Supporting Information

Synthesis of 2-Acyl Benzofurans and Indoles Based on Nucleophile–Intercepted Meyer–Schuster Rearrangement of *o*-Hydroxyphenyl and *o*-Aminophenyl Propargylic Alcohols

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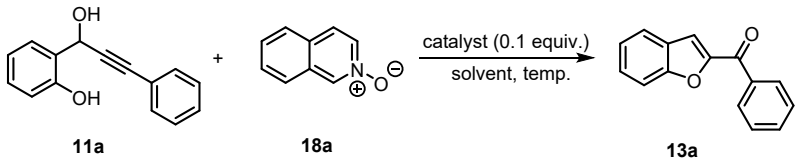
General information

All moisture or oxygen-sensitive reactions were carried out in a nitrogen atmosphere with dry solvents under anhydrous conditions, unless otherwise noted. The solvents used were purified by distillation over the drying agents indicated and were transferred under nitrogen: THF (Na), CH_2Cl_2 (CaH_2), toluene (Na), $ClCH_2CH_2Cl$ (CaH_2). Reagents were purchased at commercial quality and used without further purification. All reactions were monitored by thin-layer chromatography carried out on 0.25 mm Rushan silica gel plates (GF254) and visualized by exposure to UV light (254 nm) or $KMnO_4$. The products were purified by column chromatography on silica gel (200−300 meshes) from Qing Dao Hai Yang Chemical Industry Company in China. **^{1}H NMR** and **^{13}C NMR** spectra were recorded in $CDCl_3$ or DMSO-d_6 on a Bruker Advance III 500 MHz instrument (resonance frequencies 500 MHz for ^{1}H and 125 MHz for ^{13}C), Bruker Advance III 400 MHz instrument (resonance frequencies 400 MHz for ^{1}H and 100 MHz for ^{13}C), China Qone AS400 MHz instrument (resonance frequencies 400 MHz for ^{1}H and 100 MHz for ^{13}C), or Bruker ascend 600 MHz (resonance frequencies 600 MHz for ^{1}H and 100 MHz for ^{13}C). Chemical shifts were reported in δ value (ppm) relative to $CDCl_3$ (**^{1}H NMR**: 7.26 ppm, **^{13}CNMR**: 77.00 ppm), DMSO (**^{1}H NMR**: 2.50 ppm, **^{13}CNMR**: 39.5 ppm) or TMS (0.00 ppm). **^{19}F NMR** was recorded on a China Qone AS400 MHz instrument ($CFCl_3$ as an external standard and low field is positive). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, br = broad, td = triple doublet, dt = double triplet, m = multiplet. Mass spectrometric data were obtained using a Bruker Solaril X70 high resolution mass spectrometer (samples were dissolved in CH_3OH and the ion source was ESI). The IR spectra were recorded on a Nicolet iN10.

Screening of reaction conditions

To a 10 mL Schlenk tube, equipped with a magnetic stir bar, was added *o*-hydroxyphenyl propargylic alcohols **11a** (45 mg, 0.2 mmol) or *o*-aminophenyl propargylic alcohol **12a** (75 mg, 0.2 mmol), pyridine *N*-oxide **18** or isoquinoline *N*-oxide **18a**, and solvent (3 mL) followed by acid catalyst. The reaction mixture was heated in an oil bath at indicated temperature and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous $NaHCO_3$ solution. The aqueous phase was extracted with EtOAc (10 mL × 3). The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 3:1 or 3:1) to give the final product.

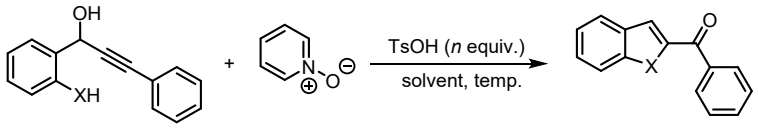


11a **18a** **13a**

Table S1. Screening of reaction conditions[a]

entry	solvent	catalyst	temp (°C)	t (h)	yield (%)[b]
1	THF	TFA	50	25	55
2	THF	TsOH	50	24	80
3	1,2-DCE	TsOH	50	24	98

[a]Reaction conditions: compounds **11a** (0.2 mmol) and **18a** (0.3 mmol), solvent (3 mL), catalyst (0.02 mmol); [b]Yield of the isolated product.



11a, X = O
12a, X = NTs

18 (*m* equiv.)

13a, X = O
14a, X = NTs

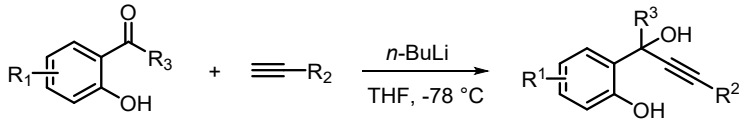
Table S2. Screening of reaction conditions[a]

entry	X	solvent	*m*	*n*	temp (°C)	t (h)	yield (%)[b]
1	O	1,2-DCE	2.0	0.1	50	24	73
2	O	1,2-DCE	2.0	0.1	70	22	80
3	O	1,2-DCE	2.0	0.1	reflux	1	98
4	O	1,2-DCE	1.0	0.1	reflux	4	93
5	**O**	**1,2-DCE**	**1.2**	**0.1**	**reflux**	**1.5**	**95**
6	O	CH_3CN	1.2	0.1	reflux	3	90
7	O	toluene	1.2	0.1	85	3	83
8	O	DMF	1.2	0.1	85	2	84
9	NTs	1,2-DCE	1.2	0.1	reflux	24	50
10	NTs	1,2-DCE	1.2	0.2	reflux	24	51
11	NTs	1,2-DCE	1.2	1.0	reflux	24	49
12	NTs	CH_3CN	1.2	0.2	reflux	14	48
13	**NTs**	**toluene**	**1.2**	**0.2**	**reflux**	**12**	**91**
14	NTs	toluene	1.2	0.1	reflux	16	72

[a]Reaction conditions: compounds **11a** or **12a** (0.2 mmol) and **18** (0.02-0.2 mmol), solvent (3 mL), catalyst; [b]Yield of the isolated product.

General procedure for the synthesis of *o*-hydroxyphenyl propargylic alcohols

o-Hydroxyphenyl propargylic alcohols **11a-11y** were prepared according to the reported literature.[1] General synthetic route of propargylic alcohols **11a-11y** is shown below.

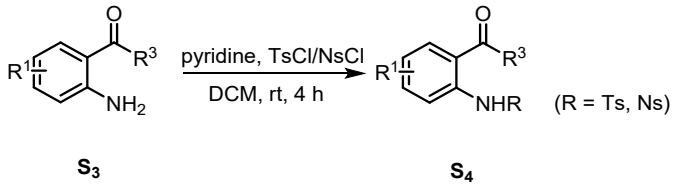


S_1 **S_2** **11a-11y**

To the solution of **S_2** (22 mmol, 2.2 equiv.) in dry THF (30 mL) was slowly added *n*-BuLi (21 mmol, 2.5 M in THF, 2.1 equiv.) at -78 °C under nitrogen atmosphere. The reaction mixture was stirred at this temperature for 1 h, then a solution of the corresponding salicylaldehyde or *o*-hydroxyphenyl ketone **S_1** (10 mmol, 1.0 equiv.) in 4 mL of THF was added dropwise via a cannula. The reaction mixture was stirred at -78 °C for another 1-1.5 h until the disappearance of the starting material indicated by TLC (thin-layer chromatography) analysis. Then the reaction mixture was quenched with saturated aqueous NH_4Cl solution and THF was removed under vacuum. The resulting aqueous phase was extracted with EtOAc (30 mL × 3). The combined organic layers were washed with water (30 mL) and brine (30 mL), dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography (petroleum ether/EtOAc = 10/1) or by crystallization with petroleum ether to give **11a-**

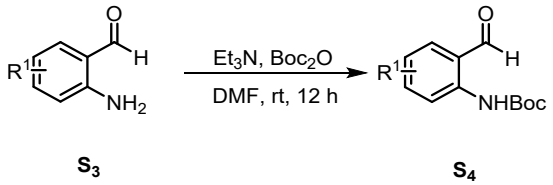
11y. The spectral data was in accordance with the reported data.[1]

General procedure for the synthesis of *o*-aminophenyl propargylalcohols



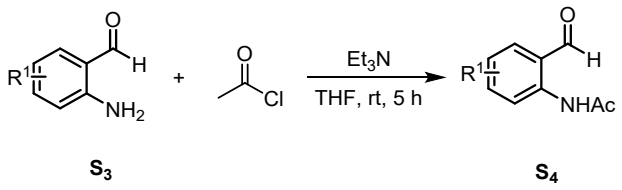
S3 **S4**

o-Aminophenyl propargylalcohols were prepared according to known procedures.[2] To an egg-shaped flask was added 2-aminobenzaldehydes or ketones **S3** (10 mmol, 1.0 equiv.), DCM (25 mL) and pyridine (13 mmol, 1.3 equiv.). Then TsCl or NsCl (12 mmol, 1.2 equiv.) was added to the above mixture under 0 °C and stirred at room temperature for about 4 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with water and extracted with DCM (30 mL × 3). The combined organic extracts were washed with water (30 mL) and brine (30 mL), dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 5:1) to afford **S4**.



S3 **S4**

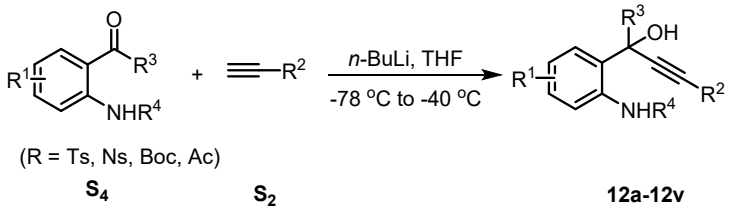
To an egg-shaped flask was added 2-aminobenzaldehydes **S3** (10 mmol, 1.0 equiv.), DMF (25 mL) and Et_3N (30 mmol, 3 equiv.). Then Boc_2O (12 mmol, 1.2 equiv.) was added to the above mixture under 0 °C and stirred at room temperature for 12 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with water and extracted with DCM (30 mL × 4). The combined organic extracts were washed with water (30 mL × 3) and brine (30 mL), dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 5:1) to afford **S4** .



S3 **S4**

To an egg-shaped flask was added 2-aminobenzaldehydes **S3** (10 mmol, 1.0 equiv.), THF (25 mL) and Et_3N (20 mmol, 2 equiv.). Then acyl chloride (10 mmol, 1.0 equiv.) was added to the above mixture under 0 °C and stirred at room temperature for 5 h. The reaction was monitored by TLC. Upon completion, the mixture was quenched with water and THF was removed under reduced pressure. The resulting aqueous phase was extracted with DCM (30 mL × 3). The combined organic extracts were

washed with water (30 mL) and brine (30 mL), dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 3:1) to afford **S_4** .

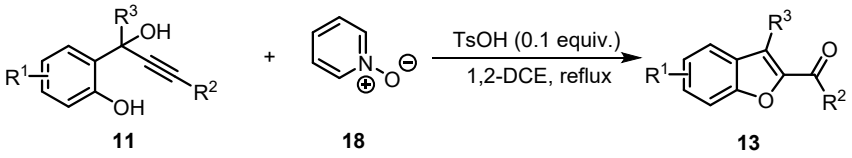


(R = Ts, Ns, Boc, Ac)

S_4 **S_2** **12a-12v**

To a solution of **S_2** (5.5 mmol, 2.2 equiv.) in THF (5 mL) was added *n*-BuLi dropwise (5.5 mmol, 2.5 M in THF, 2.2 equiv.) at -78 °C under nitrogen atmosphere. Then the mixture was stirred for 10 min at -78 °C. The mixture was warmed to -40 °C and allowed to continue for another 1 h. After that, the system was cooled down to -78 °C and a solution of **S_4** (2.5 mmol, 1.0 equiv.) in THF (4 mL) was added slowly to the above mixture. The reaction was stirred for 1 h at -78 °C and warmed to room temperature while stirring for another 1 h (monitored by TLC). Upon completion, the reaction mixture was quenched with saturated NH_4Cl solution, and extracted with EtOAc (20 mL×3) after removal of THF under vacuum. The combined organic extracts were washed with water (20 mL) and brine (20 mL), dried over Na_2SO_4, and concentrated in vacuo. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 5:1) to afford **12a-12v**. The spectral data was in accordance with the reported data.[2]

General procedure for the synthesis of 2-acyl benzofurans

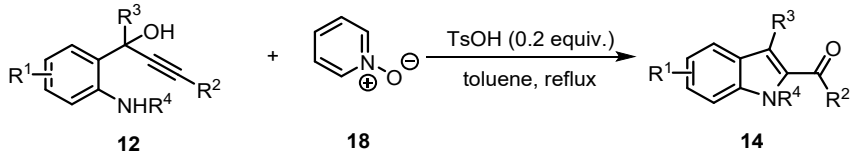


11 **18** **13**

For 0.2 mmol Scale:

To a 10 mL Schlenk tube, equipped with a magnetic stir bar, was added *o*-hydroxyphenyl propargylic alcohols **11** (0.2 mmol), pyridine *N*-oxide **18** (0.24 mmol), and 1,2-DCE (3 mL) followed by TsOH (0.02 mmol). The reaction mixture was stirred at reflux and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous $NaHCO_3$ solution. The aqueous phase was extracted with EtOAc (10 mL × 3). The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 3:1 or 3:1) to give products **13a-y**.

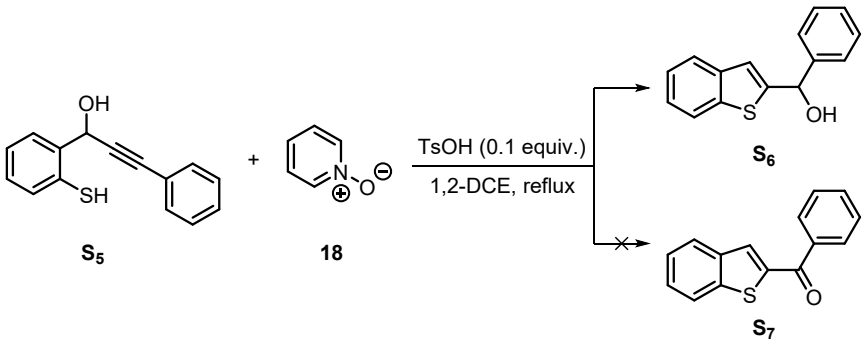
General procedure for the synthesis of 2-acyl indoles



For 0.2 mmol Scale:

To a 10 mL Schlenk tube, equipped with a magnetic stir bar, was added *o*-aminophenyl propargylalcohols **12** (0.2 mmol), pyridine *N*-oxide **18** (0.24 mmol), and toluene (3 mL) followed by TsOH (0.04 mmol). The reaction mixture was stirred at reflux and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous $NaHCO_3$ solution. The aqueous phase was extracted with EtOAc (10 mL × 3). The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 3:1) to give products **14a-v**.

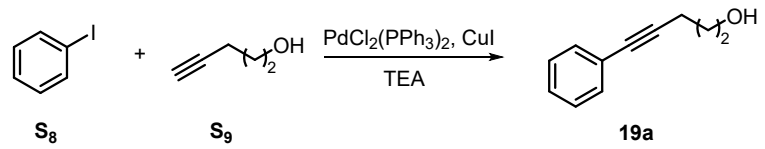
Attempt to synthesize benzothiophene



To a 10 mL Schlenk tube was added 1-(2-mercaptophenyl)-3-phenylprop-2-yn-1-ol **S5** [3] (48 mg, 0.2 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (23 mg, 0.24 mmol, 1.2 equiv.) and 1,2-DCE (3 mL) followed by TsOH (4 mg, 0.02 mmol, 0.1 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. No desired product (**S7**) was formed according to NMR and mass spectrometry analysis and benzo[*b*]thiophen-2-yl(phenyl)methanol **S6** (32 mg, 0.13 mmol) was obtained instead. The spectral data was in accordance with the reported data[4]. The investigation of this transformation is underway in our laboratory. Compound **S6** (67% yield, white solid, melting point: 80.0 – 82.0 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.74 (d, *J* = 8.0 Hz, 1H), 7.65 (d, *J* = 7.5 Hz, 1H), 7.44 (d, *J* = 7.5 Hz, 2H), 7.35 (t, *J* = 7.5 Hz, 2H), 7.32 – 7.20 (m, 3H), 7.07 (s, 1H), 6.04 (s, 1H), 2.71 (s, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 148.6, 142.5, 139.8, 139.4, 128.6, 128.2, 126.4, 124.2, 124.2, 123.6, 122.4, 121.2, 72.9. **IR**: $\bar{\upsilon}$ = 3450, 1620, 1043, 777, 599 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{15}H_{12}NaOS^+$ 263.0502; found: 263.0502.

Control experiments

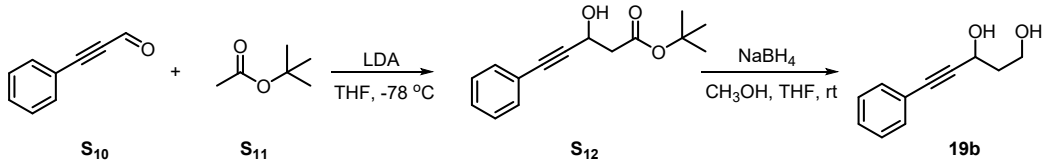
Synthesis of 5-phenylpent-4-yn-1-ol 19a



S8 **S9** **19a**

$PdCl_2(PPh_3)_2$ (70 mg, 0.1 mmol, 0.01 equiv.) and CuI (38 mg, 0.2 mmol, 0.02 equiv.) were dissolved in Et_3N (27.80 ml, 200.0 mmol, 20.0 equiv.). 4-Pentyn-1-ol **S9** (0.93 ml, 10.0 mmol, 1.0 equiv.) and iodobenzene **S8** (2.24 ml, 20.0 mmol, 2.0 equiv.) were added at the same time to the mixture. The reaction was stirred over night at room temperature and monitored by TLC. The reaction was quenched with saturated aqueous NH_4Cl solution and the aqueous layer was extracted with EtOAc (30 mL × 3). The combined organic phase was washed with H_2O and brine and was then dried over Na_2SO_4. After removing the solvent in vacuo, the residue was purified by flash column chromatography (petroleum ether/EtOAc = 6:1 to 2:1). The title product **19a** was obtained as a yellowish liquid (1.35 g, 8.4 mmol, 84% yield). The spectra were in accordance with the literature. [5]

Synthesis of 5-phenylpent-4-yne-1,3-diol 19b

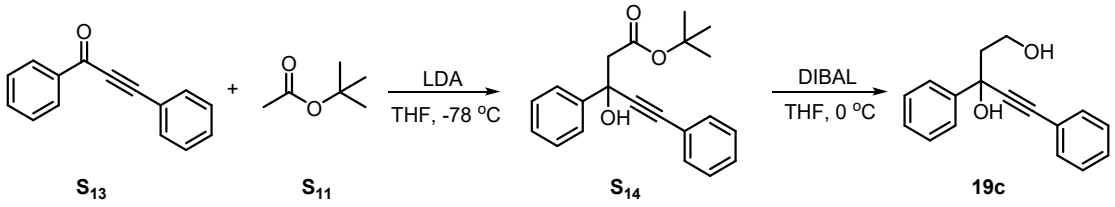


S10 **S11** **S12** **19b**

Step I: LDA (5.50 ml, 11.0 mmol, 2.0 M in THF, 1.1 equiv.) was added dropwise to a solution of *tert*-butyl acetate **S11** (1.48 ml, 11.0 mmol, 1.1 equiv.) at −78 °C in THF (25 mL). The reaction mixture was stirred for 1 h and a solution of 3-phenylpropiolaldehyde **S10** (1.22 ml, 10.0 mmol, 1.0 equiv.) in THF (20 mL) was slowly added. After 30 minutes, the reaction was quenched with saturated NH_4Cl solution. Most of the organic solvent was evaporated in vacuo. The residue was taken up in ethyl acetate (30 mL) and washed with water (30 mL). The aqueous layer was extracted with EtOAc (15 mL × 2). The organic extracts were combined and dried over Na_2SO_4. Evaporation of the solvent afforded the desired compound as a yellow oil, which was used in the next step without purification.

Step II: $NaBH_4$ (0.47 g, 12.5 mmol, 2.5 equiv.) was added to a solution of *tert*-butyl-3-hydroxy-5-phenylpent-4-ynoate **S12** (1.23 g, 5.0 mmol, 1.0 equiv.) in THF (20 mL). Methanol (4.05 ml, 100.0 mmol, 20.0 equiv.) was then added. The reaction mixture was allowed to stir at room temperature and monitored by TLC. Upon completion, the reaction was quenched with water. Most of the organic solvent was evaporated in vacuo. The residue was extracted from EtOAc (30 mL × 3). The combined organic layers were dried over anhydrous Na_2SO_4 and evaporated under vacuum. The residue was purified by column chromatography (petroleum ether/EtOAc = 10:1) on silica gel to give the title compound **19b** as a yellow oil (0.39 g, 2.3 mmol, 45% yield). All spectra were in accordance with the literature.[6]

Synthesis of 3,5-diphenylpent-4-yne-1,3-diol 19c[6]

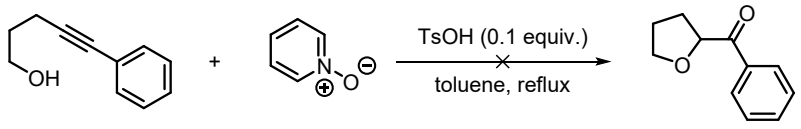


S_{13} S_{11} S_{14} **19c**

Step I: LDA (5.50 ml, 11.0 mmol, 2.0 M in THF, 1.1 equiv.) was added dropwise to a solution of *tert*-butyl acetate $\mathbf{S_{11}}$ (1.48 ml, 11 mmol, 1.1 equiv.) at −78 °C (20 mL). The reaction mixture was stirred for 1 h and a solution of 1,3-diphenylprop-2-yn-1-one $\mathbf{S_{13}}$ (2.06 g, 10 mmol, 1.0 equiv.) in THF (20 mL) was added slowly. After 30 minutes, the reaction was quenched with a solution of saturated ammonium chloride (25 mL). Most of the organic solvents were evaporated in vacuo. The residue was taken up in ethyl acetate (30 mL) and washed with water (30 mL). The aqueous layer was extracted with ethyl acetate (15 mL × 2). The organic extracts were combined and dried over Na_2SO_4. Evaporation of the solvent afforded the desired compound $\mathbf{S_{14}}$ as a yellow oil, which was used in the next step without purification.

Step II: DIBAL (10.00 ml, 20 mmol, 2.0 M in THF, 2.0 equiv.) was added to a solution of *tert*-butyl 3,5-diphenylpent-4-ynoate $\mathbf{S_{14}}$ (3.22 g, 10 mmol, 1.0 equiv.) in THF (30 mL) at 0 °C. The reaction mixture was allowed to stir at 0 °C and monitored by TLC. Upon completion, the reaction was quenched with a 10% NaOH solution and most of the organic solvents were evaporated in vacuo. The residue was extracted with ethyl acetate (30 mL × 3). The combined organic layers were dried over Na_2SO_4 and evaporated under vacuum. The residue was purified by column chromatography (petroleum ether/EtOAc = 10:1) on silica gel to give the title compound **19c** as a white solid (1.14 g, 4.5 mmol, 45% yield).

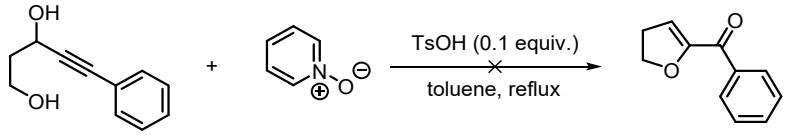
Control experiment 1：



19a **18** **20a**

To a 10 mL Schlenk tube was added 5-phenylpent-4-yn-1-ol **19a** (32 mg, 0.2 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (23 mg, 0.24 mmol, 1.2 equiv.) and toluene (3 mL) followed by TsOH (4 mg, 0.02 mmol, 0.1 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. No desired product was formed according to NMR and mass spectrometry analysis.

Control experiment 2：

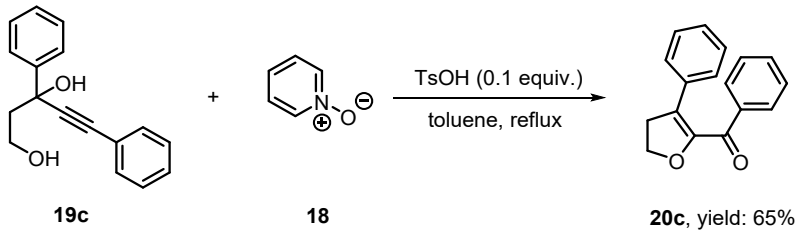


19b **18** **20b**

To a 10 mL Schlenk tube was added 5-phenylpent-4-yne-1,3-diol **19b** (35 mg, 0.2 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (23 mg, 0.24 mmol, 1.2 equiv.) and toluene (3 mL) followed by TsOH (4 mg, 0.02 mmol, 0.1 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. No desired

product was formed according to NMR and mass spectrometry analysis.

Control experiment 3：



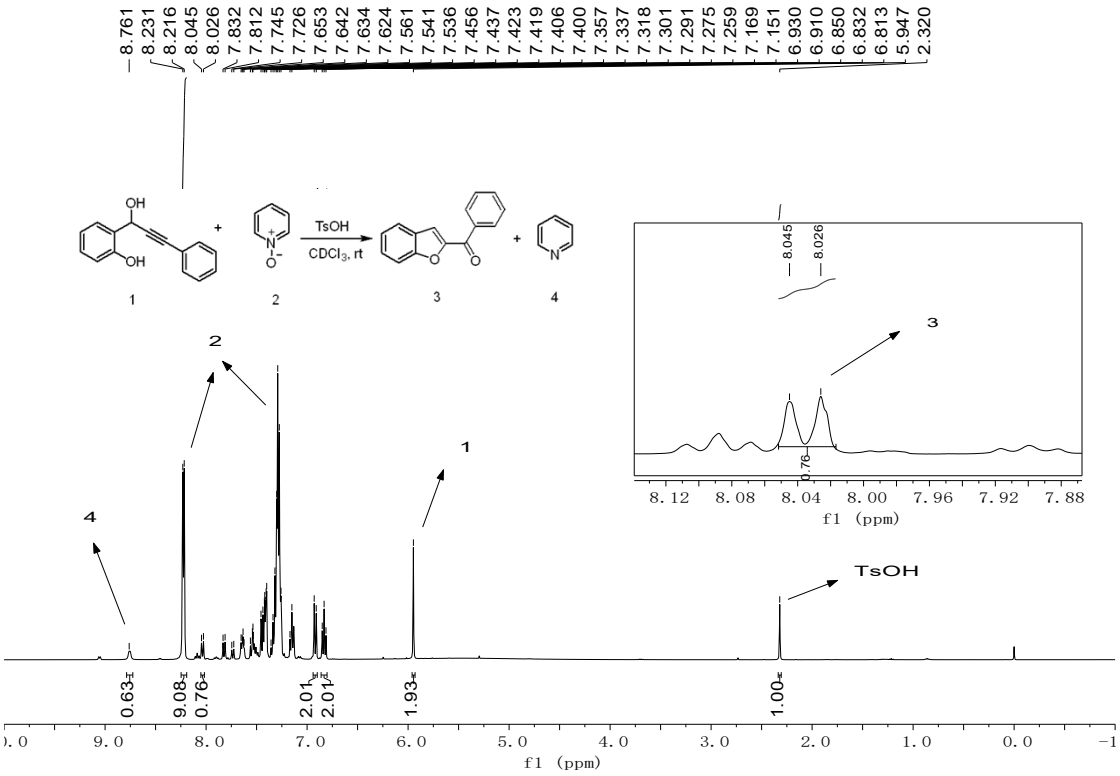
19c **18** **20c**, yield: 65%

To a 10 mL Schlenk tube was added 3,5-diphenylpent-4-yne-1,3-diol **19c** (50 mg, 0.2 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (23 mg, 0.24 mmol, 1.2 equiv.) and toluene (3 mL) followed by TsOH (4 mg, 0.02 mmol, 0.1 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. The desired product was isolated in 65% yield after work up and column chromatography. Compound **20c** (65% yield, yellow oil): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.91 – 7.86 (m, 2H), 7.51 – 7.45 (m, 1H), 7.34 (t, *J* = 7.6 Hz, 2H), 7.27 – 7.22 (m, 2H), 7.21 – 7.11 (m, 3H), 4.61 (t, *J* = 10.0 Hz, 2H), 3.30 (t, *J* = 10.0 Hz, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 189.4, 147.7, 136.3, 133.3, 133.0, 129.7, 128.2, 128.1, 127.5, 127.3, 121.6, 69.1, 35.2. **IR**: $\tilde{\upsilon}$ = 3416, 1617, 1400, 1156 cm^{-1}； **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{17}H_{14}NaO_2^+$ 273.0886; found: 273.0889.

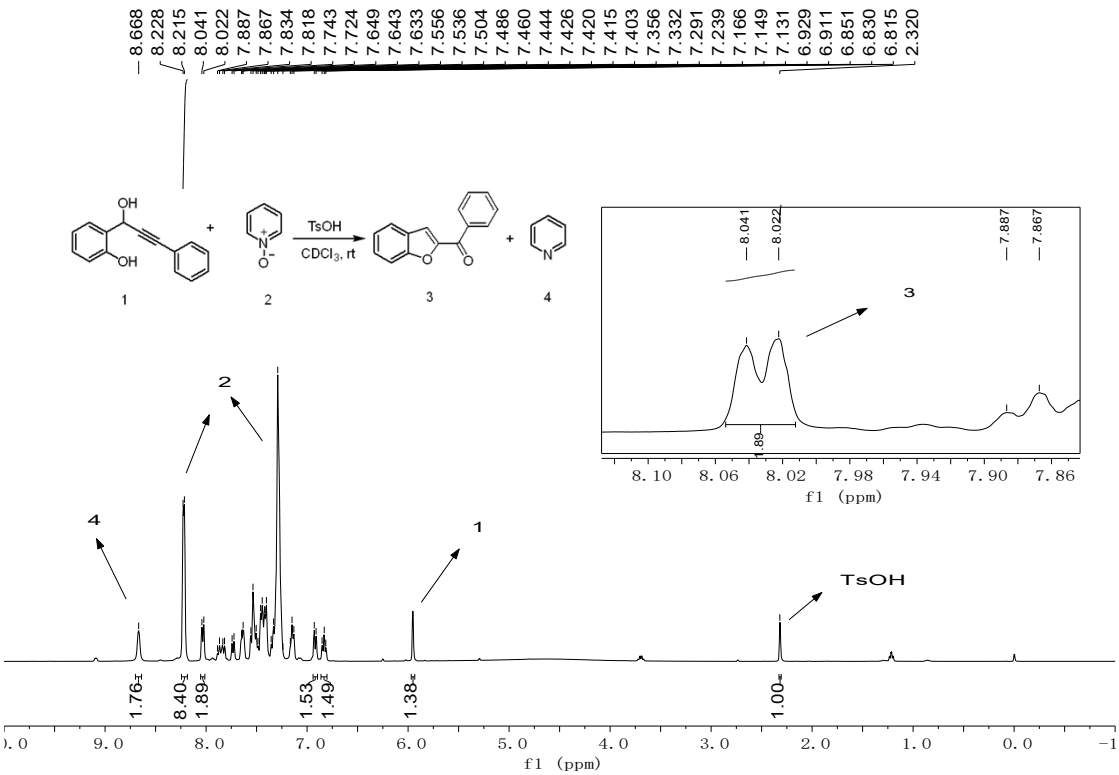
Control experiment 4：

To probe the probable reaction pathway, we set up an experiment to try to capture the intermediate. To a 10 mL Schlenk tube, equipped with a stir bar, was added *o*-hydroxyphenyl propargylic alcohol **11a** (0.2 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (0.4 mmol, 2 equiv.), and $CDCl_3$ (3 ml) followed by TsOH (0.02 mmol, 0.1 equiv.). The reaction mixture was then transferred into an NMR tube and subjected to NMR analysis after 0.5 hours and 3 hours. We could observe peaks of product **13a** and pyridine according to NMR analysis, but no useful information of possible intermediate was found.

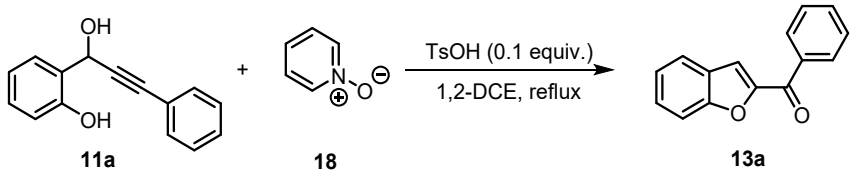
after 0.5 h



after 3 h

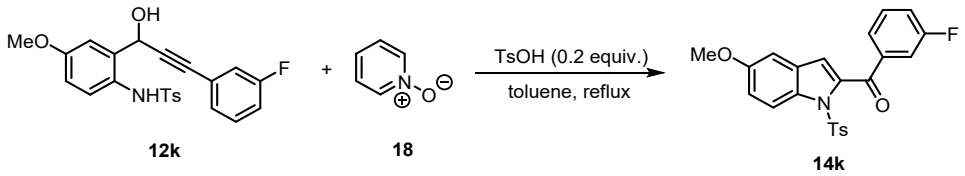


Scale-up preparation of 13a



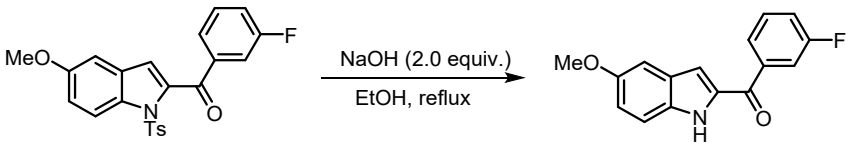
To a 100 mL round-bottom flask, equipped with a stir bar and condenser, was added *o*-hydroxyphenyl propargylic alcohol **11a** (1.121 g, 5.00 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (0.571 g, 6.00 mmol, 1.2 equiv.), and 1,2-DCE (20 ml) followed by TsOH (86 mg, 0.50 mmol, 0.1 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous $NaHCO_3$ solution. The aqueous phase was extracted with DCM (20 mL × 3). The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 3:1) to give product **13a** in 92% yield (1.024 g, 4.61 mmol).

Scale-up preparation and transformation of 14k and 3



12k **18** **14k**

To a 100 mL round-bottom flask, equipped with a stir bar and condenser, was added *o*-aminophenyl propargylalcohol **12k** (1.276 g, 3.00 mmol, 1.0 equiv.), pyridine *N*-oxide **18** (0.342 g, 3.60 mmol, 1.2 equiv.), and toluene (20 mL) followed by TsOH (103 mg, 0.60 mmol, 0.2 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous $NaHCO_3$ solution. The aqueous phase was extracted with EtOAc (20 mL × 3). The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1 to 3:1) to give product **14k** in 79% yield (1.010 g, 2.38 mmol).

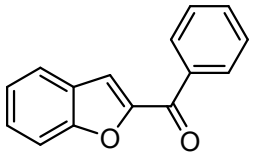


14k **3**

To a 100 mL round-bottom flask, equipped with a stir bar and condenser, was added **14k** (0.999 g, 2.36 mmol, 1.0 equiv.) and EtOH (20 mL) followed by NaOH (0.187 g, 4.72 mmol, 2.0 equiv.). The reaction mixture was stirred at reflux and monitored by TLC. Upon completion, the reaction mixture was cooled to room temperature and quenched with saturated aqueous NH_4Cl solution. The aqueous phase was extracted with EtOAc (20 mL × 3) after removal of CH_3OH. The organic extracts were combined and washed with brine, dried over anhydrous Na_2SO_4, and evaporated under vacuum. The residue was purified by column chromatography on silica gel (petroleum ether/EtOAc = 10:1) to give product **3** in 91% yield (0.577 g, 2.15 mmol).

Spectra data of compounds 13a-13y, 14a-14v, 14v', 19c, and 3

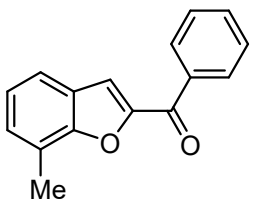
benzofuran-2-yl(phenyl)methanone (13a)



13a

Compound **13a** (95% yield, white solid, Melting point: 79.2 – 83.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.06 – 8.02 (m, 2H), 7.72 (d, *J* = 8.0 Hz, 1H), 7.63 (t, *J* = 8.0 Hz, 2H), 7.56 – 7.47 (m, 4H), 7.33 (t, *J* = 7.6 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 184.4, 156.0, 152.2, 137.2, 132.9, 129.4, 128.5, 128.4, 127.0, 124.0, 123.3, 116.5, 112.6. **IR**: $\bar{\upsilon}$ = 3062, 1649, 1329, 1186, 972 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_{15}H_{11}O_2^+$ 223.0754; found: 223.0758.

(7-methylbenzofuran-2-yl)(phenyl)methanone (13b)

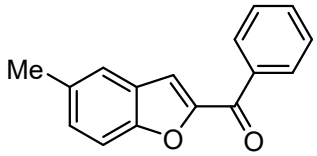


13b

Compound **13b** (>99% yield, white solid, Melting point: 115.2 – 119.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.08 – 8.01 (m, 2H), 7.65 – 7.60 (m, 1H), 7.57

– 7.49 (m, 4H), 7.29 (d, *J* = 7.2, 1H), 7.22 (t, *J* = 7.6 Hz, 1H), 2.61 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 184.4, 155.2, 152.0, 137.3, 132.7, 129.4, 129.0, 128.4, 126.4, 124.0, 122.8, 120.6, 117.0, 15.1. **IR**: $\bar{\upsilon}$ = 3451, 2065, 1600, 1398, 1156 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{16}H_{12}NaO_2^+$ 259.0730; found: 259.0736.

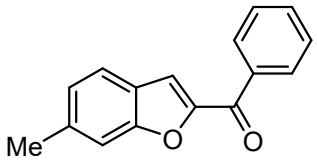
(5-methylbenzofuran-2-yl)(phenyl)methanone (13c)



13c

Compound **13c** (99% yield, yellow solid, Melting point: 130.7 – 133.0 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.03 (d, *J* = 7.5 Hz, 2H), 7.63 (t, *J* = 7.0 Hz, 1H), 7.57 – 7.47 (m, 4H), 7.45 (s, 1H), 7.31 (d, *J* = 8.5 Hz, 1H), 2.46 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 184.3, 165.6, 154.5, 152.3, 137.3, 133.6, 132.8, 130.0, 129.4, 128.5, 127.1, 122.7, 116.3, 112.0, 21.3. **IR**: $\bar{\upsilon}$ = 3130, 1709, 1380, 1130 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{12}KO_2^+$ 275.0469; found: 275.0467.

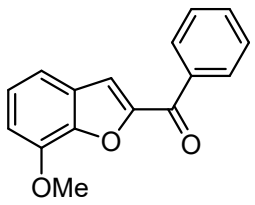
(6-methylbenzofuran-2-yl)(phenyl)methanone (13d)



13d

Compound **13d** (>99% yield, yellow solid, Melting point: 88.0 – 90.1 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.02 (d, *J* = 7.5 Hz, 2H), 7.64 – 7.57 (m, 2H), 7.52 (t, *J* = 7.5 Hz, 2H), 7.45 (d, *J* = 19.5 Hz, 2H), 7.15 (d, *J* = 8.0 Hz, 1H), 2.51 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 184.3, 156.5, 151.8, 139.4, 137.4, 132.7, 129.3, 128.4, 125.7, 124.5, 122.7, 116.8, 112.4, 22.1. **IR**: $\bar{\upsilon}$ = 3099, 2053, 1589, 1399, 1152 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{12}KO_2^+$ 275.0469; found: 275.0467.

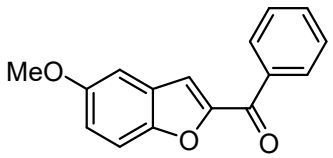
(7-methoxybenzofuran-2-yl)(phenyl)methanone (13e)



13e

Compound **13e** (98% yield, yellow oil): **^{1}H NMR** (500 MHz, $CDCl_3$) ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.10 – 8.06 (m, 2H), 7.62 (t, *J* = 7.0, 1H), 7.53 (t, *J* = 8.0 Hz, 3H), 7.30 – 7.27 (m, 1H), 7.23 (t, *J* = 7.5 Hz, 1H), 6.97 – 6.94 (m, 1H), 4.03 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.9, 152.5, 146.0, 145.7, 137.1, 132.8, 129.5, 128.5 (d, *J* = 7.9 Hz), 124.6, 116.3, 114.9, 109.6, 56.1. **IR**: $\bar{\upsilon}$ = 2942, 1648, 1265, 1131, 731 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{12}KO_3^+$ 291.0419 ; found: 291.0416.

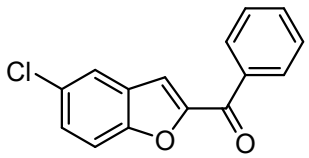
(5-methoxybenzofuran-2-yl)(phenyl)methanone (13f)



13f

Compound **13f** (>99% yield, white solid, Melting point: 120.4 – 121.4 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.0, 1.5 Hz, 2H), 7.63 (tt, *J* = 7.0, 1.4 Hz, 1H), 7.50 (t, *J* = 7.5, 3H), 7.47 (s, 1H), 7.11 (m, 2H), 3.86 (s, 3H). **^{13}C NMR** (125MHz, $CDCl_3$) δ 184.2, 156.6, 152.9, 151.2, 137.2, 132.8, 129.4, 128.5, 127.4, 118.5, 116.5, 113.2, 103.9, 55.8. **IR**: $\bar{\upsilon}$ = 3098, 2038, 1653, 1405, 1284, 1161 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{12}KO_3^+$ 291.0419; found: 291.0415.

(6-chlorobenzofuran-2-yl)(phenyl)methanone (13g)

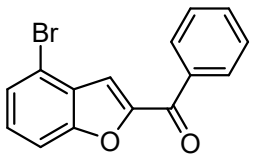


13g

Compound **13g** (99% yield, white solid, Melting point: 134.2 – 136.6 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.06 – 8.00 (m, 2H), 7.69 (d, *J* = 2.0 Hz, 1H), 7.67 – 7.62 (m, 1H), 7.55 (td, *J* = 8.3, 7.8, 4.3 Hz, 3H), 7.47 – 7.42

(m, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 184.0, 154.1, 153.2, 136.7, 133.1, 129.5, 129.4, 128.6 (d, *J* = 4.2 Hz), 128.1, 122.5, 115.4, 113.6. **IR**: $\bar{\upsilon}$ = 3161, 1719, 1610, 1400, 1130 ,770cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{15}H_9ClKO_2^+$ 294.9923 (100%), 296.9894 (32%) found: 294.9921, 296.9893.

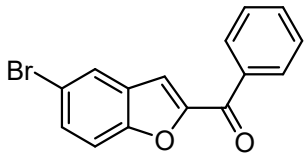
(7-bromobenzofuran-2-yl)(phenyl)methanone (13h)



13h

Compound **13h** (98% yield, white solid, Melting point: 114.0 – 115.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.0 Hz, 2H), 7.66 (t, *J* = 7.6 Hz, 1H), 7.56 (q, *J* = 8.0 Hz, 3H), 7.52 – 7.47 (m, 2H), 7.36 (t, *J* = 8.0 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 184.0, 155.5, 152.1, 136.8, 133.1, 129.4, 129.1, 128.7 (d, *J* = 4.9 Hz), 126.9, 116.3, 116.0, 111.6. **IR**: $\bar{\upsilon}$ = 3168, 2060, 1640, 1044, 1150 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{15}H_9BrNaO_2^+$ 322.9679 (100%), 324.9658 (98%); found: 322.9680, 324.9658.

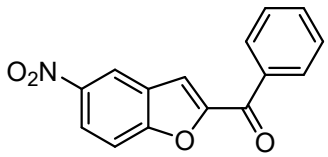
(5-bromobenzofuran-2-yl)(phenyl)methanone (13i)



13i

Compound **13i** (99% yield, white solid, Melting point: 135.9 – 136.3 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.0 Hz, 2H), 7.86 (d, *J* = 2.5 Hz, 1H), 7.65 (t, *J* = 7.5 Hz, 1H), 7.66 – 7.51 (m, 4H), 7.46 (s, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 184.0, 154.6, 153.2, 136.8, 133.1, 131.3, 129.5, 128.8, 128.6, 125.7, 117.0, 115.2, 114.0. **IR**: $\bar{\upsilon}$ = 3570, 2296, 1620, 1400 ,1160, 546 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{15}H_9BrNaO_2^+$ 322.9679 (100%), 324.9658 (98%); found: 322.9679, 324.9657.

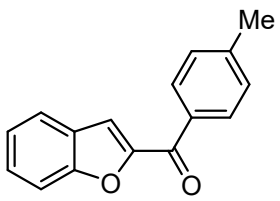
(6-nitrobenzofuran-2-yl)(phenyl)methanone (13j)



13j

Compound **13j** (91% yield, white solid, Melting point: 195.4 – 198.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.69 (d, *J* = 2.4 Hz, 1H), 8.42 (dd, *J* = 9.4, 2.4 Hz, 1H), 8.06 (d, *J* = 7.6 Hz, 2H), 7.76 (d, *J* = 9.2 Hz, 1H), 7.72 – 7.64 (m, 2H), 7.58 (t, *J* = 7.6 Hz, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.7, 158.2, 154.7, 144.9, 136.4, 133.6, 129.5, 128.8, 127.2, 123.5, 119.9, 116.0, 113.2. **IR**: $\bar{\upsilon}$ = 3420, 2252, 1631, 1400, 1048 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_{15}H_{10}NO_4^+$ 268.0605; found: 268.0606.

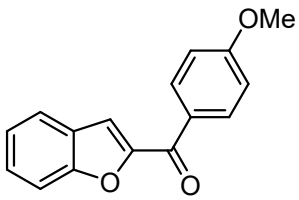
benzofuran-2-yl(p-tolyl)methanone (13k)



13k

Compound **13k** (97% yield, yellow solid, Melting point: 95.3 – 97.7 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.00 – 7.94 (m, 2H), 7.72 (d, *J* = 7.5 Hz, 1H), 7.64 (d, *J* = 8.0 Hz, 1H), 7.53 – 7.46 (m, 2H), 7.32 (t, *J* = 7.5 Hz, 3H), 2.46 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 184.0, 155.9, 152.4, 143.8, 134.5, 129.6, 129.2, 128.2, 127.0, 123.9, 123.2, 116.1, 112.5, 21.7. **IR**: $\bar{\upsilon}$ = 3010, 1737, 1620, 1420, 1172cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{12}KO_2^+$ 275.0469; found: 275.0467.

benzofuran-2-yl(4-methoxyphenyl)methanone (13l)

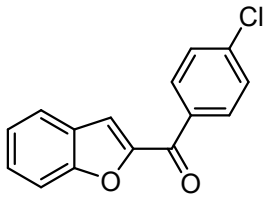


13l

Compound **13l** (97% yield, yellow solid, Melting point: 95.7 – 97.7 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.13 – 8.09 (m, 2H), 7.72 (d, *J* = 10.0 Hz, 1H), 7.63 (d, *J* = 10.0 Hz, 1H), 7.52 (s, 1H), 7.50 – 7.46 (m, 1H), 7.32 (t, *J* = 10.0 Hz, 1H), 7.04 – 7.00 (m, 2H), 3.90 (s, 3H). **^{13}C NMR** (125 MHz,

$CDCl_3$) δ 182.8, 163.5, 155.7, 152.6, 131.9, 129.7, 128.0, 127.0, 123.8, 123.1, 115.5, 113.8, 112.4, 55.5. **IR**: $\bar{\upsilon}$ = 3102, 2059, 1634, 1394, 1288, 1150 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{13}KO_3^+$ 291.0419; found: 291.0415.

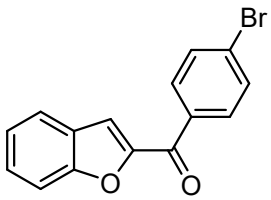
benzofuran-2-yl(4-chlorophenyl)methanone (13m)



13m

Compound **13m** (98% yield, white solid, Melting point: 148.3 – 148.9 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.02 (d, *J* = 8.4 Hz, 2H), 7.73 (d, *J* = 8.0 Hz, 1H), 7.63 (d, *J* = 8.4 Hz, 1H), 7.54 – 7.49 (m, 4H), 7.34 (t, *J* = 7.2 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 182.9, 155.9, 152.0, 139.4, 135.3, 130.9, 128.8, 128.5, 126.8, 124.1, 123.3, 116.5, 112.5. **IR**: $\bar{\upsilon}$ = 3086, 2077, 1570, 1386, 1154, 672 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{15}H_9ClNaO_2^+$ 279.0184 (100%), 281.0154 (33%); found: 279.0190, 281.0161.

