

## Supporting Information

### Palladium-Catalyzed Denitrative C–N Coupling of Amides with Nitroarenes Enabled by Al(OTf)<sub>3</sub>

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### Contents

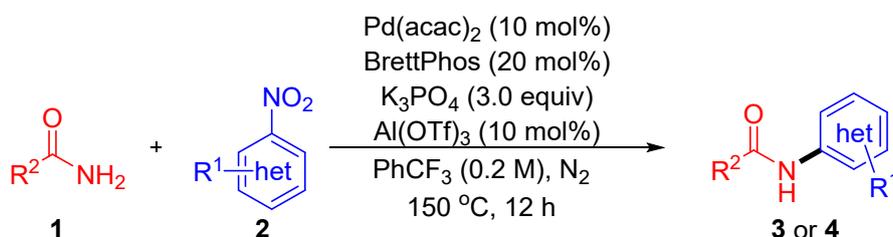
<b>I.</b>	<b>General methods.....</b>	<b>S2</b>
<b>II.</b>	<b>General procedures.....</b>	<b>S2</b>
<b>III.</b>	<b>Characterization data for products.....</b>	<b>S11</b>
<b>IV.</b>	<b>NMR spectra .....</b>	<b>S22</b>
<b>V.</b>	<b>References .....</b>	<b>S53</b>

## I. General Methods

All commercially available reagents and solvents were obtained from commercial providers and used without further purification. Flasks and tubes were dried in an oven before use. Unless otherwise stated, all the anhydrous solvents and reagents were obtained from commercially available sources without further purification. Thin-layer chromatography (TLC) was conducted using glass plates pre-coated silica gel and detected with a fluorescent indicator (254 nm). Flash column chromatography was performed using 200-300 mesh silica gel.  $^1\text{H}$ ,  $^{19}\text{F}\{^1\text{H}\}$ , and  $^{13}\text{C}\{^1\text{H}\}$  NMR spectra were recorded on Bruker Avance-400 (400 MHz) spectrometer 400 MHz for  $^1\text{H}$ , 376 MHz for  $^{19}\text{F}\{^1\text{H}\}$ , 162 MHz for  $^{31}\text{P}\{^1\text{H}\}$  and 101 MHz for  $^{13}\text{C}$ . Chemical shifts ( $\delta$ ) were expressed in ppm downfield to TMS at  $\delta = 0$  ppm, and the coupling constants ( $J$ ) were expressed in Hz.  $^{19}\text{F}\{^1\text{H}\}$  spectra were referenced externally to  $\text{CFCl}_3$  (0.00 ppm), and  $^{31}\text{P}$  NMR spectra were referenced to  $\text{H}_3\text{PO}_4$  as an external standard. Melting points were determined with an electrothermal apparatus and were uncorrected. High resolution mass spectra (HRMS) were recorded by using Agilent Mass spectrometer G6545 (ESI-QTOF).  $\text{Pd}(\text{acac})_2$  was recrystallized from ethanol before use.  $[(t\text{BuBrettPhos})\text{Pd}(\text{allyl})]\text{OTf}^1$  was prepared according to literature procedures. 2-nitrodibenzo[*b,d*]furan (**2l**),<sup>2</sup> 5-nitro-1-phenyl-1*H*-indole (**2o**),<sup>2</sup> 2-nitrodibenzo[*b,d*]thiophene (**2q**),<sup>2</sup> 1-nitropyrene (**2r**),<sup>3</sup> and dimethyl(phenyl)sulfonium trifluoromethanesulfonate **6a**<sup>4</sup> were also synthesized as described in the literature.

## II. General Procedures

### 1. General Procedure for the *N*-arylation of Amides with nitroarenes



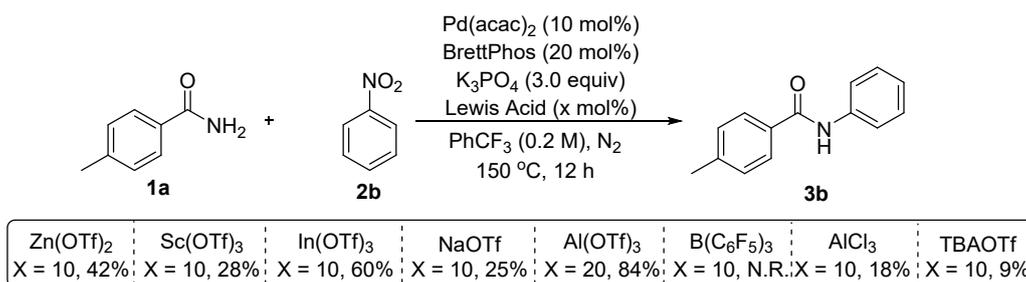
In a dried 25 mL Schlenk tube equipped with a magnetic stir bar, amide **1** (0.4 mmol), nitroarene **2** (0.6 mmol, if solid), Pd(acac)<sub>2</sub> (12.1 mg, 10 mol%), BrettPhos

(42.9 mg, 20 mol%),  $K_3PO_4$  (254.7 mg, 1.2 mmol), and  $Al(OTf)_3$  (19.0 mg, 10 mol%) were added. The tube was evacuated and backfilled with nitrogen at least three times. Trifluorotoluene ( $PhCF_3$ , 2.0 mL, 0.2 M) and nitroarene **2** (0.6 mmol, if liquid) were then added. The vessel was sealed with a PTFE screw cap, and the reaction mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 hours. After completion, the reaction mixture was cooled to room temperature and filtered through a 3 cm layer of Celite<sup>®</sup> using dichloromethane as the eluent. The filtrate was concentrated under reduced pressure, and the residue was further purified by flash column chromatography on silica gel (200–300 mesh) using a mixture of petroleum ether and ethyl acetate as the eluent to afford the desired products **3** or **4**.

## 2. 5mmol-Scale Preparation of Compound **3a**

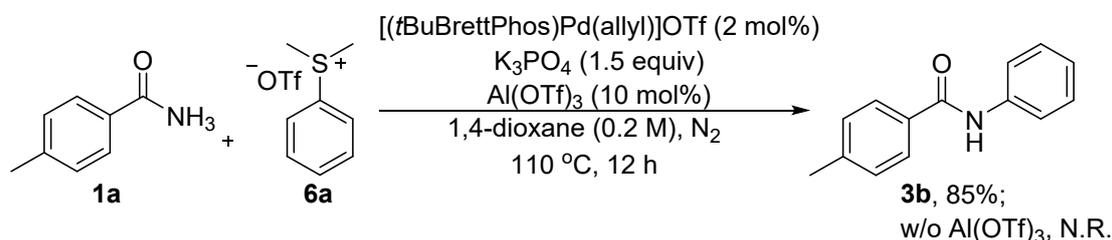
In a dried 100 mL Schlenk tube equipped with a magnetic stir bar, *p*-toluamide **1a** (5.0 mmol, 675.8 mg),  $\alpha$ -nitronaphthalene **2a** (7.5 mmol, 1299.0 mg),  $Pd(acac)_2$  (152.3 mg, 10 mol%), BrettPhos (536.8 mg, 20 mol%),  $K_3PO_4$  (3.18 g, 15.0 mmol), and  $Al(OTf)_3$  (237.1 mg, 10 mol%) were added. The tube was evacuated and backfilled with nitrogen at least three times.  $PhCF_3$  (25.0 mL, 0.2 M) was then added. The vessel was sealed with a PTFE screw cap, and the reaction mixture was stirred and heated at 150 °C in an oil bath (600–800 rpm) for 12 hours. After completion, the reaction mixture was cooled to room temperature and passed through a 5 cm layer of Celite<sup>®</sup> using dichloromethane as the eluent. The filtrate was concentrated under reduced pressure, and the residue was further purified by flash column chromatography on silica gel (200–300 mesh) using a mixture of petroleum ether and ethyl acetate as the eluent to afford 933.4 mg of product **3a** (76% yield).

### 3. Evaluation of Lewis Acid Additives



In a dried 25 mL Schlenk tube equipped with a magnetic stir bar, *p*-toluamide **1a** (0.4 mmol, 54.1 mg), Pd(acac)<sub>2</sub> (12.1 mg, 10 mol%), BrettPhos (42.9 mg, 20 mol%), K<sub>3</sub>PO<sub>4</sub> (254.7 mg, 1.2 mmol), and Lewis Acid (10 or 20 mol%) were added. The tube was evacuated and backfilled with nitrogen at least three times. Trifluorotoluene (PhCF<sub>3</sub>, 2.0 mL, 0.2 M) and nitrobenzene **2b** (0.6 mmol, 73.87 mg (61.8 μL)) were then added. The vessel was sealed with a PTFE screw cap, and the reaction mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 hours. After completion, the reaction mixture was cooled to room temperature and filtered through a 3 cm layer of Celite® using dichloromethane as the eluent. The filtrate was concentrated under reduced pressure, and the residue was further purified by flash column chromatography on silica gel (200–300 mesh) using a mixture of petroleum ether and ethyl acetate as the eluent to afford the desired products **3b**.

### 4. Pd-Catalyzed Desulfurative Amidation of Aryl Sulfonium Salt **6a**



In a dried 25 mL Schlenk tube equipped with a magnetic stir bar, *p*-toluamide **1a** (0.4 mmol, 54.1 mg), dimethyl(phenyl)sulfonium trifluoromethanesulfonate **6a** (0.5 mmol, 144.2 mg), [(*t*BuBrettPhos)Pd(allyl)]OTf (6.3 mg, 2 mol%), K<sub>3</sub>PO<sub>4</sub> (127.4 mg, 0.6 mmol), and Al(OTf)<sub>3</sub> (19.0 mg, 10 mol%) were added. The tube was

evacuated and backfilled with nitrogen at least three times. 1,4-dioxane (2.0 mL, 0.2 M) was then added. The vessel was sealed with a PTFE screw cap, and the reaction mixture was stirred and heated at 110 °C in an aluminum heating block (600–800 rpm) for 12 hours. After completion, the reaction mixture was cooled to room temperature and filtered through a 3 cm layer of Celite<sup>®</sup> using dichloromethane as the eluent. The filtrate was concentrated under reduced pressure, and the residue was further purified by flash column chromatography on silica gel (200–300 mesh) using a mixture of petroleum ether and ethyl acetate as the eluent to afford compound **3b** (71.9 mg, 85% yield). When the reaction was performed without Al(OTf)<sub>3</sub>, no desired product **3b** was detected.

### 5. Investigation of the Oxidation Process of BrettPhos Ligand

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed Pd(acac)<sub>2</sub> (15.2 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol), and K<sub>3</sub>PO<sub>4</sub> (31.8 mg, 0.15 mmol). The tube was evacuated and backfilled with nitrogen three times. PhCF<sub>3</sub> (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide (12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by <sup>31</sup>P NMR spectroscopy (**Figure S1, P1**).

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed Pd(acac)<sub>2</sub> (15.2 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol), K<sub>3</sub>PO<sub>4</sub> (31.8 mg, 0.15 mmol), and Al(OTf)<sub>3</sub> (23.7 mg, 0.05 mmol). The tube was evacuated and backfilled with nitrogen three times. PhCF<sub>3</sub> (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide

(12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by  $^{31}\text{P}$  NMR spectroscopy (Figure S2, P2).

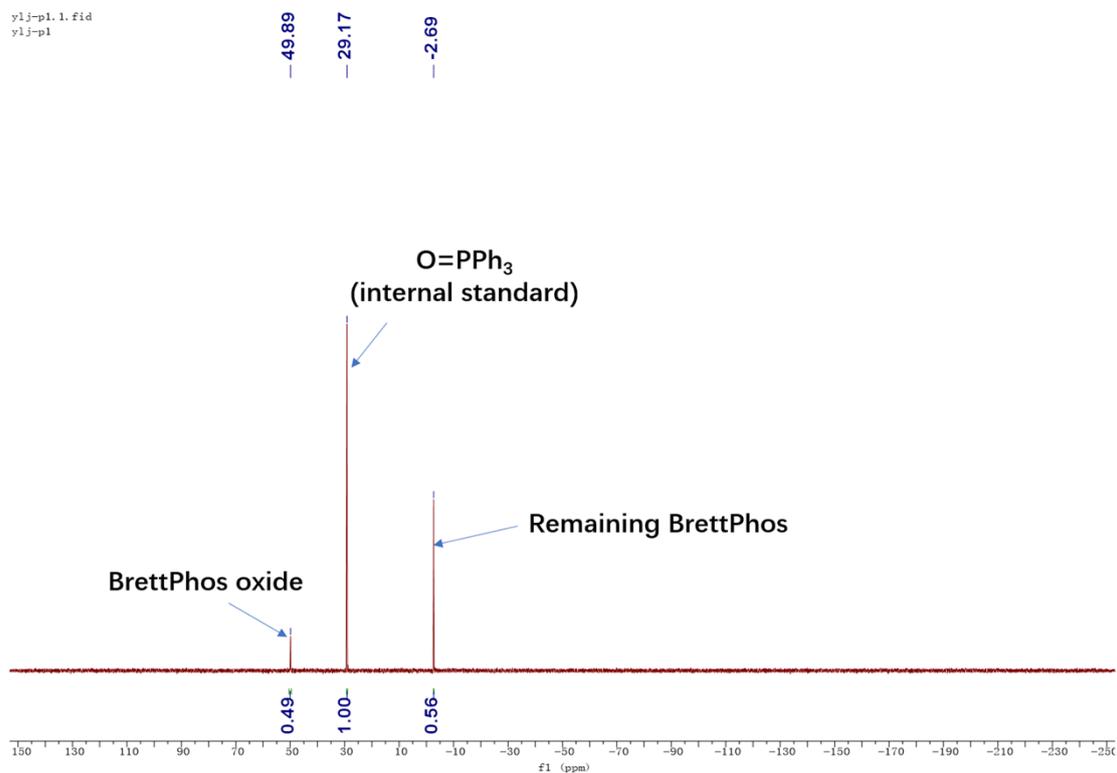


Figure S1.  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of P1

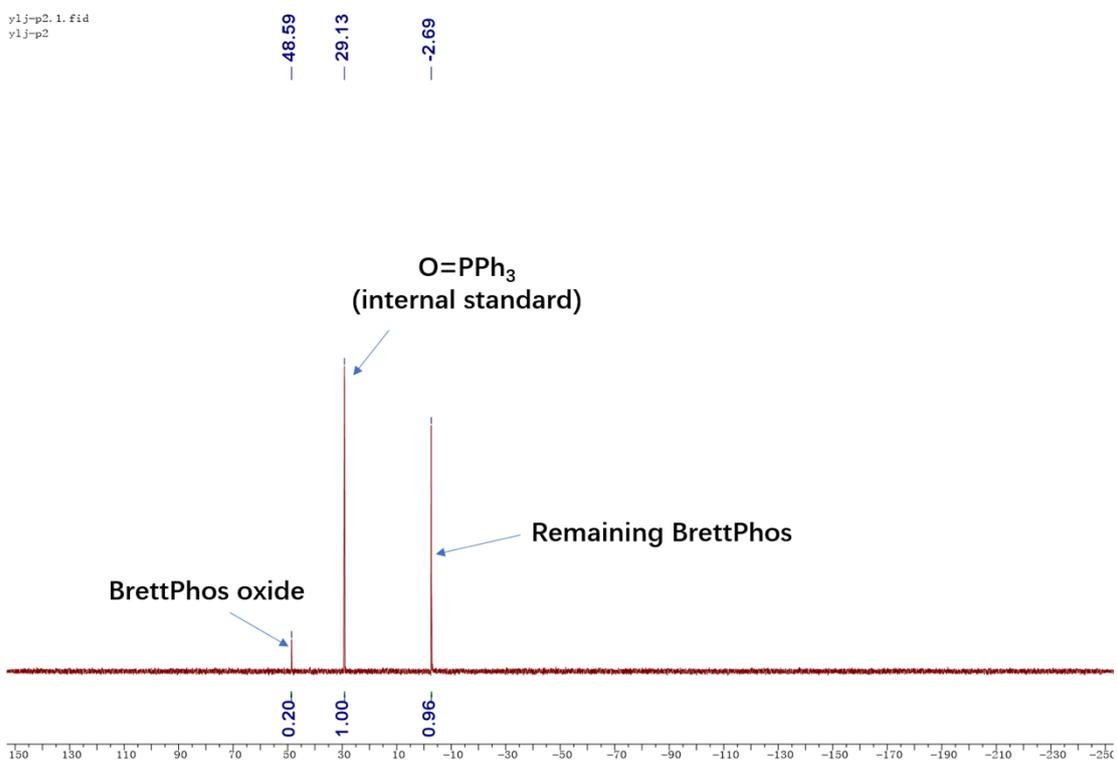
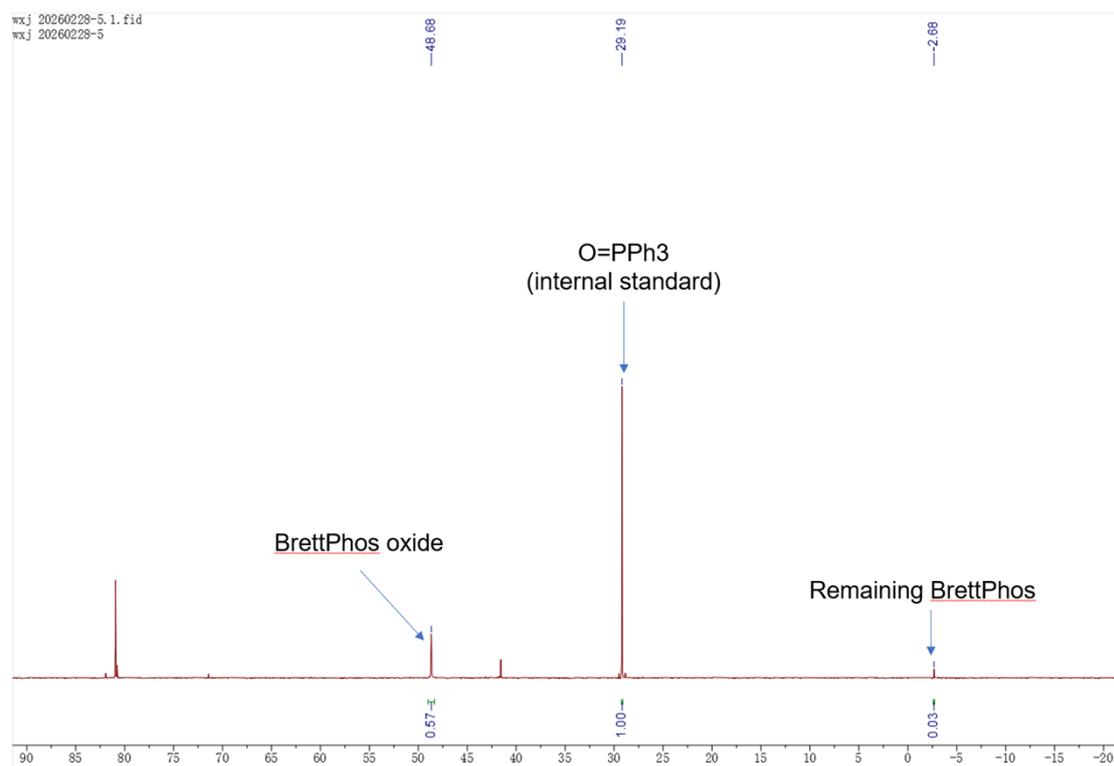


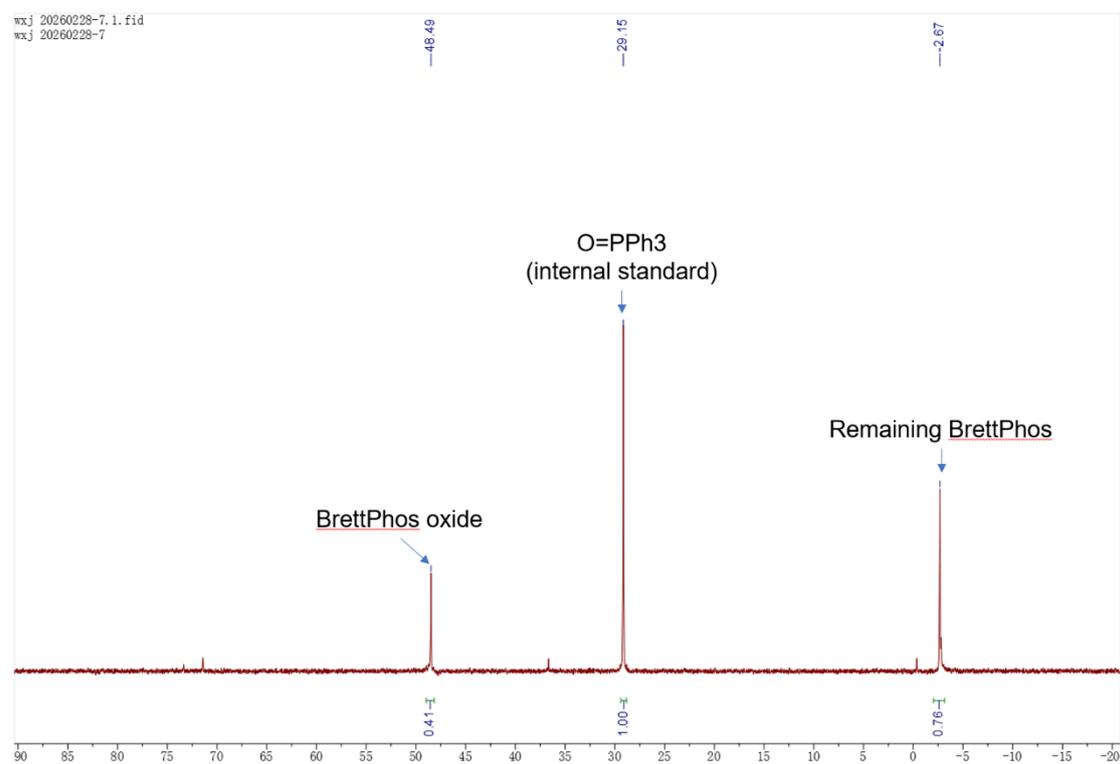
Figure S2.  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of P2

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed Pd(acac)<sub>2</sub> (15.2 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol),  $\alpha$ -nitronaphthalene **2a** (8.7 mg, 0.05 mmol) and K<sub>3</sub>PO<sub>4</sub> (31.8 mg, 0.15 mmol). The tube was evacuated and backfilled with nitrogen three times. PhCF<sub>3</sub> (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide (12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by <sup>31</sup>P NMR spectroscopy (**Figure S3, P3**).

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed Pd(acac)<sub>2</sub> (15.2 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol),  $\alpha$ -nitronaphthalene **2a** (8.7 mg, 0.05 mmol), K<sub>3</sub>PO<sub>4</sub> (31.8 mg, 0.15 mmol), and Al(OTf)<sub>3</sub> (23.7 mg, 0.05 mmol). The tube was evacuated and backfilled with nitrogen three times. PhCF<sub>3</sub> (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide (12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by <sup>31</sup>P NMR spectroscopy (**Figure S4, P4**).



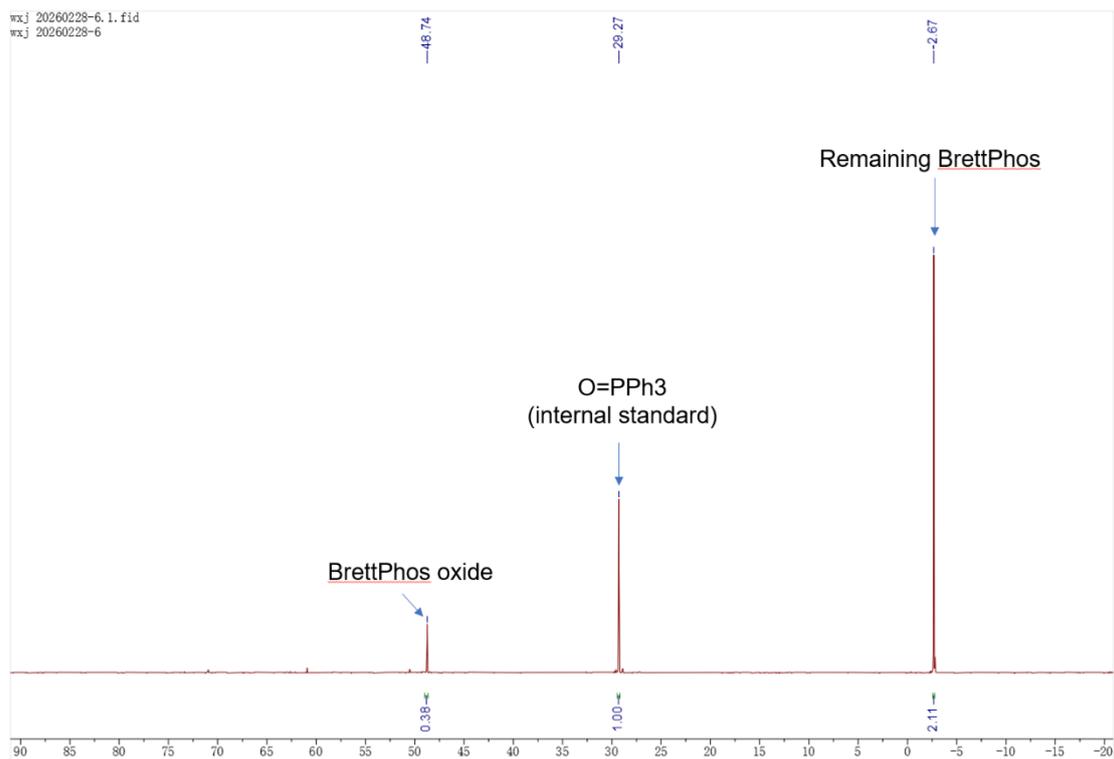
**Figure S3.**  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of **P3**



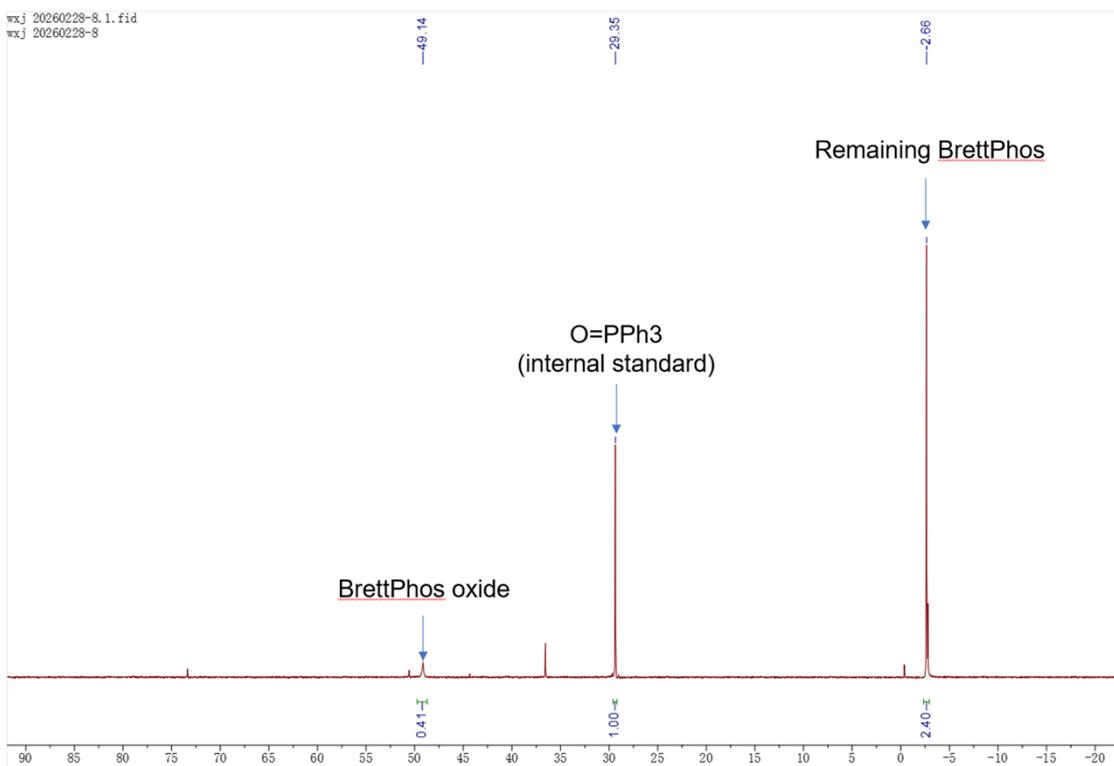
**Figure S4.**  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of **P4**

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed BrettPhos Pd G3 (45.3 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol),  $\alpha$ -nitronaphthalene **2a** (8.7 mg, 0.05 mmol) and  $K_3PO_4$  (31.8 mg, 0.15 mmol). The tube was evacuated and backfilled with nitrogen three times.  $PhCF_3$  (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide (12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by <sup>31</sup>P NMR spectroscopy (**Figure S5, P5**).

