe. The mixture was stirred at 0 °C to room temperature for several hours. After completion of the reaction (monitored by TLC), the mixture was diluted with NH_4Cl (aq.), and extracted with ethyl acetate; combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered, concentrated under vacuum to give a residue. The residue was purified by silica gel column chromatography eluting with a mixture of ethyl acetate and petroleum ether to give the **1**.

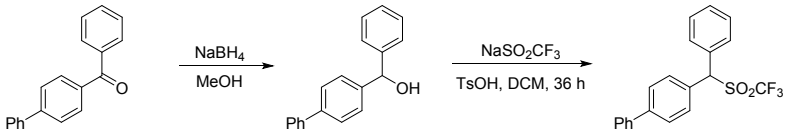
Procedure for the synthesis of 1t



S1t **1t**

Under nitrogen atmosphere, to a solution of (3-((trifluoromethyl)sulfonyl)propyl)benzene **S1t** (1.0 equiv.) in THF (0.1 M/L) was added ^{n}BuLi (1.2 equiv., 1.6 M/L) at -78°C. The mixture was stirred at -78 °C for 30 minutes, and then 1-(bromomethyl)-4-methylbenzene in THF was added via syringe. The mixture was stirred at -78 °C to room temperature for 16 hours. After completion of the reaction (monitored by TLC), the mixture was diluted with NH_4Cl (aq.), and extracted with ethyl acetate; combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered, concentrated under vacuum to give a residue. The residue was purified by silica gel column chromatography eluting with a mixture of ethyl acetate and petroleum ether (V_{EA}/V_{PE} = 1/100) to give 1-methyl-4-(4-phenyl-2-((trifluoromethyl)sulfonyl)butyl)benzene **1t**.

Procedure for the synthesis of 1ac:



S1ac-1 **S1ac-2** **1ac**

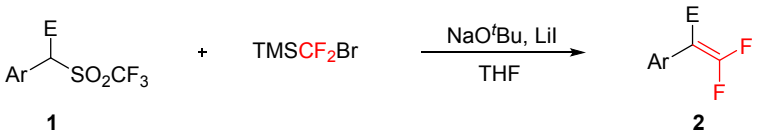
Procedure for the synthesis of S1ac-2:

Under nitrogen atmosphere, to a solution of [1,1'-biphenyl]-4-yl(phenyl)methanone (**S1ac-1**) (1.0 equiv) in MeOH (0.1 M/L) was added $NaBH_4$ (1.0 equiv) slowly at 0 ºC. After stirring at room temperature for 1 h, water was added at 0 ºC. The mixture was extracted with EtOAc, combined organic layers were dried over Na_2SO_4 and evaporated under reduced pressure to afford [1,1'-biphenyl]-4-yl(phenyl)methanol (**S1ac-2**), which was used in the next step without further purification.

Procedure for the synthesis of 1ac:

A mixture of [1,1'-biphenyl]-4-yl(phenyl)methanol (**S1ac-2**) (1.0 equiv), $NaSO_2CF_3$ (1.5 equiv) and $TsOH{\cdot}H_2O$ (1.5 equiv) in DCM (0.4 M/L) was stirred at room temperature for 36 h. The mixture was directly filtered and purified by recrystallization from a mixture of DCM and PE to give pure product **1ac**.

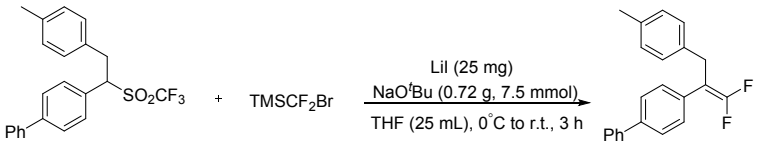
5. General procedure for the synthesis of ***gem*-difluoroakenes**



1 2

To a Schlenk tube was added **1** (0.1 mmol, 1.0 equiv), NaO^{t}Bu (0.3 mmol, 3.0 equiv, 28.0 mg) and LiI (5 mmol%, 1 mg) in the glove box. The tube was evacuated/backfilled with N_2 three times, THF (1.0 mL) was added. The reaction mixture was stirred at 0 °C for 30 minutes, and then $TMSCF_2Br$ (0.2 mmol, 2.0 equiv, 40.0 mg) was added via syringe. Then the reaction mixture was allowed to warm to room temperature and stirred for 30-60 minutes. After completion of the reaction (monitored by TLC), the mixture was concentrated under vacuum to give a residue. The residue was purified by column chromatography on silica gel eluting with a mixture of ethyl acetate and petroleum ether (or 100 % petroleum ether) to give the desired product *gem*-difluoroakenes **2**.

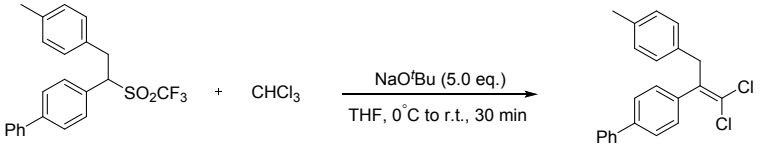
6. Gram scale synthesis of 2a



1.01 g, 2.5 mmol 1.0 g, 5.0 mmol 84 %, 0.675 g

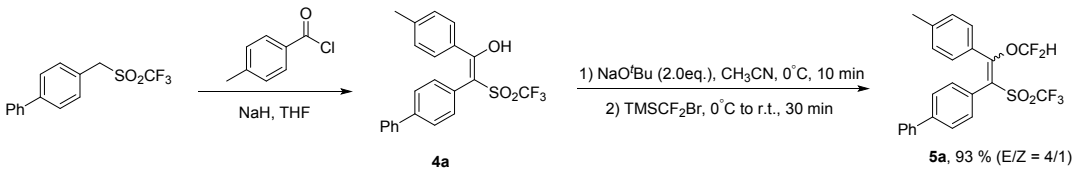
To a Schlenk tube was added **1a** (2.5 mmol, 1.0 equiv, 1.01 g), NaO^{t}Bu (7.5 mmol, 3.0 equiv, 0.72 g) in the glove box. The tube was evacuated/backfilled with N_2 three times, THF (25 mL) was added. The reaction mixture was stirred at 0 °C for 30 minutes, and then $TMSCF_2Br$ (5.0 mmol, 2.0 equiv, 1.0 g) was added via syringe within 5 minutes. Then the reaction mixture was allowed to warm to room temperature and stirred for 3 hours. The mixture was concentrated under a vacuum to give a residue. The residue was purified by column chromatography on silica gel eluting with 100 % petroleum ether to give **2a** (0.675 g, 84%).

7. Procedure for the synthesis of ***gem*-dichloroakene** 3a



To a Schlenk tube was added **1a** (0.1 mmol, 1.0 equiv, 41.0 mg), NaO^{t}Bu (0.5 mmol, 5.0 equiv, 48.0 mg) in the glove box. The tube was evacuated/backfilled with N_2 three times, THF (1.0 mL) was added. The reaction mixture was stirred at 0 °C for 30 minutes, and then $CHCl_3$ (0.2 mmol, 2.0 equiv, 24.0 mg) was added via syringe. Then the reaction mixture was allowed to warm to room temperature and stirred for 30 minutes. The mixture was concentrated under a vacuum to give a residue. The residue was purified by column chromatography on silica gel eluting with 100 % petroleum ether to give the desired product *gem*-dichloroakene **3a**.

8. Procedure for the synthesis of 5a



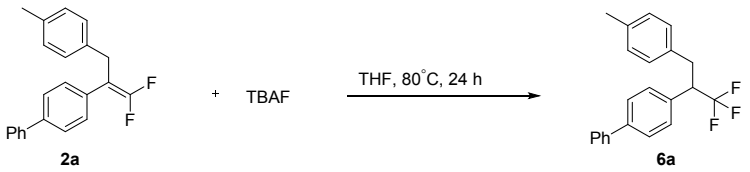
Procedure for the synthesis of 4a

Under nitrogen atmosphere, to a solution of 4-(((trifluoromethyl)sulfonyl)methyl)-1,1'-biphenyl **1ah** (1.0 equiv.) in THF (0.1 M/L) was added NaH (2.0 equiv.) at 0 °C. The mixture was stirred for 5-10 minutes, then *p*-tolchloride (1.0 equiv.) was added at 0 °C. The mixture was stirred at this temperature for 20 minutes. After completion of the reaction (monitored by TLC), the reaction mixture was quenched by water, extracted with ethyl acetate, and combined organic layers were washed with brine, dried over anhydrous Na_2SO_4, filtered, concentrated under vacuum to give a residue. The residue was purified by silica gel column chromatography eluting with a mixture of ethyl acetate and petroleum ether (EA/PE = 1/3) to give **4a**.

Procedure for the synthesis of 5a

To a Schlenk tube was added **4a** (0.1 mmol, 1.0 equiv), NaO^{t}Bu (0.2 mmol, 2.0 equiv, 19.0 mg) in the glove box. The tube was evacuated/backfilled with N_2 three times, CH_3CN (1.0 mL) was added. The reaction mixture was stirred at 0 °C for 10 minutes, and then $TMSCF_2Br$ (0.2 mmol, 2.0 equiv, 40.0 mg) was added via syringe. Then the reaction mixture was allowed to warm to room temperature and stirred for 30 minutes. After completion of the reaction (monitored by TLC), the mixture was concentrated under vacuum to give a residue. The residue was purified by thin-layer chromatography on silica gel (EA/PE =1/10) to give the mixture isomer of **5a**. Note: one of the isomer **5a'** was obtained after purification by thin-layer chromatography on silica gel (EA/PE =1/10), again.

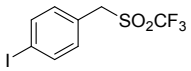
9. Procedure for the synthesis of 6a



Under nitrogen atmosphere, a mixture of **2a** (0.1 mmol, 1.0 equiv.) and tetrabutylammonium fluoride (2.0 equiv., 1.0 M/L in THF) was heated at 80 °C for 24 hours After completion of the reaction (monitored by TLC and GC-MS), the reaction mixture was cooled down to room temperature; the reaction mixture was concentrated in a vacuum to give a residue. The residue was purified by silica gel column chromatography eluting with a mixture of ethyl acetate and petroleum ether (EA/PE = 1/100) to give **6a**.

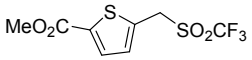
10. The characterization data of compounds：

1-Iodo-4-(((trifluoromethyl)sulfonyl)methyl)benzene (S1g)



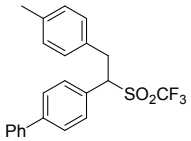
White solid, m.p. 159-161℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.80 – 7.78 (m, 2H), 7.17 – 7.15 (m, 2H), 4.41 (s, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -76.3. ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 138.5, 132.9, 122.7, 119.6 (q, *J* = 327.0 Hz), 96.6, 55.6. HRMS (ESI) calcd. for $C_8H_5F_3O_2IS$ [M-H]$^-$: 348.9013, found: 348.9014.

Methyl 5-(((trifluoromethyl)sulfonyl)methyl)thiophene-2-carboxylate (S1n)



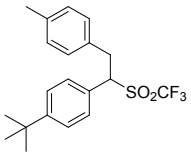
Yellow solid, m.p. 85-87℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.76 (d, *J* = 3.8 Hz, 1H), 7.23 (d, *J* = 3.8 Hz, 1H), 4.71 (s, 2H), 3.91 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -75.5. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 161.7, 136.9, 133.6, 132.2, 129.8, 119.6 (q, *J* = 326.0 Hz), 52.5, 51.2. HRMS (EI$^+$) calcd. for $C_8H_7F_3O_4S_2$ [M]$^+$: 287.9732, found: 287.9735.

4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)-1,1'-biphenyl (1a)



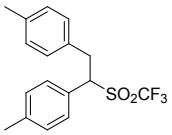
White solid, m.p. 120-122℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.52 (dd, *J* = 8.0, 2.8 Hz, 4H), 7.39 – 7.30 (m, 5H), 6.92 (d, *J* = 7.8 Hz, 2H), 6.81 (d, *J* = 7.8 Hz, 2H), 4.50 (dd, *J* = 11.6, 3.2 Hz, 1H), 3.68 (dd, *J* = 13.8, 3.2 Hz, 1H), 3.33 (dd, *J* = 13.7, 11.6 Hz, 1H), 2.18 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 142.7, 139.8, 137.1, 131.9, 130.7, 129.5, 129.1, 129.0, 128.0, 127.6, 127.4, 127.1, 120.1 (q, *J* = 330.4 Hz), 68.8, 33.9, 21.1. HRMS (EI$^+$) calcd. for $C_{22}H_{19}F_3O_2S$ [M]$^+$: 404.1052, found: 404.1048.

1-(*tert*-Butyl)-4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (1b)



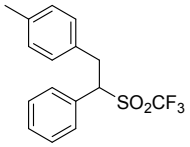
Viscous oil, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.25 (d, *J* = 8.2 Hz, 2H), 7.17 (d, *J* = 8.1 Hz, 2H), 6.85 (d, *J* = 7.8 Hz, 2H), 6.74 (d, *J* = 7.8 Hz, 2H), 4.44 (dd, *J* = 11.3, 3.2 Hz, 1H), 3.60 (dd, *J* = 13.8, 3.2 Hz, 1H), 3.27 (dd, *J* = 13.8, 11.4 Hz, 1H), 2.11 (s, 3H), 1.18 (s, 9H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 153.2, 136.9, 132.1, 129.9, 129.4, 129.0, 126.0, 125.3, 120.1 (q, *J* = 330.5 Hz), 68.8, 34.7, 33.8, 31.2, 21.0. HRMS (EI$^+$) calcd. for $C_{20}H_{23}F_3O_2S$ [M]$^+$: 384.1365, found: 384.1362.

4,4'-(1-((Trifluoromethyl)sulfonyl)ethane-1,2-diyl)bis(methylbenzene) (1c)



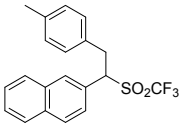
White solid, m.p. 60-62℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.22 (d, *J* = 7.8 Hz, 2H), 7.15 (d, *J* = 7.9 Hz, 2H), 6.97 (d, *J* = 7.6 Hz, 2H), 6.84 (d, *J* = 7.6 Hz, 2H), 4.49 (dd, *J* = 11.6, 3.1 Hz, 1H), 3.70 (dd, *J* = 13.7, 3.1 Hz, 1H), 3.35 (t, *J* = 12.6 Hz, 1H), 2.33 (s, 3H), 2.24 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 140.0, 136.9, 132.0, 130.0, 129.8, 129.4, 129.0, 125.3, 120.0 (q, *J* = 330.3 Hz), 68.8, 33.8, 21.3, 21.0. HRMS (FI$^+$) calcd. for $C_{17}H_{17}F_3O_2S$ [M]$^+$: 342.0896, found: 342.0902.

1-Methyl-4-(2-phenyl-2-((trifluoromethyl)sulfonyl)ethyl)benzene (**1d**)



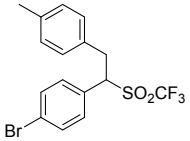
White solid, m.p. 61-63℃;^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.37 – 7.33 (m, 5H), 6.96 (d, *J* = 7.7 Hz, 2H), 6.83 (d, *J* = 7.7 Hz, 2H), 4.52 (dd, *J* = 11.6, 3.2 Hz, 1H), 3.73 (dd, *J* = 13.7, 3.2 Hz, 1H), 3.36 (dd, *J* = 13.6, 11.6 Hz, 1H), 2.23 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.0, 131.8, 130.2, 129.9, 129.4, 129.0, 129.0, 128.6, 120.0 (q, *J* = 330.2 Hz), 69.0, 33.8, 21.0. HRMS (EI$^+$) calcd. for $C_{16}H_{15}F_3O_2S$ [M]$^+$: 328.0739, found: 328.0743.

2-(2-(*p*-Tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)naphthalene (**1e**)



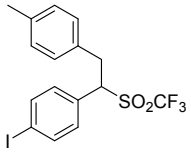
White solid, m.p. 98-100℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.87 – 7.76 (m, 4H), 7.55 – 7.49 (m, 3H), 6.93 (d, *J* = 7.8 Hz, 2H), 6.85 (d, *J* = 7.7 Hz, 2H), 4.70 (dd, *J* = 11.6, 3.1 Hz, 1H), 3.80 (dd, *J* = 13.8, 3.1 Hz, 1H), 3.50 (dd, *J* = 13.8, 11.6 Hz, 1H), 2.20 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.0, 133.7, 133.0, 131.8, 130.7, 129.4, 129.0, 128.9, 128.3, 127.8, 127.3, 126.7, 126.2, 125.9, 120.0 (q, *J* = 330.4 Hz), 69.2, 33.8, 21.0. HRMS (EI$^+$) calcd. for $C_{20}H_{17}F_3O_2S$ [M]$^+$: 378.0896, found: 378.0903.

1-Bromo-4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (**1f**)



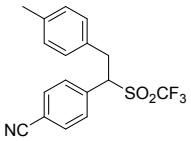
White solid, m.p. 57-59℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.49 (d, *J* = 8.1 Hz, 2H), 7.20 (d, *J* = 8.1 Hz, 2H), 6.99 (d, *J* = 7.6 Hz, 2H), 6.82 (d, *J* = 7.6 Hz, 2H), 4.49 (dd, *J* = 11.8, 3.2 Hz, 1H), 3.72 (dd, *J* = 13.8, 3.1 Hz, 1H), 3.29 (dd, *J* = 13.7, 11.7 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.8. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 136.9, 133.8, 132.4, 131.7, 130.6, 129.3, 129.2, 128.7, 127.9, 127.2, 126.0, 125.2, 124.5, 121.5, 120.1 (q, *J* = 330.2 Hz), 62.1, 35.3, 20.9. HRMS (EI$^+$) calcd. for $C_{16}H_{14}F_3O_2SBr$ [M]$^+$: 405.9844, found: 405.9848.

1-Iodo-4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (1g)



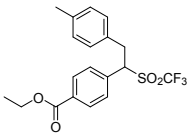
White solid, m.p. 65-67℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.69 (d, *J* = 7.9 Hz, 2H), 7.07 (d, *J* = 7.9 Hz, 2H), 6.99 (d, *J* = 7.6 Hz, 2H), 6.83 (d, *J* = 7.6 Hz, 2H), 4.46 (dd, *J* = 11.9, 3.2 Hz, 1H), 3.72 (dd, *J* = 13.9, 3.1 Hz, 1H), 3.29 (dd, *J* = 13.8, 11.6 Hz, 1H), 2.26 (s, 3H), 1.55 (s, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 138.3, 137.2, 131.8, 131.4, 129.6, 128.9, 128.4, 119.9 (q, *J* = 330.1 Hz), 96.4, 68.4, 33.7, 21.1. HRMS (EI$^+$) calcd. for $C_{16}H_{14}F_3O_2SI$ [M]$^+$: 453.9706, found: 453.9699.

4-(2-(*p*-Tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzonitrile (1h)



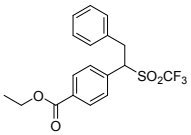
White solid, m.p. 104-106℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.65 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 7.7 Hz, 2H), 6.80 (d, *J* = 7.7 Hz, 2H), 4.57 (dd, *J* = 11.8, 3.3 Hz, 1H), 3.78 (dd, *J* = 13.8, 3.3 Hz, 1H), 3.31 (dd, *J* = 13.7, 11.8 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.5, 134.1, 132.6, 130.8, 130.7, 129.6, 128.8, 119.8 (d, *J* = 330.1 Hz), 117.8, 114.0, 68.2, 33.8, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{14}F_3NO_2S$ [M]$^+$: 353.0692, found: 353.0693.

Ethyl 4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzoate (1i)



White solid, m.p. 97-99℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.02 (d, *J* = 7.9 Hz, 2H), 7.41 (d, *J* = 8.0 Hz, 2H), 6.97 (d, *J* = 7.7 Hz, 2H), 6.81 (d, *J* = 7.7 Hz, 2H), 4.57 (dd, *J* = 11.7, 3.2 Hz, 1H), 4.38 (q, *J* = 7.1 Hz, 2H), 3.76 (dd, *J* = 13.7, 3.2 Hz, 1H), 3.35 (dd, *J* = 13.7, 11.7 Hz, 1H), 2.24 (s, 3H), 1.39 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 165.8, 137.2, 133.5, 131.9, 131.2, 130.1, 130.1, 129.5, 128.9, 119.8 (q, *J* = 330.2 Hz), 68.5, 61.3, 33.8, 21.0, 14.3. HRMS (EI$^+$) calcd. for $C_{19}H_{19}F_3O_4S$ [M]$^+$: 400.0951, found: 400.0945.

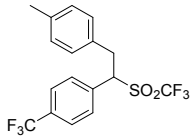
Ethyl 4-(2-phenyl-1-((trifluoromethyl)sulfonyl)ethyl)benzoate (1j)



White solid, m.p. 96-98℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.02 (d, *J* = 7.9 Hz, 2H), 7.43 (d, *J* = 8.0 Hz, 2H), 7.17-7.13 (m, 3H), 6.96-6.93 (m, 2H), 4.67 (dd, *J* = 11.8, 3.2 Hz, 1H), 4.36 (q, *J* = 7.1 Hz, 2H), 3.80 (dd, *J* = 13.7, 3.2 Hz, 1H), 3.40 (dd, *J* = 13.6, 11.7 Hz, 1H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{19}F

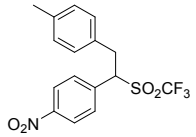
NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 165.7, 134.4, 133.4, 131.9, 130.2, 130.1, 129.1, 128.8, 127.5, 119.9 (q, *J* = 330.1 Hz), 68.4, 61.3, 34.1, 14.2. HRMS (EI$^+$) calcd. for $C_{18}H_{17}F_3O_4S$ [M]$^+$: 386.0794, found: 386.0796.

1-Methyl-4-(2-(4-(trifluoromethyl)phenyl)-2-((trifluoromethyl)sulfonyl)ethyl)benzene (**1k**)



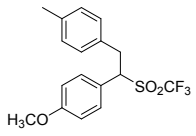
White solid, m.p. 42-44℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.62 (d, *J* = 8.1 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 7.7 Hz, 2H), 6.82 (d, *J* = 7.6 Hz, 2H), 4.59 (dd, *J* = 11.7, 3.2 Hz, 1H), 3.77 (dd, *J* = 13.8, 3.2 Hz, 1H), 3.34 (dd, *J* = 13.7, 11.7 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -63.0, -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.3, 132.9, 132.0 (q, *J* = 32.9 Hz), 131.1, 130.5, 129.6, 128.8, 126.0 (q, *J* = 3.8 Hz), 123.6 (q, *J* = 272.4 Hz), 119.8 (q, *J* = 330.0 Hz), 68.3, 33.8, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{14}F_6O_2S$ [M]$^+$: 396.0613, found: 396.0612.

1-Methyl-4-(2-(4-nitrophenyl)-2-((trifluoromethyl)sulfonyl)ethyl)benzene (**1l**)



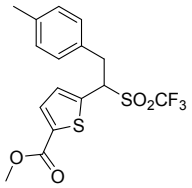
White solid, m.p. 100-102℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.22 – 8.19 (m, 2H), 7.55 – 7.52 (m, 2H), 6.98 (d, *J* = 7.8 Hz, 2H), 6.82 (d, *J* = 7.8 Hz, 2H), 4.67 (dd, *J* = 11.8, 3.4 Hz, 1H), 3.81 (dd, *J* = 13.7, 3.4 Hz, 1H), 3.35 (dd, *J* = 13.8, 11.8 Hz, 1H), 2.24 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 148.7, 137.5, 136.0, 131.1, 130.6, 129.7, 128.8, 124.1, 119.8 (q, *J* = 329.9 Hz), 67.9, 33.8, 21.0. HRMS (EI$^+$) calcd. for $C_{16}H_{14}F_3NO_4S$ [M]$^+$: 373.0590, found: 373.0585.

1-Methoxy-4-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (**1m**)



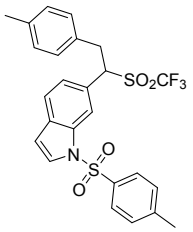
White solid, m.p. 75-77℃; ^{1}H NMR (600 MHz, Chloroform-*d*) δ: 7.25 (d, *J* = 8.6 Hz, 2H), 6.96 (d, *J* = 7.8 Hz, 2H), 6.85 – 6.83 (m, 4H), 4.51 (dd, *J* = 11.7, 3.2 Hz, 1H), 3.74 (s, 3H), 3.68 (dd, *J* = 13.7, 3.2 Hz, 1H), 3.32 (dd, *J* = 13.7, 11.7 Hz, 1H), 2.22 (s, 3H). ^{19}F NMR (564 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 160.8, 136.9, 132.0, 131.5, 129.4, 129.0, 120.1 (q, *J* = 330.4 Hz), 120.0, 114.5, 68.6, 55.2, 33.7, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{17}F_3O_3S$ [M]$^+$: 358.0845, found: 358.0852.

Methyl 5-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)thiophene-2-carboxylate (1n)



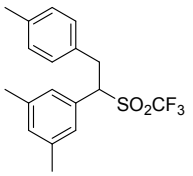
White solid, m.p. 83-85℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.64 (d, *J* = 3.9 Hz, 1H), 7.09 (d, *J* = 3.9 Hz, 1H), 7.02 (d, *J* = 7.7 Hz, 2H), 6.92 (d, *J* = 7.7 Hz, 2H), 4.87 (dd, *J* = 11.8, 3.2 Hz, 1H), 3.89 – 3.75 (m, 4H), 3.28 (dd, *J* = 13.6, 11.7 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -72.7. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 161.8, 137.5, 136.8, 136.2, 133.2, 131.2, 130.8, 129.6, 128.9, 119.9 (q, *J* = 330.5 Hz), 64.7, 52.4, 34.9, 21.0. HRMS (EI^{+}) calcd. for $C_{16}H_{15}F_3O_4S_2$ $[M]^{+}$: 392.0358, found: 392.0365.

6-(2-(*p*-Tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)-1-tosyl-1H-indole (1o)



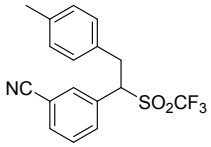
Off-white solid, m.p. 131-133℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.15 (s, 1H), 7.72 (d, *J* = 8.4 Hz, 2H), 7.56 (d, *J* = 3.7 Hz, 1H), 7.45 (d, *J* = 8.2 Hz, 1H), 7.16 (d, *J* = 8.4 Hz, 3H), 6.93 (d, *J* = 7.8 Hz, 2H), 6.85 (d, *J* = 7.9 Hz, 2H), 6.59 (d, *J* = 3.6 Hz, 1H), 4.73 (dd, *J* = 11.7, 3.3 Hz, 1H), 3.79 (dd, *J* = 13.8, 3.2 Hz, 1H), 3.48 (dd, *J* = 13.8, 11.7 Hz, 1H), 2.29 (s, 3H), 2.21 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 145.3, 136.9, 134.9, 134.7, 132.2, 131.7, 129.9, 129.4, 129.0, 128.1, 126. 9, 125.4, 124.4, 121.9, 120.0 (q, *J* = 330.5 Hz), 115.7, 109.1, 69.4, 33.9, 21.5, 21.0. HRMS (ESI^{+}) calcd. for $C_{25}H_{26}F_3N_2O_4S_2$ $[M+NH_4]^{+}$: 539.1281, found: 539.1285.

1,3-Dimethyl-5-(2-(p-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (1p)



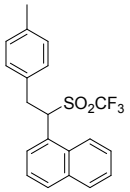
White solid, m.p. 102-104℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 6.99 (d, *J* = 7.5 Hz, 3H), 6.94 (brs, 2H), 6.85 (d, *J* = 7.7 Hz, 2H), 4.44 (dd, *J* = 11.3, 3.2 Hz, 1H), 3.67 (dd, *J* = 13.8, 3.1 Hz, 1H), 3.36 (dd, *J* = 13.8, 11.3 Hz, 1H), 2.29 (s, 6H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 138.6, 136.9, 132.1, 131.7, 129.3, 128.9, 128.2, 127.9, 120.0 (d, *J* = 330.3 Hz), 69.0, 33.9, 21.3, 21.0. HRMS (EI^{+}) calcd. for $C_{18}H_{19}F_3O_2S$ $[M]^{+}$: 356.1052, found: 356.1049.

3-(2-(*p*-Tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzonitrile (1q)



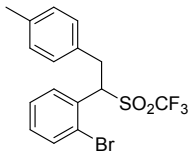
White solid, m.p. 111-113℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.67 (dd, *J* = 7.7, 1.5 Hz, 1H), 7.62 – 7.59 (m, 2H), 7.50 (t, *J* = 7.8 Hz, 1H), 6.99 (d, *J* = 7.6 Hz, 2H), 6.81 (d, *J* = 7.6 Hz, 2H), 4.56 (dd, *J* = 11.8, 3.3 Hz, 1H), 3.78 (dd, *J* = 13.9, 3.3 Hz, 1H), 3.30 (dd, *J* = 13.8, 11.7 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.5, 134.3, 133.5, 133.5, 130.7, 130. 7, 130.0, 129.7, 128.9, 119.8 (q, *J* = 330.1 Hz), 117.8, 113.4, 67.8, 33.7, 21.0. HRMS (FI^{+}) calcd. for $C_{17}H_{14}NF_3O_2S$ [M]$^{+}$: 353.0692, found: 353.0699.

1-(2-(*p*-Tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)naphthalene (1r)



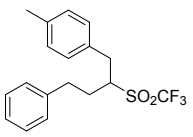
White solid, m.p. 82-84℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.01 (d, *J* = 7.3 Hz, 1H), 7.89 (d, *J* = 8.2 Hz, 1H), 7.84 – 7.82 (m, 1H), 7.71 – 7.68 (m, 1H), 7.58 (t, *J* = 7.8 Hz, 1H), 7.47 – 7.44 (m, 2H), 6.86 (brs, 4H), 5.63 (dd, *J* = 11.2, 3.4 Hz, 1H), 3.89 (dd, *J* = 13.9, 3.4 Hz, 1H), 3.56 (dd, *J* = 13.8, 11.1 Hz, 1H), 2.14 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.8. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 136.9, 133.8, 132.4, 131.7, 130.6, 129.3, 129.2, 128.7, 127.9, 127.2, 126.0, 125.2, 124.5, 121.5, 120.1 (q, *J* = 330.2 Hz), 62.1, 35.3, 20.9. HRMS (EI^{+}) calcd. for $C_{20}H_{17}F_3O_2S$ [M]$^{+}$: 378.0896, found: 378.0900.

1-Bromo-2-(2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)ethyl)benzene (1s)



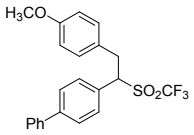
Colorless oil, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.77 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.44 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.37 (td, *J* = 7.7, 1.3 Hz, 1H), 7.15 (td, *J* = 7.8, 1.6 Hz, 1H), 6.96 (d, *J* = 7.9 Hz, 2H), 6.86 (d, *J* = 8.1 Hz, 2H), 5.52 (dd, *J* = 11.5, 3.7 Hz, 1H), 3.76 (dd, *J* = 13.8, 3.7 Hz, 1H), 3.30 (dd, *J* = 13.8, 11.5 Hz, 1H), 2.21 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -74.5. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 137.1, 133.4, 131.1, 130.8, 130.3, 129.4, 129.1, 128.8, 128.1, 127.0, 119.9 (q, *J* = 329.7 Hz), 65.8, 34.8, 21.1. HRMS (EI^{+}) calcd. for $C_{16}H_{14}F_3BrO_2S$ [M]$^{+}$: 405.9844, found: 405.9846.

1-Methyl-4-(4-phenyl-2-((trifluoromethyl)sulfonyl)butyl)benzene (1t)



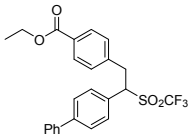
Colorless oil, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.24 – 7.16 (m, 3H), 7.14 (d, *J* = 7.8 Hz, 2H), 7.03 (d, *J* = 8.0 Hz, 2H), 6.97 – 6.95 (m, 2H), 3.52-3.45 (m, 1H), 3.41 (dd, *J* = 14.0, 3.8 Hz, 1H), 2.91 (dd, *J* = 14.1, 10.5 Hz, 1H), 2.70-2.65 (m, 2H), 2.35 (s, 3H), 2.31 – 2.20 (m, 1H), 2.12 – 2.02 (m, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -74.4. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 139.6, 137.4, 132.2, 129.8, 129.1, 128.7, 128.5, 126.6, 120.2 (q, *J* = 329.7 Hz), 61.8, 33.4, 32.5, 28.2, 21.1. HRMS (EI$^+$) calcd. for $C_{18}H_{19}F_3O_2S$ [M]$^+$: 356.1052, found: 356.1057.

4-(2-(4-Methoxyphenyl)-1-((trifluoromethyl)sulfonyl)ethyl)-1,1'-biphenyl (1aa)



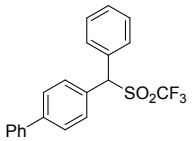
White solid, m.p. 117-119℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.60 – 7.57 (m, 4H), 7.46 – 7.35 (m, 5H), 6.91 – 6.88 (m, 2H), 6.72 – 6.70 (m, 2H), 4.56 – 4.52 (m, 1H), 3.76-3.71 (m, 4H), 3.38 (dd, *J* = 13.8, 11.5 Hz, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 158.8, 142.6, 139.8, 130.6, 130.2, 128.9, 127.9, 127.6, 127.4, 127.1, 126.8, 120.0 (q, *J* = 330.4 Hz), 114.1, 68.8, 55.2, 33.5. HRMS (EI$^+$) calcd. for $C_{22}H_{19}F_3O_3S$ [M]$^+$: 420.1002, found: 420.1005.

Ethyl 4-(2-([1,1'-biphenyl]-4-yl)-2-((trifluoromethyl)sulfonyl)ethyl)benzoate (1ab)



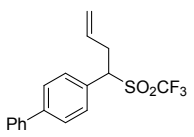
White solid, m.p. 95-97℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.88 – 7.85 (m, 2H), 7.59 – 7.55 (m, 4H), 7.45 – 7.34 (m, 5H), 7.09 – 7.07 (m, 2H), 4.62 (dd, *J* = 11.7, 3.3 Hz, 1H), 4.32 (q, *J* = 7.1 Hz, 2H), 3.83 (dd, *J* = 13.7, 3.3 Hz, 1H), 3.50 (dd, *J* = 13.7, 11.7 Hz, 1H), 1.34 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.1. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 166.1, 142.9, 140.0, 139.6, 130.4, 130.0, 129.7, 129.2, 128.9, 128.0, 127.7, 127.1, 126.8, 120.0 (q, *J* = 330.2 Hz), 68.2, 61.1, 34.2, 14.3. HRMS (ESI$^+$) calcd. for $C_{24}H_{22}F_3O_2S$ [M+H]$^+$: 463.1185, found: 463.1184.

4-(Phenyl((trifluoromethyl)sulfonyl)methyl)-1,1'-biphenyl (1ac)[2]



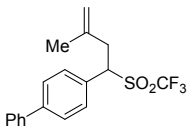
White solid, m.p. 121-123℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.72 – 7.62 (m, 6H), 7.56 – 7.55 (m, 2H), 7.46 – 7.33 (m, 6H), 5.68 (d, *J* = 2.2 Hz, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -72.8. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 142.7, 139.9, 130.5, 130.0, 129.9, 129.6, 129.3, 129.0, 128.3, 128.0, 127.9, 127.2, 120.2 (q, *J* = 330.7 Hz), 71.8.

4-(1-((Trifluoromethyl)sulfonyl)but-3-en-1-yl)-1,1'-biphenyl (1ad)



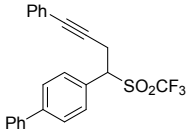
White solid, m.p. 136-138℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.61 (dd, *J* = 19.5, 7.7 Hz, 4H), 7.45 (dd, *J* = 13.8, 7.5 Hz, 4H), 7.36 (t, *J* = 7.3 Hz, 1H), 5.54 (dq, *J* = 16.7, 7.4 Hz, 1H), 5.11 (dd, *J* = 29.6, 13.6 Hz, 2H), 4.47 (dd, *J* = 11.4, 4.0 Hz, 1H), 3.17 (dt, *J* = 11.7, 4.9 Hz, 1H), 3.00 (td, *J* = 13.5, 12.8, 6.7 Hz, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.3. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 142.9, 139.9, 131.1, 130.5, 129.0, 128.0, 127.8, 127.2, 120.1, 120.0 (q, *J* = 330.2 Hz), 66.8, 32.1. HRMS (EI$^+$) calcd. for $C_{17}H_{15}F_3O_2S$ [M]$^+$: 340.0739, found: 340.0745.

4-(3-Methyl-1-((trifluoromethyl)sulfonyl)but-3-en-1-yl)-1,1'-biphenyl (1ae)



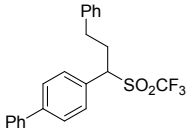
White solid, m.p. 117-119℃; ^{1}H NMR (600 MHz, Chloroform-*d*) δ: 7.63 (d, *J* = 7.9 Hz, 1H), 7.59 (d, *J* = 7.4 Hz, 1H), 7.49 – 7.43 (m, 4H), 7.36 (t, *J* = 7.4 Hz, 1H), 4.84 – 4.68 (m, 2H), 4.60 (dt, *J* = 11.9, 3.0 Hz, 1H), 3.14 – 3.11 (m, 1H), 2.99- 2.94 (m, 1H), 1.65 (s, 3H). ^{19}F NMR (564 MHz, Chloroform-*d*) δ: -73.1. ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 142.8, 139.8, 138.2, 130.5, 128.9, 127.9, 127.6, 127.3, 127.1, 120.0 (q, *J* = 330.0 Hz), 115.9, 65.9, 35.5, 22.1. HRMS (EI$^+$) calcd. for $C_{18}H_{17}F_3O_2S$ [M]$^+$: 354.0896, found: 354.0901.

4-(4-Phenyl-1-((trifluoromethyl)sulfonyl)but-3-yn-1-yl)-1,1'-biphenyl (1af)



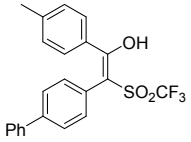
White solid, m.p. 120-122℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.68 (d, *J* = 8.0 Hz, 2H), 7.64 – 7.55 (m, 4H), 7.47-7.44 (m, 2H), 7.38 (t, *J* = 7.2 Hz, 1H), 7.27 – 7.19 (m, 5H), 4.71 (dd, *J* = 10.4, 4.6 Hz, 1H), 3.53 (dd, *J* = 17.0, 4.6 Hz, 1H), 3.40 (dd, *J* = 16.9, 10.4 Hz, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.5. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 143.1, 139.9, 131.6, 130.4, 129.0, 128.5, 128.3, 128.0, 127.8, 127.2, 127.1, 122.4, 119.9 (d, *J* = 329.7 Hz), 84.6, 82.5, 65.6, 20.6. HRMS (EI$^+$) calcd. for $C_{23}H_{17}F_3O_2S$ [M]$^+$: 414.0896, found: 414.0893.

4-(3-Phenyl-1-((trifluoromethyl)sulfonyl)propyl)-1,1'-biphenyl (1ag)



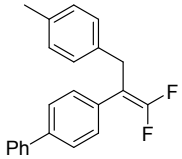
White solid, m.p. 81-83℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.67 – 7.65 (m, 2H), 7.62 – 7.59 (m, 2H), 7.46-7.42 (m, 4H), 7.39 – 7.34 (m, 1H), 7.31-7.27 (m, 2H), 7.24 – 7.19 (m, 1H), 7.08-7.06 (m, 2H), 4.35 (dd, *J* = 11.6, 3.0 Hz, 1H), 2.76 – 2.69 (m, 2H), 2.62 – 2.53 (m, 1H), 2.50 – 2.42 (m, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.2. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 143.0, 139.9, 139.0, 130.6, 129.0, 128.9, 128.5, 128.04, 127.96, 127.3, 127.2, 126.9, 120.0 (d, *J* = 330.2 Hz), 66.2, 31.9, 29.0. HRMS (EI$^+$) calcd. for $C_{22}H_{19}F_3O_2S$ [M]$^+$: 404.1052, found: 404.1055.

2-([1,1'-Biphenyl]-4-yl)-1-(*p*-tolyl)-2-((trifluoromethyl)sulfonyl)ethen-1-ol (4a)



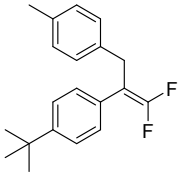
White solid, m.p. 114-116℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.84 – 7.82 (m, 2H), 7.70 (d, *J* = 8.4 Hz, 2H), 7.65 (d, *J* = 8.5 Hz, 2H), 7.56 – 7.53 (m, 2H), 7.45 – 7.41 (m, 2H), 7.38 – 7.34 (m, 1H), 7.26 – 7.24 (m, 2H), 6.40 (s, 1H), 2.38 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -73.1. ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 187.0, 146.2, 143.6, 139.6, 132.0, 131.1, 129.9, 129.2, 128.9, 128.3, 128.1, 127.2, 123.8, 119.9 (q, *J* = 330.5 Hz), 72.1, 21.8. HRMS (EI$^+$) calcd. for $C_{22}H_{17}F_3O_3S$ [M]$^+$: 418.0845, found: 418.0843.

4-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)-1,1'-biphenyl (2a)



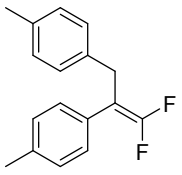
White solid, 25.9 mg, 81%, m.p. 68-70℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.49 – 7.42 (m, 4H), 7.36-7.32 (m, 2H), 7.29 – 7.23 (m, 3H), 7.02 – 6.98 (m, 4H), 3.65 (t, *J* = 2.2 Hz, 2H), 2.22 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.9 (dt, *J* = 39.9, 2.7 Hz), -90.4 (d, *J* = 39.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.5 (dd, *J* = 292.4, 287.8 Hz), 140.5, 140.0, 136.0, 135.4 (t, *J* = 2.6 Hz), 132.6 (t, *J* = 4.0 Hz), 129.2, 128.8, 128.6 (t, *J* = 3.6 Hz), 128.1, 127.4, 127.03, 126.97, 91.5 (dd, *J* = 21.5, 13.0 Hz), 33.3, 21.0. HRMS (EI$^+$) calcd. for $C_{22}H_{18}F_2$ [M]$^+$: 320.1372, found: 320.1373.

1-(*tert*-Butyl)-4-(1,1-difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzene (2b)



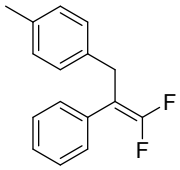
Colorless oil, 24.8 mg, 83%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.31 – 7.28 (m, 2H), 7.24 – 7.21 (m, 2H), 7.09 – 7.04 (m, 4H), 3.68 (t, *J* = 2.3 Hz, 2H), 2.29 (s, 3H), 1.28 (s, 9H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.3 (dt, *J* = 41.0, 3.0 Hz), -90.9 (d, *J* = 39.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.5 (dd, *J* = 292.1, 287.0 Hz), 150.1, 135.8, 135.6 (t, *J* = 2.6 Hz), 130.7 (t, *J* = 3.8 Hz), 129.2, 128.1, 127.7 (t, *J* = 3.6 Hz), 125.3, 91.3 (dd, *J* = 21.1, 13.0 Hz), 34.5, 33.3, 31.3, 21.0. HRMS (EI$^+$) calcd. for $C_{20}H_{22}F_2$ [M]$^+$: 300.1684, found: 300.1682.

4,4'-(3,3-Difluoroprop-2-ene-1,2-diyl)bis(methylbenzene) (2c)



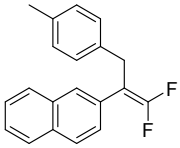
Colorless oil, 20.6 mg, 80%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.17 – 7.14 (m, 2H), 7.08 (d, *J* = 8.0 Hz, 2H), 7.04 (brs, 4H), 3.67 (t, *J* = 2.3 Hz, 2H), 2.29 (s, 3H), 2.27 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -91.0 (dt, *J* = 41.6, 3.0 Hz), -91.4 (d, *J* = 41.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.3 (dd, *J* = 290.0, 285.0 Hz), 137.0, 135.8, 135.5 (t, *J* = 2.7 Hz), 130.6 (t, *J* = 3.8 Hz), 129.2, 129.1, 128.2, 128.1 (t, *J* = 3.0 Hz), 91.6 (dd, *J* = 21.2, 13.5 Hz), 33.5, 21.1, 21.0. HRMS (EI^{+}) calcd. for $C_{17}H_{16}F_2$ [M]$^{+}$: 258.1215, found: 258.12171.

1-(3,3-Difluoro-2-phenylallyl)-4-methylbenzene (2d)



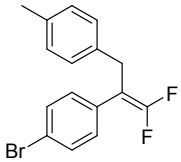
Colorless oil, 16.8 mg, 69%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.30 – 7.19 (m, 5H), 7.04 (brs, 4H), 3.69 (t, *J* = 2.2 Hz, 2H), 2.28 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.5 (dt, *J* = 40.5, 2.4 Hz), -91.1 (d, *J* = 40.5 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.4 (dd, *J* = 290.0, 285.5 Hz), 135.9, 135.4 (t, *J* = 2.5 Hz), 133.7 (t, *J* = 3.8 Hz), 129.2, 128.4, 128.3 (t, *J* = 3.5 Hz), 128.2, 127.3, 91.8 (dd, *J* = 21.4, 13.2 Hz), 33.5, 21.0. (known)

2-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)naphthalene (2e)



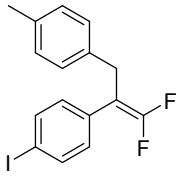
Colorless oil, 23.2 mg, 79%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.78 – 7.72 (m, 4H), 7.45 – 7.38 (m, 3H), 7.08 – 7.01 (m, 4H), 3.79 (t, *J* = 2.2 Hz, 2H), 2.26 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.0 (dt, *J* = 39.5, 3.0 Hz), -90.8 (d, *J* = 39.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.6 (dd, *J* = 292.2, 287.8 Hz), 136.0, 135.4 (t, *J* = 2.5 Hz), 133.2, 132.4, 131.1 (t, *J* = 4.0 Hz), 129.2, 128.2, 128.0, 128.0, 127.6, 127.5 (t, *J* = 3.6 Hz), 126.2, 126.16 – 126.07 (m, 2C), 92.1 (dd, *J* = 21.5, 13.1 Hz), 33.6, 21.0. HRMS (EI^{+}) calcd. for $C_{20}H_{16}F_2$ [M]$^{+}$: 294.1221, found: 294.1215.

1-Bromo-4-(1,1-difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzene (2f)



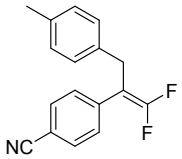
Colorless oil, 24.6 mg, 76%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.41 – 7.37 (m, 2H), 7.14 – 7.10 (m, 2H), 7.06-7.00 (m, 4H), 3.66 (t, *J* = 2.2 Hz, 2H), 2.28 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.7 (dt, *J* = 38.8, 2.7 Hz), -90.1 (d, *J* = 38.7 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.3 (dd, *J* = 292.2, 288.2 Hz), 136.1, 134.9 (t, *J* = 2.6 Hz), 132.5 (t, *J* = 3.9 Hz), 131.5, 129.9 (t, *J* = 3.6 Hz), 129.3, 128.1, 121.3, 91.2 (dd, *J* = 22.0, 13.3 Hz), 33.3, 21.0. HRMS (EI^{+}) calcd. for $C_{16}H_{13}F_2Br$ [M]$^{+}$: 322.0163, found: 322.0160.

1-(3,3-Difluoro-2-(4-iodophenyl)allyl)-4-methylbenzene (2g)



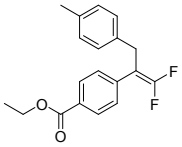
Colorless oil, 30.1 mg, 81%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.61 – 7.57 (m, 2H), 7.06 – 6.98 (m, 6H), 3.65 (t, *J* = 2.2 Hz, 2H), 2.28 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.5 (dt, *J* = 38.3, 2.8 Hz), -89.9 (d, *J* = 38.3 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.3 (dd, *J* = 292.5, 288.3 Hz), 137.5, 136.1, 134.9 (t, *J* = 2.6 Hz), 133.2 (t, *J* = 3.9 Hz), 130.1 (t, *J* = 3.6 Hz), 129.3, 128.1, 92.8, 91.3 (dd, *J* = 22.0, 13.0 Hz), 33.2, 21.0. HRMS (EI^{+}) calcd. for $C_{16}H_{13}F_2I$ [M]$^{+}$: 370.0025, found: 370.0022.

4-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzonitrile (2h)



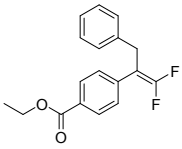
Colorless oil, 23.0 mg, 86%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.57 – 7.54 (m, 2H), 7.39 – 7.36 (m, 2H), 7.06 (d, *J* = 7.9 Hz, 2H), 7.01 (d, *J* = 8.1 Hz, 2H), 3.71 (t, *J* = 2.1 Hz, 2H), 2.29 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -87.1 (dt, *J* = 33.1, 2.7 Hz), -87.7 (d, *J* = 33.2 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.8 (dd, *J* = 294.9, 290.0 Hz), 138.6 (t, *J* = 4.3 Hz), 136.4, 134.4 (t, *J* = 2.7 Hz), 132.1, 129.4, 128.9 (dd, *J* = 4.3, 3.4 Hz), 128.0, 118.6, 110.9, 91.3 (dd, *J* = 22.8, 12.2 Hz), 32.9, 21.0. HRMS (EI^{+}) calcd. for $C_{17}H_{13}F_2N$ [M]$^{+}$: 269.1011, found: 269.1015.

Ethyl 4-(1,1-difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzoate (2i)



Colorless oil, 27.5 mg, 87%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.95 (d, *J* = 8.0 Hz, 2H), 7.34 (d, *J* = 8.1 Hz, 2H), 7.03 (d, *J* = 1.9 Hz, 4H), 4.34 (q, *J* = 7.1 Hz, 2H), 3.71 (d, *J* = 2.5 Hz, 2H), 2.28 (s, 3H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -88.5 (d, *J* = 35.8 Hz), -88.9 (d, *J* = 35.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 166.2, 154.6 (dd, *J* = 292.0, 287.0 Hz), 138.3 (t, *J* = 4.1 Hz), 136.1, 134.9 (t, *J* = 2.6 Hz), 129.6, 129.3, 129.2, 128.2 (t, *J* = 3.7 Hz), 128.1, 91.7 (dd, *J* = 22.0, 12.6 Hz), 61.0, 33.2, 21.0, 14.3. HRMS (EI^{+}) calcd. for $C_{19}H_{18}F_2O_2$ [M]$^{+}$: 316.1269, found: 316.1267.

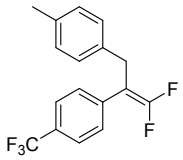
Ethyl 4-(1,1-difluoro-3-phenylprop-1-en-2-yl)benzoate (2j)



Colorless oil, 26.5 mg, 88%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.97 – 7.94 (m, 2H), 7.36 – 7.32 (m, 2H), 7.26 – 7.21 (m, 2H), 7.19 – 7.13 (m, 3H), 4.35 (q, *J* = 7.1 Hz, 2H), 3.76 (t, *J* = 2.3 Hz, 2H),

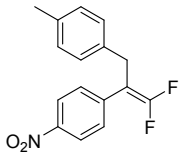
1.36 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -88.3 (dt, *J* = 35.5, 3.0 Hz), -88.8 (d, *J* = 35.4 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 166.2, 154.6 (dd, *J* = 293.9, 288.9 Hz), 138.2 (t, *J* = 4.1 Hz), 138.0 (t, *J* = 2.6 Hz), 129.6, 129.3, 128.6, 128.2, 128.2 (t, *J* = 3.5 Hz), 126.6, 91.5 (dd, *J* = 22.0, 12.9 Hz), 61.0, 33.6, 14.3. HRMS (EI$^+$) calcd. for $C_{18}H_{16}F_2O_2$ [M]$^+$: 302.1113, found: 302.1108.

1-(3,3-Difluoro-2-(4-(trifluoromethyl)phenyl)allyl)-4-methylbenzene (2k)



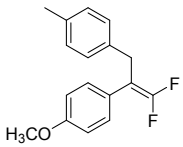
Colorless oil, 26.3 mg, 84%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.53 (d, *J* = 8.2 Hz, 2H), 7.37 (d, *J* = 8.2 Hz, 2H), 7.07 – 7.02 (m, 4H), 3.71 (t, *J* = 2.2 Hz, 2H), 2.29 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -62.7 (s, 3F), -88.5 (dt, *J* = 35.8, 2.8 Hz), -89.2 (d, *J* = 36.2 Hz). ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 154.7 (dd, *J* = 293.5, 288.9 Hz), 137.4, 136.3, 134.7 (t, *J* = 2.7 Hz), 129.4, 129.2, 128. 6 (t, *J* = 3.6 Hz), 128.1, 125.3 (q, *J* = 3.8 Hz), 124.0 (q, *J* = 272.0 Hz), 91.3 (dd, *J* = 22.4, 12.5 Hz), 33.2, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{13}F_5$ [M]$^+$: 312.0932, found: 312.0933.

1-(3,3-Difluoro-2-(4-nitrophenyl)allyl)-4-methylbenzene (2l)



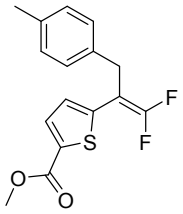
Pale yellow oil, 22.0 mg, 76%, m.p. 120-122℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 8.15 – 8.11 (m, 2H), 7.45 – 7.43 (m, 2H), 7.07-7.01 (m, 4H), 3.74 (t, *J* = 2.2 Hz, 2H), 2.29 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -86.6 (dt, *J* = 31.8, 2.8 Hz), -87.2 (d, *J* = 31.5 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.8 (dd, *J* = 293.0, 288.0 Hz), 146.7, 140.6 (t, *J* = 4.5 Hz), 136.5, 134.5 (t, *J* = 2.6 Hz), 129.5, 129.0 (dd, *J* = 5.0, 4.0 Hz), 128.0, 123.6, 91.2 (dd, *J* = 23.0, 12.0 Hz), 33.0, 21.0. HRMS (EI$^+$) calcd. for $C_{16}H_{13}ONF_2$ [M]$^+$: 289.0909, found: 289.0905.

1-(3,3-Difluoro-2-(4-methoxyphenyl)allyl)-4-methylbenzene (2m)



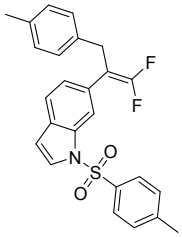
Colorless oil, 26.0 mg, 95%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.19 – 7.17 (m, 2H), 7.04 (brs, 4H), 6.82-6.80 (m, 2H), 3.76 (s, 3H), 3.65 (t, *J* = 2.3 Hz, 2H), 2.28 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -91.7 (dt, *J* = 43.1, 2.9 Hz), -92.1 (d, *J* = 43.3 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 158.6, 154.2 (dd, *J* = 290.5, 286.7 Hz), 135.9, 135.5 (t, *J* = 2.6 Hz), 129.41 (t, *J* = 3.6 Hz), 129.2, 128.2, 125. 8 (t, *J* = 3.6 Hz), 113.8, 91.3 (dd, *J* = 21.3, 13.6 Hz), 55.2, 33.6, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{16}F_2O$ [M]$^+$: 374.1164, found: 274.1171.

Methyl 5-(1,1-difluoro-3-(*p*-tolyl)prop-1-en-2-yl)thiophene-2-carboxylate (2n)



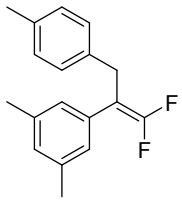
White solid, 22.3 mg, 72%, m.p. 29-31℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.61 (dd, *J* = 4.0, 1.1 Hz, 1H), 7.13 – 7.08 (m, 4H), 6.97 (d, *J* = 4.0 Hz, 1H), 3.85 (s, 3H), 3.73 (t, *J* = 2.2 Hz, 2H), 2.30 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -81.0 (d, *J* = 24.0 Hz), -87.4 (dt, *J* = 23.9, 2.5 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 162.5, 155.0 (dd, *J* = 297.0, 289.4 Hz), 142.8 (dd, *J* = 7.7, 3.8 Hz), 136.5, 134.2 (t, *J* = 2.6 Hz), 133.5, 132.1 – 131.9 (m), 129.4, 128.0, 126.3 (t, *J* = 5.5 Hz), 88.3 (dd, *J* = 26.2, 12.4 Hz), 52.2 32.9, 21.0. HRMS (EI^{+}) calcd. for $C_{16}H_{14}F_2O_2S$ [M]$^{+}$: 308.0677, found: 308.0684.

6-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)-1-tosyl-1*H*-indole (2o)



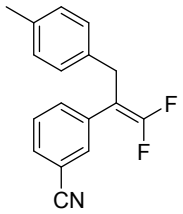
White solid, 39.8 mg, 91%, m.p. 109-111℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.93 (dd, *J* = 1.6, 0.9 Hz, 1H), 7.59 – 7.56 (m, 2H), 7.51 (d, *J* = 3.6 Hz, 1H), 7.40 (d, *J* = 8.4 Hz, 1H), 7.17 (dt, *J* = 8.3, 1.6 Hz, 1H), 7.13 – 7.05 (m, 6H), 6.56 (dd, *J* = 3.7, 0.8 Hz, 1H), 3.77 (t, *J* = 2.2 Hz, 2H), 2.31 (d, *J* = 4.7 Hz, 6H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.2 (dt, *J* = 40.5, 2.7 Hz), -90.8 (d, *J* = 40.2 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.5 (dd, *J* = 290.0, 285.5 Hz), 144.9, 135.9, 135.4 (t, *J* = 2.6 Hz), 135.0, 134.8, 130.0 (t, *J* = 4.0 Hz), 129.8, 129.3, 128.2, 126.9, 126.8, 123.6 (dd, *J* = 4.7, 2.8 Hz), 121.1, 113.4 (t, *J* = 3.7 Hz), 108.8, 92.1 (dd, *J* = 21.7, 12.8 Hz), 33.8, 21.6, 21.1. HRMS (EI^{+}) calcd. for $C_{25}H_{21}O_2NF_2S$ [M]$^{+}$: 437.1256, found: 437.1263.

1-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)-3,5-dimethylbenzene (2p)



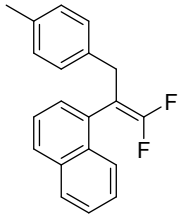
Colorless oil, 21.2 mg, 78%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.04 (brs, 4H), 6.88 – 6.85 (m, 3H), 3.66 (t, *J* = 2.3 Hz, 2H), 2.28 (s, 3H), 2.25 (s, 6H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.8 (dt, *J* = 41.0, 2.7 Hz), -91.2 (d, *J* = 41.1 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.3 (dd, *J* = 289.4, 285.2 Hz), 137.8, 135.8, 135.6 (t, *J* = 2.8 Hz), 133.5 (t, *J* = 3.5 Hz), 129.1, 129.0, 128.2, 126.1 (t, *J* = 3.3 Hz), 91.9 (dd, *J* = 20.8, 13.4 Hz), 33.5, 21.4, 21.0. HRMS (EI^{+}) calcd. for $C_{18}H_{18}F_2$ [M]$^{+}$: 272.1371, found: 272.1378.

3-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzonitrile (2q)



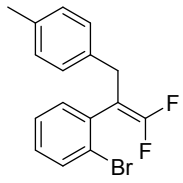
Colorless oil, 25.6 mg, 95%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.54 (q, *J* = 1.4 Hz, 1H), 7.49 (tt, *J* = 7.0, 1.5 Hz, 2H), 7.38 (t, *J* = 7.8 Hz, 1H), 7.06 (d, *J* = 7.9 Hz, 2H), 7.01 (d, *J* = 8.0 Hz, 2H), 3.69 (t, *J* = 2.2 Hz, 2H), 2.29 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -88.4 (dt, *J* = 35.8, 2.7 Hz), -89.1 (d, *J* = 35.9 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.7 (dd, *J* = 293.4, 289.3 Hz), 136.4, 135.0 (t, *J* = 4.1 Hz), 134.3 (t, *J* = 2.7 Hz), 132.7 (t, *J* = 3.5 Hz), 131.8 (t, *J* = 3.7 Hz), 130.8, 129.4, 129.3, 128.1, 118.6, 112.7, 90.8 (dd, *J* = 22.9, 12.7 Hz), 33.1, 21.0. HRMS (EI$^+$) calcd. for $C_{17}H_{13}F_2N$ [M]$^+$: 269.1011, found: 269.1017.

1-(1,1-Difluoro-3-(*p*-tolyl)prop-1-en-2-yl)naphthalene (2r)



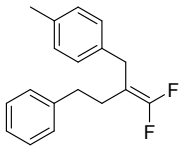
Colorless oil, 6.5 mg, 22%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.86 – 7.81 (m, 2H), 7.78 (dt, *J* = 8.3, 1.0 Hz, 1H), 7.50-7.46 (m, 2H), 7.34 (dd, *J* = 8.3, 7.1 Hz, 1H), 7.04 (dd, *J* = 7.1, 1.2 Hz, 1H), 6.99 (d, *J* = 7.8 Hz, 2H), 6.92 (d, *J* = 8.0 Hz, 2H), 3.67 (brs, 2H), 2.27 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.3 (d, *J* = 42.1 Hz), -92.9 (dt, *J* = 41.7, 2.7 Hz). ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 153.6 (dd, *J* = 288.0, 286.5 Hz), 136.0, 135.2 (t, *J* = 2.8 Hz), 133.7, 131.5 (d, *J* = 3.0 Hz), 130.9 (d, *J* = 4.4 Hz), 129.0, 128.7, 128.5, 128.3, 127.8 (d, *J* = 3.4 Hz), 126.3, 125.8, 125.2, 124.9, 90.6 (dd, *J* = 22.0, 17.7 Hz), 35.3, 21.0. HRMS (EI$^+$) calcd. for $C_{20}H_{16}F_2$ [M]$^+$: 294.1215, found: 294.1218.

1-Bromo-2-(1,1-difluoro-3-(*p*-tolyl)prop-1-en-2-yl)benzene (2s)



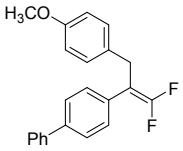
Colorless oil, 9.7 mg, 30%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.58 – 7.56 (m, 1H), 7.16 – 7.09 (m, 2H), 7.02 (d, *J* = 7.8 Hz, 2H), 6.95 (d, *J* = 8.0 Hz, 2H), 6.85 – 6.83 (m, 1H), 3.61 (s, 2H), 2.29 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -88.6 (d, *J* = 39.5 Hz), -93.9 (dt, *J* = 40.3, 2.7 Hz). ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 153.5 (t, *J* = 286.5 Hz), 136.0, 134.7 (t, *J* = 2.6 Hz), 134.1 (dd, *J* = 6.0, 1.5 Hz), 132.8, 132.4 – 131.8 (m), 129.4, 129.0, 128.8, 127.1, 124.3 (dd, *J* = 3.3, 1.3 Hz), 92.5 (dd, *J* = 24.2, 16.7 Hz), 34.1, 21.1. HRMS (EI$^+$) calcd. for $C_{16}H_{13}F_2Br$ [M]$^+$: 322.0163, found: 322.0162.

1-(2-(Difluoromethylene)-4-phenylbutyl)-4-methylbenzene (2t)



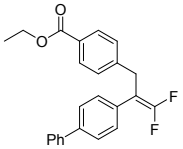
Colorless oil, 11.7 mg, 43%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.28 – 7.23 (m, 3H), 7.20 – 7.16 (m, 1H), 7.12 – 7.05 (m, 6H), 3.26 (t, *J* = 2.0 Hz, 2H), 2.64 – 2.60 (m, 2H), 2.32 (s, 3H), 2.20 – 2.16 (m, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -95.5 (dt, *J* = 53.2, 2.0 Hz), -95.8 (dt, *J* = 53.5, 2.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 153.9 (t, *J* = 282.0 Hz), 141.2, 136.1, 135.4 (t, *J* = 2.6 Hz), 129.2, 128.6, 128.4, 128.3, 126.0, 88. 6 (t, *J* = 17.1 Hz), 33.8 (t, *J* = 2.7 Hz), 32.0 (dd, *J* = 2.7, 1.1 Hz), 27.7 (d, *J* = 2.1 Hz), 21.1. HRMS (EI$^+$) calcd. for $C_{18}H_{18}F_2$ [M]$^+$: 272.1371, found: 272.1372.

4-(1,1-Difluoro-3-(4-methoxyphenyl)prop-1-en-2-yl)-1,1'-biphenyl (2aa)



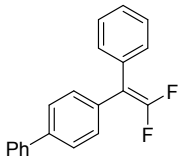
White solid, 30.8 mg, 92%, m.p. 65-67℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.57 – 7.50 (m, 4H), 7.43-7.39 (m, 2H), 7.35 – 7.30 (m, 3H), 7.12 – 7.08 (m, 2H), 6.85 – 6.73 (m, 2H), 3.75 (s, 3H), 3.70 (t, *J* = 2.3 Hz, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.1 (dt, *J* = 39.9, 2.7 Hz), -90.5 (d, *J* = 39.9 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 158.2, 154.5 (dd, *J* = 292.2, 287.7 Hz), 140.5, 140.0, 132.6 (t, *J* = 3.8 Hz), 130.5 (t, *J* = 2.0 Hz), 129.3, 128.8, 128.6 (t, *J* = 3.6 Hz), 127.4, 127.0, 127.0, 114.0, 91.7 (dd, *J* = 21.3, 12.9 Hz), 55.2, 33.0. HRMS (EI$^+$) calcd. for $C_{22}H_{18}F_2O$ [M]$^+$: 336.1320, found: 336.1318.

Ethyl 4-(2-([1,1'-biphenyl]-4-yl)-3,3-difluoroallyl)benzoate (2ab)



Colorless oil, 29.9 mg, 79%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.96 – 7.92 (m, 2H), 7.56 – 7.50 (m, 4H), 7.44 – 7.39 (m, 2H), 7.35-7.31 (m, 3H), 7.27 – 7.24 (m, 2H), 4.34 (q, *J* = 7.1 Hz, 2H), 3.82 (t, *J* = 2.2 Hz, 2H), 1.36 (t, *J* = 7.1 Hz, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.2 (dt, *J* = 38.0, 2.5 Hz), -89.7 (d, *J* = 38.1 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 166.5, 154.6 (dd, *J* = 290.0, 286.3 Hz), 143.7 (t, *J* = 2.7 Hz), 140.4, 140.2, 132.0 (t, *J* = 3.8 Hz), 129.9, 128.9, 128.8, 128.5 (t, *J* = 3.6 Hz), 128.3, 127.5, 127.2, 127.0, 91.0 (dd, *J* = 21.3, 14.0 Hz), 60.9, 33.8, 14.4. HRMS (EI$^+$) calcd. for $C_{24}H_{20}F_2O_2$ [M]$^+$: 378.1426, found: 378.1422.

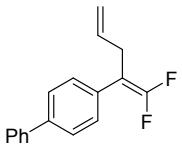
4-(2,2-Difluoro-1-phenylvinyl)-1,1'-biphenyl (2ac)[2]



White solid, 19.0 mg, 65%, m.p. 69-71℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.61 – 7.56 (m, 4H), 7.46 – 7.42 (m, 2H), 7.40 – 7.30 (m, 8H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -87.3 (d, *J* = 31.9 Hz),

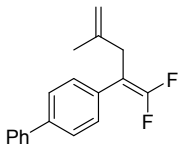
-87.5 (d, *J* = 31.6 Hz). ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 153.8 (t, *J* = 293.6 Hz), 140.5, 140.4, 134.2 (t, *J* = 3.5 Hz), 133.3 (t, *J* = 3.7 Hz), 130.0 (t, *J* = 3.5 Hz), 129.8 (t, *J* = 3.3 Hz), 128.9, 128.5, 127.7, 127.5, 127.1, 127.1, 96.0 (t, *J* = 18.1 Hz).

4-(1,1-Difluoropenta-1,4-dien-2-yl)-1,1'-biphenyl (2ad)



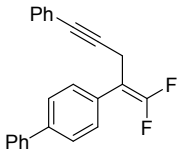
Colorless oil, 16.4 mg, 64%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.53 – 7.49 (m, 4H), 7.39 – 7.33 (m, 4H), 7.29 – 7.25 (m, 1H), 5.81-5.71 (m, 1H), 5.09 – 4.92 (m, 2H), 3.12-3.09 (m, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -89.44 (dt, *J* = 39.5, 2.9 Hz), -90.07 (d, *J* = 39.3 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 153.0 (dd, *J* = 290.9, 286.4 Hz), 139.5, 138.9, 133.5 (t, *J* = 2.7 Hz), 131. 5 (t, *J* = 4.1 Hz), 127.8, 127.3 (t, *J* = 3.7 Hz), 126.3, 126.0, 126.0, 115.4, 89.1 (dd, *J* = 21.6, 15.5 Hz), 30.9. HRMS (FI^{+}) calcd. for $C_{17}H_{14}F_2$ [M]$^{+}$: 256.1058, found: 256.1062.

4-(1,1-Difluoro-4-methylpenta-1,4-dien-2-yl)-1,1'-biphenyl (2ae)



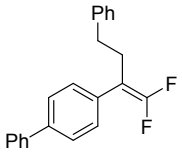
White solid, 18.9 mg, 70%, m.p. 34-36℃; ^{1}H NMR (600 MHz, Chloroform-*d*) δ: 7.60 – 7.55 (m, 4H), 7.45 – 7.41 (m, 4H), 7.35 – 7.33 (m, 1H), 4.79 (d, *J* = 17.7 Hz, 2H), 3.12 (s, 2H), 1.75 (s, 3H). ^{19}F NMR (564 MHz, Chloroform-*d*) δ: -89.2 (d, *J* = 38.9 Hz), -89.9 (d, *J* = 38.7 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.4 (dd, *J* = 292.7, 287.8 Hz), 141.9 (t, *J* = 3.0 Hz), 140.6, 139.9, 132.8 (t, *J* = 4.0 Hz), 128.8, 128.4 (t, *J* = 3.7 Hz), 127.4, 127.0 (2C), 112.2, 90.0 (dd, *J* = 21.6, 12.7 Hz), 36.0, 22.3. HRMS (EI^{+}) calcd. for $C_{18}H_{16}F_2$ [M]$^{+}$: 270.1215, found: 270.1220.

4-(1,1-Difluoro-5-phenylpent-1-en-4-yn-2-yl)-1,1'-biphenyl (2af)



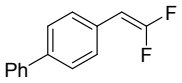
Viscous oil, 12.2 mg, 37%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.64 – 7.56 (m, 6H), 7.46-7.43 (m, 2H), 7.37 – 7.33 (m, 3H), 7.27 – 7.24 (m, 4H), 3.54 (t, *J* = 2.1 Hz, 2H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -88.0 (dt, *J* = 37.5, 3.0 Hz), -88.9 (d, *J* = 37.0 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 154.0 (dd, *J* = 290.8, 287.4 Hz), 140.5, 140.4, 131.8 (t, *J* = 3.8 Hz), 131.6, 128.8, 128.5 (t, *J* = 3.8 Hz), 128.2, 128.0, 127.5, 127.1, 127.1, 123.3, 89.0 (dd, *J* = 20.8, 15.3 Hz), 85.9 (t, *J* = 3.8 Hz), 81.8, 19.0. HRMS (EI^{+}) calcd. for $C_{23}H_{16}F_2$ [M]$^{+}$: 330.1215, found: 330.1213.

4-(1,1-Difluoro-4-phenylbut-1-en-2-yl)-1,1'-biphenyl (2ag)



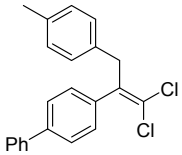
Colorless oil, 16.1 mg, 50%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.63 – 7.59 (m, 4H), 7.48 – 7.43 (m, 2H), 7.42 – 7.34 (m, 3H), 7.31 – 7.26 (m, 3H), 7.22 – 7.14 (m, 3H), 2.77 – 2.69 (m, 4H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -90.4 (dd, *J* = 41.9, 2.0 Hz), -90.9 (d, *J* = 41.6 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 153.8 (dd, *J* = 289.5, 285.5 Hz), 141.0, 140.6, 140.1, 132.4 (t, *J* = 3.8 Hz), 128.8, 128.6 (t, *J* = 3.4 Hz), 128.4, 128.4, 127.4, 127.2, 127.0, 126.1, 91.6 (dd, *J* = 21.8, 13.1 Hz), 34.1 (t, *J* = 2.6 Hz), 29.6 (d, *J* = 1.6 Hz). HRMS (EI^{+}) calcd. for $C_{22}H_{18}F_2$ [M]$^{+}$: 320.1371, found: 320.1374.

