Supporting Information

Ag-Catalyzed Oxidative Cyclization Reaction of 1,6-Enynes and Sodium Sulfinate: Access to Sulfonylated Benzofurans

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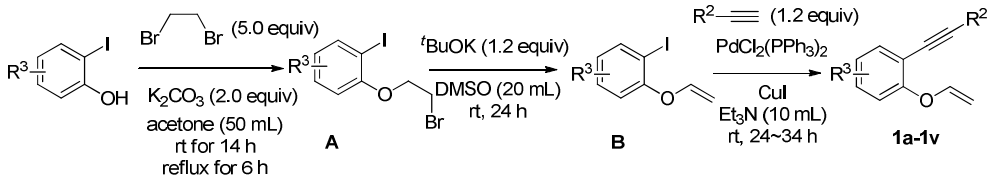
A. General Methods

Melting points were measured using a melting point instrument and are uncorrected. ^{1}H NMR (400 MHz) and ^{13}C NMR (100 or 150 MHz) spectra were recorded in $CDCl_3$ with TMS as internal standard at room temperature The chemical shifts are referenced to signals at 7.24 and 77.0 ppm, respectively, and chloroform was used as a solvent. IR spectra were recorded on an FT-IR spectrometer using KBr discs. GC-MS data were obtained using electron ionization. HRMS was carried out on a high-resolution mass spectrometer (LCMS-IT-TOF). TLC was performed using commercially available 100-400 mesh silica gel plates (GF_{254}). Unless otherwise noted, purchased chemicals were used without further purification.

B. Preparation of the Substrates[1]

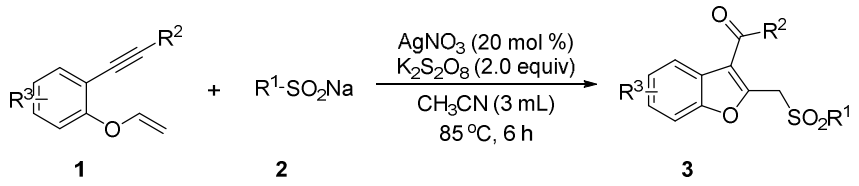


To a solution of 2-iodophenol (5.0 mmol) and 1,2-dibromoethane (5.0 equiv) in acetone (50 mL) was added K_2CO_3 (2.0 equiv). The resulting mixture was stirred at room temperature for 14 h and then reflux for 6 h. The reaction was quenched with water and extracted with CH_2Cl_2. The organic layer was washed with brine, dried over Na_2SO_4, and concentrated. The crude product was purified by a silica gel column chromatography (hexanes/EtOAc = 100: 1) to give **A** (65~76% yields) as a colorless oil.

To a solution of **A** (3.0 mmol) in DMSO (20 mL) was added KO*t*Bu (1.5 equiv). The resulting mixture was stirred at room temperature for 2 h. The reaction mixture was filtered and washed with CH_2Cl_2. The combined filtrate was concentrated and the residue was purified by a silica gel column chromatography (hexanes/EtOAc = 100: 1) to give **B** (81~95% yields) as a yellow oil.

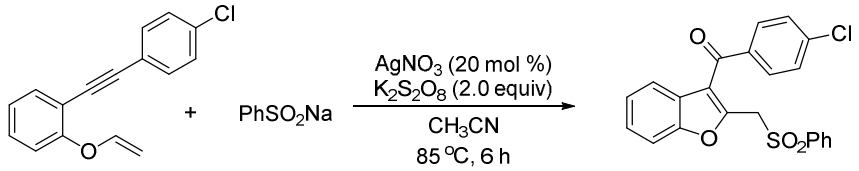
To a solution of **B** (1.0 mmol) and alkyne (1.1 equiv) in triethylamine (10 mL) was added $PdCl_2(PPh_3)_2$ (5 mol %) and CuI (5 mol %). The resulting mixture was stirred at room temperature for 24~36 h. The reaction mixture was filtered and washed with Et_2O. The combined filtrate was concentrated and the residue was purified by a silica gel column chromatography (hexanes/EtOAc = 100: 1) and recycling preparative GPC to give **1a-1v** (68~92% yields)

C. General Procedure for the Synthesis of 3



To a dried Schlenk tube was charged with 1,6-enynes **1** (0.3 mmol, 1.0 equiv), sodium sulfinates **2** (0.6 mmol, 2.0 equiv), $AgNO_3$ (0.06 mmol, 0.2 equiv), $K_2S_2O_8$ (0.6 mmol, 2.0 equiv) and CH_3CN (1 mL), which was equipped with a magnetic stirring bar. The mixture was stirred for 6 h at 85 ^oC. After the reaction was completed, saturated aqueous $NaHCO_3$ solution (2 mL) was added to quench the reaction, and then ethyl acetate (3 × 5 mL) was added into the tube. The combined organic layers were washed with brine to neutral, dried over $MgSO_4$, and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexanes/ethyl acetate = 5: 1~10: 1) to afford the desired products **3**.

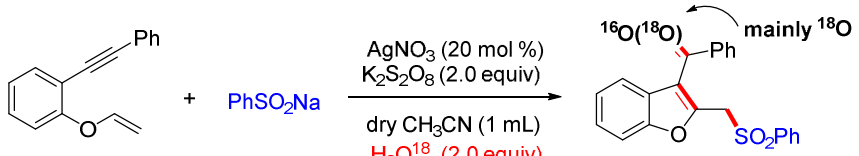
Taking 3da as an example at 1 mmol scale:



1d **2a** **3da**

To a dried Schlenk tube was charged with 1-((4-chlorophenyl)ethynyl)-2-(vinyloxy)benzene **1d** (0.25g, 1.0 mmol), sodium phenylsulfinate **2a** (0.33 g, 2.0 mmol), $AgNO_3$ (33.8 mg, 0.2 mmol), $K_2S_2O_8$ (0.54 g, 2.0 mmol) and CH_3CN (5 mL), which was equipped with a magnetic stirring bar. The mixture was stirred for 6 h at 85 ^oC. After the reaction was completed, saturated aqueous $NaHCO_3$ solution (5 mL) was added to quench the reaction, and then ethyl acetate (3 × 10 mL) was added into the tube. The combined organic layers were washed with brine to neutral, dried over $MgSO_4$, and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexanes/ethyl acetate = 8: 1) to afford the desired product **3da** (0.17g, 41%).

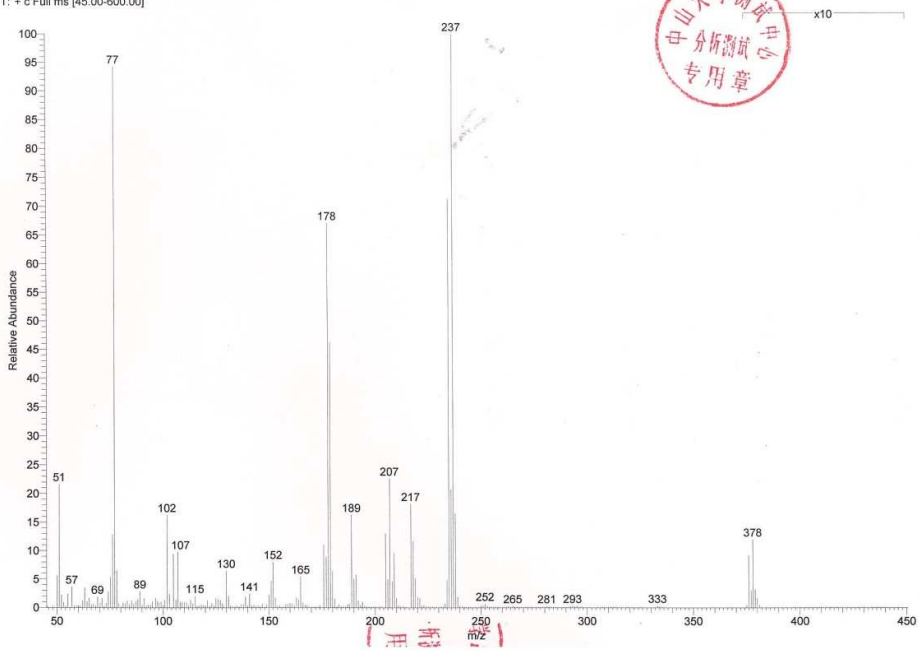
D. Mechanistic Studies



1a 0.1 mmol **2a** 0.2 mmol **3aa/[^{18}O]-3aa,** 43%

第1610B0031号分析检测报告
附页第 1 页，共 2 页

Instrument:DSQ(Thermo)
Ionization Method:EI
D:\DSQ\DATA-LR\16\100913 10/9/2016 3:54:44 PM ysj-100901
100913 #91 RT: 1.79 AV: 1 NL: 2.51E7
T: + c Full ms [45.00-600.00]

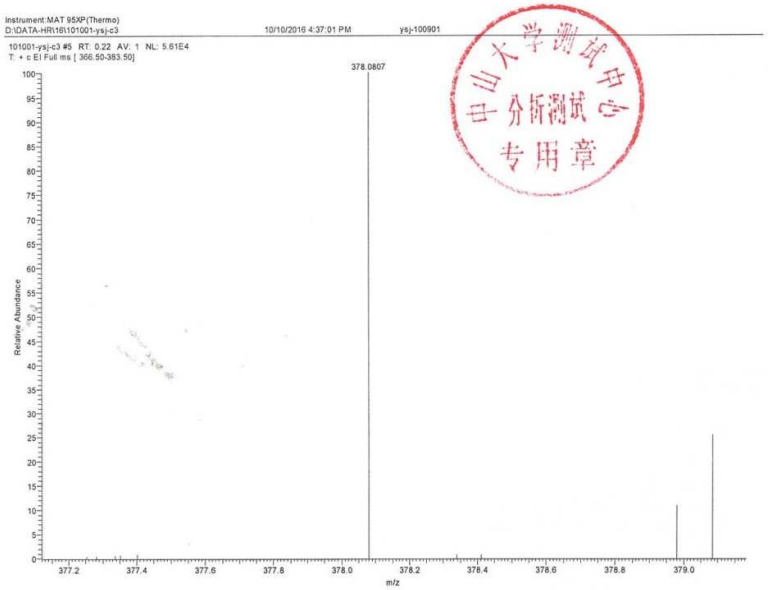


中山大学测试中心分析测试专用章

SPECTRUM - MS
File : D:\DATA-HR\16\101001-ysj-c3.RAW
Full ms [366.500 - 383.500] - Range: 378.000 - 378.100
Scan No. 5 of 18
Scan #: 5
RT: 0.22
Data points: 1

第1610B0031号分析检测报告
附页第 2 页，共 2 页

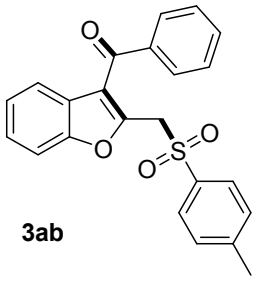
Mass	Relative Intensity	Theoretical Mass	Delta [ppm]	Delta [mmu]	RDB	Composition
378.0807	100.0	378.0806	0.2	0.1	15.0	C_{22} H_{16} O_3 $^{18}O_1$ S_1

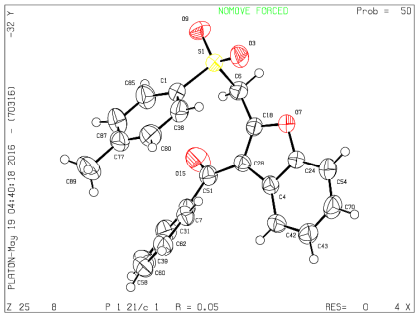


E. Reference

[1] Sakiyama, N.; Noguchi, K.; Tanaka, K. *Angew. Chem. Int. Ed.* **2012**, *51*, 5976.

F. Crystallographic Data for 3ab





Structure of 3ab

Figure 1. The ellipsoid contour percent probability level is 30% in the caption of the thermal ellipsoid plot

Datablock: 3ab

Bond precision: C-C = 0.0032 A Wavelength=0.71000

Cell: a=13.939(2) b=11.8628(16) c=12.342(2)
alpha=90 beta=105.579(18) gamma=90
Temperature: 293 K

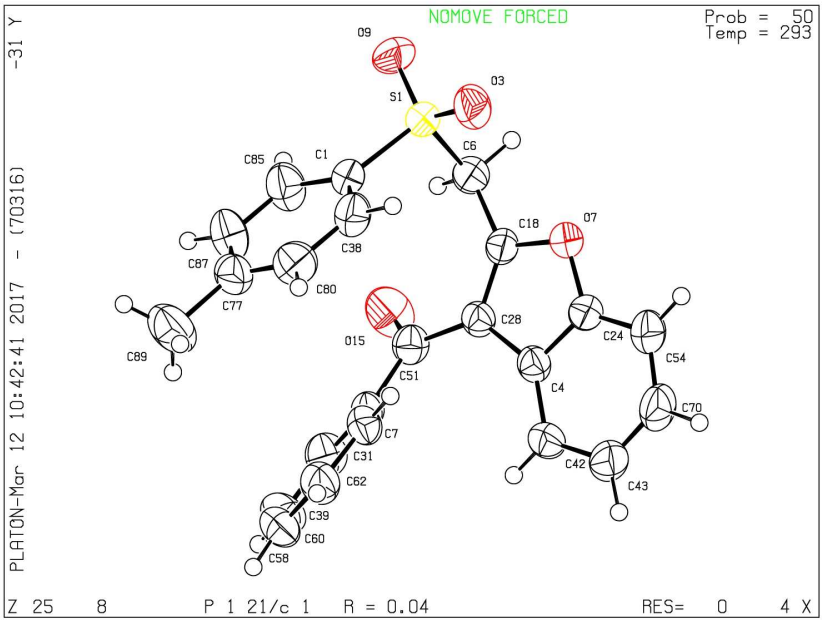
	Calculated	Reported
Volume	1965.8(5)	1965.8(6)
Space group	P 21/c	P 1 21/c 1
Hall group	-P 2ybc	-P 2ybc
Moiety formula	C23 H18 O4 S	0.13(C23 H18 O4 S)
Sum formula	C23 H18 O4 S	C2.875 H2.25 O0.5 S0.125
Mr	390.43	48.81
Dx,g cm-3	1.319	1.319
Z	4	32
Mu (mm-1)	0.188	0.190
F000	816.0	816.9
F000'	816.87	
h,k,lmax	16,14,14	16,14,14
Nref	3474	3470
Tmin,Tmax		
Tmin'		

Correction method= Not given

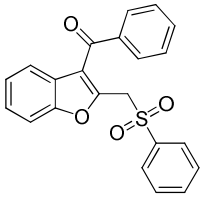
Data completeness= 0.999 Theta(max)= 25.000

R(reflections)= 0.0431(2460) wR2(reflections)= 0.1066(3470)

S = 1.061 Npar= 314

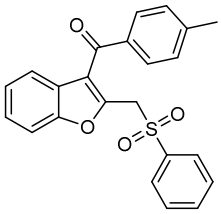


G. Characterization Data for All Products



Phenyl(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3aa)

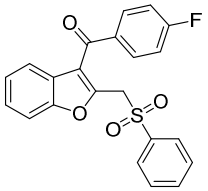
Yellow oil (88.0 mg, 78% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, J = 7.9 Hz, 1H), 7.60 (t, J = 7.0 Hz, 2H), 7.53 (t, J = 6.8 Hz, 1H), 7.47 – 7.40 (m, 2H), 7.35 (t, J = 7.3 Hz, 2H), 7.22 – 7.12 (m, 1H), 4.94 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.4, 149.9, 138.1, 133.9, 133.2, 129.3, 129.1, 128.4, 128.3, 125.9, 125.7, 124.0, 121.8, 121.2, 111.7, 54.8. IR (KBr) ν_{max} 3066, 2928, 1731, 1652, 1581, 1319, 1156, 753 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{16}O_4S$ $[M + Na]^+$ 399.0662, Found 399.0671.



(2-((Phenylsulfonyl)methyl)benzofuran-3-yl)(*p*-tolyl)methanone (3ba)

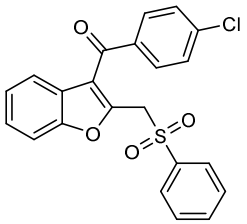
White solid (81.9 mg, 70% yield), mp: 92.7 - 94.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, J = 7.7 Hz, 2H), 7.52 (dd, J = 8.3, 2.9 Hz, 3H), 7.45 (t, J = 7.4 Hz, 1H), 7.35 (t, J = 7.9 Hz, 3H), 7.23 (d, J = 8.0 Hz, 2H), 7.19 (d, J = 3.9 Hz, 2H), 4.92 (s, 2H), 2.45 (s, 3H). ^{13}C NMR (101 MHz,

$CDCl_3$) δ 190.1, 154.4, 149.5, 144.3, 138.0, 135.2, 133.9, 129.6, 129.1, 129.1, 128.3, 125.8, 125.8, 123.9, 121.9, 121.5, 111.7, 54.8, 21.8. IR (KBr) ν_{max} 3058, 2927, 1648, 1588, 1451, 1316, 1153, 901, 747 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_4S$ $[M + Na]^+$ 413.0818, Found 413.0822



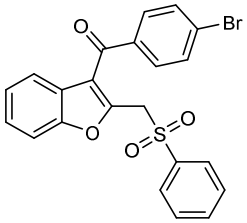
(4-Fluorophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ca)

White solid (81.6 mg, 69% yield), mp: 92.0 - 106.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 7.9 Hz, 2H), 7.68 (dd, J = 8.3, 5.6 Hz, 2H), 7.54 (d, J = 8.3 Hz, 1H), 7.47 (t, J = 7.3 Hz, 1H), 7.37 (t, J = 7.7 Hz, 3H), 7.21 (t, J = 7.5 Hz, 1H), 7.12 (m, 3H), 4.94 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.9, 165.8 (d, J = 255.6 Hz), 154.4, 149.8, 138.1, 134.0, 132.1 (d, J = 9.4 Hz), 129.2, 128.3, 126.0, 125.5, 124.1, 121.5, 121.1, 115.6 (d, J = 22.0 Hz), 111.9, 54.7. IR (KBr) ν_{max} 3071, 2930, 1655, 1587, 1458, 1318, 1156, 903, 752 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}FO_4S$ $[M + Na]^+$ 413.0567, Found 417.0571.



(4-Chlorophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3da)

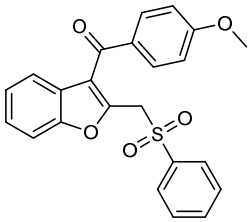
White solid (78.7 mg, 64% yield), mp: 106.3 - 107.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 7.8 Hz, 2H), 7.59 (d, J = 8.3 Hz, 2H), 7.54 (d, J = 8.4 Hz, 1H), 7.48 (t, J = 7.5 Hz, 1H), 7.42 (d, J = 8.4 Hz, 2H), 7.37 (t, J = 7.7 Hz, 3H), 7.21 (t, J = 7.5 Hz, 1H), 7.13 (d, J = 7.9 Hz, 1H), 4.94 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.2, 154.4, 150.0, 139.8, 138.1, 136.1, 134.0, 130.8, 129.2, 128.8, 128.3, 126.1, 125.4, 124.2, 121.6, 121.0, 111.9, 54.7. IR (KBr) ν_{max} 3069, 2929, 1654, 1582, 1460, 1319, 1158, 901, 749 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}ClO_4S$ $[M + Na]^+$ 433.0272, Found 433.0273.



(4-Bromophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ea)

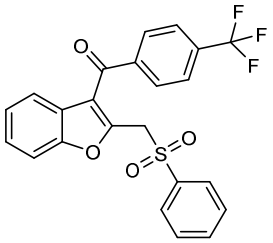
White solid (74.7 mg, 55% yield), mp: 104.6 - 106.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J

= 7.4 Hz, 2H), 7.59 (d, J = 8.5 Hz, 2H), 7.55 – 7.45 (m, 4H), 7.43 – 7.31 (m, 3H), 7.21 (t, J = 7.4 Hz, 1H), 7.13 (d, J = 7.8 Hz, 1H), 4.94 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 154.5, 150.1, 138.2, 136.5, 134.0, 131.7, 130.9, 129.2, 128.5, 128.3, 126.1, 125.4, 124.2, 121.6, 120.9, 111.9, 54.7. IR (KBr) ν_{max} 3070, 2925, 1653, 1582, 1460, 1318, 1159, 901, 750 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}BrO_4S$ $[M + Na]^+$ 476.9767, Found 476.9773.



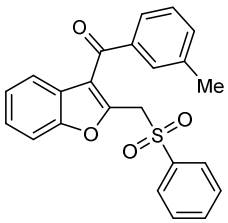
(4-Methoxyphenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ga)

White solid (69.4 mg, 57% yield), mp: 106.6 - 107.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 – 7.68 (m, 2H), 7.63 (d, J = 8.8 Hz, 2H), 7.52 (d, J = 8.4 Hz, 1H), 7.43 (t, J = 7.4 Hz, 1H), 7.38 – 7.30 (m, 3H), 7.24 – 7.16 (m, 2H), 6.91 (t, J = 9.3 Hz, 2H), 4.92 (s, 2H), 3.89 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.8, 163.8, 154.4, 149.1, 138.0, 133.9, 131.9, 130.4, 129.1, 128.3, 125.9, 125.8, 123.9, 121.7, 121.6, 113.6, 111.7, 55.5, 54.7. IR (KBr) ν_{max} 3069, 2925, 1653, 1593, 1451, 1321, 1254, 1161, 907, 750 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_5S$ $[M + Na]^+$ 429.0767, Found 429.0774.



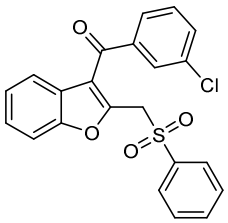
(2-((Phenylsulfonyl)methyl)benzofuran-3-yl)(4-(trifluoromethyl)phenyl)methanone (3ha)

White solid (55.9 mg, 42% yield), mp: 102.0 - 105.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 - 7.74 (m, 4H), 7.72 (d, J = 8.4 Hz, 2H), 7.55 (d, J = 8.3 Hz, 1H), 7.49 (t, J = 7.4 Hz, 1H), 7.40 (t, J = 7.4 Hz, 2H), 7.21 (t, J = 7.6 Hz, 1H), 7.07 (d, J = 7.9 Hz, 1H), 4.95 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.6, 154.5, 150.5, 140.7, 138.2, 134.7, 134.3, 134.1, 129.6, 129.2, 128.3, 126.2, 125.5 (q, J = 3.7 Hz), 122.9 (q, J = 289.0 Hz), 125.2, 122.2, 112.0, 54.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.02 (s). IR (KBr) ν_{max} 3063, 2925, 1655, 1574, 1459, 1311, 1236, 1166, 926, 745 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{15}F_3O_4S$ $[M + Na]^+$ 467.0535, Found 467.0534.



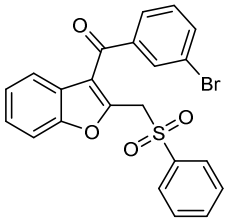
(2-((Phenylsulfonyl)methyl)benzofuran-3-yl)(*m*-tolyl)methanone (3ia)

White solid (74.8 mg, 64% yield), mp: 115.5 - 115.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 7.3 Hz, 2H), 7.53 (d, *J* = 8.4 Hz, 1H), 7.46 (t, *J* = 7.4 Hz, 1H), 7.41 (d, *J* = 6.5 Hz, 2H), 7.34 (m, 5H), 7.21 – 7.15 (m, 2H), 4.92 (s, 2H), 2.38 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 190.7, 154.5, 149.8, 138.3, 138.1, 137.9, 134.0, 133.9, 129.6, 129.1, 128.3, 128.2, 126.6, 125.9, 125.8, 124.0, 121.8, 121.4, 111.7, 54.8, 21.3. IR (KBr) v_{max} 3069, 2930, 1656, 1579, 1466, 1311, 1155, 900, 756, 533 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_4S$ $[M + Na]^+$ 413.0818, Found 413.0829



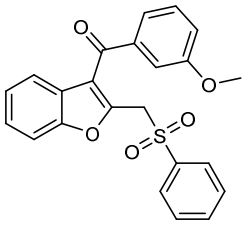
(3-Chlorophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ja)

White solid (77.4 mg, 63% yield), mp: 112.3 - 112.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 7.73 (d, *J* = 7.5 Hz, 2H), 7.56 (t, *J* = 8.1 Hz, 2H), 7.53 – 7.45 (m, 3H), 7.40 – 7.34 (m, 4H), 7.21 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 7.8 Hz, 1H), 4.94 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 189.1, 154.5, 150.3, 139.3, 138.0, 134.7, 134.0, 133.2, 129.7, 129.2, 129.1, 128.3, 127.4, 126.1, 125.3, 124.3, 121.5, 120.7, 111.9, 54.7. IR (KBr) v_{max} 3057, 2926, 1654, 1588, 1457, 1304, 1162, 749 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}ClO_4S$ $[M + Na]^+$ 433.0272, Found 433.0279.



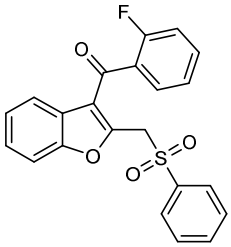
(3-Bromophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ka)

White solid (76.1 mg, 56% yield), mp: 111.0 - 114.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) *δ* 7.73 (d, *J* = 7.7 Hz, 3H), 7.66 (s, 1H), 7.55 (t, *J* = 7.8 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.8 Hz, 3H), 7.32 (t, *J* = 7.8 Hz, 1H), 7.22 (t, *J* = 7.6 Hz, 1H), 7.12 (d, *J* = 7.9 Hz, 1H), 4.94 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) *δ* 189.0, 154.5, 150.4, 139.5, 137.9, 136.1, 134.1, 132.1, 130.0, 129.2, 128.4, 127.9, 126.1, 125.3, 124.3, 122.6, 121.5, 120.7, 112.0, 54.7. IR (KBr) v_{max} 3068, 2929, 1655, 1587, 1461, 1275, 1158, 1035, 753 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}BrO_4S$ $[M + Na]^+$ 476.9767, Found 476.9771.



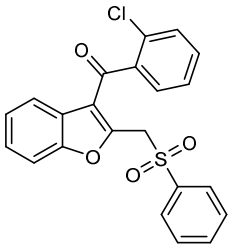
(3-Methoxyphenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3la)

White solid (54.8 mg, 45% yield), mp: 102.6 - 102.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, J = 7.4 Hz, 2H), 7.48 (d, J = 8.3 Hz, 1H), 7.43 (s, 1H), 7.35 - 7.25 (m, 4H), 7.18 (d, J = 6.0 Hz, 2H), 7.14 – 7.08 (m, 3H), 4.88 (s, 2H), 3.78 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.2, 159.6, 154.4, 149.8, 139.1, 138.1, 134.0 129.4, 129.2, 128.3, 125.9, 125.7, 124.0, 122.1, 121.9, 121.3, 119.7, 113.4, 111.7, 55.5, 54.9. IR (KBr) v_{max} 3067, 2926, 1657, 1578, 1456, 1314, 1242, 1156, 935, 747 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_5S$ $[M + H]^+$ 407.0948, Found 407.0945.



(2-Fluorophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ma)

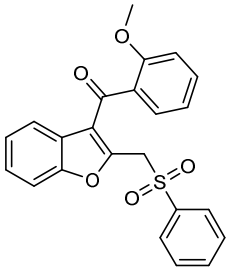
Yellow oil (69.7 mg, 59% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, J = 7.6 Hz, 2H), 7.59 (t, J = 7.5 Hz, 2H), 7.54 (d, J = 8.4 Hz, 1H), 7.49 – 7.41 (m, 3H), 7.37 (t, J = 7.7 Hz, 1H), 7.28 (d, J = 5.0 Hz, 1H), 7.19 (m, 2H), 7.05 (d, J = 8.0 Hz, 1H), 5.02 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 187.0, 160.0 (d, J = 254.8 Hz), 154.6, 150.9, 138.3, 134.1, 134.0, 130.5 (d, J = 2.1 Hz), 129.2, 128.5, 127.7 (d, J = 13.4 Hz), 126.0, 125.0 (d, J = 1.2 Hz), 124.5 (d, J = 3.7 Hz), 124.3, 121.4, 121.0, 116.5 (d, J = 21.3 Hz), 111.8, 55.2. ^{19}F NMR (376 MHz, $CDCl_3$) δ -111.63 – -112.61 (m). IR (KBr) v_{max} 2927, 1666, 1584, 1459, 1313, 1155, 1020, 903, 749, 535 cm^{-1} HRMS (ESI) Calcd for $C_{22}H_{15}FO_4S$ $[M + Na]^+$ 417.0567, Found 417.0579.



(2-Chlorophenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3na)

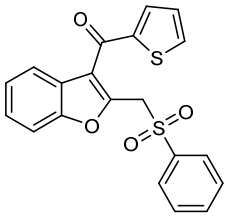
White solid (66.4 mg, 54% yield), mp: 93.3 - 94.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, J = 7.4 Hz, 2H), 7.62 (t, J = 7.5 Hz, 1H), 7.53 - 7.44 (m, 5H), 7.38 - 7.32 (m, 2H), 7.20 (d, J = 7.3 Hz, 1H), 7.14 (t, J = 7.6 Hz, 1H), 6.79 (d, J = 8.0 Hz, 1H), 5.02 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.3, 154.7, 151.7, 139.1, 138.6, 134.1, 131.9, 130.8, 130.3, 129.2, 128.9, 128.5, 127.1, 126.1, 124.7, 124.5, 121.1, 120.5, 111.8, 55.4. IR (KBr) v_{max} 2925, 1608, 1457, 1311, 1241, 1154, 739

cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}ClO_4S$ $[M + Na]^+$ 433.0272, Found 433.0277.



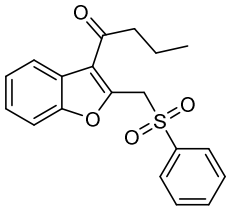
(2-Methoxyphenyl)(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3oa)

White solid (54.8 mg, 45% yield), mp: 110.2 - 111.3 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 7.5 Hz, 2H), 7.57 (d, J = 7.4 Hz, 1H), 7.53 – 7.48 (m, 2H), 7.44 (t, J = 7.8 Hz, 2H), 7.31 (s, 1H), 7.17 – 7.09 (m, 2H), 7.02 (d, J = 7.4 Hz, 1H), 6.95 (t, J = 8.3 Hz, 2H), 5.00 (s, 2H), 3.60 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.9, 157.2, 154.5, 150.5, 138.5, 133.9, 133.0, 129.5, 129.3, 129.0, 128.5, 125.6, 125.2, 124.0, 121.7, 121.2, 120.7, 111.6, 111.5, 55.5, 55.2. IR (KBr) v_{max} 3068, 2929, 1659, 1570, 1450, 1318, 1238, 1156, 904, 749 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_5S$ $[M + H]^+$ 407.0948, Found 407.0946.



(2-((Phenylsulfonyl)methyl)benzofuran-3-yl)(thiophen-2-yl)methanone (3pa)

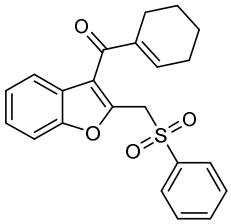
White solid (67.6 mg, 59% yield), mp: 155.9 - 157.6 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 - 7.60 (m, 3H), 7.47 (d, J = 8.3 Hz, 1H), 7.38 (d, J = 7.9 Hz, 1H), 7.34 - 7.26 (m, 3H), 7.23 - 7.16 (m, 3H), 7.02 - 6.97 (m, 1H), 4.86 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 181.5, 154.5, 149.0, 143.8, 137.8, 135.1, 135.0, 133.8, 129.0, 128.3 127.8, 126.0, 125.3, 124.0, 121.5, 121.2, 111.9, 54.5. IR (KBr) v_{max} 3068, 2929, 1659, 1570, 1450, 1318, 1156, 904, 749 cm^{-1}. HRMS (ESI) Calcd for $C_{20}H_{14}O_4S_2$ $[M + Na]^+$ 405.0226, Found 405.0231.



