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# *Supporting Information for*

# N-Heterocyclic Carbene-Catalysed Pentafluorophenylation of Aldehydes

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## General Methods

Unless otherwise indicated, all reactions were conducted under nitrogen atmosphere in an oven-dried glassware with magnetic stirring bar. Column chromatography was performed with silica gel (200~300 mesh) and analytical TLC on silica gel 60-F254. $^{1}$H NMR (400 MHz, $CDCl_3$), $^{13}$C NMR (100 MHz, $CDCl_3$) and $^{19}$F NMR (376 MHz, $CDCl_3$) spectra were recorded on a Bruker-DMX 400 spectrometer in $CDCl_3$, with tetramethylsilane as an internal standard and reported in ppm (δ). N-heterocyclic carbenes **4-6** were prepared according to literature.[1] **1a** and **1b** were purchased from J&K Chemical Co., Ltd. All other chemicals were obtained from commercial supplies and used as received. Anhydrous THF and toluene were distilled from sodium and benzophenone. DMF, $CH_2Cl_2$ and $CH_3CN$ were distilled from calcium hydride.

## General procedure for N-heterocyclic carbene-catalysed pentafluorophenylation reaction of aldehydes

Aldehyde (0.3 mmol) was dissolved in 1 mL dry $CH_3CN$, cooled to 0 $^{o}$C and $TMSC_6F_5$ **1a** (0.45 mmol, 80 μL) was added via a syringe under $N_2$, then IPr (6 mg, 5 mol%) was added subsequently. The reaction mixture was stirred at room temperature for 1-3 h until full consume of the starting aldehyde indicated by TLC. Then HCl (1.0 mL, 1.0 mol/L) was added to the mixture and stirred for 30 mins at room temperature. The

mixture was extrated with EtOAc (10 mL×3) and the combined organic phase was washed subsequently by water and sat. aq. $NaHCO_3$ and dried over anhyd. $Na_2SO_4$, filtered, and concentrated. The crude product was purified by flash column chromatography on silica gel (PE-EtOAc, 10:1) to give the desired product.

**General procedure for N-heterocyclic carbene-catalysed dual tetrafluorophenylation of aldehyde**

Aldehyde (0.6 mmol) and 1,4-bis(trimethylsilyl)tetrafluorobenzene **1b** (0.2 mmol, 60 mg) were dissolved in 1 mL dry $CH_3CN$. The solution was cooled to 0 $^oC$ and IPr (6 mg, 5 mol%) was added subsequently. The reaction mixture was stirred at room temperature for 2-3 h until full consume of the starting aldehyde indicated by TLC. Then HCl (1.0 mL, 1.0 mol/L) was added to the mixture and stirred for 30 mins at room temperature. The mixture was extrated with EtOAc (10 mL×3) and the combined organic phase was washed subsequently by water and sat. aq. $NaHCO_3$ and dried over anhyd. $Na_2SO_4$, filtered, and concentrated. The crude product was purified by flash column chromatography on silica gel (PE-EtOAc, 3:1) to give the desired product.

**Experimental Data:**

**(4-chlorophenyl)(perfluorophenyl)methanol (3a)** [2]

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.36-7.17 (m, 4H), 6.11 (s, 1H), 2.86 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 143.6 (dm, *J* = 248.0 Hz), 139.9 (dm, *J* = 248.0 Hz), 137.9, 136.6 (dm, *J* = 252.0 Hz), 133.0, 130.4, 127.8, 125.7 (t, *J* = 1.0 Hz), 65.8; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.98 (dd, *J* = 21.7, 8.0 Hz, 2F), -153.97 (t, *J* = 20.6 Hz, 1F), -161.13 (ddd, *J* = 28.3, 2102, 7.2 Hz, 2F).

**(4-fluorophenyl)(perfluorophenyl)methanol (3b)**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.40-7.37 (m, 2H), 7.10-7.04 (m, 2H), 6.23 (s, 1H), 3.02 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 163.7, 161.2, 144.5 (dm, *J* = 248.0 Hz), 140.9 (dm, *J* = 249.0 Hz), 137.7(dm, *J* = 253.0 Hz), 136.4 (m), 127.2 (dt, *J* = 8.0, 1.0 Hz), 115.7 (d, *J* = 21.0 Hz), 66.9; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -113.79 (s, 1F), 143.16 (ddd, *J* = 22.5, 7.3, 0.83 Hz, 2F), -154.29 (t, *J* = 2.0 Hz, 1F), -161.32 (ddd, *J* = 27.9, 21.1, 7.4, 2F). HRMS (EI) calcd for $C_{13}H_6OF_5$ ($M^+$) 292.0323, found 292.0322.

**(4-bromophenyl)(perfluorophenyl)methanol (3c)**[2]

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.53-7.45 (m, 1H), 7.30-7.28 (m, 2H), 6.20 (s, 1H), 2.87 (br s, 1H); $^{13}$C NMR (100MHz, $CDCl_3$) δ 144.6 (dm, *J* = 25.0 Hz), 141.0 (dm, *J* = 254.0 Hz), 139.5, 137.7(dm, *J* = 245.0 Hz), 131.8, 127.0, 122.2, 116.4 (tm, *J* = 31.0 Hz), 66.8; $^{19}$F NMR (376 MHz,

$CDCl_3$) δ -142.94 (dd, *J* = 22.0, 8.1 Hz, 2F), -153.89 (t, *J* = 20.7 Hz, 1F), -160.73 - -161.43 (ddd, *J* =26.1, 14.0, 504 Hz, 2F).

**4-(hydroxy(perfluorophenyl)methyl)benzonitrile (3d)**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.68-7.66 (m, 2H), 7.57-7.55 (m, 2H), 6.31 (s, 1H), 3.19 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 145.9, 143.6 (dm, *J* = 246.0 Hz), 141.2 (dm, *J* =254.0 Hz), 1347.7 (dm, *J* = 243.0 Hz), 132.4, 126.1 (t, *J* = 1.0 Hz), 118.4, 116.1 (tm, *J* = 18.0 Hz), 111.7, 66.1; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.52- -142.63 (m, 2F), -153.15 (t, *J* = 23.0Hz, 1F), -160.68- -160.83 (m, 2F); HRMS (EI) calcd for $C_{14}H_6ONF_5$ ($M^+$) 299.0370, found 299.0373.

**(4-nitrophenyl)(perfluorophenyl)methanol (3e)**

$^1$H NMR (400 MHz, DMSO-d6) δ 8.21 (d, *J* = 8.7 Hz, 2H), 7.67 (d, *J* = 8.5 Hz, 2H), 6.88 (d, *J* = 4.9 Hz, 1H), 6.24 (d, *J* = 4.9 Hz, 1H); $^{13}$C NMR (100 MHz, DMSO-d6) δ 149.8, 147.1, 144.7 (dm, *J* = 245.0 Hz), 140.7 (dm, *J* = 250.0 Hz), 137.5 (dm, *J* = 250.0 Hz), 127.1, 123.8, 117.8 (m), 64.6; $^{19}$F NMR (376 MHz, DMSO-d6) δ -142.6 (ddd, *J* = 23.3, 9.4, 2.1 Hz, 2F), -152.7 (tt, *J* = 20.7, 2.0Hz, 1F), -160.77 (ddd, *J* = 27.7, 20.8, 6.9 Hz, 2F); HRMS (EI) calcd for $C_{16}H_6O_3NF_5$ ($M^+$) 319.0268, found 319.0264.

**(perfluorophenyl)(phenyl)methanol (3f)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.24-7.10 (m, 5H), 6.07 (s, 1H), 2.78 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.7 (dm, *J* = 245.0 Hz), 140

.8 (dm, $J$ = 254.0 Hz), 140.5, 137.7 (dm, $J$ = 262.0 Hz), 128.7, 128.2, 125.3 (t, $J$ = 1.0 Hz), 116.9, 67.5; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.54 (dd, $J$ = 22.1, 7.9 Hz, 2F), -154.69 (t, $J$ = 21.1 Hz, 1F), -1616 (ddd, $J$ = 28.5, 21.7, 7.7 Hz, 2F).

**naphthalen-1-yl(perfluorophenyl)methanol (3g)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 8.08-8.05 (m, 1H), 7.93-7.86 (m, 2H), 7.65-7.48 (m, 4H), 6.87 (s, 1H), 3.07 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.9 (dm, $J$ = 256.0 Hz), 140.9 (dm, $J$ = 253.0 Hz), 137.7 (dm, $J$ = 252.0 Hz), 134.8, 133.8, 130.3, 129.4, 129.0, 126.8, 125.9, 125.0, 123.9 (t, $J$ = 2.0 Hz), 122.7 (t, $J$ = 2.0 Hz), 116.0 (dm, $J$ = 15.0 Hz), 65.1; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -12.3 (ddd, $J$ =23.1, 8.9, 1.9 Hz, 2F), -154.20 (t, $J$ = 21.1 Hz, 1F), -161.4 (ddd, $J$ = 27.4, 20.6, 6.4 Hz, 2F).

**naphthalen-2-yl(perfluorophenyl)methanol (3h)**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.86-7.82 (m, 4H), 7.54-7.45 (m, 3H), 6.39 (s, 1H), 2.99 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.7 (dm, $J$ = 245.0 Hz), 140.5 (dm, $J$ = 245.0 Hz), 137.8, 137.7 (dm, $J$ = 245.0 Hz), 133.1, 133.0, 128.7, 128.1, 127.7, 126.6, 126.4, 124.1 (t, $J$ = 2.0 Hz), 123.7 (t, $J$ = 2.0 Hz), 116.8, 67.7; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.86 (ddd, $J$ = 25.0, 8.8, 2.0Hz, 2F), -154.38 (tt, J = 21.2, 2.0 Hz, 1F), -161.27--161.42 (m, 2F); HRMS (EI) calcd for $C_{17}H_9OF_5$ ($M^+$) 324.0574, found 324.0574.

**(perfluorophenyl)(p-tolyl)methanol (3i)**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.25 (m, 4H), 6.21 (s, 1H), 3.03 (br s, 1H), 2.39 (s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ144.6 (dm, *J* = 250.0 Hz), 140.7 (dm, *J* = 253.0 Hz), 137.6 (dm, *J* = 249.0 Hz), 138.2, 137.6, 129.4, 125.3, 117.1, 67.5, 21.0; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.13 (dd, *J* = 22.1, 7.9 Hz, 2F), -154.91 (dd, *J* = 40.9, 20.5 Hz, 1F), -161.62- -161.76 (m, 2F); HRMS (EI) calcd for $C_{14}H_9OF_5$ ($M^+$) 288.0574, found 288.0578.

**(4-methoxyphenyl)(perfluorophenyl)methanol (3j)[4]**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.29-7.27 (m, 2H), 6.87 – 6.85 (m, 2H), 6.14 (s, 1H), 3.78 (s, 3H), 2.89 (br s, 1H); $^{13}$C NMR (100MHz, $CDCl_3$) δ 159.4, 144.6 (dm, *J* = 250.0 Hz), 140.6 (dm, *J* = 252.0 Hz), 137.7 (dm, *J* = 234.0 Hz), 132.7, 126.8 (t, *J* = 2.0 Hz), 117.1, 114.0, 67.4, 55.2; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.22 (dd, *J* = 10.0, 2.5 Hz, 2F), -155.08 (t, *J* = 20.7 Hz, 1F), -161.7(ddd, *J* =28.7, 21.8, 7.7 Hz, 2F).

**(2-methoxyphenyl)(perfluorophenyl)methanol (3k)[5]**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.53-7.49 (m, 1H), 7.35-7.28 (m, 1H), 7.05-7.01 (m, 1H), 6.90-6.88 (m, 1H), 6.37 (s, 1H), 3.83 (s, 1H), 3.33 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 156.1, 145.0 (dm, *J* = 239.0 Hz), 140.5 (dm, *J* = 249.0 Hz), 137.4 (dm, *J* = 246.0 Hz), 129.3, 128.2, 126.6 (t, *J* = 2.0 Hz), 120.6, 116.3, 110.4, 64.3, 55.2; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.25 (ddd, *J* =25.1, 10.8, 2.5 Hz, 2F), -155.89(tm, *J* = 20.9 Hz, 1F), -162.7 (ddd, *J* = 29.2, 22.4, 8.2 Hz, 2F)

**(3-methoxyphenyl)(perfluorophenyl)methanol (3l)[3]**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.15-7.10 (m, 1H), 6.85-6.68 (m, 3H), 6.04 (s, 1H), 3.66 (s, 3H), 2.92 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 159.8, 144.8 (dm, *J* = 251.0 Hz), 142.2, 140.8 (dm, *J* = 253.0 Hz), 137.6 (dm, *J* =260.0 Hz), 129.8, 117.5 (t, *J* = 2.0 Hz), 116.8, 113.3, 111.3 (t, *J* = 2.0 Hz), 67.3, 55.2; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.70 – -143.42 (m, 2F), -154.73 (tt, J = 21.3, 1.5 Hz), -161.50 – -162.66 (m, 2F).

**(perfluorophenyl)(o-tolyl)methanol (3m)**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.57-7.53(m, 1H), 7.29-7.26 (m, 2H), 7.23-7.19 (m, 1H), 6.33 (s, 1H), 2.34 (br s, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.8 (dm, *J* = 247.0 Hz), 140.8 (dm, *J* = 264.0 Hz), 138.3 (dm, *J* = 248.0 Hz), 137.8, 135.3, 130.8, 128.4, 126.1, 125.6 (t, *J* = 3.0 Hz), 115.8, 65.48, 18.93; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.09- -142.18(m, 2F), -154.52 (ddd, J = 21.2, 11.3, 2.1 Hz), -161.62(ddd, J = 26.8, 20.1, 6.1 Hz, 2F); HRMS (EI) calcd for $C_{14}H_9OF_5$ ($M^+$) 288.0574, found 288.0577.

**(2-chlorophenyl)(perfluorophenyl)methanol (3n)**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.83-7.79 (m, 1H), 7.40-7.28 (m, 3H), 6.40 (s, 1H), 3.20 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 145.1 (dm, *J* = 245.0 Hz), 141.1 (dm, *J* = 258.0 Hz), 137.6 (dm, *J* = 250.0 Hz), 137.4, 131.6, 129.5, 129.4, 127.6 (t, *J* = 3.0 Hz), 126.8, 114.9, 64.4; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -141.55 (ddd, *J* =23.1, 8.9, 3.2 Hz, 2F), -154.01 (t, *J* = 20.0 Hz, 1F), -161.83 (ddd, *J* = 27.7, 20.8, 6.7 Hz, 2F); HRMS (EI) calcd for $C_{13}H_6OClF_5$ ($M^+$) 308.0027, found 308.0024.

**(3-bromophenyl)(perfluorophenyl)methanol (3o)**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.58-7.56 (m, 1H), 7.47-7.45 (m, 1H), 7.33-7.24 (m, 2H), 6.22 (s, 1H), 2.94 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.7 (dm, *J* = 248.0 Hz), 142.7, 141.1 (dm, *J* = 251.0 Hz), 137.7 (dm, *J* = 253.0 Hz), 131.3, 130.2, 128.4 (t, *J* = 1.0 Hz), 123.9 (t, *J* = 1.0 Hz), 122.8, 116.3, 66.6; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.76- -142.81(ddd, *J* =21.2, 7.3, 6.2 Hz, 2F), -153.73 (tt, *J* = 21.1, 2.1 Hz), -160.92- -161.06 (m, 2F); HRMS (EI) calced for $C_{13}H_6BrF_5O$ ($M^+$) 351.9522, found 351.9522.

**(2,4-dichlorophenyl)(perfluorophenyl)methanol (3p)[2]**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, *J* = 8.8 Hz, 1H), 7.38-7.33 (m, 2H), 6.34 (s, 1H), 2.87-2.77 (m, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 145.1 (dm, *J*=250 Hz), 141.3 (dm, *J*=253 Hz), 137.5 (dm, *J*=249 Hz), 136.11 (m), 134.6, 132.2, 129.2, 128.7 (m), 127.1, 114.8 (m), 64.0; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -141.55- -141.67 (m, 2F), -153.44 (tt, *J* = 20.3, 2.1 Hz, 1F), -161.53 (ddd, *J* = 26.7, 19.8, 5.9 Hz, 2F).

**benzo[d][1,3]dioxol-5-yl(perfluorophenyl)methanol (3q)**

$^{1}$H NMR (400 MHz, $CDCl_3$) δ 6.87 (s, 1H), 6.82-6.70 (m, 2H), 6.10 (s, 1H), 5.93 (s, 2H), 2.94 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 148.1, 147.5, 144.5 (dm, *J* = 251 Hz), 140.4 (dm, J = 252 Hz), 137.6 (dm, *J* = 252 Hz), 134.5, 118.9, 116.9 (tm, J = 19 Hz), 108.3, 106.1, 101.3, 67.5; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.17(dd, *J* = 22.5, 8.3 Hz, 2F), -154.80

(t, $J$ = 253.8 Hz, 1F), -161.49 (tm, $J$ = 22.9 Hz, 2F); HRMS (EI) calcd for $C_{14}H_7O_3F_5$ ($M^+$) 318.0315, found 318.0315.

**furan-2-yl(perfluorophenyl)methanol (3r)[6]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.41 (dd, $J$ = 1.9 Hz, 0.88 Hz, 1H), 6.38 (dd, J = 3.3, 1.8 Hz, 2H), 6.17 (s, 1H), 3.05 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 152.1, 143.3 (dm, $J$ = 244.0 Hz), 143.0, 141.0 (dm, $J$ = 254.0 Hz), 137.65 (dm, $J$ = 246.0 Hz), 114.4, 110.6, 107.6 (t, $J$ = 1.0 Hz), 61.9; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.04 (ddd, $J$ =21.1, 7.2, 1.0 Hz, 2F), -154.1 (tm, $J$ = 20.7 Hz, 1F), -161.57 (ddd, $J$ =27.9, 21.2, 7.2 Hz, 2F).

**(perfluorophenyl)(thiophen-2-yl)methanol (3s)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.34 (dd, $J$ = 5.1, 1.2, 1H), 6.99 (dd, J = 5.1, 3.5 Hz, 1H), 6.93 (d, J = 4.7 Hz, 1H), 6.41 (s, 1H), 2.94 (br s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.6 (dm, $J$ = 252.0 Hz), 144.1, 141.0 (dm, $J$ = 253.0 Hz), 137.6 (dm, $J$ = 252.0 Hz), 127.0, 126.1, 124.9, 116.3, 64.3; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -142.96 (ddd, $J$ = 21.5, 7.3, 1.1 Hz, 2F), -153.93--154.13 (m, 1F), -161.19 (ddd, $J$ = 41.5, 20.8, 6.7 Hz, 2F).

**(E)-1-(perfluorophenyl)-3-phenylprop-2-en-1-ol (3t)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.43-7.28 (m, 5H), 6.70 (d, J = 15.8 Hz, 1H), 6.54 (ddt, J = 15.8, 6.9, 1.5Hz, 1H), 5.76 (d, $J$ = 6.92 Hz, 1H), 2.64 (s, 1H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.7 (dm, $J$ = 222.0 Hz), 140.8 (dm, $J$ = 253.0 Hz), 137.6 (dm, $J$ = 251.0 Hz), 135.58, 132.91, 128.7,

128.4, 127.2, 126.7, 115.9, 66.9; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.38 (ddd, *J* = 20.9, 7.3, 0.9 Hz, 2F), -154.7 (tm, *J* = 19.1 Hz, 1F), -162.04 (ddd, *J* = 28.7, 21.8, 7.9 Hz, 2F).

**1-(perfluorophenyl)-3-phenylpropan-1-ol (3u)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.36-7.28 (m, 1H), 7.26-7.19 (m, 3H), 5.09 (dd, *J* = 8.2, 6.2, 1H), 2.90-2.82 (m, 1H), 2.72-2.64 (m, 1H), 2.40-2.14 (m, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.6 (dm, *J* = 247.0 Hz), 141.1 (dm, *J* = 245.0 Hz), 140.4, 137.6 (dm, *J* = 240.0 Hz), 128.5, 128.2, 126.2, 116.8, 65.8, 38.1, 32.0; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.72 (ddd, *J* = 22.9, 8.7, 1.8 Hz, 2F), -155.11 (t, *J* = 20.5, 1F), -161.75 (ddd, *J* = 28.9, 22.4, 8.3 Hz, 2F).

**2-methyl-1-(perfluorophenyl)propan-1-ol (3v)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 4.63 (d, *J* = 9.2 Hz, 1H), 2.46 (br s, 1H), 2.19-2.14 (m, 1H), 1.15 (d, *J* = 6.6 Hz, 3H), 0.80 (d, *J* = 6.6 Hz, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.6 (dm, *J* = 257.0 Hz), 140.39 (dm, *J* = 260.0 Hz), 137.5 (dm, *J* = 256.0 Hz), 116.6, 72.4, 34.2, 19.1, 18.6; $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.05 (dd, *J* = 21.3, 7.1 Hz, 2F), -155.6 (tm, *J* = 20.1 Hz, 1F), -162.20 (ddd, *J* = 28.9, 22.5, 8.3 Hz, 2F).

**2,2-dimethyl-1-(perfluorophenyl)propan-1-ol (3w)[3]**

$^1$H NMR (400 MHz, $CDCl_3$) δ 4.80 (s, 1H), 2.44 (br s, 1H), 1.61-1.00 (m, 9H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 145.0 (dm, J = 278.0 Hz), 140.1 (dm, *J* = 257.0 Hz), 137.1 (dm, *J* = 259.0 Hz), 115.3 (tm, *J* = 14.0 Hz), 75.6 (dd, *J* =

3.0, 2.0 Hz), 37.1, 25.5 (t, *J* = 2.0 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -139.34 (dd, *J* =22.6, 7.8 Hz, 2F), -155.42 (tt, J = 20.9, 1.8 Hz), -162.23 (s, 2F).

**(perfluoro-1,4-phenylene)bis(phenylmethanol) (9a)**

$^1$H NMR (400 MHz, $CDCl_3$) δ 7.42-7.30 (m, 10H), 6.25 (s, 2H), 2.56 (br s, 2H); $^{13}$C NMR (100 MHz, $CDCl_3$) δ 144.5 (dm, *J* = 240.0 Hz), 140.6, 128.7, 128.2, 125.5, 121.4, 67.9 (t, *J* = 2.0 Hz); $^{19}$F NMR (376 MHz, $CDCl_3$) δ -143.3 (d, *J* = 7.5 Hz, 4F); HRMS (EI) calcd for $C_{20}H_{14}O_2F_4$ ($M^+$) 362.0930, found 362.0926.

**(perfluoro-1,4-phenylene)bis((4-chlorophenyl)methanol) (9b)**

$^1$H NMR (400 MHz, DMSO-$d_6$) δ 7.42-7.40 (m, 8H), 6.56 (s, 2H), 6.12 (br s, 2H); $^{13}$C NMR (100 MHz, DMSO-d6) δ 144.2 (dm, *J* = 246.0 Hz), 141.34, 132.2, 128.6, 127.7, 122.6, 64.9; $^{19}$F NMR (376 MHz, DMSO-$d_6$) δ -144.01 (d, *J* = 10.8 Hz, 4F); HRMS (EI) calcd for $C_{20}H_{12}O_4F_4Cl_2$ ($M^+$) 430.0150, found 430.0154.

**perfluoro-1,4-phenylene)bis((4-methoxyphenyl)methanol) (9c)**

$^1$H NMR (400 MHz, DMSO-d6) δ 7.30 (d, *J* = 8.7 Hz, 4H), 6.90 (d, *J* = 8.7Hz, 4H), 6.30 (d, *J* = 4.5 Hz, 2H), 6.05 (d, *J* = 5.1 Hz, 2H), 3.75-3.72 (d, *J* = 1.0 Hz, 6H); $^{13}$C NMR (100 MHz, DMSO-d6) δ 158.8, 144.0 (dm, *J* = 245.0 Hz), 134.4, 127.0, 123.0, 114.0, 65.4, 55.5; $^{19}$F NMR (376 MHz, DMSO-d6) δ -142.0 (d, *J* = 10.8 Hz, 4F); HRMS (EI) calcd for $C_{22}H_{18}O_4F_4$ ($M^+$) 422.1141, found 422.1143.

**(perfluoro-1,4-phenylene)bis(furan-2-ylmethanol) (9d)**

$^{1}$H NMR (400 MHz, DMSO-d6) δ 7.60 (s, 2H), 6.53 (d, *J* = 5.16 Hz, 2H), 6.44-6.43 (m, 2H), 6.39-6.38 (m, 2H), 6.10-6.08 (m, 2H); $^{13}$C NMR (100 MHz, DMSO-d6) δ 153.9, 144.3 (dm, *J* = 246.0 Hz), 143.1, 120.5, 111.0, 107.3, 60.8 (t, *J* = 2.0 Hz); $^{19}$F NMR (376 MHz, DMSO-d6) δ -143.53 (d, *J* = 5.8 Hz, 4F); HRMS (EI) calcd for $C_{16}H_{10}O_4F_4$ ($M^+$) 342.0515, found 342.0511.

## Reference


[1] A. J. Arduengo III, R. Krafczyk and R. Schmutzler, *Tetrahedron* **1999**, *55*, 14523.

[2] N. V. Bogoslovskii, N. M. Kolbina, *Org. Khim*. **1976**, 39-43.

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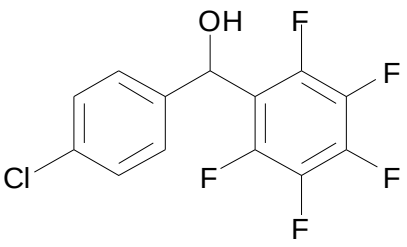
[4] F. M. EI-Torki, A. P. Zens, J. Jacobus, *J. Org. Chem*. **1985**, *50*, 1314.

[5] E. G. Lubenets, T. N. Gerasimova, Fokin, E. P. *Zh. Org. Khim* **1971**, *7*, 805.

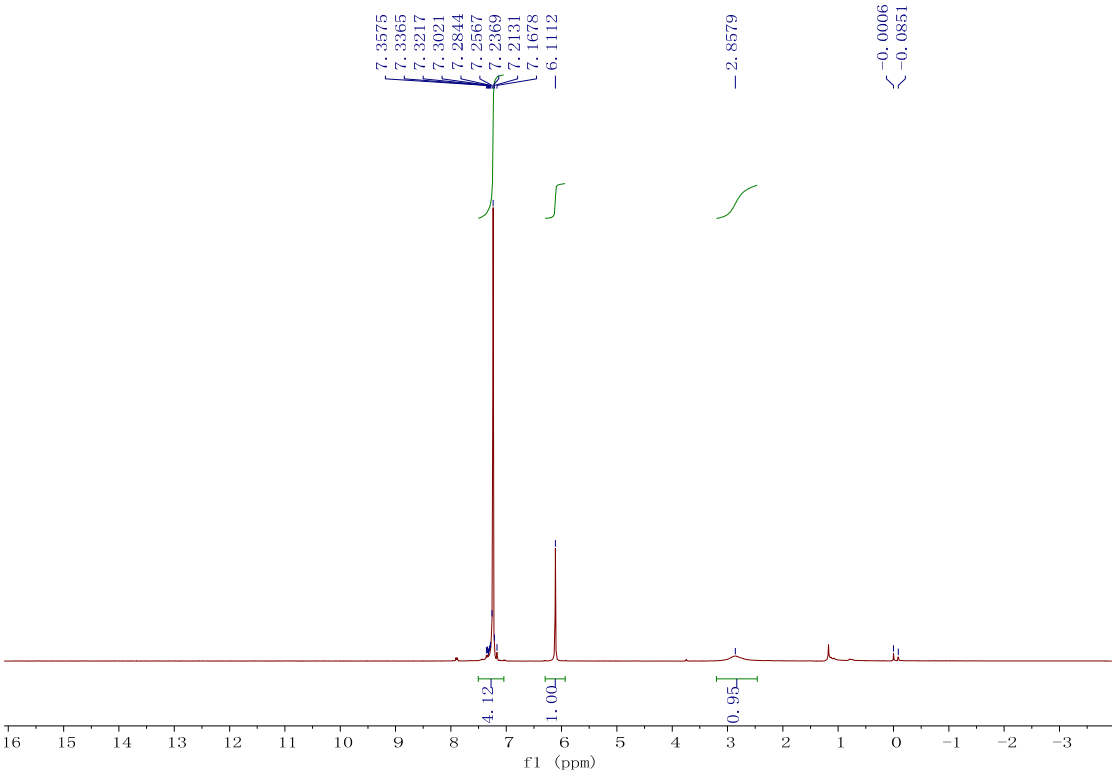
[6] J. S. Reddy, V. G. Anand, *J. Am. Chem. Soc*. **2008**, *130*, 3718.

## Copies of $^{1}$H NMR, $^{13}$C NMR and $^{19}$F NMR Spectra

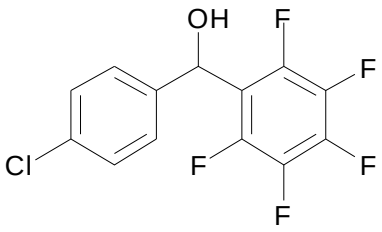
**$^{1}$H NMR**



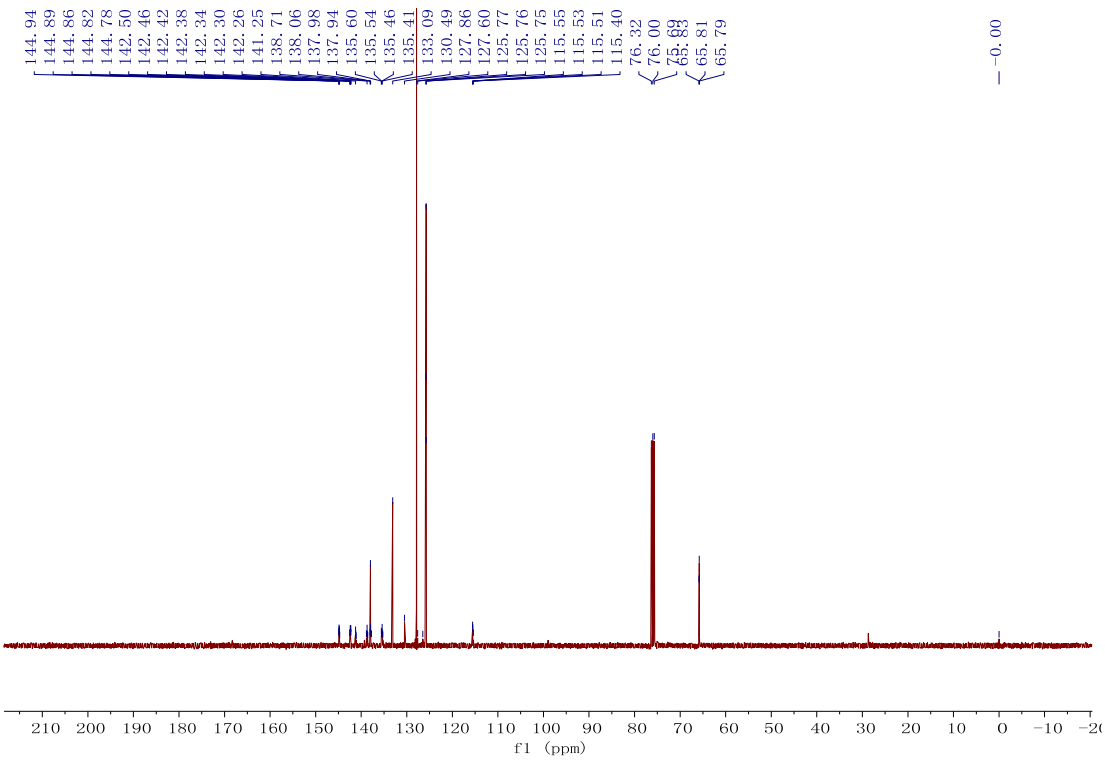

**3a**



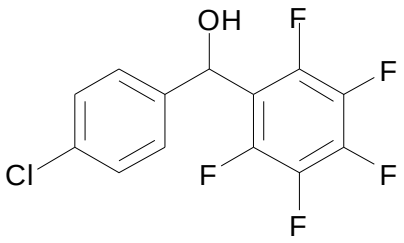
**$^{13}$C NMR**


OH
F
F
Cl
F
F
F

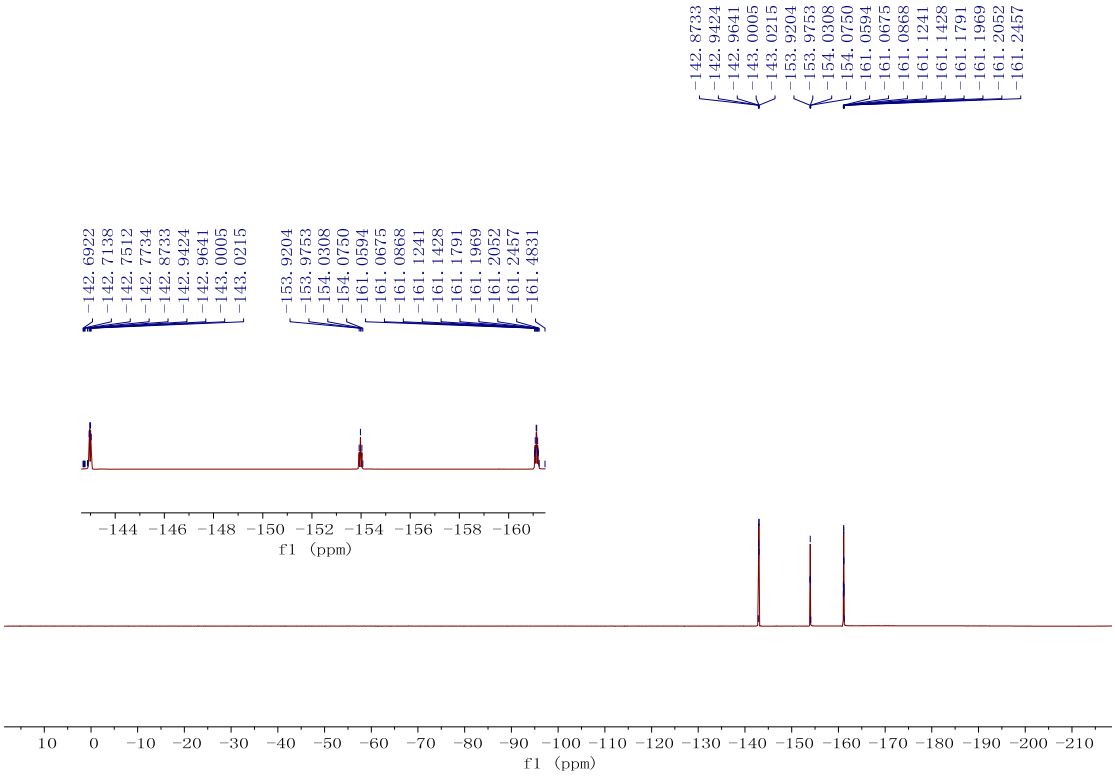
**3a**


144.94
144.89
144.86
144.82
144.78
142.50
142.46
142.42
142.38
142.34
142.30
142.26
141.25
138.71
138.06
137.98
137.94
135.60
135.54
135.46
135.41
133.09
130.49
127.86
127.60
125.77
125.76
125.75
115.55
115.53
115.51
115.40
76.32
76.00
75.69
65.83
65.81
65.79
-0.00
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**