4-(2,2-Difluorovinyl)-1,1'-biphenyl (**2ah**)[1]



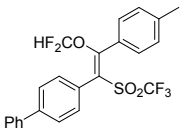
White solid, 6.3 mg, 29%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.61 – 7.57 (m, 4H), 7.46 – 7.40 (m, 4H), 7.37 – 7.33 (m, 1H), 5.32 (dd, *J* = 26.3, 3.8 Hz, 1H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -81.9 (dd, *J* = 30.7, 26.1 Hz), -83.8 (dd, *J* = 30.7, 3.9 Hz). ^{13}C NMR (150 MHz, Chloroform-*d*) δ: 156.4 (dd, *J* = 298.5, 288.6 Hz), 140.5, 139.8, 129.4 (t, *J* = 6.5 Hz), 128.9, 128.1 (dd, *J* = 6.4, 3.5 Hz), 127.5, 127.4, 127.0, 82.0 (dd, *J* = 29.2, 13.5 Hz).

4-(1,1-Dichloro-3-(*p*-tolyl)prop-1-en-2-yl)-1,1'-biphenyl (**3a**),



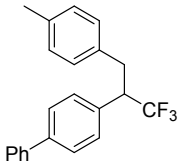
White solid, 11.3 mg, 32%, m.p. 74-76℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.60 – 7.56 (m, 2H), 7.54 – 7.50 (m, 2H), 7.46 – 7.40 (m, 2H), 7.36 – 7.31 (m, 1H), 7.18 – 7.15 (m, 2H), 7.06-7.04 (m, 2H), 7.02-7.00 (m, 2H), 3.93 (s, 2H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 140.5, 140.4, 138.9, 137.7, 136.2, 133.9, 129.2, 128.8, 128.8, 128.6, 127.5, 127.0, 126.9, 118.8, 41.9, 21.1. HRMS (EI^{+}) calcd. for $C_{22}H_{18}Cl_2$ [M]$^{+}$: 352.0780, found: 352.0777.

(***E***)**-4-(2-(Difluoromethoxy)-2-(*p*-tolyl)-1-((trifluoromethyl)sulfonyl)vinyl)-1,1'-biphenyl** (**5a'**)



White solid, 33.2 mg, 70%, m.p. 139-141℃; ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.55 – 7.53 (m, 2H), 7.50 – 7.48 (m, 2H), 7.43-7.40 (m, 2H), 7.36-7.32 (m, 1H), 7.25 (d, *J* = 2.9 Hz, 2H), 7.19 (d, *J* = 8.0 Hz, 2H), 7.08 (d, *J* = 8.1 Hz, 2H), 6.35 (t, *J* = 71.9 Hz, 1H), 2.30 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -75.1, -83.1 (d, *J* = 71.8 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 162. 8 (t, *J* = 3.5 Hz), 142.8, 142.0, 139.8, 132.6, 129.9, 129.6, 128.9, 128.5, 127.9, 127.2, 127.0, 126.9, 123.1, 120.4 (q, *J* = 328.9 Hz), 115.3 (t, *J* = 264.6 Hz), 21.5. HRMS (EI^{+}) calcd. for $C_{23}H_{17}F_5O_3S$ [M]$^{+}$: 468.0813, found: 468.0813.

4-(1,1,1-Trifluoro-3-(*p*-tolyl)propan-2-yl)-1,1'-biphenyl (**6a**)



Viscous oil, 17.2 mg, 51%, ^{1}H NMR (400 MHz, Chloroform-*d*) δ: 7.60 – 7.56 (m, 2H), 7.54 – 7.50 (m, 2H), 7.42 (dd, *J* = 8.4, 6.8 Hz, 2H), 7.36 – 7.31 (m, 1H), 7.29 (d, *J* = 8.0 Hz, 2H), 6.98 (d, *J* = 7.8 Hz, 2H), 6.89 (d, *J* = 8.0 Hz, 2H), 3.61 – 3.47 (m, 1H), 3.36 (dd, *J* = 14.0, 4.0 Hz, 1H), 3.11 (dd, *J* = 13.9, 10.9 Hz, 1H), 2.25 (s, 3H). ^{19}F NMR (376 MHz, Chloroform-*d*) δ: -69.3 (d, *J* = 9.0 Hz). ^{13}C NMR (100 MHz, Chloroform-*d*) δ: 140.8, 140.4, 136.1, 134.5, 133.4, 129.6, 129.1, 128.8, 128.8, 127.5, 127.2, 127.1, 126.8 (q, *J* = 280.5 Hz), 51.9 (q, *J* = 26.1 Hz), 35.1 (d, *J* = 2.6 Hz), 21.0. HRMS (EI^{+}) calcd. for $C_{22}H_{19}F_3$ [M]$^{+}$: 340.1433, found: 340.1430.

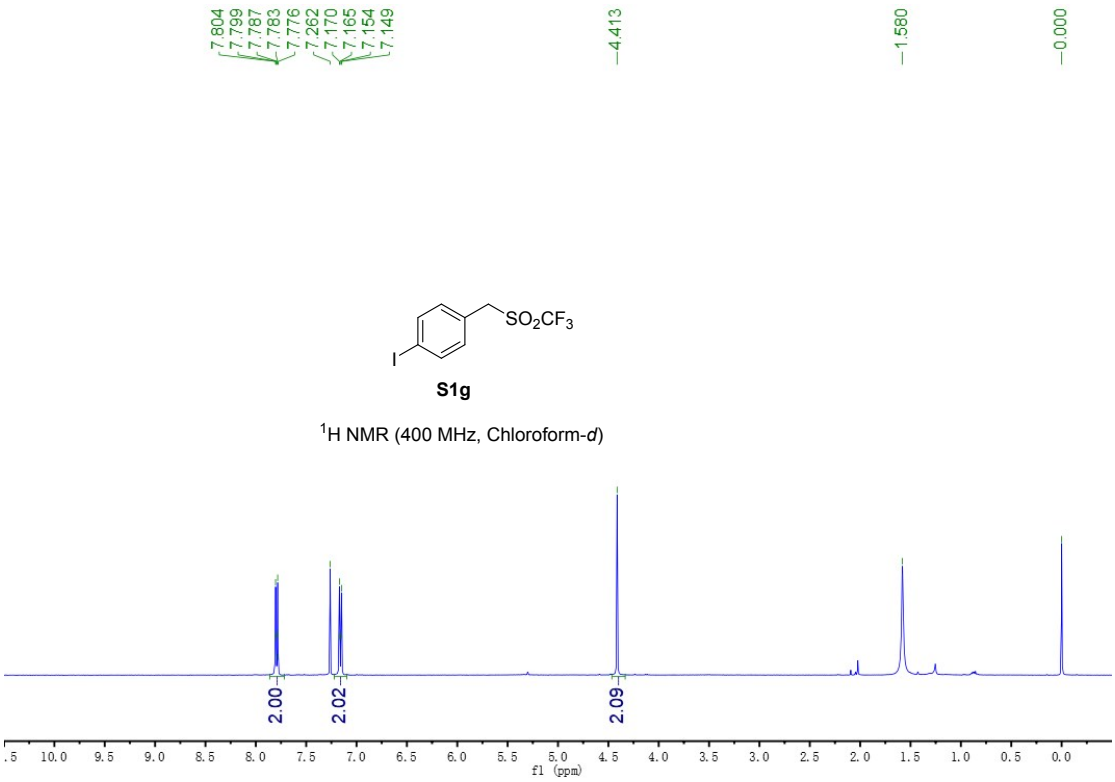
11. References

1. M. Tomoya, I. Yoshiteru, M. Masahiro, *Chem. Lett*. 2008, *37*, 1006-1007.

2. Y. Maekawa, M. Nambo, D. Yokogawa, C. M. Crudden, *J. Am. Chem. Soc.* **2020**, *142*, 15667-15672.

3. M. Nambo, J. C. Yim, L. B. O. Freitas, Y. Tahara, Z. T. Ariki, Y. Maekawa, D. Yokogawa, C. M. Crudden, *Nat. Commun.* **2019**, *10*, 4528-4535.

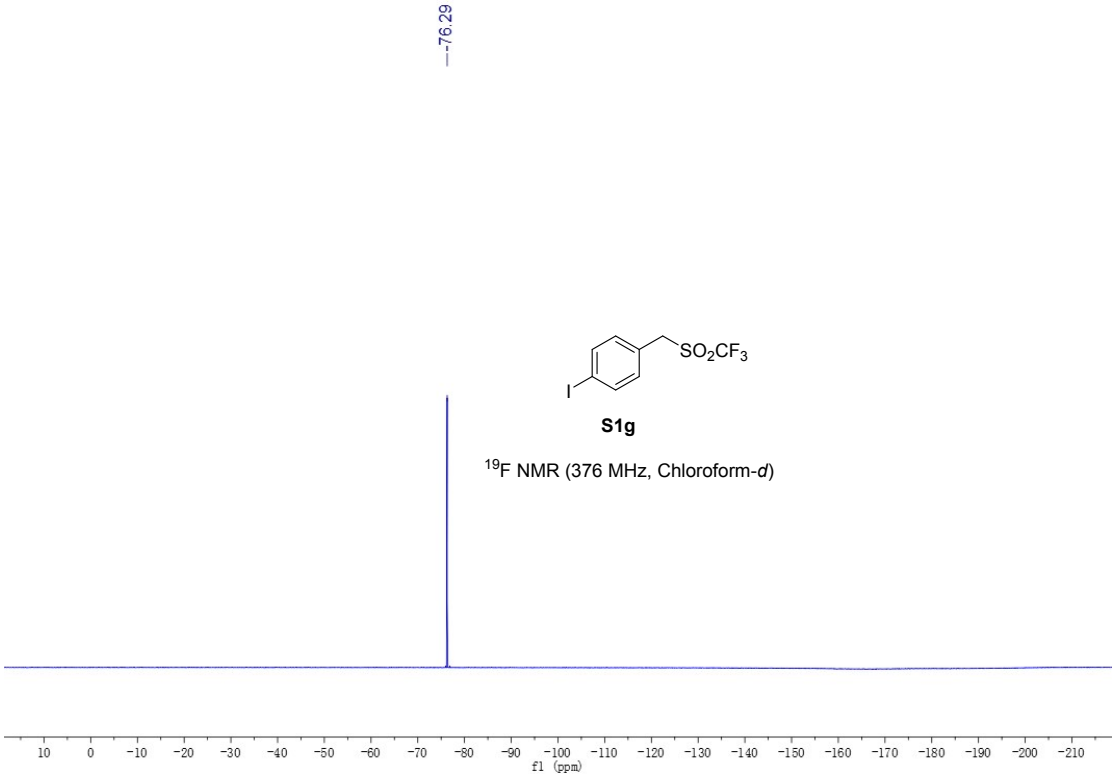
12. Copies of NMR spectra



S1g

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 1



S1g

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

Figure S 2

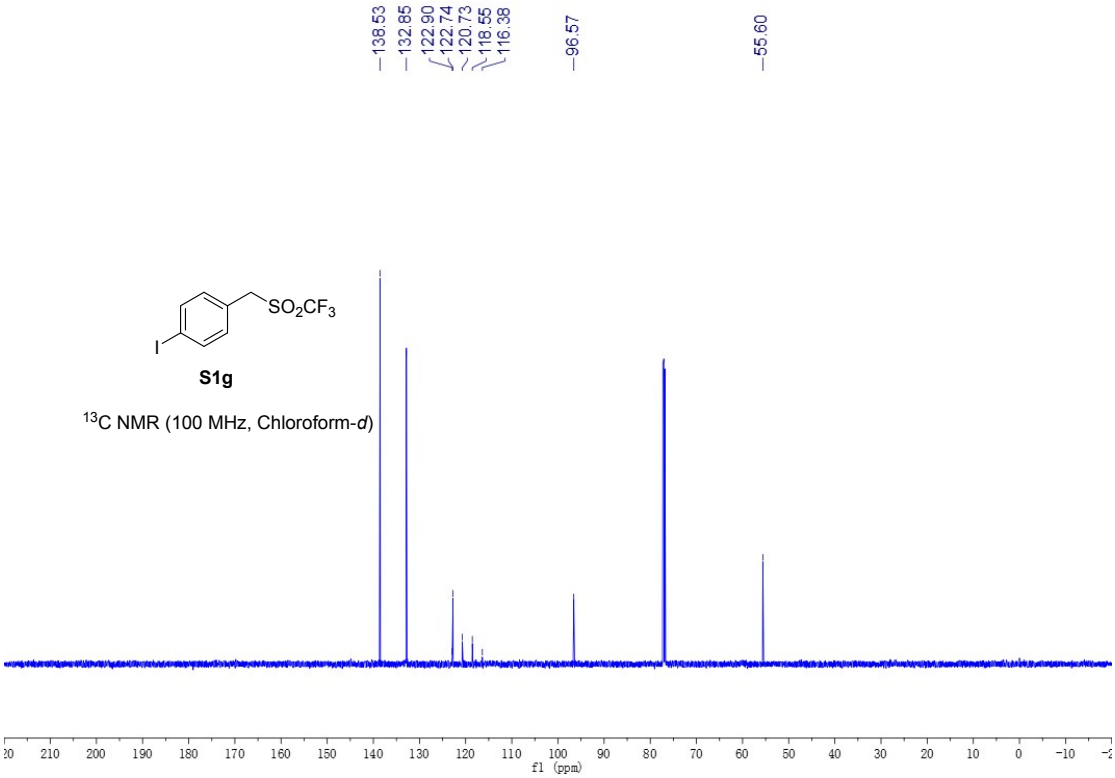


Figure S 3

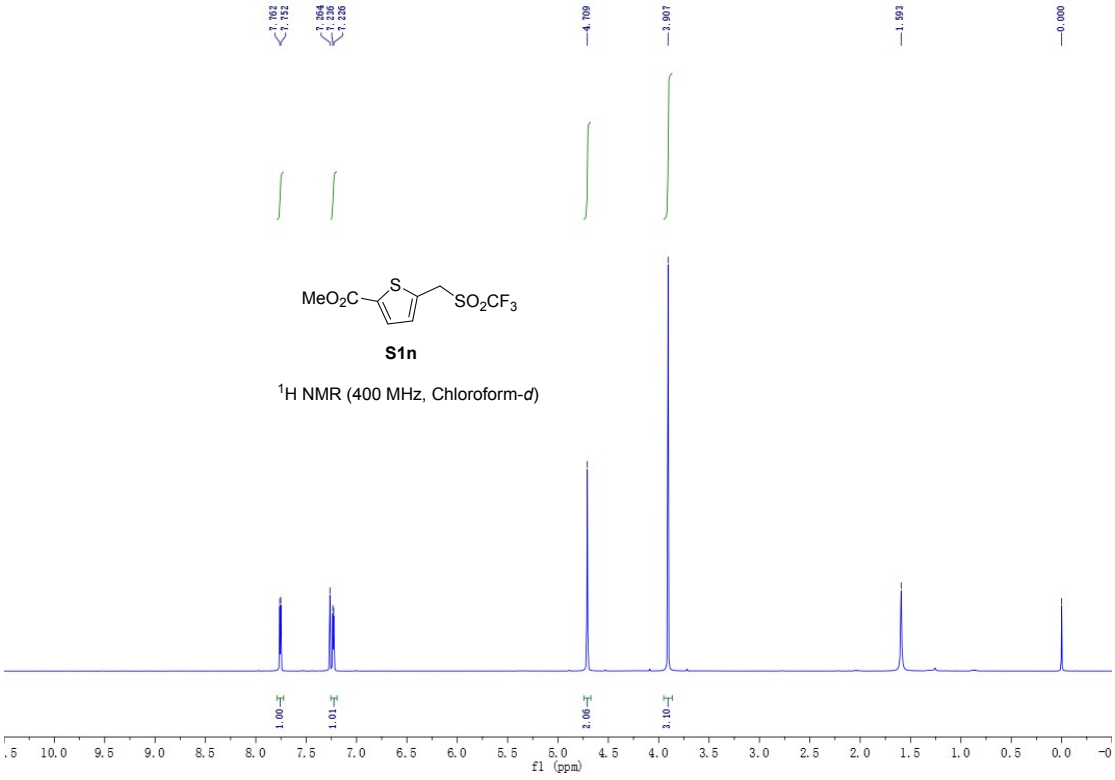
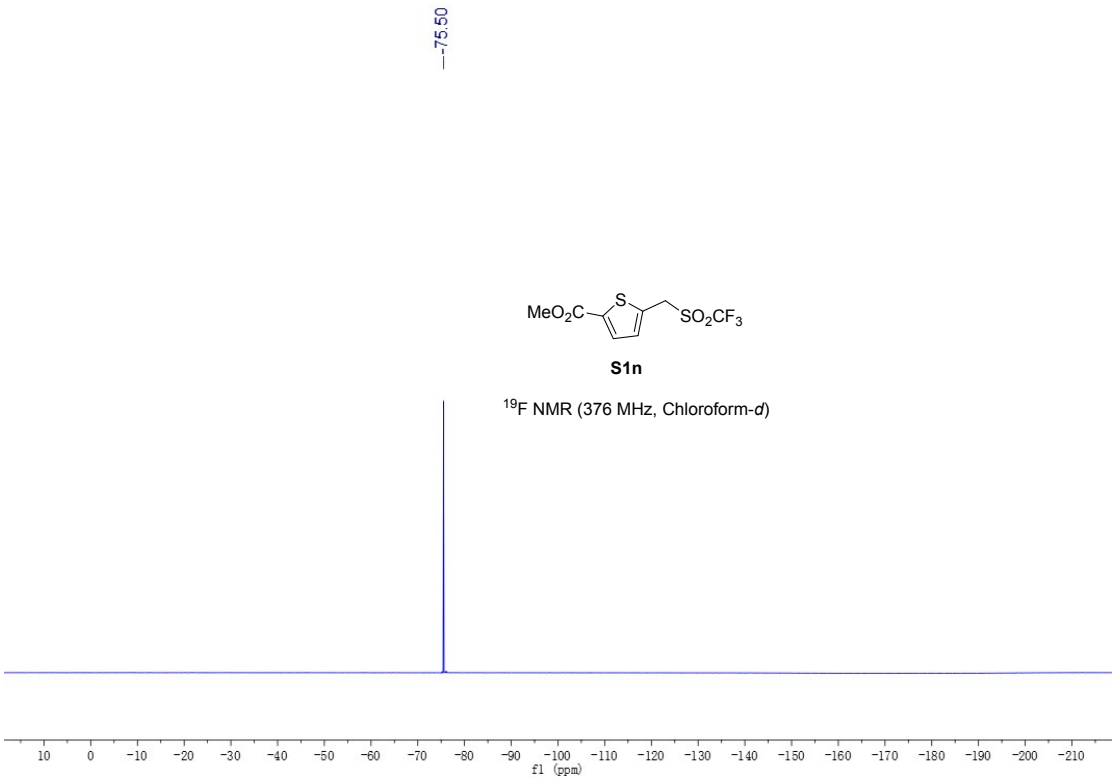


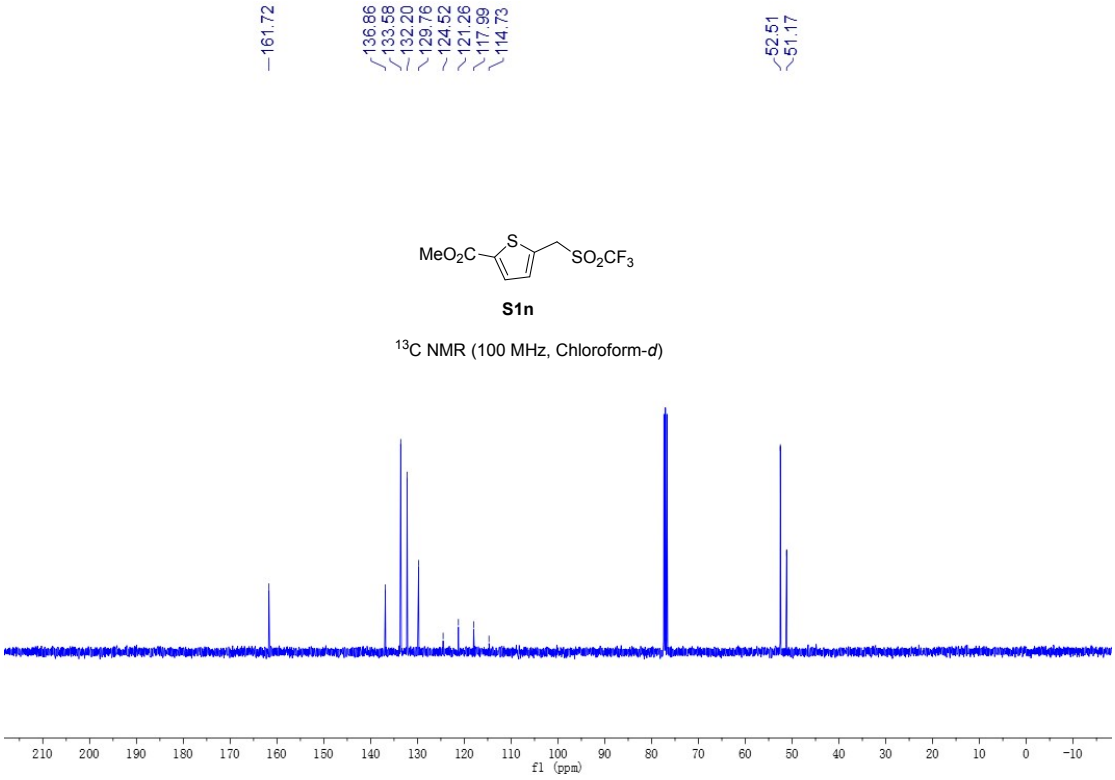
Figure S 4



S1n

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

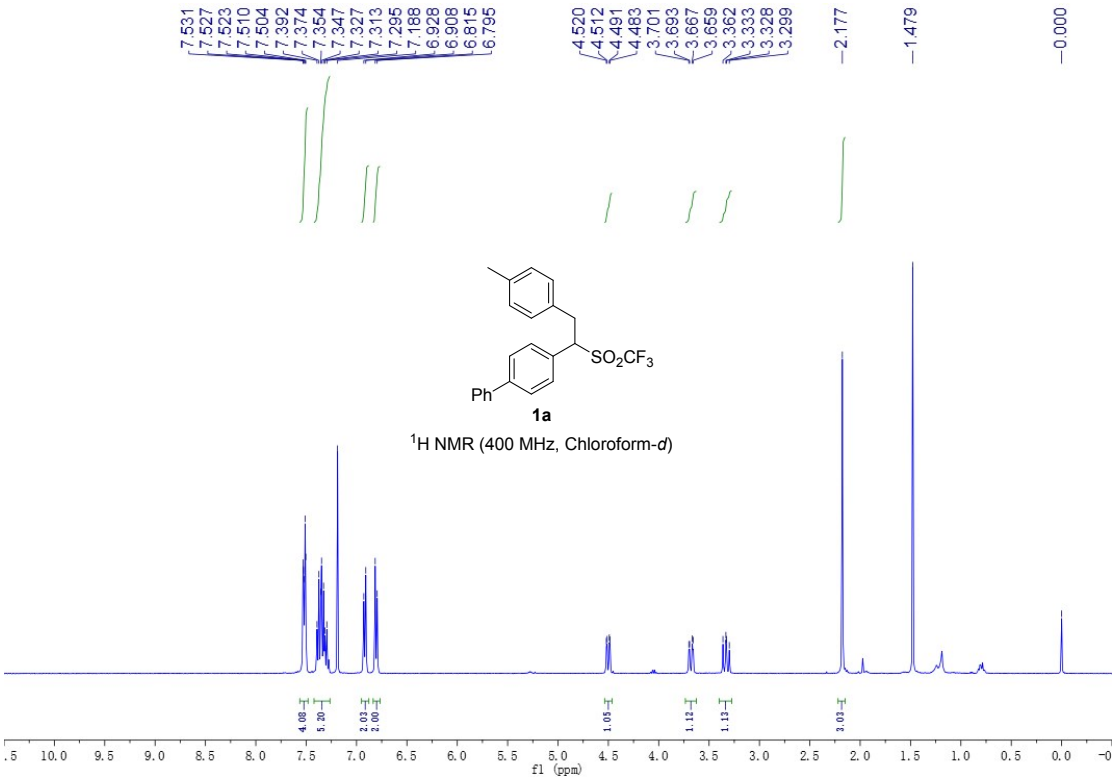
Figure S 5



S1n

^{13}C NMR (100 MHz, Chloroform-*d*)

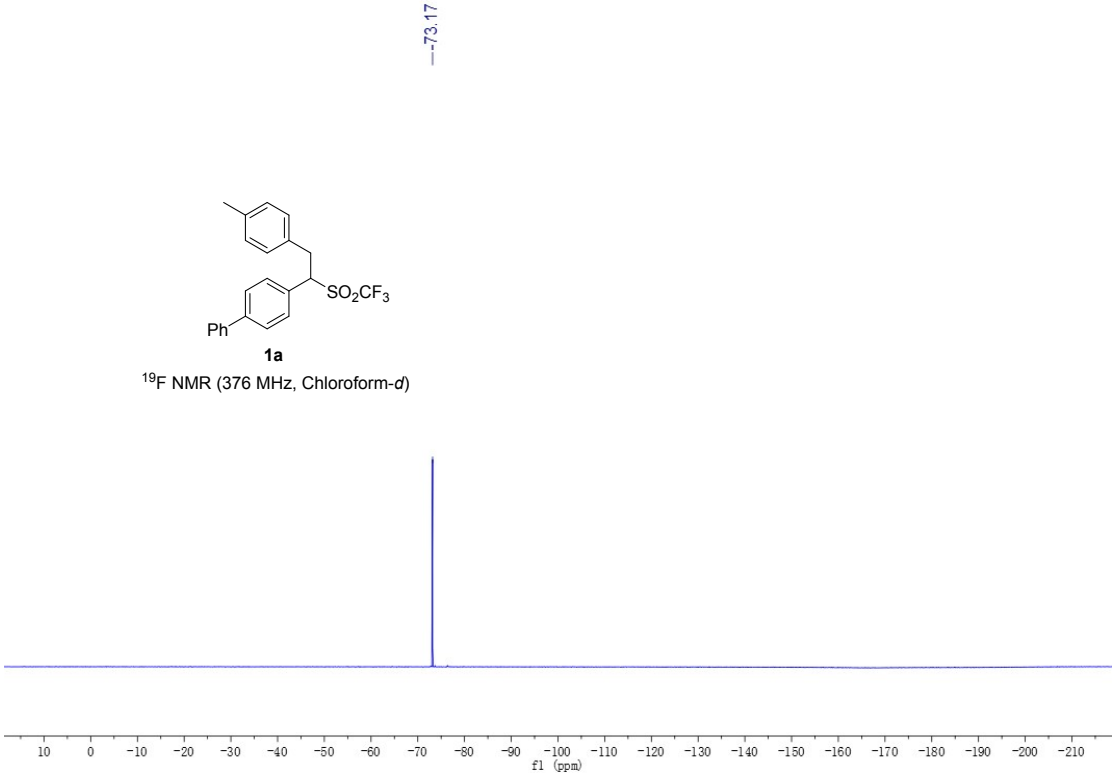
Figure S 6



1a

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 7



1a

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

Figure S 8

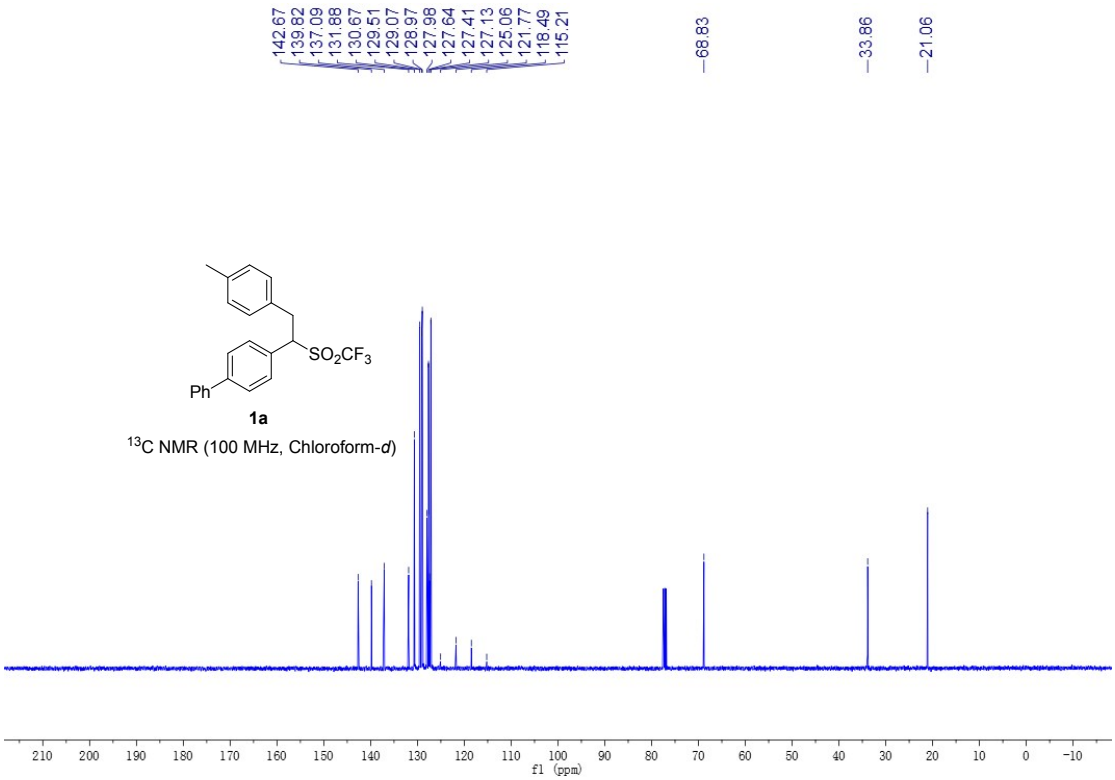


Figure S 9

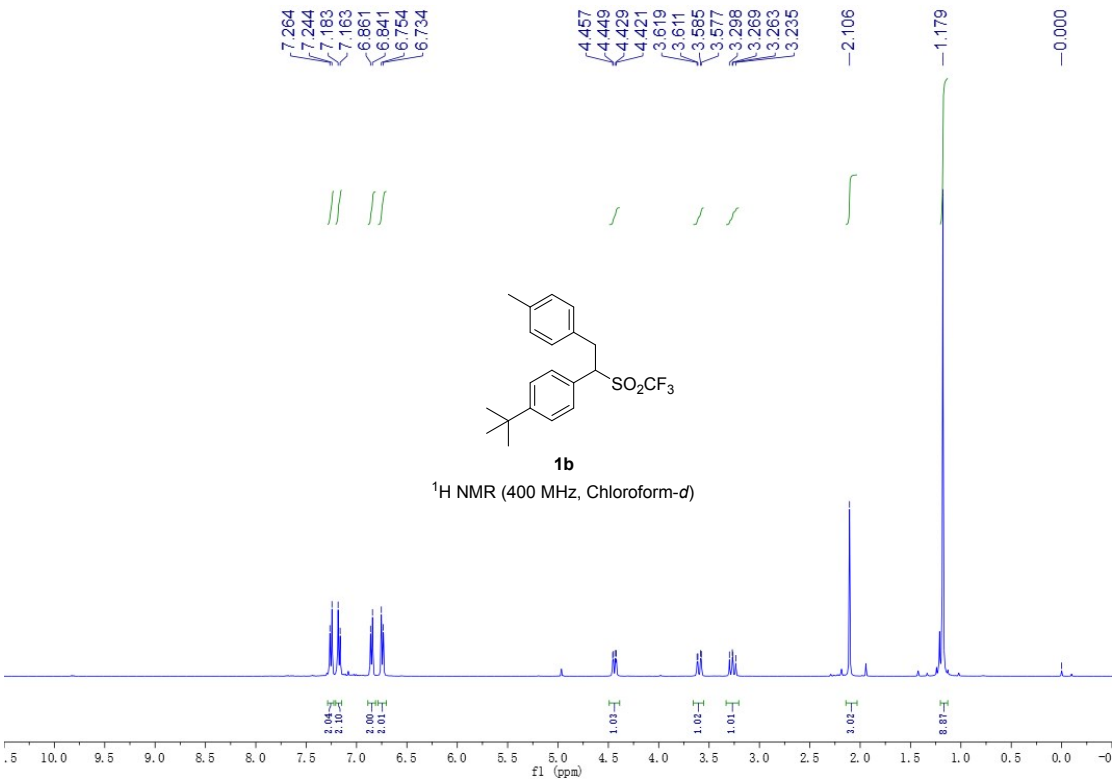


Figure S 10

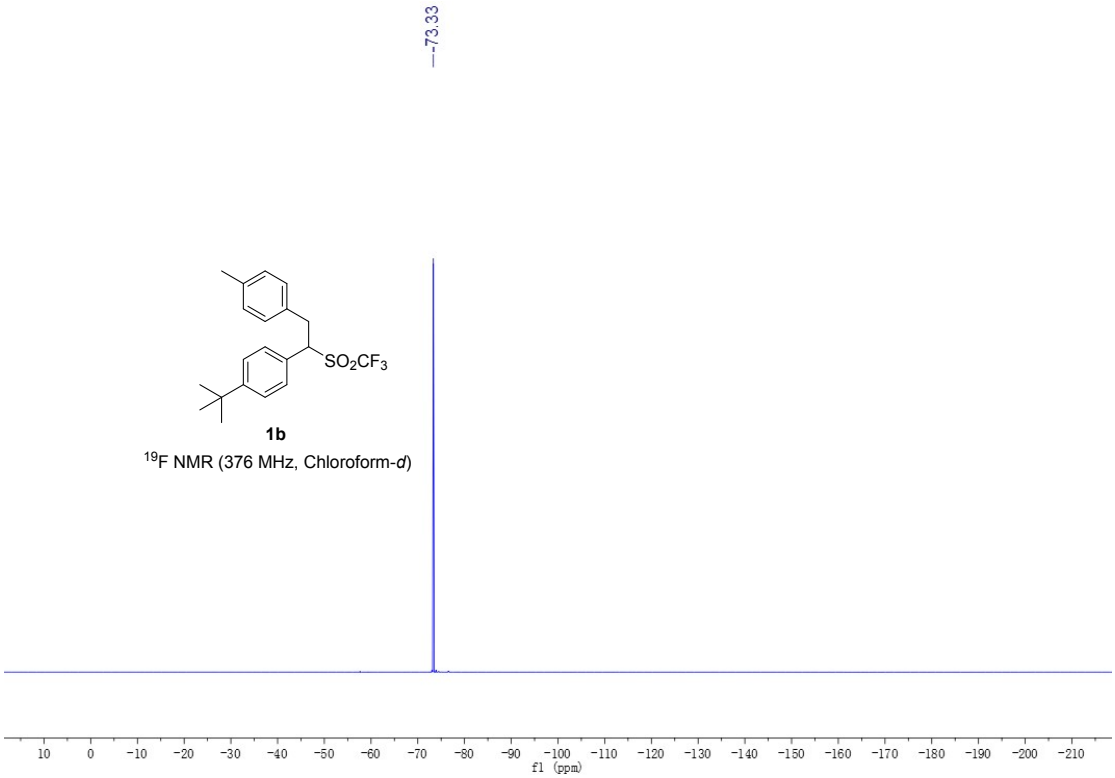


Figure S 11

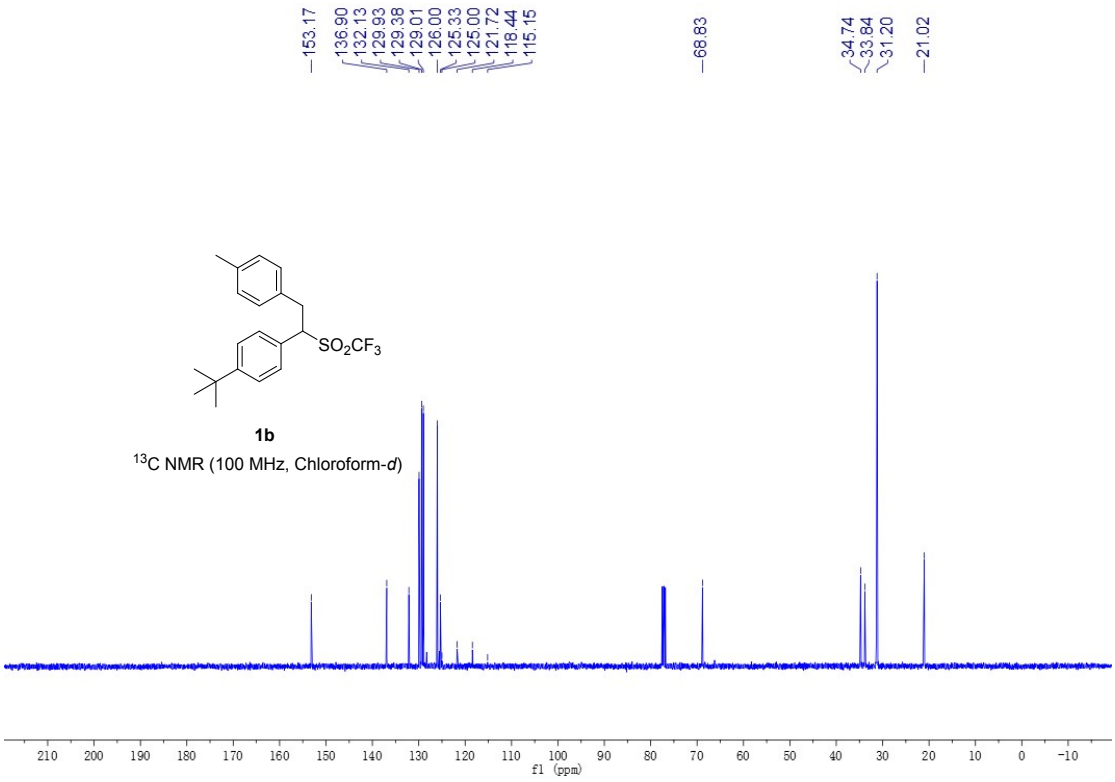


Figure S 12

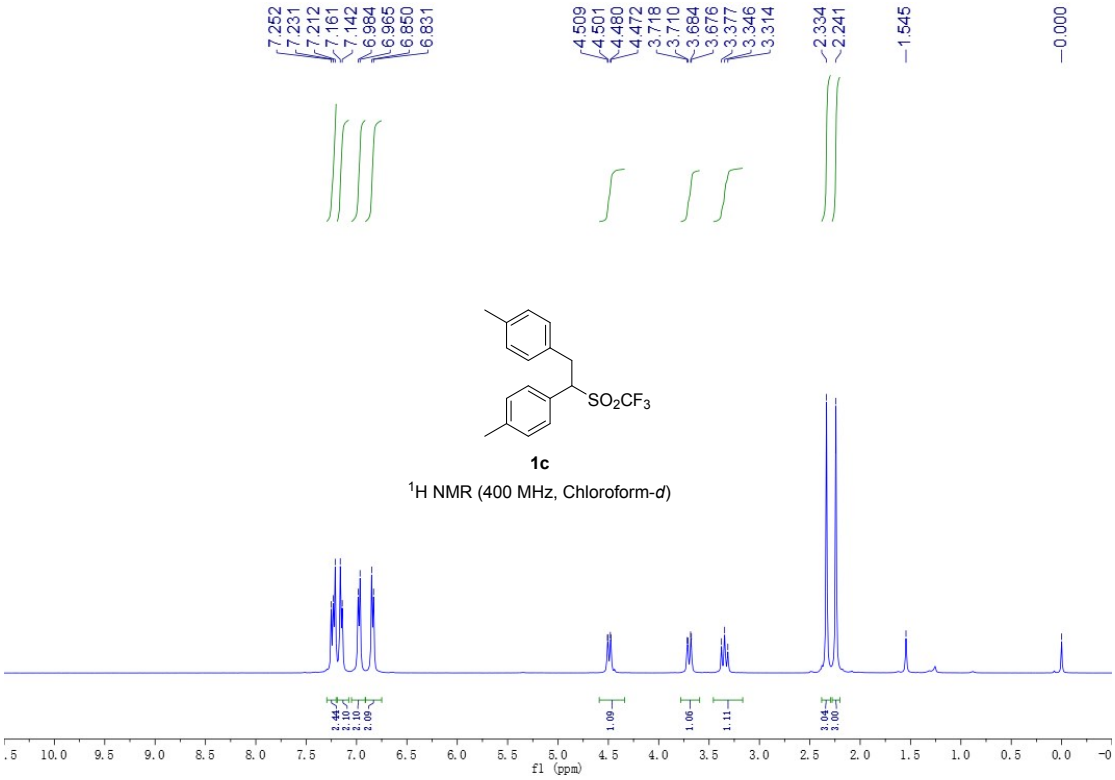


Figure S 13

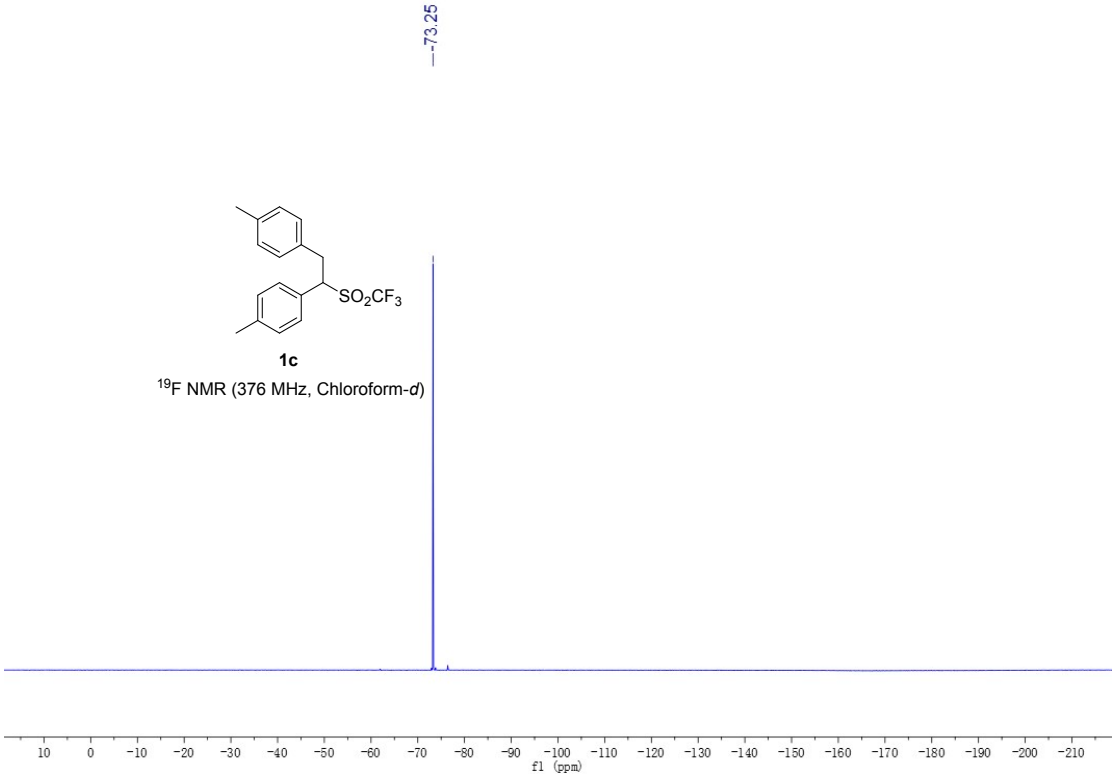
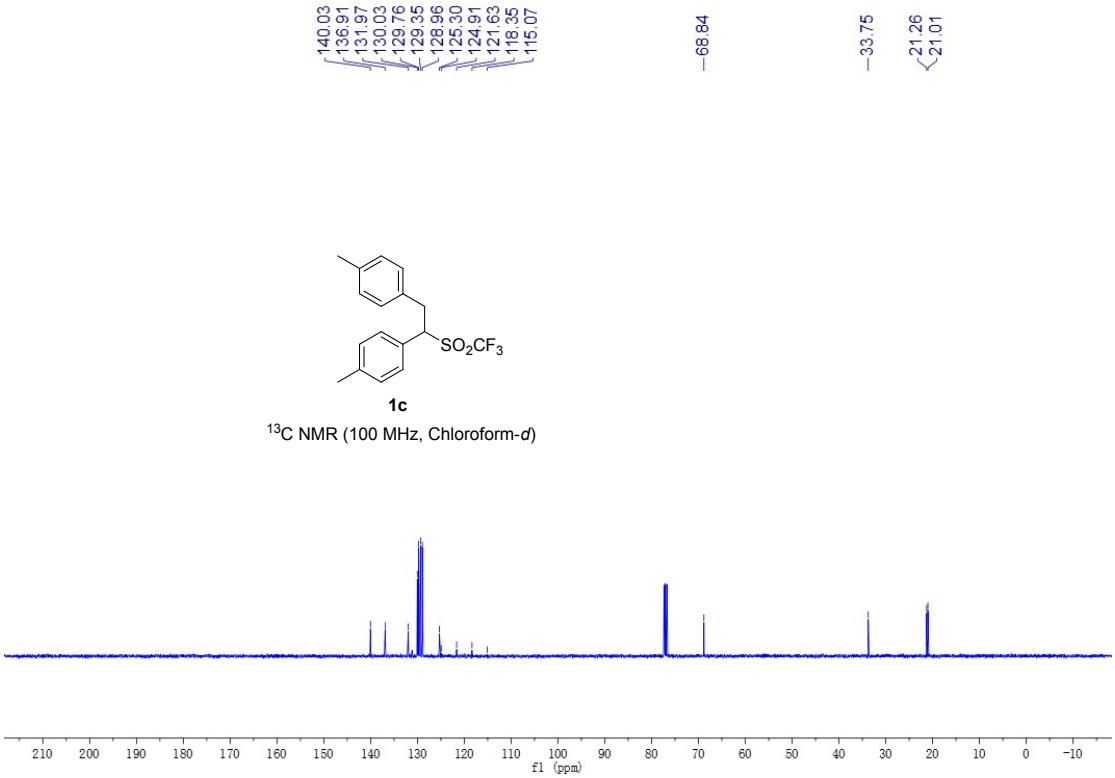


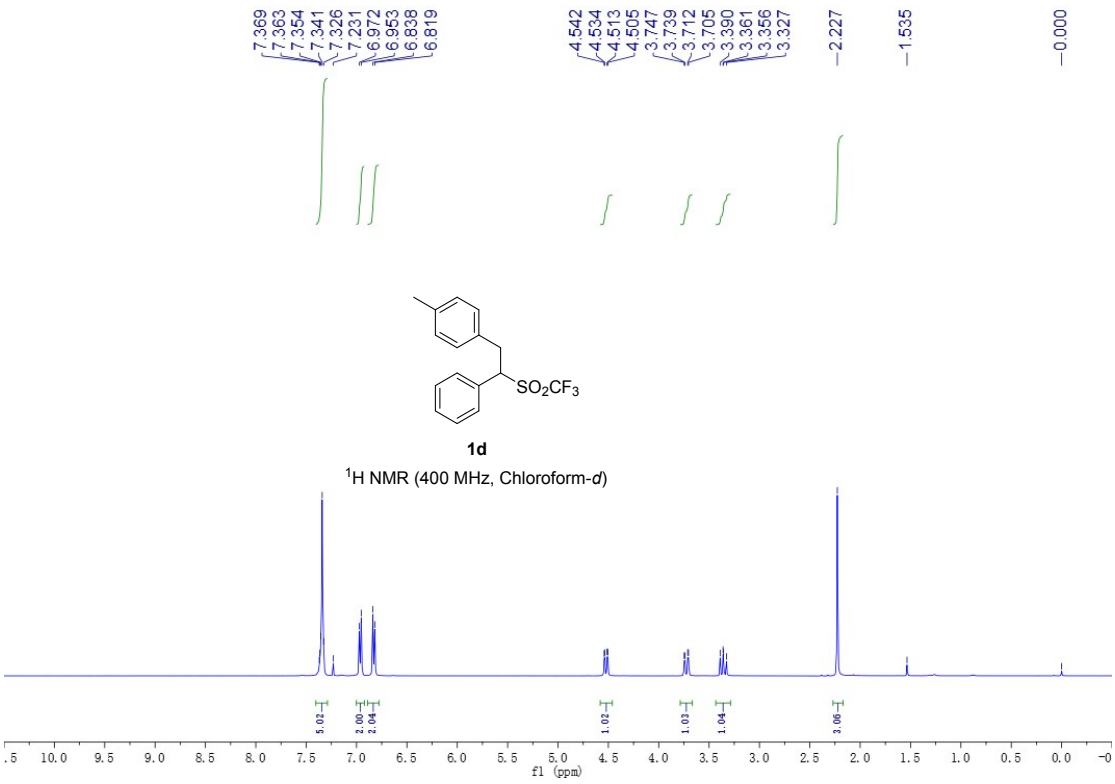
Figure S 14



1c

^{13}C NMR (100 MHz, Chloroform-*d*)

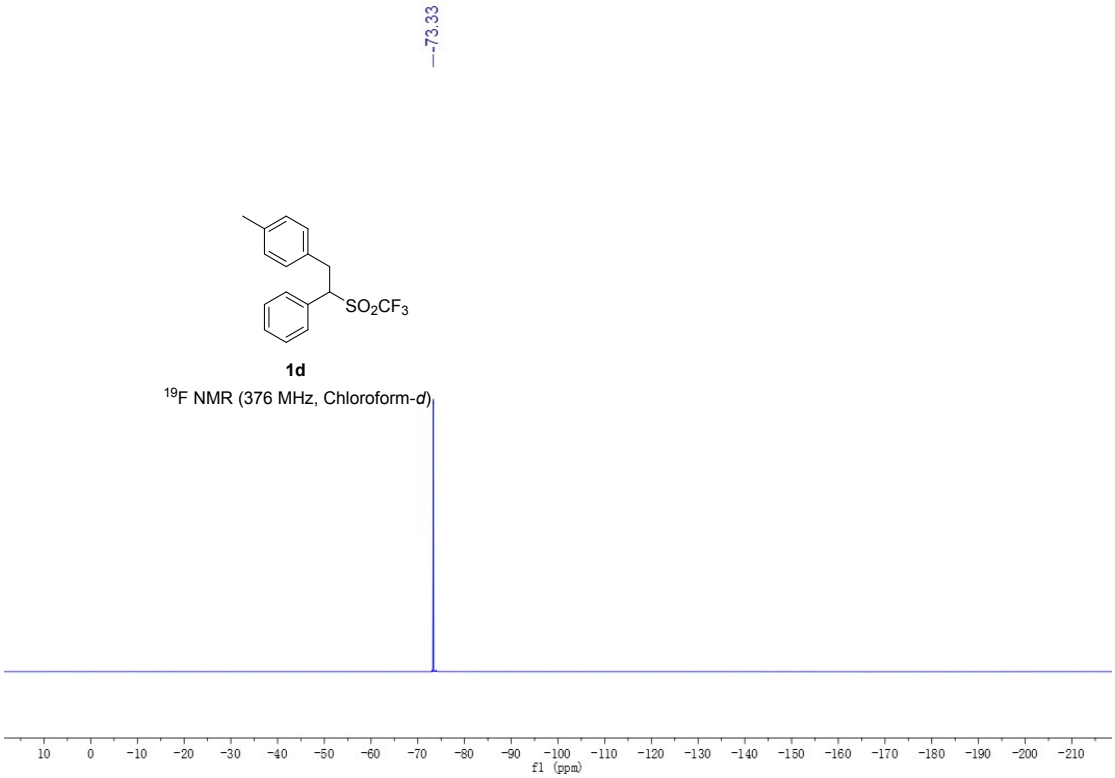
Figure S 15



1d

^{1}H NMR (400 MHz, Chloroform-*d*)

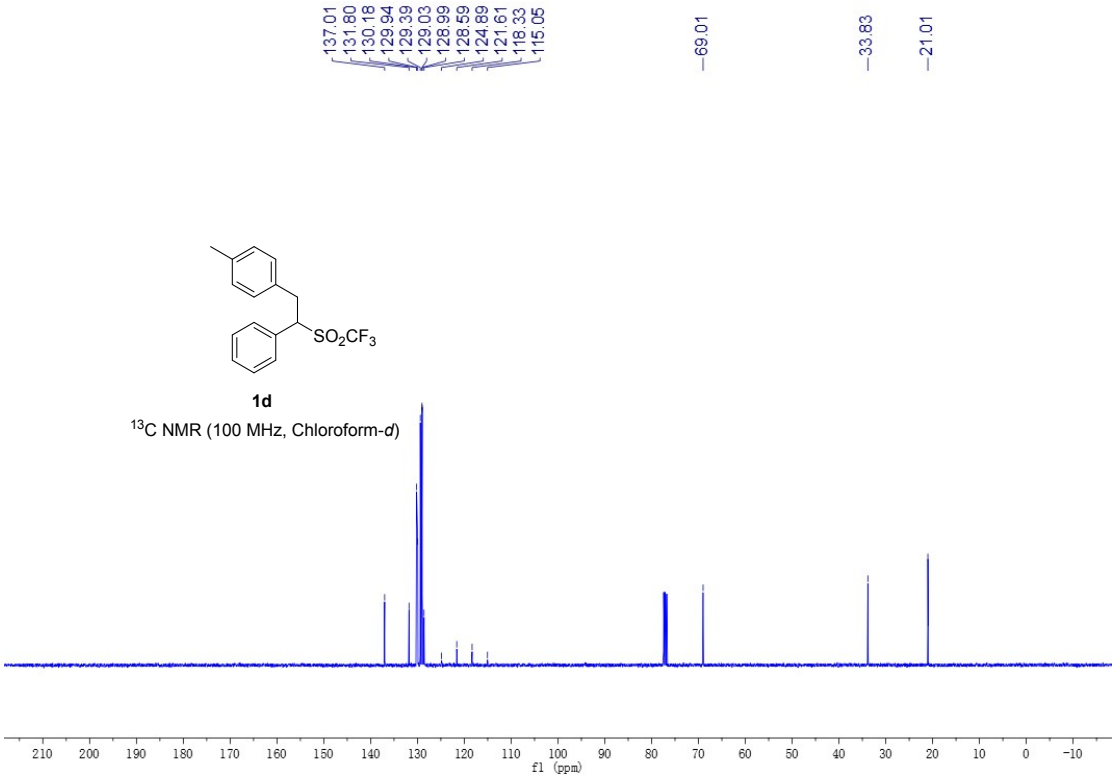
Figure S 16



1d

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

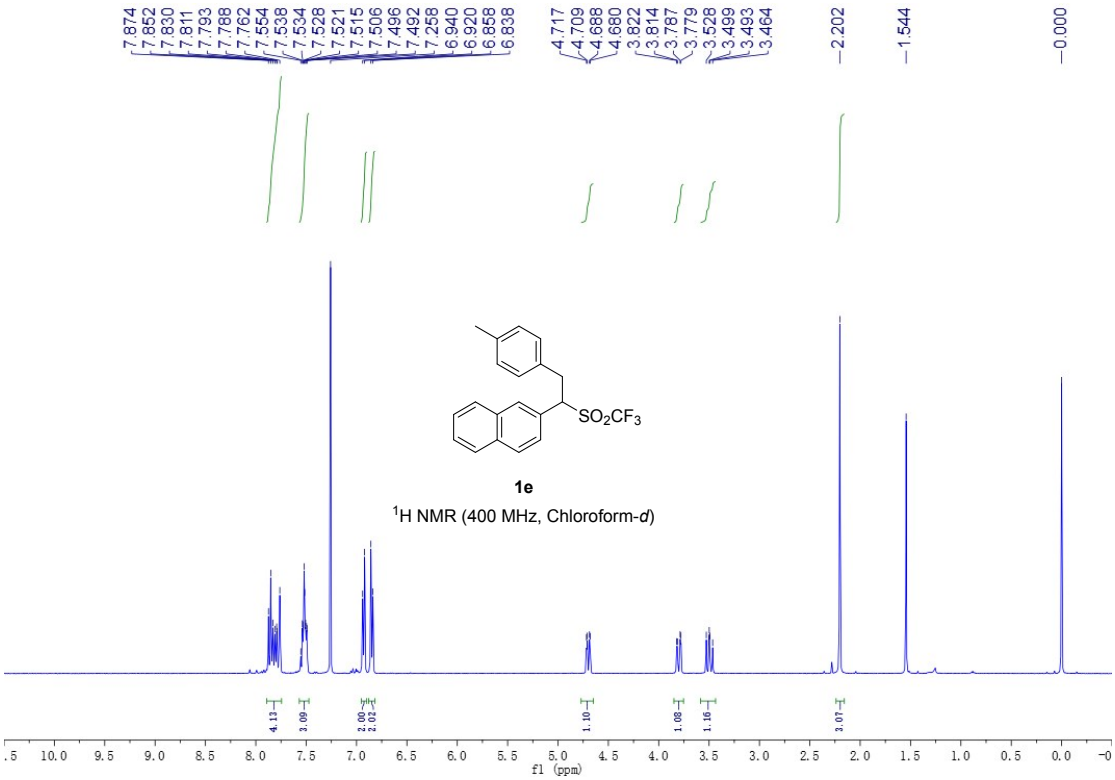
Figure S 17



1d

^{13}C NMR (100 MHz, Chloroform-*d*)

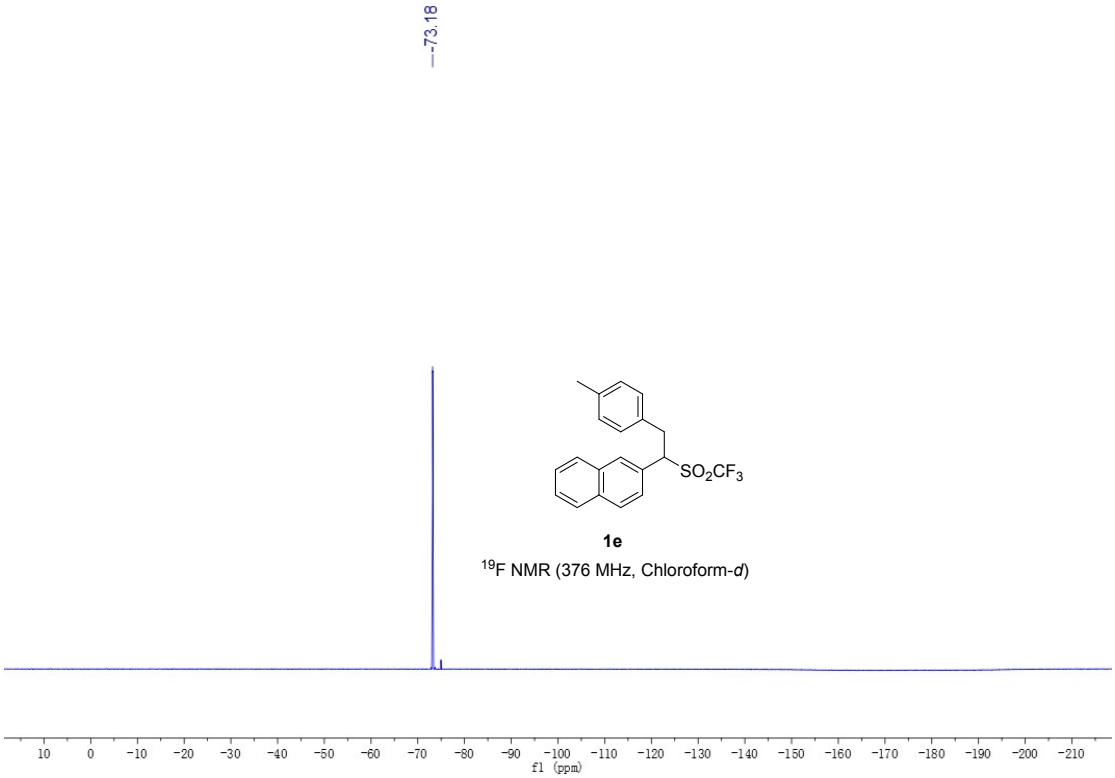
Figure S 18



1e

^{1}H NMR (400 MHz, Chloroform-*d*)

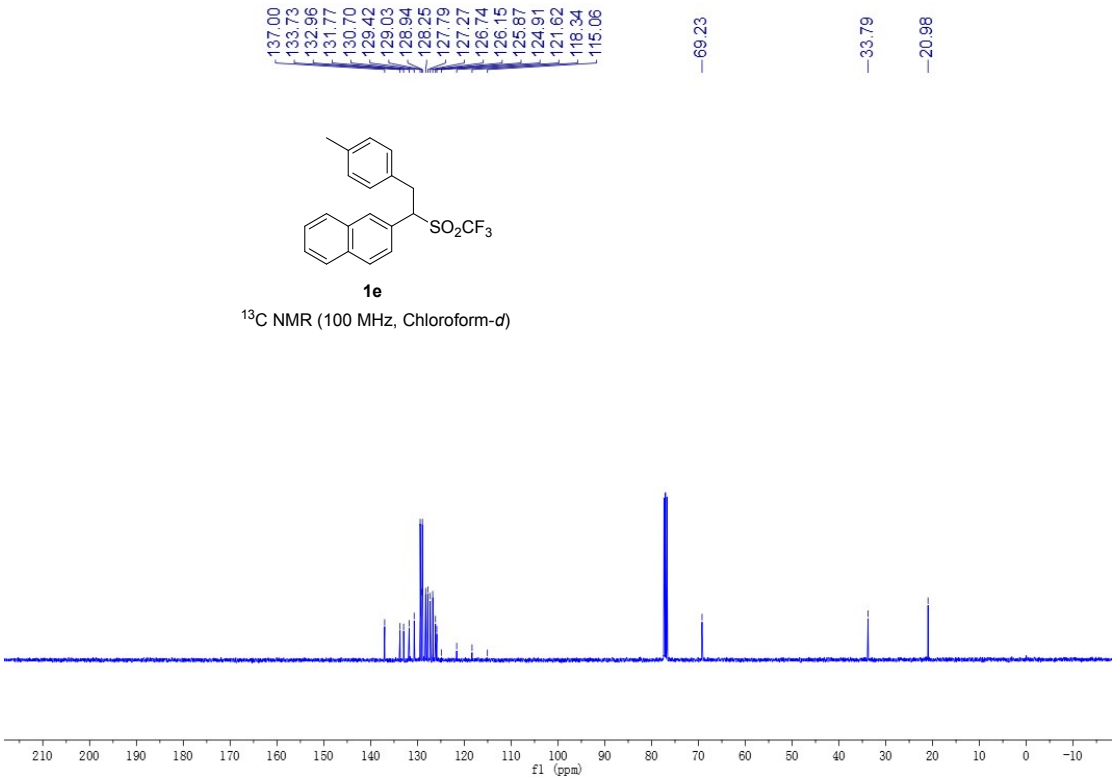
Figure S 19



1e

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

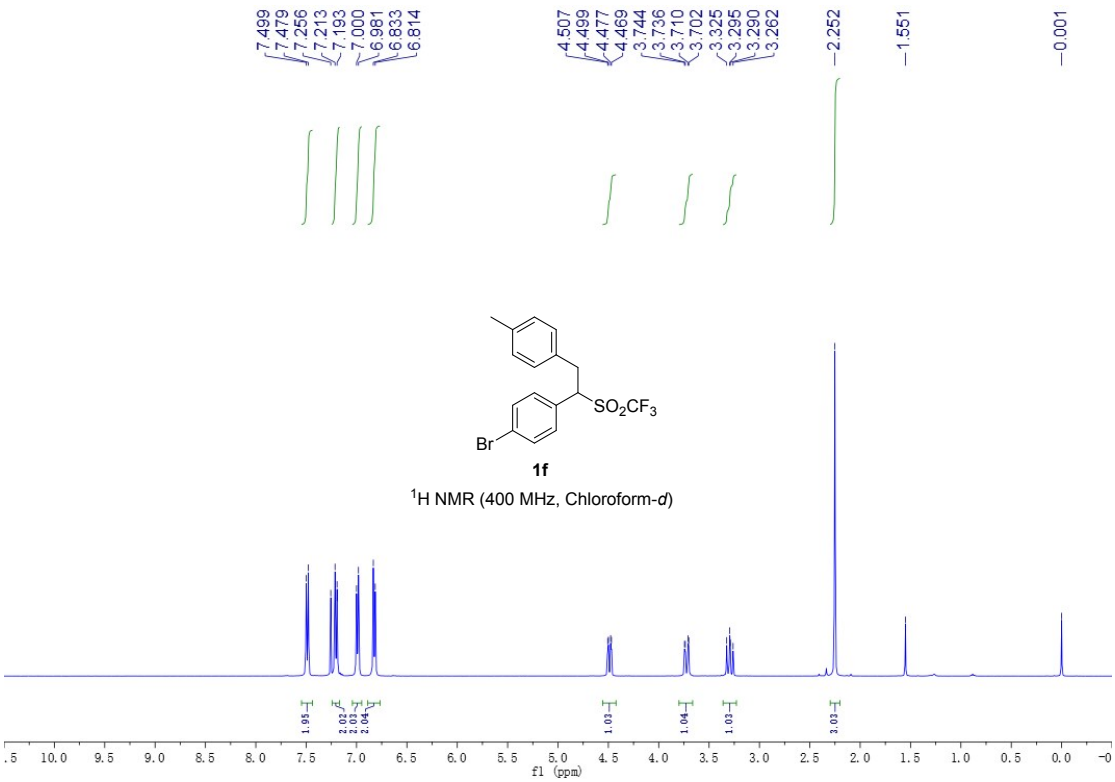
Figure S 20



1e

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 21



1f

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 22

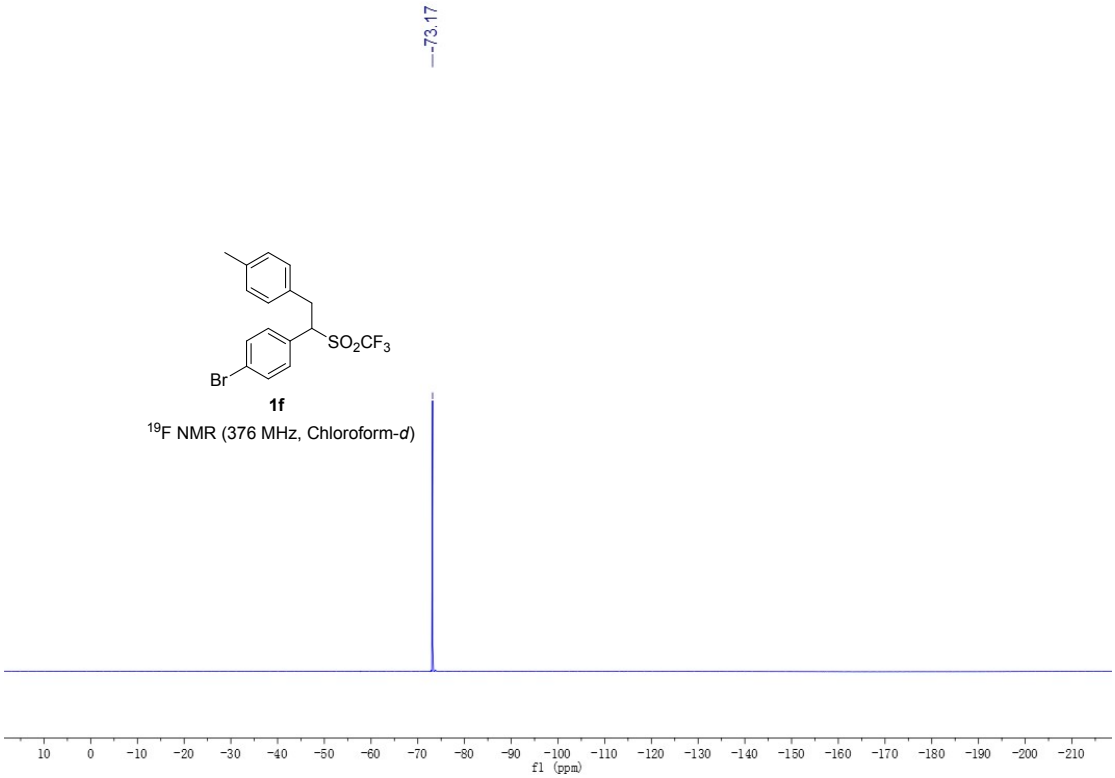


Figure S 23

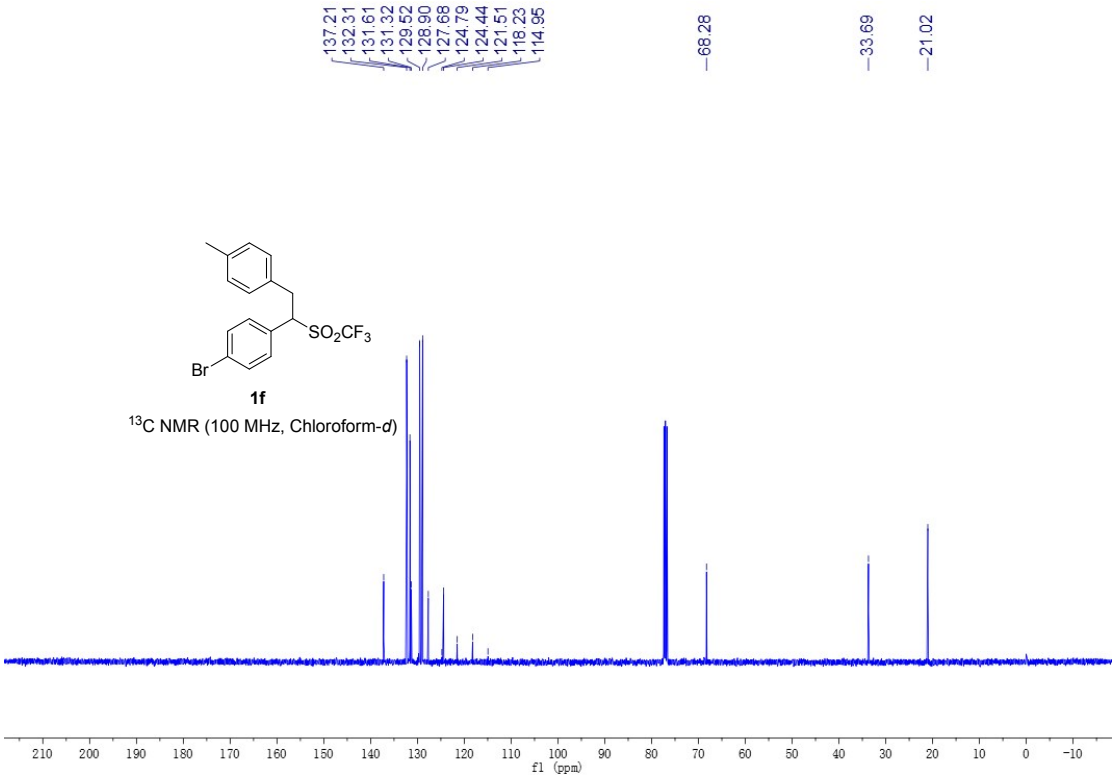
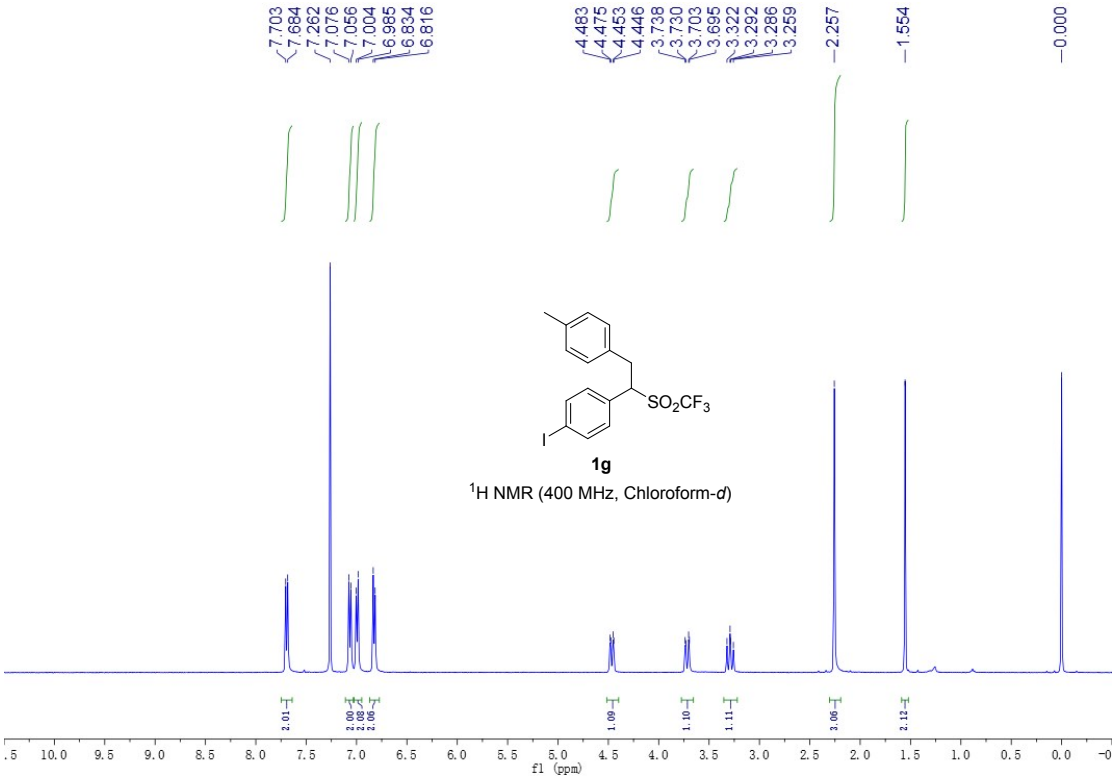