In a dried 25 mL Schlenk tube equipped with a magnetic stir bar were placed BrettPhos Pd G3 (45.3 mg, 0.05 mmol), BrettPhos (26.8 mg, 0.05 mmol),  $\alpha$ -nitronaphthalene **2a** (8.7 mg, 0.05 mmol),  $K_3PO_4$  (31.8 mg, 0.15 mmol), and  $Al(OTf)_3$  (23.7 mg, 0.05 mmol). The tube was evacuated and backfilled with nitrogen three times.  $PhCF_3$  (0.5 mL, 0.1 M) was then added, and the vessel was sealed with a PTFE screw cap. The mixture was stirred and heated at 150 °C in an aluminum heating block (600–800 rpm) for 12 h. After cooling to room temperature, the reaction mixture was filtered through a short pad of Celite<sup>®</sup>, and the filtrate was concentrated under reduced pressure. Triphenylphosphine oxide (12.0 mg, 0.043 mmol) was added as an internal standard, and the resulting mixture was analyzed by <sup>31</sup>P NMR spectroscopy (**Figure S6, P6**).

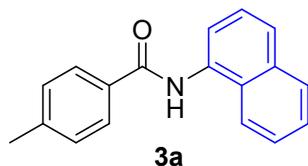


**Figure S5.**  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of **P5**



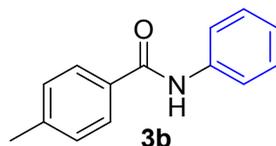
**Figure S6.**  $^{31}\text{P}$  NMR (162 MHz,  $\text{CDCl}_3$ ) spectrum of **P6**

### III. Characterization data for products



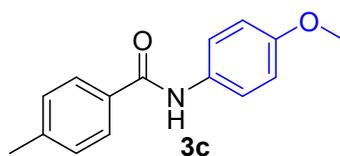
#### 4-methyl-*N*-(naphthalen-1-yl)benzamide<sup>5</sup> (**3a**)

White solid (89.0 mg, 85% yield). mp = 169–170 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.20). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.21 (s, 1H), 8.03 (d,  $J$  = 7.5 Hz, 1H), 7.94 – 7.84 (m, 4H), 7.74 (d,  $J$  = 8.2 Hz, 1H), 7.57 – 7.47 (m, 3H), 7.32 (d,  $J$  = 8.1 Hz, 2H), 2.46 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 166.3, 142.6, 134.3, 132.7, 132.2, 129.7, 129.0, 127.6, 127.4, 126.5, 126.2, 126.1, 126.0, 121.3, 120.8, 21.7.



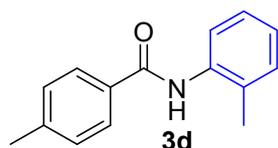
#### 4-methyl-*N*-phenylbenzamide<sup>5</sup> (**3b**)

White solid (72.7 mg, 86% yield). mp = 146–147 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.40). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.92 (s, 1H), 7.67 (d,  $J$  = 7.9 Hz, 2H), 7.55 (d,  $J$  = 7.9 Hz, 2H), 7.25 (t,  $J$  = 7.7 Hz, 2H), 7.15 (d,  $J$  = 7.9 Hz, 2H), 7.04 (t,  $J$  = 7.3 Hz, 1H), 2.32 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.9, 142.4, 138.2, 132.2, 129.5, 129.1, 127.2, 124.5, 120.4, 21.6.



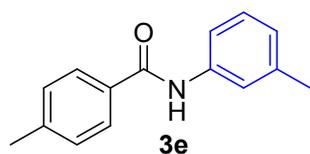
#### *N*-(4-methoxyphenyl)-4-methylbenzamide<sup>5</sup> (**3c**)

White solid (73.9 mg, 76% yield). mp = 158–160 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.24). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.86 (s, 1H), 7.74 (d,  $J$  = 8.0 Hz, 2H), 7.52 (d,  $J$  = 8.9 Hz, 2H), 7.24 (d,  $J$  = 7.9 Hz, 2H), 6.87 (d,  $J$  = 9.0 Hz, 2H), 3.79 (s, 3H), 2.40 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.8, 156.7, 142.3, 132.3, 131.3, 129.5, 127.1, 122.3, 114.3, 55.6, 21.6.



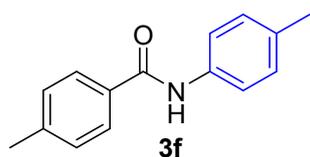
**4-methyl-*N*-(*o*-tolyl)benzamide<sup>6</sup> (3d)**

White solid (80.9 mg, 89% yield). mp = 106–108 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.28). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.94 (d,  $J$  = 8.0 Hz, 1H), 7.78 (d,  $J$  = 8.1 Hz, 2H), 7.69 (s, 1H), 7.29 (d,  $J$  = 8.1 Hz, 2H), 7.23 (dd,  $J$  = 8.0, 6.3 Hz, 2H), 7.11 (td,  $J$  = 7.5, 1.3 Hz, 1H), 2.43 (s, 3H), 2.33 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.7, 142.5, 136.0, 132.3, 130.6, 129.6, 129.3, 127.2, 127.0, 125.3, 123.2, 21.6, 17.9.



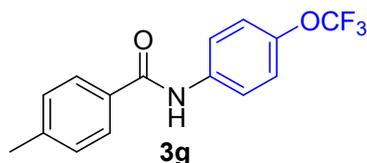
**4-methyl-*N*-(*m*-tolyl)benzamide<sup>5</sup> (3e)**

White solid (84.0 mg, 93% yield). mp = 107–108 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.27). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.89 (s, 1H), 7.74 (d,  $J$  = 7.8 Hz, 2H), 7.49 (s, 1H), 7.40 (d,  $J$  = 8.1 Hz, 1H), 7.31 – 7.17 (m, 3H), 6.94 (d,  $J$  = 7.6 Hz, 1H), 2.40 (s, 3H), 2.33 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.8, 142.4, 139.1, 138.1, 132.3, 129.5, 129.0, 127.2, 125.3, 121.0, 117.4, 21.6.



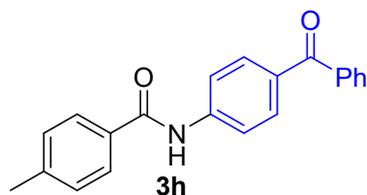
**4-methyl-*N*-(*p*-tolyl)benzamide<sup>5</sup> (3f)**

White solid (80.0 mg, 88% yield). mp = 157–158 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.33). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.88 (s, 1H), 7.74 (d,  $J$  = 7.8 Hz, 2H), 7.51 (d,  $J$  = 7.9 Hz, 2H), 7.24 (d,  $J$  = 8.2 Hz, 2H), 7.14 (d,  $J$  = 8.0 Hz, 2H), 2.40 (s, 3H), 2.32 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.8, 142.3, 135.6, 134.2, 132.3, 129.6, 129.5, 127.2, 120.4, 21.6, 21.0.



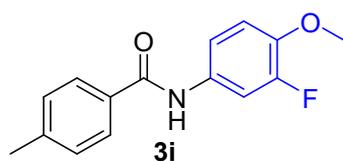
**4-methyl-N-(4-(trifluoromethoxy)phenyl)benzamide<sup>7</sup> (3g)**

White solid (76.9 mg, 65% yield). mp = 192–194 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.37). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) δ 10.34 (s, 1H), 7.89 (t,  $J$  = 7.5 Hz, 4H), 7.35 (dd,  $J$  = 8.4, 4.2 Hz, 4H), 2.39 (s, 3H). <sup>13</sup>C NMR (101 MHz, DMSO-*d*<sub>6</sub>) δ 165.5, 143.8, 141.8, 138.5, 131.7, 128.9, 127.7, 121.6, 121.4, 118.9, 21.0. <sup>19</sup>F NMR (376 MHz, DMSO-*d*<sub>6</sub>) δ -57.00.



**N-(4-benzoylphenyl)-4-methylbenzamide<sup>8</sup> (3h)**

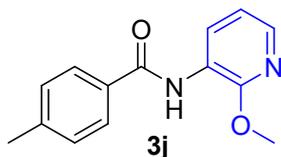
White solid (19.0 mg, 15% yield). mp = 177–178 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f$  = 0.32). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.28 (s, 1H), 7.86 – 7.74 (m, 8H), 7.62 – 7.54 (m, 1H), 7.48 (t,  $J$  = 7.6 Hz, 2H), 7.26 (d,  $J$  = 8.0 Hz, 2H), 2.41 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 195.8, 166.0, 143.0, 142.3, 138.0, 133.2, 132.4, 131.8, 130.0, 129.6, 128.4, 127.3, 119.3, 21.6.



**N-(3-fluoro-4-methoxyphenyl)-4-methylbenzamide (3i)**

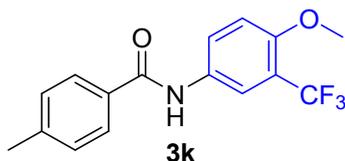
White solid (88.7 mg, 85% yield). mp = 154–155 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f$  = 0.25). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) δ 10.17 (s, 1H), 7.86 (d,  $J$  = 7.8 Hz, 2H), 7.75 (d,  $J$  = 13.8 Hz, 1H), 7.50 (d,  $J$  = 9.0 Hz, 1H), 7.33 (d,  $J$  = 7.8 Hz, 2H), 7.15 (t,  $J$  = 9.4 Hz, 1H), 3.82 (s, 3H), 2.38 (s, 3H). <sup>13</sup>C NMR (101 MHz, DMSO-*d*<sub>6</sub>) δ 165.1, 150.8 (d,  $J$  = 241.1 Hz), 143.1 (d,  $J$  = 10.8 Hz), 141.6, 132.7 (d,  $J$  = 9.2 Hz), 131.8, 128.9, 127.6, 116.2, 113.8, 108.7 (d,  $J$  = 22.7 Hz), 56.1, 21.0. <sup>19</sup>F NMR (376

MHz, DMSO-*d*<sub>6</sub>)  $\delta$  -134.20. HRMS (ESI) *m/z* calcd. for C<sub>15</sub>H<sub>14</sub>FNNaO<sub>2</sub> [M+Na<sup>+</sup>]: 282.0901; found: 282.0900.



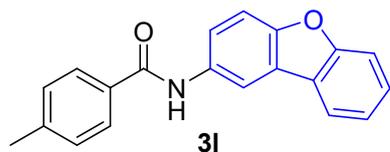
***N*-(2-methoxypyridin-3-yl)-4-methylbenzamide (3j)**

White solid (74.8 mg, 77% yield). mp = 90–91 °C. Eluent: ethyl acetate/petroleum ether (1:4, *R*<sub>f</sub> = 0.30). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  8.75 (dd, *J* = 7.8, 1.8 Hz, 1H), 8.39 (s, 1H), 7.88 (dd, *J* = 5.0, 1.7 Hz, 1H), 7.82 – 7.76 (m, 2H), 7.31 (d, *J* = 7.9 Hz, 2H), 6.95 (dd, *J* = 7.8, 5.0 Hz, 1H), 4.06 (s, 3H), 2.43 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  165.9, 153.3, 142.8, 140.3, 131.9, 129.6, 127.2, 126.6, 123.2, 117.6, 54.0, 21.7. HRMS (ESI) *m/z* calcd. for C<sub>14</sub>H<sub>14</sub>N<sub>2</sub>NaO<sub>2</sub> [M+Na<sup>+</sup>]: 265.0947; found: 265.0948.



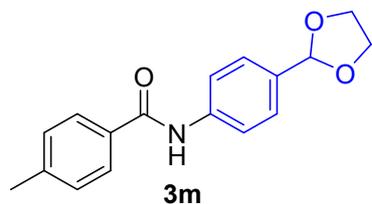
***N*-(4-methoxy-3-(trifluoromethyl)phenyl)-4-methylbenzamide (3k)**

White solid (100.6 mg, 80% yield). mp = 143–145 °C. Eluent: ethyl acetate/petroleum ether (1:4, *R*<sub>f</sub> = 0.35). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)  $\delta$  8.02 (s, 1H), 7.84 (dd, *J* = 8.9, 2.7 Hz, 1H), 7.77 – 7.73 (m, 2H), 7.71 (d, *J* = 2.7 Hz, 1H), 7.24 (d, *J* = 7.9 Hz, 2H), 6.95 (d, *J* = 9.0 Hz, 1H), 3.88 (s, 3H), 2.40 (s, 3H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>)  $\delta$  166.0, 154.4, 142.7, 131.2 (q, *J* = 89.2 Hz), 129.6, 127.2, 125.9, 123.4 (q, *J* = 272.6 Hz), 120.1 (q, *J* = 5.7 Hz), 119.0 (d, *J* = 31.1 Hz), 112.7, 56.4, 21.6. <sup>19</sup>F NMR (376 MHz, CDCl<sub>3</sub>)  $\delta$  -62.46. HRMS (ESI) *m/z* calcd. for C<sub>16</sub>H<sub>14</sub>F<sub>3</sub>NNaO<sub>2</sub> [M+Na<sup>+</sup>]: 332.0869; found: 332.0871.



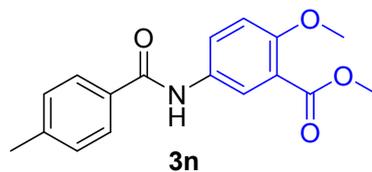
***N*-(dibenzo[*b,d*]furan-2-yl)-4-methylbenzamide (3l)**

White solid (110.0 mg, 91% yield). mp = 194–195 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f$  = 0.40).  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ )  $\delta$  10.35 (s, 1H), 8.59 (s, 1H), 8.11 (d,  $J$  = 7.7 Hz, 1H), 7.94 (d,  $J$  = 7.7 Hz, 2H), 7.81 (d,  $J$  = 8.9 Hz, 1H), 7.69 (d,  $J$  = 8.3 Hz, 2H), 7.53 (t,  $J$  = 7.8 Hz, 1H), 7.46 – 7.29 (m, 3H), 2.40 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz, DMSO- $d_6$ )  $\delta$  165.3, 156.0, 151.9, 141.6, 134.7, 132.0, 128.9, 127.7, 127.6, 123.7, 123.4, 123.1, 121.2, 121.0, 113.0, 111.7, 111.5, 21.0. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{20}\text{H}_{15}\text{NNaO}_2$  [ $\text{M}+\text{Na}^+$ ]: 324.0995; found: 324.0996.



***N*-(4-(1,3-dioxolan-2-yl)phenyl)-4-methylbenzamide (3m)**

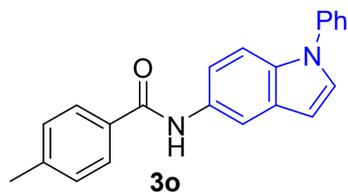
Yellow solid (60.1 mg, 52% yield). mp = 115–116 °C. Eluent: ethyl acetate/petroleum ether (1:2,  $R_f$  = 0.35).  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ )  $\delta$  10.24 (s, 1H), 7.88 (d,  $J$  = 8.0 Hz, 2H), 7.80 (d,  $J$  = 8.2 Hz, 2H), 7.41 (d,  $J$  = 8.3 Hz, 2H), 7.34 (d,  $J$  = 8.0 Hz, 2H), 5.69 (s, 1H), 4.16 – 4.01 (m, 2H), 4.00 – 3.85 (m, 2H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz, DMSO- $d_6$ )  $\delta$  165.4, 141.7, 140.0, 133.1, 132.0, 128.9, 127.7, 127.0, 119.9, 102.7, 64.8, 21.0. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{17}\text{H}_{17}\text{NNaO}_3$  [ $\text{M}+\text{Na}^+$ ]: 306.1101; found: 306.1102.



**methyl 2-methoxy-5-(4-methylbenzamido)benzoate (3n)**

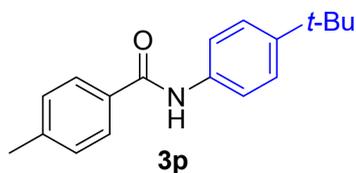
Yellow solid (71.0 mg, 59% yield). mp = 128–129 °C. Eluent: ethyl acetate/petroleum ether (1:2,  $R_f$  = 0.30).  $^1\text{H}$  NMR (400 MHz, DMSO- $d_6$ )  $\delta$  10.20 (s, 1H), 8.13 (s, 1H),

8.03 – 7.73 (m, 3H), 7.33 (d,  $J = 8.1$  Hz, 2H), 7.15 (d,  $J = 8.9$  Hz, 1H), 3.81 (s, 6H), 2.38 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{DMSO-}d_6$ )  $\delta$  166.0, 165.1, 154.5, 141.6, 131.9, 131.8, 128.9, 127.6, 125.6, 122.9, 119.5, 112.9, 56.0, 52.0, 21.0. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{17}\text{H}_{17}\text{NNaO}_4$  [ $\text{M}+\text{Na}^+$ ]: 322.1050; found: 322.1050.



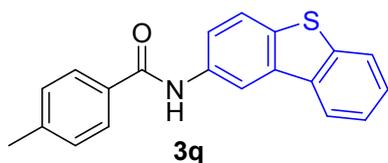
#### 4-methyl-*N*-(1-phenyl-1*H*-indol-5-yl)benzamide (**3o**)

Yellow solid (40.1 mg, 30% yield). mp = 150–151 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f = 0.32$ ).  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-}d_6$ )  $\delta$  10.12 (s, 1H), 8.15 (d,  $J = 1.9$  Hz, 1H), 7.91 (d,  $J = 8.0$  Hz, 2H), 7.66 (d,  $J = 3.2$  Hz, 1H), 7.64 – 7.56 (m, 4H), 7.55 (s, 1H), 7.52 (dd,  $J = 9.0, 1.9$  Hz, 1H), 7.40 (tt,  $J = 6.6, 1.9$  Hz, 1H), 7.34 (d,  $J = 7.9$  Hz, 2H), 6.70 (d,  $J = 3.2$  Hz, 1H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{DMSO-}d_6$ )  $\delta$  165.0, 141.2, 139.2, 132.4, 131.9, 129.8, 129.0, 128.9, 128.9, 127.6, 126.2, 123.5, 117.0, 112.6, 110.2, 103.7, 21.0. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{22}\text{H}_{18}\text{N}_2\text{NaO}$  [ $\text{M}+\text{Na}^+$ ]: 349.1311; found: 349.1312.



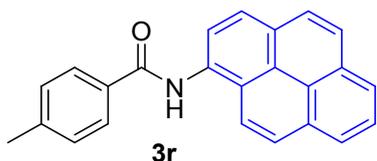
#### *N*-(4-(tert-butyl)phenyl)-4-methylbenzamide<sup>5</sup> (**3p**)

White solid (40.1 mg, 37% yield). mp = 137–138 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f = 0.40$ ).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.82 (s, 1H), 7.76 (d,  $J = 7.9$  Hz, 2H), 7.55 (d,  $J = 8.1$  Hz, 2H), 7.41 – 7.34 (m, 2H), 7.26 (d,  $J = 8.0$  Hz, 2H), 2.41 (s, 3H), 1.32 (s, 9H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  165.8, 147.6, 142.4, 135.5, 132.3, 129.5, 127.2, 126.0, 120.1, 34.5, 31.5, 21.6.



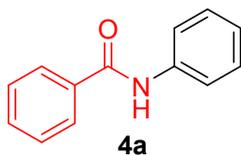
***N*-(dibenzo[*b,d*]thiophen-2-yl)-4-methylbenzamide (3q)**

White solid (103.0 mg, 81% yield). mp = 209–210 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f$  = 0.60).  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-}d_6$ )  $\delta$  10.41 (s, 1H), 8.85 – 8.74 (m, 1H), 8.22 (dt,  $J$  = 7.2, 3.6 Hz, 1H), 8.08 – 8.02 (m, 1H), 8.00 (d,  $J$  = 8.7 Hz, 1H), 7.98 – 7.93 (m, 2H), 7.92 – 7.84 (m, 1H), 7.53 (dt,  $J$  = 7.2, 3.4 Hz, 2H), 7.37 (d,  $J$  = 7.7 Hz, 2H), 2.41 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{DMSO-}d_6$ )  $\delta$  165.4, 141.7, 139.3, 136.6, 135.2, 134.9, 133.4, 132.0, 129.0, 127.7, 127.1, 124.8, 123.2, 123.0, 121.7, 120.8, 113.4, 21.0. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{20}\text{H}_{15}\text{NNaOS}$  [ $\text{M}+\text{Na}^+$ ]: 340.0767; found: 340.0767.



**4-methyl-*N*-(pyren-1-yl)benzamide (3r)**

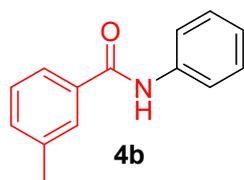
Yellow solid (70.1 mg, 52% yield). mp = 246–247 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f$  = 0.24).  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO-}d_6$ )  $\delta$  10.75 (s, 1H), 8.32 (q,  $J$  = 7.6 Hz, 3H), 8.27 – 8.16 (m, 5H), 8.14 – 8.05 (m, 3H), 7.41 (d,  $J$  = 7.8 Hz, 2H), 2.44 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{DMSO-}d_6$ )  $\delta$  166.2, 141.8, 132.0, 131.6, 130.8, 130.5, 129.1, 128.9, 128.0, 127.3, 127.2, 126.9, 126.4, 125.7, 125.3, 125.2, 125.1, 124.9, 124.4, 123.9, 123.0, 21.1. HRMS (ESI)  $m/z$  calcd. for  $\text{C}_{24}\text{H}_{17}\text{NNaO}$  [ $\text{M}+\text{Na}^+$ ]: 358.1202; found: 358.1203.



***N*-phenylbenzamide<sup>9</sup> (4a)**

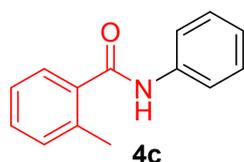
White solid (62.1 mg, 78% yield). mp = 162–163 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.23).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.96 (s, 1H), 7.86 (d,  $J$  = 7.5 Hz, 2H), 7.65 (d,  $J$  = 7.8 Hz, 2H), 7.54 (t,  $J$  = 7.3 Hz, 1H), 7.46 (t,  $J$  = 7.4 Hz, 2H), 7.36 (t,

$J = 7.6$  Hz, 2H), 7.15 (t,  $J = 7.4$  Hz, 1H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  166.0, 138.1, 135.1, 131.9, 129.2, 128.9, 127.2, 124.7, 120.4.



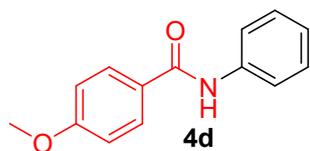
### 3-methyl-*N*-phenylbenzamide<sup>10</sup> (4b)

White solid (75.0 mg, 88% yield). mp = 127–128 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f = 0.26$ ).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.94 (s, 1H), 7.73 – 7.59 (m, 4H), 7.41 – 7.29 (m, 4H), 7.18 – 7.11 (m, 1H), 2.41 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  166.1, 138.8, 138.2, 135.1, 132.7, 129.2, 128.7, 127.9, 124.6, 124.1, 120.4, 21.5.



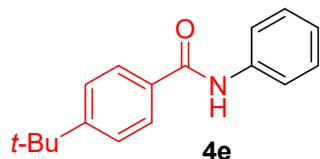
### 2-methyl-*N*-phenylbenzamide<sup>10</sup> (4c)

White solid (71.9 mg, 85% yield). mp = 125–126 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f = 0.28$ ).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.65 (d,  $J = 7.8$  Hz, 2H), 7.57 (s, 1H), 7.50 (d,  $J = 7.5$  Hz, 1H), 7.40 (t,  $J = 7.9$  Hz, 3H), 7.29 (dd,  $J = 6.7, 4.0$  Hz, 2H), 7.19 (t,  $J = 7.4$  Hz, 1H), 2.53 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  168.2, 138.1, 136.6, 131.4, 130.4, 129.2, 126.7, 126.0, 124.7, 120.0, 19.9.



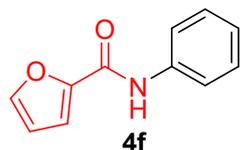
### 4-methoxy-*N*-phenylbenzamide<sup>11</sup> (4d)

White solid (76.2 mg, 83% yield). mp = 166–167 °C. Eluent: ethyl acetate/petroleum ether (1:4,  $R_f = 0.20$ ).  $^1\text{H}$  NMR (400 MHz,  $\text{DMSO}-d_6$ )  $\delta$  10.08 (s, 1H), 7.97 (dd,  $J = 9.0, 2.5$  Hz, 2H), 7.83 – 7.71 (m, 2H), 7.40 – 7.25 (m, 2H), 7.16 – 6.97 (m, 3H), 3.84 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{DMSO}-d_6$ )  $\delta$  164.9, 161.9, 139.3, 129.6, 128.5, 127.0, 123.4, 120.3, 113.6, 55.4.



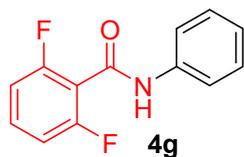
#### 4-(*tert*-butyl)-*N*-phenylbenzamide<sup>12</sup> (**4e**)

White solid (85.1 mg, 83% yield). mp = 115–116 °C. Eluent: ethyl acetate/petroleum ether (1:10,  $R_f$  = 0.40). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.92 (s, 1H), 7.85 – 7.77 (m, 2H), 7.69 – 7.60 (m, 2H), 7.52 – 7.44 (m, 2H), 7.41 – 7.31 (m, 2H), 7.20 – 7.08 (m, 1H), 1.35 (s, 9H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 165.8, 155.5, 138.2, 132.2, 129.2, 127.0, 125.8, 124.5, 120.3, 35.1, 31.3.



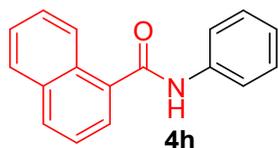
#### *N*-phenylfuran-2-carboxamide<sup>13</sup> (**4f**)

White solid (58.0 mg, 77% yield). mp = 125–126 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.32). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.12 (s, 1H), 7.65 (d,  $J$  = 8.1 Hz, 2H), 7.50 (d,  $J$  = 1.9 Hz, 1H), 7.41 – 7.30 (m, 2H), 7.23 (d,  $J$  = 3.5 Hz, 1H), 7.14 (t,  $J$  = 7.3 Hz, 1H), 6.54 (dd,  $J$  = 3.6, 1.8 Hz, 1H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 156.2, 148.0, 144.3, 137.5, 129.2, 124.6, 120.1, 115.4, 112.7.



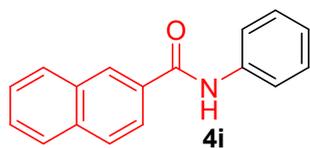
#### 2,6-difluoro-*N*-phenylbenzamide (**4g**)

White solid (49.8 mg, 53% yield). mp = 123–124 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.20). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.79 (s, 1H), 7.61 (d,  $J$  = 7.9 Hz, 2H), 7.48 – 7.31 (m, 3H), 7.17 (t,  $J$  = 7.4 Hz, 1H), 6.96 (t,  $J$  = 8.3 Hz, 2H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 161.4, 158.7 (d,  $J$  = 37.4 Hz), 137.5, 132.2 (t,  $J$  = 10.4 Hz), 129.2, 125.2, 120.3, 114.5 (d,  $J$  = 19.5 Hz), 112.3 (d,  $J$  = 23.1 Hz). <sup>19</sup>F NMR (376 MHz, CDCl<sub>3</sub>) δ -111.80. HRMS (ESI)  $m/z$  calcd. for C<sub>13</sub>H<sub>9</sub>F<sub>2</sub>NNaO [M+Na<sup>+</sup>]: 256.0544; found: 256.0542.



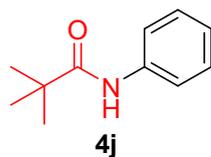
***N*-phenyl-1-naphthamide<sup>12</sup> (4h)**

White solid (90.2 mg, 90% yield). mp = 164–165 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.29). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.36 (d,  $J$  = 9.3 Hz, 1H), 7.96 (d,  $J$  = 8.3 Hz, 1H), 7.93 – 7.86 (m, 1H), 7.77 – 7.65 (m, 4H), 7.61 – 7.52 (m, 2H), 7.49 (t,  $J$  = 7.6 Hz, 1H), 7.40 (t,  $J$  = 7.8 Hz, 2H), 7.18 (t,  $J$  = 7.5 Hz, 1H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 167.7, 138.2, 134.7, 133.9, 131.2, 130.2, 129.3, 128.6, 127.5, 126.8, 125.4, 125.2, 124.9, 124.8, 120.1.



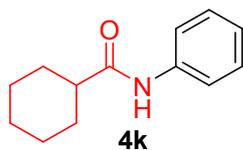
***N*-phenyl-2-naphthamide<sup>14</sup> (4i)**

White solid (92.0 mg, 93% yield). mp = 166–167 °C. Eluent: ethyl acetate/petroleum ether (1:8,  $R_f$  = 0.24). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) δ 10.44 (s, 1H), 8.59 (s, 1H), 8.30 – 7.94 (m, 4H), 7.84 (d,  $J$  = 7.9 Hz, 2H), 7.64 (s, 2H), 7.39 (t,  $J$  = 7.9 Hz, 2H), 7.13 (t,  $J$  = 7.5 Hz, 1H). <sup>13</sup>C NMR (101 MHz, DMSO-*d*<sub>6</sub>) δ 165.6, 139.2, 134.2, 132.3, 132.1, 128.9, 128.6, 128.0, 127.9, 127.8, 127.7, 126.8, 124.4, 123.7, 120.4.



***N*-phenylpivalamide<sup>15</sup> (4j)**

White solid (67.8 mg, 95% yield). mp = 126–127 °C. Eluent: ethyl acetate/petroleum ether (1:10,  $R_f$  = 0.56). <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.53 (d,  $J$  = 8.2 Hz, 2H), 7.36 (s, 1H), 7.31 (t,  $J$  = 7.8 Hz, 2H), 7.09 (t,  $J$  = 7.4 Hz, 1H), 1.31 (s, 9H). <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 176.7, 138.2, 129.1, 124.3, 120.1, 39.7, 27.8.



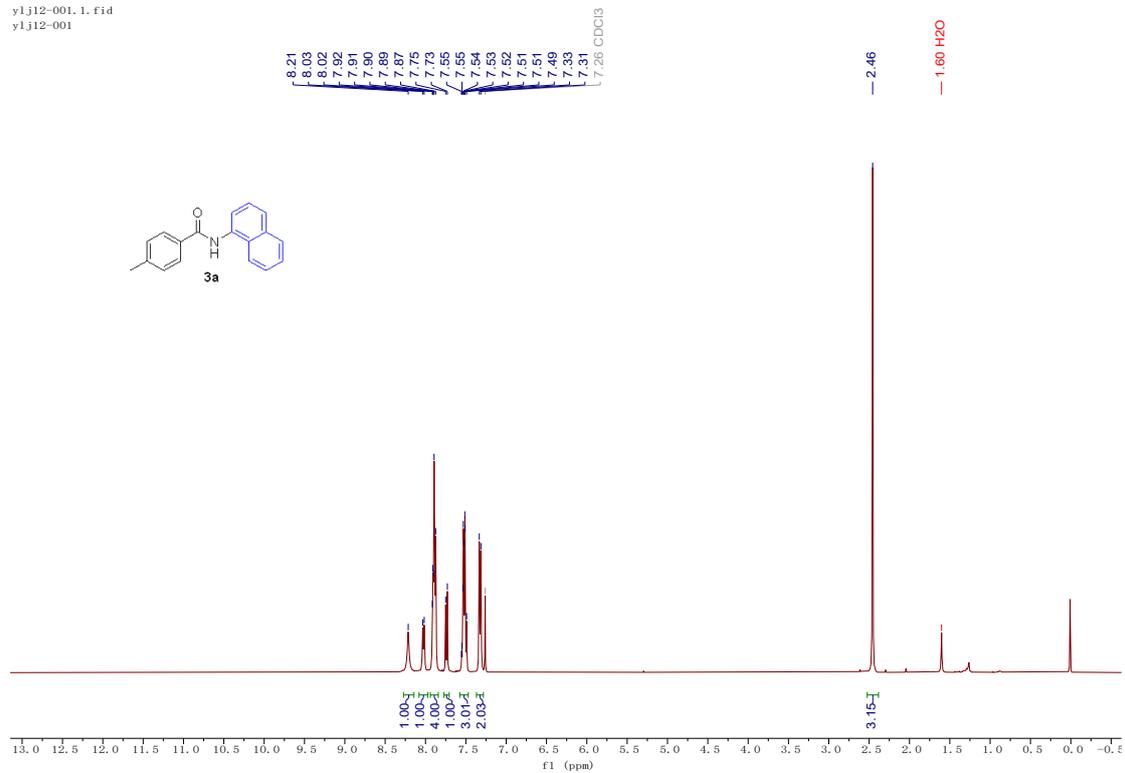
***N*-phenylcyclohexanecarboxamide<sup>16</sup> (4k)**

White solid (50.1 mg, 61% yield). mp = 145–146 °C. Eluent: ethyl acetate/petroleum ether (1:10,  $R_f$  = 0.35).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.53 (d,  $J$  = 7.9 Hz, 2H), 7.35 (s, 1H), 7.30 (t,  $J$  = 7.8 Hz, 2H), 7.08 (t,  $J$  = 7.4 Hz, 1H), 2.23 (tt,  $J$  = 11.8, 3.6 Hz, 1H), 1.95 (dd,  $J$  = 12.5, 3.5 Hz, 2H), 1.87 – 1.78 (m, 2H), 1.73 – 1.66 (m, 1H), 1.54 (qd,  $J$  = 12.1, 3.3 Hz, 2H), 1.37 – 1.21 (m, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  174.6, 138.3, 129.1, 124.2, 119.9, 46.7, 29.8, 25.8.

## IV. NMR spectra

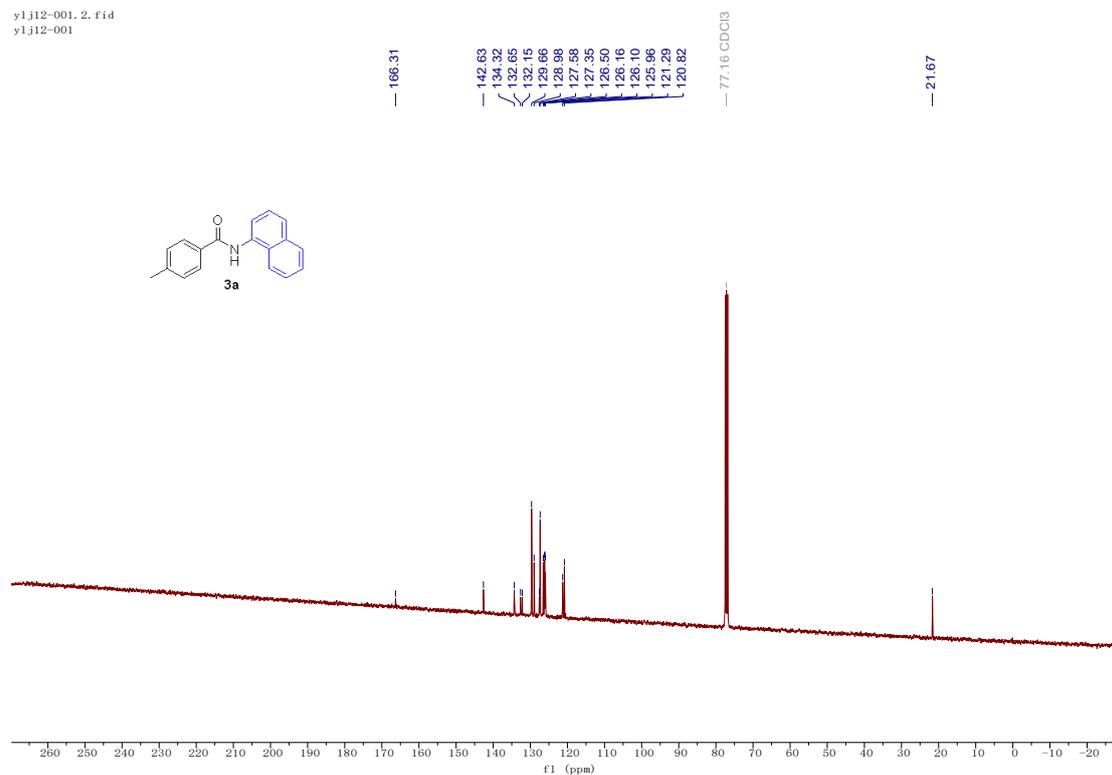
### $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3a**

ylj12-001.1.fid  
ylj12-001



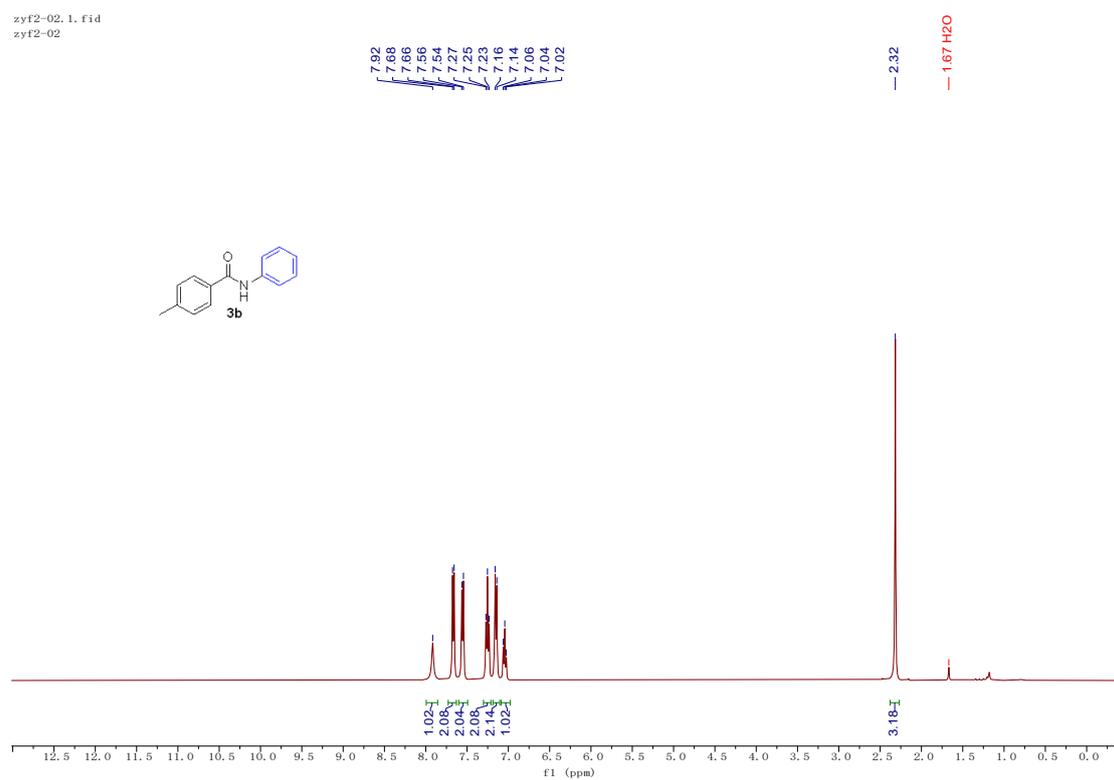
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3a**

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ylj12-001



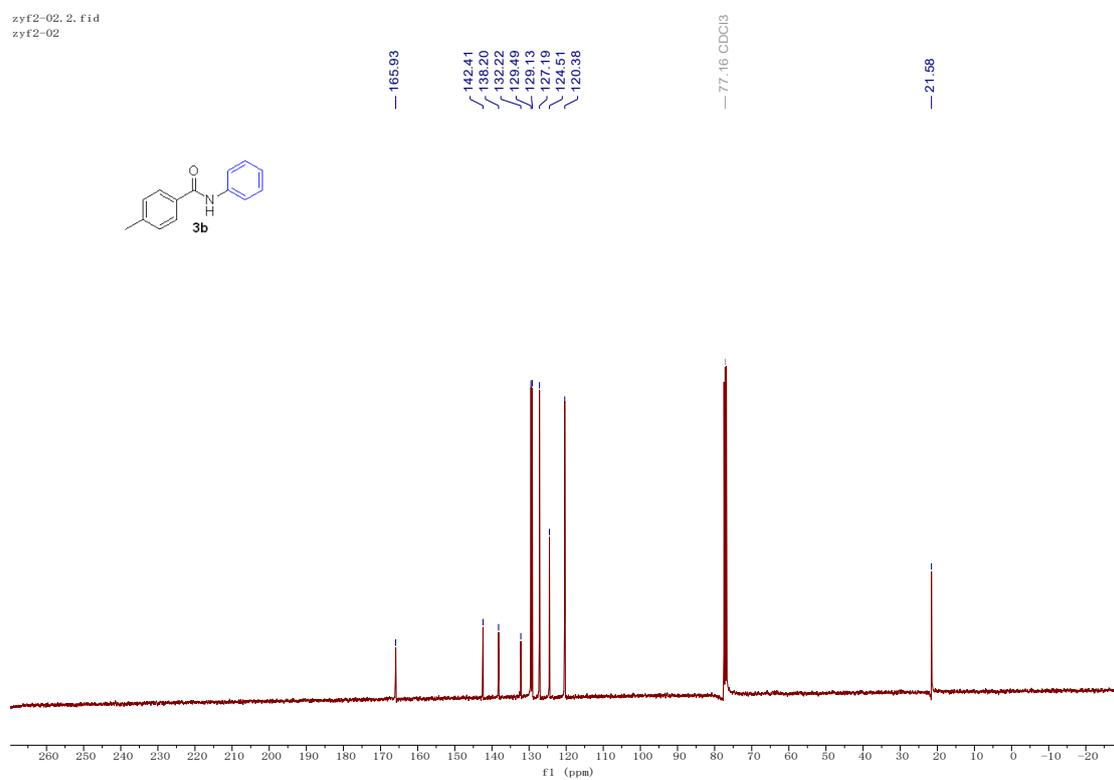
# <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) spectrum of **3b**

zyf2-02.1.fid  
zyf2-02



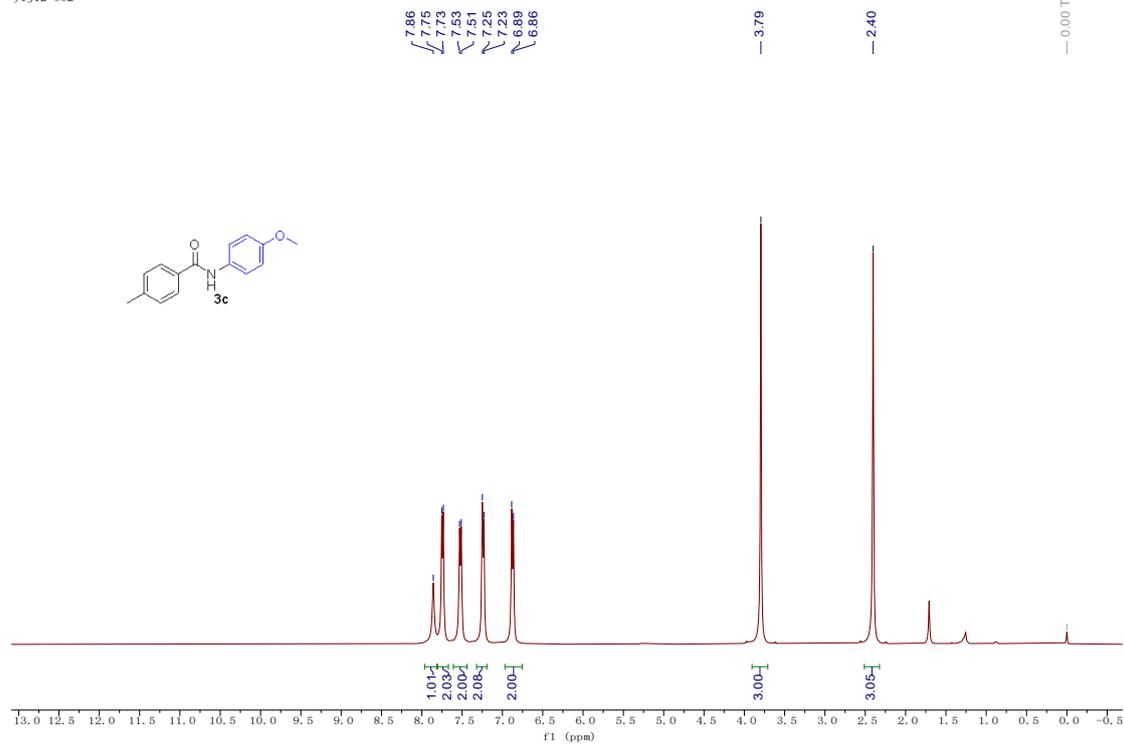
# <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) spectrum of **3b**

zyf2-02.2.fid  
zyf2-02



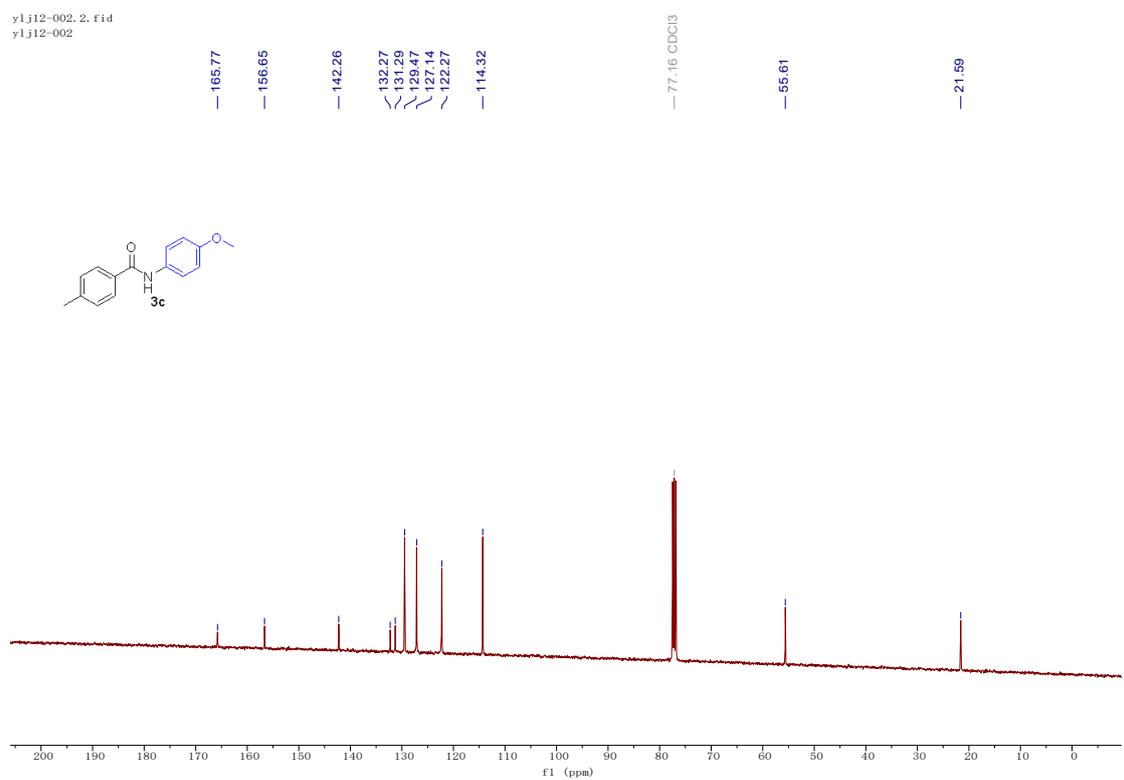
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3c**

y1j12-002.1.fid  
y1j12-002



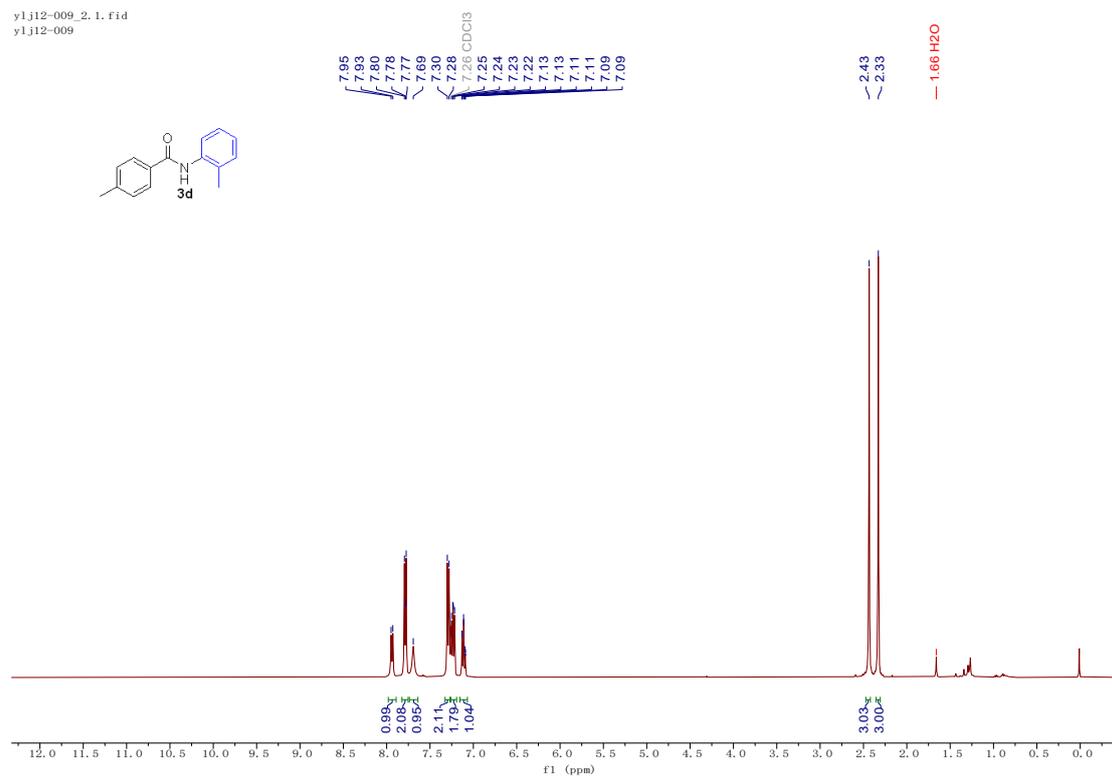
# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3c**

y1j12-002.2.fid  
y1j12-002



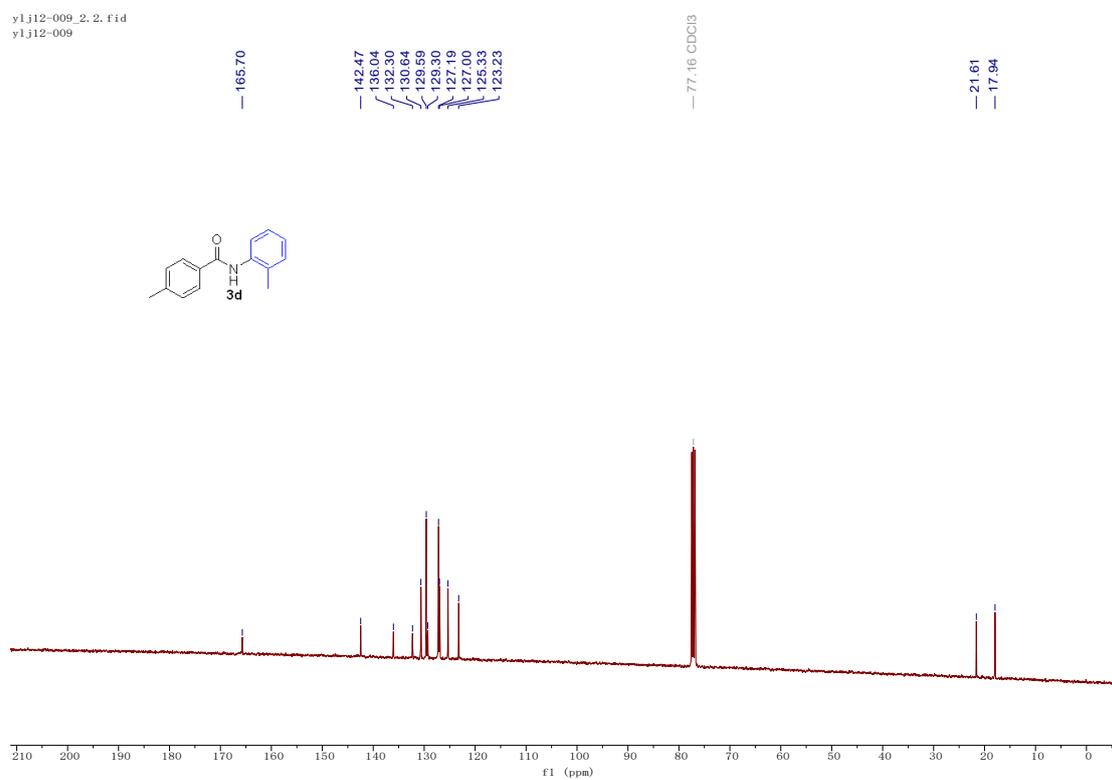
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3d**

y1j12-009\_2.1.fid  
y1j12-009



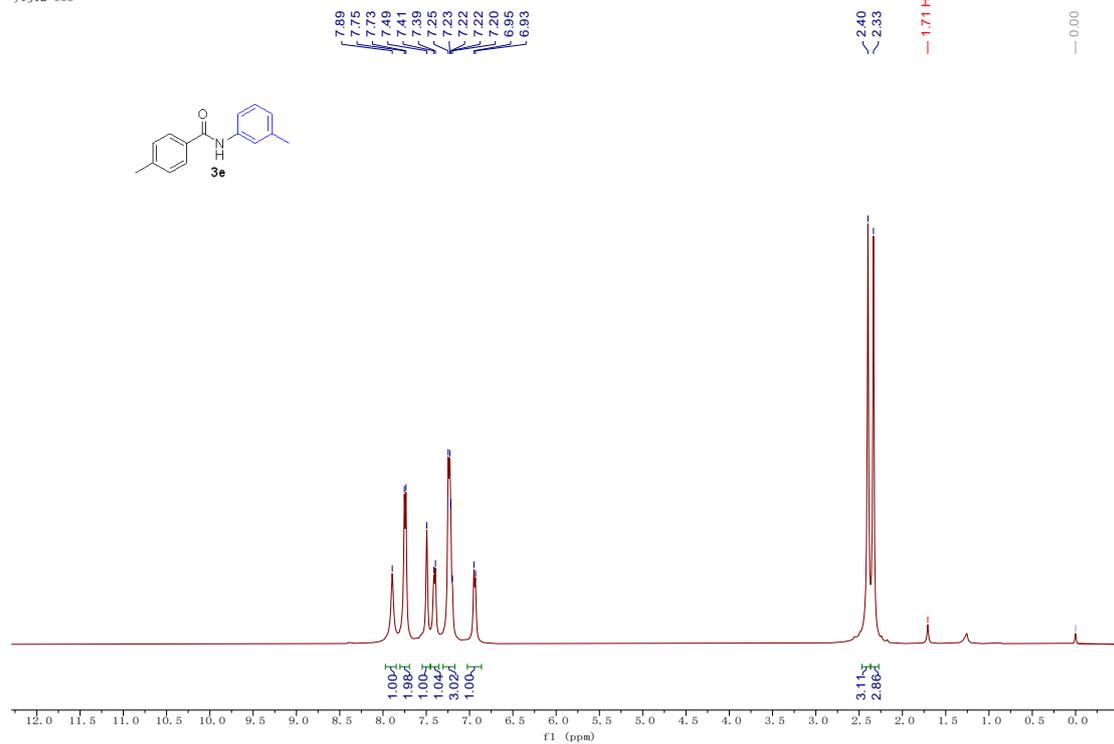
# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3d**

