Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry.

Transition-Metal-Free C-H Oxidative Activation: Persulfate-Promoted Selective Benzylic Mono- and Difluorination

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(A) General

All the reagents were commercially available and used without any further purification. The solvents were dried before use. GC-MS analyses were performed on an Thermo Trace 1300 and ISQLT instrument (Column: TR-35 MS: 30 m ×0.25 mm × 0.25 μm, ionization mode: EI, carrier gas: He, MS transfer temp: 250 ℃, ion source temp: 280 ℃, detection detector: initial temperature 50 ℃, temperature program: 10 ℃/min, final temperature 260 ℃, He: 60 mL/min). ^{1}H-NMR, ^{13}C-NMR, ^{19}F-NMRwas recorded on Bruker DRX 500 and tetramethylsilane (TMS) was used as a reference Mass.

(B) Experimental Procedures

Method A: Monofluorination

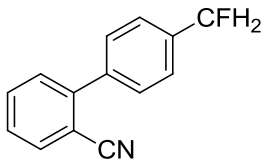
A reaction tube was charged with 4'-Methyl-2-cyanobiphenyl (**1a**) (38.6 mg, 0.2 mmoLl) at room temperature, then $K_2S_2O_8$ (81mg, 0.3 mmoL), Selectfluor (106.2 mg, 0.3 mmoL) and MeCN/H_2O (4 mL, v/v = 1:1) were added. The resulting mixture was stirred at 80 ℃ in this sealed tube equipped with a Teflon plug. After cooling to room temperature, the reaction mixture was quenched and extracted with dichloromethane (5 mL x 3).The combined organic phase was dried over anhydrous Na_2SO_4 and filtered, and all of the volatiles were removed under reduced pressure. The resulting residue was purified by flash silica gel column chromatography (eluent: hexane/EtOAc) to afford the desired products.

Method B: Difluorination

A reaction tube was charged with 4'-Methyl-2-cyanobiphenyl (**1a**) (38.6mg, 0.2mmoL) at room temperature, then $K_2S_2O_8$ (162 mg, 0.6 mmoL), Selectfluor (212.4 mg, 0.6 mmoL) and MeCN/H_2O (6 mL, v/v = 1:1) were added. The resulting mixture was stirred at 80 ℃ in this sealed tube equipped with a Teflon plug. After cooling to room temperature, the reaction mixture was quenched and extracted with dichloromethane (10 mL x 3).The combined organic phase was dried over anhydrous Na_2SO_4 and filtered, and all of the volatiles were removed under reduced pressure. The resulting residue was purified by flash silica gel column chromatography (eluent: hexane/EtOAc) to afford the desired products.

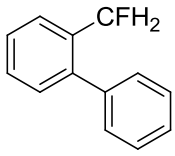
(C) Spectra Analytical data for products

1. Monofluorination:



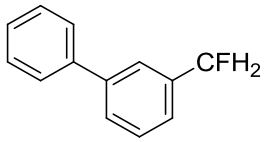
4'- (fluoromethyl)-[1, 1'-biphenyl]-2-carbonitrile

(**2a**): The product was obtain as a white solid; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.78 (dd, *J* = 7.7, 0.8 Hz, 1H), 7.66 (td, *J* = 7.7, 1.2 Hz, 1H), 7.60 (d, *J* = 7.7 Hz, 2H), 7.52 (t, *J* = 6.7 Hz, 3H), 7.46 (td, *J* = 7.7, 1.0 Hz, 1H), 5.46 (d, *J* = 47.6 Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 144.92 (s), 138.52 (s), 136.85 (s), 133.79 (s), 132.90 (s), 130.05 (s), 129.04 (s), 127.89 – 127.51 (m), 118.59 (s), 111.32 (s), 84.76 (s), 83.43 (s), 77.29 (s), 77.03 (s), 76.78 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -209.02 (s); MS (EI) $[M]^+$ Calcd for $C_{14}H_{10}FN$: 211.23, found 211.11.



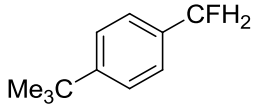
2-(fluoromethyl)-1, 1'-biphenyl

(**2b**): The product was obtained as a colorless oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.2 Hz, 1H), 7.64 – 7.56 (m, 1H), 7.55–7.48 (m, 2H), 7.47 –7.39 (m, 4H), 7.38 –7.31 (m, 3H), 6.54 (t, *J* = 54.9 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 141.24 (s), 139.04 (s), 132.36 (d, *J* = 15.9 Hz), 129.15 (s), 128.32 (t, *J* = 46.1 Hz), 127.27 (s), 126.66 (s), 126.48 (s), 82.46 (s), 81.15 (s), 76.15 (d, *J* = 31.9 Hz), 75.96 – 75.89 (m), 75.77 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -215.67 (s); MS (EI) $[M]^+$ Calcd for $C_{13}H_{11}F$: 186.22, found 186.08.



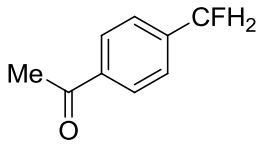
3-(fluoromethyl)-1, 1'-biphenyl

(**2c**): The product was obtained as a colorless oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.10 (s, 1H), 8.11 (d, *J* = 1.6 Hz, 2H), 7.87 (dd, *J* = 7.7, 1.5 Hz, 4H), 7.67 – 7.56 (m, 8H), 7.47 (dt, *J* = 15.9, 7.6 Hz, 6H), 7.43 – 7.32 (m, 3H), 5.45 (d, *J* = 47.8 Hz, 2H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -207.28 (s); MS (EI) $[M]^+$ Calcd for $C_{13}H_{11}F$: 186.22, found 186.12.



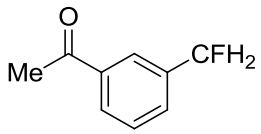
1-(*tert*-butyl)-4-(fluoromethyl)benzene

(**2d**)[1]: The product was obtained as a light yellow oil (this product is challenging to get purification due to high volatility with high reactivity, so it is hard to get pure mono- and difluorination products, we obtained the mixed compounds and the yield was detected by GC-MS, the ratio of these two compounds > 5.5 :1, determinate by ^{19}F); ^{19}F NMR (470 MHz, $CDCl_3$) -204.27 (s)(); MS (EI) $[M]^+$ Calcd for $C_{11}H_{15}F$: 166.24, found 166.11.



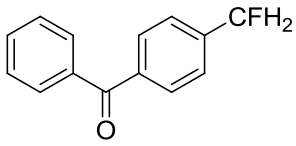
1- (4- (fluoromethyl) phenyl)ethanone

(**2e**): The product was obtained as a colorless oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (d, *J* = 7.7 Hz, 2H), 7.56 – 7.32 (m, 2H), 5.44 (d, *J* = 47.2 Hz, 2H), 2.60 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 134.39 (s), 128.53 (s), 126.85 (d, *J* = 17.6 Hz), 124.89 (s), 81.95 (s), 80.58 (s), 77.26 (s), 77.01 (s), 76.75 (s), 29.70 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -213.08 (s); MS (EI) $[M]^+$ Calcd for C_9H_9FO: 152.17, found 152.08.



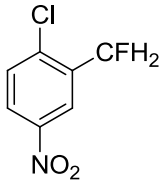
1-(3-(fluoromethyl)phenyl)ethanone

(**2f**): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, *J* = 7.9 Hz, 2H), 7.58 (d, *J* = 7.5 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 1H), 5.44 (d, *J* = 47.5 Hz, 2H), 2.62 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 196.68 (s), 137.14 – 134.67 (m), 135.03 (d, *J* = 90.0 Hz), 130.76 (s), 127.97 (s), 127.37 (d, *J* = 54.4 Hz), 127.13 – 127.08 (m), 126.00 (s), 83.60 (s), 82.27 (s), 76.29 (s), 76.04 (s), 75.79 (s), 25.65 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -209.33 (s); MS (EI) $[M]^+$ Calcd for C_9H_9FO: 152.17, found 152.12.



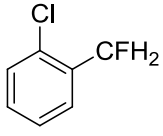
(4-(fluoromethyl)phenyl)(phenyl)methanone

(**2g**): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.82 (dd, *J* = 16.7, 7.8 Hz, 4H), 7.60 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 4H), 5.48 (d, *J* = 47.2 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 195.25 (s), 139.66 (d, *J* = 16.3 Hz), 136.74 (s), 136.45 (s), 131.59 (s), 129.82 (s), 129.20 (d, *J* = 37.8 Hz), 127.37 (s), 125.64 (s), 83.43 (s), 82.09 (s), 76.31 (s), 76.06 (s), 75.80 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -212.32 (s); MS (EI) $[M]^+$ Calcd for $C_{14}H_{11}FO$: 214.08, found 214.10.



1-chloro-2-(fluoromethyl)-4-nitrobenzene

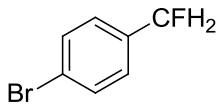
(**2h**): The product was obtained as a light yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.38 (d, *J* = 2.2 Hz, 1H), 8.17 (dd, *J* = 8.7, 2.3 Hz, 1H), 7.56 (d, *J* = 8.7 Hz, 1H), 5.56 (d, *J* = 46.6 Hz, 2H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -116.41 (s); MS (EI) $[M]^+$ Calcd for $C_7H_5ClFNO_2$: 189.00, found 189.03.



1-chloro-2-(fluoromethyl)benzene

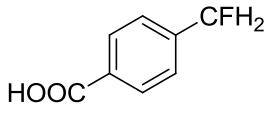
(**2i**): The product was obtained as a colorless oil (this product is challenging to get purification due to high volatility and the reported yields are the average GC yields of three trials and determined by ^{19}F NMR); ^{19}F NMR

(470 MHz, $CDCl_3$) δ -181.98 (s); MS (EI) $[M]^+$ Calcd for C_7H_5ClF: 144.01, found 144.05.



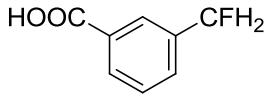
1-bromo-4-(fluoromethyl)benzene

(**2j**)[2]: The product was obtained as a red solid (this product is challenging to get purification due to high volatility and the reported yields are the average GC yields of three trials and determined by ^{19}F NMR); ^{19}F NMR (470 MHz, $CDCl_3$) δ -207.86 (s); MS (EI) $[M]^+$ Calcd for C_7H_6BrF: 187.96, found 187.97.



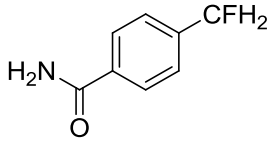
4- (fluoromethyl)benzoic acid

(**2k**): The product was obtained as a light yellow solid; ^1H NMR (500 MHz, MeOD) δ 8.03 (d, *J* = 7.9 Hz, 2H), 7.47 (d, *J* = 7.7 Hz, 2H), 5.44 (d, *J* = 47.4 Hz, 2H); ^{13}C NMR (126 MHz, MeOD) δ 166.99 (s), 140.72 (d, *J* = 17.0 Hz), 129.63 (s), 128.60 (s), 125.48 (s), 82.98 (s), 81.66 (s), 46.95 (s), 46.78 (s), 46.61 (s), 46.44 (s), 46.27 (s); ^{19}F NMR (470 MHz, MeOD) δ -214.22 (s); MS (EI) $[M]^+$ Calcd for $C_8H_7FO_2$: 154.04, found 155.07.



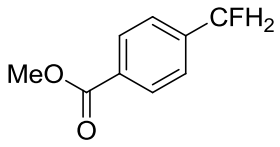
3- (fluoromethyl)benzoic acid

(**2l**): The product was obtained as a white solid; ^1H NMR (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 7.3 Hz, 2H), 7.64 (d, *J* = 7.5 Hz, 1H), 7.52 (t, *J* = 7.7 Hz, 1H), 5.45 (d, *J* = 47.5 Hz, 2H). ^{13}C NMR (126 MHz, $CDCl_3$) δ 170.63 (s), 135.85 (d, *J* = 17.4 Hz), 131.57 (s), 130.26 – 127.32 (m), 83.48 (s), 82.15 (s), 76.77 – 75.74 (m), 75.74 – 75.23 (m). ^{19}F NMR (470 MHz, $CDCl_3$) δ -209.43 (s). MS (EI) $[M]^+$ Calcd for $C_8H_7FO_2$: 154.04, found 155.06.



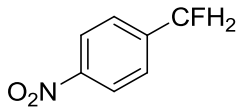
4-(fluoromethyl)benzamide

(**2m**): The product was obtained as a yellow soild; ^1H NMR (500 MHz, MeOD) δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.48 (d, *J* = 7.6 Hz, 2H), 5.44 (d, *J* = 47.4 Hz, 2H);^{13}C NMR (126 MHz, MeOD) δ 169.52 (s), 139.53 (d, *J* = 17.0 Hz), 126.55 (s), 125.69 (s), 83.01 (s), 81.69 (s), 46.78 (s), 46.61 (s), 46.44 (s); ^{19}F NMR (470 MHz, MeOD) δ -213.21 (s); MS (EI) $[M]^+$ Calcd for C_8H_8FNO: 153.06, found 153.10.



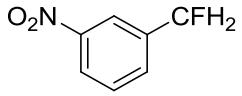
methyl 4-(fluoromethyl)benzoate

(**2n**): The product was obtained as a colorless oil; ^1H NMR (500 MHz, $CDCl_3$) δ 8.06 (d, *J* = 7.9 Hz, 2H), 7.43 (d, *J* = 7.8 Hz, 2H), 5.44 (d, *J* = 47.2 Hz, 2H), 3.92 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 165.71 (s), 140.21 (d, *J* = 17.1 Hz), 129.31 (s), 128.89 (s), 125.63 (s), 83.38 (s), 82.04 (s), 76.29 (s), 76.29 (s), 76.38 – 75.30 (m), 51.20 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -212.85 (s); MS (EI) $[M]^+$ Calcd for $C_9H_9FO_2$: 168.06, found 168.10.



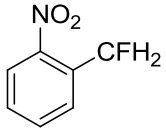
1- (fluoromethyl)-4-nitrobenzene

(**2q)**: The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.4 Hz, 2H), 7.53 (d, *J* = 8.3 Hz, 2H), 5.51 (d, *J* = 46.8 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 146.98 (s), 142.40 (d, *J* = 17.3 Hz), 126.05 (d, *J* = 5.8 Hz), 122.86 (s), 82.56 (s), 81.20 (s), 76.16 (d, *J* = 31.9 Hz), 75.77 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -215.66 (s); MS (EI) $[M]^+$ Calcd for $C_7H_6FNO_2$: 155.04, found 155.04.



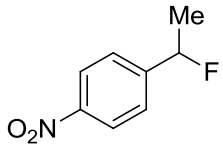
1- (fluoromethyl)-3-nitrobenzene

(2r): the product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.33 – 8.13 (m, 2H), 7.70 (d, *J* = 7.6 Hz, 1H), 7.59 (t, *J* = 7.9 Hz, 1H), 5.49 (d, *J* = 47.0 Hz, 2H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -212.33 (s); MS (EI) $[M]^+$ Calcd for $C_7H_6FNO_2$: 155.04, found 155.07.



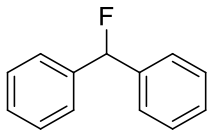
1-(fluoromethyl)-2-nitrobenzene

(**2s)**: The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.2 Hz, 1H), 7.78 (dd, *J* = 28.4, 7.7 Hz, 2H), 7.53 (d, *J* = 7.8 Hz, 1H), 5.87 (d, *J* = 47.9 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 134.39 (s), 128.53 (s), 126.85 (d, *J* = 17.6 Hz), 124.89 (s), 81.95 (s), 80.58 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -219.15 (s); MS (EI) $[M]^+$ Calcd for $C_7H_6FNO_2$: 155.04, found 138.05.



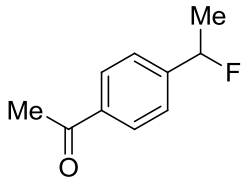
1-(1-fluoroethyl)-4-nitrobenzene

(**2t)**: The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 2H), 7.51 (d, *J* = 8.5 Hz, 2H), 5.73 (dd, *J* = 47.4, 6.5 Hz, 1H), 1.69 (d, *J* = 6.5 Hz, 1H), 1.64 (d, *J* = 6.5 Hz, 2H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -172.69 (s); MS (EI) $[M]^+$ Calcd for $C_8H_8FNO_2$: 169.05, found 169.04.



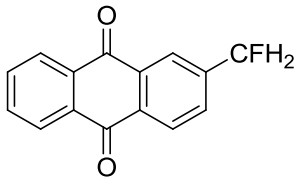
(fluoromethylene)dibenzene

(**2u**): The product was obtained as a colorless oil (because of hydrolysis issues, we got the crude 1H NMR and 1H NMR of hydrolysis product); ^{19}F NMR (470 MHz, CDCl3) δ -166.51 (s); MS (EI) $[M]^+$ Calcd for $C_{13}H_{11}F$: 185.09, found 186.08.



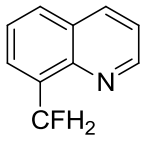
1-(4-(1-fluoroethyl)phenyl)ethanone

(2v): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.1 Hz, 2H), 7.43 (d, *J* = 8.0 Hz, 2H), 5.68 (dq, *J* = 47.6, 6.5 Hz, 1H), 2.61 (s, 3H), 1.64 (dd, *J* = 24.0, 6.5 Hz, 3H); ^{13}C NMR (126 MHz, CDCl3) δ 197.76 (s), 146.78 (d, J = 19.6 Hz), 136.94 (s), 128.69 (s), 125.20 (d, J = 6.1 Hz), 91.05 (s), 89.70 (s), 77.38 (s), 77.00 (d, J = 31.9 Hz), 76.49 – 76.31 (m), 26.73 (s), 23.17 (s), 22.97 (s); ^{19}F NMR (470 MHz, CDCl3) δ -171.32 (d, J = 8.8 Hz), -171.62 (s); MS (EI) $[M]^+$ Calcd for $C_{10}H_{11}FO$: 166.08, found 166.08.



2- (fluoromethyl)anthracene-9, 10-dione

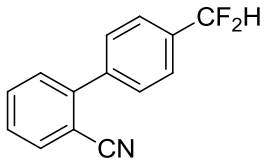
(**2w**): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.40 – 8.25 (m, 4H), 7.82 (td, *J* = 7.4, 4.0 Hz, 3H), 5.57 (d, *J* = 46.9 Hz, 2H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -215.27 (s); MS (EI) $[M]^+$ Calcd for $C_{15}H_9FO_2$: 240.06, found 240.06.



8- (fluoromethyl)quinoline

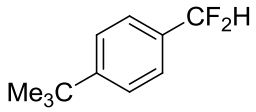
(**2x)**: The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.93 (dd, *J* = 4.1, 1.4 Hz, 1H), 8.19 (dd, *J* = 8.3, 1.4 Hz, 1H), 7.83 (t, *J* = 6.6 Hz, 2H), 7.59 (t, *J* = 7.6 Hz, 1H), 7.45 (dd, *J* = 8.3, 4.2 Hz, 1H), 6.15 (d, *J* = 47.5 Hz, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 148.79 (s), 144.28 (s), 135.44 (s), 133.67 (d, *J* = 16.5 Hz), 126.81 (dd, *J* = 74.4, 15.1 Hz), 125.39 (s), 120.38 (s), 81.41 (s), 80.10 (s), 76.71 – 75.49 (m); ^{19}F NMR (470 MHz, $CDCl_3$) δ -219.22 (s); MS (EI) $[M]^+$ Calcd for $C_{10}H_8FN$: 161.06, found 161.07.

2. Difluorination:



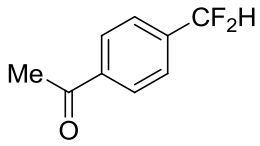
4'-(difluoromethyl)- [1, 1'-biphenyl]-2-carbonitrile

(**3a**): The product was obtained as a white solid; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.7 Hz, 1H), 7.72 – 7.61 (m, 5H), 7.55 – 7.46 (m, 2H), 6.72 (t, *J* = 56.4 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 144.37 (s), 140.54 (s), 134.66 (s), 133.85 (s), 133.04 (s), 130.08 (s), 129.19 (s), 128.18 (s), 126.05 (t, *J* = 6.0 Hz), 118.44 (s), 116.32 (s), 114.42 (s), 112.52 (s), 111.31 (s), 77.35 (s), 77.09 (s), 76.84 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -111.24 (s); MS (EI) $[M]^+$ Calcd for $C_{14}H_9F_2N$: 229.07, found 229.10.



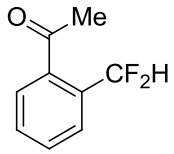
1- (*tert*-butyl)-4- (difluoromethyl)benzene

(**3b**)[3]: The product was obtained as a yellow oil (this product is challenging to get purification due to high volatility and the reported yields are the average GC yields of three trials and determined by crude ^{19}F NMR, BF_4^- δ -151.22 (s)); ^{19}F NMR (470 MHz, $CDCl_3$) δ -109.53 (s) (); MS (EI) $[M]^+$ Calcd for $C_{11}H_{11}F_2$: 184.11, found 184.13.



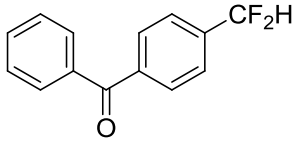
1-(4-(difluoromethyl)phenyl)ethanone

(**3c**): The product was obtained as a yellow oil; ^1H NMR (500 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.1 Hz, 2H), 7.61 (d, *J* = 8.1 Hz, 2H), 6.69 (t, *J* = 56.1 Hz, 1H), 2.63 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 197.62 (s), 141.36 (d, *J* = 17.2 Hz), 137.15 (s), 128.61 (s), 126.78 (d, *J* = 6.6 Hz), 84.30 (s), 82.96 (s), 77.31 (s), 77.05 (s), 76.80 (s), 26.65 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -112.30 (s); $[M]^+$ Calcd for $C_{11}H_{11}F_2$: 184.11, found 184.13.



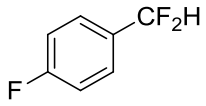
1- (2- (difluoromethyl)phenyl)ethanone

(**3d**): The product was obtained as a yellow oil; ^1H NMR (500 MHz, $CDCl_3$) δ 7.86 – 7.80 (m, 2H), 7.63 (t, *J* = 7.6 Hz, 1H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.38 (t, *J* = 55.6 Hz, 1H), 2.64 (s, 3H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -113.46 (s); $[M]^+$ Calcd for $C_9H_8F_2O$: 170.05, found 170.03.



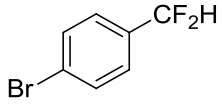
(4- (difluoromethyl)phenyl) (phenyl)methanone

(**3e**): The product was obtained as a white solid; ^1H NMR (500 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.0 Hz, 1H), 7.80 (d, *J* = 7.6 Hz, 1H), 7.63 (dd, *J* = 13.2, 7.6 Hz, 2H), 7.50 (t, *J* = 7.6 Hz, 2H), 6.73 (t, *J* = 56.2 Hz, 1H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -112.04 (s); $[M]^+$ Calcd for $C_{14}H_{10}F_2O$: 232.07, found 232.11.



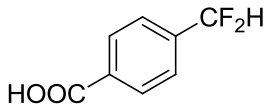
1- (difluoromethyl)-4-fluorobenzene

(3f)[1]: The product was obtained as a red oil (this product is challenging to get purification due to high volatility and the reported yields are the average GC yields of three trials and determined by crude ^{19}F NMR,); ^{19}F NMR (470 MHz, $CDCl_3$) δ -103.37(s), δ -109.74(t) (1-fluoro-4-methylbenzene as stanrdard δ -116.48 (s)); $[M]^+$ Calcd for $C_7H_5F_3$: 146.03, found 145.05.



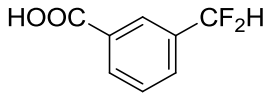
1-bromo-4- (difluoromethyl)benzene

(3g)[4]: The product was obtained as a red oil (this product is challenging to get purification due to high volatility and the reported yields are the average GC yields of three trials and determined by crude ^{19}F NMR,); ^{19}F NMR (470 MHz, $CDCl_3$) δ -111.11 (s); $[M]^+$ Calcd for $C_7H_5BrF_2$: 205.95, found 205.98.



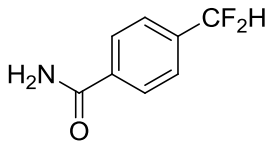
4- (difluoromethyl)benzoic acid

(**3h)**: The product was obtained as a white solid; ^1H NMR (500 MHz, MeOD) δ 8.11 (d, *J* = 8.1 Hz, 2H), 7.63 (d, *J* = 8.1 Hz, 2H), 6.82 (t, *J* = 55.9 Hz, 1H); ^{13}C NMR (126 MHz, MeOD) δ 166.41 (s), 137.81 (t, *J* = 22.7 Hz), 131.90 (s), 128.73 (s), 124.41 (s), 113.35 (s), 46.95 (s), 46.78 (s), 46.61 (s), 46.44 (s), 46.27 (s); ^{19}F NMR (470 MHz, MeOD) δ -113.47 (s); $[M]^+$ Calcd for $C_8H_6F_2O_2$: 172.03, found 172.04.



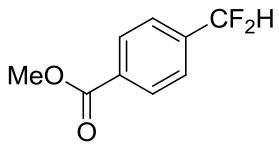
3-(difluoromethyl)benzoic acid

(**3i**): The product was obtained as a white solid; ^1H NMR (500 MHz, $CDCl_3$) δ 8.32 – 8.20 (m, 2H), 7.78 (d, *J* = 7.6 Hz, 1H), 7.60 (t, *J* = 7.7 Hz, 1H), 6.72 (t, *J* = 56.2 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 169.52 (s), 134.13 (d, *J* = 23.0 Hz), 131.39 (s), 129.69 (s), 128.57 (d, *J* = 104.3 Hz), 128.05 – 127.41 (m), 126.58 (s), 112.98 (s), 76.14 (d, *J* = 31.9 Hz), 75.76 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -110.63 (s); $[M]^+$ Calcd for $C_8H_6F_2O_2$: 172.03, found 172.05.



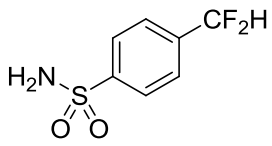
4-(difluoromethyl)benzamide

(**3j**): The product was obtained as a yellow solid; ^1H NMR (500 MHz, MeOD) δ 7.97 (d, *J* = 8.1 Hz, 2H), 7.64 (d, *J* = 8.0 Hz, 2H), 6.83 (t, *J* = 56.0 Hz, 1H); ^{19}F NMR (470 MHz, MeOD) δ -113.22 (s); $[M]^+$ Calcd for $C_8H_7F_2NO$: 171.05, found 171.05.



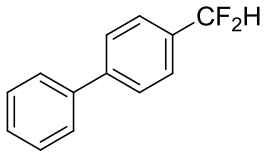
methyl 4-(difluoromethyl)benzoate

(**3k**): The product was obtained as a light yellow oil; ^1H NMR (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.2 Hz, 2H), 7.59 (d, *J* = 8.1 Hz, 2H), 6.69 (t, *J* = 56.1 Hz, 1H), 3.95 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 166.36 (s), 132.44 (s), 130.06 (s), 125.74 (s), 114.09 (s), 77.23 (d, *J* = 31.9 Hz), 76.85 (s), 52.48 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -112.25 (s); $[M]^+$ Calcd for $C_9H_8F_2O_2$: 186.05, found 184.03.



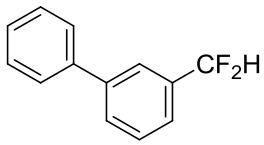
4-(difluoromethyl)benzenesulfonamide **4-(difluoromethyl)benzenesulfonamide**

(**3l**): The product was obtained as a yellow solid; ^{1}H NMR (500 MHz, MeOD) δ 7.93 (d, J = 8.4 Hz, 2H), 7.63 (d, J = 8.3 Hz, 2H), 6.78 (t, J = 55.8 Hz, 1H);^{19}F NMR (470 MHz, MeOD) δ -113.54 (s); $[M]^+$ Calcd for $C_7H_7NF_2O_2S$: 207.20, found 207.01.



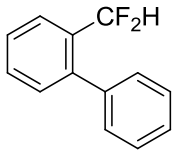
4- (difluoromethyl)-1, 1'-bipheny

(**3n**):The product was obtained as a white solid; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.1 Hz, 2H), 7.65 (dd, *J* = 10.2, 8.1 Hz, 4H), 7.52 (t, *J* = 7.6 Hz, 2H), 7.45 (t, *J* = 7.3 Hz, 1H), 6.75 (t, *J* = 56.5 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 143.75 (s), 140.23 (s), 133.47 (s), 133.29 (s), 133.11 (s), 129.00 (s), 127.99 (s), 127.49 (s), 127.31 (s), 126.11 (t, *J* = 6.0 Hz), 116.76 (s), 114.86 (s), 112.96 (s), 77.38 (s), 77.12 (s), 76.87 (s);^{19}F NMR (470 MHz, $CDCl_3$) δ -110.14 (s); $[M]^+$ Calcd for $C_{13}H_{10}F_2$: 204.08, found 204.09.



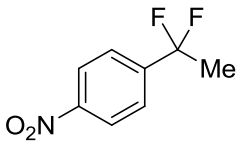
3- (difluoromethyl)-1, 1'-bipheny

(**3o**): The product was obtained as a purple solid; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.68 – 7.61 (m, 2H), 7.56 – 7.50 (m, 2H), 7.46 (t, *J* = 7.6 Hz, 1H), 7.40 (dd, *J* = 15.8, 8.3 Hz, 2H), 7.31 (t, *J* = 7.4 Hz, 1H), 6.64 (t, *J* = 56.5 Hz, 1H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -110.63 (s); $[M]^+$ Calcd for $C_{13}H_{10}F_2$: 204.08, found 204.11.



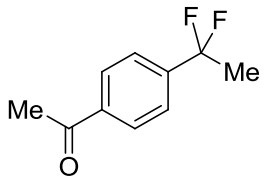
2-(difluoromethyl)-1, 1'-bipheny

(**3p**): The product was obtained as a colorless oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.2 Hz, 1H), 7.64 – 7.56 (m, 1H), 7.55 – 7.48 (m, 2H), 7.48 – 7.40 (m, 4H), 7.36 (dd, *J* = 5.2, 3.0 Hz, 3H), 6.54 (t, *J* = 54.9 Hz, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 141.24 (s), 139.04 (s), 132.36 (d, *J* = 15.9 Hz), 129.15 (s), 128.32 (t, *J* = 46.1 Hz), 127.27 (s), 126.66 (s), 126.48 (s), 82.46 (s), 81.15 (s), 76.15 (d, *J* = 31.9 Hz), 75.96 – 75.89 (m), 75.77 (s); ^{19}F NMR (470 MHz, $CDCl_3$) δ -107.40 (s); $[M]^+$ Calcd for $C_{13}H_{10}F_2$: 204.08, found 204.05.



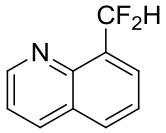
1-(1, 1-difluoroethyl)-4-nitrobenzene

(**3q**): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.29 (d, *J* = 8.6 Hz, 2H), 7.69 (d, *J* = 8.7 Hz, 2H), 5.35 (t, *J* = 4.7 Hz, 1H), 5.17 – 5.07 (m, 1H), 1.95 (t, *J* = 18.2 Hz, 4H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -89.01 (s); $[M]^+$ Calcd for $C_8H_7F_2NO$: 187.04, found 187.08.



1-(4-(1, 1-difluoroethyl)phenyl)ethanone

(**3r**): The product was obtained as a yellow oil; ^{1}H NMR (500 MHz, CDCl3) δ 7.97 (d, J = 8.1 Hz, 2H), 7.57 (d, J = 8.0 Hz, 2H), 2.56 (s, 3H), 1.92 (t, J = 6.5 Hz, 3H); ^{13}C NMR (126 MHz, CDCl3) δ 128.61 (s), 125.09 (s), 77.24 (d, J = 31.9 Hz), 77.24 (d, J = 31.9 Hz), 77.58 – 76.38 (m), 26.81 (s), 25.99 (s); ^{19}F NMR (470 MHz, CDCl3) δ -88.75 (s); $[M]^{+}$ Calcd for $C_{10}H_{10}F_2O$: 184.07, found 184.10.



8-(difluoromethyl)quinoline

(**3t**): The product was obtained as a colorless oil;^{1}H NMR (500 MHz, $CDCl_3$) δ 8.98 (dd, *J* = 4.1, 1.6 Hz, 1H), 8.22 (dd, *J* = 8.3, 1.5 Hz, 1H), 8.06 (d, *J* = 7.1 Hz, 1H), 7.96 (d, *J* = 8.1 Hz, 1H), 7.84 (s, 1H), 7.73 (s, 1H), 7.65 (t, *J* = 7.7 Hz, 1H), 7.53 – 7.43 (m, 1H); ^{19}F NMR (470 MHz, $CDCl_3$) δ -115.84 (s); $[M]^{+}$ Calcd for $C_{10}H_7F_2N$: 179.05, found 179.05.

References

[1] J. B. Xia, C. Zhu, C. Chen, *J. Am. Chem. Soc.*, 2013, **135**, 17494

[2] K. Shing, *Tetrahedron* 2004, **60**, 6923-6930

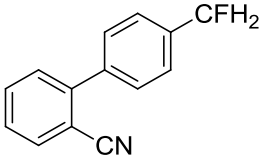
[3] F. Kenichi, ***Org. Lett.*** 2011, **13**, 5560-5563

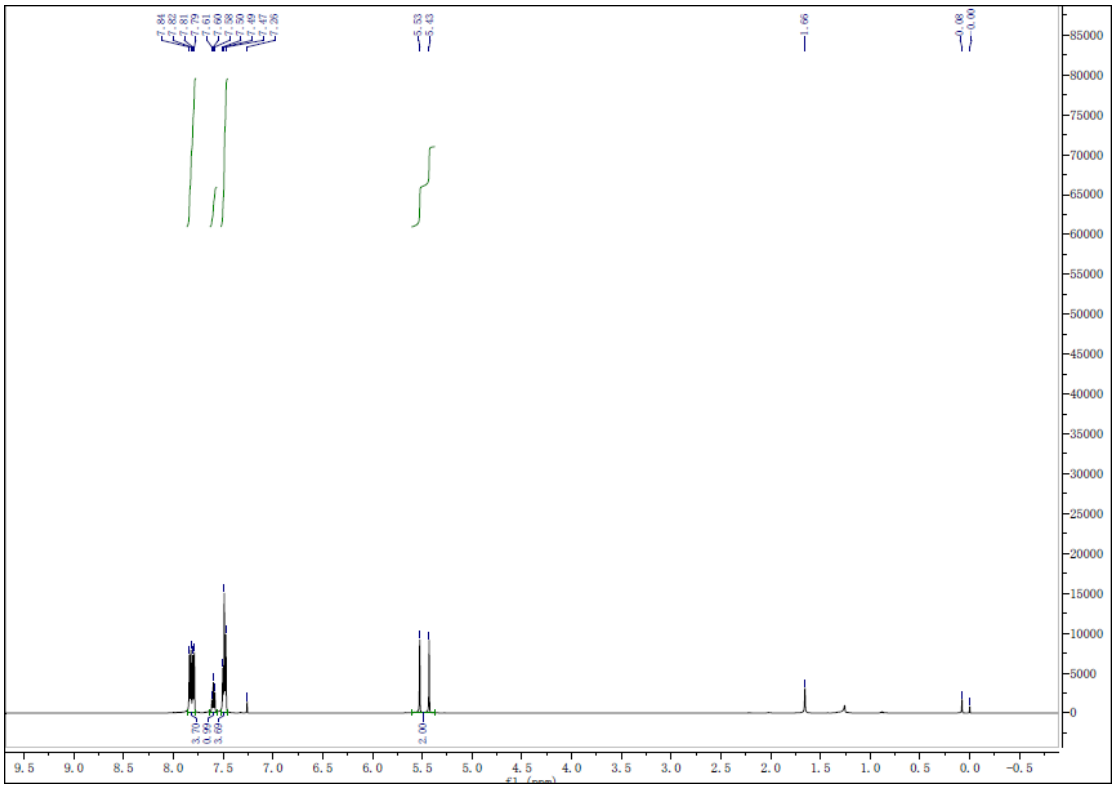
[4] H. Alois, ***Chem. Beri.*** 1988, **121**,1329-1340.

^{1}H NMR, ^{13}C NMR, ^{1}9F NMR and GC-MS Spectra

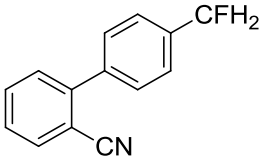
1. monofluorintion

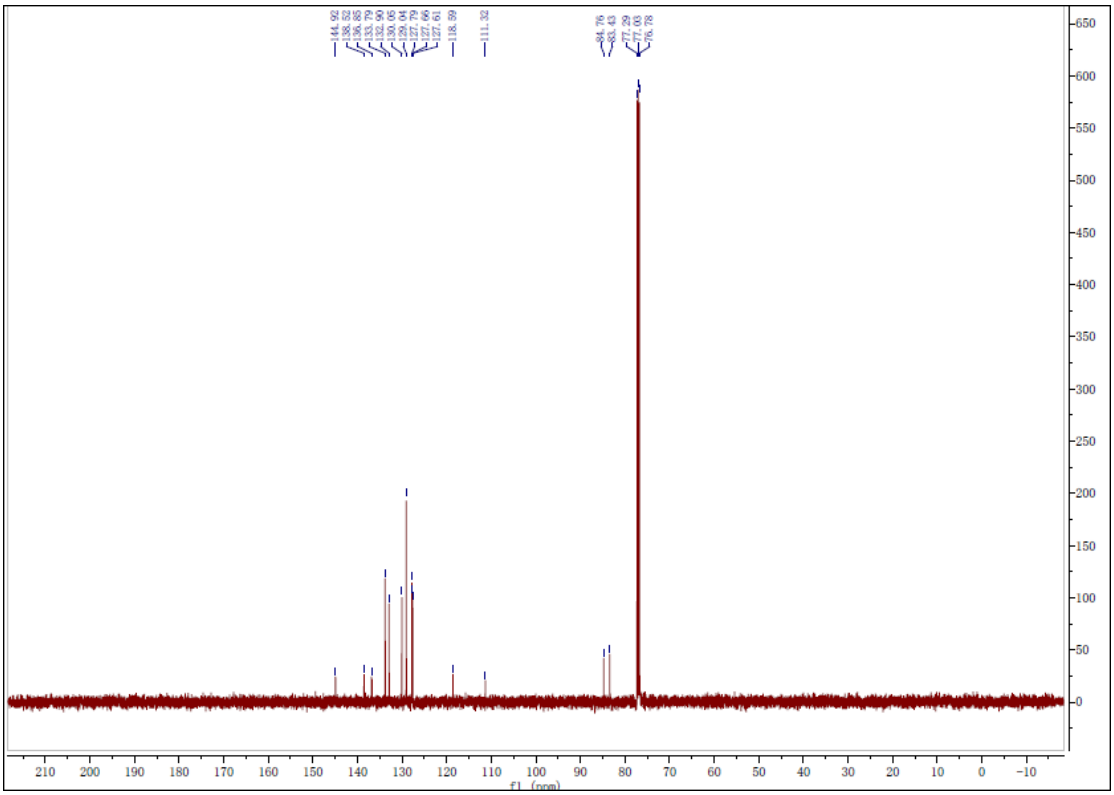
^{1}H NMR of 4'-(fluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1a)



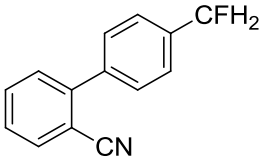


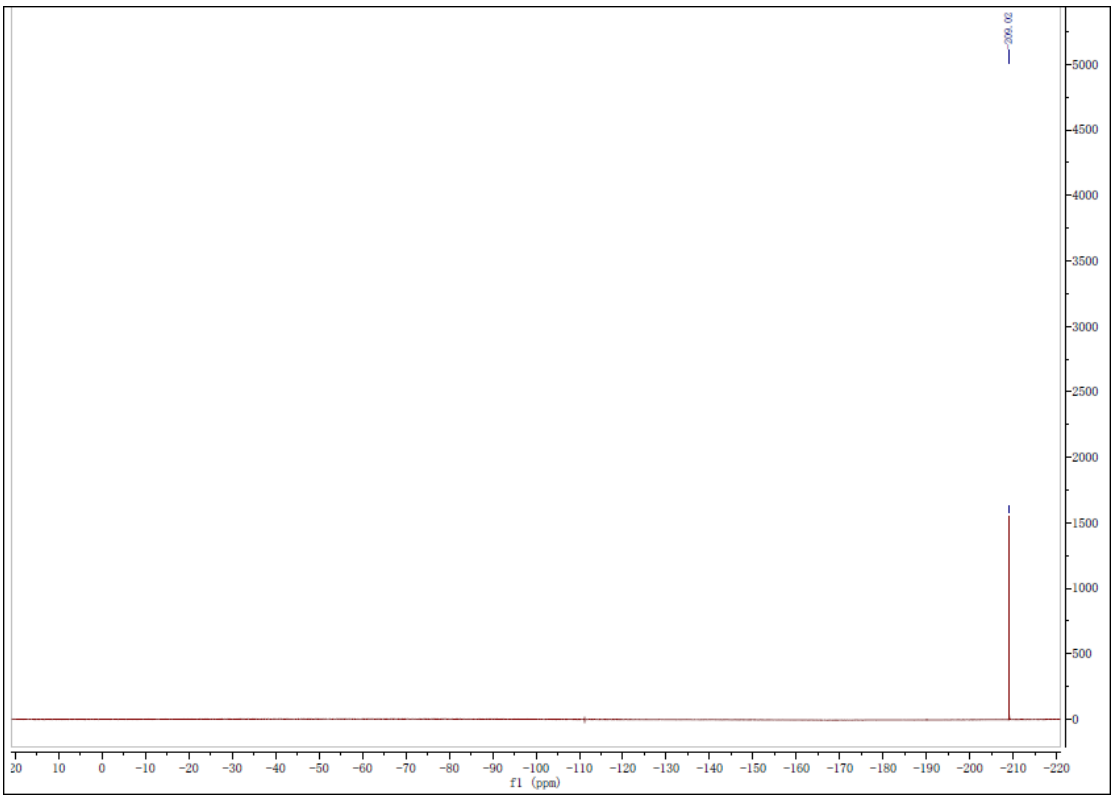
^{13}C NMR of 4'- (fluoromethyl) - [1, 1'-biphenyl]-2-carbonitrile (1a)



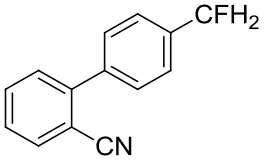


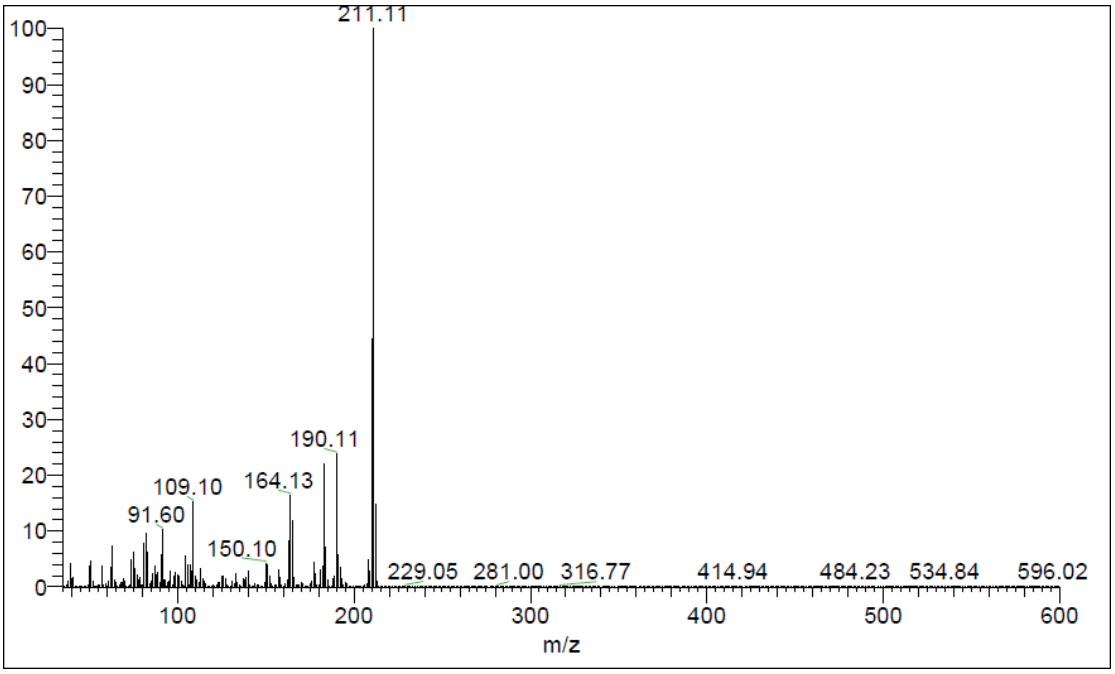
^{19}F NMR of 4'- (fluoromethyl) - [1, 1'-biphenyl]-2-carbonitrile (1a)



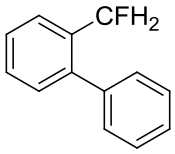


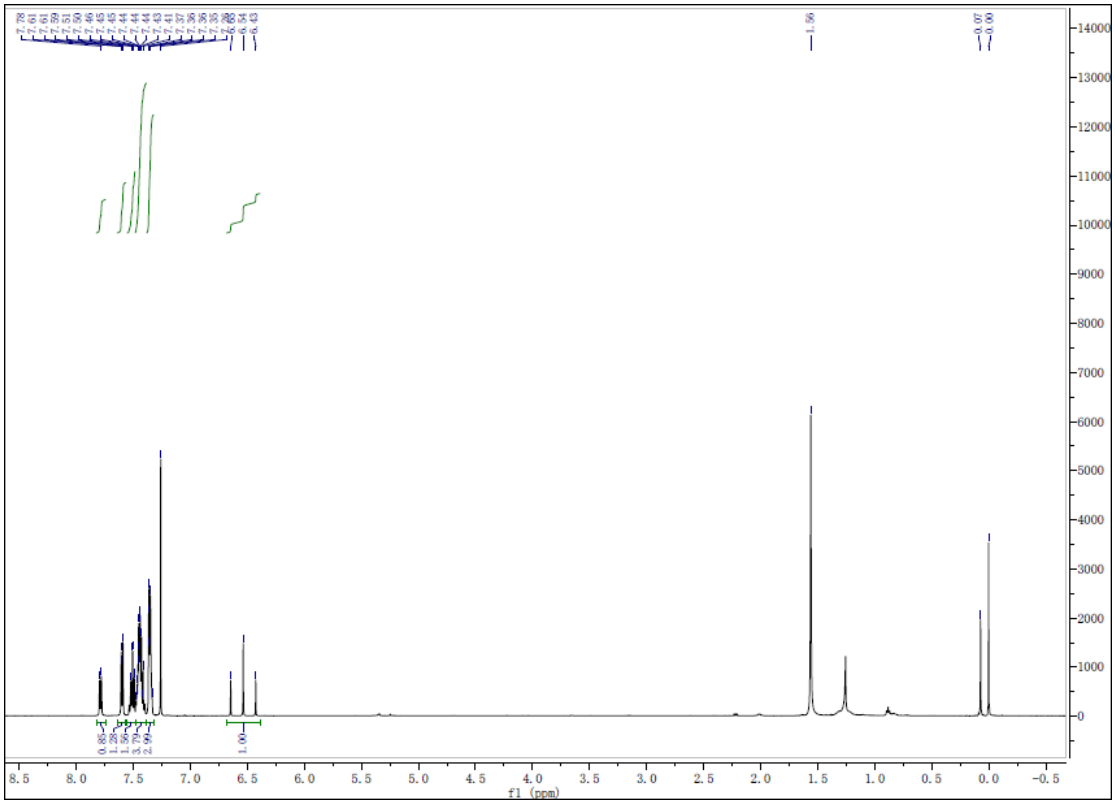
MS of 4'- (fluoromethyl) - [1, 1'-biphenyl]-2-carbonitrile (1a)



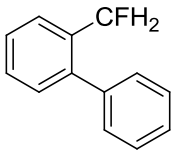


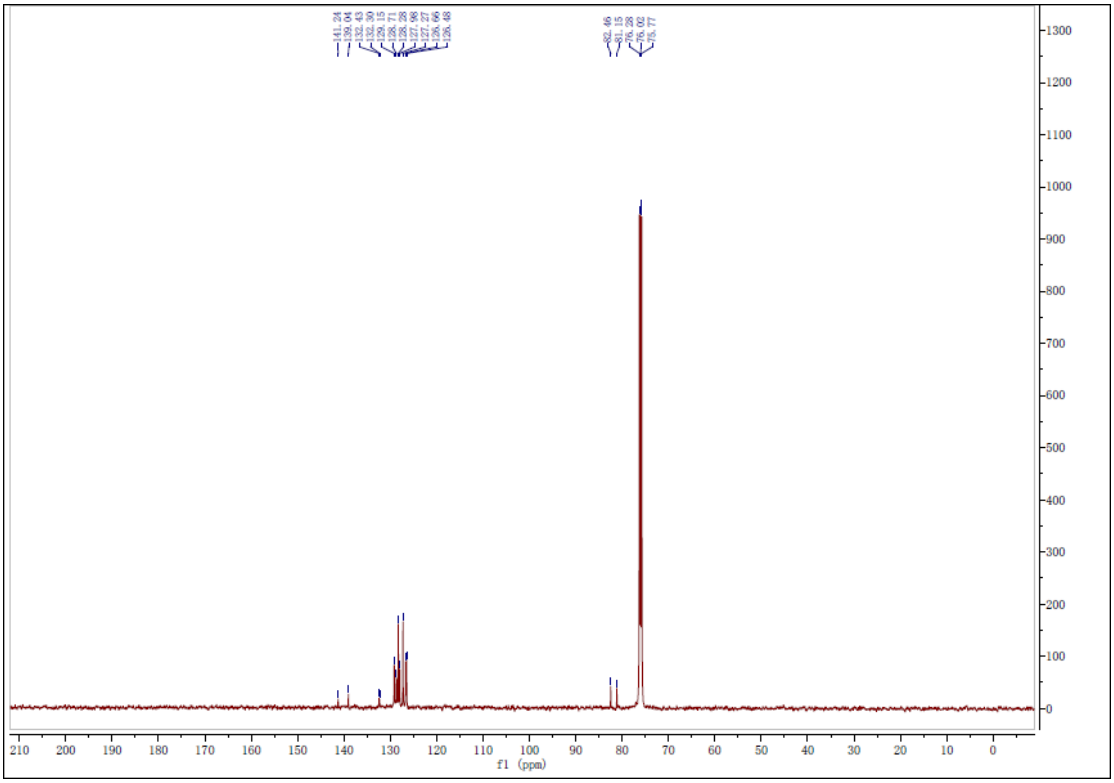
^{1}H NMR of 2- (fluoromethyl)-1, 1'-biphenyl (2b)



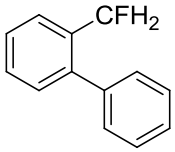


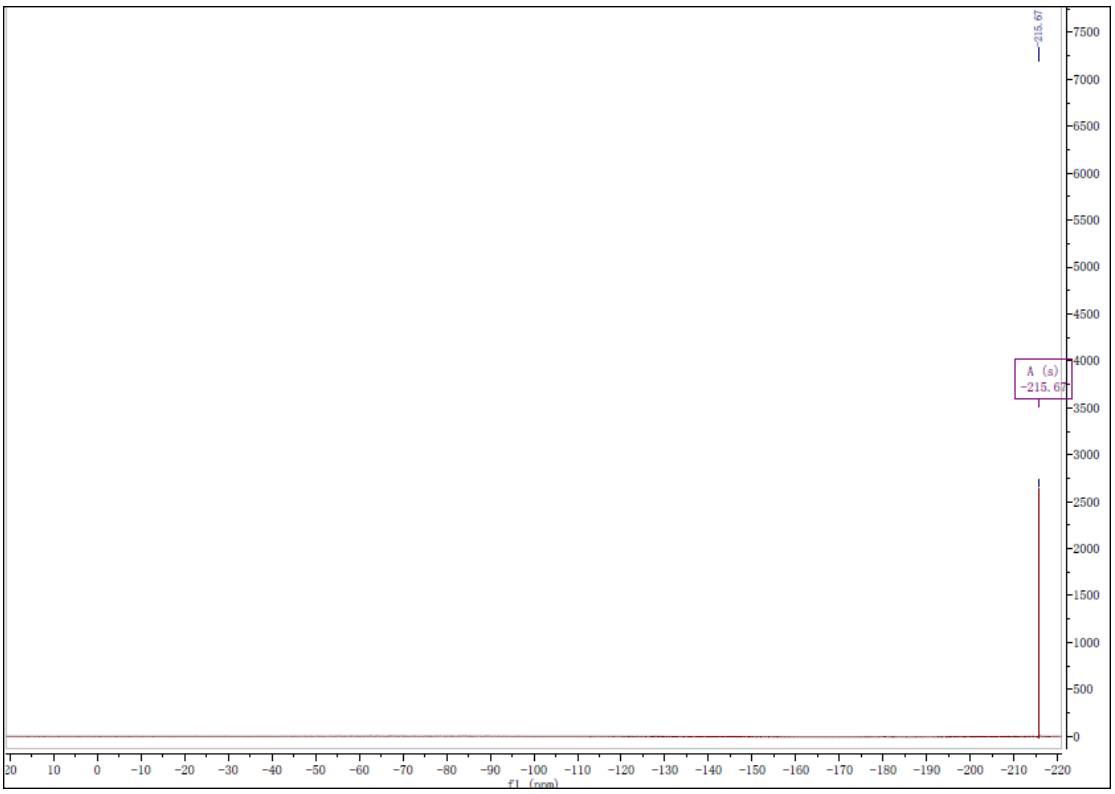
^{13}C NMR of 2- (fluoromethyl) - 1, 1'-biphenyl (2b)