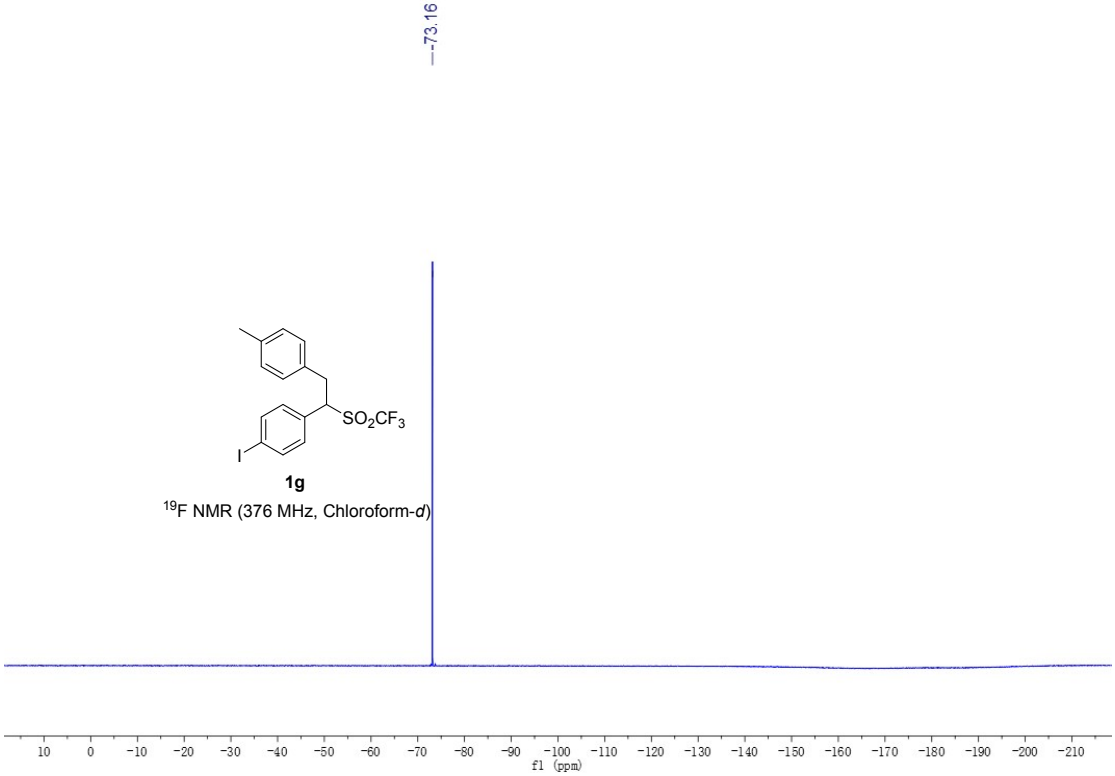
Figure S 24



1g

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 25



1g

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

Figure S 26

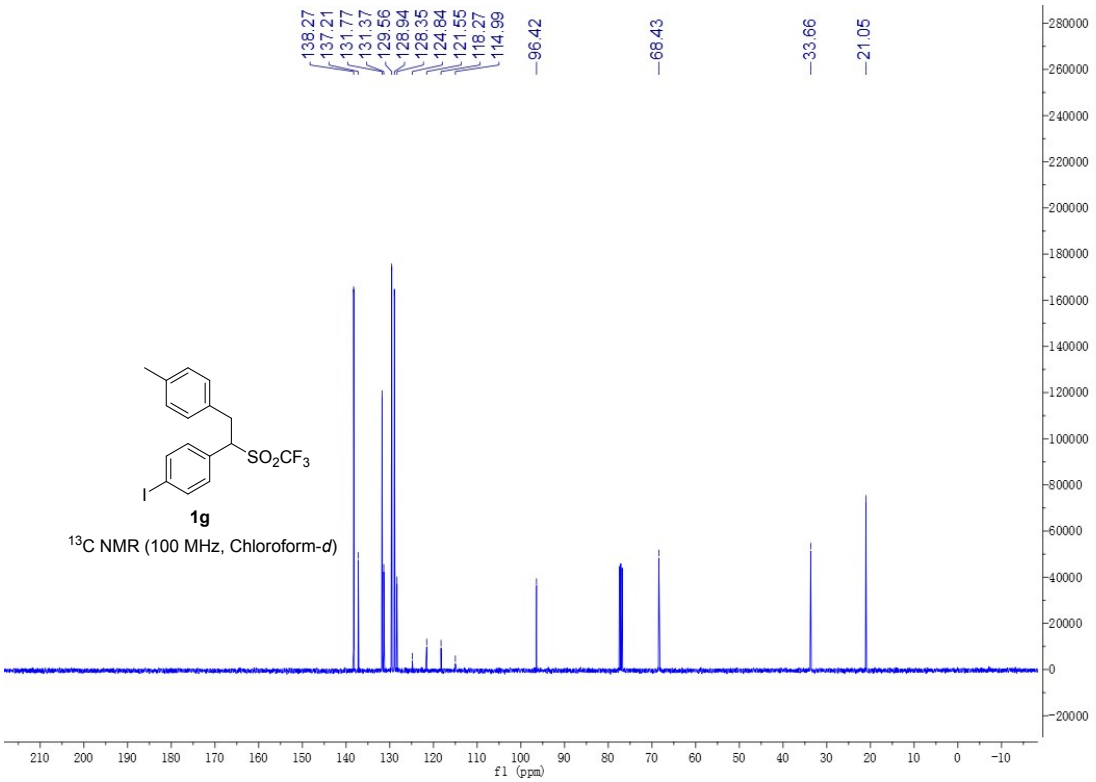


Figure S 27

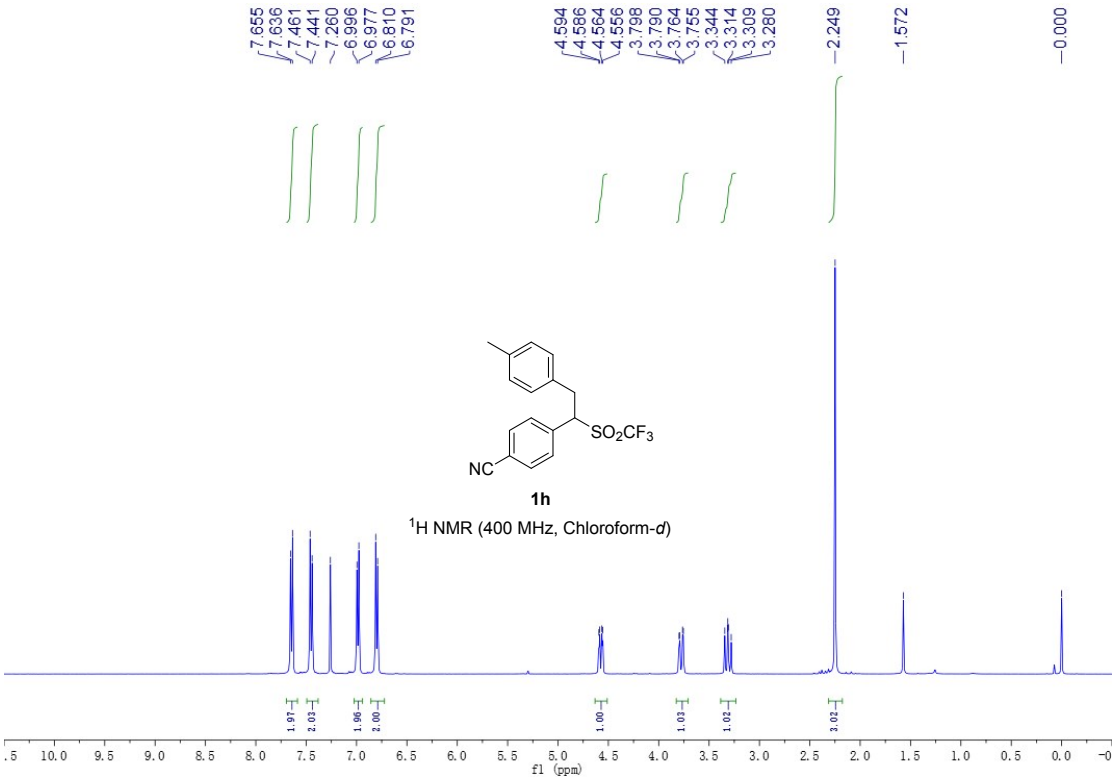


Figure S 28

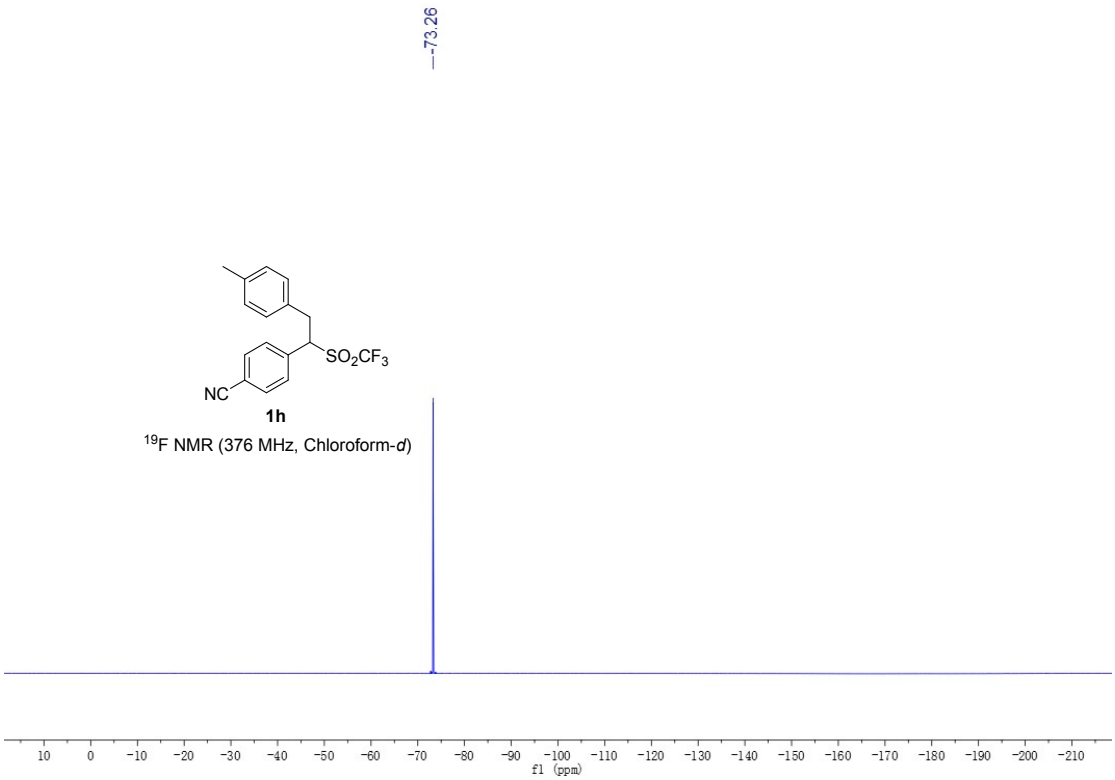


Figure S 29

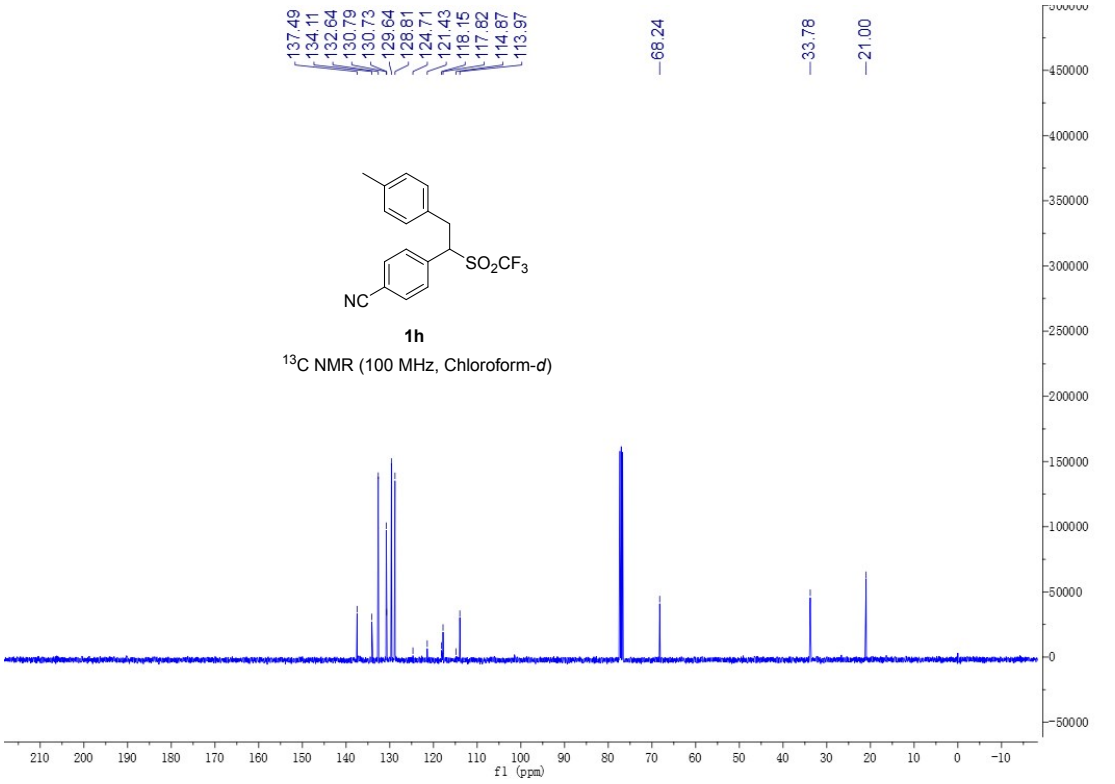
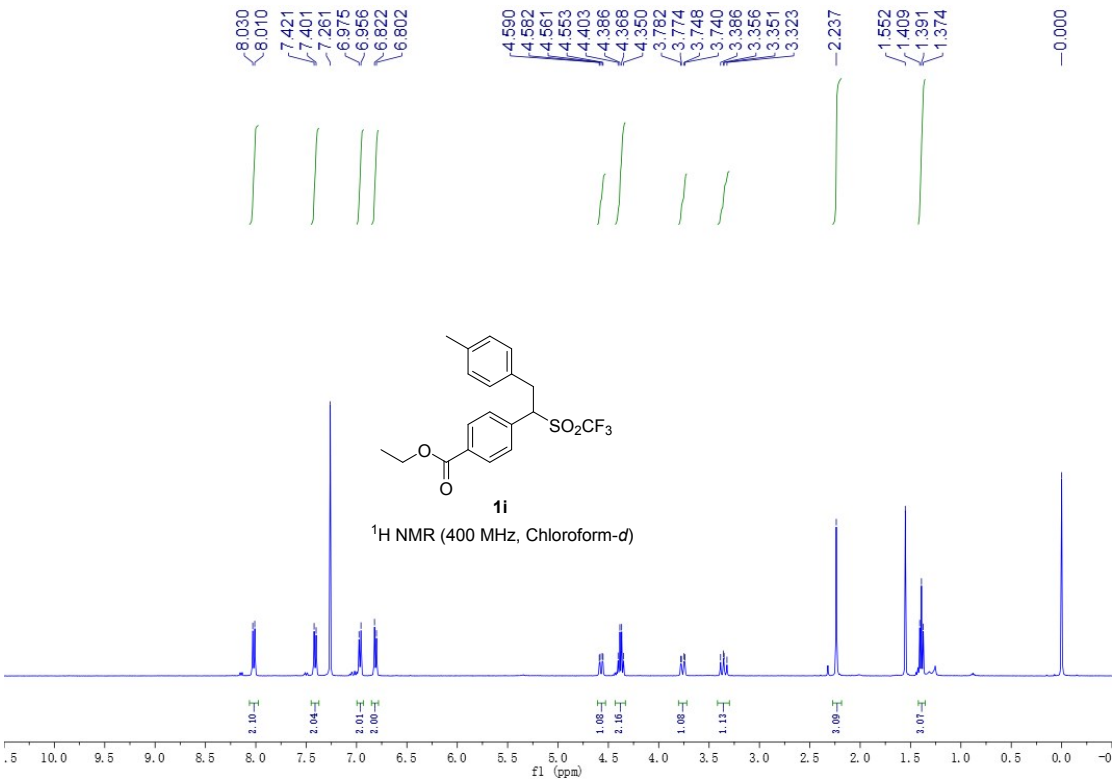


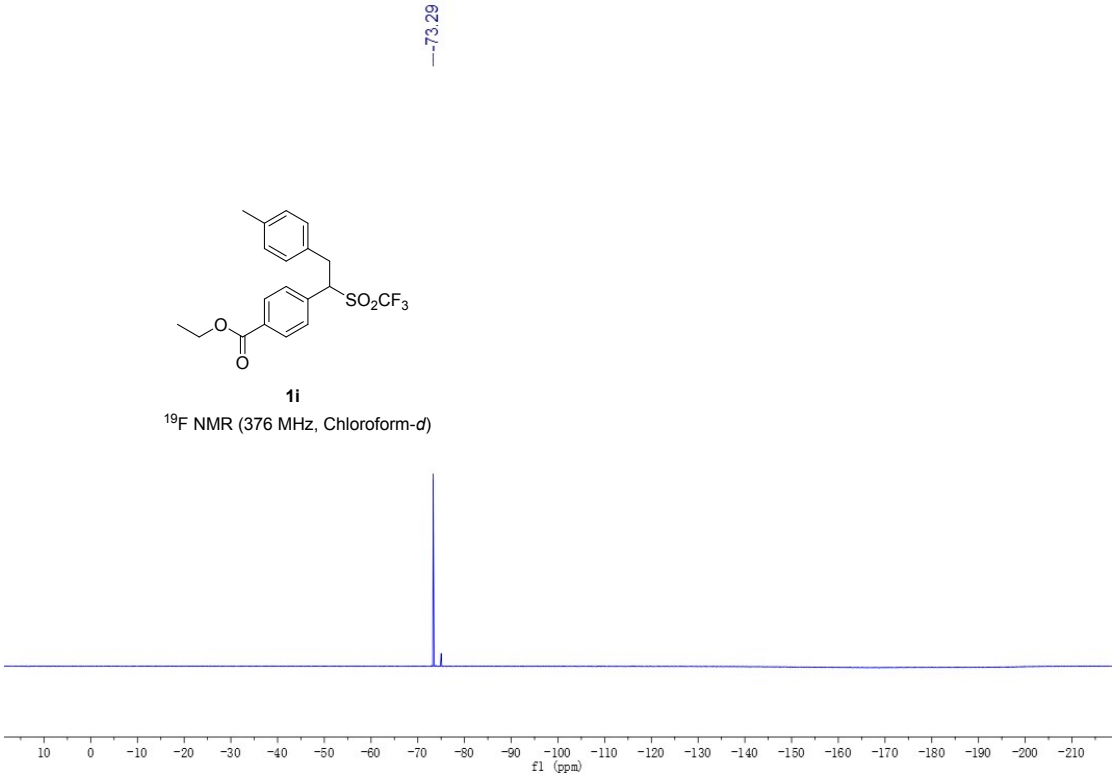
Figure S 30



1i

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 31



1i

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

Figure S 32

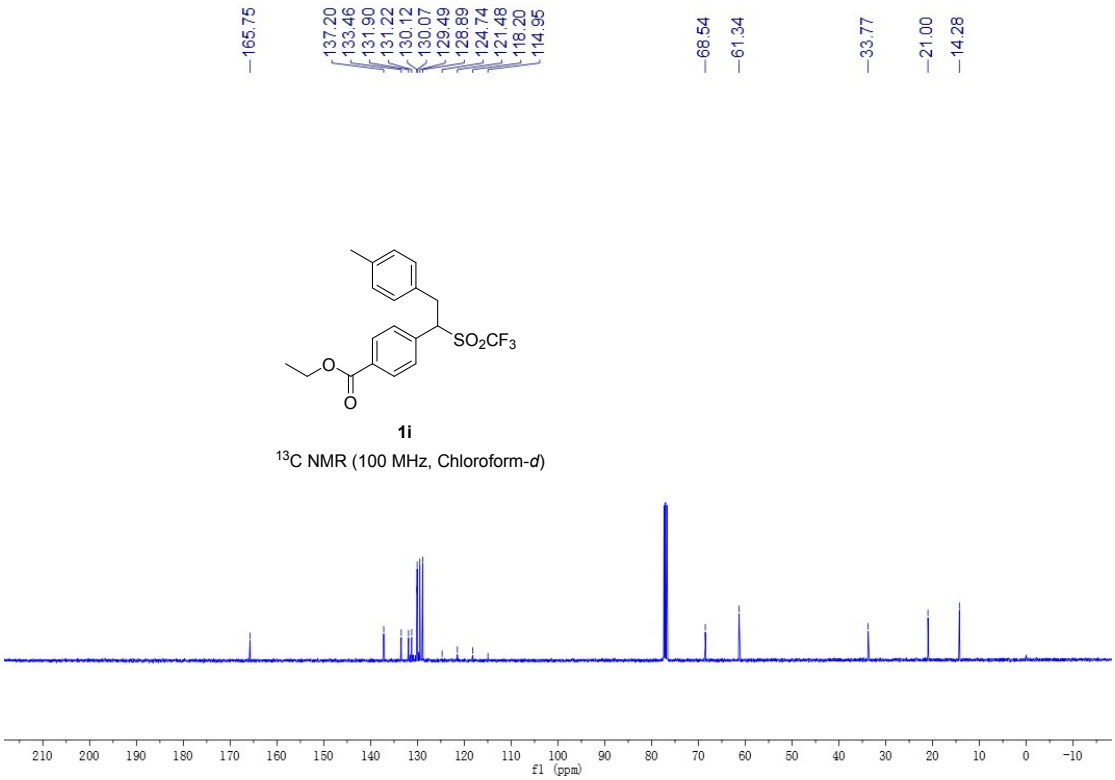


Figure S 33

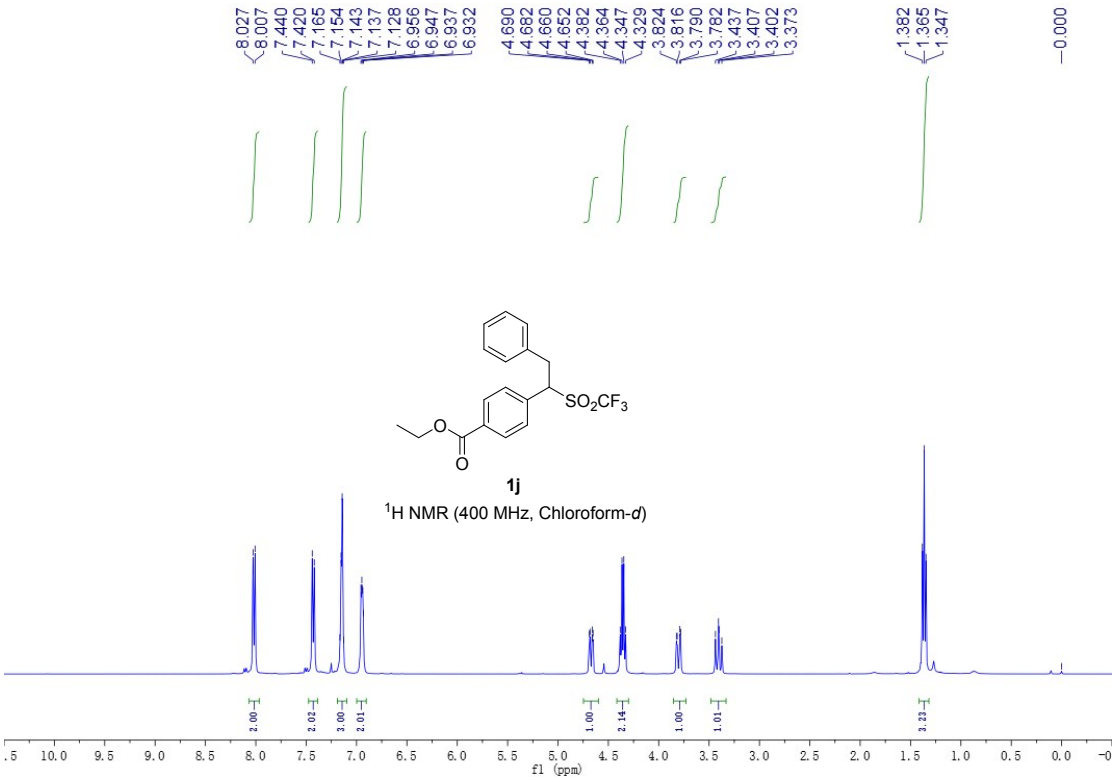
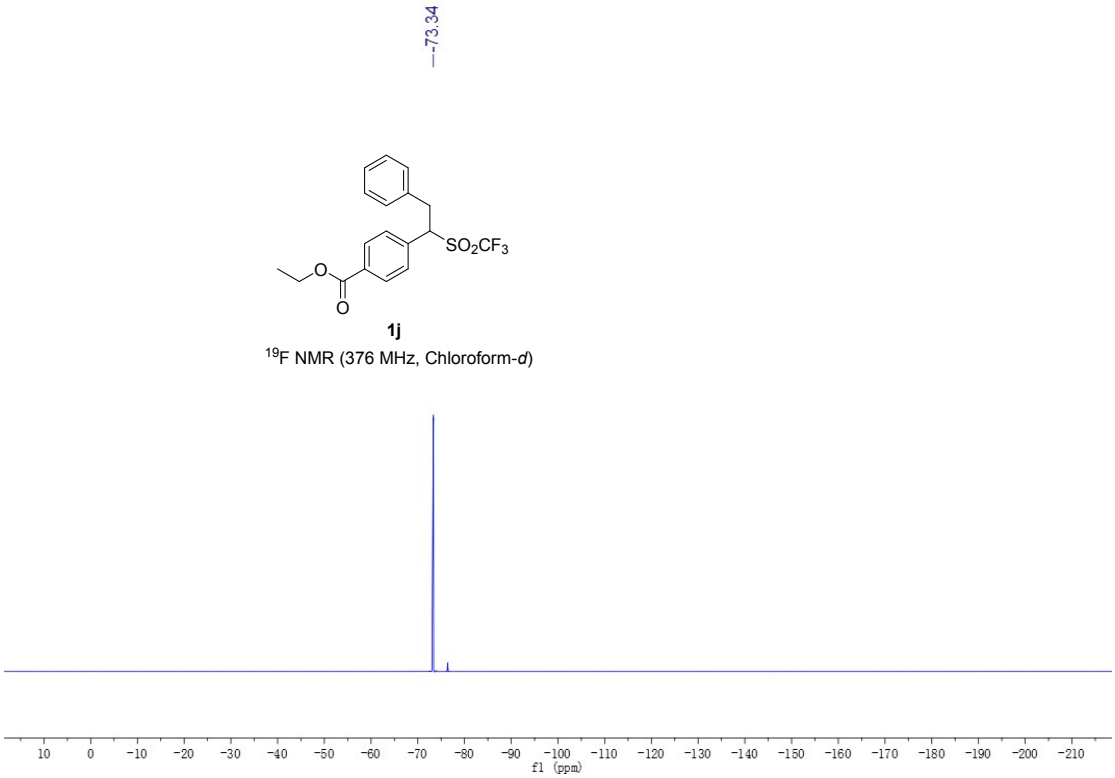


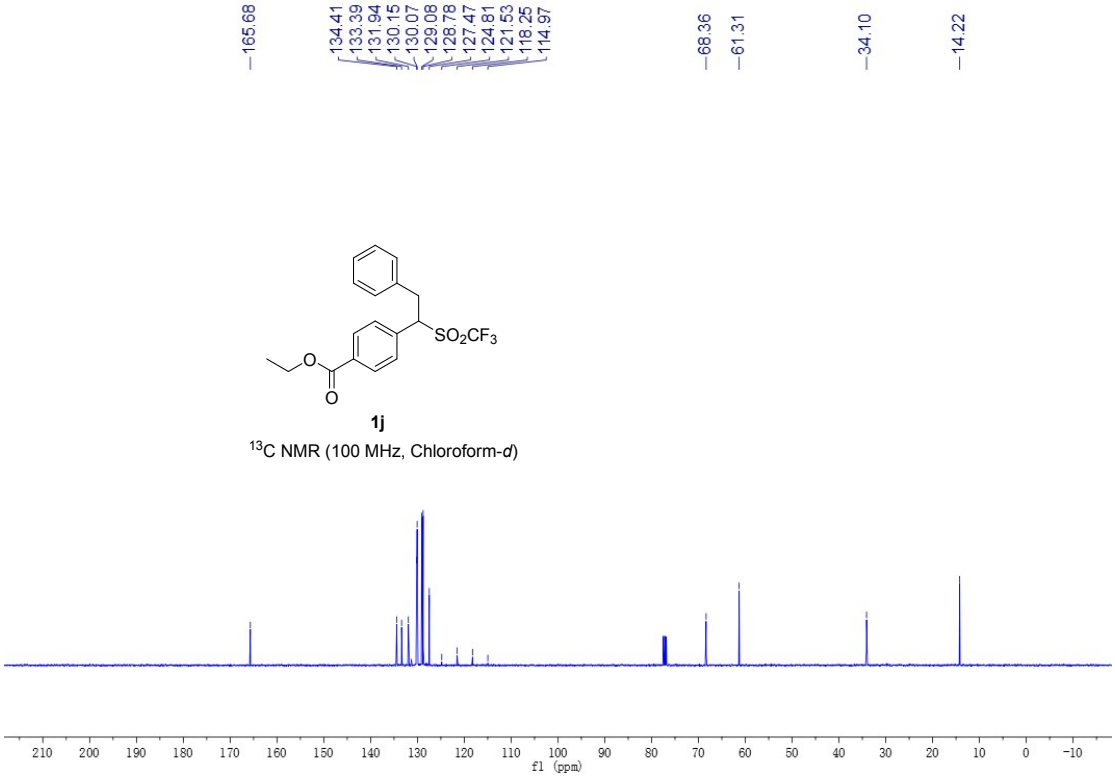
Figure S 34



1j

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

Figure S 35



1j

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 36

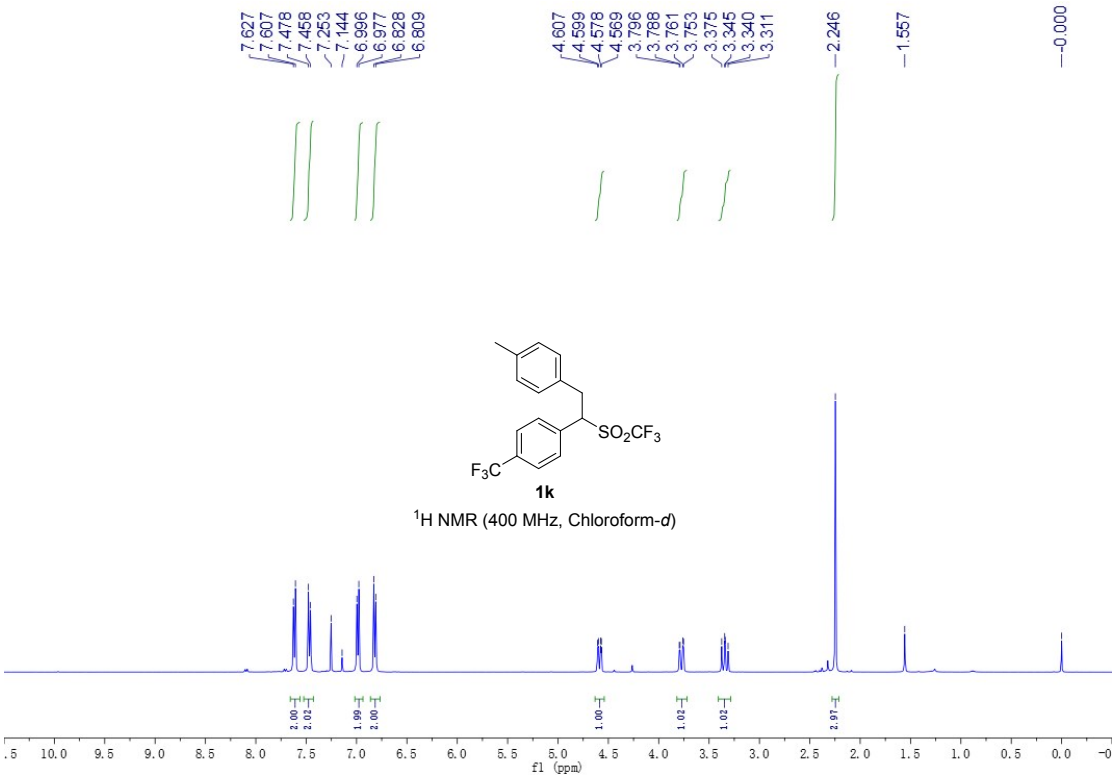


Figure S 37

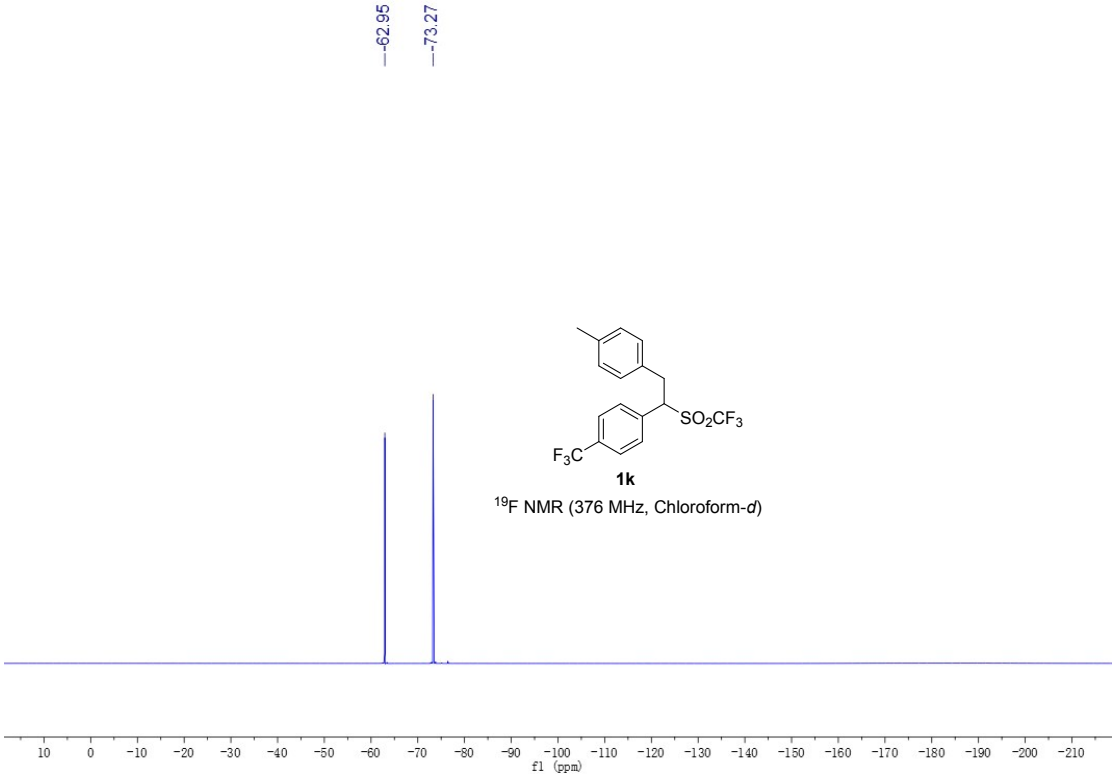


Figure S 38

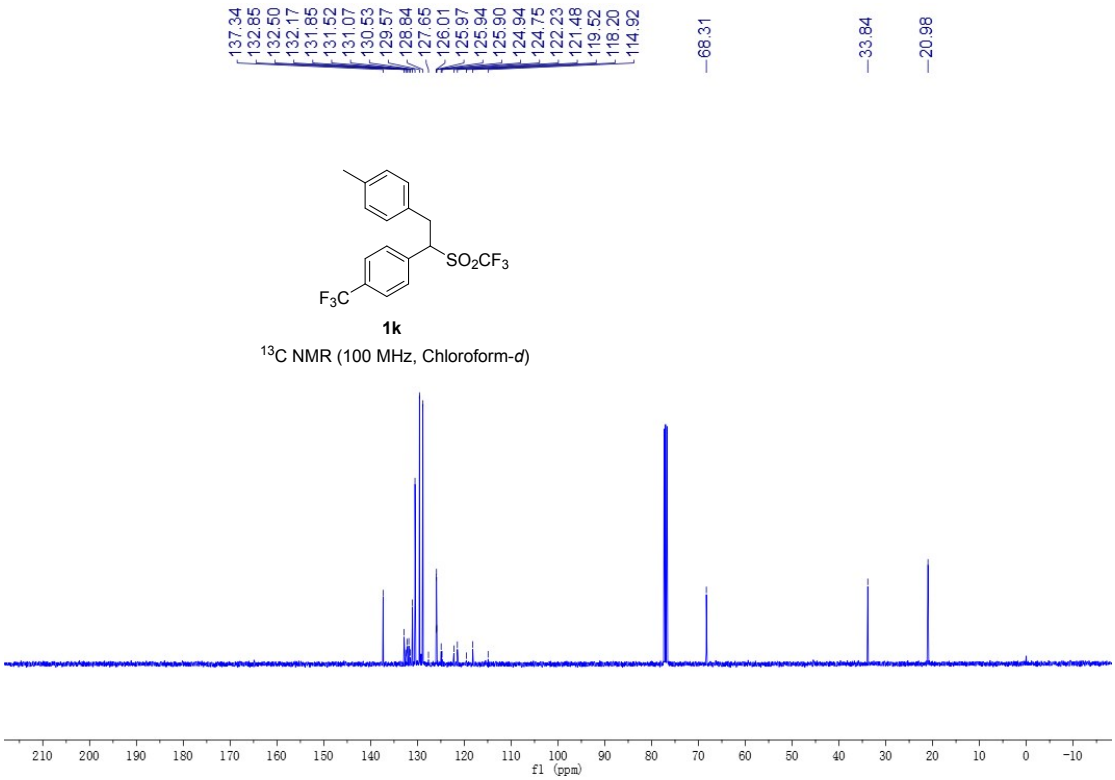


Figure S 39

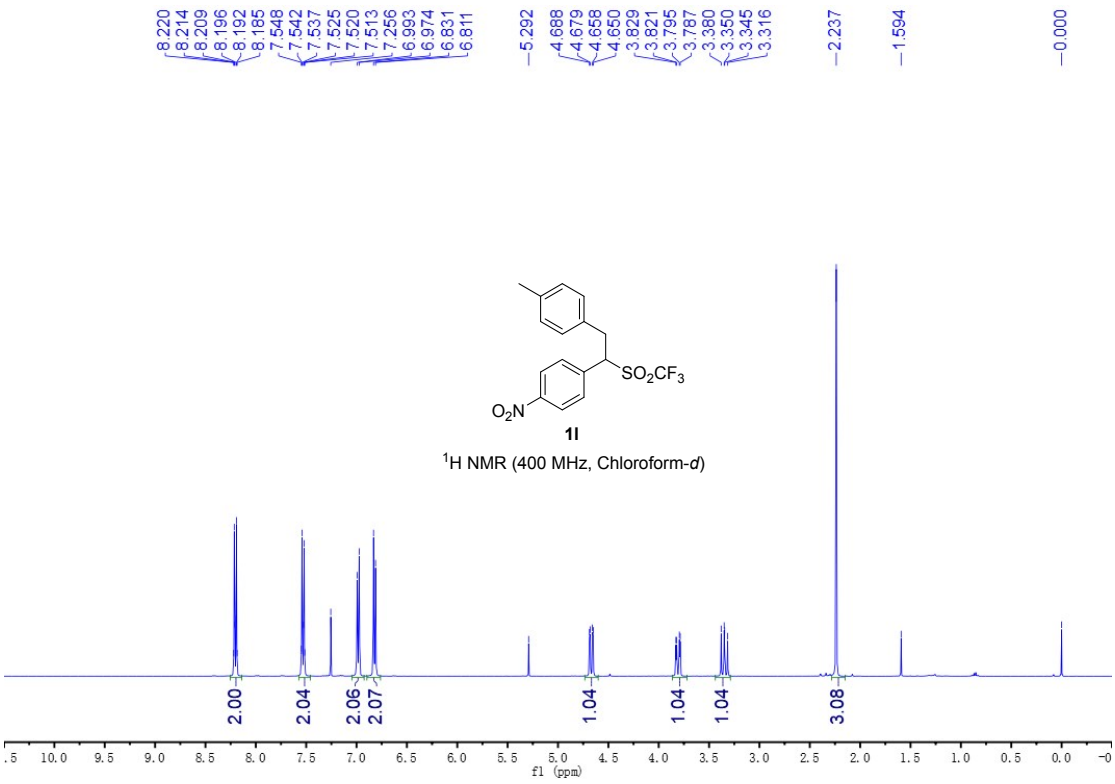


Figure S 40

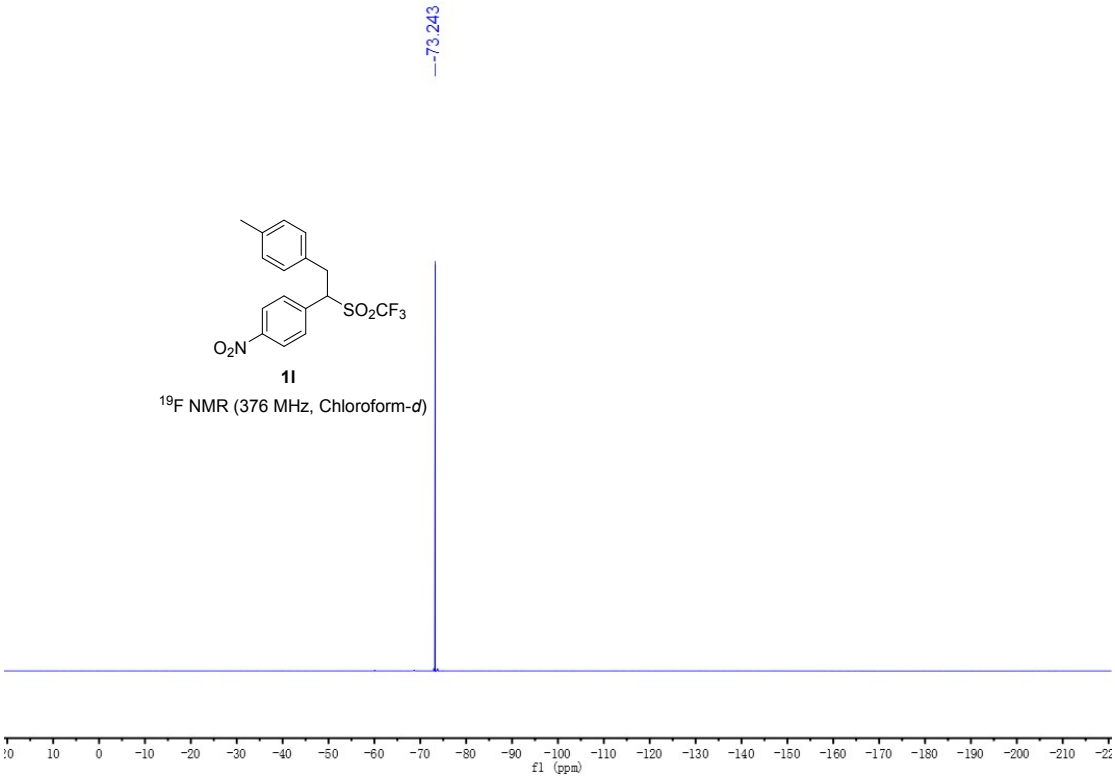


Figure S 41

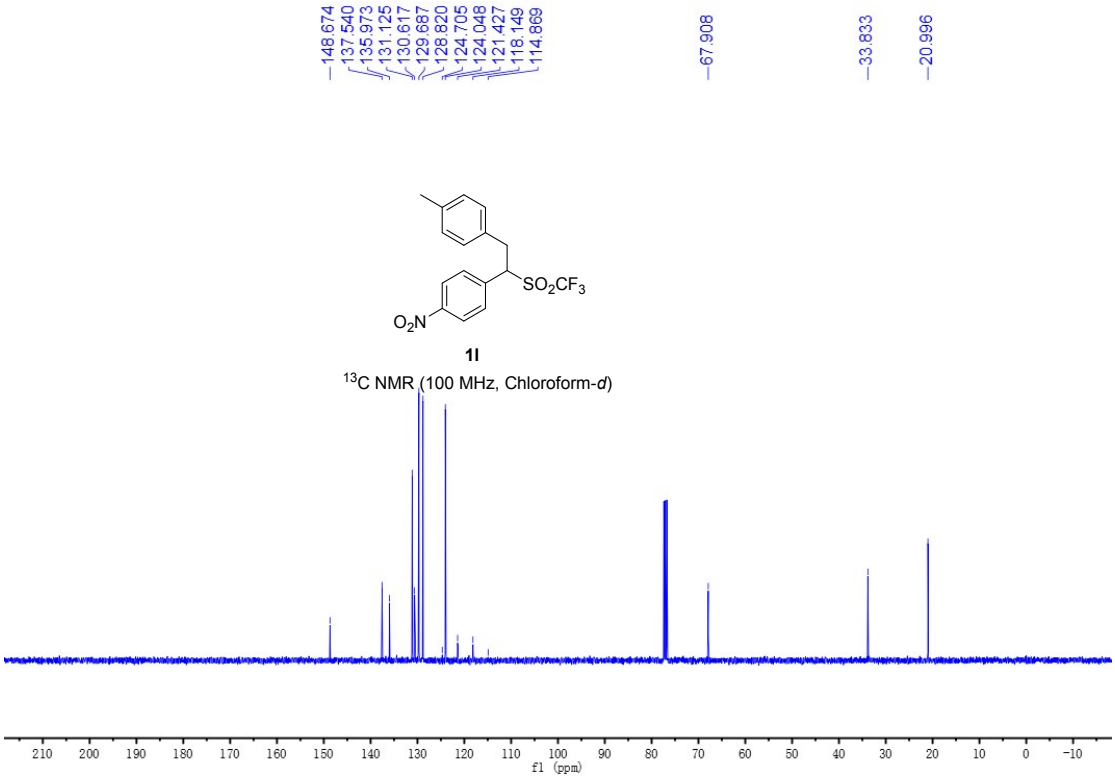


Figure S 42

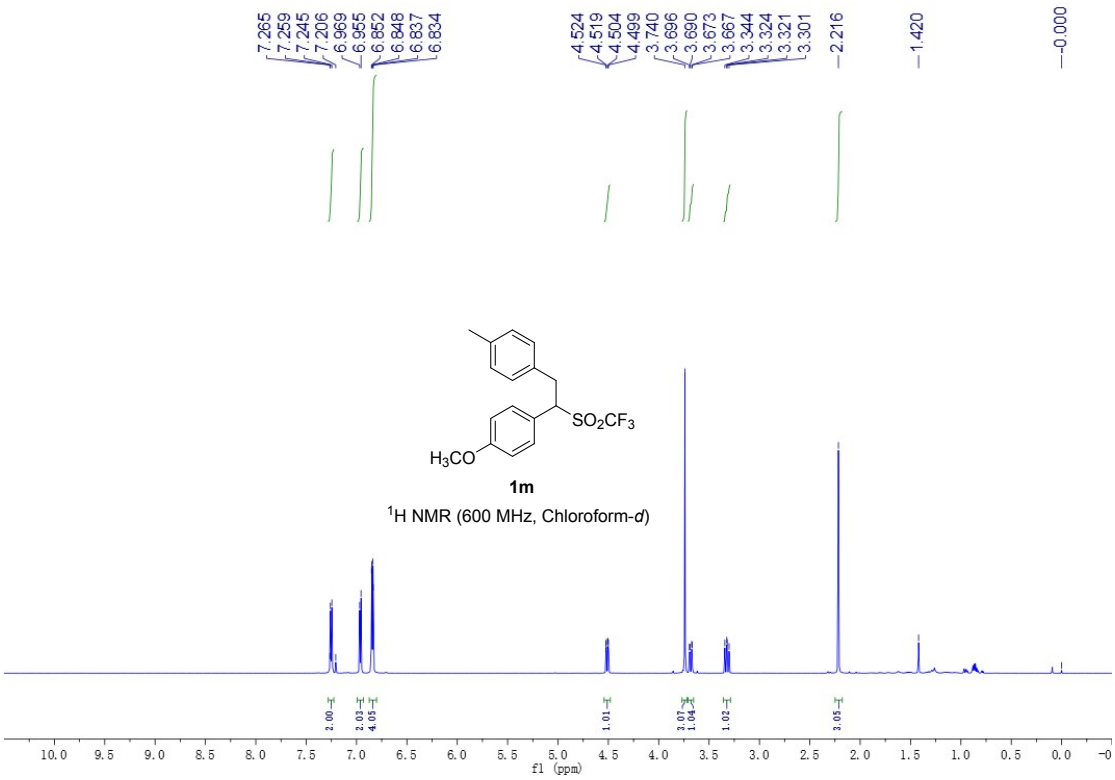


Figure S 43

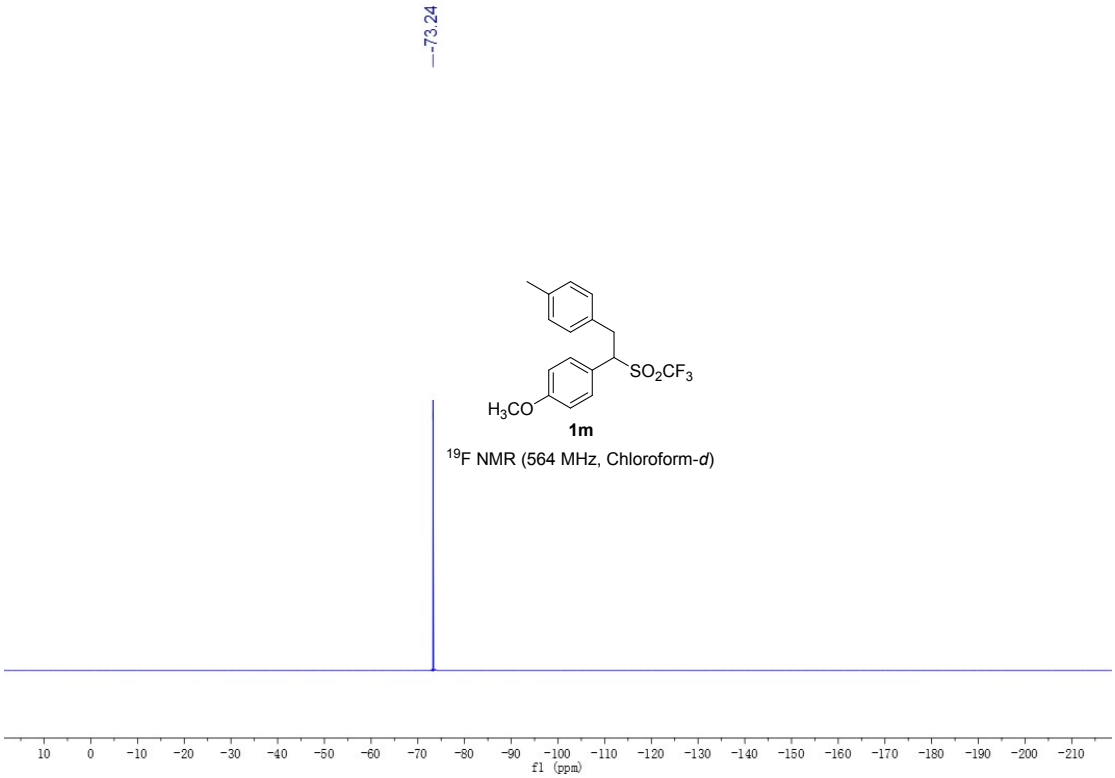
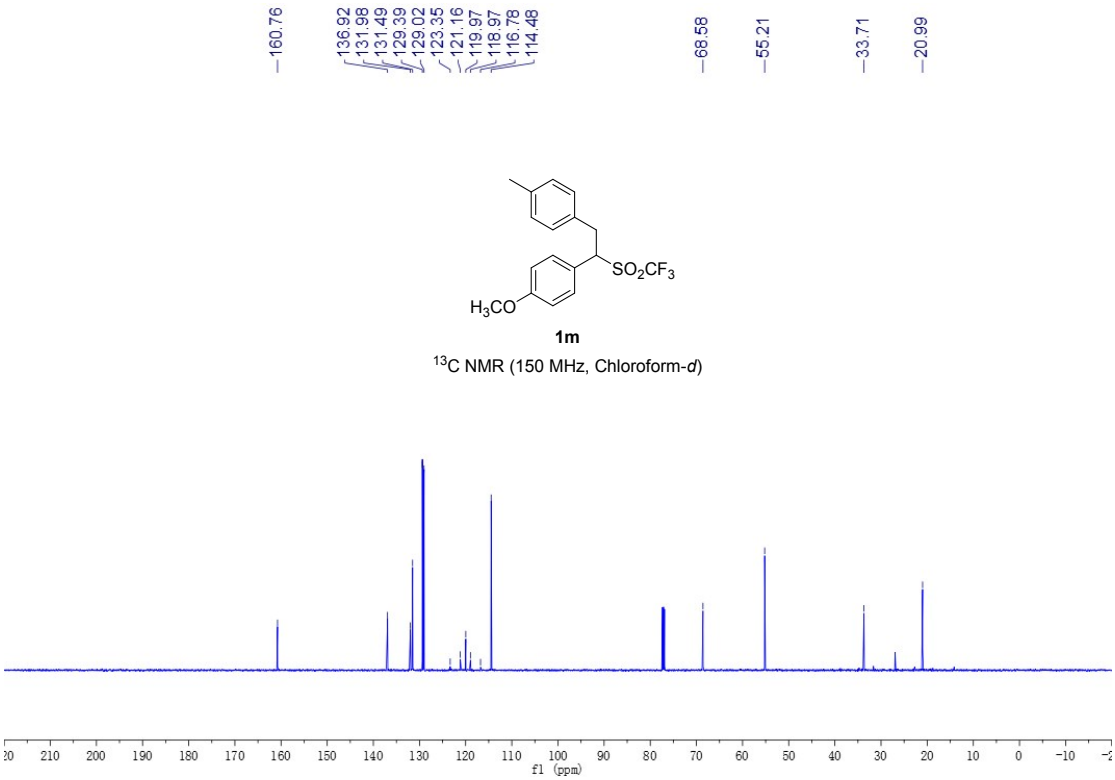


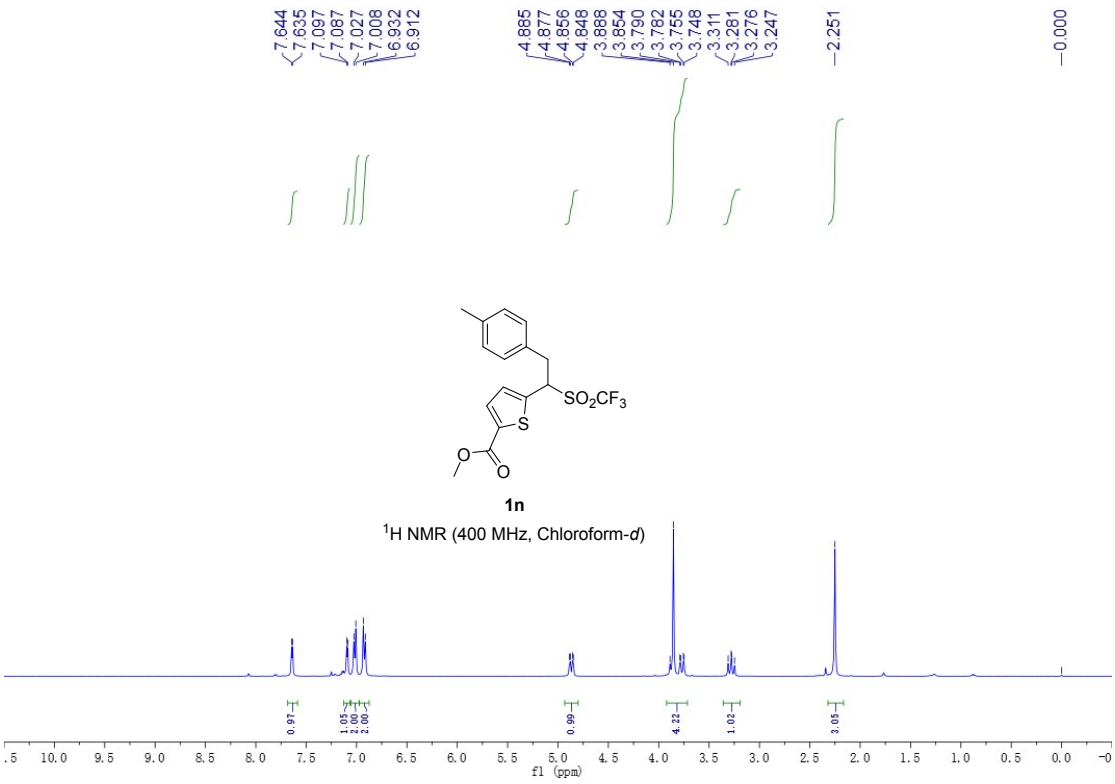
Figure S 44



1m

^{13}C NMR (150 MHz, Chloroform-*d*)

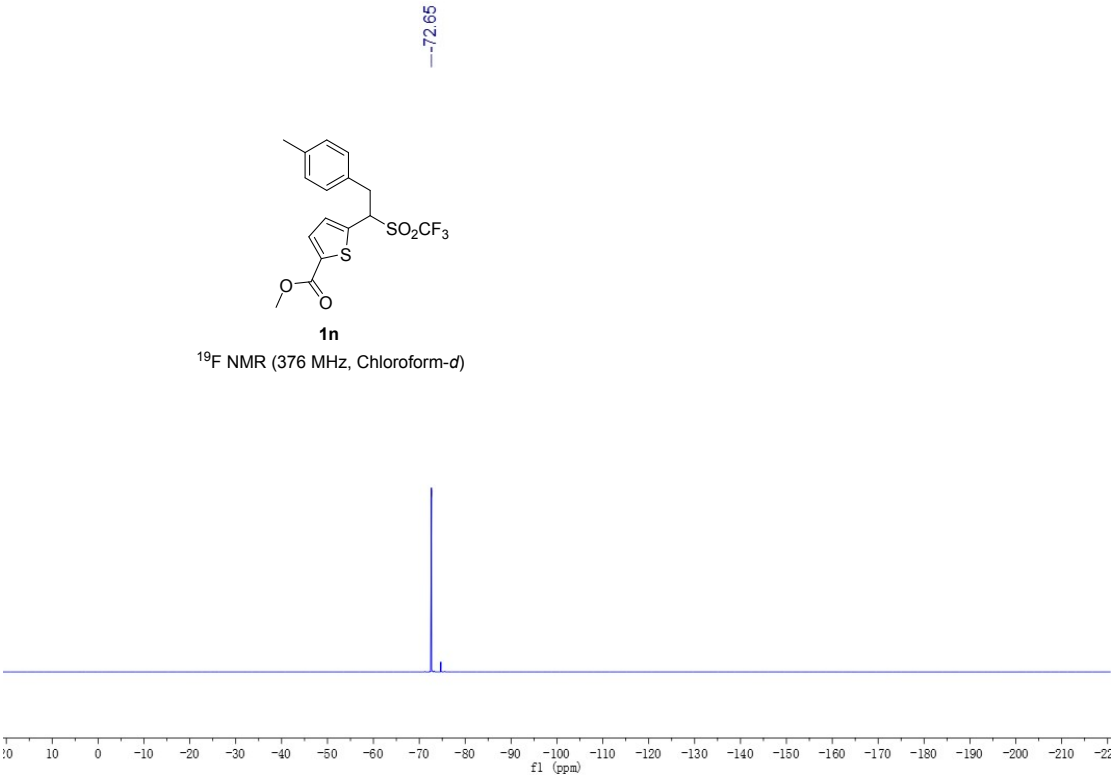
Figure S 45



1n

^{1}H NMR (400 MHz, Chloroform-*d*)

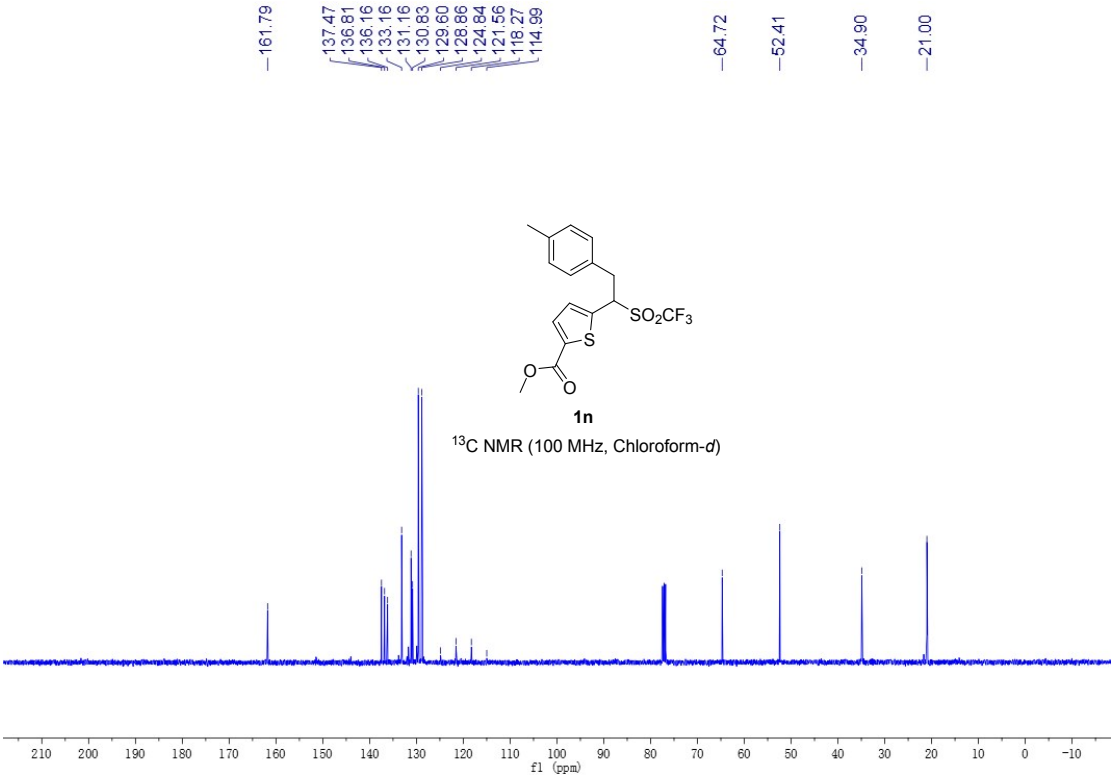
Figure S 46



1n

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

Figure S 47



1n

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 48

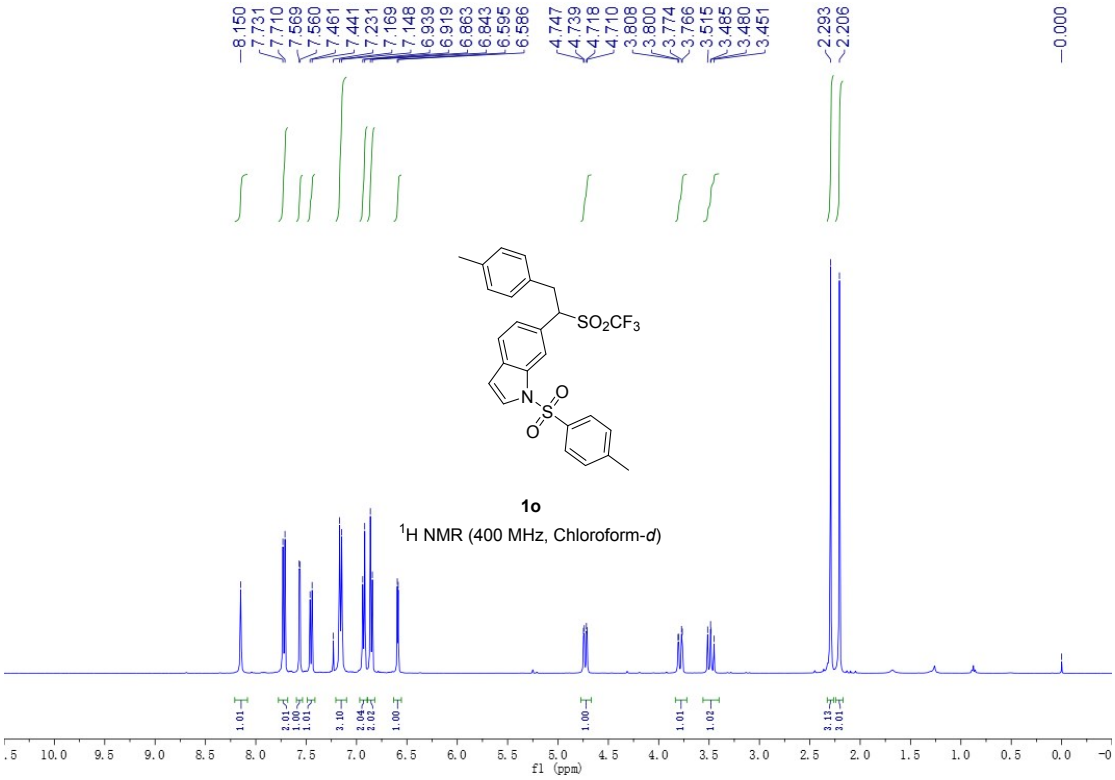


Figure S 49

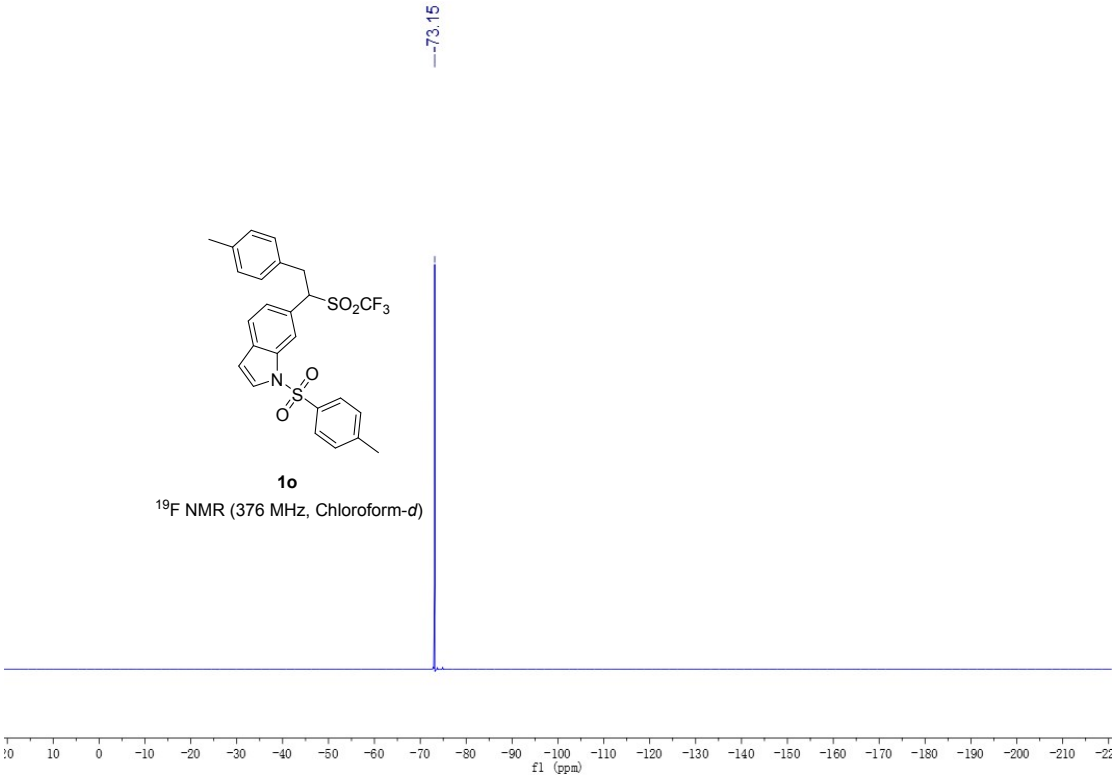


Figure S 50

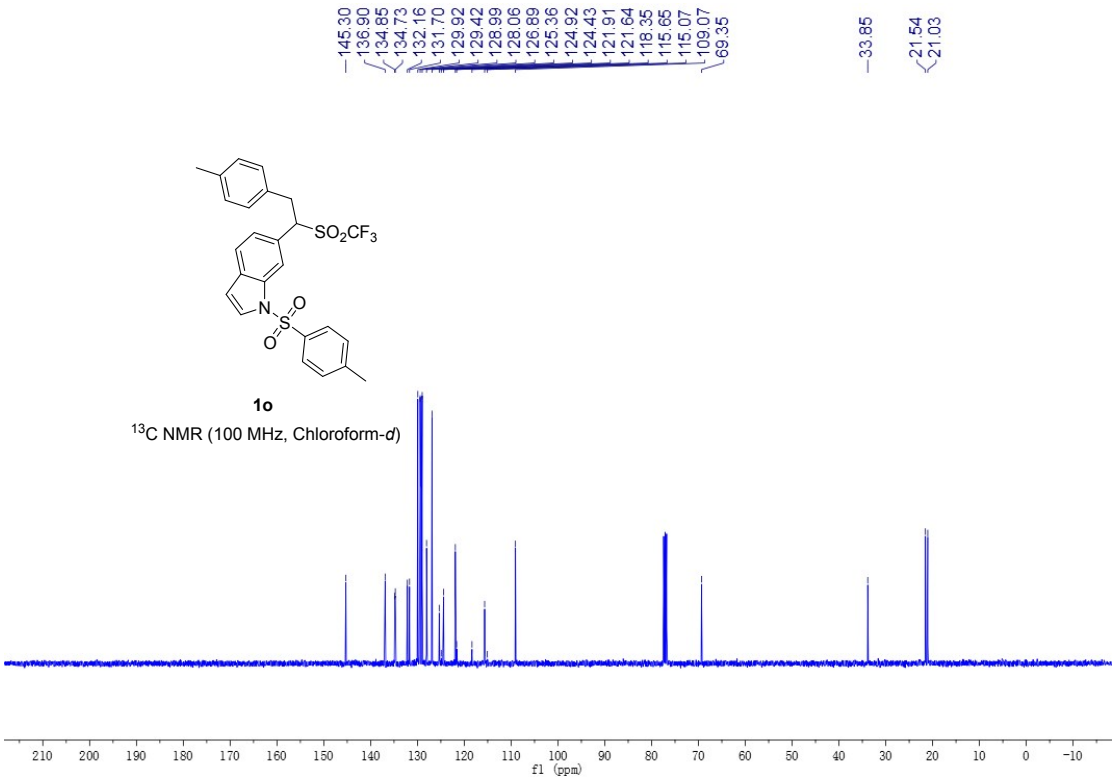


Figure S 51

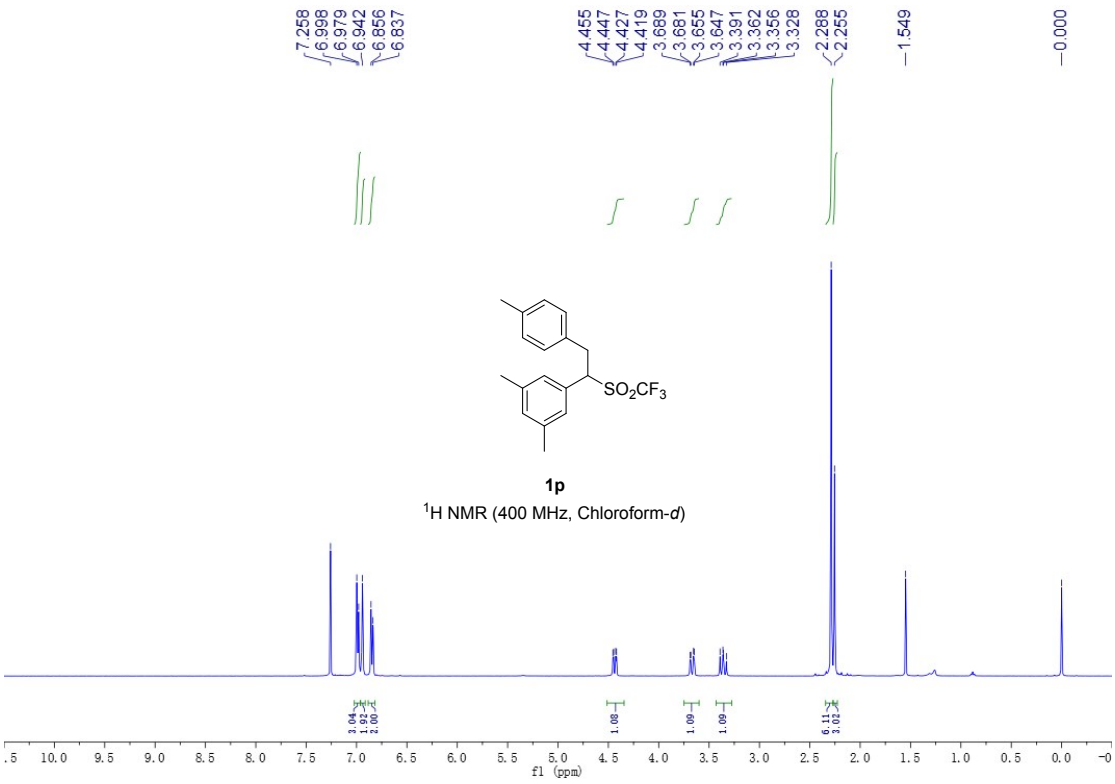
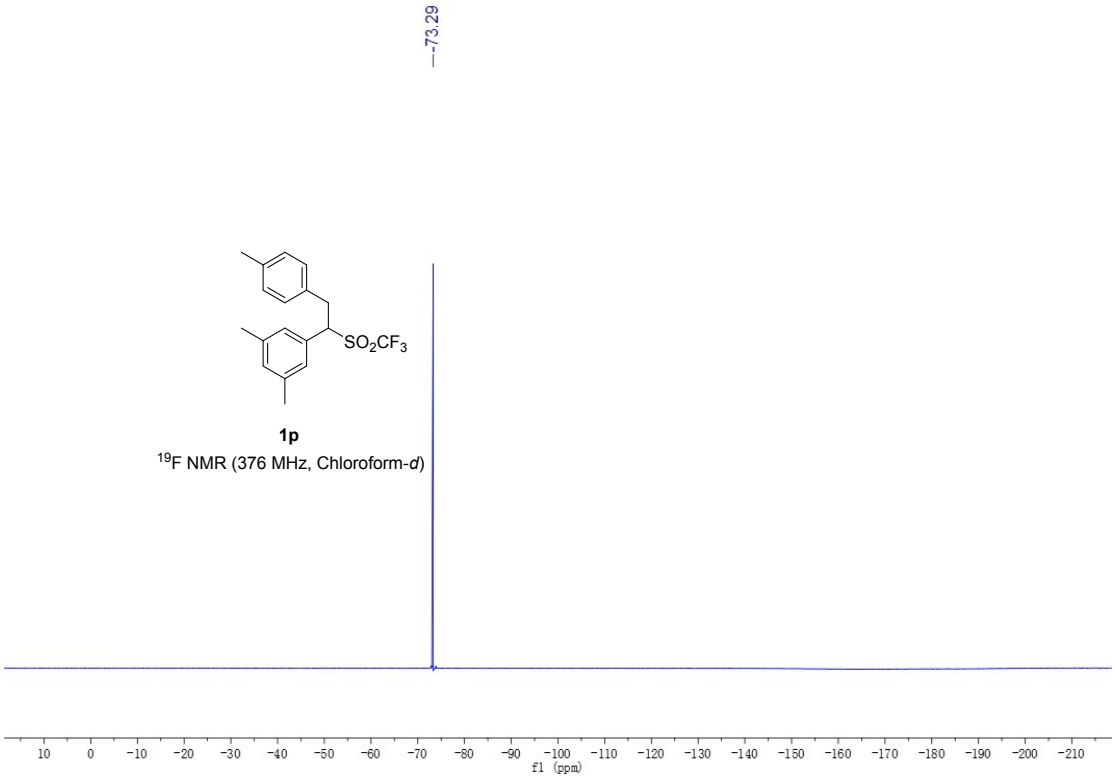


