Supporting Information for

Gold-Catalyzed Ligand-Controlled Annulation for the Construction of Indoles and Furoindoles

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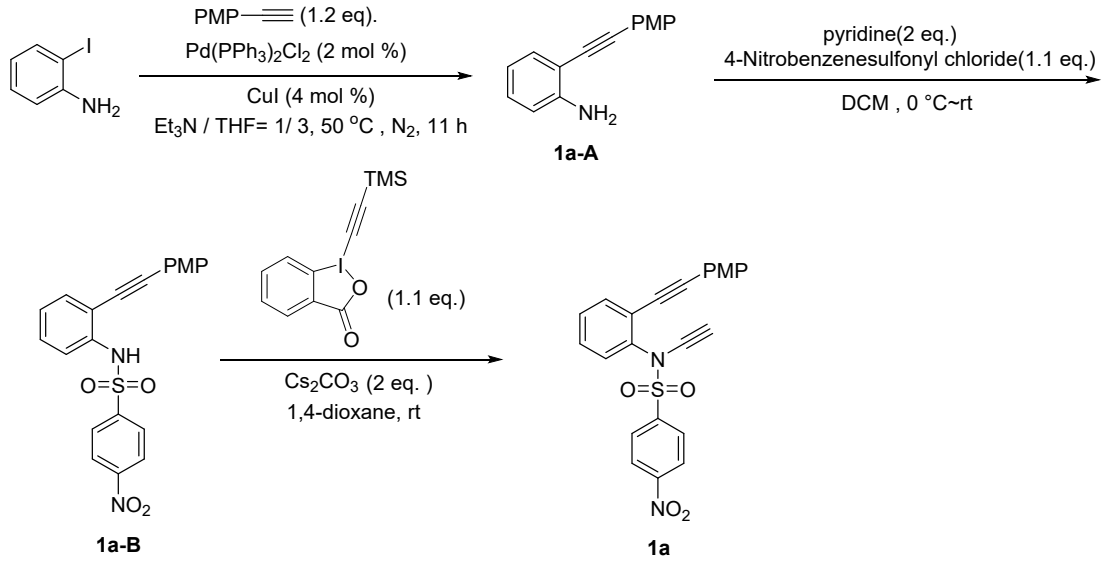
General

Ethyl acetate (ACS grade), hexanes (ACS grade), dichloromethane (ACS grade) were purchased from Fisher Scientific and used without further purification. ACS grade 1,2-dichloroethane were purchased from Acros Organics and used directly. Commercially available reagents were used without further purification. Reactions were monitored by thin layer chromatography (TLC) using Silicycle precoated silica gel plates. Flash column chromatography was performed over Silicycle silica gel (230-400 mesh). ^{1}H NMR and ^{13}C NMR spectra were recorded on a Varian 400 MHz, 500 MHz and 600 MHz spectrometers using residue solvent peaks as internal standards ($CHCl_3$,^{1}H: 7.26 ppm; ^{13}C: 77.00 ppm). ^{19}F NMR spectra were recorded on Varian 400 MHz. Mass spectra were recorded with Waters micromass ZQ detector using electrospray method.

Synthesis of the gold complex LAuCl

Gold complex PPh_3AuCl, BrettPhosAuCl, $Me_4{}^tBuXPhosAuCl$ were prepared according to the literature procedure.[1] Their spectroscopic data were in accordance with the literature data.[1]

Preparation of Starting Materials 1



Taking substrate **1a** for an example:

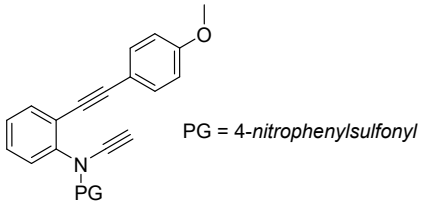
Step A: To a three-necked flask with a stir bar were added 2-iodoaniline derivative (3.0 mmol), methoxyphenylacetylene (3.6 mmol), $Pd(PPh_3)_2Cl_2$ (2 mol %) and CuI (4 mol %) under N_2 atmosphere. After adding corresponding mixed solvent at room temperature, the reaction was heated to 50 °C (oil bath). The progress of the reaction was monitored by TLC. Upon completion, the reaction was diluted with water,

extracted with EtOAc for 3 times, dried over $MgSO_4$ and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford the desired aniline precursor **1a-A** in 90% yield.

Step B: The above aniline product **1a-A** (2.0 mmol) was dissolved in DCM (10.0 mL) and cooled to 0 °C. Then, pyridine (0.32 mL, 4.0 mmol) and the corresponding 4-nitrobenzenesulfonyl chloride (2.2 mmol) were added sequentially. The reaction mixture was stirred at room temperature and the progress of the reaction was monitored by TLC. Upon completion, the reaction was quenched with 1 M HCl, extracted with EtOAc for 3 times, dried over $MgSO_4$ and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford the protected aniline **1a-B** in 85% yield.

Step C: To a sealed tube were added above protected aniline **1a-B** (1.0 mmol), cesium carbonate (2.0 mmol), 1-((trimethylsilyl)ethynyl)-1λ3-benzo[d][1,2]iodaoxol-3(1*H*) one (1.1 mmol) and 1,4-dioxane (7.0 mL) at room temperature. The progress of the reaction was monitored by TLC. Upon completion, the reaction was filtered through a pad of silica gel and concentrated. The filtrate was purified by column chromatography on silica gel to afford the desired ynamide **1a** in 80% yield.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide (**1a**)



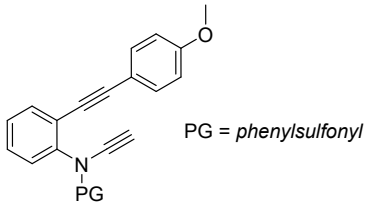
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide **1a** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.24 (d, J = 8.4 Hz, 2H), 8.02 (d, J = 8.5 Hz, 2H), 7.66 – 7.42 (m, 4H), 7.20 (d, J = 8.3 Hz, 2H), 6.88 (d, J = 8.3 Hz, 2H), 4.24 (s, 1H), 3.79 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.4, 150.6, 142.3, 137.7, 133.5, 133.2, 130.7, 130.5, 130.1, 130.0, 125.2, 122.4, 114.6, 113.8, 96.0, 83.8, 75.0, 62.8, 55.8.

ESI HRMS m/z $(M+H)^+$ calcd 433.0853, found 433.0850.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1b**)



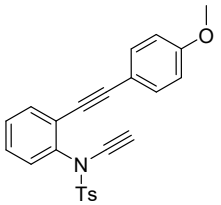
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl) benzenesulfonamide **1b** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 7.89 – 7.76 (m, 2H), 7.50 – 7.41 (m, 2H), 7.37 – 7.27 (m, 7H), 6.88 – 6.74 (m, 2H), 3.79 (s, 3H), 2.92 (s, 1H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.0, 137.9, 137.4, 133.89, 133.3, 133.1, 129.6, 129.4, 129.0, 128.7, 128.3, 123.3, 114.9, 113.8, 95.9, 83.7, 75.9, 59.2, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 410.0821, found 410.0831.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-4methylbenzenesulfonamide (**1c**)



N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-4methylbenzenesulfonamide **1c** was prepared according to the general procedure as a yellow solid in 50% yield, PE/EA = 1/1.

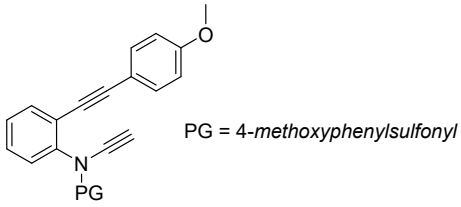
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, J = 8.4 Hz, 2H), 7.51 – 7.46 (m, 1H), 7.42 – 7.38 (m, 1H), 7.37 –7.32 (m, 2H), 7.28 (d, *J* = 8.4 Hz, 2H), 7.12 (d, *J* = 8.0 Hz, 2H), 6.83 (d, *J* = 8.8 Hz, 2H), 3.84 (s, 3H), 2.90 (s, 1H), 2.23 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 159.8, 144.8, 138.0, 134.5, 133.1, 133.0, 129.7, 129.5, 129.1, 128.6, 128.3, 123.1, 115.0, 113.7, 95.6, 83.7, 75.9, 59.0, 55.3, 21.5.

ESI HRMS m/z $(M + Na^+)$ calcd 424.0978, found 424.0979.

N-ethynyl-4-methoxy-*N*-(2-((4-ethoxyphenyl)ethynyl)phenyl)benzenesulfonamide

(**1d**)



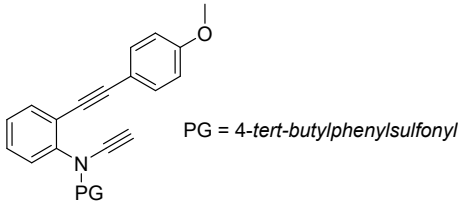
N-ethynyl-4-methoxy-*N*-(2-((4-ethoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1d** was prepared according to the general procedure as a yellow solid in 85% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ7.73 (d, *J* = 8.9 Hz, 2H), 7.53 – 7.45 (m, 1H), 7.40 (dt, *J* = 8.2, 3.2 Hz, 1H), 7.37 – 7.32 (m, 2H), 7.31 – 7.25 (m, 2H), 6.89 – 6.79 (m, 2H), 6.75 (d, *J* = 9.1 Hz, 2H), 3.81 (s, 3H), 3.63 (s, 3H), 2.93 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.8, 159.9, 138.1, 133.1, 133.1, 130.6, 130.0, 129.2, 128.9, 128.7, 123.1, 115.0, 114.2, 113.8, 95.6, 83.8, 76.1, 59.1, 55.4, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 418.1108, found 418.1107

4-(*tert*-butyl)-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1e**)



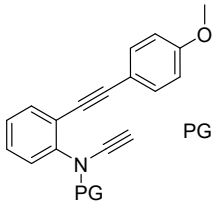
4-(*tert*-butyl)-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1e** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.72 (m, 2H), 7.51 – 7.45 (m, 1H), 7.44 – 7.39 (m, 1H), 7.38 – 7.28 (m, 6H), 6.84 – 6.78 (m, 2H), 3.83 – 3.76 (m, 3H), 2.93 (s, 1H), 1.13 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.9, 157.6, 137.9, 134.5, 133.2, 133.1, 129.9, 129.3, 128.6, 128.2, 126.1, 123.2, 114.9, 113.9, 95.8, 83.8, 76.0, 59.3, 55.4, 35.1, 30.8.

ESI HRMS m/z $(M+H)^+$ calcd 444.1628, found 444.1635.

4-chloro-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1f**)



PG = 4-*chlorophenylsulfonyl*

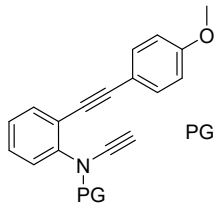
4-chloro-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1f** was prepared according to the general procedure as a yellow solid in 60% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.66 (m, 2H), 7.52 – 7.39 (m, 2H), 7.39 – 7.33 (m, 2H), 7.32 – 7.20 (m, 4H), 6.84 (d, *J* = 8.7 Hz, 2H), 3.83 (s, 3H), 2.96 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.0, 140.6, 137.6, 135.8, 133.2, 133.1, 130.0, 129.7, 129.5, 129.3, 128.9, 123.0, 114.6, 114.0, 95.9, 83.5, 75.4, 59.5, 55.4.

ESI HRMS m/z $(M+Na)^+$ calcd 444.0432, found 444.0439.

4-fluoro-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1g**)



PG = 4-*fluorophenylsulfonyl*

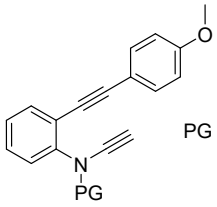
4-fluoro-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1g** was prepared according to the general procedure as a yellow solid in 83% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 – 7.76 (m, 2H), 7.51 – 7.44 (m, 1H), 7.42 – 7.37 (m, 1H), 7.36 – 7.31 (m, 2H), 7.31 – 7.26 (m, 2H), 6.96 (t, *J* = 8.6 Hz, 2H), 6.86 – 6.80 (m, 2H), 3.79 (s, 3H), 2.97 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.8 (d, *J* = 256.4 Hz), 160.1, 137.7, 133.4, 133.4, 133.2, 133.1, 131.2, 131.1, 129.9, 129.5, 128.9, 123.1, 116.5, 116.2, 114.7, 113.3, 95.9, 83.6, 75.6, 59.5, 55.4.

ESI HRMS m/z $(M+Na)^+$ calcd 428.0727, found 428.0735.

4-cyano-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1h**)



PG = 4-*cyanophenylsulfonyl*

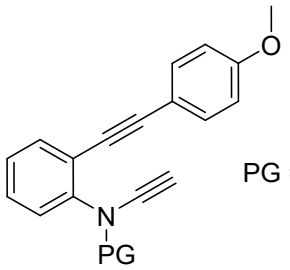
4-cyano-*N*-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1h** was prepared according to the general procedure as a yellow solid in 60% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 – 7.80 (m, 2H), 7.57 – 7.44 (m, 4H), 7.38 (dd, *J* = 5.9, 3.5 Hz, 2H), 7.25 – 7.17 (m, 2H), 6.86 (d, *J* = 8.7 Hz, 2H), 3.85 (s, 3H), 3.02 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.3, 141.3, 137.3, 133.2, 133.0, 132.7, 130.3, 129.8, 129.0, 128.8, 122.6, 117.2, 117.1, 114.2, 114.1, 96.0, 83.4, 74.9, 59.9, 55.4.

ESI HRMSm/z $(M+H)^+$ calcd 413.0954, found 413.0959.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-3-(trifluoromethyl)benzenesulfonamide (**1i**)



PG = 3-*trifluoromethylphenylsulfonyl*

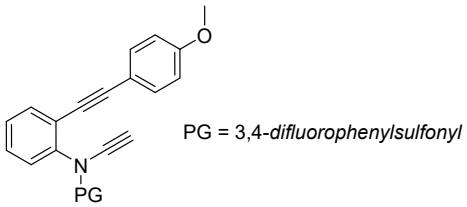
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-3-(trifluoromethyl)benzenesulfonamide (**1i**) was prepared according to the general procedure as a yellow solid in 81% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H), 8.00 (d, *J* = 7.9 Hz, 1H), 7.60 (d, *J* = 7.9 Hz, 1H), 7.48 (dd, *J* = 6.5, 2.7 Hz, 1H), 7.45 – 7.32 (m, 4H), 7.20 (d, *J* = 8.4 Hz, 2H), 6.78 (d, *J* = 8.4 Hz, 2H), 3.77 (s, 3H), 3.00 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.1, 138.4, 137.5, 133.2, 133.1, 131.5, 131.3 (d, *J* = 33.7 Hz), 130.4 (q, *J* = 3.6 Hz), 130.0, 129.9, 129.7, 128.9, 125.4 (q, *J* = 3.9 Hz), 123.1 (q, *J* = 273.0 Hz), 123.0, 114.4, 113.9, 96.1, 83.4, 75.1, 59.9, 55.3.

ESI HRMS m/z $(M+Na)^+$ calcd 478.0695, found 478.0703.

N-ethynyl-3,4-difluoro-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide (**1j**)

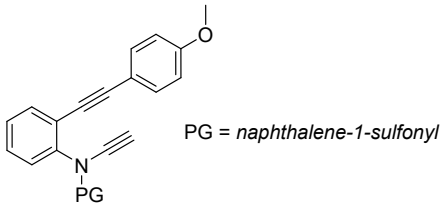


N-ethynyl-3,4-difluoro-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)benzenesulfonamide **1j** was prepared according to the general procedure as a yellow solid in 82% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.47 (m, 1H), 7.45 – 7.41 (m, 1H), 7.36 (qd, *J* = 6.4, 5.2, 3.6 Hz, 4H), 7.33 – 7.27 (m, 2H), 6.88 – 6.81 (m, 2H), 6.80 – 6.72 (m, 1H), 3.81 (s, 3H), 3.00 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.8 (d, *J* = 11.7 Hz), 161.3 (d, *J* = 11.7 Hz), 160.1, 140.2 (t, *J* = 9.0 Hz), 137.3, 133.3, 133.1, 130.00, 129.8, 128.9, 122.9, 114.4, 113.9, 112.1, 112.0 (d, *J* = 11.5 Hz), 111.8, 109.4 (t, *J* = 25.0 Hz), 96.0, 83.2, 74.9, 59.8, 55.4.
ESI HRMS m/z $(M+H)^+$ calcd 424.0813, found 424.0818.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)naphthalene-1-sulfonamide (**1k**)



N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)naphthalene-1-sulfonamide **1k** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 10/1.

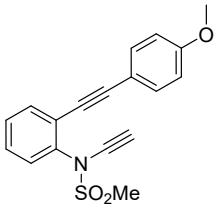
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42 (d, *J* = 1.9 Hz, 1H), 7.89 – 7.66 (m, 4H), 7.58 – 7.43 (m, 4H), 7.38 – 7.32 (m, 2H), 7.05 – 6.89 (m, 2H), 6.67 – 6.50 (m, 2H), 3.76 (s, 3H), 2.94 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.6, 138.0, 135.4, 134.5, 133.1, 132.8, 131.9, 130.2,

130.0, 129.5, 129.4, 129.3, 129.1, 128.7, 127.9, 127.4, 123.2, 114.5, 113.6, 95.9, 83.6, 75.8, 59.3, 55.3.

ESI HRMS m/z $(M+Na)^+$ calcd 460.0978, found 460.0986.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)methanesulfonamide (**1l**)



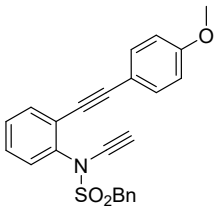
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)methanesulfonamide **1l** was prepared according to the general procedure as a yellow solid in 83% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 7.72 – 7.64 (m, 1H), 7.59 (dd, J = 14.0, 6.9 Hz, 3H), 7.54 – 7.46 (m, 2H), 7.03 (d, J = 8.3 Hz, 2H), 4.10 (s, 1H), 3.80 (s, 3H), 3.46 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.5, 138.6, 133.5, 133.3, 130.3, 130.1, 129.8, 123.1, 115.0, 114.3, 96.1, 84.6, 76.2, 61.8, 55.8.

ESI HRMS m/z $(M+Na)^+$ calcd 348.0665, found 348.0673.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-1-phenylmethanesulfonamide (**1m**)



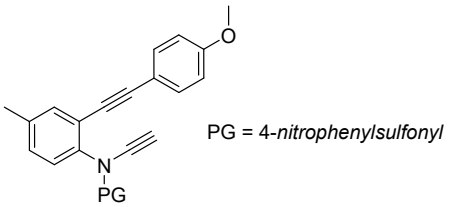
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)phenyl)-1-phenylmethanesulfonamide **1l** was prepared according to the general procedure as a yellow solid in 77% yield, PE/EA = 10/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, J = 8.1 Hz, 3H), 7.49 – 7.30 (m, 6H), 7.24 (d, J = 7.5 Hz, 1H), 6.90 (dd, J = 16.3, 8.1 Hz, 3H), 4.70 (s, 2H), 3.80 (s, 3H), 3.02 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.2, 138.1, 133.3, 133.0, 131.3, 129.4, 129.3, 129.0, 129.0, 127.3, 123.4, 114.7, 114.2, 96.6, 84.2, 75.7, 59.6, 58.08, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 402.1158, found 402.1154.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-4-methylphenyl)-4-nitrobenzenesulfonamide (**1n**)



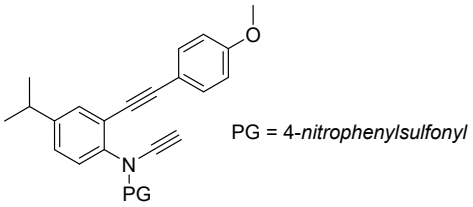
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-4-methylphenyl)-4-nitrobenzenesulfonamide **1n** was prepared according to the general procedure as a yellow solid in 72% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (d, J = 8.8 Hz, 2H), 8.01 (d, J = 8.8 Hz, 2H), 7.47 – 7.23 (m, 3H), 7.19 (d, J = 8.7 Hz, 2H), 6.87 (d, J = 8.7 Hz, 2H), 4.19 (s, 1H), 3.78 (s, 3H), 2.33 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.29, 150.54, 142.32, 140.68, 135.22, 133.66, 133.17, 130.66, 130.18, 129.92, 125.10, 122.11, 114.53, 113.90, 95.56, 83.97, 75.18, 62.42, 55.68, 20.85.

ESI HRMS m/z $(M+Na)^+$ calcd 469.0829, found 469.0830.

N-ethynyl-*N*-(4-isopropyl-2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide (**1o**)



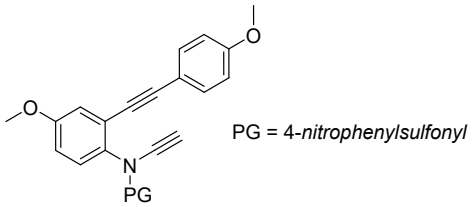
N-ethynyl-*N*-(4-isopropyl-2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide **1o** was prepared according to the general procedure as a yellow solid in 76% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.24 (d, J = 8.4 Hz, 2H), 8.03 (d, J = 8.5 Hz, 2H), 7.47 (s, 1H), 7.38 (s, 2H), 7.19 (d, J = 8.3 Hz, 2H), 6.87 (d, J = 8.4 Hz, 2H), 4.21 (s, 1H), 3.79 (s, 3H), 2.95 (p, J = 6.9 Hz, 1H), 1.21 (d, J = 6.8 Hz, 6H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.3, 151.2, 150.6, 142.4, 135.5, 133.2, 131.2,

130.4, 130.0, 128.2, 125.2, 122.2, 114.6, 113.9, 95.5, 84.2, 75.1, 62.5, 55.7, 33.5, 23.9.
ESI HRMS m/z $(M+H)^+$ calcd 475.1322, found 475.1324.

N-ethynyl-*N*-(4-methoxy-2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide (**1P**)

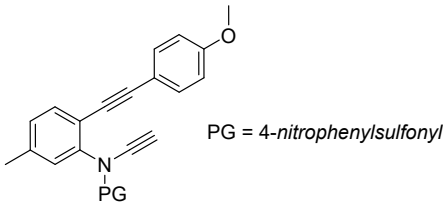


N-ethynyl-*N*-(4-methoxy-2-((4-methoxyphenyl)ethynyl)phenyl)-4-nitrobenzenesulfonamide **1P** was prepared according to the general procedure as a yellow solid in 73% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 – 7.82 (m, 4H), 7.38 (d, *J* = 8.7 Hz, 1H), 7.13 (d, *J* = 8.3 Hz, 2H), 6.99 – 6.85 (m, 2H), 6.76 (d, *J* = 8.3 Hz, 2H), 3.82 (s, 6H), 3.03 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.3, 160.1, 150.2, 142.9, 132.8, 131.6, 130.1, 129.5, 124.1, 123.5, 117.3, 115.3, 114.0, 114.9, 95.5, 83.4, 75.1, 59.5, 55.7, 55.4.
ESI HRMS m/z $(M+Na)^+$ calcd 485.0778, found 485.0774.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-methylphenyl)-4-nitrobenzenesulfonamide (**1q**)

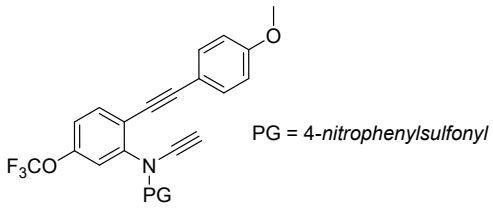


N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-methylphenyl)-4-nitrobenzenesulfonamide **1q** was prepared according to the general procedure as a yellow solid in 72% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.22 (d, *J* = 8.5 Hz, 2H), 8.02 (d, *J* = 8.4 Hz, 2H), 7.47 (d, *J* = 7.9 Hz, 1H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.16 (d, *J* = 8.1 Hz, 2H), 6.86 (d, *J* = 8.4 Hz, 2H), 4.22 (s, 1H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.2, 150.6, 142.3, 140.4, 137.6, 133.2, 133.1, 131.4, 130.9, 123.0, 125.1, 119.4, 114.5, 114.0, 95.2, 83.0, 75.0, 62.7, 55.7, 21.1.
ESI HRMS m/z $(M+Na)^+$ calcd 469.0829, found 469.0832.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-(trifluoromethoxy)phenyl)-4-nitrobenzenesulfonamide (**1r**)



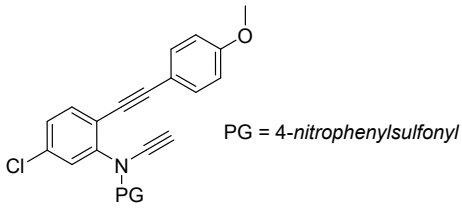
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-(trifluoromethoxy)phenyl)-4-nitrobenzenesulfonamide **1r** was prepared according to the general procedure as a yellow solid in 71% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, DMSO-d_6) δ 8.21 (d, J = 8.5 Hz, 2H), 8.04 (d, J = 8.5 Hz, 2H), 7.72 (d, J = 8.5 Hz, 1H), 7.63 – 7.51 (m, 2H), 7.18 (d, J = 8.4 Hz, 2H), 6.87 (d, J = 8.4 Hz, 2H), 4.32 (s, 1H), 3.79 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.6, 150.7, 148.0, 142.0, 138.7, 135.0, 133.3, 130.1, 125.2, 123.6, 123.3, 121.7, 120.3 (d, J = 258.2 Hz), 114.5, 113.3, 97.2, 82.6, 74.2, 63.5, 55.7.

ESI HRMS m/z $(M+H)^+$ calcd 517.0676, found 517.0671.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-chloro-phenyl)-4-nitrobenzenesulfonamide (**1s**)



N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-5-chloro-phenyl)-4-nitrobenzenesulfonamide **1s** was prepared according to the general procedure as a yellow solid in 72% yield, PE/EA = 5/1.

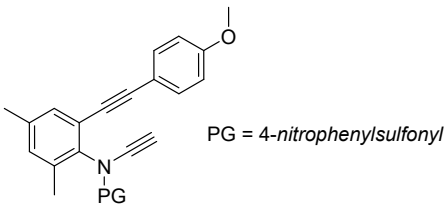
^{1}H NMR (400 MHz, DMSO-d_6) δ 8.21 (d, J = 8.7 Hz, 2H), 8.04 (d, J = 8.7 Hz, 2H), 7.69 (s, 1H), 7.62 (s, 2H), 7.17 (d, J = 8.5 Hz, 2H), 6.87 (d, J = 8.6 Hz, 2H), 4.31 (s,

1H), 3.79 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.5, 150.7, 142.1, 138.5, 134.7, 133.7, 133.3, 131.0, 130.7, 130.1, 125.2, 121.3, 114.6, 113.4, 97.2, 82.9, 74.3, 63.5, 55.8.

ESI HRMS m/z $(M+H)^+$ calcd 467.0463, found 467.0464.

N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-3,5-dimethylphenyl)-4-nitrobenzenesulfonamide (**1t**)



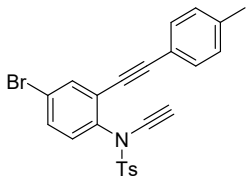
N-ethynyl-*N*-(2-((4-methoxyphenyl)ethynyl)-3,5-dimethylphenyl)-4-nitrobenzenesulfonamide **1t** was prepared according to the general procedure as a yellow solid in 70% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 – 7.90 (m, 4H), 7.11 (dd, J = 15.7, 2.1 Hz, 2H), 7.06 – 6.95 (m, 2H), 6.74 – 6.65 (m, 2H), 3.80 (s, 3H), 2.97 (s, 1H), 2.49 (s, 3H), 2.31 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.1, 149.9, 143.6, 140.0, 139.3, 134.5, 132.80, 132.2, 131.3, 129.7, 123.9, 122.6, 114.1, 113.8, 94.4, 84.6, 74.9, 58.8, 55.4, 21.0, 18.8.

ESI HRMS m/z $(M+H)^+$ calcd 461.1166, found 461.1164.

N-(4-bromo-2-(p-tolylethynyl)phenyl)-*N*-ethynyl-4-methylbenzenesulfonamide (**1u**)



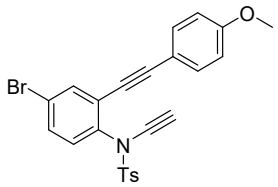
N-(4-bromo-2-(p-tolylethynyl)phenyl)-*N*-ethynyl-4-methylbenzenesulfonamide **1u** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, *J* = 8.0 Hz, 2H), 7.63 (d, *J* = 2.4 Hz, 1H), 7.46 (dd, *J* = 8.6, 2.4 Hz, 1H), 7.27 (d, *J* = 8.6 Hz, 1H), 7.20 (d, *J* = 7.8 Hz, 2H), 7.10 (dd, *J* = 8.1, 2.2 Hz, 4H), 2.92 (s, 1H), 2.37 (s, 3H), 2.18 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 145.2, 139.2, 137.1, 135.8, 134.2, 131.9, 131.6, 131.3, 129.8, 128.9, 128.3, 124.7, 123.0, 119.3, 97.2, 83.0, 75.4, 59.5, 21.7, 21.5.

ESI HRMS m/z $(M+Na)^+$ calcd 486.0134, found 486.0143.

N-(4-bromo-2-((4-methoxyphenyl)ethynyl)phenyl)-*N*-ethynyl-4-methylbenzenesulfonamide (**1v**)



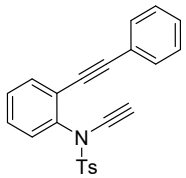
N-(4-bromo-2-((4-methoxyphenyl)ethynyl)phenyl)-*N*-ethynyl-4-methylbenzenesulfonamide **1v** was prepared according to the general procedure as a yellow solid in 80% yield, PE/EA = 5/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, *J* = 8.0 Hz, 2H), 7.61 (d, *J* = 2.4 Hz, 1H), 7.44 (dd, *J* = 8.6, 2.3 Hz, 1H), 7.33 – 7.20 (m, 3H), 7.11 (d, *J* = 8.0 Hz, 2H), 6.82 (d, *J* = 8.6 Hz, 2H), 3.82 (s, 3H), 2.93 (s, 1H), 2.20 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.2, 145.2, 137.0, 135.6, 134.2, 133.3, 131.7, 131.3, 129.8, 128.3, 124.9, 123.0, 114.4, 113.8, 97.2, 82.5, 75.5, 59.5, 55.4, 21.6.

ESI HRMS m/z $(M+Na)^+$ calcd 502.0083, found 502.0092.

N-ethynyl-4-methyl-*N*-(2-(phenylethynyl)phenyl)benzenesulfonamide (**1w**)



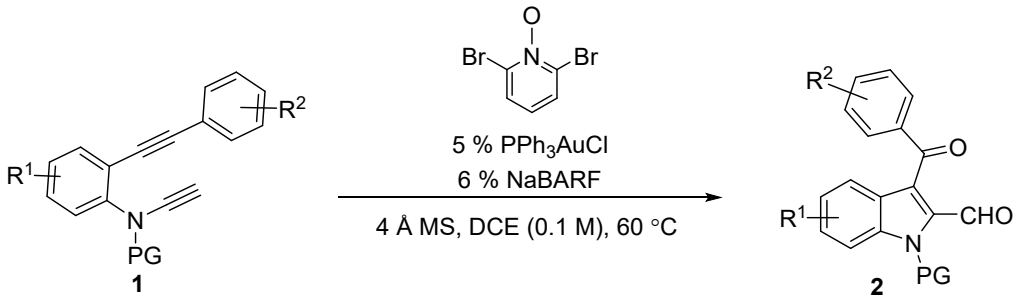
N-ethynyl-4-methyl-*N*-(2-(phenylethynyl)phenyl)benzenesulfonamide **1w** was prepared according to the general procedure as a yellow solid in 80% yield,

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.73-7.68 (2H, m), 7.54-7.49 (1H, m), 7.45-7.40 (1H, m), 7.39-7.27 (7H,m), 7.12-7.06 (2H, m), 2.94 (1H, s), 2.18 (3H, s).

^{1}C NMR (101 MHz, $CDCl_3$) δ 145.1, 138.3,134.5, 133.4, 131.7, 130.0, 129.7, 129.3, 129., 128.6, 128.4, 128.1, 122.9, 122.8, 95.5, 84.9, 76.0, 59.2, 21.6.

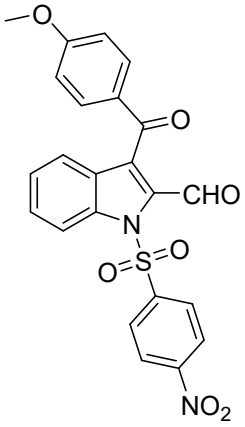
The spectroscopic properties were consistent with the data available in the literature[2].

General procedure for the synthesis compound 2



To a solution of **1** (0.1 mmol) in DCE (0.1 M) was added 0.2 mmol 2,6-dibromo-pyridine *N*-oxide, the Au catalyst, NaBArF[4], and 4Å MS. The reaction mixture was stirred at 60 °C. (oil bath). The progress of the reaction was monitored by TLC. Upon completion, the resulting mixture was concentrated and the residue was purified through silica gel flash column chromatography (eluents: EtOAc and hexanes) to give the compound **2**.

3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2a**)



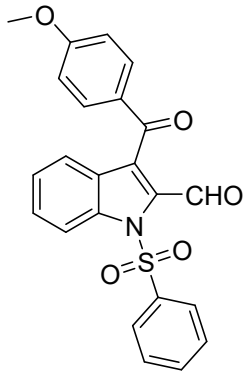
3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2a** was prepared according to the general procedure in 2 h as a yellow solid in 83% yield, 37.7 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.27 (s, 1H), 8.31 (dd, *J* = 16.7, 8.6 Hz, 3H), 8.12 (d, *J* = 8.7 Hz, 2H), 7.74 (d, *J* = 8.5 Hz, 2H), 7.62 (dd, *J* = 8.6, 7.0 Hz, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.35 (t, *J* = 7.6 Hz, 1H), 6.90 (d, *J* = 8.7 Hz, 2H), 3.87 (s, 3H).

^{1}C NMR (101 MHz, $CDCl_3$) δ 189.1, 181.5, 164.7, 151.0, 142.9, 137.5, 134.4, 133.0, 132.0, 130.1, 129.6, 128.6, 127.7, 125.9, 124.7, 123.1, 115.3, 114.2, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 487.0570, found 487.0579.

3-(4-methoxybenzoyl)-1-(phenylsulfonyl)-1*H*-indole-2-carbaldehyde (**2b**)



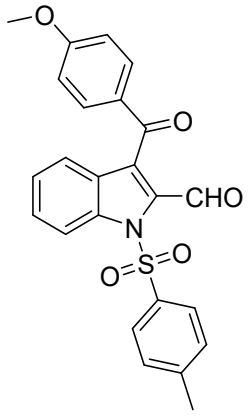
3-(4-methoxybenzoyl)-1-(phenylsulfonyl)-1*H*-indole-2-carbaldehyde **2b** was prepared according to the general procedure in 2 h as a yellow solid in 65% yield, 27.2 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.47 (s, 1H), 8.30 (d, *J* = 8.6 Hz, 1H), 7.94 – 7.85 (m, 2H), 7.75 – 7.67 (m, 2H), 7.60 (dd, *J* = 8.2, 6.9 Hz, 2H), 7.48 (t, *J* = 7.9 Hz, 2H), 7.45 – 7.40 (m, 1H), 7.33 – 7.27 (m, 1H), 6.93 – 6.85 (m, 2H), 3.85 (s, 3H).

^{1}C NMR (101 MHz, $CDCl_3$) δ 190.0, 182.4, 164.4, 137.4, 137.4, 134.7, 134.1, 131.8, 131.2, 129.7, 129.6, 129.6, 127.7, 126.9, 125.4, 122.6, 115.4, 114.1, 55.6.

ESI HRMS m/z $(M+Na)^+$ calcd 442.0720, found 442.0728.

3-(4-methoxybenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde (**2c**)



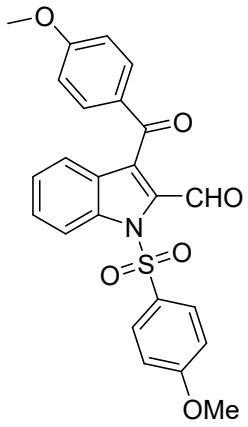
3-(4-methoxybenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde **2c** was prepared according to the general procedure in 2 h as a yellow solid in 61% yield, 24.4 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.49 (s, 1H), 8.29 (d, *J* = 8.4 Hz, 1H), 7.91 – 7.68 (m, 4H), 7.57 (t, *J* = 7.7 Hz, 1H), 7.41 (d, *J* = 7.8 Hz, 1H), 7.38 – 7.18 (m, 3H), 6.87 (d, *J* = 8.8 Hz, 2H), 3.85 (s, 3H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.1, 182.6, 164.3, 146.2, 137.3, 134.4, 134.1, 131.8, 130.9, 130.2, 129.7, 129.5, 127.7, 126.9, 125.4, 122.5, 115.4, 114.0, 55.6, 21.7.

ESI HRMS m/z $(M+H)^+$ calcd 434.1057, found 434.1059.

3-(4-methoxybenzoyl)-1-((4-methoxyphenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2d**)



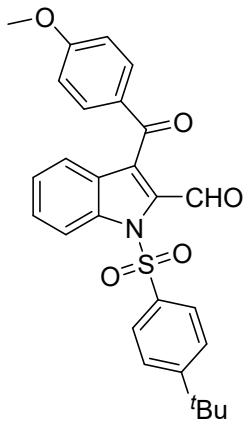
3-(4-methoxybenzoyl)-1-((4-methoxyphenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2d** was prepared according to the general procedure in 2 h as a yellow solid in 46% yield, 22.5 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ10.49 (s, 1H), 8.28 (d, *J* = 8.5 Hz, 1H), 7.79 (d, *J* = 8.9 Hz, 2H), 7.70 (d, *J* = 8.9 Hz, 2H), 7.56 (t, *J* = 7.8 Hz, 1H), 7.41 (d, *J* = 7.9 Hz, 1H), 7.28 (t, *J* = 7.6 Hz, 1H), 6.88 (dd, *J* = 10.9, 8.4 Hz, 4H), 3.81 (3H), 3.80(3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.1, 182.7, 164.5, 164.3, 137.3, 134.2, 131.8, 130.8, 129.8, 129.4, 129.3, 128.7, 127.7, 125.3, 122.5, 115.4, 114.8, 114.0, 55.8, 55.6.

ESI HRMS m/z $(M+H)^+$ calcd 450.1006, found 450.1012.

1-((4-(*tert*-butyl)phenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde (**2e**)

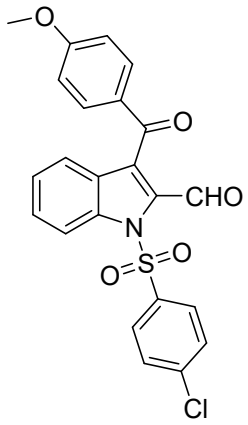


1-((4-(*tert*-butyl)phenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde **2e** was prepared according to the general procedure in 2 h as a white solid in 48% yield, 22.8 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.53 (s, 1H), 8.35 (d, *J* = 8.6 Hz, 1H), 7.87 – 7.81 (m, 2H), 7.79 – 7.72 (m, 2H), 7.60 (ddd, *J* = 8.6, 7.2, 1.3 Hz, 1H), 7.54 – 7.49 (m, 2H), 7.45 (d, *J* = 8.0 Hz, 1H), 7.32 (t, *J* = 7.6 Hz, 1H), 6.94 – 6.86 (m, 2H), 3.87 (s, 3H), 1.31 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.2, 182.6, 164.3, 159.0, 137.3, 134.5, 134.0, 131.8, 130.65, 129.8, 129.4, 127.6, 126.8, 126.7, 125.3, 122.5, 115.3, 114.0, 55.6, 35.4, 30.9. ESI HRMS m/z $(M+H)^+$ calcd 476.1526, found 476.1536.

1-((4-chlorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde (**2f**)



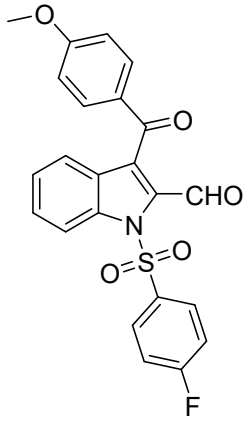
1-((4-chlorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde **2f** was prepared according to the general procedure in 2 h as a yellow oil in 76% yield, 34.4 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.40 (s, 1H), 8.27 (d, *J* = 8.6 Hz, 1H), 7.82 (d, *J* = 8.7 Hz, 2H), 7.70 (d, *J* = 8.8 Hz, 2H), 7.59 (ddd, *J* = 8.5, 7.1, 1.3 Hz, 1H), 7.45 (d, *J* = 8.7 Hz, 3H), 7.32 (t, *J* = 7.6 Hz, 1H), 6.89 (d, *J* = 8.9 Hz, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.7, 182.2, 164.5, 141.6, 137.3, 135.7, 134.2, 131.9, 131.9, 129.9, 129.8, 129.6, 128.4, 127.8, 125.7, 122.8, 115.4, 114.1, 55.6.

ESI HRMS m/z $(M+Na)^+$ calcd 476.0330, found 476.0338.

1-((4-fluorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde (**2g**)



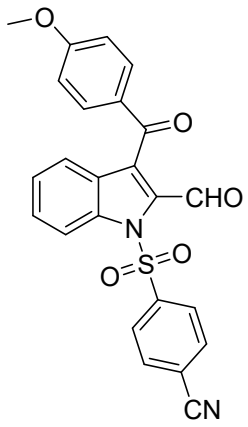
1-((4-fluorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde **2g** was prepared according to the general procedure in 2 h as a yellow oil in 70% yield, 30.6 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.42 (s, 1H), 8.27 (d, *J* = 8.6 Hz, 1H), 7.97 – 7.85 (m, 2H), 7.77 – 7.66 (m, 2H), 7.59 (ddd, *J* = 8.6, 7.1, 1.3 Hz, 1H), 7.43 (d, *J* = 8.0 Hz, 1H), 7.32 (t, *J* = 7.4 Hz, 1H), 7.20 – 7.12 (m, 2H), 6.93 – 6.85 (m, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.8, 182.3, 166.2 (d, *J* = 258.6 Hz), 164.5, 137.3, 134.2, 133.4 (d, *J* = 3.1 Hz), 131.8, 131.7, 130.1, 130.0, 129.7, 129.6, 127.7, 125.6, 122.7, 117.2, 116.9, 115.3, 114.1, 55.6.

ESI HRMS m/z $(M+Na)^+$ calcd 460.0625, found 460.0634.

4-((2-formyl-3-(4-methoxybenzoyl)-1*H*-indol-1-yl)sulfonyl)benzonitrile (**2h**)



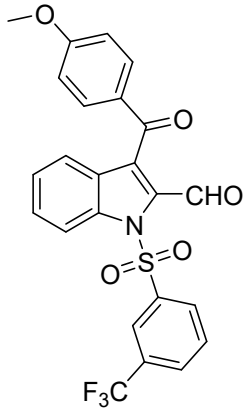
4-((2-formyl-3-(4-methoxybenzoyl)-1*H*-indol-1-yl)sulfonyl)benzonitrile **2h** was prepared according to the general procedure in 2 h as a yellow solid in 75% yield, 33.3 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.28 (s, 1H), 8.27 (d, *J* = 8.6 Hz, 1H), 8.09 – 7.96 (m, 2H), 7.85 – 7.67 (m, 4H), 7.61 (ddd, *J* = 8.6, 7.1, 1.3 Hz, 1H), 7.48 – 7.30 (m, 2H), 7.01 – 6.82 (m, 2H), 3.87 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.2, 181.6, 164.6, 141.4, 137.4, 134.3, 133.2, 132.8, 132.0, 130.0, 129.6, 127.8, 127.7, 125.8, 123.0, 118.2, 116.7, 115.3, 114.2, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 467.0672, found 467.0680.

3-(4-methoxybenzoyl)-1-((3-(trifluoromethyl)phenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2i**)



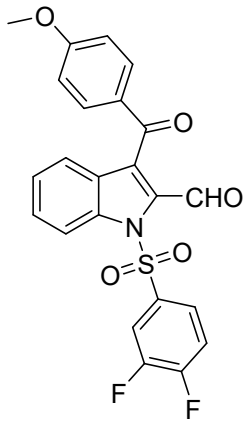
3-(4-methoxybenzoyl)-1-((3-(trifluoromethyl)phenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2i** was prepared according to the general procedure in 2 h as a yellow solid in 68% yield, 33.1 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.35 (s, 1H), 8.29 (d, *J* = 8.6 Hz, 1H), 8.20 (d, *J* = 2.1 Hz, 1H), 8.09 (dd, *J* = 7.8, 1.9 Hz, 1H), 7.88 (d, *J* = 7.8 Hz, 1H), 7.77 – 7.70 (m, 2H), 7.70 – 7.57 (m, 2H), 7.43 (d, *J* = 8.0 Hz, 1H), 7.33 (t, *J* = 7.6 Hz, 1H), 6.95 – 6.86 (m, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.5, 181.7, 164.6, 138.7, 137.4, 134.3, 132.4, 132.2 (q, *J* = 33.9 Hz), 131.9, 131.3 (q, *J* = 3.5 Hz), 130.5, 130.3, 129.9, 129.7, 127.7, 125.7, 124.2 (q, *J* = 3.9 Hz), 122.9, 122.8 (q, *J* = 272.9 Hz), 115.3, 114.2, 55.6.

ESI HRMS m/z $(M+H)^+$ calcd 488.0774, found 488.0777.

1-((3,4-difluorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde (**2j**)



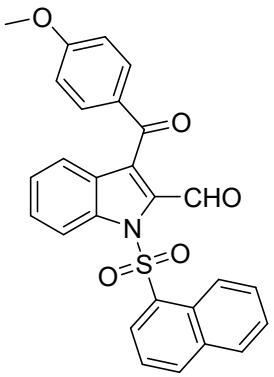
1-((3,4-difluorophenyl)sulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde **2j** was prepared according to the general procedure in 2 h as a yellow oil in 63% yield, 28.5 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.34 (s, 1H), 8.27 (d, *J* = 8.6 Hz, 1H), 7.86 – 7.76 (m, 2H), 7.64 (ddd, *J* = 8.6, 7.1, 1.3 Hz, 1H), 7.48 (dt, *J* = 5.4, 1.8 Hz, 3H), 7.43 – 7.34 (m, 1H), 7.16 – 7.05 (m, 1H), 6.98 – 6.89 (m, 2H), 3.89 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 181.6, 164.6, 164.1, 164.0, 161.5, 161.4, 140.4, 137.3, 134.2, 132.5, 131.9, 130.0, 129.6, 127.7, 125.8, 122.9, 115.2, 114.2, 111.0, 110.9, 110.8, 110.7, 110.5, 110.2, 55.6.

ESI HRMS m/z $(M+Na)^+$ calcd 478.0531, found 478.0539.

3-(4-methoxybenzoyl)-1-(naphthalen-1-ylsulfonyl)-1*H*-indole-2-carbaldehyde (**2k**)



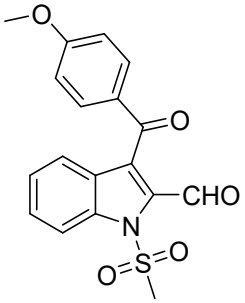
3-(4-methoxybenzoyl)-1-(naphthalen-1-ylsulfonyl)-1*H*-indole-2-carbaldehyde **2k** was prepared according to the general procedure in 2 h as a yellow oil in 58% yield, 27.2 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.55 (s, 1H), 8.51 (d, *J* = 1.9 Hz, 1H), 8.37 (d, *J* = 8.6 Hz, 1H), 7.96 (d, *J* = 8.0 Hz, 1H), 7.87 (dd, *J* = 8.6, 3.1 Hz, 2H), 7.74 – 7.55 (m, 6H), 7.43 – 7.34 (m, 1H), 7.32 – 7.23 (m, 1H), 6.82 – 6.74 (m, 2H), 3.82 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.0, 182.6, 164.3, 137.5, 135.5, 134.2, 134.1, 131.8, 131.8, 131.3, 130.1, 130.0, 129.7, 129.7, 129.6, 129.0, 128.2, 128.0, 127.7, 125.5, 122.6, 121.1, 115.5, 114.0, 55.6.

ESI HRMS m/z $(M+H)^+$ calcd 470.1057, found 470.1067.

3-(4-methoxybenzoyl)-1-(methylsulfonyl)-1*H*-indole-2-carbaldehyde (**2l**)



3-(4-methoxybenzoyl)-1-(methylsulfonyl)-1*H*-indole-2-carbaldehyde **2l** was prepared according to the general procedure in 2 h as a yellow oil in 50% yield, 22.9 mg, PE/EA = 5/1.

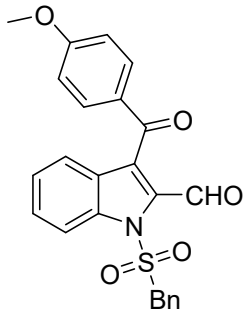
^{1}H NMR(400 MHz, $CDCl_3$) δ 10.07 (d, *J* = 0.9 Hz, 1H), 8.15 (d, *J* = 8.7 Hz, 1H), 7.89 (d, *J* = 8.6 Hz, 2H), 7.56 (ddd, *J* = 8.5, 7.3, 1.3 Hz, 1H), 7.52 – 7.43 (m, 1H), 7.39 –

7.29 (m, 1H), 6.96 (d, *J* = 8.6 Hz, 2H), 3.89 (s, 3H), 3.62 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.3, 181.5, 164.7, 137.9, 135.4, 132.5, 132.4, 130.2, 129.5, 126.8, 125.0, 122.9, 115.2, 114.2, 55.7, 43.2.

ESI HRMS m/z $(M+Na)^+$ calcd 380.0563, found 380.0572.

1-(benzylsulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde (**2m**)



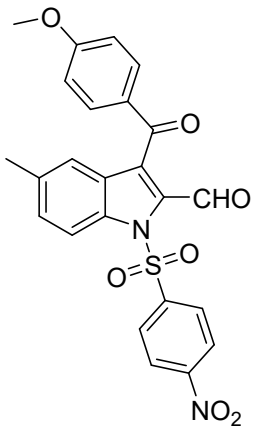
1-(benzylsulfonyl)-3-(4-methoxybenzoyl)-1*H*-indole-2-carbaldehyde **2m** was prepared according to the general procedure in 2 h as a yellow oil in 74% yield, 32.0 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 9.79 (d, *J* = 1.1 Hz, 1H), 7.84 – 7.63 (m, 3H), 7.47 – 7.38 (m, 2H), 7.35 – 7.29 (m, 1H), 7.29 – 7.22 (m, 3H), 7.18 – 7.11 (m, 2H), 6.97 – 6.89 (m, 2H), 4.96 (s, 2H), 3.88 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.5, 181.5, 164.5, 137.9, 135.8, 132.2, 130.9, 130.9, 130.1, 129.8, 129.2, 129.1, 126.61, 126.4, 124.9, 122.6, 114.9, 114.1, 61.1, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 456.0876, found 456.0885.

3-(4-methoxybenzoyl)-5-methyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2n**)



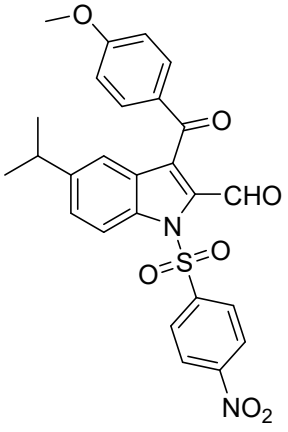
3-(4-methoxybenzoyl)-5-methyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2n** was prepared according to the general procedure in 2 h as a yellow solid in 62% yield, 29.2 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.28 (s, 1H), 8.38 – 8.27 (m, 2H), 8.15 (d, *J* = 8.7 Hz, 1H), 8.11 – 8.04 (m, 2H), 7.75 – 7.68 (m, 2H), 7.43 (dd, *J* = 8.7, 1.7 Hz, 1H), 7.24 – 7.19 (m, 1H), 6.94 – 6.85 (m, 2H), 3.87 (s, 3H), 2.36 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 181.6, 164.6, 150.9, 142.7, 136.2, 135.7, 134.2, 132.9, 131.9, 131.9, 129.5, 128.5, 128.0, 124.6, 122.5, 115.0, 114.2, 55.7, 21.2.

ESI HRMS m/z $(M+H)^+$ calcd 479.0907, found 479.0915.

5-isopropyl-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2o**)



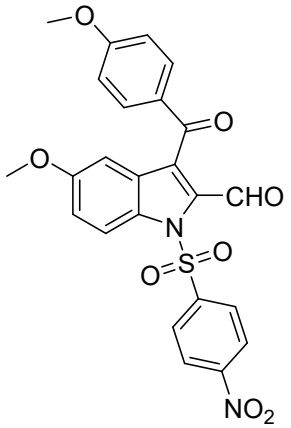
5-isopropyl-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2o** was prepared according to the general procedure in 2 h as a yellow solid in 66% yield, 33.4 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.28 (s, 1H), 8.38 – 8.27 (m, 2H), 8.15 (d, *J* = 8.7 Hz, 1H), 8.11 – 8.04 (m, 2H), 7.75 – 7.68 (m, 2H), 7.43 (dd, *J* = 8.7, 1.7 Hz, 1H), 7.24 – 7.19 (m, 1H), 6.94 – 6.85 (m, 2H), 3.87 (s, 3H), 2.36 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 181.6, 164.6, 150.9, 142.7, 136.2, 135.7, 134.2, 132.9, 131.9, 131.9, 129.5, 128.5, 128.0, 124.6, 122.5, 115.0, 114.2, 55.7, 21.2.

ESI HRMS m/z $(M+H)^+$ calcd 507.1220, found 507.1225.

5-methoxy-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2p**)



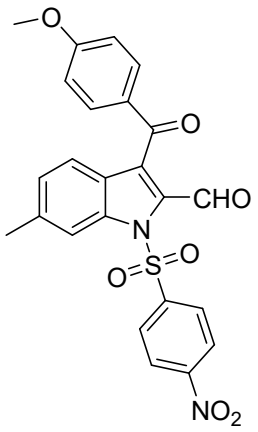
5-methoxy-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2p** was prepared according to the general procedure in 2 h as a yellow solid in 67% yield, 33.1 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.28 (s, 1H), 8.38 – 8.24 (m, 2H), 8.17 (d, *J* = 9.3 Hz, 1H), 8.08 – 7.98 (m, 2H), 7.77 – 7.64 (m, 2H), 7.22 (dd, *J* = 9.3, 2.6 Hz, 1H), 6.95 – 6.83 (m, 2H), 6.79 (d, *J* = 2.5 Hz, 1H), 3.86 (s, 3H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 181.6, 164.6, 158.0, 151.0, 142.5, 134.6, 132.6, 132.0, 131.8, 129.5, 128.9, 128.4, 124.7, 120.7, 116.5, 114.2, 103.2, 55.7, 55.7.

ESI HRMSm/z $(M+H)^+$ calcd 495.0857, found 495.0855.

3-(4-methoxybenzoyl)-6-methyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2q**)



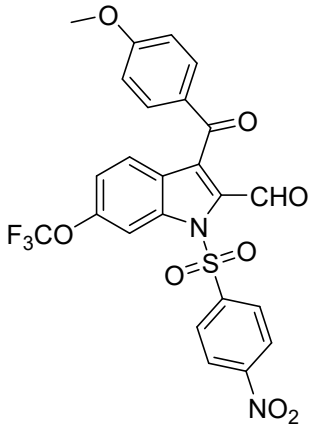
3-(4-methoxybenzoyl)-6-methyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2q** was prepared according to the general procedure in 2 h as a yellow oil in 58% yield, 27.7 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.21 (s, 1H), 8.40 – 8.27 (m, 2H), 8.17 – 8.04 (m, 3H), 7.78 – 7.66 (m, 2H), 7.31 (d, *J* = 8.2 Hz, 1H), 7.18 (dd, *J* = 8.3, 1.4 Hz, 1H), 6.95 – 6.82 (m, 2H), 3.86 (s, 3H), 2.57 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.3, 181.2, 164.6, 150.9, 143.1, 141.3, 138.1, 133.9, 133.4, 132.0, 129.6, 128.5, 127.7, 125.5, 124.6, 122.6, 115.1, 114.2, 55.7, 22.6.

ESI HRMSm/z $(M+H)^+$ calcd 479.0907, found 479.0906.

3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-6-(trifluoromethoxy)-1*H*-indole-2-carbaldehyde (**2r**)



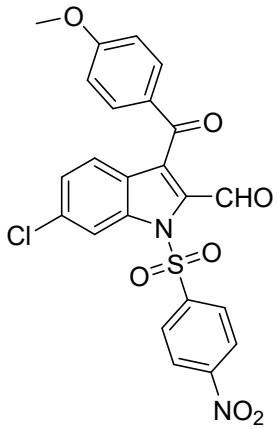
3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-6-(trifluoromethoxy)-1*H*-indole-2-carbaldehyde **2r** was prepared according to the general procedure in 2 h as a yellow solid in 64% yield, 35.1 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.24 (s, 1H), 8.46 – 8.36 (m, 2H), 8.24 – 8.12 (m, 3H), 7.85 – 7.70 (m, 2H), 7.52 (d, *J* = 8.8 Hz, 1H), 7.33 – 7.21 (m, 1H), 7.00 – 6.89 (m, 2H), 3.90 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 188.4, 181.0, 164.8, 151.1, 150.1, 142.6, 137.5, 135.6, 132.1, 132.1, 129.4, 128.7, 125.9, 124.8, 124.3, 120.4 (q, *J* = 258.9 Hz), 119.6, 114.3, 108.4, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 571.0393, found 571.0399.