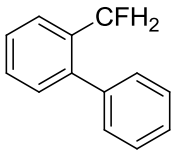


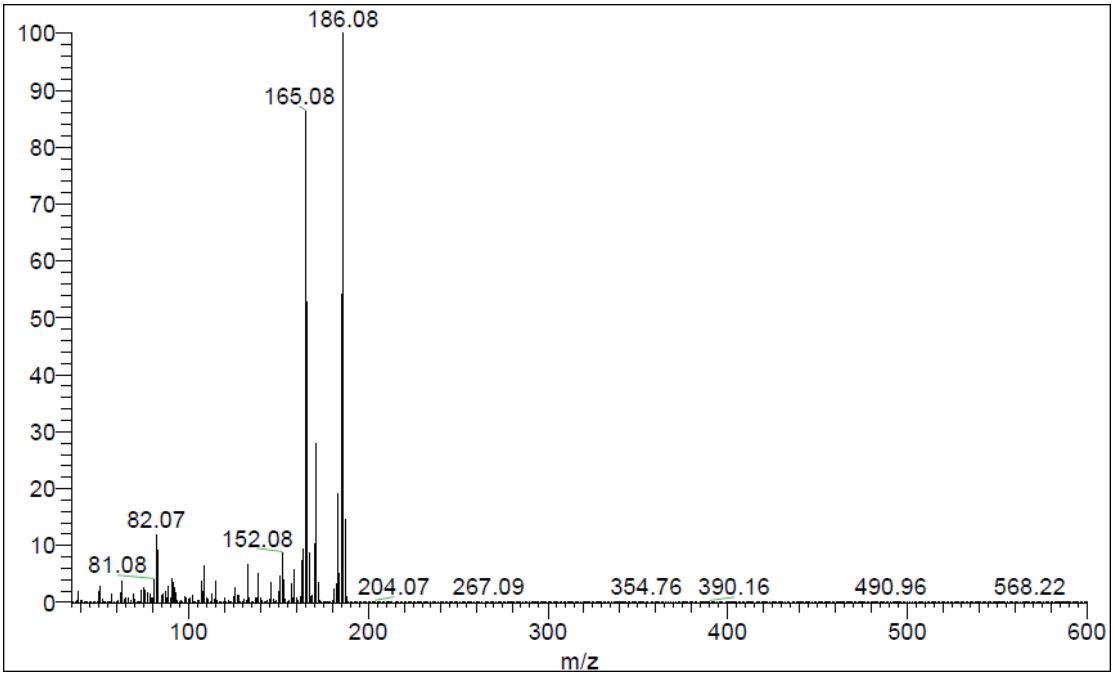
^{19}F NMR of 2- (fluoromethyl) -1, 1'-biphenyl (2b)



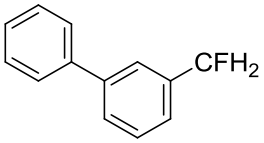


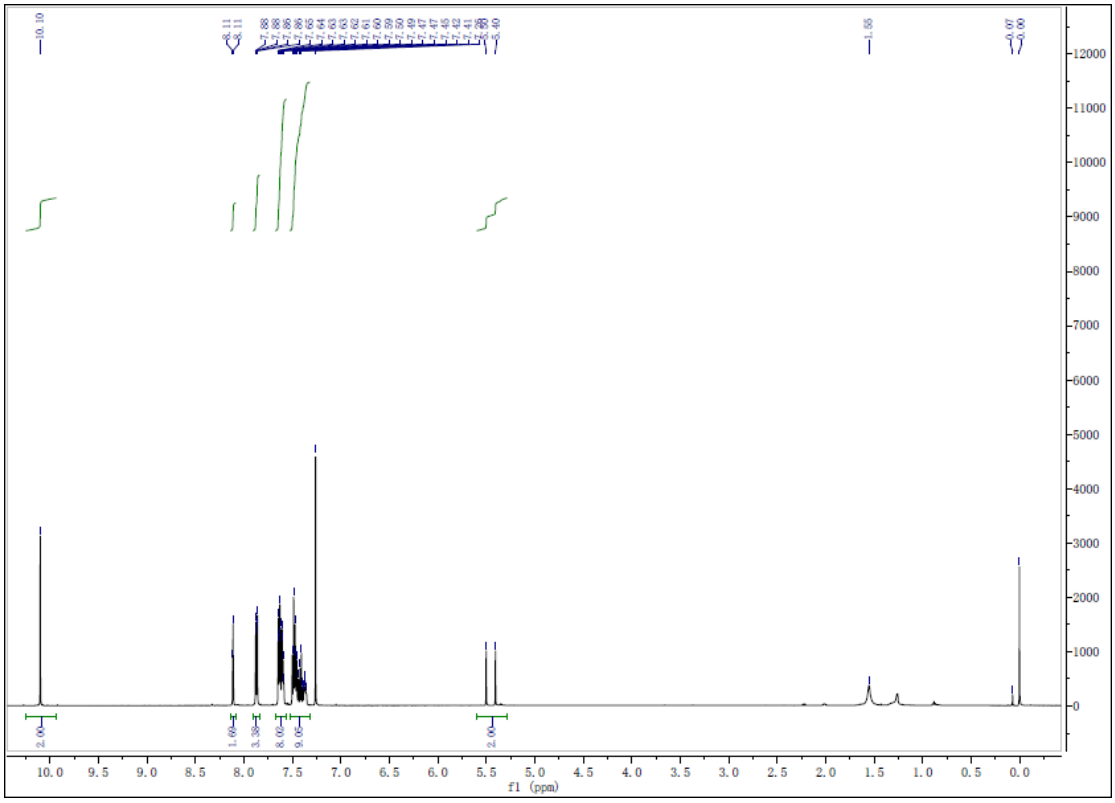
MS of 2-(fluoromethyl)-1,1'-biphenyl (2b)



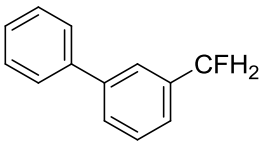


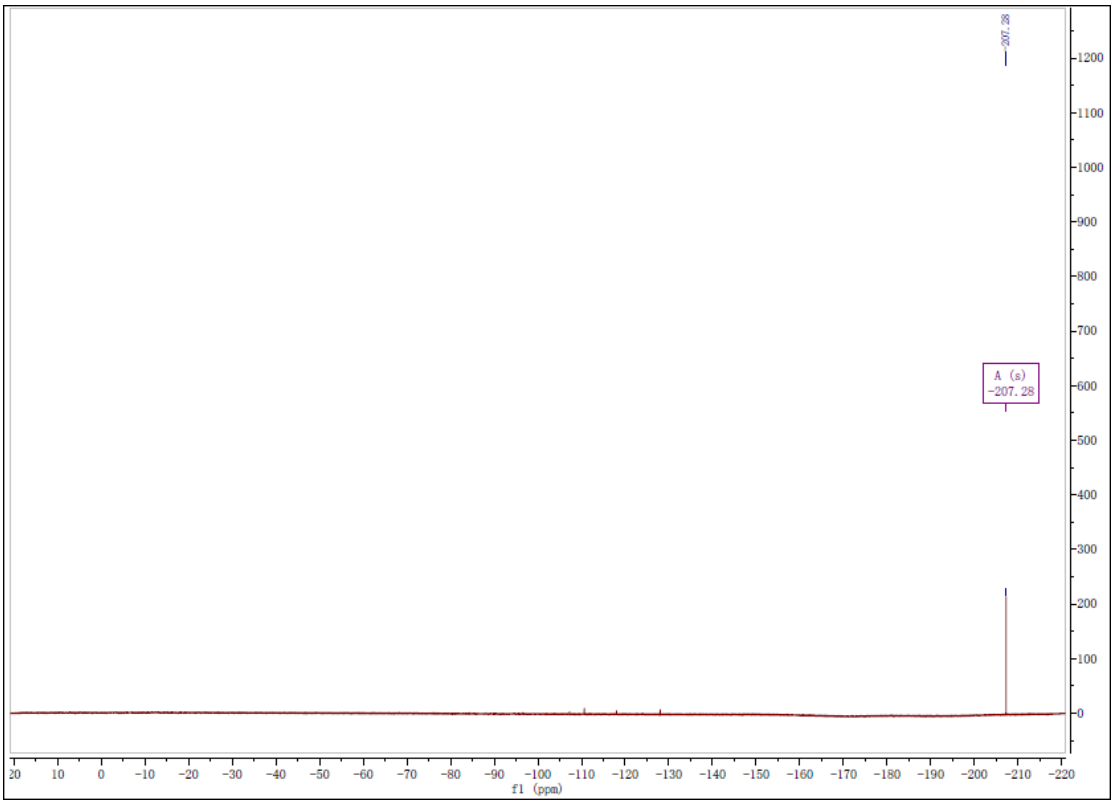
^{1}H NMR of 3- (fluoromethyl)-1, 1'- biphenyl (2c)



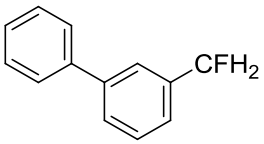


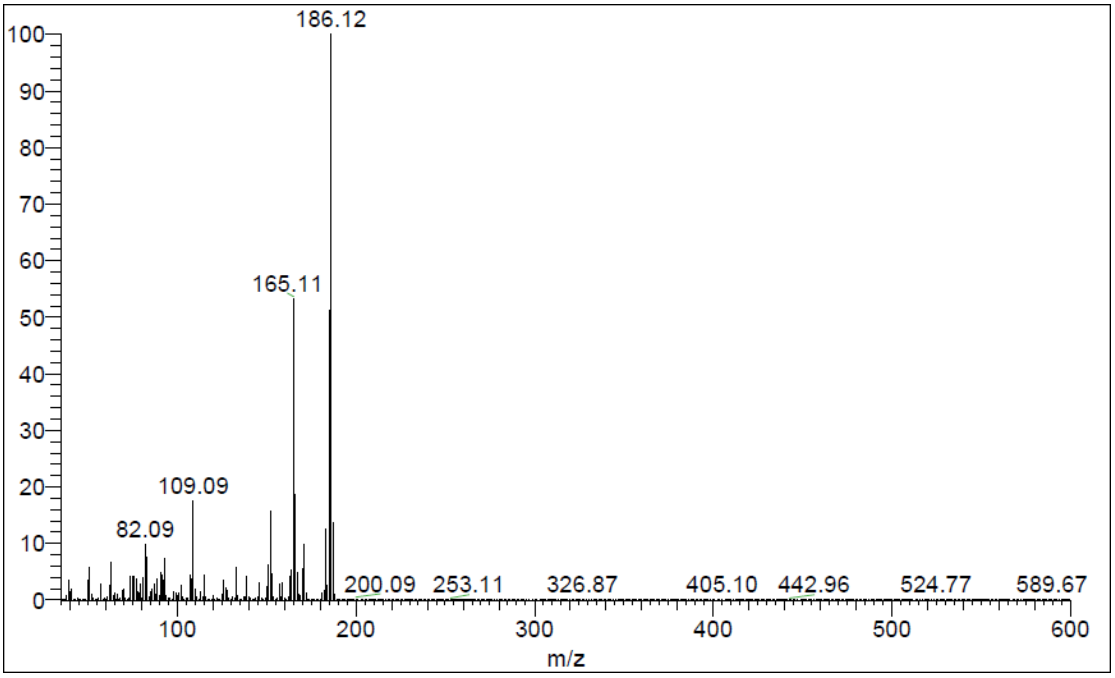
^{19}F NMR of 3- (fluoromethyl)-1, 1'- biphenyl (2c)



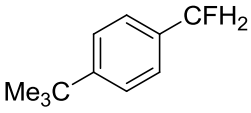


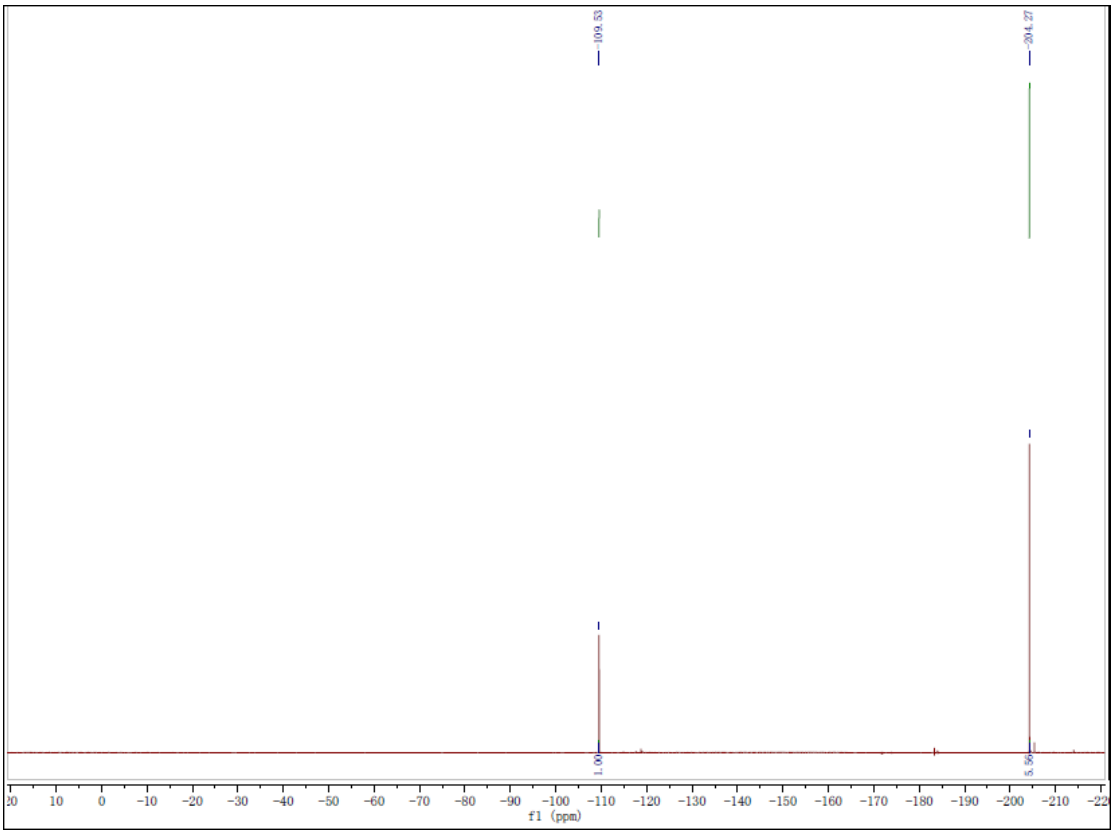
MS of 3- (fluoromethyl)-1, 1'- biphenyl (2c)



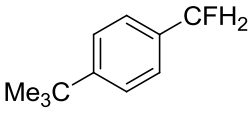


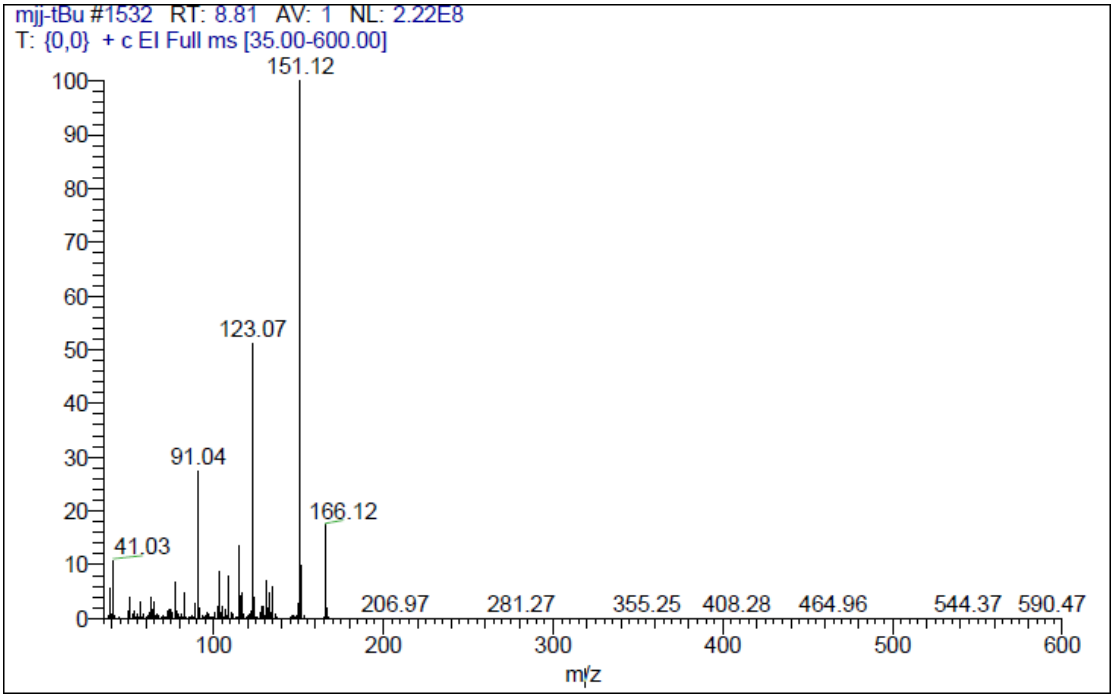
^{19}F NMR of 1- (*tert*-butyl)-4- (fluoromethyl) benzene (2d):



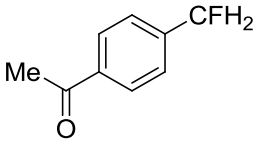


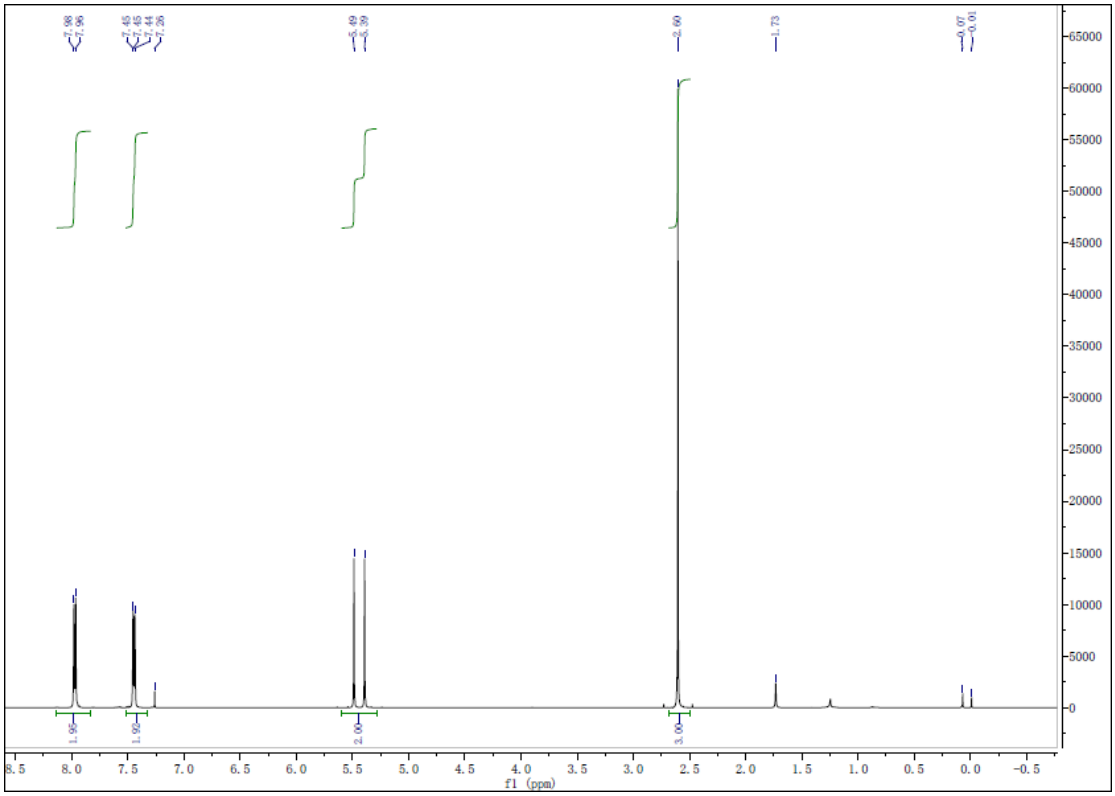
MS of 1- (*tert*-butyl)-4- (fluoromethyl) benzene (2d):



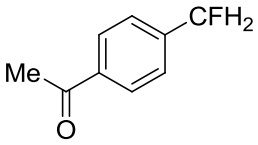


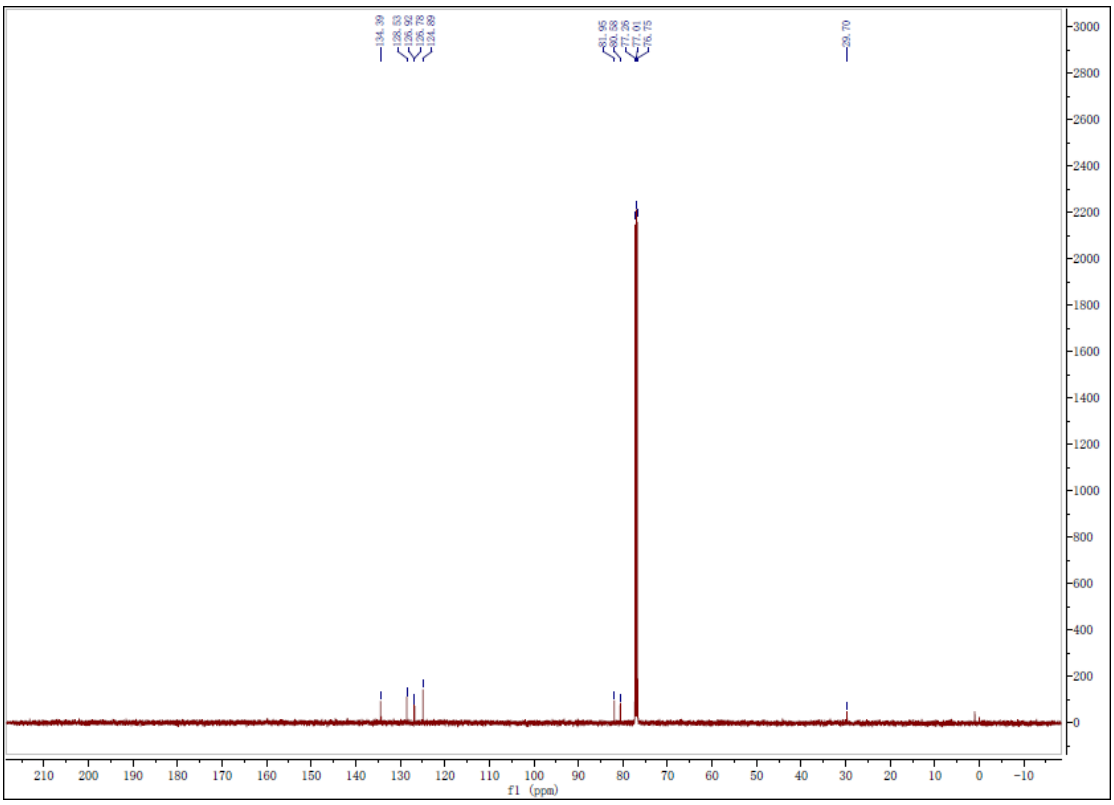
^{1}H NMR of 1- (4- (fluoromethyl) phenyl) ethanone (2e)



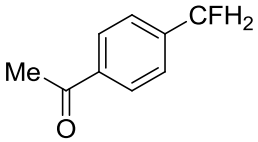


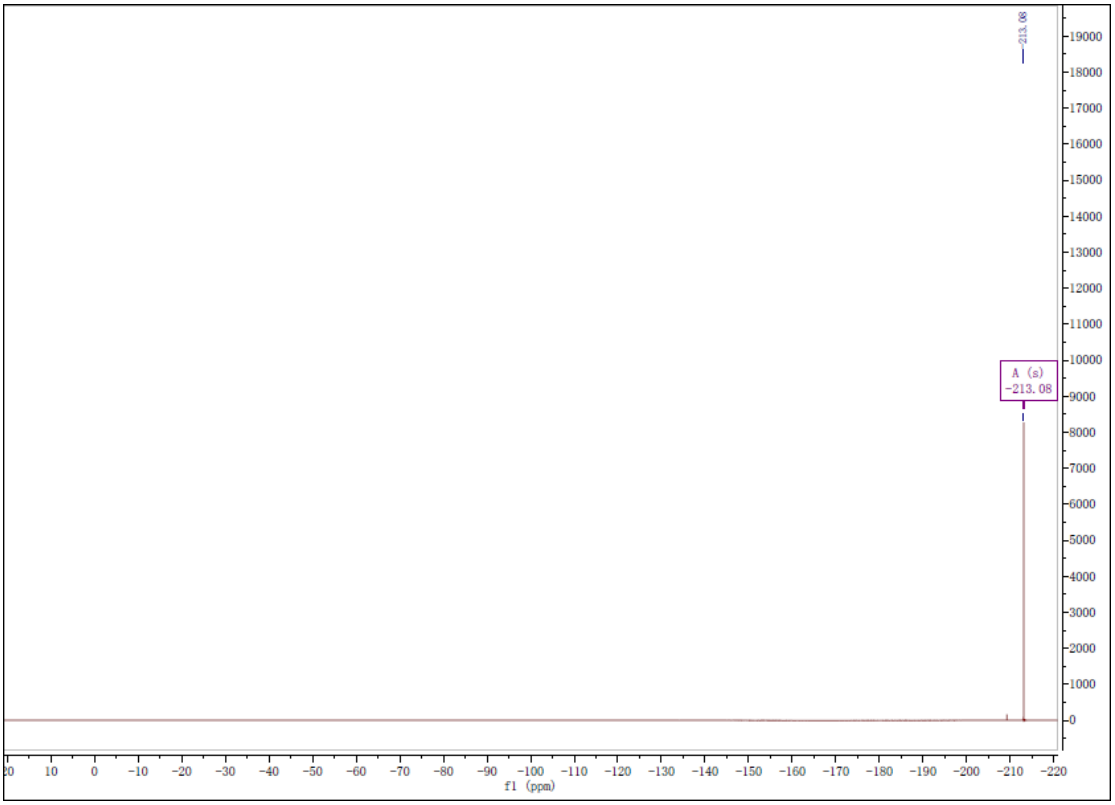
^{13}C NMR of 1- (4- (fluoromethyl) phenyl) ethanone (2e)



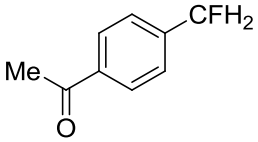


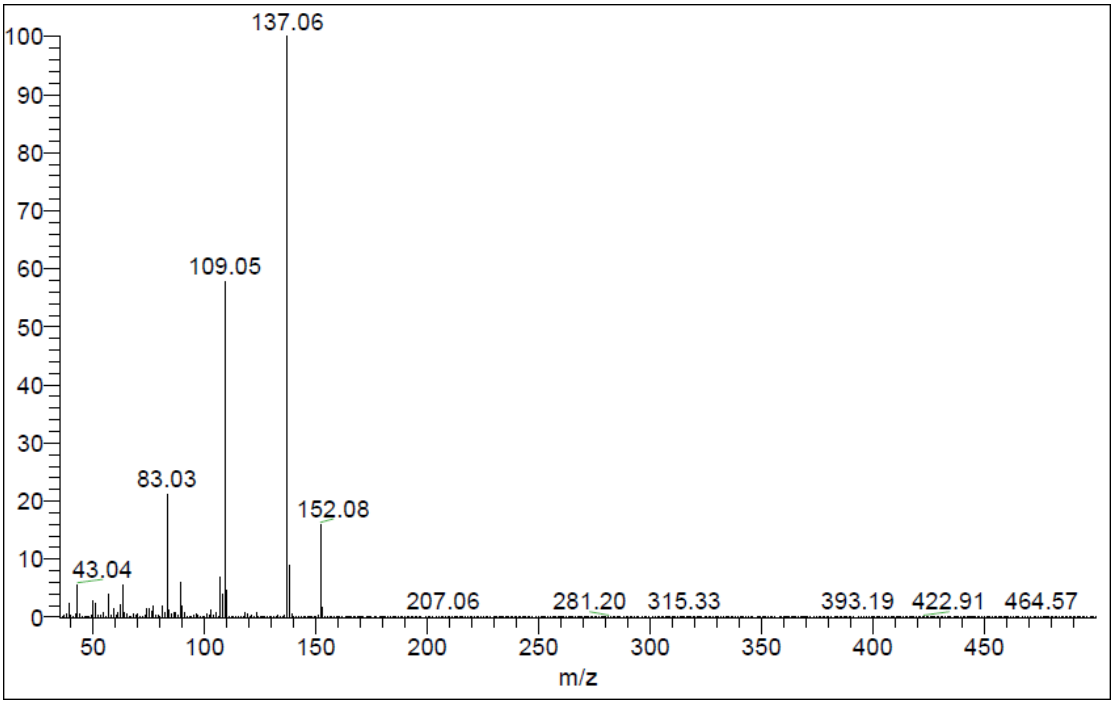
^{19}F NMR of 1- (4- (fluoromethyl) phenyl) ethanone (2e)



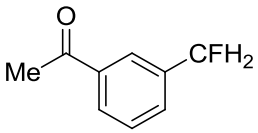


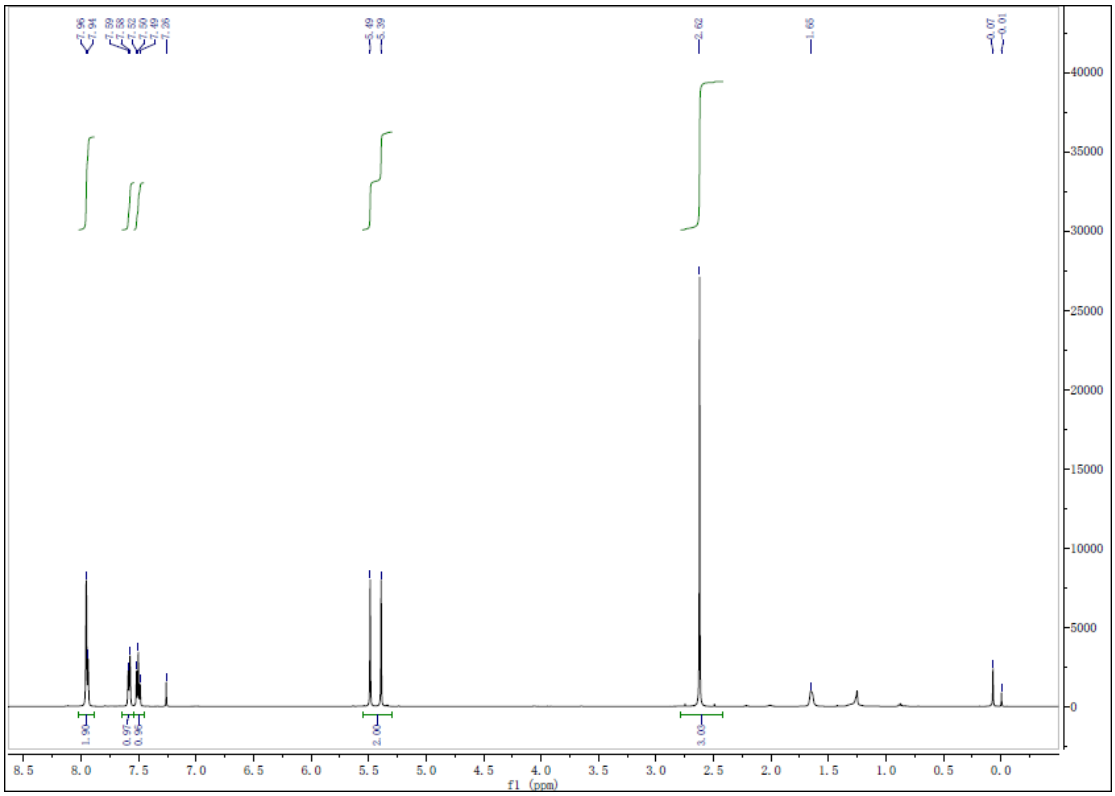
MS of 1- (4- (fluoromethyl) phenyl) ethanone (2e)



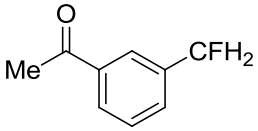


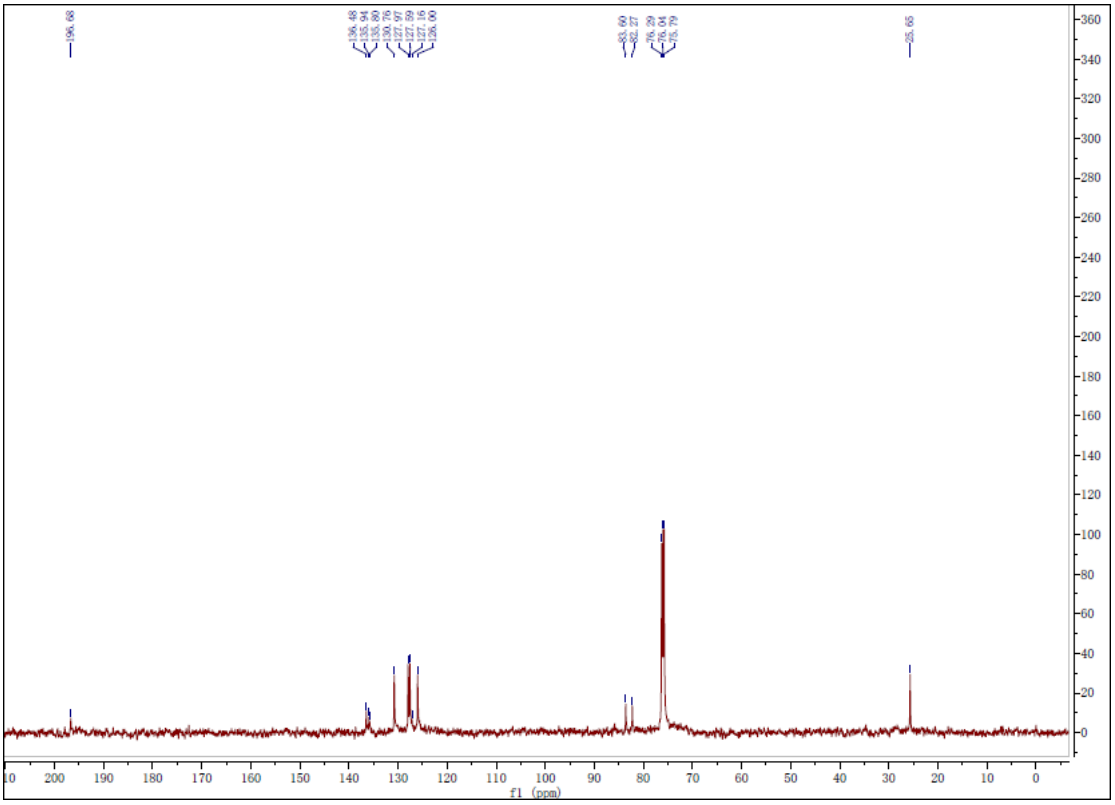
^{1}H NMR of 1-(3-(fluoromethyl)phenyl)ethanone (2f)



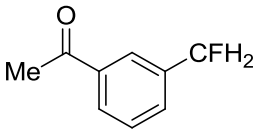


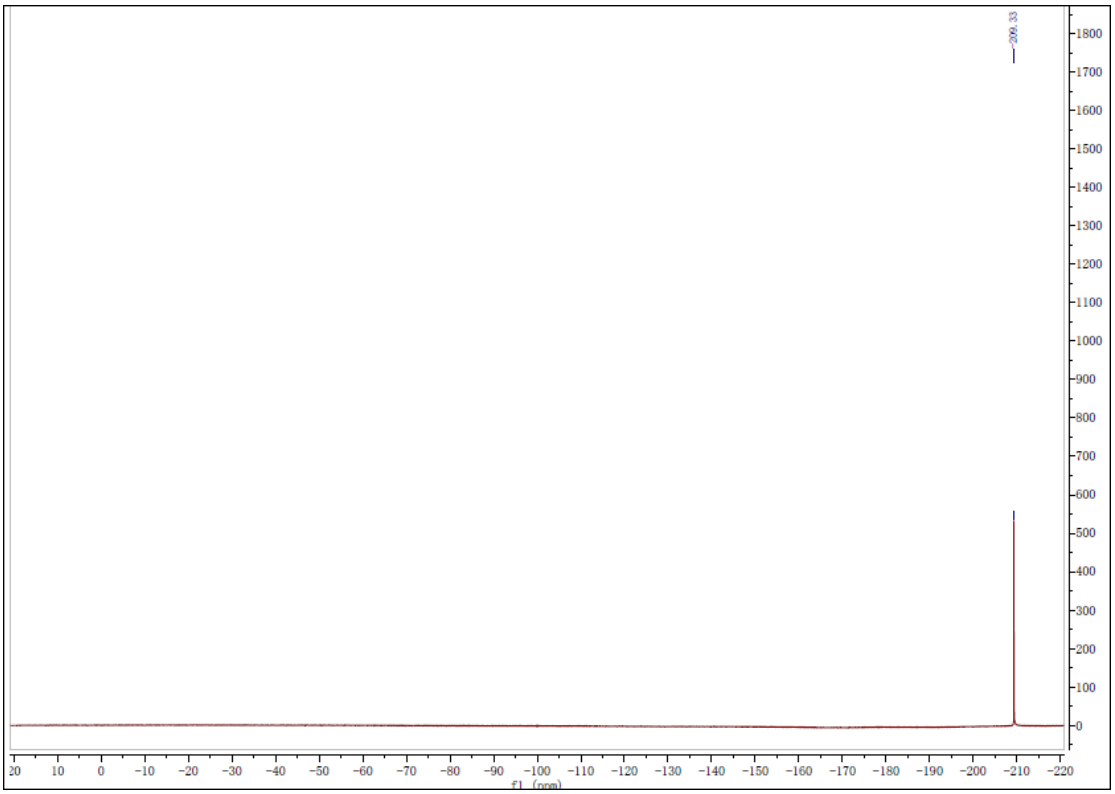
^{13}C NMR of 1-(3-(fluoromethyl)phenyl)ethanone (2f)



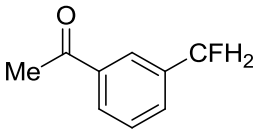


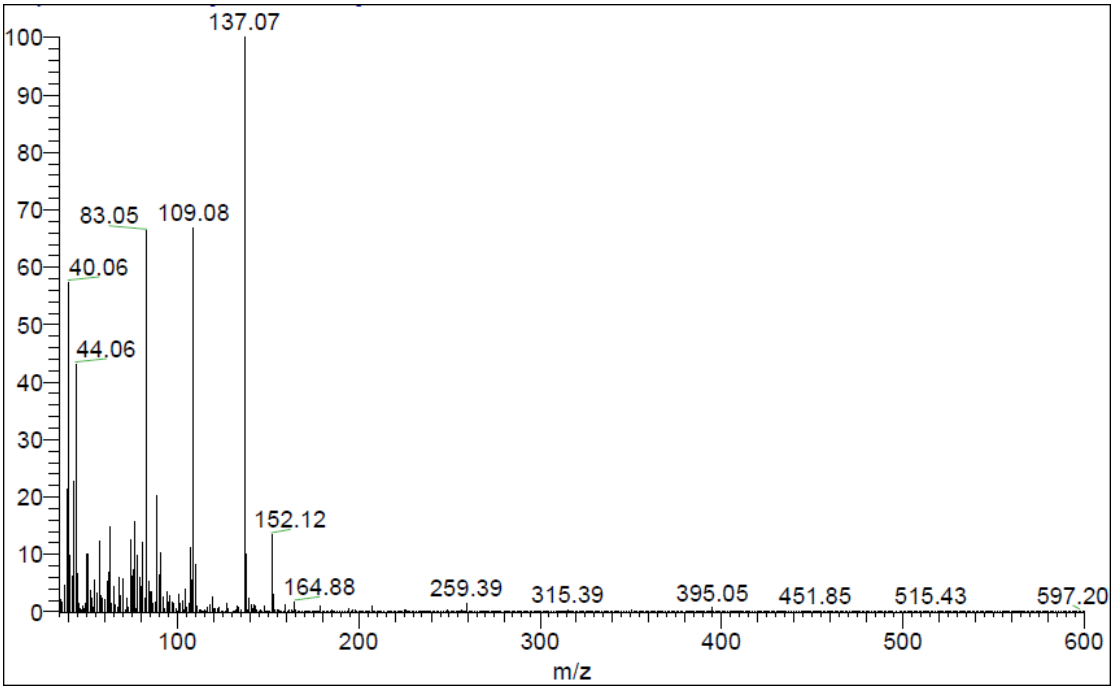
^{19}F NMR of 1-(3-(fluoromethyl)phenyl)ethanone (2f)



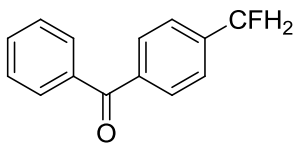


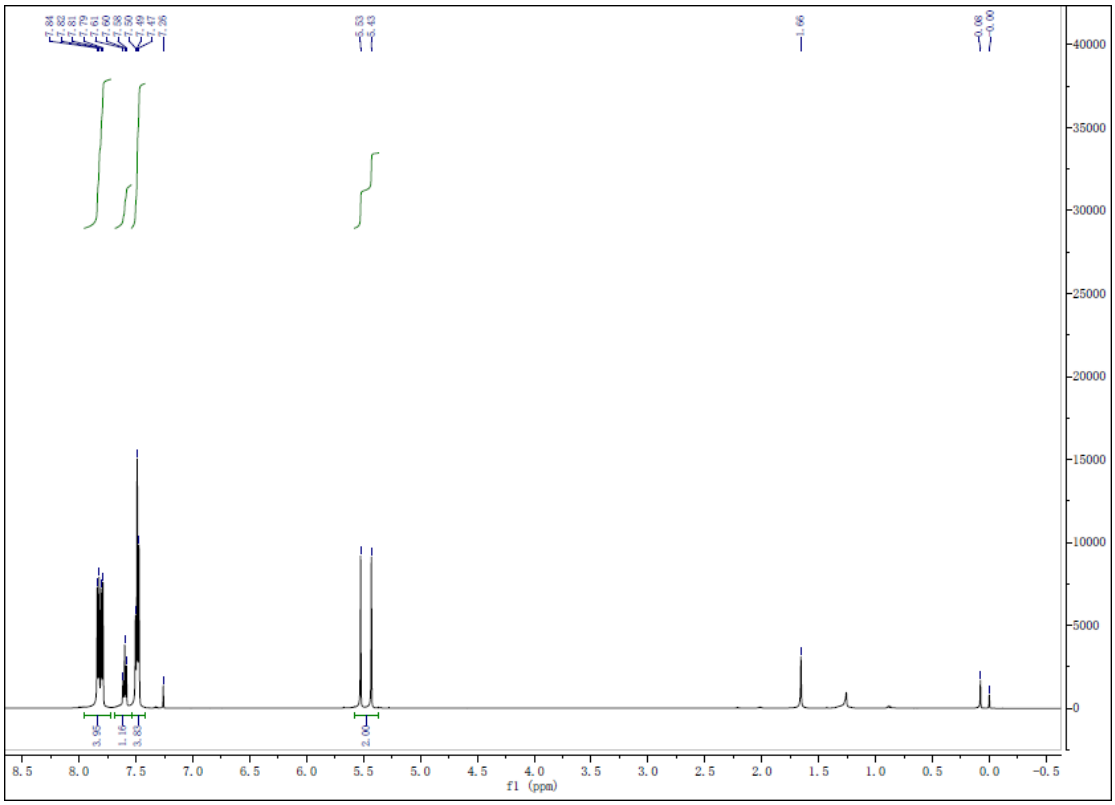
MS of 1-(3-(fluoromethyl)phenyl)ethanone (2f)



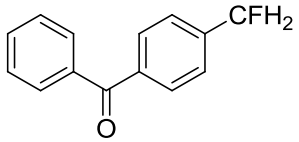


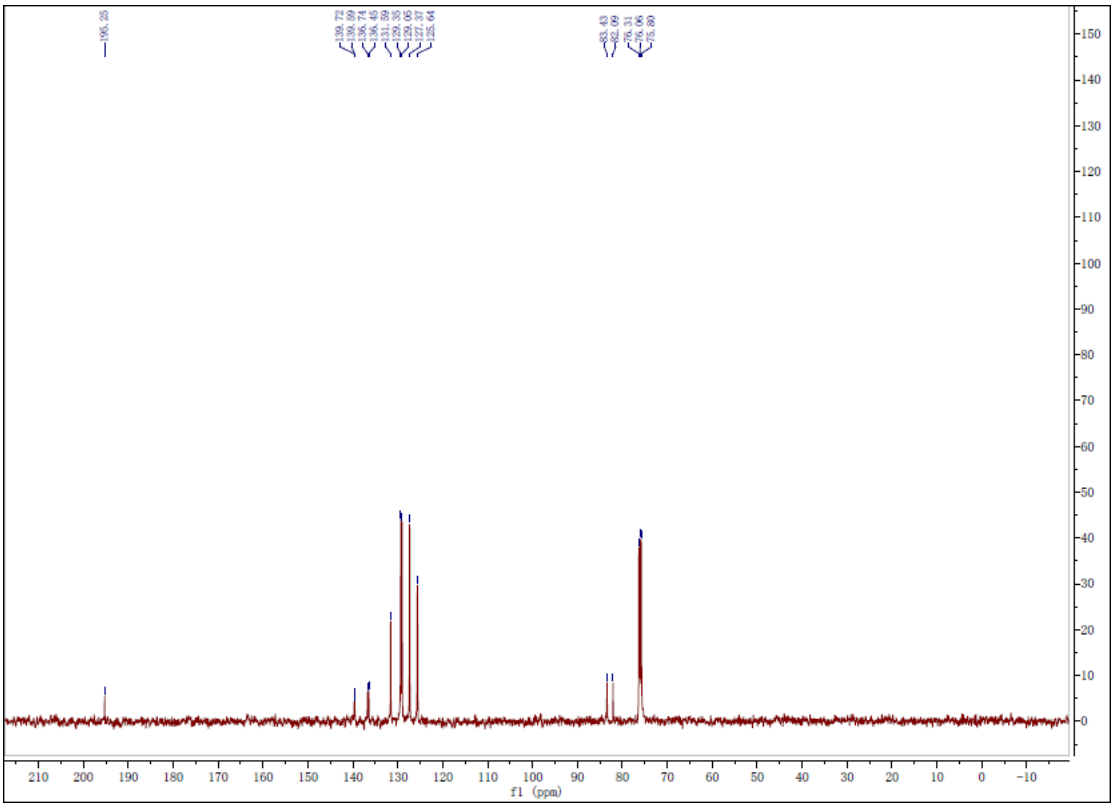
^{1}H NMR of (4-(fluoromethyl)phenyl)(phenyl)methanone (2g)



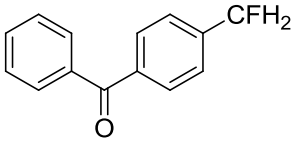


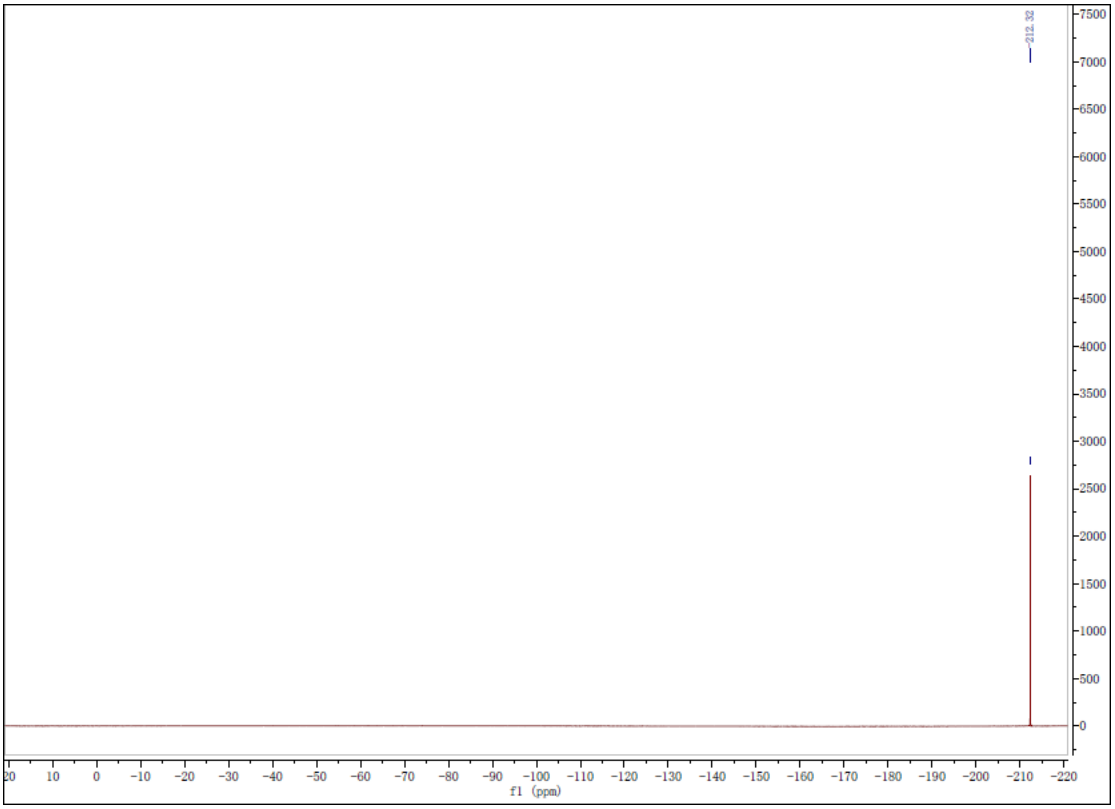
^{13}C NMR of (4 (fluoromethyl)phenyl)(phenyl)methanone (2g)



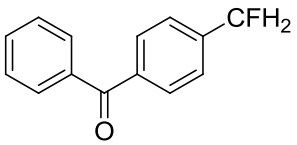


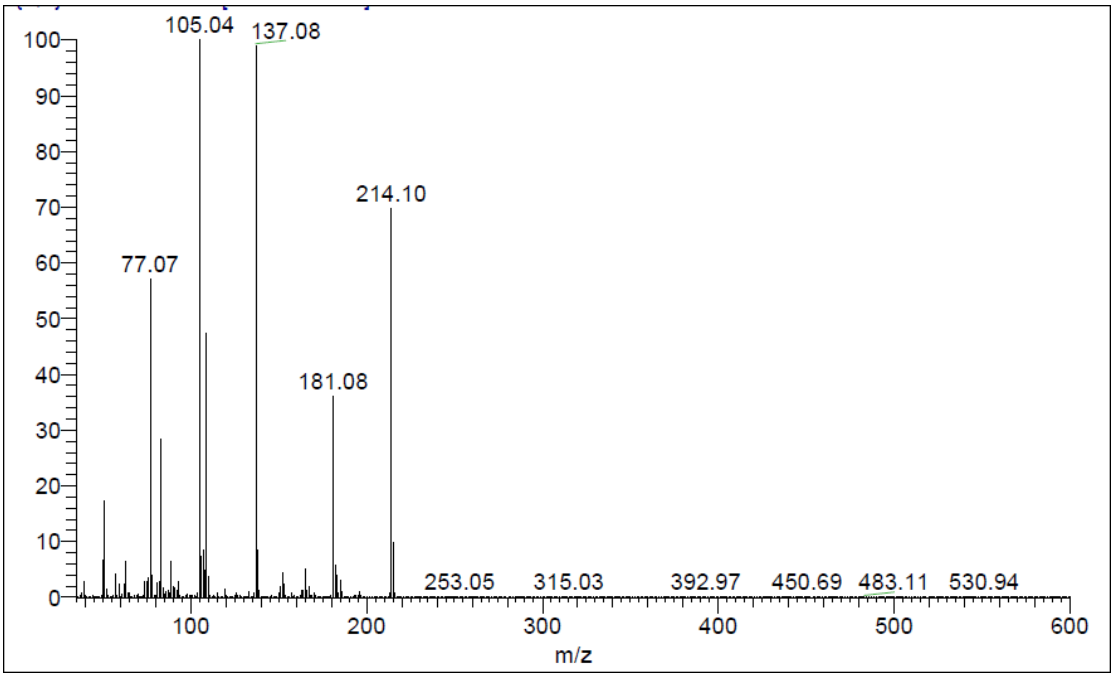
^{19}F NMR of (4-(fluoromethyl)phenyl)(phenyl)methanone (2g)



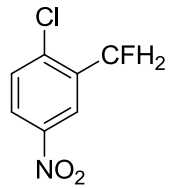


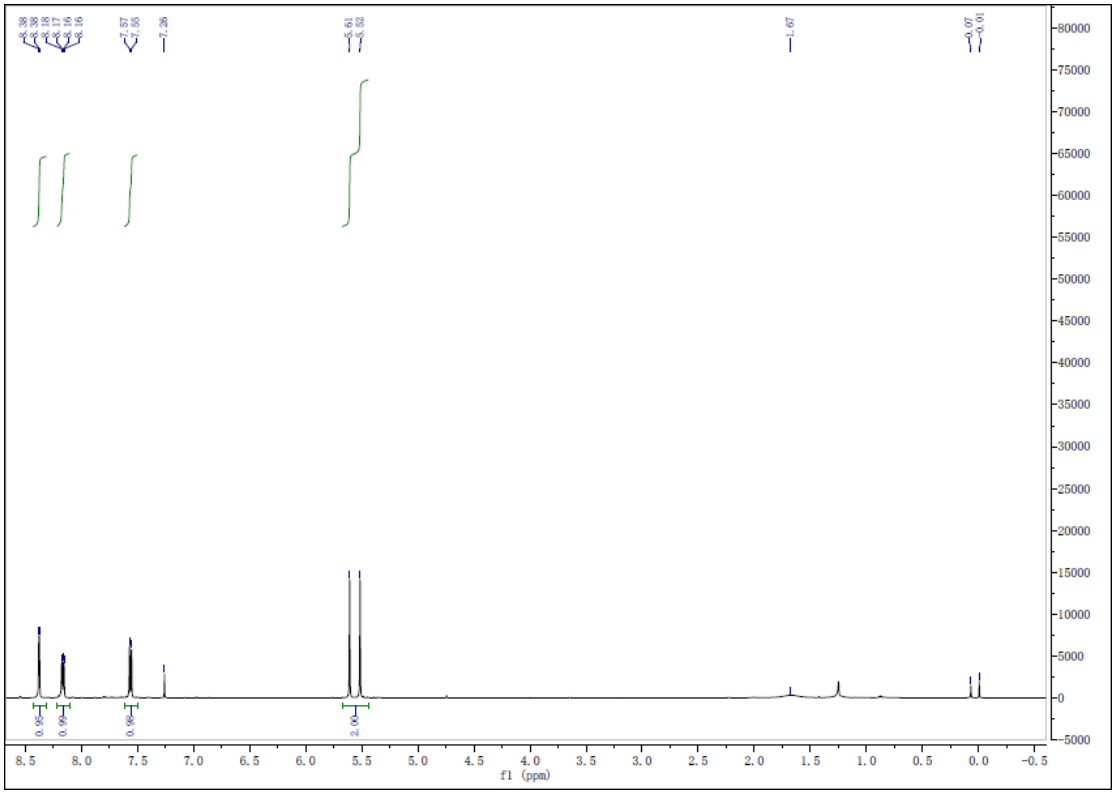
MS of (4-(fluoromethyl)phenyl)(phenyl)methanone (2g)