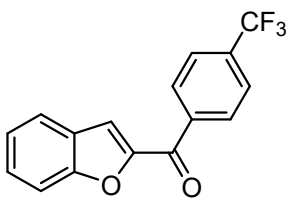
benzofuran-2-yl(4-bromophenyl)methanone (13n)



13n

Compound **13n** (93% yield, white solid, Melting point: 135.6 – 137.3 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.5 Hz, 2H), 7.74 (d, *J* = 7.5 Hz, 1H), 7.69 (d, *J* = 8.5 Hz, 2H), 7.64 (d, *J* = 8.5 Hz, 1H), 7.55 (s, 1H), 7.52 (t, *J* = 7.5 Hz, 1H), 7.35 (t, *J* = 7.5 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 183.1, 156.0, 152.0, 135.8, 131.8, 131.0, 128.6, 128.1, 126.9, 124.1, 123.3, 116.5, 112.5. **IR**: $\bar{\upsilon}$ = 3140, 1766, 1288, 1016, 794 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{15}H_9BrNaO_2^+$ 322.9679 (100%), 324.9658 (98%); found: 322.9679, 324.9657.

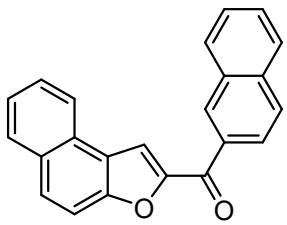
benzofuran-2-yl(4-(trifluoromethyl)phenyl)methanone (13o)



13o

Compound **13o** (89% yield, white solid, Melting point: 149.5 – 158.0 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.0 Hz, 2H), 7.80 (d, *J* = 8.0 Hz, 2H), 7.74 (d, *J* = 8.0 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.57 (s, 1H), 7.53 (t, *J* = 7.6 Hz, 1H) 7.35 (t, *J* = 7.6 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.1, 156.1, 151.8, 140.1, δ 134.2 (q, *J* = 33.2 Hz), 129.7, 128.8, 126.8, 125.5 (q, *J* = 4.0 Hz), 123.6 (q, *J* = 271.0 Hz), 124.2, 123.5, 117.0, 112.6. **^{19}F NMR** (376 MHz, DMSO-d_6) δ -61.55. **IR**: $\bar{\upsilon}$ = 3060, 1747, 1670, 1335, 1090,791cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_9F_3KO_2^+$ 329.0187; found: 329.0182.

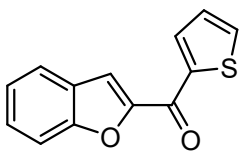
naphthalen-2-yl(naphtho[2,1-b]furan-2-yl)methanone (13p)



13p

Compound **13p** (95% yield, yellow solid, Melting point: 180.2 – 181.8 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.66 (s, 1H), 8.19 (d, *J* = 8.0 Hz, 1H), 8.14 (d, *J* = 8.5, 1H), 8.08 (s, 1H), 8.06 – 7.92 (m, 5H), 7.78 (d, *J* = 9.0 Hz, 1H), 7.68 – 7.54 (m, 4H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 183.7, 154.6, 152.1, 135.4, 134.7, 132.4, 131.0, 130.6, 130.1, 129.5, 129.1, 128.5, 128.5, 128.2, 127.9, 127.5, 126.9, 125.6, 125.3, 123.4, 122.9, 115.6, 112.9. **IR**: $\bar{\upsilon}$ = 3146, 2063, 1635, 1399, 1161 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{23}H_{14}NaO_2^+$ 345.0886; found: 345.0884.

benzofuran-2-yl(thiophen-2-yl)methanone (13q)

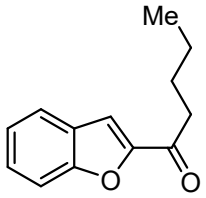


13q

Compound **13q** (88% yield, yellow solid, Melting point: 69.7 – 71.9 °C): **^{1}H**

NMR (500 MHz, $CDCl_3$) δ 8.31 (d, *J* = 3.8 Hz, 1H), 7.77 – 7.69 (m, 3H), 7.62 (d, *J* = 8.5 Hz, 1H), 7.49 (t, *J* = 8.0 Hz, 1H), 7.32 (t, *J* = 7.5 Hz, 1H), 7.23 (t, *J* = 4.0 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 174.9, 155.7, 152.5, 142.2, 134.5, 134.4, 128.3, 128.1, 126.9, 124.0, 123.2, 114.5, 112.3. **IR**: $\bar{\upsilon}$ = 3140, 1755, 1326, 1180 cm^{-1}; **HRMS** (ESI) m/z:$[M + Na]^+$ calcd for $C_{13}H_8NaO_2S^+$ 251.0138; found: 251.0144.

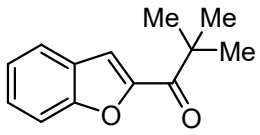
1-(benzofuran-2-yl)pentan-1-one (13r)



13r

Compound **13r** (98% yield, yellow solid, Melting point: 46.1 – 48.4 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.5 Hz, 1H), 7.58 (d, *J* = 8.0 Hz, 1H), 7.51 – 7.45 (m, 2H), 7.31 (t, *J* = 7.5 Hz, 1H), 2.95 (t, *J* = 7.5 Hz, 2H), 1.76 (m, 2H), 1.44 (m, 2H), 0.97 (t, *J* = 7.0 Hz, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 191.6, 155.5, 152.5, 128.1, 127.0, 123.8, 123.2, 112.6, 112.4, 38.6, 26.3, 22.4, 13.8. **IR**: $\bar{\upsilon}$ = 2668, 1702, 1304, 1051, 788, 617 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{13}H_{14}KO_2^+$ 241.0626; found: 241.0625.

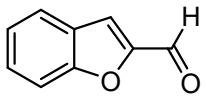
1-(benzofuran-2-yl)-2,2-dimethylpropan-1-one (13s)



13s

Compound **13s** (>99% yield, yellow oil): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.5 Hz, 1H), 7.60 – 7.52 (m, 2H), 7.46 (t, *J* = 8.0, 1H), 7.30 (t, *J* = 7.5 Hz, 1H), 1.43 (s, 9H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 196.7, 155.0, 152.6, 127.7, 126.7, 123.7, 123.0, 113.6, 112.2, 43.5, 26.7. **IR**: $\bar{\upsilon}$ = 3150, 1753, 1286, 1027, 783 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{13}H_{14}NaO_2^+$ 225.0886; found: 225.0888.

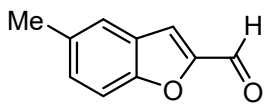
benzofuran-2-carbaldehyde (13t)



13t

Compound **13t** (97% yield, yellow oil): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 9.88 (s, 1H), 7.77 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 8.5 Hz, 1H), 7.58 (s, 1H), 7.53 (t, *J* = 8.0 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 179.8, 156.2, 152.6, 129.2, 126.6, 124.2, 123.6, 117.9, 112.7. **IR**: $\bar{\upsilon}$ = 3420, 1640, 1400, 1150 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_9H_7O_2^+$ 147.0441; found: 147.0444.

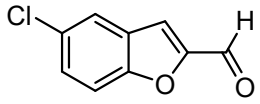
5-methylbenzofuran-2-carbaldehyde (13u)



13u

Compound **13u** (90% yield, yellow oil): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 7.49 (t, *J* = 9.2 Hz, 3H), 7.33 (d, *J* = 8.5 Hz, 1H), 2.46 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 179.7, 154.7, 152.7, 133.8, 130.8, 126.7, 123.0, 117.7, 112.1, 21.2. **IR**: $\bar{\upsilon}$ = 3365, 1731, 1457, 1186 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{10}H_8NaO_2^+$ 183.0417; found: 183.0418.

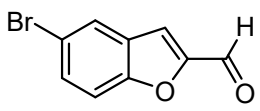
5-chlorobenzofuran-2-carbaldehyde (13v)



13v

Compound **13v** (97% yield, white solid, Melting point: 128.4 – 133.1 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.88 (s, 1H), 7.72 (s, 1H), 7.53 (d, *J* = 10.1 Hz, 2H), 7.47 (d, *J* = 8.8 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 179.6, 154.4, 153.5, 129.8, 129.4, 127.8, 122.9, 116.6, 113.7. **IR**: $\bar{\upsilon}$ = 3298, 1649, 1445, 1257, 970 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_9H_5ClNaO_2^+$ 202.9871 (100%), 204.9841 (32%); found: 202.9870, 204.9843.

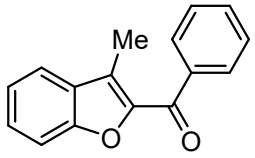
5-bromobenzofuran-2-carbaldehyde (13w)



13w

Compound **13w** (93% yield, yellow solid, Melting point: 129.9 – 132.8 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.86 (s, 1H), 7.87 (s, 1H), 7.58 – 7.57 (m, 1H), 7.49 – 7.46 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 179.6, 154.7, 153.3, 132.1, 128.4, 126.0, 117.2, 116.3, 114.2. **IR**: $\bar{\upsilon}$ = 3266, 1643, 1287, 1186 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_9H_5BrNaO_2^+$ 246.9366 (100%), 248.9345 (98%); found: 246.9361, 248.9342.

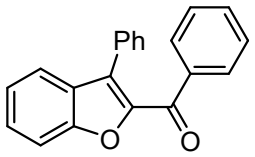
(3-methylbenzofuran-2-yl)(phenyl)methanone (13x)



13x

Compound **13x** (99% yield, yellow oil): **^{1}H NMR** (600 MHz, $CDCl_3$) δ 8.11 – 8.08 (d, *J* = 7.2 Hz, 2H), 7.71 (d, *J* = 7.8 Hz, 1H), 7.61 (t, *J* = 7.8 Hz, 1H), 7.56 – 7.48 (m, 5H), 7.34 (t, *J* = 7.8 Hz, 1H), 2.65 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 186.0, 154.2, 148.2, 137.8, 132.6, 129.7, 129.2, 128.3, 128.2, 126.9, 123.3, 121.4, 112.2, 10.0. **IR**: $\bar{\upsilon}$ = 3198, 1748, 1672, 1296, 1258, 756 $cm^{-1;}$ **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{16}H_{12}NaO_2^+$ 259.0730; found: 259.0733.

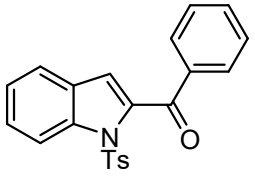
phenyl(3-phenylbenzofuran-2-yl)methanone (13y)



13y

Compound **13y** (>99% yield, yellow oil): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.5 Hz, 2H), 7.70 (d, *J* = 7.5 Hz, 1H), 7.64 (d, *J* = 8.5 Hz, 1H), 7.54 – 5.45 (m, 4H), 7.38 – 7.32 (m, 6H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 185.7, 154.6, 147.1, 137.2, 132.6, 130.9, 130.0, 129.8, 129.3, 128.3 (d, *J* = 6.3 Hz), 128.2, 128.1 (d, *J* = 6.2 Hz), 123.9, 122.4, 112.4. **IR**: $\bar{\upsilon}$ = 3140, 1720, 1660, 1390, 1141 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{21}H_{14}NaO_2^+$ 321.0886; found: 321.0887.

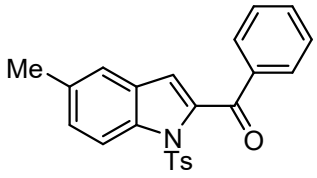
phenyl(1-tosyl-1*H*-indol-2-yl)methanone(14a)



14a

Compound **14a** (91% yield, yellow solid, Melting point: 170.2–172.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.15 – 8.12 (m, 1H), 7.99 – 7.93 (m, 4H), 7.61 (t, *J* = 7.2, 1H), 7.56 (d, *J* = 7.6, 1H), 7.51 – 7.43 (m, 3H), 7.31 – 7.25 (m, 3H), 6.92 (s, 1H), 2.36 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.7, 145.2, 138.0, 137.7, 137.6, 135.2, 133.6, 130.1, 129.7, 128.7, 128.6, 127.7, 127.0, 124.3, 122.6, 116.7, 115.2, 77.4, 77.1, 76.8, 21.7. **IR**: $\bar{\upsilon}$ = 3138, 3180, 1269, 1044, 788 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_{22}H_{18}NO_3S^+$ 376.1002; found: 376.1000.

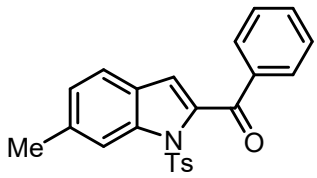
(5-methyl-1-tosyl-1*H*-indol-2-yl)(phenyl)methanone (14b)



14b

Compound **14b** (88% yield, yellow solid, Melting point: 140.9 – 141.2 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.4 Hz, 1H), 7.90 – 7.82 (m, 2H), 7.80 (d, *J* = 8.4 Hz, 2H), 7.51 – 7.46 (m, 1H), 7.36 (t, *J* = 8.0 Hz, 2H), 7.22 (s, 1H), 7.17 (d, *J* = 1.7 Hz, 1H), 7.15 – 7.11 (m, 3H), 6.75 (s, 1H), 2.30 (s, 3H), 2.23 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.5, 144.9, 137.9, 137.5, 135.9, 135.0, 133.9, 133.4, 129.9, 129.5, 128.8, 128.4, 128.4, 127.4, 122.2, 116.7, 114.7, 21.5, 21.1. **IR**: $\bar{\upsilon}$ = 2970, 1807, 1262, 1036, 794 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_{23}H_{20}NO_3S^+$ 390.1159; found: 390.1161.

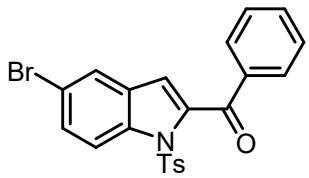
(6-methyl-1-tosyl-1*H*-indol-2-yl)(phenyl)methanone (14c)



14c

Compound **14c** (76% yield, yellow solid, Melting point: 182.3 – 183.5 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.87 (m, 5H), 7.51 (t, *J* = 7.6 Hz 1H), 7.41 – 7.32 (m, 3H), 7.20 – 7.15 (m, 2H), 7.03 (d, *J* = 8.0, 1H), 6.80 (s, 1H), 2.44 (s, 3H), 2.28 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.3, 144.9, 138.3, 137.6, 137.5, 137.4, 135.4, 133.3, 129.9, 129.5, 128.4, 127.4, 126.2, 125.8, 122.1, 117.2, 115.1, 22.2, 21.5. **IR**: $\bar{\upsilon}$ = 3410, 1764, 1265, 1035, 805 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{23}H_{19}NKO_3S^+$ 428.0718; found: 428.0719.

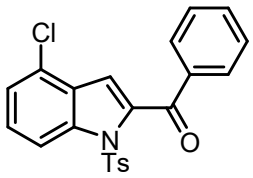
(4-bromo-1-tosyl-1*H*-indol-2-yl)(phenyl)methanone (14d)



14d

Compound **14d** (93% yield, yellow solid, Melting point: 153.0 – 155.4 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.01 (d, *J* = 8.8 Hz, 1H), 7.95 (m, *J* = 7.6 Hz, 2H), 7.90 (d, *J* = 8.4 Hz, 2H), 7.68 (d, *J* = 2.0 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.54 – 7.45 (m, 3H), 7.26 (d, *J* = 8.0 Hz, 2H), 6.82 (s, 1H), 2.36 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 187.3, 145.4, 138.7, 137.1, 136.0, 134.7, 133.7, 130.3, 129.9, 129.6 (d, *J* = 14.0 Hz), 128.5, 127.5, 124.9, 117.4, 116.4, 114.7, 21.6. **IR**: $\bar{\upsilon}$ = 3174, 1636, 1398, 1156, 762 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{22}H_{16}BrNNaO_3S^+$ 475.9927 (100%), 477.9906 (94%); found: 475.9925, 477.9906.

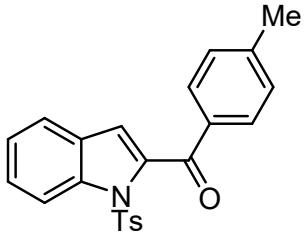
(5-chloro-1-tosyl-1*H*-indol-2-yl)(phenyl)methanone (14e)



14e

Compound **14e** (91% yield, yellow solid, Melting point: 128.5 – 131.1 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.04 (d, *J* = 8.0 Hz, 1H), 7.97 (dd, *J* = 11.0, 7.5 Hz, 4H), 7.62 (t, *J* = 7.5 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 2H), 7.36 (t, *J* = 8.0 Hz, 1H), 7.29 – 7.27 (m, 3H), 7.01 (s, 1H), 2.36 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 187.3, 145.4, 138.0, 137.9, 137.0, 134.9, 133.7, 130.0, 129.7, 128.5, 127.6, 127.5, 127.5, 127.4, 123.8, 113.5, 113.4, 21.6. **IR**: $\bar{\upsilon}$ = 2870, 2184, 1708, 1275, 1080, 736 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{22}H_{16}ClNNaO_3S^+$ 432.0432 (100%), 433.0464 (25%); found: 432.0428, 433.0463.

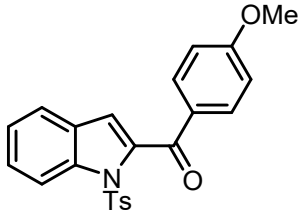
***p*-tolyl(1-tosyl-1*H*-indol-2-yl)methanone (14f)**



14f

Compound **14f** (75% yield, yellow solid, Melting point: 165.5 – 167.6 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 8.5 Hz, 1H), 7.90 (dd, *J* = 26.5, 7.5 Hz, 4H), 7.53 (d, *J* = 7.5, 1H), 7.42 (t, *J* = 7.5 Hz, 1H), 7.28 – 7.22 (m, 5H), 6.88 (s, 1H), 2.42 (s, 3H), 2.33 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 187.3, 145.0, 144.4, 138.0, 137.4, 135.1, 135.0, 130.1, 129.5, 129.2, 128.6, 127.5, 126.6, 124.1, 122.4, 116.0, 115.0, 21.7, 21.5. **IR**: $\bar{\upsilon}$ = 3485, 1605, 1400, 1172 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{23}H_{19}NKO_3S^+$ 428.0718; found: 428.0714.

(4-methoxyphenyl)(1-tosyl-1H-indol-2-yl)methanone (14g)

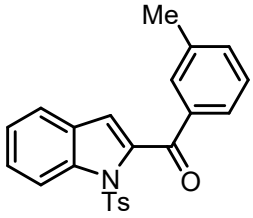


14g

Compound **14g** (75% yield, yellow solid, Melting point: 158.9 – 159.1 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 8.5 Hz, 1H), 7.95 (dd, *J* = 15.5, 8.5 Hz, 4H), 7.54 (d, *J* = 8.0 Hz, 1H), 7.42 (t, *J* = 8.0 Hz, 1H), 7.30 – 7.22 (m, 3H), 6.96 (d, *J* = 9.0 Hz, 2H), 6.87 (s, 1H), 3.87 (s, 3H), 2.34 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 186.4, 164.0, 145.0, 138.0, 137.3,

135.1, 132.4, 130.4, 129.5, 128.7, 127.5, 126.5, 124.1, 122.3, 115.4, 115.0, 113.8, 55.5, 21.6. **IR**: $\bar{\upsilon}$ = 3421, 1602, 1399, 1294, 1155 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{23}H_{19}NKO_4S^+$ 444.0667; found: 444.0668.

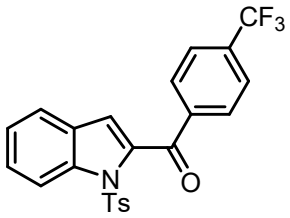
***m*-tolyl(1-tosyl-1H-indol-2-yl)methanone (14h)**



14h

Compound **14h** (90% yield, brown solid, Melting point: 108.8 – 111.7 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.5 Hz, 1H), 7.95 (d, *J* = 8.0 Hz, 2H), 7.80 (s, 1H), 7.75 (d, *J* = 8.0 Hz, 1H), 7.54 (d, *J* = 8.0 Hz, 1H), 7.46 – 7.38 (m, 2H), 7.35 (t, *J* = 8.0 Hz, 1H), 7.29 – 7.20 (m, 3H), 6.89 (s, 1H), 2.39 (s, 3H), 2.33 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 187.7, 145.0, 138.2, 137.9, 137.5, 137.4, 135.1, 134.3, 130.2, 129.5, 128.5, 128.3, 127.5, 127.4, 126.8, 124.1, 122.4, 116.3, 115.0, 21.5, 21.2. **IR**: $\bar{\upsilon}$ = 3440, 1271, 1043, 783 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{23}H_{19}NKO_3S^+$ 428.0718; found: 428.0716.

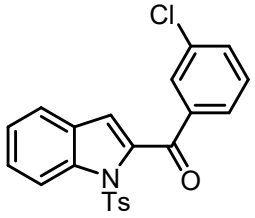
(1-tosyl-1*H*-indol-2-yl)(4-(trifluoromethyl)phenyl)methanone (14i)



14i

Compound **14i** (83% yield, yellow solid, Melting point: 173.9 – 174.7 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J* = 8.0 Hz, 2H), 7.87 (d, *J* = 8.4 Hz, 2H), 7.74 (d, *J* = 8.0 Hz, 2H), 7.56 (d, *J* = 8.0 Hz, 1H), 7.46 (t, *J* = 8.0 Hz, 1H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.24 (d, *J* = 8.0 Hz, 2H), 6.98 (s, 1H), 2.34 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 186.4, 145.3, 140.4, 137.8, 137.4, 134.7, 134.4 (q, *J* = 32.7 Hz), 130.1, 129.6, 128.6, 127.4 ,127.3, 125.5 (q, *J* = 3.8 Hz), 123.6 (q, *J* = 272.8 Hz), 124.4, 122.7, 117.5, 115.2, 21.5. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -63.00. **IR**: $\bar{\upsilon}$ = 3424, 1661, 1400, 1175 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{23}H_{16}F_3NKO_3S^+$ 482.0435; found: 482.0434.

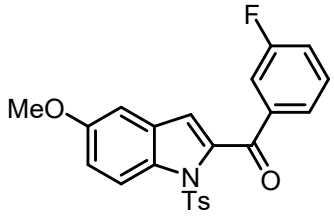
(3-chlorophenyl)(1-tosyl-1*H*-indol-2-yl)methanone (14j)



14j

Compound **14j** (85% yield, brown solid, Melting point: 134.6 – 136.6 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.5 Hz, 1H), 8.00 – 7.78 (m, 4H), 7.61 – 7.37 (m, 4H), 7.34 – 7.21 (m, 3H), 6.95 (s, 1H), 2.35 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 186.2, 145.2, 139.1, 137.7, 137.3, 134.9, 134.8, 133.3, 129.8, 129.6, 129.6, 128.5, 128.1, 127.5, 127.2, 124.3, 122.6, 117.1, 115.2, 21.6. **IR**: $\bar{\upsilon}$ = 3397, 1615, 1398, 1156, 614 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{22}H_{16}ClNKO_3S^+$ 448.0171 (100%), 449.0204 (25%); found: 448.0177, 449.0210.

(3-fluorophenyl)(5-methoxy-1-tosyl-1*H*-indol-2-yl)methanone (14k)

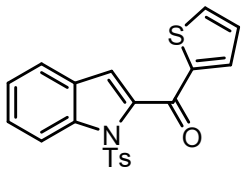


14k

Compound **14k** (81% yield, brown solid, Melting point: 151.0 – 152.5 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.01 (d, *J* = 9.2 Hz, 1H), 7.81 (d, *J* = 8.0 Hz, 2H), 7.71 (d, *J* = 7.6 Hz, 1H), 7.65 (d, *J* = 8.4 Hz, 1H), 7.43 (m, 1H), 7.27 (t, *J* = 8.0, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.06 (d, *J* = 8.8 Hz, 1H), 6.96 (s, 1H), 6.89 (s, 1H), 3.79 (s, 3H), 2.32 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 186.2, 162.6 (d, *J* = 246.0 Hz), 157.0, 145.1, 139.6 (d, *J* = 6.5 Hz), 138.1, 134.5, 132.3, 130.1 (d, *J* = 7.7 Hz), 129.7 (d, *J* = 11.9 Hz), 129.6, 127.3, 125.8 (d, *J* = 2.9 Hz), 120.4 (d, *J* = 21.0 Hz), 117.3, 116.7, 116.4, 116.2, 104.1, 55.6, 21.5. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -111.88. **IR**: $\bar{\upsilon}$ = 3450, 1620, 1035, 787 cm^{-1}; **HRMS**

(ESI) m/z: $[M + Na]^+$ calcd for $C_{23}H_{18}FNNaO_4S^+$ 446.0833; found: 446.0824.

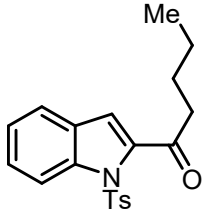
thiophen-2-yl(1-tosyl-1*H*-indol-2-yl)methanone (14l)



14l

Compound **14l** (78% yield, yellow solid, Melting point: 202.5 – 204.5 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.14 – 8.11 (m, 1H), 8.00 – 7.98 (m, 2H), 7.78 – 7.74 (m, 2H), 7.58 – 7.56 (m, 1H), 7.47 – 7.43 (m, 1H), 7.31 – 7.26 (m, 3H), 7.18 – 7.15 (m, 1H), 7.05 (s, 1H), 2.35 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 179.1, 145.1, 144.1, 137.7, 137.2, 135.3, 135.1 (d, J = 8.8 Hz), 129.6, 128.3, 128.2, 127.7, 126.9, 124.1, 122.5, 116.3, 115.1, 21.6. **IR**: $\bar{\upsilon}$ = 3194, 1637, 1397, 1149 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{20}H_{15}NKO_3S_2^+$ 420.0125; found: 420.0128.

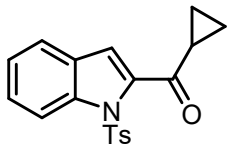
1-(1-tosyl-1*H*-indol-2-yl)pentan-1-one (14m)



14m

Compound **14m** (68% yield, yellow solid, Melting point: 49.4 – 51.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.11 (d, J = 8.4 Hz, 1H), 7.84 (t, J = 8.0 Hz, 2H), 7.53 (d, J = 7.6 Hz, 1H), 7.42 (t, J = 7.2 Hz, 1H), 7.27 – 7.20 (m, 3H), 7.02 (s, 1H), 2.96 (m, J = 8.0 Hz, 2H), 2.32 (s, 3H), 1.77 – 1.68 (m, 2H), 1.46 – 1.36 (m, 2H), 0.93 (t, J = 7.2, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 195.4, 144.8, 139.9, 138.4, 135.1, 129.4, 128.5, 127.4, 127.1, 124.2, 122.6, 115.9, 115.5, 42.3, 26.7, 22.3, 21.5, 13.8. **IR**: $\bar{\upsilon}$ = 3209, 1752, 1234, 1044, 787, 760 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{20}H_{21}NKO_3S^+$ 394.0874; found: 394.0879.

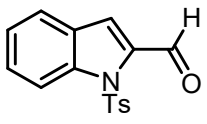
cyclopropyl(1-tosyl-1*H*-indol-2-yl)methanone (14n)



14n

Compound **14n** (74% yield, white solid, Melting point: 112.7 – 114.7 °C): **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.12 (d, J = 8.5 Hz, 1H), 7.81 (d, J = 7.5 Hz, 2H), 7.54 (d, J = 7.5 Hz, 1H), 7.42 (t, J = 7.5 Hz, 1H), 7.27 – 7.19 (m, 1H), 7.20 (d, J = 7.5 Hz, 2H), 7.13 (s, 1H), 2.62 – 2.57 (m, 1H), 2.32 (s, 3H), 1.32 – 1.29 (m, 2H), 1.12 – 1.08 (m, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 194.7, 144.8, 140.5, 138.5, 135.0, 129.4, 128.6, 127.3, 127.2, 124.2, 122.6, 116.5, 115.7, 21.8, 21.5, 12.6. **IR**: $\bar{\upsilon}$ = 3413, 1598, 1399, 1156 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{19}H_{17}NKO_3S^+$ 378.0561; found: 378.0567.

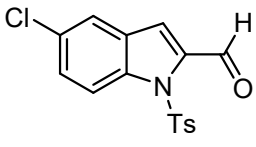
1-tosyl-1*H*-indole-2-carbaldehyde (14o)



14o

Compound **14o** (78% yield, yellow solid, Melting point: 121.0 – 122.1 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.44 (s, 1H), 8.13 (d, J = 8.4 Hz, 1H), 7.56 (d, J = 2.8, 2H), 7.51 (d, J = 8.0, 1H), 7.42 (t, J = 8.0 Hz, 1H), 7.36 (d, J = 2.8 Hz, 1H), 7.21 (t, J = 7.6 Hz, 1H), 7.08 (d, J = 8.0 Hz, 2H), 2.21 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.2, 145.5, 138.3, 137.7, 134.5, 129.9, 128.7, 128.0, 126.5, 124.7, 123.5, 118.8, 115.2, 21.5. **IR**: $\bar{\upsilon}$ = 3448, 1674, 1401, 1173 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{16}H_{13}NKO_3S^+$ 338.0248; found: 338.0241.

5-chloro-1-tosyl-1*H*-indole-2-carbaldehyde (14p)

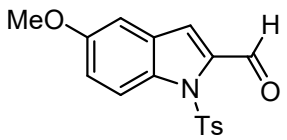


14p

Compound **14p** (91% yield, white solid, Melting point: 129.2 – 130.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.53 (s, 1H), 8.18 (d, J = 9.0 Hz, 1H), 7.64 (d, J = 7.7 Hz, 2H), 7.60 (s, 1H), 7.47 (d, J = 9.0 Hz, 1H), 7.39 (s, 1H), 7.22 (d, J

= 7.8 Hz, 3H), 2.35 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.1, 145.9, 138.6, 136.6, 134.3, 130.6, 130.1, 129.2, 129.0, 126.6, 122.9, 117.5, 116.5, 21.6. **IR**: $\bar{\upsilon}$ = 3412, 1771, 1429, 1165cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{16}H_{12}ClNNaO_3S^+$ 356.0119 (100%), 358.0090 (38%); found: 356.0120, 358.0091.

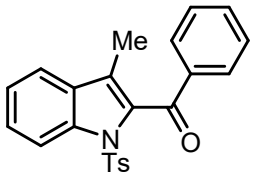
5-methoxy-1-tosyl-1*H*-indole-2-carbaldehyde (14q)



14q

Compound **14q** (83% yield, yellow oil): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.52 (s, 1H), 8.13 (d, *J* = 9.2 Hz, 1H), 7.62 (d, *J* = 8.0 Hz, 2H), 7.40 (s, 1H), 7.19 – 7.13 (m, 3H), 6.99 (s, 1H), 3.83 (s, 3H), 2.33 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 183.4, 157.2, 145.5, 138.2, 134.4, 133.2, 129.9, 129.2, 126.5, 119.1, 118.7, 116.4, 104.1, 77.3, 77.0, 76.7, 55.6, 21.6. **IR**: $\bar{\upsilon}$ = 3445, 1697, 1386, 1153 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{17}H_{15}KNO_4S^+$ 368.0353; found: 368.0358.

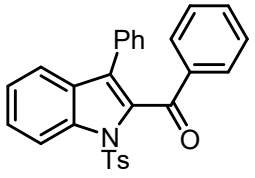
(3-methyl-1-tosyl-1*H*-indol-2-yl)(phenyl)methanone (14r)



14r

Compound **14r** (71% yield, brown oil): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.4 Hz, 1H), 7.91 (d, *J* = 8.0 Hz, 2H), 7.70 (d, *J* = 8.0 Hz, 2H), 7.57 (t, *J* = 7.2 Hz, 1H), 7.50 – 7.38 (m, 4H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.14 (d, *J* = 8.0 Hz, 2H), 2.28 (s, 3H), 2.16 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 189.5, 144.9, 138.4, 136.4, 133.7, 133.6, 133.3, 131.2, 129.5, 129.5, 128.5, 127.3, 126.6, 124.5, 124.2, 120.3, 115.3, 21.5, 9.3. **IR**: $\bar{\upsilon}$ = 3160, 1650, 1036, 1170, 764 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{23}H_{19}NNaO_3S^+$ 412.0978; found: 412.0971.

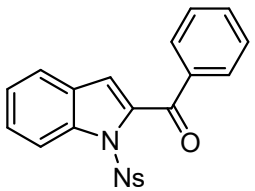
phenyl(3-phenyl-1-tosyl-1*H*-indol-2-yl)methanone (14s)



14s

Compound **14s** (75% yield, yellow solid, Melting point: 196.7 – 198.5 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.26 – 8.22 (m, 1H), 7.96 – 7.89 (m, 4H), 7.64 (d, *J* = 7.9 Hz, 1H), 7.53 (td, *J* = 7.6, 6.0 Hz, 2H), 7.44 (dd, *J* = 9.3, 7.5 Hz, 4H), 7.41 – 7.31 (m, 4H), 7.29 (d, *J* = 9.4 Hz, 2H), 2.38 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 189.6, 145.2, 137.9, 135.9, 134.3, 133.4, 132.7, 130.9, 129.7, 129.6, 129.6 (2C), 128.4, 128.4, 128.0, 127.5, 126.8, 126.4, 124.4, 121.2, 114.9, 21.6. **DEPT** (135°)(100 MHz, $CDCl_3$) δ 133.5, 129.8, 129.7, 128.6, 128.6, 128.2, 127.6, 126.6, 124.5, 121.3, 115.0, 21.7. **IR**: $\bar{\upsilon}$ = 3061, 1646, 1455, 1121, 978, 756, 696 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{28}H_{21}NKO_3S^+$ 490.0874; found: 490.0882.

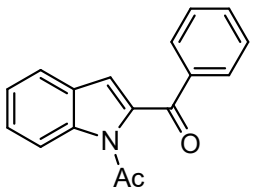
(1-((4-nitrophenyl)sulfonyl)-1*H*-indol-2-yl)(phenyl)methanone (14t)



14t

Compound **14t** (97% yield, white solid, Melting point: 190.2 – 193.6 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.32 (q, *J* = 8.9 Hz, 4H), 8.17 (d, *J* = 8.5 Hz, 1H), 7.97 (d, *J* = 7.4 Hz, 2H), 7.67 – 7.57 (m, 3H), 7.55 – 7.47 (m, 3H), 7.35 (t, *J* = 7.5 Hz, 1H), 7.01 (s, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 186.9, 150.5, 144.0, 137.9, 137.6, 136.9, 133.8, 130.0, 128.8, 128.6, 128.3, 127.7, 124.7, 124.1, 123.0, 118.4, 114.8. **IR**: $\bar{\upsilon}$ = 3451 1646, 1372, 1142 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{21}H_{14}KN_2O_5S^+$ 445.0255; found: 445.0254.

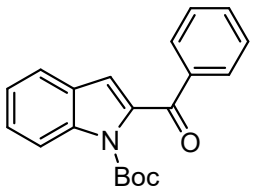
1-(2-benzoyl-1*H*-indol-1-yl)ethan-1-one (14u)



14u

Compound **14u** (56% yield, white solid, Melting point: 117 – 129 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 1H), 8.03 (d, *J* = 7.3 Hz, 2H), 7.69 – 7.62 (m, 2H), 7.57 - 7.48 (m, 4H), 7.31 (t, *J* = 7.5 Hz, 1H), 7.07 (s, 1H), 2.56 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.1, 170.7, 138.6, 137.2, 137.0, 133.5, 129.7, 128.7, 128.3, 127.3, 124.0, 122.6, 119.9, 115.6, 27.3. **IR**: $\bar{\upsilon}$ = 3274, 3069, 1703, 1529，1276 cm^{-1}; **HRMS** (ESI) m/z: $[M + H]^+$ calcd for $C_{17}H_{14}NO_2^+$ 264.1019; found: 264.1027.

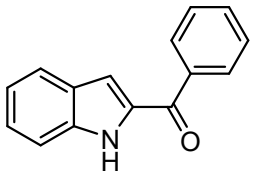
***tert*-butyl 2-benzoyl-1*H*-indole-1-carboxylate (14v)**



14v

Compound **14v** (43% yield, 43% of **14v** and 44% of **14v'** were isolated, yellow solid, Melting point: 123.6 – 129.4 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.22 (d, *J* = 8.4 Hz, 1H), 7.92 (d, *J* = 7.7 Hz, 2H), 7.65 – 7.58 (m, 2H), 7.50 – 7.44 (m, 3H), 7.31 (t, *J* = 7.5 Hz, 1H), 6.94 (s, 1H), 1.36 (s, 9H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.7, 149.1, 137.4, 137.3, 137.0, 133.2, 129.5, 128.5, 127.9, 126.6, 123.5, 122.1, 115.1, 114.2, 85.0, 27.5. **IR**: $\bar{\upsilon}$ = 3451, 2071, 1620, 1363 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{20}H_{19}KNO_3^+$ 360.0997; found: 360.1000.

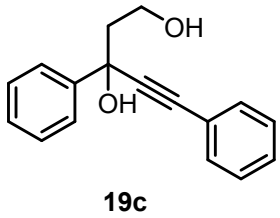
(1*H*-indol-2-yl)(phenyl)methanone (14v')



14v'

Compound **14v'** (44% yield, yellow solid, Melting point: 149.0– 151.2 °C): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 10.02 (s, 1H), 8.01 (d, *J* = 7.7 Hz, 2H), 7.70 (d, *J* = 8.1 Hz, 1H), 7.60 (t, *J* = 7.3 Hz, 1H), 7.52 (t, *J* = 8.9 Hz, 3H), 7.35 (t, *J* = 7.6 Hz, 1H), 7.16 – 7.13 (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 187.4, 138.0, 137.8, 134.3, 132.3, 129.2, 128.4, 127.6, 126.4, 123.1, 120.9, 113.0, 112.4. **IR**: $\bar{\upsilon}$ = 3444, 3064, 1630, 1524, 1340, 1125 cm^{-1}; **HRMS** (ESI) m/z: $[M + K]^+$ calcd for $C_{15}H_{11}KNO^+$ 260.0473; found: 260.0470.

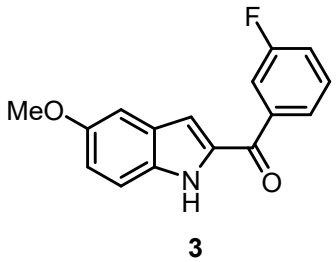
3,5-diphenylpent-4-yne-1,3-diol (19c)



19c

Compound **19c** (45% yield, white solid, Melting point: 138.6 – 141.3 °C): **^{1}H NMR** (500 MHz, DMSO-d_6) δ 7.62 (d, *J* = 7.5 Hz, 2H), 7.47 (dd, *J* = 7.5, 4.0 Hz, 2H), 7.43 – 7.35 (m, 5H), 7.29 (t, *J* = 7.0 Hz, 1H), 6.20 (s, 1H), 4.50 (t, *J* = 5.0 Hz, 1H), 3.68 – 3.68 (m, 1H), 3.57 – 3.51 (m, 1H), 2.17 – 2.03 (m, 2H). **^{13}C NMR** (125 MHz, DMSO-d_6) δ 145.5, 131.3, 128.7, 128.6, 127.9, 127.1, 125.1, 122.3, 93.0, 84.1, 70.5, 57.8, 47.8. **IR**: $\bar{\upsilon}$ = 3172, 2910, 1646, 1044, 1160 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{17}H_{16}NaO_2^+$ 275.1043; found: 275.1045.

(3-fluorophenyl)(5-methoxy-1H-indol-2-yl)methanone (3)



3

Compound **3** (91% yield, brown oil): **^{1}H NMR** (400 MHz, $CDCl_3$) δ 9.72 (s, 1H), 7.78 (dt, *J* = 8.0, 1.2Hz, 1H), 7.69 – 7.66 (m, 1H), 7.50 (td, *J* = 8.0, 5.6 Hz, 1H), 7.41 – 7.37 (m, 1H), 7.31 (td, *J* = 8.4, 2.8 Hz, 1H), 7.10 – 7.05 (m, 3H), 3.84 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 185.5, 162.5 (d, *J* = 246.0 Hz), 154.9, 140.0 (d, *J* = 6.7 Hz), 134.3, 133.4, 130.1 (d, *J* = 7.8 Hz), 127.9, 125.0 (d, *J* = 2.7 Hz), 119.2 (d, *J* = 21.0 Hz), 118.8, 116.1 (d, *J* = 20.0 Hz), 113.3, 112.7, 102.6, 55.6. **^{19}F NMR** (376 MHz, $CDCl_3$) δ -111.82 (q, *J* = 8.5 Hz). **IR**: $\bar{\upsilon}$ = 3319, 1630, 1519, 1234, 752 cm^{-1}; **HRMS** (ESI) m/z: $[M + Na]^+$ calcd for $C_{16}H_{12}FNNaO_2^+$ 292.0745; found: 292.0746.

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[1] (a) Li, Y.; Xue, J.; Li, X.; Chen, R. *Synlett* **2012**, *23*, 1043-1046. (b) Ranjith Kumar, G.; Kiran Kumar, Y.; Kant, R.; Sridhar Reddy, M. *Org. Biomol. Chem.* **2016**, *14*, 4077-4088. (c) Saha, S.; Schneider, C. *Org. Lett.* **2015**, *17*, 648-651. (d) Yoshida, M.; Fujino, Y.; Doi, T. *Org. Lett.* **2011**, *13*, 4526-4529. (e) Zhang, M.; Yang, J.; Xu, Q.; Dong, C.; Han, L.-B.; Shen, R. *Adv. Synth. Catal.* **2018**, *360*, 334-345.

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[4] Sangeetha, S.; Sekar, G. *Org. Lett.* **2017**, *19*, 1670-1673.

[5] Geffers, F. J.; Kurth, F. R.; Jones, P. G.; Werz, D. B. *Chemistry* **2021**, *27*, 14846-14850.

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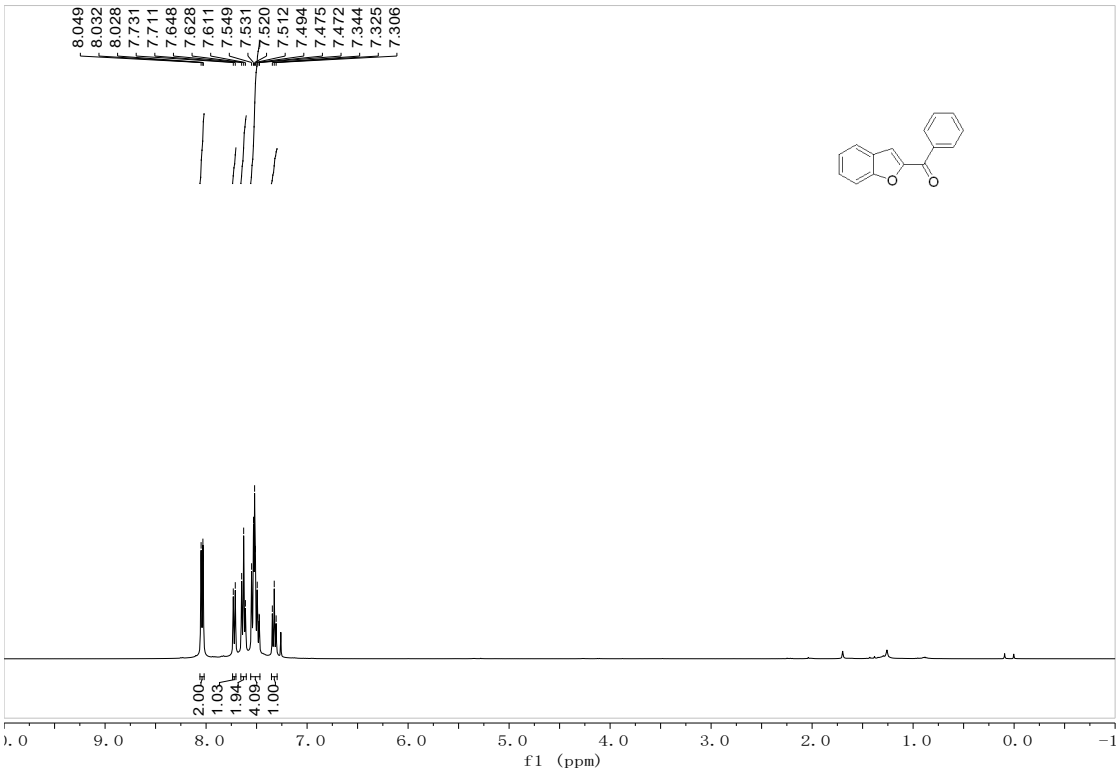
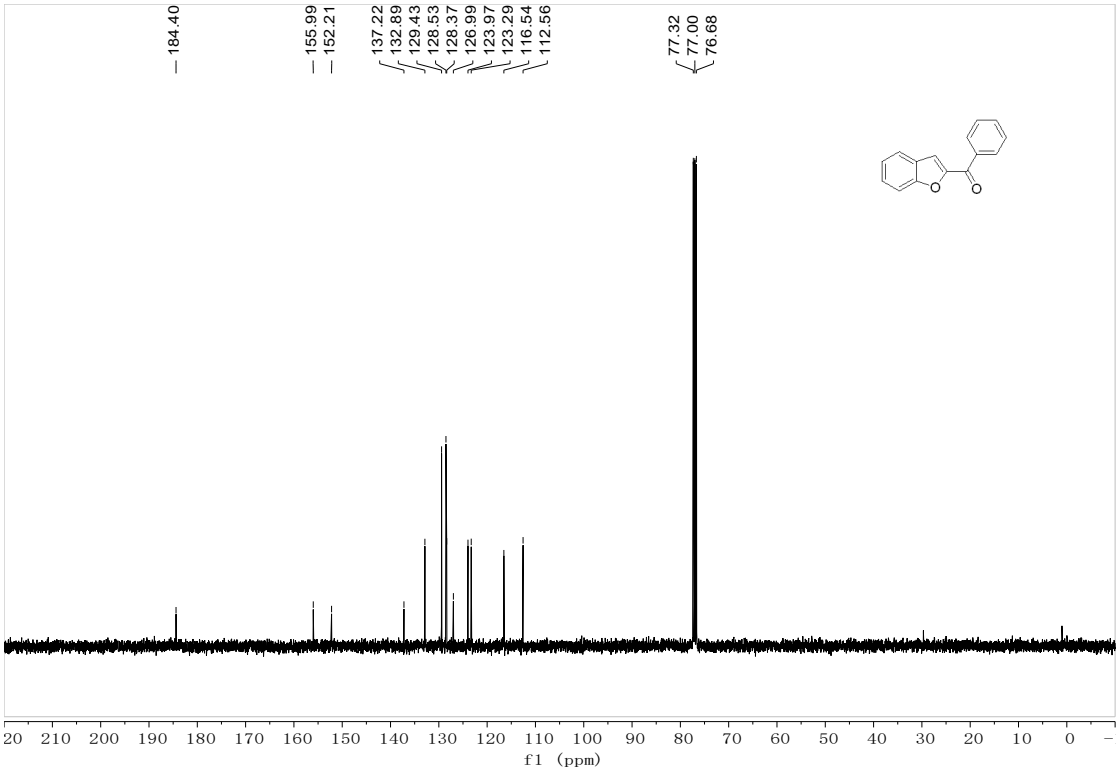
Copies of NMR spectra

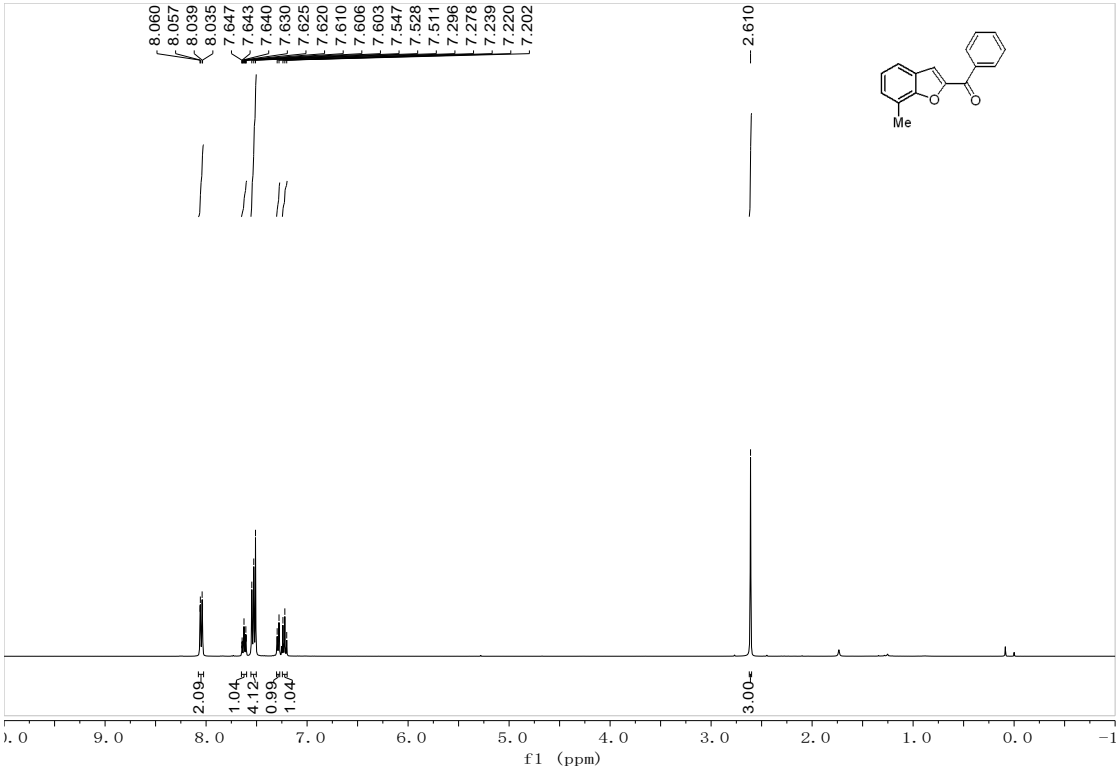
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13a**



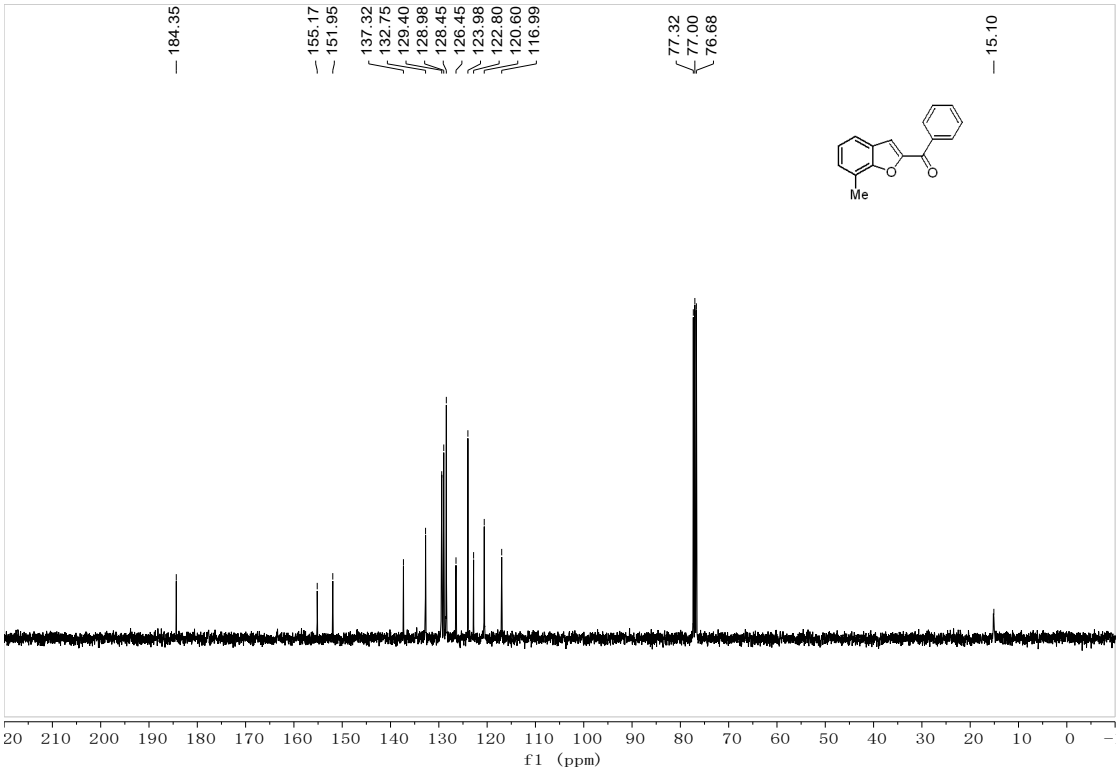
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13a**



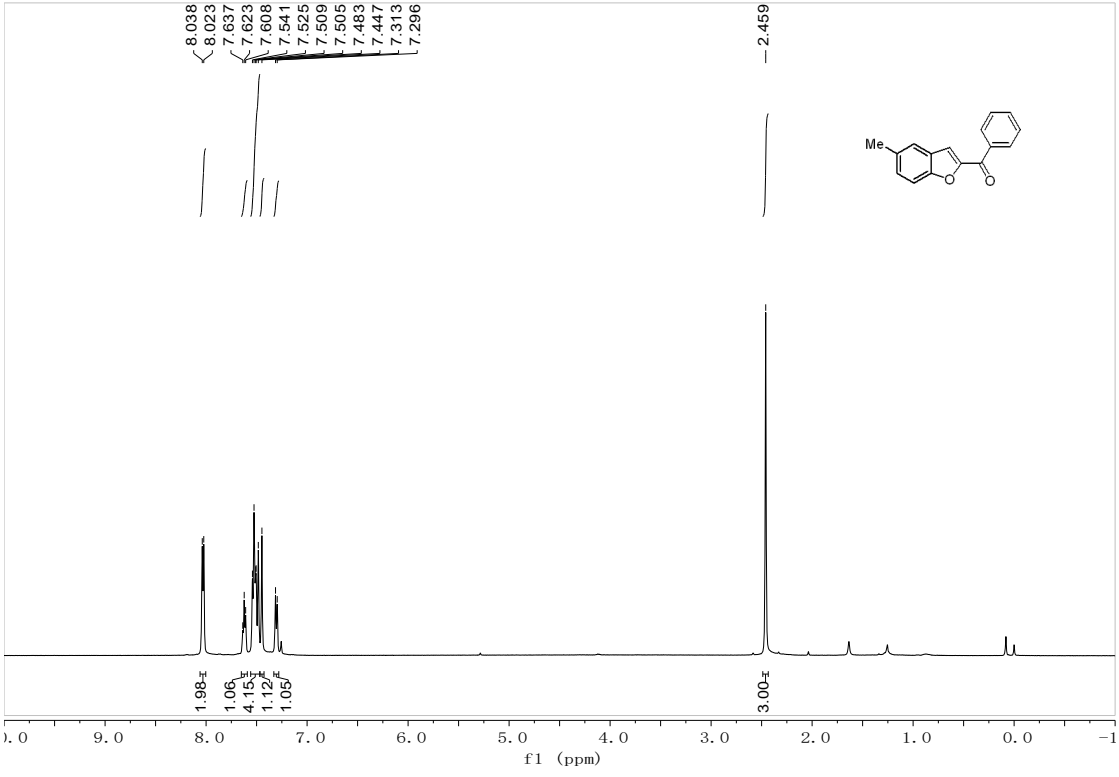
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13b**



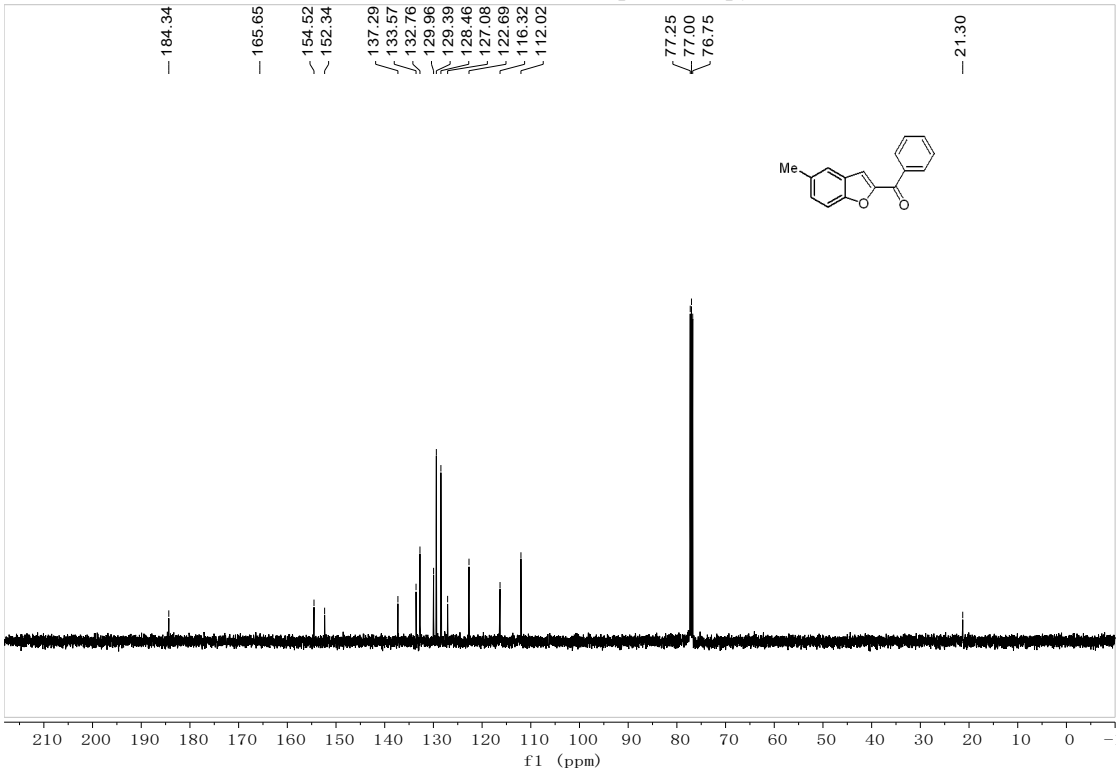
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13b**



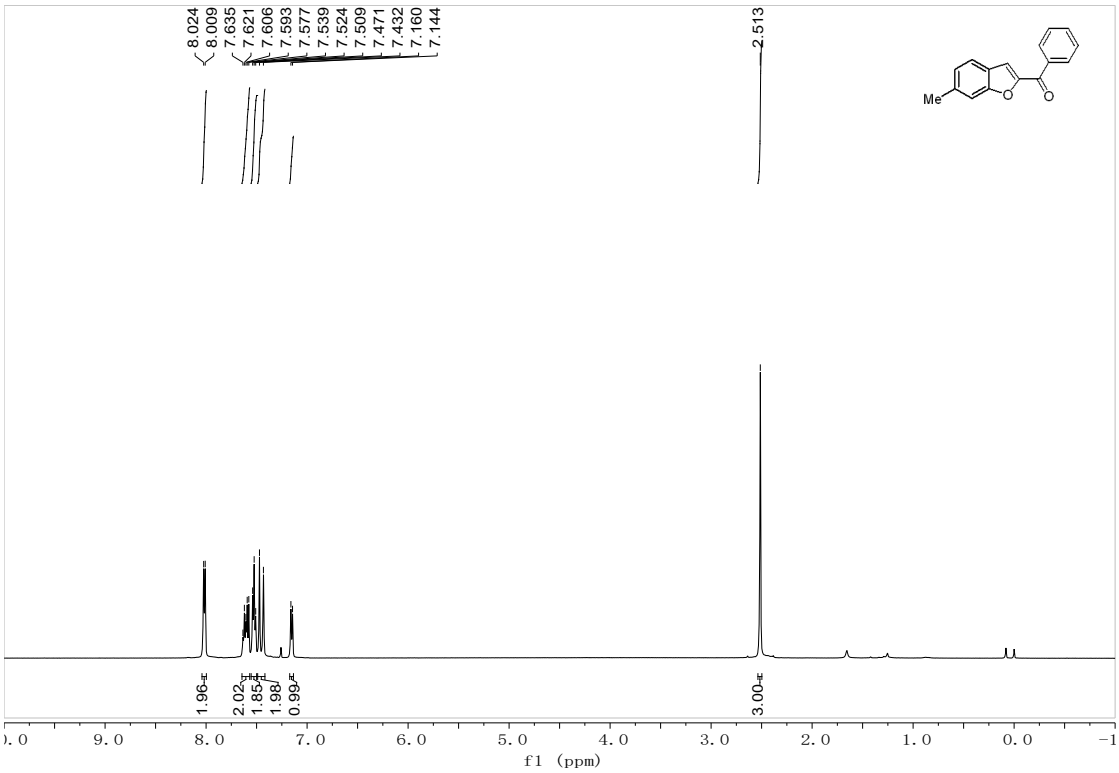
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13c**



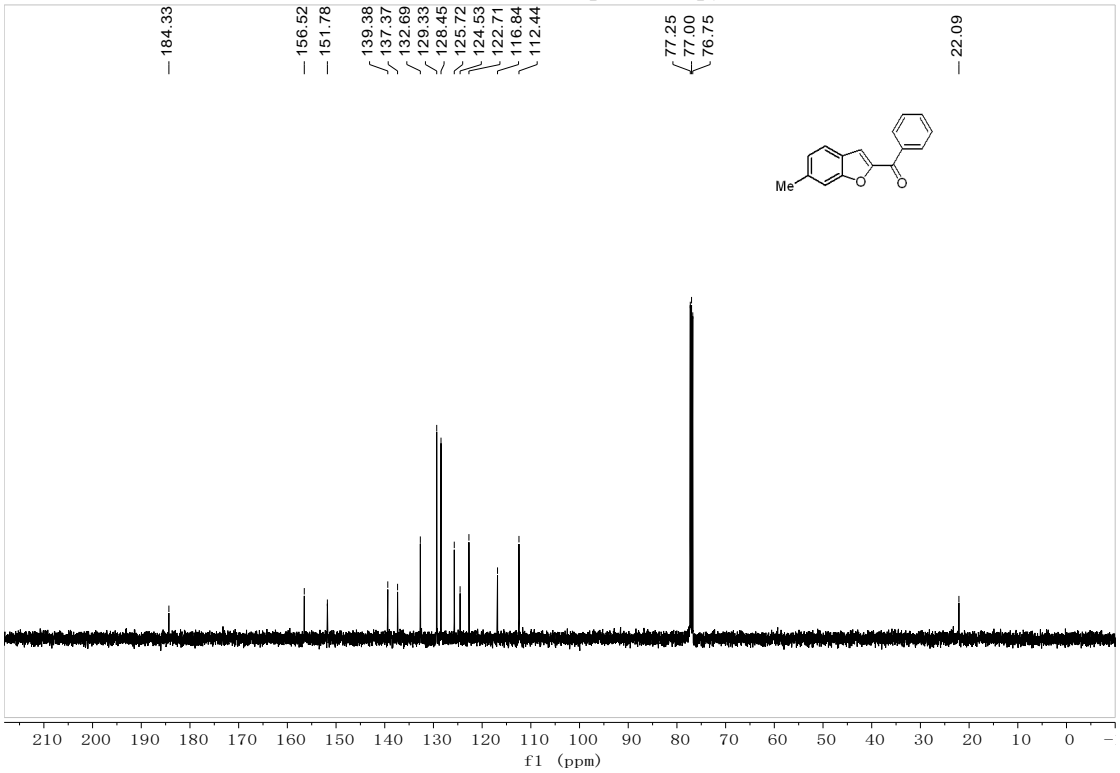
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13c**



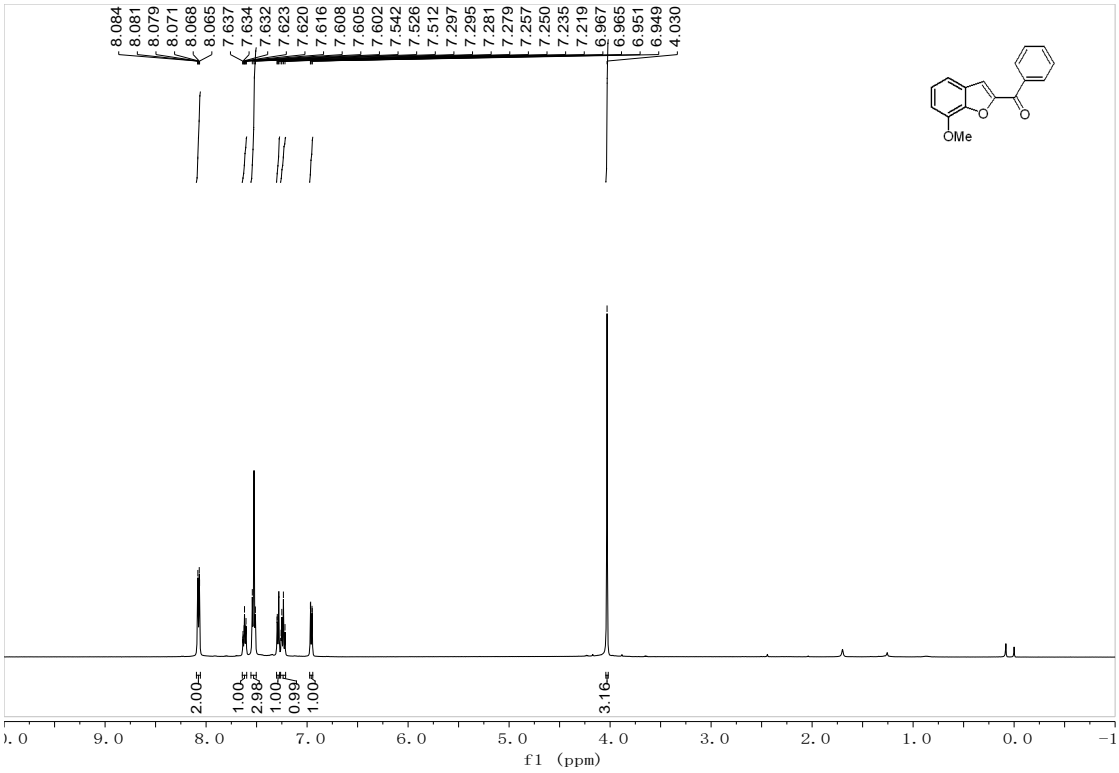
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13d**



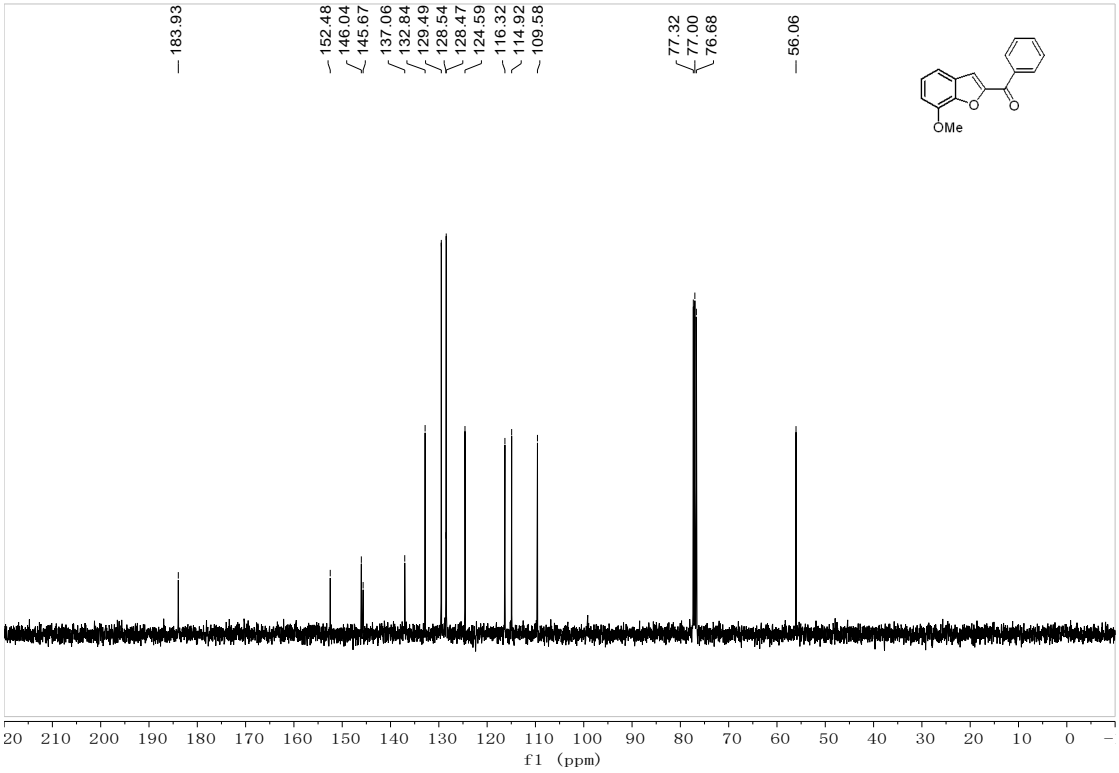
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13d**



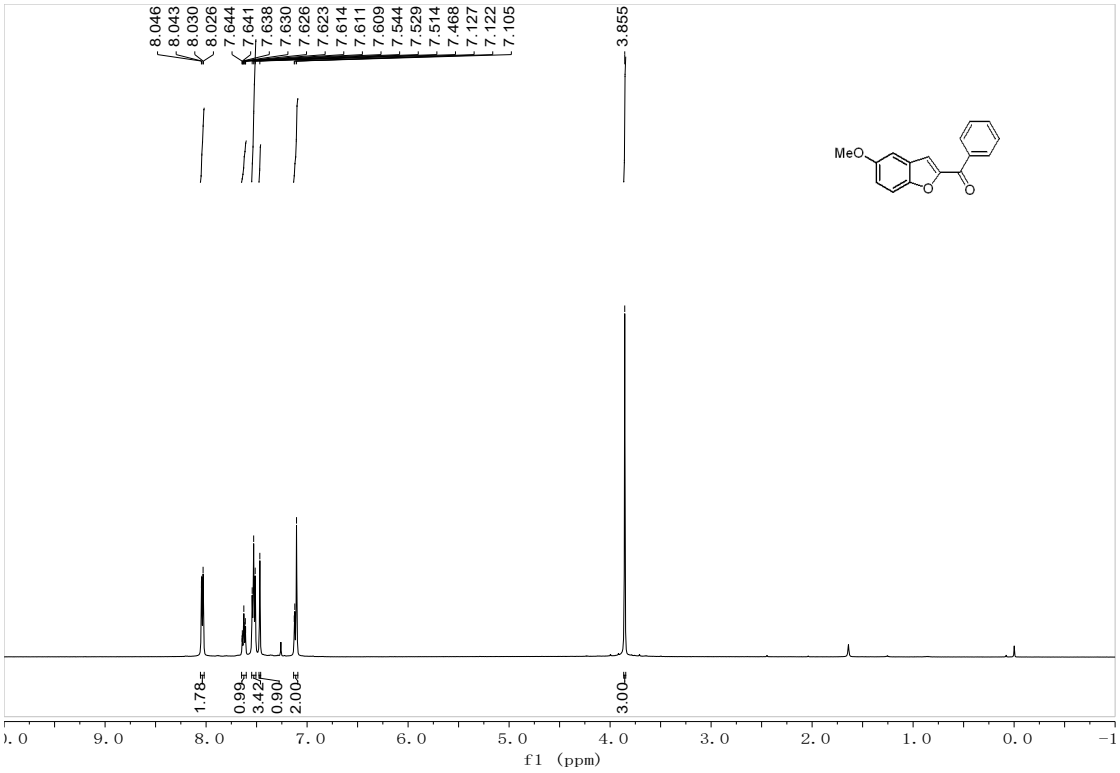
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13e**



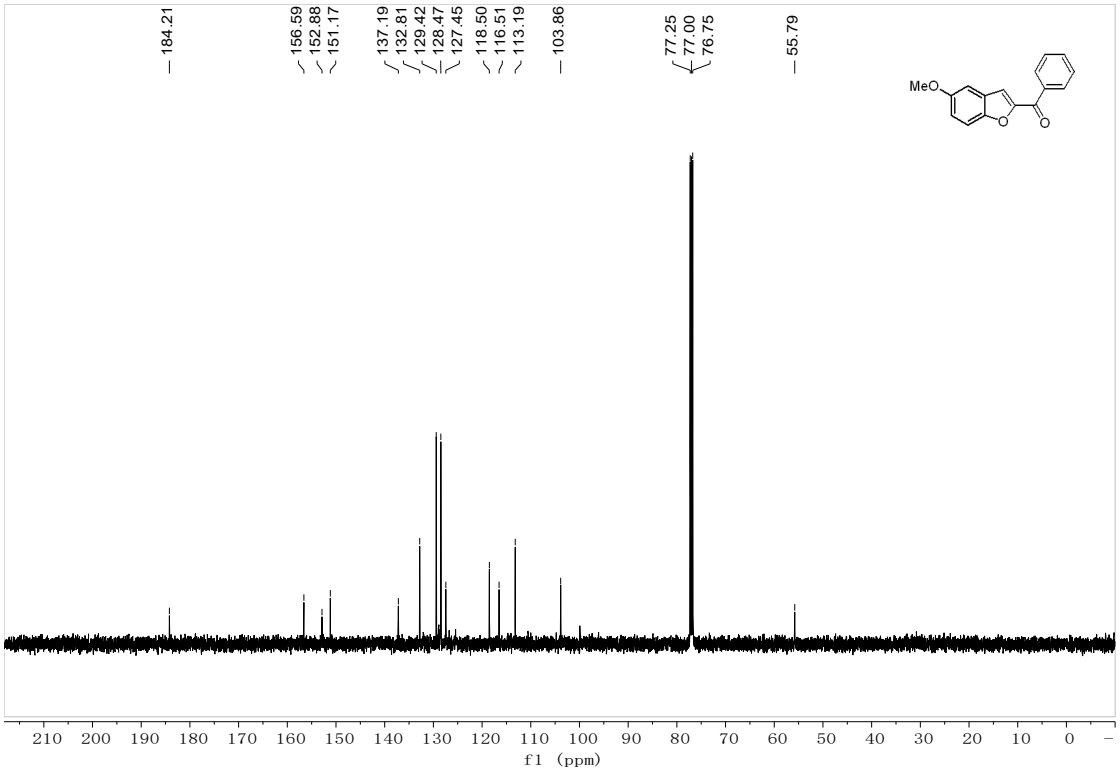
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13e**



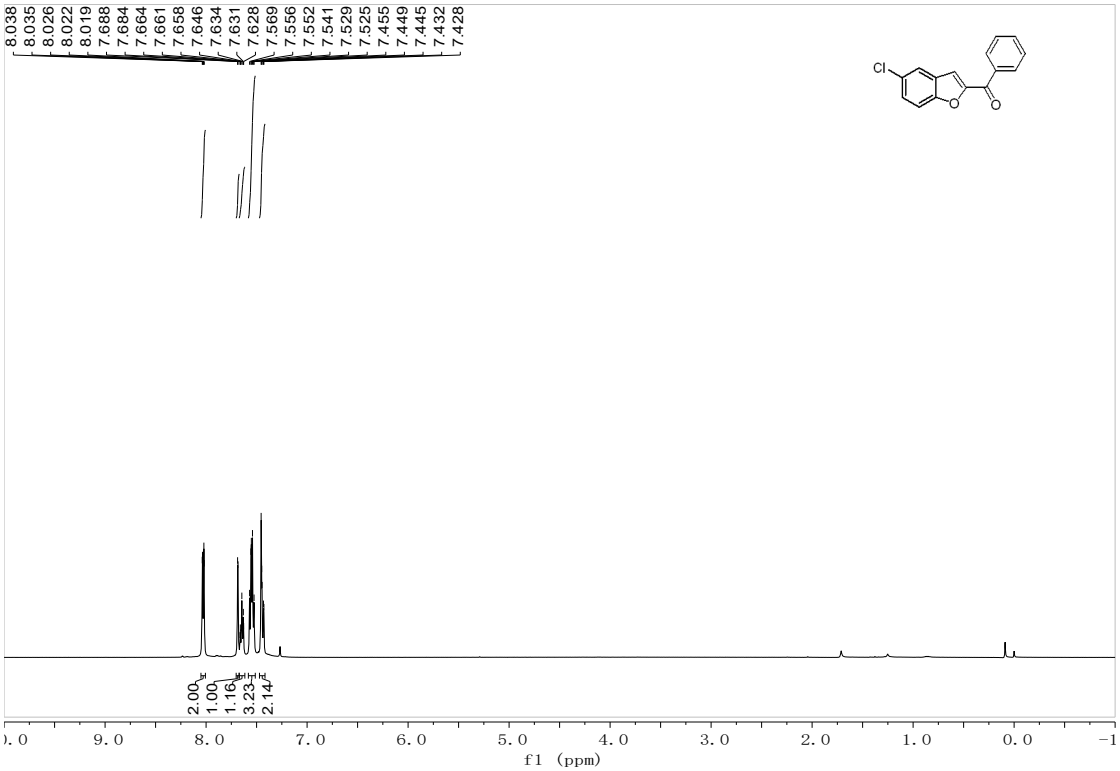
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13f**



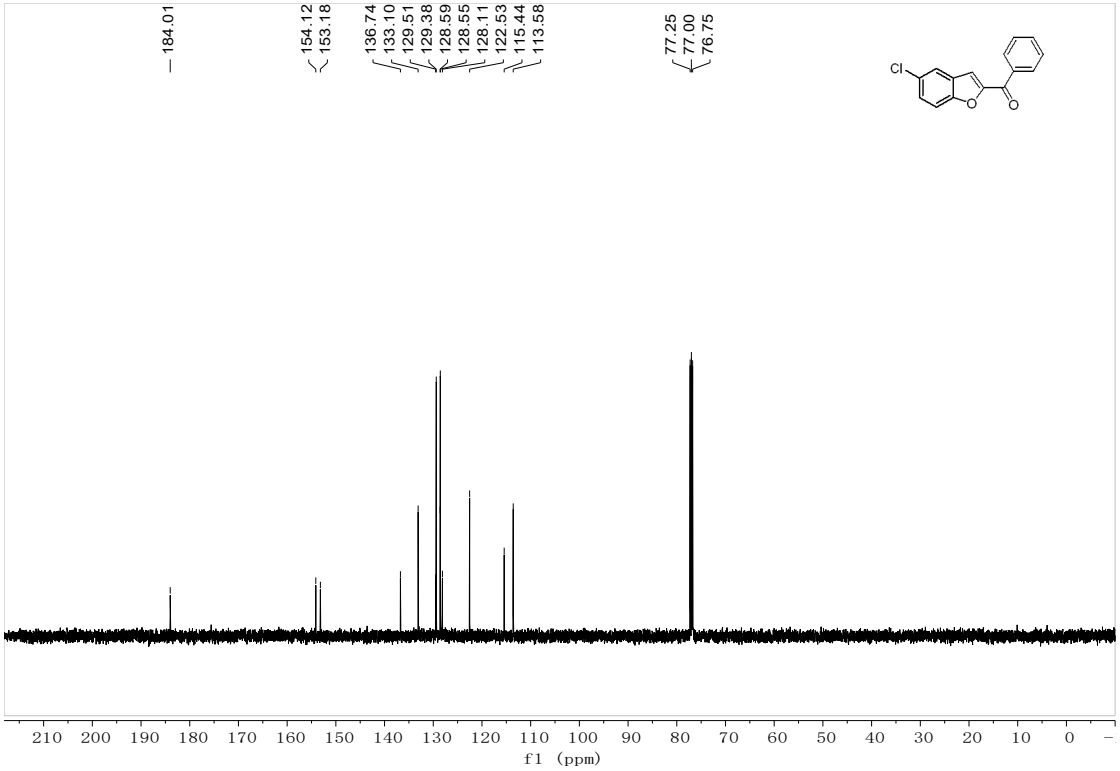
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13f**



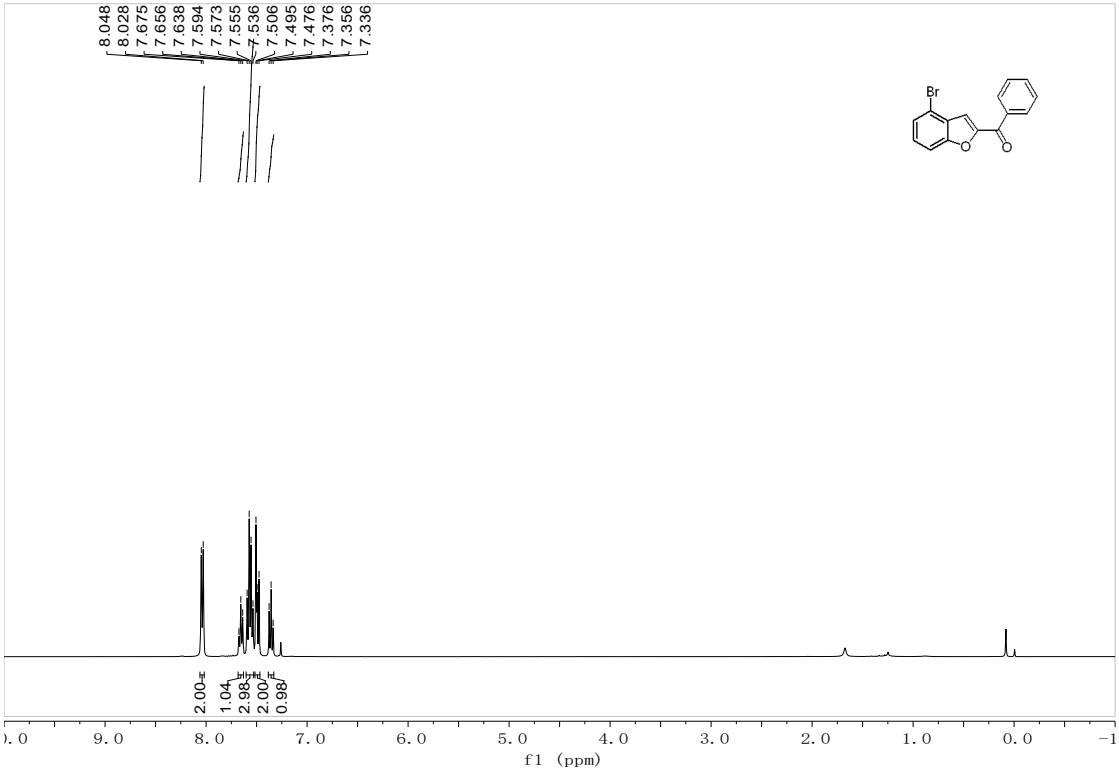
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13g**



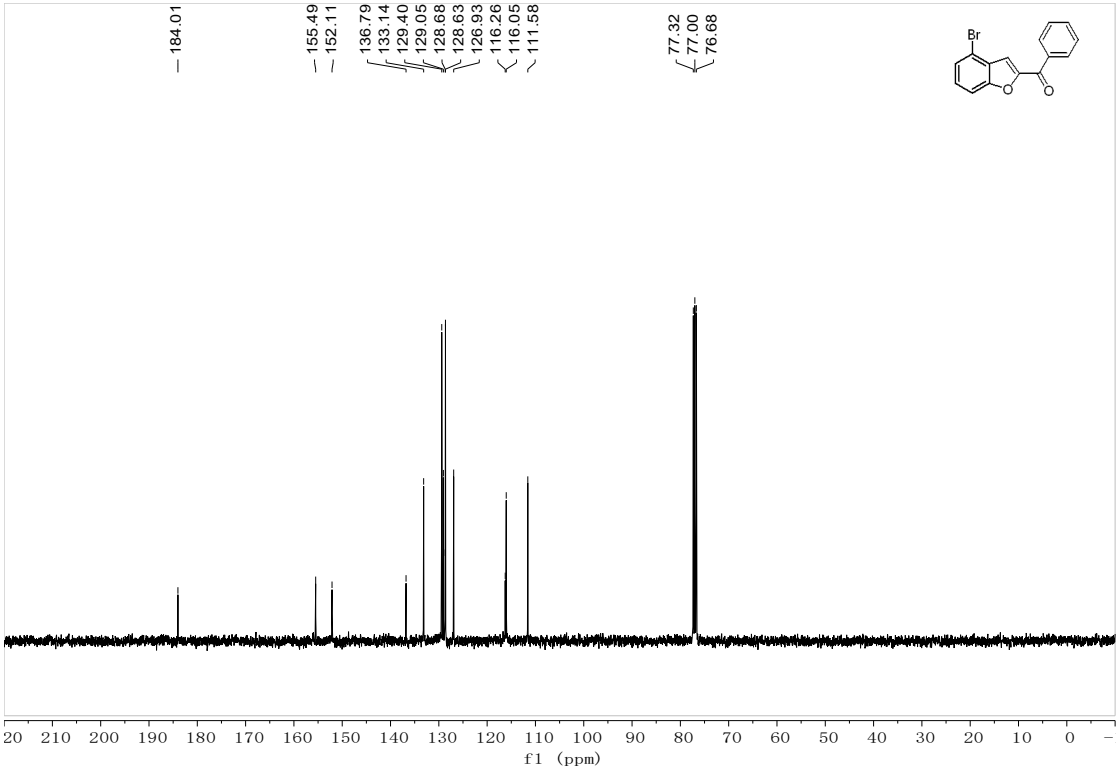
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13g**



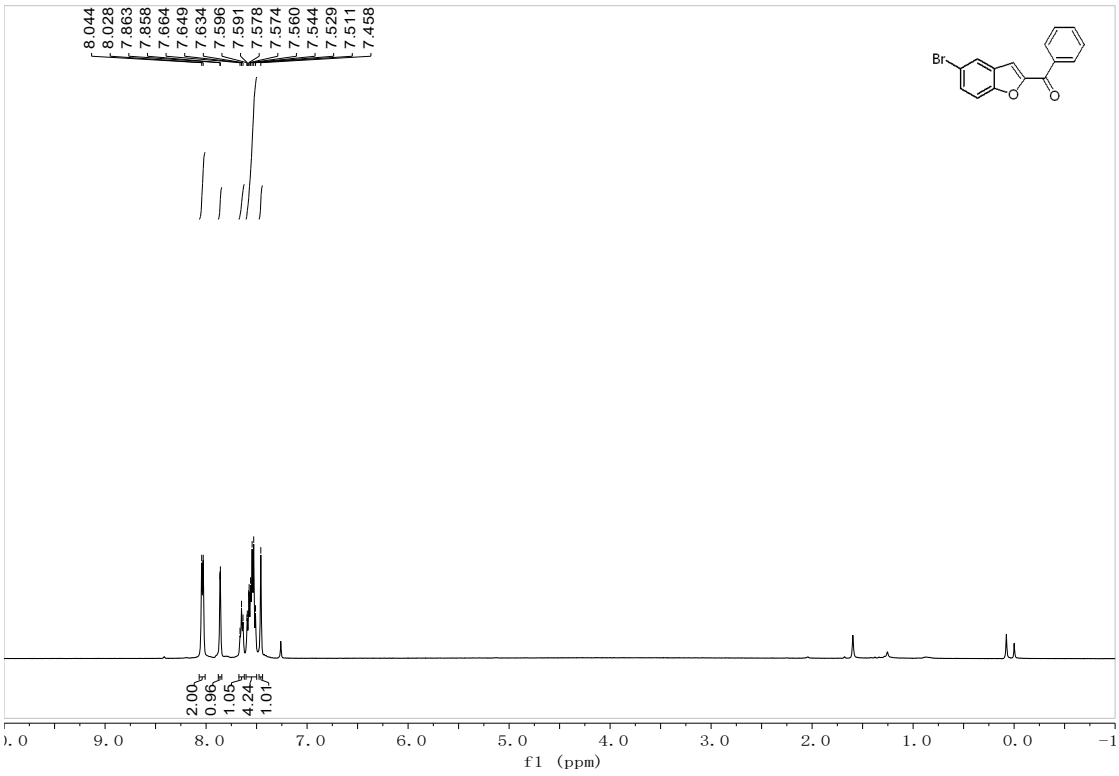
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13h**



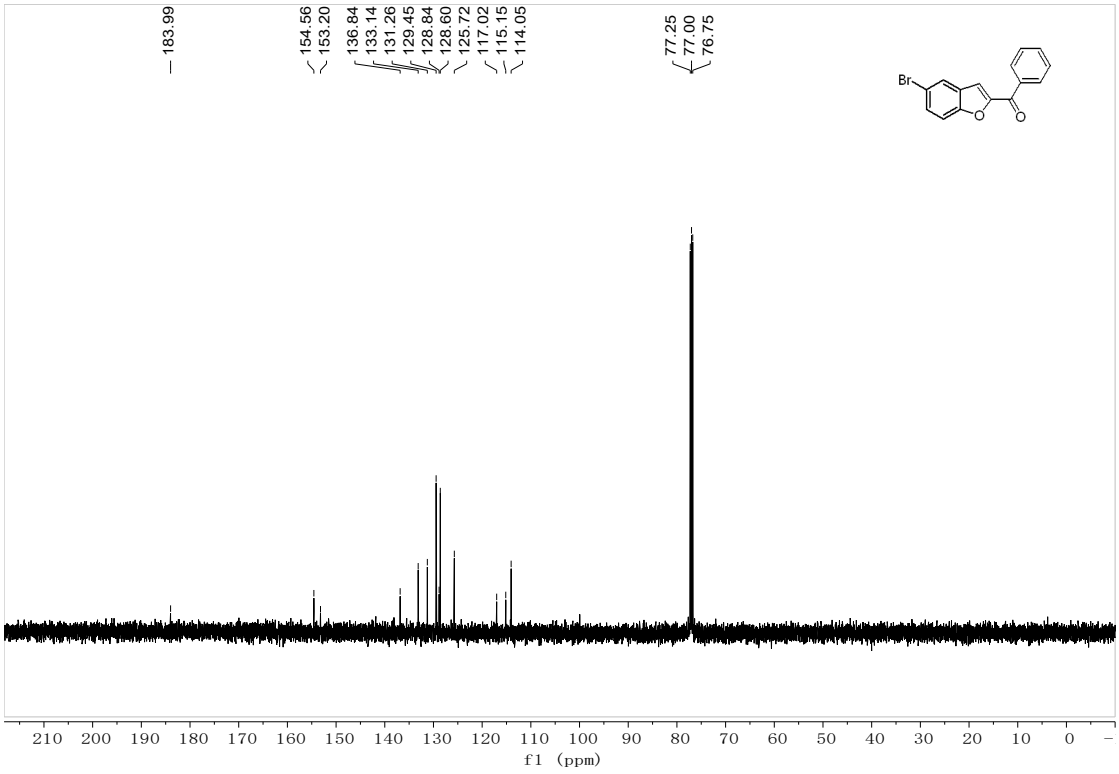
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13h**



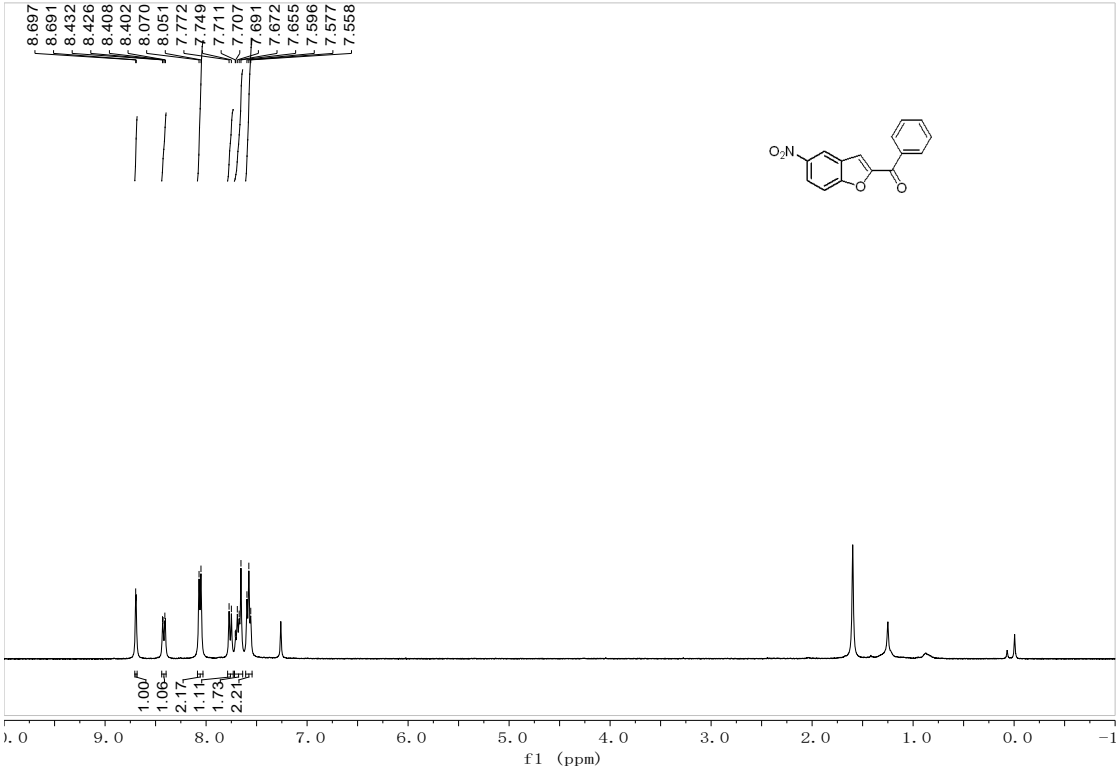
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13i**



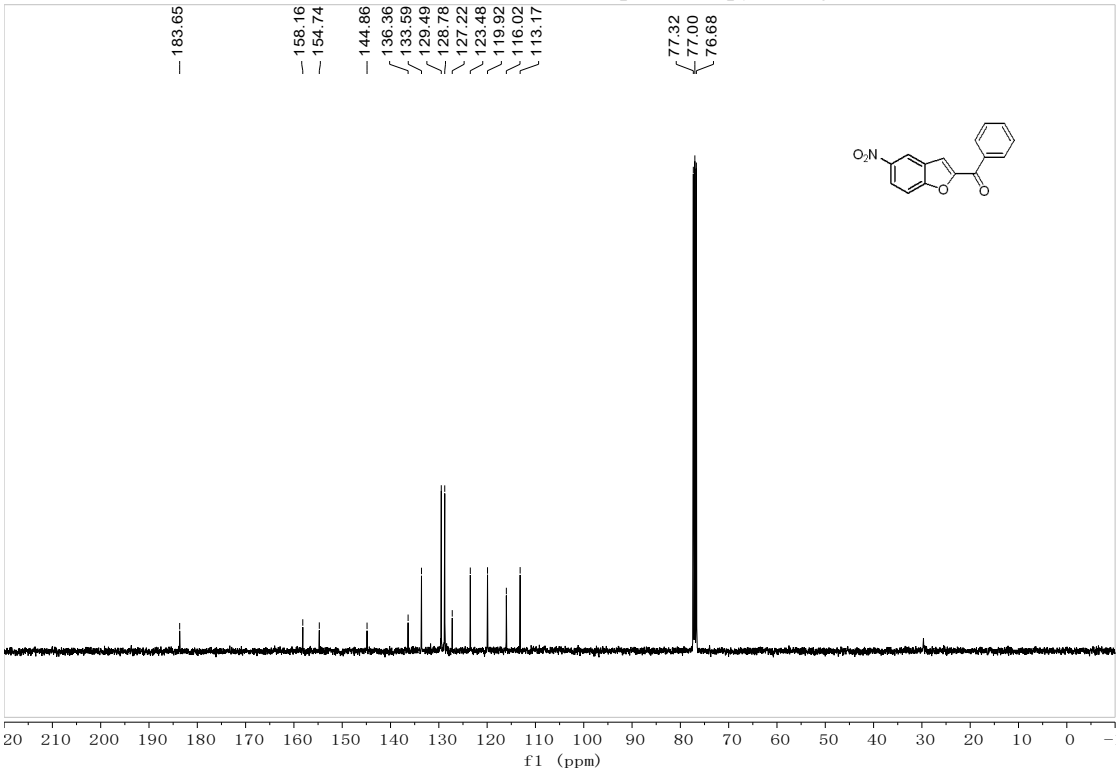
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13i**



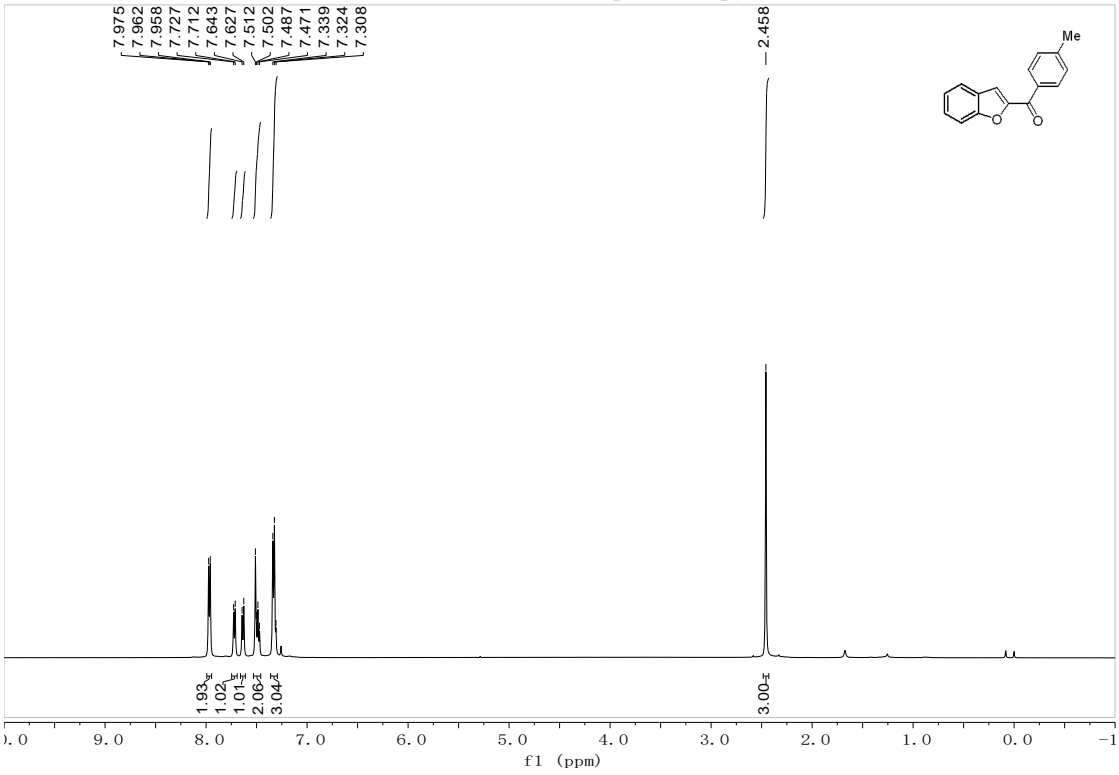
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13j**



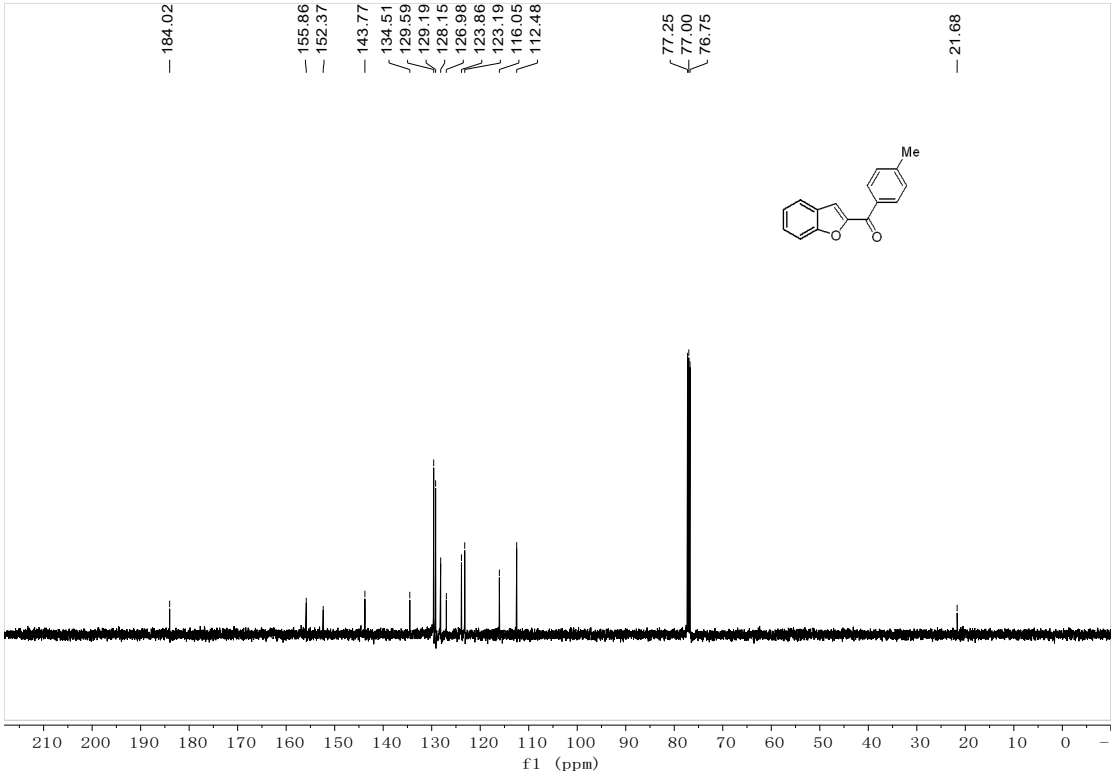
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13j**



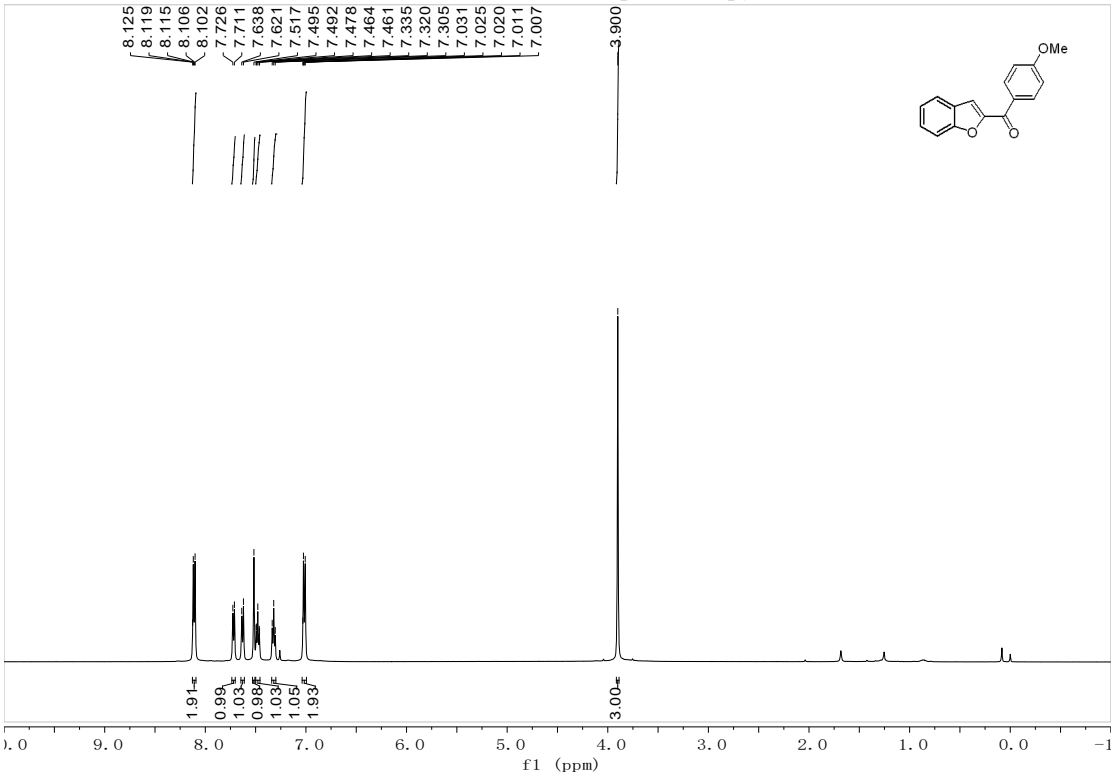
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13k**



^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13k**



^{1}H NMR (500 MHz, $CDCl_3$)spectroscopy of **13l**



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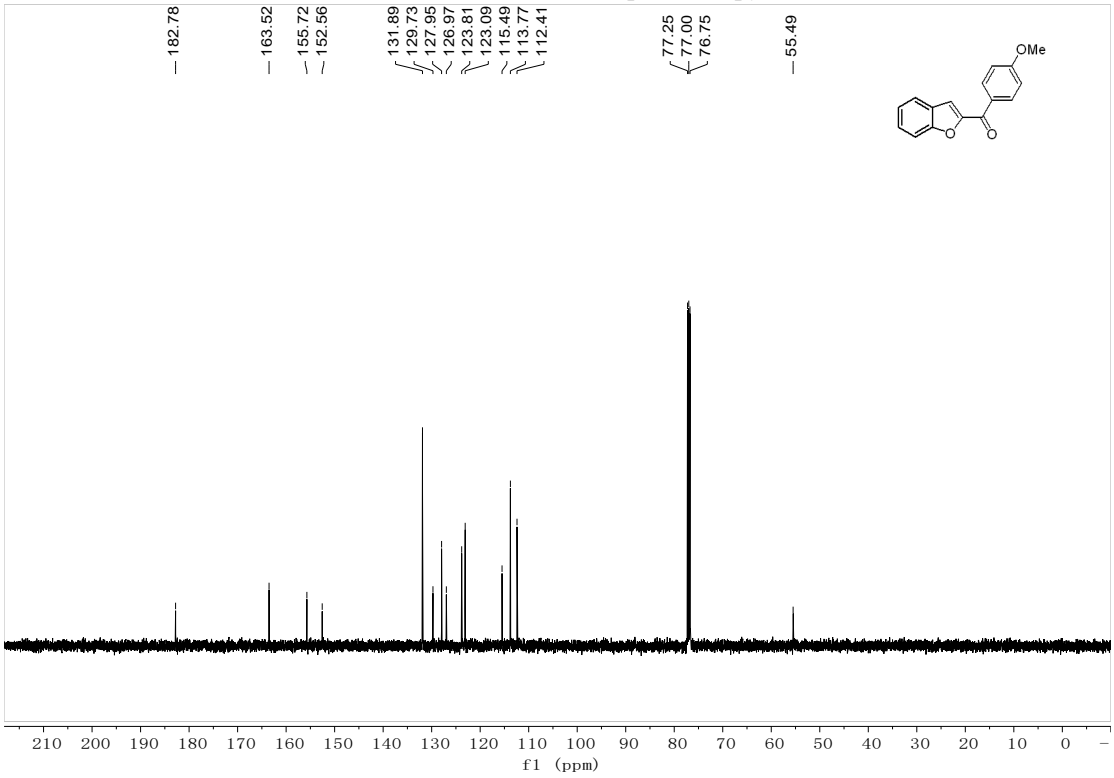
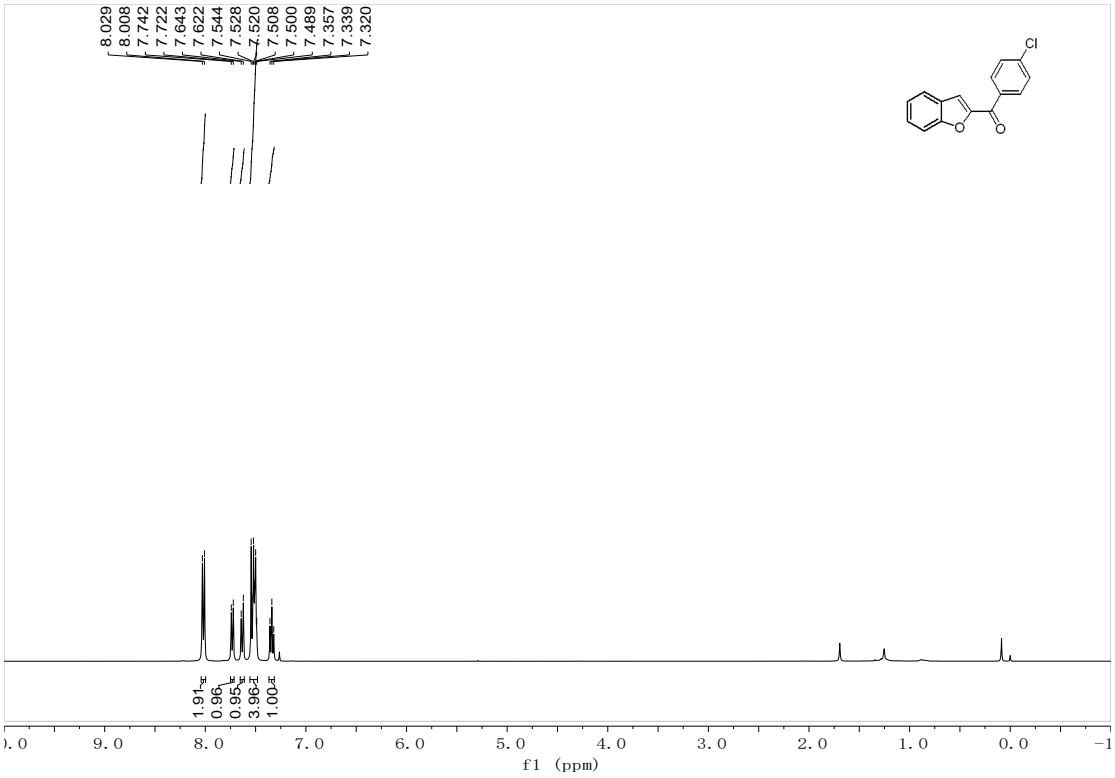
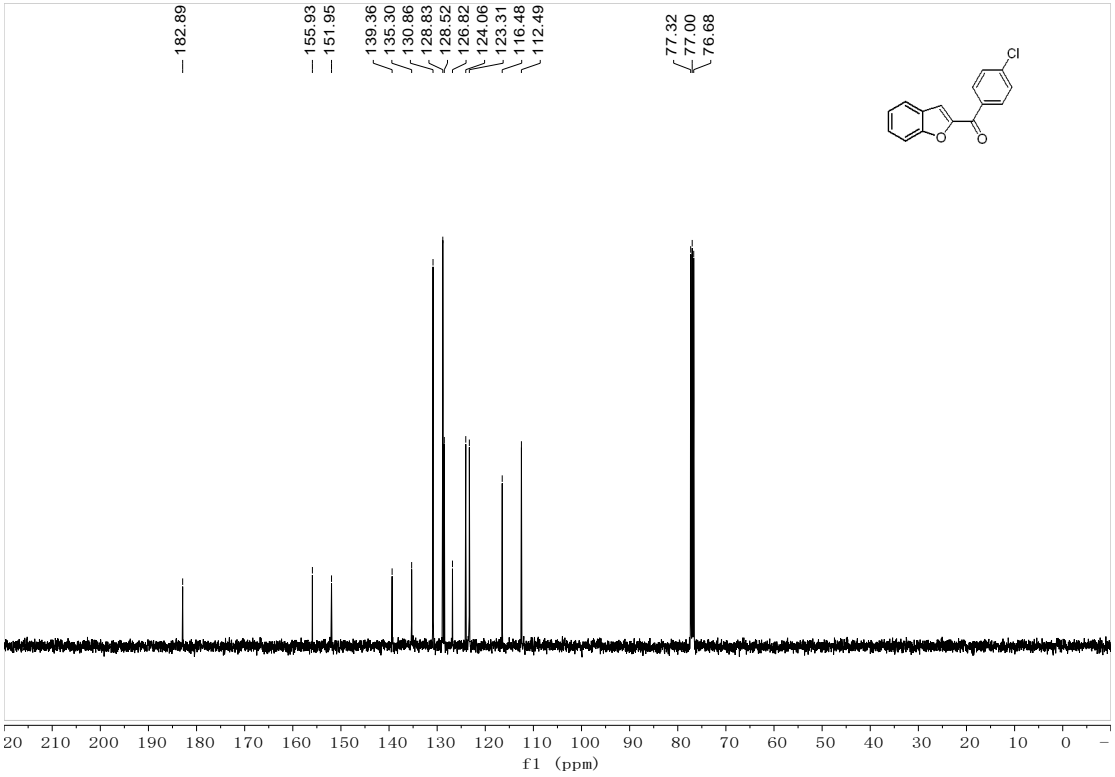


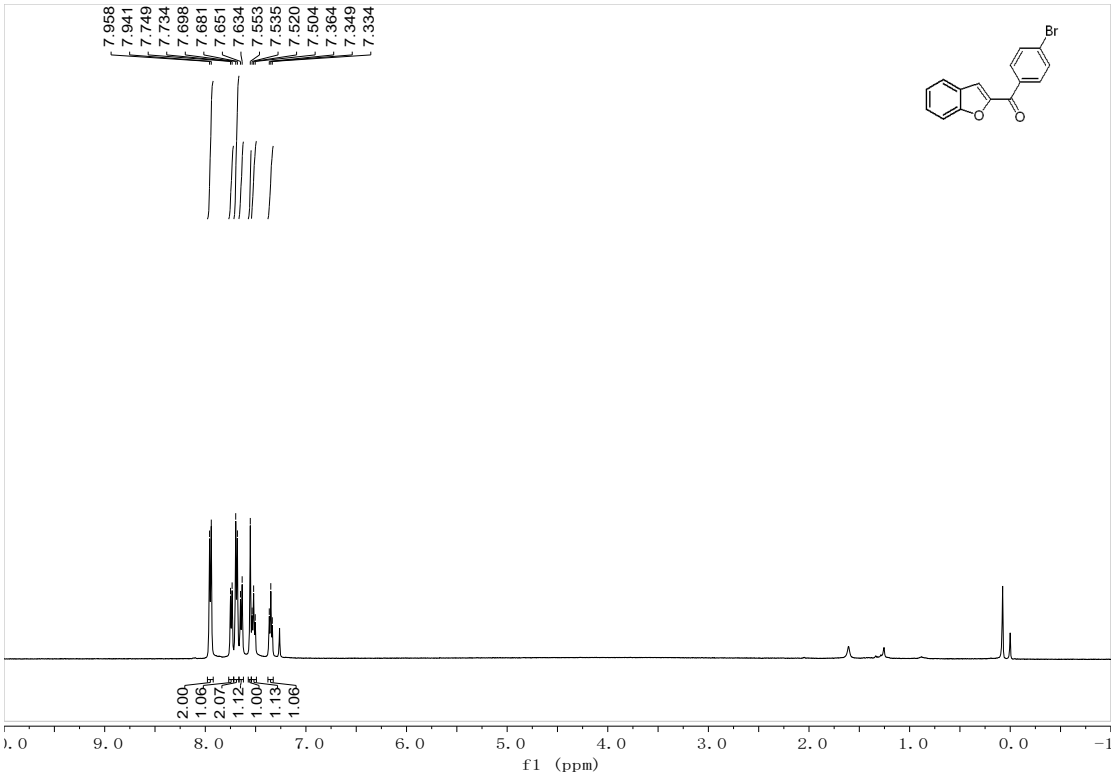
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13m**



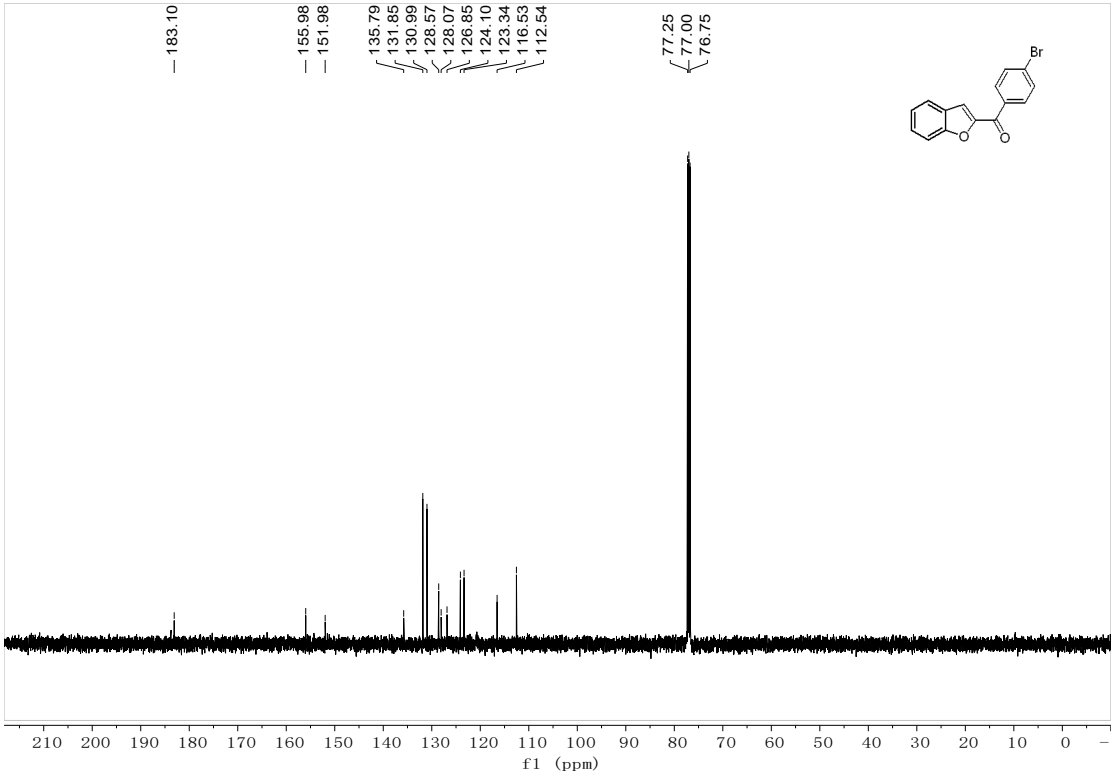
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13m**



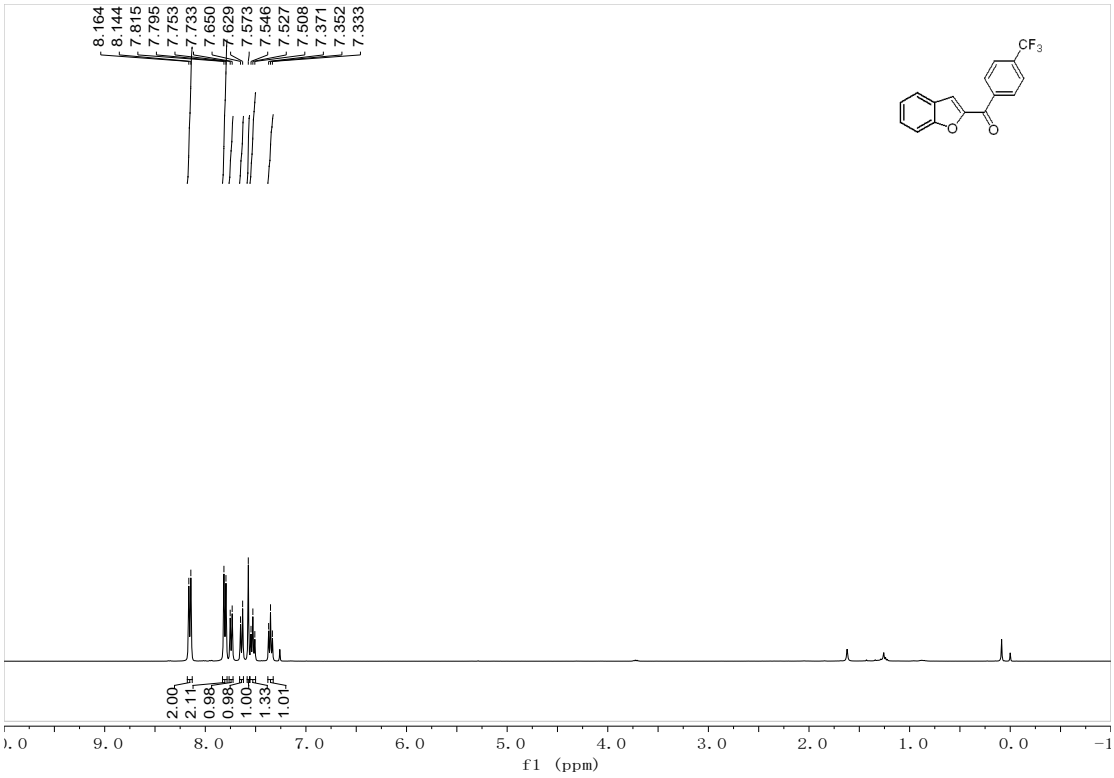
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13n**



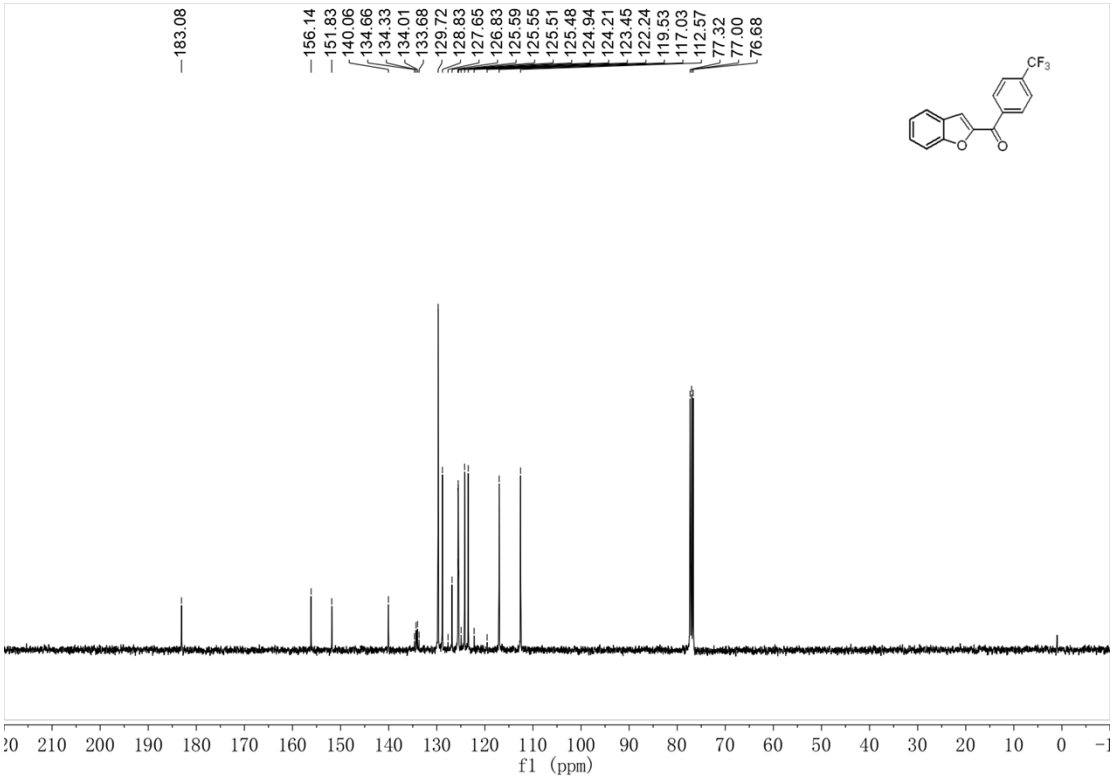
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13n**



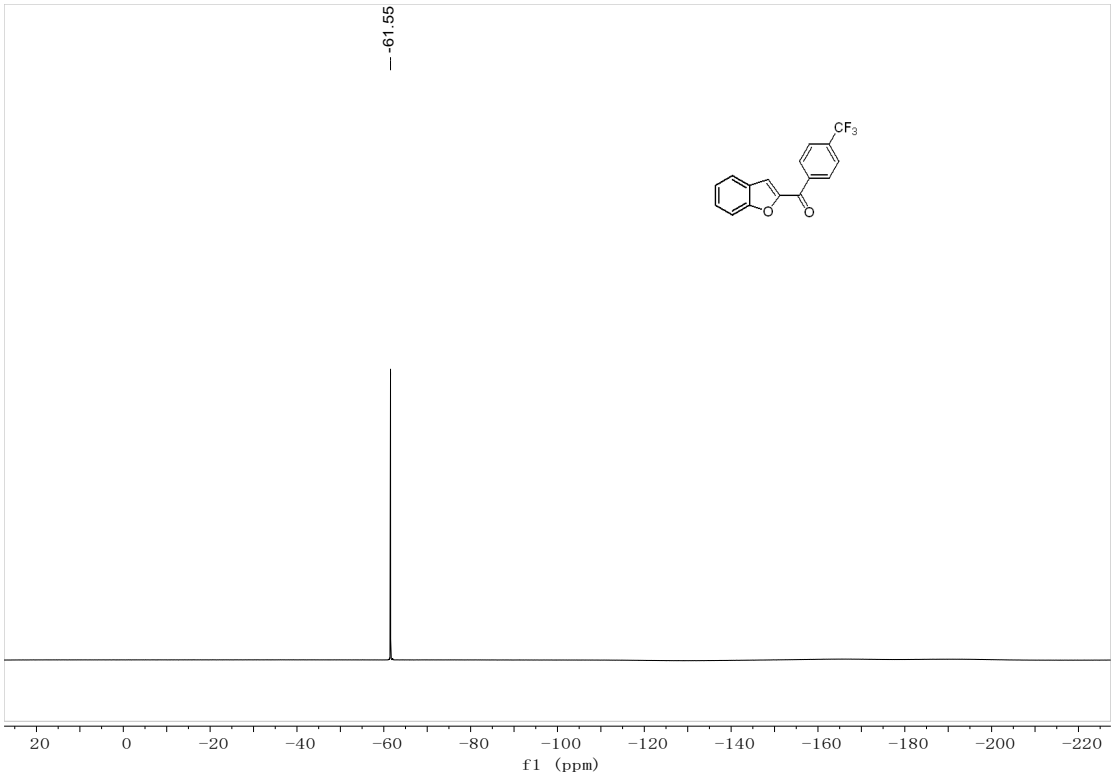
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13o**



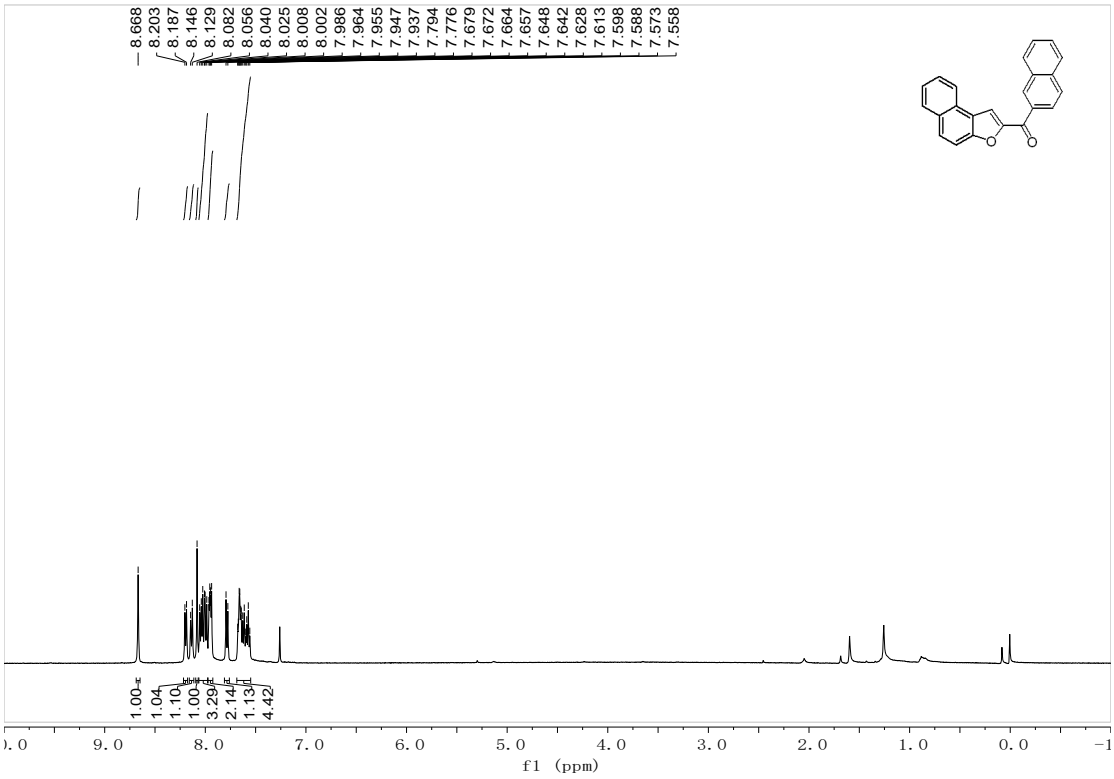
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13o**



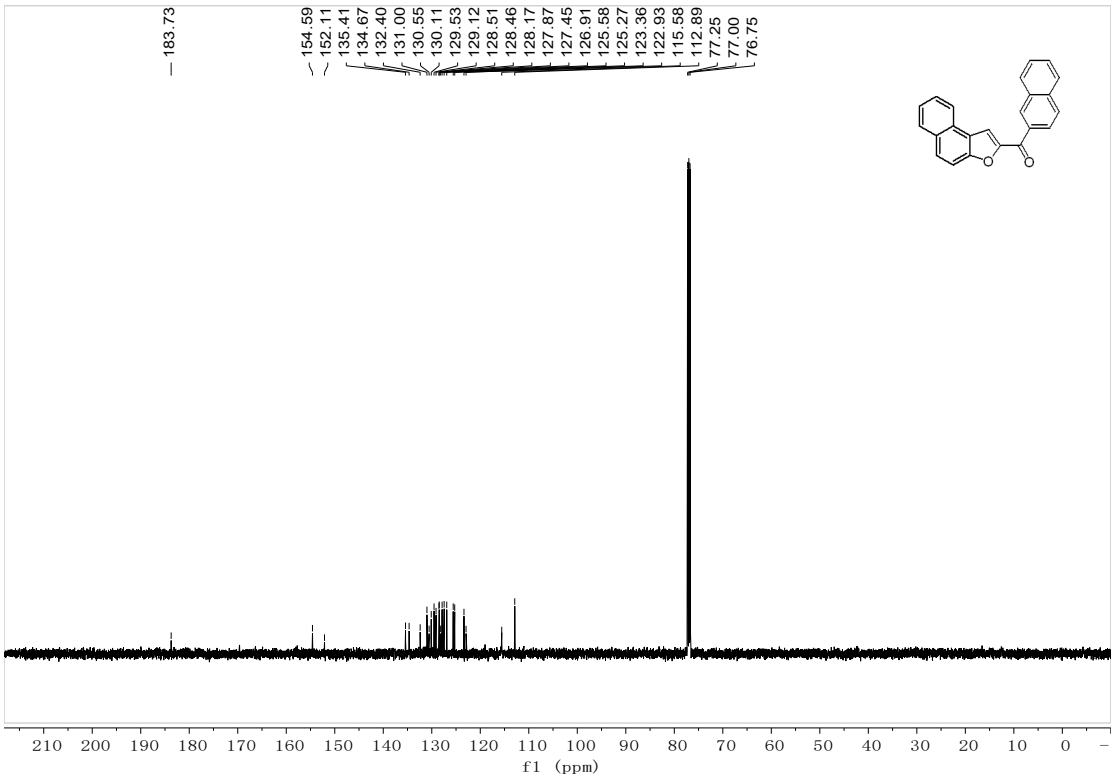
^{19}F NMR (376 MHz, DMSO-d_6) spectroscopy of **13o**



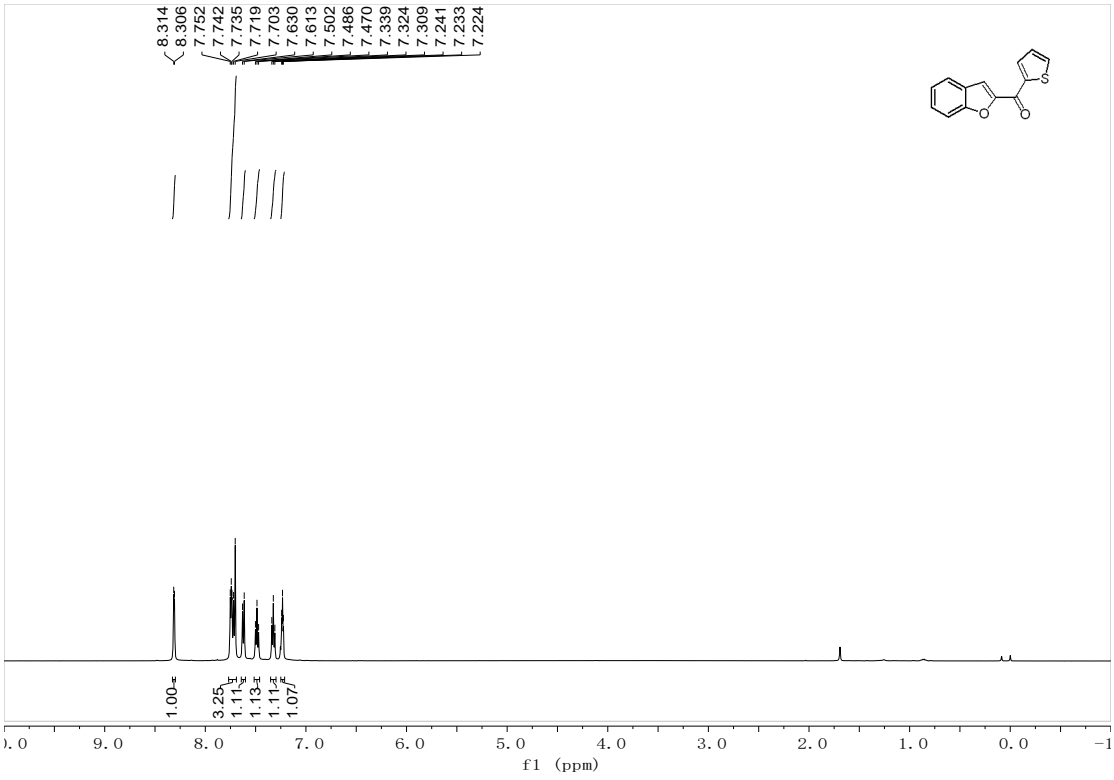
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13p**



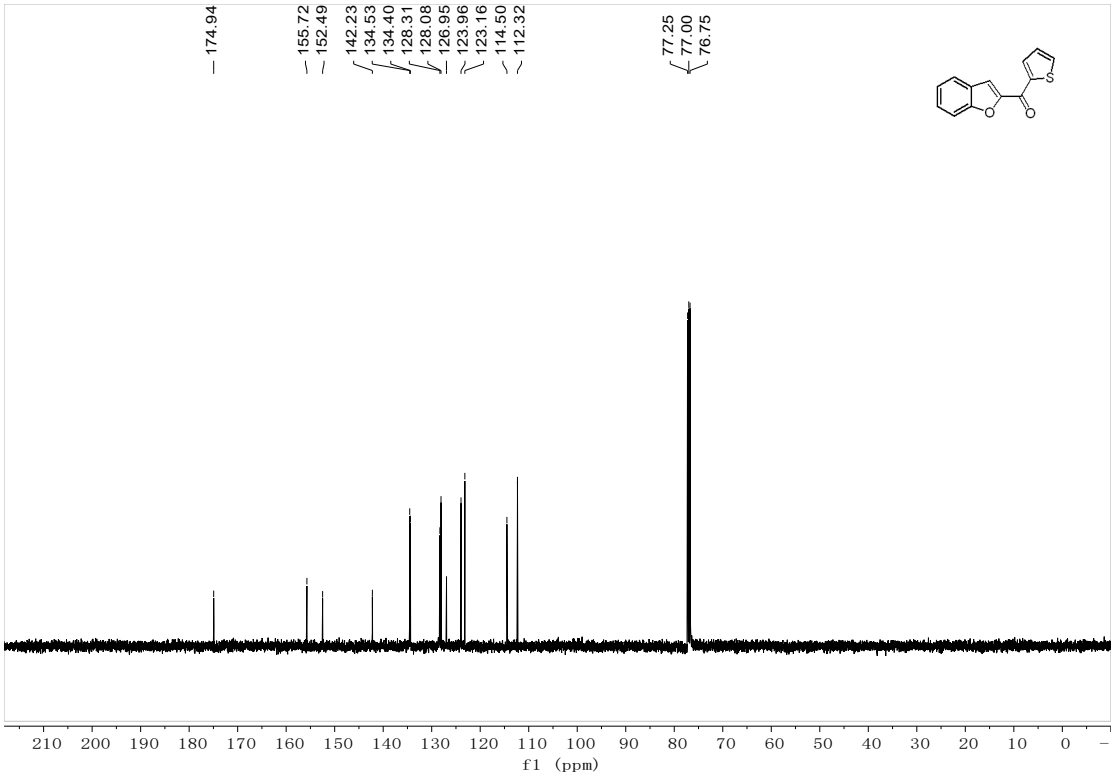
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13p**



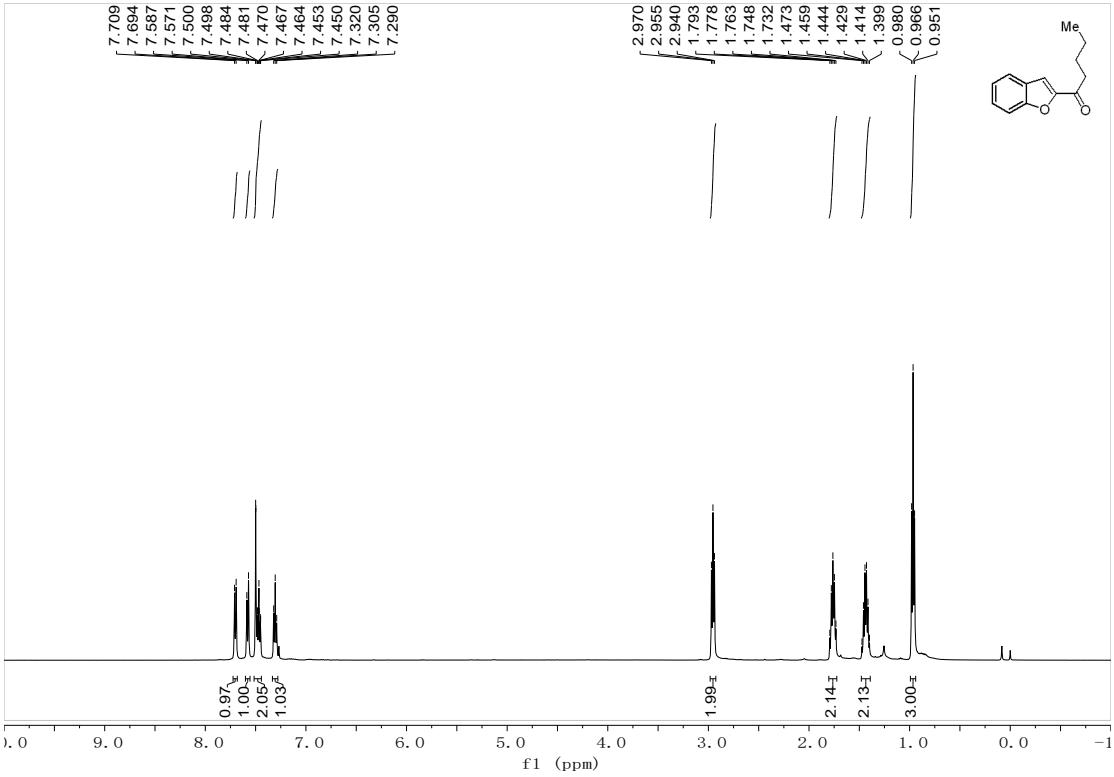
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13q**



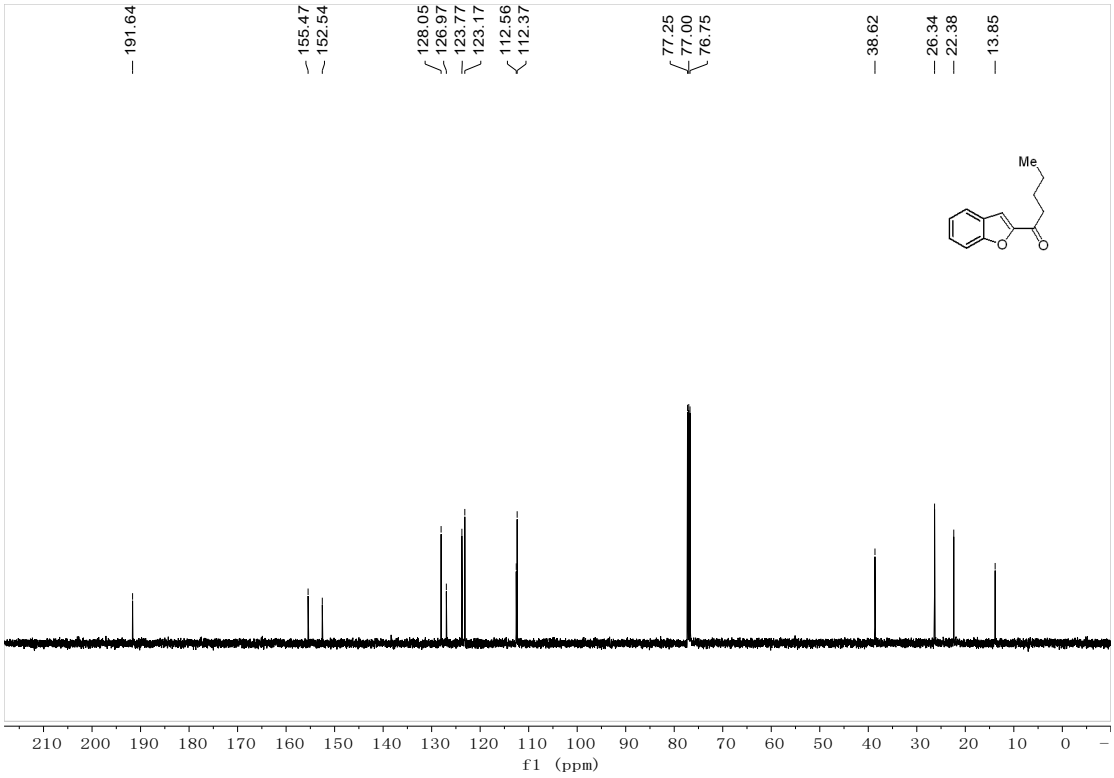
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13q**



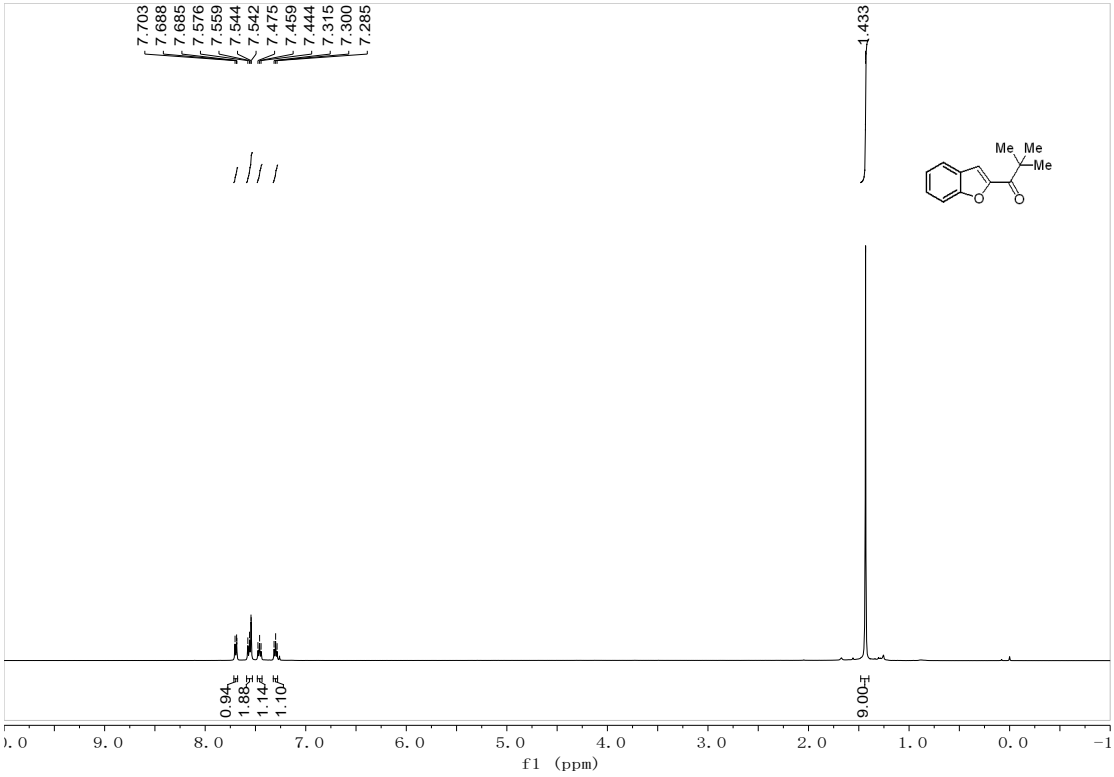
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13r**



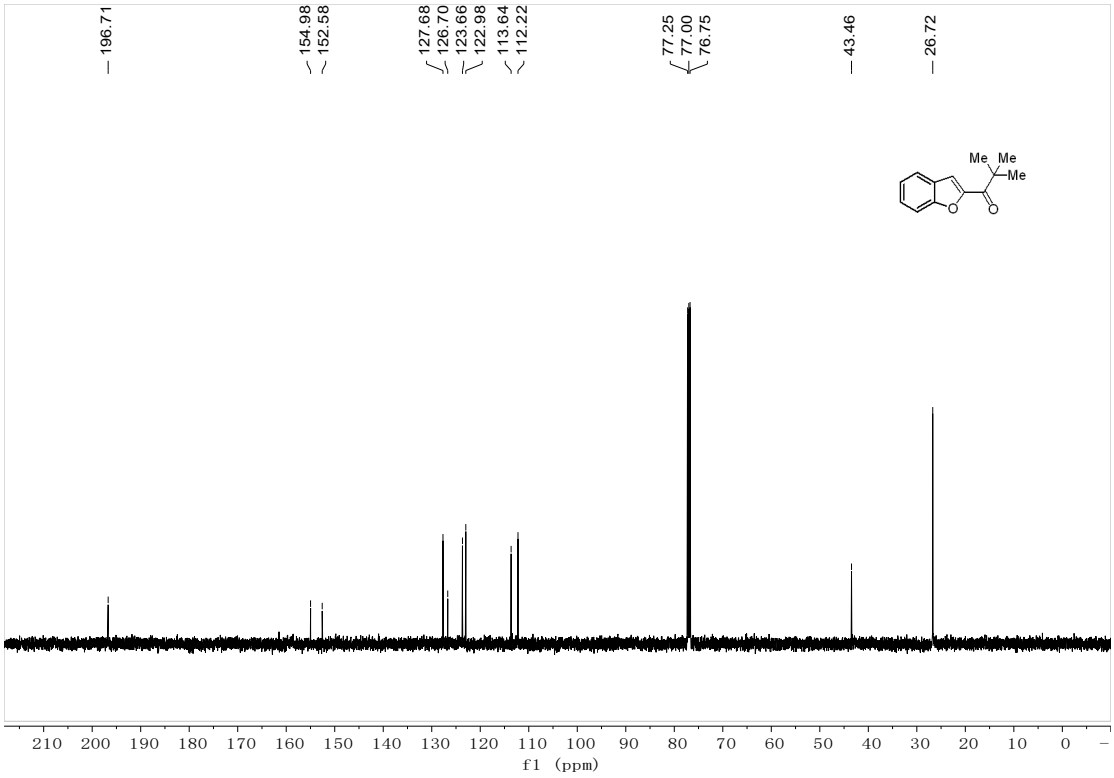
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13r**



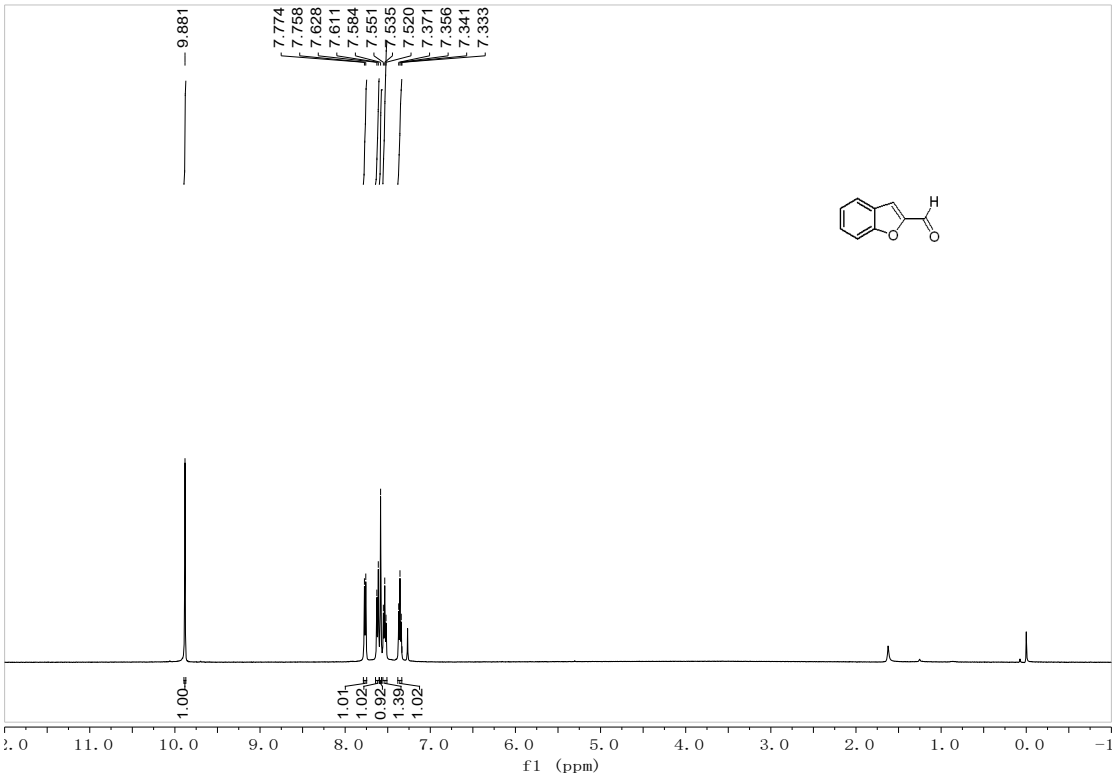
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13s**



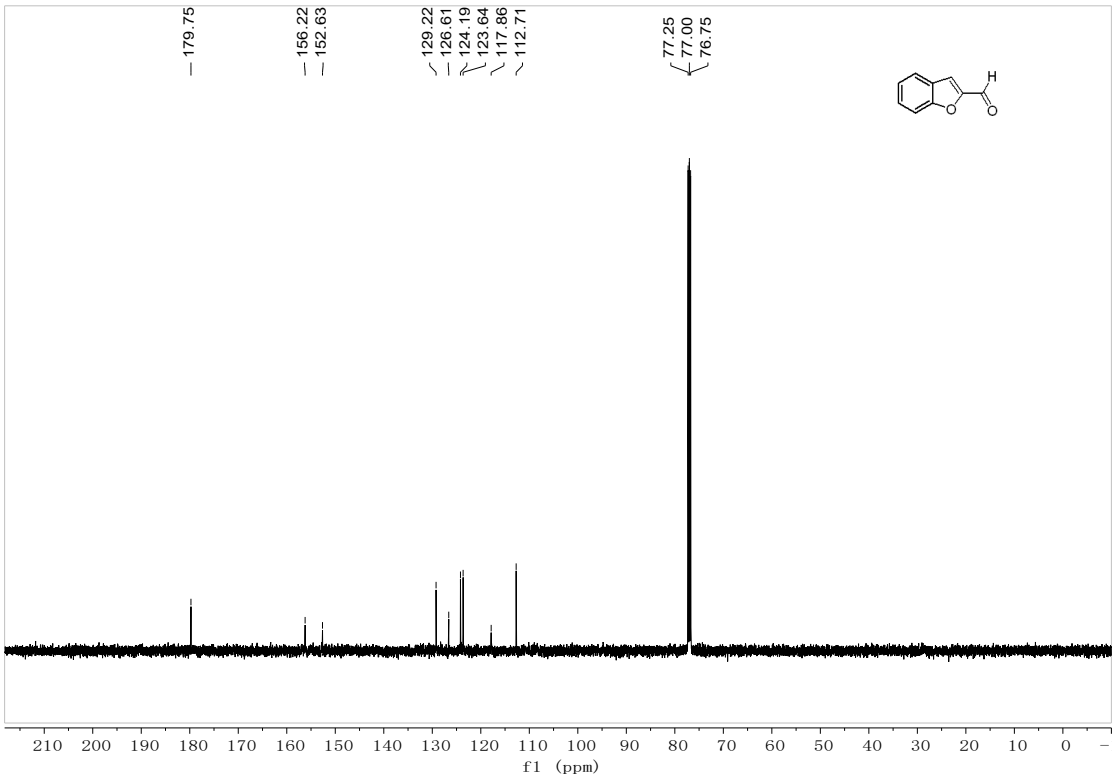
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13s**



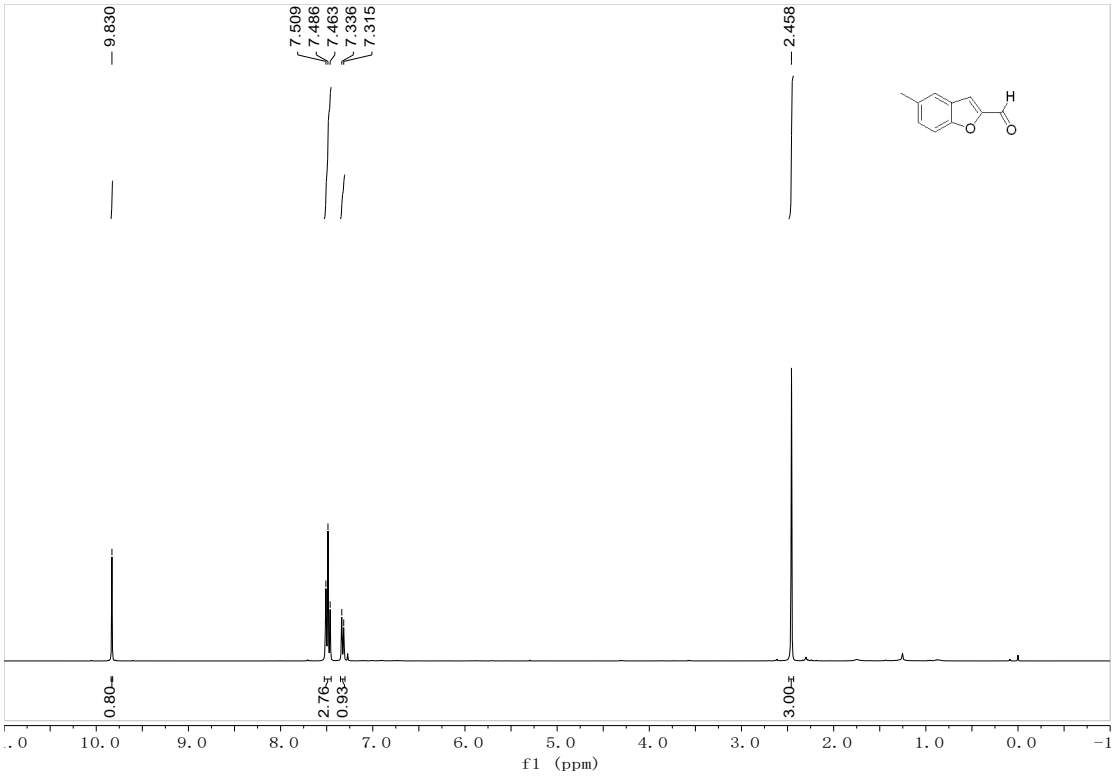
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13t**



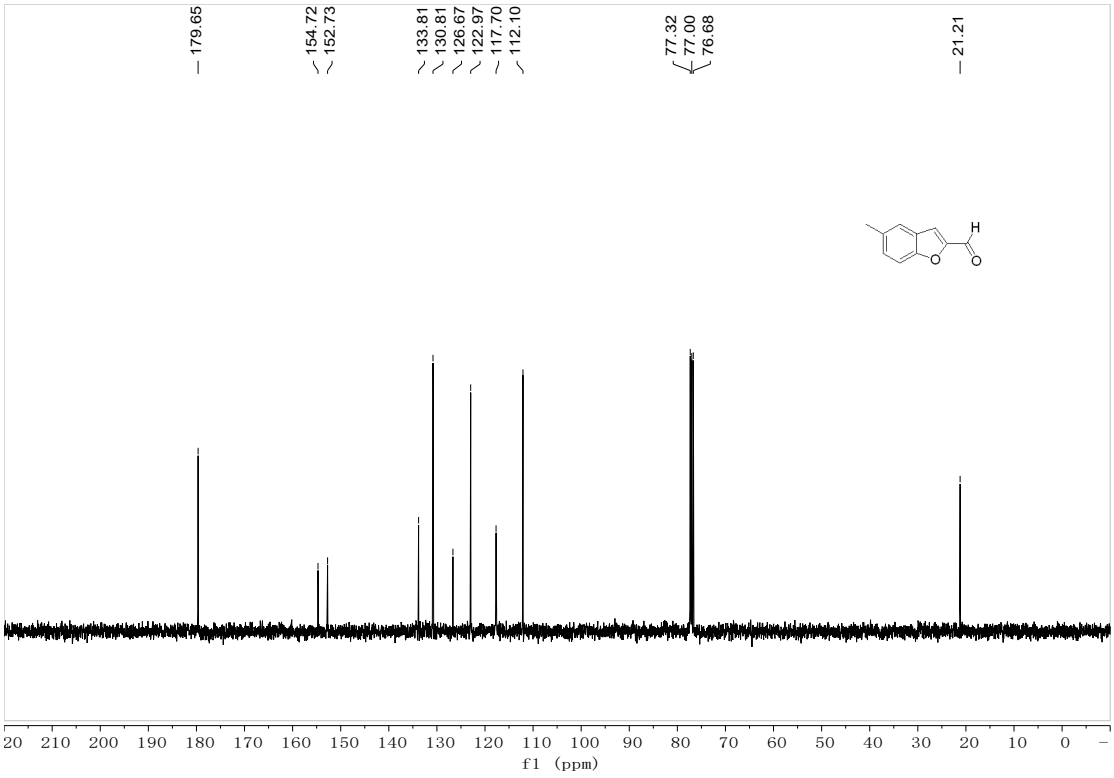
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13t**



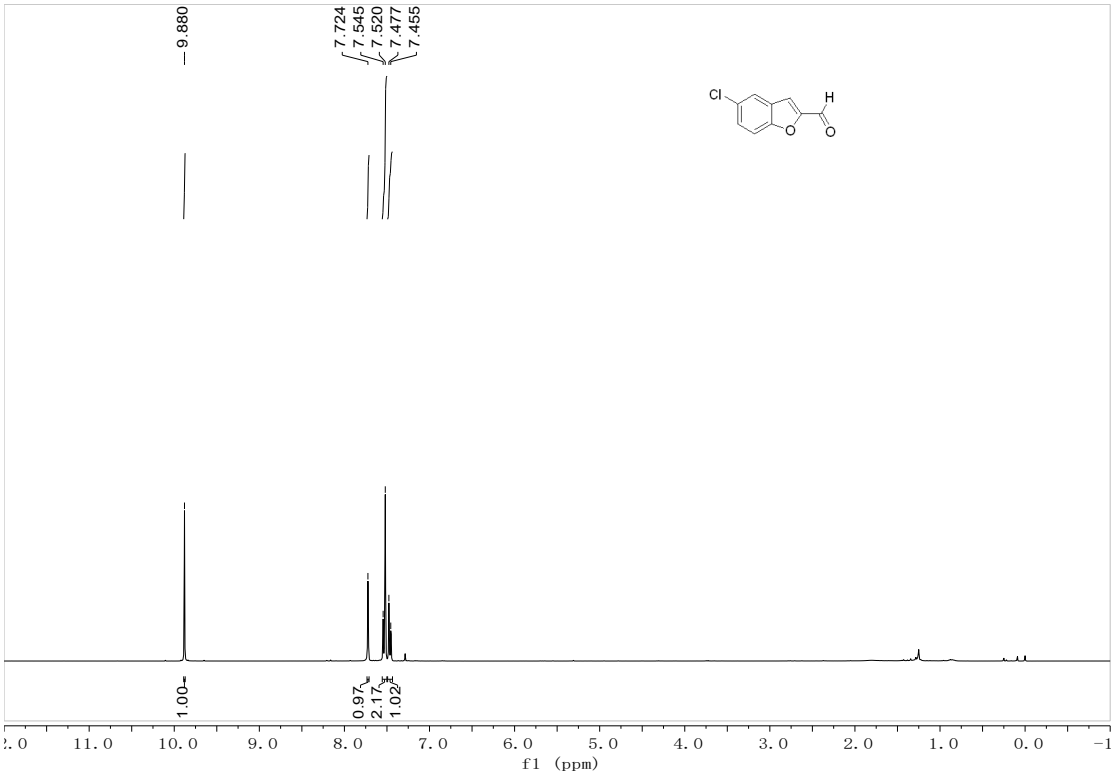
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13u**



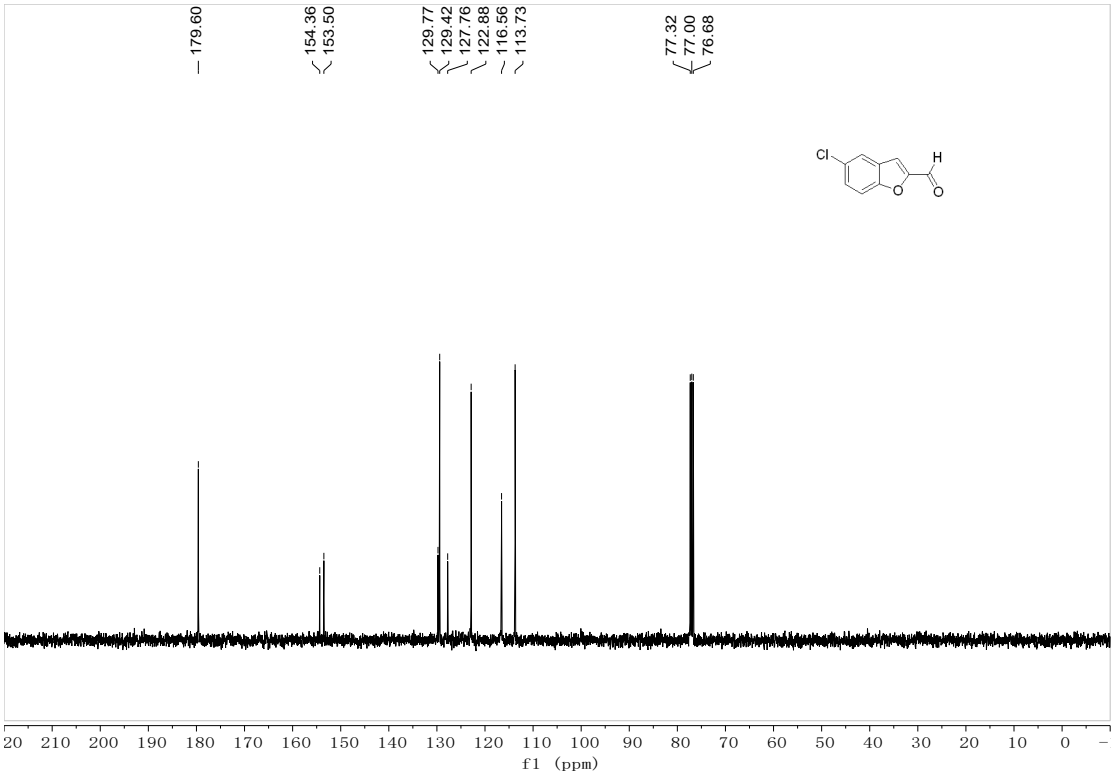
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13u**



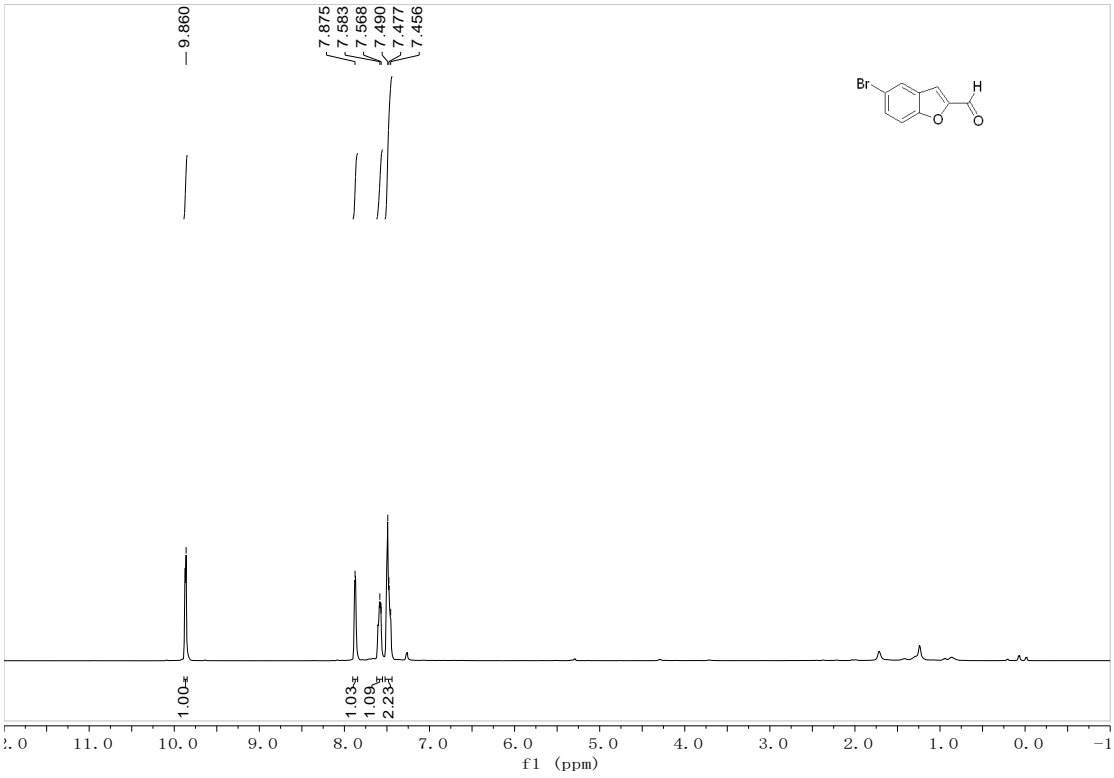
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13v**



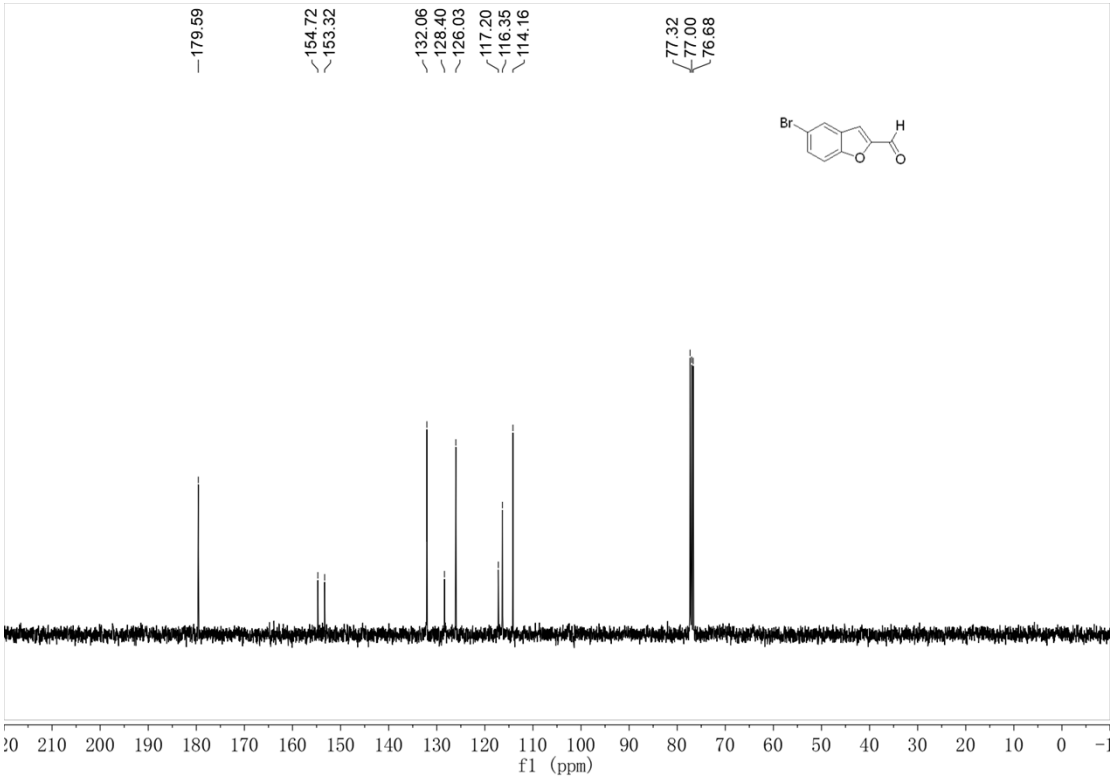
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13v**



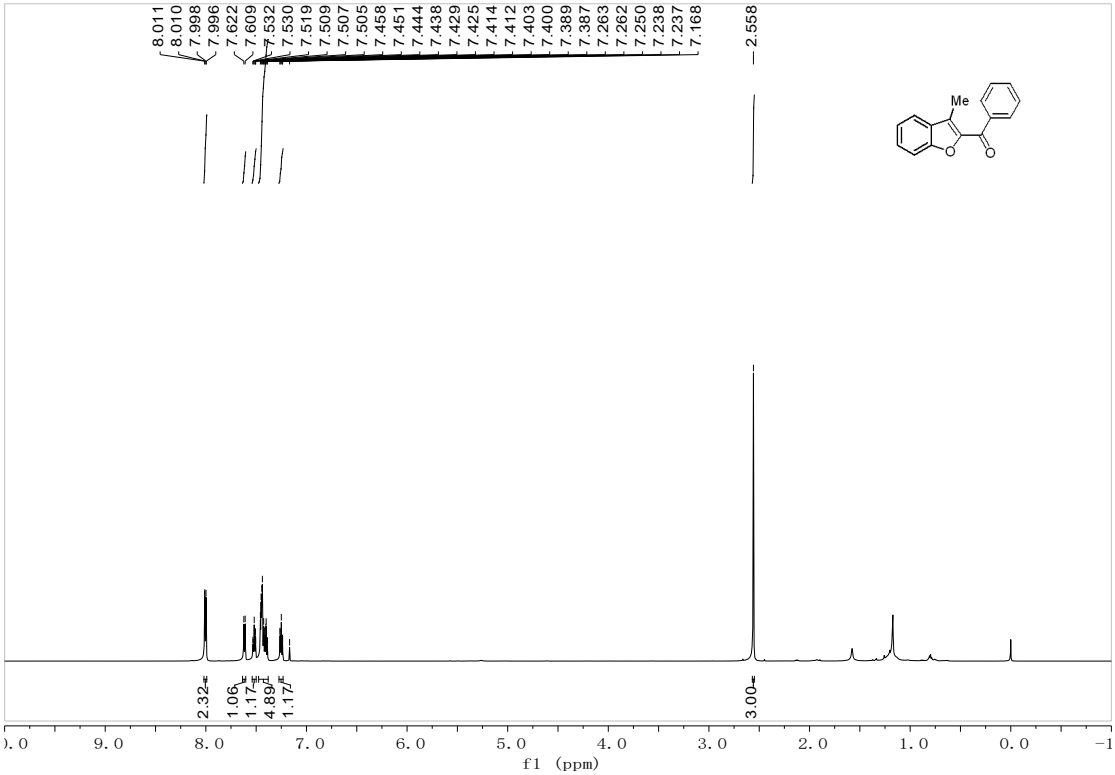
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **13w**



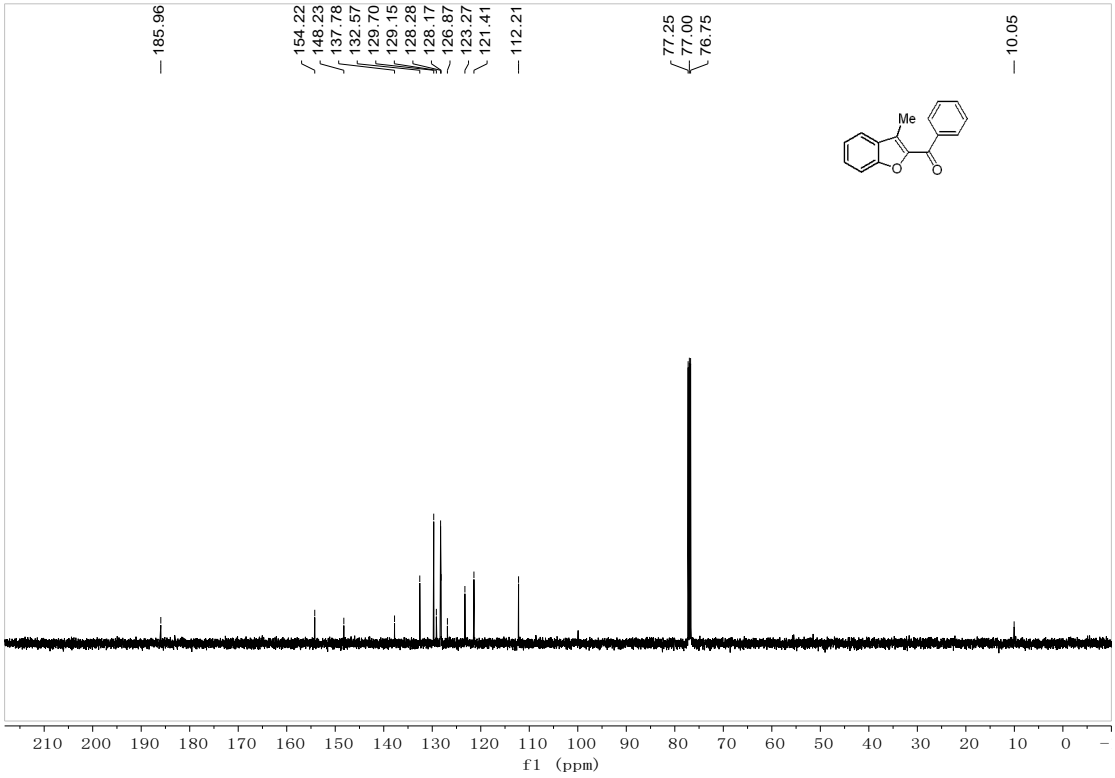
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **13w**



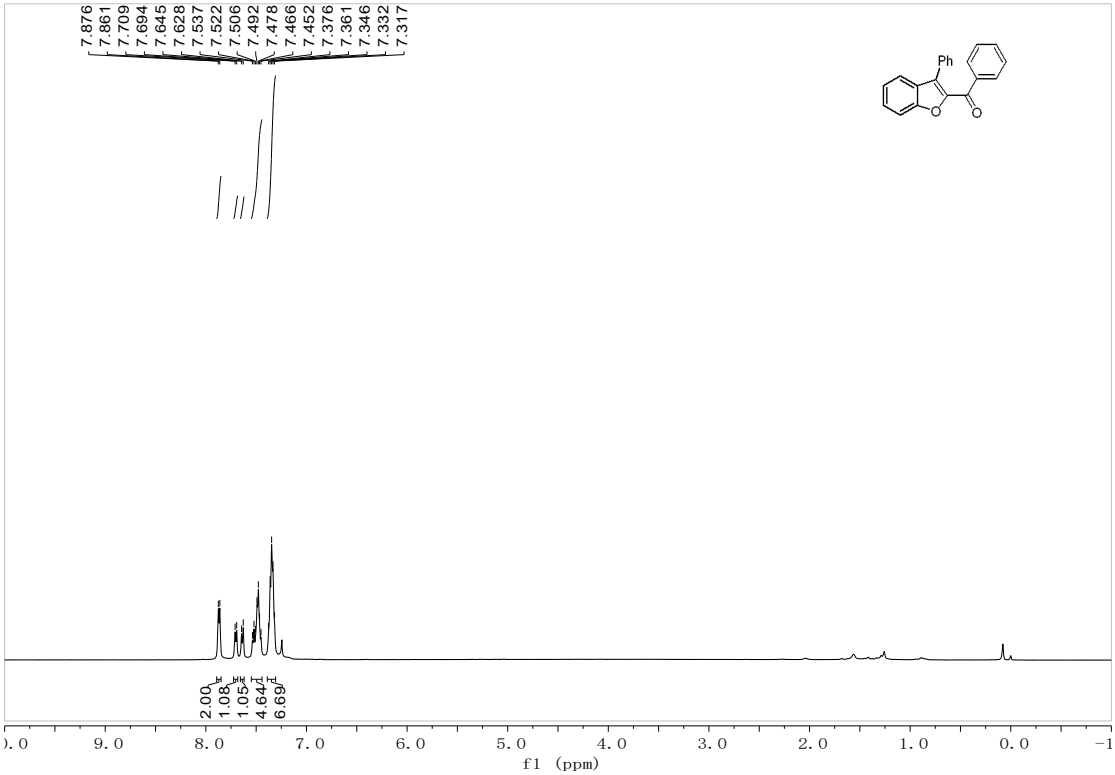
^{1}H NMR (600 MHz, $CDCl_3$) spectroscopy of **13x**



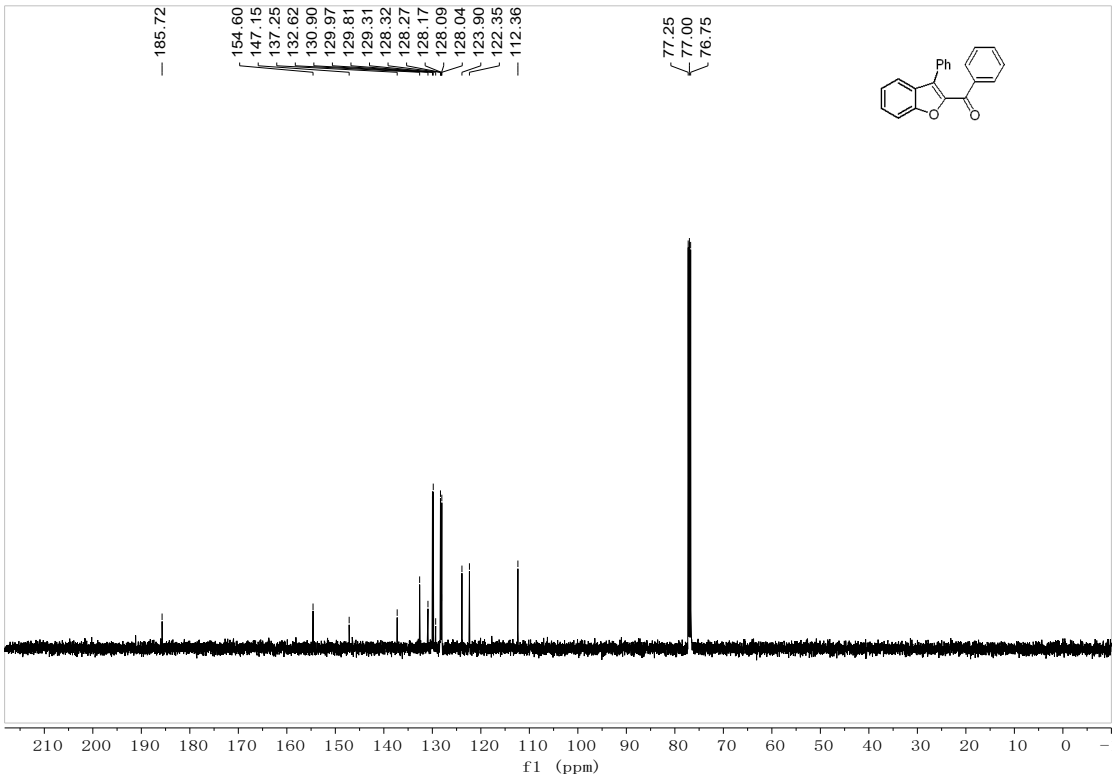
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13x**



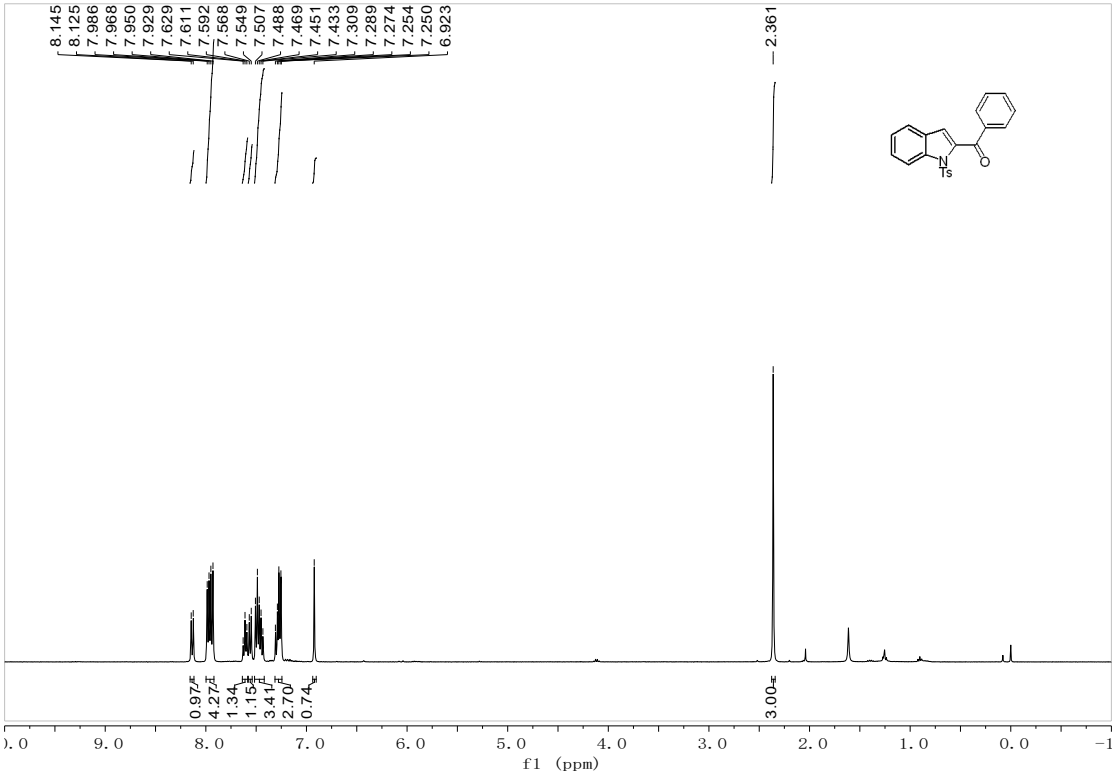
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **13y**



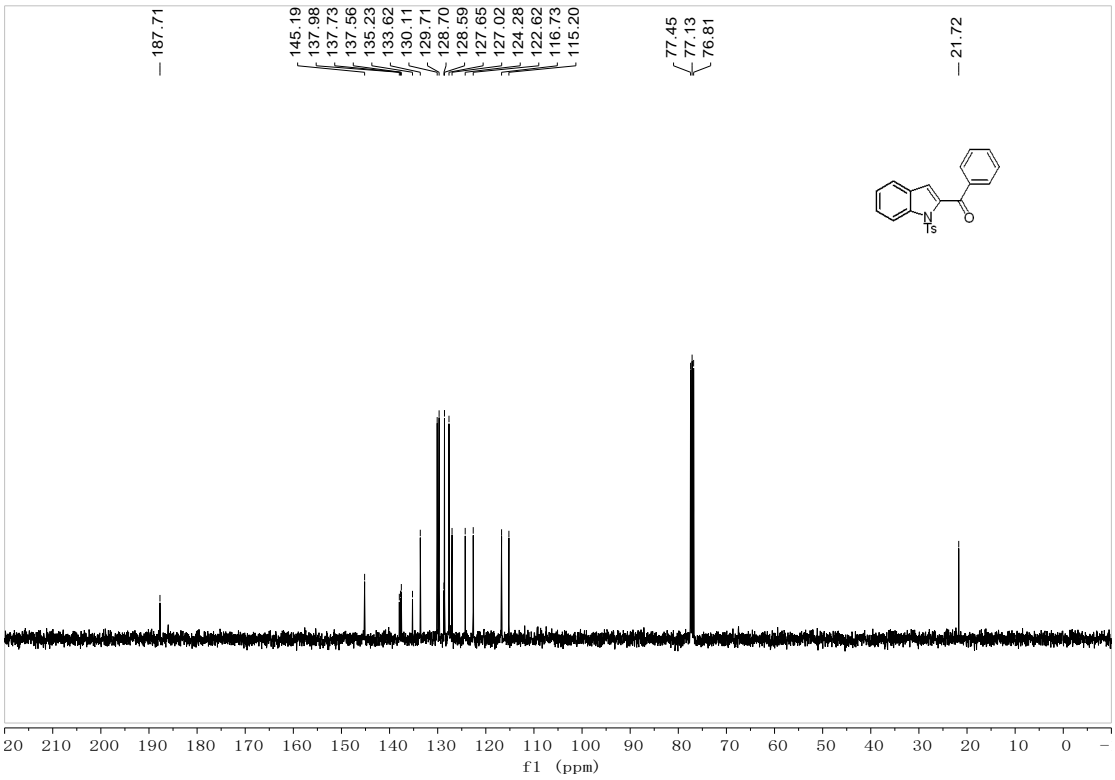
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **13y**



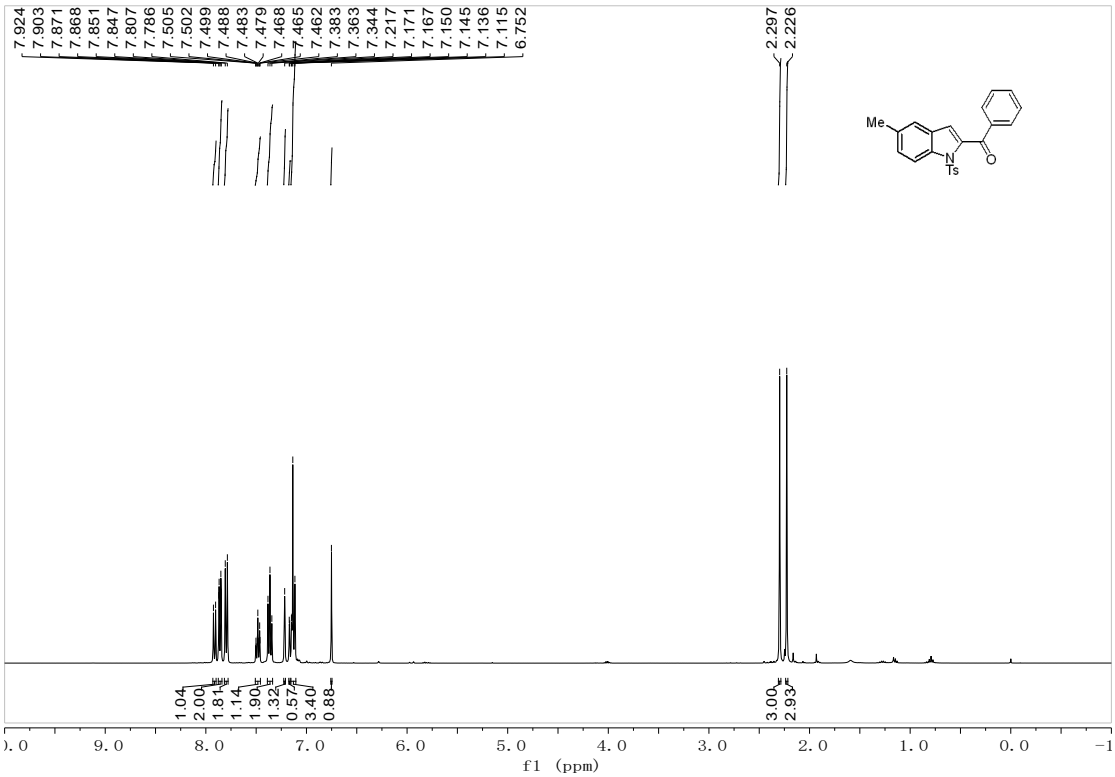
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14a**



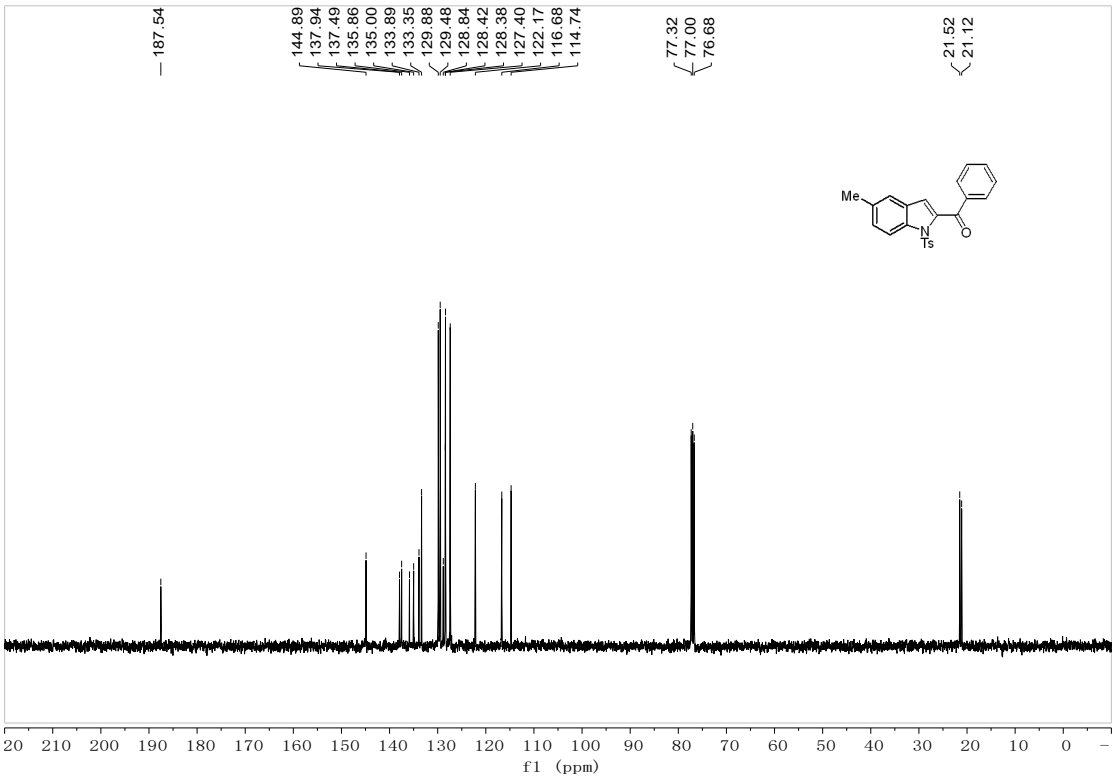
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14a**



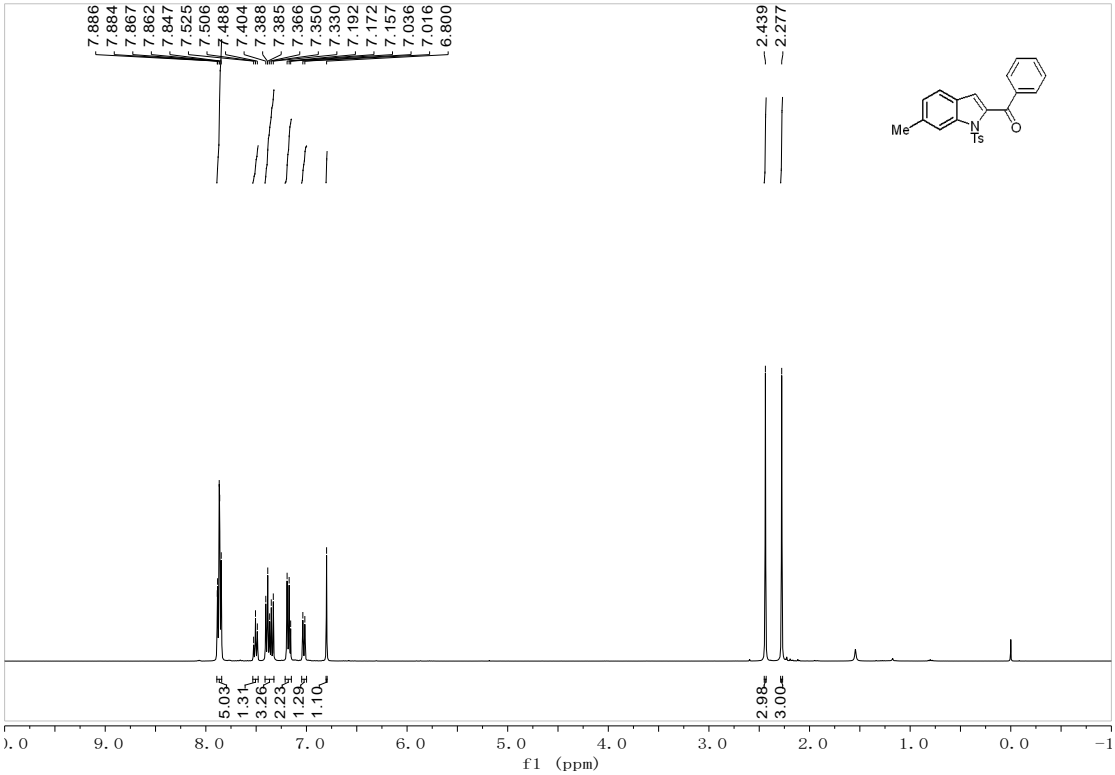
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14b**



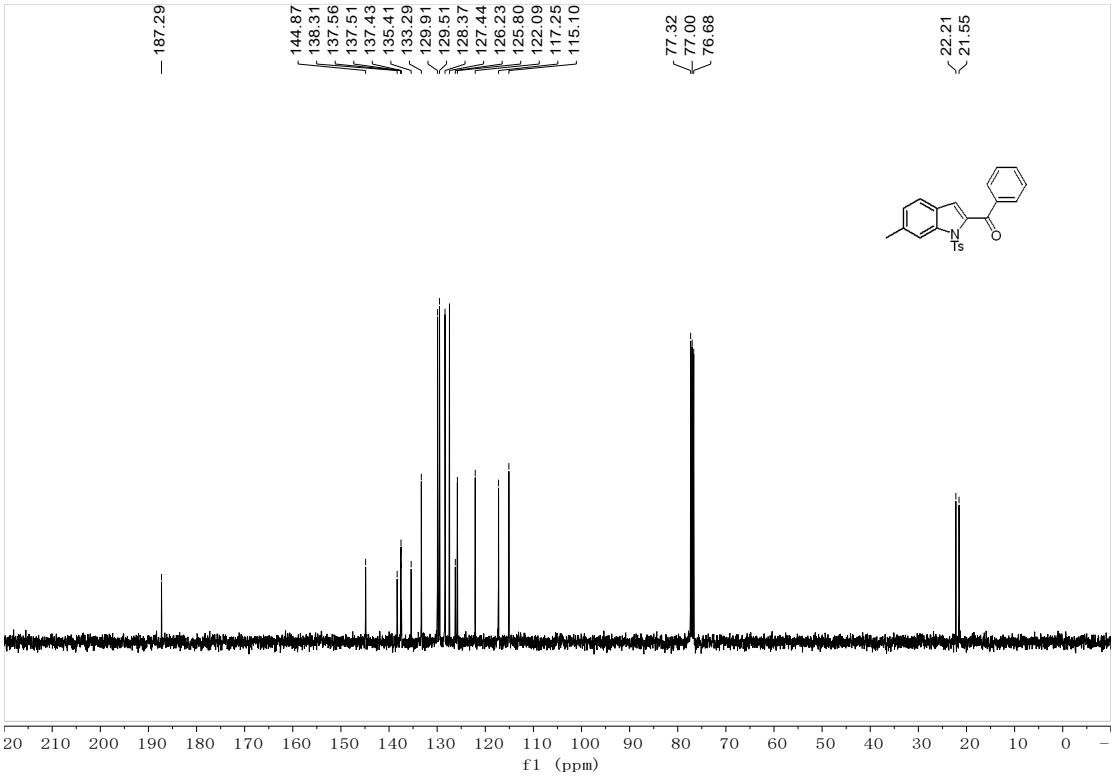
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14b**



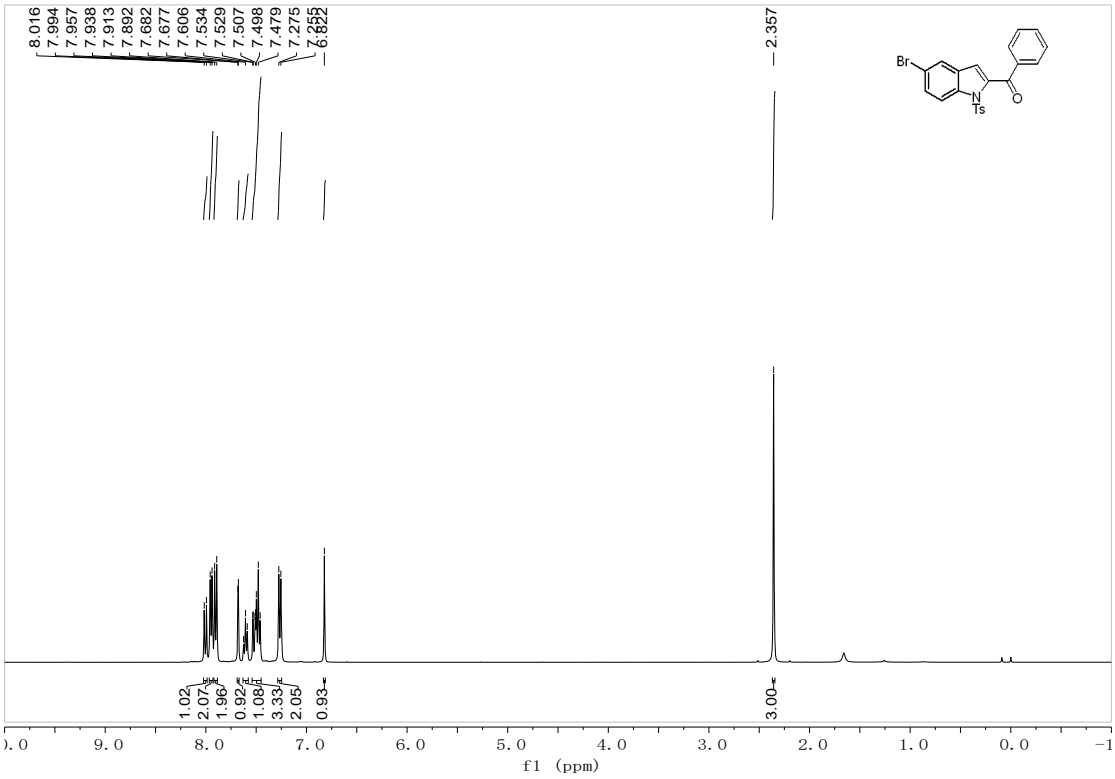
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14c**



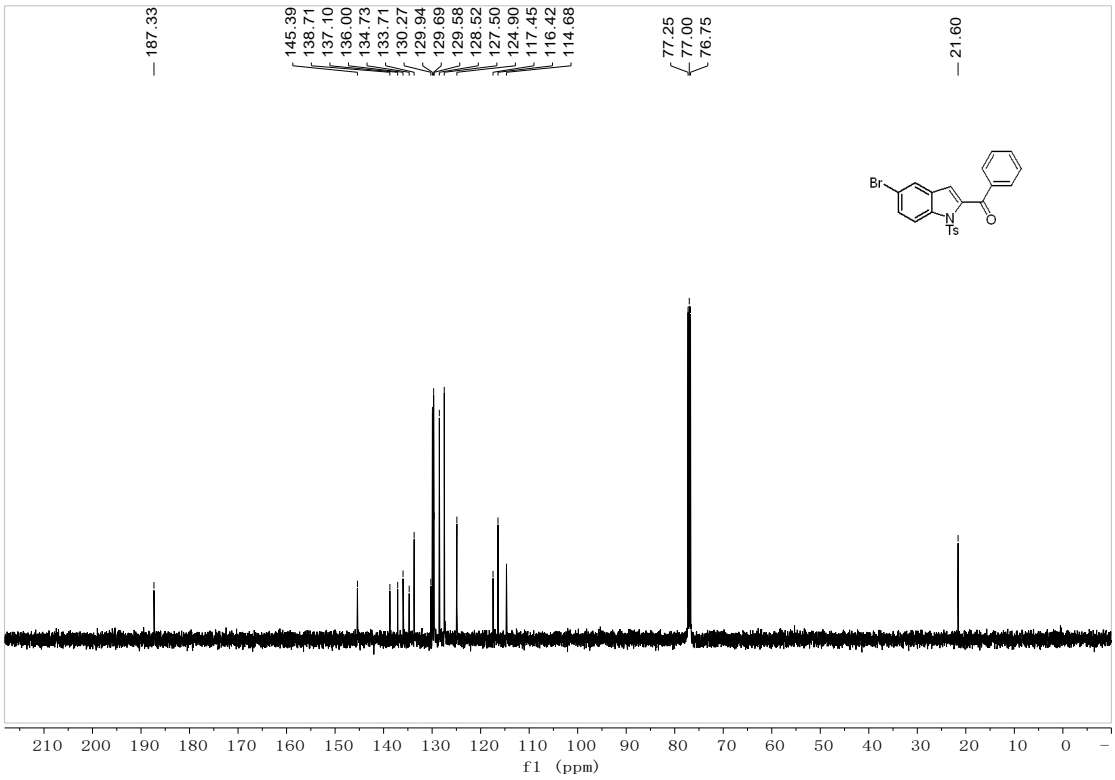
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14c**



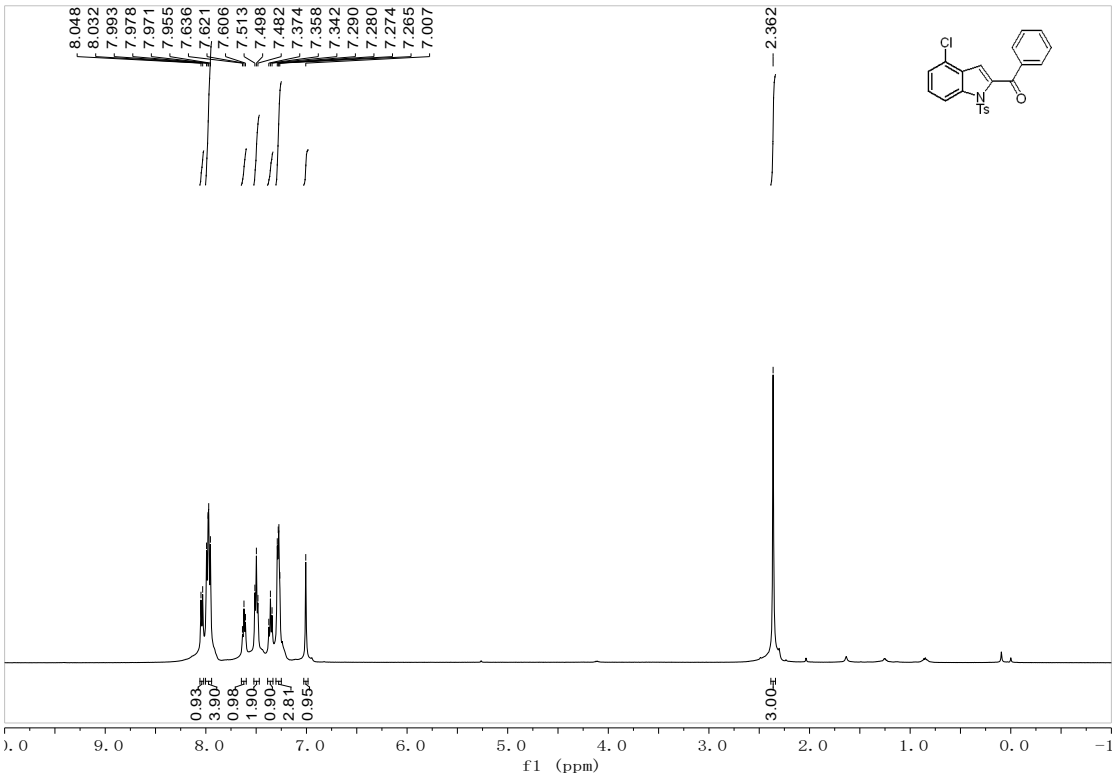
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14d**



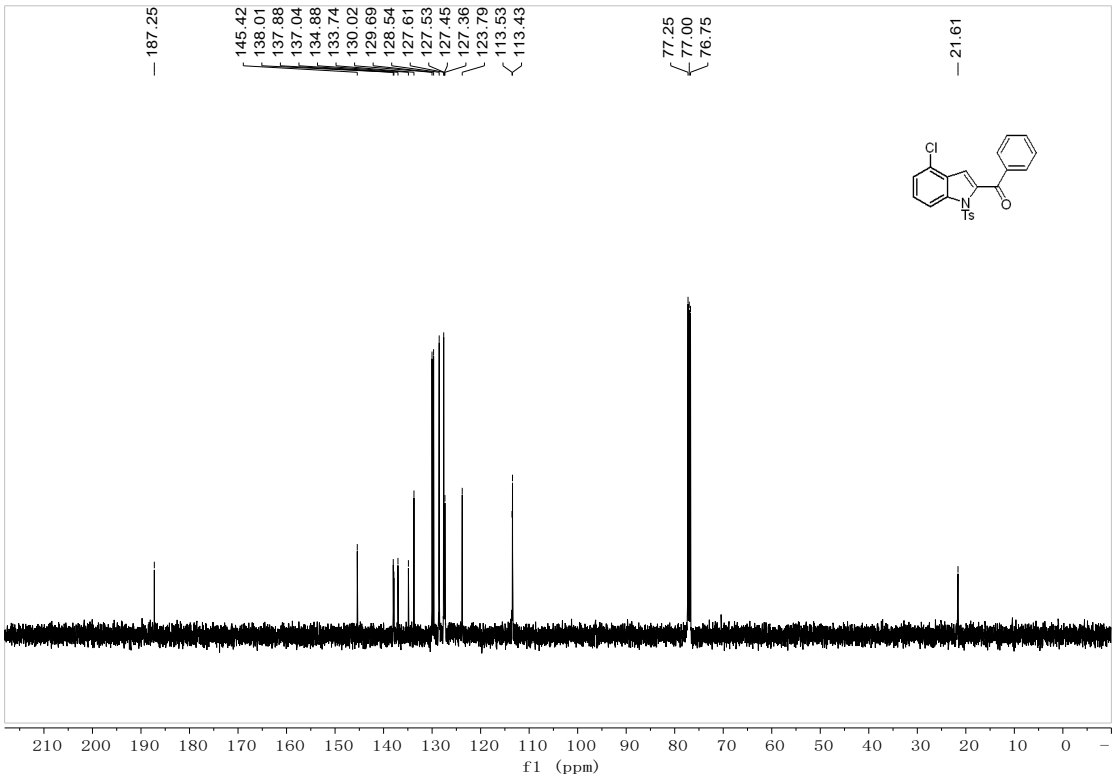
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14d**



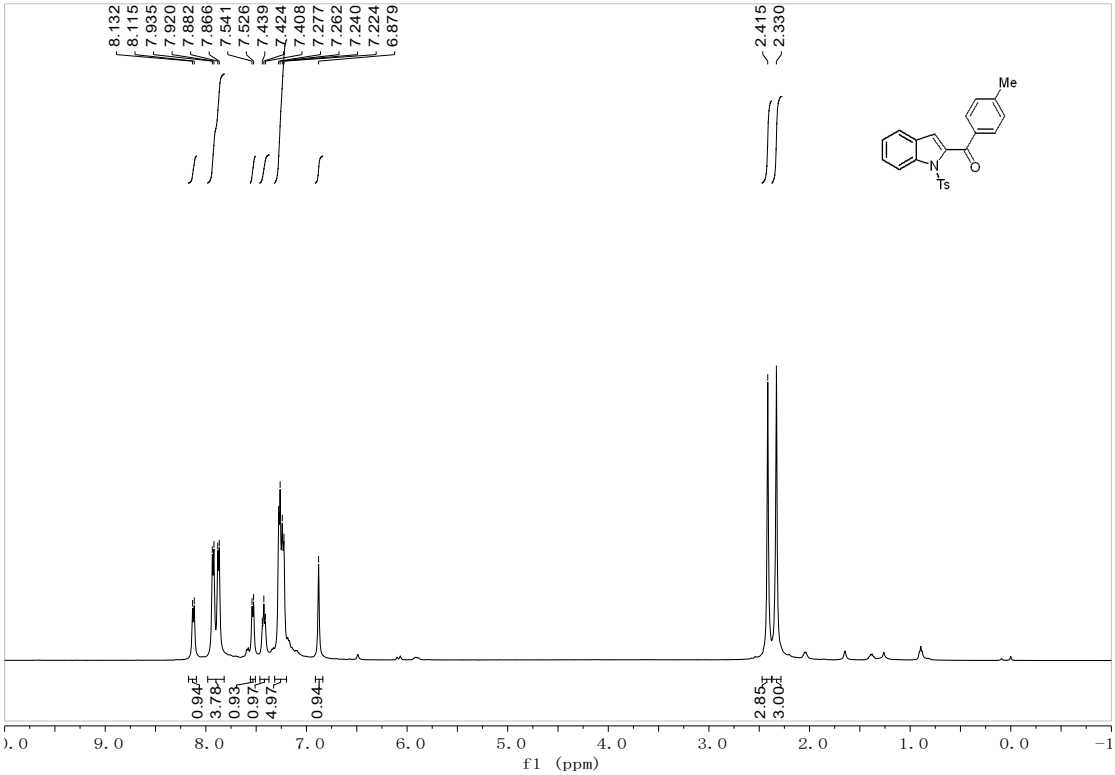
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14e**



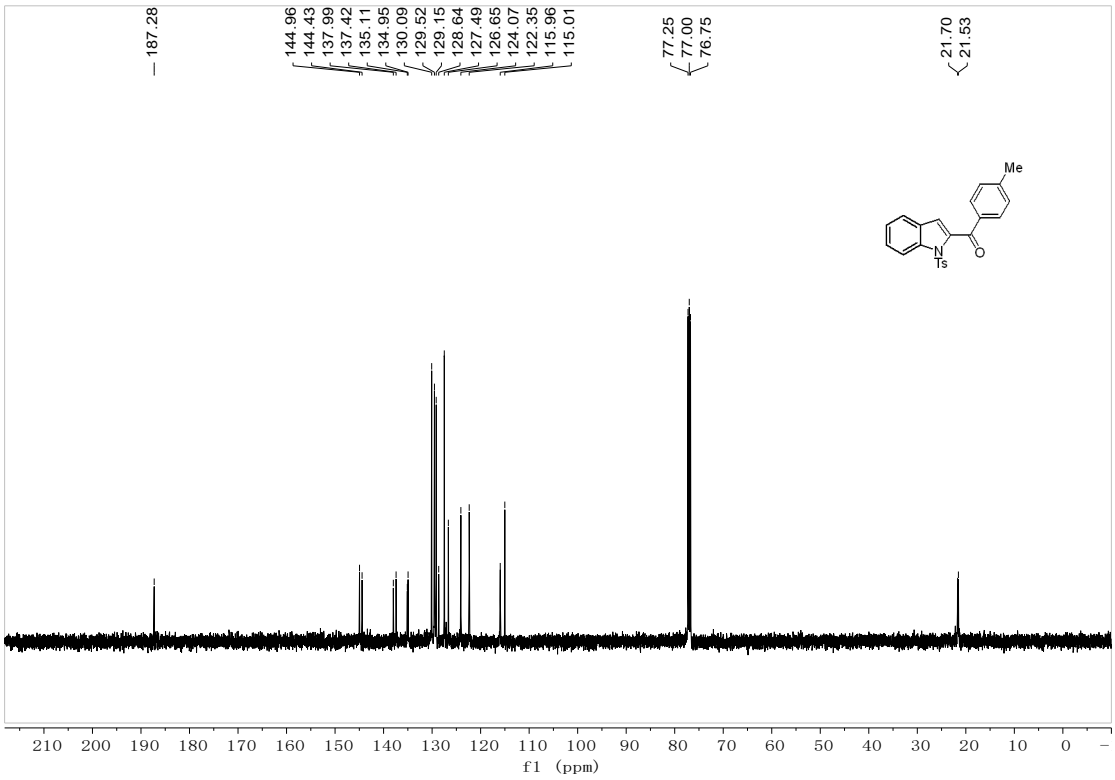
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14e**



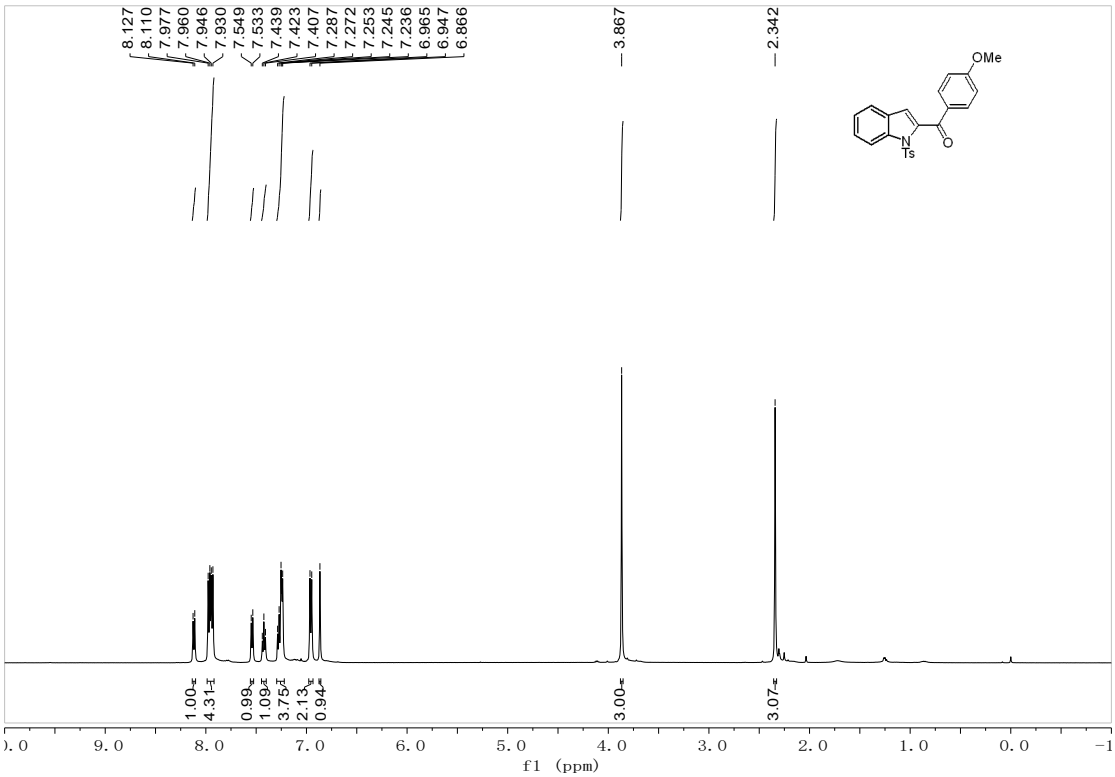
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14f**



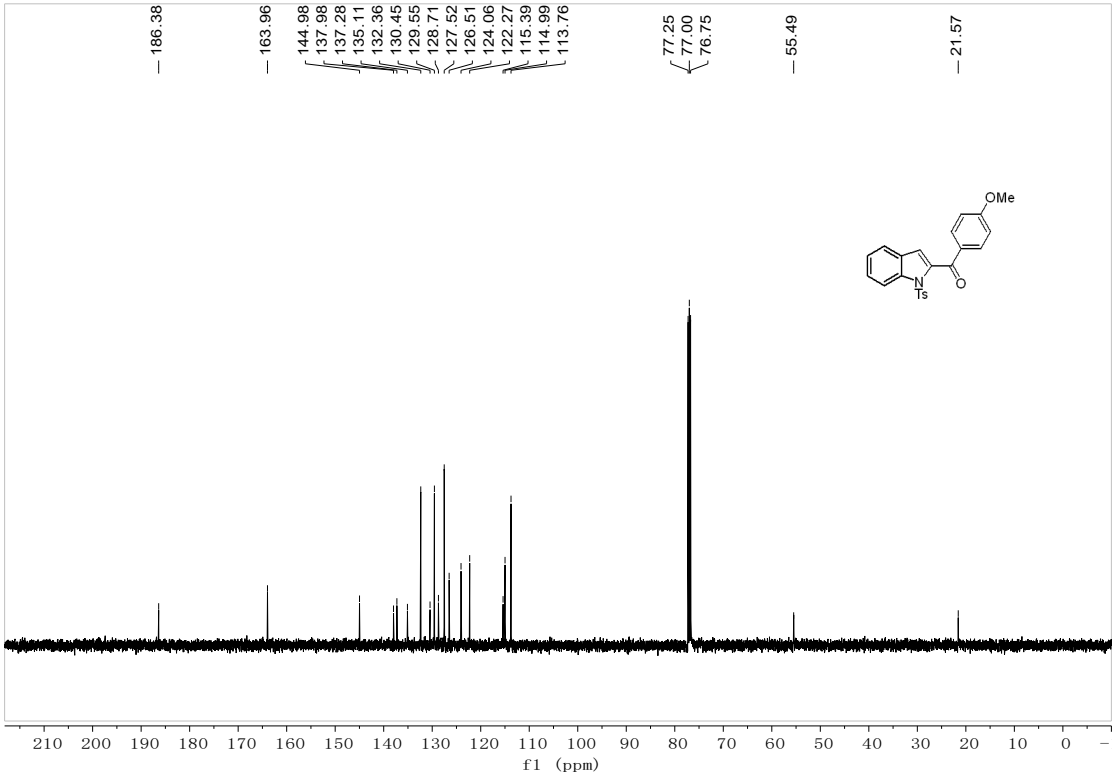
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14f**



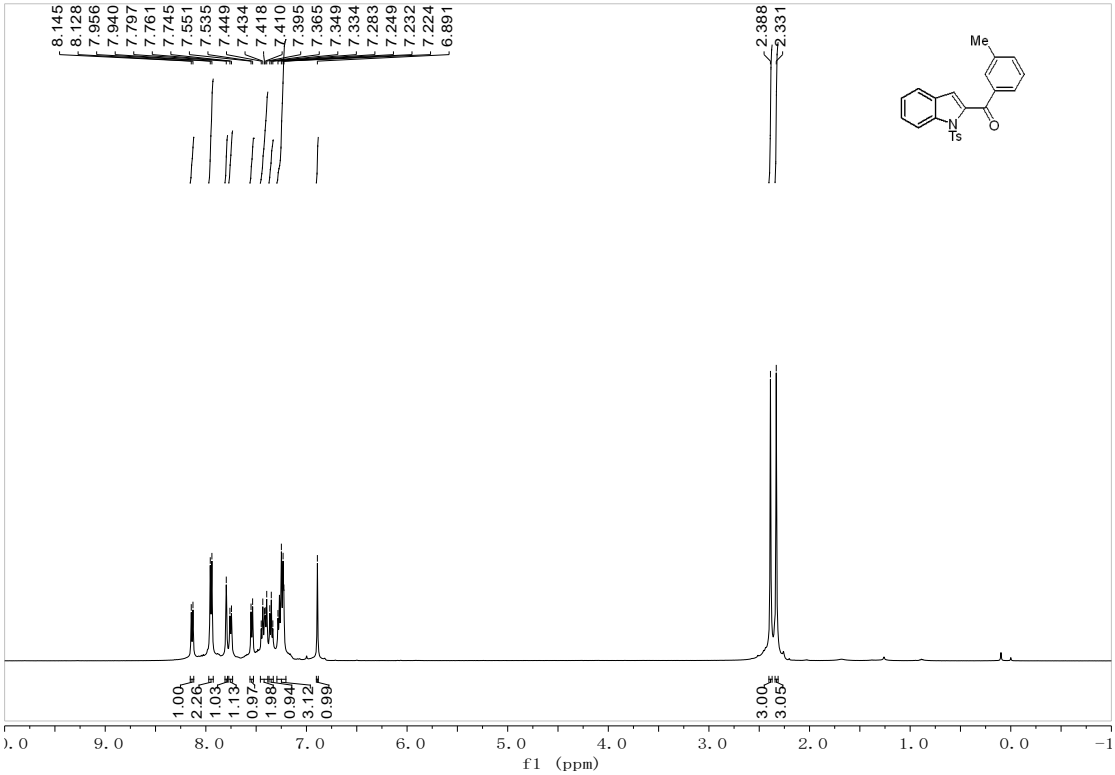
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14g**



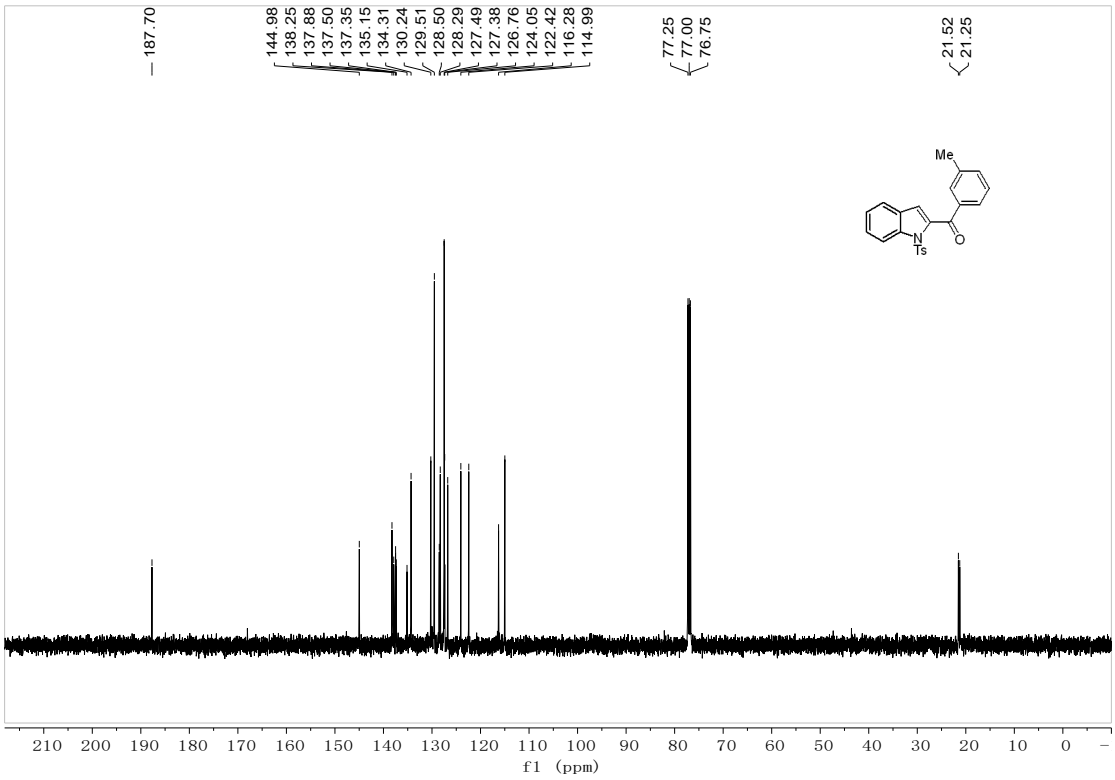
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14g**



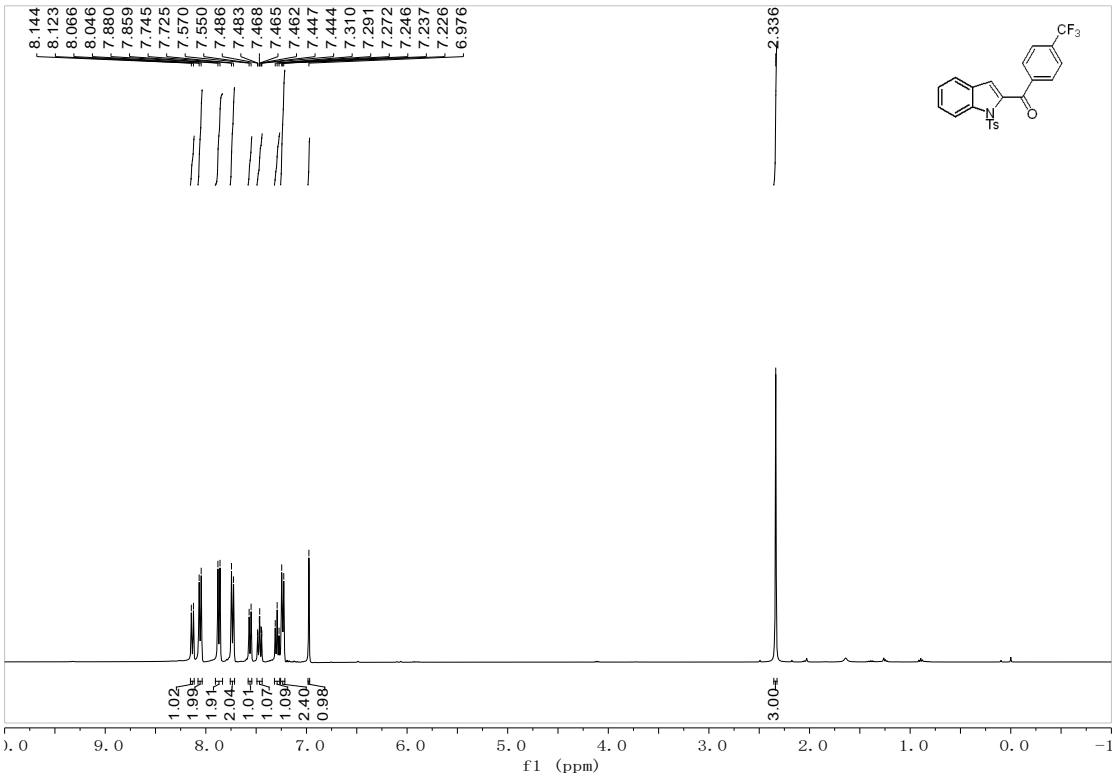
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14h**



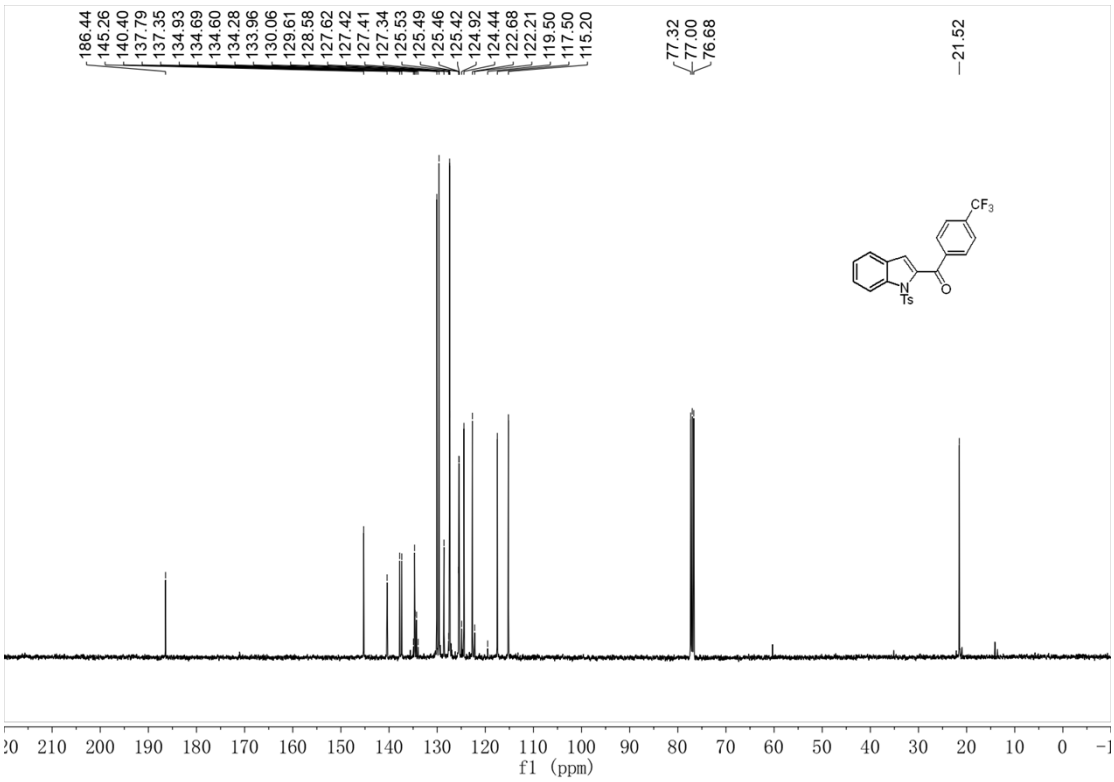
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14h**



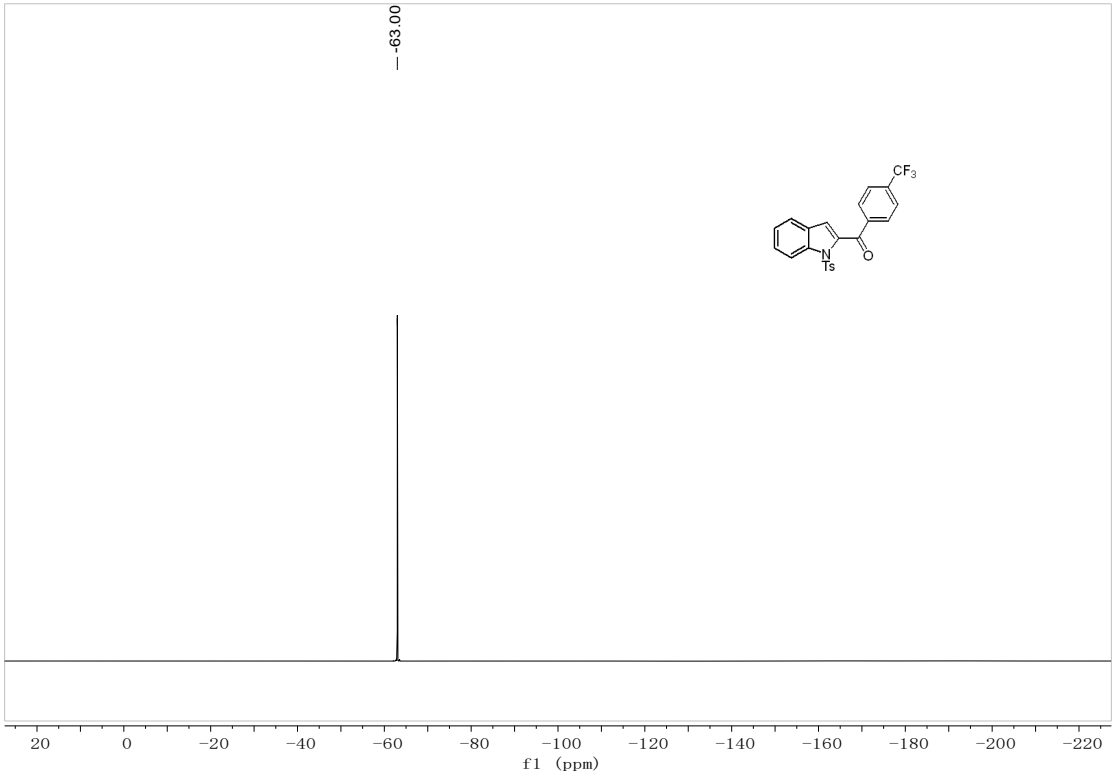
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14i**



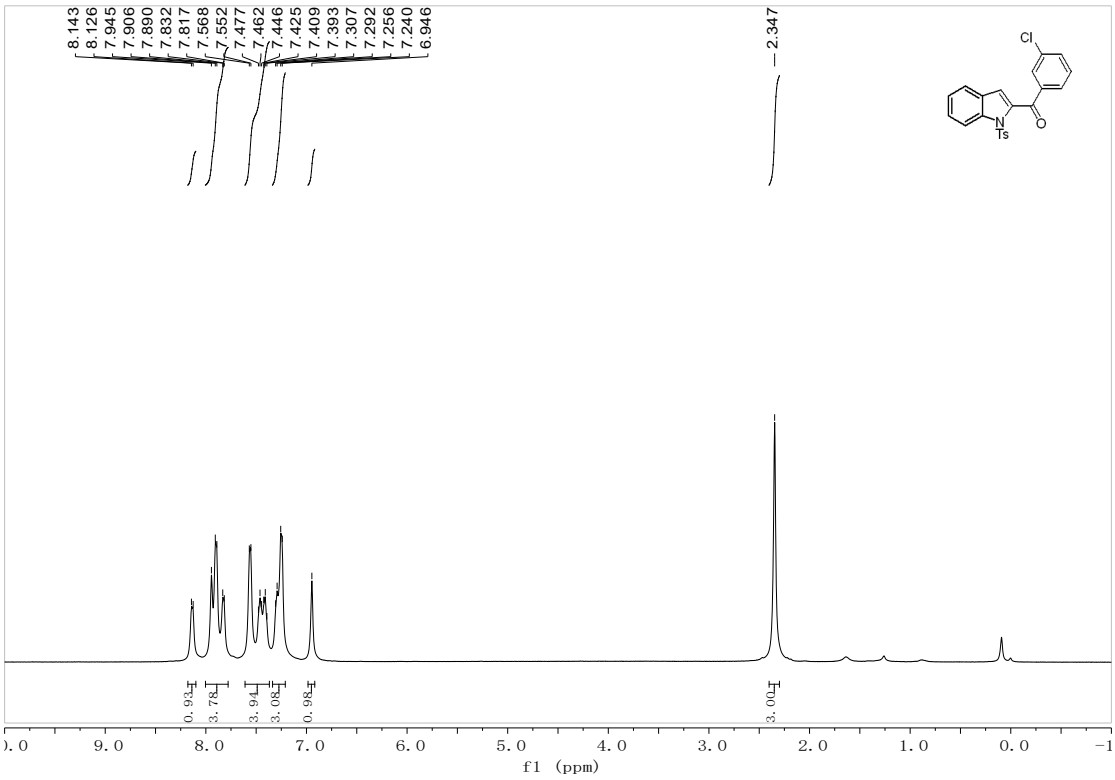
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14i**



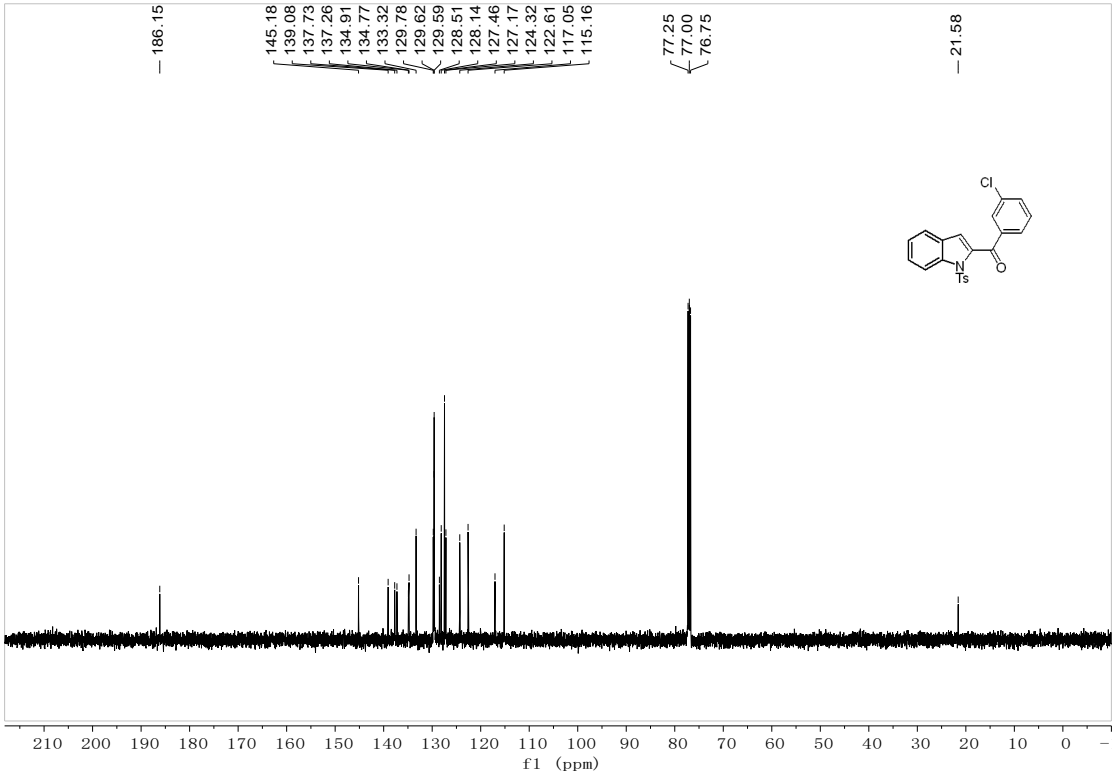
^{19}F NMR (376 MHz, $CDCl_3$) spectroscopy of **14i**



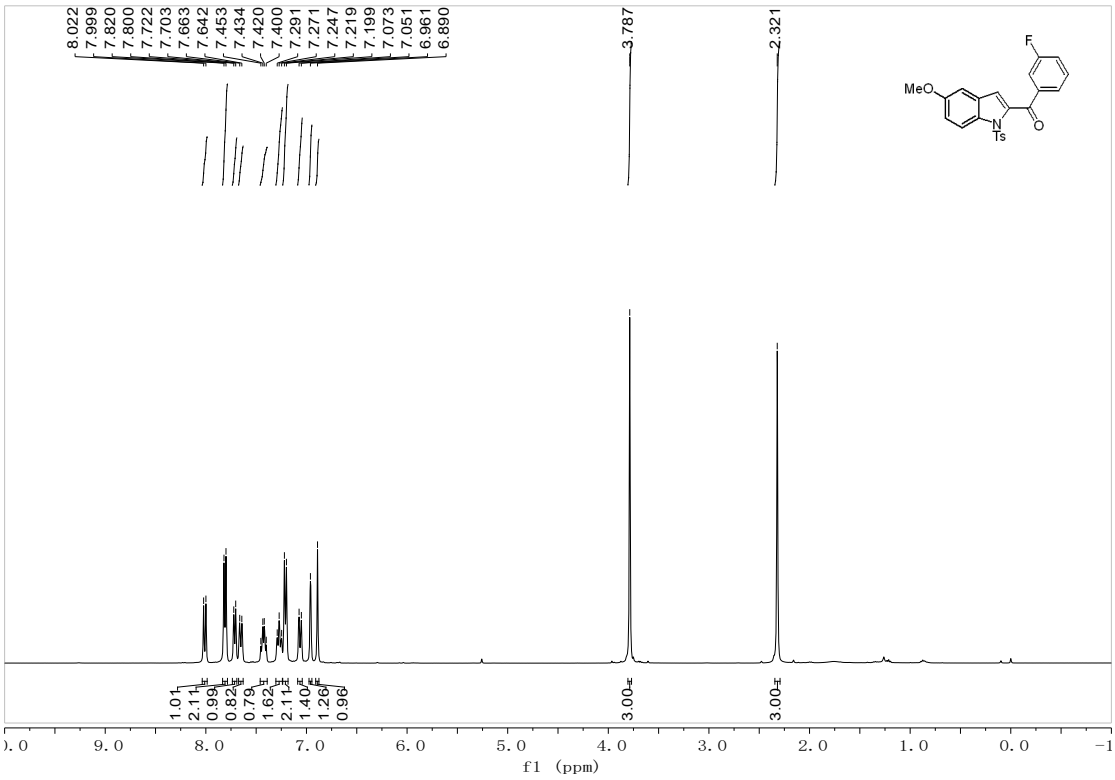
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14j**



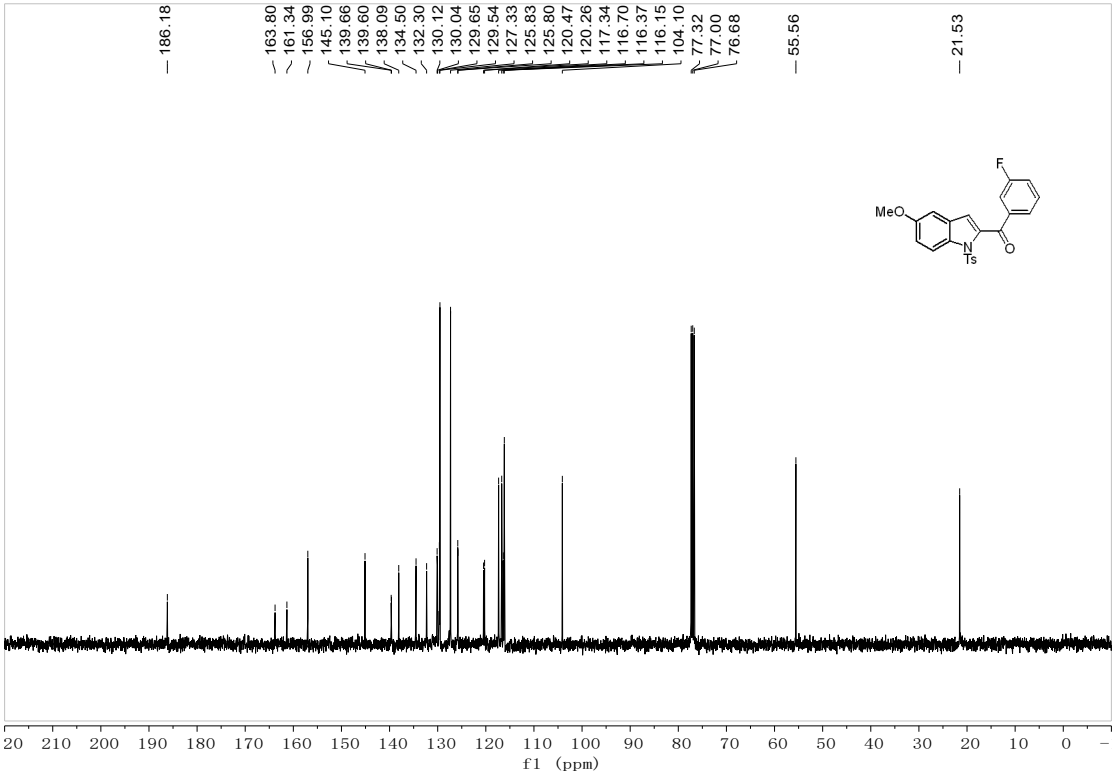
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14j**



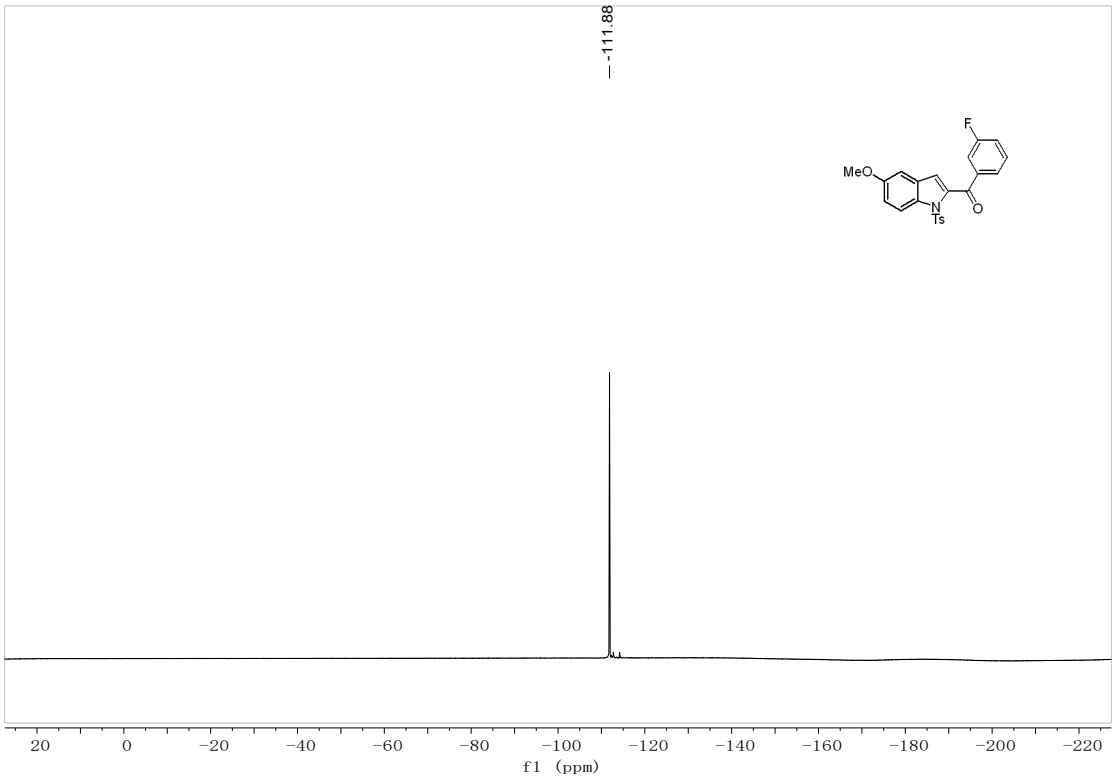
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14k**



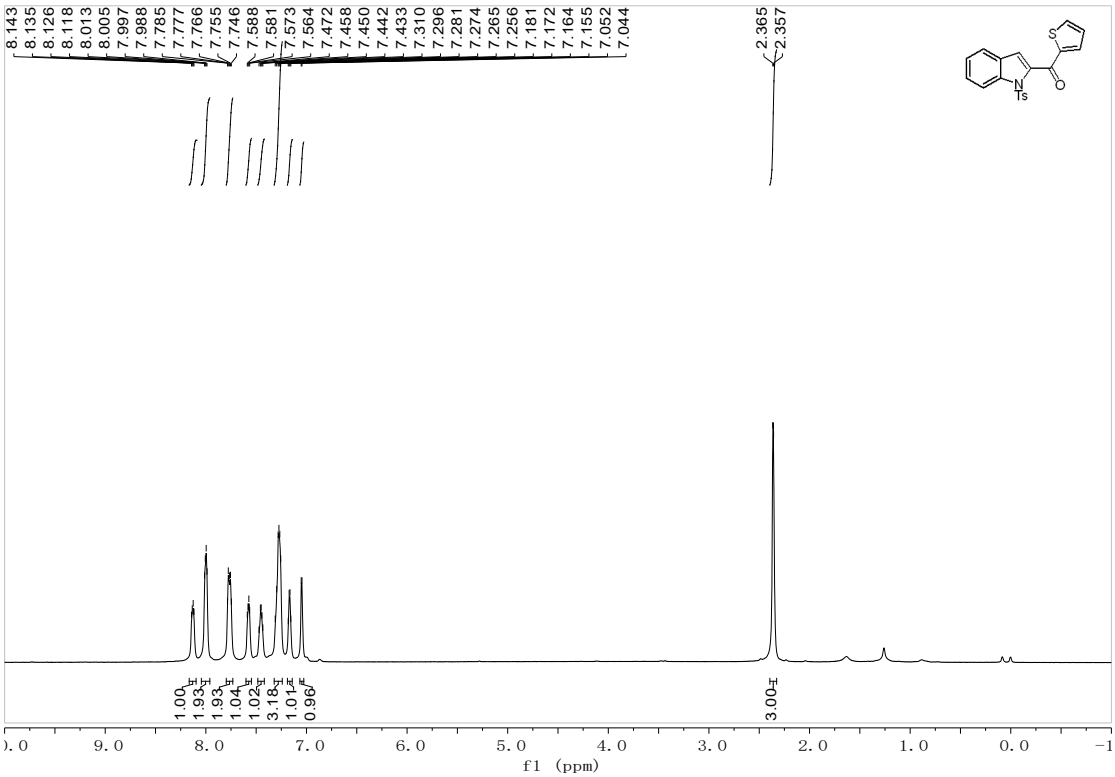
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14k**



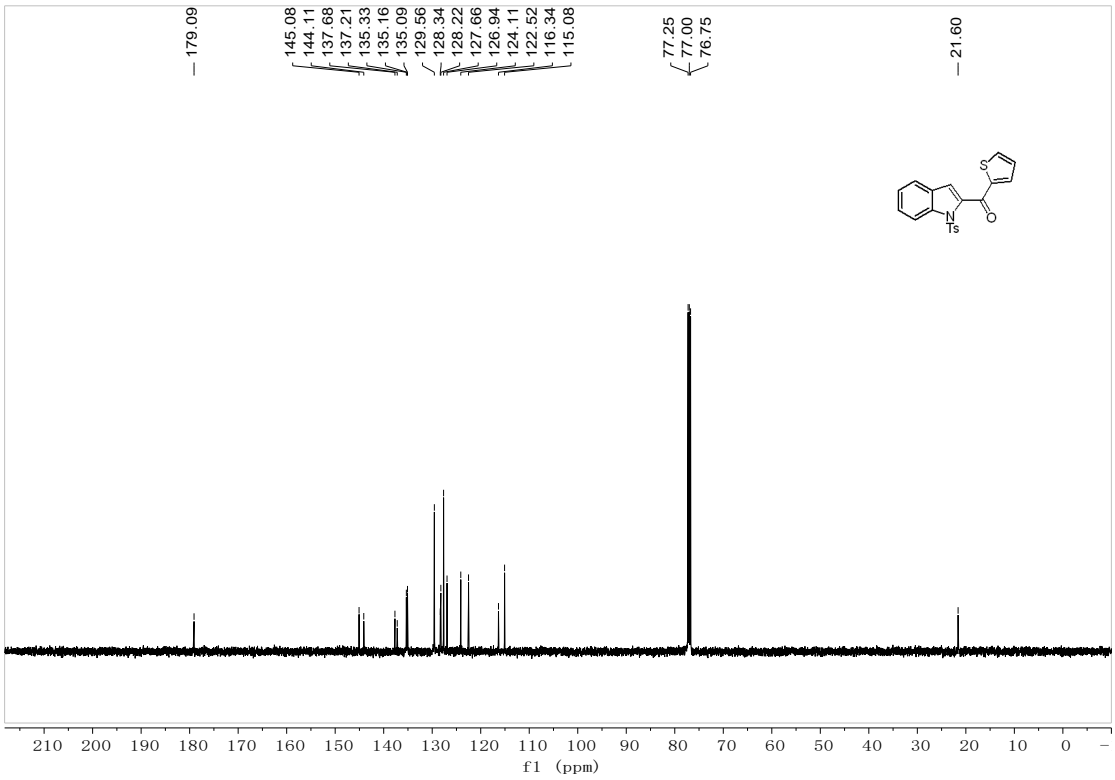
^{19}F NMR (376 MHz, $CDCl_3$) spectroscopy of **14k**



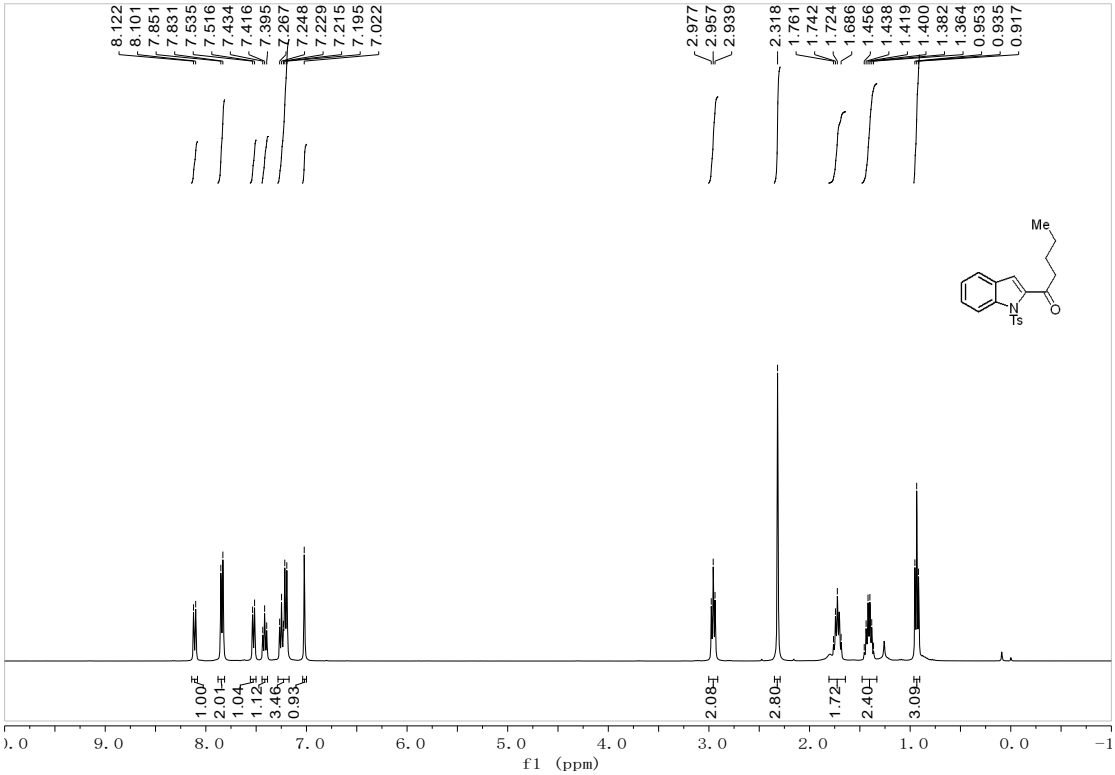
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14l**



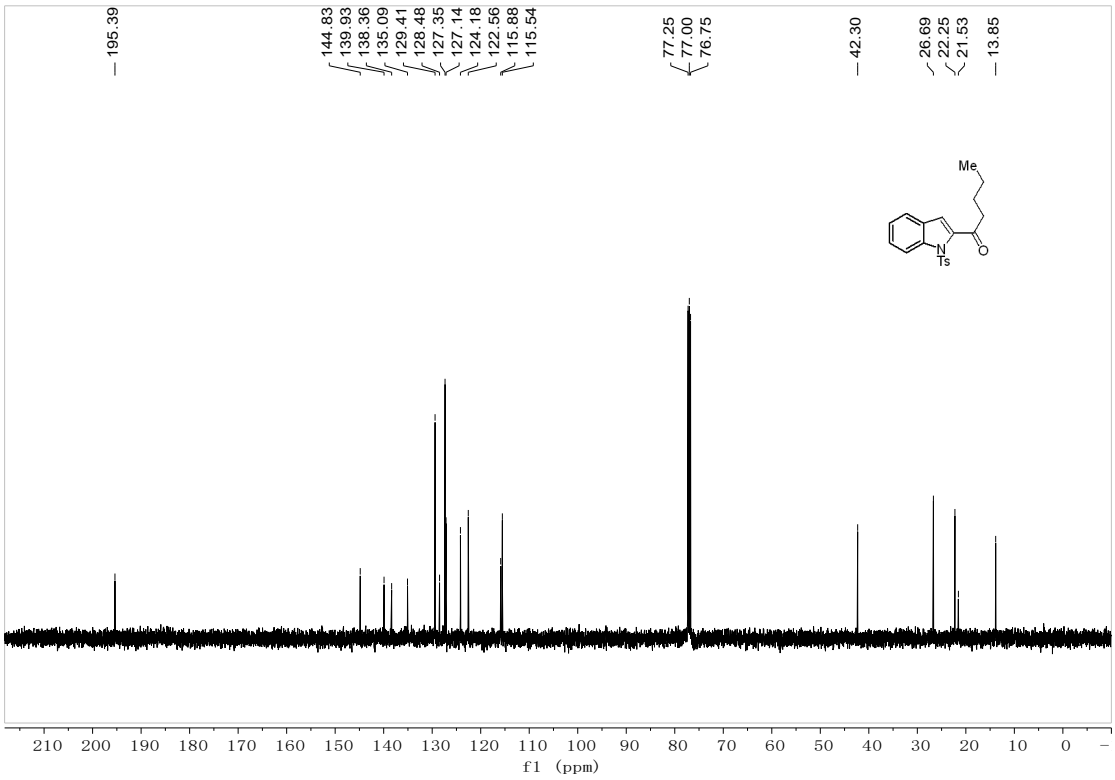
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14l**



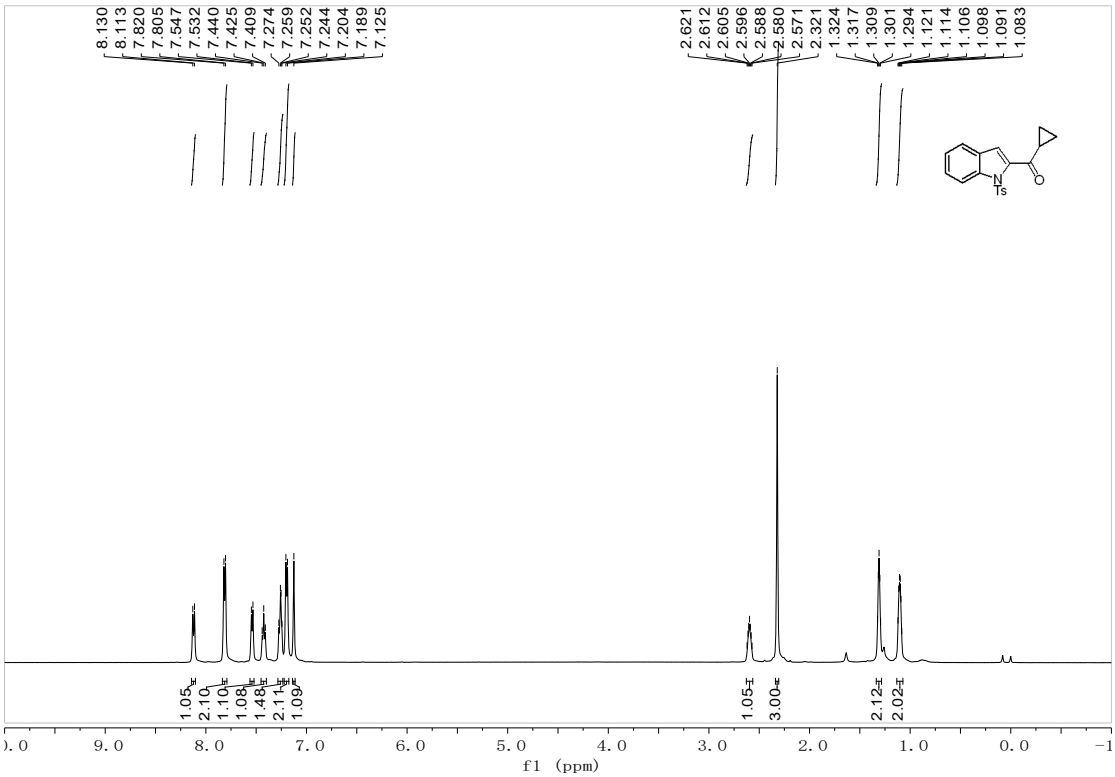
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14m**



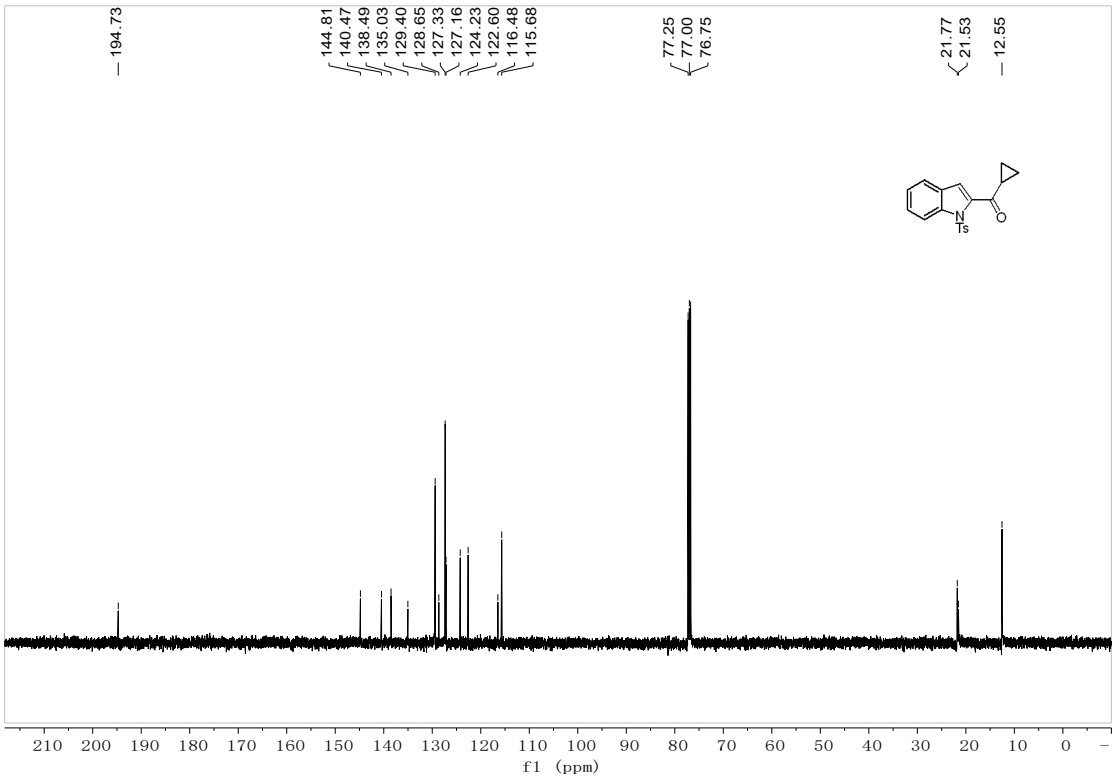
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14m**



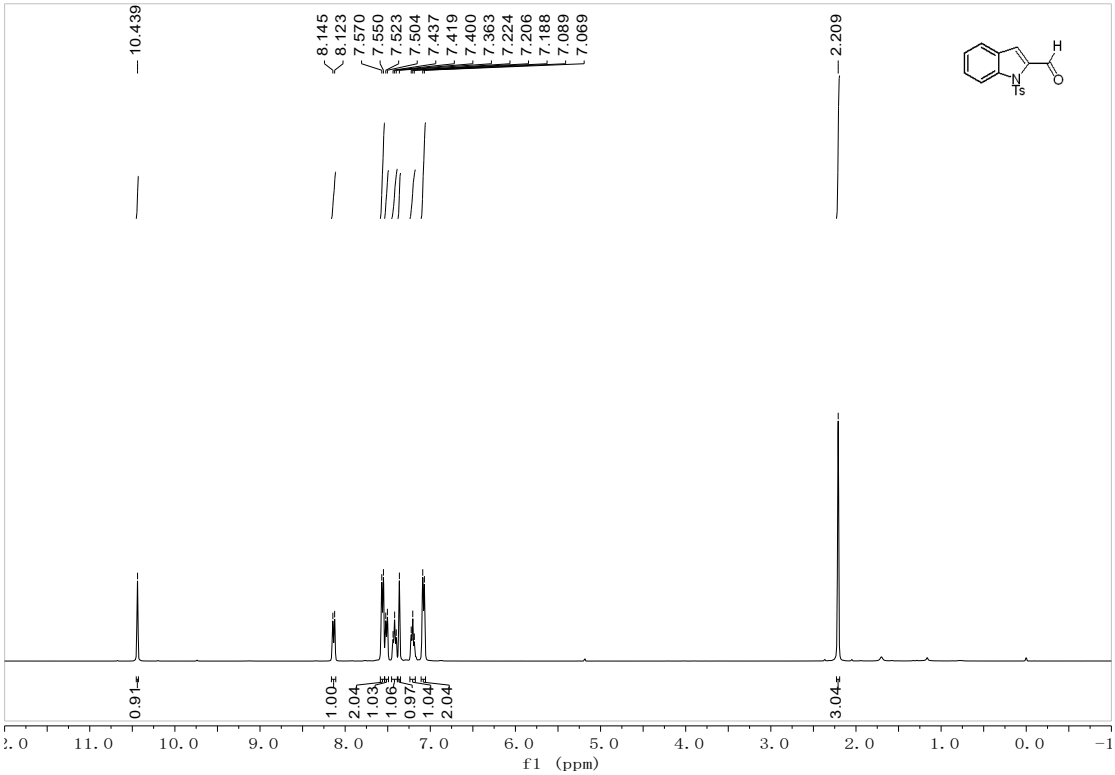
^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **14n**



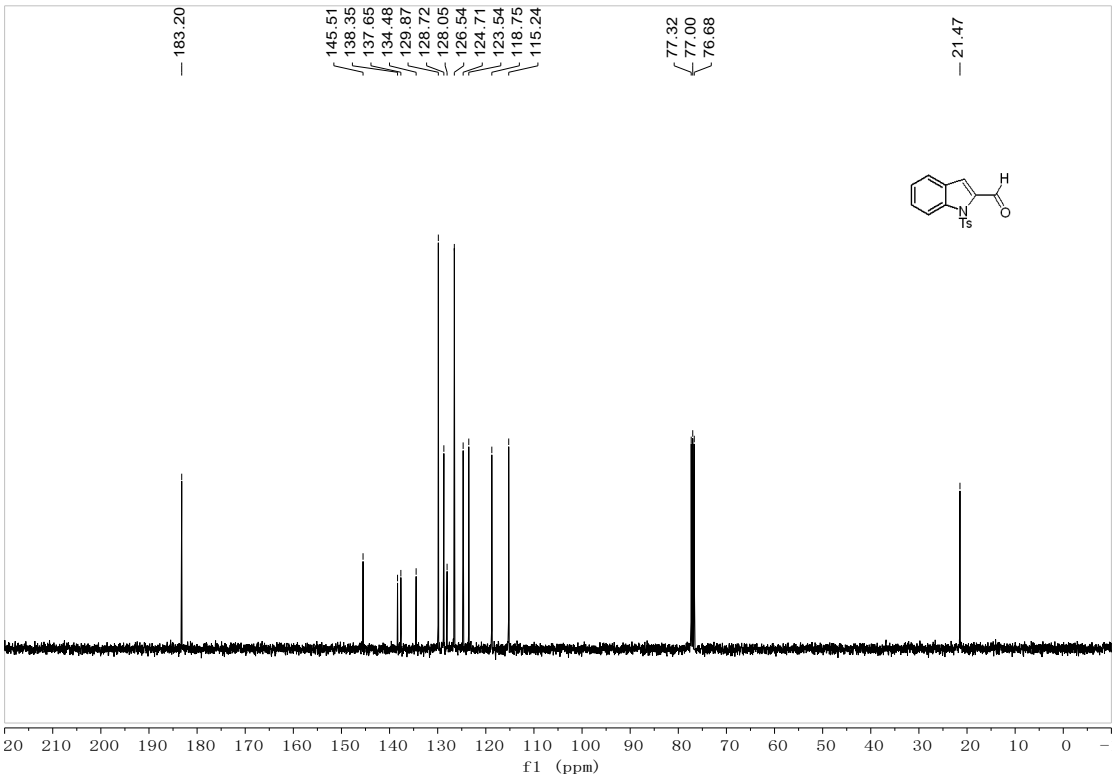
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14n**



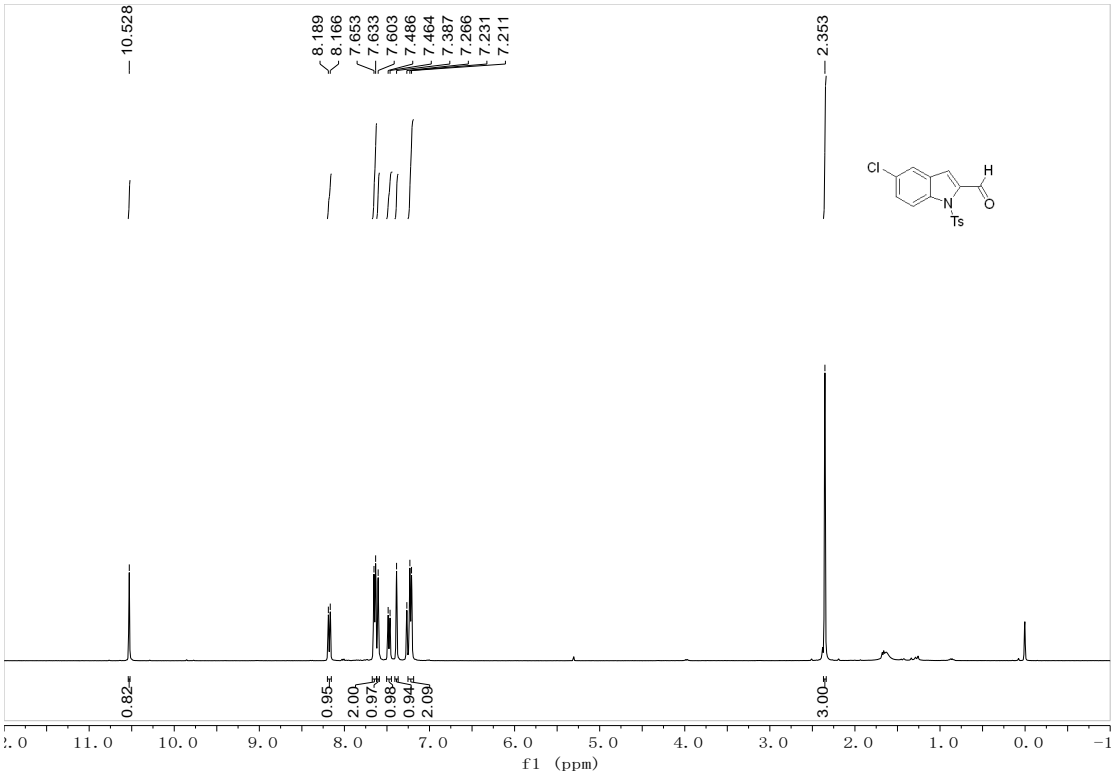
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14o**



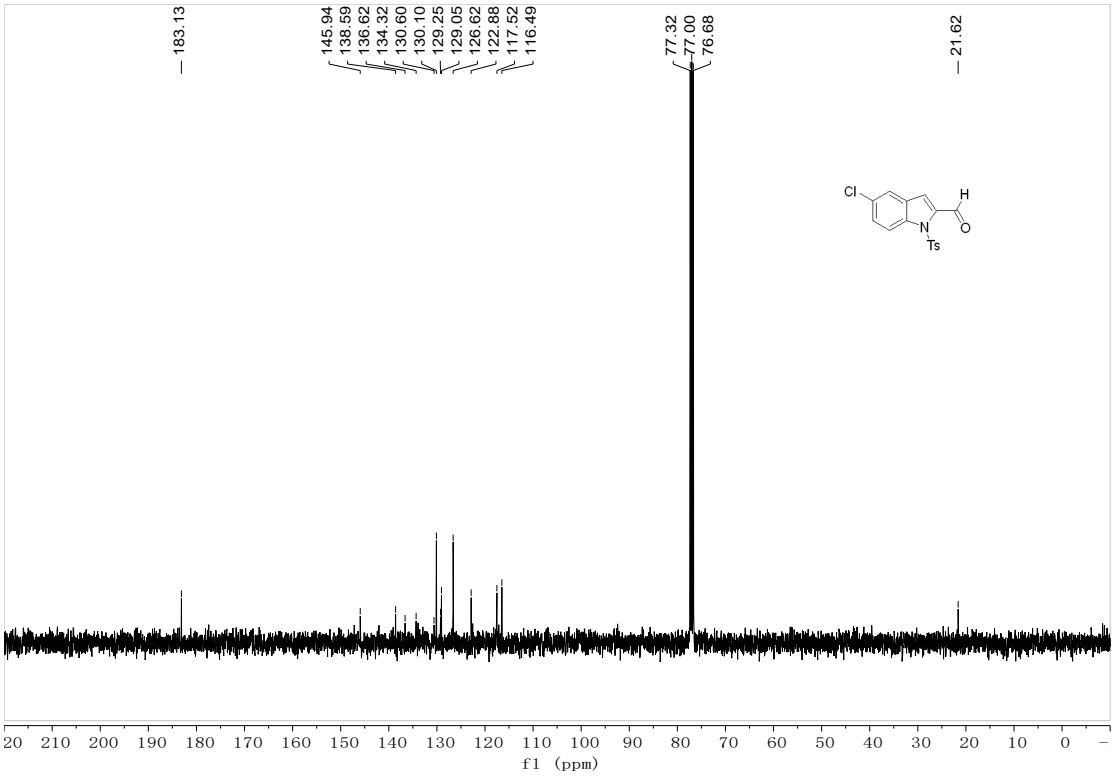
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14o**



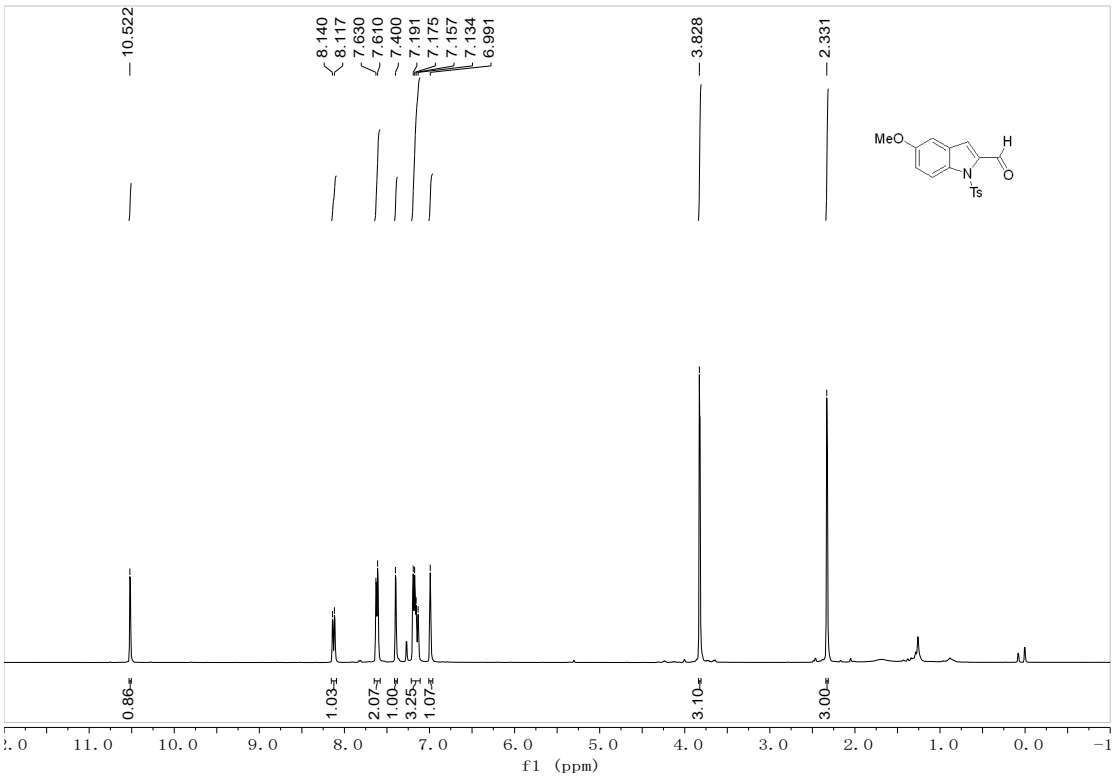
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14p**



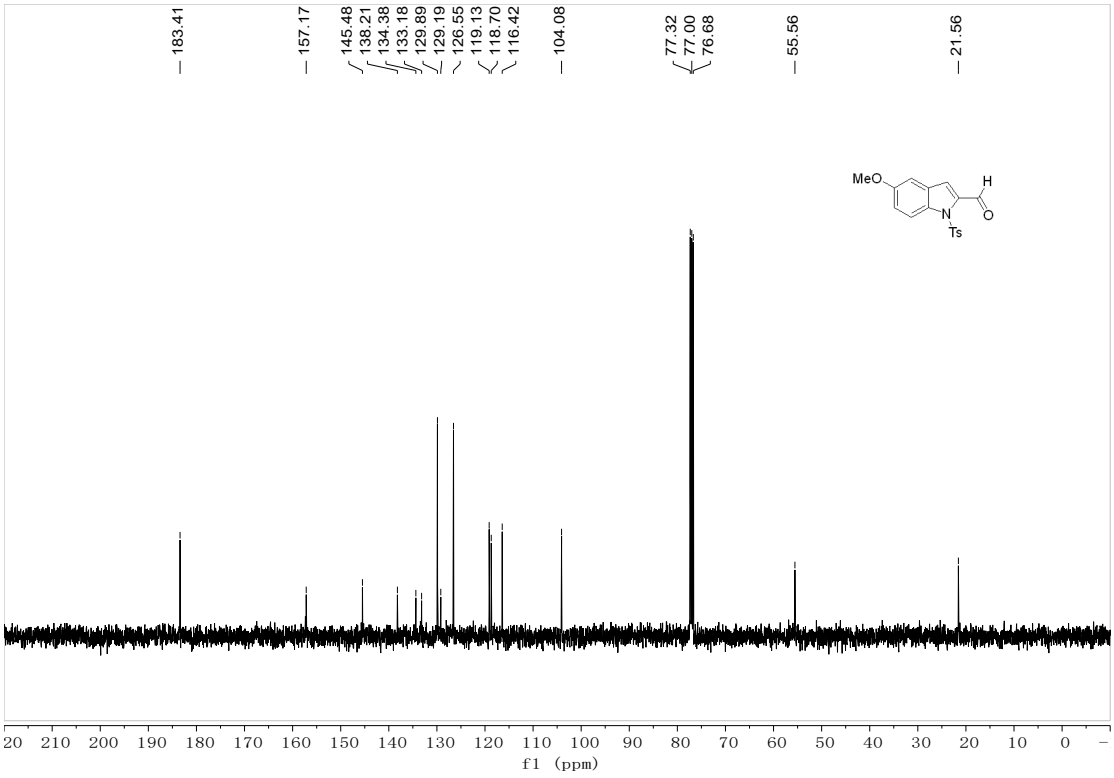
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14p**



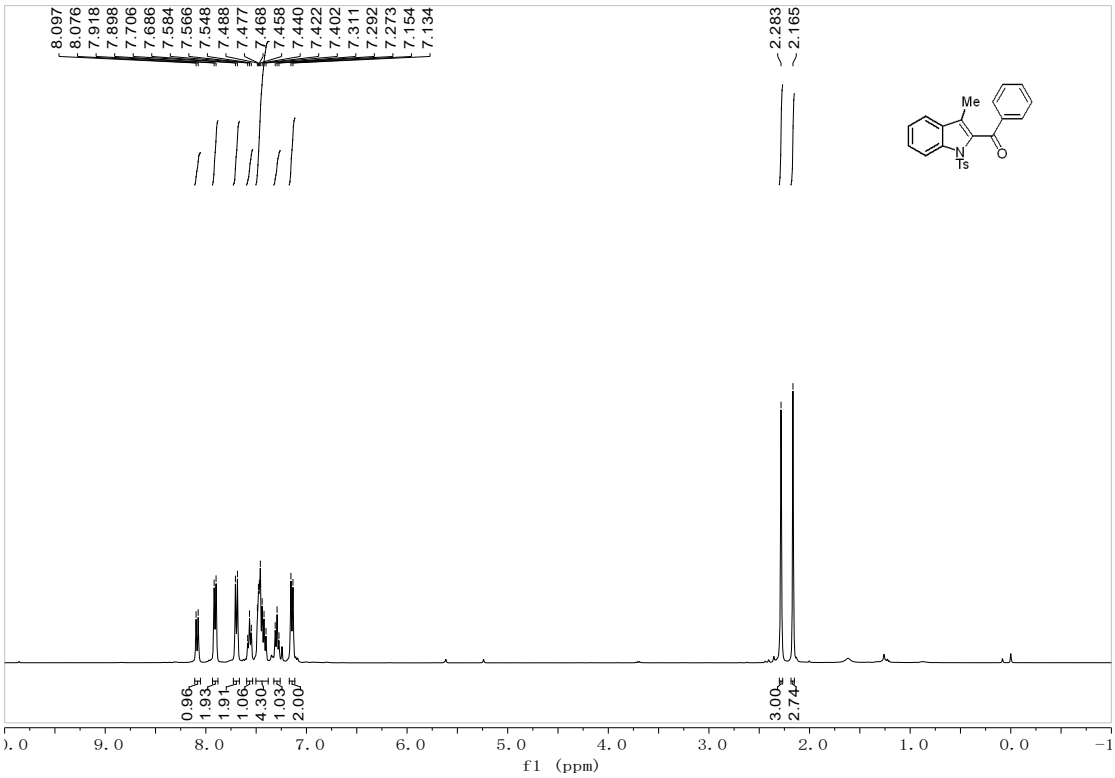
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14q**



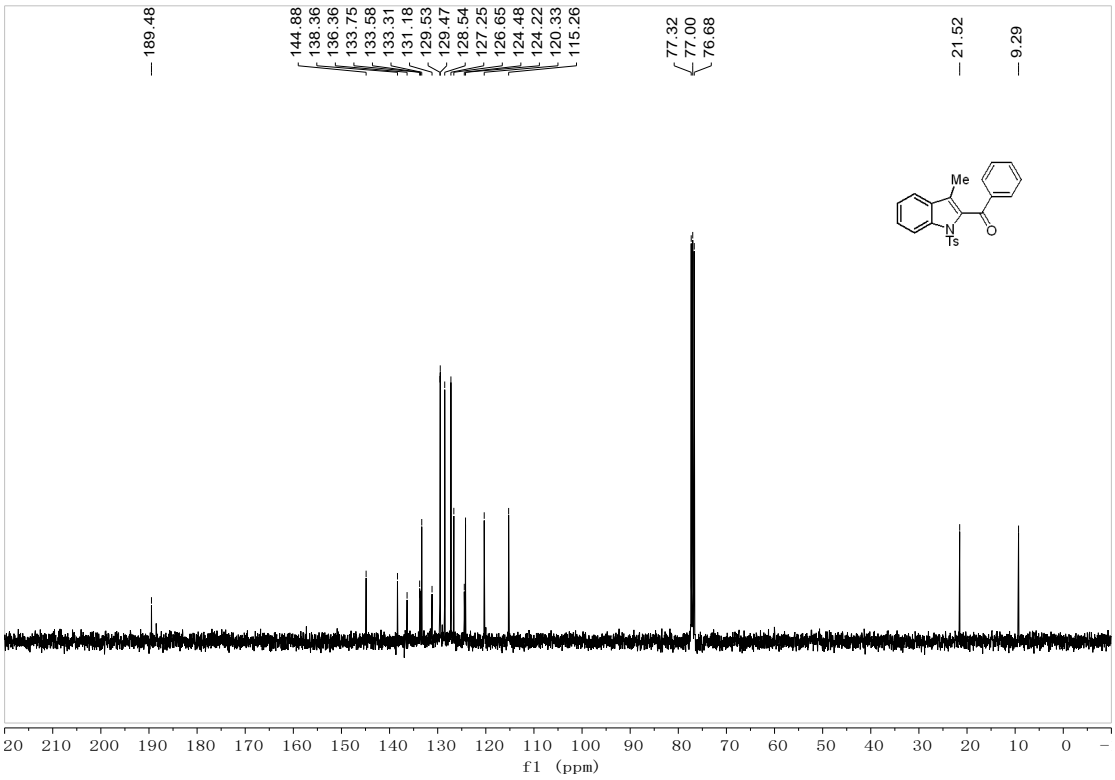
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14q**



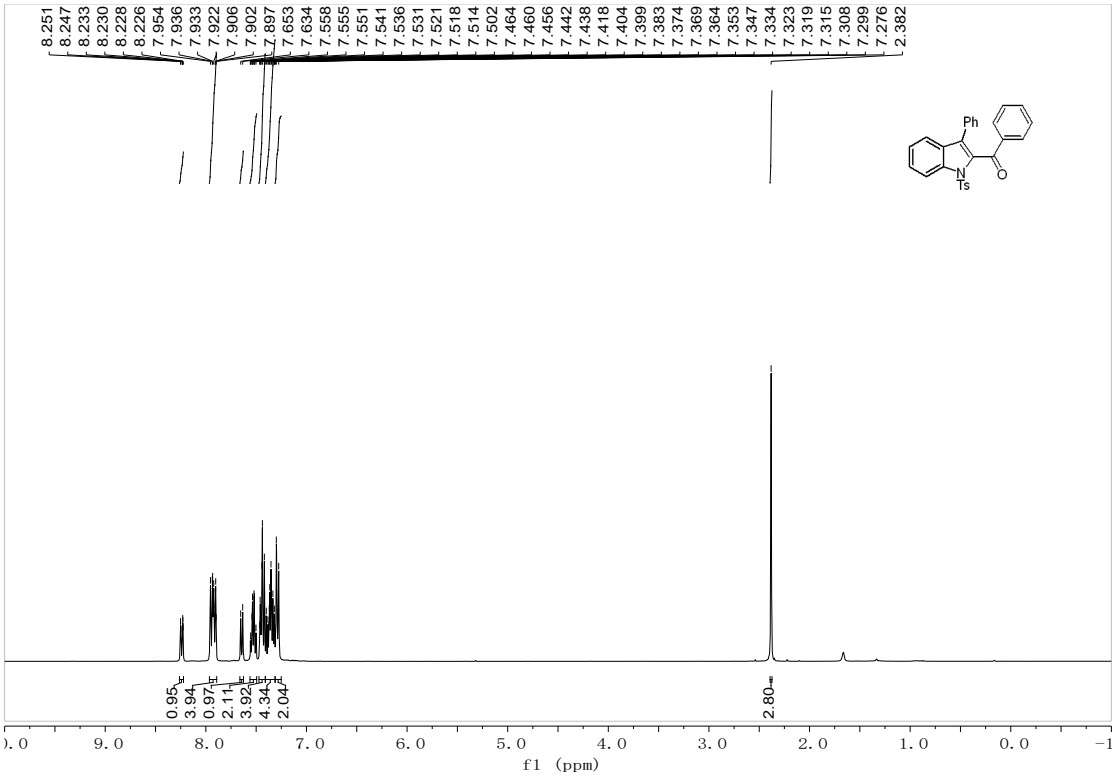
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14r**



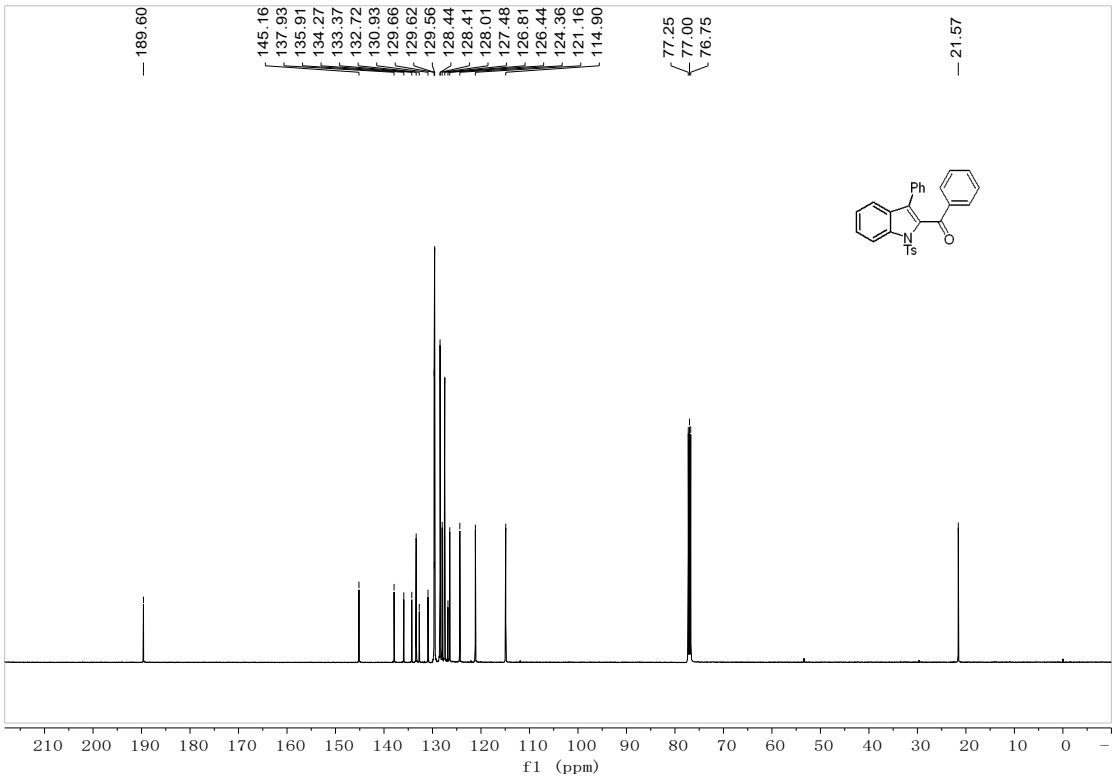
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14r**



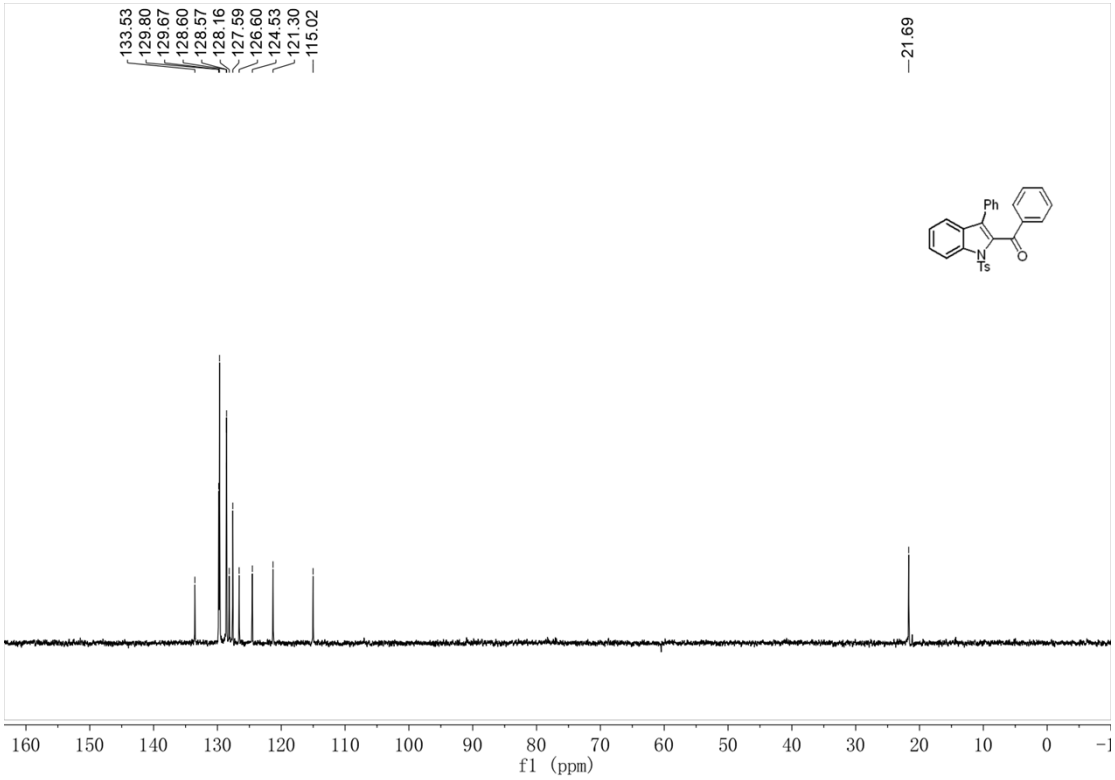
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14s**



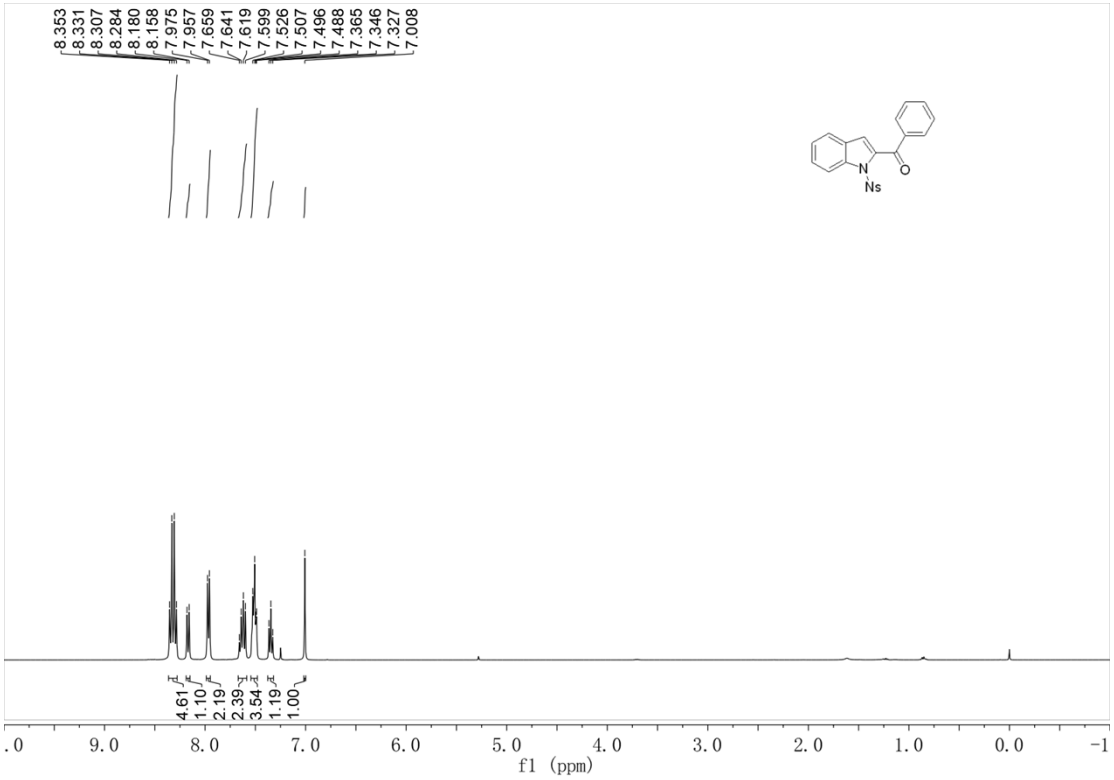
^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **14s**



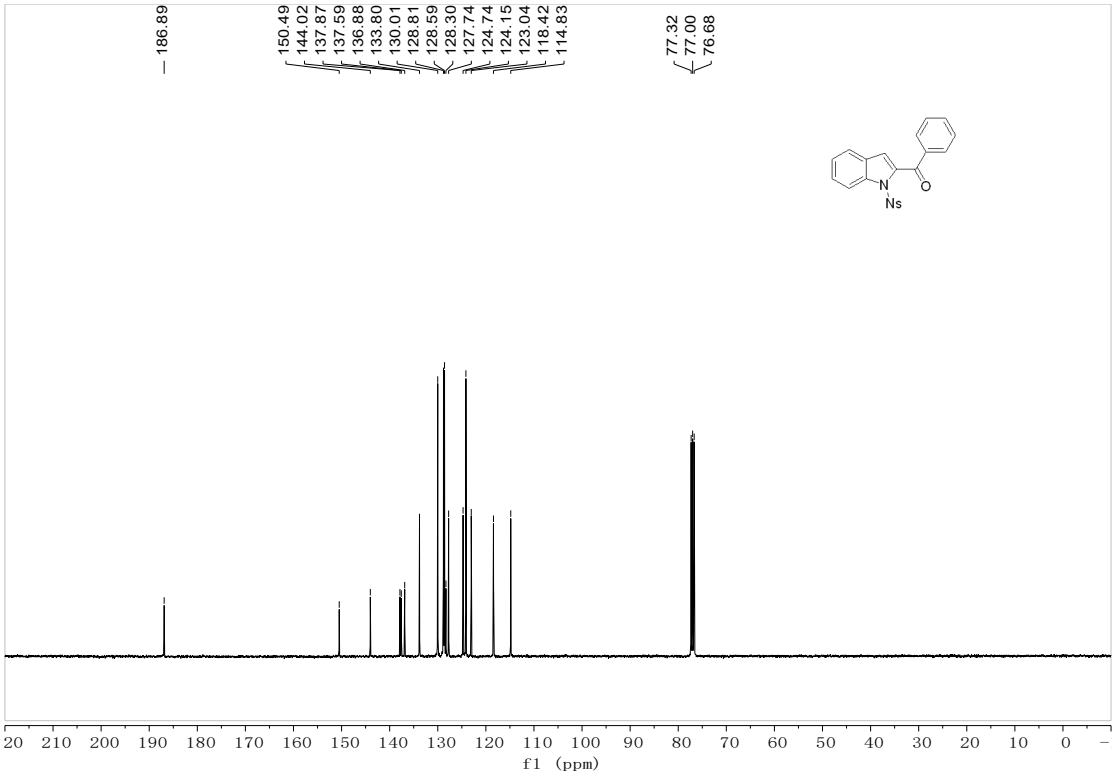
DEPT (θ =135°, 100 MHz, $CDCl_3$) spectroscopy of **14s**



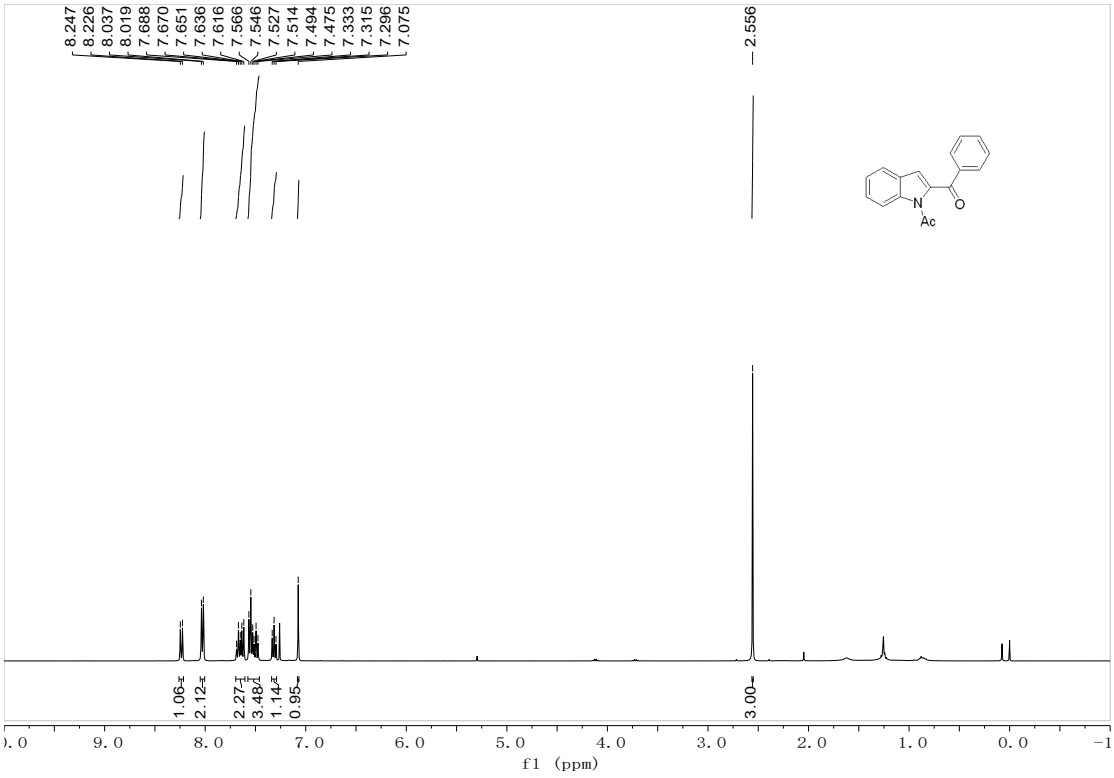
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14t**



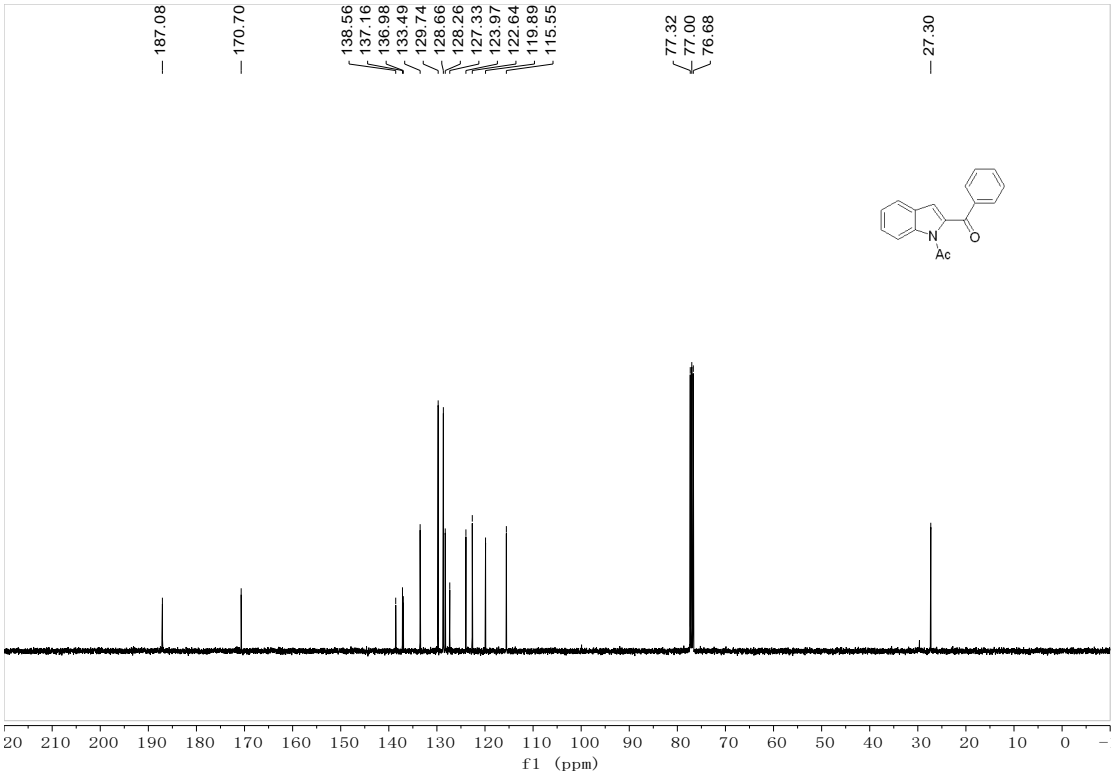
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14t**



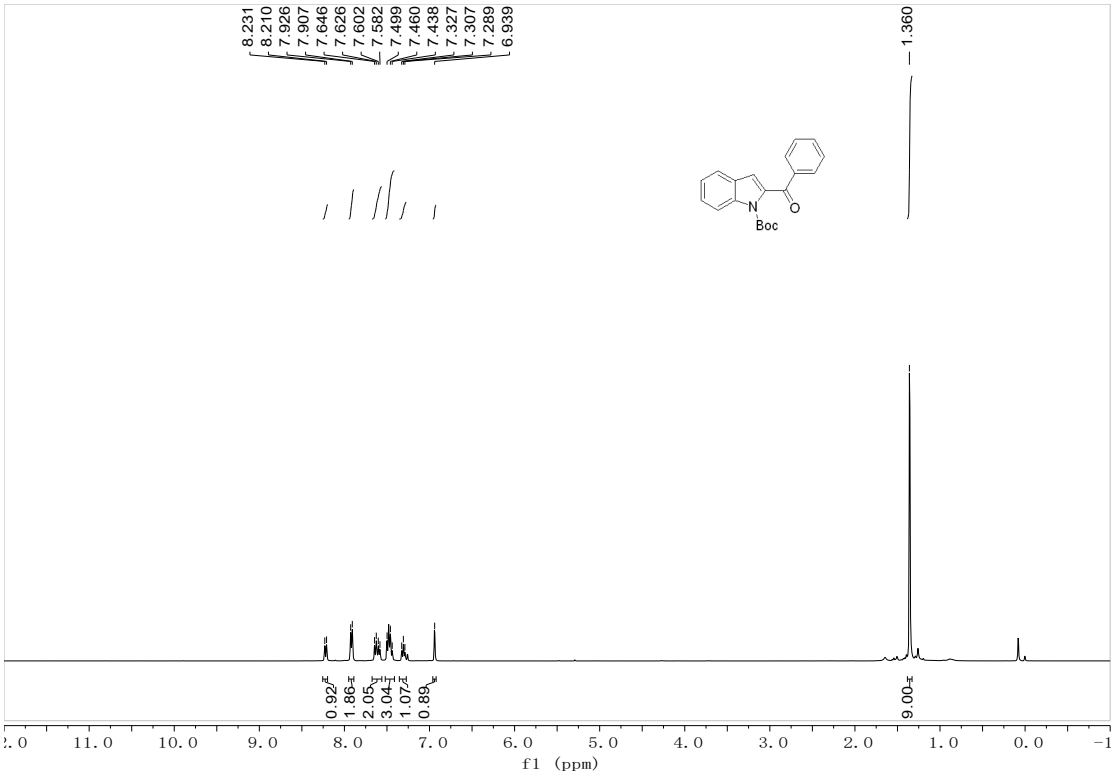
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14u**



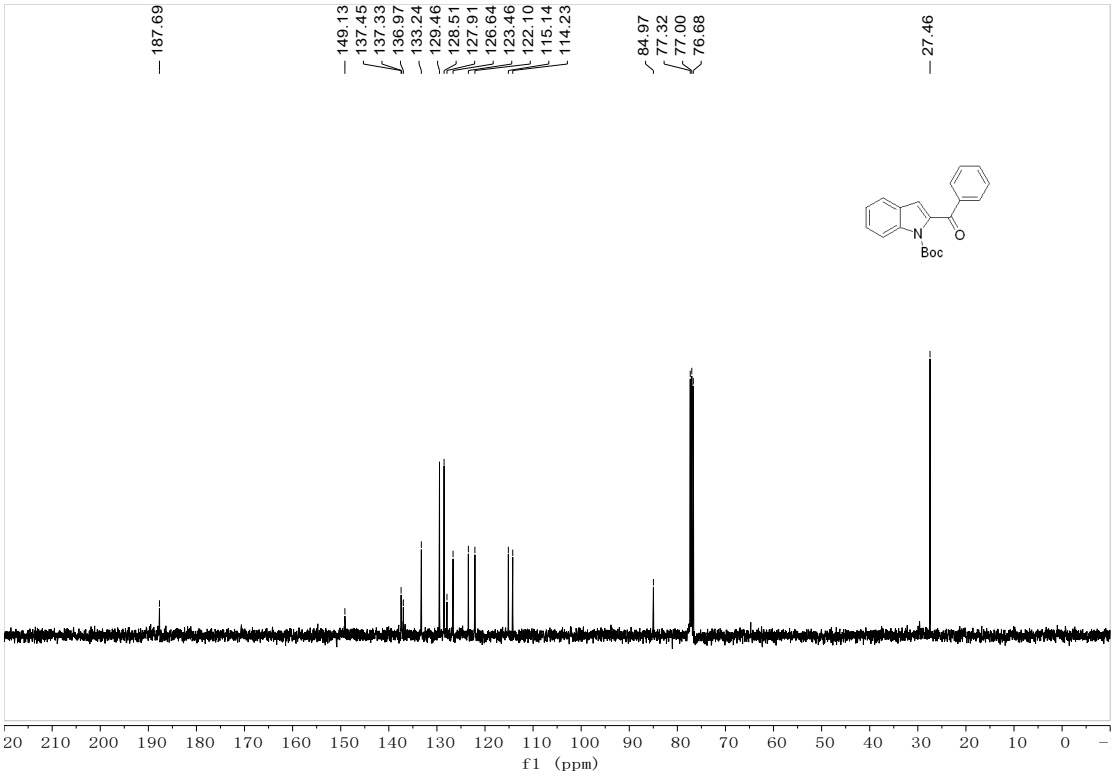
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14u**



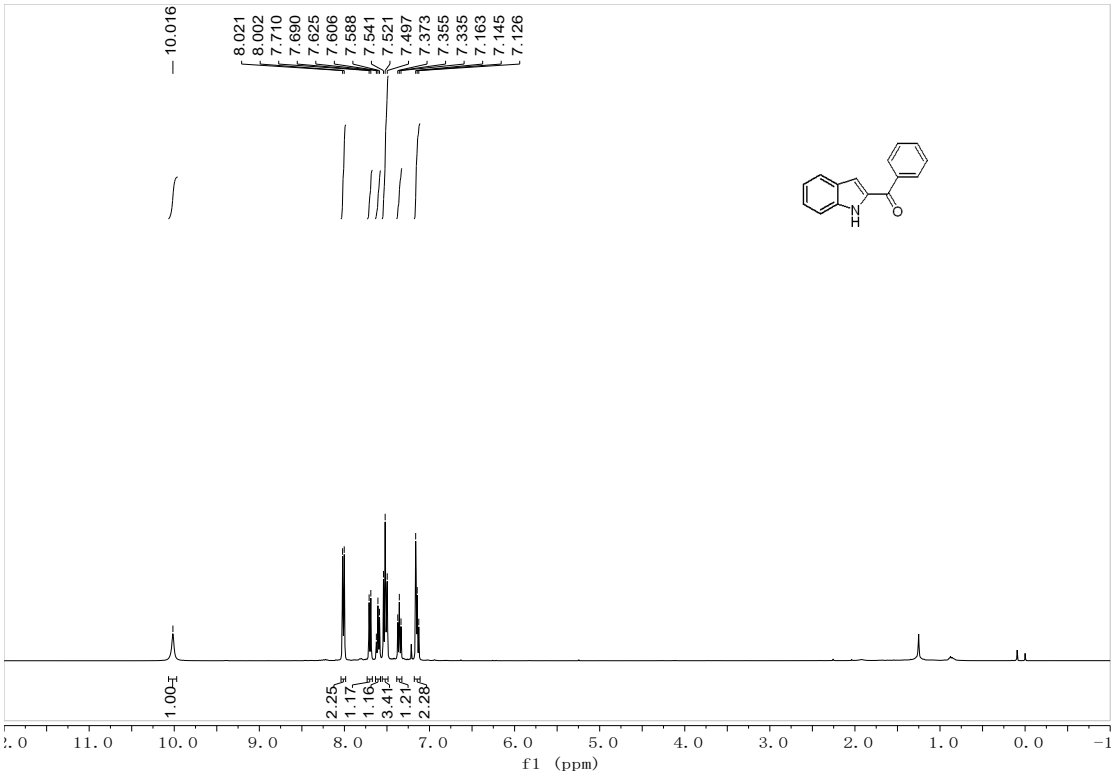
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14v**



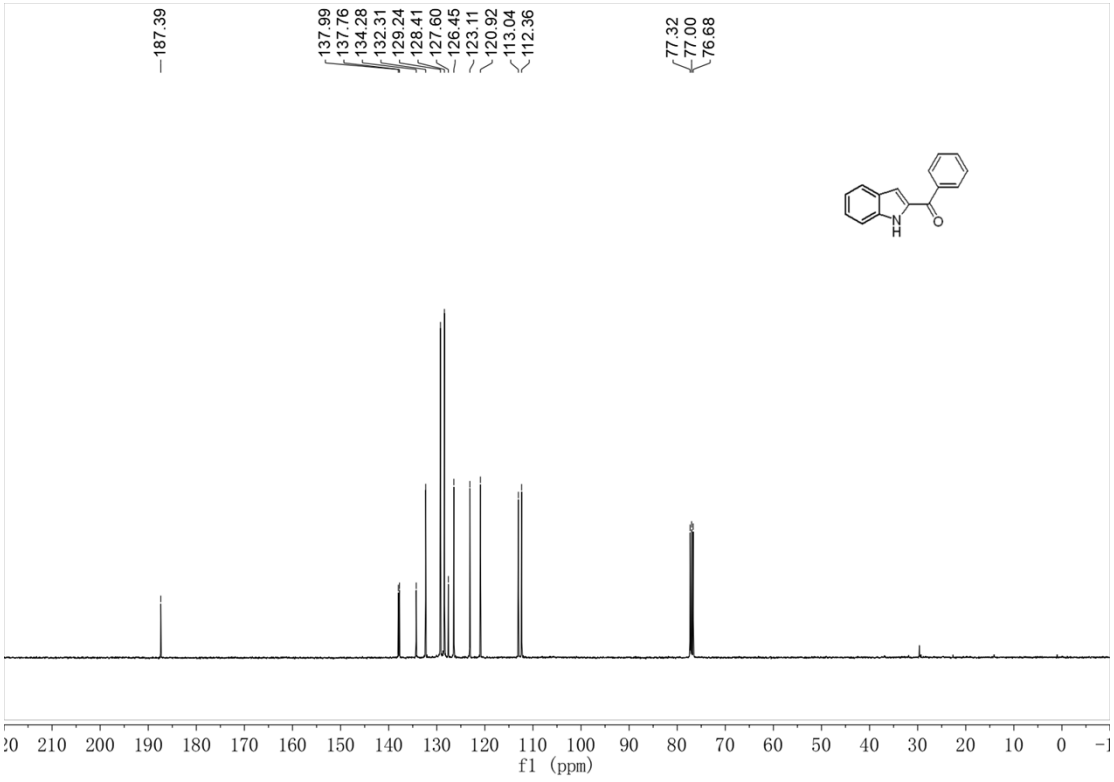
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14v**



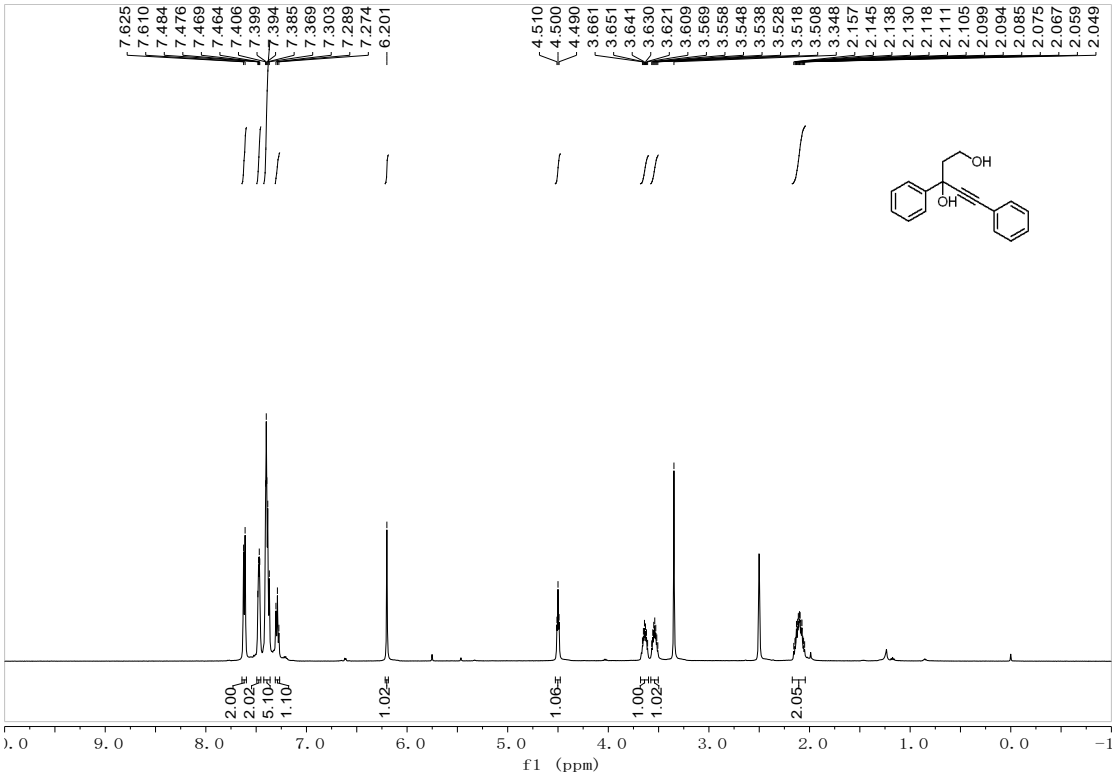
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **14v'**



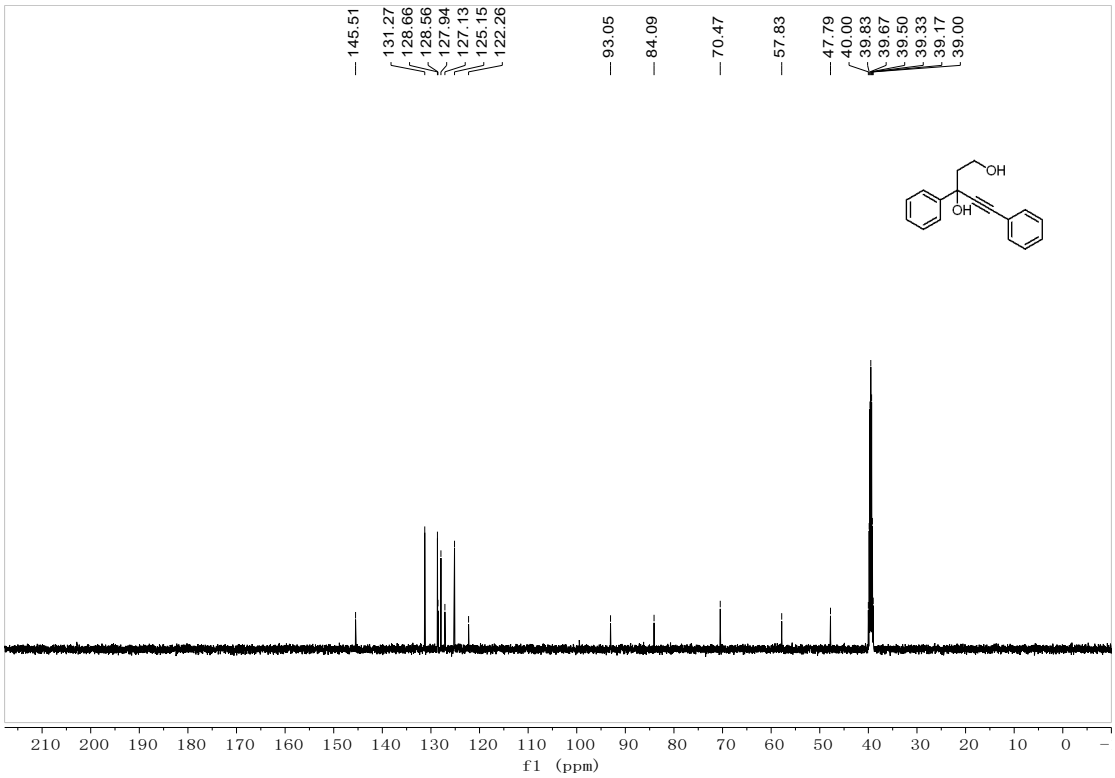
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **14v'**



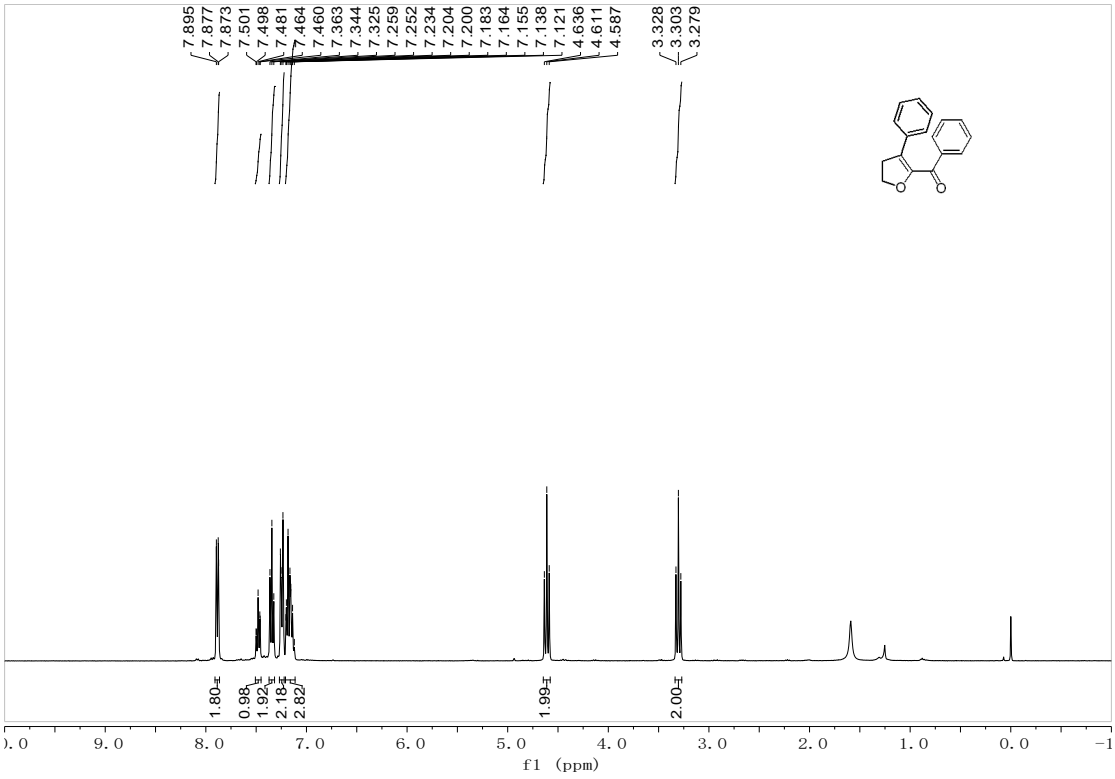
^{1}H NMR (500 MHz, DMSO-d_6) spectroscopy of **19c**



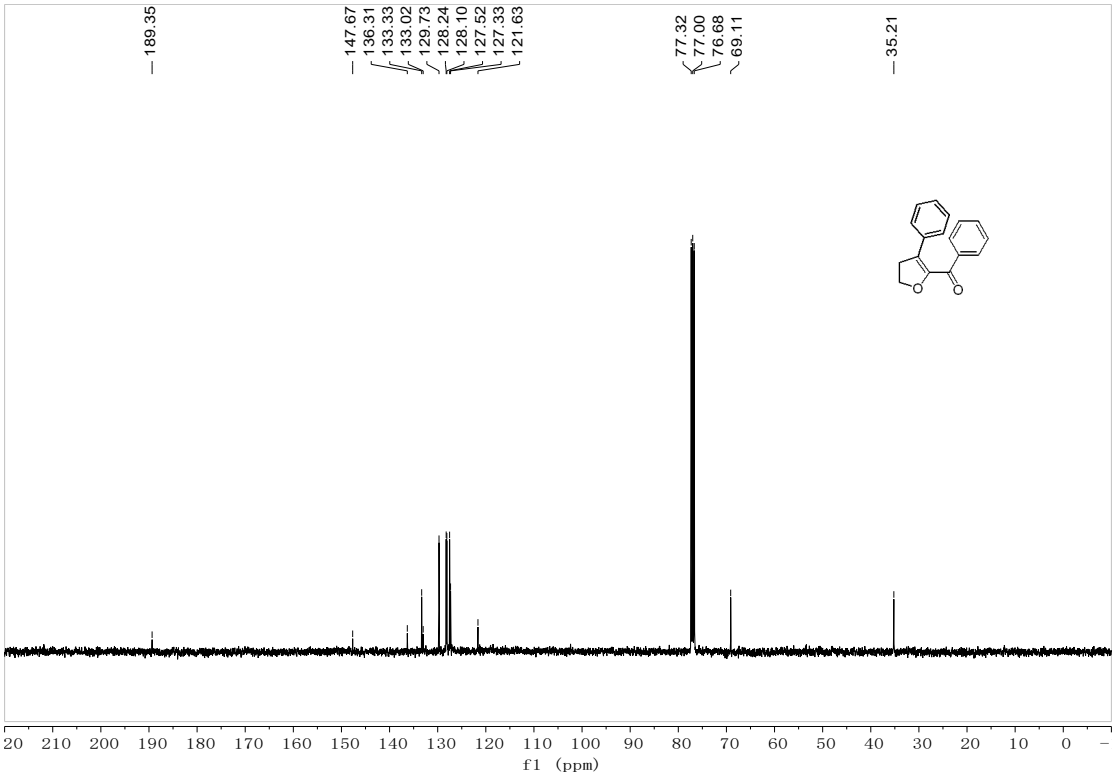
^{13}C NMR (125 MHz, DMSO-d_6) spectroscopy of **19c**



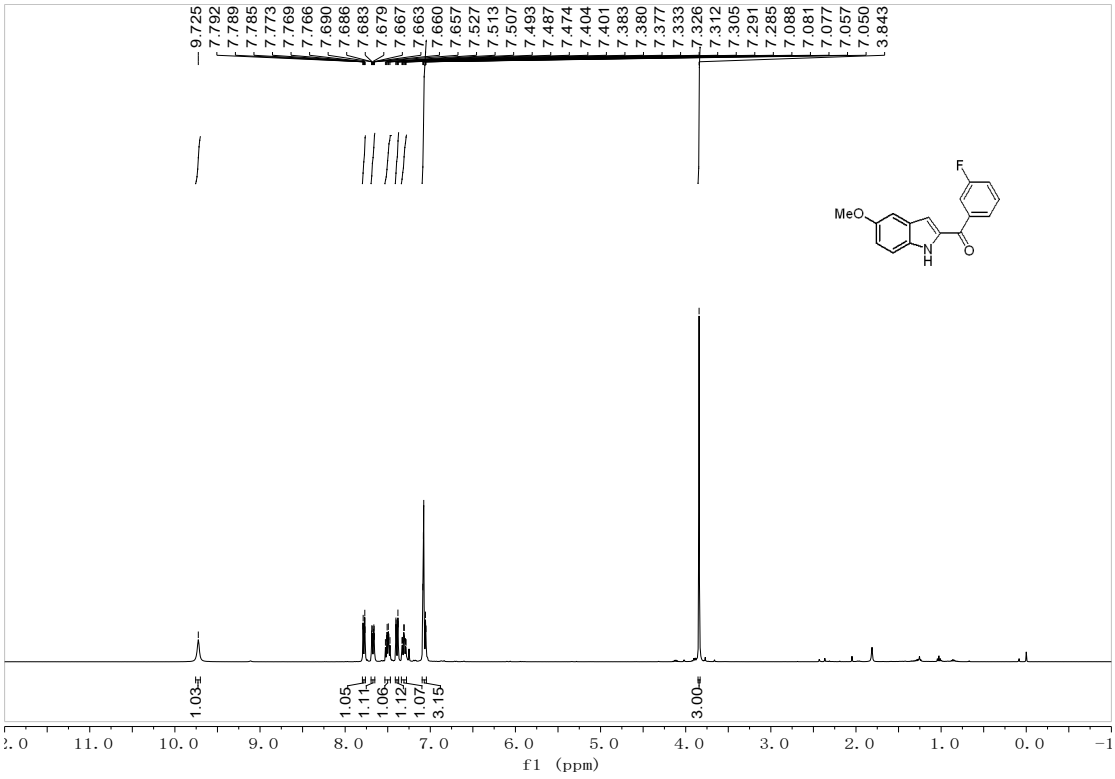
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **20c**



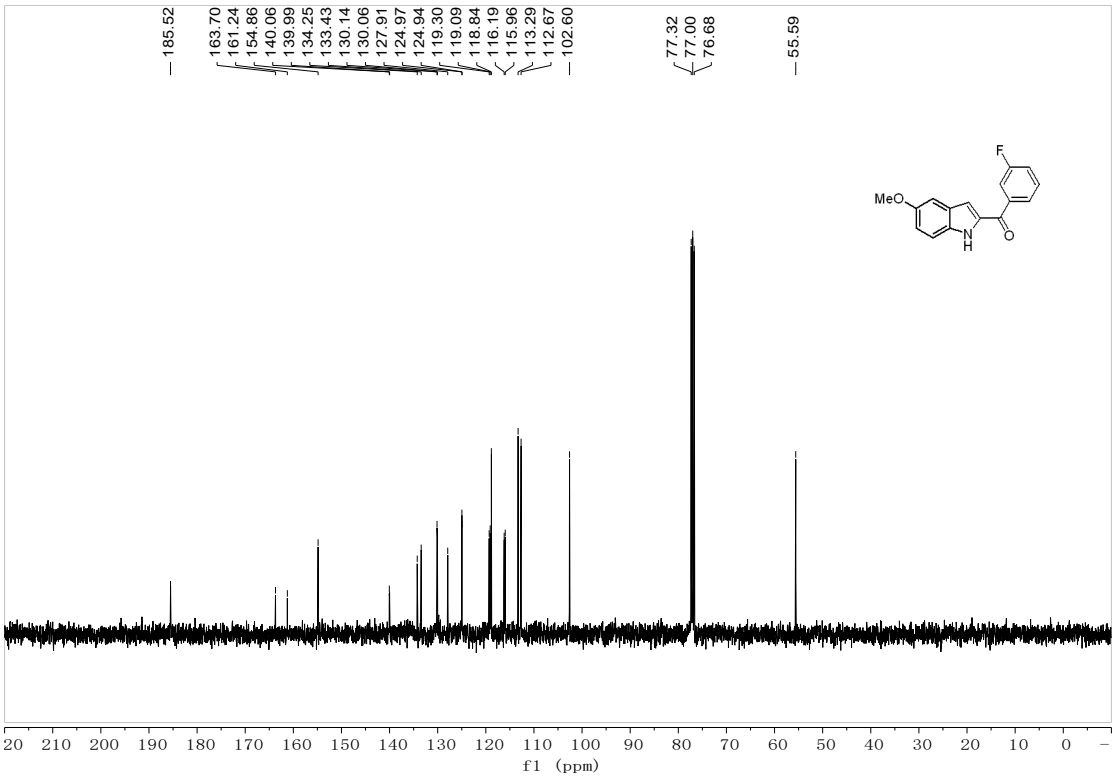
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **20c**



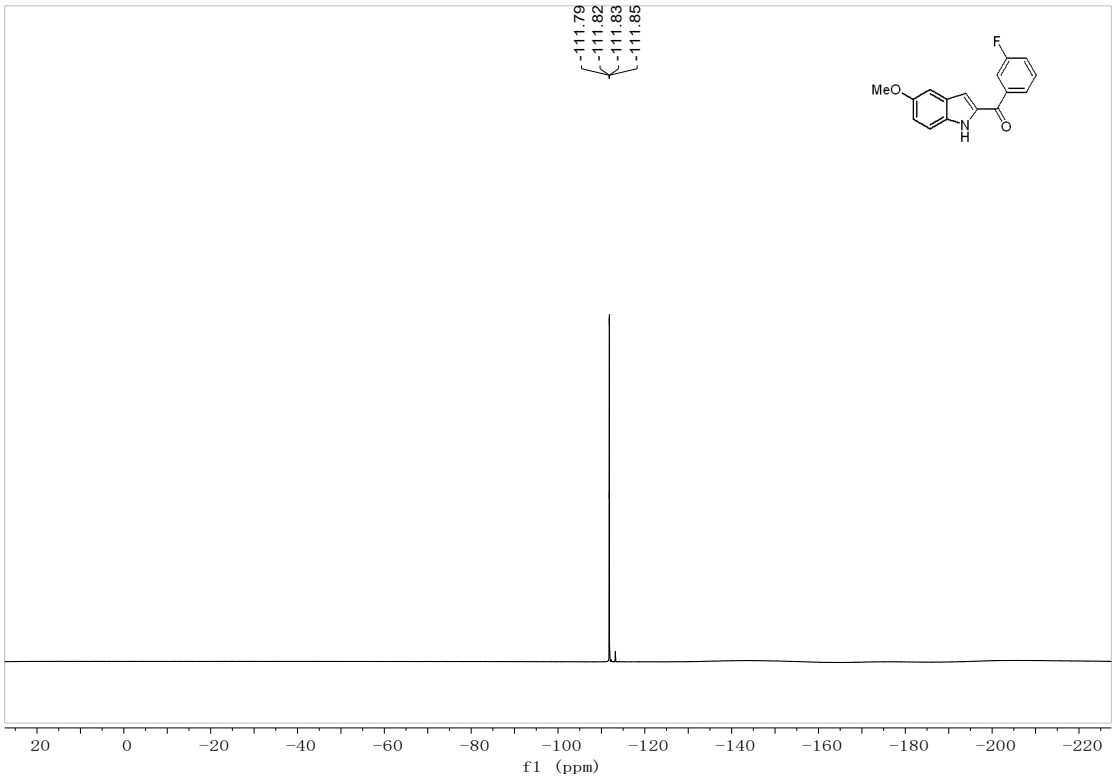
^{1}H NMR (400 MHz, $CDCl_3$) spectroscopy of **3**



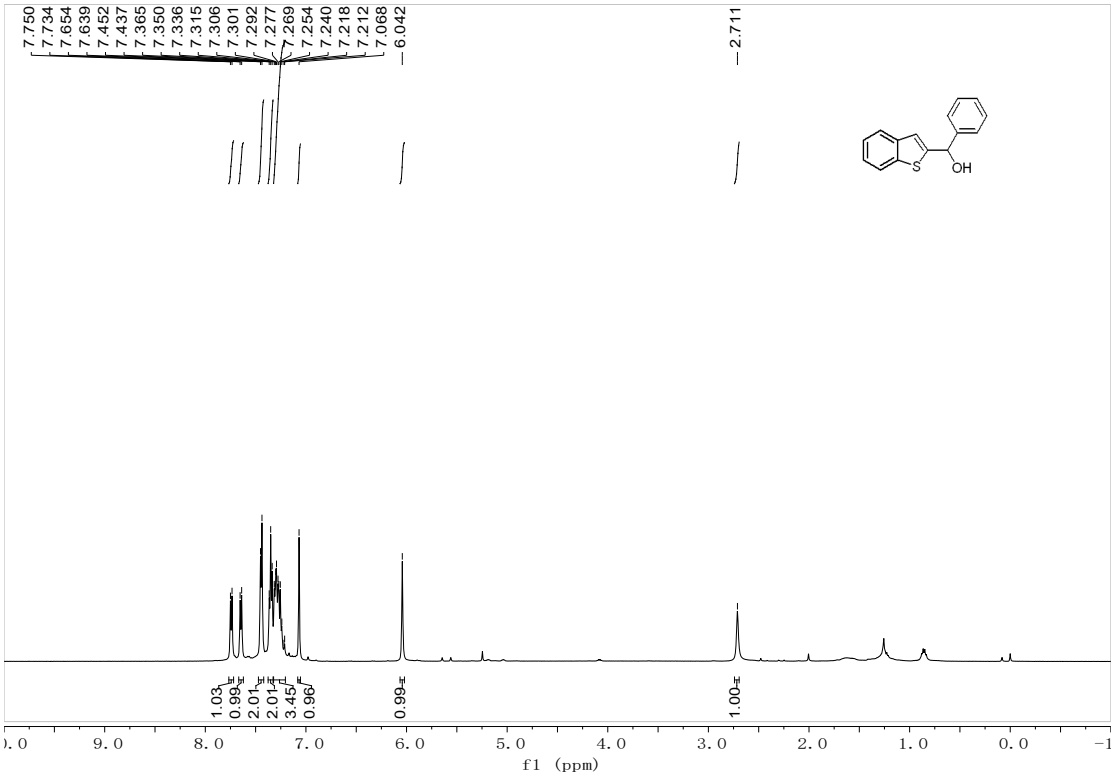
^{13}C NMR (100 MHz, $CDCl_3$) spectroscopy of **3**



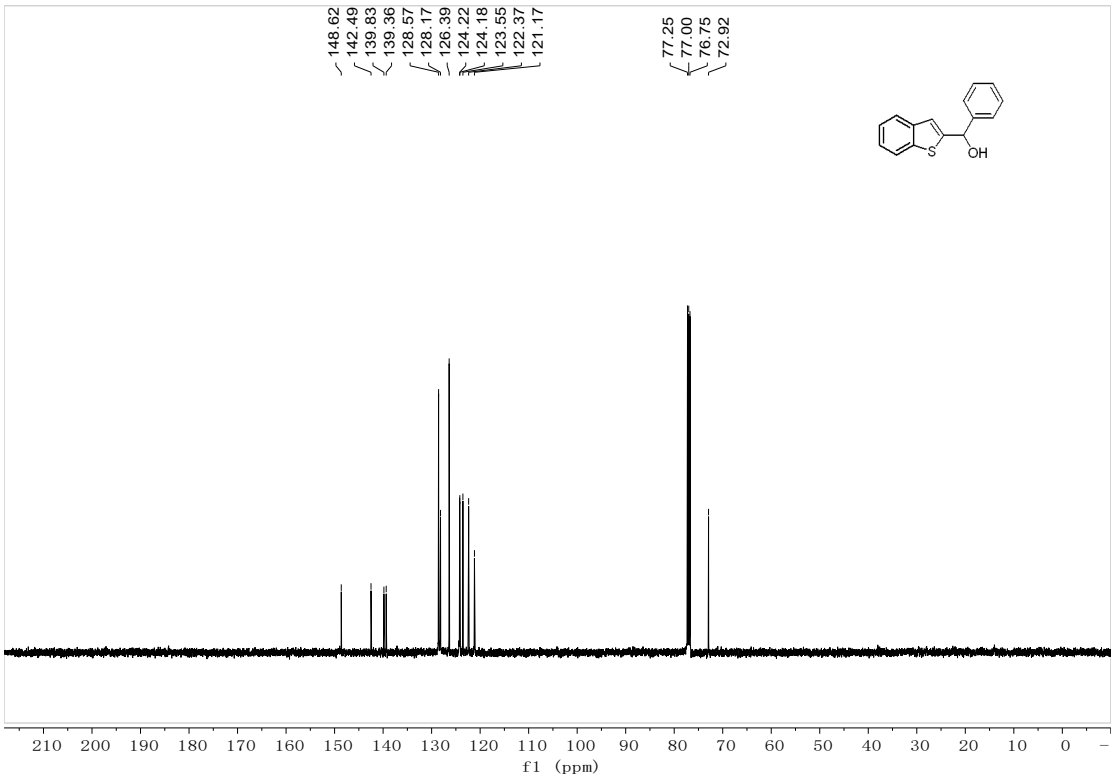
^{19}F NMR (376 MHz, $CDCl_3$) spectroscopy of **3**



^{1}H NMR (500 MHz, $CDCl_3$) spectroscopy of **S_6**



^{13}C NMR (125 MHz, $CDCl_3$) spectroscopy of **S_6**


148.62
142.49
139.83
139.36
128.57
128.17
126.39
124.22
124.18
123.55
122.37
121.17
77.25
77.00
76.75
72.92
S
OH
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)