Supporting Information

Electrochemical *N*-Acylation and *N*-*α*-Ketoacylation of Sulfoximines via the Selective Decarboxylation and Dehydration of *α*-Ketoacids

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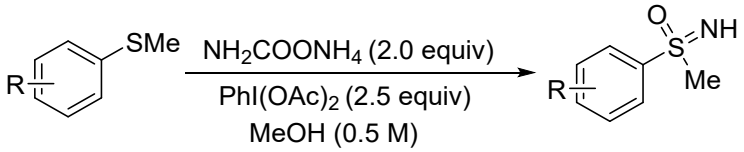
Contents

A. Instrumentation and Chemicals

All purchased reagents and solvents were used without further purification unless otherwise noted. All the electrochemical reactions were performed in an undivided cell unless otherwise noted. The electrolysis instrument used is an adjustable DC regulated power supply (PGD-2303S) (Taiwan Gwinstek Electronic Technology Co., Ltd.). Cyclic voltammograms were obtained on a CHI 760E potentiostat (CH Instruments, Inc.). All the thioether, electrolyte, and redox mediators were purchased from WuXi AppTec. TecAnalytical thin-layer chromatography was performed by using commercially prepared 100-400 mesh silica gel plates (GF_{254}) and visualization was effected at 254 nm. All the *NH*-sulfoximines were prepared according to known procedures. ^{1}H and ^{13}C NMR spectras were recorded using a Bruker DRX-500 spectrometer using $CDCl_3$ as solvent. The chemical shifts are referenced to signals at 7.26 and 77.0 ppm, respectively. Mass spectra were recorded on a Thermo Scientific ISQ gas chromatograph-mass spectrometer. The data of HRMS was carried out on a high-resolution mass spectrometer (LCMS-IT-TOF). Melting points were determined with a Büchi Melting Point B-545 instrument.

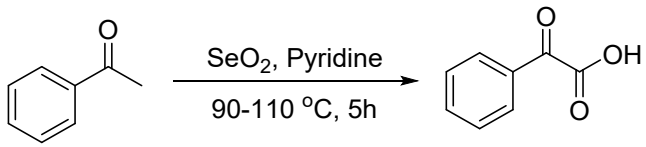
B. Experimental Procedure

B1. General Procedure for Synthesis of *NH*-sulfoximines[1-5]



The sulfide 1 (0.5 mmol), (diacetoxyiodo)benzene (1.25 mmol, 2.5 equiv) and ammonium carbamate (2.0 equiv) were added to a flask containing a stirrer bar. MeOH (1 mL, 0.5 M) was added and the reaction was stirred at 25 °C for 3 h. The solvent was removed under reduced pressure. Purification by flash chromatography afforded the sulfoximine products.

B2. General Procedure for Synthesis of 2-Oxo-2-Phenylacetic Acid[6-10].



Methyl ketones (5 mmol), SeO_2 (6 mmol), 20 mL of pyridine were added in a 50 mL round-bottom flask. The reaction mixture was stirred at 110 ºC for 1 h in an oil bath, then reduce the temperature to 90 ºC for 4 h. The desired products were isolated by flash chromatography on silica gel using (EA / petroleum ether = 1: 20) to give 2-oxo-2-phenylacetic acid acids in 65-90% yields.

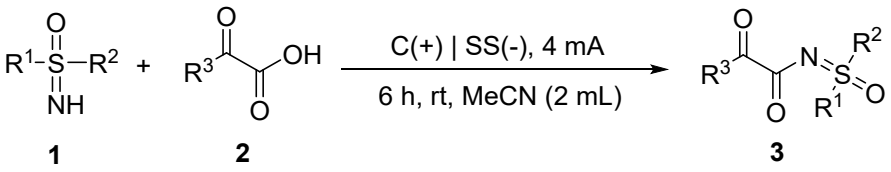
B3. General Procedures for the Electrolysis

B3.1 The Materials Used to Make the Electrolytic Cell

All the materials used to make the electrolytic cell were commercially available. The anode used graphite rod (φ= 6 mm, working height = 1.5 cm) and cathode used stainless steel electrodes (1.0 cm × 1.0 cm).

Figure S1. The materials

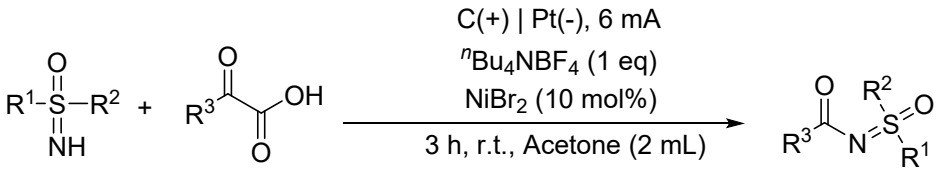
B3.2 General Procedure for the Synthesis of 3.



1 2 3

NH-Sulfoximines (**1**) (0.2 mmol, 1.0 equiv), 2-oxo-2-phenylacetic acid (**2**) (0.6 mmol, 3.0 eq), CH_3CN (2 mL), carbon rod (φ= 6 mm, working height = 1.5 cm) as the anode, stainless steel plate (1x1 cm^2) as cathode, were added in an undivided cell under air atmosphere for 6 hours. After the condensation was completed (monitored by TLC), the resulting mixture was extracted with ethyl acetate, dried over anhydrous $MgSO_4$, filtered and evaporated in vacuo. The desired products **3** were obtained in the corresponding yields after being purified by column chromatography on silica gel with a mixture of petroleum ether and ethyl acetate.

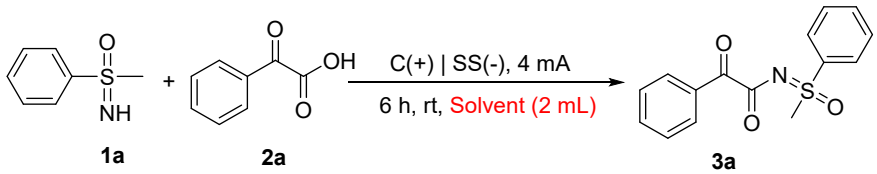
B3.3 General Procedure for the Synthesis of 4 .



1 2 4

NH-Sulfoximines (**1**) (0.2 mmol, 1.0 equiv), 2-oxo-2-phenylacetic acid (**2**) (0.4 mmol, 2.0 eq), $^nBu_4NBF_4$ (1 eq), $NiBr_2$ (10 mol%), Acetone (2 mL), carbon rod (φ= 6 mm, working height = 1.5 cm) as the anode, platinum plate (1x1 cm^2) as cathode, were added in an undivided cell under air atmosphere for 3 hours. After the condensation was completed (monitored by TLC), the resulting mixture was extracted with ethyl acetate, dried over anhydrous $MgSO_4$, filtered and evaporated in vacuo. The desired products **4** were obtained in the corresponding yields after being purified by column chromatography on silica gel with a mixture of petroleum ether and ethyl acetate.

Table S1. Optimization of 3a

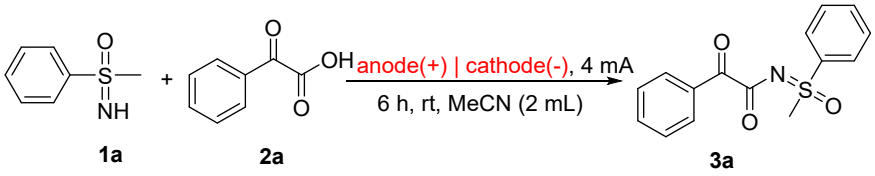


1a 2a 3a

Entry [a]	Solvent	Yield[b] (**3a** %)
1	DCM	36
2	DCE	41

3	DMF	N.R.
4	DMSO	N.R.
5	EtOH	N.R.
6	THF	N.R.
7	1,4-Dioxane	N.R.
8	MeCN:H_2O (5:1)	Trace

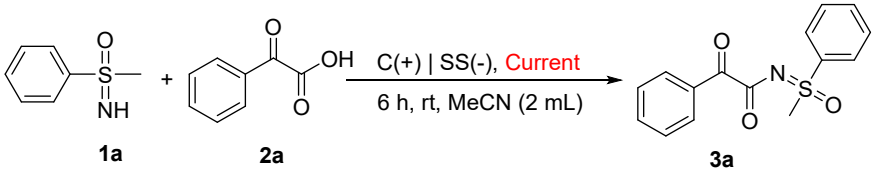
[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.60 mmol), MeCN (2 mL). graphite rod (Ø 6 mm) as anode, Fe sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 4 mA, room temperature, 6 h. [b] Isolated yields. [c] N.R. = No Reaction.



1a **2a** **3a**

Entry[a]	**anode/cathode**	Yield[b] (**3a** %)
1	C/Ni	17
2	RVC/Ni	21
3	SS/Pt	N.R.
4	C/C	23
5	C/Zn	N.R.
6	Pt/C	N.R.
7	Pt/Zn	N.R.
8	Pt/Ni	Trace

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.60 mmol), MeCN (2 mL). graphite rod (Ø 6 mm) as anode, Fe sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 4 mA, room temperature, 6 h. [b] Isolated yields. [c] N.R. = No Reaction.

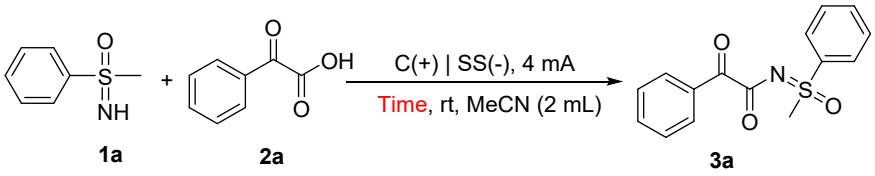


1a **2a** **3a**

Entry[a]	**Current/mA**	Yield[b] (**3a** %)
1	2 mA	15

2	4 mA	72
3	6 mA	38
4	8 mA	41
5	10 mA	56
6	12 mA	46

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.60 mmol), MeCN (2 mL). graphite rod (Ø 6 mm) as anode, Fe sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 4 mA, room temperature, 6 h. [b] Isolated yields. [c] N.R. = No Reaction.

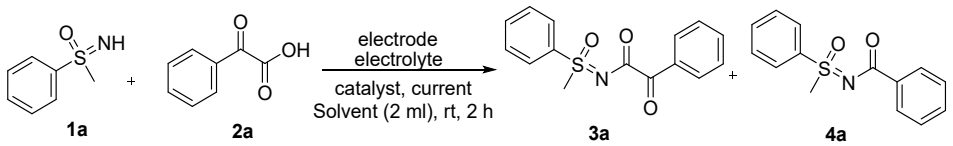


1a **2a** **3a**

Entry[a]	**Time/h**	Yield[b] (**3a** %)
1	2 h	52
2	4 h	78
3	6 h	95
4	7 h	88
5	8 h	89

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.60 mmol), MeCN (2 mL). graphite rod (Ø 6 mm) as anode, Fe sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 4 mA, room temperature, 6 h. [b] Isolated yields. [c] N.R. = No Reaction.

Table S2. Optimization of 4a

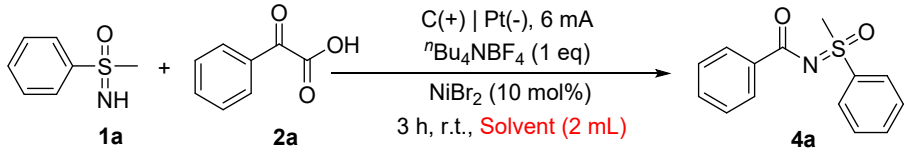


1a **2a** **3a** **4a**

Entry	Variation from standard conditions	Yield[b] (**3a** %)	Yield[b] (**4a** %)
1	None	38	22
2	MeOH instead of MeCN	29	20
3	acetone instead of MeCN	33	56
4	H_2O instead of solvent	N.R.	N.R.

5	$TBAPF_6$ instead of $^nBu_4NBF_4$	15	23
6	$^nBu_4NClO_4$ instead of $^nBu_4NBF_4$	16	18
7	$^nBu_4NOAc$ instead of $^nBu_4NBF_4$	28	21
8	2eq $^nBu_4NBF_4$	12	48
9	Without electrolyte	33	26
10	RVC anode	35	24
11	Pt(+) anode	trace	trace
12	SS(−) cathode	trace	trace
13	4 mA instead of 6 mA	28	53
14	10 mA instead of 6 mA	22	53
15	2 equiv. of 2a	19	64
16	3 equiv. of 2a	22	59
17[c]	With catalyst	N.D.	88

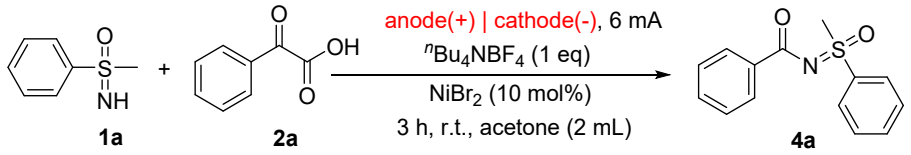
[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), $^nBu_4NBF_4$ (1 eq), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] $NiBr_2$ (10 mmol%). [d] N.R. = No Reaction. [e] N.D. = No Detected.



Entry [a]	**Solvent**	Yield[b] (**4a** %)
1	DCM	N.R.
2	DCE	29
3	DMF	N.R.
4	DMSO	N.R.
5	EtOH	N.R.
6	THF	23
7	1,4-Dioxane	N.R.
8	acetone	56

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), $^nBu_4NBF_4$ (1 eq), $NiBr_2$

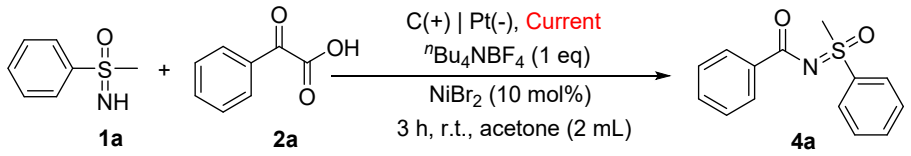
(10 mmol%), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] N.R. = No Reaction.



1a **2a** **4a**

Entry[a]	**anode/cathode**	Yield[b] (**4a** %)
1	C/Ni	28
2	RVC/Ni	21
3	Fe/Pt	N.R.
4	C/C	25
5	C/Zn	N.R.
6	Pt/C	trace
7	Pt/Zn	N.R.
8	Pt/Ni	N.R.

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), ^{n}Bu$_4$NBF$_4$ (1 eq), NiBr$_2$ (10 mmol%), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] N.R. = No Reaction.

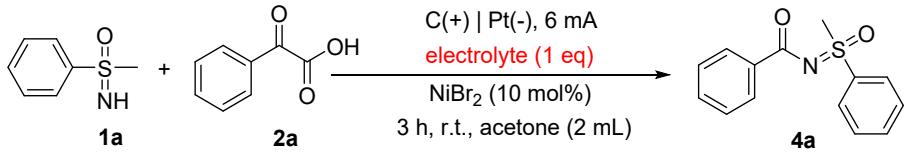


1a **2a** **4a**

Entry[a]	**Current/mA**	Yield[b] (**4a** %)
1	2 mA	15
2	4 mA	53
3	6 mA	56
4	8 mA	51
5	10 mA	53
6	12 mA	42

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), ^{n}Bu$_4$NBF$_4$ (1 eq), NiBr$_2$

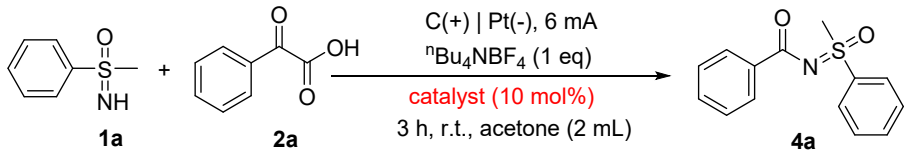
(10 mmol%), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] N.R. = No Reaction.



1a **2a** **4a**

Entry[a]	**Electrolyte**	Yield[b] (**4a** %)
1	TEAB	Trace
2	$TBPAF_6$	23
3	$^{n}Bu_4NClO_4$	18
4	$^{n}Bu_4NOAc$	21
5	TBAI	N.R.
6	TBAF	Trace
7	$LiClO_4$	Trace
8	KPF_6	Trace

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), $^{n}Bu_4NBF_4$ (1 eq), $NiBr_2$ (10 mmol%), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] N.R. = No Reaction.



1a **2a** **4a**

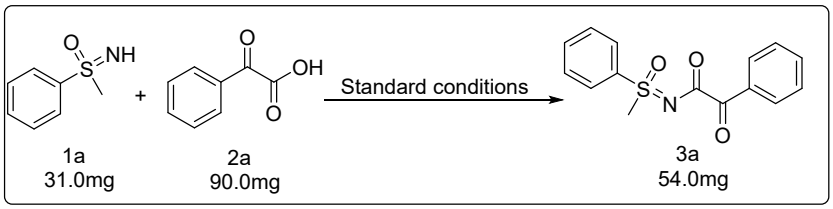
Entry[a]	**Catalyst**	Yield[b] (**4a** %)
1	$Ni(OTf)_2$	49
2	NiI_2	65
3	$NiCl_2$	59
4	$NiBr_2$	88
5	$Ni(PPh_3)_2Cl_2$	66
6	NiOAC	76

[a] Reaction conditions: undivided cell, **1a** (0.20 mmol), **2a** (0.40 mmol), $^{n}Bu_4NBF_4$ (1 eq),

$NiBr_2$ (10 mmol%), acetone (2 mL). graphite rod (Ø 6 mm) as anode, Pt sheets (10 mm × 10 mm × 0.1 mm) as cathode, constant current = 6 mA, room temperature, 3 h. [b] Isolated yields. [c] N.R. = No Reaction.

C. Green Chemistry Metrics Analysis[11-18]

C1. Green Chemistry Metrics for 3a and 4a

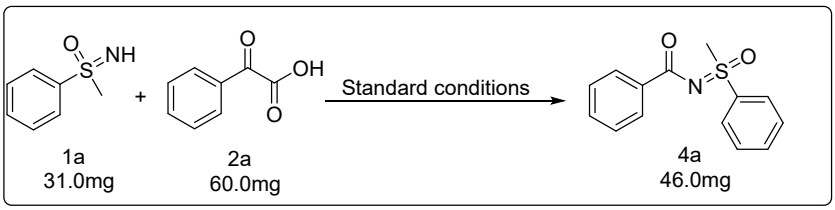


Total amount of reactants: 31.0 mg + 90.0 mg = 121.0 mg
Amount of final product: 54.0 mg
Amount of waste: 121.0 mg - 54.0 mg = 67.0 mg
E-Factor = Amount of waste/Amount of product = 67.0/54.0 = 1.24

Molecular weight of product: 287
Sum of molecular weight of reagent: 155 + 150 = 305
Atom economy = Molecular weight of product/Sum of molecular weight of reagent = 287/305 = 94%

Mass of product: 54.0 mg
Total mass of reagent: 31.0 mg + 90.0 mg = 121.0 mg
RME = Mass of product/Total mass of reagent = 54.0/121.0 = 45%

Total mass in process: 31.0 mg + 90.0 mg = 121.0 mg
Mass of product: 54.0 mg
PMI = Total mass in process/Mass of product = 121.0/54.0 = 2.24



Total amount of reactants: 31.0 mg + 60.0 mg + 4.37 mg = 95.4 mg
Amount of final product: 46.0 mg
Amount of waste: 95.4 mg - 46.0 mg = 49.4 mg
E-Factor = Amount of waste/Amount of product = 49.4/46.0 = 1.07

Molecular weight of product: 259
Sum of molecular weight of reagent: 155 + 150 = 305
Atom economy = Molecular weight of product/Sum of molecular weight of reagent = 259/305 = 85%

Mass of product: 46.0 mg
Total mass of reagent: 31.0 mg + 60.0 mg = 91.0 mg
RME = Mass of product/Total mass of reagent = 46.0/91.0 = 51%

Total mass in process: 31.0 mg + 60.0 mg + 4.37 mg = 95.4 mg
Mass of product: 46.0 mg
PMI = Total mass in process/Mass of product = 95.4/46.0 = 2.07

C2. Green Chemistry Metrics Compared with Scheme a-f

According to the above green index calculation method, we compared our work with the previous works. The results showed that our work has the advantages of high atom economy and low negative impact on the environment, the reaction mass efficiency is at a medium level, and the process mass intensity is better than most of the previous work.

Method	This work（**3a**）	Scheme-1d	Scheme-1e	Scheme-1f
E-factor	1.24	0.89	7.79	0.88
AE	94.0%	74.0%	26.0%	89%
RME	45.0%	52.9%	11.4%	54%
PMI	2.24	1.89	8.79	1.87

Method	This work（**4a**）	Scheme-1a	Scheme-1b	Scheme-1c
E-factor	1.07	9.44	1.13	2.31
AE	85.0%	58.0%	99.0%	85.7%
RME	51.0%	9.78%	46.9%	43.0%
PMI	2.07	10.43	2.13	30.2

C3. Eco-Scale for this work

According to the calculation method proposed in the reference（DOI: 10.1186/1860-5397-2-3）, we also carried out the Eco-Scale calculation. As shown in the table, our work can reach qualified to excellent results. The results indicated that our work carried a minimal risk to the operator and a minimal impact to the environment.

The Penalty Points for This Work

Penalty (3a)		**Penalty (4a)**	
1 Yield:95%	(100-95)/2=2.5	1 Yield:88%	(100-88)/2=6
2 Inexpensive	0	2 Inexpensive	0
3 MeCN (T、F)	10	3 Acetone (T、F)	10
4 common setup	0	4 common setup	0
5 temperature/time	1	5 temperature/time	1
6 classical chromatography	10	6 classical chromatography	10
Penalty points total:	23.5	Penalty points total:	27
Eco-Scale	76.5（excellent）	Eco-Scale	73（qualified）

Green chemistry metrics for other compounds and protocols were calculated following the above procedures, which were similar to compound **3a** and **4a**.

D. References

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E. Gram-Scale Experiment

NH-Sulfoximines (**1**) (7 mmol), 2-oxo-2-phenylacetic acid (21 mmol, 3.0 eq), CH_3CN (10 mL), carbon rod (φ= 6 mm, working height = 1.5 cm) as the anode, stainless steel plate (1x1 cm^2) as cathode, were added in an undivided cell under air atmosphere for 12 h with 12 mA constant current. After the condensation was completed (monitored by TLC), the resulting mixture was extracted with ethyl acetate, dried over anhydrous $MgSO_4$, filtered and evaporated in vacuo. The desired products **3a** were obtained in the corresponding yields after being purified by column chromatography on silica gel with a mixture of petroleum ether and ethyl acetate.

NH-Sulfoximines (**1**) (7 mmol), 2-oxo-2-phenylacetic acid (14 mmol, 2.0 eq), $^nBu_4NBF_4$ (7 mmol, 1.0 eq), $NiBr_2$ (10 mol%), Acetone (10 mL), carbon rod (φ= 6 mm, working height = 1.5 cm) as the anode, platinum plate (1x1 cm^2) as cathode, were added in an undivided cell under air atmosphere for 12 h with 12 mA constant current. After the condensation was completed (monitored by TLC), the resulting mixture was extracted with ethyl acetate, dried over anhydrous $MgSO_4$, filtered and evaporated in vacuo. The desired products **4a** were obtained in the corresponding yields after being purified by column chromatography on silica gel with a mixture of petroleum ether and ethyl acetate.

F. Electric On/off Current Experiment.

To the 10 mL three-necked round bottom flask with a magnetic stir bar was added S-Methyl-S-phenylsulfoximide (**1a**) (0.2 mmol), 2-oxo-2-phenylacetic acid (**2a**) (0.6 mmol, 3.0 eq), CH_3CN (2 mL) in an undivided cell. The flask was equipped with a carbon rod (φ= 6 mm, working height = 1.5 cm) as an anode, stainless steel plate (1 x 1 cm^2) as a cathode. The electrolysis was carried out at room temperature using a constant current of 4 mA. The reaction mixture was stirred and electrolyzed for 0, 2, 4, and 6 hours respectively. Meanwhile, the setting time span for 1 hours, and only stirred without electrolyzed. The yield of the product was determined by GC and dodecane as internal standard.

G. H_2 Detection Experiments

Figure S2 H_2 detection experiment by a H_2 detector

In order to prove the mechanism, the model reaction of S-Methyl-S-phenylsulfoximide (**1a**), 2-oxo-2-phenylacetic acid (**2a**) were monitored by a H_2 detector under standard conditions. Just as shown in Figure S2, as the reaction proceeded, it was observed that no H_2 was produced in dehydration reaction system.

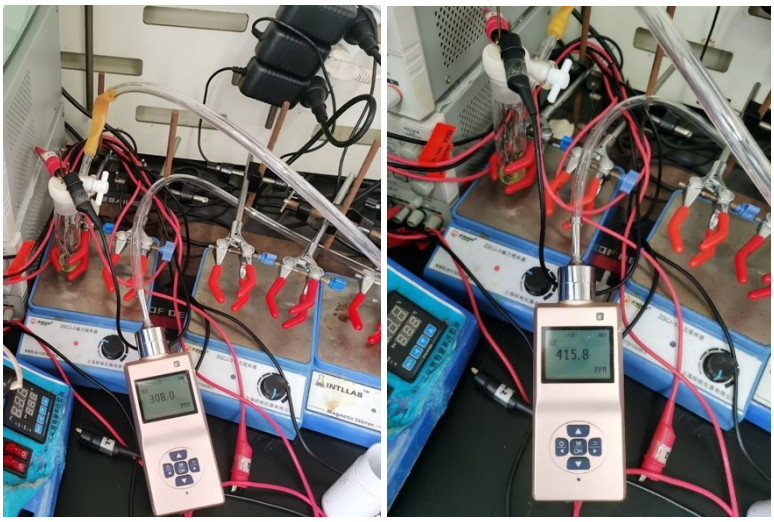
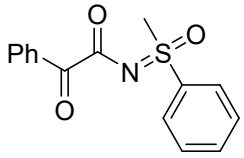


Figure S3 H_2 detection experiment by a H_2 detector

In order to demonstrate the release of H_2 during the decarboxylation, the model reaction of S-Methyl-S-phenylsulfoximide (**1a**), 2-oxo-2-phenylacetic acid (**2a**) were monitored by a H_2 detector under standard conditions. Just as shown in Figure S2, as the decarboxylation reaction proceeded, the H_2 was observed clearly and the concentration increased gradually.

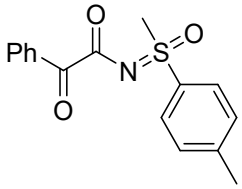
H. Characterisation Data

***N*-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3a)**



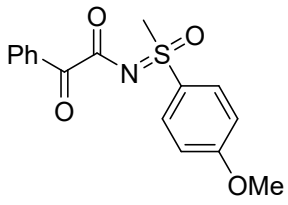
Yield 54.5 mg (95%, white solid); mp 131.6-132.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.23-7.88 (m, 4H), 7.72 (t, *J* = 7.4 Hz, 1H), 7.64 (t, *J* = 7.7 Hz, 2H), 7.61-7.57 (m, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 3.47 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.1, 173.2, 137.6, 134.4, 134.2, 132.7, 130.1, 129.9, 128.6, 127.1, 44.8. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{15}H_{13}NO_3NaS$ 310.0518); Found 310.0514.

***N*-(methyl(oxo)(*p*-tolyl)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3b)**



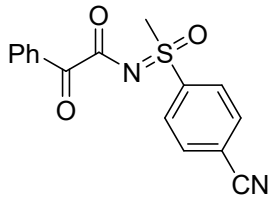
Yield 57.8 mg (96%, white solid); mp 88.3-89.8 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.10-8.01 (m, 2H), 7.95 (dd, *J* = 8.4, 2.1 Hz, 2H), 7.60 (td, *J* = 6.6, 5.7, 3.6 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.45-7.39 (m, 2H), 3.47 (s, 3H), 2.47 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.3, 173.3, 145.8, 134.5, 134.2, 132.8, 130.6, 130.2, 128.7, 127.2, 45.0, 21.7. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{16}H_{15}NO_3NaS$ 324.0665); Found 324.0667.

***N*-((4-methoxyphenyl)(methyl)(oxo)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3c)**



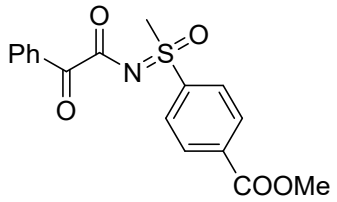
Yield 53.3 mg (84%, yellow solid); mp 117.2-119.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.06 (dd, *J* = 7.2, 2.2 Hz, 2H), 8.00 (dd, *J* = 9.1, 2.9 Hz, 2H), 7.67 -7.57 (m, 1H), 7.48 (td, *J* = 6.3, 4.8, 2.3 Hz, 2H), 7.09 (dd, *J* = 9.2, 2.9 Hz, 2H), 3.90 (s, 3H), 3.48 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.4, 173.3, 164.4, 134.2, 132.8, 130.2, 129.5, 128.7, 128.4, 115.2, 55.9, 45.3. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{16}H_{15}NO_4NaS$ 340.0614); Found 340.0617.

***N*-((4-cyanophenyl)(methyl)(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3d)**



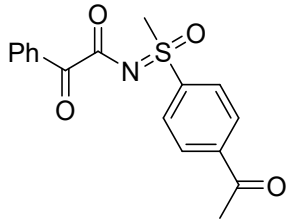
Yield 47.4 mg (76%, yellow solid); mp 143.3-146.4 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.26-8.18 (m, 2H), 8.02 (ddd, *J* = 8.5, 4.7, 1.5 Hz, 2H), 7.99-7.90 (m, 2H), 7.63 (ddt, *J* = 8.8, 4.4, 1.3 Hz, 1H), 7.50 (td, *J* = 7.8, 3.2 Hz, 2H), 3.51 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.7, 173.0, 142.1, 134.6, 133.6, 132.4, 130.2, 128.8, 128.1, 118.3, 116.8, 44.4. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{16}H_{12}N_2O_3NaS$ 335.0461); Found 335.0465.

Methyl 4-(*S*-methyl-*N*-(2-oxo-2-phenylacetyl)sulfonimidoyl)benzoate (3e)



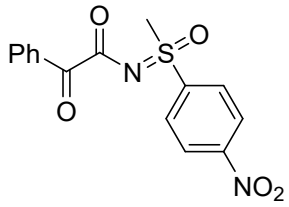
Yield 46.2 mg (67%, white solid); mp 92.8-94.8 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.34-8.23 (m, 2H), 8.16 (dd, *J* = 8.7, 2.4 Hz, 2H), 8.10-7.94 (m, 2H), 7.62 (t, *J* = 7.5 Hz, 1H), 7.48 (t, *J* = 7.9 Hz, 2H), 3.99 (s, 3H), 3.51 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.9, 173.1, 165.2, 141.6, 135.5, 134.4, 132.6, 131.0, 130.2, 128.7, 127.4, 52.9, 44.6. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{17}H_{15}NO_5NaS$ 368.0563); Found 368.0565.

***N*-((4-acetylphenyl)(methyl)(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3f)**



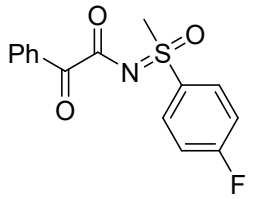
Yield 48.0 mg (73%, white solid); mp 119.1-121.1 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.17 (d, *J* = 2.8 Hz, 4H), 8.07-7.90 (m, 2H), 7.65-7.57 (m, 1H), 7.47 (td, *J* = 6.6, 5.3, 2.1 Hz, 2H), 3.49 (s, 3H), 2.67 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 196.5, 189.9, 173.2, 141.5, 141.4, 134.4, 132.6, 130.2, 129.6, 128.8, 127.7, 44.5, 27.0. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{17}H_{15}NO_4NaS$ 352.0614); Found 352.0617.

***N*-(methyl(4-nitrophenyl)(oxo)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3g)**



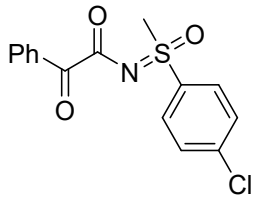
Yield 39.8 mg (60%, yellow solid); mp 123.2-124.5 °C. ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.64-8.51 (m, 2H), 8.44-8.29 (m, 2H), 7.86 (d, J = 7.6 Hz, 2H), 7.75 (t, J = 7.4 Hz, 1H), 7.61 (t, J = 7.7 Hz, 2H), 3.85 (d, J = 3.4 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, DMSO-d_6) δ 190.6, 173.1, 151.3, 143.6, 135.4, 132.5, 129.9, 129.7, 129.5, 125.4, 43.0. HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd ($C_{15}H_{13}N_2O_5S$ 333.0540); Found 333.0540.

***N*-((4-fluorophenyl)(methyl)(oxo)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide(3h)**



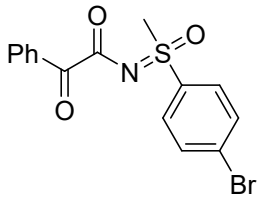
Yield 43.3 mg (71%, yellow solid); mp 109.1-110.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.15-8.08 (m, 2H), 8.07-8.00 (m, 2H), 7.65-7.58 (m, 1H), 7.49 (t, J = 7.8 Hz, 2H), 7.33 (t, J = 8.5 Hz, 2H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.1, 173.2, 166.3 (d, J = 256.3 Hz), 132.3 (d, J = 513.8 Hz), 133.4 (d, J = 2.5 Hz), 132.6, 130.2, 129.3 (d, J = 207.5 Hz), 128.7, 117.4 (d, J = 23.8 Hz), 45.0. ^{19}F NMR (471 MHz, Chloroform-*d*) δ -101.8. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{15}H_{12}NO_3NaSF$ 328.0414); Found 328.0417.

***N*-((4-chlorophenyl)(methyl)(oxo)- λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3i)**



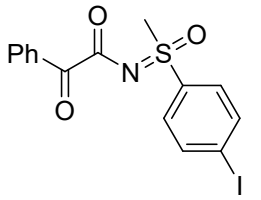
Yield 44.9 mg (70%, yellow solid); mp 84.3-85.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09-7.98 (m, 4H), 7.68-7.57 (m, 3H), 7.49 (t, J = 7.7 Hz, 2H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 173.2, 141.4, 136.1, 134.4, 133.8, 132.6, 130.3, 130.2, 128.7, 44.9. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{15}H_{12}NO_3NaSCl$ 344.0119); Found 344.0120.

***N*-((4-bromophenyl)(methyl)(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3j)**



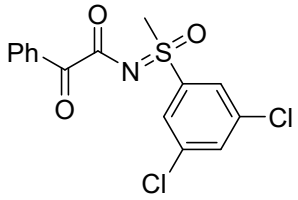
Yield 44.5 mg (61%, white solid); mp 114.9-116.0 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08-8.01 (m, 2H), 7.98-7.90 (m, 2H), 7.80 (dd, *J* = 8.6, 1.7 Hz, 1H), 7.66-7.58 (m, 2H), 7.49 (t, *J* = 7.8 Hz, 1H), 3.49 (s, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 173.2, 136.7, 134.4, 133.3, 132.6, 130.2, 130.0, 128.8, 128.7, 44.8. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{13}NO_2SBr$ 337.9845); Found 337.9855.

***N*-((4-iodophenyl)(methyl)(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3k)**



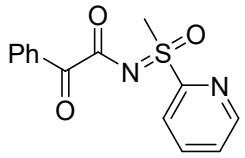
Yield 55.3 mg (67%, white solid); mp 126.3-128.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.11-7.96 (m, 4H), 7.79 (d, *J* = 8.3 Hz, 2H), 7.63 (t, *J* = 7.5 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H), 3.48 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 173.2, 139.3, 137.4, 134.4, 132.6, 130.2, 128.7, 128.5, 102.7, 44.8. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{12}NO_3NaSI$ 435.9475); Found 435.9482.

***N*-((3,5-dichlorophenyl)(methyl)(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3l)**



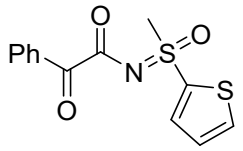
Yield 44.7 mg (63%, white solid); mp 100.5-100.9 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08-8.00 (m, 2H), 7.96 (t, *J* = 2.0 Hz, 2H), 7.71 (q, *J* = 2.1 Hz, 1H), 7.64 (t, *J* = 7.5 Hz, 1H), 7.51 (t, *J* = 7.8 Hz, 2H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.6, 173.0, 140.7, 137.1, 134.6, 134.5, 132.5, 130.2, 128.8, 125.7, 44.7. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{11}NO_3NaSCl_2$ 377.9729); Found 377.9731.

***N*-(methyl(oxo)(pyridin-2-yl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3m)**



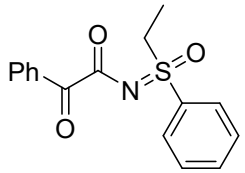
Yield 48.4 mg (84%, yellow liquid); mp 93.5-95.1 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.77 (dd, *J* = 4.7, 2.0 Hz, 1H), 8.37 (d, *J* = 8.0 Hz, 1H), 8.05 (td, *J* = 7.8, 1.7 Hz, 1H), 8.02-7.89 (m, 2H), 7.67-7.54 (m, 2H), 7.50-7.39 (m, 2H), 3.58 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 172.9, 155.8, 150.3, 138.6, 134.2, 132.8, 130.1, 128.7, 128.1, 123.6, 40.2. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{14}H_{12}N_2O_3NaS$ 311.0461); Found 311.0464.

***N*-(methyl(oxo)(thiophen-2-yl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3n)**



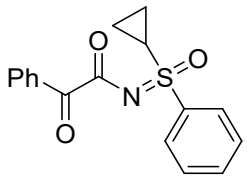
Yield 52.2 mg (89%, white solid); mp 89.2-89.9 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.31 (dt, *J* = 3.6, 1.8 Hz, 1H), 8.10-7.96 (m, 2H), 7.61 (td, *J* = 7.3, 3.7 Hz, 1H), 7.57 (dt, *J* = 5.5, 2.8 Hz, 1H), 7.54-7.50 (m, 1H), 7.48 (td, *J* = 7.8, 2.0 Hz, 2H), 3.55 (d, *J* = 2.3 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.2, 173.2, 136.8, 134.3, 133.3, 132.7, 130.2, 129.6, 128.7, 125.1, 45.1. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{13}H_{11}NO_3NaS_2$ 316.0073); Found 316.0074.

***N*-(ethyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3o)**



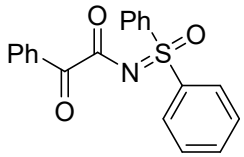
Yield 54.8 mg (91%, yellow solid); mp 92.6-94.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.10-7.98 (m, 4H), 7.77-7.69 (m, 1H), 7.68-7.55 (m, 3H), 7.47 (td, *J* = 7.9, 2.3 Hz, 2H), 3.60 (dddd, *J* = 28.8, 12.1, 8.3, 6.1 Hz, 2H), 1.32 (td, *J* = 7.4, 3.1 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.3, 173.5, 135.2, 134.5, 134.3, 132.8, 130.2, 129.9, 128.7, 128.0, 51.2, 6.9. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{16}H_{15}NO_3NaS$ 324.0665); Found 324.0669.

***N*-(cyclopropyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3p)**



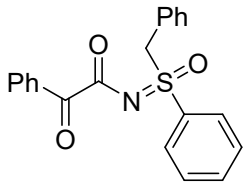
Yield 46.3 mg (74%, white solid); mp 93.4-94.4 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.03 (dd, *J* = 8.1, 2.9 Hz, 4H), 7.71 (dd, *J* = 8.9, 5.9 Hz, 1H), 7.67-7.55 (m, 3H), 7.47 (td, *J* = 7.8, 2.6 Hz, 2H), 3.00-2.59 (m, 1H), 1.71 (ddd, *J* = 9.9, 7.4, 4.7 Hz, 1H), 1.31 (dddt, *J* = 16.2, 12.5, 7.2, 4.7 Hz, 2H), 1.08 (qt, *J* = 8.3, 4.0 Hz, 1H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.3, 172.9, 137.9, 134.2, 134.1, 132.8, 130.2, 129.8, 128.7, 127.3, 33.7, 7.1, 5.6. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{17}H_{15}NO_3NaS$ 336.0665); Found 336.0669.

2-oxo-*N*-(oxodiphenyl-λ^6-sulfanylidene)-2-phenylacetamide (3q)



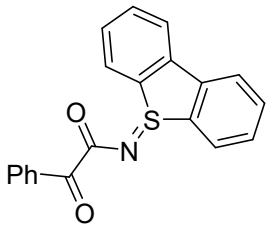
Yield 54.5 mg (78%, yellow solid); mp 80.1-81.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 7.6 Hz, 6H), 7.60 (dq, *J* = 28.3, 7.7 Hz, 7H), 7.50 (s, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.2, 173.3, 138.8, 134.3, 134.0, 133.9, 132.7, 130.3, 130.2, 129.8, 129.8, 128.7, 127.7, 127.6. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{20}H_{15}NO_3NaS$ 372.0665); Found 372.0669.

***N*-(benzyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3r)**



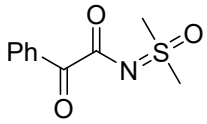
Yield 69.0 mg (95%, white solid); mp 153.1-155.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 7.7 Hz, 2H), 7.71 (d, *J* = 7.8 Hz, 2H), 7.63 (dt, *J* = 19.1, 7.6 Hz, 2H), 7.48 (td, *J* = 7.8, 3.9 Hz, 4H), 7.34 (t, *J* = 7.5 Hz, 1H), 7.24 (t, *J* = 7.6 Hz, 2H), 7.03 (d, *J* = 7.5 Hz, 2H), 5.01-4.80 (m, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.4, 173.7, 134.5, 134.3, 132.8, 131.4, 130.2, 129.6, 129.4, 128.7, 128.7, 128.5, 126.2, 62.8. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{21}H_{17}NO_3NaS$ 386.0821); Found 386.0824.

N-(5λ^4-dibenzo[b,d]thiophen-5-ylidene)-2-oxo-2-phenylacetamide (3s)



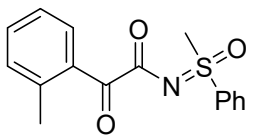
Yield 33.1 mg (50%, white solid); mp 220.9-221.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.32 (d, *J* = 7.8 Hz, 2H), 8.08 (d, *J* = 7.8 Hz, 2H), 7.86 (d, *J* = 7.8 Hz, 2H), 7.73 (t, *J* = 7.6 Hz, 2H), 7.61 (dt, *J* = 15.6, 7.6 Hz, 3H), 7.49 (t, *J* = 7.6 Hz, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 174.1, 136.1, 135.2, 134.3, 133.3, 132.9, 130.9, 130.2, 128.7, 125.8, 122.0. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{20}H_{13}NO_2NaS$ 354.0565); Found 354.0568.

***N*-(dimethyl(oxo)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3t)**



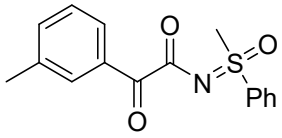
Yield 28.8 mg (64%, white solid); mp 96.5-97.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.13-8.00 (m, 2H), 7.64 (tt, *J* = 7.3, 1.4 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H), 3.47 (d, *J* = 1.7 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.2, 173.2, 134.3, 132.7, 130.2, 128.7, 42.2. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{10}H_{11}NO_3S$ 226.0532); Found 226.0535.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-(*o*-tolyl)acetamide (3u)**



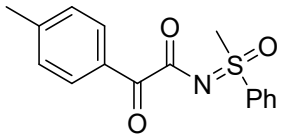
Yield 52.4 mg (87%, yellow solid); mp 130.6-132.9 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12-8.04 (m, 2H), 7.84 (d, *J* = 7.7 Hz, 1H), 7.73 (t, *J* = 7.5 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 2H), 7.45 (dt, *J* = 7.5, 3.8 Hz, 1H), 7.28 (d, *J* = 7.8 Hz, 2H), 3.49 (s, 3H), 2.64 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 192.6, 173.9, 141.2, 137.7, 134.4, 133.1, 132.7, 132.1, 131.6, 129.9, 127.2, 125.8, 44.8, 21.7. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{16}H_{15}NO_3NaS$ 324.0665); Found 324.0669.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-(m-tolyl)acetamide (3v)**



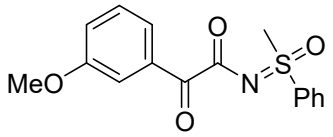
Yield 53.0 mg (88%, yellow solid); mp 104.9-106.1 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (dd, *J* = 7.7, 2.4 Hz, 2H), 7.85 (q, *J* = 3.8, 2.2 Hz, 2H), 7.77-7.71 (m, 1H), 7.69-7.60 (m, 2H), 7.43 (d, *J* = 7.6 Hz, 1H), 7.40-7.32 (m, 1H), 3.49 (s, 3H), 2.41 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.4, 173.5, 138.5, 137.7, 135.1, 134.5, 132.7, 130.5, 129.94, 128.6, 127.5, 127.2, 44.9, 21.3. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{16}H_{15}NO_3NaS$ 324.0665); Found 324.0661.

_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-(*p*-tolyl)acetamide (3w)



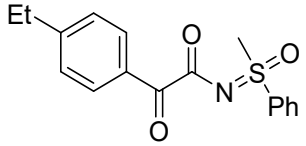
Yield 50.0 mg (83%, white solid); mp 131.2-133.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (dd, *J* = 7.3, 2.2 Hz, 2H), 7.99-7.93 (m, 2H), 7.77-7.69 (m, 1H), 7.68-7.61 (m, 2H), 7.28 (dd, *J* = 8.3, 2.8 Hz, 2H), 3.49 (s, 3H), 2.43 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.9, 173.5, 145.4, 137.7, 134.5, 130.4, 130.2, 129.9, 129.4, 127.2, 44.8, 21.9. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{16}H_{15}NO_3NaS$ 324.0665); Found 324.0660.

2-(3-methoxyphenyl)-_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxoacetamide (3x)



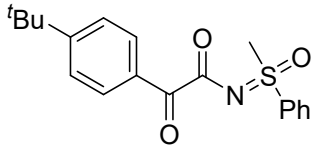
Yield 45.7 mg (72%, yello solid); mp 66-67 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12-8.02 (m, 2H), 7.78-7.71 (m, 1H), 7.69-7.60 (m, 3H), 7.59-7.54 (m, 1H), 7.39 (td, *J* = 8.0, 2.3 Hz, 1H), 7.22-7.13 (m, 1H), 3.85 (s, 3H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.0, 173.3, 159.8, 137.6, 134.5, 134.0, 130.0, 129.7, 127.2, 123.4, 121.4, 113.2, 55.5, 44.8. HRMS (ESI-TOF) m/z: [M+Na]$^{+}$ Calcd ($C_{16}H_{15}NO_4NaS$ 340.0614); Found 340.0610.

2-(4-ethylphenyl)-_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxoacetamide (3y)



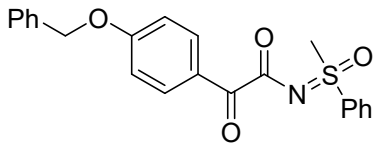
Yield 39.1 mg (62%, white solid); mp 120.5-122.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.13-8.05 (m, 2H), 7.99 (d, *J* = 7.9 Hz, 2H), 7.74 (t, *J* = 7.5 Hz, 1H), 7.66 (t, *J* = 7.7 Hz, 2H), 7.31 (d, *J* = 8.0 Hz, 2H), 3.49 (s, 3H), 2.72 (q, *J* = 7.6 Hz, 2H), 1.26 (t, *J* = 7.6 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.9, 173.6, 151.5, 137.8, 134.4, 130.5, 129.9, 128.3, 127.2, 44.9, 29.1, 15.1. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{17}H_{17}NO_3NaS$ 338.0821); Found 338.0818.

2-(4-(tert-butyl)phenyl)-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxoacetamide (3z)



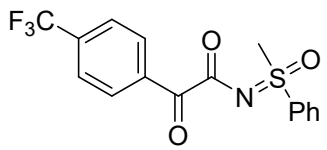
Yield 47.4 mg (69%, white solid); mp 105.6-107.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 7.8 Hz, 2H), 8.00 (d, *J* = 8.0 Hz, 2H), 7.79-7.70 (m, 1H), 7.70-7.61 (m, 2H), 7.50 (d, *J* = 8.1 Hz, 2H), 3.50 (s, 3H), 1.35 (s, 9H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 189.9, 173.5, 158.2, 137.8, 134.4, 130.2, 129.9, 127.2, 125.7, 44.8, 35.3, 31.1, 31.0. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{19}H_{21}NO_3NaS$ 366.1134); Found 366.1130.

2-(4-(benzyloxy)phenyl)-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxoacetamide (3aa)



Yield 53.5 mg (68%, white solid); mp 162.5-163.7 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.15-7.93 (m, 4H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.66 (t, *J* = 7.7 Hz, 2H), 7.48-7.31 (m, 5H), 7.03 (d, *J* = 8.9 Hz, 2H), 5.15 (s, 2H), 3.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 188.8, 173.7, 163.6, 137.7, 136.0, 134.4, 132.7, 129.9, 128.7, 128.3, 127.5, 127.2, 125.9, 114.9, 70.2, 44.9. HRMS (ESI-TOF) m/z: [M+Na]$^+$ Calcd ($C_{22}H_{19}NO_4NaS$ 416.0927); Found 416.0925.

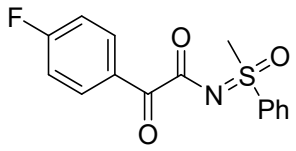
***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-(4-(trifluoromethyl)phenyl)acetamide (3ab)**



Yield 37.6 mg (53%, white solid); mp 121.2-124.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19 (d, *J* = 8.0 Hz, 2H), 8.14-8.04 (m, 2H), 7.76 (t, *J* = 6.9 Hz, 3H), 7.68 (t, *J* = 7.7 Hz, 2H), 3.51 (s, 3H).

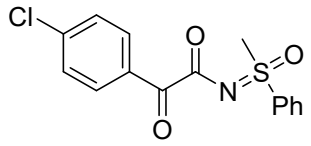
$^{13}C\{^{1}H\}$ NMR (125 MHz, Chloroform-*d*) δ 188.8, 172.2, 137.4, 135.6, 135.2 (d, *J* = 32.5 Hz), 134.6, 130.6, 130.0, 127.2, 125.7 (q, *J* = 3.8 Hz), 124.5 (d, *J* = 21.3 Hz), 44.9. ^{19}F NMR (471 MHz, $CDCl_3$) δ -63.25. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{16}H_{12}NO_3NaSF_3$ 378.0382); Found 378.0388.

2-(4-fluorophenyl)-*N*-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)-2-oxoacetamide (3ac)



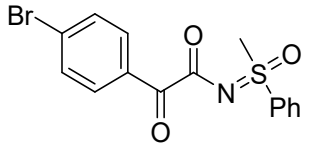
Yield 31.1 mg (51%, white solid); mp 128.5-129.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19-8.02 (m, 4H), 7.79-7.71 (m, 1H), 7.66 (td, *J* = 7.8, 2.8 Hz, 2H), 7.22-7.04 (m, 2H), 3.50 (s, 3H); $^{13}C\{^{1}H\}$ NMR (125 MHz, Chloroform-*d*) δ 188.5, 172.9, 166.5 (d, *J* = 255.0 Hz), 137.6, 134.5, 133.1, 133.0 (d, *J* = 10 Hz), 129.3 (d, *J* = 3.8 Hz), 127.2, 116.0 (d, *J* = 21.3 Hz), 44.9. ^{19}F NMR (471 MHz, Chloroform-*d*) δ -102.66, -102.68, -102.69. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{12}NO_3NaSF$ 328.0414); Found 328.0417.

2-(4-chlorophenyl)-*N*-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)-2-oxoacetamide (3ad)



Yield 44.3 mg (69%, white solid); mp 136.5-138.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12-8.05 (m, 2H), 8.02 (dd, *J* = 8.7, 1.9 Hz, 2H), 7.79-7.71 (m, 1H), 7.67 (dt, *J* = 9.1, 4.7 Hz, 2H), 7.48-7.43 (m, 2H), 3.50 (s, 3H); $^{13}C\{^{1}H\}$ NMR (125 MHz, Chloroform-*d*) δ 188.8, 172.7, 140.8, 137.6, 134.6, 131.6, 131.2, 130.0, 129.1, 127.2, 44.9. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{12}NO_3NaSCl$ 344.0119); Found 344.0110.

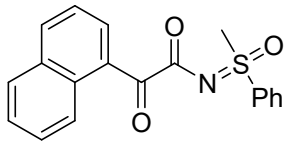
2-(4-bromophenyl)-*N*-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)-2-oxoacetamide (3ae)



Yield 38.0 mg (52%, white solid); mp 130.0-132.1 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12-8.05 (m, 2H), 7.94 (dd, *J* = 8.6, 3.2 Hz, 2H), 7.75 (t, *J* = 5.0 Hz, 2H), 7.66 (ddt, *J* = 17.6, 8.3, 3.1 Hz, 3H), 3.50 (s, 3H); $^{13}C\{^{1}H\}$ NMR (125 MHz, Chloroform-*d*) δ 189.0, 172.6, 137.6, 134.6, 132.0, 131.7,

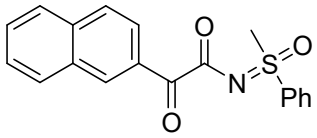
130.0, 129.8, 129.7, 127.2, 44.9. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{12}NO_3NaSBr$ 387.9613); Found 387.9613.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-(naphthalen-1-yl)-2-oxoacetamide (3af)**



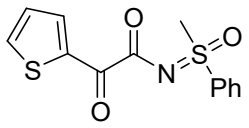
Yield 36.4 mg (54%, white solid); mp 143.1-144.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 9.11 (dd, *J* = 8.8, 3.9 Hz, 1H), 8.16 (d, *J* = 7.1 Hz, 1H), 8.13-8.01 (m, 3H), 7.91 (d, *J* = 8.0 Hz, 1H), 7.77-7.70 (m, 1H), 7.66 (q, *J* = 7.6, 6.3 Hz, 3H), 7.61-7.46 (m, 2H), 3.51 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 192.8, 173.9, 137.7, 135.1, 134.5, 134.2, 134.0, 131.3, 129.9, 128.8, 128.7, 128.6, 127.2, 126.7, 125.9, 124.5, 44.8. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{19}H_{15}NO_3NaS$ 360.0665); Found 360.0661.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-(naphthalen-2-yl)-2-oxoacetamide (3ag)**



Yield 39.8 mg (59%, white solid); mp 129.2-133.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.62 (s, 1H), 8.18-8.05 (m, 3H), 8.00-7.84 (m, 3H), 7.80-7.73 (m, 1H), 7.72-7.66 (m, 2H), 7.64 (ddd, *J* = 8.2, 6.8, 1.3 Hz, 1H), 7.57 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 3.52 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.1, 173.4, 137.7, 136.2, 134.5, 133.6, 132.4, 130.0, 130.0, 129.1, 128.7, 127.9, 127.3, 126.9, 124.4, 44.9. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{19}H_{15}NO_3NaS$ 360.0665); Found 360.0663.

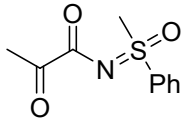
***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-(thiophen-2-yl)acetamide (3ah)**



Yield 36.3 mg (62%, yellow solid); mp 120.7-123.0 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.15-8.02 (m, 3H), 7.79-7.70 (m, 2H), 7.69-7.60 (m, 2H), 7.15 (t, *J* = 4.4 Hz, 1H), 3.49 (s, 3H); ^{13}C{^{1}H}

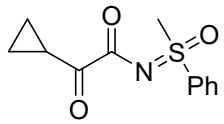
NMR (125 MHz, Chloroform-*d*) δ 180.8, 170.7, 139.1, 137.5, 136.9, 136.7, 134.5, 130.0, 128.3, 127.2, 44.7. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{13}H_{11}NO_3NaS_2$ 316.0073); Found 316.0078.

_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxopropanamide (3ai)



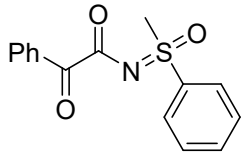
Yield 26.6 mg (59%, yellow solid); mp 77.6-78.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.02 (d, *J* = 7.9 Hz, 2H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 2H), 3.45 (s, 3H), 2.44 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 197.0, 169.8, 137.6, 134.4, 129.9, 127.1, 44.5, 26.0. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{10}H_{11}NO_3NaS$ 248.0352); Found 248.0359.

2-cyclopropyl-_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxoacetamide (3aj)



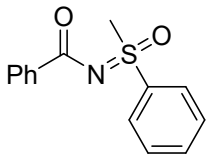
Yield 26 .1 mg (52%, white solid); mp 78.8-80.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.03 (d, *J* = 7.9 Hz, 2H), 7.73 (t, *J* = 7.5 Hz, 1H), 7.64 (t, *J* = 7.8 Hz, 2H), 3.45 (s, 3H), 2.79 (tt, *J* = 8.3, 4.5 Hz, 1H), 1.19 (t, *J* = 4.5 Hz, 2H), 1.12-1.04 (m, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 198.7, 170.0, 137.7, 134.4, 129.9, 127.1, 44.5, 17.1, 13.8, 13.7. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{12}H_{13}NO_3NaS$ 274.0508); Found 274.0511.

_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-2-oxo-2-phenylacetamide (3a) from gram scale



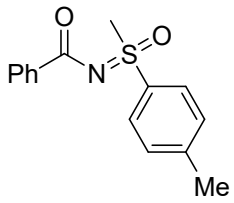
Yield 1305 mg (65%, white solid); mp 96.5-97.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.14-8.02 (m, 4H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.66 (t, *J* = 7.7 Hz, 2H), 7.64-7.57 (m, 1H), 7.48 (t, *J* = 7.7 Hz, 2H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 190.2, 173.3, 137.6, 134.5, 134.3, 132.7, 130.2, 130.0, 128.7, 127.2, 44.9.

_N_-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4a)



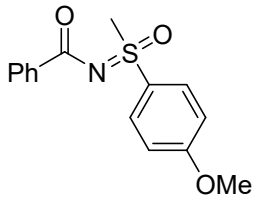
Yield 45.6 mg (88%, white solid); mp 78.5-79.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.23-8.15 (m, 2H), 8.09 (dd, *J* = 7.6, 2.0 Hz, 2H), 7.76-7.69 (m, 1H), 7.64 (ddd, *J* = 8.7, 6.7, 1.7 Hz, 2H), 7.54 (tt, *J* = 7.3, 1.5 Hz, 1H), 7.47-7.39 (m, 2H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 139.1, 135.6, 133.8, 132.2, 129.7, 129.5, 128.1, 127.2, 44.4. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{14}H_{13}NO_2NaS$ 282.0565); Found 282.0565.