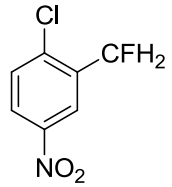


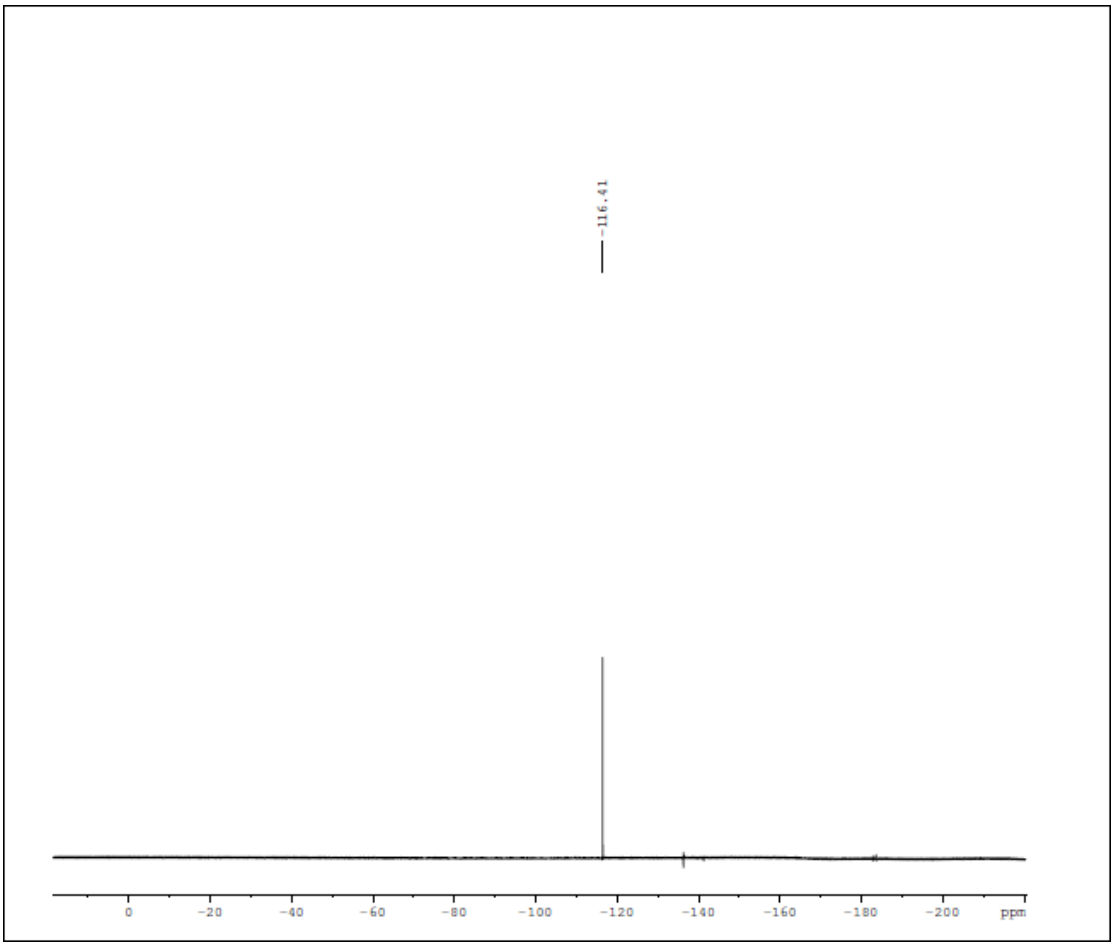
^{1}H NMR of 1-chloro-2- (fluoromethyl)-4-nitrobenzene (2h)



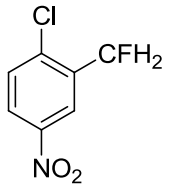


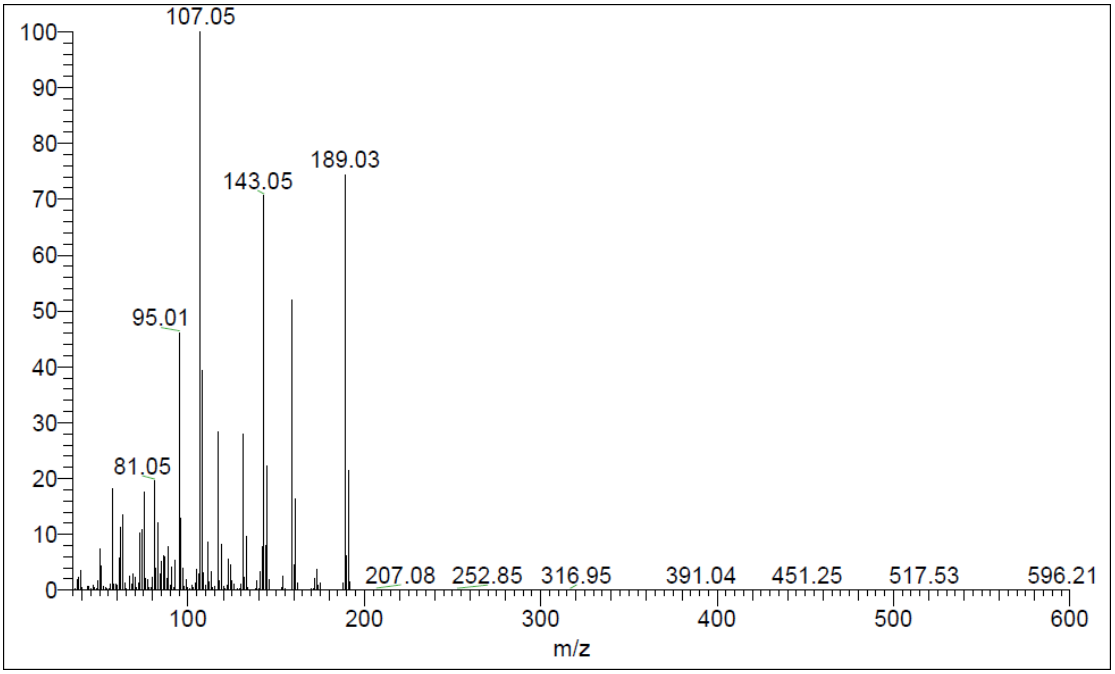
^{19}F NMR of 1-chloro-2-(fluoromethyl)-4-nitrobenzene (2h)



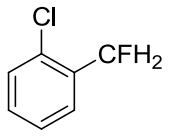


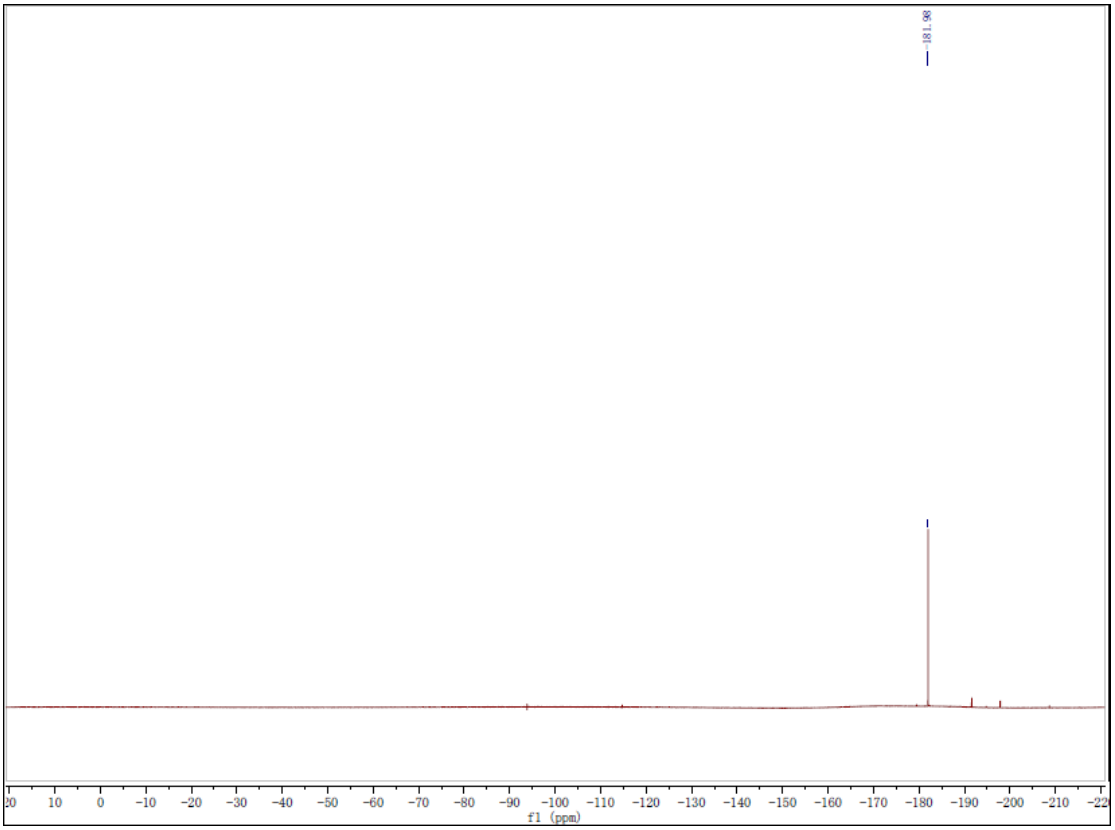
MS of 1-chloro-2-(fluoromethyl)-4-nitrobenzene (2h)



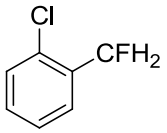


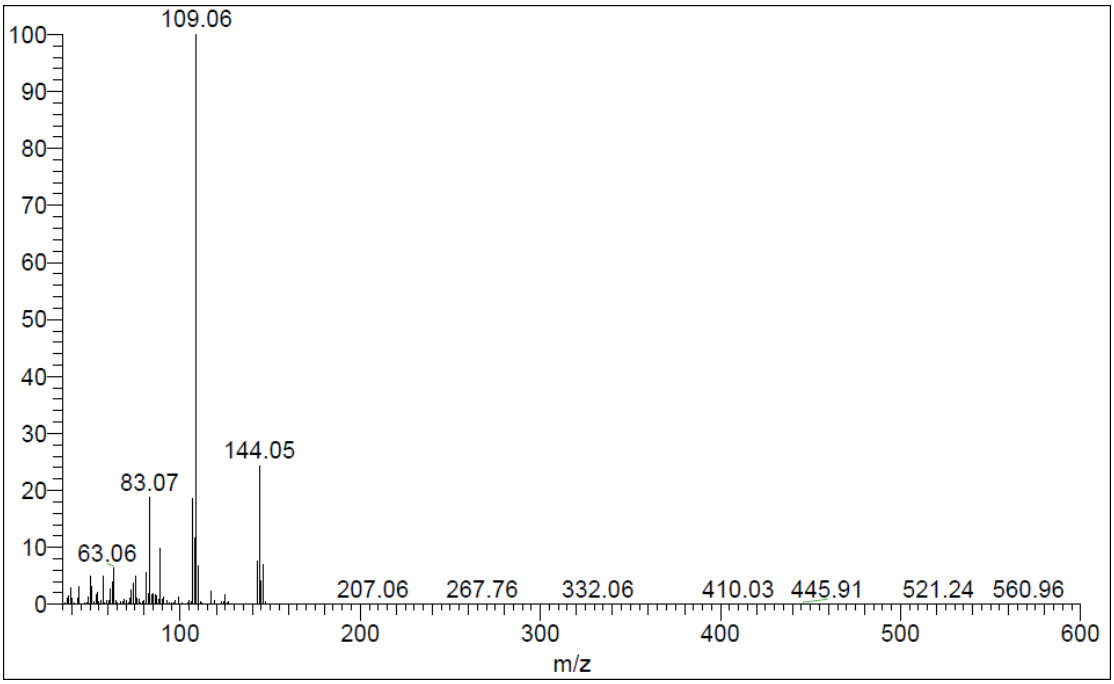
^{19}F NMR of 1-chloro-2- (fluoromethyl) benzene (2i)



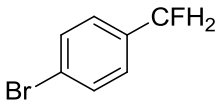


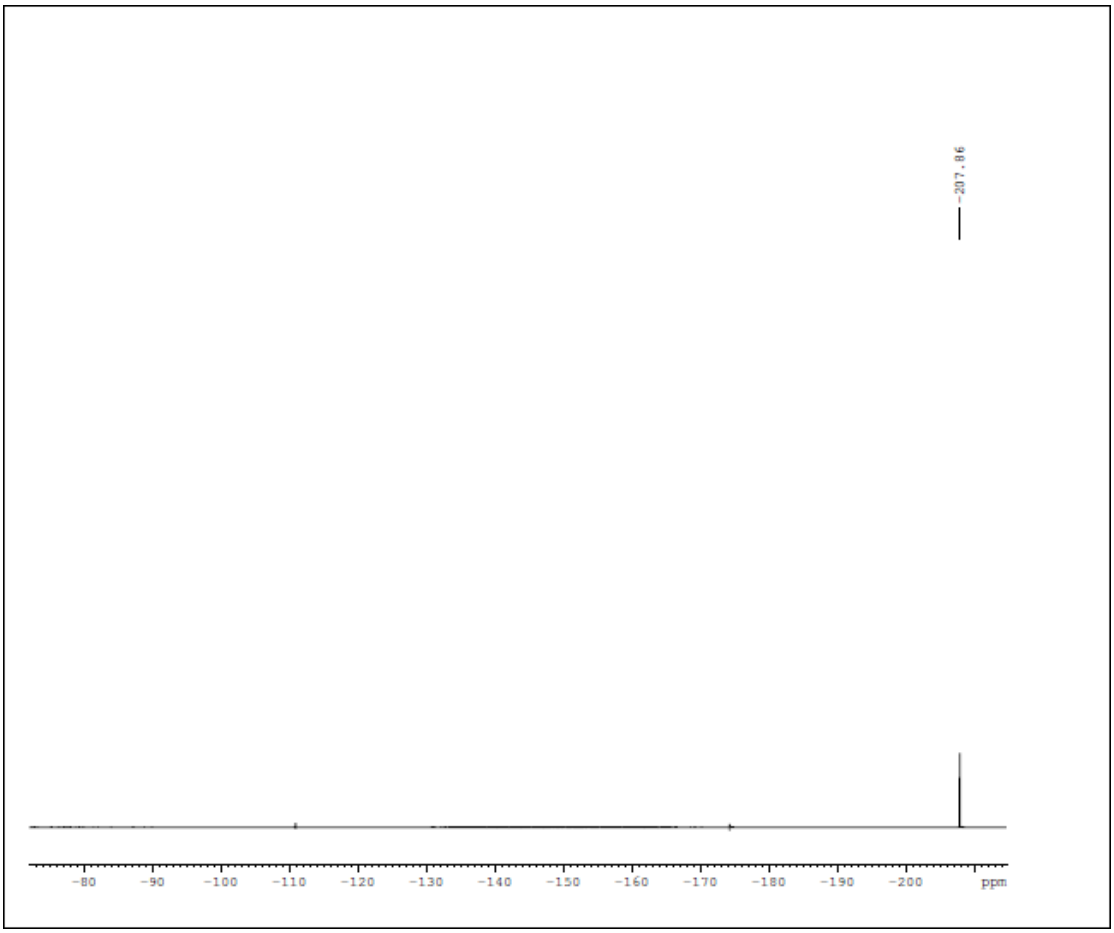
MS of 1-chloro-2- (fluoromethyl) benzene (2i)



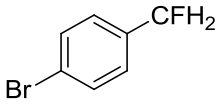


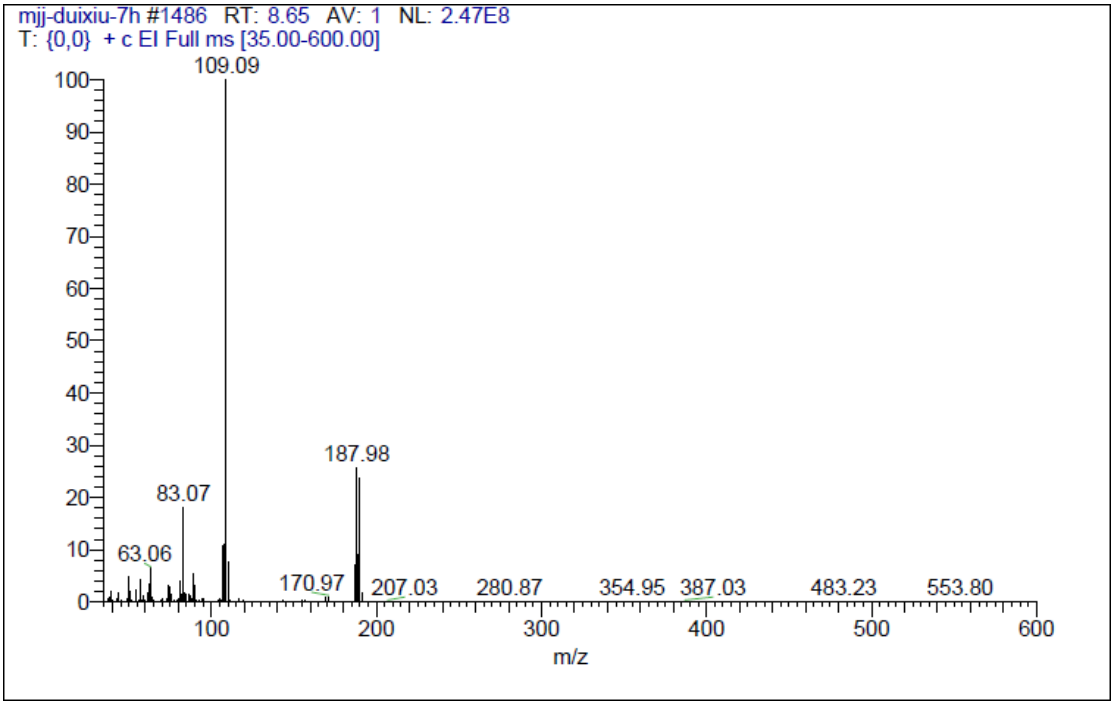
^{19}F NMR of 1-bromo-4- (fluoromethyl) benzene (2j)



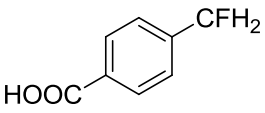


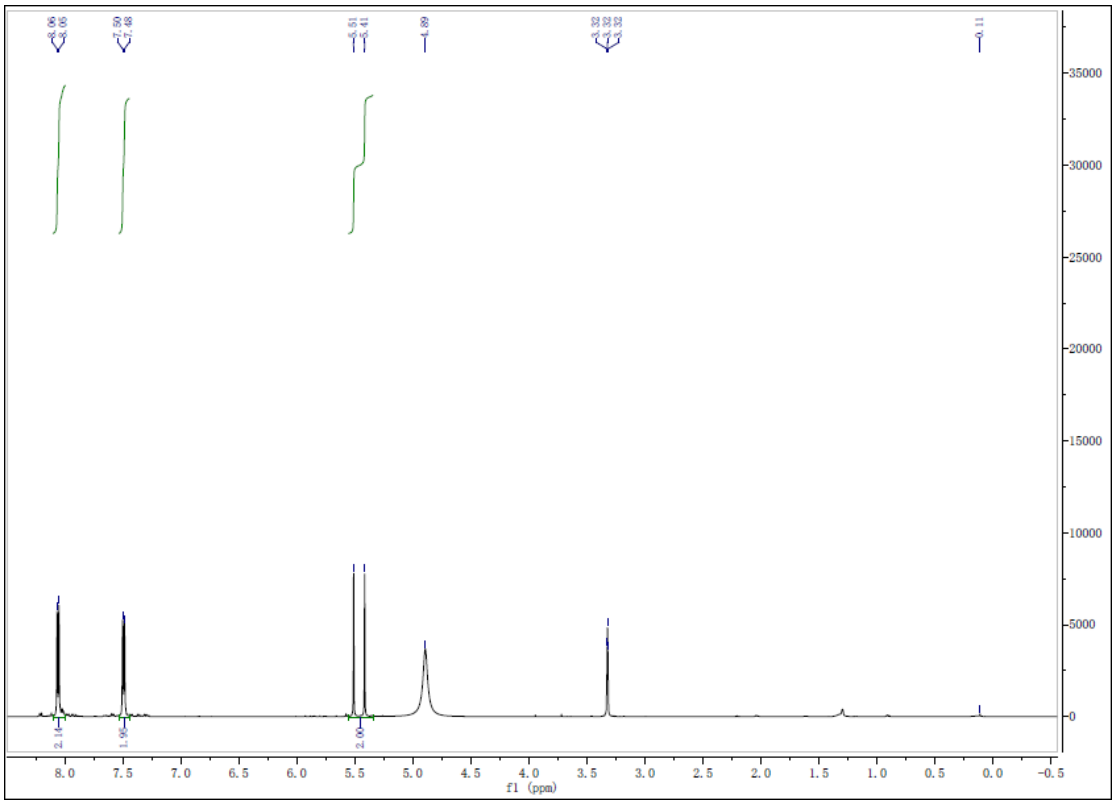
MS of 1-bromo-4- (fluoromethyl) benzene (2j)



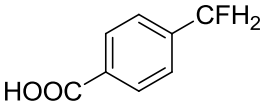


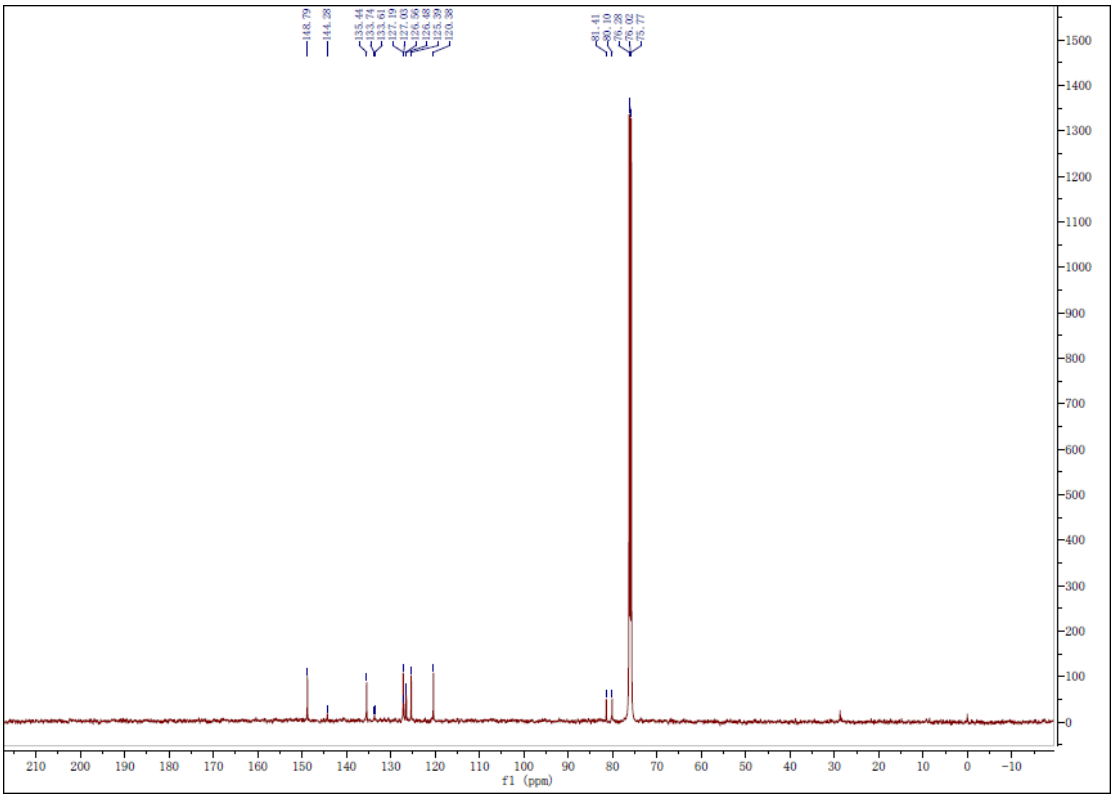
^{1}H NMR of 4- (fluoromethyl) benzoic acid (2k)



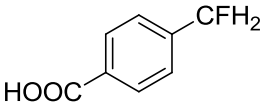


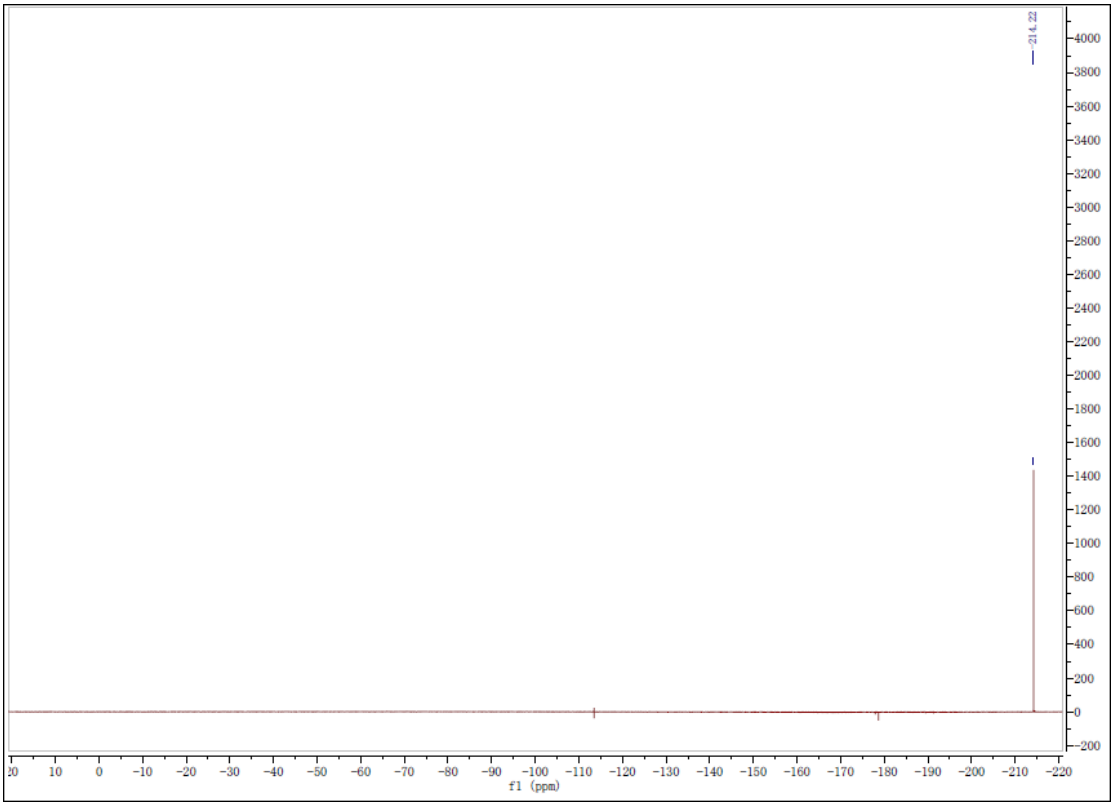
^{13}C NMR of 4- (fluoromethyl) benzoic acid (2k)



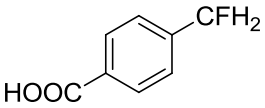


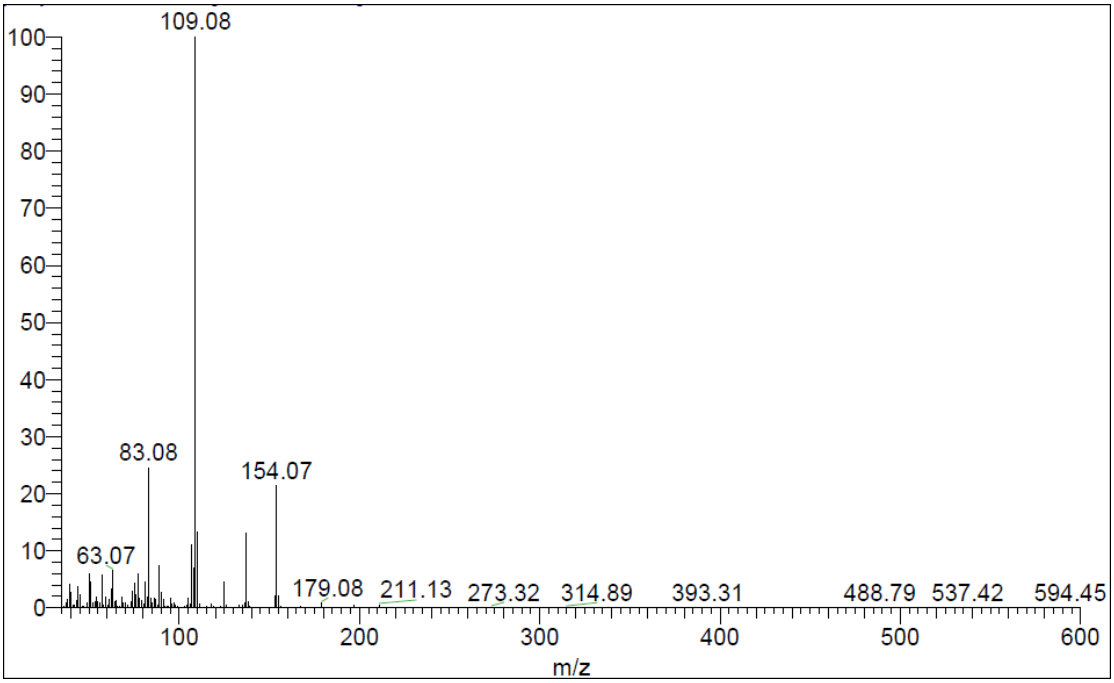
^{19}F NMR of 4- (fluoromethyl) benzoic acid (2k)



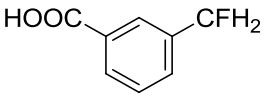


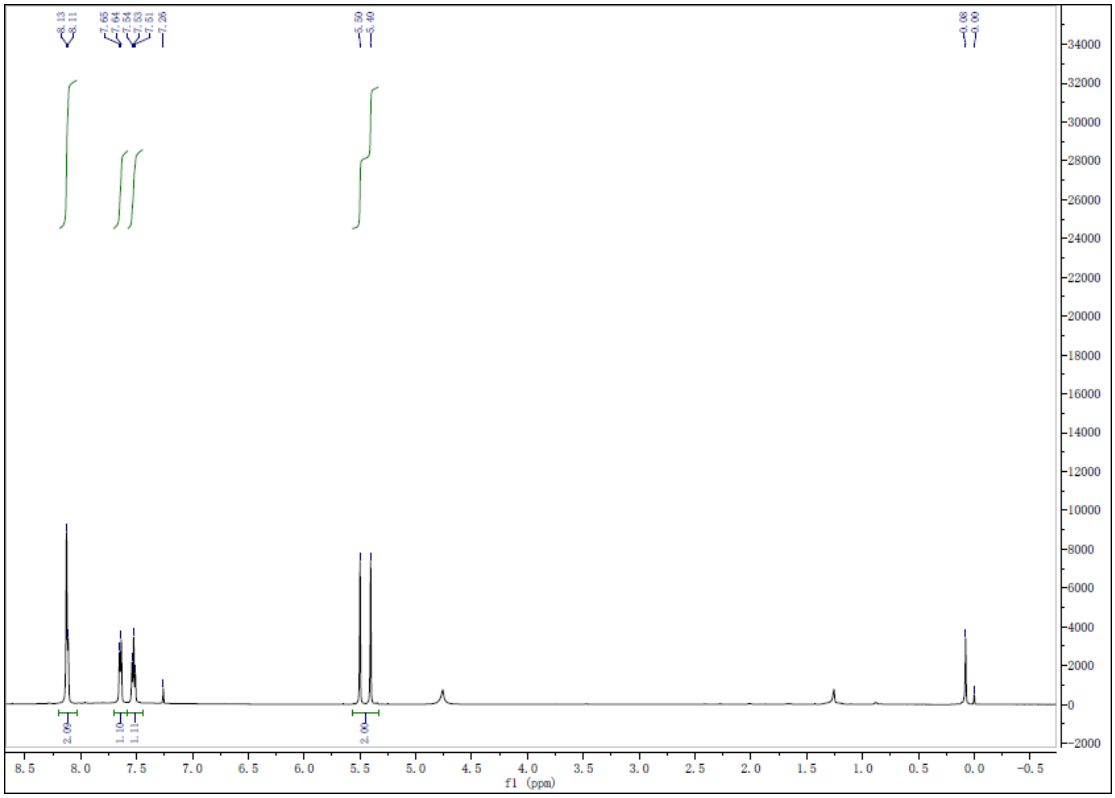
MS of 4- (fluoromethyl) benzoic acid (2k)



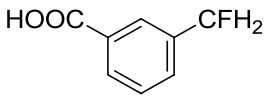


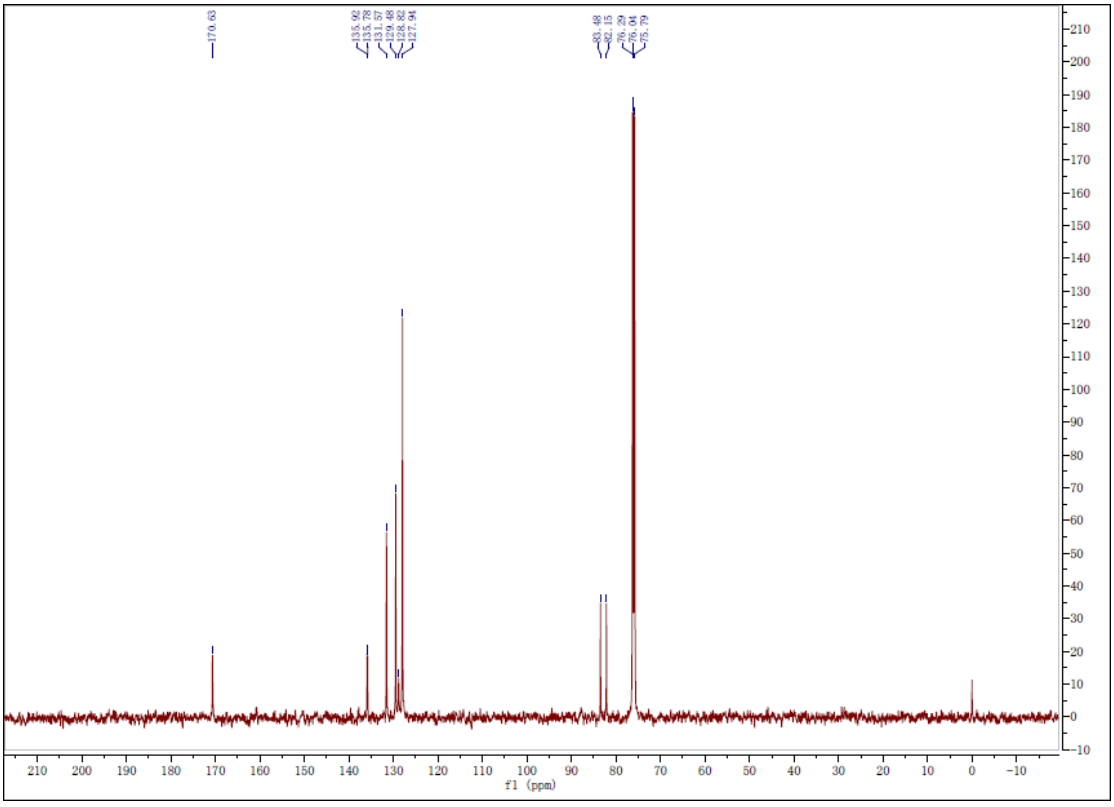
^{1}H NMR of 3- (fluoromethyl) benzoic acid (2l)



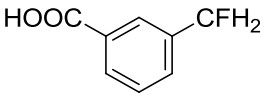


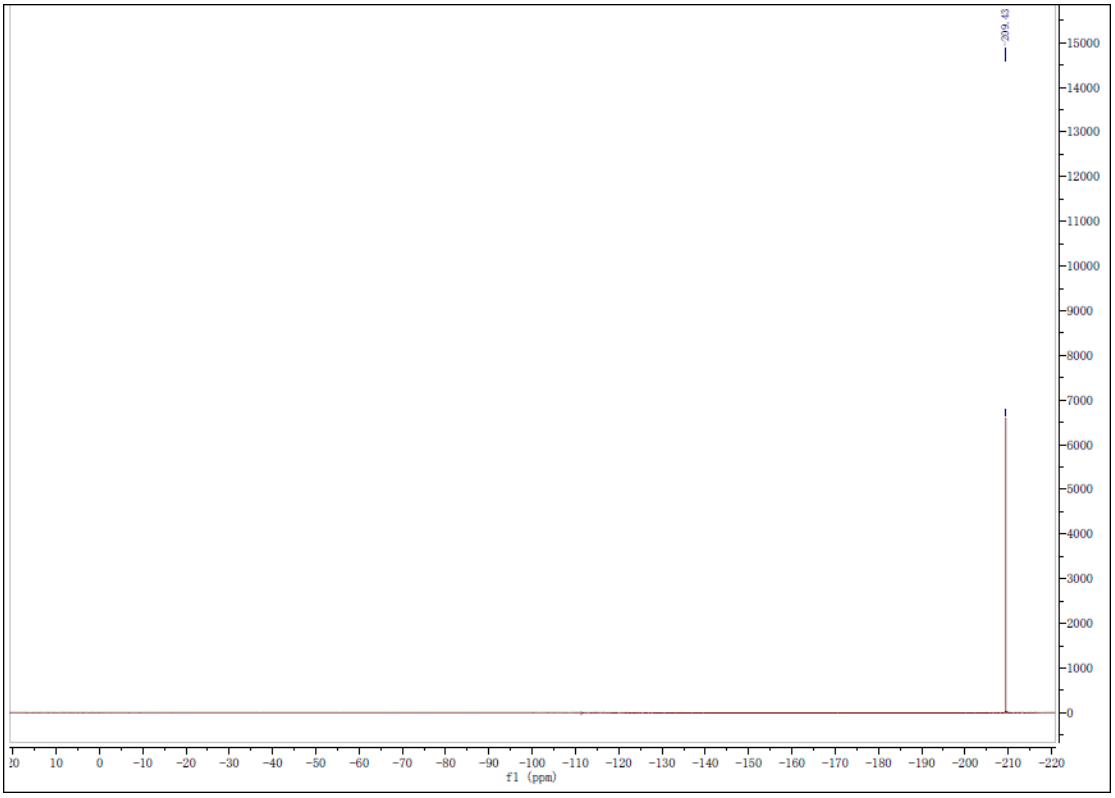
^{13}C NMR of 3- (fluoromethyl) benzoic acid (2l)



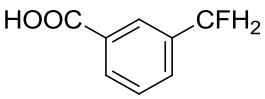


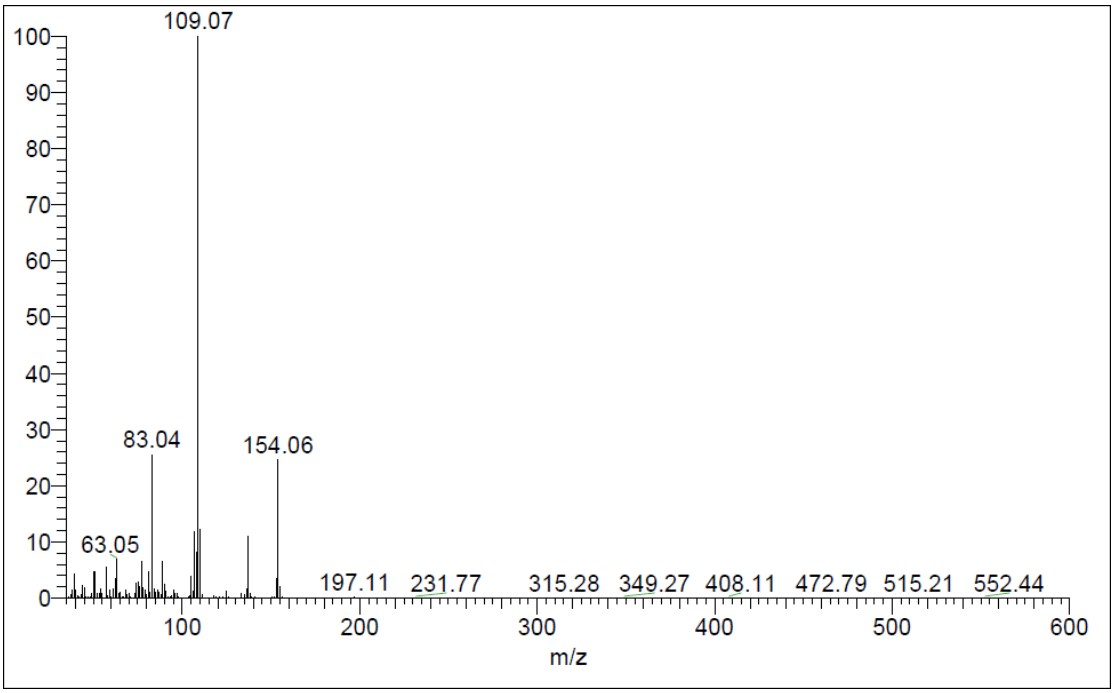
^{19}F NMR of 3-(fluoromethyl)benzoic acid (2l)



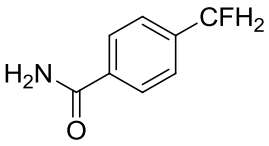


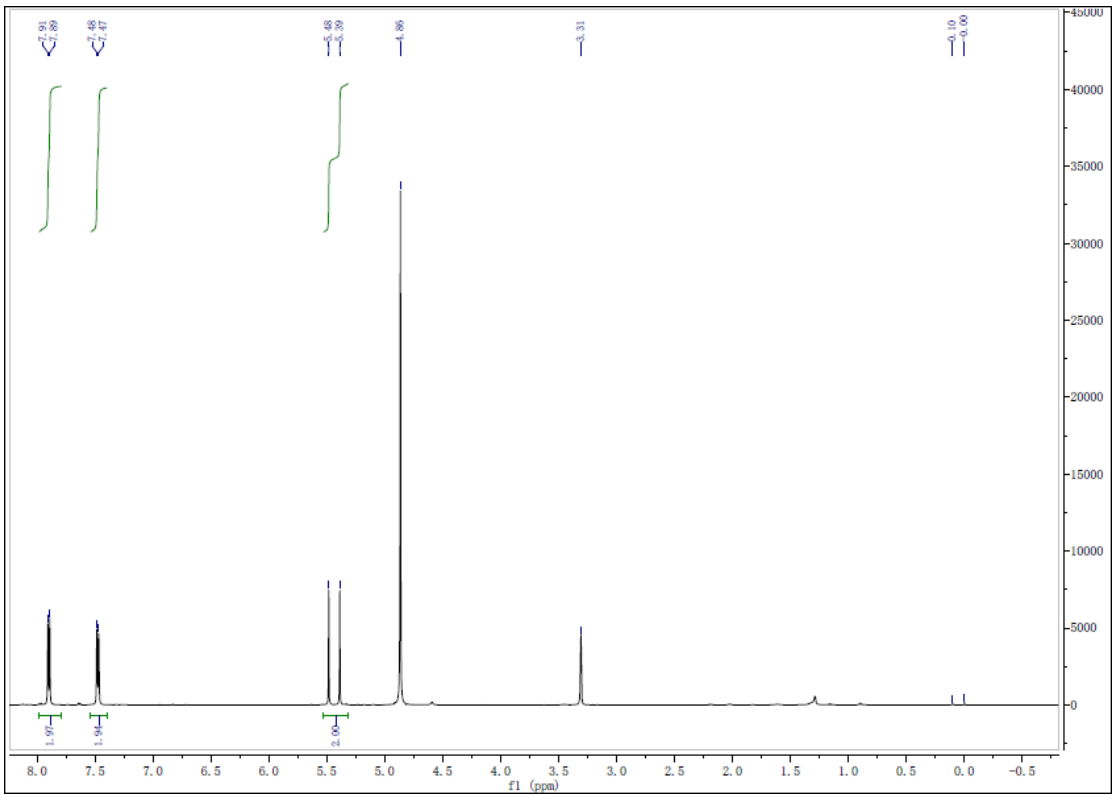
MS of 3- (fluoromethyl)benzoic acid (2l)



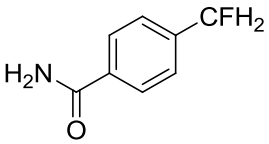


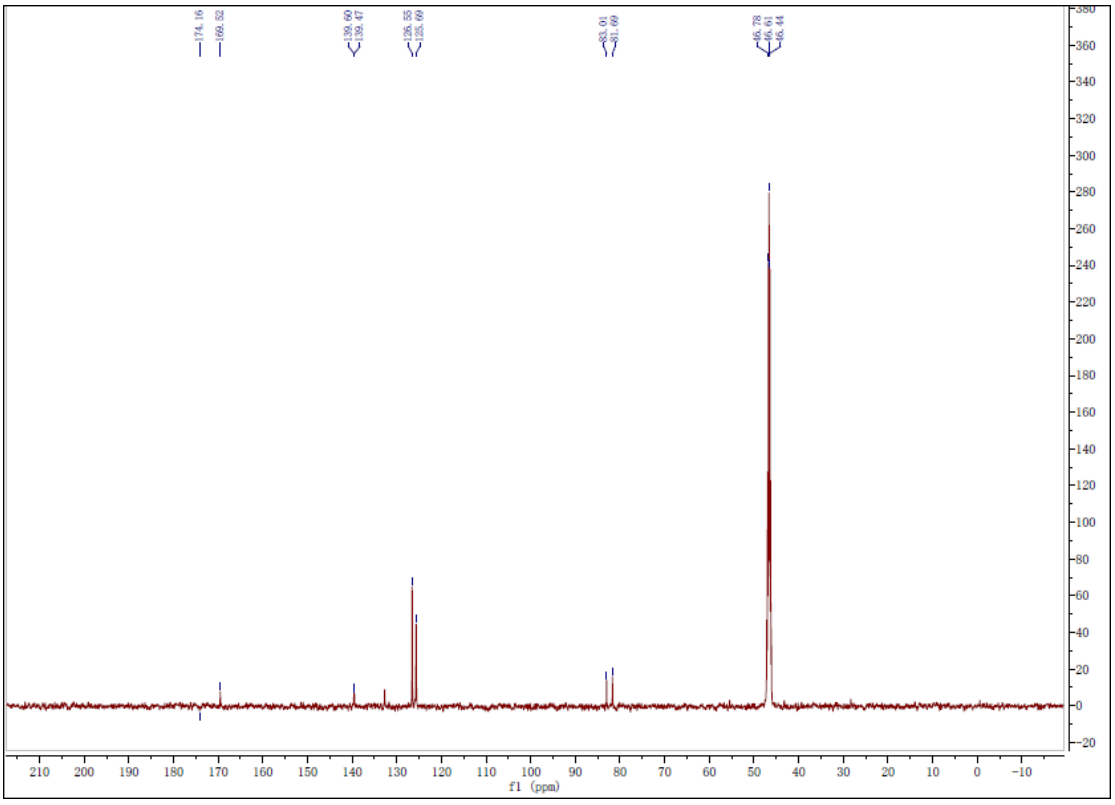
^{1}H NMR of 4- (fluoromethyl) benzamide (2m)



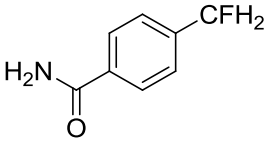


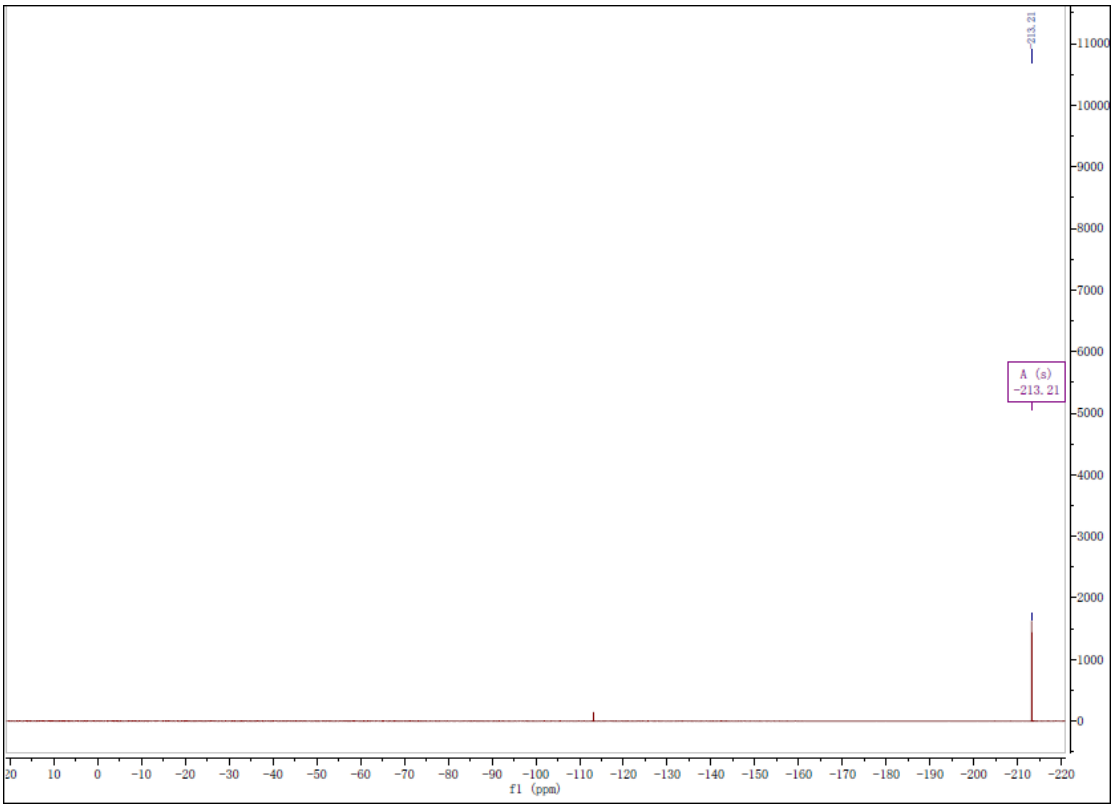
^{13}C NMR of 4- (fluoromethyl) benzamide (2m)



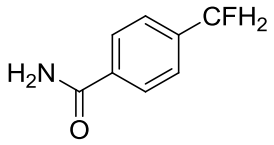


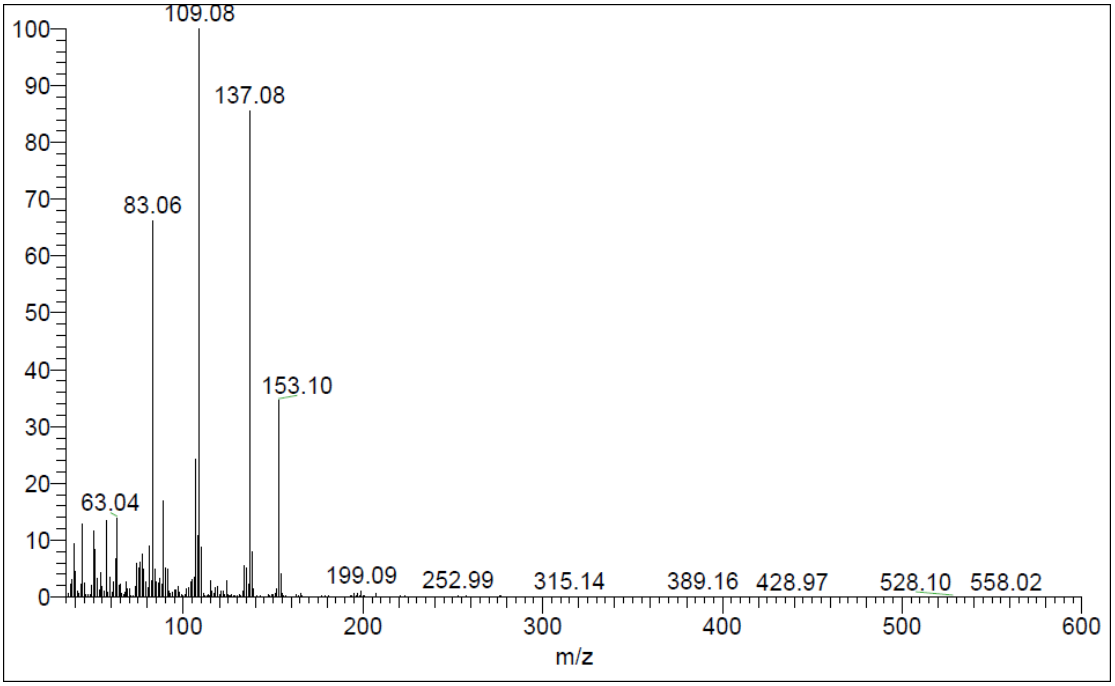
^{19}F NMR of 4- (fluoromethyl) benzamide (2m)