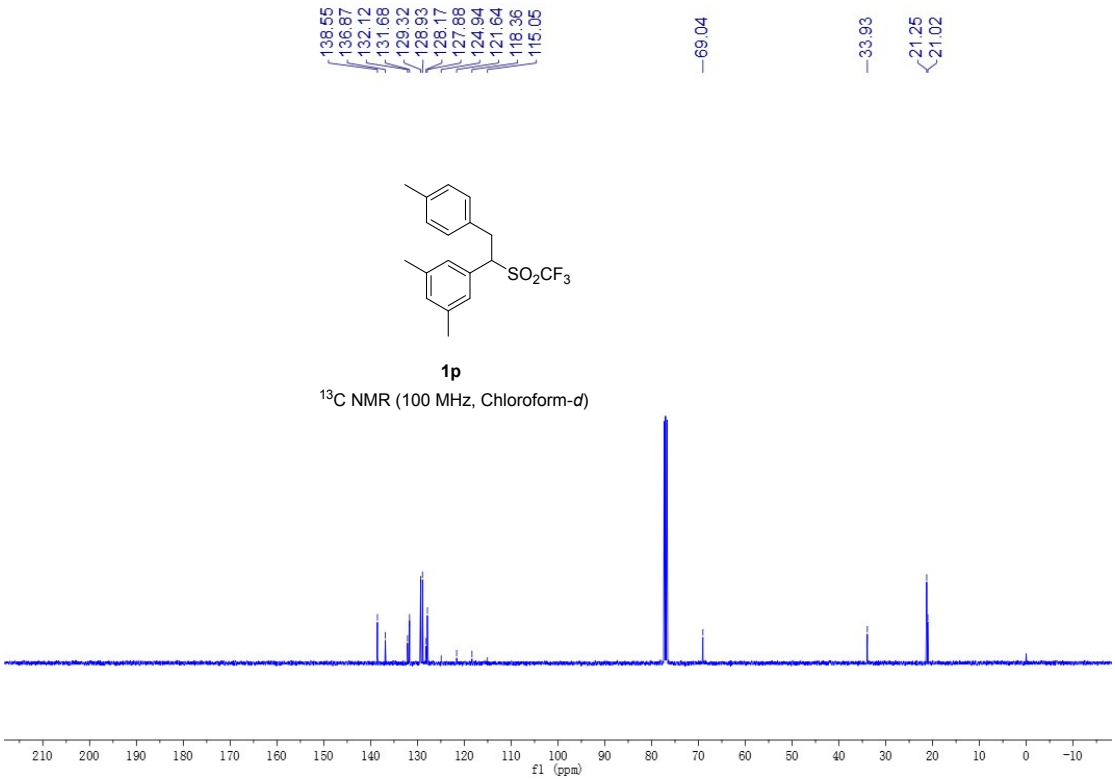
Figure S 52



1p

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

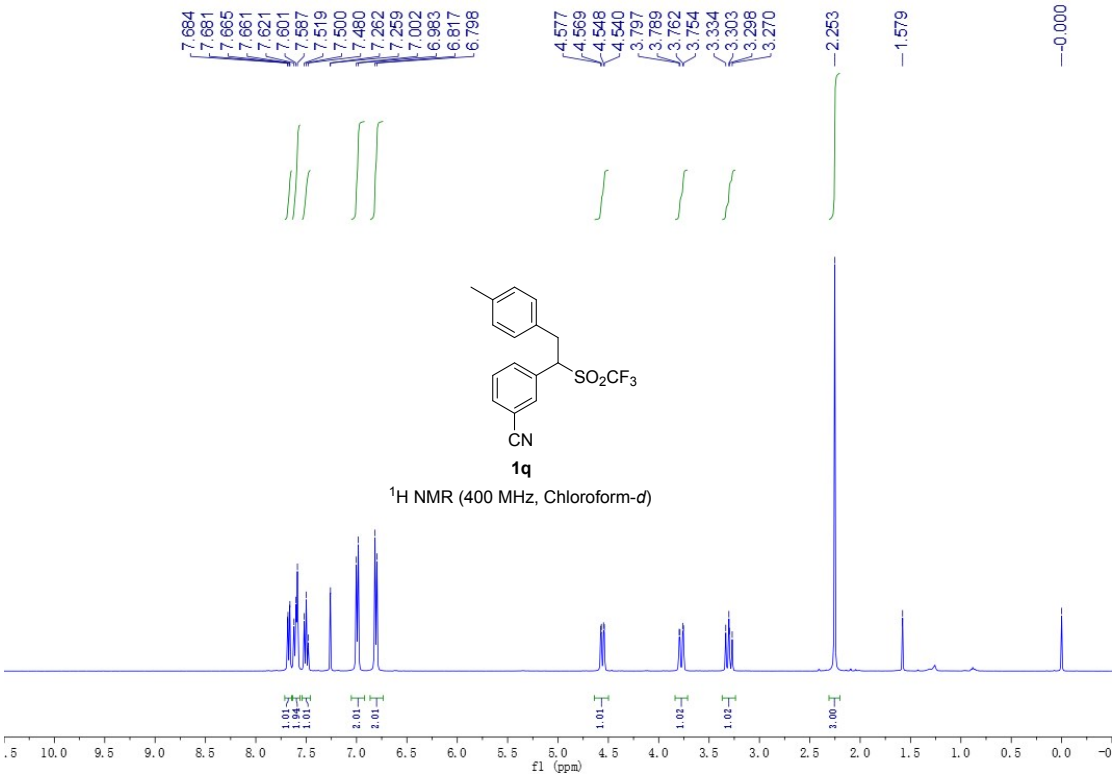
Figure S 53



1p

^{13}C NMR (100 MHz, Chloroform-*d*)

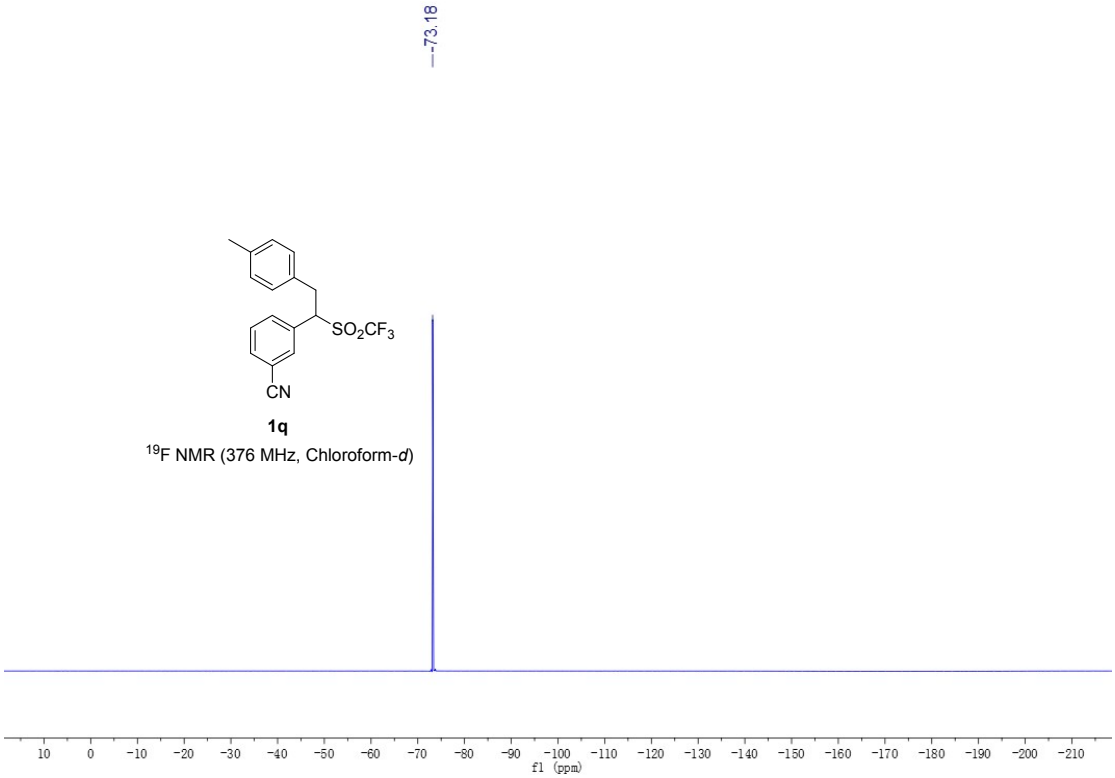
Figure S 54



1q

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 55



1q

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

Figure S 56

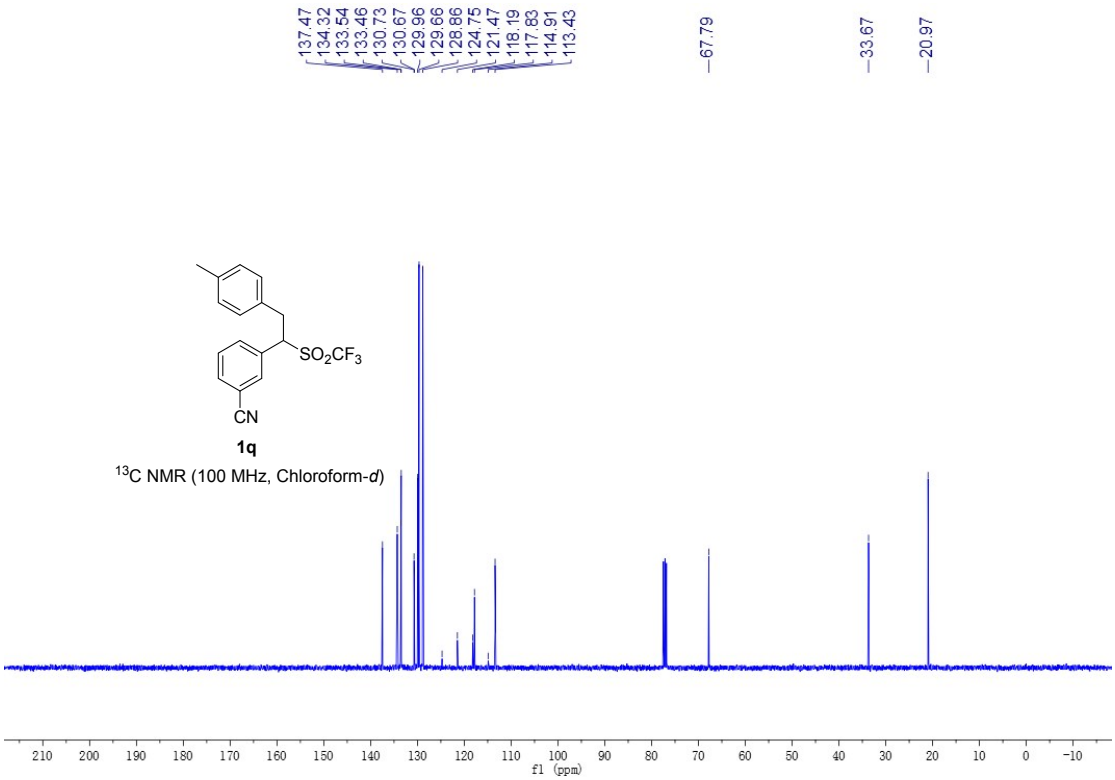


Figure S 57

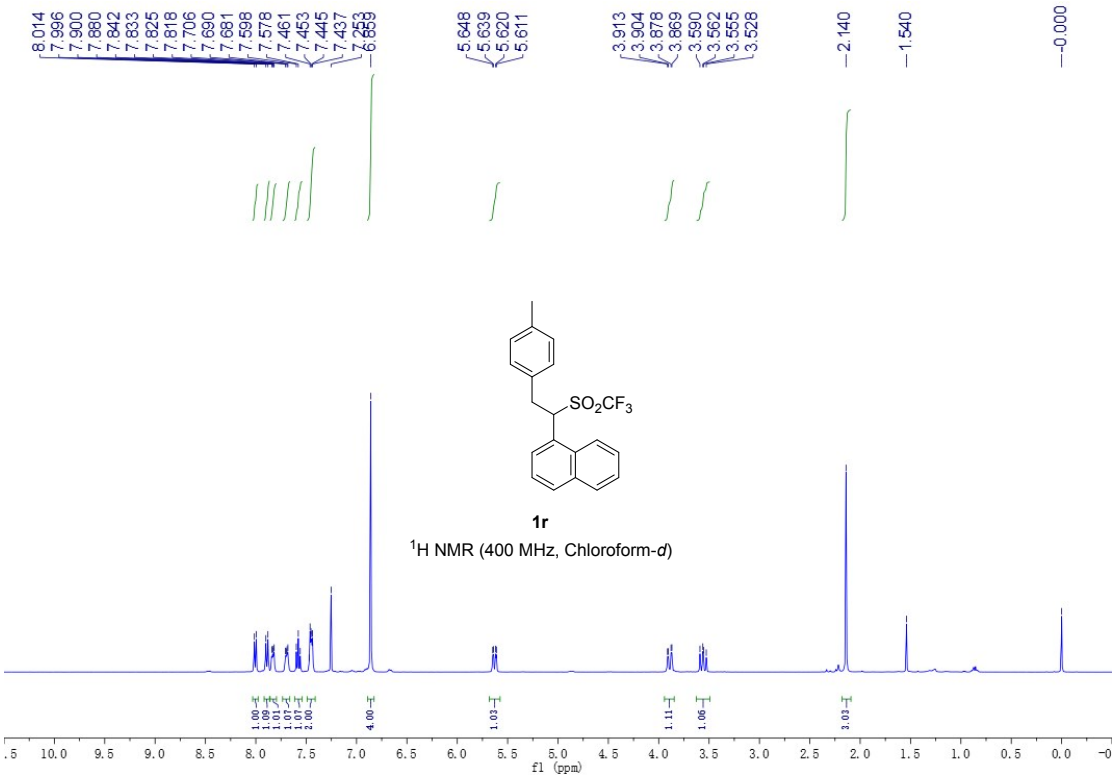
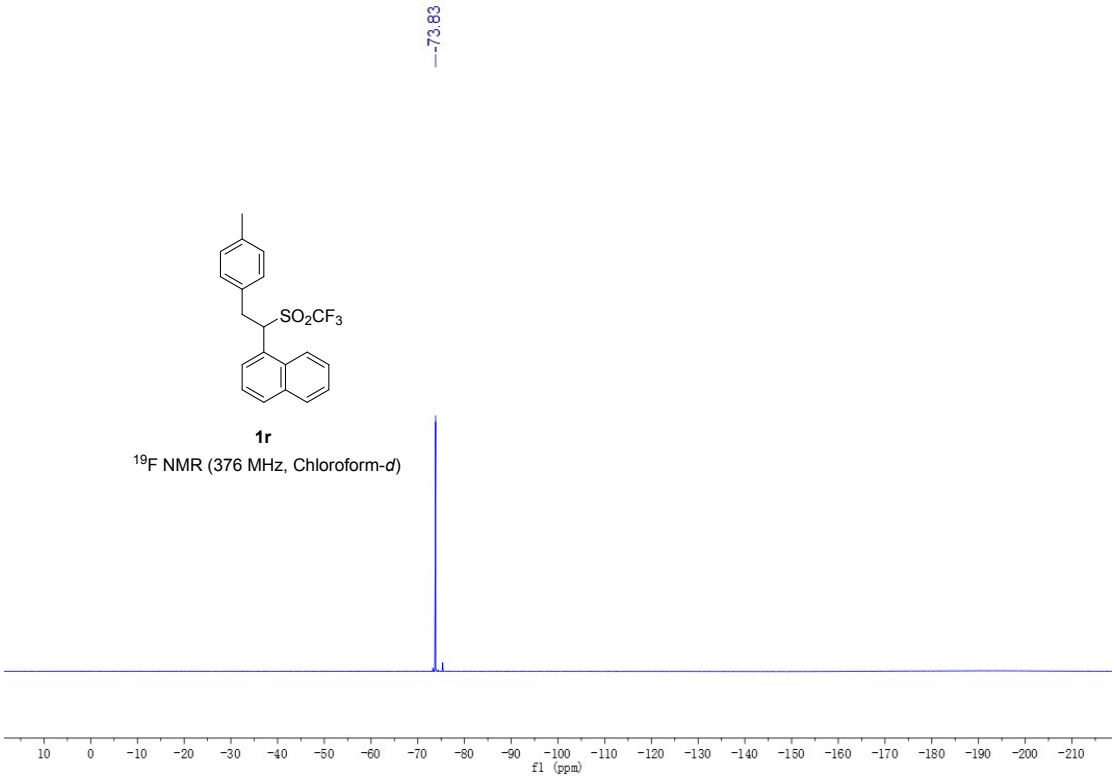


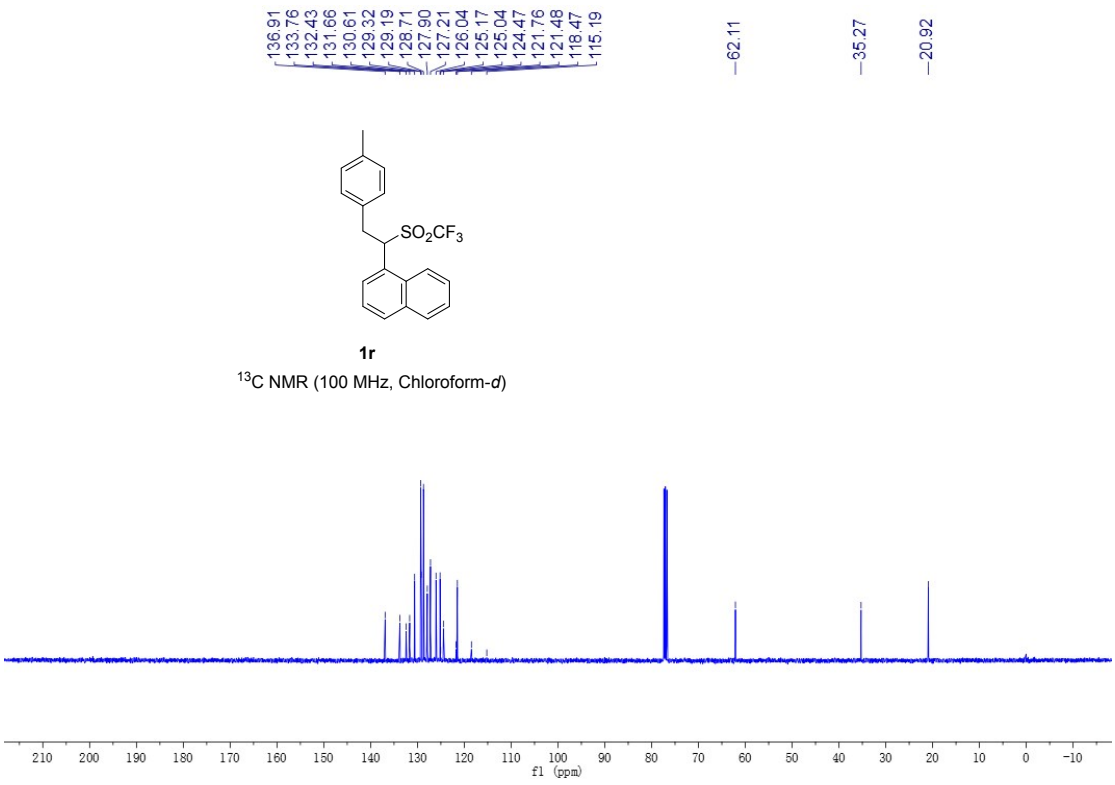
Figure S 58



1r

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

Figure S 59



1r

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 60

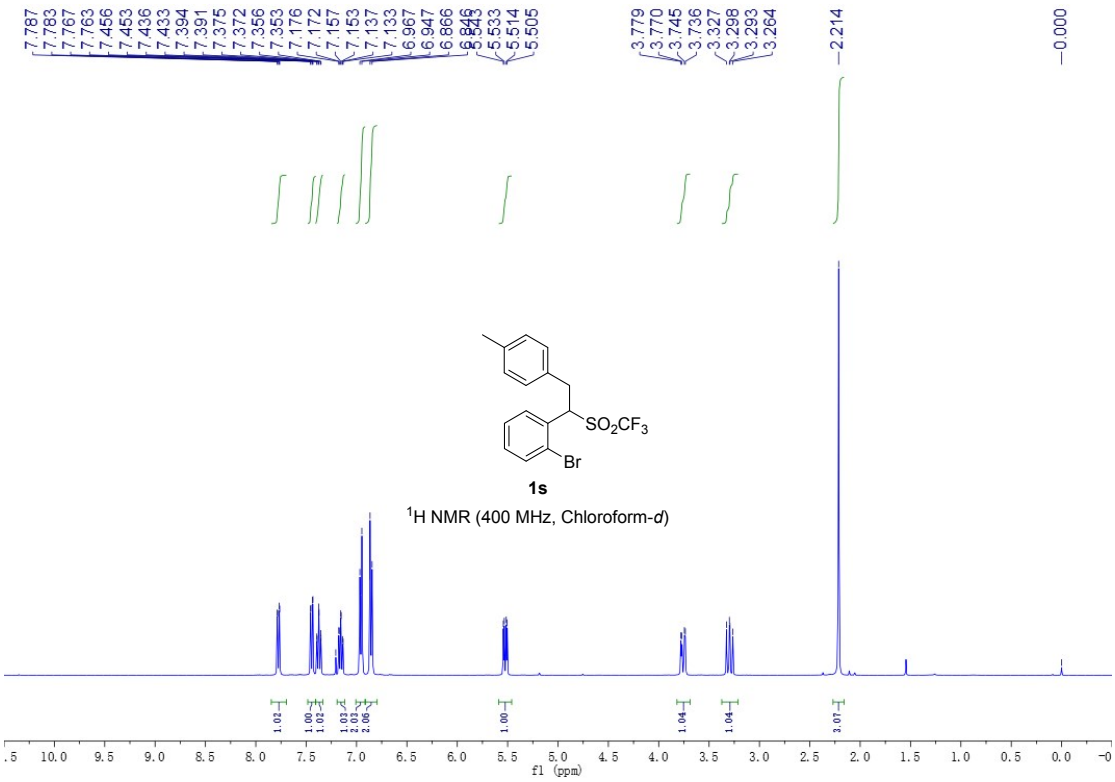


Figure S 61

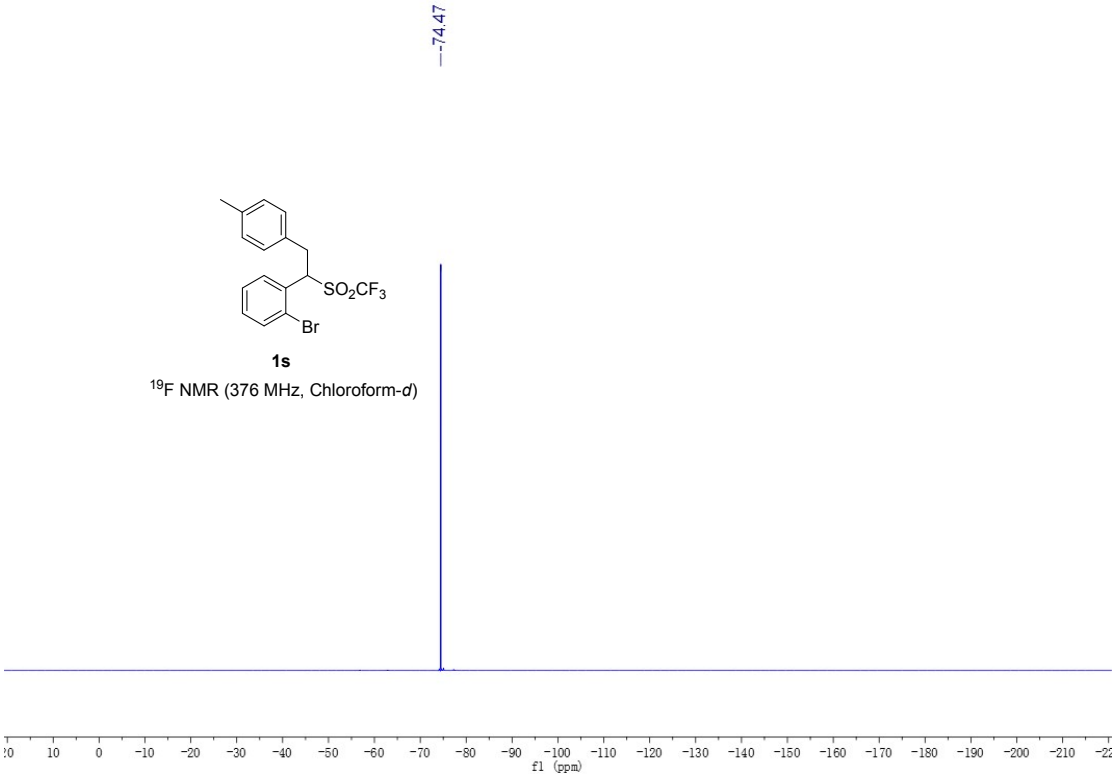


Figure S 62

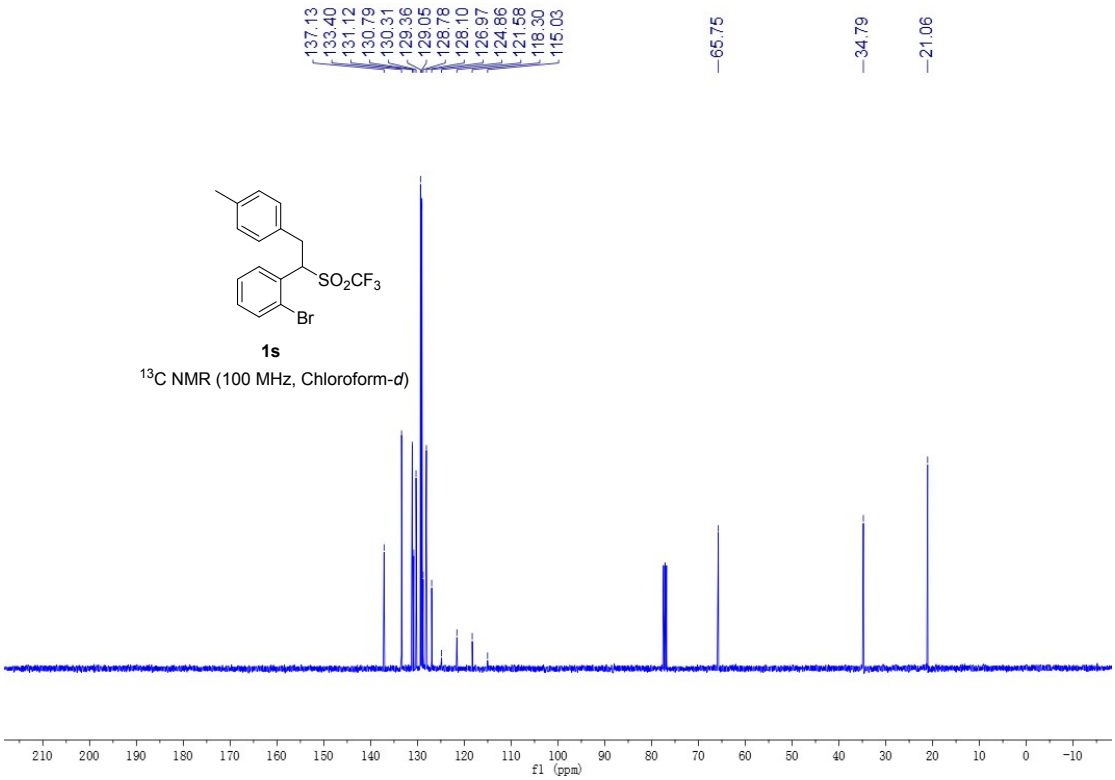


Figure S 63

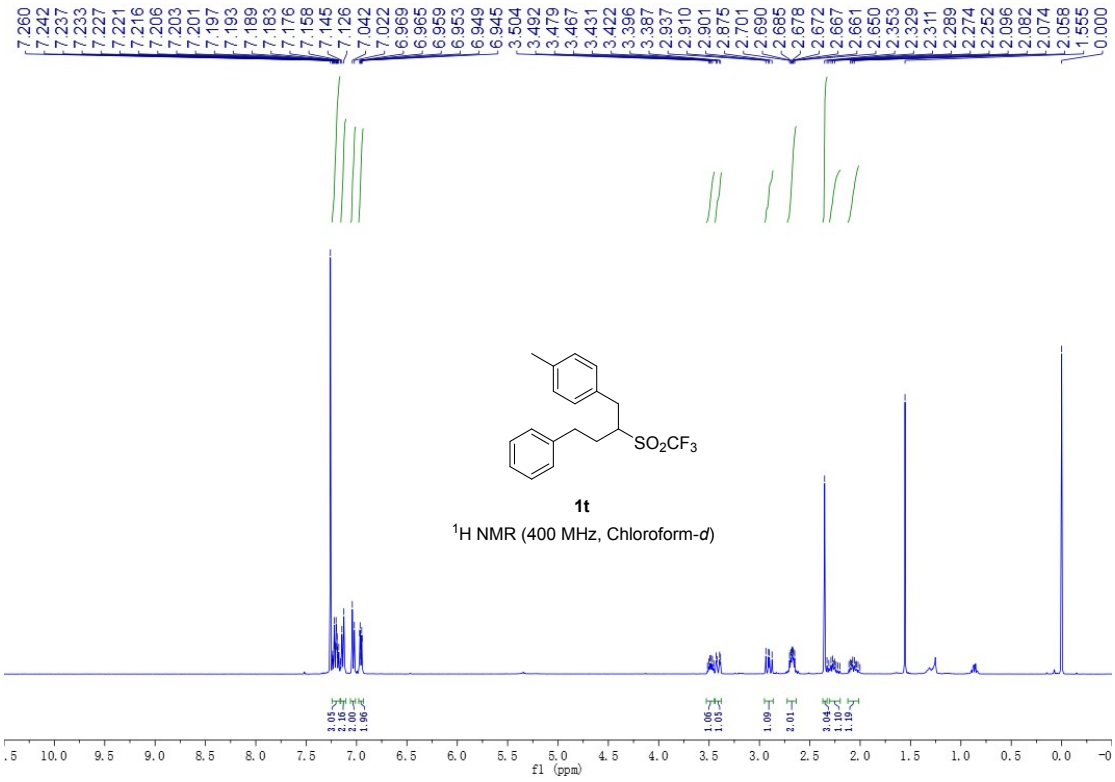


Figure S 64

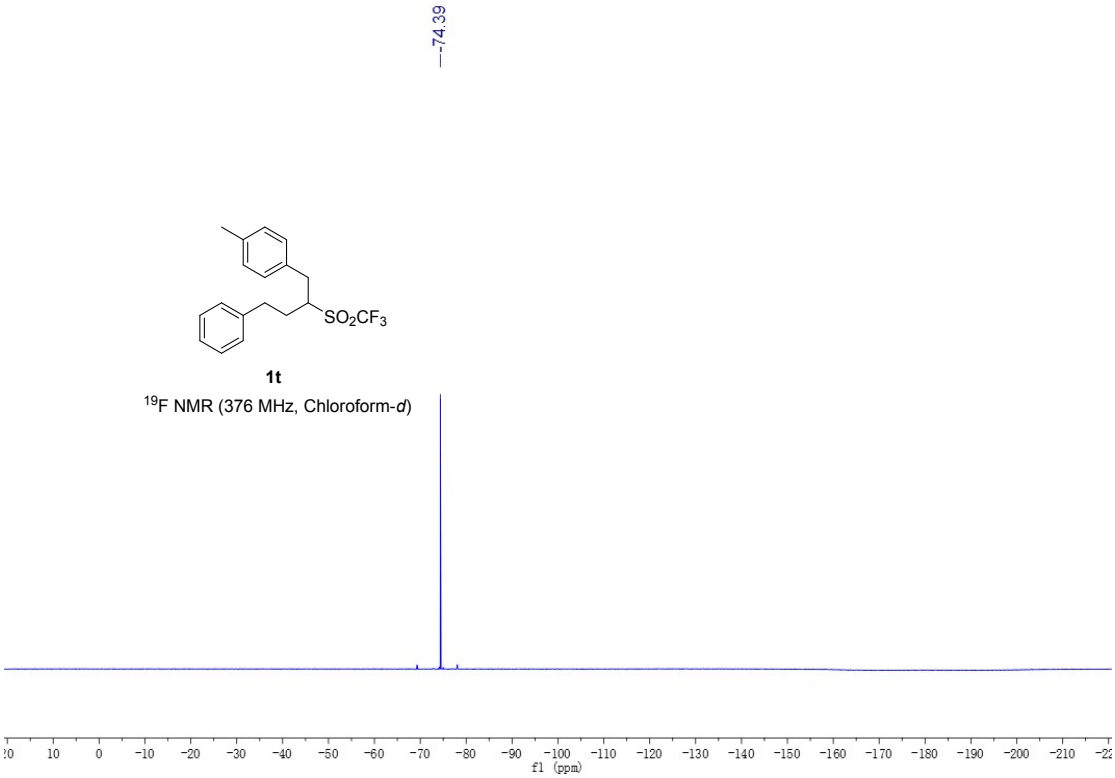


Figure S 65

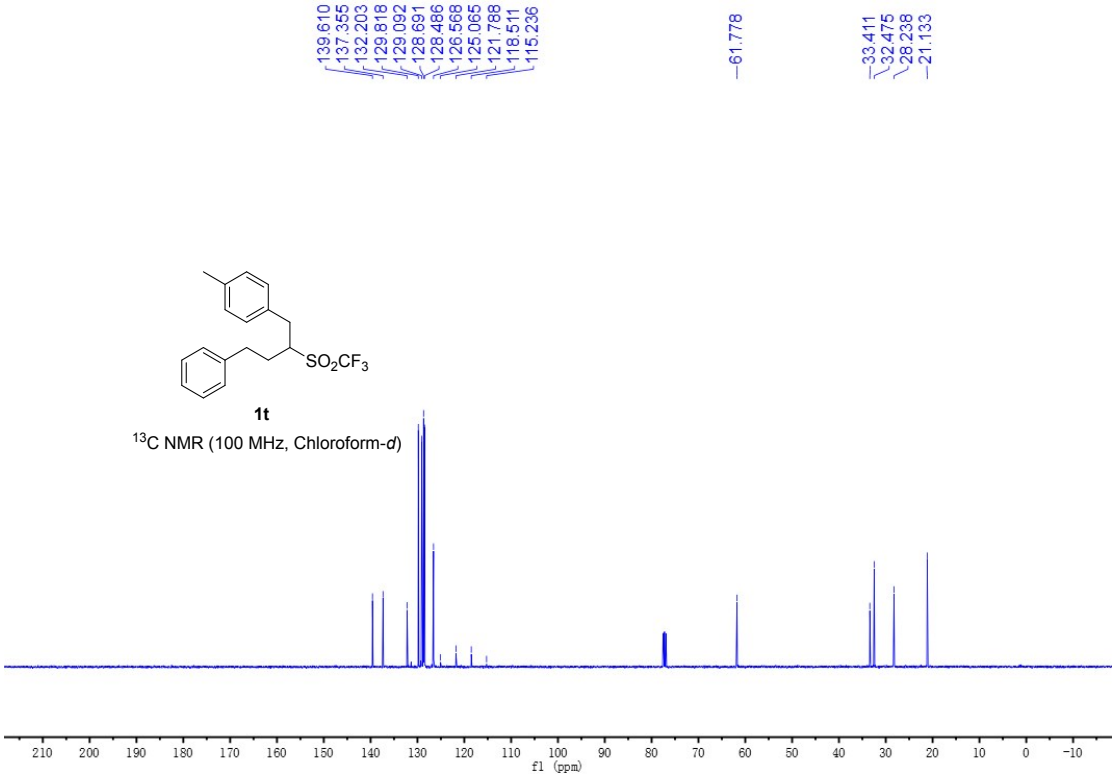


Figure S 66

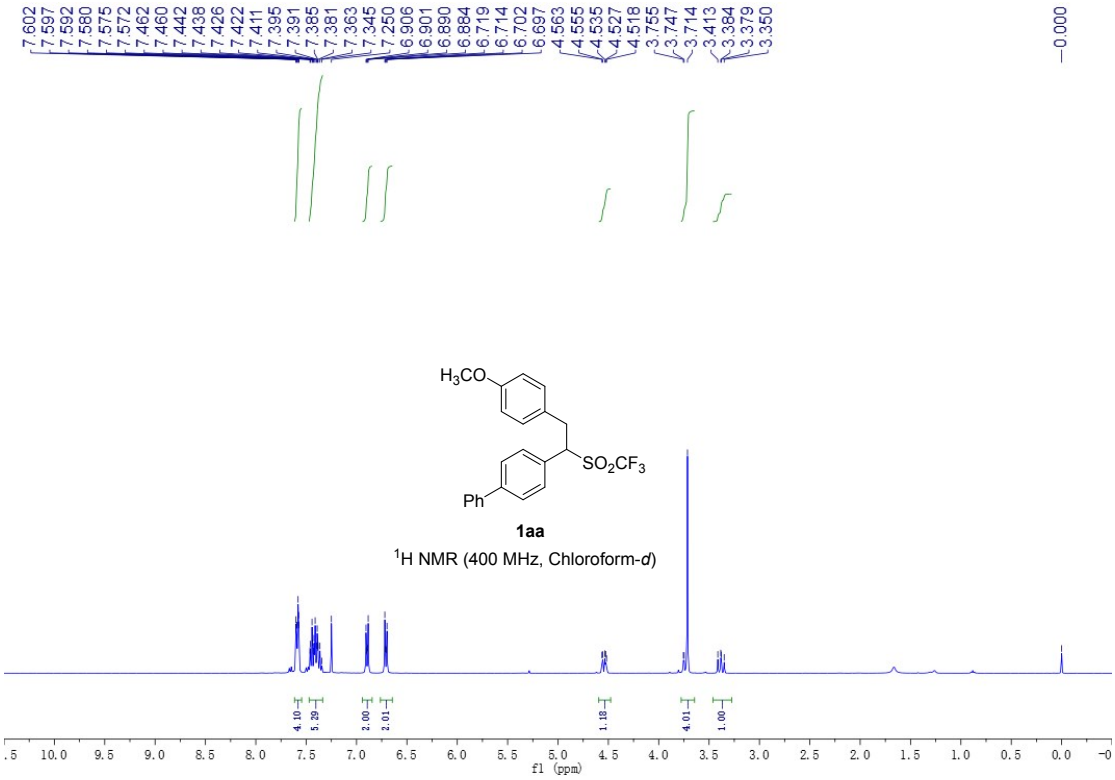


Figure S 67

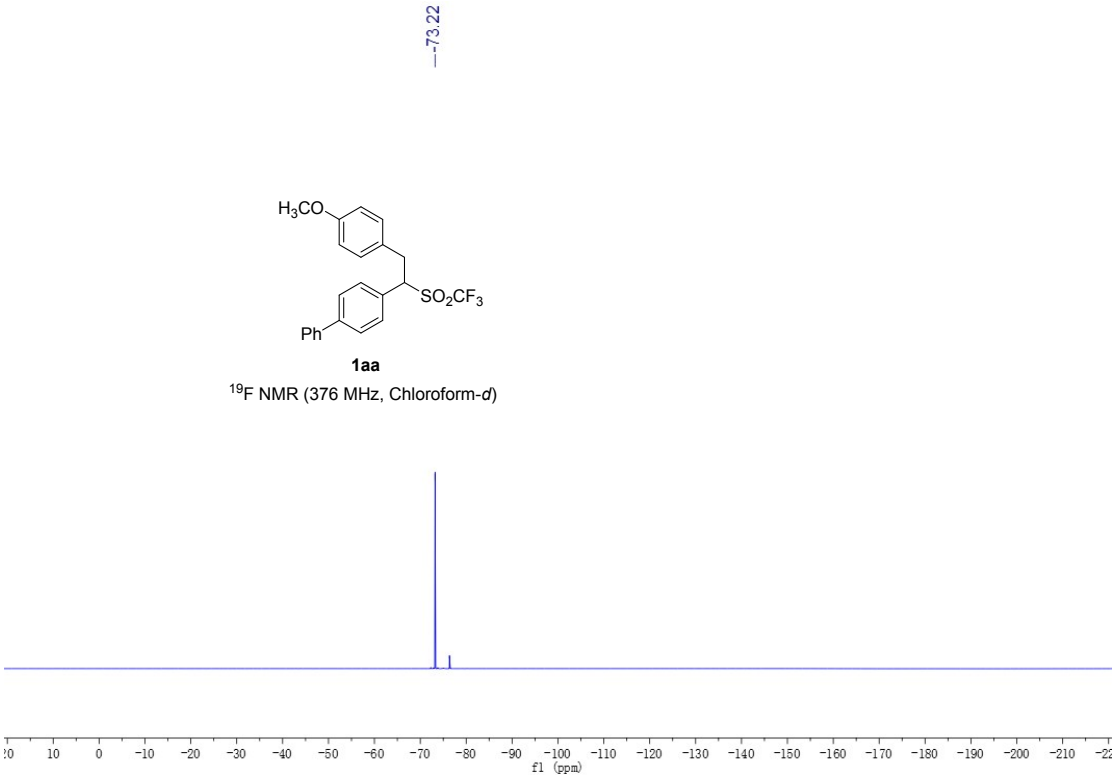


Figure S 68

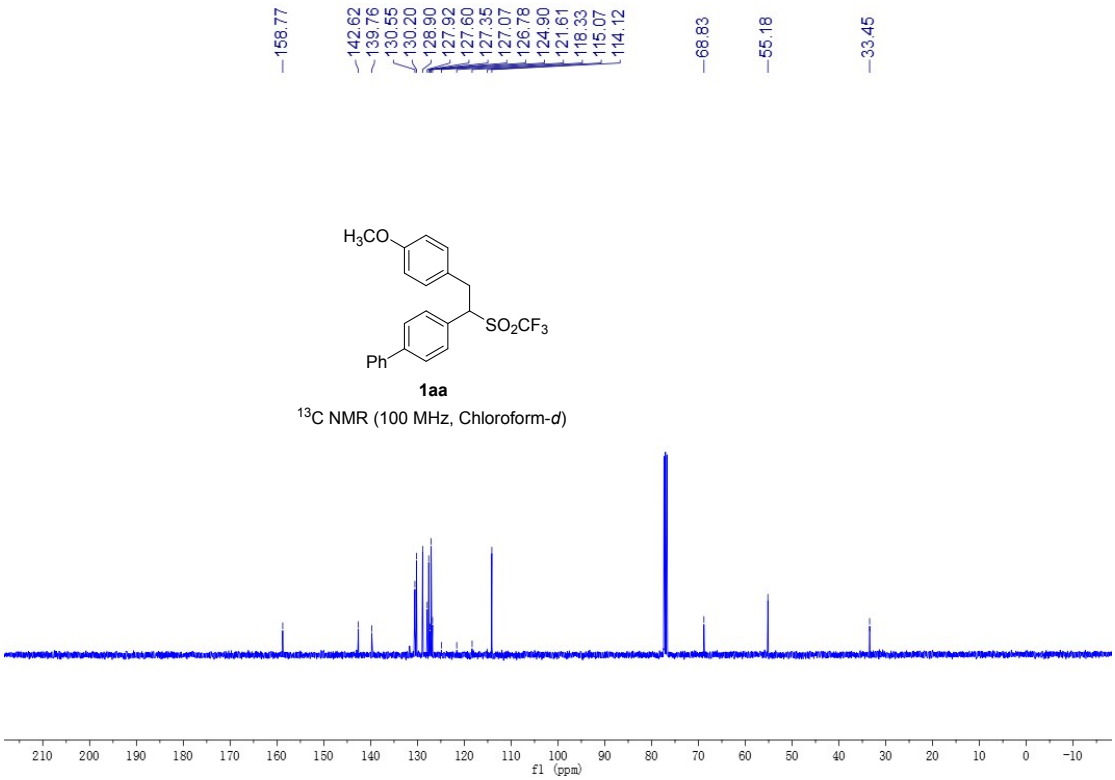


Figure S 69

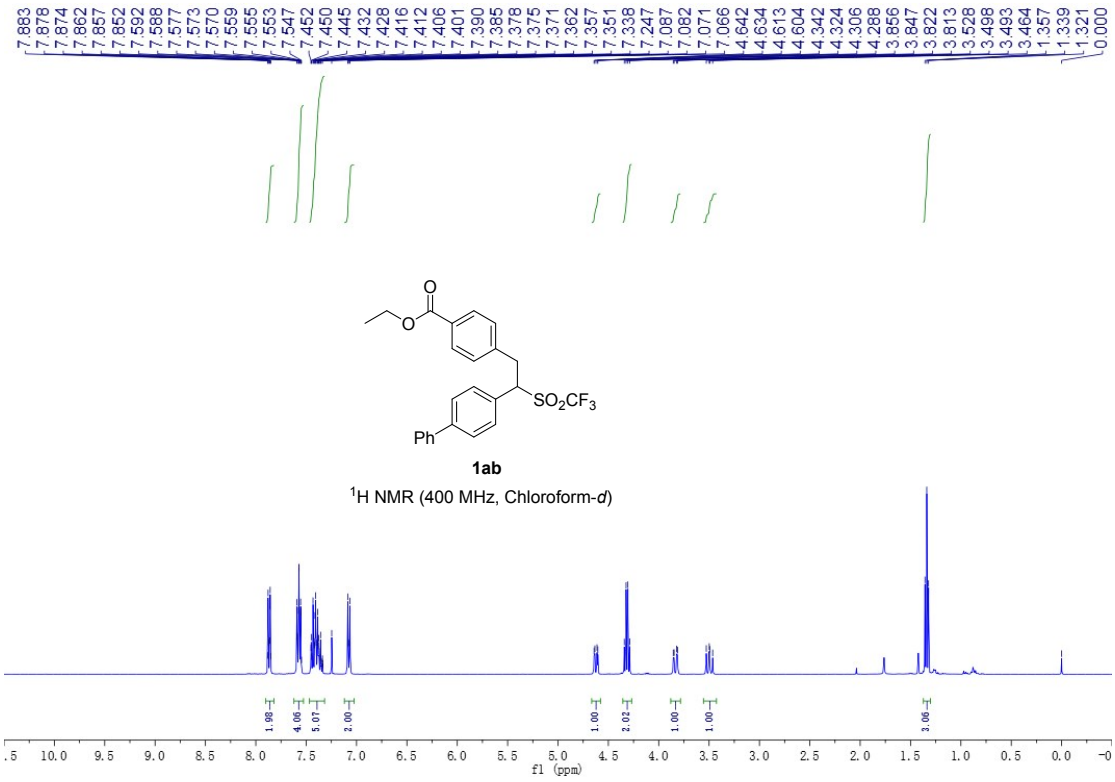
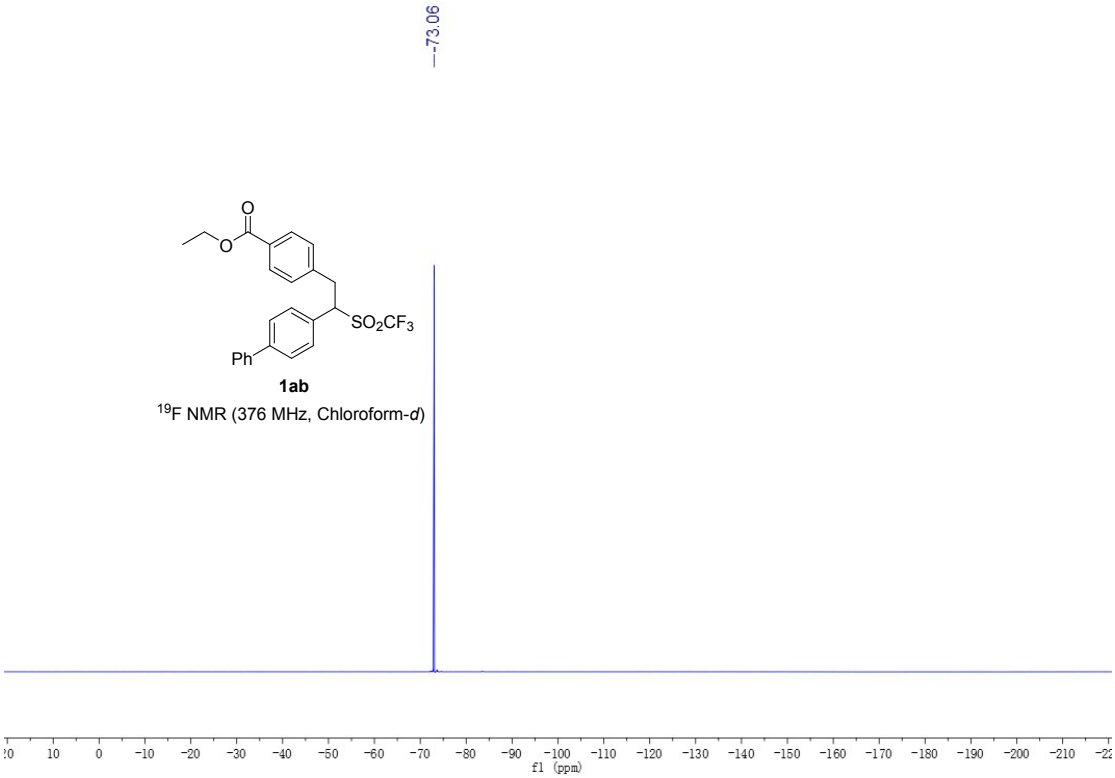


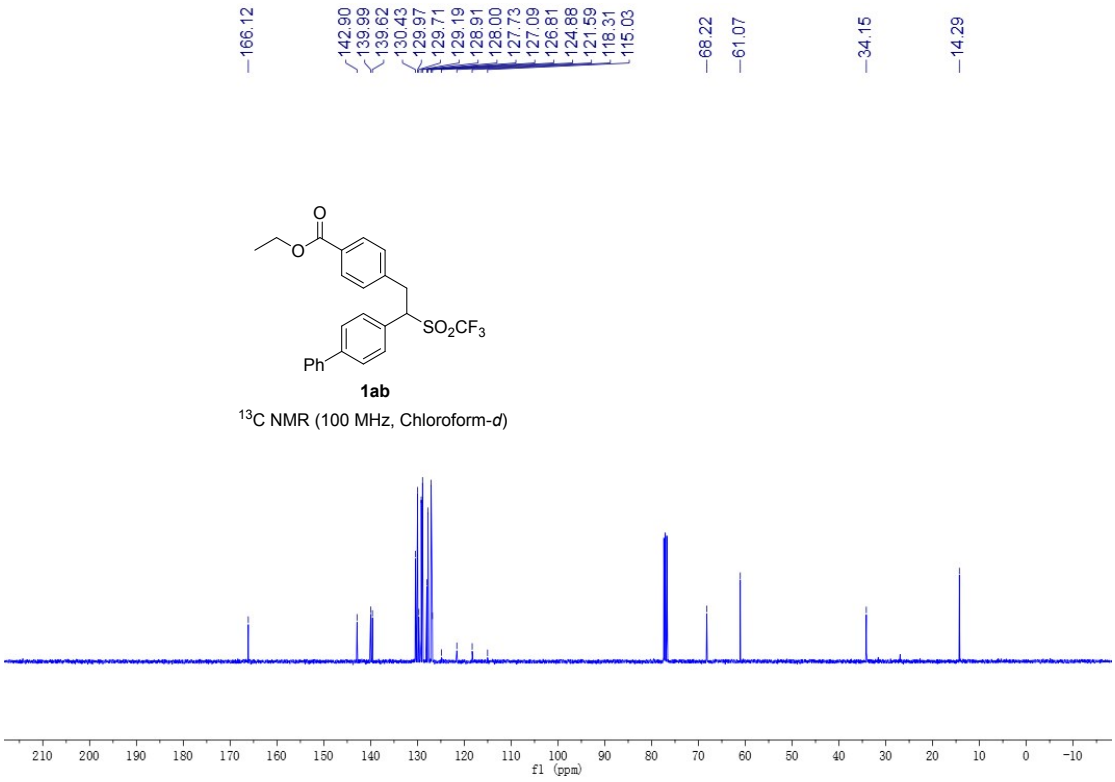
Figure S 70



1ab

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

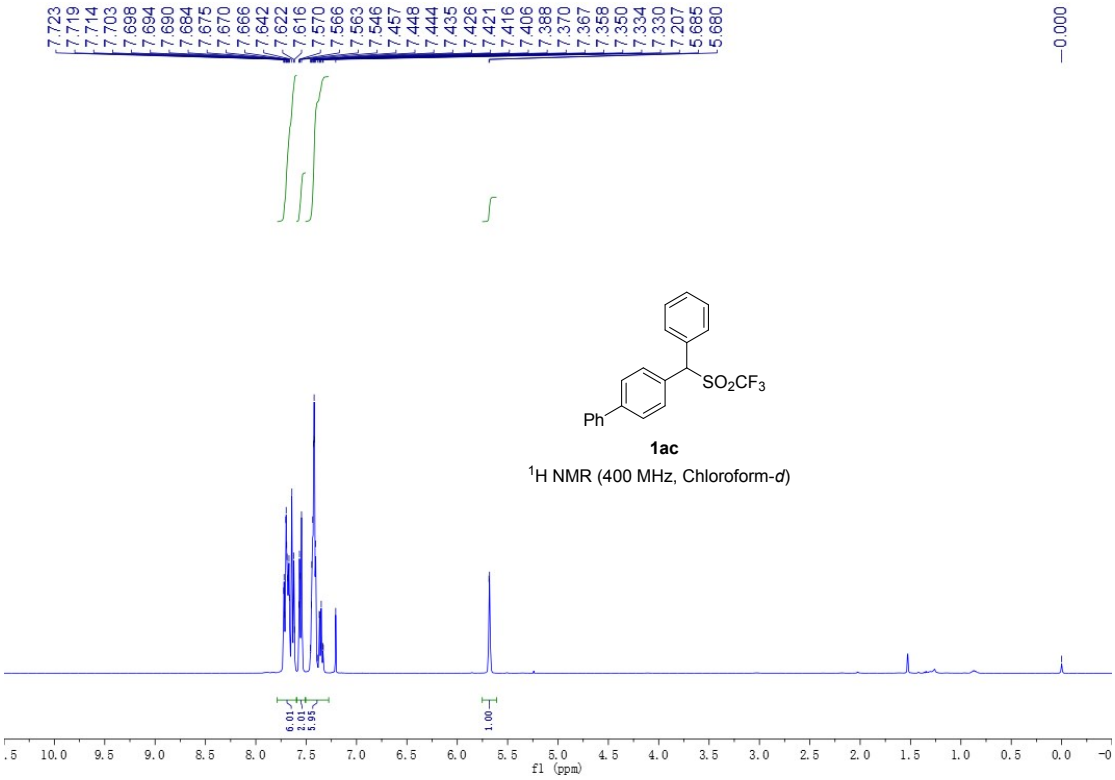
Figure S 71



1ab

^{13}C NMR (100 MHz, Chloroform-*d*)