OH
F
F
Cl
F
F
F

**3a**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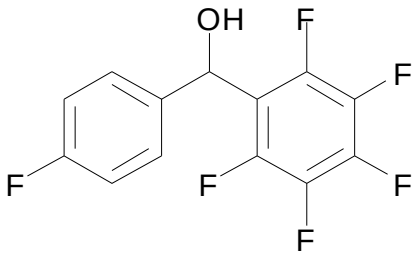
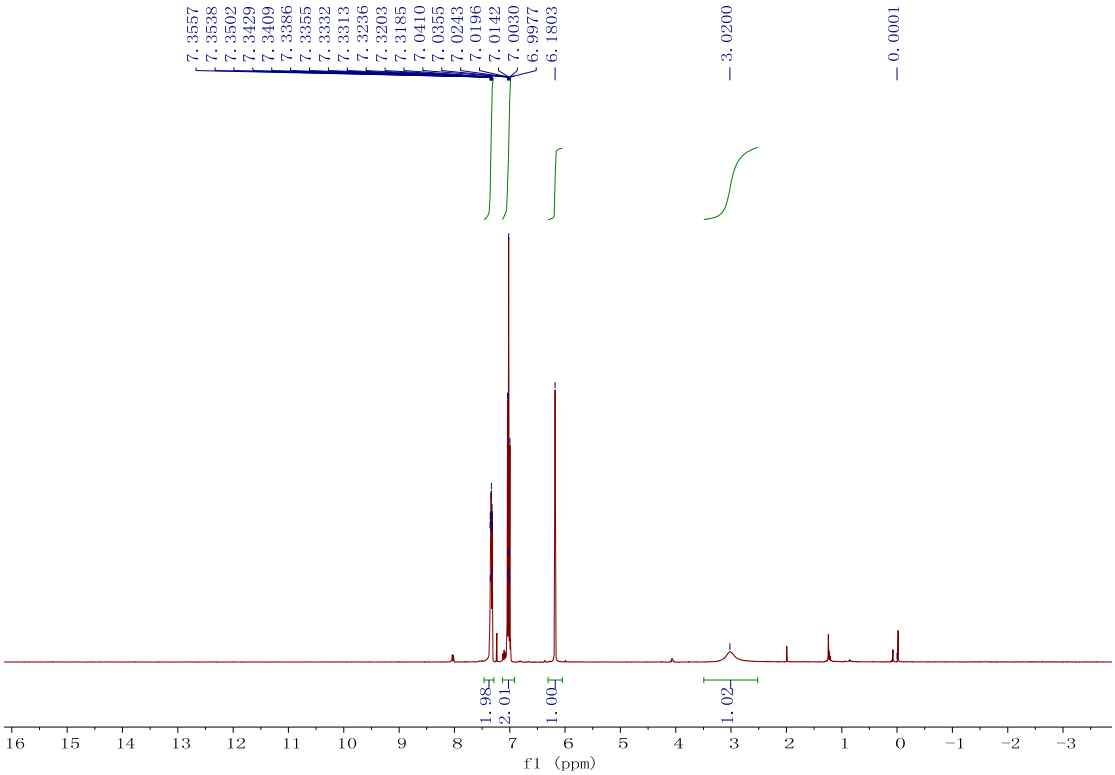
-142.9424
-142.9641
-143.0005
-143.0215
-153.9204
-153.9753
-154.0308
-154.0750
-161.0594
-161.0675
-161.0868
-161.1241
-161.1428
-161.1791
-161.1969
-161.2052
-161.2457
-142.6922
-142.7138
-142.7512
-142.7734
-142.8733
-142.9424
-142.9641
-143.0005
-143.0215
-153.9204
-153.9753
-154.0308
-154.0750
-161.0594
-161.0675
-161.0868
-161.1241
-161.1428
-161.1791
-161.1969
-161.2052
-161.2457
-161.4831
-144 -146 -148 -150 -152 -154 -156 -158 -160
f1 (ppm)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

**$^1$H NMR**


OH
F
F
F
F
F
F

**3b**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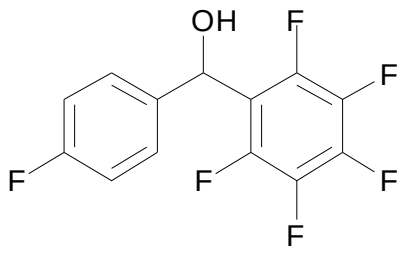
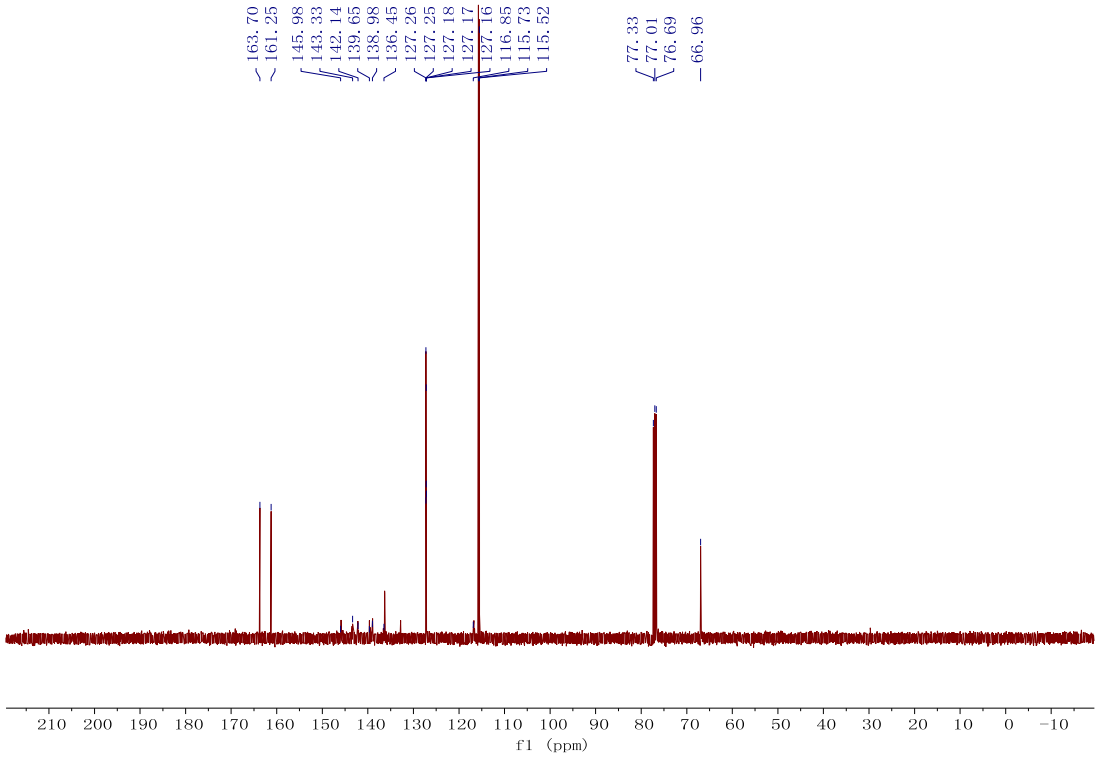
7.3538
7.3502
7.3429
7.3409
7.3386
7.3355
7.3332
7.3313
7.3236
7.3203
7.3185
7.0410
7.0355
7.0243
7.0196
7.0142
7.0030
6.9977
6.1803
3.0200
0.0001
1.98
2.01
1.00
1.02
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

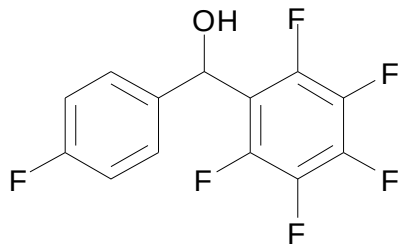
**$^{13}$C NMR**


OH
F
F
F
F
F

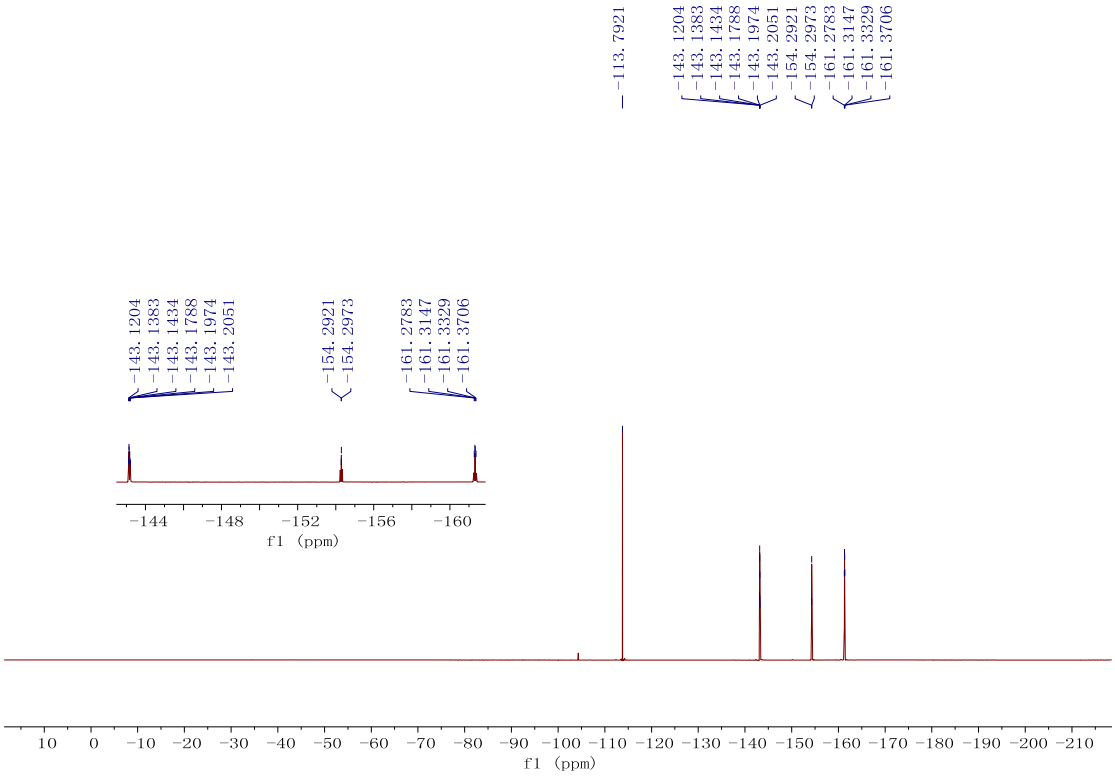
**3b**


163.70
161.25
145.98
143.33
142.14
139.65
138.98
136.45
127.26
127.25
127.18
127.17
127.16
116.85
115.73
115.52
77.33
77.01
76.69
66.96
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**


OH
F
F
F
F
F

**3b**


−113.7921
−143.1204
−143.1383
−143.1434
−143.1788
−143.1974
−143.2051
−154.2921
−154.2973
−161.2783
−161.3147
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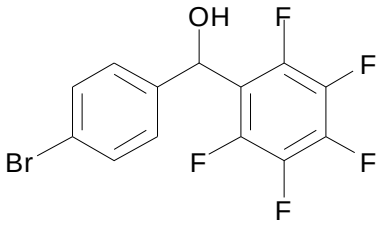
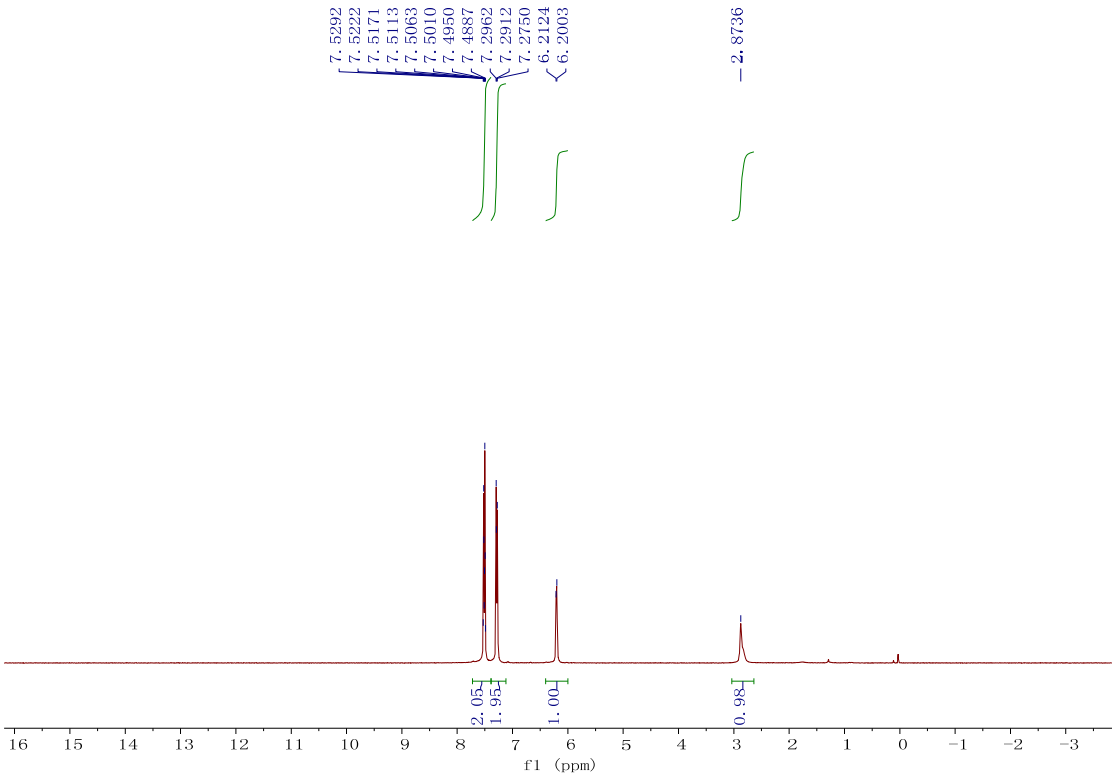
−161.3706
f1 (ppm)
f1 (ppm)

**$^1$H NMR**


OH
F
F
F
F
F
Br

**3c**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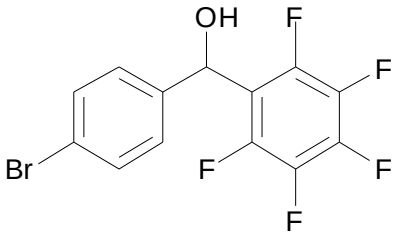
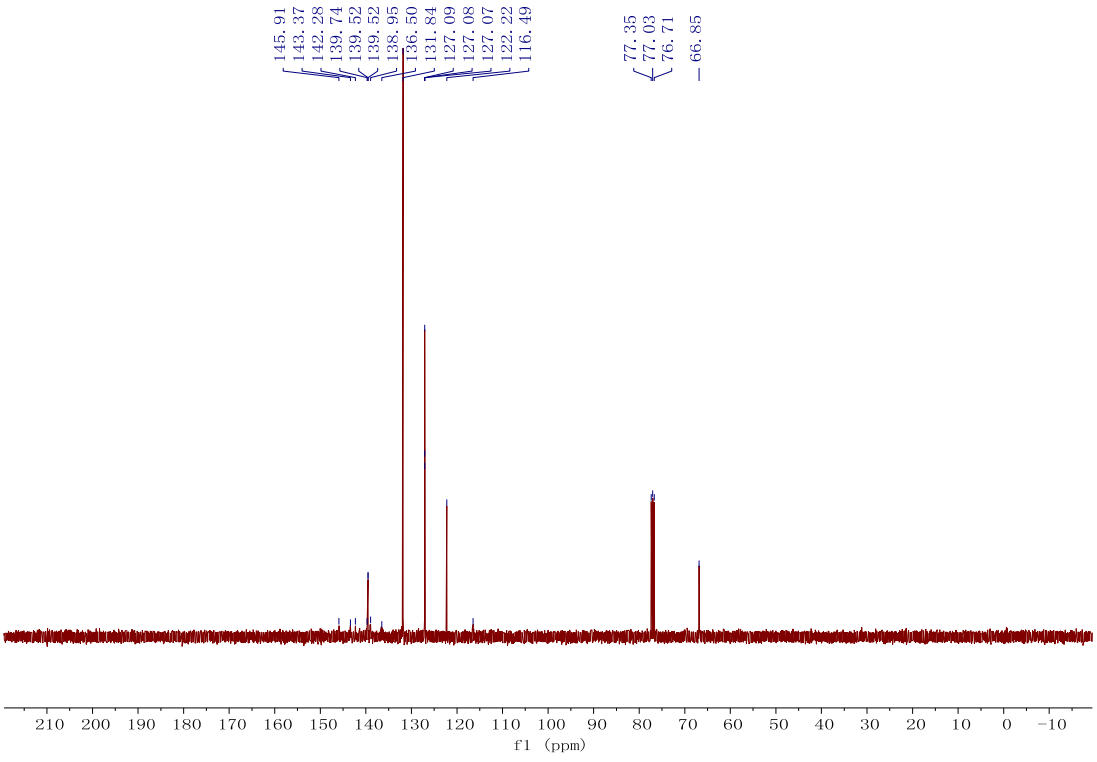
7.5222
7.5171
7.5113
7.5063
7.5010
7.4950
7.4887
7.2962
7.2912
7.2750
6.2124
6.2003
2.8736
2.05
1.95
1.00
0.98
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

**$^{13}$C NMR**


OH
F
F
Br
F
F
F

**3c**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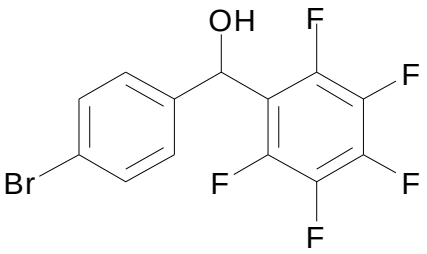
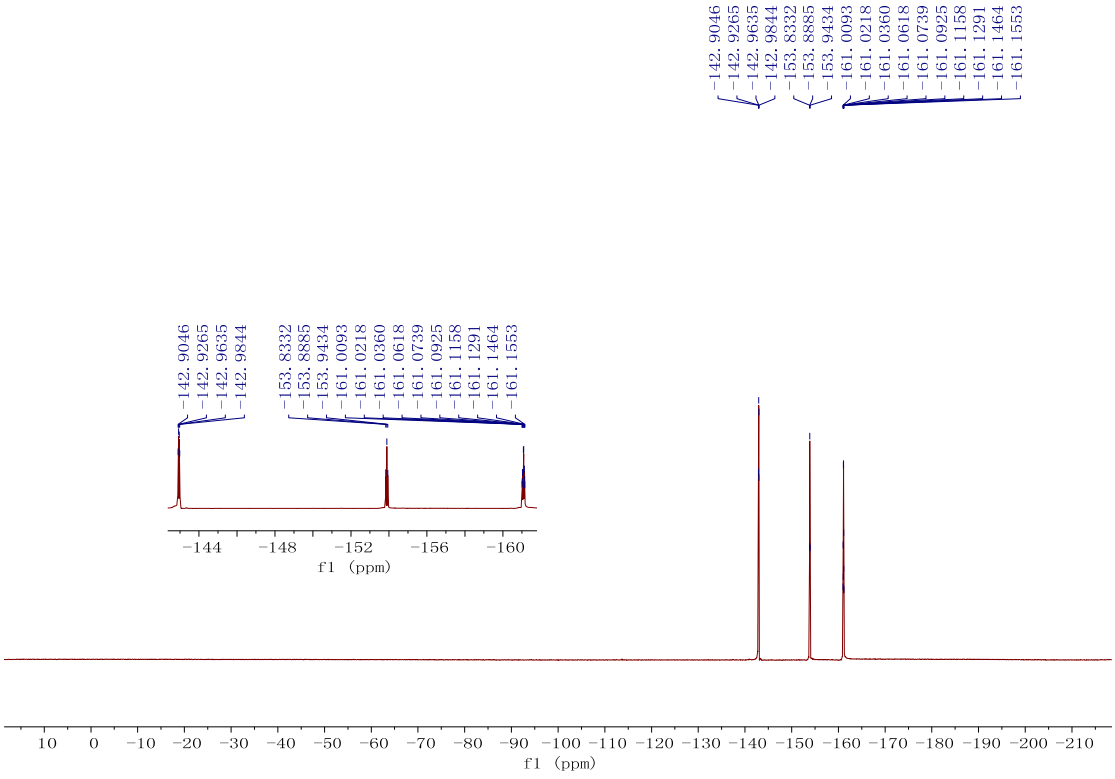
143.37
142.28
139.74
139.52
139.52
138.95
136.50
131.84
127.09
127.08
127.07
122.22
116.49
77.35
77.03
76.71
66.85
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**


OH
F
F
Br
F
F
F

**3c**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-153.8885
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-161.0218
-161.0360
-161.0618
-161.0739
-161.0925
-161.1158
-161.1291
-161.1464
-161.1553
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
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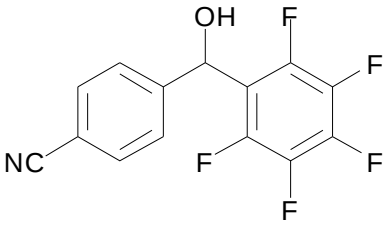
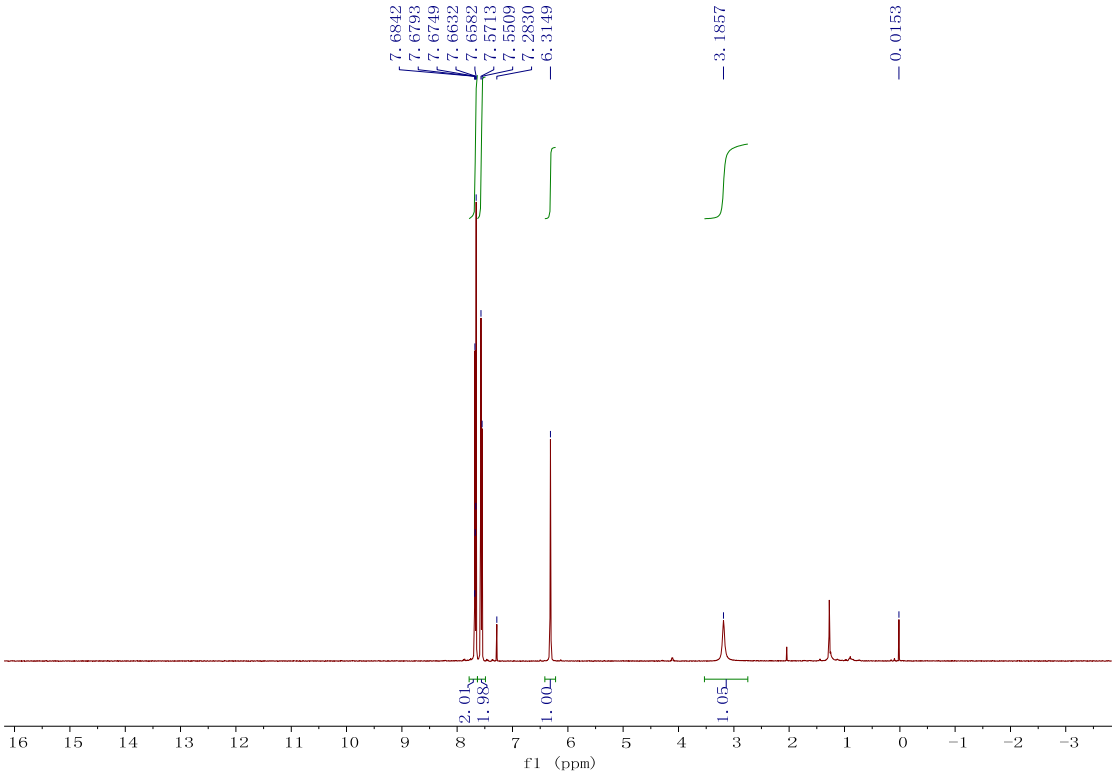
-190
-200
-210
f1 (ppm)

**$^1$H NMR**


OH
F
F
NC
F
F
F

**3d**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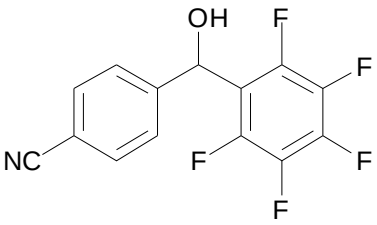
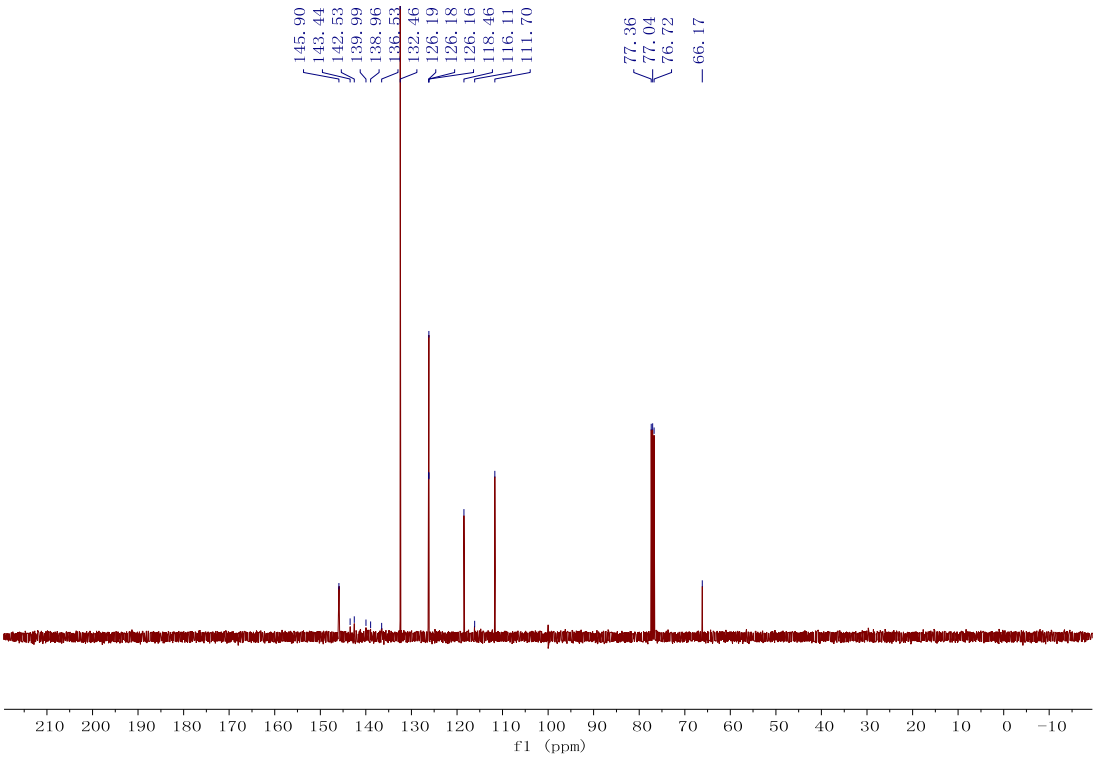
7.6749
7.6632
7.6582
7.5713
7.5509
7.2830
6.3149
3.1857
0.0153
2.01
1.98
1.00
1.05
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

**$^{13}$C NMR**


OH
F
F
NC
F
F
F

**3d**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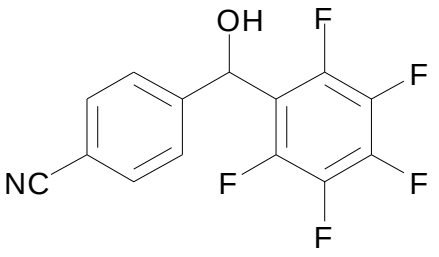
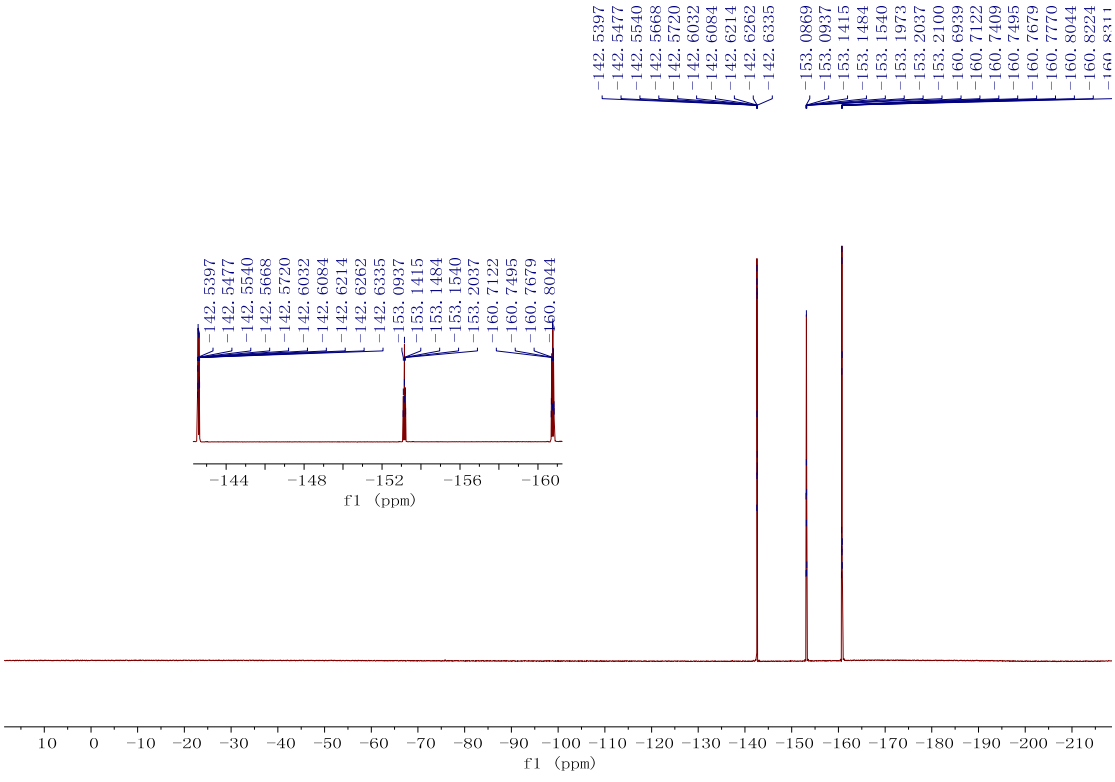
142.53
139.99
138.96
136.53
132.46
126.19
126.18
126.16
118.46
116.11
111.70
77.36
77.04
76.72
66.17
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**


OH
F
F
NC
F
F
F

**3d**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-153.1484
-153.1540
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-153.2037
-153.2100
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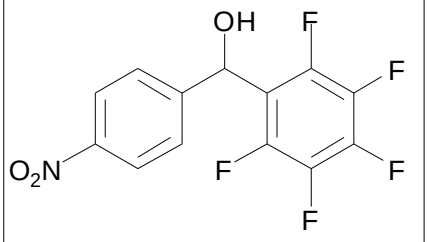
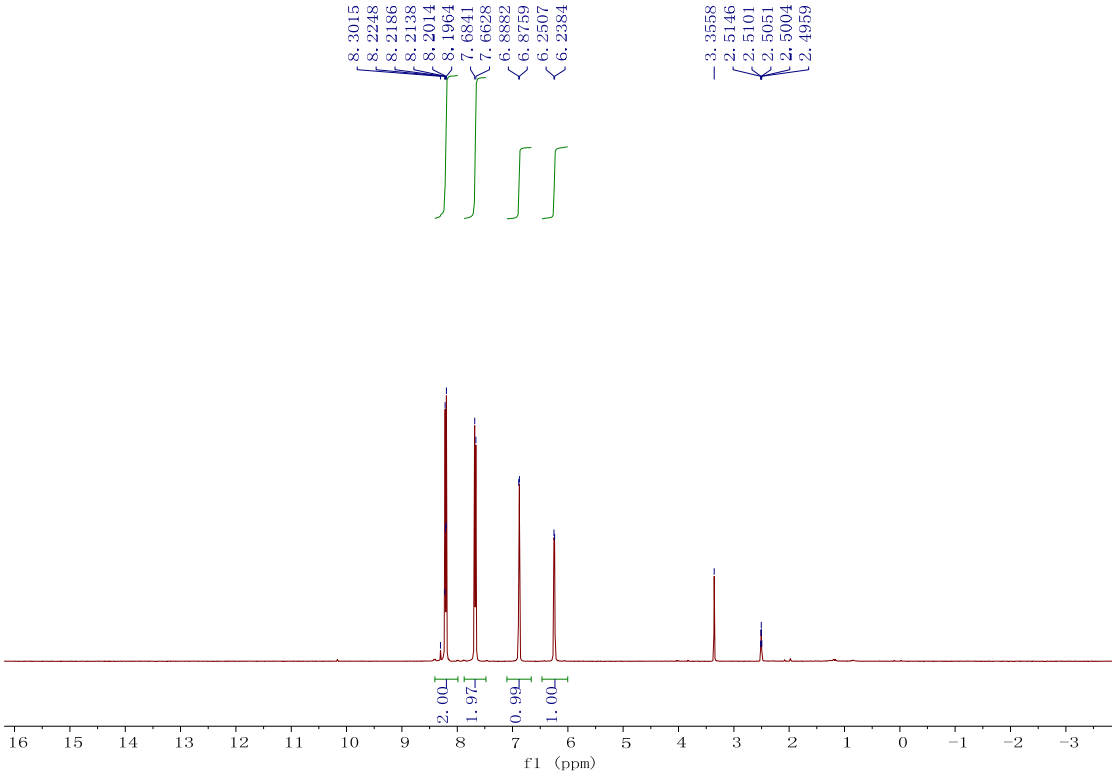
-160.7495
-160.7679
-160.7770
-160.8044
-160.8224
-160.8311
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

**$^1$H NMR**


OH
F
F
F
F
F
$O_2N$

**3e**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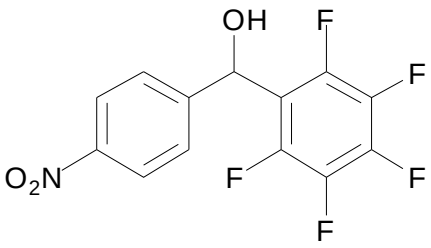
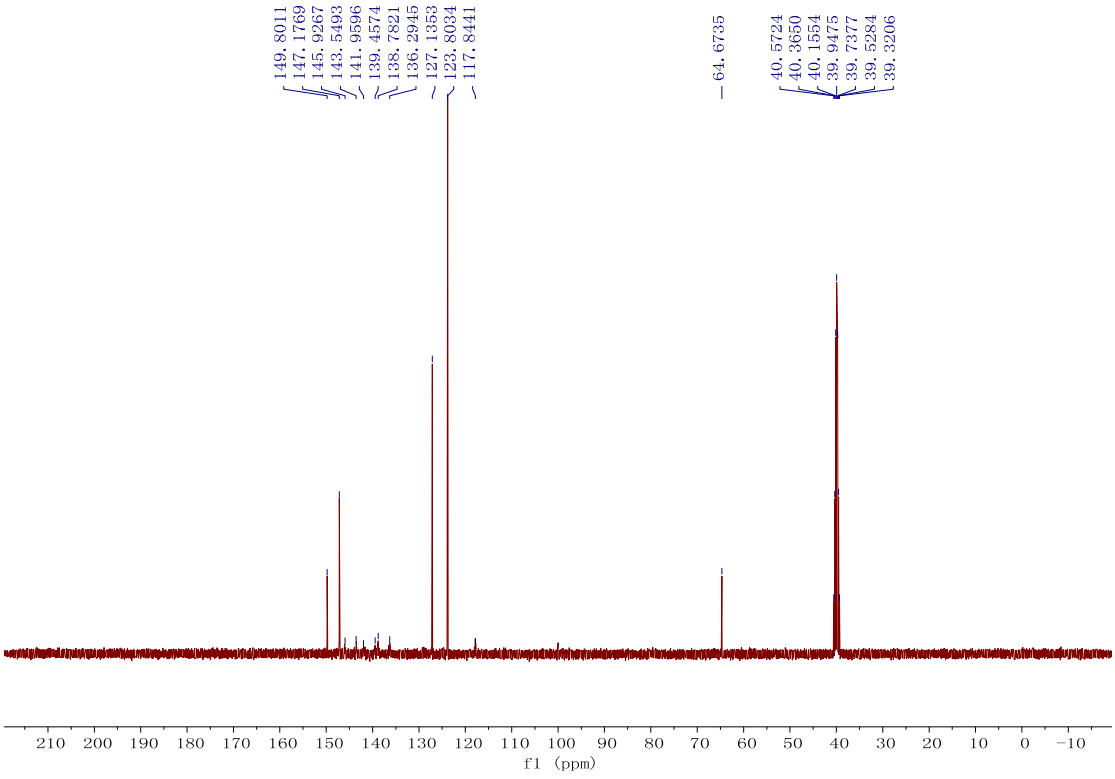
8.2138
8.2014
8.1964
7.6841
7.6628
6.8882
6.8759
6.2507
6.2384
3.3558
2.5146
2.5101
2.5051
2.5004
2.4959
2.00
1.97
0.99
1.00
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

**$^{13}$C NMR**


OH
F
F
F
F
F
$O_2N$

**3e**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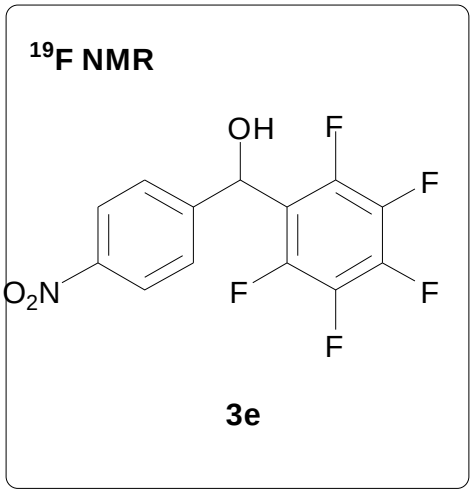
145.9267
143.5493
141.9596
139.4574
138.7821
136.2945
127.1353
123.8034
117.8441
64.6735
40.5724
40.3650
40.1554
39.9475
39.7377
39.5284
39.3206
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)