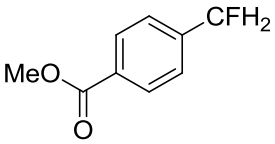


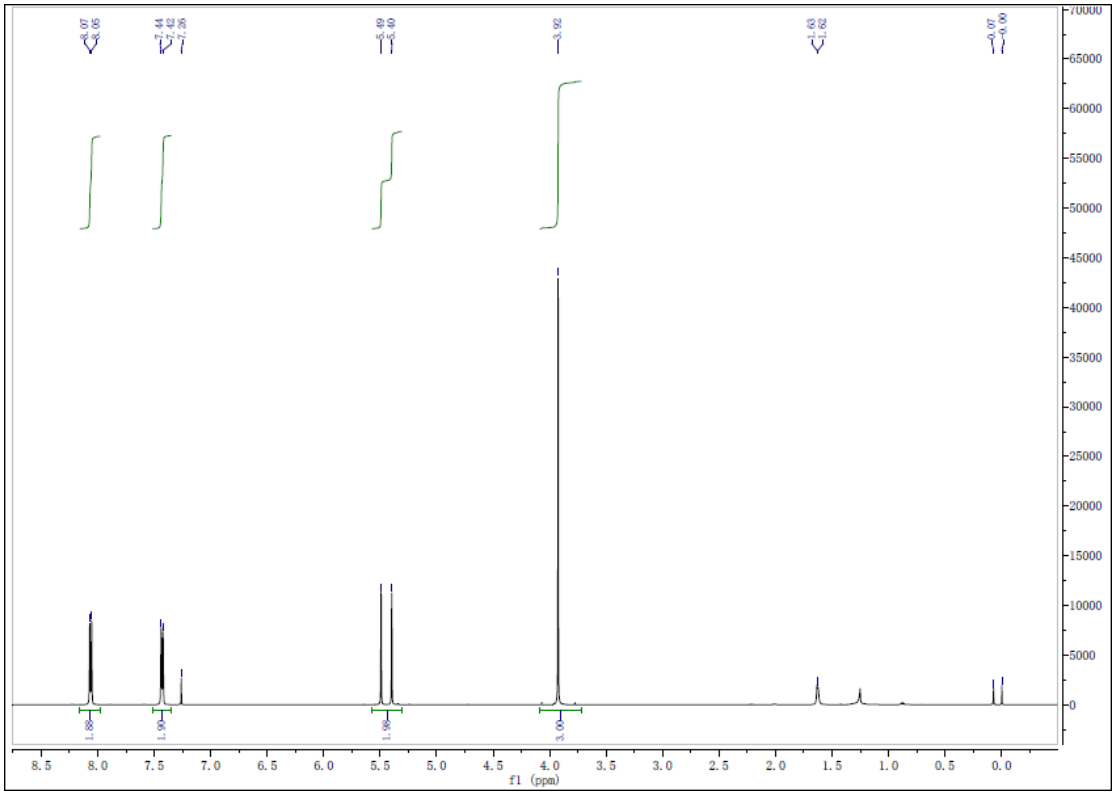
MS of 4- (fluoromethyl) benzamide (2m)



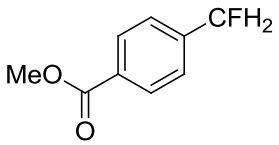


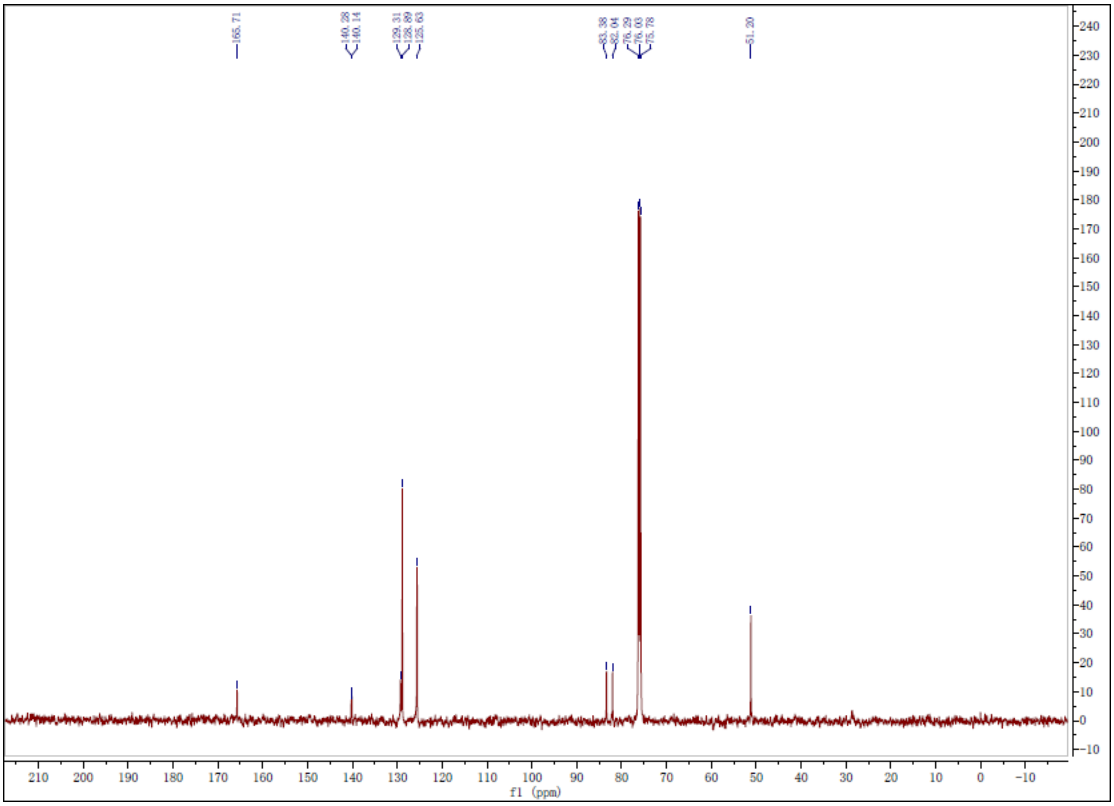
^{1}H NMR of methyl 4-(fluoromethyl)benzoate (2n)



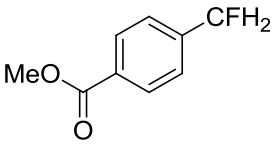


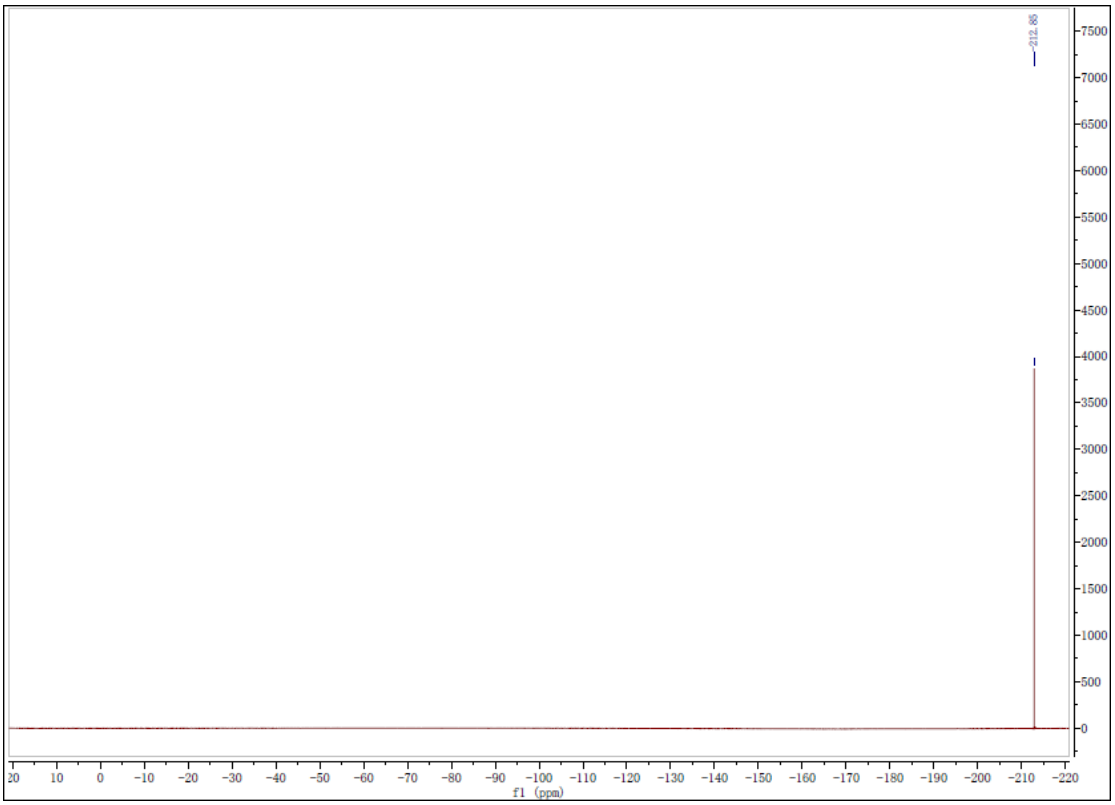
^{13}C NMR of methyl 4-(fluoromethyl)benzoate (2n)



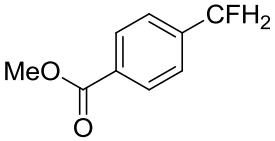


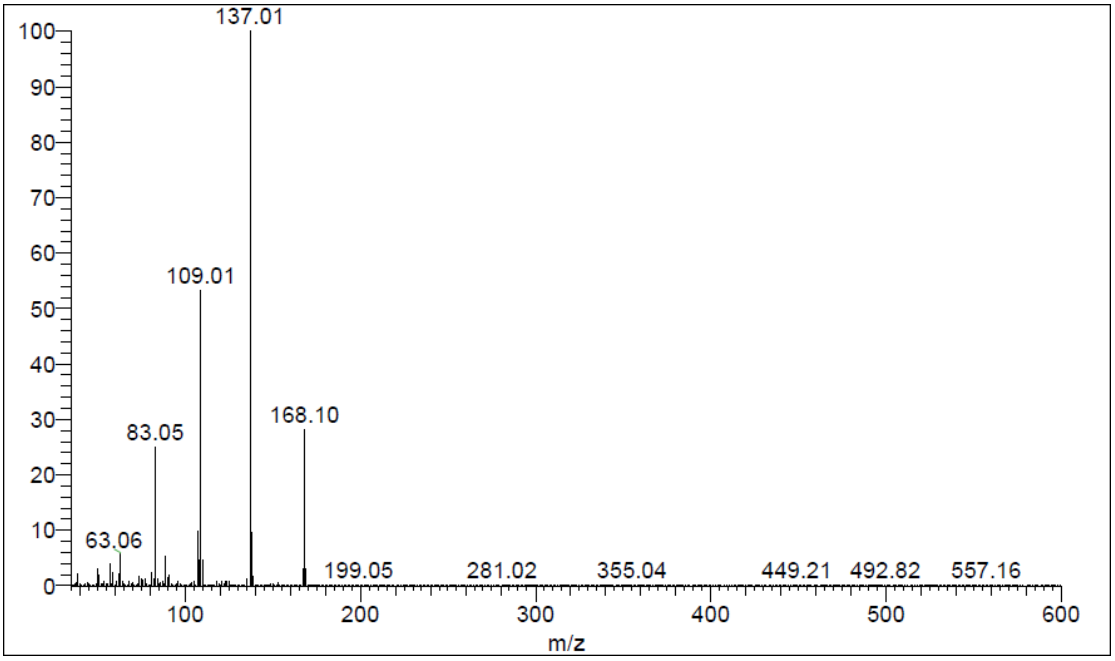
^{19}F NMR of methyl 4-(fluoromethyl)benzoate (2n)



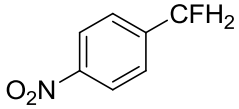


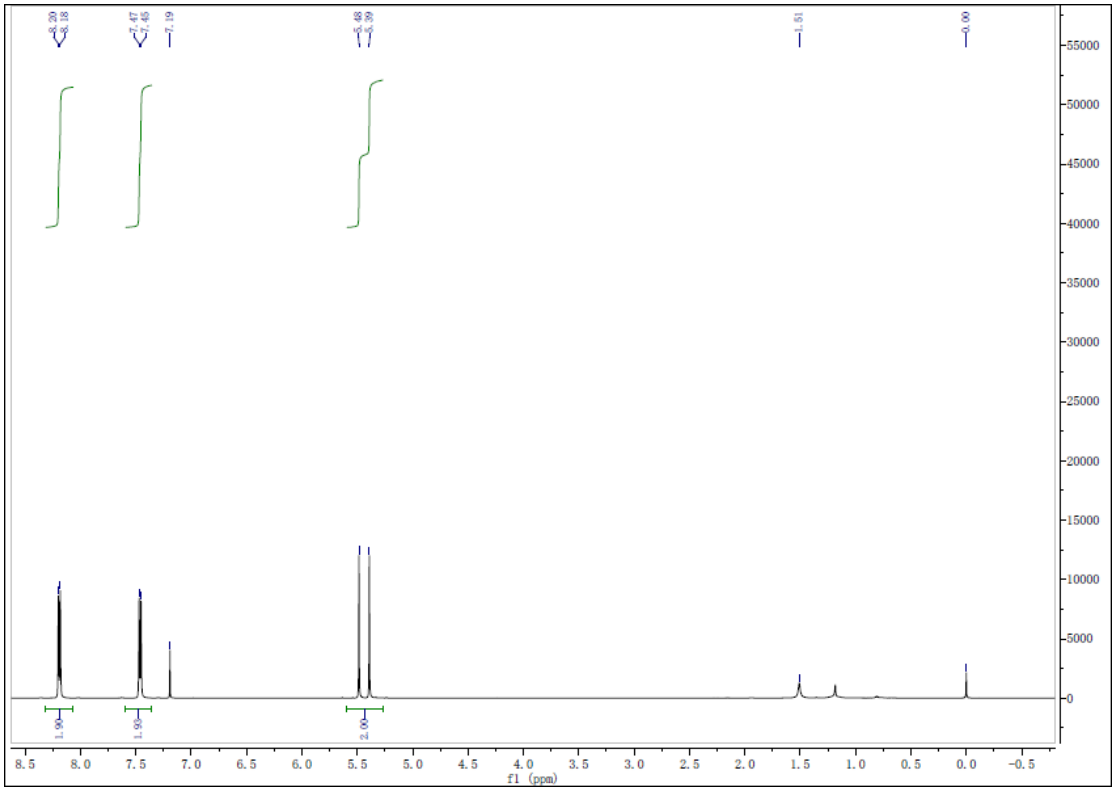
MS of methyl 4-(fluoromethyl)benzoate (2n)



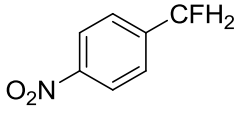


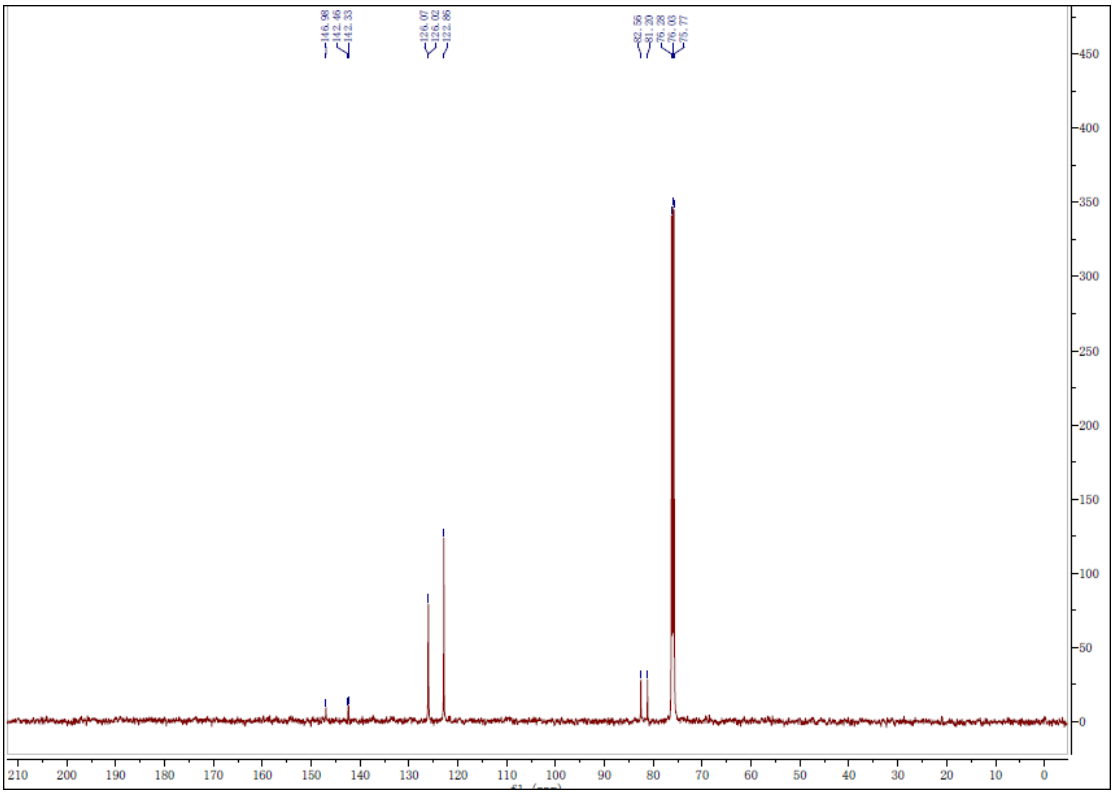
^{1}H NMR of 1- (fluoromethyl)-4-nitrobenzene (2q)



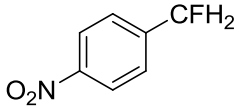


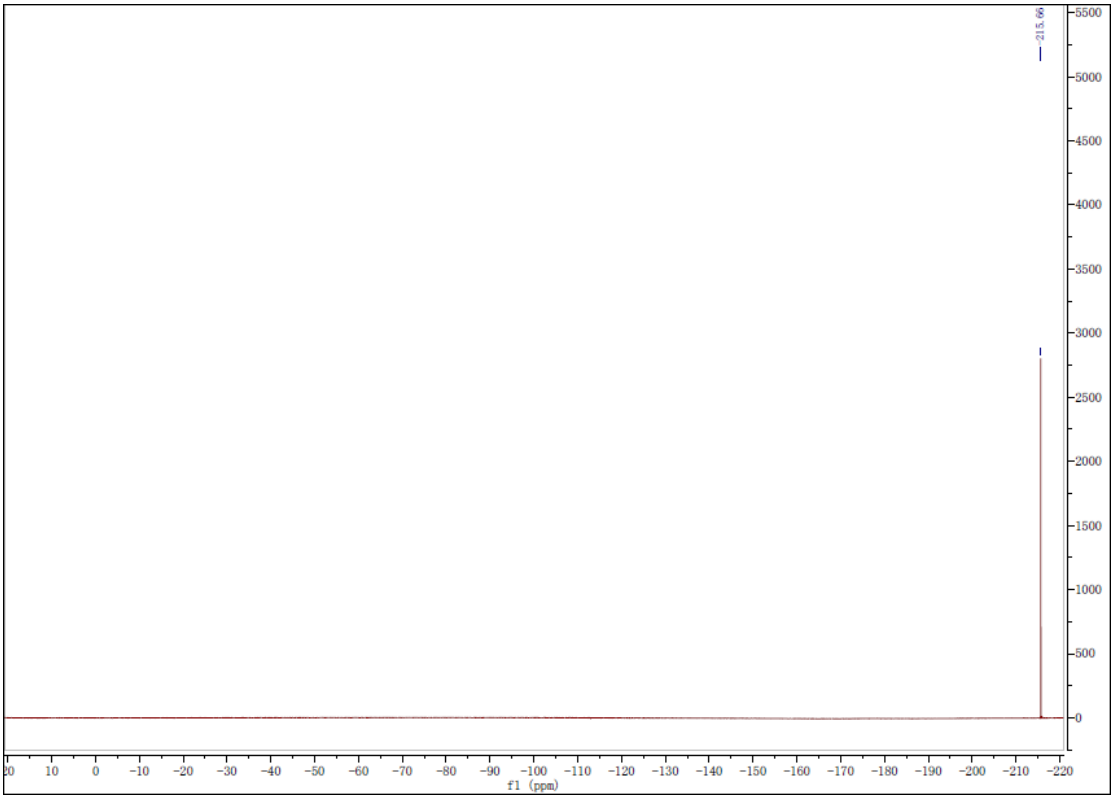
^{13}C NMR of 1- (fluoromethyl)-4-nitrobenzene (2q)



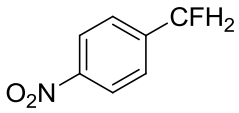


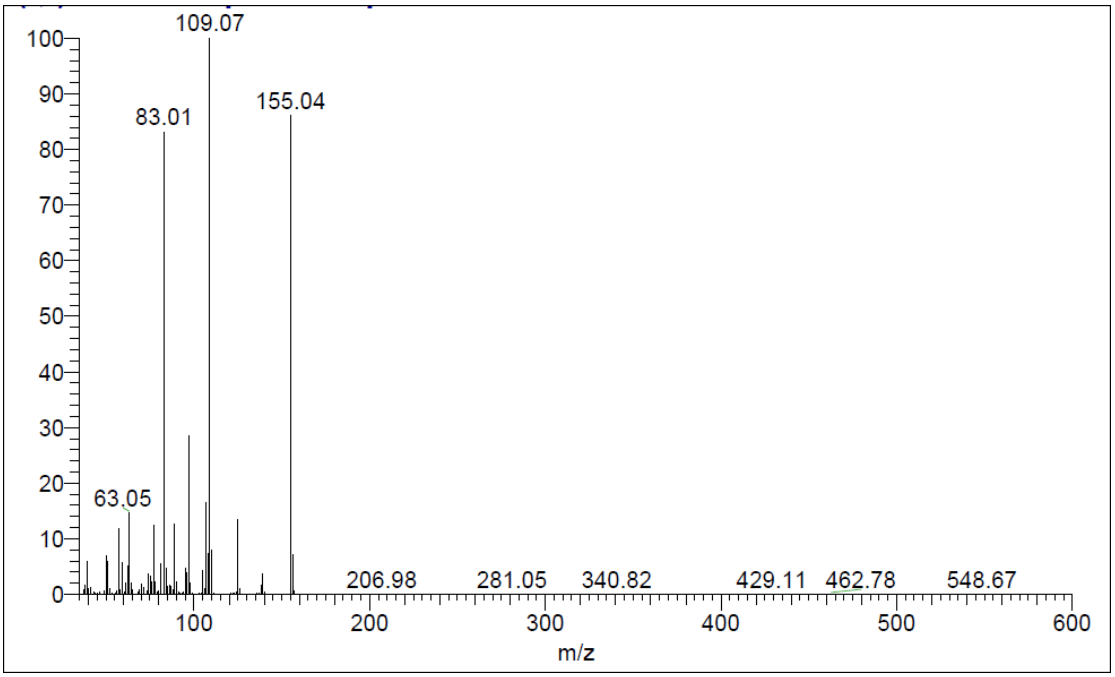
^{19}F NMR of 1- (fluoromethyl)-4-nitrobenzene (2q)



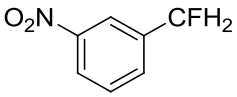


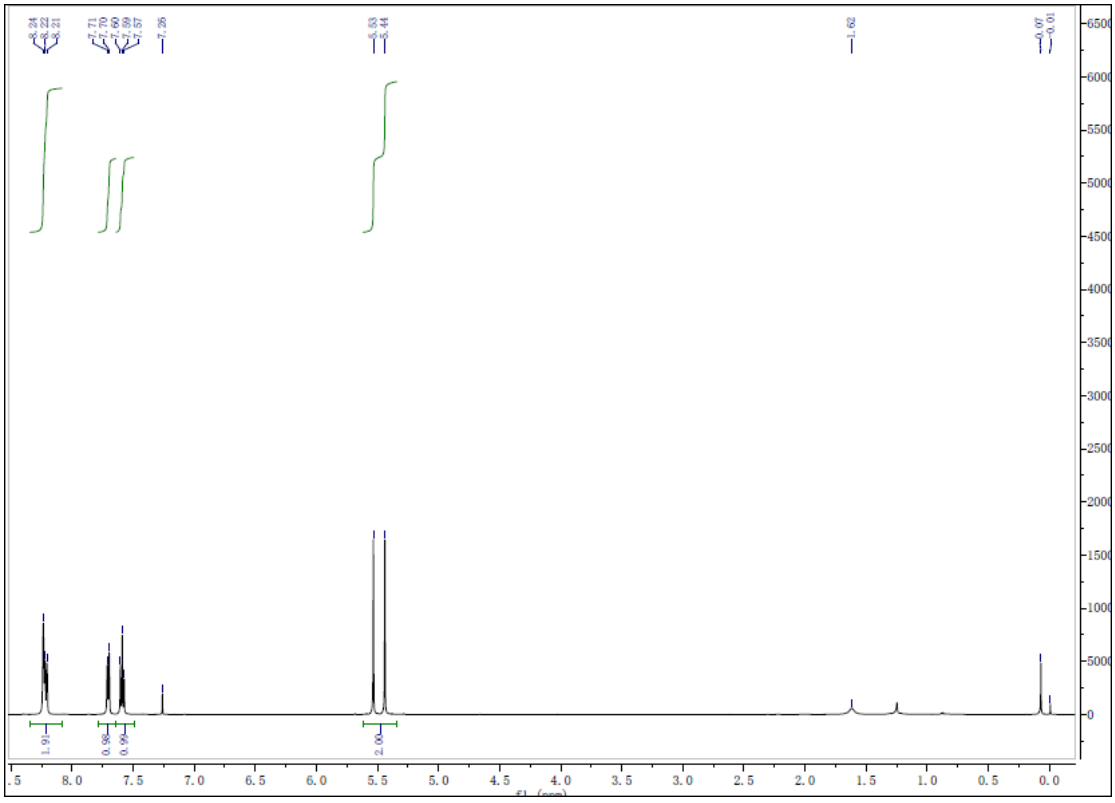
MS of 1- (fluoromethyl)-4-nitrobenz)ene (2q)



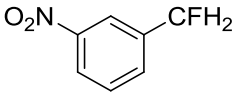


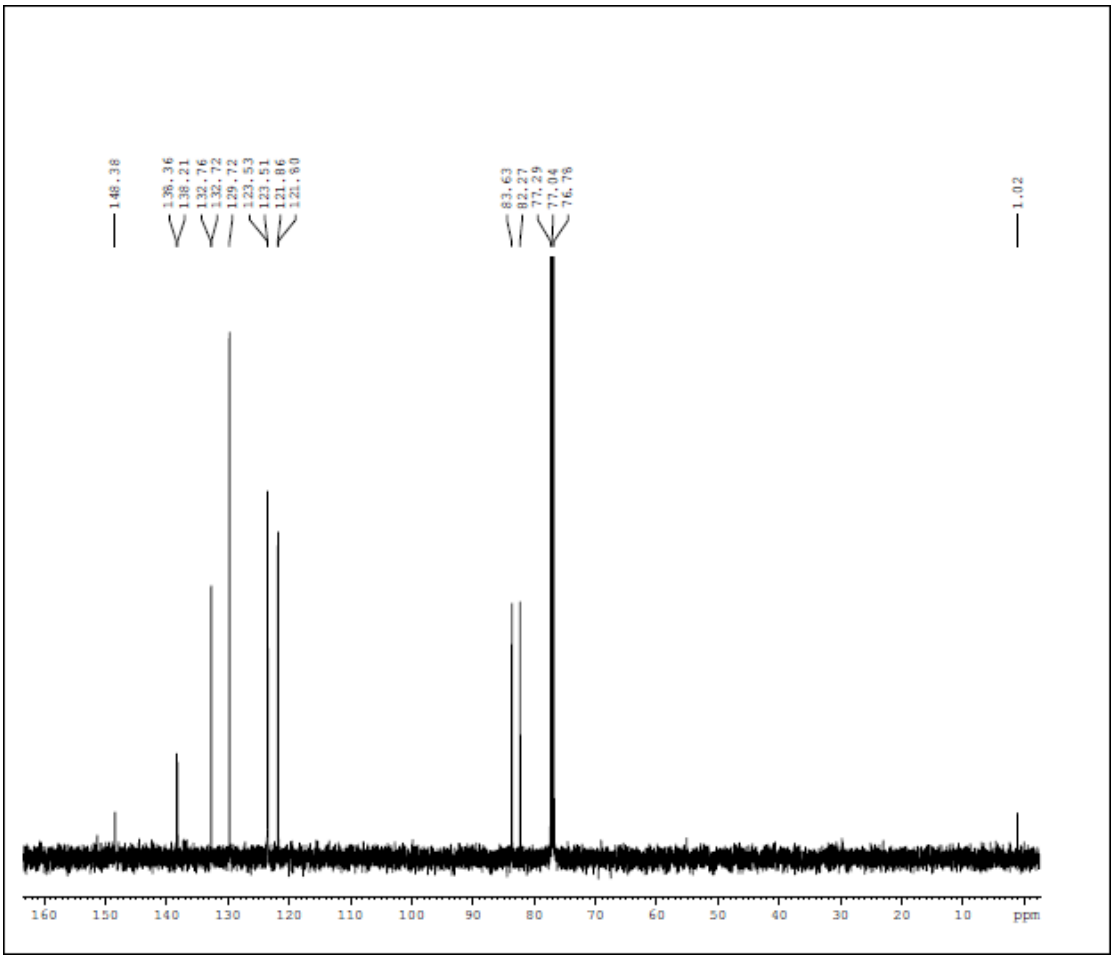
^{1}H NMR of 1- (fluoromethyl)-3-nitrobenzene (2r)



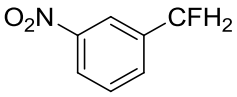


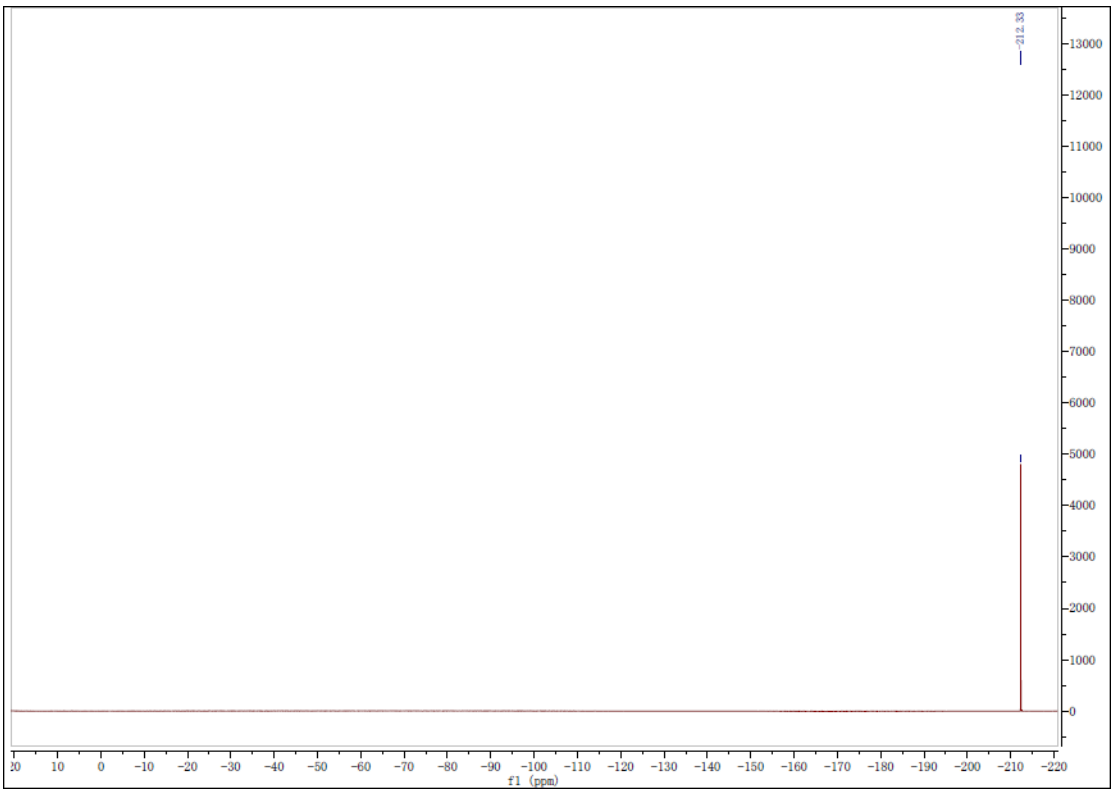
^{13}C NMR of 1- (fluoromethyl)-3-nitrobenzene (2r)



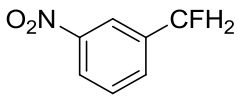


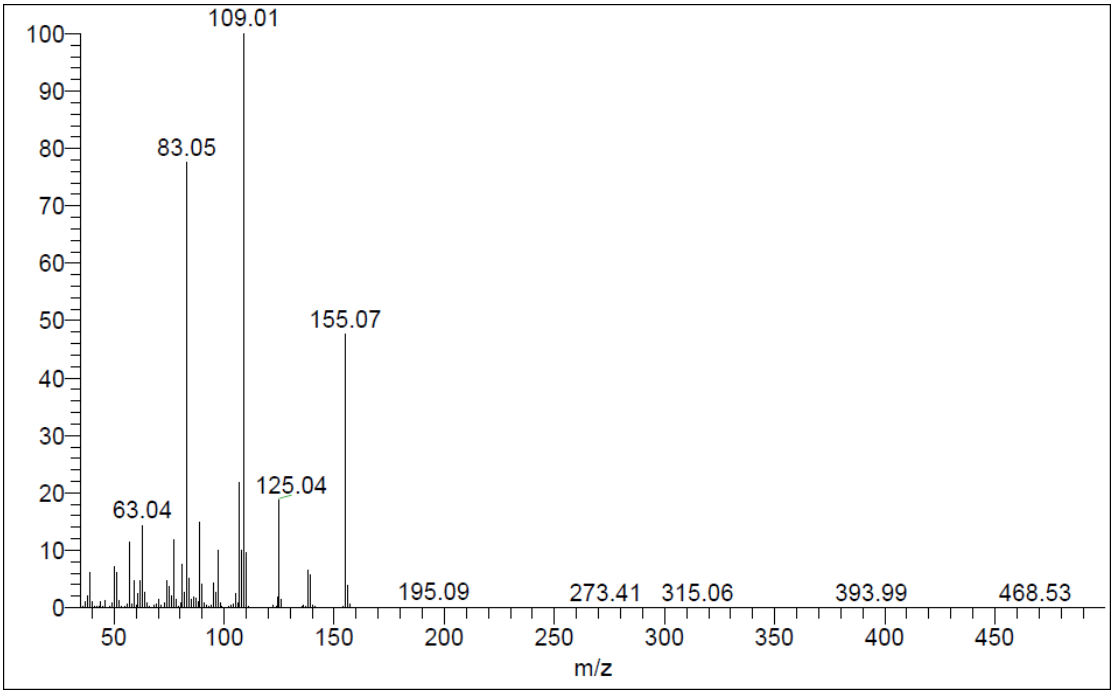
^{19}F NMR of 1-(fluoromethyl)-3-nitrobenzene (2r)



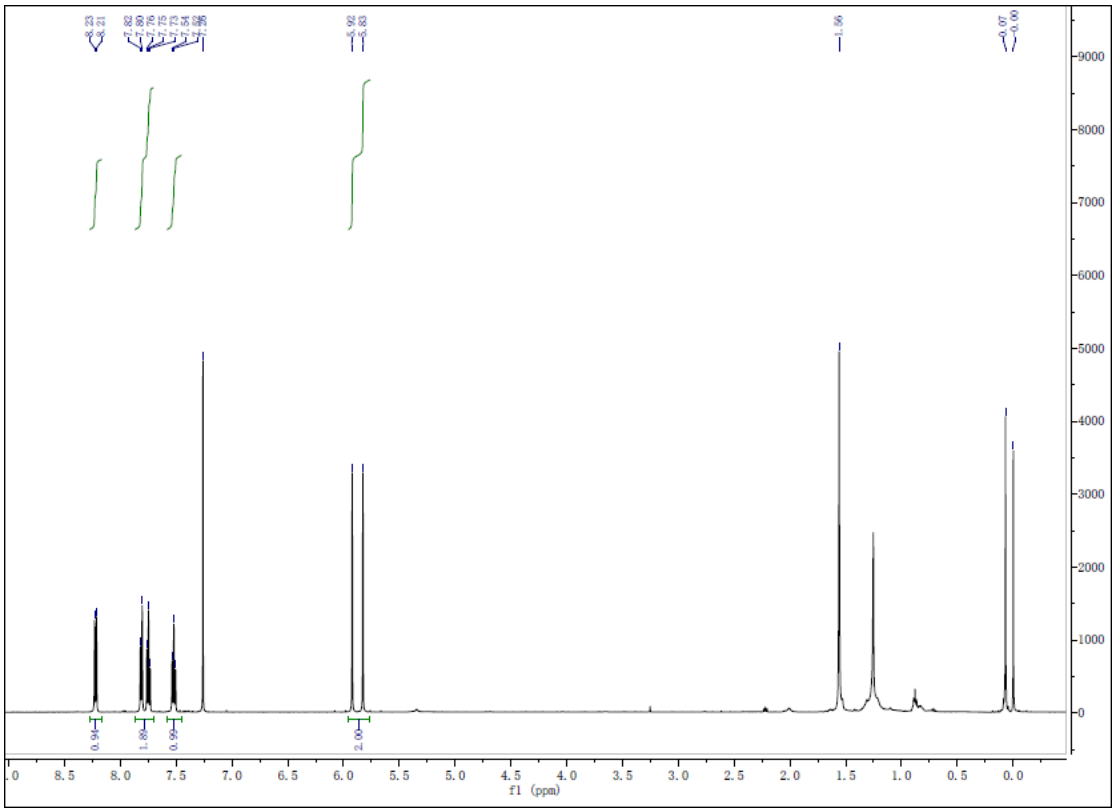


MS of 1- (fluoromethyl)-3-nitrobenzene (2r)

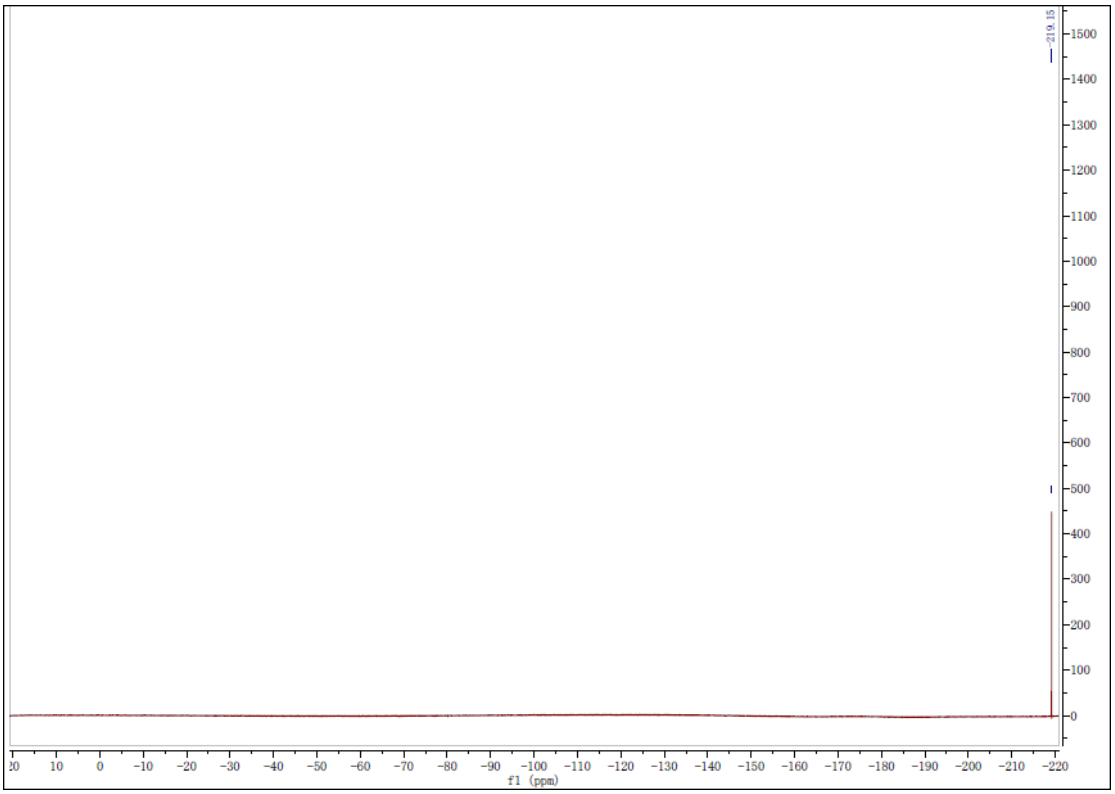




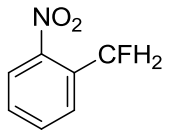
^{1}H NMR of 1- (fluoromethyl)-2-nitrobenzene (2s)

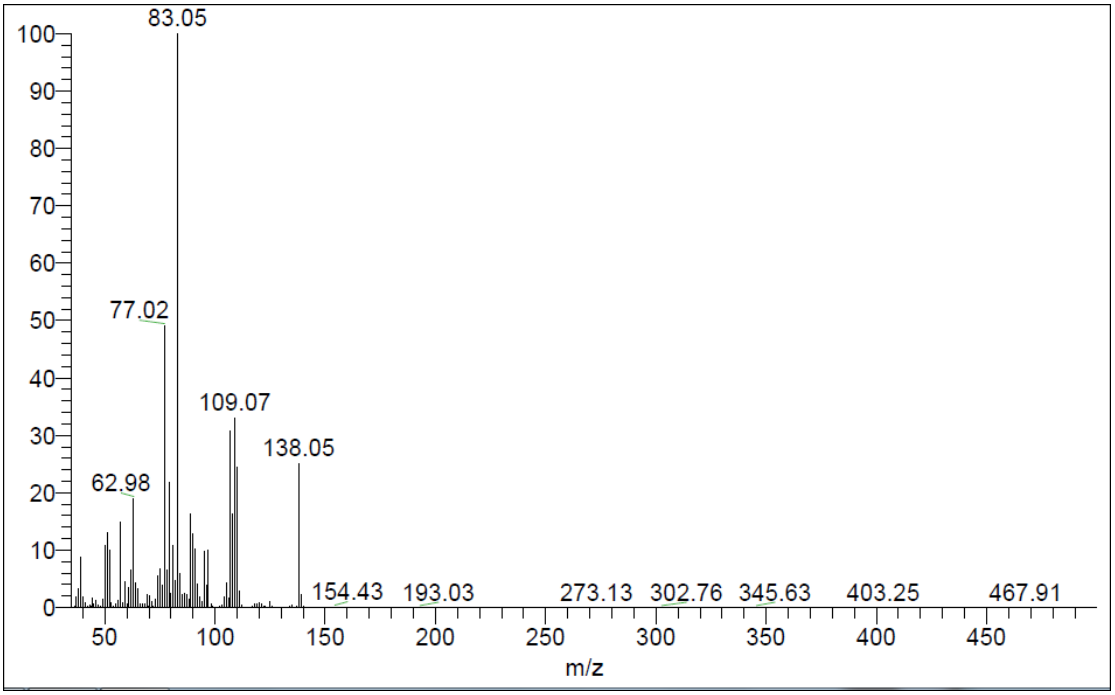


^{19}F NMR of 1- (fluoromethyl)-2-nitrobenzene (2s)

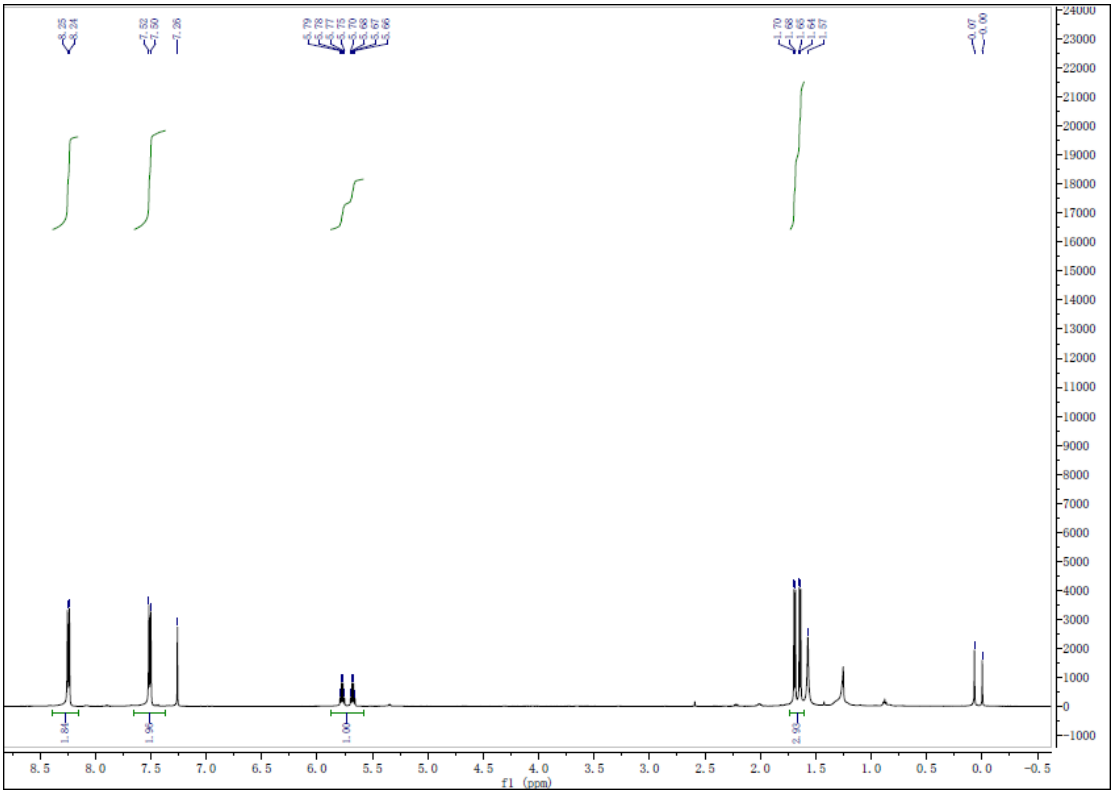


MS of 1- (fluoromethyl)-2-nitrobenzene (2s)

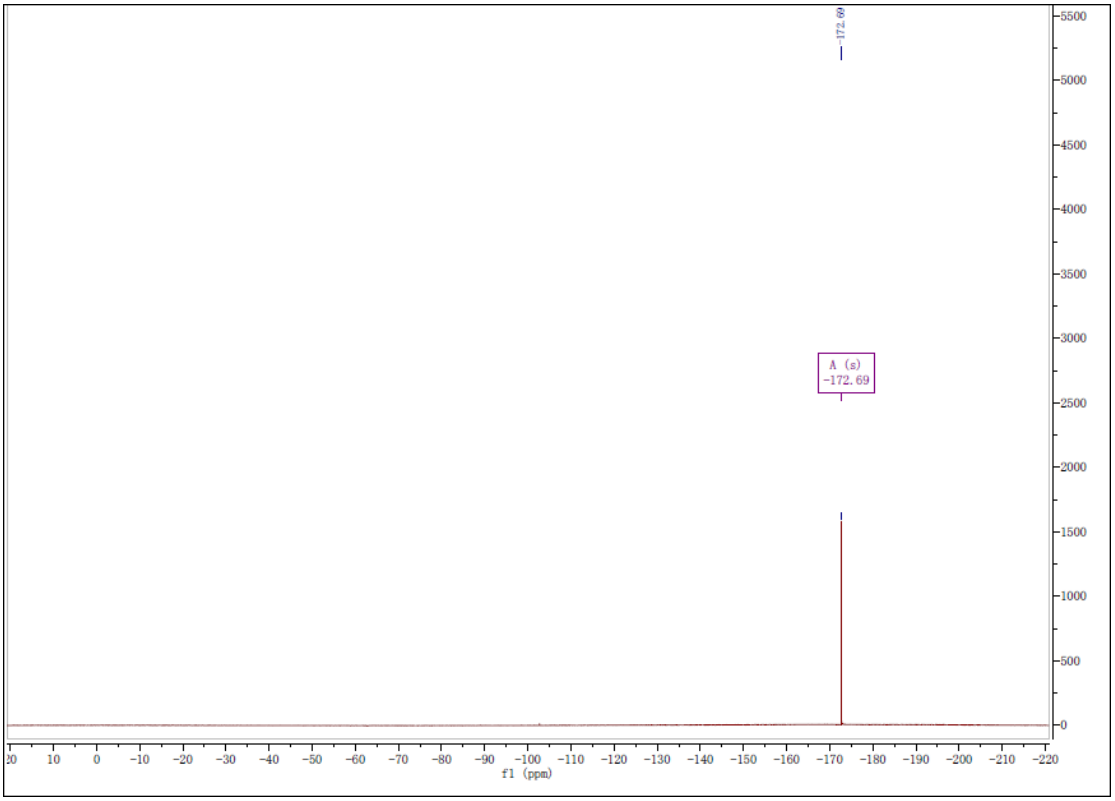




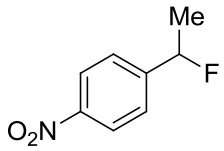
^{1}H NMR of 1- (1-fluoroethyl)-4-nitrobenzene (2t)

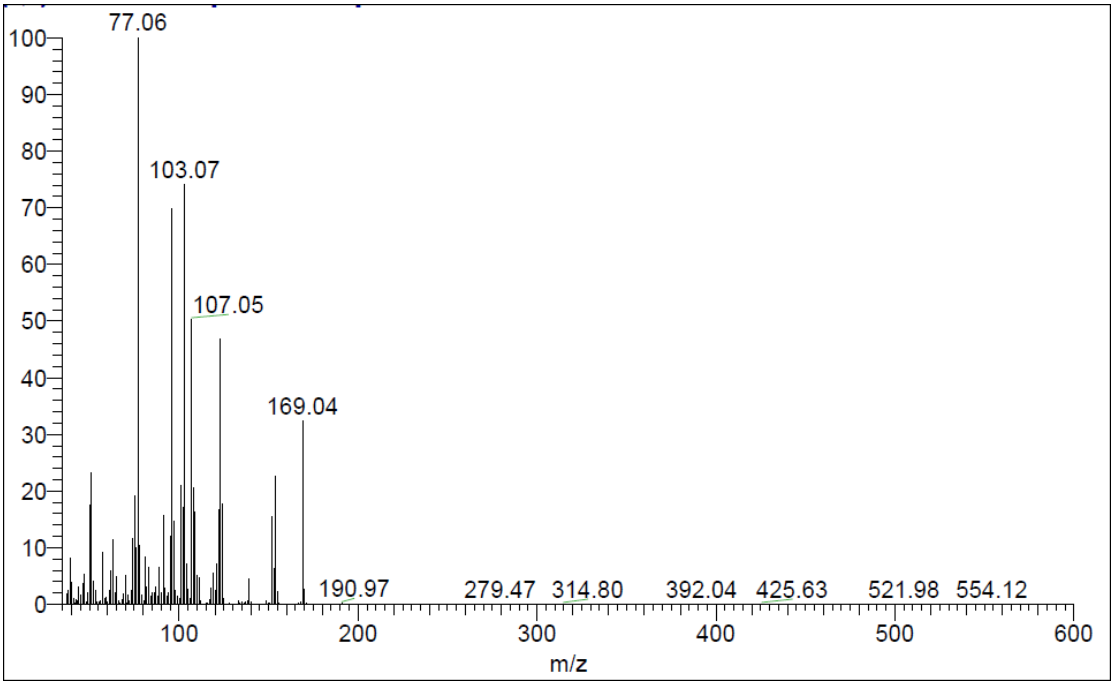


^{19}F NMR of 1- (1-fluoroethyl)-4-nitrobenzene (2t)

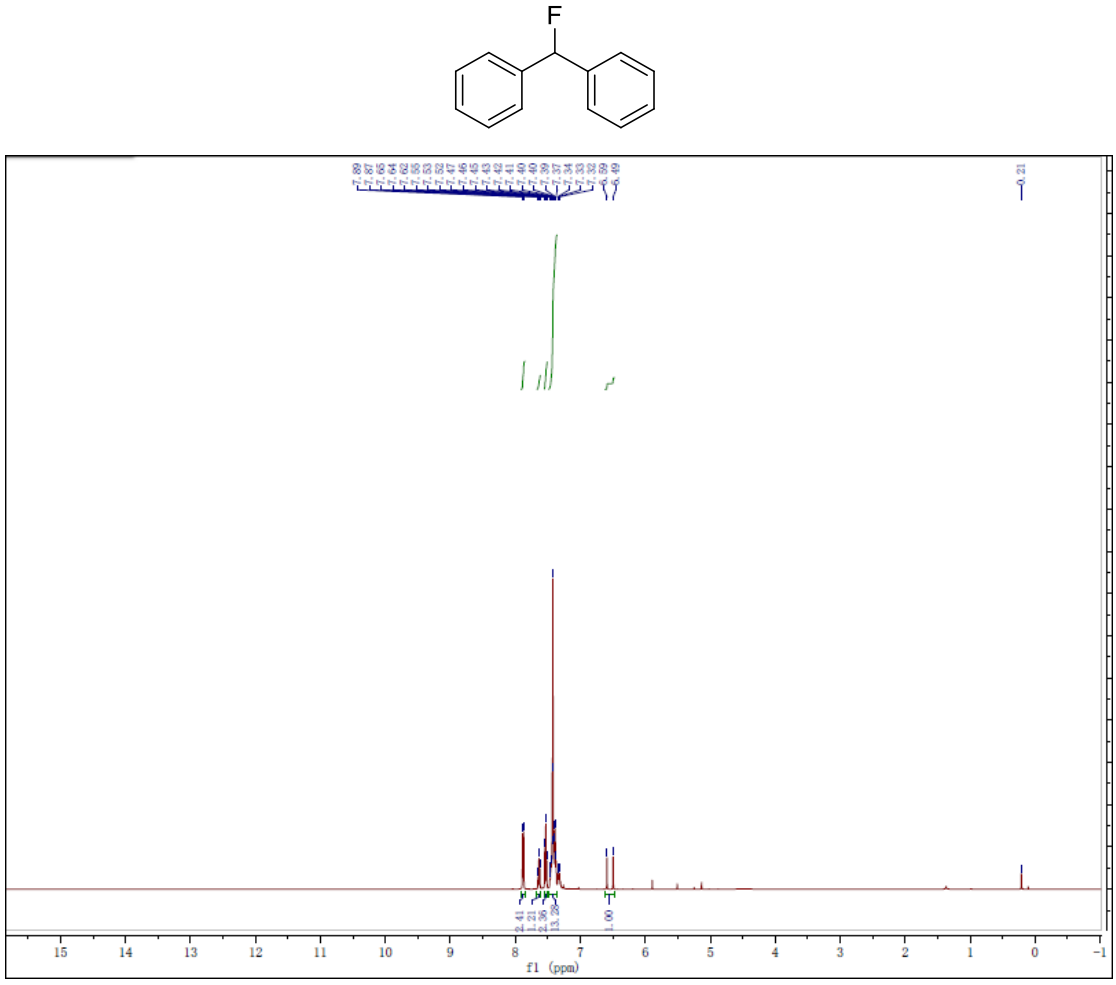


MS of 1- (1-fluoroethyl)-4-nitrobenzene (2t)