y1j12-009\_2.2.fid  
y1j12-009



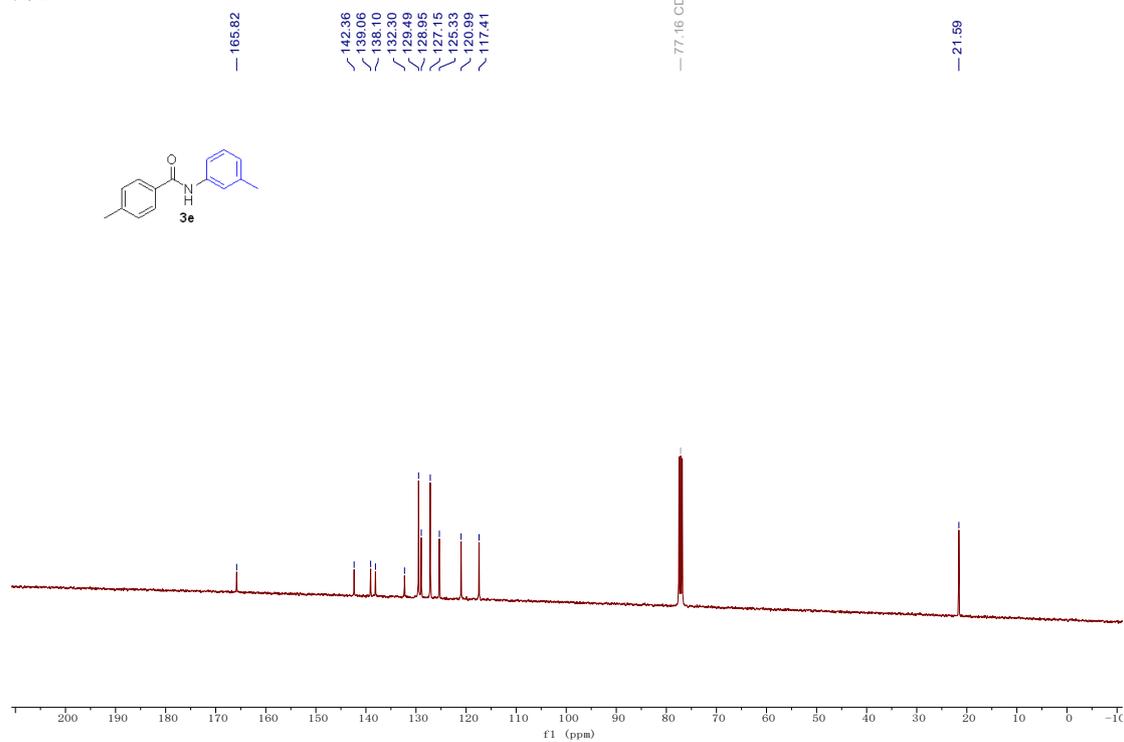
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3e**

ylj12-005.1.fid  
ylj12-005



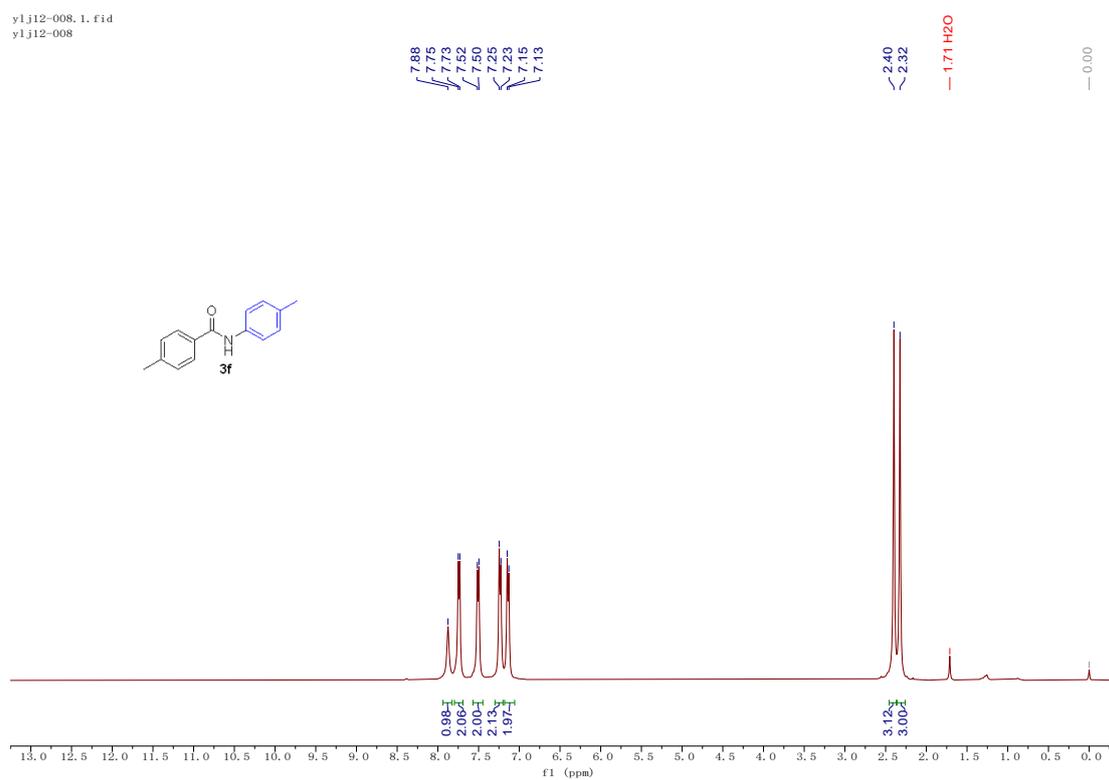
# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3e**

ylj12-005.2.fid  
ylj12-005



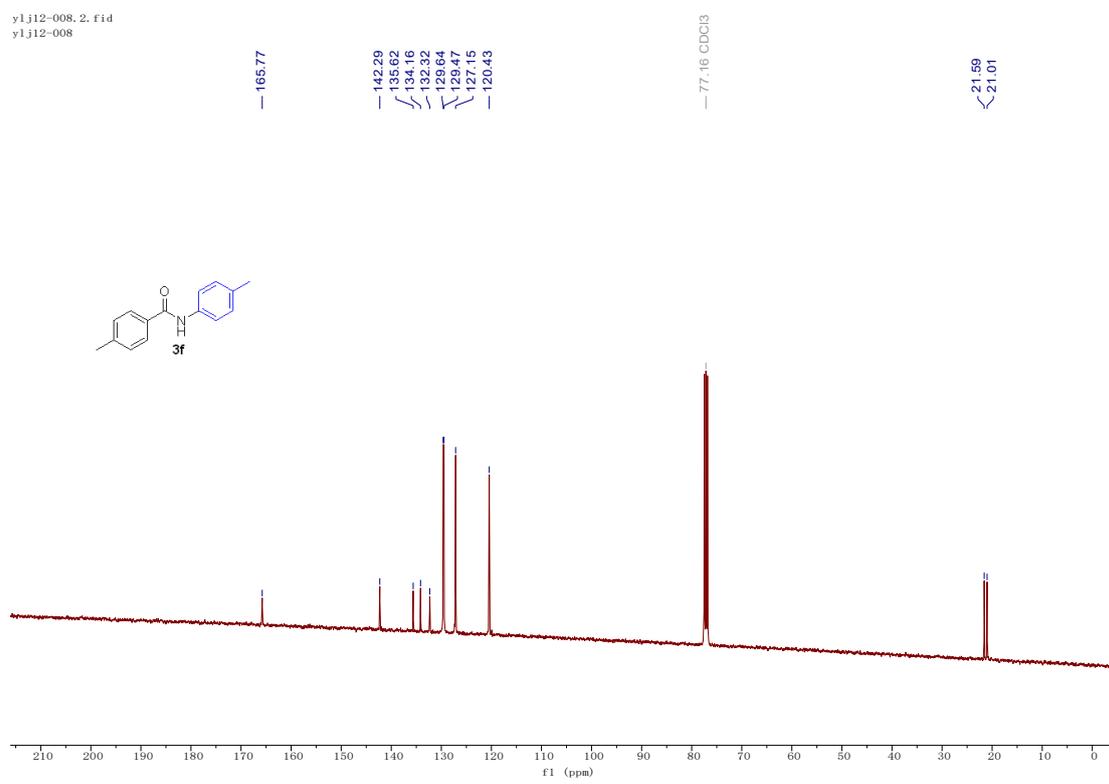
# <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) spectrum of **3f**

y1j12-008.1.fid  
y1j12-008



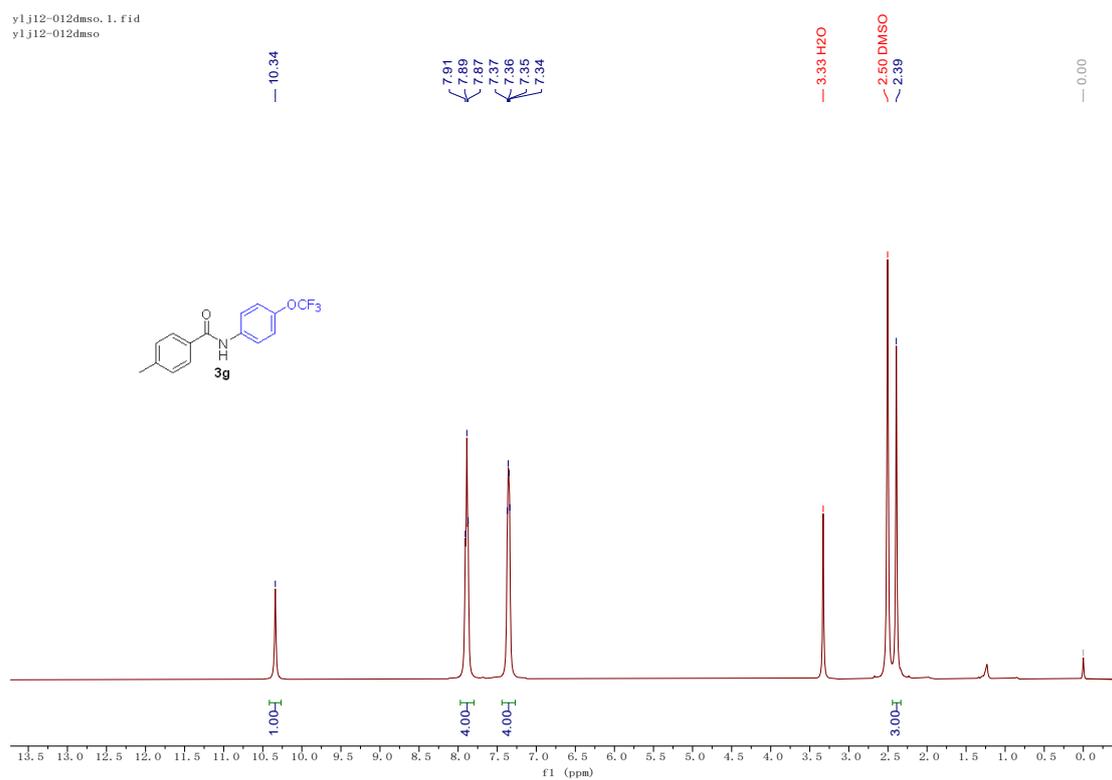
# <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) spectrum of **3f**

y1j12-008.2.fid  
y1j12-008



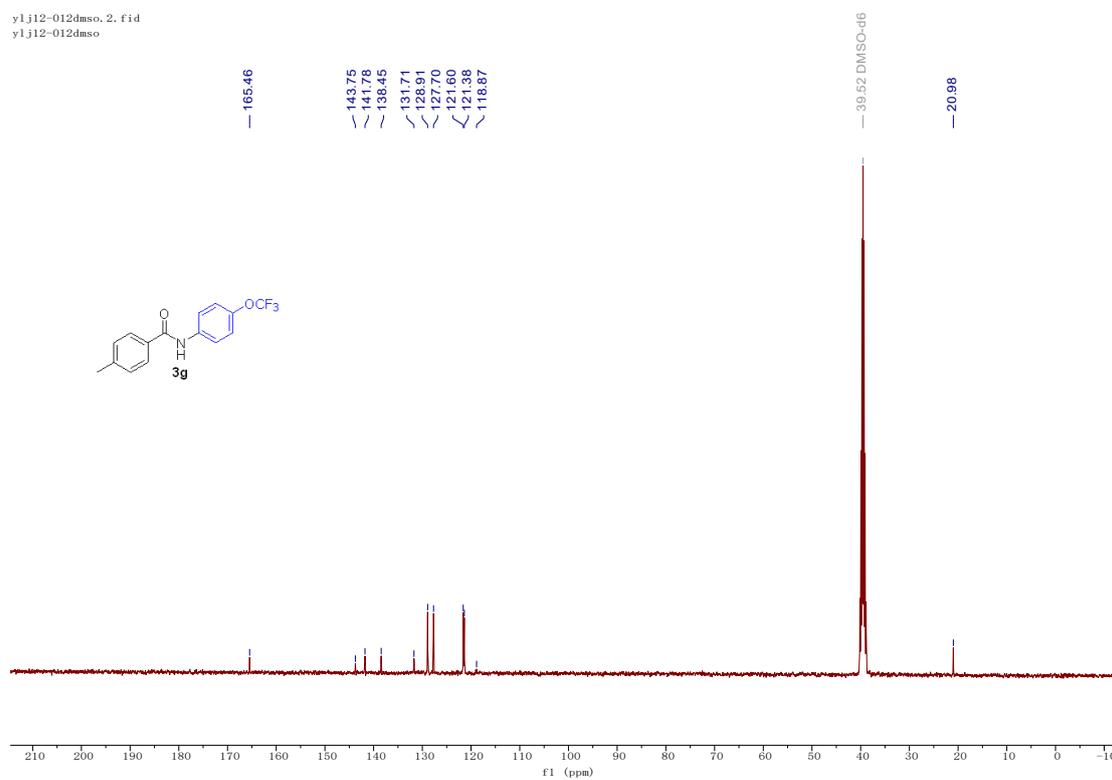
# $^1\text{H}$ NMR (400 MHz, $\text{DMSO-}d_6$ ) spectrum of **3g**

yljl2-012dms0.1.fid  
yljl2-012dms0



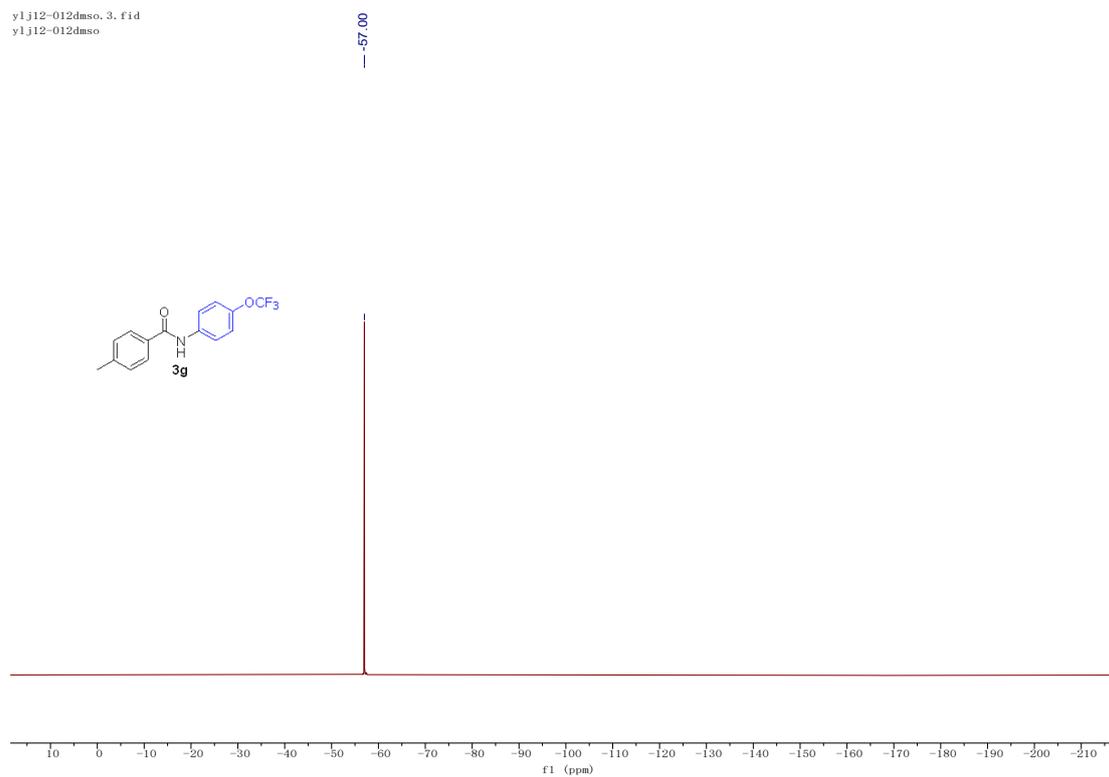
# $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3g**

yljl2-012dms0.2.fid  
yljl2-012dms0



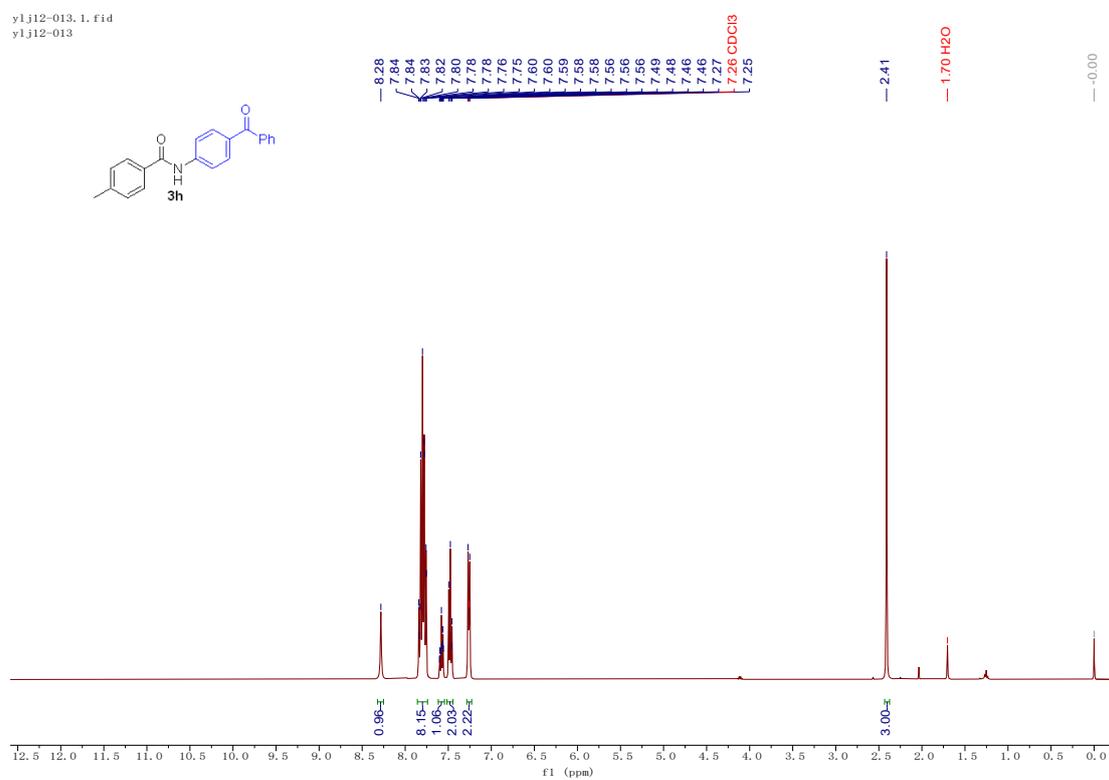
# $^{19}\text{F}$ NMR (376 MHz, $\text{DMSO-}d_6$ ) spectrum of **3g**

ylj12-012dms0.3.fid  
ylj12-012dms0

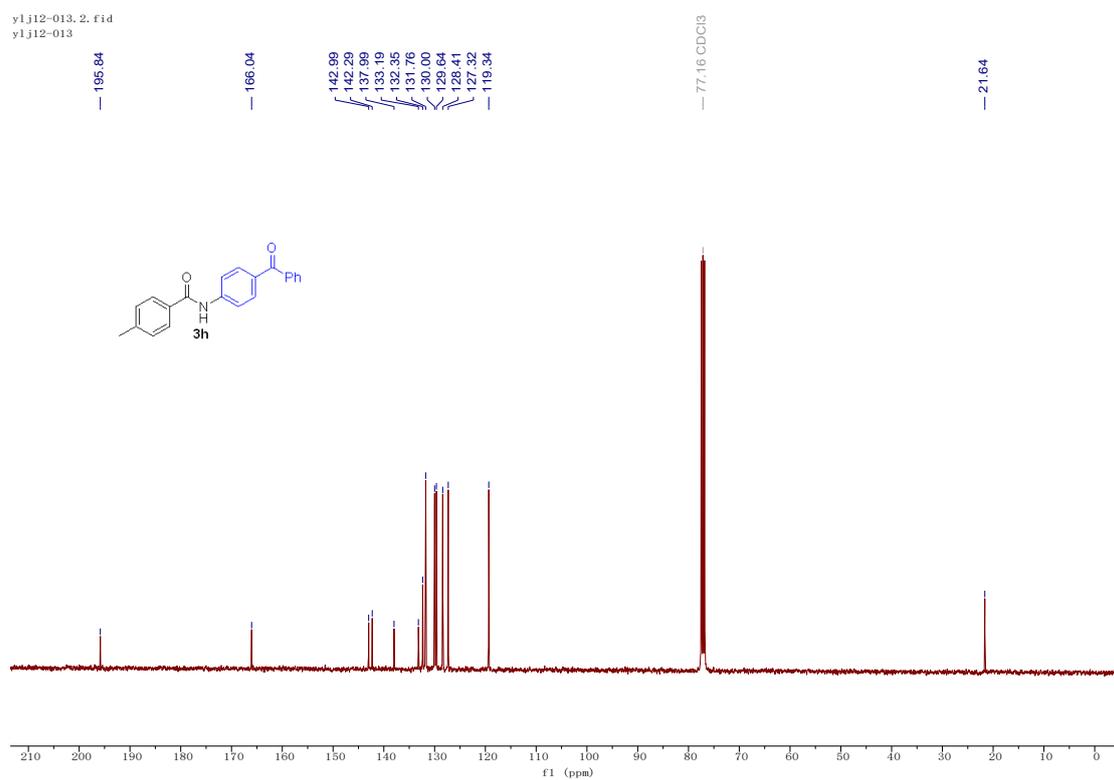


# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3h**

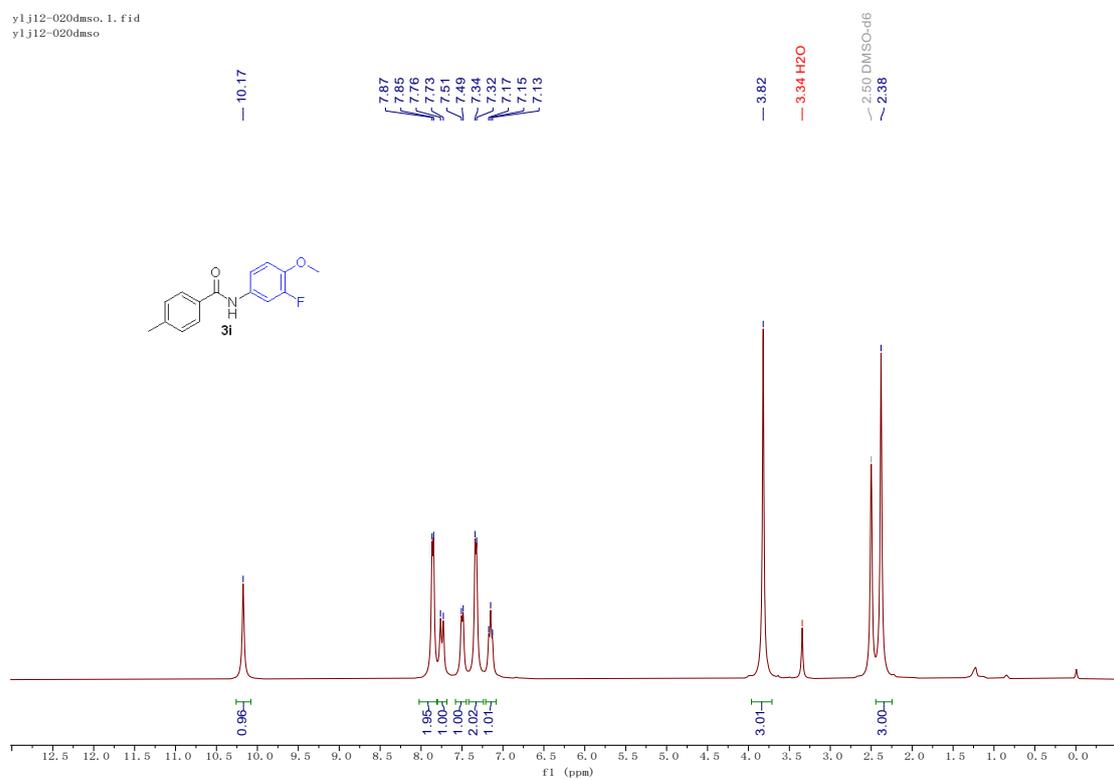
ylj12-013.1.fid  
ylj12-013



### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3h**

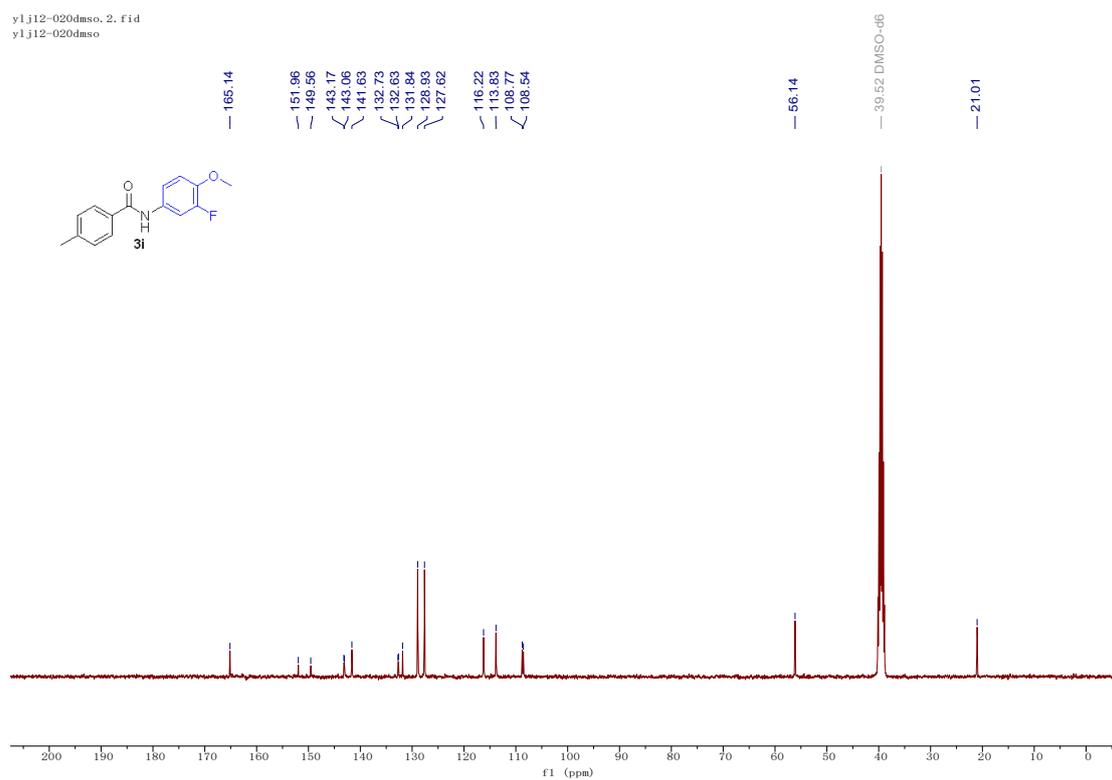


### $^1\text{H}$ NMR (400 MHz, $\text{DMSO-}d_6$ ) spectrum of **3i**



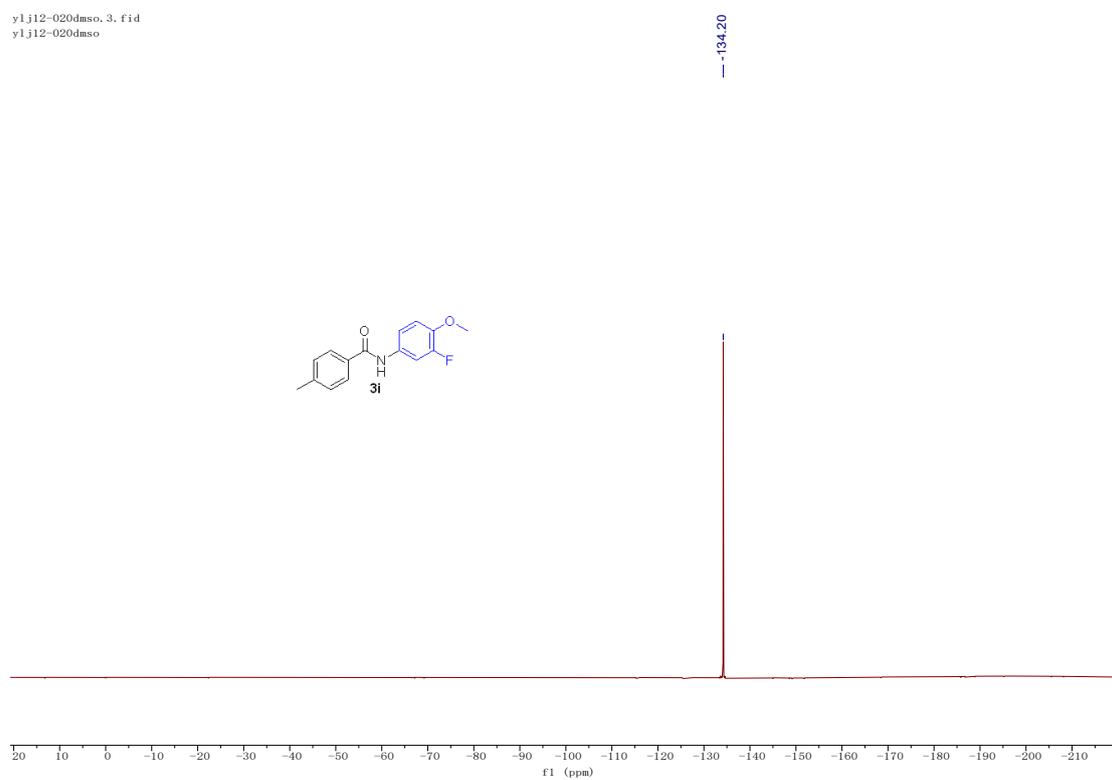
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3i**