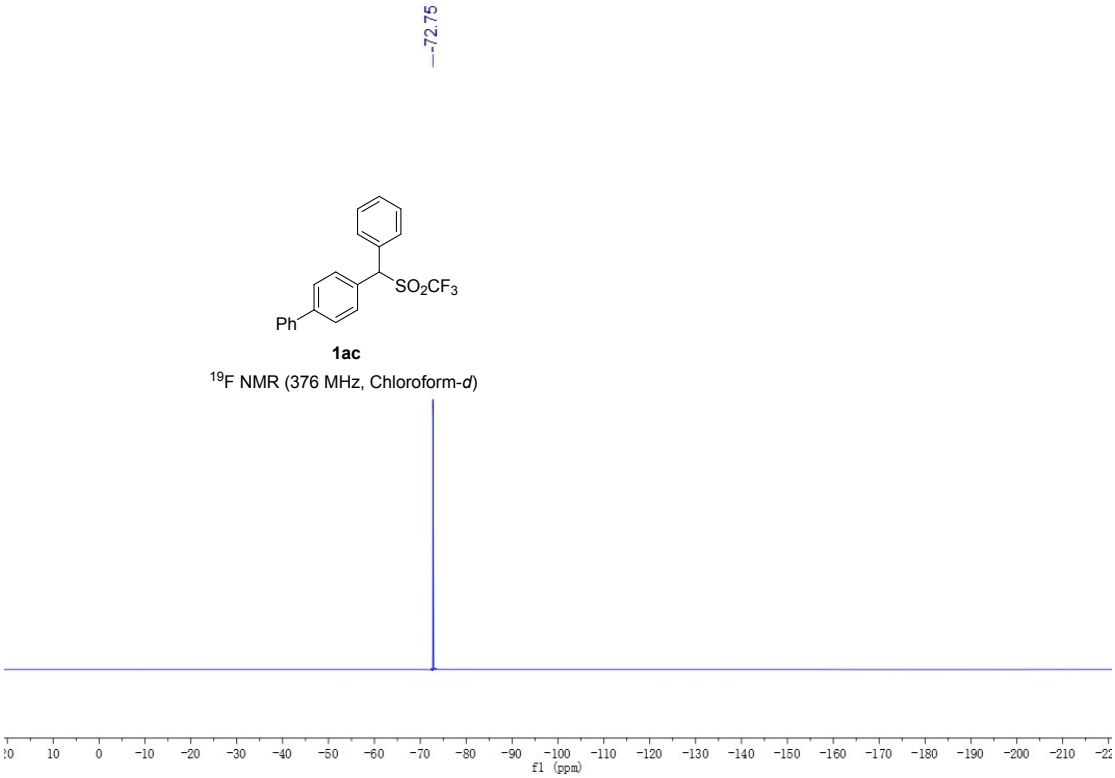
Figure S 72



1ac

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 73



1ac

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

Figure S 74

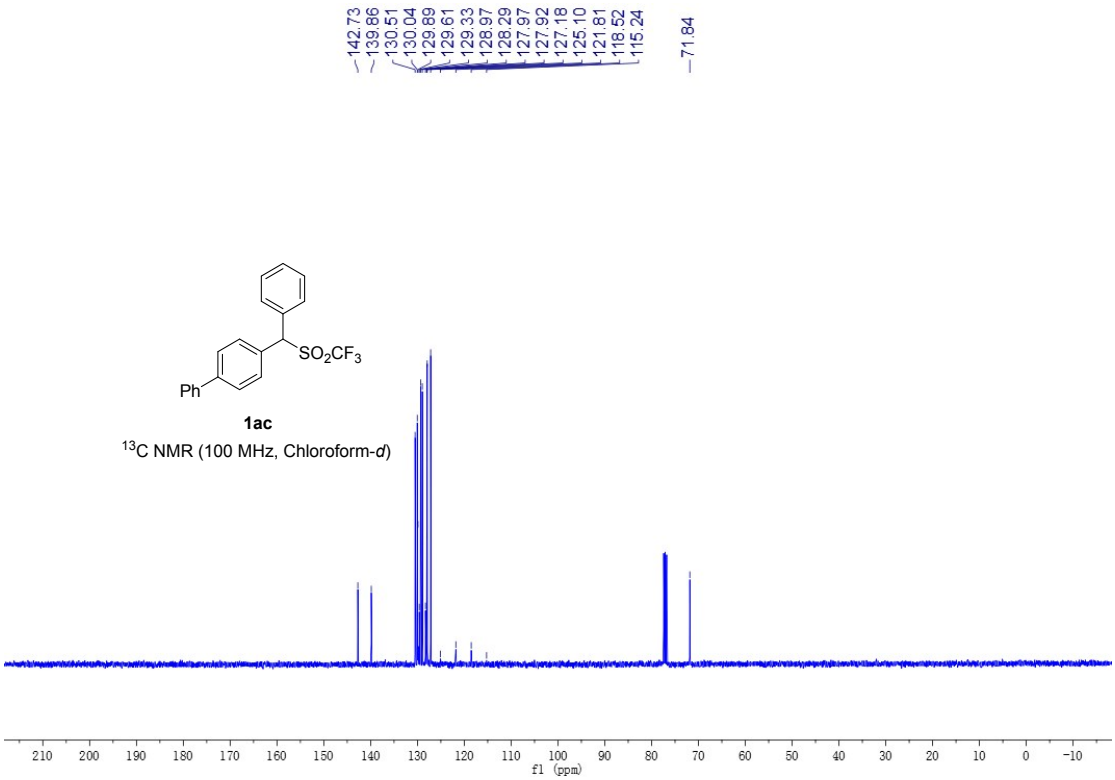


Figure S 75

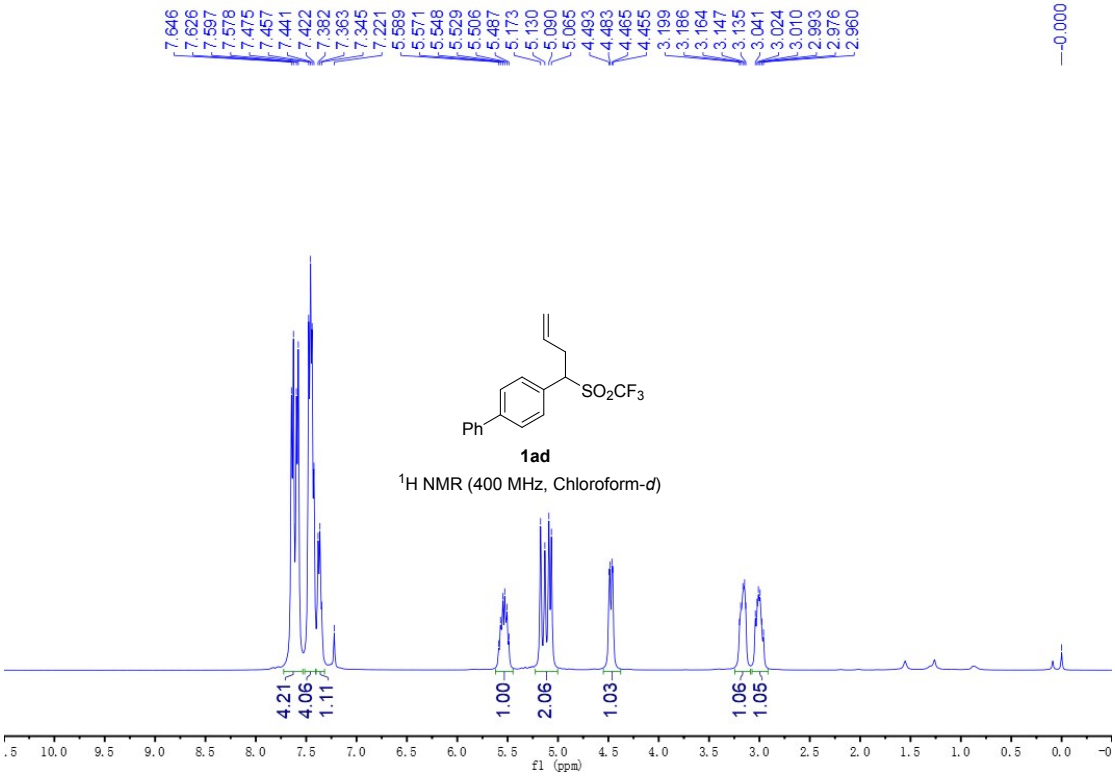


Figure S 76

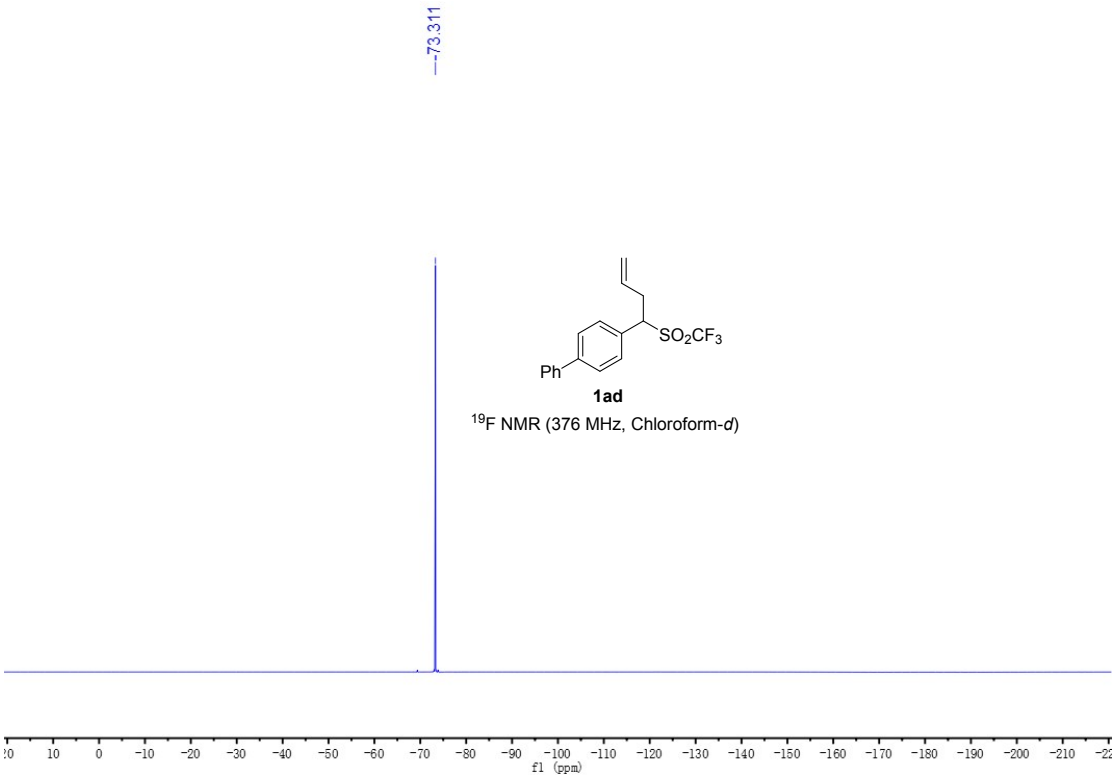


Figure S 77

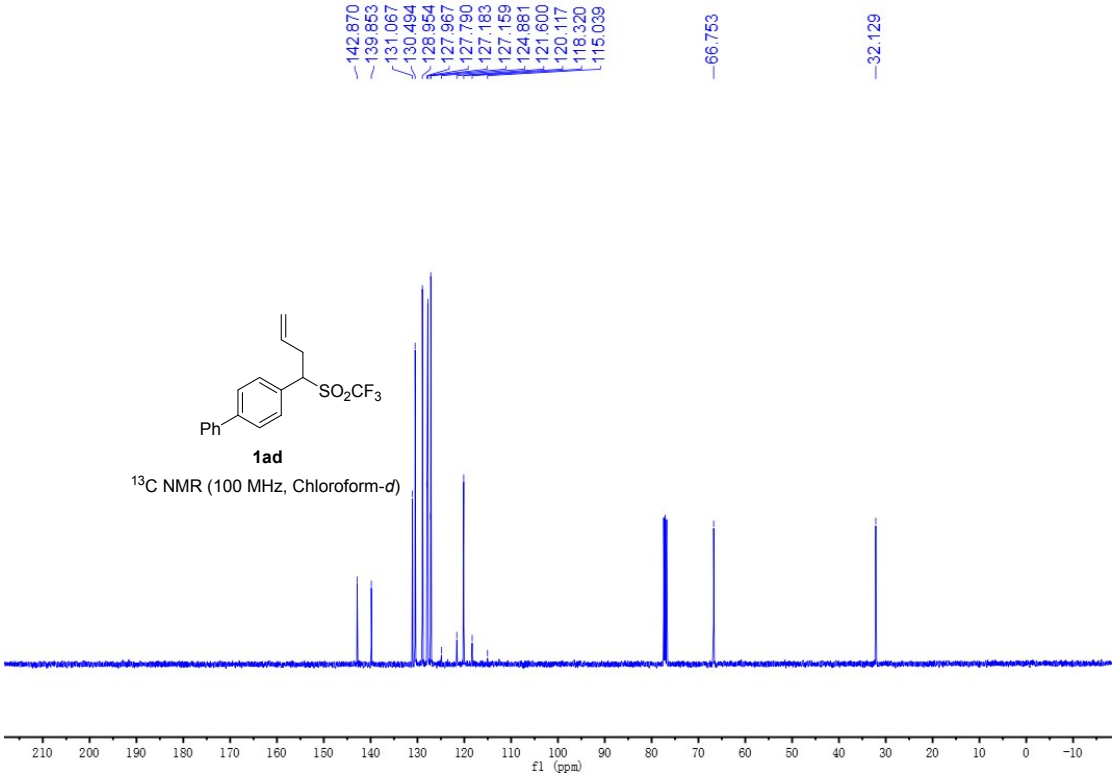


Figure S 78

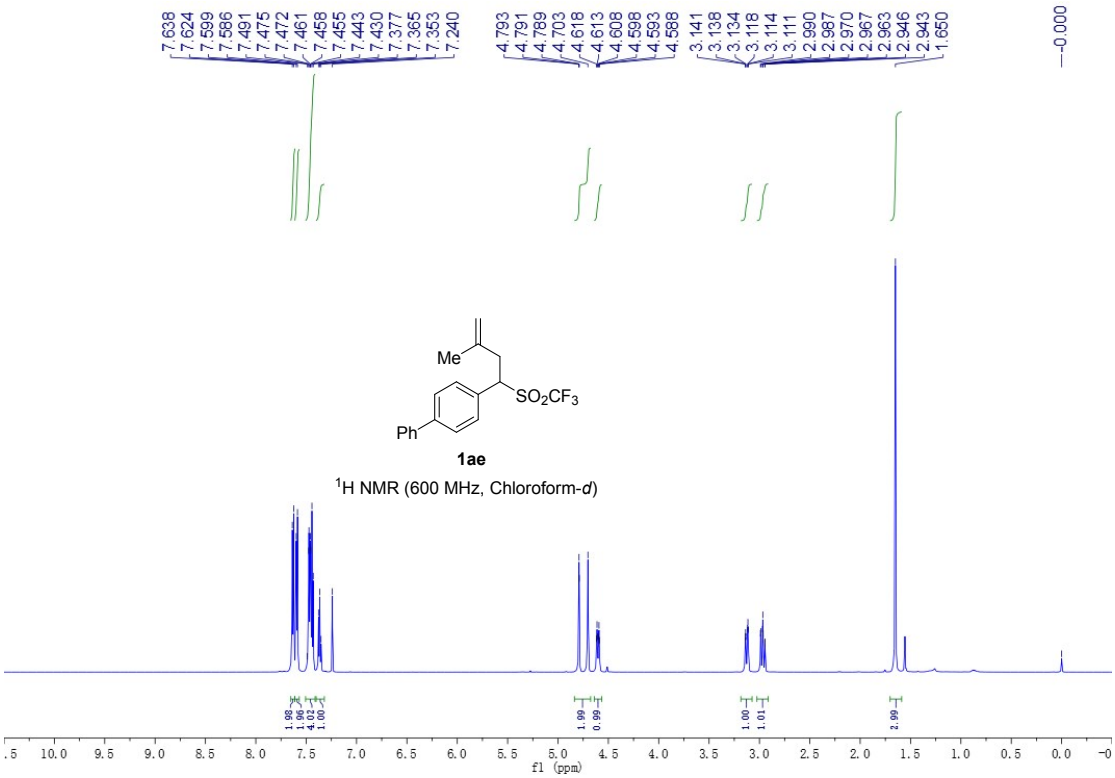


Figure S 79

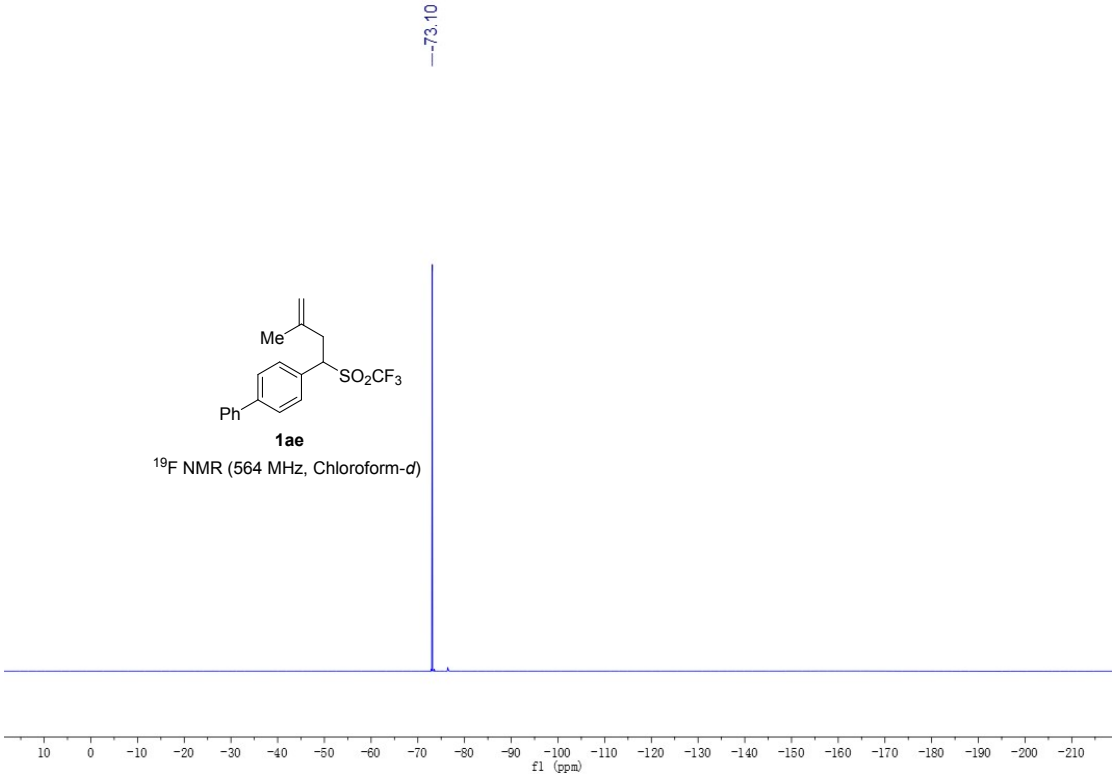


Figure S 80

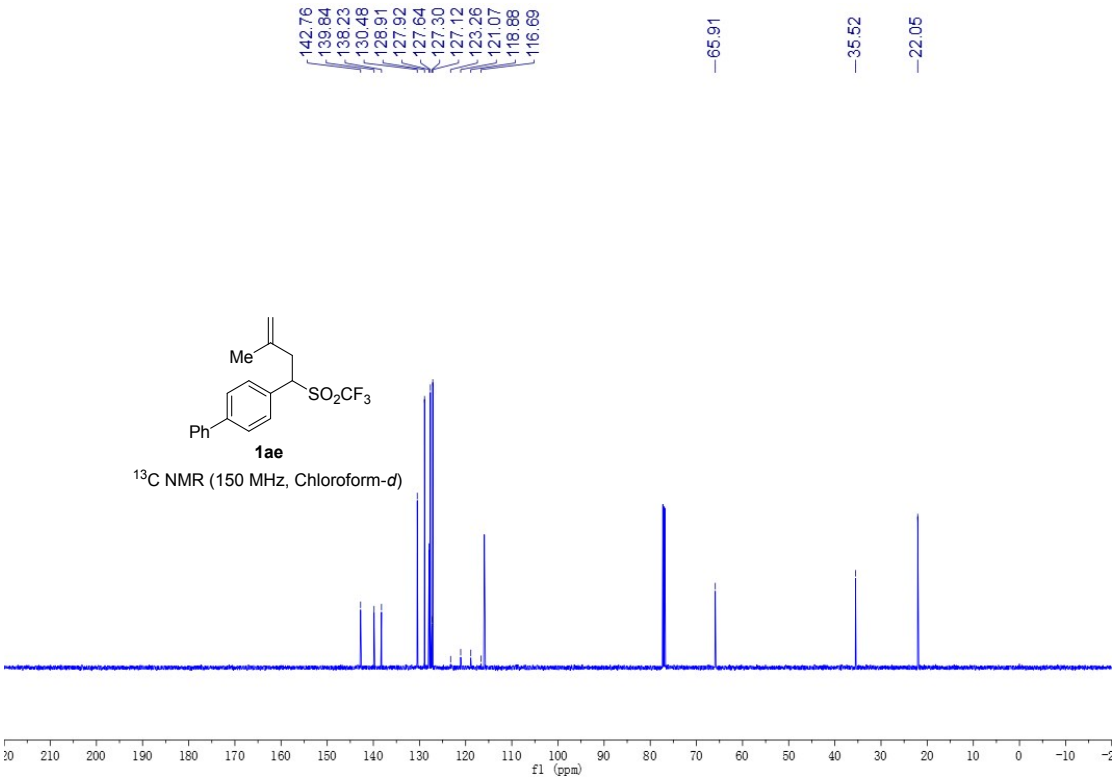


Figure S 81

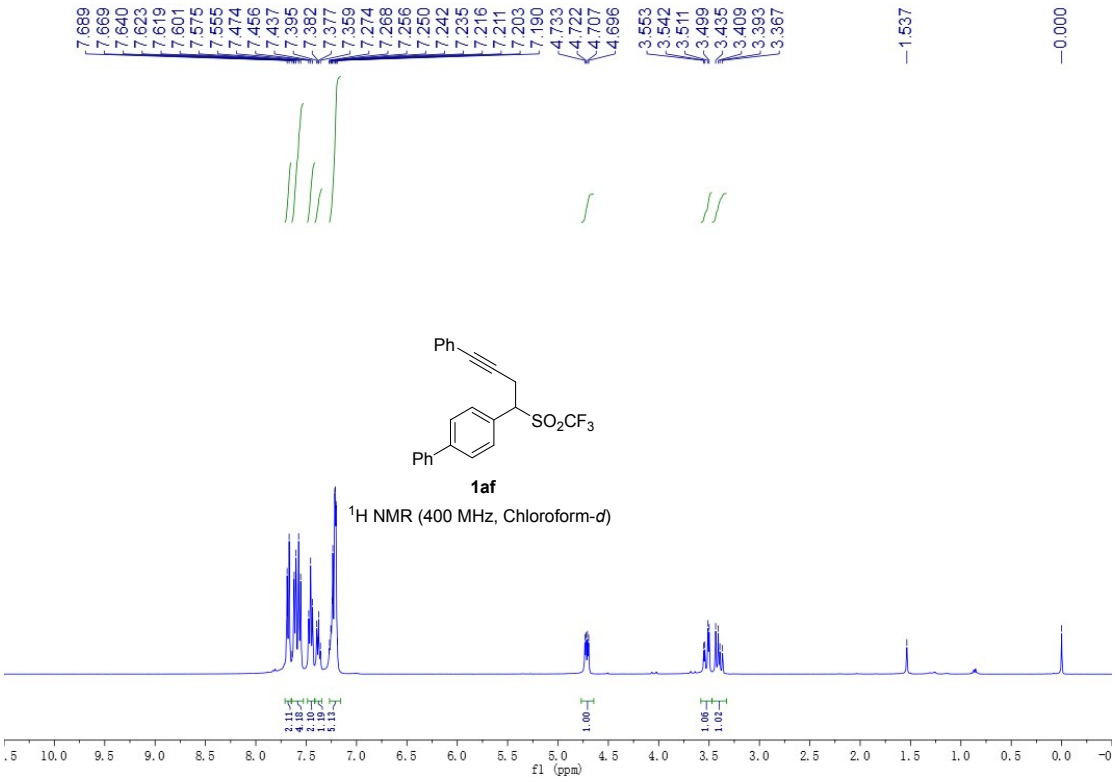


Figure S 82

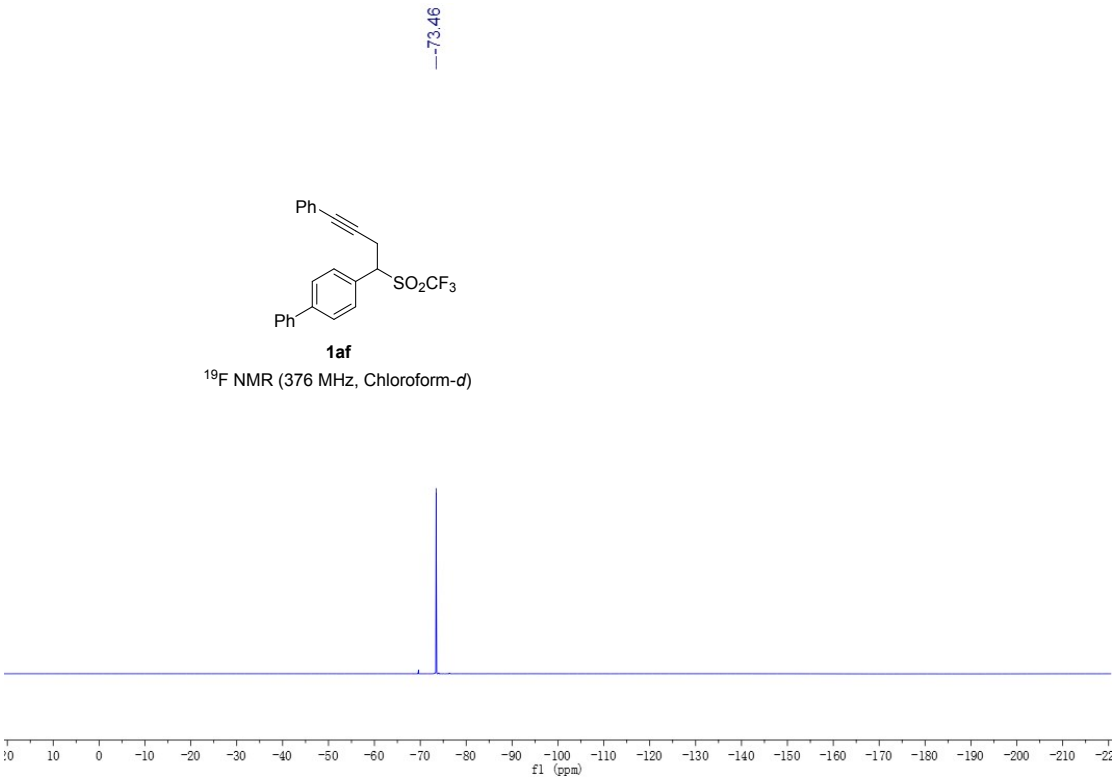


Figure S 83

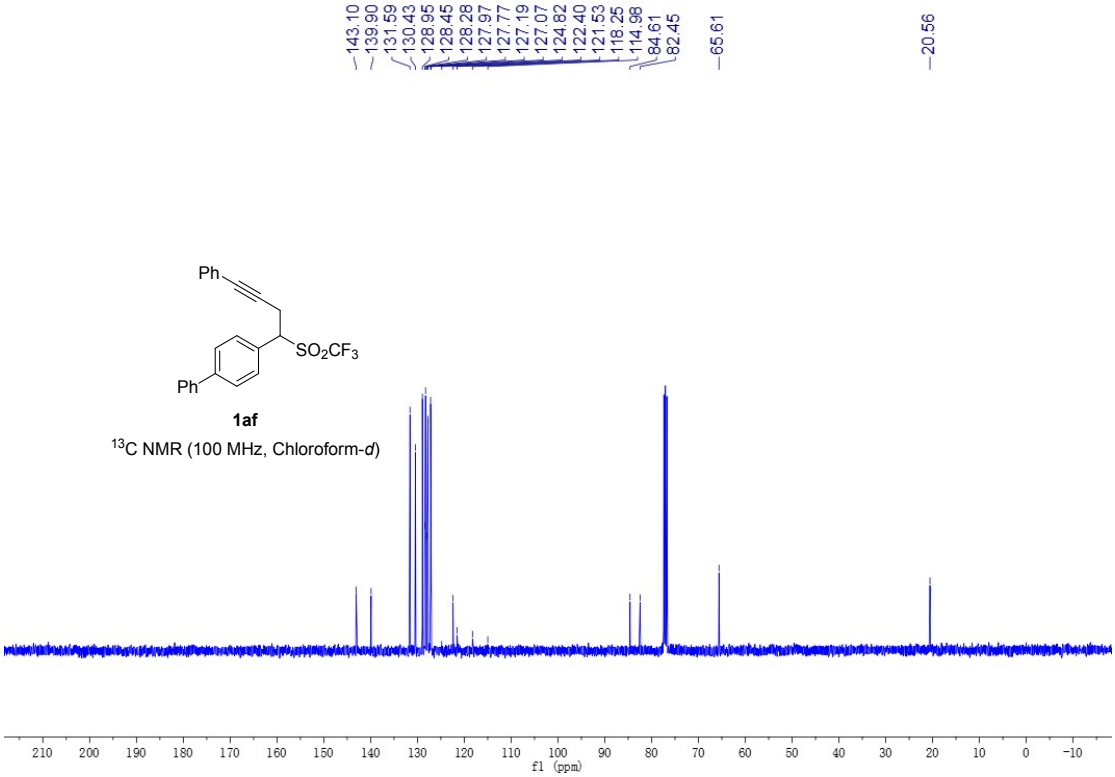
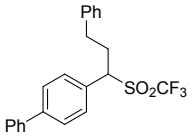


Figure S 84



1ag

^{1}H NMR (400 MHz, Chloroform-*d*)

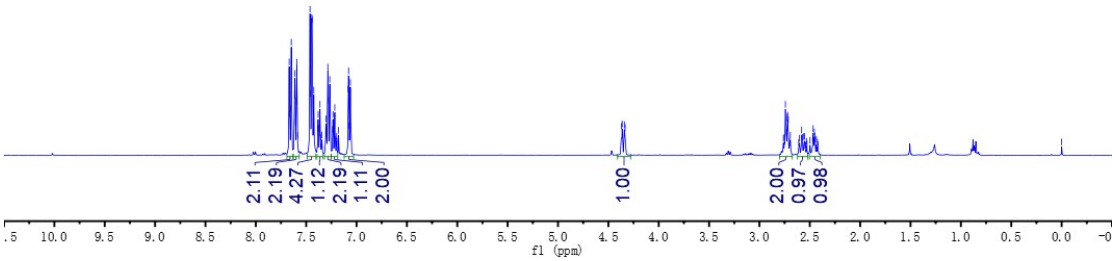
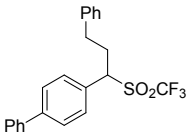


Figure S 85



1ag

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

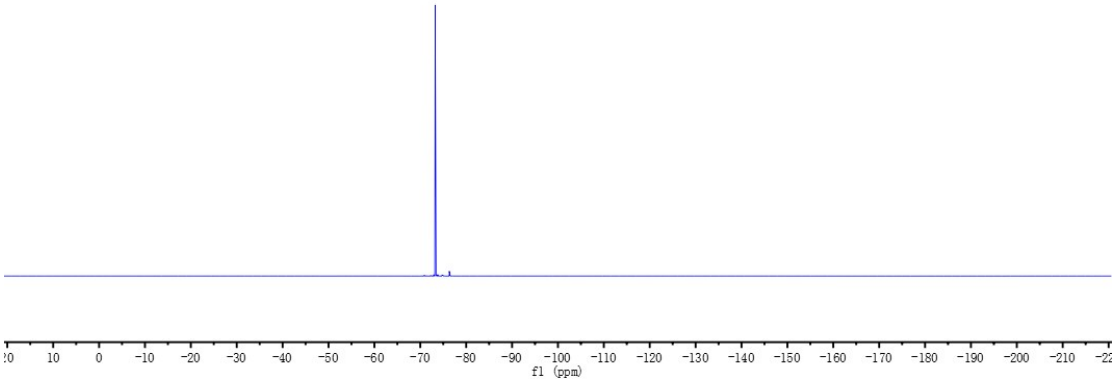


Figure S 86

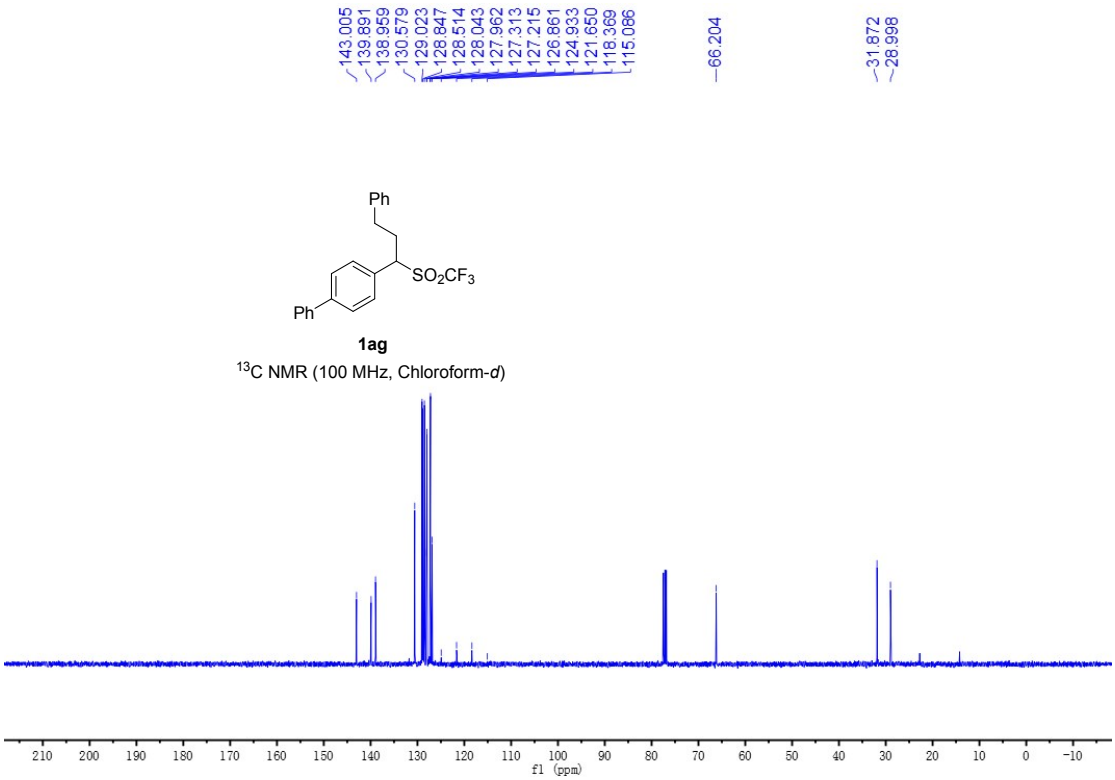


Figure S 87

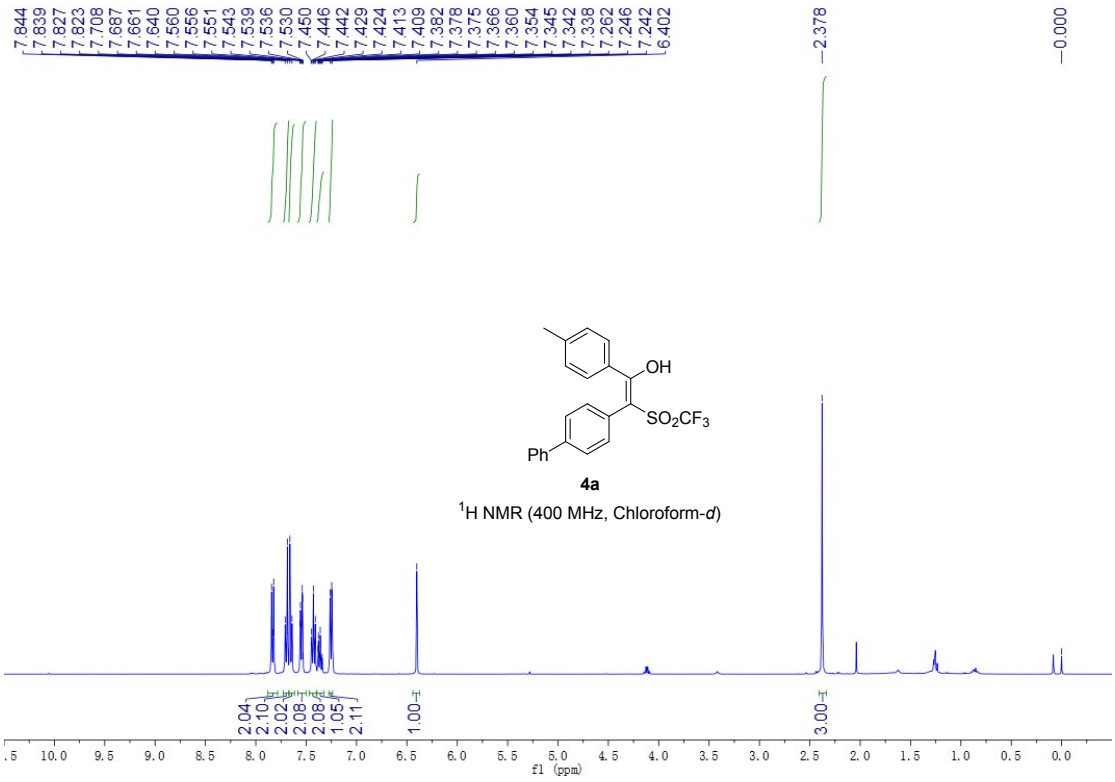


Figure S 88

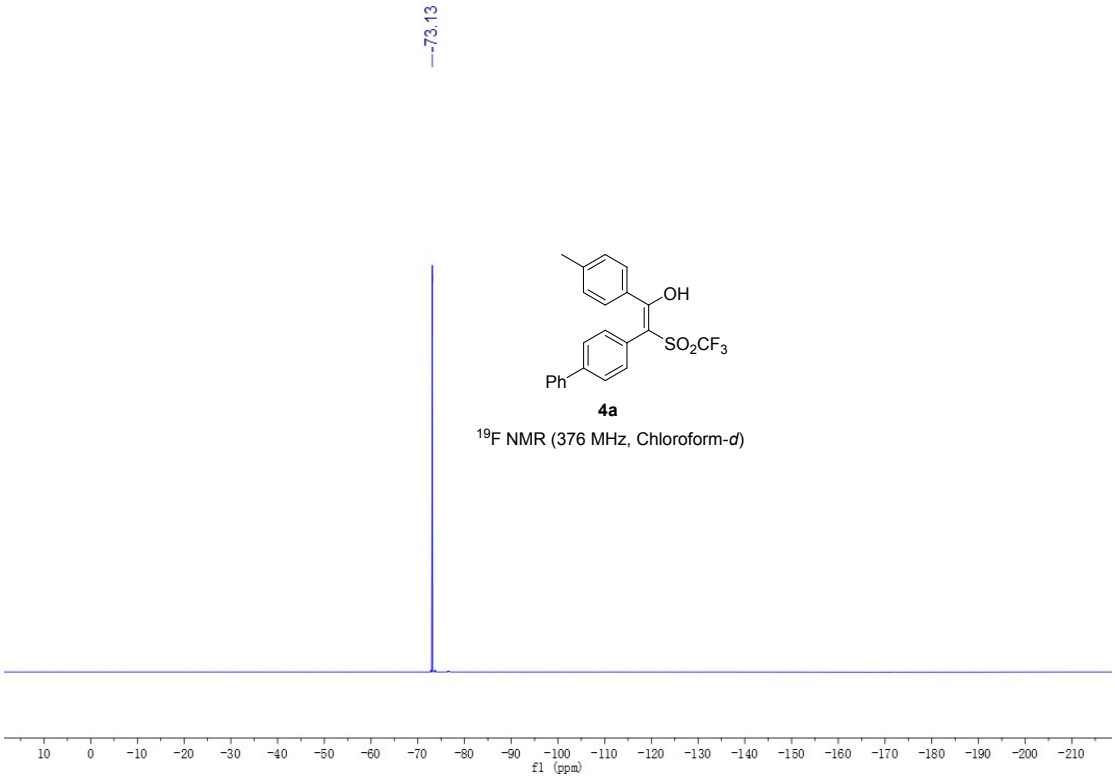


Figure S 89

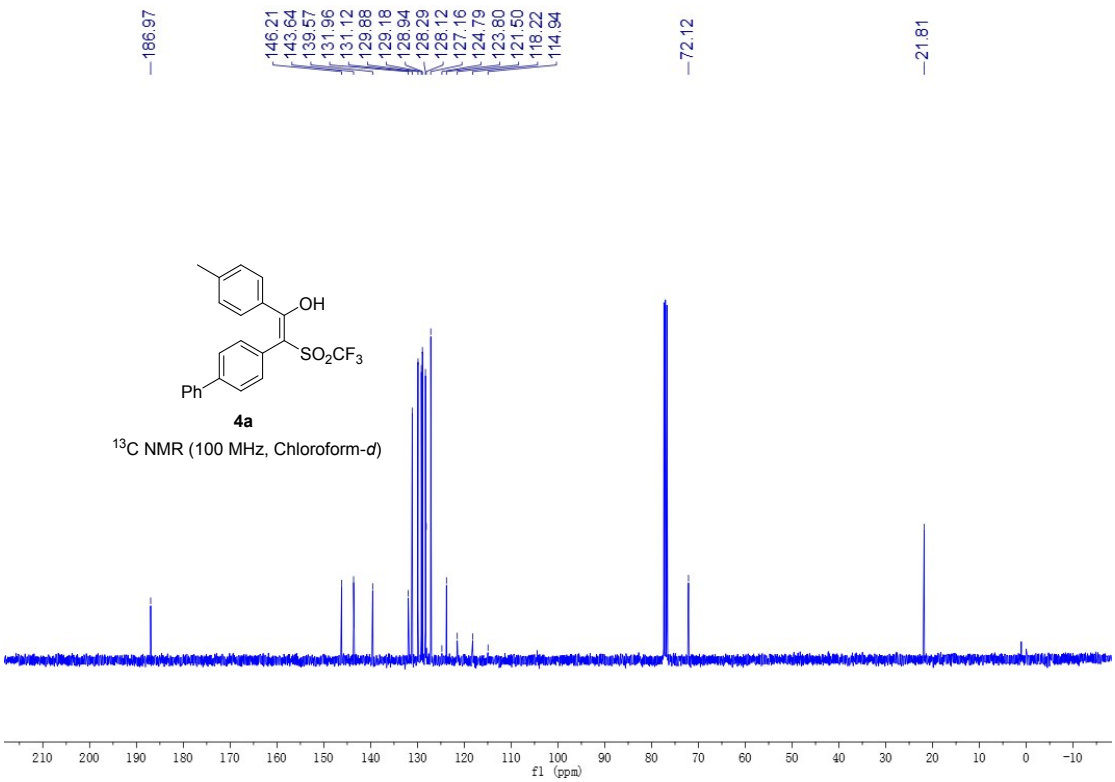


Figure S 90

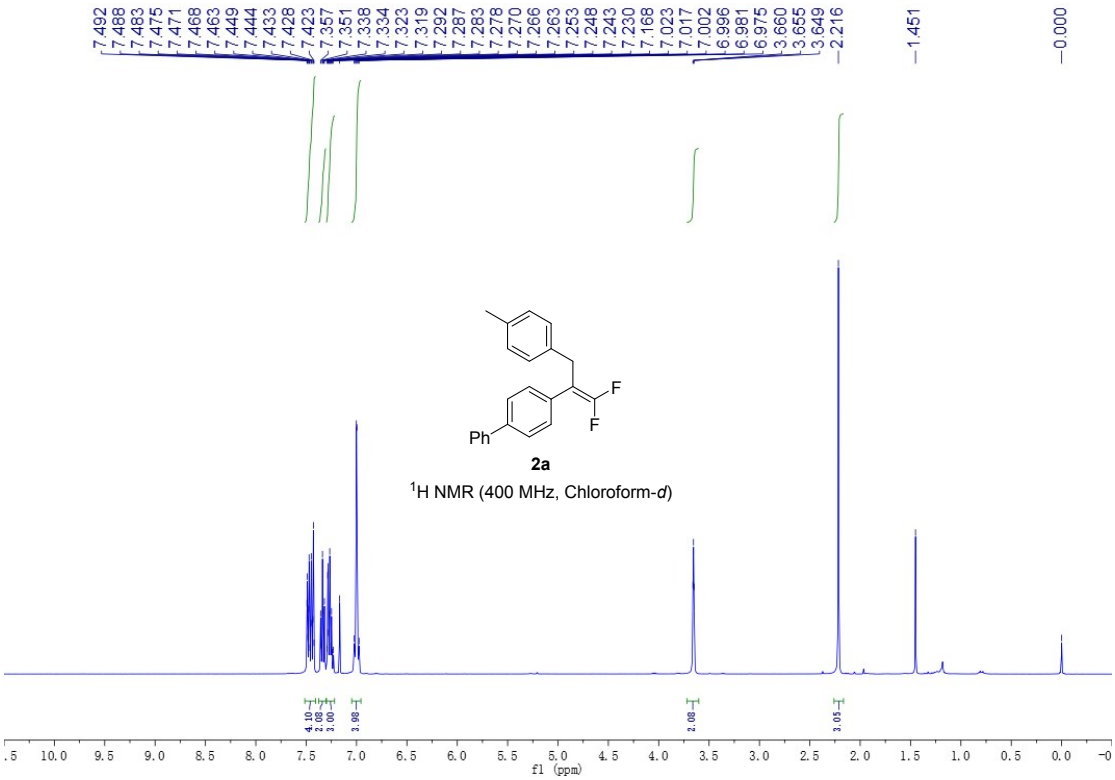


Figure S 91

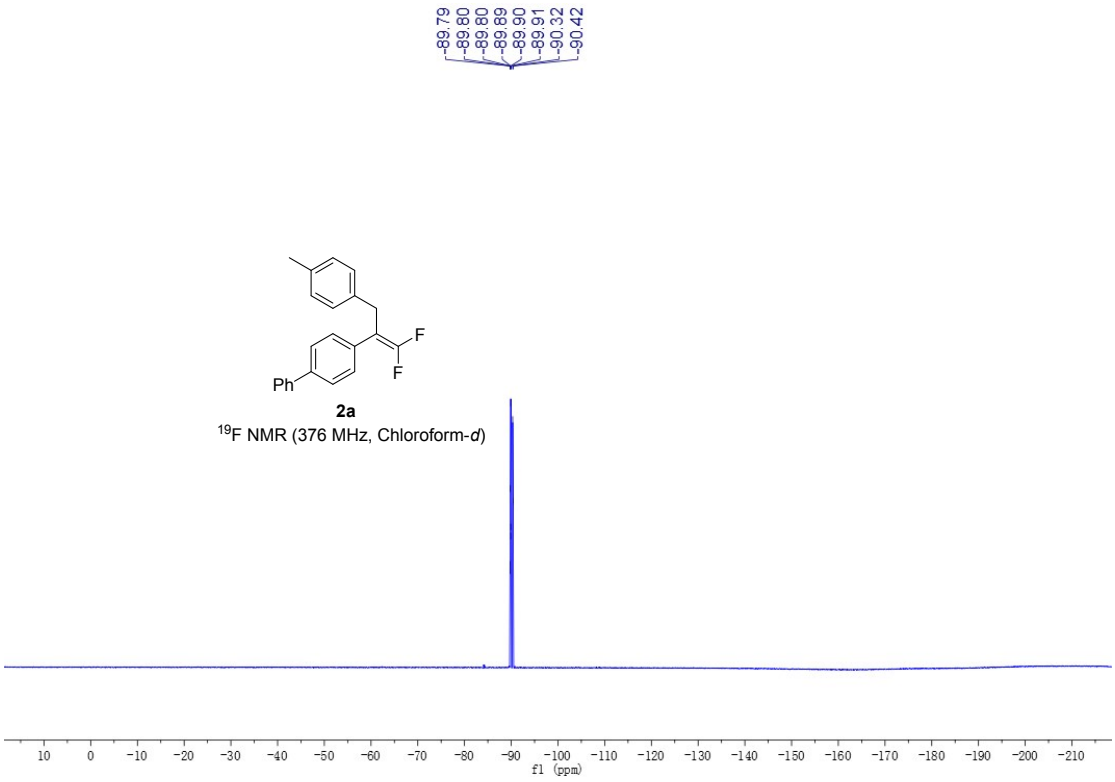
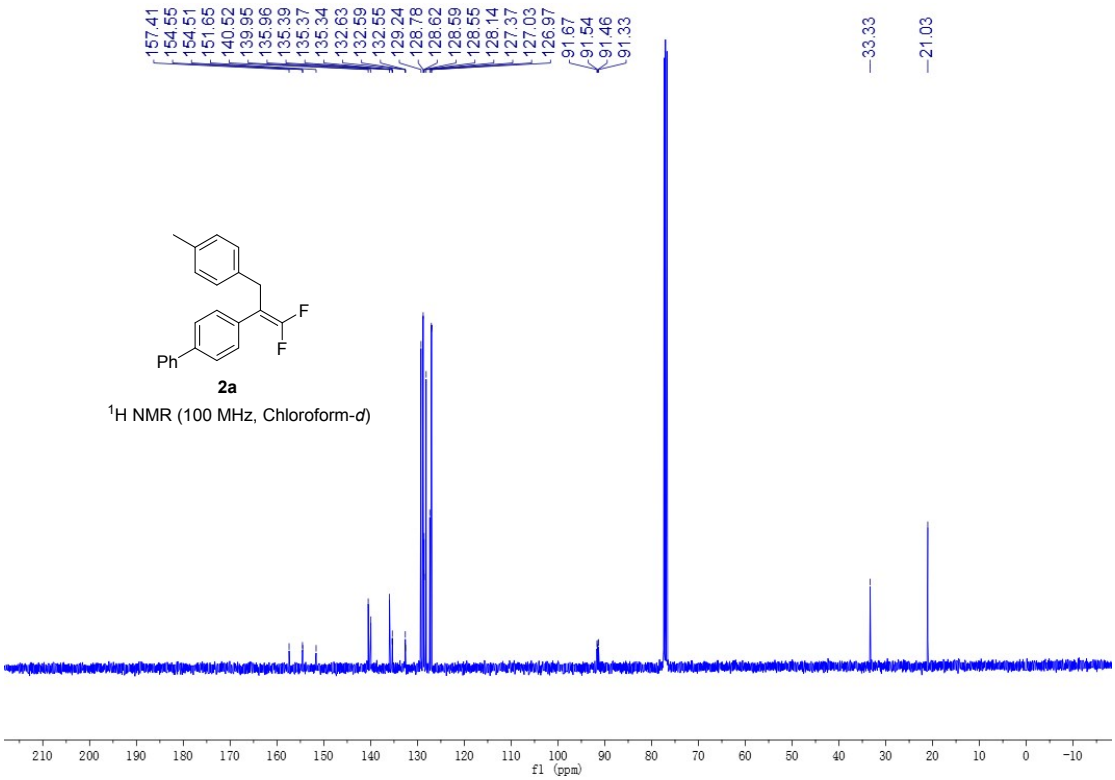


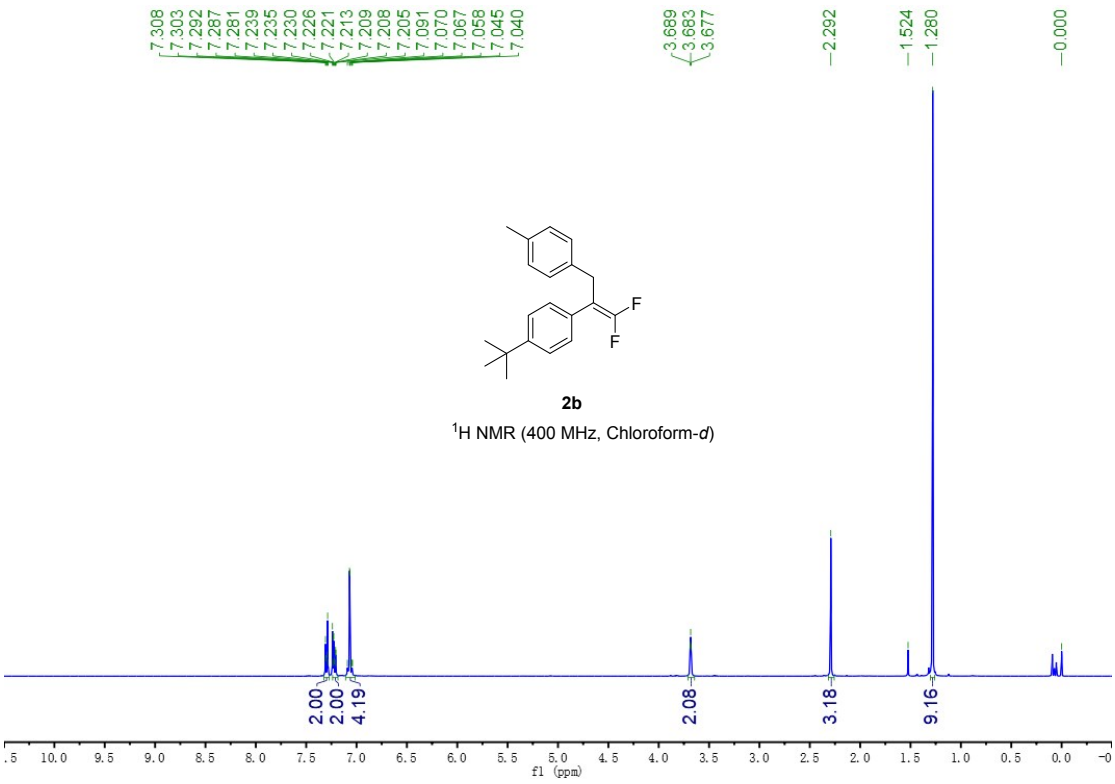
Figure S 92



2a

^{1}H NMR (100 MHz, Chloroform-*d*)

Figure S 93



2b

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 94

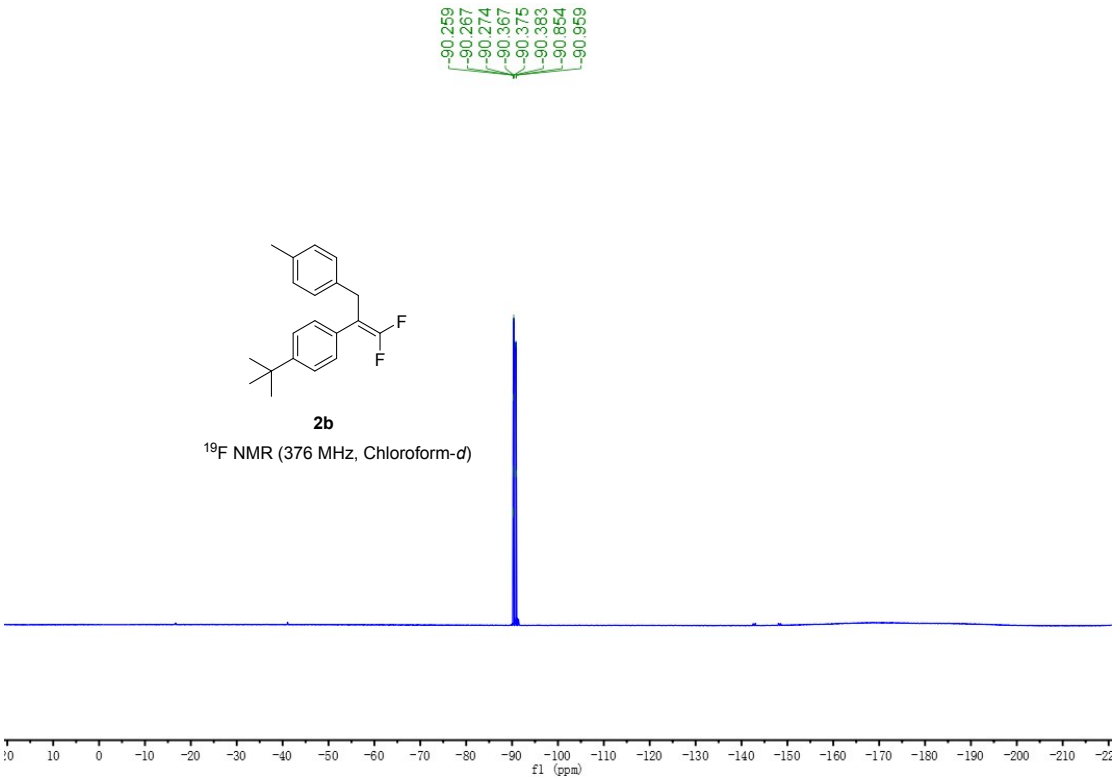


Figure S 95

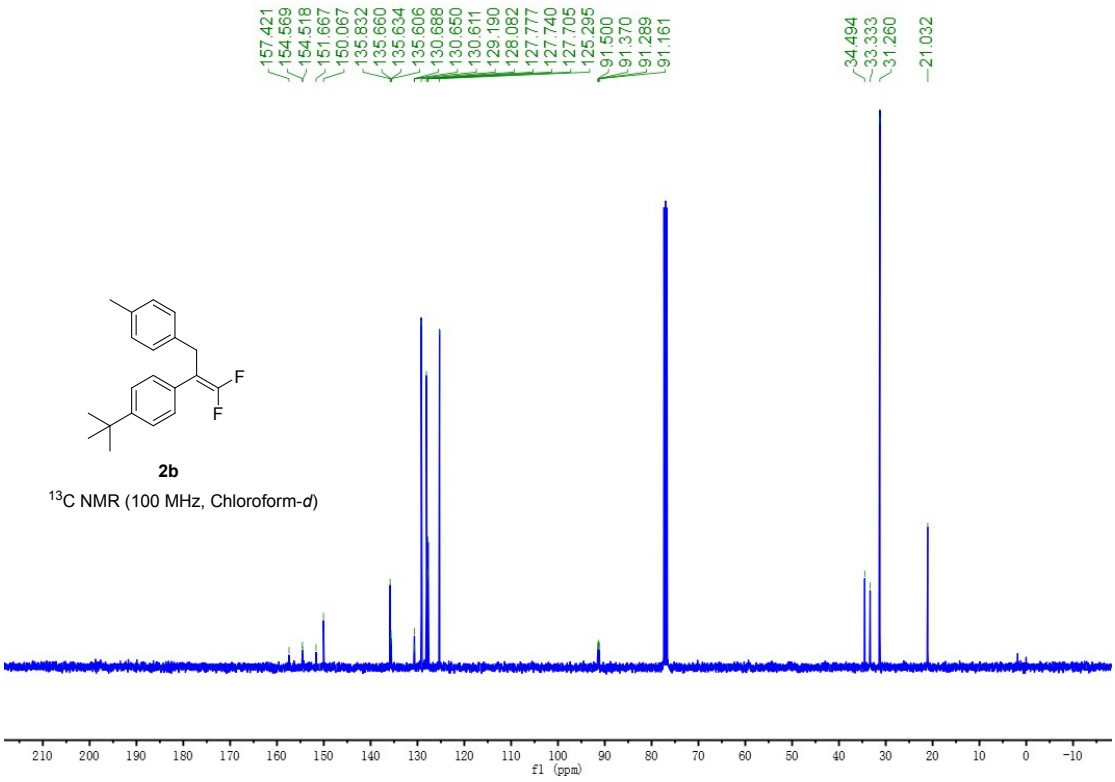
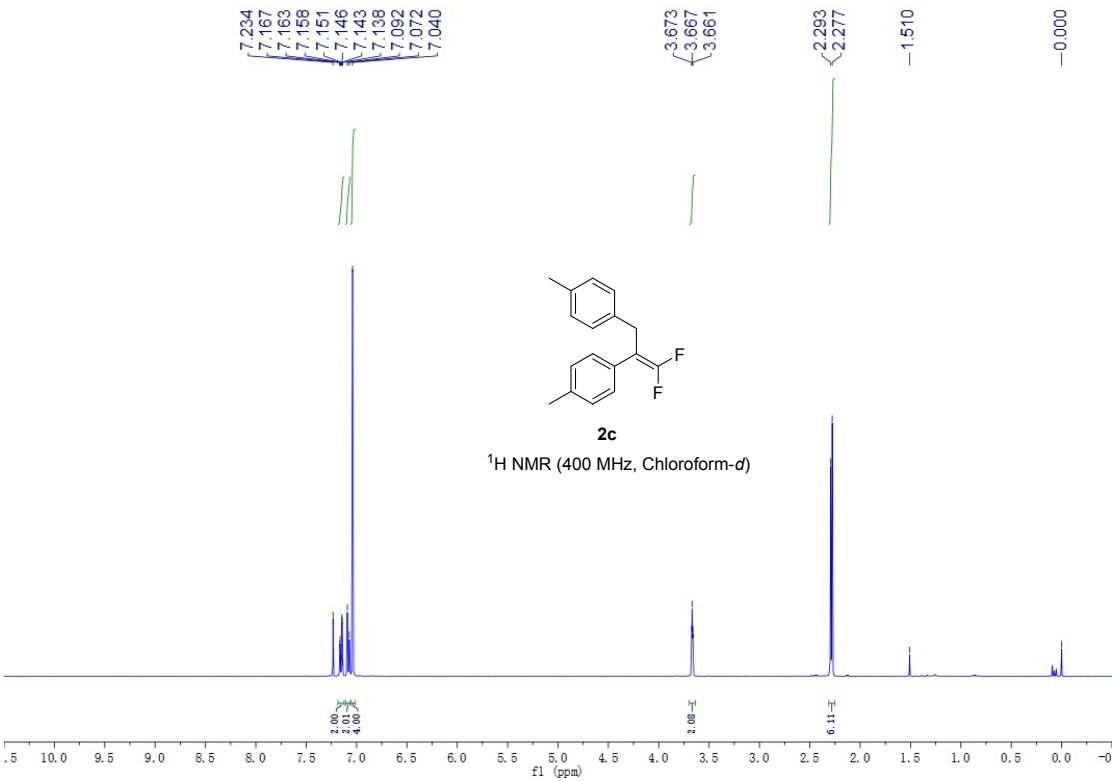