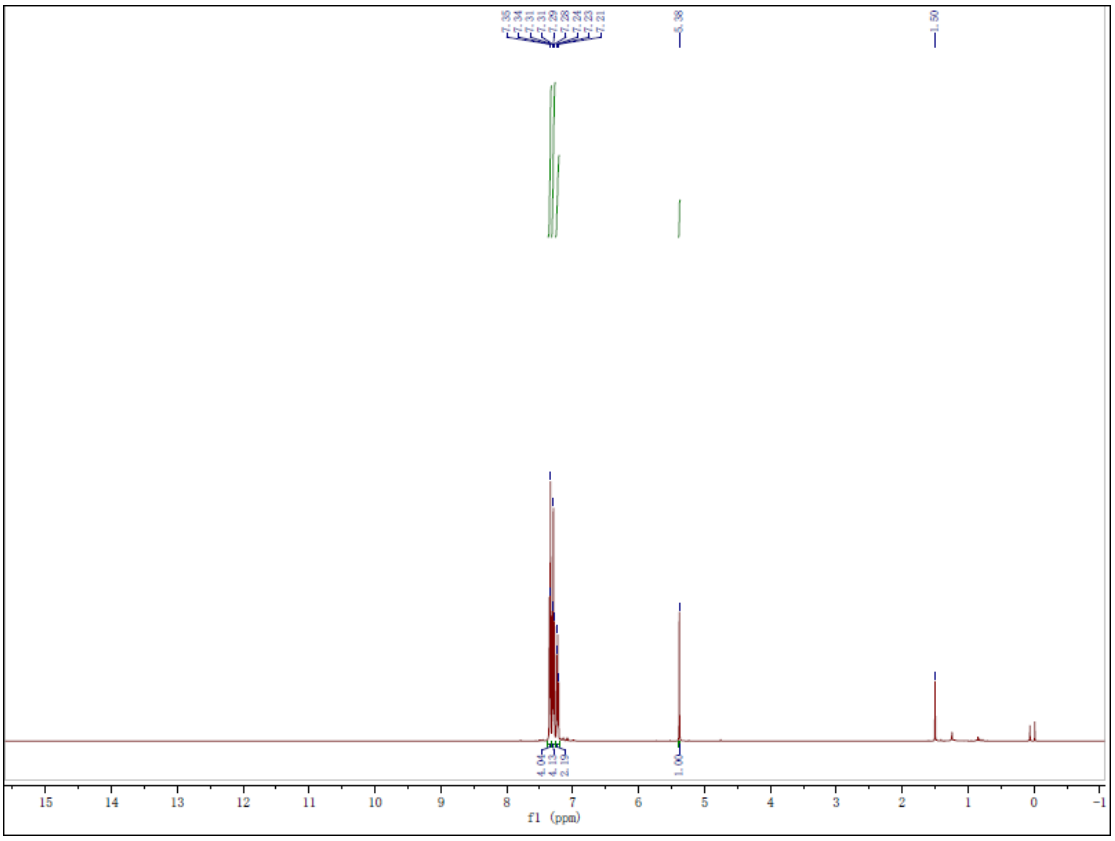




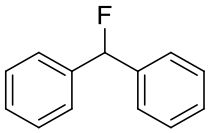
Crude ^{1}H NMR of (fluoromethylene)dibenzene (2u)

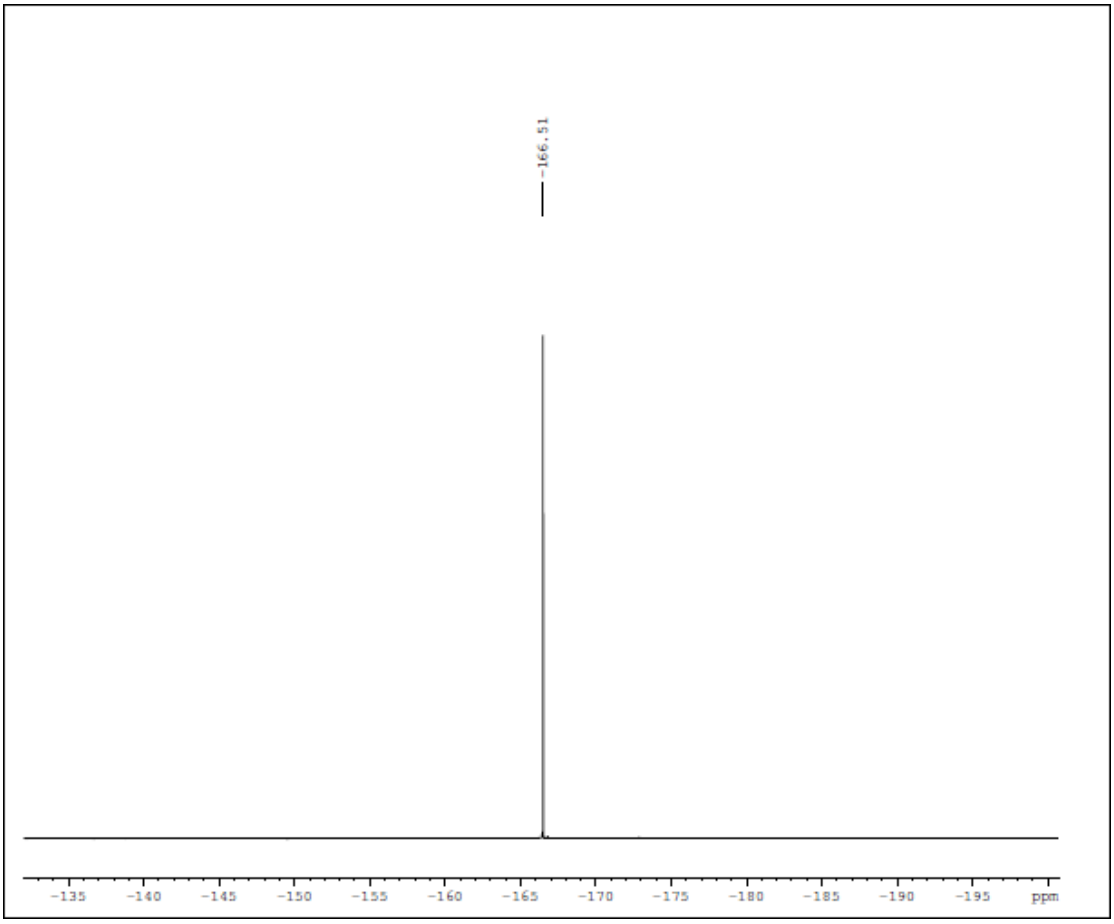


^{1}H NMR of hydrolysis (fluoromethylene)dibenzene (2u)

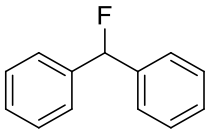


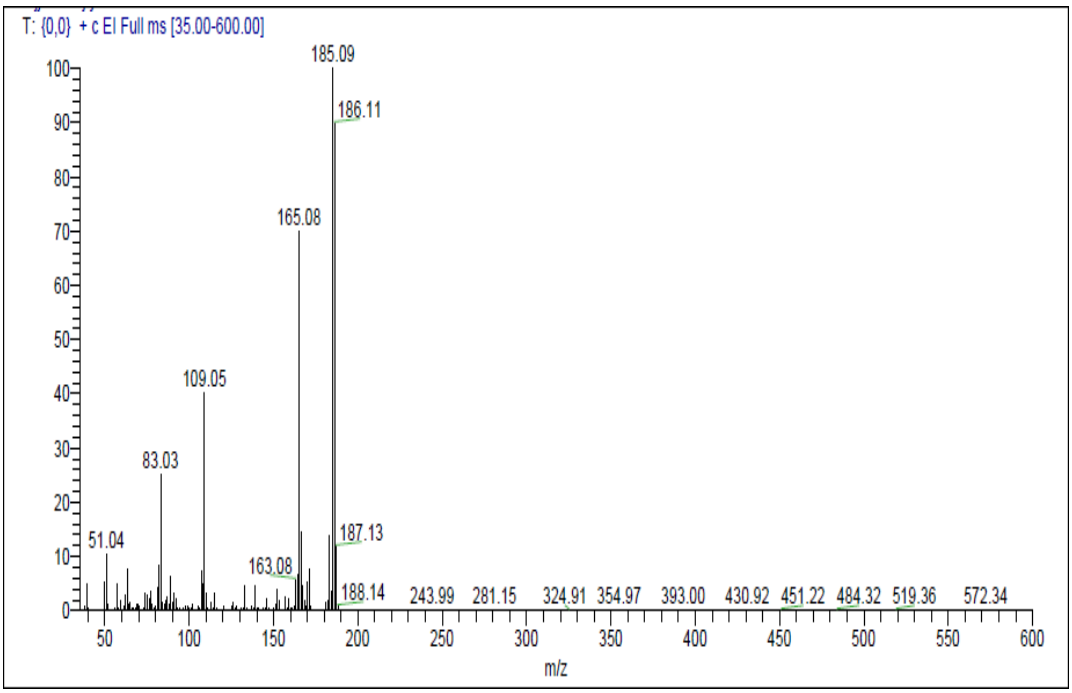
^{19}F NMR of (fluoromethylene)dibenzene (2u)



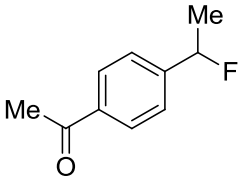


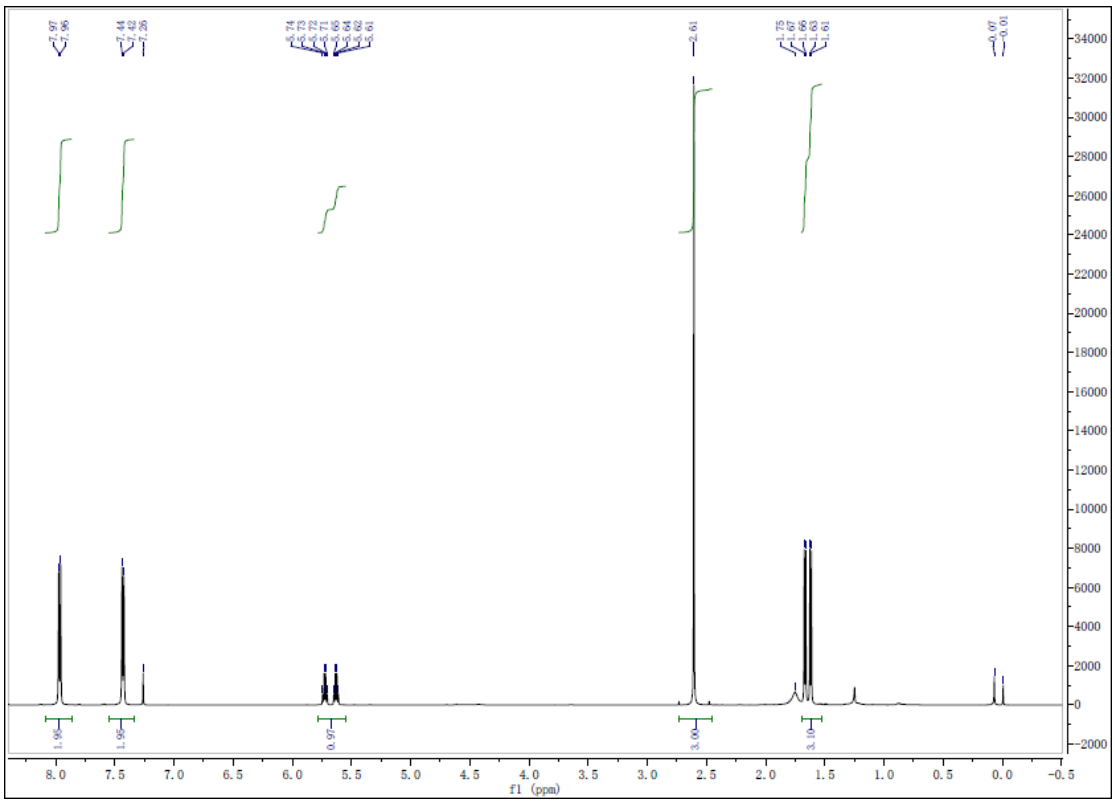
MS of (fluoromethylene)dibenzene (2u)



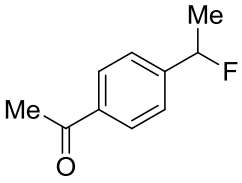


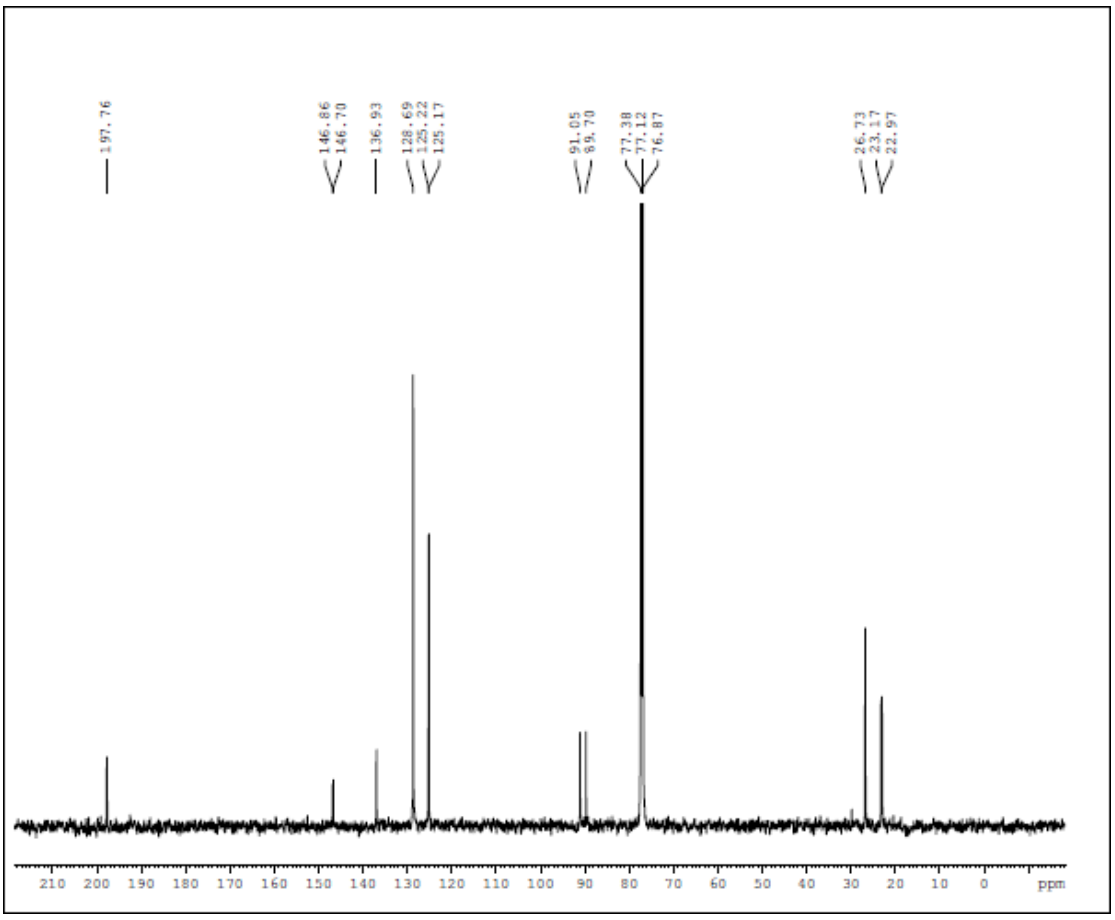
^{1}H NMR of 1- (4- (1-fluoroethyl)phenyl)ethanone (2v)



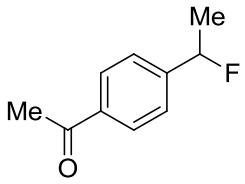


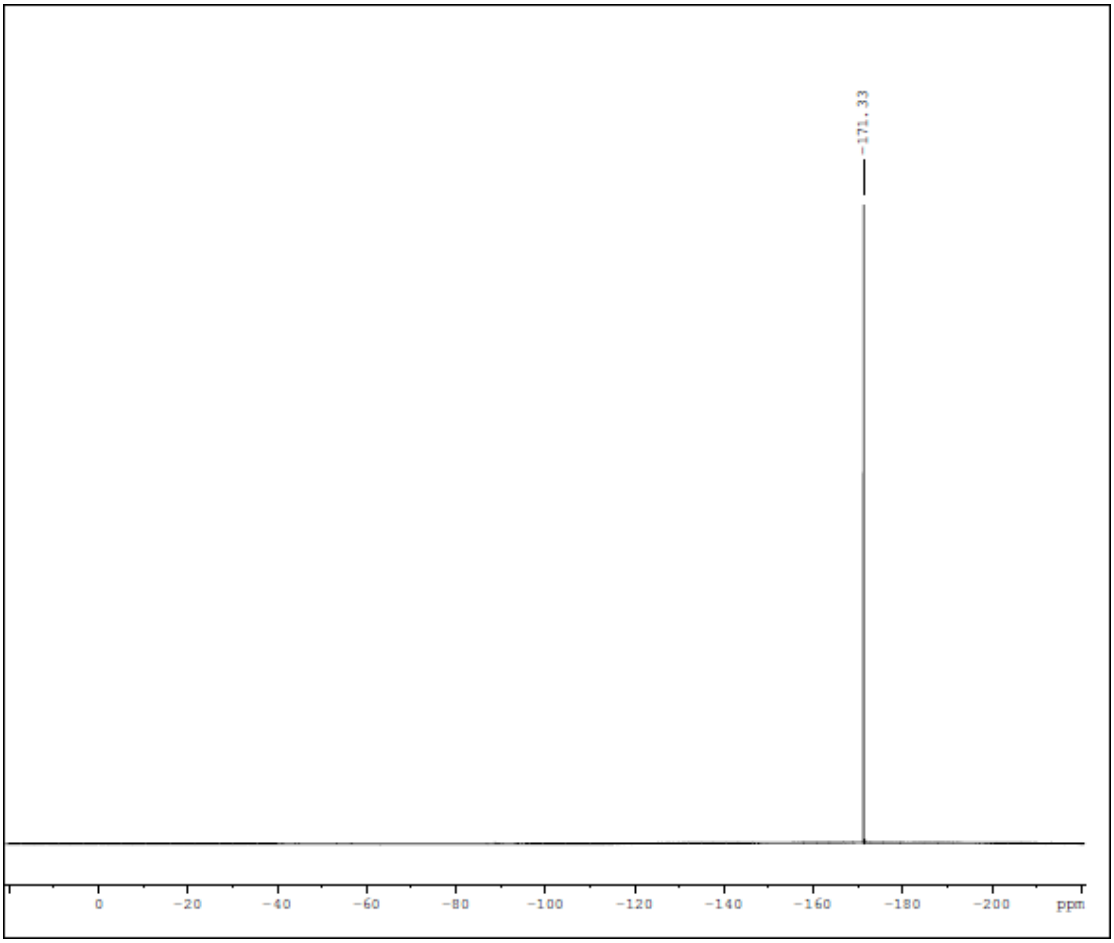
^{13}C NMR 1- (4- (1-fluoroethyl)phenyl)ethanone of (2v)



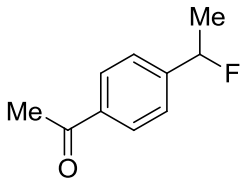


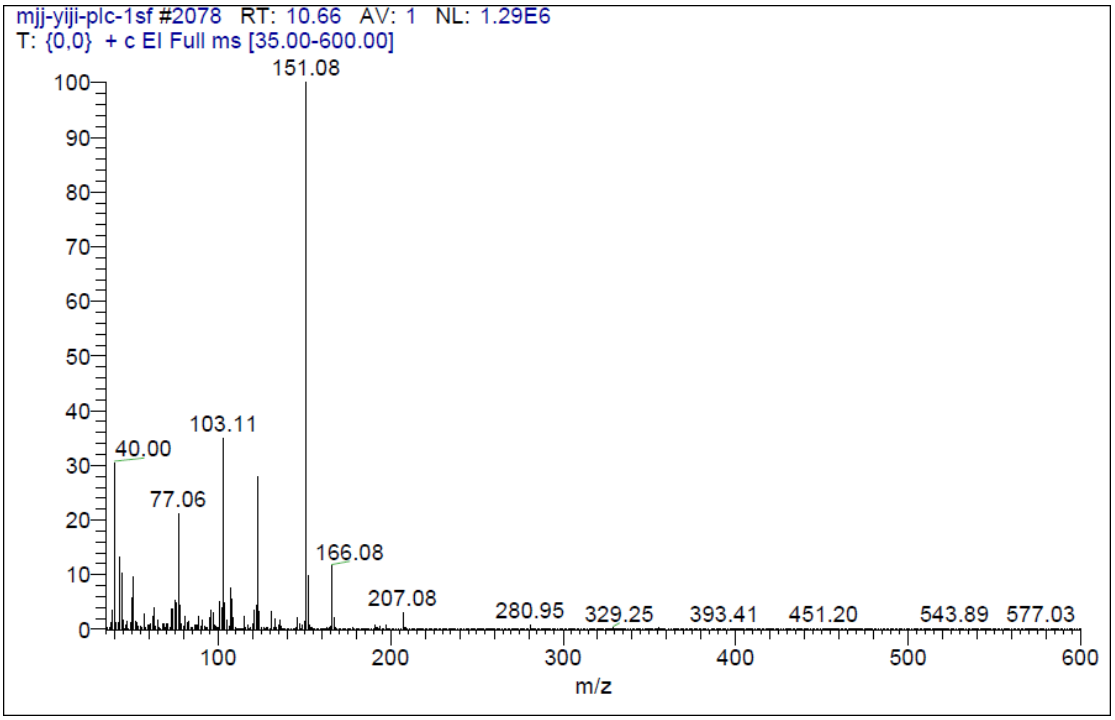
^{19}F NMR of 1- (4- (1-fluoroethyl)phenyl)ethanone (2v)



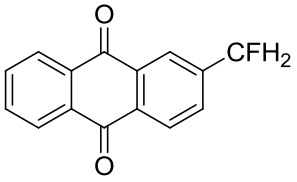


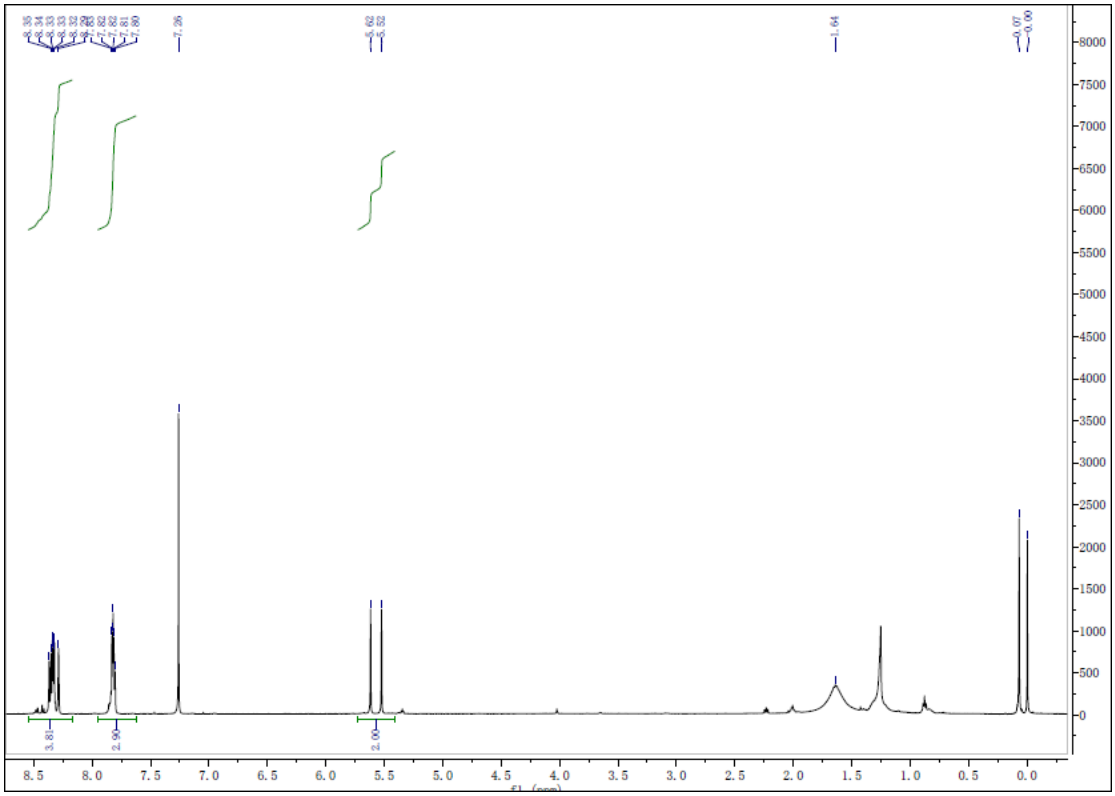
MS of 1- (4- (1-fluoroethyl)phenyl)ethanone (2v)



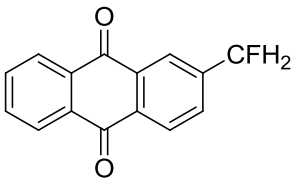


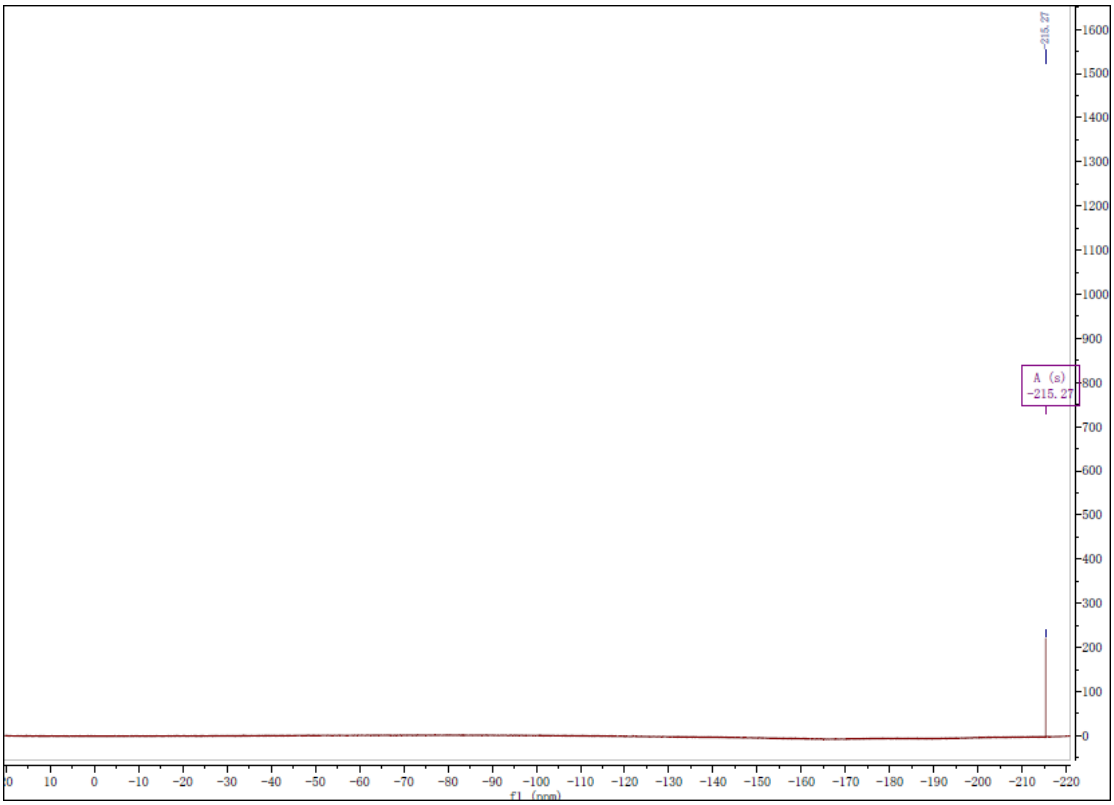
^{1}H NMR of 2- (fluoromethyl)anthracene-9, 10-dione (2w)



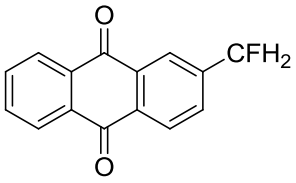


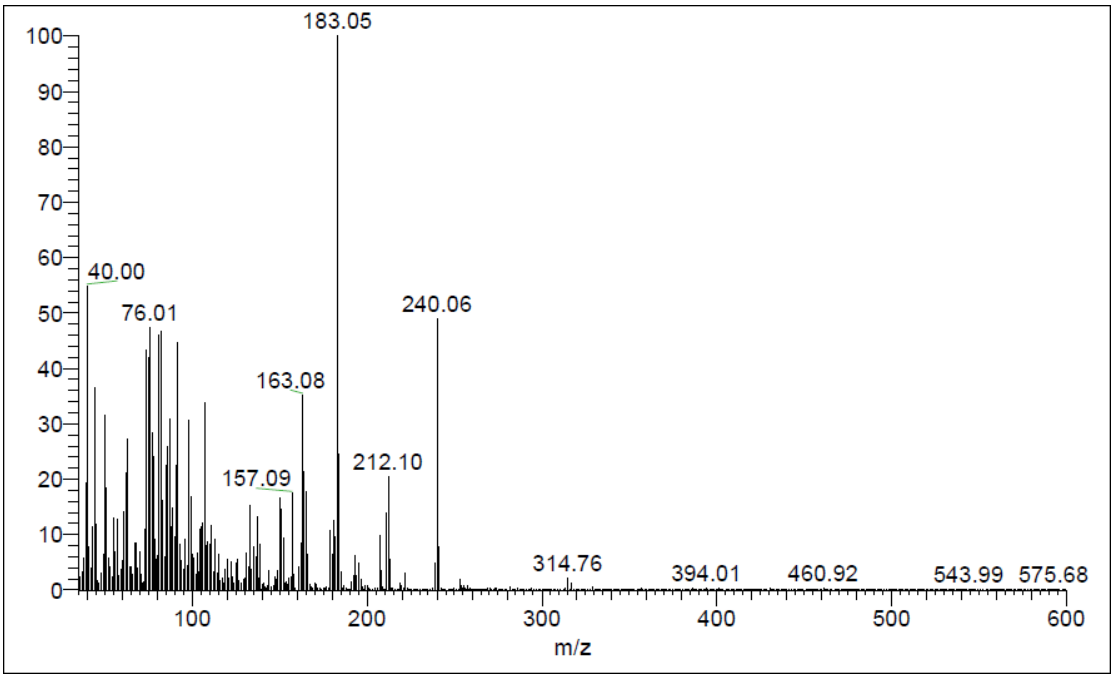
^{19}F NMR of 2- (fluoromethyl)anthracene-9, 10-dione (2w)



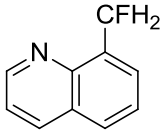


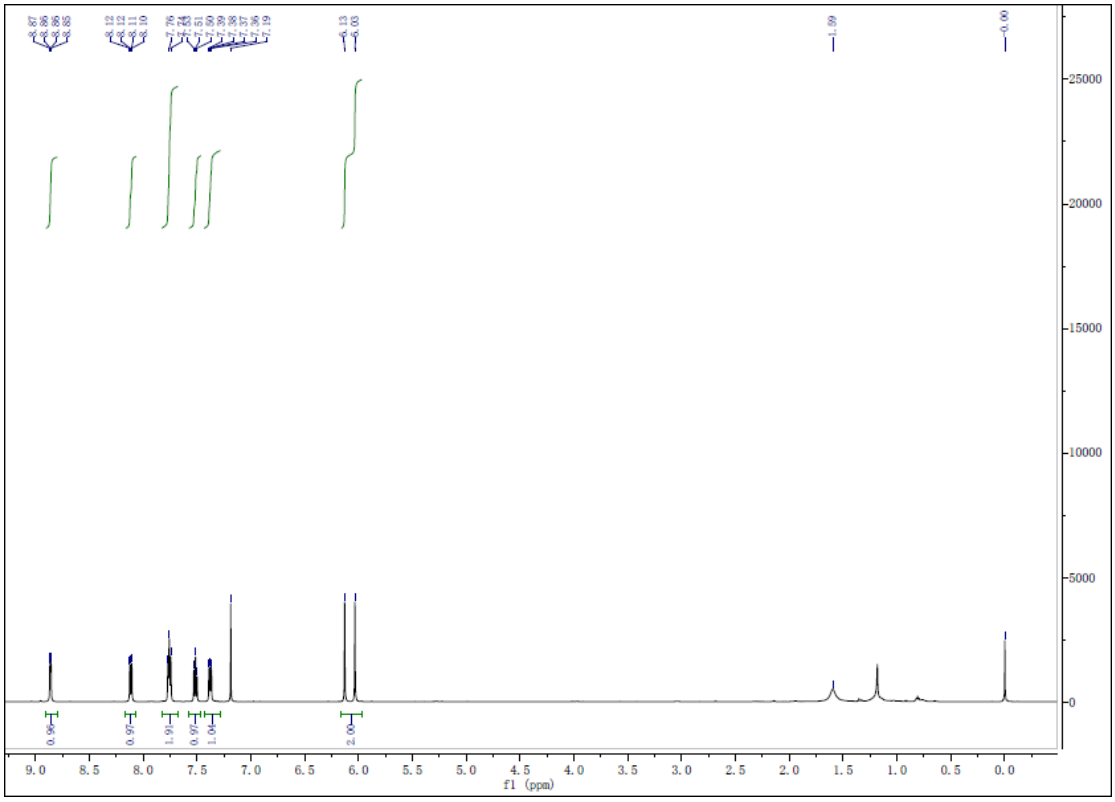
MS of 2- (fluoromethyl)anthracene-9, 10-dione (2w)



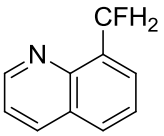


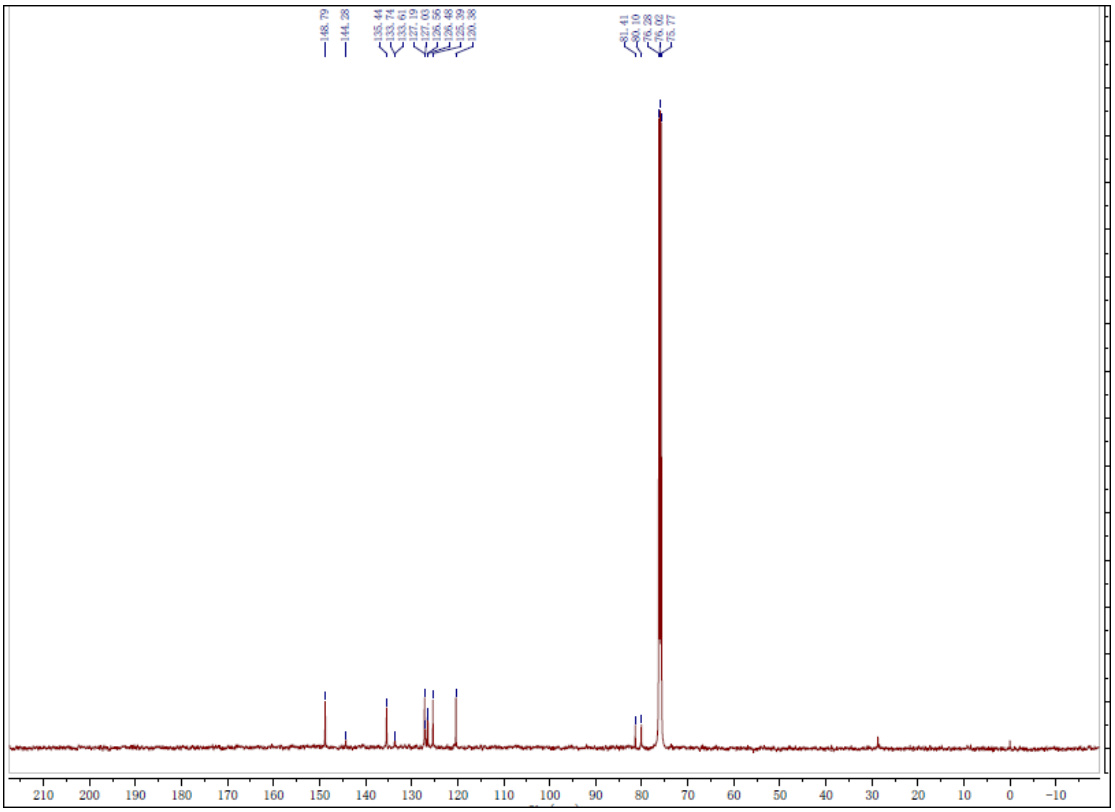
^{1}H NMR of 8- (fluoromethyl)quinoline (2x)



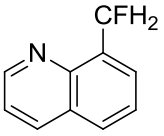


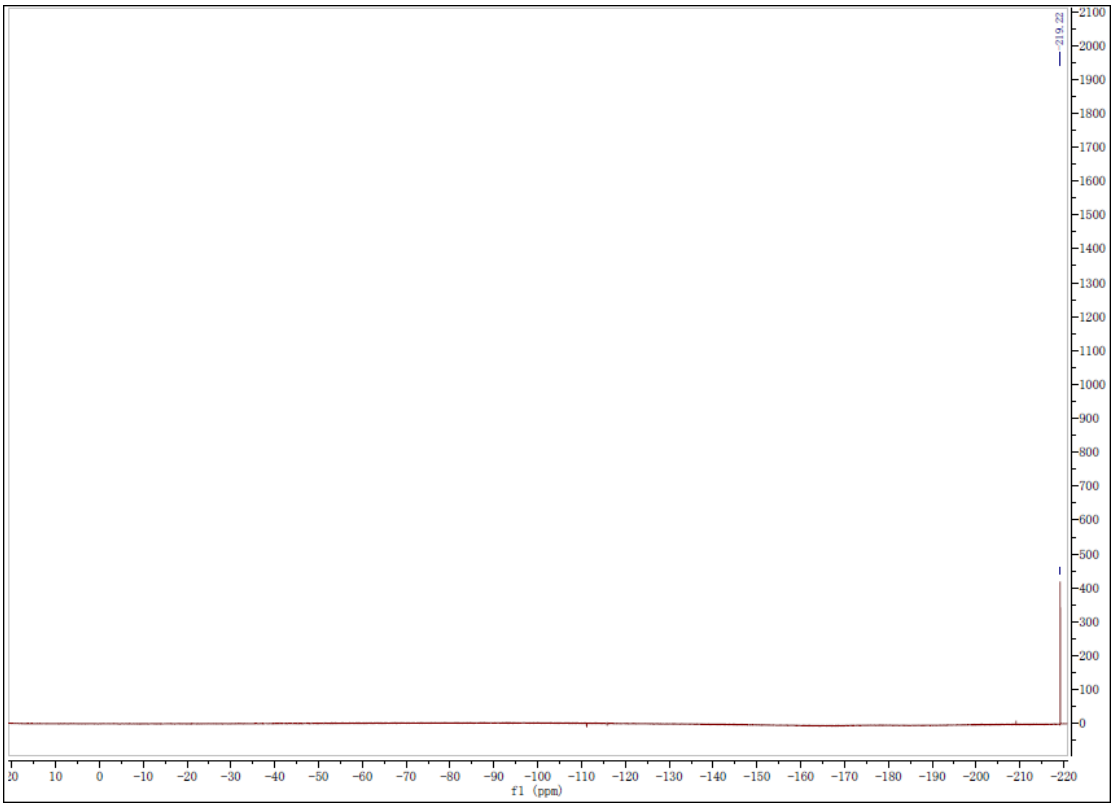
^{13}C NMR of 8- (fluoromethyl)quinoline (2x)



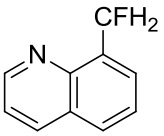


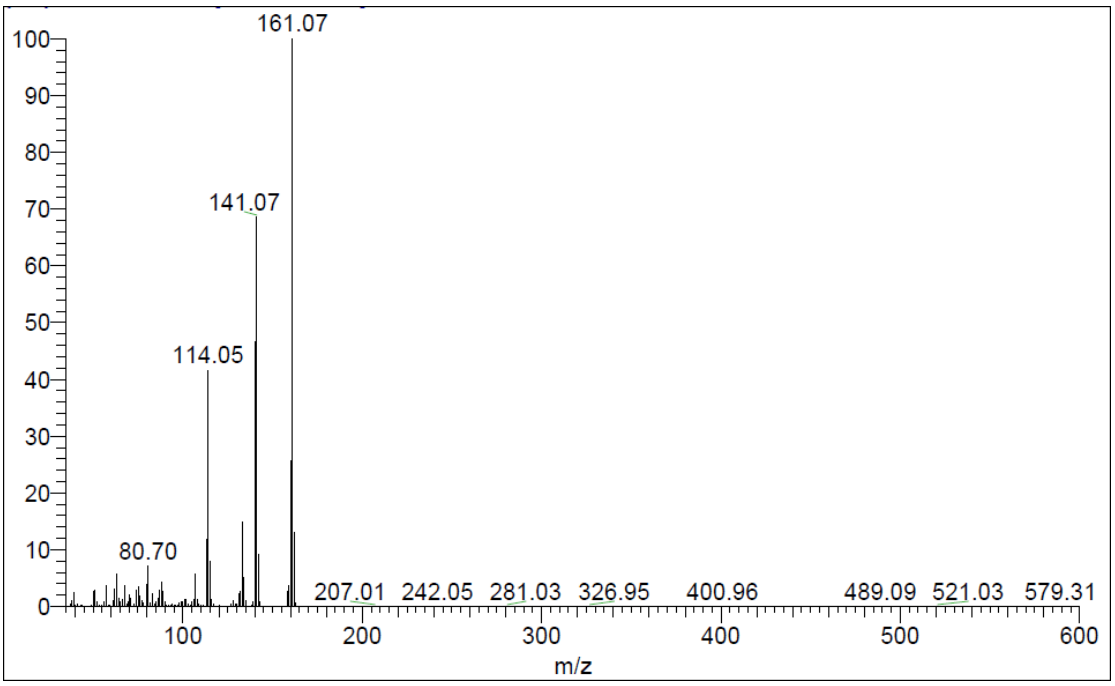
^{19}F NMR of 8-(fluoromethyl)quinoline (2x)





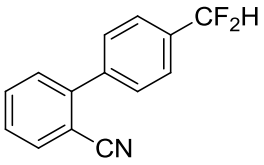
MS of 8- (fluoromethyl)quinoline (2x)

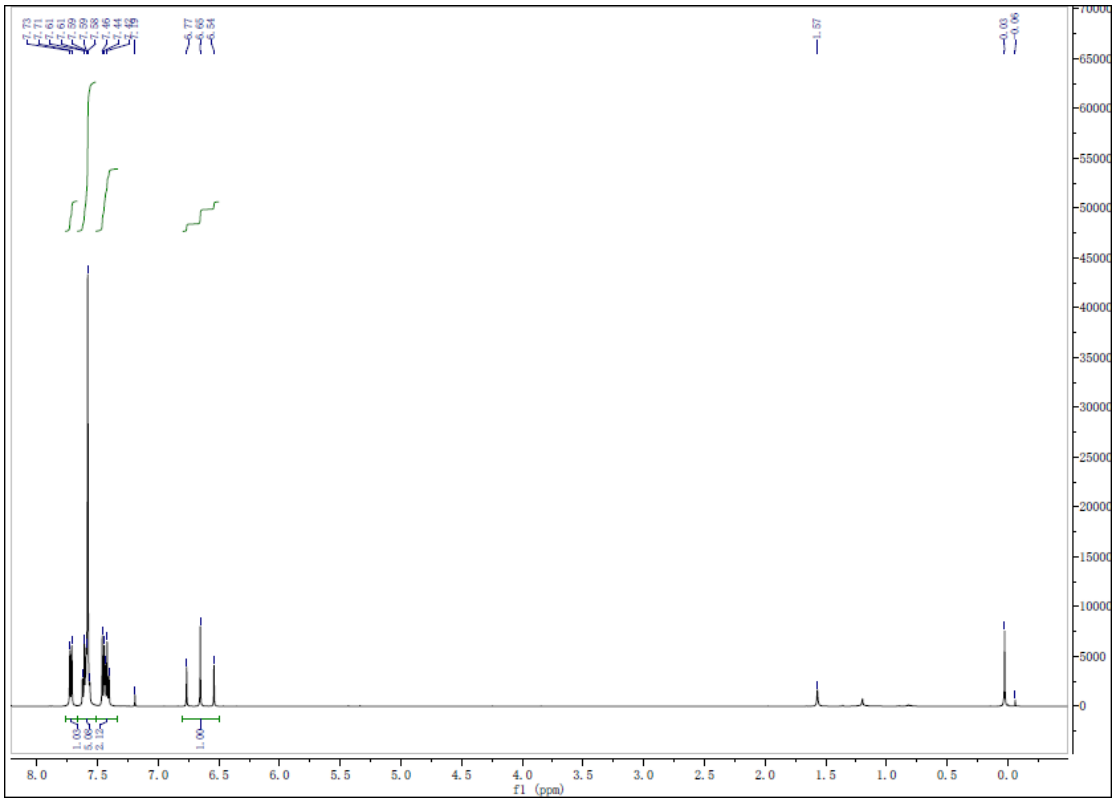




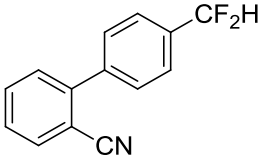
2. Difluorination:

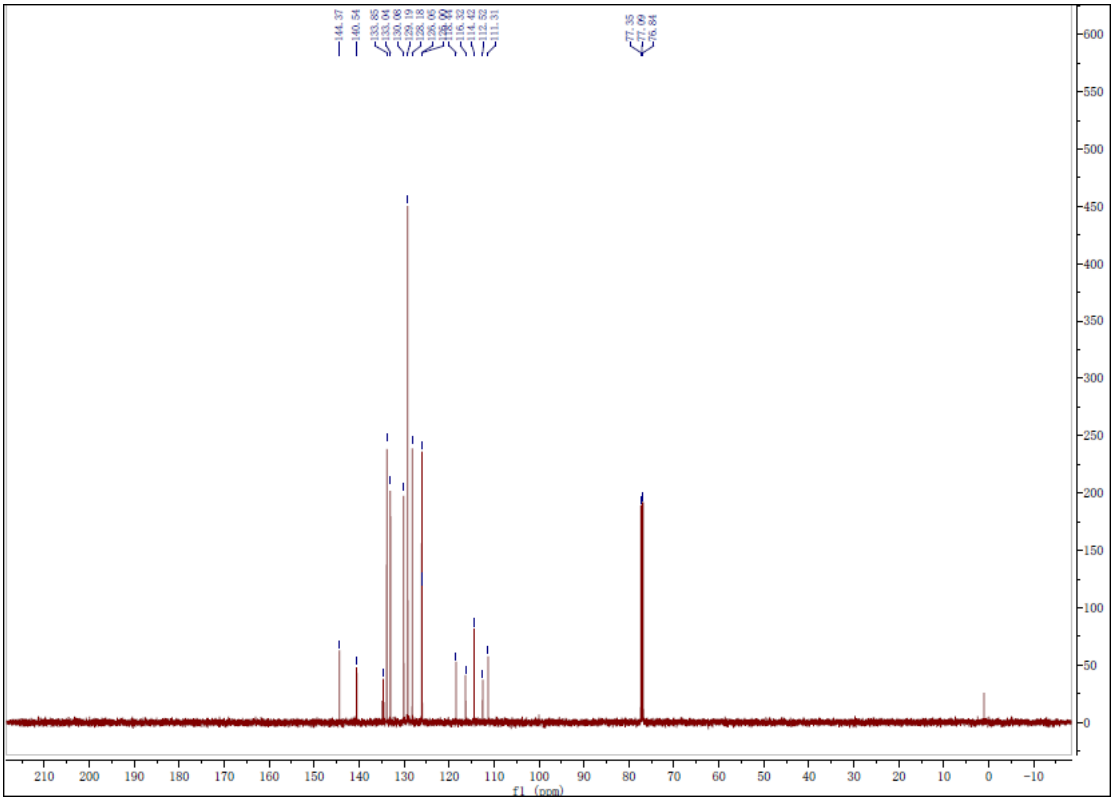
^{1}H NMR of 4'- (difluoromethyl)- [1, 1'-biphenyl]-2-carbonitrile (3a)



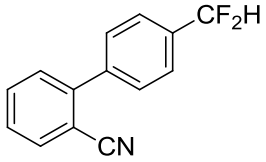


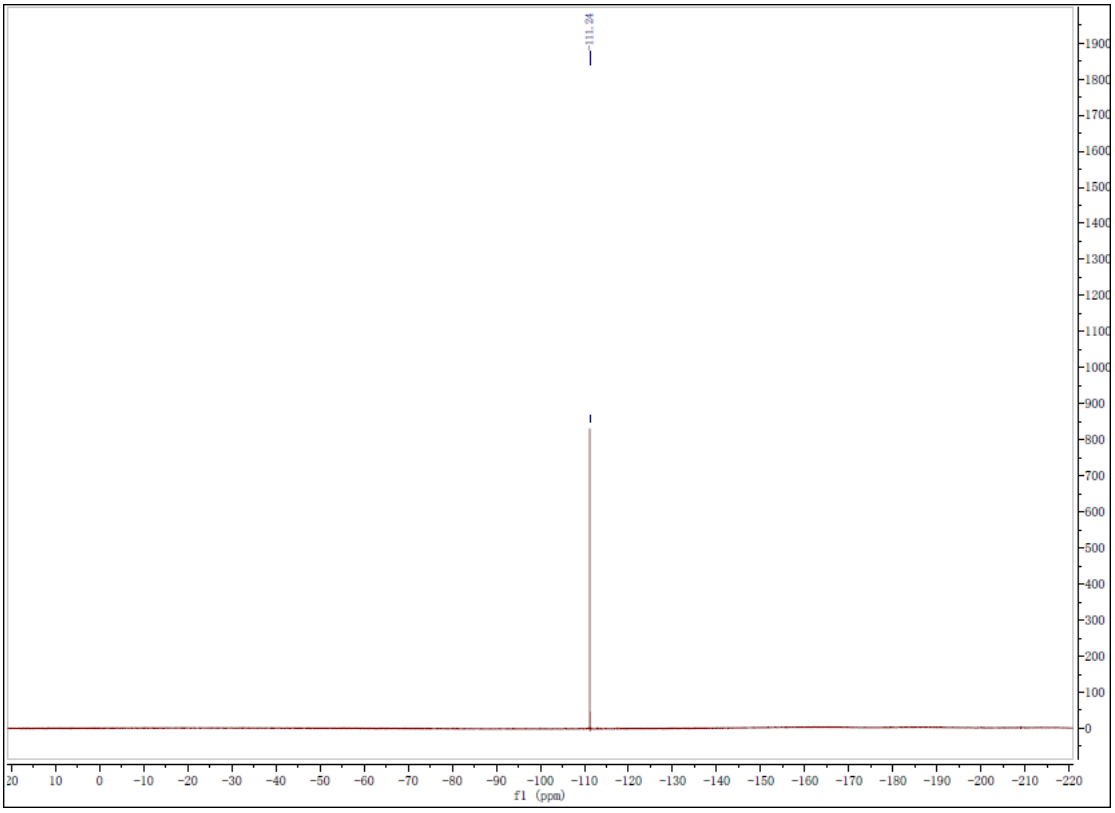
^{13}C NMR of 4'- (difluoromethyl)- [1, 1'-biphenyl]-2-carbonitrile (3a)



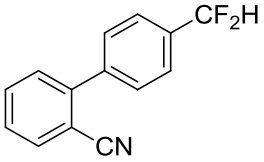


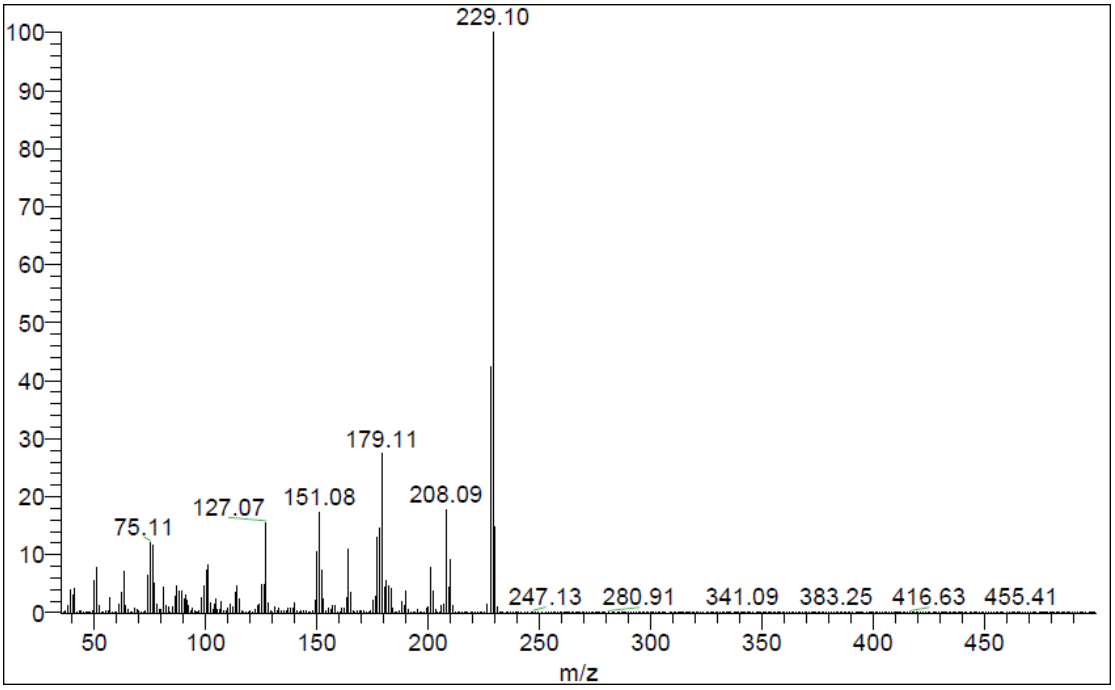
^{19}F NMR of 4'- (difluoromethyl)- [1, 1'-biphenyl]-2-carbonitrile (3a)