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yljl2-020dms0



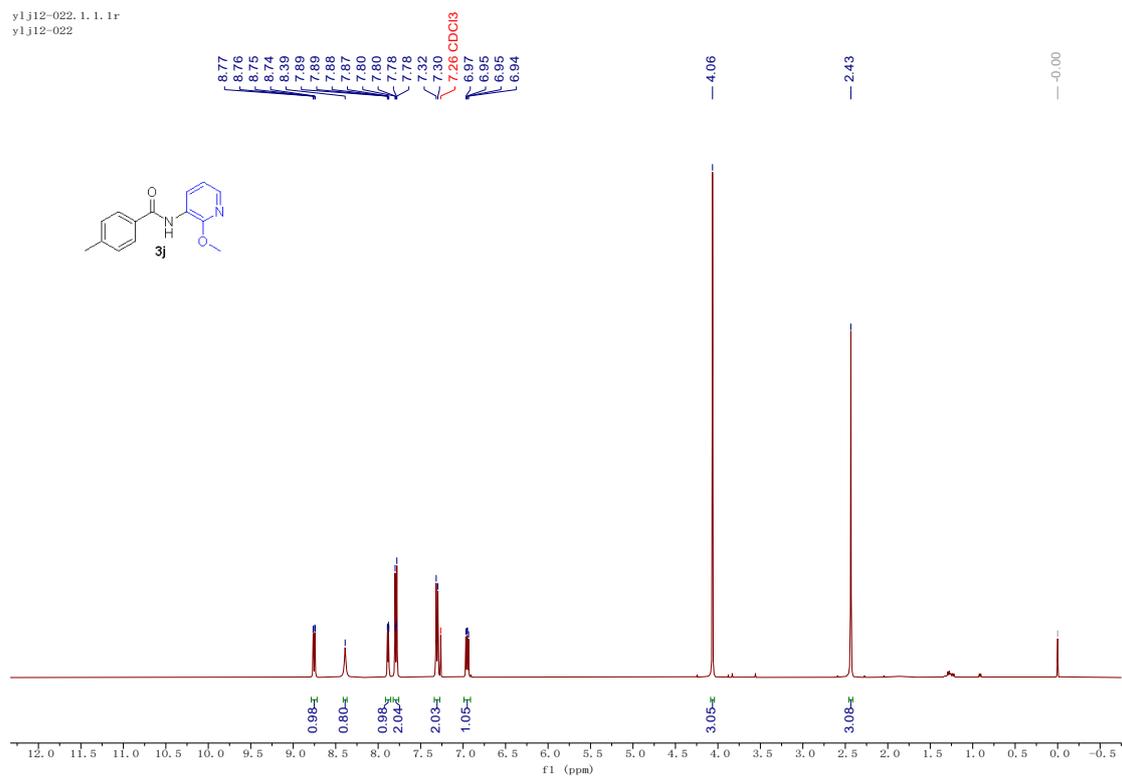
### $^{19}\text{F}$ NMR (376 MHz, $\text{DMSO-}d_6$ ) spectrum of **3i**

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yljl2-020dms0



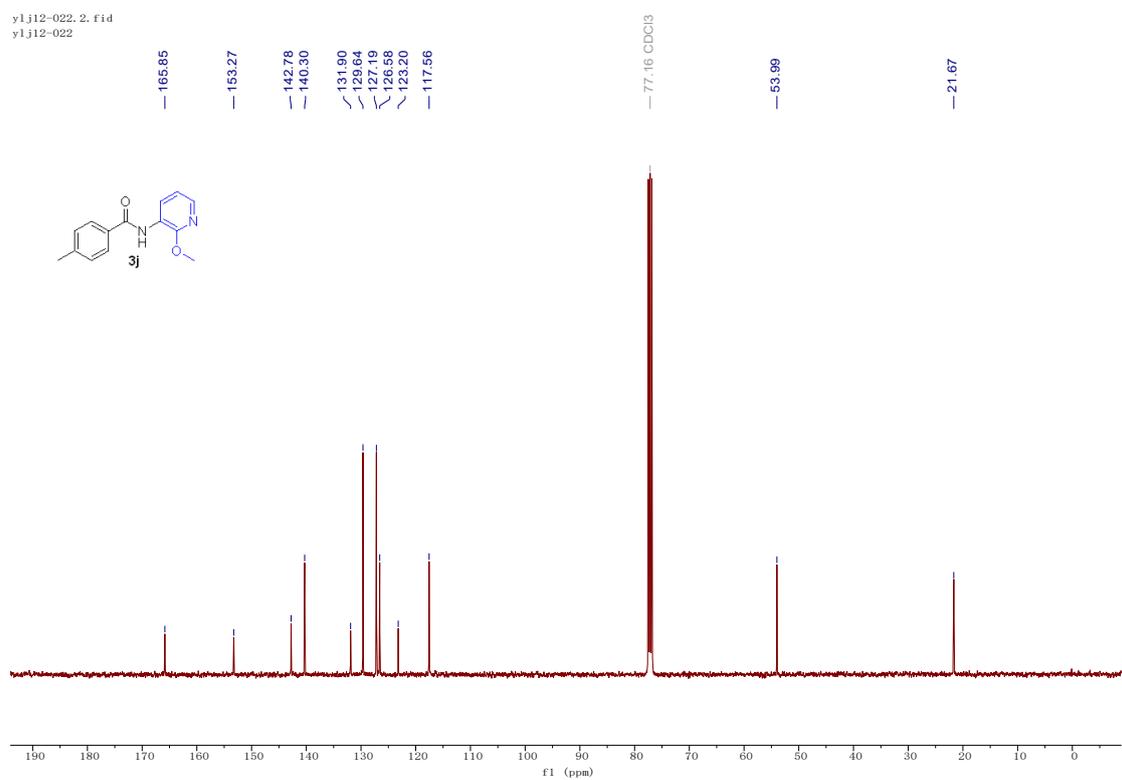
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3j**

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y1j12-022



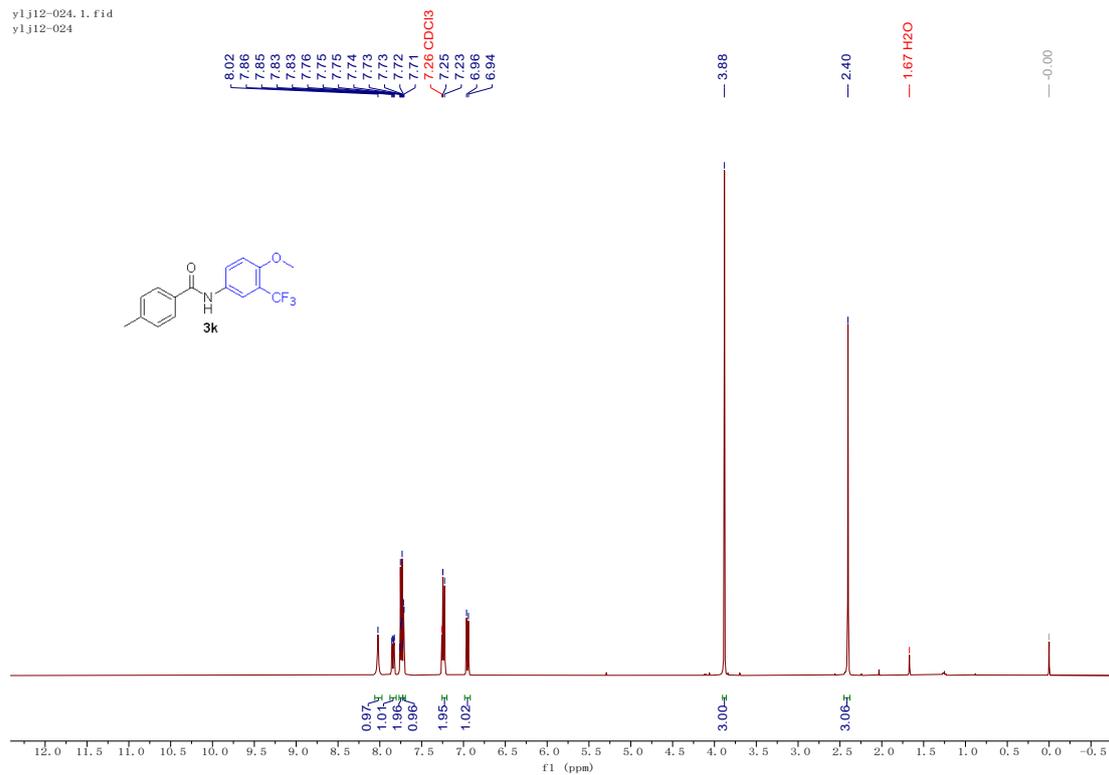
# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3j**

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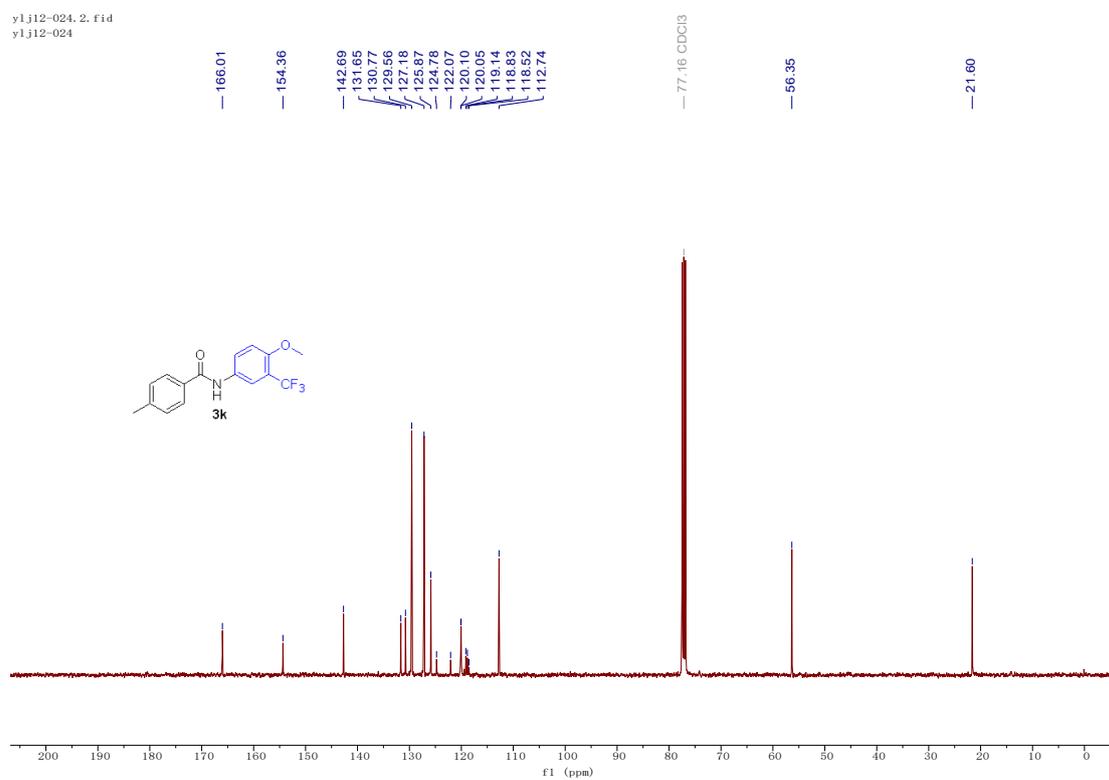
# <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) spectrum of **3k**

ylj12-024.1.fid  
ylj12-024



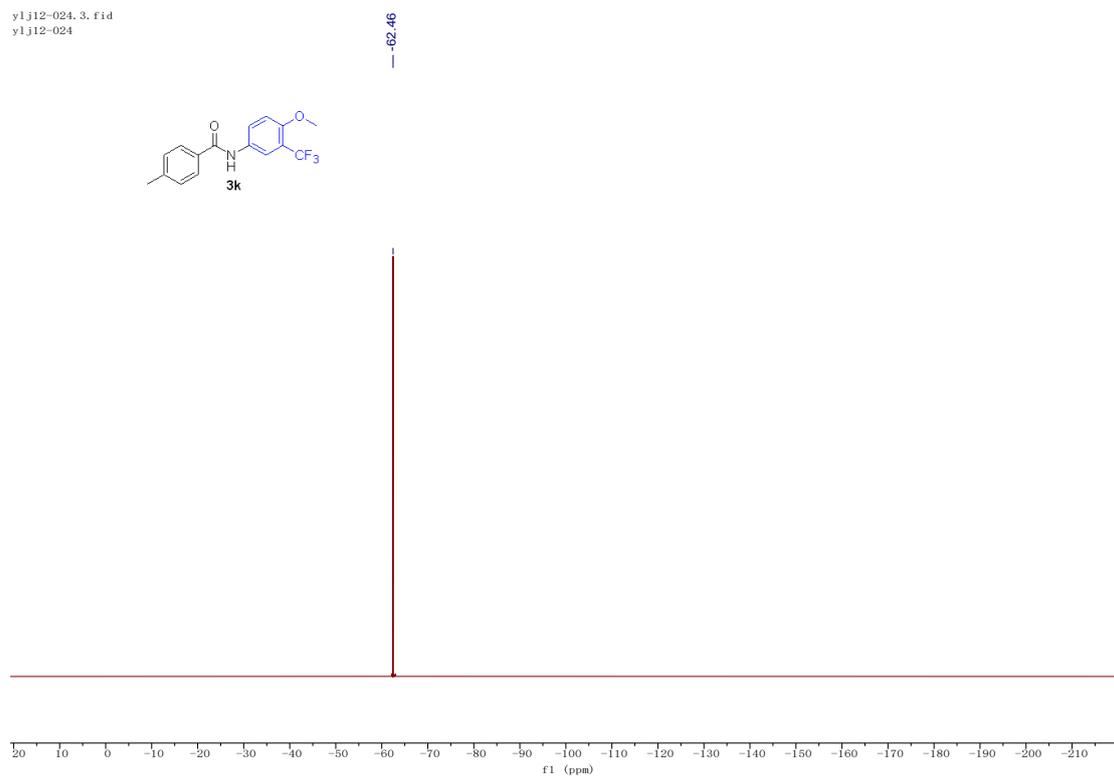
# <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) spectrum of **3k**

ylj12-024.2.fid  
ylj12-024



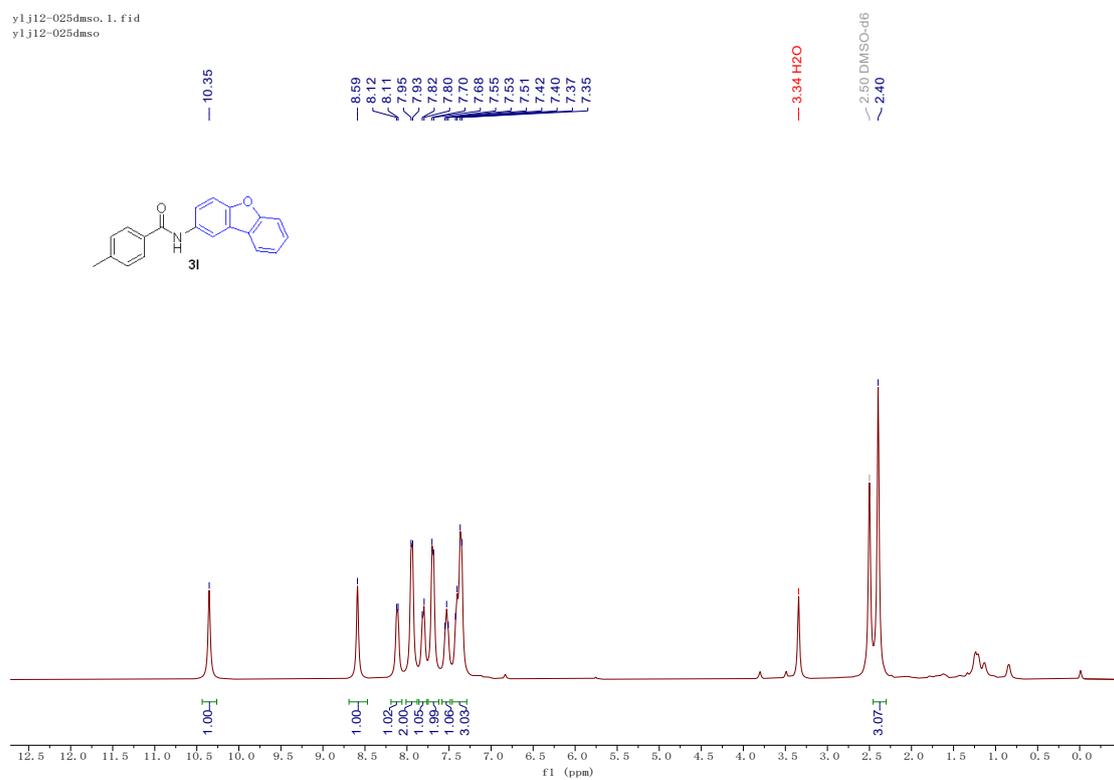
# <sup>19</sup>F NMR (376 MHz, CDCl<sub>3</sub>) spectrum of **3k**

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ylj12-024



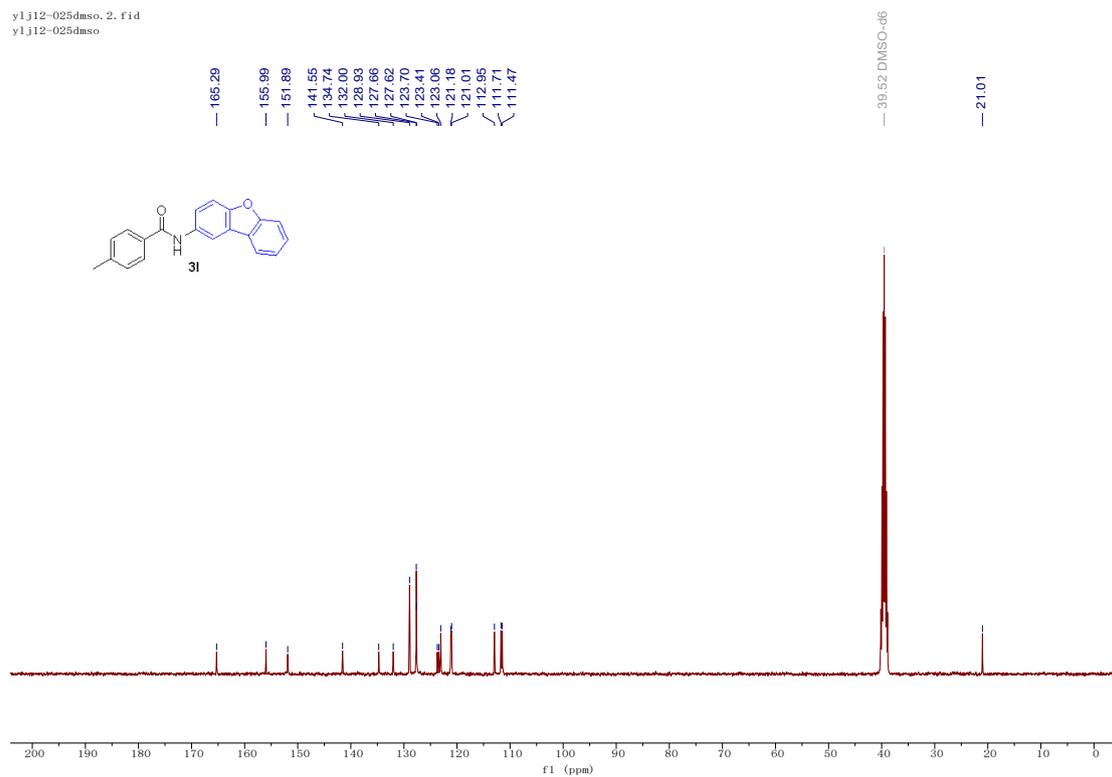
# <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) spectrum of **3l**

ylj12-025dms0.1.fid  
ylj12-025dms0



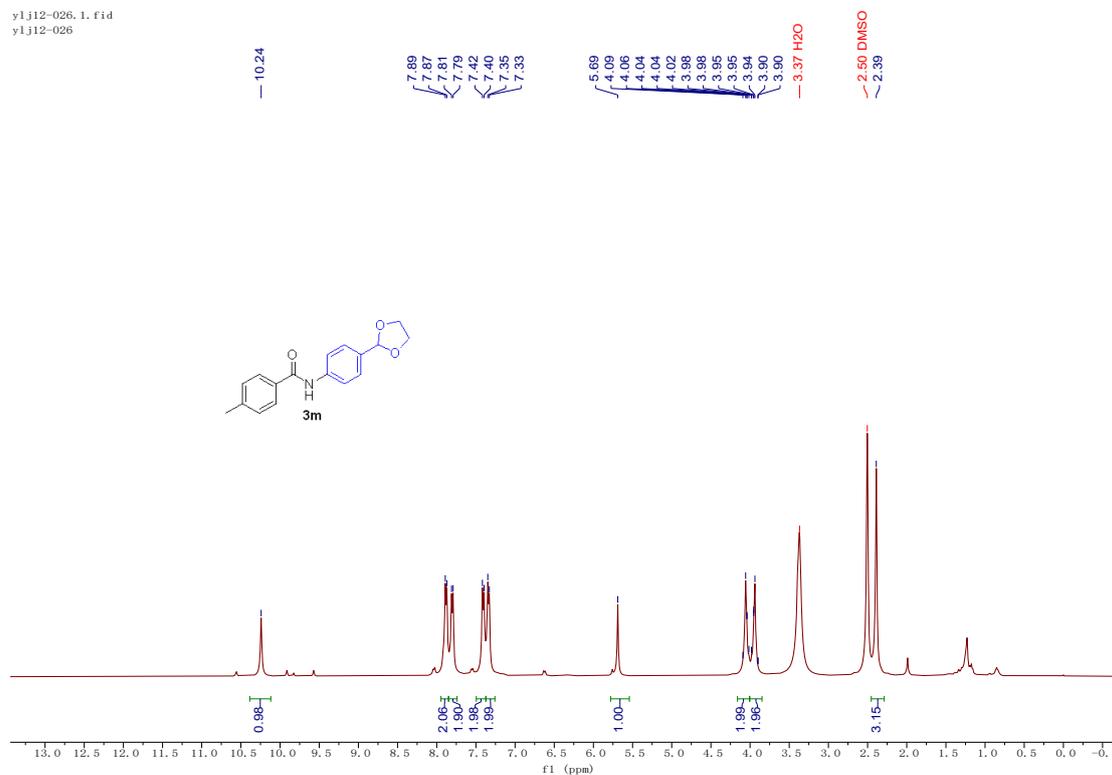
### <sup>13</sup>C NMR (101 MHz, DMSO-*d*<sub>6</sub>) spectrum of **3l**

ylj12-025dms0.2.fid  
ylj12-025dms0



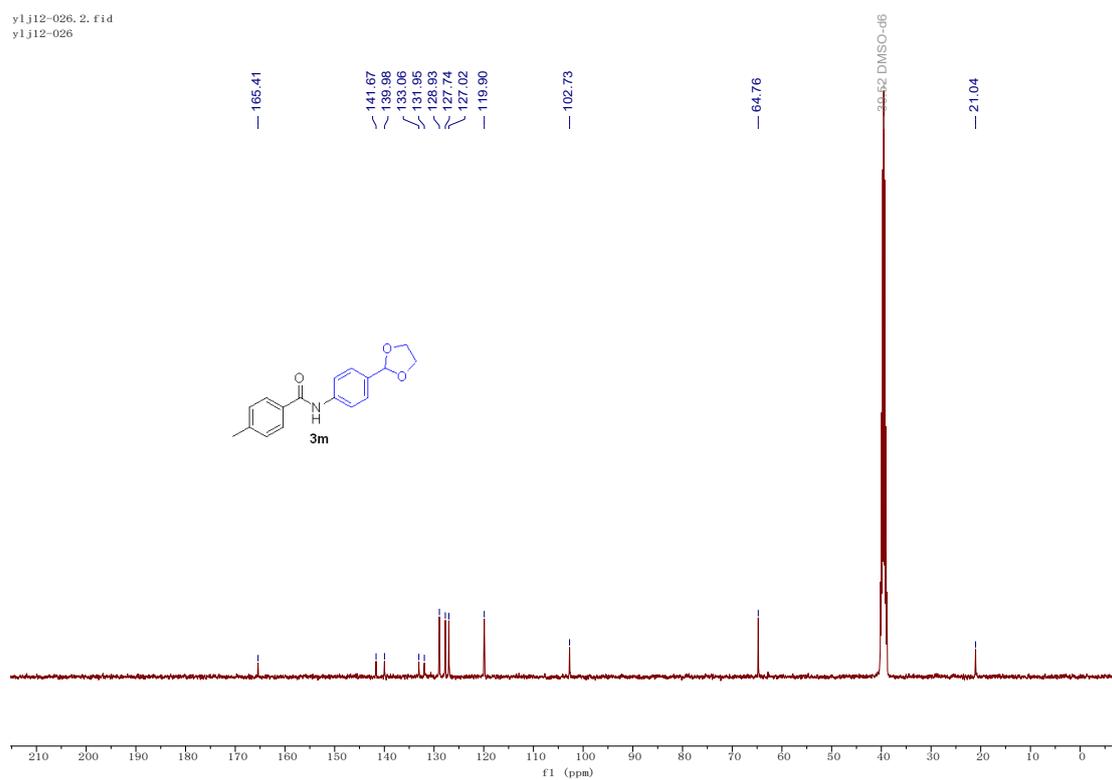
### <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) spectrum of **3m**

ylj12-026.1.fid  
ylj12-026



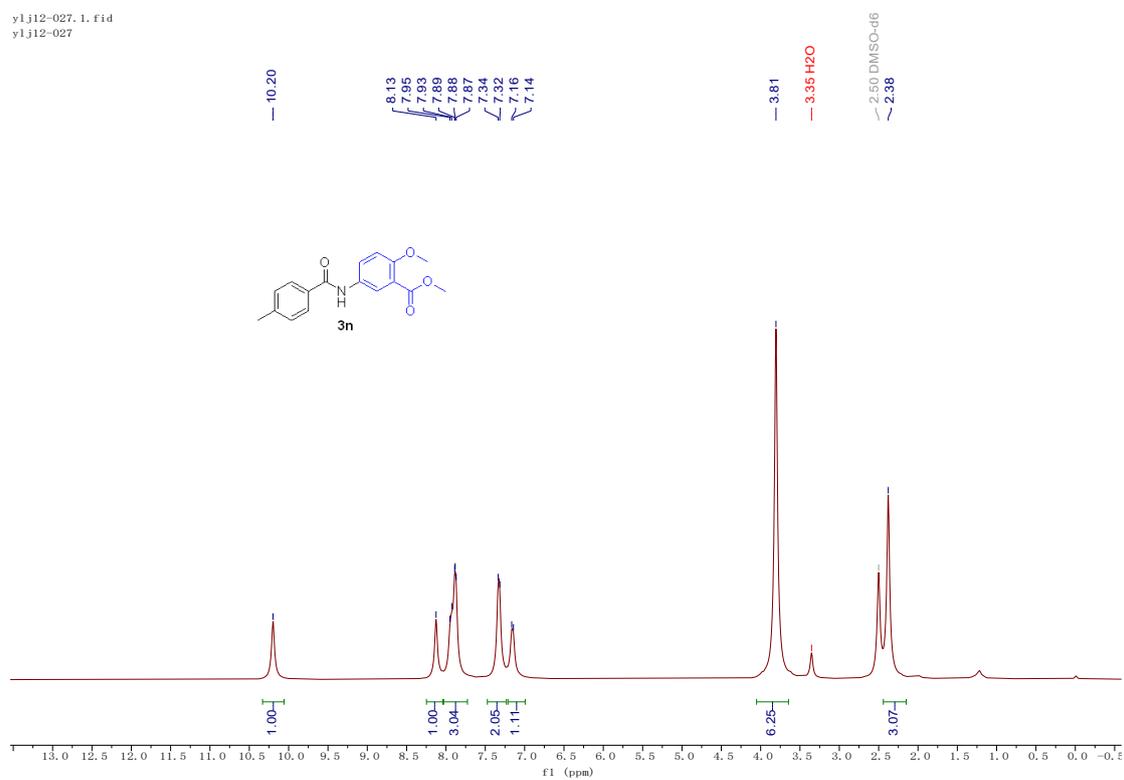
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3m**

y1j12-026. 2. fid  
y1j12-026



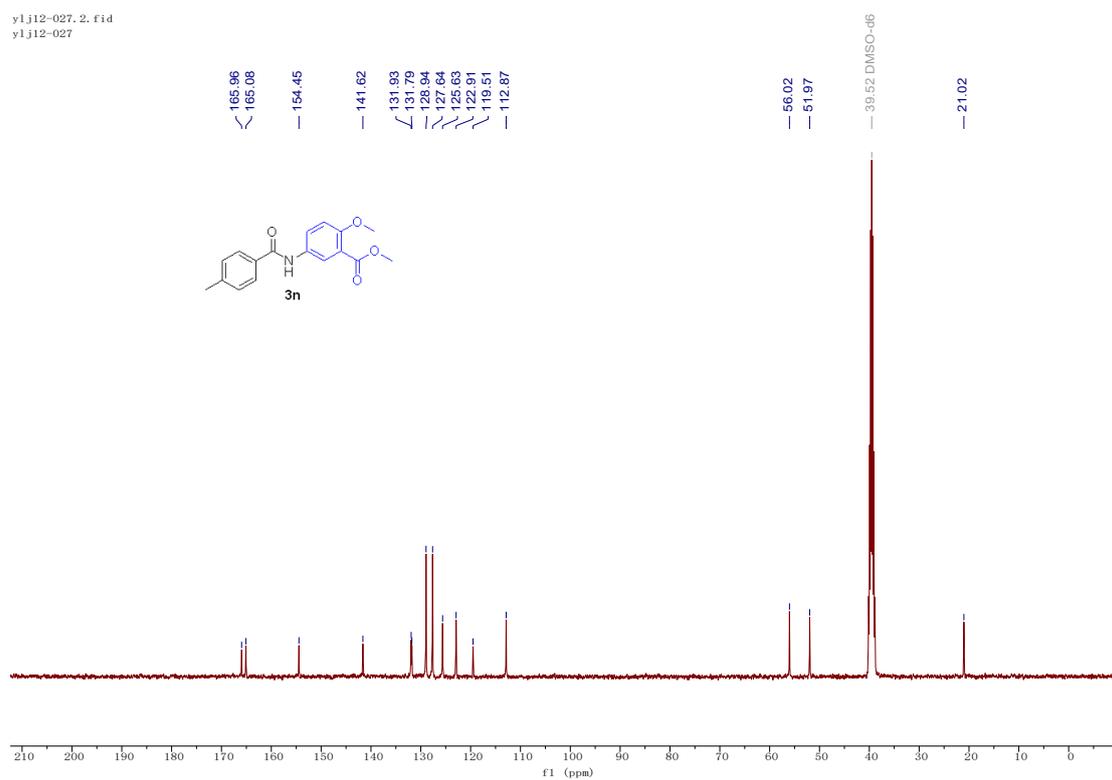
### $^1\text{H}$ NMR (400 MHz, $\text{DMSO-}d_6$ ) spectrum of **3n**

y1j12-027. 1. fid  
y1j12-027



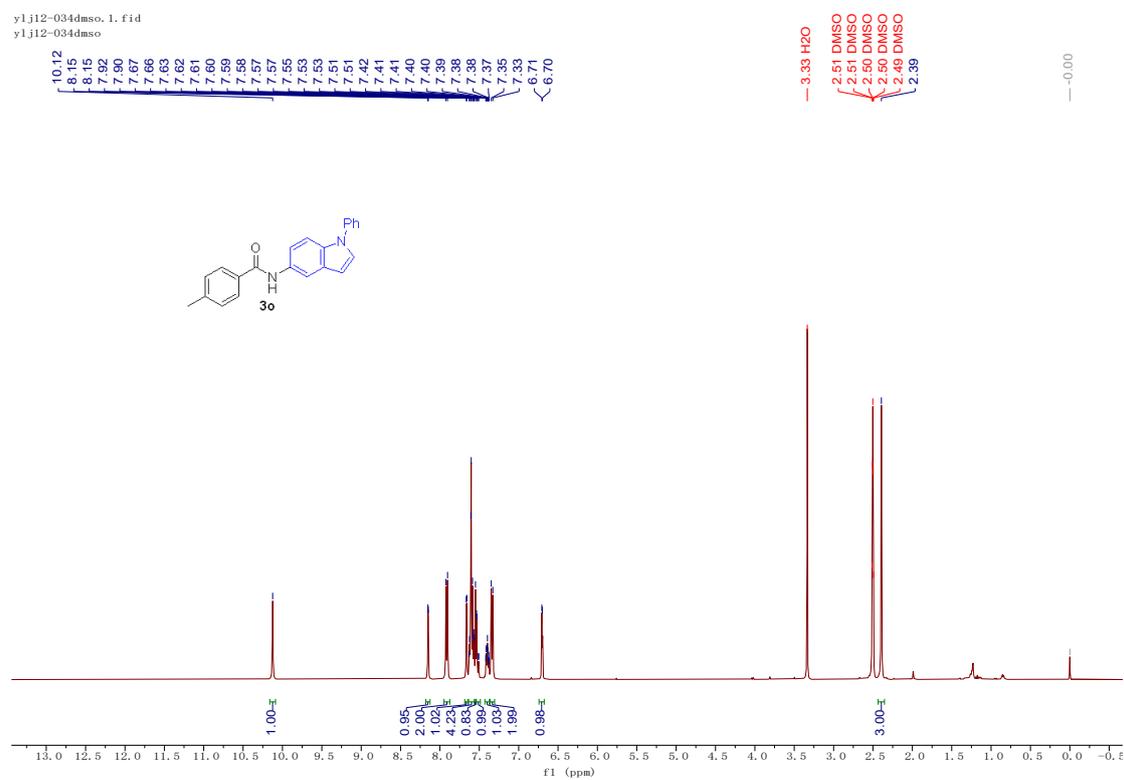
### <sup>13</sup>C NMR (101 MHz, DMSO-*d*<sub>6</sub>) spectrum of **3n**

ylj12-027. 2. fid  
ylj12-027



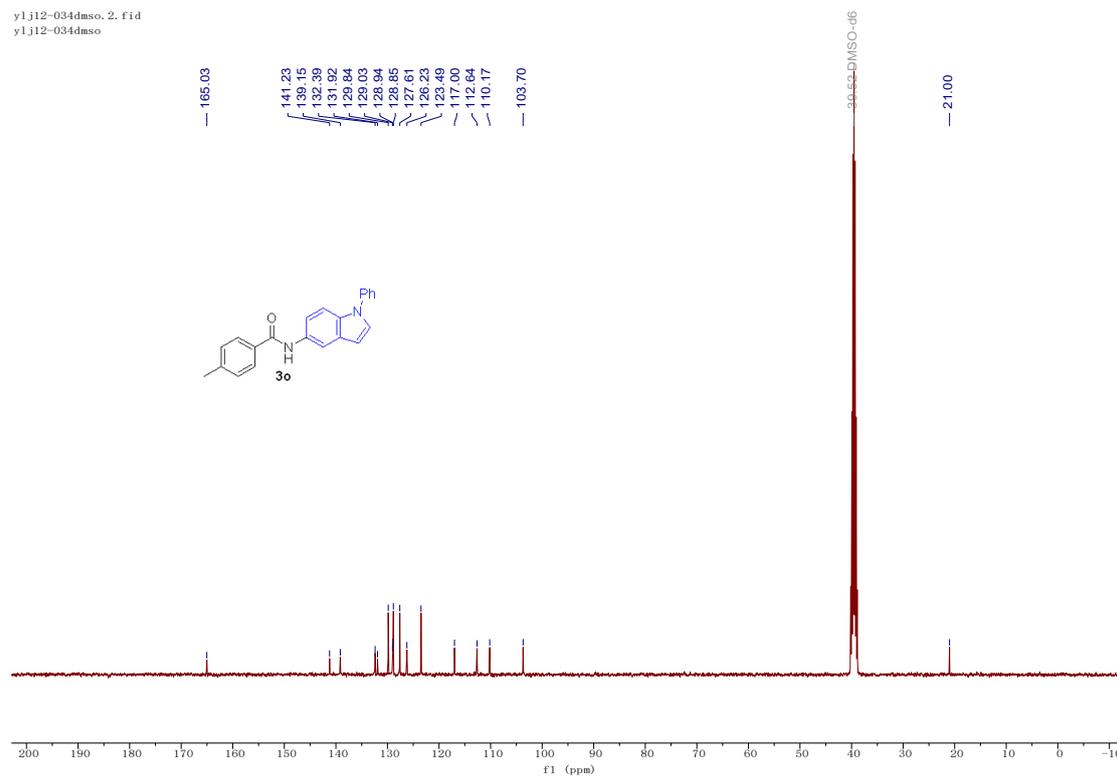
### <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) spectrum of **3o**

ylj12-034dms0. 1. fid  
ylj12-034dms0



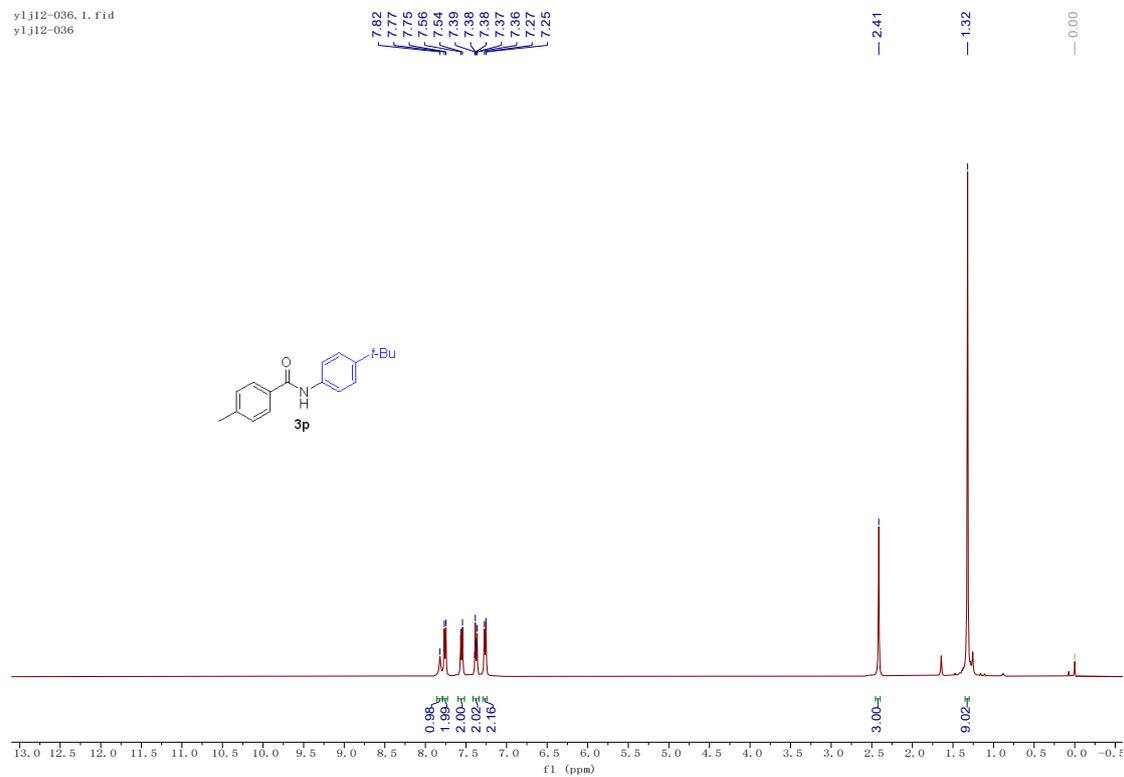
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3o**

ylj12-034dms0.2.fid  
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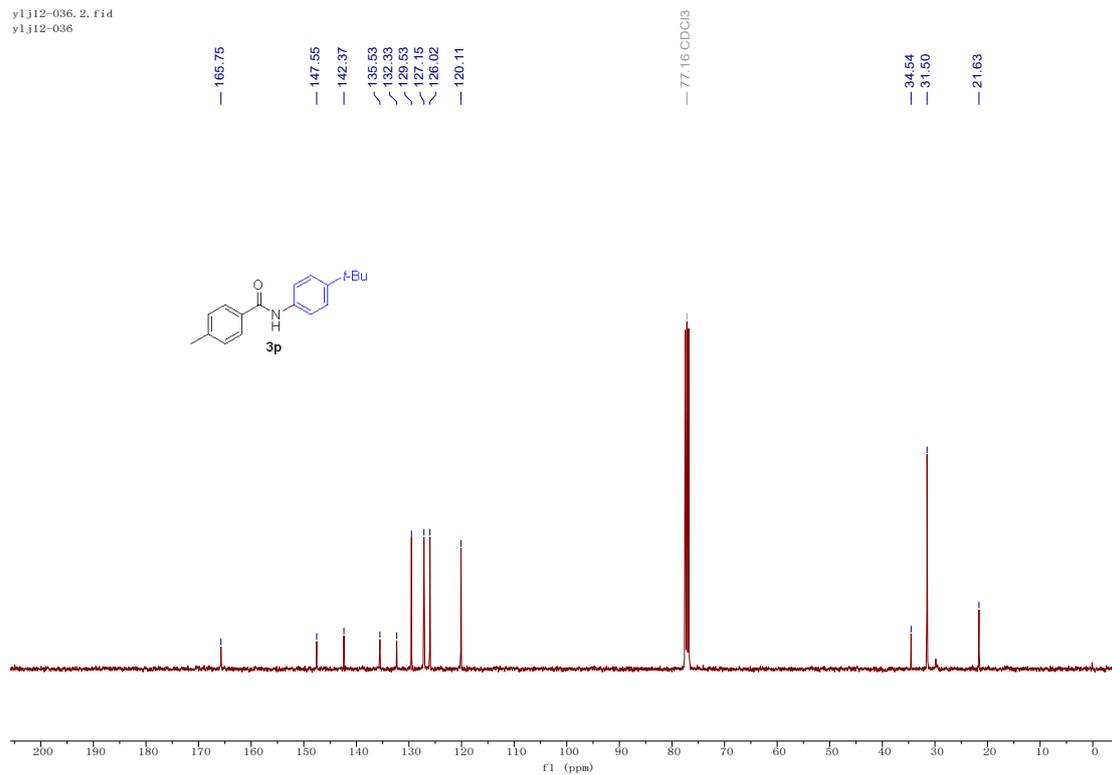
### $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **3p**

ylj12-036.1.fid  
ylj12-036



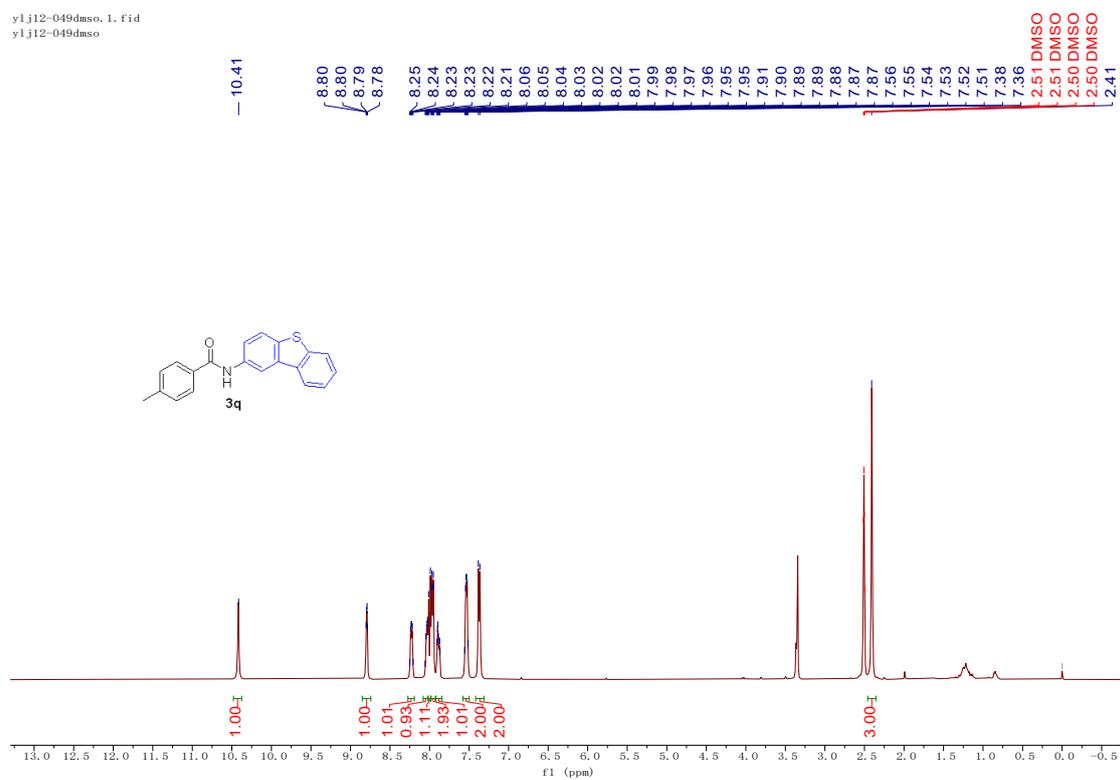
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **3p**

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ylj12-036



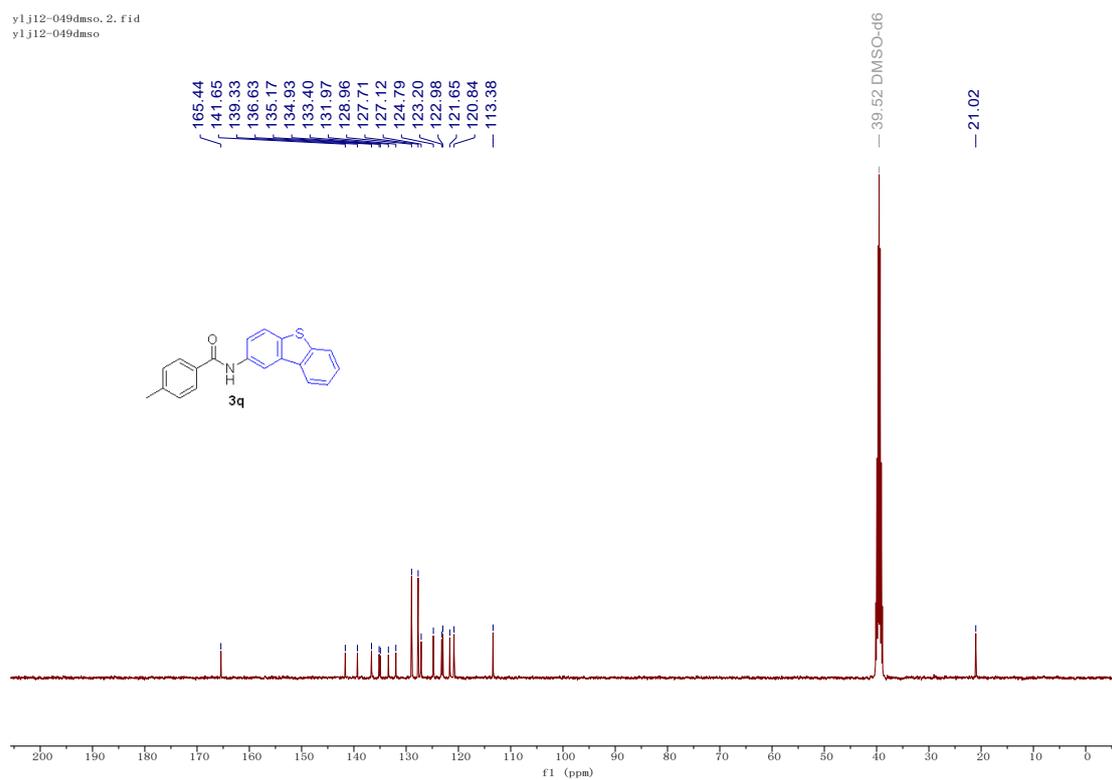
### $^1\text{H}$ NMR (400 MHz, $\text{DMSO}-d_6$ ) spectrum of **3q**

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ylj12-049dms0



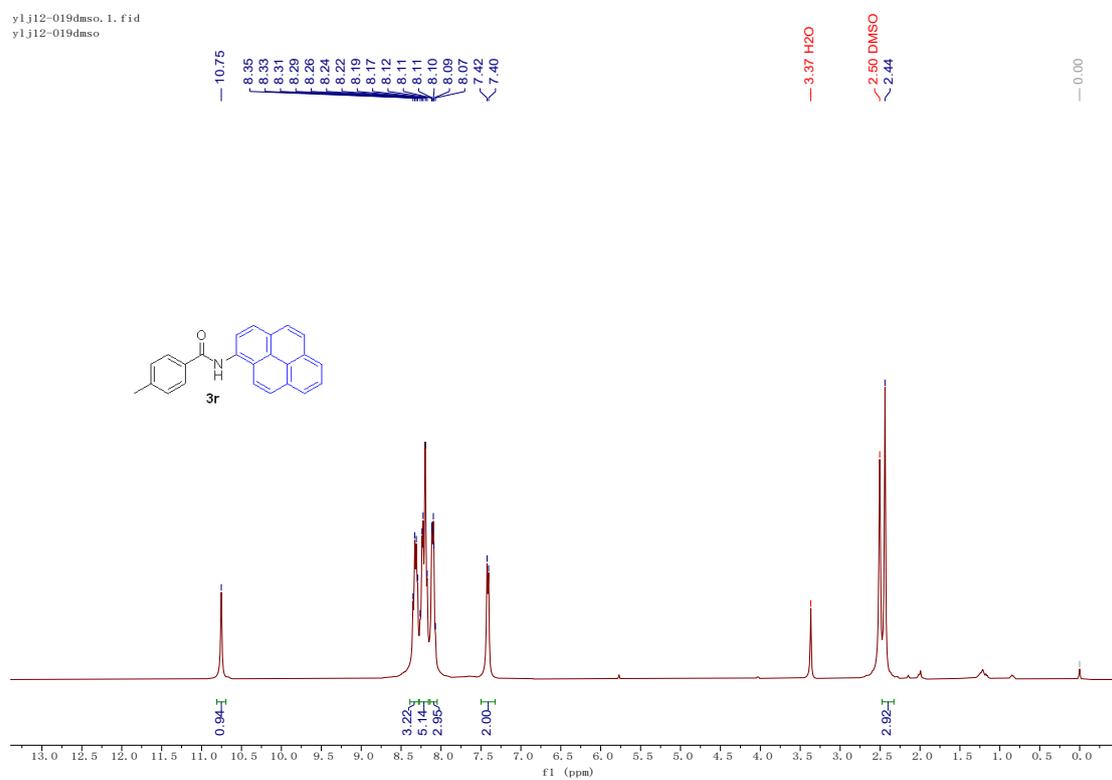
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3q**

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yljl2-049dms0



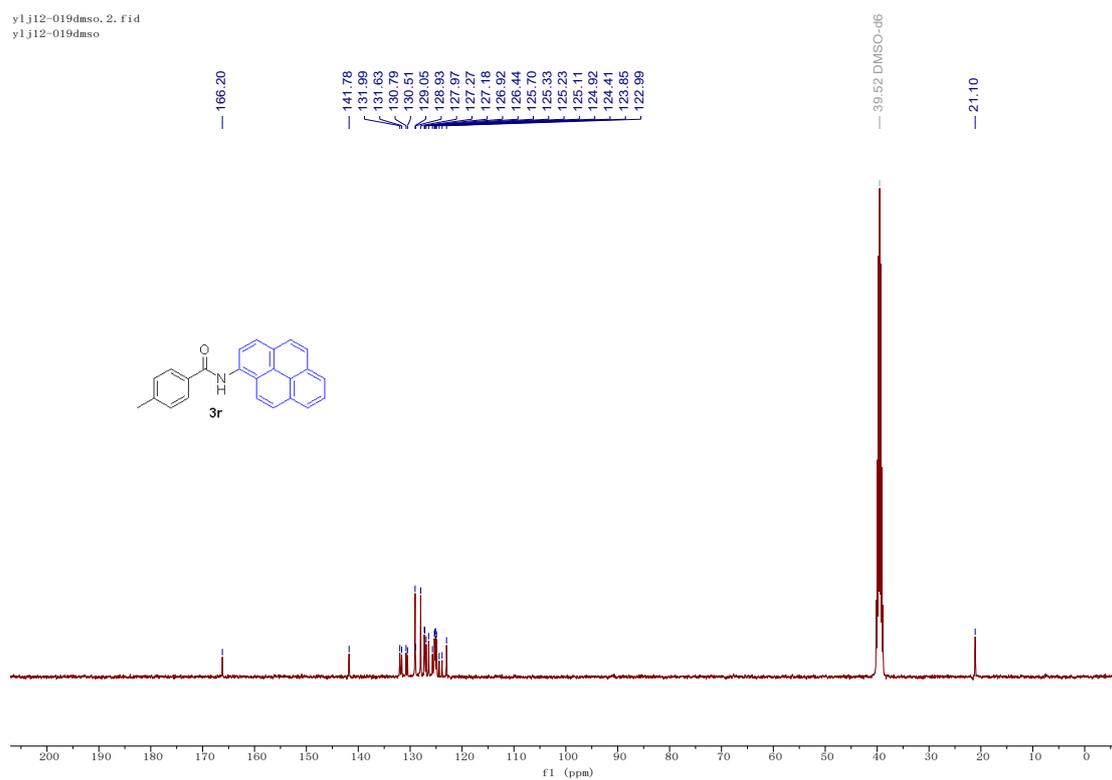
### $^1\text{H}$ NMR (400 MHz, $\text{DMSO-}d_6$ ) spectrum of **3r**

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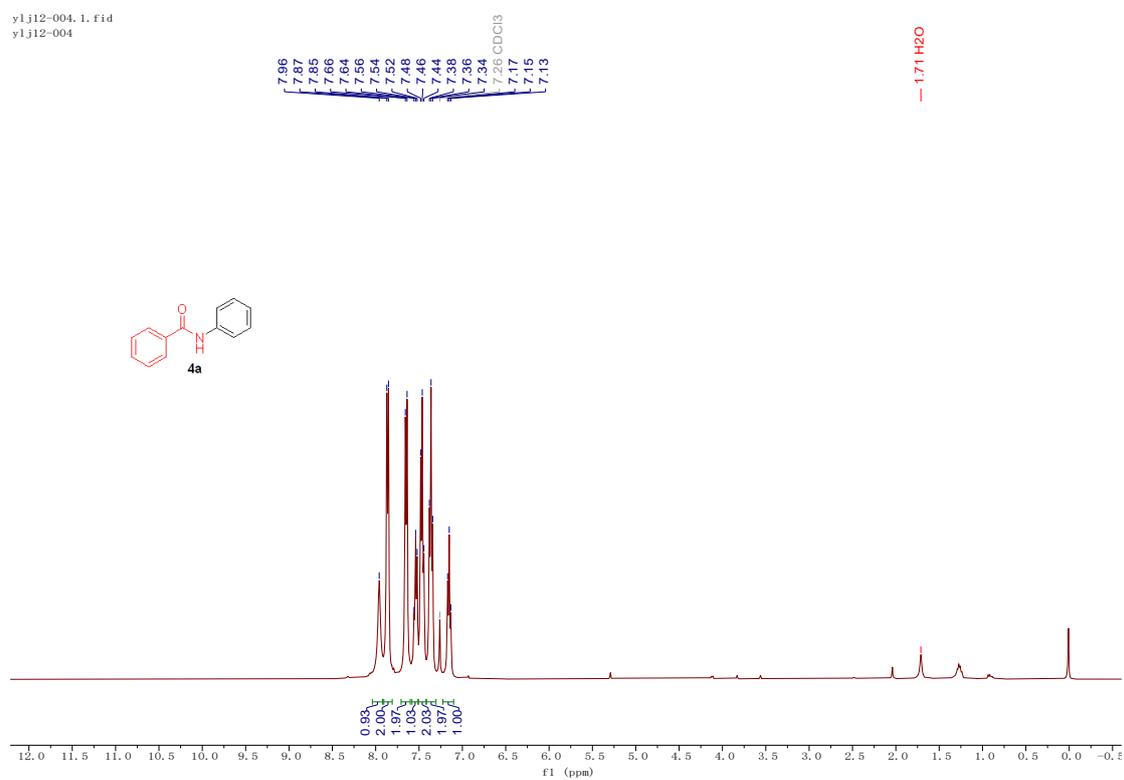
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **3r**

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yljl2-019dms0



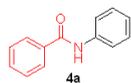
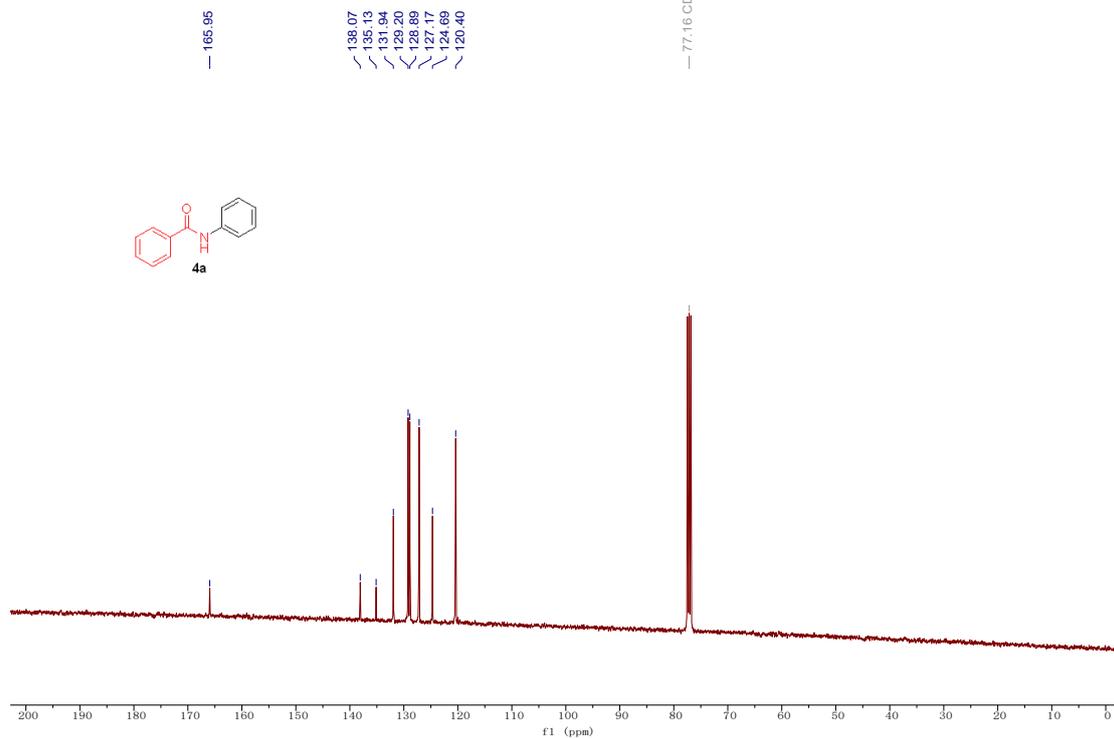
### $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **4a**

yljl2-004.1.fid  
yljl2-004



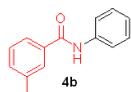
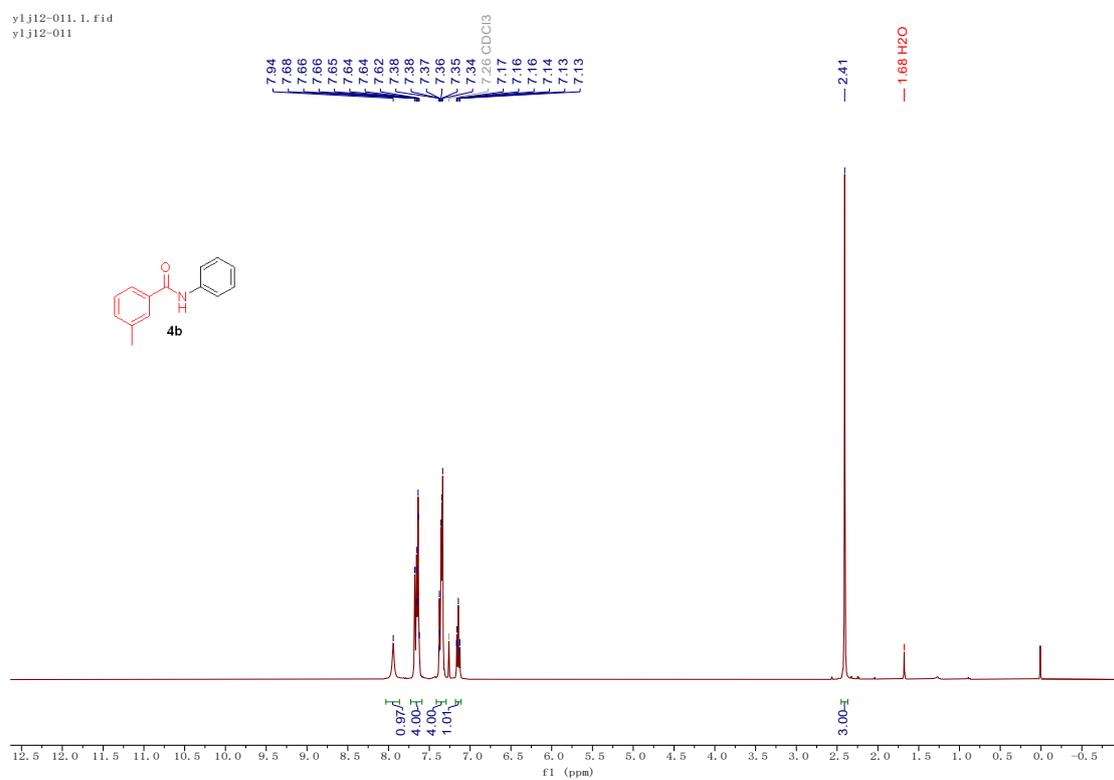
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4a**

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y1j12-004



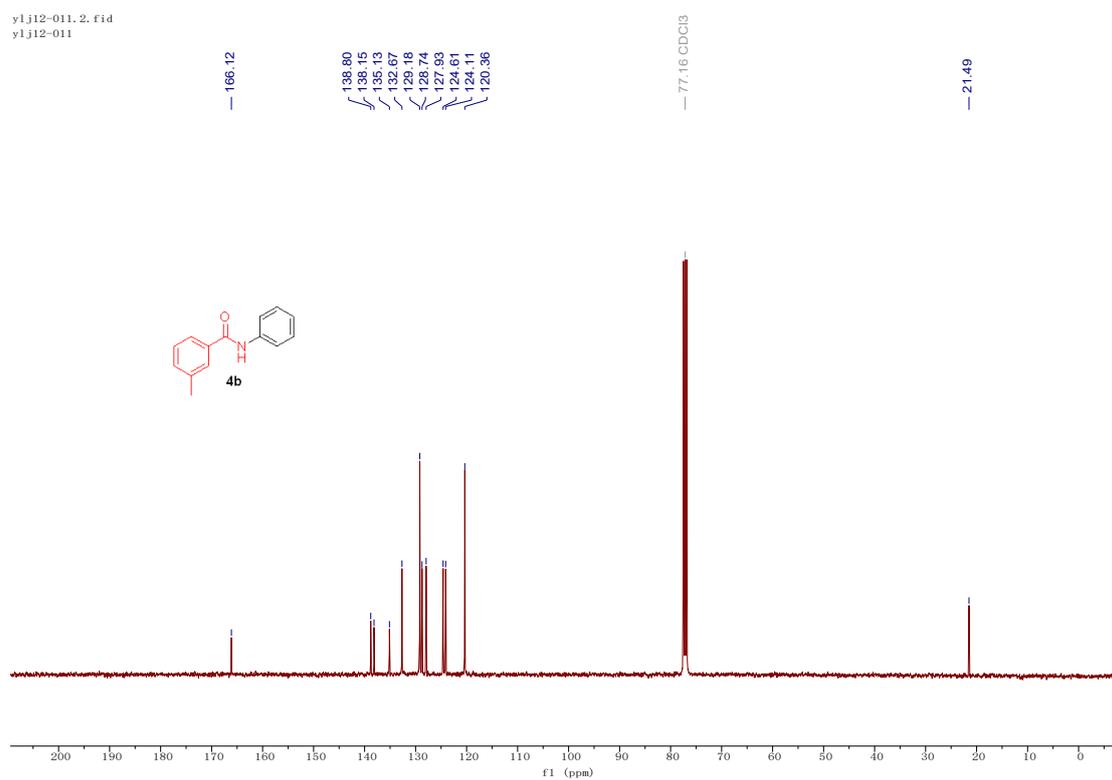
### $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **4b**

y1j12-011.1.fid  
y1j12-011



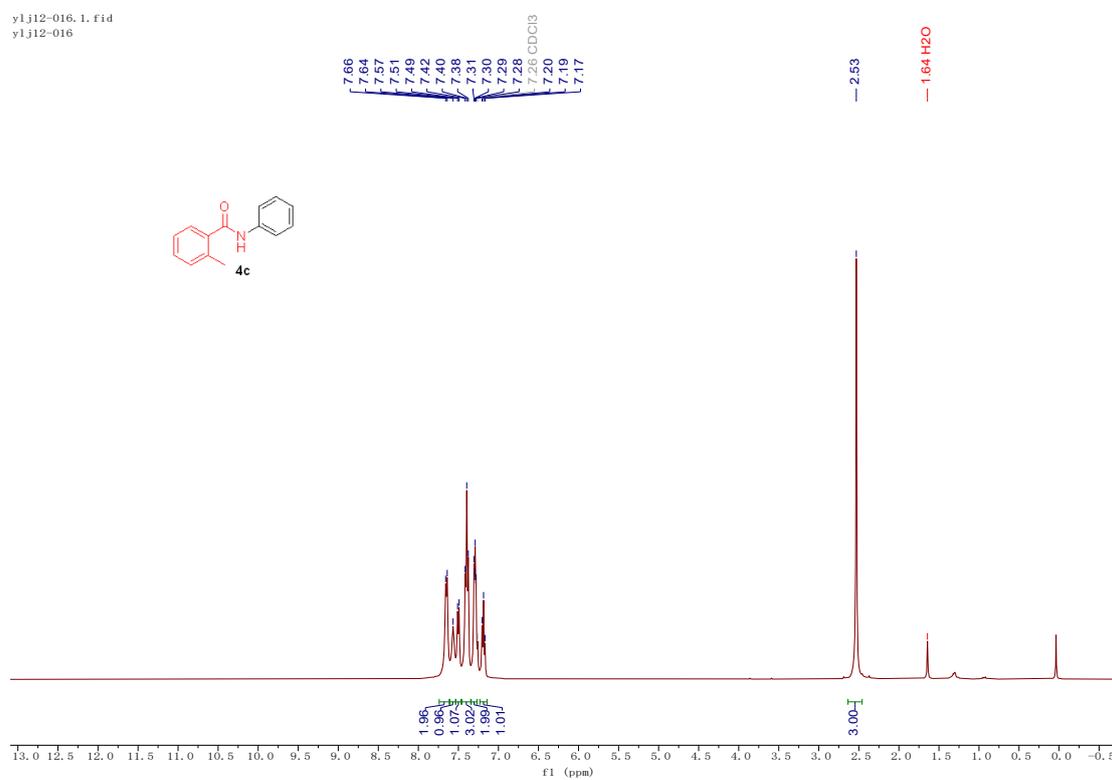
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4b**

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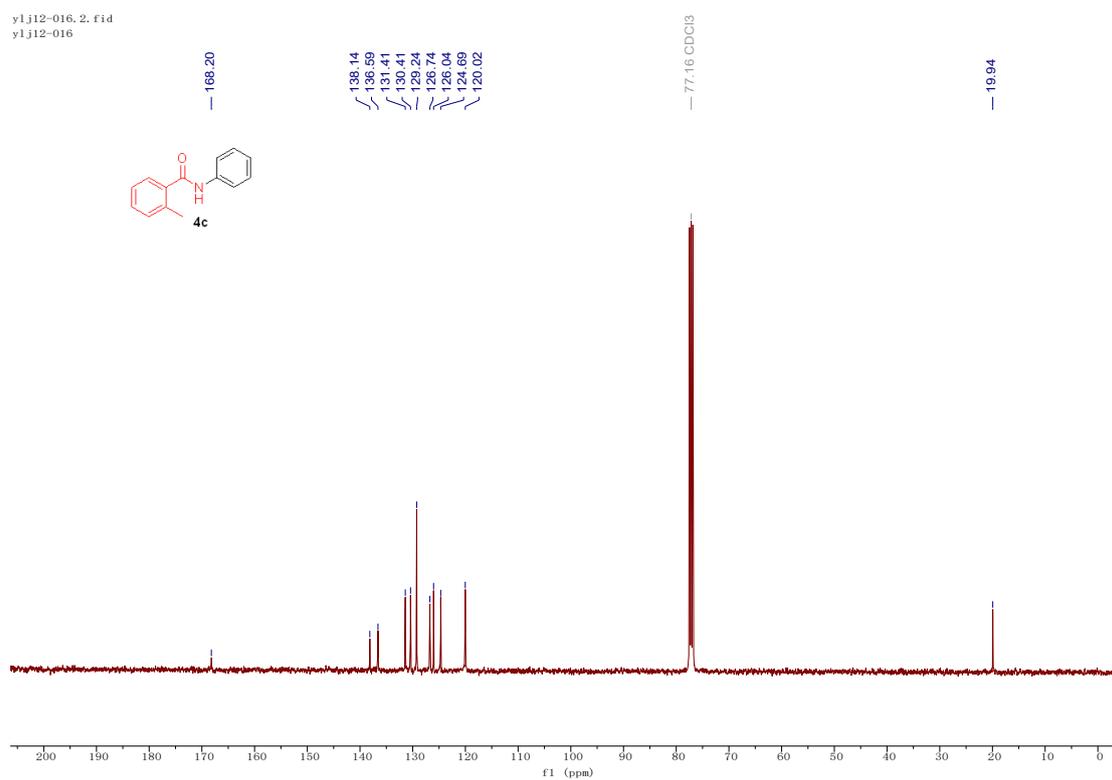
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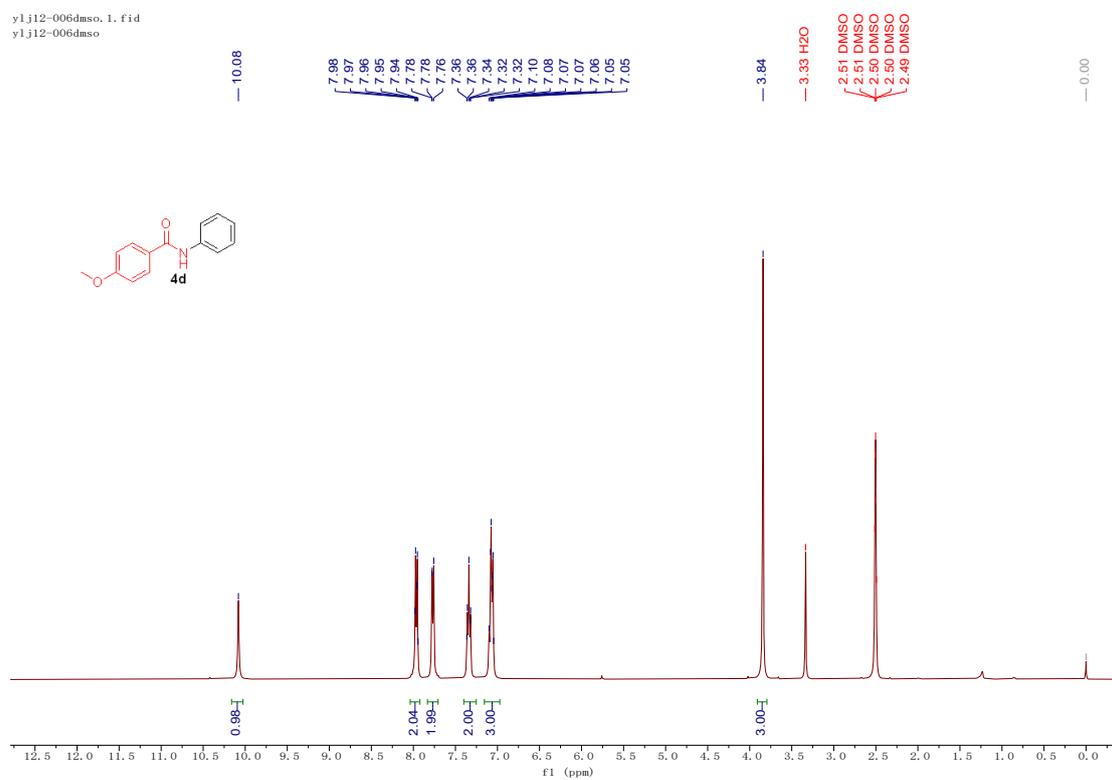
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4c**

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ylj12-016



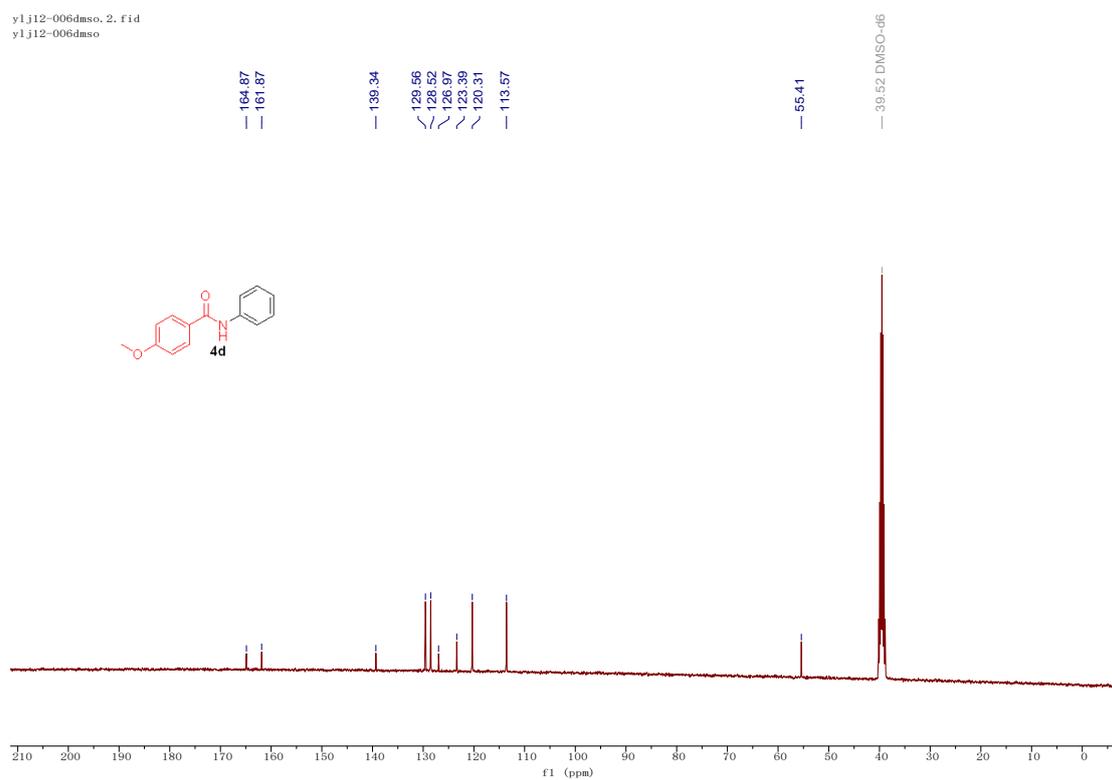
### $^1\text{H}$ NMR (400 MHz, $\text{DMSO}-d_6$ ) spectrum of **4d**

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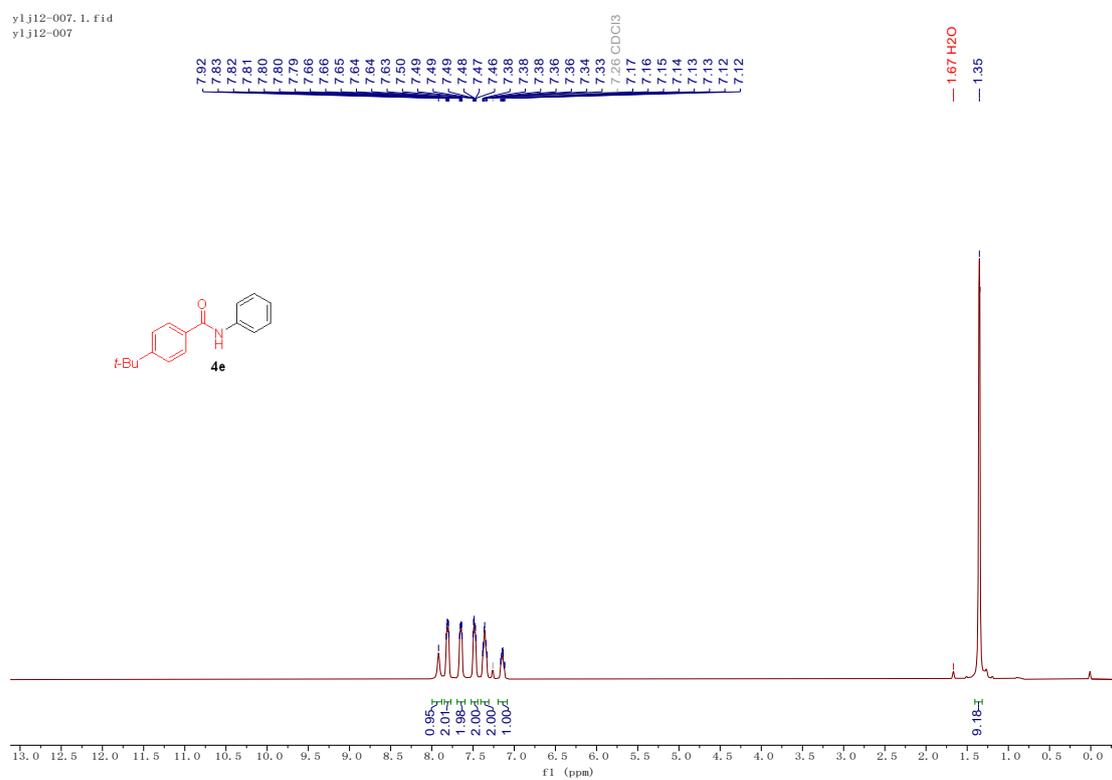
### $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **4d**

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### $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **4e**

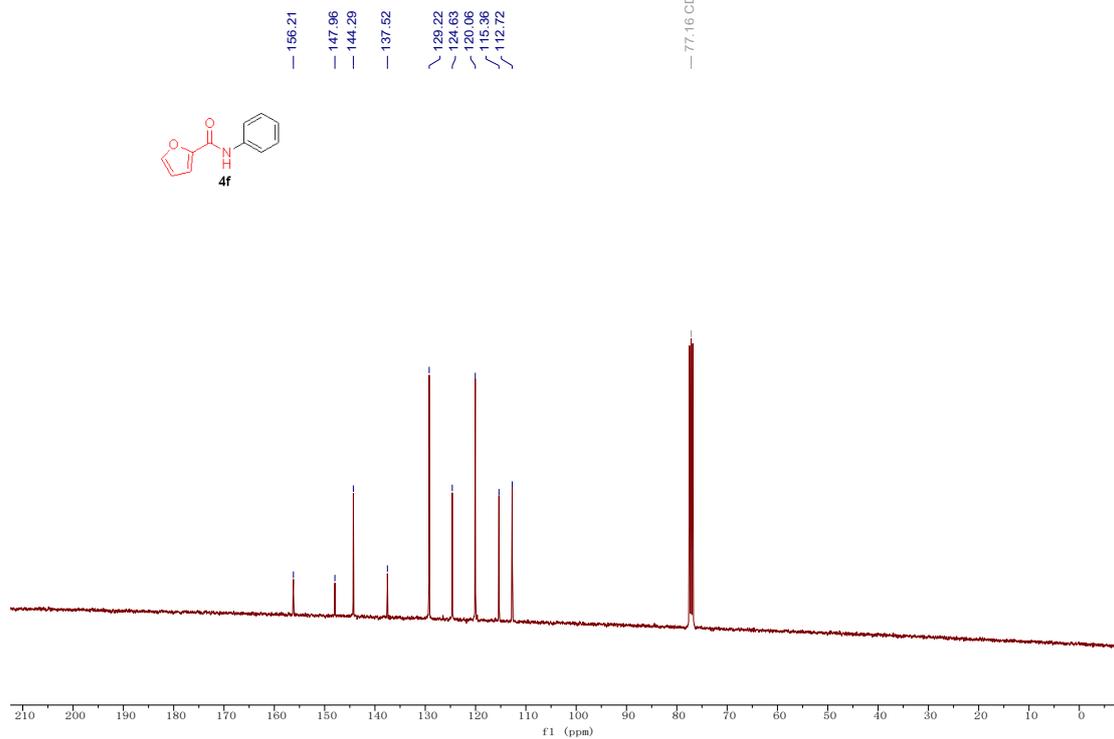
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ylj12-007





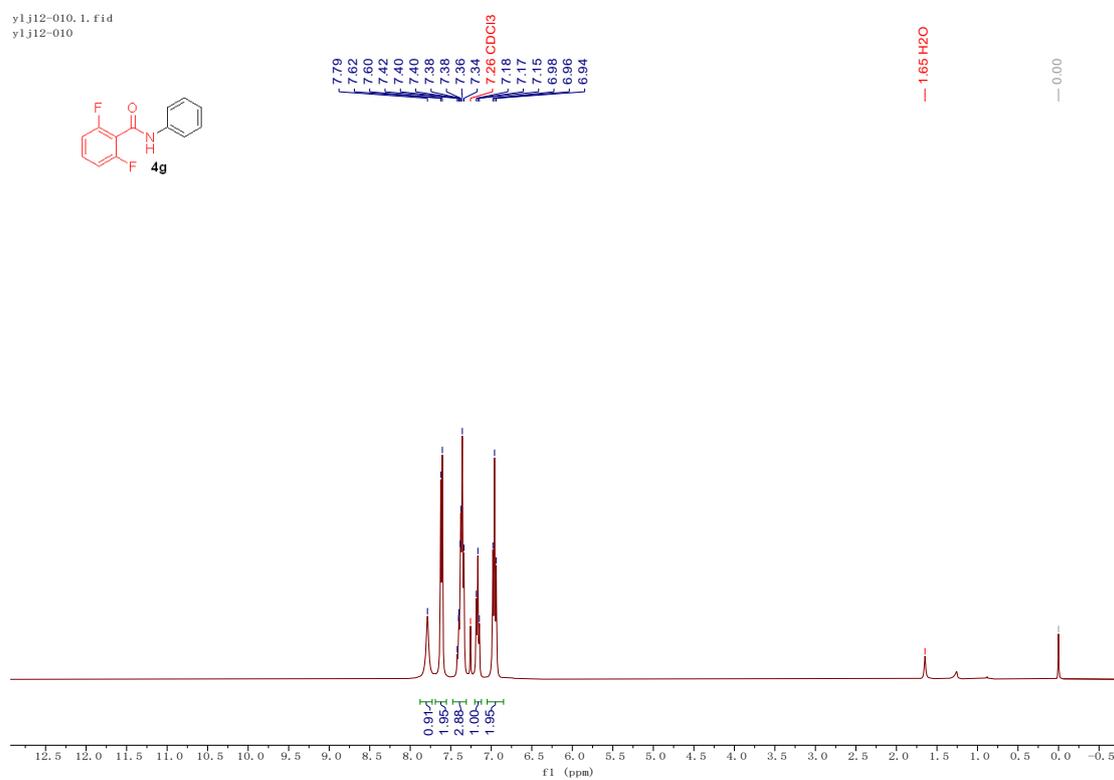
### <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) spectrum of **4f**

y1j12-003.2.fid  
y1j12-003



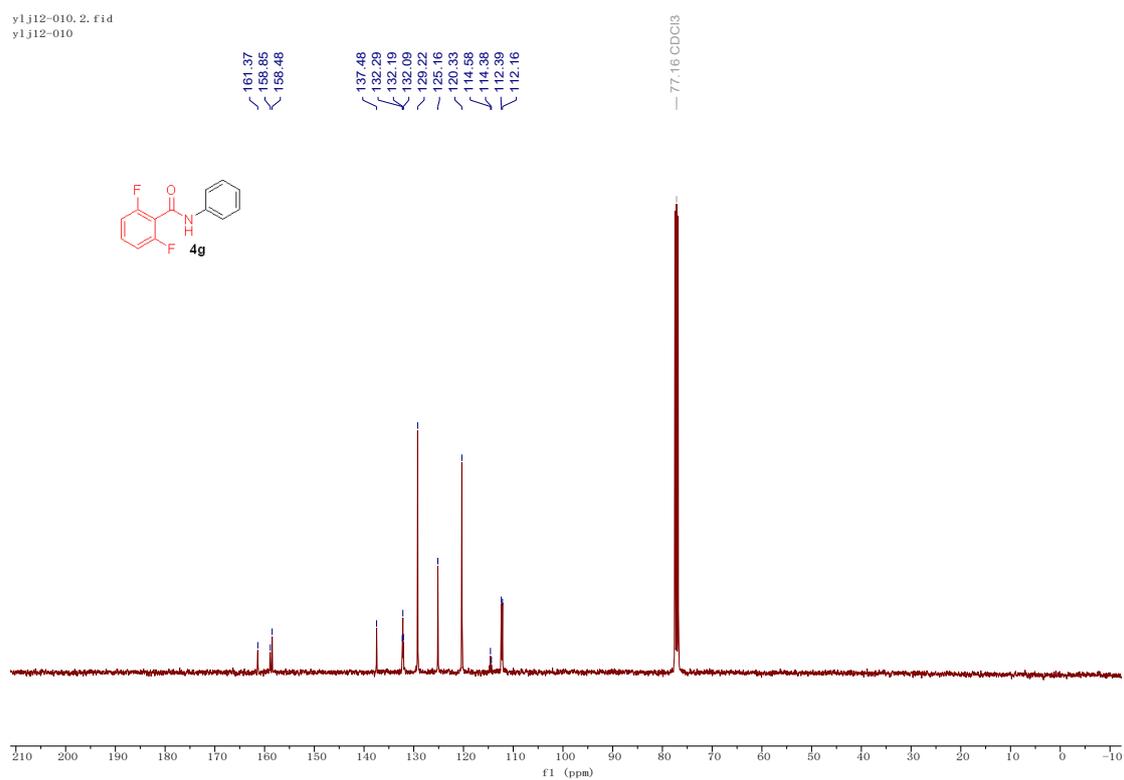
### <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) spectrum of **4g**

y1j12-010.1.fid  
y1j12-010



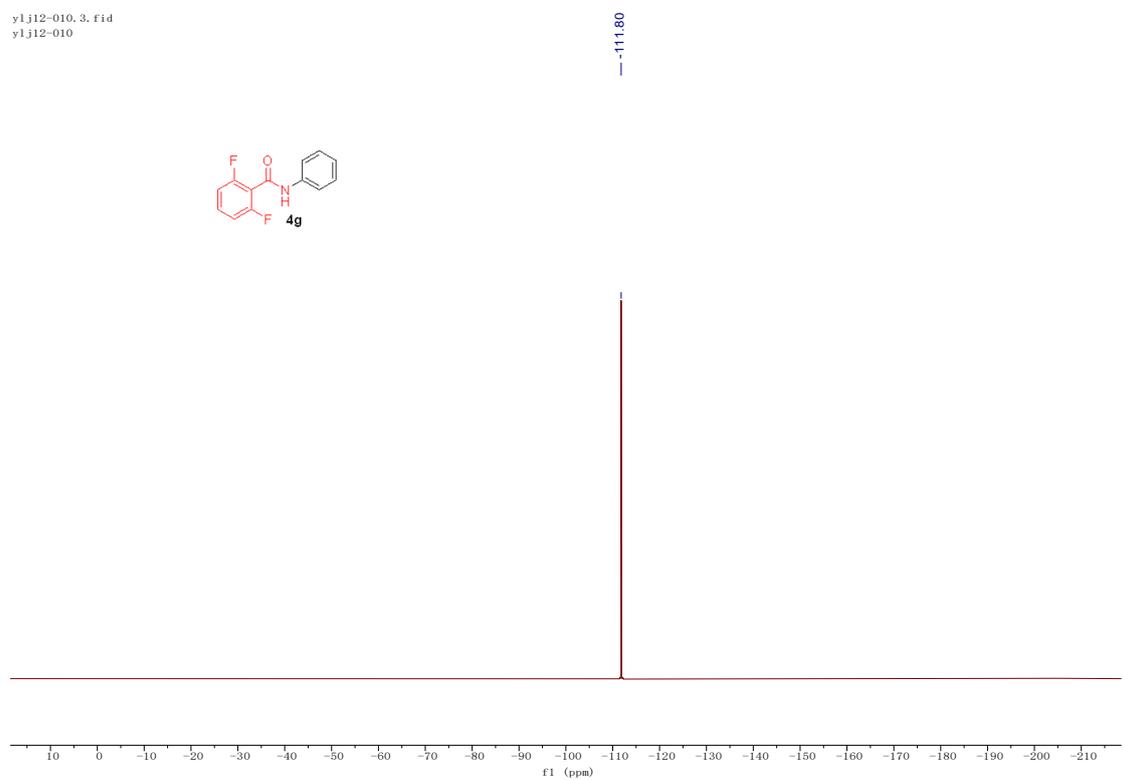
### $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4g**

y1j12-010.2.fid  
y1j12-010



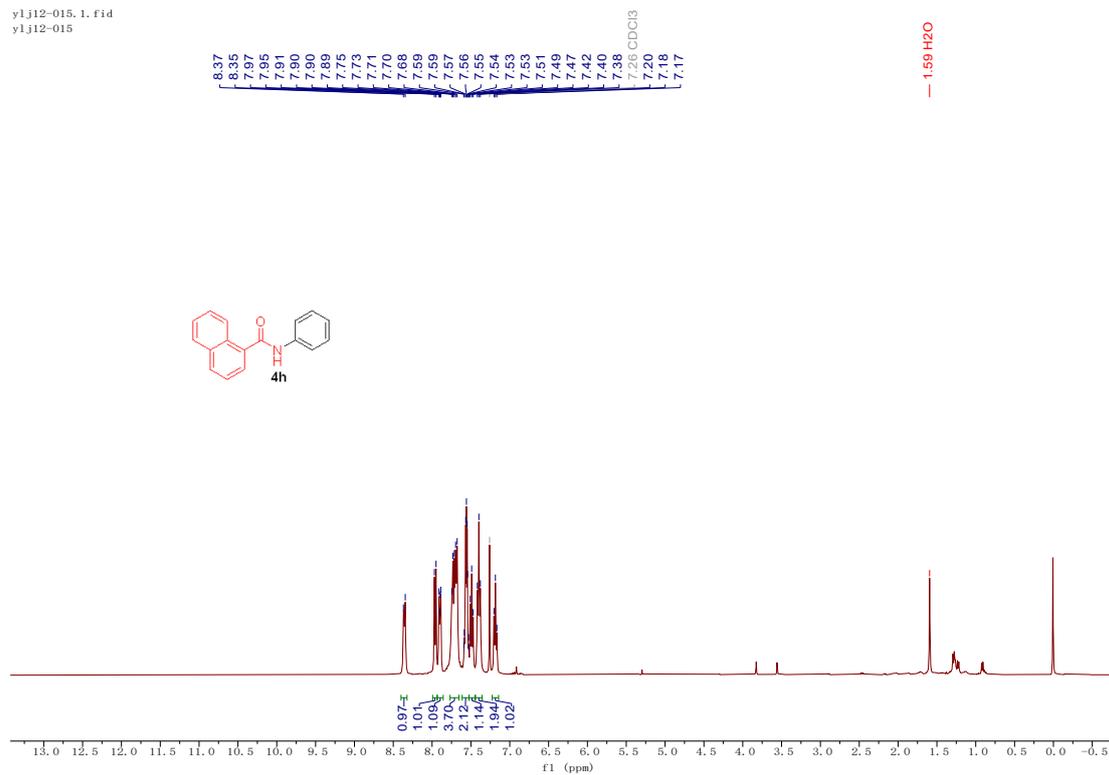
### $^{19}\text{F}$ NMR (376 MHz, $\text{CDCl}_3$ ) spectrum of **4g**

y1j12-010.3.fid  
y1j12-010



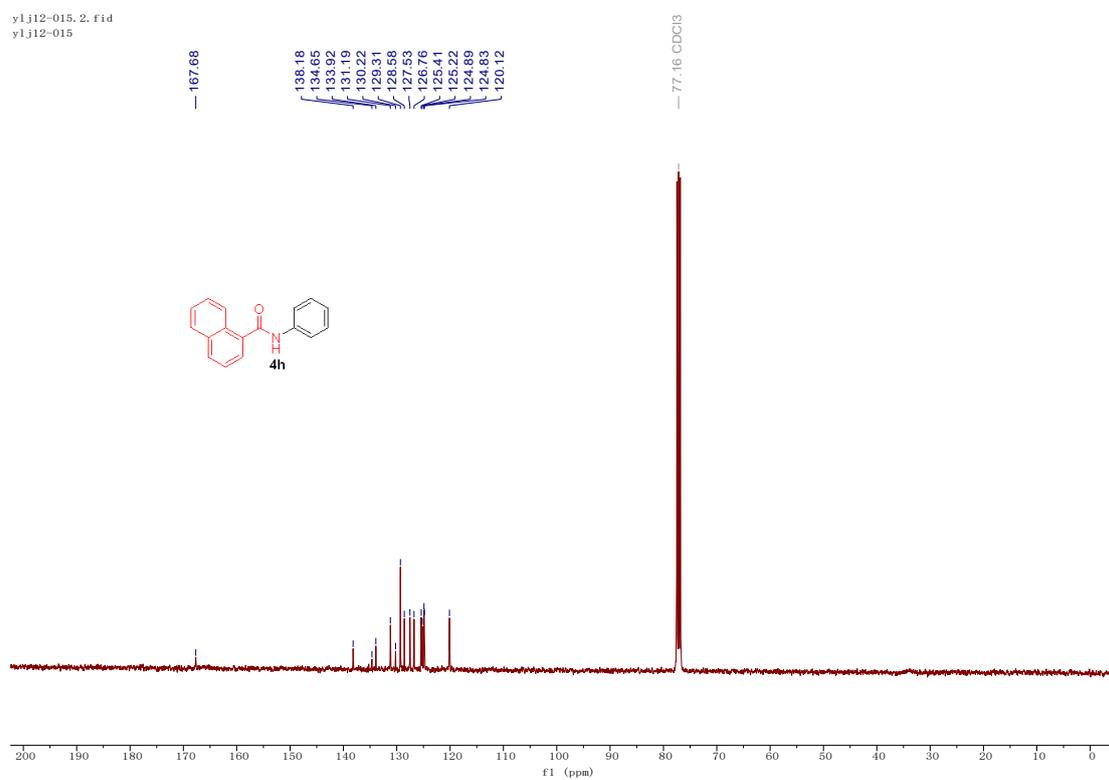
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **4h**

ylj12-015. 1. fid  
ylj12-015



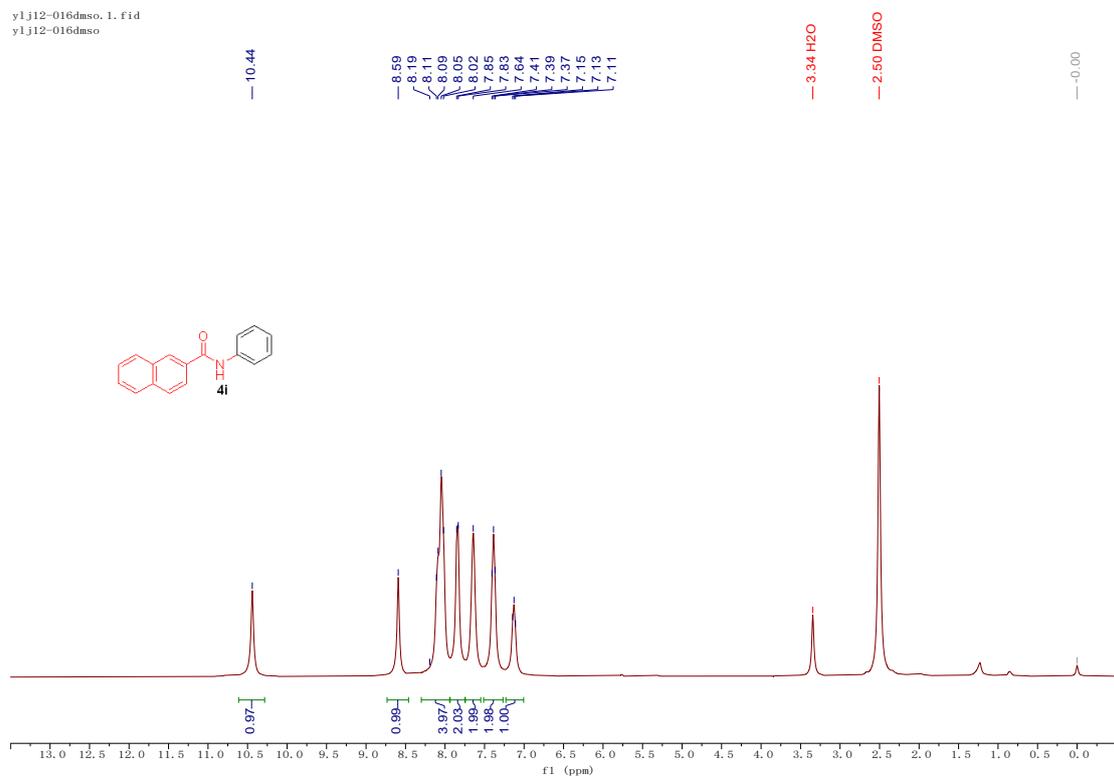
# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4h**

ylj12-015. 2. fid  
ylj12-015



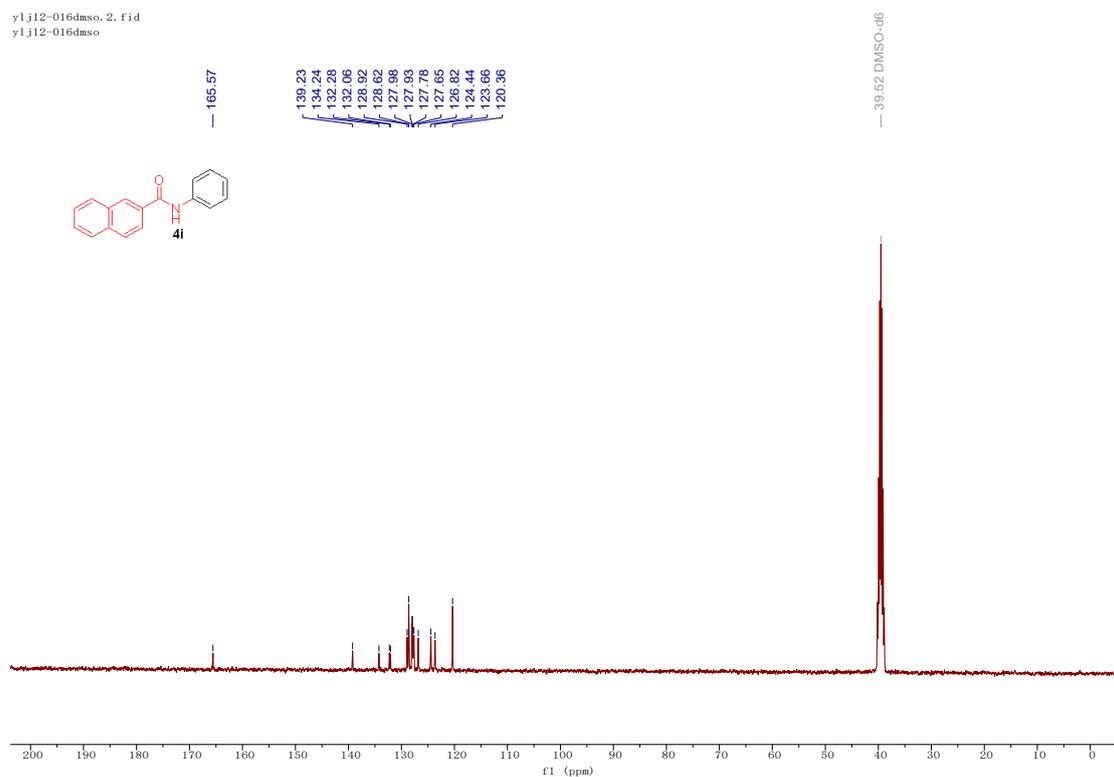
# $^1\text{H}$ NMR (400 MHz, $\text{DMSO-}d_6$ ) spectrum of **4i**

ylj12-016dms0.1.fid  
ylj12-016dms0



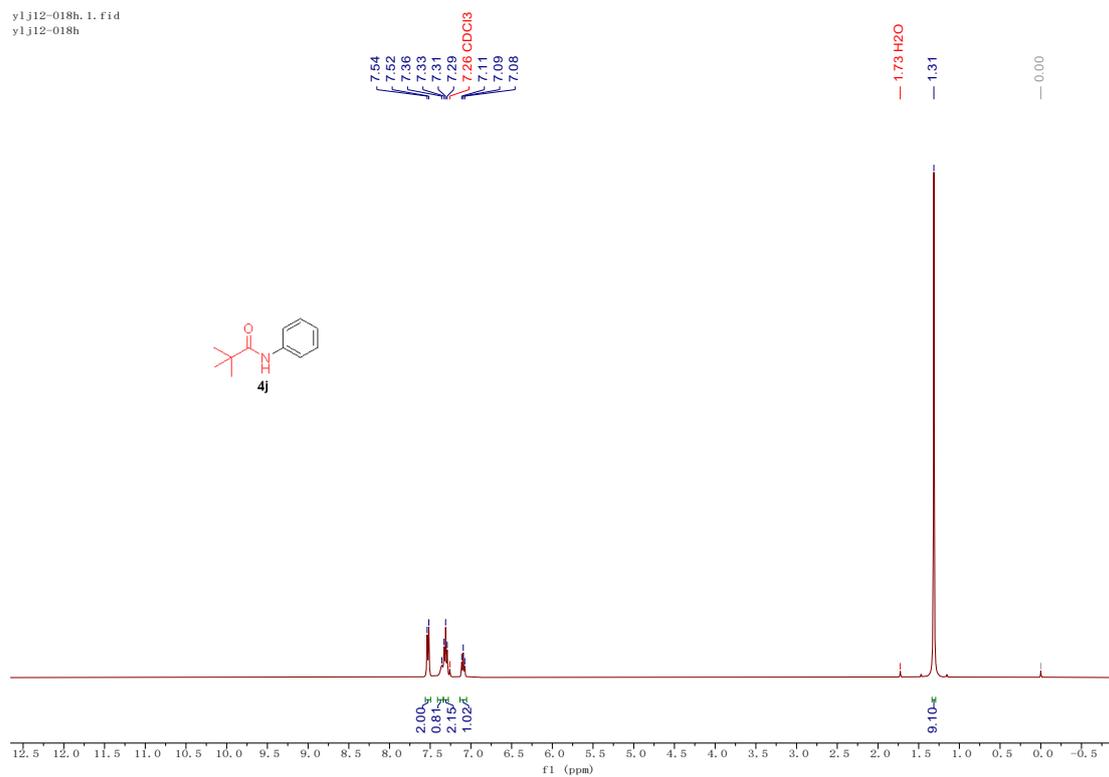
# $^{13}\text{C}$ NMR (101 MHz, $\text{DMSO-}d_6$ ) spectrum of **4i**

ylj12-016dms0.2.fid  
ylj12-016dms0



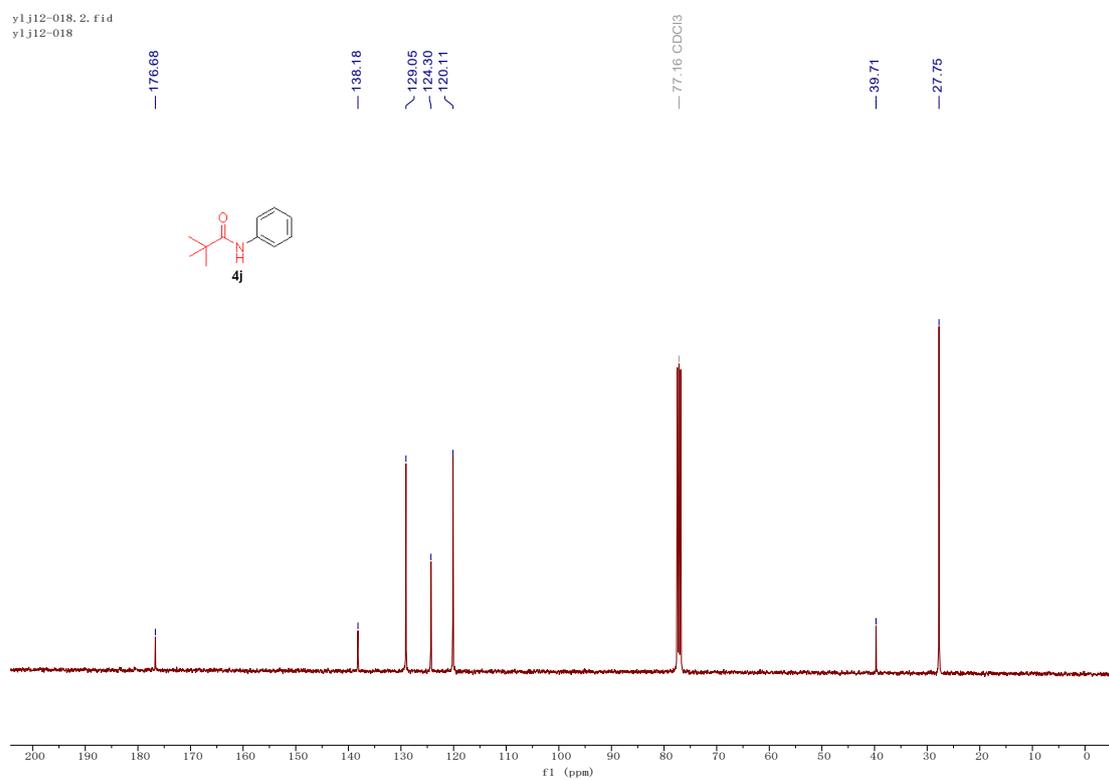
# <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) spectrum of **4j**

y1j12-018h.1.fid  
y1j12-018h



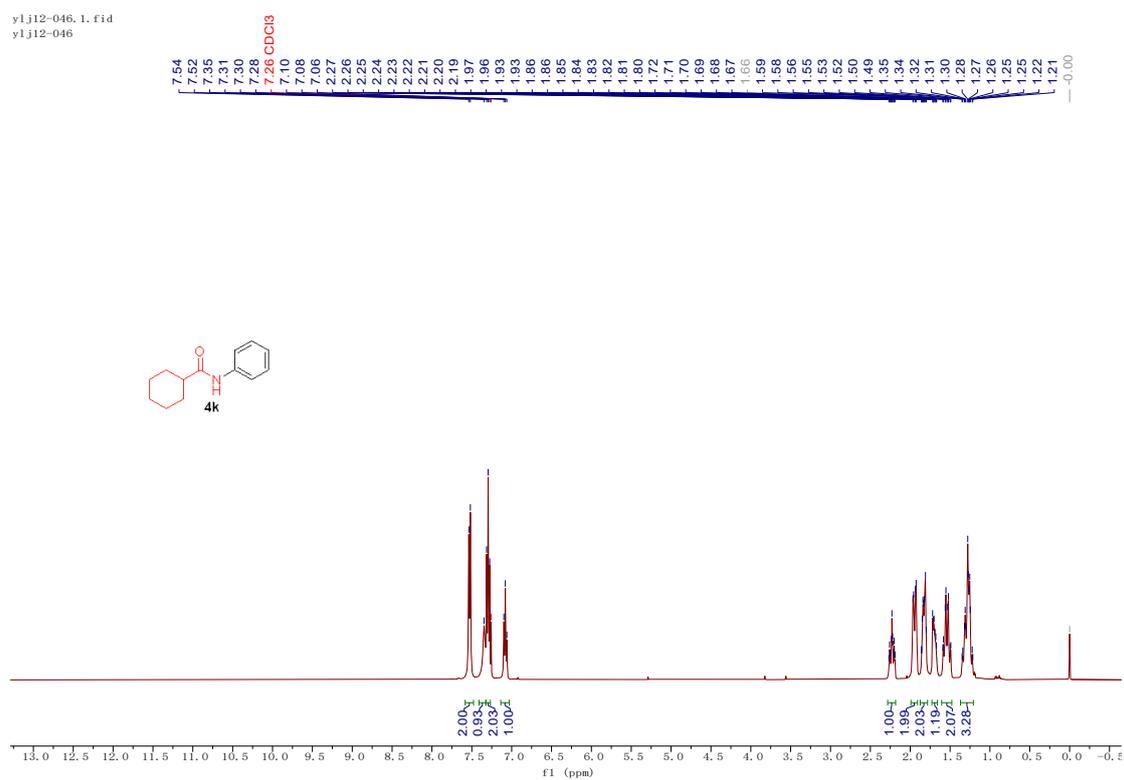
# <sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) spectrum of **4j**

y1j12-018.2.fid  
y1j12-018



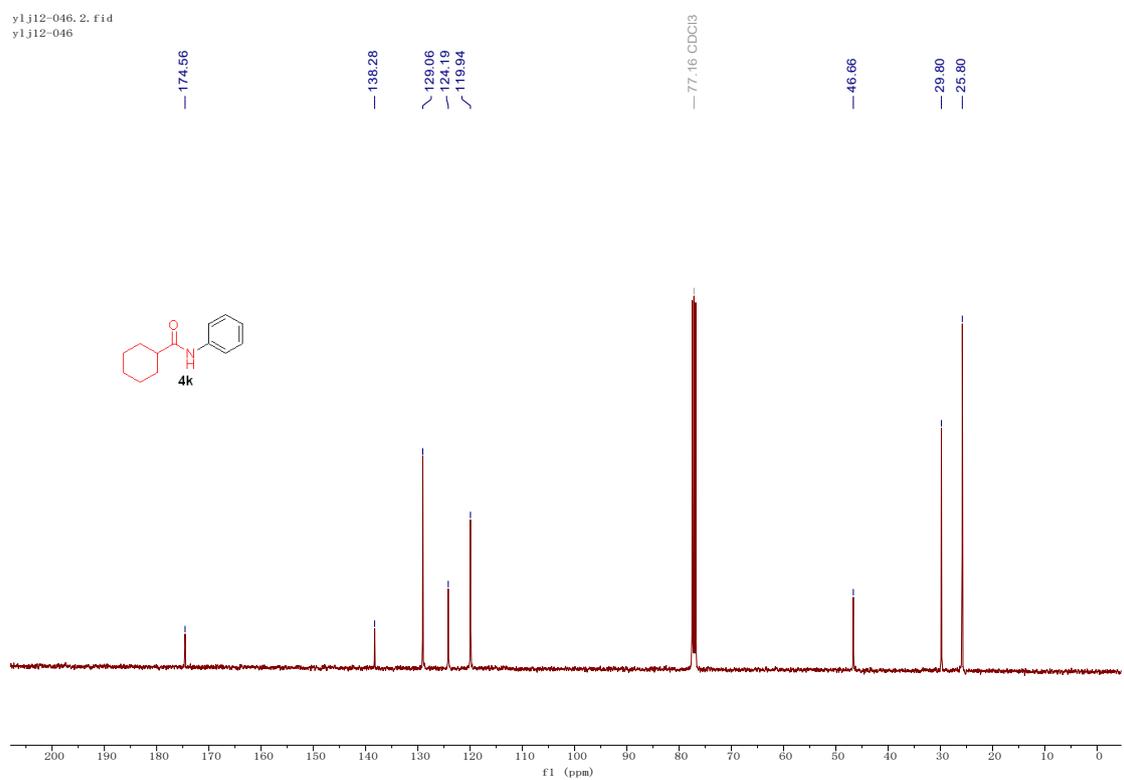
# $^1\text{H}$ NMR (400 MHz, $\text{CDCl}_3$ ) spectrum of **4k**

y1j12-046.1.fid  
y1j12-046



# $^{13}\text{C}$ NMR (101 MHz, $\text{CDCl}_3$ ) spectrum of **4k**

y1j12-046.2.fid  
y1j12-046



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