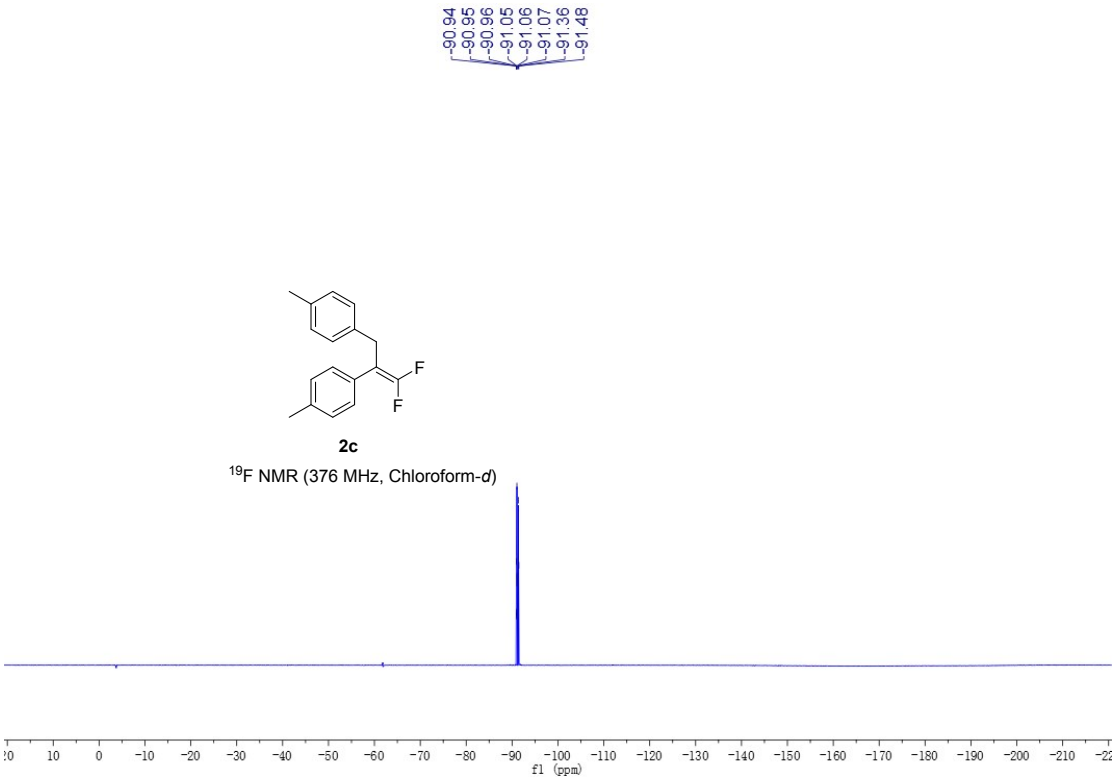
Figure S 96



2c

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 97



2c

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

Figure S 98

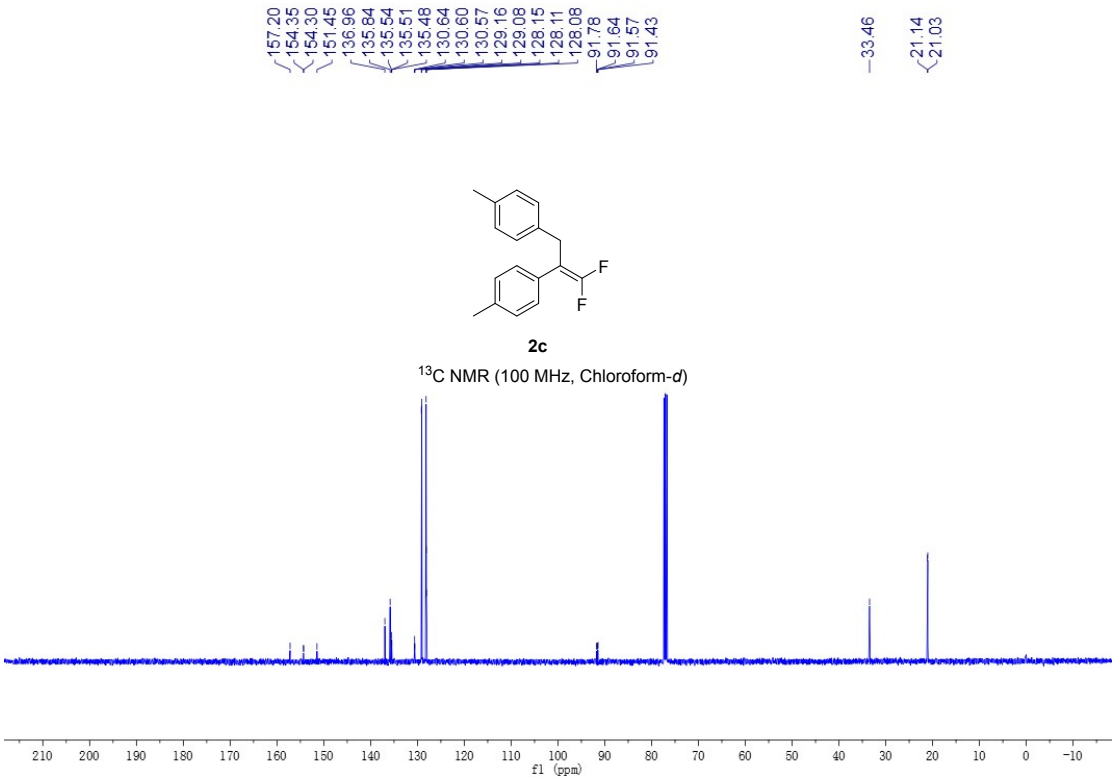


Figure S 99

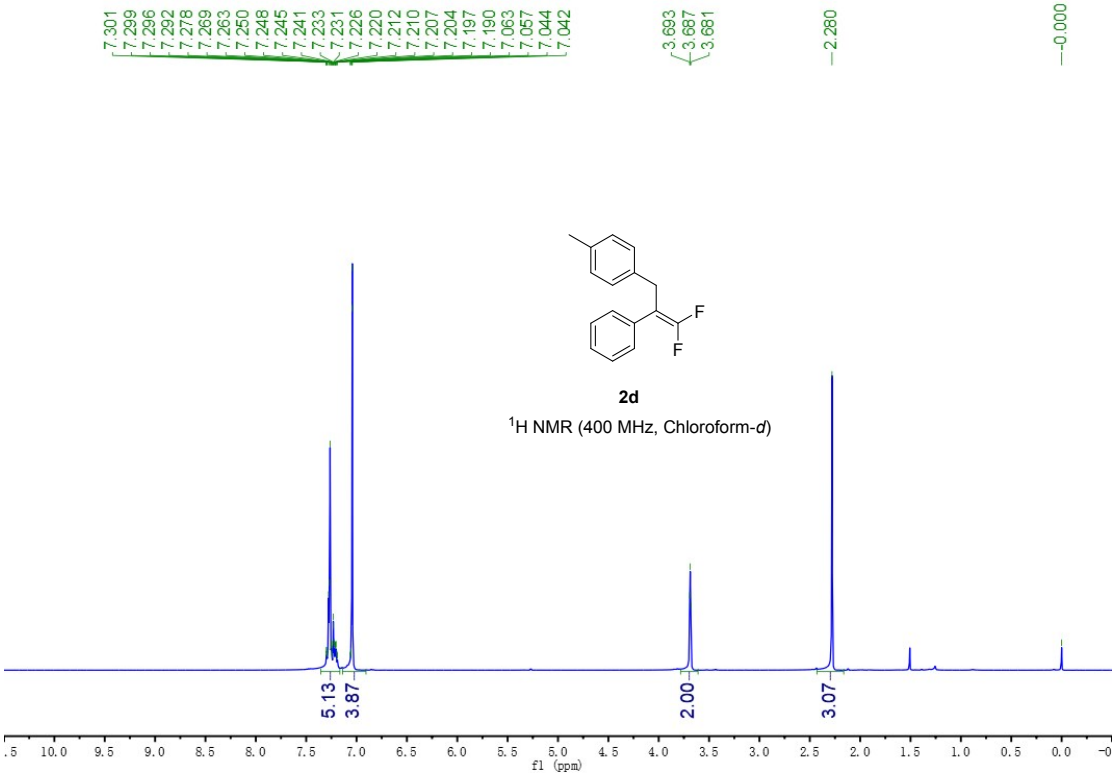


Figure S 100

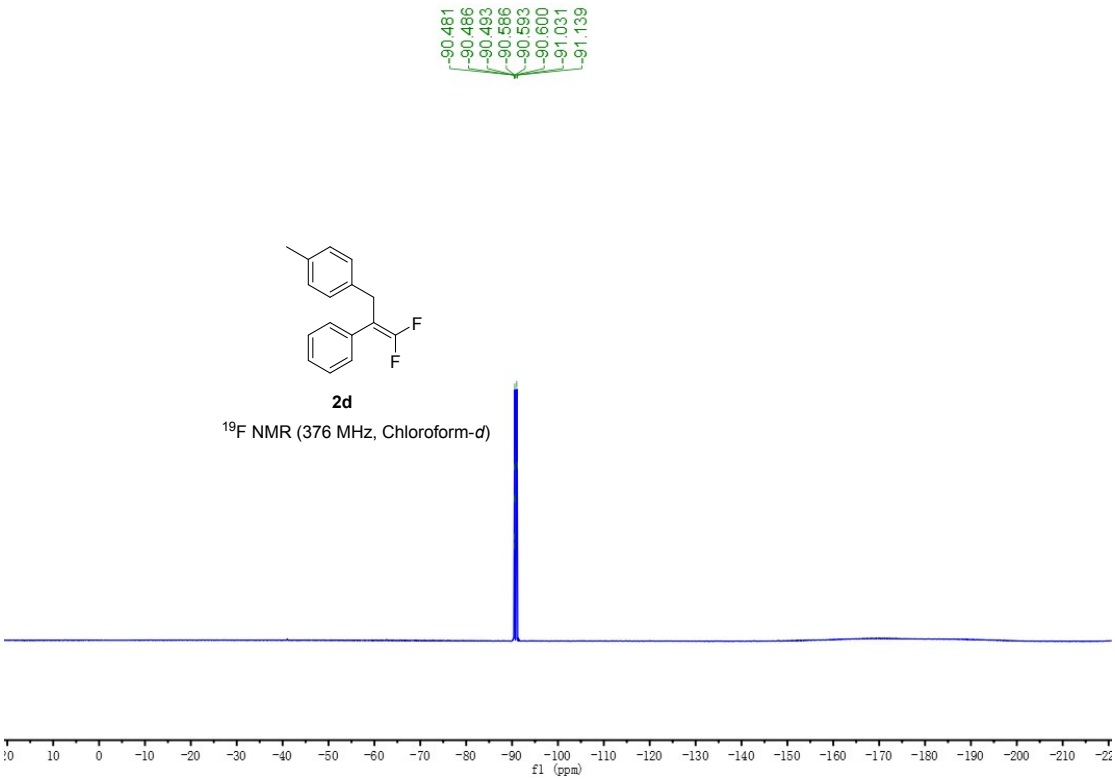


Figure S 101

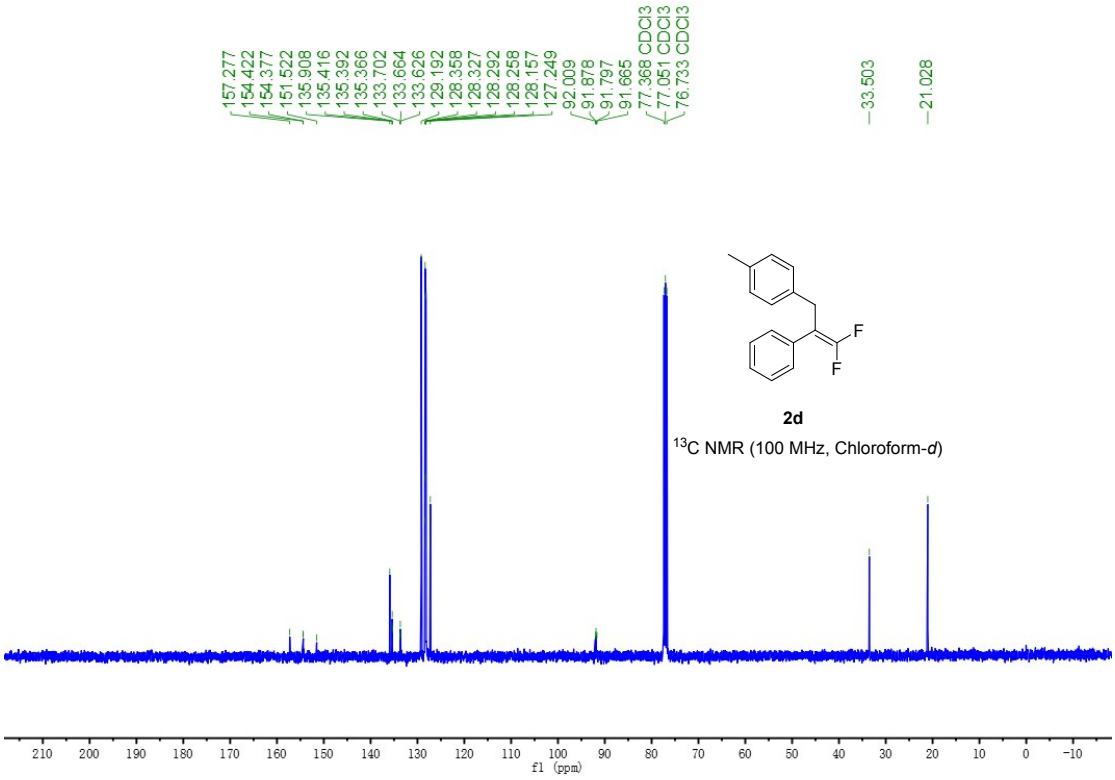


Figure S 102

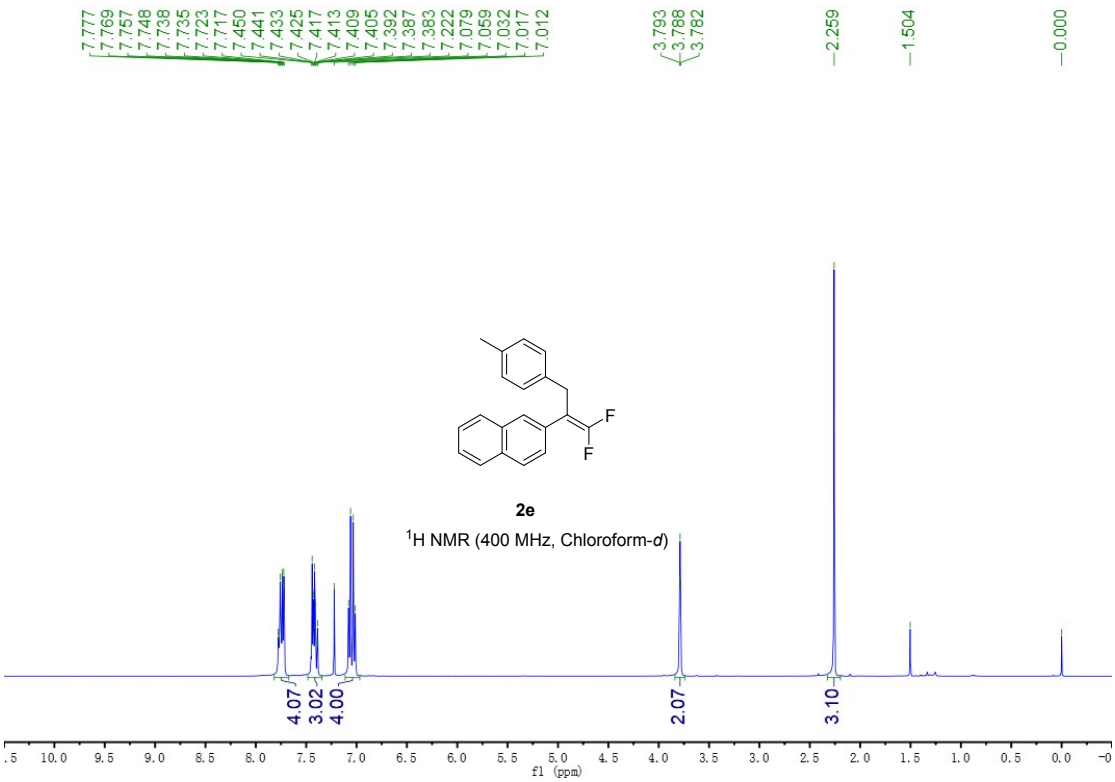


Figure S 103

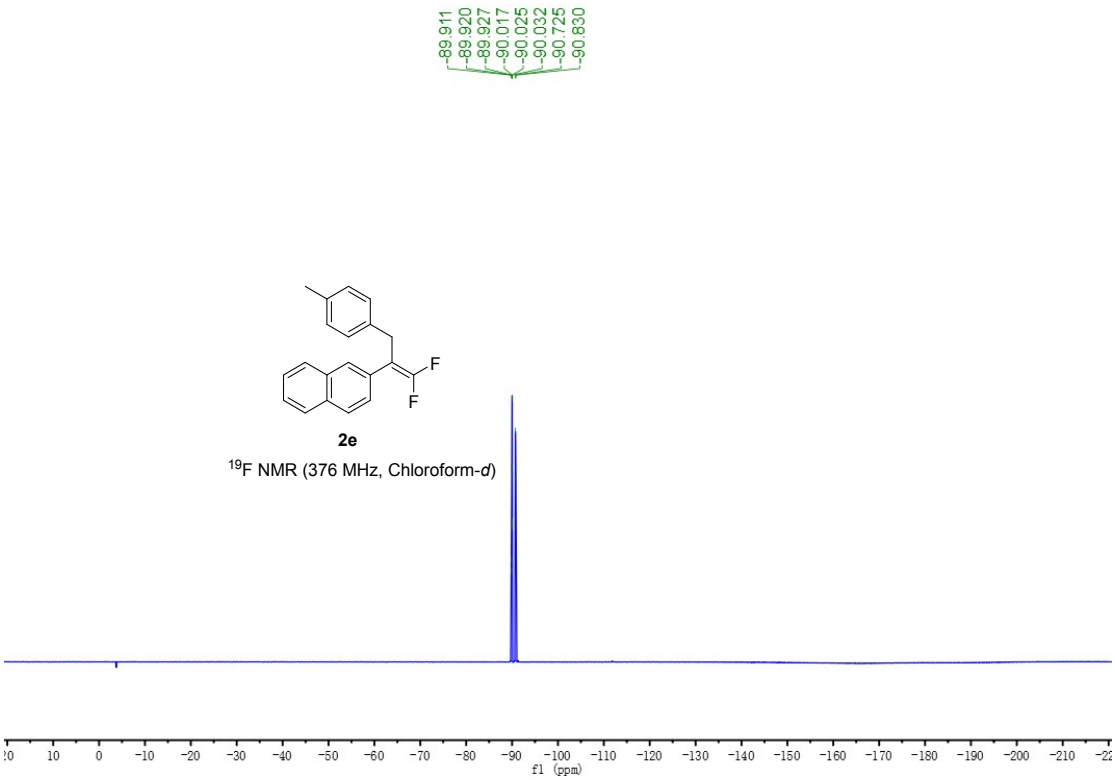


Figure S 104

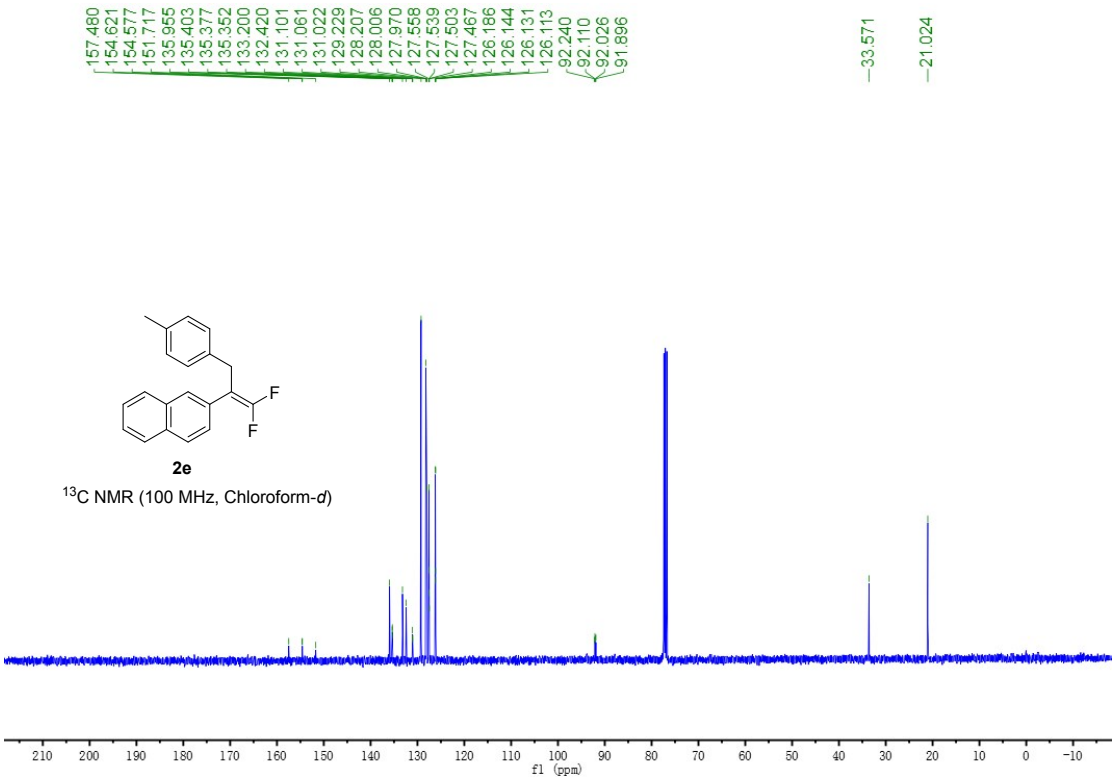


Figure S 105

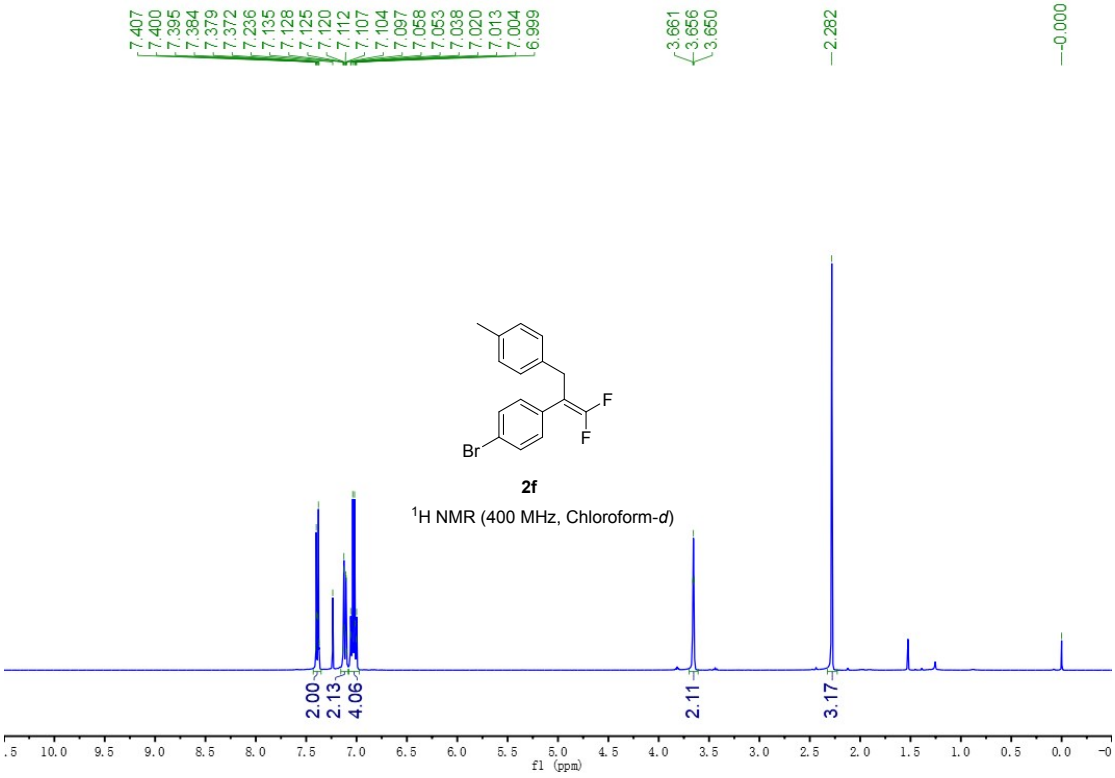


Figure S 106

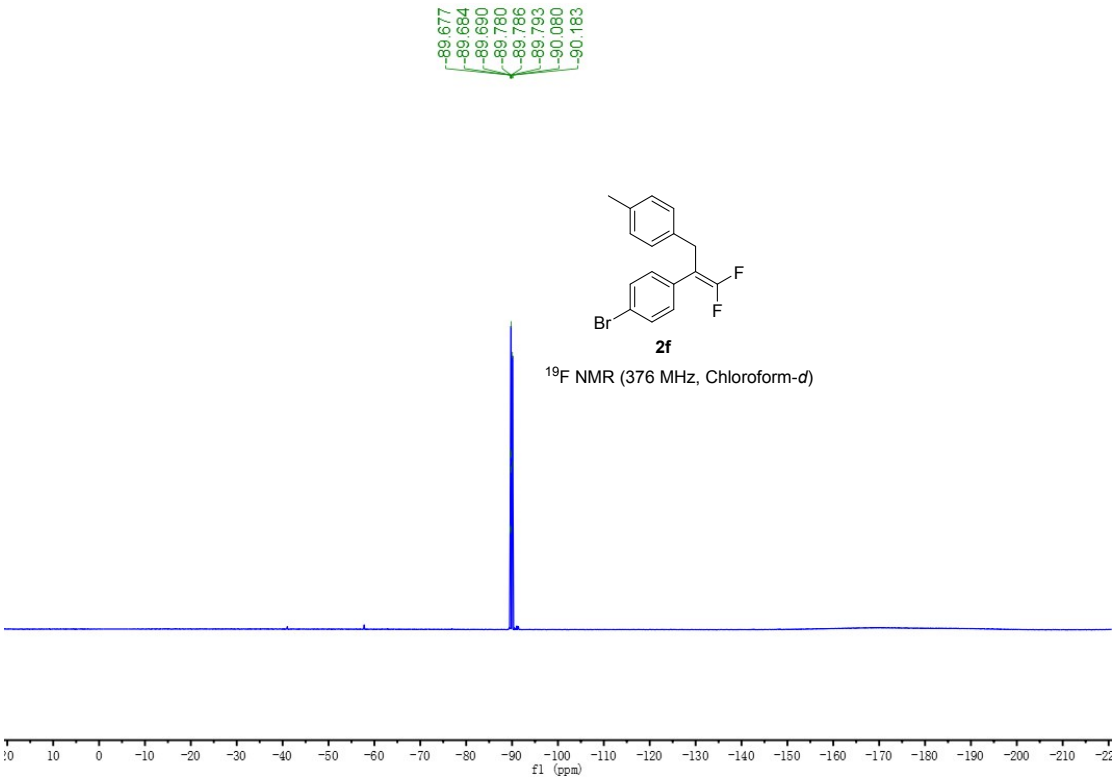


Figure S 107

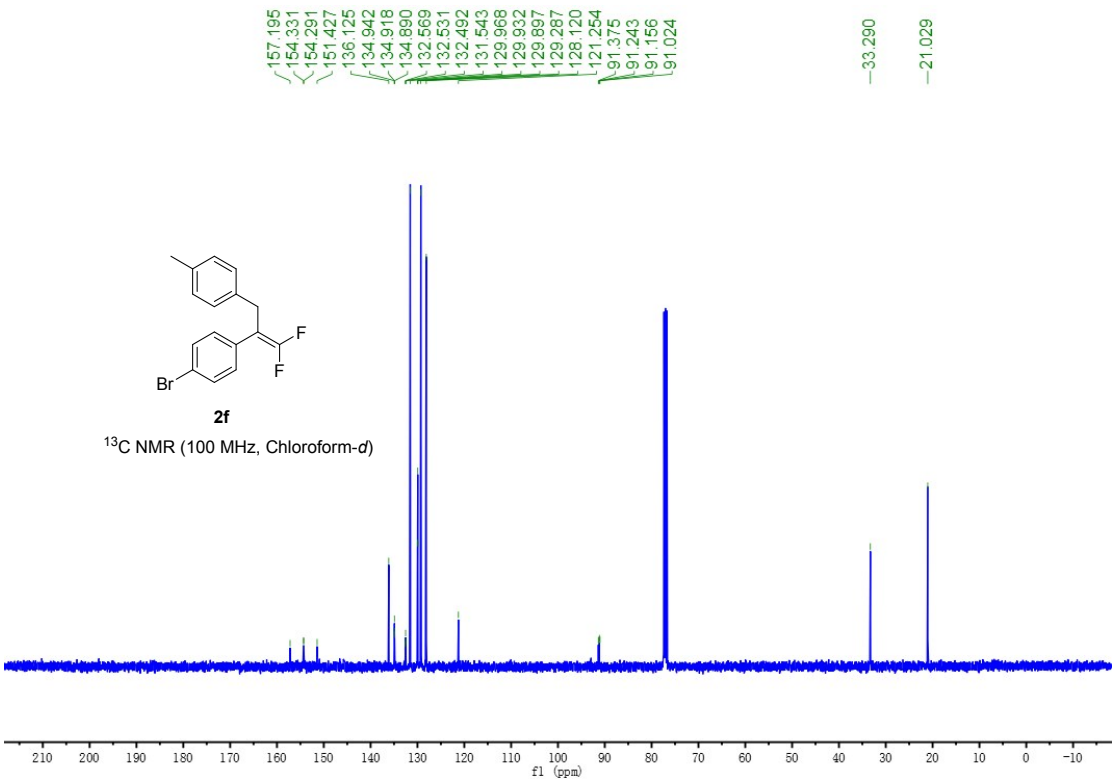


Figure S 108

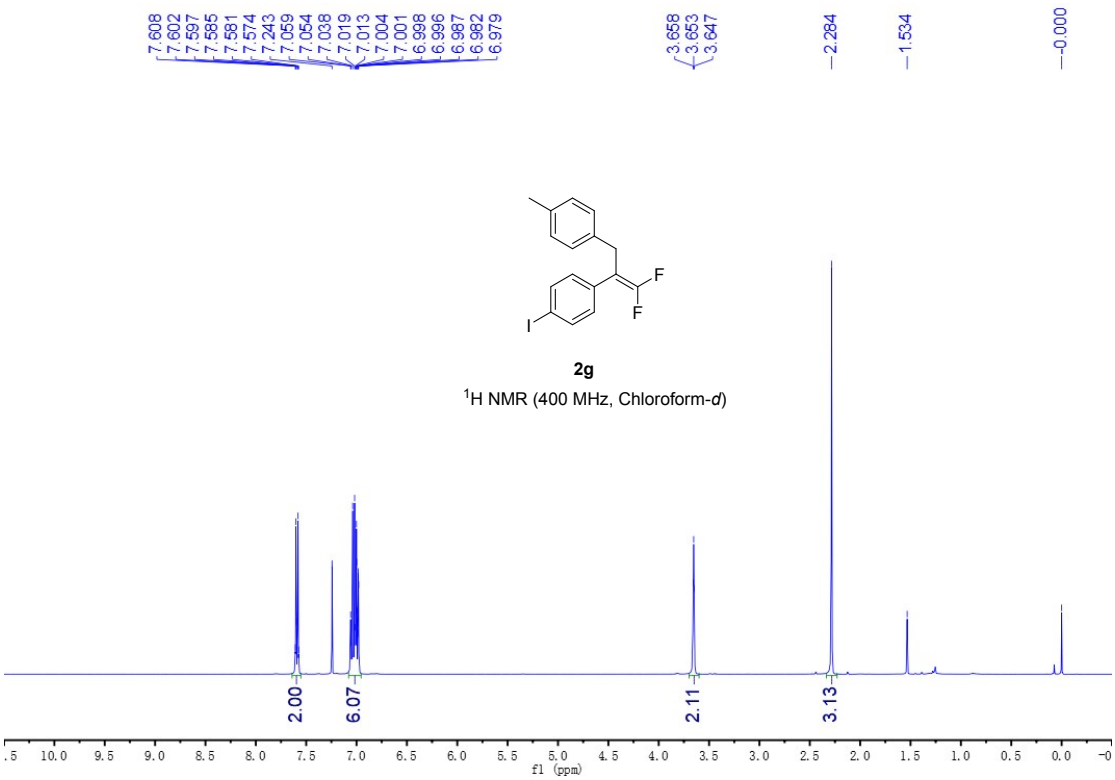


Figure S 109

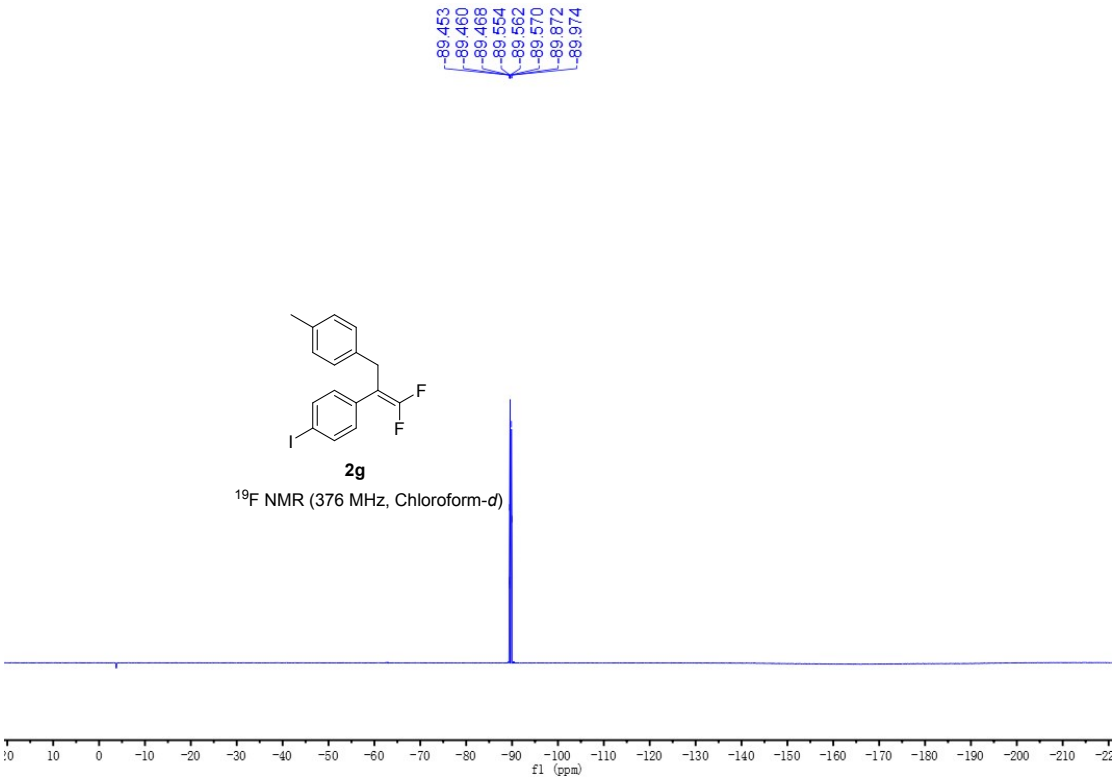


Figure S 110

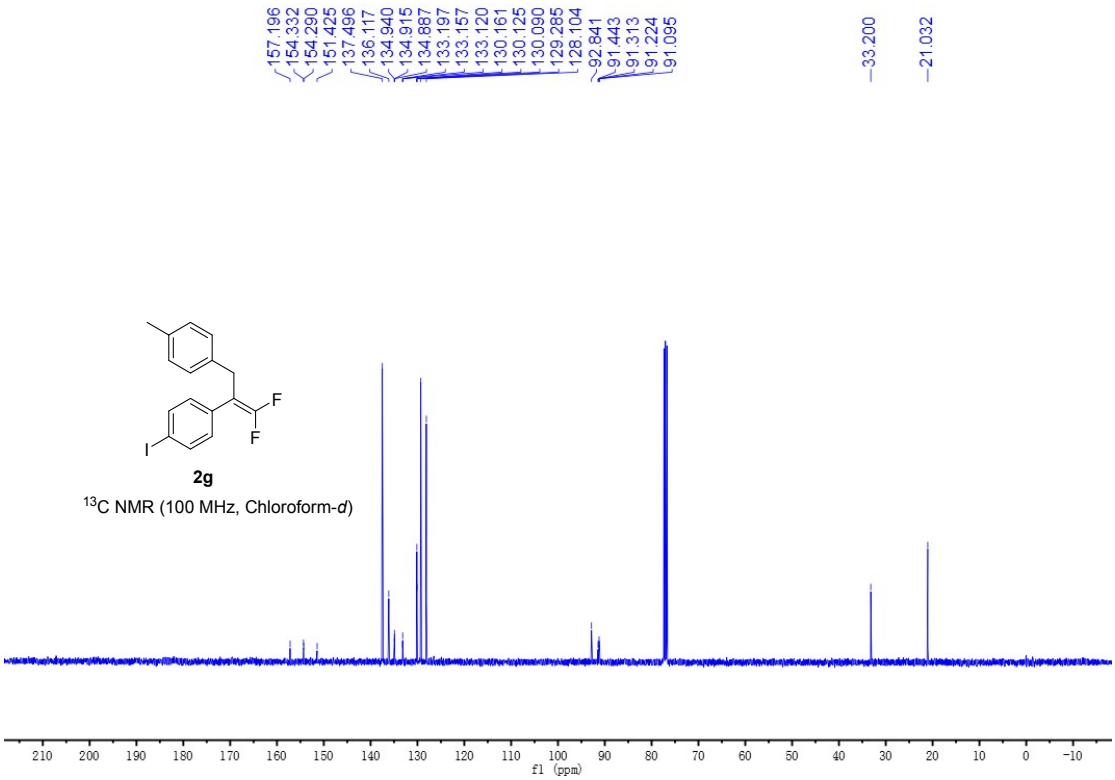


Figure S 111

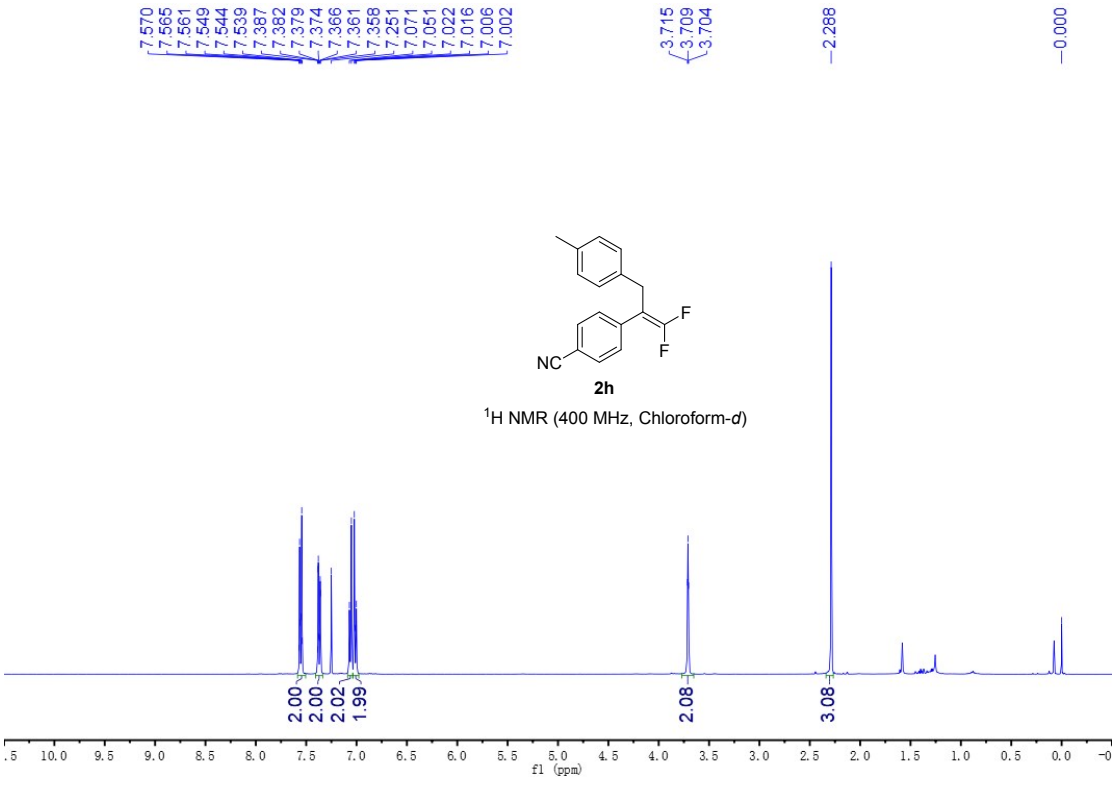


Figure S 112

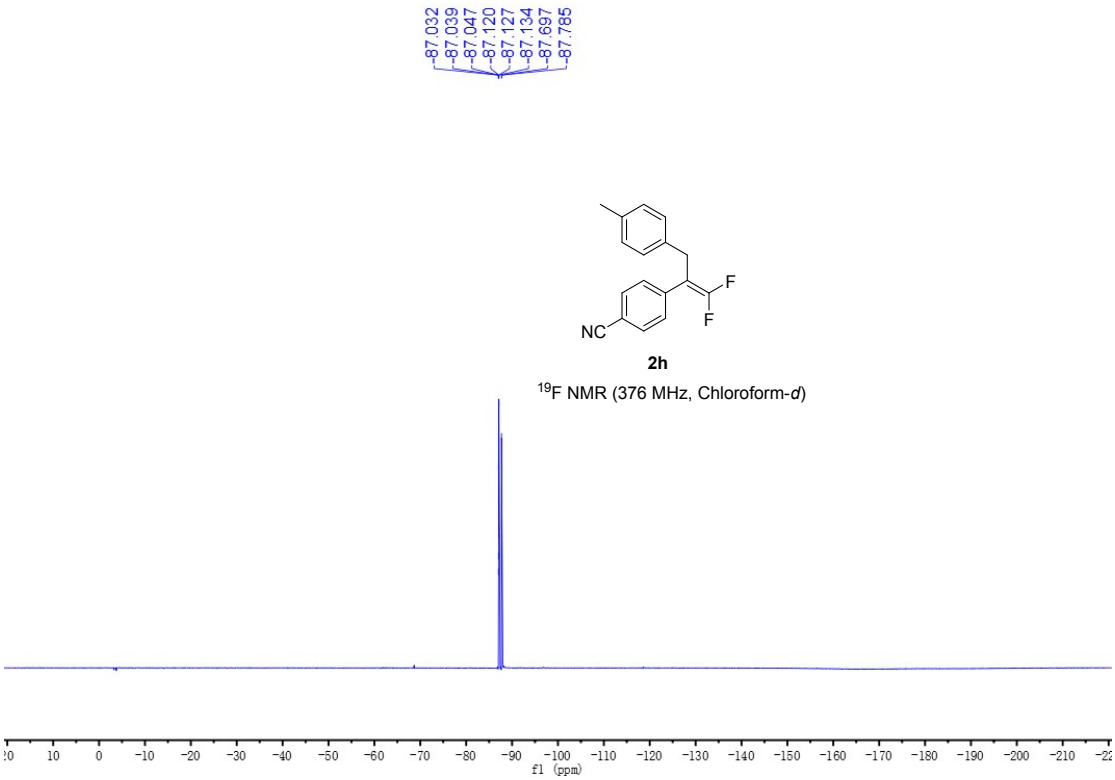


Figure S 113

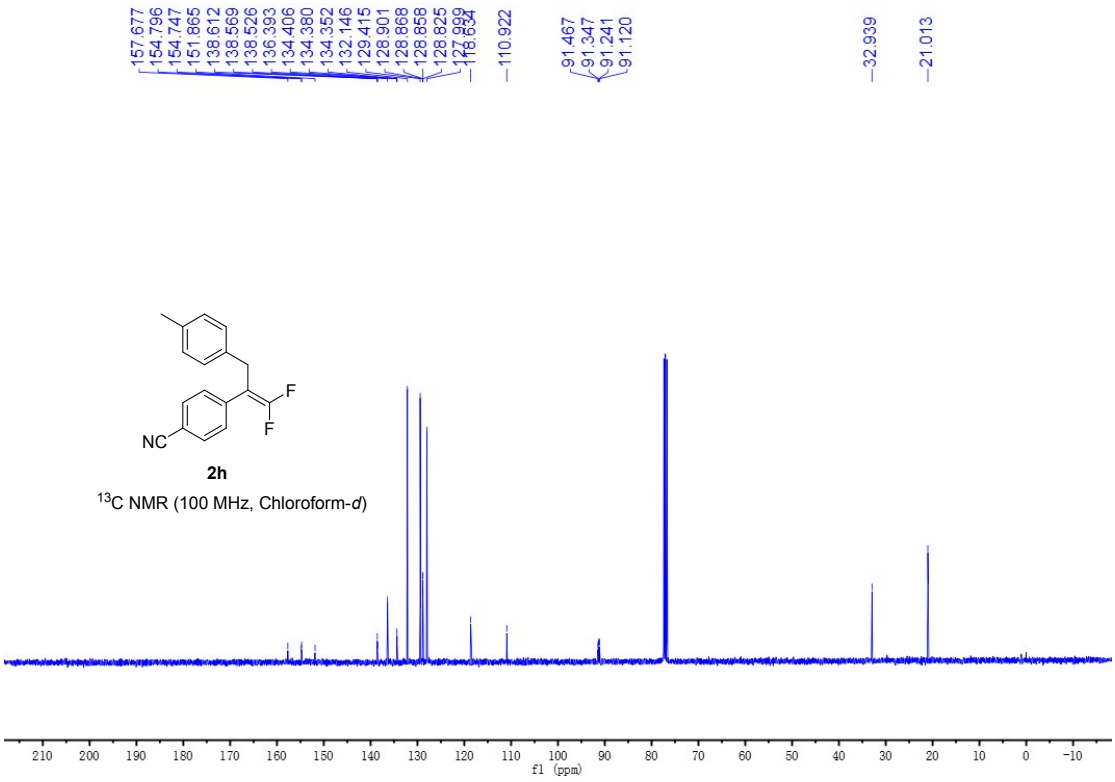
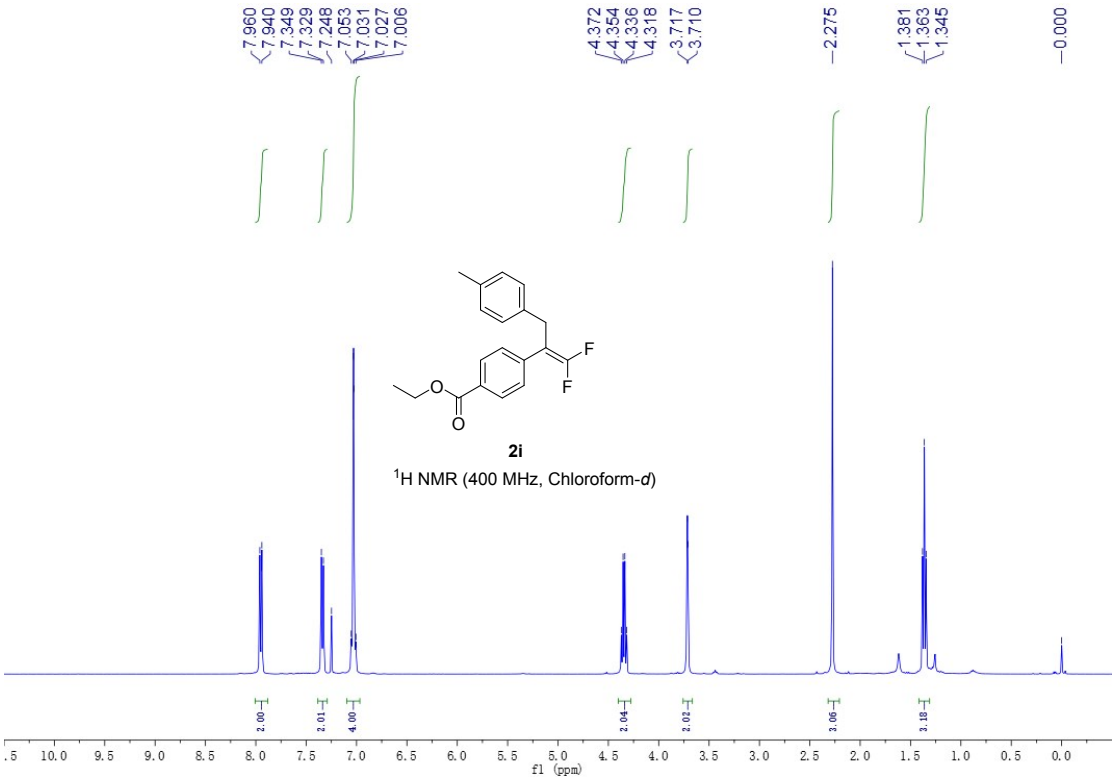


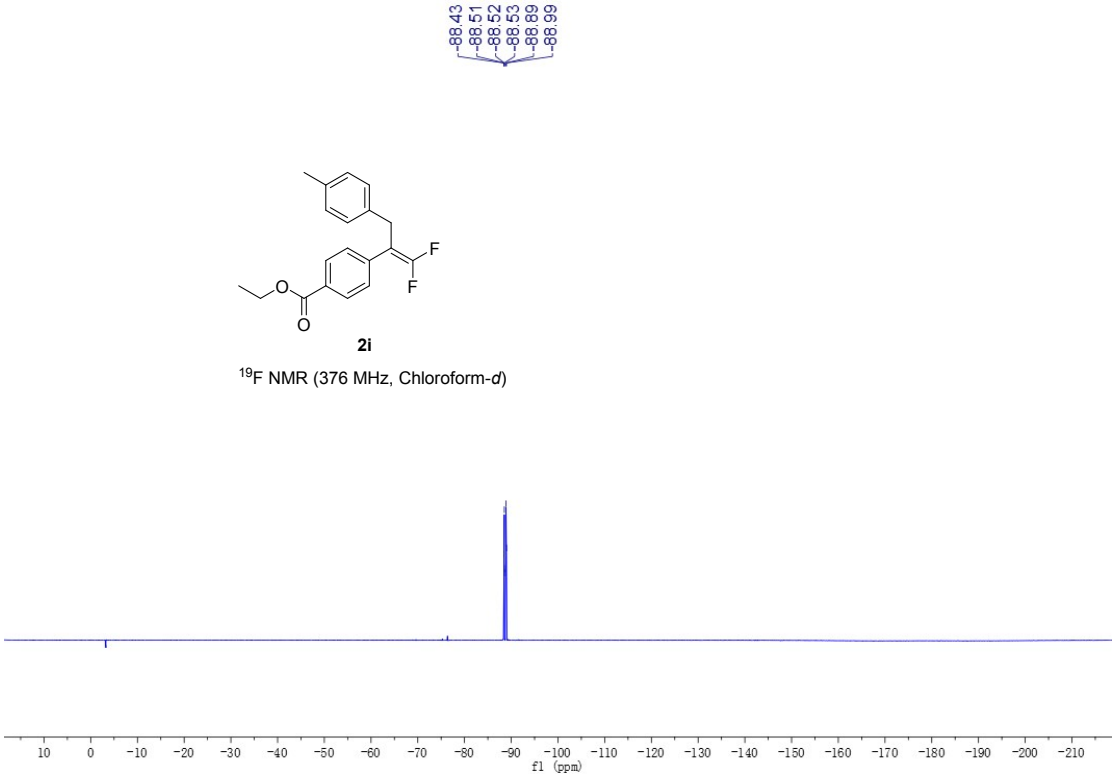
Figure S 114



2i

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 115



2i

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

Figure S 116

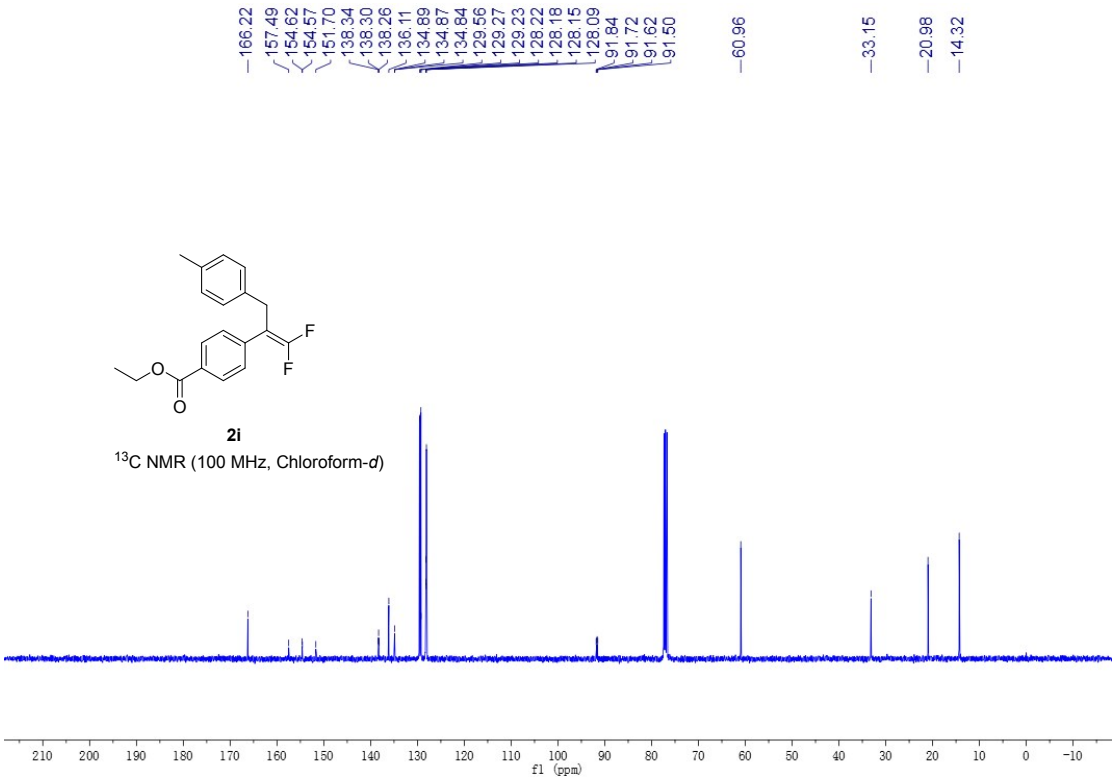


Figure S 117

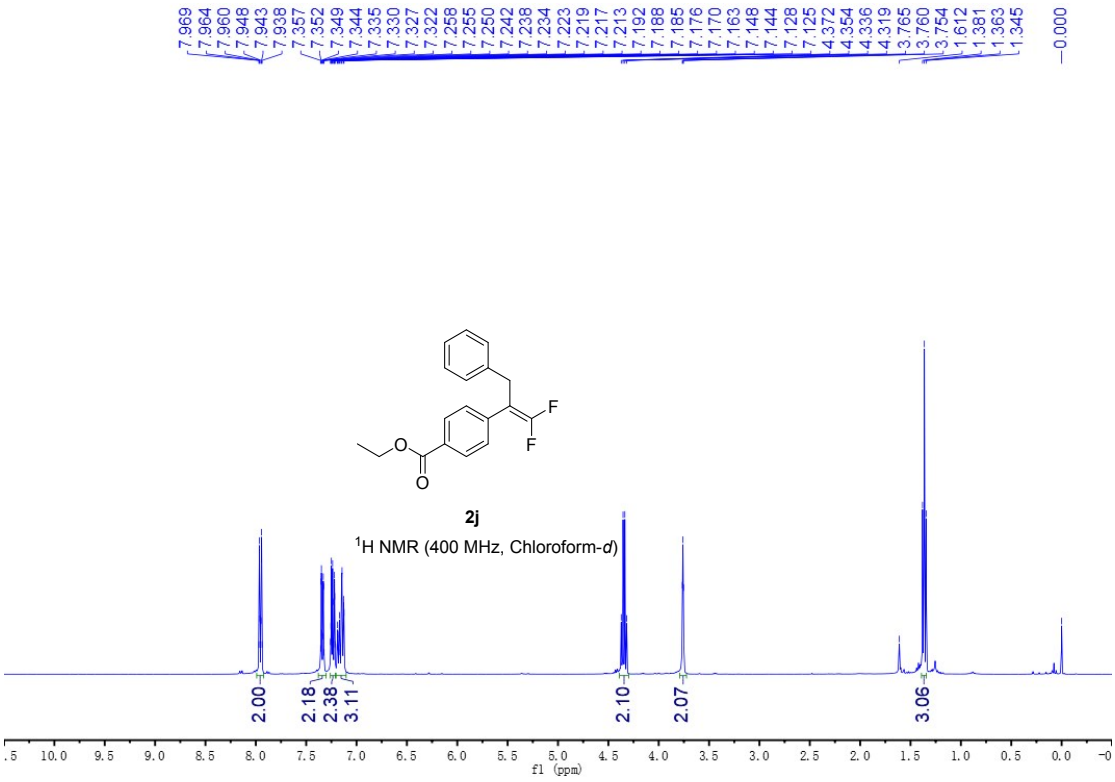
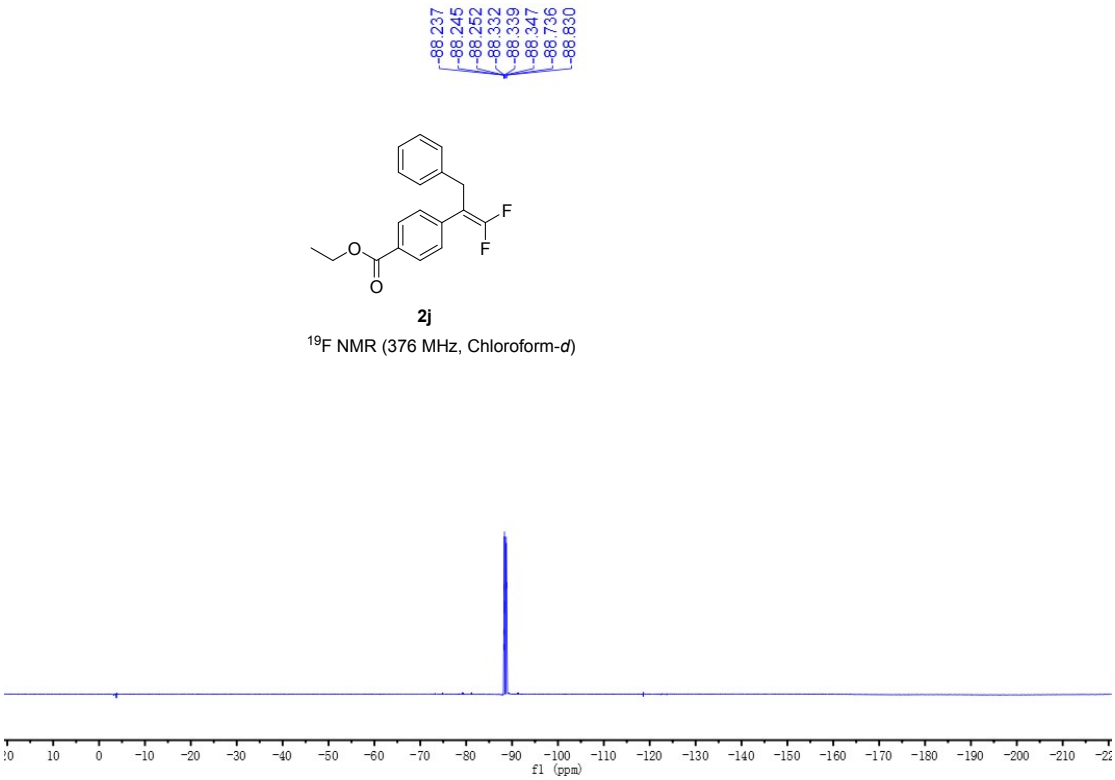


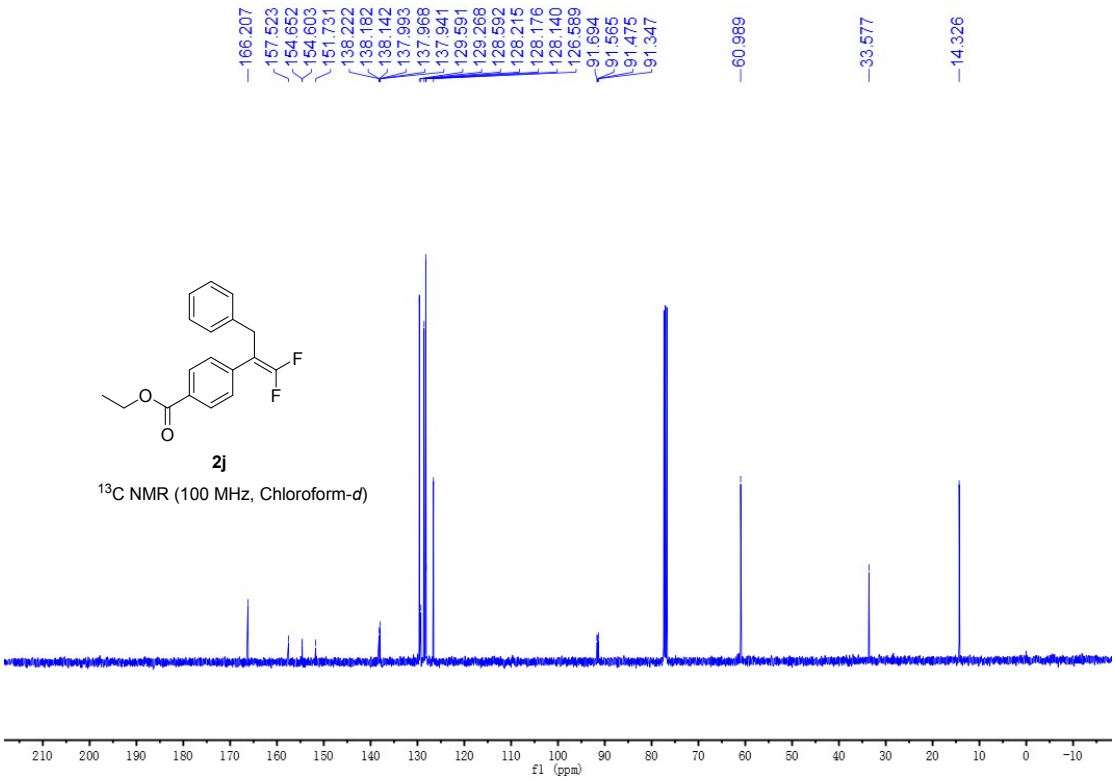
Figure S 118



2j

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

Figure S 119



2j

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 120

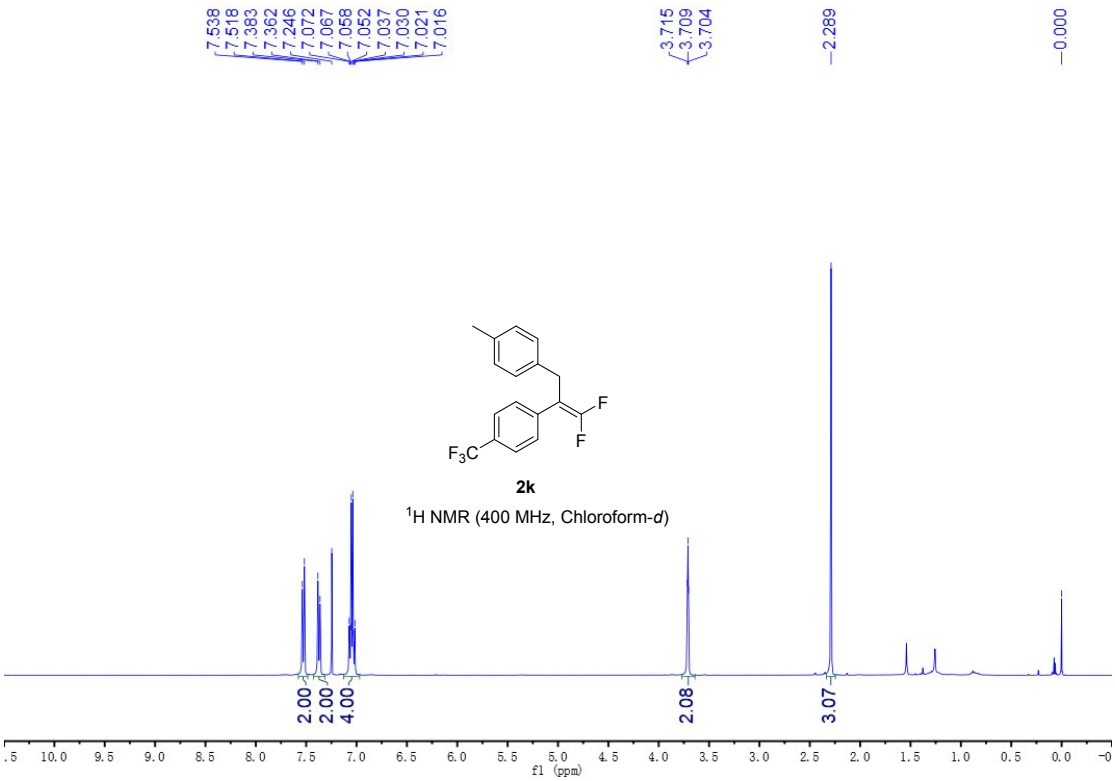


Figure S 121

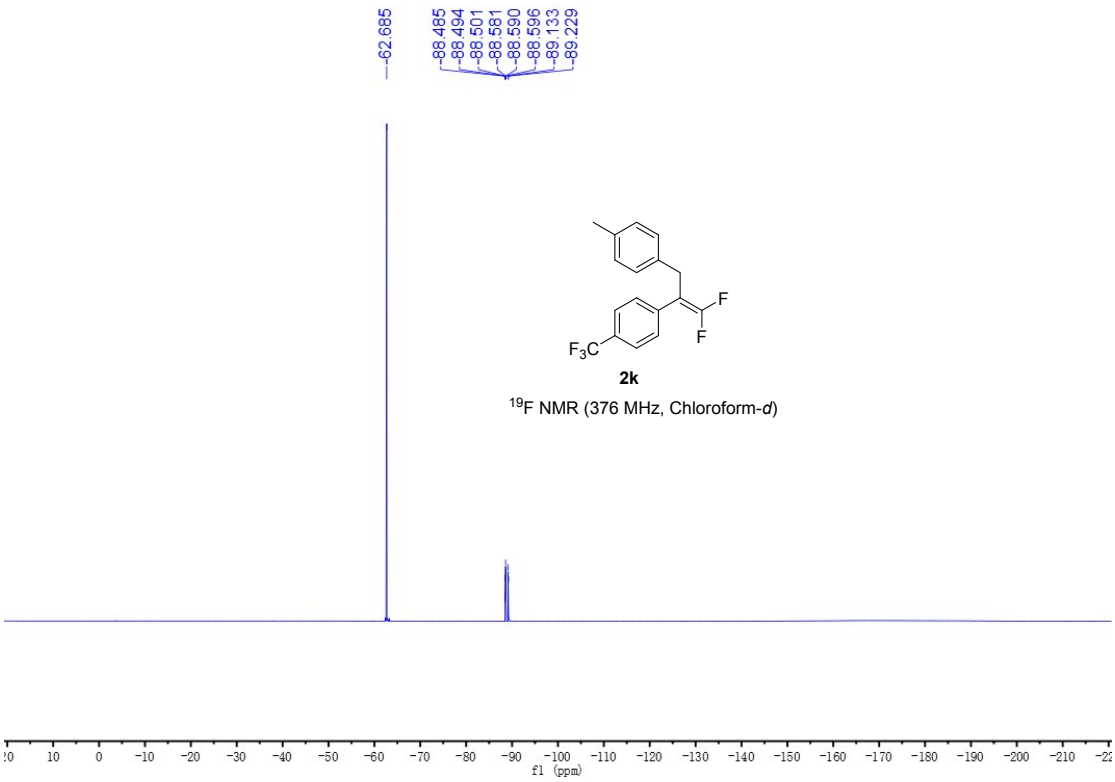


Figure S 122

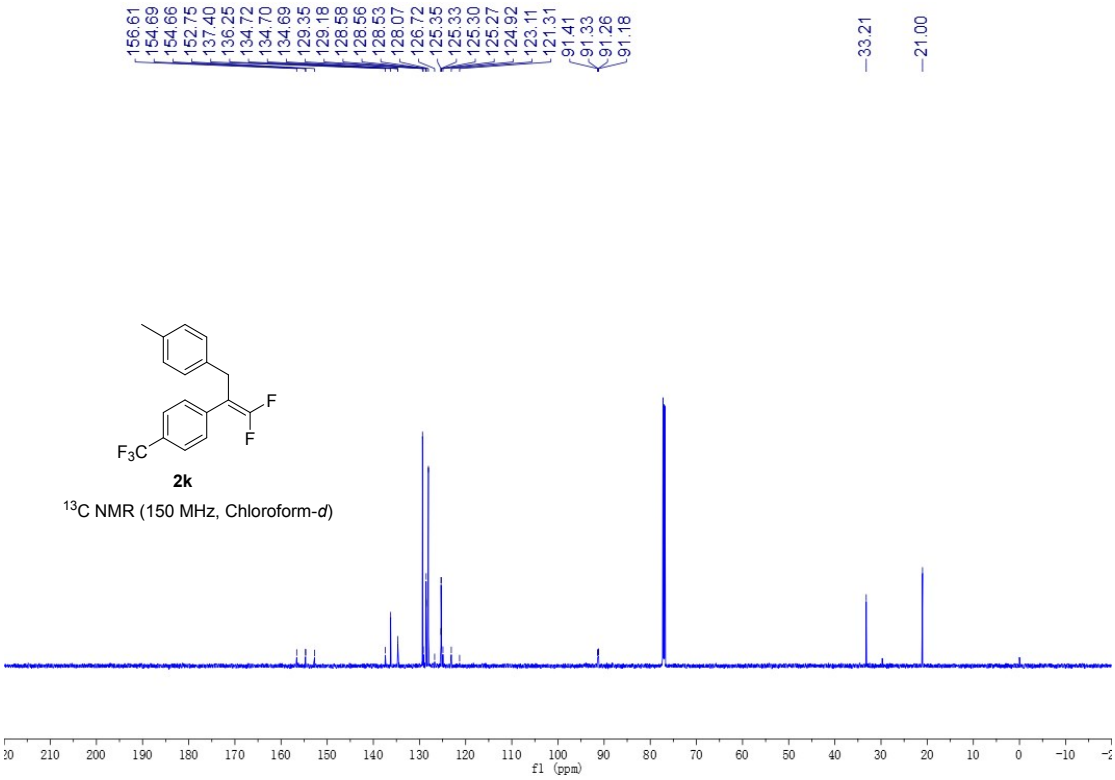


Figure S 123

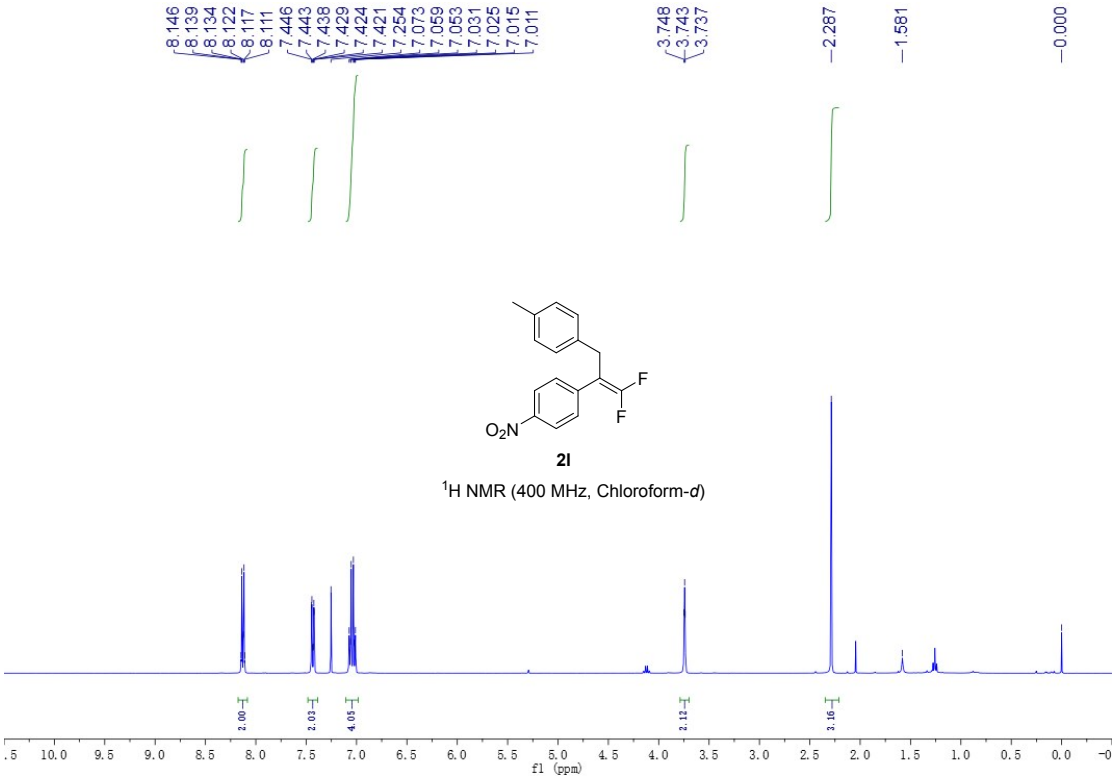


Figure S 124

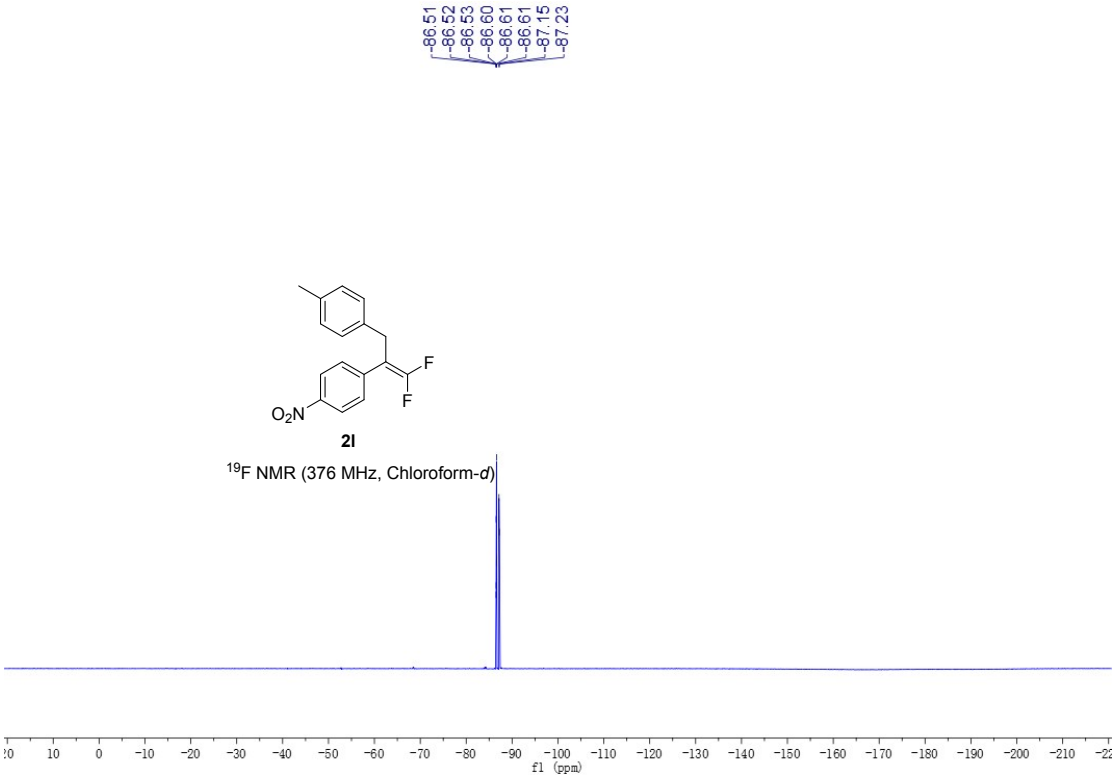


Figure S 125

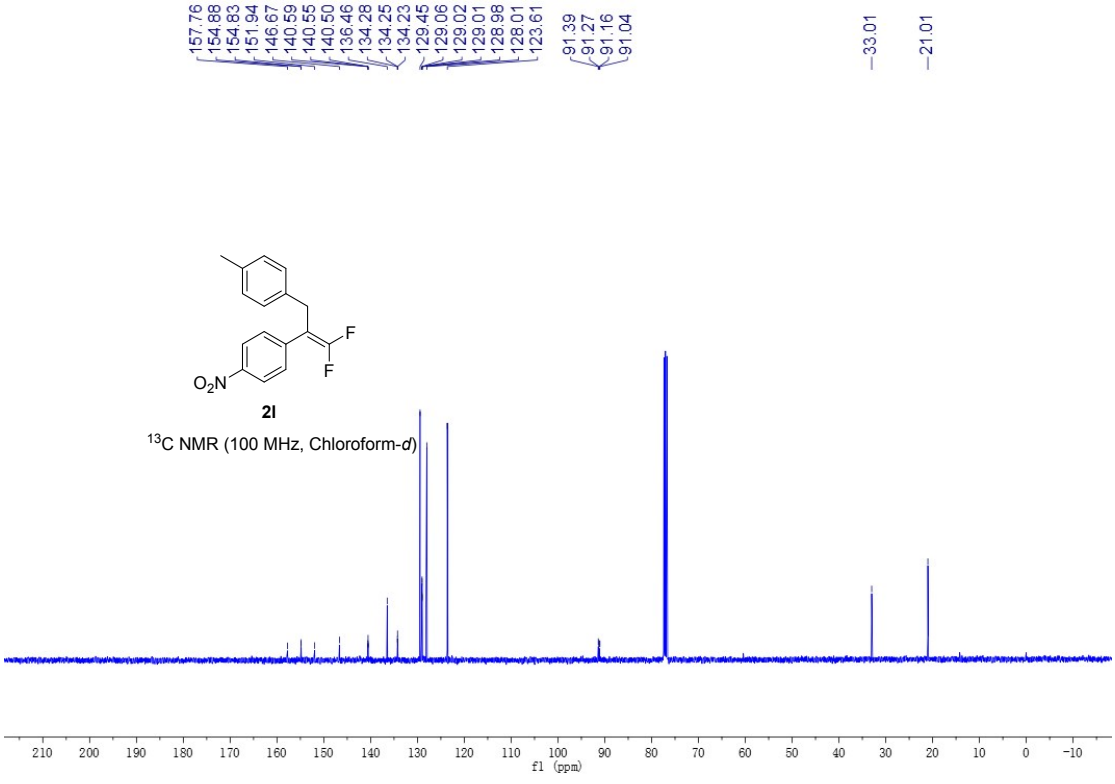


Figure S 126

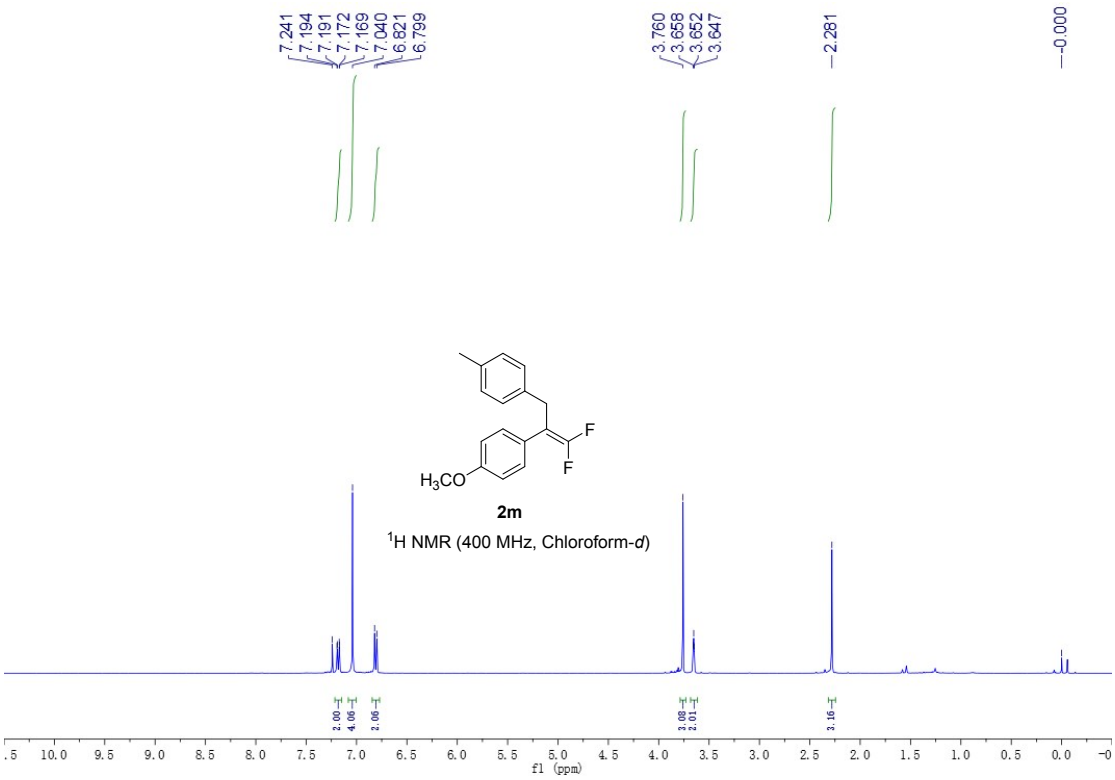


Figure S 127

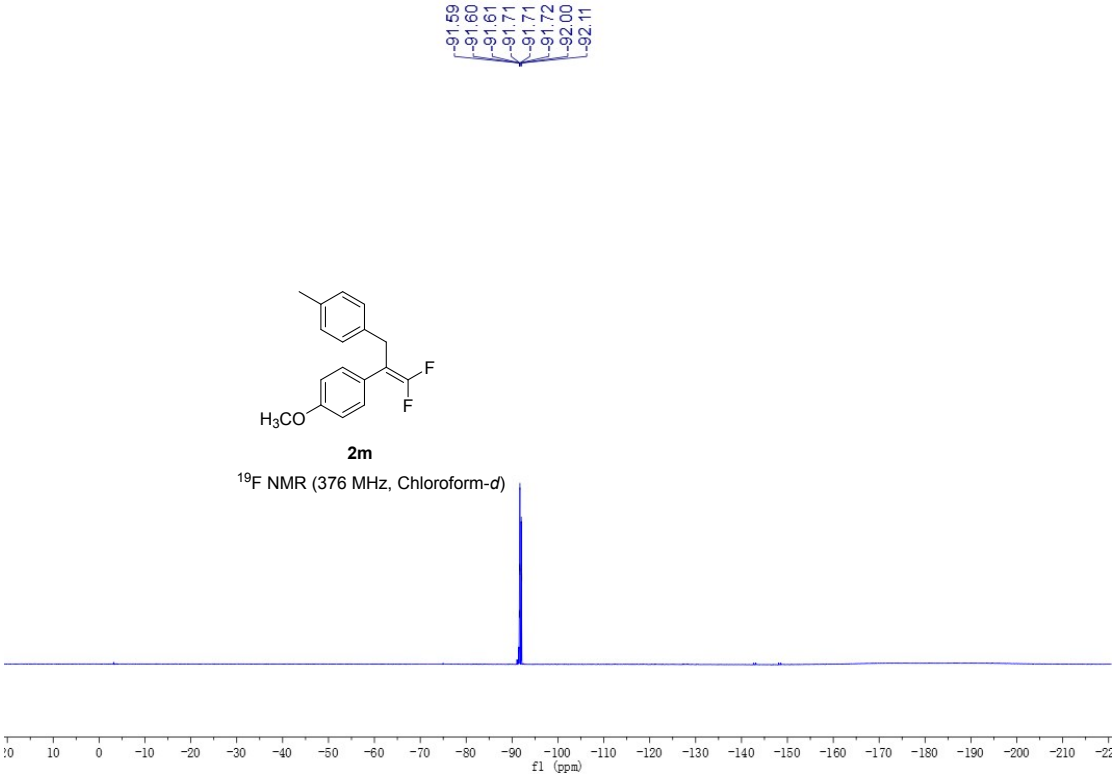


Figure S 128

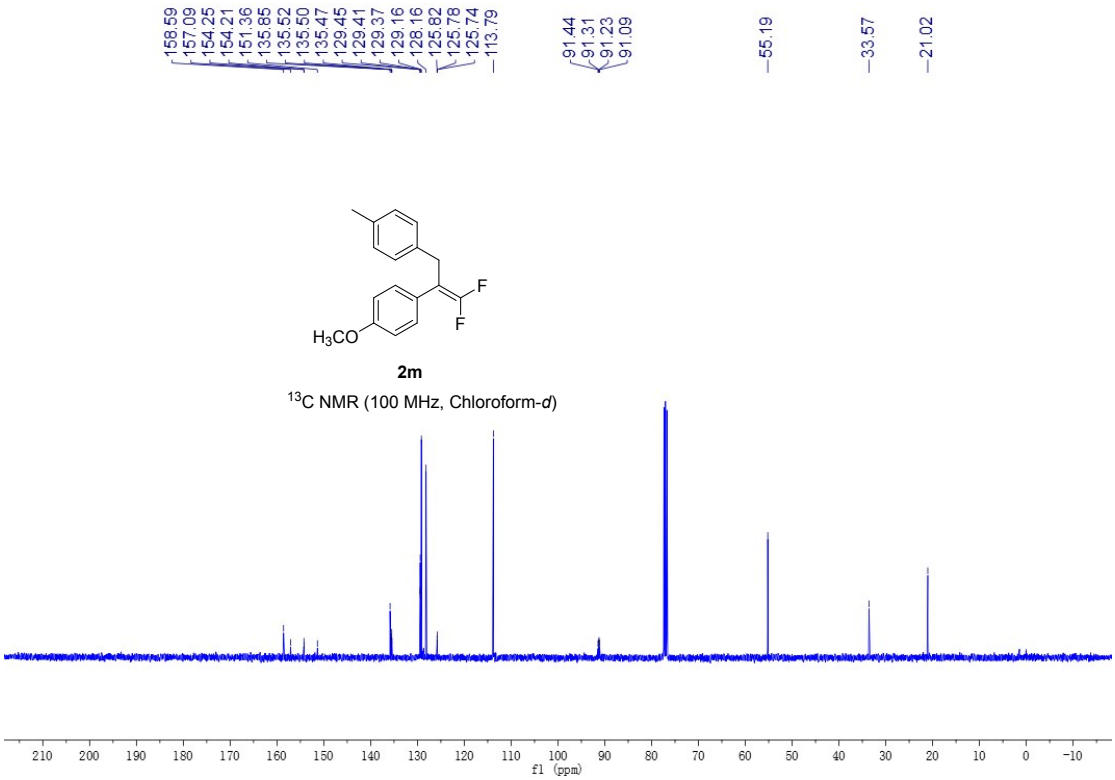


Figure S 129

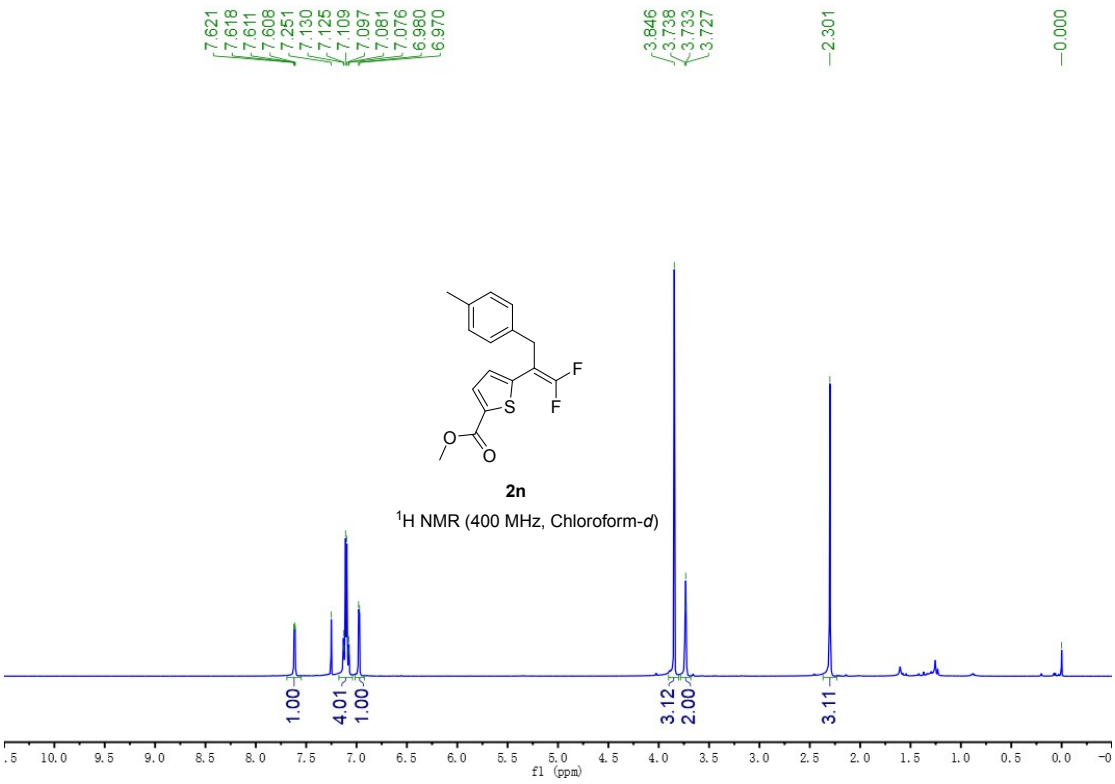
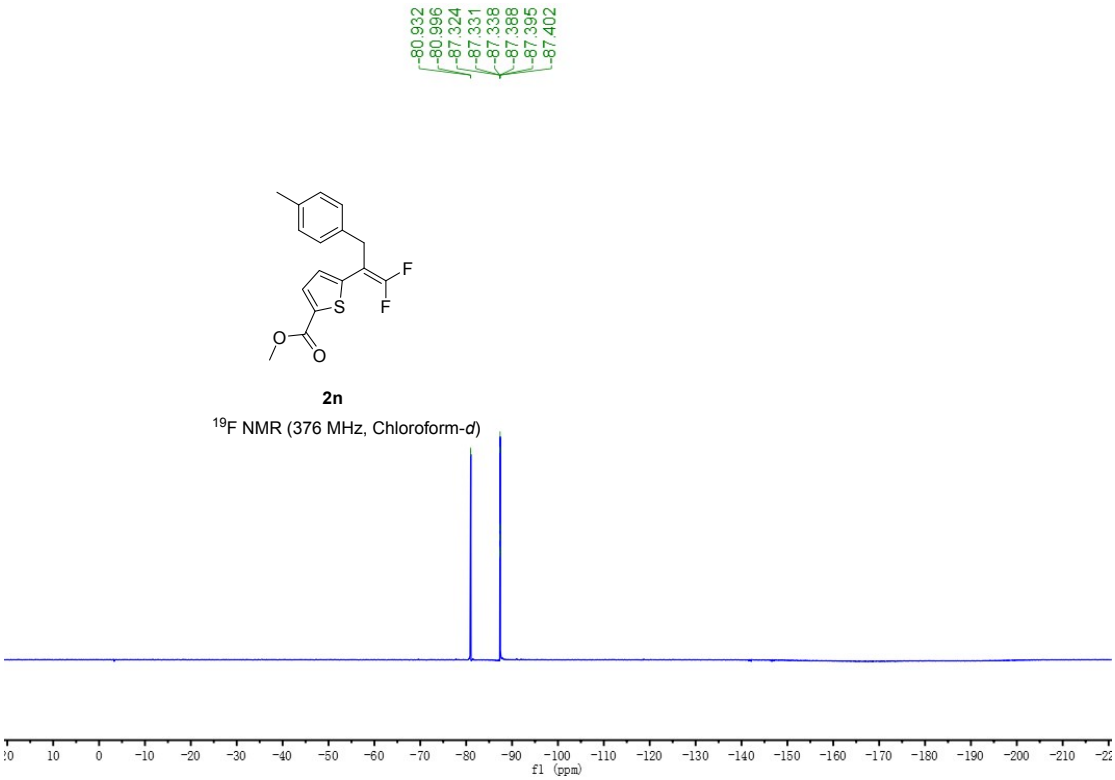