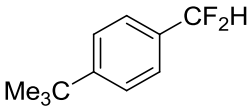


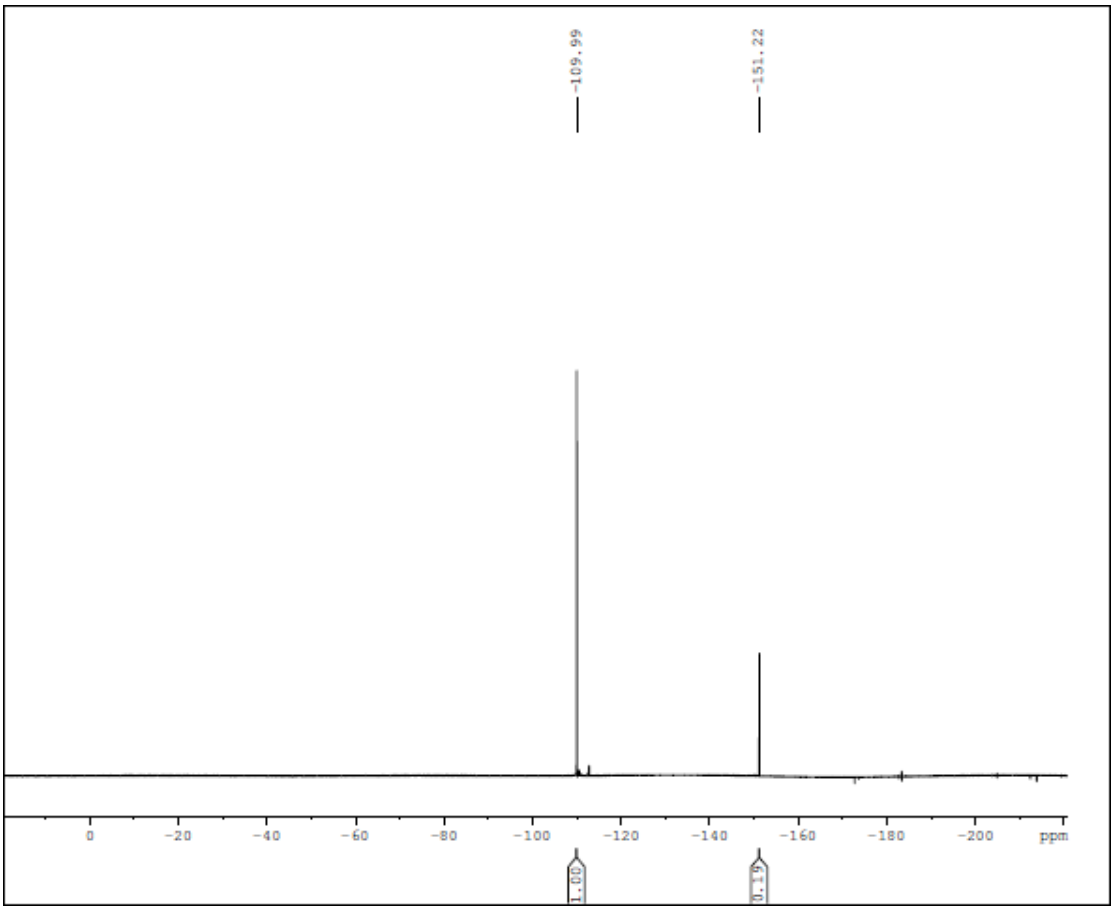
MS of 4'- (difluoromethyl)- [1, 1'-biphenyl]-2-carbonitrile (3a)



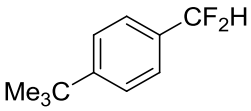


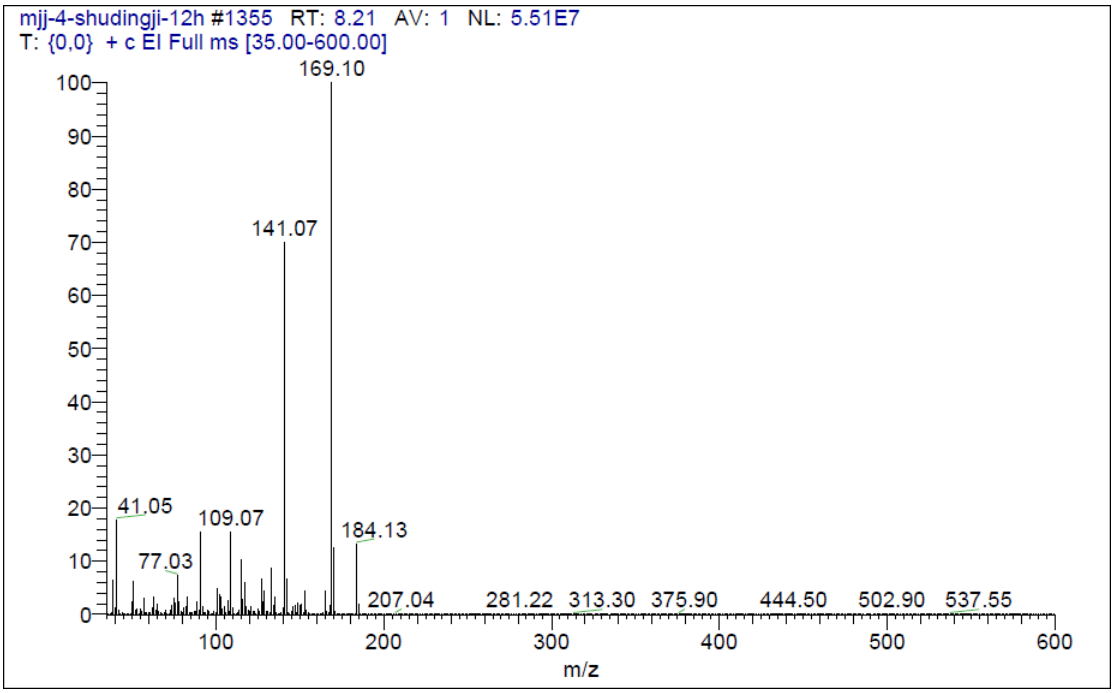
^{19}F NMR of 1- (*tert*-butyl)-4- (difluoromethyl)benzene (3b)



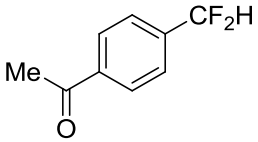


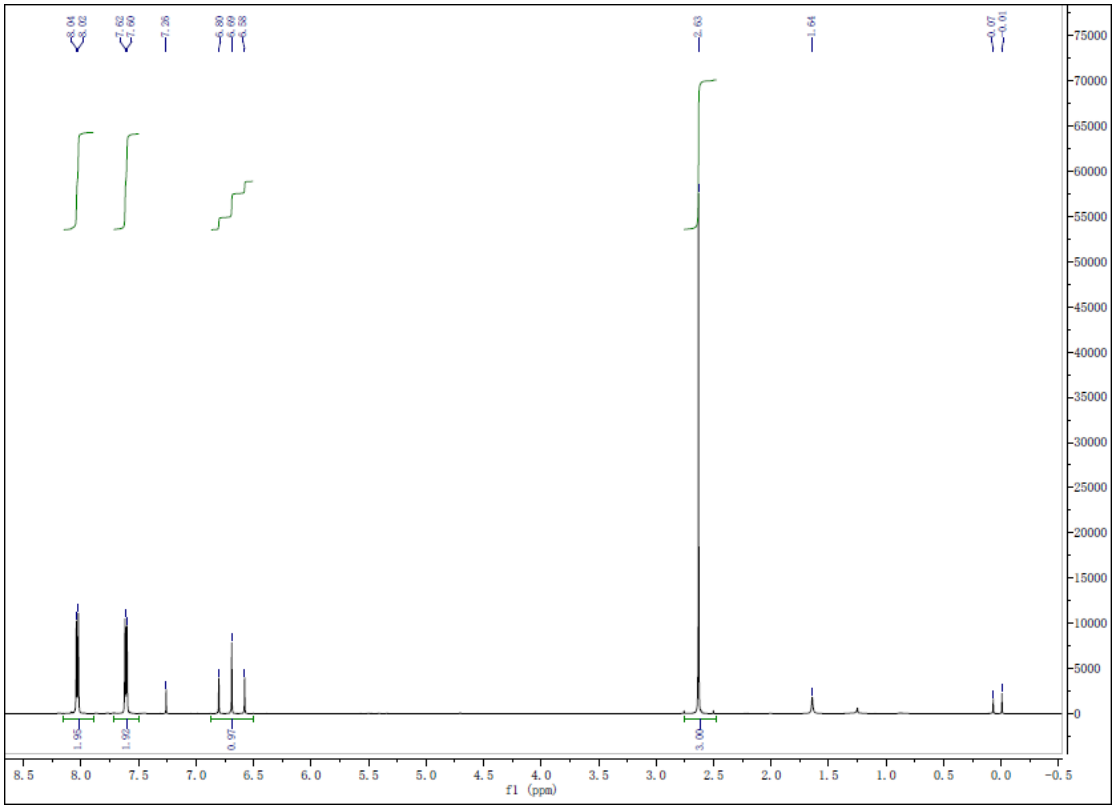
MS of 1- (*tert*-butyl)-4- (difluoromethyl)benzene (3b)



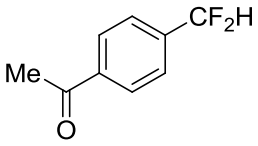


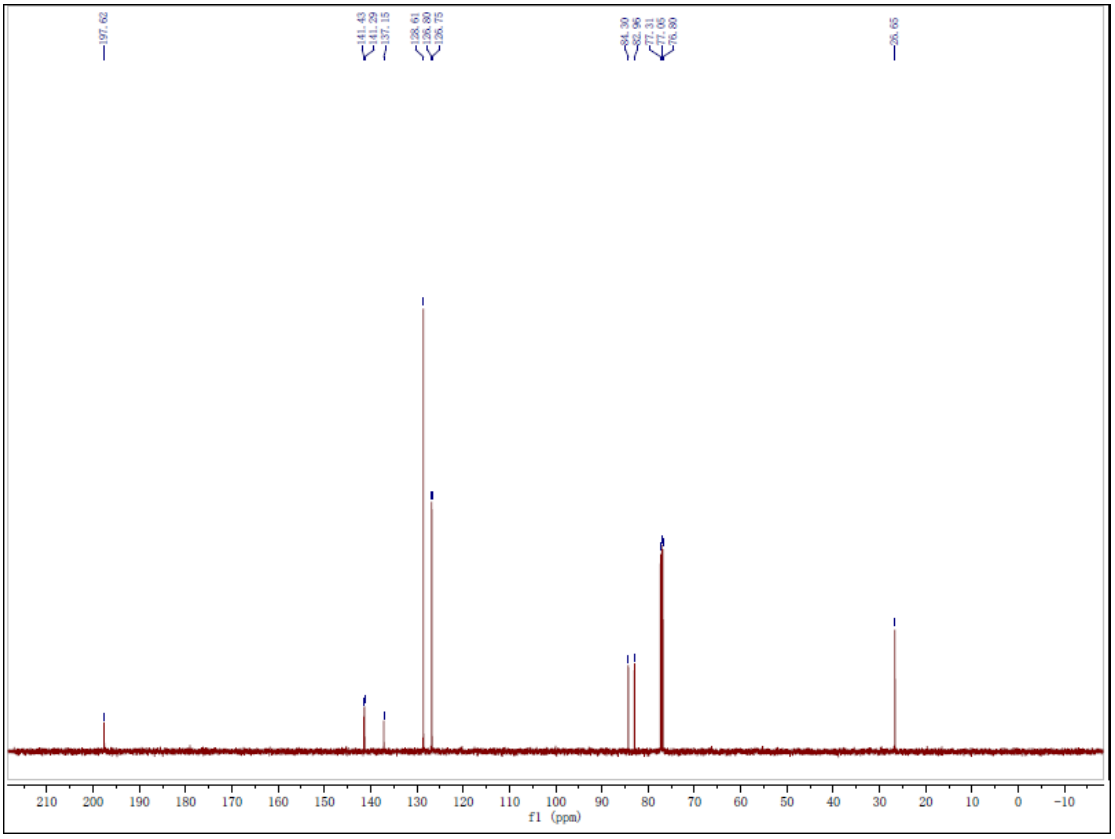
^{1}H NMR of 1- (4- (difluoromethyl)phenyl)ethanone (3c)



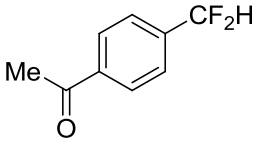


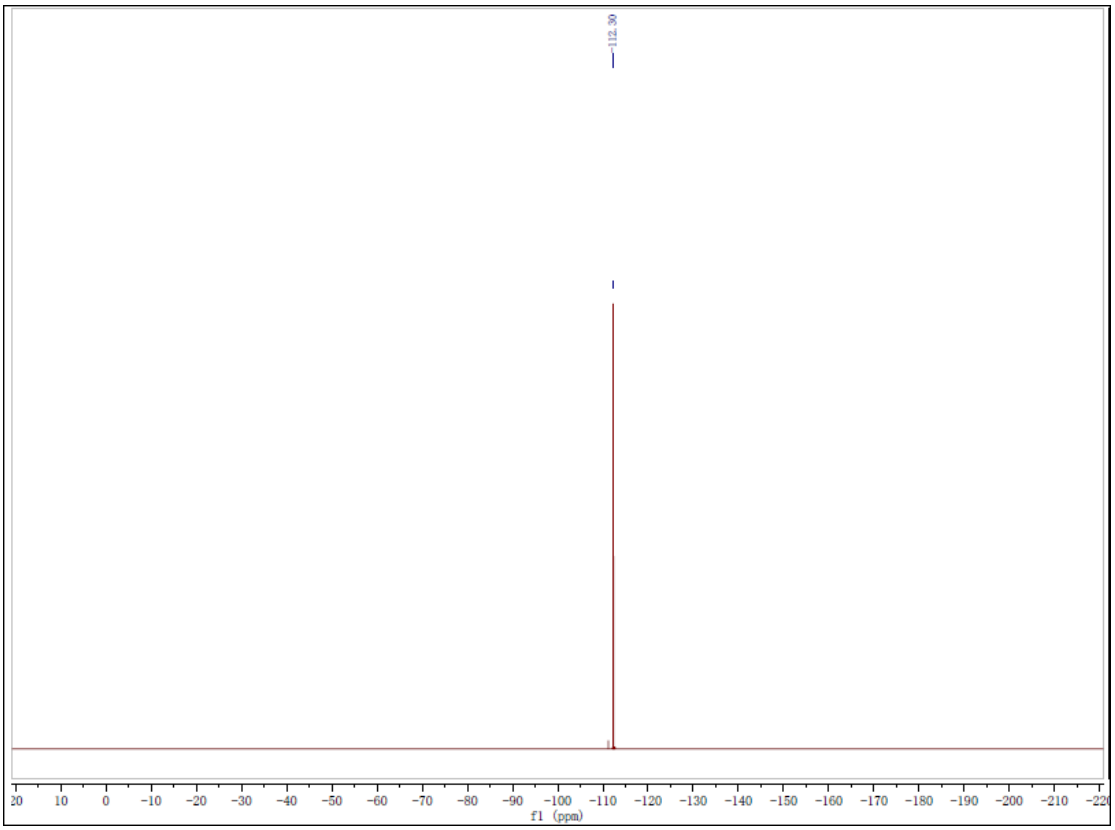
^{13}C NMR of 1- (4- (difluoromethyl)phenyl)ethanone (3c)



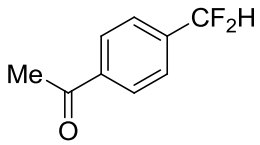


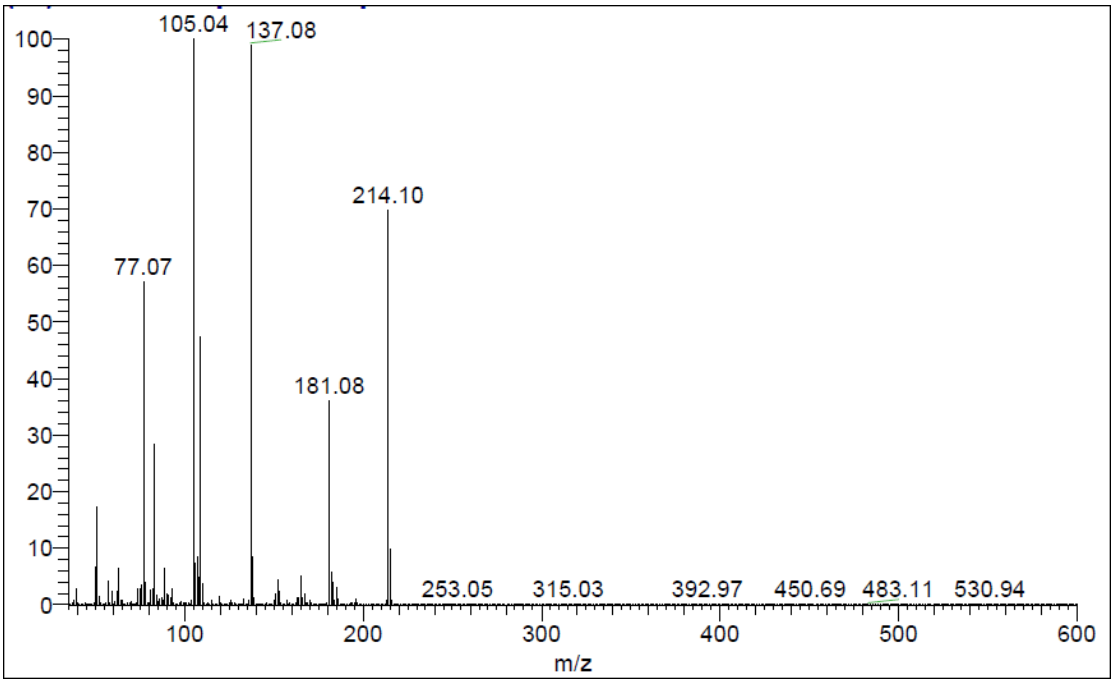
^{19}F NMR of 1- (4- (difluoromethyl)phenyl)ethanone (3c)



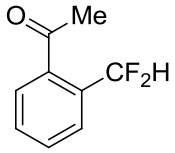


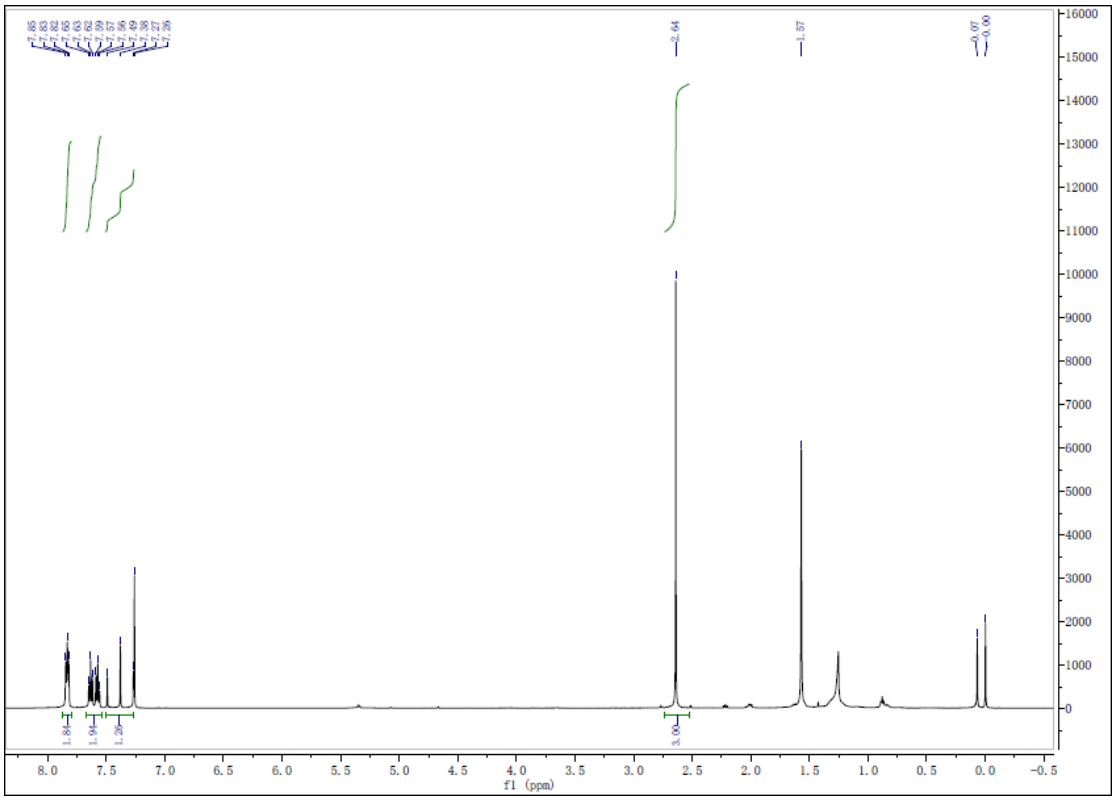
MS of 1- (4- (difluoromethyl)phenyl)ethanone (3c)



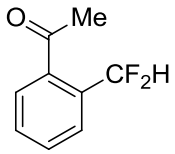


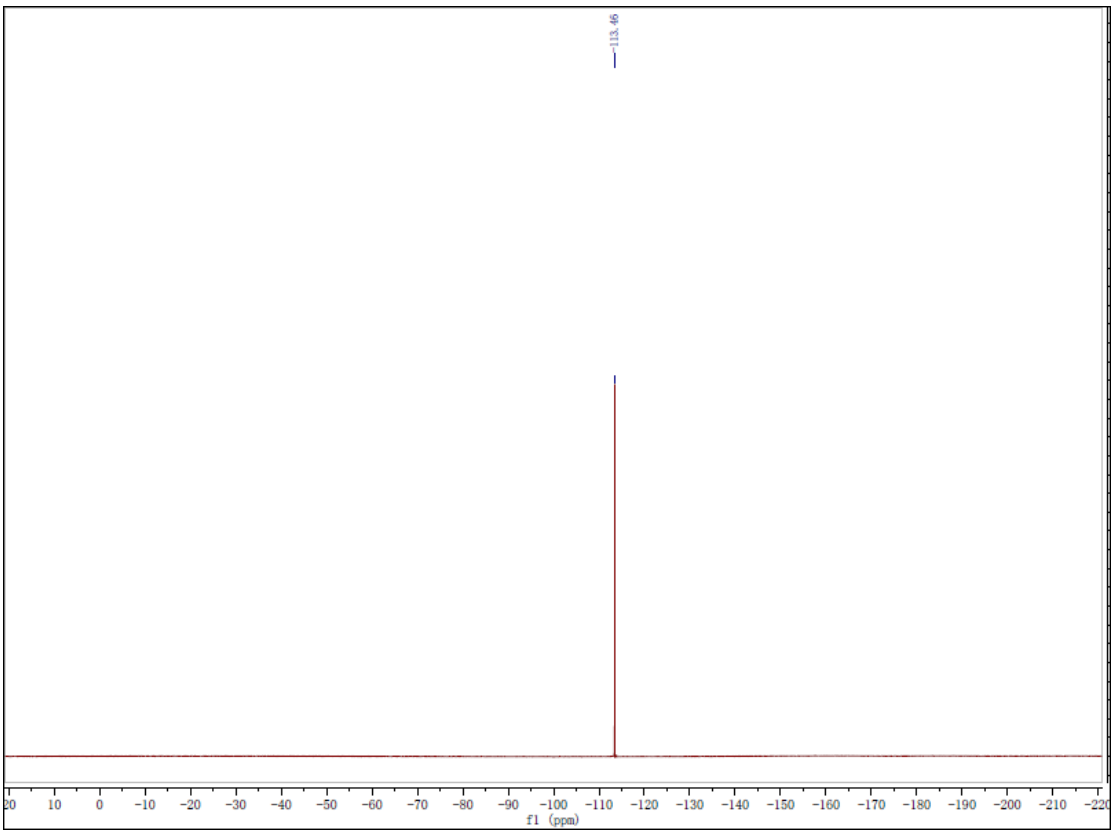
^{1}H NMR of 1- (2- (difluoromethyl)phenyl)ethanone (3d)



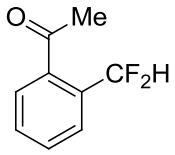


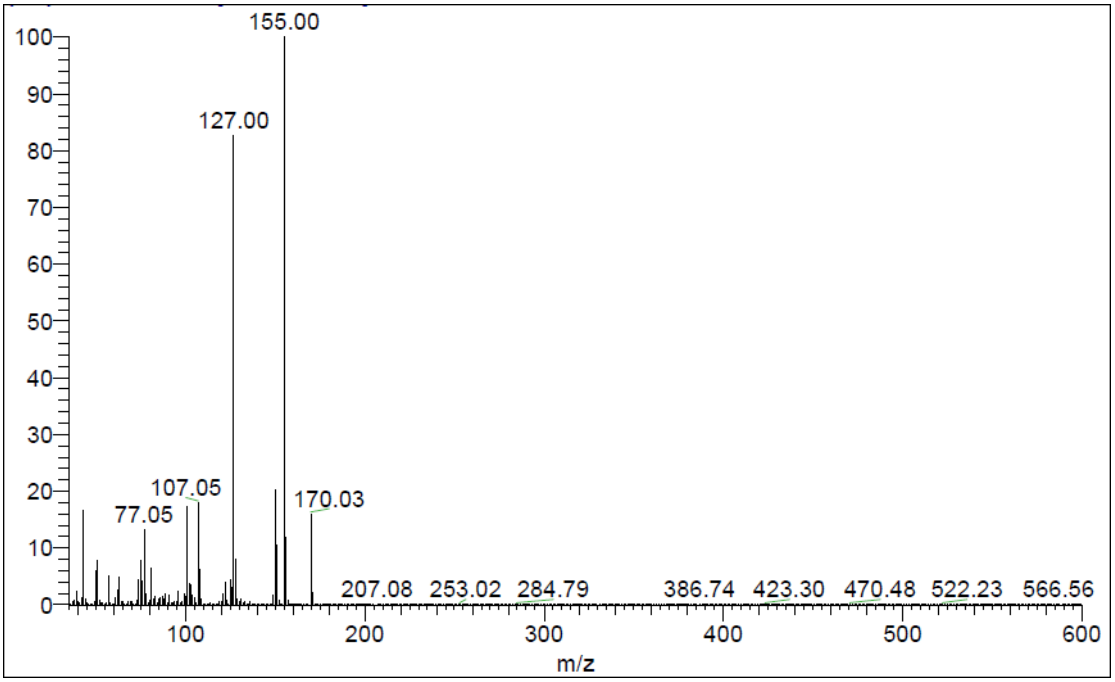
^{19}F NMR of 1- (2- (difluoromethyl)phenyl)ethanone (3d)



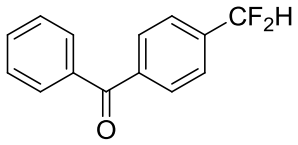


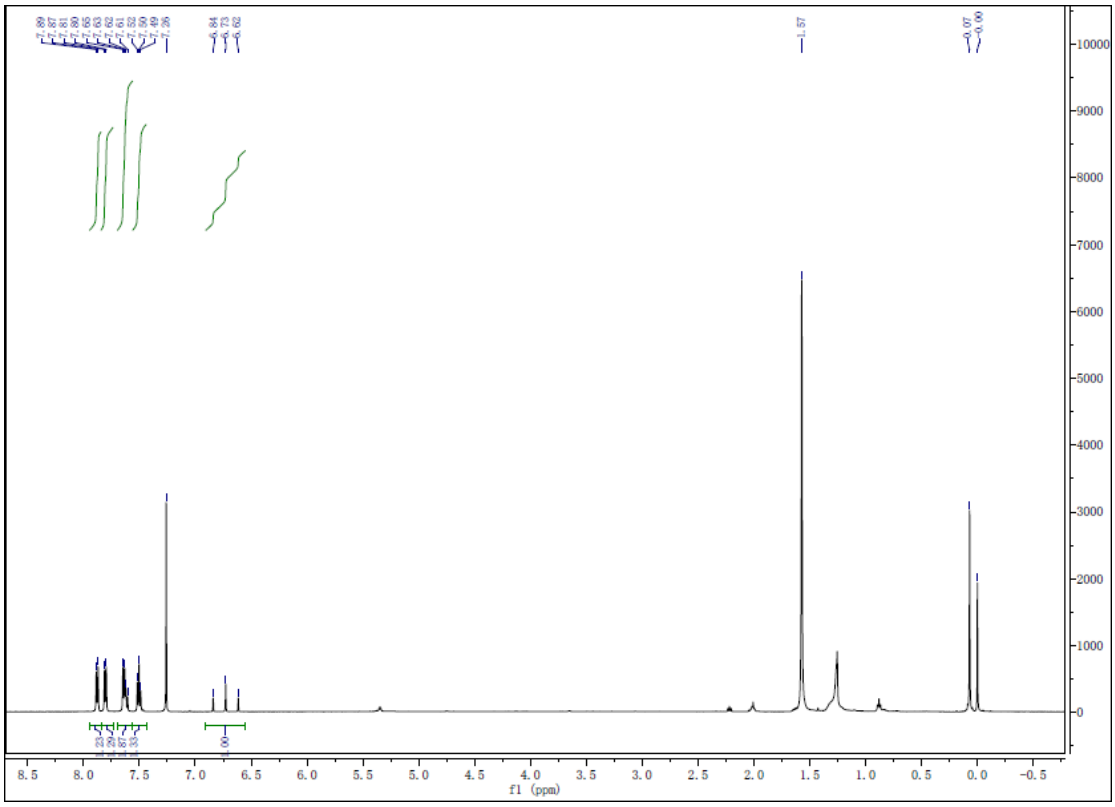
MS of 1- (2- (difluoromethyl)phenyl)ethanone (3d)



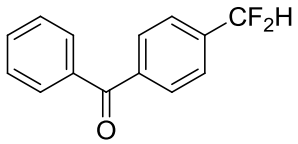


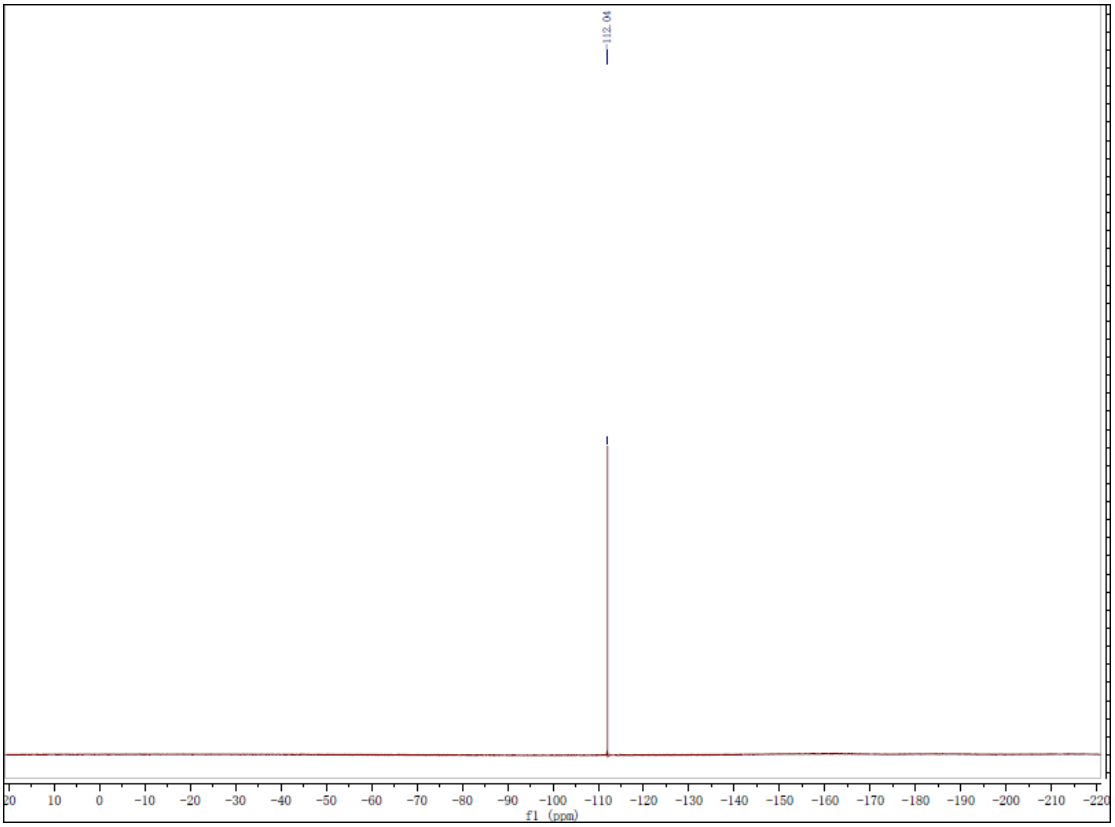
^{1}H NMR of (4- (difluoromethyl)phenyl) (phenyl)methanone (3e)



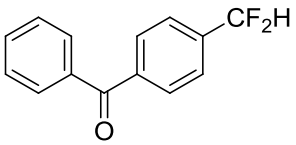


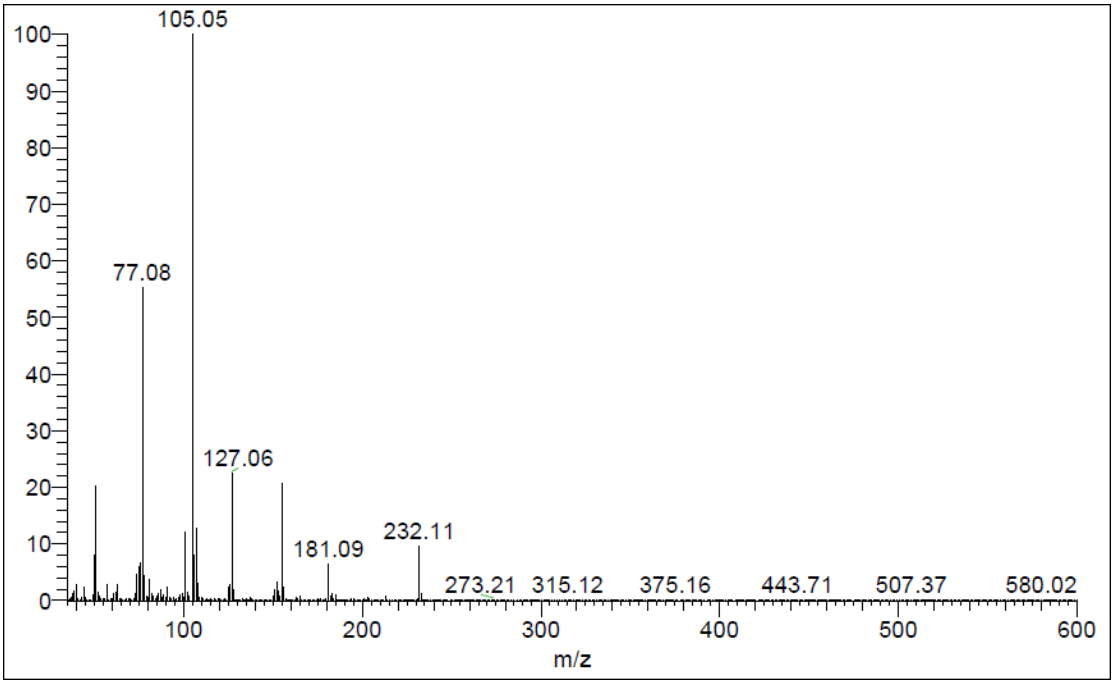
^{19}F NMR of (4- (difluoromethyl)phenyl) (phenyl)methanone (3e)



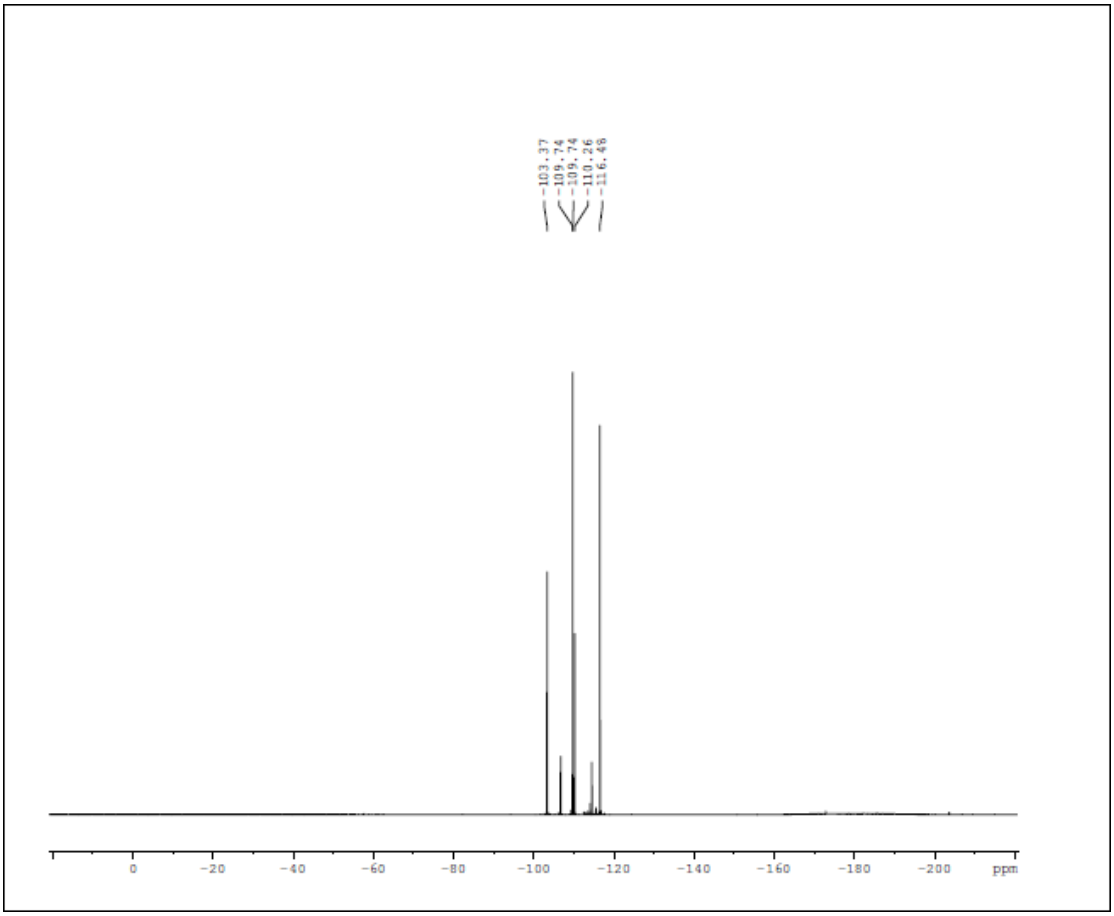


MS of (4- (difluoromethyl)phenyl) (phenyl)methanone (3e)

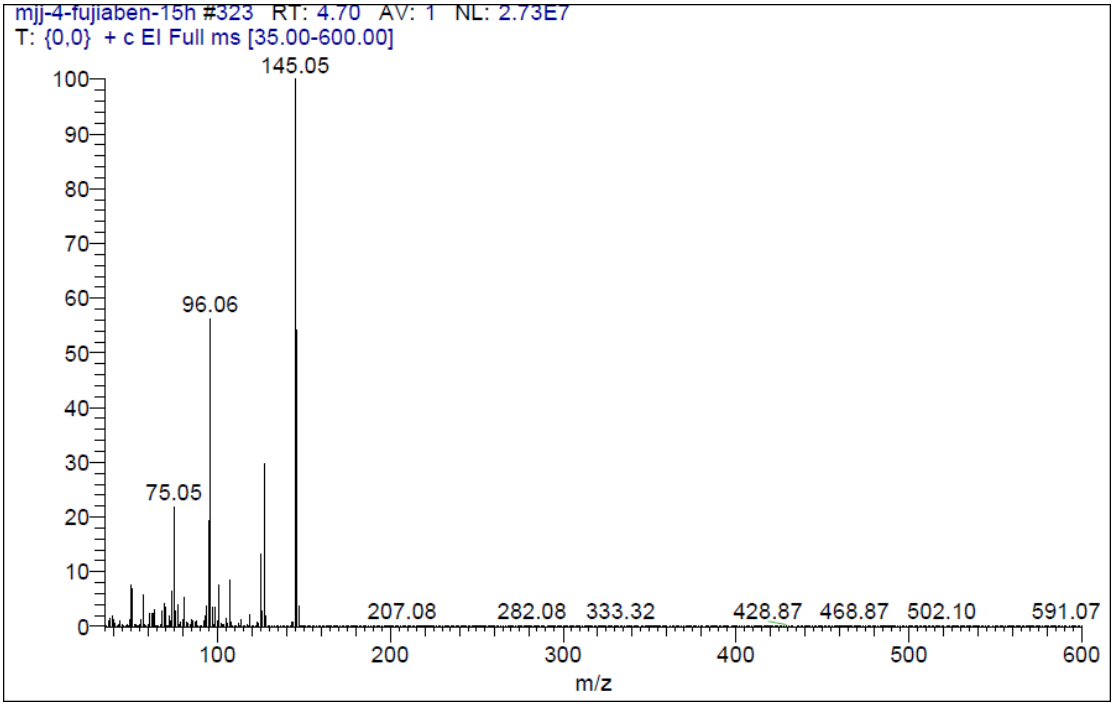




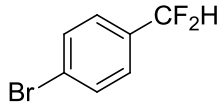
^{19}F NMR of 1- (difluoromethyl)-4-fluorobenzene (3f)

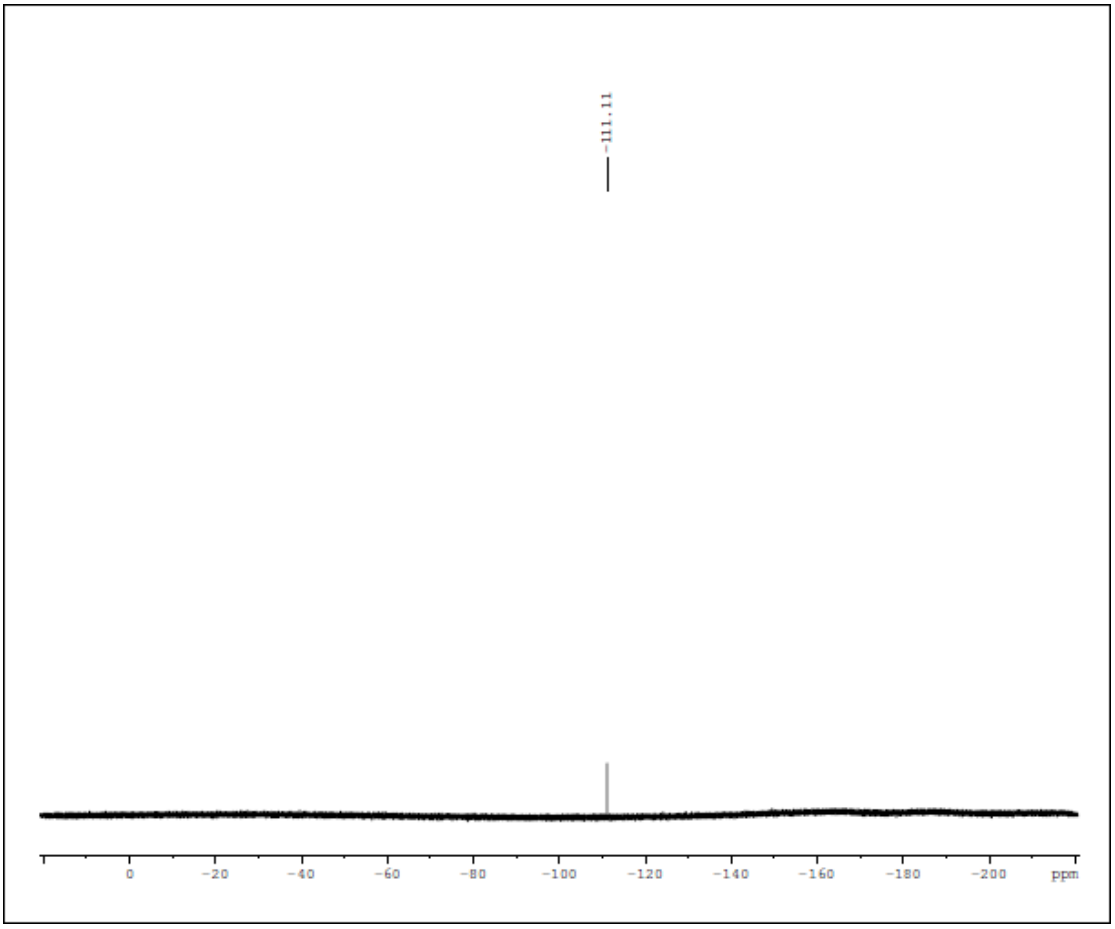


MS of 1- (difluoromethyl)-4-fluorobenzene (3f)

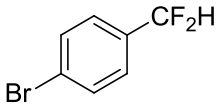


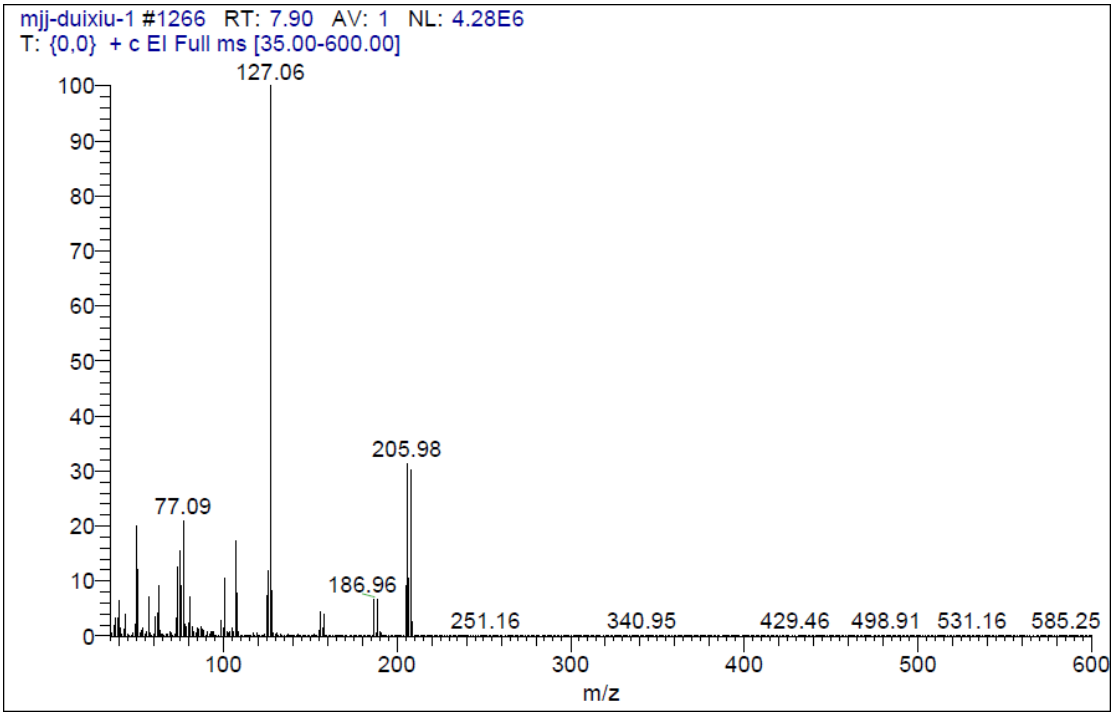
^{19}F NMR of 1-bromo-4- (difluoromethyl)benzene (3g)



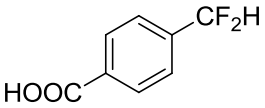


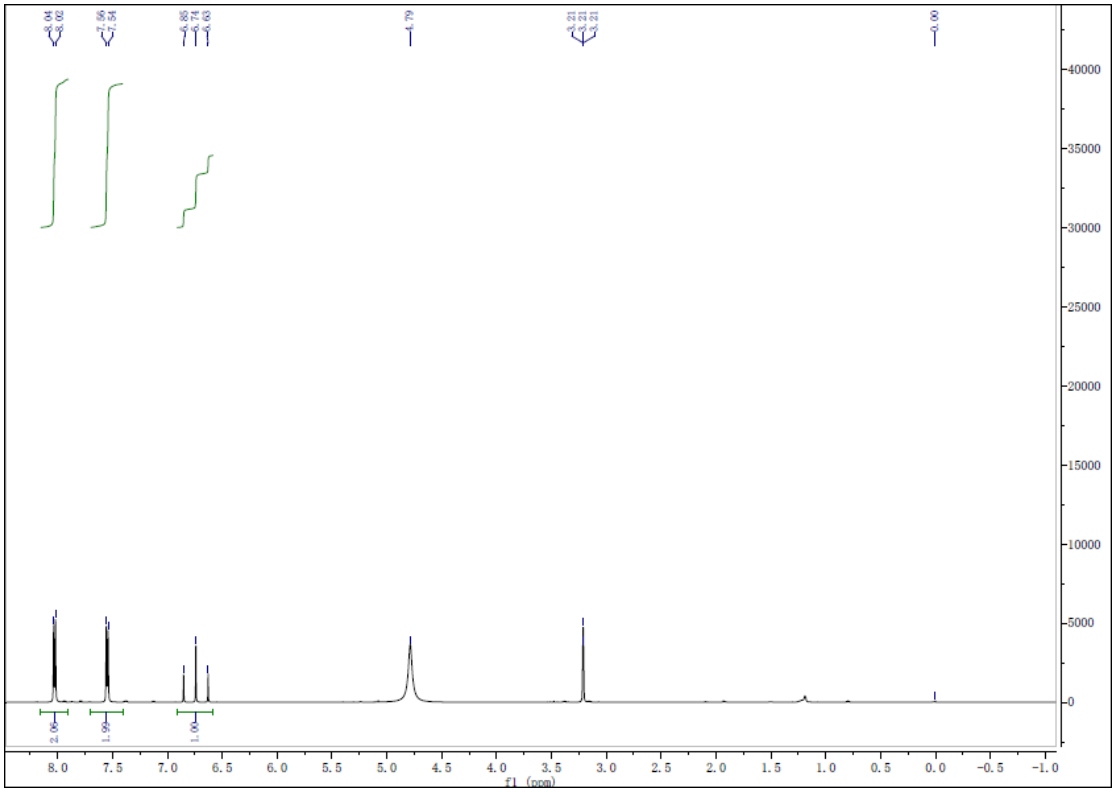
MS of 1- (difluoromethyl)-4-fluorobenzene (3g)



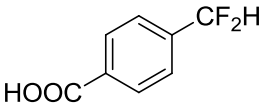


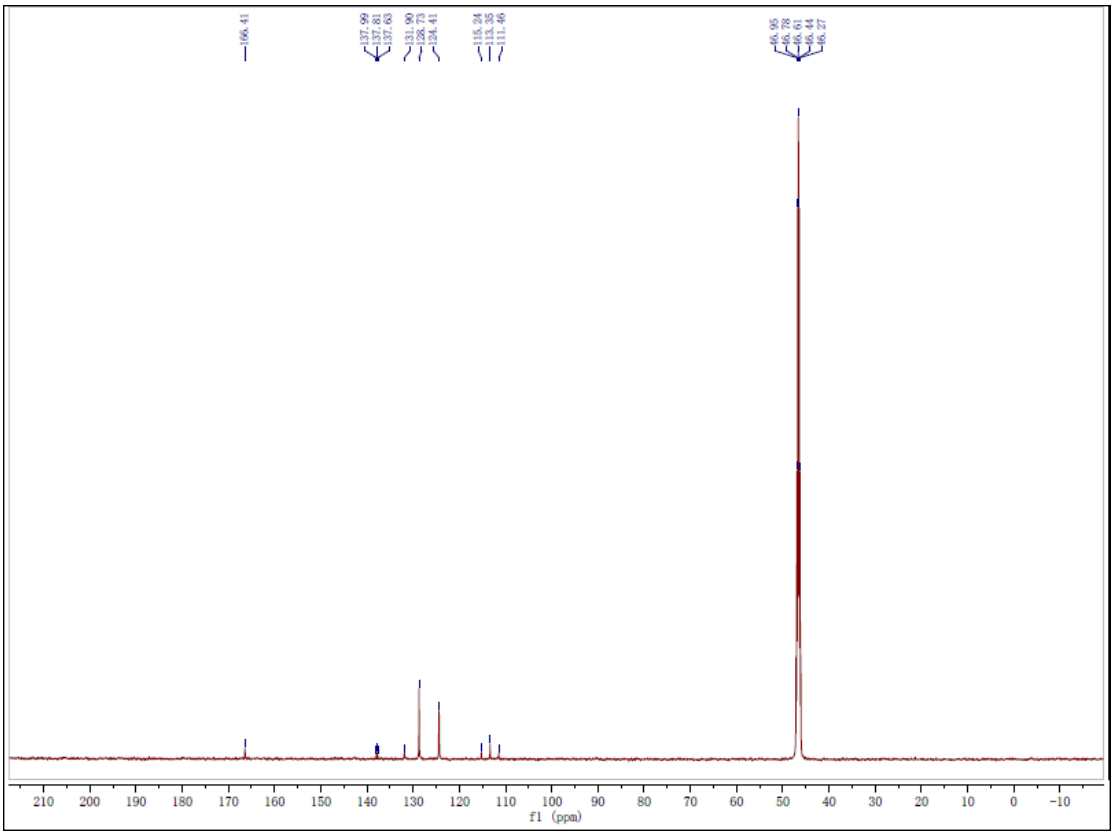
^{1}H NMR of 4- (difluoromethyl)benzoic acid (3h)



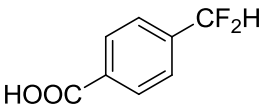


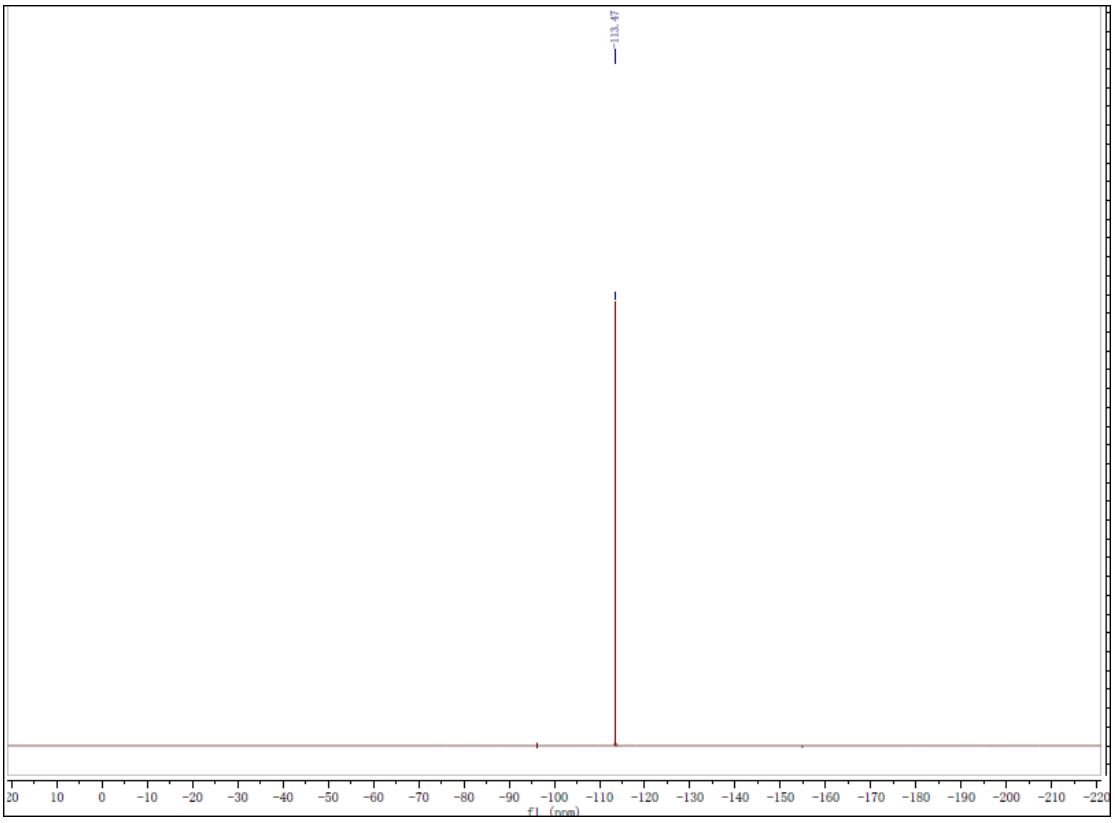
^{13}C NMR of 4- (difluoromethyl)benzoic acid (3h)



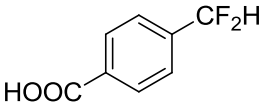


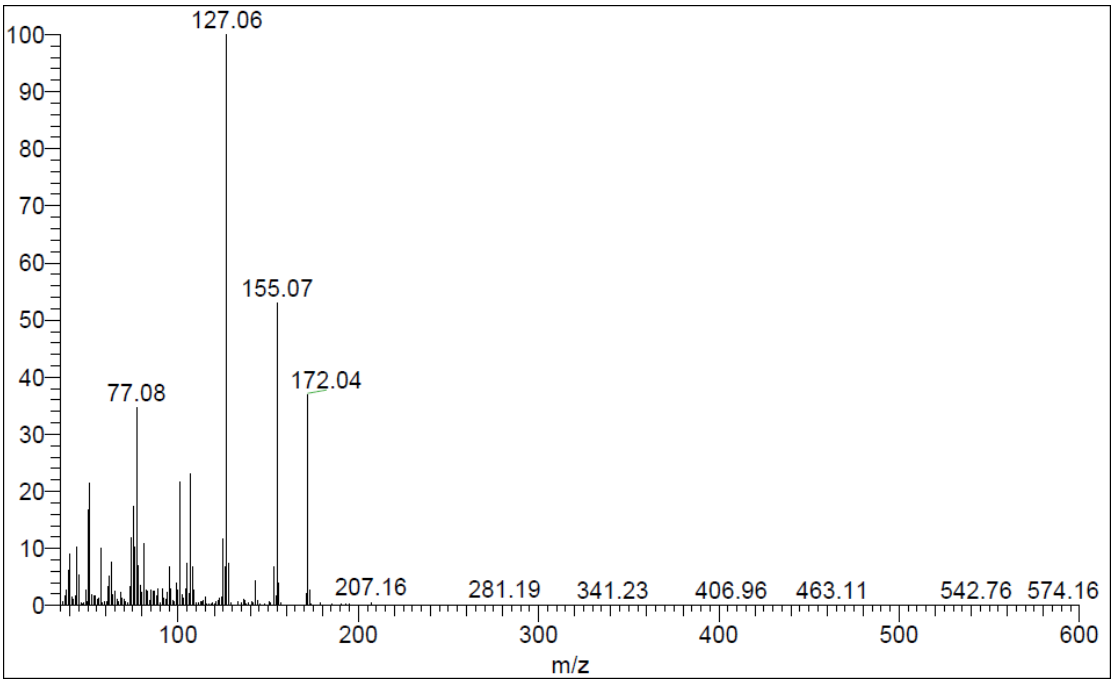
^{19}F NMR of4- (difluoromethyl)benzoic acid (3h)



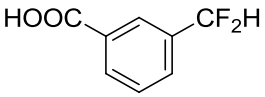


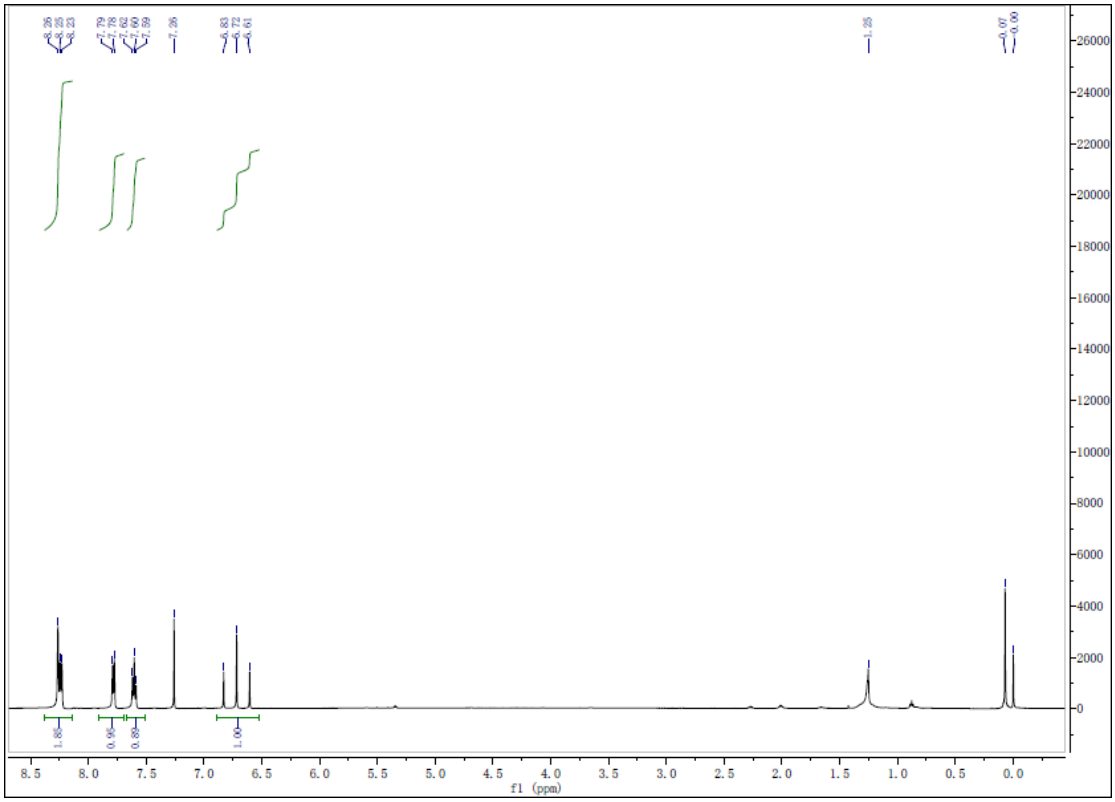
MS of 4- (difluoromethyl)benzoic acid (3h)



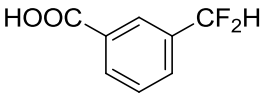


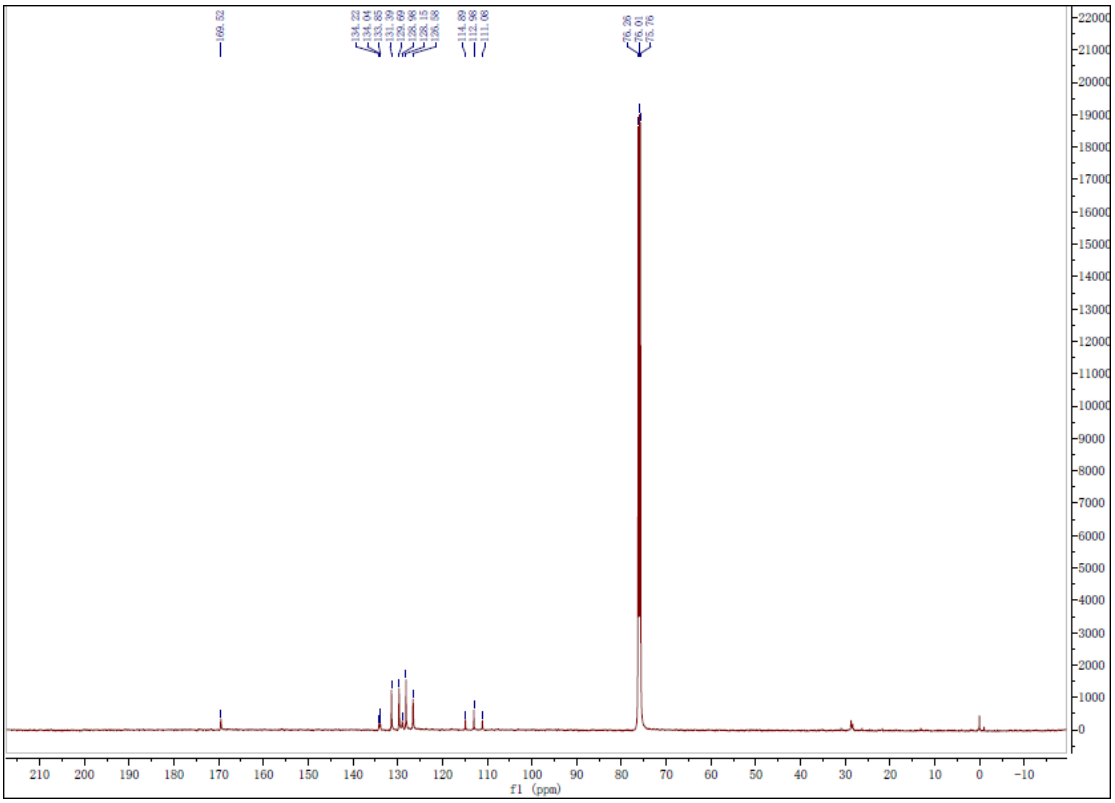
^{1}H NMR of 3- (difluoromethyl)benzoic acid (3i)



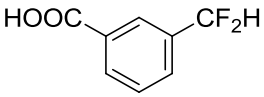


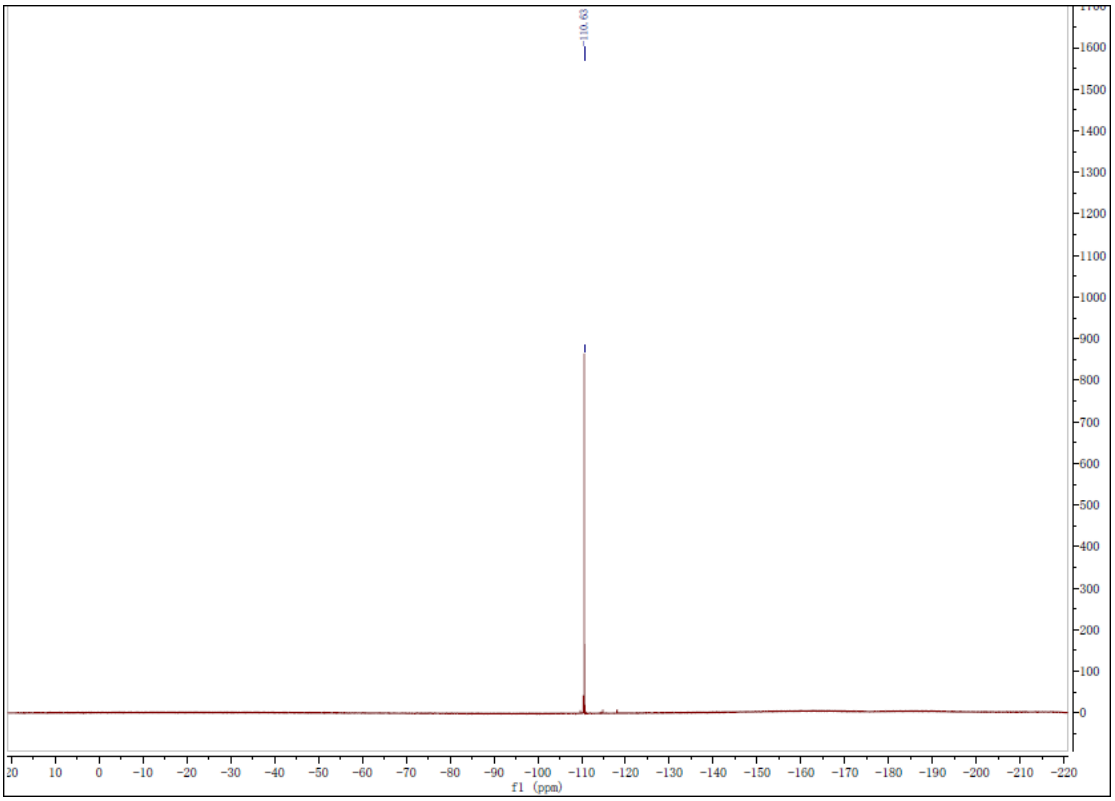
^{13}C NMR of 3- (difluoromethyl)benzoic acid (3i)



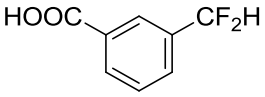


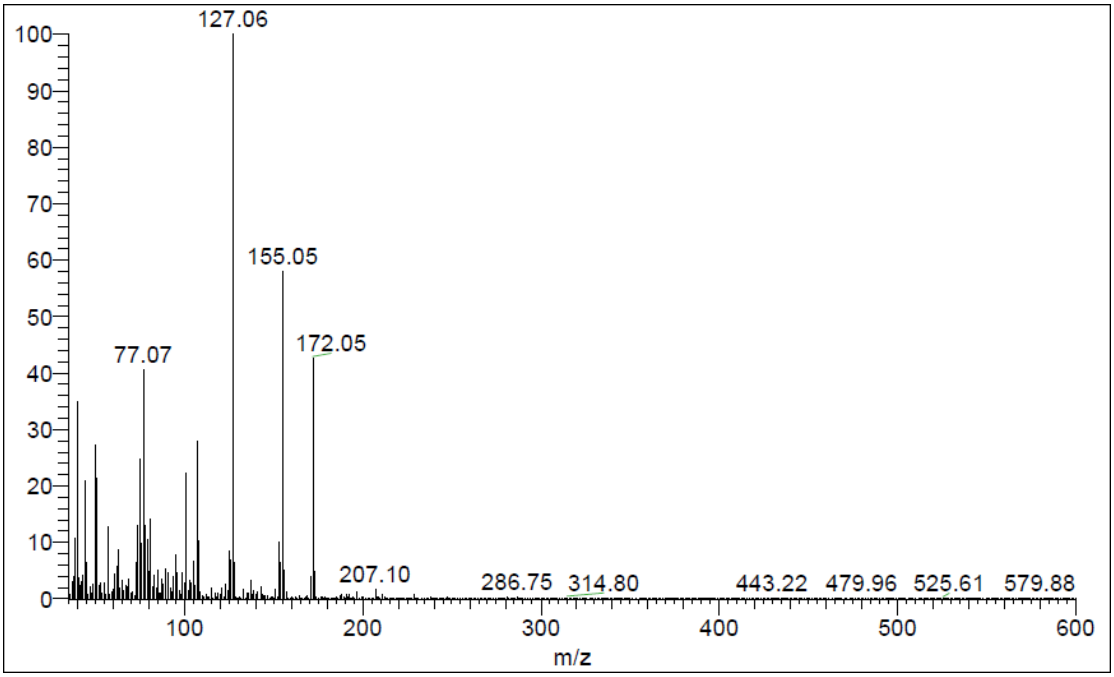
^{19}F NMR of 3- (difluoromethyl)benzoic acid (3i)



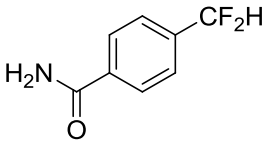


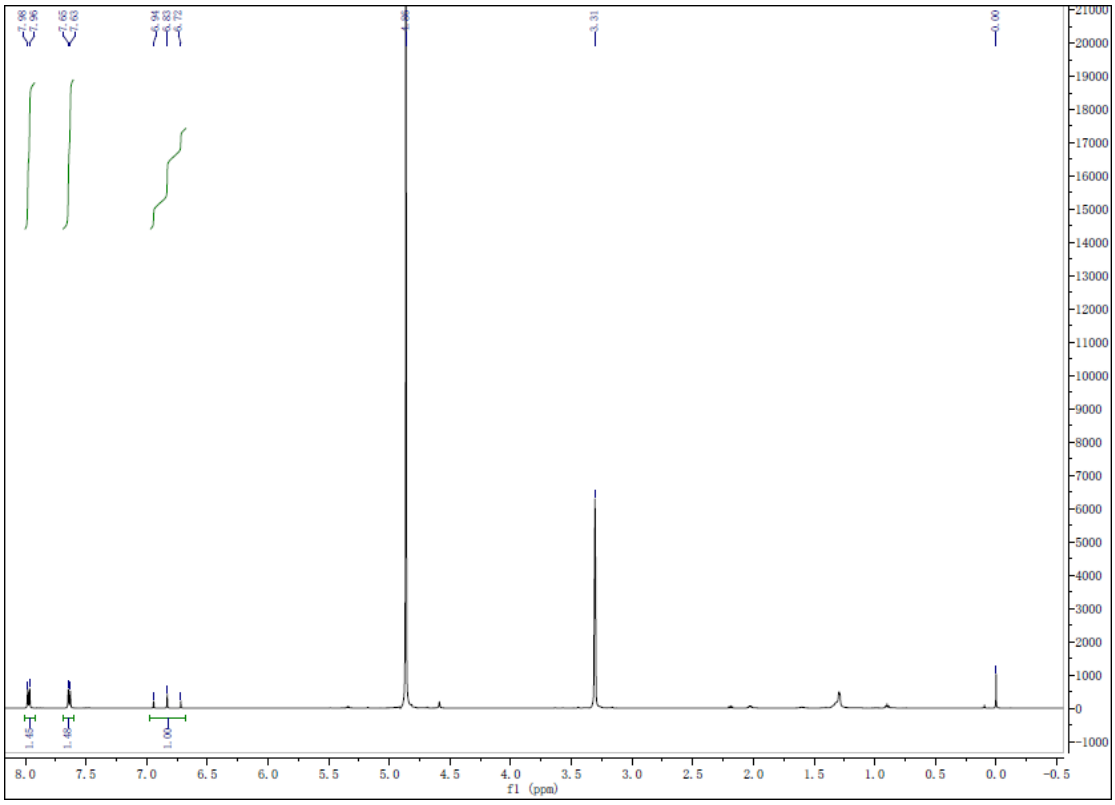
MS of 3- (difluoromethyl)benzoic acid (3i)



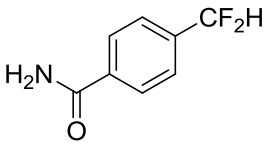


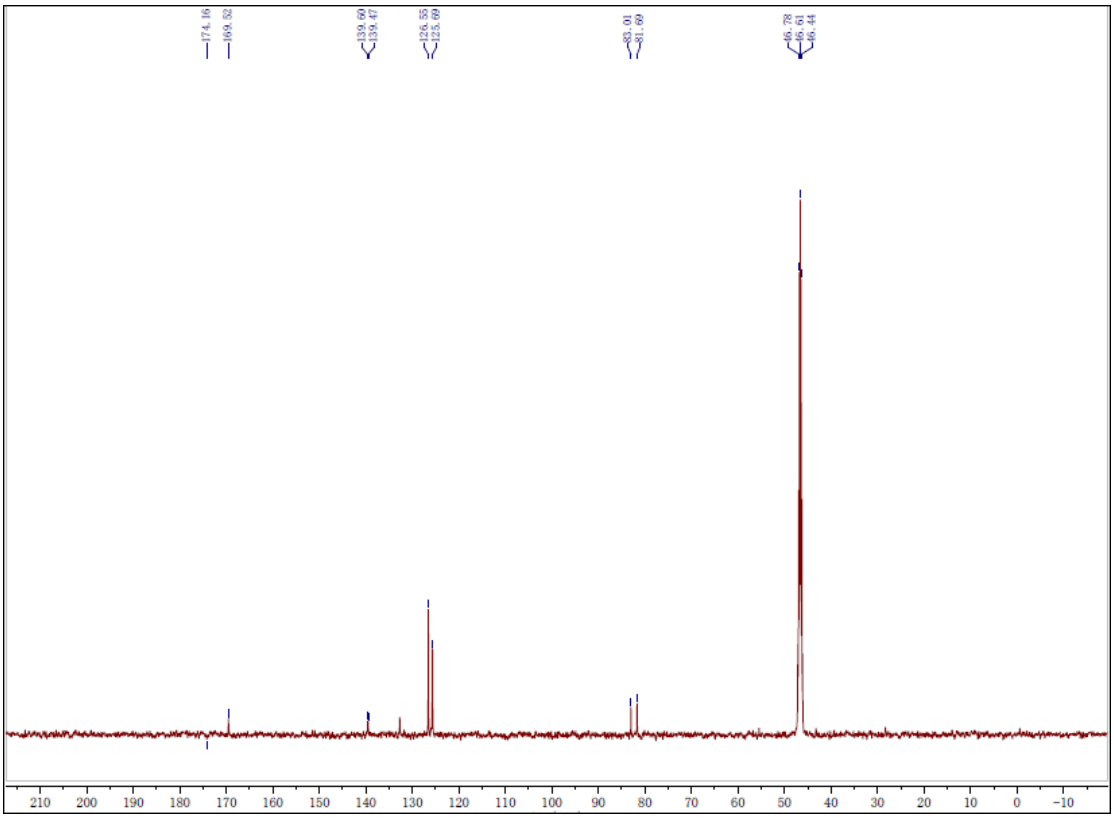
^{1}H NMR of 4- (difluoromethyl)benzamide (3j)



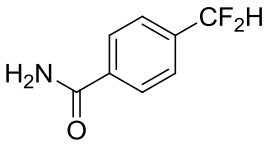


^{13}C NMR of 4- (difluoromethyl)benzamide (3j)

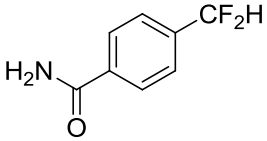


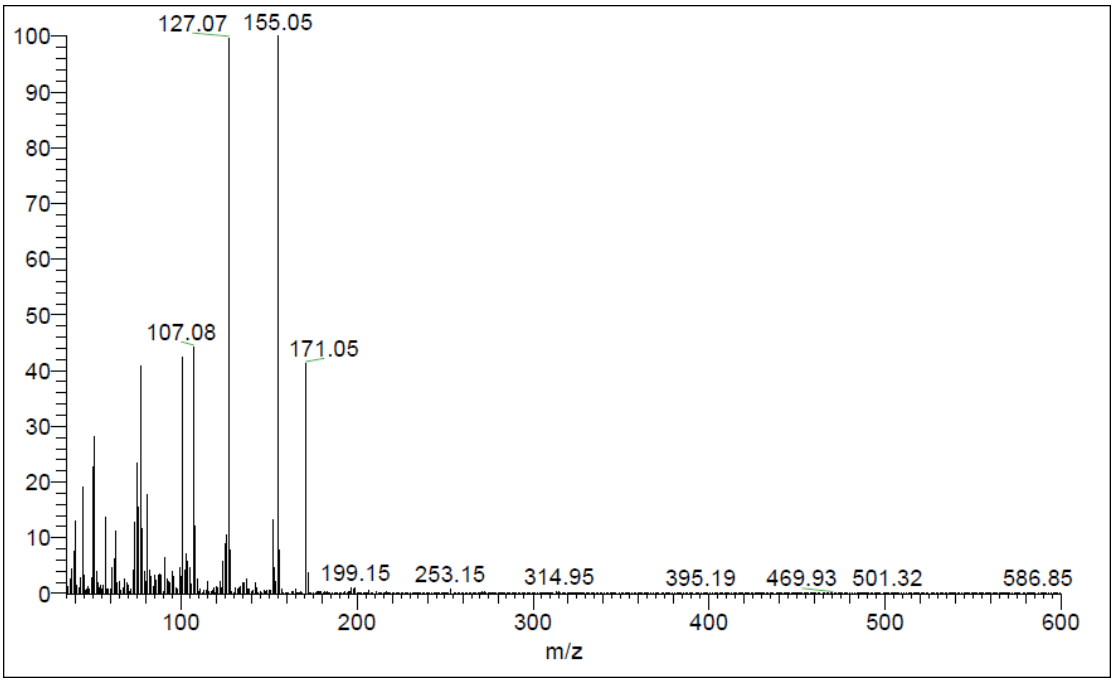


^{19}F NMR of 4- (difluoromethyl)benzamide (3j)

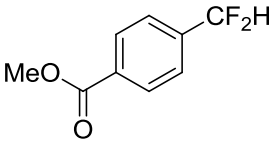


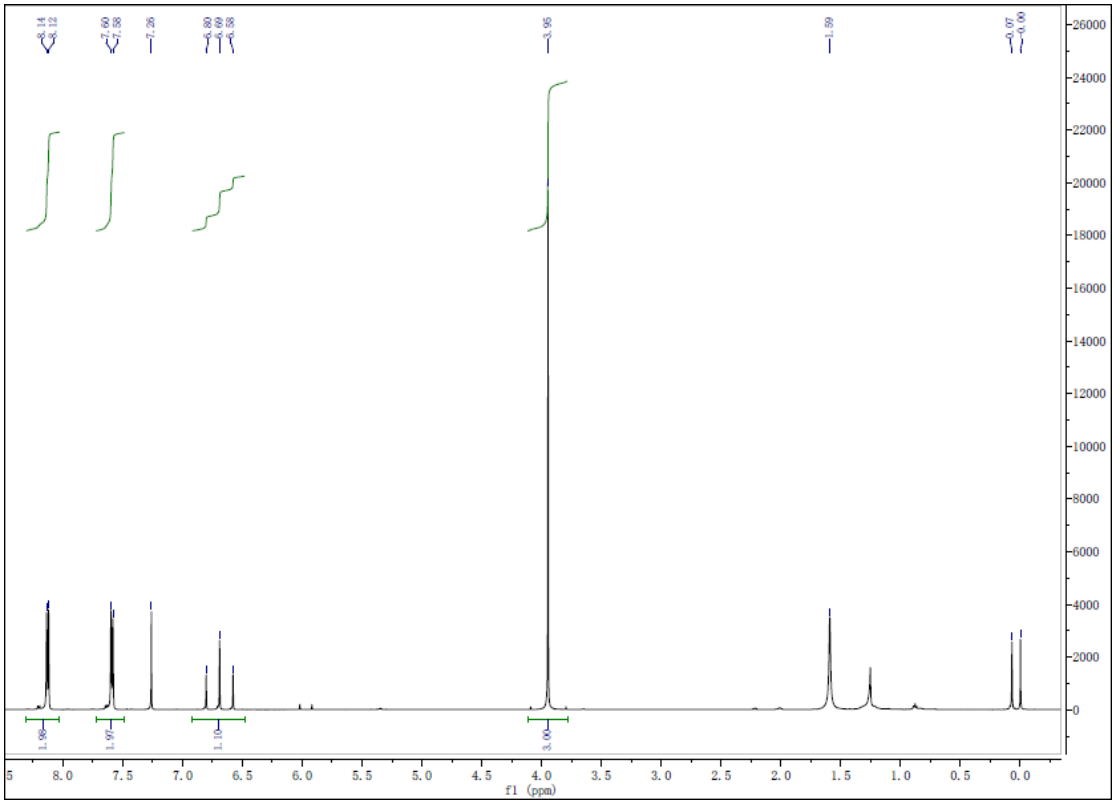
MS of 4- (difluoromethyl)benzamide (3j)



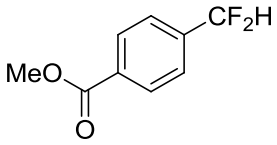


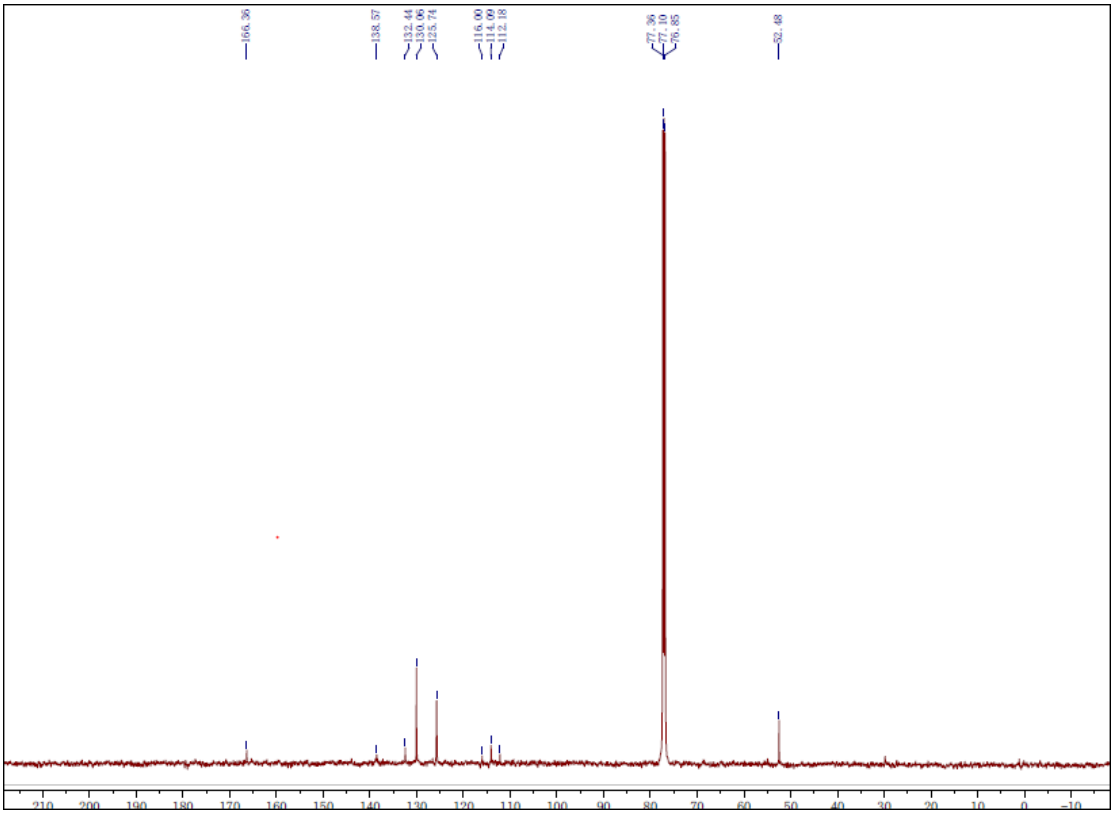
^{1}H NMR of methyl 4- (difluoromethyl)benzoate (3k)



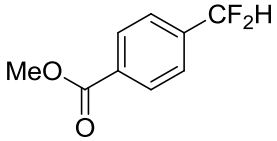


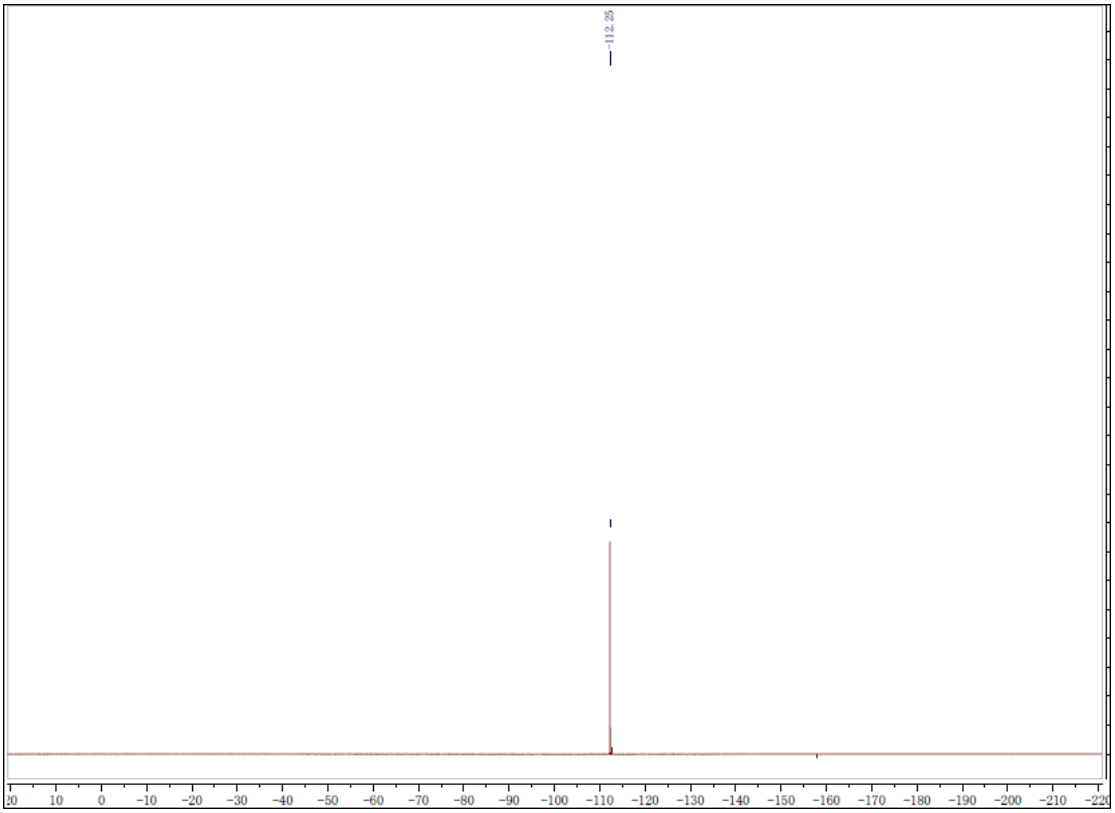
^{13}C NMR of methyl 4- (difluoromethyl)benzoate (3k)



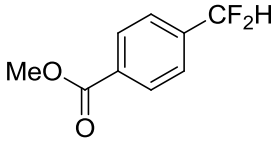


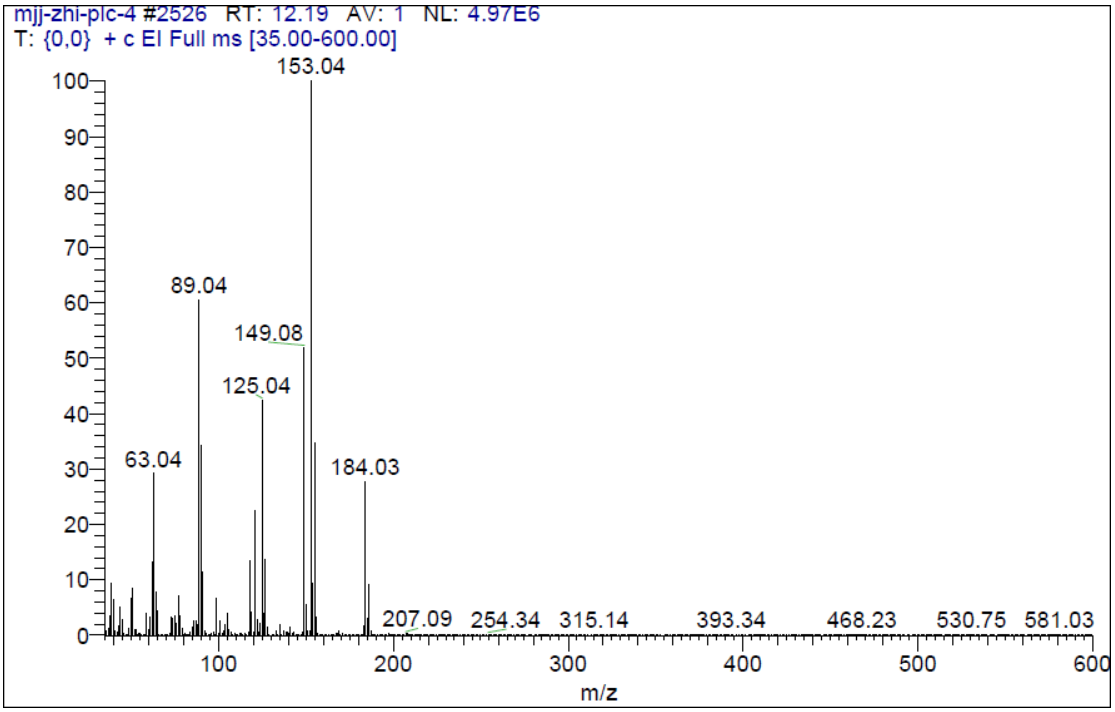
^{19}F NMR of methyl 4- (difluoromethyl)benzoate (3k)



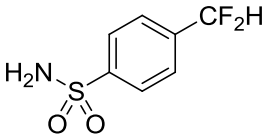


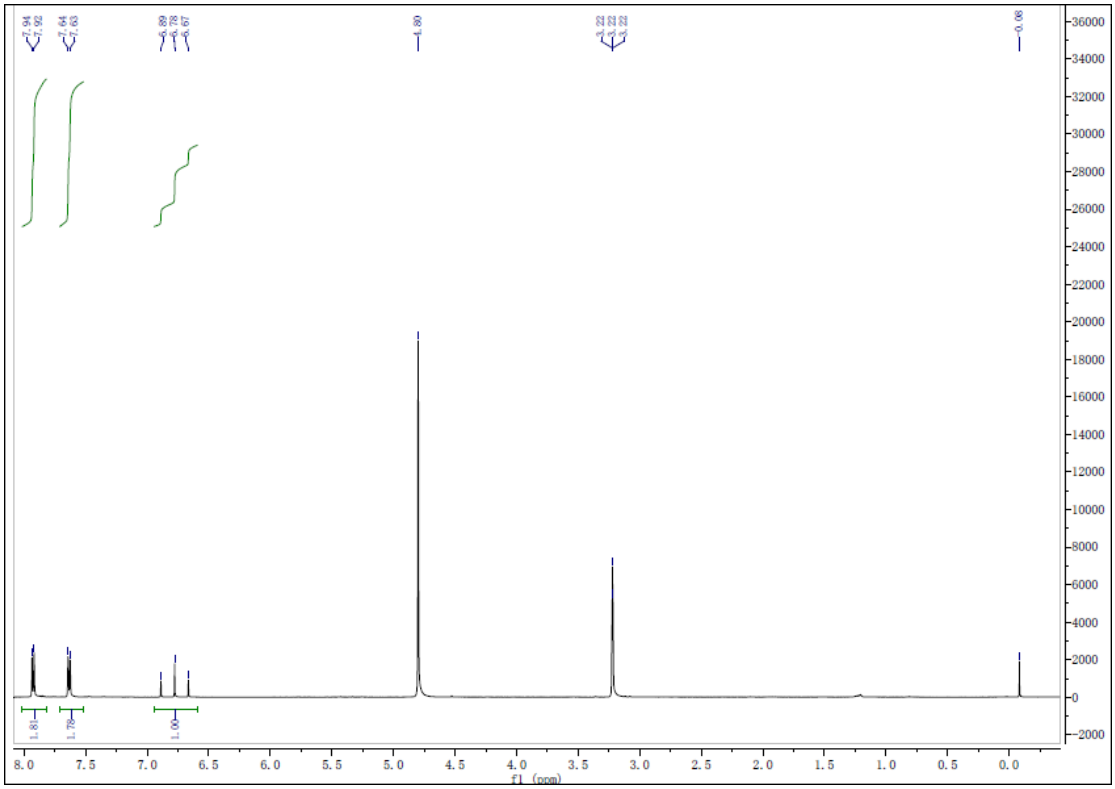
MS of methyl 4- (difluoromethyl)benzoate (3k)



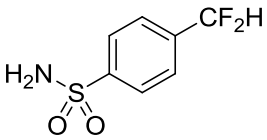


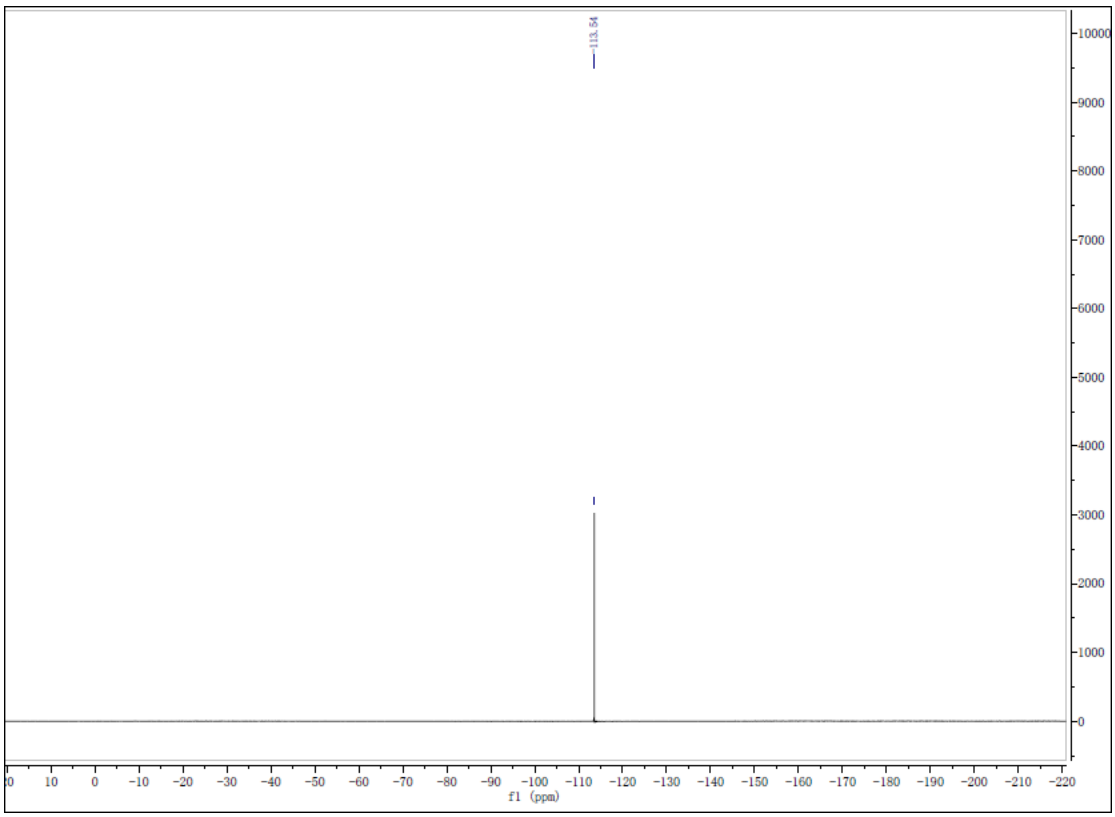
^{1}H NMR of 4-(difluoromethyl)benzenesulfonamide (3l)



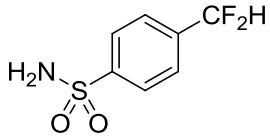


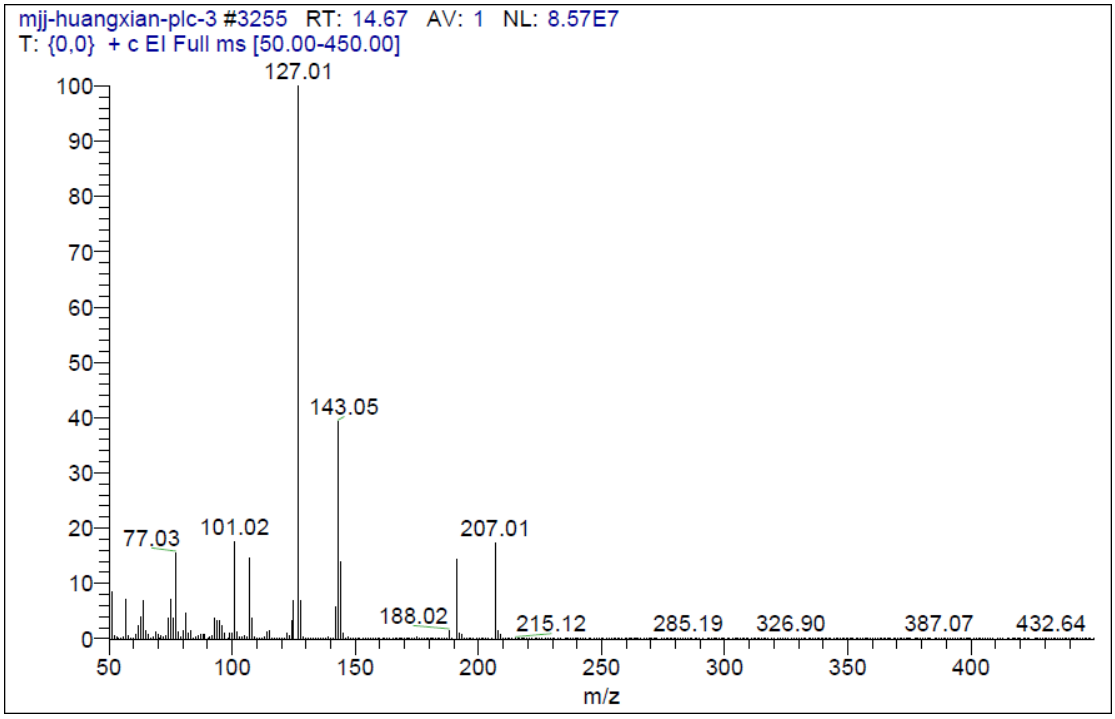
^{19}F NMR of 4-(difluoromethyl)benzenesulfonamide (3l)



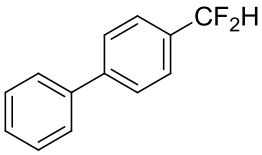


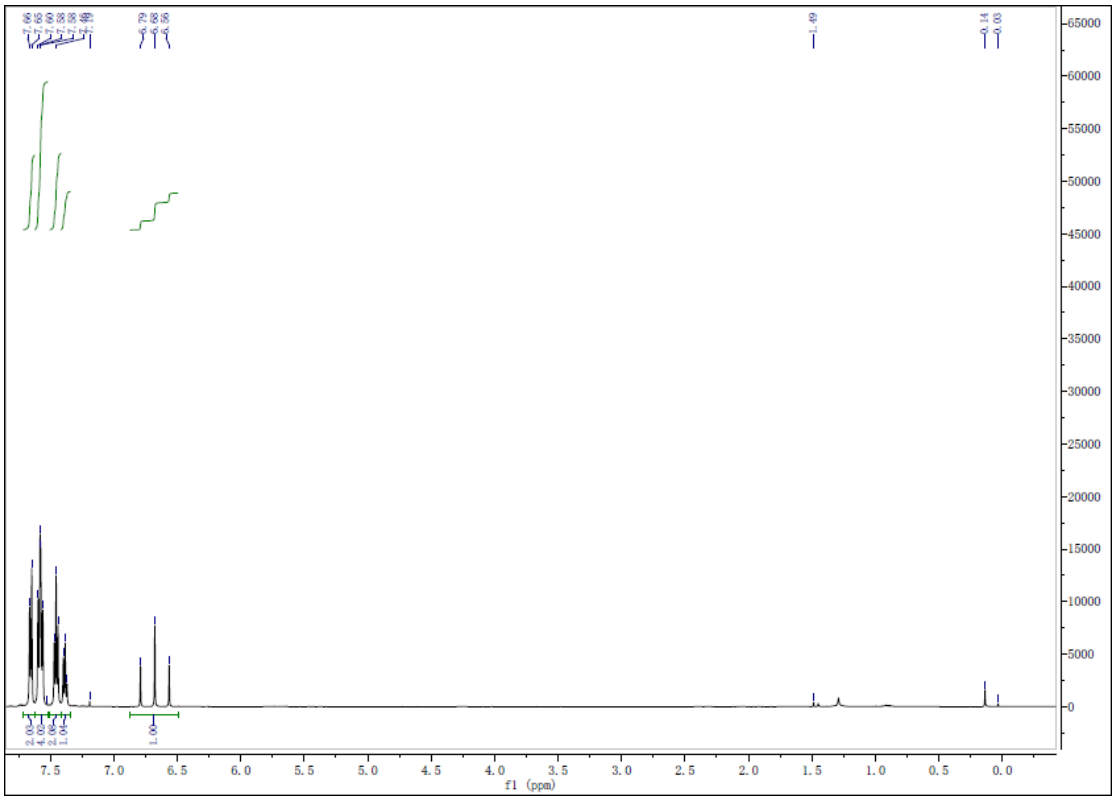
MS of 4-(difluoromethyl)benzenesulfonamide (3l)



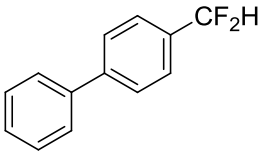


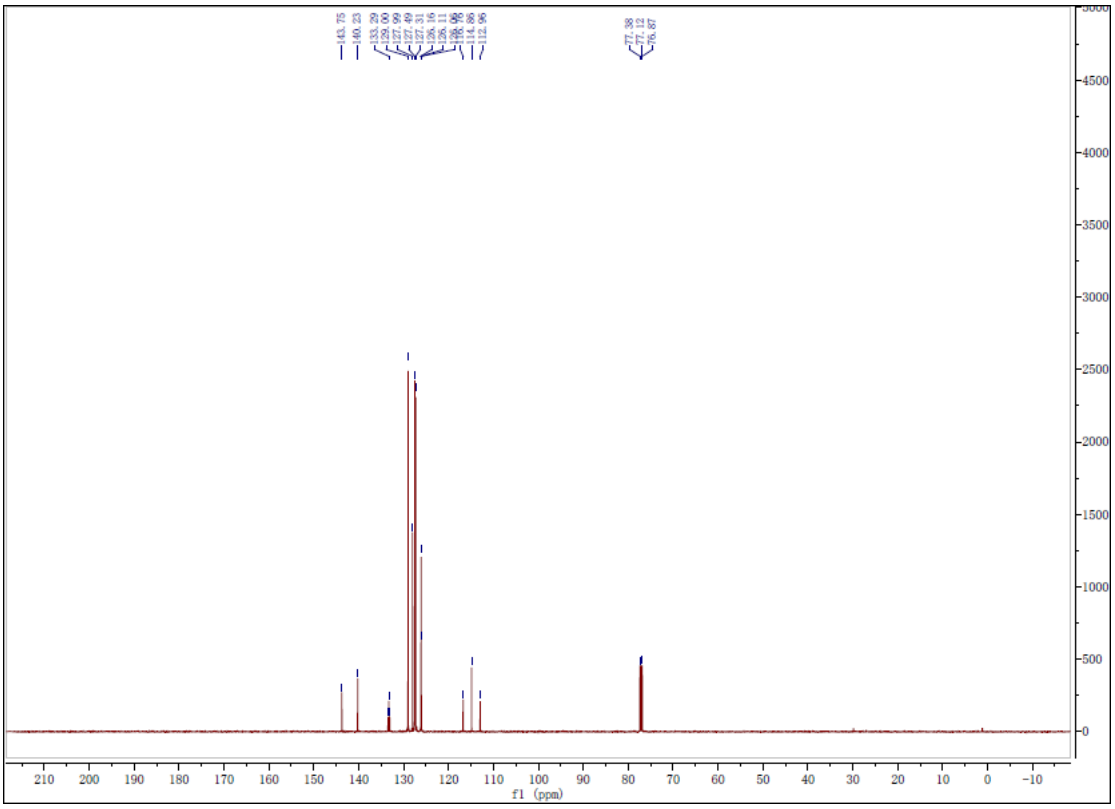
^{1}H NMR of 4- (difluoromethyl)-1, 1'-bipheny (3n)



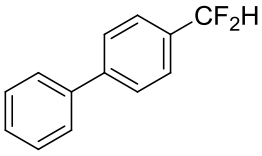


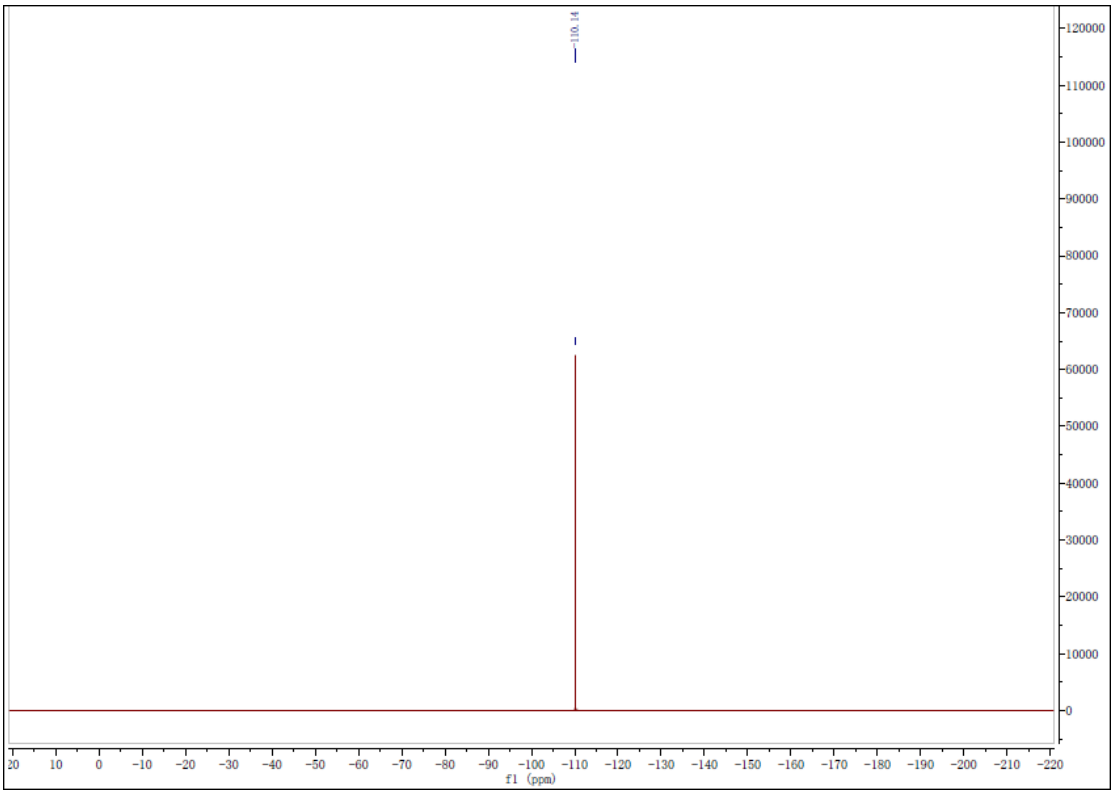
^{13}C NMR of 4- (difluoromethyl)-1, 1'-bipheny (3n)



