Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting Information

Ultrafast N-Arylation of Sulfoximines Enabled by Micellar Catalysis in Water

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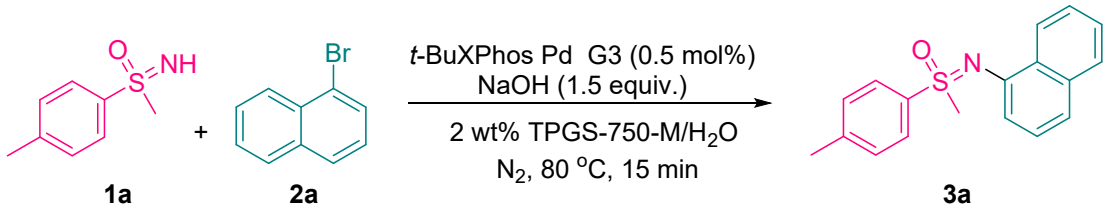
1. General information

All commercially available reagents are used without further purification. All precatalysts were purchased from commercial sources. Compound **1a, 1c, 1d, 1e, 1f, 1g, 1h, 1j, 1k, 1l** was prepared according to reported literature procedure.[1] TPGS-750-M was synthesized accroding to Lipshutz's work.[2] ^{1}H NMR and ^{13}C NMR were recorded on a 400 MHz Bruker spectrometer (400 MHz for ^{1}H NMR and 100 MHz for ^{13}C NMR). Chemical shifts (δ) of ^{1}H NMR and ^{13}C NMR are reported in ppm relative to TMS and the residual solvent peak were converted to the TMS scale ($CDCl_3$: δH = 7.26 ppm, δC = 77.16 ppm, H_2O: δH: 1.56; DMSO-d_6: δH = 2.50 ppm, δC = 39.52 ppm, H_2O: δH: 3.33). The coupling constants (*J*) are in Hertz (Hz). The used abbreviations are as follows: s (singlet), d (doublet), t (triplet), q (quartet), dd (doublet of doublets), ddd (doublet of doublet of doublets), dt (doublet of triplets), td (triplet of doublets), tt (triplet of triplets), qd (quartet of doublets), m (multiplet). The high resolution mass spectra (HRMS) data were measured on a UHPLC Q-TOF HR-MS by means of the ESI technique. The low resolution mass spectra (LRMS) data were measured on the SHIMADZU GCMS-QP 2010 SE mass spectrometer (Kyoto, Japan) by means of EI technique. The melting points of these compounds were determined by an X-4A micro-melting point apparatus (Shanghai, China).

Table S1. Surfactant screening.[a]



1a + **2a** → **3a**

Entry	Variations from the standard condition	Yield/[%][b]
1	DDAB	25
2	TBAB	26
3	DODAB	28
4	Tween 80	44
5	PEG-750	36
6	1 wt% TPGS-750-M	80
7	3 wt% TPGS-750-M	82

8	2 mL 2 wt% TPGS-750-M/H_2O	87
9	0.5 mL 2 wt% TPGS-750-M/H_2O	75
10	Na^{t}Obu, toluene, 4 h	65
11	DMF, 12 h	trace

[a] Reaction condition: **1a** (0.2 mmol), **2a** (0.2 mmol), *t*-BuXPhos-Pd-G3 (0.5 mol%), NaOH (1.5 equiv.), 2 wt% TPGS-750-M/H_2O (1 mL), N_2, 80 °C, 15 min. [b] Isolated yield.

2. Preparation of a stock solution

The catalyst solution was prepared by dissolving the corresponding precatalyst (2.5 mol%) in 200 μL THF. This stock solution was used freshly or can be stored up to a few weeks under argon in a freezer). For 0.5 mol% catalyst loading, 40 μL of this stock solution was used.

3. General procedure for C-N coupling

To an oven-dried 25 mL schlenk tube with a magnetic stir bar was added NH-sulfoximine **1** (0.2 mmol), NaOH (1.5 equiv.), and TPGS-750-M (2 wt%, 1 mL) aqueous solution. Then, aryl bromide **2** (1.0 equiv.) was added to the solution. The tube was sealed with rubber septum, evacuated, and backfilled with nitrogen three times. Subsequently, 40 μL *t*-BuXPhos-Pd-G3 (0.5 mol%, 4% THF) were added to the previous solution by syringe. Then the reaction was placed into an oil bath and stirred (1000-1500 rpm) at 80 °C for 15 min. The schlenk tube was removed from oil bath and allowed to cool to room temperature. Ethyl acetate (250 μL) was added to the schlenk tube and stirred briefly. Stirring was halted and after separation, the organic layer was removed via pipette. An additional extraction was performed with ethyl acetate (125 μL). The organic layes were combined, and dried with Na_2SO_4. Volatiles were removed under vacuum, and the crude residue was purified by silica gel column chromatography to give the product **3a-4k**.

4. Reaction Process monitoring the yield versus the reaction time

To three oven-dried 25 mL schlenk tubes with a magnetic stir bar were added imino(methyl)(*p*-tolyl)-λ^6-sulfanone **1a** (0.2 mmol, 34 mg), NaOH (1.5 equiv.), and TPGS-750-M (2 wt%, 1 mL) aqueous solution. Then, 4-bromophenyl methyl sulfone

2i (0.2 mmol, 48 mg) was added to the solution. The three tubes were sealed with rubber septum, evacuated, and backfilled with nitrogen three times. Subsequently, 40 μL *t*-BuXPhos-Pd-G3 (0.5 mol%, 4% THF) were added to the previous solution by syringe. Then the three reactions were placed into an oil bath and stirred (1000-1500 rpm) at 80 °C for 5 min, 10 min, 15 min, respectively. The three schlenk tubes were removed from oil bath and allowed to cool to room temperature. Ethyl acetate (250 μL) was added to the three schlenk tubes and stirred briefly. Stirring was halted and after separation, the organic layer was removed via pipette. An additional extraction was performed with ethyl acetate (125 μL). The organic layes were combined, and dried with Na_2SO_4. Volatiles were removed under vacuum, and the crude residue was purified by silica gel column chromatography to give the product **3i**.

5. Synthesis of bissulfoximines

To an oven-dried 25 mL schlenk tube with a magnetic stir bar was added imino(methyl)(*p*-tolyl)-λ^6-sulfanone **1a** (0.4 mmol, 68 mg), NaOH (1.5 equiv.), and TPGS-750-M (2 wt%, 2 mL) queous solution. Then, 4,4'-dibromobiphenyl **2q** (0.2 mmol, 63 mg) was added to the solution. The tube was sealed with rubber septum, evacuated, and backfilled with nitrogen three times. Subsequently, 80 μL *t*-BuXPhos-Pd-G3 (0.5 mol%, 1.6 mg) was added to the previous solution by syringe. Then the reaction was placed into an oil bath and stirred (1000-1500 rpm) at 80 °C for 0.5 h. The schlenk tube was removed from oil bath and allowed to cool to room temperature. Ethyl acetate (250 μL) was added to the schlenk tube and stirred briefly. Stirring was halted and after separation, the organic layer was removed via pipette. An additional extraction was performed with ethyl acetate (125 μL). The organic layes were combined, and dried with Na_2SO_4. Volatiles were removed under vacuum, and the crude residue was purified by silica gel column chromatography to give the product **5a**.

6. Gram-Scale synthesis of 3e

To an oven-dried 100 mL schlenk tube with a magnetic stir bar was added 1.016 g imino(methyl)(*p*-tolyl)-λ^6-sulfanone **1a** (6.0 mmol, 1.0 equiv.), 360 mg NaOH (1.5 equiv.), and TPGS-750-M (30 mL, 2 wt%) queous solution. Then, 24.0 mg *t*-BuXPhos-

Pd-G3 and 3'-bromoacetophenone **2e** (1.0 equiv.) was added to the solution. The tube was sealed with rubber septum, evacuated, and backfilled with nitrogen three times. Then the reaction was placed into an oil bath and stirred (1000-1500 rpm) at 80 °C for 6 h. The schlenk tube was removed from oil bath and allowed to cool to room temperature. Ethyl acetate (1 mL) was added to the schlenk tube and stirred briefly. Stirring was halted and after separation, the organic layer was removed via pipette. An additional extraction was performed with ethyl acetate (0.5 mL). The organic layes were combined, and dried with Na_2SO_4. Volatiles were removed under vacuum, and the crude residue was purified by silica gel column chromatography to give the product **3e** (1.5 g)**.**

E Factor calulations:

Note: Using the density of each liquid at 25 °C, toluene = 0.867 g/mL, water = 1.00 g/mL, dichloromethane = 1.325 g/mL, ethyl acetate = 0.897 g/mL. Additionally, the using solvents of silica gel column chromatography is NOT included as we are only considering solvents from the experimental procedure.

Previous work (Harmata[3]):

Solvents:

7 mL toluene (6 g)

10 mL Dichloromethane (13.25 g)

$$\frac{19.25 \text{ g waste}}{0.179 \text{ g product}} = 108 \text{ E Factor}$$

This work:

Water NOT included as waste:

Solvents:

1.5 mL Ethyl acetate (1.35 g)

$$\frac{1.35 \text{ g waste}}{1.5 \text{ g product}} = 0.9 \text{ E Factor}$$

Water included as waste:

Solvents:

30 mL H_2O (30 g)

1.5 mL Ethyl acetate (1.35 g)

$$\frac{\text{31.35 g waste}}{\text{1.5 g product}} = 20.9 \text{ E Factor}$$

Water and base included as waste:

Solvents:

30 mL H_2O (30 g)

1.5 mL Ethyl acetate (1.35 g)

Base：

360 mg NaOH

$$\frac{\text{31.71 g waste}}{\text{1.5 g product}} = 21.14 \text{ E Factor}$$

2 wt% TPGS-750-M/H_2O and base included as waste:

Solvents:

30 mL 2 wt% TPGS-750-M/H_2O (30.6 g)

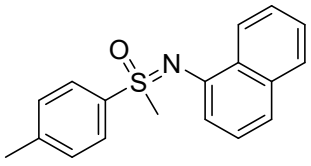
1.5 mL Ethyl acetate (1.35 g)

Base：

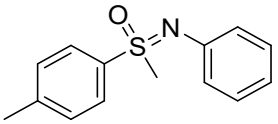
360 mg NaOH

$$\frac{\text{32.31 g waste}}{\text{1.5 g product}} = 21.54 \text{ E Factor}$$

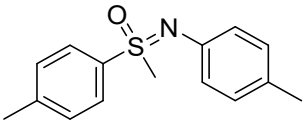
7. Characterization data of all products



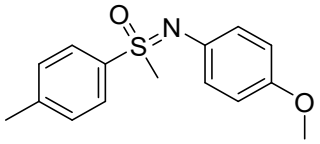
methyl(naphthalen-1-ylimino)(*p*-tolyl)-λ^6-sulfanone (3a) Light yellow oil (51 mg, 87% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 – 8.50 (m, 1H), 7.90 – 7.84 (m, 2H), 7.75 (dd, *J* = 7.5, 2.0 Hz, 1H), 7.53 – 7.43 (m, 2H), 7.38 (d, *J* = 8.2 Hz, 1H), 7.29 – 7.26 (m, 2H), 7.19 – 7.14 (m, 1H), 7.08 (dd, *J* = 7.4, 1.1 Hz, 1H), 3.33 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.3, 141.8, 136.3, 134.6, 130.3, 130.2, 128.6, 127.8, 126.1, 125.9, 125.1, 124.1, 121.5, 116.6, 46.2. HRMS (ESI) calcd for $C_{18}H_{18}NOS$ ($[M+H]^+$): 296.1104, Found: 296.1108.



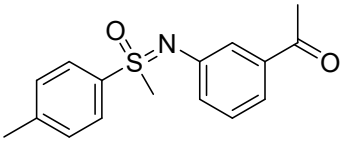
methyl(phenylimino)(*p*-tolyl)-λ⁶-sulfanone (3b)[4]Light yellow oil (35 mg, 80% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$ δ 7.84 (d, *J* = 8.3 Hz, 2H), 7.31 (d, *J* = 8.1 Hz, 2H), 7.12 (t, *J* = 7.8 Hz, 2H), 7.03 – 6.98 (m, 2H), 6.86 (t, *J* = 7.3 Hz, 1H), 3.22 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.2, 144.2, 136.3, 130.3, 129.0, 128.7, 123.3, 121.6, 77.4, 77.1, 76.8, 46.3, 21.6. LRMS (EI): m/z calcd for $C_{14}H_{15}NOS$ $[M]^+$, 245.09; found, 244.90.



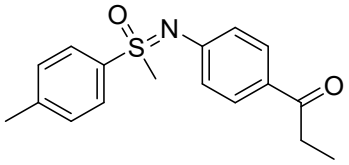
methyl(*p*-tolyl)(*p*-tolylimino)-λ⁶-sulfanone (3c)[4] Light yellow oil (40 mg, 78% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 – 7.81 (m, 2H), 7.30 (d, *J* = 7.8 Hz, 2H), 6.91 (d, *J* = 1.3 Hz, 4H), 3.20 (s, 3H), 2.40 (s, 3H), 2.20 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.1, 142.4, 136.5, 130.9, 130.2, 129.6, 128.8, 123.2, 77.4, 77.1, 76.8, 46.1, 21.6, 20.7. LRMS (EI): m/z calcd for $C_{15}H_{17}NOS$ $[M]^+$, 259.10; found, 259.10.



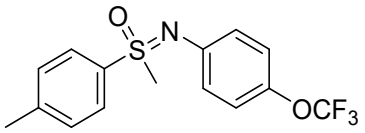
((4-methoxyphenyl)imino)(methyl)(*p*-tolyl)-λ⁶-sulfanone (3d) White solid (45 mg, 82% yield), (hexane/EA = 3:1 as eluent); mp 82-85 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 – 8.06 (m, 2H), 7.56 (d, *J* = 8.0 Hz, 2H), 7.25 – 7.17 (m, 2H), 6.97 – 6.90 (m, 2H), 3.95 (s, 3H), 3.45 (s, 3H), 2.66 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.7, 144.1, 138.1, 136.4, 130.2, 128.8, 124.4, 114.3, 55.4, 45.9, 21.6. HRMS (ESI) calcd for $C_{15}H_{18}NO_2S$ ($[M+H]^+$): 276.1053, Found: 276.1055.



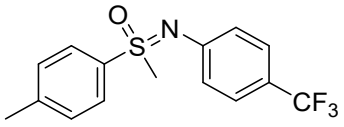
((3-acetylphenyl)imino)(methyl)(*p*-tolyl)-λ⁶-sulfanone (3e) Light yellow oil (49 mg, 95% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 – 7.81 (m, 2H), 7.58 – 7.56 (m, 1H), 7.47 – 7.44 (m, 1H), 7.32 (d, *J* = 7.9 Hz, 2H), 7.20 – 7.17 (m, 2H), 3.25 (s, 3H), 2.50 (s, 3H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.4, 145.8, 144.5, 138.1, 135.9, 130.4, 129.2, 128.7, 127.7, 123.4, 121.5, 46.4, 26.8, 21.6. HRMS (ESI) calcd for $C_{16}H_{18}NO_2S$ ($[M+H]^+$): 288.1053, Found: 288.1056.



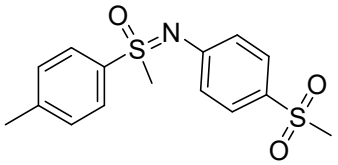
methyl((4-propionylphenyl)imino)(*p*-tolyl)-λ⁶-sulfanone (3f) Light yellow solid (49 mg, 82% yield), (hexane/EA = 3:1 as eluent); mp 90-92 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 – 7.79 (m, 2H), 7.76 – 7.72 (m, 2H), 7.35 – 7.29 (m, 2H), 7.03 – 6.97 (m, 2H), 3.26 (s, 3H), 2.87 (q, *J* = 7.3 Hz, 2H), 2.41 (s, 3H), 1.15 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 199.9, 150.6, 144.7, 135.7, 130.5, 130.3, 129.5, 128.6, 122.5, 46.7, 31.3, 21.6, 8.5. HRMS (ESI) calcd for $C_{17}H_{20}NO_2S$ ($[M+H]^+$): 302.1209, Found: 302.1212.



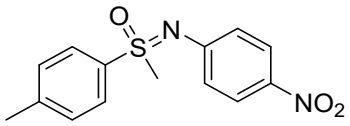
methyl(*p*-tolyl)((4-(trifluoromethoxy)phenyl)imino)-λ⁶-sulfanone (3g) Colorless oil (60 mg, 91% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, *J* = 8.1 Hz, 2H), 7.33 (d, *J* = 8.1 Hz, 2H), 7.00 – 6.92 (m, 4H), 3.22 (s, 3H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.5, 144.1, 143.7 (q, J = 2.0 Hz), 136.0, 130.4, 128.7, 124.0, 121.8, 120.7 (q, J = 254.5 Hz), 46.4, 21.6. HRMS (ESI) calcd for $C_{15}H_{15}F_3NO_2S$ ($[M+H]^+$): 330.0770, Found: 330.0770.



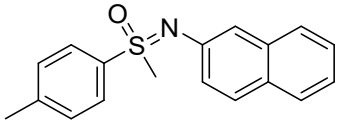
methyl(*p*-tolyl)((4-(trifluoromethyl)phenyl)imino)-λ⁶-sulfanone (3h)[1]White solid (53 mg, 85% yield), (hexane/EA = 3:1 as eluent); mp 39-44 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 – 7.79 (m, 2H), 7.33 (dd, *J* = 8.4, 4.4 Hz, 4H), 7.04 (d, *J* = 8.4 Hz, 2H), 3.25 (s, 3H), 2.41 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.0, 144.7, 135.7, 130.5, 128.6, 126.3 (2C, q, J = 3.8 Hz), 124.8 (q, J = 269.7 Hz), 123.2 (q, J = 32.2 Hz), 122.9, 46.6, 21.6. LRMS (EI): m/z calcd for $C_{15}H_{14}F_3NOS$ $[M]^+$, 313.07; found, 313.05.



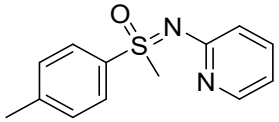
methyl((4-(methylsulfonyl)phenyl)imino)(*p*-tolyl)-λ⁶-sulfanone (3i) White solid (62 mg, 96% yield), (EA as eluent); mp 138-144 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 – 7.78 (m, 2H), 7.67 – 7.61 (m, 2H), 7.37 – 7.31 (m, 2H), 7.10 – 7.04 (m, 2H), 3.27 (s, 3H), 2.97 (s, 3H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.4, 145.1, 135.3, 132.2, 130.6, 128.7, 128.6, 123.0, 46.8, 44.8, 21.7. HRMS (ESI) calcd for $C_{15}H_{18}NO_3S_2$ ($[M+H]^+$): 324.0723, Found: 324.0724.



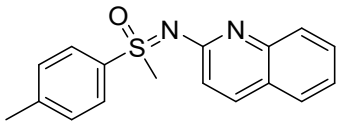
methyl((4-nitrophenyl)imino)(*p*-tolyl)-λ⁶-sulfanone (3j)[5] Light yellow solid (46 mg, 81% yield), (hexane/EA = 3:1 as eluent); mp 112-114 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 – 7.96 (m, 2H), 7.84 – 7.78 (m, 2H), 7.35 (d, *J* = 7.6 Hz, 2H), 7.02 – 6.96 (m, 2H), 3.29 (s, 3H), 2.43 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.9, 145.2, 141.7, 135.1, 130.7, 128.5, 125.2, 122.5, 46.8, 21.7. LRMS (EI): m/z calcd for $C_{14}H_{14}N_2O_3S$ $[M]^+$, 290.07, found, 290.10.



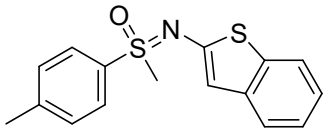
methyl(naphthalen-2-ylimino)(*p*-tolyl)-λ⁶-sulfanone (3k) Light brown solid (49 mg, 83% yield), (hexane/EA = 3:1 as eluent); mp 85-89 °C. ^{1}HNMR (400 MHz, $CDCl_3$) δ 7.91 – 7.85 (m, 2H), 7.67 (d, *J* = 8.2 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 1H), 7.59 (d, *J* = 8.4 Hz, 1H), 7.38 (d, *J* = 2.2 Hz, 1H), 7.36 – 7.29 (m, 2H), 7.29 – 7.23 (m, 3H), 3.28 (s, 3H), 2.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.3, 143.2, 136.1, 134.5, 130.3, 129.5, 128.8, 128.7, 127.5, 126.9, 125.9, 124.9, 123.7, 118.6, 46.4, 21.6. HRMS (ESI) calcd for $C_{18}H_{18}NOS$ ($[M+H]^+$): 296.1104, Found: 296.1108.



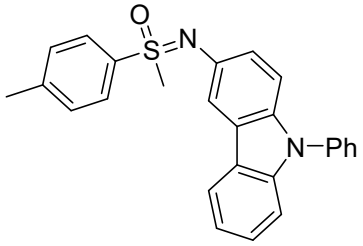
methyl(pyridin-2-ylimino)(*p*-tolyl)-λ⁶-sulfanone (3l) Light yellow oil (45 mg, 92% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (ddd, *J* = 5.0, 2.0, 0.9 Hz, 1H), 7.93 – 7.86 (m, 2H), 7.46 (ddd, *J* = 8.2, 7.2, 2.0 Hz, 1H), 7.36 – 7.30 (m, 2H), 6.85 (dt, *J* = 8.2, 1.0 Hz, 1H), 6.72 (ddd, *J* = 7.3, 5.0, 1.1 Hz, 1H), 3.35 (s, 3H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.1, 148.0, 144.0, 137.7, 137.2, 130.2, 128.0, 116.8, 116.2, 45.8, 21.6. HRMS (ESI) calcd for $C_{13}H_{15}N_2OS$ ($[M+H]^+$): 247.0900, Found: 247.0903.



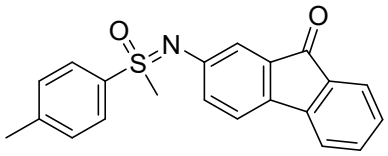
methyl(quinolin-2-ylimino)(*p*-tolyl)-λ⁶-sulfanone (3m) White solid (24 mg, 55% yield), (hexane/EA = 3:1 as eluent); mp 102-105 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00 – 7.94 (m, 2H), 7.90 (dd, *J* = 8.8, 0.8 Hz, 1H), 7.69 (dd, *J* = 8.4, 1.1 Hz, 1H), 7.62 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.50 (ddd, *J* = 8.4, 6.9, 1.5 Hz, 1H), 7.34 (d, *J* = 7.8 Hz, 2H), 7.30 – 7.26 (m, 1H), 7.04 (d, *J* = 8.7 Hz, 1H), 3.49 (s, 3H), 2.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.3, 147.5, 144.1, 137.6, 137.3, 130.1, 129.0, 127.9, 127.7, 127.2, 124.6, 123.6, 118.3, 45.5, 21.6. HRMS (ESI) calcd for $C_{17}H_{17}N_2OS$ ($[M+H]^+$): 297.1056, Found: 297.1056.



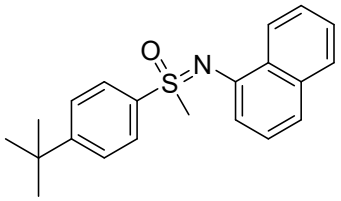
(benzo[*b*]thiophen-2-ylimino)(methyl)(*p*-tolyl)-λ⁶-sulfanone (3n) Colorless oil (49 mg, 82% yield)**,** (hexane/EA = 4:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, *J* = 7.4 Hz, 1H), 7.86 (d, *J* = 8.3 Hz, 2H), 7.73 (d, *J* = 7.9 Hz, 1H), 7.39 (ddd, *J* = 8.1, 7.1, 1.2 Hz, 1H), 7.35 – 7.32 (m, 1H), 7.30 (d, *J* = 8.0 Hz, 2H), 6.58 (s, 1H), 3.32 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.5, 138.2, 137.3, 137.3, 135.9, 130.3, 128.7, 124.5, 123.6, 122.7, 121.8, 107.9, 45.4, 21.6. HRMS (ESI) calcd for $C_{16}H_{16}NOS_2$ ([M+H]$^+$): 302.0668, Found: 302.0671.



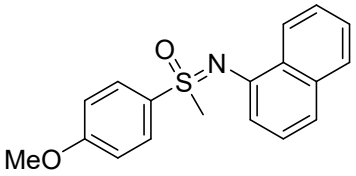
methyl((9-phenyl-9*H*-carbazol-3-yl)imino)(*p*-tolyl)-λ⁶-sulfanone (3o) Light yellow solid (67 mg, 80% yield), (hexane/EA = 1:1 as eluent); mp 142-146 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 7.7 Hz, 2H), 7.94 – 7.90 (m, 2H), 7.39 (s, 1H), 7.36 (dt, *J* = 6.5, 1.3 Hz, 2H), 7.34 (d, *J* = 1.2 Hz, 1H), 7.31 (s, 1H), 7.30 – 7.28 (m, 1H), 7.27 (d, *J* = 2.2 Hz, 1H), 7.26 – 7.24 (m, 1H), 7.23 (t, *J* = 1.0 Hz, 1H), 7.22 – 7.18 (m, 2H), 7.18 (d, *J* = 2.1 Hz, 1H), 3.28 (s, 3H), 2.45 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.7, 144.5, 141.2, 136.3, 131.1, 130.5, 128.7, 127.9, 125.8, 124.2, 123.1, 120.2, 119.6, 109.9, 46.6, 21.7. HRMS (ESI) calcd for $C_{26}H_{23}N_2OS$ ([M+H]$^+$): 411.1526, Found: 411.1526.