19F NMR
OH
F
F
F
F
F
O2N
3e


-142.5212
-142.5285
-142.5352
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-142.6153
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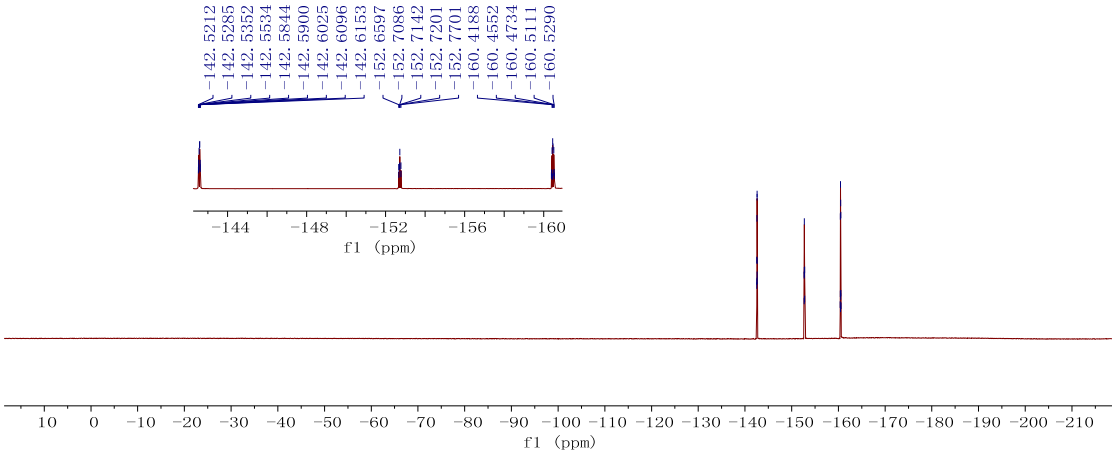
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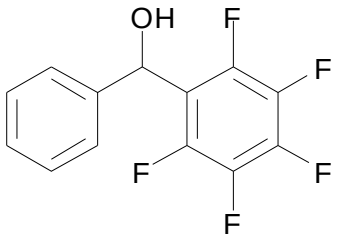
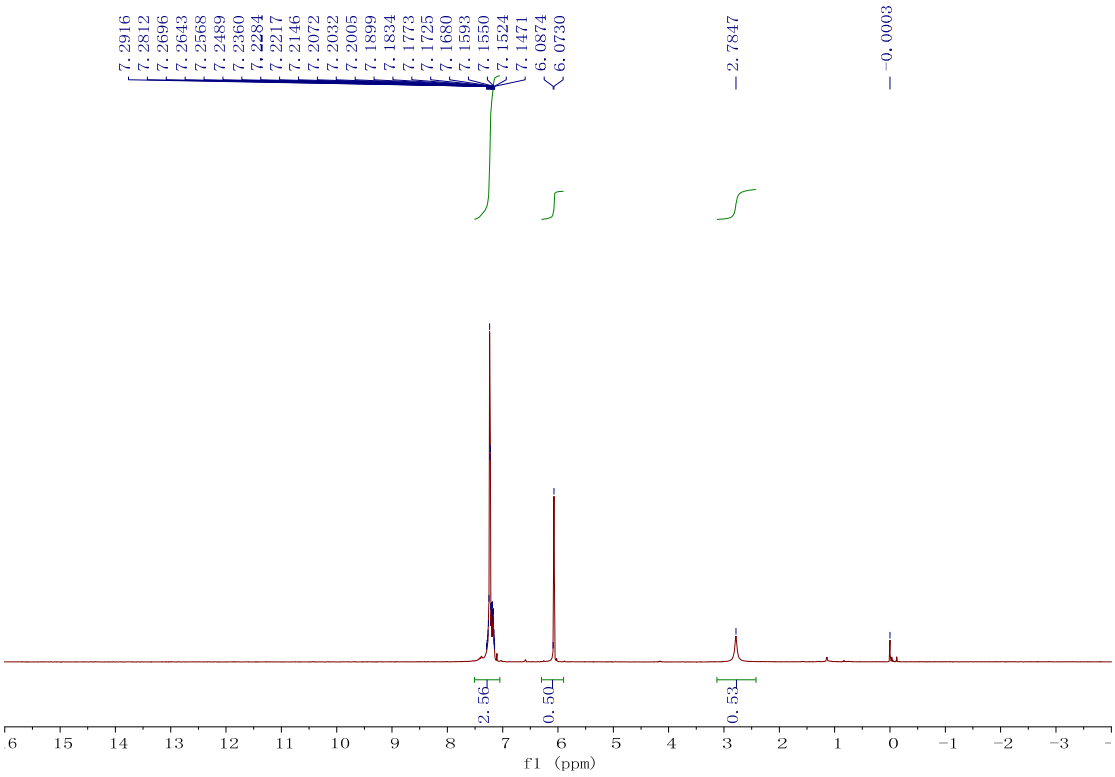
-142.6025
-142.6096
-142.6153
-152.6597
-152.7086
-152.7142
-152.7201
-152.7701
-160.4188
-160.4552
-160.4734
-160.5111
-160.5290
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

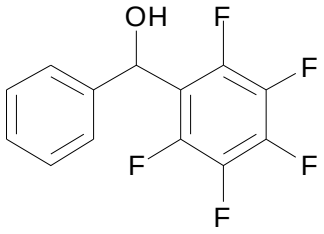
**$^1$H NMR**


OH
F
F
F
F
F

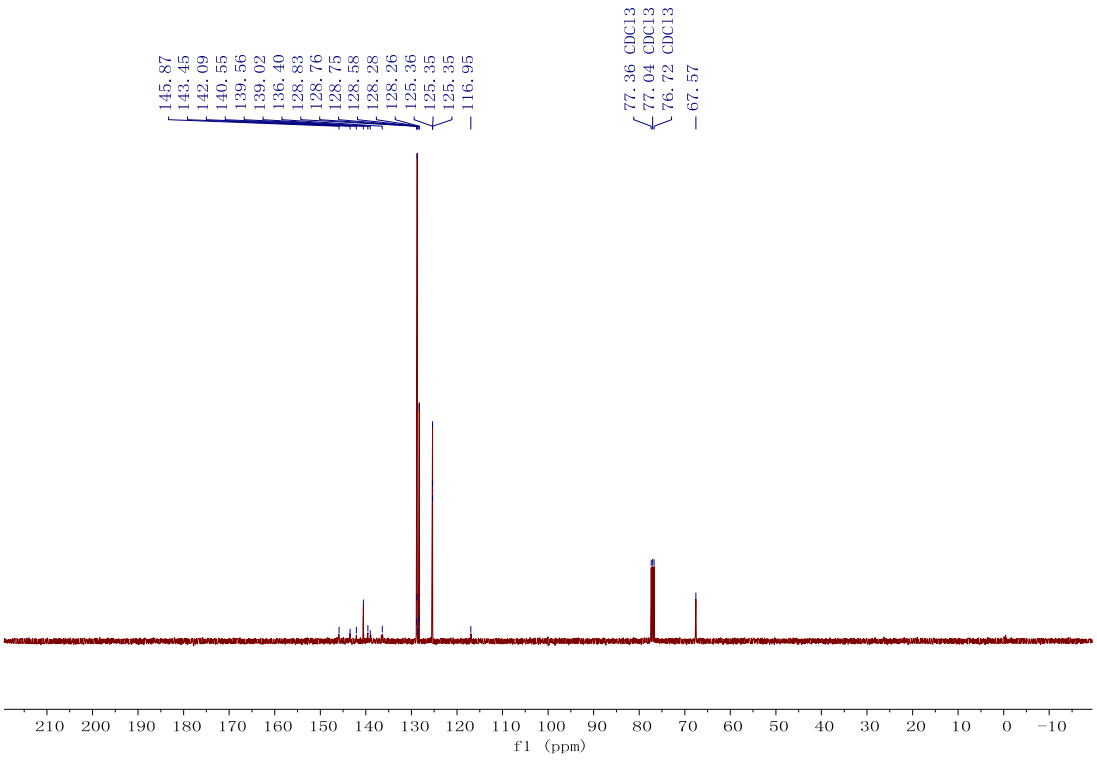
**3f**


7.2916
7.2812
7.2696
7.2643
7.2568
7.2489
7.2360
7.2284
7.2217
7.2146
7.2072
7.2032
7.2005
7.1899
7.1834
7.1773
7.1725
7.1680
7.1593
7.1550
7.1524
7.1471
6.0874
6.0730
2.7847
-0.0003
2.56
0.50
0.52
f1 (ppm)

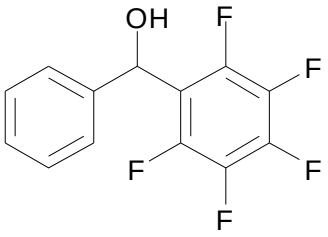
**$^{13}$C NMR**


OH
F
F
F
F

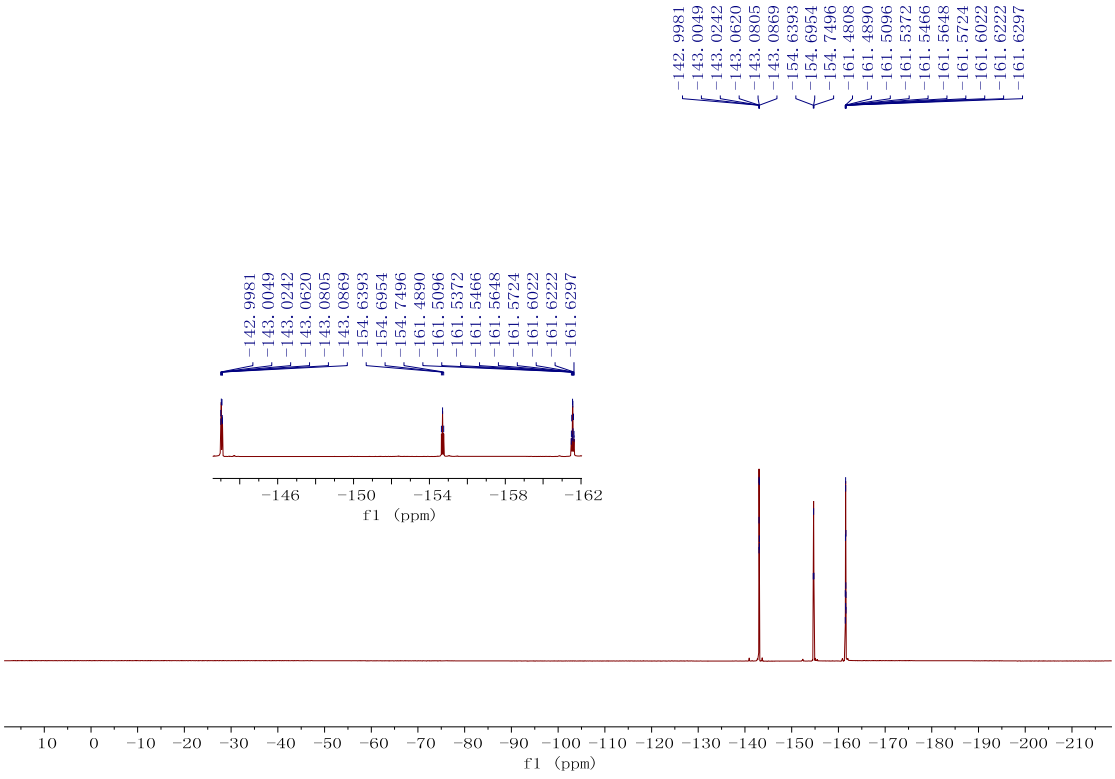
**3f**


145.87
143.45
142.09
140.55
139.56
139.02
136.40
128.83
128.76
128.75
128.58
128.28
128.26
125.36
125.35
125.35
116.95
77.36 CDCl3
77.04 CDCl3
76.72 CDCl3
67.57
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

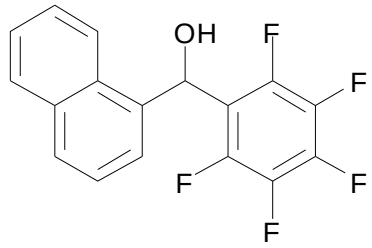
**$^{19}$F NMR**


OH
F
F
F
F
F

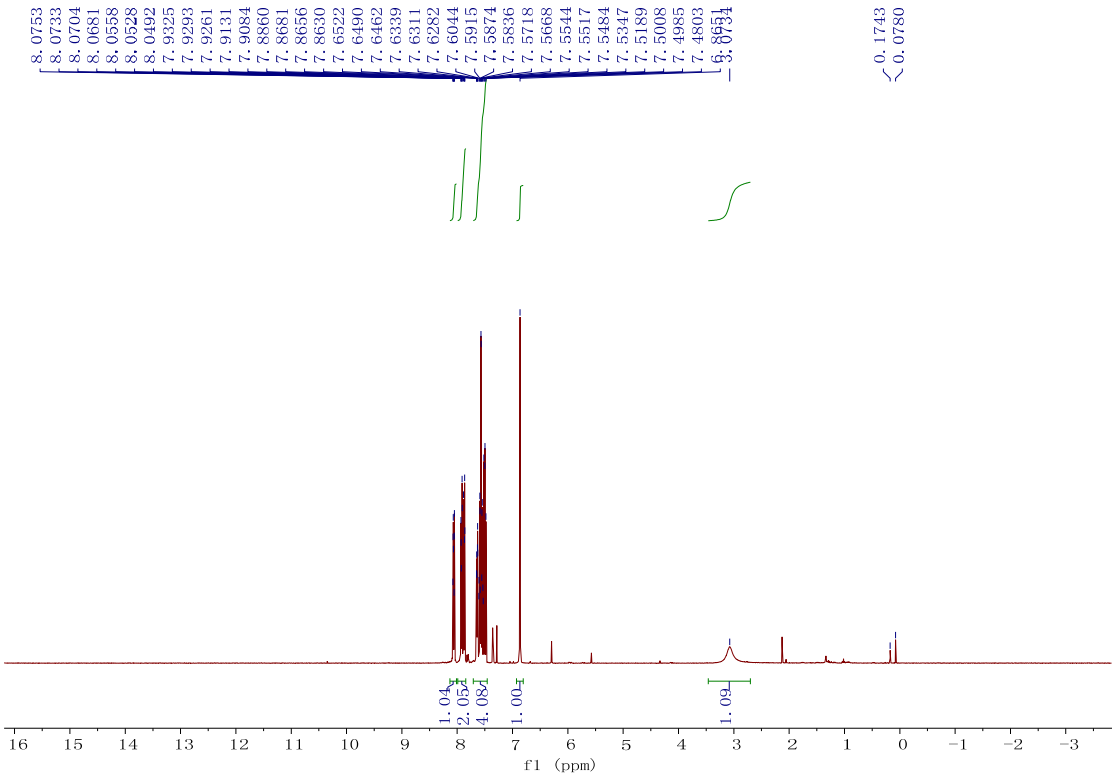
**3f**


-142.9981
-143.0049
-143.0242
-143.0620
-143.0805
-143.0869
-154.6393
-154.6954
-154.7496
-161.4808
-161.4890
-161.5096
-161.5372
-161.5466
-161.5648
-161.5724
-161.6022
-161.6222
-161.6297
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

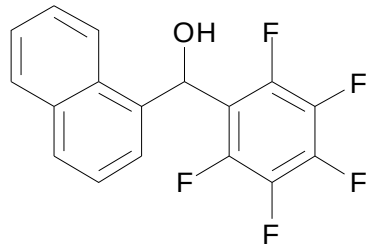
**$^1$H NMR**


OH
F
F
F
F
F

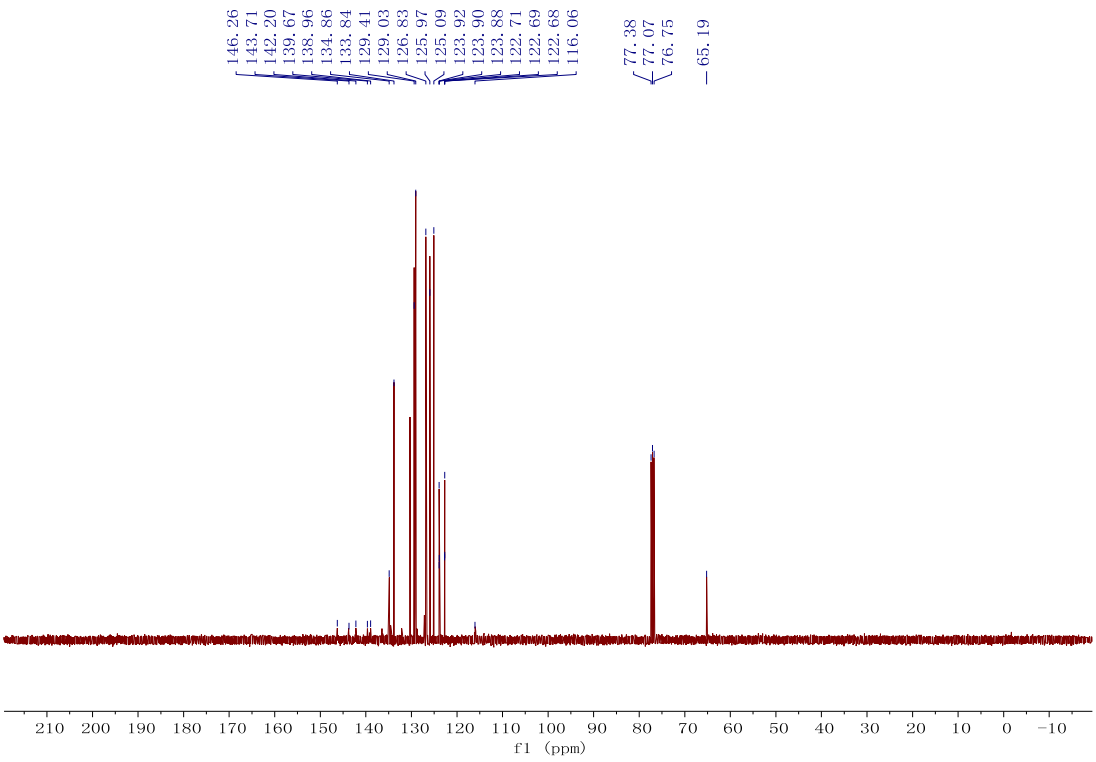
**3g**


8.0753
8.0733
8.0704
8.0681
8.0558
8.0528
8.0492
7.9325
7.9293
7.9261
7.9131
7.9084
7.8860
7.8681
7.8656
7.8630
7.6522
7.6490
7.6462
7.6339
7.6311
7.6282
7.6044
7.5915
7.5874
7.5836
7.5718
7.5668
7.5544
7.5517
7.5484
7.5347
7.5189
7.5008
7.4985
7.4803
6.8651
6.8534
0.1743
0.0780
1.04
2.05
4.08
1.00
1.09
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)

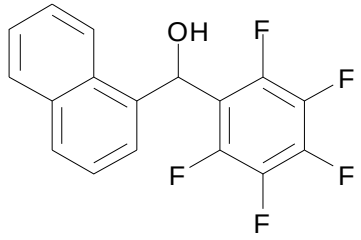
**$^{13}$C NMR**


OH
F
F
F
F

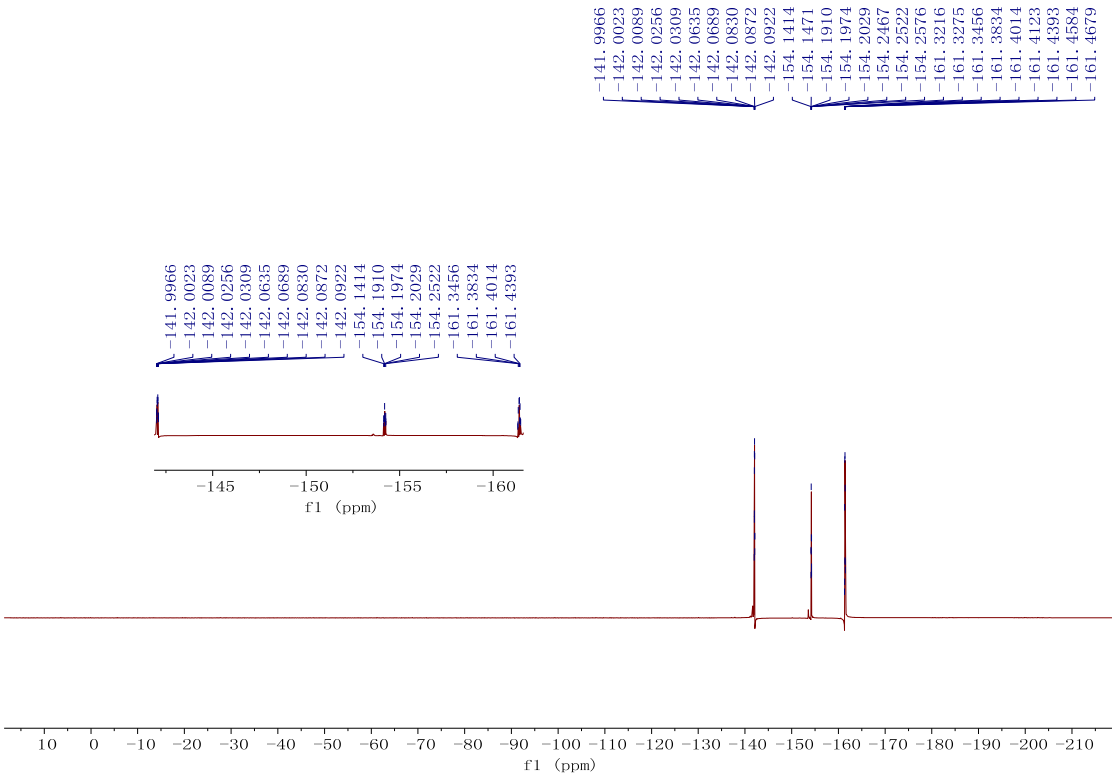
**3g**


146.26
143.71
142.20
139.67
138.96
134.86
133.84
129.41
129.03
126.83
125.97
125.09
123.92
123.90
123.88
122.71
122.69
122.68
116.06
77.38
77.07
76.75
65.19
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

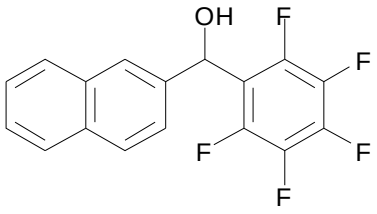
**$^{19}$F NMR**


OH
F
F
F
F
F

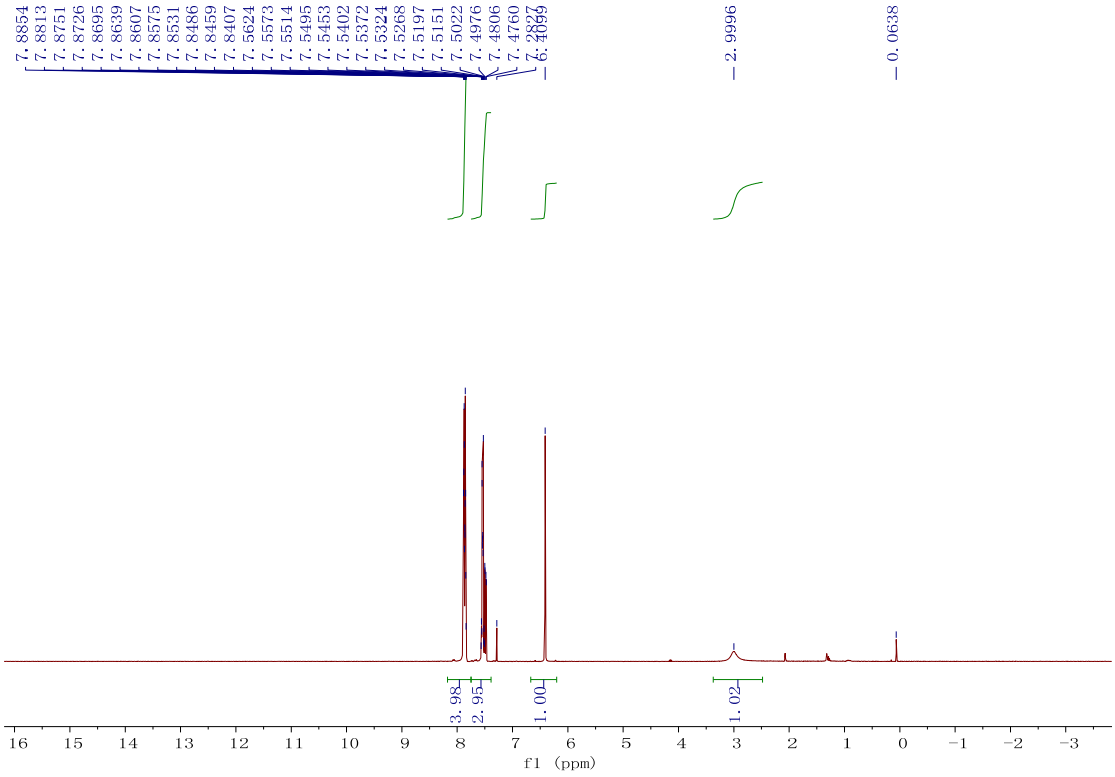
**3g**


−141.9966
−142.0023
−142.0089
−142.0256
−142.0309
−142.0635
−142.0689
−142.0830
−142.0872
−142.0922
−154.1414
−154.1471
−154.1910
−154.1974
−154.2029
−154.2467
−154.2522
−154.2576
−161.3216
−161.3275
−161.3456
−161.3834
−161.4014
−161.4123
−161.4393
−161.4584
−161.4679
−145
−150
−155
−160
f1 (ppm)
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −210
f1 (ppm)

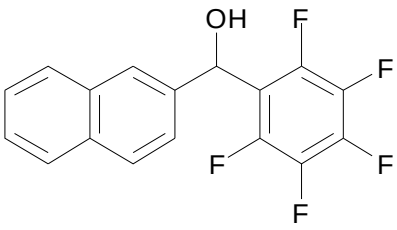
**$^1$H NMR**


OH
F
F
F
F
F

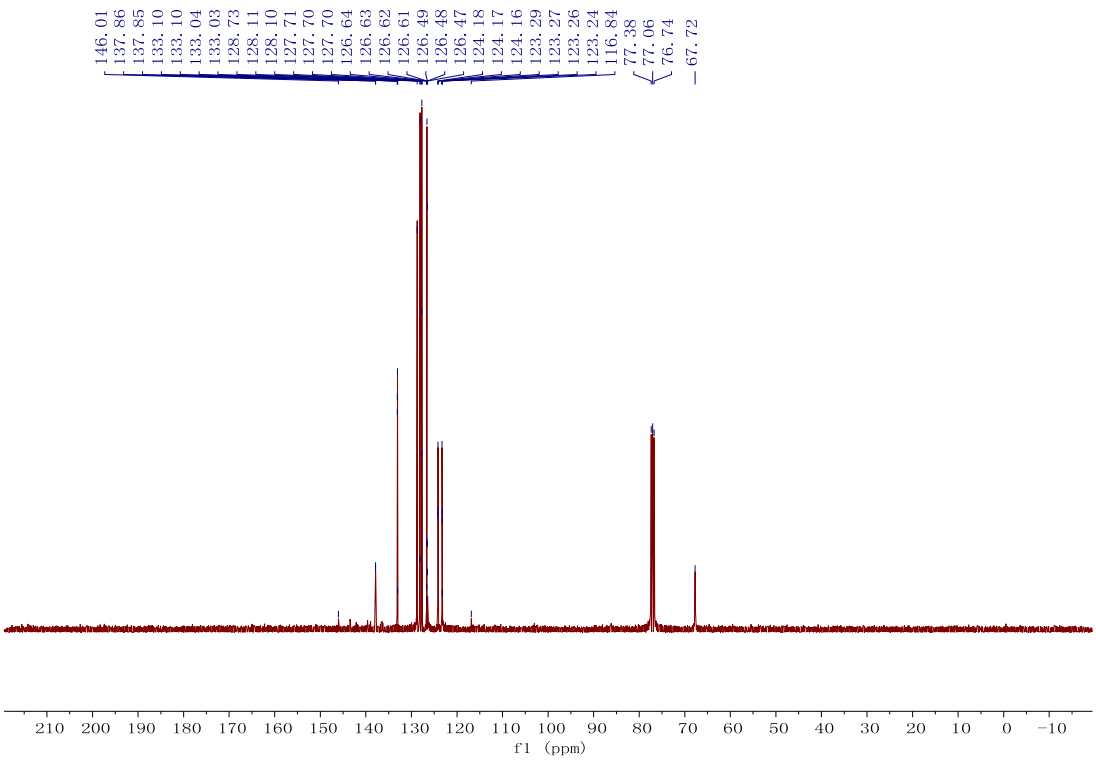
**3h**


7.8854
7.8813
7.8751
7.8726
7.8695
7.8639
7.8607
7.8575
7.8531
7.8486
7.8459
7.8407
7.5624
7.5573
7.5514
7.5495
7.5453
7.5402
7.5372
7.5324
7.5268
7.5197
7.5151
7.5022
7.4976
7.4806
7.4760
7.2827
6.4099
2.9996
0.0638
3.98
2.95
1.00
1.02
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

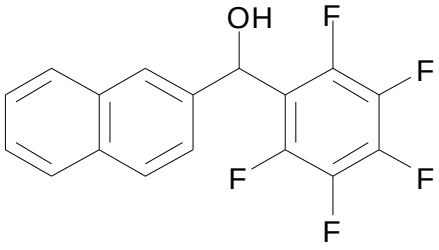
**$^{13}$C NMR**


OH
F
F
F
F
F

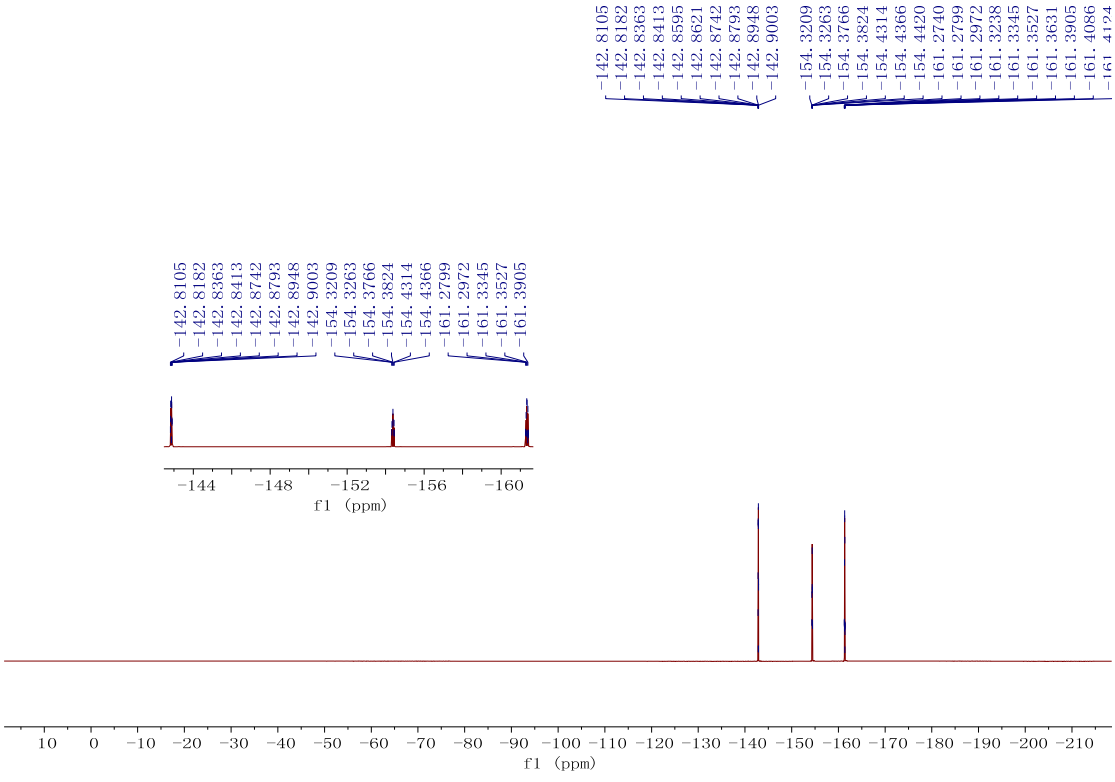
**3h**


146.01
137.86
137.85
133.10
133.10
133.04
133.03
128.73
128.11
128.10
127.71
127.70
127.70
126.64
126.63
126.62
126.61
126.49
126.48
126.47
124.18
124.17
124.16
123.29
123.27
123.26
123.24
116.84
77.38
77.06
76.74
67.72
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

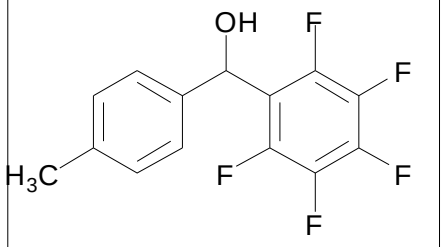
**$^{19}$F NMR**


OH
F
F
F
F
F

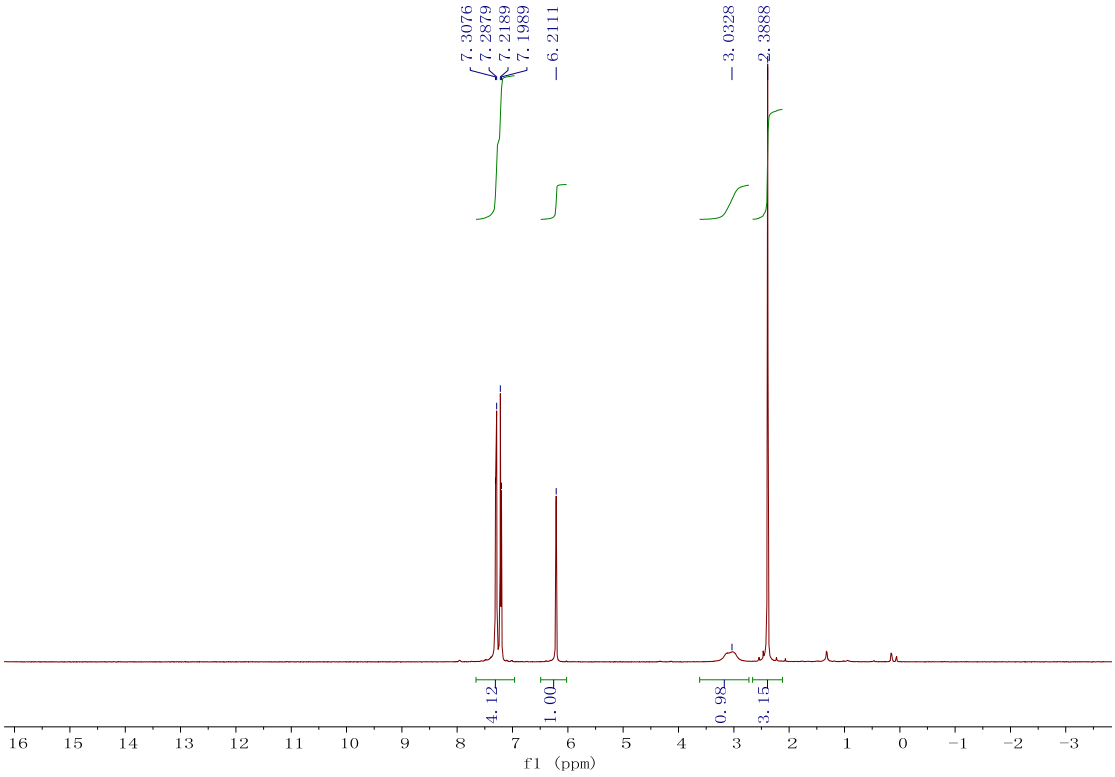
**3h**


-142.8105
-142.8182
-142.8363
-142.8413
-142.8595
-142.8621
-142.8742
-142.8793
-142.8948
-142.9003
-154.3209
-154.3263
-154.3766
-154.3824
-154.4314
-154.4366
-154.4420
-161.2740
-161.2799
-161.2972
-161.3238
-161.3345
-161.3527
-161.3631
-161.3905
-161.4086
-161.4194
-142.8105
-142.8182
-142.8363
-142.8413
-142.8742
-142.8793
-142.8948
-142.9003
-154.3209
-154.3263
-154.3766
-154.3824
-154.4314
-154.4366
-161.2799
-161.2972
-161.3345
-161.3527
-161.3905
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