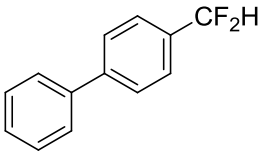


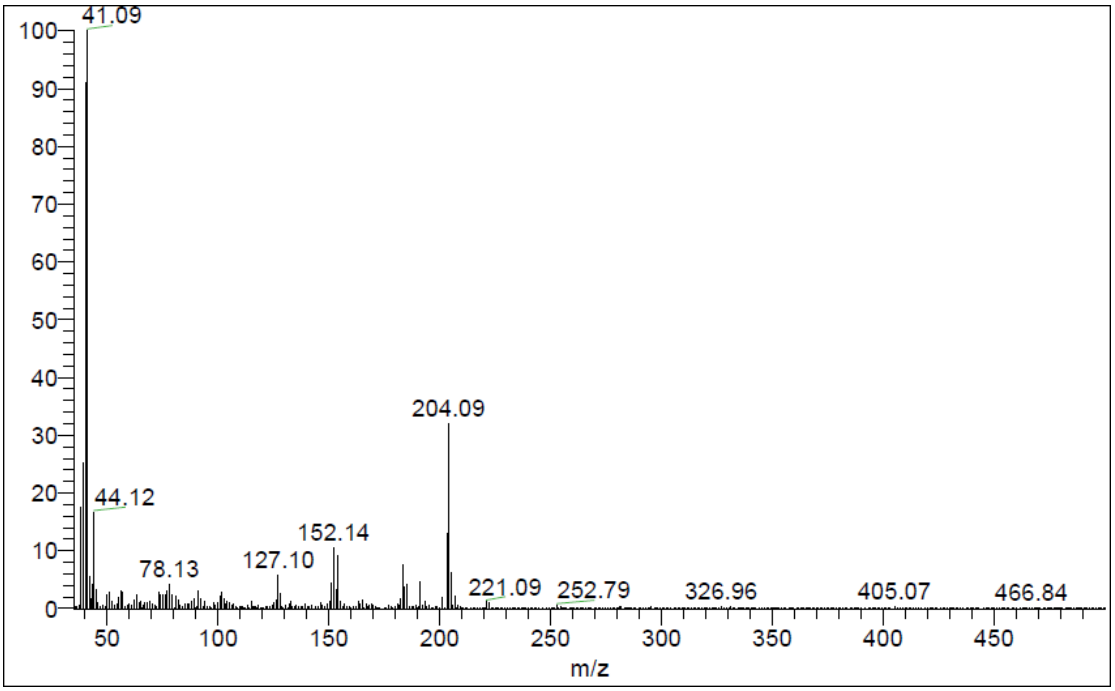
^{19}F NMR of 4-(difluoromethyl)-1,1'-bipheny (3n)



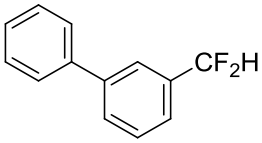


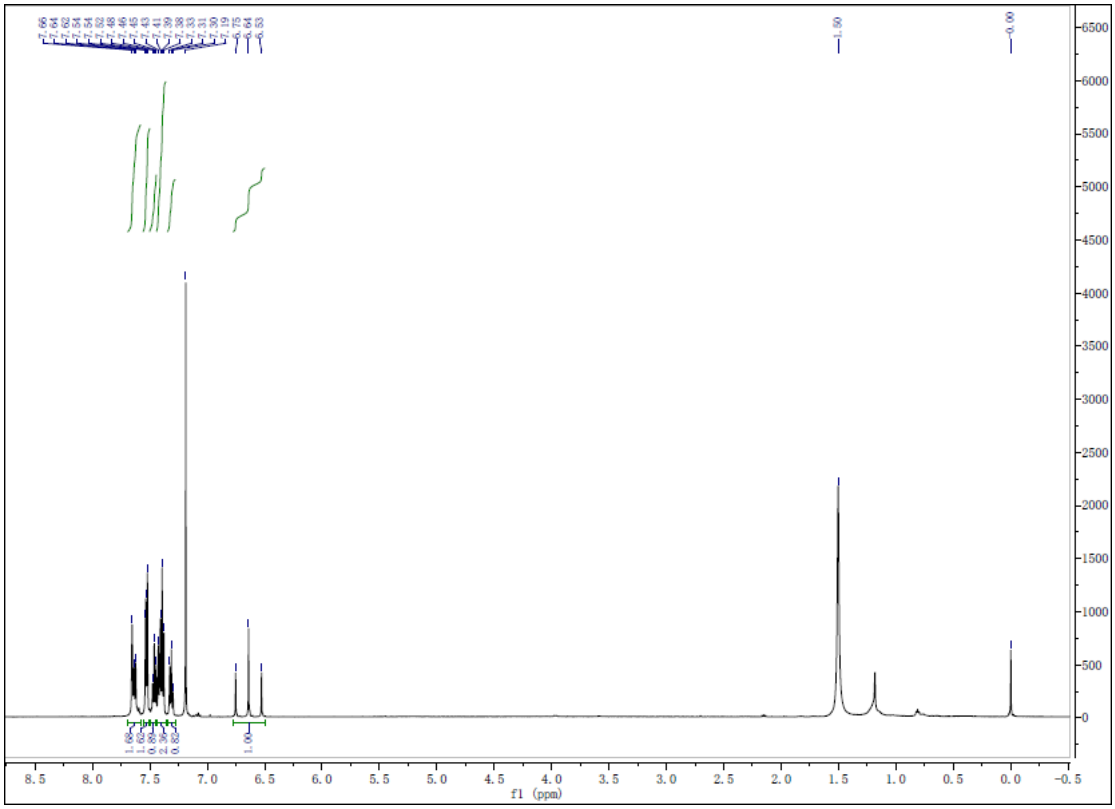
MS of 4- (difluoromethyl)-1, 1'-bipheny (3n)



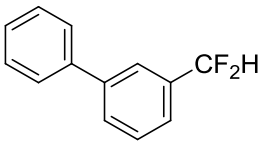


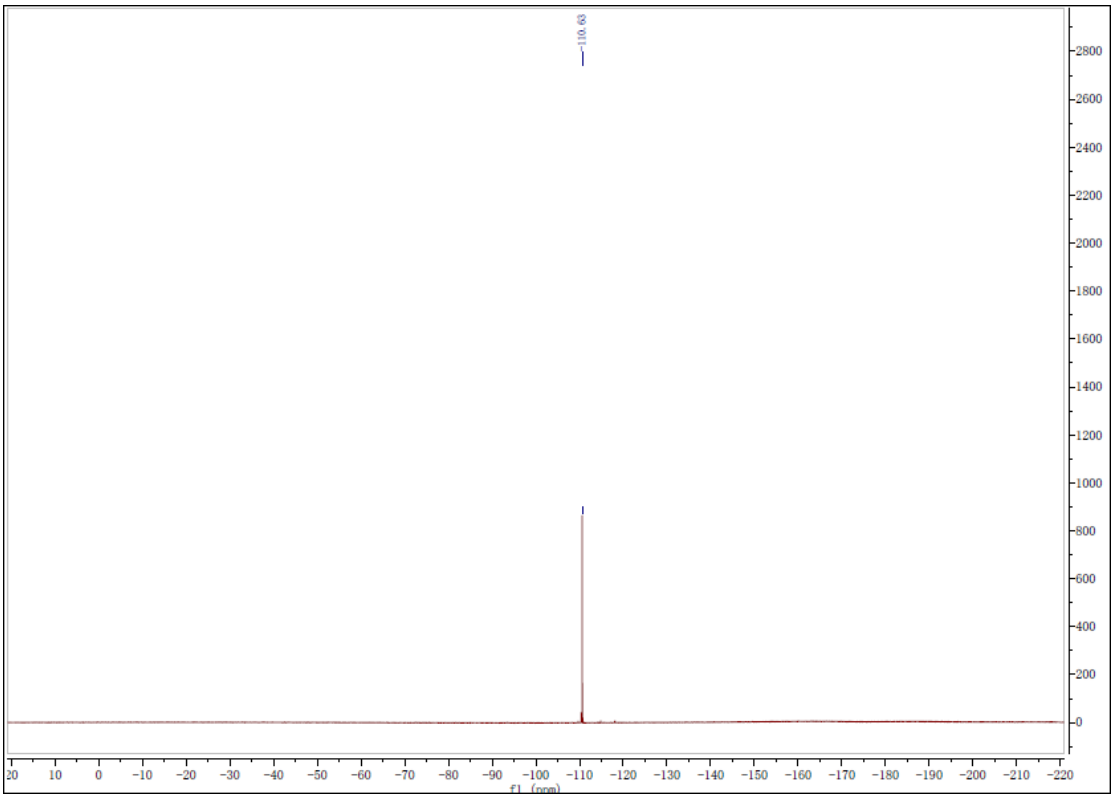
^{1}H NMR of 3- (difluoromethyl)-1, 1'-biphenyl (3o)



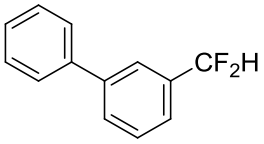


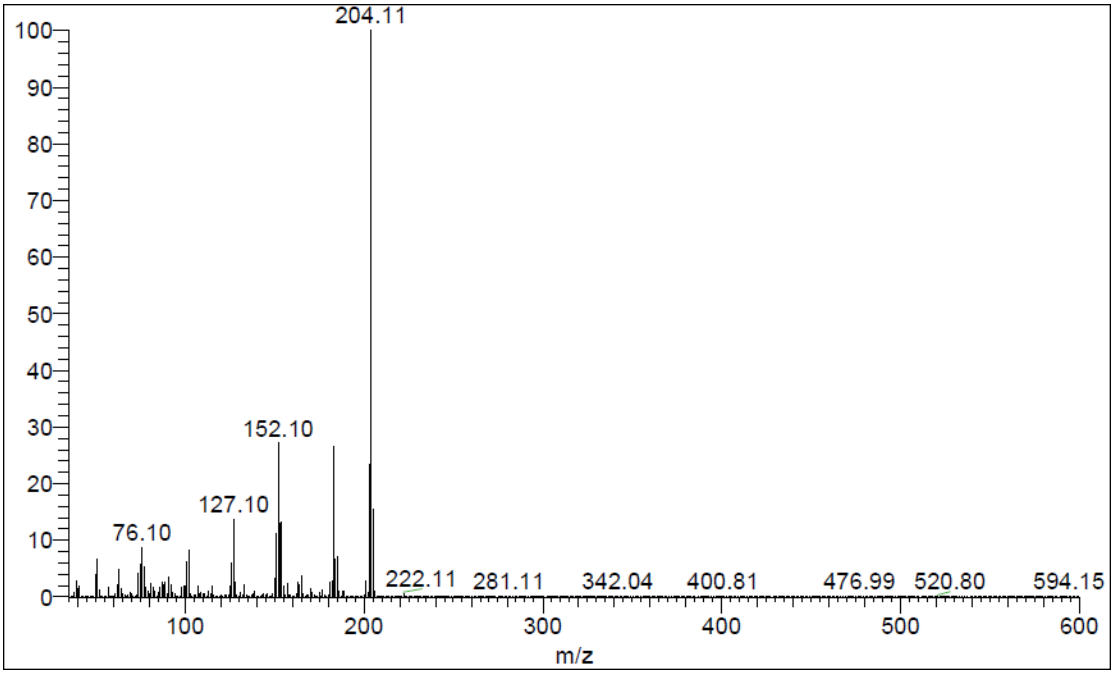
^{19}F NMR of 3- (difluoromethyl)-1, 1'-biphenyl (3o)



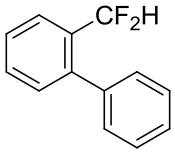


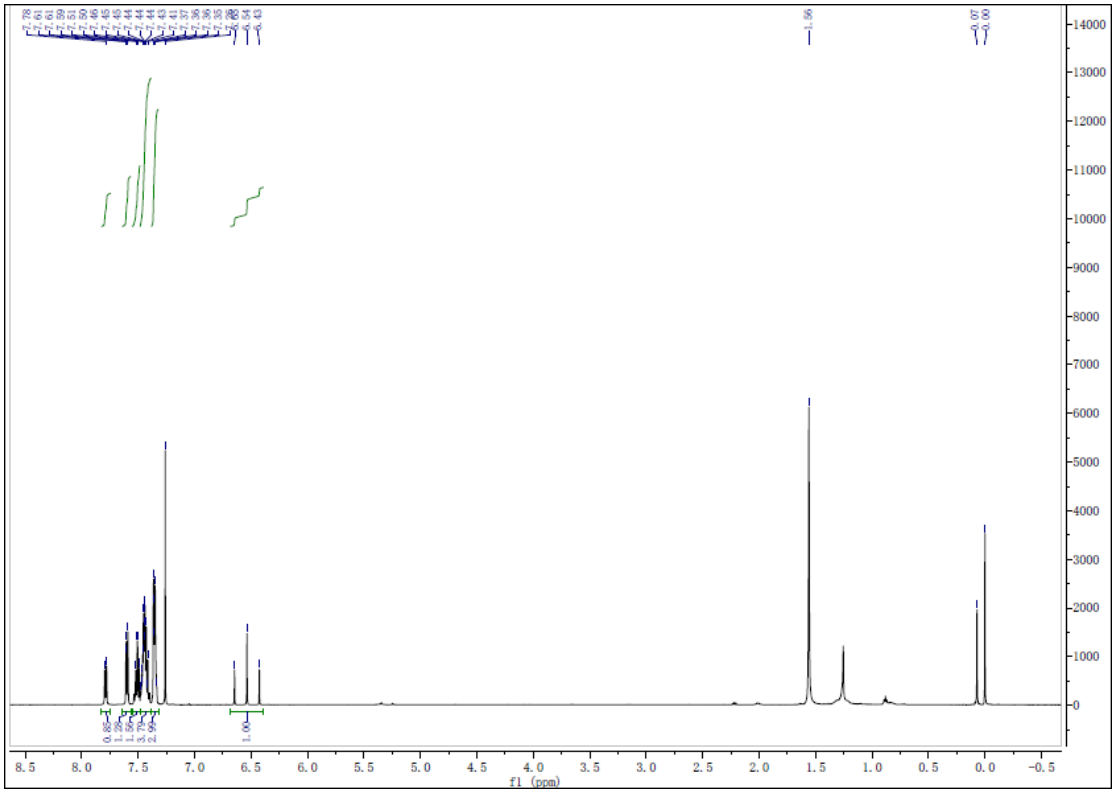
MS of 3- (difluoromethyl)-1, 1'-biphenyl (3o)



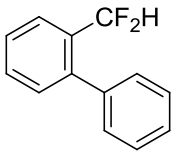


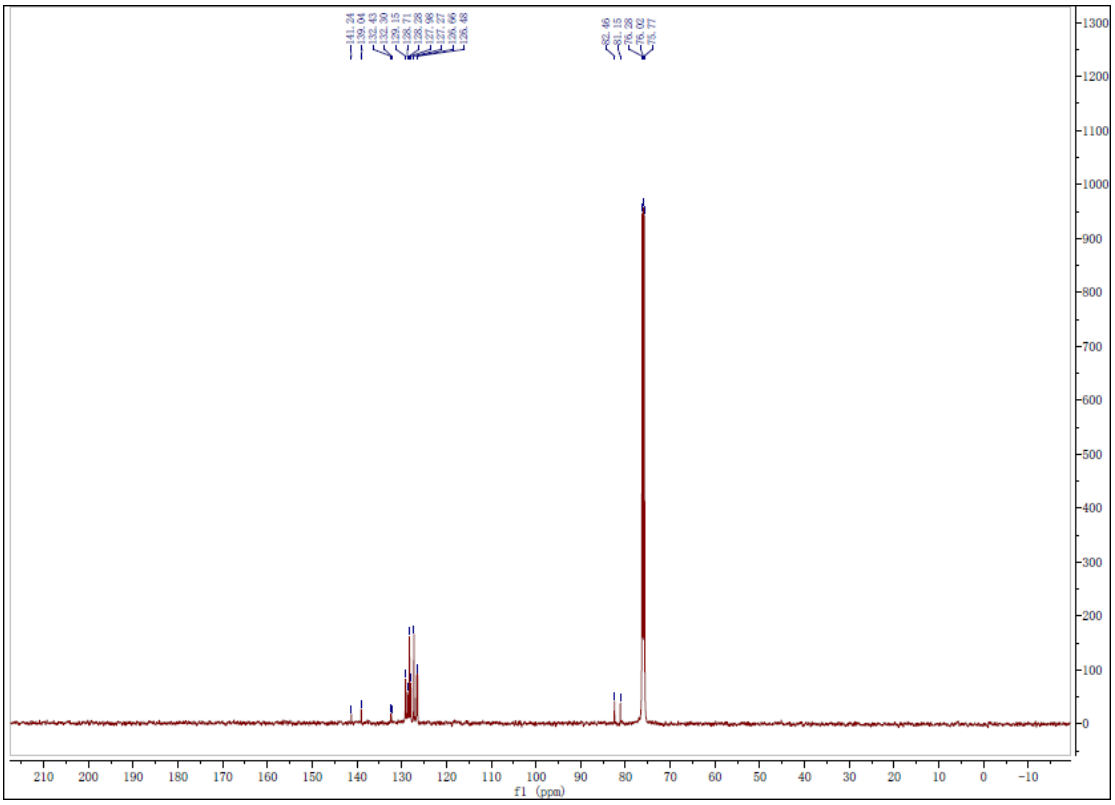
^{1}H NMR of 2- (difluoromethyl)-1, 1'- biphenyl (3p)



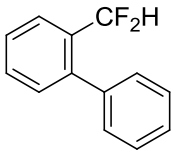


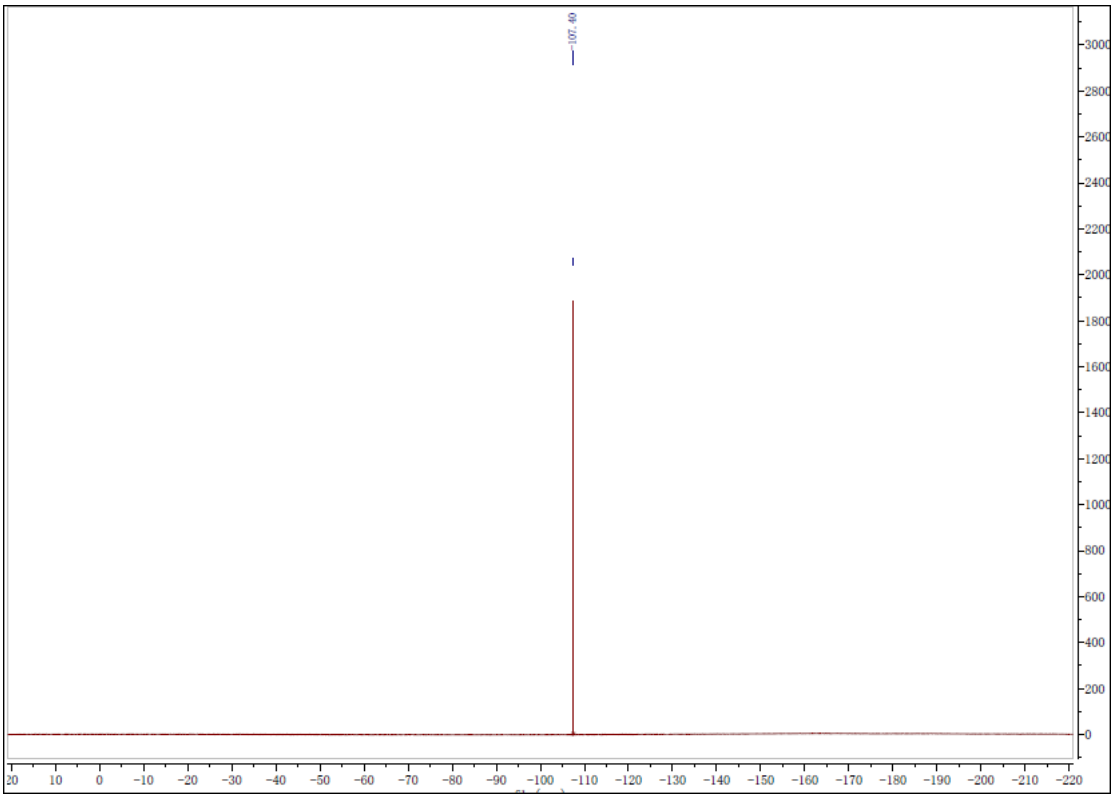
^{13}C NMR of 2- (difluoromethyl)-1, 1'- biphenyl (3p)



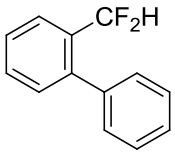


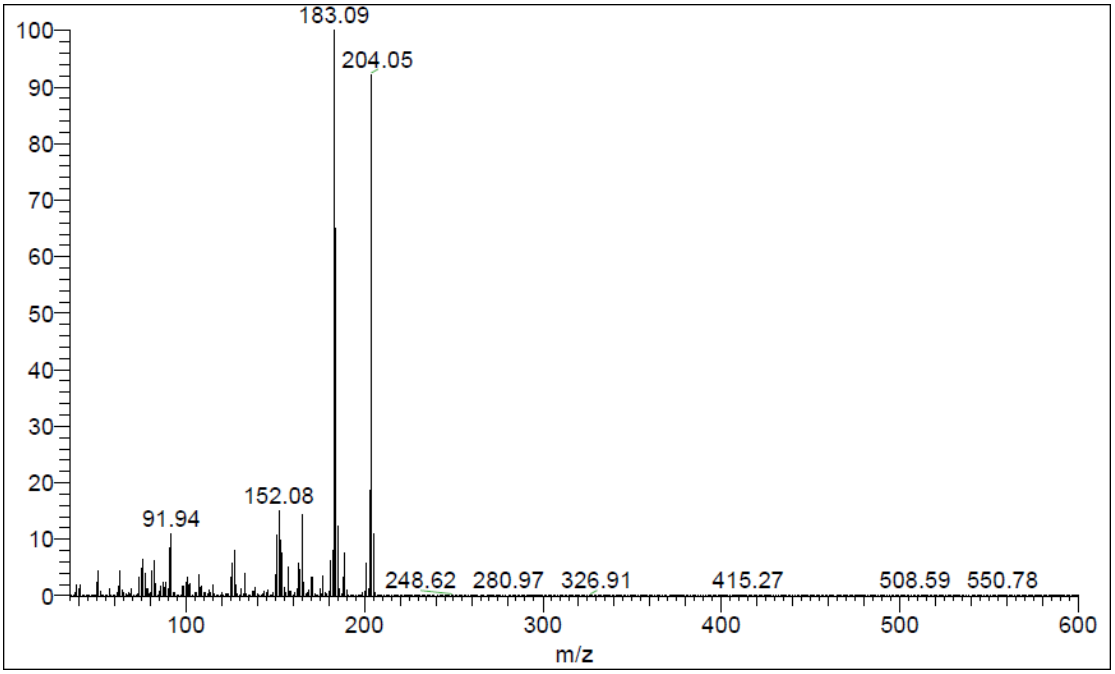
^{19}F NMR of 2- (difluoromethyl)-1, 1'- biphenyl (3p)



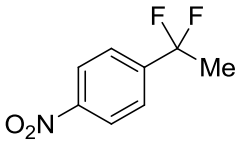


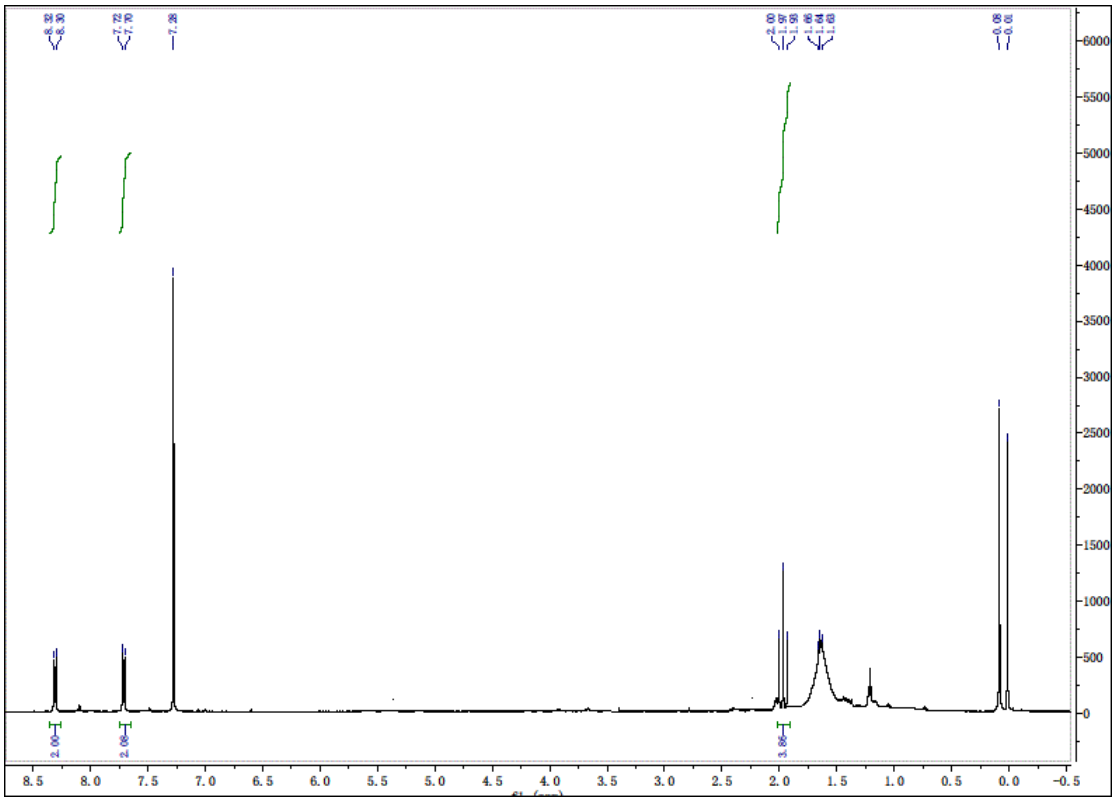
MS of 2- (difluoromethyl)-1, 1'- biphenyl (3p)



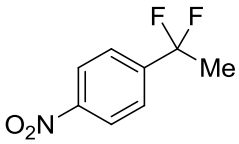


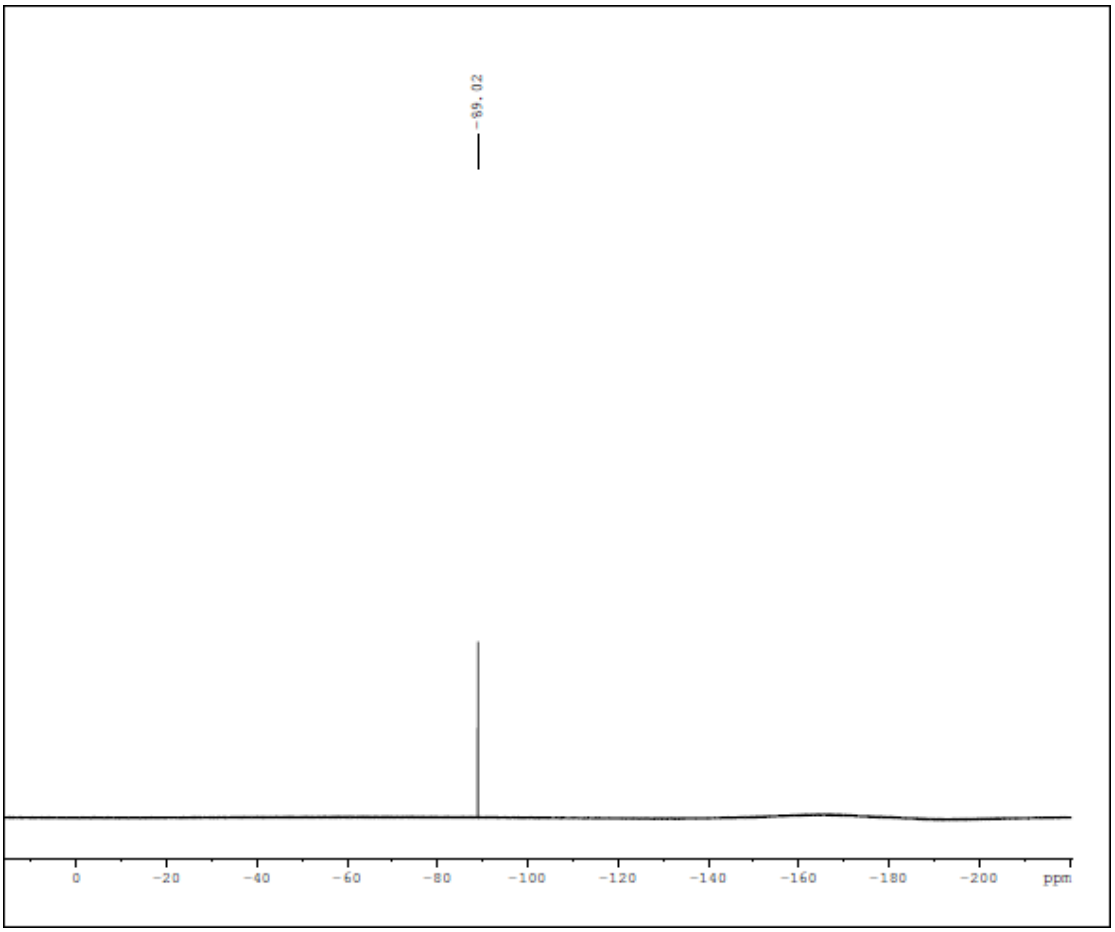
^{1}H NMR of 1- (1, 1- difluoroethyl)-4-nitrobenzene (3q)



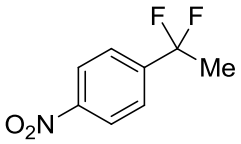


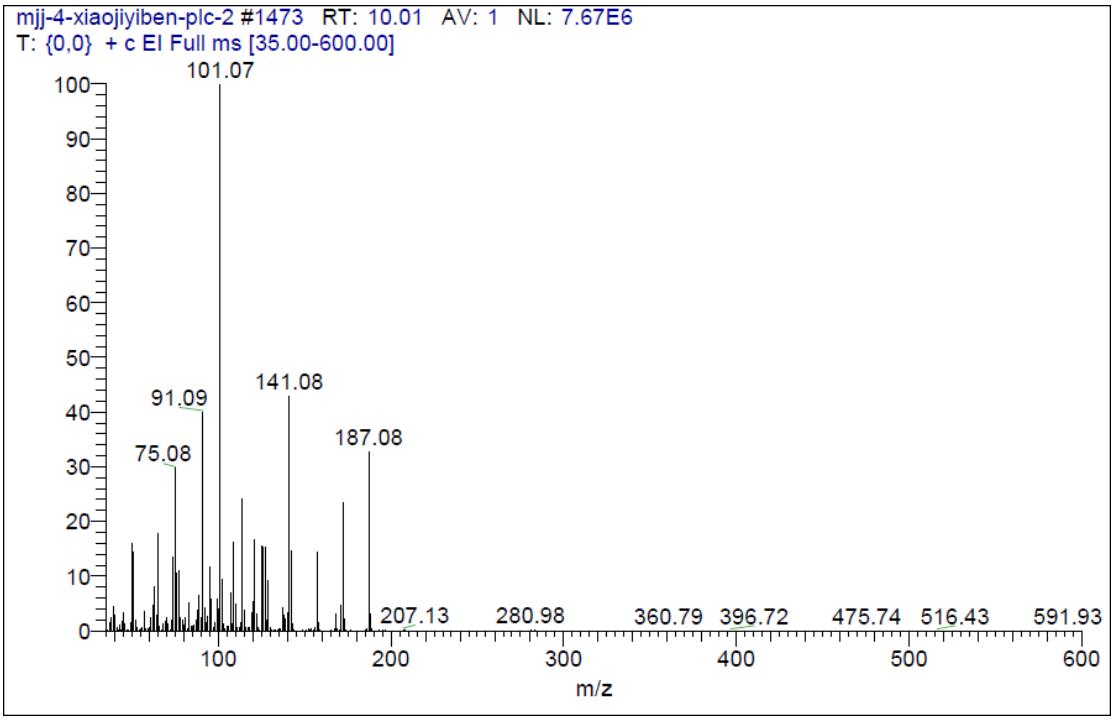
^{19}F NMR of 1- (1, 1- difluoroethyl)-4-nitrobenzene (3q)



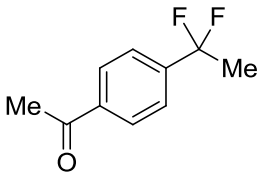


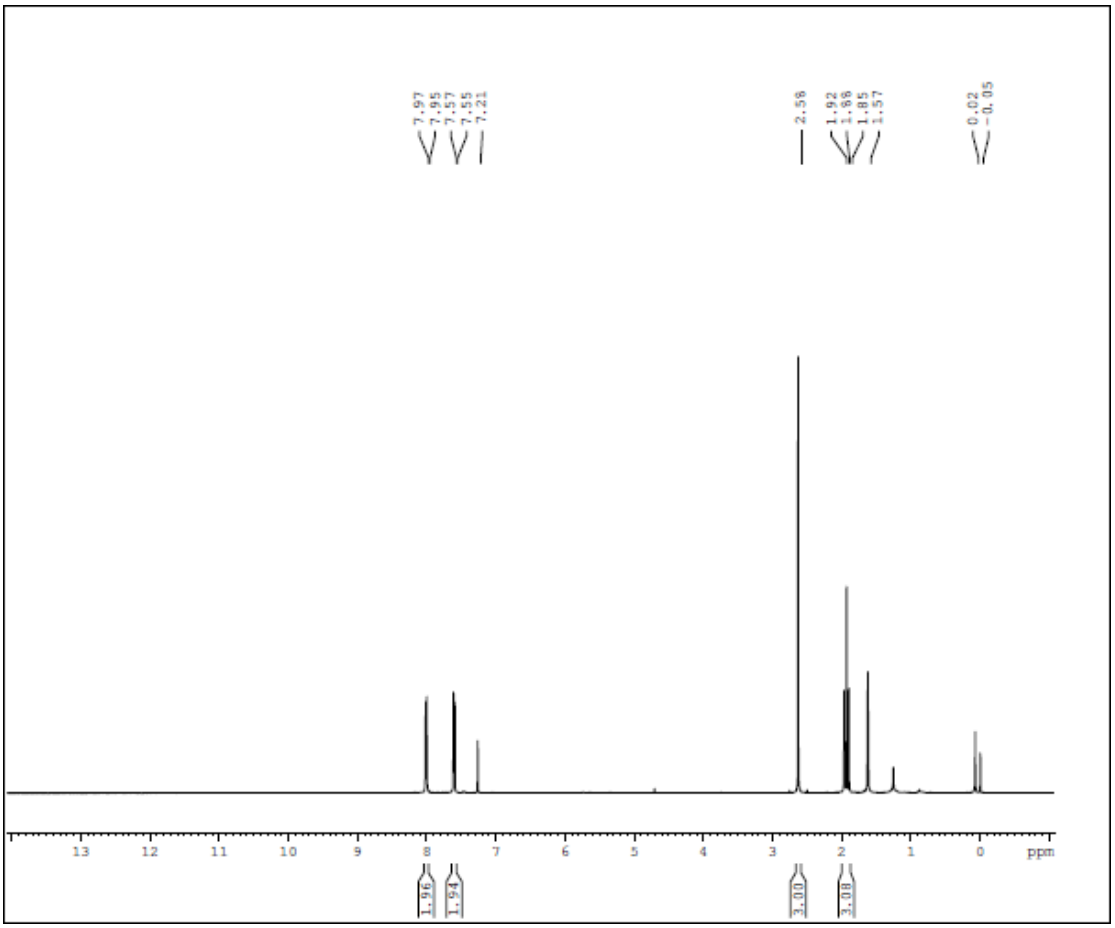
MS of 1- (1, 1- difluoroethyl)-4-nitrobenzene (3q)



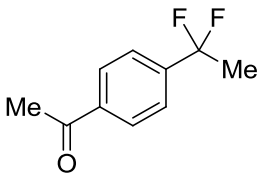


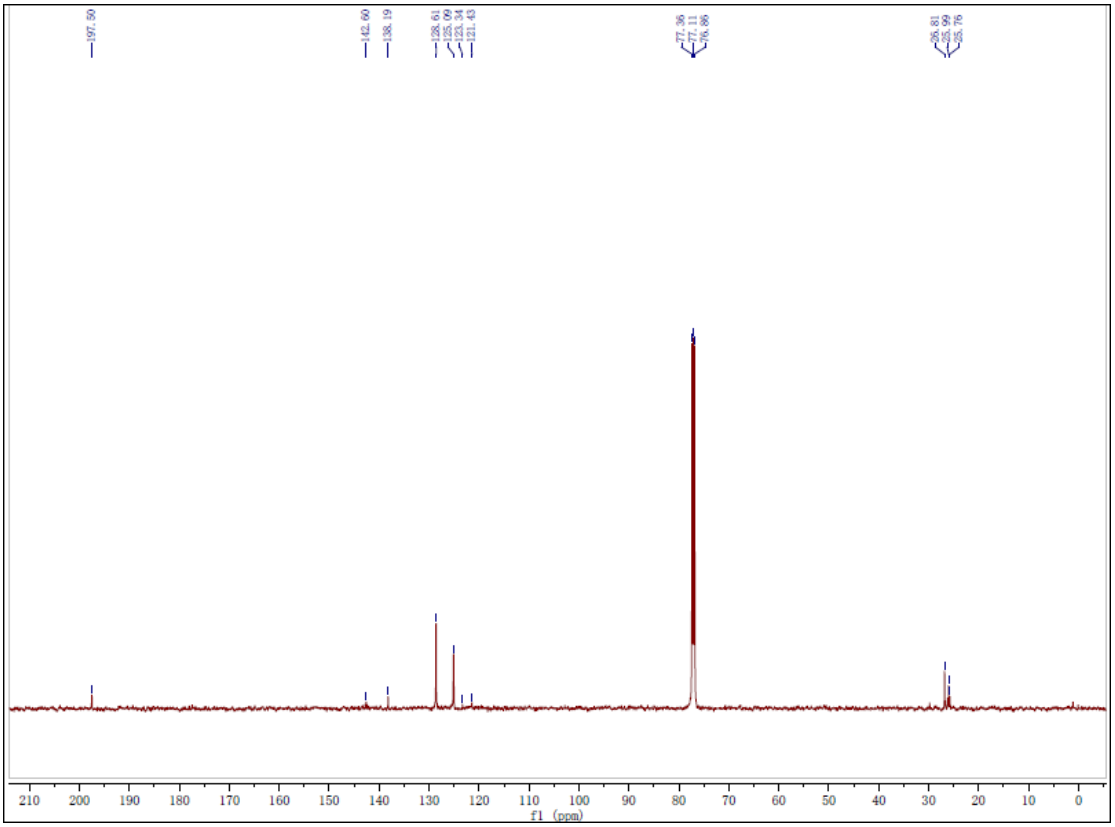
^{1}H NMR of 1- (4- (1, 1-difluoroethyl)phenyl)ethanone (3r)



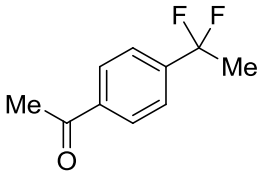


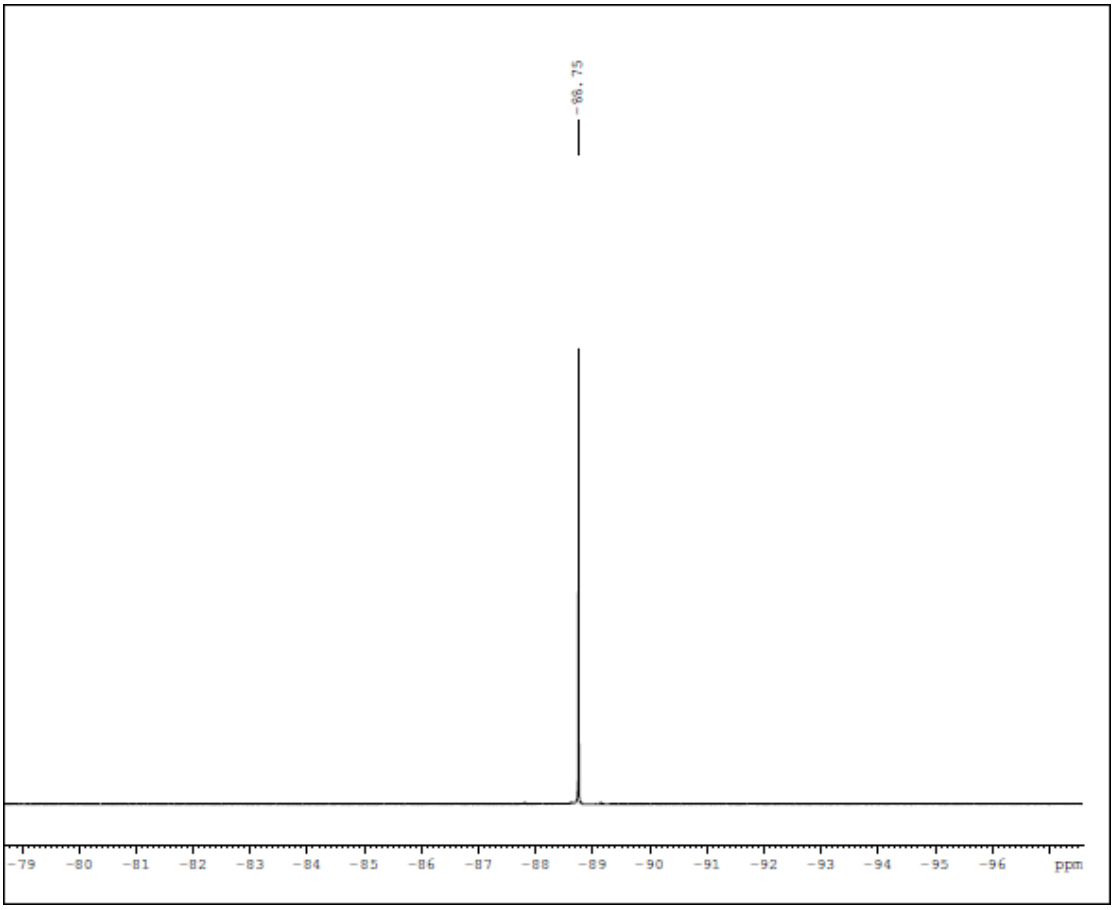
^{13}C NMR of 1- (4- (1, 1-difluoroethyl)phenyl)ethanone (3r)



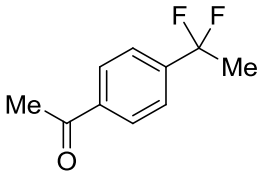


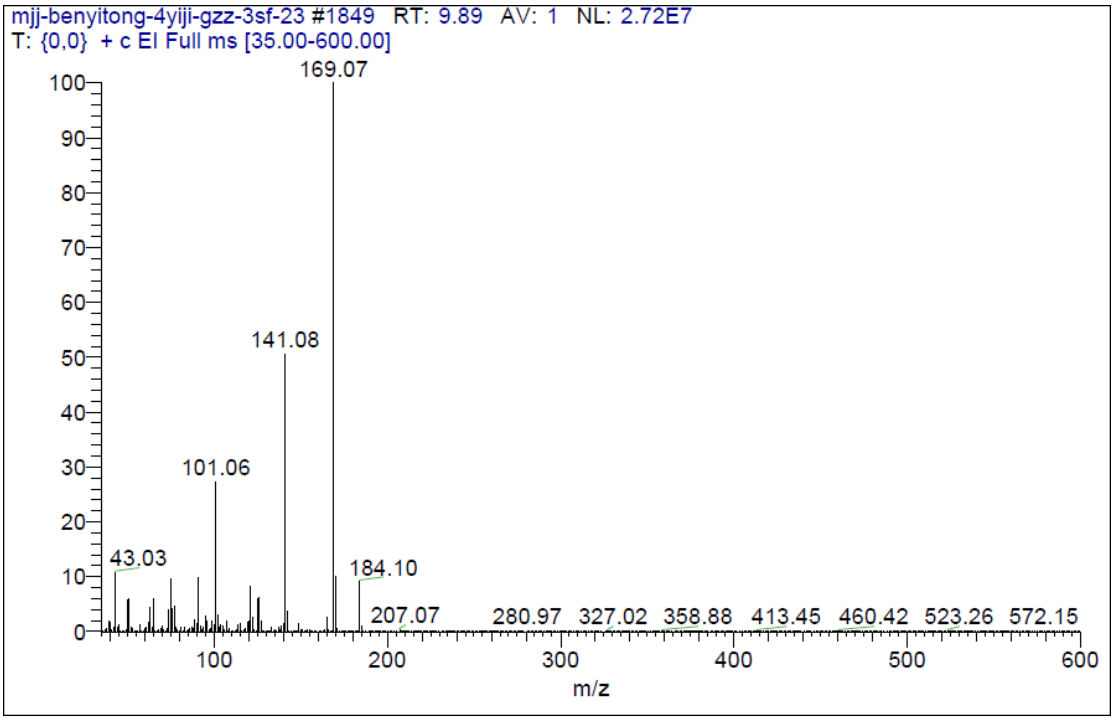
^{19}F NMR of 1- (4- (1, 1-difluoroethyl)phenyl)ethanone (3r)



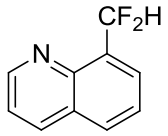


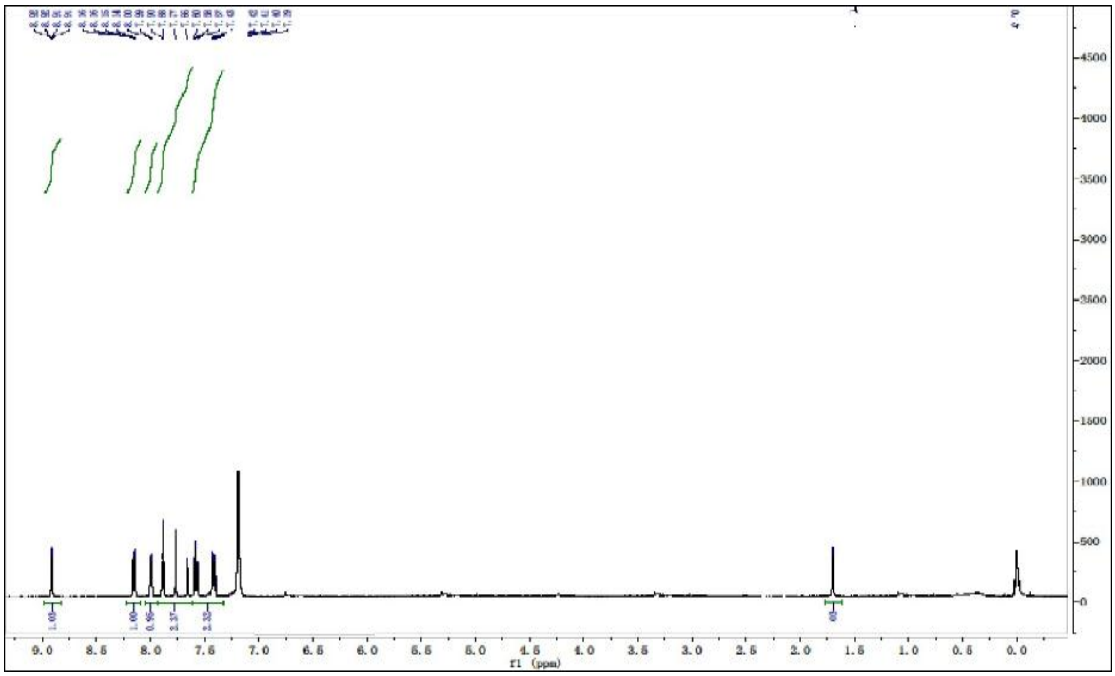
MS of 1- (4- (1, 1-difluoroethyl)phenyl)ethanone (3r)



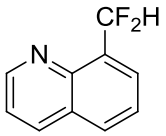


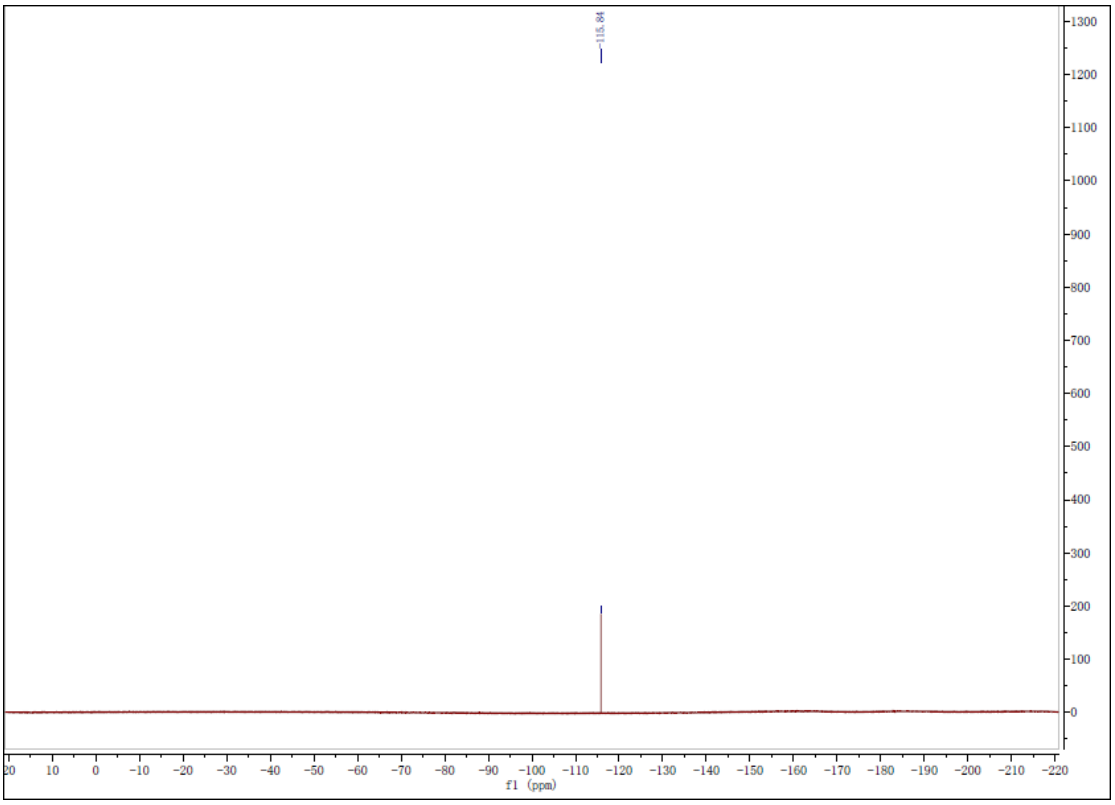
^{1}H NMR of 8- (difluoromethyl)quinoline (3t)



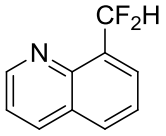


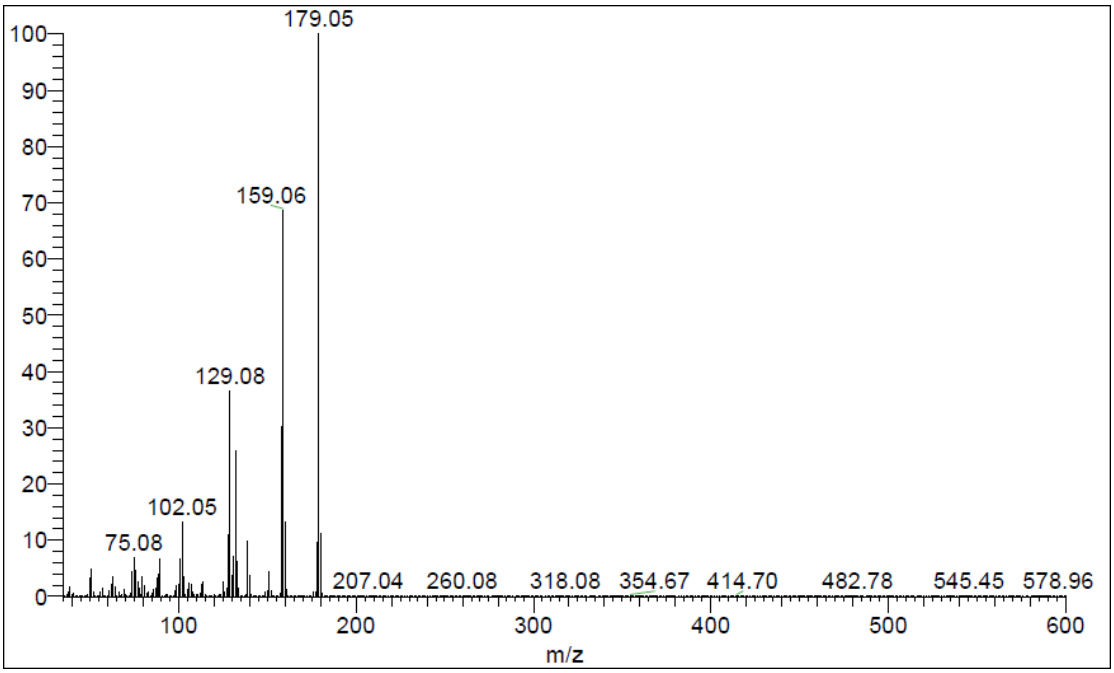
^{19}F NMR of 8- (difluoromethyl)quinoline (3t)





MS of 8- (difluoromethyl)quinoline (3t)

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