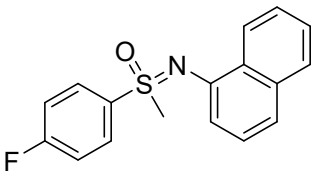
methyl((9-oxo-9*H*-fluoren-2-yl)imino)(*p*-tolyl)-λ⁶-sulfanone (3p) Orange solid (60 mg, 86% yield), (hexane/EA = 2:1 as eluent); mp 77-81 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 – 7.79 (m, 2H), 7.53 (d, *J* = 7.3 Hz, 1H), 7.37 (td, *J* = 7.4, 1.2 Hz, 1H), 7.32 (d, *J* = 7.4 Hz, 3H), 7.27 (d, *J* = 2.1 Hz, 1H), 7.23 (d, *J* = 7.9 Hz, 1H), 7.14 (td, *J* = 7.4, 1.2 Hz, 1H), 7.09 (dd, *J* = 8.0, 2.1 Hz, 1H), 3.25 (s, 3H), 2.39 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 194.2, 146.9, 145.1, 144.6, 137.5, 135.8, 135.4, 134.7, 134.4, 130.4, 128.7, 128.6, 127.8, 124.2, 121.0, 119.5, 119.5, 46.4, 21.6. HRMS (ESI) calcd for $C_{21}H_{18}NO_2S$ ([M+H]$^+$): 348.1053, Found: 348.1052.



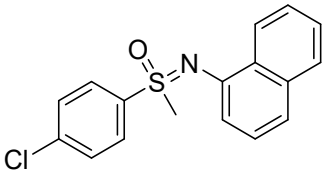
(4-(*tert*-butyl)phenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4a) Brown so lid (63 mg, 93% yield), (hexane/EA = 2:1 as eluent); mp 107-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.58 – 8.54 (m, 1H), 7.94 – 7.90 (m, 2 H), 7.77 (dd, *J* = 7.6, 1.9 Hz, 1H), 7.54 – 7.44 (m, 4H), 7.40 (d, *J* = 8.1 Hz, 1H), 7.20 (t, *J* = 7.7 Hz, 1H), 7.14 (dd, *J* = 7.4, 1.2 Hz, 1H), 3.32 (s, 3H), 1.31 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.2, 141.9, 136.4, 134.6, 130.2, 128.4, 127.8, 12 6.7, 126.2, 125.9, 125.0, 124.1, 121.4, 116.6, 46.1, 35.2, 31.1. HRMS (ESI) ca lcd for $C_{21}H_{24}NOS$ ([M+H]$^+$): 338.1573, Found: 338.1571.



(4-methoxyphenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4b)[6]White solid (46 mg, 74% yield), (hexane/EA = 3:1 as eluent); mp 135-139 °C.^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (dd, *J* = 8.0, 1.1 Hz, 1H), 7.95 – 7.87 (m, 2H), 7.79 – 7.72 (m, 1H), 7.53 – 7.44 (m, 2H), 7.39 (d, *J* = 8.1 Hz, 1H), 7.18 (t, *J* = 7.8 Hz, 1H), 7.10 (dd, *J* = 7.5, 1.1 Hz, 1H), 6.96 – 6.90 (m, 2H), 3.81 (s, 3H), 3.32 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.5, 141.9, 134.6, 130.7, 130.5, 130.2, 127.8, 126.1, 125.9, 125.0, 124.1, 121.4, 116.6, 114.8, 55.7, 46.44. LRMS (EI): m/z calcd for $C_{18}H_{17}NO_2S$ [M]$^+$, 311.10; found, 311.05.

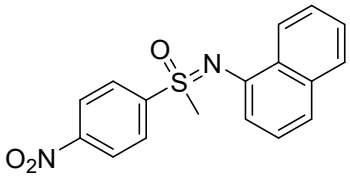


(4-fluorophenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4c) White solid (58 mg, 97% yield), (hexane/EA = 3:1 as eluent); mp 111-115 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.52 (dd, *J* = 8.4, 1.6 Hz, 1H), 8.03 – 7.97 (m, 2H), 7.77 (dd, *J* = 7.5, 2.0 Hz, 1H), 7.49 (m, *J* = 14.6, 8.3, 6.8, 1.5 Hz, 2H), 7.41 (d, *J* = 8.1 Hz, 1H), 7.21 – 7.12 (m, 3H), 7.08 (dd, *J* = 7.5, 1.1 Hz, 1H), 3.35 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.7 (d, J =254.4 Hz), 141.4, 135.2 (d, J = 3.0 Hz), 134.6, 131.4, 131.3, 130.1, 127.9, 126.1 (d, J = 3.6 Hz), 125.2, 123.9, 121.8, 117.0, 116.8, 116.6, 46.2. HRMS (ESI) calcd for $C_{17}H_{15}FNOS$ ([M+H]$^+$): 300.0853, Found: 300.0855.

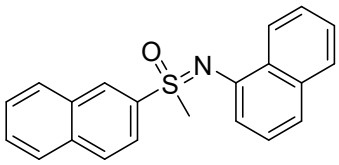


(4-chlorophenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4d) White solid (29 mg, 46% yield), (hexane/EA = 3:1 as eluent); mp 100-103 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 – 8.46 (m, 1H), 7.95 – 7.90 (m, 2H), 7.76 (dd, *J* = 7.4, 2.2 Hz, 1H), 7.54 – 7.43 (m, 4H), 7.41 (d, *J* = 8.2 Hz, 1H), 7.18 (t, *J* = 7.8 Hz, 1H), 7.06 (dd, *J* = 7.4, 1.1 Hz, 1H), 3.35 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.3, 140.1, 137.9, 134.6, 130.1,

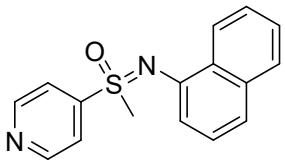
130.0, 127.9, 126.1, 125.2, 123.9, 121.9, 116.6, 46.2. HRMS (ESI) calcd for $C_{17}H_{15}ClNOS$ ($[M+H]^+$): 316.0557, Found: 316.0554.



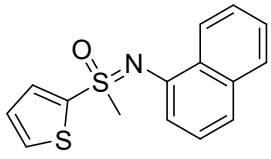
methyl(naphthalen-1-ylimino)(4-nitrophenyl)-λ⁶-sulfanone (4e) Light yellow solid (54 mg, 83% yield), (hexane/EA = 3:1 as eluent); mp 150-155 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.48 (dd, *J* = 8.4, 1.4 Hz, 1H), 8.33 – 8.27 (m, 2H), 8.21 – 8.14 (m, 2H), 7.77 (dd, *J* = 7.6, 1.9 Hz, 1H), 7.55 – 7.46 (m, 2H), 7.42 (d, *J* = 8.2 Hz, 1H), 7.19 – 7.13 (m, 1H), 7.05 (dd, *J* = 7.5, 1.1 Hz, 1H), 3.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 150.7, 145.6, 140.7, 134.6, 130.0, 128.0, 126.3, 126.0, 125.5, 124.8, 123.7, 122.5, 116.7, 77.4, 77.1, 76.8, 45.9. HRMS (ESI) calcd for $C_{17}H_{15}N_2O_3S$ ($[M+H]^+$): 327.0798, Found: 327.0798.



methyl(naphthalen-1-ylimino)(naphthalen-2-yl)-λ⁶-sulfanone (4f) Light yellow oil (64 mg, 96% yield), (hexane/EA = 3:1 as eluent). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (dd, *J* = 12.4, 1.5 Hz, 2H), 7.94 (dd, *J* = 7.7, 1.6 Hz, 1H), 7.91 – 7.89 (m, 2H), 7.86 (d, *J* = 8.4 Hz, 1H), 7.76 (d, *J* = 7.4 Hz, 1H), 7.65 – 7.58 (m, 2H), 7.54 (ddd, *J* = 8.3, 6.8, 1.4 Hz, 1H), 7.48 (ddd, *J* = 8.1, 6.8, 1.4 Hz, 1H), 7.37 (dt, *J* = 7.2, 3.6 Hz, 1H), 7.17 – 7.12 (m, 2H), 3.42 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.7, 136.41, 135.2, 134.6, 132.6, 130.7, 130.2, 129.9, 129.4, 129.1, 128.0, 127.9, 127.6, 126.1, 126.0, 125.1, 124.1, 123.0, 121.6, 116.6, 46.1. HRMS (ESI) calcd for $C_{21}H_{18}NOS$ ($[M+H]^+$): 332.1104, Found: 332.1104.

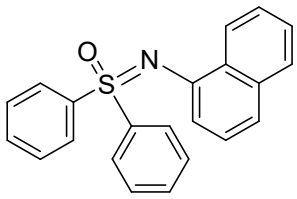


methyl(naphthalen-1-ylimino)(pyridin-4-yl)-λ⁶-sulfanone (4g) White solid (26 mg, 46% yield), (hexane/EA = 21:1 as eluent); mp 174-176 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.84 – 8.79 (m, 2H), 8.48 (dd, *J* = 7.9, 1.1 Hz, 1H), 7.86 – 7.82 (m, 2H), 7.77 (dd, *J* = 7.5, 2.1 Hz, 1H), 7.54 – 7.46 (m, 2H), 7.43 (d, *J* = 8.3 Hz, 1H), 7.20 – 7.15 (m, 1H), 7.06 (dd, *J* = 7.5, 1.1 Hz, 1H), 3.38 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.6, 140.8, 128.0, 126.2, 126.0, 125.4, 123.8, 122.4, 121.9, 116.8, 77.4, 77.1, 76.8, 45.5. HRMS (ESI) calcd for $C_{16}H_{15}N_2OS$ ($[M+H]^+$): 283.0900, Found: 283.0907.

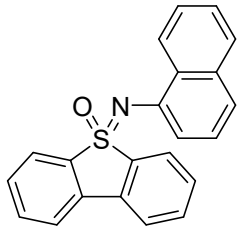


methyl(naphthalen-1-ylimino)(thiophen-2-yl)-λ⁶-sulfanone (4h) Light brown solid

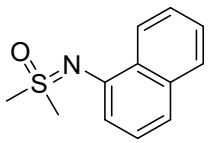
(50 mg, 87% yield), (hexane/EA = 2:1 as eluent); mp 123-126 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.77 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.63 – 7.58 (m, 2H), 7.49 (qd, *J* = 7.1, 1.5 Hz, 2H), 7.46 – 7.41 (m, 1H), 7.26 – 7.21 (m, 2H), 7.03 (dd, *J* = 5.0, 3.8 Hz, 1H), 3.49 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.2, 140.8, 134.6, 134.2, 134.1, 130.2, 128.2, 127.8, 126.1, 126.0, 125.2, 124.1, 122.2, 117.0, 47.8. HRMS (ESI) calcd for $C_{15}H_{14}NOS_2$ ([M+H]$^+$): 288.0511, Found: 288.0512.



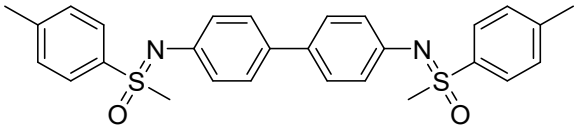
(naphthalen-1-ylimino)diphenyl-λ^6-sulfanone (4i)[7] White solid (62 mg, 90% yield), (hexane/EA = 3:1 as eluent); mp 169-174 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.74 (d, *J* = 7.8 Hz, 1H), 8.15 – 8.10 (m, 4H), 7.78 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.57 (ddd, *J* = 8.3, 6.8, 1.4 Hz, 1H), 7.54 – 7.44 (m, 7H), 7.39 (dd, *J* = 7.1, 2.0 Hz, 1H), 7.21 – 7.14 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.2, 141.1, 134.72, 132.8, 130.5, 129.4, 128.5, 127.9, 126.2, 126.0, 125.2, 124.1, 121.6, 117.1. LRMS (EI): m/z calcd for $C_{22}H_{17}NOS$ [M]$^+$, 343.10; found, 343.05.



5-(naphthalen-1-ylimino)-5*H*-5λ^4-dibenzo[*b*,*d*]thiophene 5-oxide (4j)[8]Orange soli d (53 mg, 78% yield), (hexane/EA = 3:1 as eluent); mp 175-179 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.4 Hz, 1H), 7.86 (d, *J* = 7.7 Hz, 2H), 7.8 1 (d, *J* = 7.5 Hz, 2H), 7.76 (d, *J* = 8.1 Hz, 1H), 7.62 (td, *J* = 7.6, 1.1 Hz, 2H), 7.58 – 7.53 (m, 2H), 7.44 (td, *J* = 7.6, 1.0 Hz, 2H), 7.39 (ddd, *J* = 8.2, 6.9, 1.3 Hz, 2H), 7.29 (ddd, *J* = 8.2, 6.7, 1.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.4, 139.2, 134.7, 133.2, 132.0, 130.5, 130.3, 127.7, 126.1, 126.0, 125.2, 124.5, 123.0, 122.6, 121.7, 118.7. LRMS (EI): m/z calcd for $C_{22}H_{15}NOS$ [M]$^+$, 341.09; found, 341.05.



dimethyl(naphthalen-1-ylimino)-λ^6-sulfanone (4k) White solid (20 mg, 47% yield), (hexane/EA = 3:1 as eluent); mp 114-117 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 – 8.26 (m, 1H), 7.82 – 7.76 (m, 1H), 7.51 (d, *J* = 8.1 Hz, 1H), 7.49 – 7.42 (m, 2H), 7.35 (t, *J* = 7.7 Hz, 1H), 7.29 (dd, *J* = 7.4, 1.3 Hz, 1H), 3.23 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.6, 134.8, 130.3, 127.9, 126.2, 126.1, 125.2, 124.1, 122.3, 117.3, 42.2. HRMS (ESI) calcd for $C_{12}H_{13}NOSNa$ ([M+Na]$^+$): 242.0610, Found: 242.0611.



([1,1'-biphenyl]-4,4'-diylbis(azanylylidene))bis(methyl(*p*-tolyl)-λ^6-sulfanone) (5a) Light yellow solid (67 mg, 69% yield), (EA as eluent); mp 83-87 ^{o}C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 – 7.80 (m, 4H), 7.29 (d, *J* = 8.1 Hz, 4H), 7.27 – 7.24 (m, 4H), 7.02 – 6.96 (m, 4H), 3.22 (s, 6H), 2.39 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.2, 144.0, 136.3, 134.1, 130.3, 128.8, 127.0, 123.5, 46.3, 21.6. HRMS (ESI) calcd for $C_{28}H_{29}N_2O_2S_2$ ($[M+H]^+$): 489.1665, Found: 489.1663.

8. References

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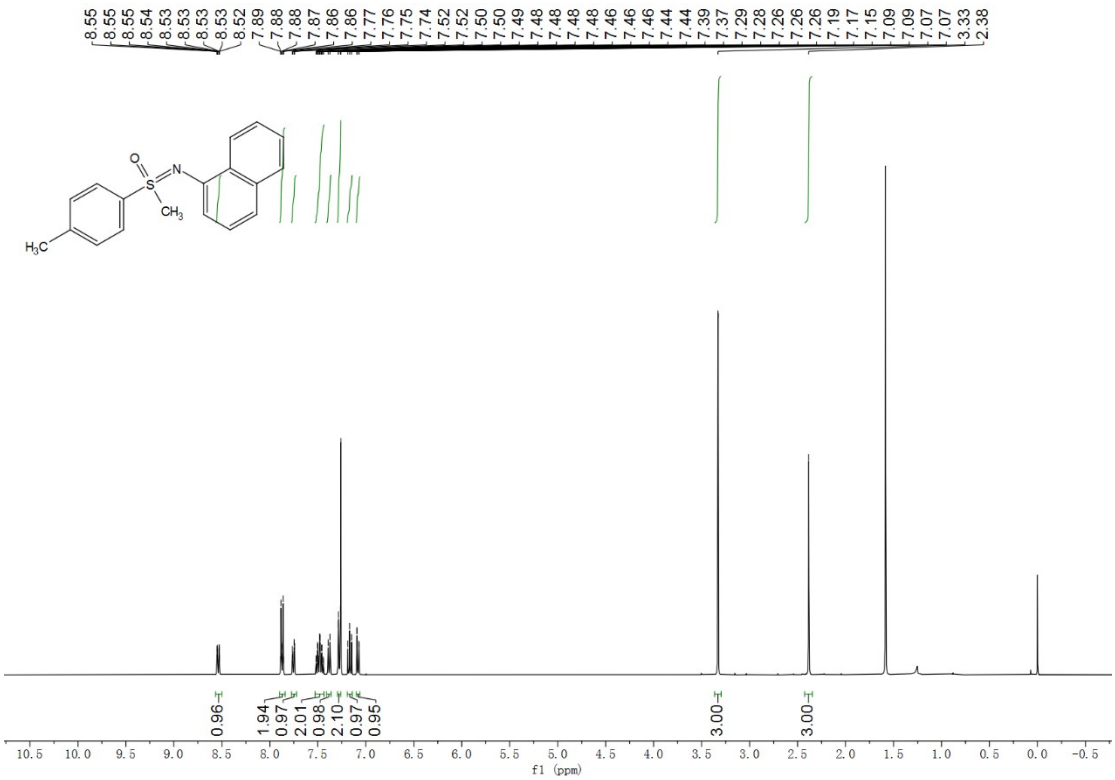
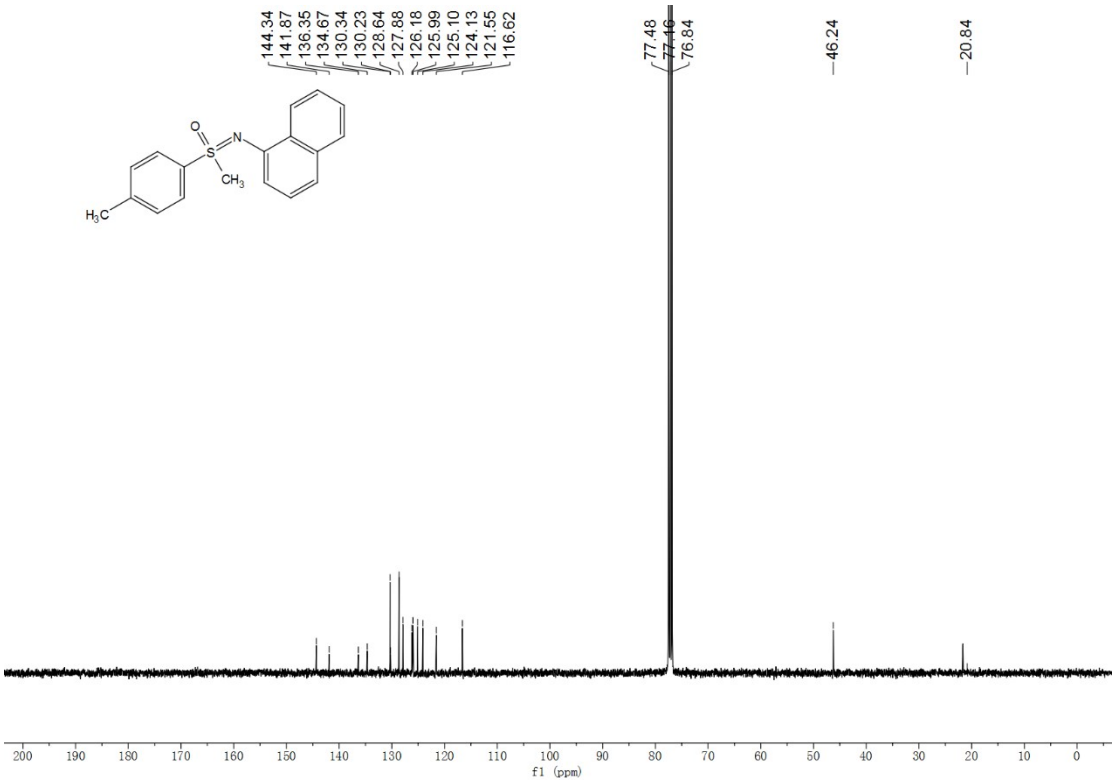
9. The NMR spectra of all products

methyl(naphthalen-1-ylimino)(*p*-tolyl)-λ^6-sulfanone (3a)

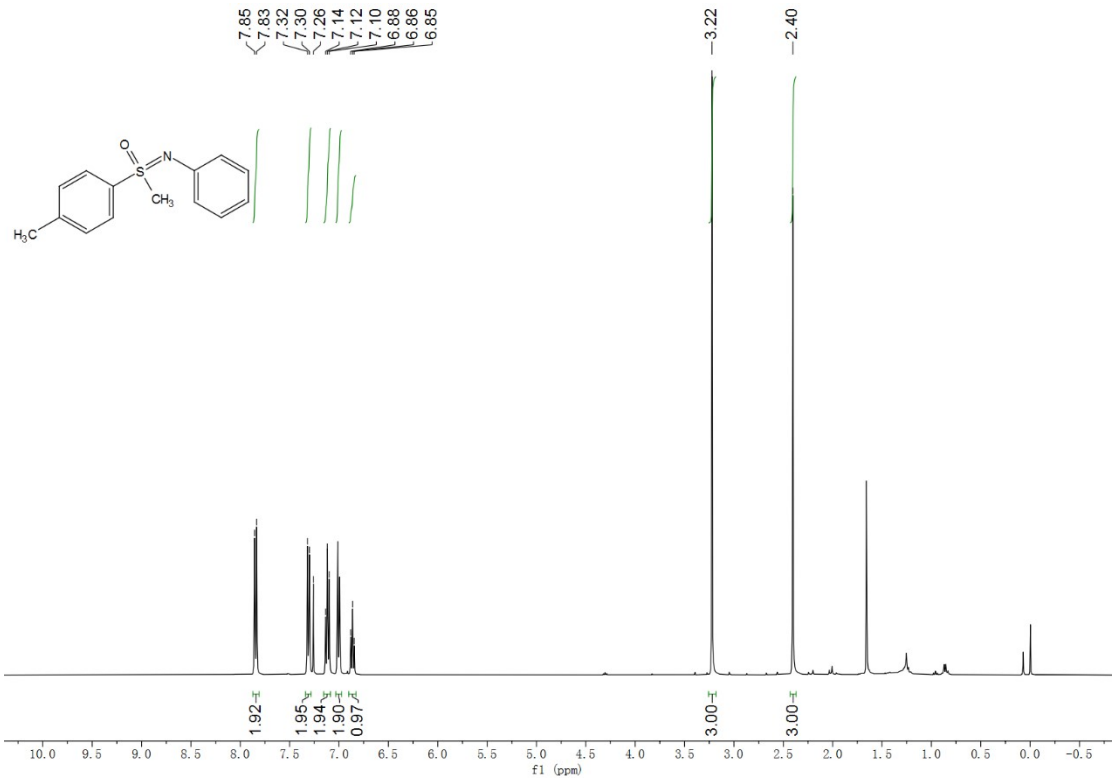


^{1}H NMR ($CDCl_3$, 400 MHz) of **3a**

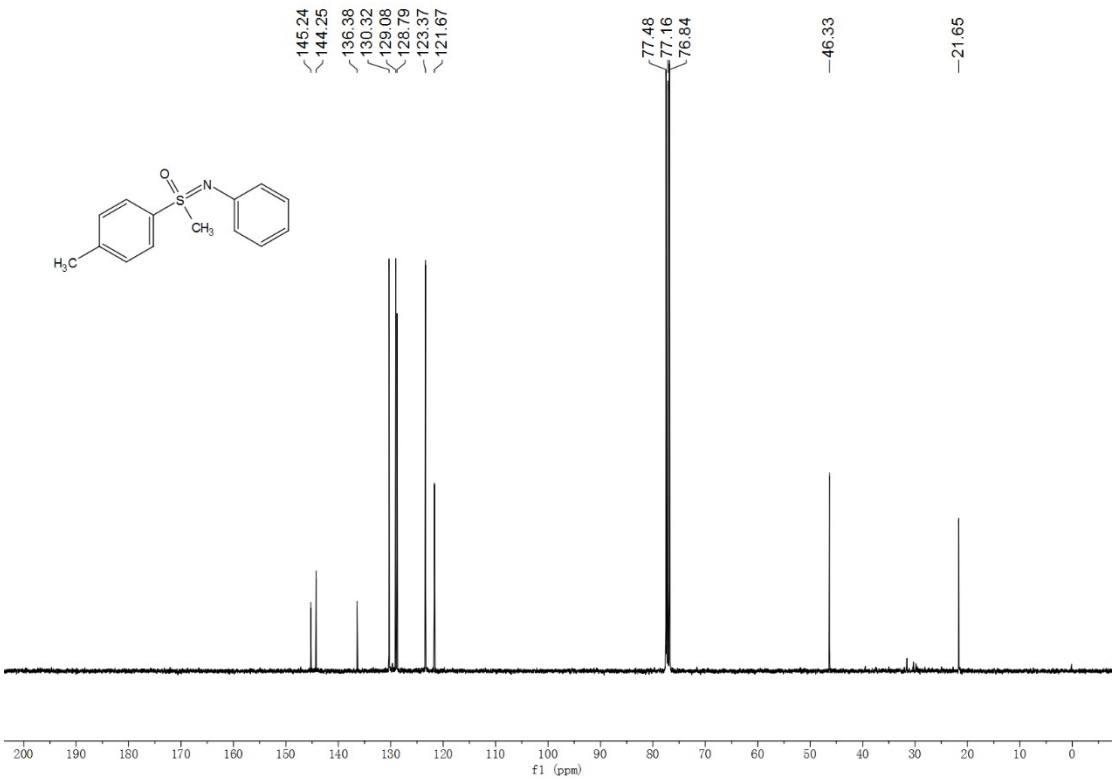


^{13}C NMR ($CDCl_3$, 100 MHz) of **3a**

methyl(phenylimino)(*p*-tolyl)-λ^{6}-sulfanone (**3b**)

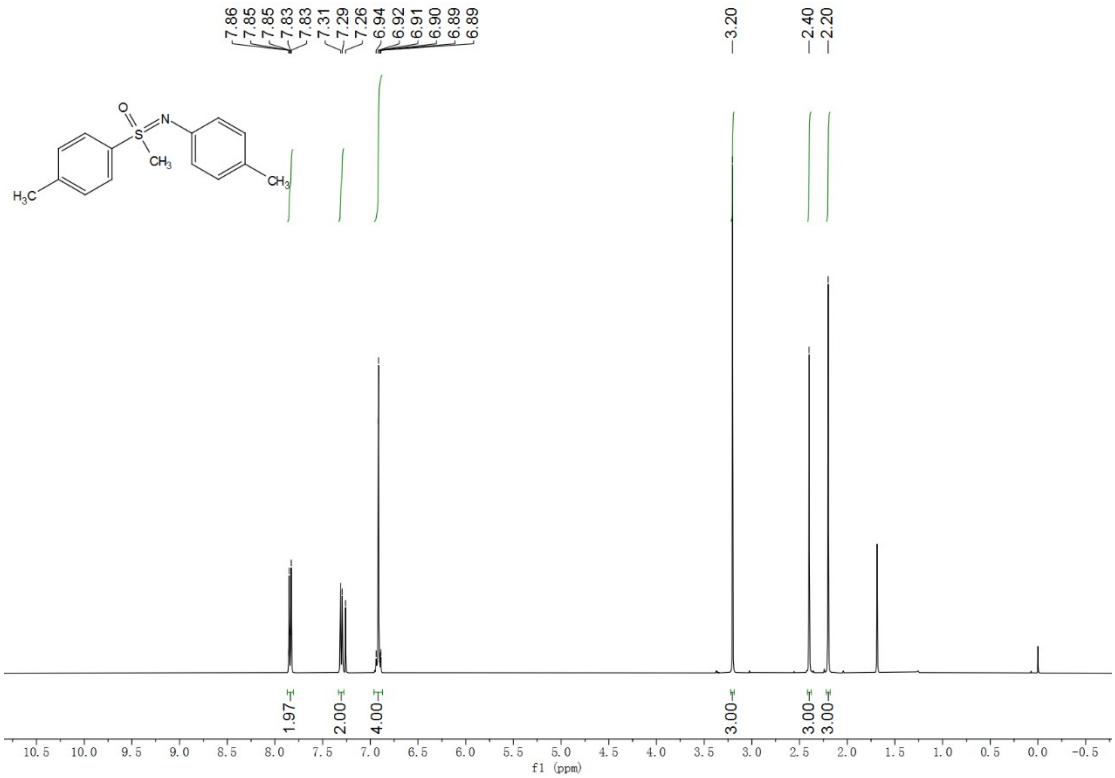


^{1}H NMR ($CDCl_3$, 400 MHz) of **3b**

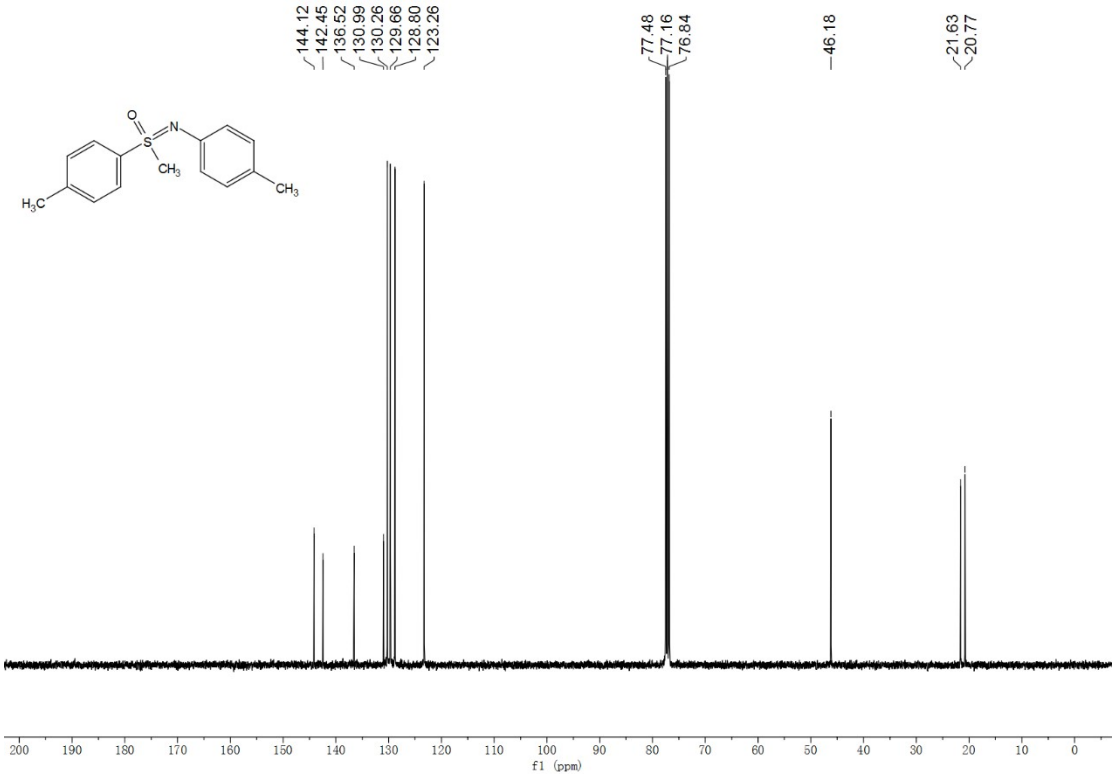


^{13}C NMR ($CDCl_3$, 100 MHz) of **3b**

methyl(*p*-tolyl)(*p*-tolylimino)-λ^6-sulfanone (3c)

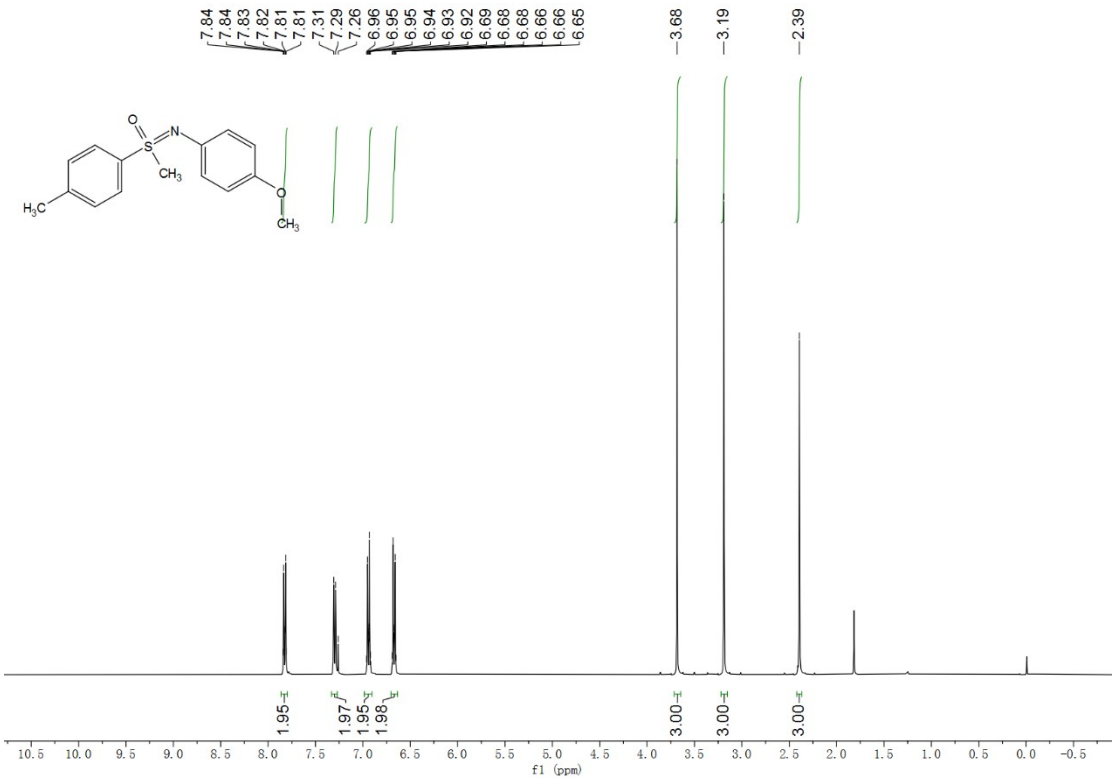


^{1}H NMR ($CDCl_3$, 400 MHz) of **3c**

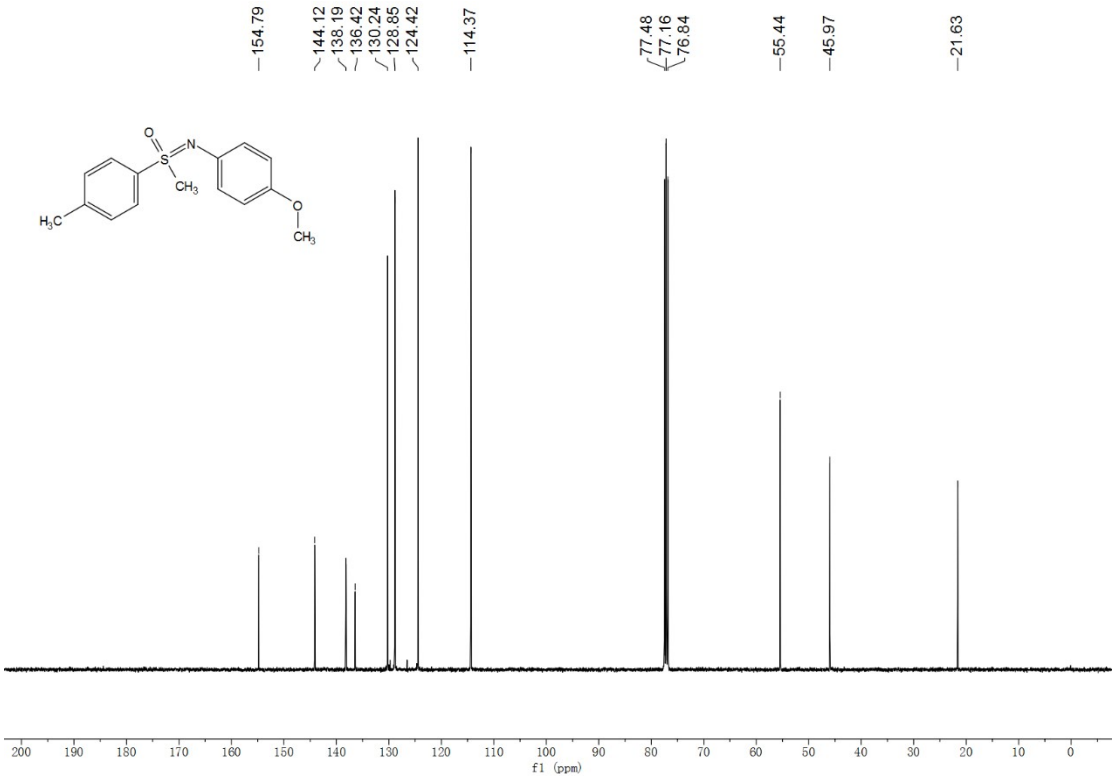


^{13}C NMR ($CDCl_3$, 100 MHz) of **3c**

((4-methoxyphenyl)imino)(methyl)(*p*-tolyl)-λ^{6}-sulfanone (3d)

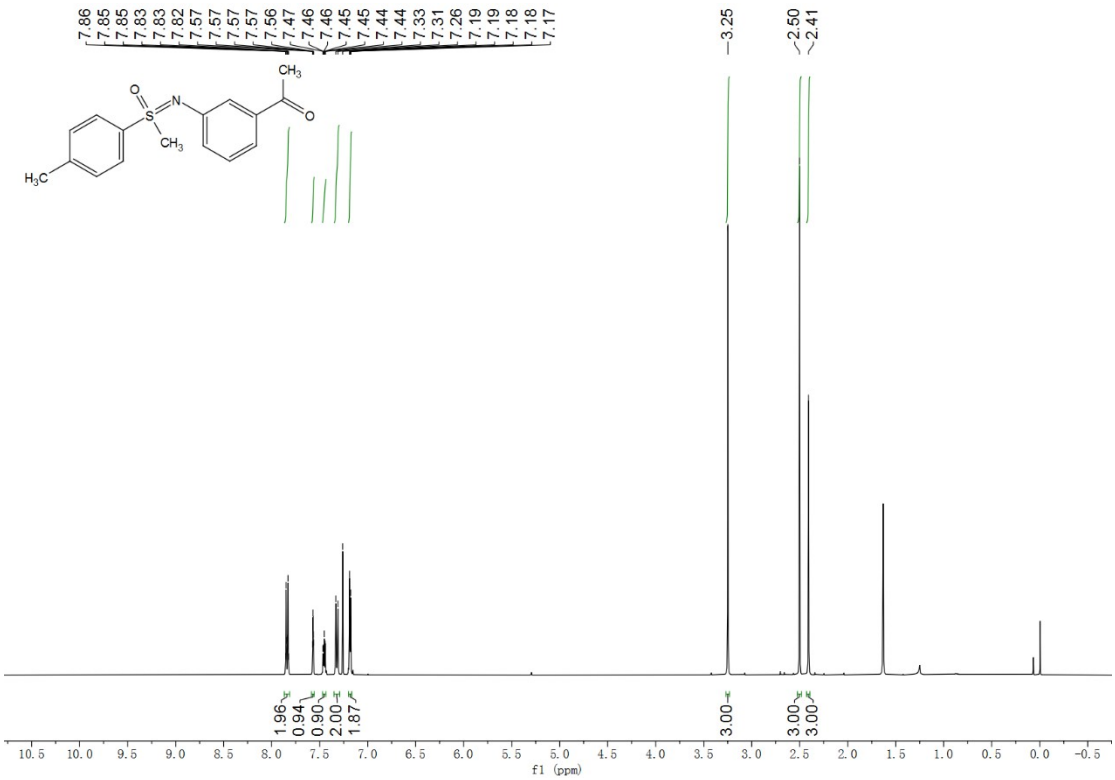


^{1}H NMR ($CDCl_3$, 400 MHz) of **3d**

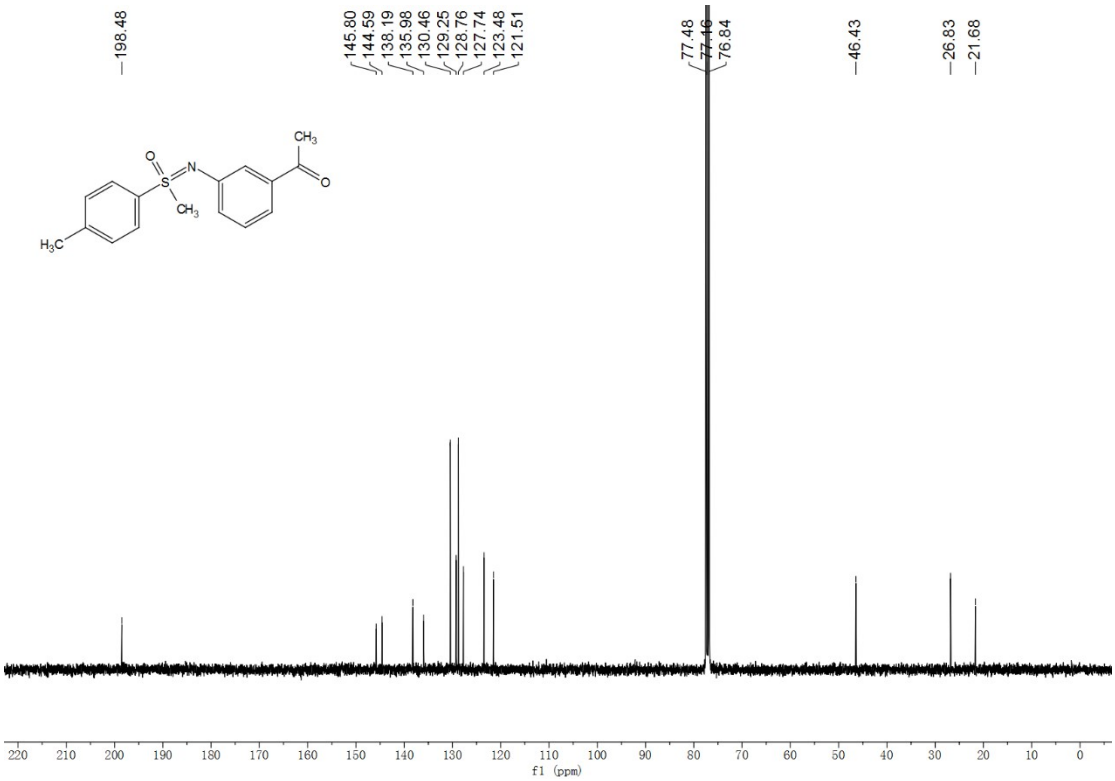


^{13}C NMR ($CDCl_3$, 100 MHz) of **3d**

((3-acetylphenyl)imino)(methyl)(*p*-tolyl)-λ^6-sulfanone (3e)

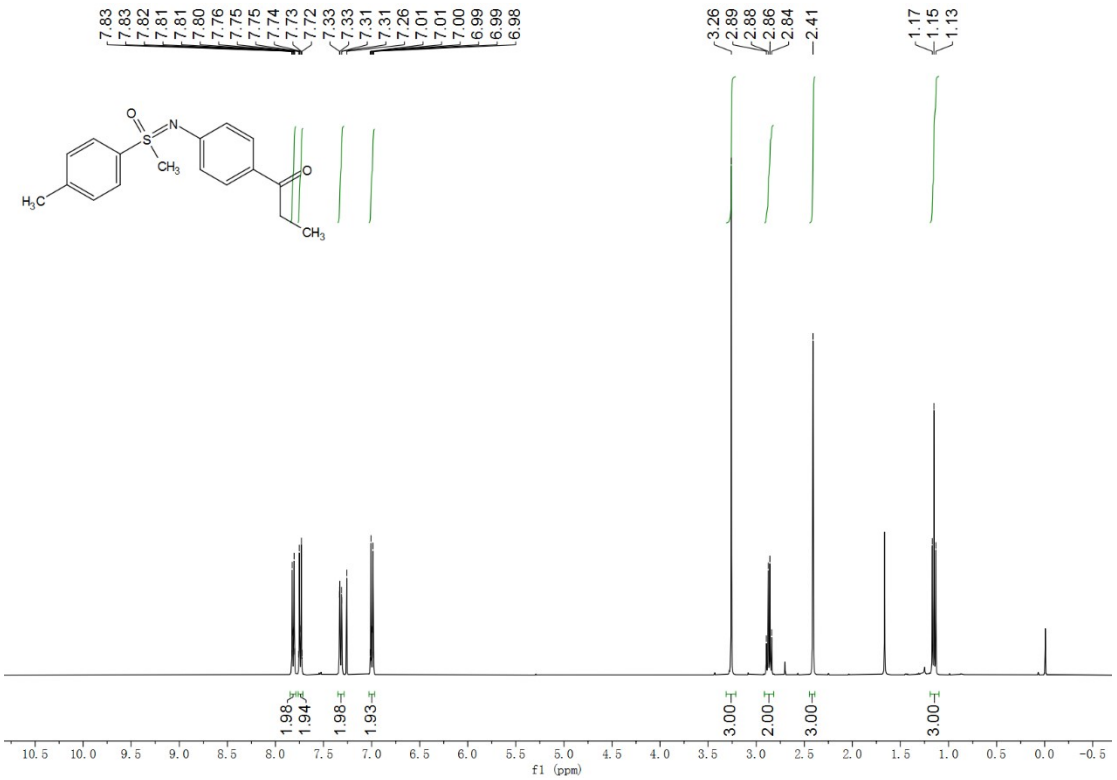


^{1}H NMR ($CDCl_3$, 400 MHz) of **3e**

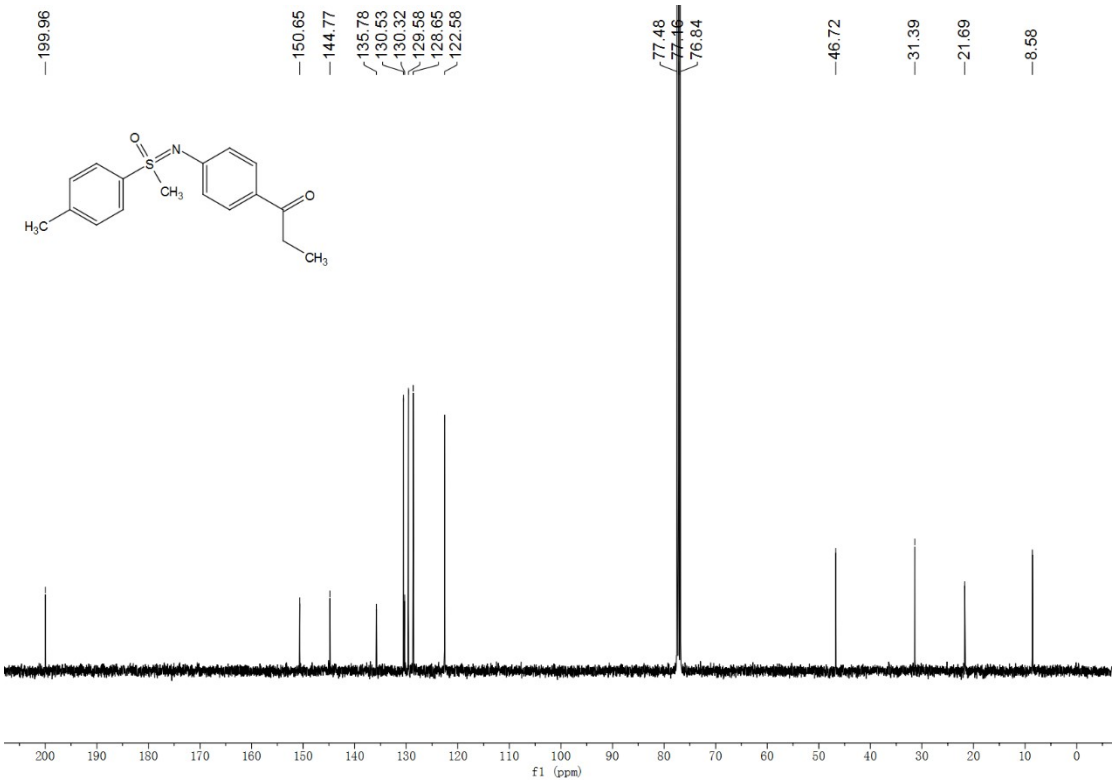


^{13}C NMR ($CDCl_3$, 100 MHz) of **3e**

methyl((4-propionylphenyl)imino)(*p*-tolyl)-λ^6-sulfanone (3f)

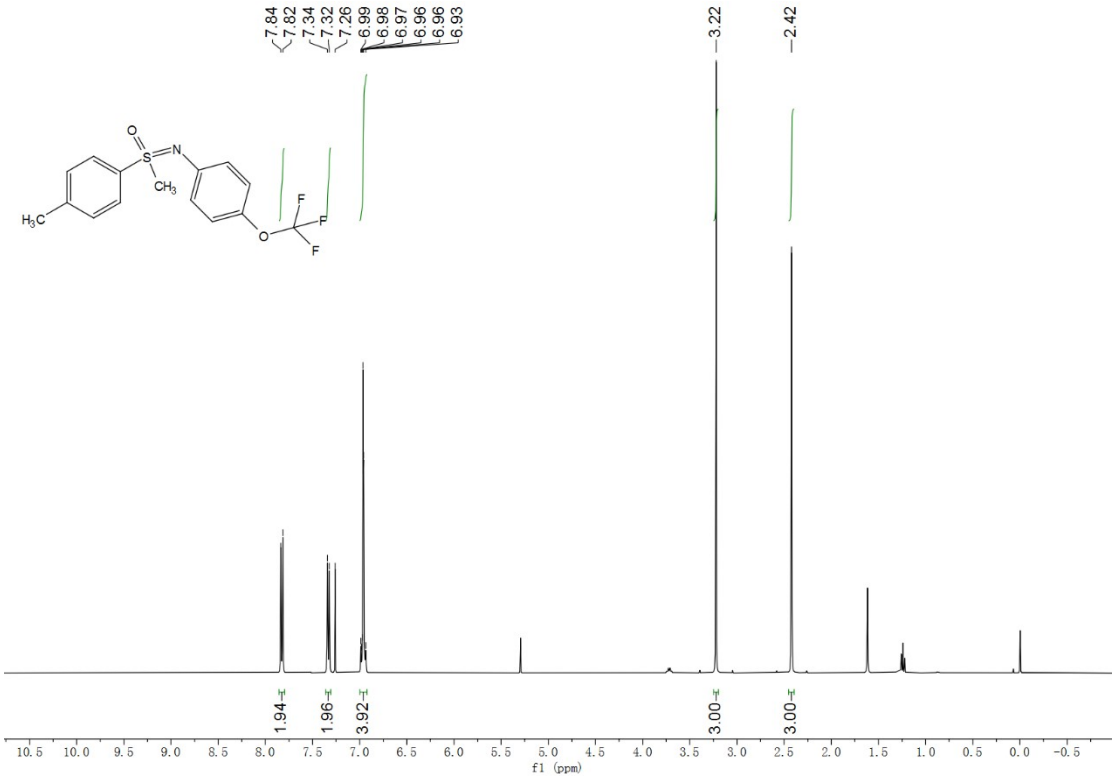


^{1}H NMR ($CDCl_3$, 400 MHz) of **3f**

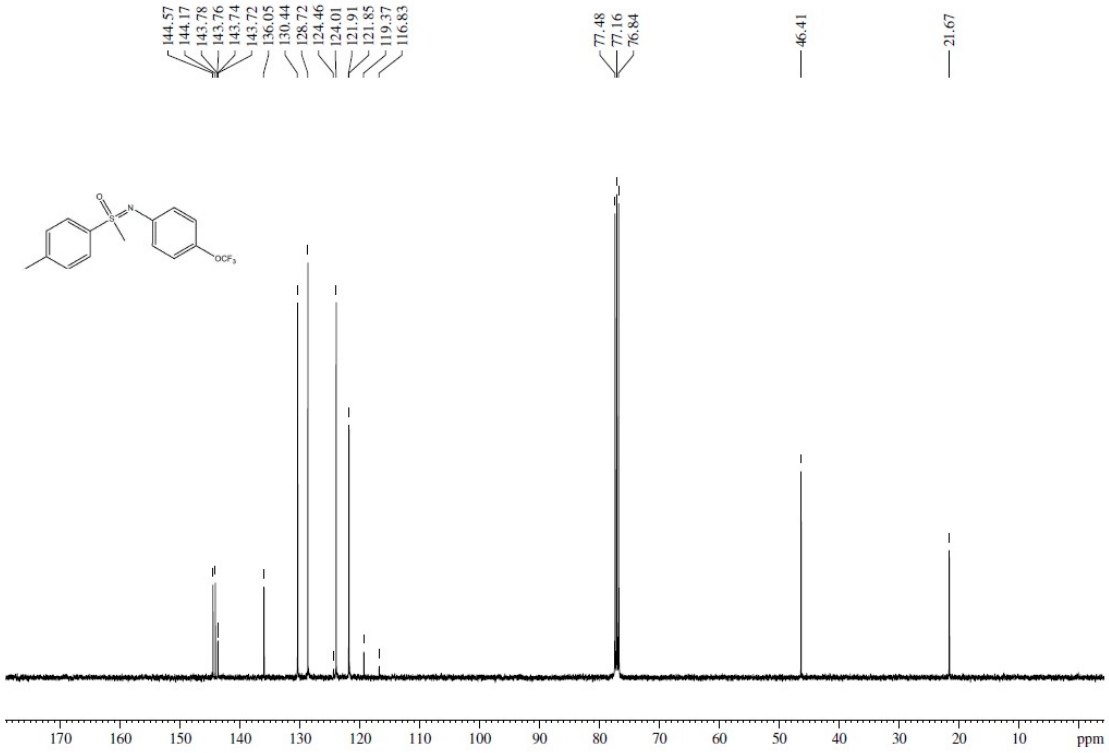


^{13}C NMR ($CDCl_3$, 100MHz) of **3f**

methyl(*p*-tolyl)((4-(trifluoromethoxy)phenyl)imino)-λ^{6}-sulfanone (3g)

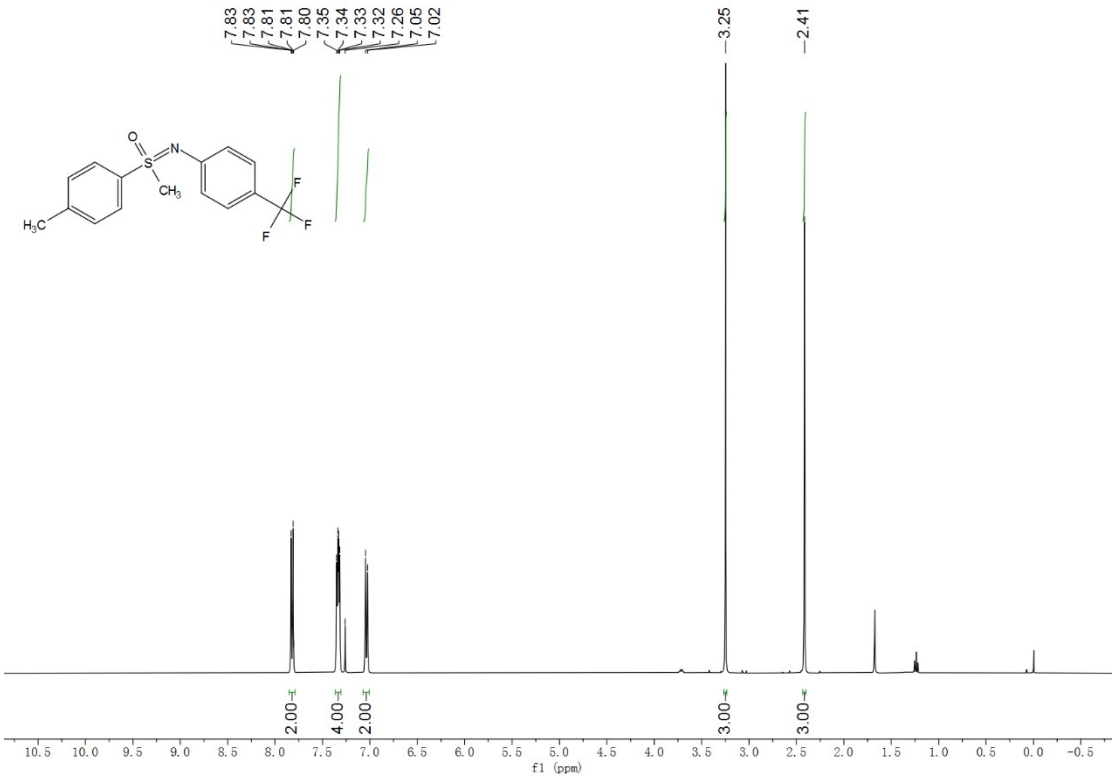


^{1}H NMR ($CDCl_3$, 400 MHz) of **3g**

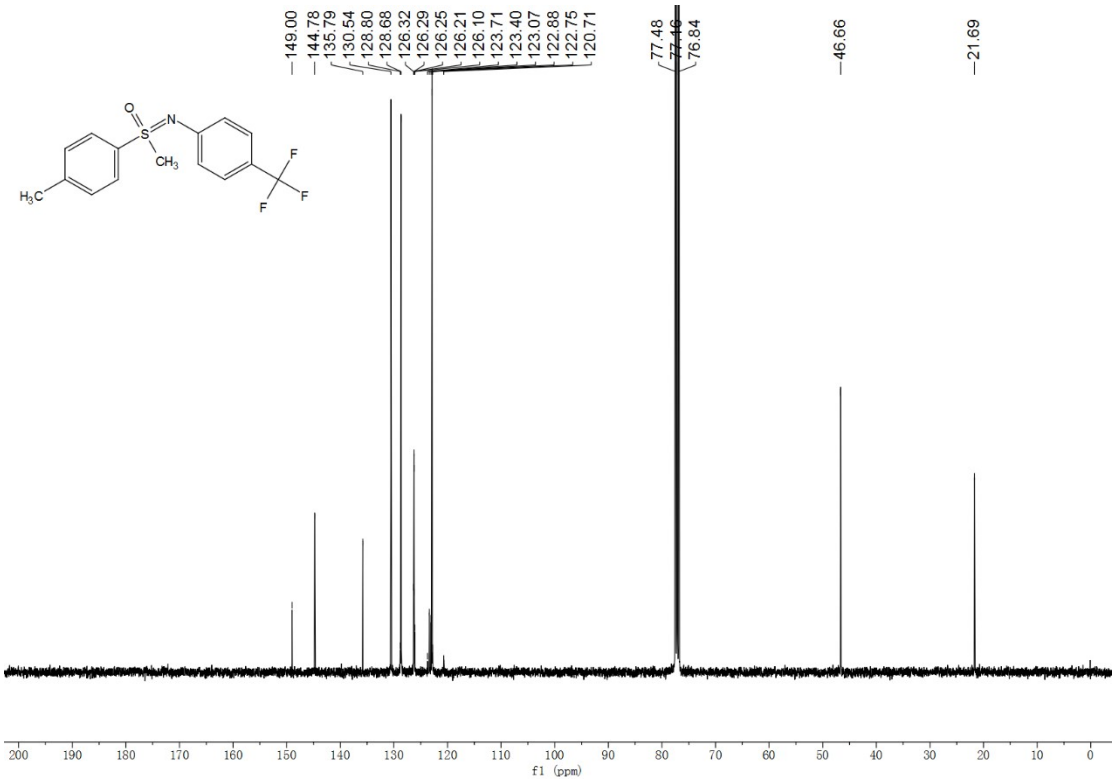


^{13}C NMR ($CDCl_3$, 100 MHz) of **3g**

methyl(*p*-tolyl)((4-(trifluoromethyl)phenyl)imino)-λ^6-sulfanone (3h)

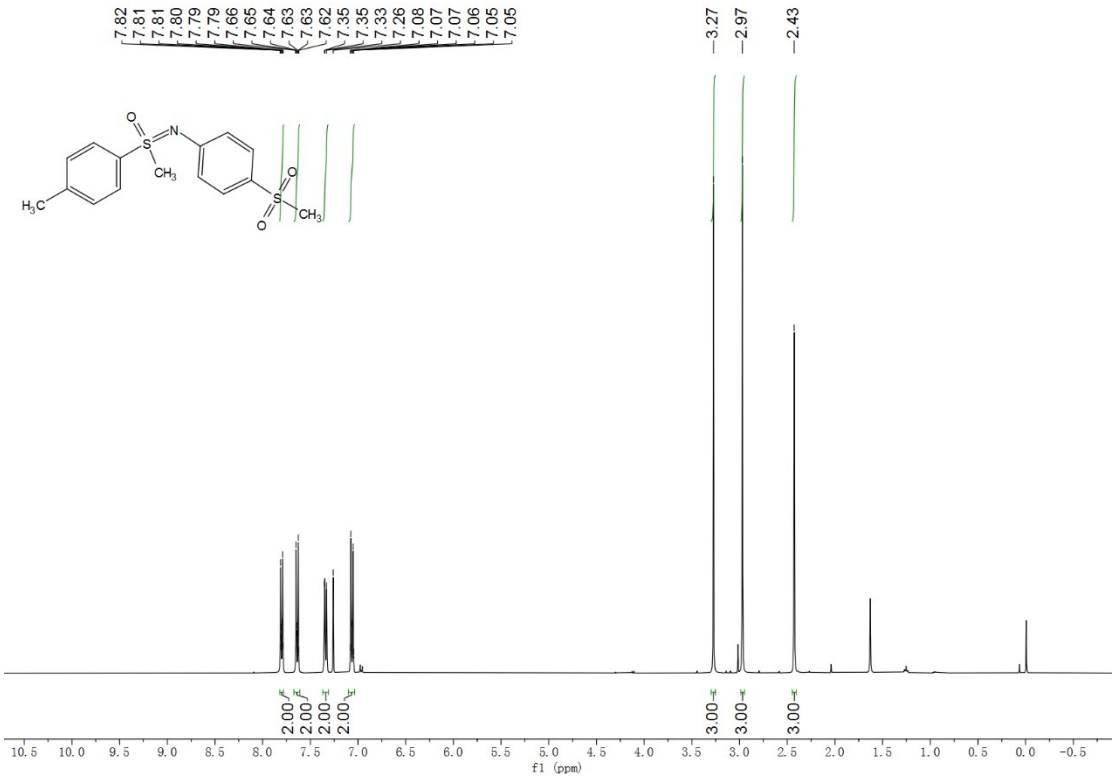


^{1}H NMR ($CDCl_3$, 400 MHz) of **3h**

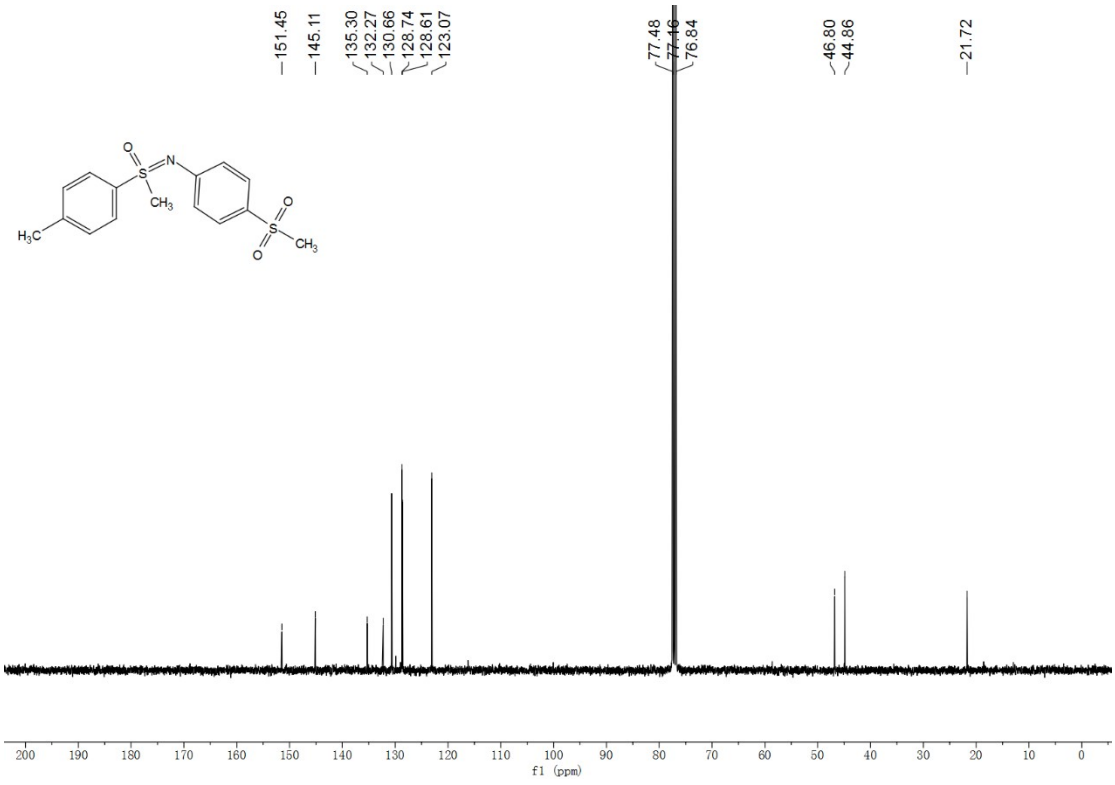


^{13}C NMR ($CDCl_3$, 100 MHz) of **3h**

methyl((4-(methylsulfonyl)phenyl)imino)(*p*-tolyl)-λ^6-sulfanone (3i)

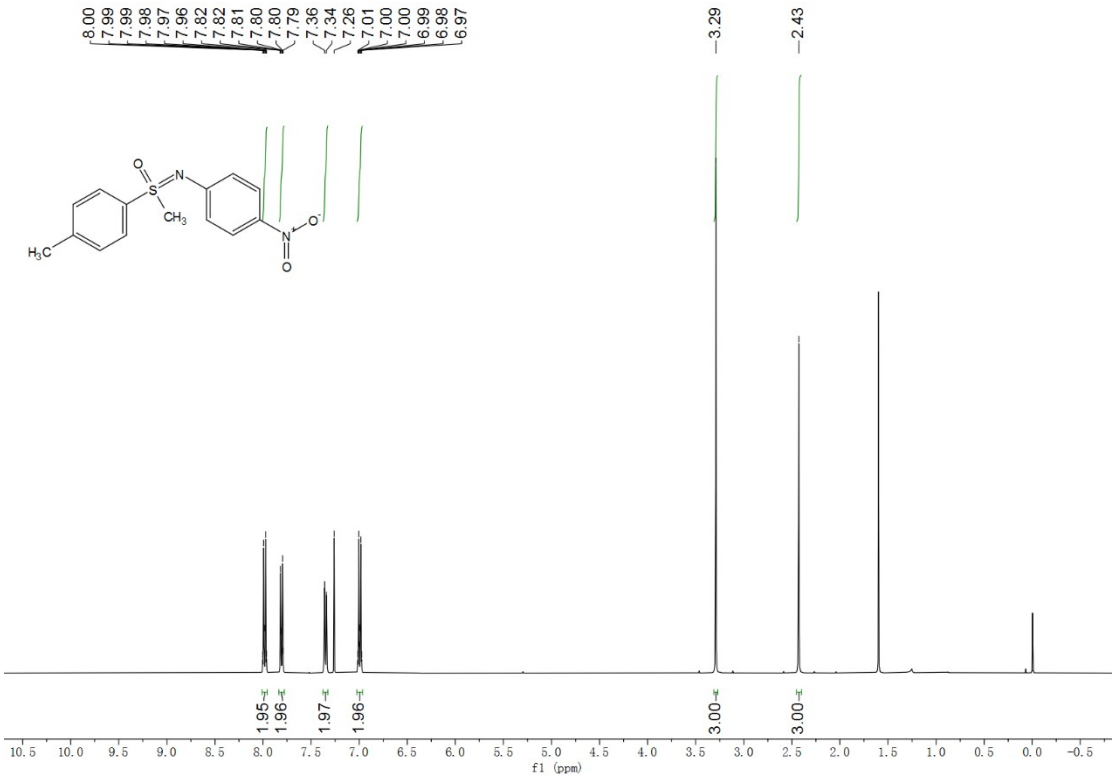


^{1}H NMR ($CDCl_3$, 400 MHz) of **3i**

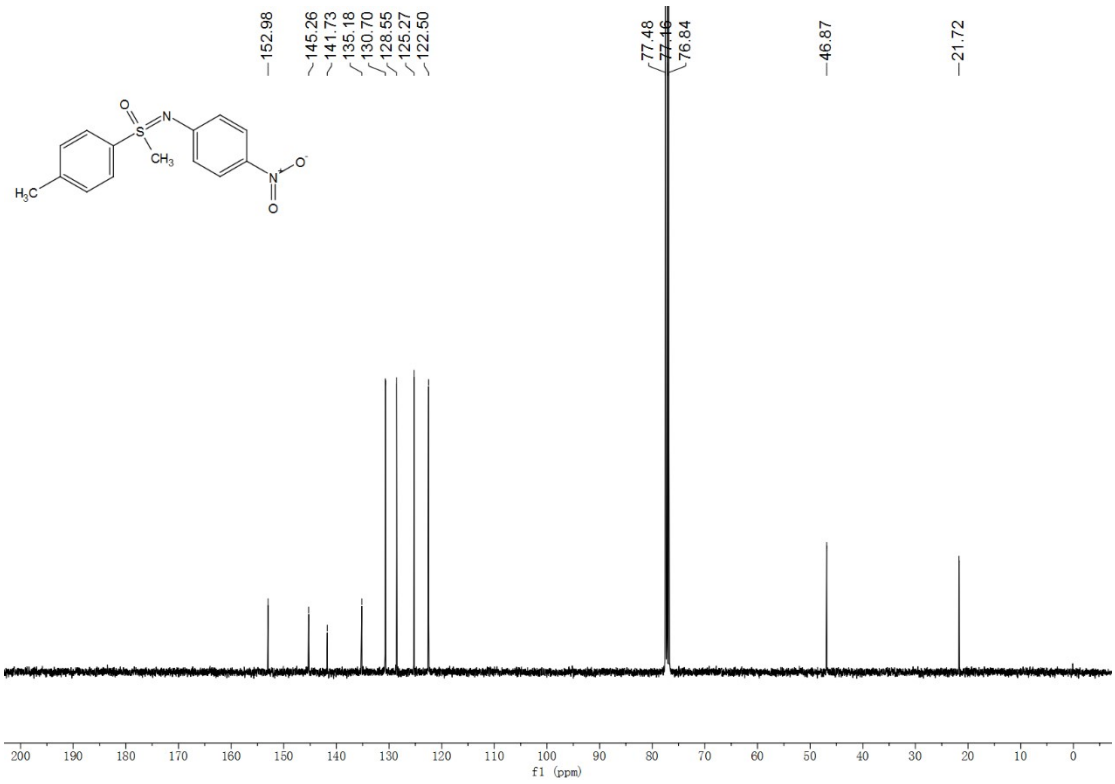


^{13}C NMR ($CDCl_3$, 100 MHz) of **3i**

methyl((4-nitrophenyl)imino)(*p*-tolyl)-λ^6-sulfanone (3j)

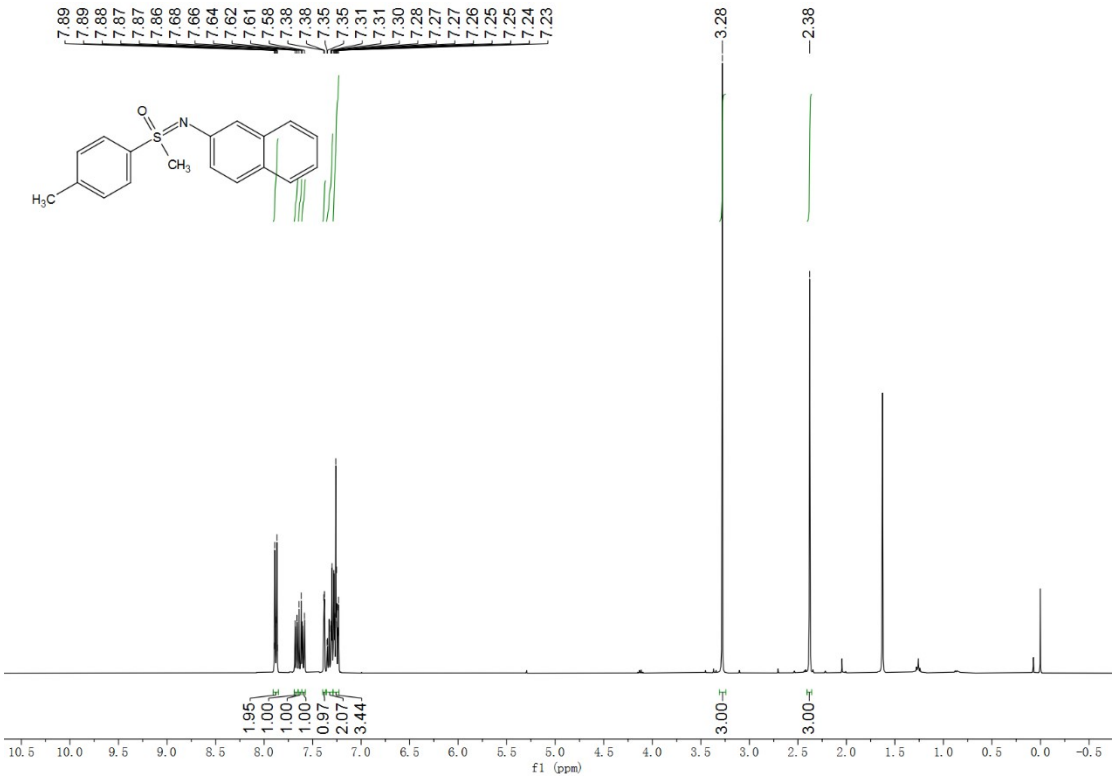


^{1}H NMR ($CDCl_3$, 400 MHz) of **3j**

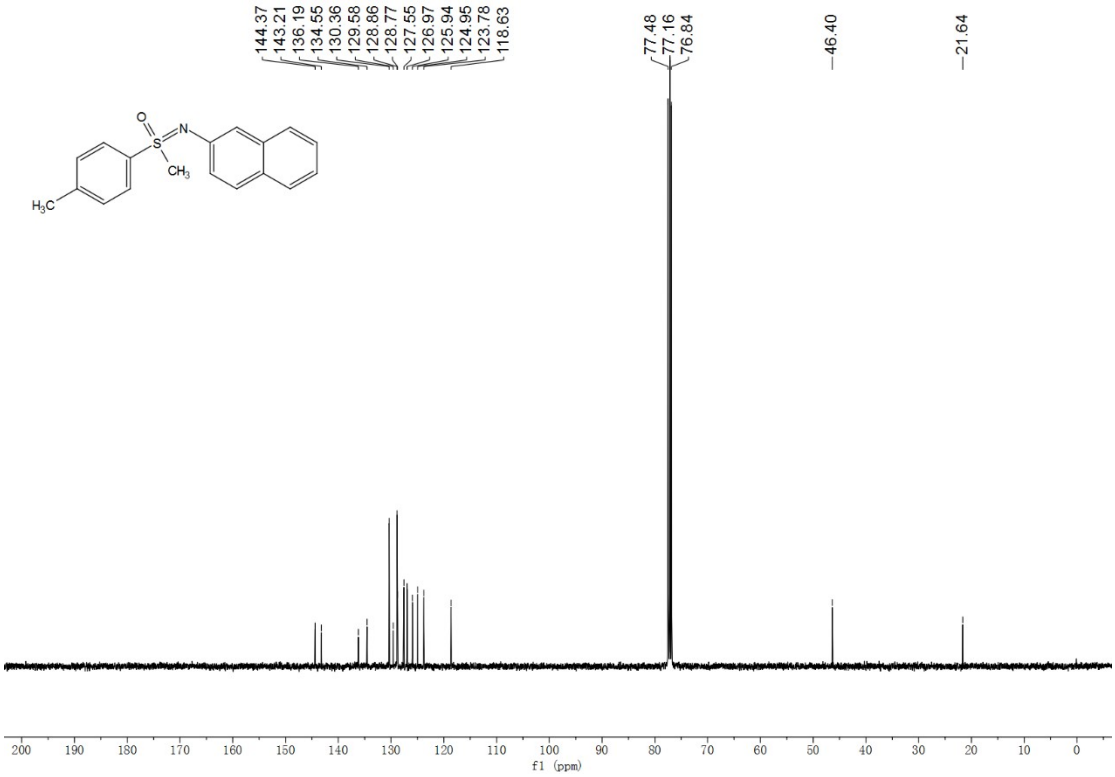


^{13}C NMR ($CDCl_3$, 100 MHz) of **3j**

methyl(naphthalen-2-ylimino)(*p*-tolyl)-λ^6-sulfanone (3k)

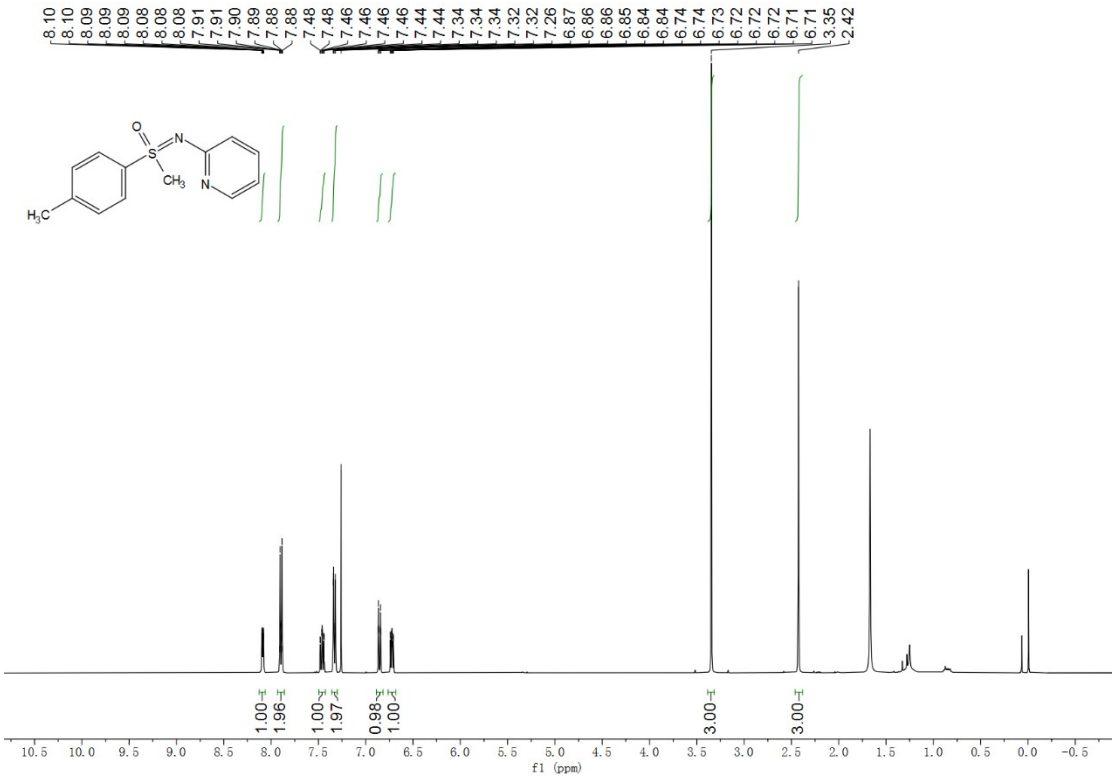


^{1}H NMR ($CDCl_3$, 400 MHz) of **3k**

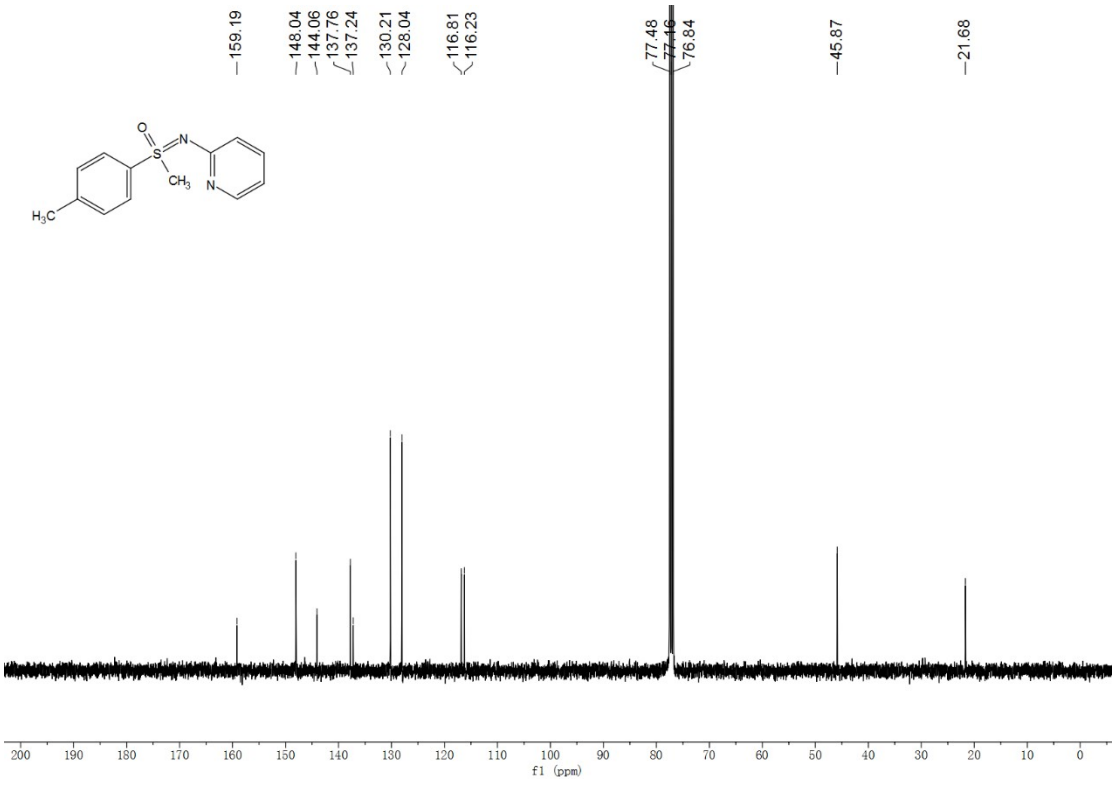


^{13}C NMR ($CDCl_3$, 100 MHz) of **3k**

methyl(pyridin-2-ylimino)(*p*-tolyl)-λ^6-sulfanone (3l)

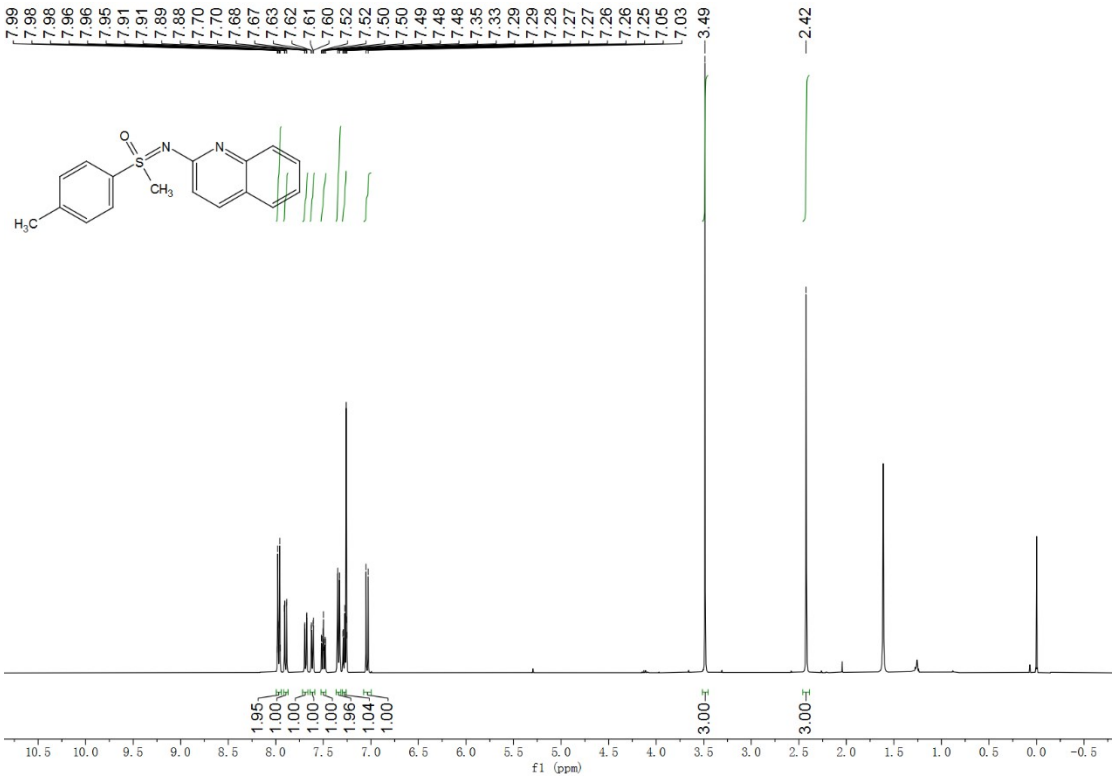


^{1}H NMR ($CDCl_3$, 400 MHz) of **3l**

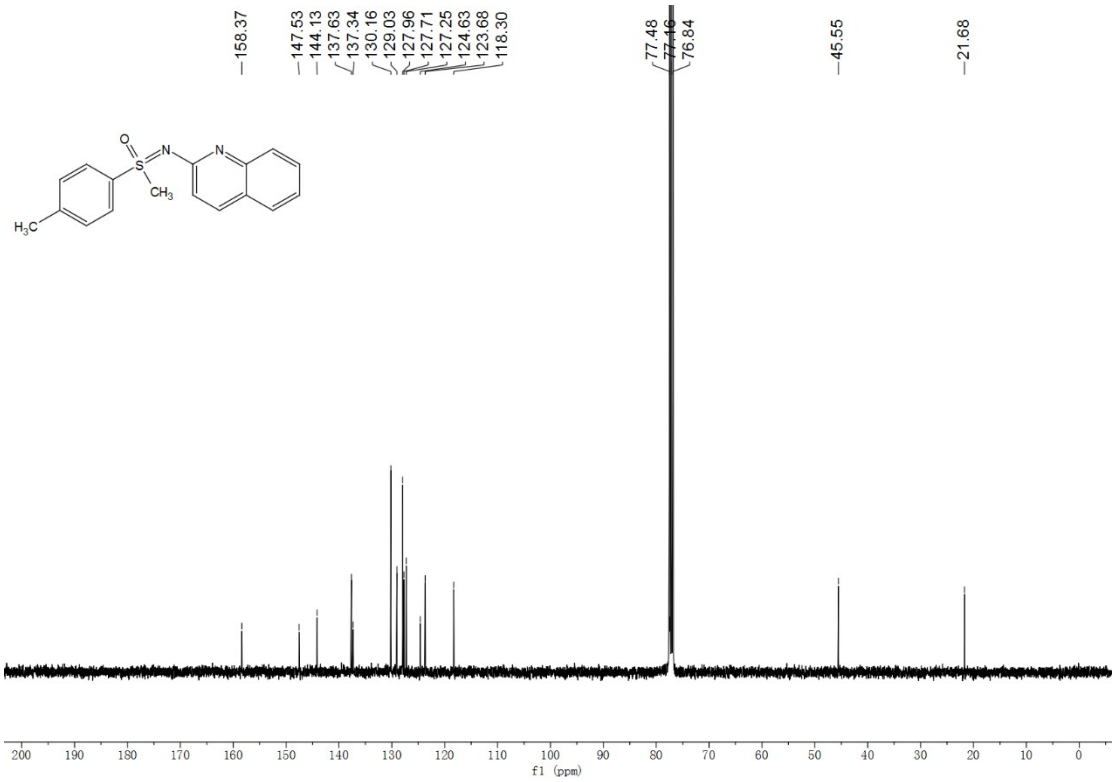


^{13}C NMR ($CDCl_3$, 100 MHz) of **3l**

methyl(quinolin-2-ylimino)(*p*-tolyl)-λ^6-sulfanone (3m)

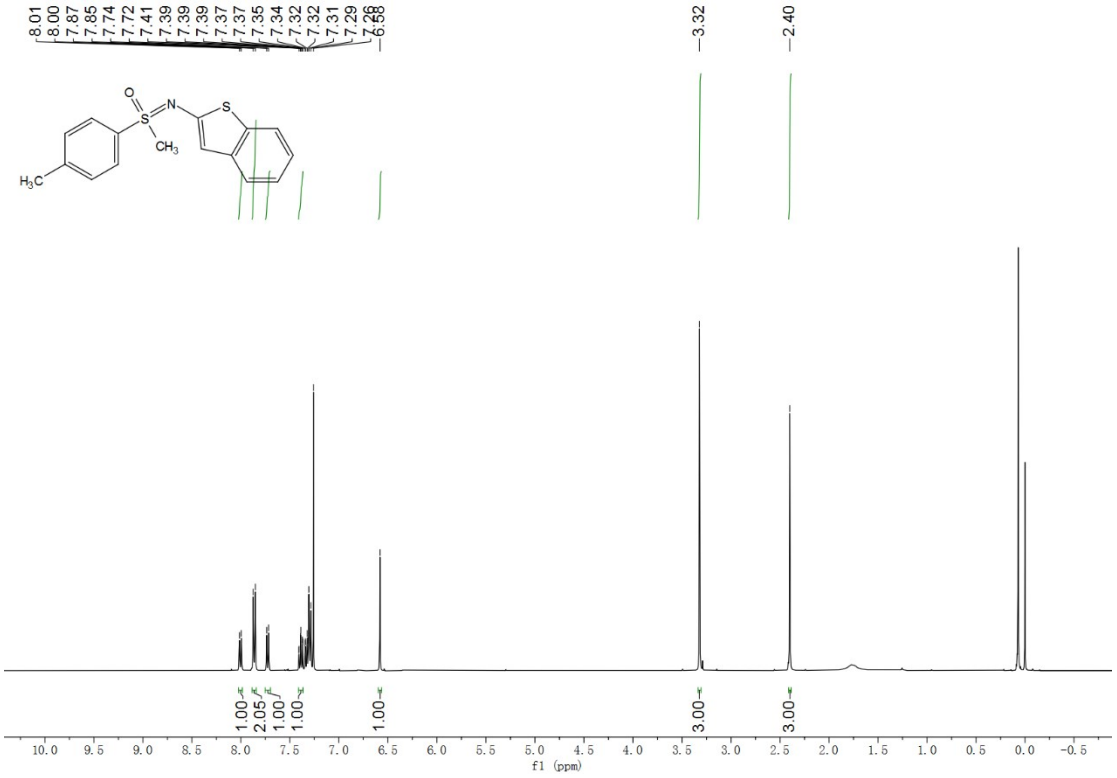


^{1}H NMR ($CDCl_3$, 400 MHz) of **3m**

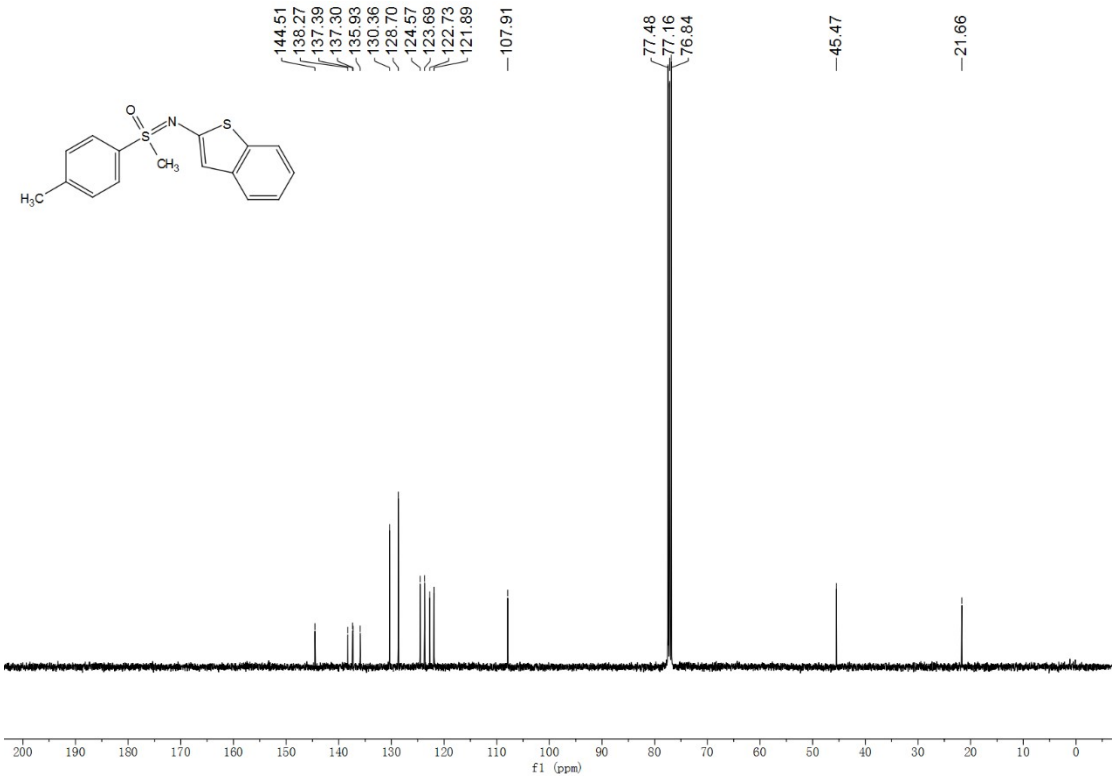


^{13}C NMR ($CDCl_3$, 100 MHz) of **3m**

(benzo[*b*]thiophen-2-ylimino)(methyl)(*p*-tolyl)-λ^6-sulfanone (3n)

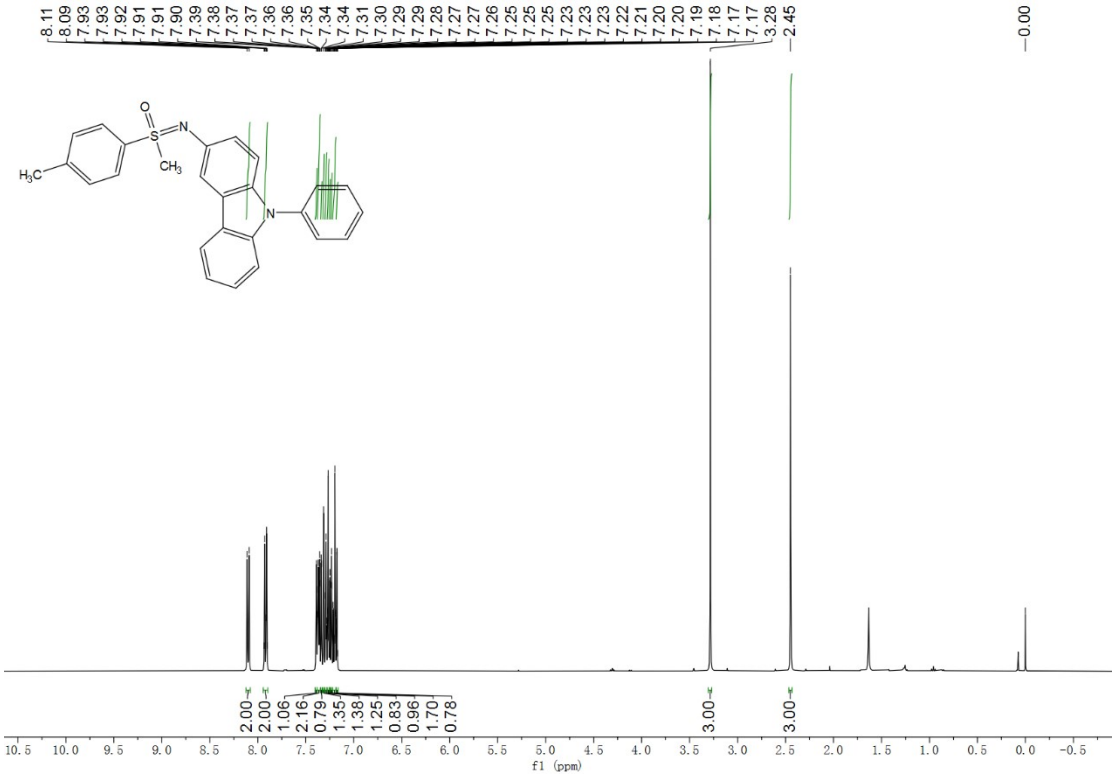


^{1}H NMR ($CDCl_3$, 400 MHz) of **3n**

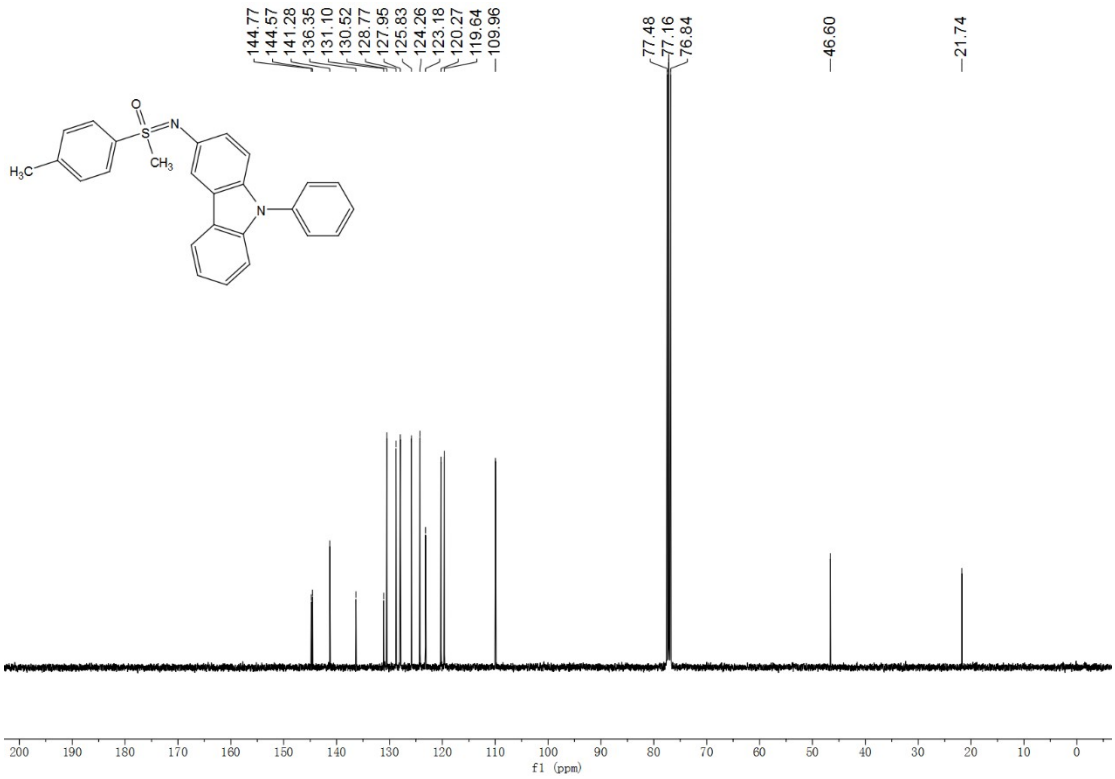


^{13}C NMR ($CDCl_3$, 100 MHz) of **3n**

methyl((9-phenyl-9*H*-carbazol-3-yl)imino)(*p*-tolyl)-λ^6-sulfanone (3o)