***N*-(methyl(oxo)(p-tolyl)-λ^6-sulfanylidene)benzamide (4b)**



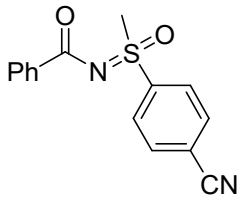
Yield 43.1 mg (79%, white solid); mp 92.0-92.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.23-8.17 (m, 2H), 7.96 (d, *J* = 8.6 Hz, 2H), 7.56-7.48 (m, 1H), 7.43 (t, *J* = 7.9 Hz, 4H), 3.48 (s, 3H), 2.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 144.9, 136.0, 135.7, 132.1, 130.3, 129.4, 128.0, 127.2, 44.5, 21.6. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{15}NO_2S$ 274.0896); Found 274.0893.

***N*-((4-methoxyphenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4c)**



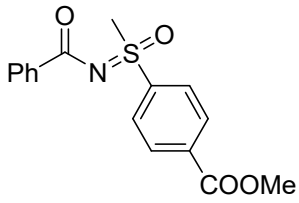
Yield 41.0 mg (71%, white solid); mp 88.8-89.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19 (d, *J* = 7.8 Hz, 2H), 8.03-7.96 (m, 2H), 7.52 (t, *J* = 7.1 Hz, 1H), 7.43 (t, *J* = 7.6 Hz, 2H), 7.08 (d, *J* = 9.4 Hz, 2H), 3.90 (s, 3H), 3.47 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 163.9, 135.8, 132.1, 130.1, 129.4, 129.4, 128.0, 114.9, 55.8, 44.7. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{15}NO_3S$ 290.0845); Found 290.0841.

***N*-((4-cyanophenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4d)**



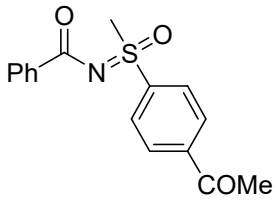
Yield 42.0 mg (74%, white solid); mp 135.5-136.7 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19 (dd, *J* = 8.5, 1.7 Hz, 2H), 8.17-8.12 (m, 2H), 7.93 (d, *J* = 8.5 Hz, 2H), 7.56 (td, *J* = 7.3, 1.5 Hz, 1H), 7.44 (t, *J* = 7.8 Hz, 2H), 3.48 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 143.6, 134.9, 133.4, 132.6, 129.5, 128.2, 128.0, 117.6, 117.0, 44.0. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{12}N_2O_2S$ 285.0692); Found 285.0689.

Methyl 4-(*N*-benzoyl-S-methylsulfonimidoyl)benzoate (4e)



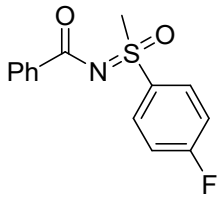
Yield 41.2 mg (65%, white solid); mp 138.6-140.0 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.28 (dd, *J* = 8.5, 1.9 Hz, 2H), 8.21-8.10 (m, 4H), 7.55 (td, *J* = 7.3, 1.6 Hz, 1H), 7.44 (t, *J* = 7.8 Hz, 2H), 4.00 (s, 3H), 3.50 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 165.4, 143.1, 135.2, 135.0, 132.4, 130.8, 129.5, 128.1, 127.4, 52.8, 44.2. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{16}H_{15}NO_4S$ 318.0794); Found 318.0792.

***N*-((4-acetylphenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4f)**



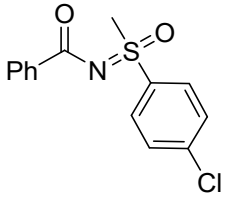
Yield 37.9 mg (63%, white solid); mp 118.6-120.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.22-7.43 (m, 6H), 7.55 (t, *J* = 7.3 Hz, 1H), 7.44 (t, *J* = 7.6 Hz, 2H), 3.49 (s, 3H), 2.69 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 196.6, 174.2, 143.1, 141.0, 135.2, 132.4, 129.5, 129.4, 128.1, 127.7, 44.1, 27.0. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{16}H_{15}NO_3S$ 302.0845); Found 302.0843.

***N*-((4-fluorophenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4g)**



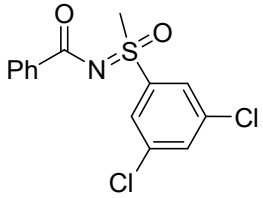
Yield 33.8 mg (61%, white solid); mp 108.6-109.4 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.22-8.15 (m, 2H), 8.11 (ddd, *J* = 9.1, 4.9, 2.3 Hz, 2H), 7.54 (td, *J* = 7.1, 1.4 Hz, 1H), 7.44 (t, *J* = 7.7 Hz, 2H), 7.31 (t, *J* = 8.5 Hz, 2H), 3.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 165.9 (d, J_{C-F} = 265 Hz), 135.4, 134.9 (d, J_{C-F} = 3.75 Hz), 131.2 (d, J_{C-F} = 271 Hz), 130.1, 128.8 (d, J_{C-F} = 169 Hz), 128.5, 117.1 (d, J_{C-F} = 22.5 Hz), 44.6. ^{19}F NMR (471 MHz, Chloroform-*d*) δ -103.3, -103.3, -103.3, -103.3, -103.3. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{12}FNO_2S$ 278.0646); Found 278.0650.

***N*-((4-chlorophenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4h)**



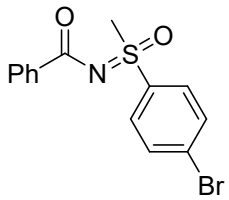
Yield 39.3 mg (67%, white solid); mp 136.7-137.9 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.21-8.11 (m, 2H), 8.02 (d, *J* = 8.6 Hz, 2H), 7.61 (d, *J* = 8.6 Hz, 2H), 7.57-7.49 (m, 1H), 7.44 (t, *J* = 7.7 Hz, 2H), 3.48 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 140.7, 137.5, 135.3, 132.4, 130.1, 129.5, 128.7, 128.1, 44.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{12}ClNO_2S$ 294.0350); Found 294.0349.

***N*-((3,5-dichlorophenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4i)**



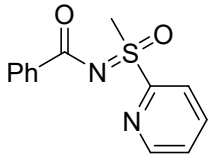
Yield 41.2 mg (63%, white solid); mp 137.9-139.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.20-8.10 (m, 2H), 7.92 (d, *J* = 1.9 Hz, 2H), 7.67 (t, *J* = 1.9 Hz, 1H), 7.55 (td, *J* = 7.2, 1.5 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 3.47 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.1, 142.2, 136.8, 134.9, 133.9, 132.6, 129.5, 128.2, 125.7, 44.3. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{11}Cl_2NO_2S$ 327.9960); Found 327.9962.

***N*-((4-bromophenyl)(methyl)(oxo)-λ^6-sulfanylidene)benzamide (4j)**



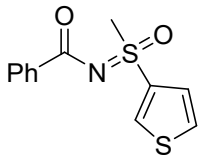
Yield 35.0 mg (52%, white solid); mp 142.2-144.0 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.19-8.14 (m, 2H), 7.93 (dd, *J* = 8.7, 3.0 Hz, 2H), 7.77 (dd, *J* = 8.6, 3.0 Hz, 2H), 7.54 (t, *J* = 7.6 Hz, 1H), 7.44 (td, *J* = 7.7, 2.9 Hz, 2H), 3.47 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 138.1, 135.3, 133.1, 132.4, 129.47, 129.2, 128.8, 128.1, 44.4. HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd ($C_{14}H_{13}NO_2SBr$ 337.9850); Found 337.9855.

***N*-(methyl(oxo)(pyridin-2-yl)-λ^6-sulfanylidene)benzamide (4k)**



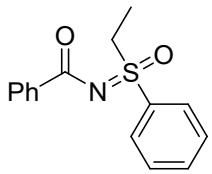
Yield 34.3 mg (66%, yellow solid); mp 101.0-103.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.75-8.68 (m, 1H), 8.40 (d, *J* = 8.0 Hz, 1H), 8.18-8.10 (m, 2H), 8.05 (td, *J* = 7.9, 1.8 Hz, 1H), 7.58 (dd, *J* = 7.7, 4.7 Hz, 1H), 7.53-7.46 (m, 1H), 7.40 (t, *J* = 7.6 Hz, 2H), 3.58 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 157.1, 150.0, 138.3, 135.2, 132.2, 129.5, 128.0, 127.3, 123.4, 39.8. HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd ($C_{13}H_{12}N_2O_2S$ 261.0692); Found 261.0690.

***N*-(methyl(oxo)(thiophen-3-yl)-λ^6-sulfanylidene)benzamide (4l)**



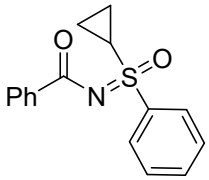
Yield 37.6 mg (71%, green solid); mp 104.6-106.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.29 (dd, *J* = 3.1, 1.5 Hz, 1H), 8.23-8.12 (m, 2H), 7.53 (pt, *J* = 3.5, 2.2, 1.6 Hz, 3H), 7.44 (t, *J* = 7.6 Hz, 2H), 3.56 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.1, 138.7, 135.5, 132.4, 132.2, 129.4, 128.9, 128.1, 125.4, 44.6. HRMS (ESI-TOF) m/z: [M+H]$^+$ Calcd ($C_{12}H_{11}NO_2S_2$ 266.0304); Found 266.0297.

***N*-(ethyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4m)**



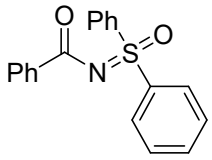
Yield 37.7 mg (69%, black solid); mp 120.0-122.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.20 (d, *J* = 7.7 Hz, 2H), 8.03 (d, *J* = 7.4 Hz, 2H), 7.70 (t, *J* = 7.3 Hz, 1H), 7.63 (t, *J* = 7.6 Hz, 2H), 7.53 (t, *J* = 6.8 Hz, 1H), 7.44 (t, *J* = 7.4 Hz, 2H), 3.69-3.59 (m, 2H), 1.37-1.33 (m, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 136.6, 135.7, 133.8, 132.1, 129.6, 129.5, 128.0, 50.7, 7.3. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{15}NO_2S$ 274.0896); Found 274.0893.

***N*-(cyclopropyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4n)**



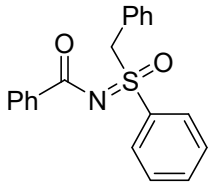
Yield 31.9 mg (56%, white solid); mp 140.7-142.4 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.22-8.11 (m, 2H), 8.04-7.95 (m, 2H), 7.70-7.63 (m, 1H), 7.60 (t, *J* = 7.7 Hz, 2H), 7.55-7.48 (m, 1H), 7.43 (t, *J* = 7.6 Hz, 2H), 2.80 (tt, *J* = 7.9, 4.8 Hz, 1H), 1.74 (ddt, *J* = 10.3, 7.3, 5.1 Hz, 1H), 1.46 (ddt, *J* = 10.4, 7.2, 5.1 Hz, 1H), 1.35-1.23 (m, 1H), 1.10 (dtd, *J* = 9.1, 7.5, 5.4 Hz, 1H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.7, 139.3, 135.8, 133.4, 132.1, 129.6, 129.4, 128.0, 127.3, 33.4, 7.0, 5.5. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{16}H_{15}NO_2S$ 286.0896); Found 286.0890.

***N*-(oxodiphenyl-λ^6-sulfanylidene)benzamide (4o)**



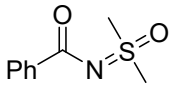
Yield 39.8 mg (62%, yellow solid); mp 118.2-119.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.28 (d, *J* = 7.7 Hz, 2H), 8.16-8.01 (m, 4H), 7.57 (dt, *J* = 15.6, 7.3 Hz, 7H), 7.46 (t, *J* = 7.7 Hz, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.9, 139.9, 135.8, 133.9, 133.3, 132.3, 129.8, 129.6, 129.6, 128.1, 127.7, 127.6, 124.8. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{19}H_{15}NO_2S$ 322.0896); Found 322.0893.

***N*-(benzyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4p)**



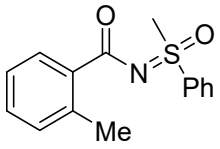
Yield 49.6 mg (74%, white solid); mp 128.2-129.7 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.21 (d, *J* = 8.4 Hz, 2H), 7.73 (d, *J* = 7.9 Hz, 2H), 7.65 (t, *J* = 7.5 Hz, 1H), 7.55 (t, *J* = 7.4 Hz, 1H), 7.52-7.41 (m, 4H), 7.32 (t, *J* = 7.5 Hz, 1H), 7.23 (t, *J* = 7.7 Hz, 2H), 7.03 (d, *J* = 7.3 Hz, 2H), 5.07-4.69 (m, 2H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.6, 135.8, 135.6, 133.8, 132.2, 131.3, 129.5, 129.1, 129.1, 128.6, 128.5, 128.1, 127.4, 62.2. HRMS (ESI-TOF) m/z: [M+H]$^{+}$ Calcd ($C_{20}H_{17}NO_2S$ 336.1052); Found 336.1051.

_N_-(dimethyl(oxo)- λ^6-sulfanylidene)benzamide (4q)



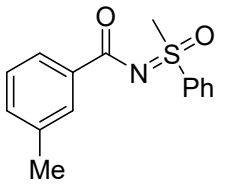
Yield 26.0 mg (66%, yellow solid); mp 76.2-77.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.20-8.10 (m, 2H), 7.53 (td, *J* = 7.2, 1.5 Hz, 1H), 7.43 (td, *J* = 7.6, 1.7 Hz, 2H), 3.41 (d, *J* = 2.0 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.2, 135.4, 132.2, 129.3, 128.1, 41.8. HRMS (ESI-TOF) m/z: [M+H]$^{+}$ Calcd ($C_9H_{11}NO_2S$ 198.0583); Found 198.0582.

2-methyl-_N_-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)benzamide (4r)



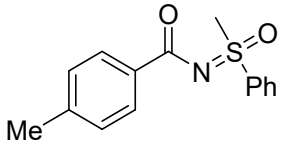
Yield 36.0 mg (66%, white solid); mp 155.7-158.4 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (dt, *J* = 7.6, 2.5 Hz, 3H), 7.71 (dd, *J* = 8.4, 6.4 Hz, 1H), 7.65 (td, *J* = 7.5, 7.0, 3.7 Hz, 2H), 7.36 (td, *J* = 7.5, 1.7 Hz, 1H), 7.27-7.18 (m, 2H), 3.46 (s, 3H), 2.62 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 176.6, 139.3, 139.1, 135.3, 133.8, 131.6, 131.0, 130.6, 129.7, 127.2, 125.4, 44.5, 21.8. HRMS (ESI-TOF) m/z: [M+H]$^{+}$ Calcd ($C_{15}H_{15}NO_2S$ 274.0896); Found 274.0894.

3-methyl-_N_-(methyl(oxo)(phenyl)- λ^6-sulfanylidene)benzamide (4s)



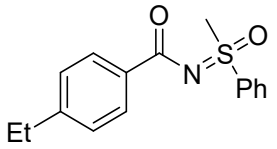
Yield 38.8 mg (71%, white solid); mp 66.7-68.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08 (dd, *J* = 7.3, 1.8 Hz, 2H), 8.00 (d, *J* = 8.3 Hz, 2H), 7.75-7.68 (m, 1H), 7.64 (t, *J* = 7.7 Hz, 2H), 7.37-7.30 (m, 2H), 3.49 (s, 3H), 2.42 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.5, 139.1, 137.8, 135.5, 133.8, 133.0, 130.0, 129.7, 128.0, 127.2, 126.6, 44.4, 21.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{15}NO_2S$ 274.0896); Found 274.0892.

4-methyl-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4t)



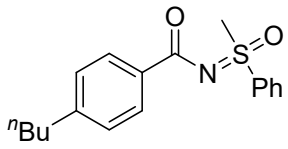
Yield 42.1 mg (77%, white solid); mp 167.5-168.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 7.7 Hz, 4H), 7.71 (t, *J* = 7.4 Hz, 1H), 7.64 (t, *J* = 7.8 Hz, 2H), 7.24 (d, *J* = 7.9 Hz, 2H), 3.49 (s, 3H), 2.43 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 142.7, 139.2, 133.8, 132.9, 129.7, 129.5, 128.8, 127.2, 44.4, 21.6. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{15}NO_2S$ 274.0896); Found 274.0894.

4-ethyl-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4u)



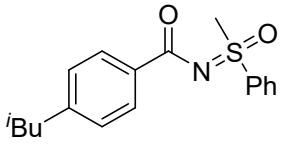
Yield 41.3 mg (72%, white solid); mp 110.9-112.0 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.16-8.05 (m, 4H), 7.71 (dd, *J* = 8.5, 6.6 Hz, 1H), 7.64 (t, *J* = 7.9 Hz, 2H), 7.28 (d, *J* = 6.0 Hz, 2H), 3.49 (s, 3H), 2.72 (q, *J* = 7.7 Hz, 2H), 1.28 (t, *J* = 7.5 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 149.0, 139.2, 133.8, 133.2, 129.7, 129.6, 127.6, 127.2, 44.4, 29.0, 15.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{16}H_{17}NO_2S$ 288.1053); Found 288.1052.

4-butyl-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4v)



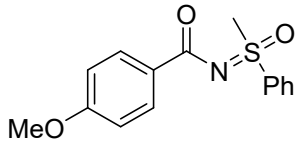
Yield 36.6 mg (58%, white solid); mp 103.8-104.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.09 (t, *J* = 8.5 Hz, 4H), 7.71 (t, *J* = 7.4 Hz, 1H), 7.63 (t, *J* = 7.6 Hz, 2H), 7.24 (d, *J* = 7.9 Hz, 2H), 3.48 (s, 3H), 2.68 (t, *J* = 7.8 Hz, 2H), 1.64 (q, *J* = 7.8 Hz, 2H), 1.38 (h, *J* = 7.6 Hz, 2H), 0.95 (t, *J* = 7.4 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 147.7, 139.2, 133.8, 133.1, 129.7, 129.5, 128.2, 127.2, 44.4, 35.7, 33.4, 22.3, 14.0. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{18}H_{21}NO_2S$ 316.1366); Found 316.1363.

4-isobutyl-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4w)



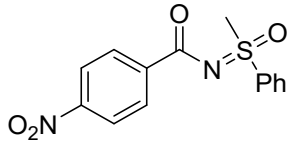
Yield 41.6 mg (66%, yellow solid); mp 108.7-109.1 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.14-8.00 (m, 4H), 7.71 (t, *J* = 7.4 Hz, 1H), 7.64 (t, J = 7.7 Hz, 2H), 7.21 (d, *J* = 7.9 Hz, 2H), 3.49 (s, 3H), 2.55 (d, *J* = 7.1 Hz, 2H), 1.92 (dh, *J* = 13.5, 6.4 Hz, 1H), 0.92 (d, *J* = 6.6 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.4, 146.5, 139.2, 133.8, 133.2, 129.7, 129.4, 128.9, 127.2, 45.4, 44.4, 30.2, 22.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{18}H_{21}NO_2S$ 316.1366); Found 316.1363.

4-methoxy-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4x)



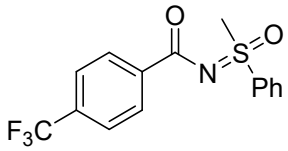
Yield 42.2 mg (73%, yellow solid); mp 128.9-130.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 7.6 Hz, 3H), 7.71 (t, *J* = 7.3 Hz, 1H), 7.64 (t, *J* = 7.6 Hz, 2H), 7.28 (s, 1H), 7.24 (d, *J* = 7.9 Hz, 2H), 3.49 (s, 3H), 2.43 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 142.7, 139.2, 133.8, 132.9, 129.7, 129.5, 128.8, 127.2, 44.4, 21.6. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{15}H_{15}NO_3S$ 312.0665); Found 312.0665.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-4-nitrobenzamide (4y)**



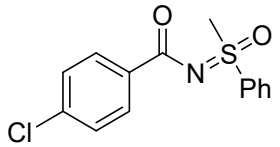
Yield 35.8 mg (59%, yellow solid); mp 87.1-88.6 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 8.4 Hz, 2H), 8.07 (d, *J* = 7.4 Hz, 2H), 7.72 (t, *J* = 7.4 Hz, 1H), 7.65 (t, *J* = 7.6 Hz, 2H), 7.40 (d, *J* = 8.5 Hz, 2H), 3.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.2, 138.8, 138.5, 134.1, 133.9, 130.9, 129.8, 128.3, 127.2, 44.4.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)-4-(trifluoromethyl)benzamide (4z)**



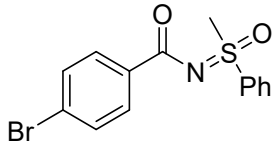
Yield 41.2 mg (63%, white solid); mp 116.8-117.8 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.29 (d, *J* = 8.0 Hz, 2H), 8.08 (d, *J* = 7.3 Hz, 2H), 7.74 (t, *J* = 7.4 Hz, 1H), 7.71-7.62 (m, 4H), 3.51 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 172.9, 138.8, 138.6, 134.1, 133.6 (d, $J_{C\text{-}F}$ = 32.5 Hz), 129.8, 129.8, 127.1, 125.1 (q, $J_{C\text{-}F}$ = 3.8 Hz), 122.8, 44.4. ^{19}F NMR (471 MHz, Chloroform-*d*) δ -62.9. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{15}H_{12}F_3NO_2S$ 328.0614); Found 328.0613.

4-chloro-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4aa)



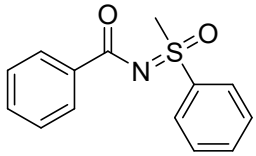
Yield 36.9 mg (65%, white solid); mp 102.6-105.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 8.5 Hz, 2H), 8.07 (dd, *J* = 7.6, 1.8 Hz, 2H), 7.73 (dd, *J* = 8.4, 6.4 Hz, 1H), 7.65 (t, *J* = 7.7 Hz, 2H), 7.40 (d, *J* = 8.5 Hz, 2H), 3.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.2, 138.9, 138.5, 134.1, 133.9, 130.9, 129.8, 128.3, 127.2, 44.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{12}ClNO_2S$ 294.0350); Found 294.0351.

4-bromo-*N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4ab)



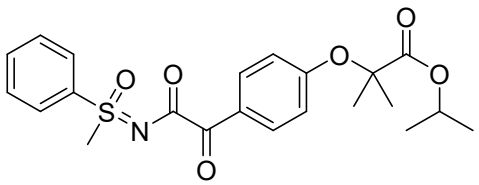
Yield 46.5 mg (69%, white solid); mp 118.1-119.3 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.06 (ddd, *J* = 10.9, 5.8, 2.0 Hz, 4H), 7.76-7.69 (m, 1H), 7.68-7.61 (m, 2H), 7.57 (dd, *J* = 8.6, 2.2 Hz, 2H), 3.49 (s, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.4, 138.8, 134.5, 134.0, 131.3, 131.1, 129.8, 127.2, 127.2, 44.4. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{14}H_{12}BrNO_2S$ 337.9845); Found 337.9842.

***N*-(methyl(oxo)(phenyl)-λ^6-sulfanylidene)benzamide (4a) from gram scale**



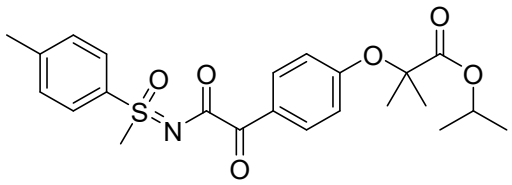
Yield 1033 mg (57%, white solid); mp 78.5-79.2 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.23-8.17 (m, 2H), 8.09 (dd, *J* = 7.6, 2.0 Hz, 2H), 7.75-7.68 (m, 1H), 7.64 (ddd, *J* = 8.7, 6.7, 1.7 Hz, 2H), 7.56-7.49 (m, 1H), 7.44 (t, *J* = 7.7 Hz, 2H), 3.50 (d, *J* = 2.0 Hz, 3H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 174.3, 139.1, 135.6, 133.8, 132.2, 129.7, 129.5, 128.1, 127.2, 44.4.

Isopropyl 2-methyl-2-(4-(2-((methyl(oxo)(phenyl)-λ^6-sulfanylidene)amino)-2-oxoacetyl)phenoxy)propanoate (5a)



Yield 49.1 mg (67%, white solid); mp 178.8-179.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.14-8.03 (m, 2H), 8.03-7.93 (m, 2H), 7.73 (dd, *J* = 8.4, 6.4 Hz, 1H), 7.65 (t, *J* = 7.9 Hz, 2H), 6.89-6.73 (m, 2H), 5.07 (hept, *J* = 6.3 Hz, 1H), 3.48 (s, 3H), 1.65 (s, 6H), 1.19 (d, *J* = 6.3 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 188.8, 173.6, 173.0, 160.9, 137.7, 134.42, 132.2, 129.9, 127.2, 126.0, 117.3, 79.5, 69.4, 44.8, 25.3, 21.5. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{22}H_{25}NO_6NaS$ 454.1295); Found 454.1292.

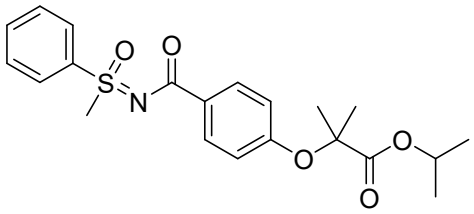
Isopropyl 2-methyl-2-(4-(2-((methyl(oxo)(p-tolyl)-λ^6-sulfanylidene)amino)-2-oxoacetyl)phenoxy)propanoate (5b)



Yield 57.0 mg (64%, white solid); mp 174.8-175.5 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.04-7.91 (m, 4H), 7.44 (d, *J* = 8.0 Hz, 2H), 6.84 (d, *J* = 8.9 Hz, 2H), 5.08 (hept, *J* = 6.3 Hz, 1H), 3.46 (s, 3H), 2.49 (s, 3H), 1.65 (s, 6H), 1.19 (d, *J* = 6.4 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 188.9,

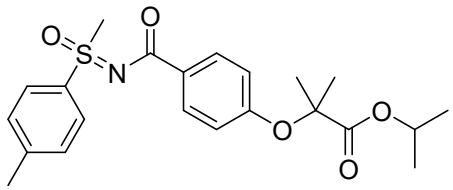
173.0, 145.7, 134.6, 132.2, 130.5, 126.1, 117.3, 79.5, 69.4, 45.0, 25.3, 21.7, 21.5. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{23}H_{27}NO_6NaS$ 468.1451); Found 468.1450.

Isopropyl 2-methyl-2-(4-((methyl(oxo)(phenyl)- λ^6-sulfanylidene)carbamoyl)phenoxy)propanoate (6a)



Yield 37.1 mg (46%, white solid); mp 116.8-117.8 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.08 (ddd, *J* = 8.2, 5.4, 2.0 Hz, 4H), 7.71 (td, *J* = 7.1, 1.4 Hz, 1H), 7.66-7.58 (m, 2H), 6.83 (dd, *J* = 9.0, 2.2 Hz, 2H), 5.09 (h, *J* = 6.2 Hz, 1H), 3.48 (s, 3H), 1.65 (s, 6H), 1.21 (dd, *J* = 6.4, 1.7 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.8, 173.5, 159.2, 139.2, 133.8, 131.0, 129.7, 128.9, 127.2, 117.1, 79.2, 69.2, 44.4, 29.7, 25.4, 25.3, 21.5. HRMS (ESI-TOF) m/z: $[M+H]^+$ Calcd ($C_{21}H_{25}NO_5S$ 404.1526); Found 404.1525.

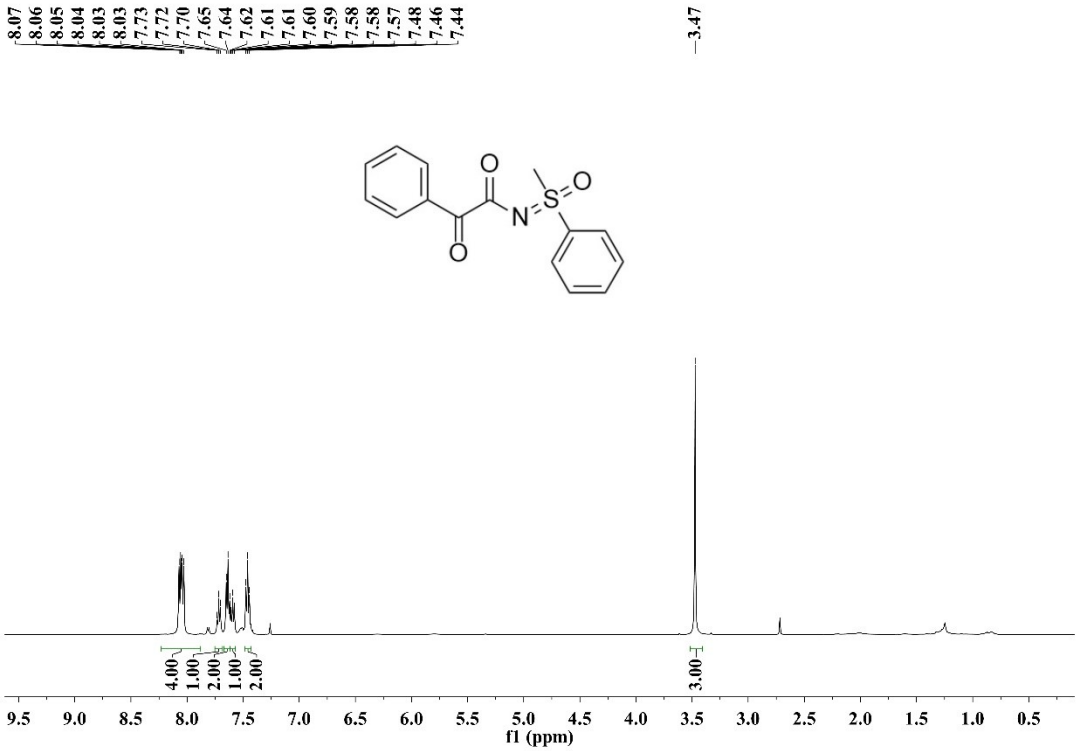
Isopropyl 2-methyl-2-(4-((methyl(oxo)(p-tolyl)- λ6-sulfanylidene)carbamoyl)phenoxy)propanoate (6b)



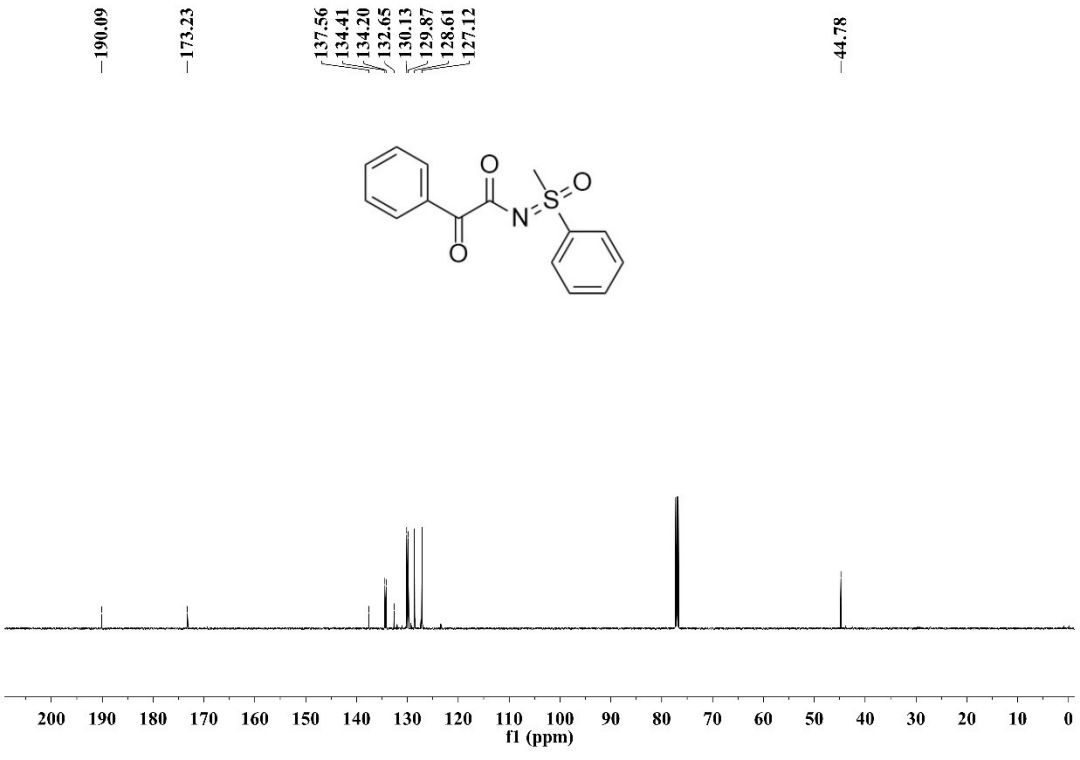
Yield 42.5 mg (51%, white solid); mp 118.5-119.8 °C. ^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.14-8.03 (m, 2H), 7.94 (dd, *J* = 6.3, 4.5 Hz, 2H), 7.42 (d, *J* = 7.9 Hz, 2H), 6.88-6.76 (m, 2H), 5.09 (p, *J* = 6.3 Hz, 1H), 3.45 (s, 3H), 2.48 (s, 3H), 1.65 (s, 6H), 1.21 (dd, *J* = 6.3, 1.7 Hz, 6H); ^{13}C{^{1}H} NMR (125 MHz, Chloroform-*d*) δ 173.8, 173.5, 159.1, 144.8, 136.1, 131.0, 130.3, 129.0, 127.2, 117.1, 79.17, 69.2, 44.5, 25.4, 25.3, 21.5. HRMS (ESI-TOF) m/z: $[M+Na]^+$ Calcd ($C_{22}H_{27}NO_5NaS$ 440.1502); Found 440.1503.

I. Copies of ^{1}H and ^{13}C NMR Spectra

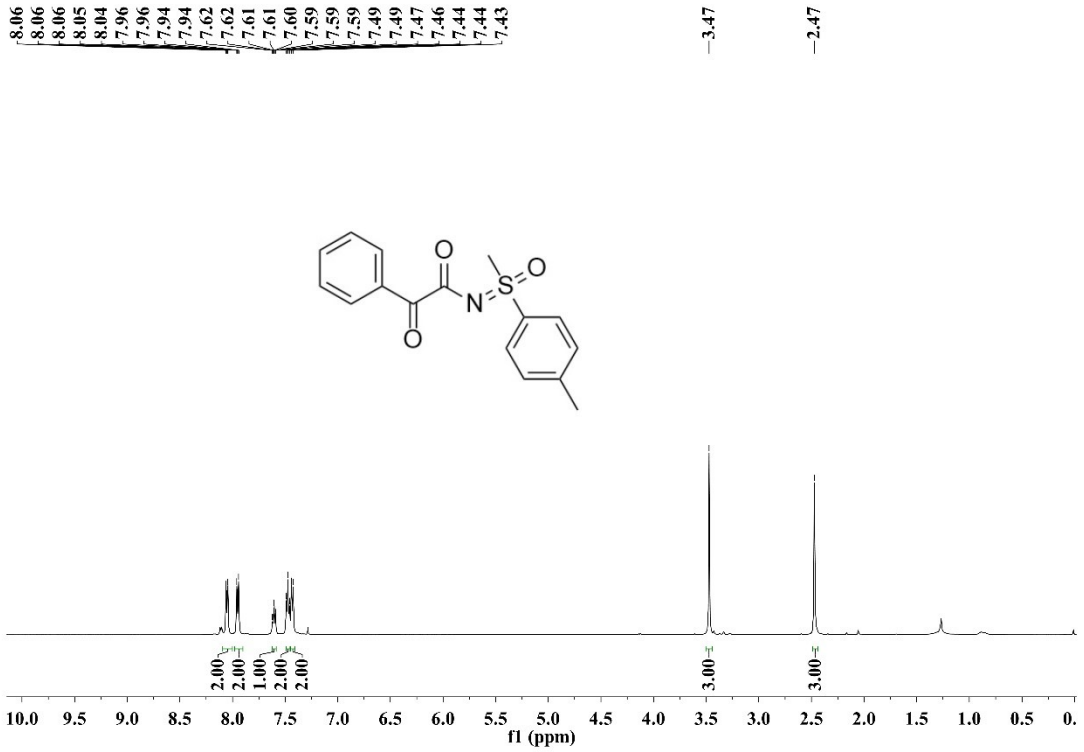
^{1}H NMR spectrum of 3a (500 MHz, $CDCl_3$)



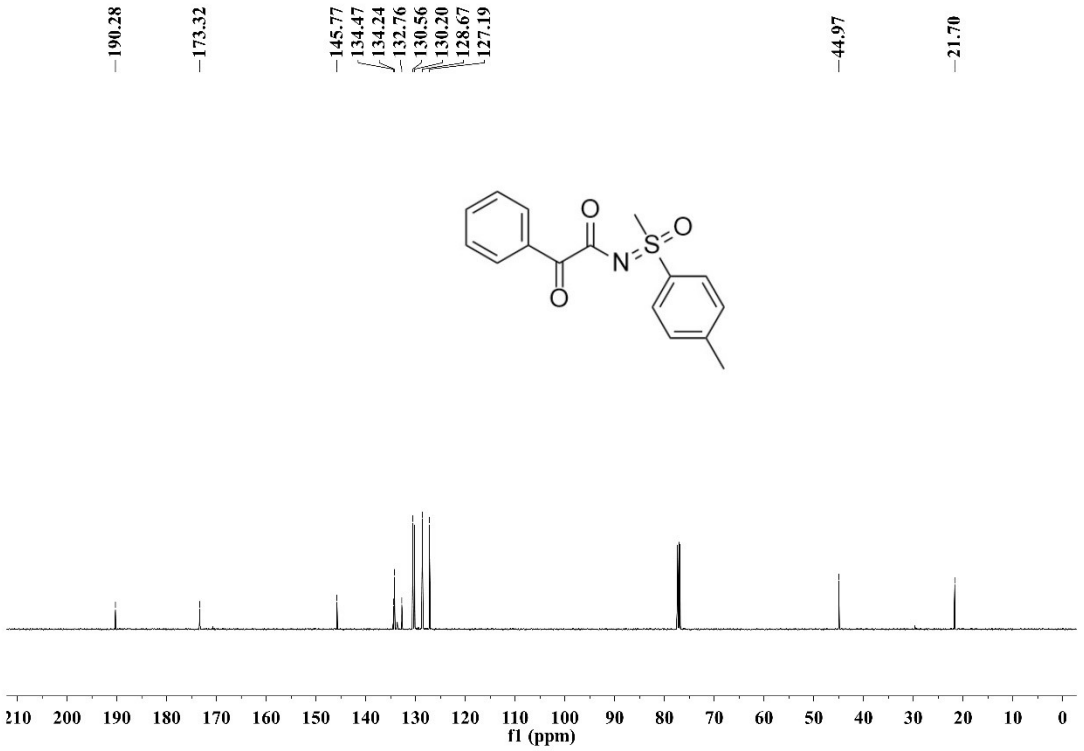
$^{13}C\{^{1}H\}$ NMR spectrum of 3a (125 MHz, $CDCl_3$)



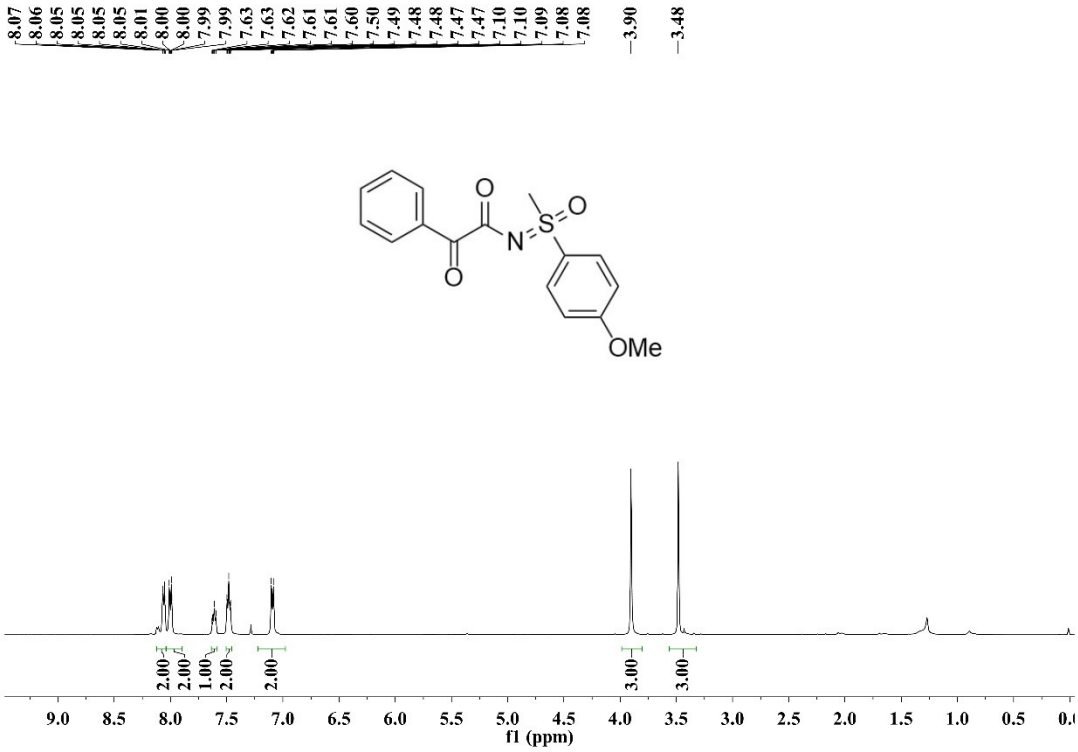
^{1}H NMR spectrum of 3b (500 MHz, $CDCl_3$)



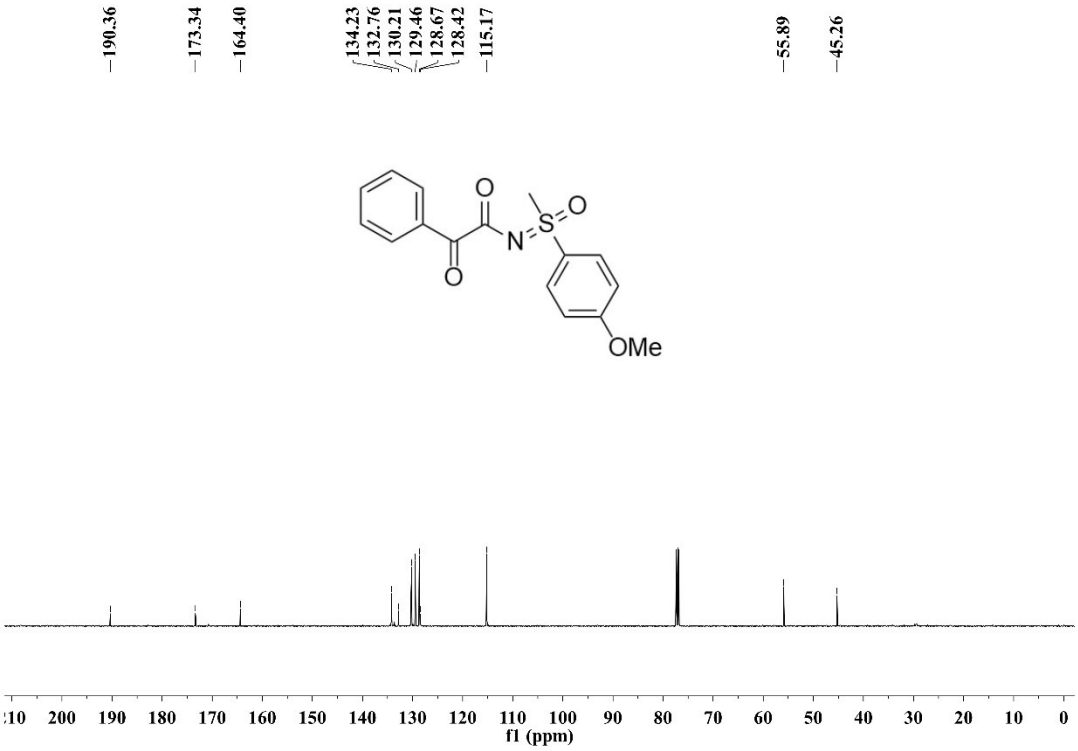
^{13}C{^{1}H} NMR spectrum of 3b (125 MHz, $CDCl_3$)



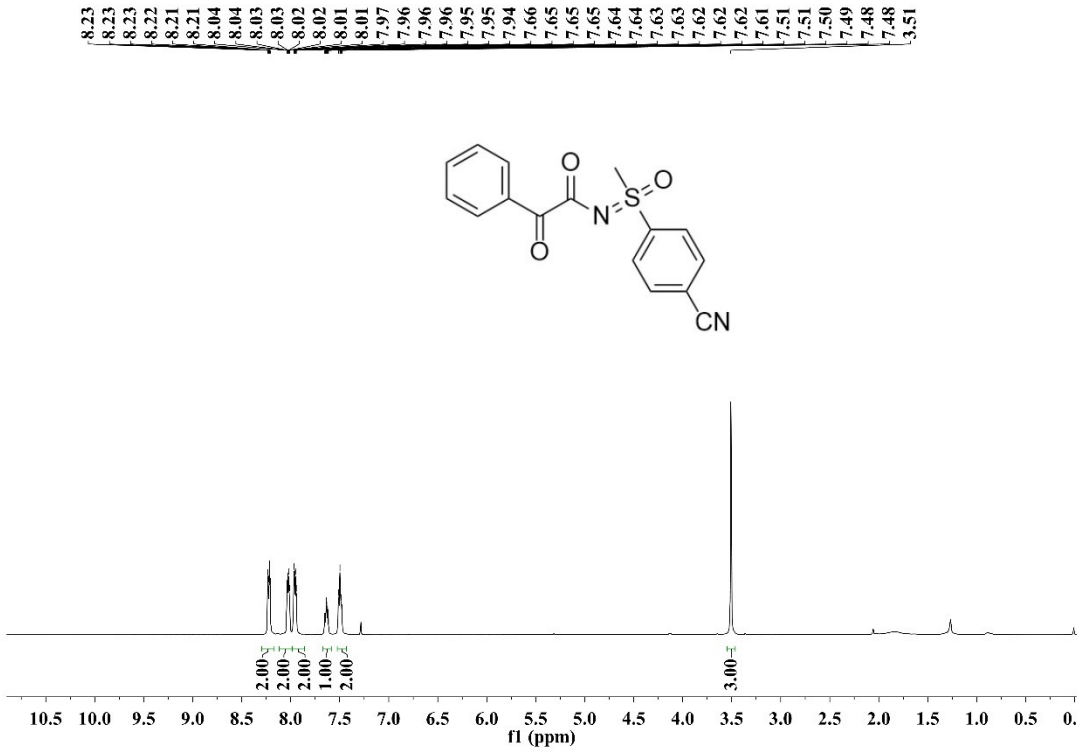
^{1}H NMR spectrum of 3c (500 MHz, $CDCl_3$)



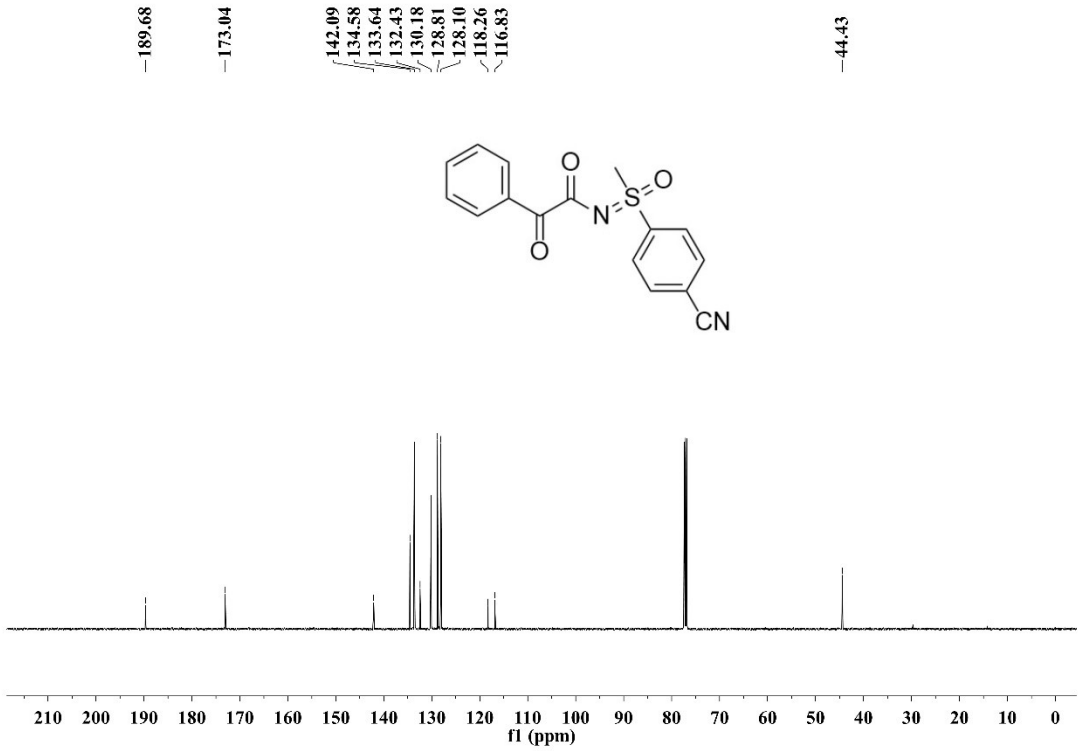
^{13}C{^{1}H} NMR spectrum of 3c (125 MHz, $CDCl_3$)



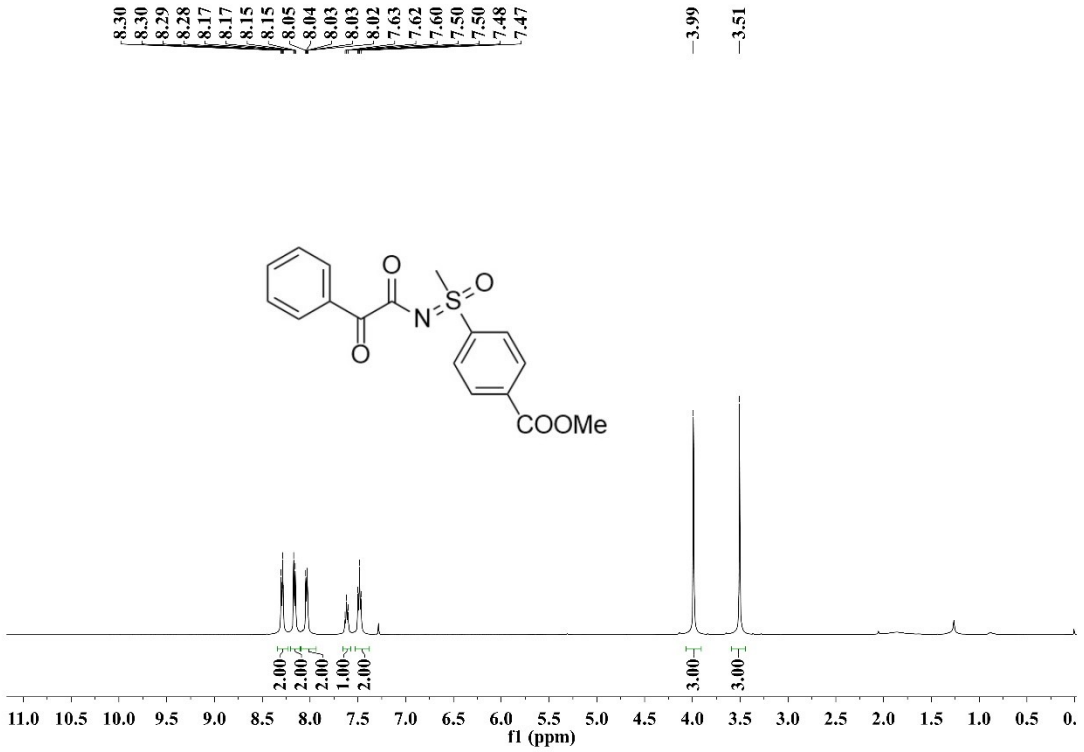
^{1}H NMR spectrum of 3d (500 MHz, $CDCl_3$)



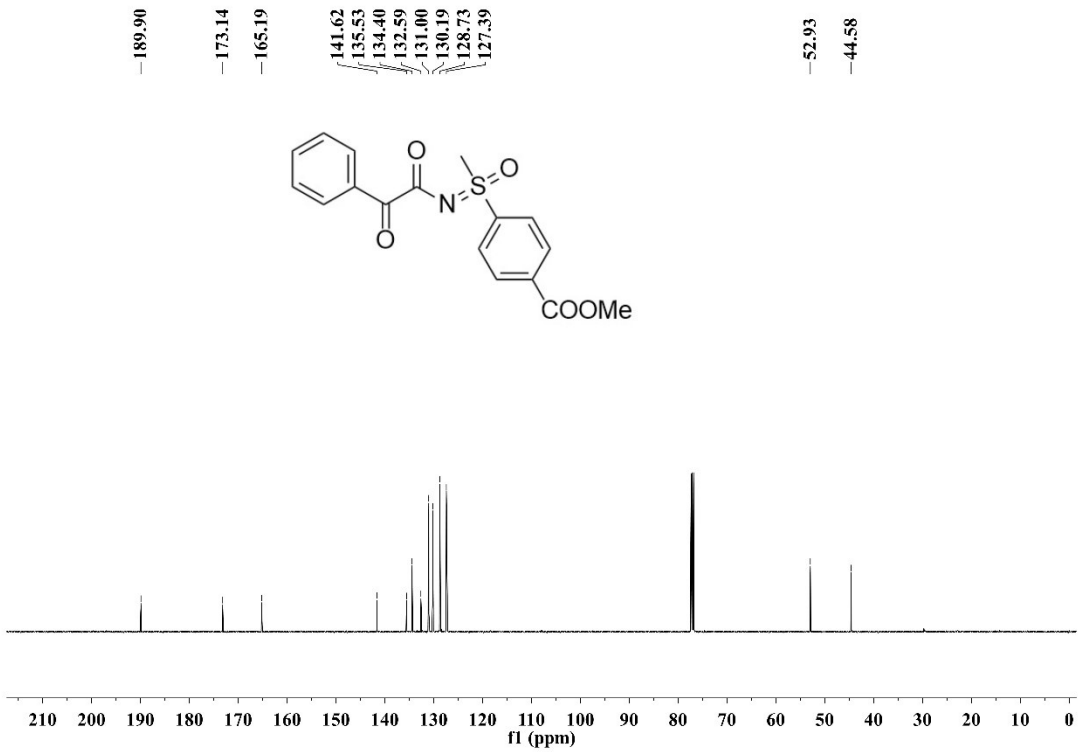
^{13}C{^{1}H} NMR spectrum of 3d (125 MHz, $CDCl_3$)



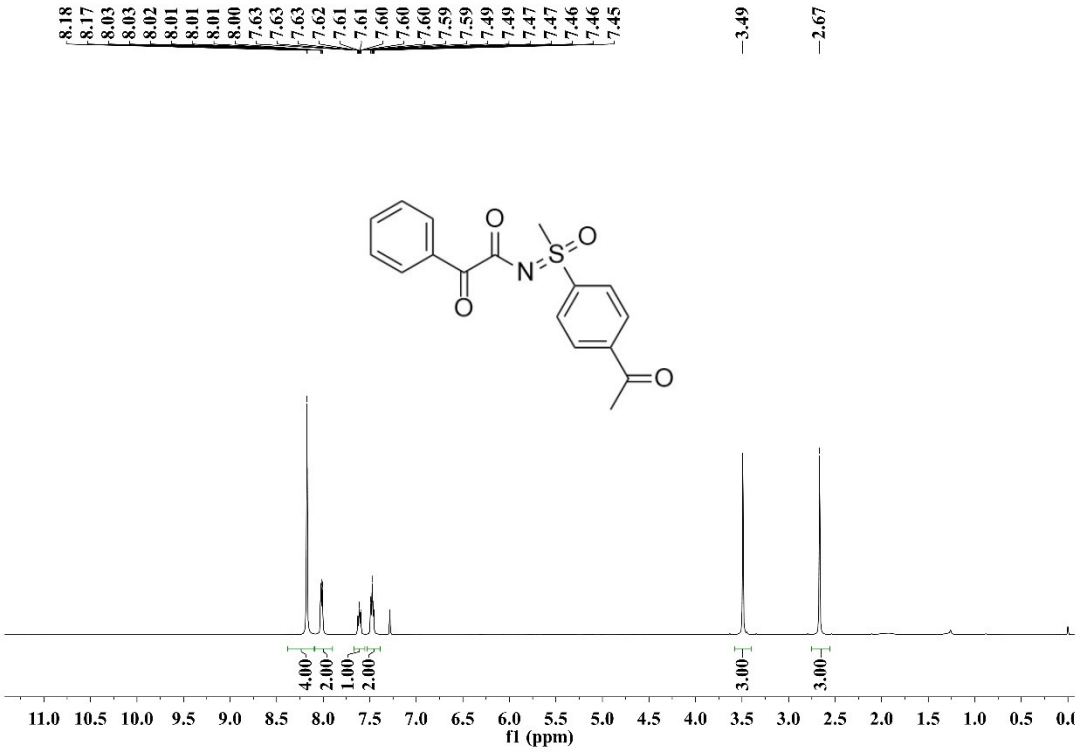
^{1}H NMR spectrum of 3e (500 MHz, $CDCl_3$)