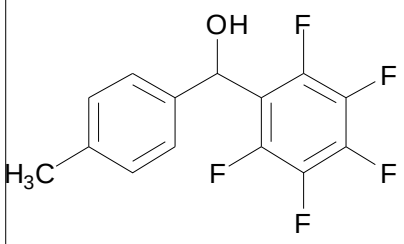
**$^1$H NMR**


OH
F
F
F
F
F
$H_3C$

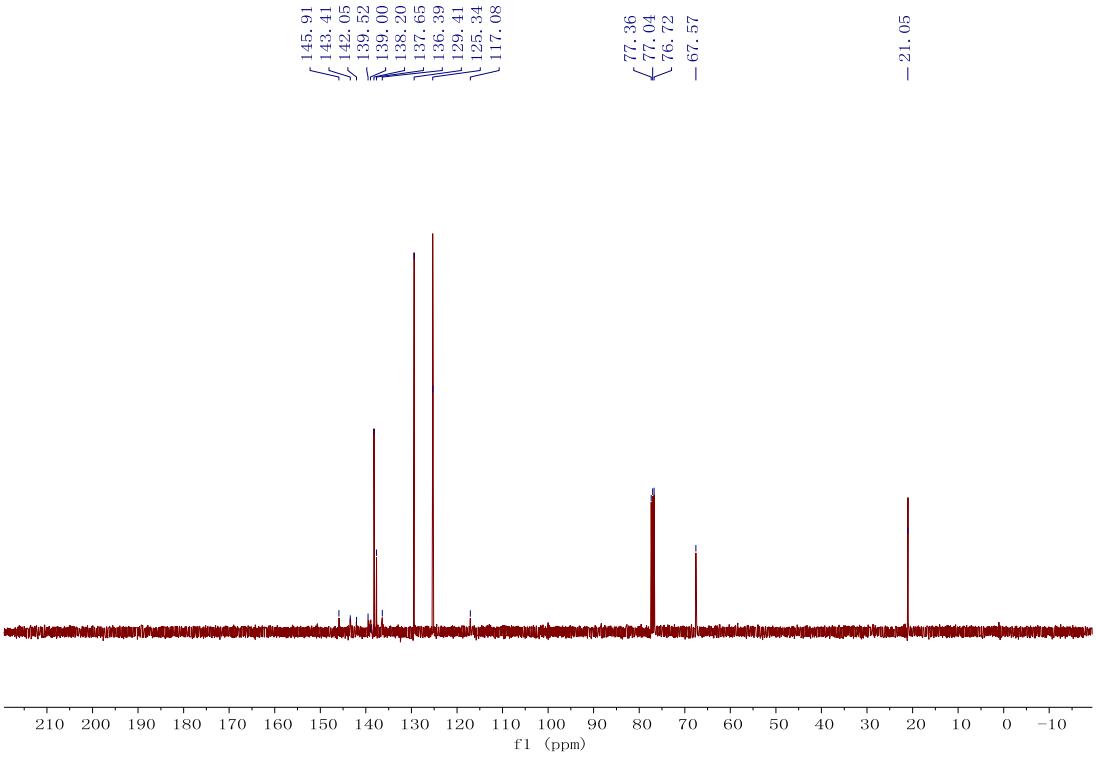
**3i**


7.3076
7.2879
7.2189
7.1989
6.2111
3.0328
2.3888
4.12
1.00
0.98
3.15
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

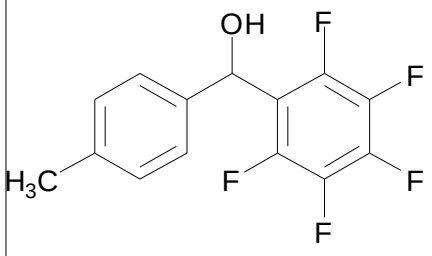
**$^{13}$C NMR**


OH
F
F
F
F
F
$H_3C$

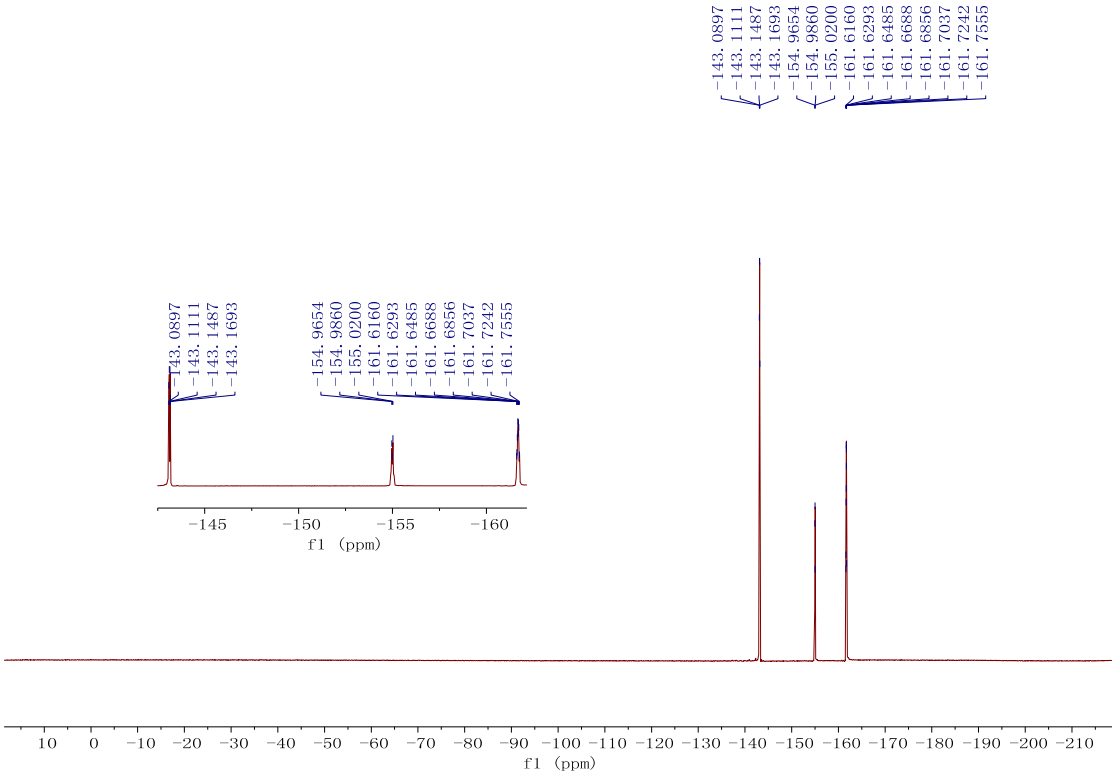
**3i**


145.91
143.41
142.05
139.52
139.00
138.20
137.65
136.39
129.41
125.34
117.08
77.36
77.04
76.72
67.57
21.05
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

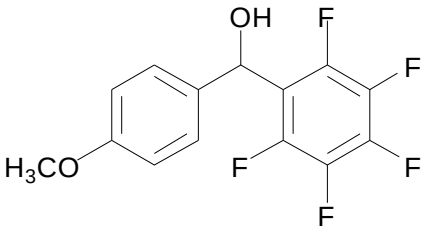
**$^{19}$F NMR**


OH
F
F
F
F
F
$H_3C$

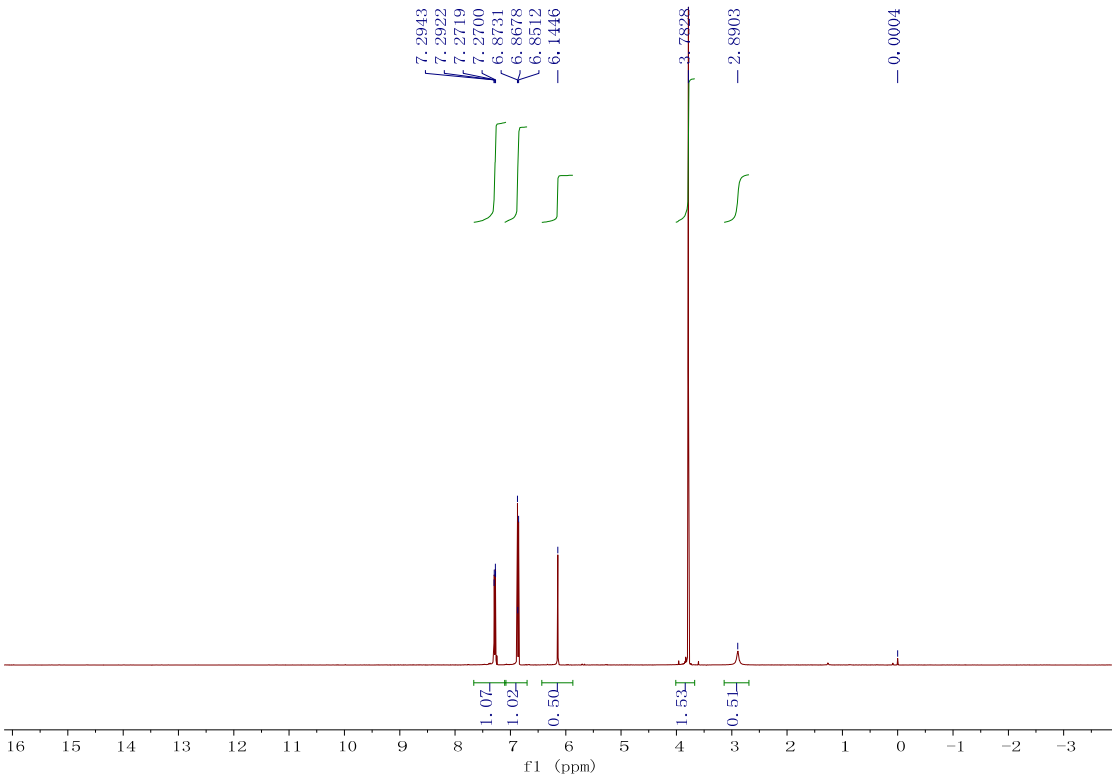
**3i**


-143.0897
-143.1111
-143.1487
-143.1693
-154.9654
-154.9860
-155.0200
-161.6160
-161.6293
-161.6485
-161.6688
-161.6856
-161.7037
-161.7242
-161.7555
f1 (ppm)
f1 (ppm)

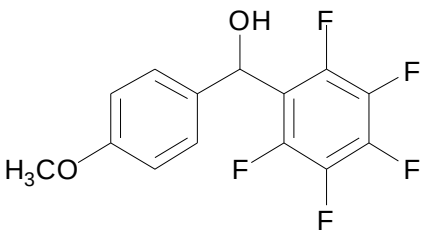
**$^1$H NMR**


OH
F
F
F
F
F
$H_3CO$

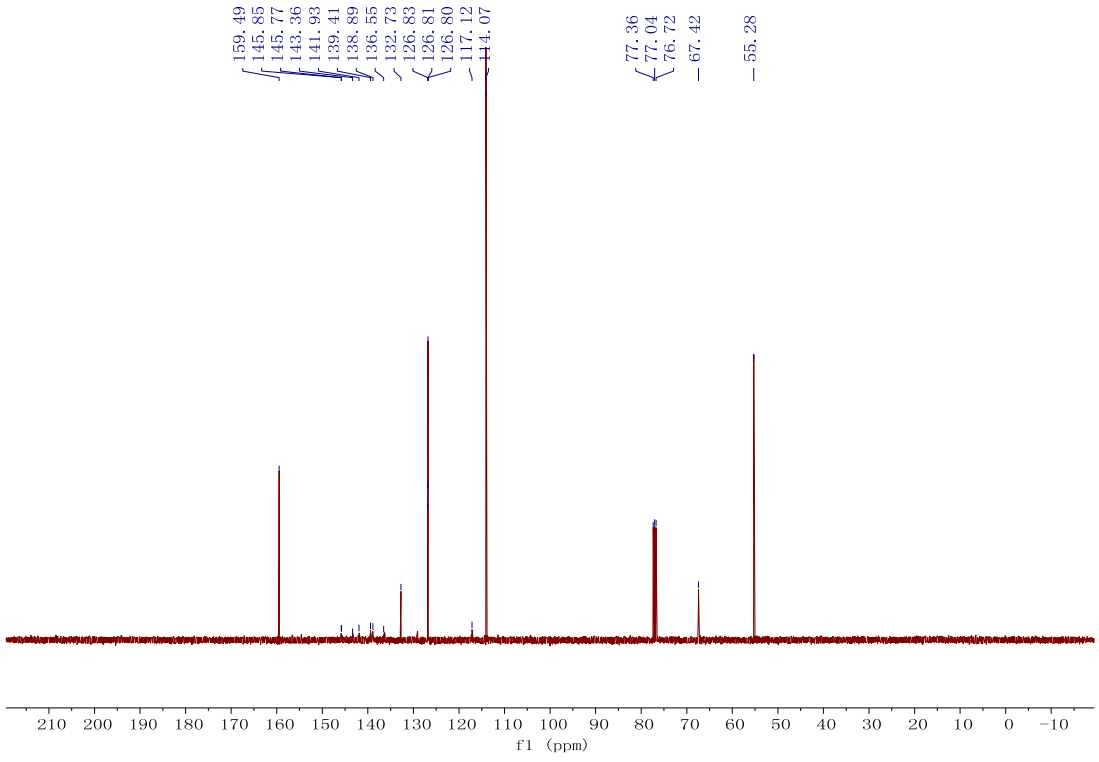
**3j**


7.2943
7.2922
7.2719
7.2700
6.8731
6.8678
6.8512
6.1446
3.7828
2.8903
0.0004
1.07
1.02
0.50
1.53
0.51
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

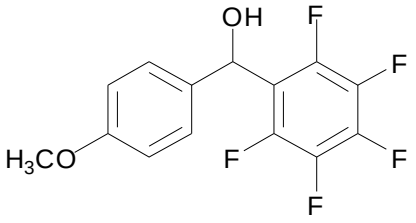
**$^{13}$C NMR**


OH
F
F
F
F
F
$H_3CO$

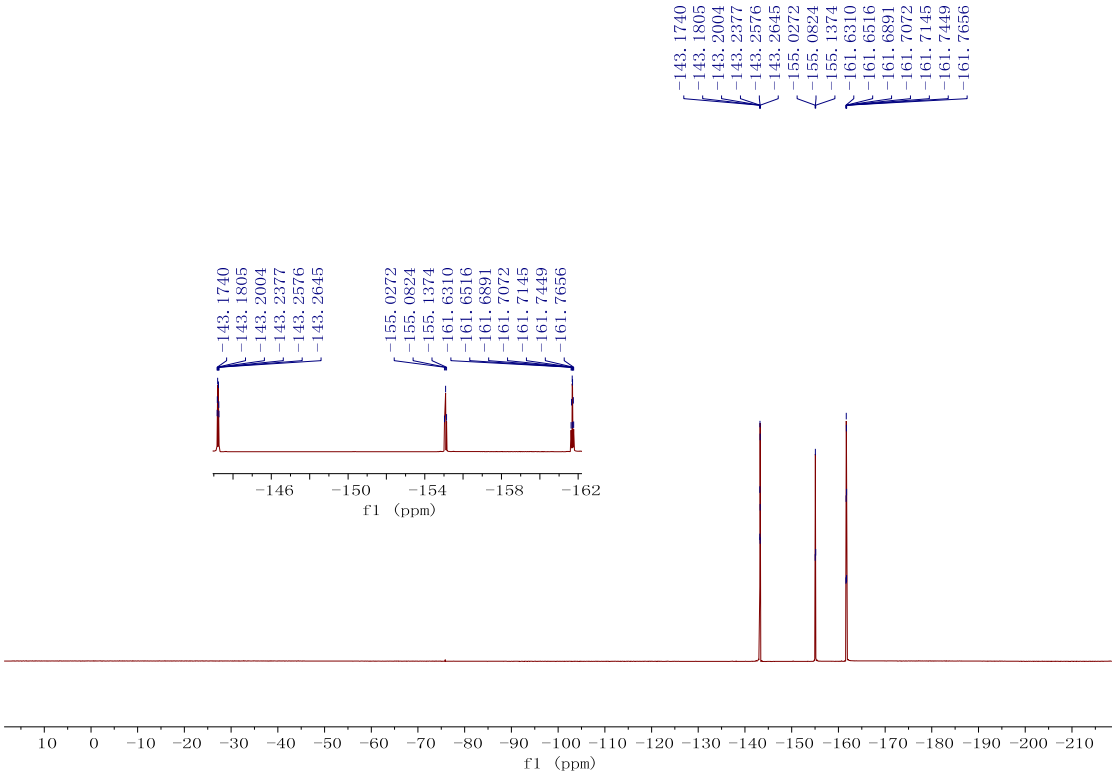
**3j**


159.49
145.85
145.77
143.36
141.93
139.41
138.89
136.55
132.73
126.83
126.81
126.80
117.12
114.07
77.36
77.04
76.72
67.42
55.28
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

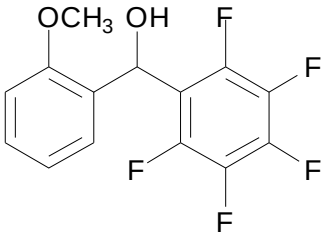
**$^{19}$F NMR**


OH
F
F
F
F
F
$H_3CO$

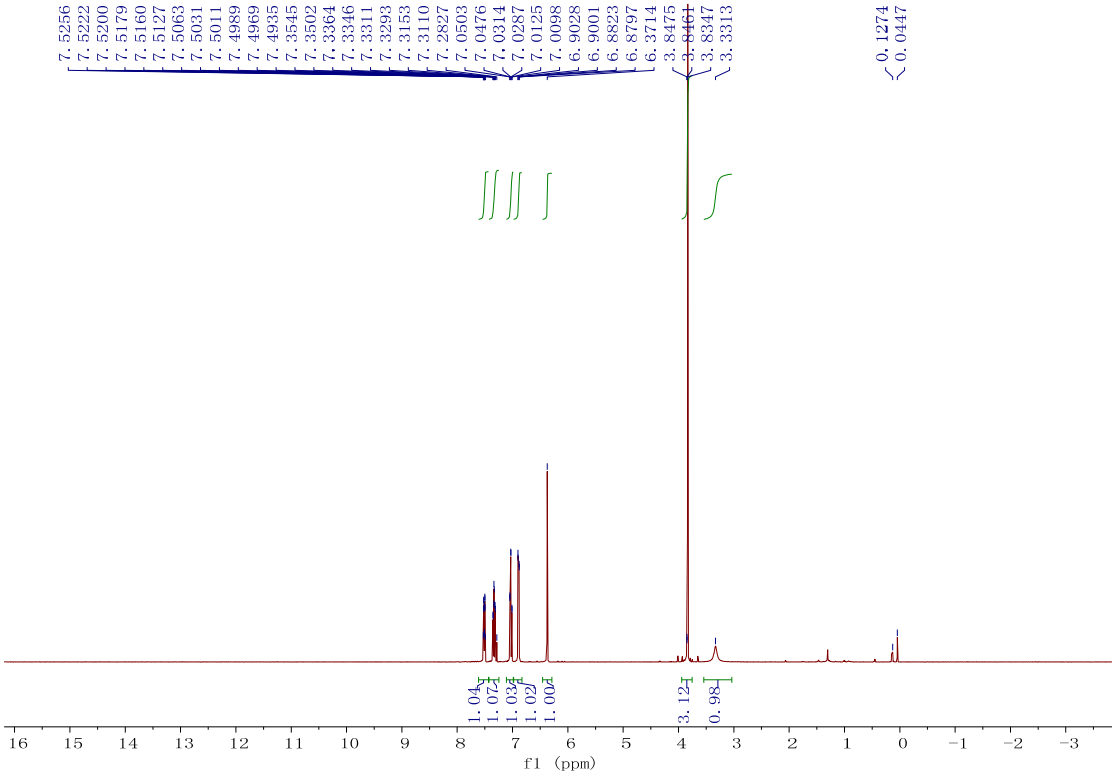
**3j**


-143.1740
-143.1805
-143.2004
-143.2377
-143.2576
-143.2645
-155.0272
-155.0824
-155.1374
-161.6310
-161.6516
-161.6891
-161.7072
-161.7145
-161.7449
-161.7656
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

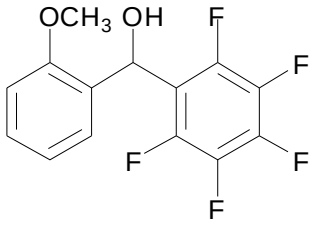
**$^1$H NMR**


OCH3
OH
F
F
F
F
F

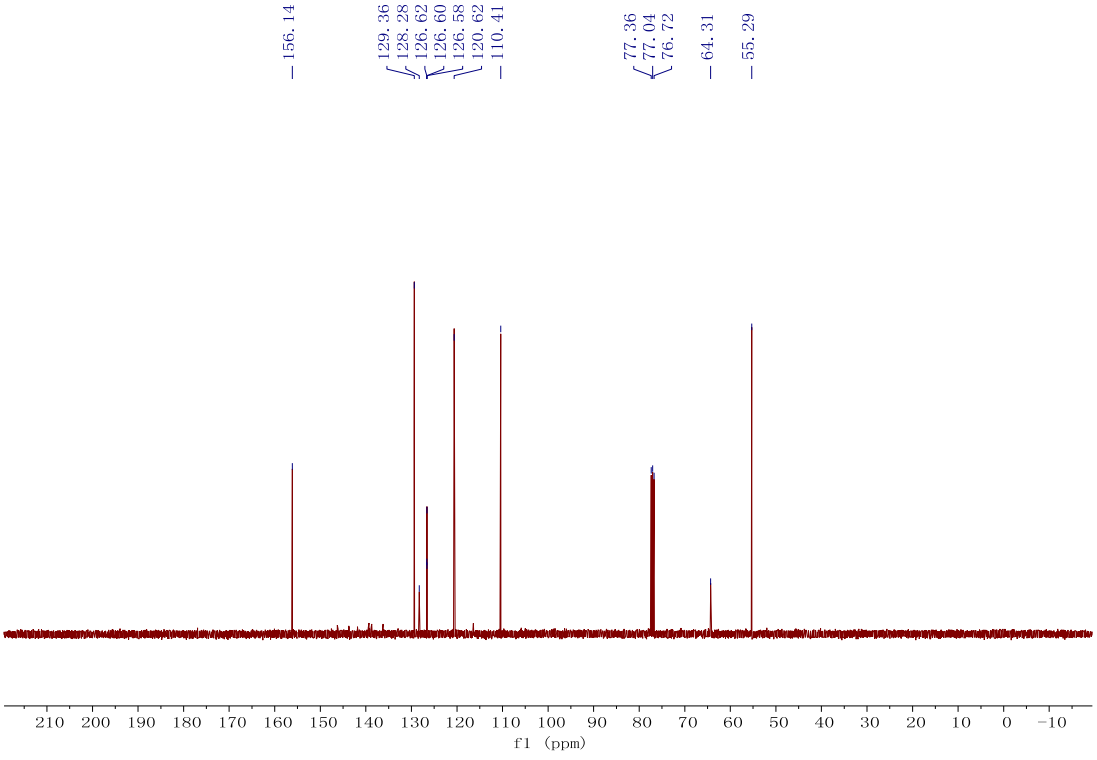
**3k**


7.5256
7.5222
7.5200
7.5179
7.5160
7.5127
7.5063
7.5031
7.5011
7.4989
7.4969
7.4935
7.3545
7.3502
7.3364
7.3346
7.3311
7.3293
7.3153
7.3110
7.2827
7.0503
7.0476
7.0314
7.0287
7.0125
7.0098
6.9028
6.9001
6.8823
6.8797
6.3714
3.8475
3.8461
3.8347
3.3313
0.1274
0.0447
1.04
1.07
1.03
1.02
1.00
3.12
0.98
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
f1 (ppm)

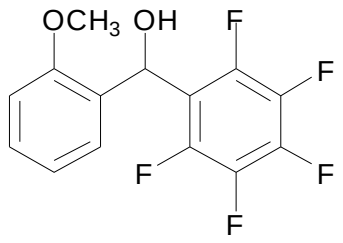
**$^{13}$C NMR**


OCH3
OH
F
F
F
F
F

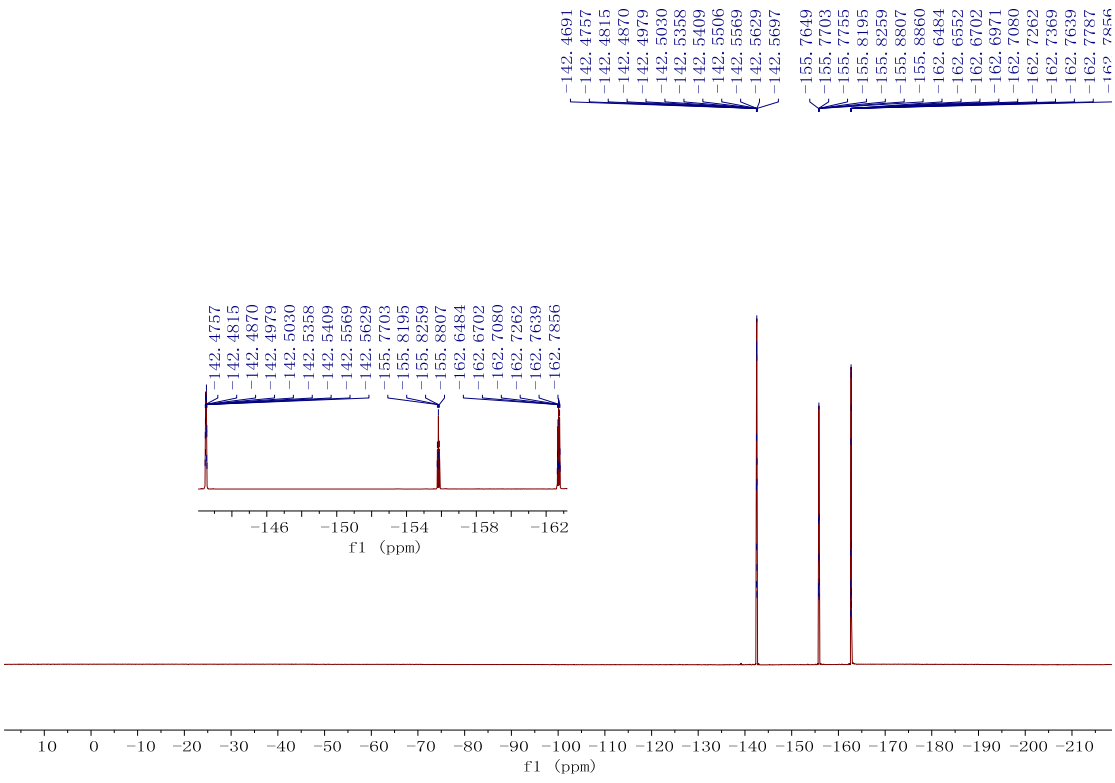
**3k**


156.14
129.36
128.28
126.62
126.60
126.58
120.62
110.41
77.36
77.04
76.72
64.31
55.29
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

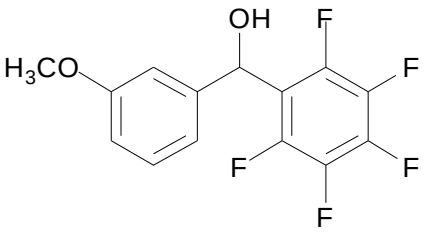
**$^{19}$F NMR**


OCH3
OH
F
F
F
F
F

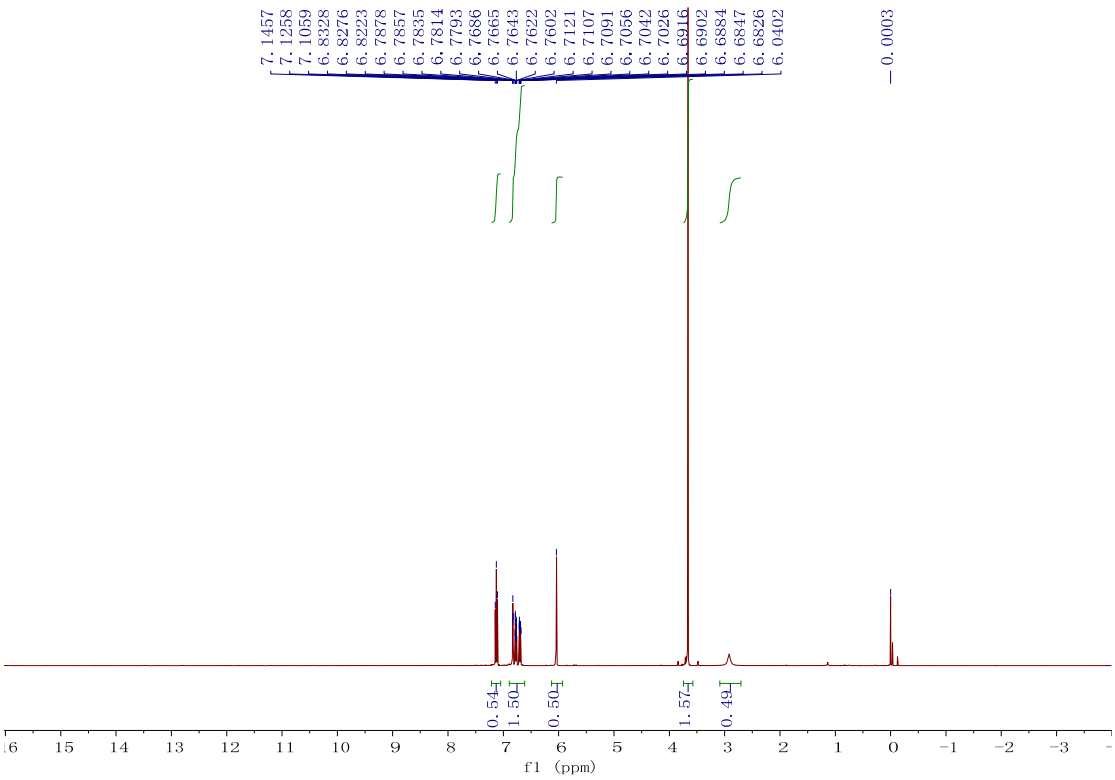
**3k**

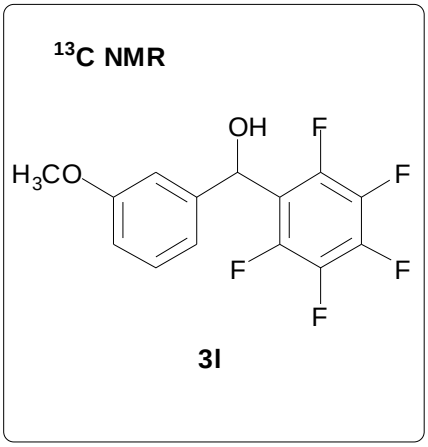

-142.4691
-142.4757
-142.4815
-142.4870
-142.4979
-142.5030
-142.5358
-142.5409
-142.5506
-142.5569
-142.5629
-142.5697
-155.7649
-155.7703
-155.7755
-155.8195
-155.8259
-155.8807
-155.8860
-162.6484
-162.6552
-162.6702
-162.6971
-162.7080
-162.7262
-162.7369
-162.7639
-162.7787
-162.7856
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

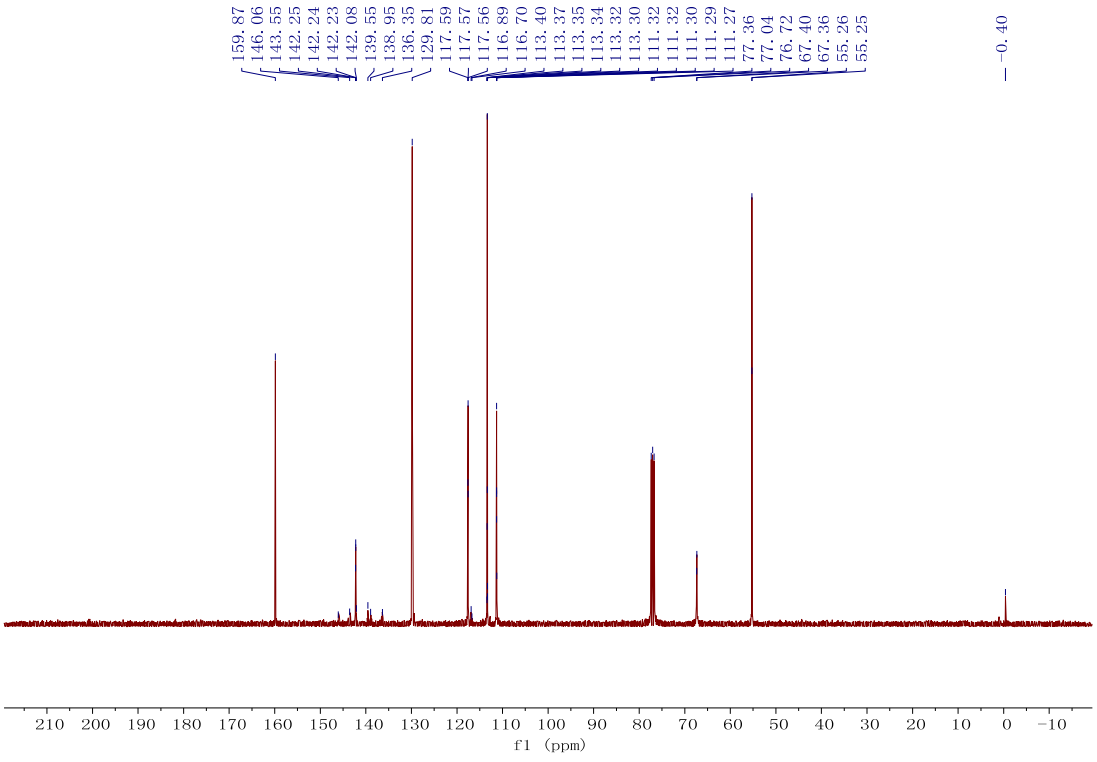
**$^1$H NMR**


OH
F
H3CO
F
F
F
F

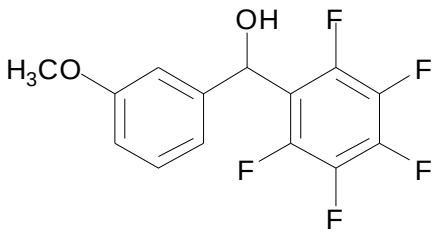
**3l**


7.1457
7.1258
7.1059
6.8328
6.8276
6.8223
6.7878
6.7857
6.7835
6.7814
6.7793
6.7686
6.7665
6.7643
6.7622
6.7602
6.7121
6.7107
6.7091
6.7056
6.7042
6.7026
6.6916
6.6902
6.6884
6.6847
6.6826
6.0402
0.0003
0.54
1.50
0.50
1.57
0.49
f1 (ppm)

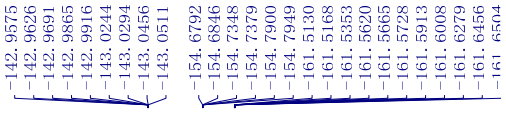

13C NMR
OH
F
H3CO
F
F
F
F
3l

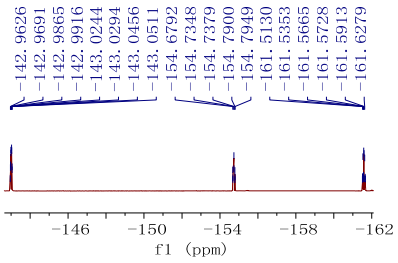

159.87
146.06
143.55
142.25
142.24
142.23
142.08
139.55
138.95
136.35
129.81
117.59
117.57
117.56
116.89
116.70
113.40
113.37
113.35
113.34
113.32
113.30
111.32
111.32
111.30
111.29
111.27
77.36
77.04
76.72
67.40
67.36
55.26
55.25
-0.40
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

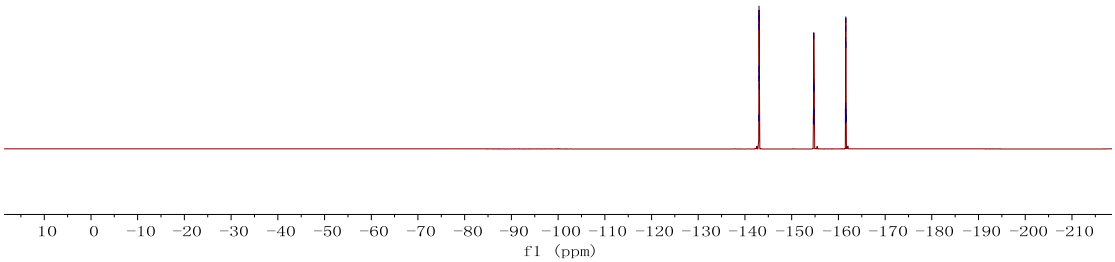
**$^{19}$F NMR**


OH
F
H3CO
F
F
F
F

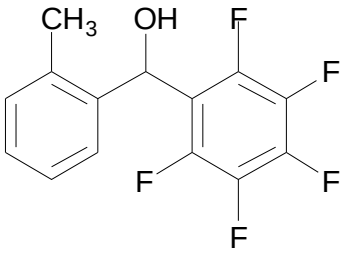
**3l**


-142.9575
-142.9626
-142.9691
-142.9865
-142.9916
-143.0244
-143.0294
-143.0456
-143.0511
-154.6792
-154.6846
-154.7348
-154.7379
-154.7900
-154.7949
-161.5130
-161.5168
-161.5353
-161.5620
-161.5665
-161.5728
-161.5913
-161.6008
-161.6279
-161.6456