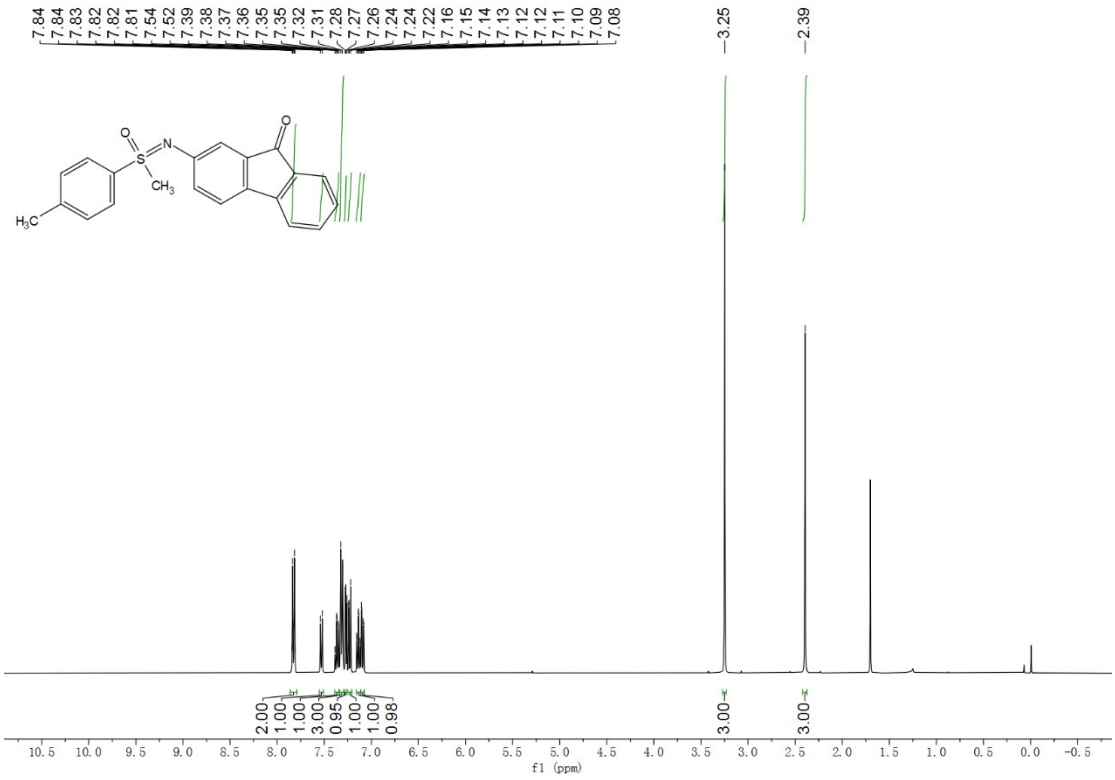


^{1}H NMR ($CDCl_3$, 400 MHz) of **3o**

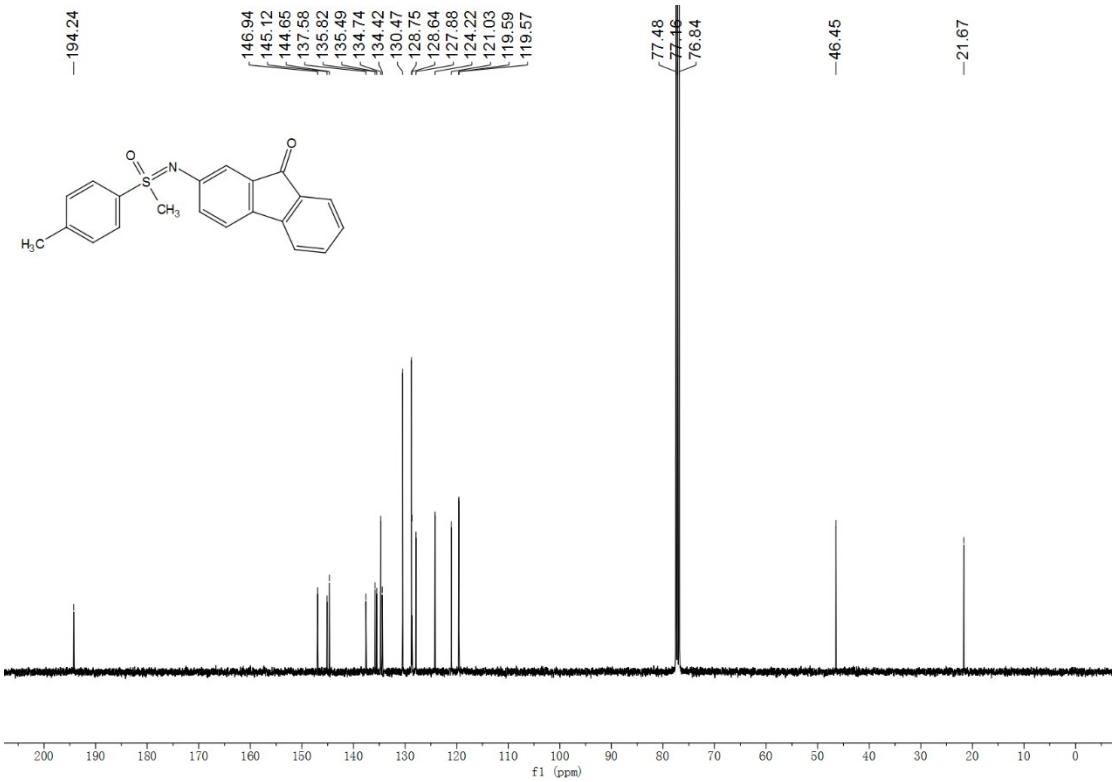


^{13}C NMR ($CDCl_3$, 100 MHz) of **3o**

methyl((9-oxo-9*H*-fluoren-2-yl)imino)(*p*-tolyl)-λ^6-sulfanone (3p)

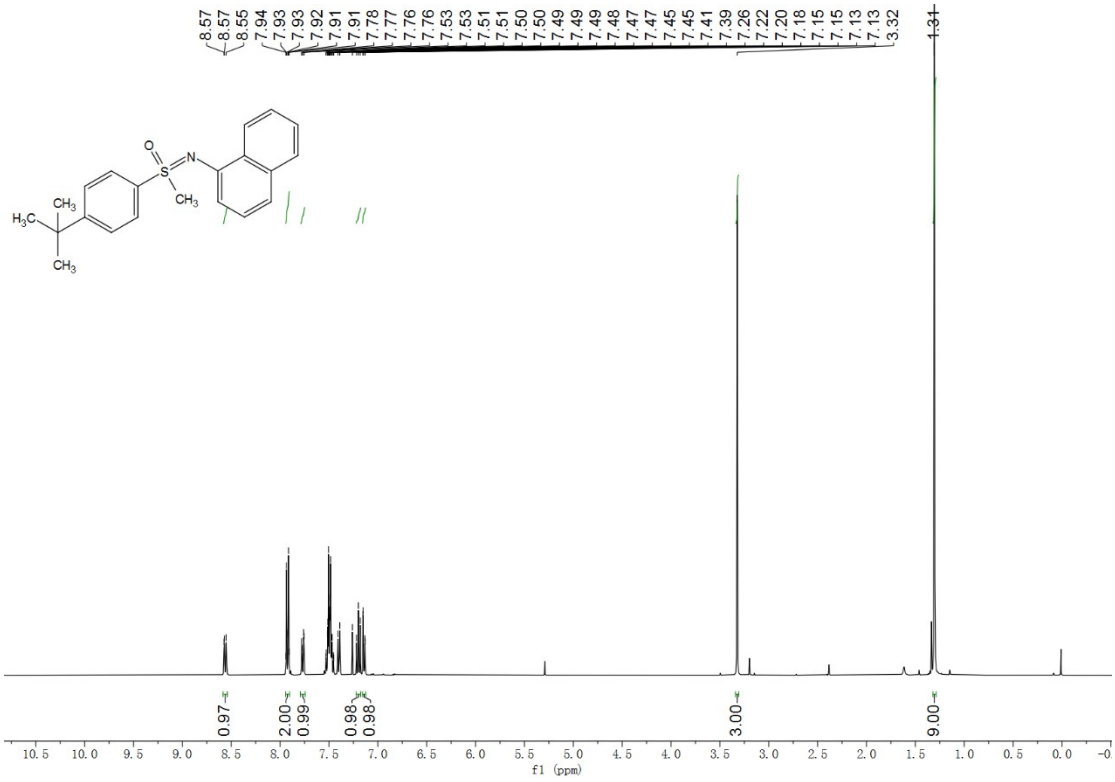


^{1}H NMR ($CDCl_3$, 400 MHz) of **3p**

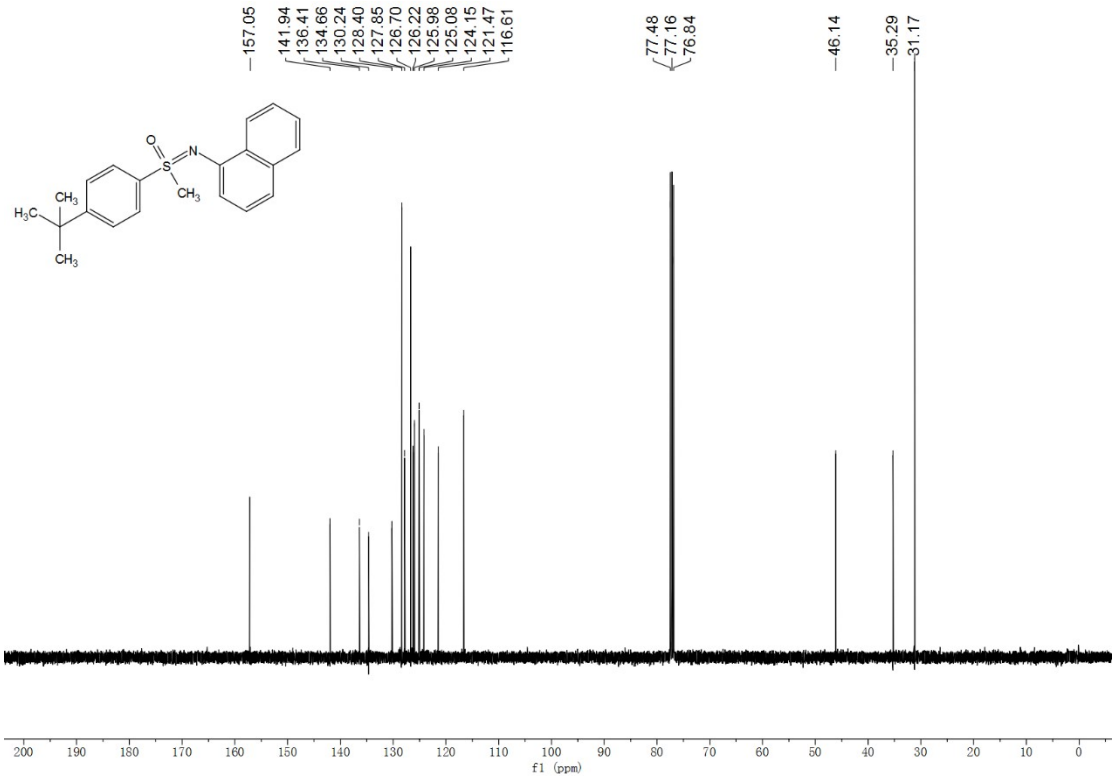


^{13}C NMR ($CDCl_3$, 100 MHz) of **3p**

(4-(*tert*-butyl)phenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4a)

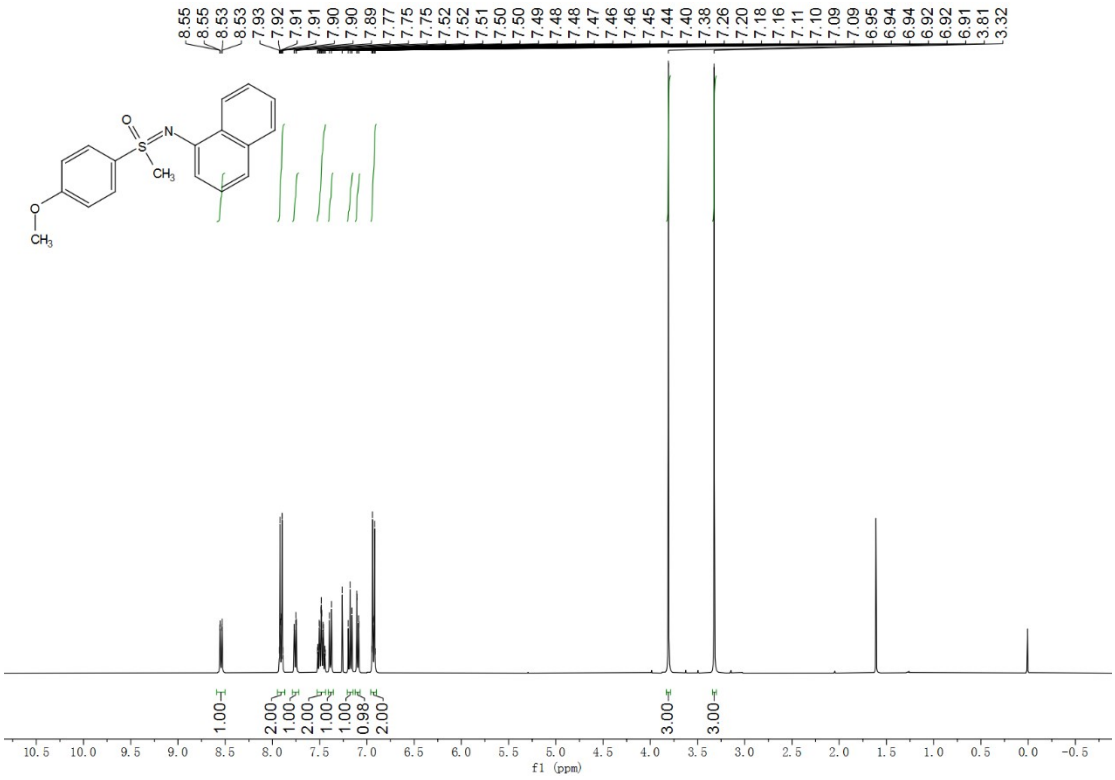


^{1}H NMR ($CDCl_3$, 400 MHz) of **4a**

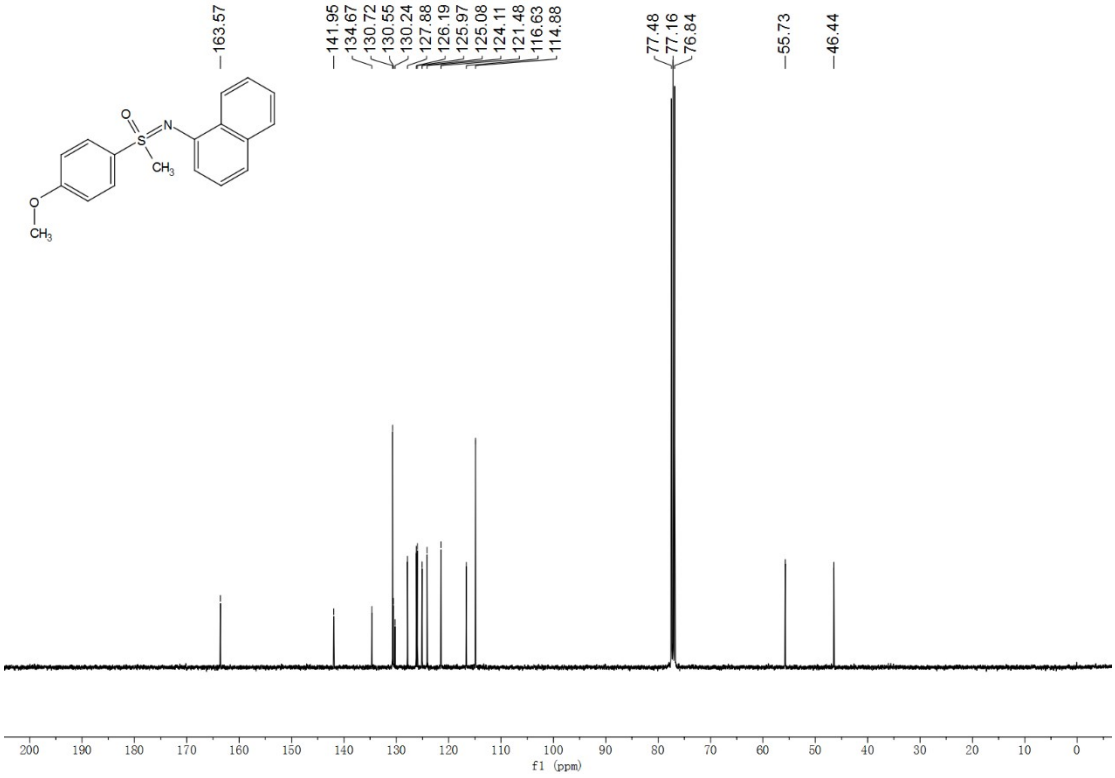


^{13}C NMR ($CDCl_3$, 100 MHz) of **4a**

(4-methoxyphenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4b)

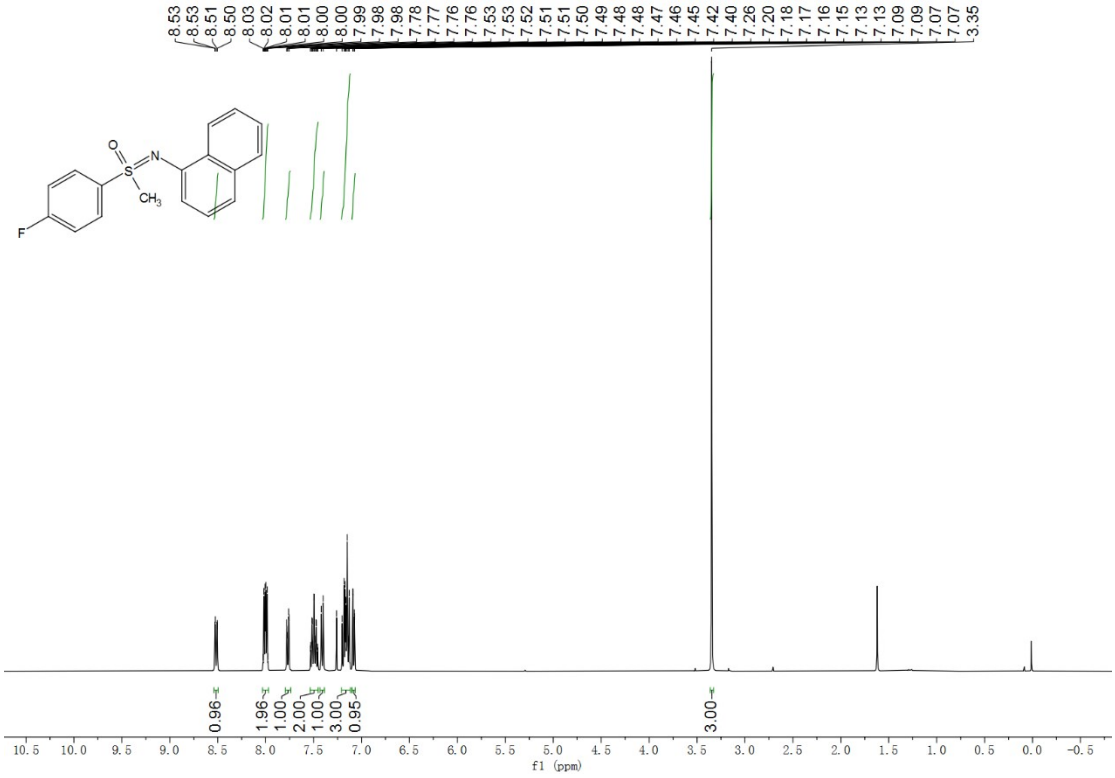


^{1}H NMR ($CDCl_3$, 400 MHz) of **4b**

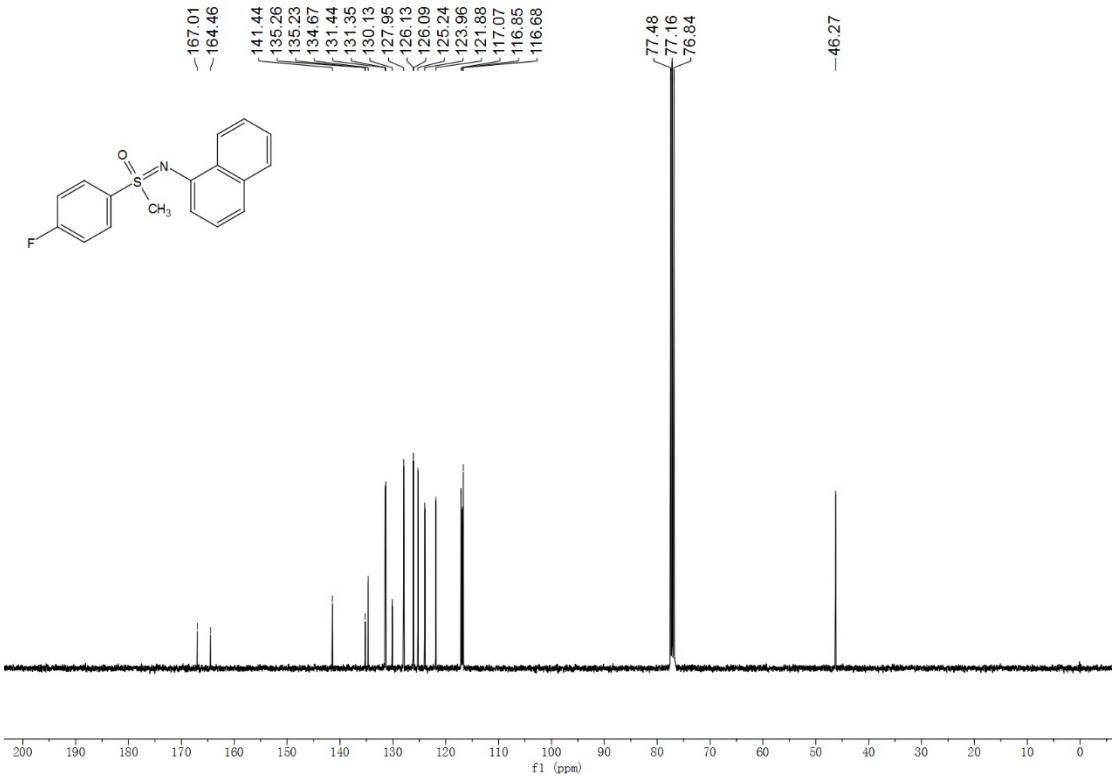


^{13}C NMR ($CDCl_3$, 100 MHz) of **4b**

(4-fluorophenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone (4c)