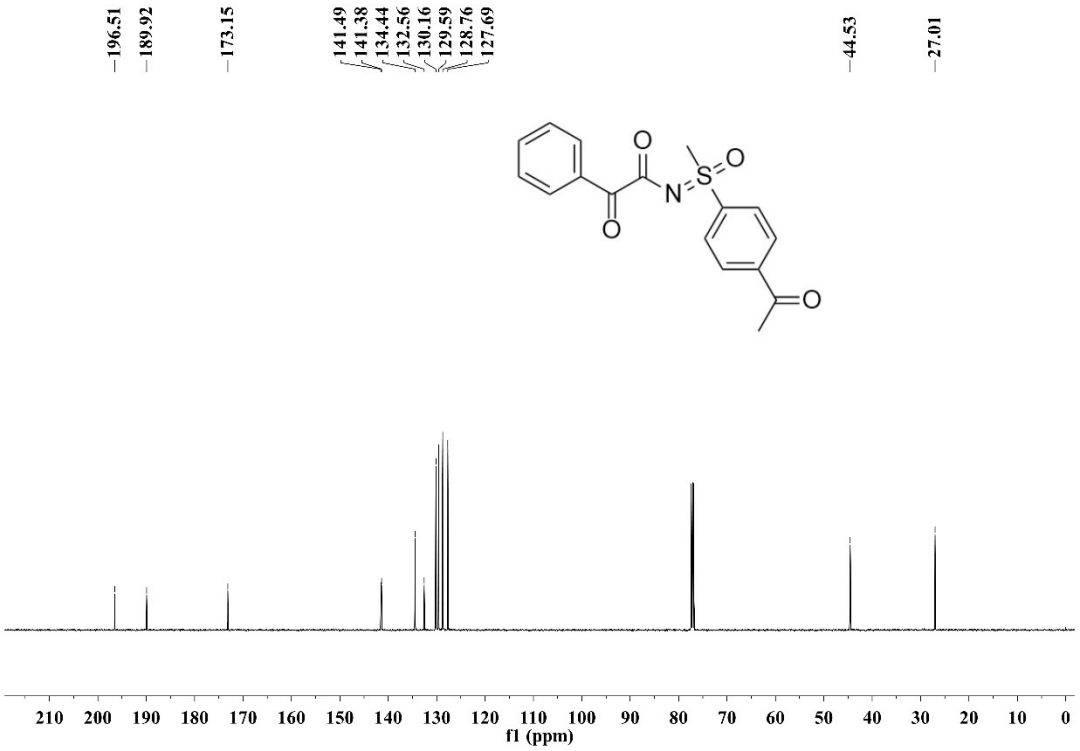
^{13}C{^{1}H} NMR spectrum of 3e (125 MHz, $CDCl_3$)



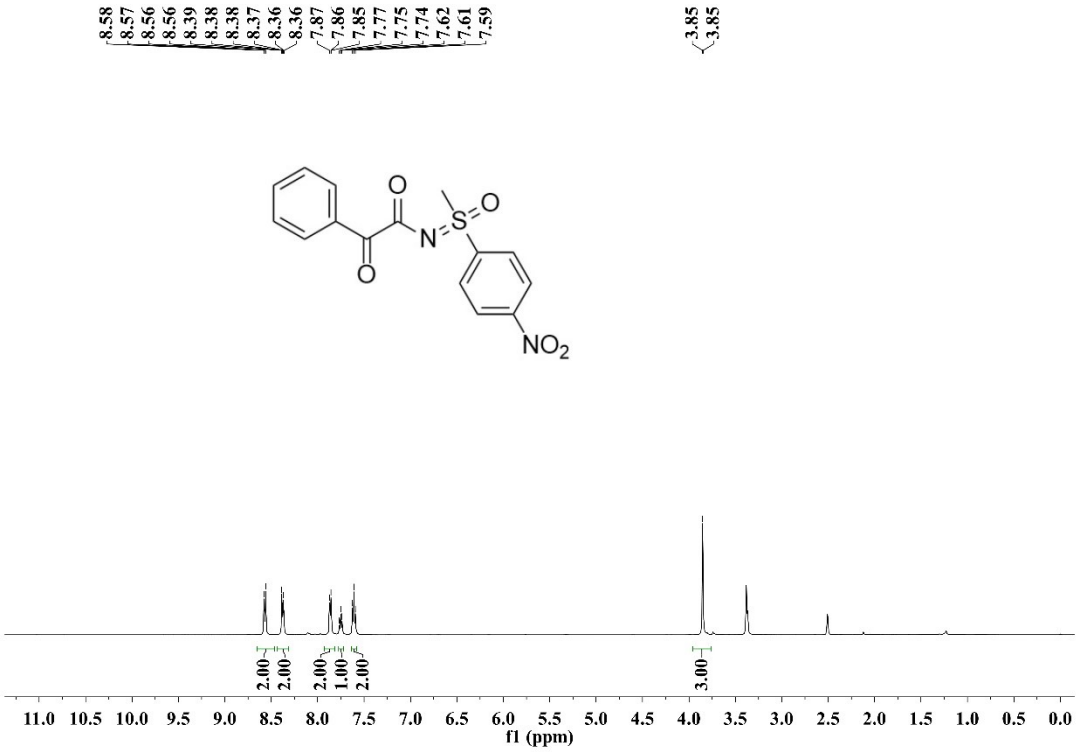
^{1}H NMR spectrum of 3f (500 MHz, $CDCl_3$)



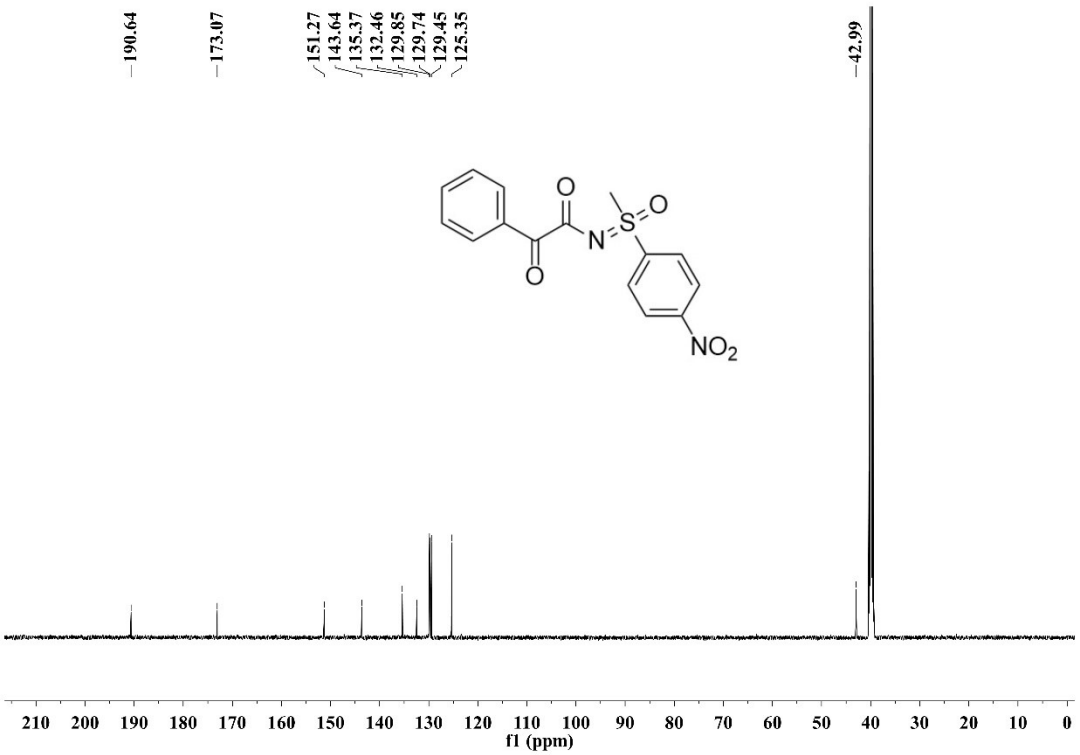
^{13}C{^{1}H} NMR spectrum of 3f (125 MHz, $CDCl_3$)



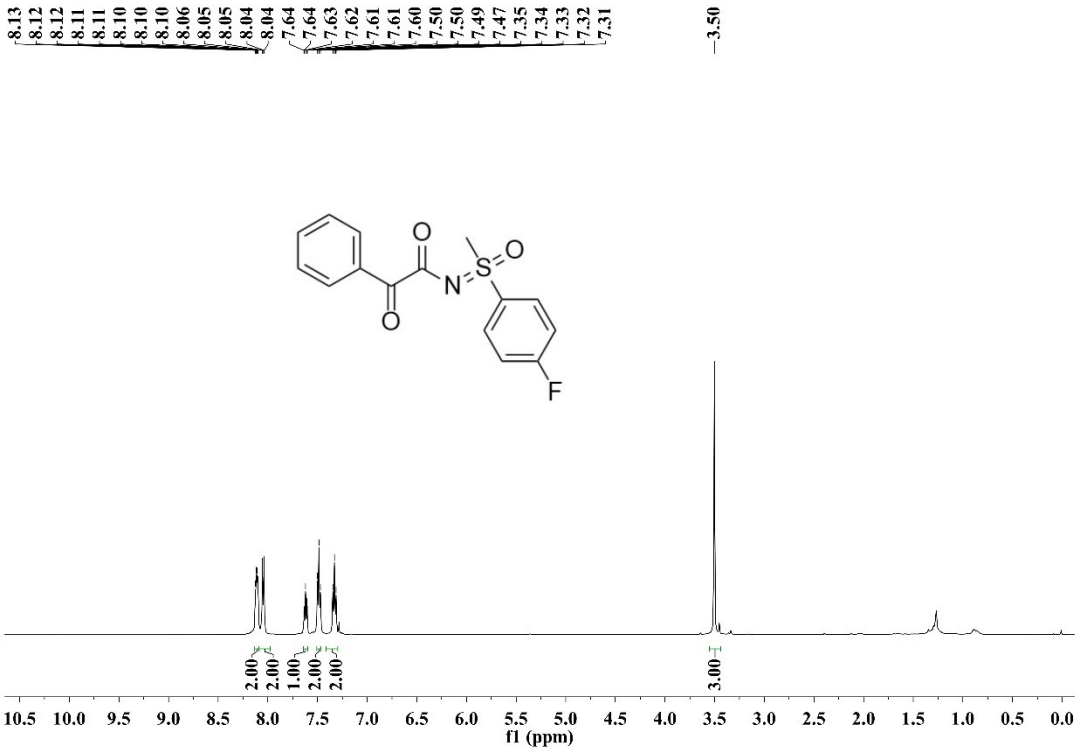
^{1}H NMR spectrum of 3g (500 MHz, DMSO-d_6)



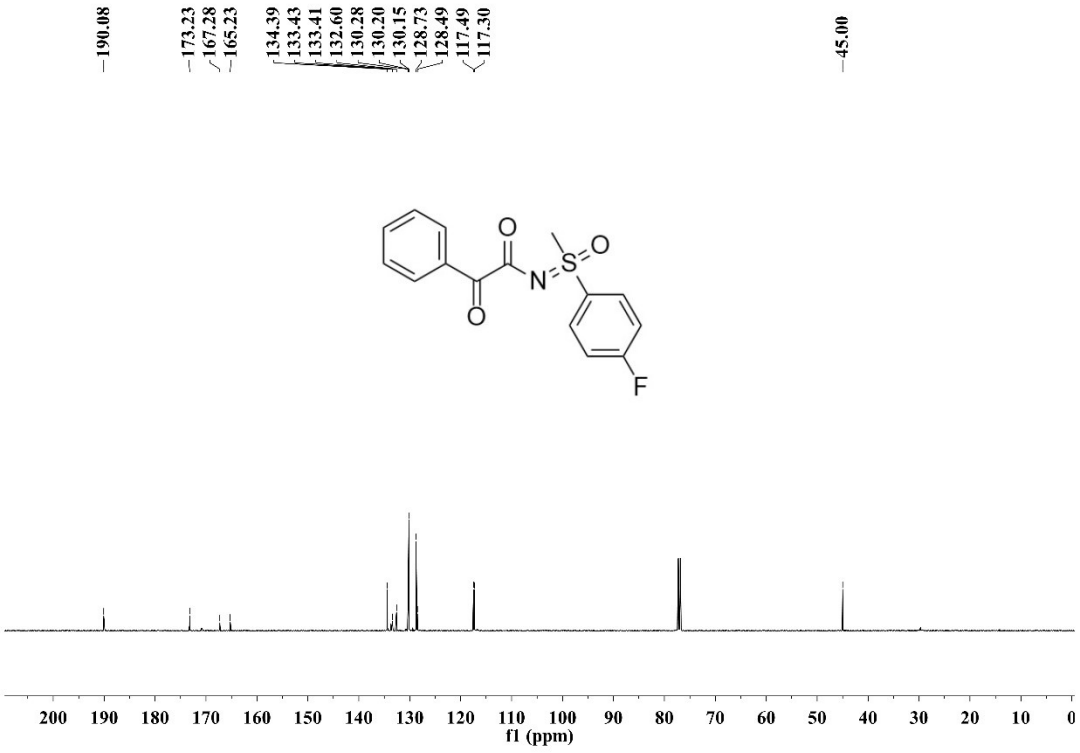
^{13}C{^{1}H} NMR spectrum of 3g (125 MHz, DMSO-d_6)



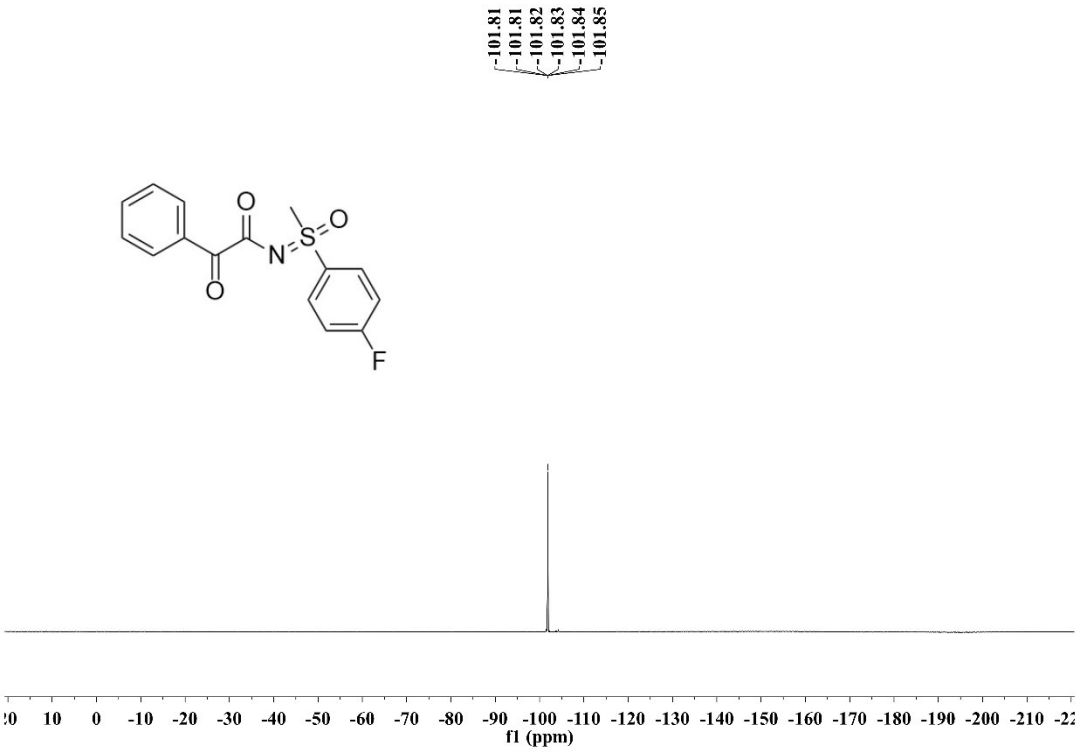
^{1}H NMR spectrum of 3h (500 MHz, $CDCl_3$)



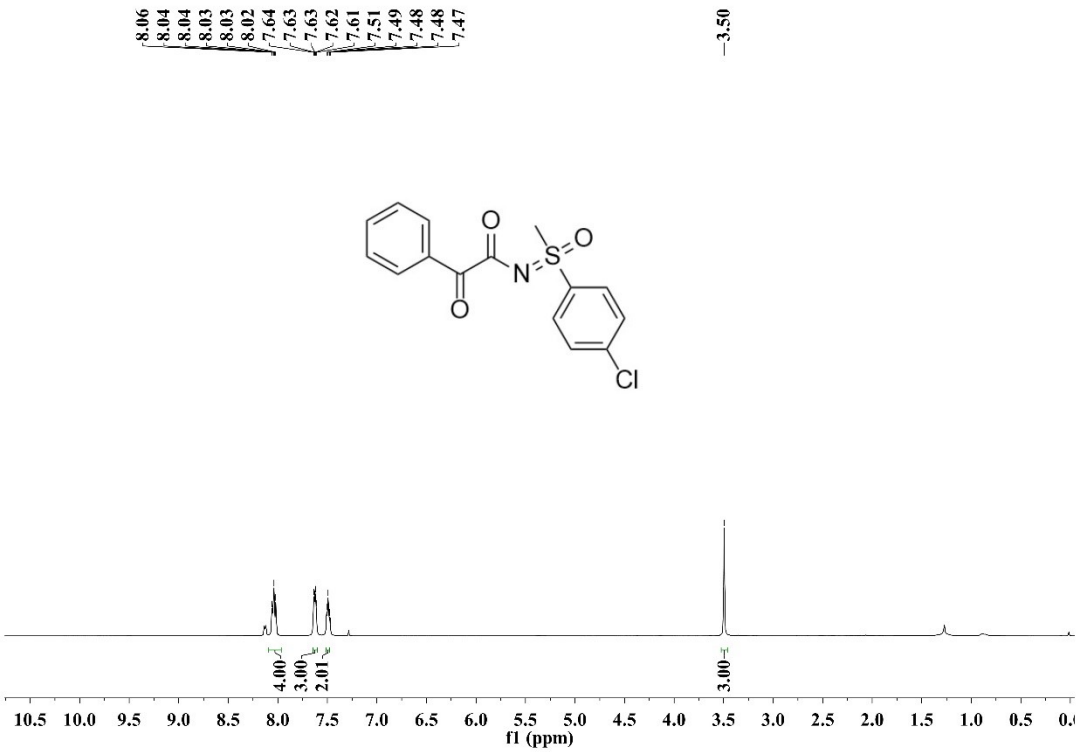
^{13}C{^{1}H} NMR spectrum of 3h (125 MHz, $CDCl_3$)



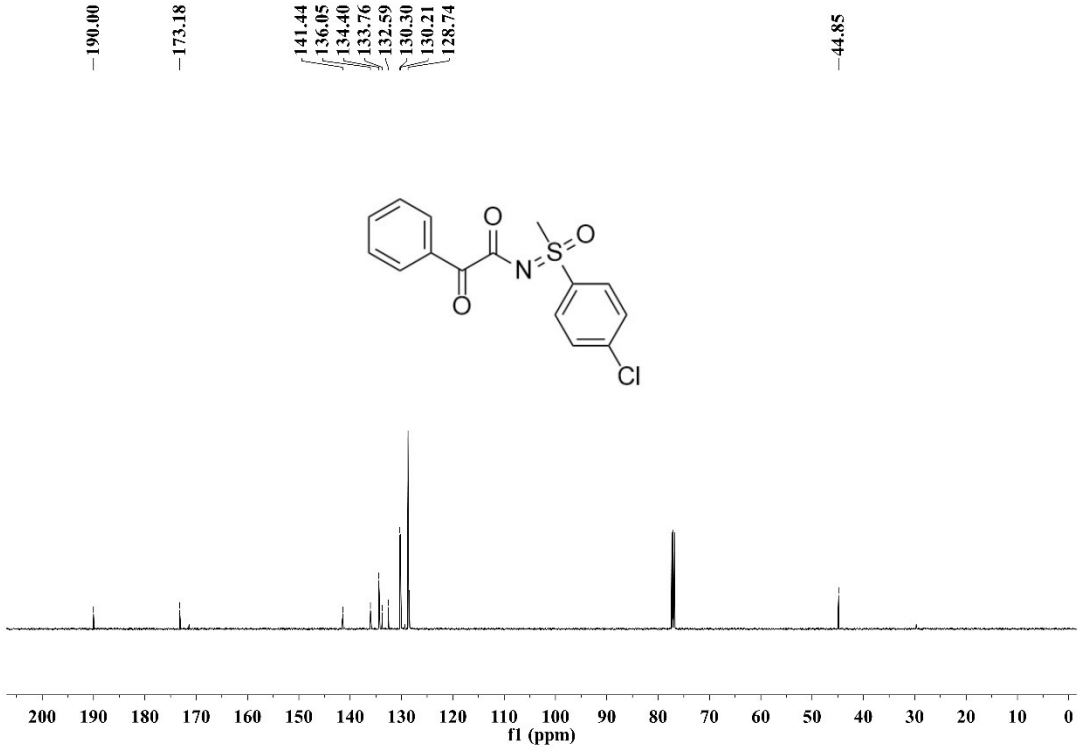
^{19}F NMR spectrum of 3h (125 MHz, $CDCl_3$)



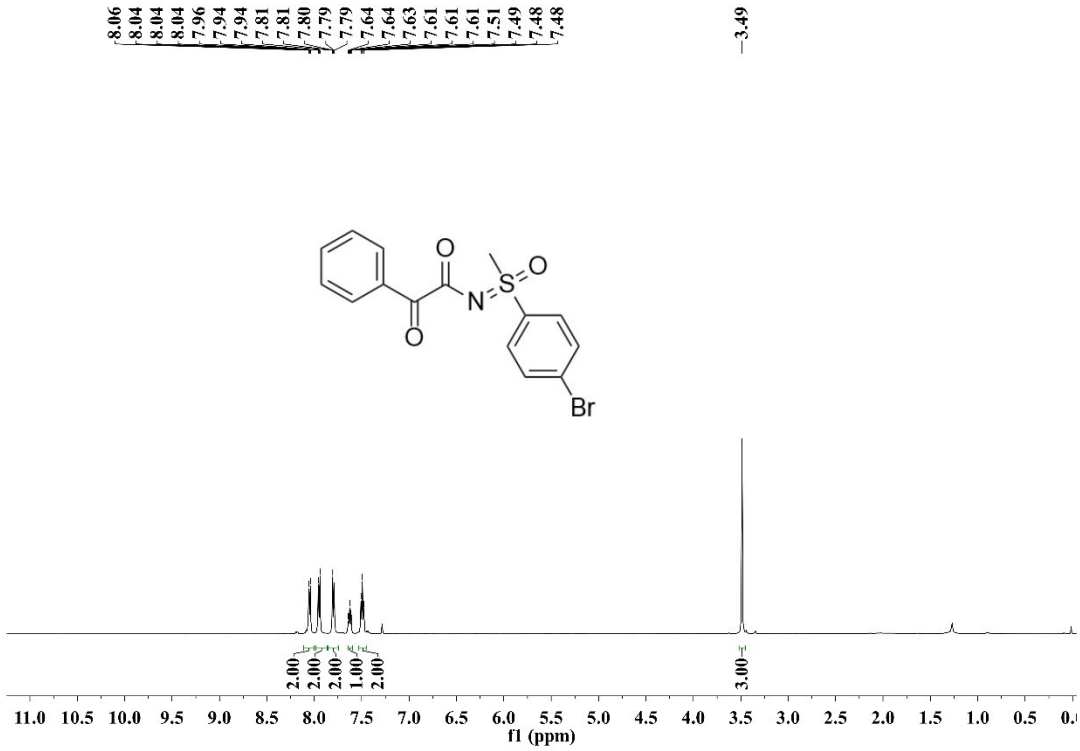
^{1}H NMR spectrum of 3i (500 MHz, $CDCl_3$)



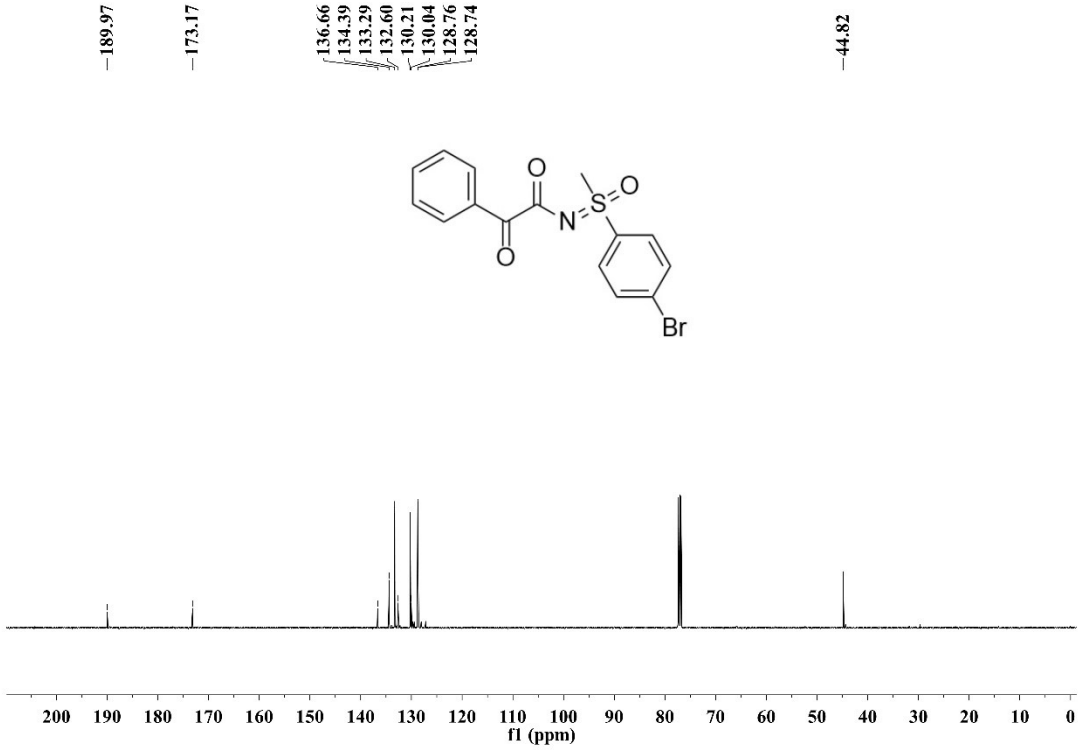
$^{13}C\{^{1}H\}$ NMR spectrum of 3i (125 MHz, $CDCl_3$)



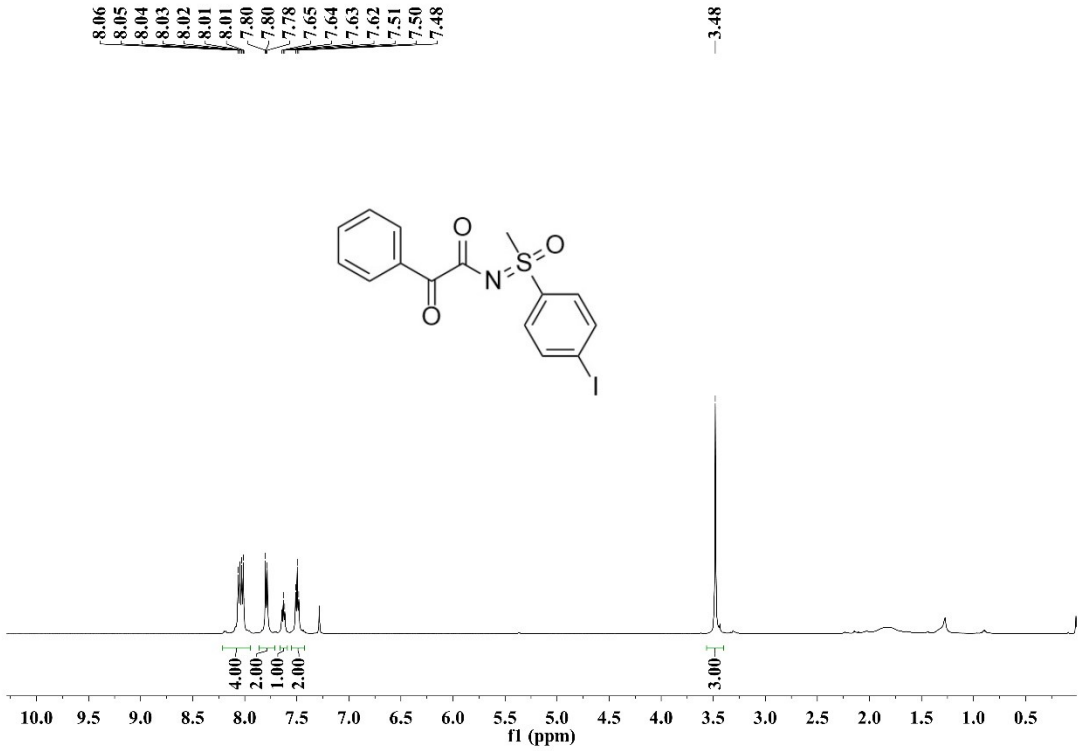
^{1}H NMR spectrum of 3j (500 MHz, $CDCl_3$)



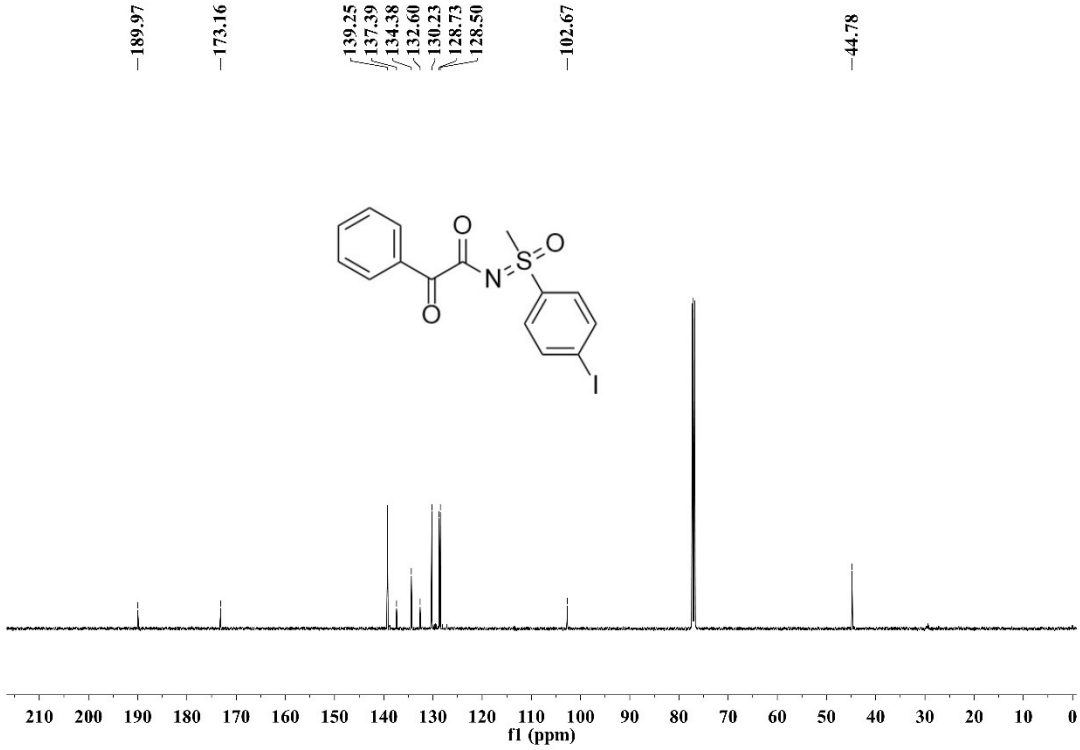
$^{13}C\{^{1}H\}$ NMR spectrum of 3j (125 MHz, $CDCl_3$)



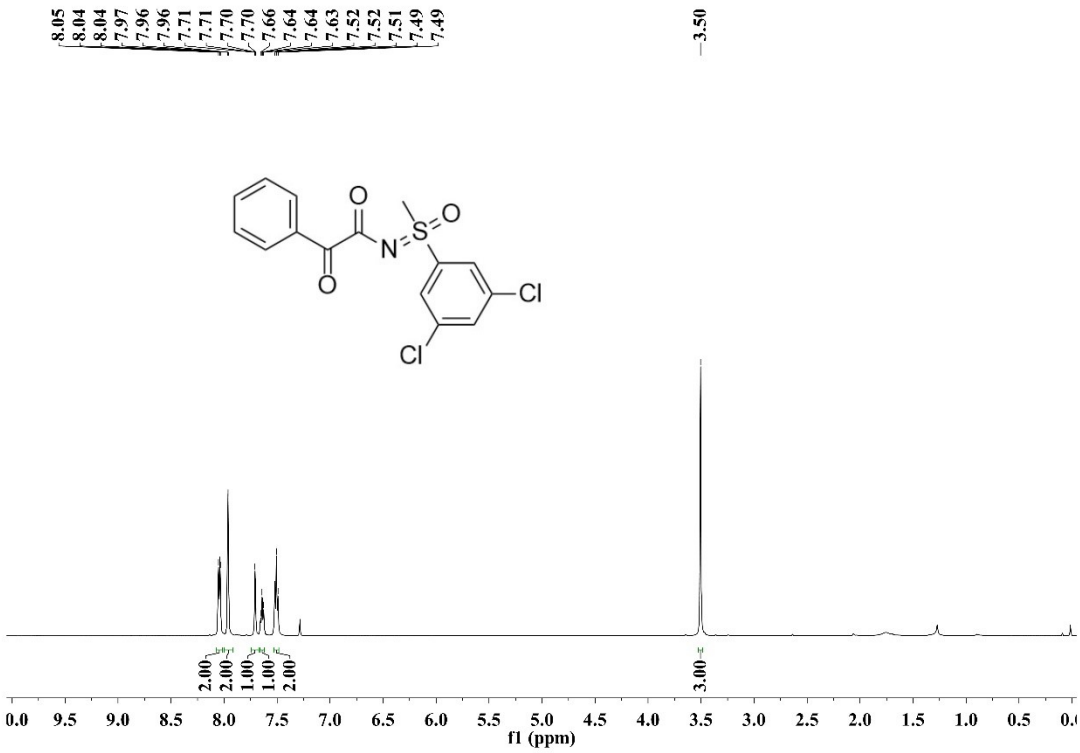
^{1}H NMR spectrum of 3k (500 MHz, $CDCl_3$)



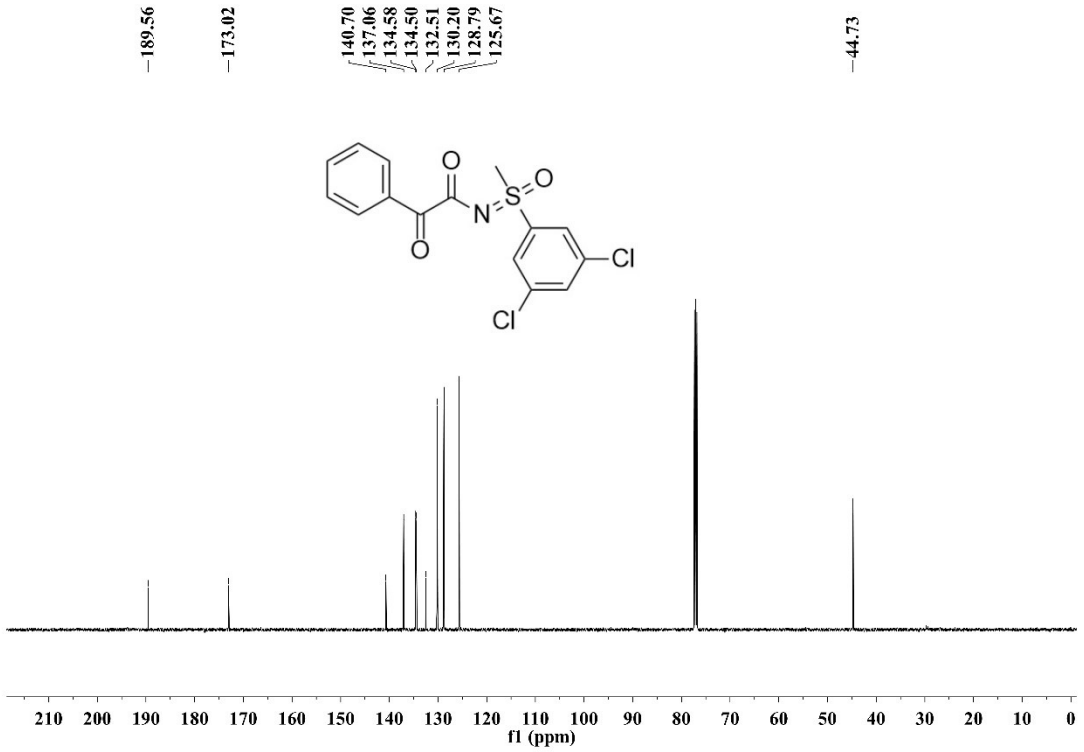
$^{13}C\{^{1}H\}$ NMR spectrum of 3k (125 MHz, $CDCl_3$)



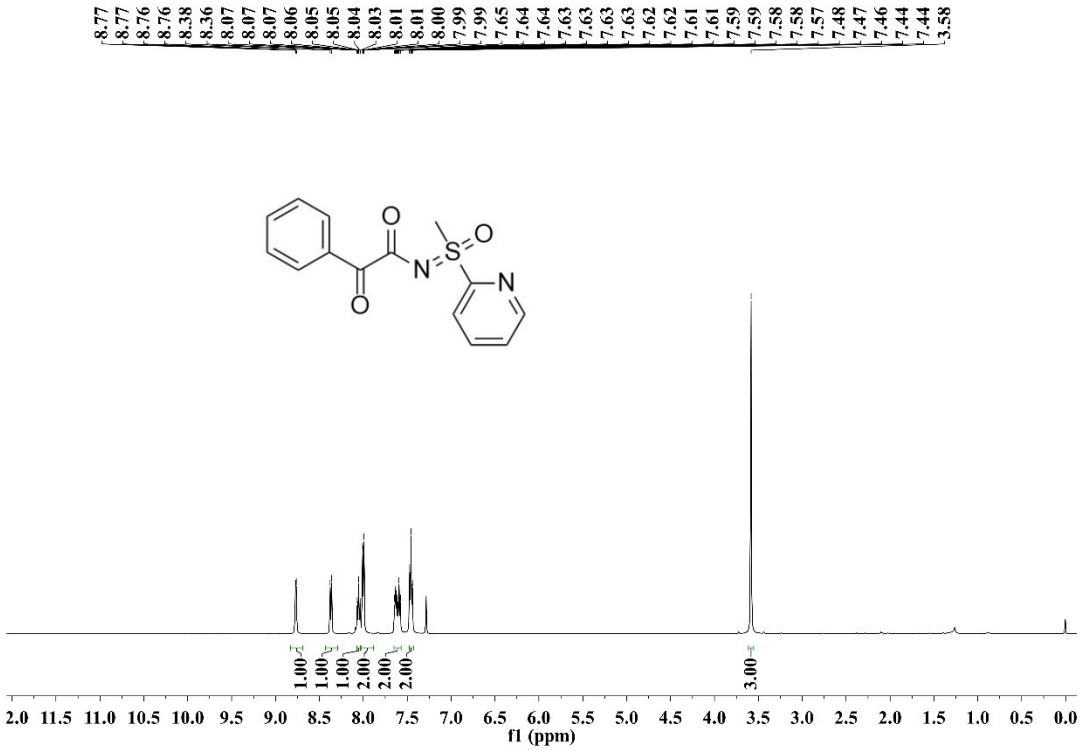
^{1}H NMR spectrum of 3l (500 MHz, $CDCl_3$)



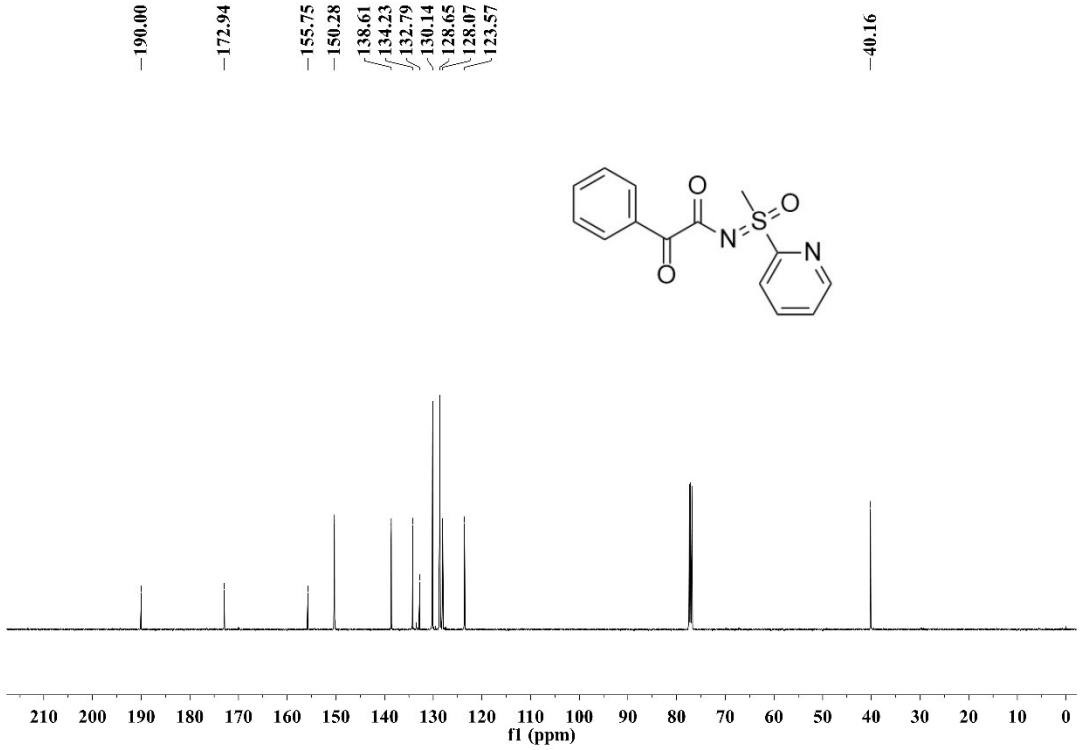
$^{13}C\{^{1}H\}$ NMR spectrum of 3l (125 MHz, $CDCl_3$)



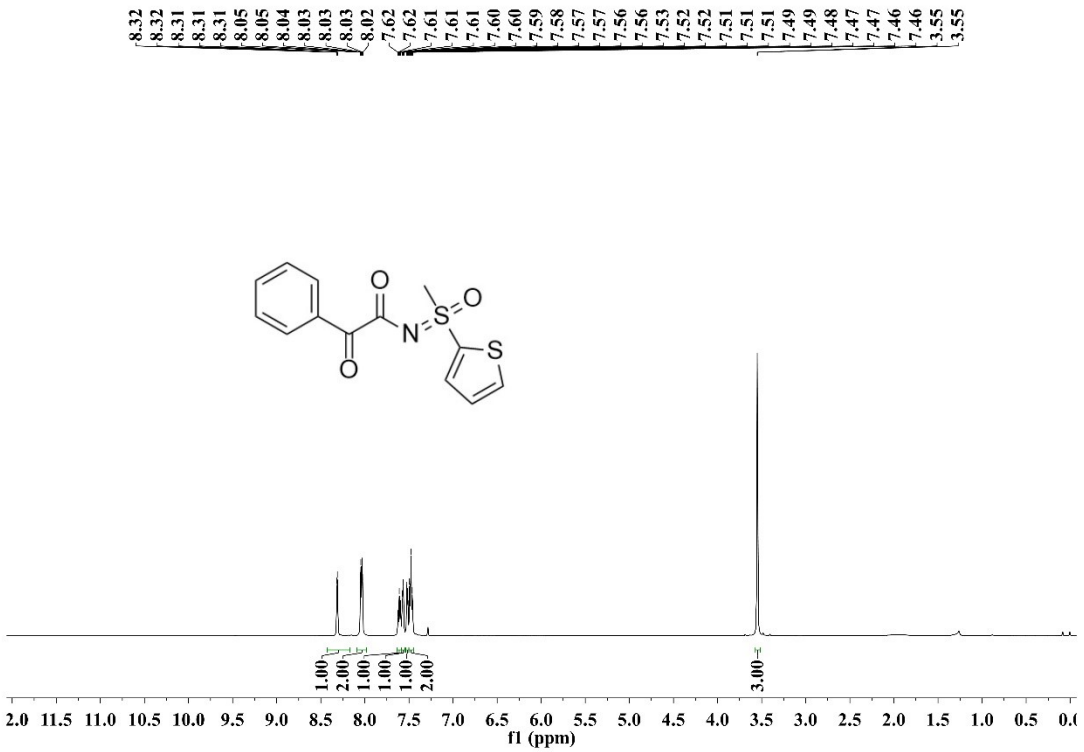
^{1}H NMR spectrum of 3m (500 MHz, $CDCl_3$)



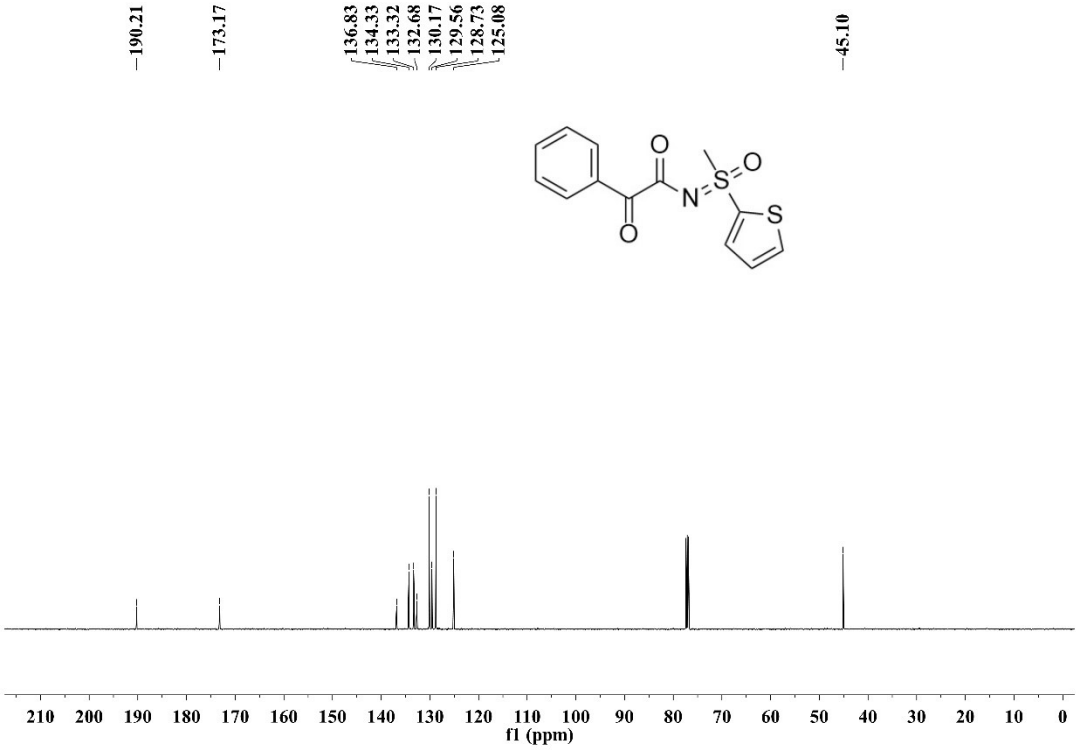
$^{13}C\{^{1}H\}$ NMR spectrum of 3m (125 MHz, $CDCl_3$)



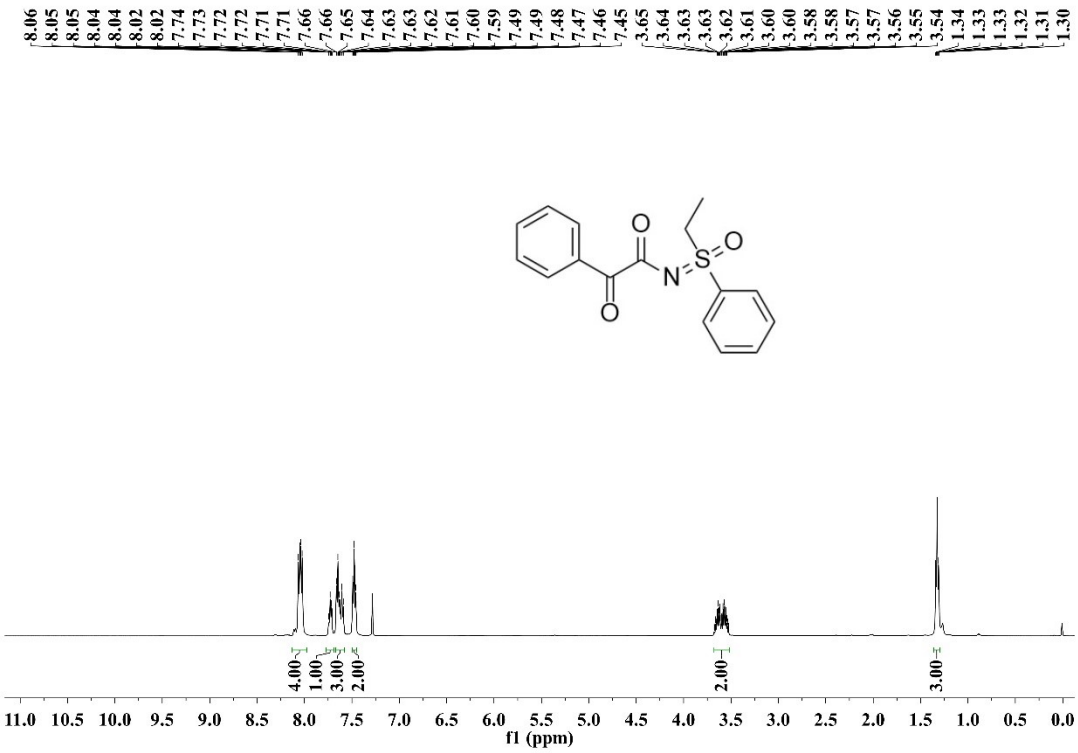
^{1}H NMR spectrum of 3n (500 MHz, $CDCl_3$)



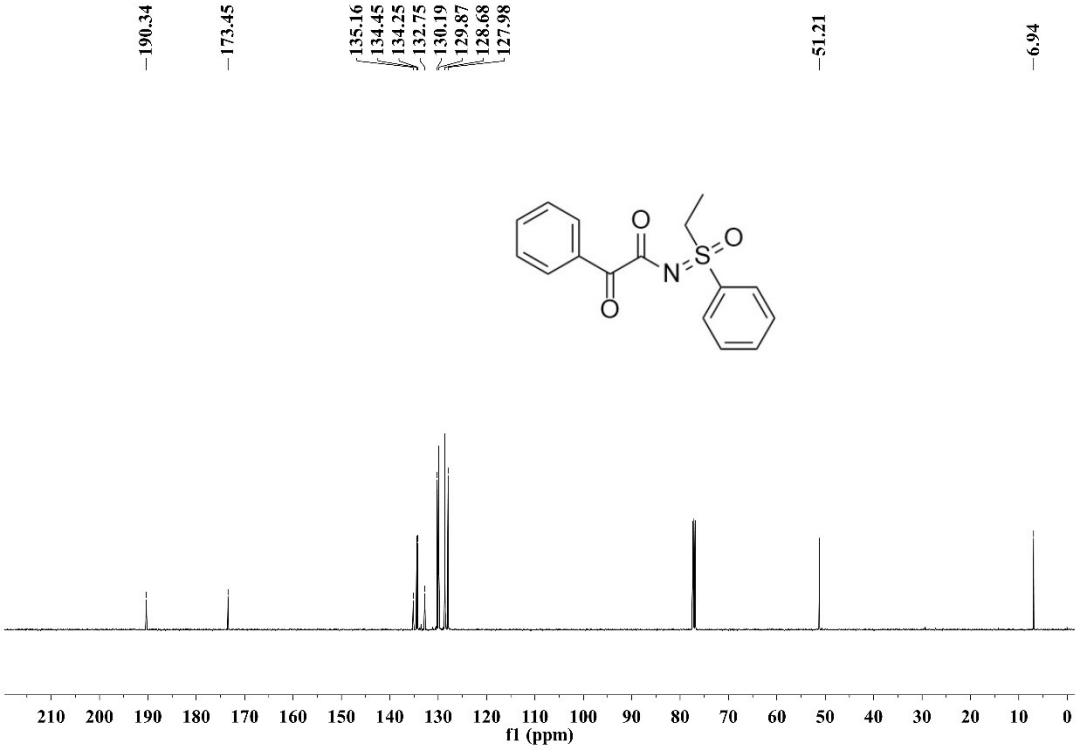
$^{13}C\{^{1}H\}$ NMR spectrum of 3n (125 MHz, $CDCl_3$)



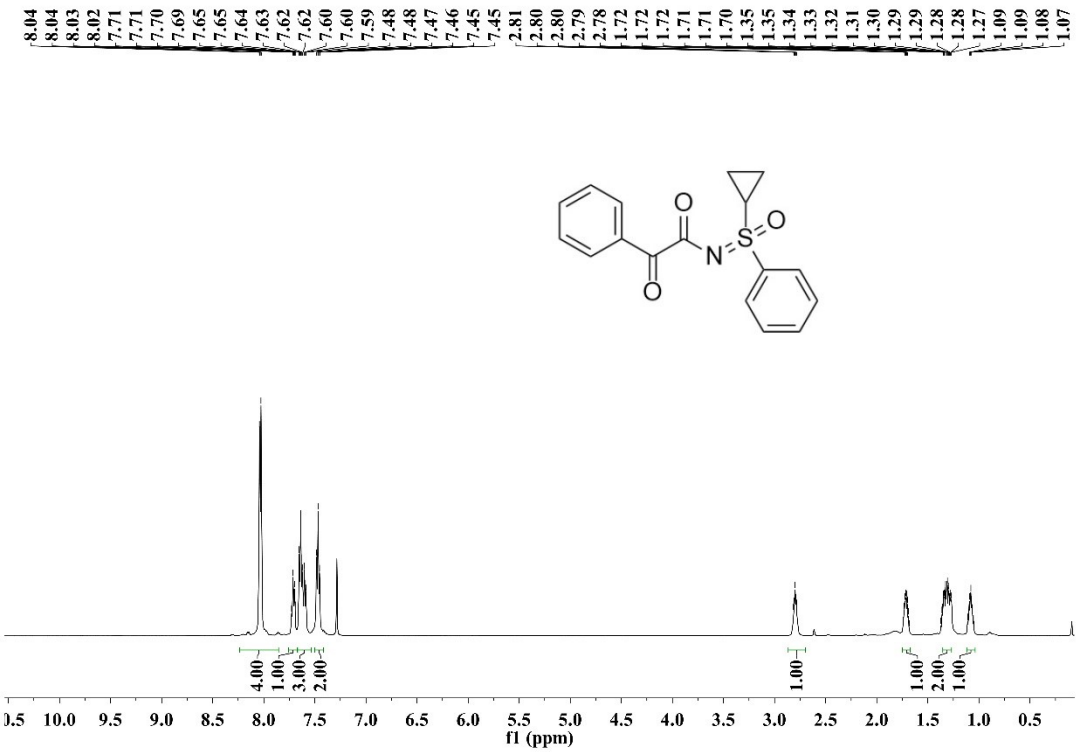
^{1}H NMR spectrum of 3o (500 MHz, $CDCl_3$)



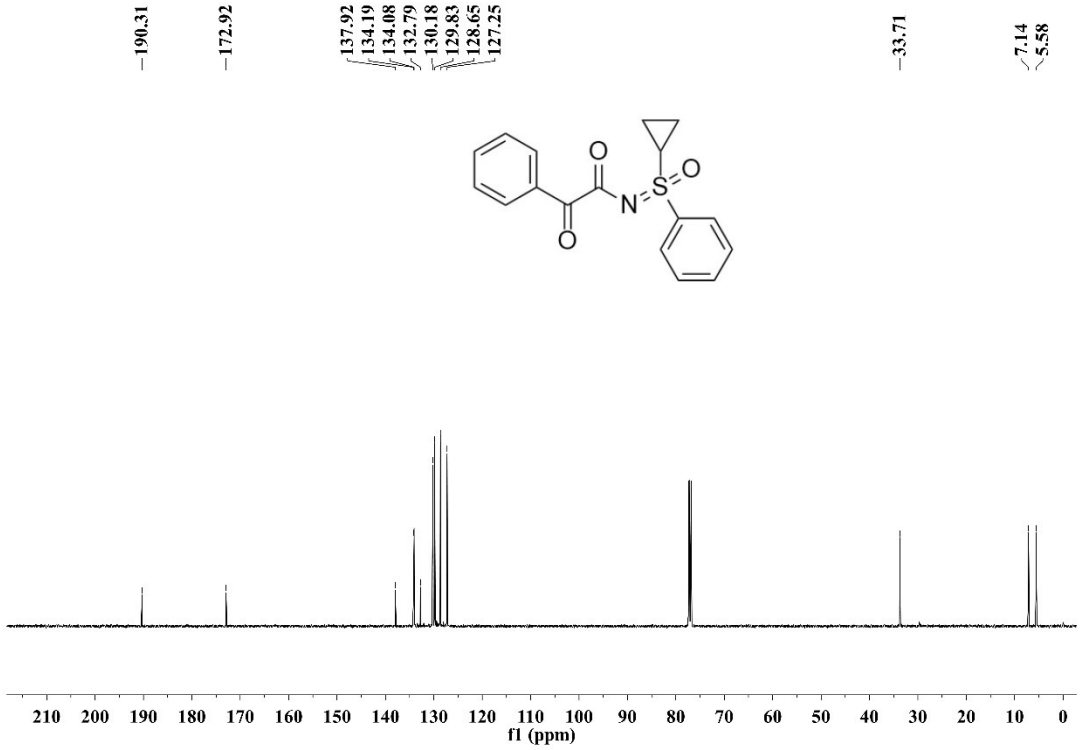
$^{13}C\{^{1}H\}$ NMR spectrum of 3o (125 MHz, $CDCl_3$)



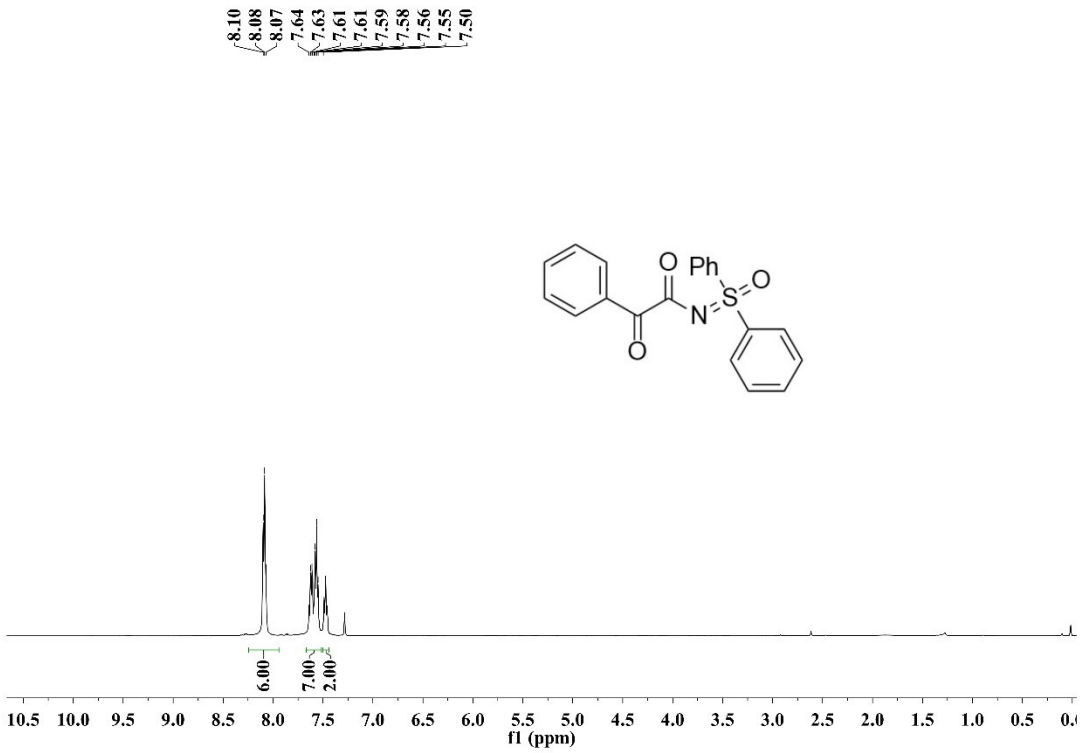
^{1}H NMR spectrum of 3p (500 MHz, $CDCl_3$)



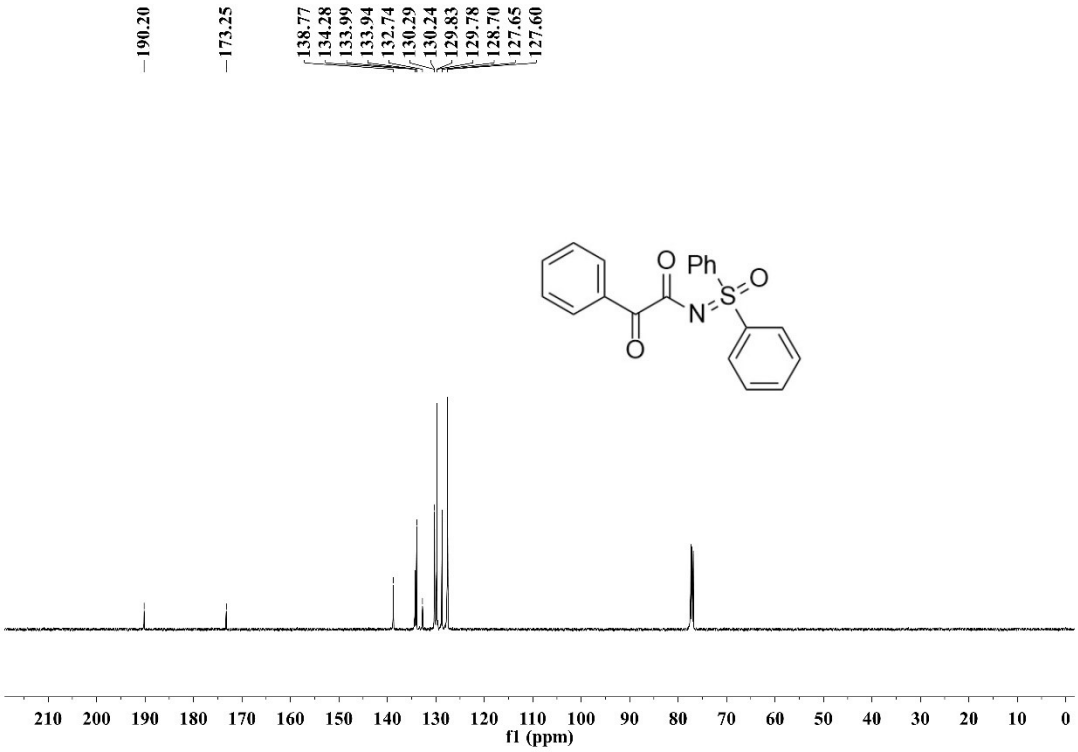
$^{13}C\{^{1}H\}$ NMR spectrum of 3p (125 MHz, $CDCl_3$)



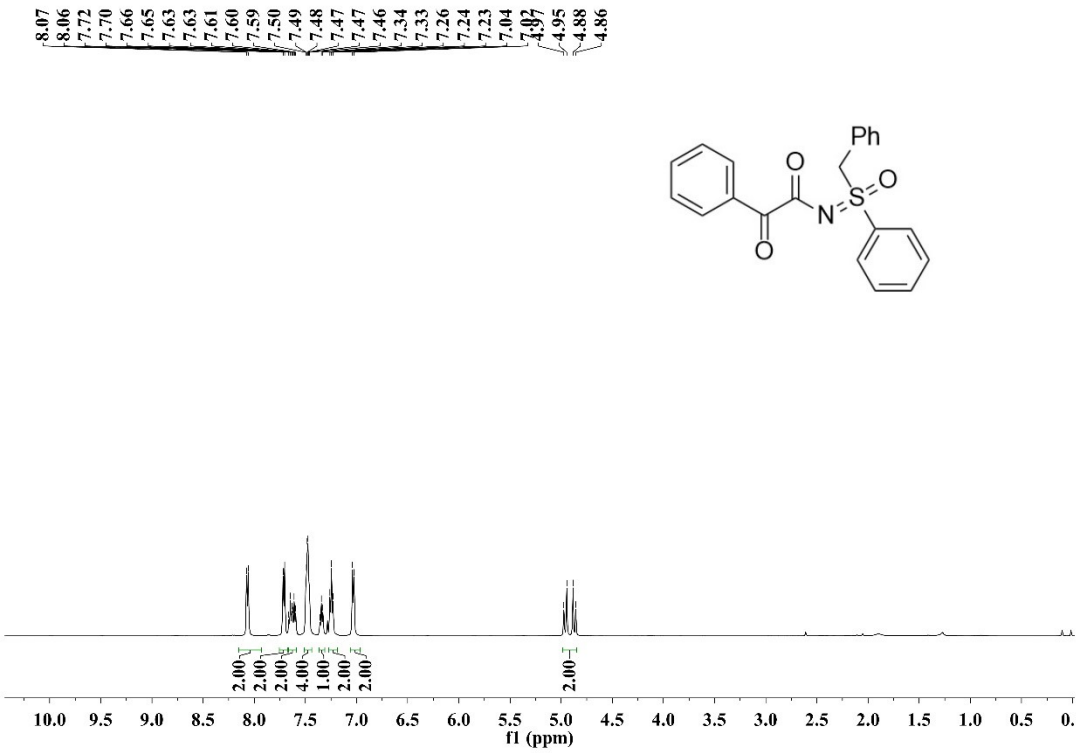
^{1}H NMR spectrum of 3q (500 MHz, $CDCl_3$)



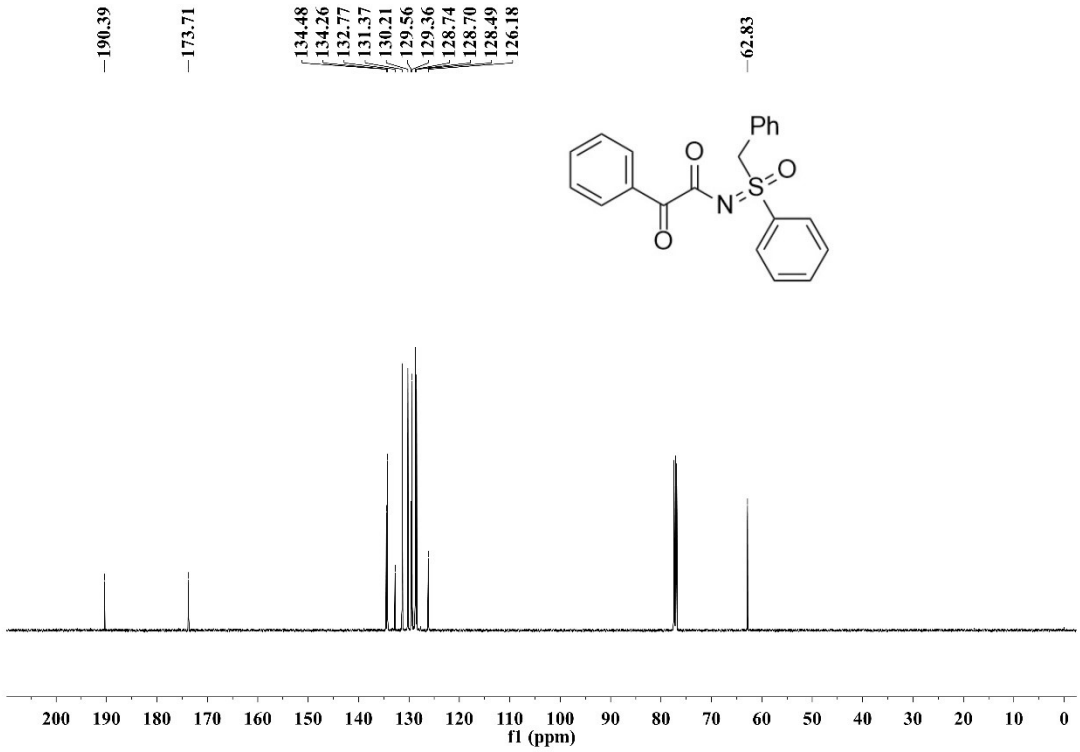
$^{13}C\{^{1}H\}$ NMR spectrum of 3q (125 MHz, $CDCl_3$)



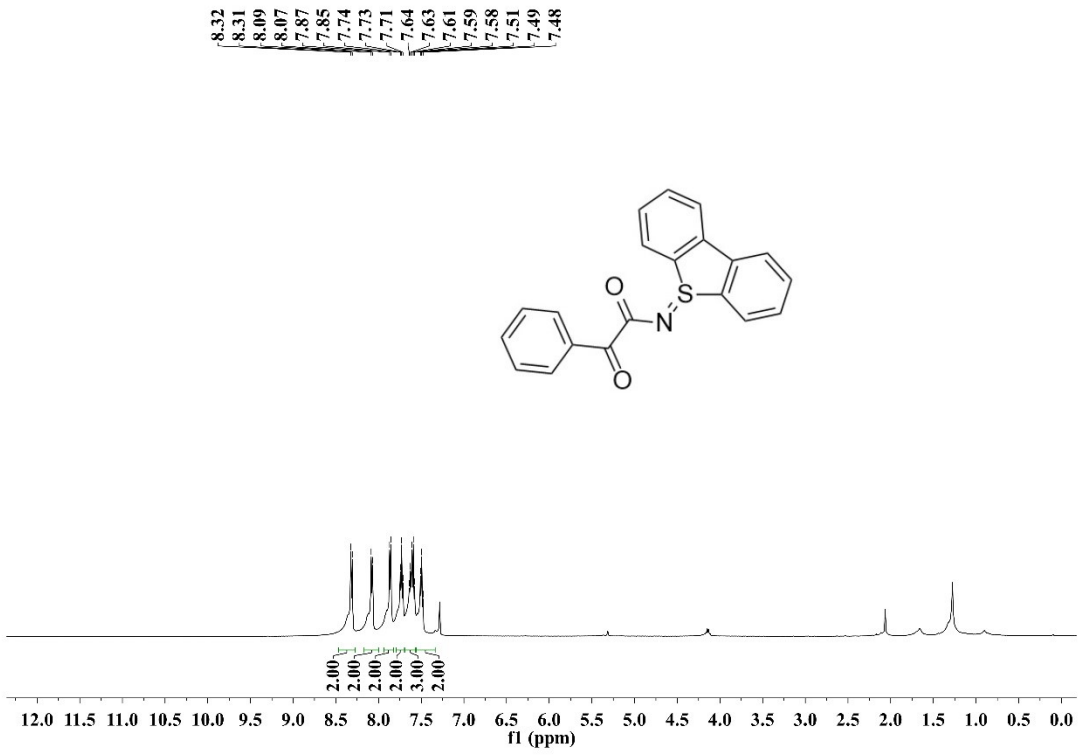
^{1}H NMR spectrum of 3r (500 MHz, $CDCl_3$)



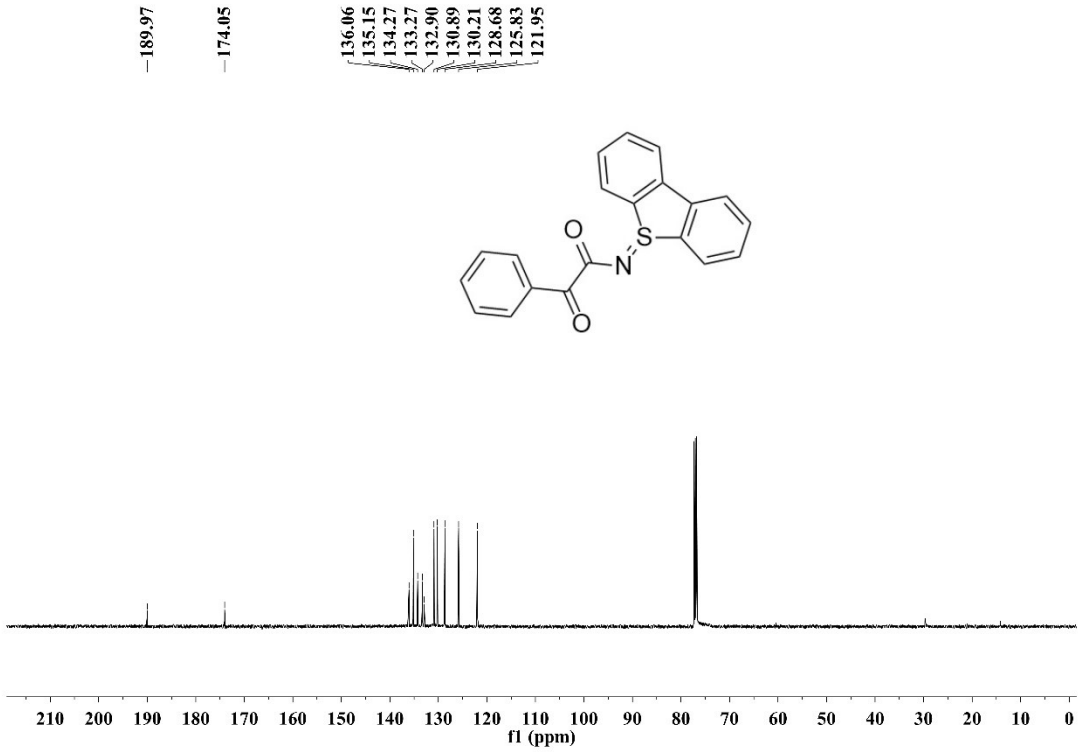
$^{13}C\{^{1}H\}$ NMR spectrum of 3r (125 MHz, $CDCl_3$)



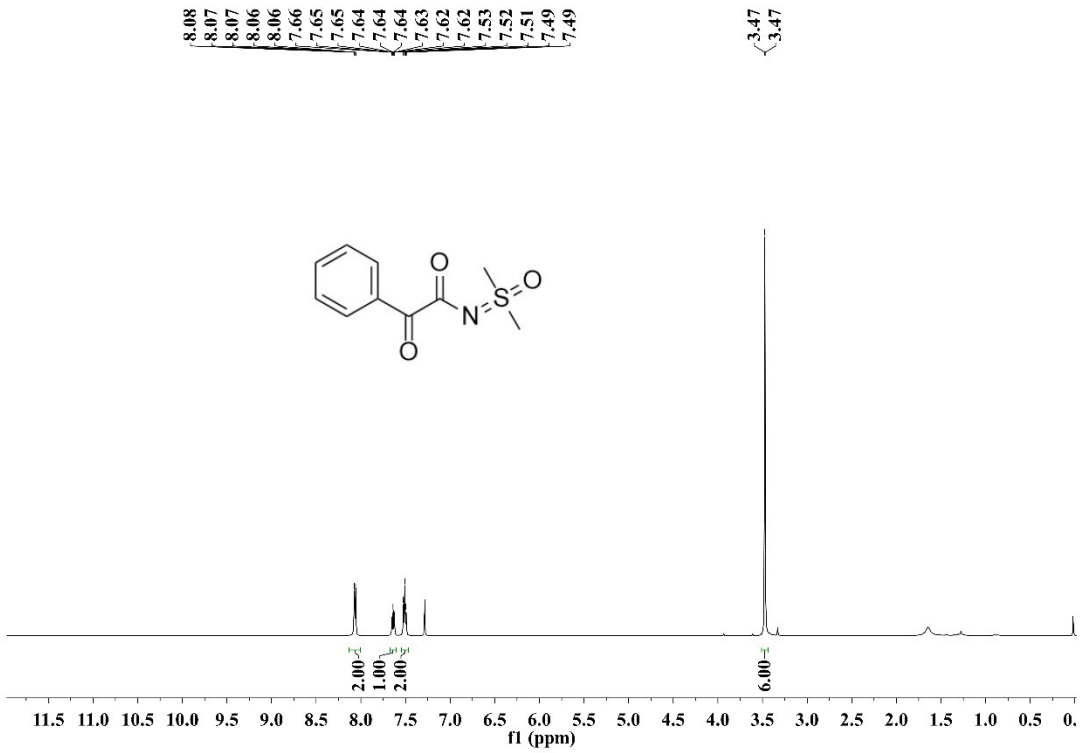
^{1}H NMR spectrum of 3s (500 MHz, $CDCl_3$)



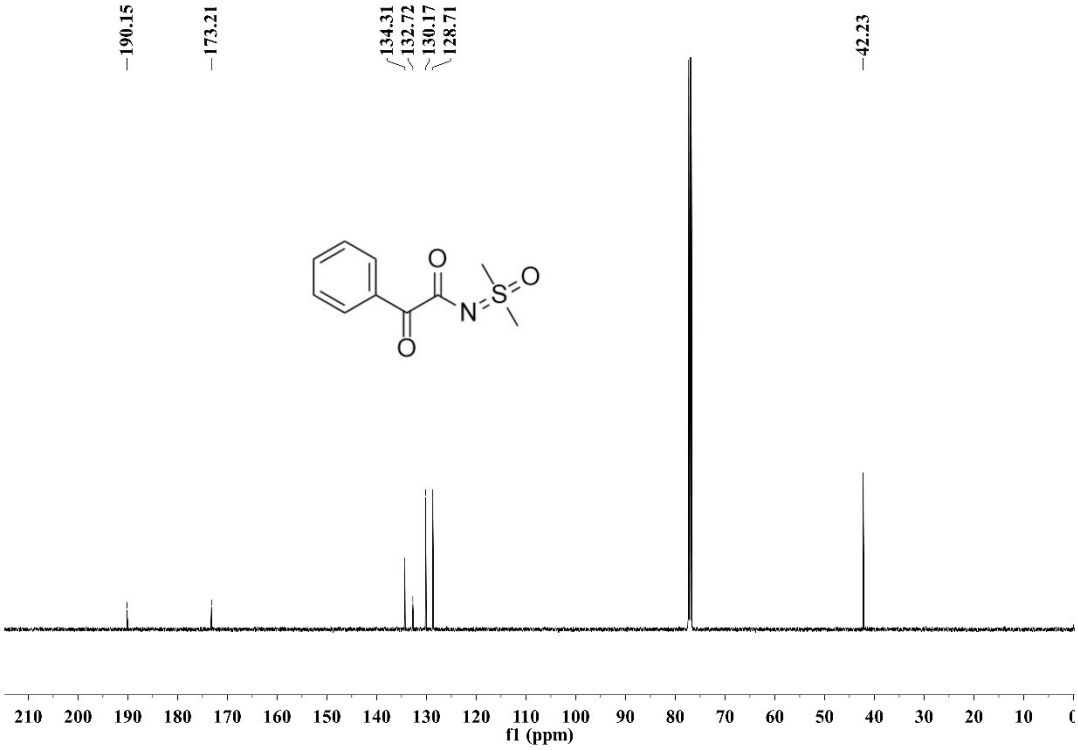
$^{13}C\{^{1}H\}$ NMR spectrum of 3s (125 MHz, $CDCl_3$)



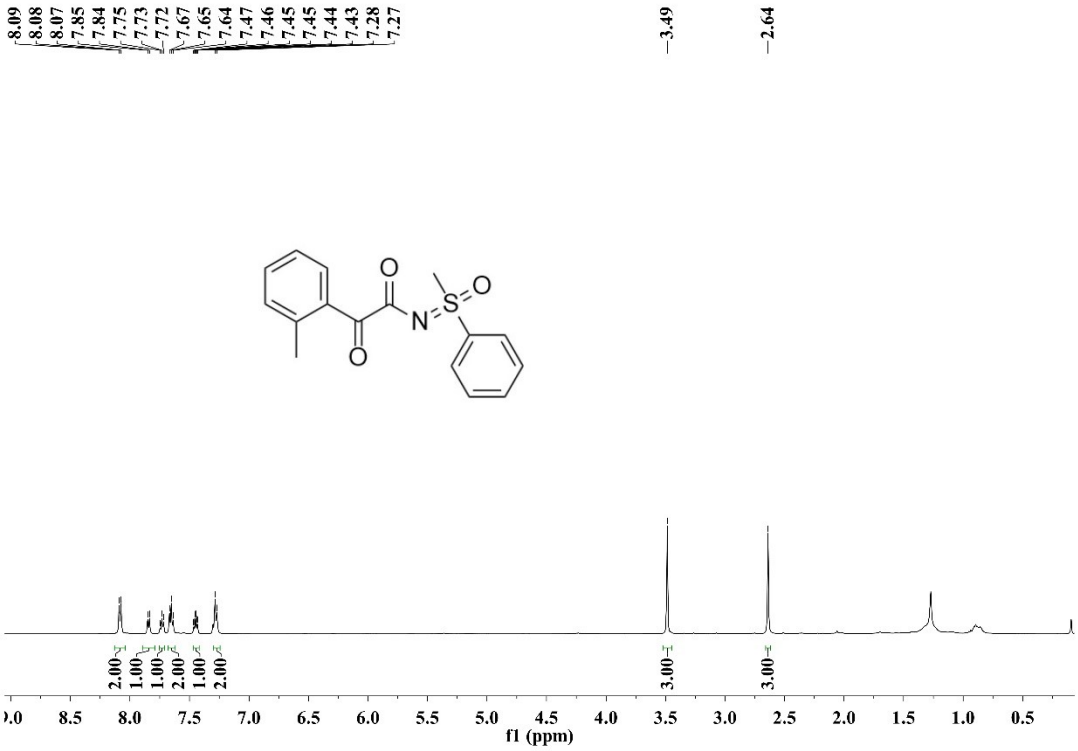
^{1}H NMR spectrum of 3t (500 MHz, $CDCl_3$)



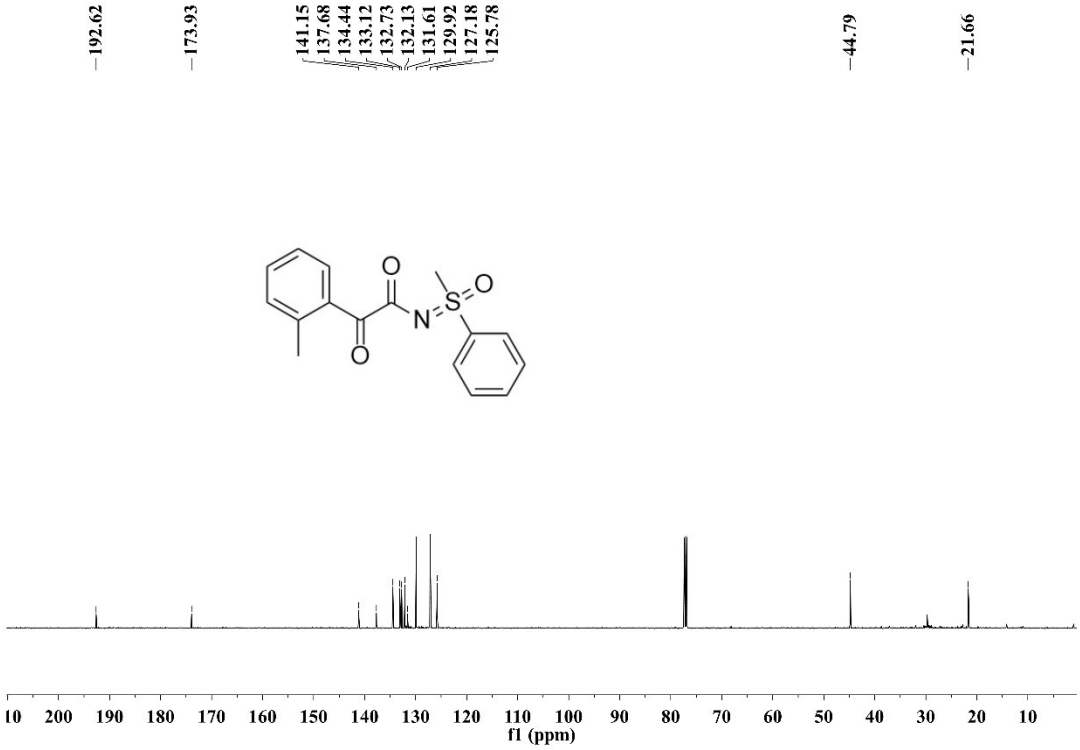
$^{13}C\{^{1}H\}$ NMR spectrum of 3t (125 MHz, $CDCl_3$)



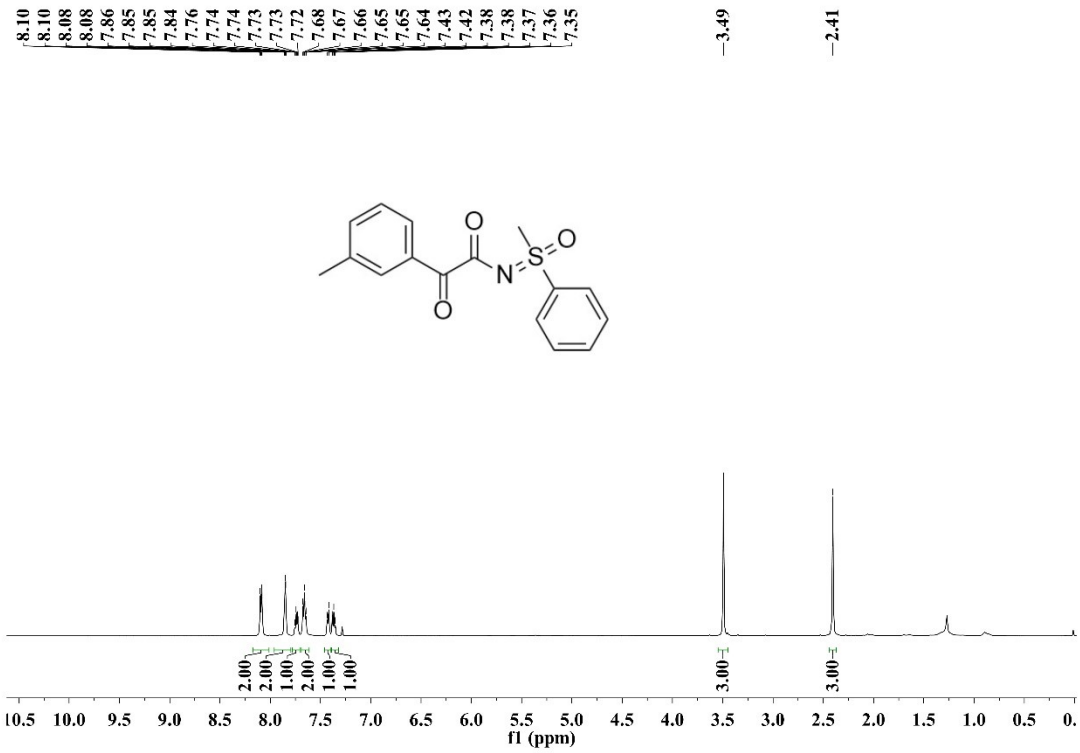
^{1}H NMR spectrum of 3u (500 MHz, $CDCl_3$)



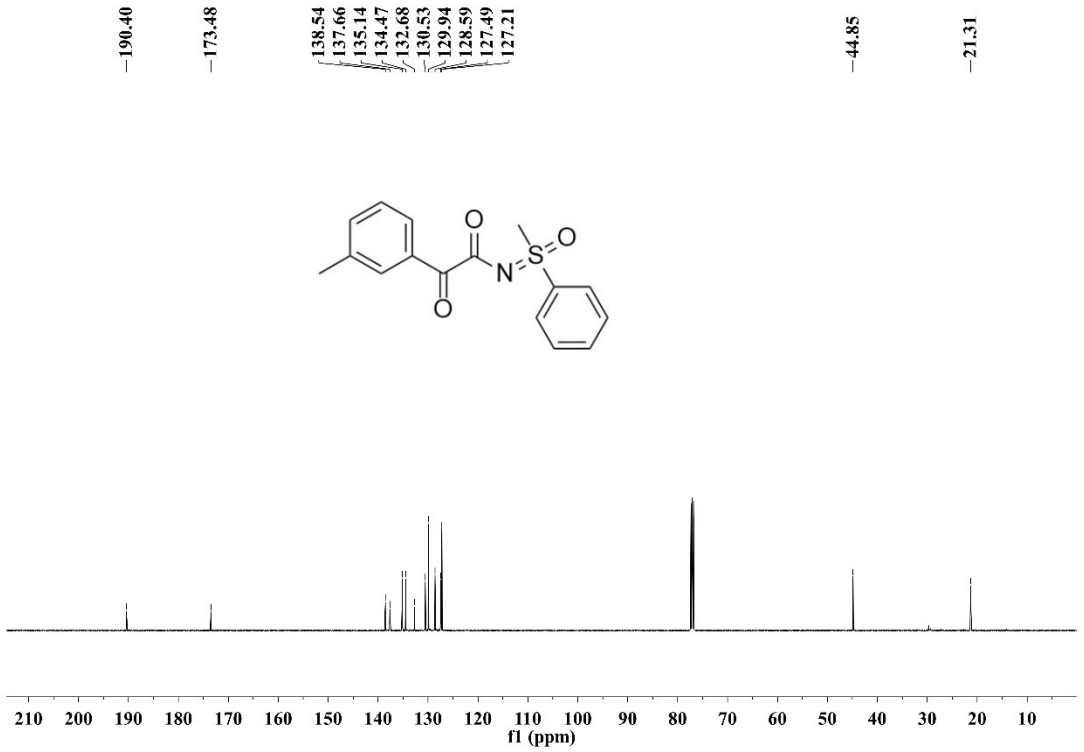
$^{13}C\{^{1}H\}$ NMR spectrum of 3u (125 MHz, $CDCl_3$)



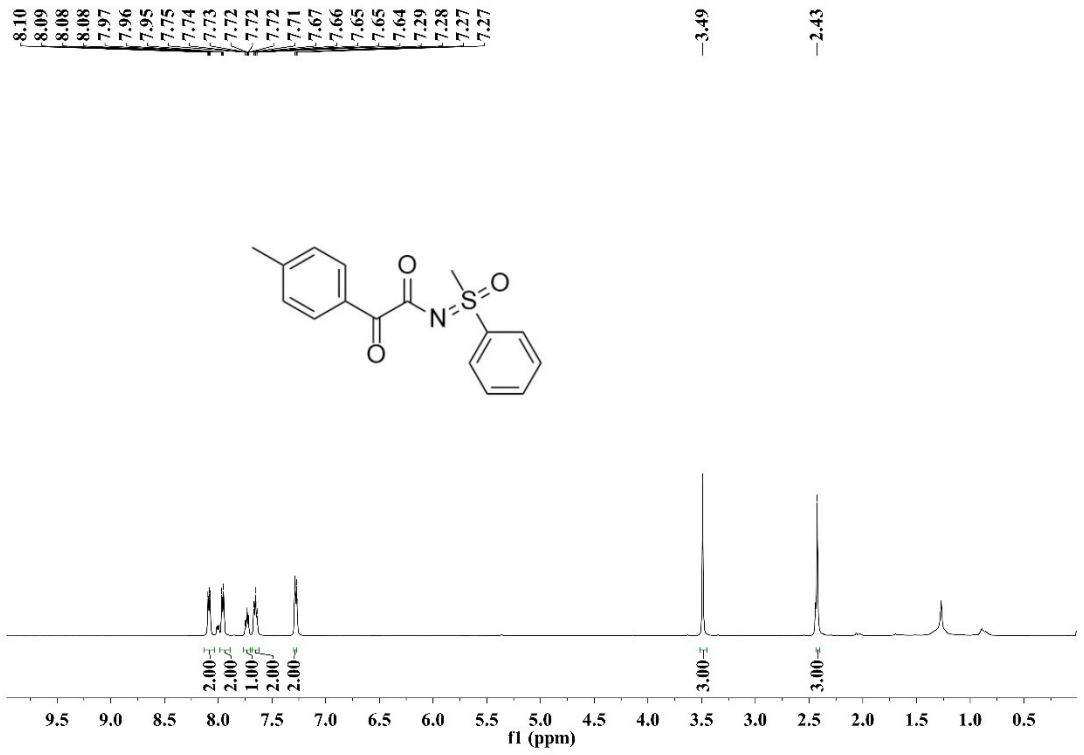
^{1}H NMR spectrum of 3v (500 MHz, $CDCl_3$)



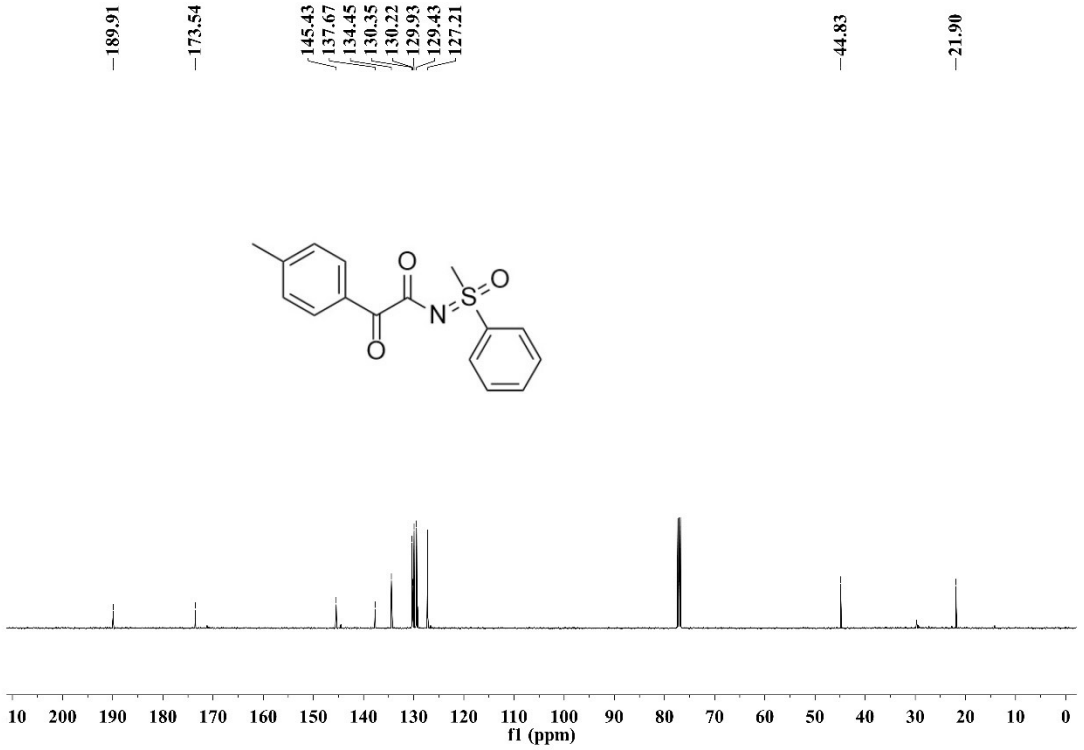
$^{13}C\{^{1}H\}$ NMR spectrum of 3v (125 MHz, $CDCl_3$)



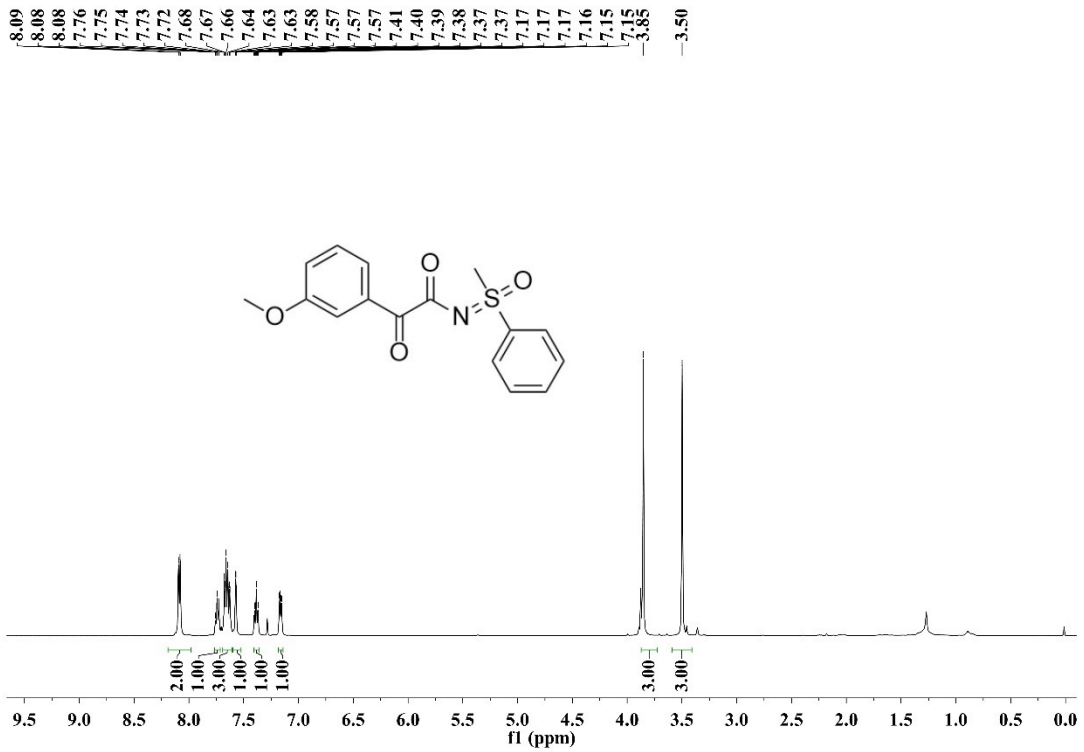
^{1}H NMR spectrum of 3w (500 MHz, $CDCl_3$)



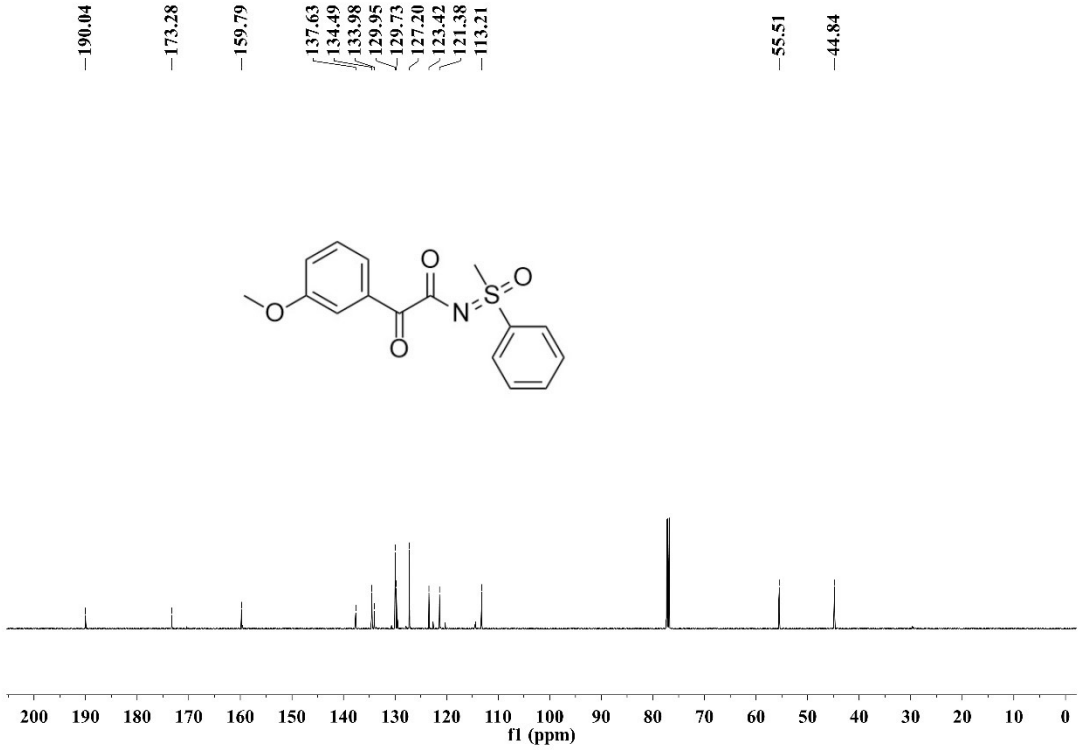
$^{13}C\{^{1}H\}$ NMR spectrum of 3w (125 MHz, $CDCl_3$)



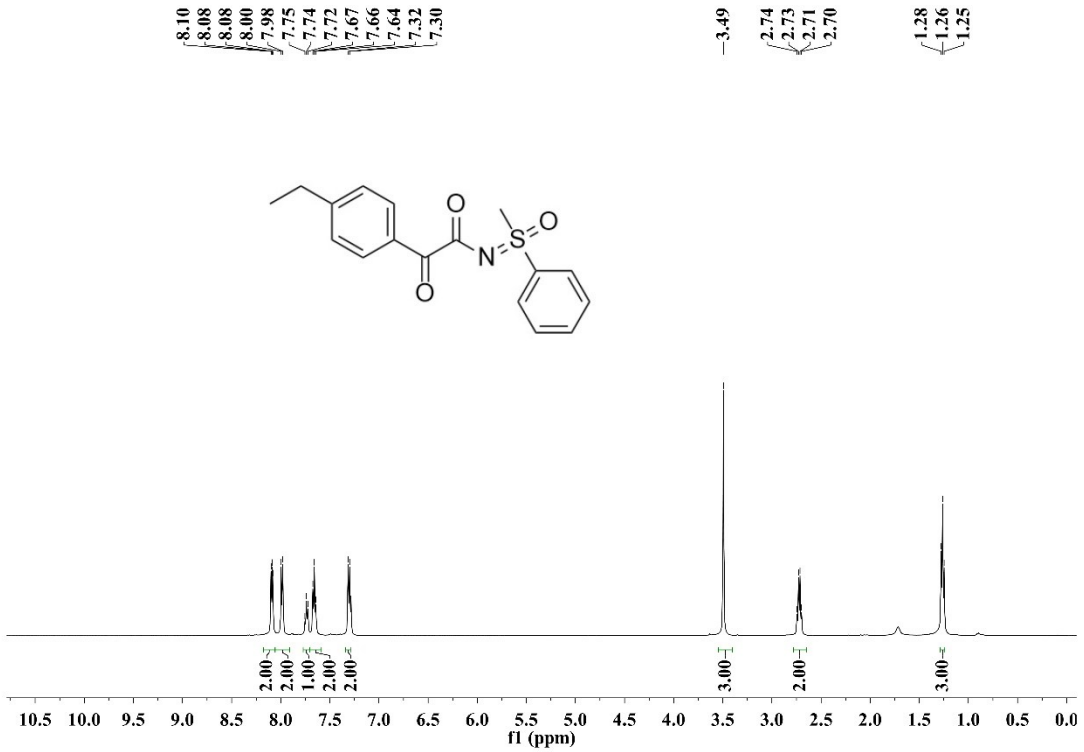
^{1}H NMR spectrum of 3x (500 MHz, $CDCl_3$)



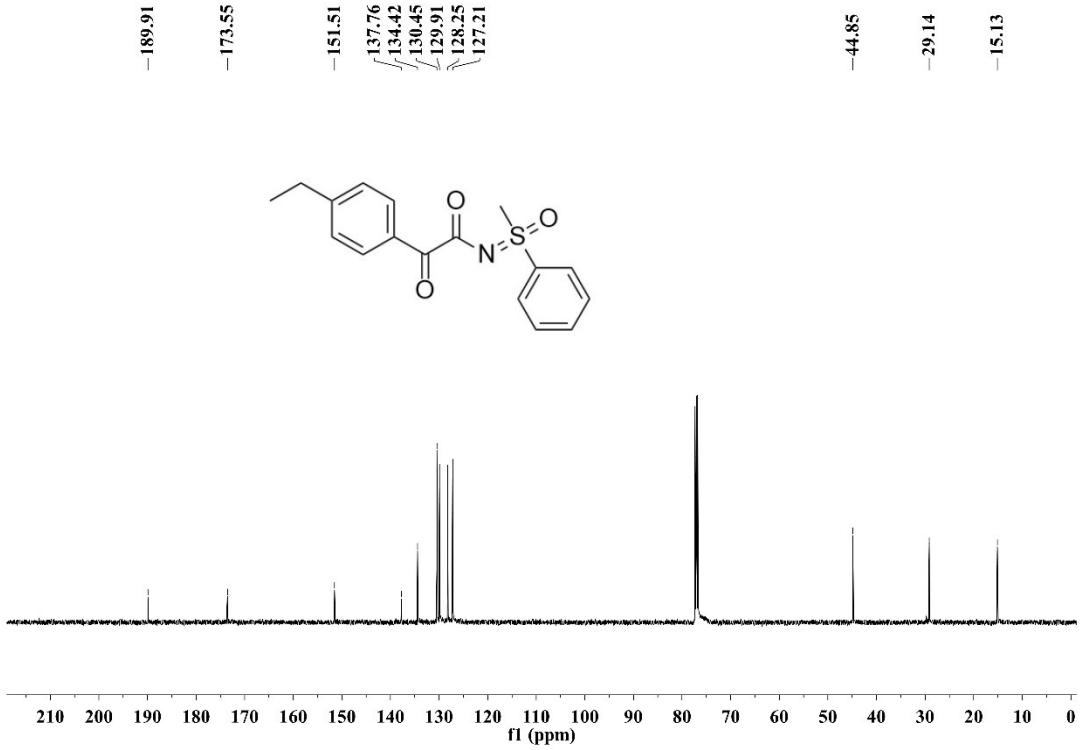
$^{13}C\{^{1}H\}$ NMR spectrum of 3x (125 MHz, $CDCl_3$)



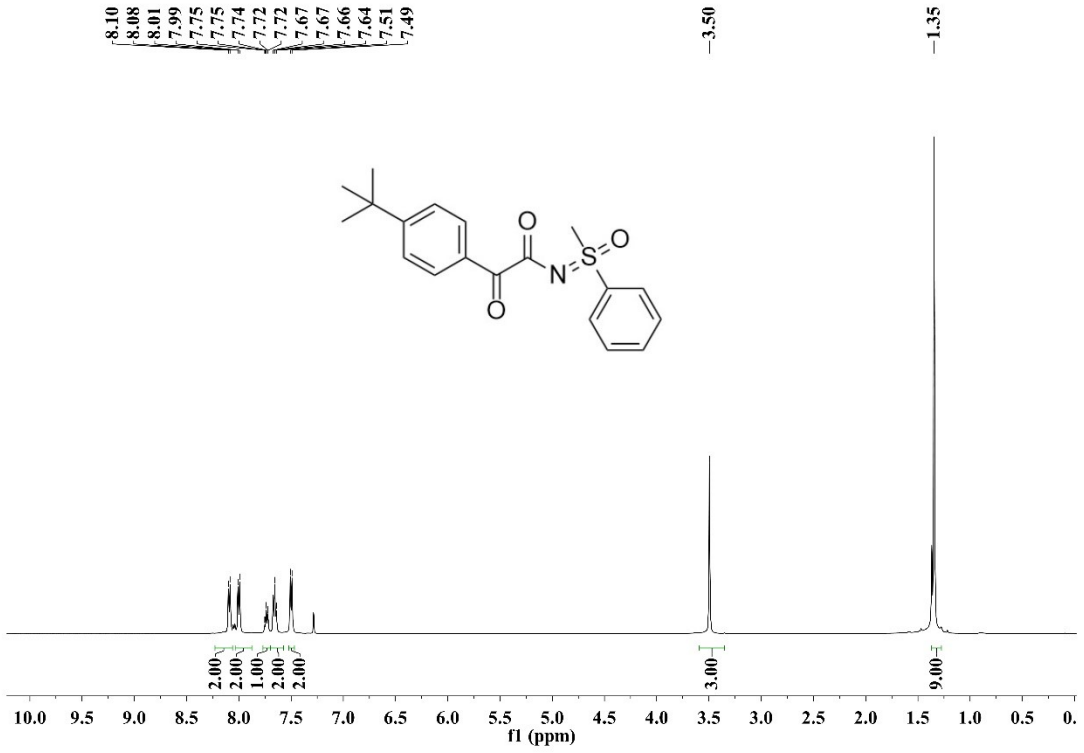
^{1}H NMR spectrum of 3y (500 MHz, $CDCl_3$)



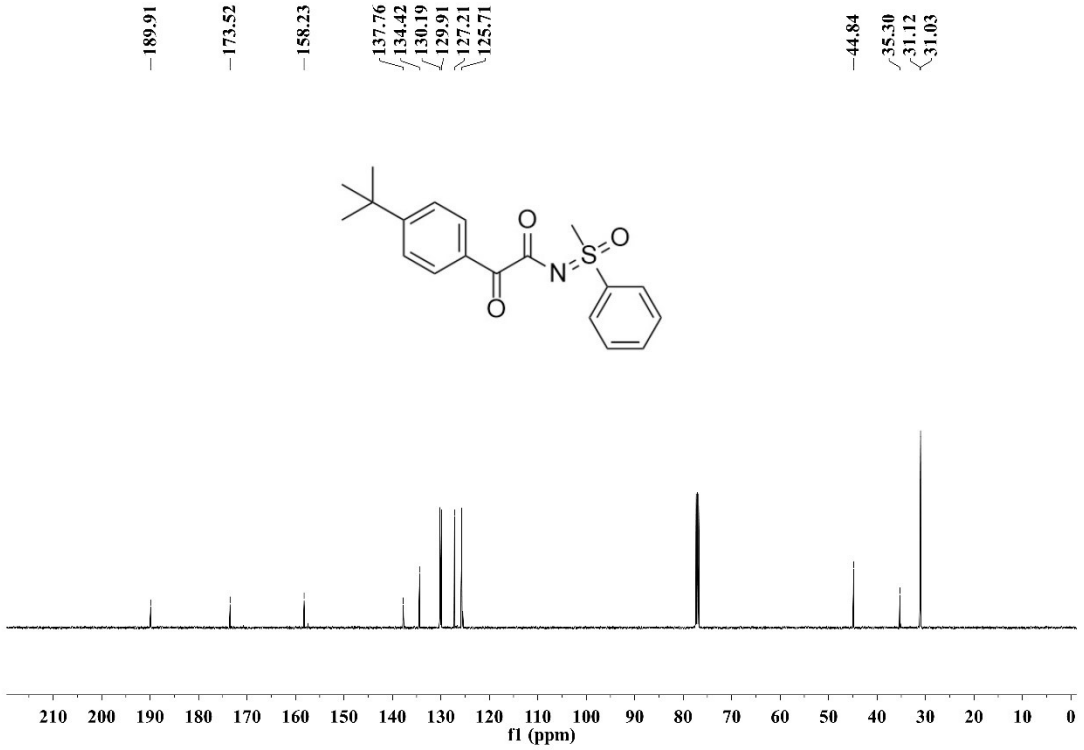
$^{13}C\{^{1}H\}$ NMR spectrum of 3y (125 MHz, $CDCl_3$)



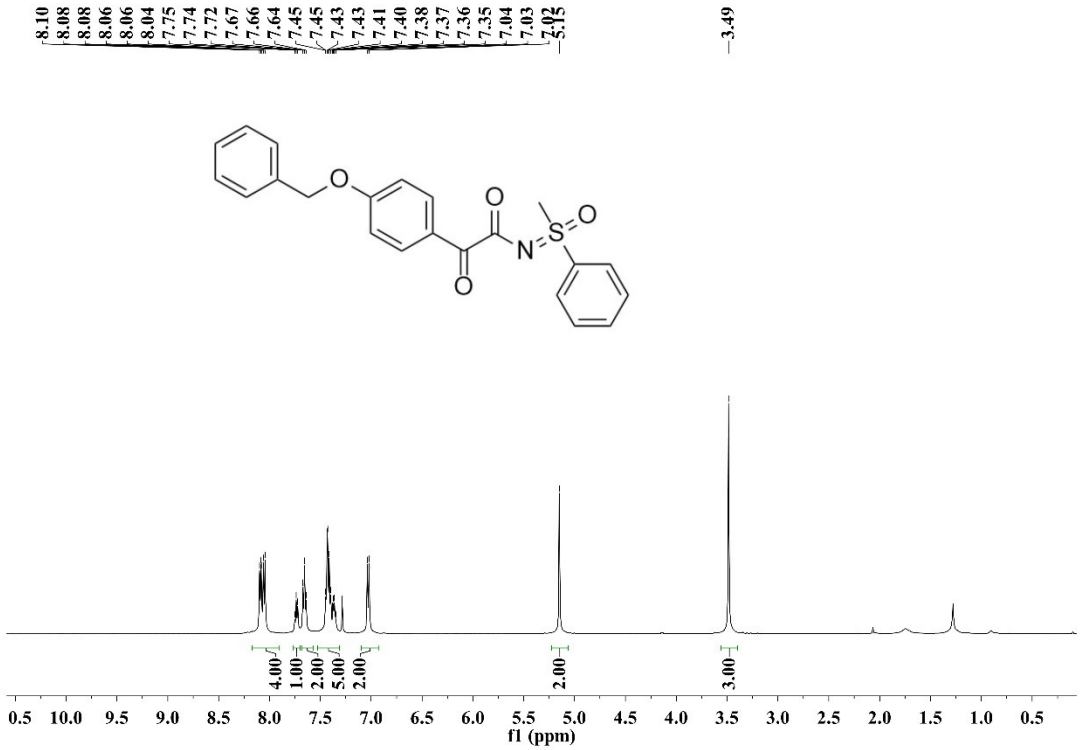
^{1}H NMR spectrum of 3z (500 MHz, $CDCl_3$)



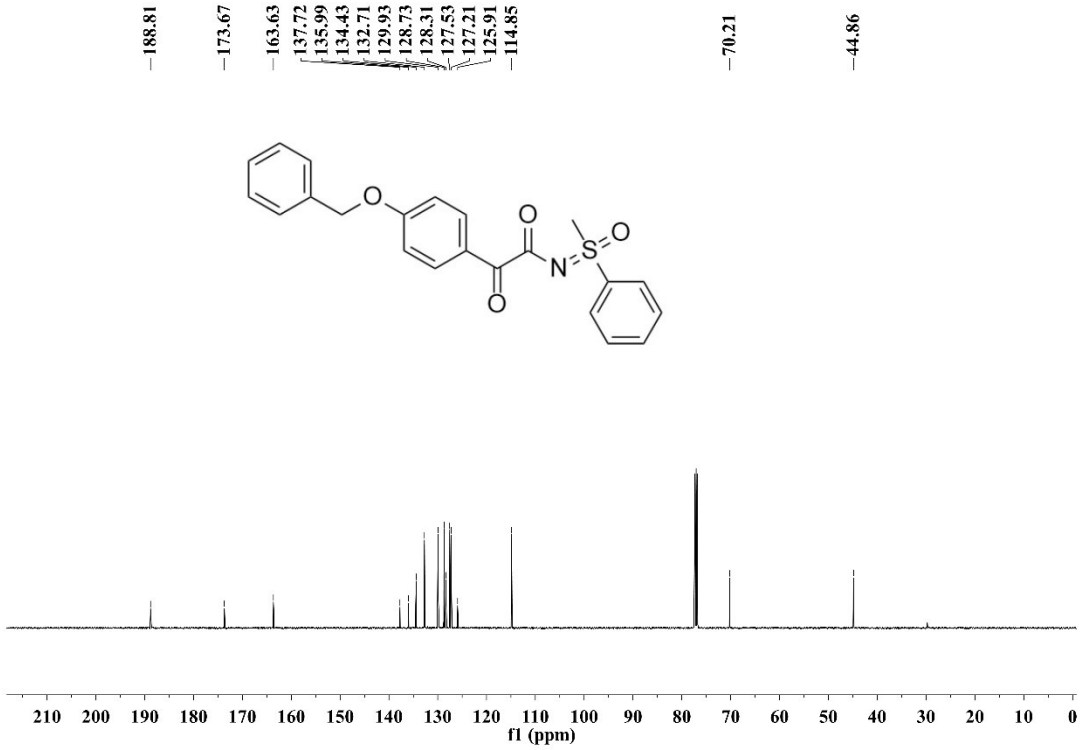
$^{13}C\{^{1}H\}$ NMR spectrum of 3z (125 MHz, $CDCl_3$)



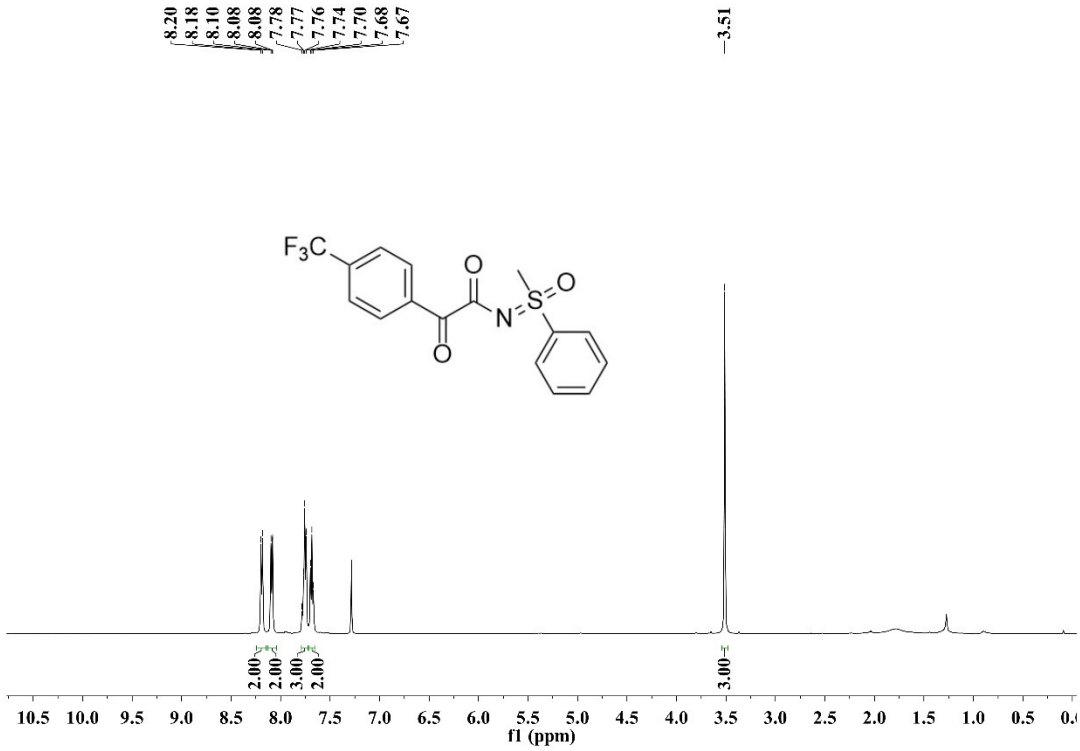
^{1}H NMR spectrum of 3aa (500 MHz, $CDCl_3$)