6-chloro-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2s**)



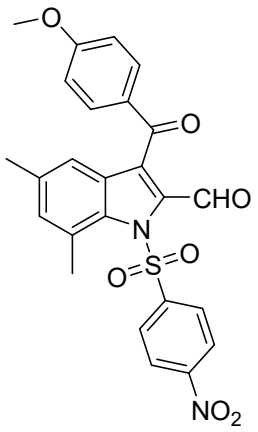
6-chloro-3-(4-methoxybenzoyl)-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2s** was prepared according to the general procedure in 2 h as a yellow solid in 62% yield, 30.9 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.18 (s, 1H), 8.44 – 8.30 (m, 3H), 8.21 – 8.12 (m, 2H), 7.79 – 7.70 (m, 2H), 7.44 – 7.30 (m, 2H), 6.99 – 6.85 (m, 2H), 3.88 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 188.6, 181.0, 164.8, 151.1, 142.9, 137.8, 136.3, 134.8, 132.4, 132.1, 129.5, 128.7, 126.8, 126.0, 124.8, 123.9, 115.4, 114.3, 55.7.

ESI HRMS m/z $(M+Na)^+$ calcd 521.0181, found 521.0186.

3-(4-methoxybenzoyl)-5,7-dimethyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde (**2t**)

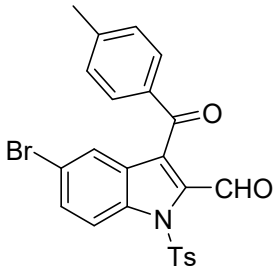


3-(4-methoxybenzoyl)-5,7-dimethyl-1-((4-nitrophenyl)sulfonyl)-1*H*-indole-2-carbaldehyde **2t** was prepared according to the general procedure in 2 h as a yellow solid in 55% yield, 27.1 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.12 (s, 1H), 8.39 – 8.16 (m, 2H), 7.99 – 7.78 (m, 2H), 7.68 – 7.46 (m, 2H), 7.22 (d, *J* = 1.6 Hz, 1H), 7.00 – 6.71 (m, 3H), 3.86 (s, 3H), 2.68 (s, 3H), 2.28 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.0, 182.0, 164.7, 150.8, 141.2, 137.4, 137.3, 137.3, 137.2, 135.1, 131.8, 131.6, 129.2, 129.2, 128.8, 124.1, 120.7, 114.1, 55.7, 21.4, 21.0. ESI HRMSm/z $(M+H)^+$ calcd 493.1064, found 493.1064.

5-bromo-3-(4-methylbenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde (**2u**)



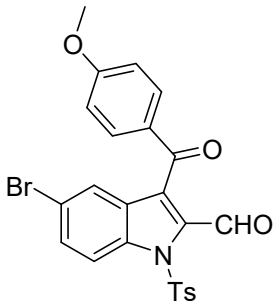
5-bromo-3-(4-methylbenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde **2u** was prepared according to the general procedure in 2 h as a yellow solid in 55% yield, 27.2 mg, PE/EA = 5/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.46 (s, 1H), 8.17 (d, *J* = 9.0 Hz, 1H), 7.71 (d, *J* = 8.1 Hz, 2H), 7.68 – 7.56 (m, 4H), 7.28 (d, *J* = 8.3 Hz, 2H), 7.22 (d, *J* = 7.9 Hz, 2H), 2.41 (s, 3H), 2.40 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 190.7, 182.5, 146.6, 145.4, 135.8, 135.0, 134.1, 134.0, 132.4, 130.4, 129.6, 129.4, 129.2, 129.1, 126.9, 124.9, 118.9, 116.8, 21.9, 21.8.

ESI HRMSm/z $(M+Na)^+$ calcd 518.0032, found 518.0037.

5-bromo-3-(4-methoxybenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde (**2v**)



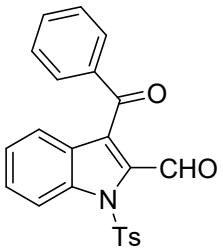
5-bromo-3-(4-methoxybenzoyl)-1-tosyl-1*H*-indole-2-carbaldehyde **2v** was prepared according to the general procedure in 2 h as a yellow solid in 79% yield, 40.4 mg, PE/EA = 3/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 10.47 (s, 1H), 8.17 (d, *J* = 9.0 Hz, 1H), 7.76 – 7.67 (m, 4H), 7.65 (dd, *J* = 9.1, 2.0 Hz, 1H), 7.57 (d, *J* = 1.9 Hz, 1H), 7.28 (d, *J* = 8.2 Hz, 2H), 6.94 – 6.85 (m, 2H), 3.86 (s, 3H), 2.39 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 189.4, 182.4, 164.5, 146.5, 135.6, 134.8, 134.2, 132.4, 131.8, 130.4, 129.5, 129.4, 129.1, 126.9, 124.9, 118.8, 116.8, 114.2, 55.6, 21.7.

ESI HRMS m/z $(M+Na)^+$ calcd 533.9981, found 533.9985.

3-benzoyl-1-tosyl-1*H*-indole-2-carbaldehyde (**2w**)



3-benzoyl-1-tosyl-1*H*-indole-2-carbaldehyde **2w** was prepared according to the general procedure in 2 h as a yellow solid in 61% yield, 24.6 mg, PE/EA = 5/1.

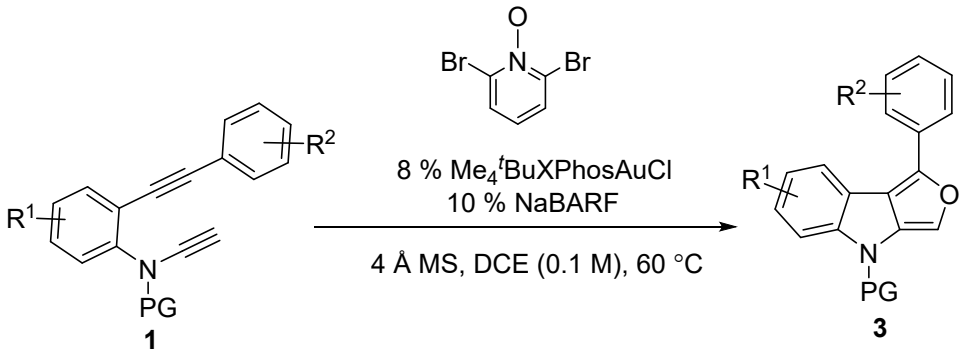
^{1}H NMR(400 MHz, $CDCl_3$) δ 10.49 (s, 1H), 8.30 (d, *J* = 8.6 Hz, 1H), 7.73 (dd, *J* = 7.9, 2.3 Hz, 4H), 7.62 – 7.54 (m, 2H), 7.41 (td, *J* = 8.0, 2.5 Hz, 3H), 7.30 (t, *J* = 7.6 Hz,

1H), 7.26 (d, *J* = 8.1 Hz, 2H), 2.38 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 191.8, 182.7, 146.2, 137.3, 136.7, 134.5, 134.4, 134.0, 130.38, 130.3, 129.5, 129.3, 128.8, 127.6, 126.9, 125.4, 122.4, 115.4, 21.7.

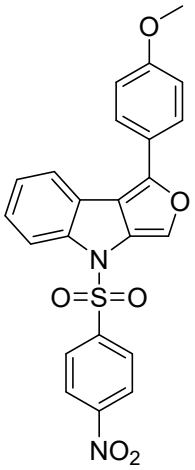
ESI HRMS m/z $(M+H)^+$ calcd 404.0951, found 404.0959.

General procedure for the synthesis compound 3:



To a solution of **1** (0.1 mmol) in DCE (0.1 M) was added 0.3 mmol 2,6-dibromo-pyridine *N*-oxide, the Au catalyst, $NaBArF^4$, and 4Å MS. The reaction mixture was stirred at 60 °C (oil bath). The progress of the reaction was monitored by TLC. Upon completion, the resulting mixture was concentrated and the residue was purified through silica gel flash column chromatography (eluents: EtOAc and hexanes) to give the compound **3**.

1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3a**)



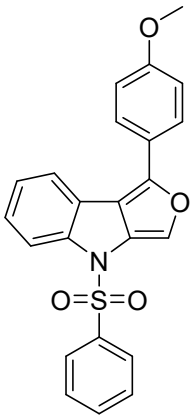
1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3a** was prepared according to the general procedure in 0.5 h as a white solid in 84% yield, 39.6 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.41 – 8.14 (m, 2H), 8.12 – 7.97 (m, 3H), 7.94 – 7.68 (m, 4H), 7.35 (dp, *J* = 38.9, 8.7, 8.2 Hz, 2H), 7.17 – 6.93 (m, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.7, 150.8, 144.2, 143.8, 141.7, 134.2, 128.2, 127.5, 126.6, 125.2, 124.3, 123.3, 123.2, 122.8, 122.4, 115.4, 115.1, 114.5, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 449.0802, found 449.0799.

1-(4-methoxyphenyl)-4-(phenylsulfonyl)-4*H*-furo[3,4-*b*]indole (**3b**)



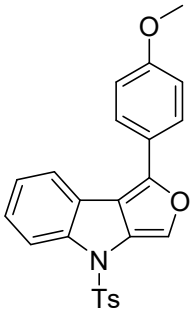
1-(4-methoxyphenyl)-4-(phenylsulfonyl)-4*H*-furo[3,4-*b*]indole **3b** was prepared according to the general procedure in 0.5 h as a white solid in 68% yield, 27.4 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.05 (dt, *J* = 8.2, 0.9 Hz, 1H), 7.92 – 7.87 (m, 2H), 7.85 (dt, *J* = 7.7, 1.1 Hz, 1H), 7.82 – 7.74 (m, 3H), 7.50 (d, *J* = 7.5 Hz, 1H), 7.43 – 7.35 (m, 3H), 7.28 (td, *J* = 7.6, 1.1 Hz, 1H), 7.07 – 6.99 (m, 2H), 3.87 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4, 144.328, 143.6, 136.8, 134.7, 134.0, 129.1, 127.2, 127.0, 126.5, 124.4, 123.7, 122.8, 122.5, 122.2, 115.6, 115.0, 114.4, 55.4.

ESI HRMS m/z $(M+Na)^+$ calcd 426.0770, found 404.0955.

1-(4-methoxyphenyl)-4-tosyl-4*H*-furo[3,4-*b*]indole (**3c**)



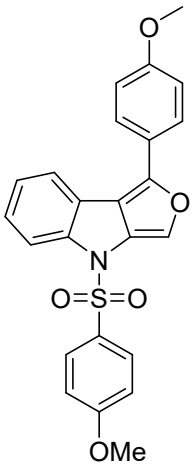
1-(4-methoxyphenyl)-4-tosyl-4*H*-furo[3,4-*b*]indole **3c** was prepared according to the general procedure in 0.5 h as a white solid in 84% yield, 35 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.41 – 8.14 (m, 2H), 8.12 – 7.97 (m, 3H), 7.94 – 7.68 (m, 4H), 7.35 (dp, *J* = 38.9, 8.7, 8.2 Hz, 2H), 7.17 – 6.93 (m, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.7, 150.8, 144.2, 143.8, 141.7, 134.2, 128.2, 127.5, 126.6, 125.2, 124.3, 123.3, 123.2, 122.8, 122.4, 115.4, 115.1, 114.5, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 418.1108, found 418.1109.

1-(4-methoxyphenyl)-4-((4-methoxyphenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3d**)



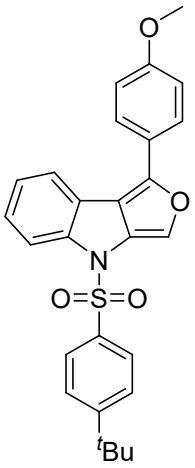
1-(4-methoxyphenyl)-4-((4-methoxyphenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3d** was prepared according to the general procedure in 0.5 h as a white solid in 67% yield, 29.0 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.00 (d, *J* = 8.3 Hz, 1H), 7.82 (d, *J* = 7.8 Hz, 1H), 7.79 – 7.70 (m, 5H), 7.40 – 7.33 (m, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 6.99 (d, *J* = 8.9 Hz, 2H), 6.76 (d, *J* = 9.2 Hz, 2H), 3.83 (s, 3H), 3.69 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.9, 159.4, 144.4, 143.5, 134.9, 129.2, 128.3, 127.2, 126.5, 124.2, 123.7, 122.9, 122.5, 122.2, 115.7, 115.0, 114.4, 114.3, 55.5, 55.4.

ESI HRMSm/z $(M+H)^+$ calcd 434.1057, found 434.1062.

4-((4-(tert-butyl)phenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole (**3e**)



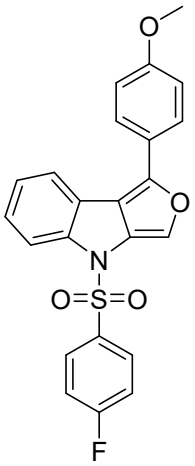
4-((4-(tert-butyl)phenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole **3e** was prepared according to the general procedure in 0.5 h as a yellow solid in 70% yield, 32.1 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.2 Hz, 1H), 7.83 (d, *J* = 7.7 Hz, 1H), 7.81 – 7.71 (m, 5H), 7.41 – 7.33 (m, 3H), 7.24 (t, *J* = 7.7 Hz, 1H), 6.99 (d, *J* = 8.8 Hz, 2H), 3.83 (s, 3H), 1.20 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4, 157.9, 144.3, 143.53, 134.7, 134.0, 127.2, 126. 9, 126.5, 126.2, 124.1, 123.7, 122.7, 122.3, 122.2, 115.6, 114.9, 114.4, 55.4, 35.2, 30.9.

ESI HRMS m/z $(M+H)^+$ calcd 460.1577, found 460.1581.

4-((4-fluorophenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole (**3g**)



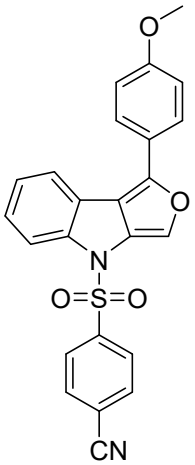
4-((4-fluorophenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole **3g** was prepared according to the general procedure in 0.5 h as a yellow solid in 65% yield, 39.6 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.99 (d, *J* = 8.2 Hz, 1H), 7.91 – 7.80 (m, 3H), 7.78 – 7.67 (m, 3H), 7.37 (td, *J* = 7.9, 1.3 Hz, 1H), 7.34 – 7.23 (m, 1H), 7.09 – 6.91 (m, 4H), 3.84 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.9 (d, *J* = 256.8 Hz), 159.5, 144.2, 143.80, 134.6, 132.7 (d, *J* = 3.0 Hz), 129.8, 129.7, 127.3, 126.6, 124.6, 123.6, 129.8(d, *J* = 9.5 Hz), 122.3, 116.5 (d, *J* = 22.7 Hz), 115.6, 115.1, 114.4, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 422.0857, found 422.0863.

4-((1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indol-4-yl)sulfonyl)benzonitrile (**3h**)



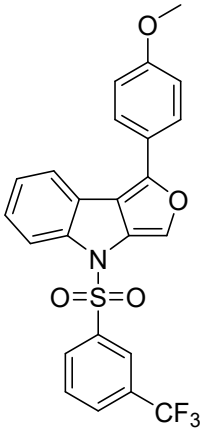
4-((1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indol-4-yl)sulfonyl)benzonitrile **3h** was prepared according to the general procedure in 0.5 h as a white solid in 70% yield, 30.0 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.96 (dd, *J* = 20.1, 8.2 Hz, 3H), 7.83 (d, *J* = 7.7 Hz, 1H), 7.79 – 7.57 (m, 5H), 7.39 (t, *J* = 7.9 Hz, 1H), 7.29 (t, *J* = 11.4 Hz, 1H), 7.01 (d, *J* = 8.4 Hz, 2H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.6, 144.1, 143.8, 140.3, 134.2, 132. 9, 127.5, 127.6, 126.6, 125.1, 123.4, 123.1, 122.7, 122.4, 117.7, 117.0, 115.4, 115.1, 114.5, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 429.0904, found 429.0904.

1-(4-methoxyphenyl)-4-((3-(trifluoromethyl)phenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3i**)



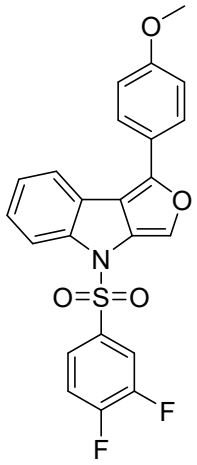
1-(4-methoxyphenyl)-4-((3-(trifluoromethyl)phenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3i** was prepared according to the general procedure in 0.5 h as a yellow solid in 60% yield, 28.2 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 1.9 Hz, 1H), 8.00 (t, *J* = 7.8 Hz, 2H), 7.82 (dd, *J* = 7.8, 1.3 Hz, 1H), 7.78 – 7.68 (m, 4H), 7.50 (t, *J* = 7.9 Hz, 1H), 7.45 – 7.35 (m, 1H), 7.28 (td, *J* = 7.6, 1.1 Hz, 1H), 7.00 (d, *J* = 8.9 Hz, 2H), 3.84 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.5, 144.0, 143.9, 137.6, 134.3, 131.6 (q, *J* = 33.6 Hz), 130.7 (q, *J* = 3.4 Hz), 130.0, 130.0, 127.4, 126.6, 124.9, 124.1 (q, *J* = 3.7 Hz), 123.5, 123.0, 122.9 (q, *J* = 272.9 Hz), 122.6, 122.3, 115.5, 115.0, 114.4, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 472.0825, found 472.0829.

4-((3,4-difluorophenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole (**3j**)



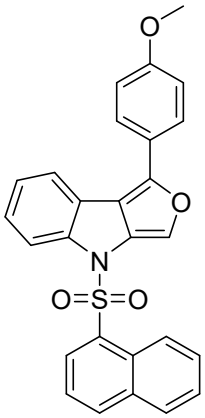
4-((3,4-difluorophenyl)sulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole **3j** was prepared according to the general procedure in 0.5 h as a yellow solid in 77% yield, 33.8 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.3 Hz, 1H), 7.84 (d, *J* = 7.7 Hz, 1H), 7.77 – 7.69 (m, 3H), 7.45 – 7.34 (m, 3H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.04 – 6.96 (m, 2H), 6.92 (tt, *J* = 8.4, 2.4 Hz, 1H), 3.85 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.8 (d, *J* = 11.7 Hz), 161.3 (d, *J* = 11.7 Hz), 159.6, 144.1, 143.8, 140.9, 140.2, 139.5, 139.4, 139.28, 134.2, 127.5, 127.1, 126.6, 125.0, 123.4, 123.0, 122.6, 122.4, 115.4, 115.0, 114.4, 110.8, 110.7 (d, *J* = 11.2 Hz), 110.6, 110.0, 109.8, 109.5, 55.4.

ESI HRMSm/z $(M+H)^+$ calcd 440.0763, found 440.0762.

1-(4-methoxyphenyl)-4-(naphthalen-1-ylsulfonyl)-4*H*-furo[3,4-*b*]indole (**3k**)



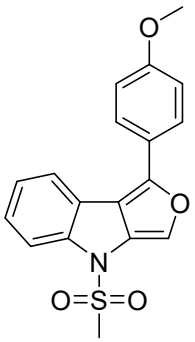
1-(4-methoxyphenyl)-4-(naphthalen-1-ylsulfonyl)-4*H*-furo[3,4-*b*]indole **3k** was prepared according to the general procedure in 0.5 h as a yellow solid in 80% yield, 36.2 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.46 (s, 1H), 8.07 (d, *J* = 8.3 Hz, 1H), 7.97 – 7.58 (m, 8H), 7.42 (dt, *J* = 51.0, 6.8 Hz, 3H), 7.20 (t, *J* = 7.8 Hz, 1H), 6.95 (d, *J* = 8.5 Hz, 2H), 3.80 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4, 144.3, 143.7, 135.4, 134.8, 133.8, 131.8, 129.5, 129.2, 128.8, 127.8, 127.7, 127.3, 126.5, 124.3, 123.7, 122.8, 122.5, 122.2, 121.8, 115.6, 115.0, 114.4, 55.4.

ESI HRMS m/z $(M+H)^+$ calcd 454.1108, found 454.1117.

1-(4-methoxyphenyl)-4-(methylsulfonyl)-4*H*-furo[3,4-*b*]indole (**3l**)



1-(4-methoxyphenyl)-4-(methylsulfonyl)-4*H*-furo[3,4-*b*]indole **3l** was prepared according to the general procedure in 0.5 h as a yellow solid in 67% yield, 22.8 mg, PE/EA = 15/1.

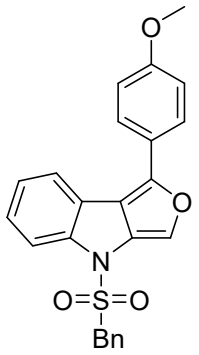
^{1}H NMR(400 MHz, $CDCl_3$) δ 7.92 (dd, *J* = 25.6, 7.9 Hz, 2H), 7.80 (d, *J* = 8.4 Hz, 2H),

7.60 (s, 1H), 7.38 (dt, *J* = 27.0, 7.6 Hz, 2H), 7.05 (d, *J* = 8.5 Hz, 2H), 3.88 (s, 3H), 2.94 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.5, 144.6, 143.9, 134.6, 127.5, 126.6, 124.7, 123.7 122.9, 122.3, 122.2, 115.6, 114.7, 114.5, 55.4, 36.5.

ESI HRMS m/z $(M+H)^+$ calcd 342.0795, found 342.0800.

4-(benzylsulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole (**3m**)



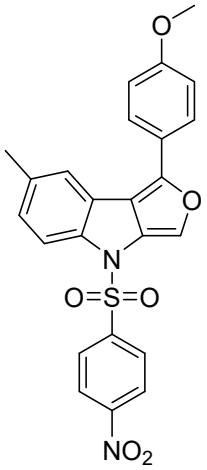
4-(benzylsulfonyl)-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole **3m** was prepared according to the general procedure in 0.5 h as a yellow solid in 77% yield, 37.5 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.90 (dd, *J* = 5.9, 3.2 Hz, 1H), 7.82 – 7.76 (m, 2H), 7.66 (dd, *J* = 6.0, 3.3 Hz, 1H), 7.39 (s, 1H), 7.26 (dt, *J* = 6.0, 3.5 Hz, 2H), 7.21 – 7.14 (m, 1H), 7.10 (t, *J* = 7.5 Hz, 2H), 7.04 (td, *J* = 8.4, 7.7, 1.9 Hz, 4H), 4.40 (s, 2H), 3.88 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.5, 145.1, 143.5, 135.0, 130.8, 129.1, 128.5, 127.2, 126.7, 126.6, 124.1, 123.8, 122.1, 122.1, 121.8, 115.2, 114.5, 114.4, 57.0, 55.5.

ESI HRMS m/z $(M+Na)^+$ calcd 440.0927, found 440.0928.

1-(4-methoxyphenyl)-7-methyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3n**)



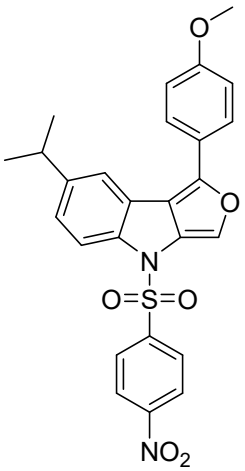
1-(4-methoxyphenyl)-7-methyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3n** was prepared according to the general procedure in 0.5 h as a yellow solid in 89% yield, 41.1 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.30 (d, J = 8.6 Hz, 2H), 8.19 – 8.03 (m, 3H), 7.89 (d, J = 8.5 Hz, 1H), 7.74 (d, J = 9.0 Hz, 3H), 7.33 (d, J = 8.5 Hz, 1H), 7.12 (d, J = 8.4 Hz, 2H), 3.82 (s, 3H), 2.41 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.5, 150.7, 142.1, 138.5, 134.7, 133.7, 133.3, 131.0, 130.7, 130.1, 125.2, 121.3, 114.6, 113.4, 97.2, 82.9, 74.3, 63.5, 55.8

ESI HRMS $(M+Na)^+$ calcd 463.0958, found 463.0959.

7-isopropyl-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3o**)



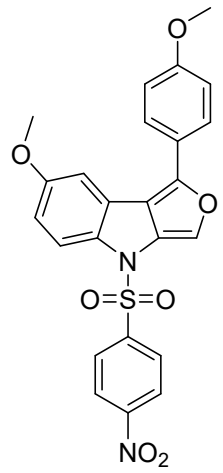
7-isopropyl-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3o** was prepared according to the general procedure in 0.5 h as a red solid in 75% yield, 36.8 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.31 (d, *J* = 8.4 Hz, 2H), 8.25 – 8.10 (m, 3H), 7.92 (d, *J* = 8.6 Hz, 1H), 7.74 (d, *J* = 9.1 Hz, 3H), 7.41 (d, *J* = 8.6 Hz, 1H), 7.13 (d, *J* = 8.3 Hz, 2H), 3.82 (s, 3H), 3.03 (p, *J* = 7.0 Hz, 1H), 1.23 (d, *J* = 6.8 Hz, 6H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 159.8, 151.5, 146.2, 143.6, 141.7, 140.6, 134.1, 128.9, 126.8, 126.5, 125.5, 123.8, 122.9, 122.3, 120.9, 115.4, 115.2, 115.0, 55.8, 33.7, 24.4.

ESI HRMS m/z $(M+H)^+$ calcd 491.1271, found 491.1272.

7-methoxy-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3p**)



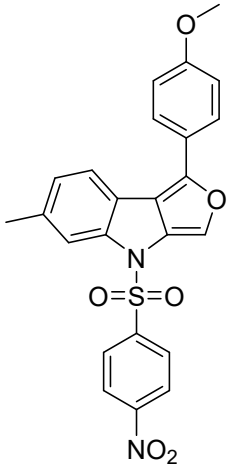
7-methoxy-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3p** was prepared according to the general procedure in 0.5 h as a red solid in 97% yield, 46.4 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.28 (d, *J* = 8.4 Hz, 2H), 8.10 (d, *J* = 4.6 Hz, 3H), 7.90 (d, *J* = 9.0 Hz, 1H), 7.68 (d, *J* = 8.4 Hz, 2H), 7.31 (s, 1H), 7.09 (d, *J* = 8.6 Hz, 3H), 3.81 (d, *J* = 9.3 Hz, 6H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 159.8, 157.5, 151.4, 143.8, 140.3, 137.4, 134.4, 128.9, 126.9, 125.4, 124.2, 123.7, 122.7, 116.2, 115.3, 115.2, 114.1, 108.1, 56.0, 55.7.

ESI HRMS m/z $(M+H)^+$ calcd 479.0907, found 479.0913.

1-(4-methoxyphenyl)-6-methyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3q**)

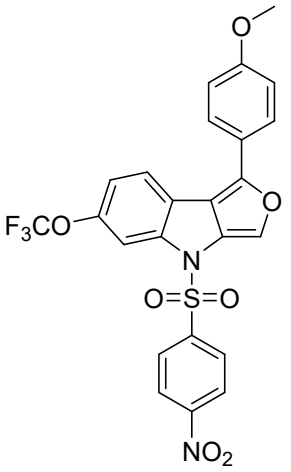


1-(4-methoxyphenyl)-6-methyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3q** was prepared according to the general procedure in 0.5 h as a red solid in 80% yield, 37.0 mg, PE/EA = 10/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.46 – 8.06 (m, 5H), 7.83 (t, J = 3.9 Hz, 2H), 7.72 (d, J = 8.4 Hz, 2H), 7.21 (d, J = 8.0 Hz, 1H), 7.11 (d, J = 8.4 Hz, 2H), 3.81 (s, 3H), 2.50 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 159.7, 151.5, 143.9, 143.1, 140.6, 138.70, 134.0, 128.9, 126.7, 126.7, 125.5, 123.9, 122.9, 122.8, 119.7, 115.5, 115.3, 115.0, 55.7, 22.0. ESI HRMS m/z $(M+Na)^+$ calcd 485.0778, found 463.0958.

1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-6-(trifluoromethoxy)-4*H*-furo[3,4-*b*]indole (**3r**)



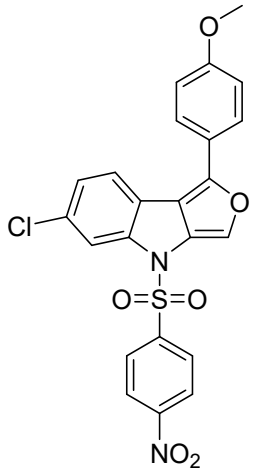
1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-6-(trifluoromethoxy)-4*H*-furo[3,4-*b*]indole **3r** was prepared according to the general procedure in 0.5 h as a red solid in 61% yield, 32.3 mg, PE/EA = 10/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.33 (d, J = 8.5 Hz, 2H), 8.27 – 8.19 (m, 3H), 8.04 (d, J = 8.6 Hz, 1H), 7.89 (s, 1H), 7.73 (d, J = 8.4 Hz, 2H), 7.40 (d, J = 8.5 Hz, 1H), 7.10 (d, J = 8.3 Hz, 2H), 3.82 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 160.0, 151.7, 147.7, 144.2, 144.1, 140.2, 134.2, 129.0, 126.9, 125.6, 124.3, 124.0, 122.5, 120.6 (q, J = 257.1 Hz), 118.7, 115.3, 113.9, 108.4, 55.8.

ESI HRMS m/z $(M+H)^+$ calcd 533.0625, found 533.0623.

6-chloro-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3s**)



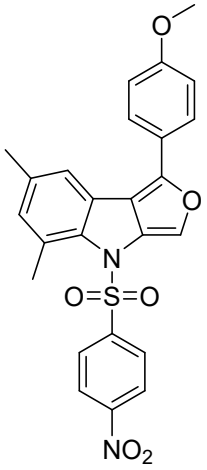
6-chloro-1-(4-methoxyphenyl)-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3s** was prepared according to the general procedure in 0.5 h as a yellow solid in 75% yield, 36.2 mg, PE/EA = 10/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.54 – 8.07 (m, 5H), 7.93 (d, J = 11.0 Hz, 2H), 7.70 (d, J = 8.4 Hz, 2H), 7.43 (d, J = 8.4 Hz, 1H), 7.09 (d, J = 8.4 Hz, 2H), 3.81 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 159.9, 151.7, 144.2, 144.0, 140.3, 133.9, 132.6, 129.0, 126.9, 125.9, 125.6, 124.2, 123.9, 122.5, 121.3, 115.3, 114.8, 114.1, 55.7.

ESI HRMS m/z $(M+H)^+$ calcd 483.0412, found 483.0414.

1-(4-methoxyphenyl)-5,7-dimethyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole (**3t**)



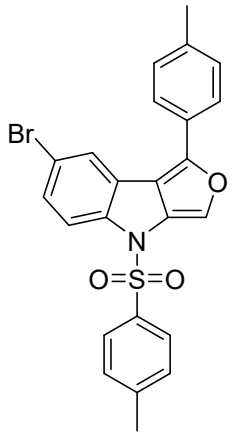
1-(4-methoxyphenyl)-5,7-dimethyl-4-((4-nitrophenyl)sulfonyl)-4*H*-furo[3,4-*b*]indole **3t** was prepared according to the general procedure in 0.5 h as a red solid in 70% yield, 26.3 mg, PE/EA = 10/1.

^{1}H NMR(400 MHz, DMSO-d_6) δ 8.19 (d, J = 8.4 Hz, 2H), 8.05 (s, 1H), 7.67 (dd, J = 28.8, 8.4 Hz, 4H), 7.45 (s, 1H), 7.22 – 7.01 (m, 3H), 3.79 (s, 3H), 2.65 (s, 3H), 2.34 (s, 3H).

^{13}C NMR (101 MHz, DMSO-d_6) δ 159.7, 151.1, 143.3, 142.3, 139.6, 136.7, 135.8, 132.6, 129.9, 129.4, 127.7, 126.9, 125.9, 124.8, 122.8, 120.7, 116.3, 115.2, 55.7, 21.4, 21.1.

ESI HRMS m/z $(M+H)^+$ calcd 477.1115, found 477.1119.

7-bromo-1-(*p*-tolyl)-4-tosyl-4*H*-furo[3,4-*b*]indole (**3u**)



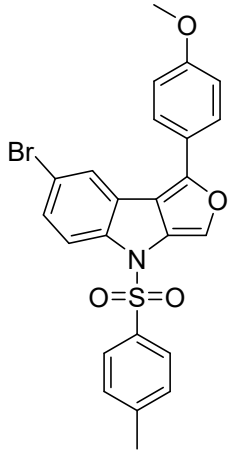
7-bromo-1-(*p*-tolyl)-4-tosyl-4*H*-furo[3,4-*b*]indole **3u** was prepared according to the general procedure in 0.5 h as a white solid in 60% yield, 28.2 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.1 Hz, 2H), 7.80 – 7.63 (m, 5H), 7.53 – 7.42 (m, 1H), 7.16 (d, *J* = 8.0 Hz, 2H), 7.01 (d, *J* = 8.4 Hz, 2H), 3.86 (s, 3H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.7, 145.4, 144.2, 143.2, 134.8, 133.5, 129.9, 127.0, 126.6, 124.9, 124.8, 123.3, 122.6, 117.4, 116.3, 114.6, 114.5, 55.4, 21.6.

ESI HRMS m/z $(M+Na)^+$ calcd 502.0083, found 502.0089.

7-bromo-1-(4-methoxyphenyl)-4-tosyl-4H-furo[3,4-*b*]indole (**3v**)



7-bromo-1-(4-methoxyphenyl)-4-tosyl-4H-furo[3,4-*b*]indole **3v** was prepared according to the general procedure in 0.5 h as a white solid in 80% yield, 39.6 mg, PE/EA = 15/1.

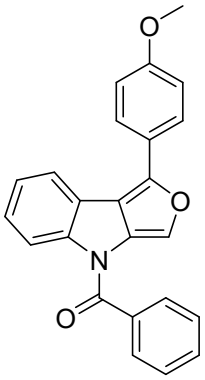
^{1}H NMR(400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.1 Hz, 2H), 7.80 – 7.64 (m, 5H), 7.55 –

7.42 (m, 1H), 7.16 (d, *J* = 8.0 Hz, 2H), 7.01 (d, *J* = 8.4 Hz, 2H), 3.86 (s, 3H), 2.29 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.7, 145.4, 144.2, 143.2, 134.8, 133.5, 129.9, 129.8, 127.0, 126.6, 124.9, 124.8, 123.3, 122.6, 117.4, 116.3, 114.6, 114.5, 55.4, 21.6.

ESI HRMS m/z $(M+H)^+$ calcd 496.0213, found 496.0211.

(1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indol-4-yl)(phenyl)methanone (**3w**)



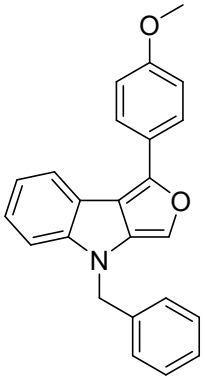
(1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indol-4-yl)(phenyl)methanone **3w** was prepared according to the general procedure in 24 h as a yellow oil in 99% yield, 36.3 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 7.71 – 7.53 (m, 4H), 7.36 (t, *J* = 7.4 Hz, 1H), 7.22 (ddd, *J* = 14.4, 7.6, 2.4 Hz, 6H), 6.68 (d, *J* = 8.6 Hz, 3H), 3.68 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 159.1, 141.2, 138.1, 135.1, 133.0, 130.3, 129.7, 129.46, 128.4, 125.6, 124.0, 123.1, 120.6, 114.0, 113.8, 108.6, 55.3.

ESI HRMS m/z $(M+H)^+$ calcd 368.1281, found 368.1280.

4-benzyl-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole (**3x**)



4-benzyl-1-(4-methoxyphenyl)-4*H*-furo[3,4-*b*]indole **3x** was prepared according to the general procedure in 24 h as a yellow oil in 80% yield, 28.2 mg, PE/EA = 15/1.

^{1}H NMR(400 MHz, $CDCl_3$) δ 8.18 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.56 – 7.46 (m, 1H), 7.35 – 7.17 (m, 7H), 7.14 – 7.07 (m, 2H), 6.87 – 6.75 (m, 2H), 6.51 (d, *J* = 0.7 Hz, 1H), 5.21 (s, 2H), 3.79 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4, 151.8, 140.5, 137.2, 134.7, 130.1, 129.6, 128.5, 128.5, 126.7, 124.4, 123.4, 120.5, 115.6, 113.3, 110.5, 68.7, 55.3.

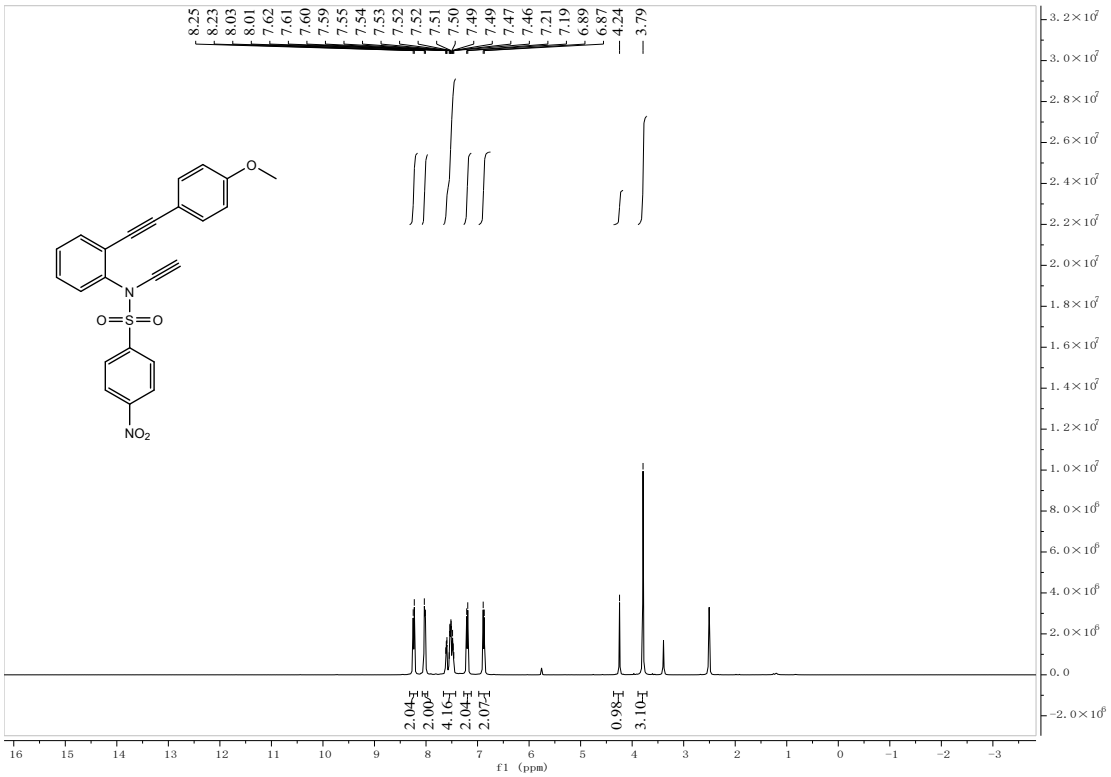
ESI HRMS m/z $(M+Na)^+$ calcd 376.1308, found 376.1308.

References:

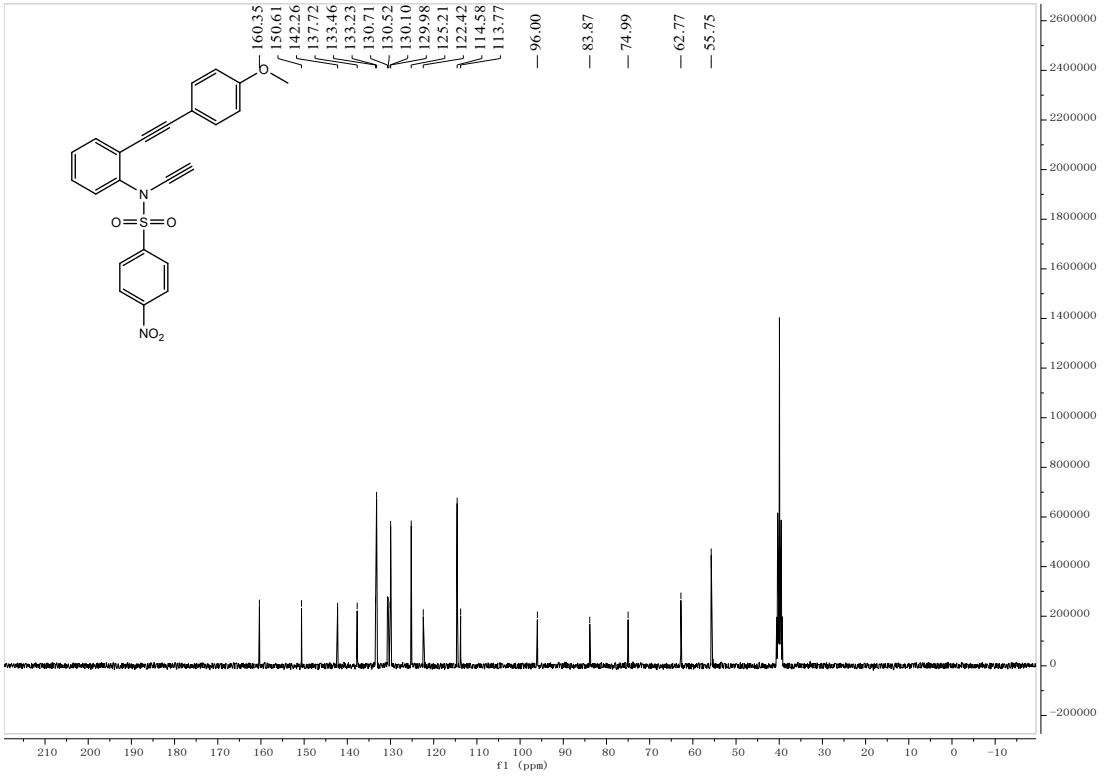
[1] Li, T.; Wang, H.; Qian, P.; Yang, Y.; Li, B.; Zhang, L. *Chem. Comm*., **2018**, *54*, 10447.

[2] Huang, E.-H.; Zhang, Y.-Q.; Cui, D.-Q.; Zhu, X.-Q.; Li, X.; Ye, L.-W. *Org. Lett.* **2022**, *24*, 196.