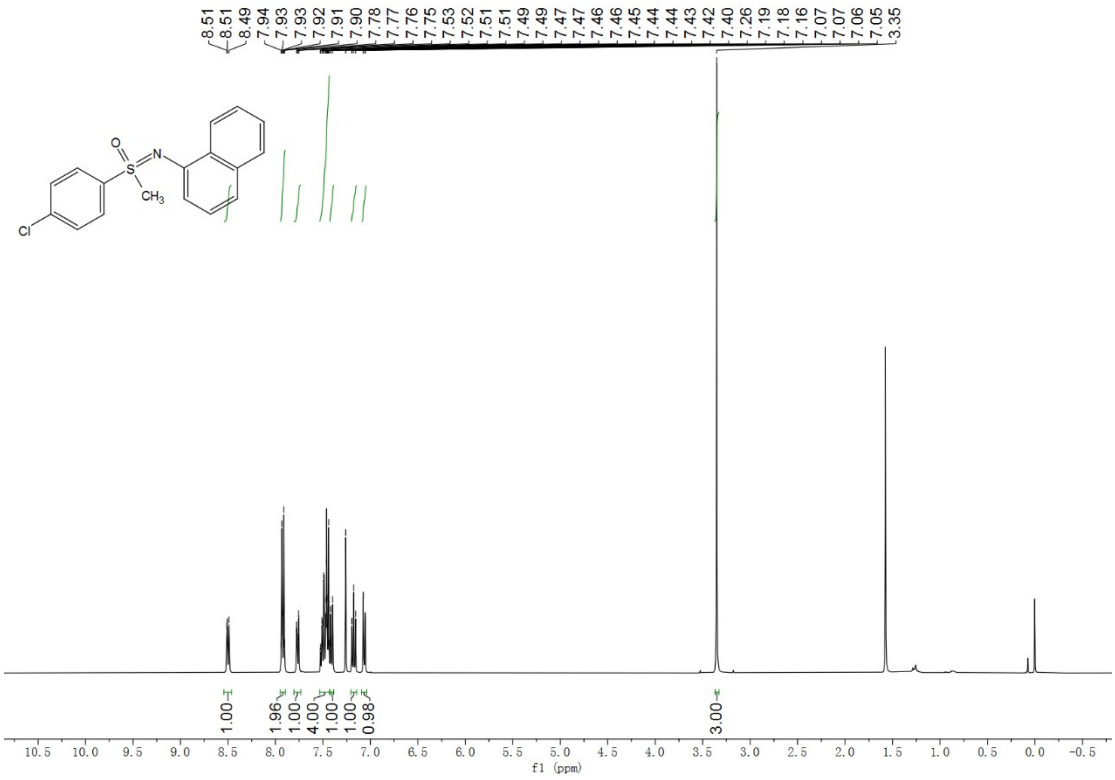


^{1}H NMR ($CDCl_3$, 400 MHz) of **4c**

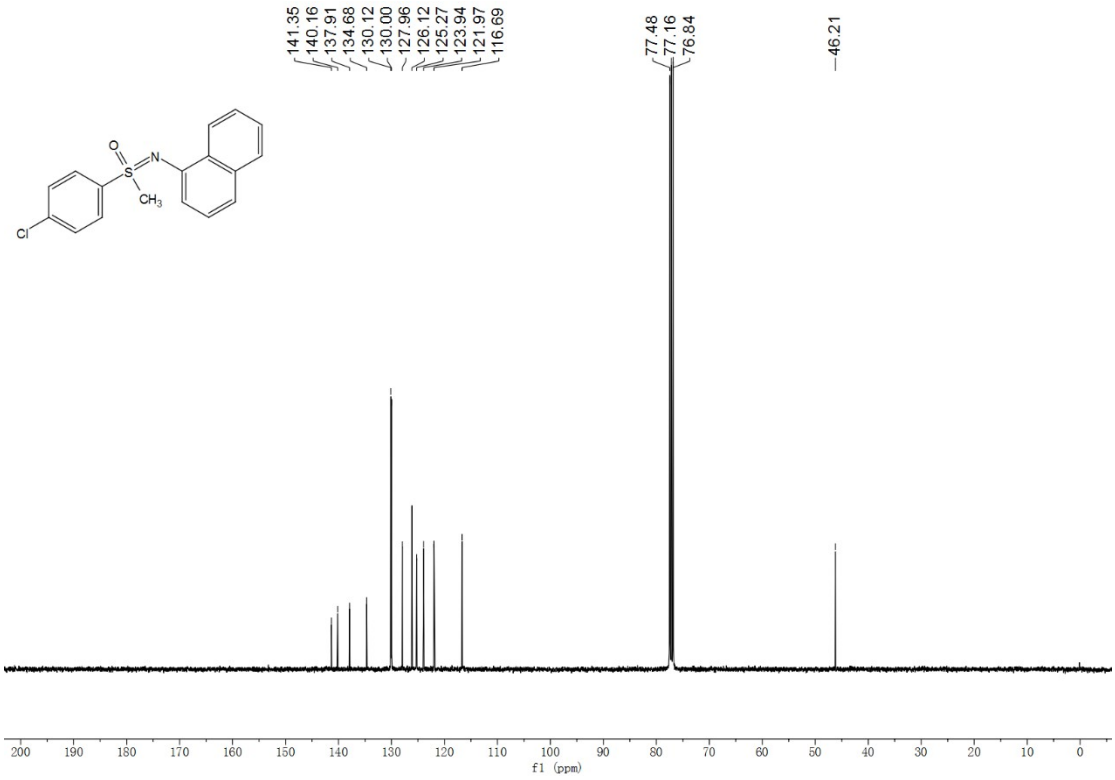


^{13}C NMR ($CDCl_3$, 100 MHz) of **4c**

(4-chlorophenyl)(methyl)(naphthalen-1-ylimino)-λ⁶-sulfanone(4d)

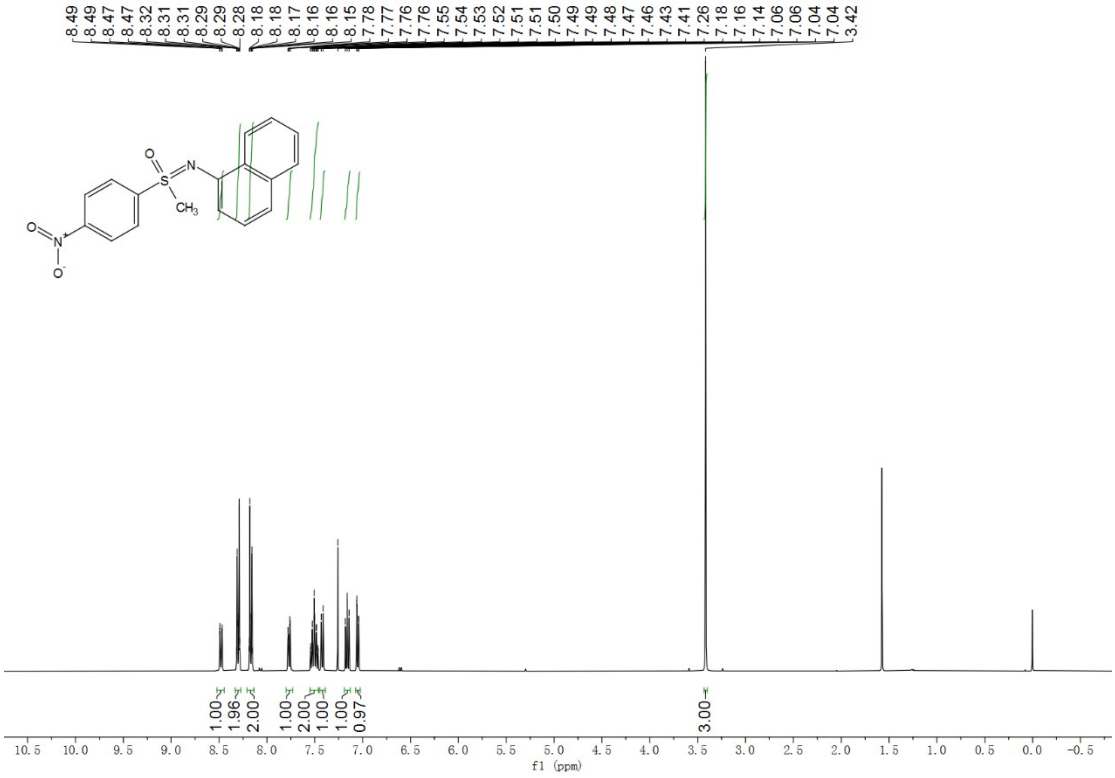


^{1}H NMR ($CDCl_3$, 400 MHz) of **4d**

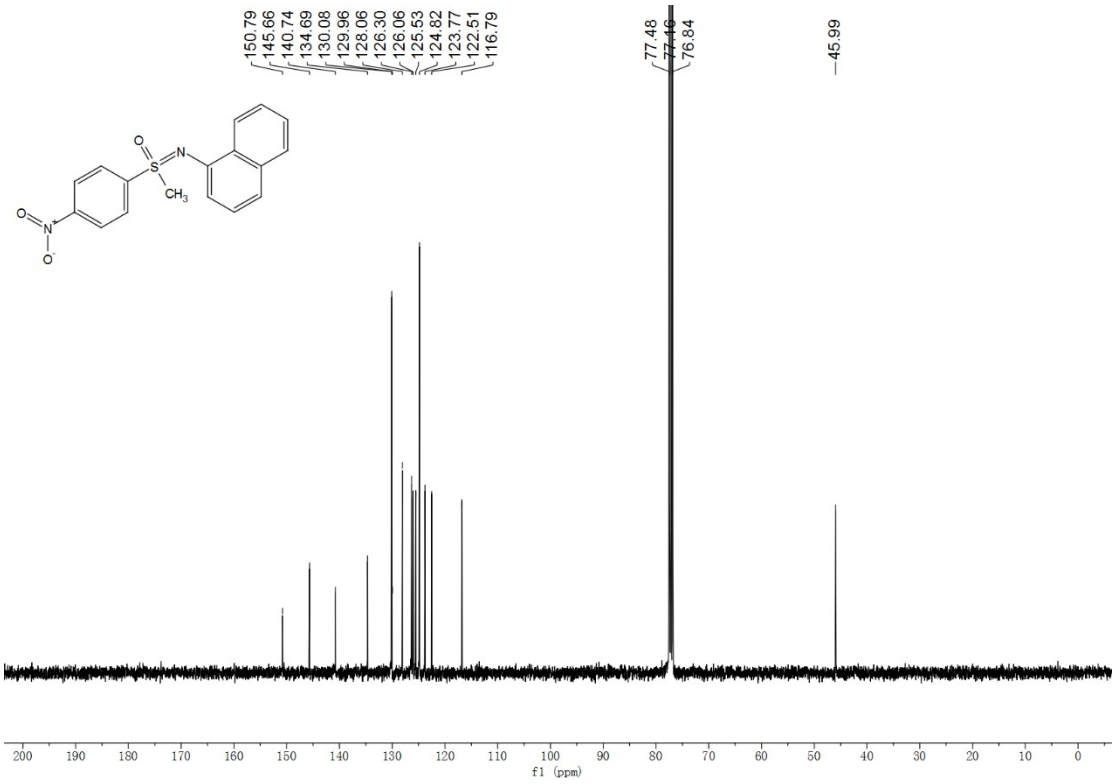


^{13}C NMR ($CDCl_3$, 100 MHz) of **4d**

methyl(naphthalen-1-ylimino)(4-nitrophenyl)-λ⁶-sulfanone (4e)

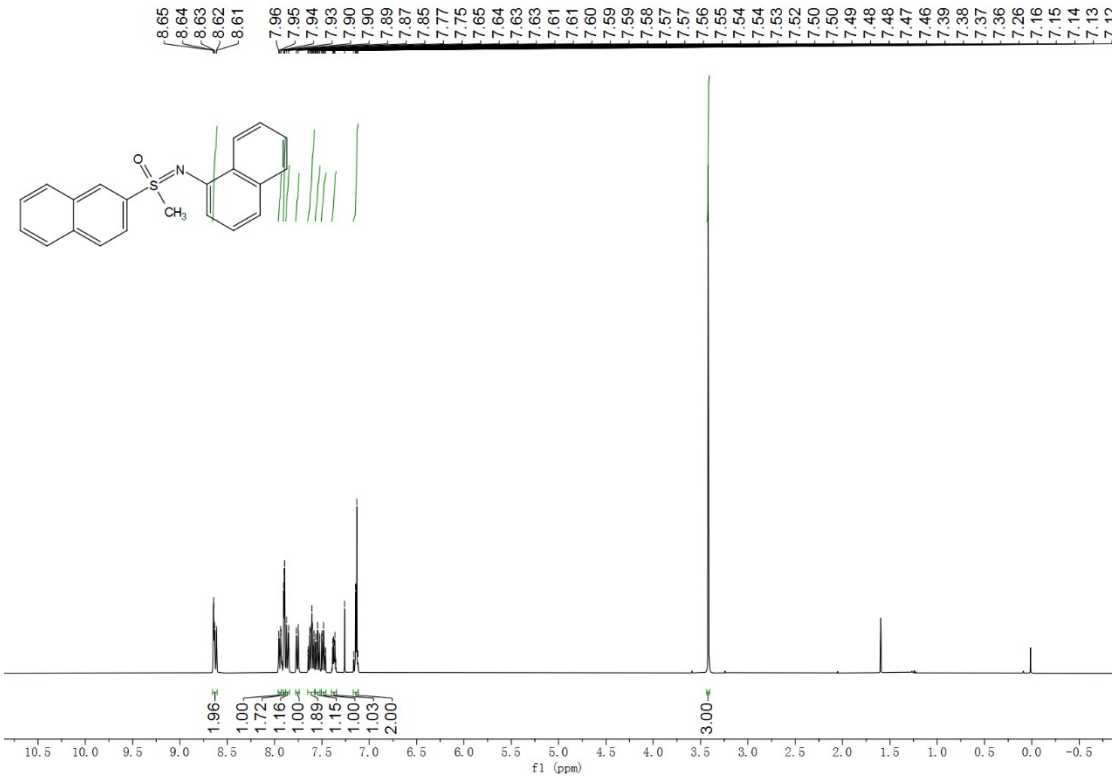


^{1}H NMR ($CDCl_3$, 400 MHz) of **4e**

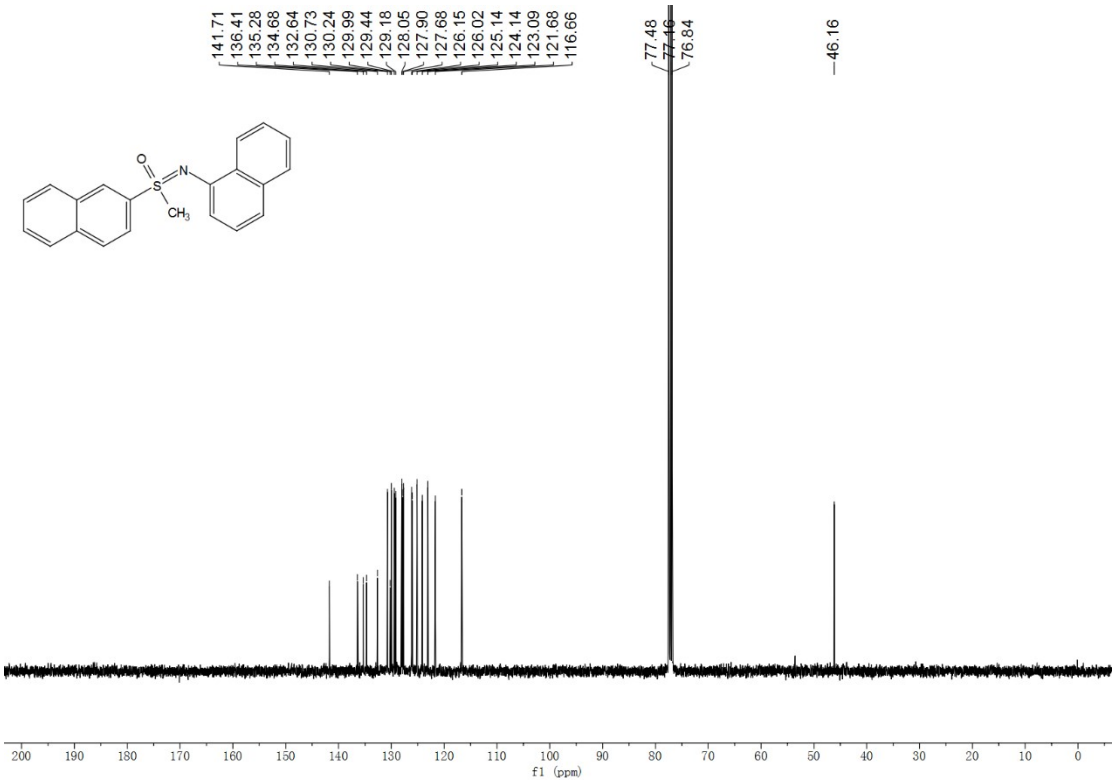


^{13}C NMR ($CDCl_3$, 100 MHz) of **4e**

methyl(naphthalen-1-ylimino)(naphthalen-2-yl)-λ^6-sulfanone (4f)

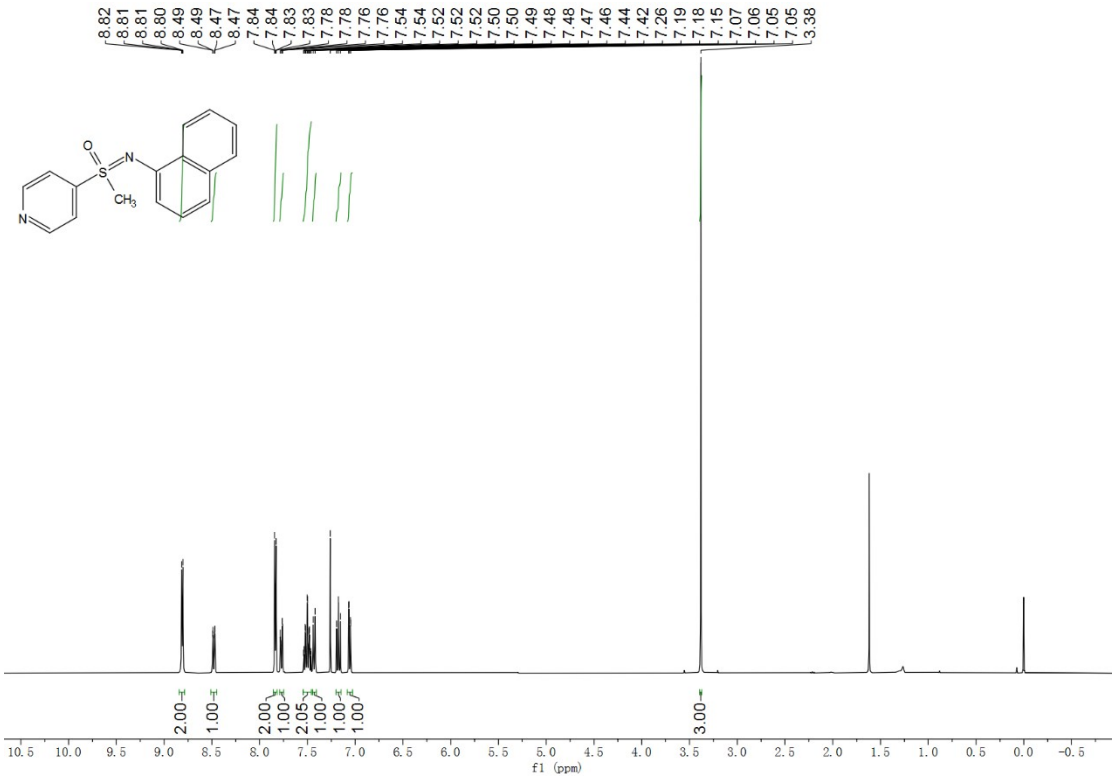


^{1}H NMR ($CDCl_3$, 400 MHz) of **4f**

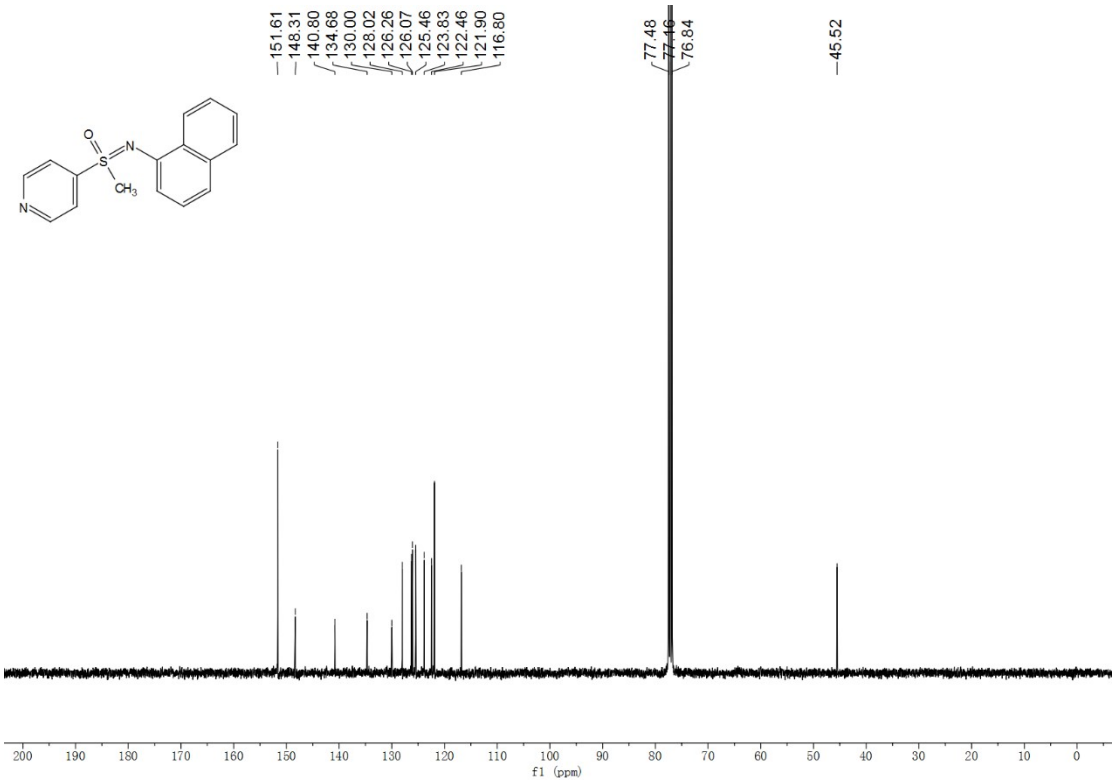


^{13}C NMR ($CDCl_3$, 100 MHz) of **4f**

methyl(naphthalen-1-ylimino)(pyridin-4-yl)-λ⁶-sulfanone (4g)

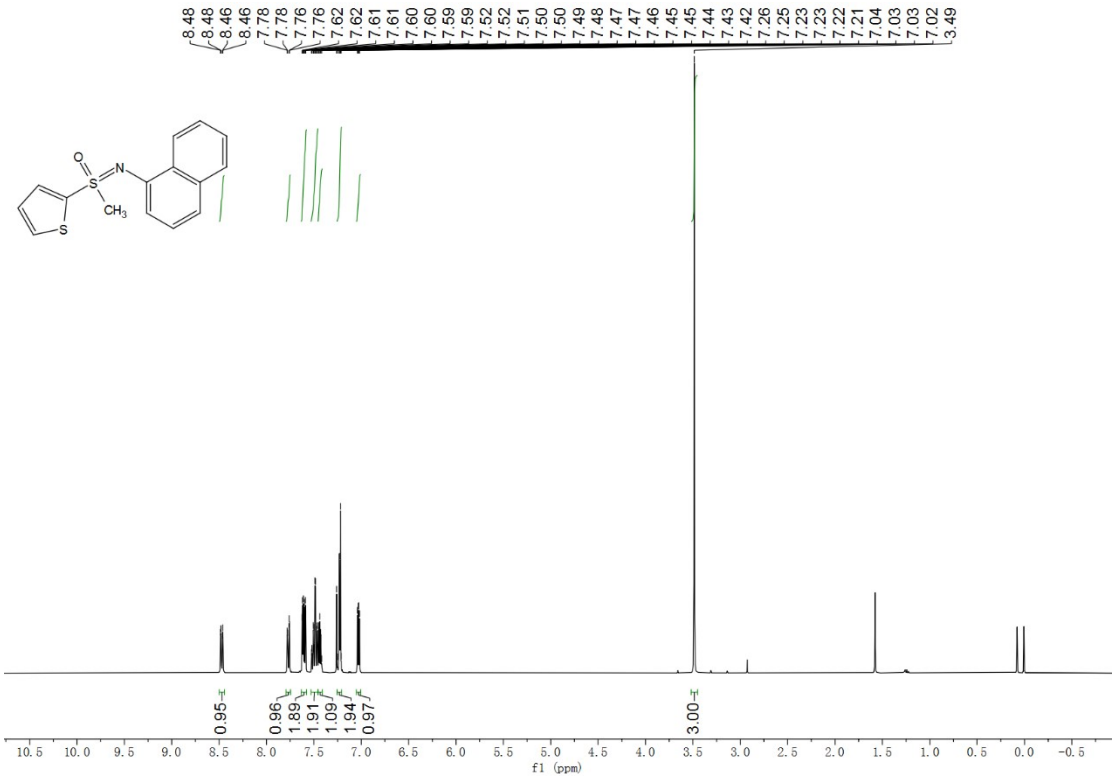


^{1}H NMR ($CDCl_3$, 400 MHz) of **4g**

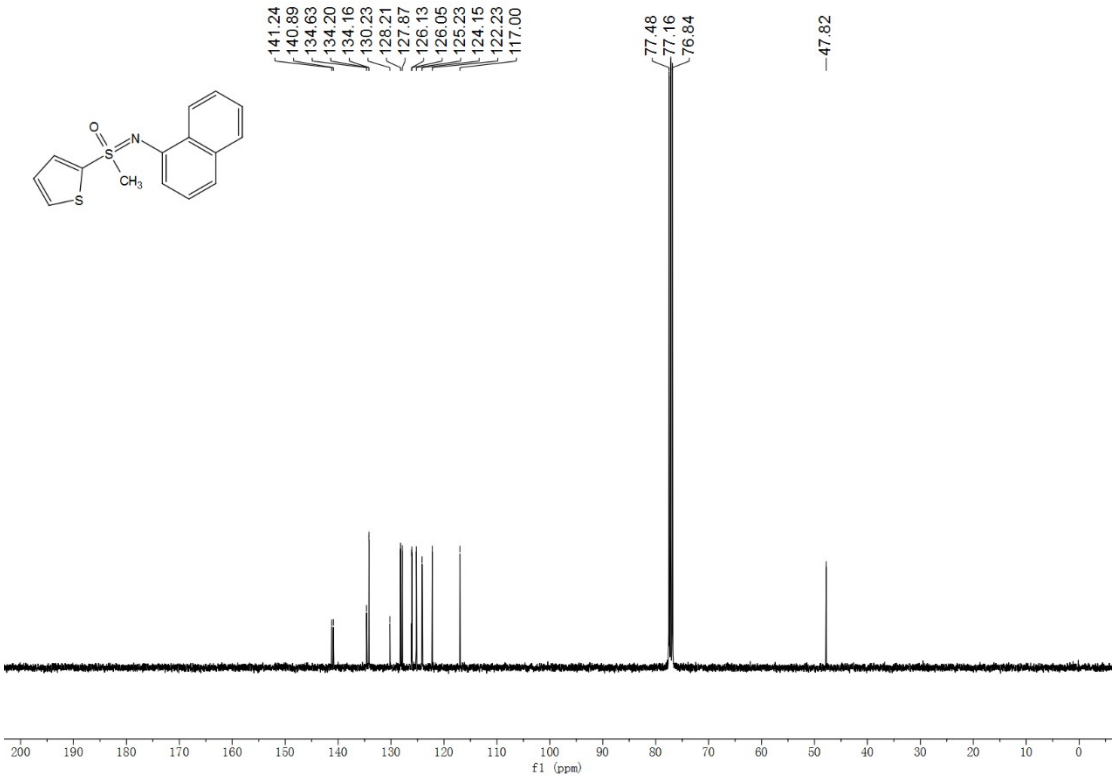


^{13}C NMR ($CDCl_3$, 100 MHz) of **4g**

methyl(naphthalen-1-ylimino)(thiophen-2-yl)-λ⁶-sulfanone (4h)