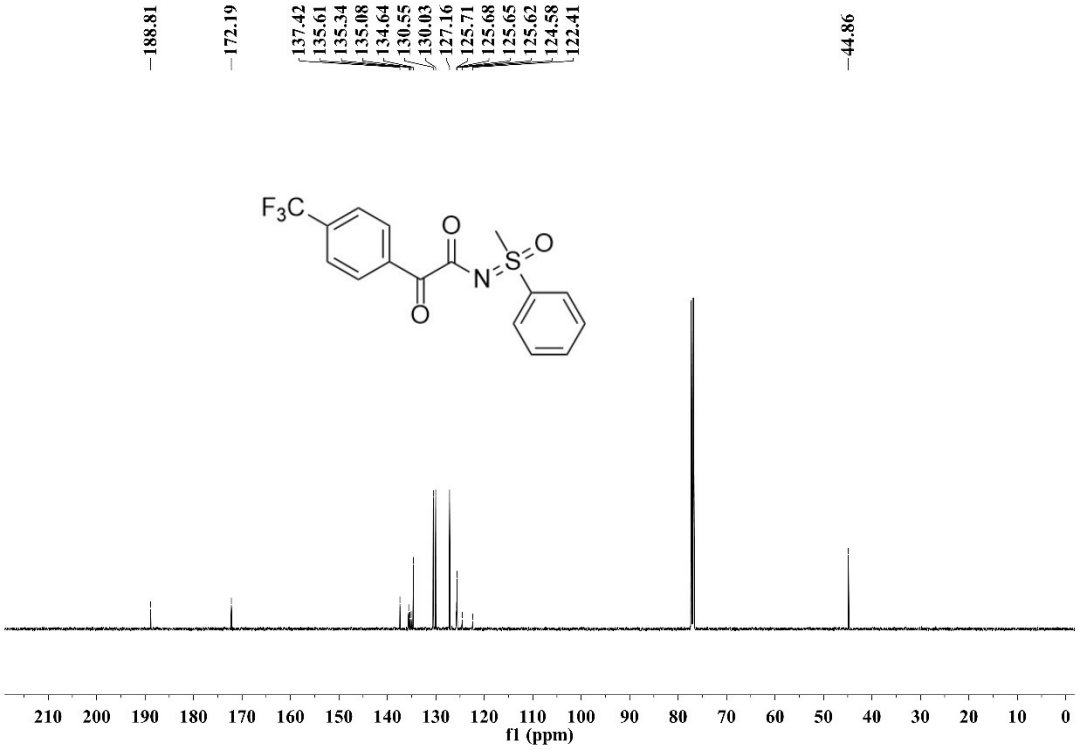
$^{13}C\{^{1}H\}$ NMR spectrum of 3aa (125 MHz, $CDCl_3$)



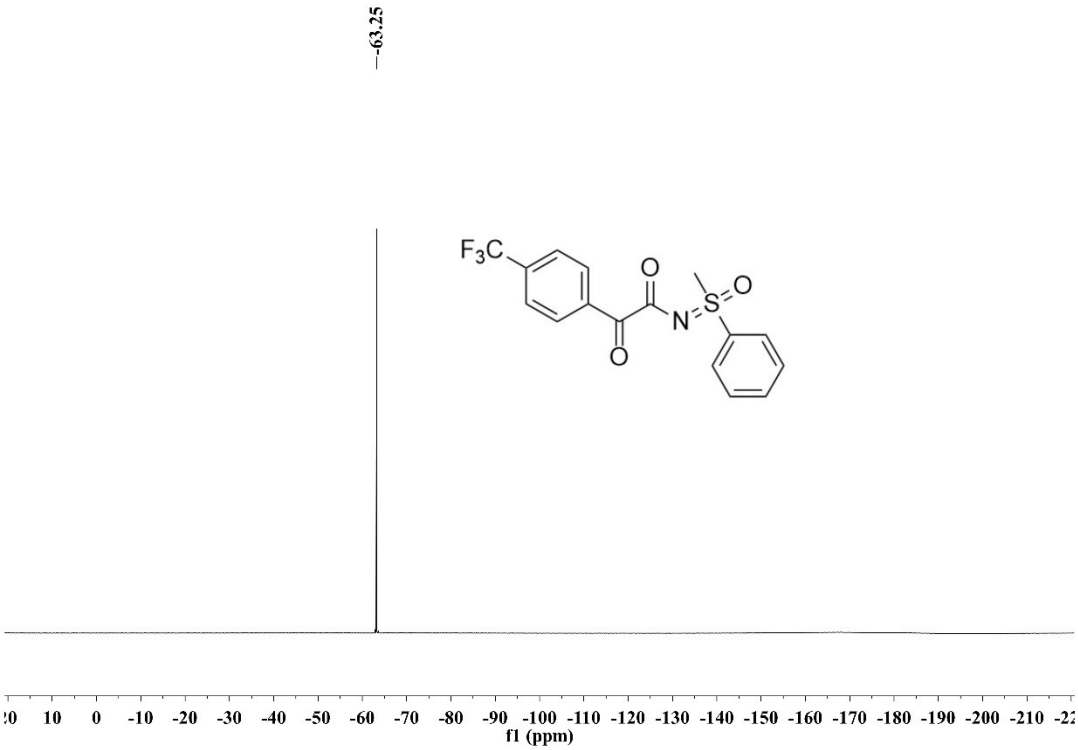
^{1}H NMR spectrum of 3ab (500 MHz, $CDCl_3$)



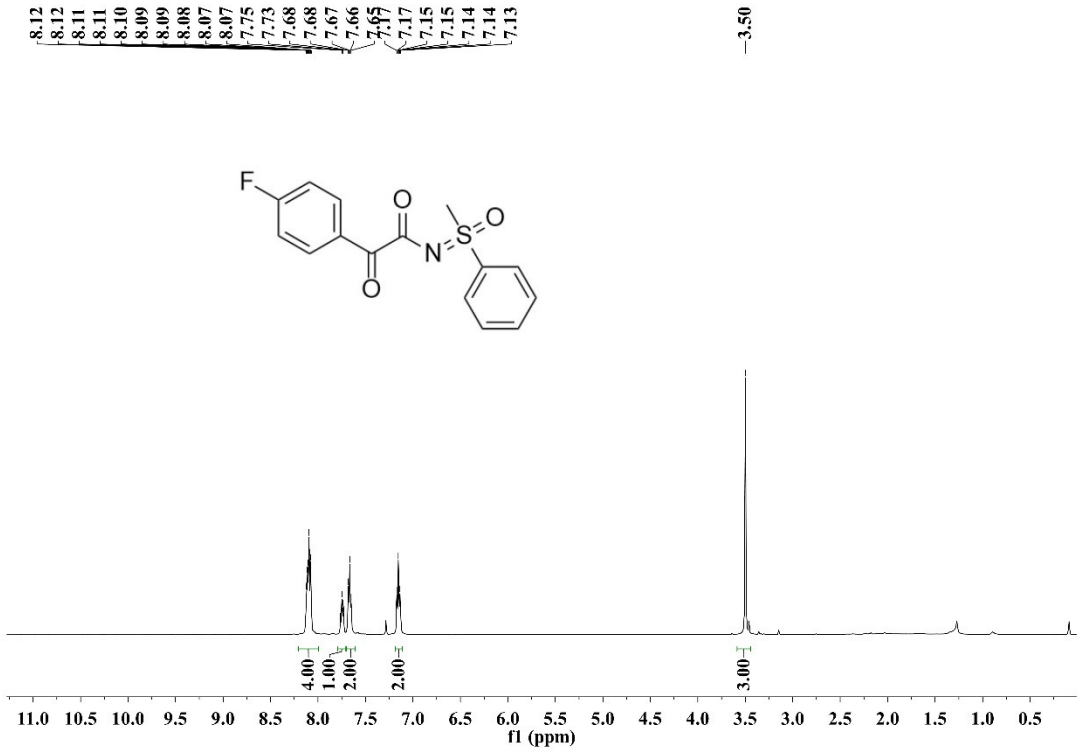
$^{13}C\{^{1}H\}$ NMR spectrum of 3ab (125 MHz, $CDCl_3$)



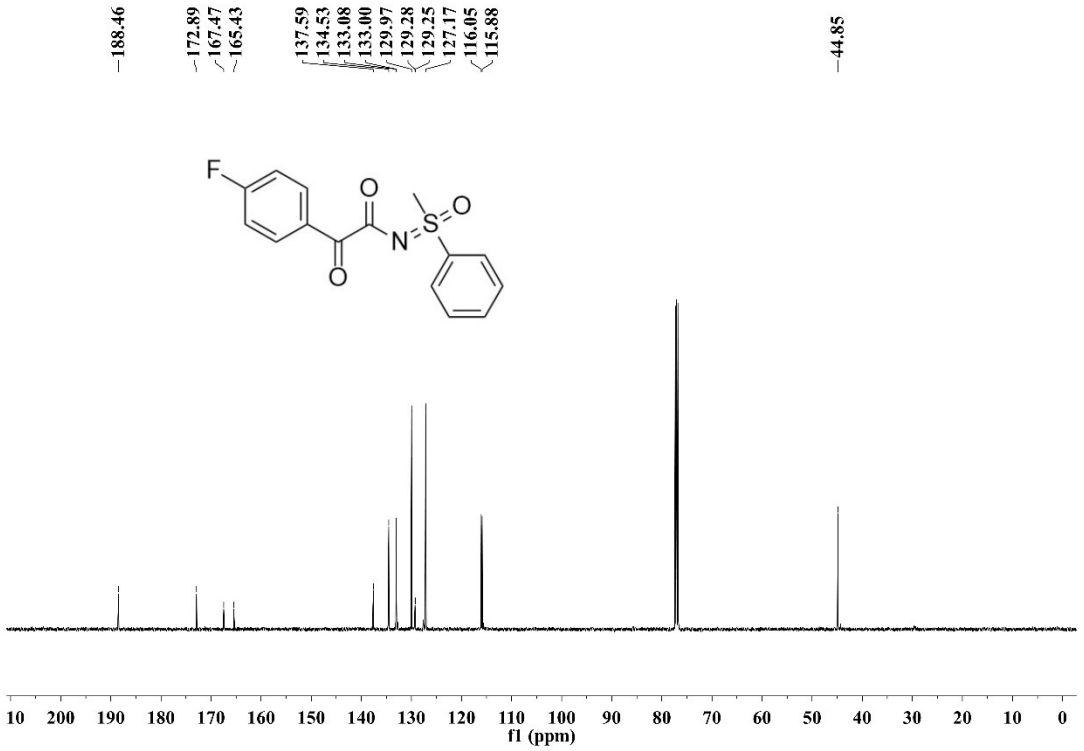
^{19}F NMR spectrum of of 3ab (125 MHz, $CDCl_3$)



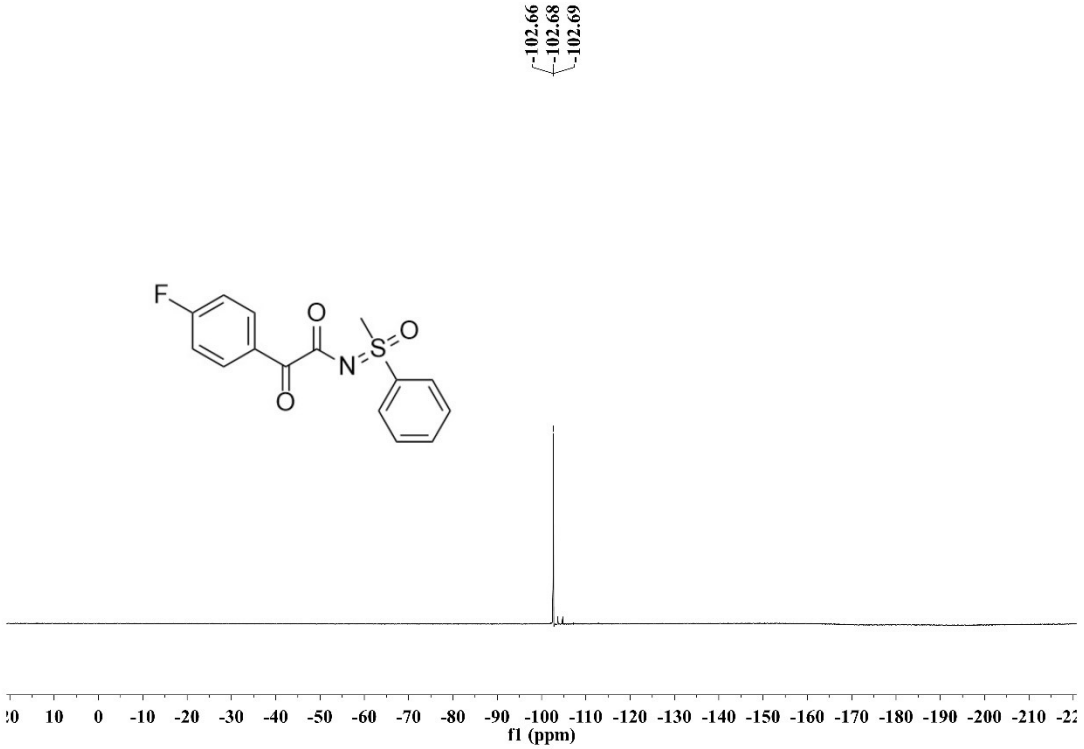
^{1}H NMR spectrum of 3ac (500 MHz, $CDCl_3$)



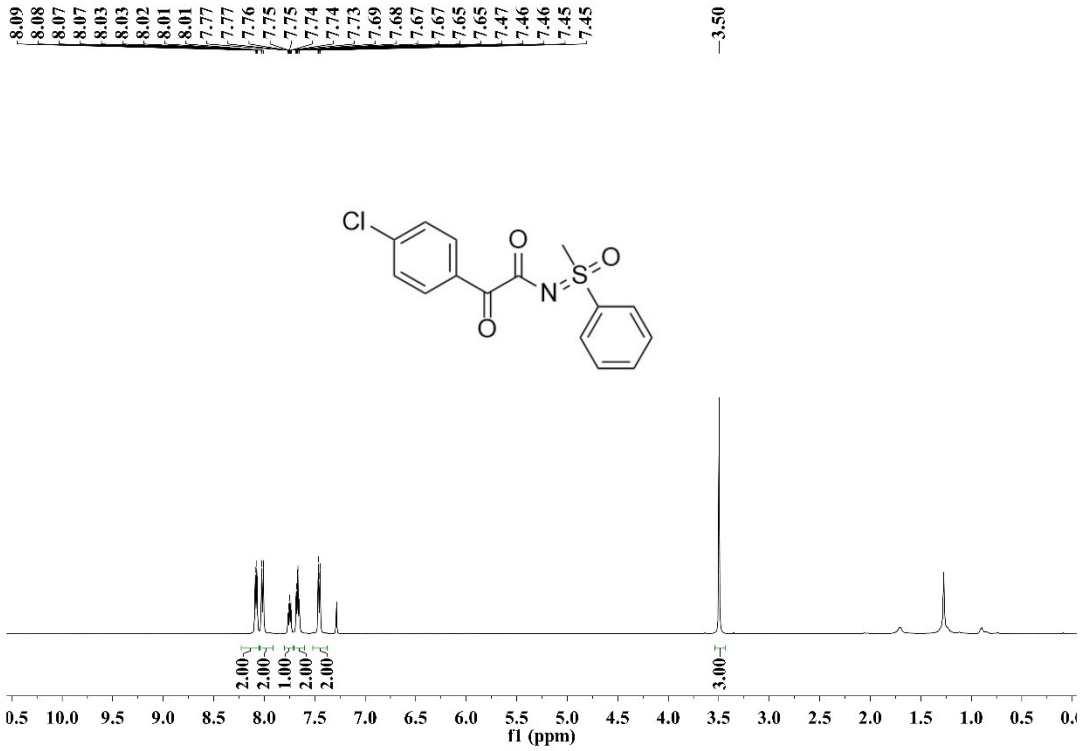
^{13}C{^{1}H} NMR spectrum of 3ac (125 MHz, $CDCl_3$)



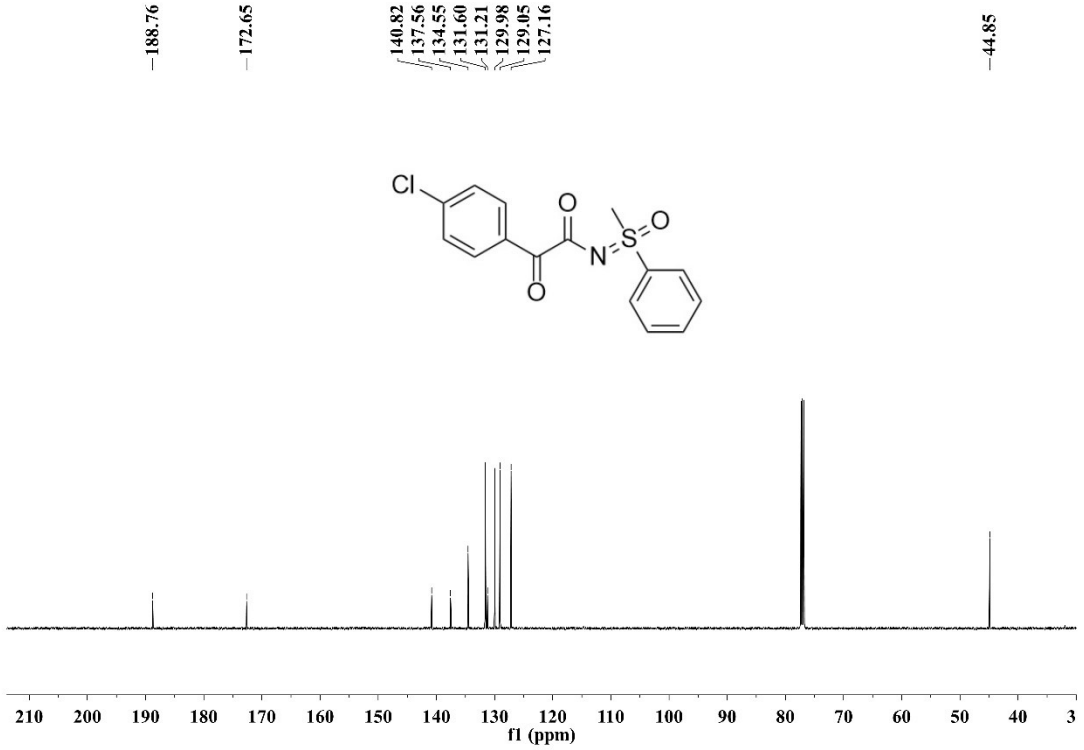
^{19}F NMR spectrum of of 3ac (125 MHz, $CDCl_3$)



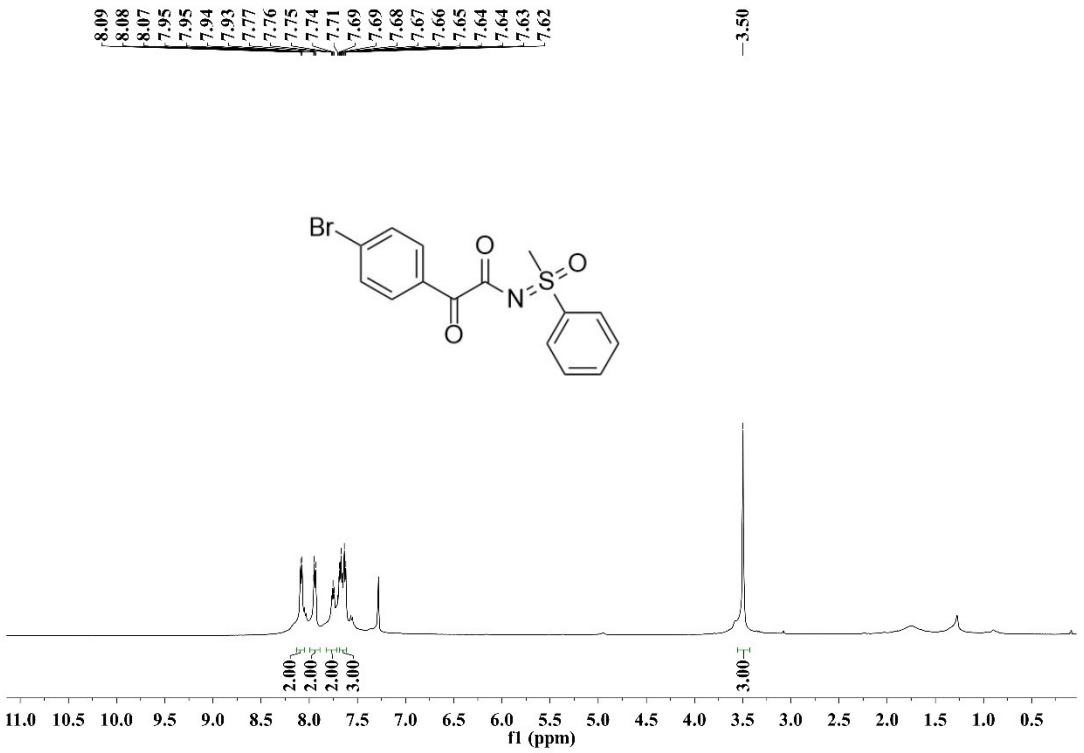
^{1}H NMR spectrum of 3ad (500 MHz, $CDCl_3$)



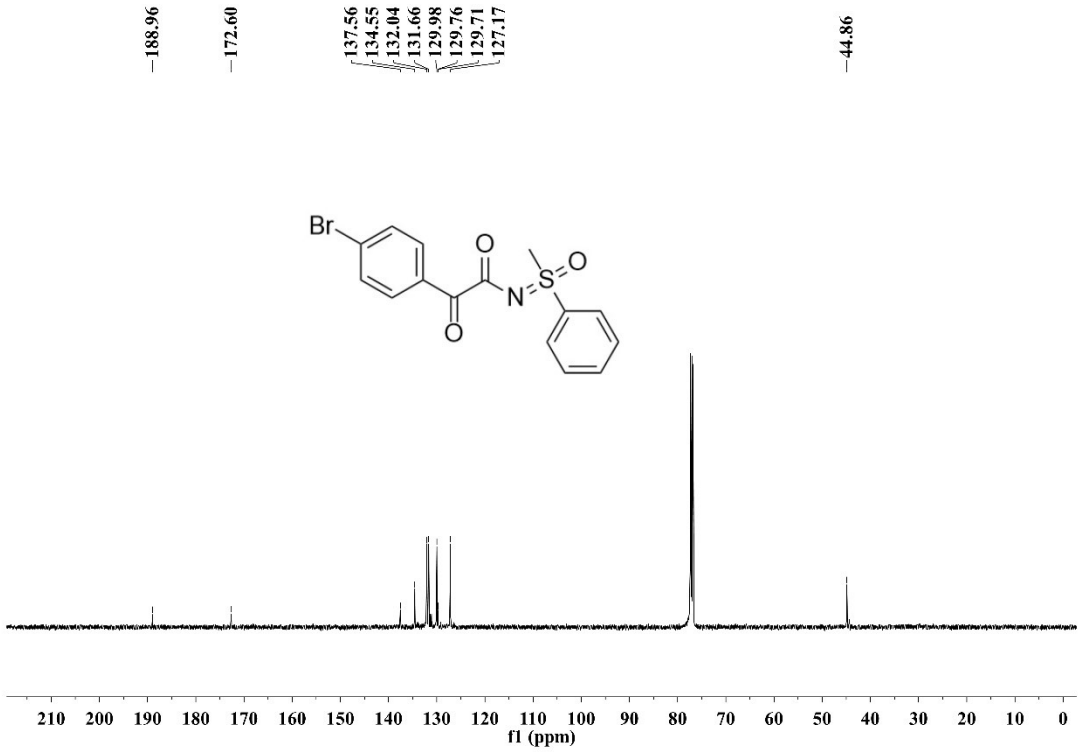
$^{13}C\{^{1}H\}$ NMR spectrum of 3ad (125 MHz, $CDCl_3$)



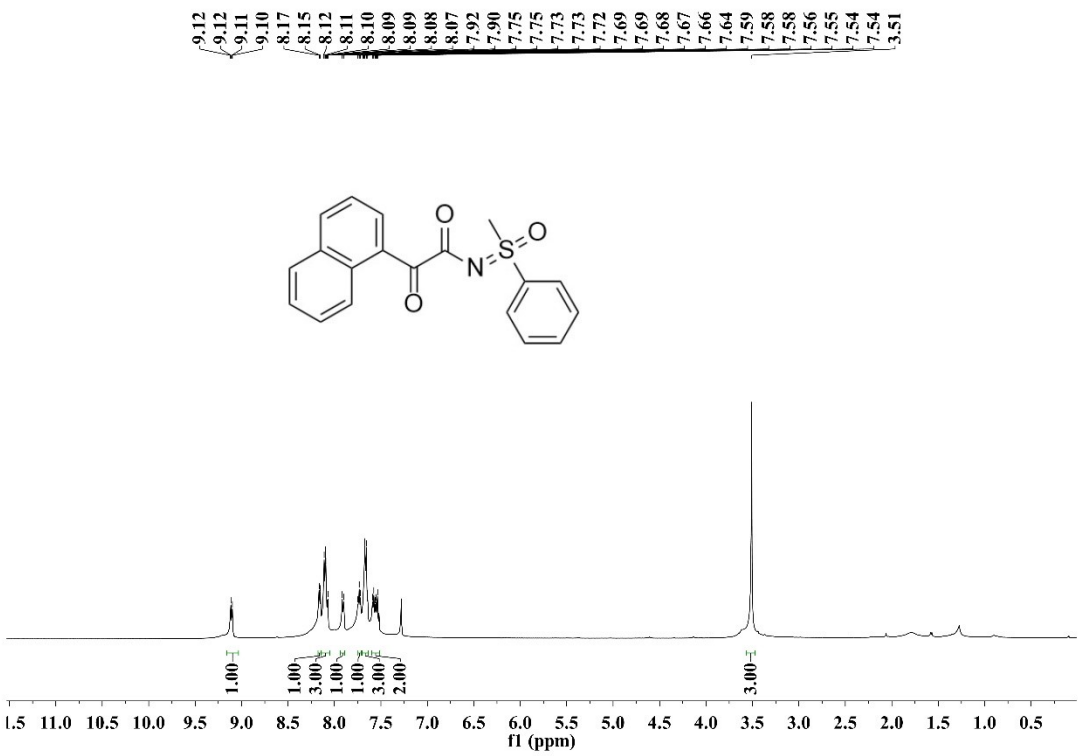
^{1}H NMR spectrum of 3ae (500 MHz, $CDCl_3$)



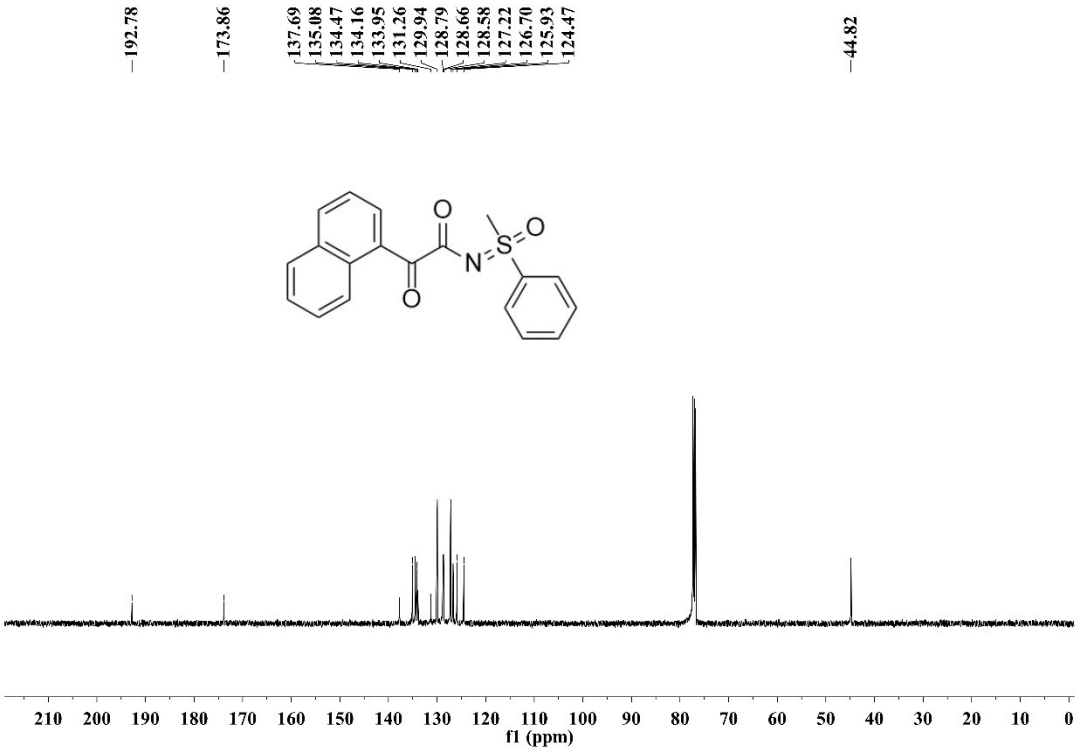
$^{13}C\{^{1}H\}$ NMR spectrum of 3ae (125 MHz, $CDCl_3$)



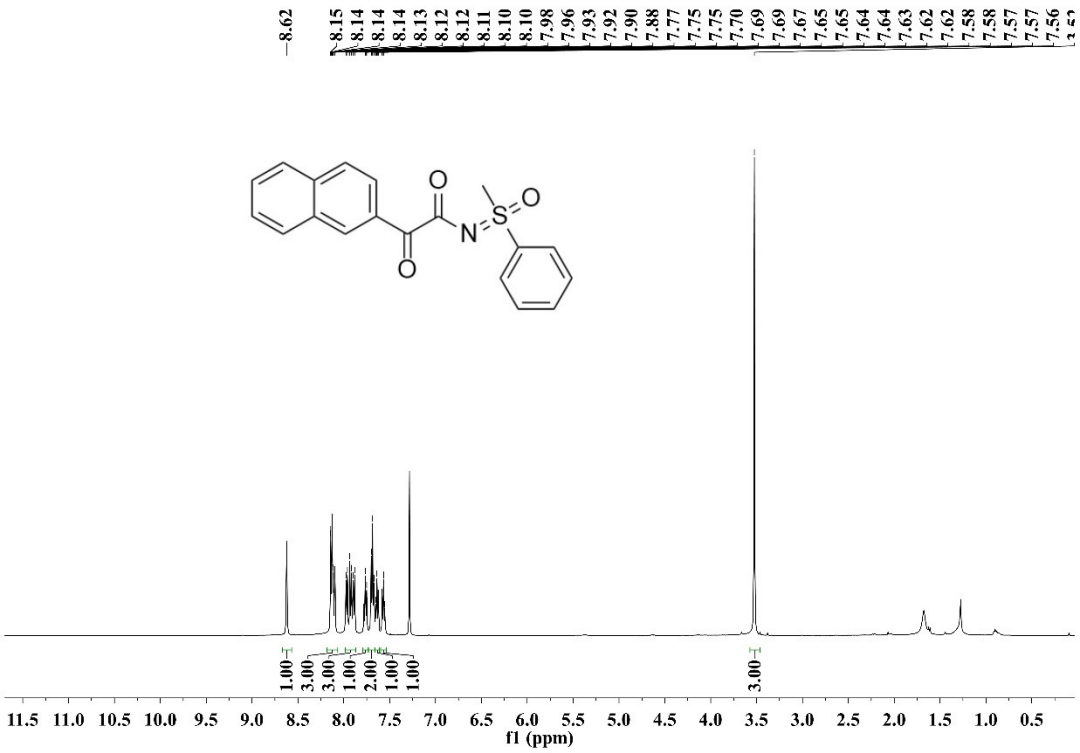
^{1}H NMR spectrum of 3af (500 MHz, $CDCl_3$)



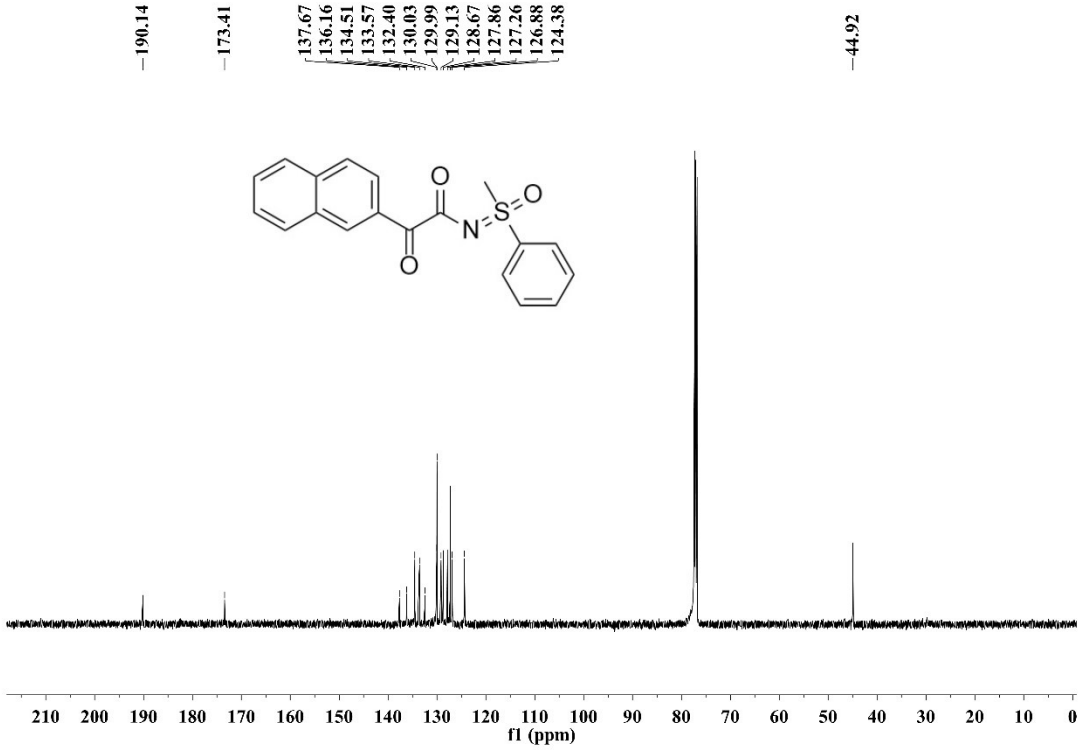
$^{13}C\{^{1}H\}$ NMR spectrum of 3af (125 MHz, $CDCl_3$)



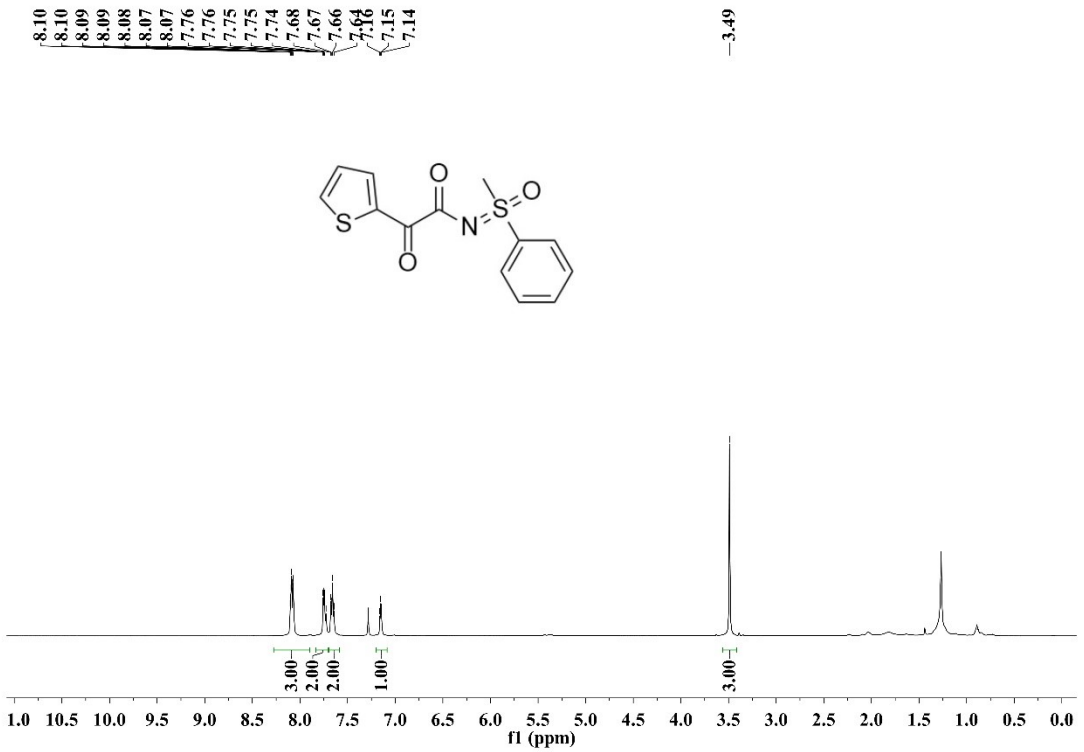
^{1}H NMR spectrum of 3ag (500 MHz, $CDCl_3$)



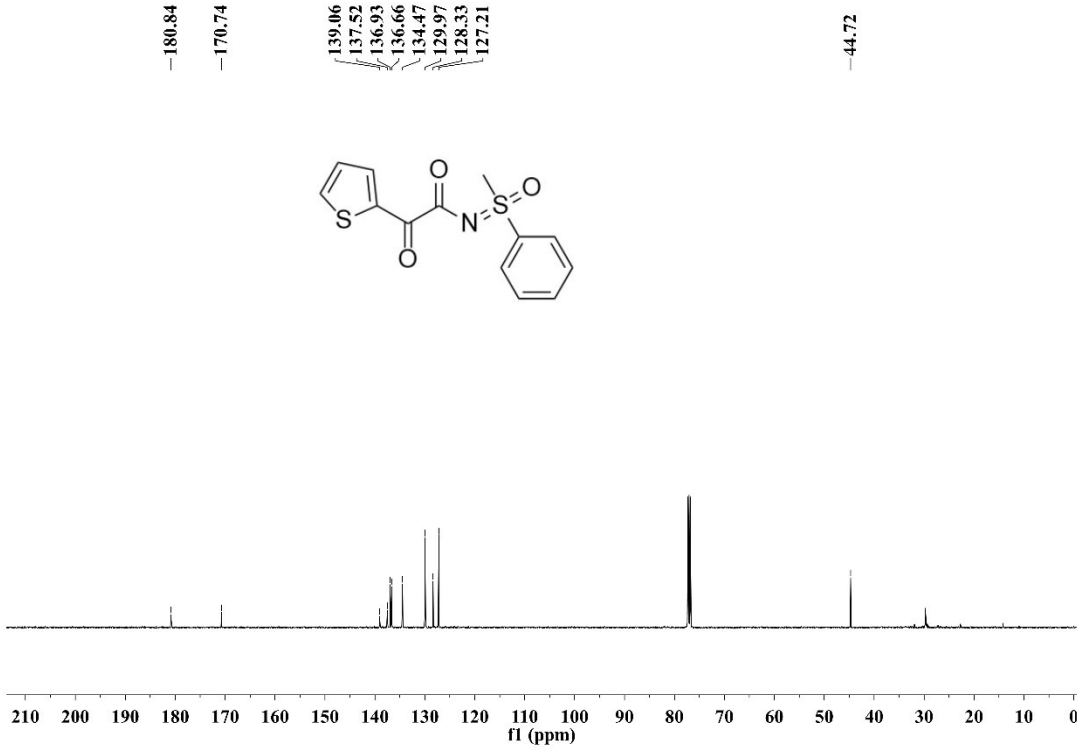
$^{13}C\{^{1}H\}$ NMR spectrum of 3ag (125 MHz, $CDCl_3$)



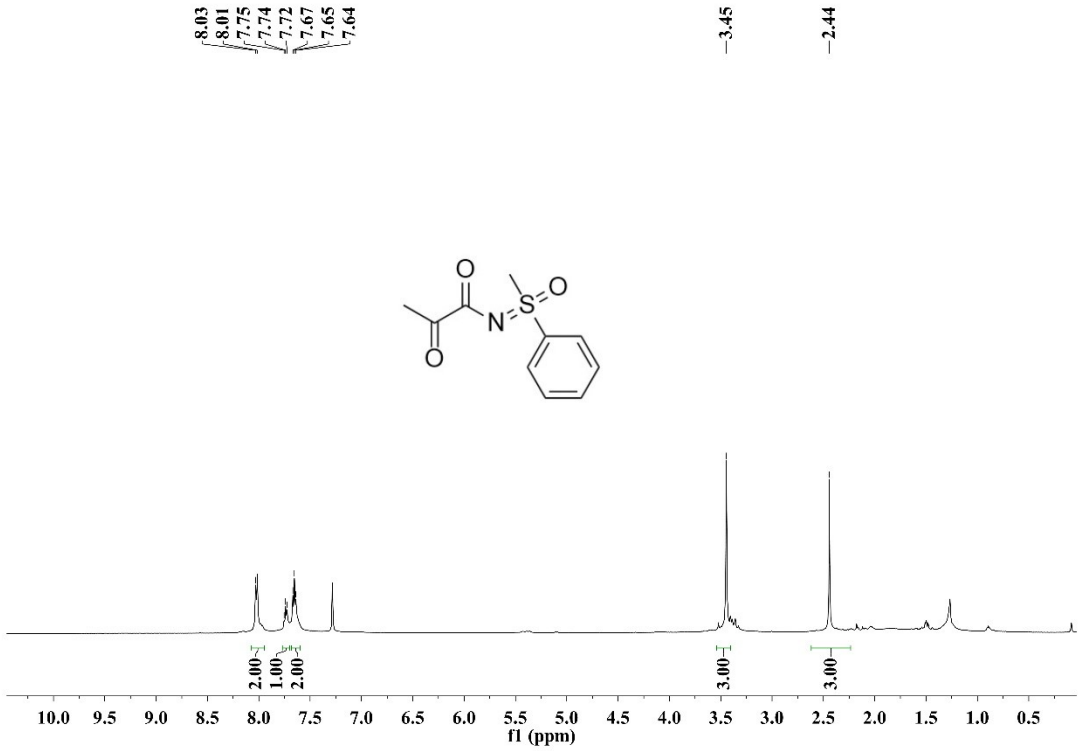
^{1}H NMR spectrum of 3ah (500 MHz, $CDCl_3$)



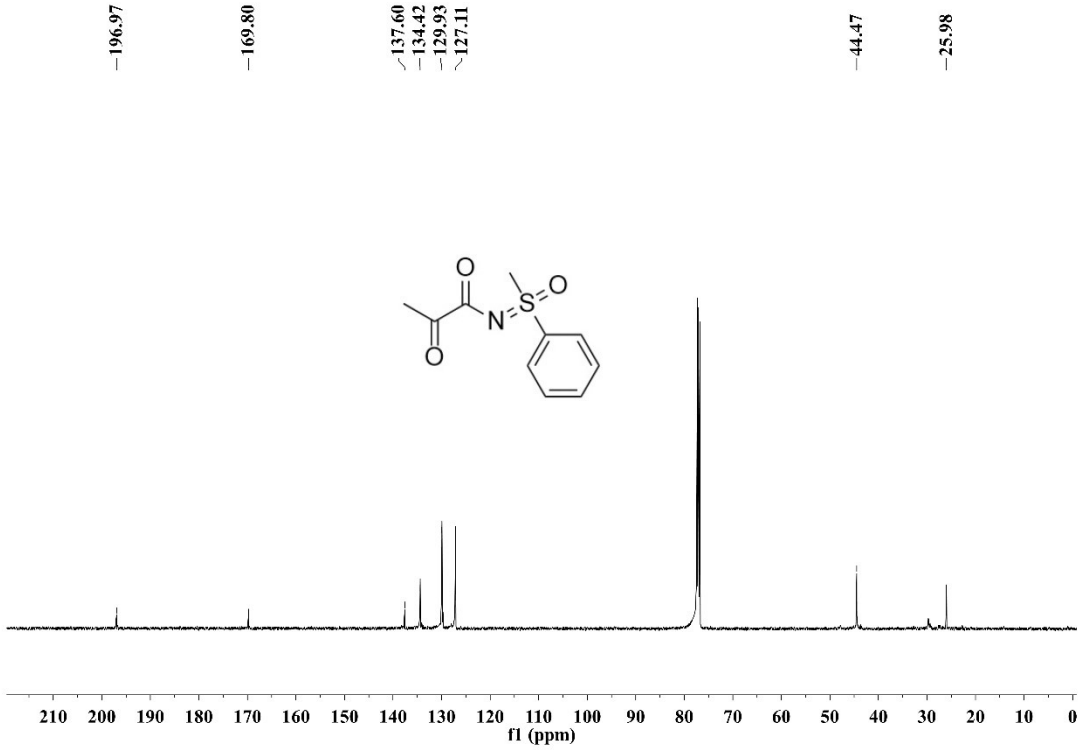
$^{13}C\{^{1}H\}$ NMR spectrum of 3ah (125 MHz, $CDCl_3$)



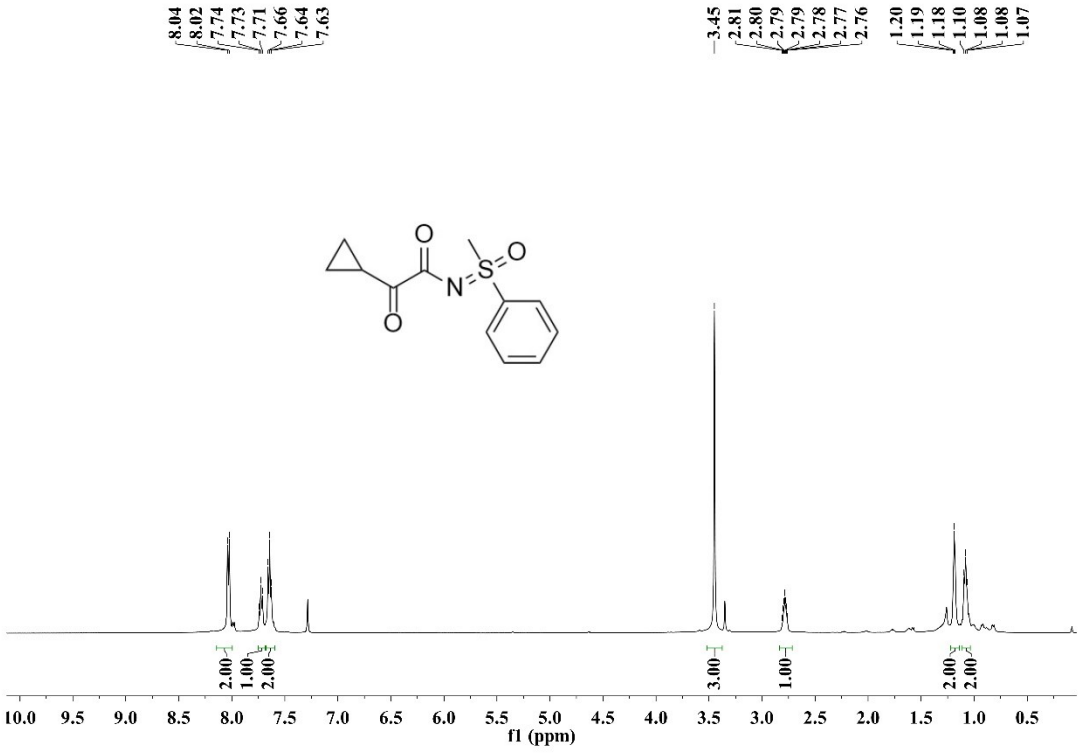
^{1}H NMR spectrum of 3ai (500 MHz, $CDCl_3$)



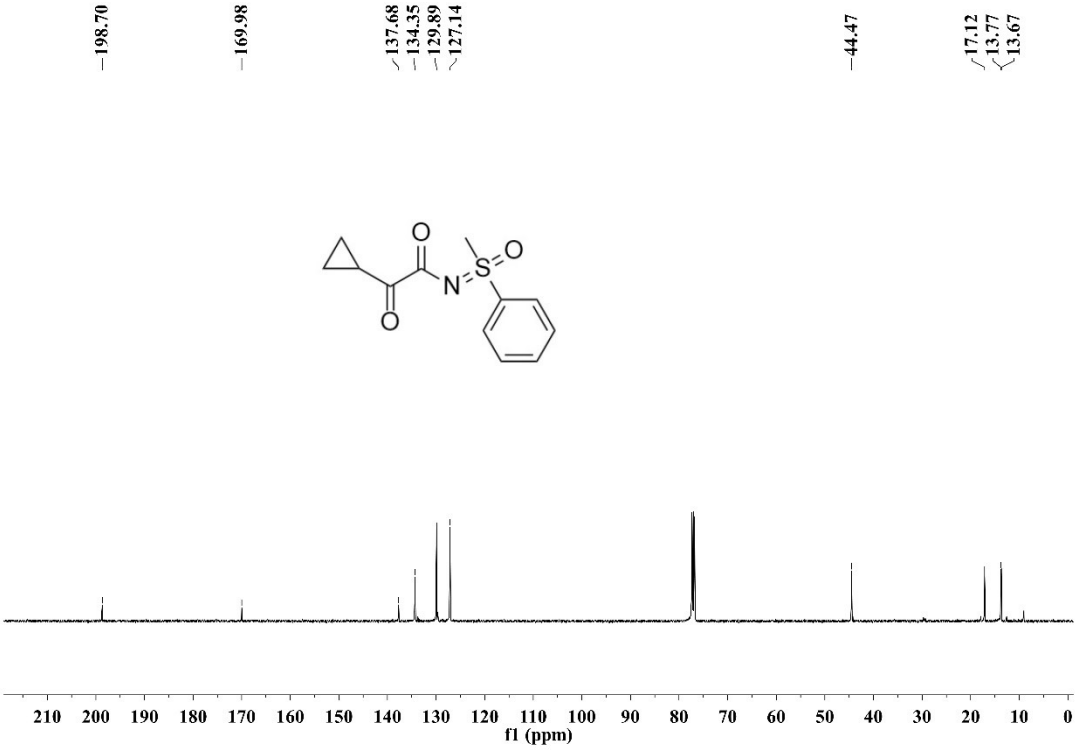
$^{13}C\{^{1}H\}$ NMR spectrum of 3ai (125 MHz, $CDCl_3$)



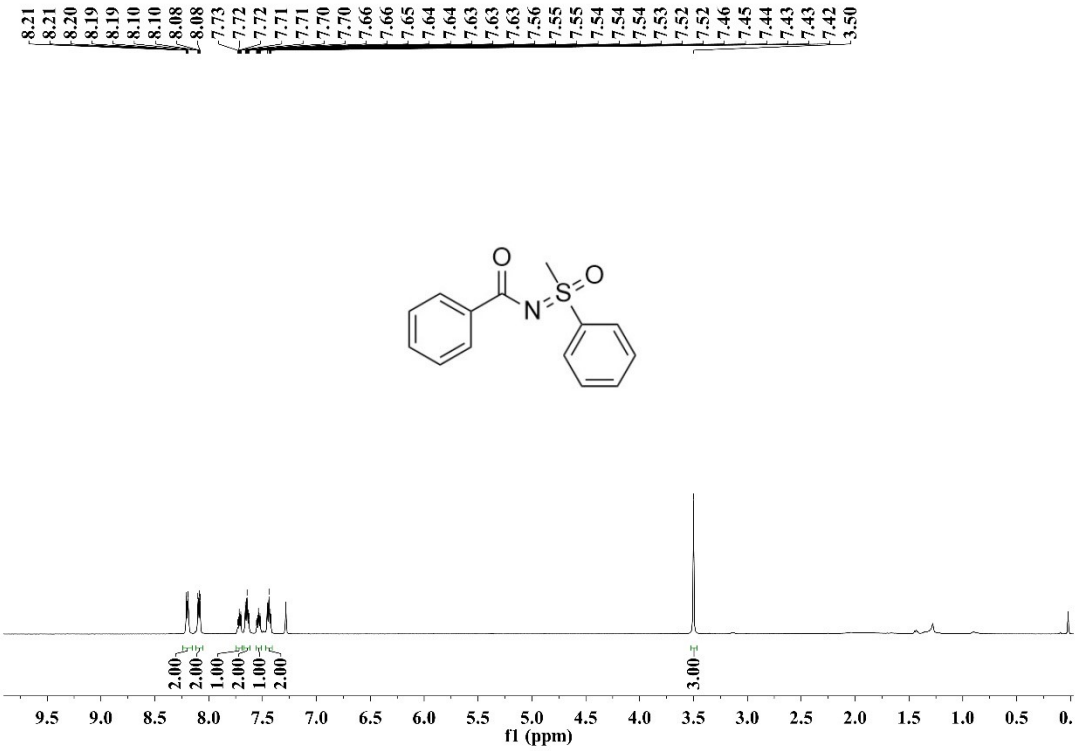
^{1}H NMR spectrum of 3aj (500 MHz, $CDCl_3$)



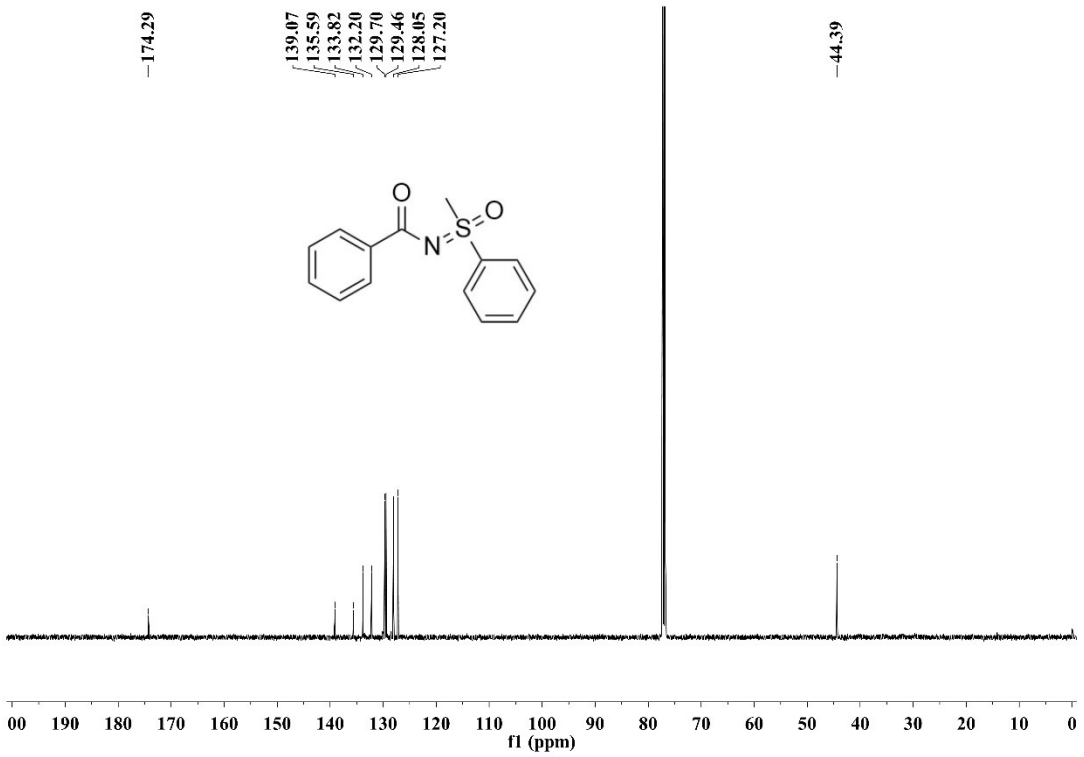
$^{13}C\{^{1}H\}$ NMR spectrum of 3aj (125 MHz, $CDCl_3$)



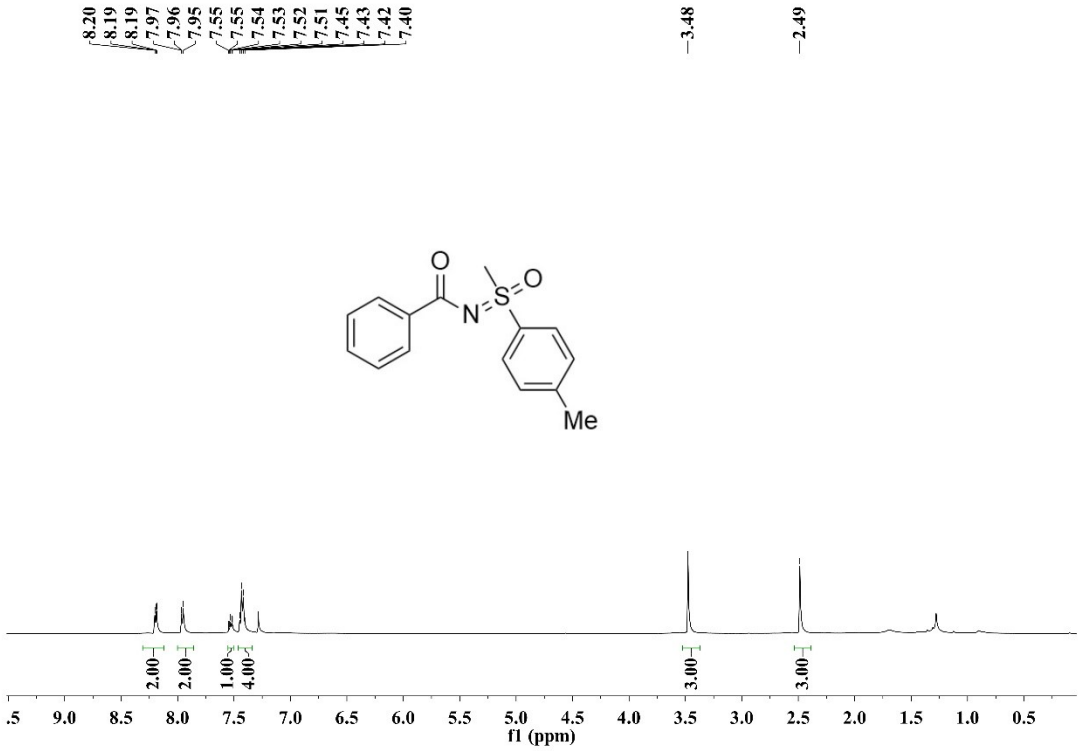
^{1}H NMR spectrum of 4a (500 MHz, $CDCl_3$)