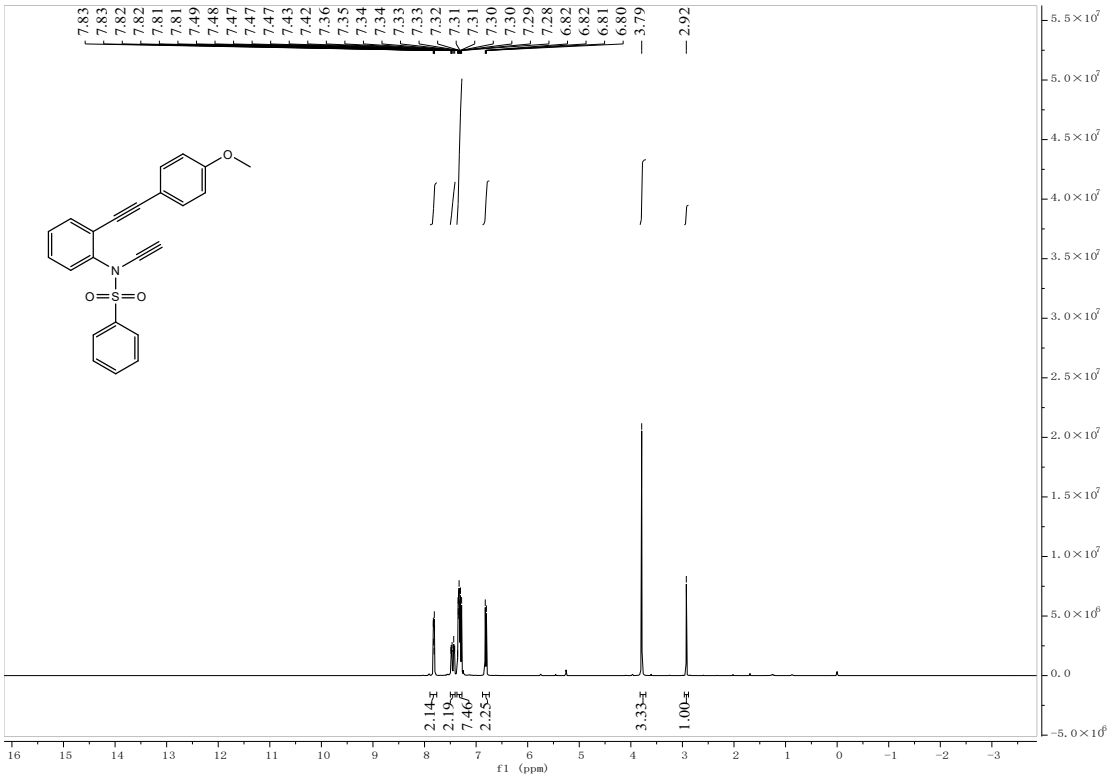
^{1}H NMR spectrum of **1a**



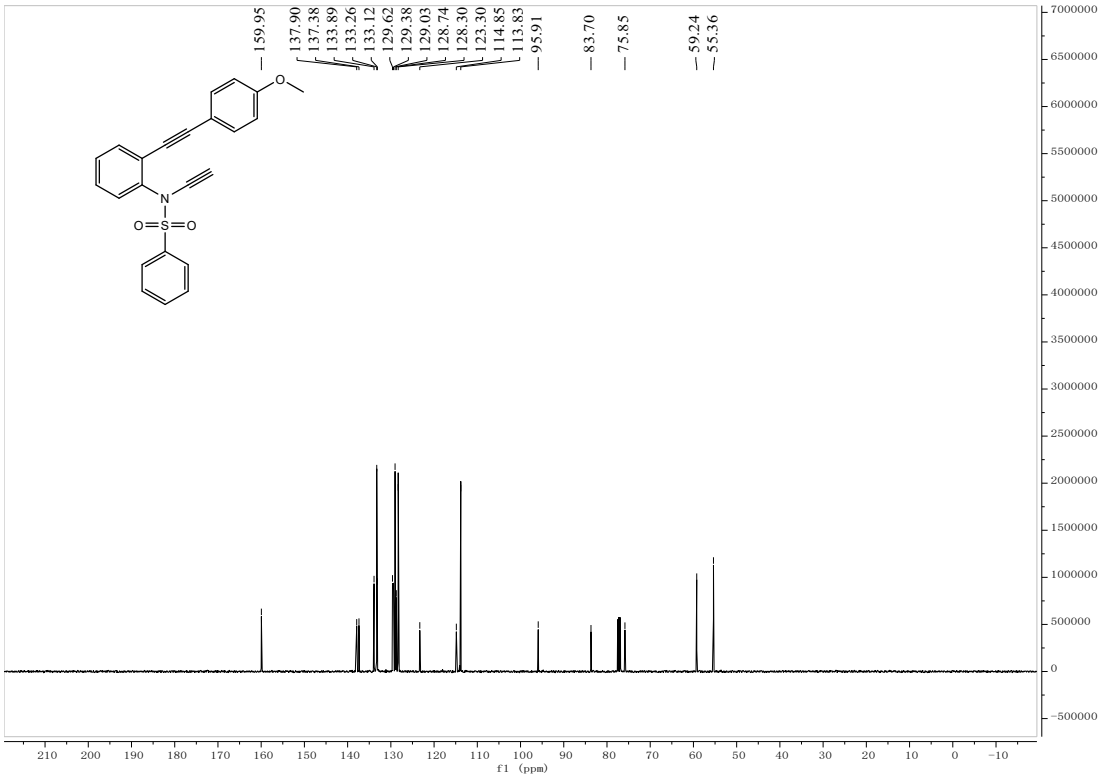
^{13}C NMR spectrum of **1a**



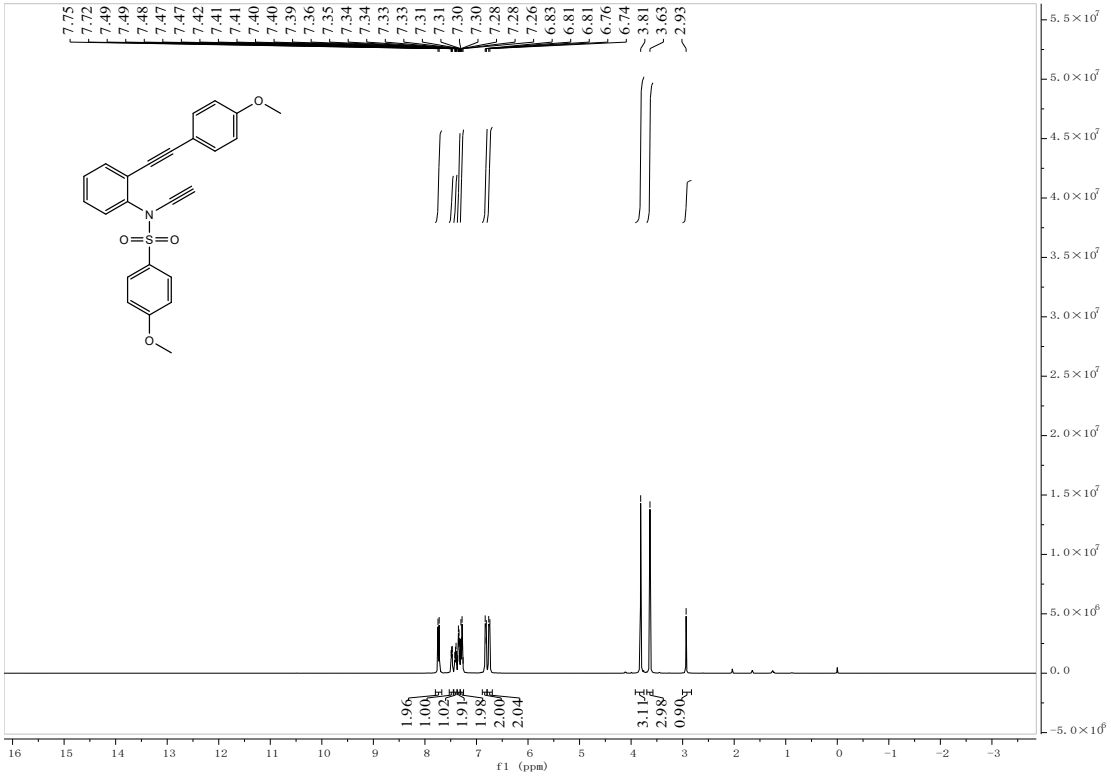
^{1}H NMR spectrum of **1b**



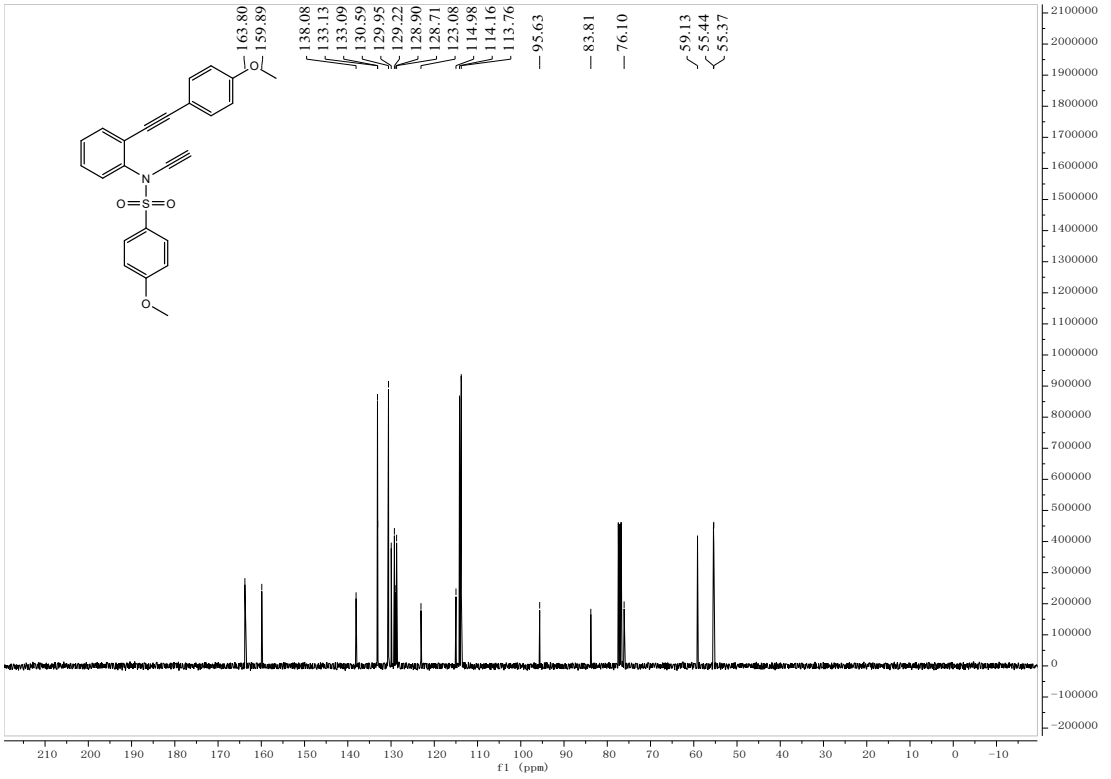
^{13}C NMR spectrum of **1b**



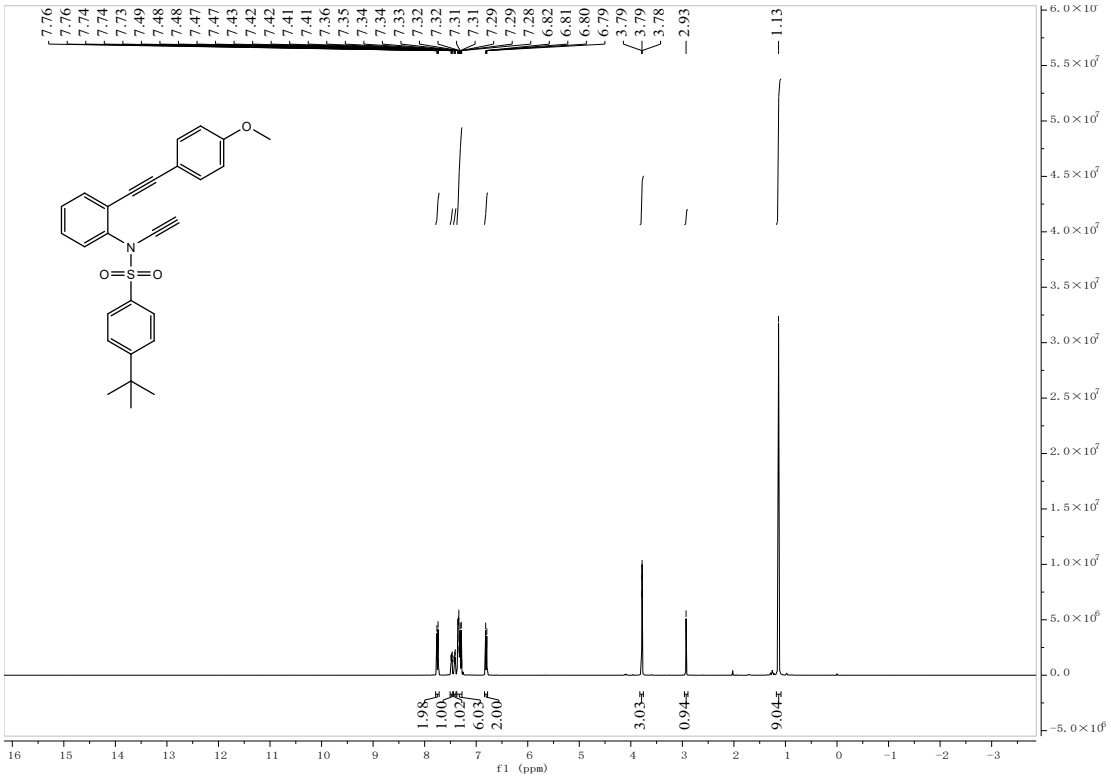
^{1}H NMR spectrum of **1d**



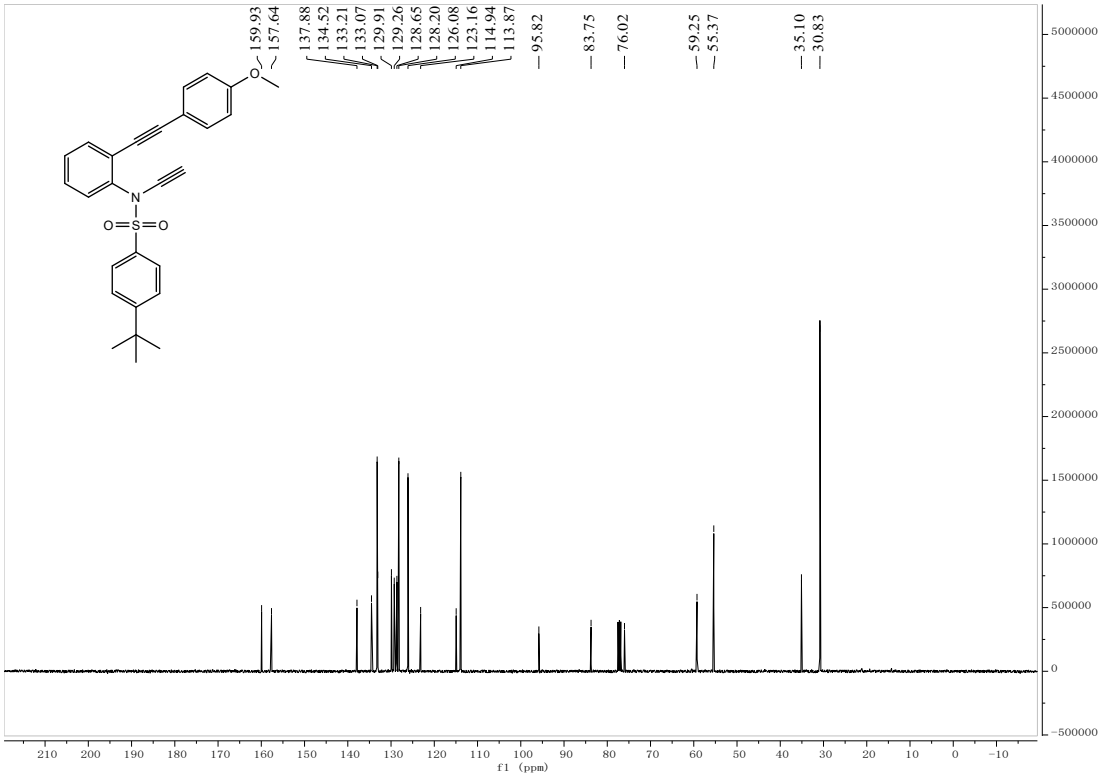
^{13}C NMR spectrum of **1d**



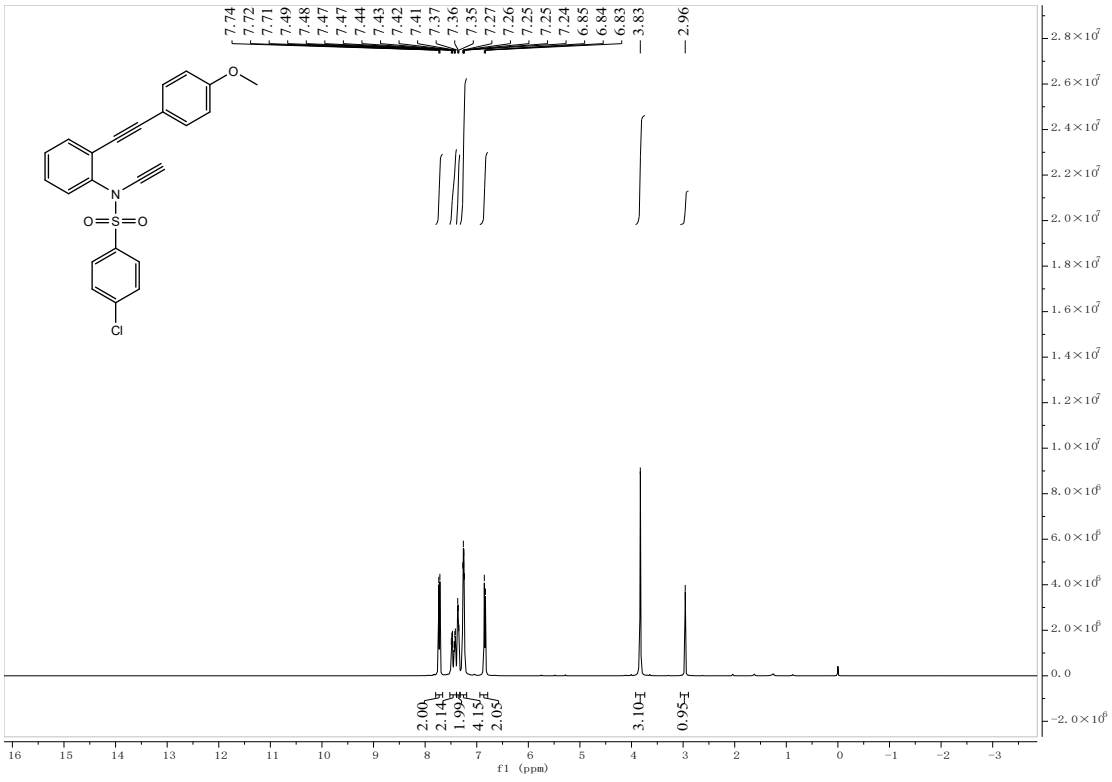
^{1}H NMR spectrum of **1e**



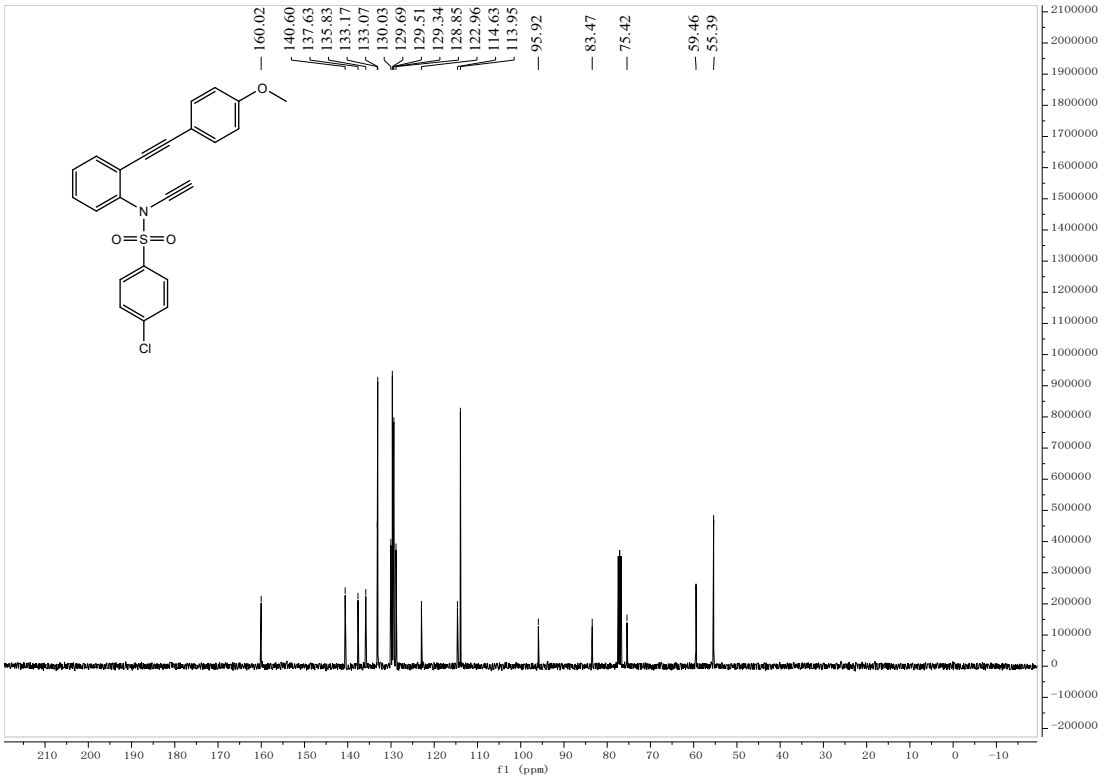
^{13}C NMR spectrum of **1e**



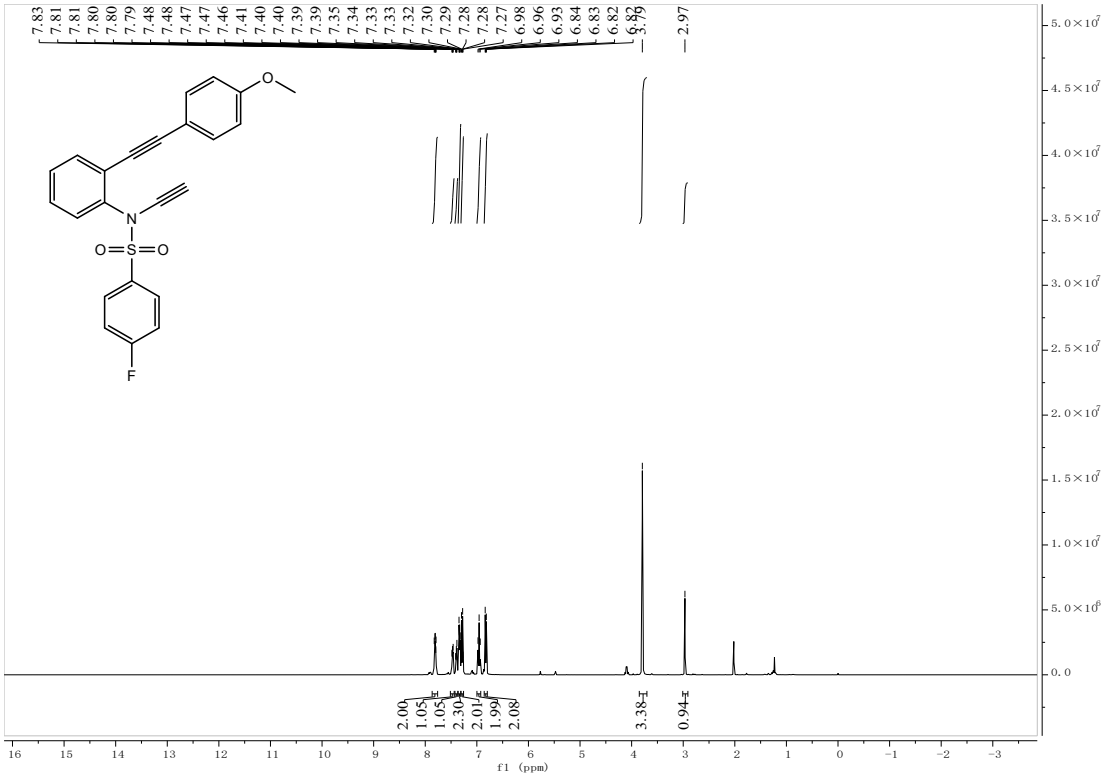
^{1}H NMR spectrum of **1f**



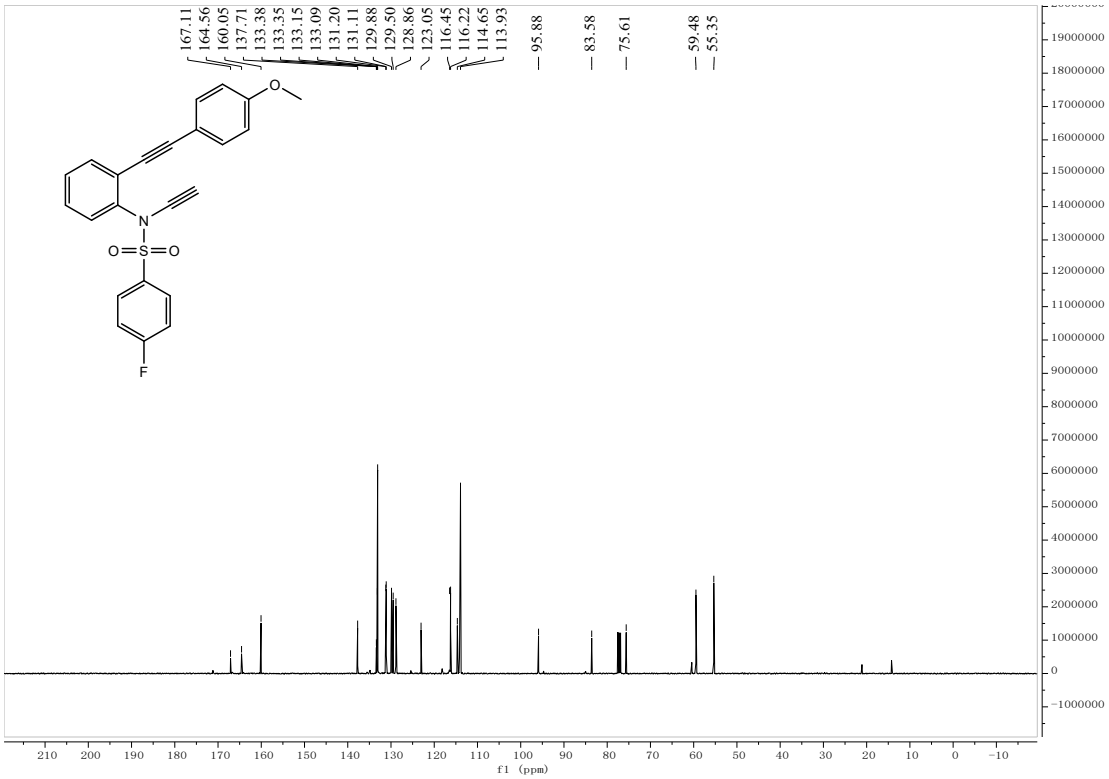
^{13}C NMR spectrum of **1f**



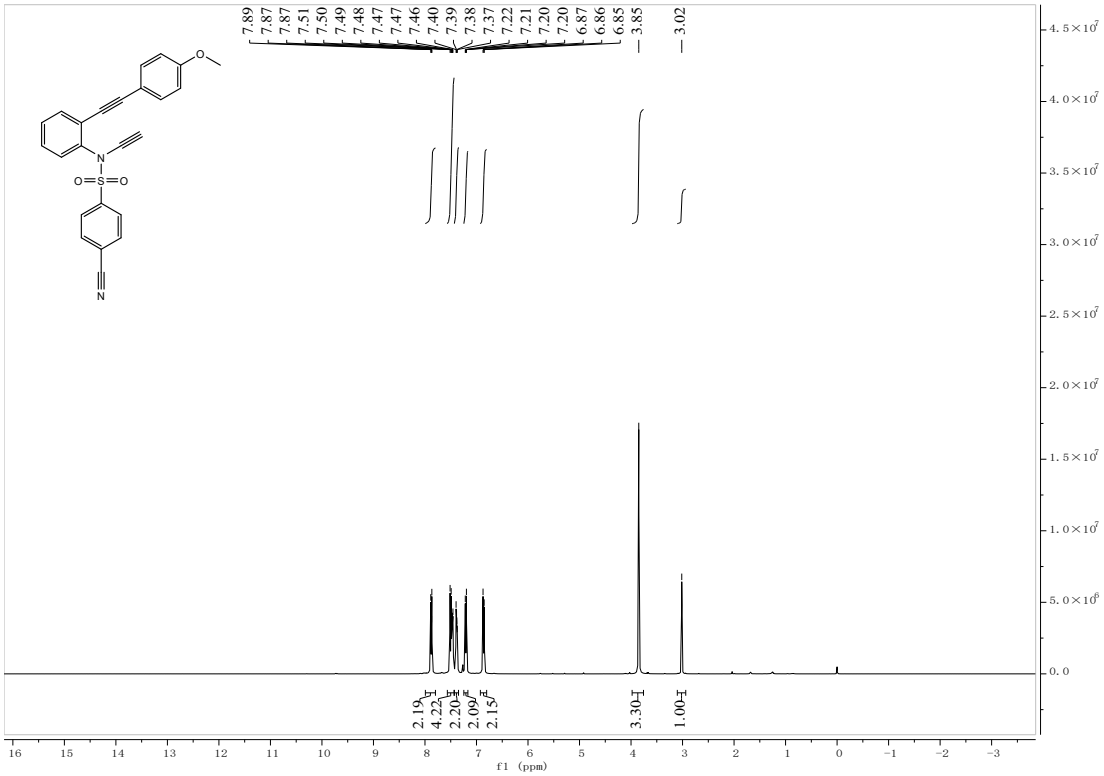
^{1}H NMR spectrum of **1g**



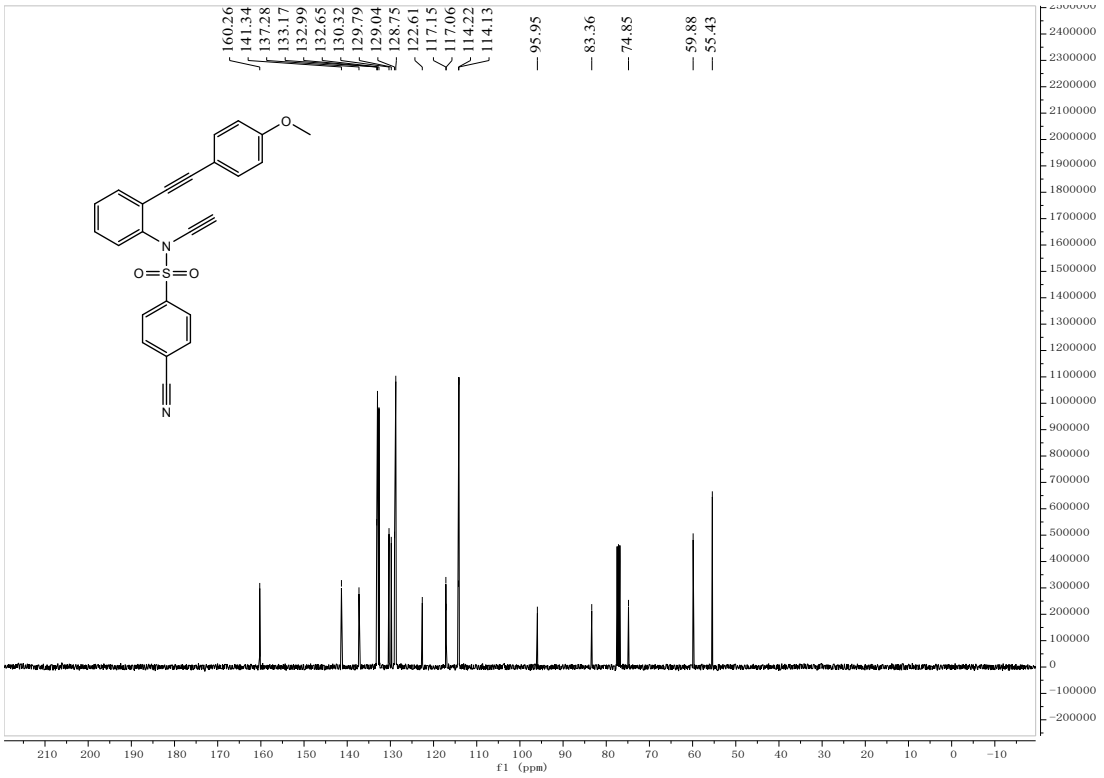
^{13}C NMR spectrum of **1g**



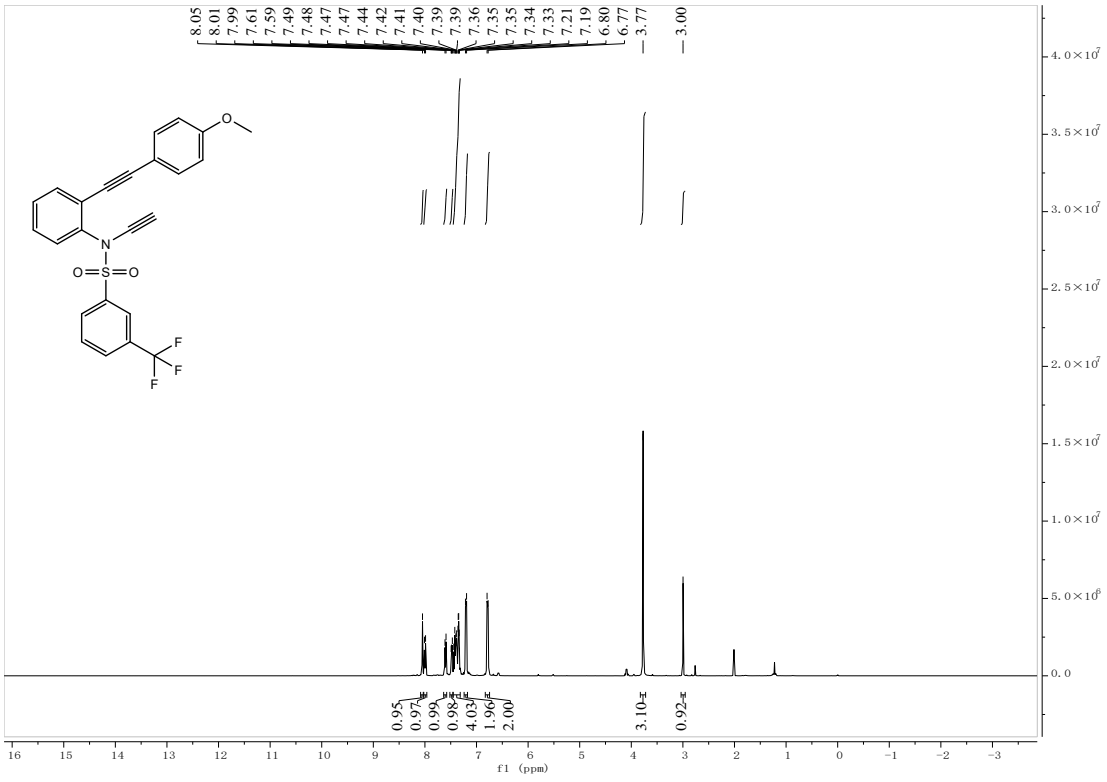
^{1}H NMR spectrum of **1h**



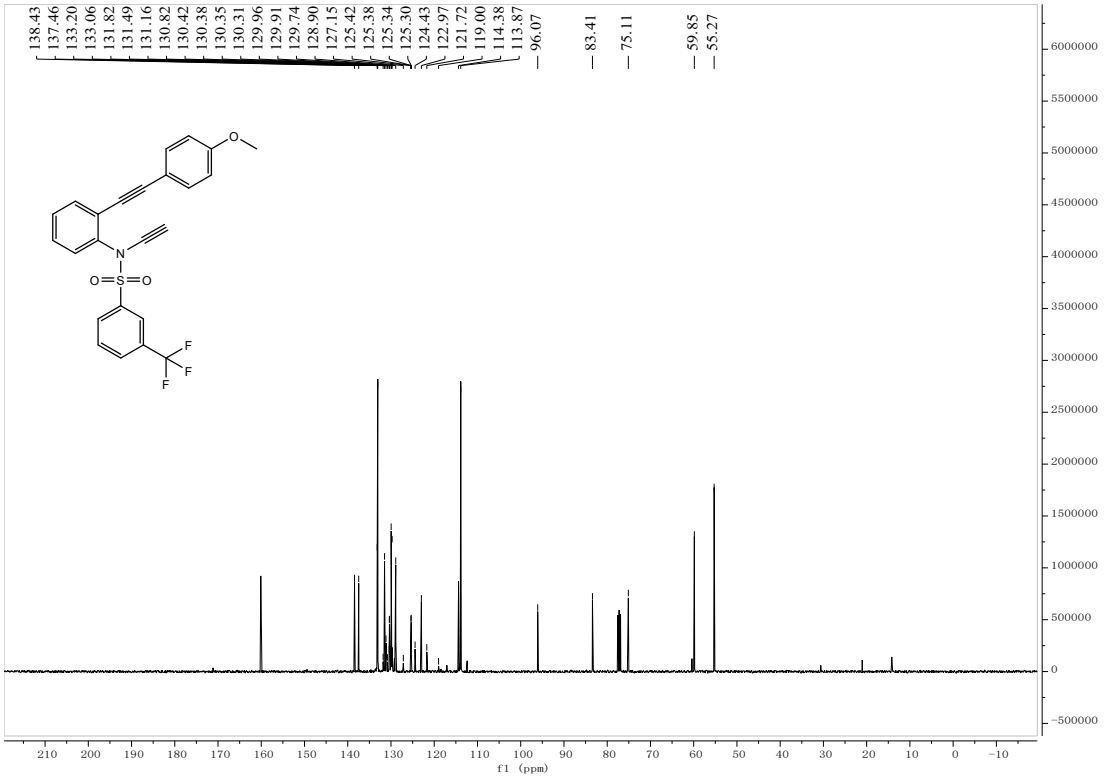
^{13}C NMR spectrum of **1h**



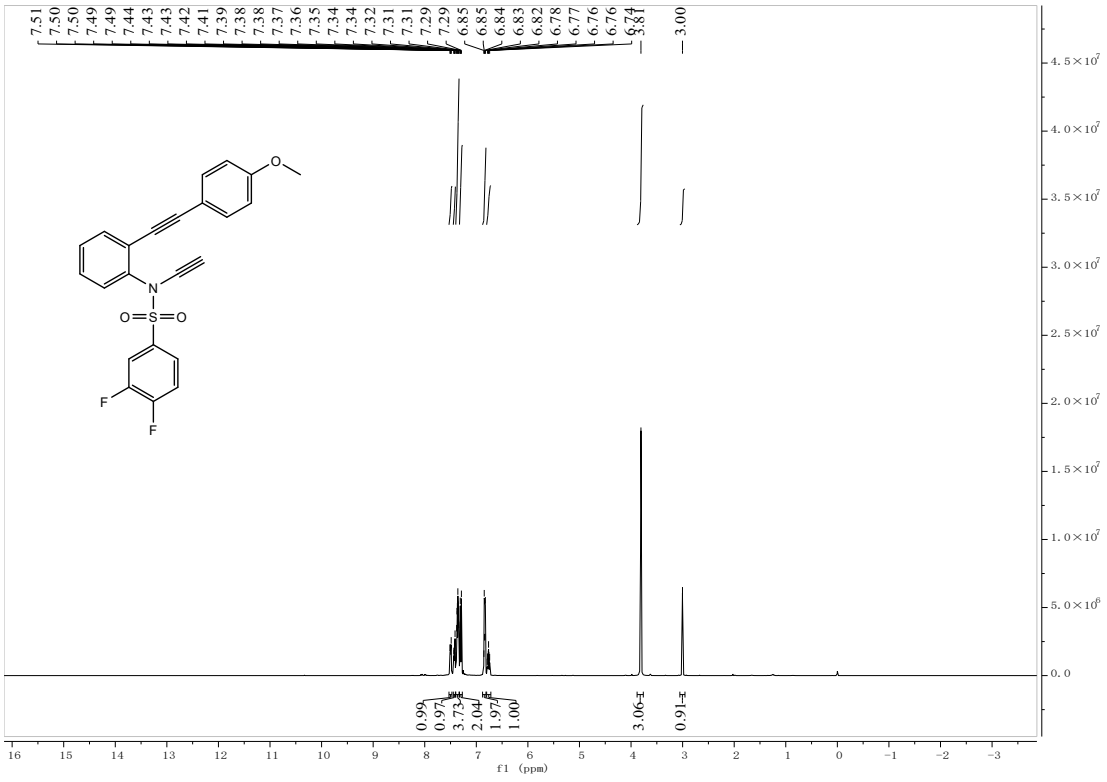
^{1}H NMR spectrum of **1i**



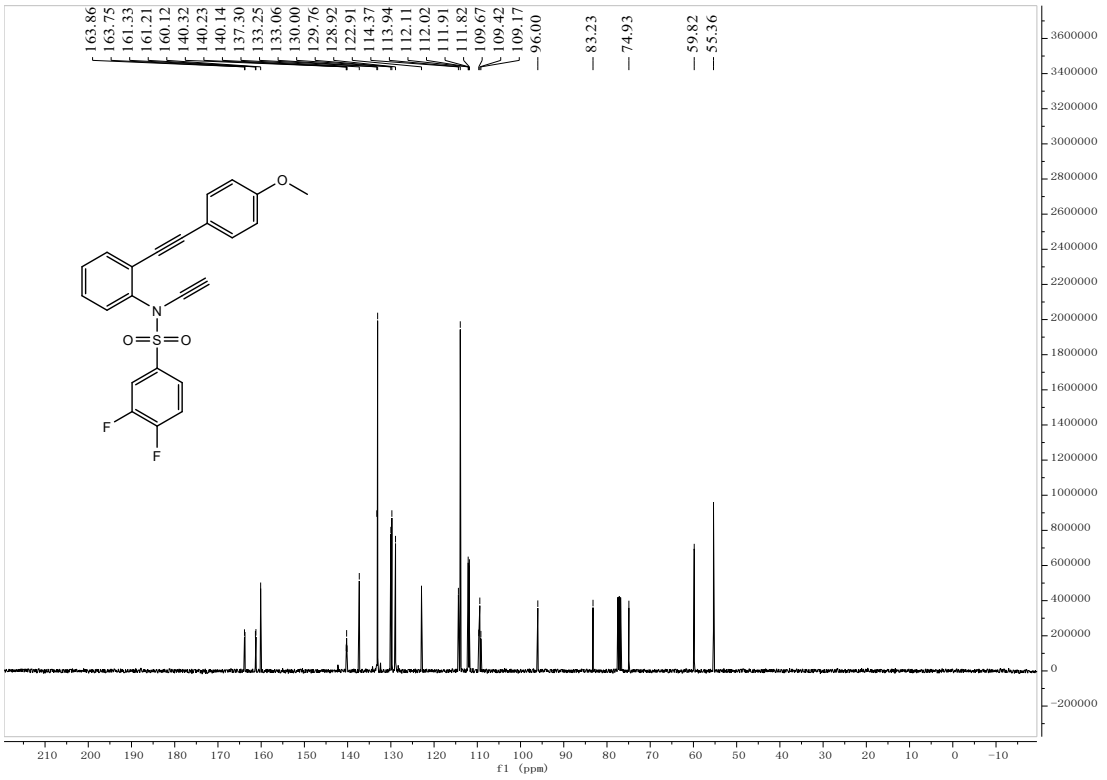
^{1}H NMR spectrum of **1i**



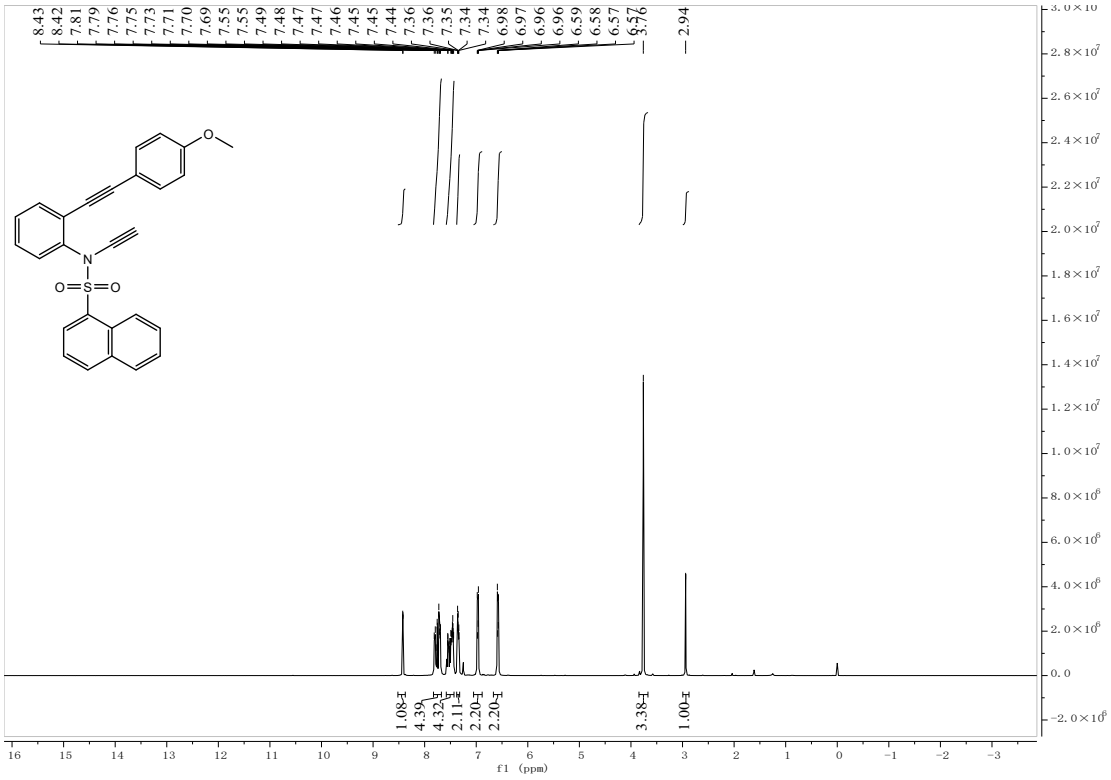
^{1}H NMR spectrum of **1j**



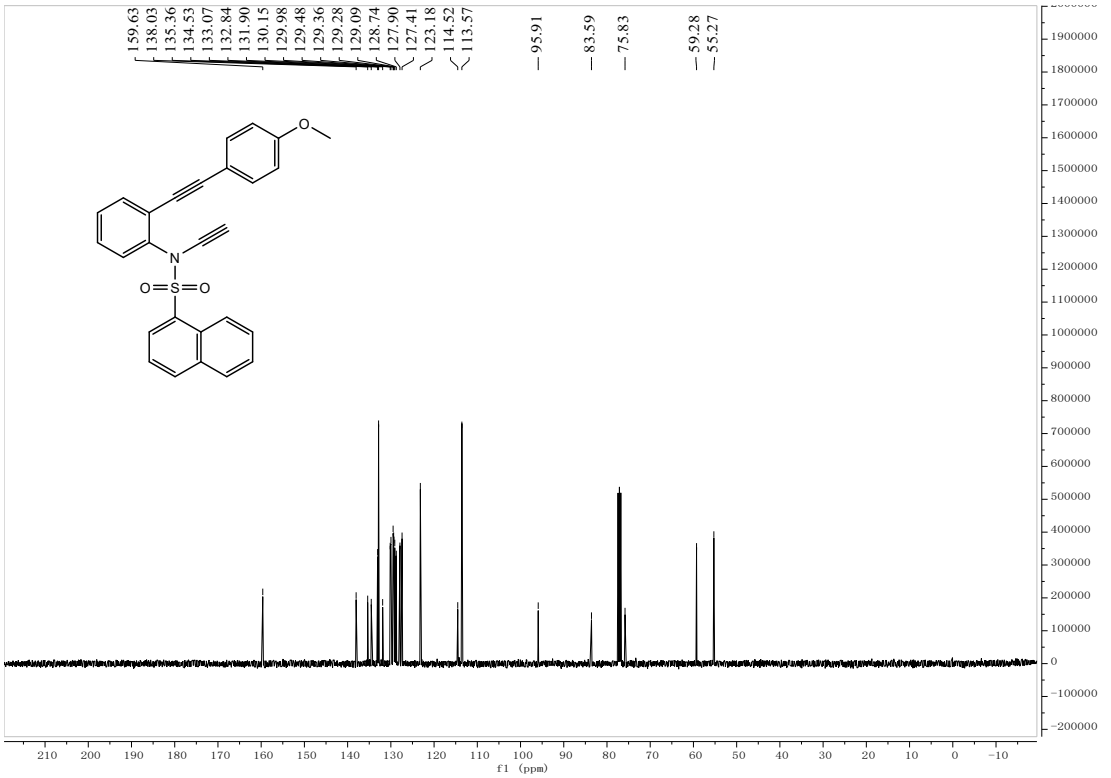
^{13}C NMR spectrum of **1j**



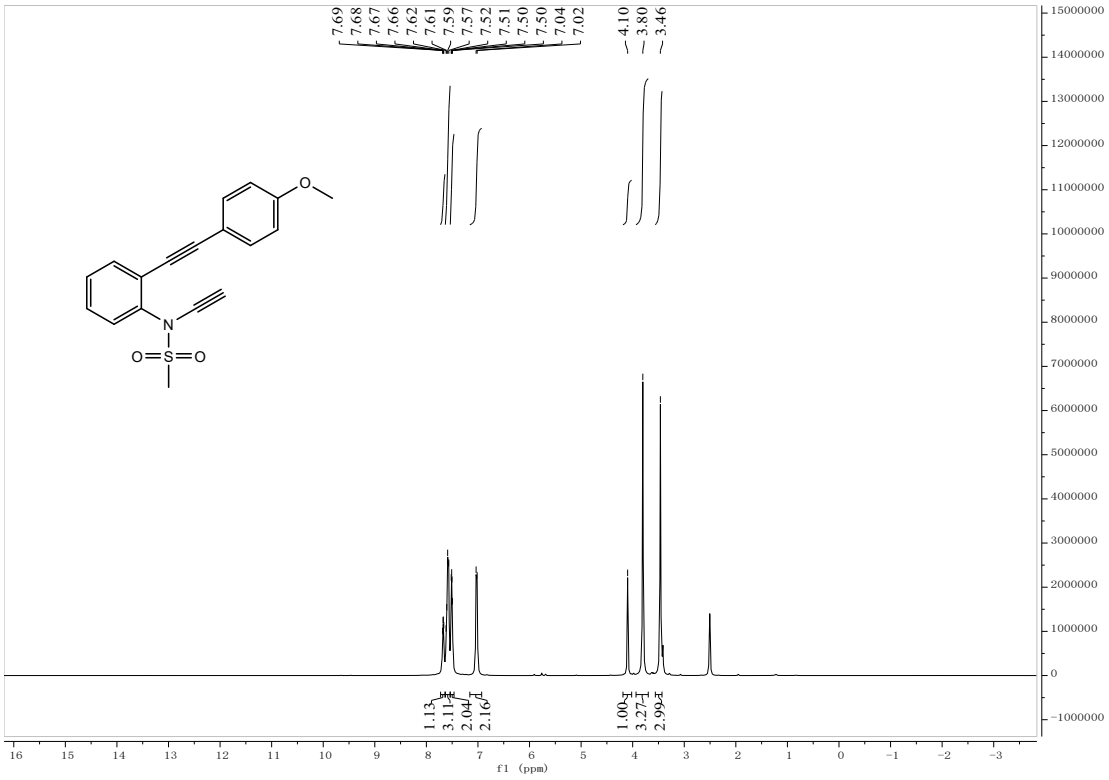
^{1}H NMR spectrum of **1k**



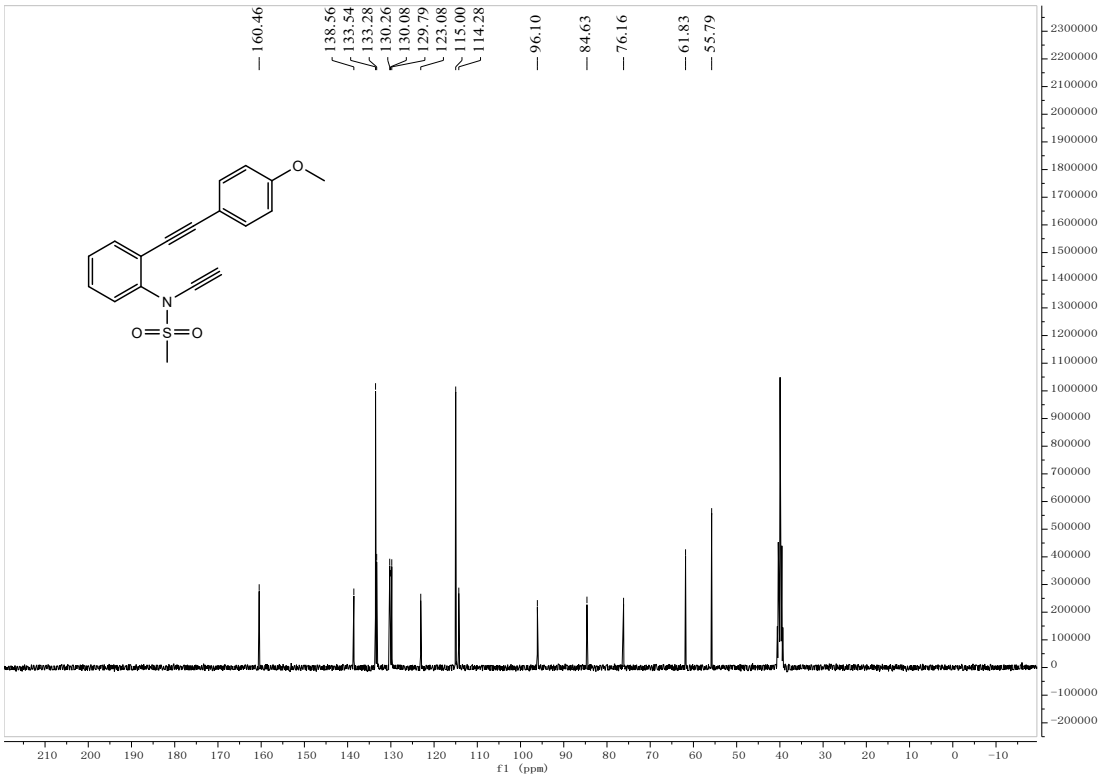
^{13}C NMR spectrum of **1k**



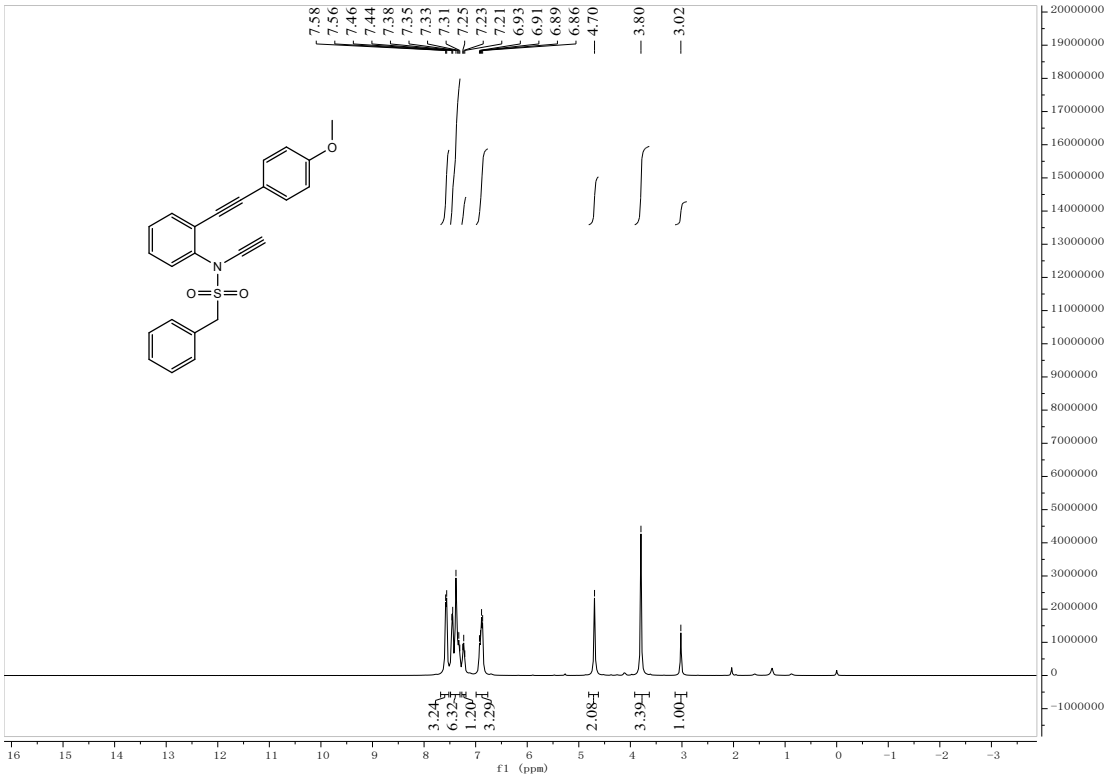
^{1}H NMR spectrum of **1l**



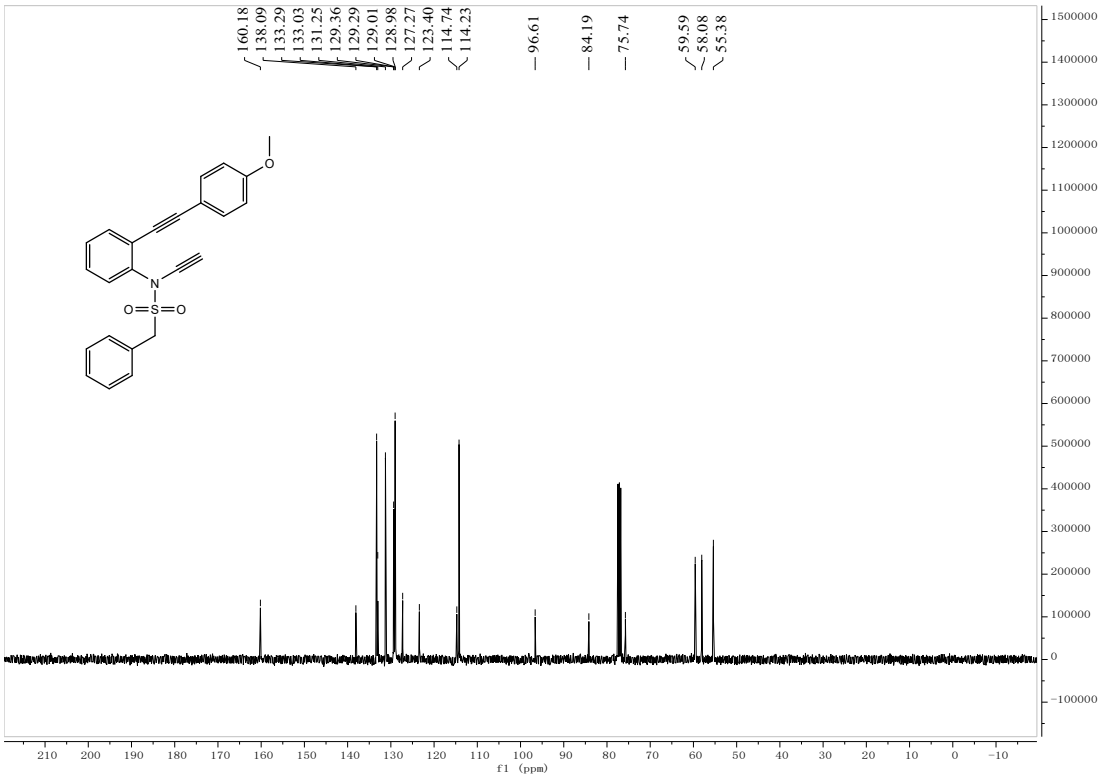
^{13}C NMR spectrum of **1l**