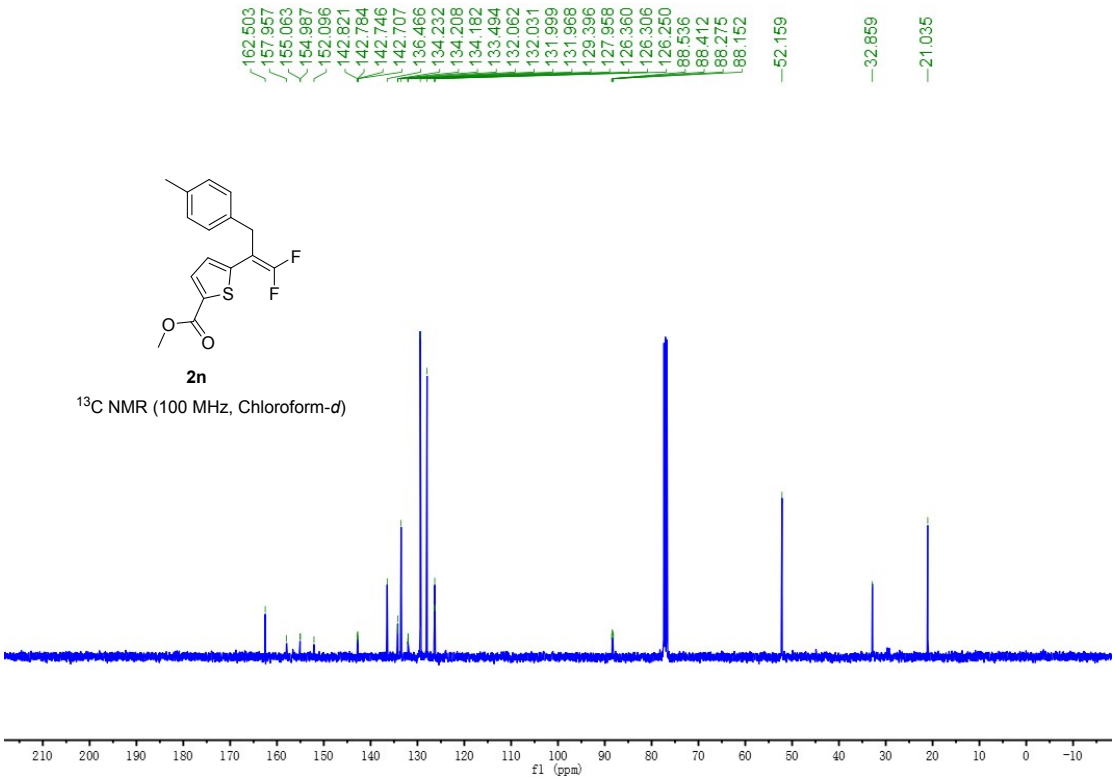
Figure S 130



2n

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

Figure S 131



2n

^{13}C NMR (100 MHz, Chloroform-*d*)

Figure S 132

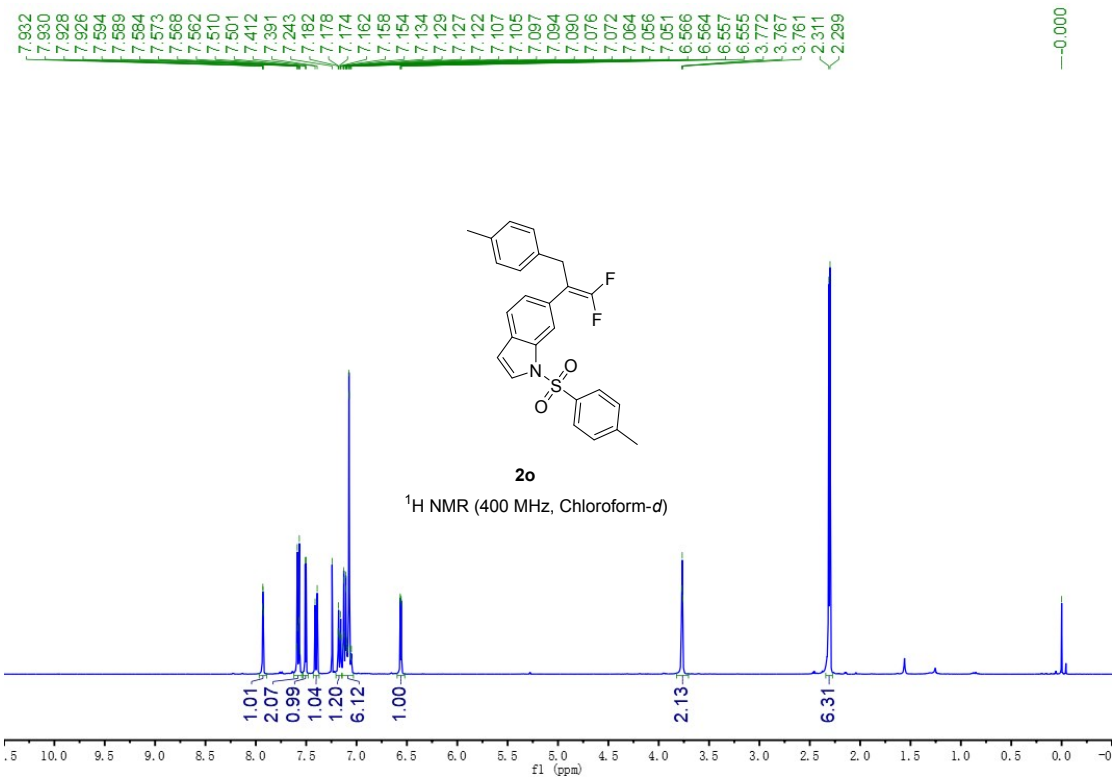


Figure S 133

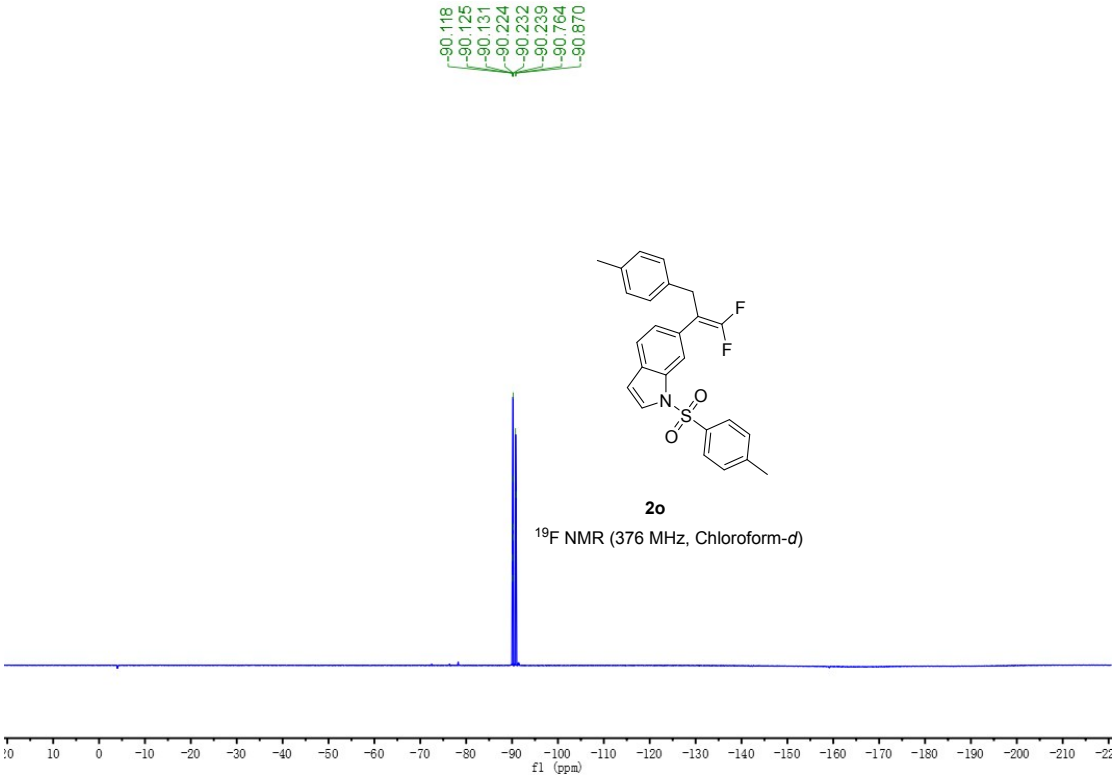


Figure S 134

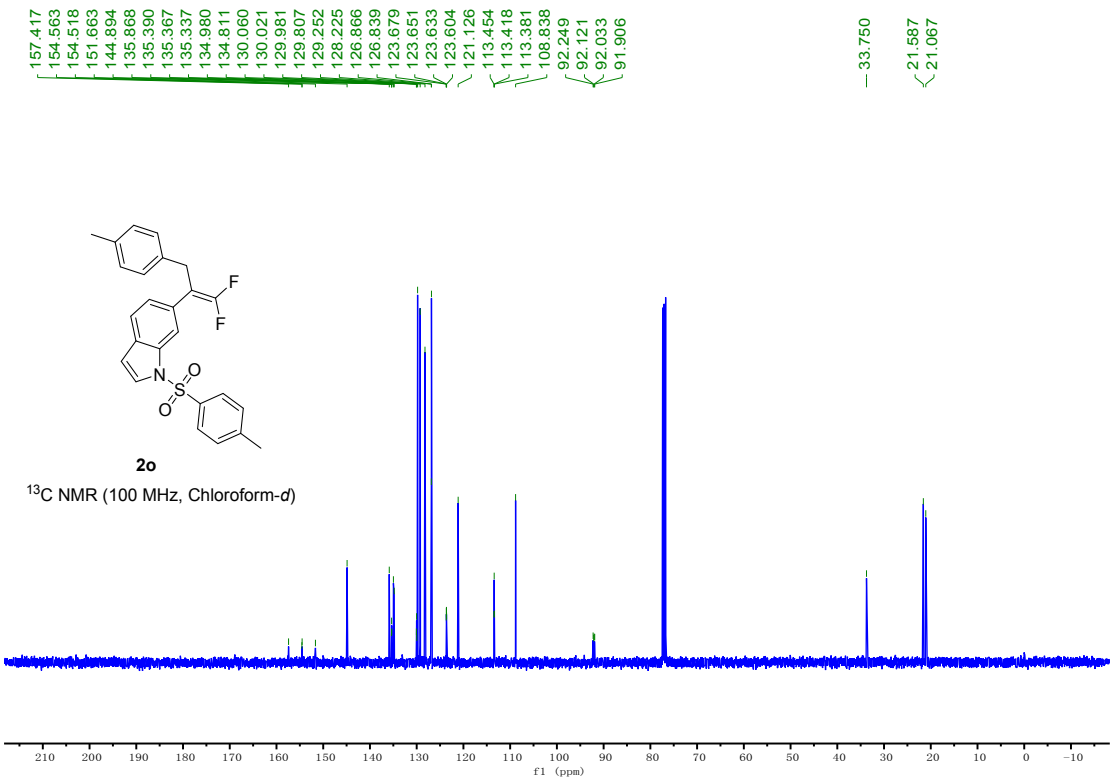


Figure S 135

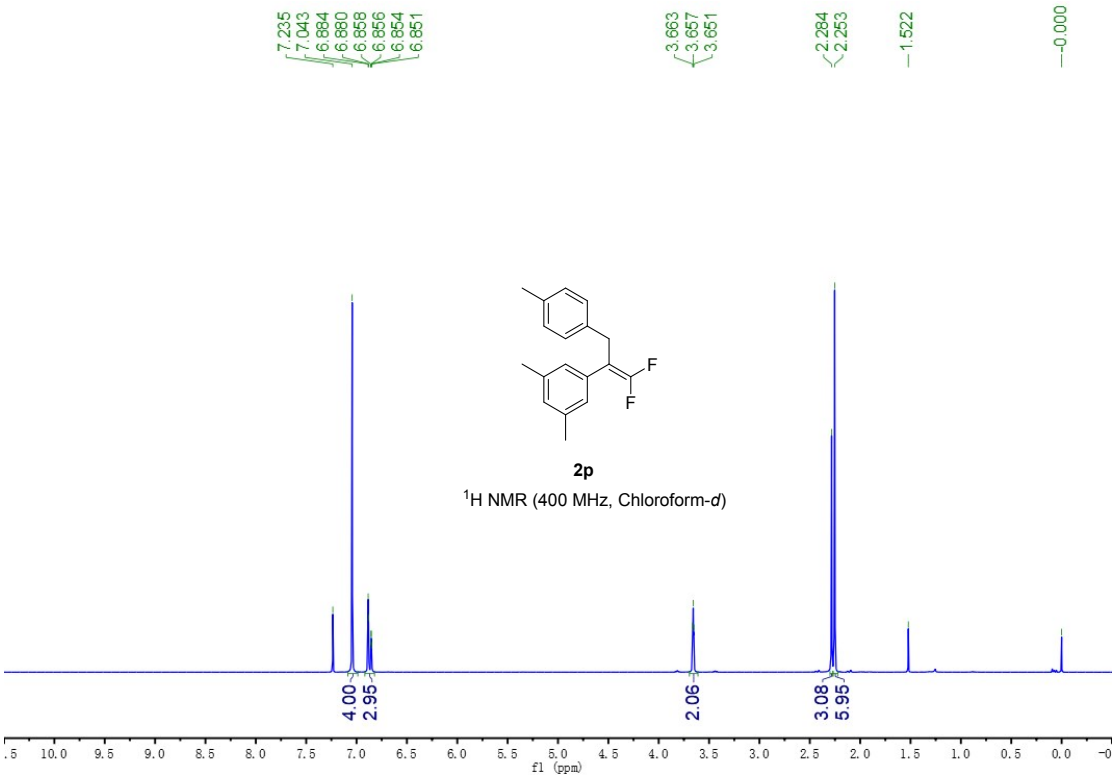


Figure S 136

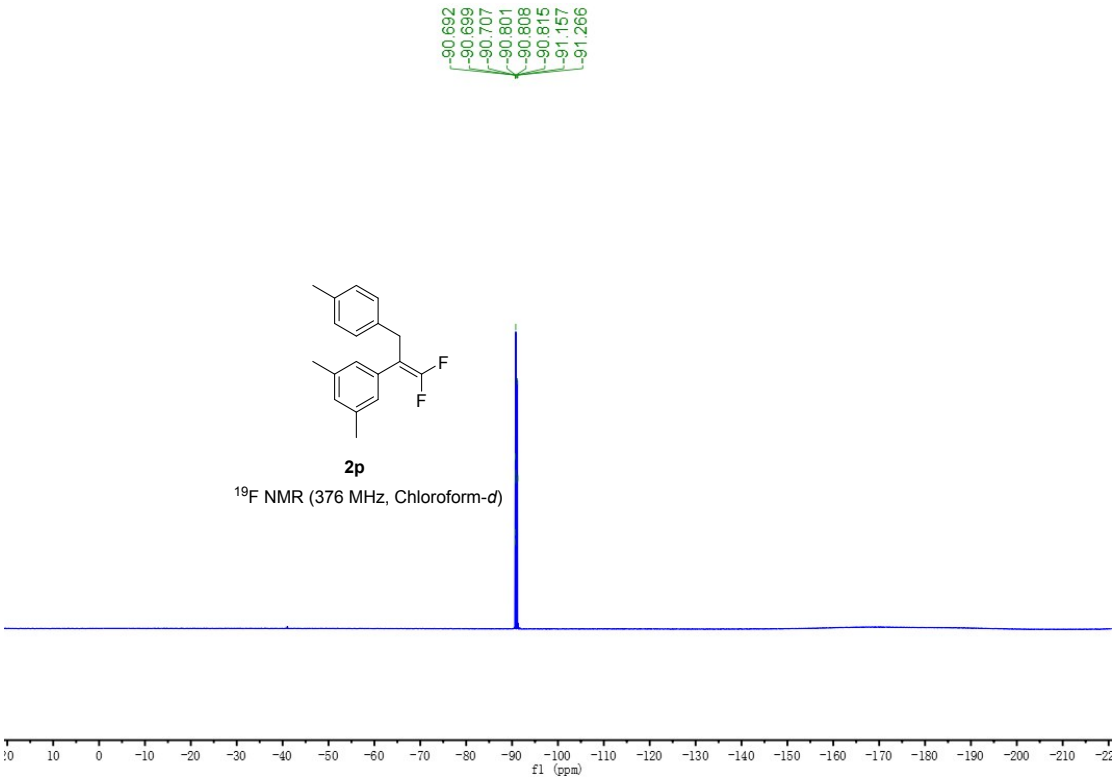


Figure S 137

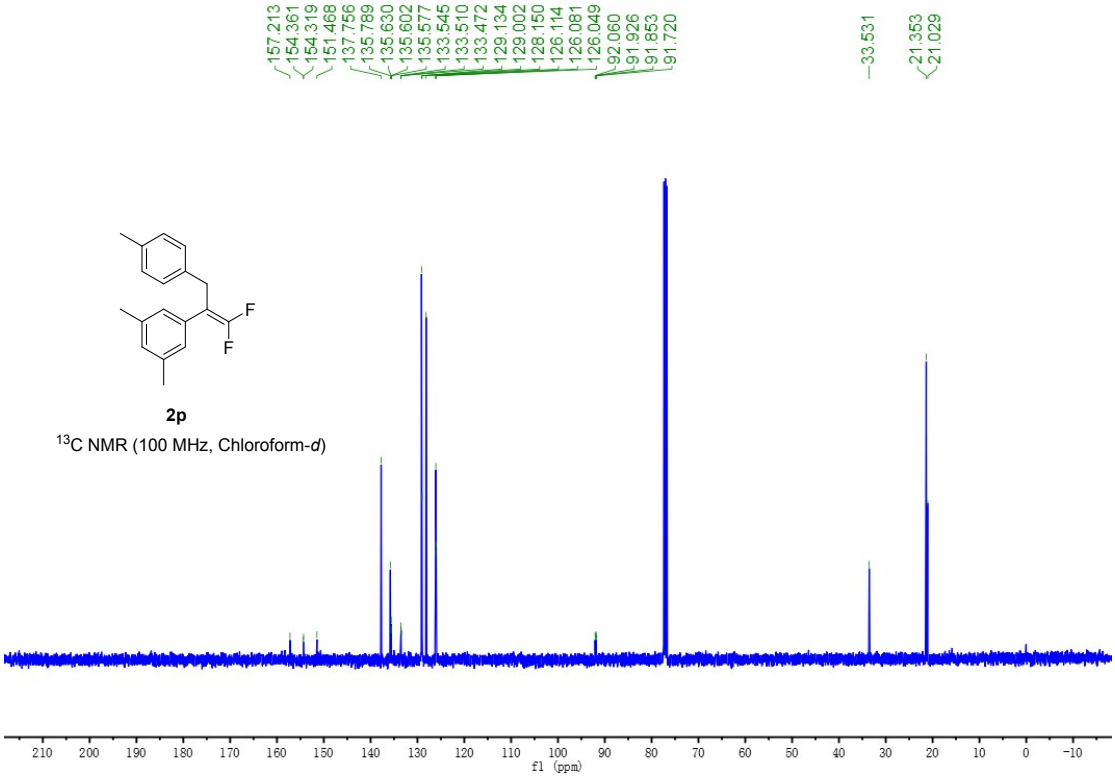


Figure S 138

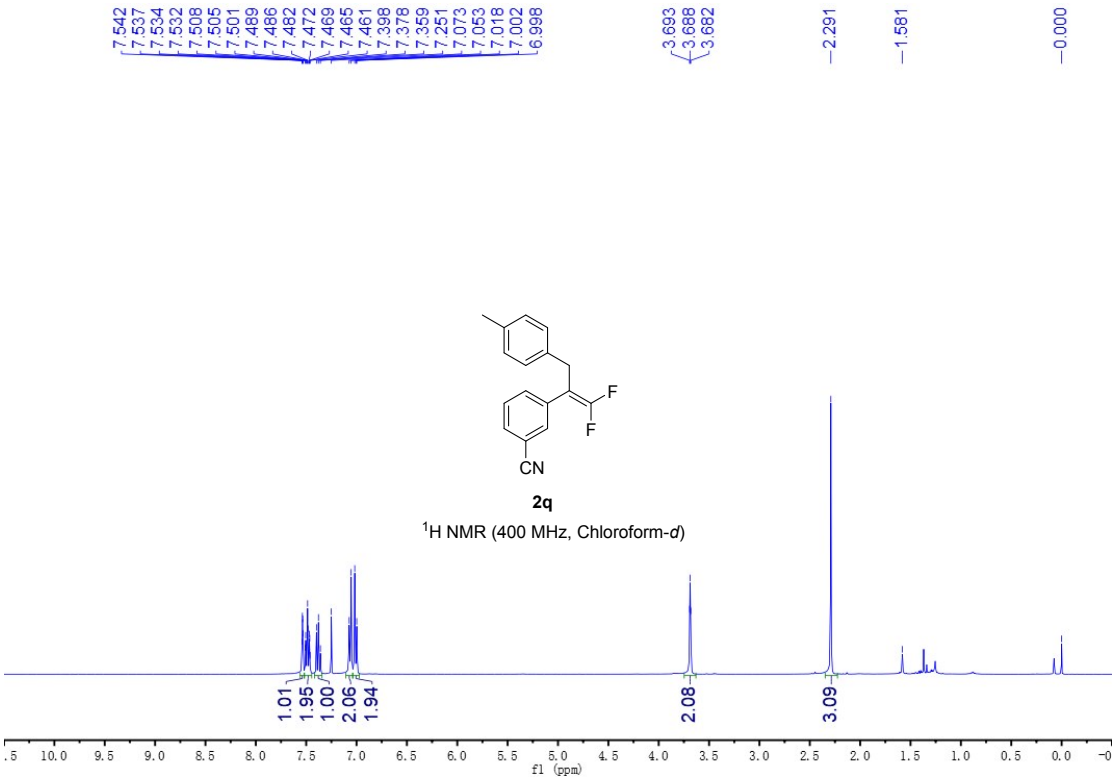


Figure S 139

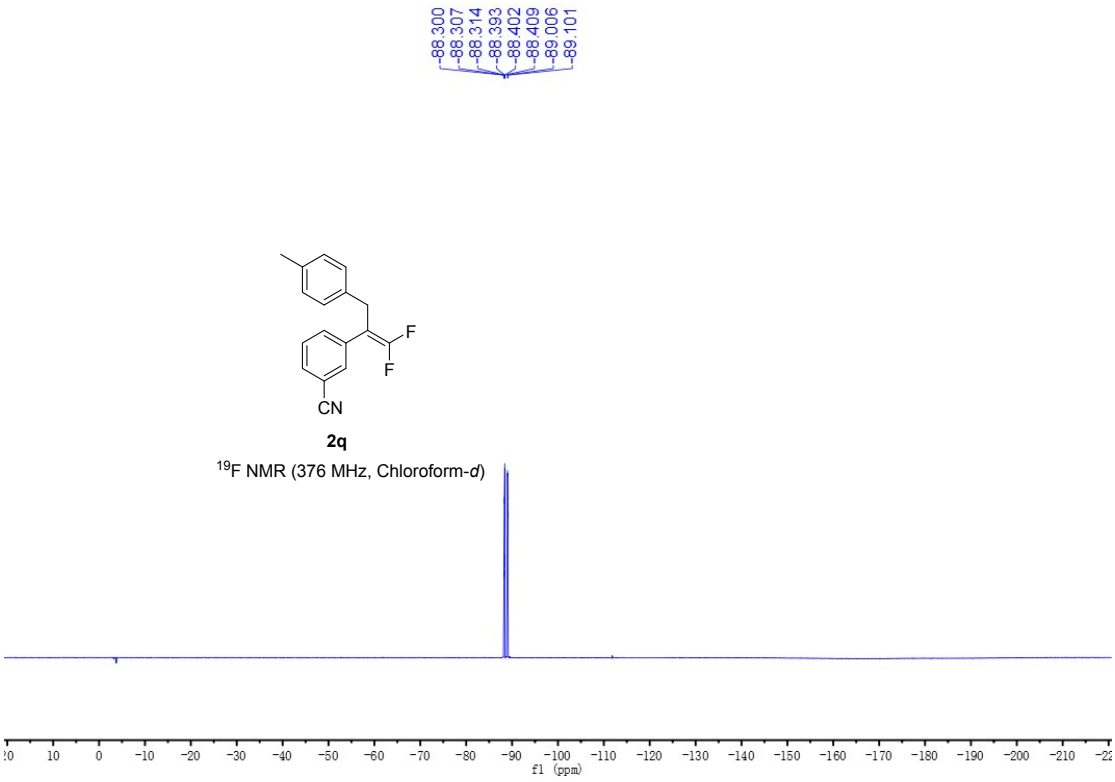


Figure S 140

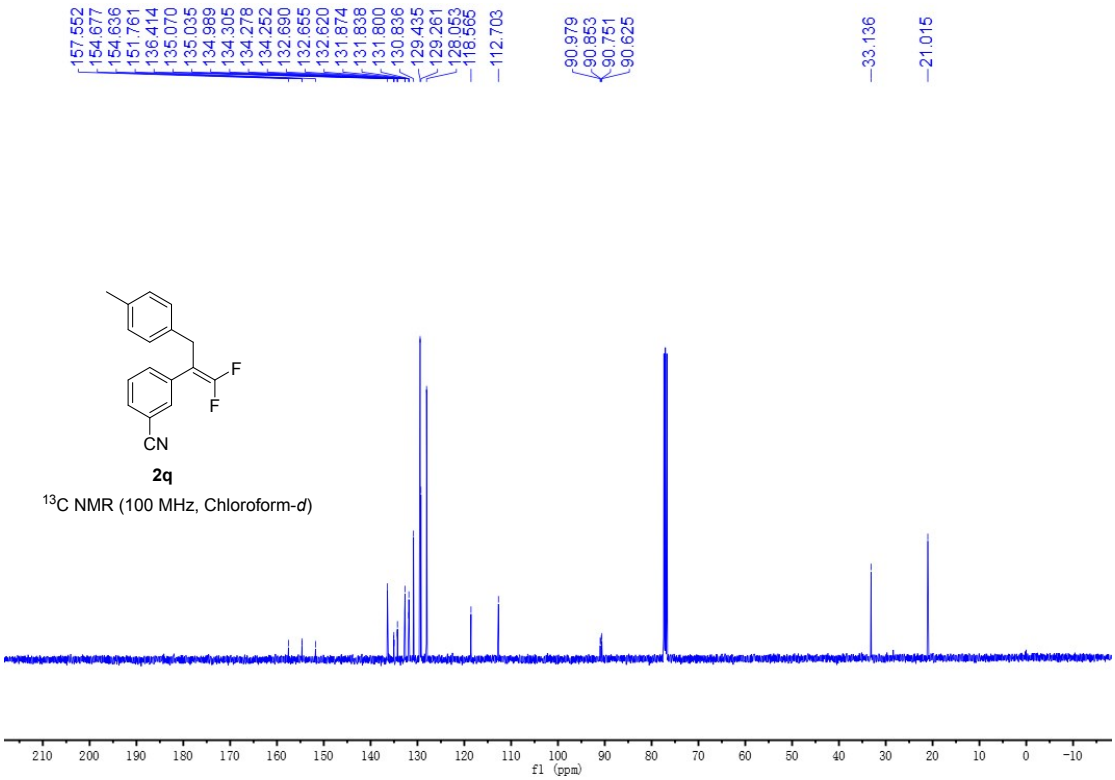


Figure S 141

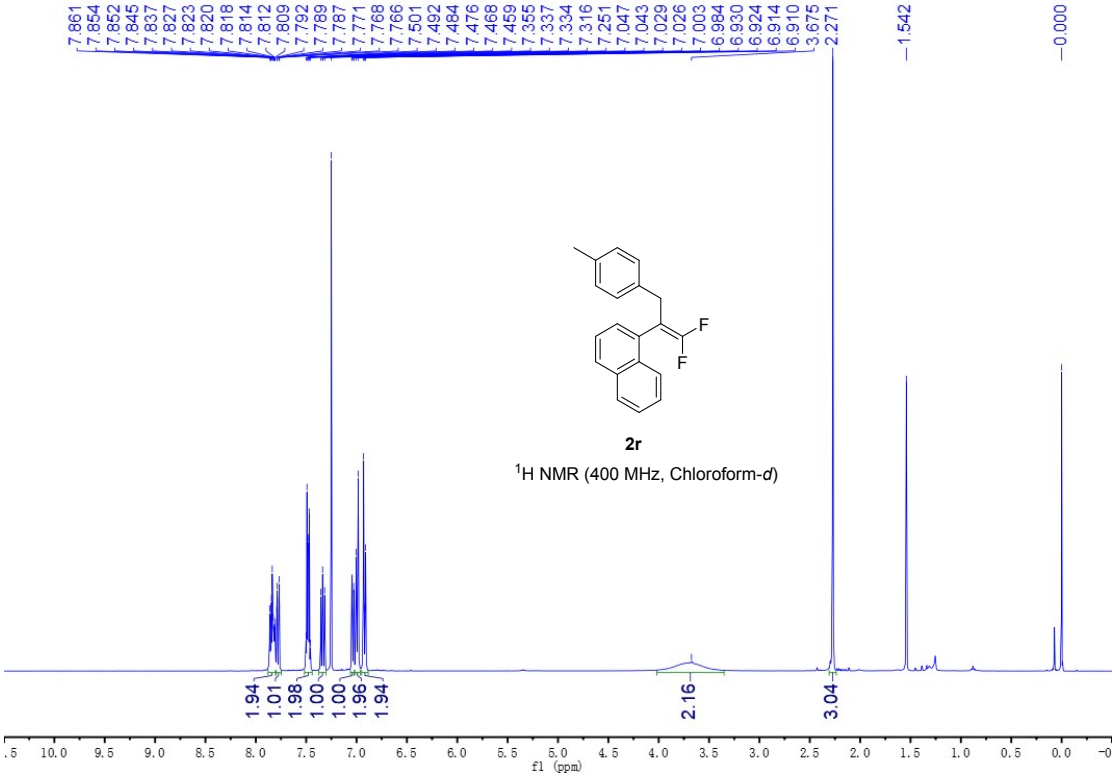
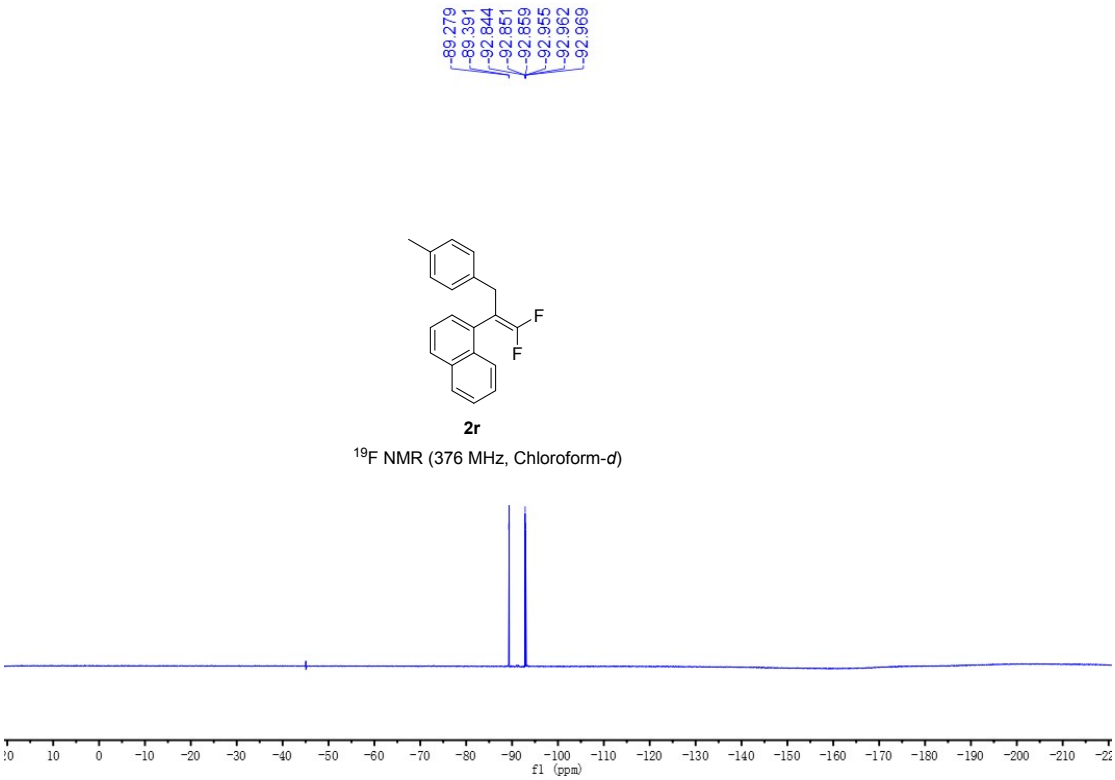


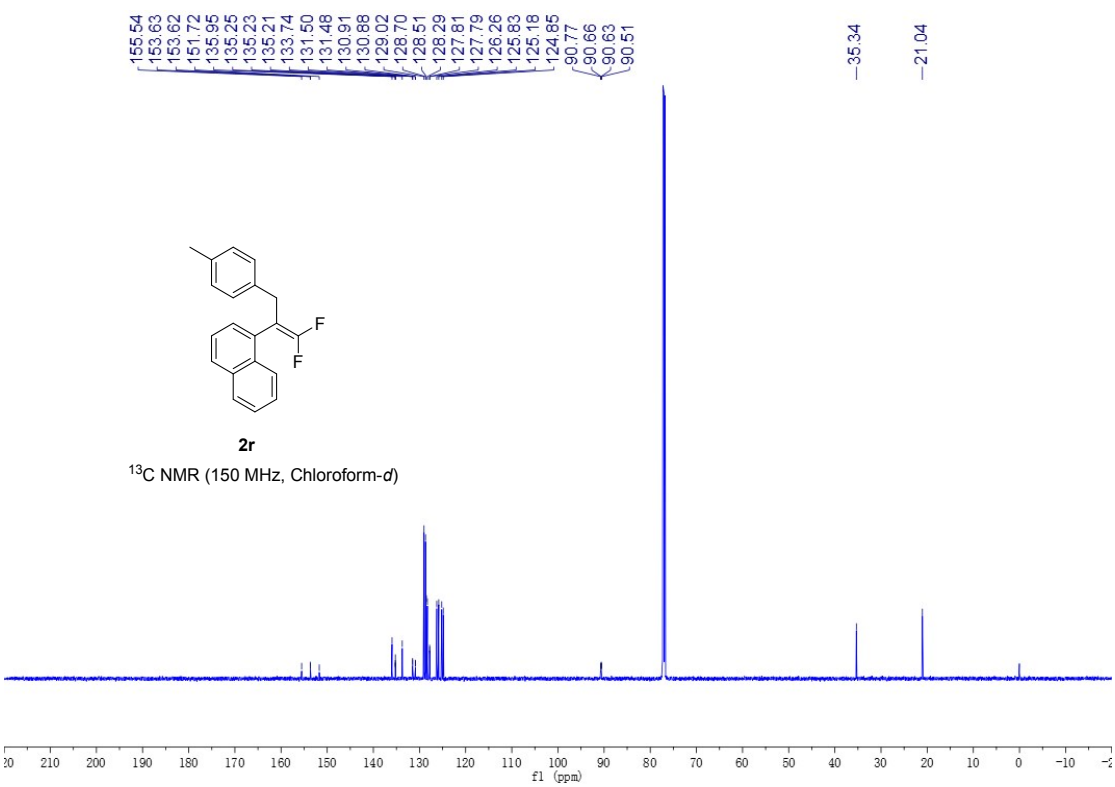
Figure S 142



2r

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

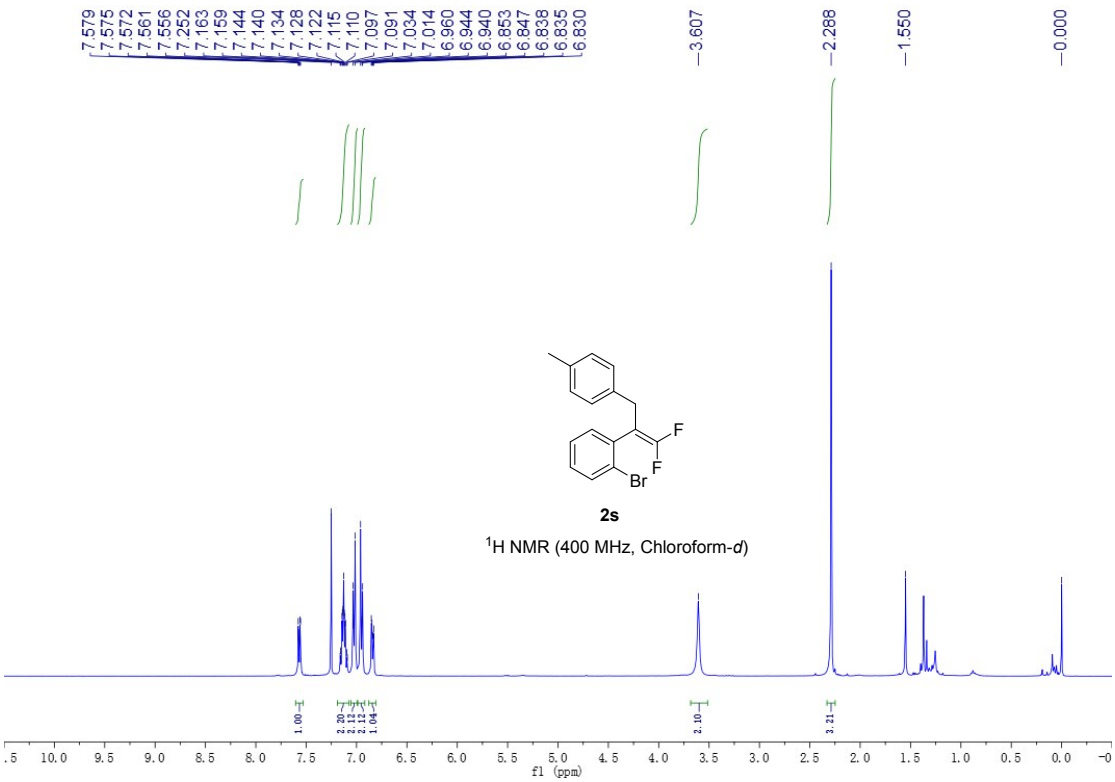
Figure S 143



2r

^{13}C NMR (150 MHz, Chloroform-*d*)

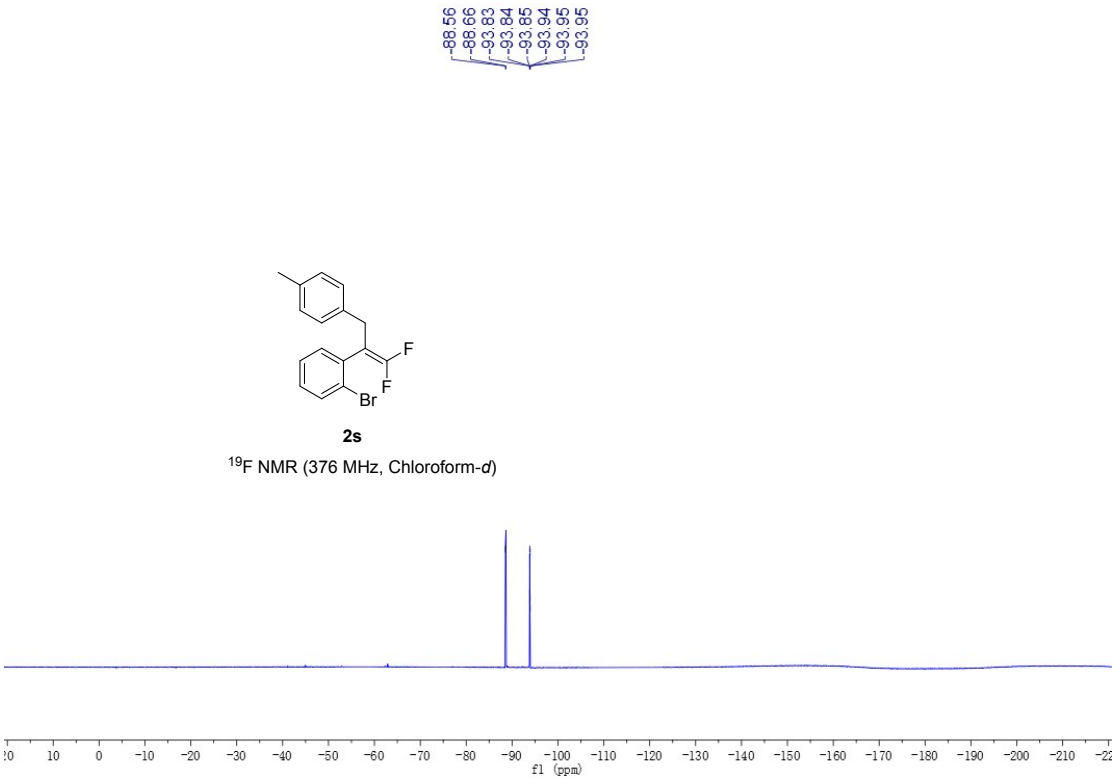
Figure S 144



2s

^{1}H NMR (400 MHz, Chloroform-*d*)

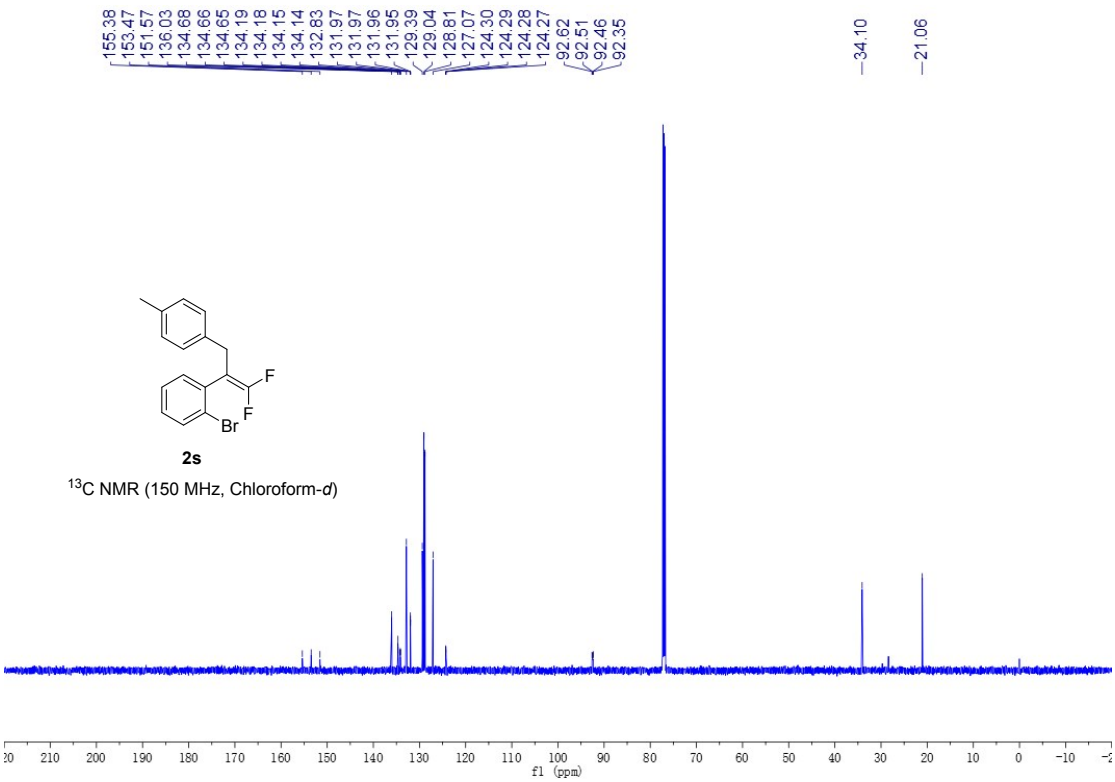
Figure S 145



2s

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

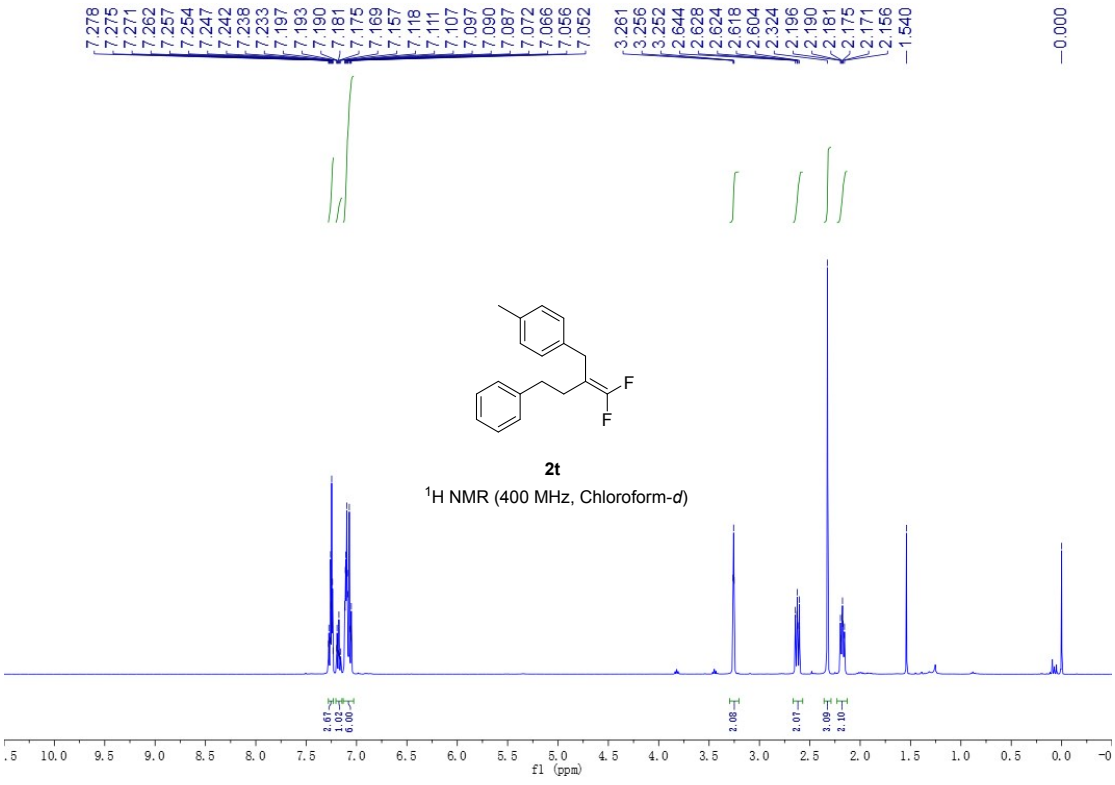
Figure S 146



2s

^{13}C NMR (150 MHz, Chloroform-*d*)

Figure S 147



2t

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 148

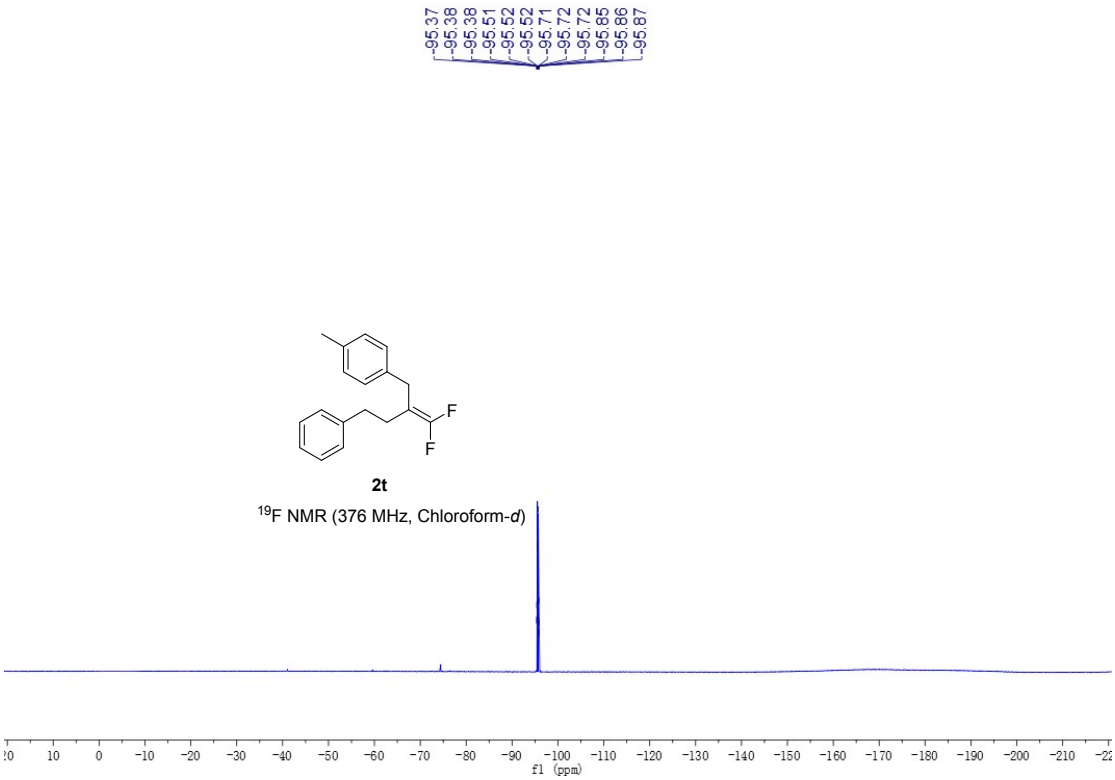


Figure S 149

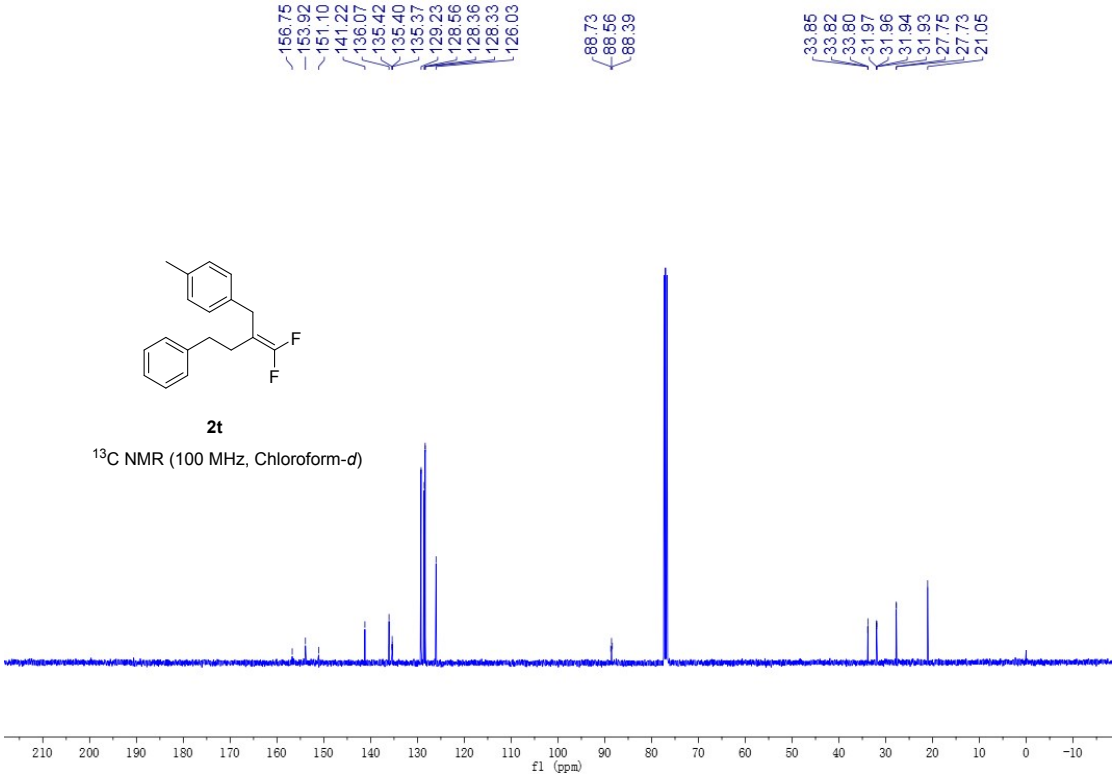


Figure S 150

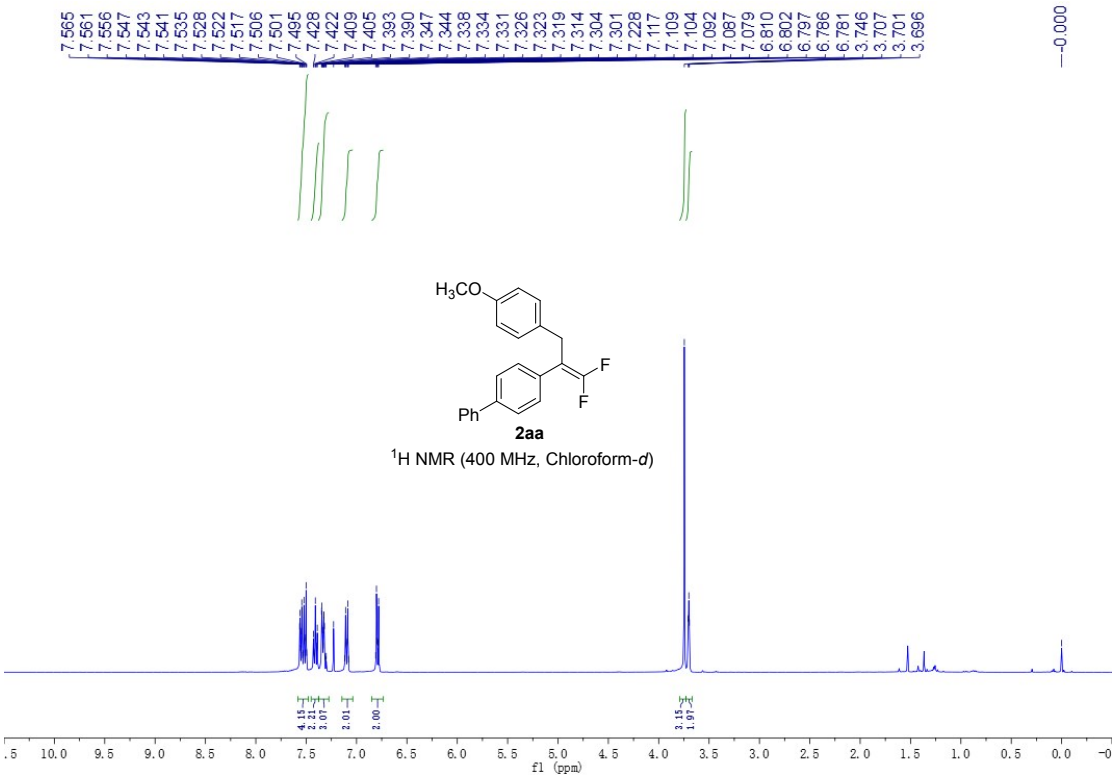


Figure S 151

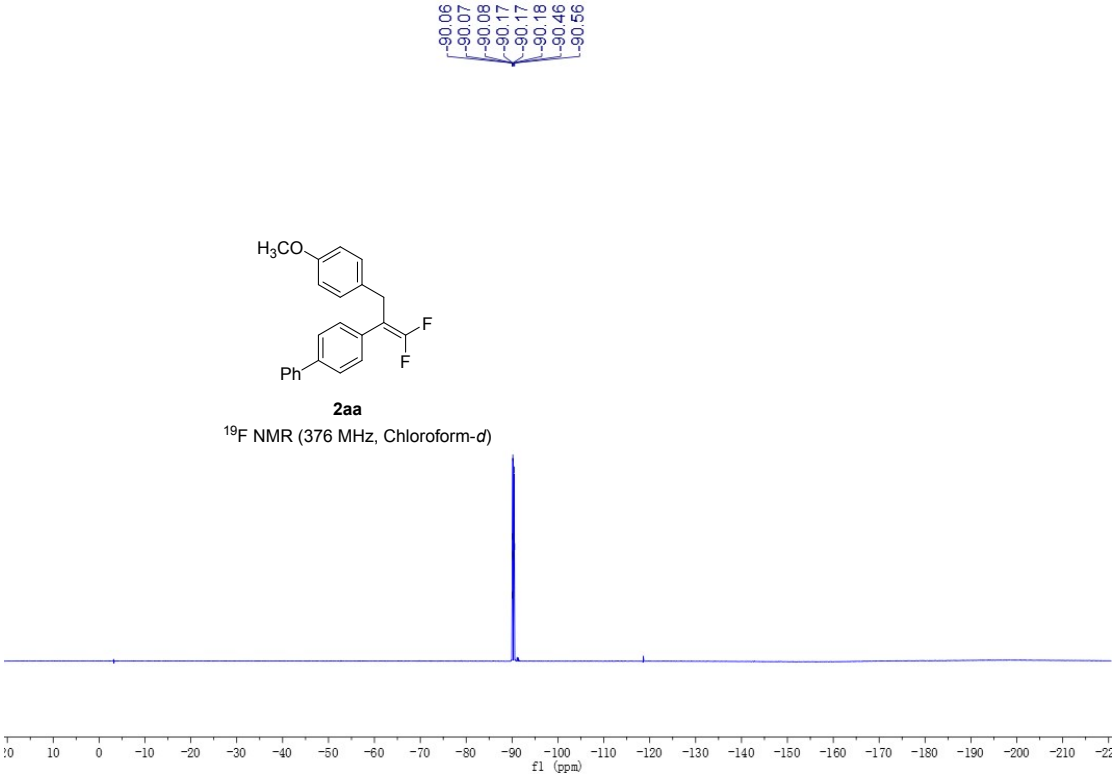


Figure S 152

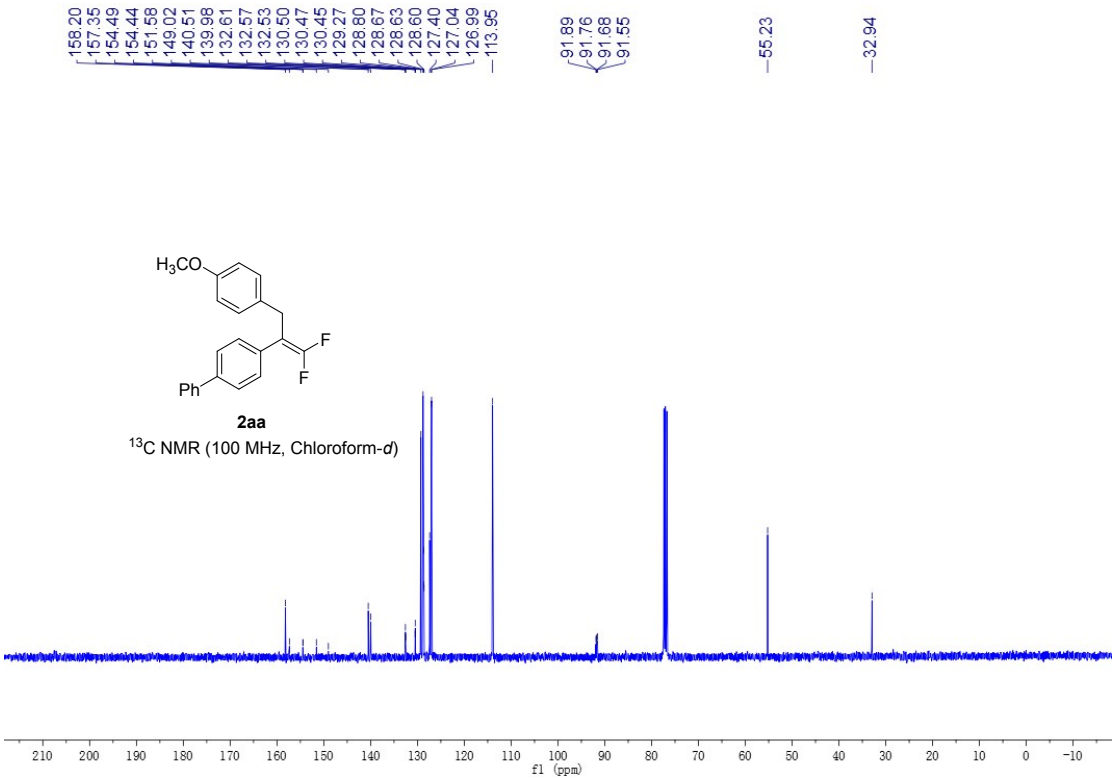


Figure S 153

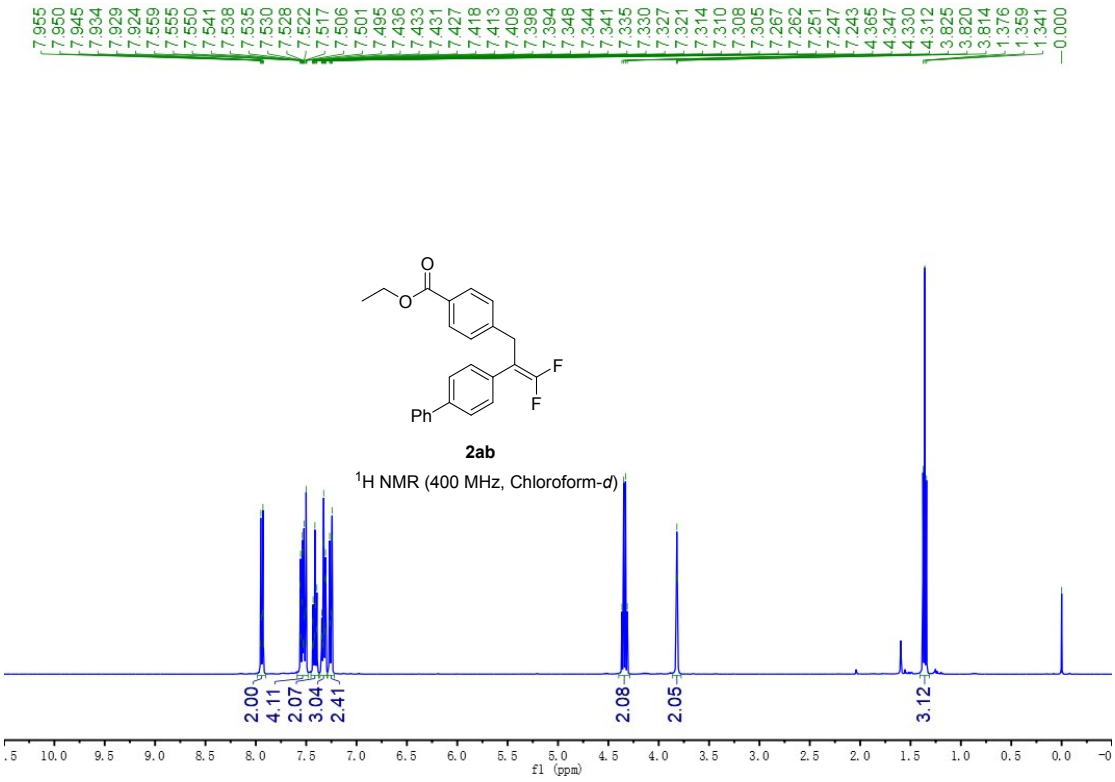
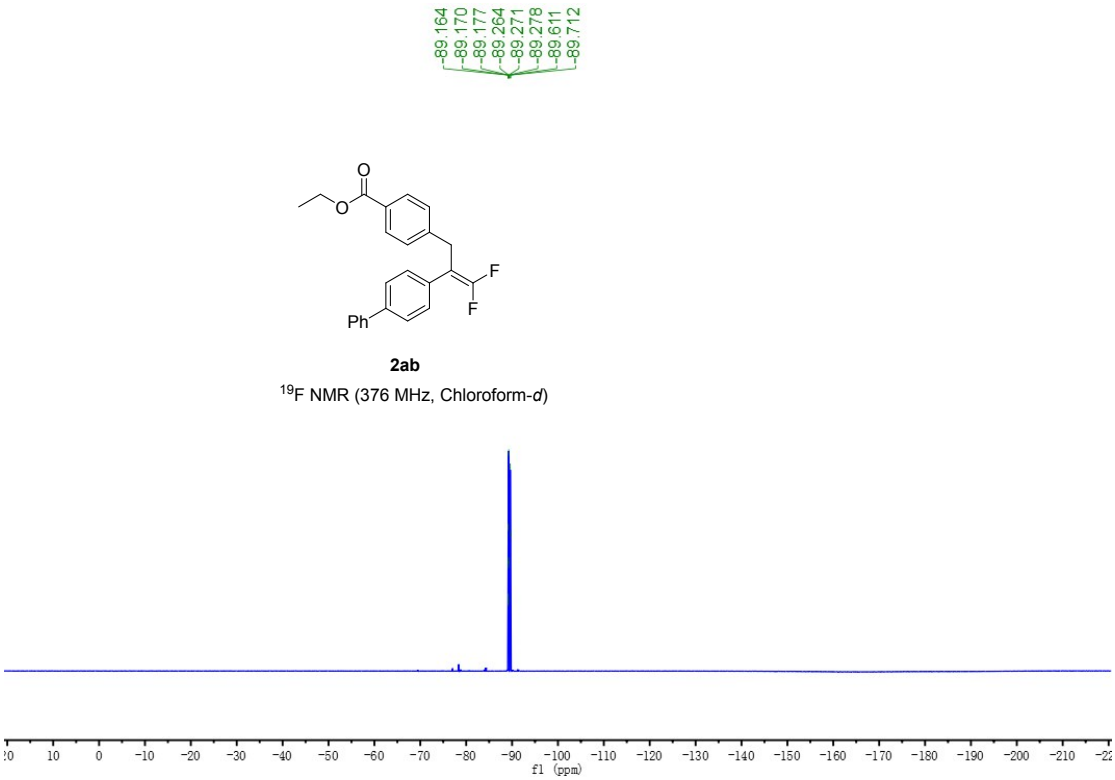


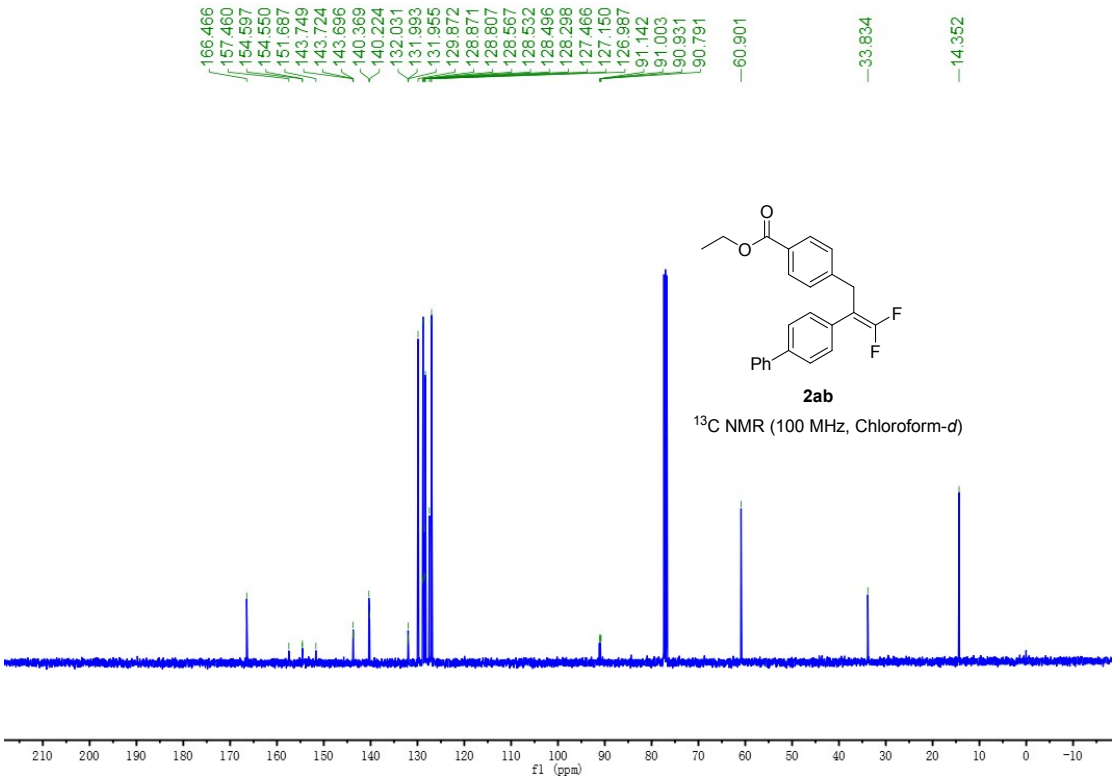
Figure S 154



2ab

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

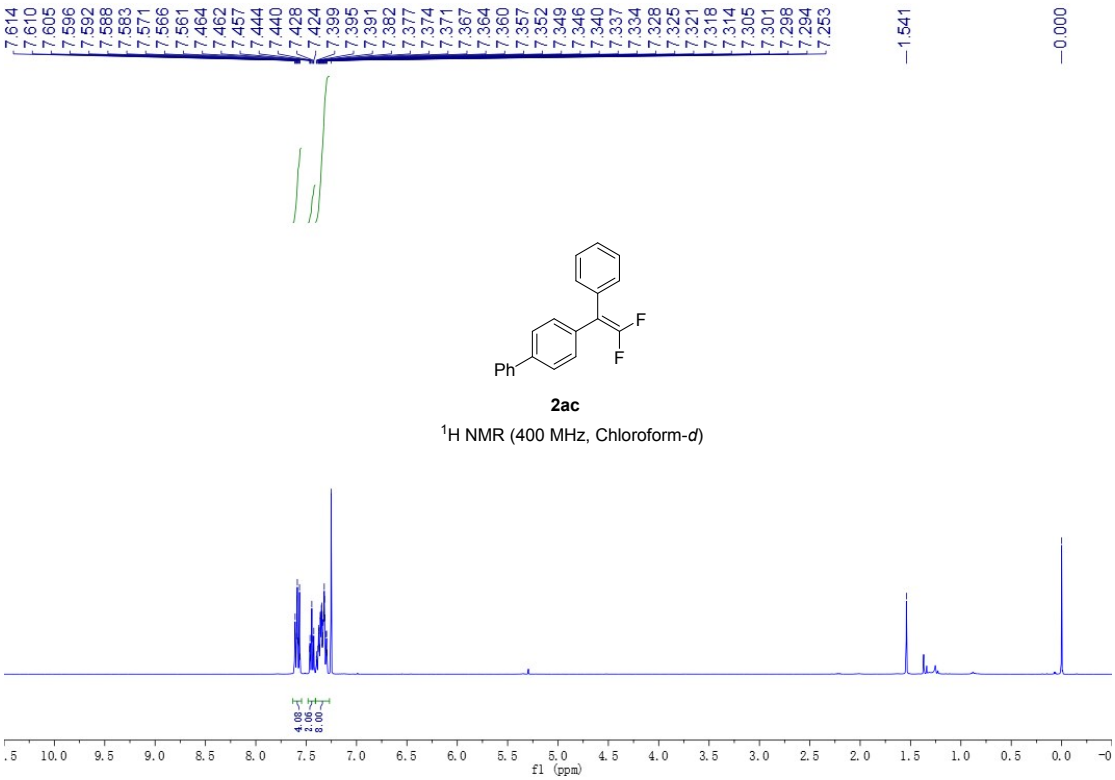
Figure S 155



2ab

^{13}C NMR (100 MHz, Chloroform-*d*)

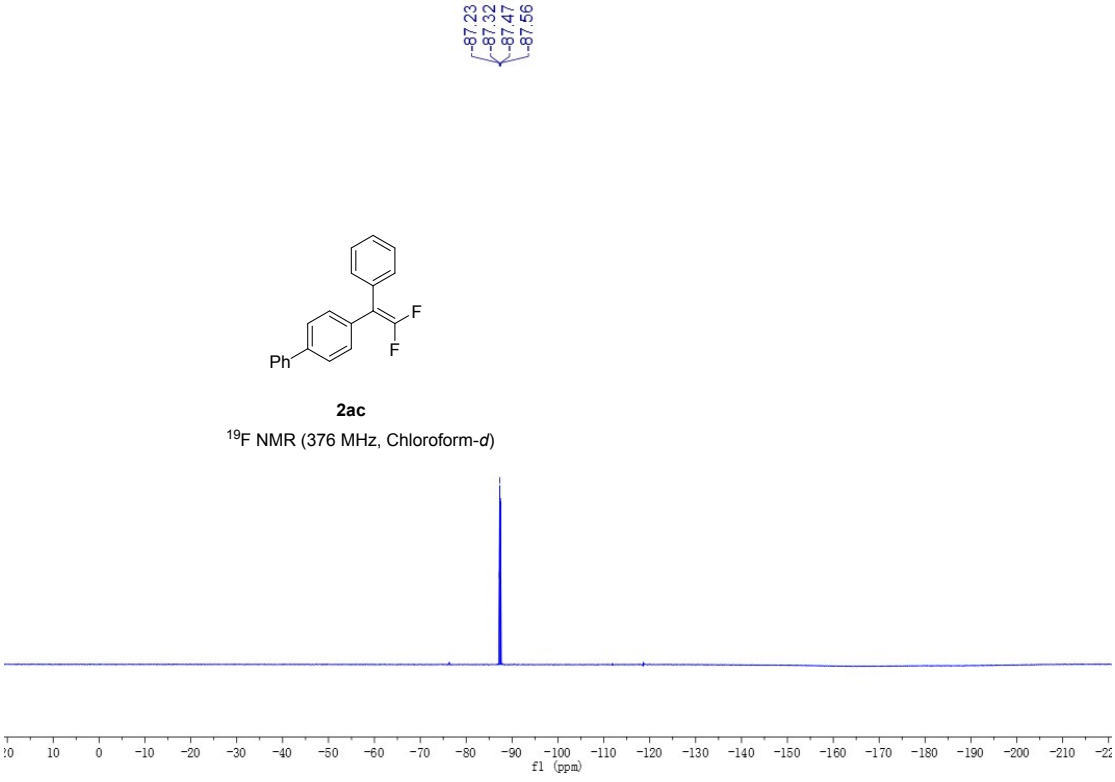
Figure S 156



2ac

^{1}H NMR (400 MHz, Chloroform-*d*)

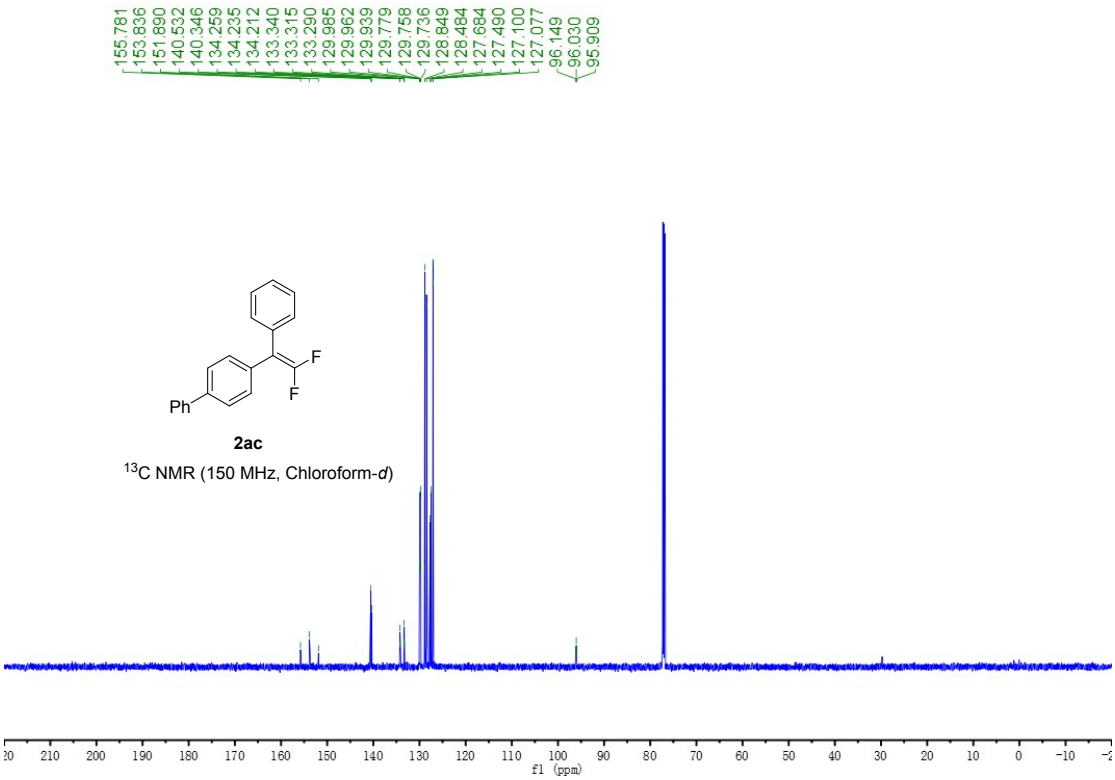
Figure S 157



2ac

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

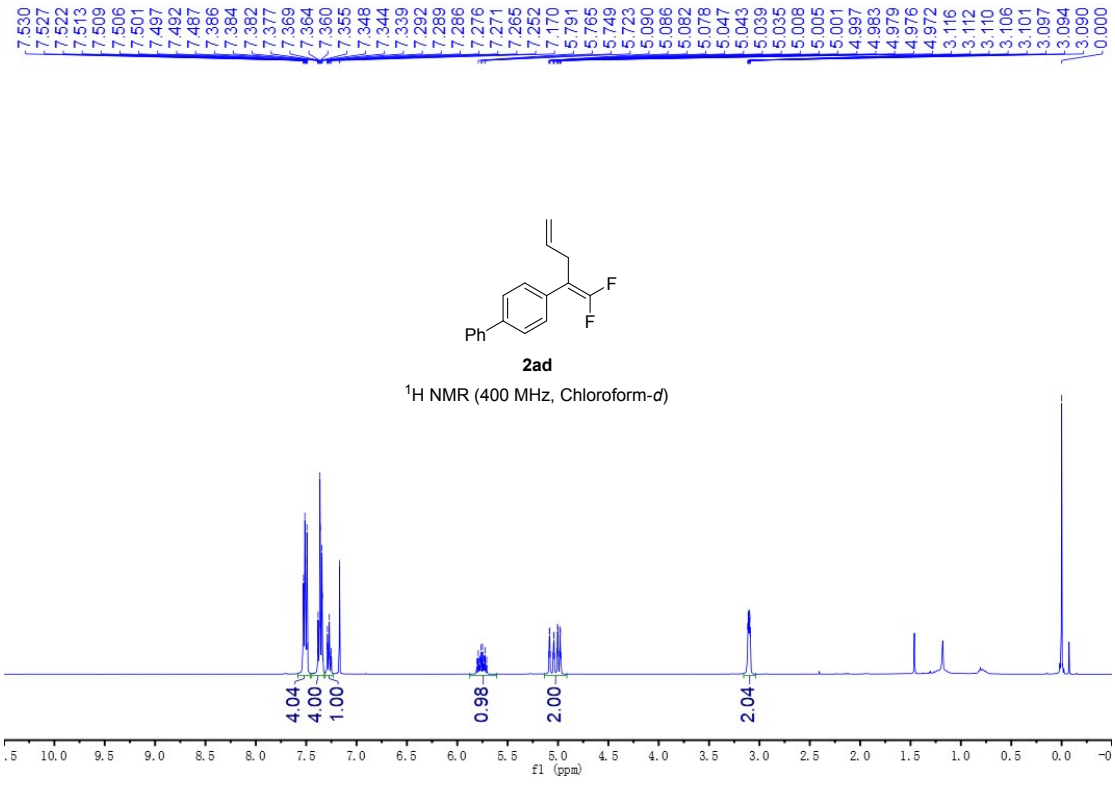
Figure S 158



2ac

^{13}C NMR (150 MHz, Chloroform-*d*)

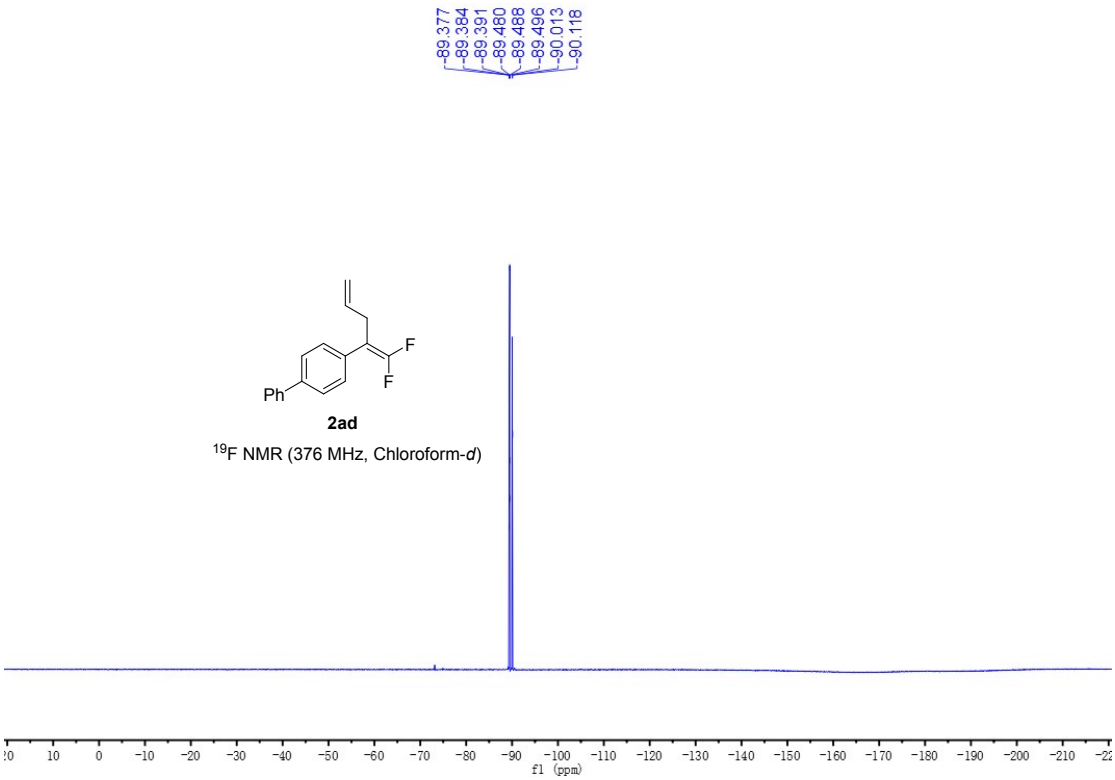
Figure S 159



2ad

^{1}H NMR (400 MHz, Chloroform-*d*)

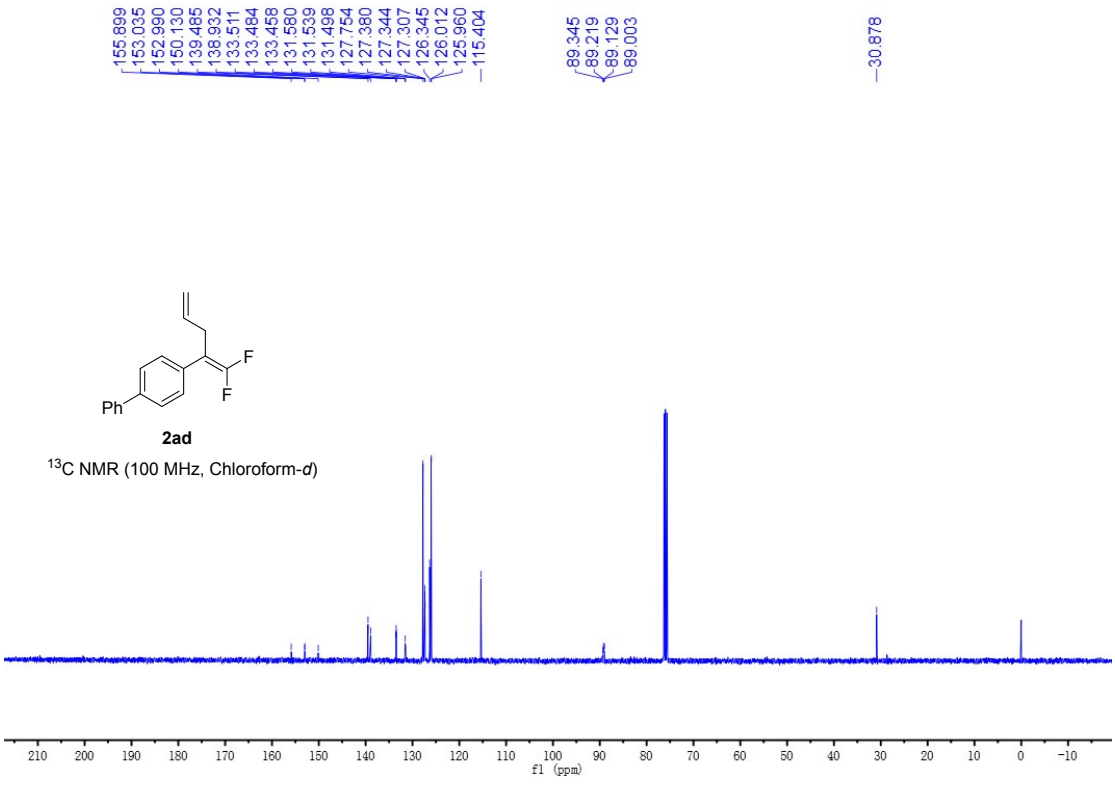
Figure S 160



2ad

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

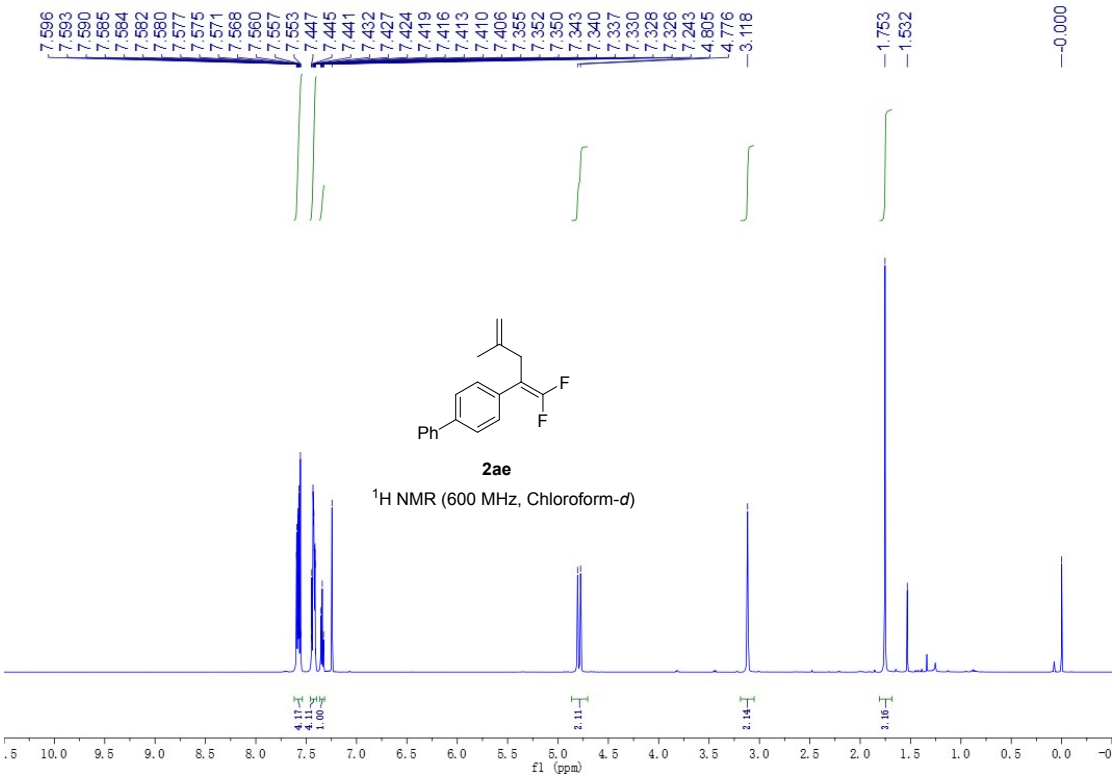
Figure S 161



2ad

^{13}C NMR (100 MHz, Chloroform-*d*)

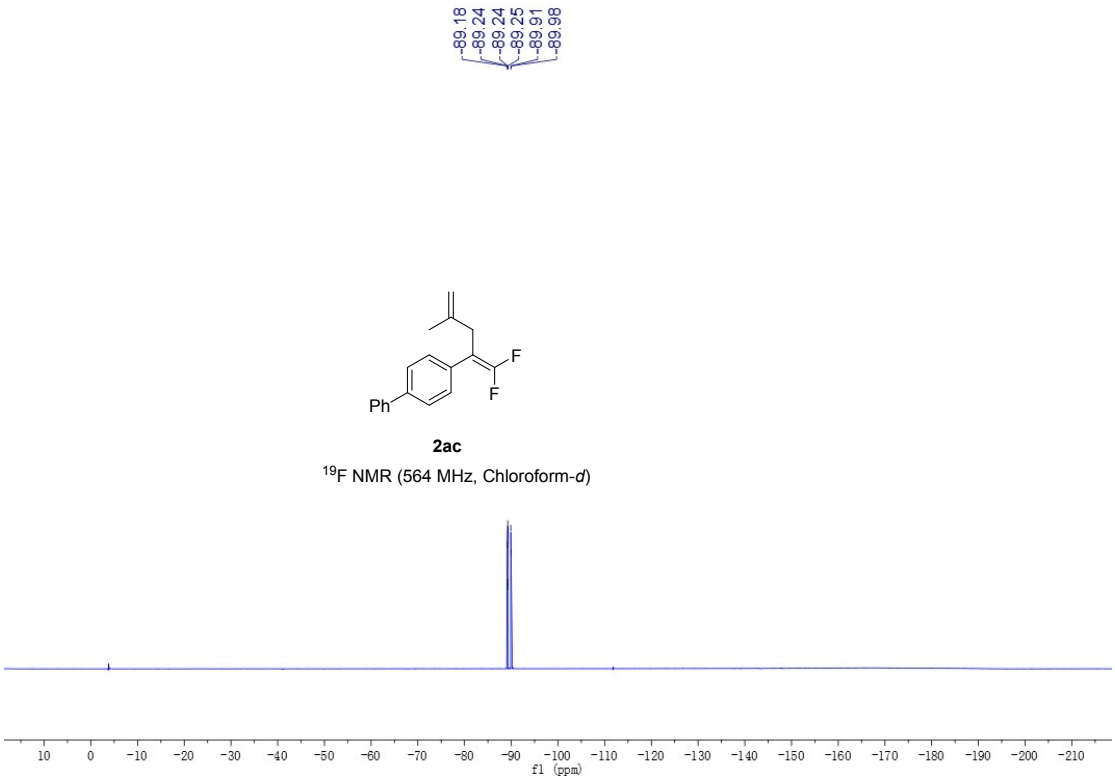
Figure S 162



2ae

^{1}H NMR (600 MHz, Chloroform-*d*)

Figure S 163



2ac

^{19}F NMR (564 MHz, Chloroform-*d*)

Figure S 164

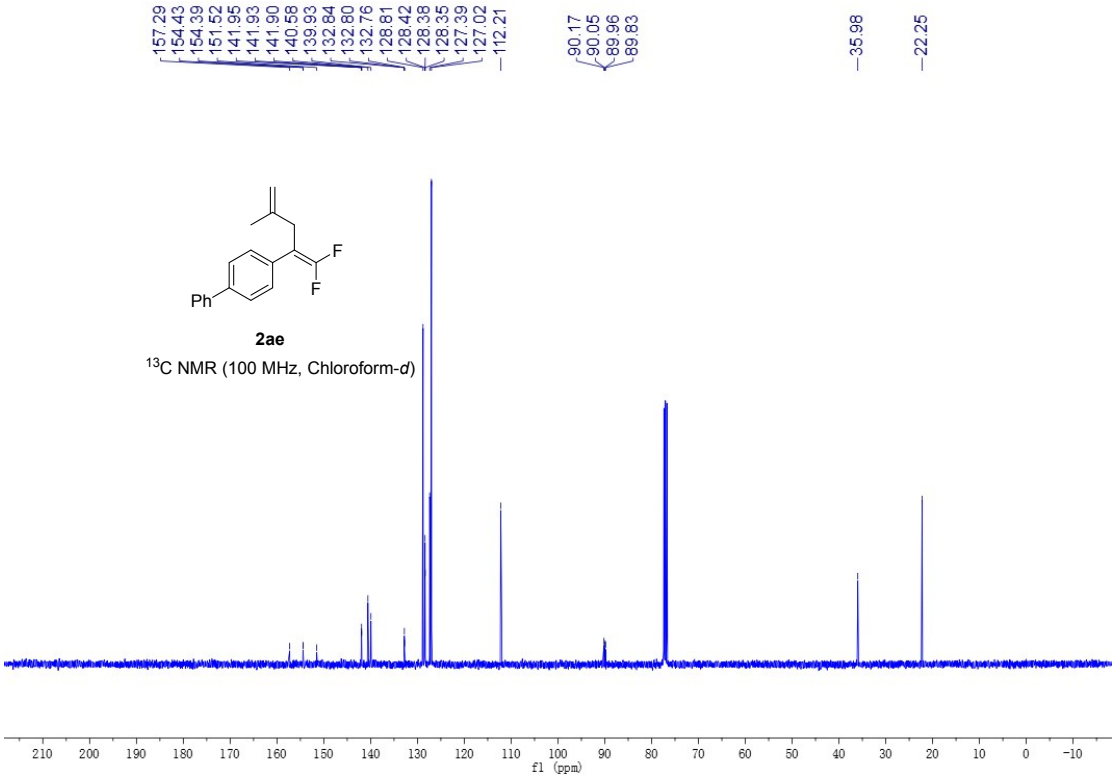


Figure S 165

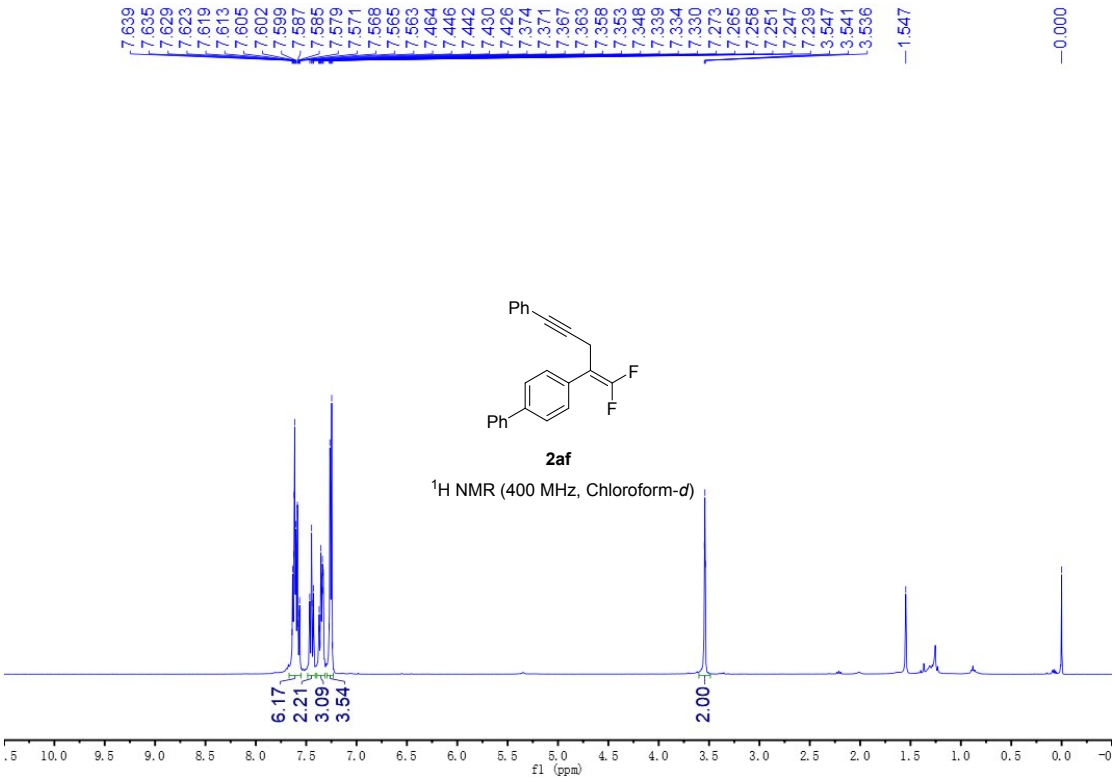


Figure S 166

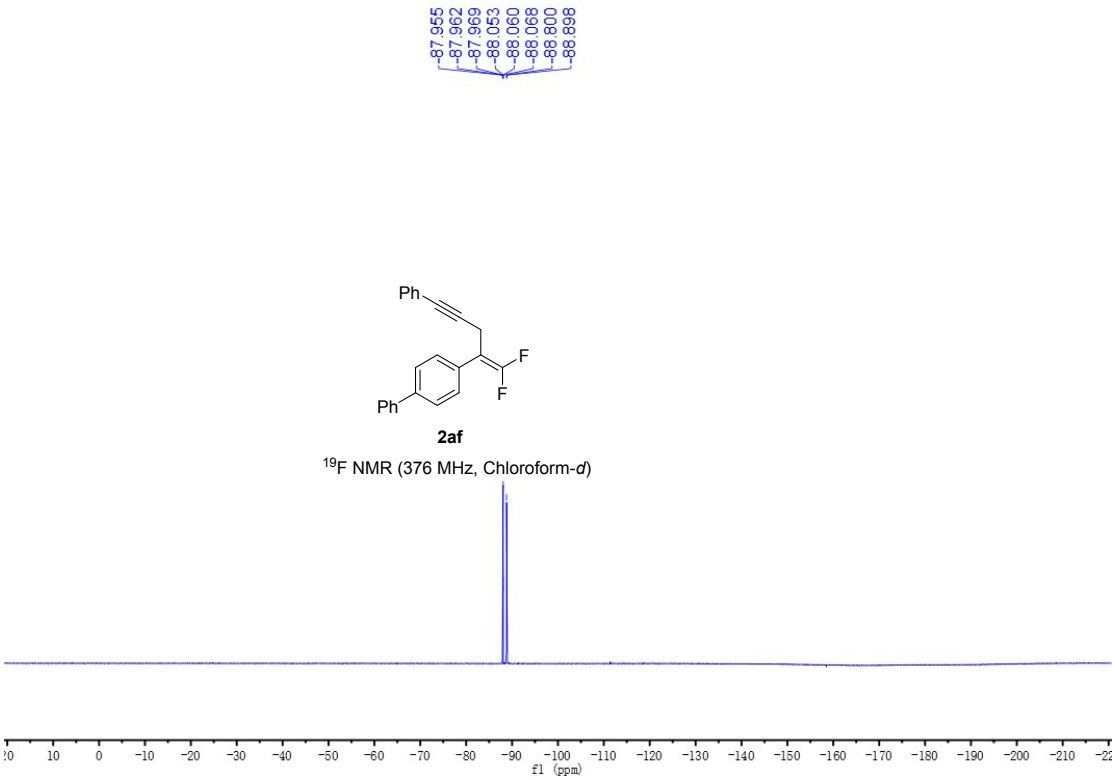


Figure S 167

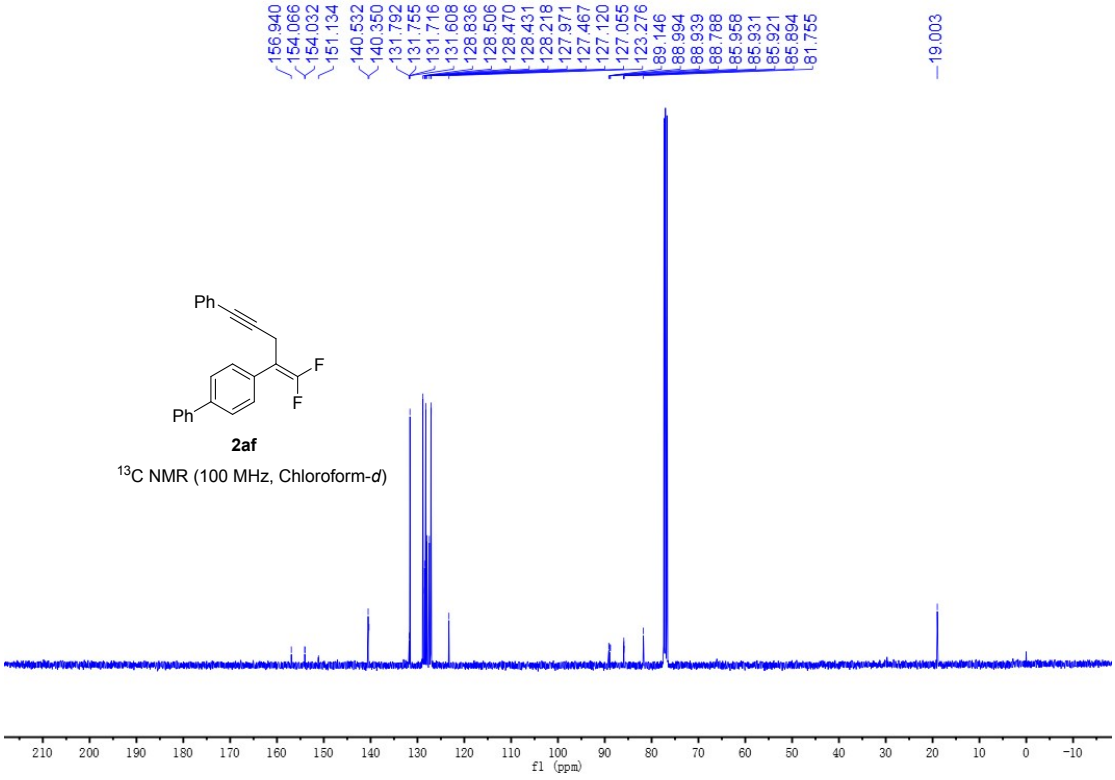


Figure S 168

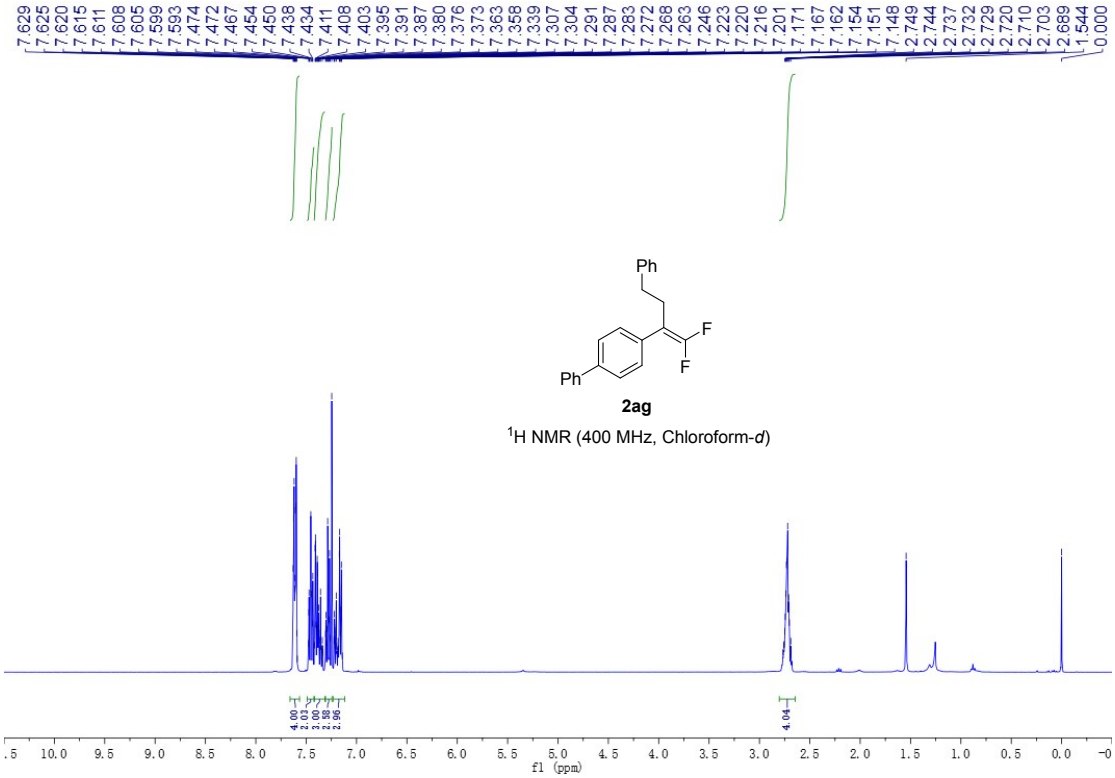


Figure S 169

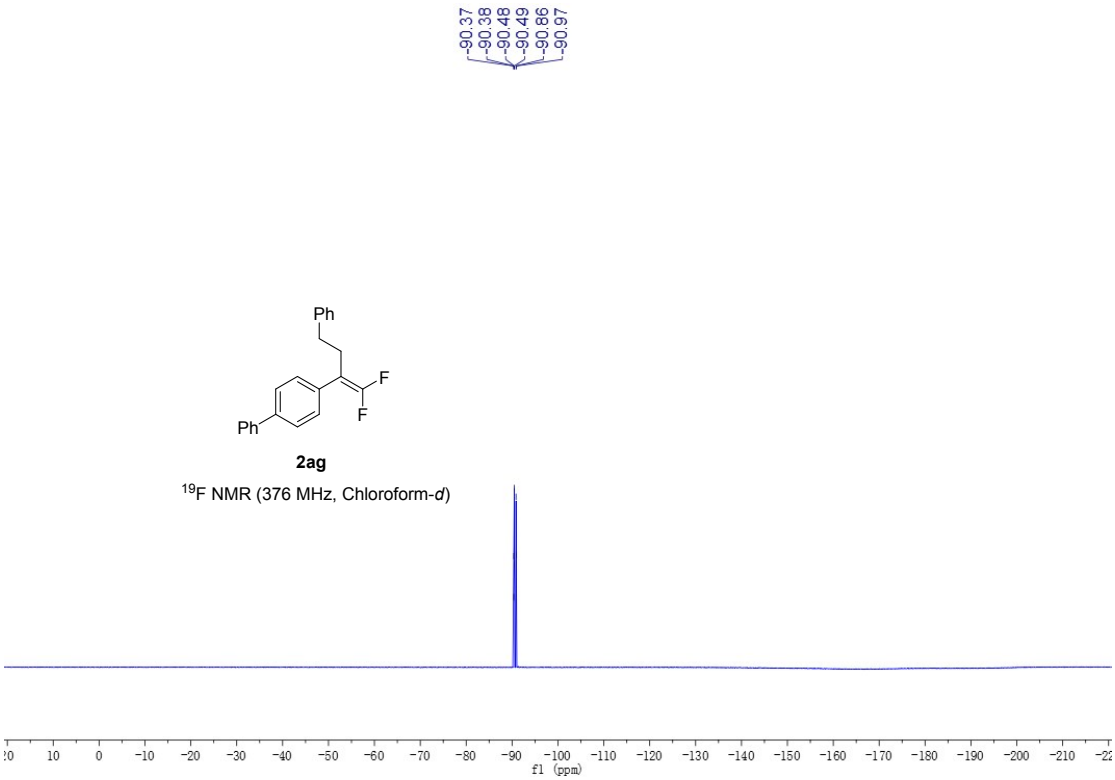
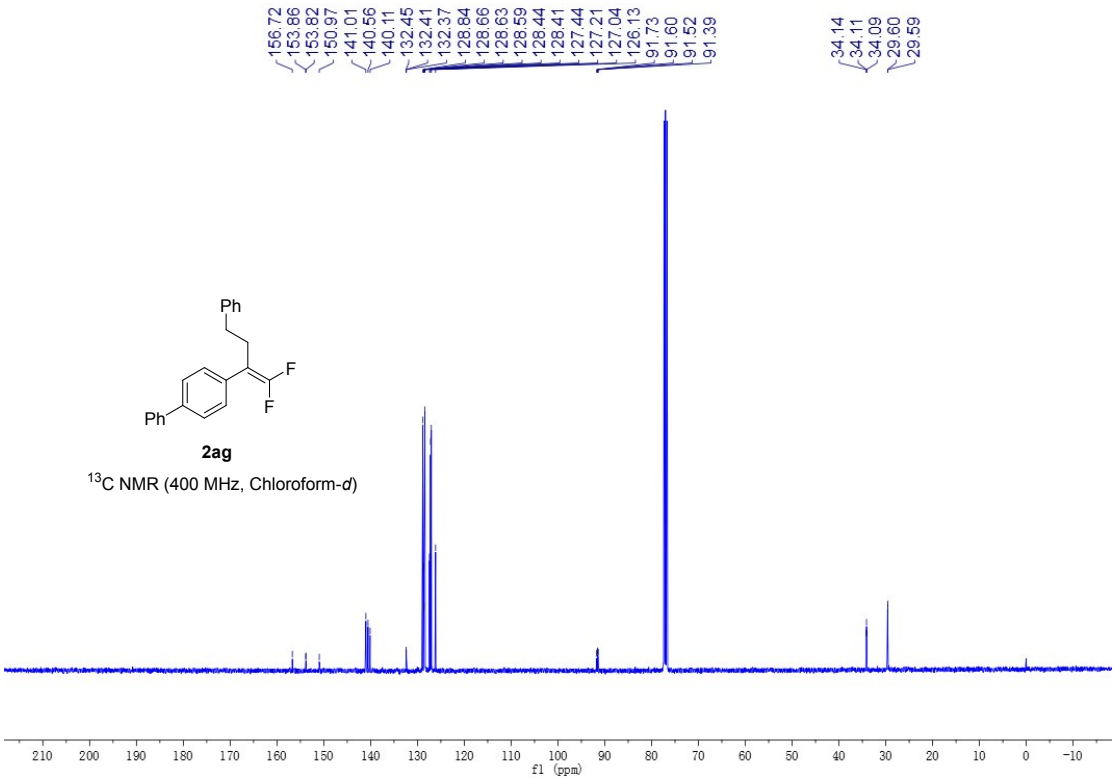


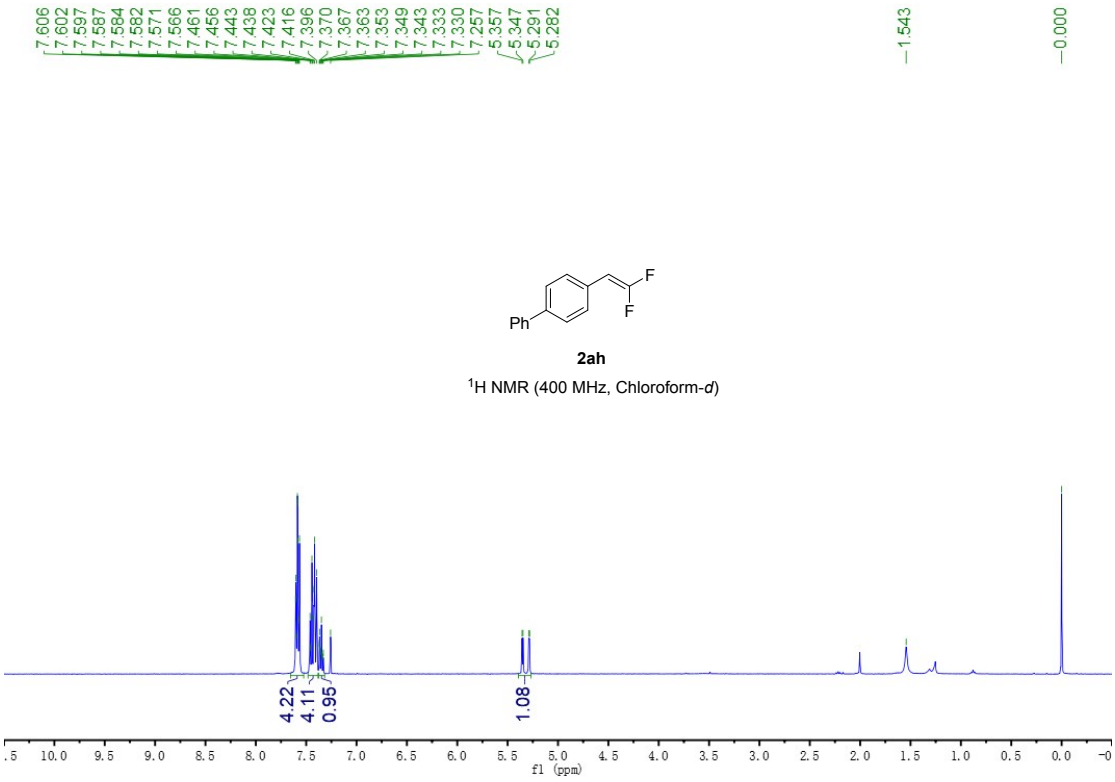
Figure S 170



2ag

^{13}C NMR (400 MHz, Chloroform-*d*)

Figure S 171



2ah

^{1}H NMR (400 MHz, Chloroform-*d*)

Figure S 172

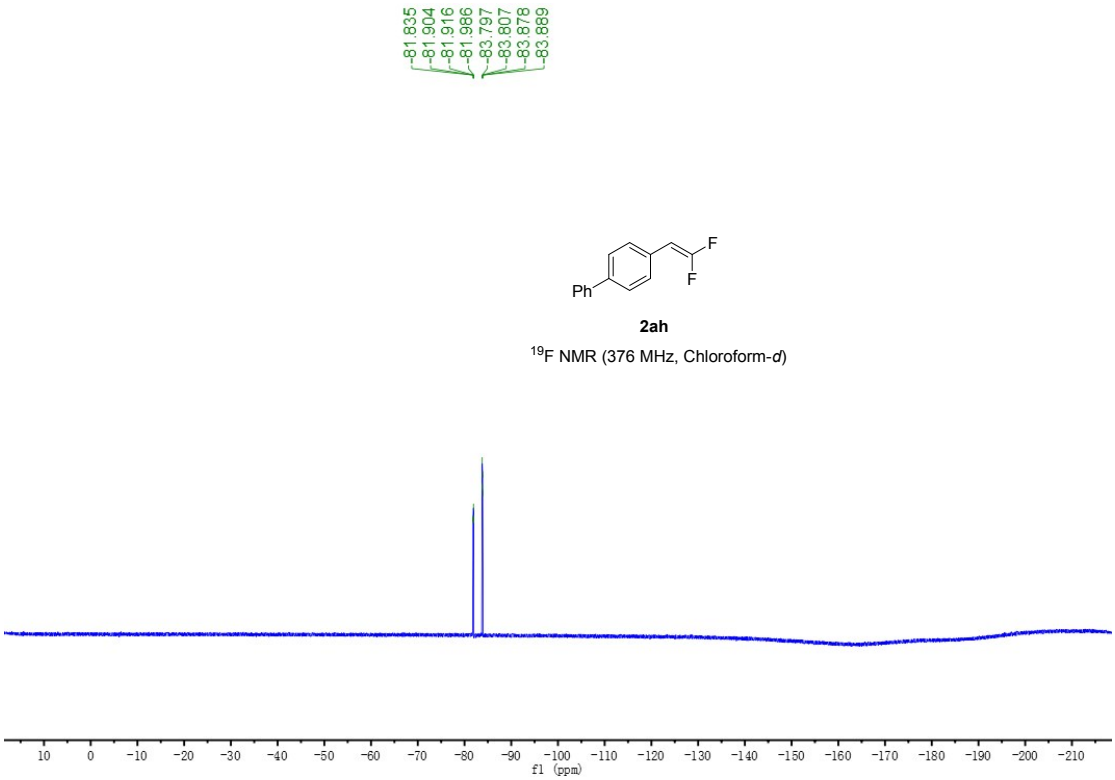


Figure S 173

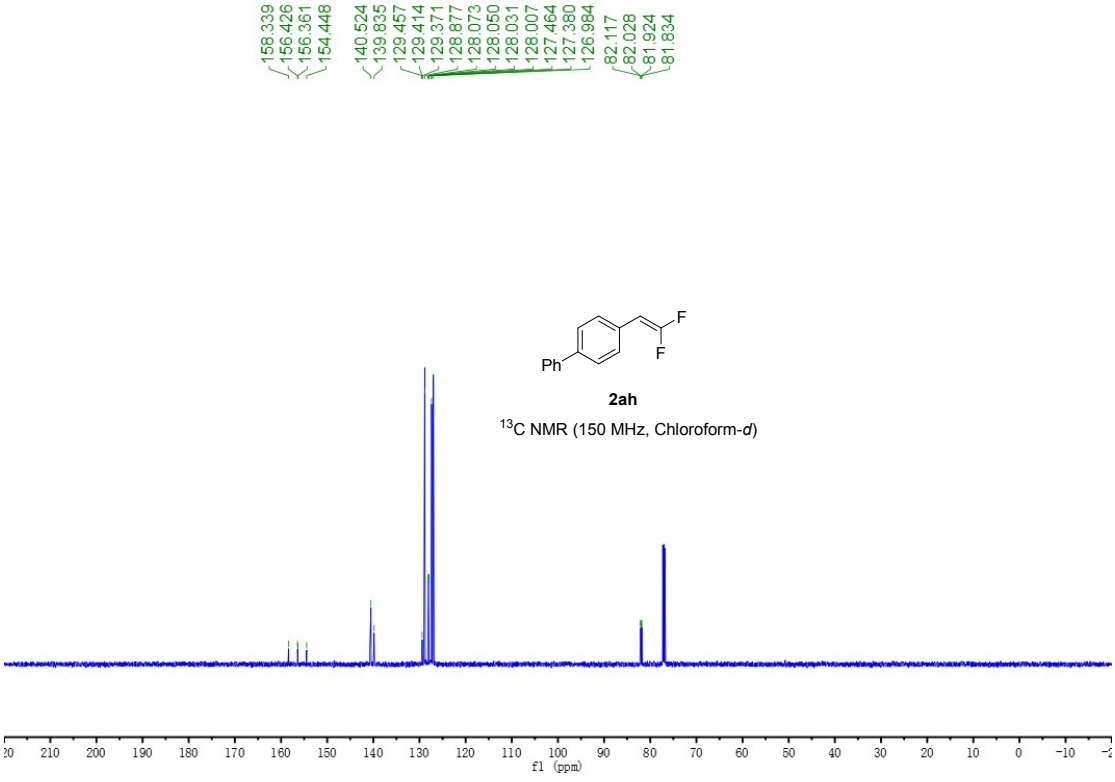


Figure S 174

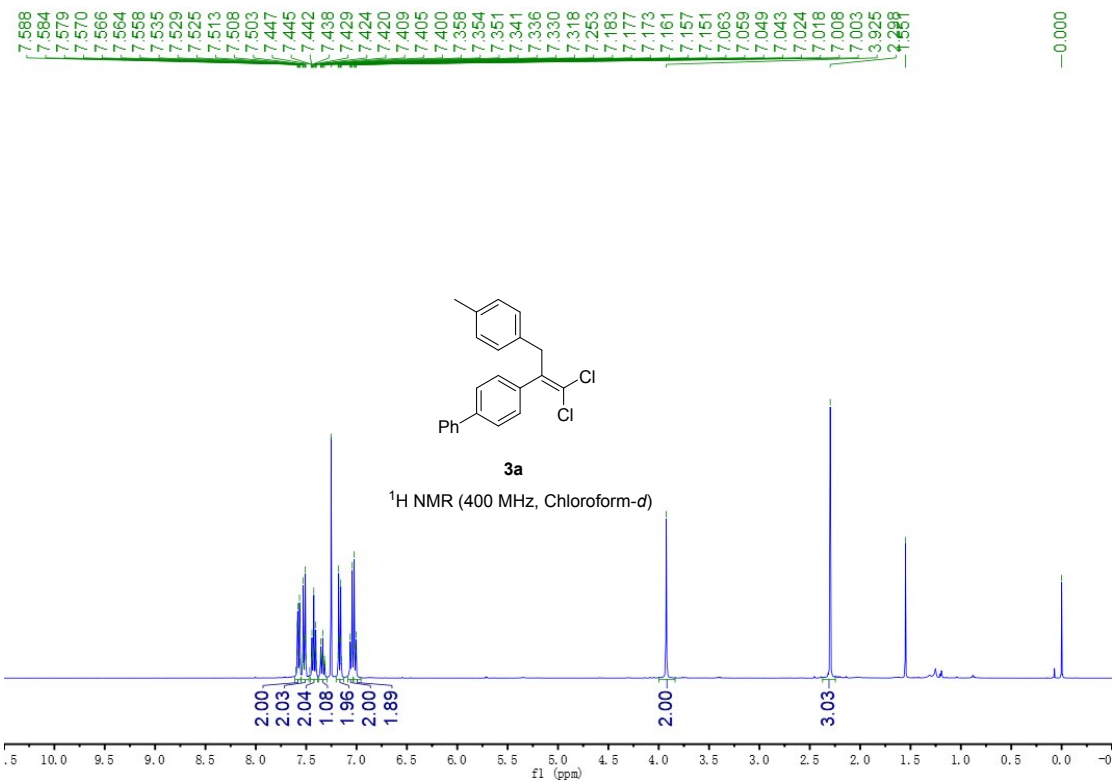


Figure S 175

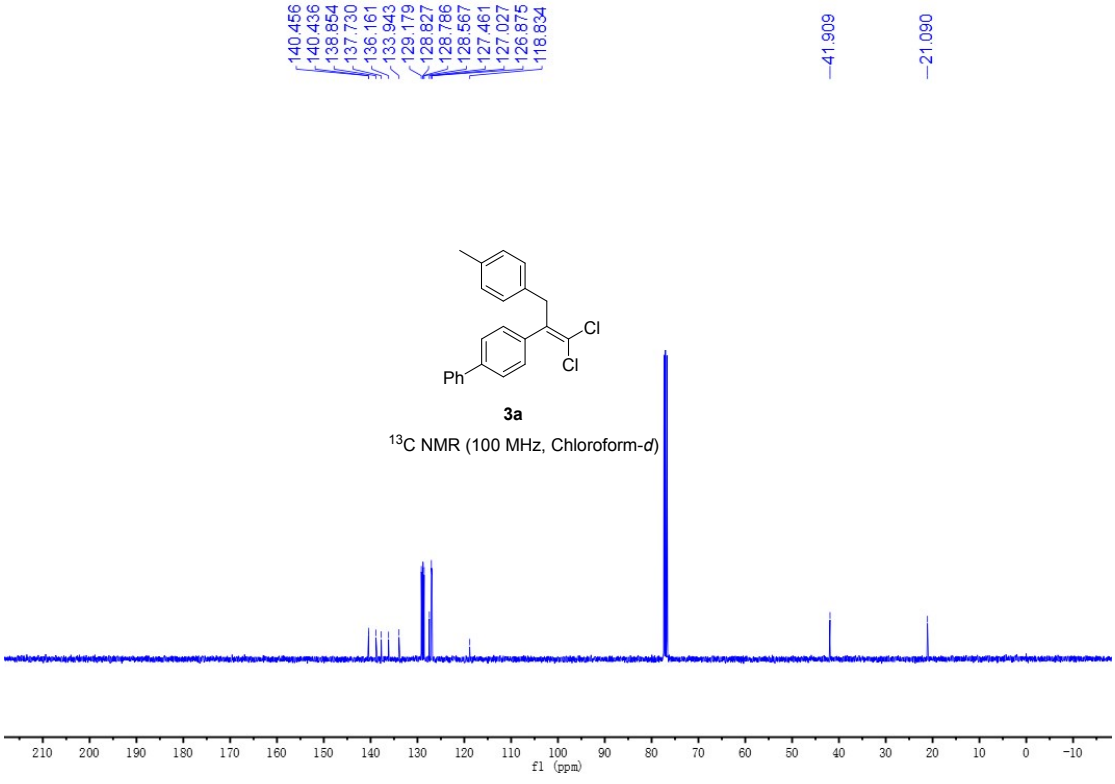


Figure S 176

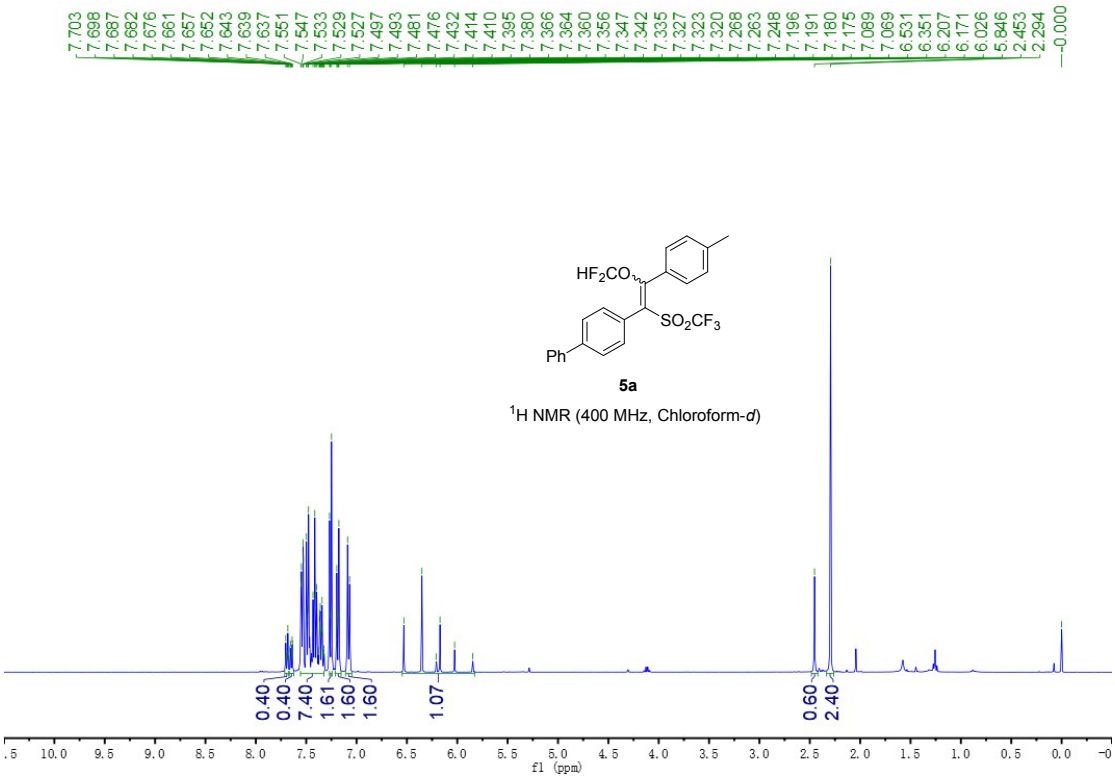


Figure S 177

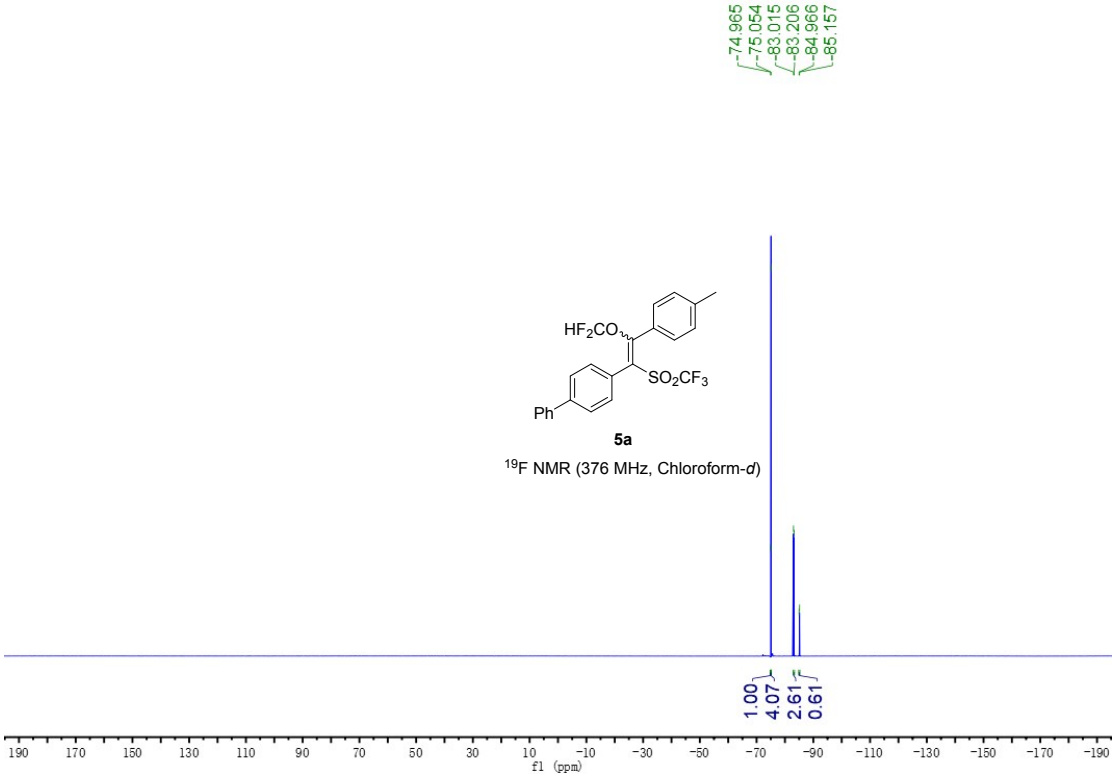


Figure S 178

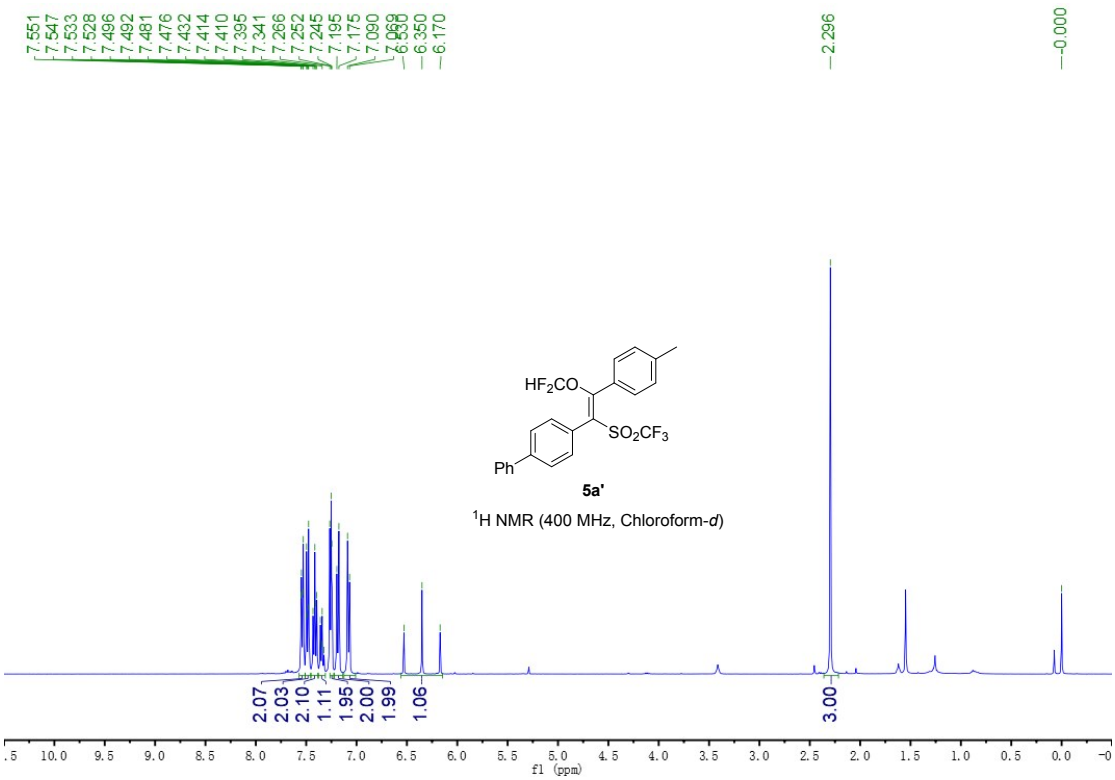


Figure S 179

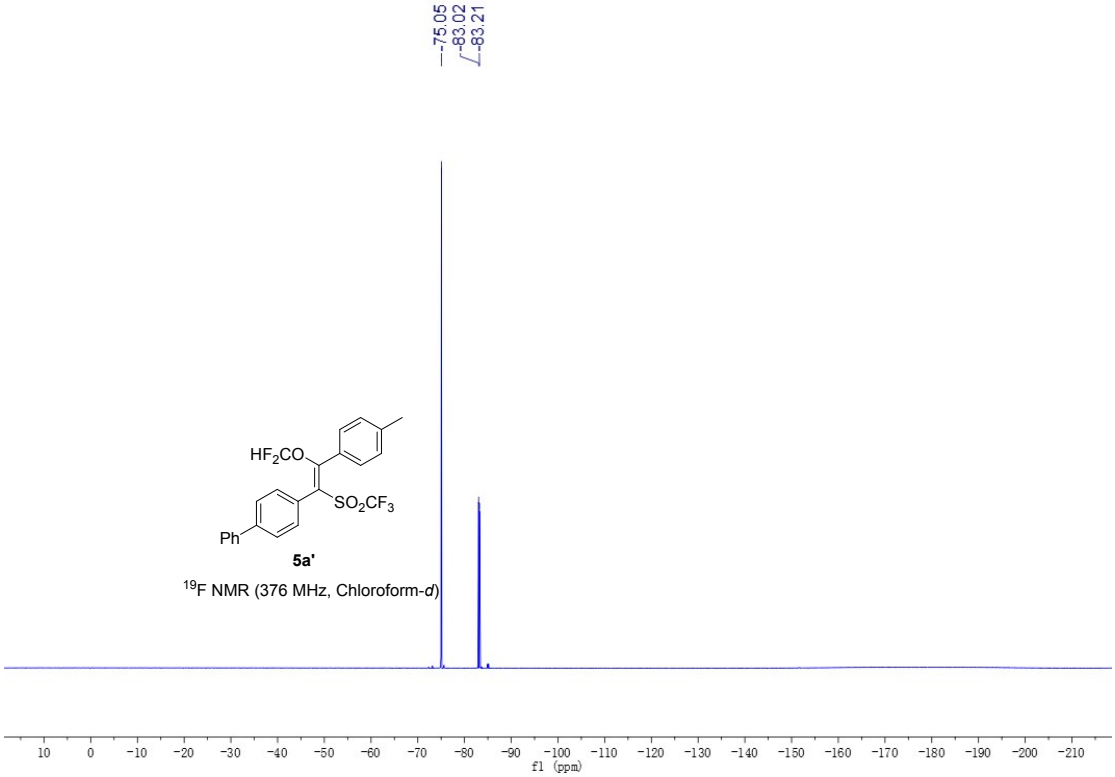


Figure S 180

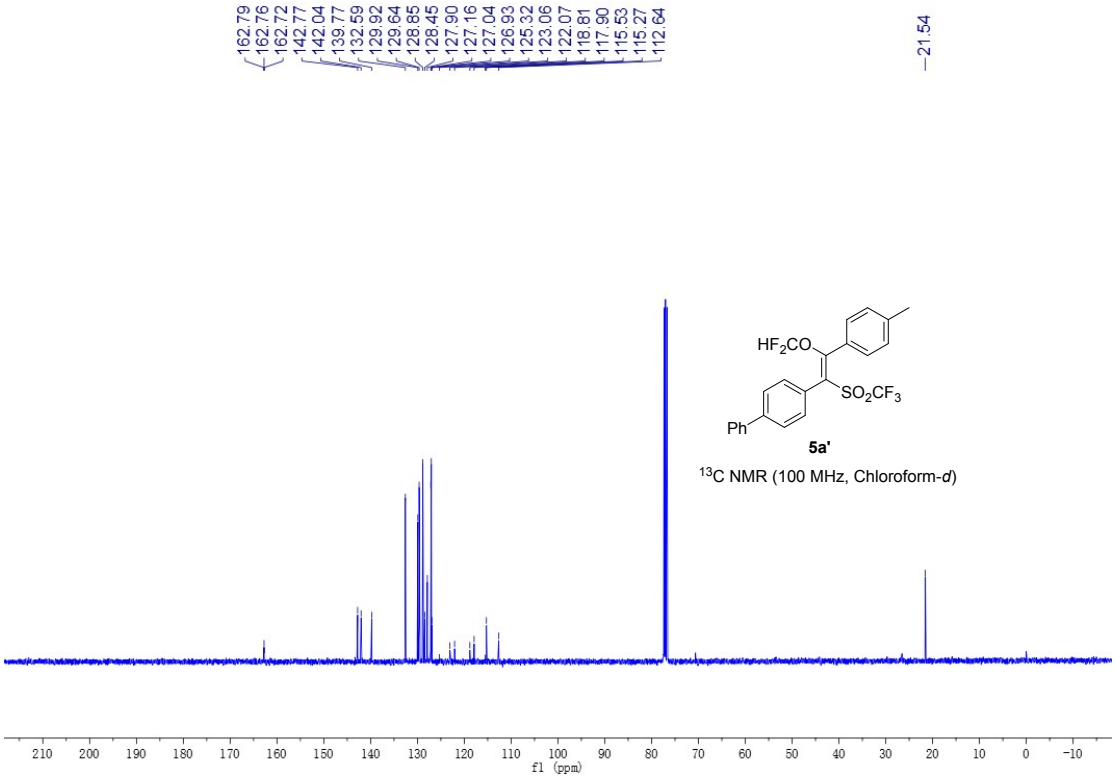


Figure S 181

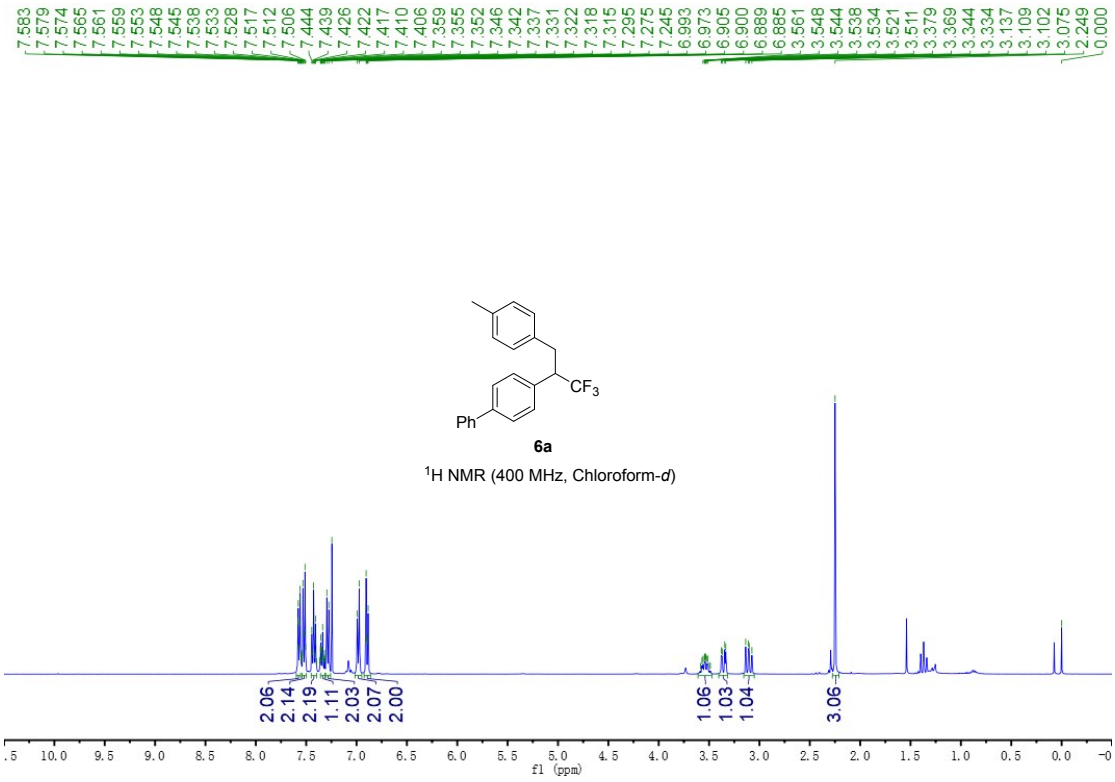


Figure S 182

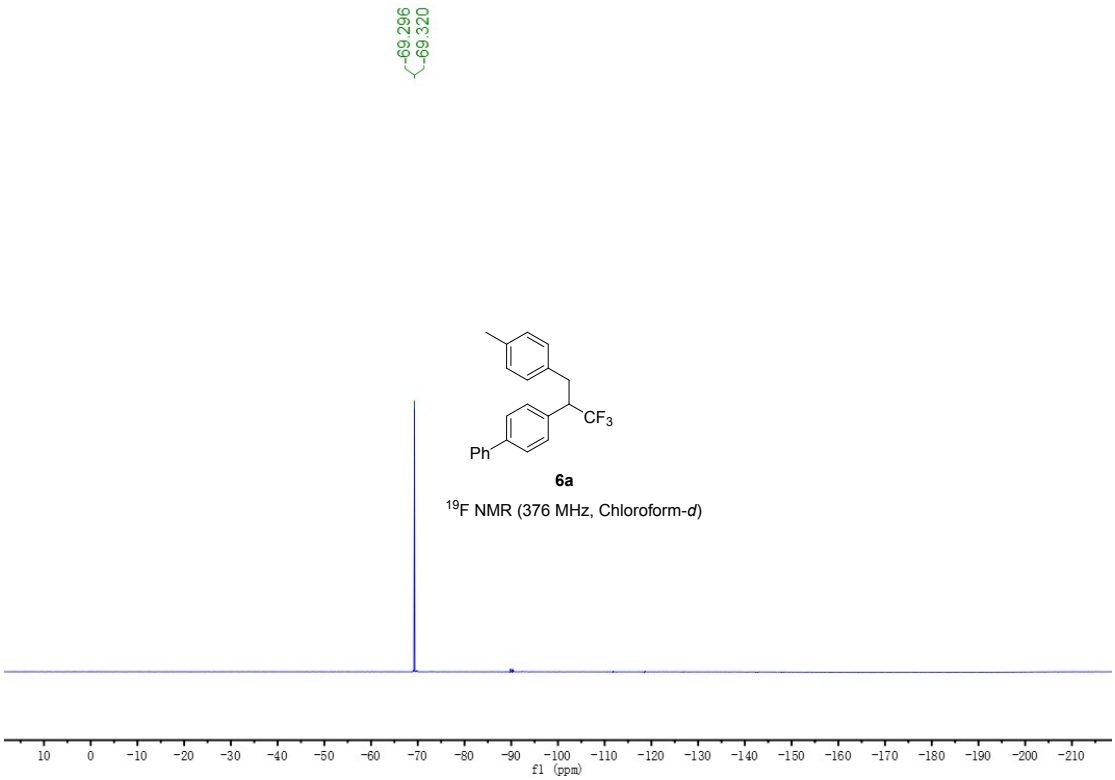


Figure S 183

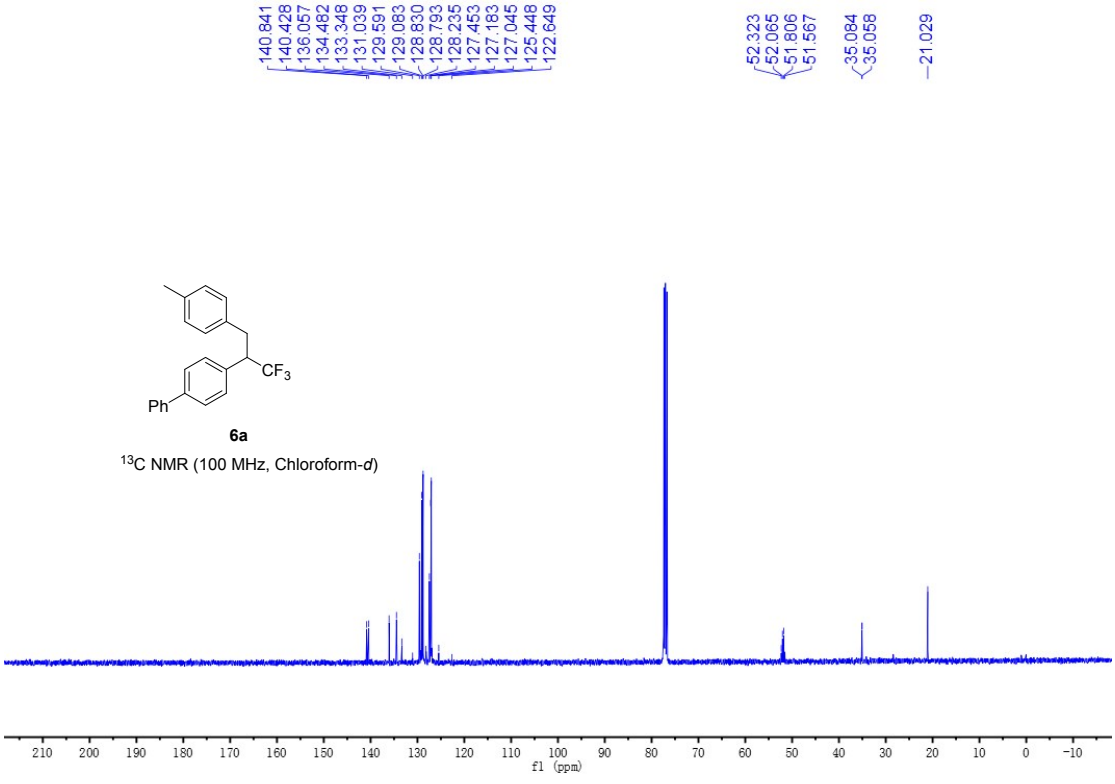


Figure S 184