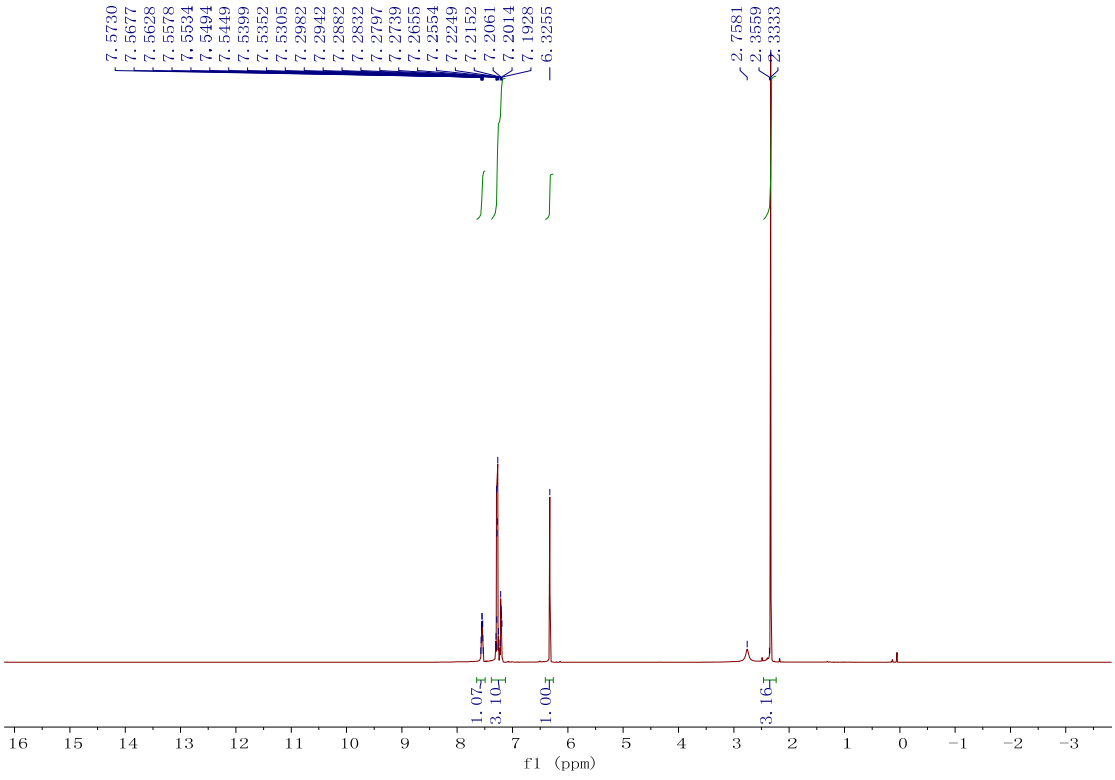

-142.9626
-142.9691
-142.9865
-142.9916
-143.0244
-143.0294
-143.0456
-143.0511
-154.6792
-154.7348
-154.7379
-154.7900
-154.7949
-161.5130
-161.5353
-161.5665
-161.5728
-161.5913
-161.6279
-146
-150
-154
-158
-162
f1 (ppm)


10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

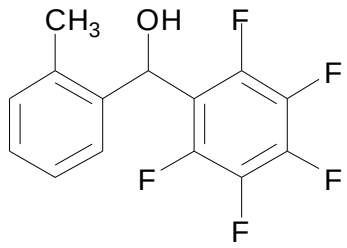
**$^1$H NMR**


CH3
OH
F
F
F
F
F

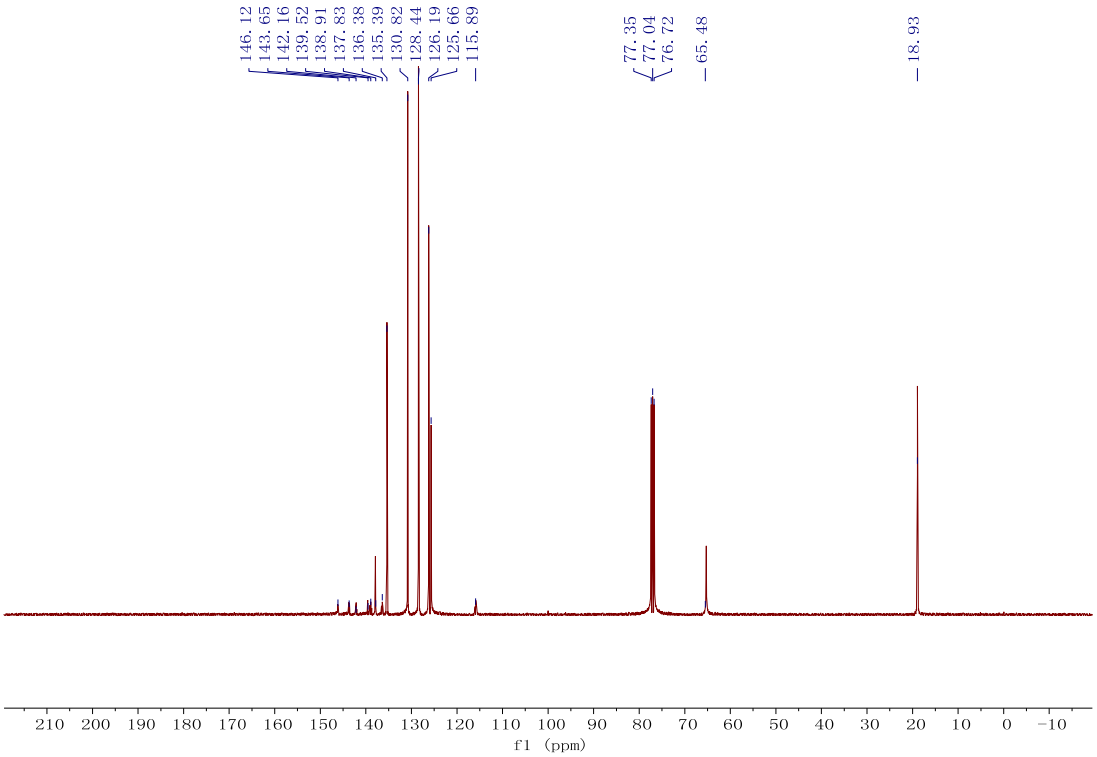
**3m**


7.5730
7.5677
7.5628
7.5578
7.5534
7.5494
7.5449
7.5399
7.5352
7.5305
7.2982
7.2942
7.2882
7.2832
7.2797
7.2739
7.2655
7.2554
7.2249
7.2152
7.2061
7.2014
7.1928
6.3255
2.7581
2.3559
2.3333
1.07
3.10
1.00
3.16
f1 (ppm)

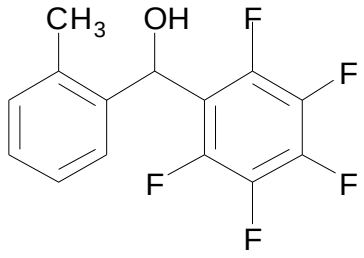
**$^{13}$C NMR**


CH3
OH
F
F
F
F
F

**3m**


146.12
143.65
142.16
139.52
138.91
137.83
136.38
135.39
130.82
128.44
126.19
125.66
115.89
77.35
77.04
76.72
65.48
18.93
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**


CH3
OH
F
F
F
F
F

**3m**


-142.0888
-142.0951
-142.1026
-142.1124
-142.1177
-142.1240
-142.1502
-142.1556
-142.1712
-142.1792
-142.1846
-154.4529
-154.4582
-154.5020
-154.5075
-154.5127
-154.5580
-154.5634
-154.5689
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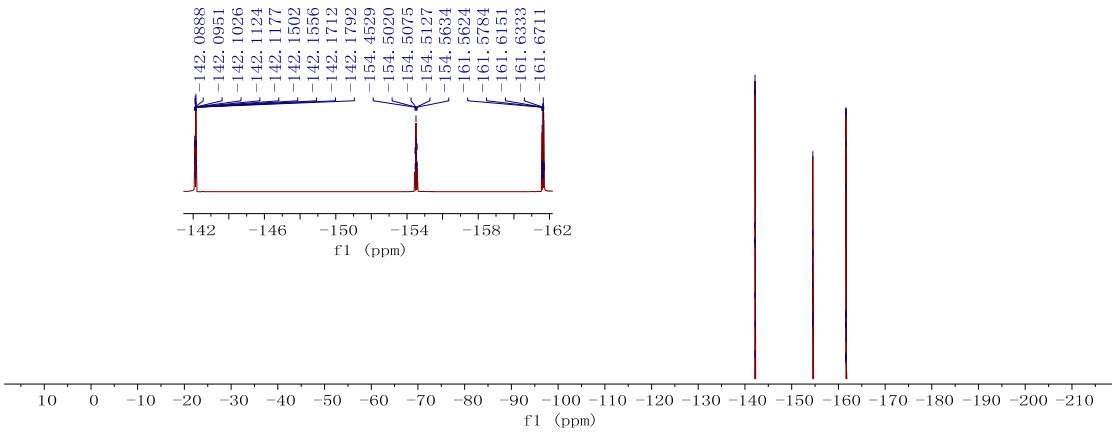
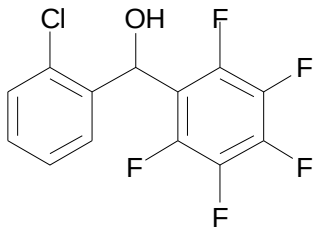
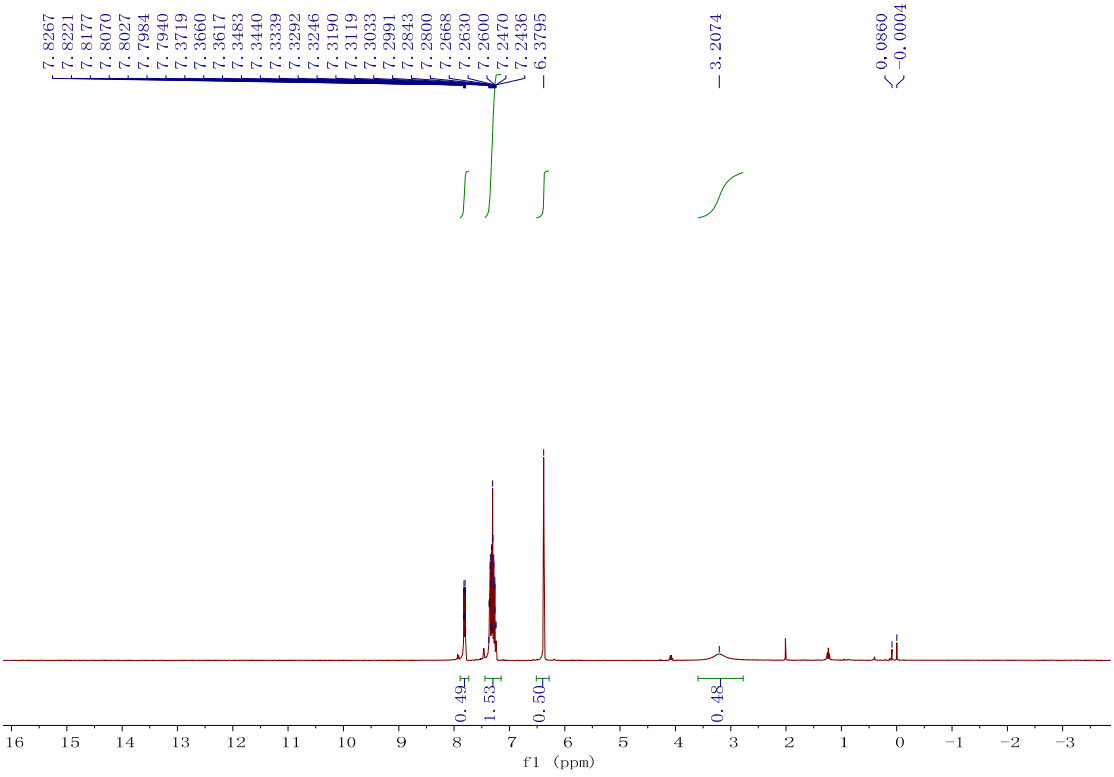
-161.5624
-161.5784
-161.6151
-161.6333
-161.6433
-161.6711
-161.6920


-142.0888
-142.0951
-142.1026
-142.1124
-142.1177
-142.1502
-142.1556
-142.1712
-142.1792
-154.4529
-154.5020
-154.5075
-154.5127
-154.5634
-161.5624
-161.5784
-161.6151
-161.6333
-161.6711
-142
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

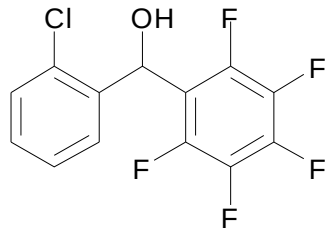
**$^1$H NMR**


Cl
OH
F
F
F
F
F

**3n**

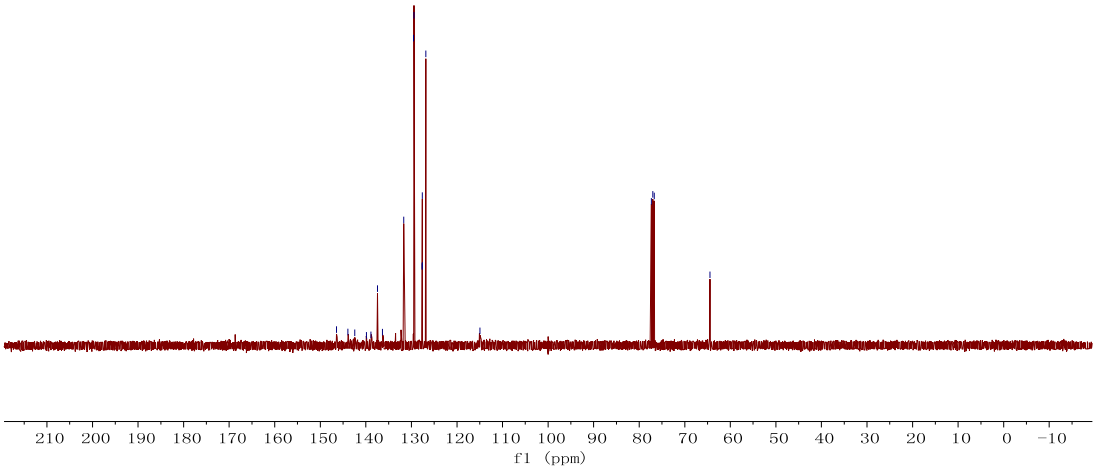

7.8267
7.8221
7.8177
7.8070
7.8027
7.7984
7.7940
7.3719
7.3660
7.3617
7.3483
7.3440
7.3339
7.3292
7.3246
7.3190
7.3119
7.3033
7.2991
7.2843
7.2800
7.2668
7.2630
7.2600
7.2470
7.2436
6.3795
3.2074
0.0860
-0.0004
0.49
1.53
0.50
0.48
f1 (ppm)

**$^{13}$C NMR**

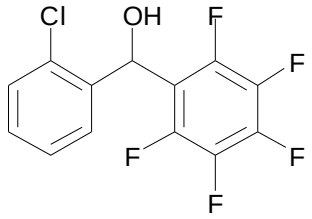

Cl
OH
F
F
F
F
F

**3n**


146.44
143.94
142.44
139.86
138.87
137.43
136.37
131.69
129.54
129.43
127.65
127.62
127.59
126.85
114.97
77.34
77.03
76.71
64.46

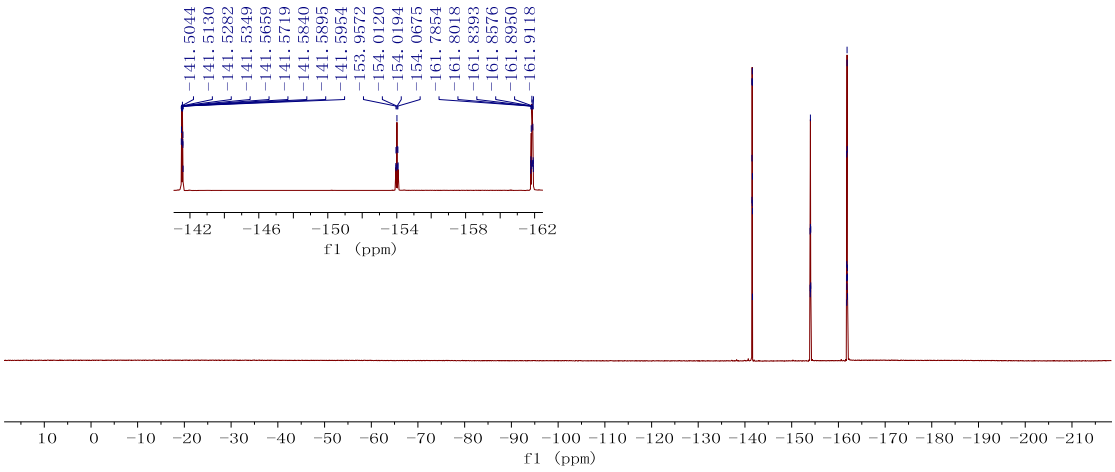

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**

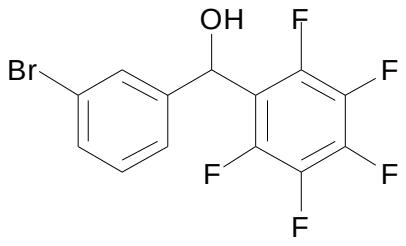

Cl
OH
F
F
F
F
F

**3n**

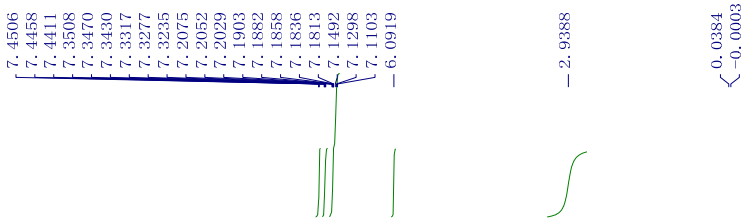

-141.5044
-141.5130
-141.5282
-141.5349
-141.5659
-141.5719
-141.5840
-141.5895
-141.5954
-141.6031
-153.9501
-153.9572
-154.0120
-154.0194
-154.0607
-154.0675
-154.0741
-161.7782
-161.7854
-161.8018
-161.8278
-161.8393
-161.8576
-161.8684
-161.8950
-161.9118

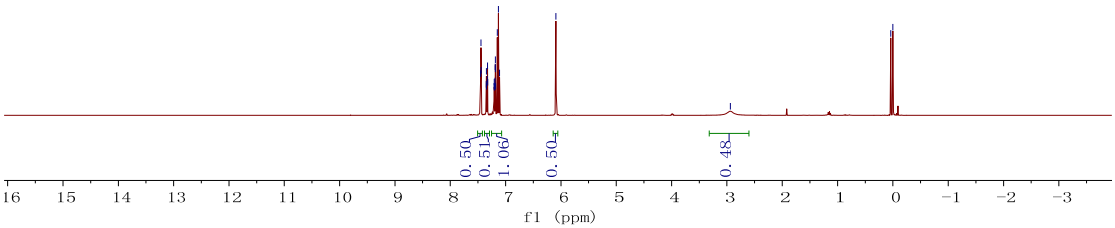

-141.5044
-141.5130
-141.5282
-141.5349
-141.5659
-141.5719
-141.5840
-141.5895
-141.5954
-153.9572
-154.0120
-154.0194
-154.0675
-161.7854
-161.8018
-161.8393
-161.8576
-161.8950
-161.9118
-142
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

**$^1$H NMR**

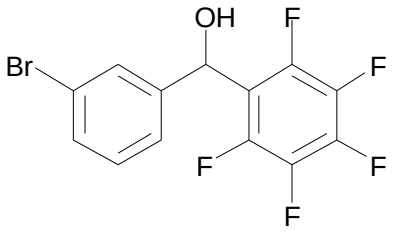

OH
F
Br
F
F
F
F

**3o**

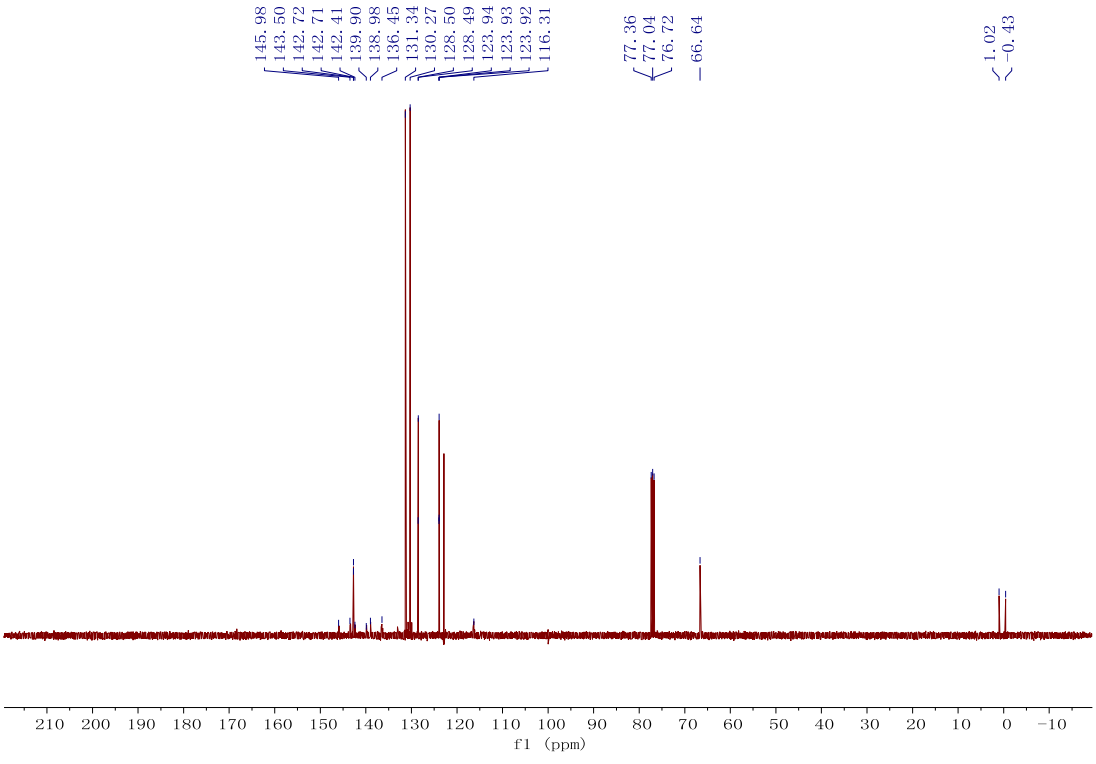

7.4506
7.4458
7.4411
7.3508
7.3470
7.3430
7.3317
7.3277
7.3235
7.2075
7.2052
7.2029
7.1903
7.1882
7.1858
7.1836
7.1813
7.1492
7.1298
7.1103
6.0919
2.9388
0.0384
-0.0003


0.50
0.51
1.06
0.50
0.48
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

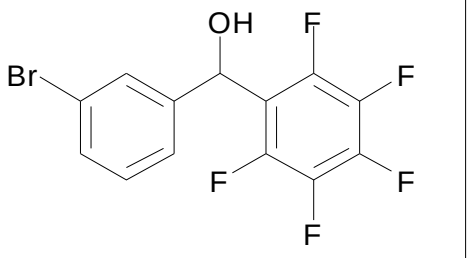
**$^{13}$C NMR**


OH
F
Br
F
F
F
F

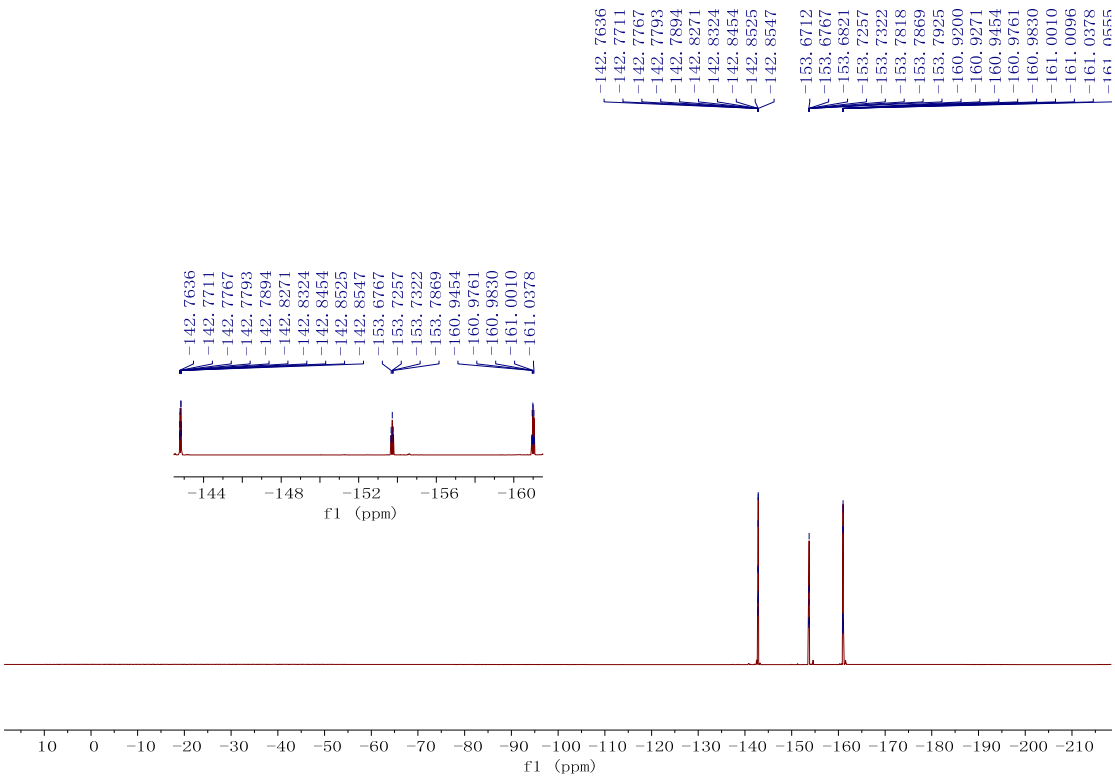
**3o**


145.98
143.50
142.72
142.71
142.41
139.90
138.98
136.45
131.34
130.27
128.50
128.49
123.94
123.93
123.92
116.31
77.36
77.04
76.72
66.64
1.02
-0.43
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

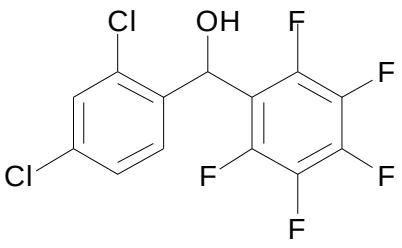
**$^{19}$F NMR**


OH
F
Br
F
F
F
F

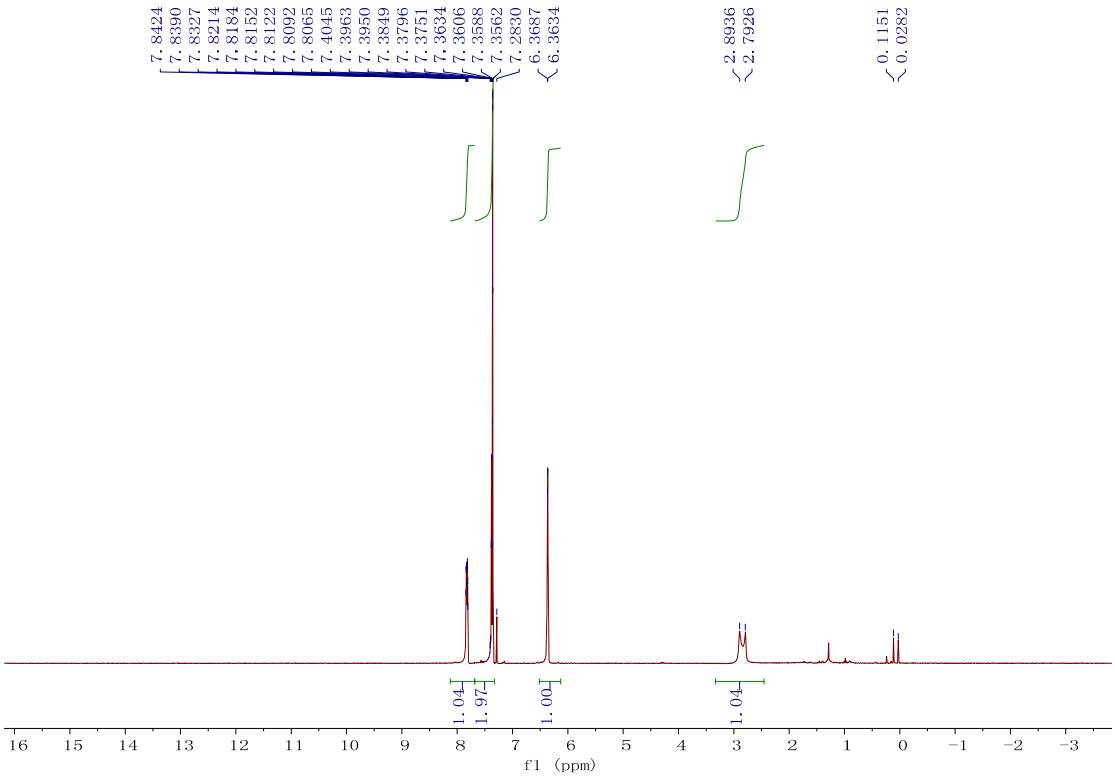
**3o**


-142.7636
-142.7711
-142.7767
-142.7793
-142.7894
-142.8271
-142.8324
-142.8454
-142.8525
-142.8547
-153.6712
-153.6767
-153.6821
-153.7257
-153.7322
-153.7818
-153.7869
-153.7925
-160.9200
-160.9271
-160.9454
-160.9761
-160.9830
-161.0010
-161.0096
-161.0378
-144
-148
-152
-156
-160
f1 (ppm)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

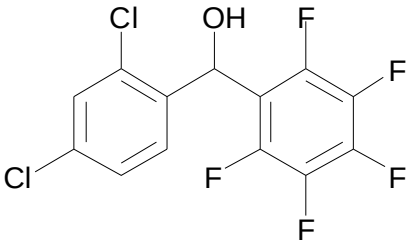
**$^1$H NMR**


Cl
OH
F
F
Cl
F
F
F

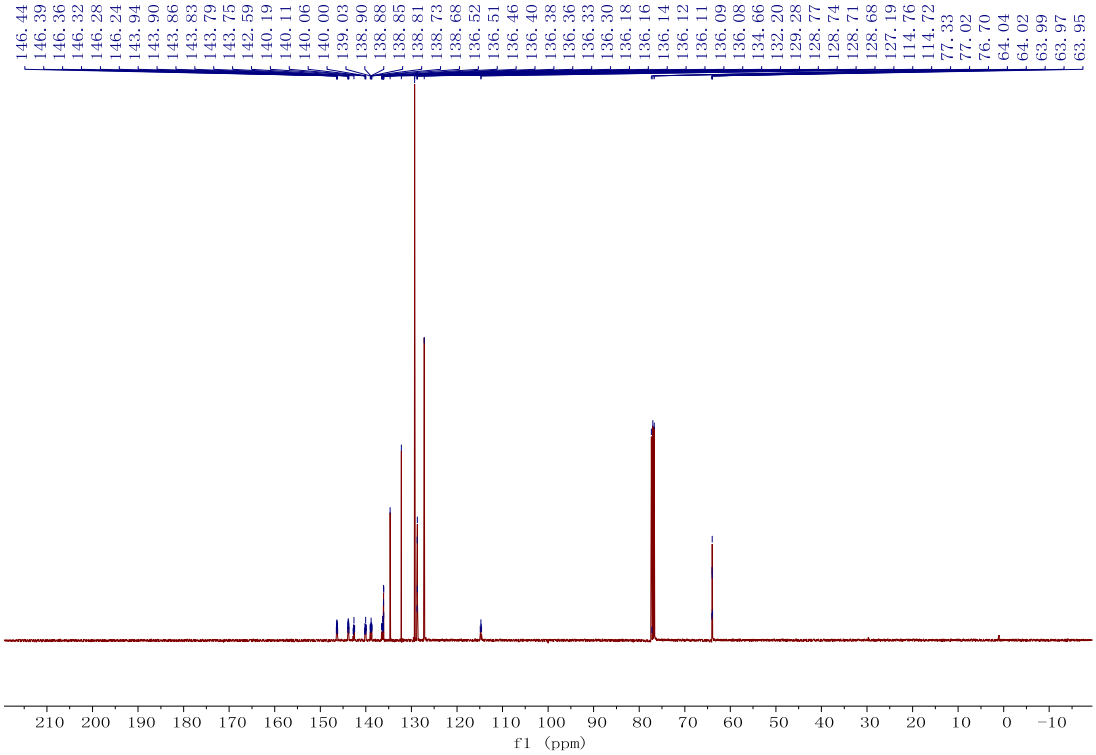
**3p**


7.8424
7.8390
7.8327
7.8214
7.8184
7.8152
7.8122
7.8092
7.8065
7.4045
7.3963
7.3950
7.3849
7.3796
7.3751
7.3634
7.3606
7.3588
7.3562
7.2830
6.3687
6.3634
2.8936
2.7926
0.1151
0.0282
1.04
1.97
1.00
1.04
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

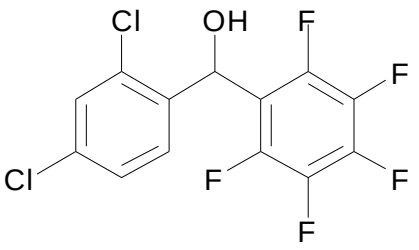
**$^{13}$C NMR**


Cl
OH
F
F
Cl
F
F
F

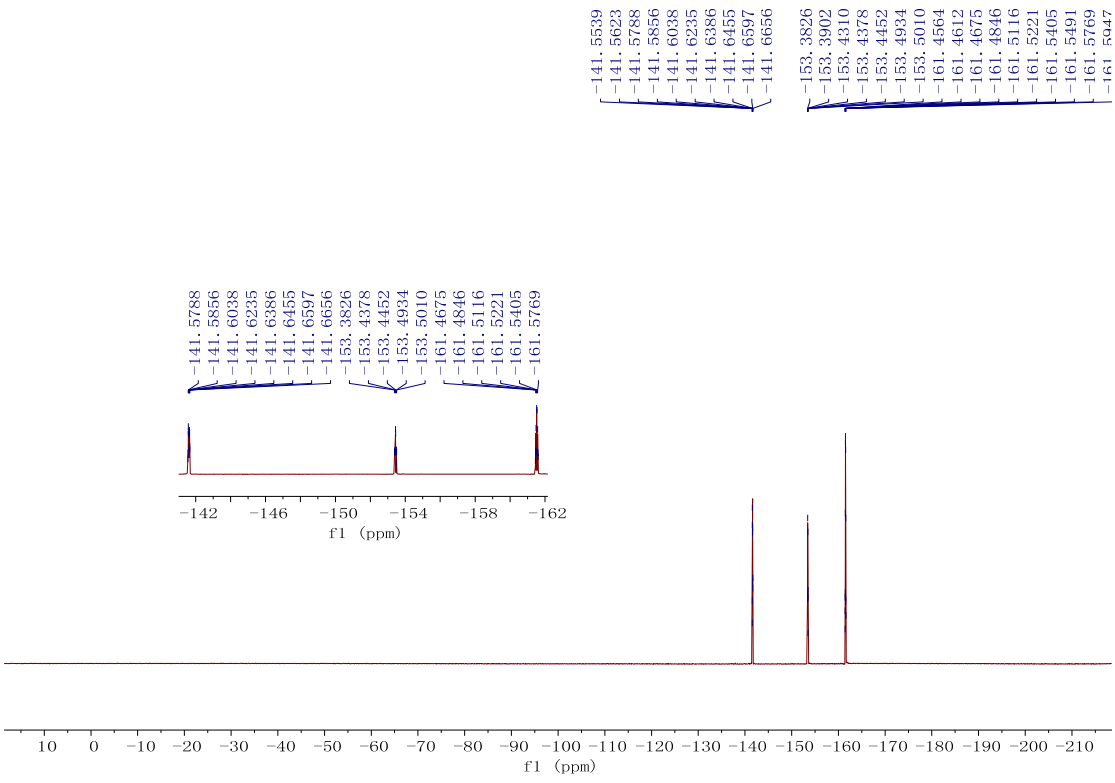
**3p**


146.44
146.39
146.36
146.32
146.28
146.24
143.94
143.90
143.86
143.83
143.79
143.75
142.59
140.19
140.11
140.06
140.00
139.03
138.90
138.88
138.85
138.81
138.73
138.68
136.52
136.51
136.46
136.40
136.38
136.36
136.33
136.30
136.18
136.16
136.14
136.12
136.11
136.09
136.08
134.66
132.20
129.28
128.77
128.74
128.71
128.68
127.19
114.76
114.72
77.33
77.02
76.70
64.04
64.02
63.99
63.97
63.95
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

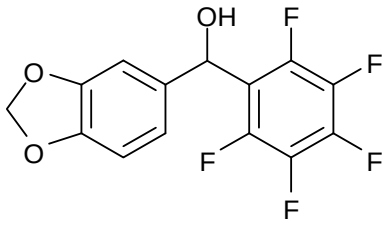
**$^{19}$F NMR**


Cl
OH
F
F
Cl
F
F
F

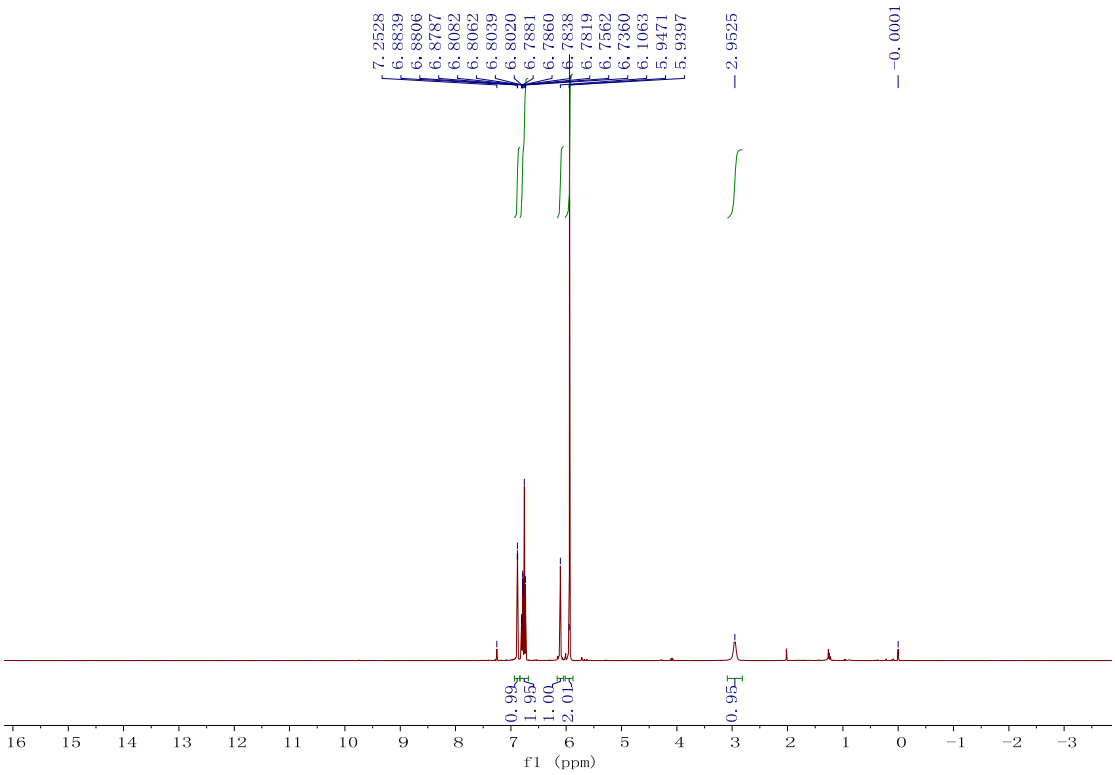
**3p**


−141.5539
−141.5623
−141.5788
−141.5856
−141.6038
−141.6235
−141.6386
−141.6455
−141.6597
−141.6656
−153.3826
−153.3902
−153.4310
−153.4378
−153.4452
−153.4934
−153.5010
−161.4564
−161.4612
−161.4675
−161.4846
−161.5116
−161.5221
−161.5405
−161.5491
−161.5769
−142
−146
−150
−154
−158
−162
f1 (ppm)
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−120
−130
−140
−150
−160
−170
−180
−190
−200
−210
f1 (ppm)

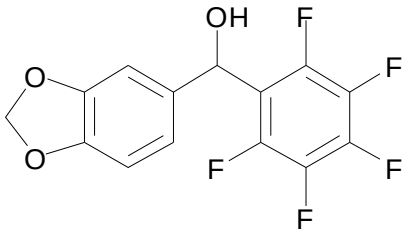
**$^1$H NMR**


OH
F
F
F
F
F
O
O

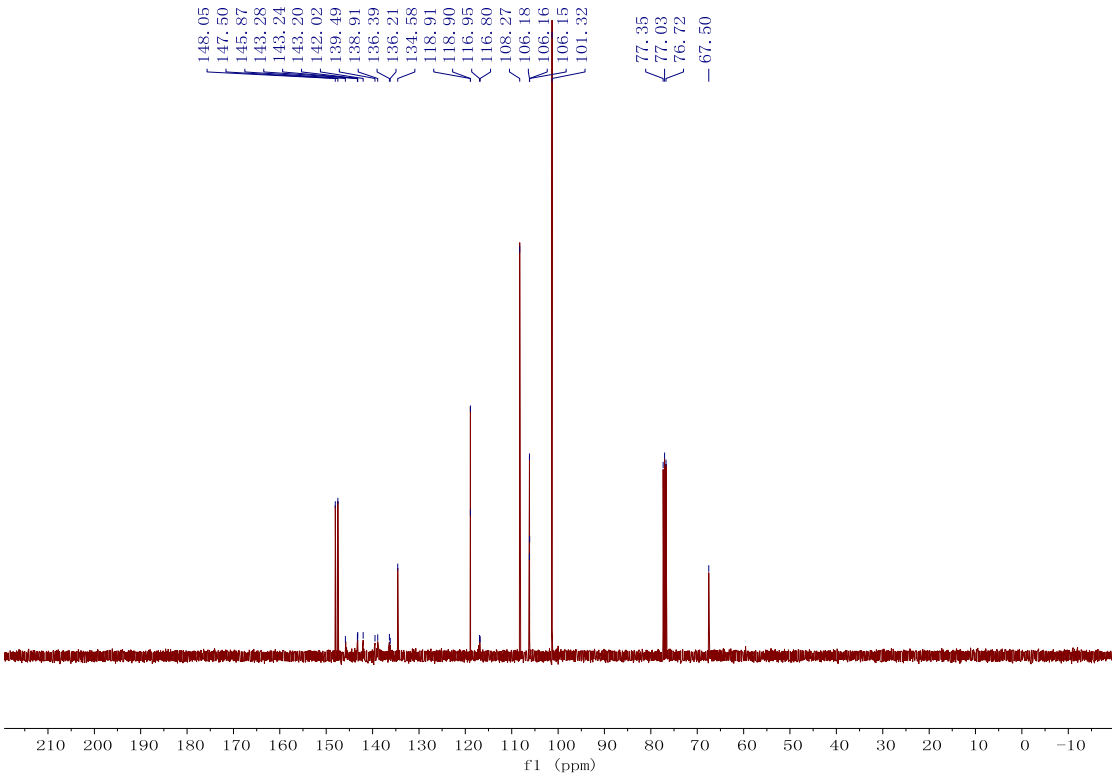
**3q**


7.2528
6.8839
6.8806
6.8787
6.8082
6.8062
6.8039
6.8020
6.7881
6.7860
6.7838
6.7819
6.7562
6.7360
6.1063
5.9471
5.9397
2.9525
-0.0001
0.99
1.95
1.00
2.01
0.95
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3
f1 (ppm)

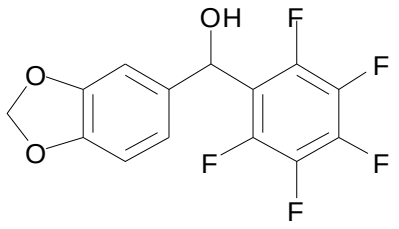
**$^{13}$C NMR**


OH
F
F
F
F
F
O
O

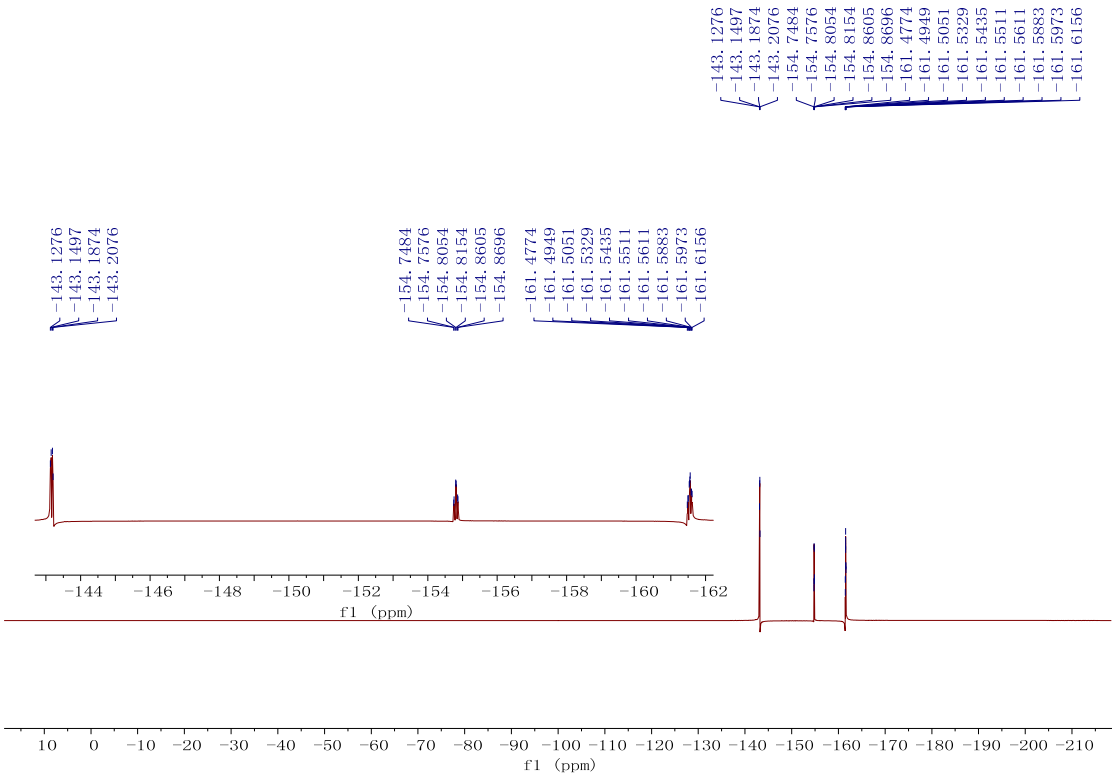
**3q**


148.05
147.50
145.87
143.28
143.24
143.20
142.02
139.49
138.91
136.39
136.21
134.58
118.91
118.90
116.95
116.80
108.27
106.18
106.16
106.15
101.32
77.35
77.03
76.72
67.50
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −10
f1 (ppm)

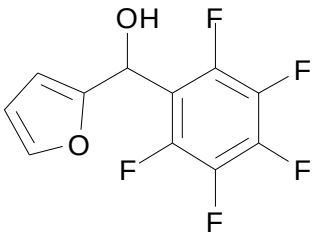
**$^{19}$F NMR**


OH
F
F
O
O
F
F
F

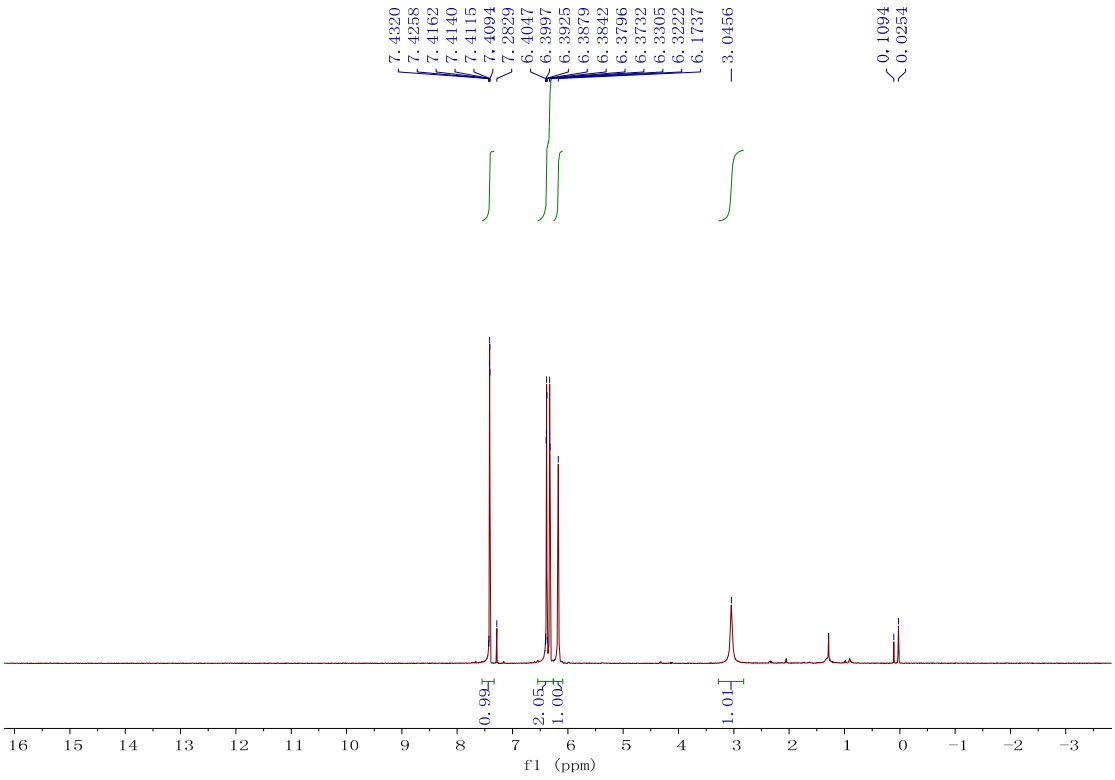
**3q**


-143.1276
-143.1497
-143.1874
-143.2076
-154.7484
-154.7576
-154.8054
-154.8154
-154.8605
-154.8696
-161.4774
-161.4949
-161.5051
-161.5329
-161.5435
-161.5511
-161.5611
-161.5883
-161.5973
-161.6156
-144
-146
-148
-150
-152
-154
-156
-158
-160
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

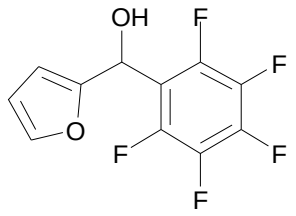
**$^1$H NMR**


OH
F
F
F
F
O
F

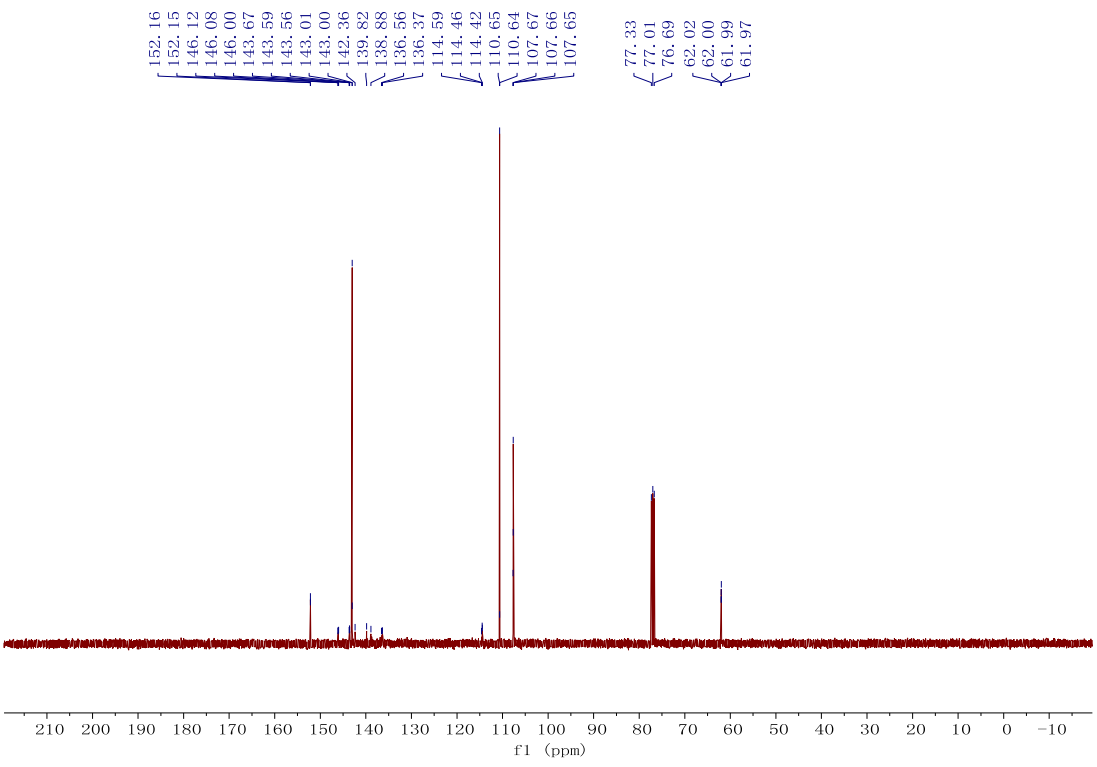
**3r**


7.4320
7.4258
7.4162
7.4140
7.4115
7.4094
7.2829
6.4047
6.3997
6.3925
6.3879
6.3842
6.3796
6.3732
6.3305
6.3222
6.1737
3.0456
0.1094
0.0254
0.99
2.05
1.00
1.01
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

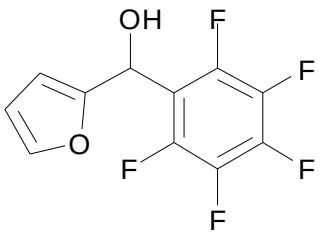
**$^{13}$C NMR**


OH
F
F
F
F
O
F

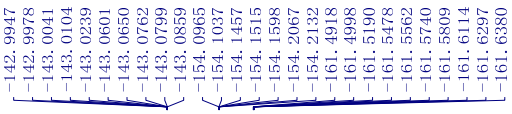
**3r**

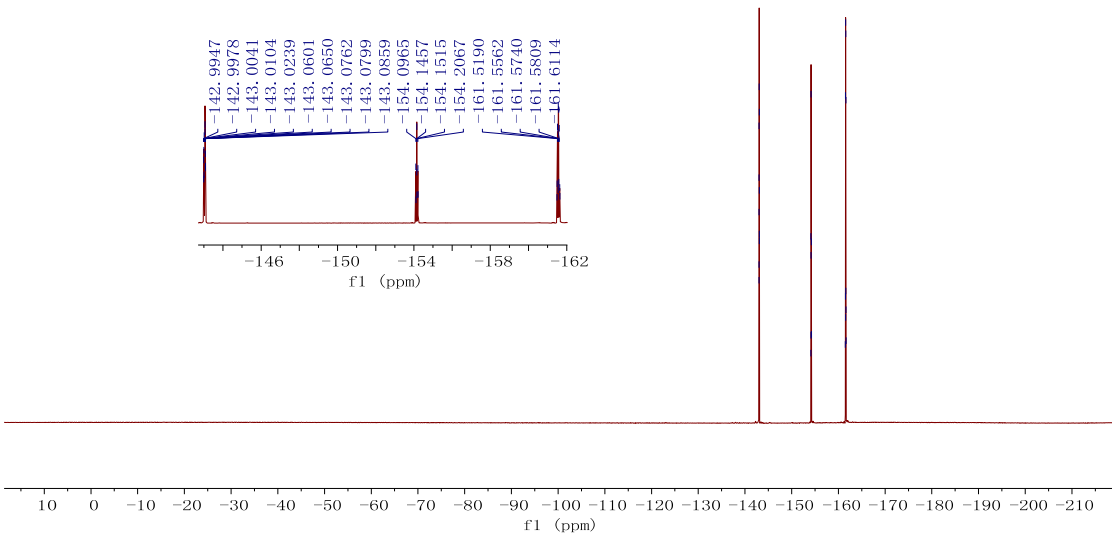

152.16
152.15
146.12
146.08
146.00
143.67
143.59
143.56
143.01
143.00
142.36
139.82
138.88
136.56
136.37
114.59
114.46
114.42
110.65
110.64
107.67
107.66
107.65
77.33
77.01
76.69
62.02
62.00
61.99
61.97
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**

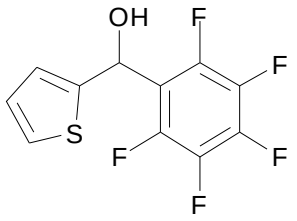

OH
F
F
F
F
F
O

**3r**

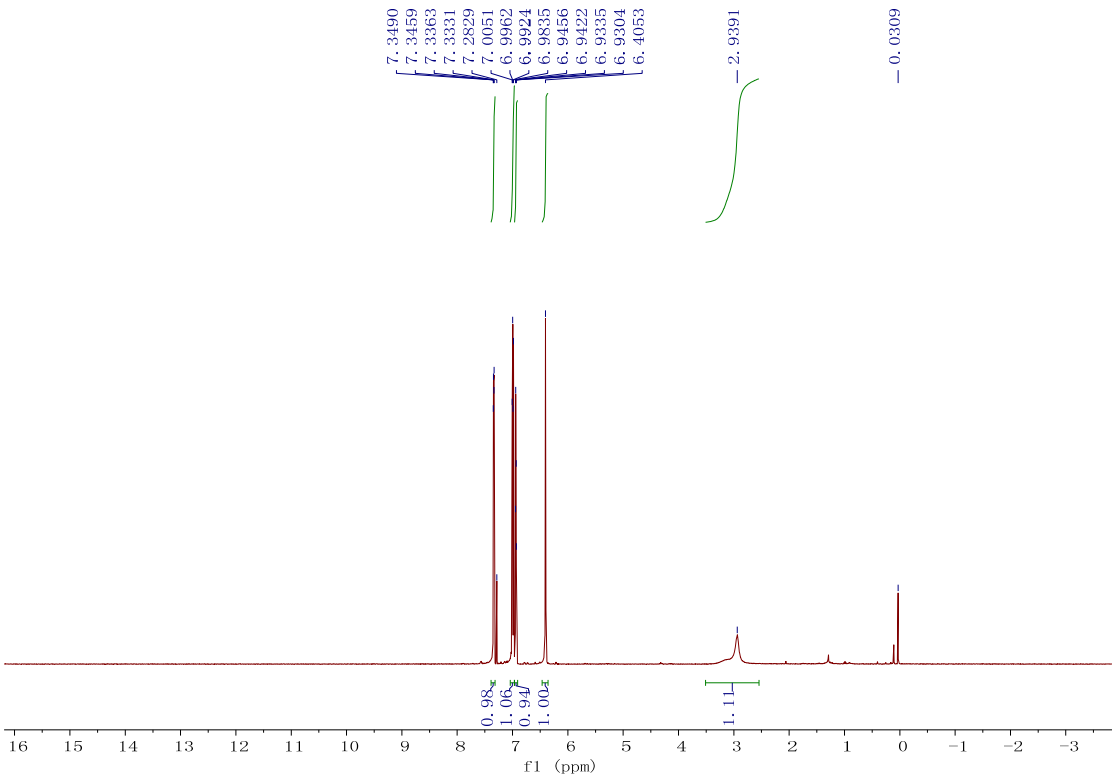

-142.9947
-142.9978
-143.0041
-143.0104
-143.0239
-143.0601
-143.0650
-143.0762
-143.0799
-143.0859
-154.0965
-154.1037
-154.1457
-154.1515
-154.1598
-154.2067
-154.2132
-161.4918
-161.4998
-161.5190
-161.5478
-161.5562
-161.5740
-161.5809
-161.6114
-161.6297
-161.6380


-142.9947
-142.9978
-143.0041
-143.0104
-143.0239
-143.0601
-143.0650
-143.0762
-143.0799
-143.0859
-154.0965
-154.1457
-154.1515
-154.2067
-161.5190
-161.5562
-161.5740
-161.5809
-161.6114
-146
-150
-154
-158
-162
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

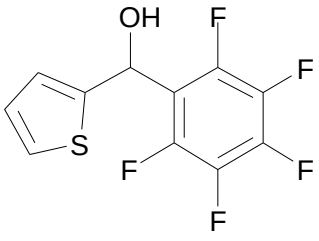
**$^1$H NMR**


OH
F
F
F
F
S

**3s**

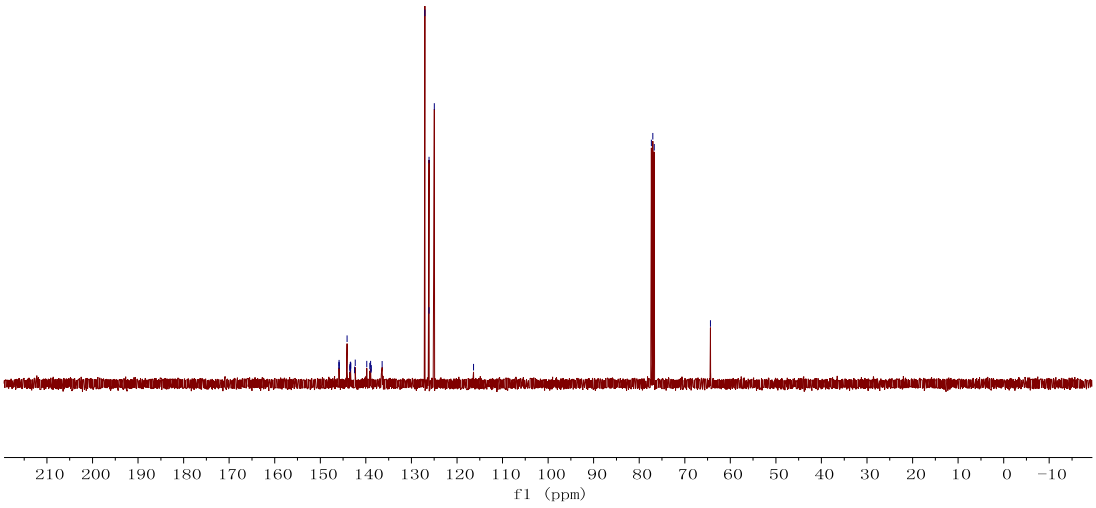

7.3490
7.3459
7.3363
7.3331
7.2829
7.0051
6.9962
6.9924
6.9835
6.9456
6.9422
6.9335
6.9304
6.4053
2.9391
0.0309
0.98
1.06
0.94
1.00
1.11
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

**$^{13}$C NMR**

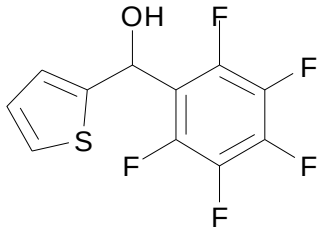

OH
F
F
S
F
F
F

**3s**

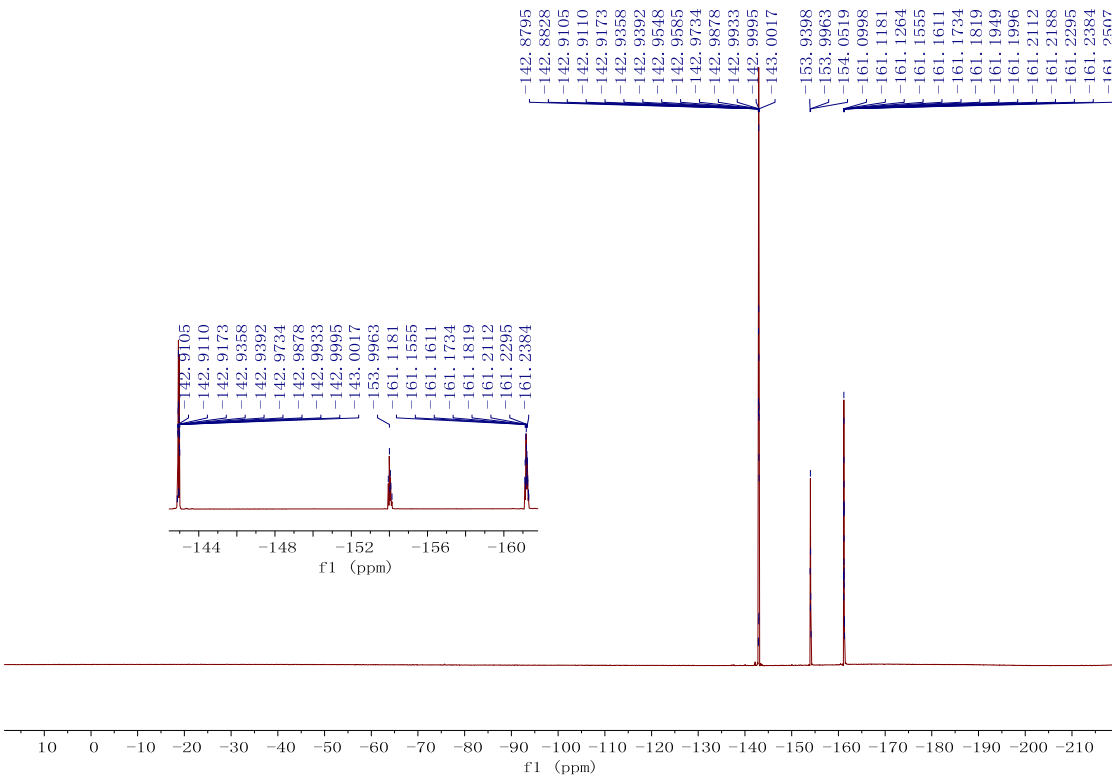

145.91
145.87
145.83
144.13
143.51
143.47
143.43
143.39
143.35
143.32
142.48
142.34
139.81
139.12
138.94
138.90
138.82
136.42
127.03
126.15
126.12
124.97
116.36
77.34
77.03
76.71
64.38


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

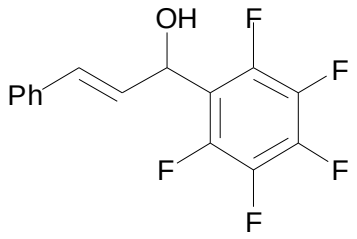
**$^{19}$F NMR**


OH
F
F
F
F
S

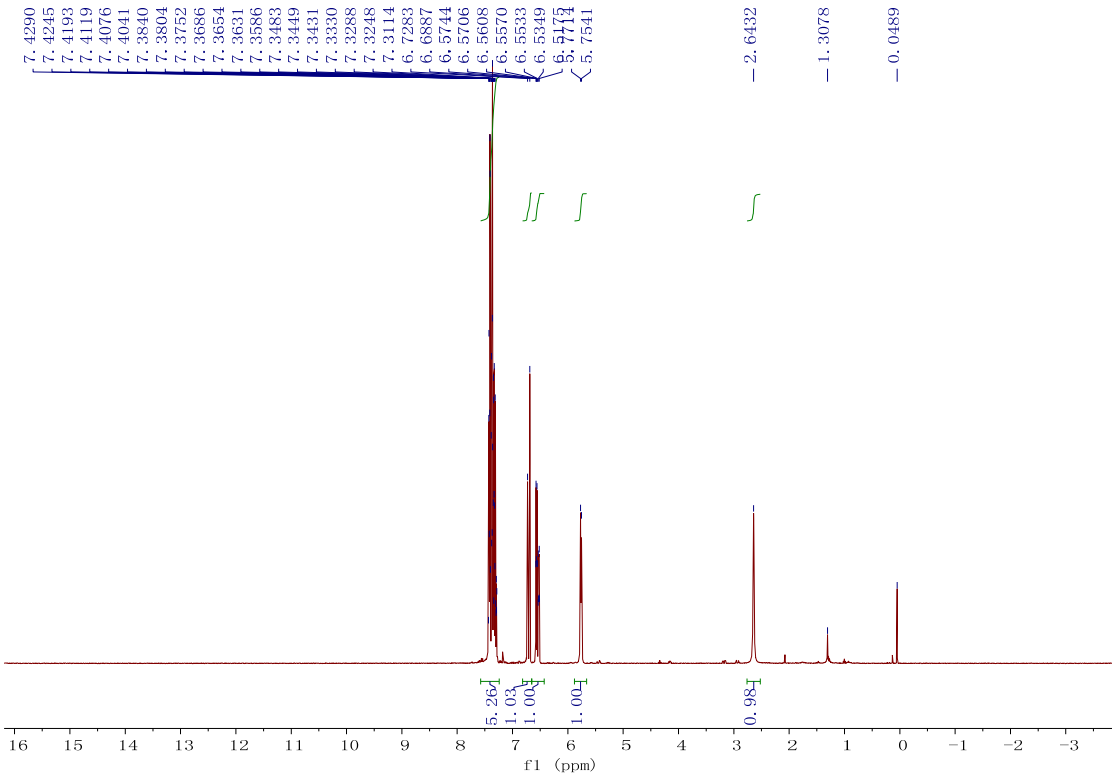
**3s**


-142.8795
-142.8828
-142.9105
-142.9110
-142.9173
-142.9358
-142.9392
-142.9548
-142.9585
-142.9734
-142.9878
-142.9933
-142.9995
-143.0017
-153.9398
-153.9963
-154.0519
-161.0998
-161.1181
-161.1264
-161.1555
-161.1611
-161.1734
-161.1819
-161.1949
-161.1996
-161.2112
-161.2188
-161.2295
-161.2384
-142.9105
-142.9110
-142.9173
-142.9358
-142.9392
-142.9734
-142.9878
-142.9933
-142.9995
-143.0017
-153.9963
-161.1181
-161.1555
-161.1611
-161.1734
-161.1819
-161.2112
-161.2295
-161.2384
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

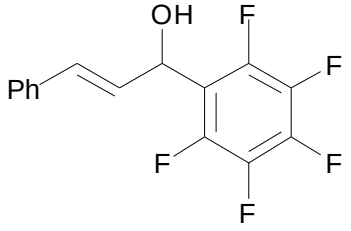
**$^1$H NMR**


OH
F
F
Ph
F
F
F

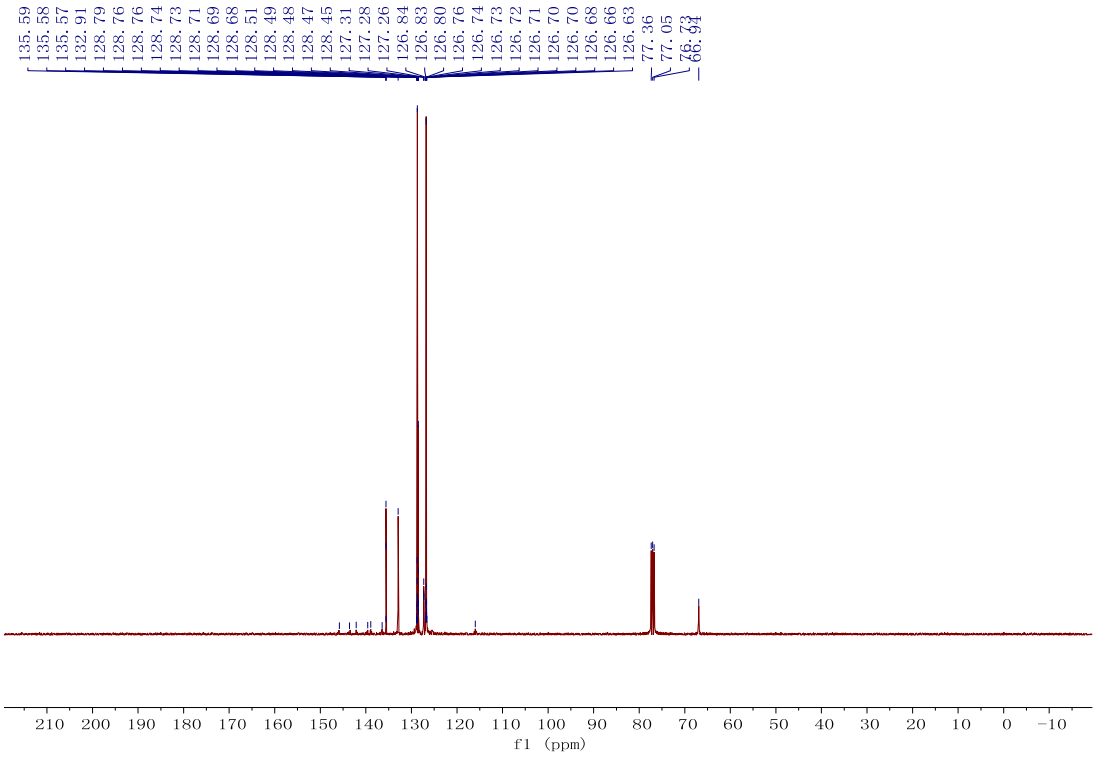
**3t**


7.4290
7.4245
7.4193
7.4119
7.4076
7.4041
7.3840
7.3804
7.3752
7.3686
7.3654
7.3631
7.3586
7.3483
7.3449
7.3431
7.3330
7.3288
7.3248
7.3114
6.7283
6.6887
6.5744
6.5706
6.5608
6.5570
6.5533
6.5349
5.7541
2.6432
1.3078
0.0489
5.26
1.03
1.00
1.00
0.98
f1 (ppm)