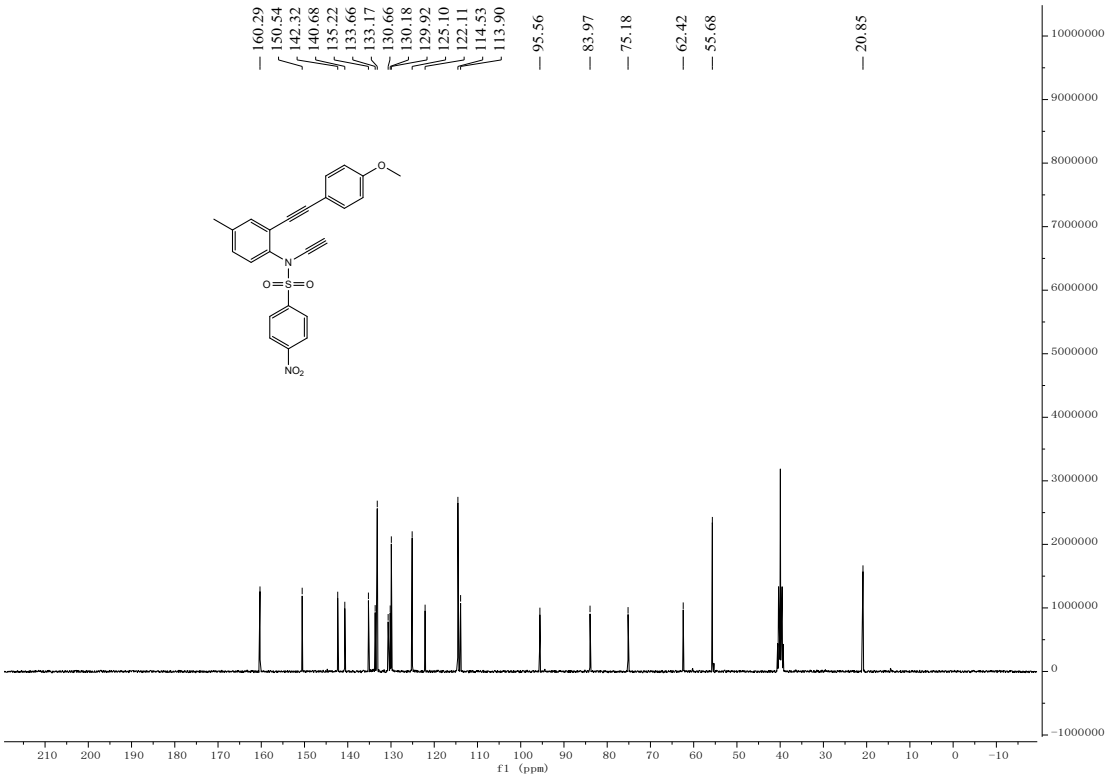
^{1}H NMR spectrum of **1m**



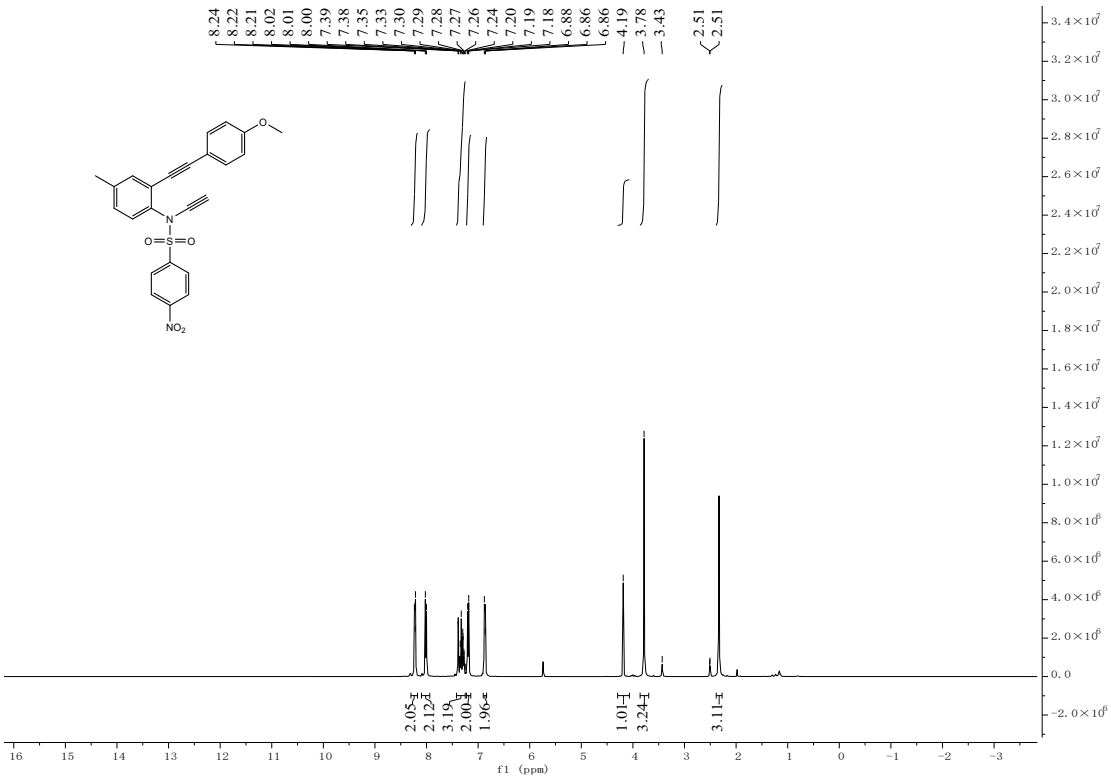
^{13}C NMR spectrum of **1m**



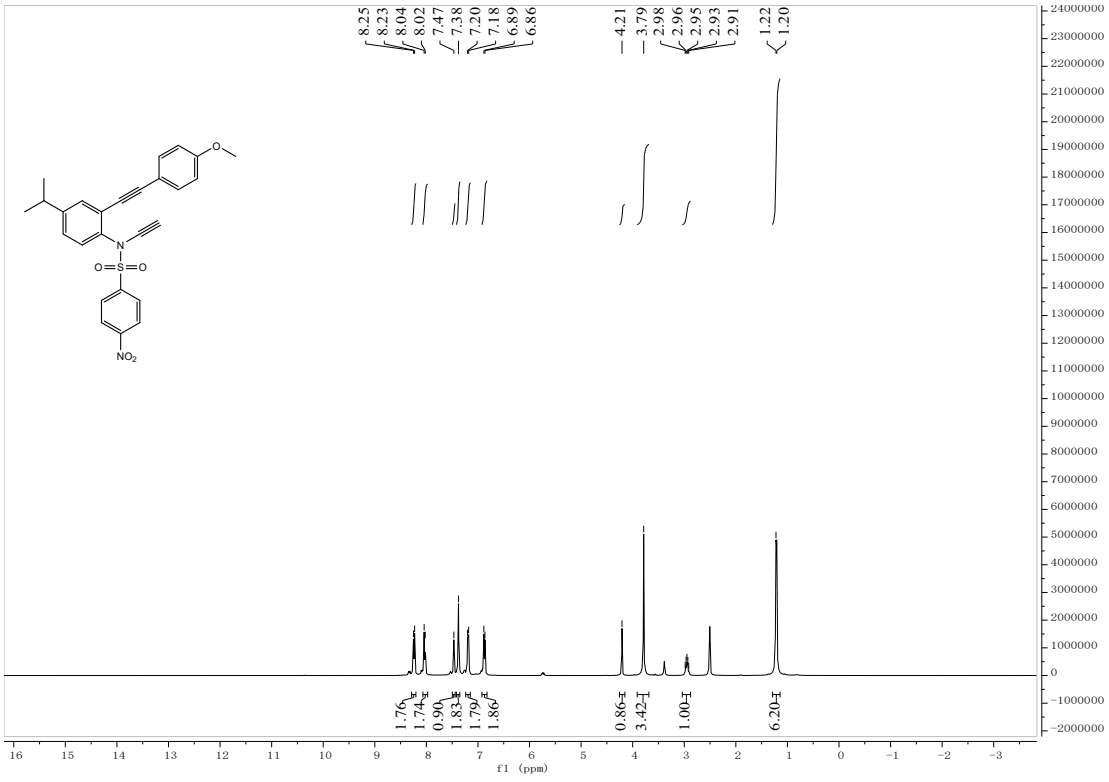
^{1}H NMR spectrum of **1n**



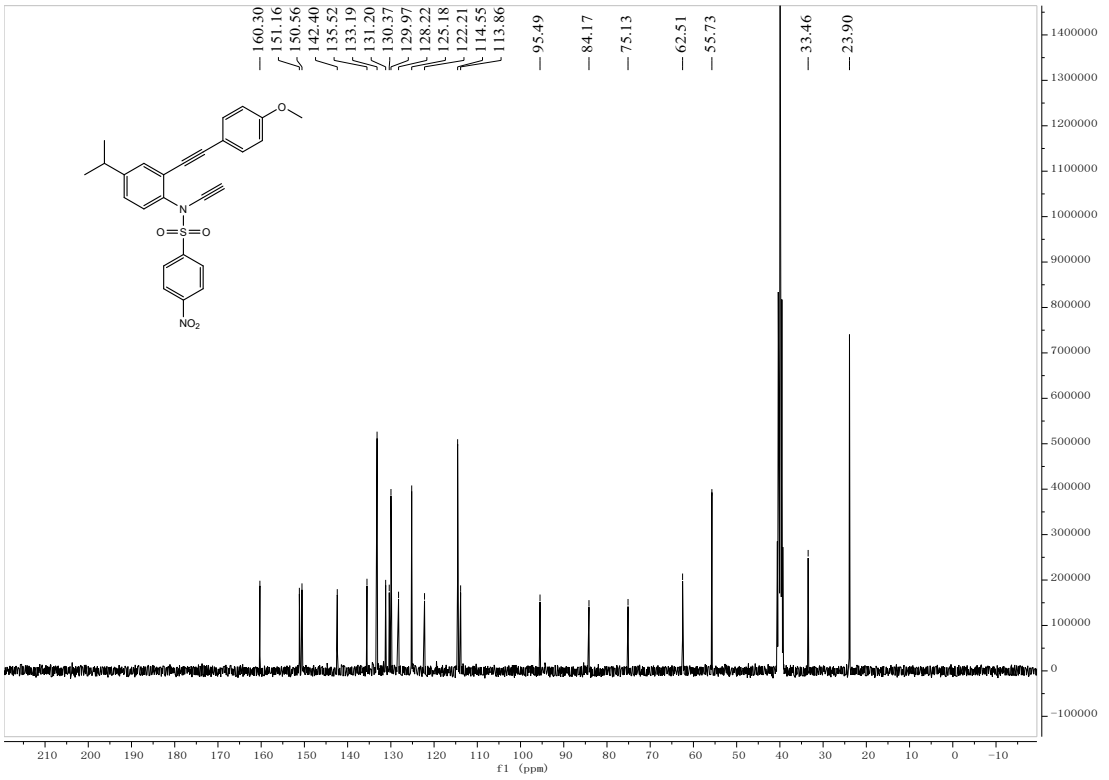
^{13}C NMR spectrum of **1n**



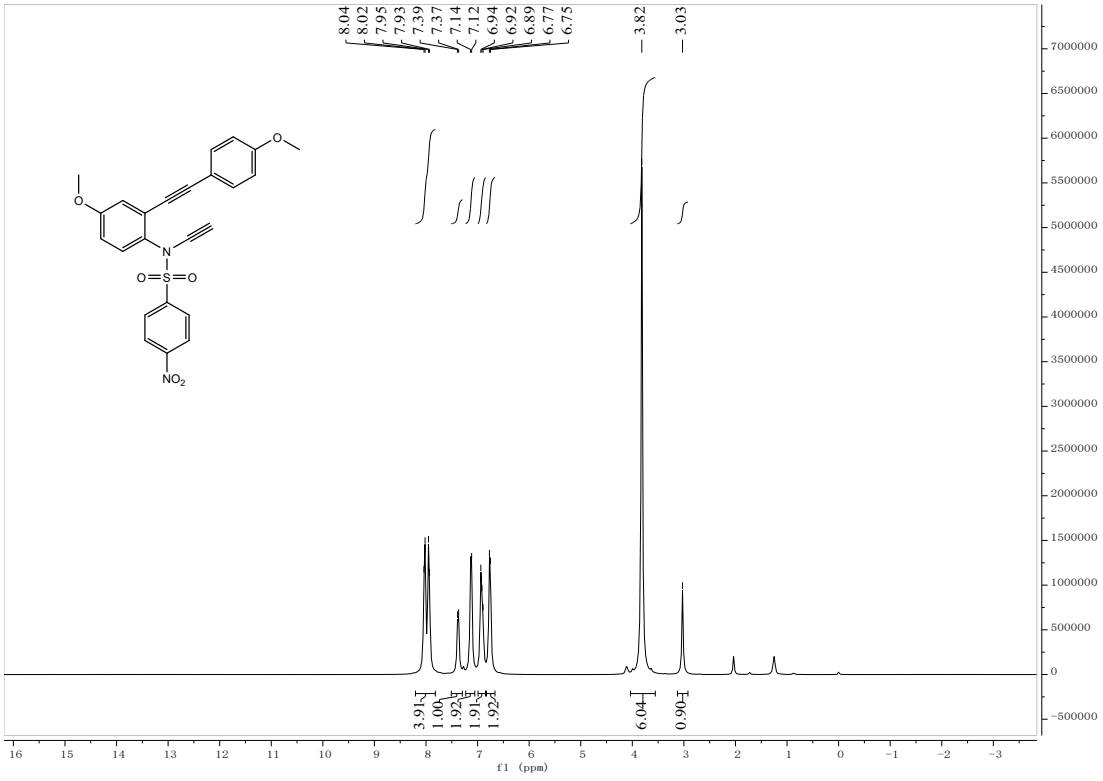
^{1}H NMR spectrum of **1o**



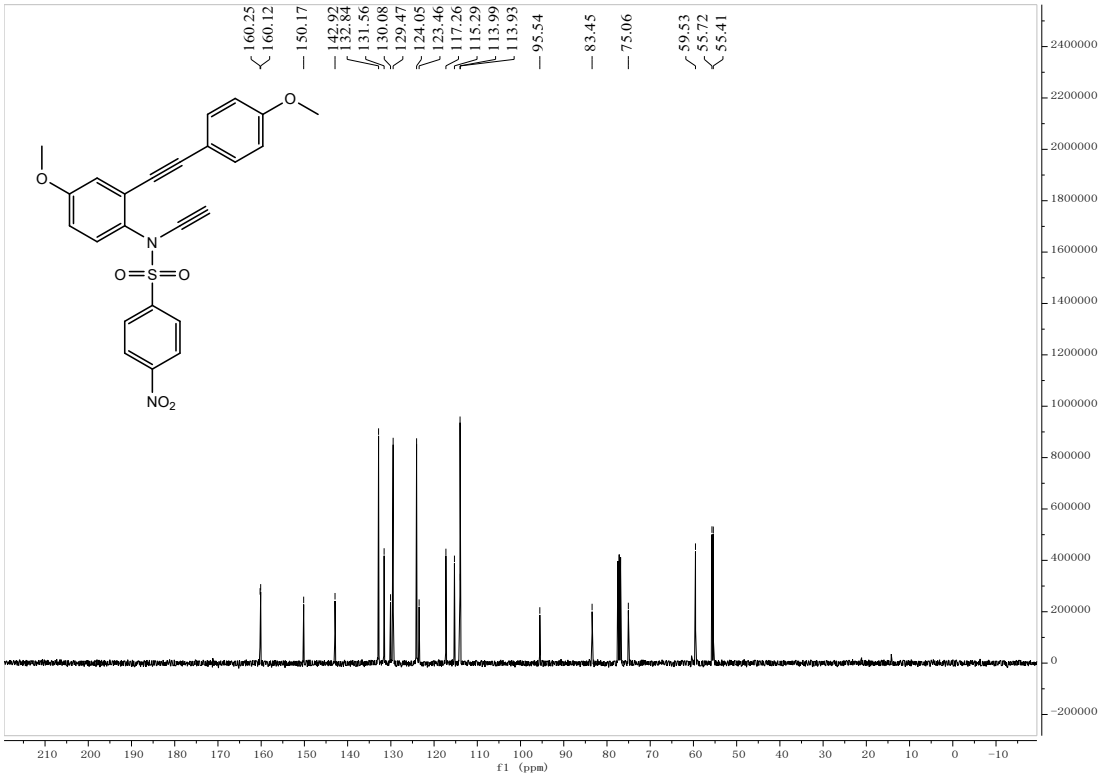
^{13}C NMR spectrum of **1o**



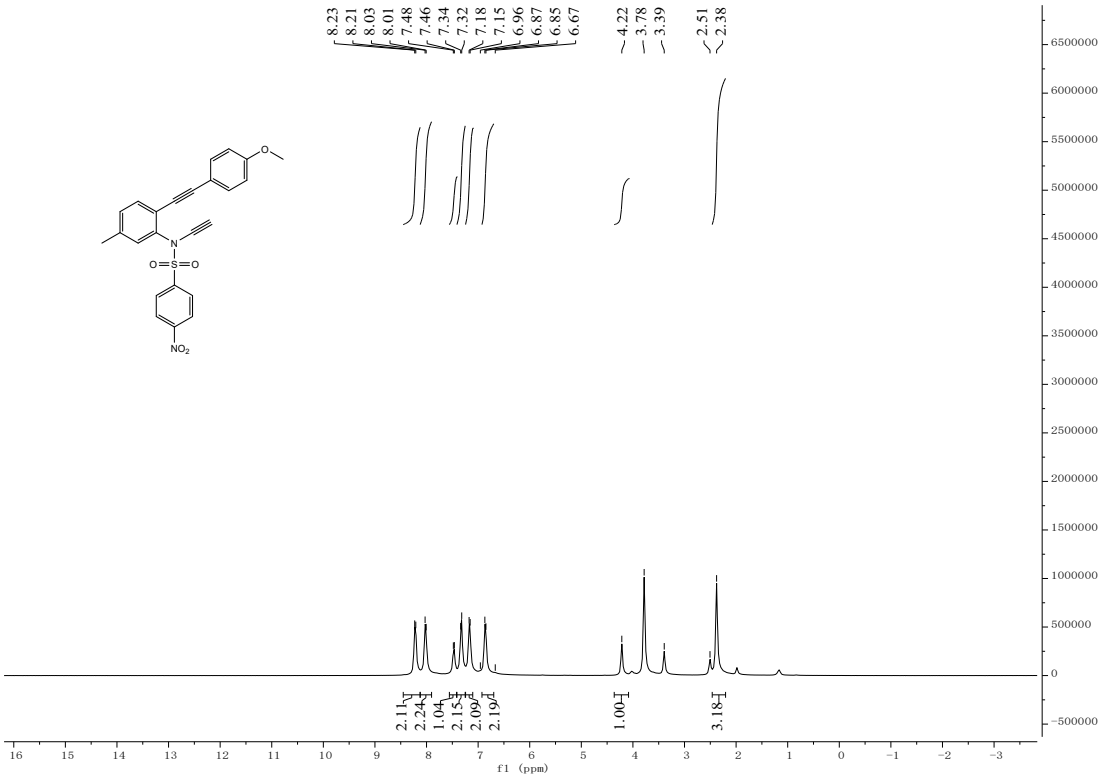
^{1}H NMR spectrum of **1p**



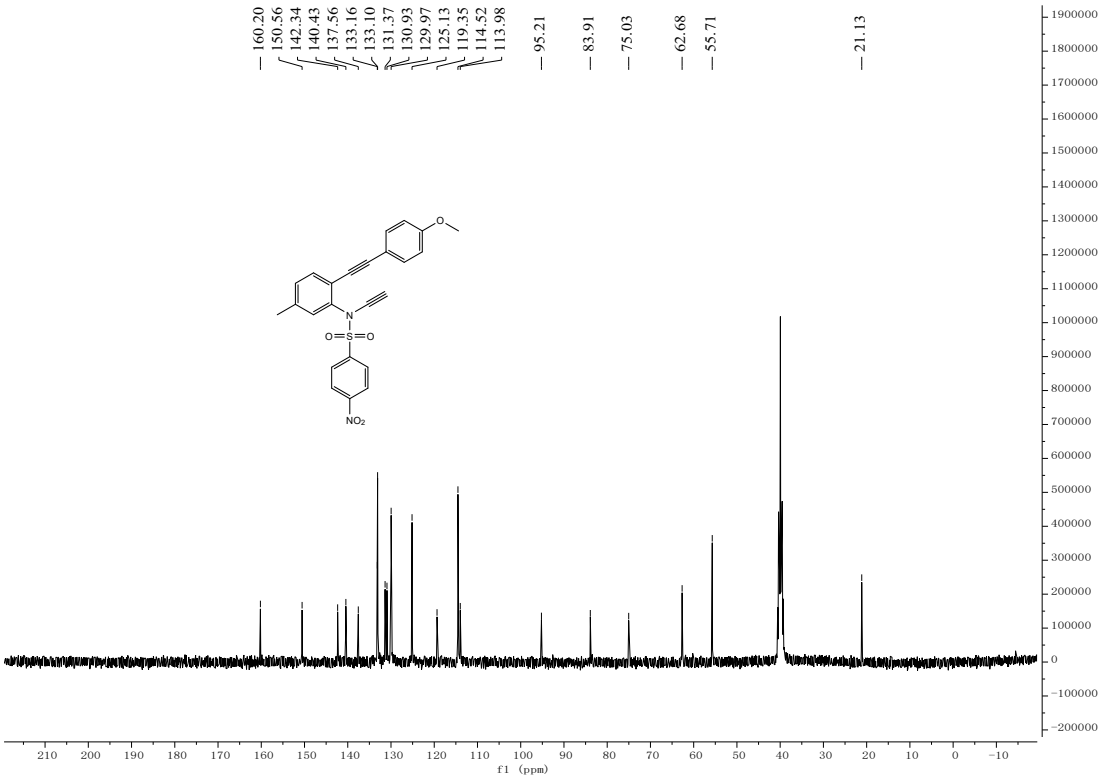
^{13}C NMR spectrum of **1p**



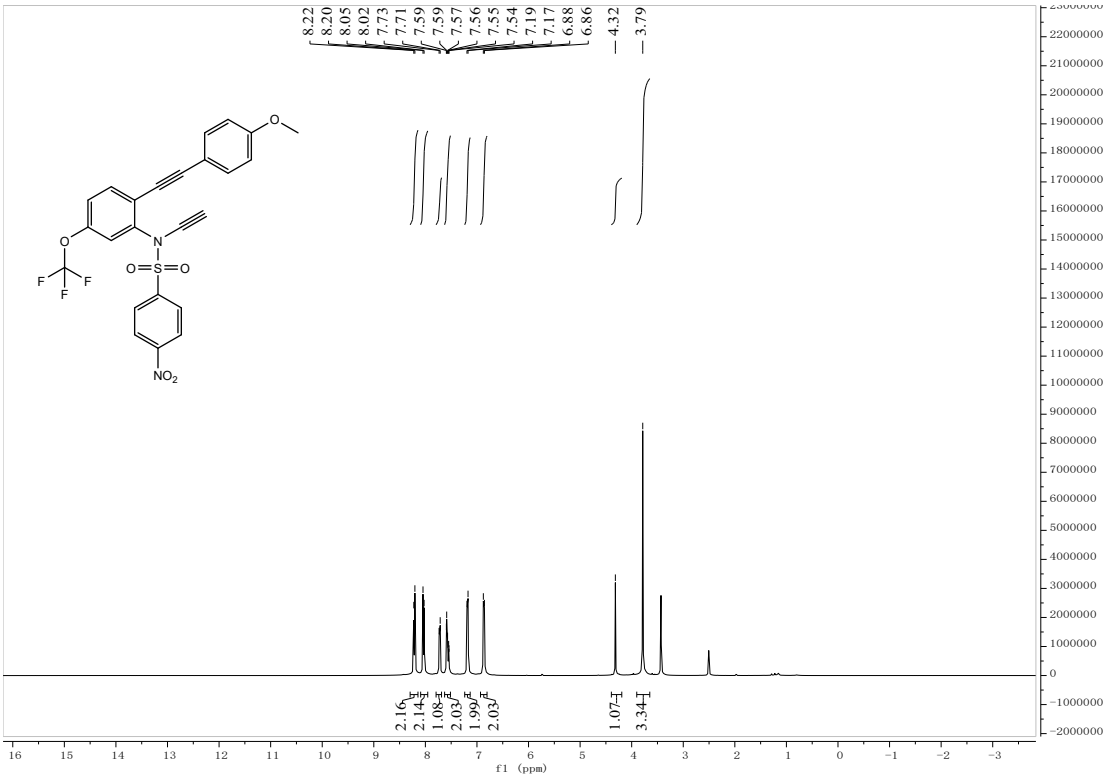
^{1}H NMR spectrum of **1q**



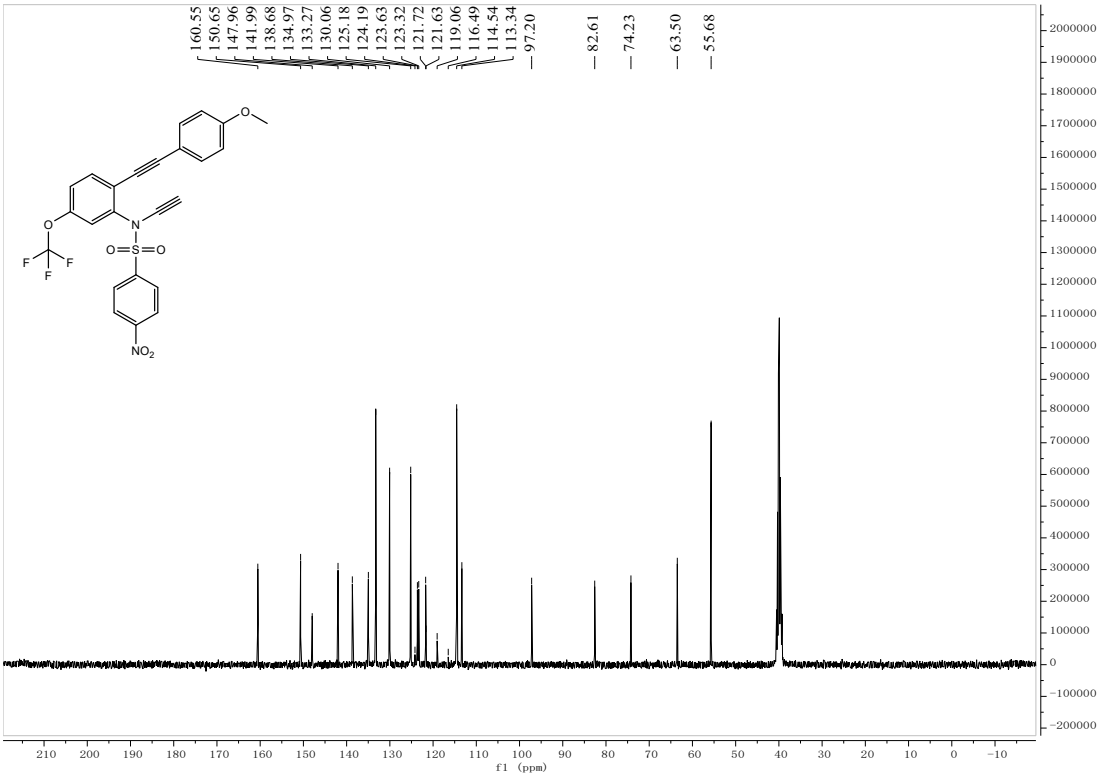
^{13}C NMR spectrum of **1q**



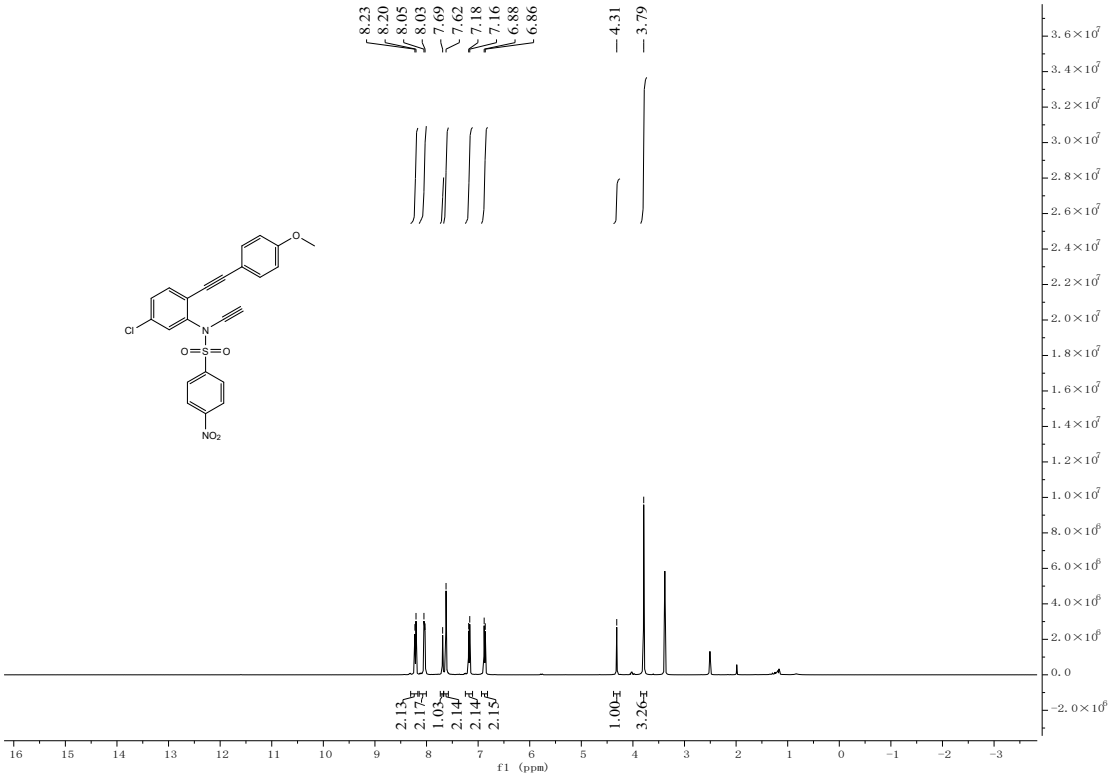
^{1}H NMR spectrum of **1r**



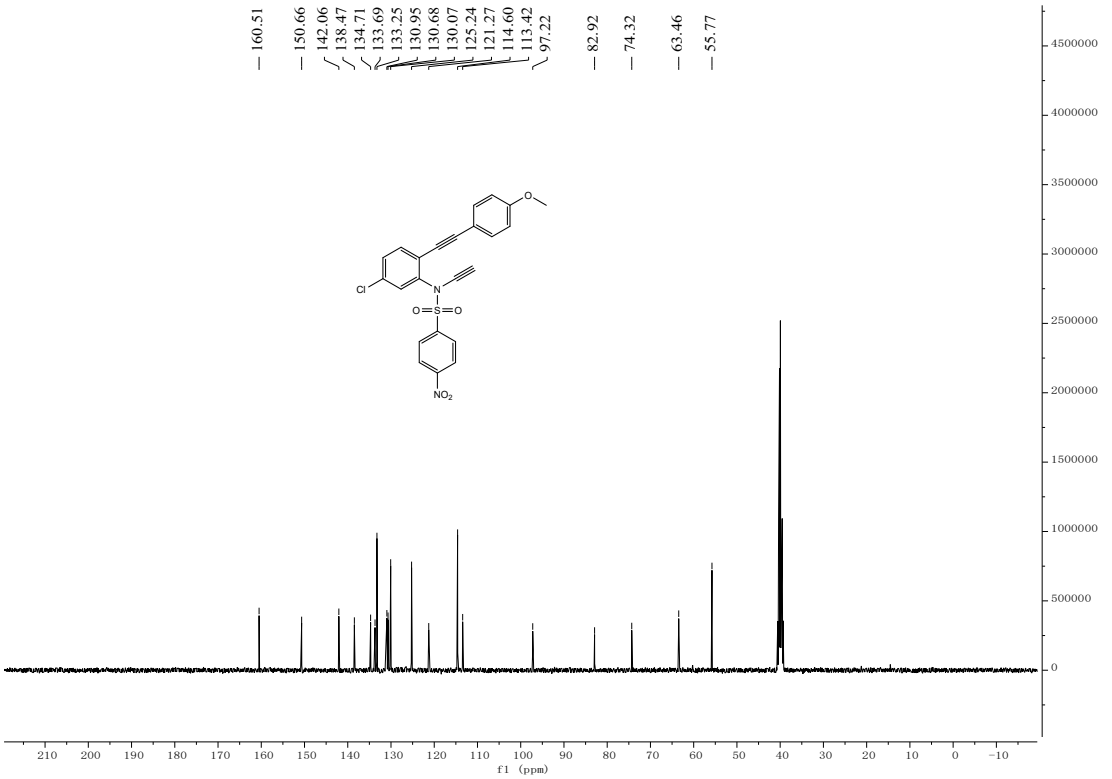
^{13}C NMR spectrum of **1r**



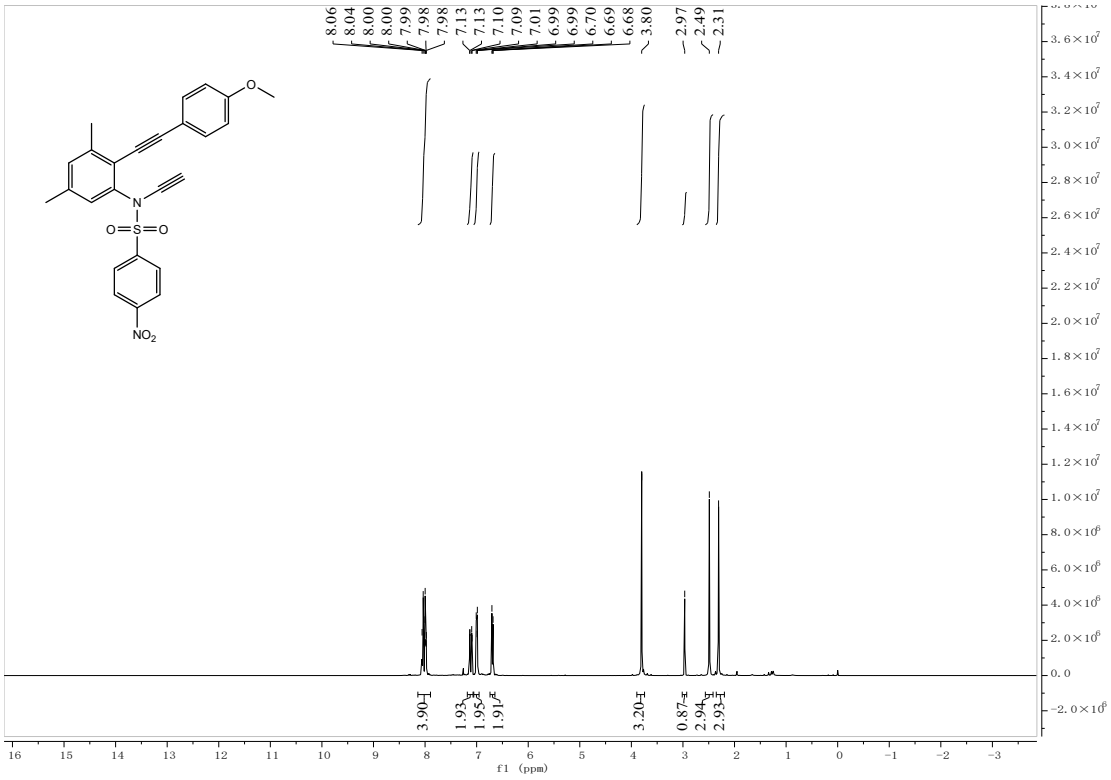
^{1}H NMR spectrum of **1s**



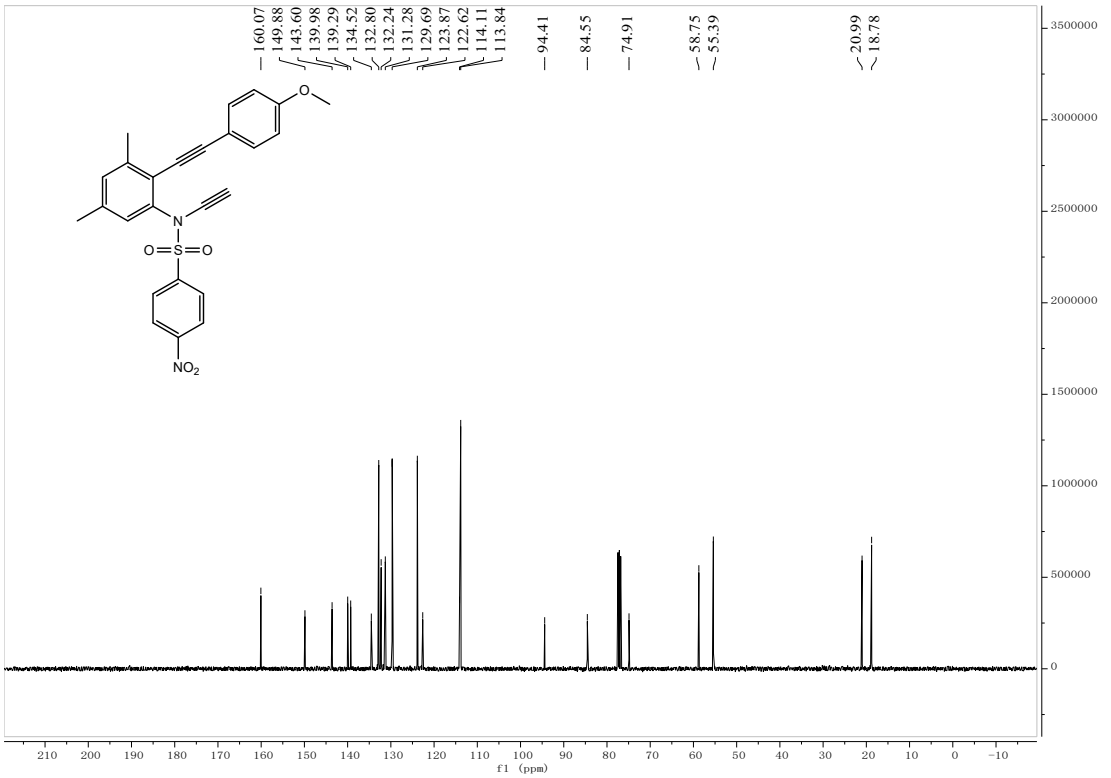
^{13}C NMR spectrum of **1s**



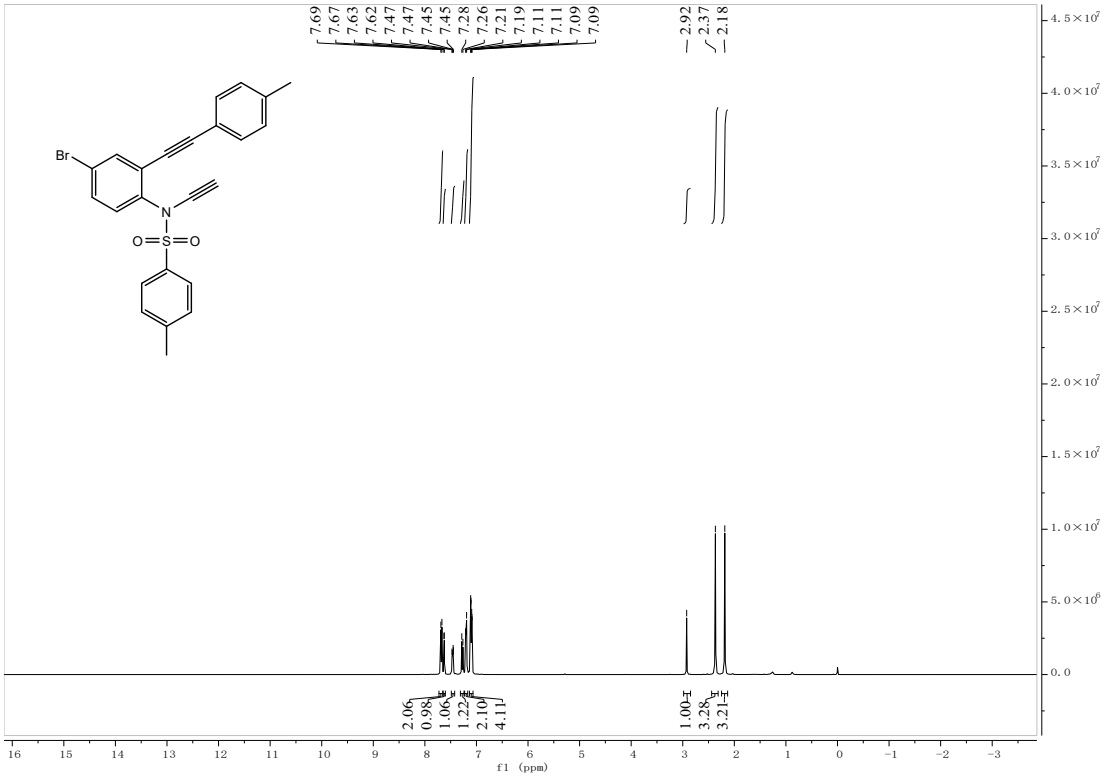
^{1}H NMR spectrum of **1t**



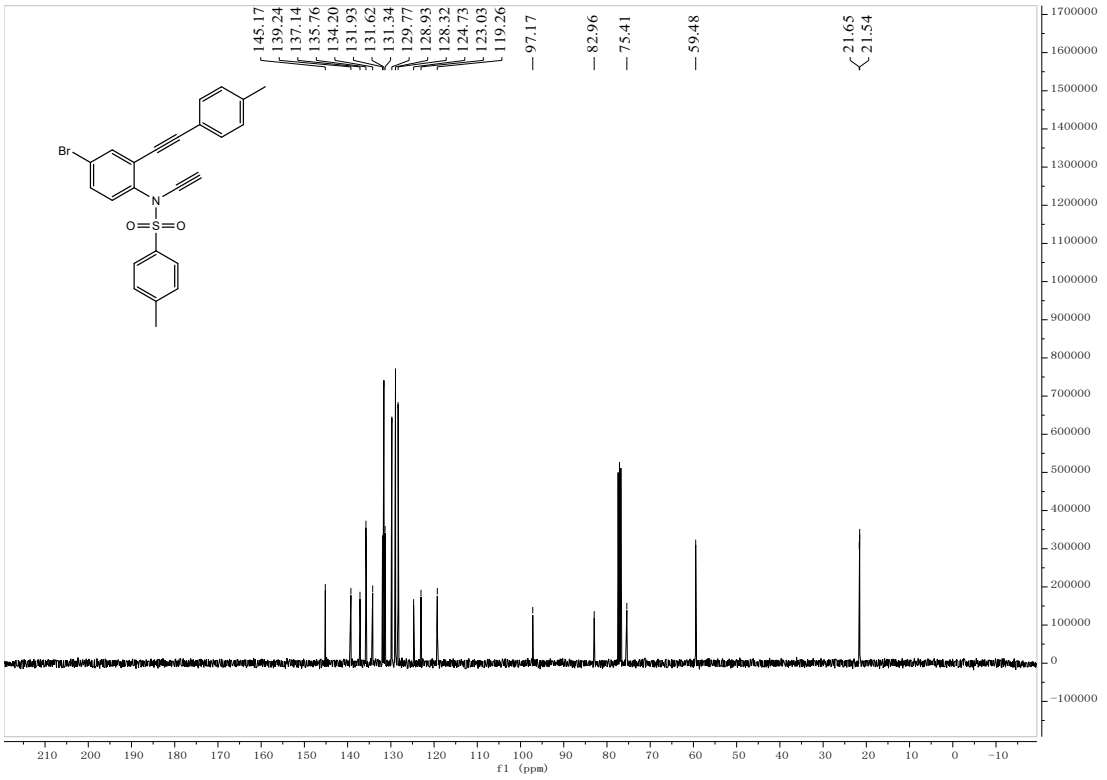
^{13}C NMR spectrum of **1t**



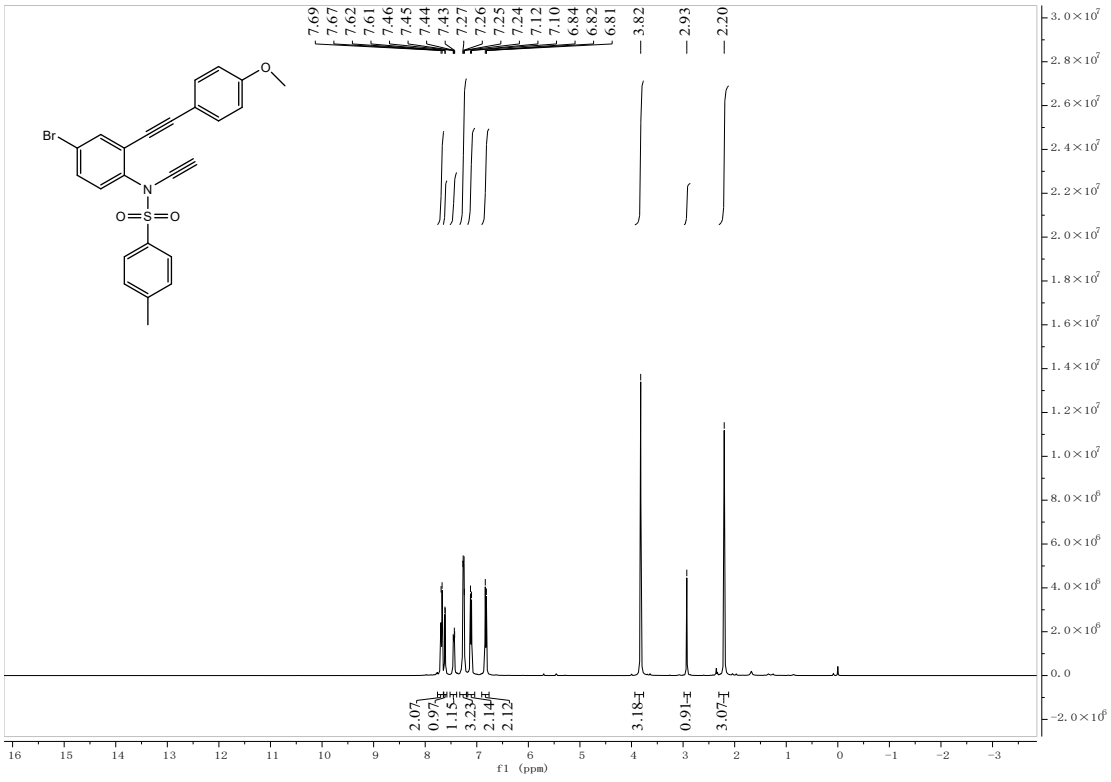
^{1}H NMR spectrum of **1u**



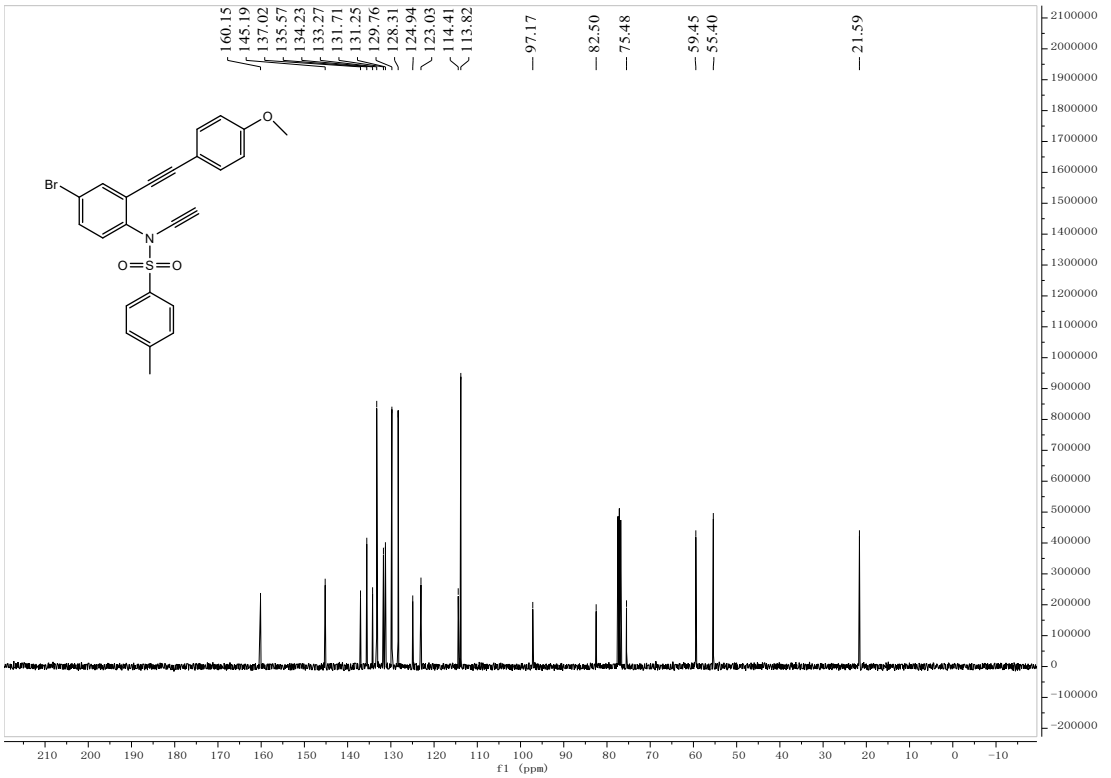
^{13}C NMR spectrum of **1u**



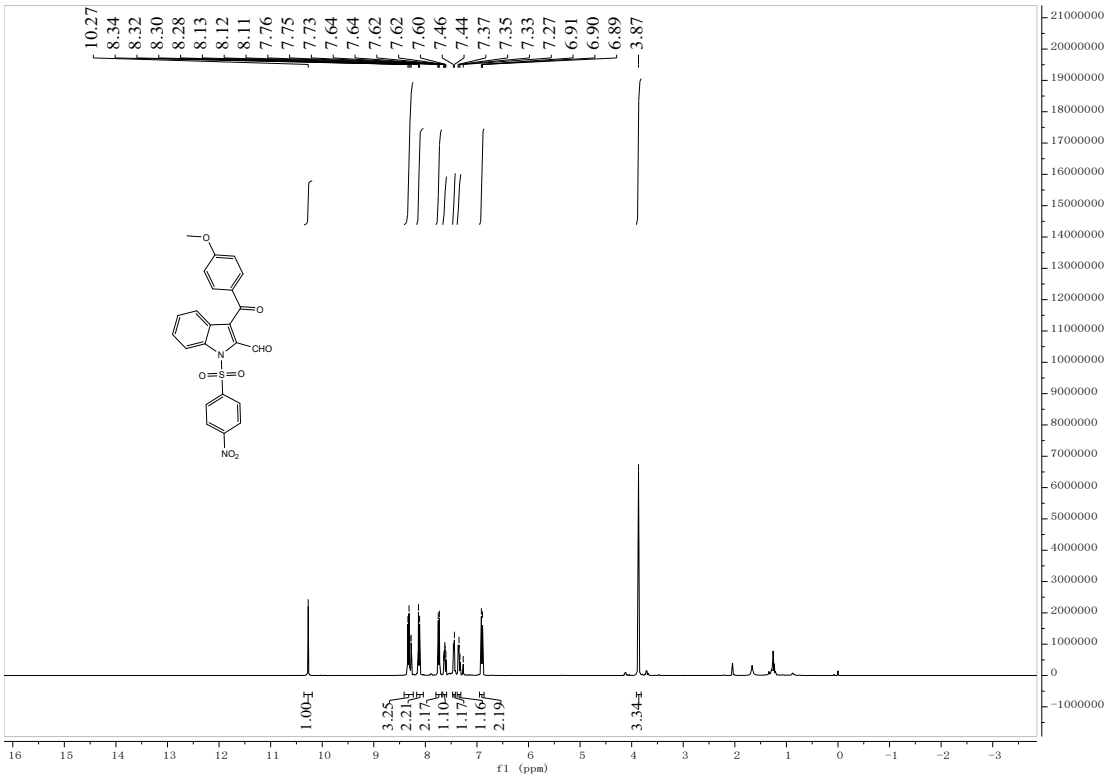
^{1}H NMR spectrum of **1v**



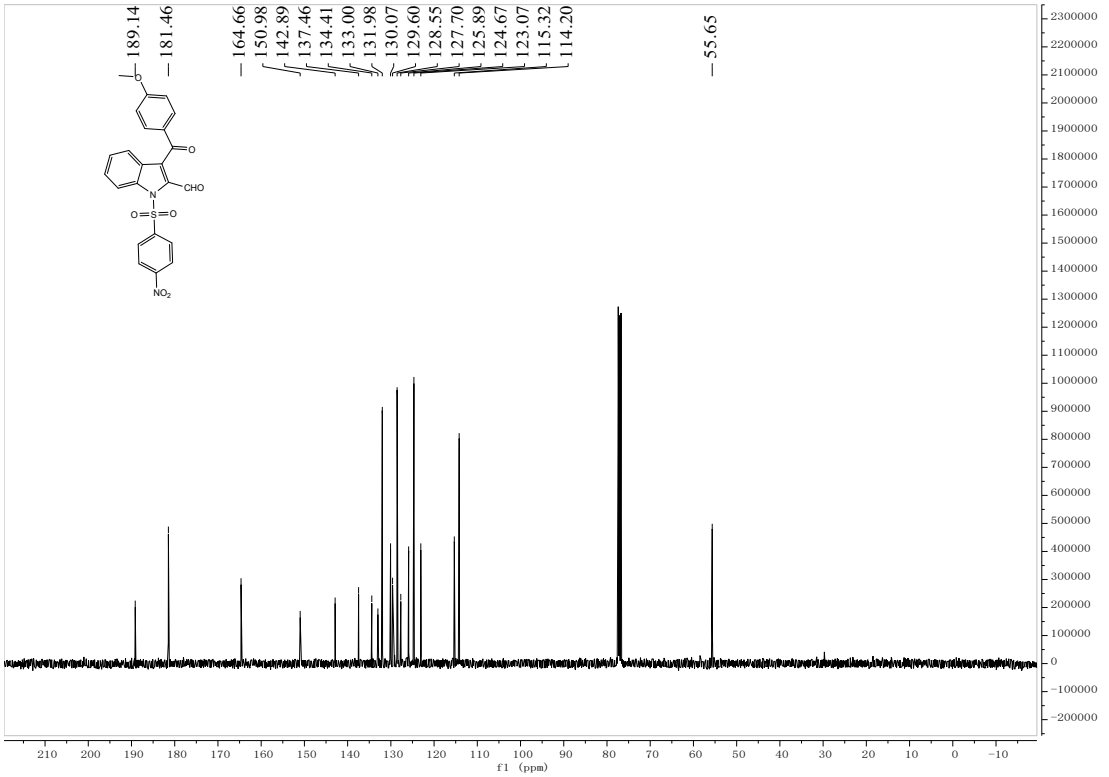
^{13}C NMR spectrum of **1v**



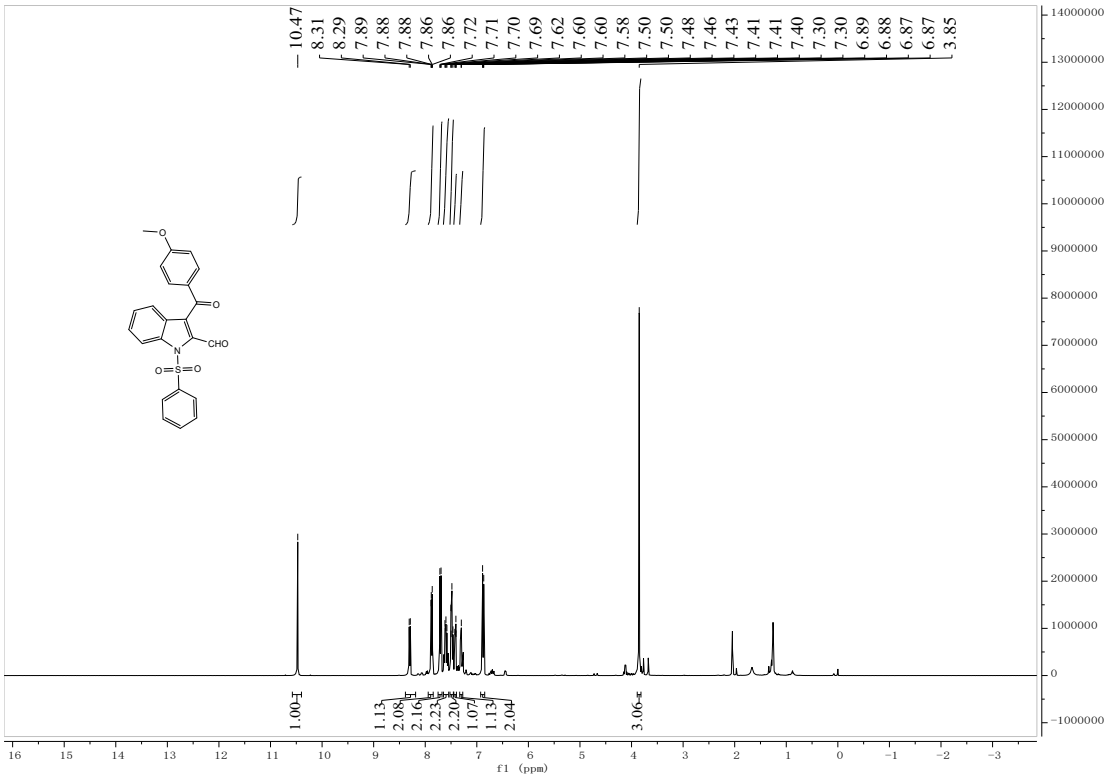
^{1}H NMR spectrum of **2a**



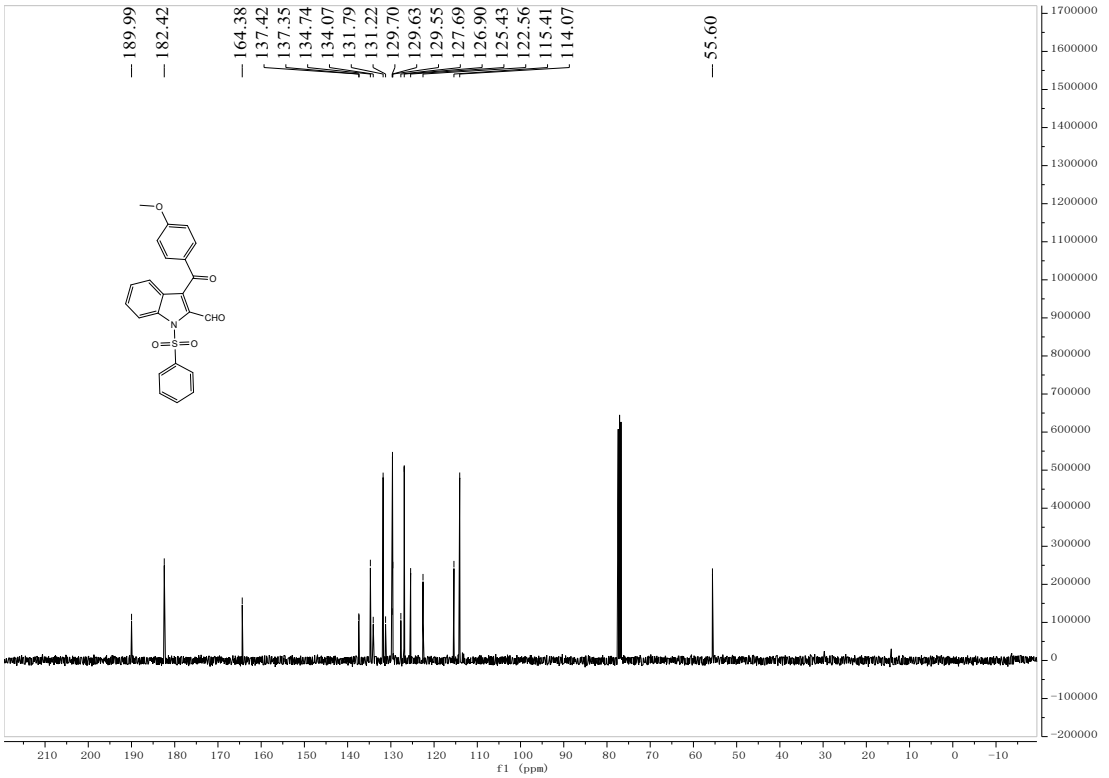
^{13}C NMR spectrum of **2a**