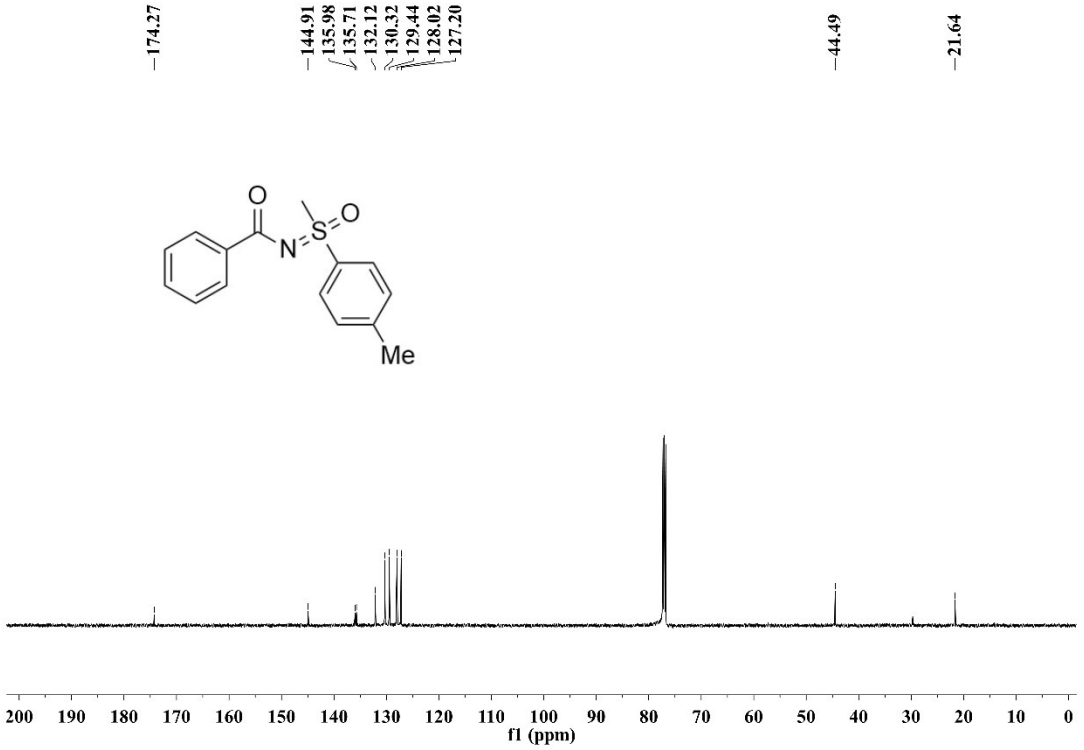
$^{13}C\{^{1}H\}$ NMR spectrum of 4a (125 MHz, $CDCl_3$)



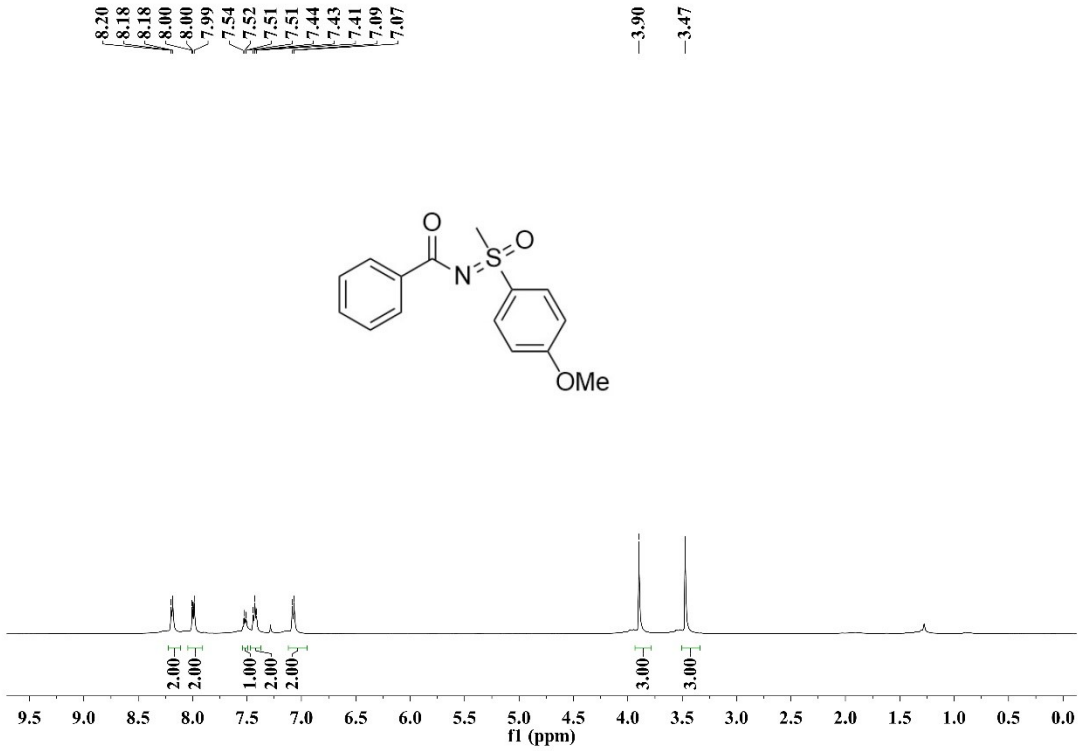
^{1}H NMR spectrum of 4b (500 MHz, $CDCl_3$)



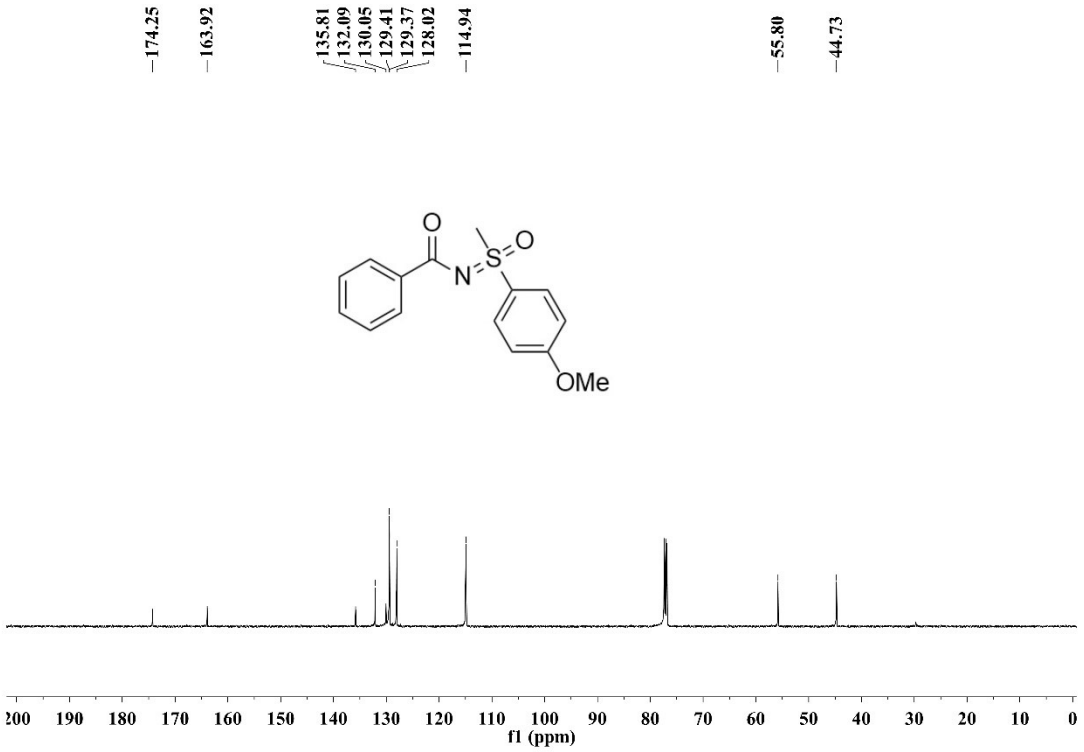
$^{13}C\{^{1}H\}$ NMR spectrum of 4b (125 MHz, $CDCl_3$)



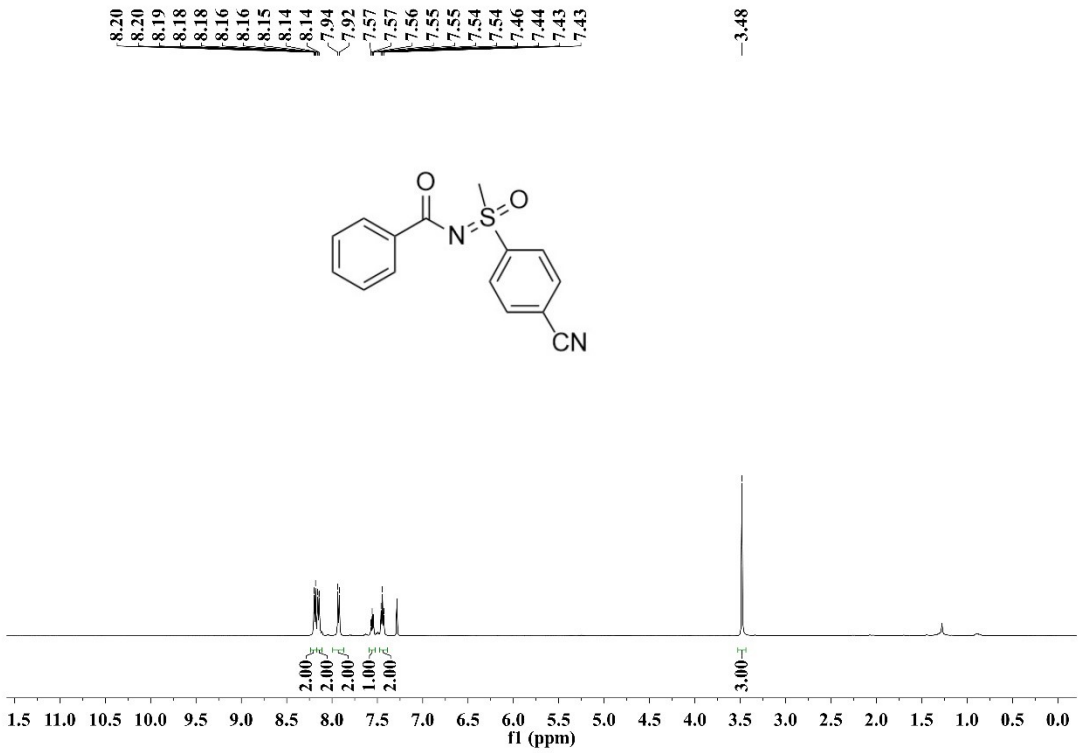
^{1}H NMR spectrum of 4c (500 MHz, $CDCl_3$)



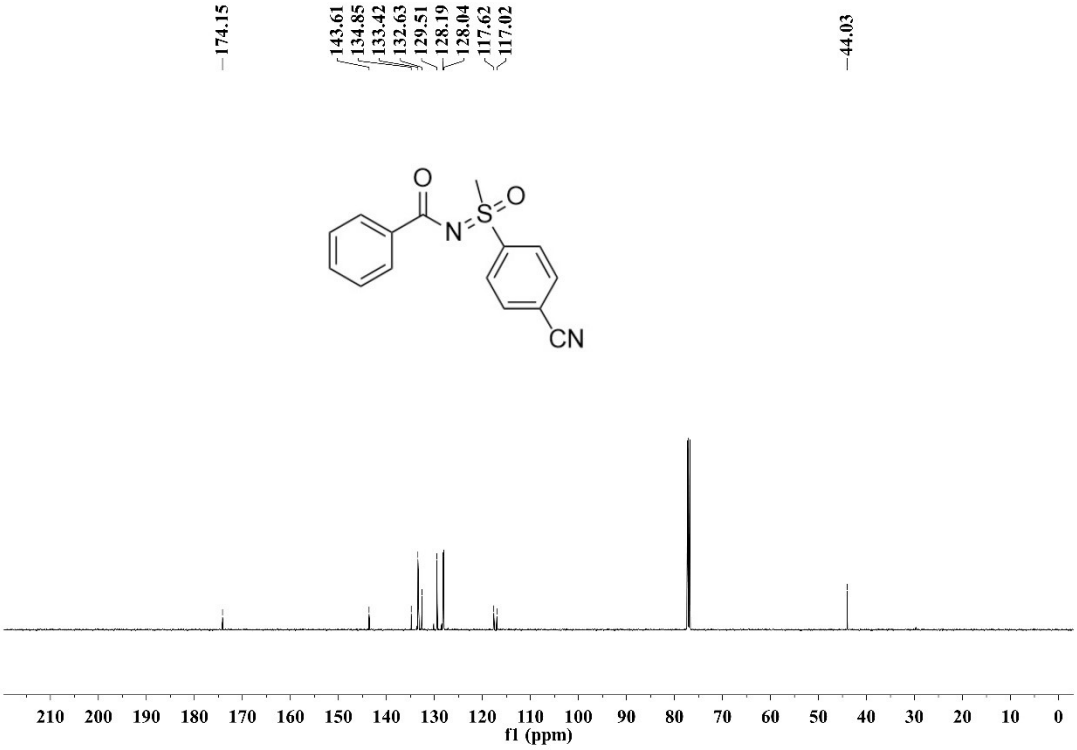
$^{13}C\{^{1}H\}$ NMR spectrum of 4c (125 MHz, $CDCl_3$)



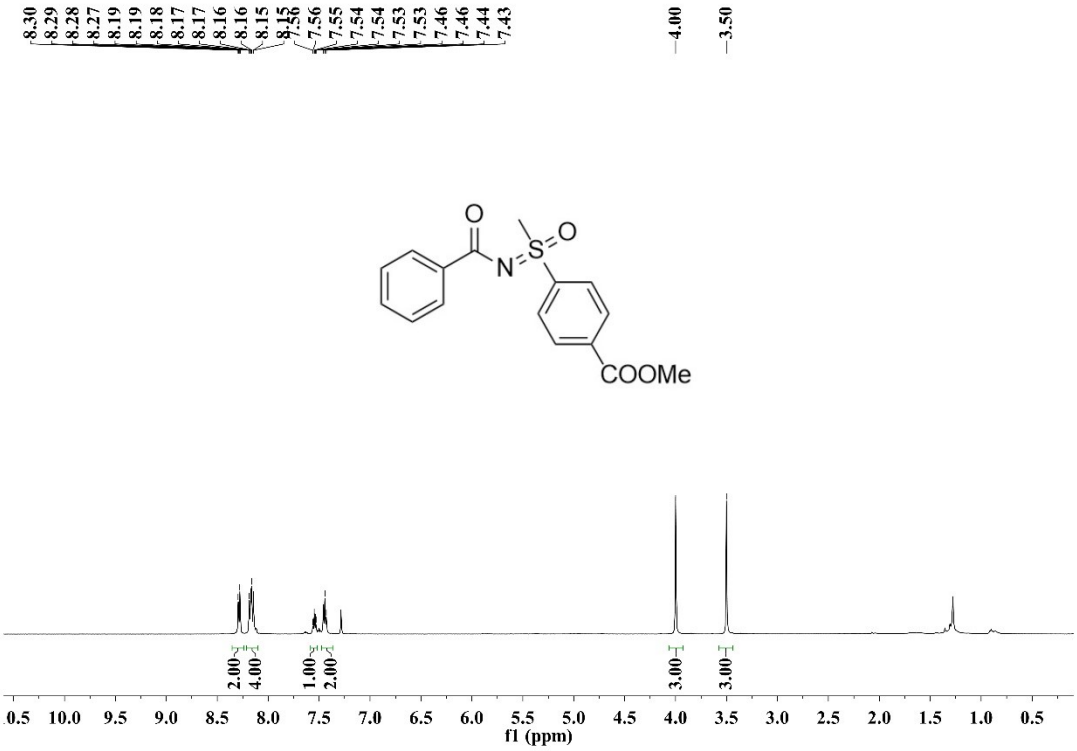
^{1}H NMR spectrum of 4d (500 MHz, $CDCl_3$)



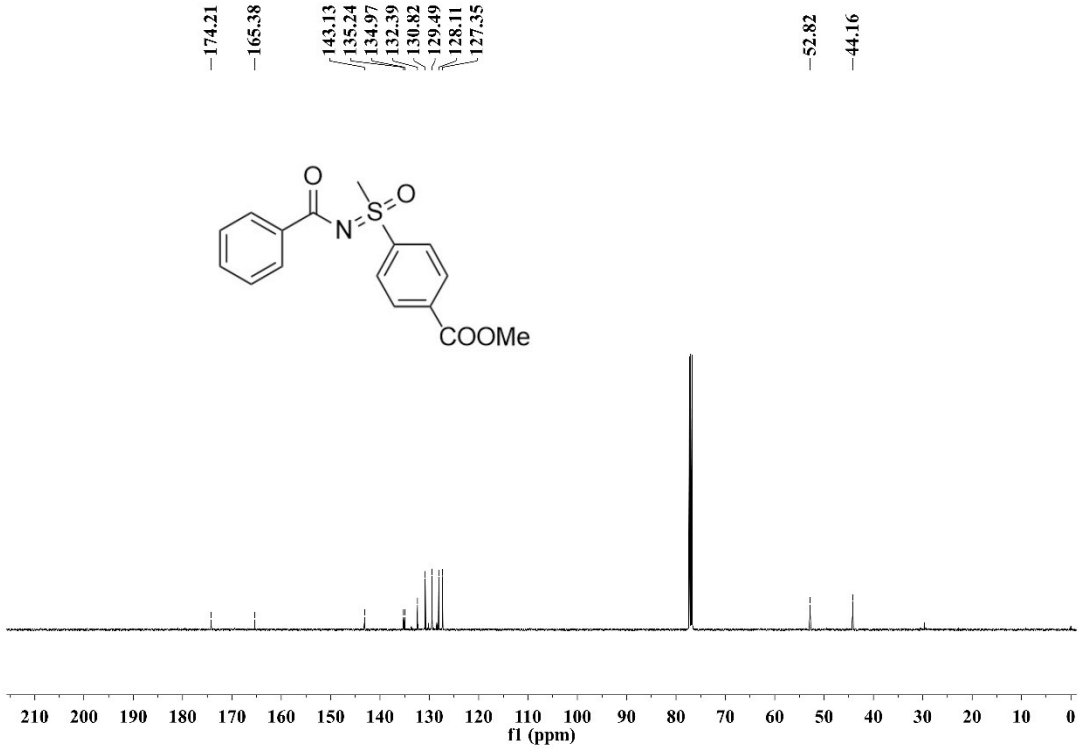
$^{13}C\{^{1}H\}$ NMR spectrum of 4d (125 MHz, $CDCl_3$)



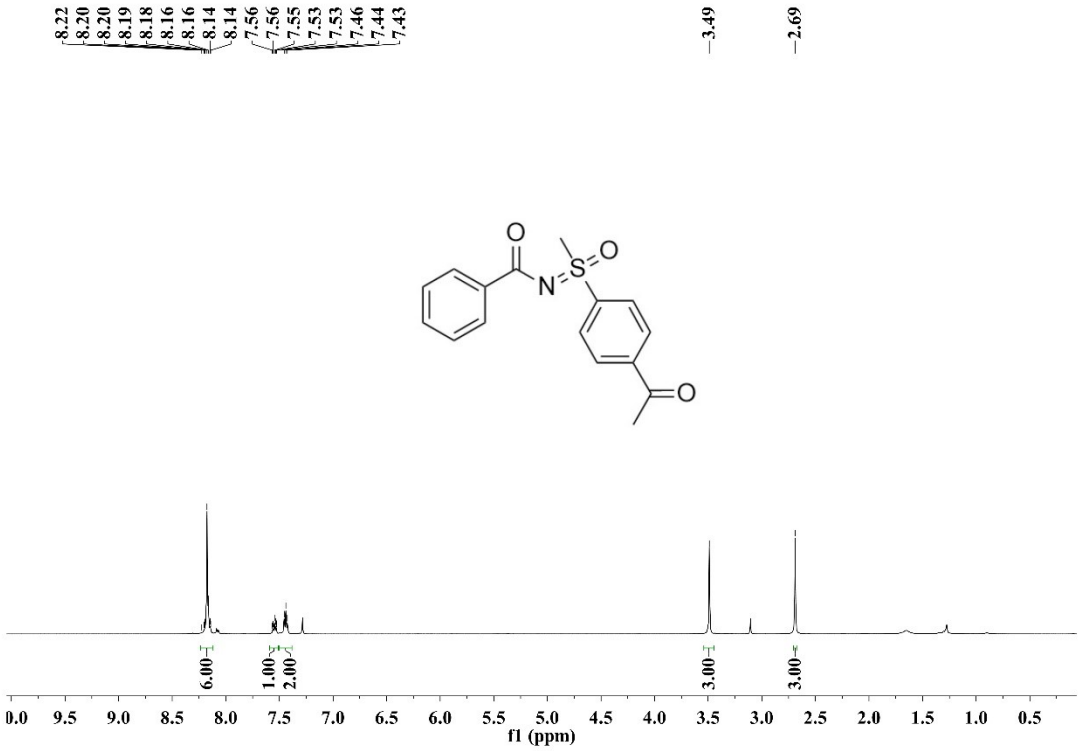
^{1}H NMR spectrum of 4e (500 MHz, $CDCl_3$)



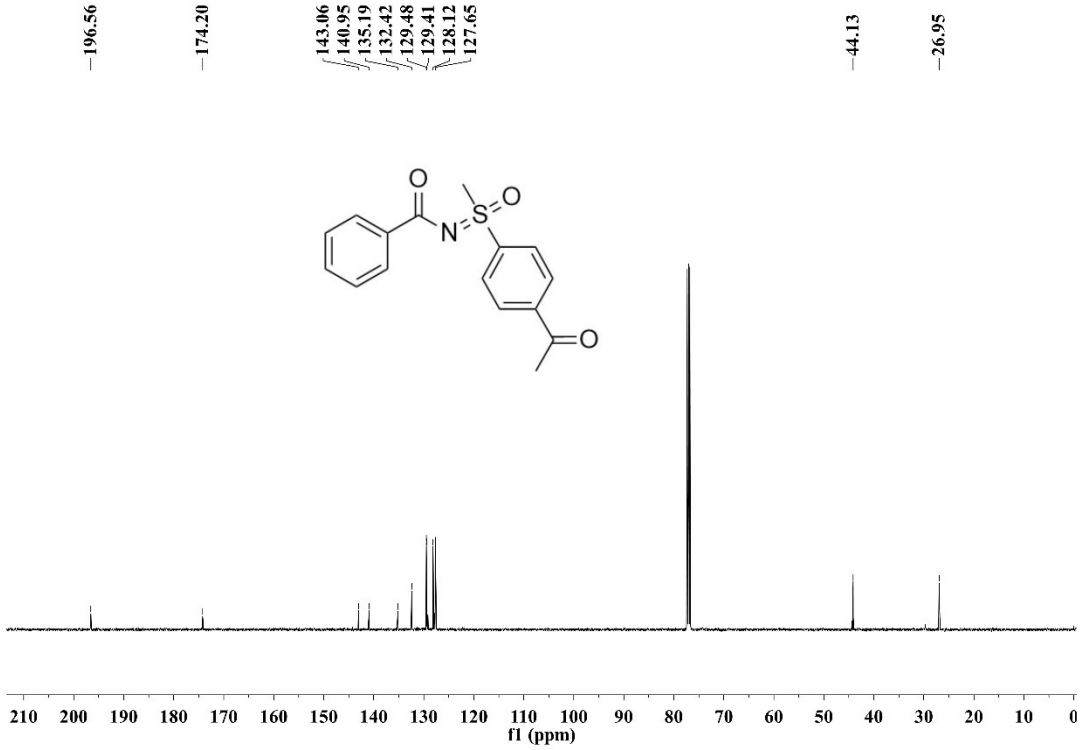
$^{13}C\{^{1}H\}$ NMR spectrum of 4e (125 MHz, $CDCl_3$)



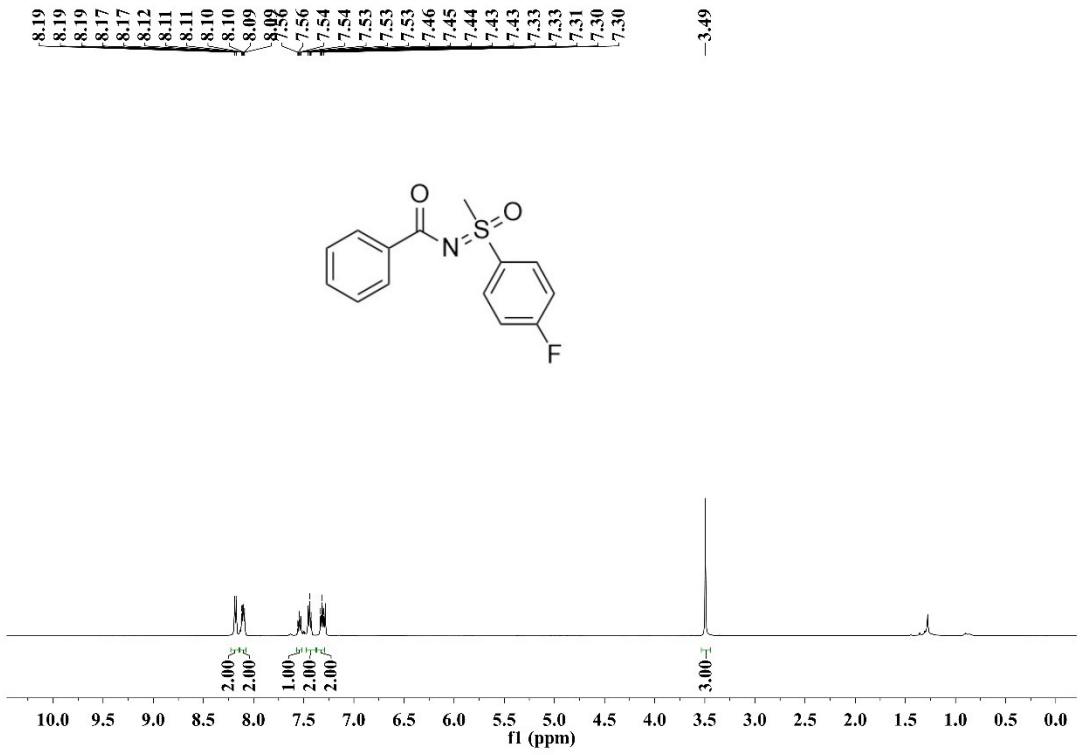
^{1}H NMR spectrum of 4f (500 MHz, $CDCl_3$)



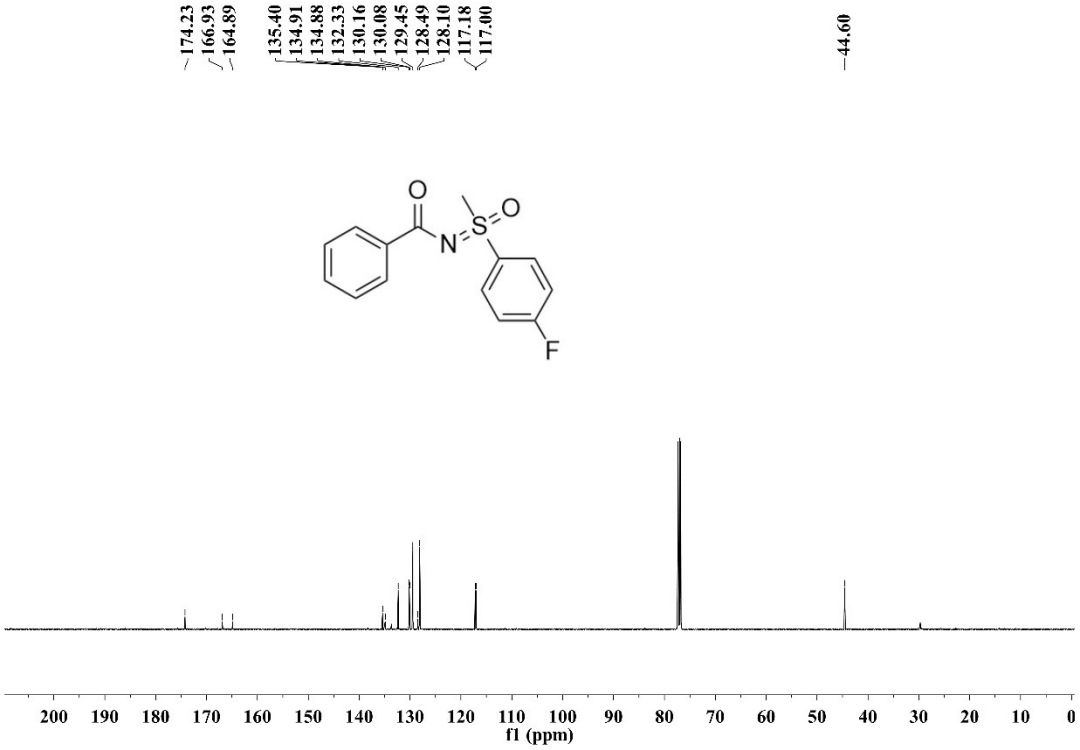
$^{13}C\{^{1}H\}$ NMR spectrum of 4f (125 MHz, $CDCl_3$)



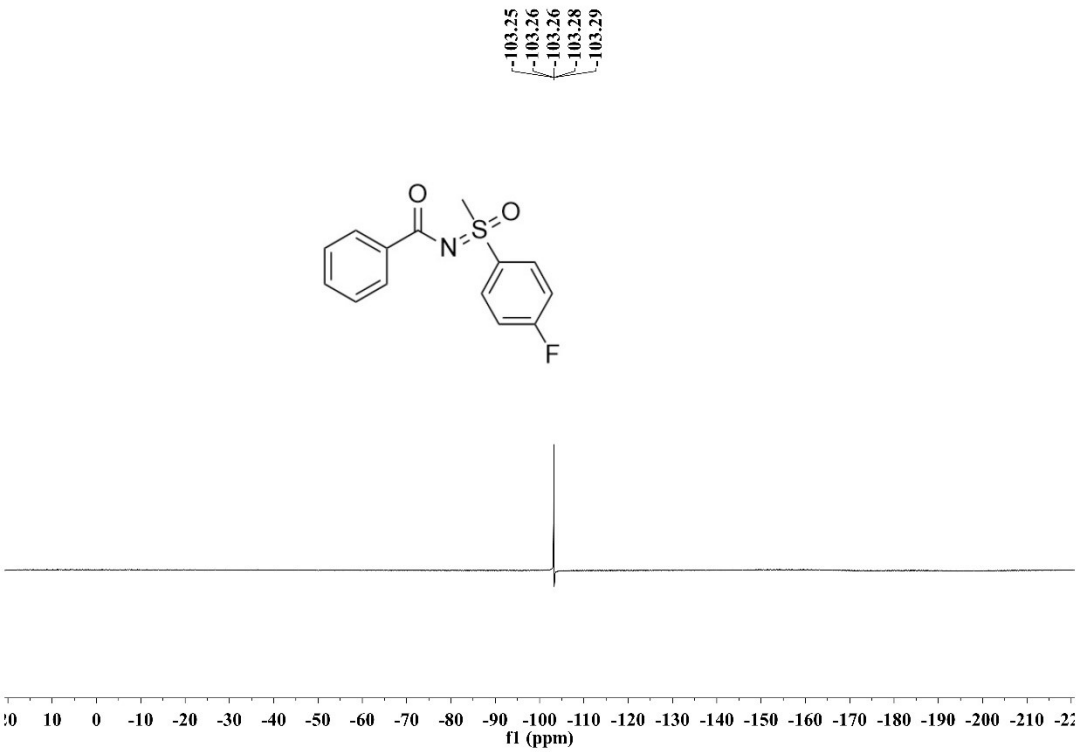
^{1}H NMR spectrum of 4g (500 MHz, $CDCl_3$)



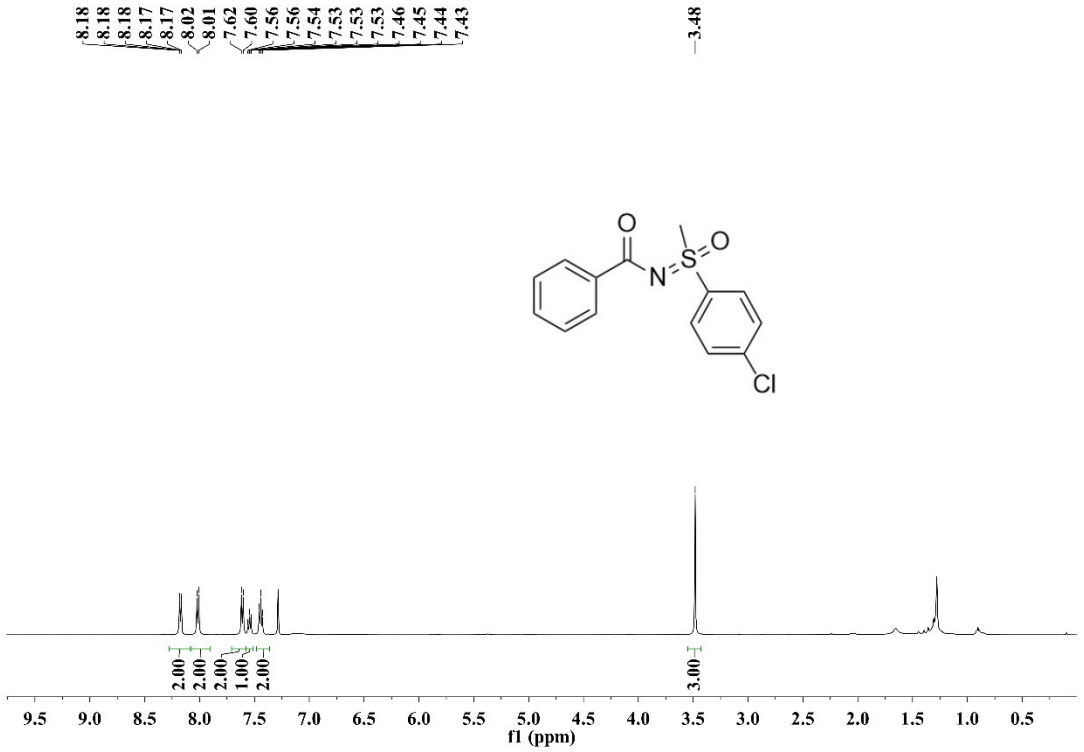
$^{13}C\{^{1}H\}$ NMR spectrum of 4g (125 MHz, $CDCl_3$)



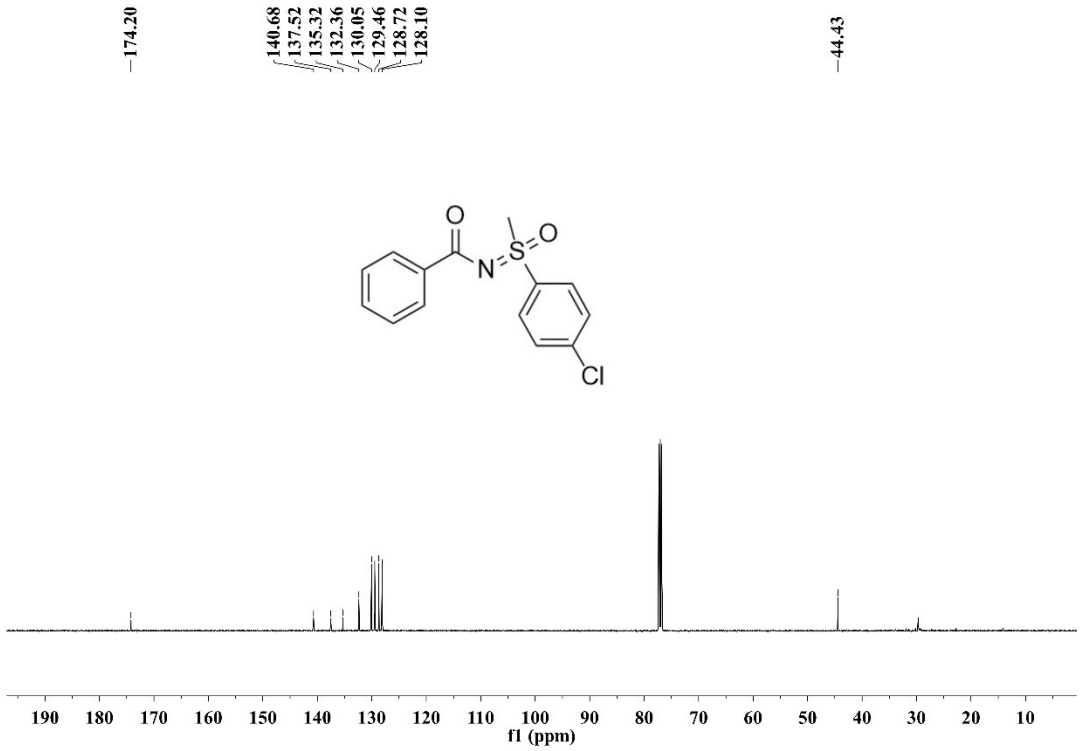
^{19}F NMR spectrum of of 4g (125 MHz, $CDCl_3$)



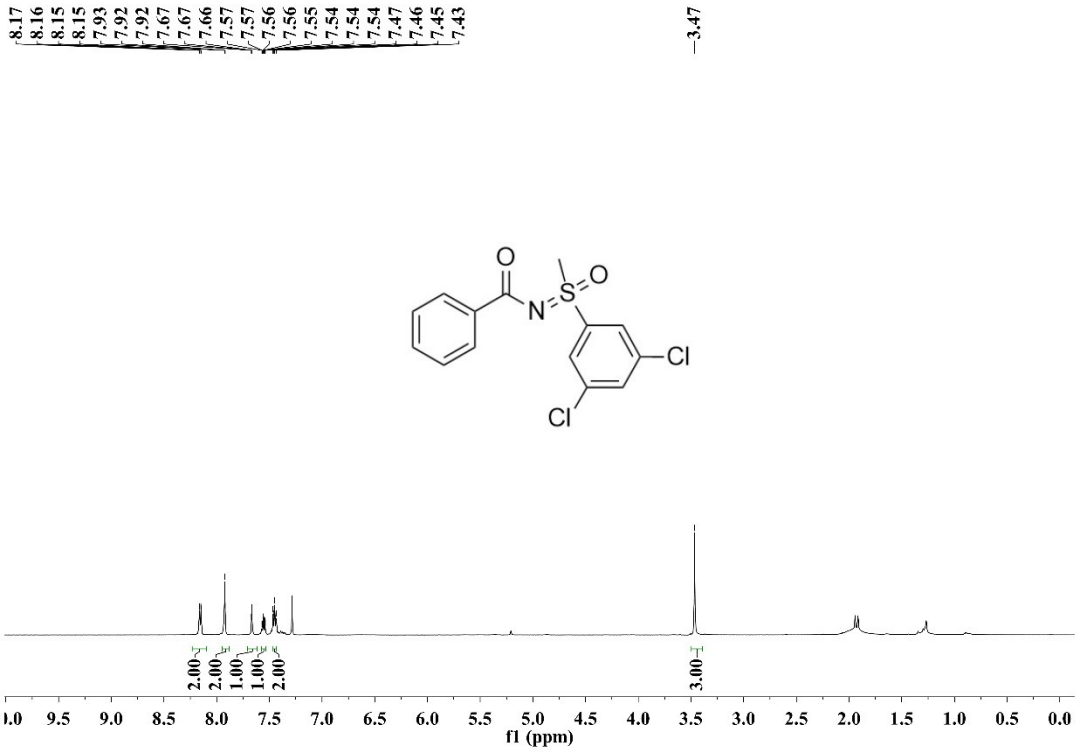
^{1}H NMR spectrum of 4h (500 MHz, $CDCl_3$)



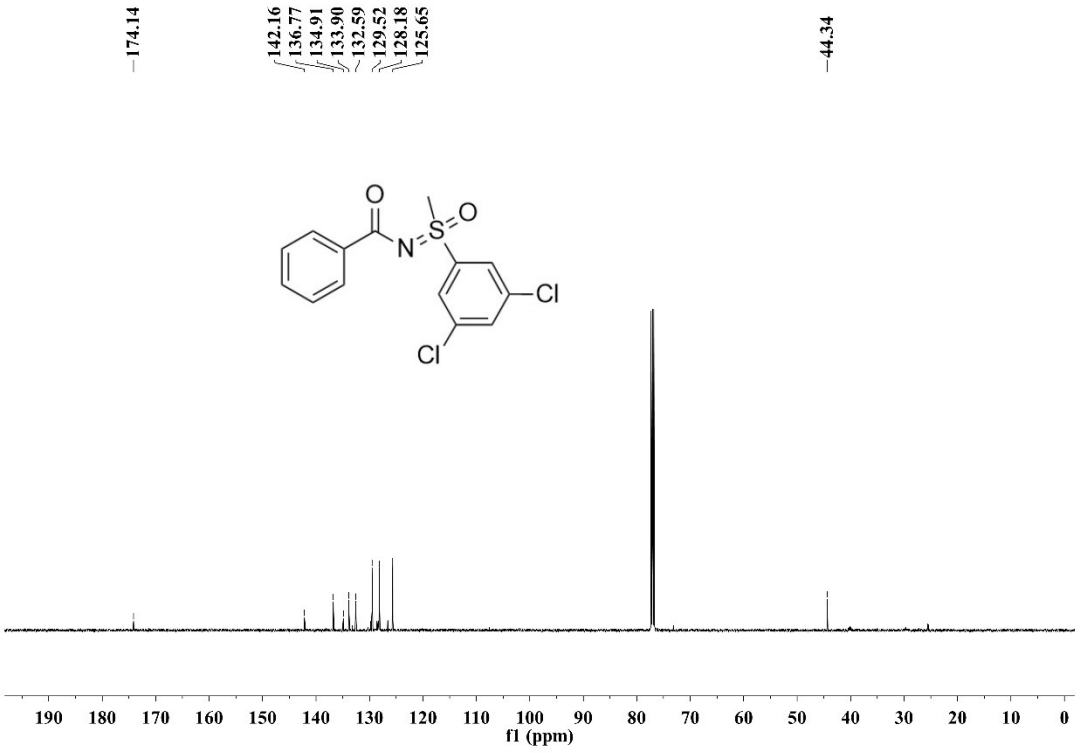
^{13}C{^{1}H} NMR spectrum of 4h (125 MHz, $CDCl_3$)



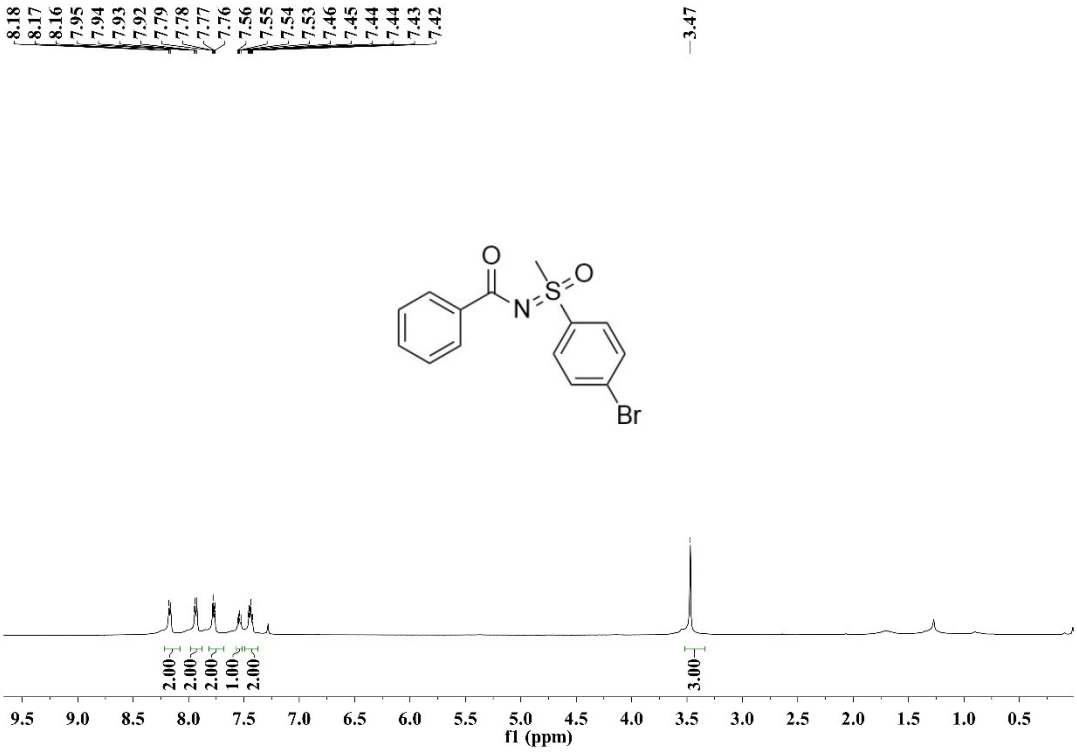
^{1}H NMR spectrum of 4i (500 MHz, $CDCl_3$)



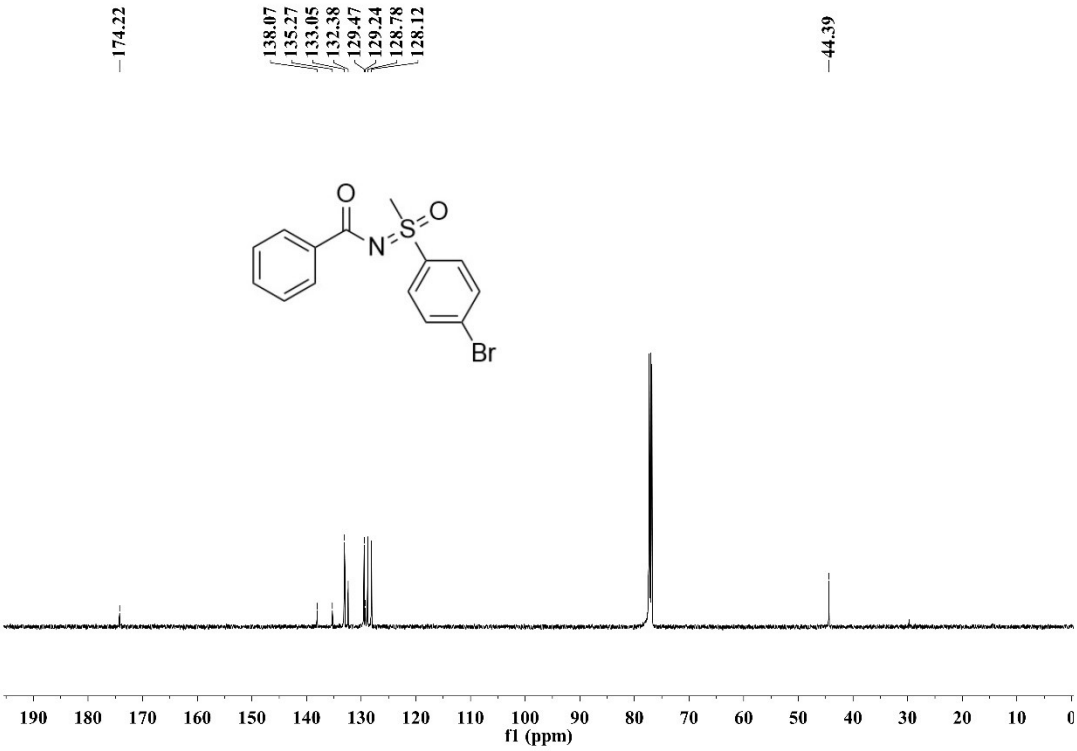
^{13}C{^{1}H} NMR spectrum of 4i (125 MHz, $CDCl_3$)



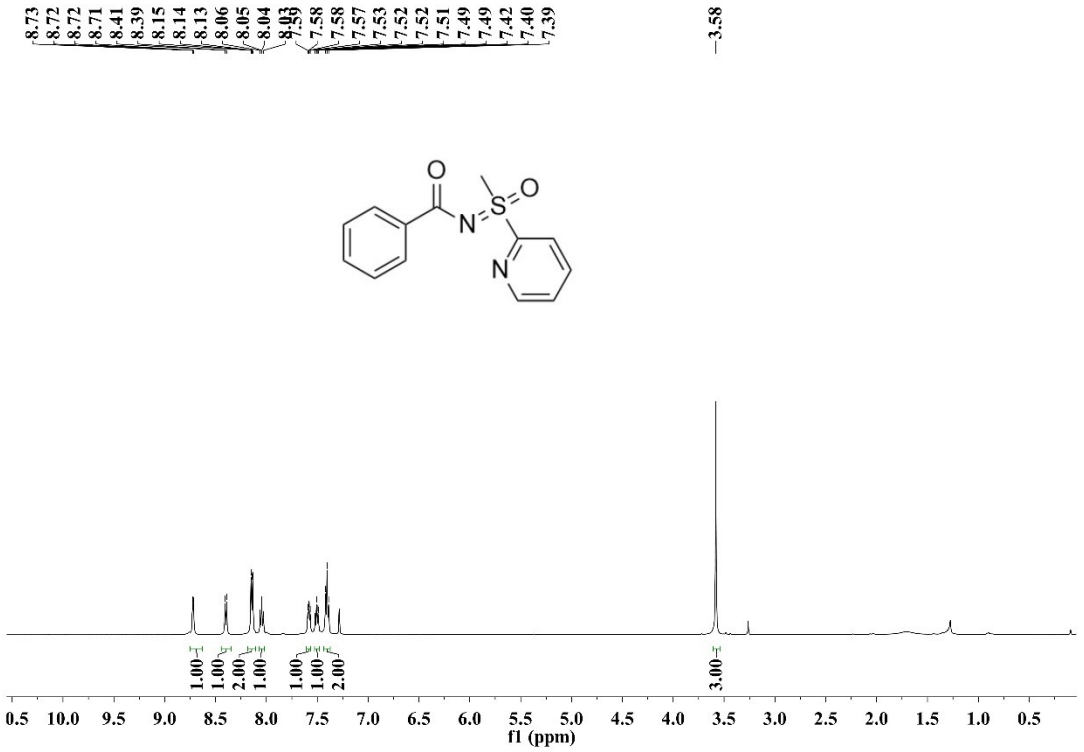
^{1}H NMR spectrum of 4j (500 MHz, $CDCl_3$)



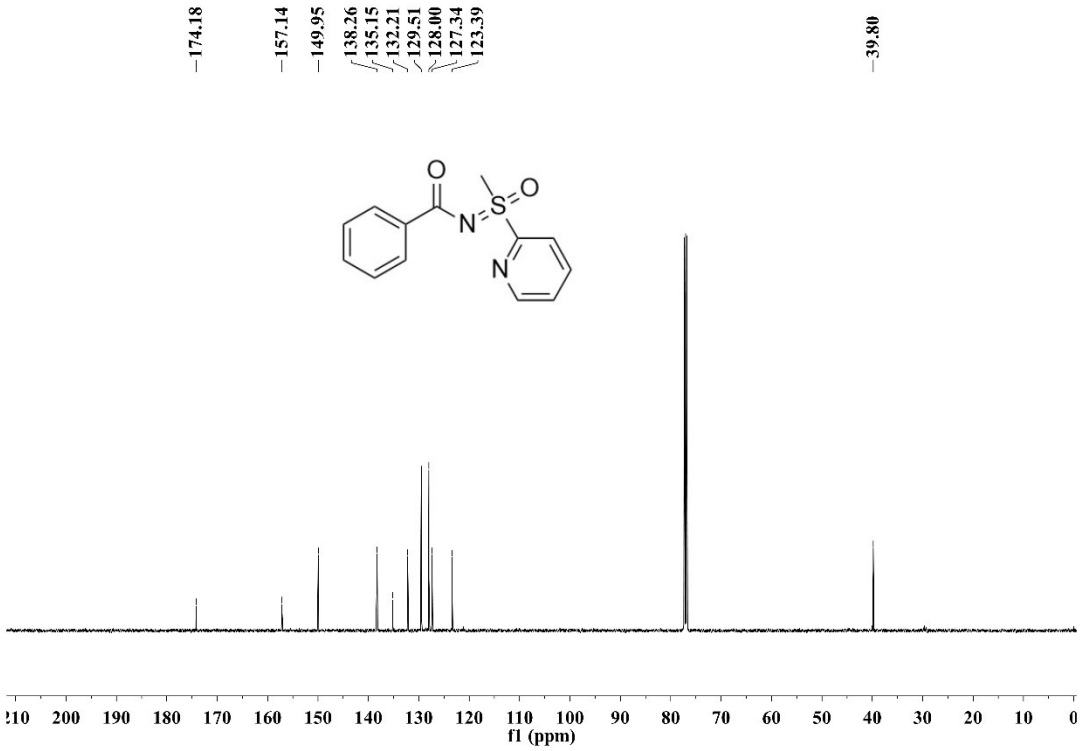
^{13}C{^{1}H} NMR spectrum of 4j (125 MHz, $CDCl_3$)



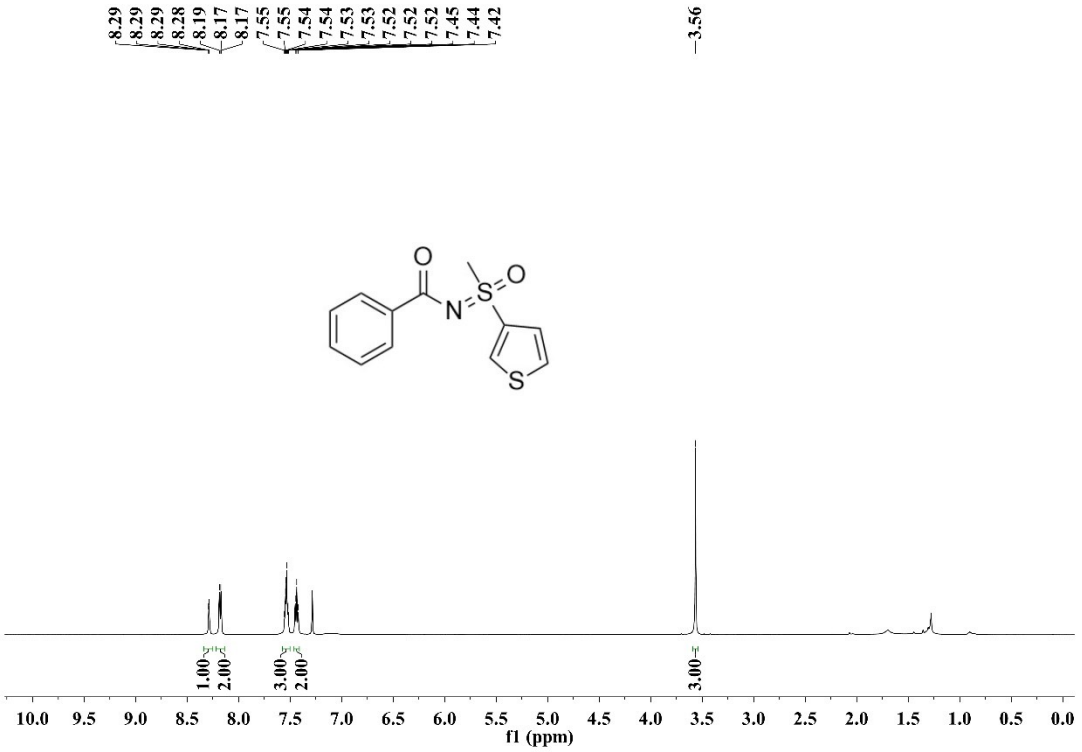
^{1}H NMR spectrum of 4k (500 MHz, $CDCl_3$)



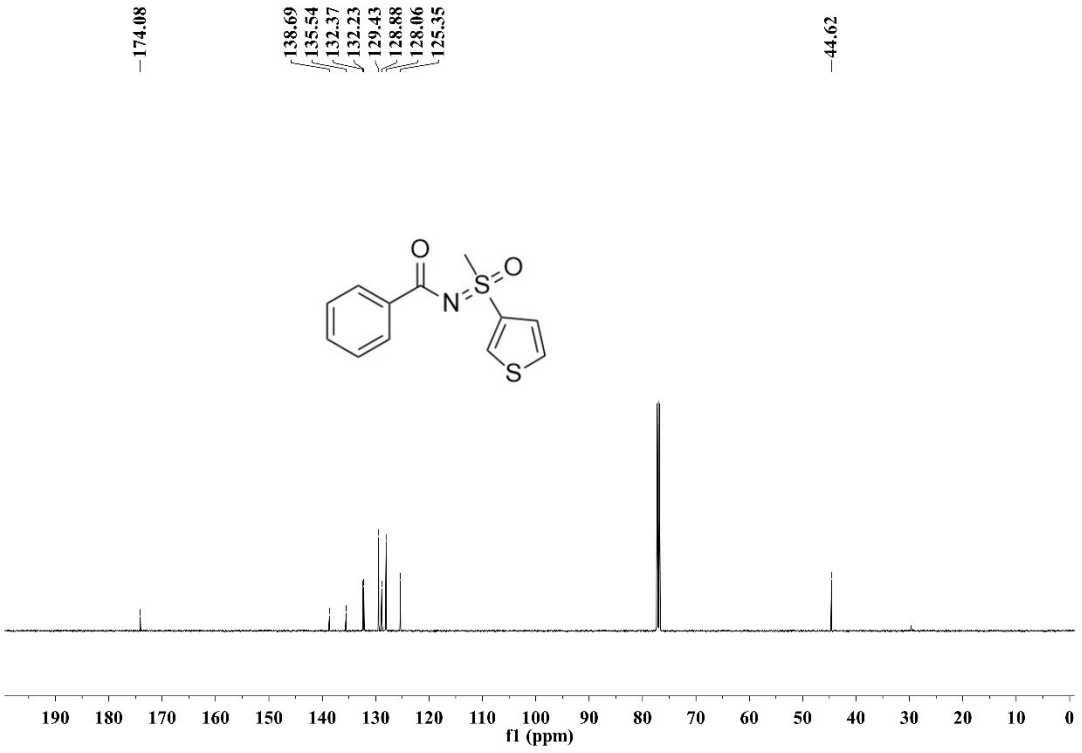
^{13}C{^{1}H} NMR spectrum of 4k (125 MHz, $CDCl_3$)



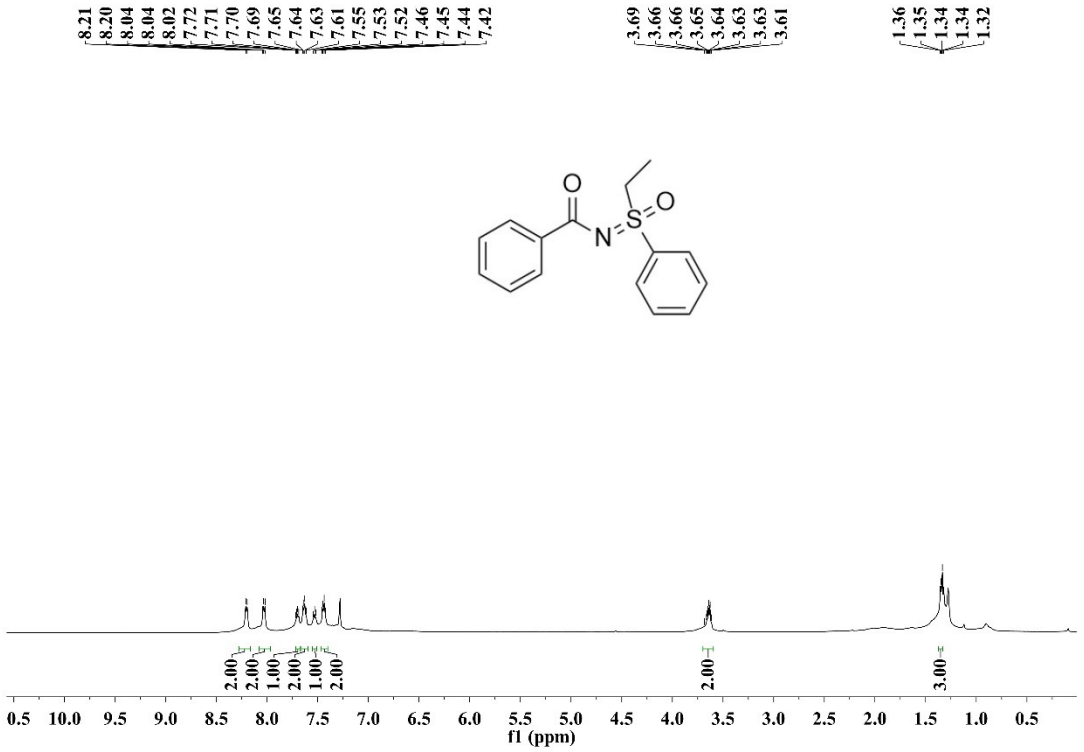
^{1}H NMR spectrum of 4l (500 MHz, $CDCl_3$)



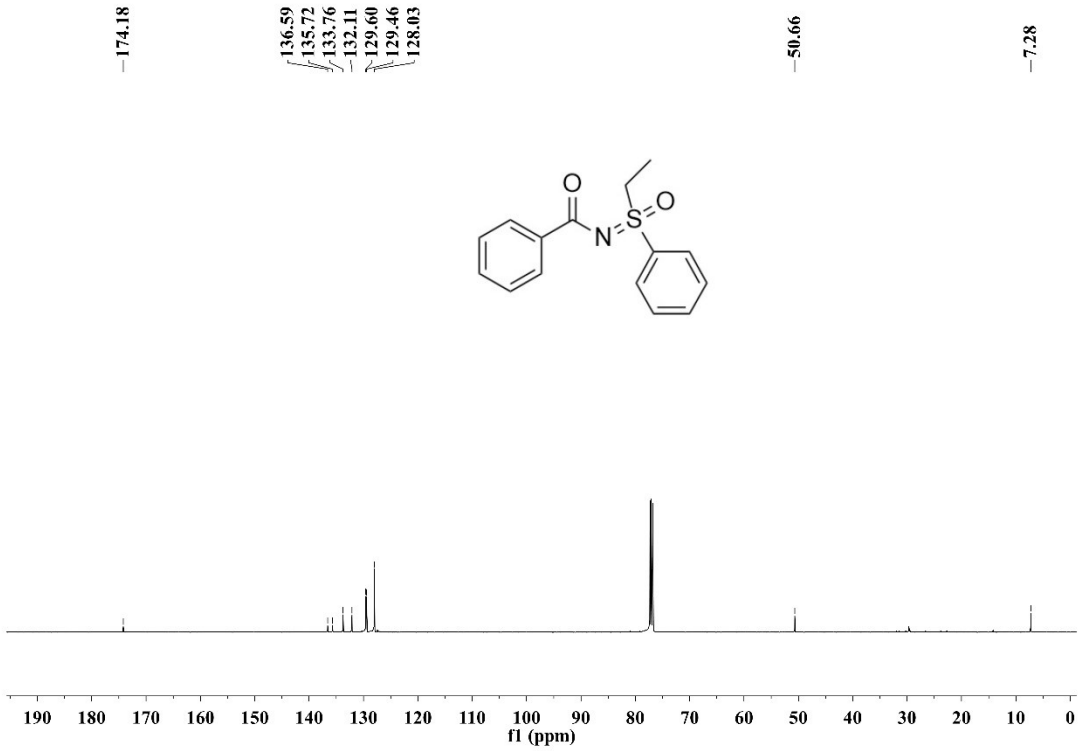
^{13}C{^{1}H} NMR spectrum of 4l (125 MHz, $CDCl_3$)



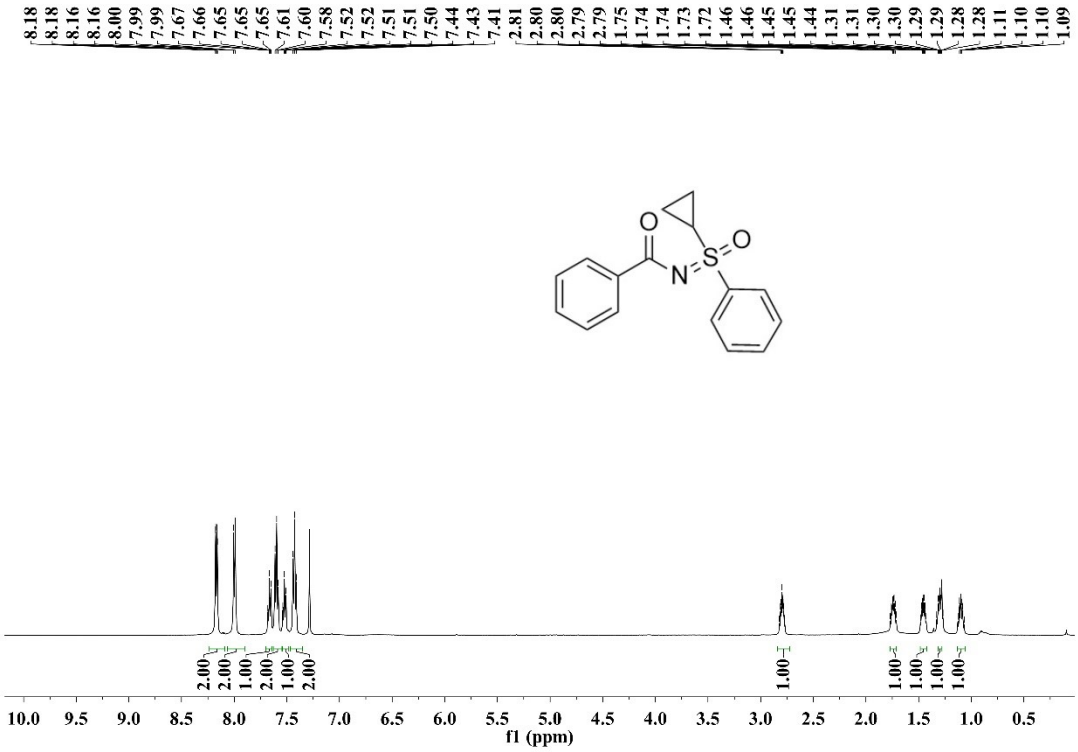
^{1}H NMR spectrum of 4m (500 MHz, $CDCl_3$)



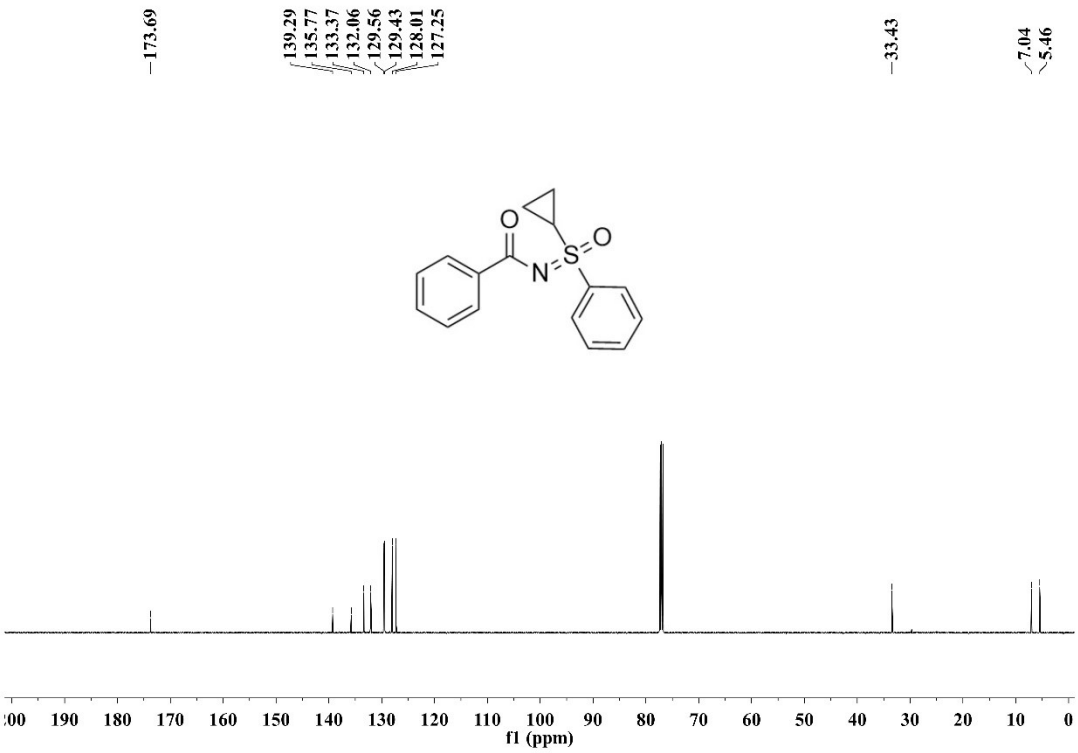
^{13}C{^{1}H} NMR spectrum of 4m (125 MHz, $CDCl_3$)



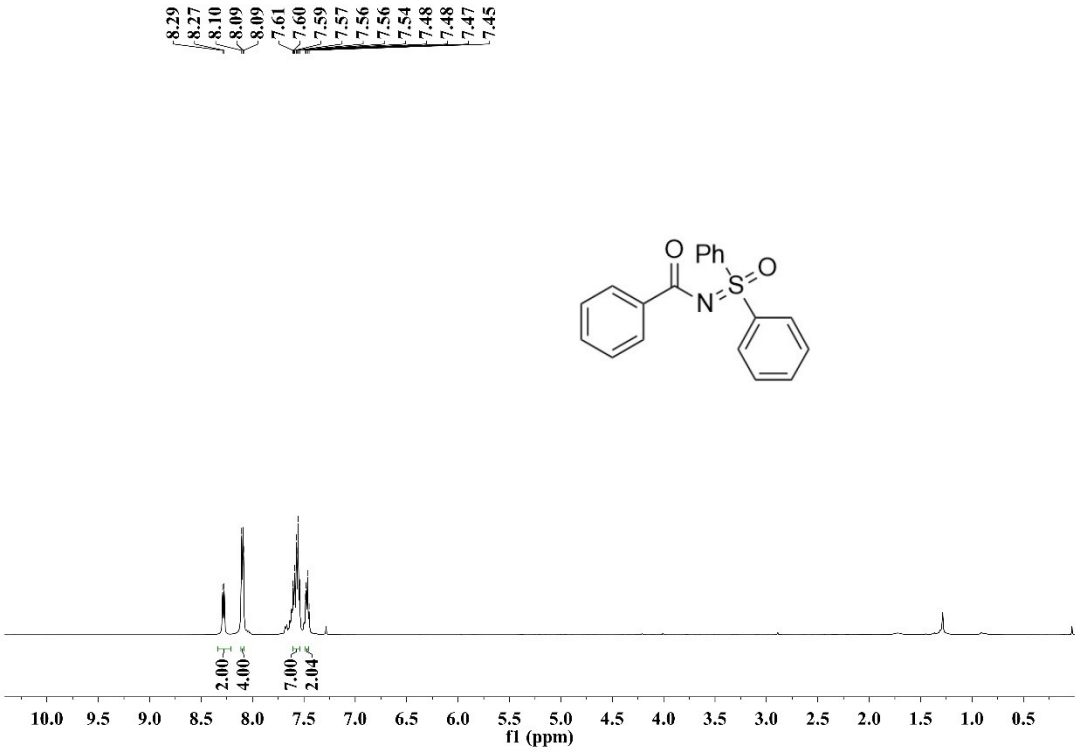
^{1}H NMR spectrum of 4n (500 MHz, $CDCl_3$)



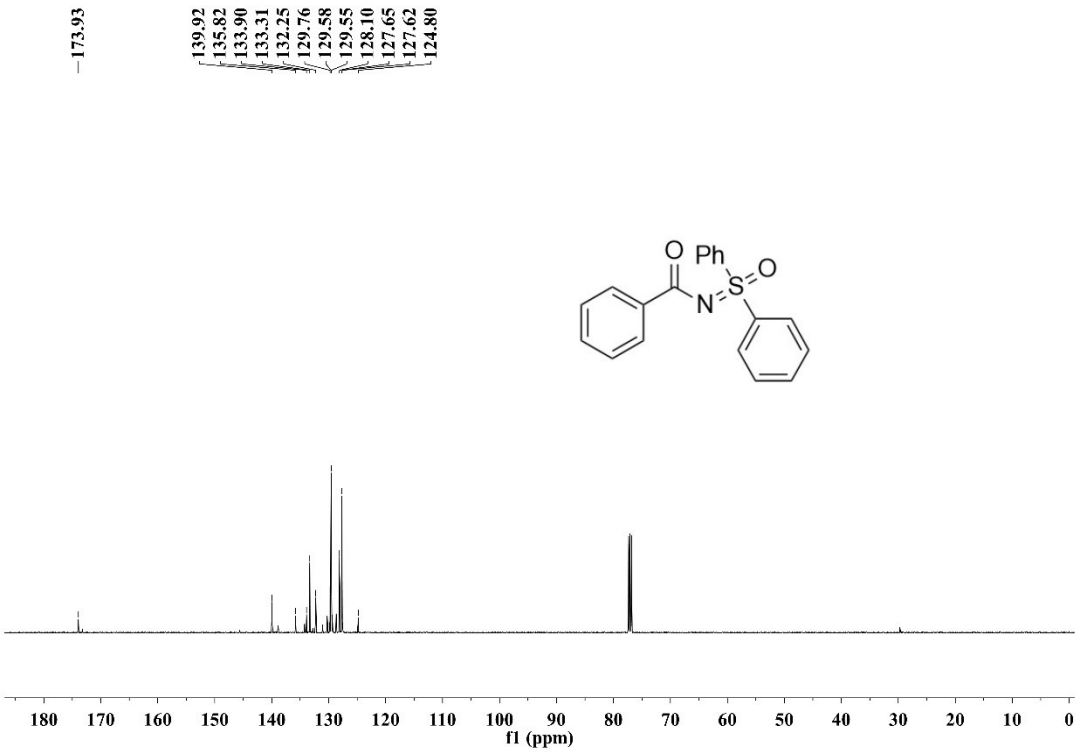
^{13}C{^{1}H} NMR spectrum of 4n (125 MHz, $CDCl_3$)



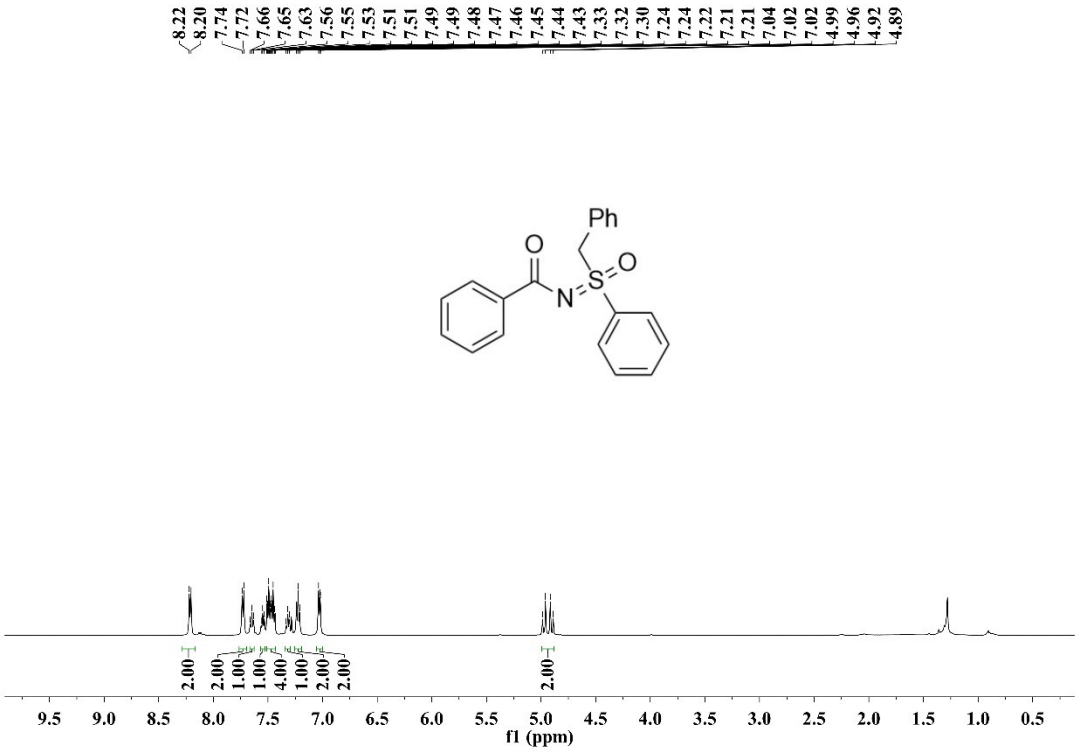
^{1}H NMR spectrum of 4o (500 MHz, $CDCl_3$)



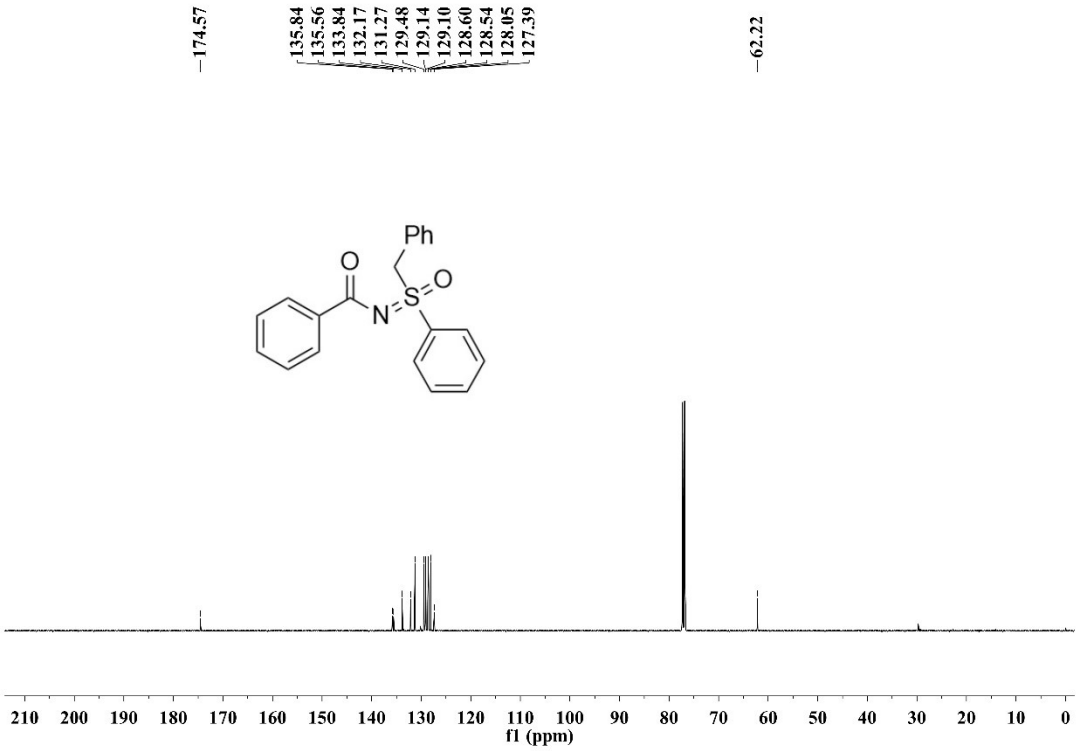
^{13}C{^{1}H} NMR spectrum of 4o (125 MHz, $CDCl_3$)



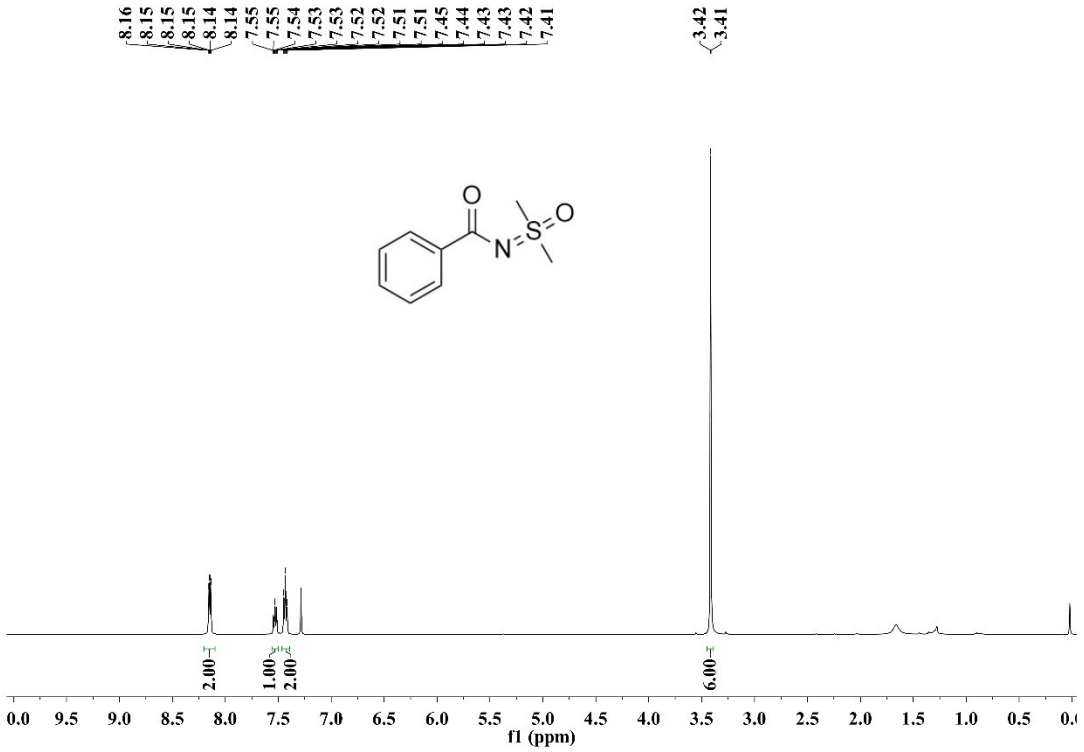
^{1}H NMR spectrum of 4p (500 MHz, $CDCl_3$)



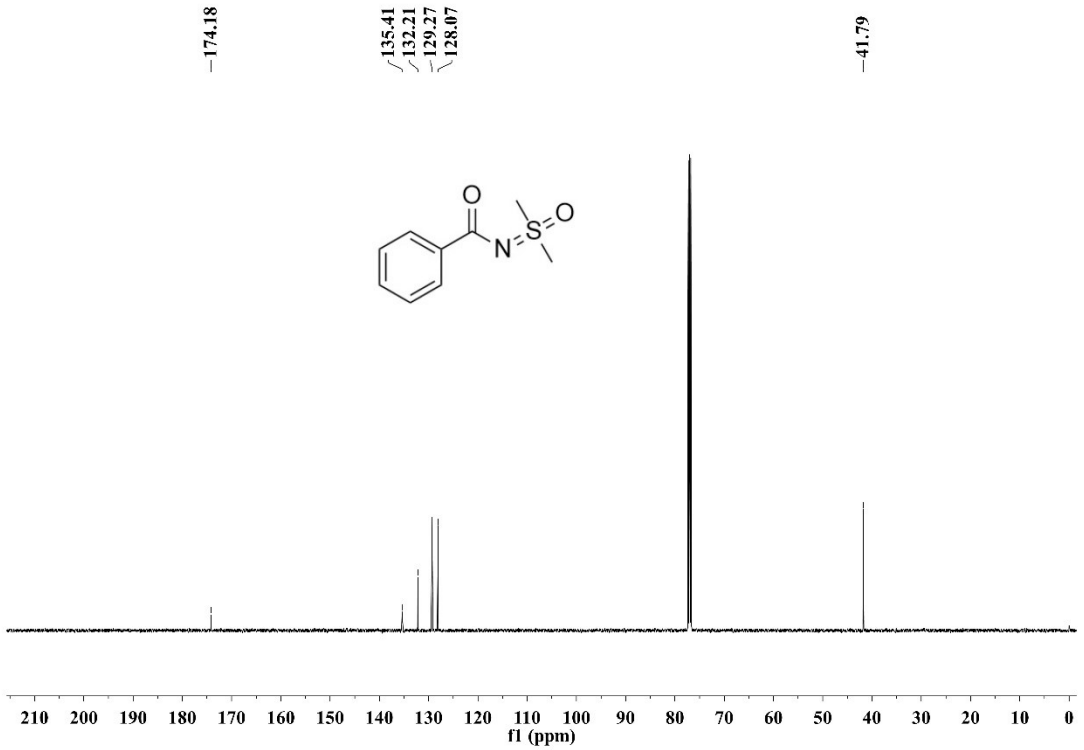
^{13}C{^{1}H} NMR spectrum of 4p (125 MHz, $CDCl_3$)



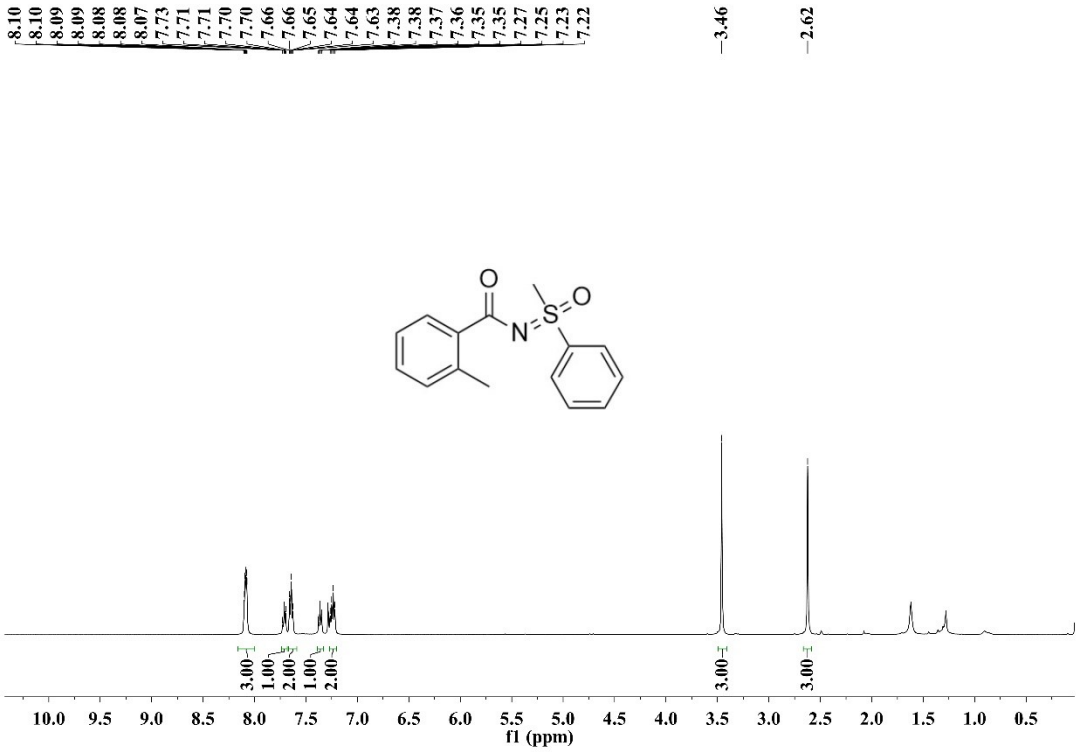
^{1}H NMR spectrum of 4q (500 MHz, $CDCl_3$)



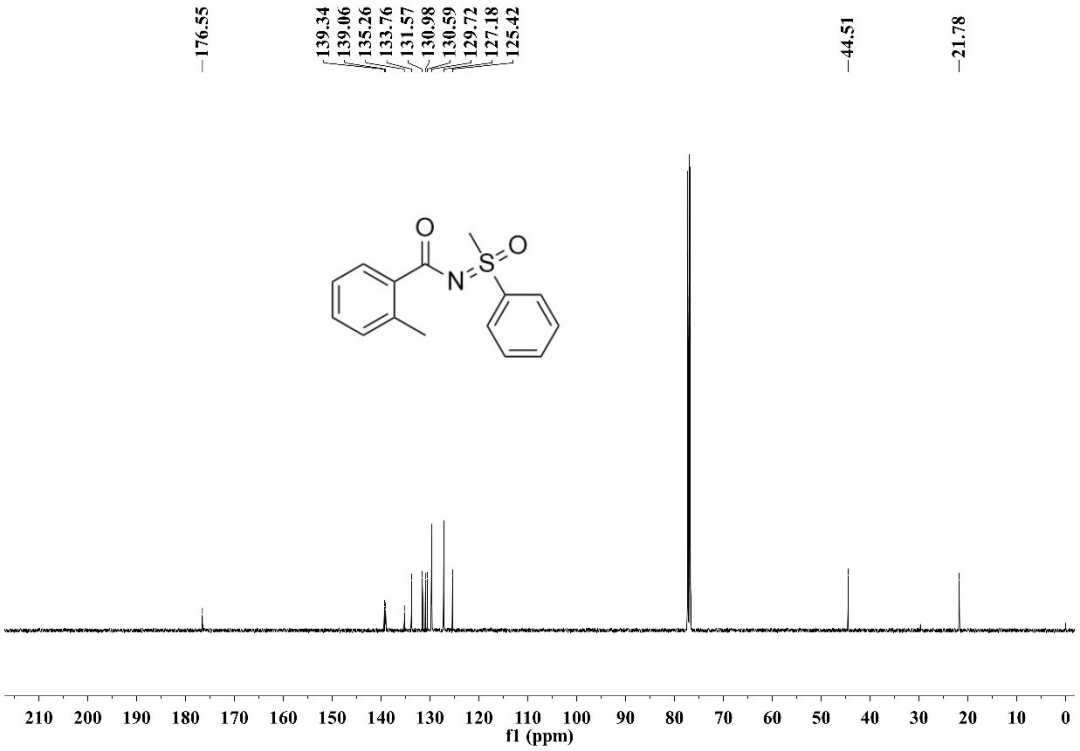
^{13}C{^{1}H} NMR spectrum of 4q (125 MHz, $CDCl_3$)



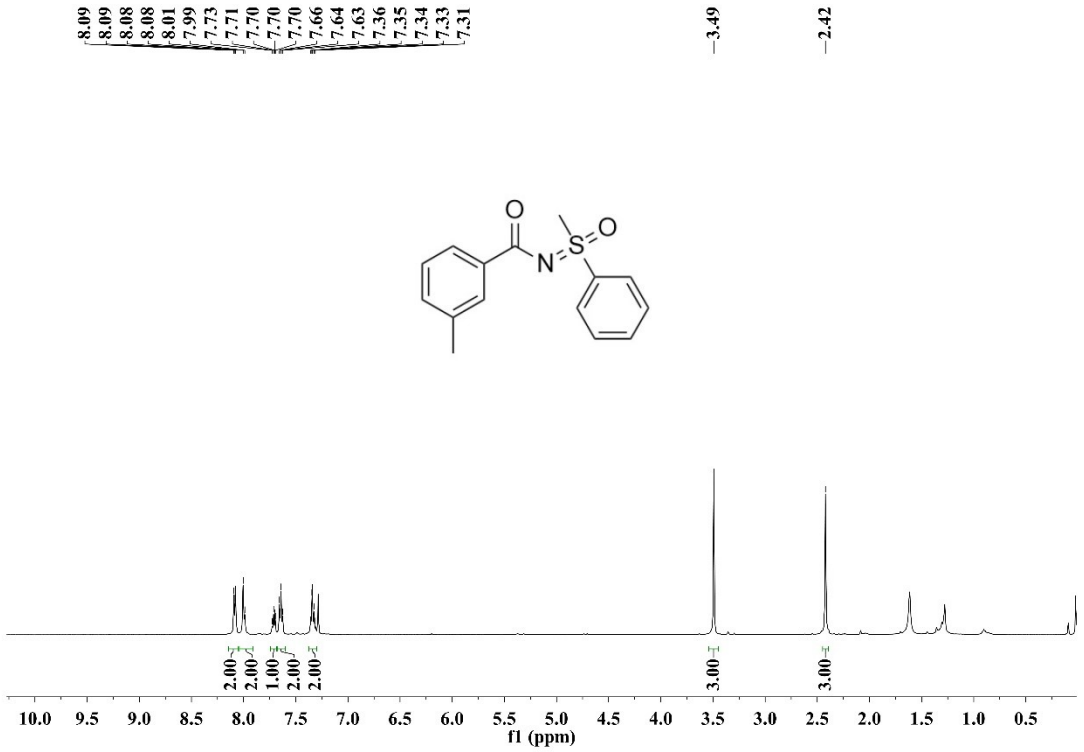
^{1}H NMR spectrum of 4r (500 MHz, $CDCl_3$)



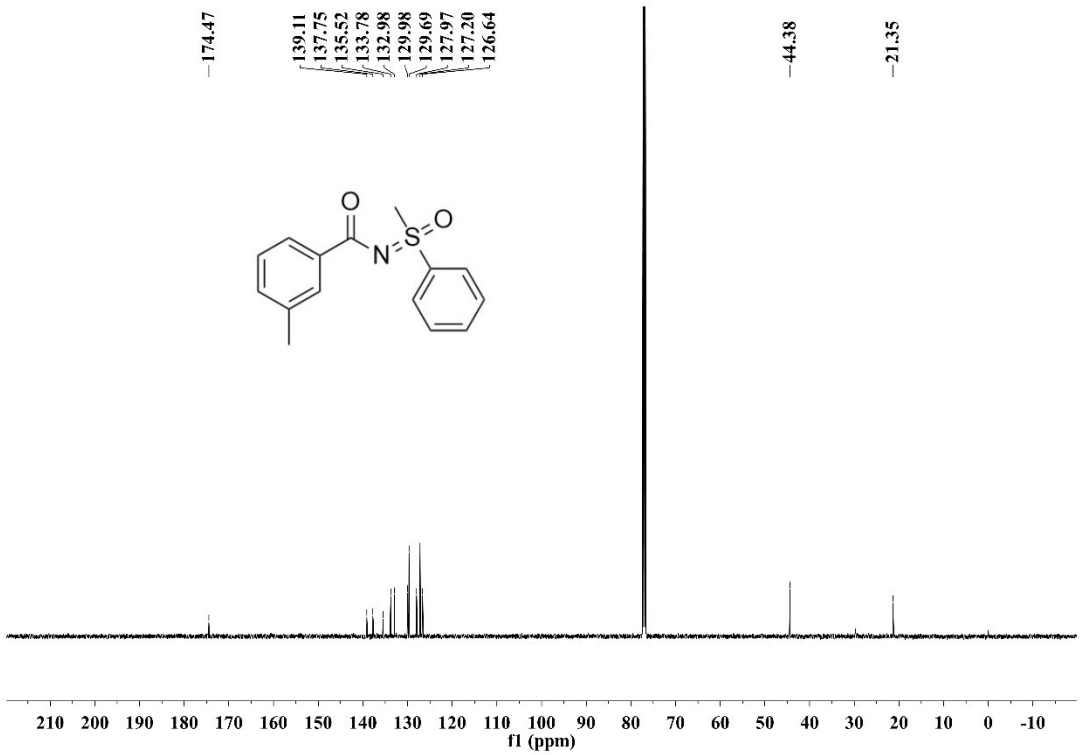
^{13}C{^{1}H} NMR spectrum of 4r (125 MHz, $CDCl_3$)



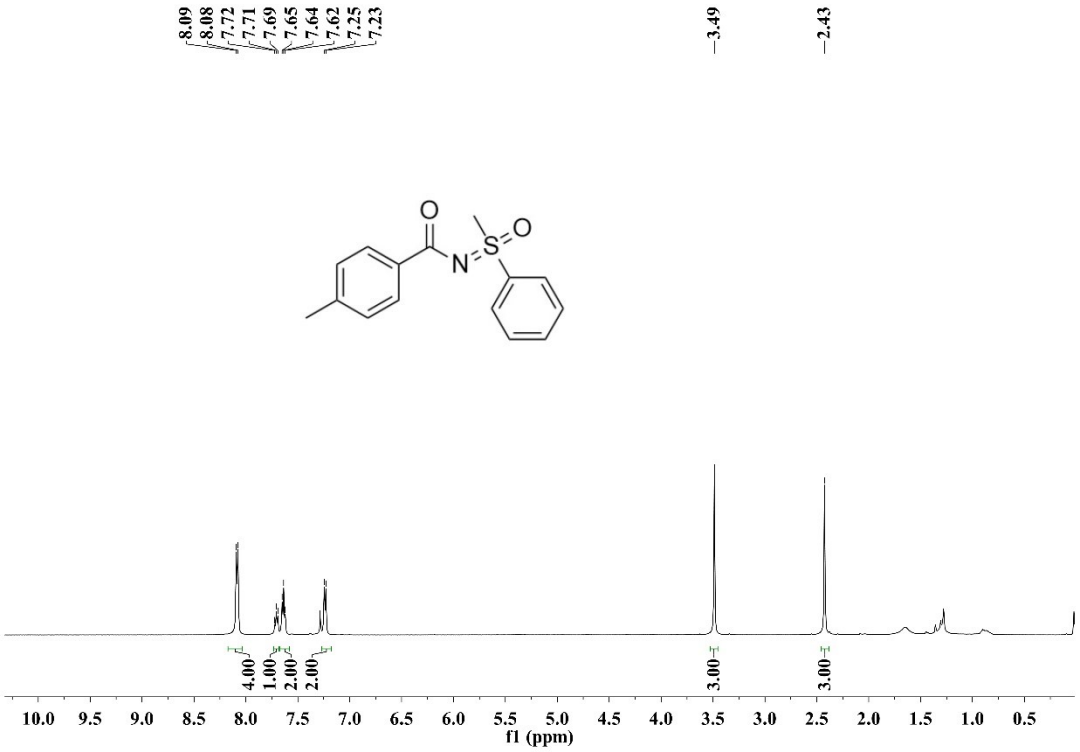
^{1}H NMR spectrum of 4s (500 MHz, $CDCl_3$)



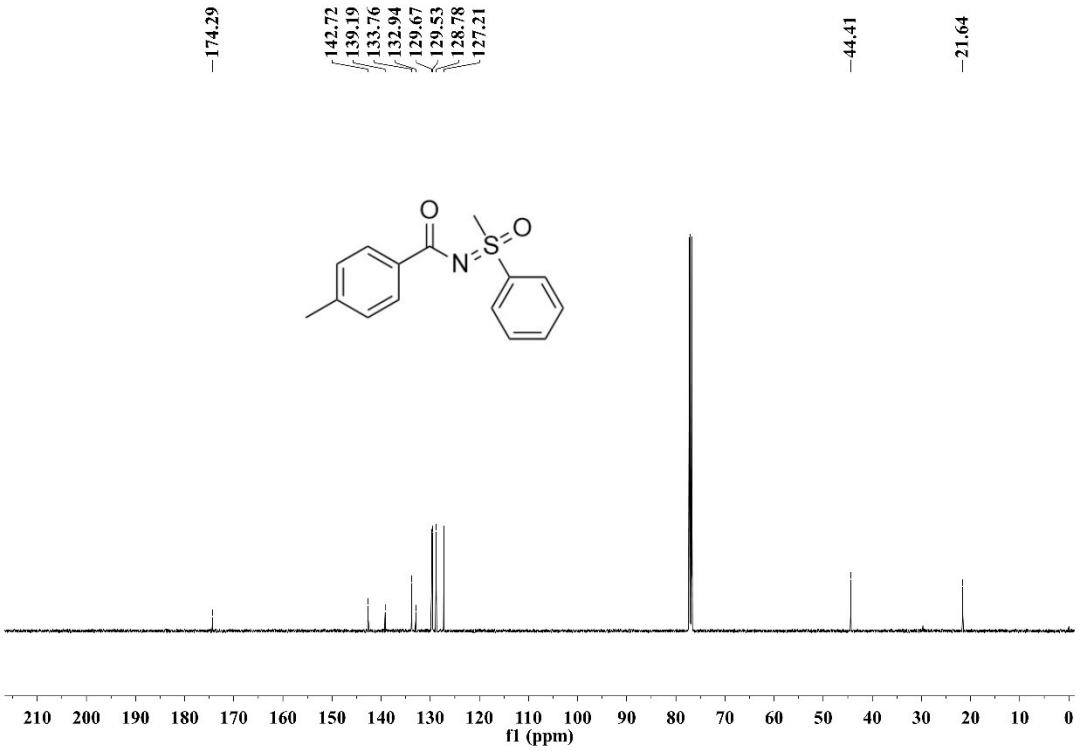
^{13}C{^{1}H} NMR spectrum of 4s (125 MHz, $CDCl_3$)



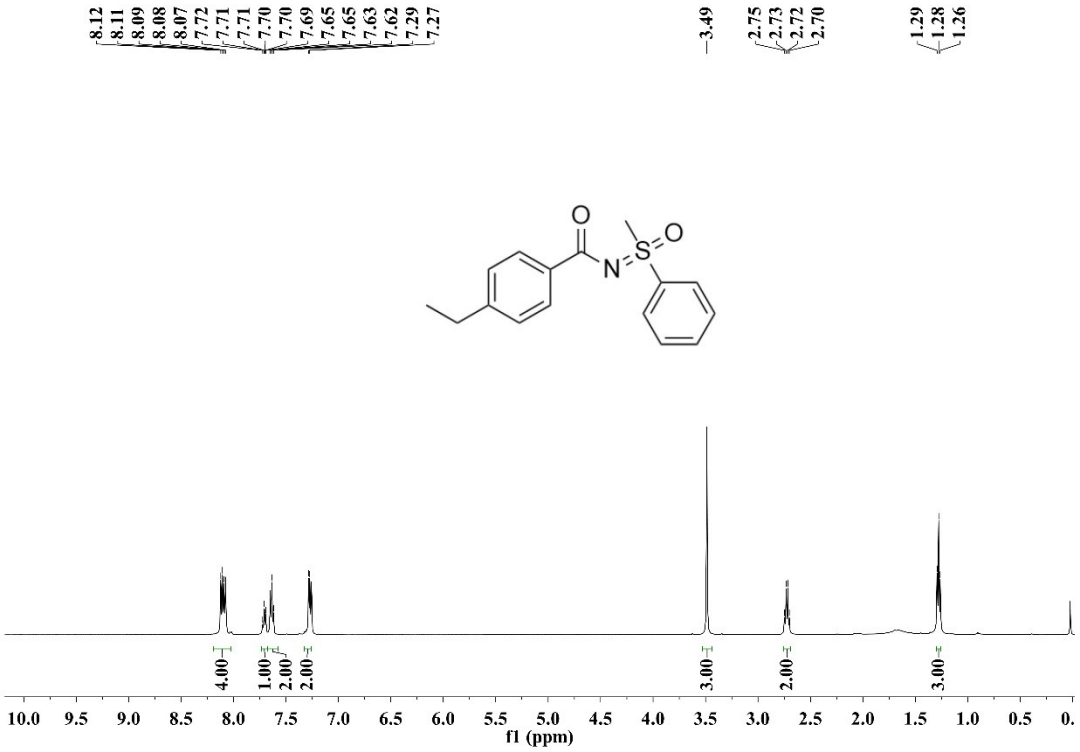
^{1}H NMR spectrum of 4t (500 MHz, $CDCl_3$)



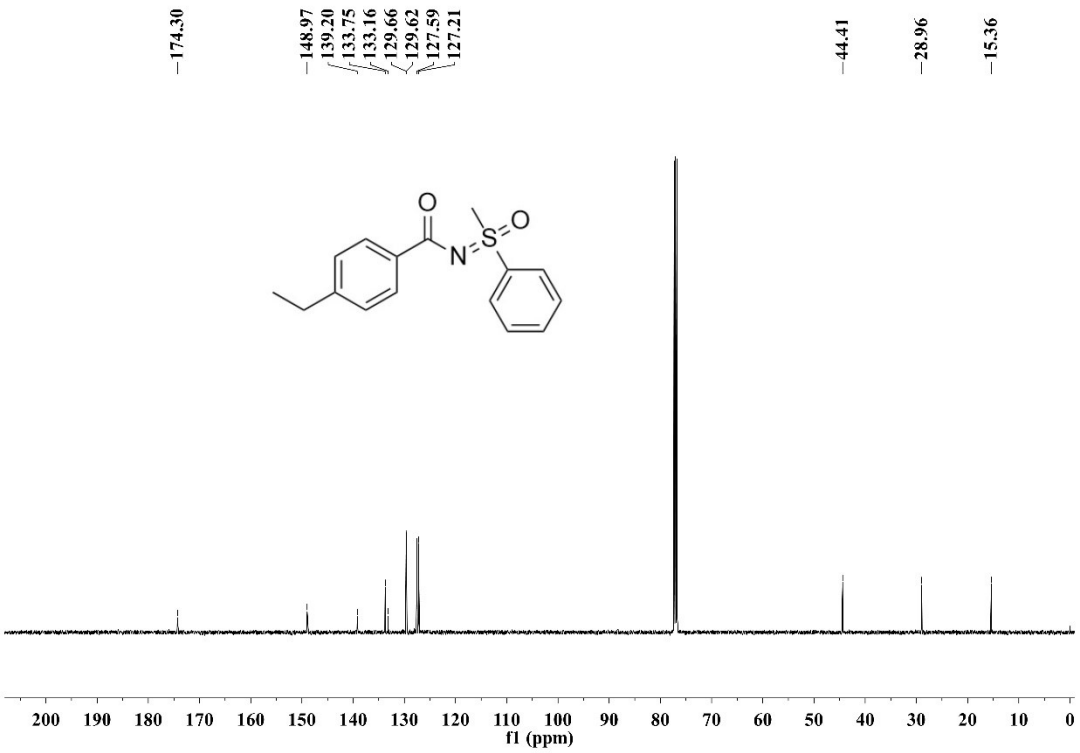
^{13}C{^{1}H} NMR spectrum of 4t (125 MHz, $CDCl_3$)



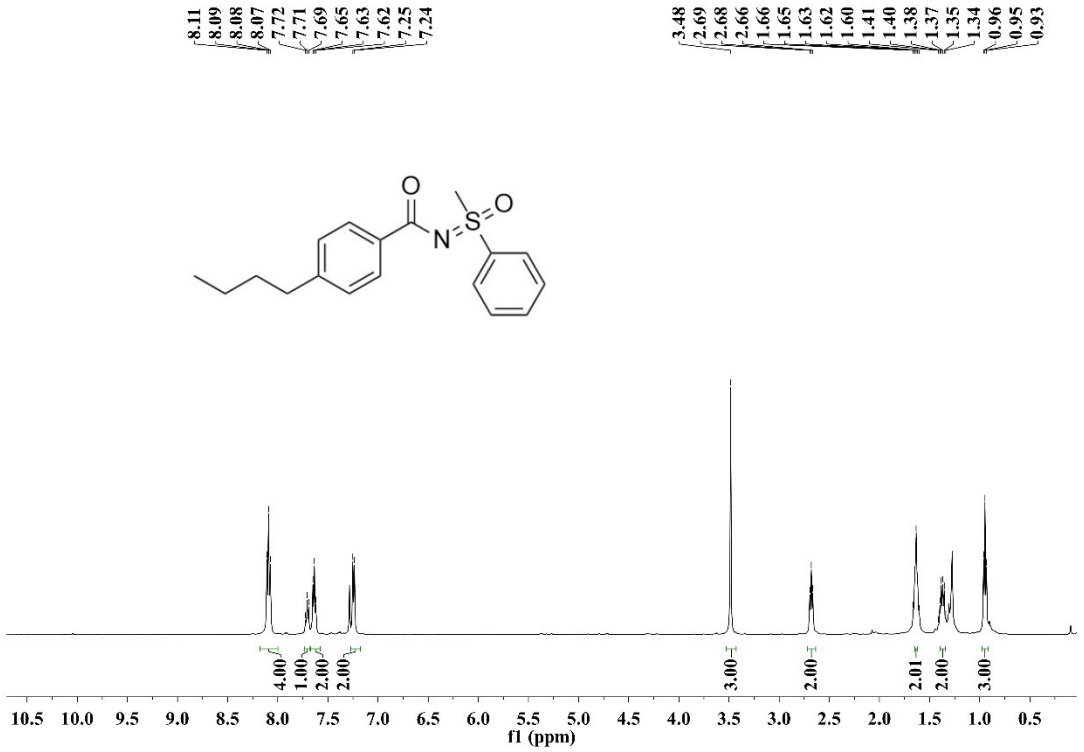
^{1}H NMR spectrum of 4u (500 MHz, $CDCl_3$)



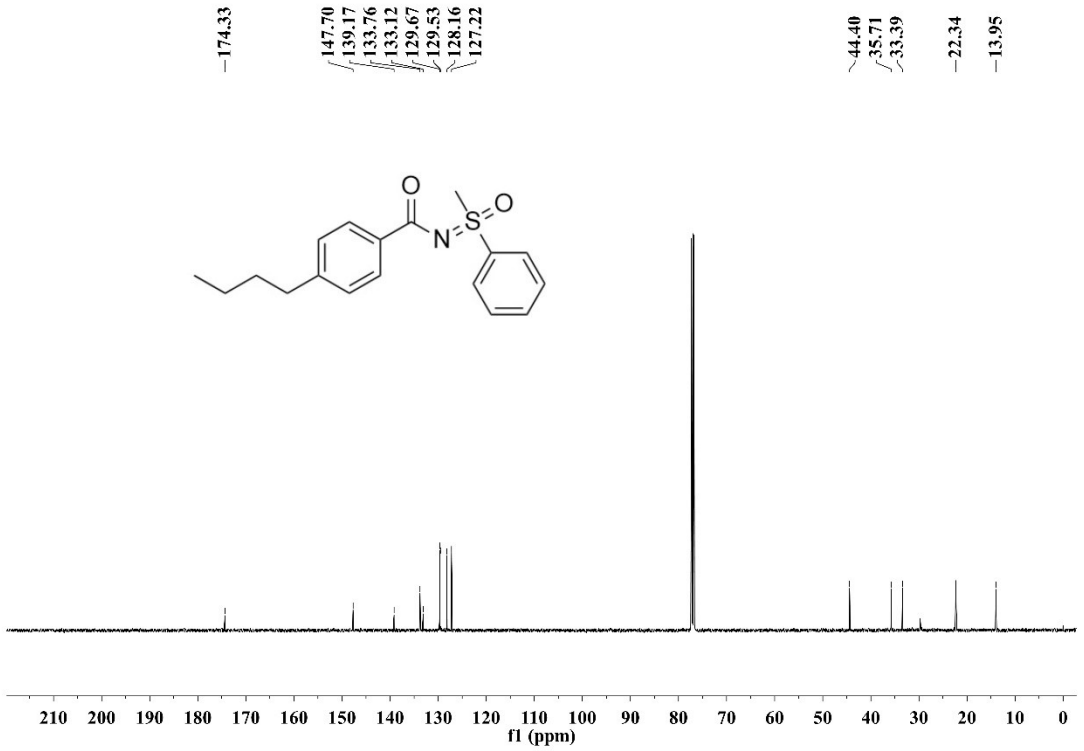
^{13}C{^{1}H} NMR spectrum of 4u (125 MHz, $CDCl_3$)



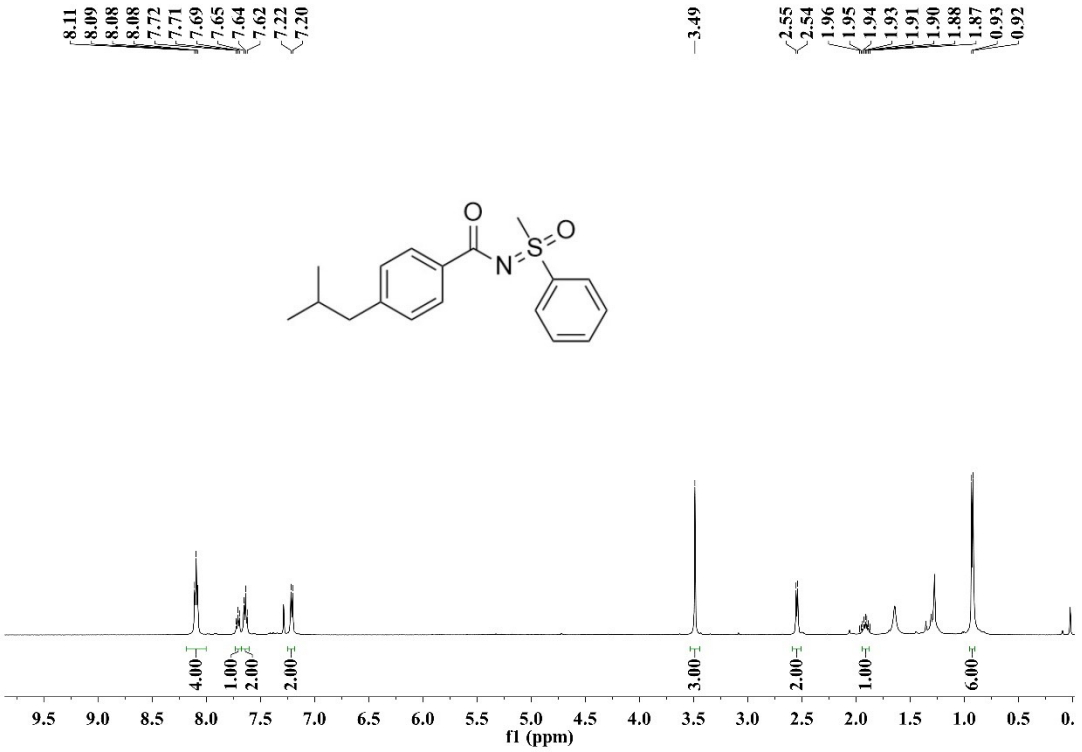
^{1}H NMR spectrum of 4v (500 MHz, $CDCl_3$)



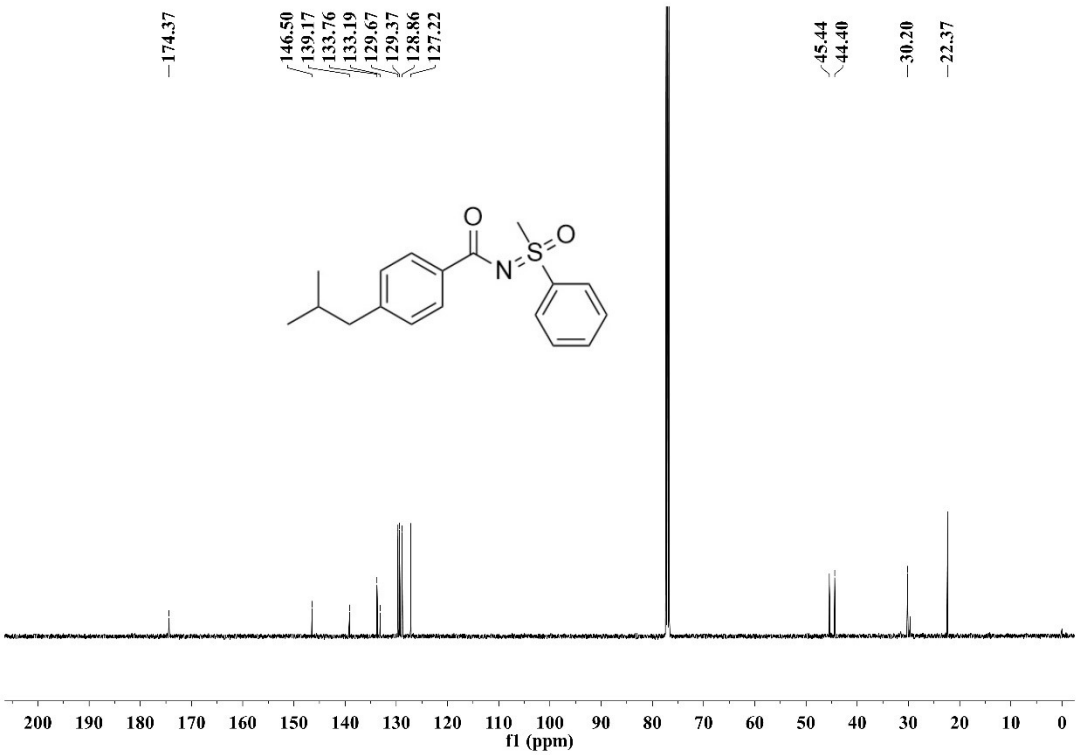
^{13}C{^{1}H} NMR spectrum of 4v (125 MHz, $CDCl_3$)



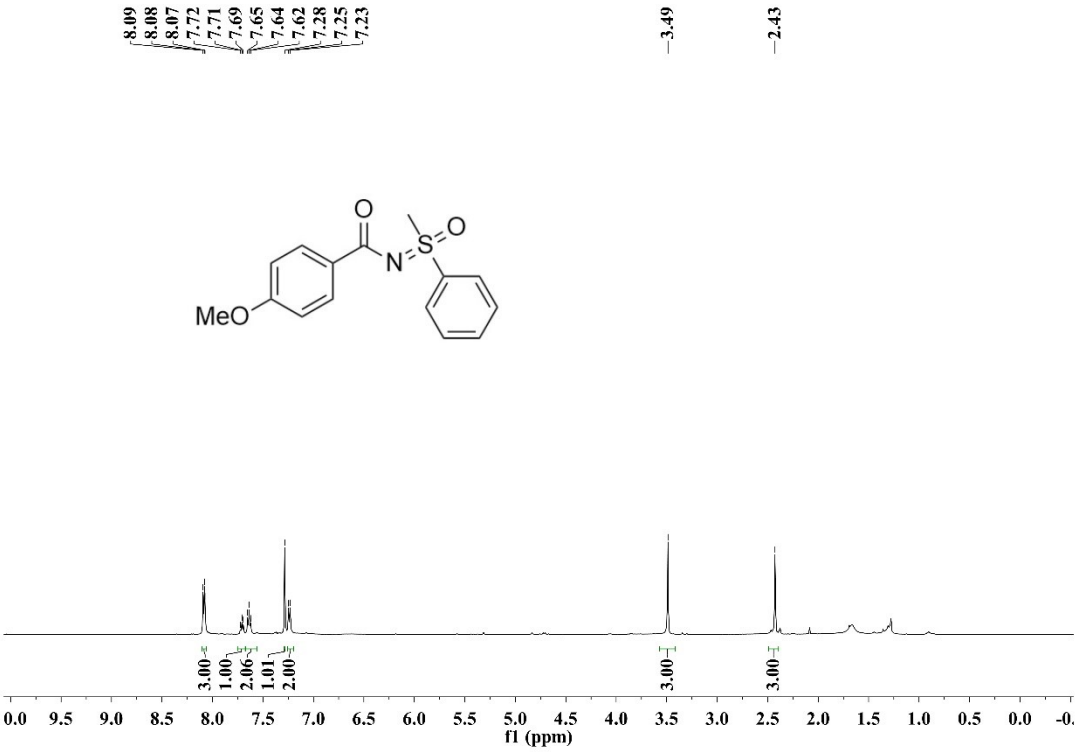
^{1}H NMR spectrum of 4w (500 MHz, $CDCl_3$)



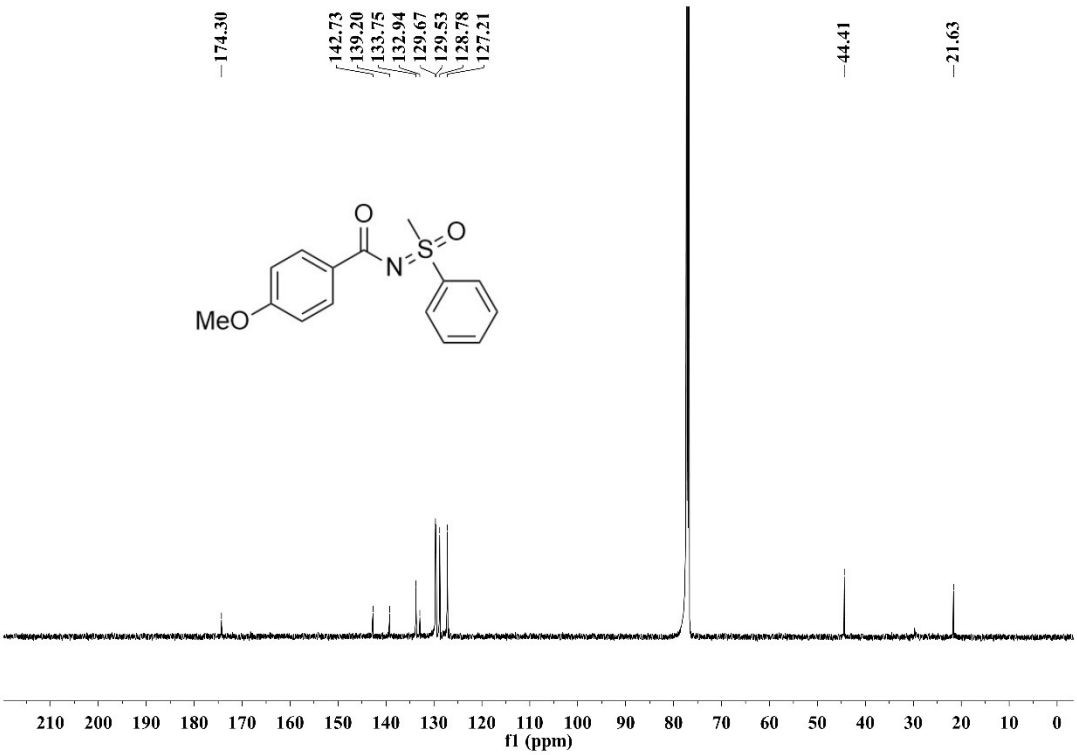
^{13}C{^{1}H} NMR spectrum of 4w (125 MHz, $CDCl_3$)



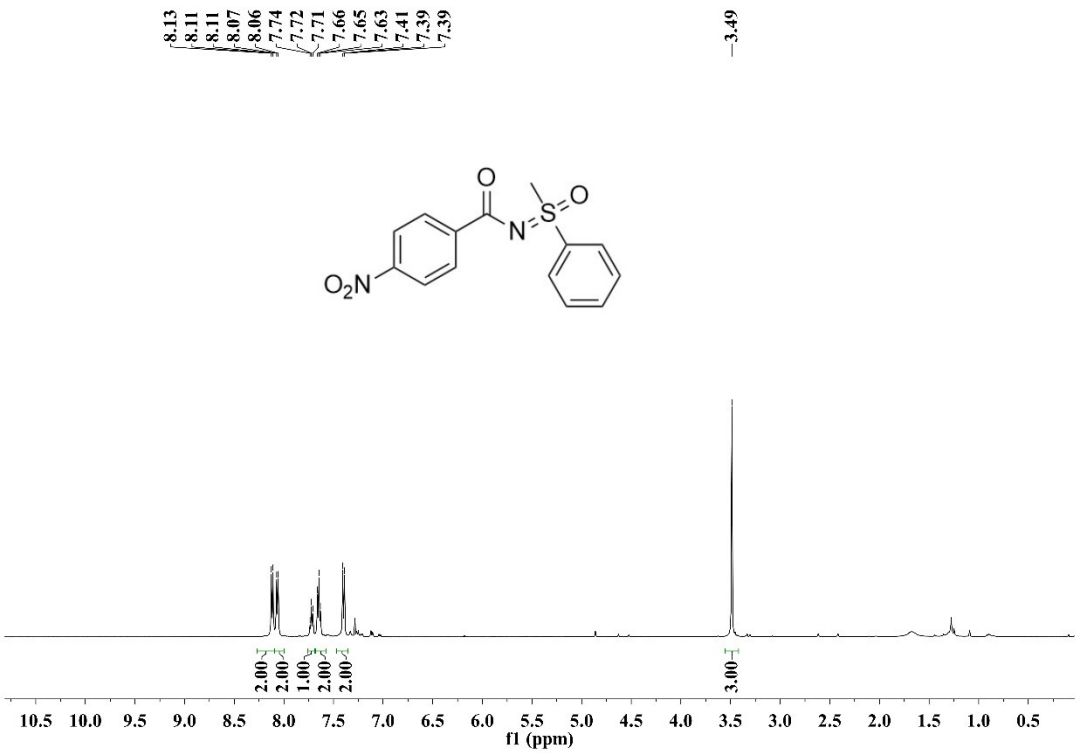
^{1}H NMR spectrum of 4x (500 MHz, $CDCl_3$)



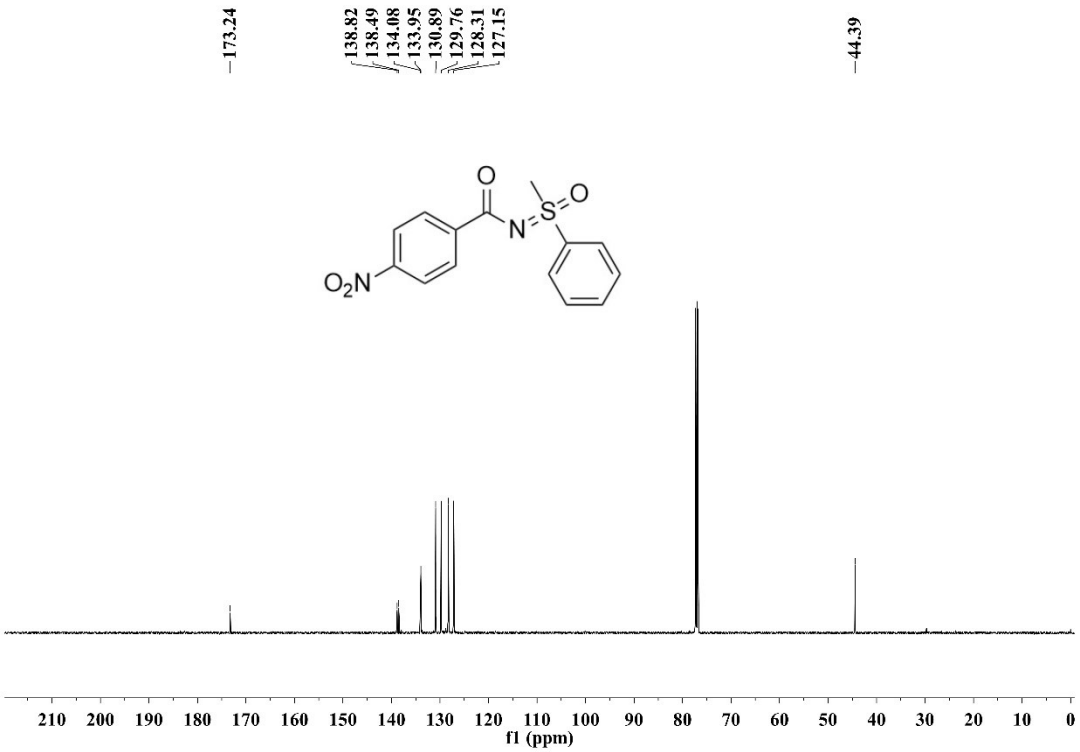
^{13}C{^{1}H} NMR spectrum of 4x (125 MHz, $CDCl_3$)



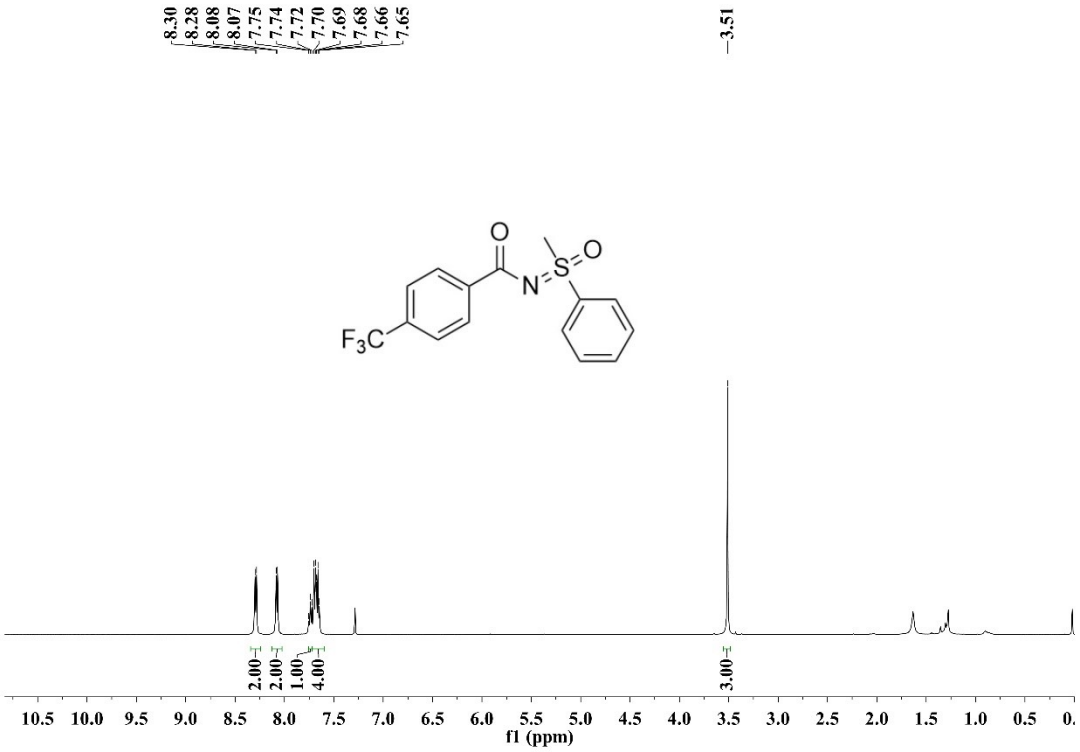
^{1}H NMR spectrum of 4y (500 MHz, $CDCl_3$)



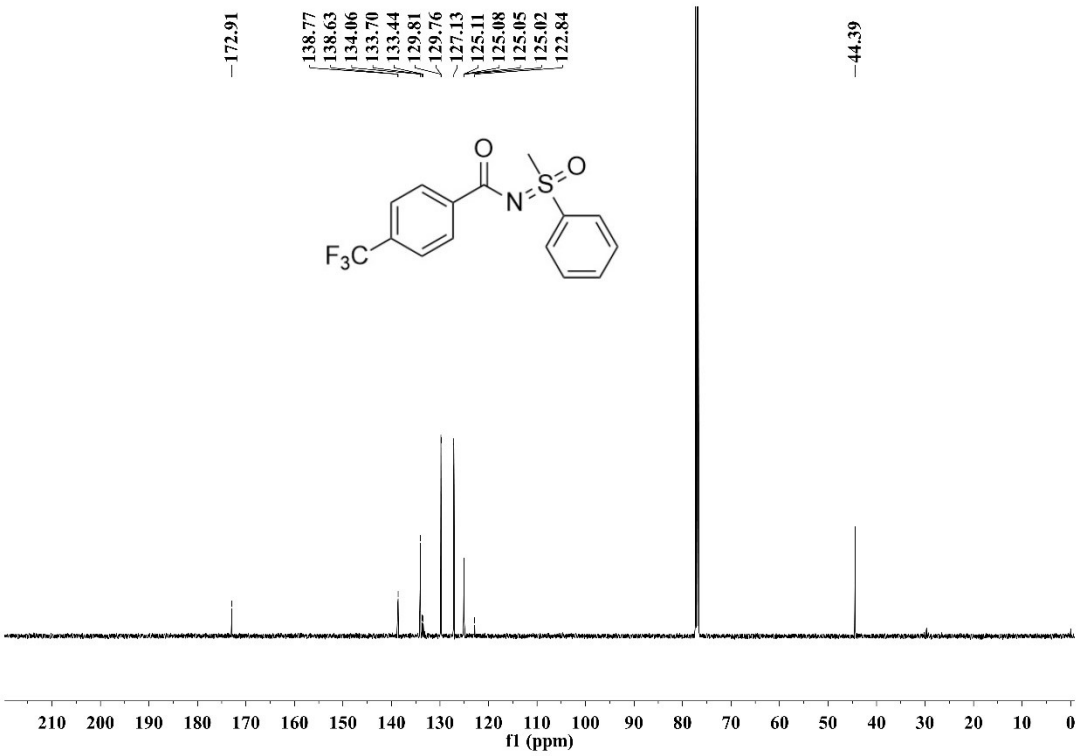
^{13}C{^{1}H} NMR spectrum of 4y (125 MHz, $CDCl_3$)



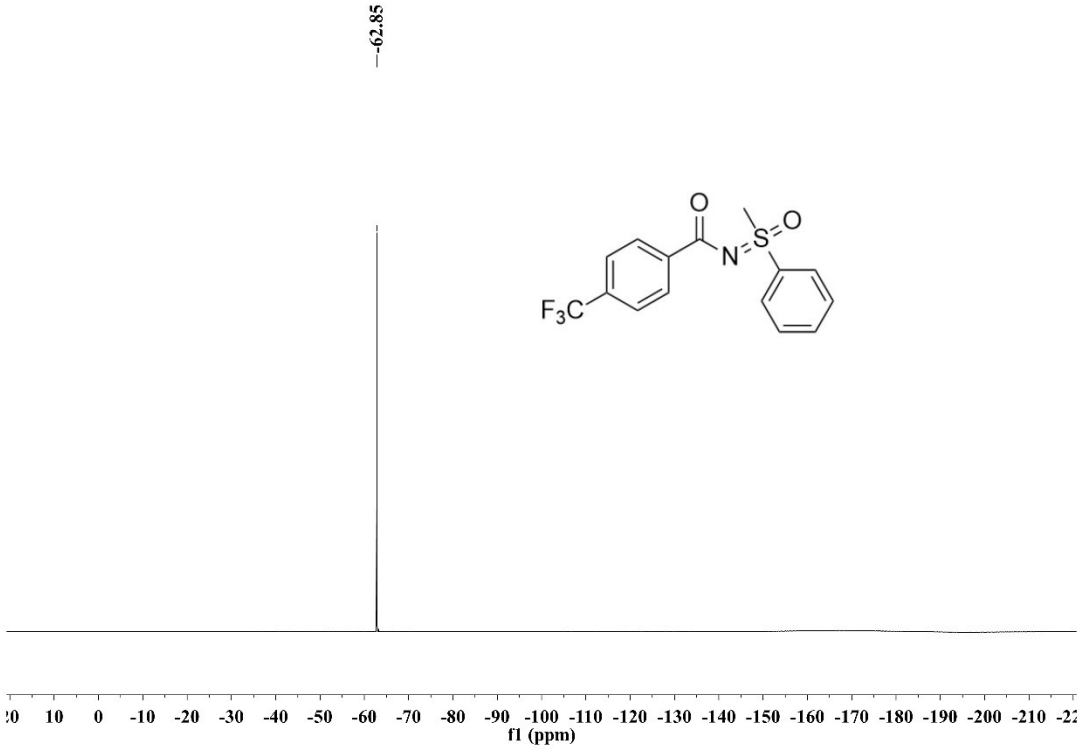
^{1}H NMR spectrum of 4z (500 MHz, $CDCl_3$)



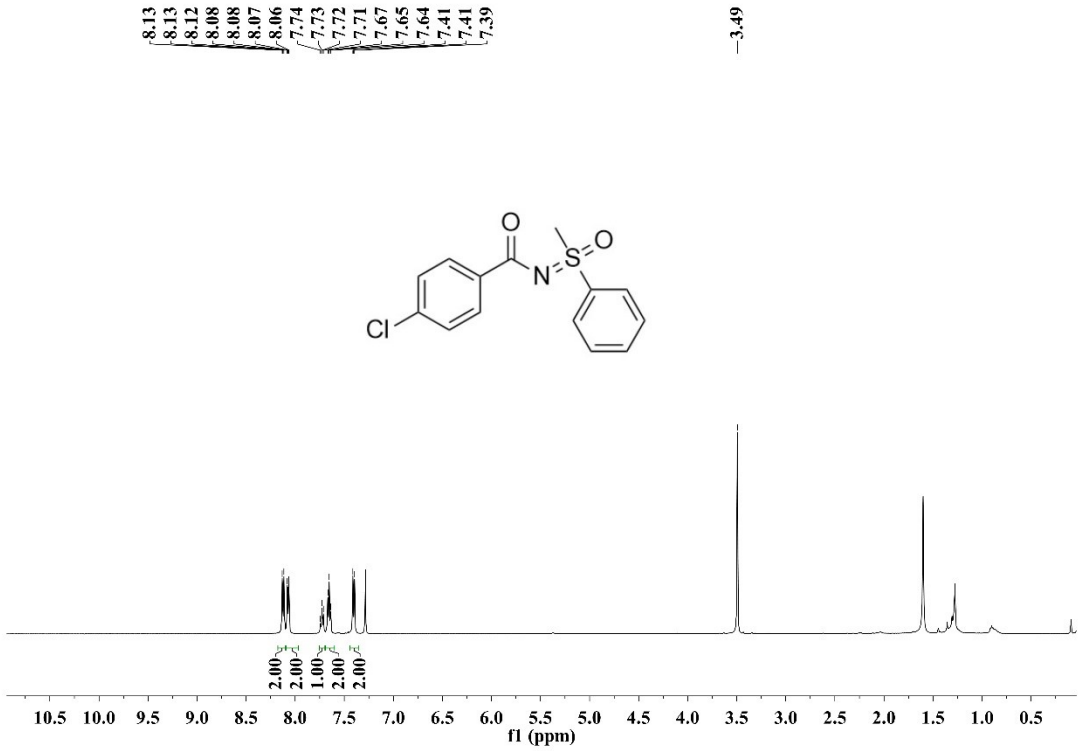
^{13}C{^{1}H} NMR spectrum of 4z (125 MHz, $CDCl_3$)



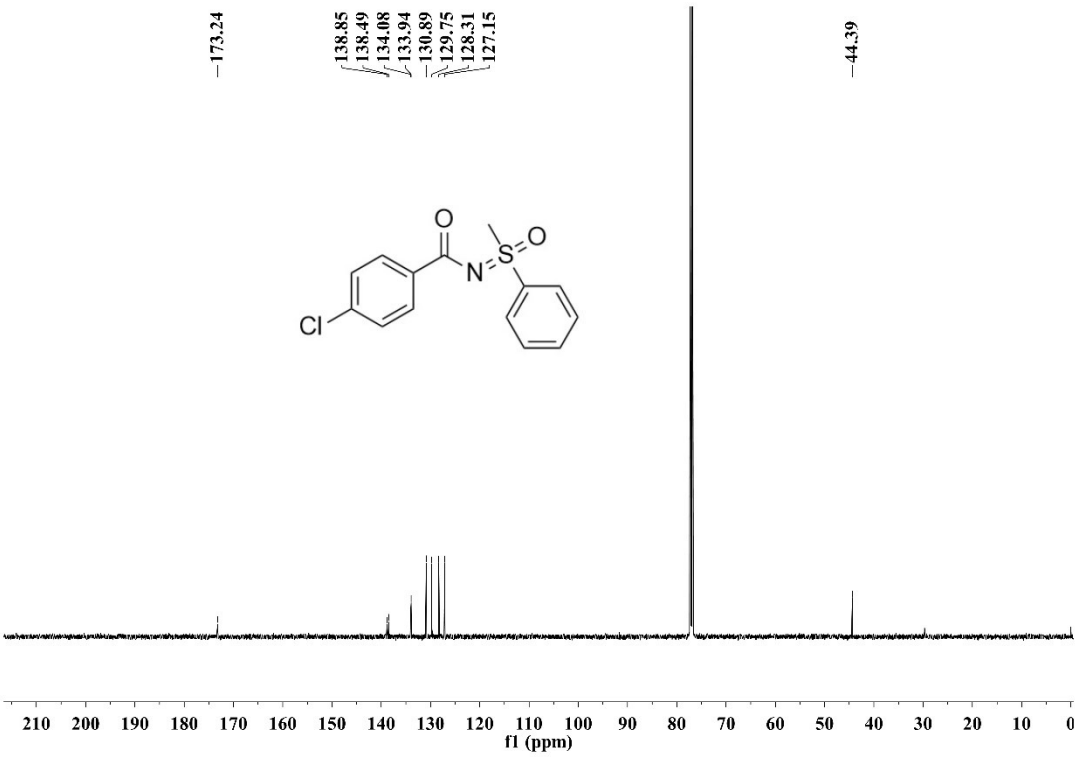
^{19}F NMR spectrum of of 4z (125 MHz, $CDCl_3$)



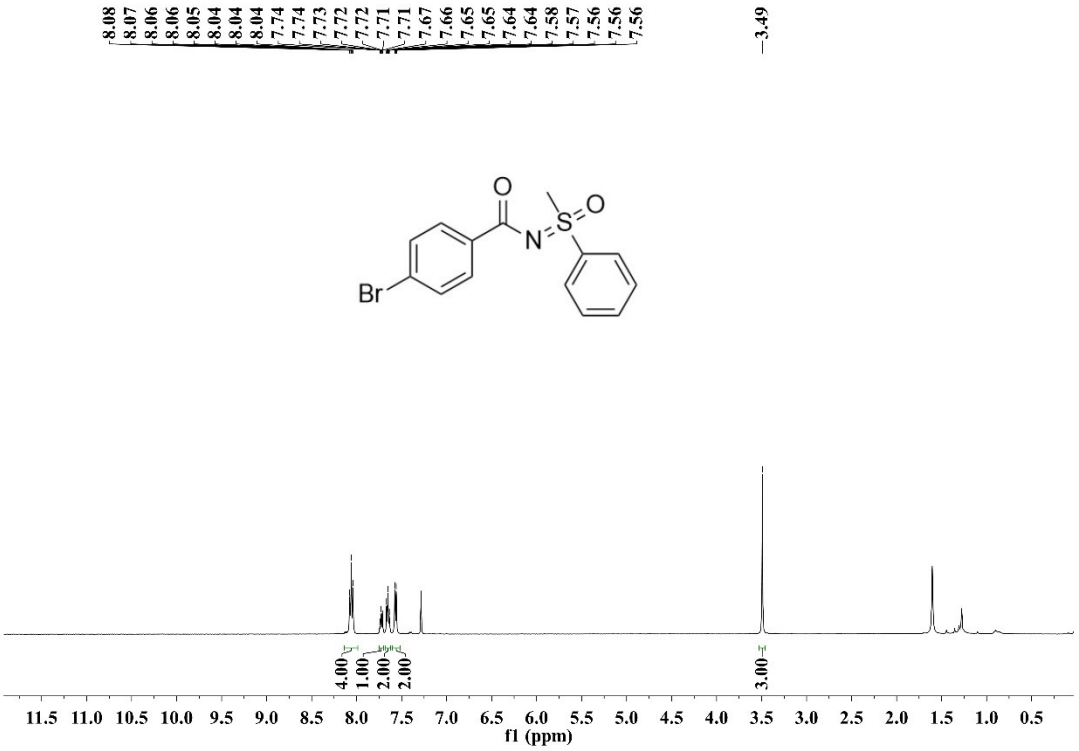
^{1}H NMR spectrum of 4aa (500 MHz, $CDCl_3$)



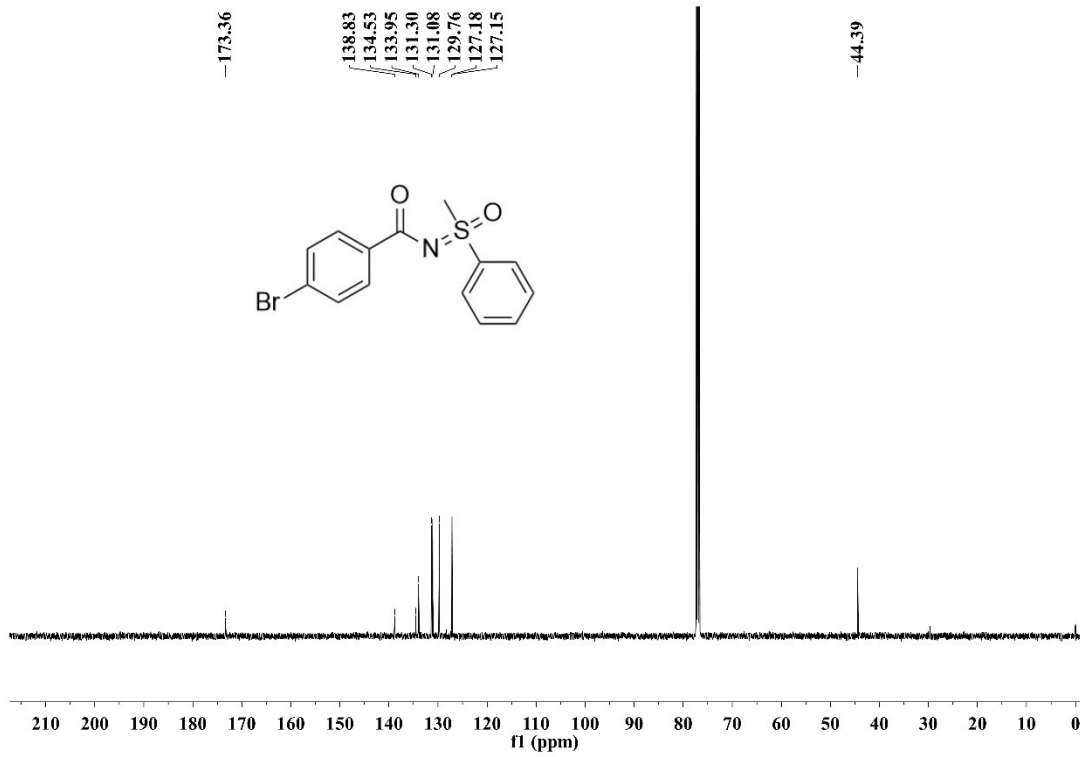
$^{13}C\{^{1}H\}$ NMR spectrum of 4aa (125 MHz, $CDCl_3$)



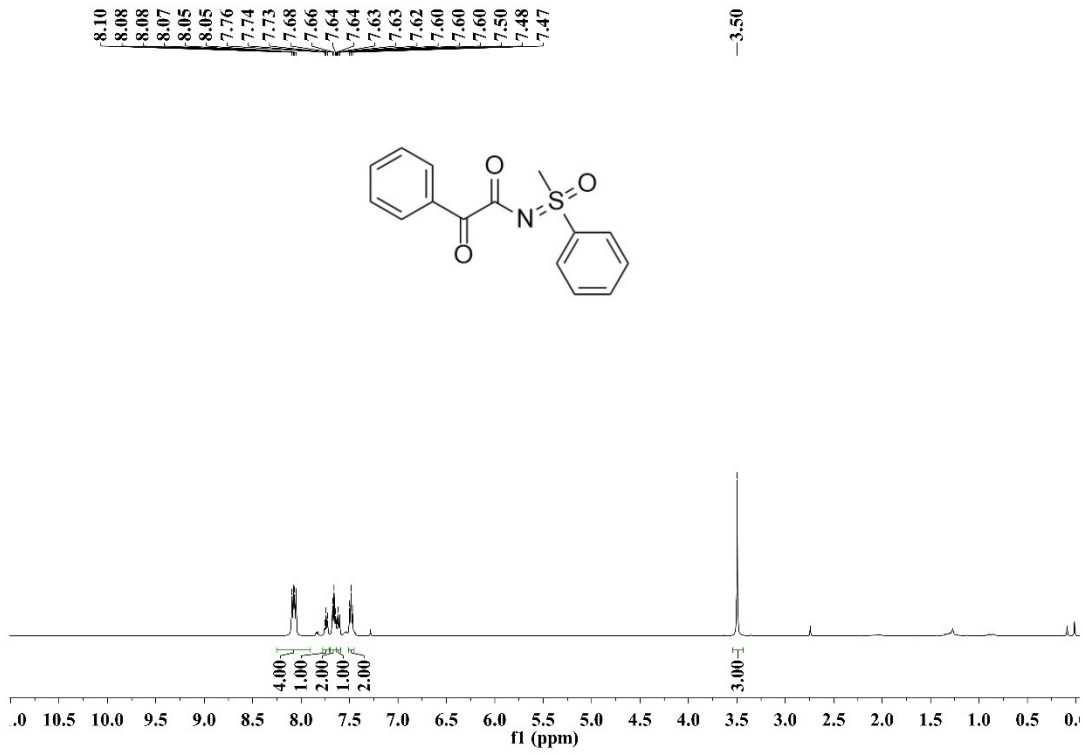
^{1}H NMR spectrum of 4ab (500 MHz, $CDCl_3$)



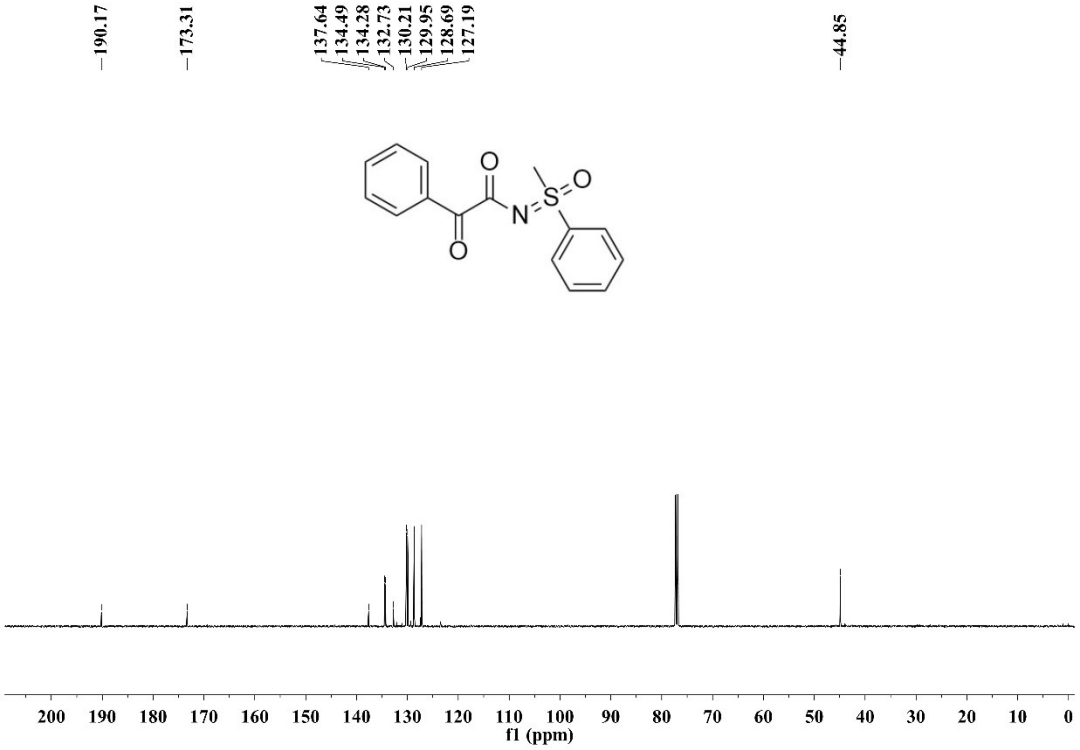
$^{13}C\{^{1}H\}$ NMR spectrum of 4ab (125 MHz, $CDCl_3$)



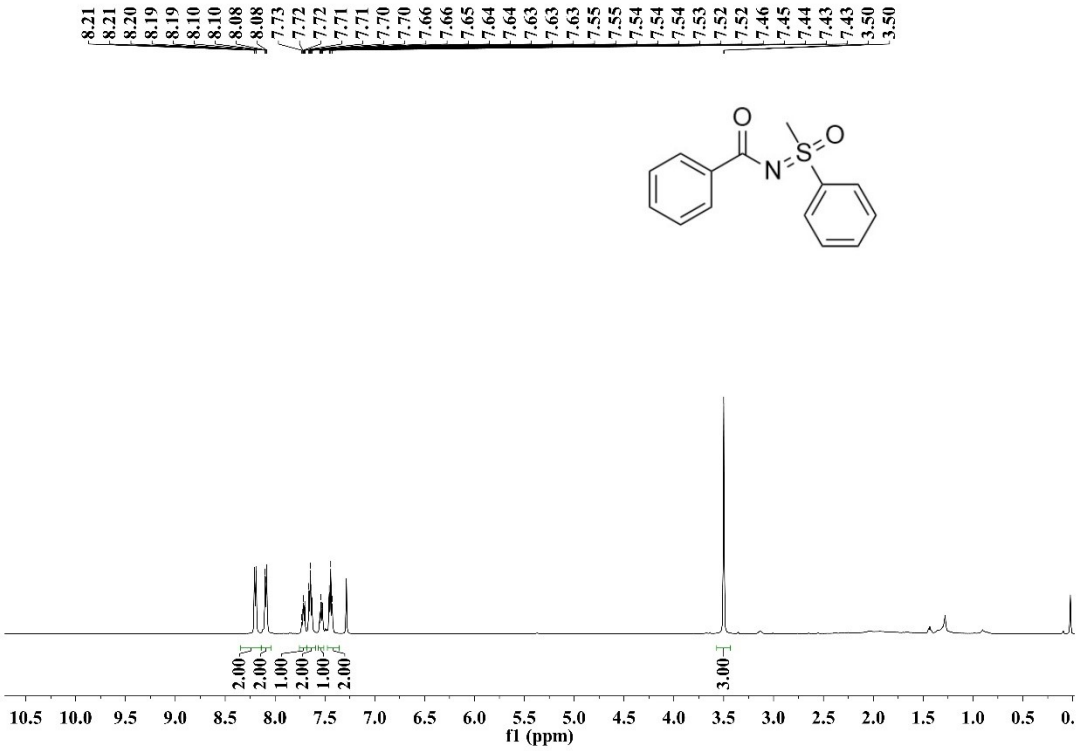
^{1}H NMR spectrum of 3a from gram-scale (500 MHz, $CDCl_3$)



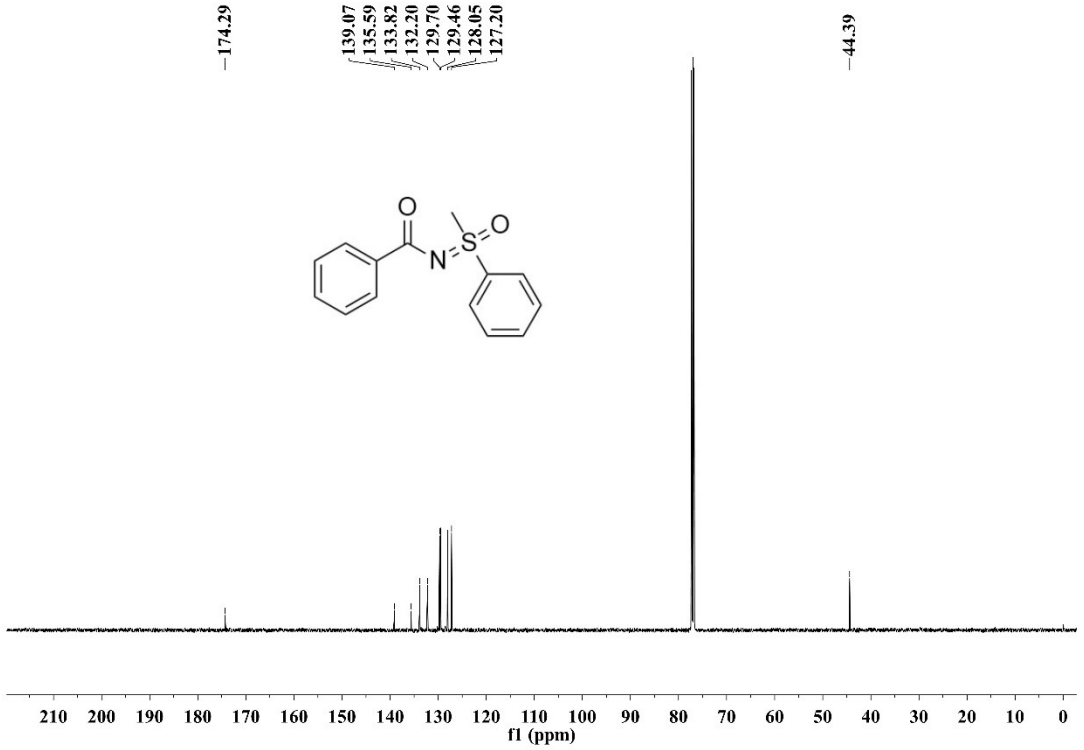
$^{13}C\{^{1}H\}$ NMR spectrum of 3a from gram-scale (125 MHz, $CDCl_3$)



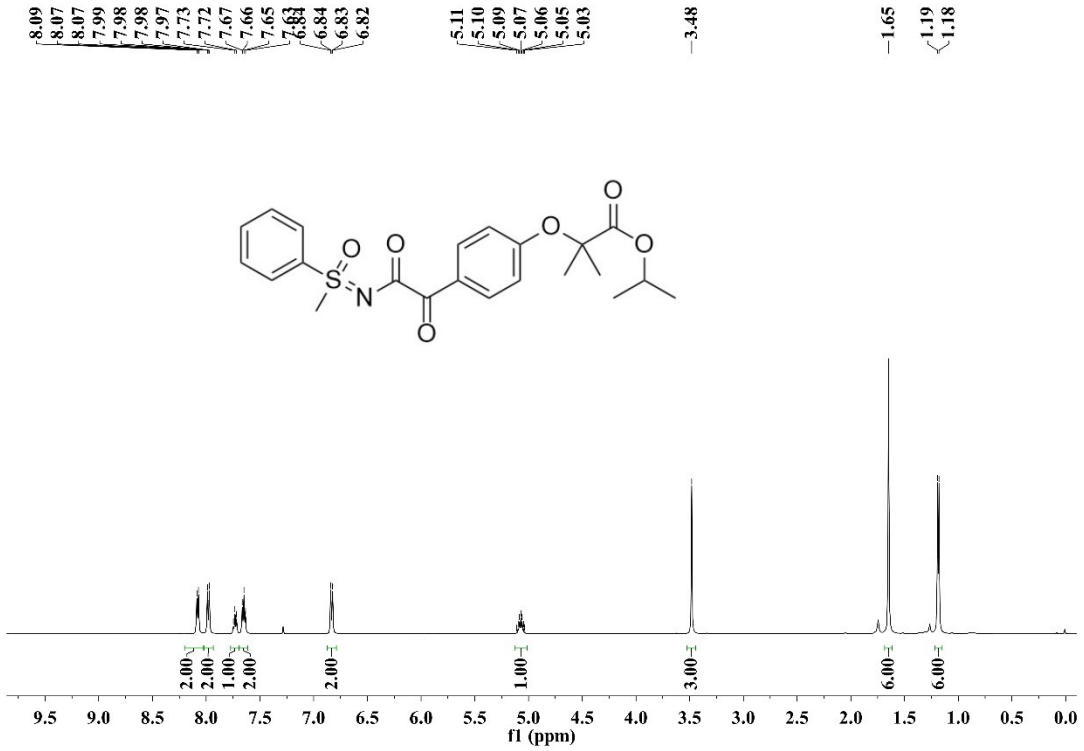
^{1}H NMR spectrum of 4a from gram-scale (500 MHz, $CDCl_3$)



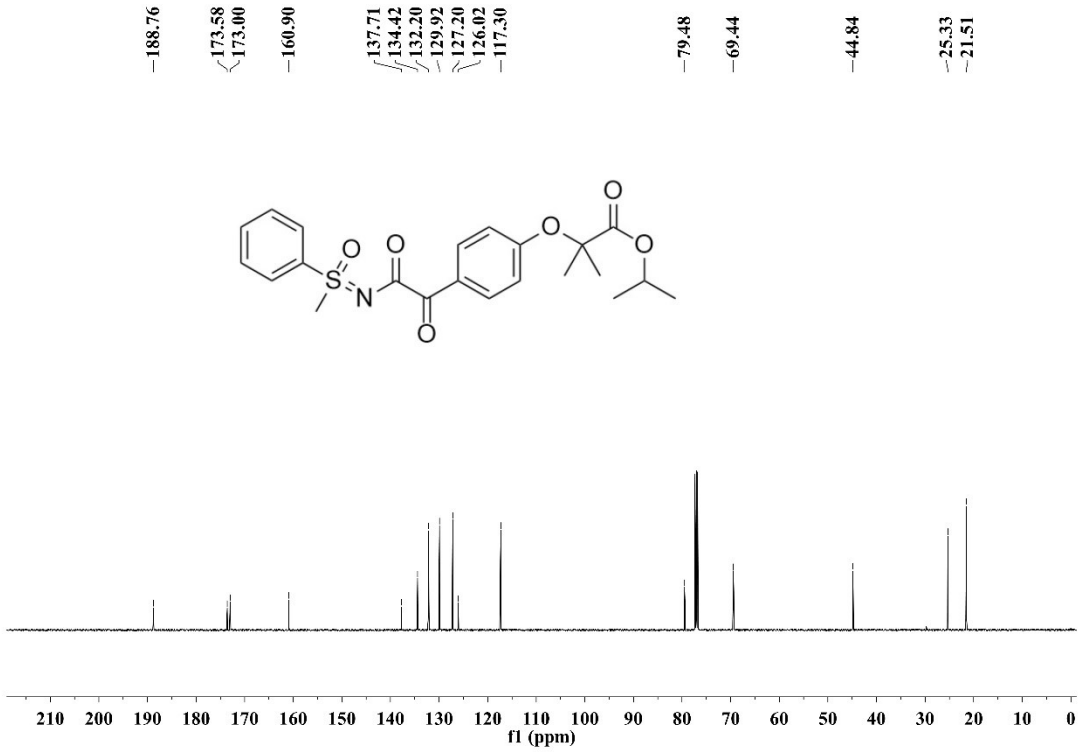
$^{13}C\{^{1}H\}$ NMR spectrum of 4a from gram-scale (125 MHz, $CDCl_3$)



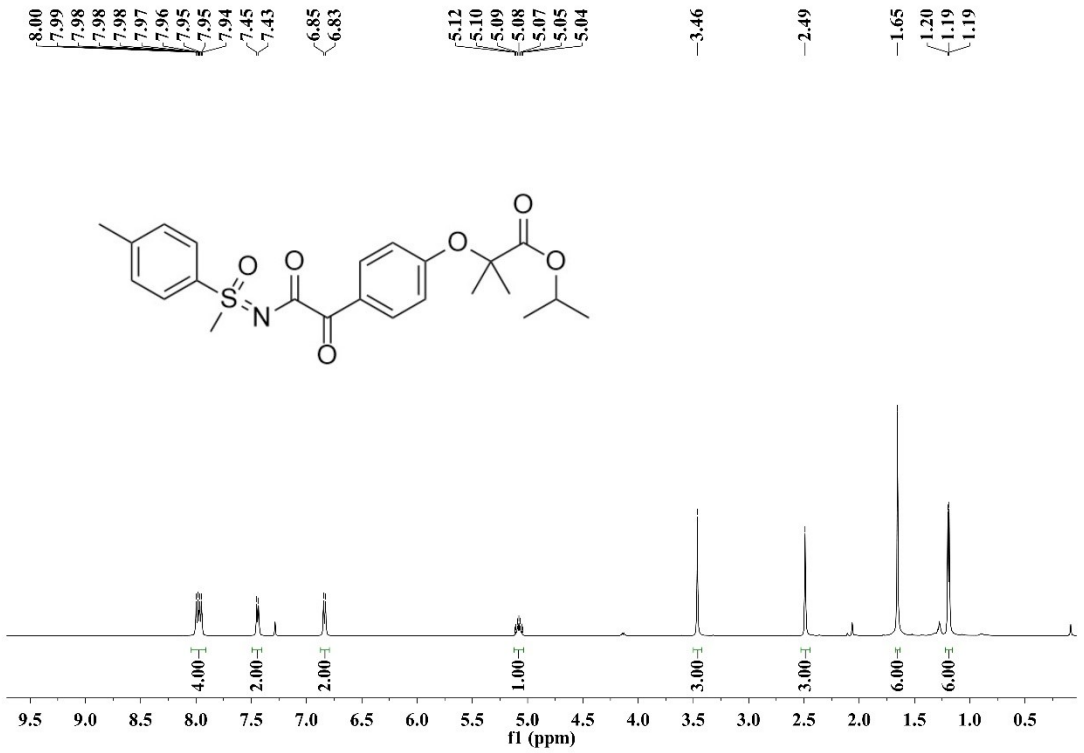
^{1}H NMR spectrum of 5a (500 MHz, $CDCl_3$)



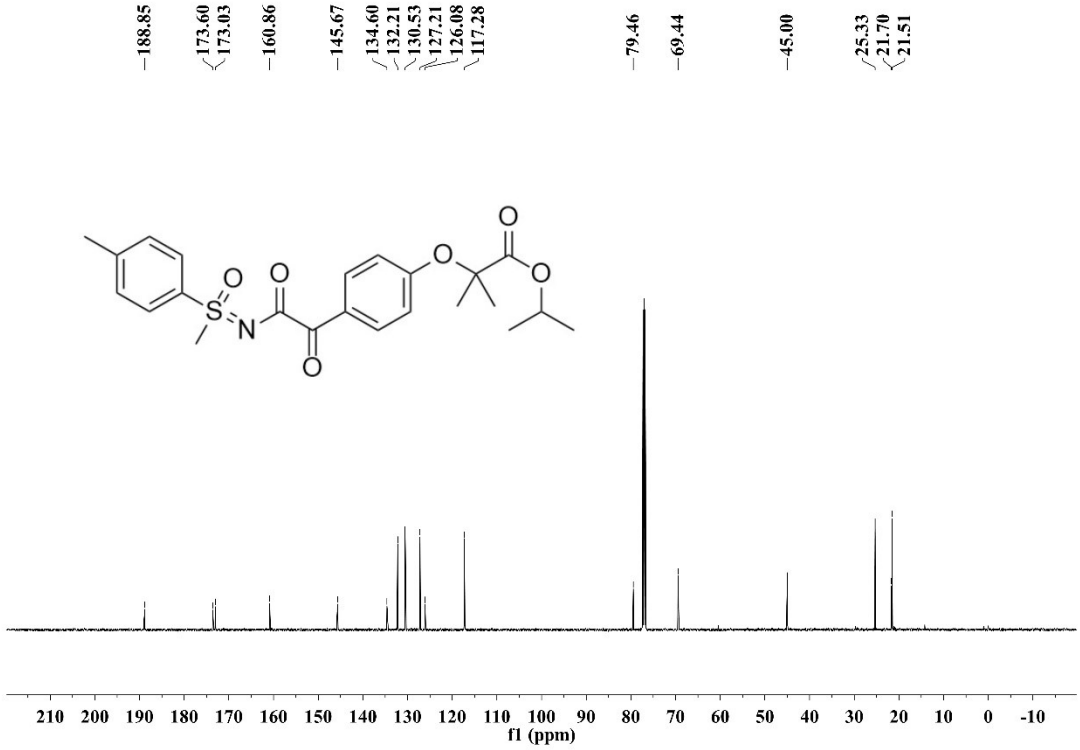
$^{13}C\{^{1}H\}$ NMR spectrum of 5a (125 MHz, $CDCl_3$)



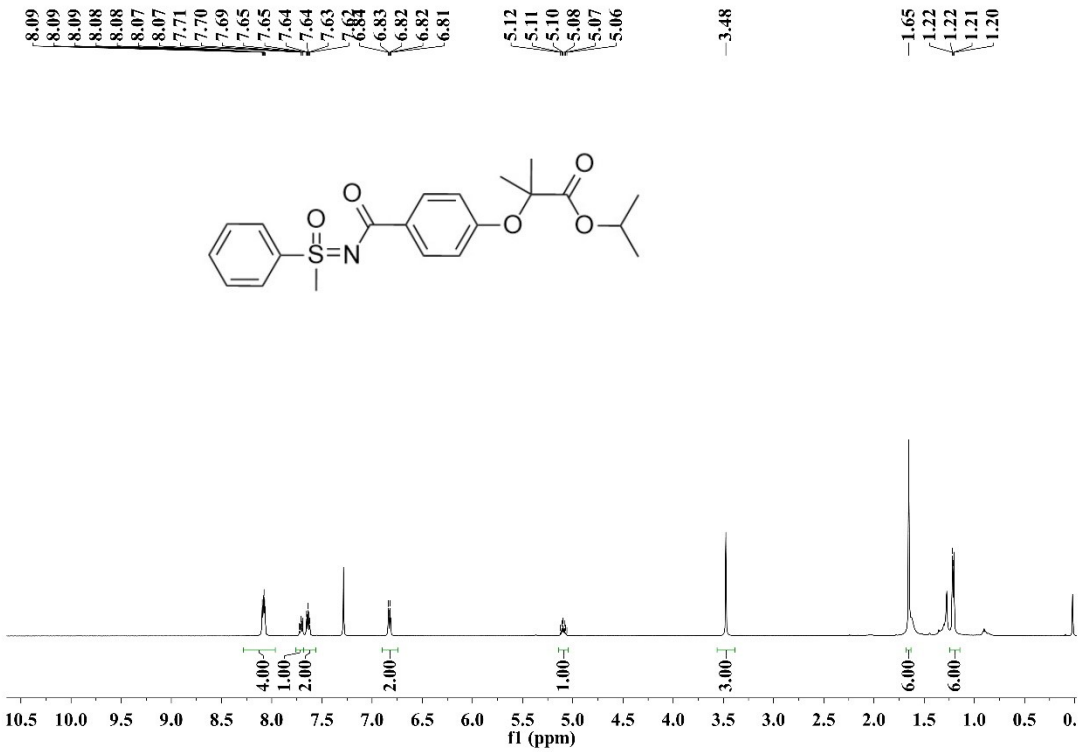
^{1}H NMR spectrum of 5b (500 MHz, $CDCl_3$)



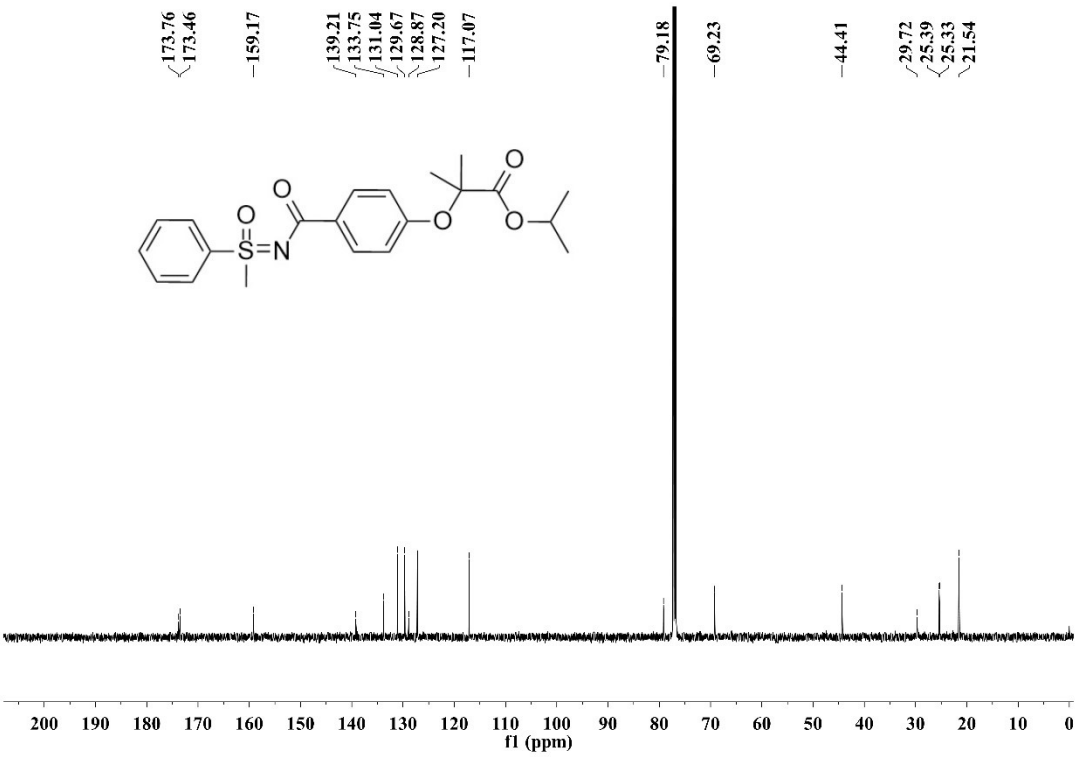
$^{13}C\{^{1}H\}$ NMR spectrum of 5b (125 MHz, $CDCl_3$)



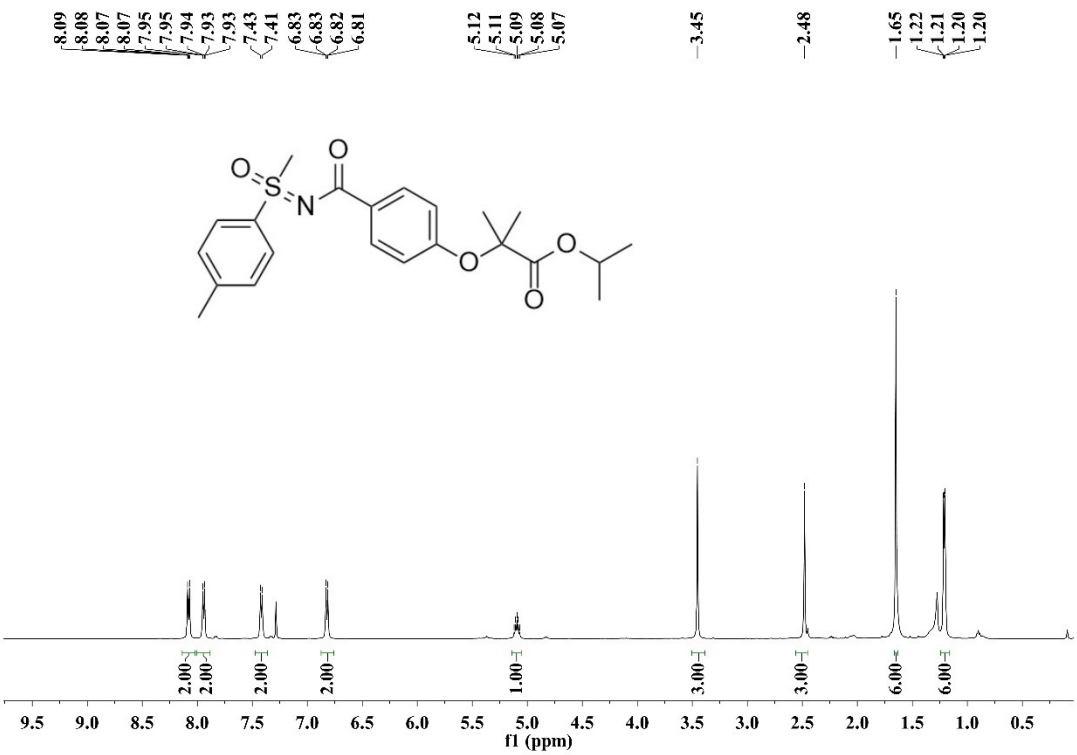
^{1}H NMR spectrum of 6a (500 MHz, $CDCl_3$)



$^{13}C\{^{1}H\}$ NMR spectrum of 6a (125 MHz, $CDCl_3$)



^{1}H NMR spectrum of 6b (500 MHz, $CDCl_3$)



$^{13}C\{^{1}H\}$ NMR spectrum of 6b (125 MHz, $CDCl_3$)