1-(2-((Phenylsulfonyl)methyl)benzofuran-3-yl)butan-1-one (3qa)

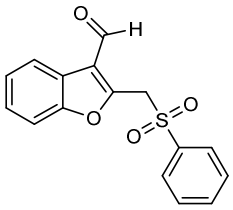
Yellow oil (56.4 mg, 55% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (t, J = 7.7 Hz, 3H), 7.60 (t, J = 7.4 Hz, 1H), 7.53 (d, J = 7.5 Hz, 1H), 7.45 (t, J = 7.8 Hz, 2H), 7.44 - 7.35 (m, 2H), 5.13 (s, 2H),

2.79 (t, J = 7.2 Hz, 2H), 1.65 - 1.59 (m, 2H), 0.96 (t, J = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 196.0, 154.7, 150.6, 138.5, 133.9, 128.9, 128.9, 125.9, 124.4, 124.3, 121.5, 120.5, 112.1, 55.5, 45.2, 16.7, 13.7. IR (KBr) ν_{max} 3063, 2933, 1633, 1452, 1313, 1151, 751, 532 cm^{-1}. HRMS (ESI) Calcd for $C_{19}H_{18}O_4S$ $[M + Na]^+$ 365.0818, Found 365.0825.



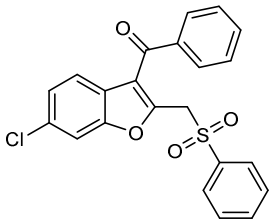
Cyclohex-1-en-1-yl(2-((phenylsulfonyl)methyl)benzofuran-3-yl)methanone (3ra)

Yellow oil (39.9 mg, 35% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (d, J = 7.6 Hz, 2H), 7.59 (t, J = 7.4 Hz, 1H), 7.51 – 7.40 (m, 4H), 7.34 (t, J = 7.7 Hz, 1H), 7.29 – 7.22 (m, 1H), 6.50 (t, J = 3.9 Hz, 1H), 4.90 (s, 2H), 2.27 - 2.20 (m, 2H), 2.19 - 2.18 (m, 2H), 1.70 - 1.66 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.1, 154.3, 148.0, 144.4, 139.6, 138.2, 133.8, 129.1, 128.5, 126.2, 125.6, 123.8, 121.5, 121.4, 111.7, 54.6, 26.0, 23.0, 21.8, 21.5. IR (KBr) ν_{max} 2925, 1651, 1463, 1323, 1164, 697 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{20}O_4S$ $[M + H]^+$ 381.1155, Found 381.1150.



2-((Phenylsulfonyl)methyl)benzofuran-3-carbaldehyde (3sa)

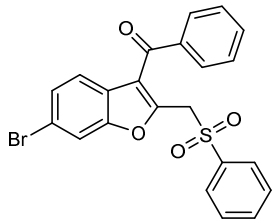
White solid (40.5 mg, 45% yield), mp: 124.1 - 125.3 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.57 (s, 1H), 7.95 -7.85 (m, 2H), 7.77 - 7.63 (m, 2H), 7.60 - 7.50 (m, 3H), 7.03 - 6.89 (m, 2H), 4.73 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 193.0, 163.3, 138.5, 137.9, 134.4, 131.5, 129.3, 128.5, 119.5, 119.2, 118.7, 63.6. IR (KBr) ν_{max} 3512, 2928, 1624, 1307, 1151, 748 cm^{-1}. HRMS (ESI) Calcd for $C_{16}H_{12}O_4S$ $[M + Na]^+$ 323.0349, Found 323.0346.



(6-Chloro-2-((phenylsulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ta)

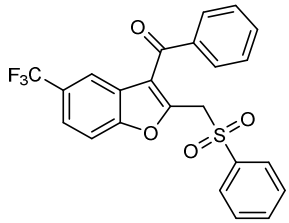
Yellow oil (83.6 mg, 68% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, J = 7.8 Hz, 2H), 7.65 – 7.57 (m, 3H), 7.54 (s, 1H), 7.47 - 7.35 (m, 3H), 7.37 (t, J = 7.6 Hz, 2H), 7.18 (d, J = 8.5 Hz, 1H),

7.08 (d, J = 8.5 Hz, 1H), 4.89 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.0, 154.4, 150.5, 138.0, 137.6, 134.1, 133.5, 132.0, 129.3, 129.2, 128.5, 128.3, 124.9, 124.4, 122.4, 121.1, 112.3, 54.8. IR (KBr) v_{max} 3060, 2930, 1727, 1659, 1588, 1461, 1273, 1149, 911, 701 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}ClO_4S$ $[M + Na]^+$ 433.0272, Found 433.0280.



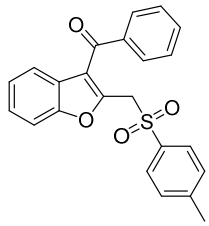
(6-Bromo-2-((phenylsulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ua)

White solid (81.5 mg, 60% yield), mp: 116.4 - 117.5 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 - 7.70 (m, 3H), 7.60 - 7.58 (m, 3H), 7.49 - 7.41 (m, 3H), 7.37 (t, J = 7.7 Hz, 2H), 7.32 (dd, J = 8.5, 1.7 Hz, 1H), 7.03 (d, J = 8.5 Hz, 1H), 4.89 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.9, 154.5, 150.4, 138.0, 137.6, 134.1, 133.5, 129.3, 129.2, 128.5, 128.3, 127.6, 124.8, 122.8, 121.1, 119.4, 115.2, 54.7. IR (KBr) v_{max} 3065, 2926, 1732, 1654, 1587, 1459, 1320, 1257, 1037, 901, 699 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}BrO_4S$ $[M + Na]^+$ 476.9767, Found 476.9771.



Phenyl(2-((phenylsulfonyl)methyl)-5-(trifluoromethyl)benzofuran-3-yl)methanone (3va)

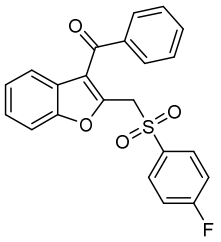
White solid (83.9 mg, 63% yield), mp: 105.8 - 113.4 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, J = 7.7 Hz, 2H), 7.66 - 7.59 (m, 5H), 7.52 (s, 1H), 7.47 (t, J = 7.8 Hz, 3H), 7.38 (t, J = 7.5 Hz, 2H), 4.90 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.6, 155.6, 151.6, 137.8, 137.3, 134.2, 133.8, 129.3 (d, J = 5.9 Hz), 128.6, 128.3, 126.9 (q, J = 32.7 Hz), 126.0, 124.9, 123.1, 119.7 (q, J = 3.7 Hz), 112.4, 54.8. IR (KBr) v_{max} 3067, 2929, 1732, 1656, 1588, 1452, 1132, 1037, 699 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{15}F_3O_4S$ $[M + Na]^+$ 467.0535, Found 467.0544.



Phenyl(2-(tosylmethyl)benzofuran-3-yl)methanone (3ab)

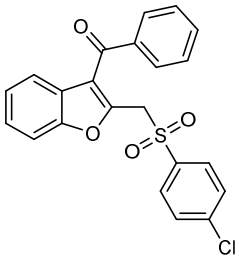
Yellow oil (86.6 mg, 74% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 - 7.52 (m, 6H), 7.43 (t, J =

7.6 Hz, 2H), 7.35 (t, J = 7.7 Hz, 1H), 7.18 (t, J = 7.5 Hz, 1H), 7.14 – 7.07 (m, 3H), 4.94 (s, 3H), 2.21 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.4, 150.2, 145.1, 137.6, 134.9, 133.2, 129.8, 129.4, 128.3, 128.3, 125.8, 125.7, 124.0, 121.8, 111.8, 54.7, 21.5. IR (KBr) v_{max} 3056, 2928, 1732, 1653, 1648, 1585, 1455, 1317, 1155, 903, 755, 702 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_4S$ [M + H]$^+$ 391.0997, Found 391.0999.



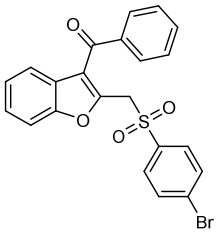
(2-(((4-Fluorophenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ac)

White solid (85.1 mg, 72% yield), mp: 125.0 – 125.9 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (dd, J = 7.3, 5.3 Hz, 2H), 7.62 (d, J = 7.7 Hz, 3H), 7.55 (d, J = 8.3 Hz, 1H), 7.45 (t, J = 7.6 Hz, 2H), 7.37 (t, J = 7.6 Hz, 1H), 7.23 – 7.13 (m, 2H), 7.00 (t, J = 8.1 Hz, 1H), 4.95 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.3, 165.9 (d, J = 257.4 Hz), 154.4, 149.8, 137.5, 133.9 (d, J = 3.2 Hz), 133.5, 131.3 (d, J = 9.8 Hz), 129.3, 128.4, 126.0, 125.5, 124.1, 121.8, 121.2, 116.6, 116.4, 111.8, 54.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.6. IR (KBr) v_{max} 3068, 2924, 2855, 1730, 1652, 1589, 1455, 1326, 1238, 1150, 902, 755, 703 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}FO_4S$ [M + Na]$^+$ 417.0567, Found 417.0569.



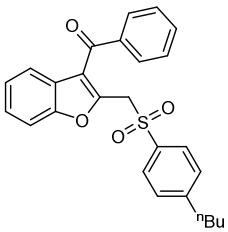
(2-(((4-Chlorophenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ad)

White solid (88.6 mg, 72% yield), mp: 105.9 - 106.1 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (s, 1H), 7.63 (d, J = 2.8 Hz, 1H), 7.61 (s, 1H), 7.59 (s, 1H), 7.56 (d, J = 8.4 Hz, 1H), 7.45 (t, J = 7.7 Hz, 2H), 7.37 (t, J = 8.3 Hz, 1H), 7.29 (s, 1H), 7.27 (d, J = 4.1 Hz, 1H), 7.20 (t, J = 7.5 Hz, 1H), 7.14 (d, J = 7.5 Hz, 1H), 4.97 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.5, 149.7, 140.9, 137.5, 136.4, 133.5, 129.9, 129.5, 129.3, 128.5, 126.1, 125.5, 124.1, 121.8, 121.2, 111.8, 54.7. IR (KBr) v_{max} 3074, 2928, 2852, 1733, 1654, 1580, 1460, 1327, 1245, 1159, 901, 758, 703 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}ClO_4S$ [M + Na]$^+$ 433.0272, Found 433.0274.



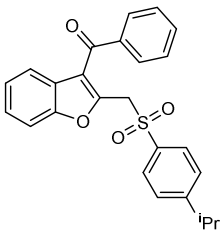
(2-(((4-Bromophenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ae)

White solid (88.3 mg, 65% yield), mp: 128.4 - 129.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, J = 7.3 Hz, 1H), 7.51 (dd, J = 11.0, 8.3 Hz, 5H), 7.39 (t, J = 7.8 Hz, 4H), 7.30 (t, J = 7.7 Hz, 1H), 7.12 (t, J = 7.5 Hz, 1H), 7.06 (d, J = 7.8 Hz, 1H), 4.90 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 154.4, 150.1, 138.1, 136.5, 134.0, 131.7, 130.9, 129.2, 128.4, 128.3, 126.1, 125.4, 124.2, 121.5, 120.9, 111.9, 54.6. IR (KBr) ν_{max} 3076, 2927, 2854, 1735, 1653, 1578, 1459, 1330, 1244, 1159, 902, 758, 705 cm^{-1}. HRMS (ESI) Calcd for $C_{22}H_{15}BrO_4S$ $[M + Na]^+$ 476.9767, Found 476.9766.



(2-(((4-Butylphenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3af)

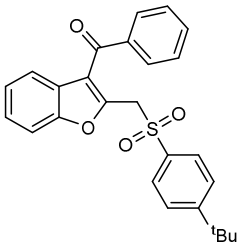
White solid (82.9 mg, 64% yield), mp: 83.4 - 84.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (m, 5H), 7.54 (d, J = 8.4 Hz, 1H), 7.43 (t, J = 7.7 Hz, 2H), 7.35 (t, J = 7.7 Hz, 1H), 7.18 (t, J = 7.5 Hz, 1H), 7.15 – 7.09 (m, 3H), 4.94 (s, 2H), 2.49 (t, J = 7.7 Hz, 2H), 1.52 – 1.37 (m, 2H), 1.35 – 1.16 (m, 1H), 0.89 (t, J = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.5, 150.3, 150.0, 137.8, 135.1, 133.2, 129.3, 129.1, 128.4, 128.3, 125.8, 125.7, 123.9, 121.78, 121.0, 111.8, 54.8, 35.5, 32.9, 22.2, 13.8. IR (KBr) ν_{max} 3060, 2929, 2859, 1654, 1566, 1454, 1319, 1152, 901, 755, 702 cm^{-1}. HRMS (ESI) Calcd for $C_{26}H_{24}O_4S$ $[M + H]^+$ 433.1468, Found 433.1465.



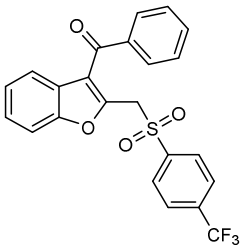
(2-(((4-Isopropylphenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ag)

White solid (81.5 mg, 65% yield), mp: 126.4 - 130.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (m, 5H), 7.54 (d, J = 8.3 Hz, 1H), 7.43 (t, J = 7.7 Hz, 1H), 7.35 (t, J = 7.7 Hz, 1H), 7.18 (dd, J = 10.5, 7.8 Hz, 1H), 7.12 (d, J = 7.8 Hz, 1H), 4.94 (s, 1H), 2.81 (dt, J = 13.8, 6.9 Hz, 1H), 1.12 (d, J = 6.9 Hz, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5, 155.7, 154.5, 150.3, 137.9, 135.3, 133.2, 129.3, 128.5, 128.7, 127.3, 125.8, 125.7, 123.9, 121.8, 120.9, 111.8, 54.9, 34.1, 23.4. IR (KBr) ν_{max} 3062,

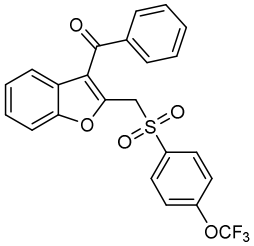
2924, 2856, 1650, 1589, 1458, 1318, 1154, 901, 755, 699 cm^{-1}. HRMS (ESI) Calcd for $C_{25}H_{22}O_4S$ $[M + H]^+$ 419.1312, Found 419.1315.



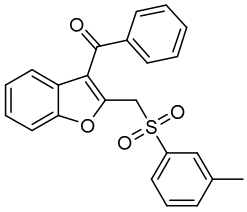
(2-(((4-(*tert*-Butyl)phenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ah)
White solid (80.3 mg, 62% yield), mp: 120.7 - 121.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (m, 5H), 7.54 (d, J = 8.3 Hz, 1H), 7.44 (t, J = 7.5 Hz, 2H), 7.35 (t, J = 7.8 Hz, 3H), 7.18 (t, J = 7.6 Hz, 1H), 7.11 (d, J = 7.9 Hz, 1H), 4.95 (s, 2H), 1.19 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5, 158.0, 154.50 (s, 150.4, 138.0, 135.0, 133.1, 129.3, 128.4, 128.2, 126.2, 125.8, 125.7, 123.9, 121.8, 120.8, 111.8, 54.9, 35.1, 30.8. IR (KBr) ν_{max} 3065, 2927, 2859, 1730, 1655, 1591, 1456, 1320, 1158, 900, 755, 702 cm^{-1}. HRMS (ESI) Calcd for $C_{26}H_{24}O_4S$ $[M + Na]^+$ 455.1288, Found 455.1293.



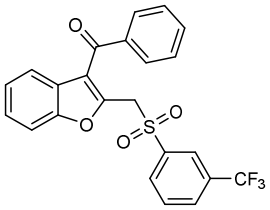
Phenyl(2-(((4-(trifluoromethyl)phenyl)sulfonyl)methyl)benzofuran-3-yl)methanone (3ai)
White solid (66.6 mg, 50% yield), mp: 144.8 - 147.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, J = 8.2 Hz, 2H), 7.64 - 7.57 (m, 4H), 7.55 (d, J = 11.1 Hz, 2H), 7.43 (t, J = 7.7 Hz, 2H), 7.37 (t, J = 7.7 Hz, 1H), 7.20 (t, J = 7.6 Hz, 1H), 7.12 (d, J = 7.9 Hz, 1H), 5.03 (s, 2H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.3, 154.6, 149.5, 141.7, 137.6, 135.7 (q, J = 32.9 Hz), 133.6, 129.2, 129.2, 128.5, 126.3 (q, J = 3.4 Hz), 126.2, 125.5, 124.2, 123.8, 122.0, 121.3, 111.9, 54.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.3. IR (KBr) ν_{max} 3067, 2928, 2868, 1729, 1659, 1590, 1459, 1323, 1149, 1070, 752, 704 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{15}F_3O_4S$ $[M + Na]^+$ 467.0535, Found 467.0542.



Phenyl(2-(((4-(trifluoromethoxy)phenyl)sulfonyl)methyl)benzofuran-3-yl)methanone (3aj)
White solid (71.8 mg, 52% yield), mp: 148.5 - 149.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 8.3 Hz, 2H), 7.62 (d, J = 7.5 Hz, 3H), 7.54 (d, J = 8.4 Hz, 1H), 7.45 (t, J = 7.6 Hz, 2H), 7.37 (t, J = 7.7 Hz, 1H), 7.23 – 7.12 (m, 4H), 4.98 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.5, 153.2, 149.7, 137.6, 136.1, 133.4, 130.8, 129.2, 128.5, 126.1, 125.5, 124.1, 121.9, 121.2, 120.6, 111.8, 54.9. ^{19}F NMR (376 MHz, $CDCl_3$) δ -57.7. IR (KBr) ν_{max} 3067, 2928, 2868, 1729, 1659, 1590, 1459, 1323, 1149, 1070, 752, 704 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{15}F_3O_5S$ $[M + Na]^+$ 483.0484, Found 483.0479.

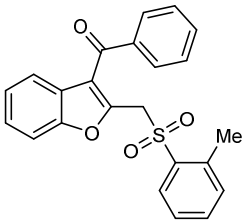


Phenyl(2-((*m*-tolylsulfonyl)methyl)benzofuran-3-yl)methanone (3ak)
Yellow oil (76.0 mg, 65% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 - 7.55 (m, 3H), 7.56 - 7.48 (m, 3H), 7.43 (t, J = 7.7 Hz, 2H), 7.36 (t, J = 7.4 Hz, 1H), 7.23 - 7.15 (m, 4H), 4.92 (s, 2H), 2.20 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.5, 154.5, 150.0, 139.6, 137.8, 137.8, 134.8, 133.3, 129.4, 129.0, 128.6, 128.4, 125.9, 125.8, 125.5, 124.0, 121.8, 121.3, 111.8, 54.8, 21.1. IR (KBr) ν_{max} 3064, 2928, 2867, 1737, 1663, 1583, 1455, 1319, 1240, 1147, 901, 761, 701 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_4S$ $[M + Na]^+$ 413.0818, Found 413.0814.



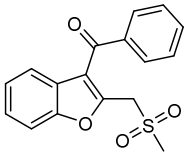
Phenyl(2-(((3-(trifluoromethyl)phenyl)sulfonyl)methyl)benzofuran-3-yl)methanone (3al)
White solid (73.2 mg, 55% yield), mp: 138.1 - 140.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 – 7.91 (m, 2H), 7.70 (d, J = 7.7 Hz, 1H), 7.66 – 7.58 (m, 3H), 7.55 - 7.49 (m, 2H), 7.44 (t, J = 7.7 Hz, 2H), 7.38 (t, J = 7.7 Hz, 1H), 7.23 - 7.15 (m, 2H), 4.99 (s, 1H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.3, 154.5, 149.3, 139.4, 137.7, 133.5, 131.8, 130.6 (q, J = 3.3 Hz), 129.9, 129.3, 128.5, 126.2, 125.8 (q, J = 3.7 Hz), 125.5, 124.2, 121.9, 121.5, 111.8, 54.9. ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.9.

IR (KBr) ν_{max} 3068, 2926, 2865, 1733, 1650, 1581, 1449, 1326, 1240, 1138, 901, 763, 696 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{15}F_3O_4S$ $[M + Na]^+$ 467.0535, Found 467.0526.



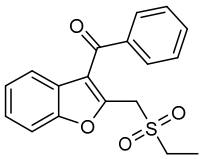
Phenyl(2-((*o*-tolylsulfonyl)methyl)benzofuran-3-yl)methanone (3am)

White solid (70.2 mg, 60% yield), mp: 93.1 - 94.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, J = 8.1 Hz, 1H), 7.63 – 7.55 (m, 3H), 7.53 (s, 1H), 7.42 (t, J = 7.5 Hz, 2H), 7.35 (t, J = 7.7 Hz, 1H), 7.24 (d, J = 7.5 Hz, 1H), 7.17 (t, J = 7.6 Hz, 1H), 7.12 (t, J = 6.7 Hz, 3H), 4.98 (s, 2H), 2.58 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 190.4, 154.4, 149.8, 138.8, 137.6, 135.8, 134.0, 133.3, 132.8, 130.5, 129.4, 128.3, 126.4, 125.9, 125.7, 123.9, 121.7, 121.2, 111.8, 53.8, 20.1. IR (KBr) ν_{max} 3064, 2931, 2858, 1736, 1663, 1582, 1459, 1314, 1244, 1158, 901, 756, 710 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{18}O_4S$ $[M + Na]^+$: 413.0818, Found: 413.0810.



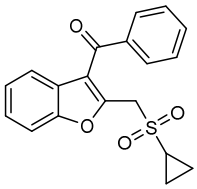
(2-((Methylsulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3an)

Yellow oil (72.5 mg, 77% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, J = 7.8 Hz, 2H), 7.66 (t, J = 7.4 Hz, 1H), 7.61 (d, J = 8.4 Hz, 1H), 7.52 (t, J = 7.5 Hz, 2H), 7.40 (t, J = 7.6 Hz, 1H), 7.27 – 7.22 (m, 1H), 7.20 (t, J = 6.3 Hz, 1H), 4.80 (s, 2H), 3.07 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.0, 154.6, 150.6, 138.0, 133.6, 129.4, 128.7, 126.2, 125.5, 124.2, 121.9, 121.3, 112.0, 53.8, 41.3. IR (KBr) ν_{max} 3014, 2930, 2855, 1736, 1663, 1584, 1454, 1314, 1246, 1140, 901, 756, 702 cm^{-1}. HRMS (ESI) Calcd for $C_{17}H_{14}O_4S$ $[M + Na]^+$ 337.0505, Found 337.0500.



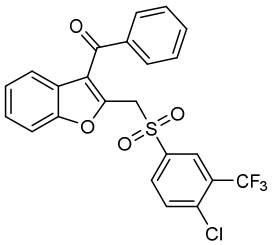
(2-((Ethylsulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ao)

Yellow oil (68.9 mg, 70% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, J = 7.4 Hz, 2H), 7.65 (t, J = 7.4 Hz, 1H), 7.60 (d, J = 8.4 Hz, 1H), 7.51 (t, J = 7.7 Hz, 2H), 7.38 (t, J = 7.6 Hz, 1H), 7.25 – 7.17 (m, 2H), 4.77 (s, 2H), 3.19 (q, J = 7.5 Hz, 2H), 1.42 (t, J = 7.5 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.1, 154.5, 150.4, 138.1, 133.5, 129.4, 128.7, 126.1, 125.6, 124.2, 121.9, 121.4, 111.9, 51.5, 48.0, 6.3. IR (KBr) ν_{max} 3064, 2932, 2859, 1734, 1653, 1584, 1455, 1315, 1245, 1132, 901, 753, 700 cm^{-1}. HRMS (ESI) Calcd for $C_{18}H_{16}O_4S$ $[M + Na]^+$ 351.0662, Found 351.0665.



(2-((Cyclopropylsulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ap)

Yellow oil (53.0 mg, 52% yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.59 (d, J = 8.3 Hz, 1H), 7.51 (t, J = 7.7 Hz, 2H), 7.41 - 7.35 (m, 1H), 7.23 – 7.20 (m, 2H), 4.84 (s, 1H), 2.74 - 2.35 (m, 1H), 1.27 - 1.08 (m, 1H), 1.06 - 0.80 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.0, 154.4, 150.5, 138.2, 133.4, 129.4, 128.7, 126.0, 125.8, 124.1, 121.8, 121.2, 111.8, 52.7, 30.2, 5.2. IR (KBr) ν_{max} 3061, 2932, 1737, 1653, 1585, 1454, 1318, 1251, 1188, 1135, 894, 753, 705 cm^{-1}. HRMS (ESI) Calcd for $C_{19}H_{16}O_4S$ [M + Na]$^+$ 363.0662, Found 363.0668.

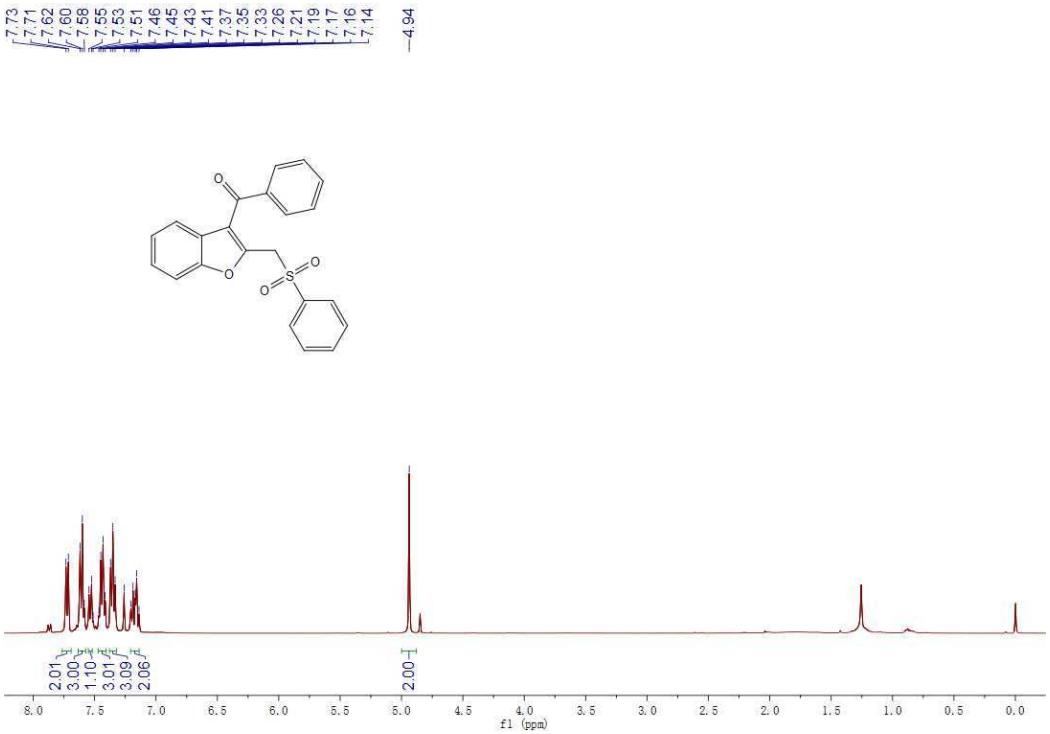


(2-(((4-Chloro-3-(trifluoromethyl)phenyl)sulfonyl)methyl)benzofuran-3-yl)(phenyl)methanone (3ar)

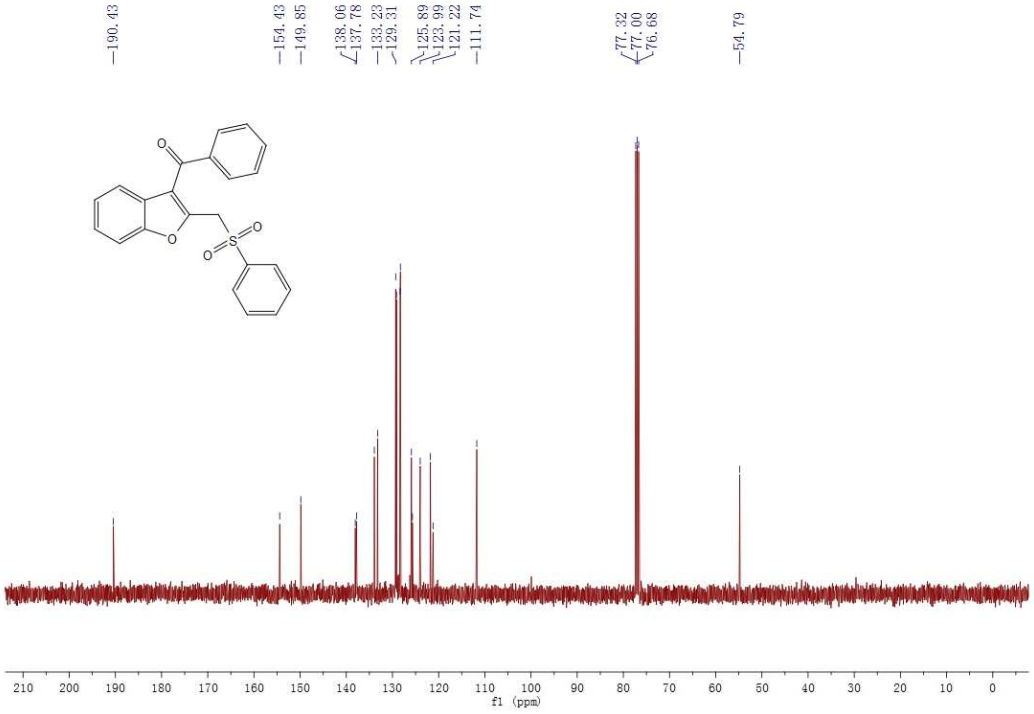
White solid (78.8 mg, 55% yield), mp: 92.2 - 93.4 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 (s, 1H), 7.82 (d, J = 8.3 Hz, 1H), 7.64 (d, J = 7.3 Hz, 1H), 7.60 (d, J = 7.9 Hz, 2H), 7.56 (d, J = 8.4 Hz, 1H), 7.45 (t, J = 7.6 Hz, 3H), 7.39 (t, J = 7.7 Hz, 1H), 7.21 (t, J = 7.5 Hz, 1H), 7.15 (d, J = 7.9 Hz, 1H), 5.01 (s, 2H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 190.2, 154.5, 149.3, 139.0, 137.4, 137.2, 133.6, 132.7, 132.4, 129.6 (q, J = 33.0 Hz), 129.2, 128.6, 128.2 (q, J = 5.1 Hz), 126.3, 125.3, 124.3, 122.6, 121.4, 120.8, 111.8, 54.9. ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.2. IR (KBr) ν_{max} 3075, 2928, 2857, 1735, 1654, 1586, 1469, 1312, 1247, 1152, 903, 756, 704 cm^{-1}. HRMS (ESI) Calcd for $C_{23}H_{14}ClF_3O_4S$ [M + Na]$^+$ 501.0146, Found 501.0147.