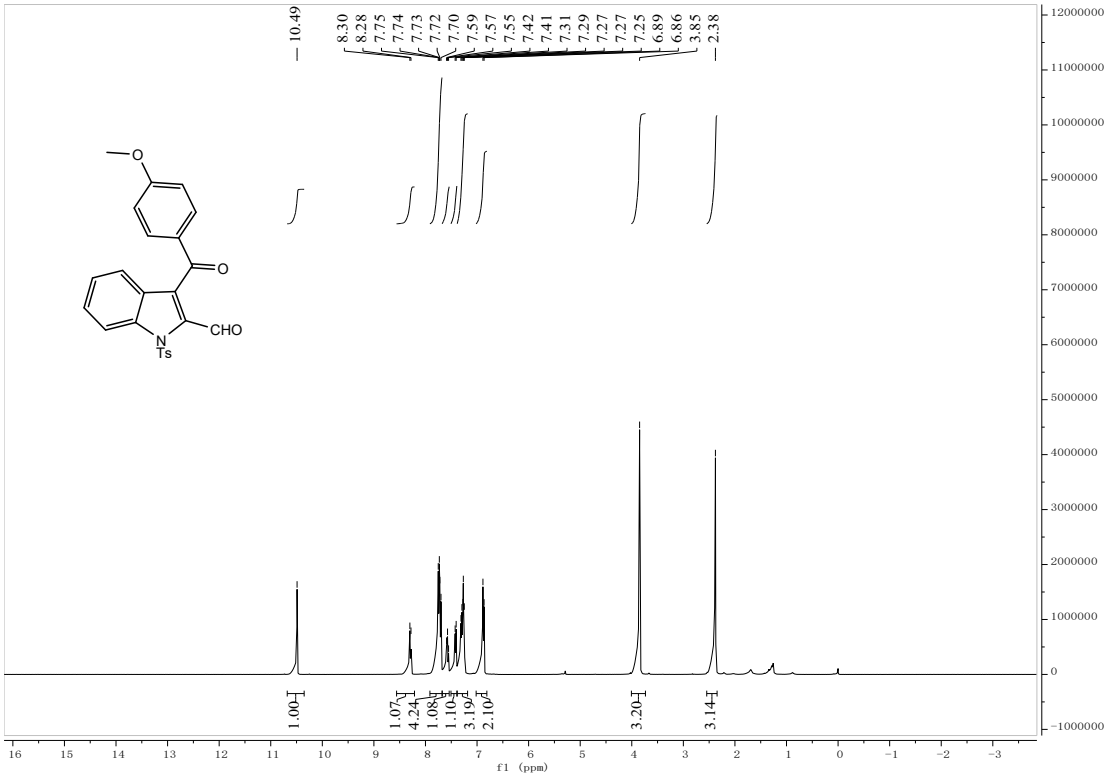
^{1}H NMR spectrum of **2b**



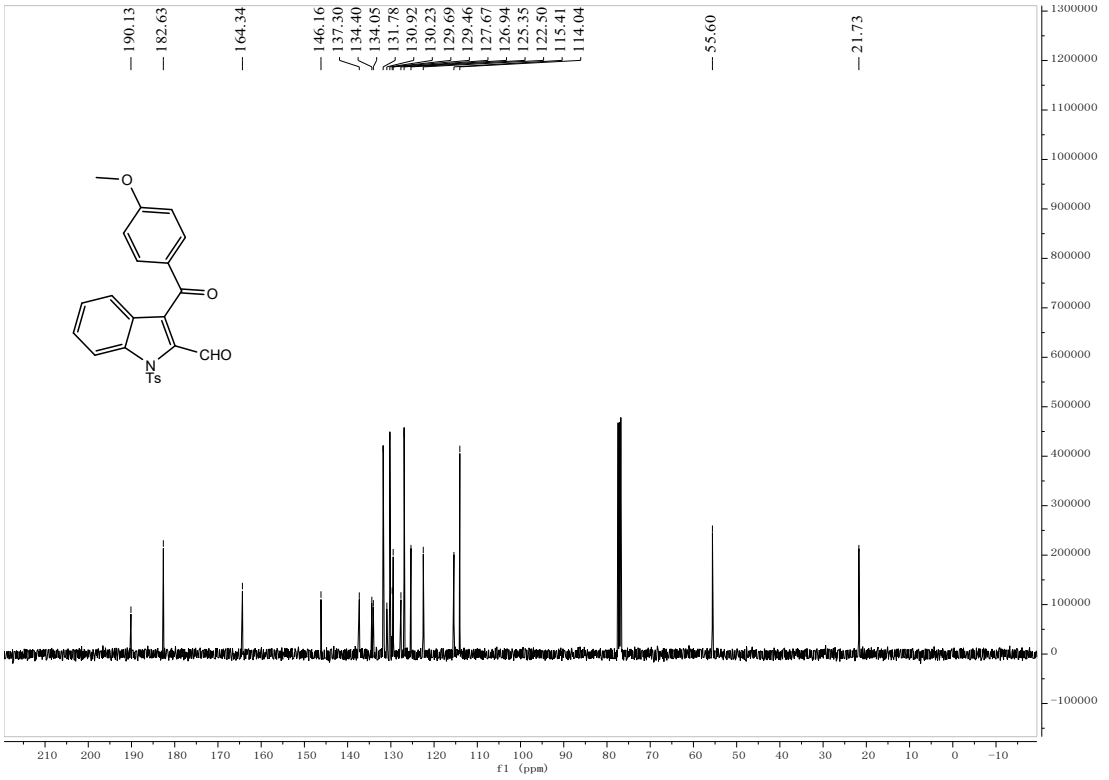
^{1}H NMR spectrum of **2b**



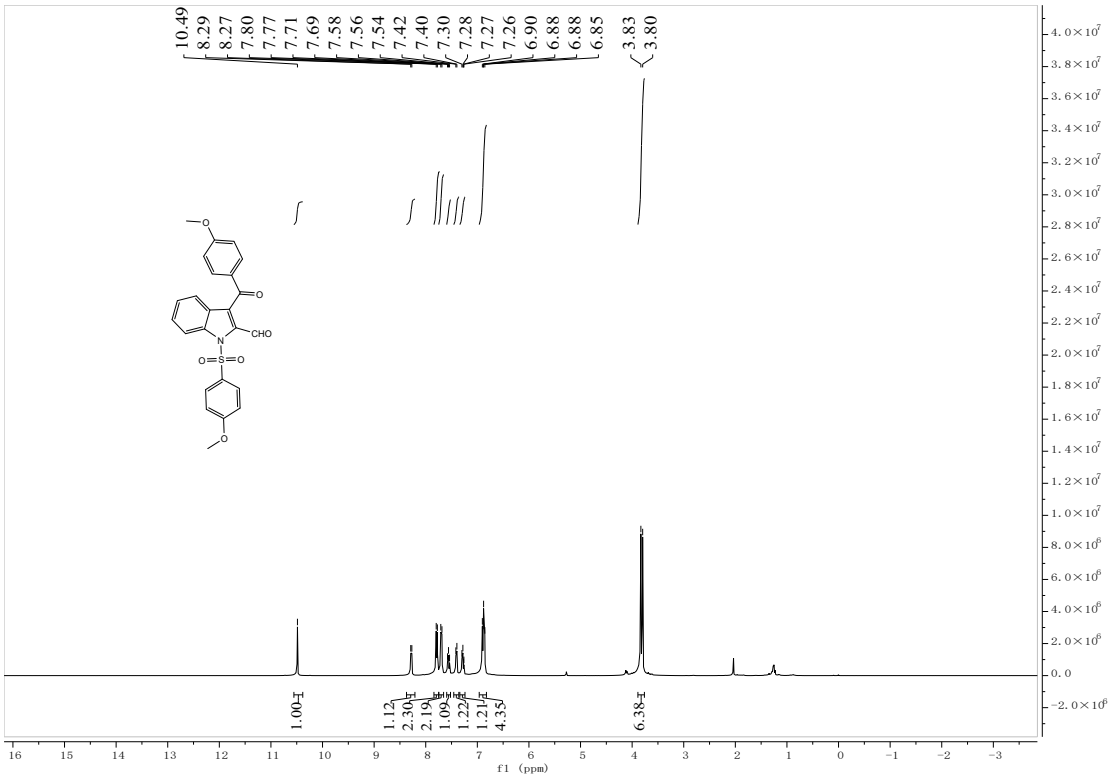
^{1}H NMR spectrum of **2c**



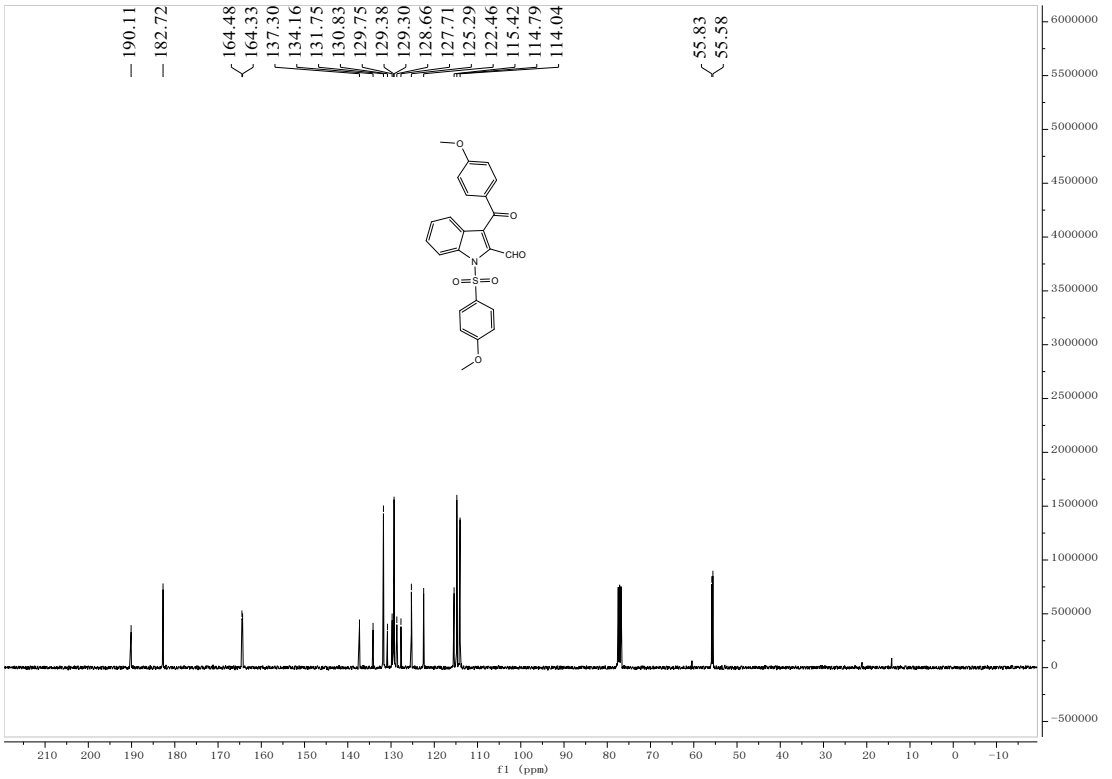
^{13}C NMR spectrum of **2c**



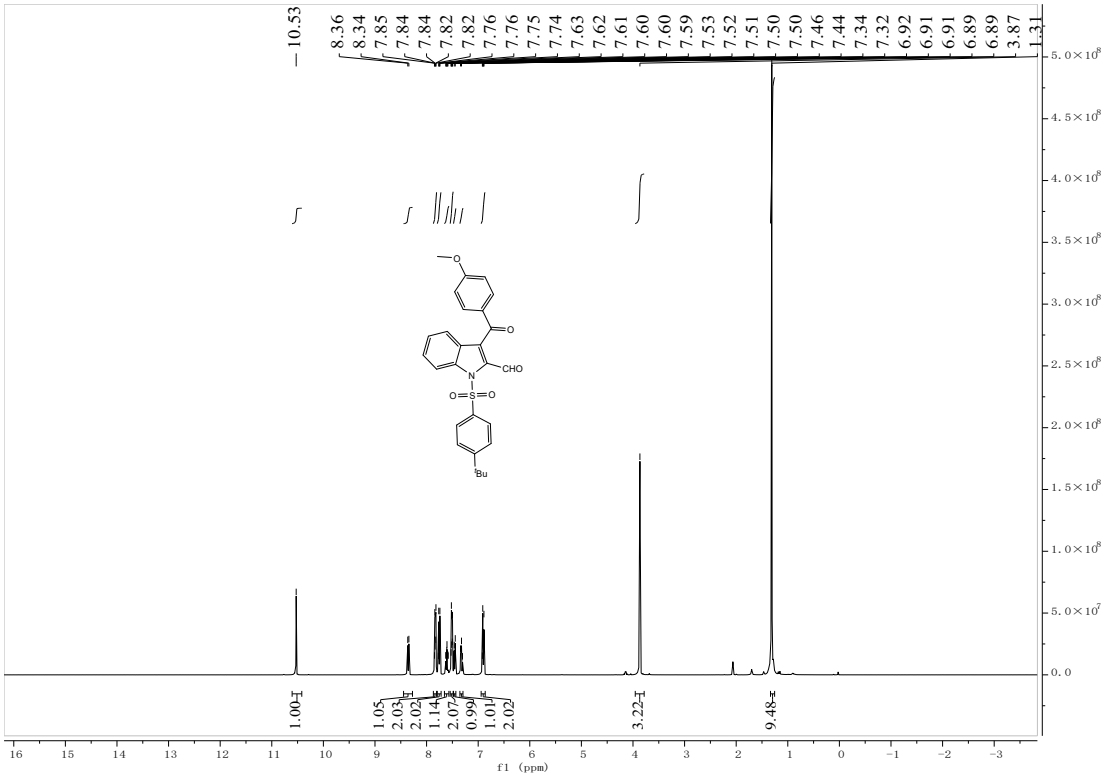
^{1}H NMR spectrum of **2d**



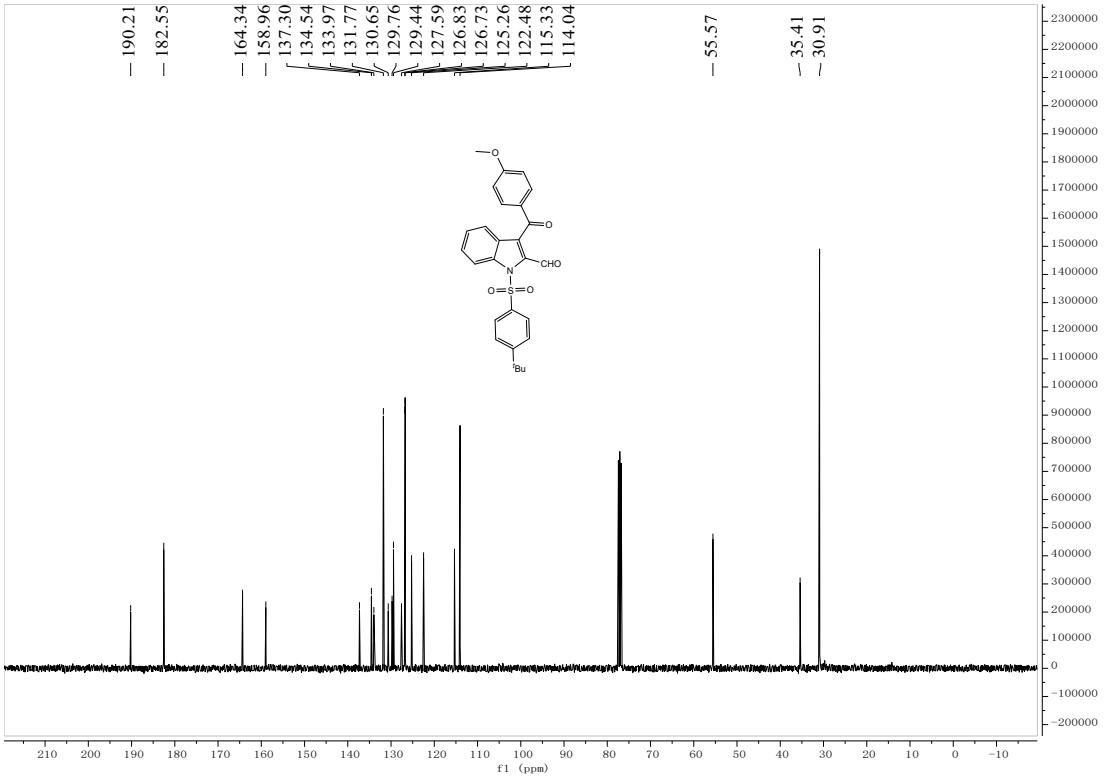
^{13}C NMR spectrum of **2d**



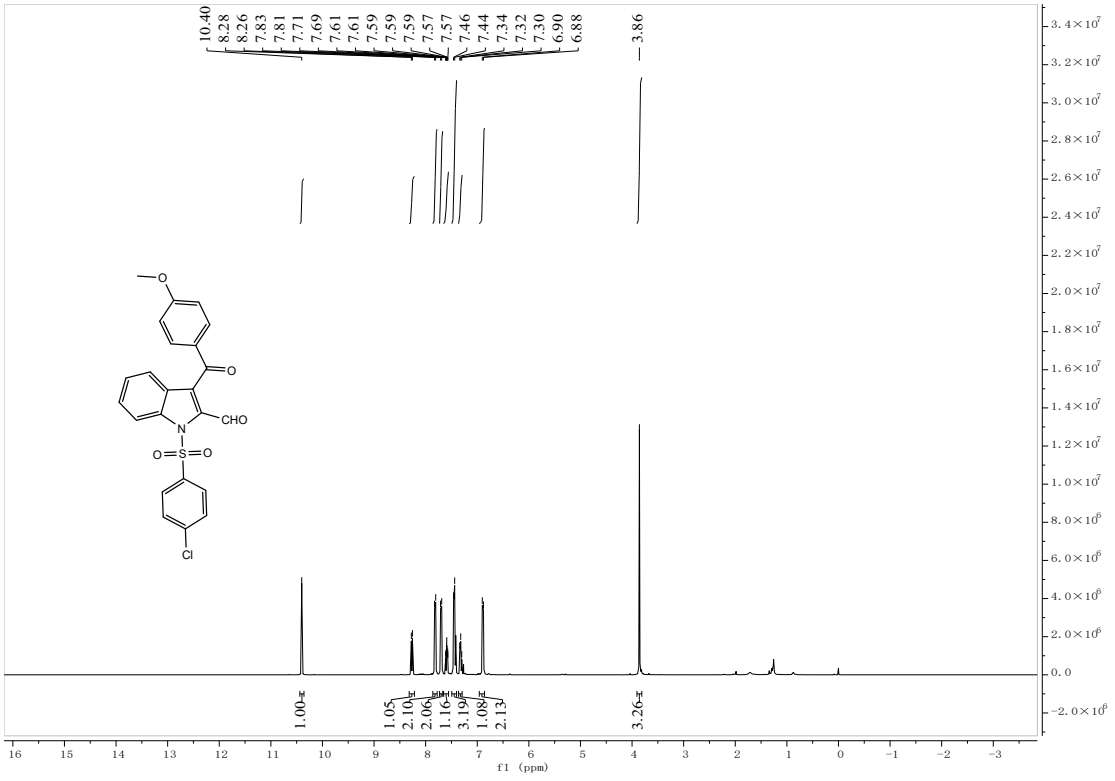
^{1}H NMR spectrum of **2e**



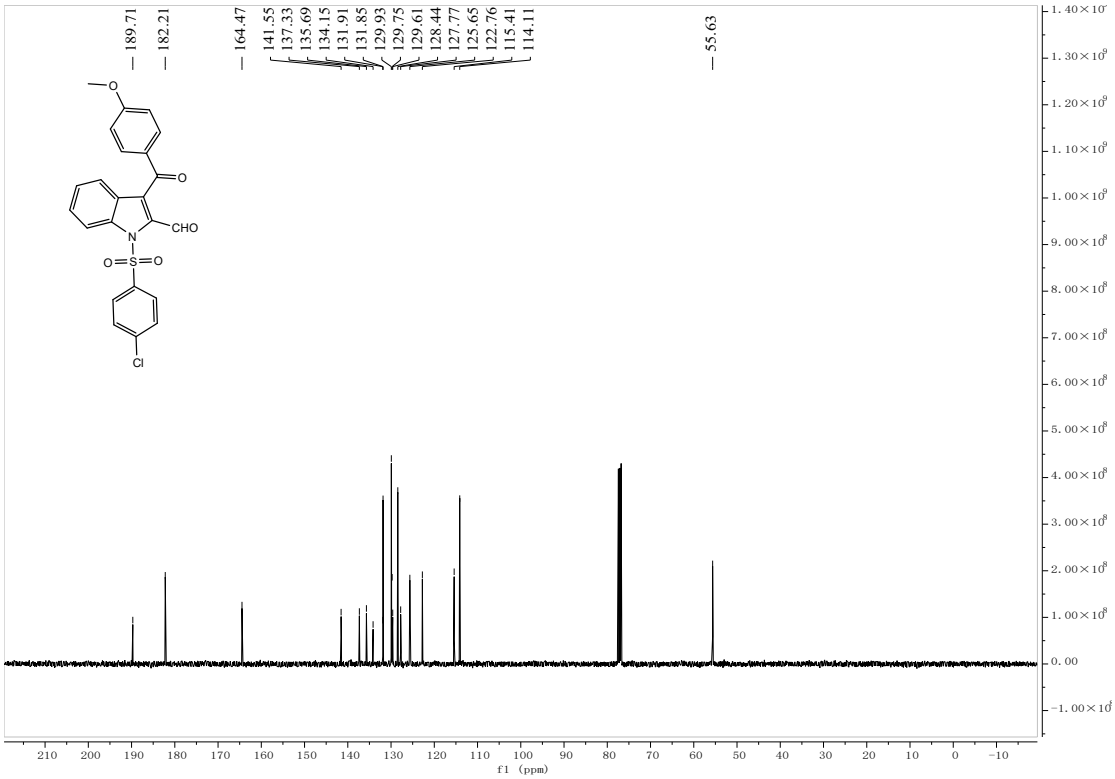
^{13}C NMR spectrum of **2e**



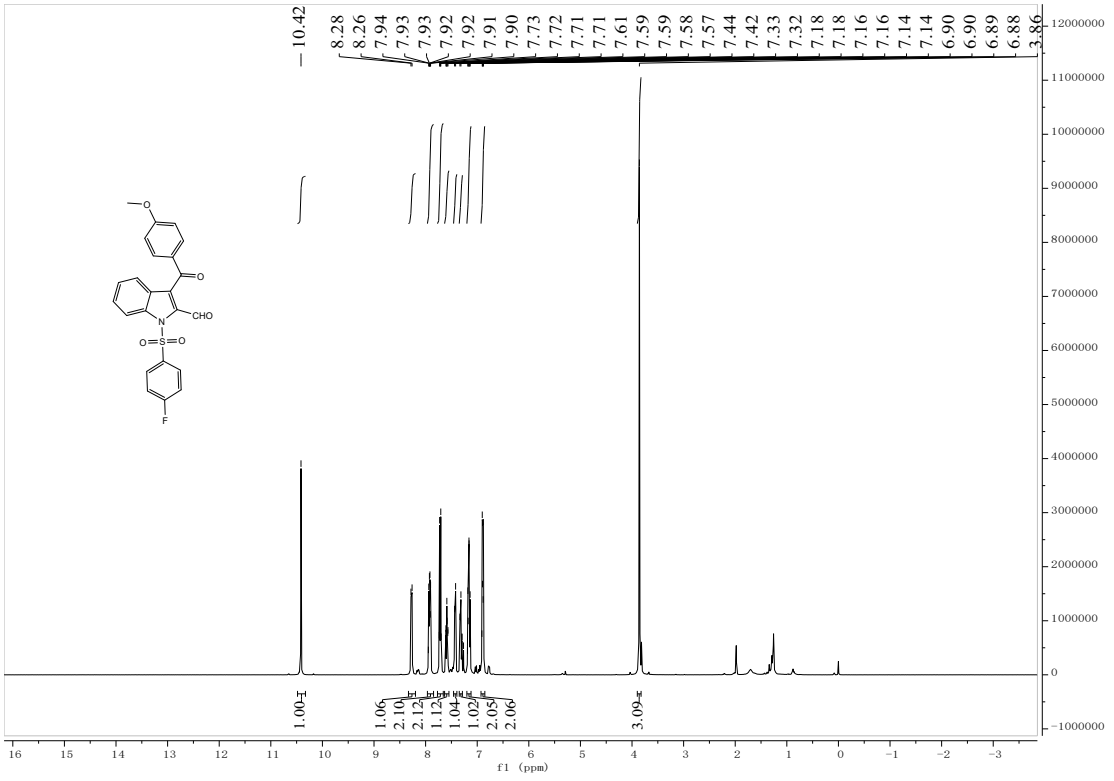
[1]H NMR spectrum of **2f**



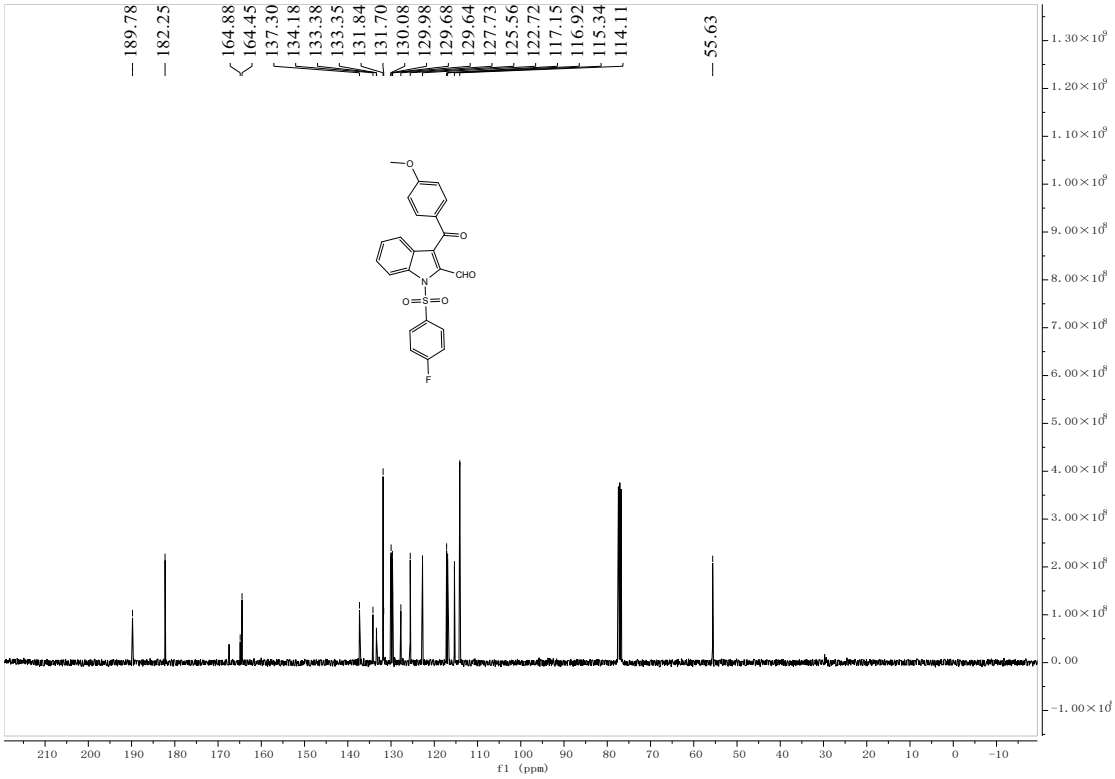
[13]C NMR spectrum of **2f**



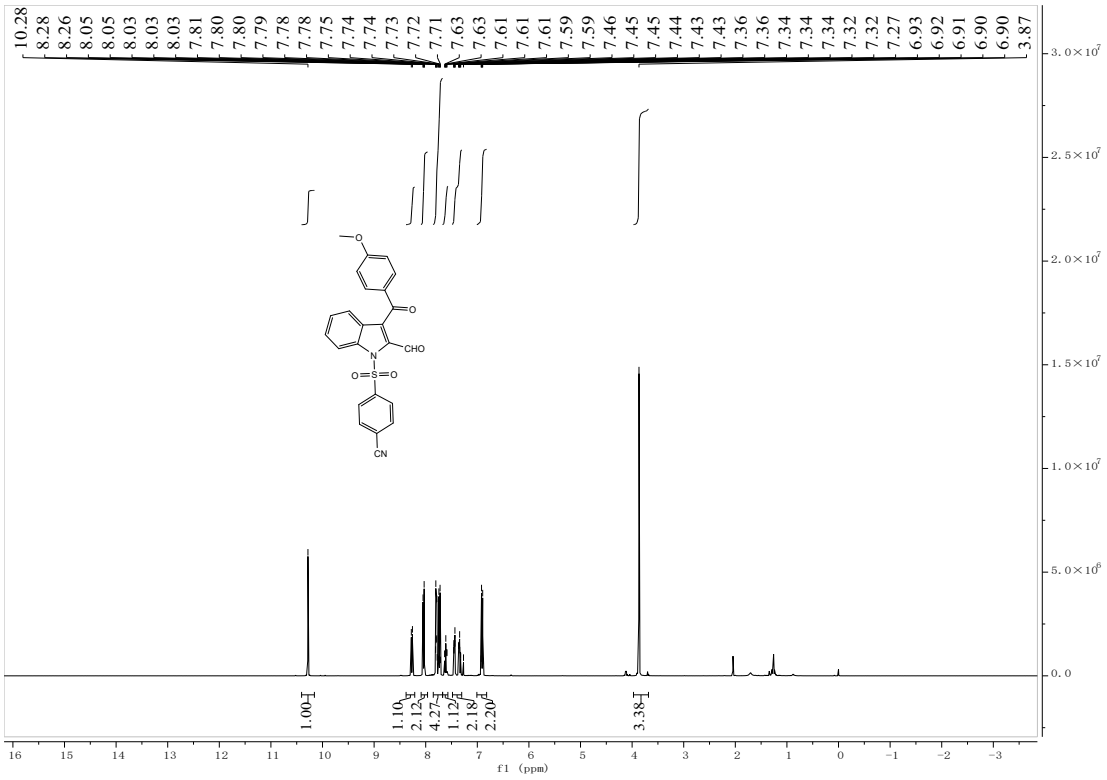
^{1}H NMR spectrum of **2g**



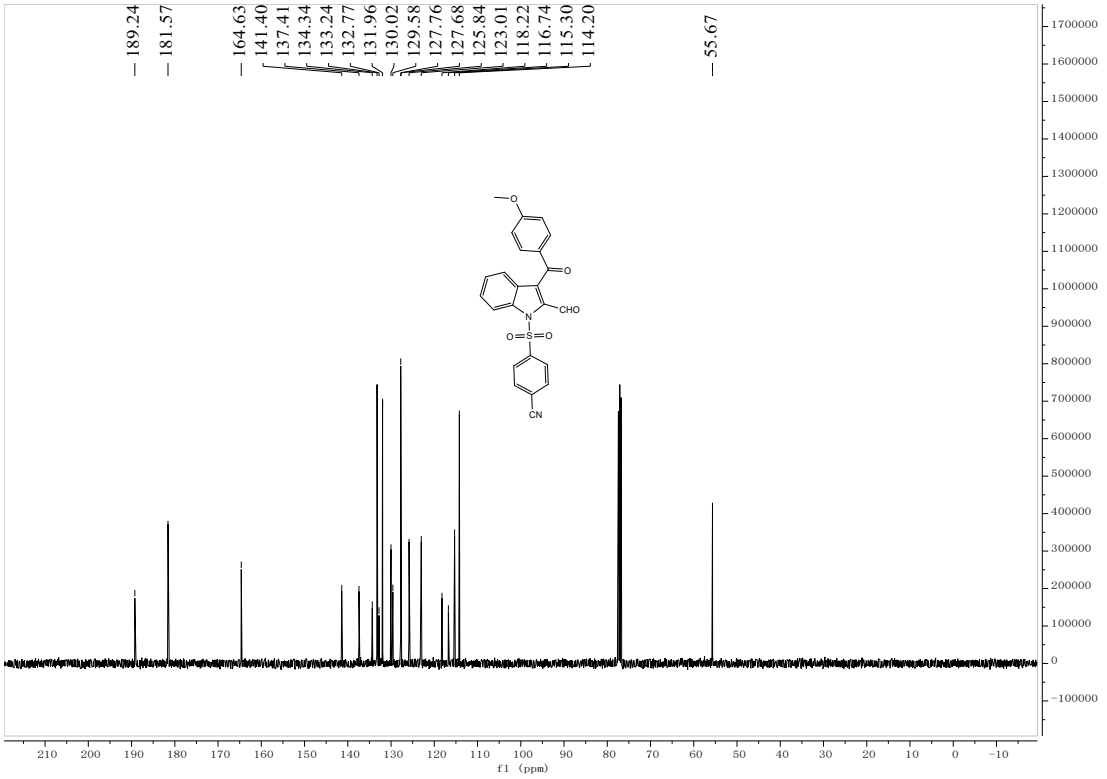
^{13}C NMR spectrum of **2g**



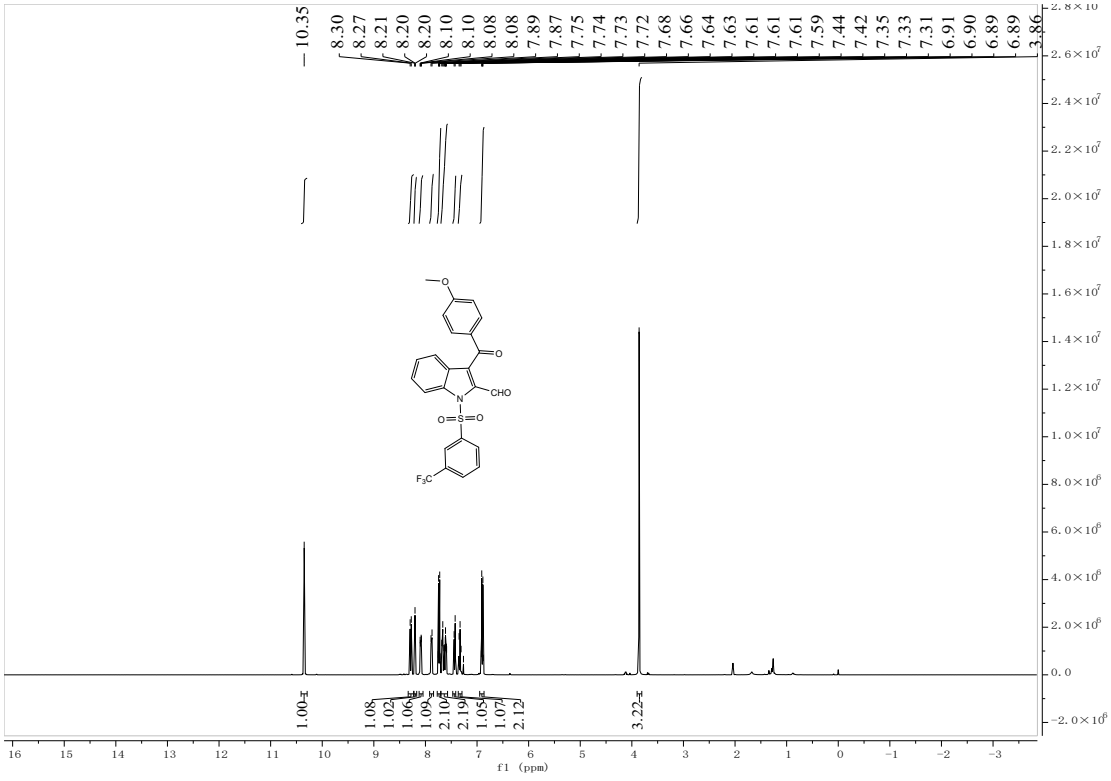
^{1}H NMR spectrum of **2h**



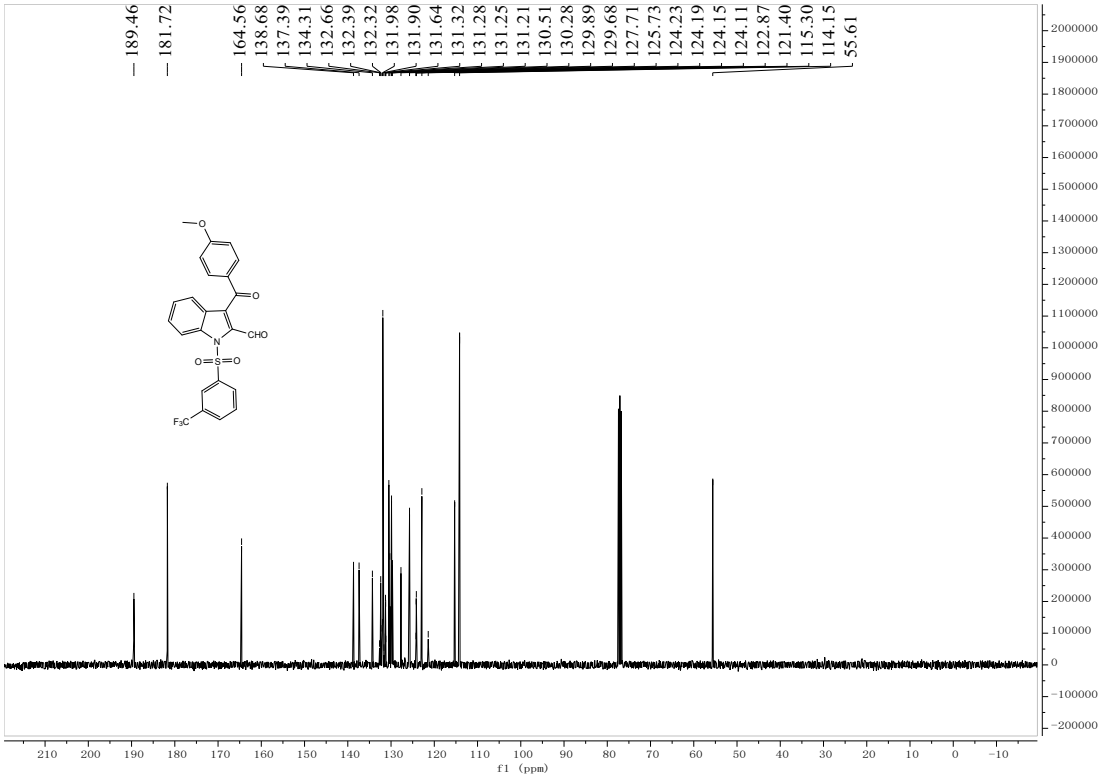
^{13}C NMR spectrum of **2h**



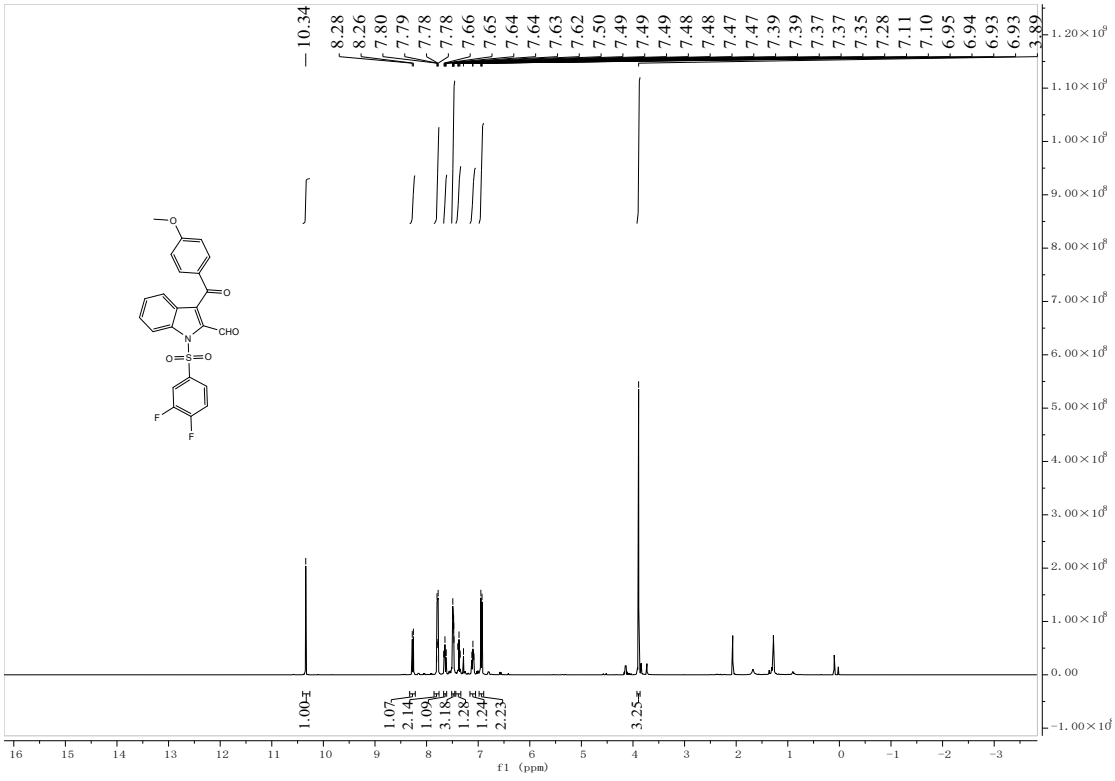
^{1}H NMR spectrum of **2i**



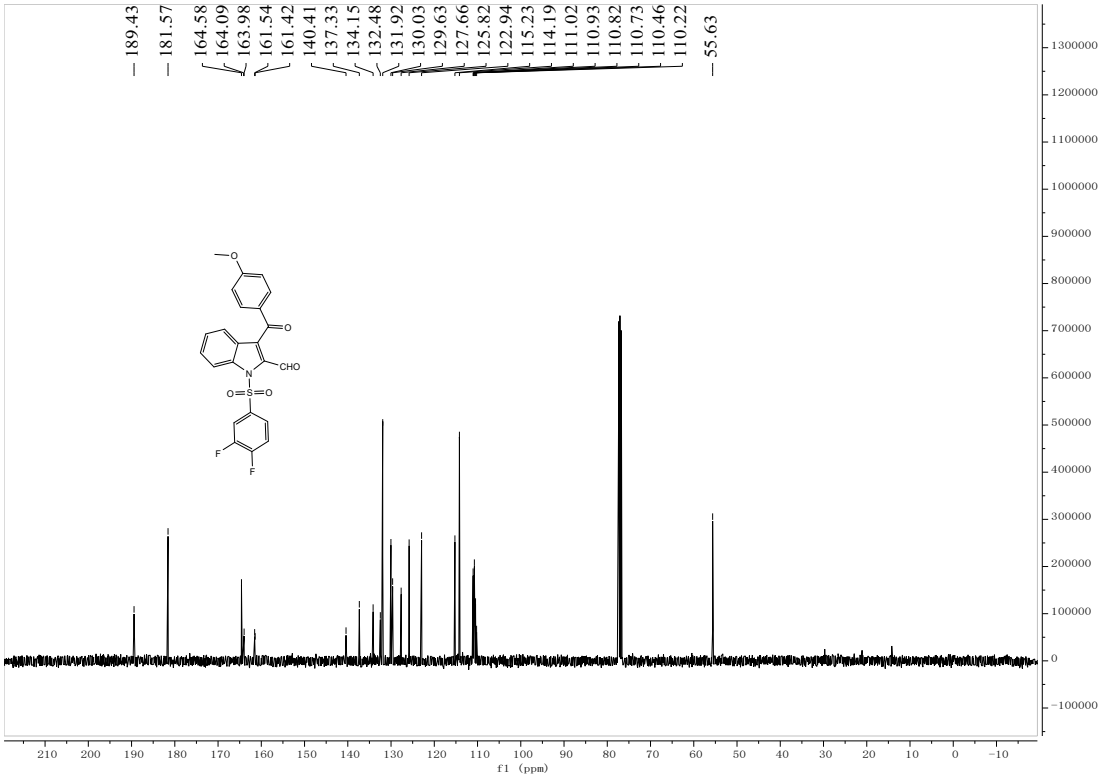
^{13}C NMR spectrum of **2i**



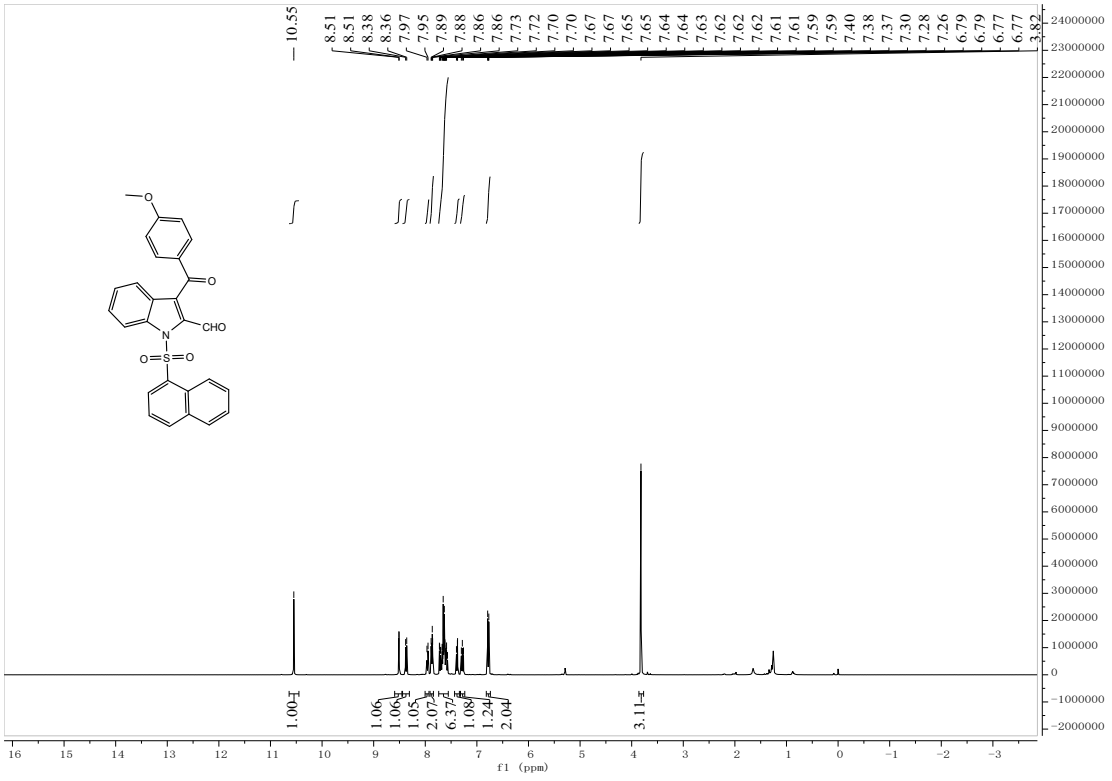
^{1}H NMR spectrum of **2j**



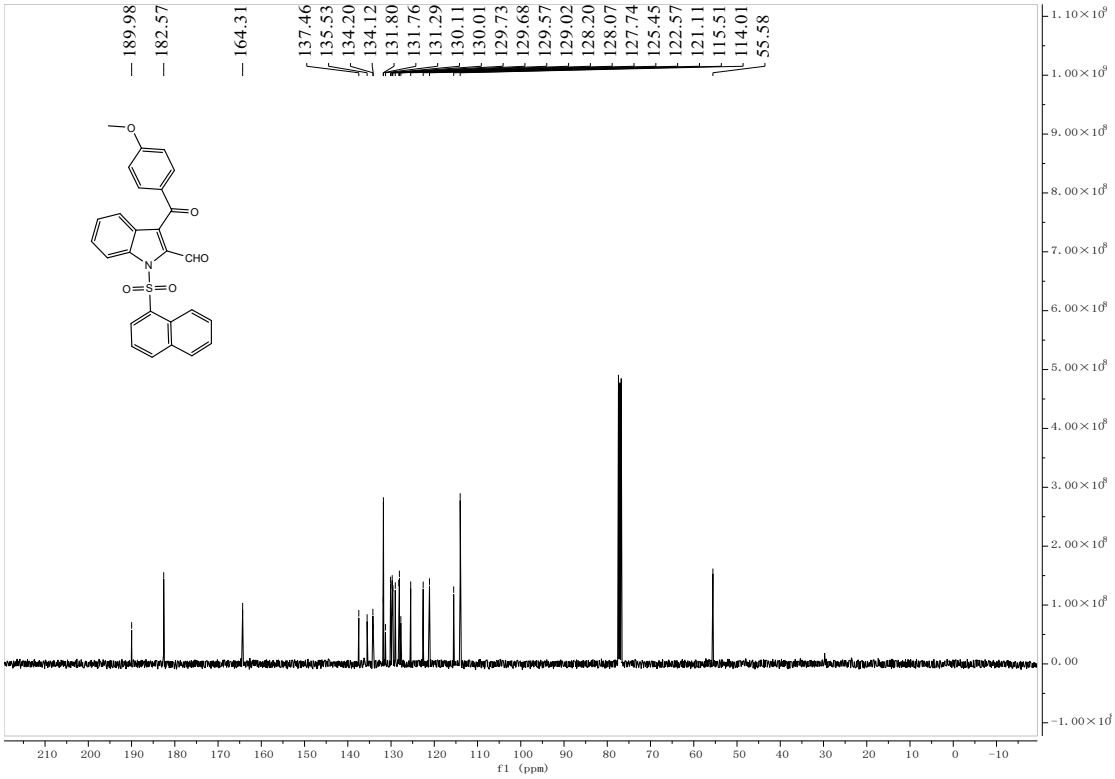
^{13}C NMR spectrum of **2j**



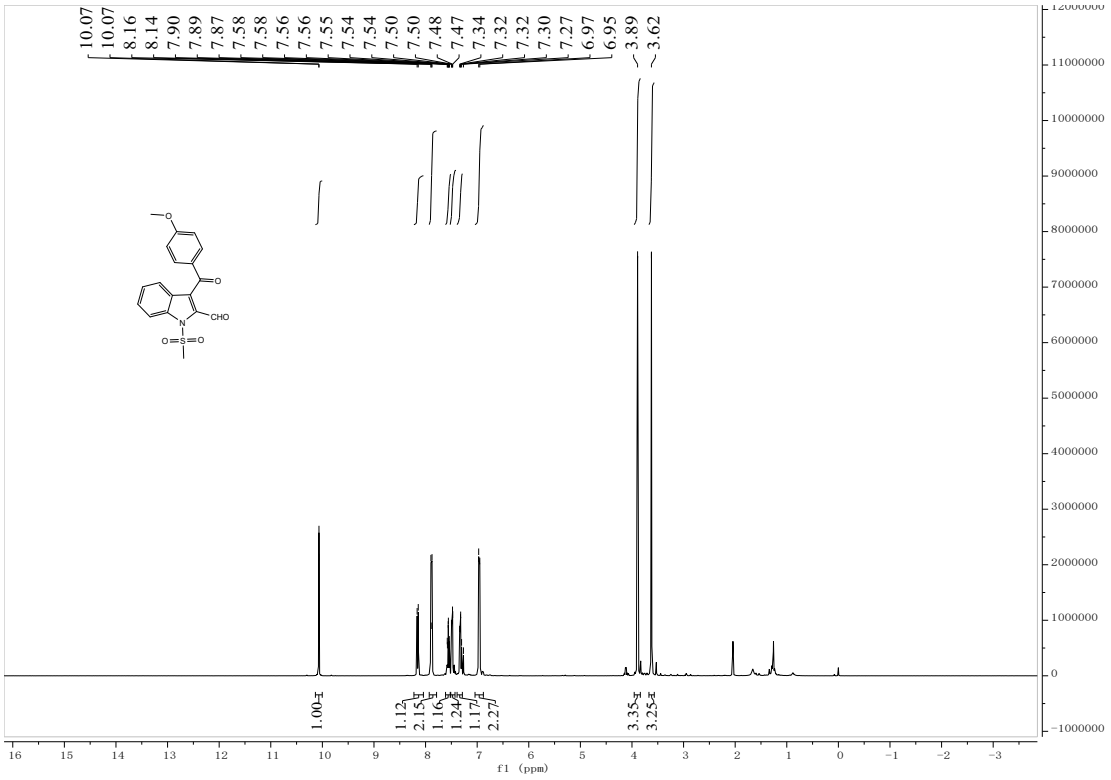
^{1}H NMR spectrum of **2k**



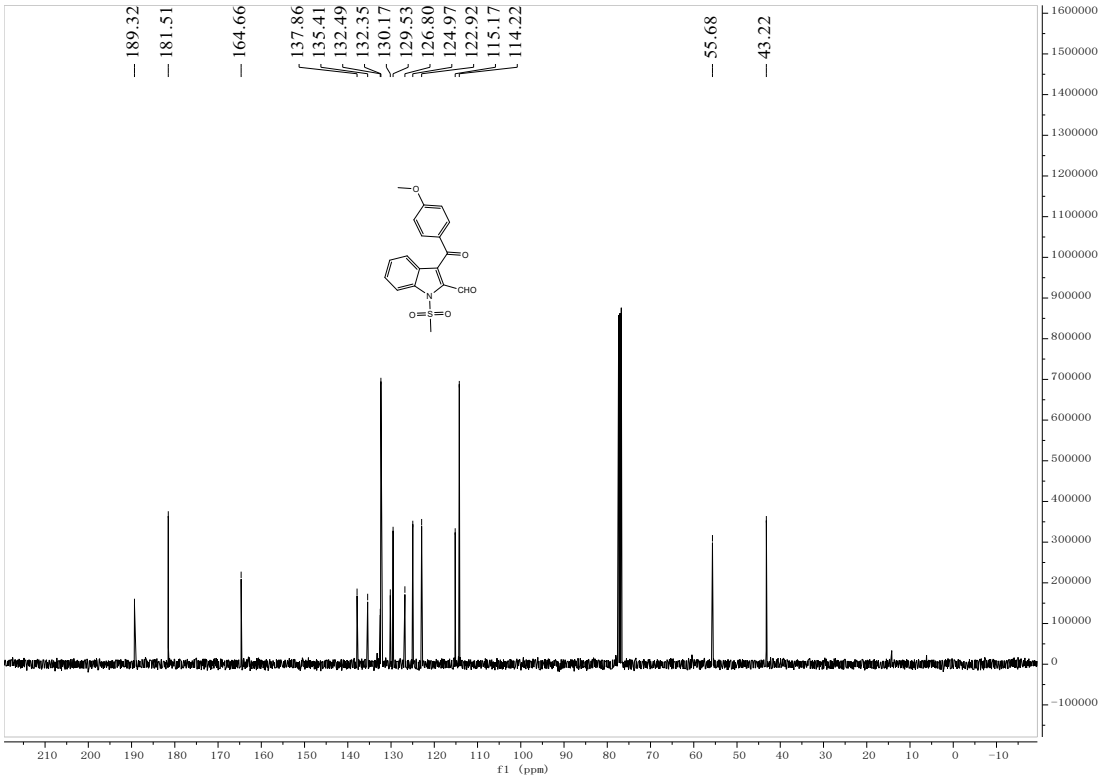
^{13}C NMR spectrum of **2k**



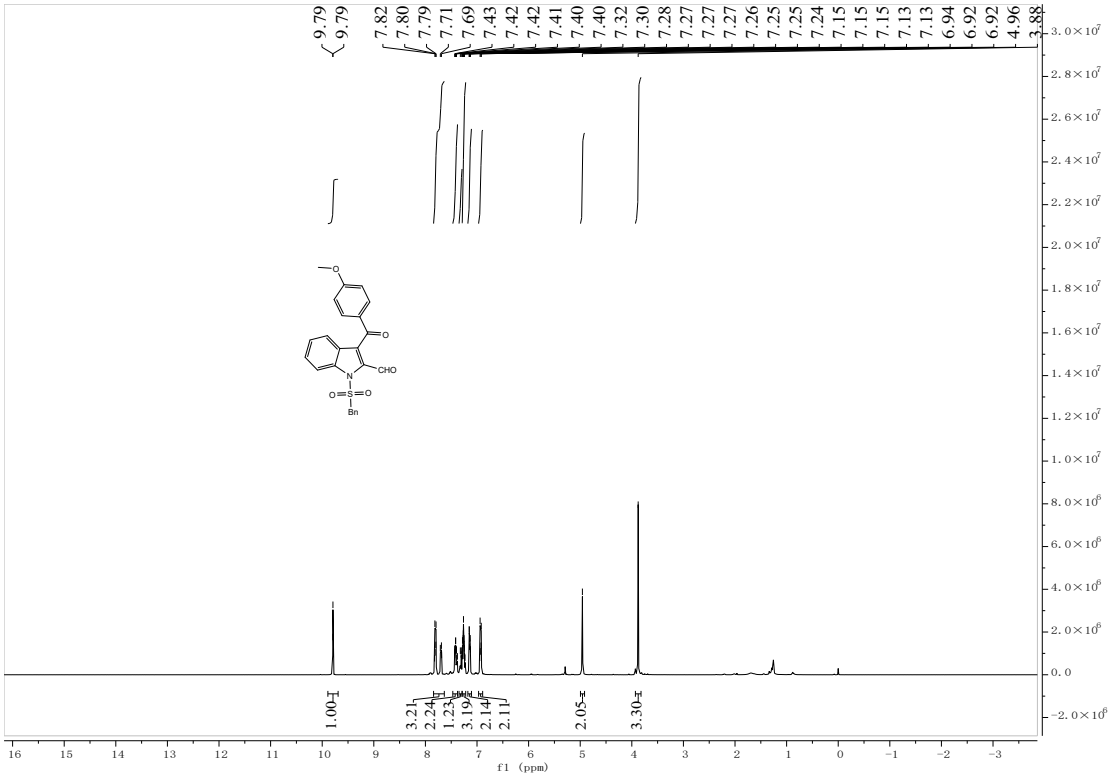
^{1}H NMR spectrum of **2l**



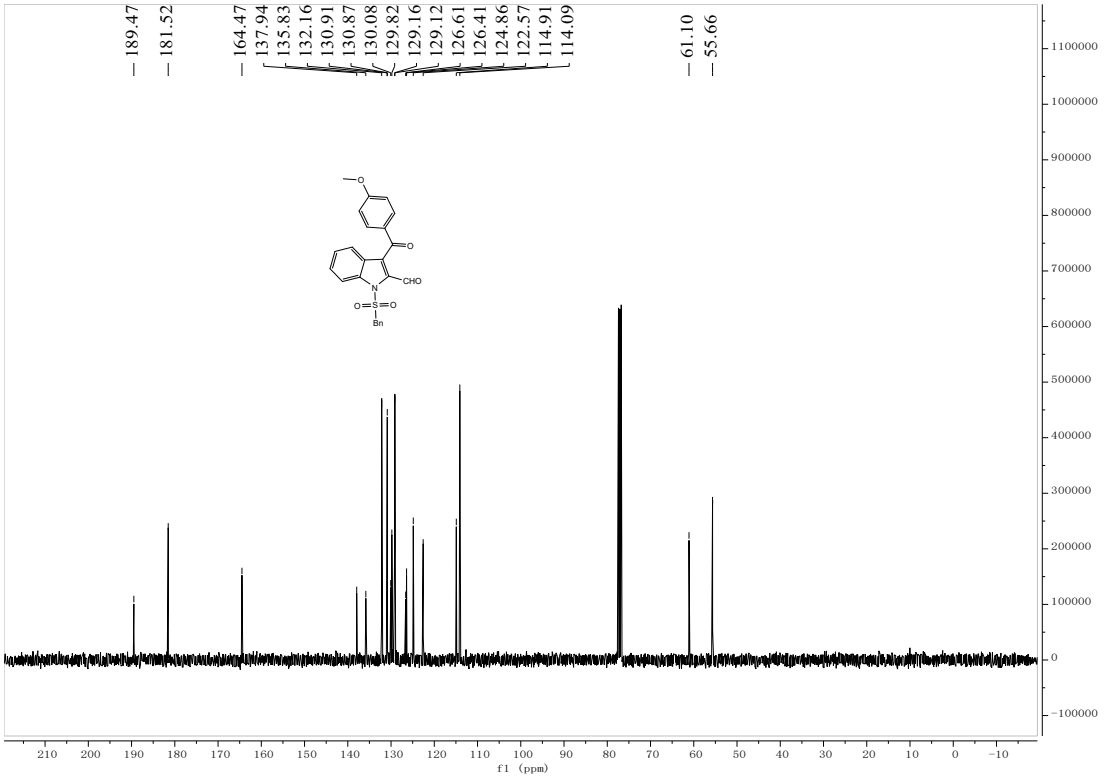
^{13}C NMR spectrum of **2l**