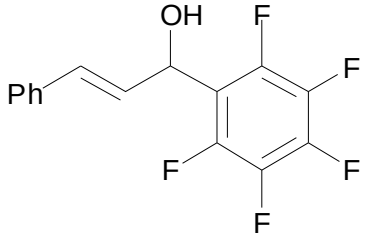
**$^{13}$C NMR**


OH
F
F
Ph
F
F
F

**3t**

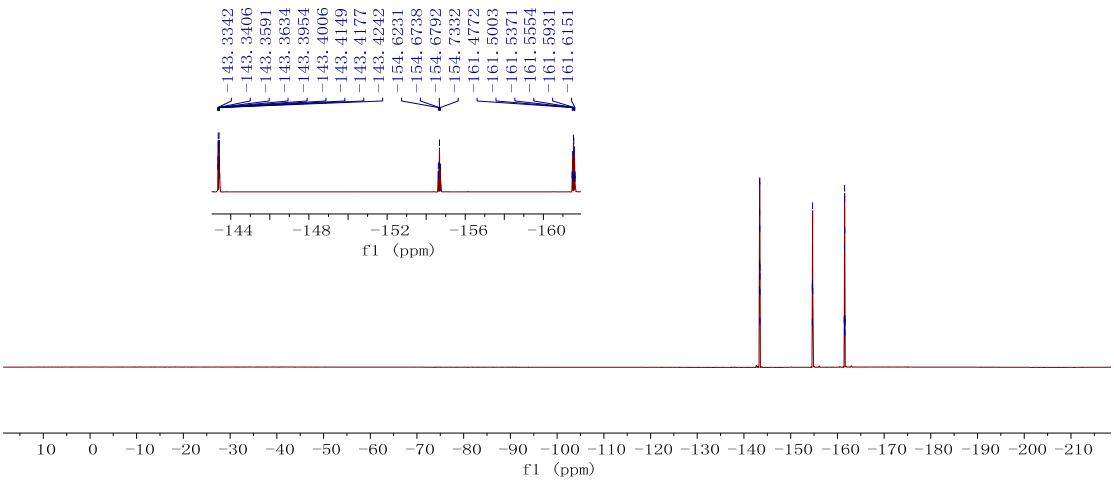

135.59
135.58
135.57
132.91
128.79
128.76
128.76
128.74
128.73
128.71
128.69
128.68
128.51
128.49
128.48
128.47
128.45
127.31
127.28
127.26
126.84
126.83
126.80
126.76
126.74
126.73
126.72
126.71
126.70
126.68
126.66
126.63
77.36
77.05
76.73
66.94
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

**$^{19}$F NMR**

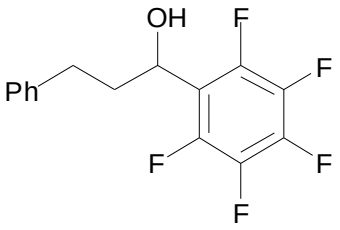

OH
F
F
Ph
F
F
F

**3t**

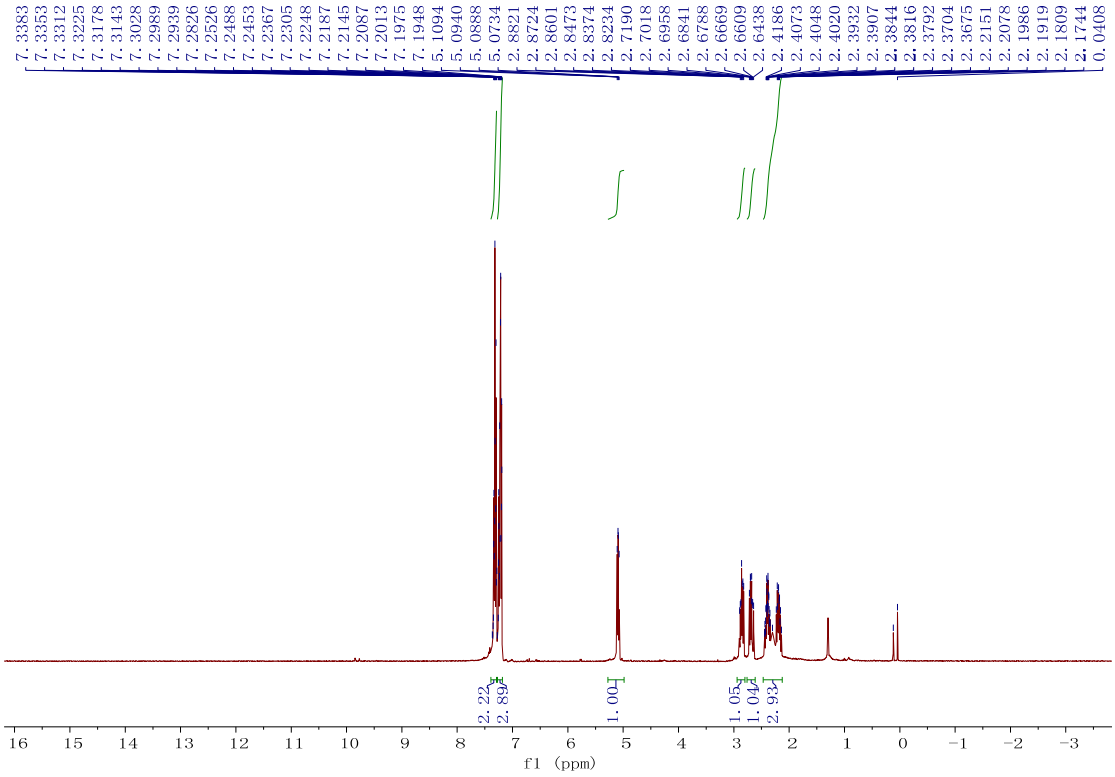

-143.3342
-143.3406
-143.3591
-143.3634
-143.3954
-143.4006
-143.4149
-143.4177
-143.4242
-143.4292
-154.6231
-154.6284
-154.6738
-154.6792
-154.7332
-161.4772
-161.4829
-161.5003
-161.5271
-161.5371
-161.5554
-161.5659
-161.5931
-161.6095
-161.6151
-161.6210


-143.3342
-143.3406
-143.3591
-143.3634
-143.3954
-143.4006
-143.4149
-143.4177
-143.4242
-154.6231
-154.6738
-154.6792
-154.7332
-161.4772
-161.5003
-161.5371
-161.5554
-161.5931
-161.6151
-144
-148
-152
-156
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

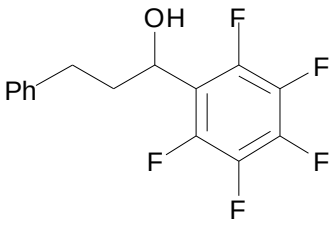
**$^1$H NMR**


OH
F
Ph
F
F
F
F

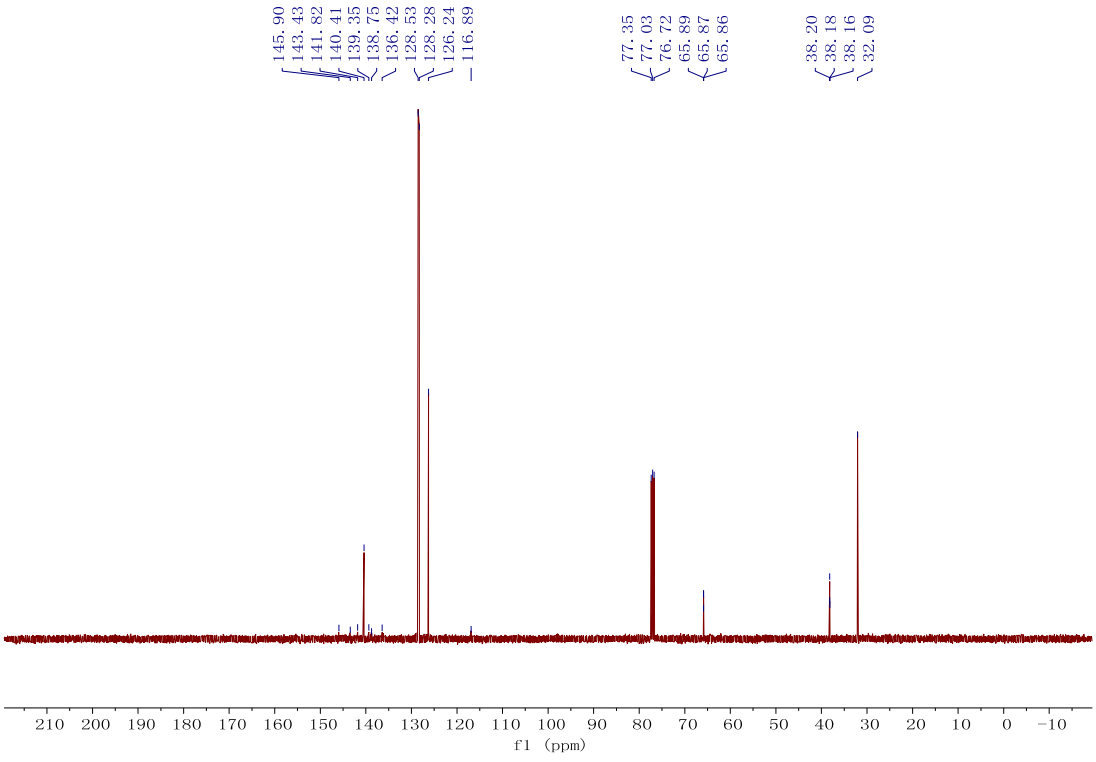
**3u**


7.3383
7.3353
7.3312
7.3225
7.3178
7.3143
7.3028
7.2989
7.2939
7.2826
7.2526
7.2488
7.2453
7.2367
7.2305
7.2248
7.2187
7.2145
7.2087
7.2013
7.1975
7.1948
5.1094
5.0940
5.0888
5.0734
2.8821
2.8724
2.8601
2.8473
2.8374
2.8234
2.7190
2.7018
2.6958
2.6841
2.6788
2.6669
2.6609
2.6438
2.4186
2.4073
2.4048
2.4020
2.3932
2.3907
2.3844
2.3816
2.3792
2.3704
2.3675
2.2151
2.2078
2.1986
2.1919
2.1809
2.1744
0.0408
2.22
2.89
1.00
1.05
1.04
2.93
f1 (ppm)

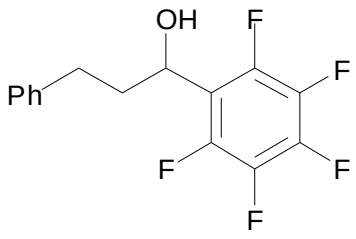
**$^{13}$C NMR**


OH
F
F
Ph
F
F
F

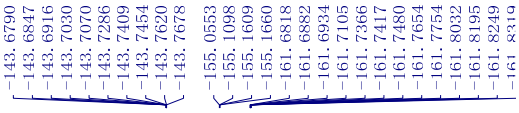
**3u**

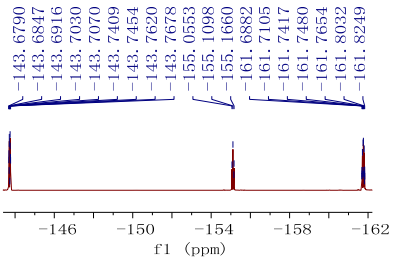

145.90
143.43
141.82
140.41
139.35
138.75
136.42
128.53
128.28
126.24
116.89
77.35
77.03
76.72
65.89
65.87
65.86
38.20
38.18
38.16
32.09
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

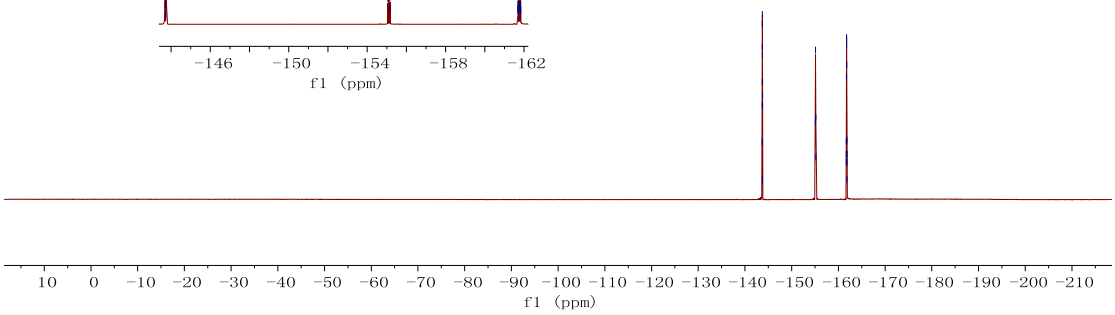
**$^{19}$F NMR**


OH
F
F
Ph
F
F
F

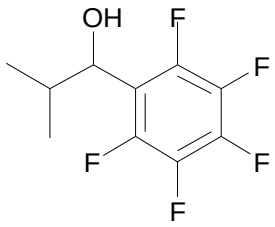
**3u**


-143.6790
-143.6847
-143.6916
-143.7030
-143.7070
-143.7286
-143.7409
-143.7454
-143.7620
-143.7678
-155.0553
-155.1098
-155.1609
-155.1660
-161.6818
-161.6882
-161.6934
-161.7105
-161.7366
-161.7417
-161.7480
-161.7654
-161.7754
-161.8032
-161.8195
-161.8249

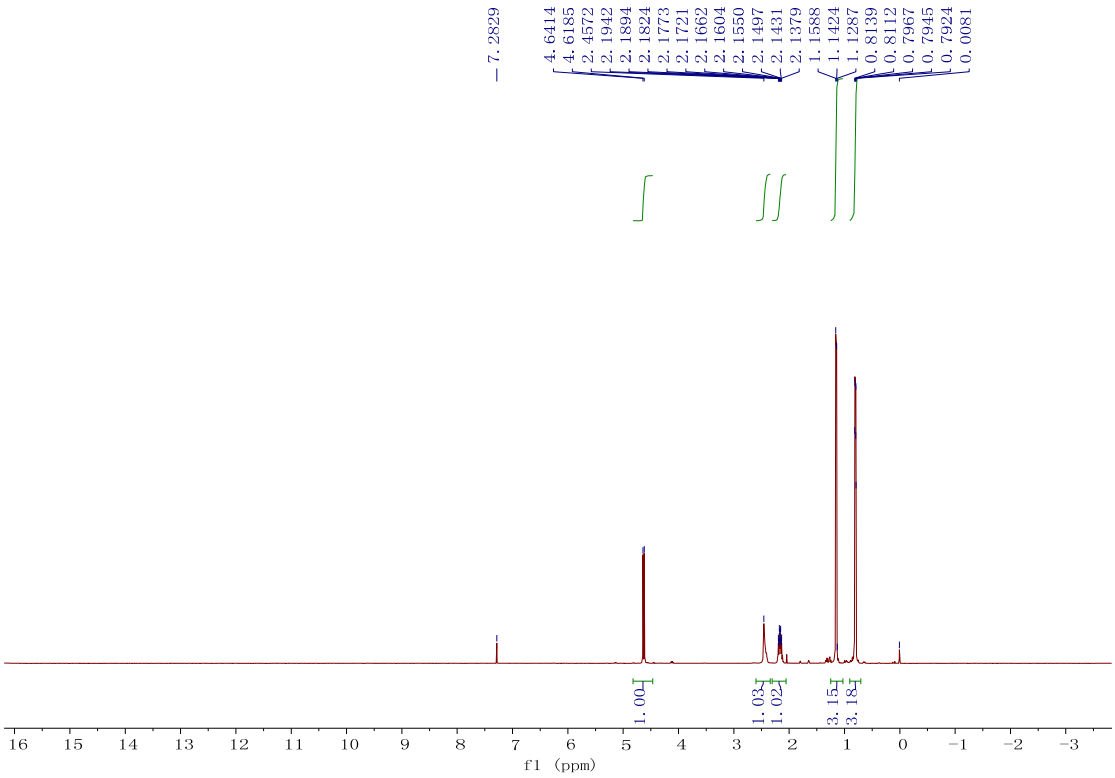

-143.6790
-143.6847
-143.6916
-143.7030
-143.7070
-143.7409
-143.7454
-143.7620
-143.7678
-155.0553
-155.1098
-155.1660
-161.6882
-161.7105
-161.7417
-161.7480
-161.7654
-161.8032
-161.8249
-146
-150
-154
-158
-162
f1 (ppm)


10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

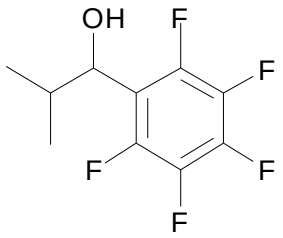
**$^1$H NMR**


OH
F
F
F
F
F

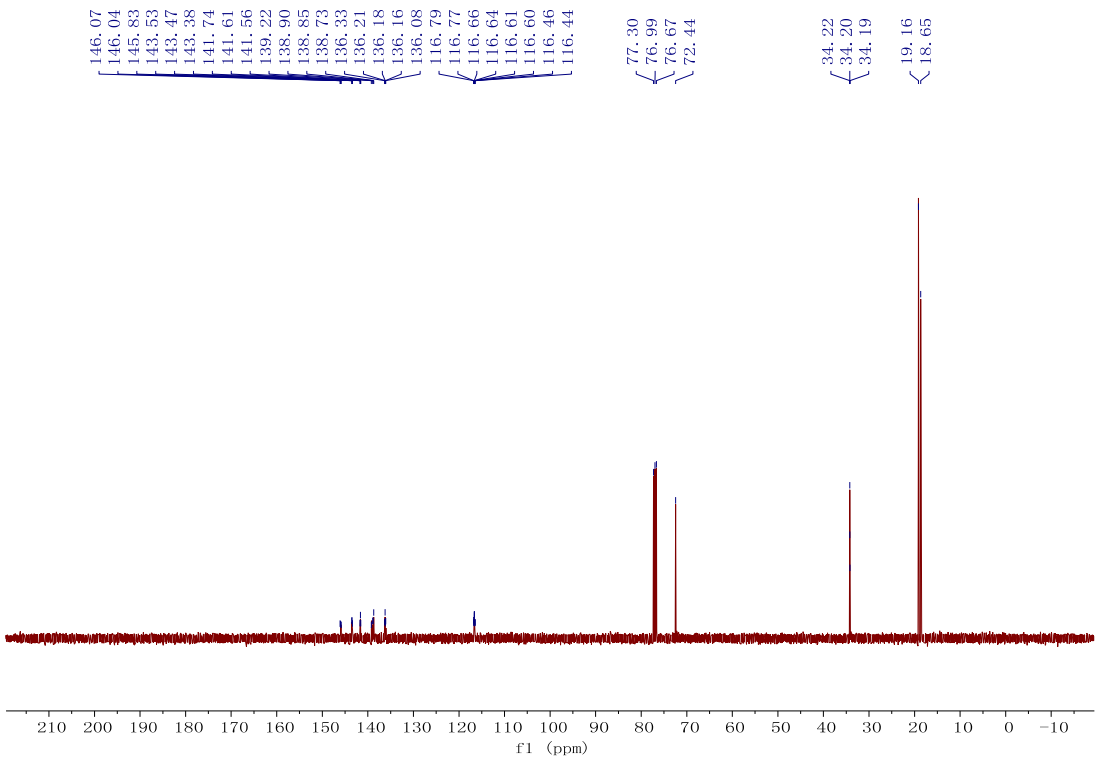
**3v**


7.2829
4.6414
4.6185
2.4572
2.1942
2.1894
2.1824
2.1773
2.1721
2.1662
2.1604
2.1550
2.1497
2.1431
2.1379
1.1588
1.1424
1.1287
0.8139
0.8112
0.7967
0.7945
0.7924
0.0081
1.00
1.03
1.02
3.15
3.18
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

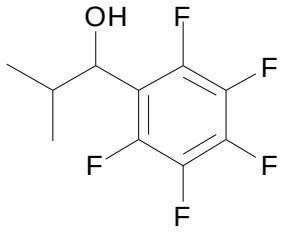
**$^{13}$C NMR**


OH
F
F
F
F
F

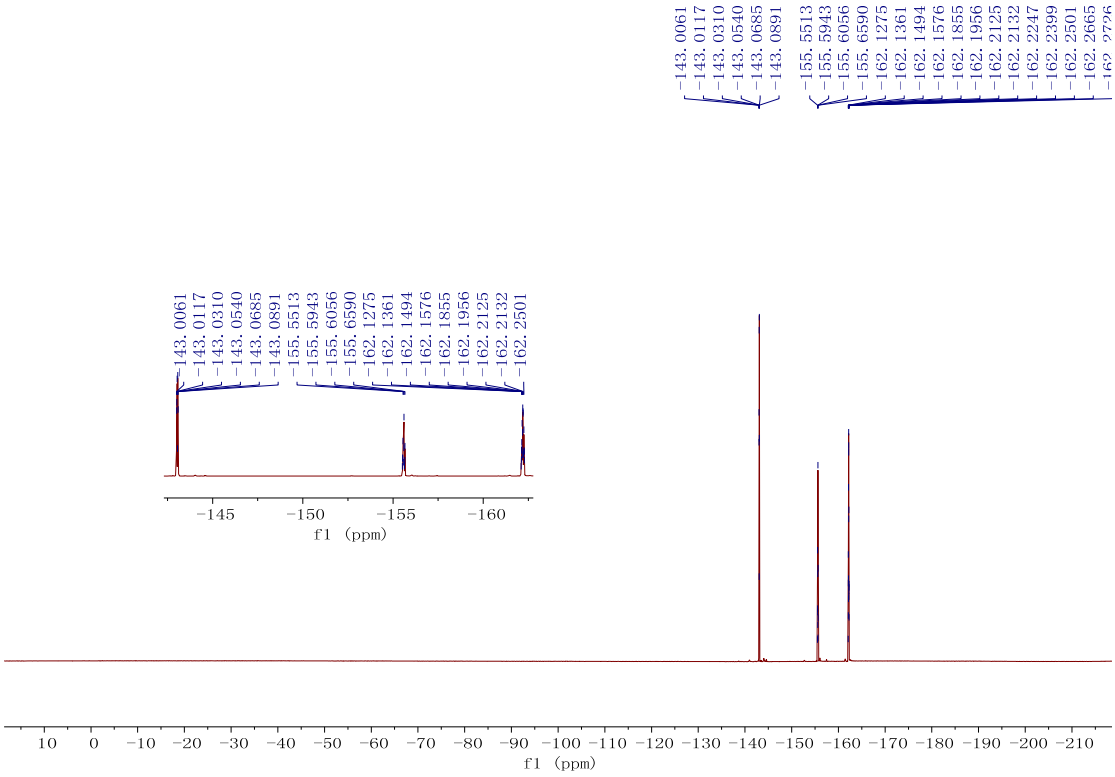
**3v**


146.07
146.04
145.83
143.53
143.47
143.38
141.74
141.61
141.56
139.22
138.90
138.85
138.73
136.33
136.21
136.18
136.16
136.08
116.79
116.77
116.66
116.64
116.61
116.60
116.46
116.44
77.30
76.99
76.67
72.44
34.22
34.20
34.19
19.16
18.65
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

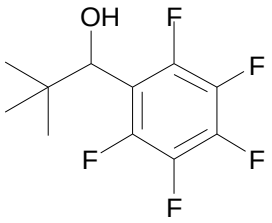
**$^{19}$F NMR**


OH
F
F
F
F
F

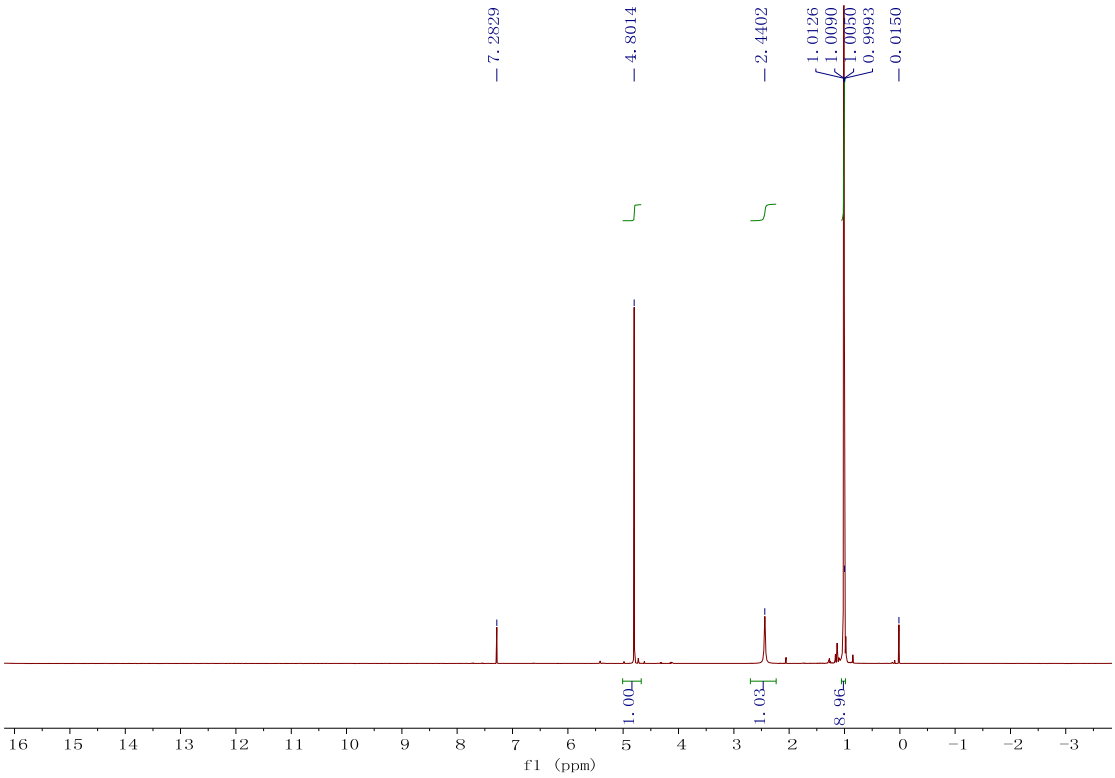
**3v**


-143.0061
-143.0117
-143.0310
-143.0540
-143.0685
-143.0891
-155.5513
-155.5943
-155.6056
-155.6590
-162.1275
-162.1361
-162.1494
-162.1576
-162.1855
-162.1956
-162.2125
-162.2132
-162.2247
-162.2399
-162.2501
-162.2665
-145
-150
-155
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

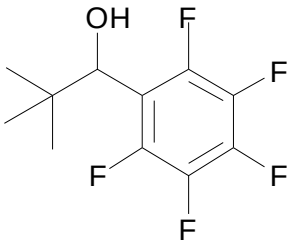
**$^1$H NMR**


OH
F
F
F
F
F

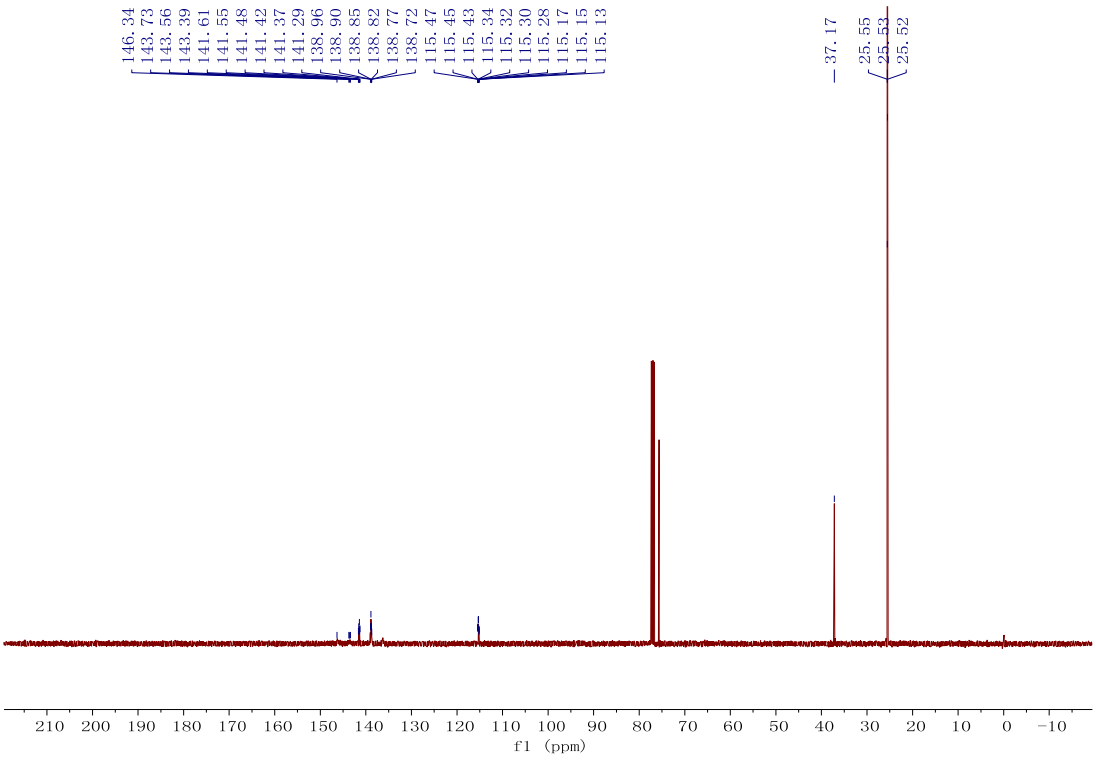
**3w**


7.2829
4.8014
2.4402
1.0126
1.0090
1.0050
0.9993
0.0150
1.00
1.03
8.96
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

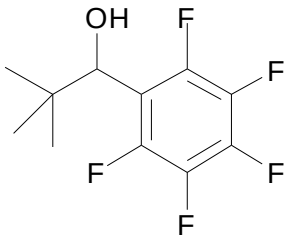
**$^{13}$C NMR**


OH
F
F
F
F
F

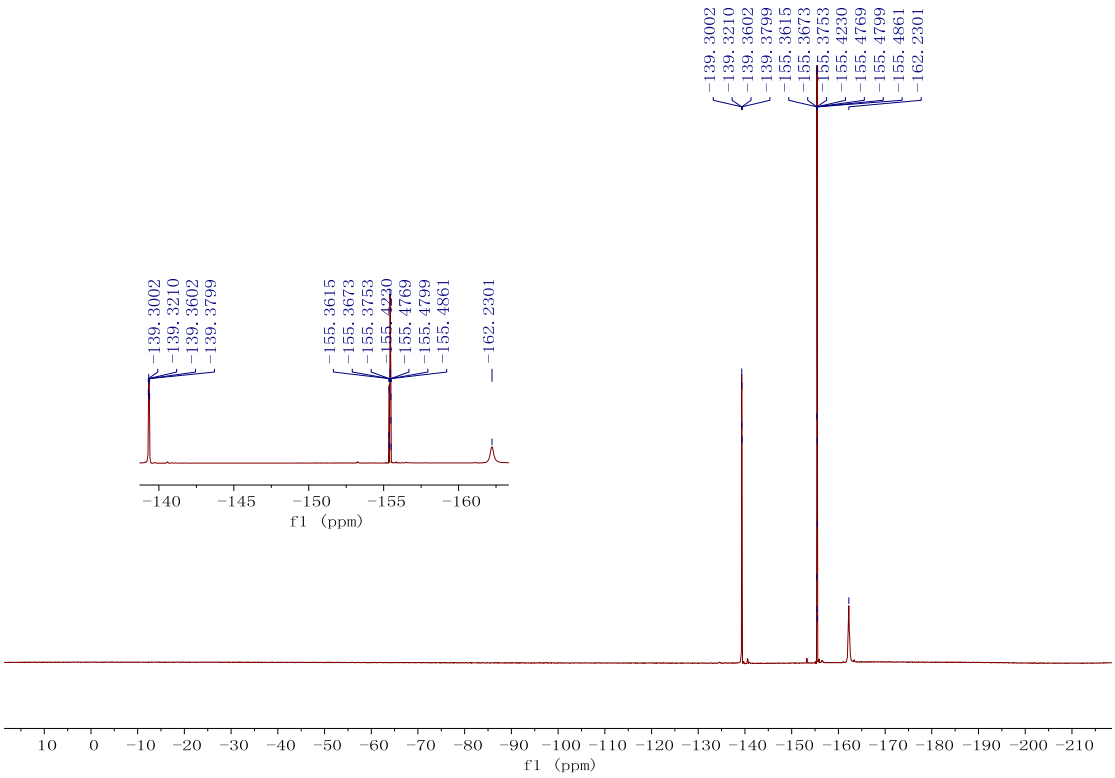
**3w**


146.34
143.73
143.56
143.39
141.61
141.55
141.48
141.42
141.37
141.29
138.96
138.90
138.85
138.82
138.77
138.72
115.47
115.45
115.43
115.34
115.32
115.30
115.28
115.17
115.15
115.13
37.17
25.55
25.53
25.52
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

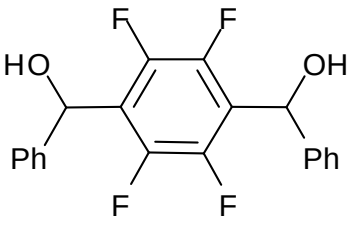
**$^{19}$F NMR**


OH
F
F
F
F
F

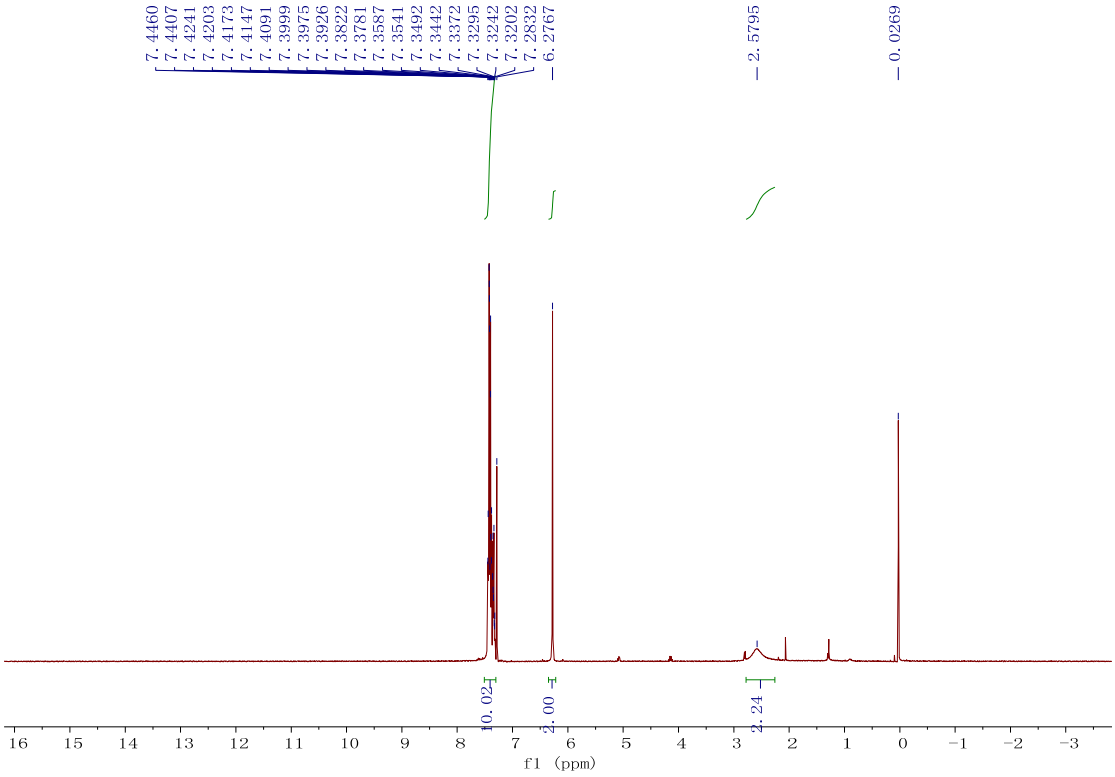
**3w**


-139.3002
-139.3210
-139.3602
-139.3799
-155.3615
-155.3673
-155.3753
-155.4230
-155.4769
-155.4799
-155.4861
-162.2301
-140
-145
-150
-155
-160
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

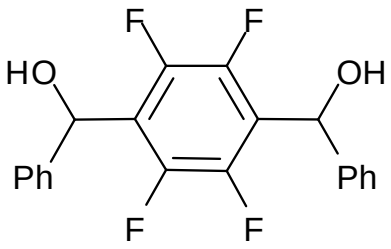
**$^1$H NMR**


F
F
HO
OH
Ph
Ph
F
F

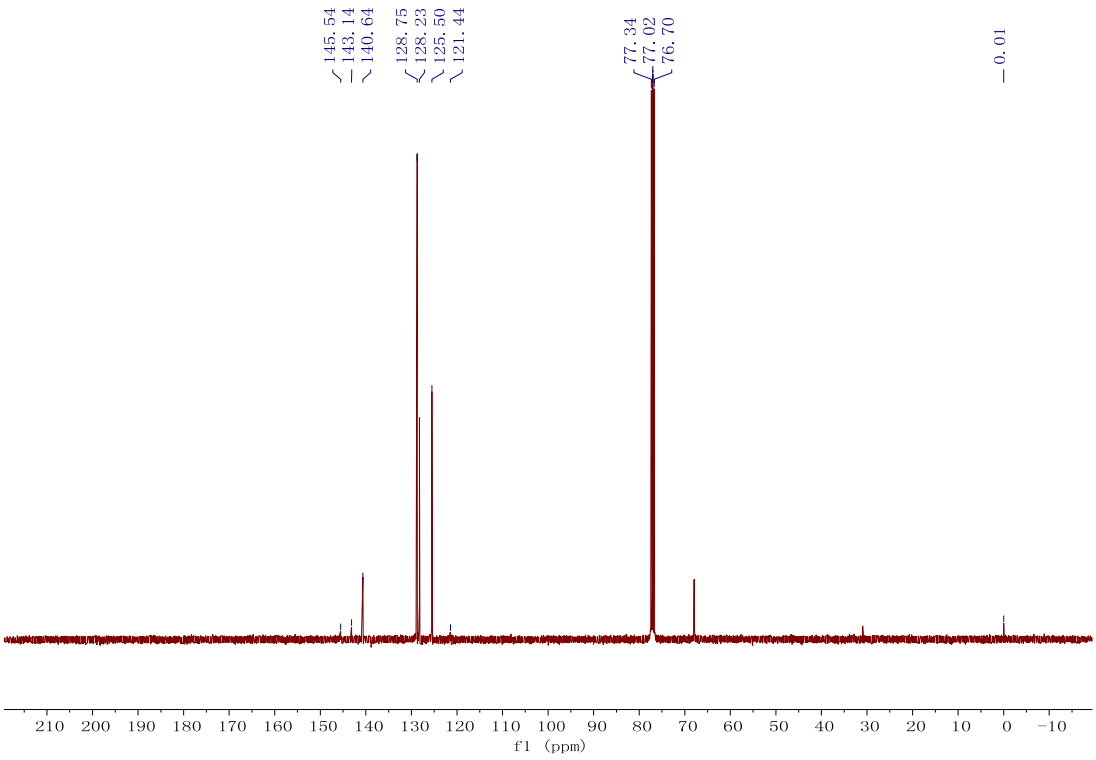
**9a**


7.4460
7.4407
7.4241
7.4203
7.4173
7.4147
7.4091
7.3999
7.3975
7.3926
7.3822
7.3781
7.3587
7.3541
7.3492
7.3442
7.3372
7.3295
7.3242
7.3202
7.2832
6.2767
2.5795
0.0269
10.02
2.00
2.24
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

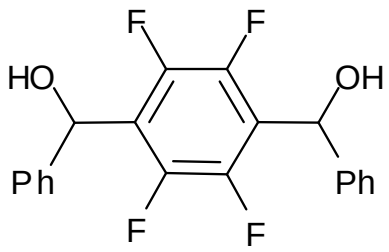
**$^{13}$C NMR**


F
F
HO
OH
Ph
Ph
F
F

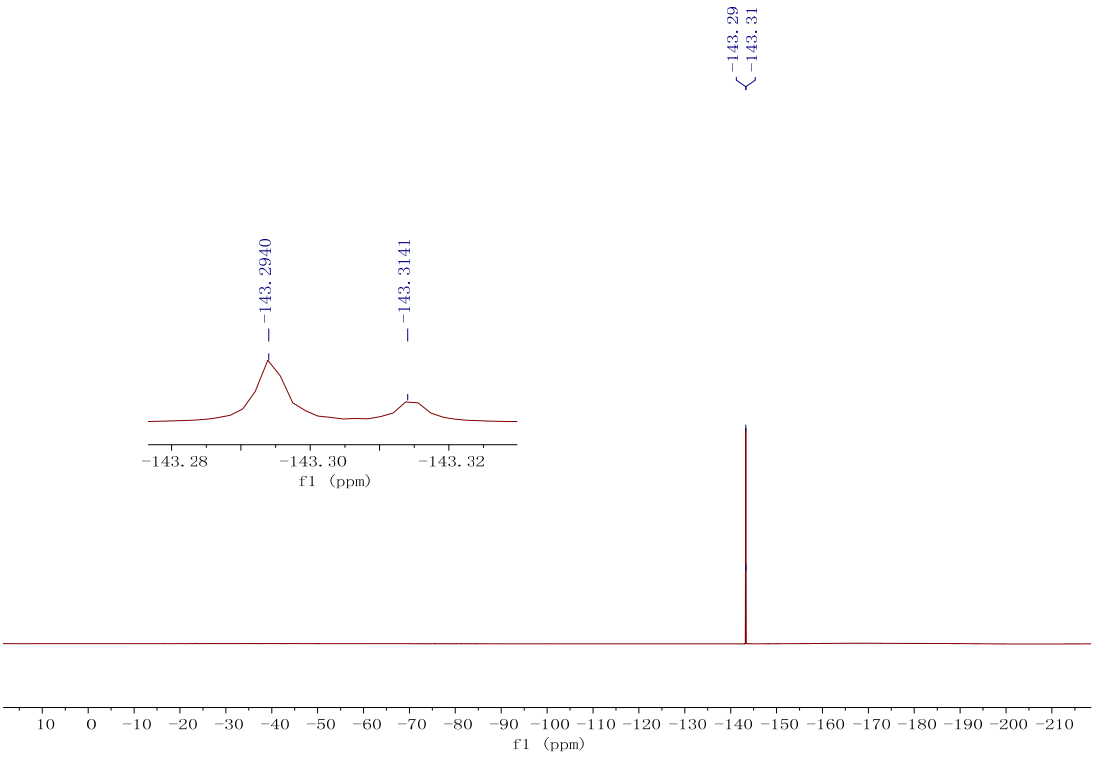
**9a**


145.54
143.14
140.64
128.75
128.23
125.50
121.44
77.34
77.02
76.70
0.01
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

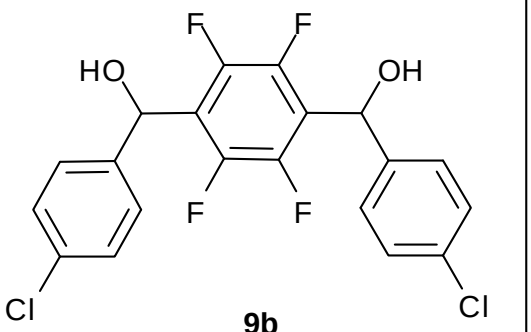
**$^{19}$F NMR**


F
F
HO
OH
Ph
Ph
F
F

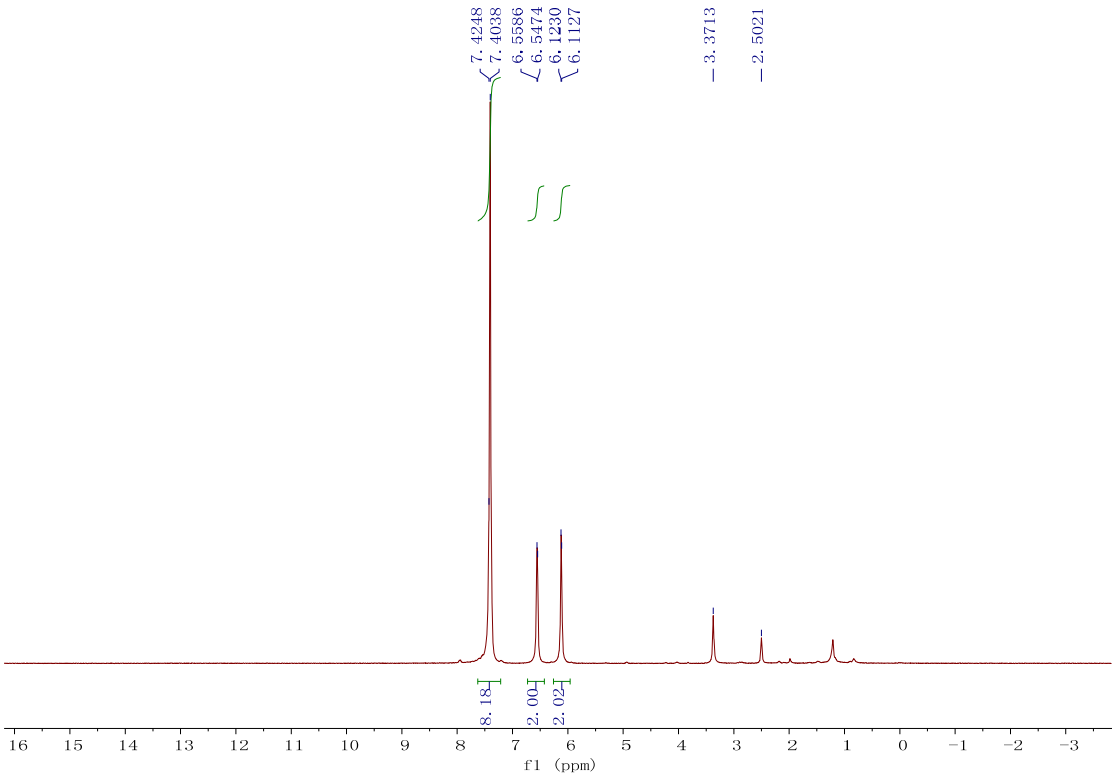
**9a**

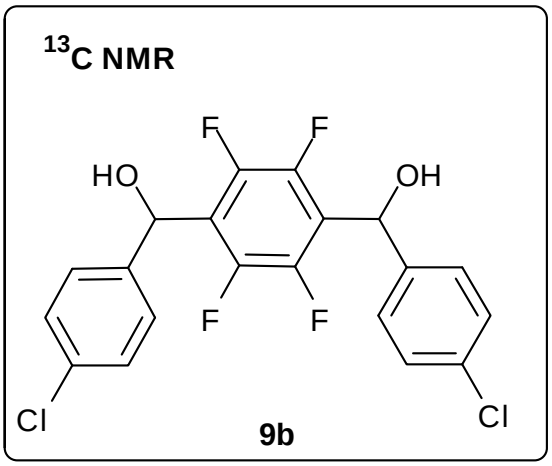

−143.29
−143.31
−143.2940
−143.3141
−143.28
−143.30
−143.32
f1 (ppm)
10 0 −10 −20 −30 −40 −50 −60 −70 −80 −90 −100 −110 −120 −130 −140 −150 −160 −170 −180 −190 −200 −210
f1 (ppm)

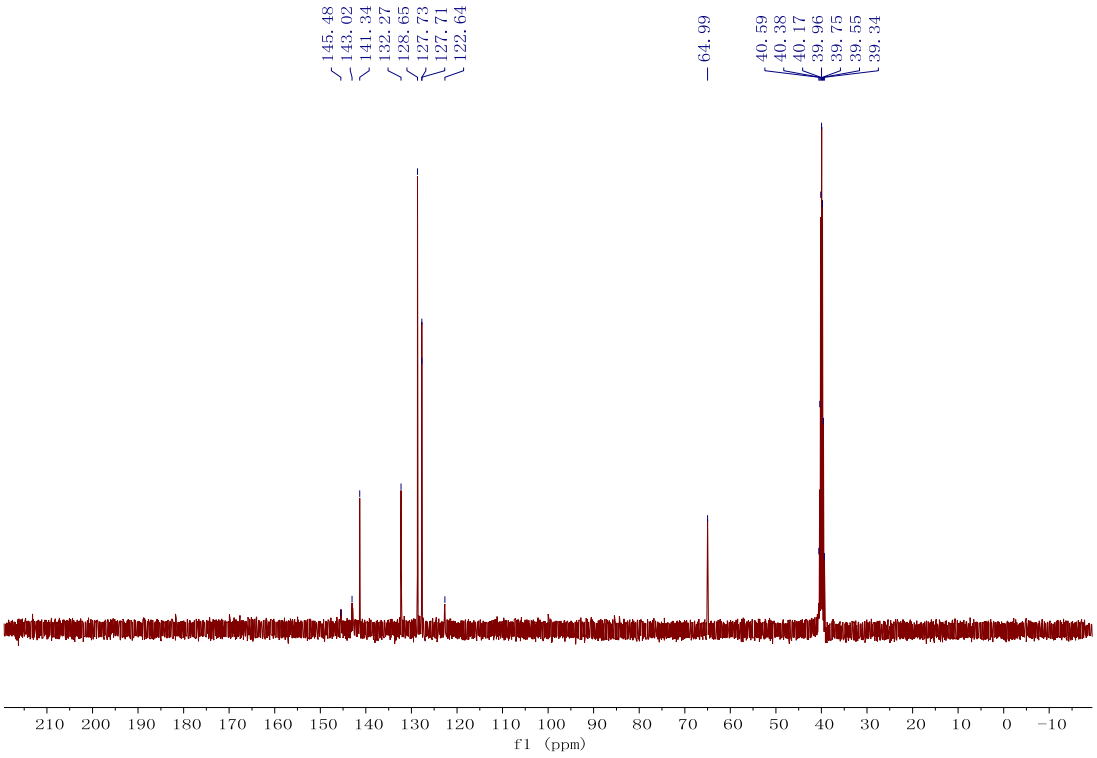
**$^1$H NMR**

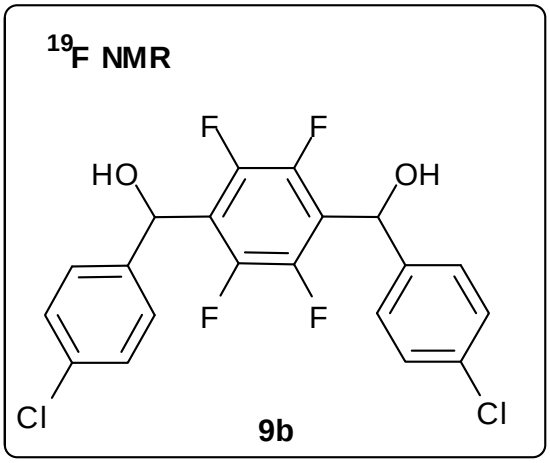

F
F
HO
OH
F
F
Cl
Cl

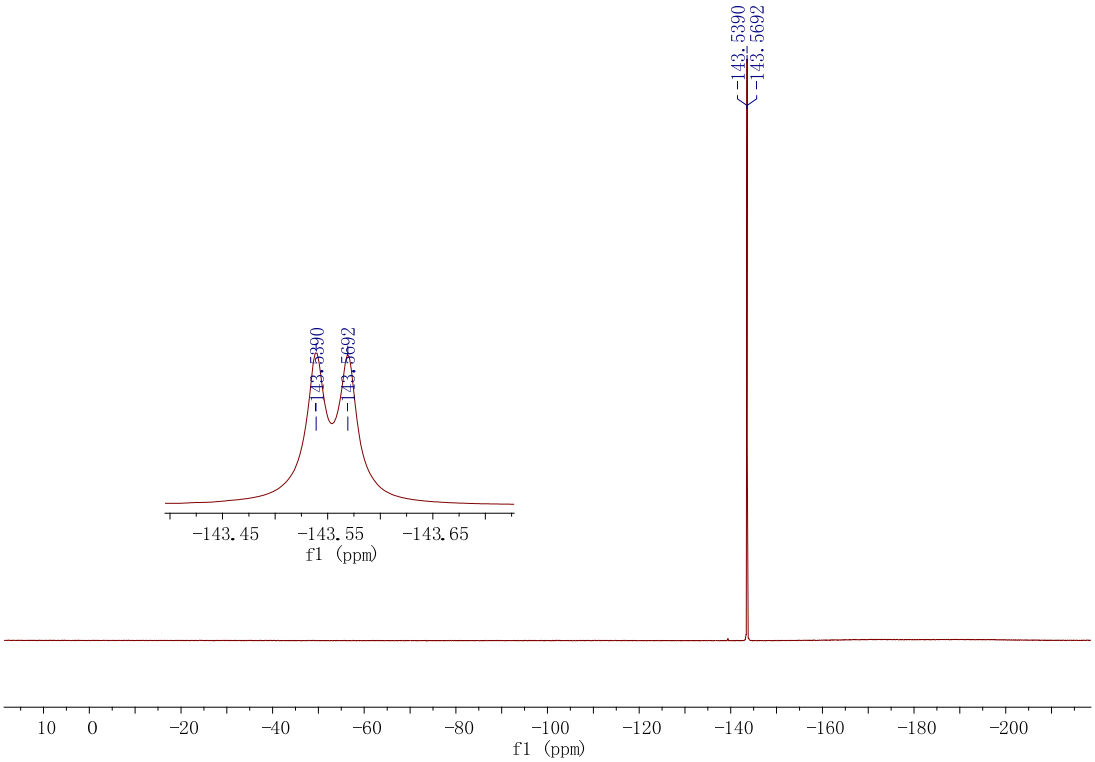
**9b**


7.4248
7.4038
6.5586
6.5474
6.1230
6.1127
3.3713
2.5021
8.18
2.00
2.02
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

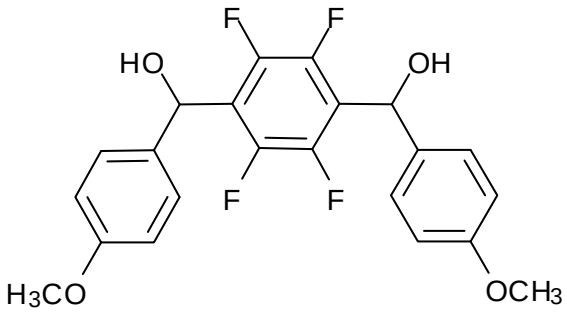

13C NMR
F
F
HO
OH
F
F
Cl
Cl
9b


145.48
143.02
141.34
132.27
128.65
127.73
127.71
122.64
64.99
40.59
40.38
40.17
39.96
39.75
39.55
39.34
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

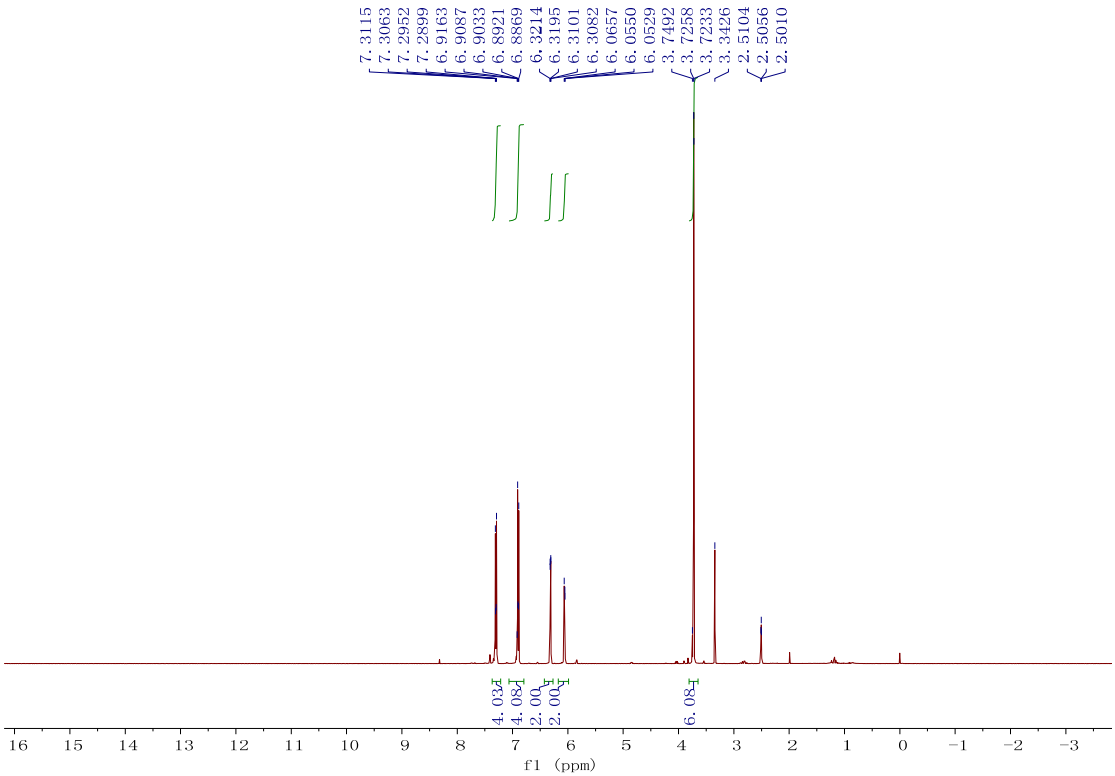

19F NMR
F
F
HO
OH
F
F
Cl
Cl
9b


-143.5390
-143.5692
-143.5390
-143.5692
-143.45
-143.55
-143.65
f1 (ppm)
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
f1 (ppm)

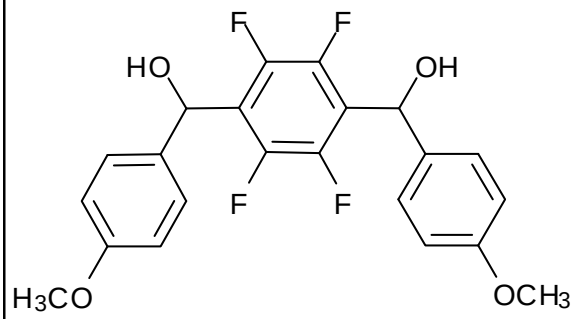
**$^1$H NMR**


F
F
HO
OH
F
F
H3CO
OCH3

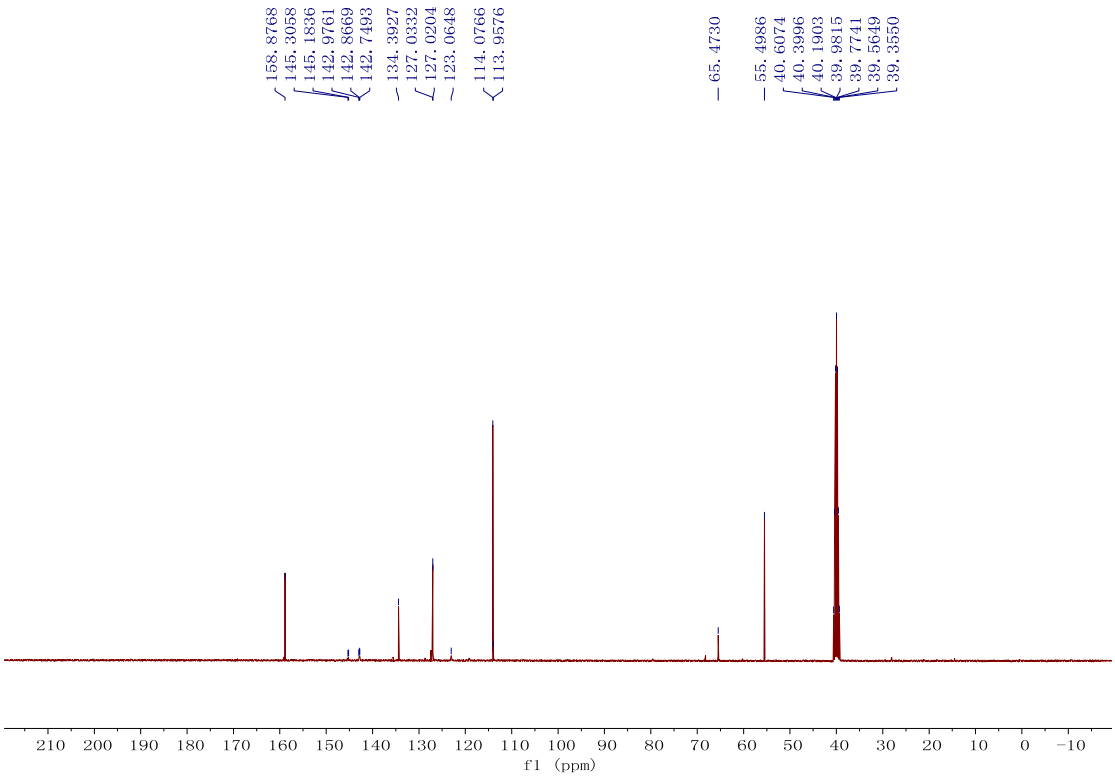
**9c**


7.3115
7.3063
7.2952
7.2899
6.9163
6.9087
6.9033
6.8921
6.8869
6.3214
6.3195
6.3101
6.3082
6.0657
6.0550
6.0529
3.7492
3.7258
3.7233
3.3426
2.5104
2.5056
2.5010
4.03
4.08
2.00
2.00
6.08
f1 (ppm)

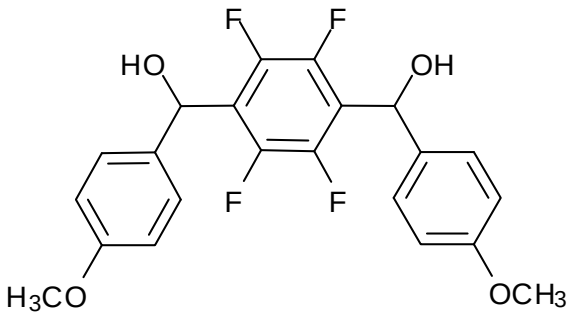
**$^{13}$C NMR**


F
F
HO
OH
F
F
H3CO
OCH3

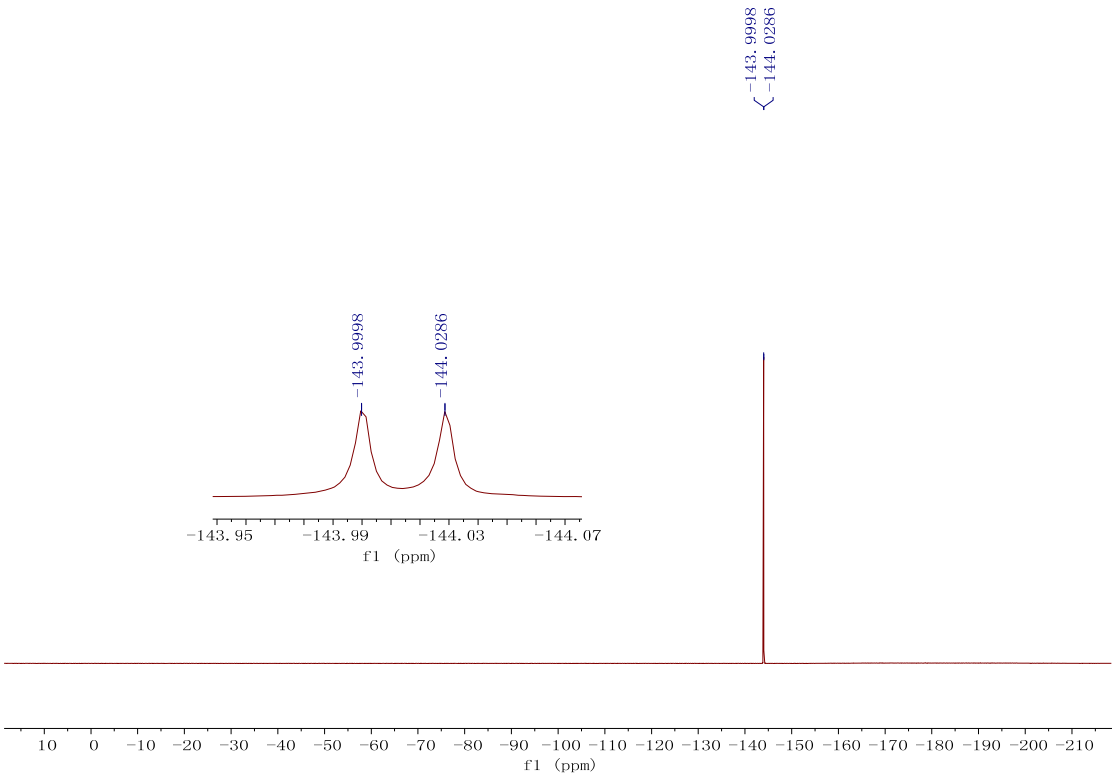
**9c**

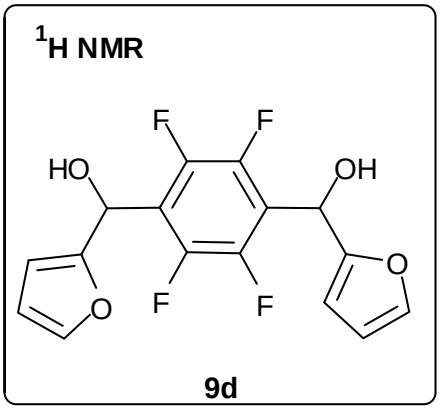

158.8768
145.3058
145.1836
142.9761
142.8669
142.7493
134.3927
127.0332
127.0204
123.0648
114.0766
113.9576
65.4730
55.4986
40.6074
40.3996
40.1903
39.9815
39.7741
39.5649
39.3550
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

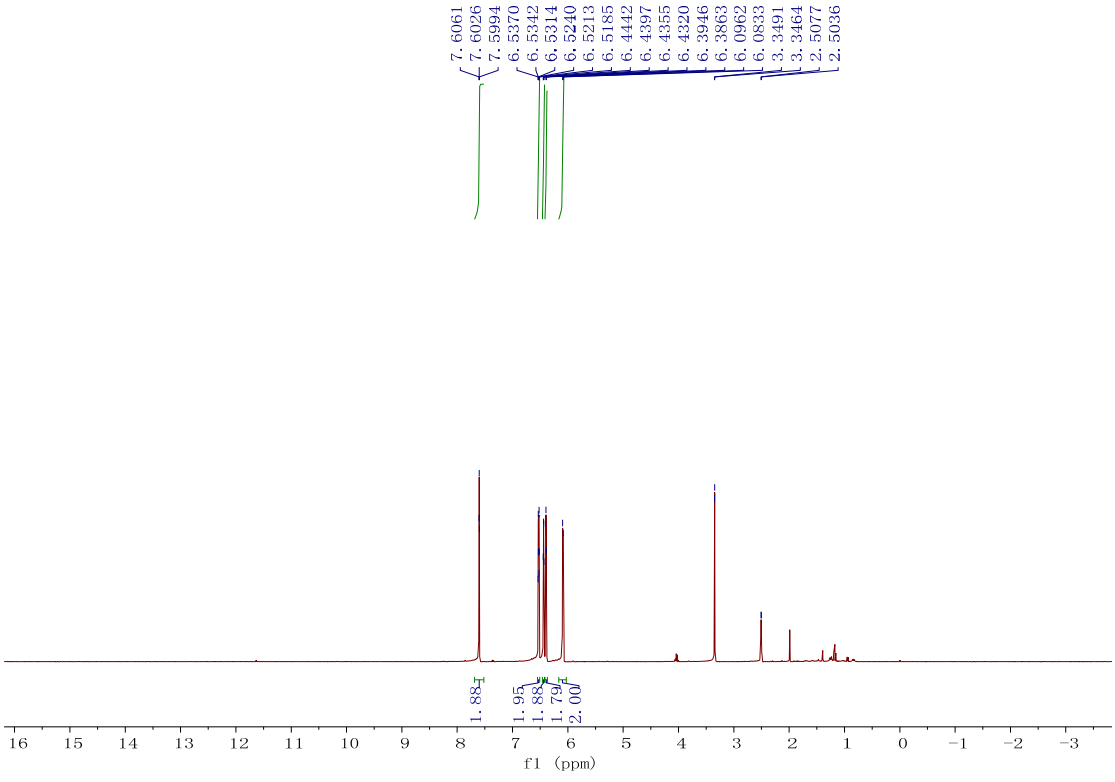
**$^{19}$F NMR**


F
F
HO
OH
F
F
H3CO
OCH3

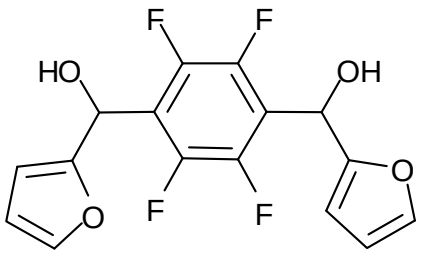
**9c**


-143.9998
-144.0286
-143.9998
-144.0286
-143.95
-143.99
-144.03
-144.07
f1 (ppm)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


1H NMR
F
F
HO
OH
O
O
F
F
9d

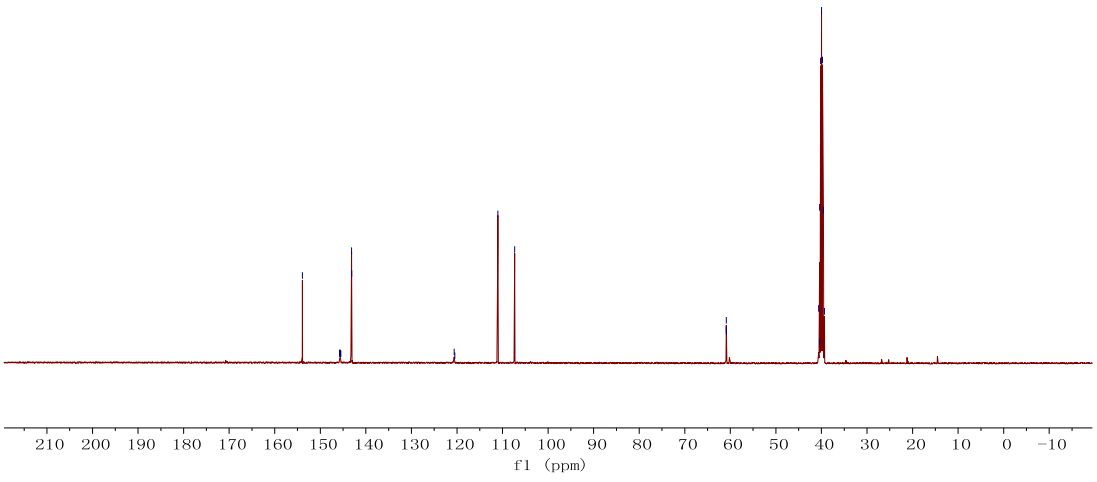

7.6061
7.6026
7.5994
6.5370
6.5342
6.5314
6.5240
6.5213
6.5185
6.4442
6.4397
6.4355
6.4320
6.3946
6.3863
6.0962
6.0833
3.3491
3.3464
2.5077
2.5036
1.88
1.95
1.88
1.79
2.00
16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 −1 −2 −3
f1 (ppm)

**$^{13}$C NMR**

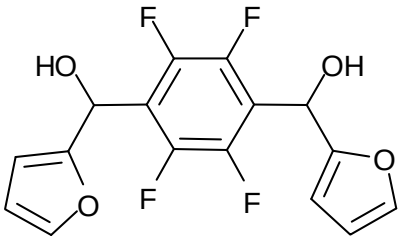



**9d**

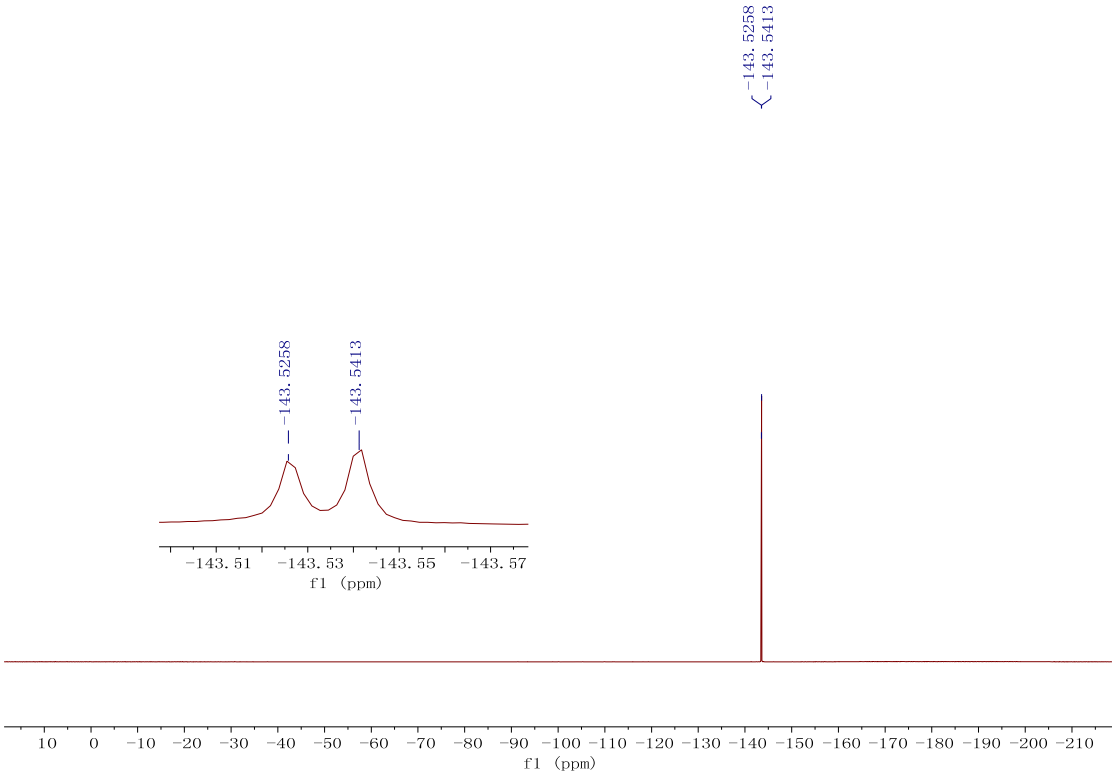
153.92
145.77
145.72
145.63
145.59
145.56
145.49
143.13
143.12
120.62
120.46
111.03
107.33
60.89
60.87
60.85
40.59
40.44
40.39
40.18
39.97
39.76
39.55
39.34



**$^{19}$F NMR**


F
F
HO
OH
O
O
F
F

**9d**


-143.5258
-143.5413
-143.5258
-143.5413
-143.51
-143.53
-143.55
-143.57
f1 (ppm)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)