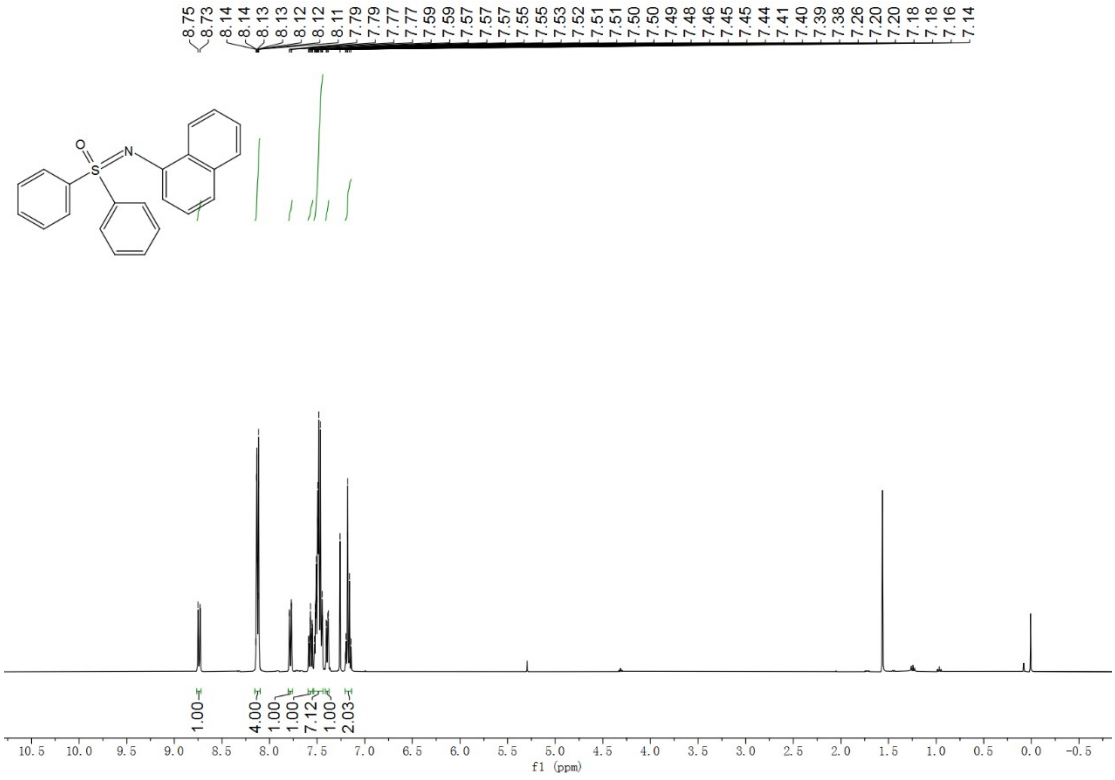


^{1}H NMR ($CDCl_3$, 400 MHz) of **4h**

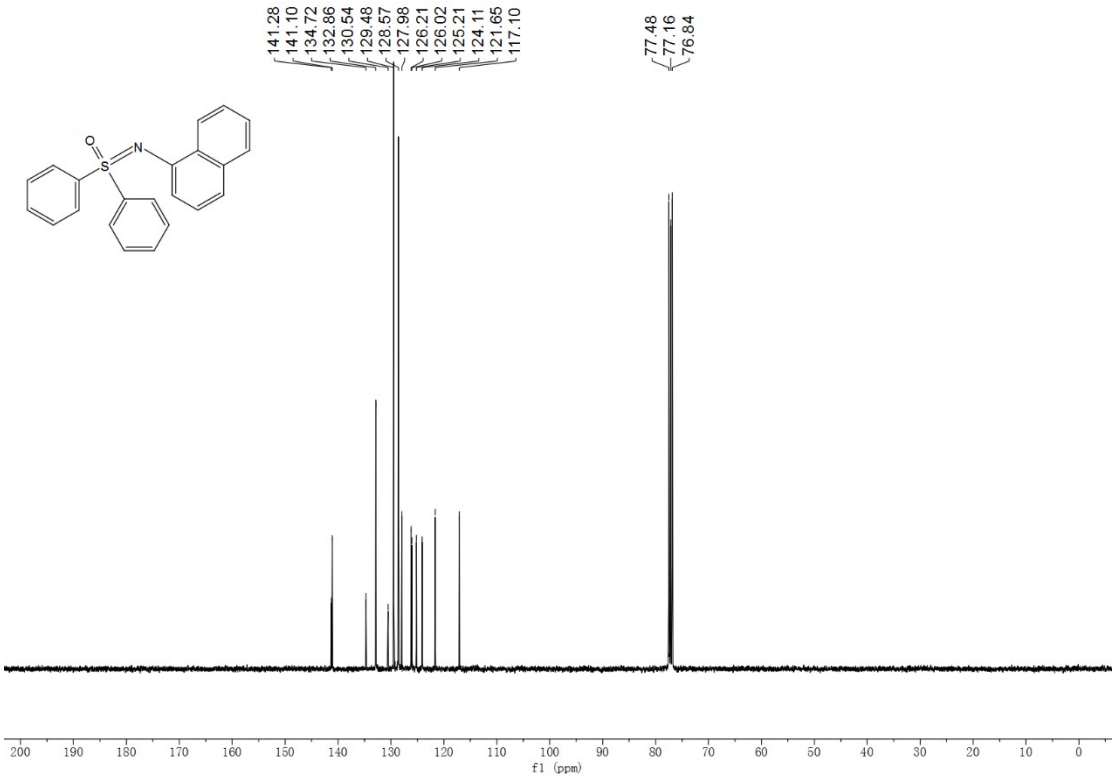


^{13}C NMR ($CDCl_3$, 100 MHz) of **4h**

(naphthalen-1-ylimino)diphenyl-λ⁶-sulfanone (4i)

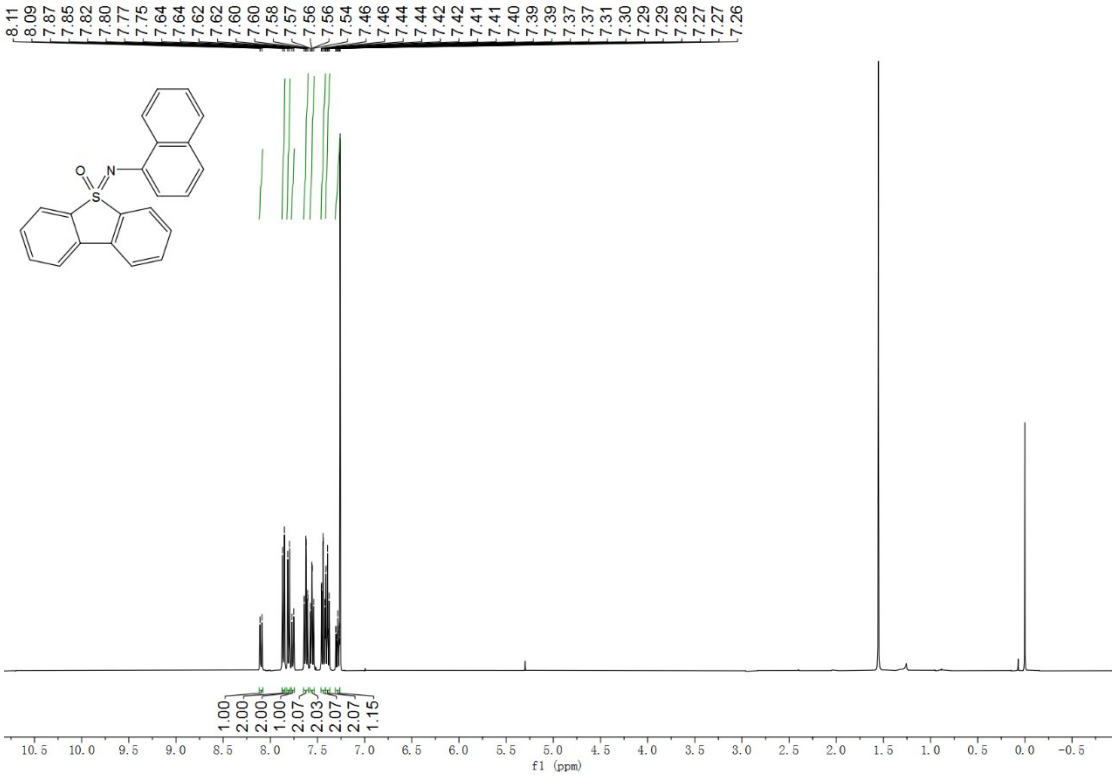


^{1}H NMR ($CDCl_3$, 400 MHz) of **4i**

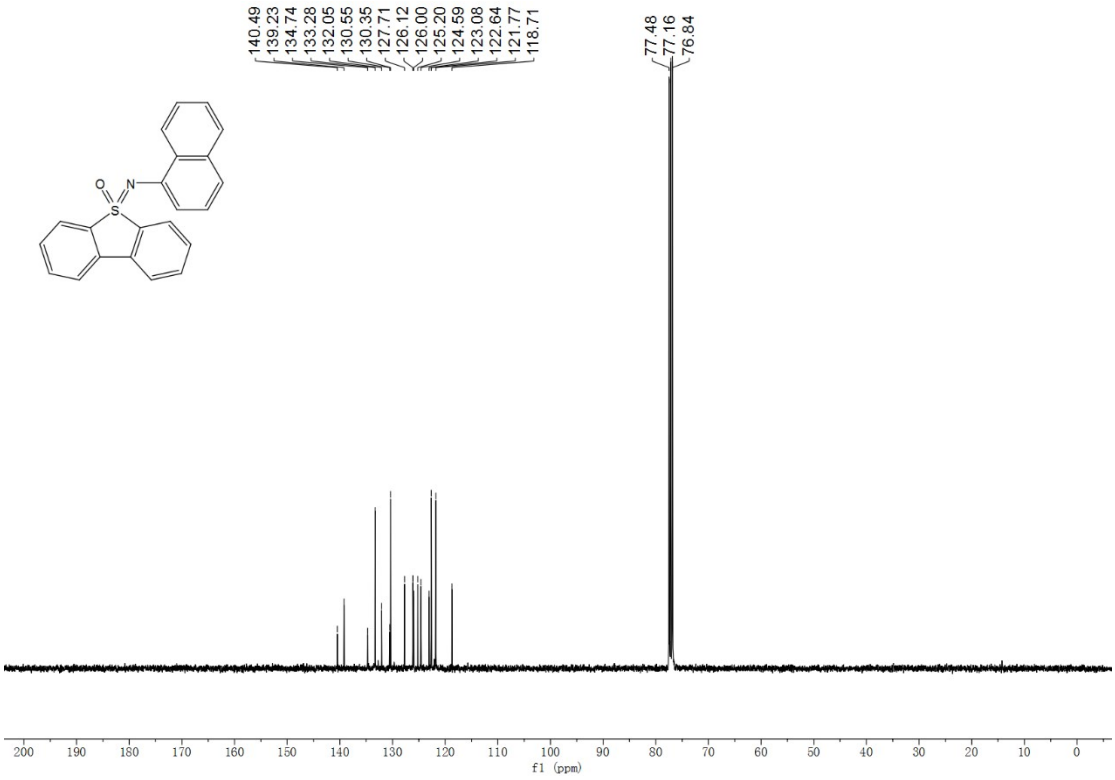


^{13}C NMR ($CDCl_3$, 100 MHz) of **4i**

5-(naphthalen-1-ylimino)-5*H*-5λ^4-dibenzo[*b*,*d*]thiophene 5-oxide (4j)

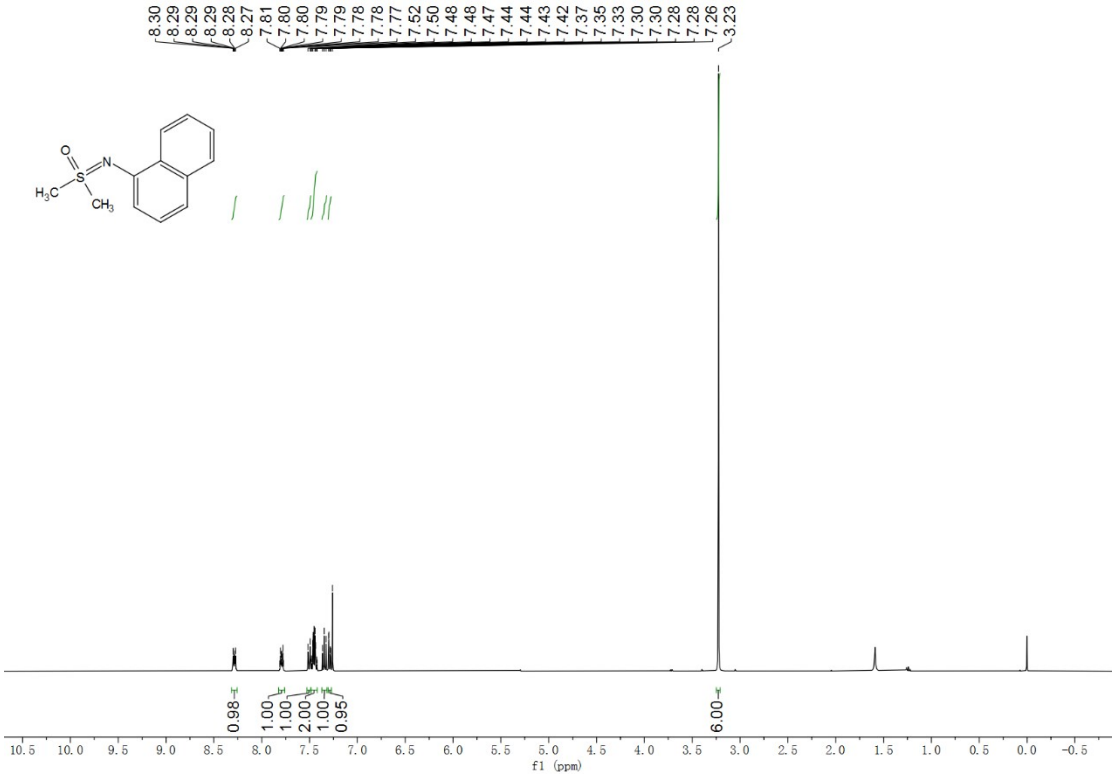


^{1}H NMR ($CDCl_3$, 400 MHz) of **4j**

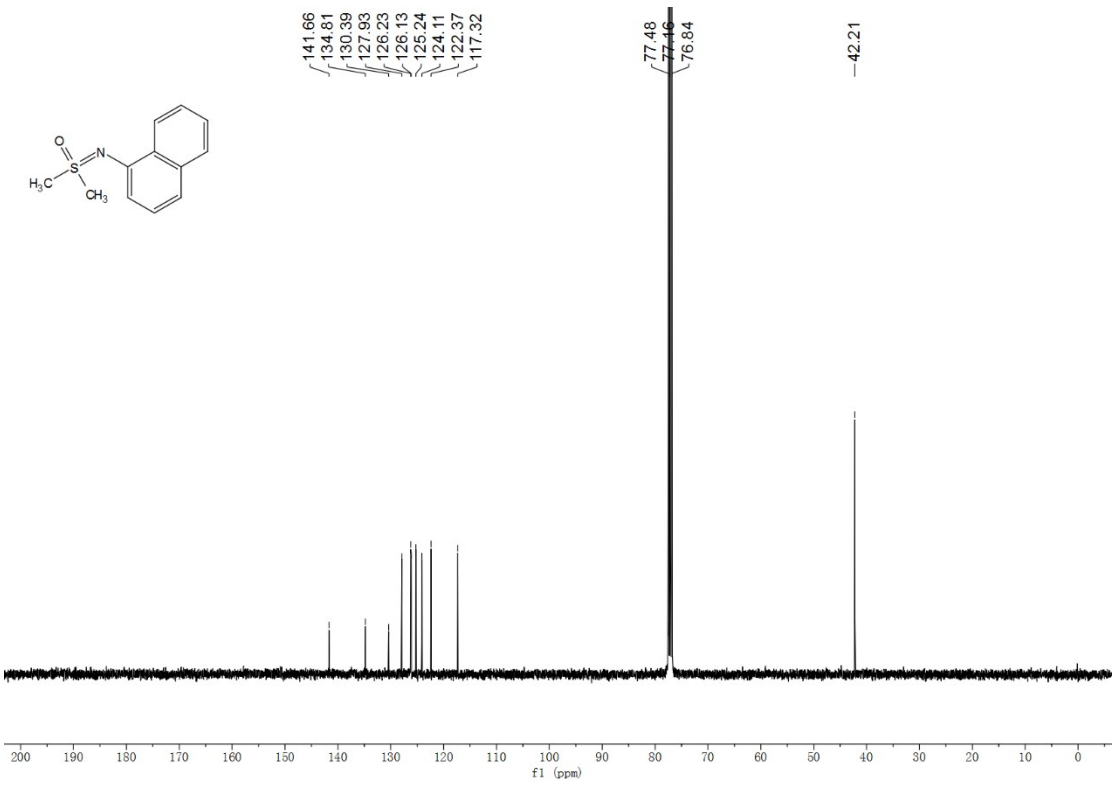


^{13}C NMR ($CDCl_3$, 100 MHz) of **4j**

dimethyl(naphthalen-1-ylimino)-λ⁶-sulfanone (4k)

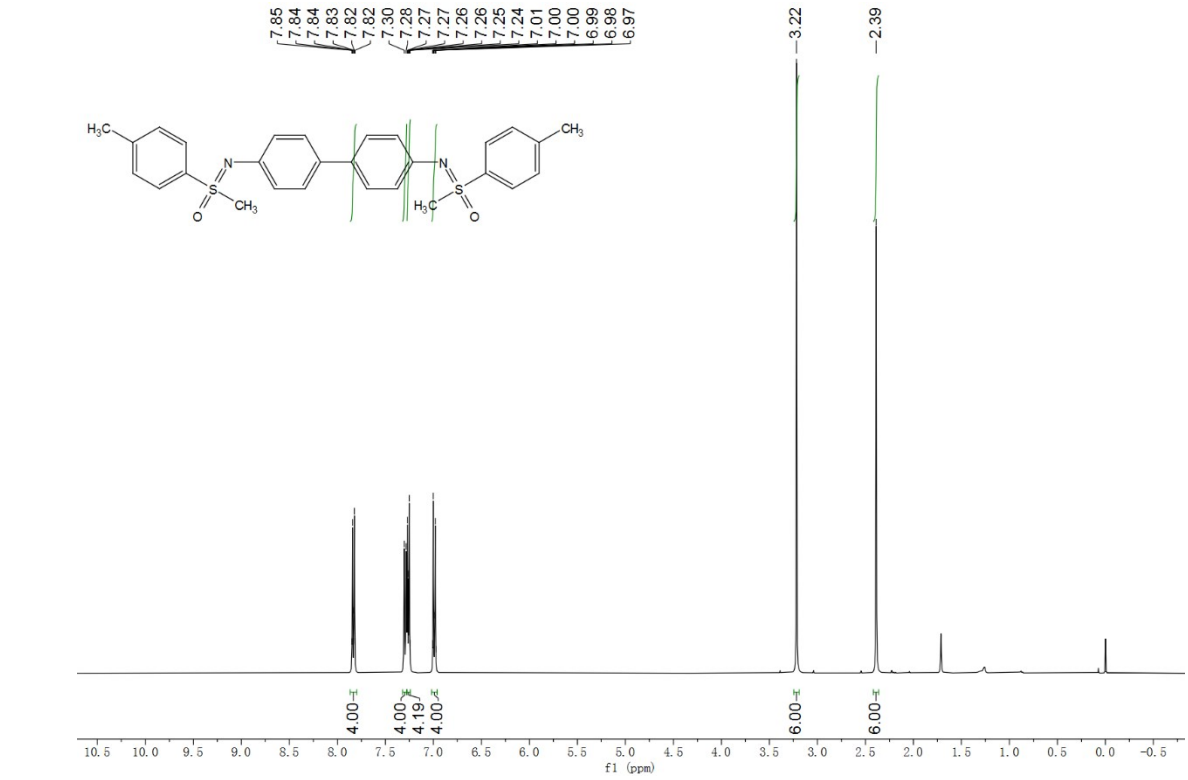


^{1}H NMR ($CDCl_3$, 400 MHz) of **4k**

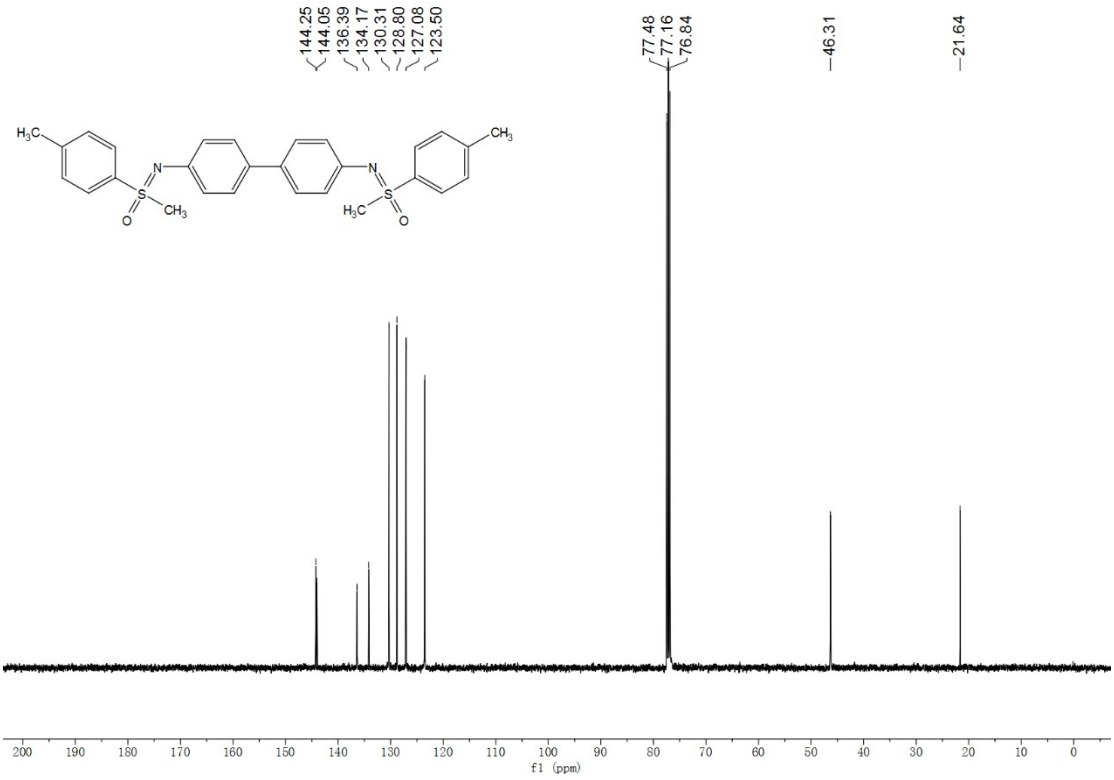


^{13}C NMR ($CDCl_3$, 100 MHz) of **4k**

([1,1'-biphenyl]-4,4'-diylbis(azanylylidene))bis(methyl(*p*-tolyl)-λ⁶-sulfanone)(5a)



^{1}H NMR ($CDCl_3$, 400 MHz) of **5a**



^{13}C NMR ($CDCl_3$, 100 MHz) of **5a**