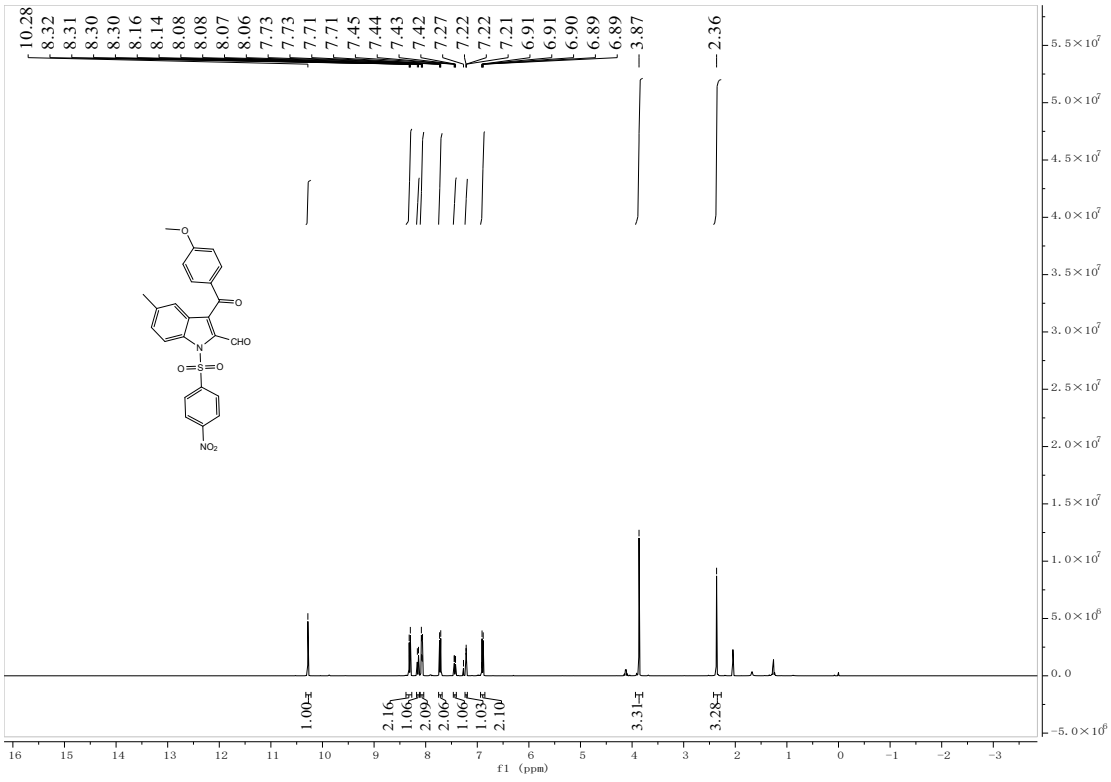
^{1}H NMR spectrum of **2m**



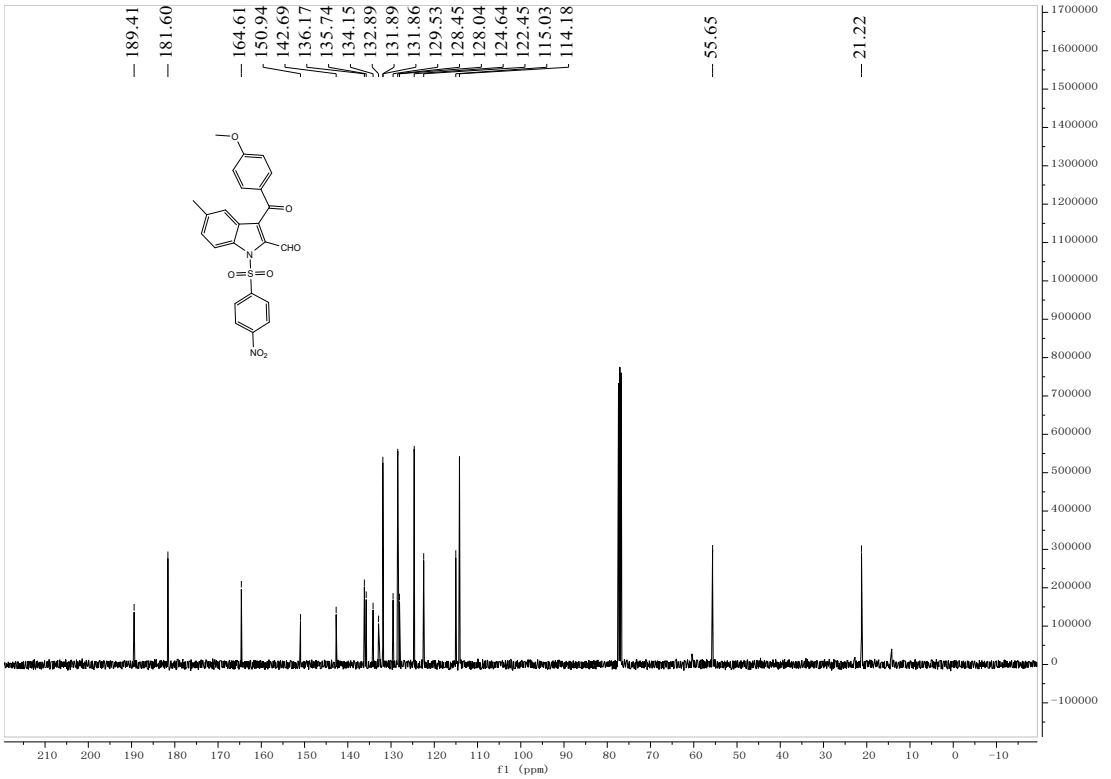
^{13}C NMR spectrum of **2m**



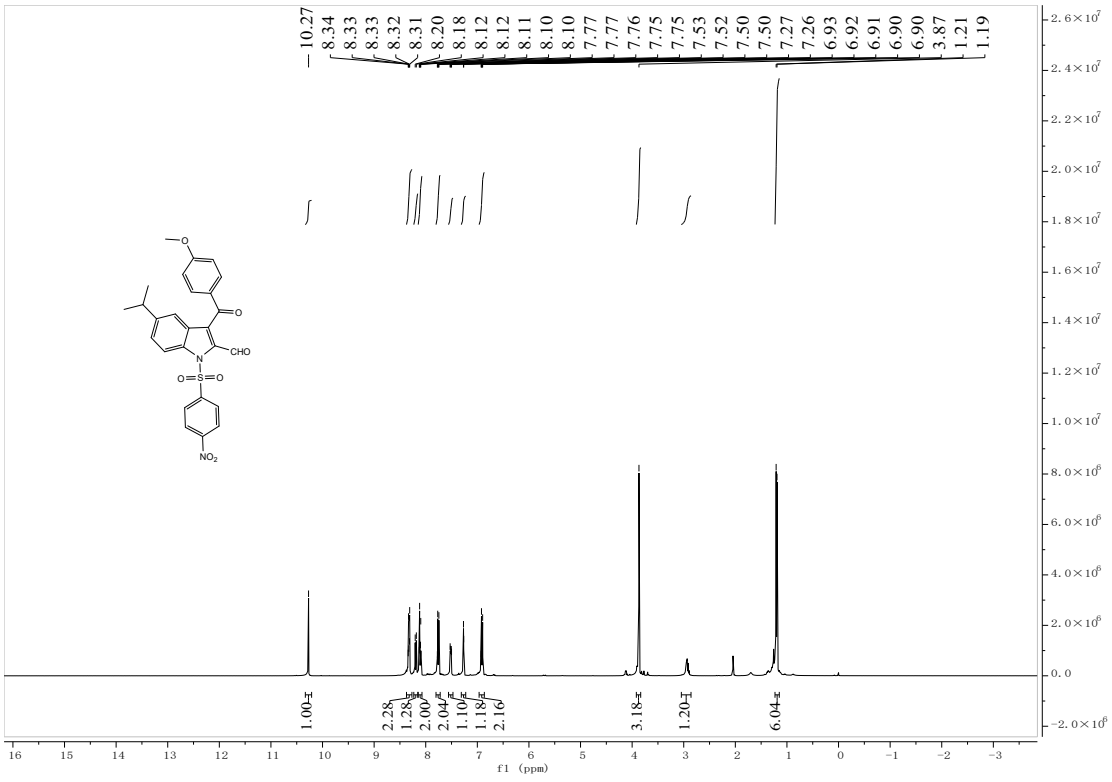
^{1}H NMR spectrum of **2n**



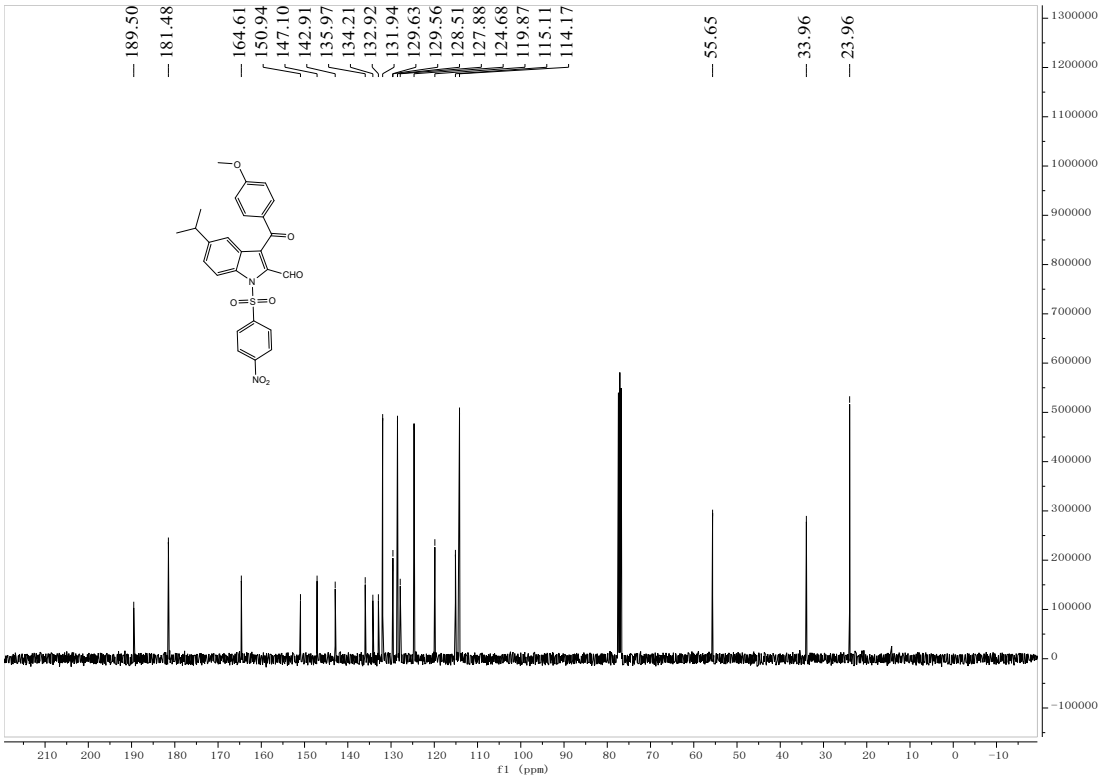
^{13}C NMR spectrum of **2n**



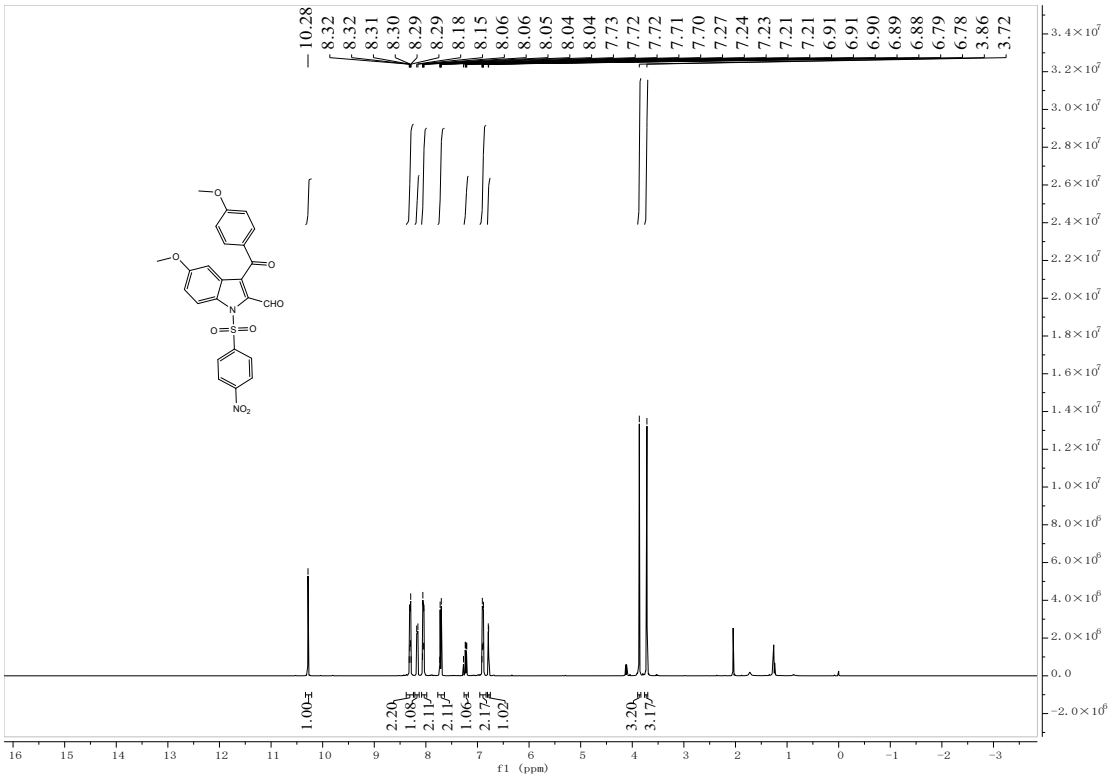
^{1}H NMR spectrum of **2o**



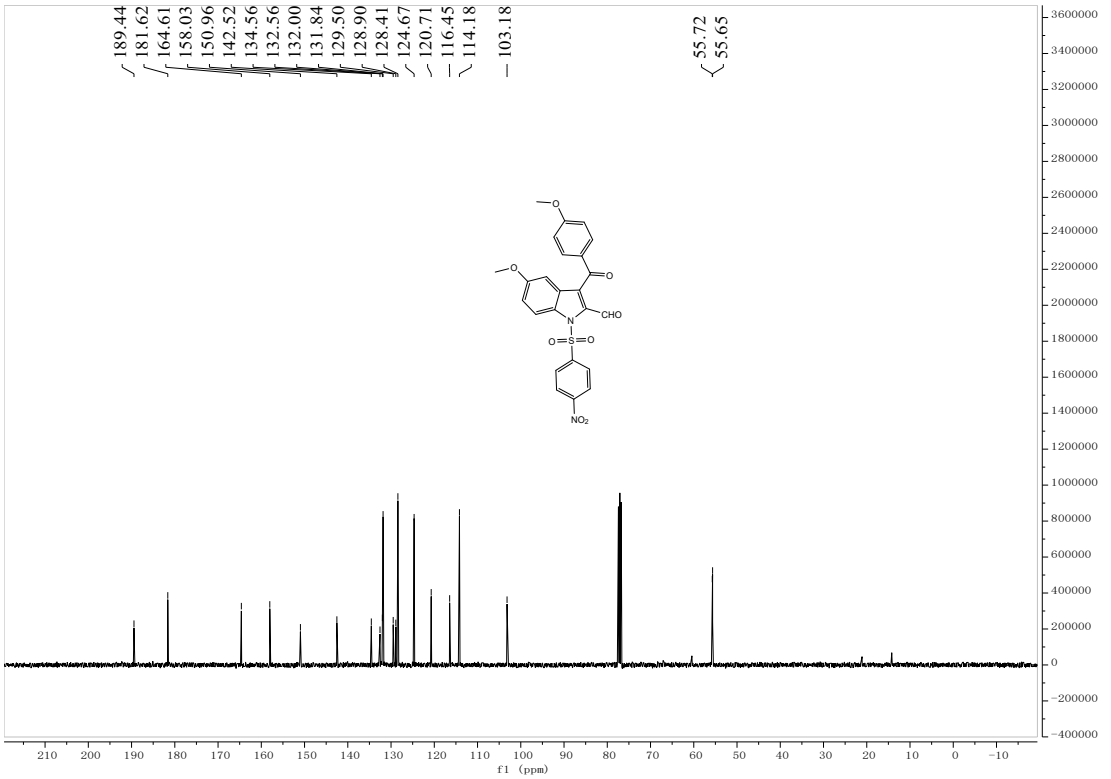
^{13}C NMR spectrum of **2o**



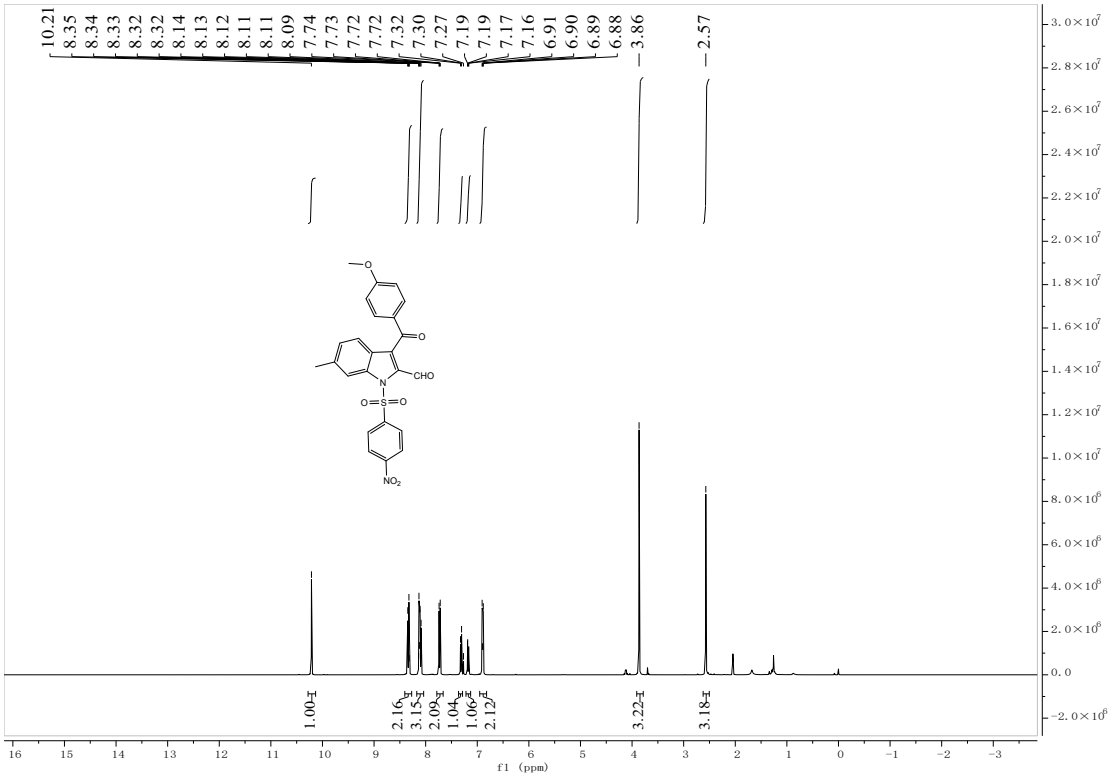
^{1}H NMR spectrum of **2p**



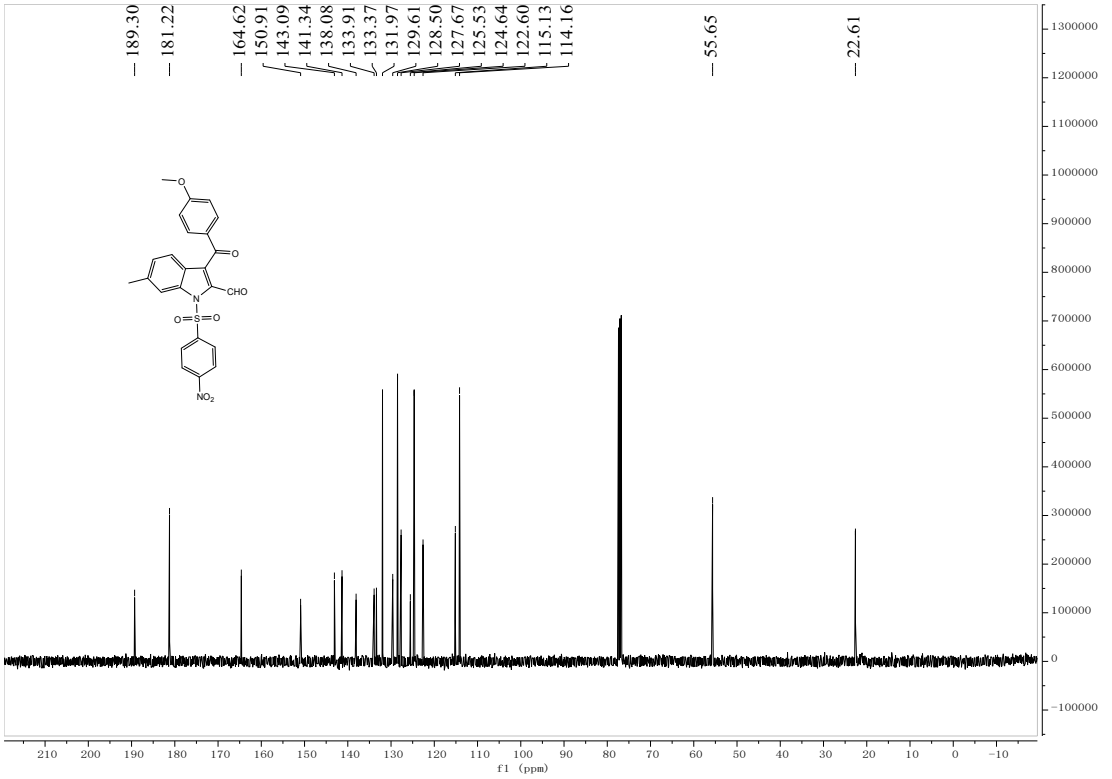
^{13}C NMR spectrum of **2p**



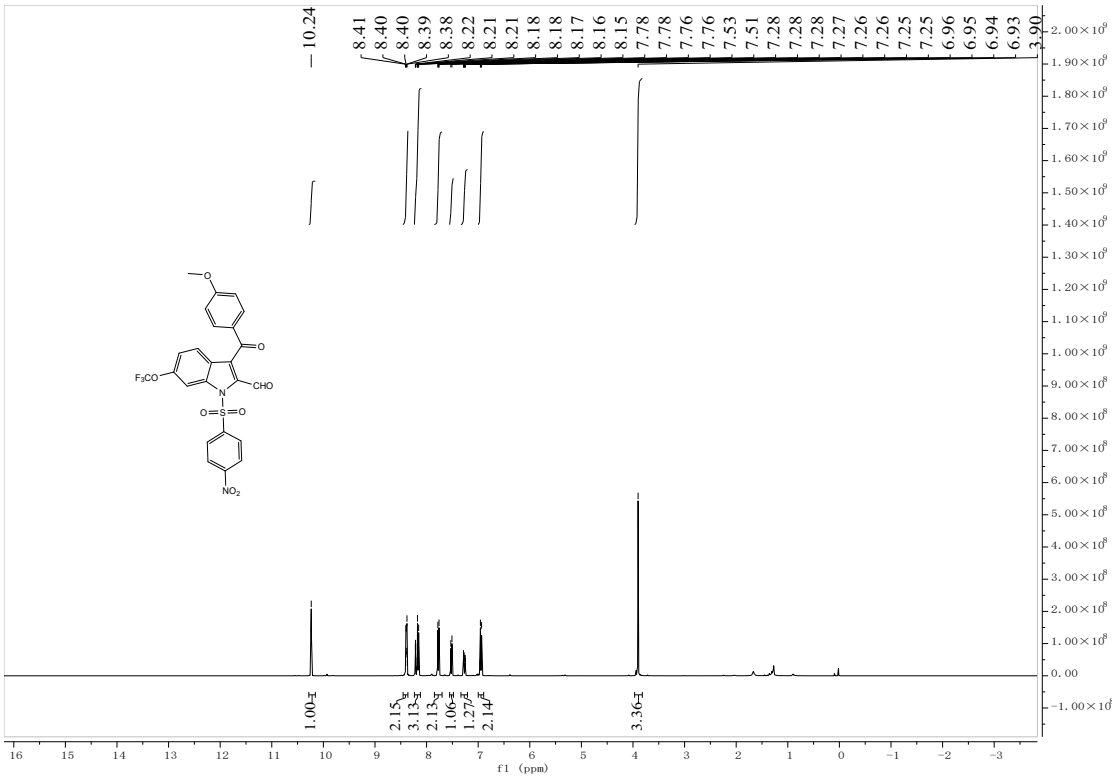
^{1}H NMR spectrum of **2q**



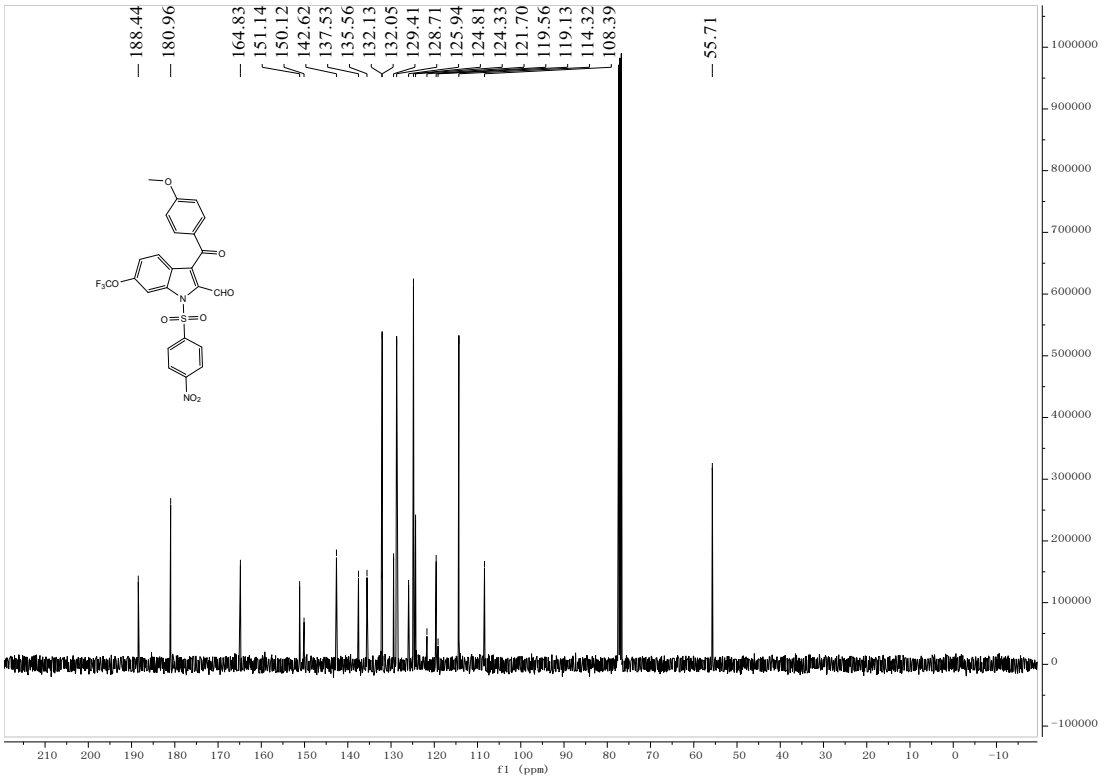
^{13}C NMR spectrum of **2q**



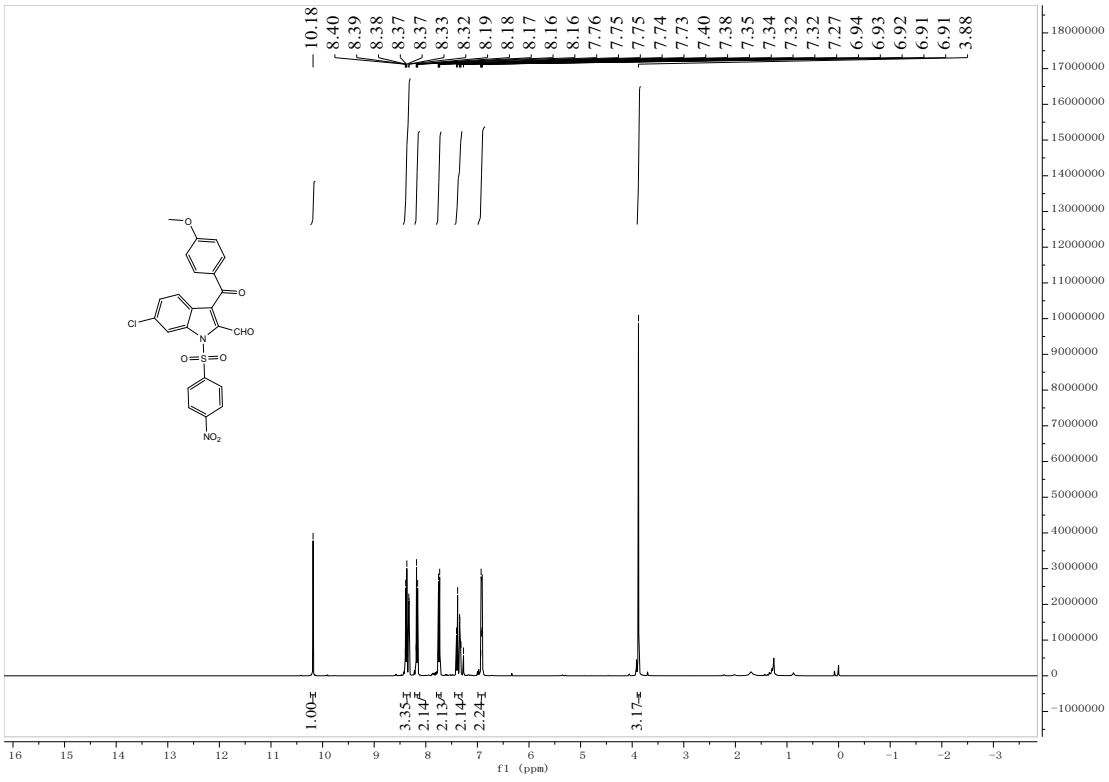
^{1}H NMR spectrum of **2r**



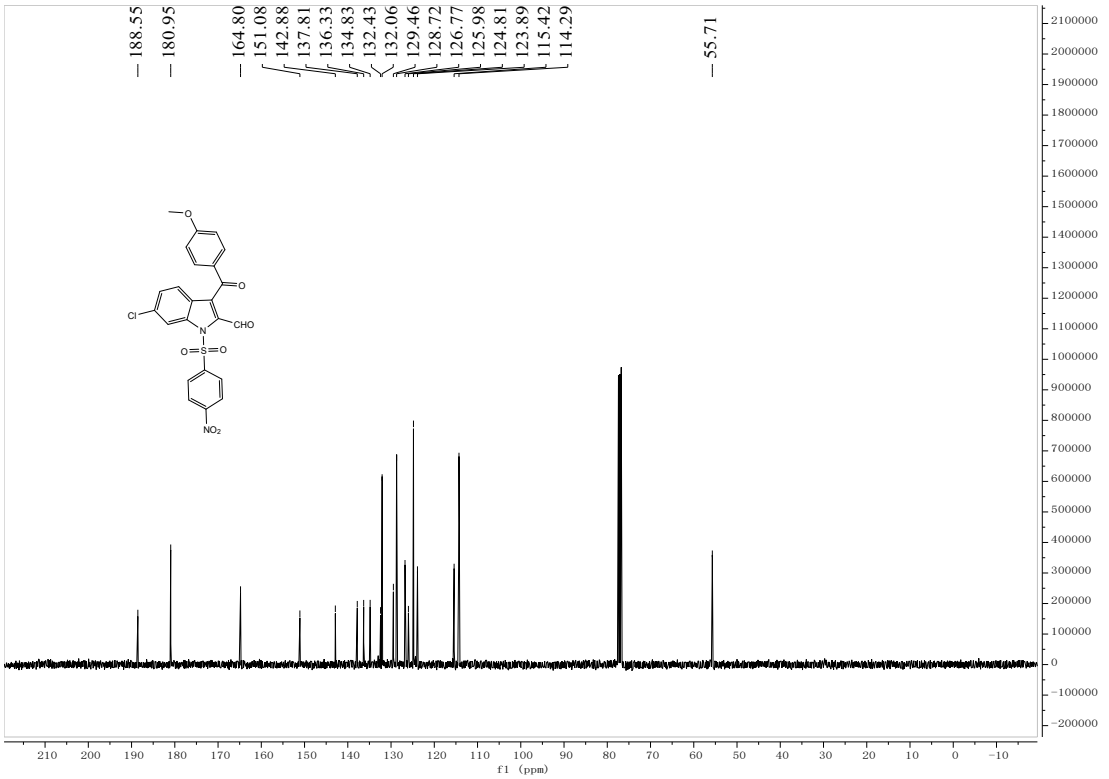
^{13}C NMR spectrum of **2r**



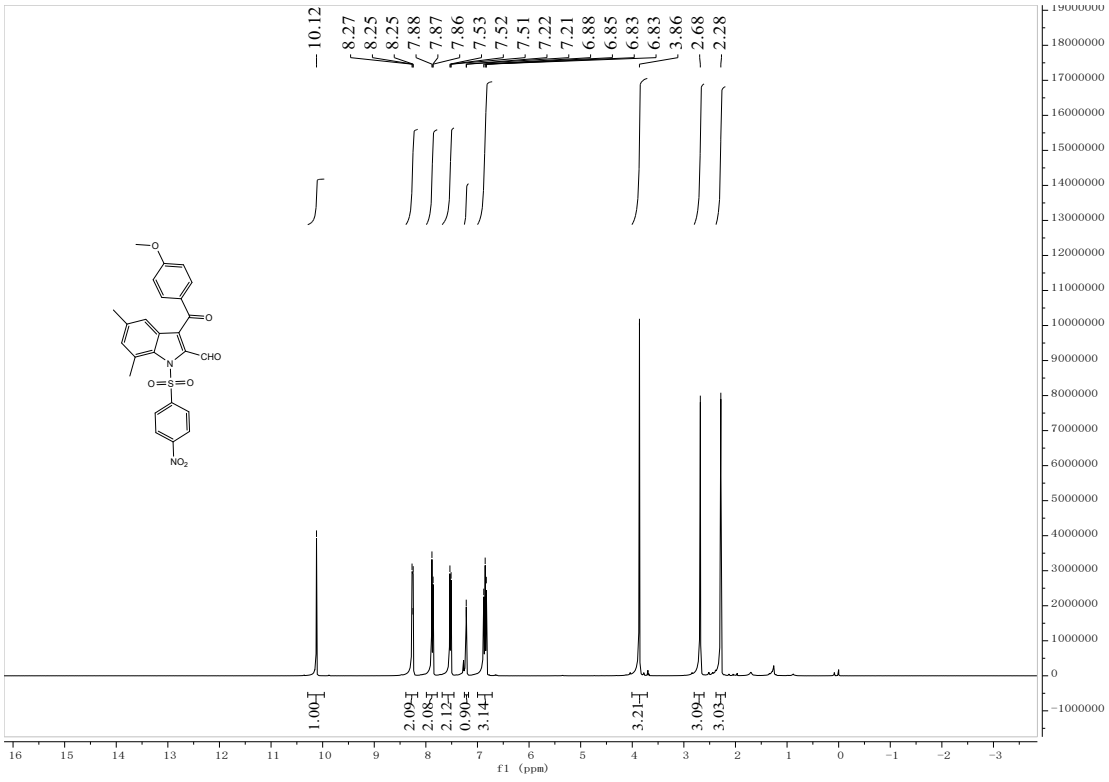
^{1}H NMR spectrum of **2s**



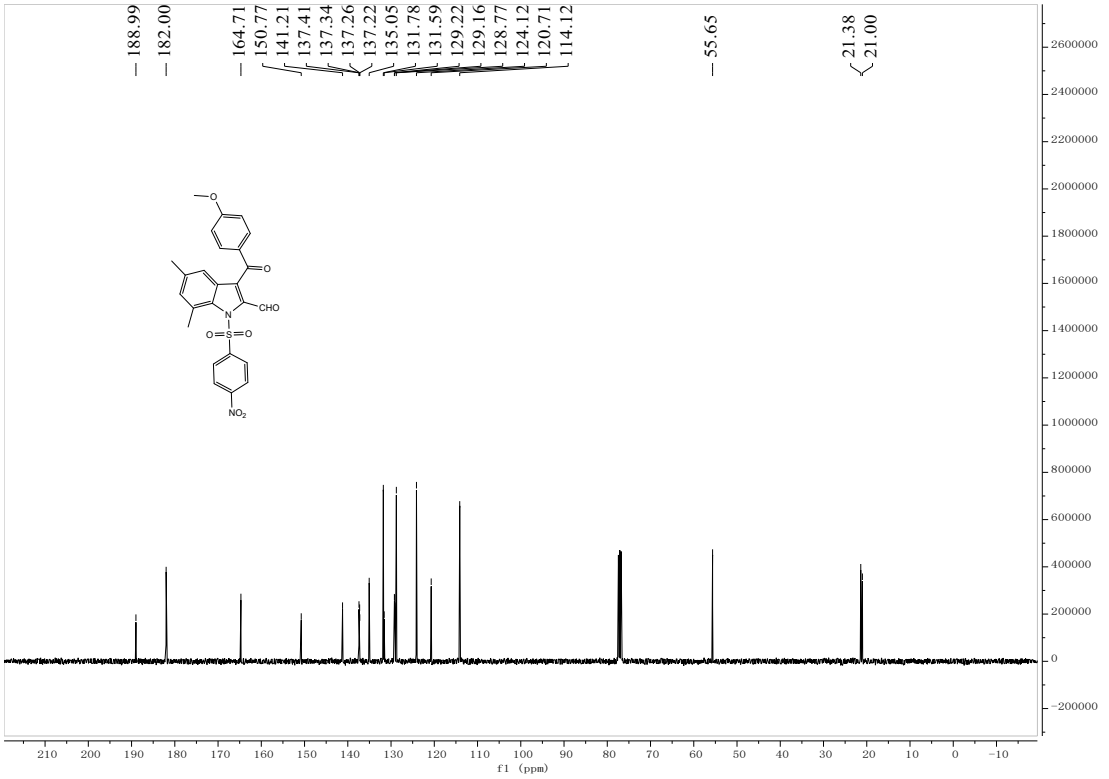
^{13}C NMR spectrum of **2s**



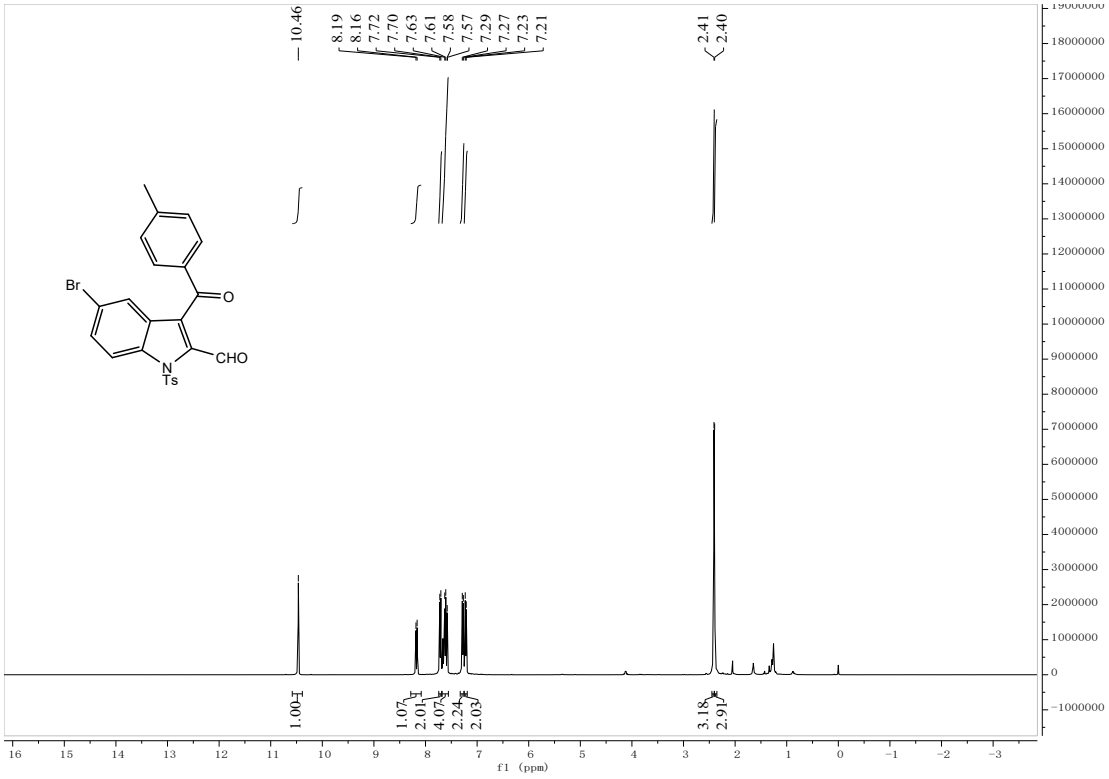
^{1}H NMR spectrum of **2t**



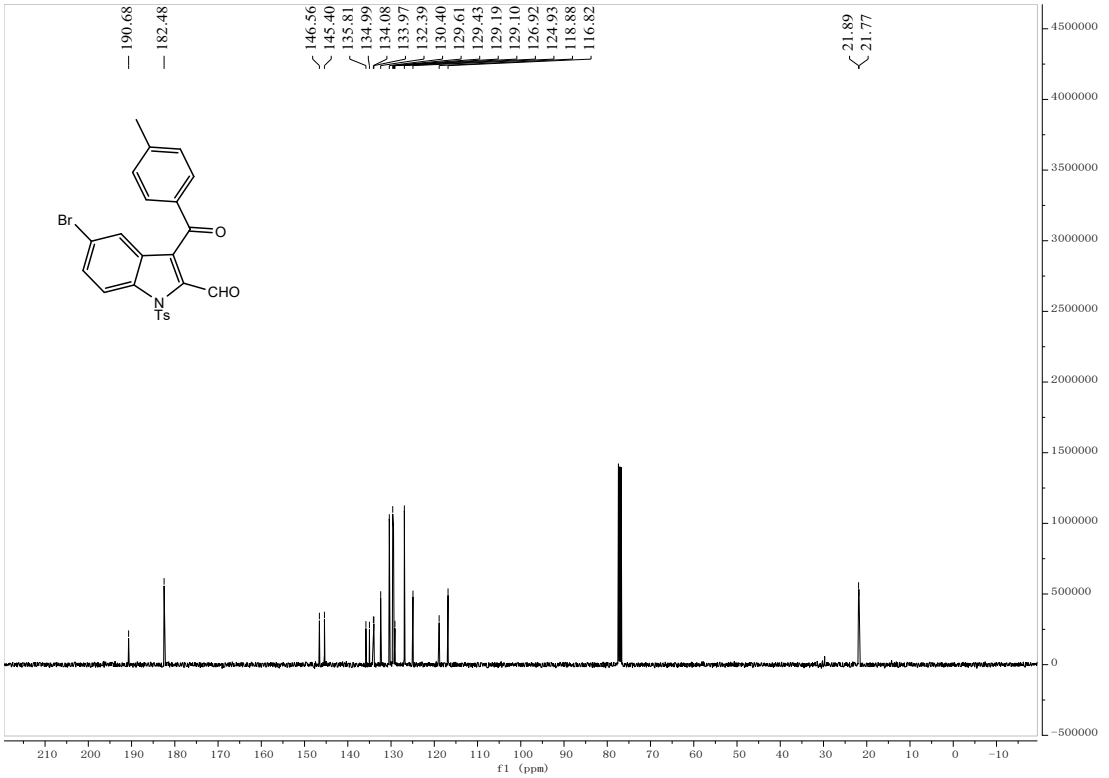
^{13}C NMR spectrum of **2t**



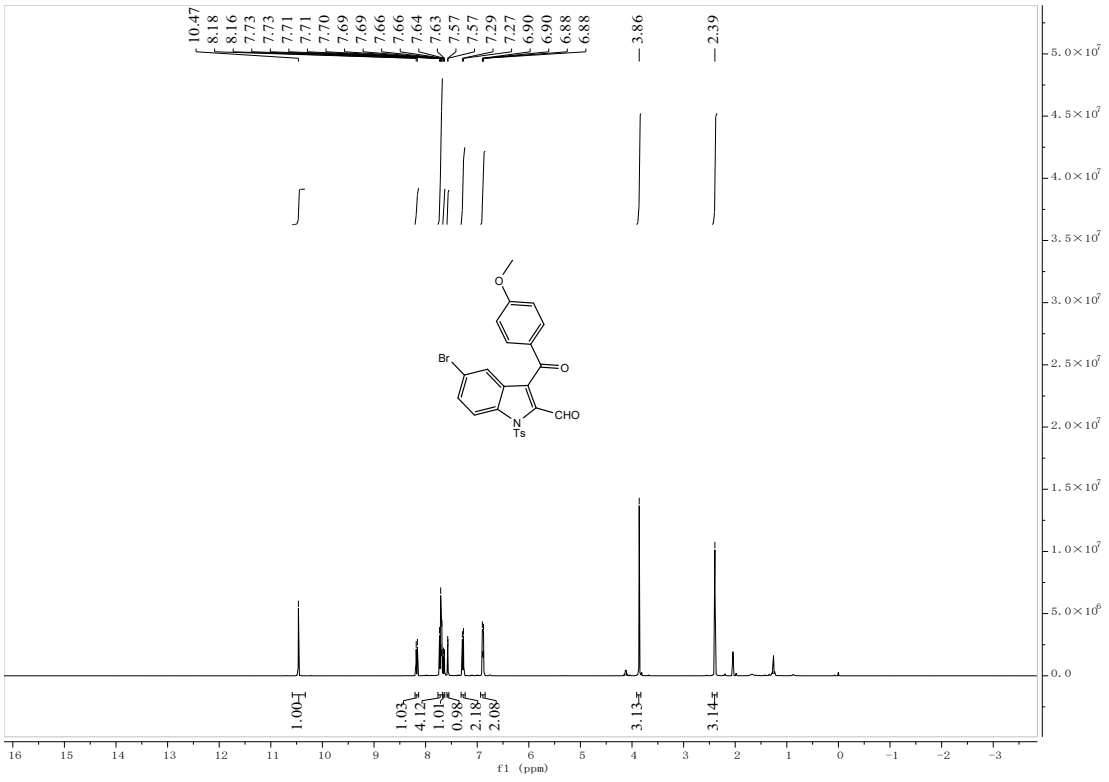
^{1}H NMR spectrum of **2u**



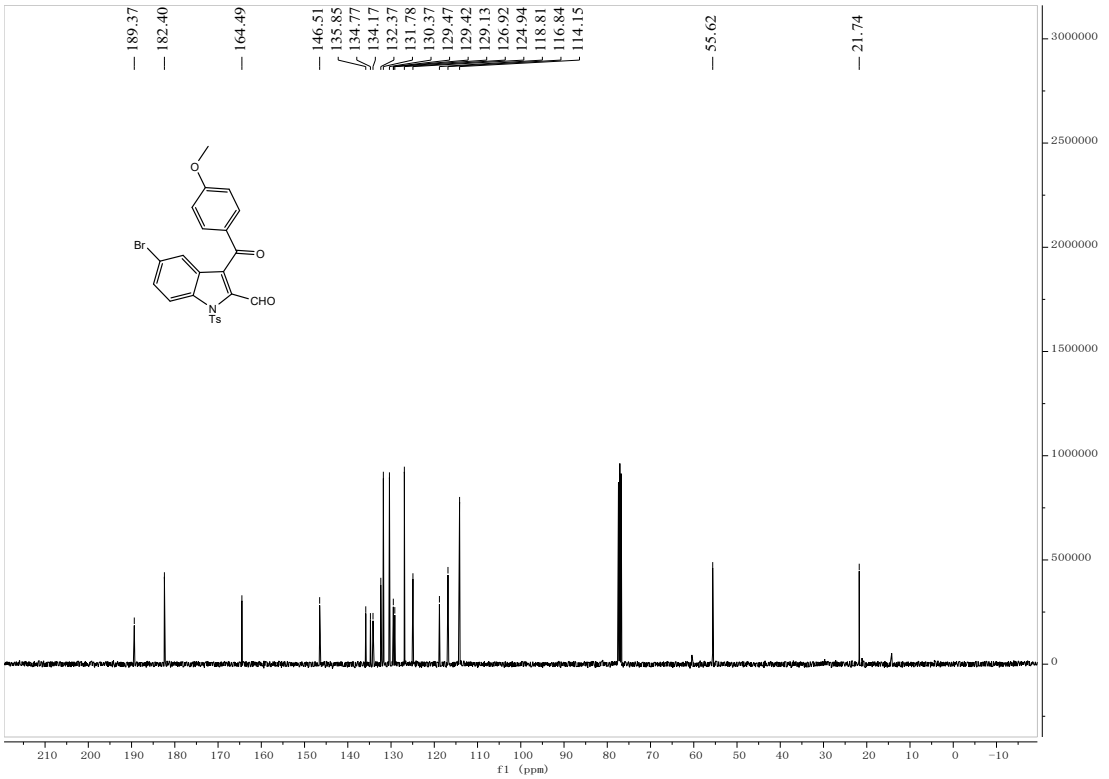
^{13}C NMR spectrum of **2u**



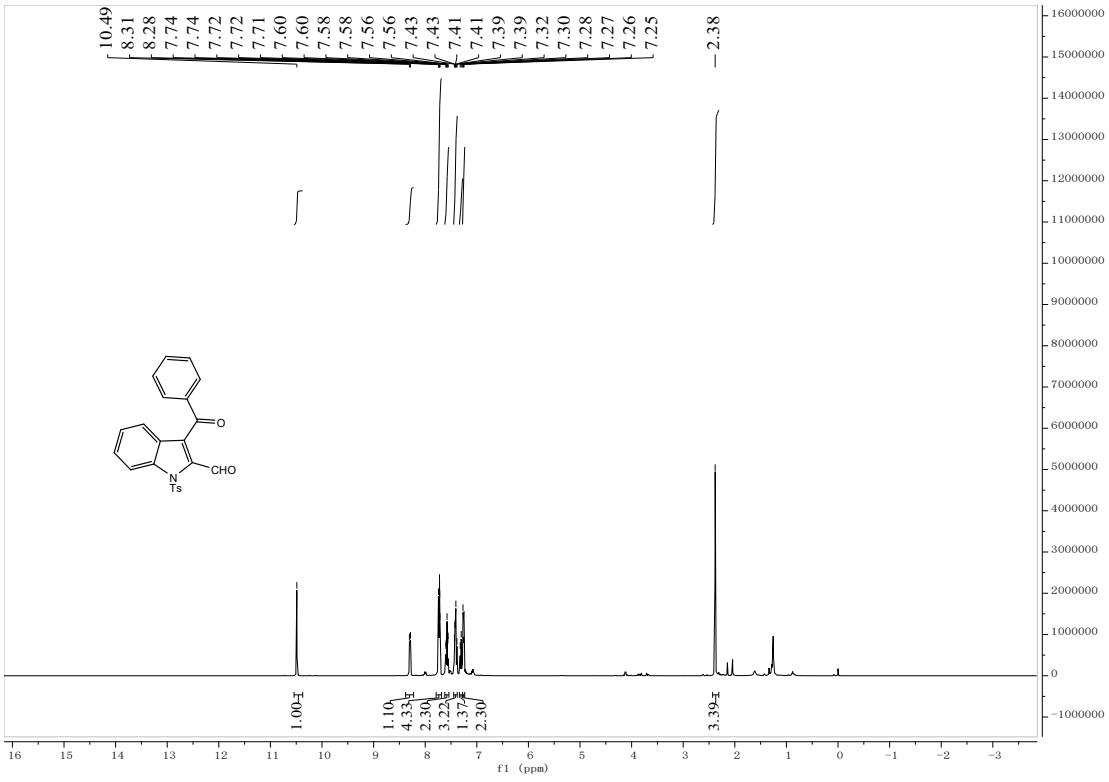
^{1}H NMR spectrum of **2v**



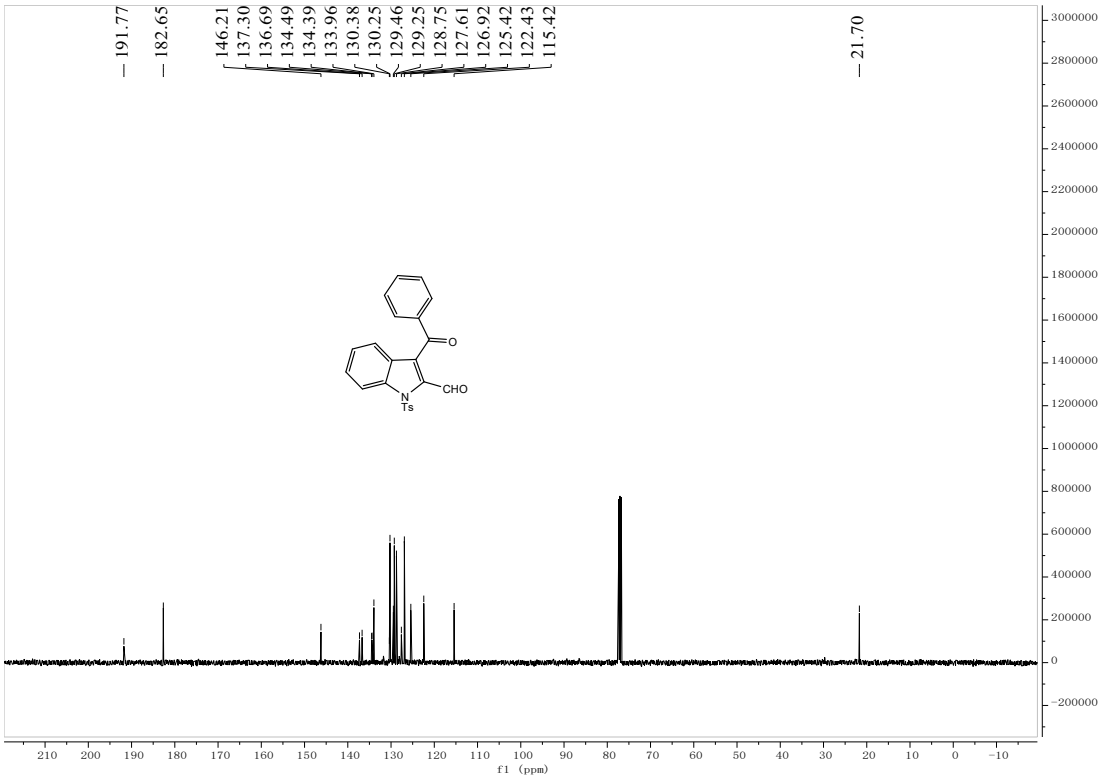
^{13}C NMR spectrum of **2v**



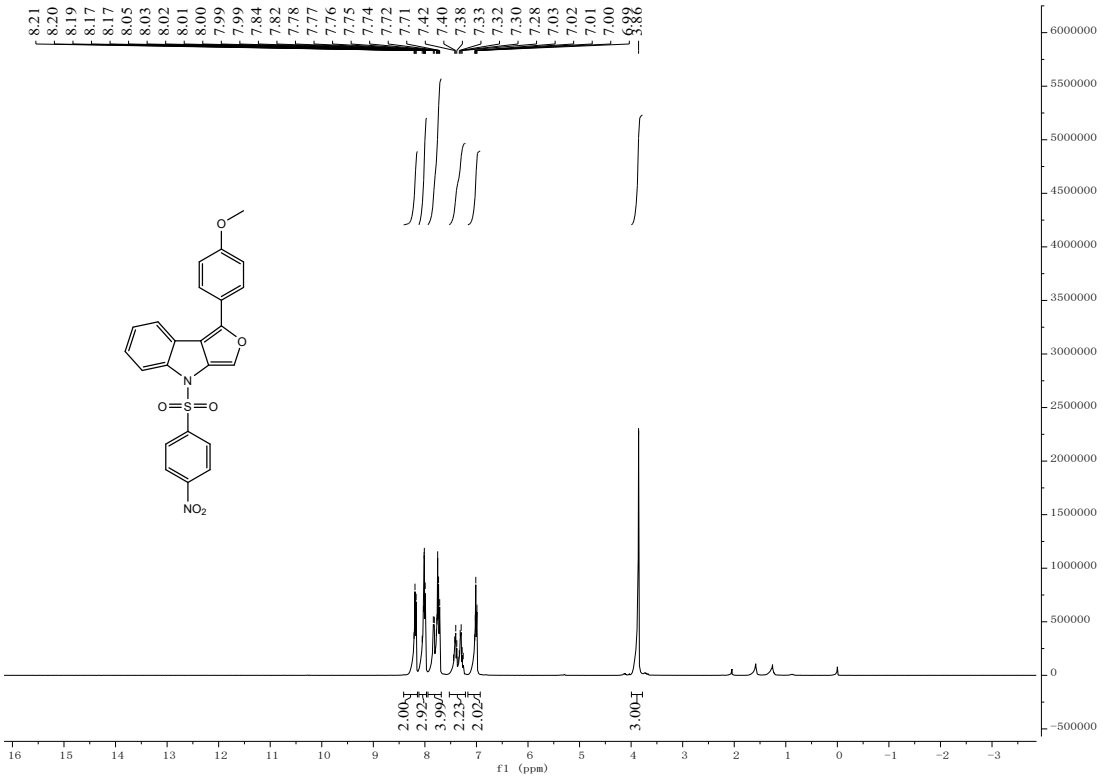
^{1}H NMR spectrum of **2w**



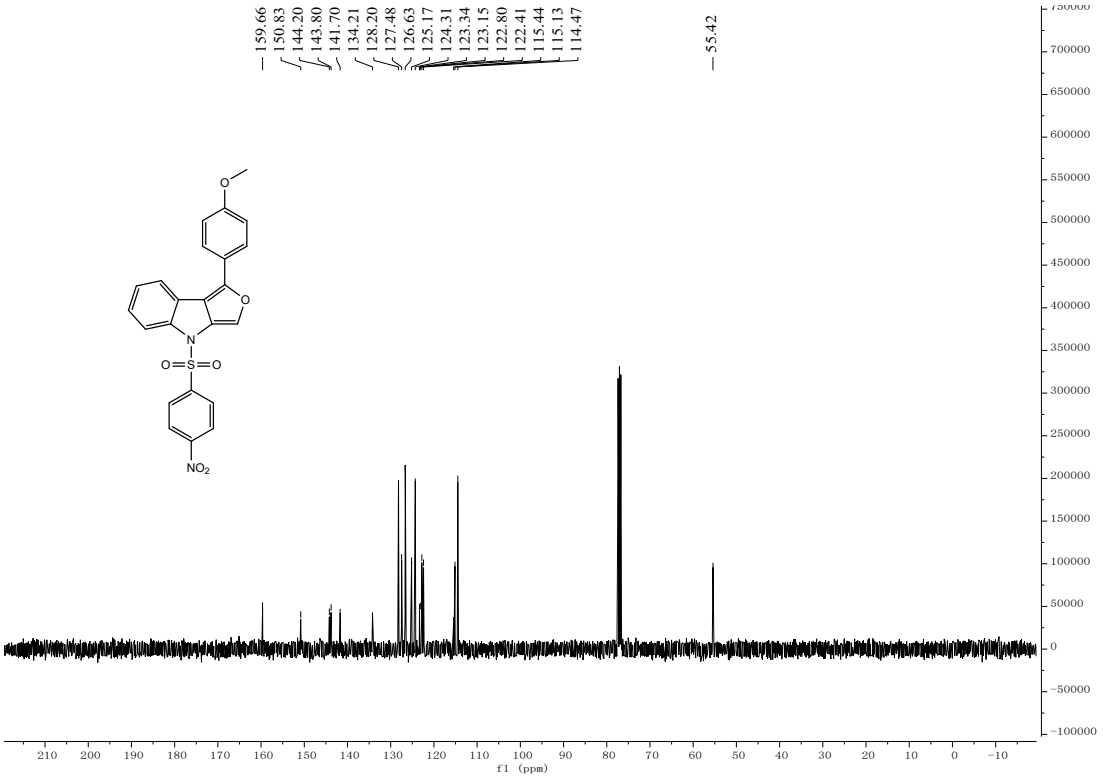
^{13}C NMR spectrum of **2w**



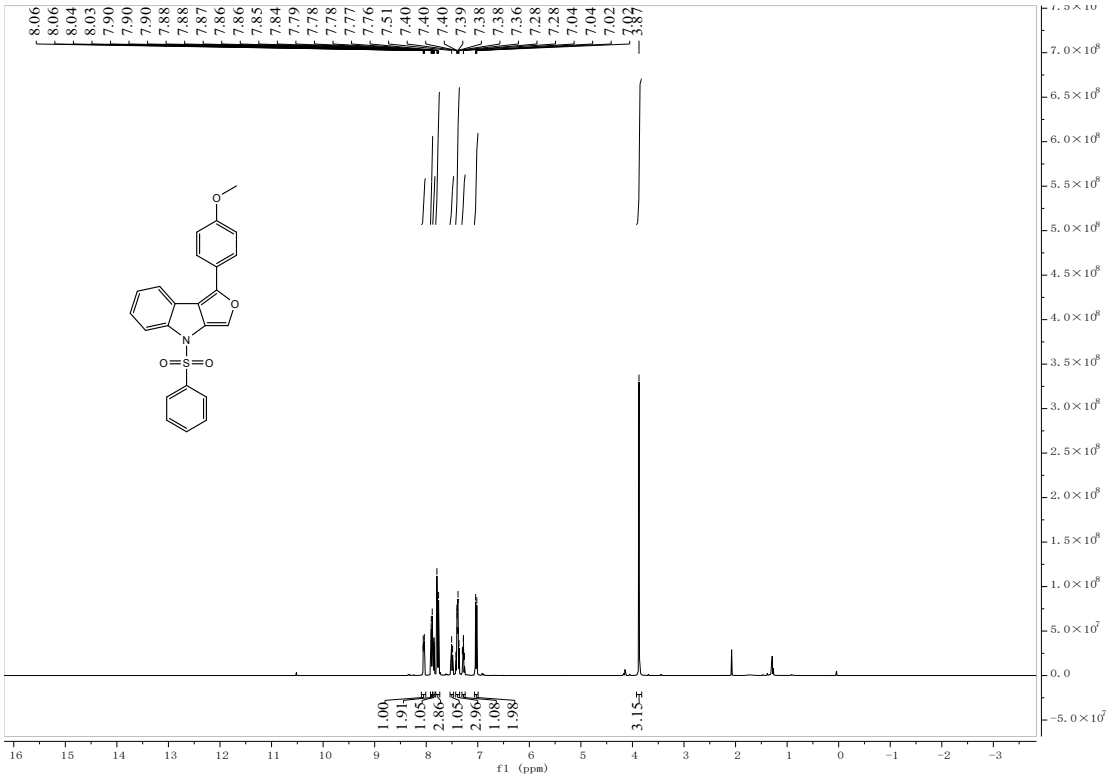
^{1}H NMR spectrum of **3a**



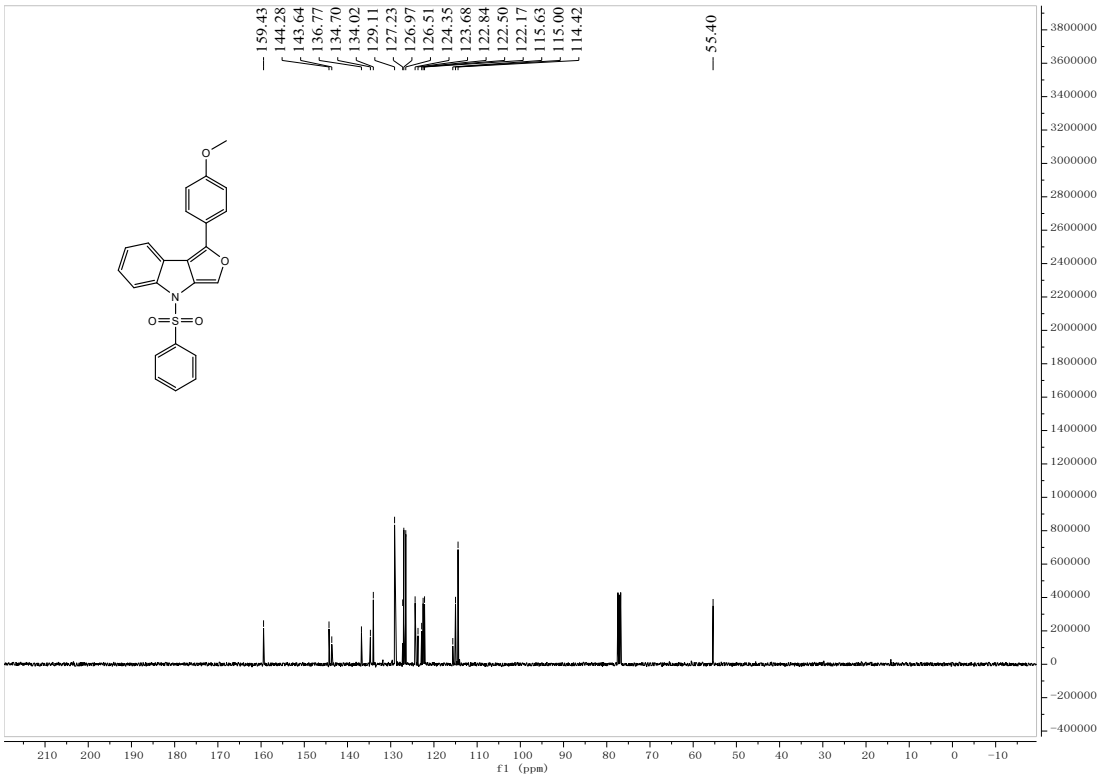
^{13}C NMR spectrum of **3a**



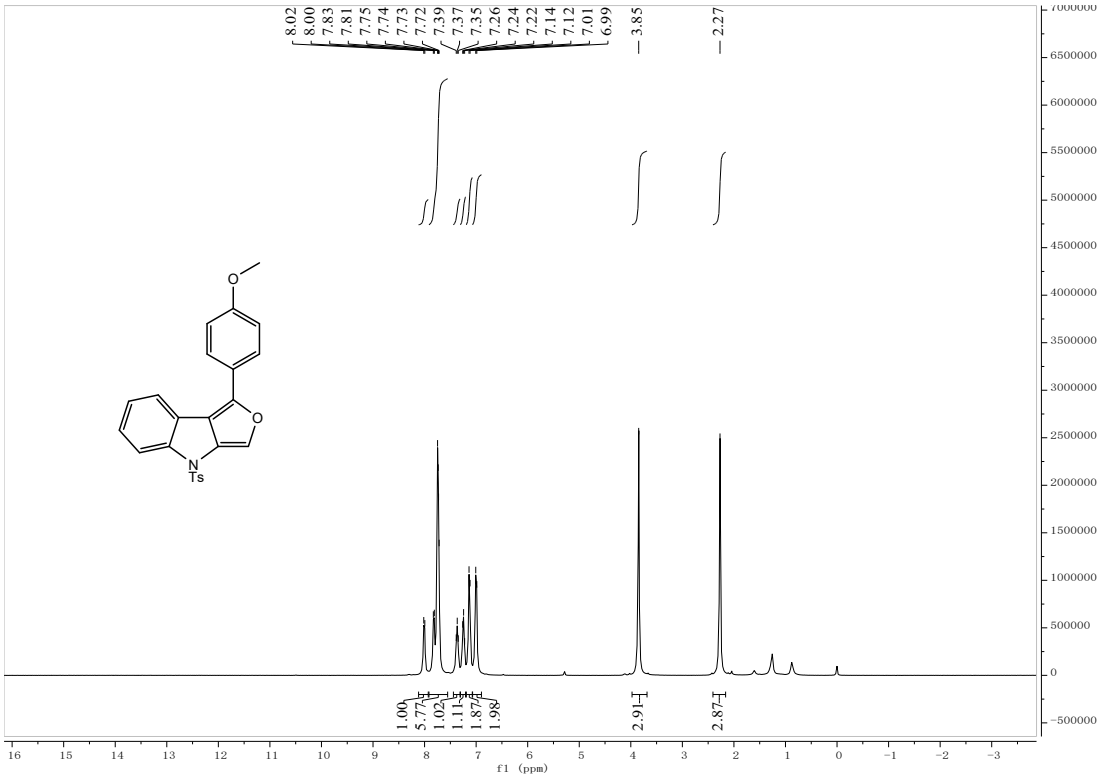
^{1}H NMR spectrum of **3b**



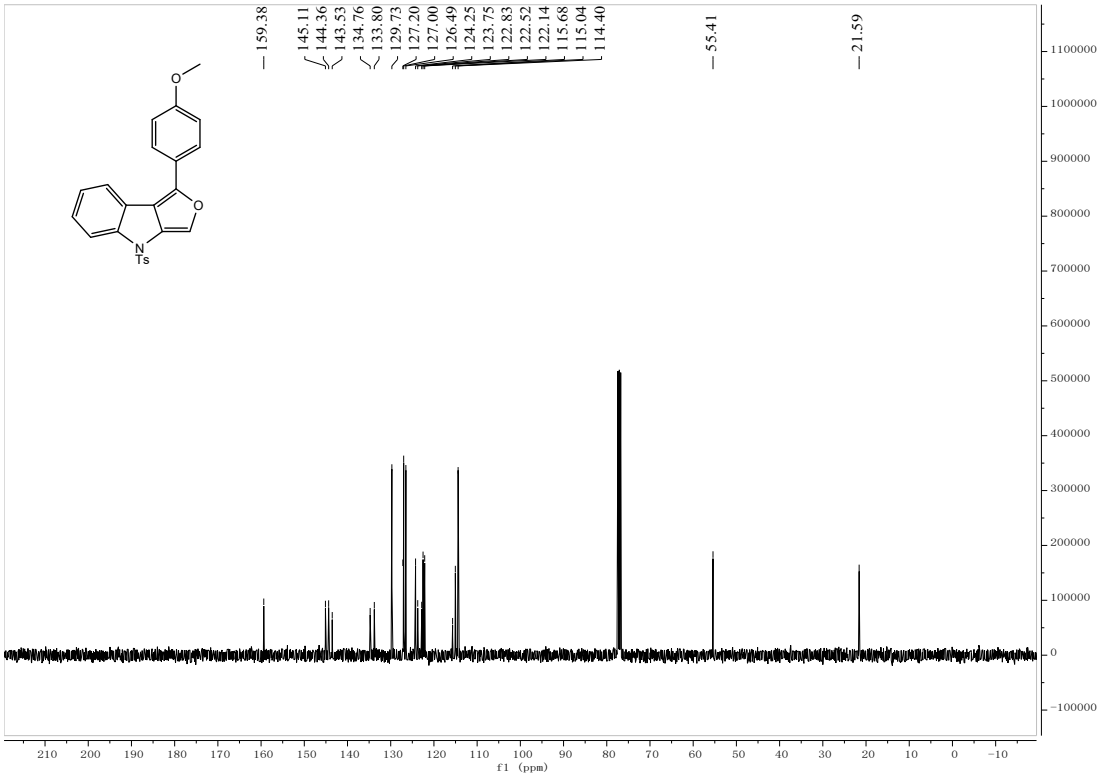
^{13}C NMR spectrum of **3b**



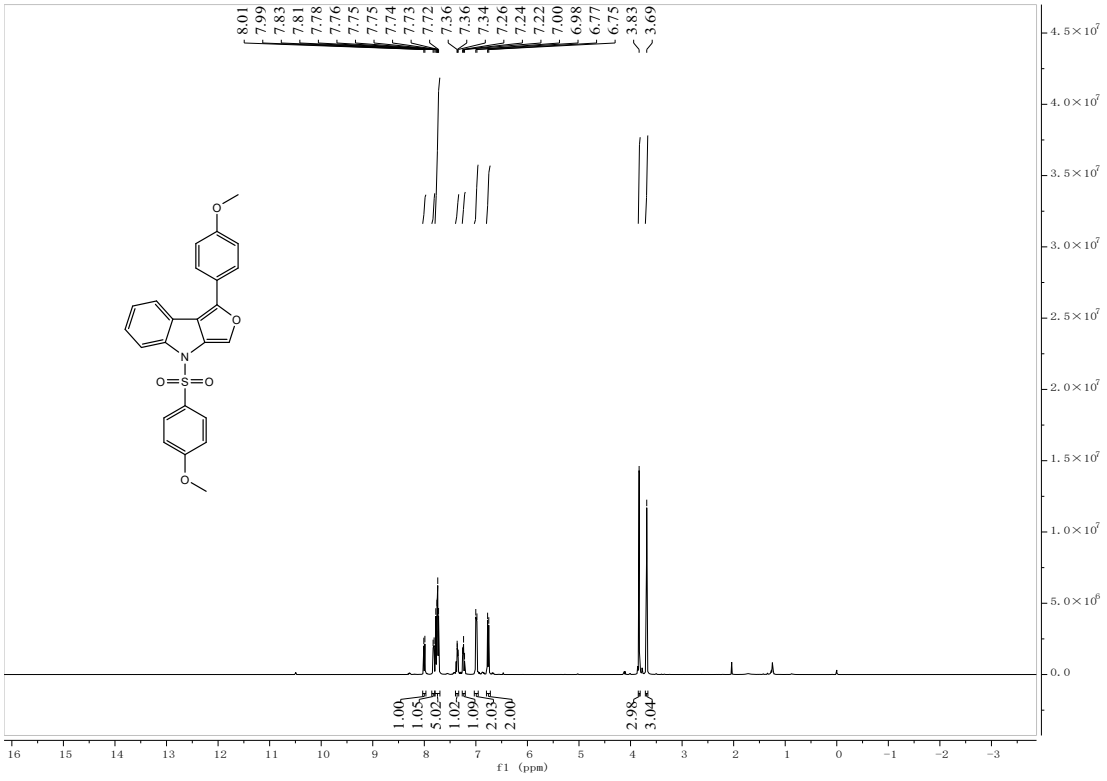
^{1}H NMR spectrum of **3c**



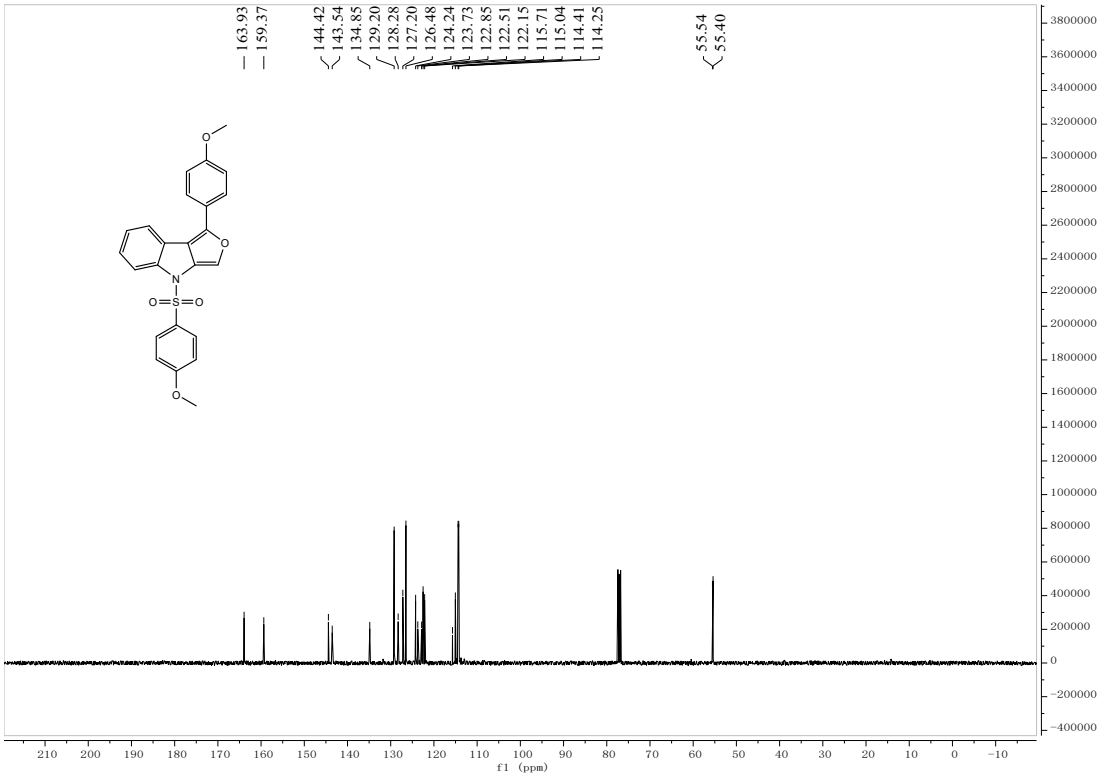
^{13}C NMR spectrum of **3c**



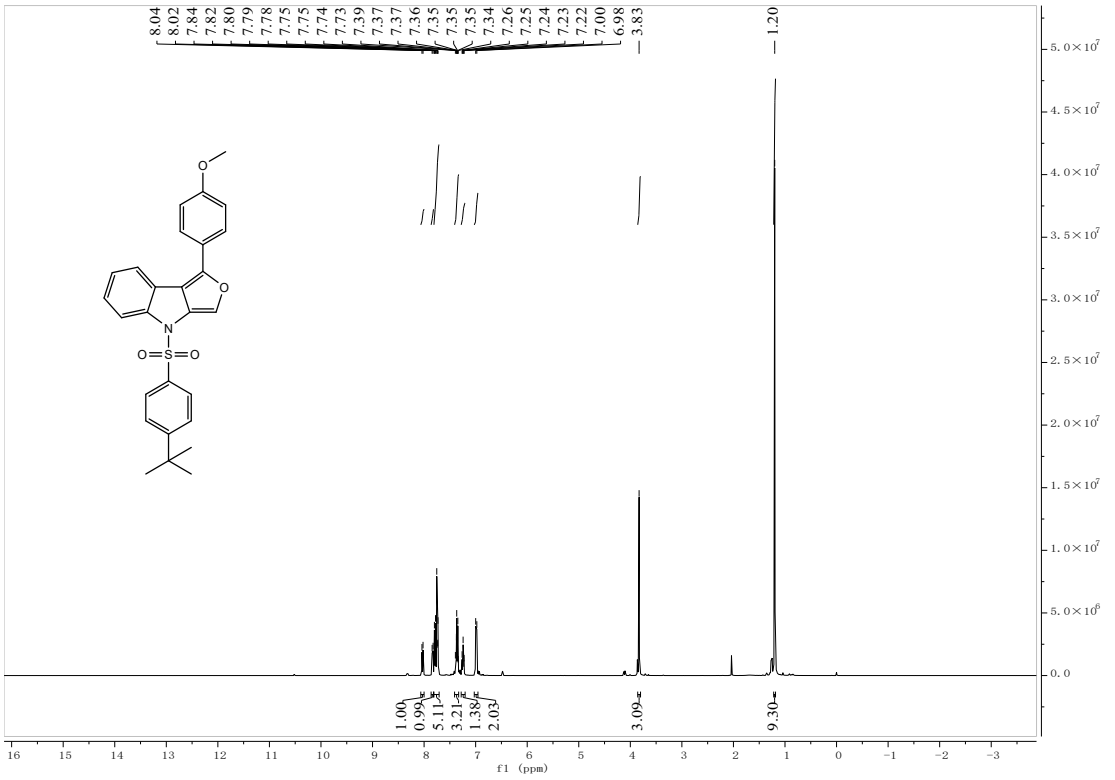
^{1}H NMR spectrum of **3d**



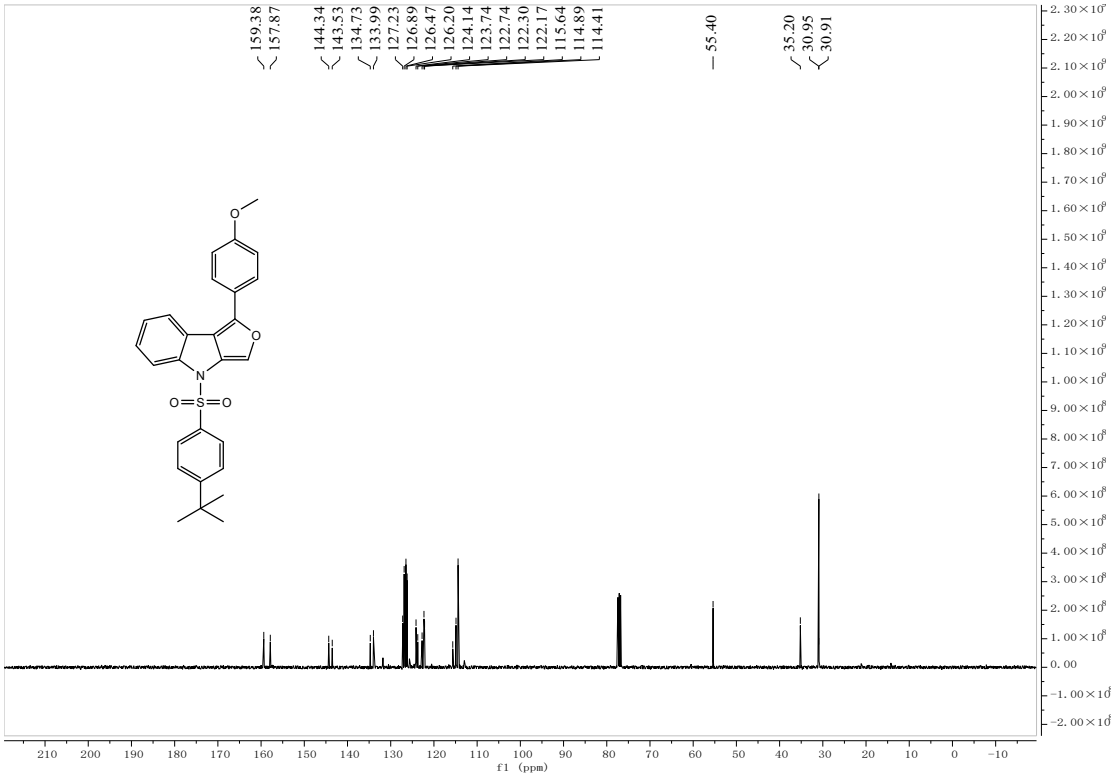
^{13}C NMR spectrum of **3d**



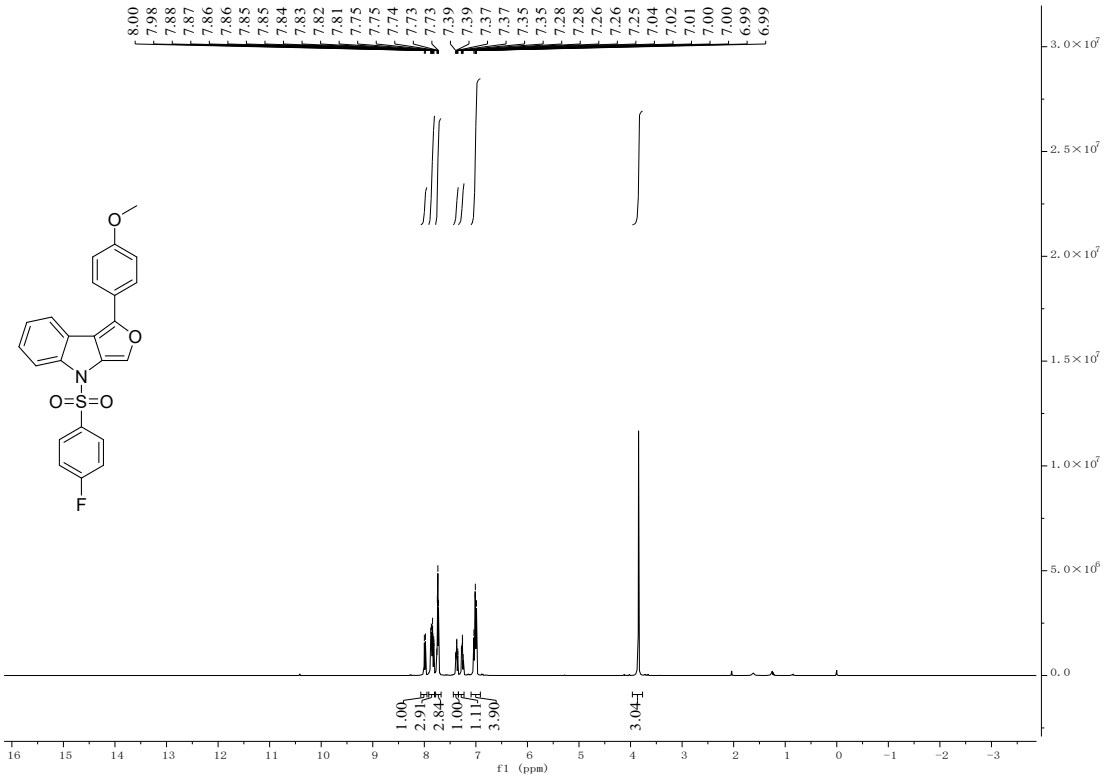
^{1}H NMR spectrum of **3e**



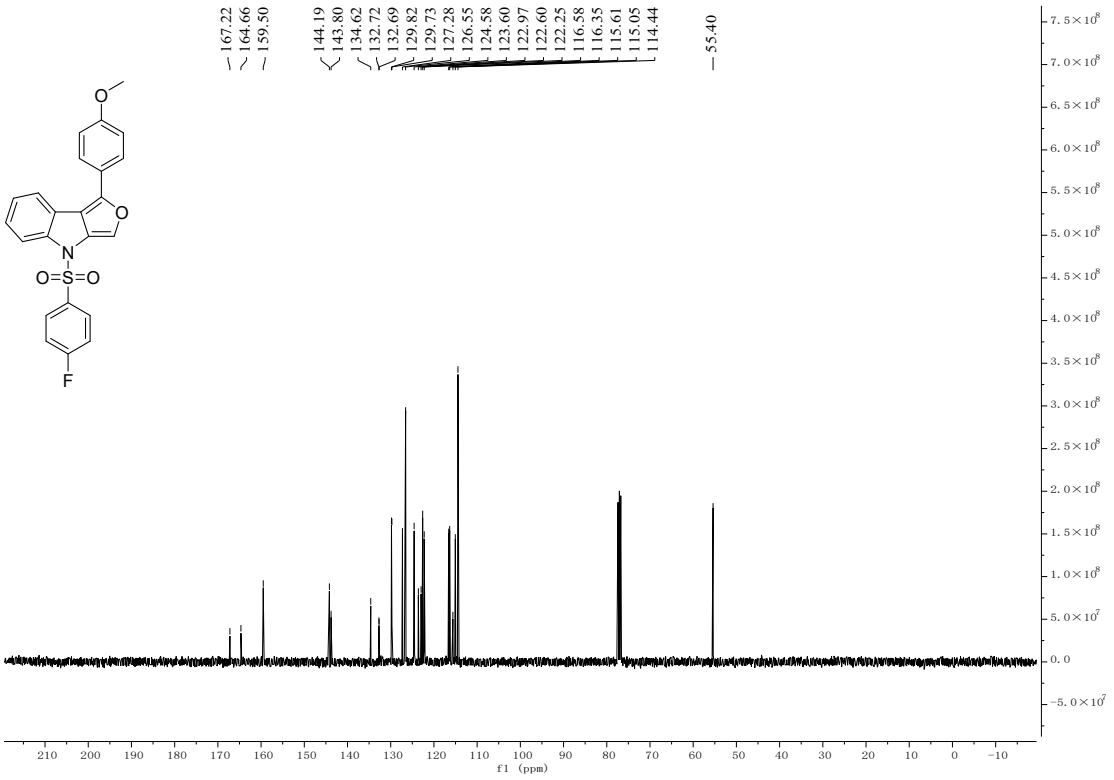
^{13}C NMR spectrum of **3e**



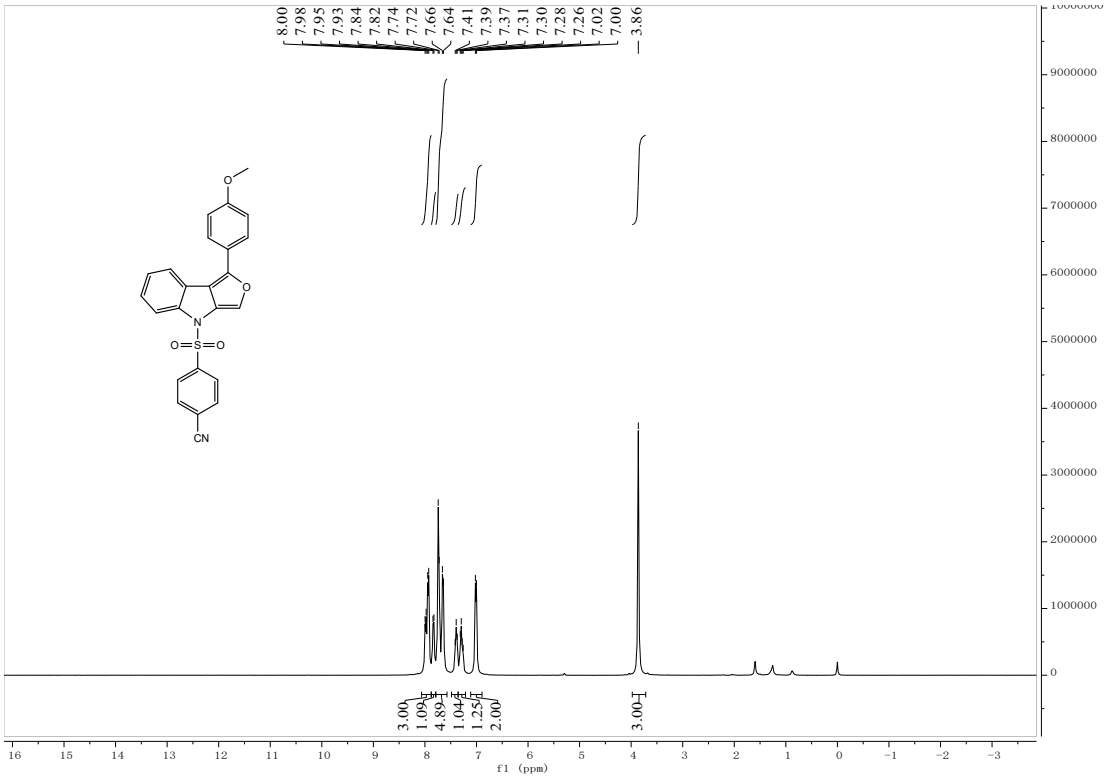
^{1}H NMR spectrum of **3g**



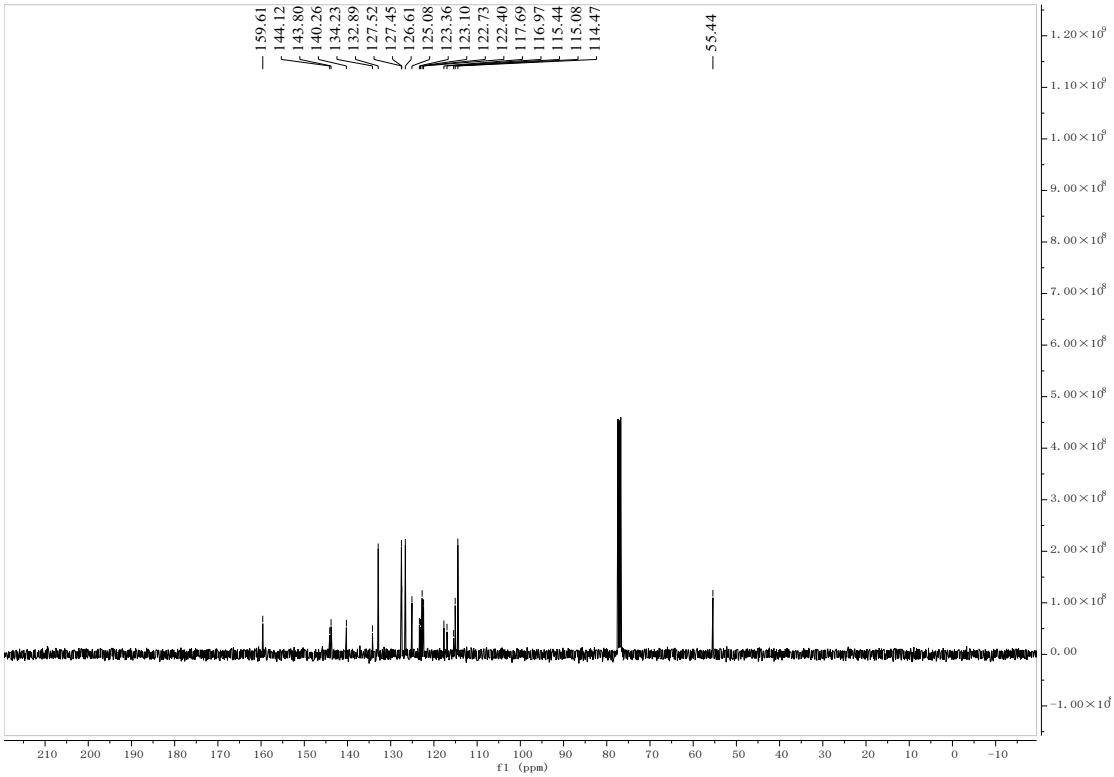
^{13}C NMR spectrum of **3g**



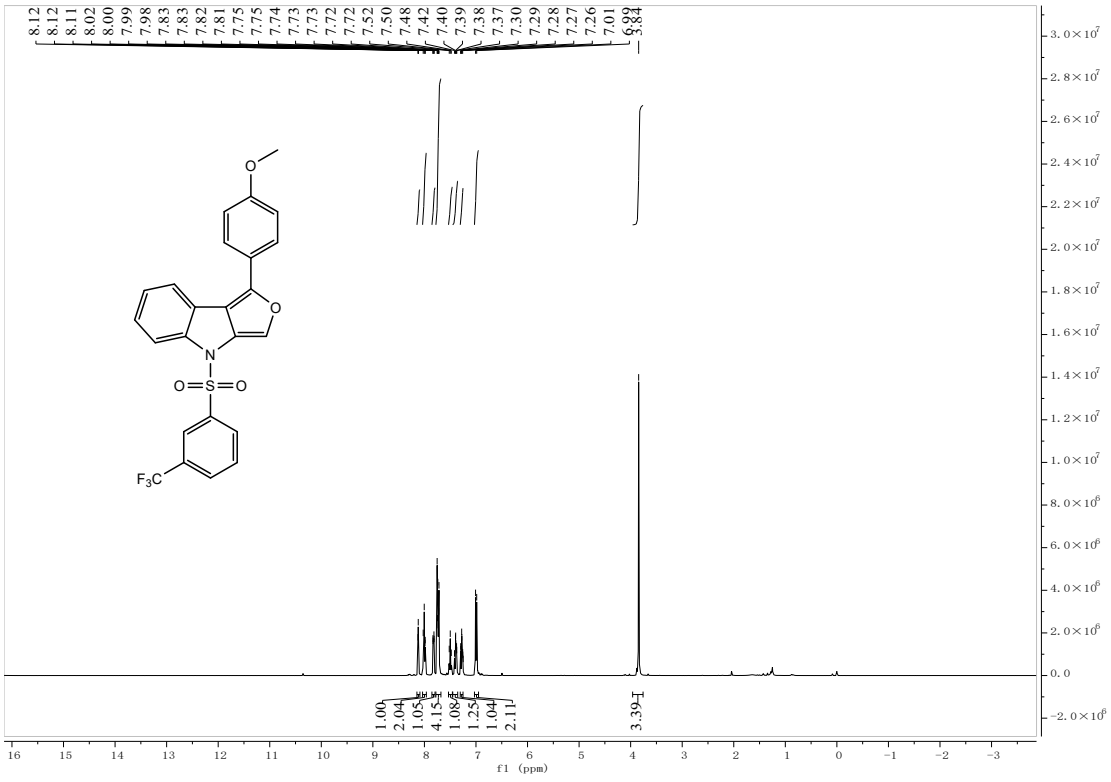
^{1}H NMR spectrum of **3h**



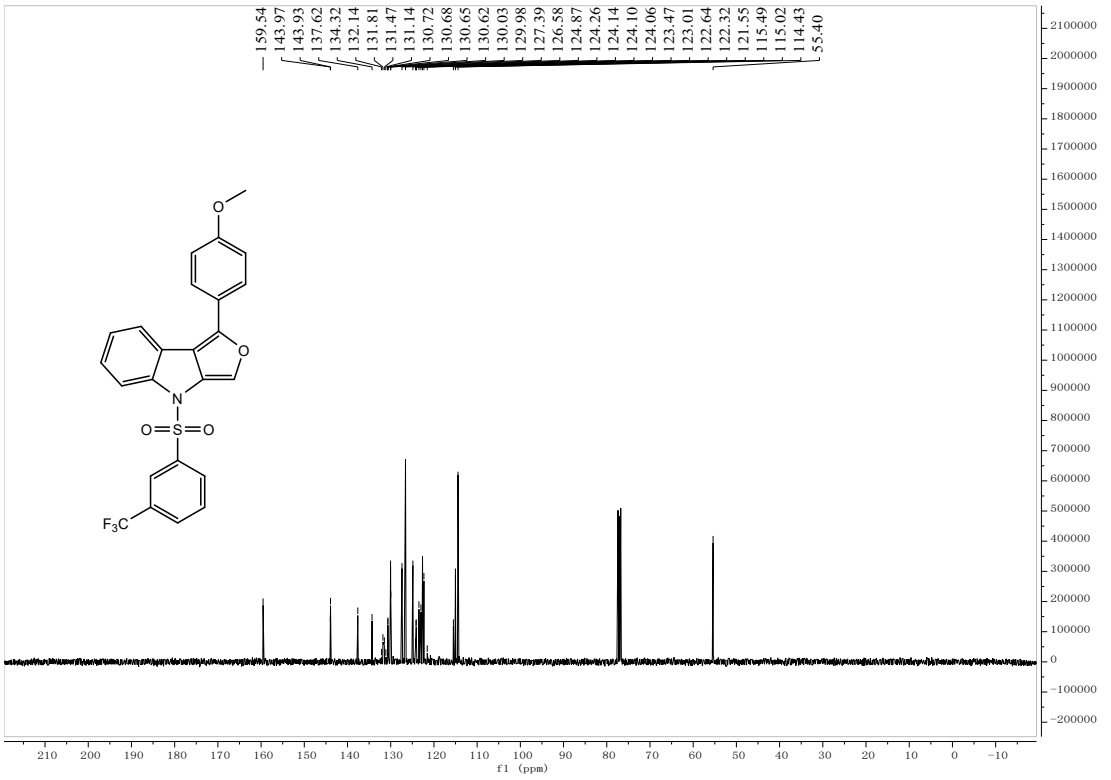
^{13}C NMR spectrum of **3h**



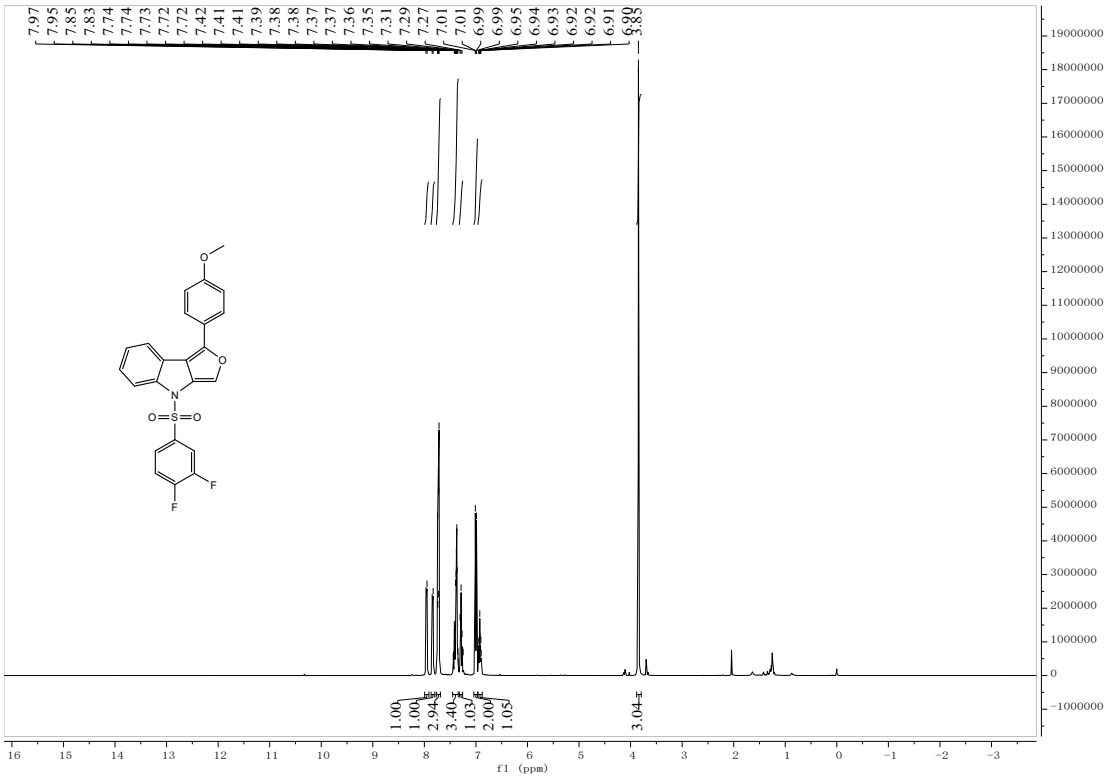
^{1}H NMR spectrum of **3i**



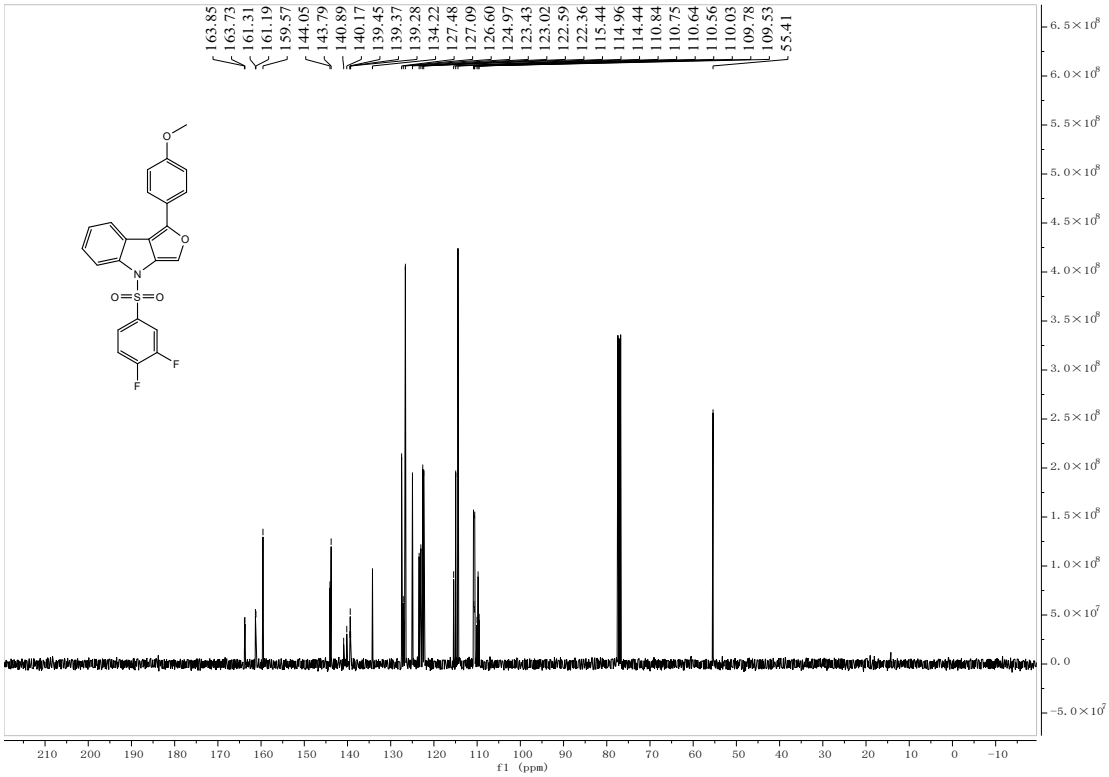
^{13}C NMR spectrum of **3i**



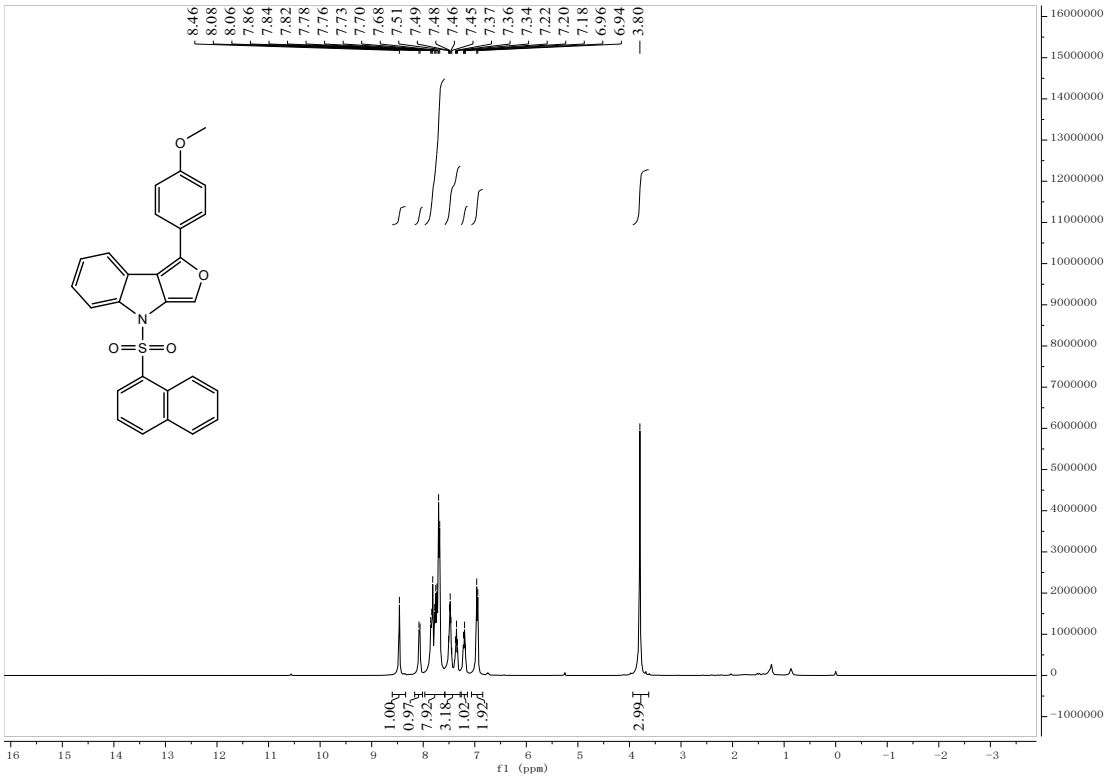
^{1}H NMR spectrum of **3j**



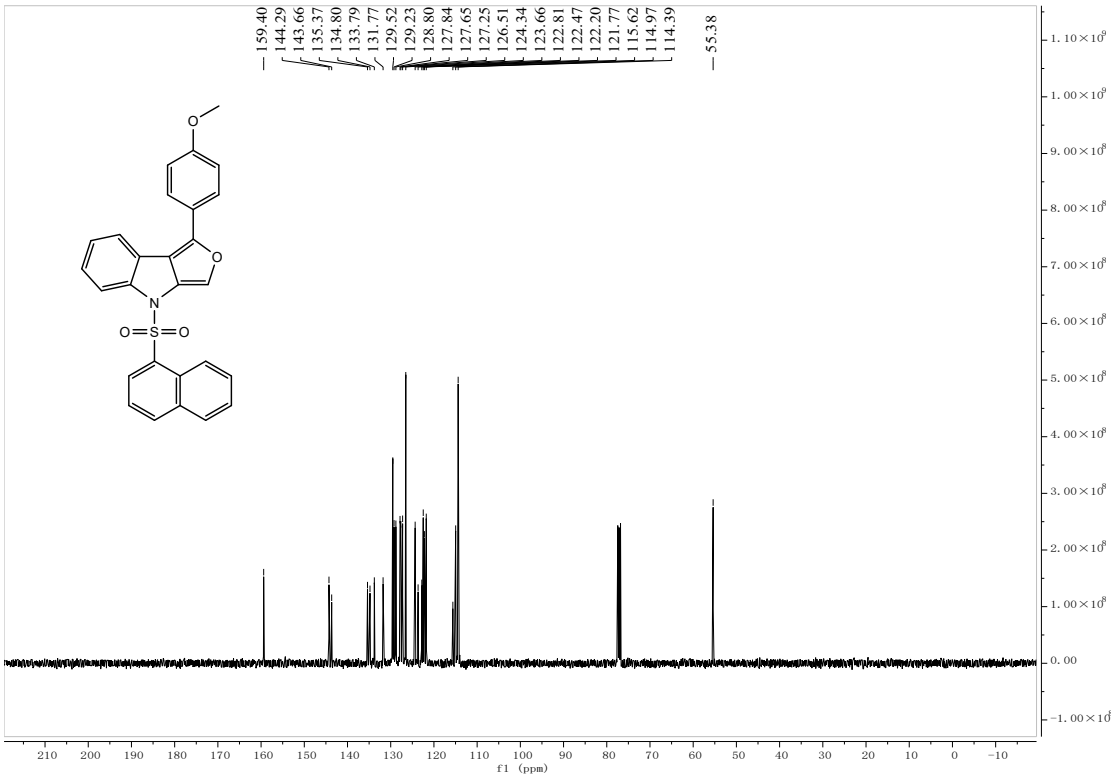
^{13}C NMR spectrum of **3j**



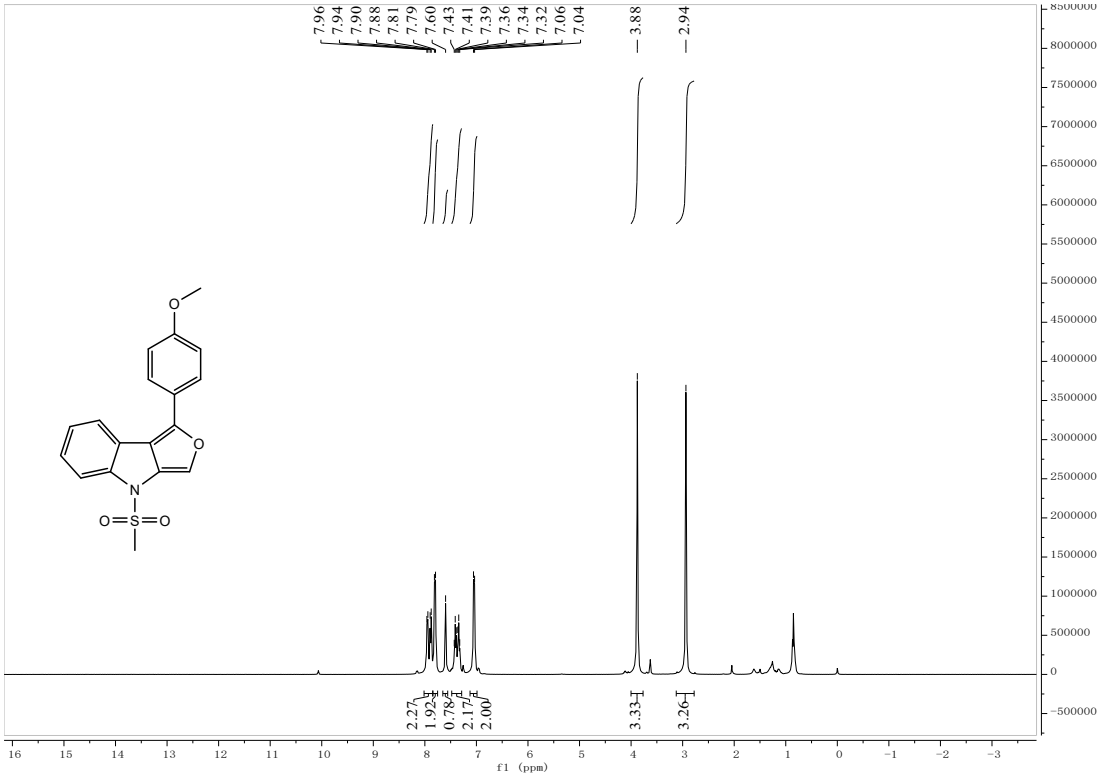
^{1}H NMR spectrum of **3k**



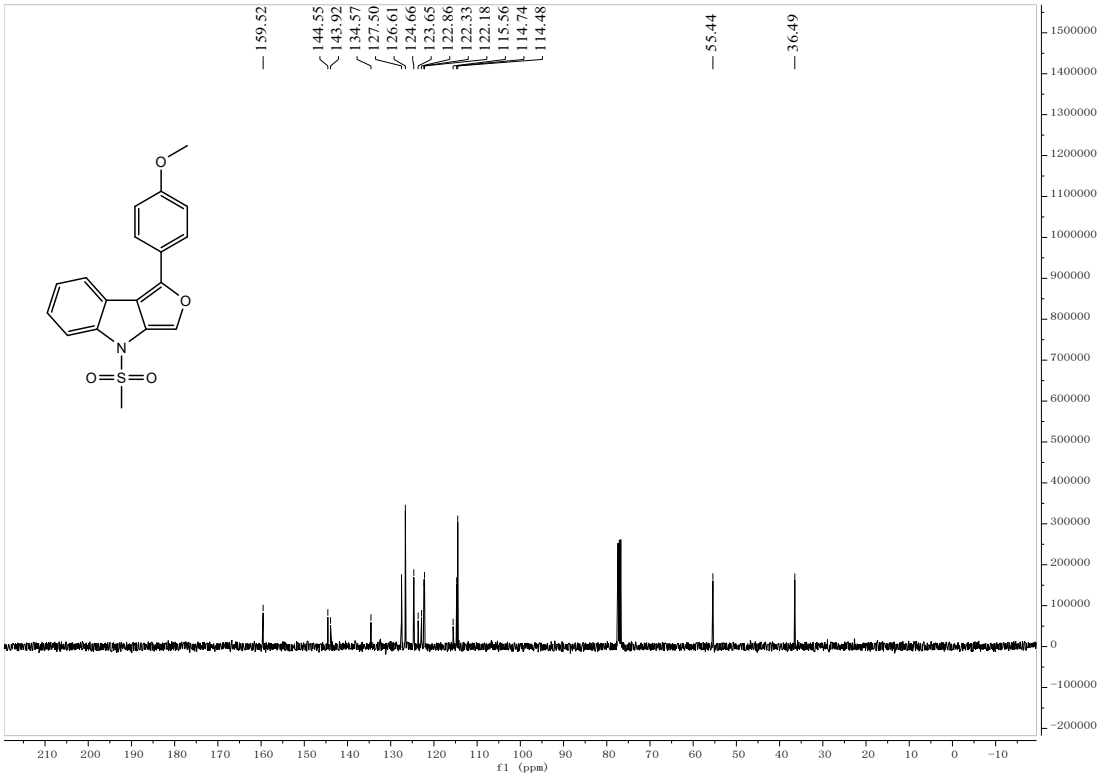
^{13}C NMR spectrum of **3k**



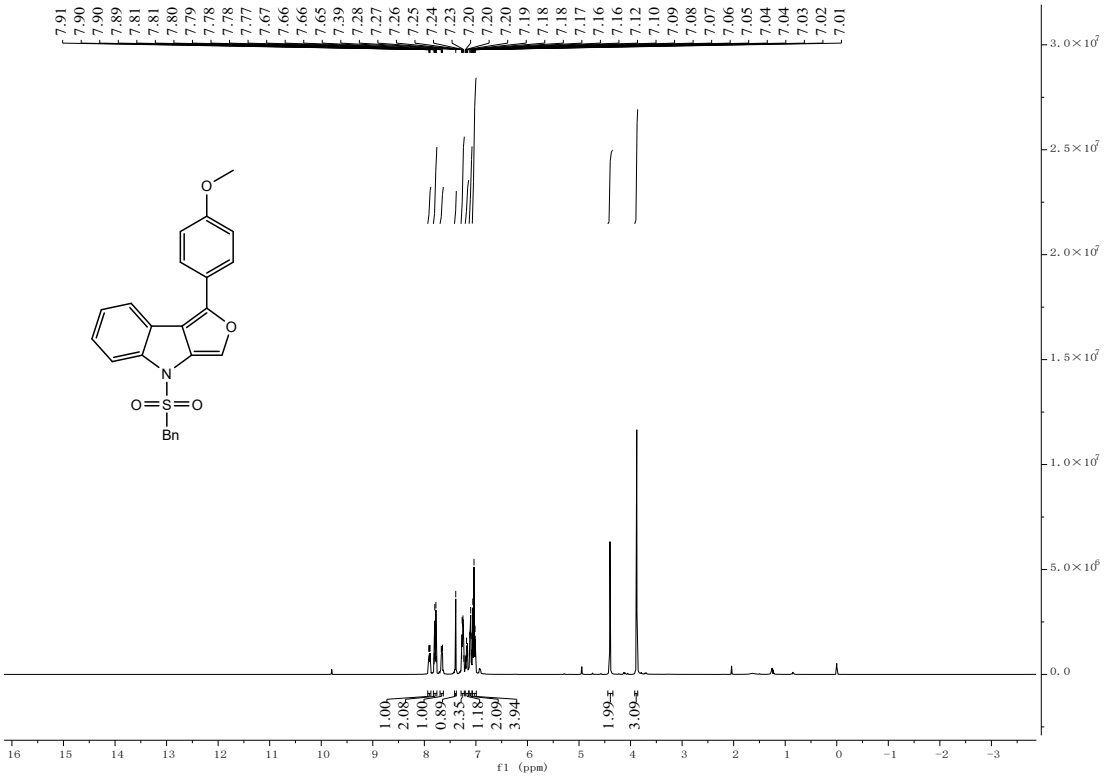
^{1}H NMR spectrum of **3l**



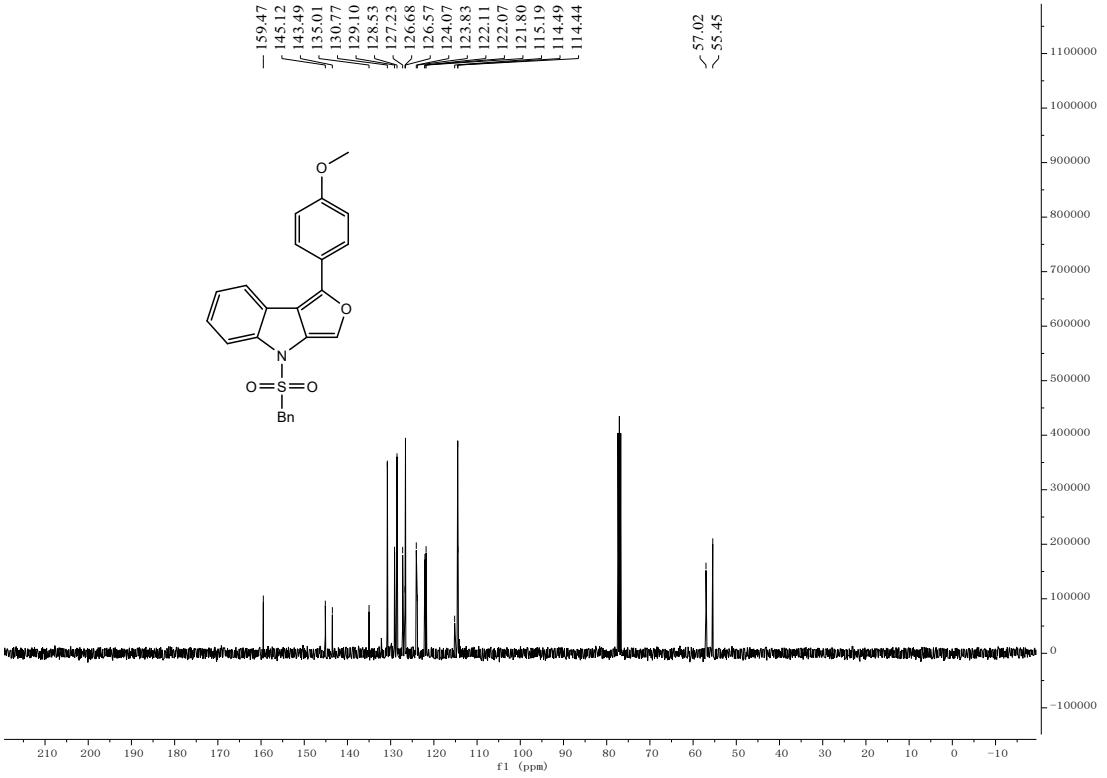
^{13}C NMR spectrum of **3l**