H. NMR Spectra for All Compounds

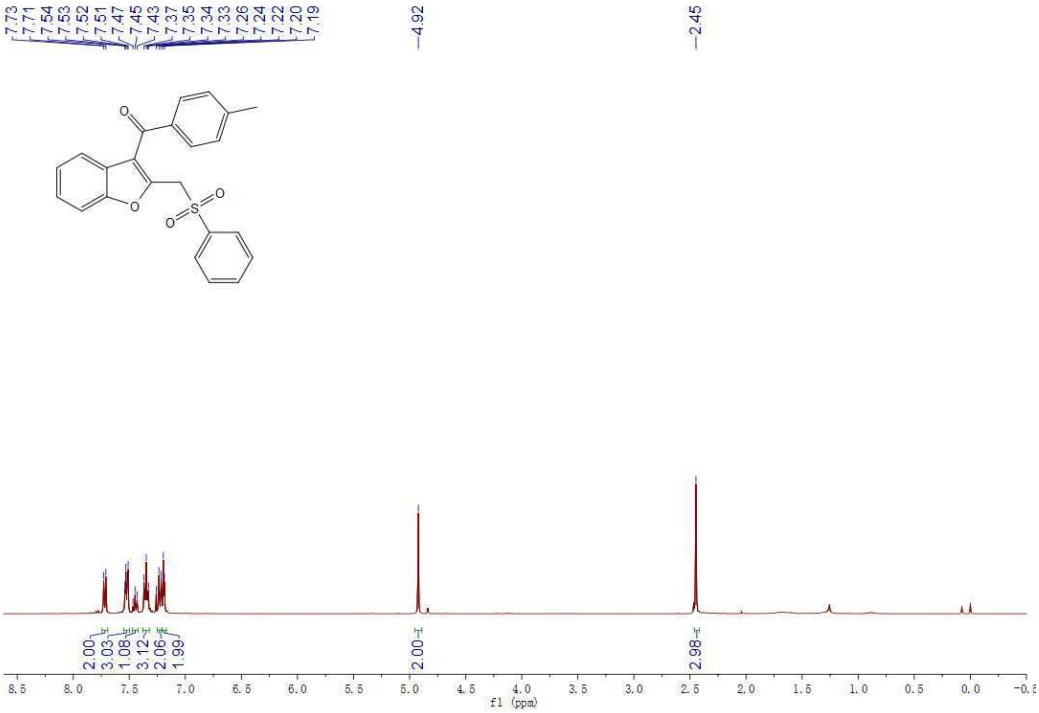
^{1}H NMR for Compound **3aa**:



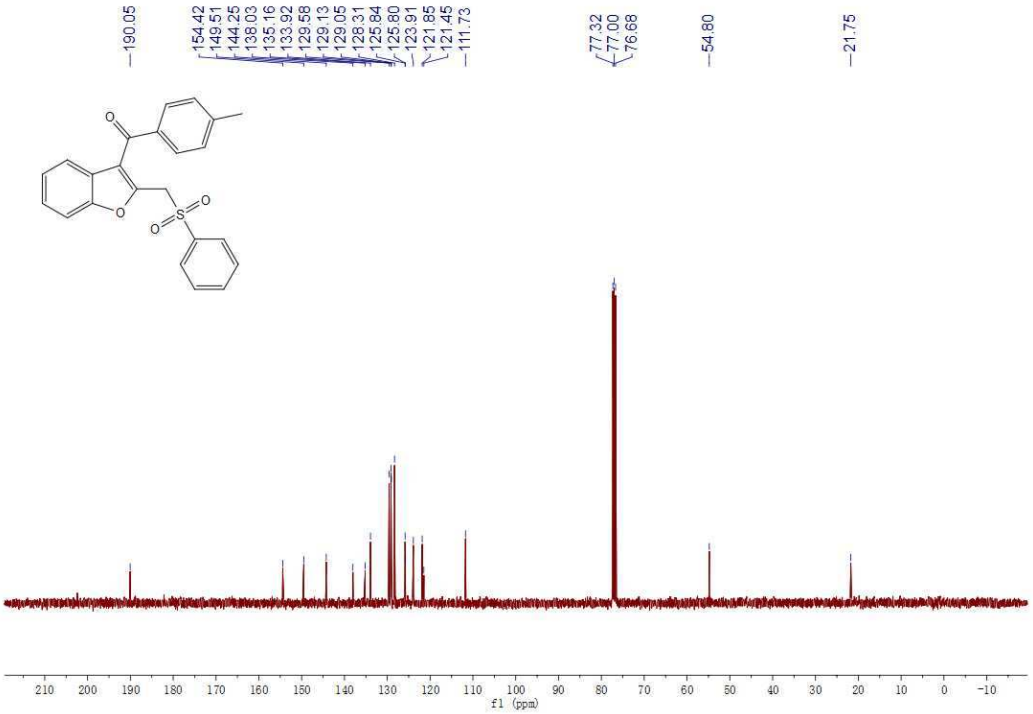
^{13}C NMR for Compound **3aa**:



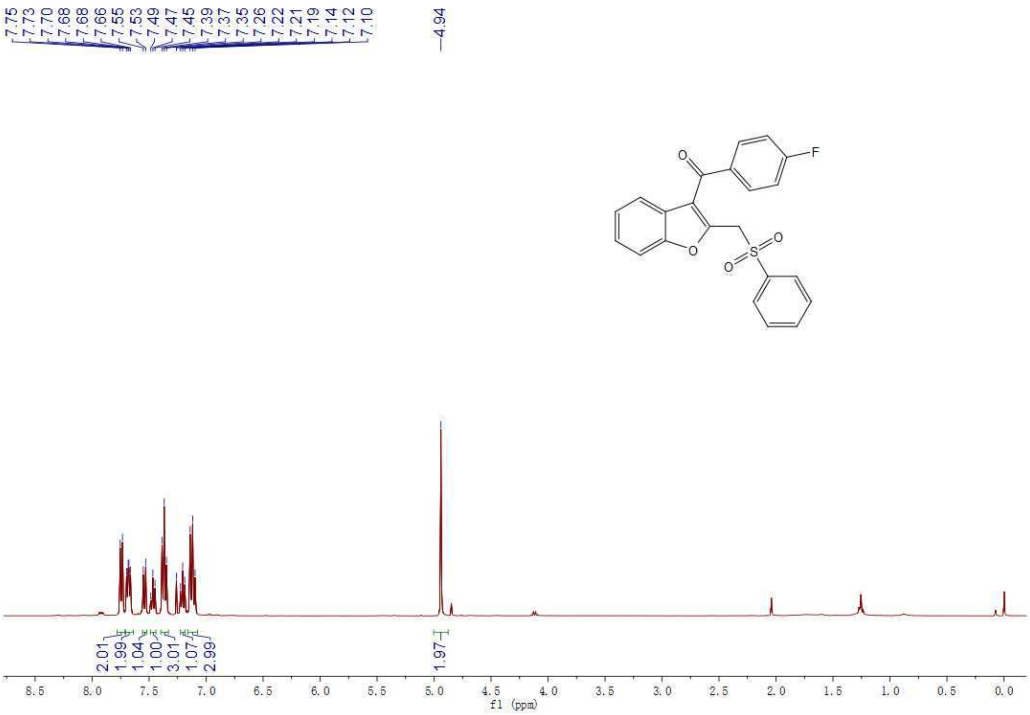
^{1}H NMR for Compound **3ba**:



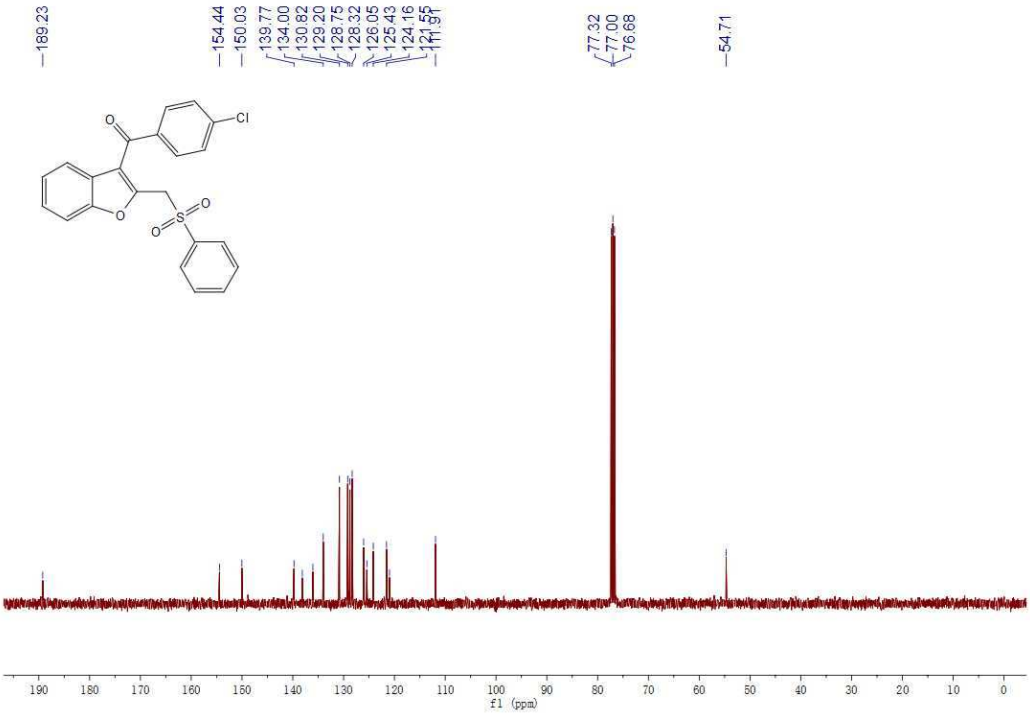
^{13}C NMR for Compound **3ba**:



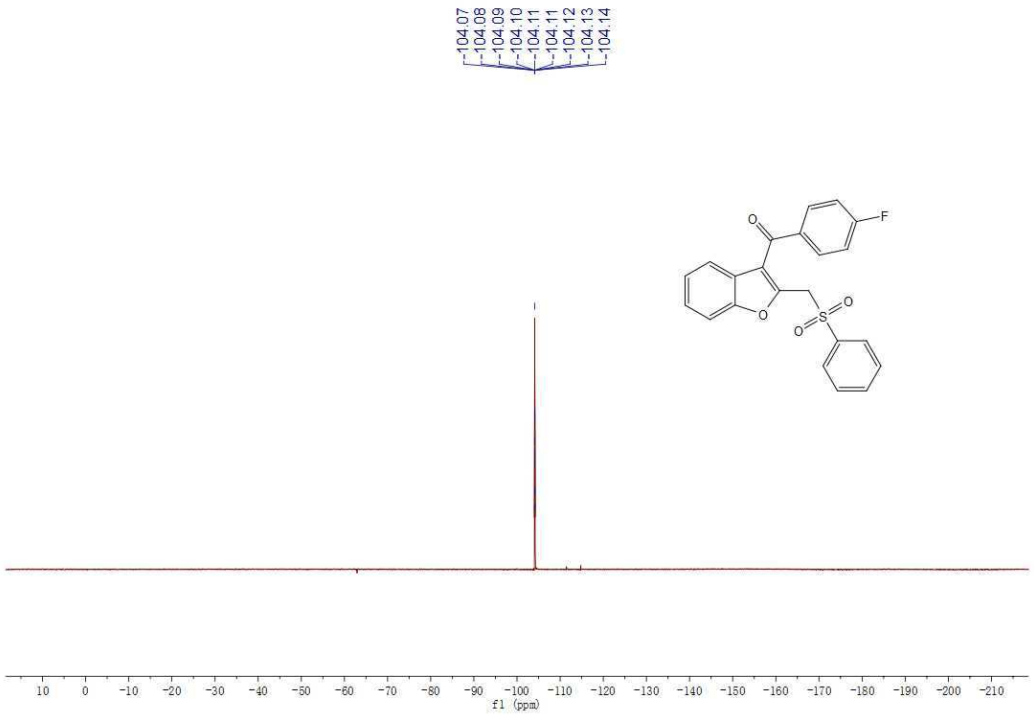
^{1}H NMR for Compound **3ca**:



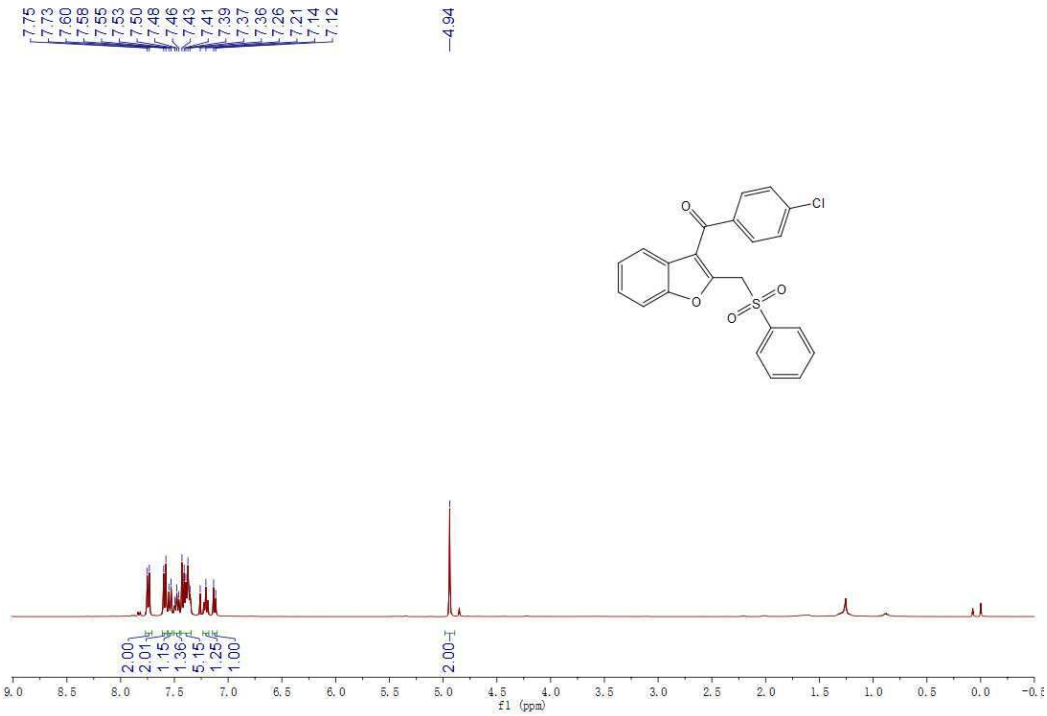
^{13}C NMR for Compound **3ca**:



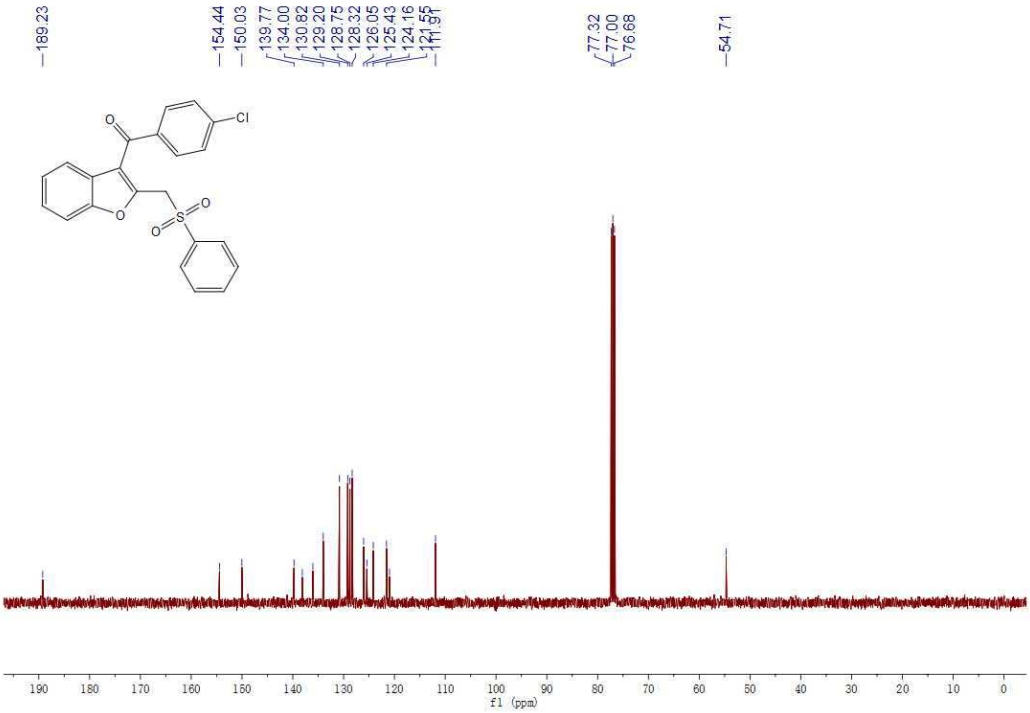
^{19}F NMR for Compound **3ca**:



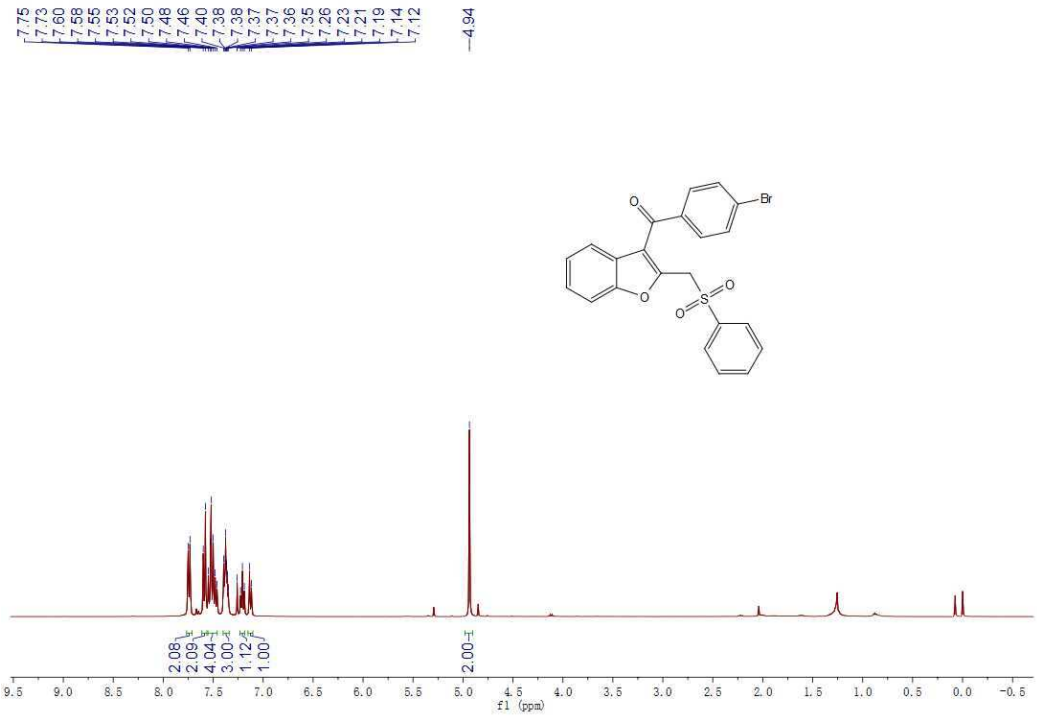
^{1}H NMR for Compound **3da**:



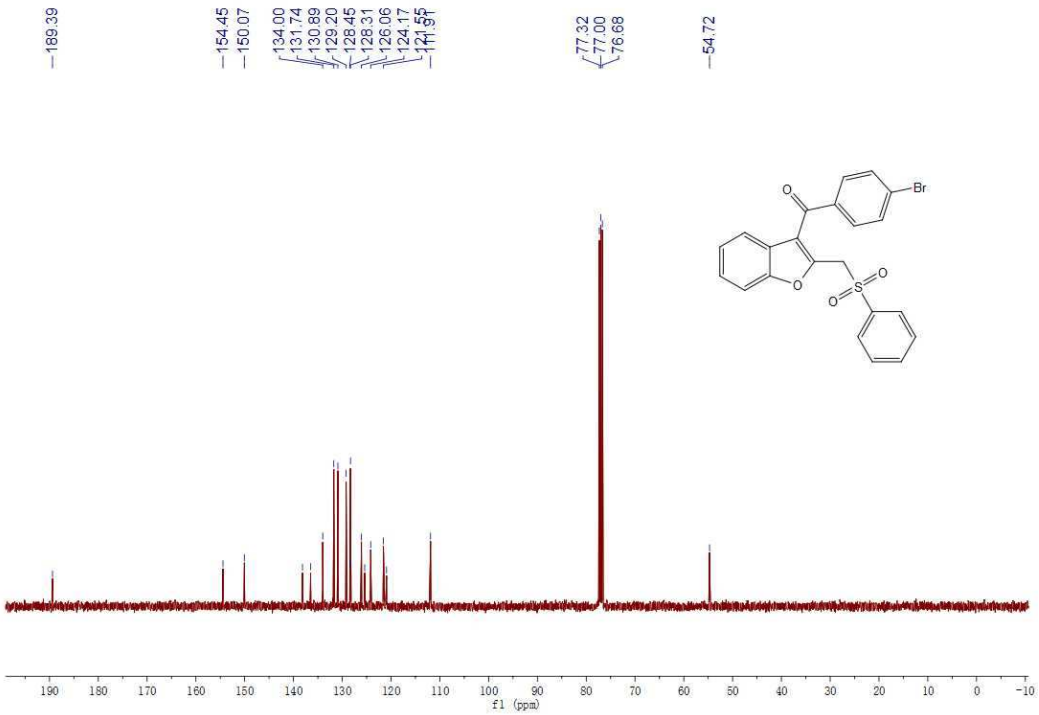
^{13}C NMR for Compound **3da**:



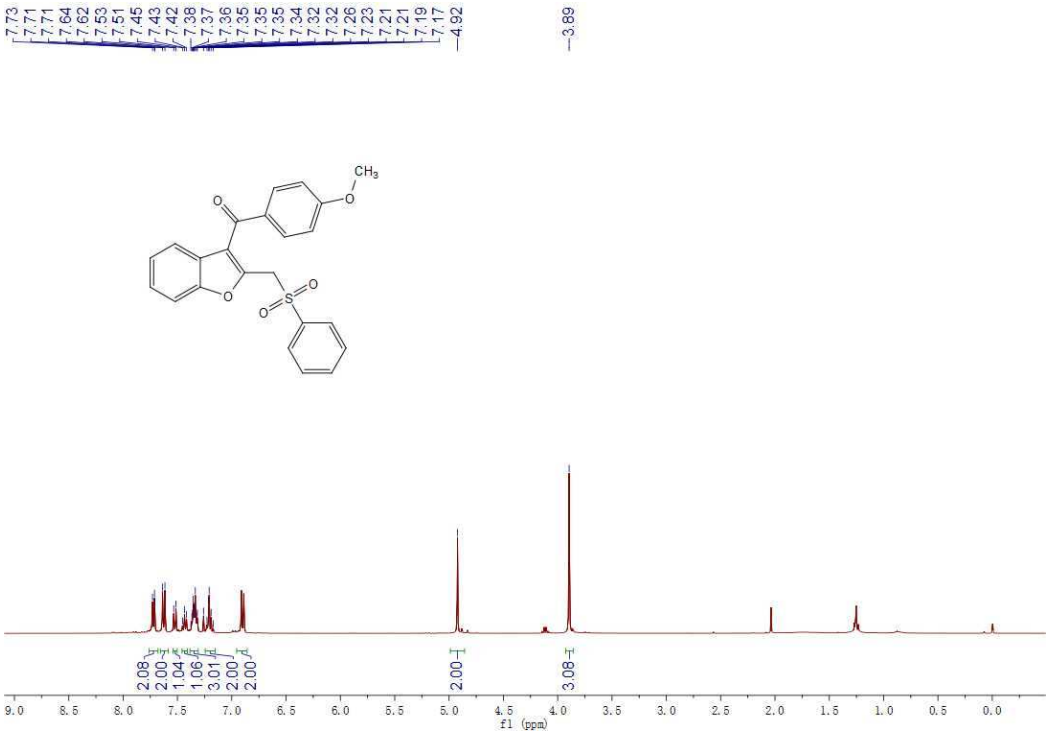
^{1}H NMR for Compound **3ea**:



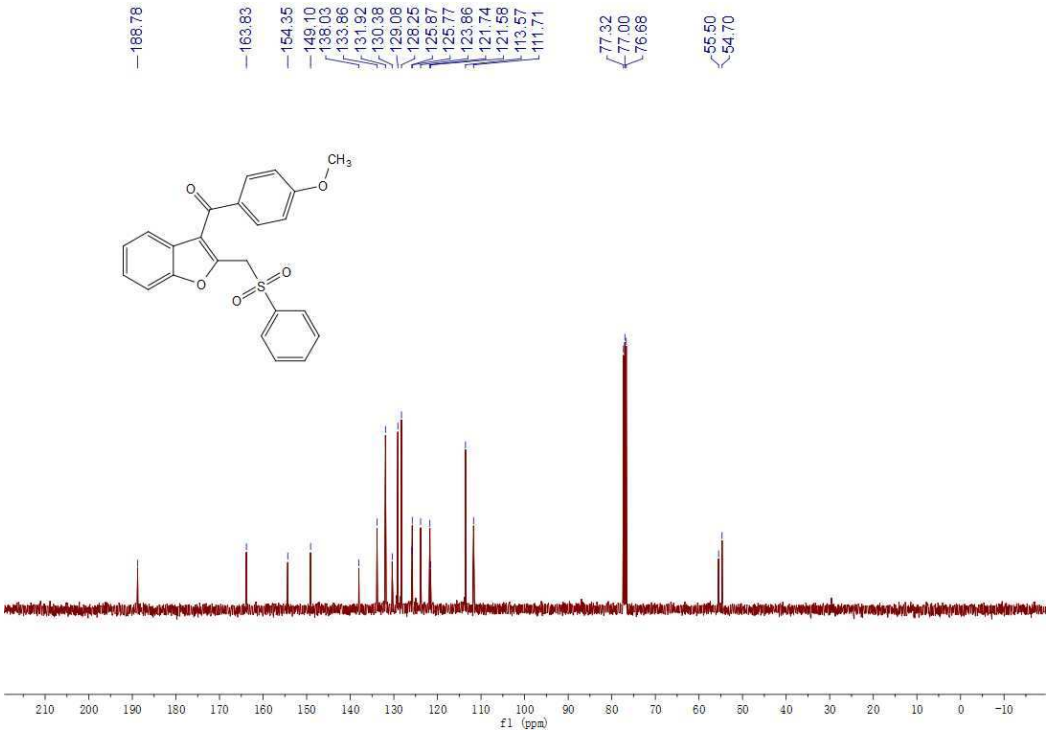
^{13}C NMR for Compound **3ea**:



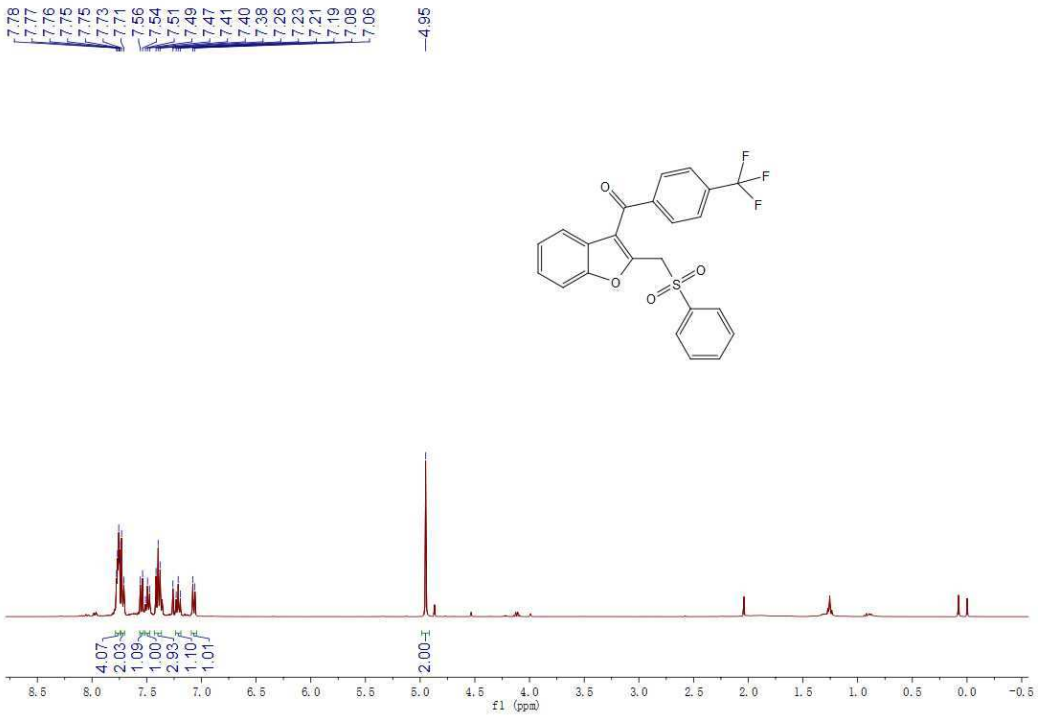
^{1}H NMR for Compound **3ga**:



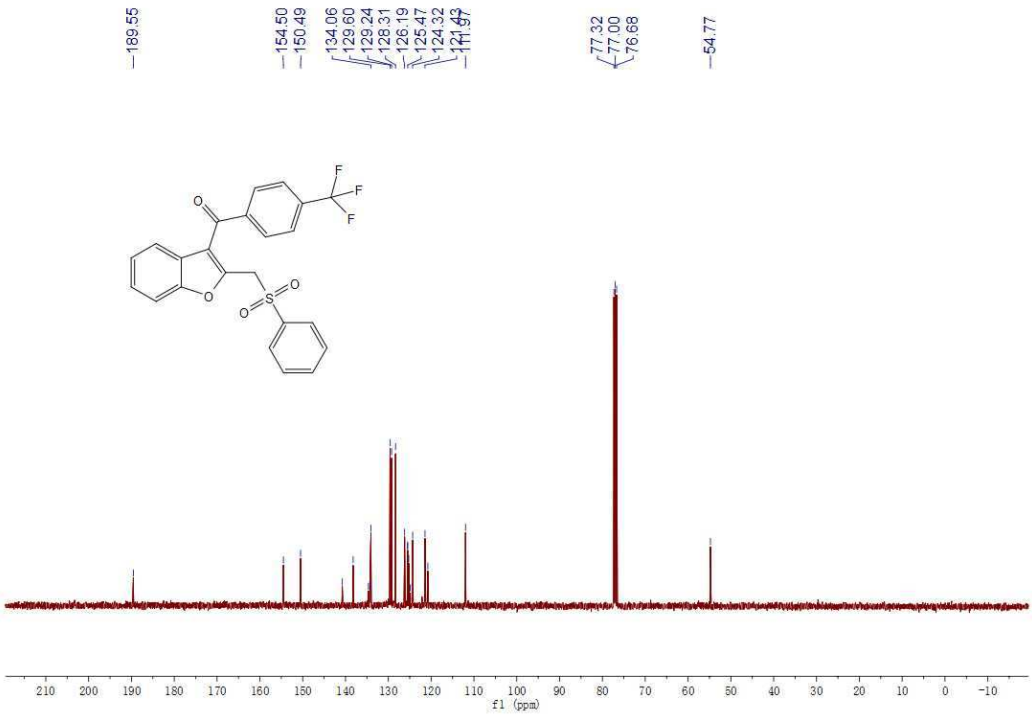
^{13}C NMR for Compound **3ga**:



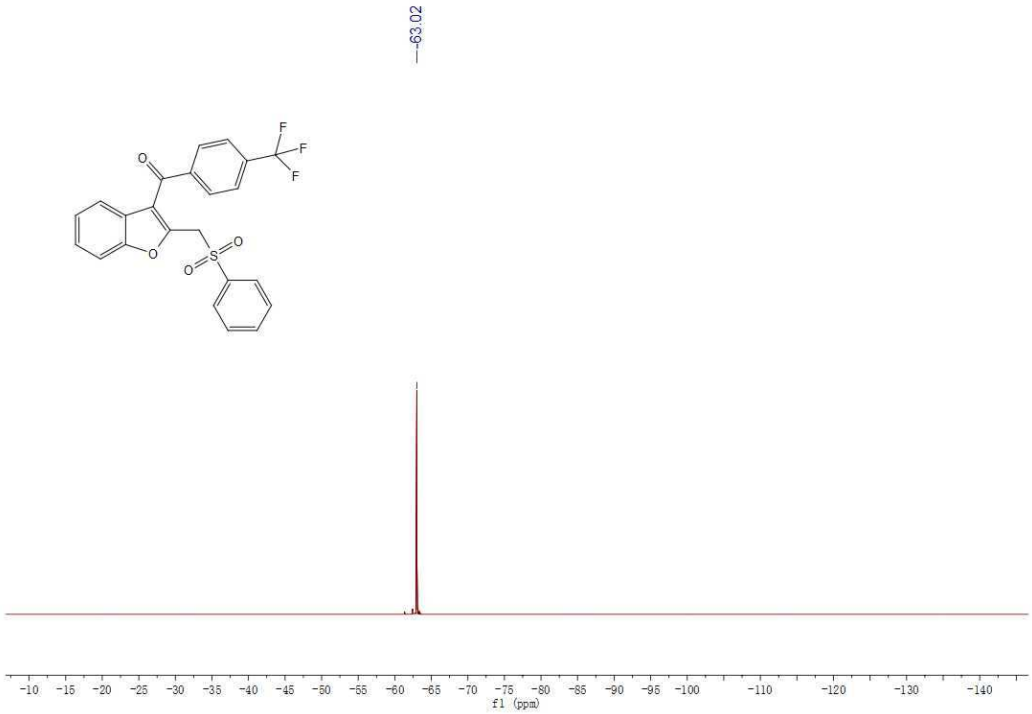
^{1}H NMR for Compound **3ha**:



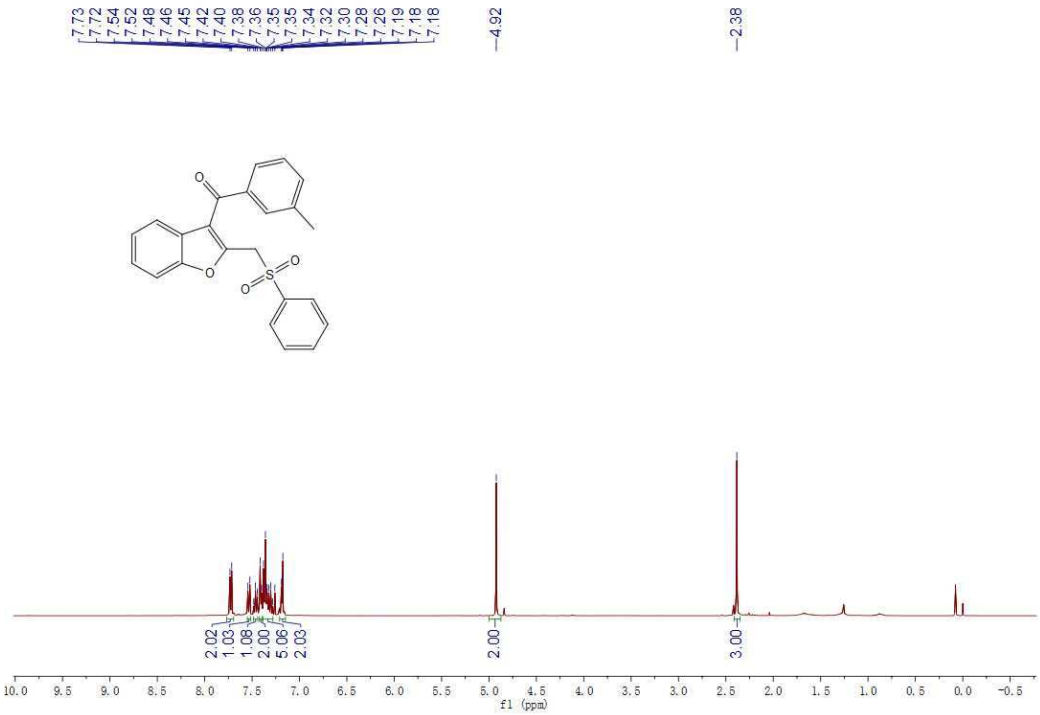
^{13}C NMR for Compound **3ha**:



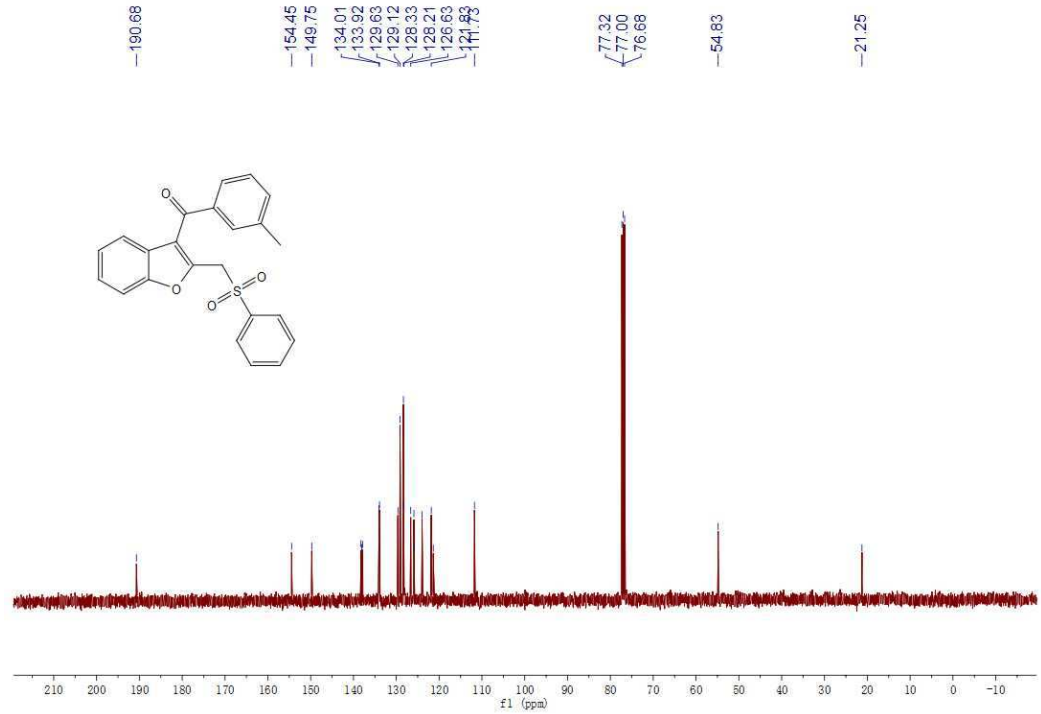
^{19}F NMR for Compound **3ha**:



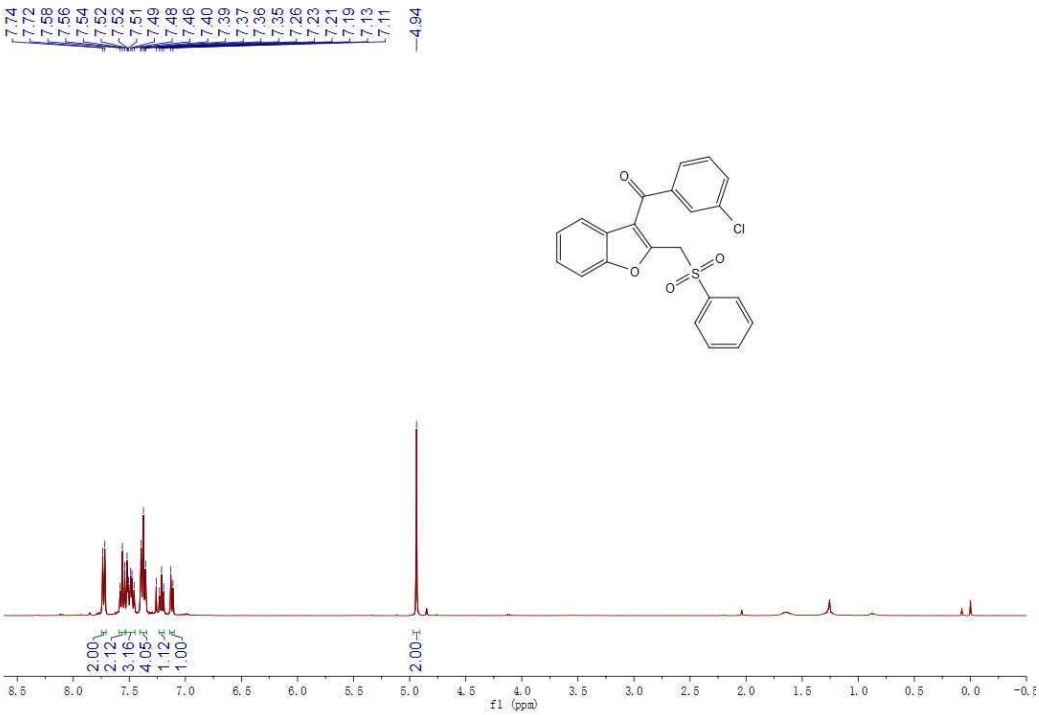
^{1}H NMR for Compound **3ia**:



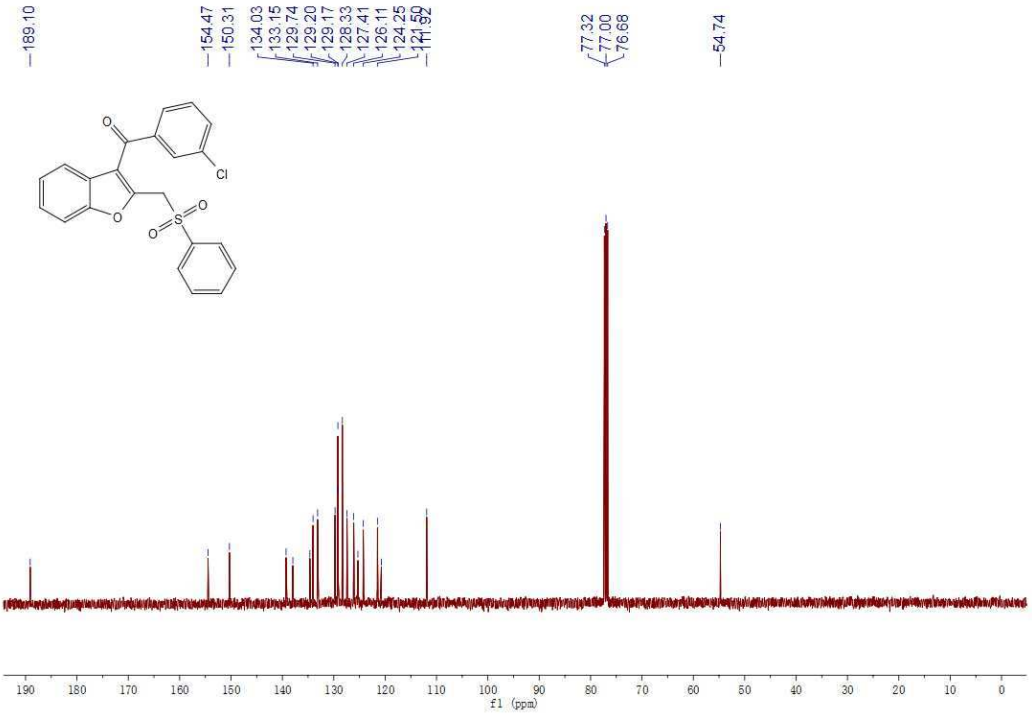
^{13}C NMR for Compound **3ia**:



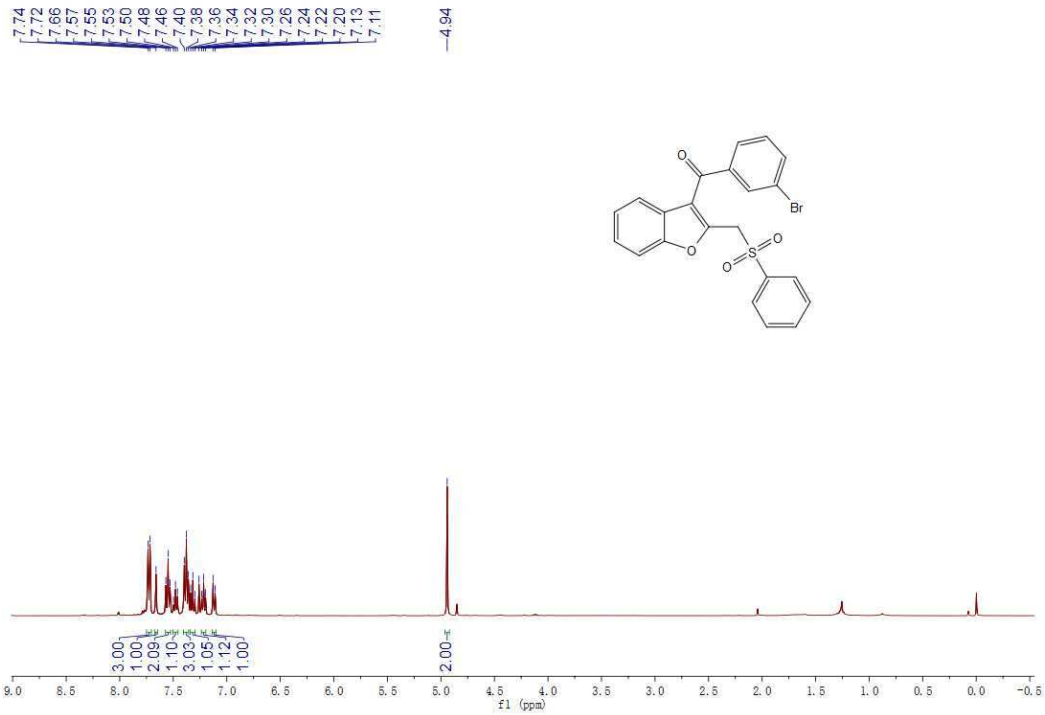
^{1}H NMR for Compound **3ja**:



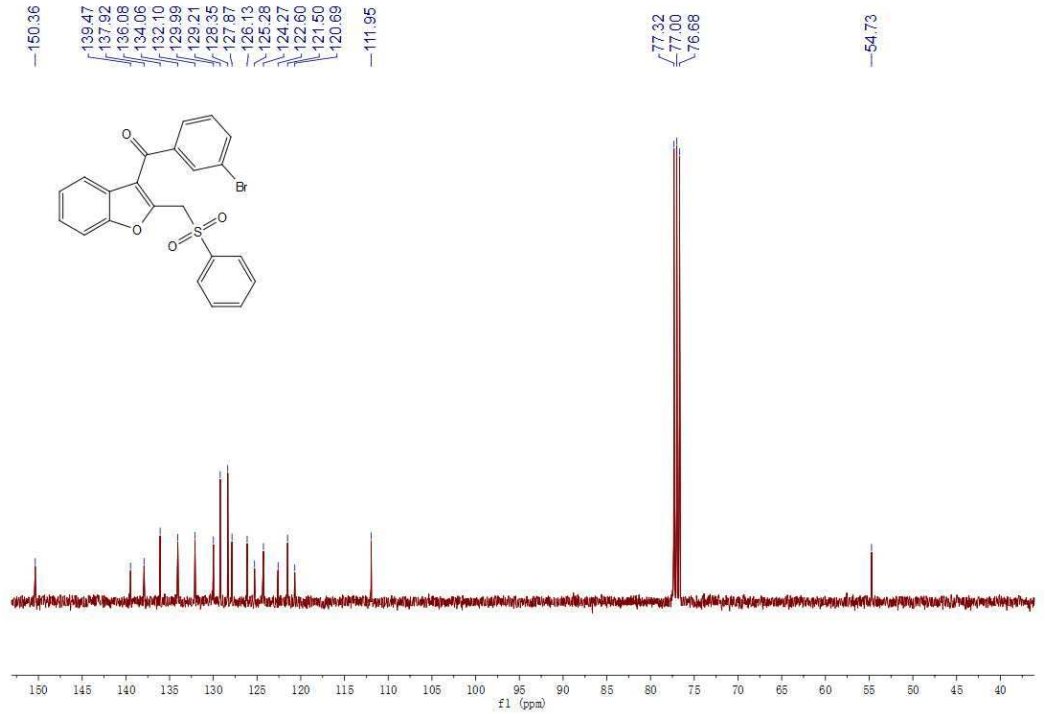
^{13}C NMR for Compound **3ja**:



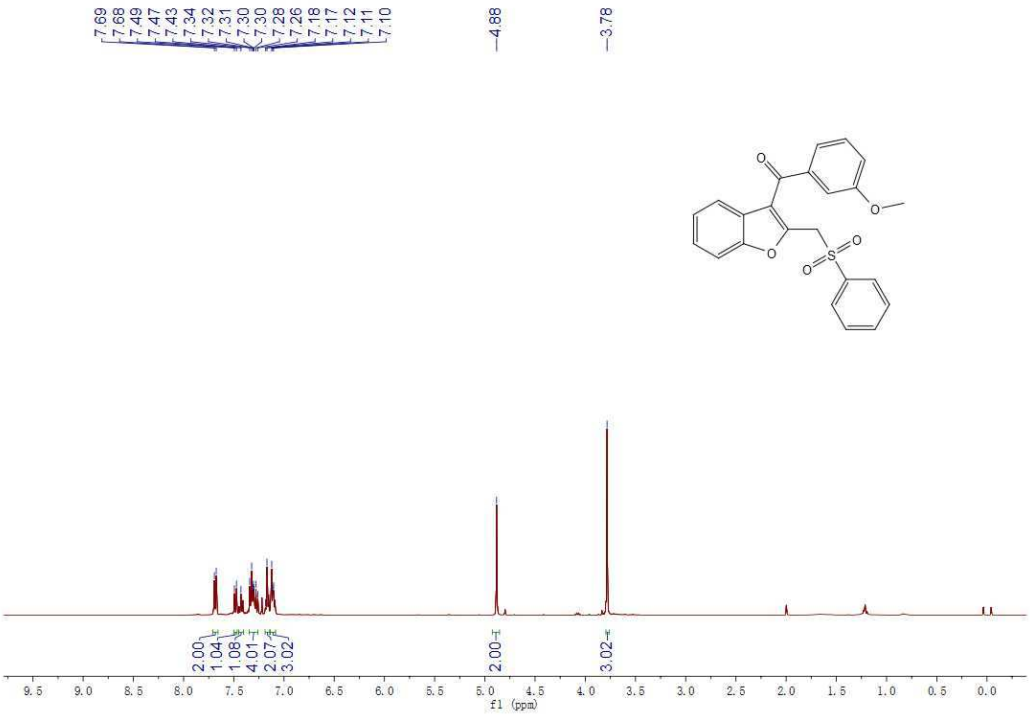
^{1}H NMR for Compound **3ka**:



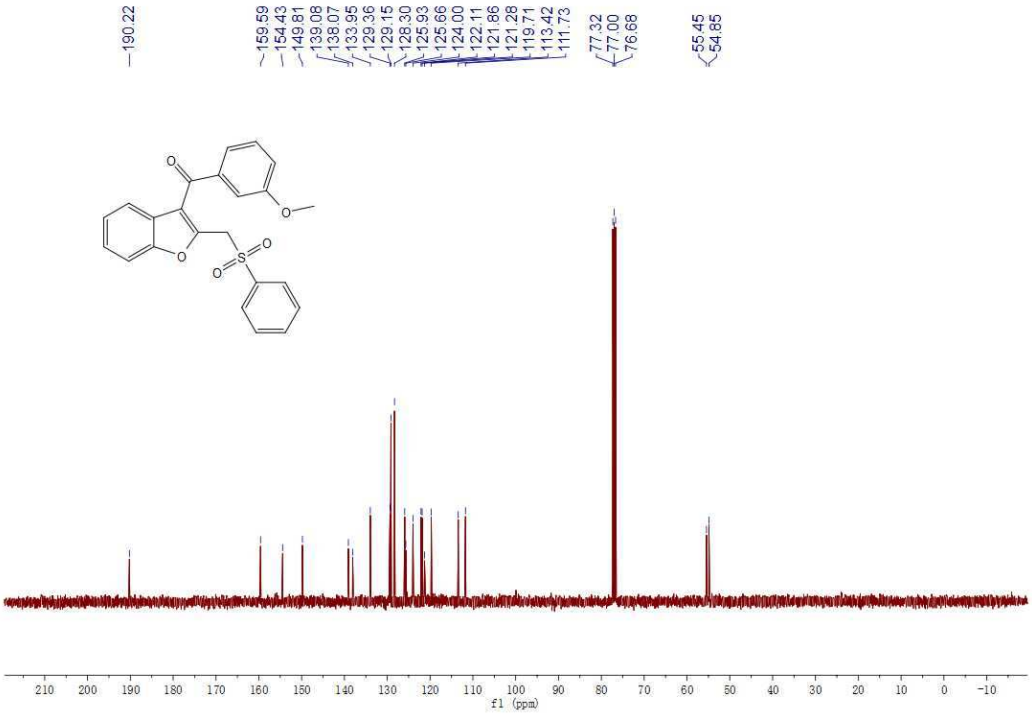
^{13}C NMR for Compound **3ka**:



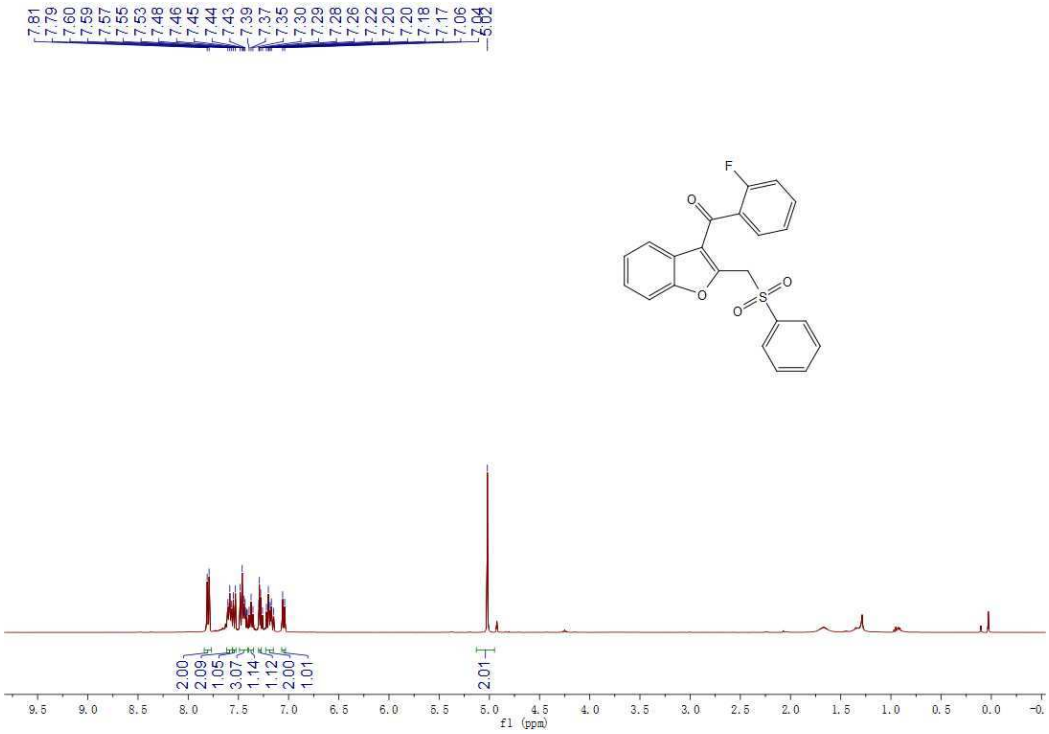
^{1}H NMR for Compound **3la**:



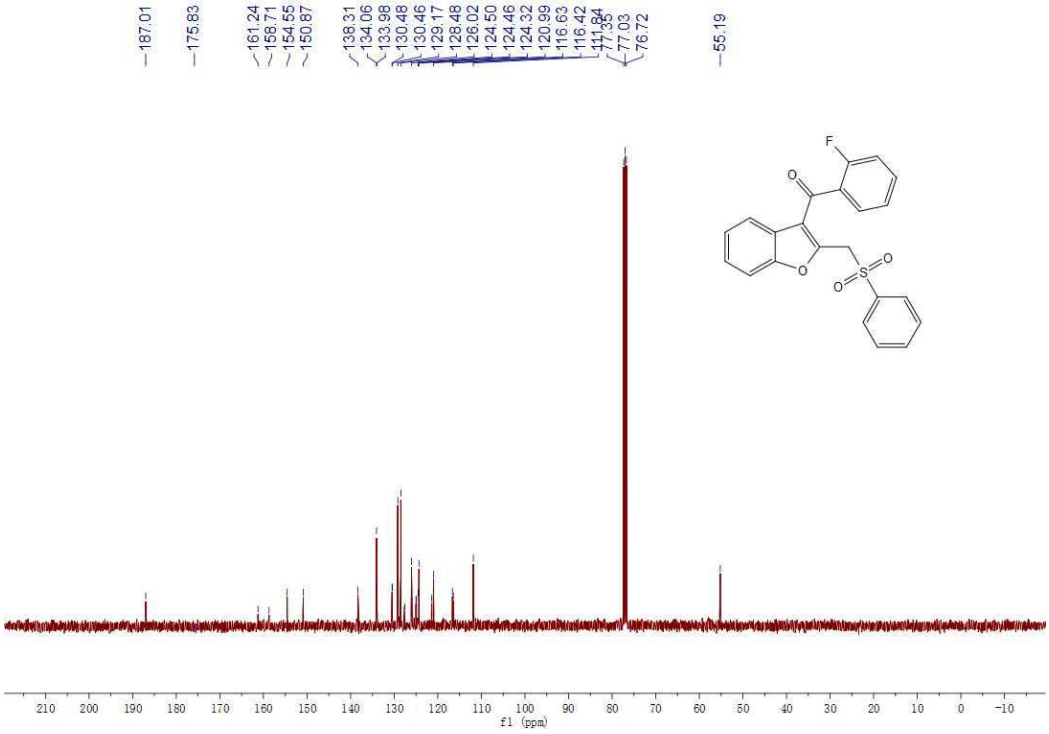
^{13}C NMR for Compound **3la**:



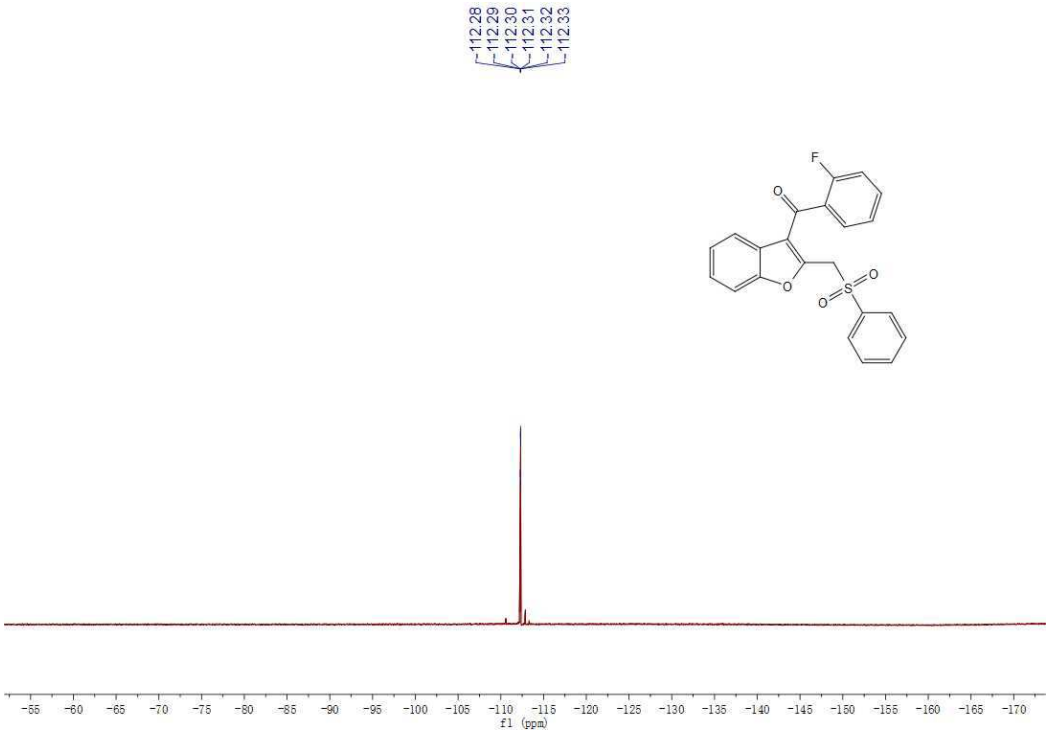
^{1}H NMR for Compound **3ma**:



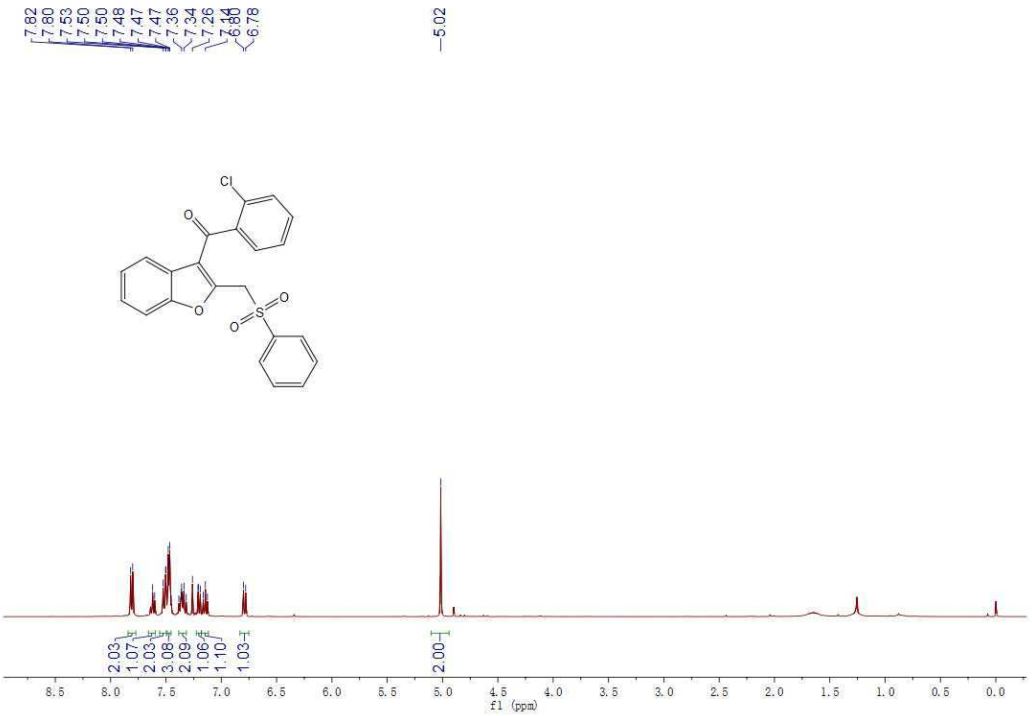
^{13}C NMR for Compound **3ma**:



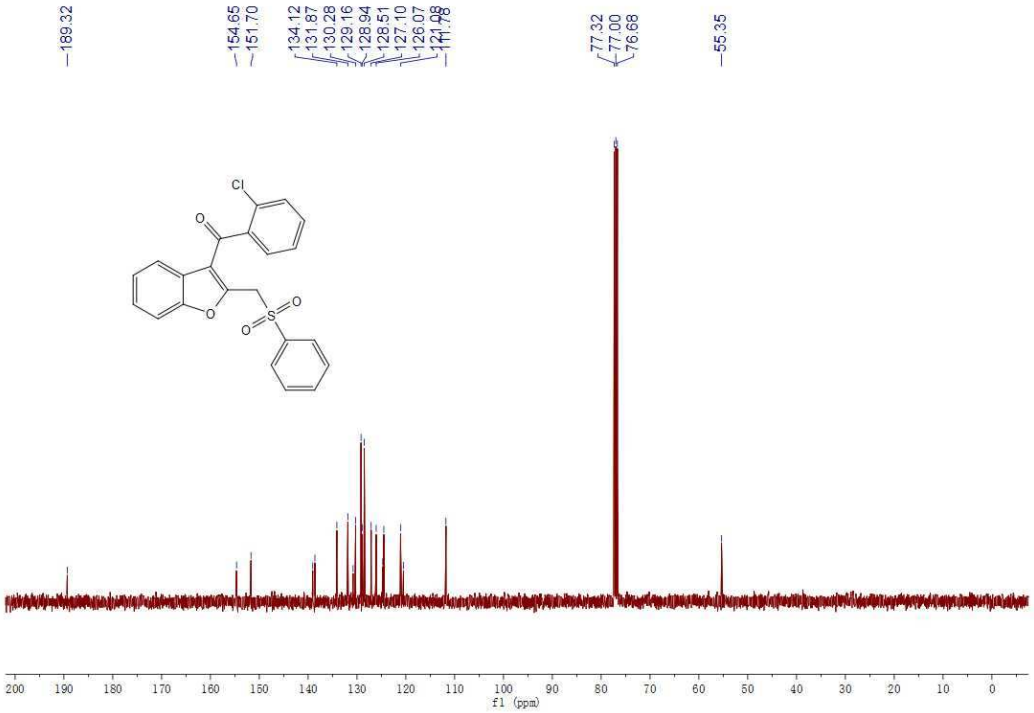
^{19}F NMR for Compound **3na**:



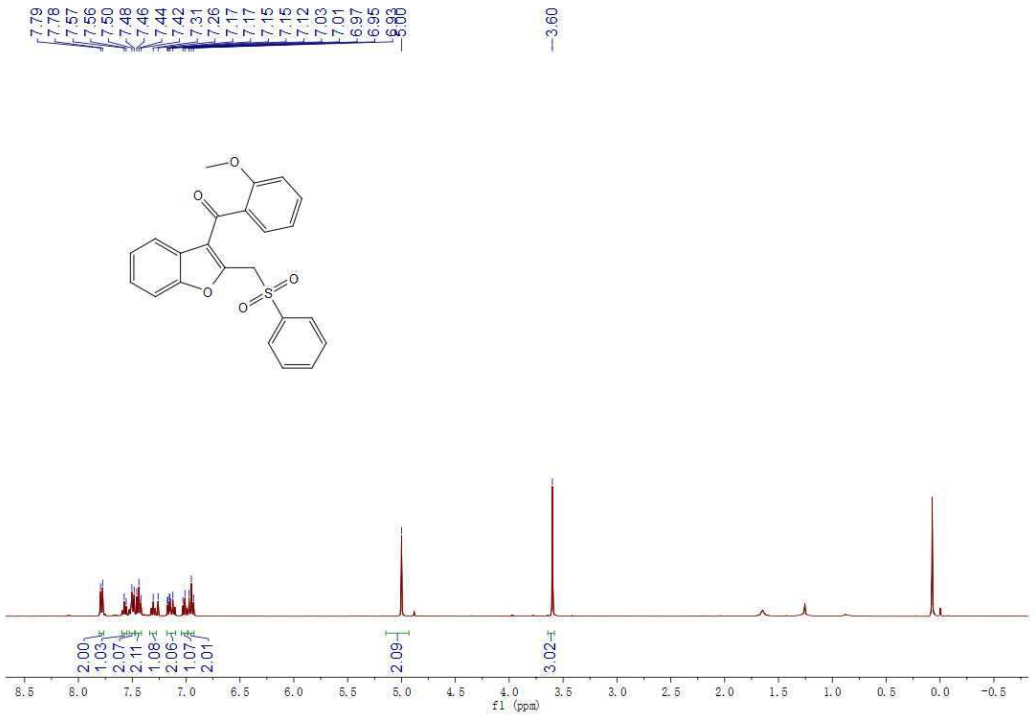
^{1}H NMR for Compound **3na**:



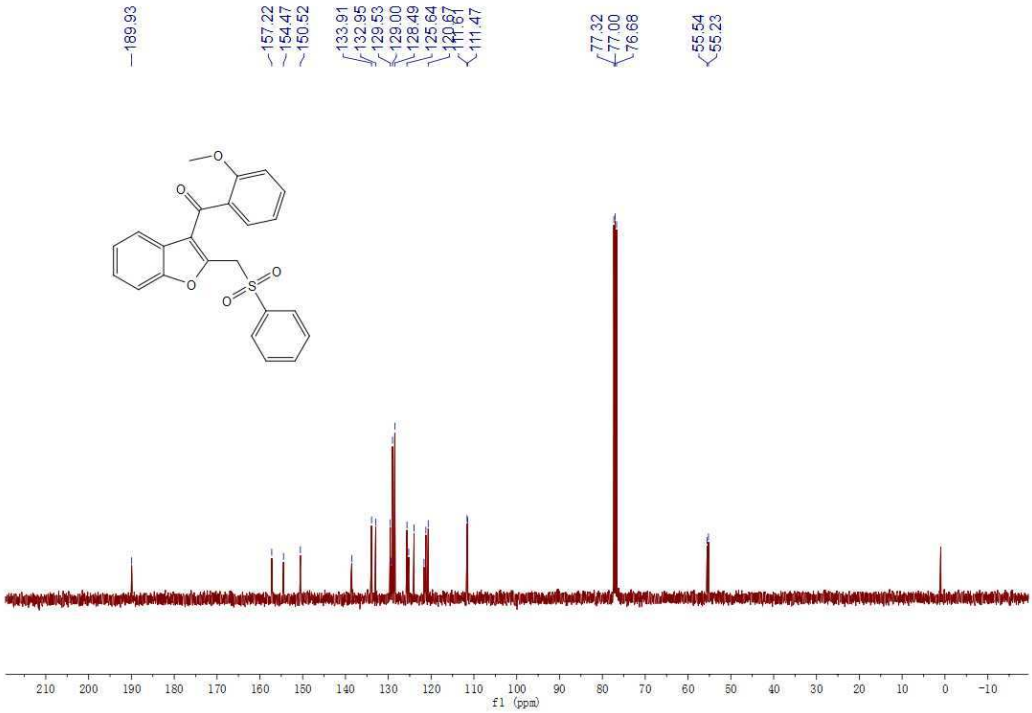
^{13}C NMR for Compound **3na**:



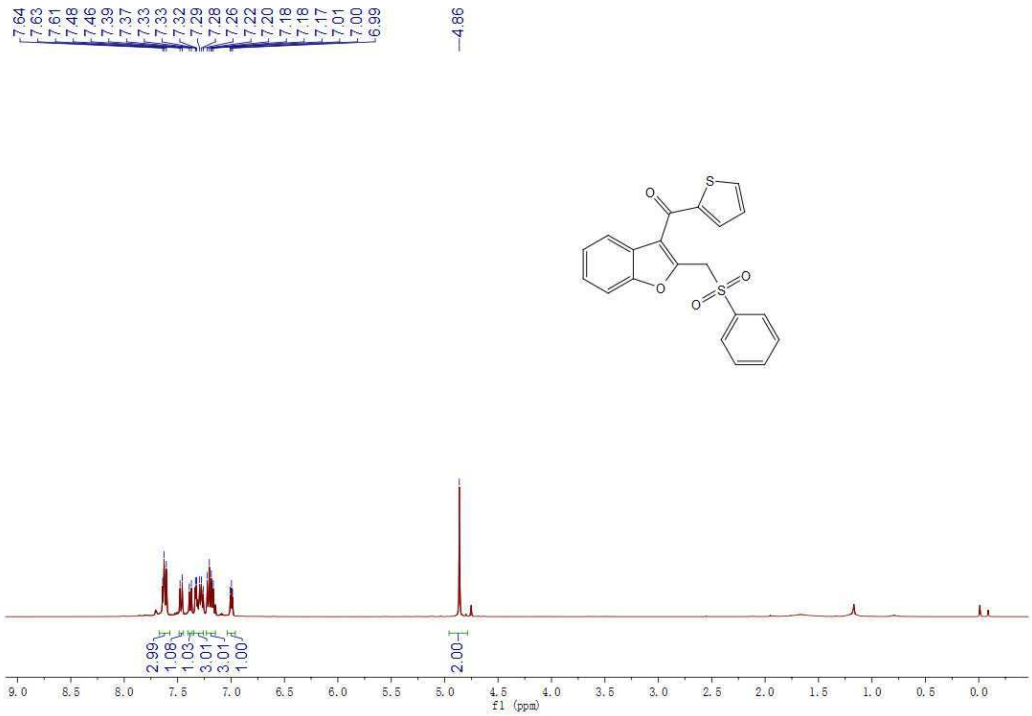
^{1}H NMR for Compound **3oa**:



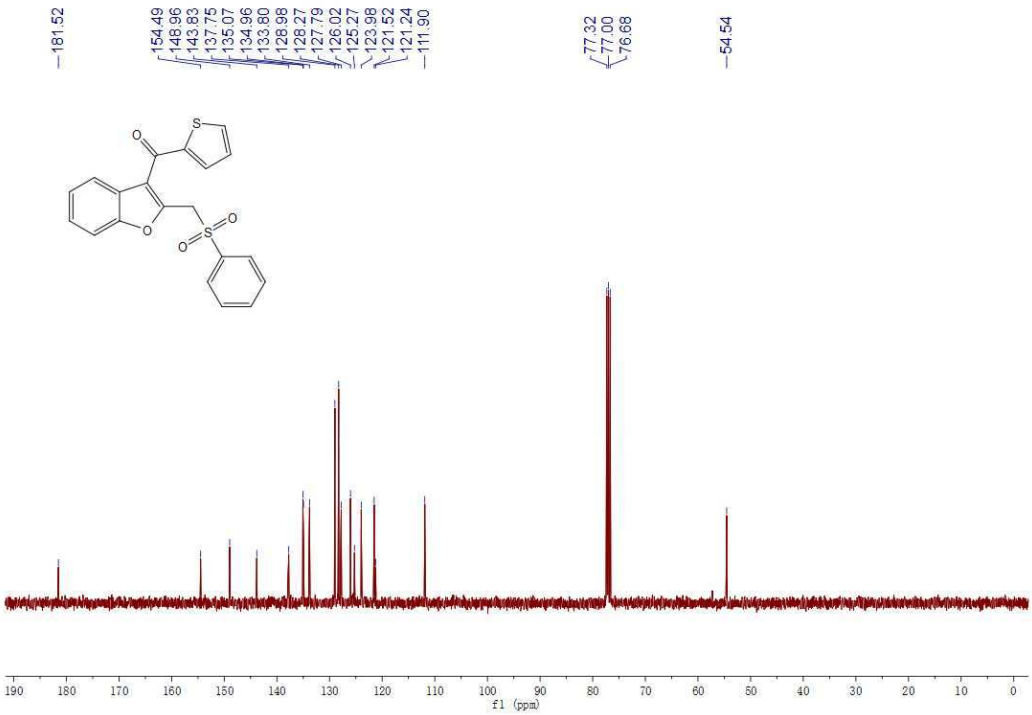
^{13}C NMR for Compound **3oa**:



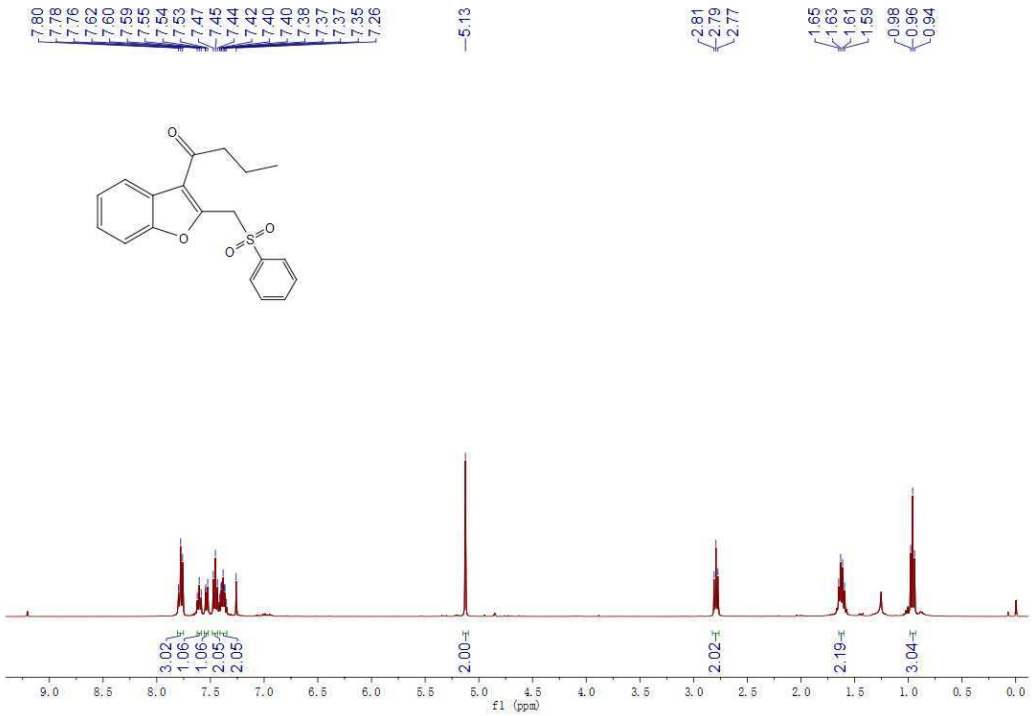
^{1}H NMR for Compound **3pa**:



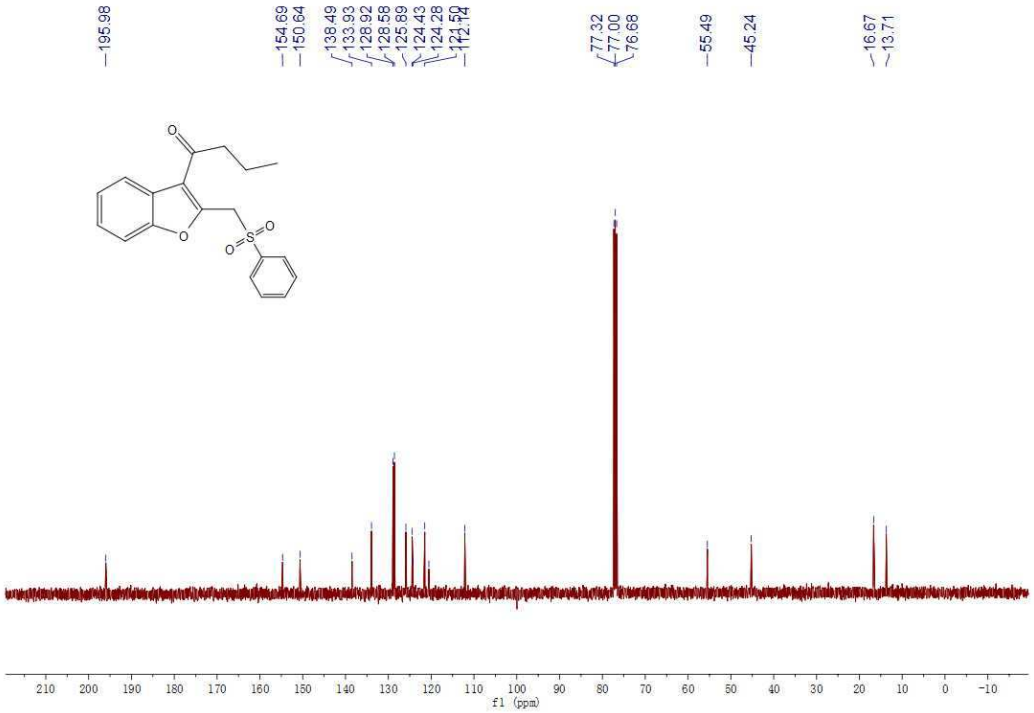
^{13}C NMR for Compound **3pa**:



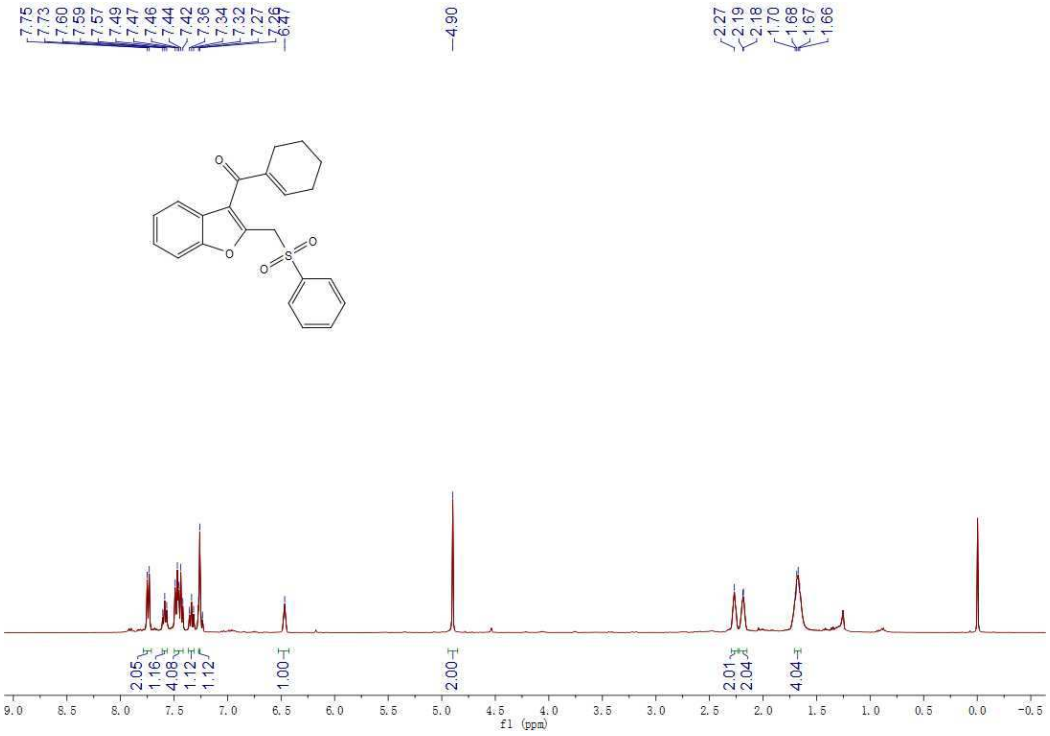
^{1}H NMR for Compound **3qa**:



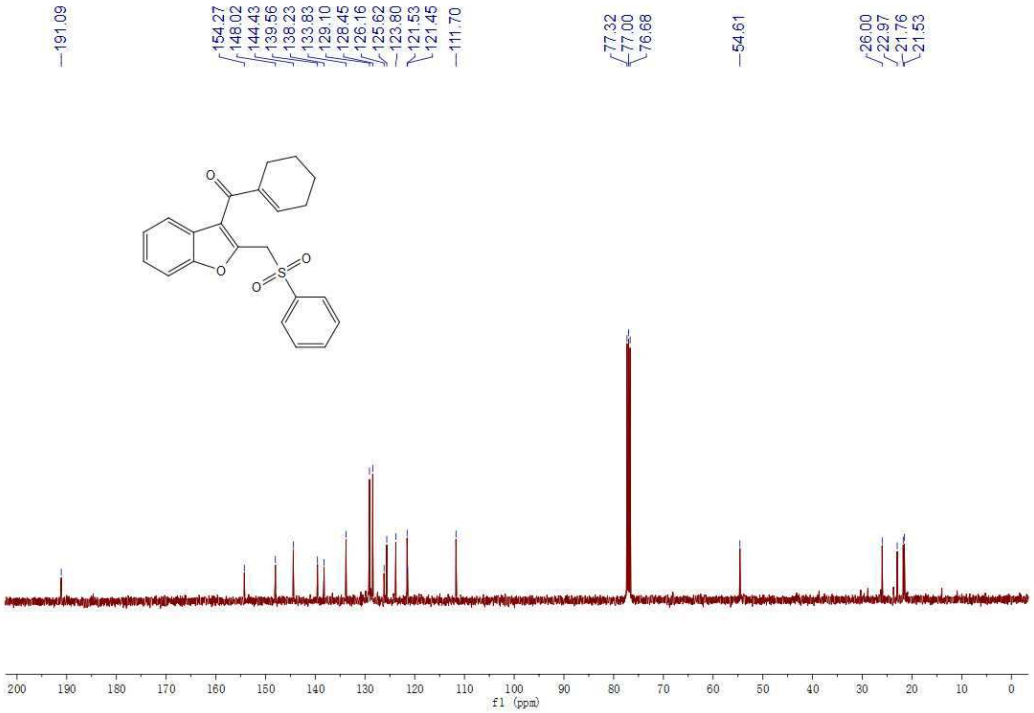
^{13}C NMR for Compound **3qa**:



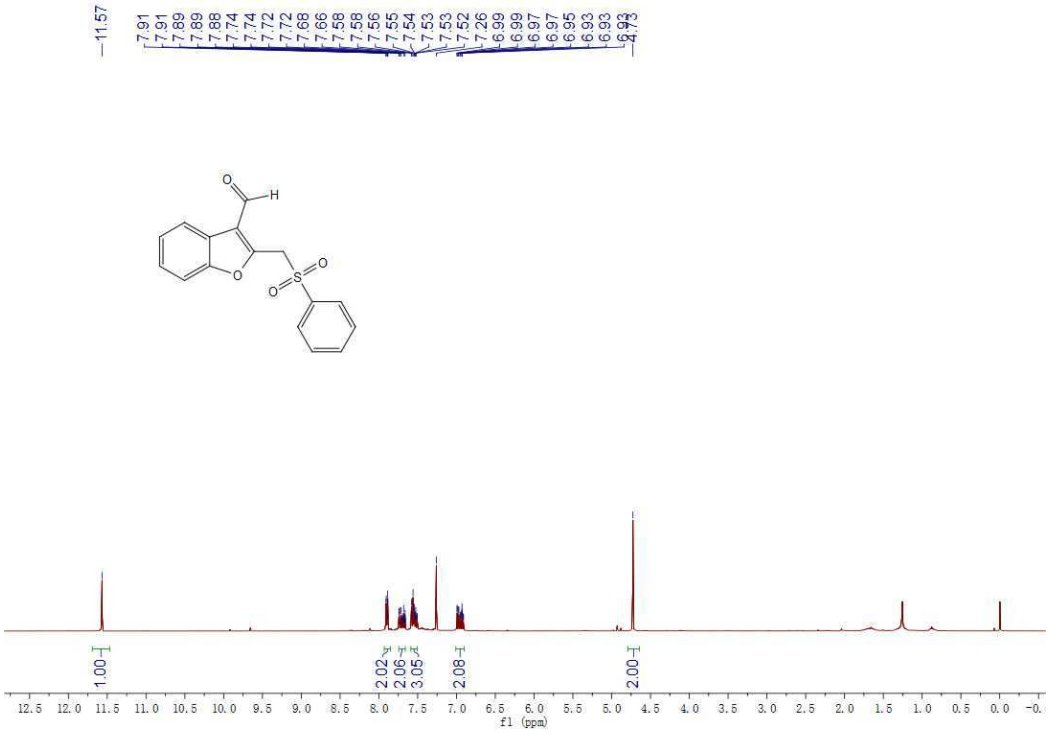
^{1}H NMR for Compound **3ra**:



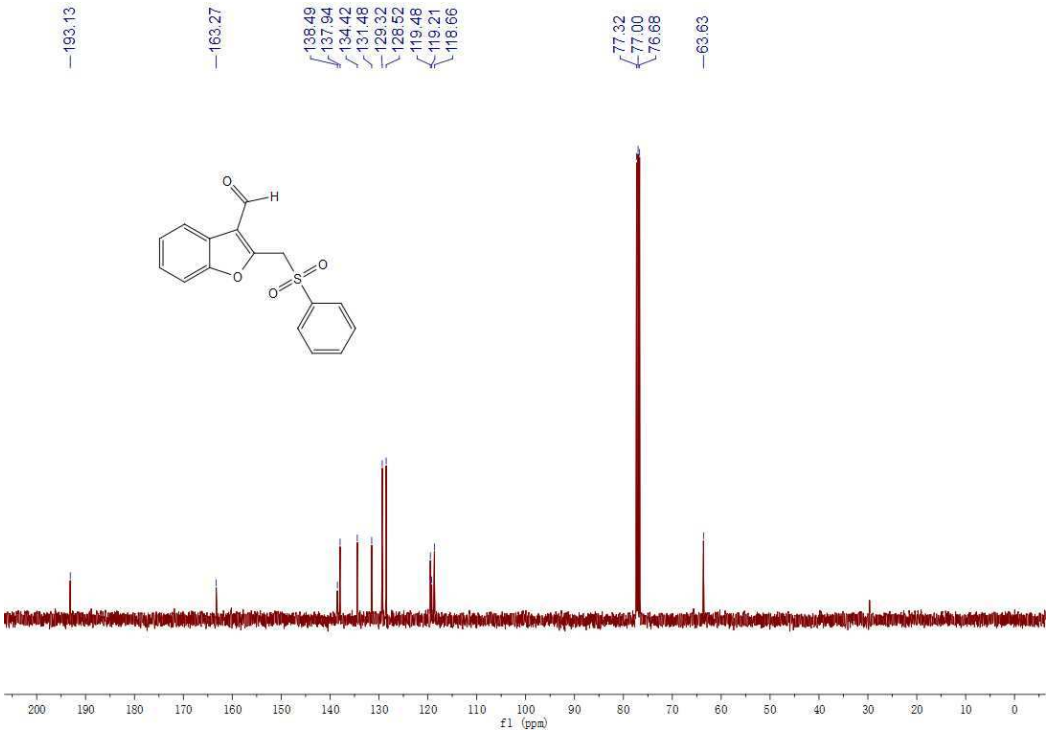
^{13}C NMR for Compound **3ra**:



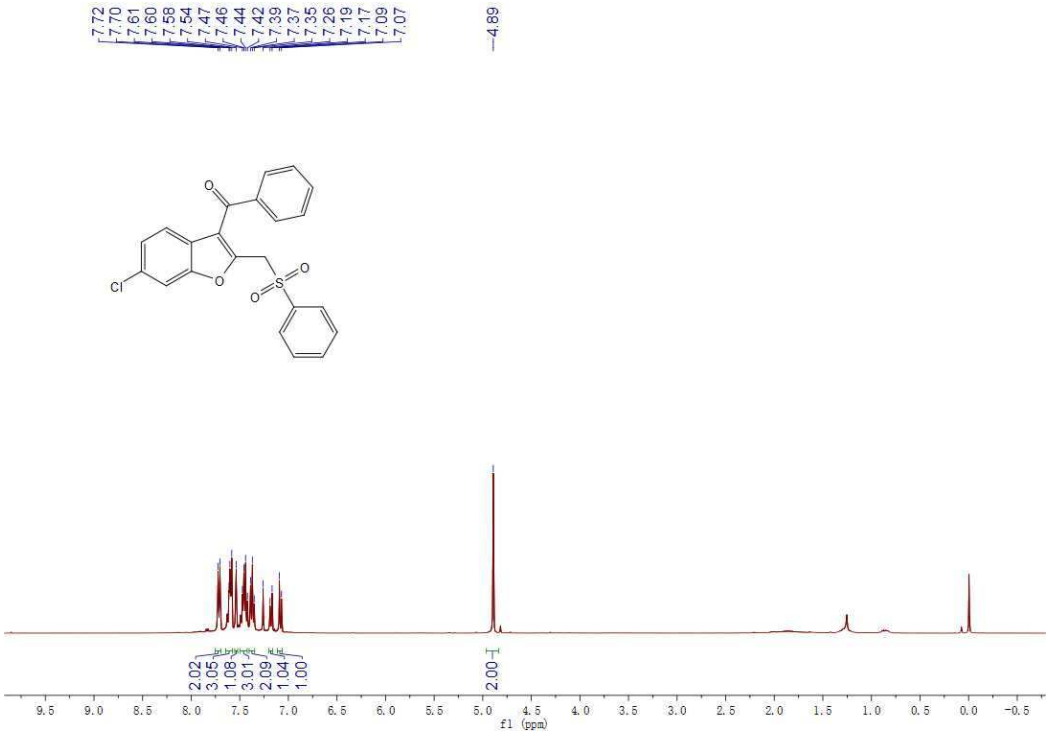
^{1}H NMR for Compound **3sa**:



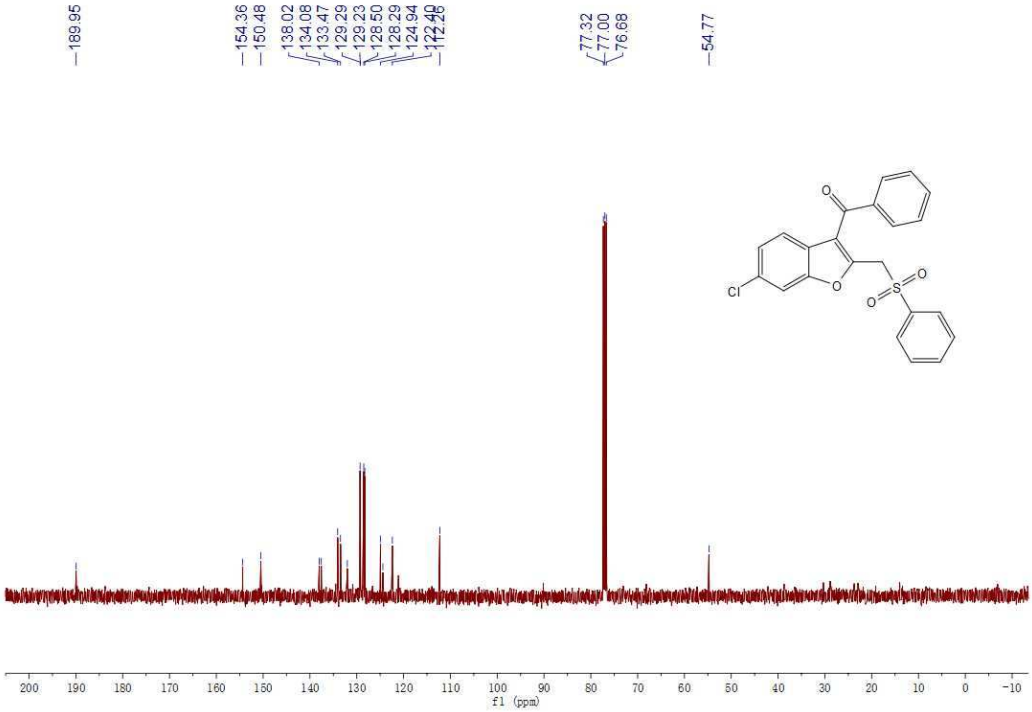
^{13}C NMR for Compound **3sa**:



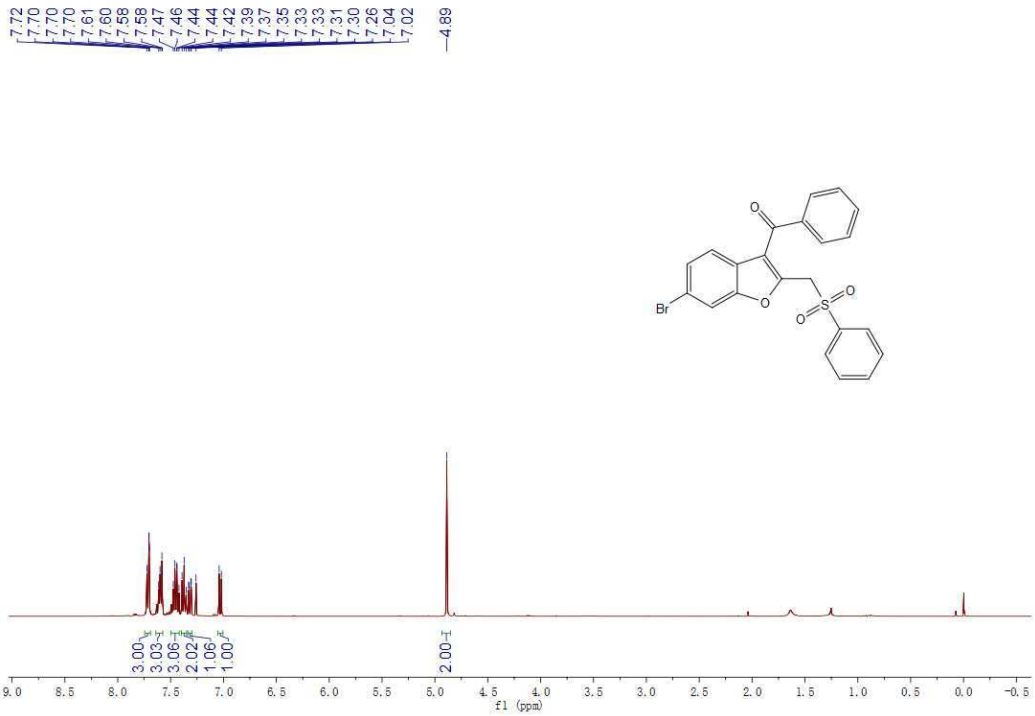
^{1}H NMR for Compound **3ta**:



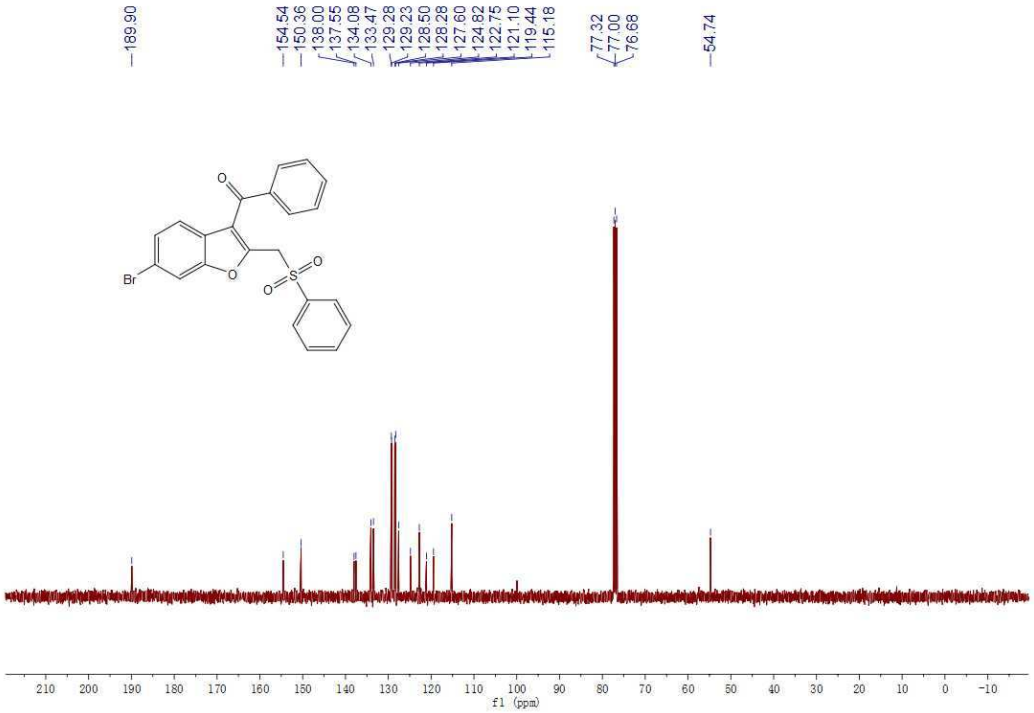
^{13}C NMR for Compound **3ta**:



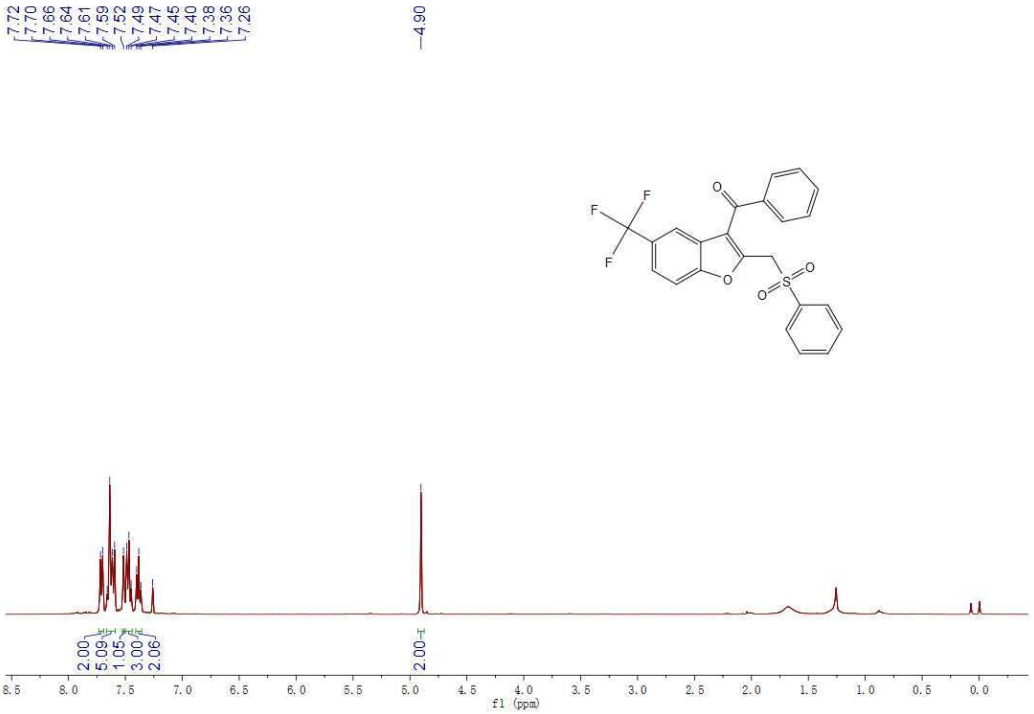
^{1}H NMR for Compound **3ua**:



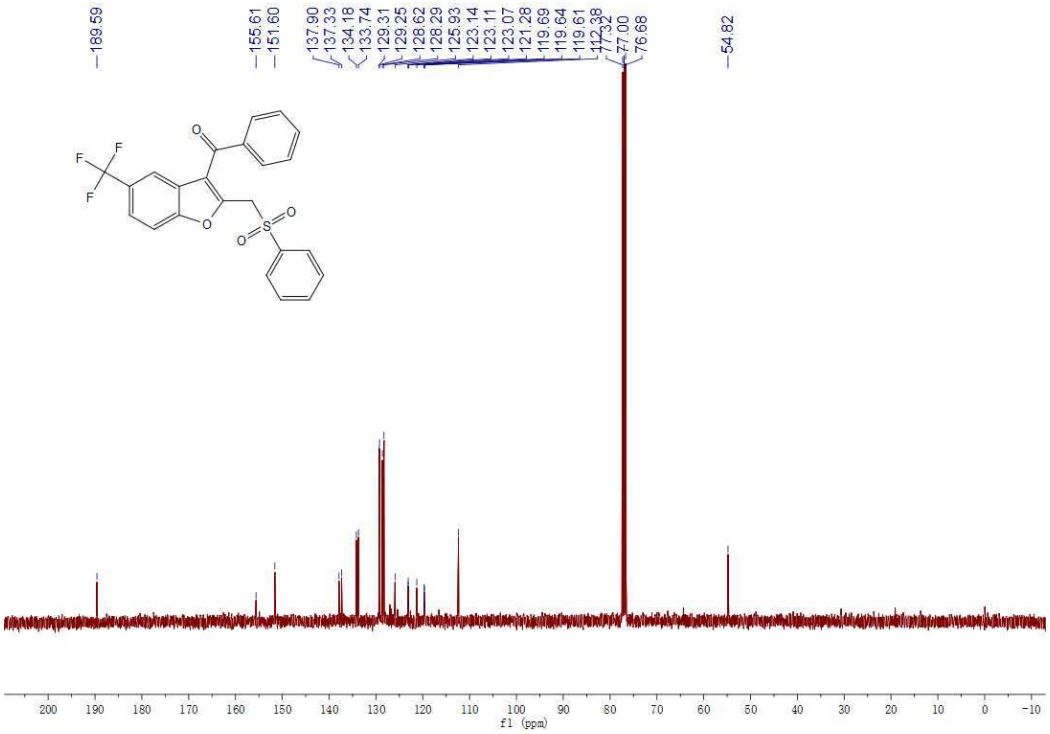
^{13}C NMR for Compound **3ua**:



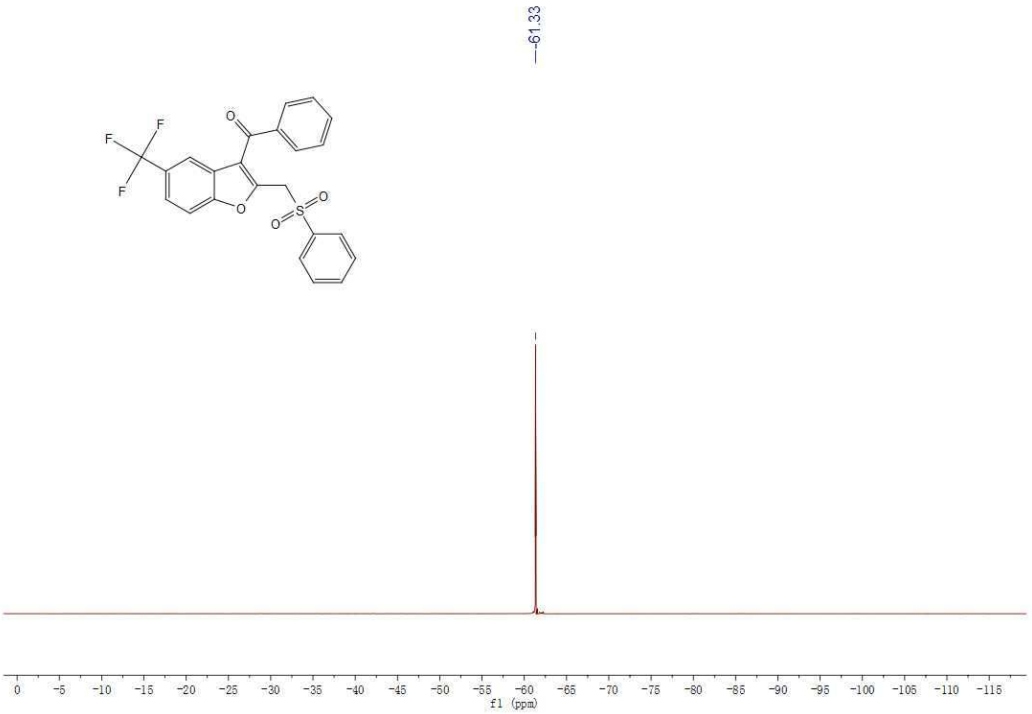
^{1}H NMR for Compound **3va**:



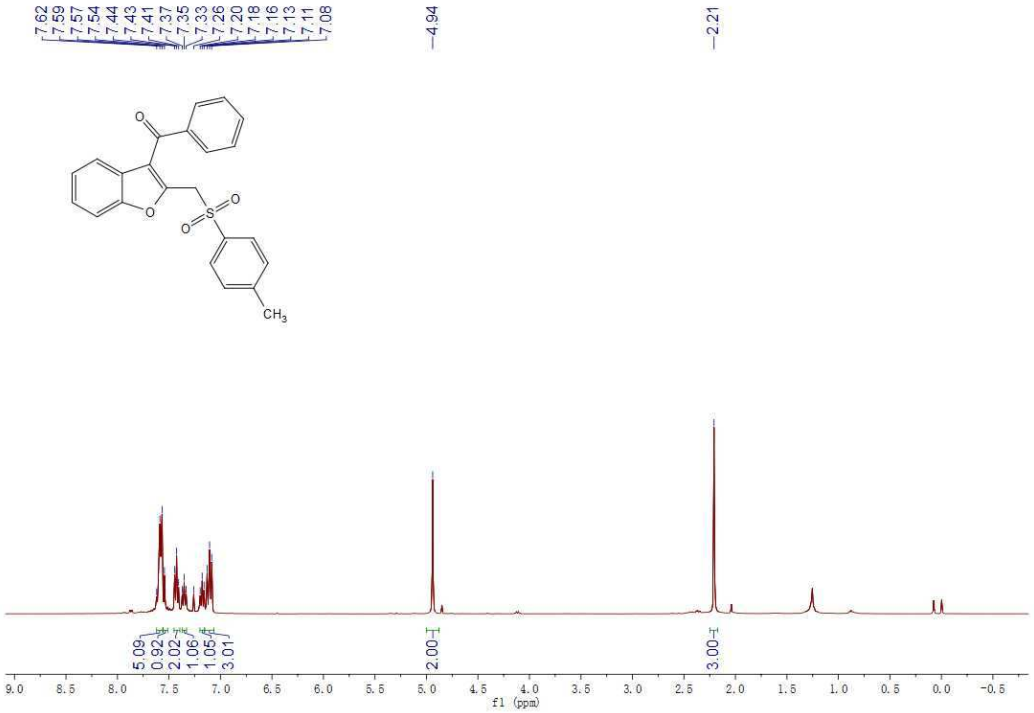
^{13}C NMR for Compound **3va**:



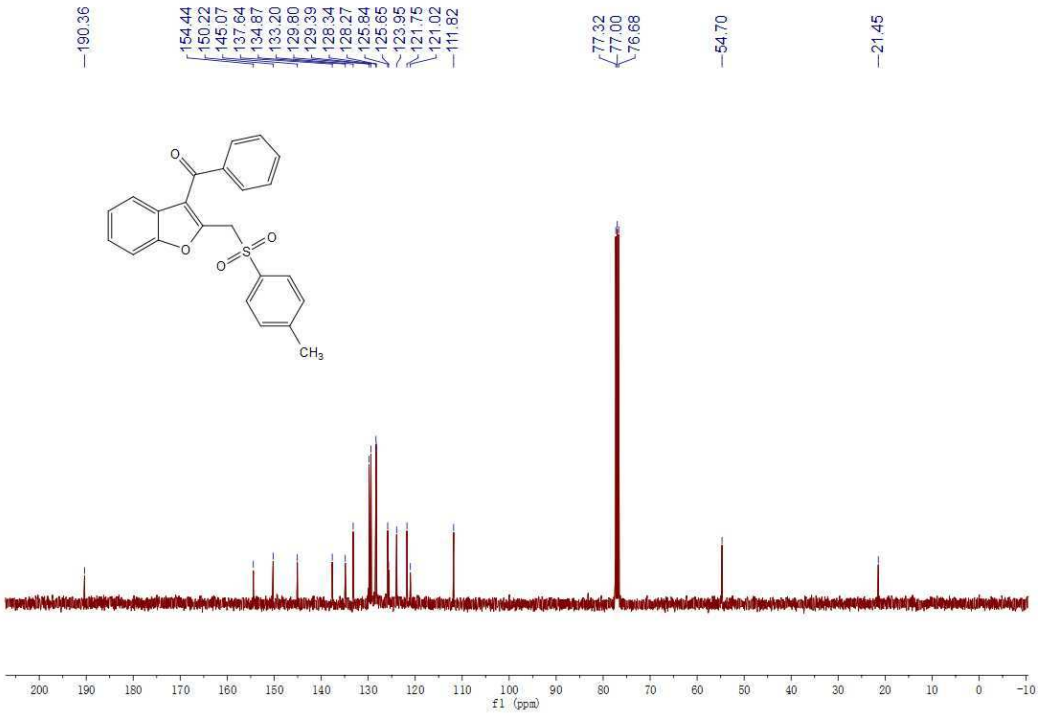
^{19}F NMR for Compound **3ua**:



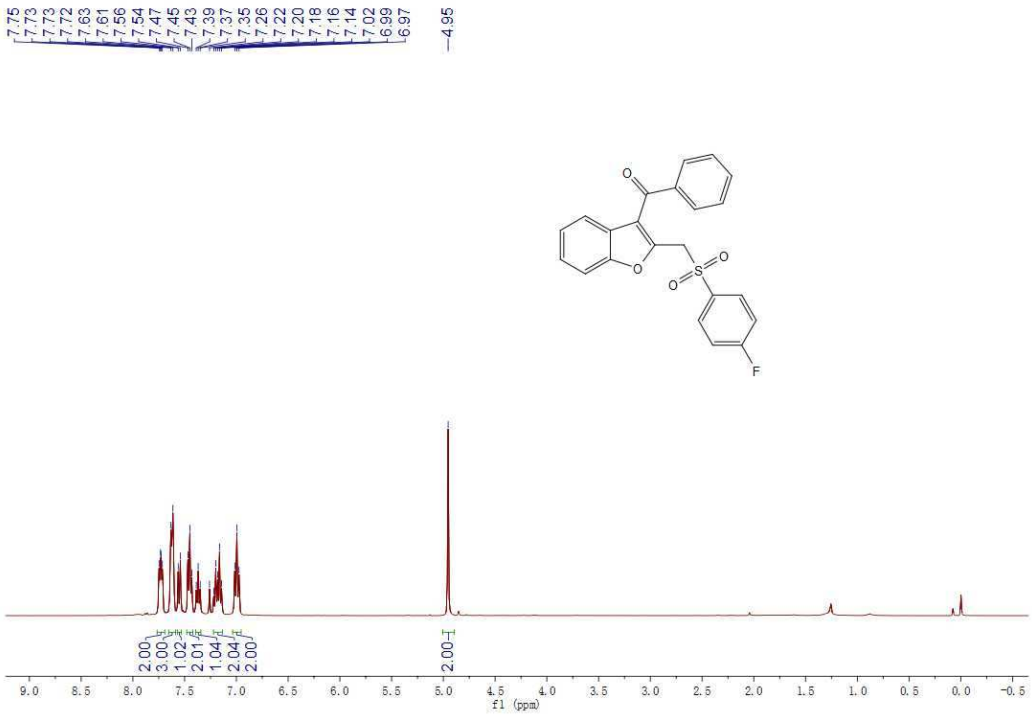
^{1}H NMR for Compound **3ab**:



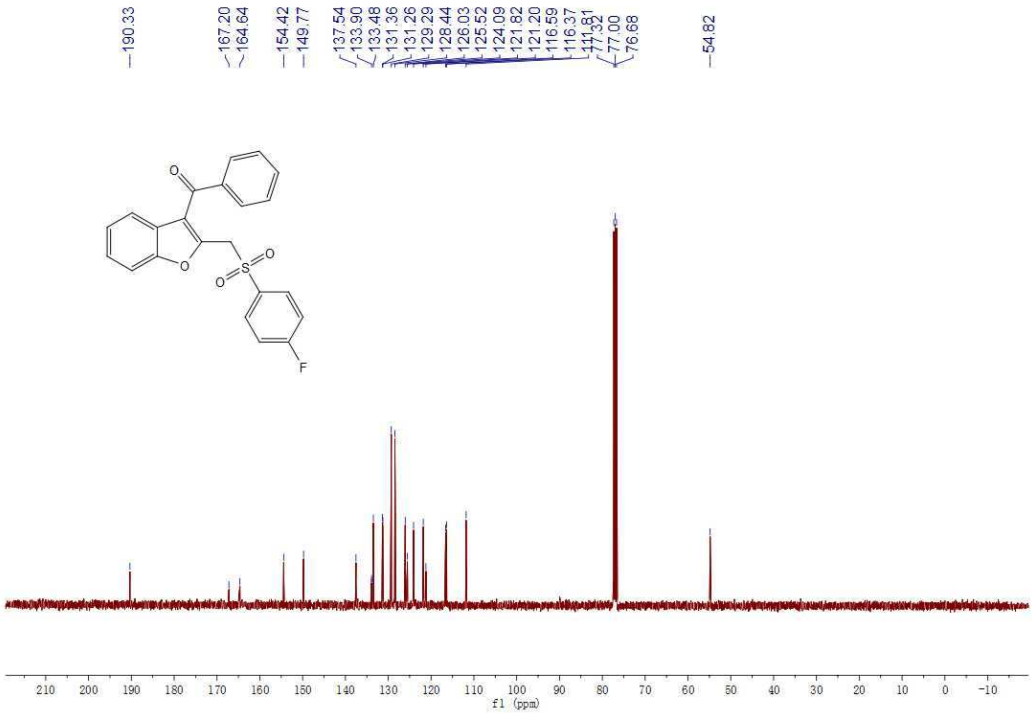
^{13}C NMR for Compound **3ab**:



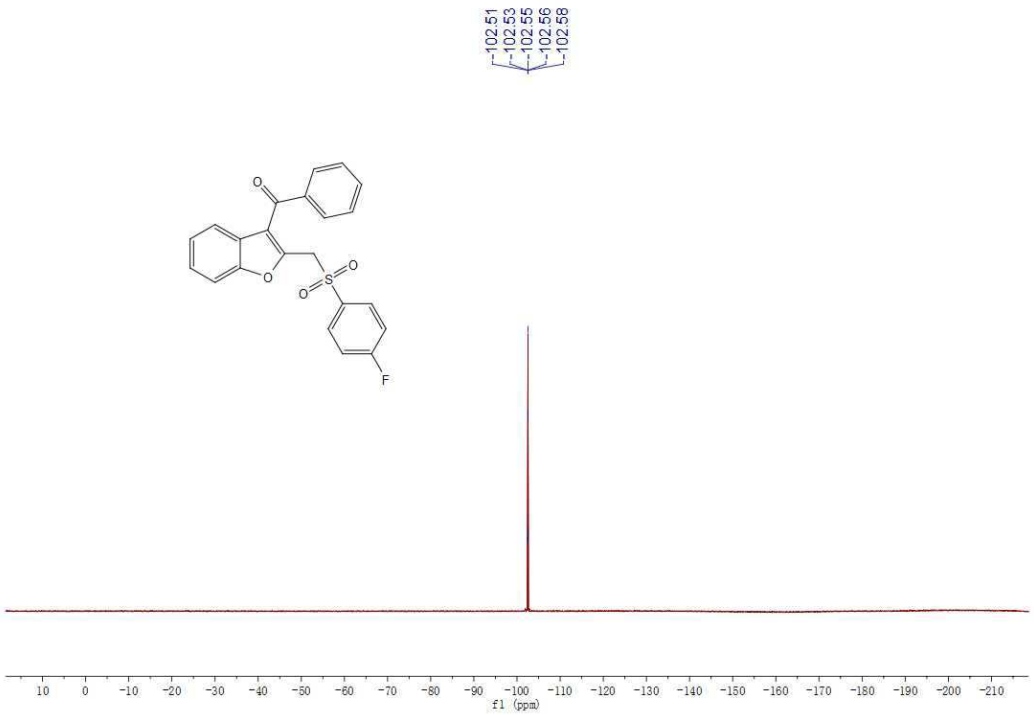
^{1}H NMR for Compound **3ac:**



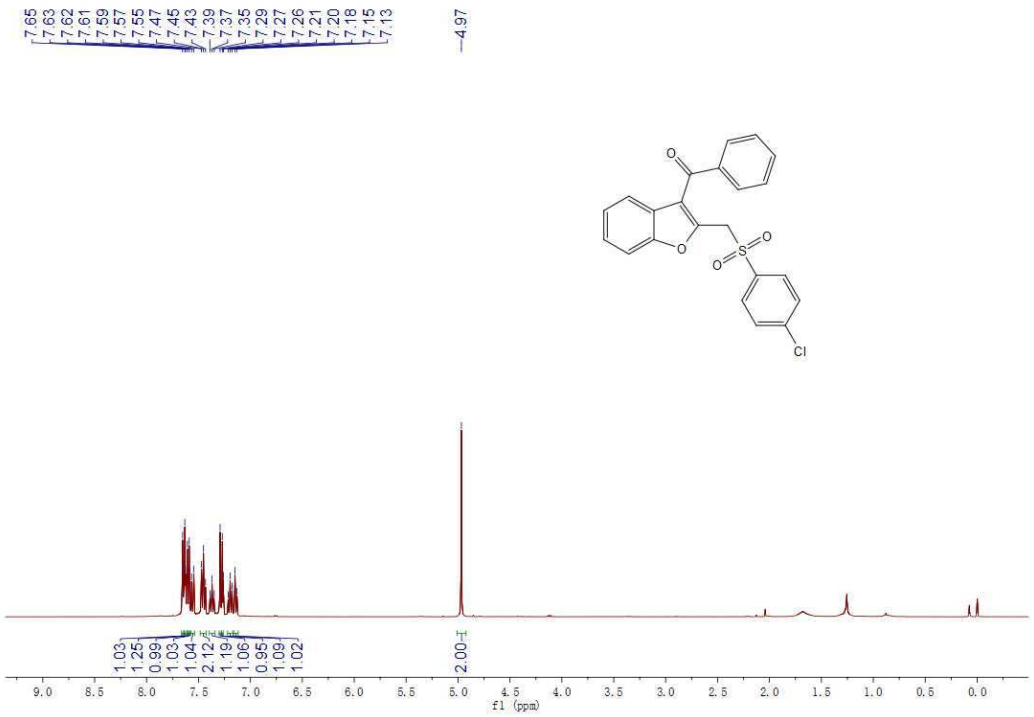
^{13}C NMR for Compound **3ac**:



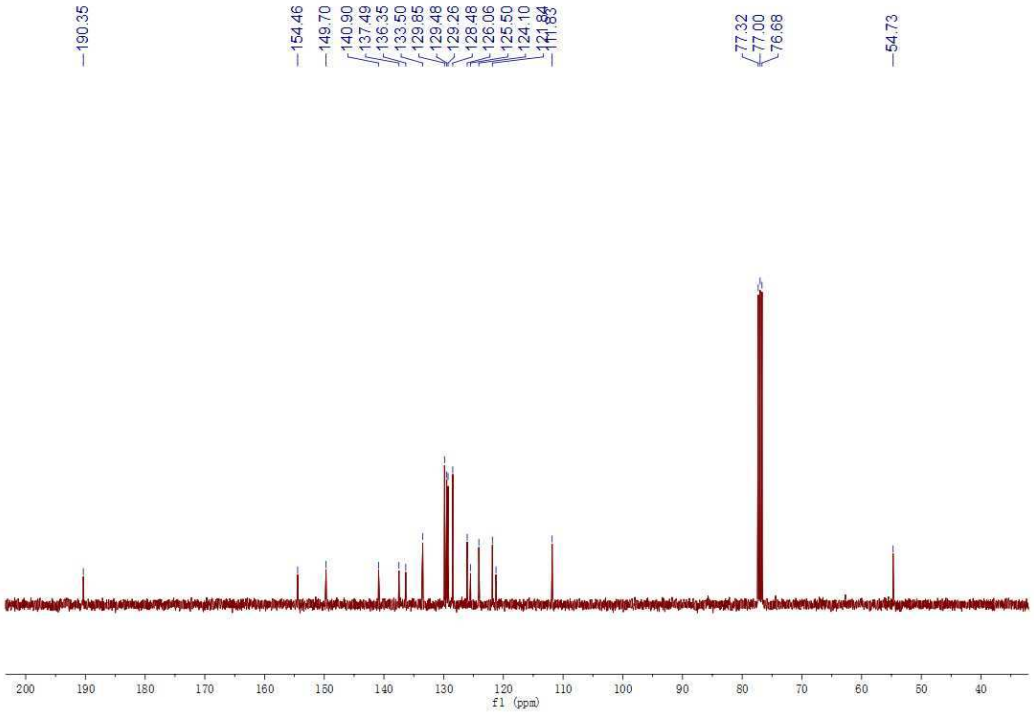
^{19}F NMR for Compound **3ac**:



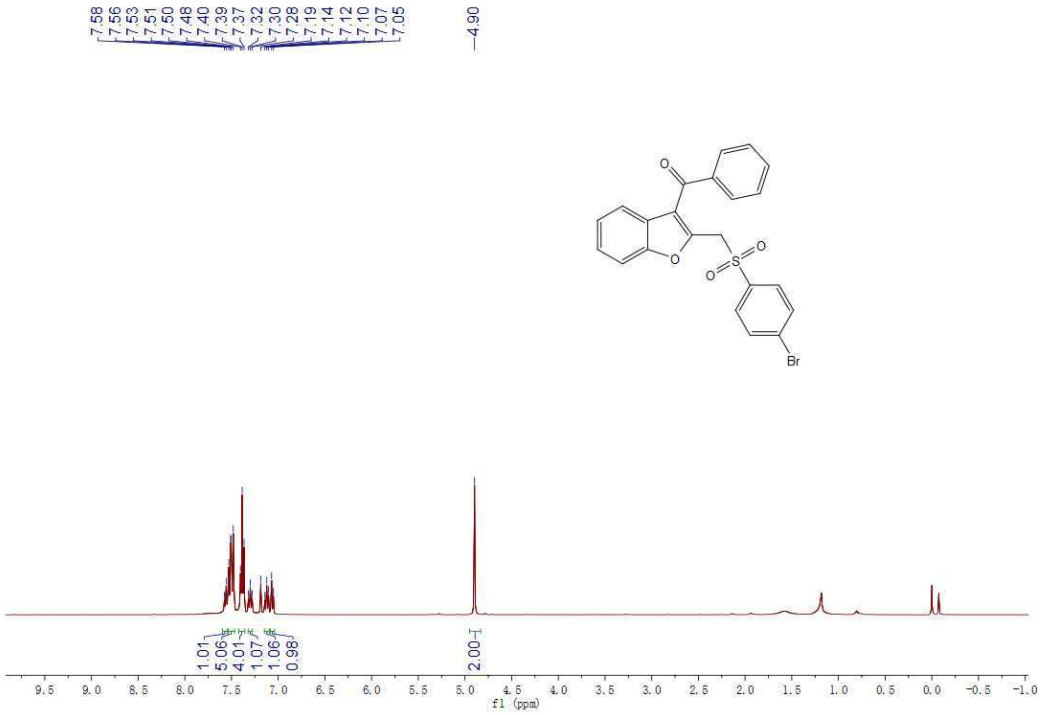
^{1}H NMR for Compound **3ad**:



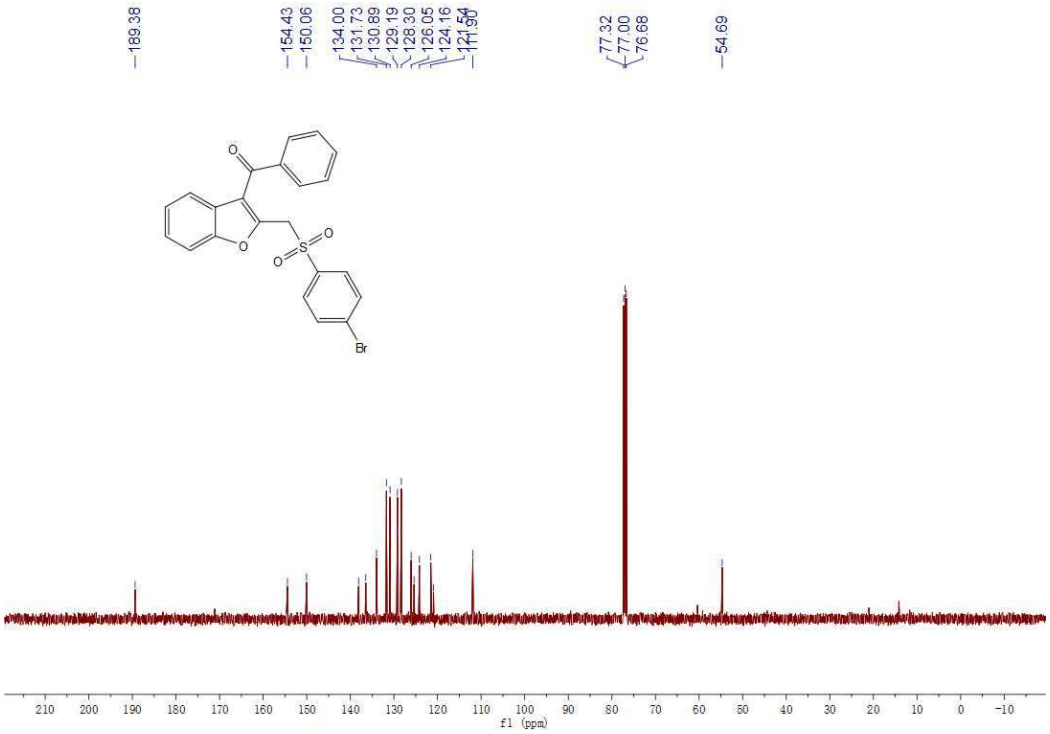
^{13}C NMR for Compound **3ad**:



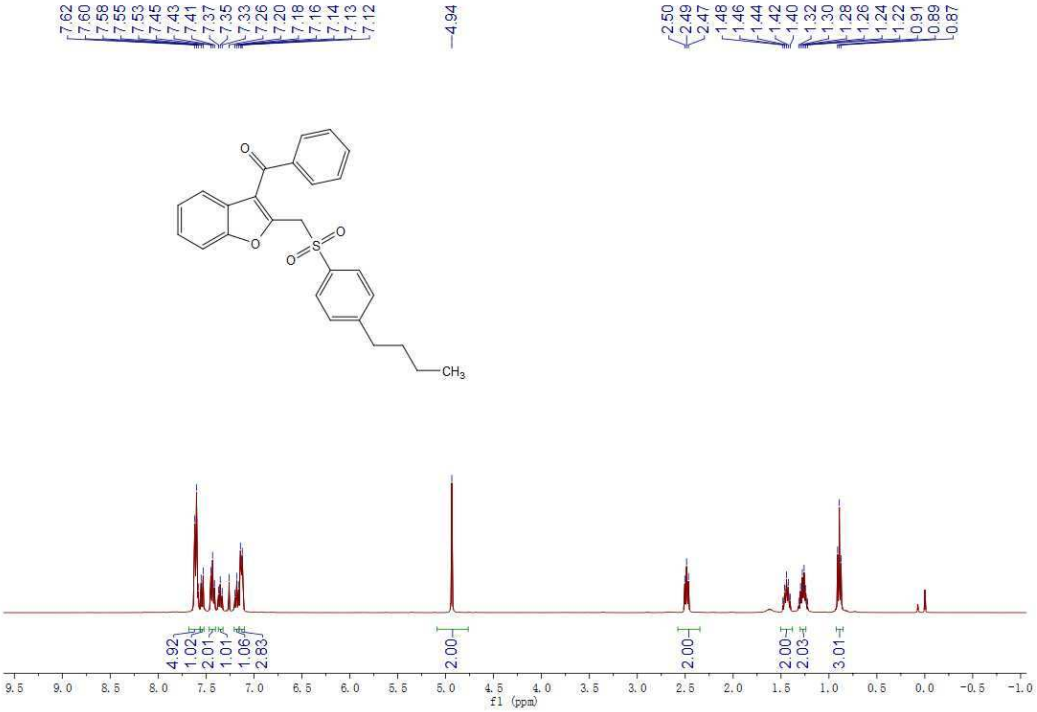
^{1}H NMR for Compound **3ae**:



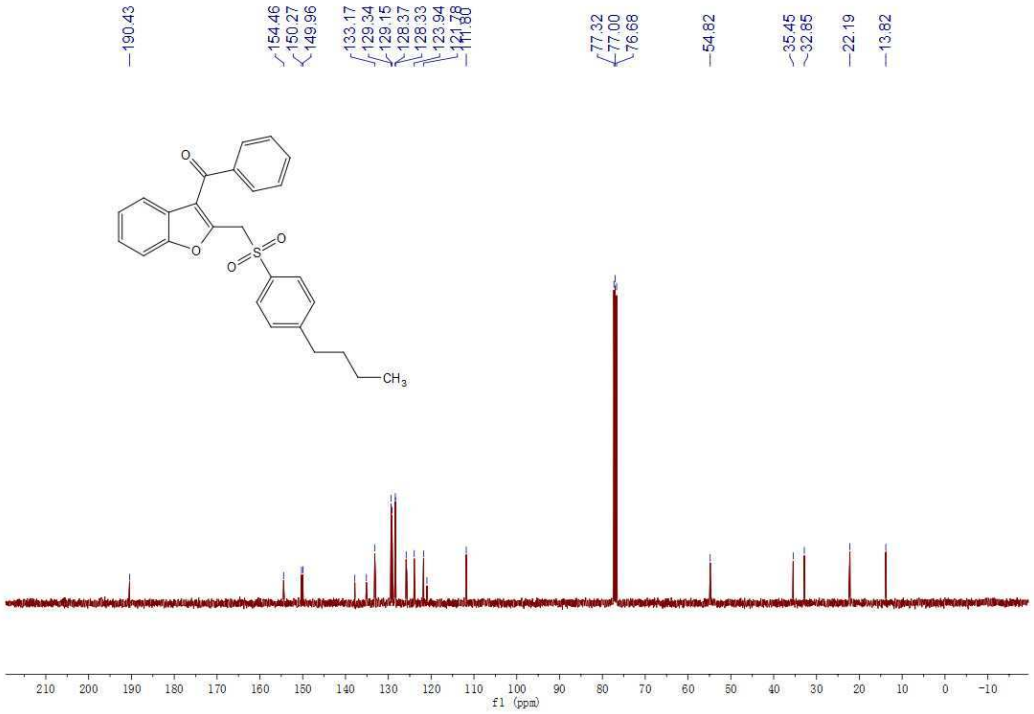
^{13}C NMR for Compound **3ae**:



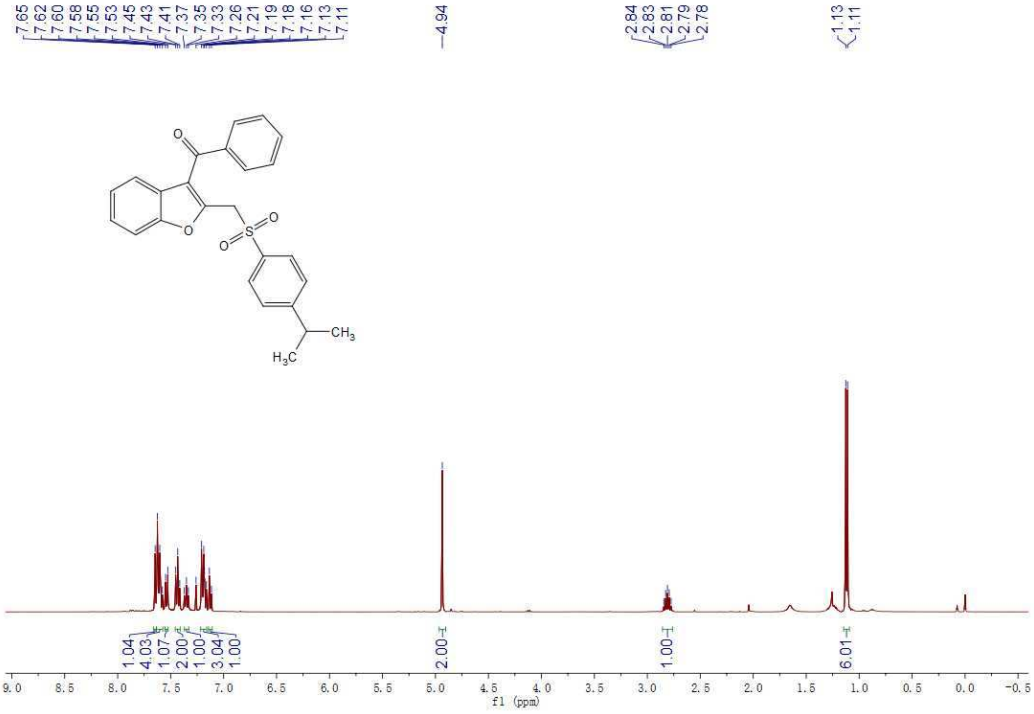
^{1}H NMR for Compound **3af**:



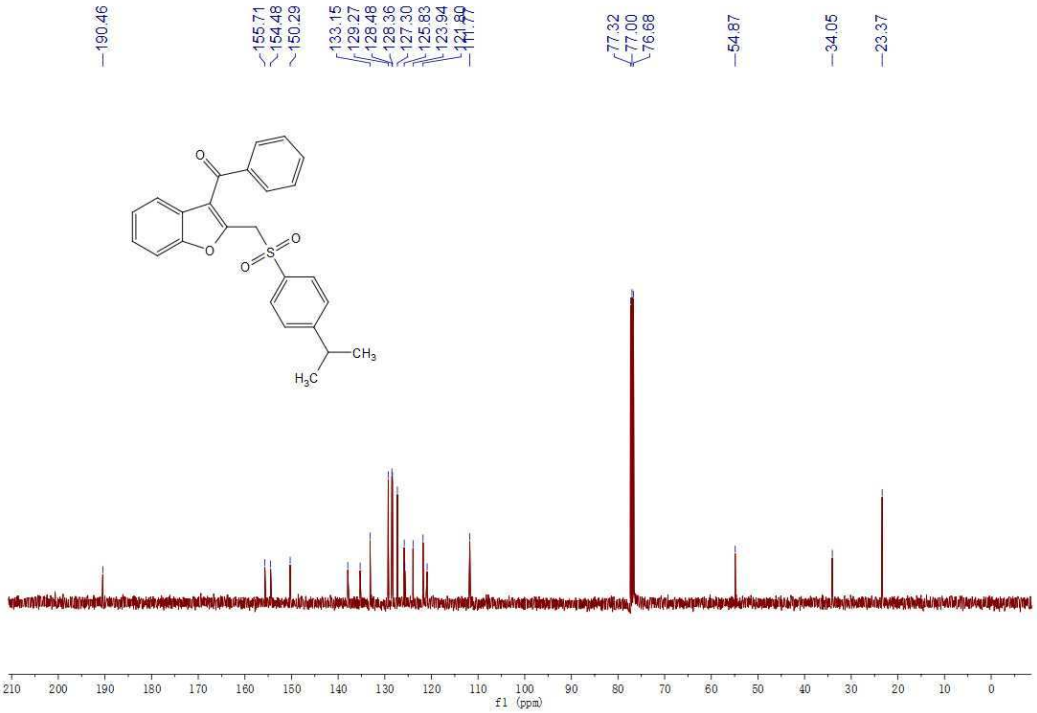
^{13}C NMR for Compound **3af**:



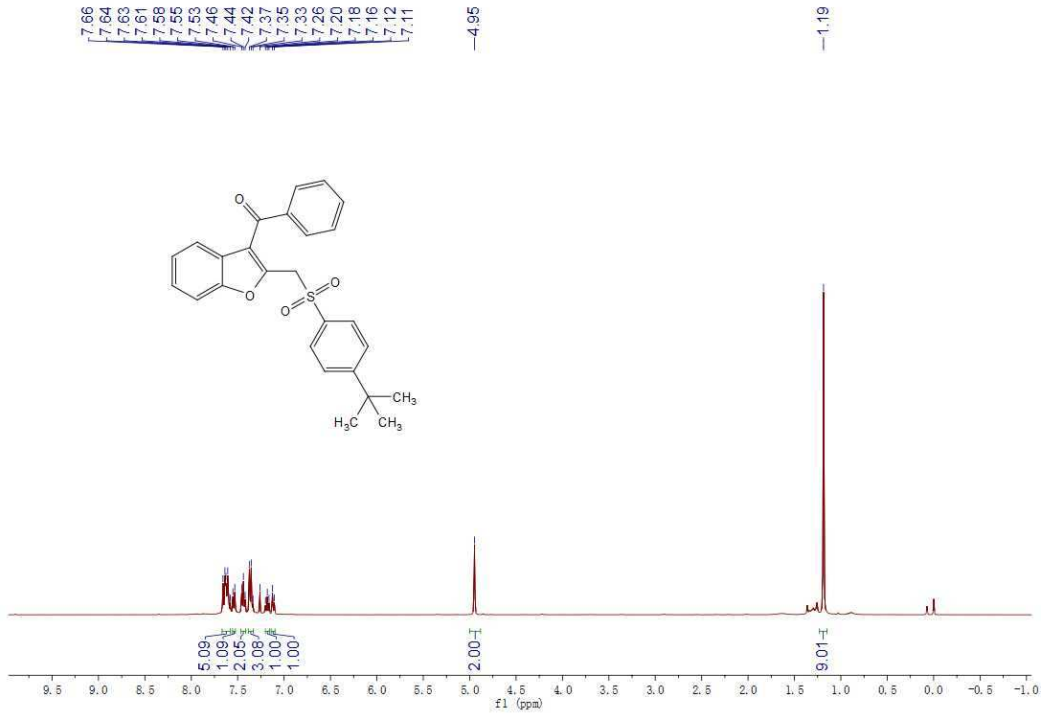
^{1}H NMR for Compound **3ag**:



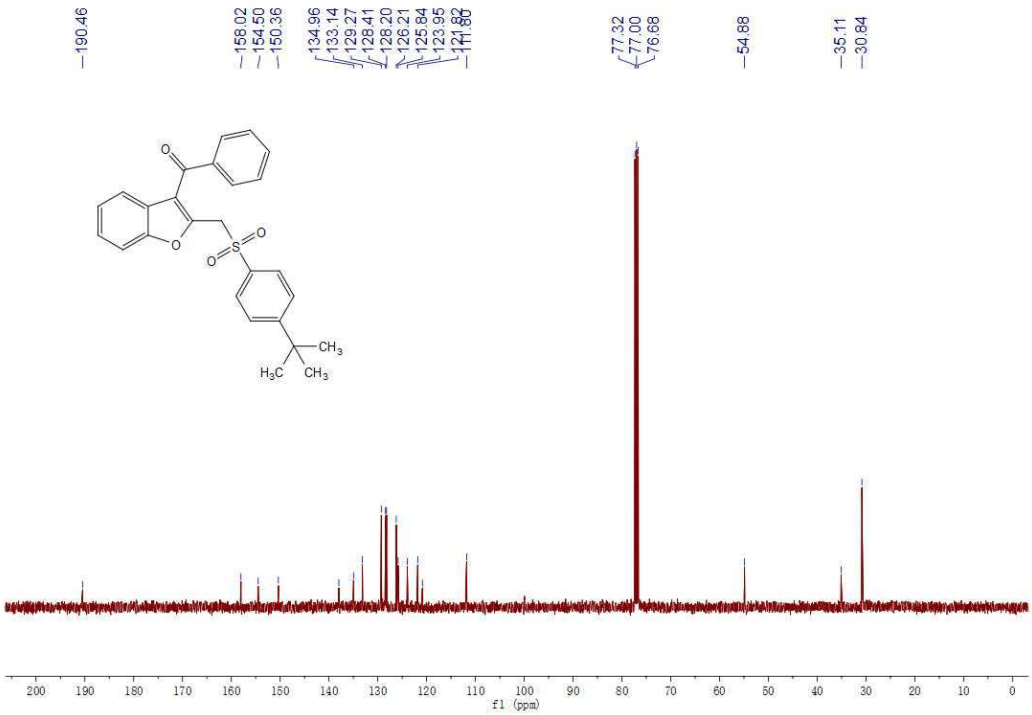
^{13}C NMR for Compound **3ag**:



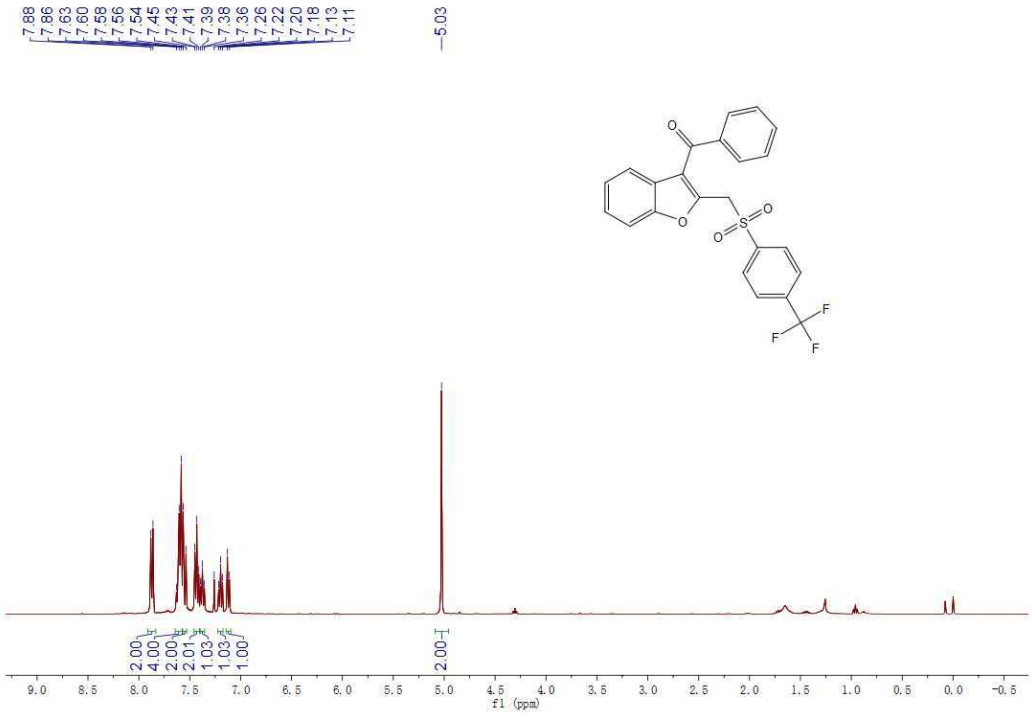
^{1}H NMR for Compound **3ah**:



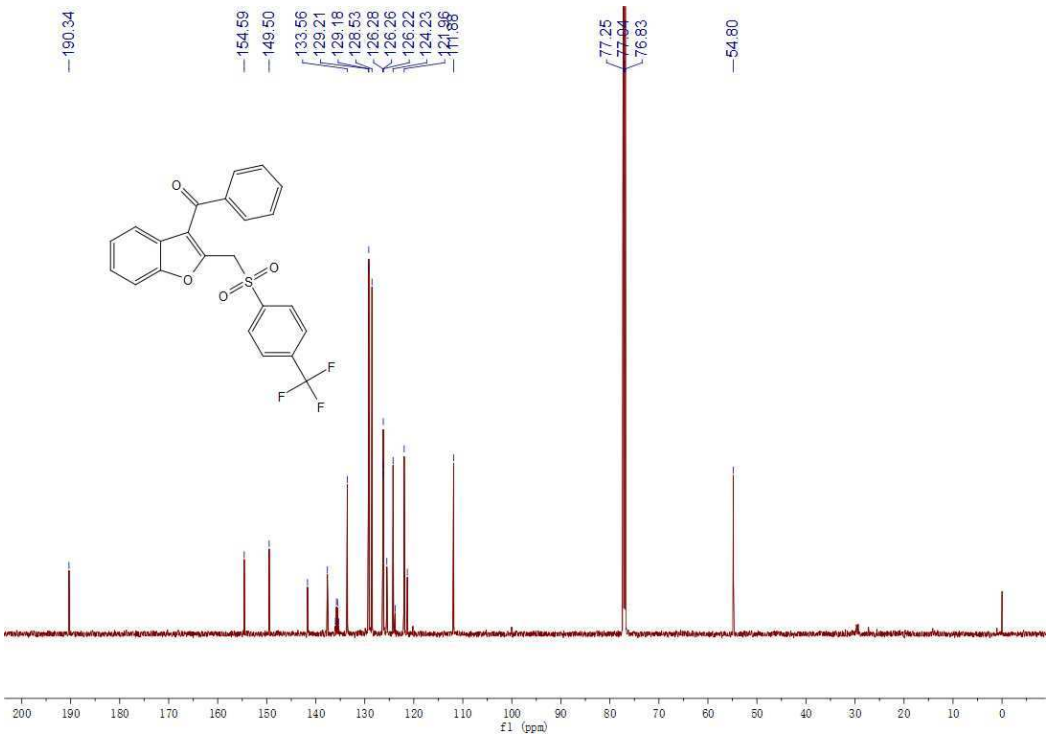
^{13}C NMR for Compound **3ah**:



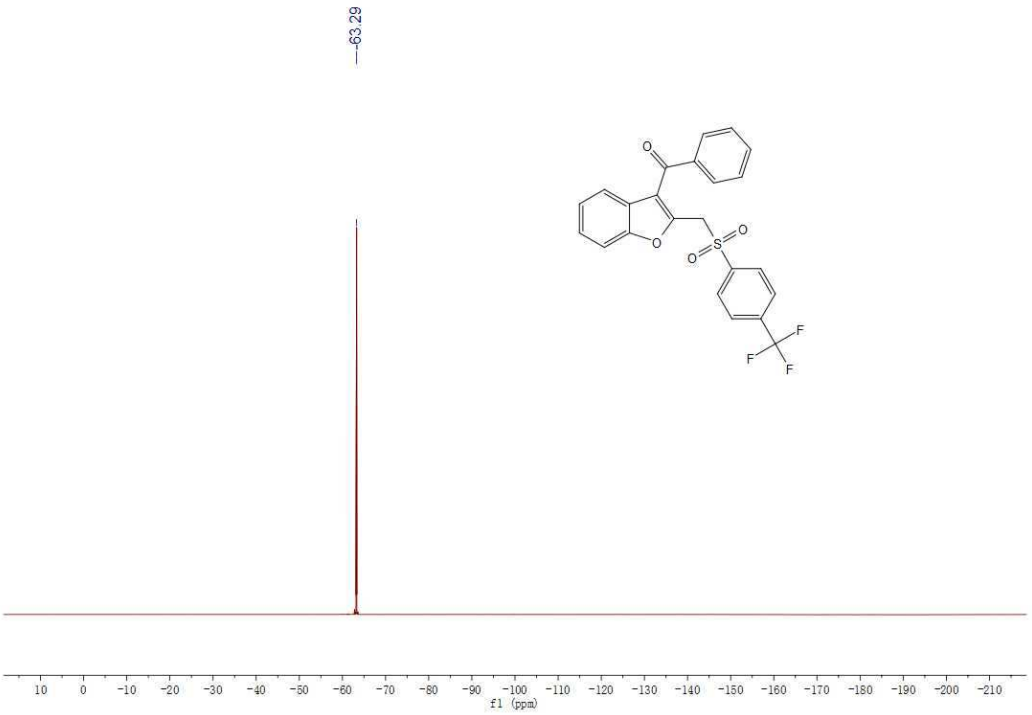
^{1}H NMR for Compound **3ai**:



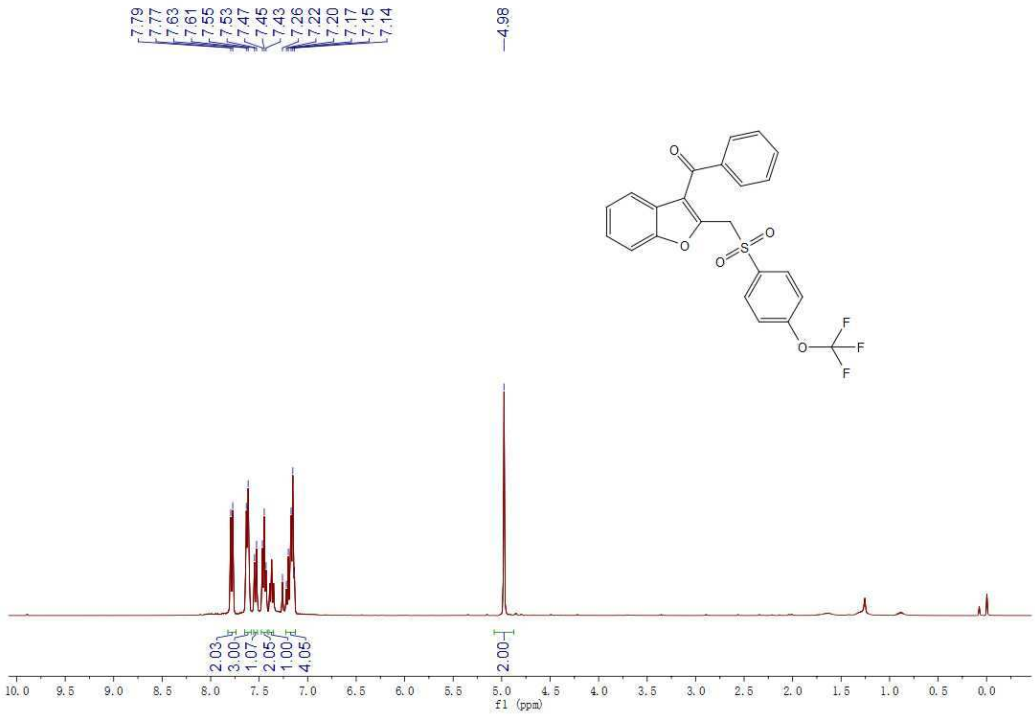
^{13}C NMR for Compound **3ai**:



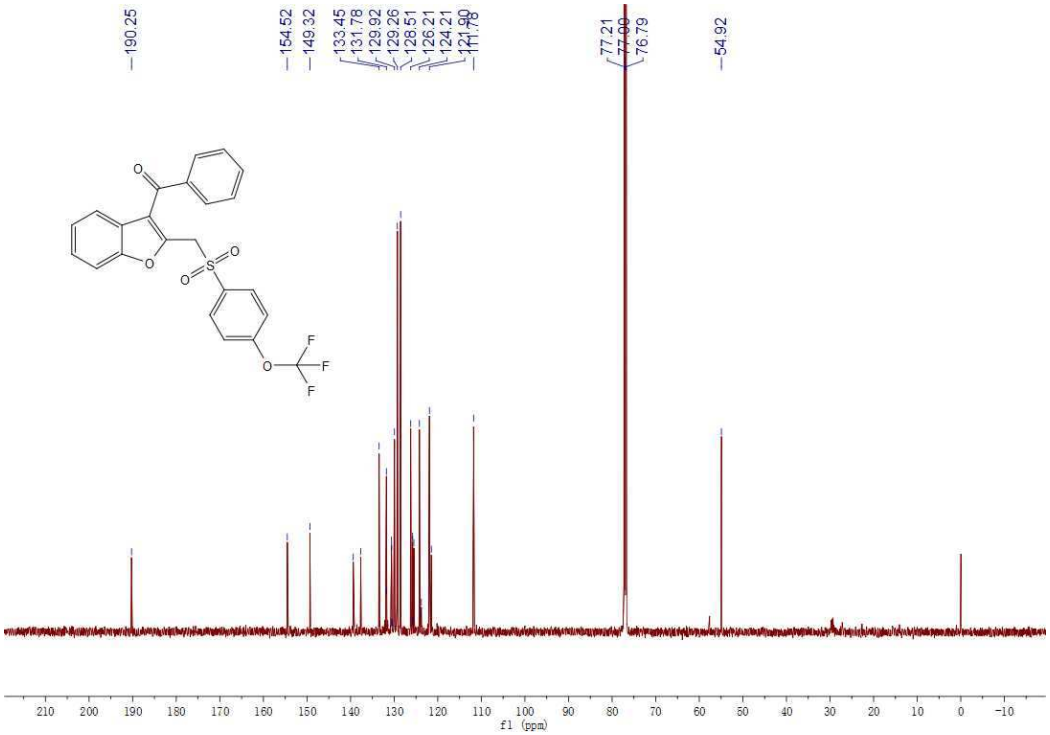
^{19}F NMR for Compound **3ai**:



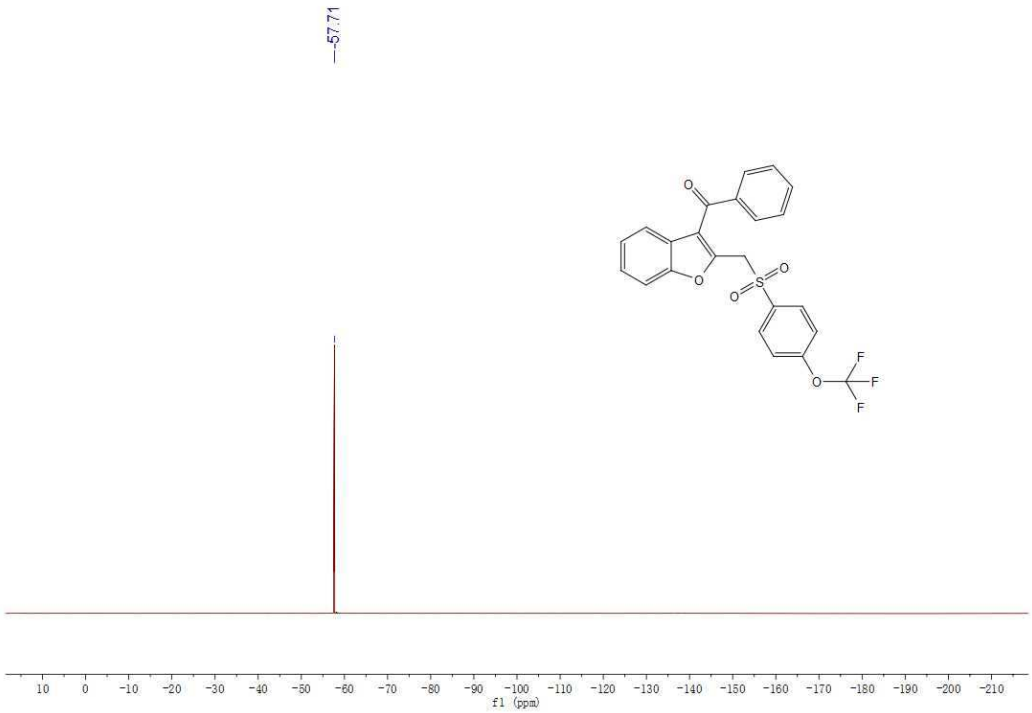
^{1}H NMR for Compound **3aj**:



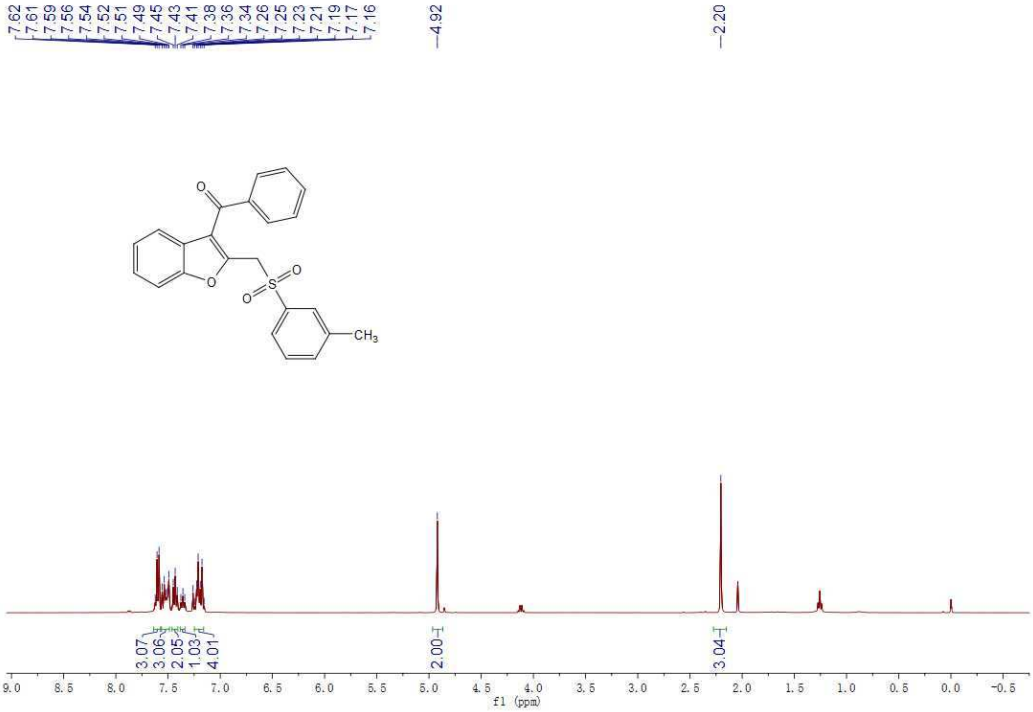
^{13}C NMR for Compound **3aj**:



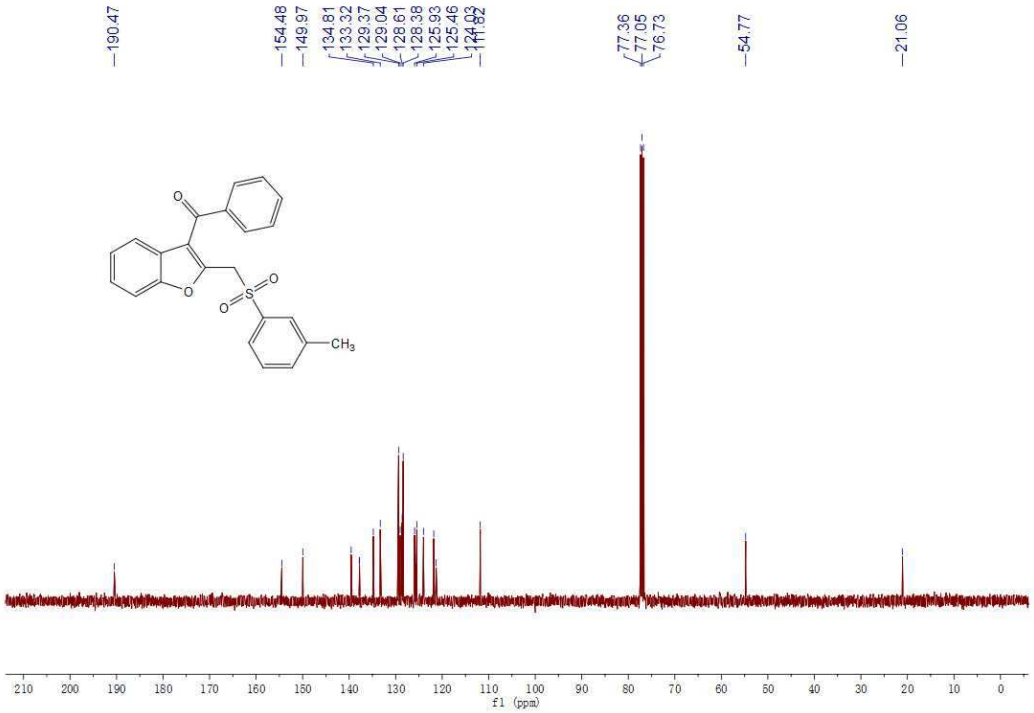
^{19}F NMR for Compound **3aj**:



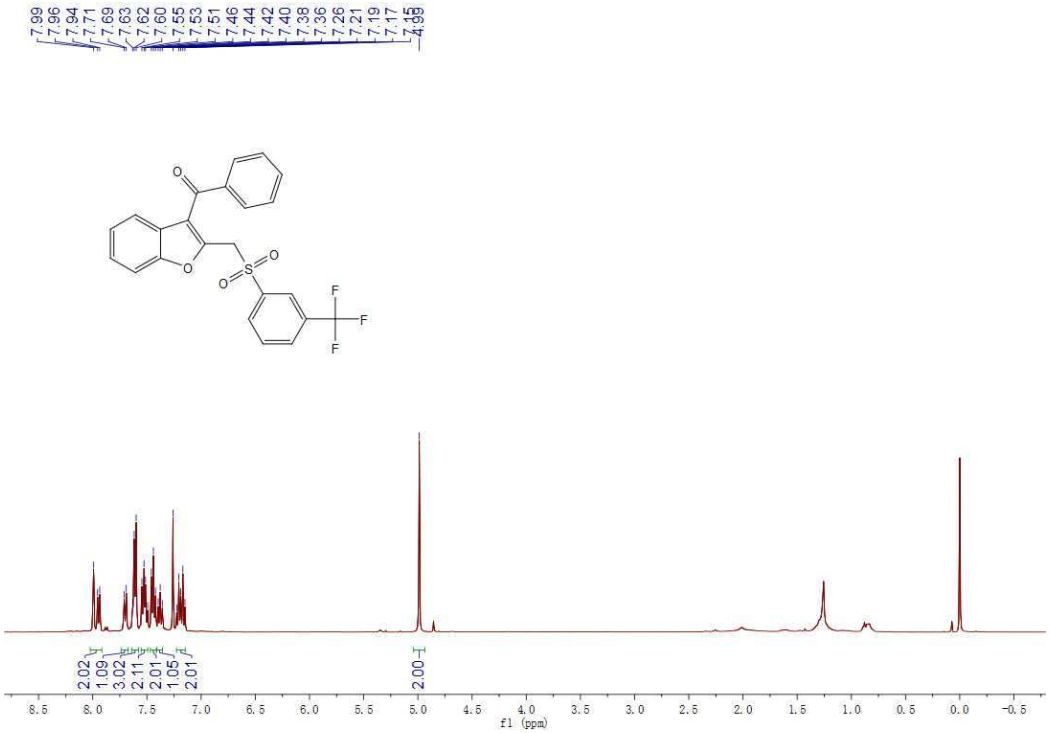
^{1}H NMR for Compound **3ak**:



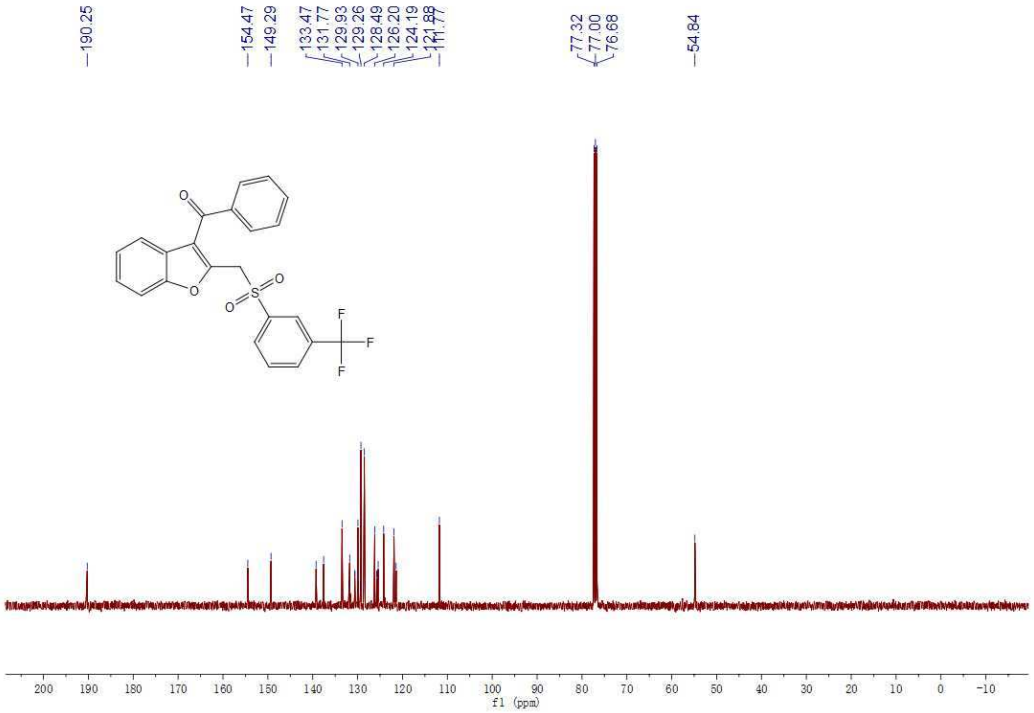
^{13}C NMR for Compound **3ak**:



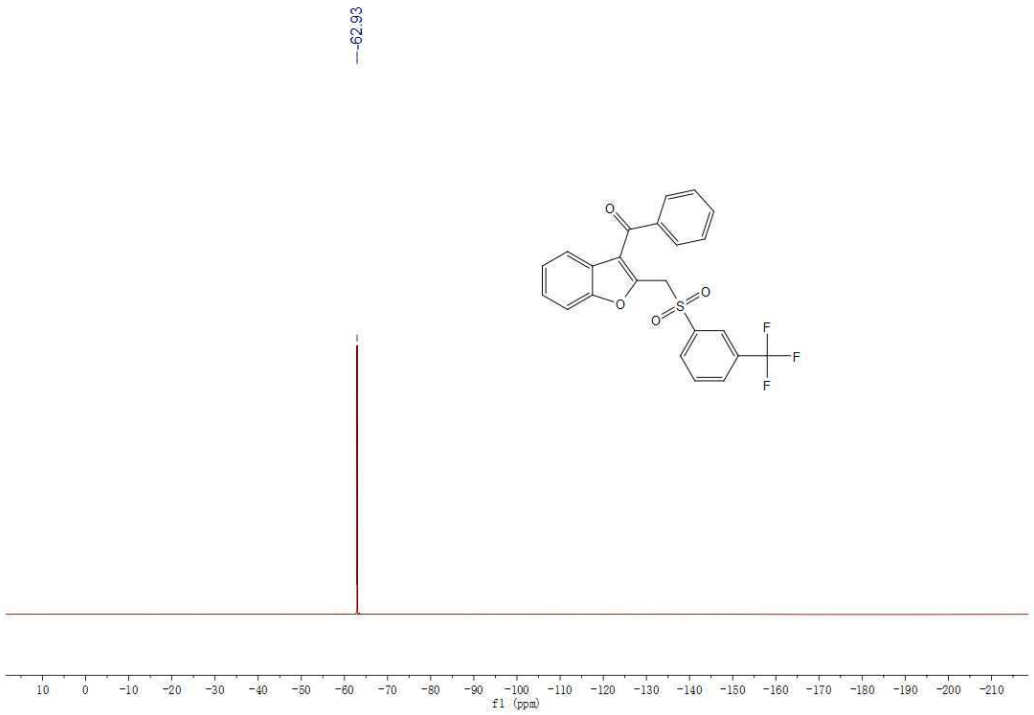
^{1}H NMR for Compound **3al**:



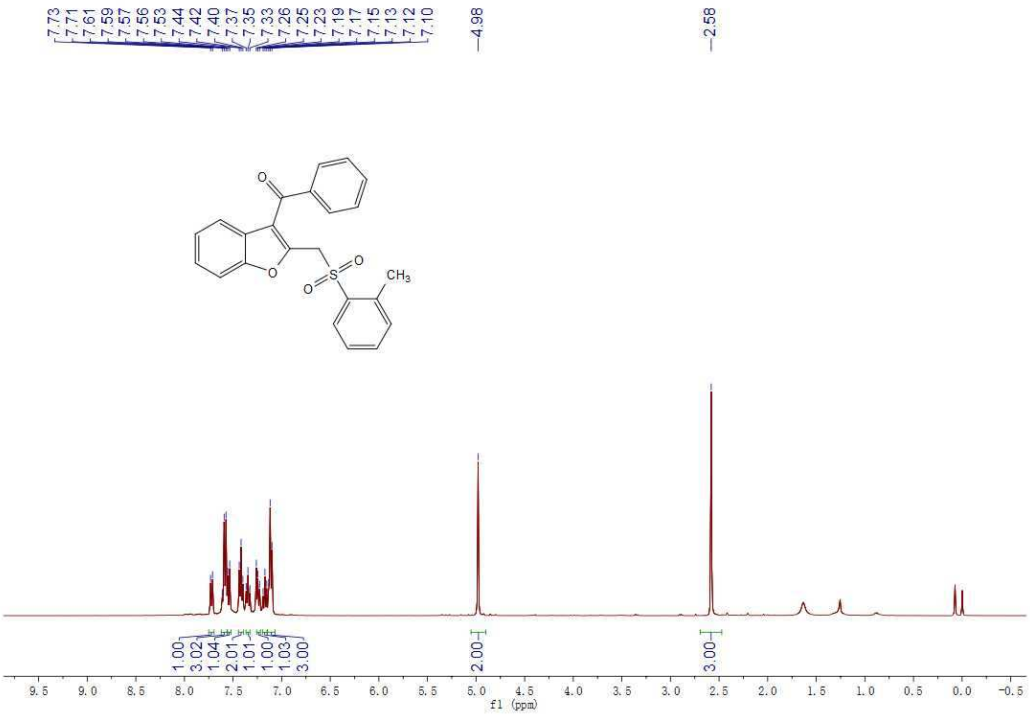
^{13}C NMR for Compound **3al**:



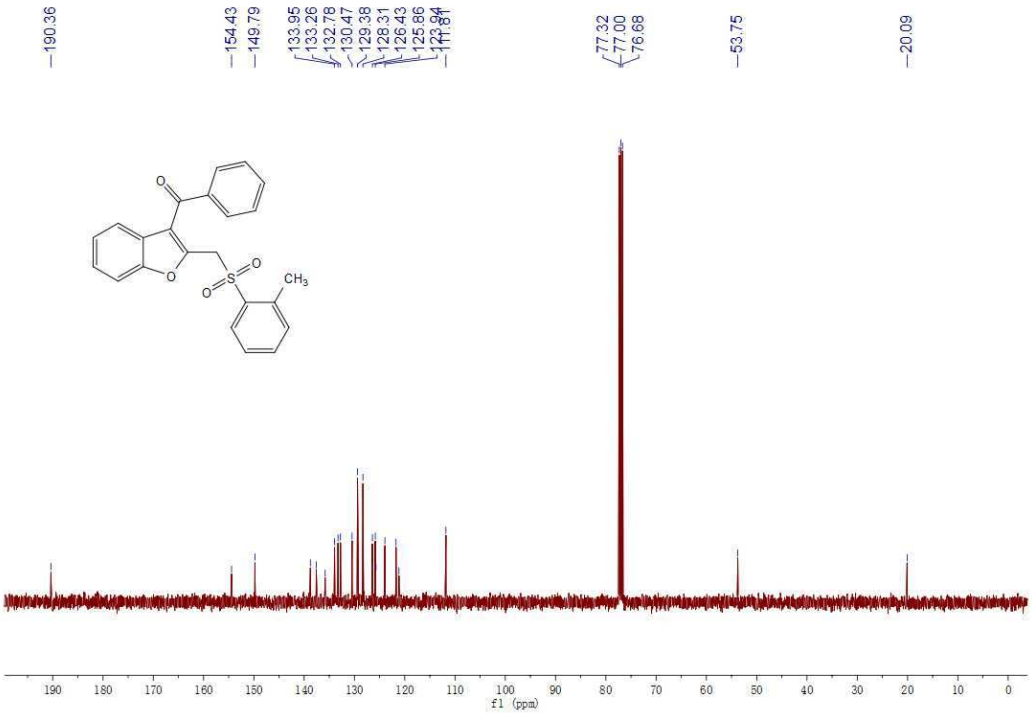
^{19}F NMR for Compound **3al**:



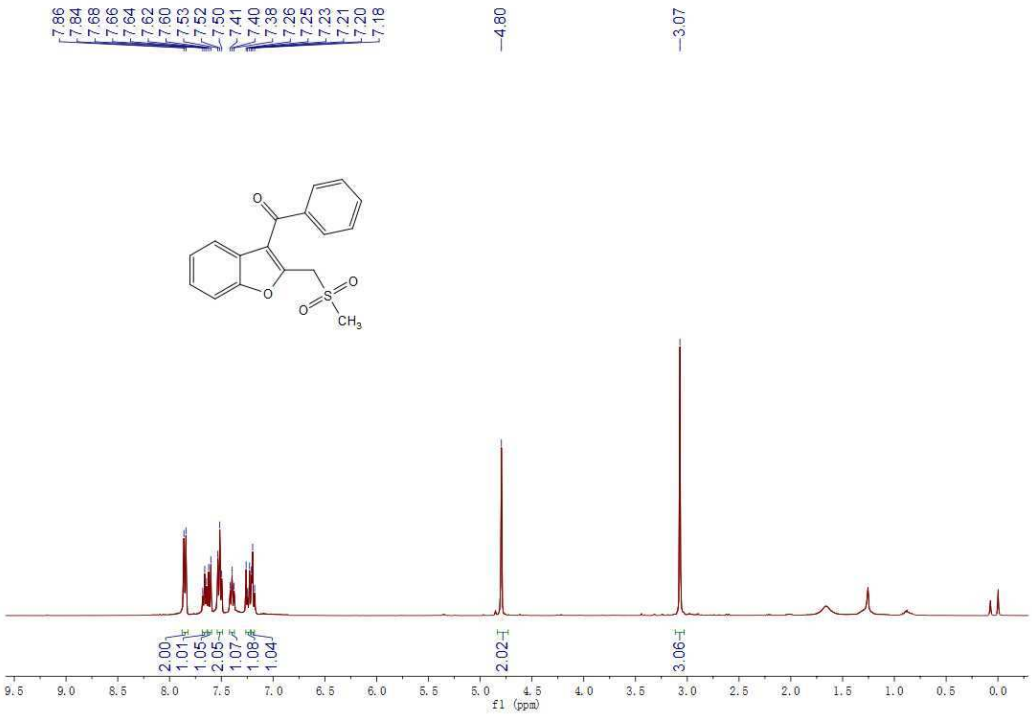
^{1}H NMR for Compound **3am**:



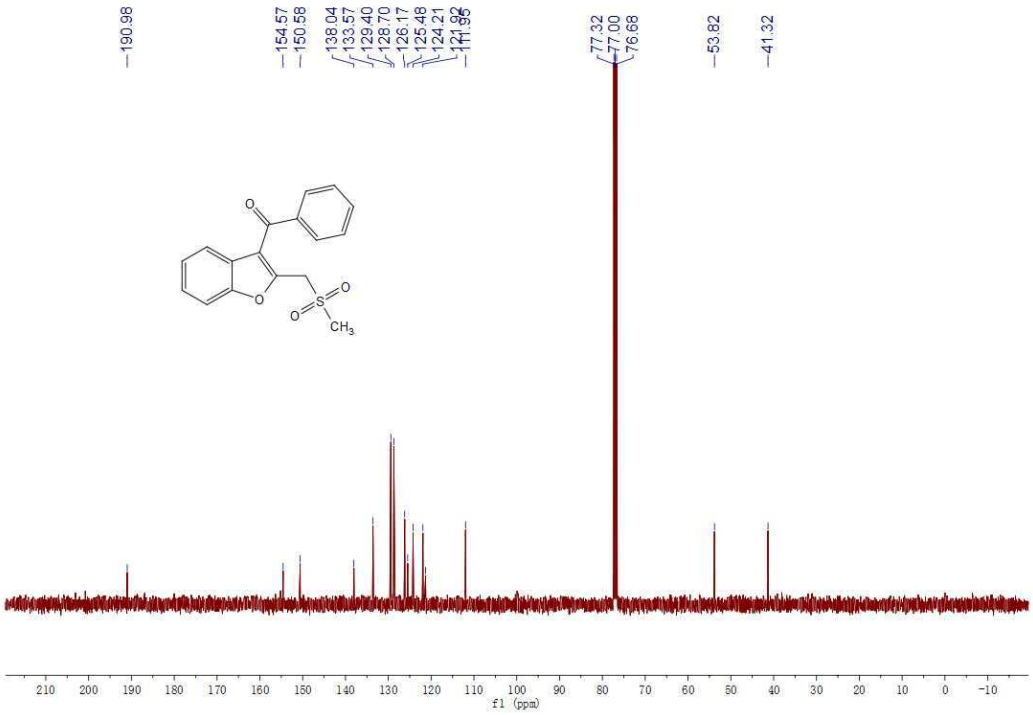
^{13}C NMR for Compound **3am**:



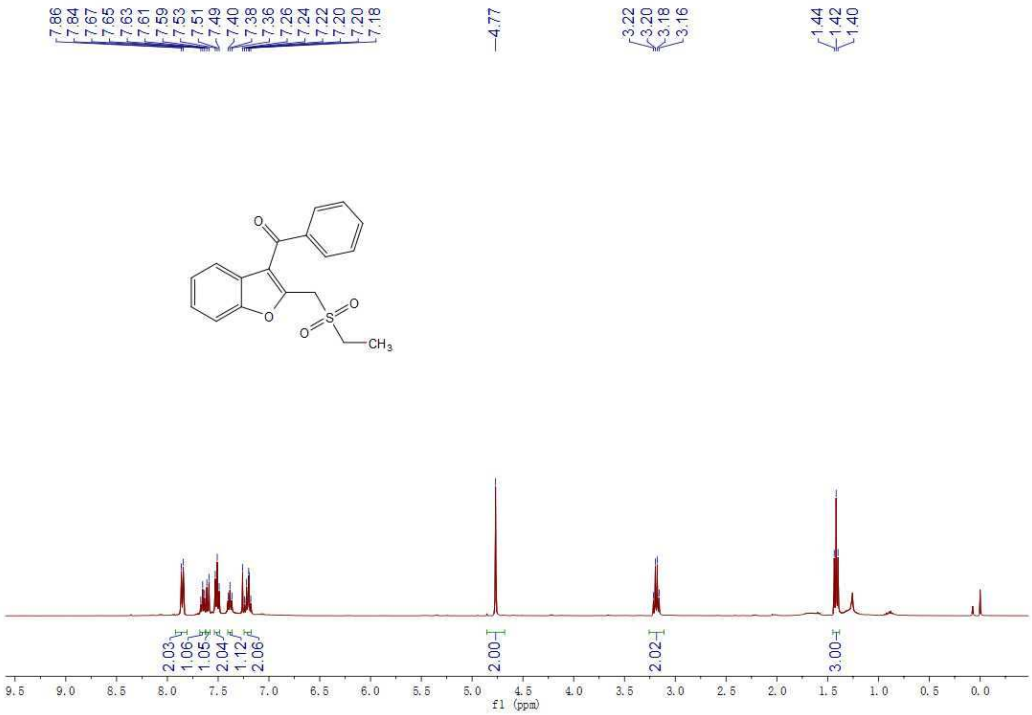
^{1}H NMR for Compound **3an**:



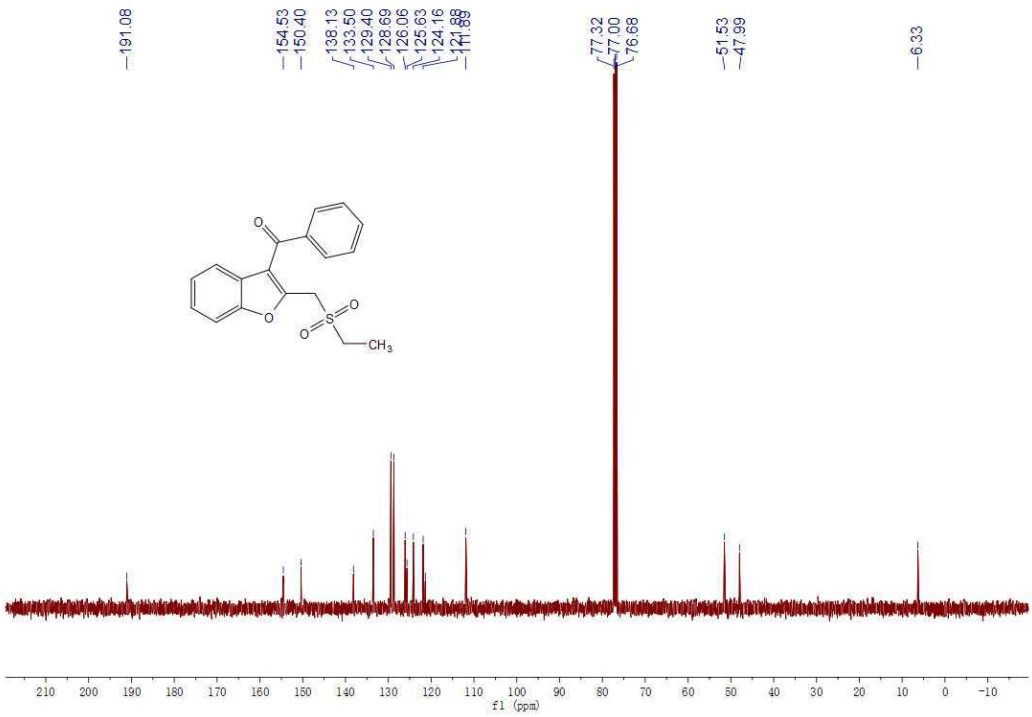
^{13}C NMR for Compound **3an**:



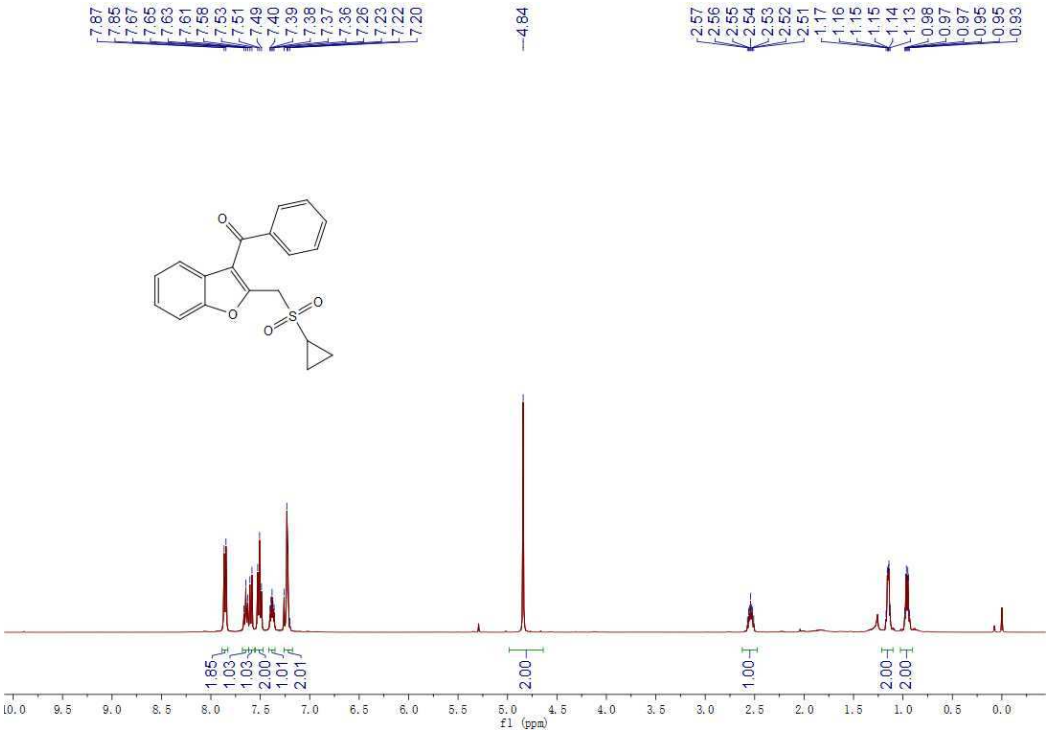
^{1}H NMR for Compound **3ao**:



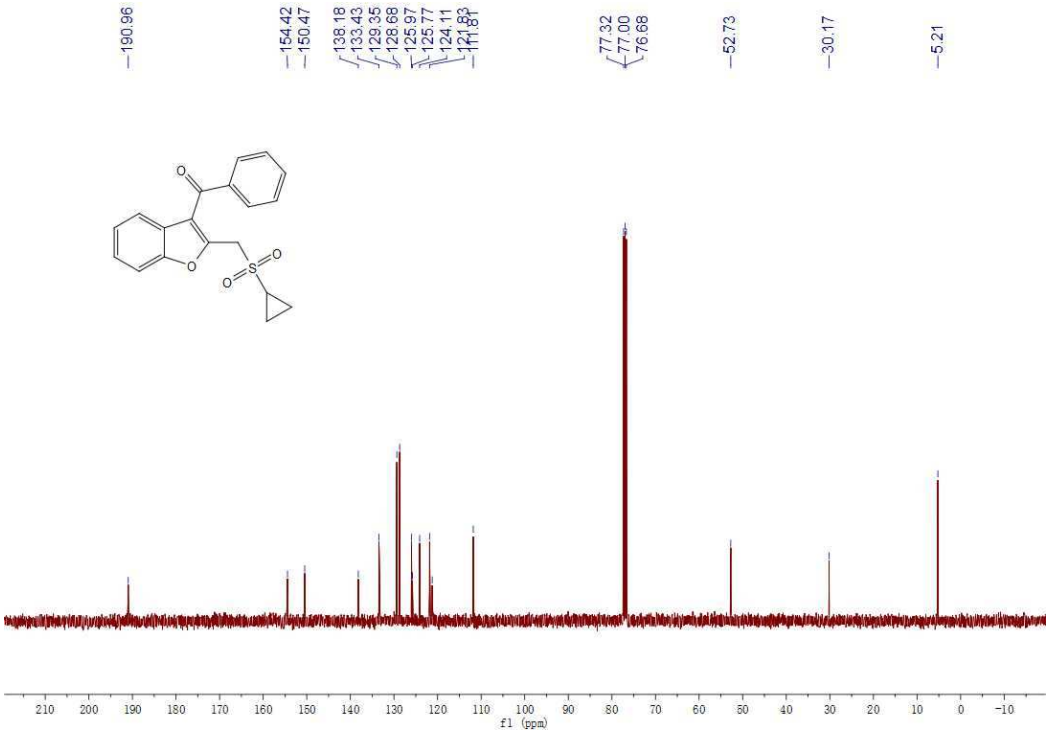
^{13}C NMR for Compound **3ao**:



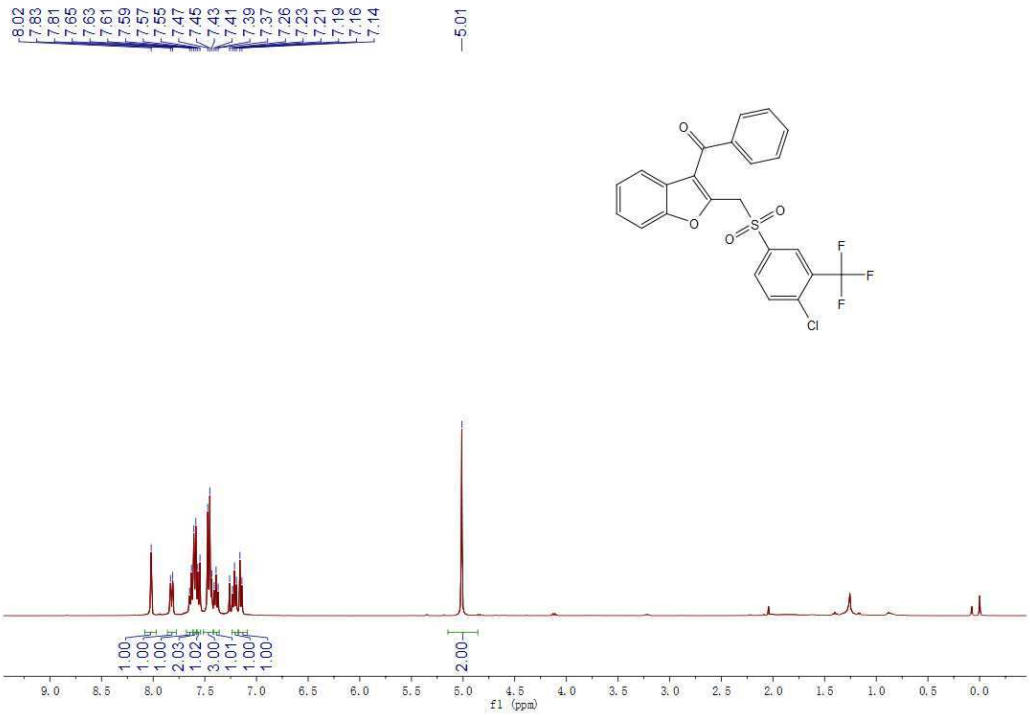
^{1}H NMR for Compound **3ap**:



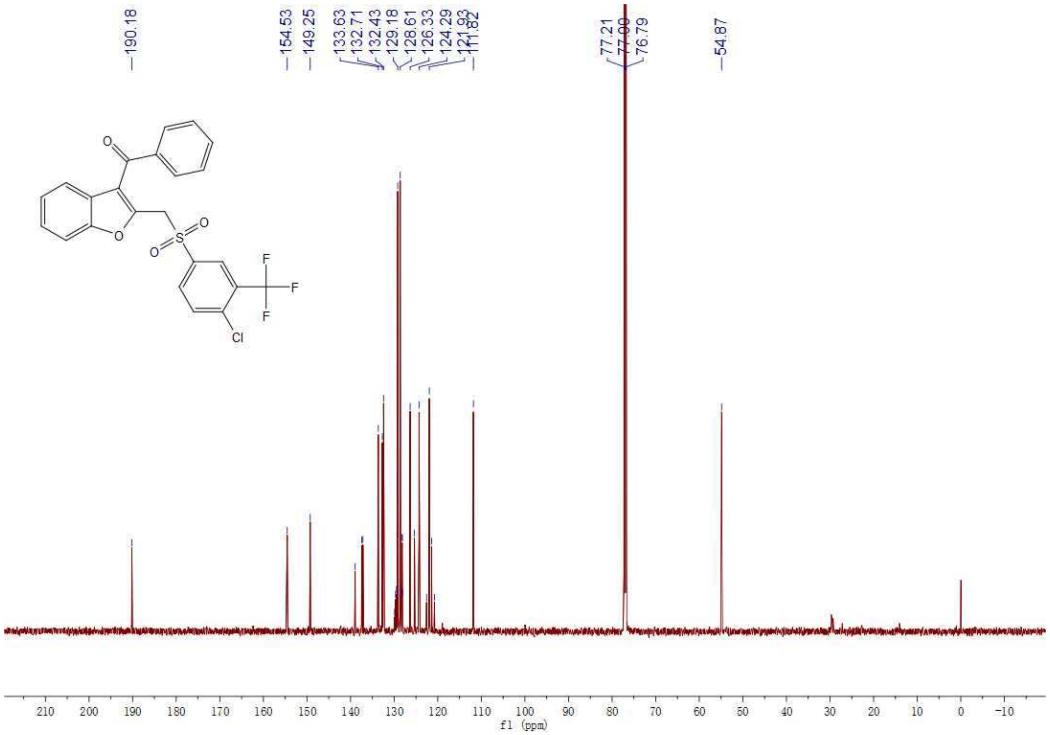
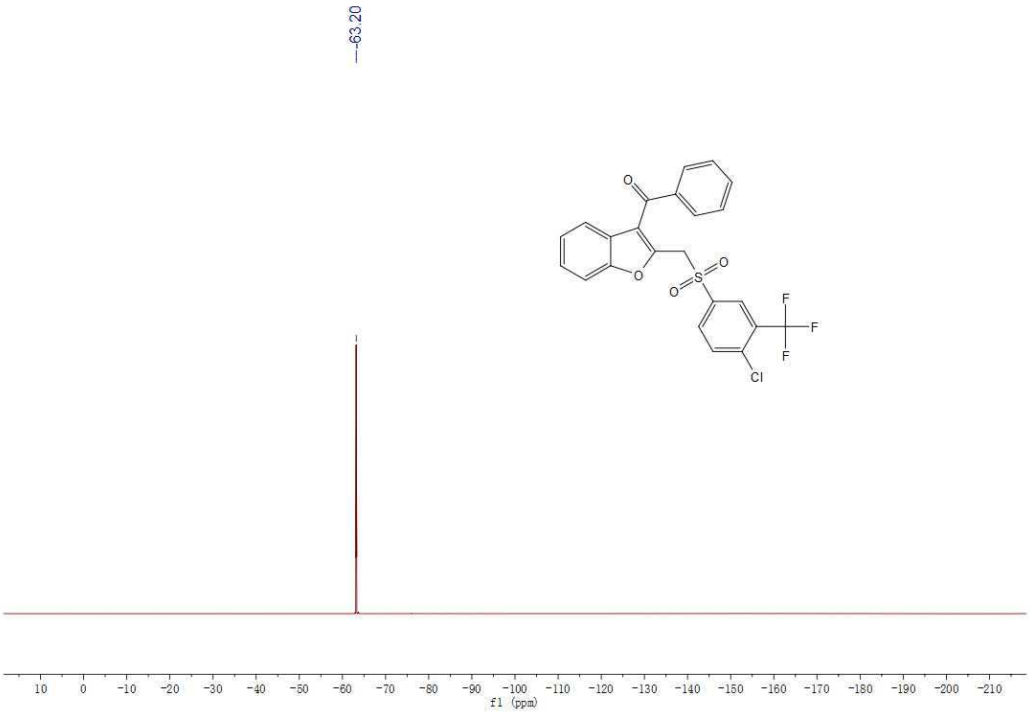
^{13}C NMR for Compound **3ap**:



^{1}H NMR for Compound **3ar**:



^{13}C NMR for Compound **3ar**:



^{19}F NMR for Compound **3ar**: