

## *Supporting Information*

### *Direct C-H amination of indoles enabled by tert-butyl chlorosulfonylcarbamate with diisopropylethylamine*

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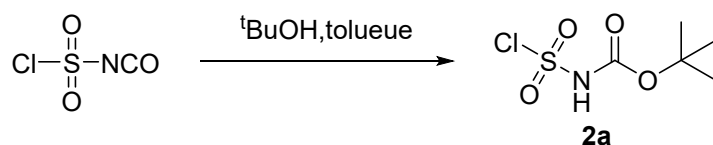
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## 1. General method

Unless otherwise noted, all the reagents were purchased from commercial suppliers including J&K chemical, Accela, Bidepharm, Adamas and used without further purification. The progress of all the reactions was monitored by thin layer chromatography with standard TLC silica gel plates, and the developed plates were visualized under UV light. All the compounds were purified by column chromatography. Chromatography was performed on silica gel (100–200 mesh). Nuclear magnetic resonance spectra were recorded on Bruker Avance III 400/500/600 NMR spectrometer. Chemical shifts were reported in parts per million (ppm,  $\delta$ ). Proton coupling multiplicity are described as (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad). Tetramethylsilane (TMS) was used as internal standard ( $^1\text{H}$  NMR: TMS at 0.00 ppm;  $\text{CHCl}_3$  at 7.26 ppm, DMSO at 2.50 ppm;  $^{13}\text{C}$  NMR:  $\text{CHCl}_3$  at 77.16 ppm, DMSO at 39.52 ppm). Low-resolution mass spectra (LRMS) were recorded using an Agilent HPLC-MS (1200-6110). High-resolution mass spectra (HRMS) were recorded on an Agilent 1290-6545 UHPLC-QTOF (ESI) mass spectrometer.

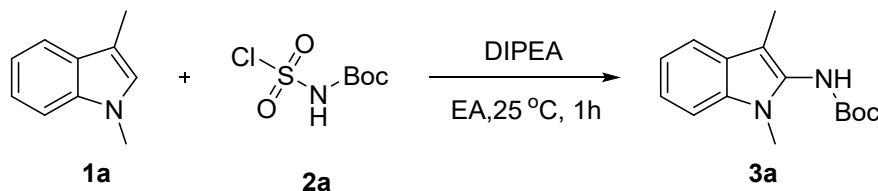
## 2. Experimental procedure

### 2.1 General synthesis procedure of tert-butyl chlorosulfonylcarbamate (2a)



Add a solution of chlorosulfonyl isocyanate (1.93 g, 13.62 mmol, 1.0 equiv.) in 5.4 mL of toluene dropwise to a solution of anhydrous tert-butanol (1.11 g, 14.98 mmol, 1.1 equiv.) in 0.8 mL of anhydrous toluene under argon at  $0^\circ\text{C}$ . Stir the reaction mixture vigorously for 1 hour at  $0^\circ\text{C}$ . Add 14.0 mL of petroleum ether and stir the resulting reaction mixture for an additional 30 minutes at  $25^\circ\text{C}$ . Filter the product, wash with  $3 \times 10$  mL of petroleum ether and dry under vacuum for several minutes to yield 2.28 g tert-butyl (chlorosulfonyl)carbamate, white solid, yield = 78%. Store the product under argon at  $-18^\circ\text{C}$  until use.  $^1\text{H}$  NMR (400 MHz, Chloroform-*d*)  $\delta$  8.46 (s, 1H), 1.57 (s, 9H);  $^{13}\text{C}$  NMR (125 MHz, Chloroform-*d*)  $\delta$  147.63, 87.21, 28.01.

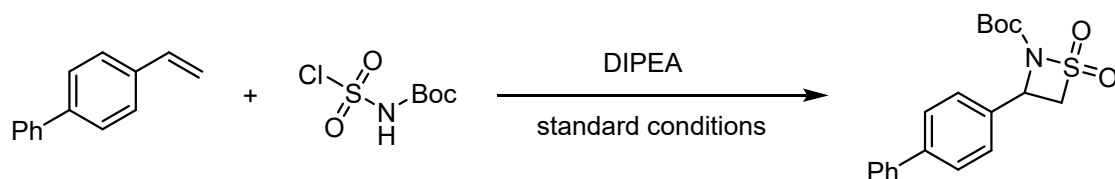
### 2.2 General synthetic procedure of amination of indoles



To a 8 mL vial with a magnetic stir bar was added 1,3-dimethylindole **1a** (58 mg, 0.4 mmol), fresh prepared tert-butyl (chlorosulfonyl)carbamate **2a** (258 mg, 1.2 mmol) and anhydrous EA (4.0 mL). Then, *N,N*-diisopropylethylamine (155 mg, 1.2 mmol) was added. After that, the vial was capped and stirred at  $25^\circ\text{C}$  for 1 hours. The mixture was transferred to a 25 mL round-bottom flask and the solvent was removed under reduced pressure. The residue was purified by flash silica

column chromatography eluting with 5-10% ethyl acetate/petroleum ether to afford the desired product **3a**.

### 2.3 The intermediate trapping experiment



To a 8 mL vial with a magnetic stir bar was added 4-vinyl-1,1'-biphenyl (72 mg, 0.4 mmol), fresh prepared tert-butyl (chlorosulfonyl)carbamate (258 mg, 1.2 mmol) and anhydrous EA (4.0 mL, 0.1 M). Then, *N,N*-diisopropylethylamine (155 mg, 1.2 mmol) was added. After that, the vial was capped and stirred at 25 °C for 1 hour. The mixture was transferred to a 25 mL round-bottom flask and the solvent was removed under reduced pressure. The residue was purified by flash silica column chromatography eluting with 15-30% ethyl acetate/petroleum ether to afford the desired product.

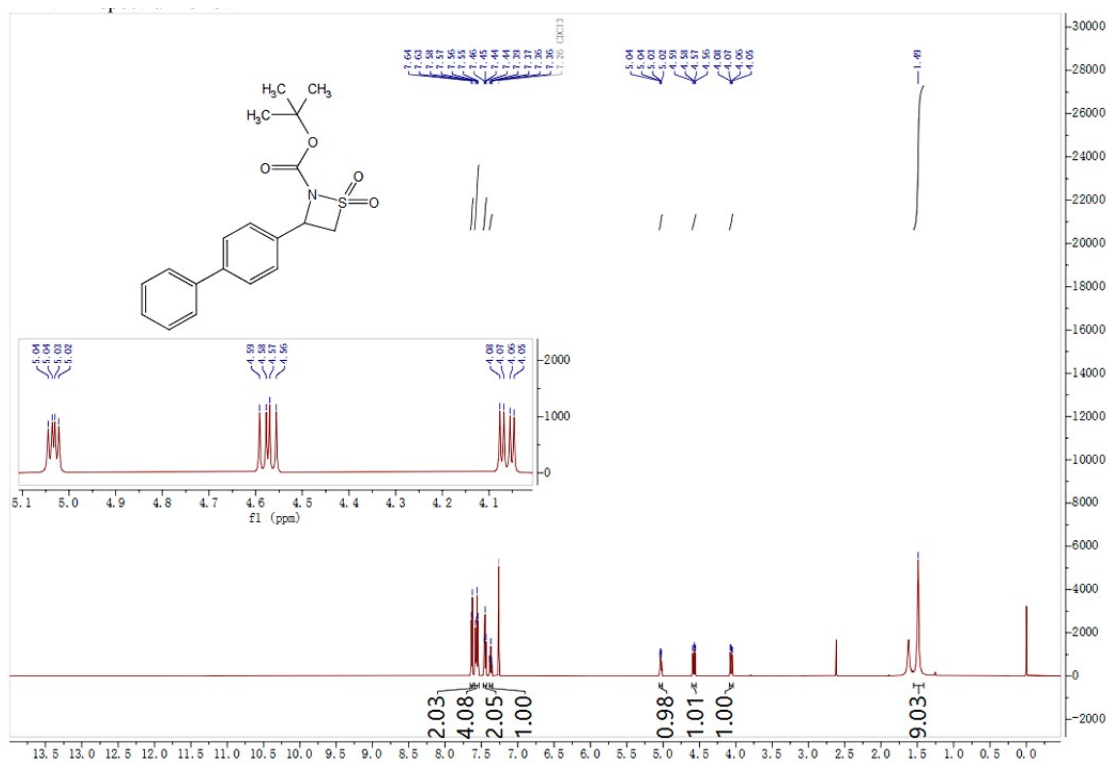
**<sup>1</sup>H NMR** (600 MHz, CDCl<sub>3</sub>) δ 7.65 – 7.61 (m, 2H), 7.60 – 7.53 (m, 4H), 7.47 – 7.43 (m, 2H), 7.39 – 7.35 (m, 1H), 5.03 (dd, *J* = 8.6, 5.2 Hz, 1H), 4.57 (dd, *J* = 12.9, 8.6 Hz, 1H), 4.06 (dd, *J* = 12.9, 5.2 Hz, 1H), 1.49 (s, 9H).

**<sup>13</sup>C NMR** (125 MHz, CDCl<sub>3</sub>) δ 142.38, 140.37, 135.88, 129.02, 128.10, 127.86, 127.28, 126.89, 84.99, 66.04, 47.82, 28.21.

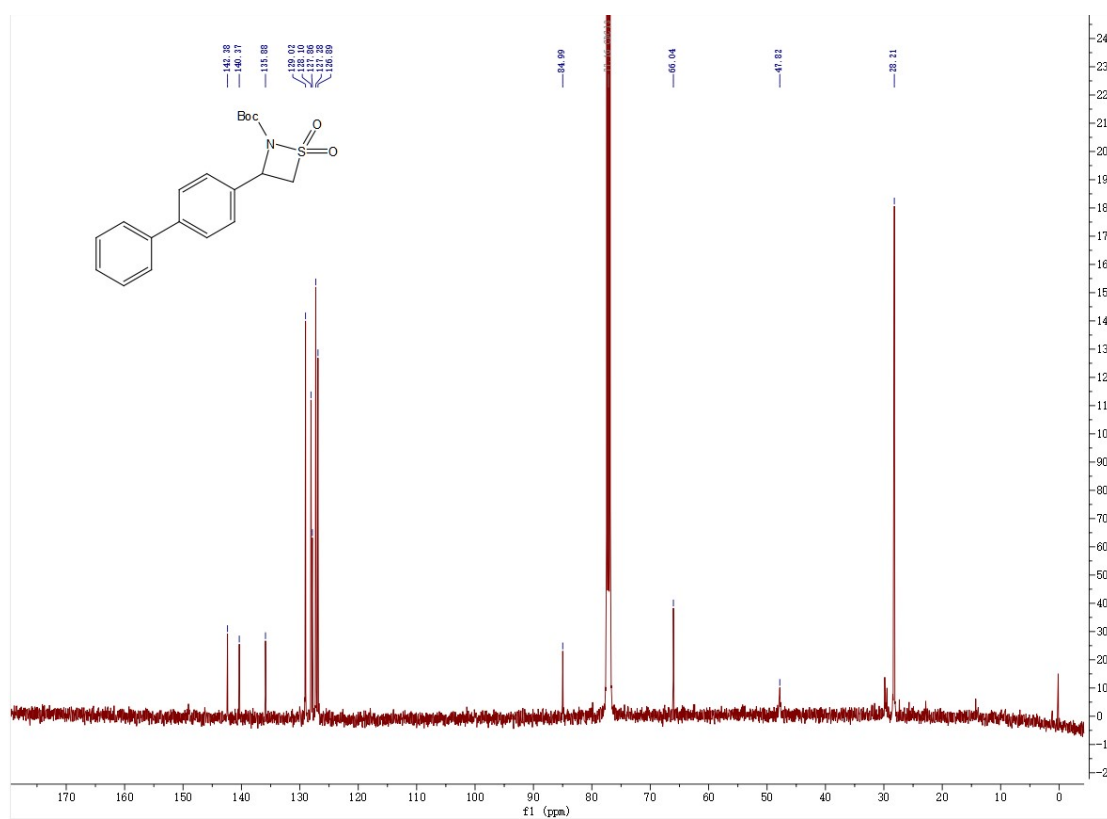
**LRMS (ESI)** (*m/z*): 382.2 [M+Na]<sup>+</sup>, 741.2 [2M+Na]<sup>+</sup>

**HRMS (ESI)** calculated for [C<sub>19</sub>H<sub>25</sub>N<sub>2</sub>O<sub>4</sub>S]<sup>+</sup> [M+NH<sub>4</sub>]<sup>+</sup>: 377.1530, found *m/z* 377.1530.

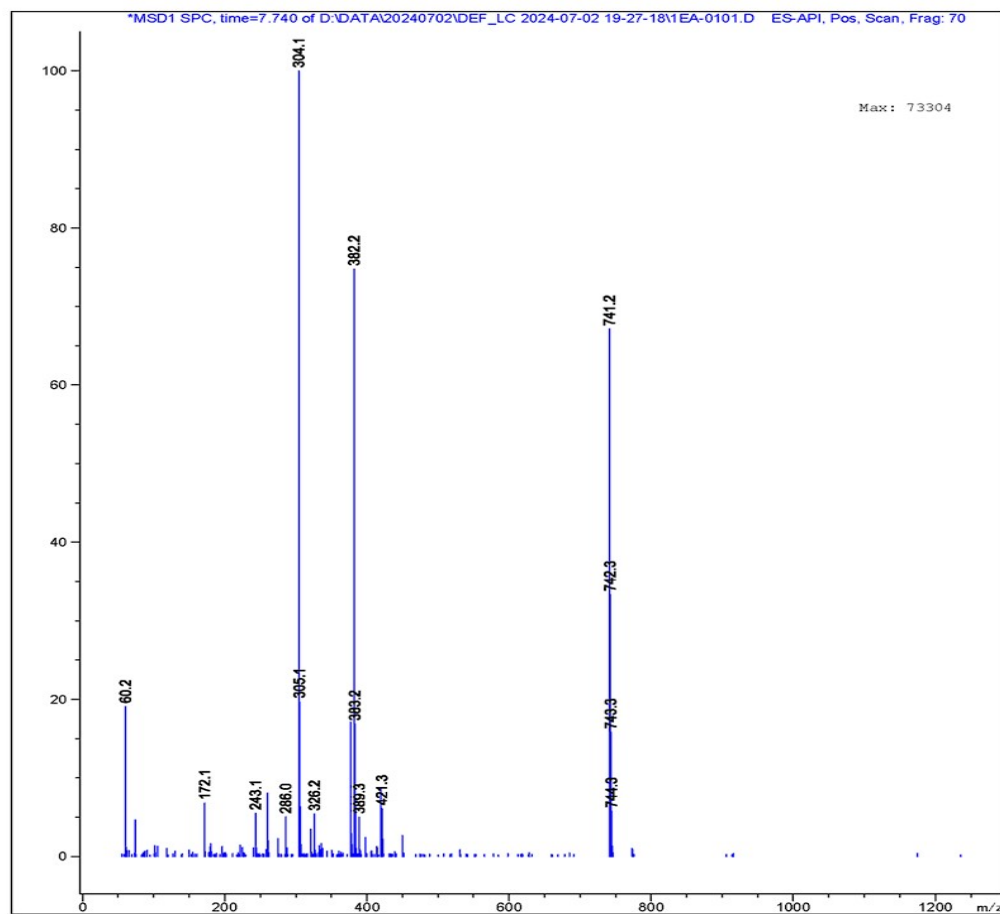
#### <sup>1</sup>H NMR spectrum of **5a**



### <sup>13</sup>C NMR spectrum of 5a

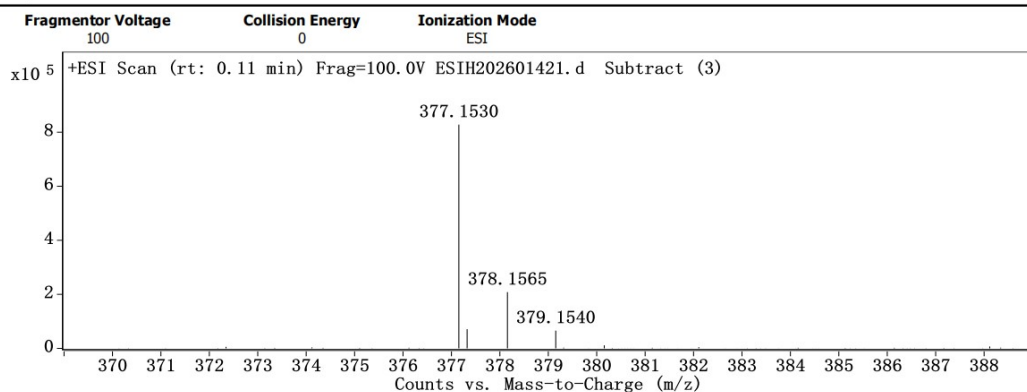


### LRMS data of 5a



## HRMS data of **5a**

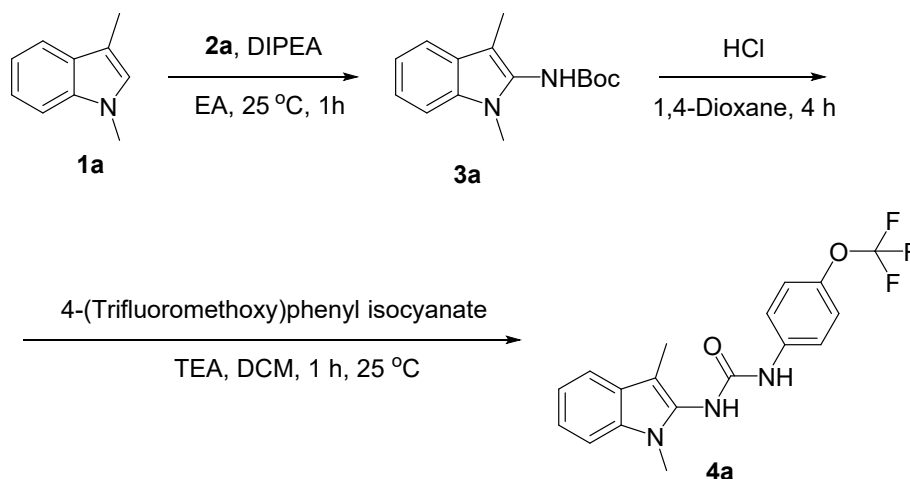
### User Spectra



### Formula Calculator Results

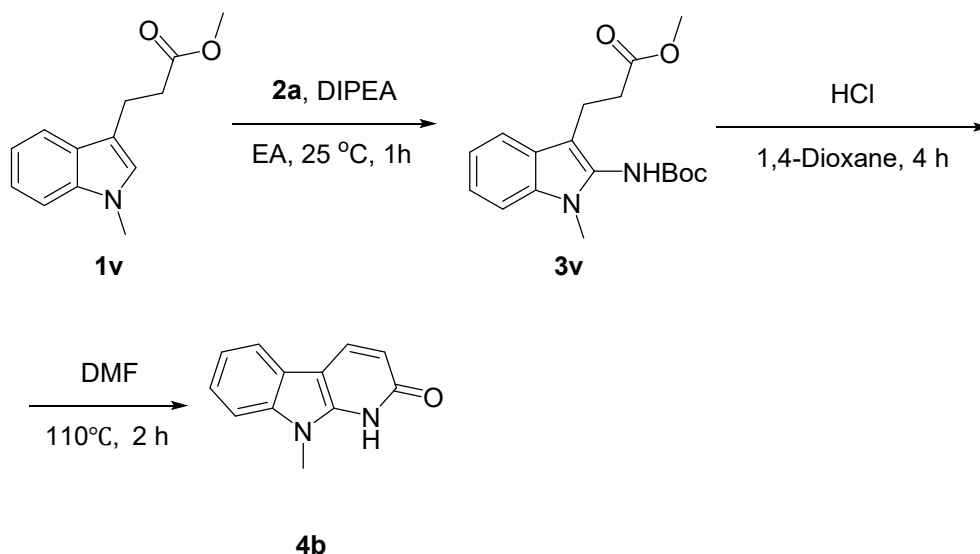
m/z	Calc m/z	Diff (mDa)	Diff (ppm)	Ion Formula	Ion
377.153	377.153	-0.01	-0.02	C19 H25 N2 O4 S	(M+NH4)+

## 2.4 The preparation of compound **4a** and **4b**



A 150 mL reaction flask equipped with a magnetic stir bar was charged with **1a** (1 g, 6.9 mmol) and **2a** (4.45 g, 20.7 mmol), which were dissolved in anhydrous EA (69 mL). DIPEA (2.67 g, 20.7 mmol) was then added, and the mixture was stirred at 25 °C for 1 h. Purification by column chromatography (PE: EA = 15:1) afforded product **3a** (1.11 g, 4.23 mmol) as a white solid in 62% yield.

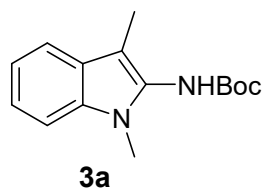
Compound **3a** (1.11 g, 4.23 mmol) was taken up in 4 M HCl in 1,4-dioxane (15 mL). The resulting solution was stirred for 4 h and then concentrated to dryness under reduced pressure to afford the corresponding hydrochloride salt. Without isolation, the residue was dissolved in DCM (20 mL) and cooled to 0 °C. Triethylamine (854 mg, 8.46 mmol) and 4-(trifluoromethoxy)phenyl isocyanate (1.03 g, 5.08 mmol) were then added. The resulting mixture was allowed to warm to 25 °C and stirred for 1 h. The mixture was concentrated under reduced pressure and purified by column chromatography (PE: EA = 30:1) afforded the title compound **4a** (1.45 g) with overall 58% yield.



A 150 mL reaction flask equipped with a magnetic stir bar was charged with methyl 3-(1-methylindol-3-yl)propanoate (1 g, 4.61 mmol) and **2a** (2.97 g, 13.83 mmol), which were dissolved in anhydrous EA (46 mL). DIPEA (1.78 g, 13.83 mmol) was then added, and the mixture was stirred at 25 °C for 1 h. Purification by column chromatography (PE: EA = 15:1) afforded product **3v** (827 mg, 2.49 mmol) as a white solid in 54% yield.

Compound **3v** (826 mg, 2.49 mmol) was taken up in 4 M HCl in 1,4-dioxane (15 mL). The resulting solution was stirred for 4 h and then concentrated to dryness under reduced pressure to afford the corresponding hydrochloride salt. Without isolation, the residue was taken up in DMF (10 mL) and stirred at 110 °C for 2 h. The mixture was then concentrated under reduced pressure and purified by column chromatography (PE: EA = 30:1) to afford compound **4b** (466 mg) with 51% overall yield.

### 3. Characterization data of products



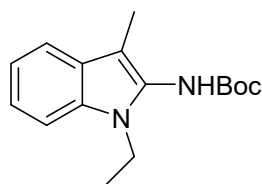
**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.95 (s, 1H), 7.44 (d, *J* = 7.8 Hz, 1H), 7.33 (d, *J* = 8.2 Hz, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.00 (t, *J* = 7.5 Hz, 1H), 3.51 (s, 3H), 2.09 (s, 3H), 1.47 (s, 9H).

**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.11, 133.91, 130.34, 126.51, 120.91, 118.50, 118.08, 109.19, 102.79, 79.19, 28.54, 28.02, 8.24.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>21</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 261.1598, found *m/z* 261.1599.

**The eluent:** PE/EA (15:1, v/v) **The amount isolated:** 71 mg

**Yield:** 68%



**3b**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.87 (s, 1H), 7.44 (d, *J* = 7.8 Hz, 1H), 7.35 (d, *J* = 8.2 Hz, 1H), 7.11 (t, *J* = 7.7 Hz, 1H), 6.99 (t, *J* = 7.1 Hz, 1H), 4.55 – 3.73 (m, 2H), 2.08 (s, 3H), 1.46 (s, 9H), 1.25 – 1.15 (m, 3H).

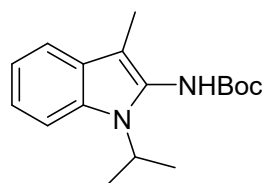
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.22, 132.83, 129.56, 126.69, 120.98, 118.42, 118.27, 109.25, 103.63, 79.10, 36.55, 28.01, 14.97, 8.19.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:275.1754, found *m/z* 275.1756.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 66 mg

**Yield:** 60%



**3c**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.82 (s, 1H), 7.49 (d, *J* = 8.3 Hz, 1H), 7.44 (d, *J* = 7.9 Hz, 1H), 7.07 (t, *J* = 7.7 Hz, 1H), 6.98 (t, *J* = 7.5 Hz, 1H), 4.66 – 4.41 (m, 1H), 2.06 (s, 3H), 1.49 (s, 6H), 1.47 (s, 9H).

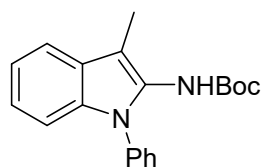
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.36, 131.92, 129.54, 127.11, 120.75, 118.43, 118.08, 110.91, 103.92, 79.01, 45.51, 28.01, 21.12, 8.11.

**HRMS** (ESI) calculated for [C<sub>17</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:289.1911, found *m/z* 289.1911.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 70 mg

**Yield:** 61%



**3d**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.83 (s, 1H), 7.60 – 7.51 (m, 3H), 7.47 – 7.35 (m, 3H), 7.18 – 7.08 (m, 3H), 2.19 (s, 3H), 1.34 (s, 9H).

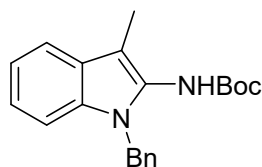
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.33, 136.64, 134.12, 129.91, 129.24, 127.06, 126.96, 126.82, 122.18, 119.67, 118.65, 109.64, 106.27, 78.98, 27.89, 8.15.

**HRMS** (ESI) calculated for [C<sub>20</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:323.1754, found *m/z* 323.1755.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 67 mg

**Yield:** 52%



**3e**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.06 (s, 1H), 7.47 (d, *J* = 7.7 Hz, 1H), 7.30 – 7.15 (m, 4H), 7.14 – 6.96 (m, 4H), 5.25 (s, 2H), 2.14 (s, 3H), 1.42 (s, 9H).

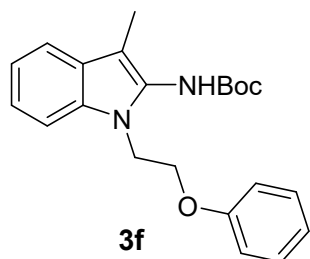
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 153.99, 138.27, 133.43, 130.17, 128.29, 126.96, 126.87, 126.74, 121.13, 118.74, 118.24, 109.78, 103.66, 79.13, 45.20, 27.94, 8.31.

**HRMS** (ESI) calculated for [C<sub>21</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:337.1911, found *m/z* 337.1910.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 60 mg

**Yield:** 45%



**3f**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.91 (s, 1H), 7.43 (t, *J* = 7.1 Hz, 2H), 7.22 (t, *J* = 7.8 Hz, 2H), 7.10 (t, *J* = 7.6 Hz, 1H), 6.99 (t, *J* = 7.4 Hz, 1H), 6.92 – 6.80 (m, 3H), 4.35 (t, *J* = 5.9 Hz, 2H), 4.15 (t, *J* = 5.9 Hz, 2H), 2.08 (s, 3H), 1.45 (s, 9H).

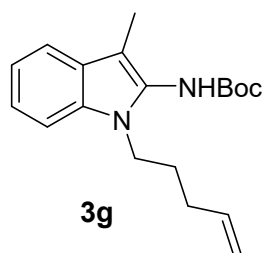
**<sup>13</sup>C NMR** (125 MHz, CDCl<sub>3</sub>) δ 158.16, 153.95, 133.86, 129.69, 128.99, 127.70, 121.84, 121.53, 119.34, 119.13, 114.57, 108.89, 105.43, 80.96, 67.26, 41.91, 28.37, 8.67.

**HRMS** (ESI) calculated for [C<sub>22</sub>H<sub>27</sub>N<sub>2</sub>O<sub>3</sub>]<sup>+</sup> [M+H]<sup>+</sup>:367.2016, found *m/z* 367.2017.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 85 mg

**Yield:** 58%



**3g**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.90 (s, 1H), 7.45 (d, *J* = 7.8 Hz, 1H), 7.36 (d, *J* = 8.1 Hz, 1H), 7.12 (t, *J* = 8.2 Hz, 1H), 7.01 (t, *J* = 7.4 Hz, 1H), 5.82 (ddt, *J* = 16.8, 10.2, 6.5 Hz, 1H), 5.07 – 4.95 (m, 2H), 3.99 (t, *J* = 6.7 Hz, 2H), 2.09 (s, 3H), 2.02 (q, *J* = 7.3 Hz, 2H), 1.72 (p, *J* = 7.5 Hz, 2H), 1.47 (s, 9H).

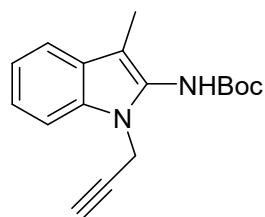
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.17, 137.90, 133.28, 129.80, 126.57, 120.99, 118.43, 118.24, 115.07, 109.37, 103.62, 79.09, 41.33, 30.42, 28.48, 28.01, 8.20.

**HRMS** (ESI) calculated for [C<sub>19</sub>H<sub>27</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:315.2067, found *m/z* 315.2066.

**The eluent:** PE/EA (5:1, v/v)

**The amount isolated:** 69 mg

**Yield:** 55%



**3h**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.99 (s, 1H), 7.46 (d, *J* = 7.8 Hz, 1H), 7.42 (d, *J* = 8.2 Hz, 1H), 7.15 (t, *J* = 8.3 Hz, 1H), 7.04 (t, *J* = 7.7 Hz, 1H), 4.82 (d, *J* = 2.5 Hz, 2H), 3.21 (s, 1H), 2.09 (s, 3H), 1.46 (s, 9H).

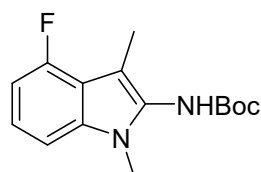
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 153.92, 133.17, 129.60, 126.96, 121.29, 119.06, 118.28, 109.67, 103.92, 79.30, 79.27, 74.26, 31.31, 27.99, 8.20.

**HRMS** (ESI) calculated for [C<sub>17</sub>H<sub>20</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:285.1598, found m/z 285.1598.

**The eluent:** PE/EA (20:1, v/v)

**The amount isolated:** 69 mg

**Yield:** 61%



**3i**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.01 (s, 1H), 7.19 (d, *J* = 8.2 Hz, 1H), 7.05 (td, *J* = 8.0, 5.2 Hz, 1H), 6.73 (dd, *J* = 11.4, 7.8 Hz, 1H), 3.52 (s, 3H), 2.20 (s, 3H), 1.47 (s, 9H).

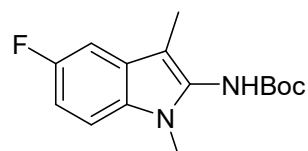
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 156.38 (d, *J* = 243.2 Hz), 154.04, 136.44 (d, *J* = 11.9 Hz), 130.58, 121.22 (d, *J* = 7.6 Hz), 114.55 (d, *J* = 19.4 Hz), 106.01 (d, *J* = 3.2 Hz), 103.69 (d, *J* = 19.1 Hz), 79.42, 29.05, 27.98, 9.79.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>FN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:279.1503, found m/z 279.1504.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 71 mg

**Yield:** 64%



**3j**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.02 (s, 1H), 7.35 (dd, *J* = 8.8, 4.6 Hz, 1H), 7.21 (dd, *J* = 9.8, 2.5 Hz, 1H), 6.94 (td, *J* = 9.2, 2.6 Hz, 1H), 3.51 (s, 3H), 2.06 (s, 3H), 1.46 (s, 9H).

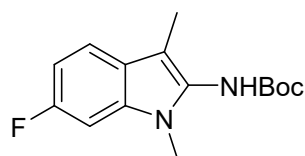
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 156.85 (d, *J* = 231.3 Hz), 153.91, 132.08, 130.55, 126.66 (d, *J* = 10.0 Hz), 110.35 (d, *J* = 9.5 Hz), 108.70 (d, *J* = 25.7 Hz), 103.07, 102.88, 79.34, 28.83, 27.99, 8.22.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>FN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:279.1503, found m/z 279.1502.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 63 mg

**Yield:** 57%



**3k**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.95 (s, 1H), 7.43 (dd, *J* = 8.6, 5.5 Hz, 1H), 7.22 (dd, *J* = 10.5, 2.4 Hz, 1H), 6.85 (ddd, *J* = 9.9, 8.6, 2.3 Hz, 1H), 3.48 (s, 3H), 2.08 (s, 3H), 1.46 (s, 9H).

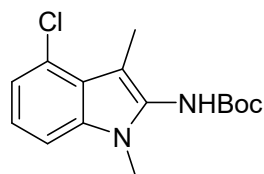
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 158.89 (d, *J* = 233.8 Hz), 154.09, 133.83 (d, *J* = 13.0 Hz), 130.70, 123.16, 119.21 (d, *J* = 10.2 Hz), 106.67 (d, *J* = 24.2 Hz), 103.19, 95.82 (d, *J* = 26.3 Hz), 79.28, 28.77, 27.99, 8.20.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>FN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 279.1503, found *m/z* 279.1503.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 60 mg

**Yield:** 54%



**3l**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.05 (s, 1H), 7.34 (dd, *J* = 8.1, 1.0 Hz, 1H), 7.07 (t, *J* = 7.9 Hz, 1H), 7.00 (dd, *J* = 7.7, 1.0 Hz, 1H), 3.52 (s, 3H), 2.31 (s, 3H), 1.47 (s, 9H).

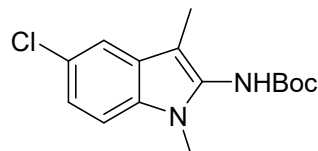
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.02, 135.28, 131.82, 124.77, 122.73, 121.50, 119.39, 108.74, 103.20, 79.47, 28.93, 27.98, 10.35.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>ClN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 295.1208, found *m/z* 295.1206.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 65 mg

**Yield:** 55%



**3m**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.05 (s, 1H), 7.48 (d, *J* = 1.8 Hz, 1H), 7.38 (d, *J* = 9.0 Hz, 1H), 7.11 (dd, *J* = 8.6, 2.0 Hz, 1H), 3.52 (s, 3H), 2.07 (s, 3H), 1.46 (s, 9H).

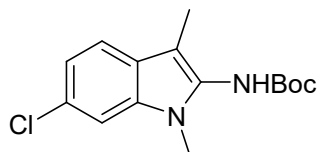
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 153.88, 132.33, 131.92, 127.56, 123.22, 120.69, 117.37, 110.94, 102.75, 79.42, 28.82, 27.98, 8.12.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>ClN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 295.1208, found *m/z* 295.1208.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 64 mg

**Yield:** 54%



**3n**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.01 (s, 1H), 7.48 (d, *J* = 1.8 Hz, 1H), 7.45 (d, *J* = 8.4 Hz, 1H), 7.01 (dd, *J* = 8.4, 1.9 Hz, 1H), 3.51 (s, 3H), 2.08 (s, 3H), 1.47 (s, 9H).

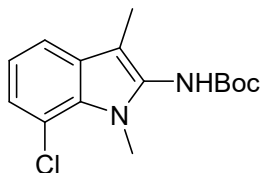
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 153.92, 134.26, 131.28, 125.69, 125.20, 119.49, 118.72, 109.18, 103.15, 79.37, 28.75, 27.97, 8.12.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>ClN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 295.1208, found *m/z* 295.1206.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 60 mg

**Yield:** 51%



**3o**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.06 (s, 1H), 7.42 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.12 (dd, *J* = 7.7, 1.1 Hz, 1H), 6.98 (t, *J* = 7.7 Hz, 1H), 3.81 (s, 3H), 2.08 (s, 3H), 1.47 (s, 9H).

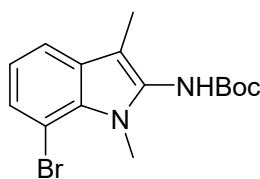
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 153.96, 132.09, 129.66, 129.11, 122.60, 119.44, 117.47, 115.29, 104.08, 79.49, 31.15, 27.98, 8.20.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>ClN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 295.1208, found *m/z* 295.1208.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 52 mg

**Yield:** 44%



**3p**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.06 (s, 1H), 7.46 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.30 (dd, *J* = 7.6, 1.0 Hz, 1H), 6.92 (t, *J* = 7.7 Hz, 1H), 3.82 (s, 3H), 2.08 (s, 3H), 1.47 (s, 9H).

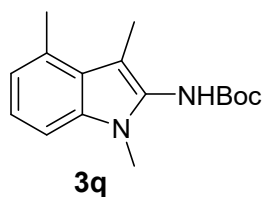
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.41, 132.67, 130.77, 130.28, 126.55, 120.45, 118.43, 104.42, 103.20, 79.98, 31.64, 28.45, 8.60.

**HRMS** (ESI) calculated for [C<sub>15</sub>H<sub>20</sub>BrN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 339.0703, found *m/z* 339.0700.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 68 mg

**Yield:** 50%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.87 (s, 1H), 7.13 (d, *J* = 8.2 Hz, 1H), 6.96 (t, *J* = 7.7 Hz, 1H), 6.71 (d, *J* = 7.1 Hz, 1H), 3.47 (s, 3H), 2.61 (s, 3H), 2.27 (s, 3H), 1.47 (s, 9H).

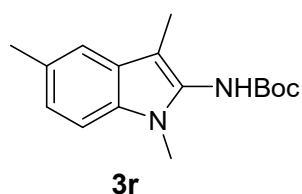
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.38, 134.13, 130.06, 129.79, 124.86, 120.84, 120.04, 107.23, 103.96, 79.13, 28.57, 28.02, 19.81, 10.97.

**HRMS** (ESI) calculated for [C<sub>16</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:275.1754, found *m/z* 275.1754.

**The eluent:** PE/EA (10:1, v/v)

**The amount isolated:** 60 mg

**Yield:** 55%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.89 (s, 1H), 7.24 – 7.18 (m, 2H), 6.94 (d, *J* = 8.4 Hz, 1H), 3.47 (s, 3H), 2.38 (s, 3H), 2.06 (s, 3H), 1.46 (s, 9H).

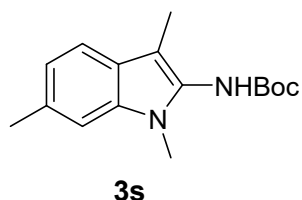
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.07, 132.34, 130.30, 126.91, 126.63, 122.39, 117.79, 108.96, 102.30, 79.14, 28.55, 28.01, 21.22, 8.23.

**HRMS** (ESI) calculated for [C<sub>16</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:275.1754, found *m/z* 275.1754.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 57 mg

**Yield:** 52%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.88 (s, 1H), 7.24 (d, *J* = 8.2 Hz, 1H), 6.90 – 6.78 (m, 2H), 3.73 (s, 3H), 2.69 (s, 3H), 2.05 (s, 3H), 1.47 (s, 9H).

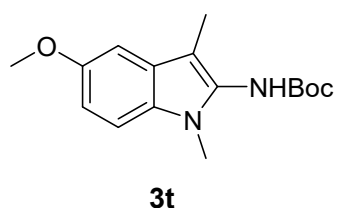
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.22, 132.77, 130.51, 127.17, 123.76, 120.45, 118.49, 116.17, 103.18, 79.14, 31.18, 28.02, 19.56, 8.29.

**HRMS** (ESI) calculated for [C<sub>16</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:275.1754, found *m/z* 275.1754.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 53 mg

**Yield:** 48%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.92 (s, 1H), 7.23 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.94 (d, *J* = 2.6 Hz, 1H), 6.76 (dd, *J* = 8.8, 2.7 Hz, 1H), 3.77 (s, 3H), 3.48 (s, 3H), 2.08 (s, 3H), 1.48 (s, 9H).

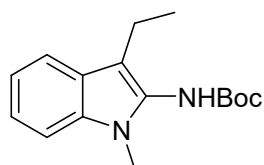
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.07, 153.20, 130.79, 129.11, 126.73, 110.60, 109.97, 102.53, 100.31, 79.12, 55.35, 28.61, 28.00, 8.29.

**HRMS** (ESI) calculated for [C<sub>16</sub>H<sub>23</sub>N<sub>2</sub>O<sub>3</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 291.1703, found *m/z* 291.1704.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 45 mg

**Yield:** 39%



**3u-1**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.93 (s, 1H), 7.49 (d, *J* = 7.9 Hz, 1H), 7.35 (d, *J* = 8.2 Hz, 1H), 7.12 (t, *J* = 7.7 Hz, 1H), 7.01 (t, *J* = 7.5 Hz, 1H), 3.52 (s, 3H), 2.60 (q, *J* = 7.7 Hz, 2H), 1.48 (s, 9H), 1.15 (t, *J* = 7.6 Hz, 3H).

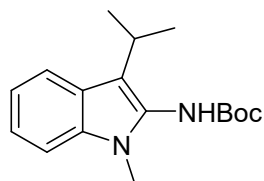
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.42, 133.95, 129.65, 125.54, 120.83, 118.45, 118.20, 109.58, 109.30, 79.12, 28.36, 27.98, 16.69, 14.75.

**HRMS** (ESI) calculated for [C<sub>16</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 275.1754, found *m/z* 275.1753.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 66 mg

**Yield:** 60%



**3u-2**

**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 8.86 (s, 1H), 7.59 (d, *J* = 7.9 Hz, 1H), 7.35 (d, *J* = 8.1 Hz, 1H), 7.12 (t, *J* = 8.1 Hz, 1H), 6.99 (t, *J* = 7.6 Hz, 1H), 3.49 (s, 3H), 3.14 – 3.04 (m, 1H), 1.48 (s, 9H), 1.32 (s, 3H), 1.31 (s, 3H).

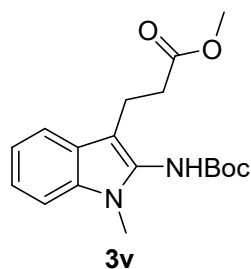
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.57, 134.10, 128.63, 124.50, 120.71, 119.21, 118.31, 113.97, 109.48, 79.08, 28.22, 28.02, 25.00, 22.51.

**HRMS** (ESI) calculated for [C<sub>17</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 289.1911, found *m/z* 289.1912.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 61 mg

**Yield:** 53%



**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.48 (d, *J* = 7.5 Hz, 1H), 7.27 (d, *J* = 7.5 Hz, 1H), 7.20 (t, *J* = 7.6 Hz, 1H), 7.09 (t, *J* = 7.4 Hz, 1H), 3.62 (s, 3H), 3.60 (s, 3H), 2.99 (t, *J* = 6.2 Hz, 2H), 2.70 (t, *J* = 6.2 Hz, 2H), 1.55 (s, 9H).

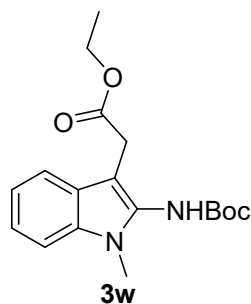
**<sup>13</sup>C NMR** (125 MHz, CDCl<sub>3</sub>) δ 174.86, 154.64, 134.85, 130.49, 125.83, 121.45, 119.14, 118.22, 109.36, 105.78, 80.86, 51.71, 34.01, 29.30, 28.35, 18.71.

**HRMS** (ESI) calculated for [C<sub>18</sub>H<sub>25</sub>N<sub>2</sub>O<sub>4</sub>]<sup>+</sup> [M+H]<sup>+</sup>:333.1809, found *m/z* 333.1809.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 73 mg

**Yield:** 55%



**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.55 (d, *J* = 6.2 Hz, 1H), 7.29 (d, *J* = 6.2 Hz, 1H), 7.21 (t, *J* = 7.6 Hz, 1H), 7.11 (t, *J* = 7.5 Hz, 1H), 4.14 (q, *J* = 7.0 Hz, 2H), 3.71 (s, 2H), 3.64 (s, 3H), 1.51 (s, 9H), 1.25 (t, *J* = 7.1 Hz, 3H).

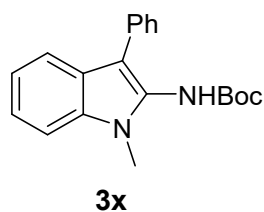
**<sup>13</sup>C NMR** (150 MHz, CDCl<sub>3</sub>) δ 172.56, 154.19, 134.63, 130.98, 126.06, 121.82, 119.60, 118.57, 109.43, 100.63, 81.21, 61.12, 30.04, 29.37, 28.33, 14.33.

**HRMS** (ESI) calculated for [C<sub>18</sub>H<sub>25</sub>N<sub>2</sub>O<sub>4</sub>]<sup>+</sup> [M+H]<sup>+</sup>:333.1809, found *m/z* 333.1810.

**The eluent:** PE/EA (8:1, v/v)

**The amount isolated:** 58 mg

**Yield:** 44%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 9.14 (s, 1H), 7.65 (d, *J* = 8.0 Hz, 1H), 7.57 – 7.38 (m, 5H), 7.32 – 7.19 (m, 2H), 7.10 (t, *J* = 7.6 Hz, 1H), 3.61 (s, 3H), 1.47 (s, 9H).

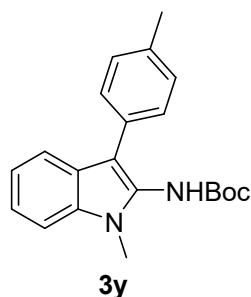
**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 154.88, 134.21, 134.08, 129.96, 128.52, 128.24, 125.72, 124.57, 121.79, 119.87, 118.60, 109.97, 79.41, 28.54, 28.02.

**HRMS** (ESI) calculated for [C<sub>20</sub>H<sub>23</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:323.1754, found *m/z* 323.1753.

**The eluent:** PE/EA (15:1, v/v)

**The amount isolated:** 103 mg

**Yield:** 80%



**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.71 (d, *J* = 8.0 Hz, 1H), 7.41 (d, *J* = 7.6 Hz, 2H), 7.35 – 7.27 (m, 1H), 7.25 – 7.24 (m, 3H), 7.12 (t, *J* = 7.8 Hz, 1H), 6.18 (s, 1H), 3.66 (s, 3H), 2.39 (s, 3H), 1.47 (s, 9H).

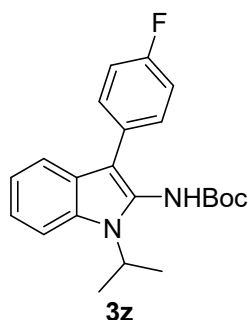
**<sup>13</sup>C NMR** (125 MHz, CDCl<sub>3</sub>) δ 154.94, 135.69, 134.69, 131.32, 129.41, 128.83, 125.42, 122.13, 119.97, 119.59, 110.58, 109.50, 81.12, 28.90, 28.20, 21.25.

**HRMS** (ESI) calculated for [C<sub>21</sub>H<sub>25</sub>N<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 337.1911, found *m/z* 337.1911.

**The eluent:** PE/EA (10:1, v/v)

**The amount isolated:** 109 mg

**Yield:** 81%



**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.67 (d, *J* = 8.0 Hz, 1H), 7.55 (d, *J* = 8.4 Hz, 1H), 7.47 (t, *J* = 6.7 Hz, 2H), 7.25 – 7.18 (m, 1H), 7.17 – 7.08 (m, 3H), 5.96 (s, 1H), 4.87 – 4.61 (m, 1H), 1.67 (s, 3H), 1.66 (s, 3H), 1.45 (s, 9H).

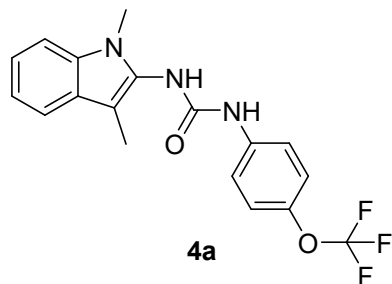
**<sup>13</sup>C NMR** (125 MHz, CDCl<sub>3</sub>) δ 161.66 (d, *J* = 245.1 Hz), 154.90, 132.70, 130.70, 130.32 (d, *J* = 3.3 Hz), 127.86, 126.20, 122.09, 119.80, 115.69, 115.52, 111.77, 111.21, 81.32, 46.63, 28.26, 21.61.

**HRMS** (ESI) calculated for [C<sub>22</sub>H<sub>26</sub>FN<sub>2</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>: 369.1973, found *m/z* 369.1973.

**The eluent:** PE/EA (10:1, v/v)

**The amount isolated:** 100 mg

**Yield:** 68%



**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.65 – 7.59 (m, 1H), 7.40 – 7.31 (m, 4H), 7.24 – 7.17 (m, 1H), 7.12 (d, *J* = 8.5 Hz, 2H), 6.55 (s, 1H), 6.29 (s, 1H), 3.68 (s, 3H), 2.32 (s, 3H).

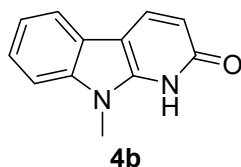
**<sup>13</sup>C NMR** (150 MHz, MeOD) δ 156.98, 145.63, 139.63, 136.32, 130.20, 128.33, 122.74, 122.68, 122.01 (d, *J* = 254.9 Hz), 121.80, 119.90, 119.53, 110.07, 106.18, 28.97, 8.37.

**HRMS** (ESI) calculated for [C<sub>18</sub>H<sub>17</sub>F<sub>3</sub>N<sub>3</sub>O<sub>2</sub>]<sup>+</sup> [M+H]<sup>+</sup>:364.1267, found m/z 364.1266.

**The eluent:** PE/EA (30:1, v/v)

**The amount isolated:** 1.45 g

**Yield (overall) :** 58%



**<sup>1</sup>H NMR** (400 MHz, DMSO-*d*<sub>6</sub>) δ 10.95 (s, 1H), 8.32 (d, *J* = 8.4 Hz, 1H), 7.99 (d, *J* = 8.7 Hz, 1H), 7.55 (d, *J* = 8.1 Hz, 1H), 7.38 (t, *J* = 7.7 Hz, 1H), 7.21 (t, *J* = 7.6 Hz, 1H), 6.47 (d, *J* = 8.3 Hz, 1H), 3.82 (s, 3H).

**<sup>13</sup>C NMR** (125 MHz, DMSO-*d*<sub>6</sub>) δ 162.68, 138.53, 131.93, 124.14, 120.65, 119.61, 119.32, 109.31, 101.59, 27.50.

**HRMS** (ESI) calculated for [C<sub>12</sub>H<sub>11</sub>N<sub>2</sub>O]<sup>+</sup> [M+H]<sup>+</sup>:199.0866, found m/z 199.0868.

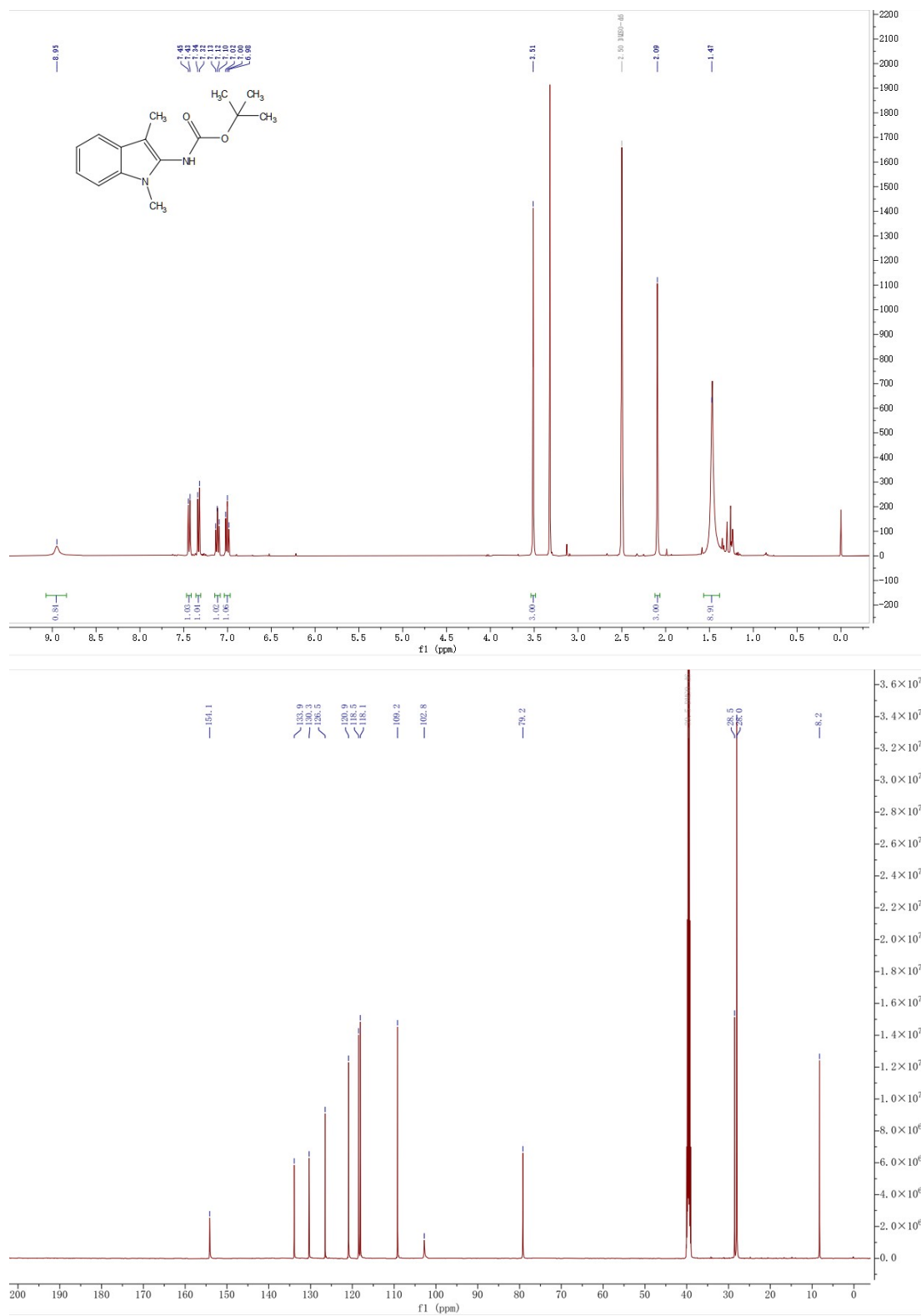
**The eluent:** PE/EA (30:1, v/v)

**The amount isolated:** 466 mg

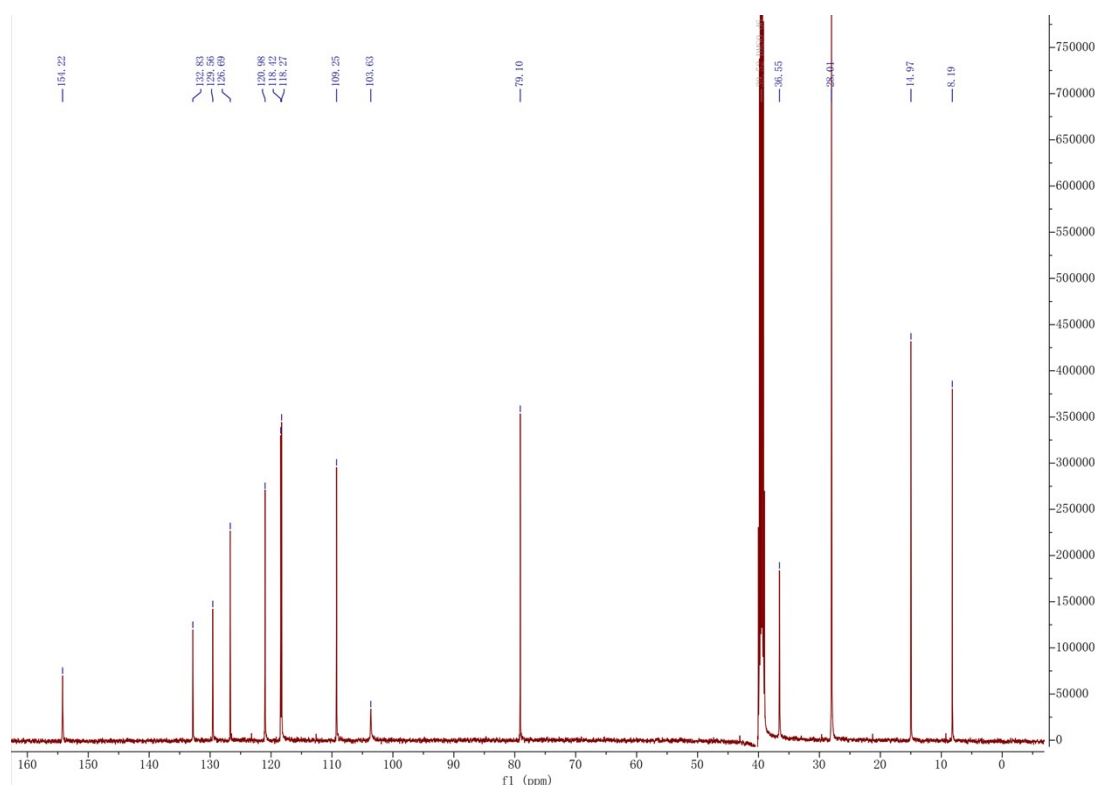
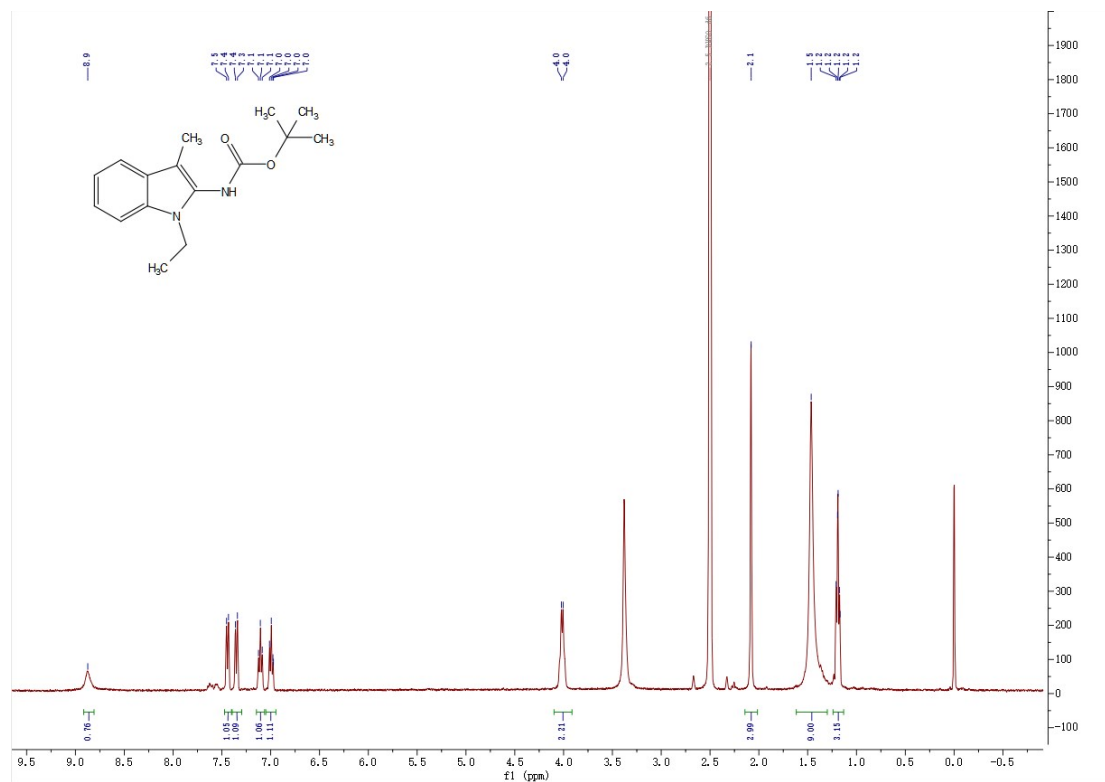
**Yield (overall) :** 51%

## 4. NMR spectrum

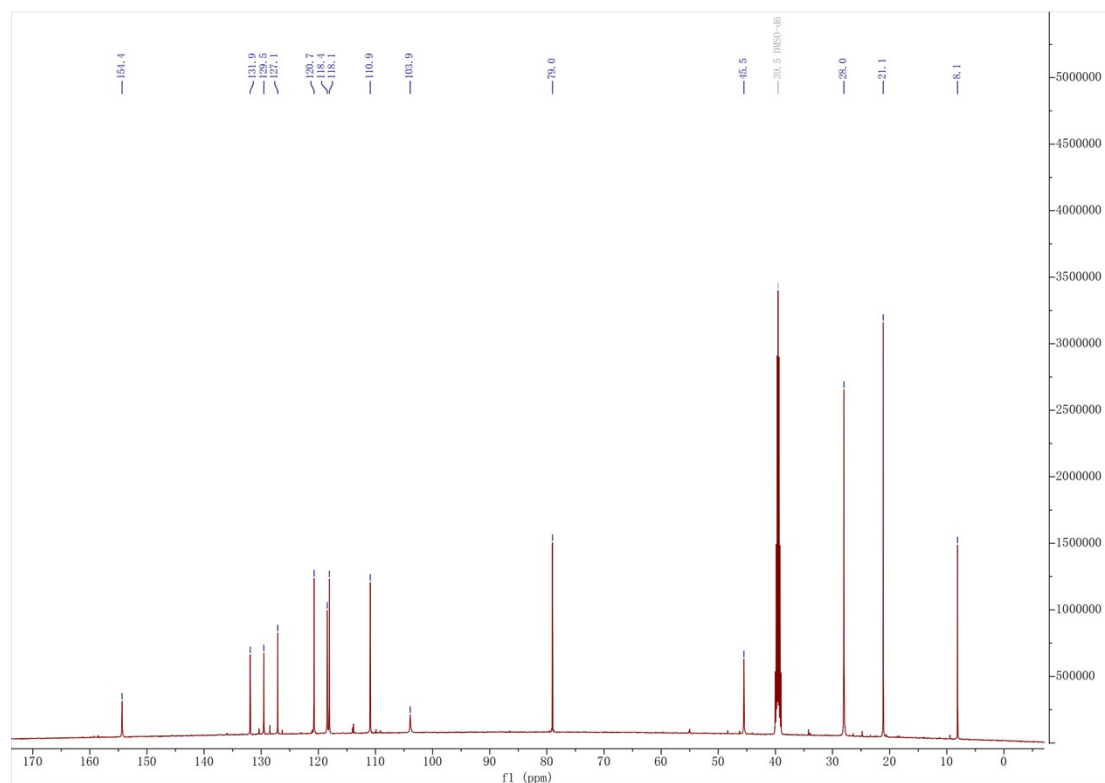
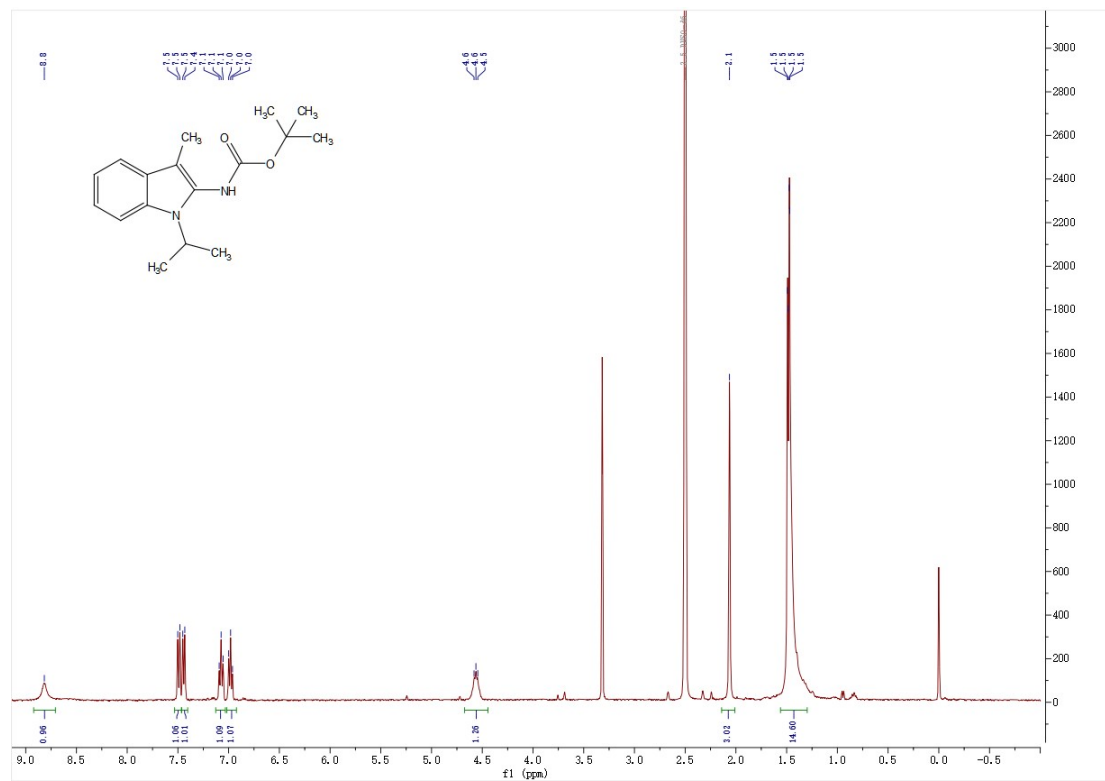
3a



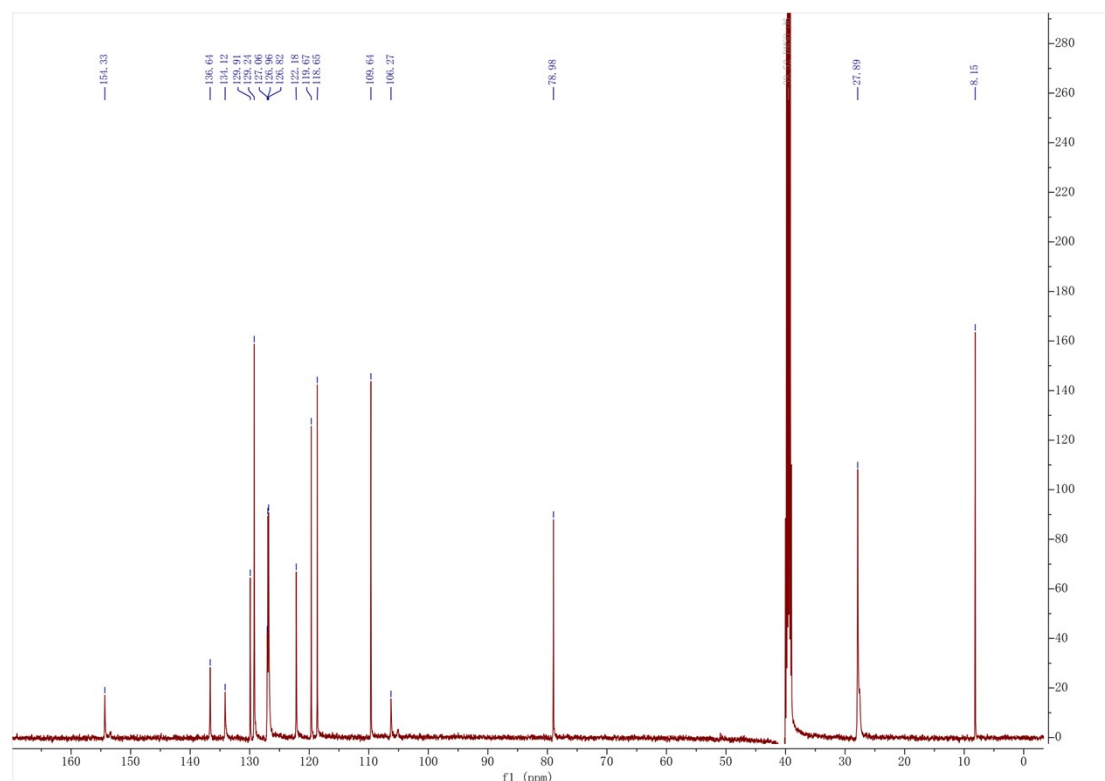
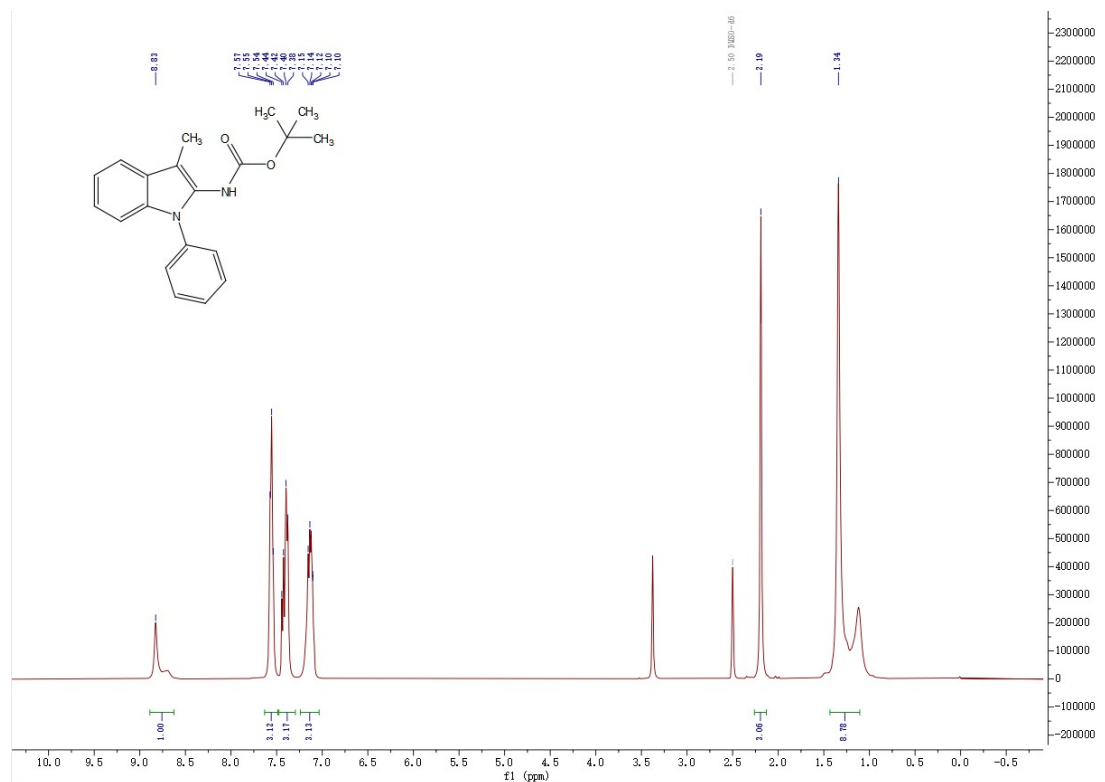
3b



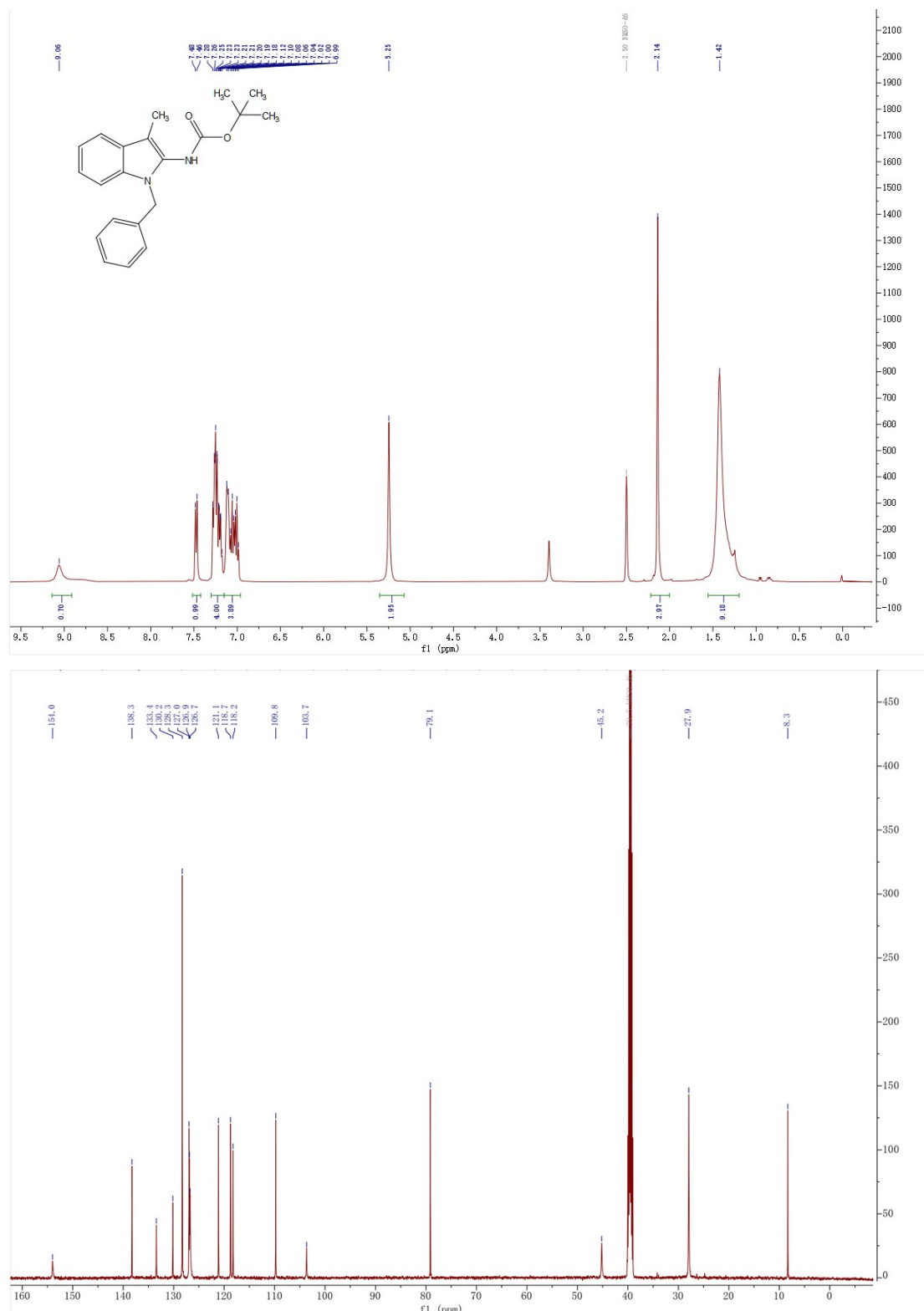
3c



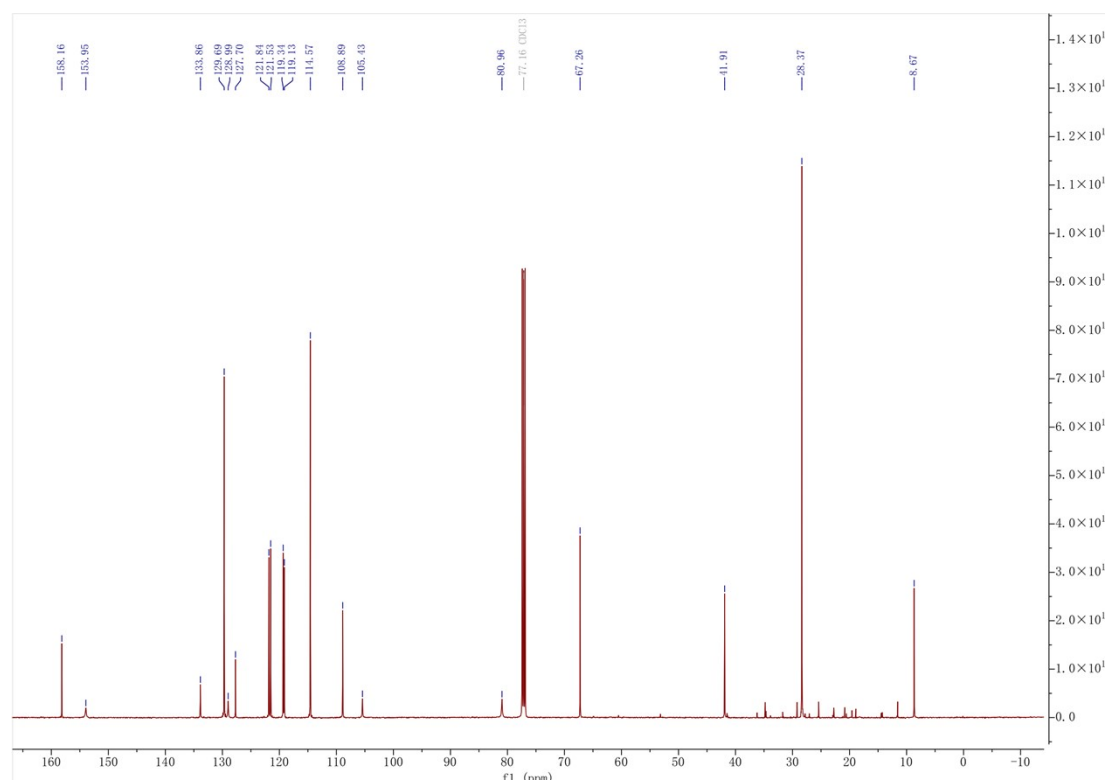
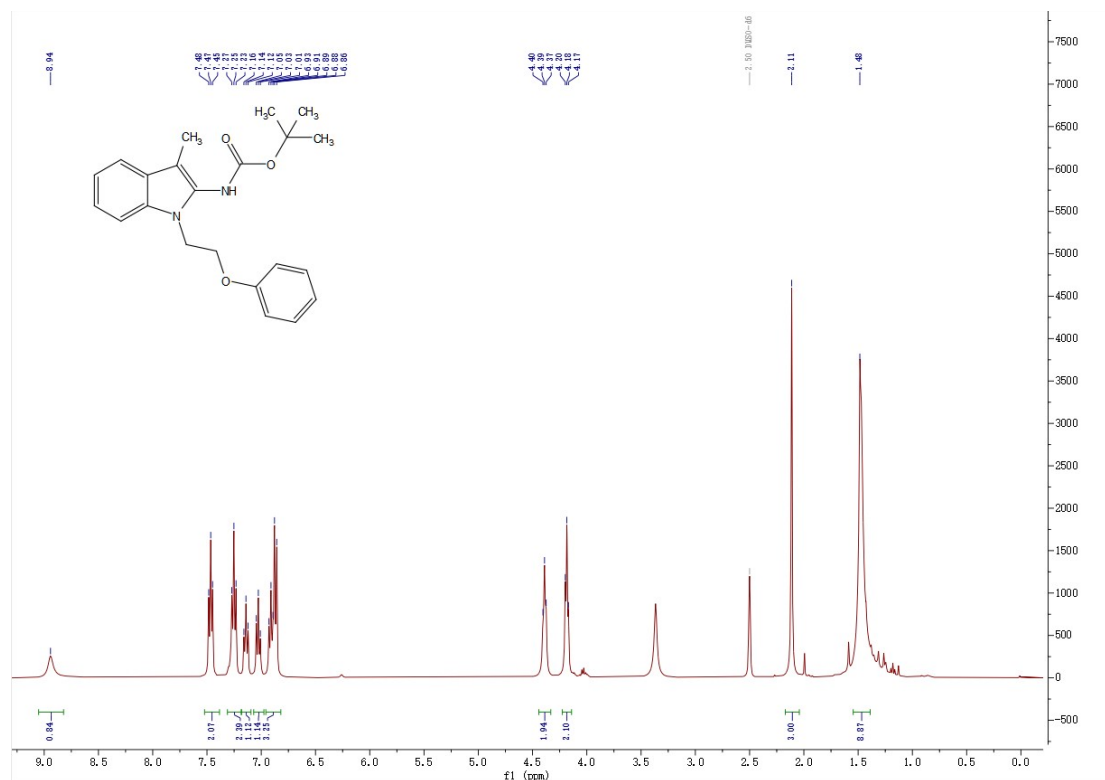
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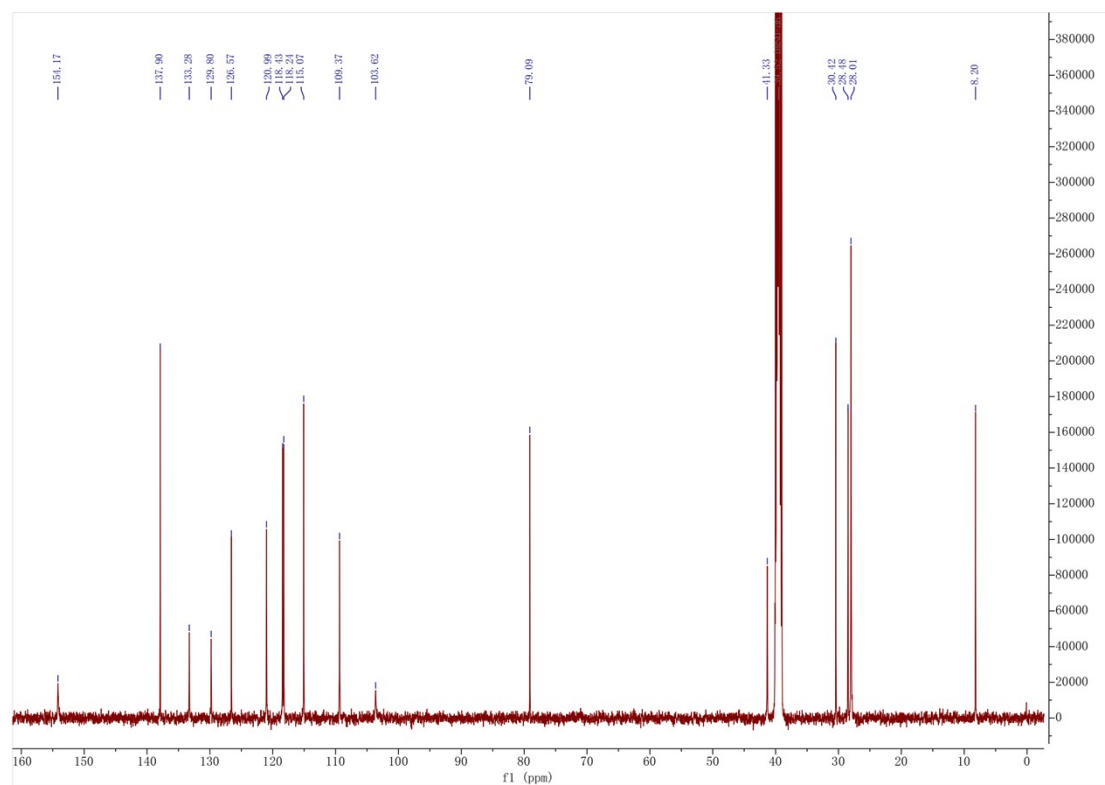
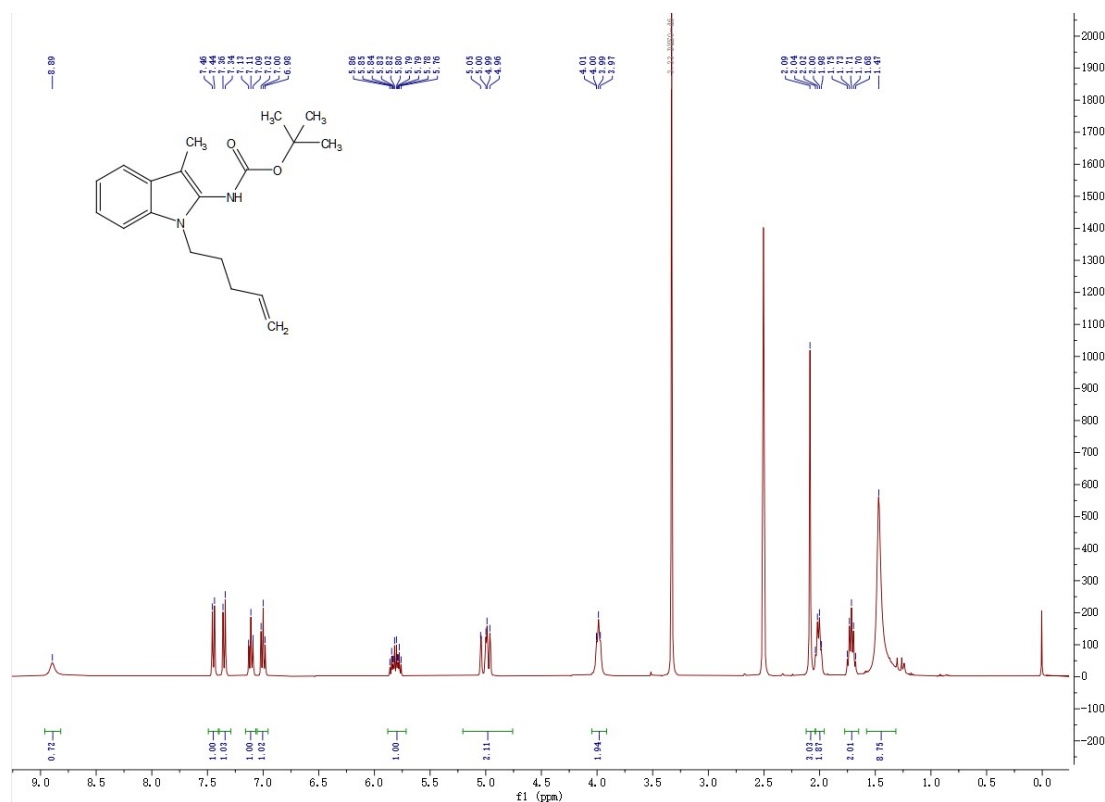
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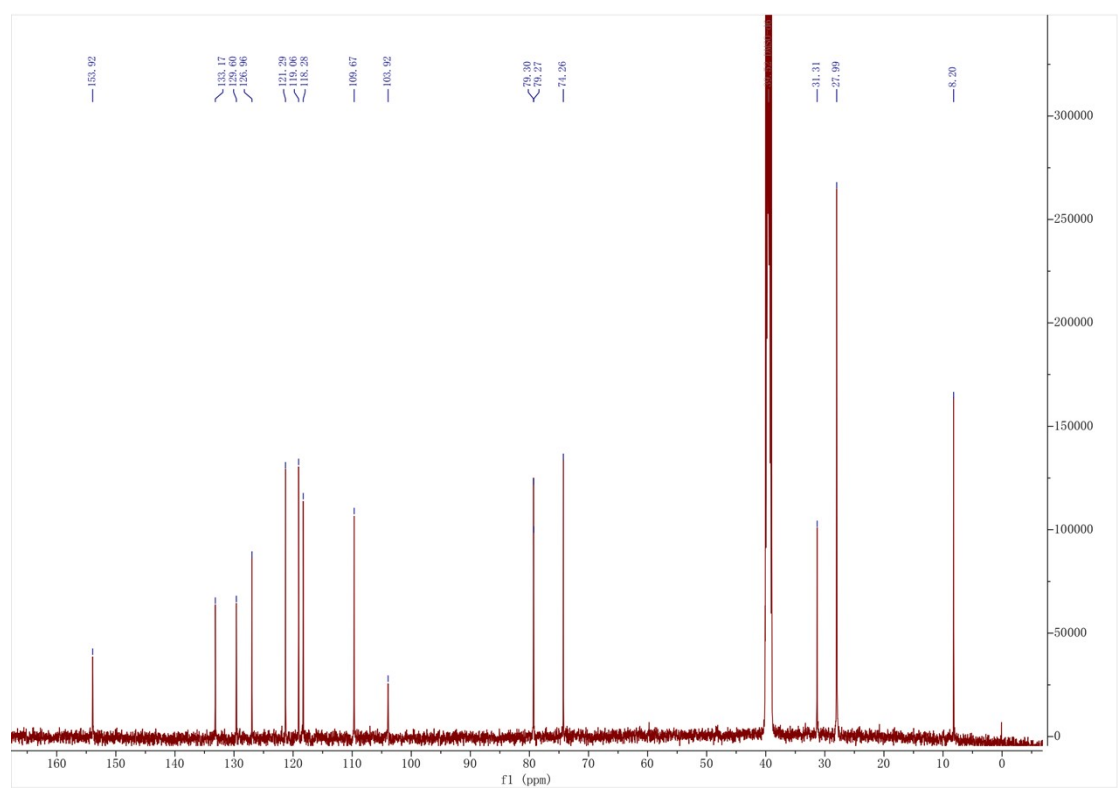
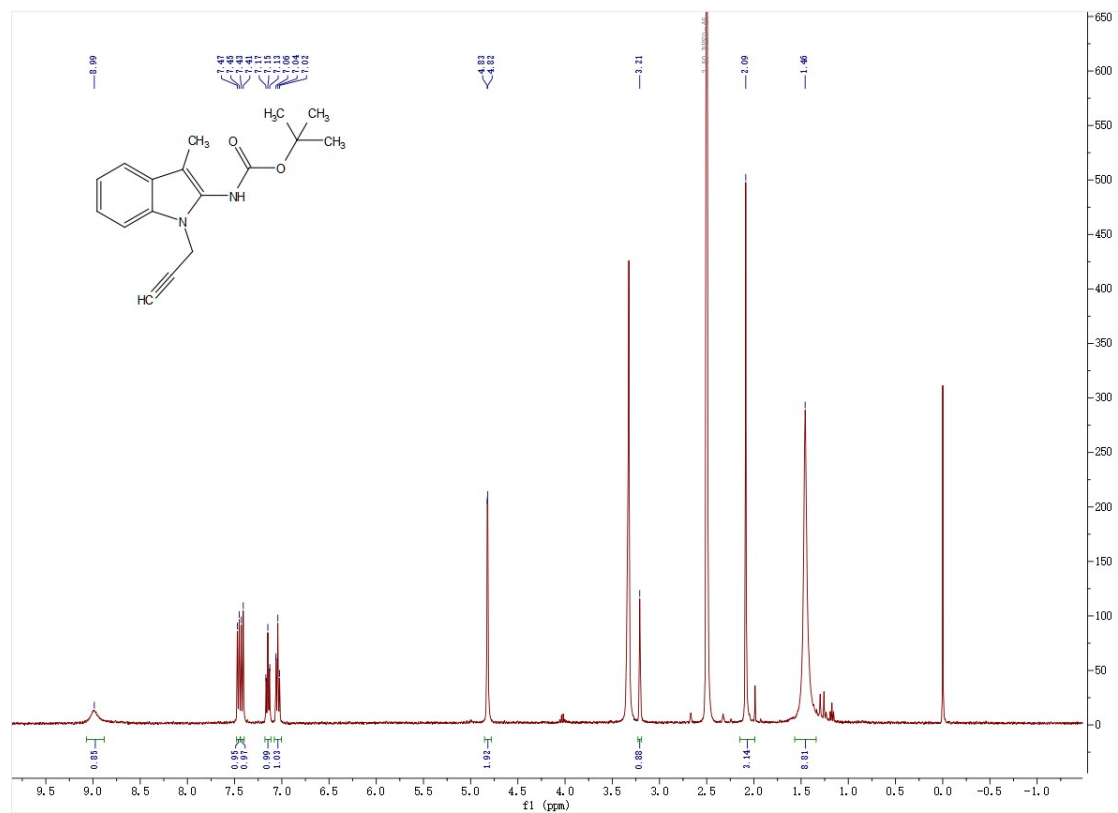
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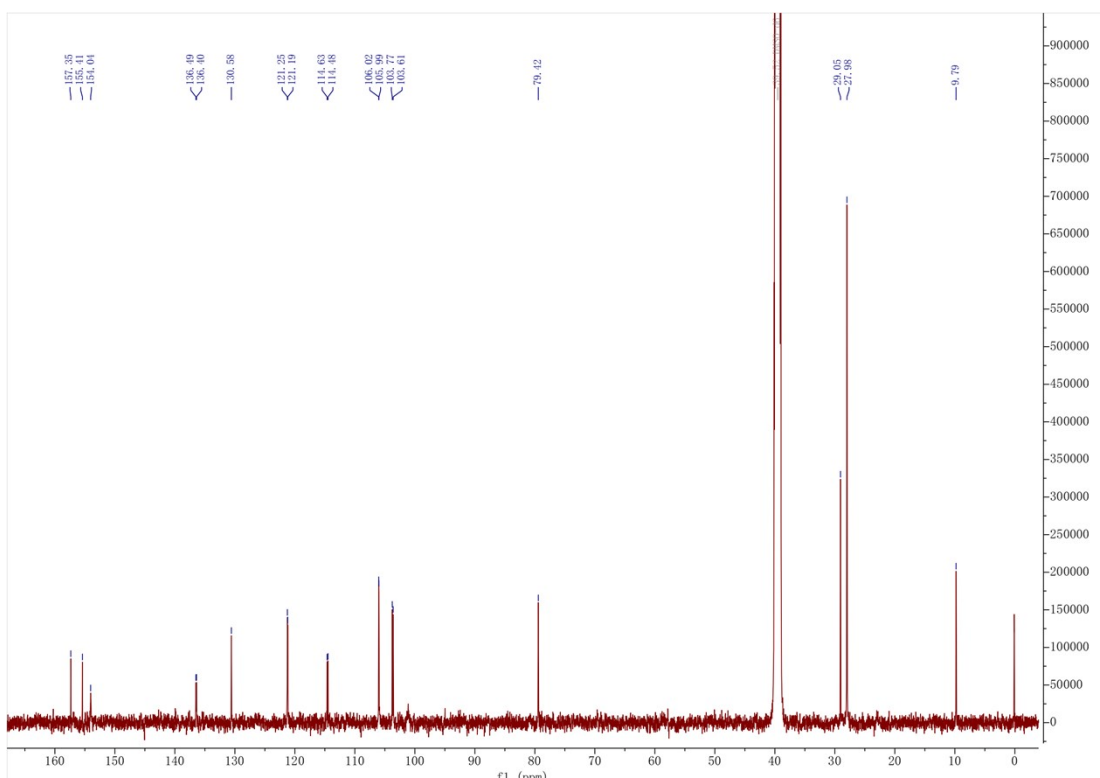
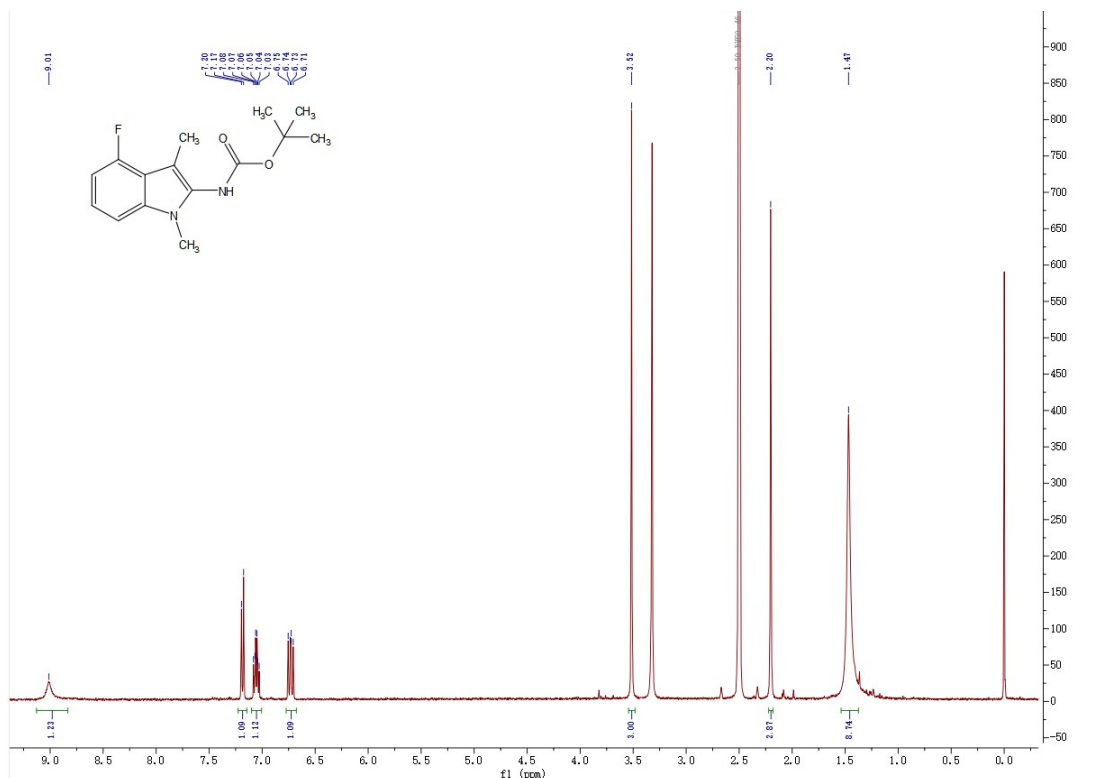
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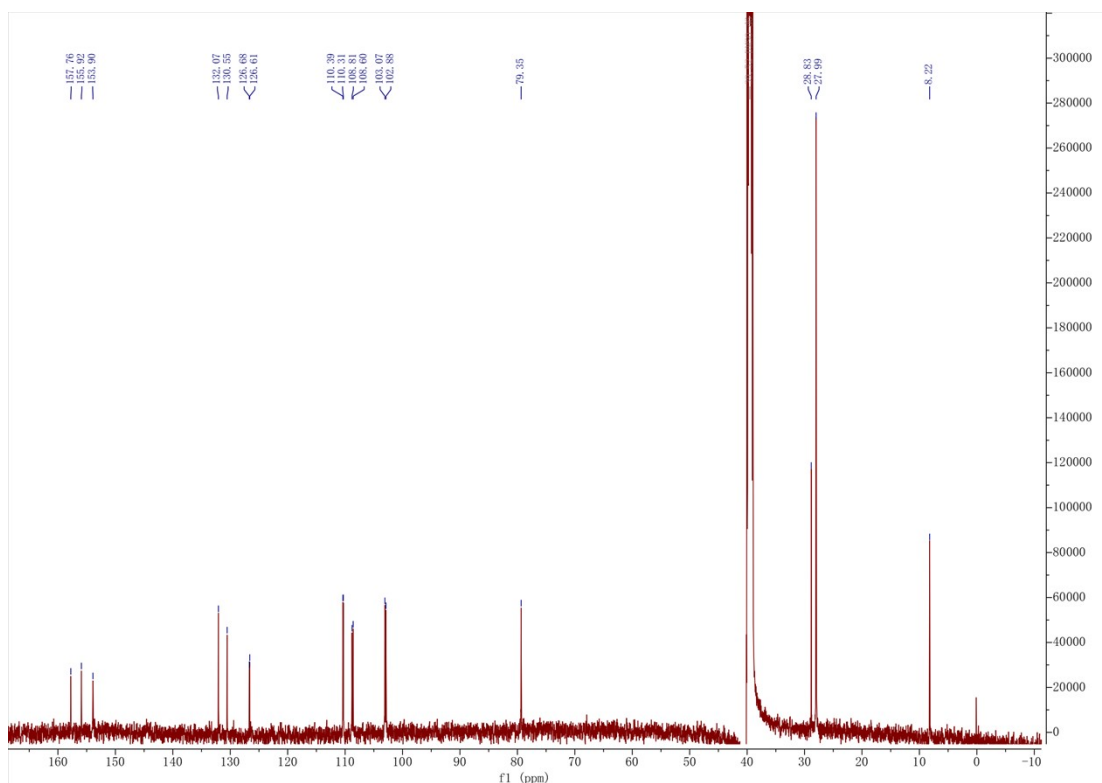
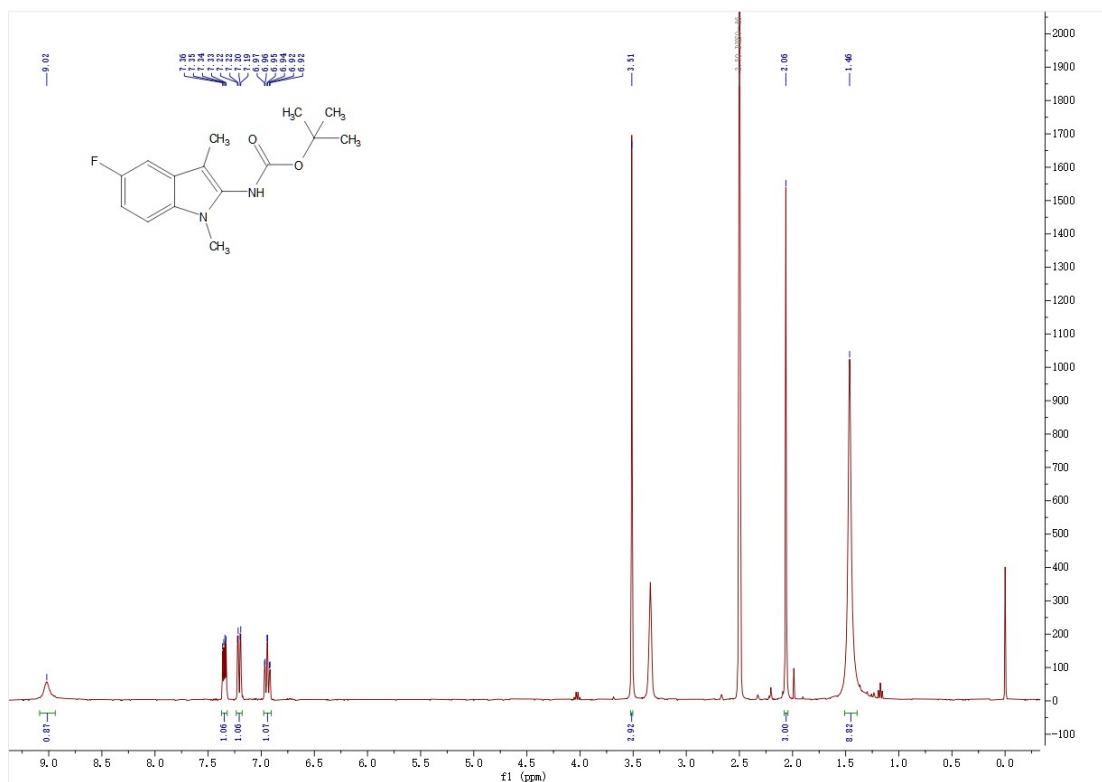
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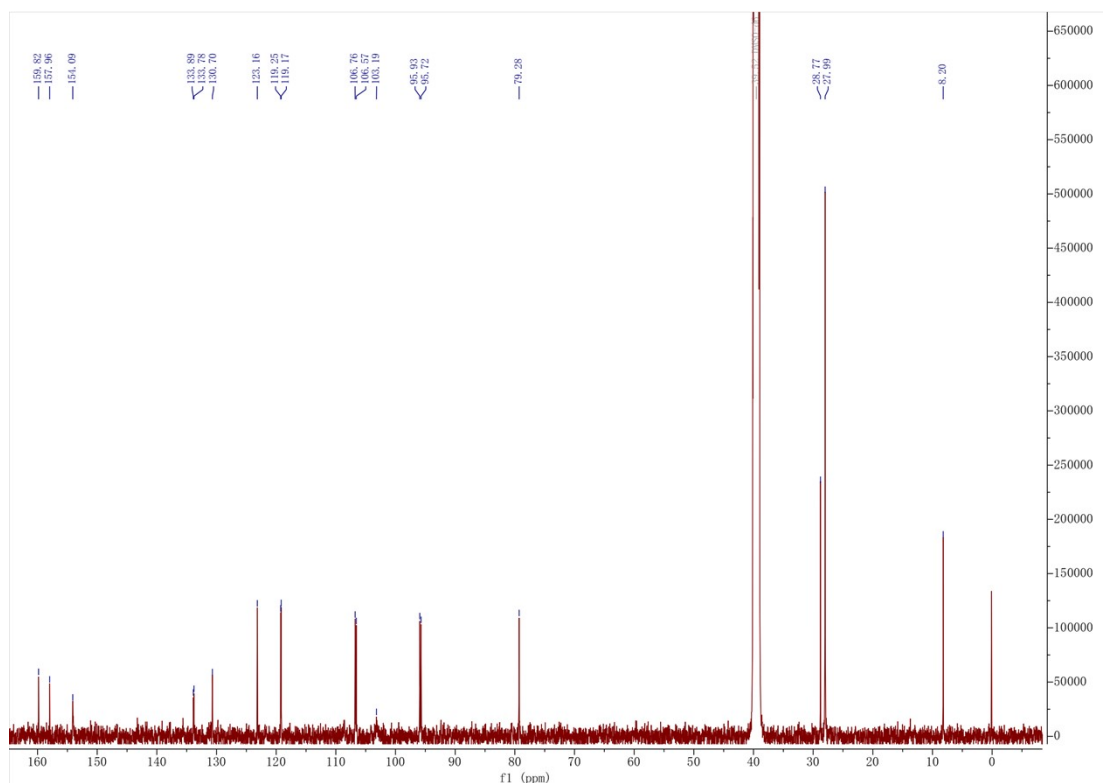
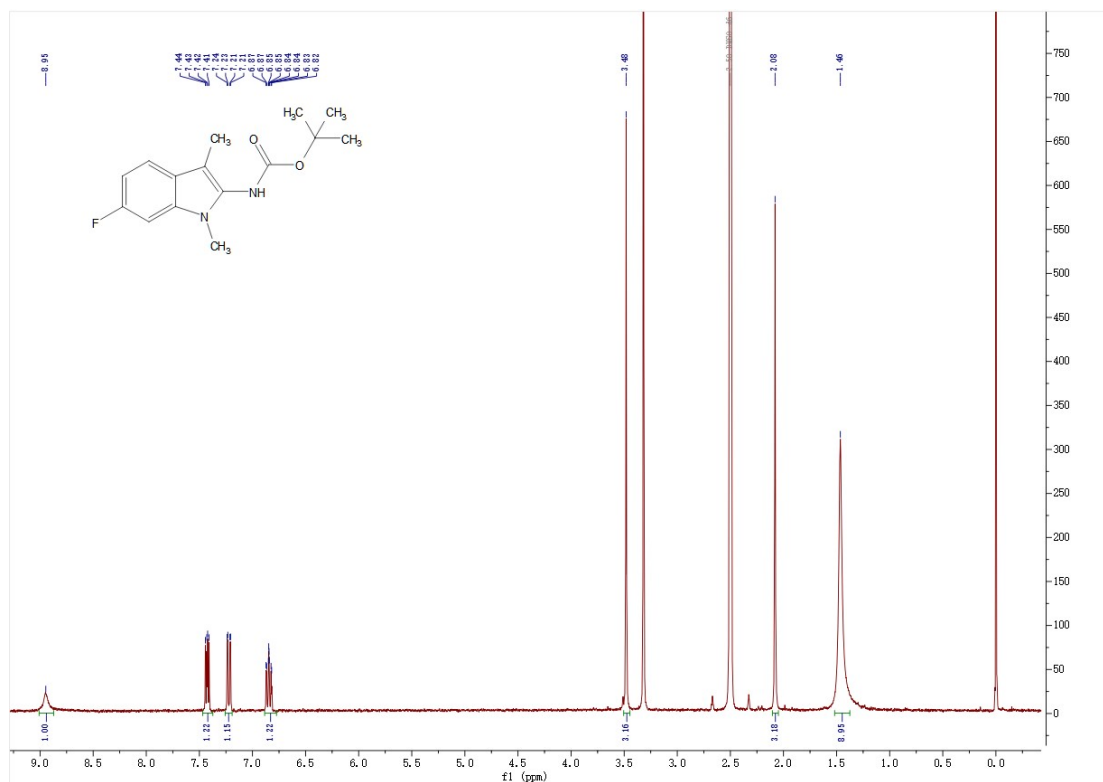
3i



3j

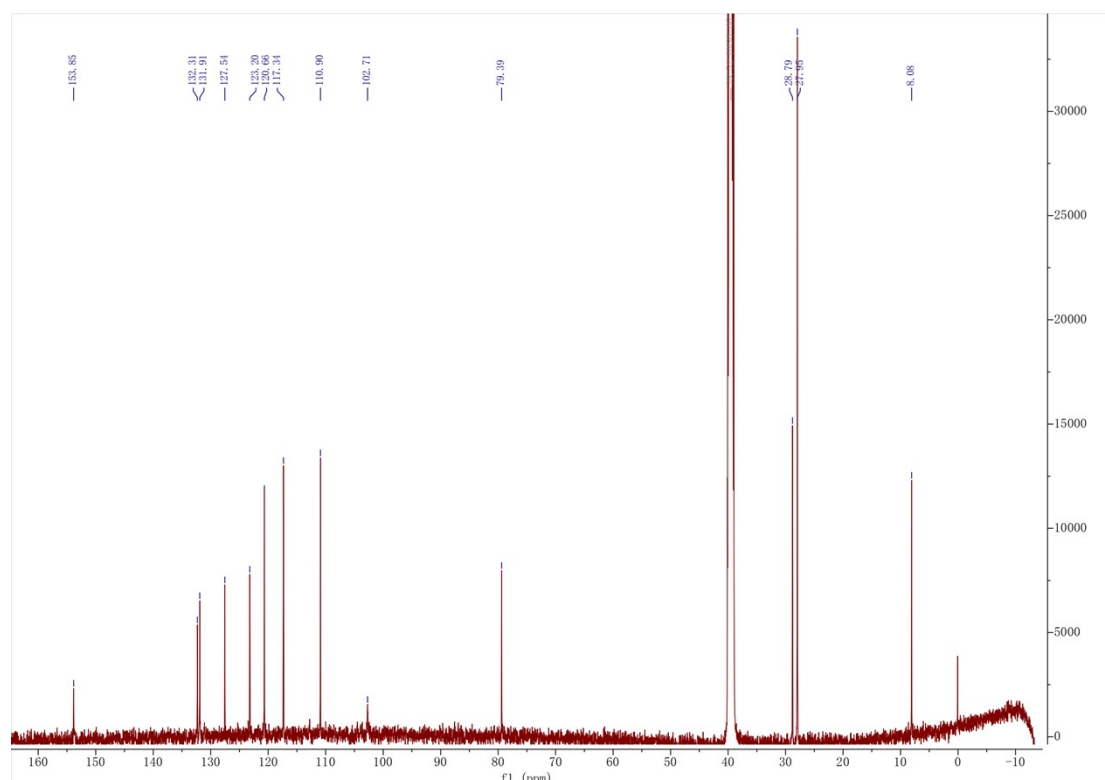
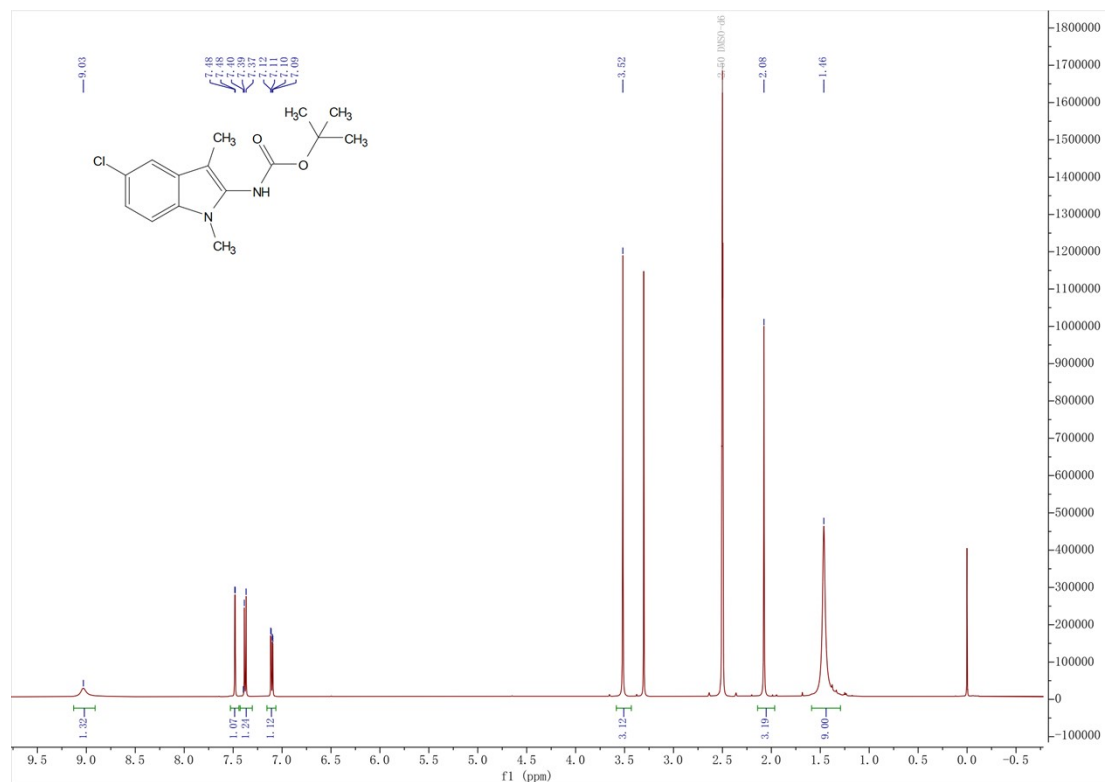


3k

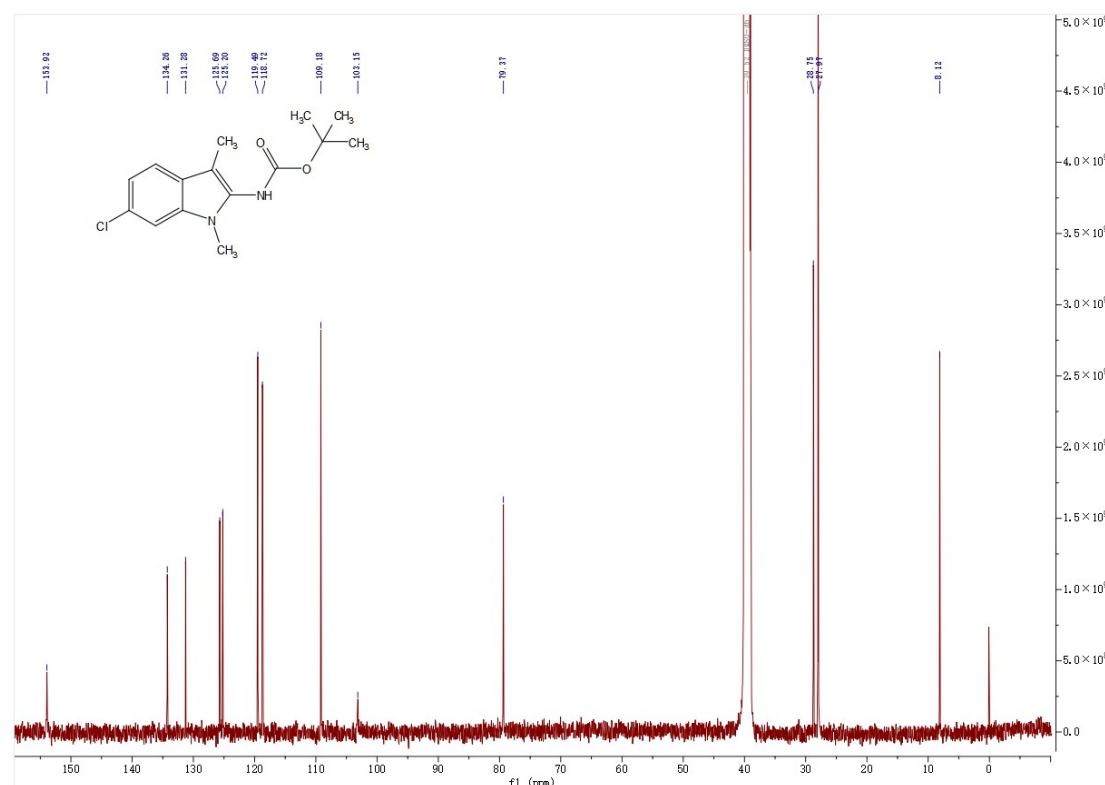
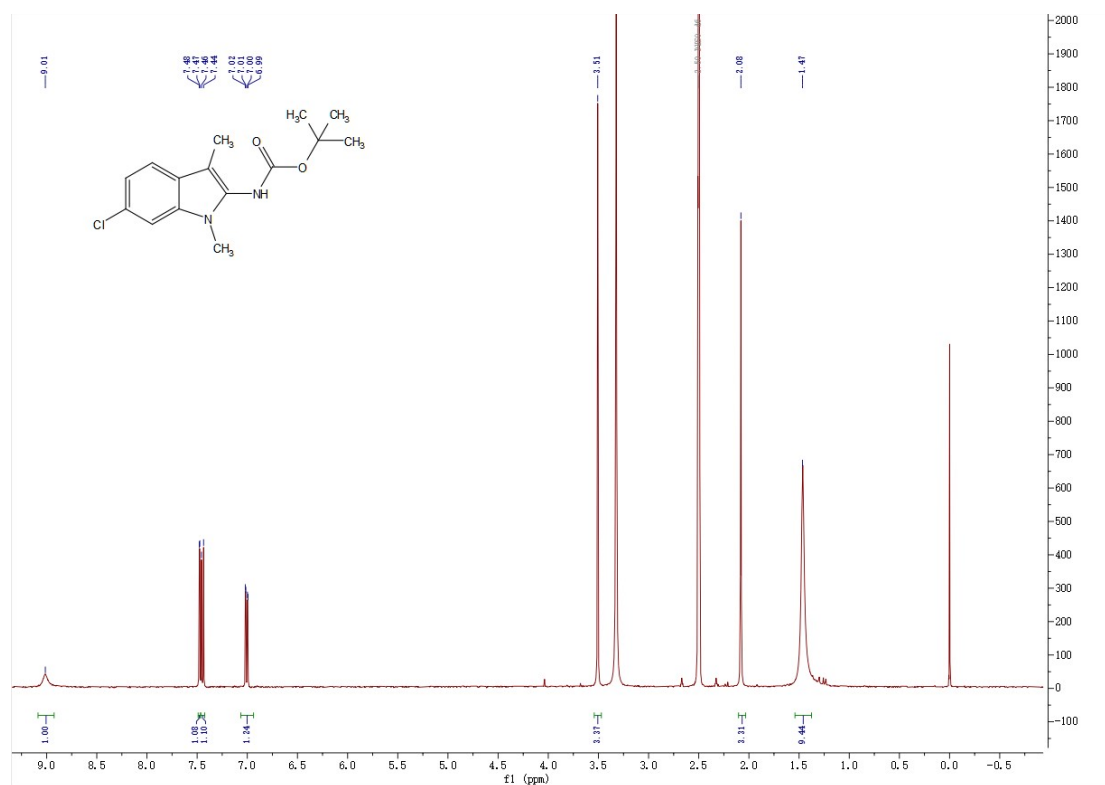




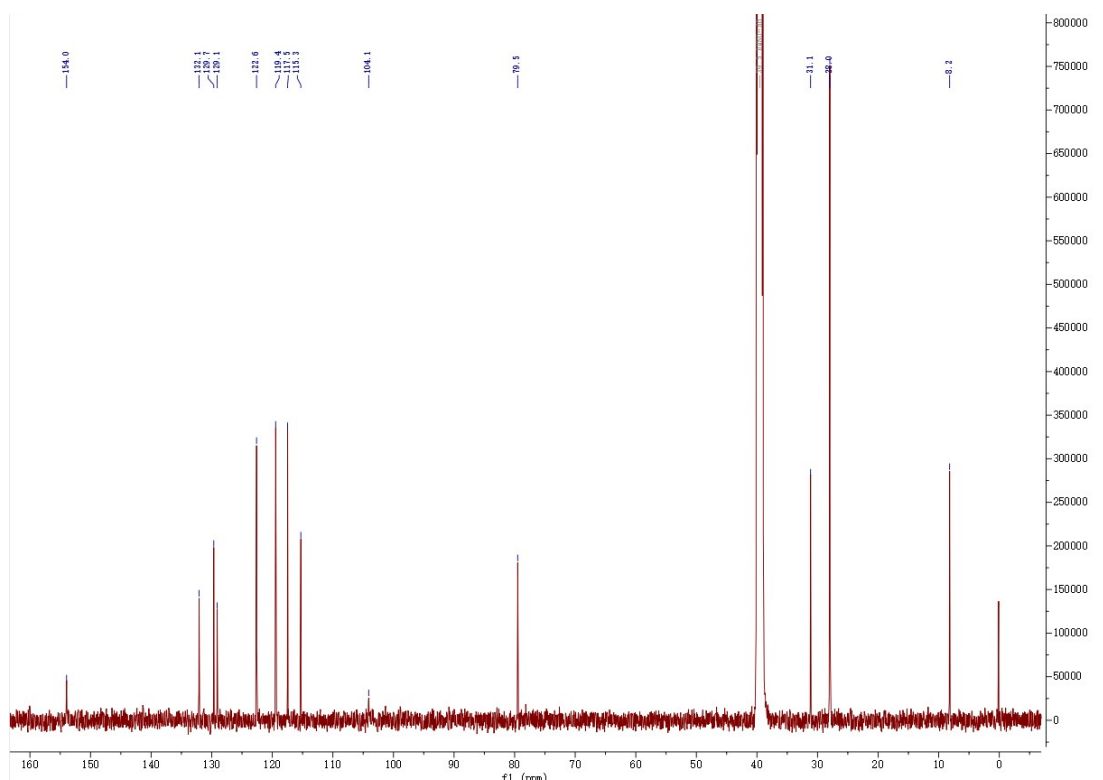
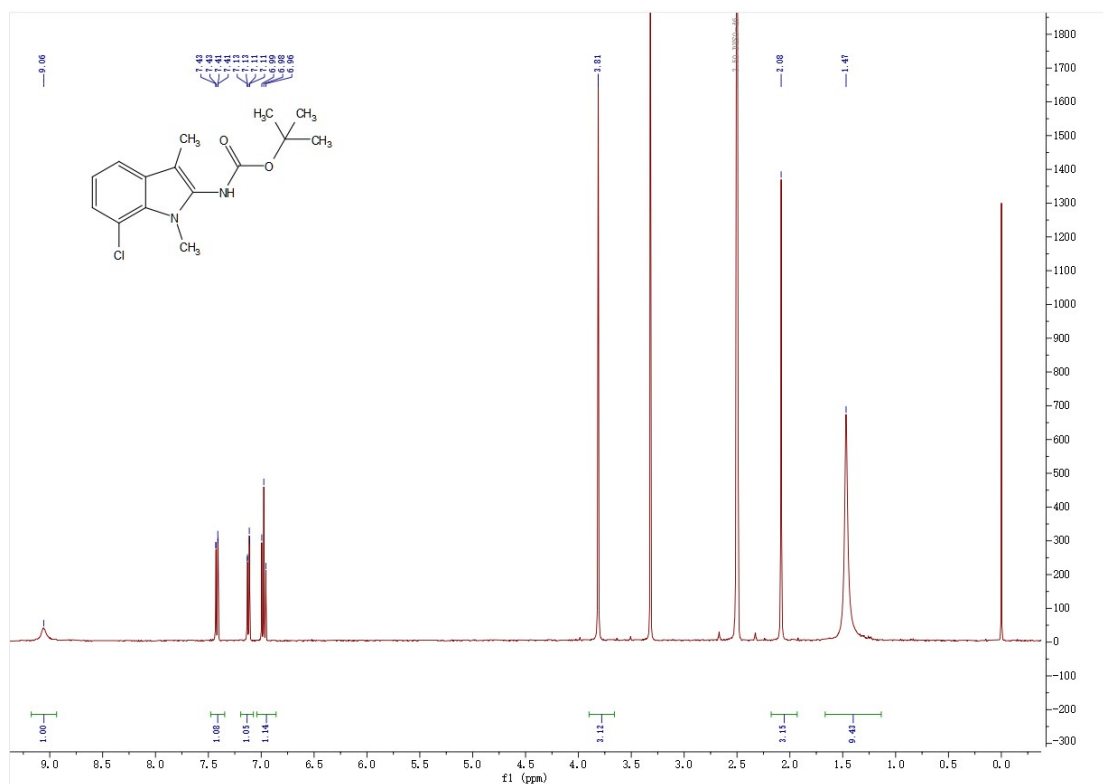
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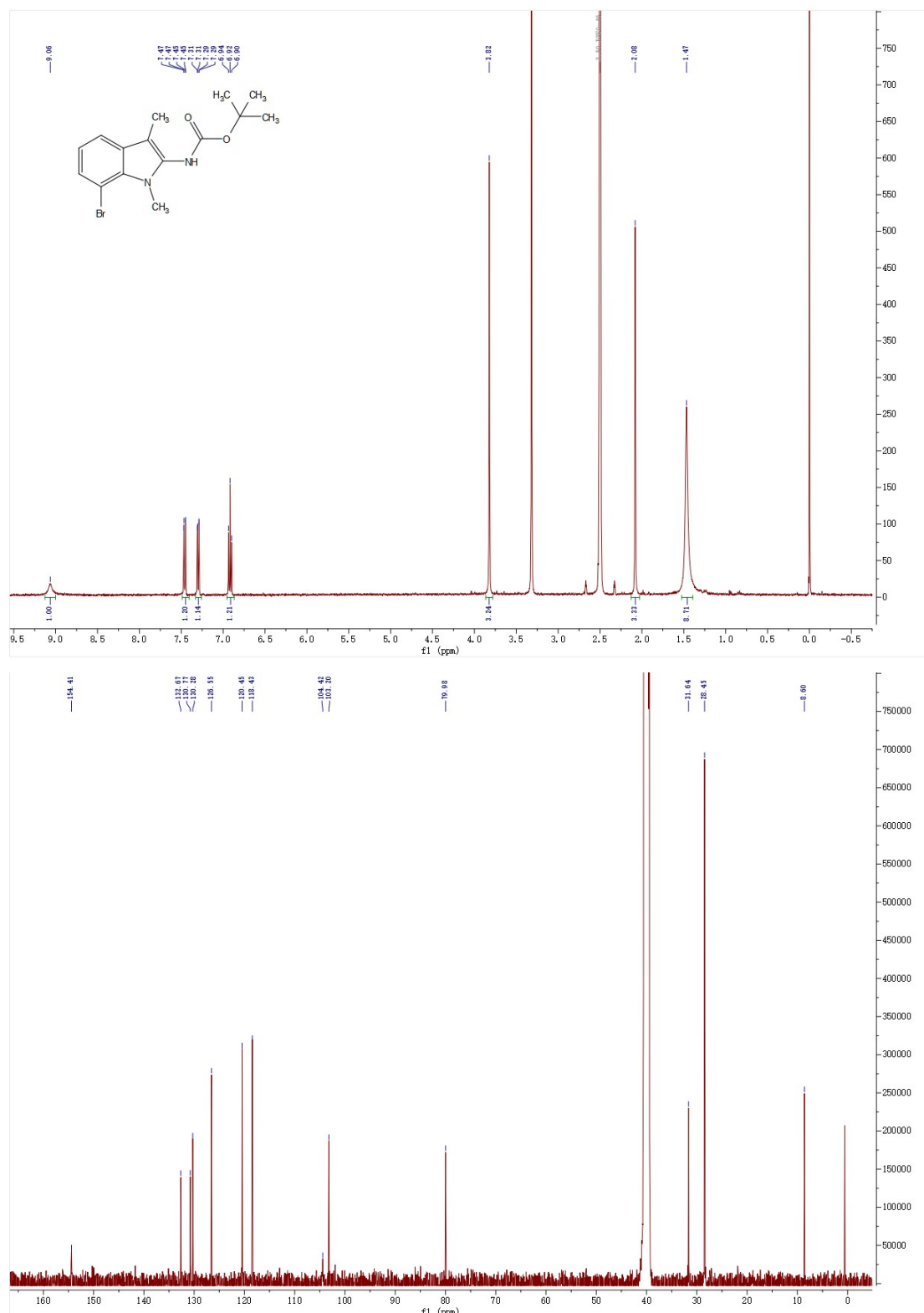
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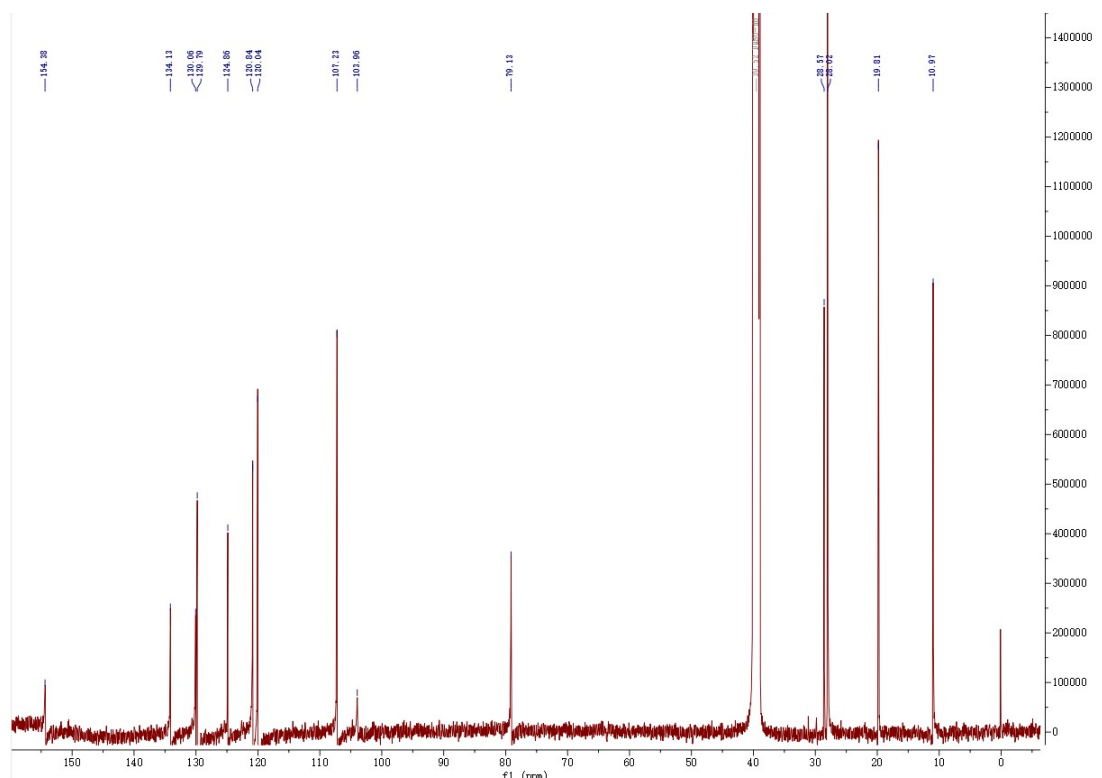
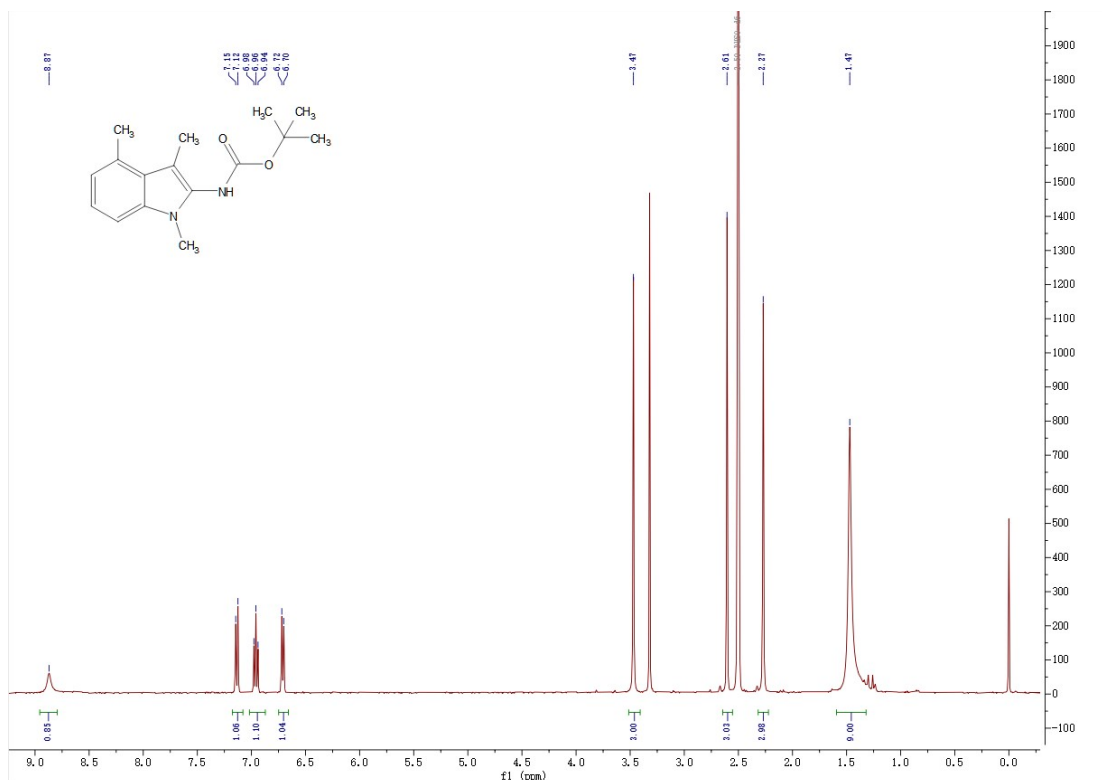
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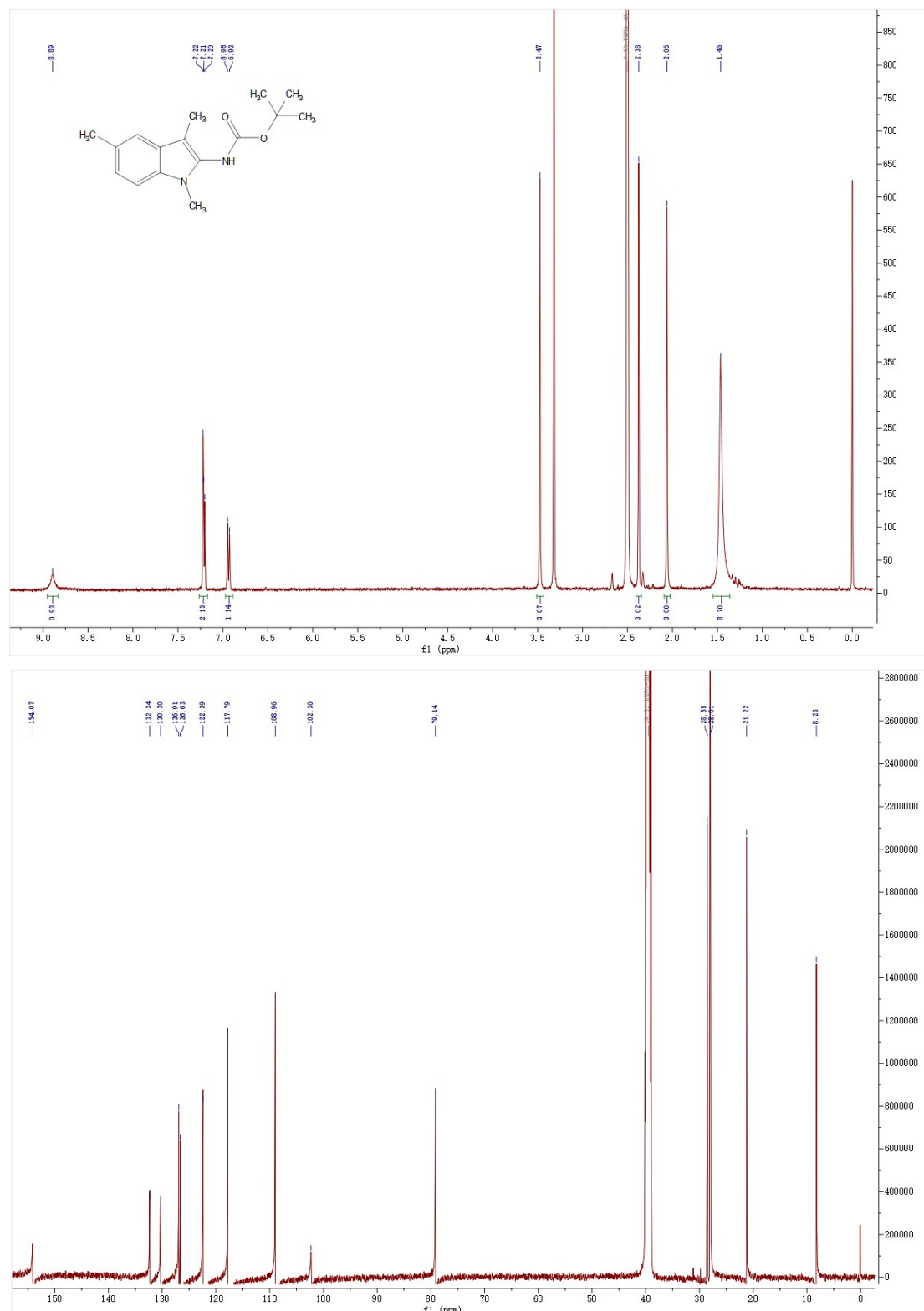
3p



3q

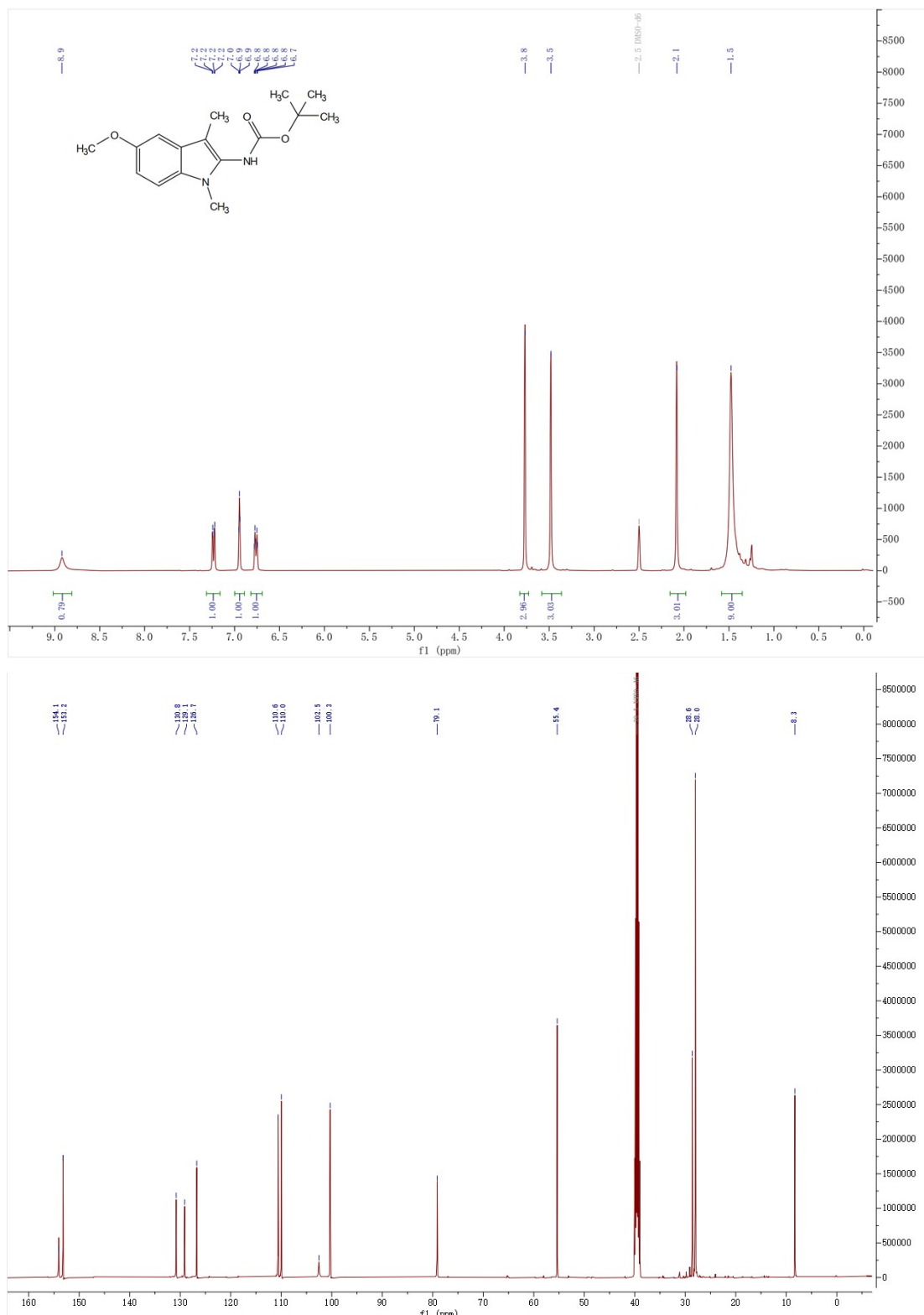


3r

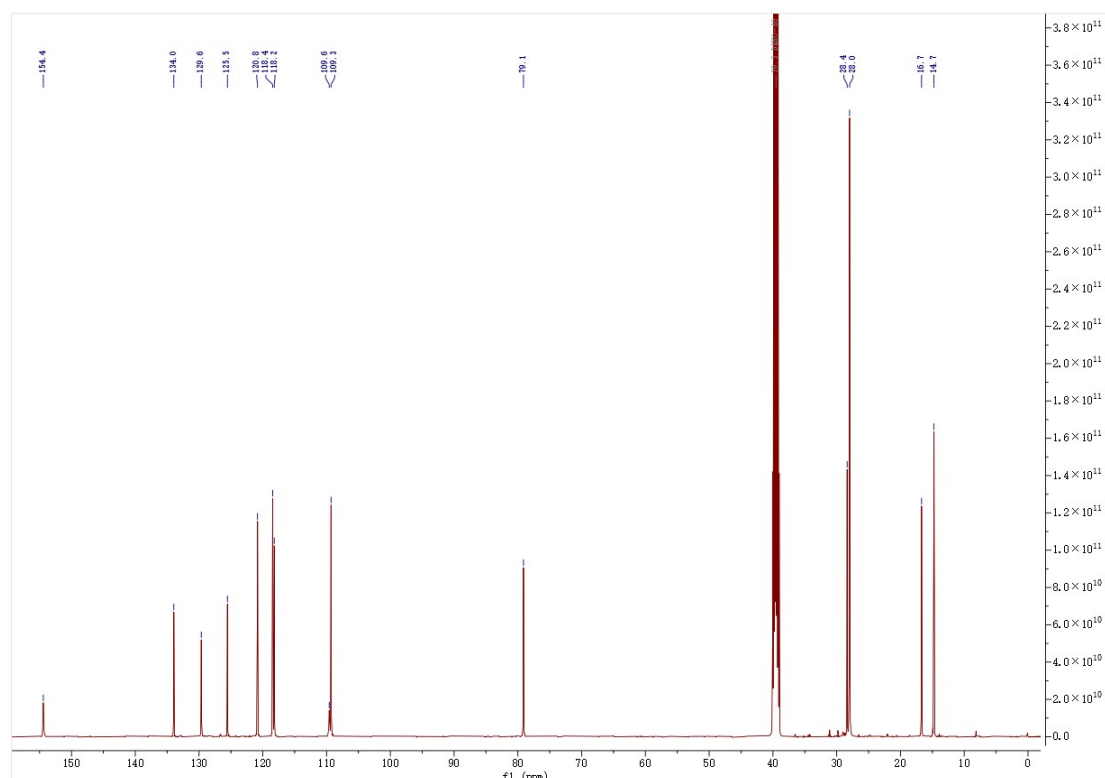
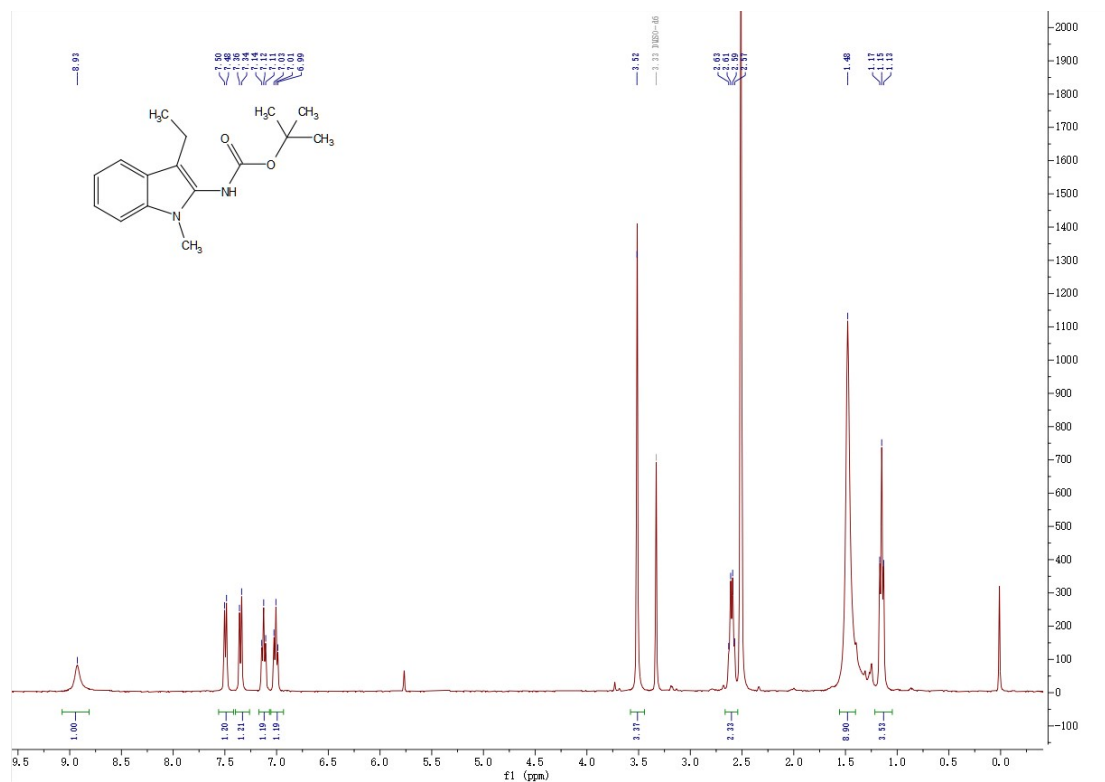




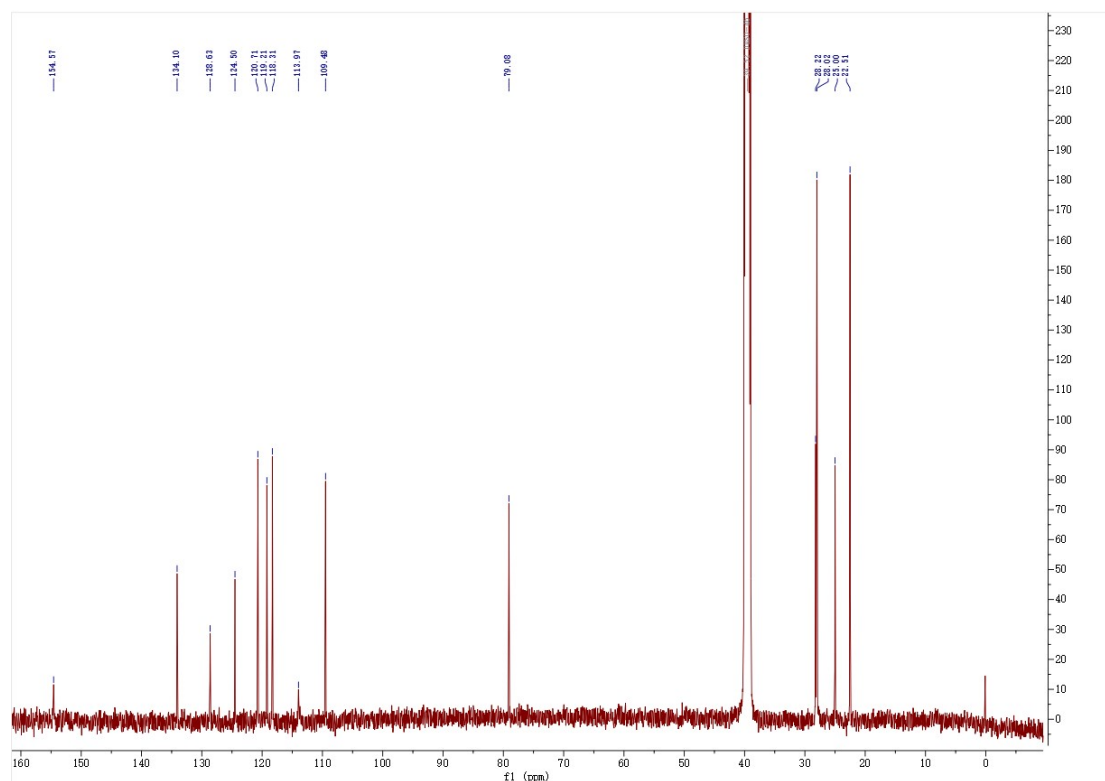
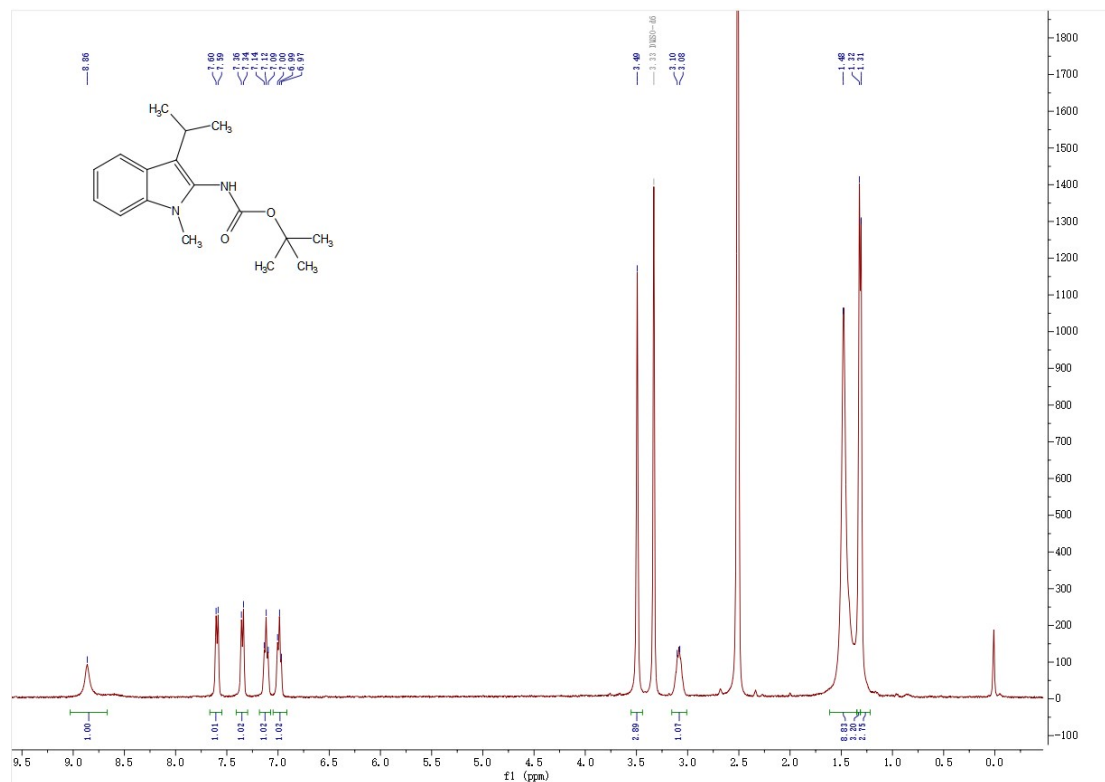
3t



# 3u-1



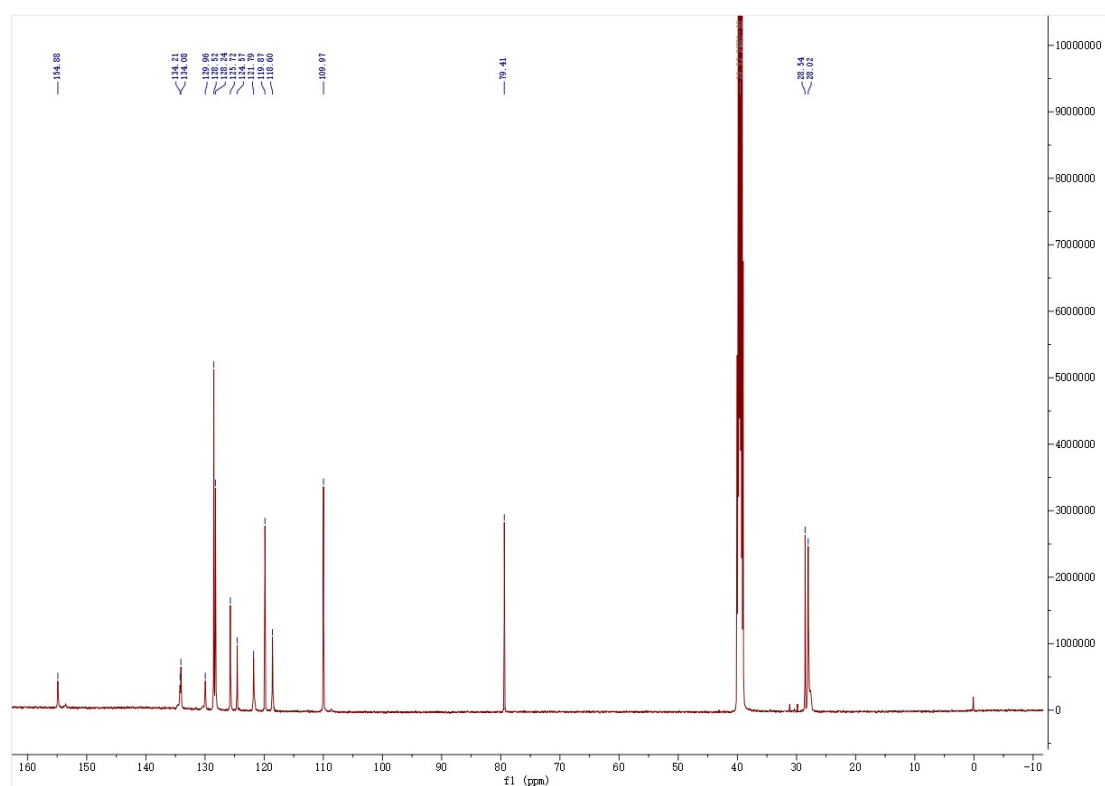
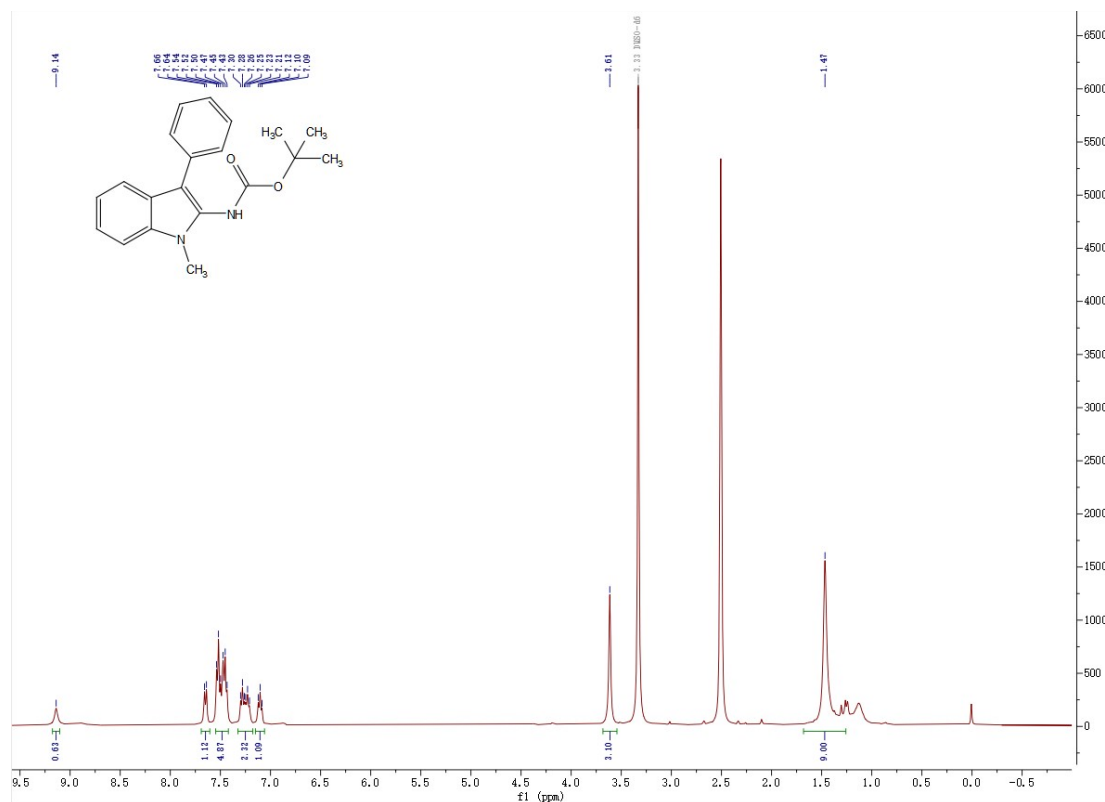
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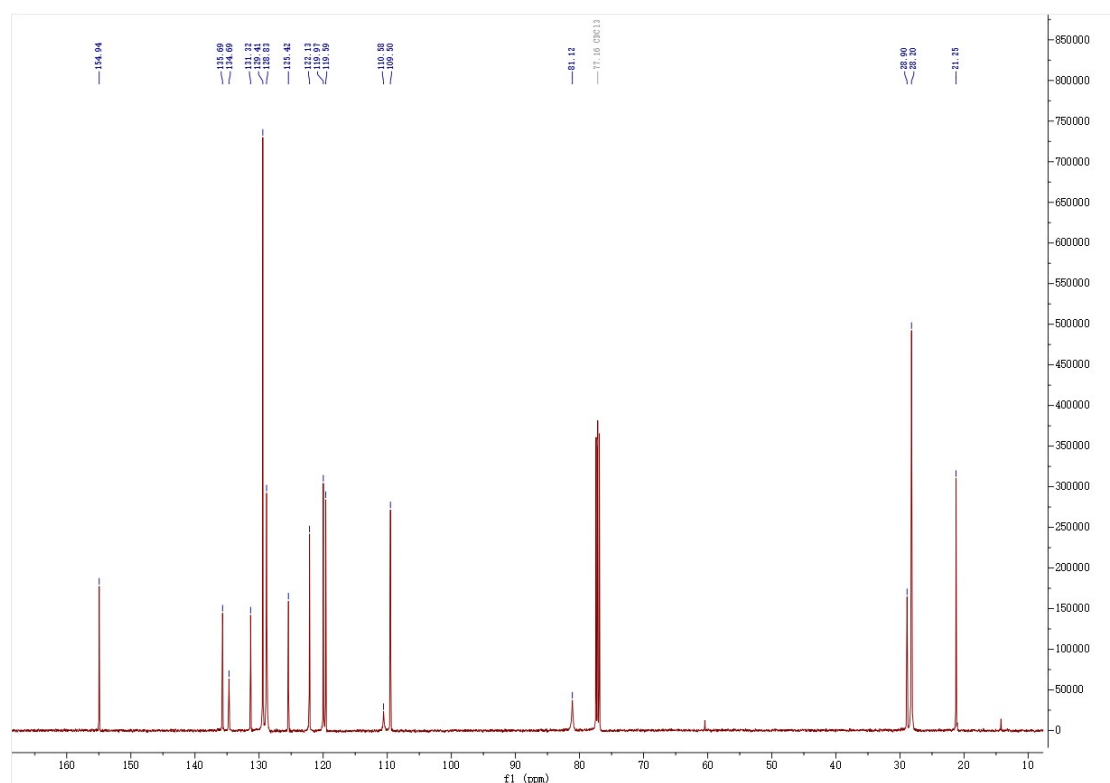
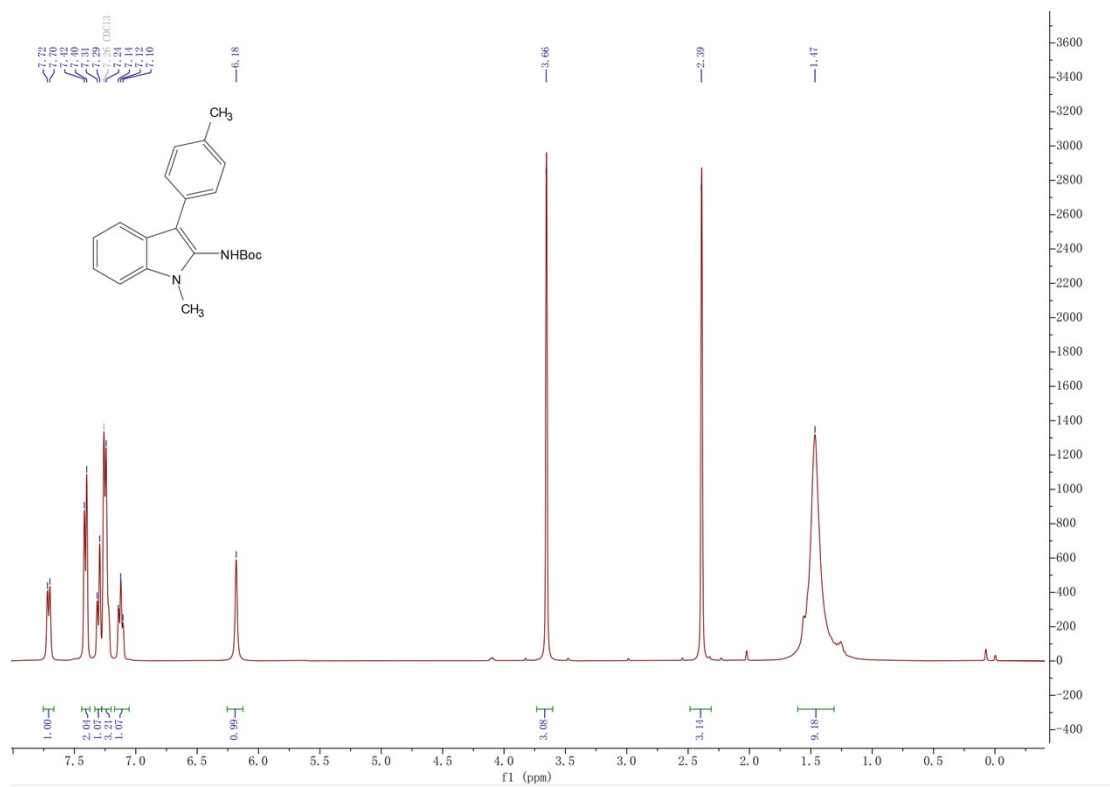




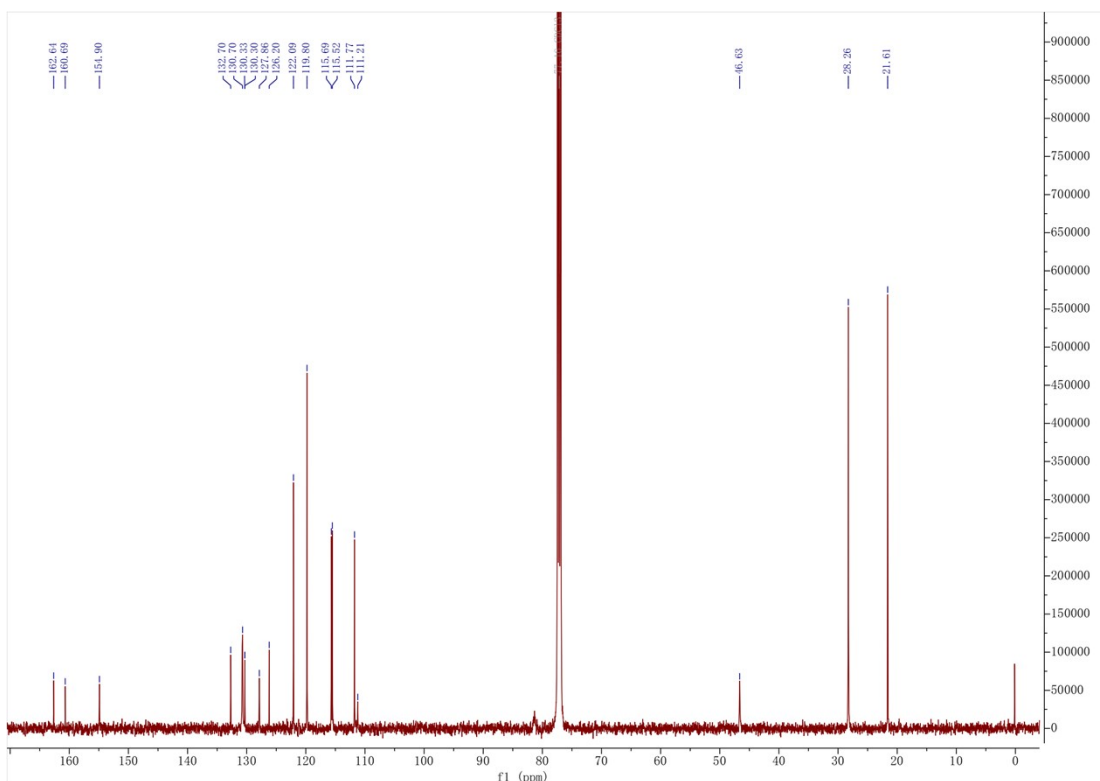
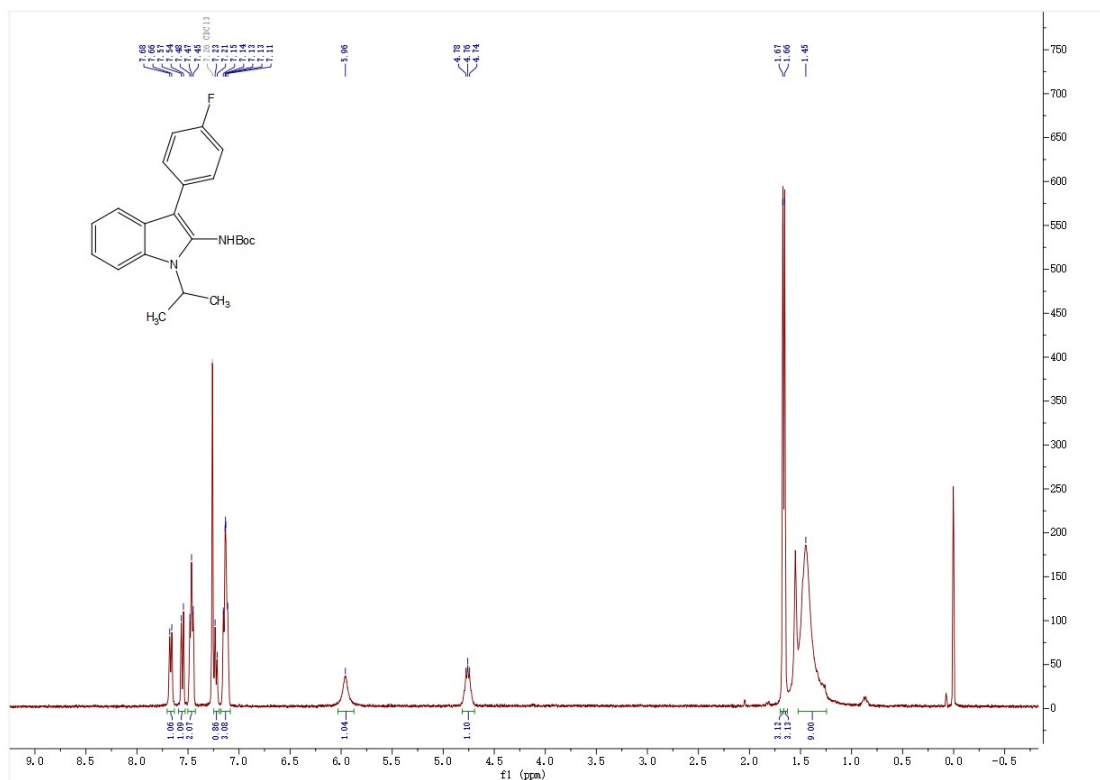
3x



3y



3z



4a