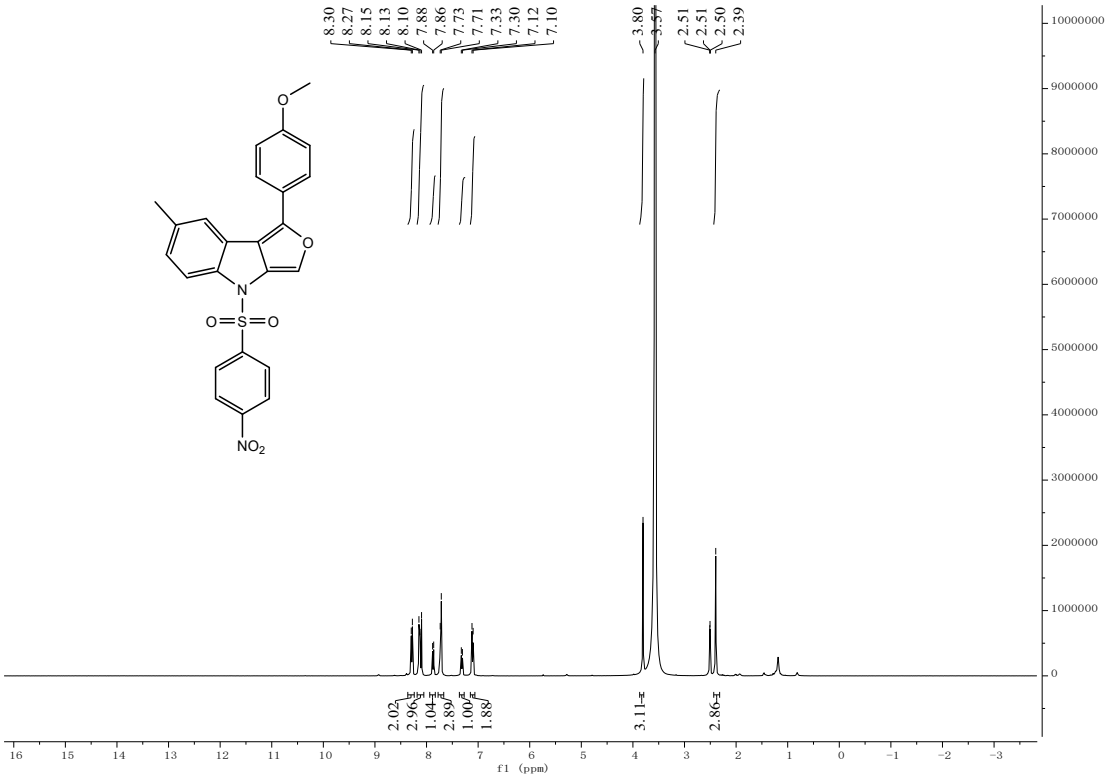
^{1}H NMR spectrum of **3m**



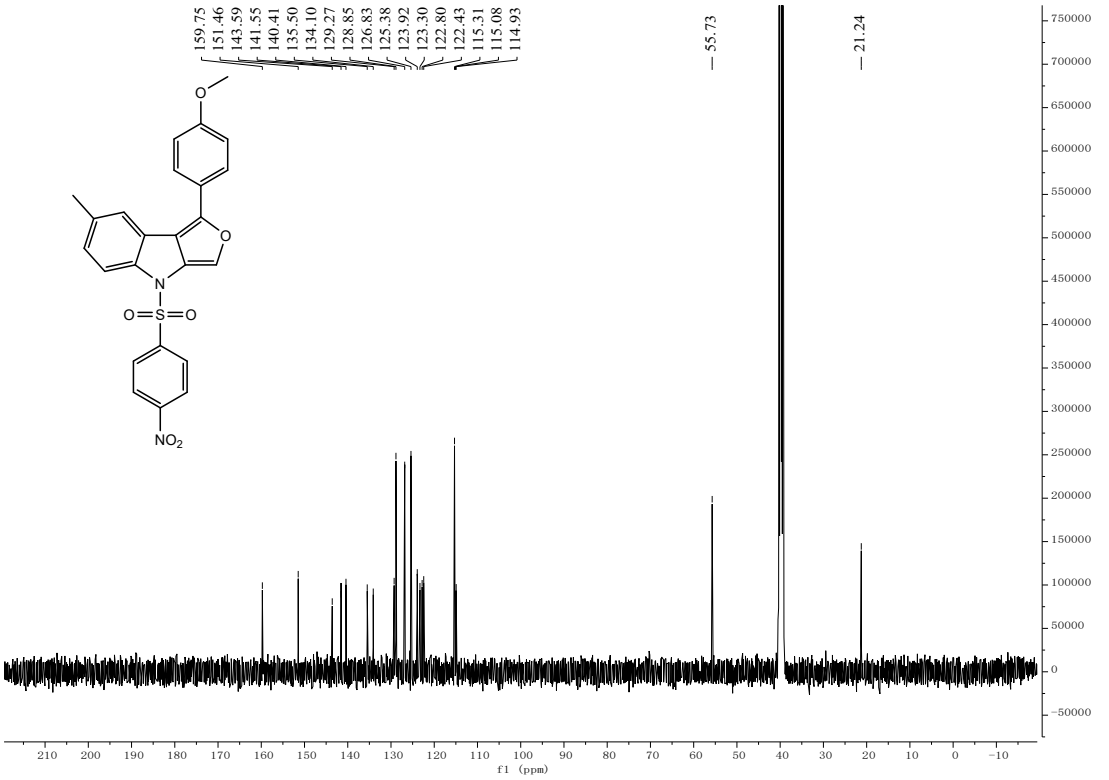
^{13}C NMR spectrum of **3m**



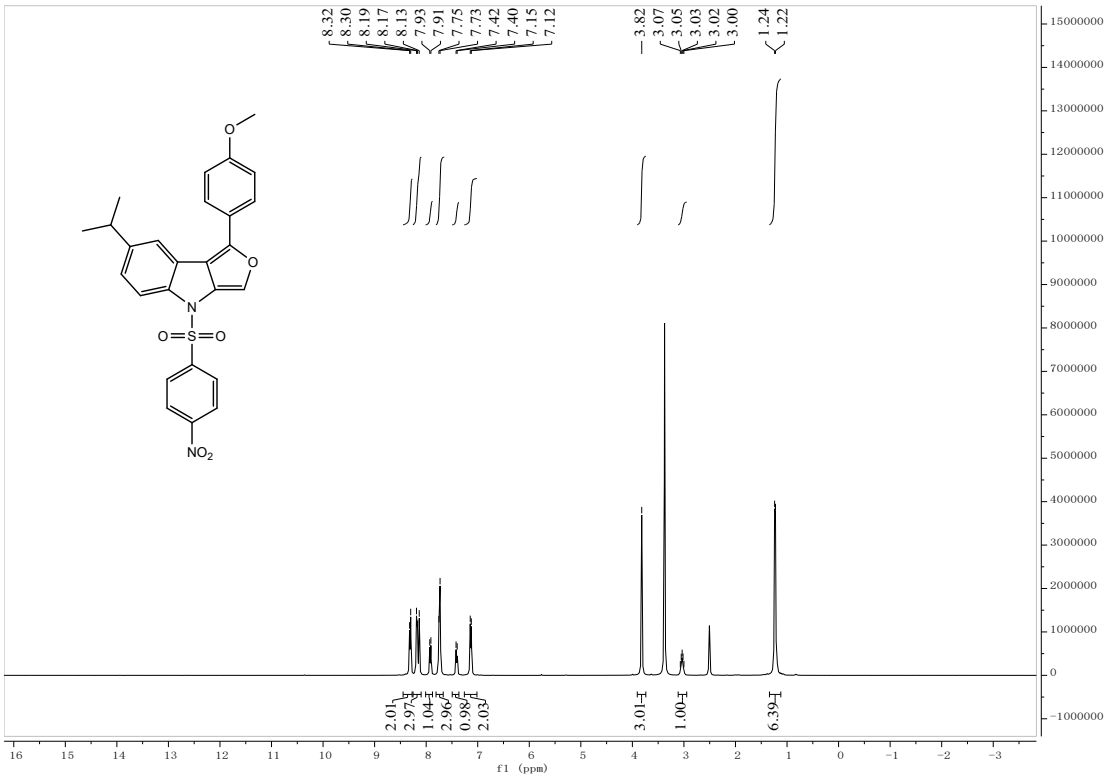
^{1}H NMR spectrum of **3n**



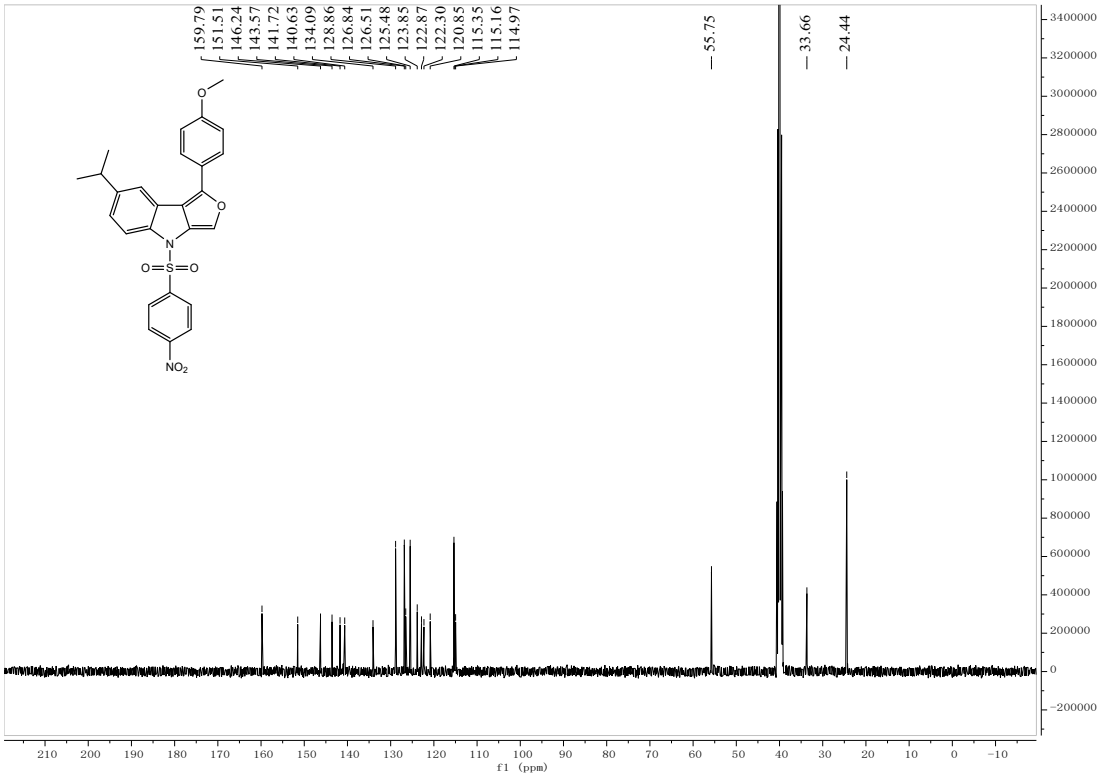
^{13}C NMR spectrum of **3m**



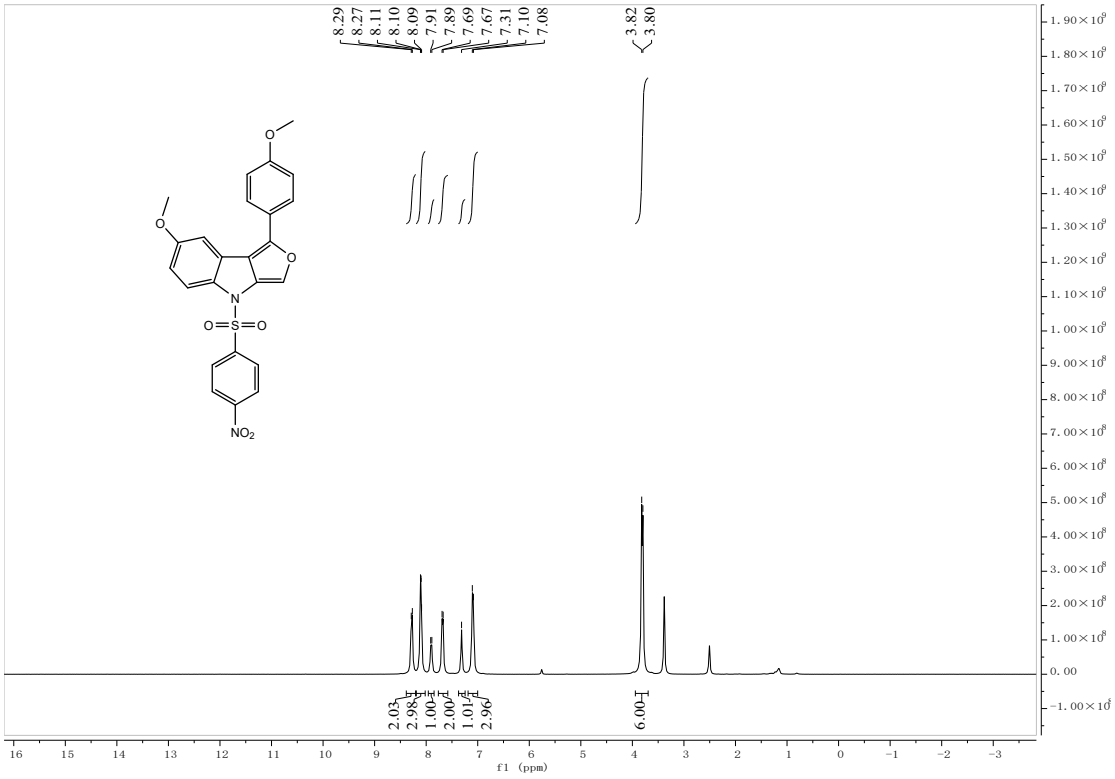
^{1}H NMR spectrum of **3o**



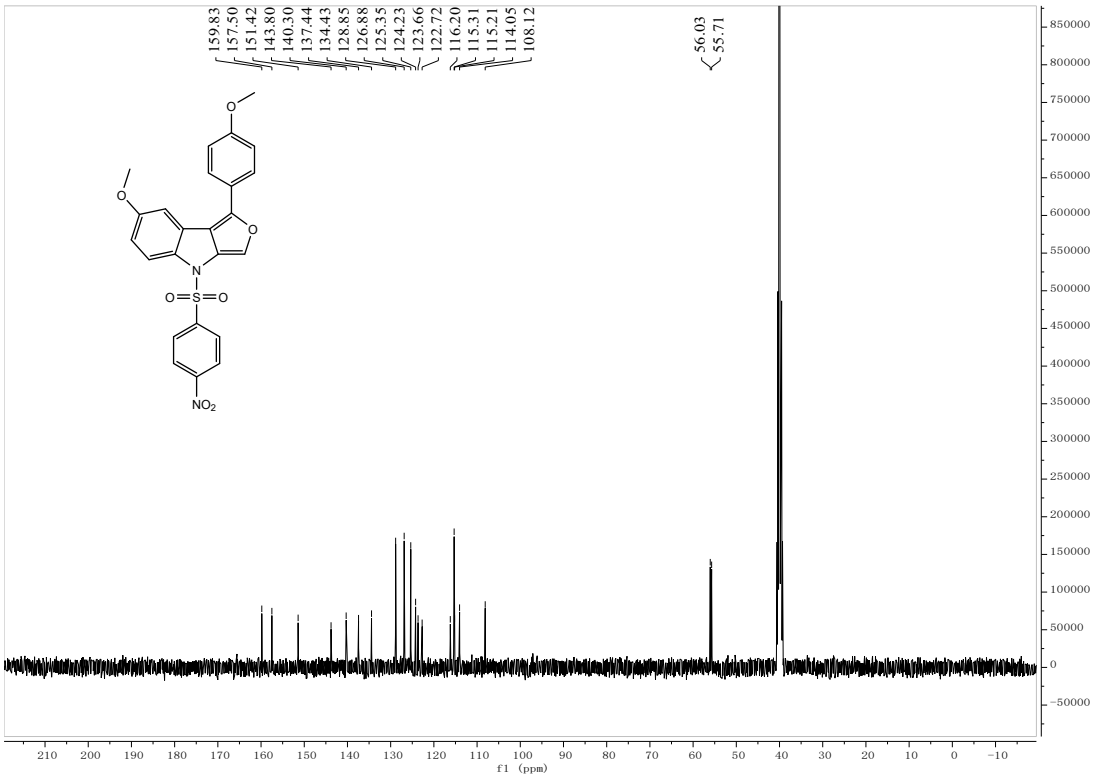
^{13}C NMR spectrum of **3o**



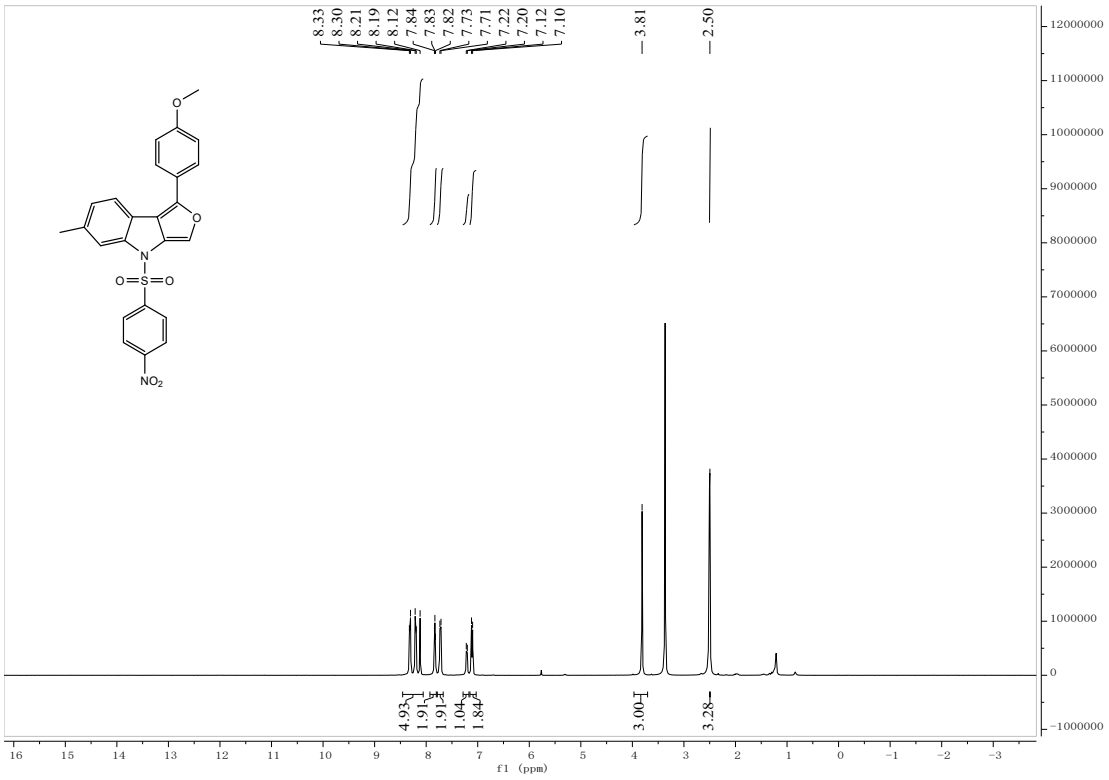
^{1}H NMR spectrum of **3p**



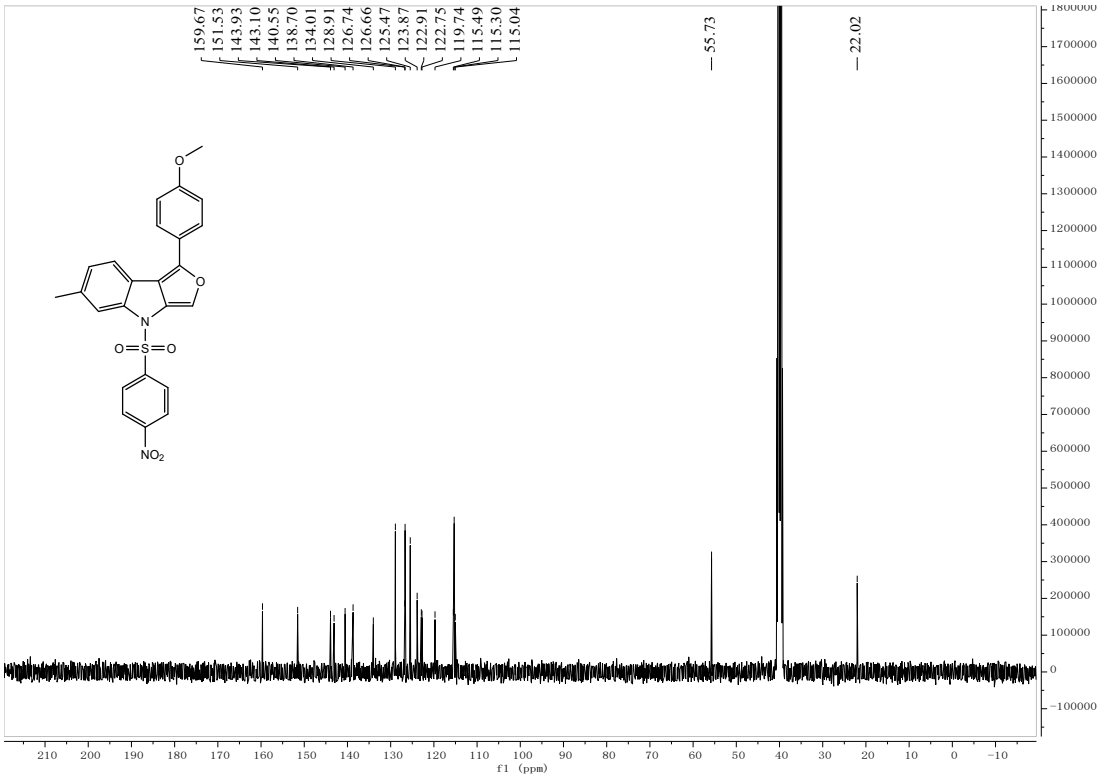
^{13}C NMR spectrum of **3p**



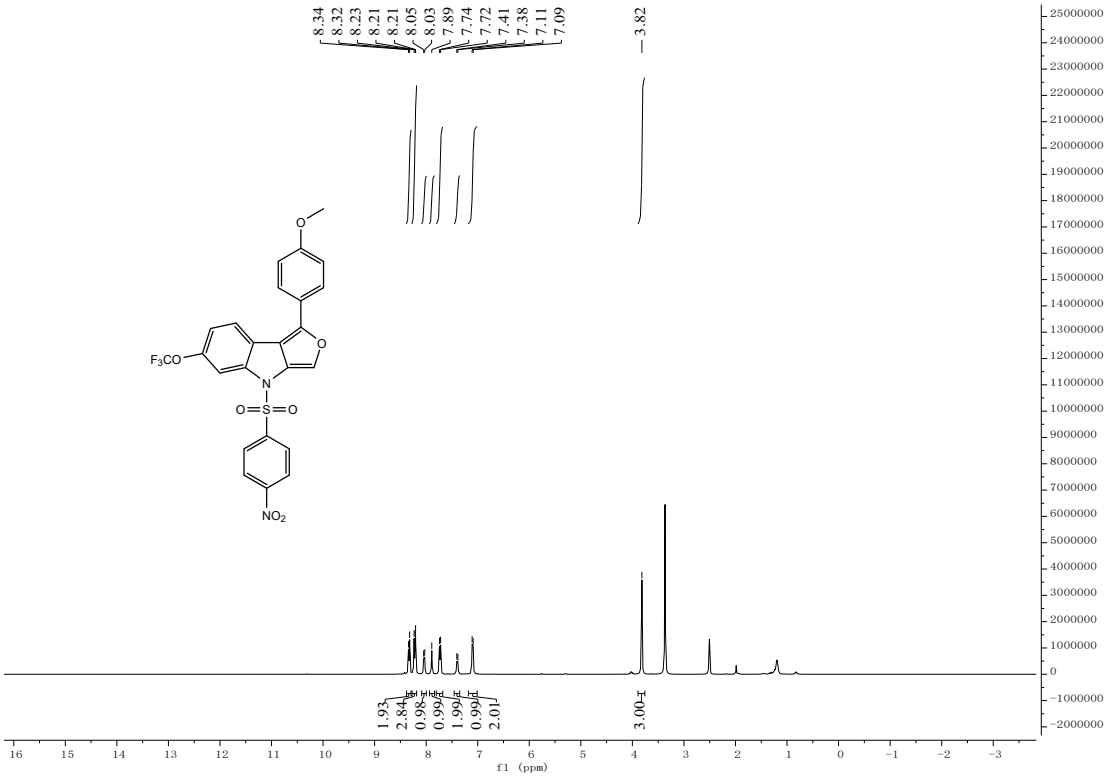
^{1}H NMR spectrum of **3q**



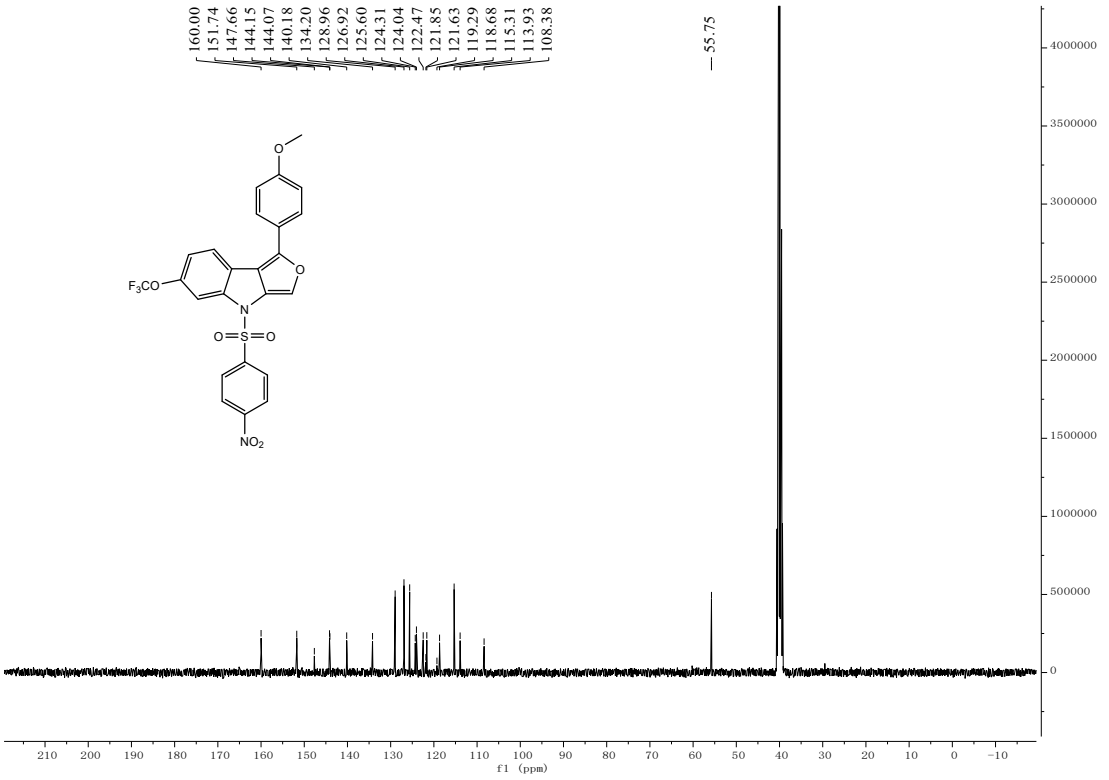
^{13}C NMR spectrum of **3q**



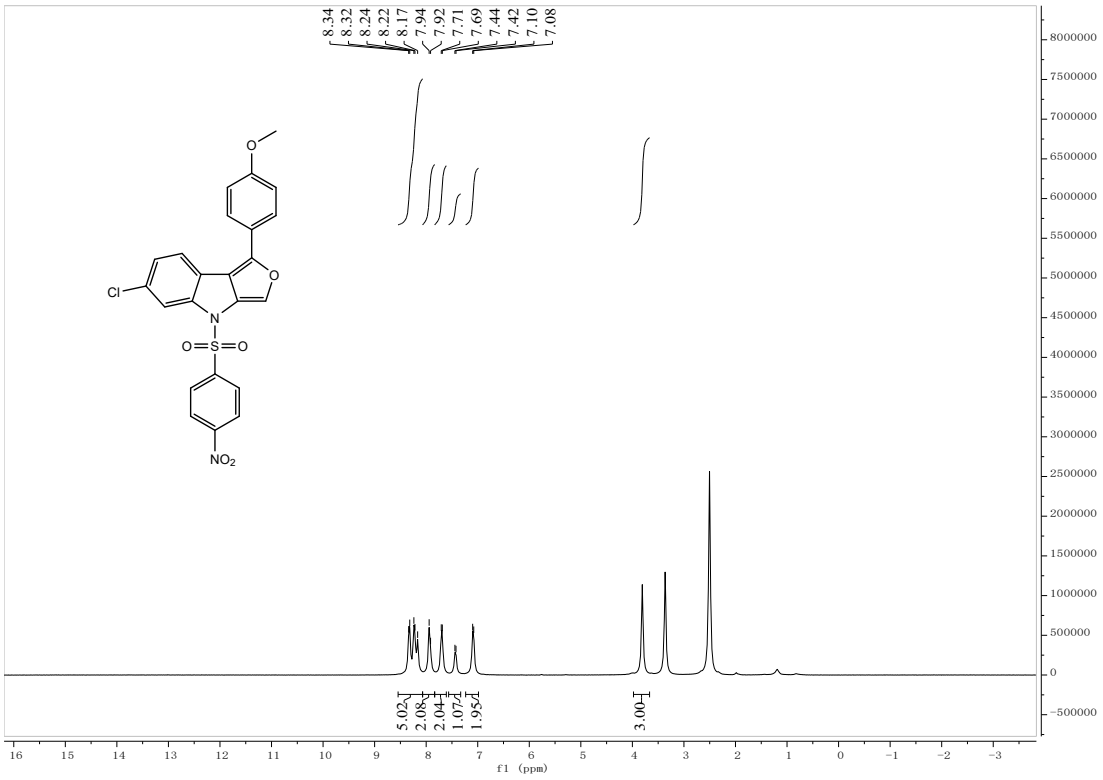
^{1}H NMR spectrum of **3r**



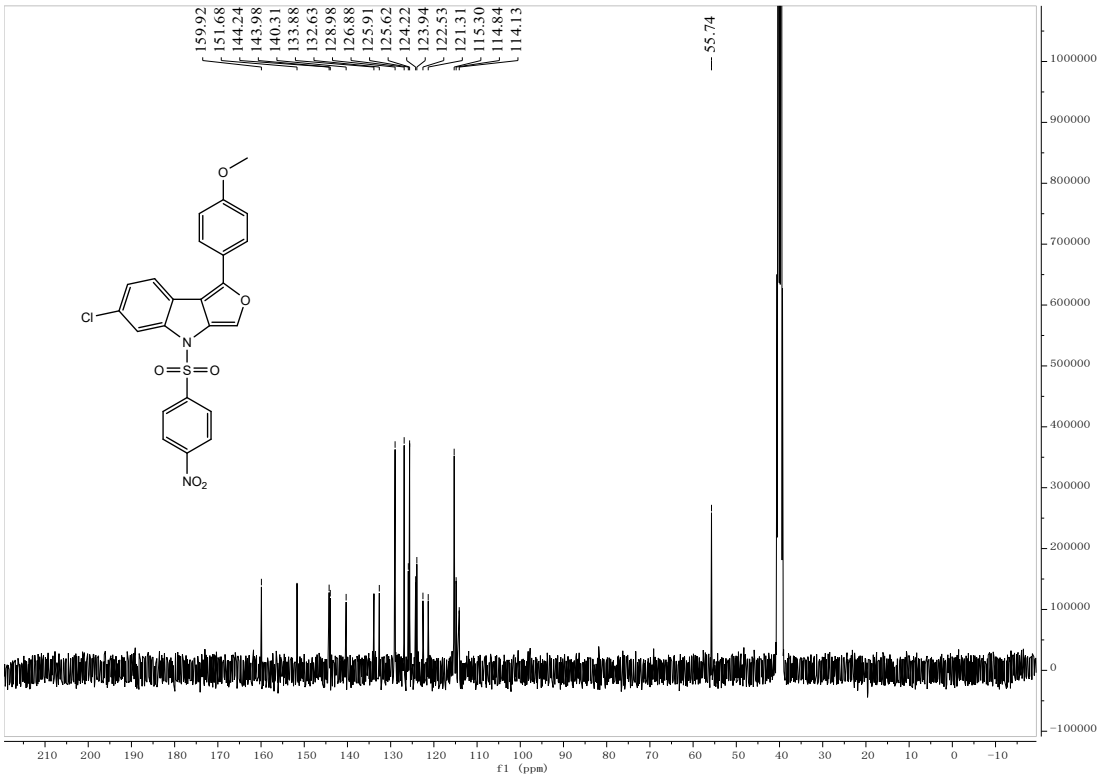
^{13}C NMR spectrum of **3r**



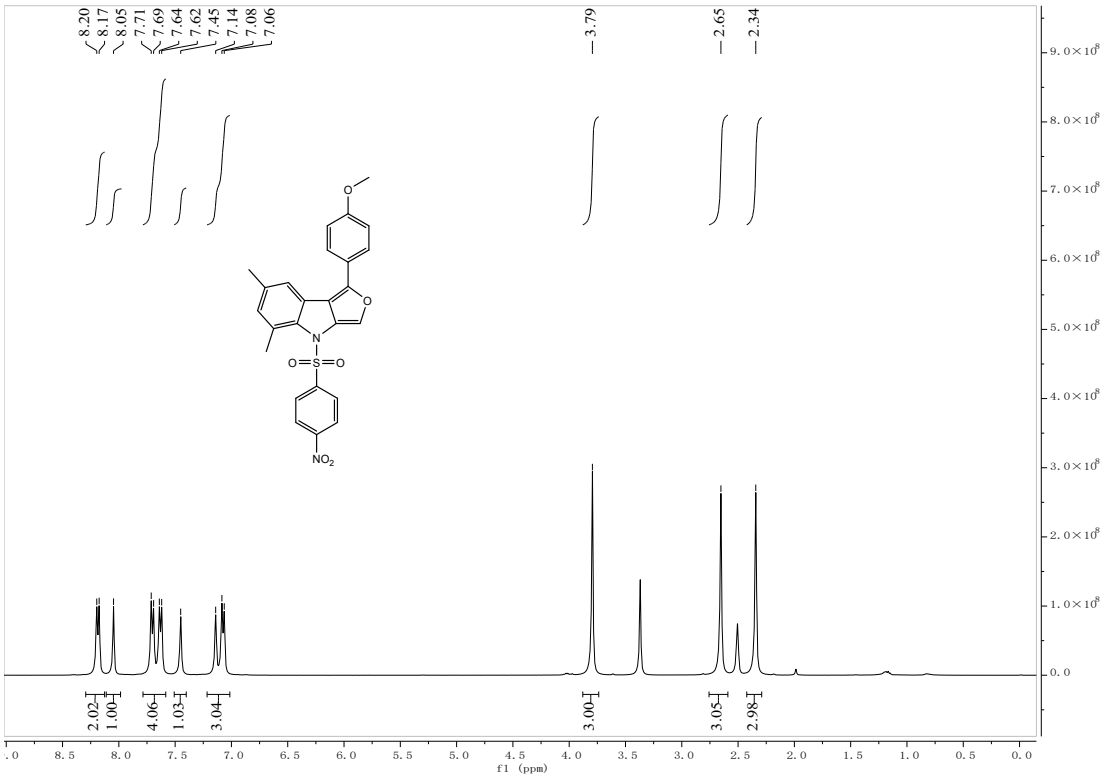
^{1}H NMR spectrum of **3s**



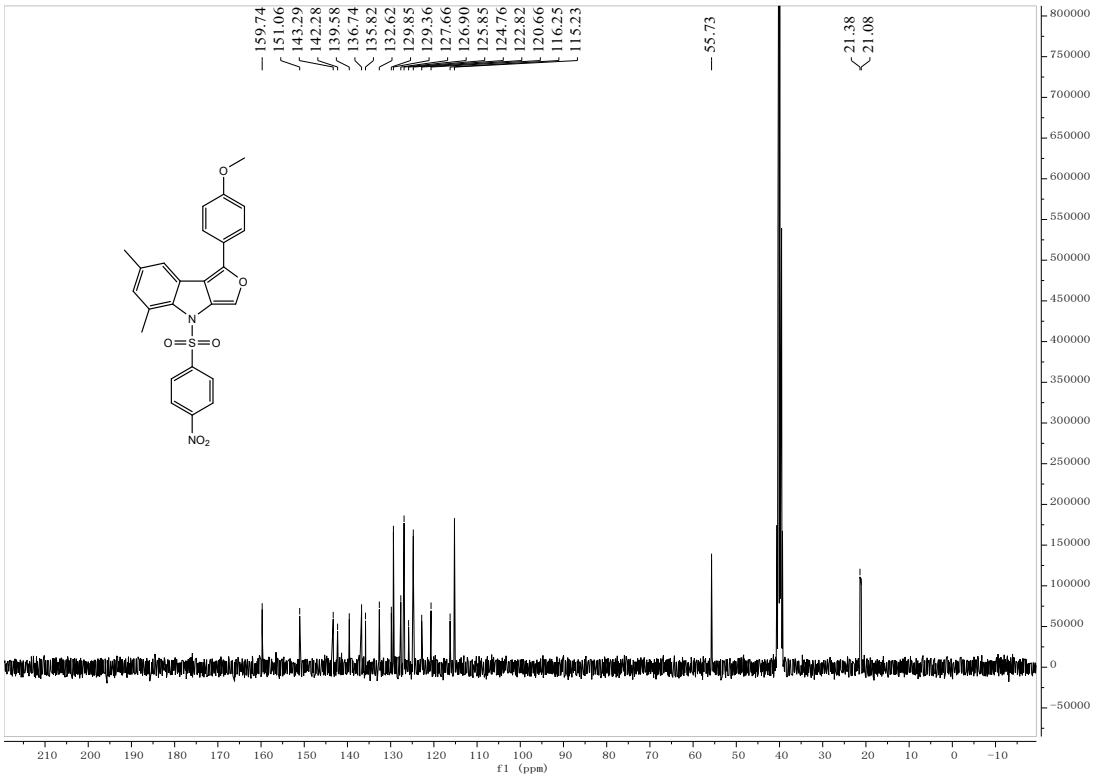
^{13}C NMR spectrum of **3s**



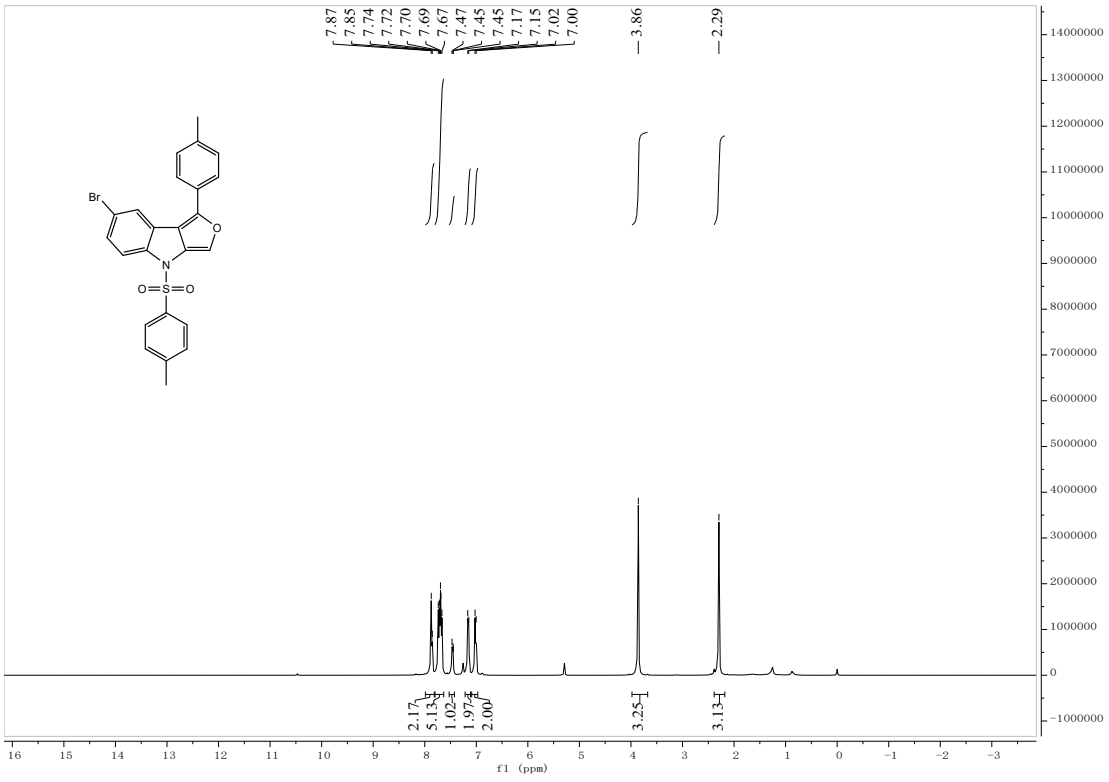
^{1}H NMR spectrum of **3t**



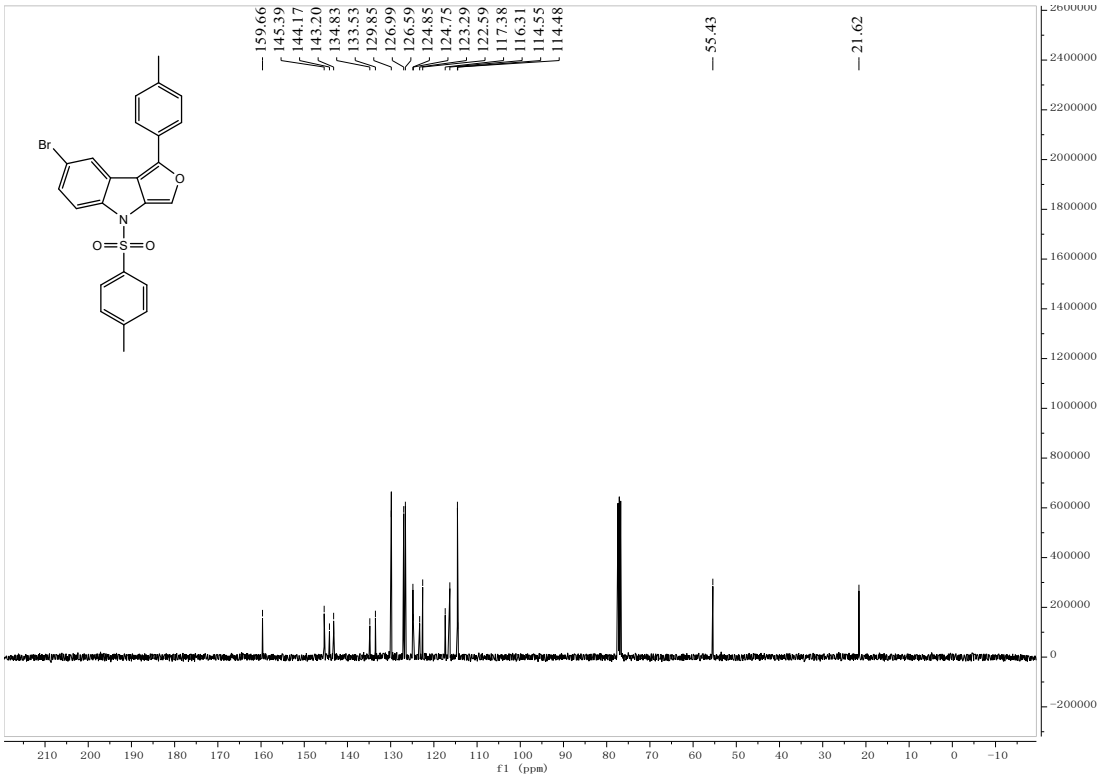
^{13}C NMR spectrum of **3t**



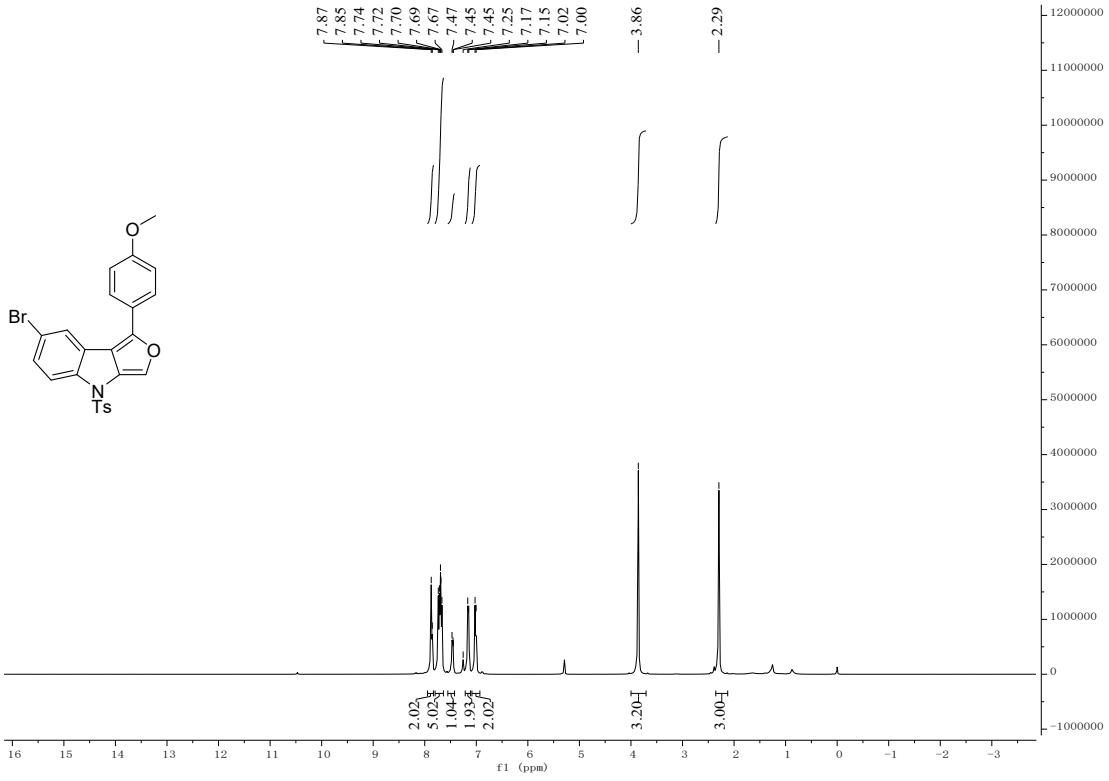
^{1}H NMR spectrum of **3u**



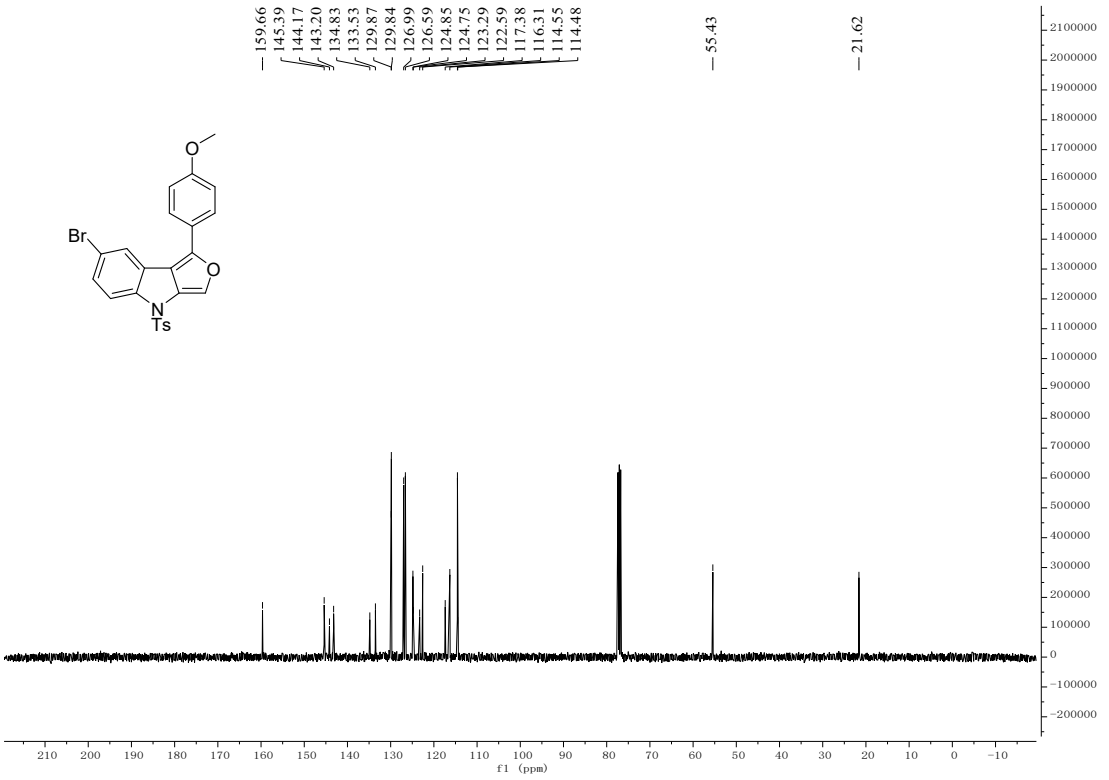
^{13}C NMR spectrum of **3u**



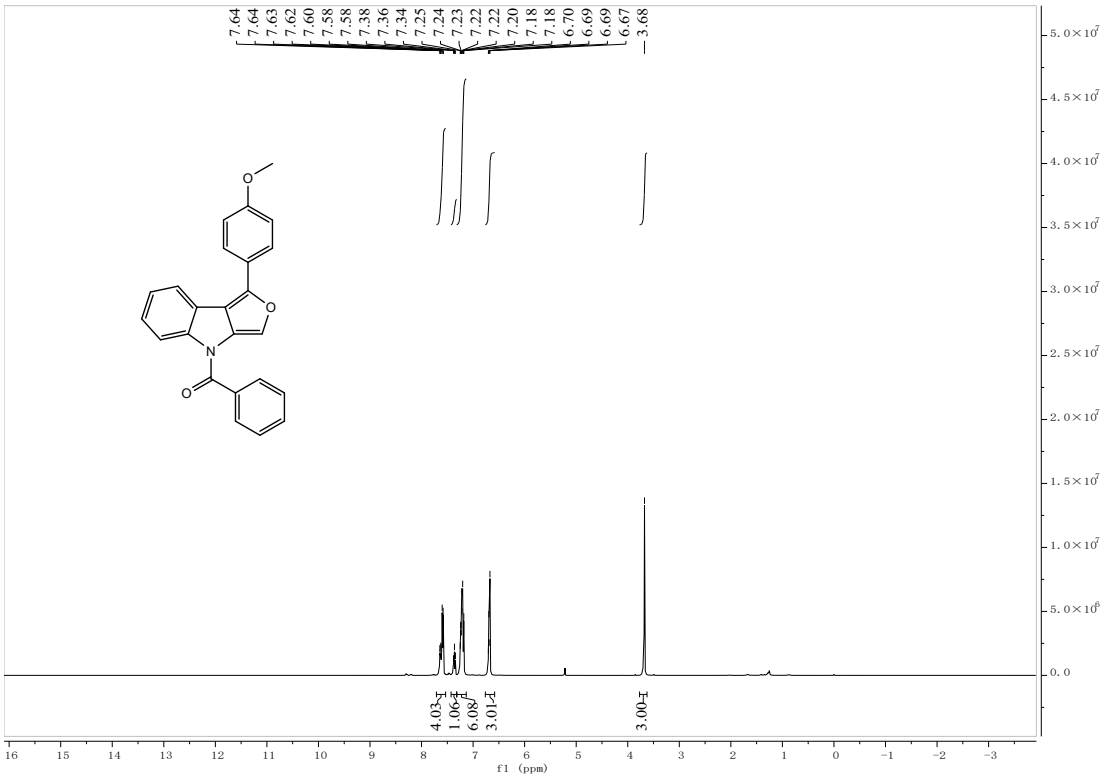
^{1}H NMR spectrum of **3v**



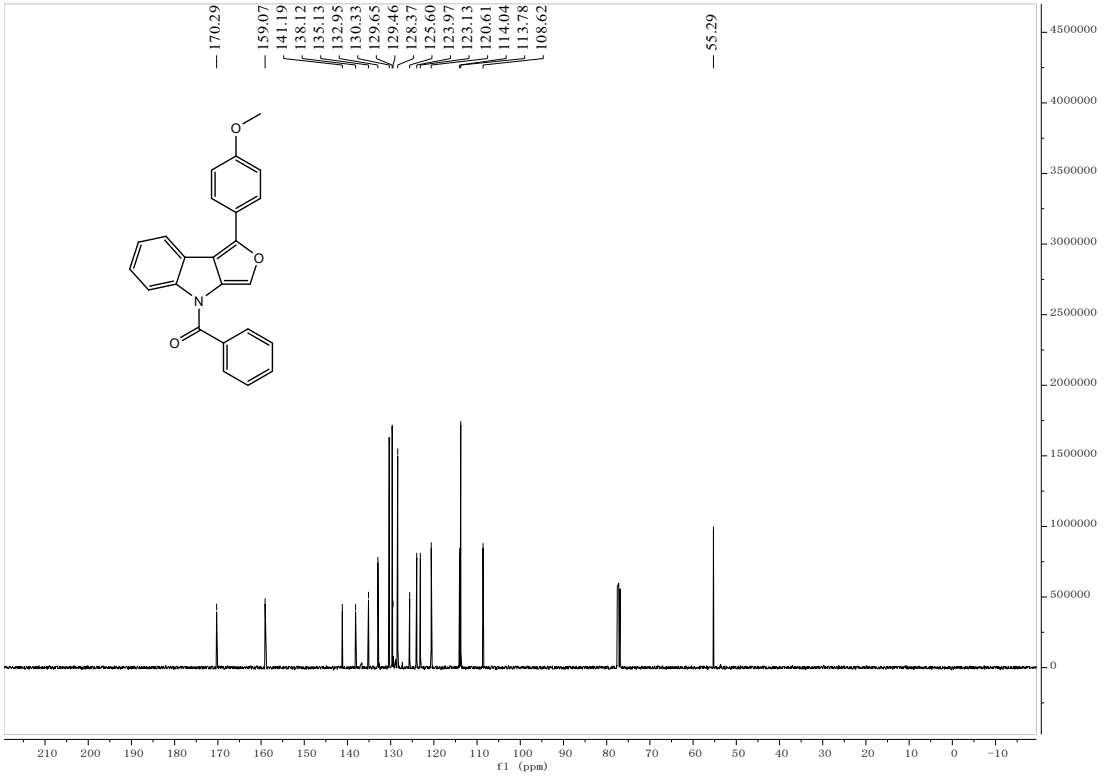
^{13}C NMR spectrum of **3v**



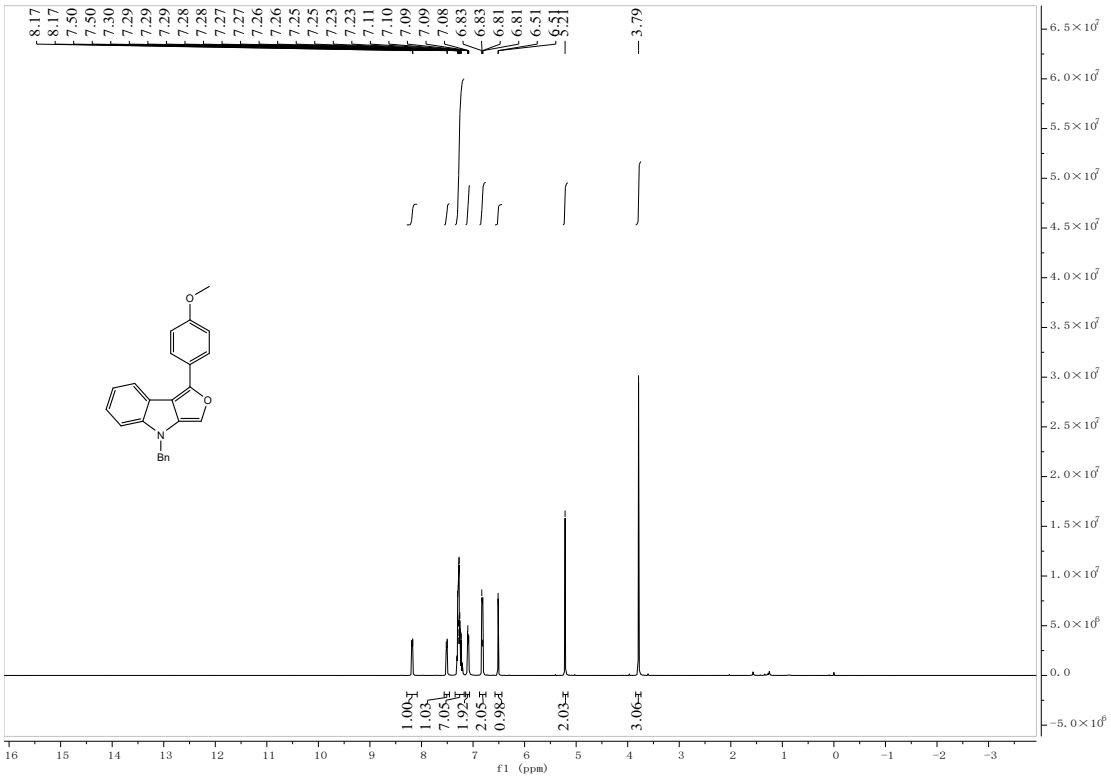
^{1}H NMR spectrum of **3x**



^{13}C NMR spectrum of **3x**



^{1}H NMR spectrum of **3y**



^{13}C NMR spectrum of **3y**