

## Supporting Information

# Addition of *N*-Heterocyclic Carbene Catalyst to Aryl Esters Induces Remote C-Si Bond Activation and Benzylic Carbon Functionalization

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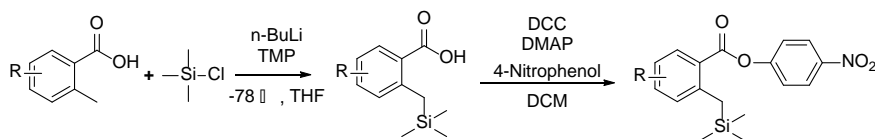
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## I: General Information

Commercially available materials purchased from J&K or Aladdin were used as received. THF was distilled over sodium. Unless otherwise specified, all reactions were carried out under an atmosphere of nitrogen in 10 mL dry Schlenk tube. Proton nuclear magnetic resonance ( $^1\text{H}$  NMR) spectra were recorded on a Bruker (400 MHz) spectrometer. Chemical shifts were recorded in parts per million (ppm,  $\delta$ ) relative to tetramethylsilane ( $\delta$  0.00) or chloroform ( $\delta$  = 7.26, singlet).  $^1\text{H}$  NMR splitting patterns are designated as singlet (s), doublet (d), triplet (t), quartet (q), dd (doublet of doublets); m (multiplets), and etc. All first-order splitting patterns were assigned on the basis of the appearance of the multiplet. Splitting patterns that could not be easily interpreted are designated as multiplet (m) or broad (br). Carbon nuclear magnetic resonance ( $^{13}\text{C}$  NMR) spectra were recorded on a Bruker (100 MHz) spectrometer. Fluorine ( $^{19}\text{F}$ ) nuclear magnetic resonance ( $^{19}\text{F}$  NMR) spectra were recorded on a Bruker (376 MHz) spectrometer. IR spectra were recorded on a Shimadzu IR Prestige-21FT-IR spectrometer as neat thin films between NaCl plates. High resolution mass spectral analysis (HRMS) was performed on Finnigan MAT 95 XP mass spectrometer (Thermo Electron Corporation). Analytical thin-layer chromatography (TLC) was carried out on Merck 60 F254 pre-coated silica gel plate (0.2 mm thickness). Visualization was performed using a UV lamp.

## II: Preparation of substrates

### Preparation of 2-[(trimethylsilyl)methyl]benzoic acid esters:

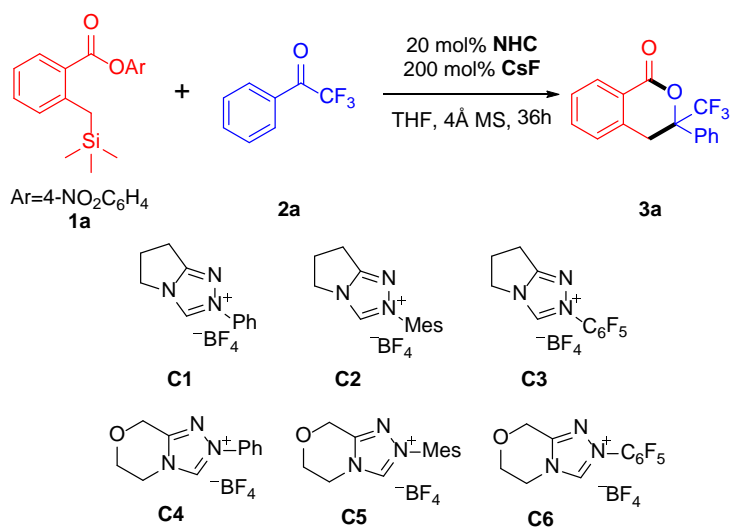


To a 100 mL flame dried two neck round bottom flask equipped with a magnetic stir bar, was added 2,2,6,6-tetramethylpiperidine (20mmol). The flask was sealed with septum, evacuated and refilled with nitrogen. Dry THF (10 mL) was added, and the mixture was stirred at -78 °C. Then n-Butyllithium (2.4 M, 20 mmol) was added dropwise via syringe under nitrogen atmosphere by 10 minutes. After 30 min., the *o*-toluic acids (10 mmol) dissolved in anhydrous tetrahydrofuran (10 mL) was slowly added via syringe at the same temperature. After stirring an additional 20 minutes, chlorotrimethylsilane (60 mmol) was added via syringe. The reaction mixture was then warmed to room temperature and stirred for overnight. After completion of the reaction, the reaction mixture was concentrated under reduced pressure. The residue was dissolved in diethyl ether (30 mL), and washed with water (3×10 mL), brine (10 mL), dried over sodium sulfate. The mixture was concentrated under reduced pressure and the residue was subjected to column chromatography directly using hexane/EtOAc (10/1) as eluent to afford the desired acid product.

To a 100 mL round bottom flask equipped with a magnetic stir bar, was added the above acid (10 mmol), DCM (30 mL), DCC (10 mmol) and DMAP (2 mmol). The reaction mixture was then stirred at room temperature for 6 hours. After completion of the reaction, the reaction mixture was filtered and washed with cool DCM, the combined CH<sub>2</sub>Cl<sub>2</sub> was concentrated under reduced pressure and the residue was subjected to column chromatography directly using hexane/EtOAc (10/1) as eluent to afford the desired ester product.

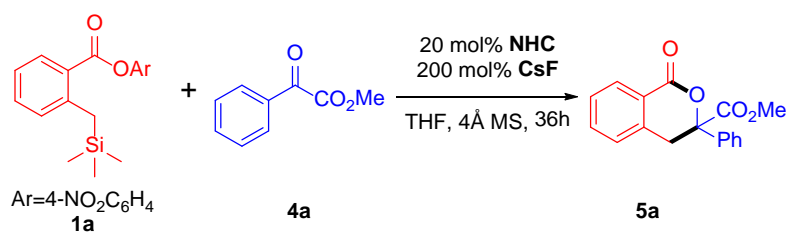
### III: Reaction Conditions Optimization

**Table 1.** Screening of different achiral carbene catalysts and bases <sup>a</sup>



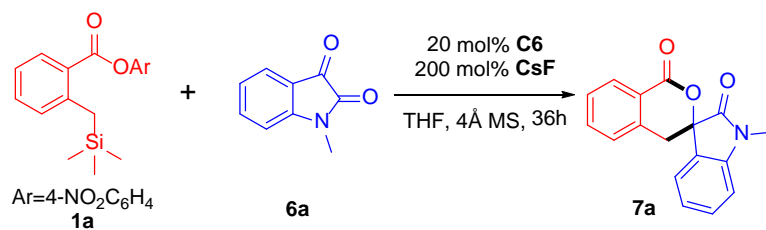
entry	NHC	Base	yield (%) <sup>b</sup>
1	—	Cs <sub>2</sub> CO <sub>3</sub>	n.r. <sup>c</sup>
2	<b>C1</b>	Cs <sub>2</sub> CO <sub>3</sub>	trace
3	<b>C2</b>	Cs <sub>2</sub> CO <sub>3</sub>	77
4	<b>C3</b>	Cs <sub>2</sub> CO <sub>3</sub>	84
5	<b>C4</b>	Cs <sub>2</sub> CO <sub>3</sub>	trace
6	<b>C5</b>	Cs <sub>2</sub> CO <sub>3</sub>	62
<b>7</b>	<b>C6</b>	<b>Cs<sub>2</sub>CO<sub>3</sub></b>	<b>88</b>
8	<b>C6</b>	DMAP	67
9	<b>C6</b>	DABCO	76
10	<b>C6</b>	DBU	24
11	<b>C6</b>	DIEA	79
12	<b>C6</b>	KOAc	33
<b>13</b>	<b>C6</b>	<b>K<sub>2</sub>CO<sub>3</sub></b>	<b>94</b>
14	<b>C6</b>	K <sub>2</sub> CO <sub>3</sub> , no CsF	n.r

<sup>a</sup> Reaction conditions: **1a** (0.12 mmol), **2a** (0.1 mmol), base (0.1 mmol), 4Å MS (100 mg), THF (2 mL), rt, 36 h. <sup>b</sup> Isolated yield of **3a**. <sup>c</sup> n.r. = no reaction. Mes = 2,4,6-Trimethylphenyl. THF = Tetrahydrofuran. DMAP = 4-Dimethylaminopyridine. DABCO = 1,4-Diazabicyclo[2.2.2]octane. DBU = 1,8-Diazabicyclo[5.4.0]undec-7-ene. DIEA = Diisopropylethy.

**Table 2.** Screening different achiral carben catalysts and bases <sup>a</sup>

entry	NHC	Base	yield (%) <sup>b</sup>
1	<b>C1</b>	Cs <sub>2</sub> CO <sub>3</sub>	53
2	<b>C2</b>	Cs <sub>2</sub> CO <sub>3</sub>	trace
<b>3</b>	<b>C3</b>	<b>Cs<sub>2</sub>CO<sub>3</sub></b>	<b>75</b>
5	<b>C4</b>	Cs <sub>2</sub> CO <sub>3</sub>	58
6	<b>C5</b>	Cs <sub>2</sub> CO <sub>3</sub>	trace
7	<b>C6</b>	Cs <sub>2</sub> CO <sub>3</sub>	68
9	<b>C3</b>	Na <sub>2</sub> CO <sub>3</sub>	32
10	<b>C3</b>	K <sub>2</sub> CO <sub>3</sub>	70
<b>11</b>	<b>C3</b>	<b>DABCO</b>	<b>95</b>
12	<b>C3</b>	DBU	20
13	<b>C3</b>	DIEA	90

<sup>a</sup> Reaction conditions: **1a** (0.12 mmol), **4a** (0.1 mmol), base (0.1 mmol), 4 Å MS (100 mg), THF (2 mL), rt, 36 h. <sup>b</sup> Isolated yield of **5a**. Mes = 2,4,6-Trimethylphenyl. THF = Tetrahydrofuran. DMAP = 4-Dimethylaminopyridine. DABCO = 1,4-Diazabicyclo[2.2.2]octane. DBU = 1,8-Diazabicyclo[5.4.0]undec-7-ene. DIEA = Diisopropylethy.

**Table 3.** Screening of different bases <sup>a</sup>

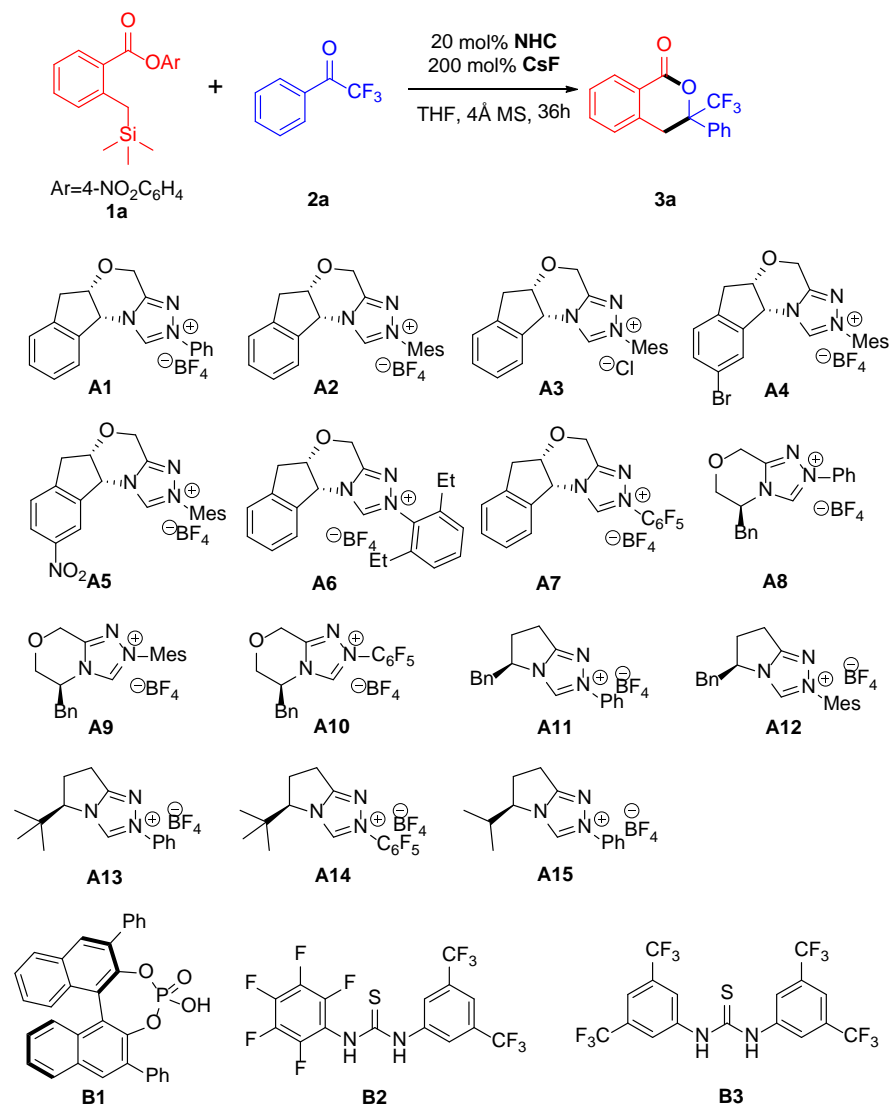
entry	Base	yield (%) <sup>b</sup>
1	DBU	20
2	DIEA	58
3	DABCO	60
4	DMAP	trace
5	Na <sub>2</sub> CO <sub>3</sub>	n.r. <sup>c</sup>
<b>7</b>	<b>Cs<sub>2</sub>CO<sub>3</sub></b>	<b>90</b>
8	t-BuONa	n.r.
9	t-BuOK	trace
10	KOAc	trace
11	NaOAc	n.r.

<sup>a</sup> Reaction conditions: **1a** (0.12 mmol), **6a** (0.1 mmol), base (0.1 mmol), 4 Å MS (100 mg), THF (2 mL), rt, 36 h. <sup>b</sup> Isolated yield of **7a**. <sup>c</sup> n.r. = no reaction. THF = Tetrahydrofuran. DMAP = 4-Dimethylaminopyridine. DABCO = 1,4-Diazabicyclo[2.2.2]octane. DBU = 1,8-Diazabicyclo[5.4.0]undec-7-ene. DIEA = Diisopropylethy.

**Table 4.** Attempts on enantioselective [4+2] reactions<sup>[a]</sup>

Different chiral NHC precursor (synthesis via known literature procedures) were tested for enantioselective catalysis. For this, the reactions were performed on a 0.1 mmol scale.

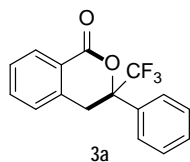
er's are determined via HPLC. [CHIRALPAK OD-H column; 0.4 mL/min; solvent system: i-PrOH/hexane = 5:90; retention times: 25.7 min (major), 28.6 min (minor)].



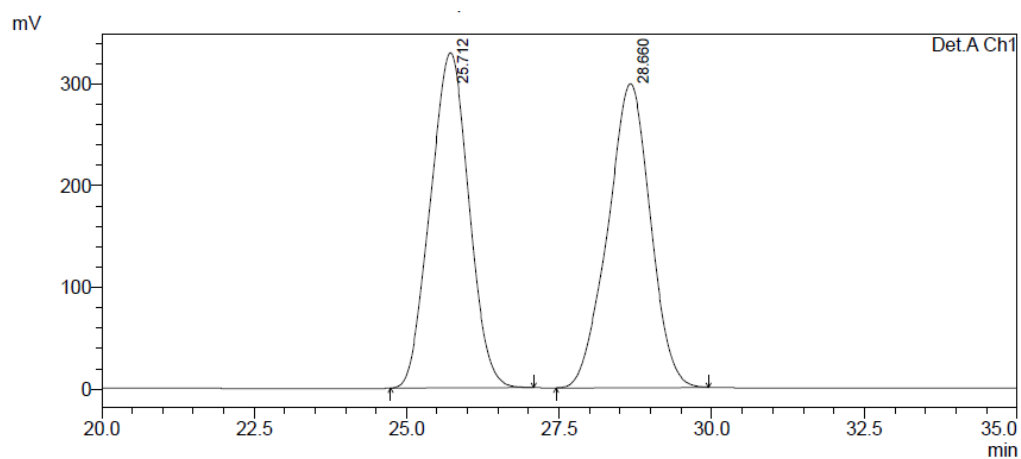
entry	NHC	Additive	Yield <sup>[b]</sup> / %	er
1	<b>A1</b>	—	58	55:45
<b>2</b>	<b>A2</b>	—	<b>90</b>	<b>75:25</b> (see below for HPLC trace)
3	<b>A3</b>	—	67	73:27
4	<b>A4</b>	—	24	63:37
5	<b>A5</b>	—	36	69:31
6	<b>A6</b>	—	trace	—
7	<b>A7</b>	—	58	52:48
8	<b>A8</b>	—	47	53:47

9	<b>A9</b>	—	39	55:45
10	<b>A10</b>	—	trace	—
11	<b>A11</b>	—	21	49:51
12	<b>A12</b>	—	52	47:53
13	<b>A13</b>	—	trace	—
14	<b>A14</b>	—	n.d. <sup>c</sup>	—
15	<b>A15</b>	—	trace	—
16	<b>A2</b>	<b>LiCl</b>	n.r. <sup>d</sup>	—
17	<b>A2</b>	<b>Sc(OTf)<sub>3</sub></b>	n.r.	—
18	<b>A2</b>	<b>Mg(OTf)<sub>2</sub></b>	n.r.	—
19	<b>A2</b>	<b>B1</b>	trace	—
20	<b>A2</b>	<b>B2</b>	34	66:34
21	<b>A3</b>	<b>B3</b>	34	65:35

<sup>a</sup> Reaction conditions: **1a** (0.12 mmol), **2a** (0.1 mmol), base (0.1 mmol), 4Å MS (100 mg), THF (2 mL), rt, 36 h. <sup>b</sup> Isolated yield of **3a**. <sup>c</sup> n.d. = no desired product, <sup>d</sup> n.r. = no reaction



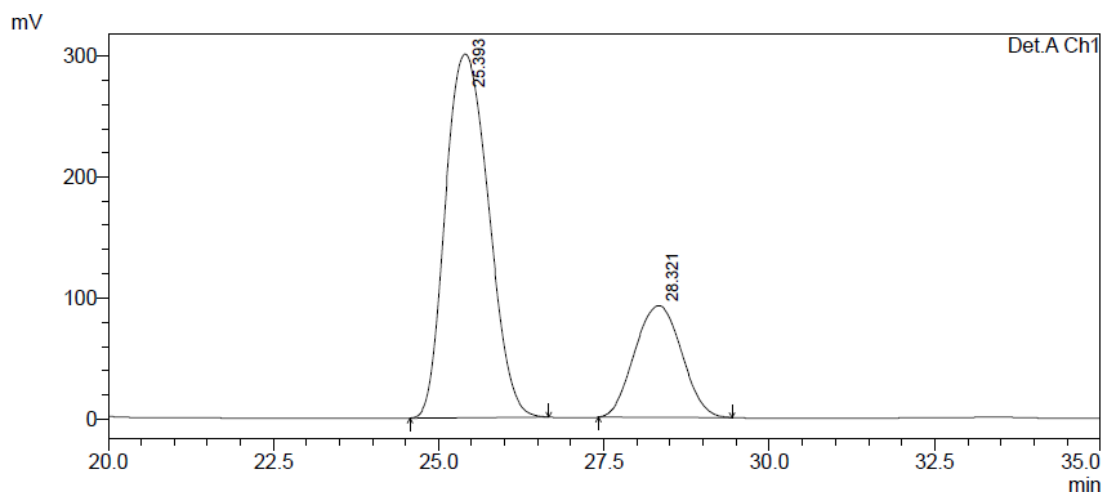
HPLC trace of racemate after reaction with achiral catalyst **C6**



UV Detector Ch1 254nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.712	14468148	329175	49.935	52.458
2	28.660	14505688	298322	50.065	47.542
Total		28973837	627497	100.000	100.000

HPLC trace of enantioenriched compound after reaction with chiral catalyst **A2**.

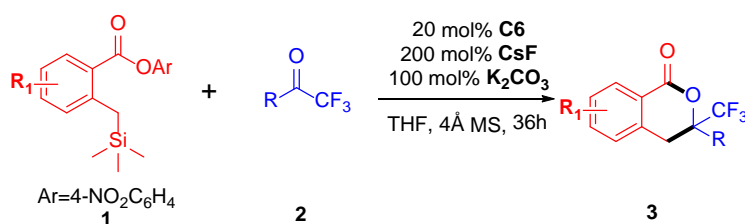


UV Detector Ch1 254nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	25.393	13679275	300780	74.951	76.512
2	28.321	4571680	92337	25.049	23.488
Total		18250954	393117	100.000	100.000

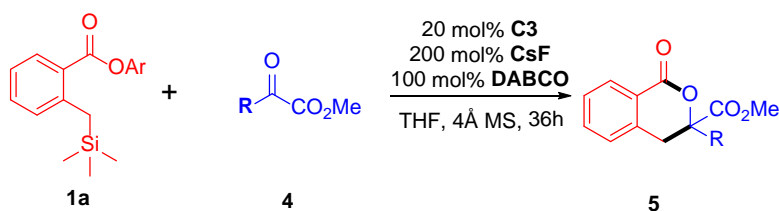
#### IV: General procedure for the catalytic reactions

##### 1) General procedure for the catalytic synthesis of products 3:



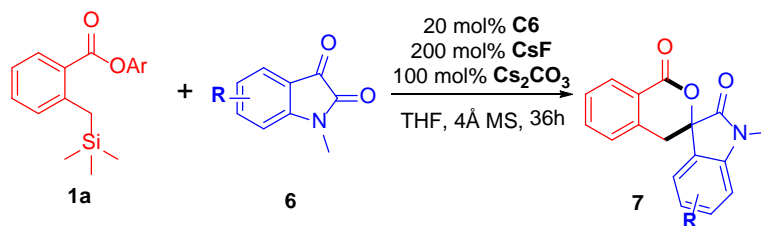
To a 10 mL flame-dry Schlenk reaction tube equipped with a magnetic stir bar, was added chiral NHC pre-catalyst **C6** (0.02 mmol, 20 mol%, 7.6 mg), K<sub>2</sub>CO<sub>3</sub> (0.1 mmol, 100 mol%, 14 mg), aryl carboxylic ester **1** (0.12 mmol) and 4 Å molecular sieves (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Freshly distilled anhydrous THF (2 mL) was added and trifluoromethyl ketone **2** (0.1 mmol) were then added via syringe. The reaction mixture was allowed to stir for 36 hours at rt. After completion of the reaction, monitored by TLC plate, the reaction mixture was concentrated under reduced pressure and the residue was subjected to column chromatography or TLC plate directly using hexane/EtOAc as eluent to afford the desired product **3**.

##### 2) General procedure for the catalytic synthesis of products 5:



To a 10 mL flame-dry Schlenk reaction tube equipped with a magnetic stir bar, was added chiral NHC pre-catalyst **C3** (0.02 mmol, 20 mol%, 7.6 mg), DABCO (0.1 mmol, 100 mol%, 12 mg), aryl carboxylic ester **1a** (0.12 mmol, 39.5 mg) and 4 Å molecular sieves (100 mg). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Freshly distilled anhydrous THF (2 mL) was added and phenylglyoxylate esters **4** (0.1 mmol) were then added via syringe. The reaction mixture was allowed to stir for 36 hours at rt. After completion of the reaction, monitored by TLC plate, the reaction mixture was concentrated under reduced pressure and the residue was subjected to column chromatography or TLC plate directly using hexane/EtOAc as eluent to afford the desired product **5**.

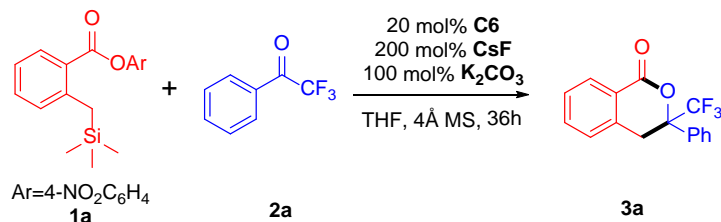
##### 3) General procedure for the catalytic synthesis of products 7:



To a 10 mL flame-dry Schlenk reaction tube equipped with a magnetic stir bar, was added chiral NHC pre-catalyst **C6** (0.02 mmol, 20 mol%, 7.6 mg), Cs<sub>2</sub>CO<sub>3</sub> (0.1 mmol, 100 mol%, 32.4 mg), aryl carboxylic ester **1a** (0.12 mmol, 39.5 mg) N-substituted isatin **6** (0.1 mmol) and 4 Å molecular sieves (100 mg). The Schlenk tube

was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Freshly distilled anhydrous THF (2 mL) was added. The reaction mixture was allowed to stir for 36 hours at rt. After completion of the reaction, monitored by TLC plate, the reaction mixture was concentrated under reduced pressure and the residue was subjected to column chromatography or TLC plate directly using hexane/EtOAc as eluent to afford the desired product **7**.

4) Procedure for synthesis of **3a** with 1mmol scale:



To a 50 mL flame-dry Schlenk reaction tube equipped with a magnetic stir bar, was added chiral NHC pre-catalyst **C6** (0.2 mmol, 20 mol%, 76 mg), K<sub>2</sub>CO<sub>3</sub> (1 mmol, 100 mol%, 140 mg), aryl carboxylic ester **1a** (1.2 mmol, 395 mg) and 4 Å molecular sieves (1 g). The Schlenk tube was sealed with a septum, evacuated and refilled with nitrogen (3 cycles). Freshly distilled anhydrous THF (20 mL) was added and trifluoromethyl ketone **2a** (1 mmol, 140 μl) were then added via syringe. The reaction mixture was allowed to stir for 36 hours at rt. After completion of the reaction, monitored by TLC plate, the reaction mixture was concentrated under reduced pressure and the residue was subjected to column chromatography or TLC plate directly using hexane/EtOAc as eluent to afford the desired product **3a** (86% yield, 251 mg).

### **V: *In Vitro* antibacterial bioassay**

The target compounds were dissolved in 150  $\mu$ L DMSO and diluted with sterile distilled water containing 0.1 % Tween20 (4 mL) to prepare 1000 and 500  $\mu$ g/mL stock solution. Their antibacterial activities against *Xanthomonas oryzae pv. oryzae* was evaluated by the turbidimeter test. 1 mL of stock solution was added to 4mL nutrient broth liquid medium NB (3 g of beef extract, 5 g of peptone, 1 g of yeast powder, 10 g of glucose, and 1000 mL of distilled water, pH 7.0-7.2) in tubes. Then, to the tube, 40  $\mu$ L NB containing bacteria was added and incubated with continuous shaking at 180 rpm for 24 h at  $30 \pm 1^\circ\text{C}$ . The test concentration was fixed at 200 and 100  $\mu$ g/mL. The data of bacterial growth was reported by measuring the optical density at 600 nm (OD600) with a spectrophotometer.

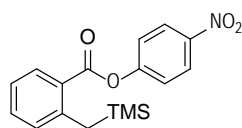
DMSO in sterile distilled water containing 0.1 % Tween20 served as the negative control, whereas bismethiazol served as positive control. The inhibitory rate of bacterial culture growth was calculated which formula follows:

$$\text{Inhibition rate (\%)} = (CK-T)/CK \times 100$$

“CK” means the value of corrected optical density of bacterial growth on untreated NB (negative control), and “T” means the value of corrected optical density of bacterial growth on treated NB.

## VI: Characterization of products:

### a) Characterizations of substrates.



1a: 88%

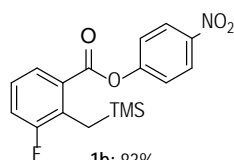
**4-nitrophenyl 2-[(trimethylsilyl)-methyl] benzoate (1a):** white solid, 88% yield, 2.89 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.33 (d, *J* = 9.1 Hz, 2H), 8.15 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.49-7.45 (m, 1H), 7.38 (d, *J* = 9.1 Hz, 2H), 7.24-7.20 (m, 1H), 7.15 (d, *J* = 7.8 Hz, 1H), 2.75 (s, 2H), -0.02 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 165.2, 156.1, 146.0, 145.6, 133.3, 131.8, 131.3, 125.6, 125.5, 124.4, 123.1, 26.1, -1.3;

**IR  $\nu_{\max}$**  (film, cm<sup>-1</sup>): 1742, 1526, 1348, 1203, 852;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>19</sub>NO<sub>4</sub>SiH<sup>+</sup> 330.1156, found 330.1161.



1b: 83%

**4-nitrophenyl 3-fluoro-2-[(trimethylsilyl)-methyl] benzoate (1b):** white solid, 83% yield, 2.88 g;

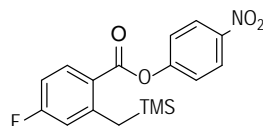
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.32 (d, *J* = 9.2 Hz, 2H), 7.94 (d, *J* = 7.8 Hz, 1H), 7.37 (d, *J* = 9.2 Hz, 2H), 7.29-7.24 (m, 1H), 7.20-7.16 (m, 1H), 2.75 (d, *J* = 3.2 Hz, 2H), -0.01 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 164.5 (d, *J* = 3.7 Hz), 160.8 (d, *J* = 241.8 Hz), 155.9, 146.7, 133.8 (d, *J* = 18.2 Hz), 127.8 (d, *J* = 4.9 Hz), 127.4 (d, *J* = 3.3 Hz), 125.6, 124.9 (d, *J* = 8.6 Hz), 123.0, 120.1 (d, *J* = 23.7 Hz), 17.2 (d, *J* = 4.2 Hz), -1.0;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -113.1;

**IR  $\nu_{\max}$**  (film, cm<sup>-1</sup>): 1742, 1525, 1348, 1256, 845;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>18</sub>FNO<sub>4</sub>SiH<sup>+</sup> 348.1062, found 348.1068.



1c: 50%

**4-nitrophenyl 4-fluoro-2-[(trimethylsilyl)-methyl] benzoate (1c):** white solid, 50% yield, 1.73 g;

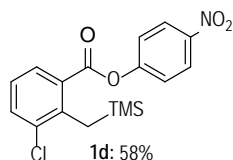
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.33 (d, *J* = 9.1 Hz, 2H), 8.19 (dd, *J* = 6.0, 2.8 Hz, 1H), 7.36 (d, *J* = 9.1 Hz, 2H), 6.94-6.91 (m, 1H), 6.83 (dd, *J* = 10.0, 2.6 Hz, 1H), 2.77 (s, 2H), -0.01 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 165.5 (d, *J* = 253.8 Hz); 164.3, 155.9, 150.1 (d, *J* = 9.3 Hz), 146.9, 134.7, 125.6, 123.1, 121.8, 117.6 (d, *J* = 41.2 Hz), 111.9 (d, *J* = 21.6 Hz), 26.8, -1.4;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -105.2;

**IR  $\nu_{\max}$**  (film, cm<sup>-1</sup>): 1732, 1523, 1346, 1201, 848;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>18</sub>FNO<sub>4</sub>SiH<sup>+</sup> 348.1062, found 348.1068.



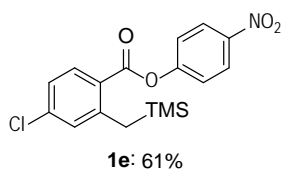
**4-nitrophenyl 3-chloro-2-[(trimethylsilyl)-methyl] benzoate (1d):** white solid, 58% yield, 2.11 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.34 (d, *J* = 9.2 Hz, 2H), 8.04 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.71 (dd, *J* = 7.9, 1.4 Hz, 1H), 7.38 (d, *J* = 9.2 Hz, 2H), 7.16 (t, *J* = 7.9 Hz, 1H), 2.99 (s, 2H), 0.02 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 164.8, 155.8, 145.7, 143.9, 135.3, 134.6, 130.2, 128.0, 125.6, 124.8, 123.0, 22.1, -0.4;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1743, 1525, 1346, 1199, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>18</sub>ClNO<sub>4</sub>SiH<sup>+</sup> 364.0766, found 364.0772.



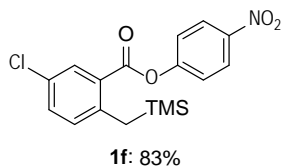
**4-nitrophenyl 4-chloro-2-[(trimethylsilyl)-methyl] benzoate (1e):** white solid, 61% yield, 2.22 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.33 (d, *J* = 9.1 Hz, 2H), 8.09 (d, *J* = 8.5 Hz, 1H), 7.36 (d, *J* = 9.1 Hz, 2H), 7.20 (dd, *J* = 8.5, 2.1 Hz, 1H), 7.14 (d, *J* = 2.1 Hz, 1H), 2.73 (s, 2H), 0.00 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 164.5, 155.9, 148.3, 145.7, 139.7, 133.2, 130.9, 125.6, 124.8, 124.0, 123.1, 27.7, -1.4;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1741, 1526, 1348, 1029, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>18</sub>ClNO<sub>4</sub>SiH<sup>+</sup> 364.0766, found 364.0772.



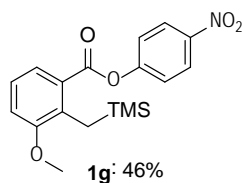
**4-nitrophenyl 5-chloro-2-[(trimethylsilyl)-methyl] benzoate (1f):** white solid, 83% yield, 3.02 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.34 (d, *J* = 9.1 Hz, 2H), 8.12 (d, *J* = 2.4 Hz, 1H), 7.43 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.37 (d, *J* = 9.2 Hz, 2H), 7.09 (d, *J* = 8.4 Hz, 1H), 2.72 (s, 2H), -0.01 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 164.1, 155.8, 145.8, 144.6, 133.4, 132.4, 131.4, 130.1, 126.9, 125.6, 123.0, 25.8, -1.4;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1743, 1523, 1346, 1033, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>18</sub>ClNO<sub>4</sub>SiH<sup>+</sup> 364.0766, found 364.0768.



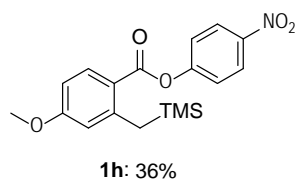
**4-nitrophenyl 3-methoxy-2-[(trimethylsilyl)-methyl] benzoate (1g):** white solid, 46% yield, 1.65 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.36 (d, *J* = 9.2 Hz, 2H), 7.75 (dd, *J* = 8.0, 1.1 Hz, 1H), 7.42 (d, *J* = 9.2 Hz, 2H), 7.22 (t, *J* = 8.1 Hz, 1H), 7.09 (dd, *J* = 8.1, 0.8 Hz, 1H), 3.89 (s, 3H), 2.82 (s, 2H), 0.00 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 165.5, 157.3, 156.1, 145.6, 135.3, 127.0, 125.6, 124.5, 123.2, 123.1, 114.2, 55.6, 17.7, -0.8;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1739, 1525, 1348, 1035, 739;

**HRMS** (ESI, m/z): calcd. for C<sub>18</sub>H<sub>21</sub>NO<sub>5</sub>SiH<sup>+</sup> 360.1262, found 360.1267.



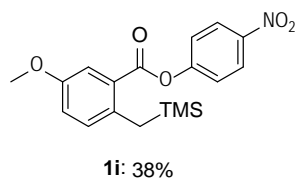
**4-nitrophenyl 4-methoxy-2-[(trimethylsilyl)-methyl] benzoate (1h):** white solid, 36% yield, 1.26 g;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.30 (d, *J* = 7.7 Hz, 2H), 8.15 (dd, *J* = 8.8, 0.8 Hz, 1H), 7.35 (d, *J* = 7.9 Hz, 2H), 6.73 (dd, *J* = 8.8, 1.1 Hz, 1H), 6.62 (s, 1H), 3.87 (s, 3H), 2.75 (s, 2H), -0.01 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 164.7, 163.4, 156.4, 149.1, 145.4, 134.2, 125.5, 123.1, 118.0, 115.8, 110.5, 55.6, 29.7, -1.36;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1734, 1525, 1348, 1018, 739;

**HRMS** (ESI, m/z): calcd. for C<sub>18</sub>H<sub>21</sub>NO<sub>5</sub>SiH<sup>+</sup> 360.1262, found 360.1267.



**4-nitrophenyl 5-methoxy-2-[(trimethylsilyl)-methyl] benzoate (1i):** white solid, 38% yield, 1.33 g;

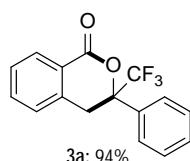
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.33 (d, *J* = 9.1 Hz, 2H), 7.64 (t, *J* = 1.6 Hz, 1H), 7.37 (d, *J* = 9.1 Hz, 2H), 7.06 (d, *J* = 1.6 Hz, 2H), 3.89 (s, 3H), 2.65 (s, 2H), -0.03 (s, 9H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 165.1, 156.5, 156.1, 145.7, 137.9, 132.3, 126.1, 125.6, 123.1, 120.4, 115.8, 55.8, 24.9, -1.38;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1735, 1521, 1348, 1026, 744;

**HRMS** (ESI, m/z): calcd. for C<sub>18</sub>H<sub>21</sub>NO<sub>5</sub>SiH<sup>+</sup> 360.1262, found 360.1259.

## b). Characterization of Products



**3-phenyl-3-(trifluoromethyl)isochroman-1-one (3a):** white powder, 94% yield, 27.5 mg;

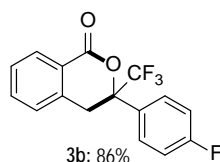
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.85 – 7.72 (m, 1H), 7.52 (d, *J* = 5.7 Hz, 2H), 7.40 – 7.16 (m, 5H), 3.96 (d, *J* = 16.7 Hz, 1H), 3.61 (d, *J* = 16.7 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.6, 135.6, 134.9, 133.7, 130.6, 129.8, 129.0, 128.4, 128.2, 127.3, 124.6, 123.5 (d, *J* = 281.0 Hz), 83.4 (q, *J* = 30.3 Hz), 31.3;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -79.6;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1735, 1606, 1265, 1076, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>11</sub>F<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 293.0784, found 293.0795.



**3-(4-fluorophenyl)-3-(trifluoromethyl)isochroman-1-one (3b):** white solid, 86% yield, 26.7 mg;

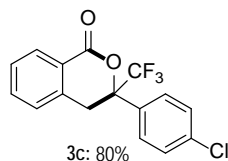
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.97 (d, *J* = 7.7 Hz, 1H), 7.53 – 7.50 (m, 3H), 7.34 – 7.27 (m, 2H), 7.00 (t, *J* = 8.6 Hz, 2H), 3.84 (d, *J* = 16.4 Hz, 1H), 3.65 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 163.2 (d, *J* = 248.6 Hz), 162.4, 136.4, 135.0, 130.6, 129.6 (d, *J* = 3.3 Hz), 129.4 (d, *J* = 8.3 Hz), 128.5, 128.2, 124.5, 123.4 (d, *J* = 283.7 Hz), 116.1 (d, *J* = 21.8 Hz), 83.1 (q, *J* = 31.3 Hz), 31.3;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -79.8, -111.4;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1741, 1512, 1172, 1074, 734;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>F<sub>4</sub>O<sub>2</sub>H<sup>+</sup> 311.0690, found 311.0701.



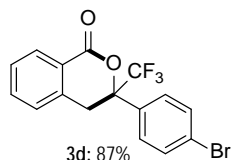
**3-(4-chlorophenyl)-3-(trifluoromethyl)isochroman-1-one (3c):** colorless oil, 80% yield, 26.2 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.97 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.54–7.50 (m, 2H), 7.46 (d, *J* = 8.5 Hz, 1H), 7.35–7.26 (m, 4H), 3.84 (d, *J* = 16.4 Hz, 1H), 3.66 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.3, 136.2, 135.2, 136.1, 132.4, 130.7, 129.3, 128.8, 128.6, 128.1, 124.5, 123.3 (d, *J* = 281.8 Hz), 83.1 (q, *J* = 30 Hz), 31.2;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1747, 1265, 1186, 1074, 734;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>ClF<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 327.0394, found 327.0403.



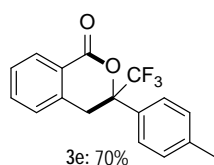
**3-(4-bromophenyl)-3-(trifluoromethyl)isochroman-1-one (3d):** colorless oil, 87% yield, 32.2 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.99 (d, *J* = 7.7 Hz, 1H), 7.54 (t, *J* = 6.7 Hz, 1H), 7.45 (dd, *J* = 23.4, 8.4 Hz, 4H), 7.36 – 7.28 (m, 2H), 3.85 (d, *J* = 16.3 Hz, 1H), 3.66 (d, *J* = 16.3 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.3, 136.2, 136.1, 132.9, 132.3, 1307, 129.0, 128.6, 128.1, 124.5, 124.4, 123.2 (d, *J* = 281.9 Hz), 82.8 (q, *J* = 30.6 Hz), 31.2;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1743, 1265, 1188, 1076, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>BrF<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 370.9889, found 370.9898.



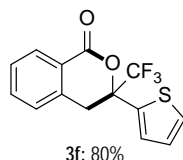
**3-(p-tolyl)-3-(trifluoromethyl)isochroman-1-one (3e):** white powder, 70% yield, 21.4 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.96 (d, *J* = 7.8, 1H), 7.49 (m, 1H), 7.39 (d, *J* = 8.2 Hz, 2H), 7.32 – 7.26 (m, 2H), 7.11 (d, *J* = 8.0 Hz, 2H), 3.82 (d, *J* = 16.3 Hz, 1H), 3.67 (d, *J* = 16.3 Hz, 1H), 2.27 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.7, 139.9, 135.7, 134.8, 130.7, 130.6, 129.7, 128.3, 126.2, 127.2, 124.7, 123.5 (d, *J* = 251.7 Hz), 83.4 (q, *J* = 30.4 Hz), 31.3, 21.3;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1739, 1288, 1234, 908, 732;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>13</sub>F<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 307.0940, found 307.0946.



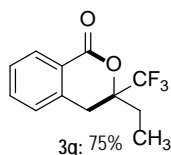
**3-(thiophen-2-yl)-3-(trifluoromethyl)isochroman-1-one (3f):** white solid, 80% yield, 24 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.02 (d, *J* = 7.8, 1H), 7.57-7.53 (m, 1H), 7.37-7.28 (m, 3H), 7.20 (d, *J* = 3.6 Hz, 1H), 6.93 (dd, *J* = 5.1, 3.7 Hz, 1H), 3.85 (d, *J* = 16.4 Hz, 1H), 3.57 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (101 MHz, CDCl<sub>3</sub>) δ 162.0, 136.8, 135.5, 135.0, 130.8, 129.1, 128.5, 128.3, 128.0, 127.5, 124.3, 123.0 (d, *J* = 281.6 Hz), 82.2 (q, *J* = 31.8 Hz), 32.7;

**IR**  $\nu_{\text{max}}$  (film, cm<sup>-1</sup>): 1747, 1612, 1267, 1192, 704;

**HRMS** (ESI, *m/z*): calcd. for C<sub>14</sub>H<sub>9</sub>F<sub>3</sub>O<sub>2</sub>SN<sup>+</sup> 321.0168, found 321.0171.



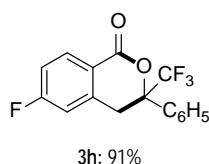
**3-ethyl-3-(trifluoromethyl)isochroman-1-one (3g):** colorless oil, 75% yield, 18.4 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.11 (d, *J* = 7.8 Hz, 1H), 7.61-7.57 (m, 1H), 7.42 (t, *J* = 7.7 Hz, 1H), 7.27 (d, *J* = 8.4 Hz, 1H), 3.37 (d, *J* = 16.8 Hz, 1H), 3.19 (d, *J* = 16.8 Hz, 1H), 1.98 (q, *J* = 7.6 Hz, 2H), 1.04-1.00 (m, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.6, 135.8, 134.8, 130.5, 128.3, 127.0, 124.9 (d, *J* = 283.6 Hz), 124.1, 82.6 (q, *J* = 26.4 Hz), 29.6, 27.2, 8.0;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1737, 1637, 1462, 1120, 740;

**HRMS** (ESI, m/z): calcd. for C<sub>12</sub>H<sub>11</sub>F<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 245.0784, found 245.0789.



**6-fluoro-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3h):** white powder, 91% yield, 24 mg

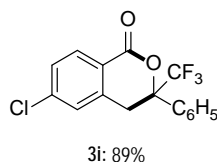
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.02 - 7.98 (m, 1H), 7.52 - 7.50 (m, 2H), 7.36 - 7.32 (m, 3H), 7.00 - 6.96 (m, 2H), 3.83 (d, *J* = 16.4, 1H), 3.67 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 166.5 (d, *J* = 256.3 Hz), 161.7, 138.7 (d, *J* = 9.7 Hz), 133.8 (d, *J* = 10.0 Hz), 133.5, 130.0, 129.1, 127.2, 123.4 (d, *J* = 281.9 Hz), 121.1 (d, *J* = 2.8 Hz), 116.1 (d, *J* = 22 Hz), 115.3 (d, *J* = 22.7 Hz), 83.4 (q, *J* = 30.7 Hz), 31.5;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -79.7, -101.7;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1743, 1616, 1257, 1184, 721;

**HRMS** (ESI, m/z): calcd. for C<sub>16</sub>H<sub>10</sub>F<sub>4</sub>O<sub>2</sub>H<sup>+</sup> 311.0690, found 311.0704.



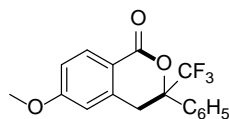
**6-chloro-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3i):** white powder, 89% yield, 29.2 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.91 (d, *J* = 8.8 Hz, 1H), 7.52 - 7.49 (m, 2H), 7.36 - 7.33 (m, 3H), 7.29 - 7.27 (m, 2H), 3.81 (d, *J* = 16.4 Hz, 1H), 3.66 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 161.8, 141.4, 137.3, 133.4, 132.2, 130.0, 129.2, 129.0, 128.2, 127.2, 123.4 (d, *J* = 281.9 Hz), 123.1, 83.4 (q, *J* = 30.6 Hz), 31.3;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1745, 1633, 1265, 1188, 736;

**HRMS** (ESI, m/z): calcd. for C<sub>16</sub>H<sub>10</sub>ClF<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 327.0394, found 327.0408.



3j: 80%

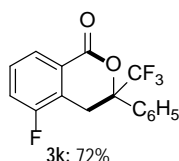
**6-methoxy-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3j):** white powder, 80% yield, 25.6 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.91 (d, *J* = 8.7 Hz, 1H), 7.54 – 7.52 (m, 2H), 7.35 – 7.30 (m, 3H), 6.77 (dd, *J* = 8.7, 2.4 Hz, 1H), 6.72 (s, 1H), 3.82 (s, 3H), 3.79 (d, *J* = 16.4 Hz, 1H), 3.62 (d, *J* = 16.4 Hz, 1H).

**<sup>13</sup>C NMR** (101 MHz, CDCl<sub>3</sub>) δ 164.7, 162.5, 137.9, 133.9, 133.1, 129.8, 129.0, 127.2, 123.6 (d, *J* = 281.9 Hz), 117.1, 113.9, 113.3, 83.2 (q, *J* = 30.1 Hz), 55.9, 31.6;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1734, 1610, 1265, 1074, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>13</sub>F<sub>3</sub>O<sub>3</sub>H<sup>+</sup> 323.0890, found 323.0894.



3k: 72%

**5-fluoro-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3k):** white powder, 72% yield, 22 mg

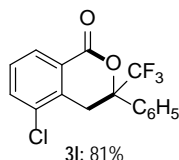
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.85 – 7.72 (m, 1H), 7.52 (d, *J* = 5.7 Hz, 2H), 7.40 – 7.16 (m, 5H), 3.96 (d, *J* = 16.7 Hz, 1H), 3.61 (d, *J* = 16.7 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 161.4, 159.4 (d, *J* = 246.7 Hz), 133.7, 130.0, 129.3, 129.1, 127.1, 126.5 (d, *J* = 4.1 Hz), 126.3 (d, *J* = 3.1 Hz), 123.4 (d, *J* = 281.9 Hz), 123.0 (d, *J* = 18.5 Hz), 121.3 (d, *J* = 21.2 Hz), 83.5 (q, *J* = 30.7 Hz), 24.6;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -79.7, -119.4;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1749, 1477, 1265, 1174, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>F<sub>4</sub>O<sub>2</sub>H<sup>+</sup> 311.0690, found 311.0692.



3l: 81%

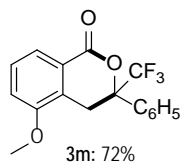
**5-chloro-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3l):** white powder, 81% yield, 26.4 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.89 (d, *J* = 7.8 Hz, 1H), 7.57 – 7.50 (m, 3H), 7.36 – 7.32 (m, 3H), 7.27 – 7.23 (m, 1H), 4.10 (d, *J* = 16.8 Hz, 1H), 3.64 (d, *J* = 16.8 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 161.8, 135.1, 133.9, 133.5, 133.4, 130.1, 129.2, 129.0, 127.2, 126.6, 123.4 (d, *J* = 281.8 Hz), 83.4 (q, *J* = 30.5 Hz), 28.5;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1743, 1635, 1265, 1188, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>ClF<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 327.0394, found 327.0385.



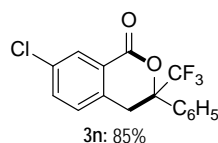
**5-methoxy-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3m):** white powder, 72% yield, 23.2 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.58 – 7.51 (m, 3H), 7.33 – 7.29 (m, 3H), 7.23 (d, *J* = 8.4 Hz, 1H), 7.03 (d, *J* = 9 Hz, 1H), 4.00 (d, *J* = 16.9 Hz, 1H), 3.90 (s, 3H), 3.47 (d, *J* = 16.9 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.6, 156.1, 134.3, 129.7, 128.9, 128.6, 127.2, 125.6, 124.6, 123.6 (d, *J* = 281.8 Hz), 122.1, 115.8, 83.5 (q, *J* = 30.3 Hz), 56.2, 24.8;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1741, 1645, 1265, 1174, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>13</sub>F<sub>3</sub>O<sub>3</sub>H<sup>+</sup> 323.0890, found 323.0900.



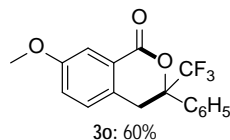
**7-chloro-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3n):** white powder, 85% yield, 27.8 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.84 (d, *J* = 2.2 Hz, 1H), 7.51 – 7.45 (m, 3H), 7.35 – 7.33 (m, 3H), 7.23 (d, *J* = 8.2 Hz, 1H), 3.79 (d, *J* = 16.4 Hz, 1H), 3.68 (d, *J* = 16.4 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 161.5, 134.9, 134.5, 133.9, 133.4, 130.5, 130.0, 129.6, 129.2, 127.2, 126.1, 123.4 (d, *J* = 281.6 Hz), 83.6 (q, *J* = 30.6 Hz); 30.9;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1747, 1635, 1265, 1186, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>16</sub>H<sub>10</sub>ClF<sub>3</sub>O<sub>2</sub>H<sup>+</sup> 327.0394, found 327.0400.



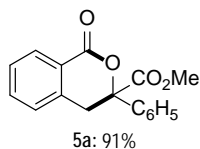
**7-methoxy-3-phenyl-3-(trifluoromethyl)isochroman-1-one (3o):** white powder, 60% yield, 19.3 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.53 – 7.51 (m, 2H), 7.45 (d, *J* = 2.7 Hz, 1H), 7.34 – 7.31 (m, 3H), 7.16 (d, *J* = 8.4 Hz, 1H), 7.04 (dd, *J* = 8.4, 2.8 Hz, 1H), 3.77 (d, *J* = 15.7 Hz, 4H), 3.62 (d, *J* = 16.2 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 162.8, 159.5, 133.9, 129.8, 129.3, 129.0, 127.7, 127.3, 125.5, 123.6 (d, *J* = 284.3 Hz), 122.7, 113.4, 83.7 (q, *J* = 30.6 Hz), 56.8, 30.5;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1735, 1502, 1265, 1066, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>13</sub>F<sub>3</sub>O<sub>3</sub>H<sup>+</sup> 323.0890, found 323.0896.



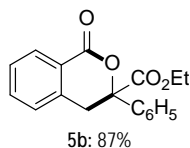
**Methyl 1-oxo-3-phenylisochromane-3-carboxylate (5a):** white solid, 91% yield, 25.7 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.12 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.72 – 7.69 (m, 2H), 7.58 – 7.55 (m, 1H), 7.45 – 7.32 (m, 1H), 3.92 (d, *J* = 16.1 Hz, 1H), 3.59 (s, 3H), 3.53 (d, *J* = 16.1 Hz, 1H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 171.1, 164.1, 137.6, 137.0, 134.6, 130.6, 129.3, 129.1, 128.5, 128.1, 125.6, 125.0, 85.1, 53.6, 37.4;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1734, 1625, 1265, 1082, 736;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>14</sub>O<sub>4</sub>H<sup>+</sup> 283.0965, found 283.0978.



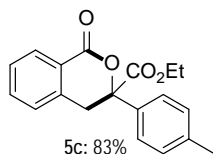
**Ethyl 1-oxo-3-phenylisochromane-3-carboxylate (5b):** white solid, 87% yield, 25.9 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.12 (dd, *J* = 7.8, 1.0 Hz, 1H), 7.73 – 7.71 (m, 2H), 7.59 – 7.54 (m, 1H), 7.45 – 7.32 (m, 5H), 4.09 – 4.01 (m, 2H), 3.91 (d, *J* = 16.0 Hz, 1H), 3.52 (d, *J* = 16.0 Hz, 1H), 1.00 (t, *J* = 7.1 Hz, 3H).

**<sup>13</sup>C NMR** (101 MHz, CDCl<sub>3</sub>) δ 170.5, 164.2, 137.6, 137.0, 134.5, 130.5, 129.2, 129.0, 128.5, 128.1, 125.6, 125.3, 85.0, 62.7, 37.2, 14.0;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1734, 1635, 1265, 1082, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>18</sub>H<sub>16</sub>O<sub>4</sub>H<sup>+</sup> 297.1121, found 297.1133.



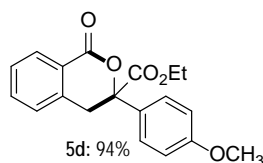
**Ethyl 1-oxo-3-(p-tolyl)isochromane-3-carboxylate (5c):** white solid, 83% yield, 25.9 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.11 (d, *J* = 6.8 Hz, 1H), 7.65 – 7.52 (m, 3H), 7.40 (t, *J* = 7.6 Hz, 1H), 7.32 (d, *J* = 7.6 Hz, 1H), 7.22 (d, *J* = 8.0 Hz, 2H), 4.03 (q, *J* = 7.0 Hz, 2H), 3.88 (d, *J* = 16.0 Hz, 1H), 3.51 (d, *J* = 16.0 Hz, 1H), 2.36 (s, 3H), 1.00 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 170.7, 164.3, 139.1, 137.1, 134.7, 134.4, 130.4, 129.7, 128.4, 128.1, 125.5, 125.3, 85.0, 62.6, 37.1, 21.4, 14.1;

**IR *v*<sub>max</sub>** (film, cm<sup>-1</sup>): 1732, 1627, 1265, 1085, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>19</sub>H<sub>18</sub>O<sub>4</sub>H<sup>+</sup> 311.1278, found 311.1277.



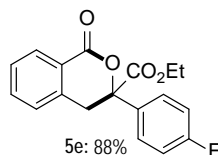
**Ethyl 3-(4-methoxyphenyl)-1-oxoisochromane-3-carboxylate (5d):** white solid, 94% yield, 30.8 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.10 (dd, *J* = 7.7, 0.8 Hz, 1H), 7.62 (d, *J* = 9 Hz, 2H), 7.58 – 7.53 (m, 1H), 7.40 (t, *J* = 7.6 Hz, 1H), 7.33 (d, *J* = 7.6 Hz, 1H), 6.93 (d, *J* = 9 Hz, 2H), 4.02 (q, *J* = 7.1 Hz, 2H), 3.87 (d, *J* = 16.0 Hz, 1H), 3.81 (d, *J* = 5.5 Hz, 3H), 3.51 (d, *J* = 16.0 Hz, 1H), 0.99 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 170.6, 164.2, 160.2, 137.0, 134.4, 130.3, 129.6, 128.4, 128.1, 126.9, 125.2, 114.2, 84.7, 62.5, 55.5, 36.9, 14.0;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1732, 1514, 1251, 910, 732;

**HRMS** (ESI, *m/z*): calcd. for C<sub>19</sub>H<sub>18</sub>O<sub>5</sub>H<sup>+</sup> 327.1227, found 327.1232.



**Ethyl 3-(4-fluorophenyl)-1-oxoisochromane-3-carboxylate (5e):** yellow solid, 88% yield, 27.9 mg

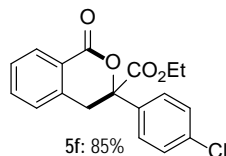
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.11 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.75 – 7.66 (m, 2H), 7.59 – 7.55 (m, 1H), 7.42 (t, *J* = 7.6 Hz, 1H), 7.33 (d, *J* = 7.6 Hz, 1H), 7.11 (t, *J* = 8.7 Hz, 2H), 4.10 – 3.97 (m, 2H), 3.88 (t, *J* = 16.0 Hz, 1H), 3.49 (d, *J* = 16.0 Hz, 1H), 1.00 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 170.4, 164.0, 163.3 (d, *J* = 244.6 Hz), 136.8, 134.6, 133.5 (d, *J* = 3.2 Hz), 130.5, 128.6, 128.1, 127.6 (d, *J* = 8.4 Hz), 125.2, 116.0 (d, *J* = 21.6 Hz), 84.6, 62.8, 37.3, 14.0;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -112.7;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1734, 1629, 1508, 1265, 736;

**HRMS** (ESI, *m/z*): calcd. for C<sub>18</sub>H<sub>15</sub>FO<sub>4</sub>H<sup>+</sup> 315.1027, found 315.1027.



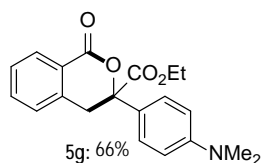
**Ethyl 3-(4-chlorophenyl)-1-oxoisochromane-3-carboxylate (5f):** white solid, 85% yield, 28 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.11 (dd, *J* = 7.8, 1.0 Hz, 1H), 7.67 (d, *J* = 8.8 Hz, 2H), 7.68 – 7.66 (m, 1H), 7.48 – 7.37 (m, 3H), 7.32 (d, *J* = 7.6 Hz, 1H), 4.06 – 4.01 (m, 2H), 3.87 (d, *J* = 16.0 Hz, 1H), 3.48 (d, *J* = 16.0 Hz, 1H), 1.00 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 170.2, 163.9, 136.7, 136.2, 135.4, 134.6, 130.5, 129.2, 128.6, 128.1, 127.1, 125.1, 84.5, 62.9, 37.2, 14.0;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1732, 1492, 1265, 1195, 736;

**HRMS** (ESI, *m/z*): calcd. for C<sub>18</sub>H<sub>15</sub>ClO<sub>4</sub>H<sup>+</sup> 331.0732, found 331.0742.



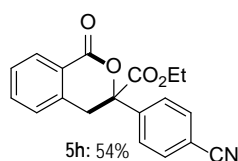
**Ethyl 3-(4-(dimethylamino)-phenyl)-1-oxoisochromane-3-carboxylate (5g):** yellow powder, 66% yield, 22.4 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.13 (dd, *J* = 7.8, 0.9 Hz, 1H), 7.62 – 7.52 (m, 3H), 7.42 (t, *J* = 7.6 Hz, 1H), 7.35 (d, *J* = 7.6 Hz, 1H), 6.74 (d, *J* = 9.0 Hz, 2H), 4.05 (q, *J* = 7.1 Hz, 2H), 3.89 (d, *J* = 16.0 Hz, 1H), 3.56 (d, *J* = 16.0 Hz, 1H), 2.99 (s, 6H), 1.03 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 170.9, 164.7, 150.9, 137.3, 134.3, 130.4, 128.3, 128.1, 126.6, 125.4, 124.7, 112.3, 85.1, 62.4, 40.6, 36.7, 14.1;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1734, 1635, 1521, 1265, 738;

**HRMS** (ESI, m/z): calcd. for C<sub>20</sub>H<sub>21</sub>NO<sub>4</sub>H<sup>+</sup> 340.1543, found 340.1544.



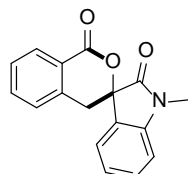
**Ethyl 3-(4-cyanophenyl)-1-oxoisochromane-3-carboxylate (5h):** yellow needle solid, 54% yield, 17.5 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.11 (d, *J* = 7.2 Hz, 1H), 7.90 (d, *J* = 8.6 Hz, 2H), 7.74 (d, *J* = 8.6 Hz, 2H), 7.63 – 7.58 (m, 1H), 7.45 (t, *J* = 7.6 Hz, 1H), 7.36 (d, *J* = 7.6 Hz, 1H), 4.08 – 4.02 (m, 2H), 3.92 (d, *J* = 16.0 Hz, 1H), 3.49 (d, *J* = 16.0 Hz, 1H), 1.00 (t, *J* = 7.1 Hz, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 169.6, 163.4, 142.4, 136.1, 134.7, 132.7, 130.7, 128.8, 128.1, 126.4, 124.8, 118.4, 113.2, 84.3, 63.2, 37.2, 13.9;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 2254, 1747, 1608, 1288, 912, 742;

**HRMS** (ESI, m/z): calcd. for C<sub>19</sub>H<sub>15</sub>NO<sub>4</sub>H<sup>+</sup> 322.1074, found 322.1080.



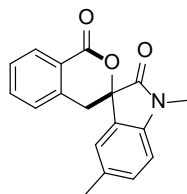
**1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7a):** yellow solid, 90% yield, 25.1 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (dd, *J* = 7.7, 0.9 Hz, 1H), 7.62 – 7.58 (m, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.38 7.34 m, 1H), 7.25 (d, *J* = 7.7 Hz, 1H), 7.01 – 6.82 (m, 3H), 3.56 (d, *J* = 16.6 Hz, 1H), 3.29 (d, *J* = 16.6 Hz, 1H), 3.21 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.6, 163.9, 143.5, 136.1, 134.5, 131.3, 130.4, 128.5, 128.3, 127.5, 125.2, 124.3, 123.6, 109.2, 80.7, 34.4, 26.7;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1730, 1616, 1265, 1080, 736;

**HRMS** (ESI, m/z): calcd. for C<sub>17</sub>H<sub>13</sub>NO<sub>3</sub>H<sup>+</sup> 280.0968, found 280.0974.



7b: 91%

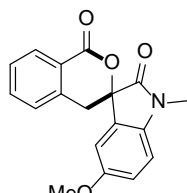
**1,5-dimethylspiro[indoline-3,3'-isochromane]-1',2-dione (7b):** brown powder, 91% yield, 26.7 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (dd, *J* = 7.7, 1.1 Hz, 1H), 7.62 – 7.58 (dm, 1H), 7.49 (t, *J* = 7.3 Hz, 1H), 7.24 (s, 2H), 7.16 (dd, *J* = 7.5, 1.2 Hz, 1H), 6.75 (d, *J* = 8.0 Hz, 2H), 3.51 (d, *J* = 16.6 Hz, 1H), 3.32 (d, *J* = 16.7 Hz, 1H), 3.18 (s, 3H), 2.22 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.7, 141.2, 136.2, 134.5, 133.3, 131.5, 130.4, 128.5, 128.2, 127.6, 125.2, 125.1, 116.0, 109.0, 80.9, 34.4, 26.7, 21.3;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1730, 1500, 1419, 1265, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>18</sub>H<sub>15</sub>NO<sub>3</sub>H<sup>+</sup> 294.1125, found 294.1130.



7c: 94%

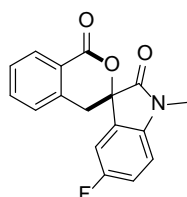
**5-methoxy-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7c):** pink powder, 94% yield, 29.3 mg

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.19 (d, *J* = 7.7 Hz, 1H), 7.62 – 7.58 (m, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.25 (d, *J* = 7.8 Hz, 1H), 6.87 (dd, *J* = 8.6, 2.4 Hz, 1H), 6.77 (d, *J* = 8.5 Hz, 1H), 6.53 (d, *J* = 2.5 Hz, 1H), 3.67 (s, 3H), 3.54 (d, *J* = 16.6 Hz, 1H), 3.29 (d, *J* = 16.6 Hz, 1H), 3.18 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.4, 164.0, 156.6, 136.9, 136.1, 134.5, 130.4, 128.5, 128.3, 126.4, 125.2, 115.4, 111.9, 109.6, 81.0, 56.1, 34.5, 26.8;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1732, 1500, 1265, 1118, 734;

**HRMS** (ESI, *m/z*): calcd. for C<sub>18</sub>H<sub>15</sub>NO<sub>4</sub>H<sup>+</sup> 310.1074, found 310.1073.



7d: 86%

**5-fluoro-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7d):** yellow powder, 86% yield, 25.7 mg

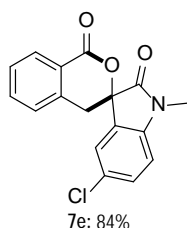
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (d, *J* = 7.8 Hz, 1H), 7.64 – 7.60 (m, 1H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.26 (t, *J* = 3.7 Hz, 1H), 7.10 – 7.05 (m, 1H), 6.80 (dd, *J* = 8.6, 4.0 Hz, 1H), 6.65 (dd, *J* = 7.6, 2.6 Hz, 1H), 3.57 (d, *J* = 16.6 Hz, 1H), 3.26 (d, *J* = 16.6 Hz, 1H), 3.20 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.3, 163.5, 159.4 (d, *J* = 241.5 Hz), 139.5, 135.7, 134.7, 130.5, 128.9 (d, *J* = 7.9 Hz), 128.7, 128.3, 125.0, 117.6 (d, *J* = 25.3 Hz), 112.6 (d, *J* = 25.3 Hz), 109.9 (d, *J* = 7.9 Hz), 80.6, 34.3, 26.9;

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -118.7;

**IR** *v*<sub>max</sub> (film, cm<sup>-1</sup>): 1732, 1633, 1506, 1265, 744;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>12</sub>FNO<sub>3</sub>H<sup>+</sup> 298.0874, found 298.0878.

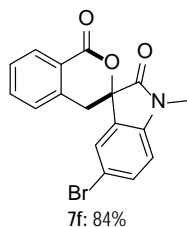


**5-chloro-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7e):** brown powder, 86% yield, 26.4 mg  
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (d, *J* = 7.8 Hz, 1H), 7.64 – 7.60 (m, 1H), 7.51 (t, *J* = 7.7 Hz, 1H), 7.35 (dd, *J* = 8.3, 2.1 Hz, 1H), 7.25 (d, *J* = 5.3 Hz, 1H), 6.91 (d, *J* = 2.0 Hz, 1H), 6.80 (d, *J* = 8.4 Hz, 1H), 3.53 (d, *J* = 16.7 Hz, 1H), 3.30 (d, *J* = 16.7 Hz, 1H), 3.19 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.2, 163.5, 142.2, 135.7, 134.7, 134.5, 131.2, 130.6, 129.1, 128.9, 128.7, 128.3, 125.0, 110.2, 80.4, 34.2, 26.9;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1743, 1419, 1265, 815, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>12</sub>ClNO<sub>3</sub>H<sup>+</sup> 314.0578, found 314.0585.

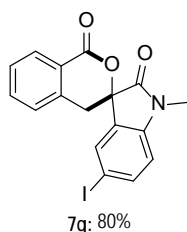


**5-bromo-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7f):** brown powder, 84% yield, 30.2 mg  
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (dd, *J* = 7.7, 1.0 Hz, 1H), 7.64 – 7.60 (m, 1H), 7.55 – 7.46 (m, 2H), 7.25 (s, 1H), 7.06 (d, *J* = 1.9 Hz, 1H), 6.76 (d, *J* = 8.3 Hz, 1H), 3.51 (d, *J* = 16.7 Hz, 1H), 3.31 (d, *J* = 16.7 Hz, 1H), 3.19 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.1, 163.5, 142.6, 135.6, 134.7, 134.1, 130.6, 129.4, 128.7, 128.2, 127.7, 125.0, 116.1, 110.6, 80.3, 34.3, 26.8;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1635, 1419, 1265, 1101, 738;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>12</sub>BrNO<sub>3</sub>H<sup>+</sup> 358.0073, found 358.0088.

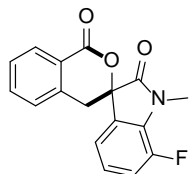


**5-iodo-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7g):** orange powder, 80% yield, 32.5 mg  
**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.20 (dd, *J* = 7.8, 1.0 Hz, 1H), 7.69 (dd, *J* = 8.2, 1.7 Hz, 1H), 7.64 – 7.59 (m, 1H), 7.50 (t, *J* = 7.1 Hz, 1H), 7.27 – 7.23 (m, 2H), 6.65 (d, *J* = 8.2 Hz, 1H), 3.47 (d, *J* = 16.7 Hz, 1H), 3.34 (d, *J* = 16.7 Hz, 1H), 3.17 (s, 3H);

**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.1, 163.6, 143.3, 140.1, 135.6, 134.7, 132.2, 130.5, 129.7, 128.7, 128.2, 125.0, 111.2, 85.8, 77.0, 34.3, 26.8;

**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1734, 1635, 1265, 894, 748;

**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>12</sub>IINO<sub>3</sub>H<sup>+</sup> 405.9935, found 405.9940.



7h: 90%

**7-fluoro-1-methylspiro[indoline-3,3'-isochromane]-1',2-dione (7h):** faint yellow powder, 90% yield, 26.7 mg;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.19 (d, *J* = 7.0 Hz, 1H), 7.63 – 7.59 (m, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 7.25 (d, *J* = 7.7 Hz, 1H), 7.12 – 7.07 (m, 1H), 6.97 – 6.83 (m, 1H), 6.76 (dd, *J* = 7.5, 0.8 Hz, 1H), 3.53 (d, *J* = 16.6 Hz, 1H), 3.41 (d, *J* = 2.8 Hz, 3H), 3.31 (d, *J* = 16.6 Hz, 1H);

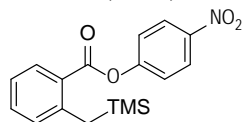
**<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 172.3, 163.6, 148.1 (d, *J* = 243.7 Hz), 135.7, 134.6, 130.4, 130.3, 128.6, 128.2, 125.0, 124.3 (d, *J* = 6.3 Hz), 120.1 (d, *J* = 3.4 Hz), 119.4, 119.2, 80.4, 34.5, 29.2 (d, *J* = 5.9 Hz);

**<sup>19</sup>F NMR** (376 MHz, CDCl<sub>3</sub>) δ -135.1 (s);

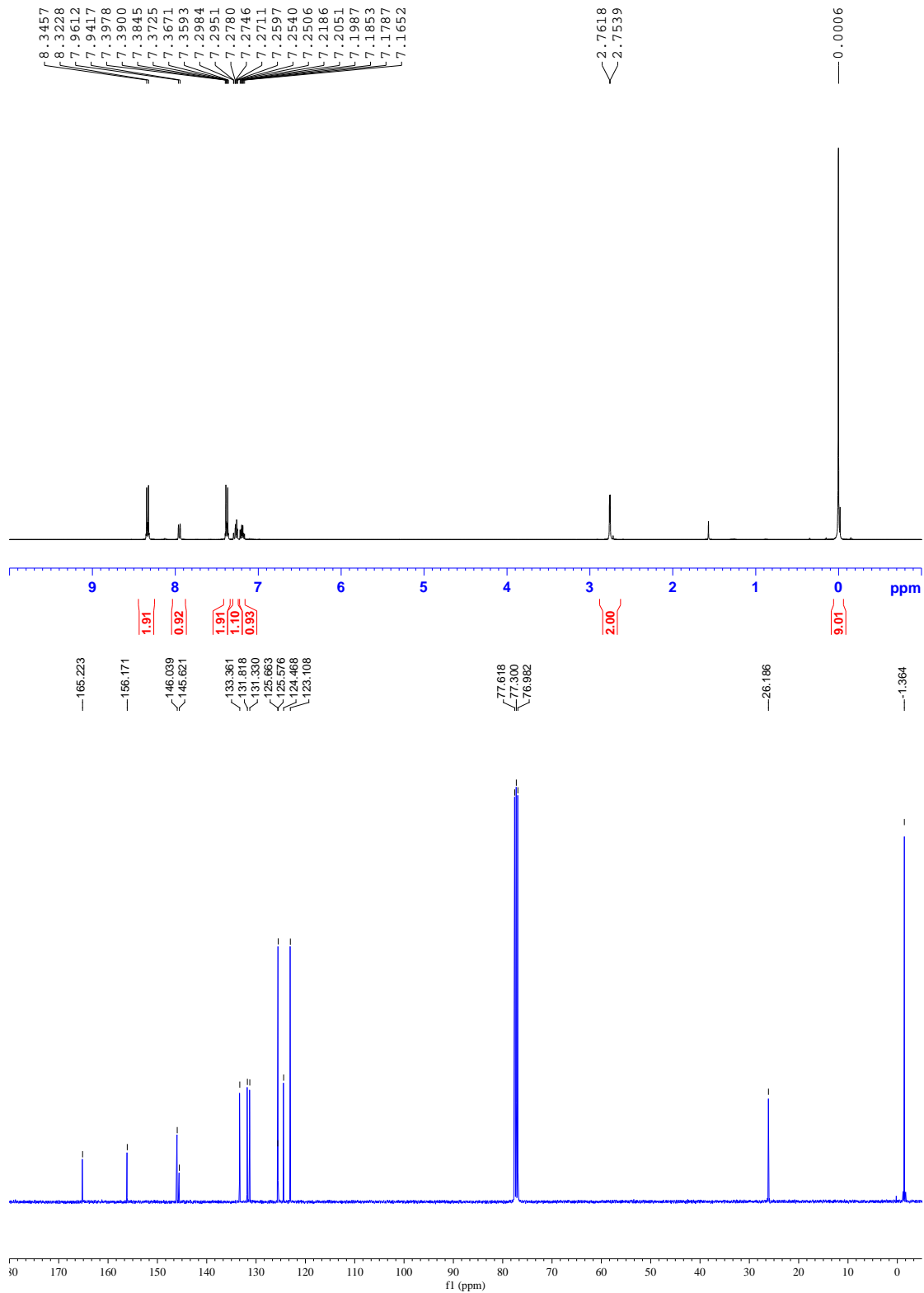
**IR**  $\nu_{\max}$  (film, cm<sup>-1</sup>): 1734, 1631, 1373, 910, 734;

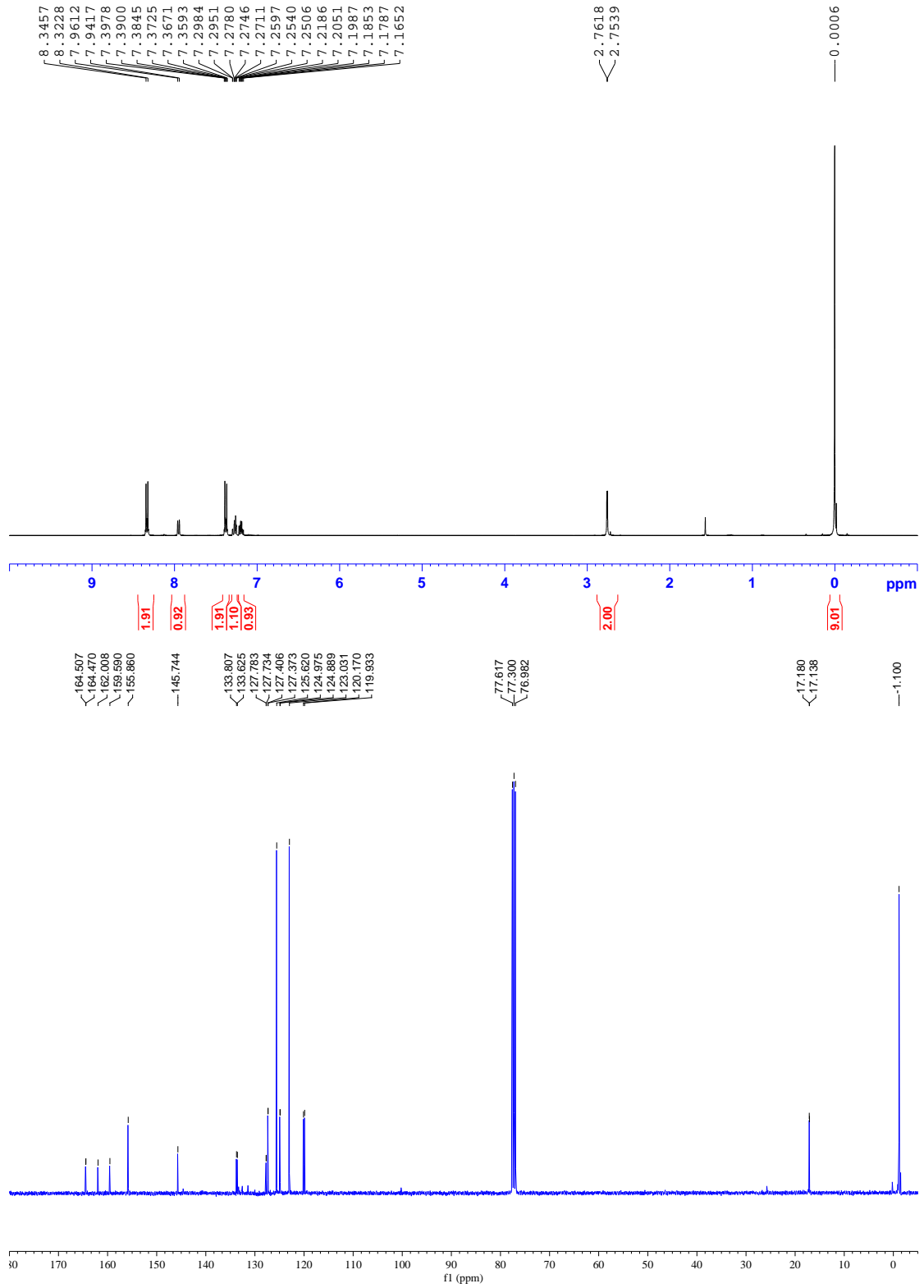
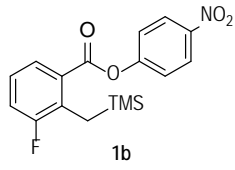
**HRMS** (ESI, *m/z*): calcd. for C<sub>17</sub>H<sub>12</sub>FNO<sub>3</sub>H<sup>+</sup> 298.0874, found 298.0882.

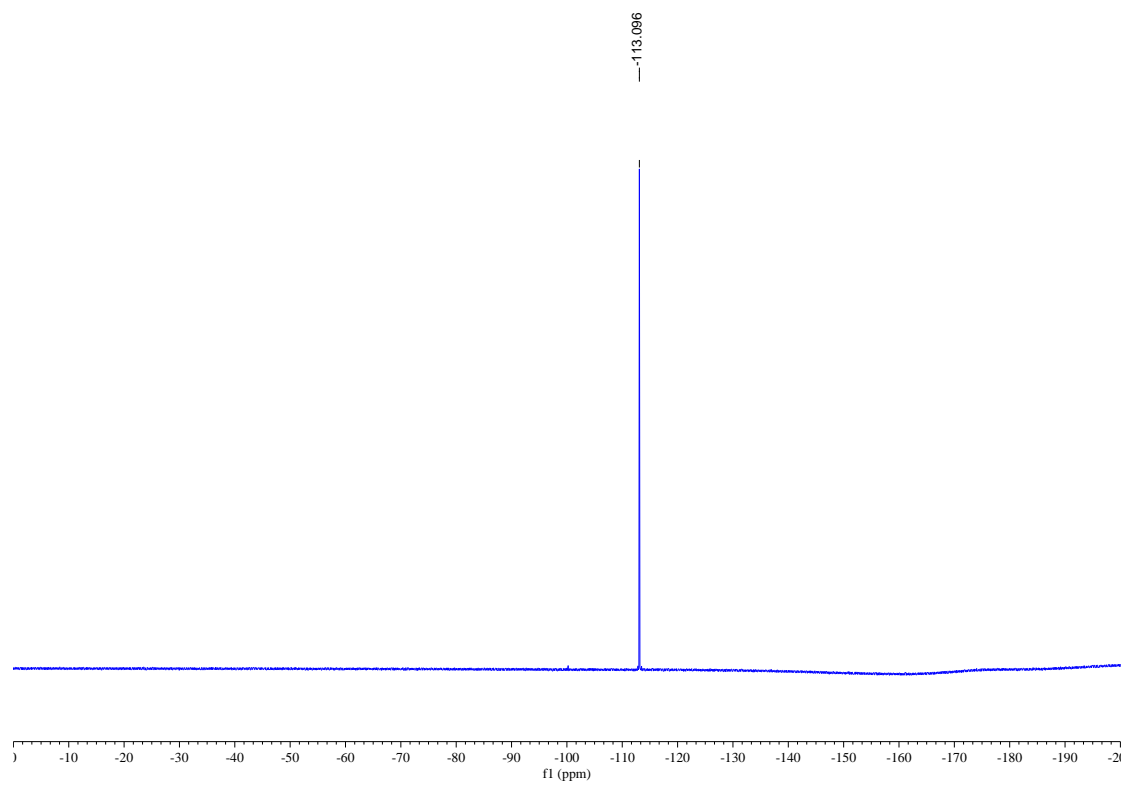
VII:  $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{19}\text{F}$  NMR

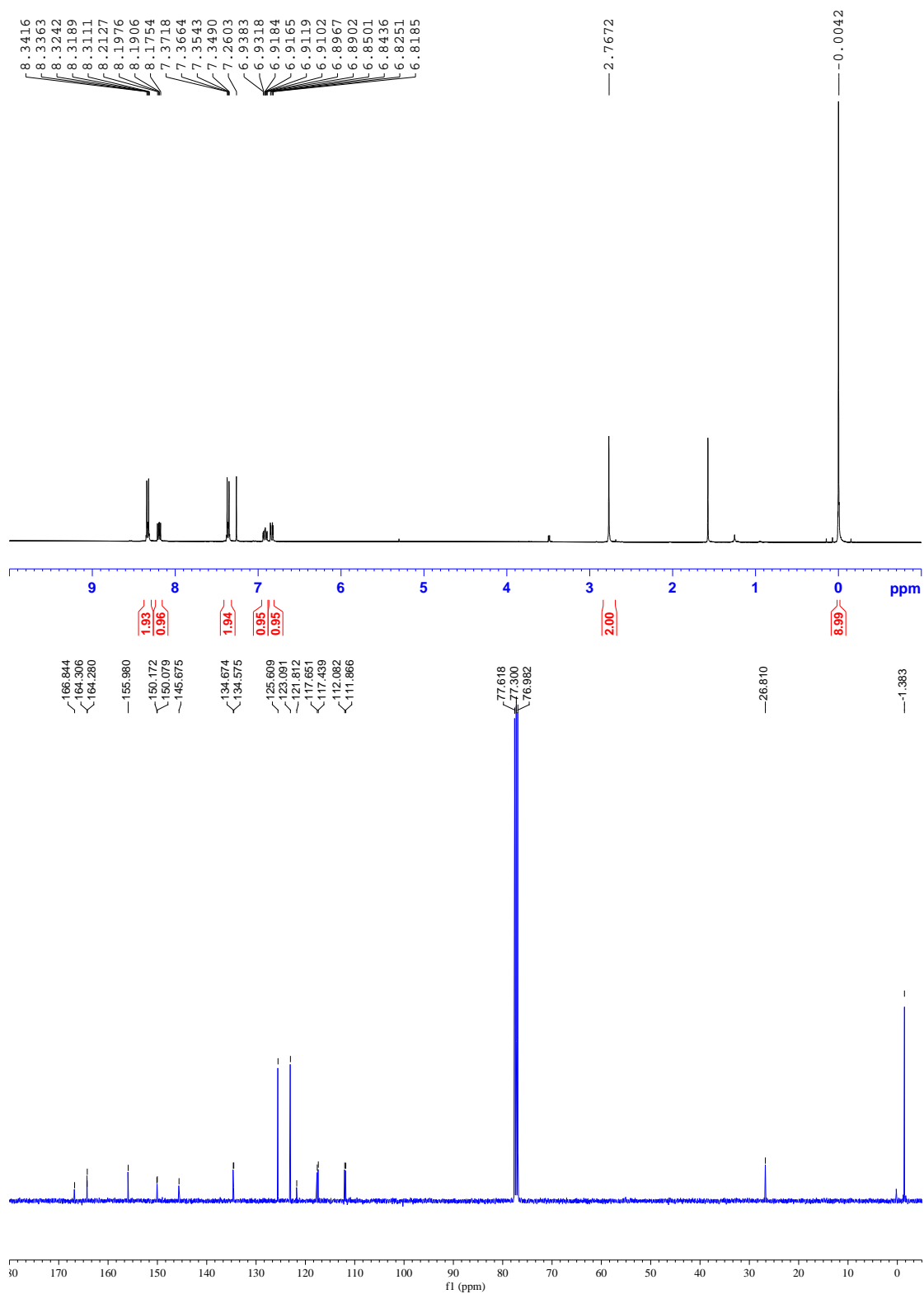
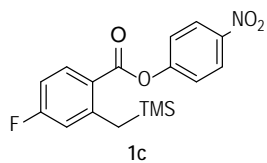


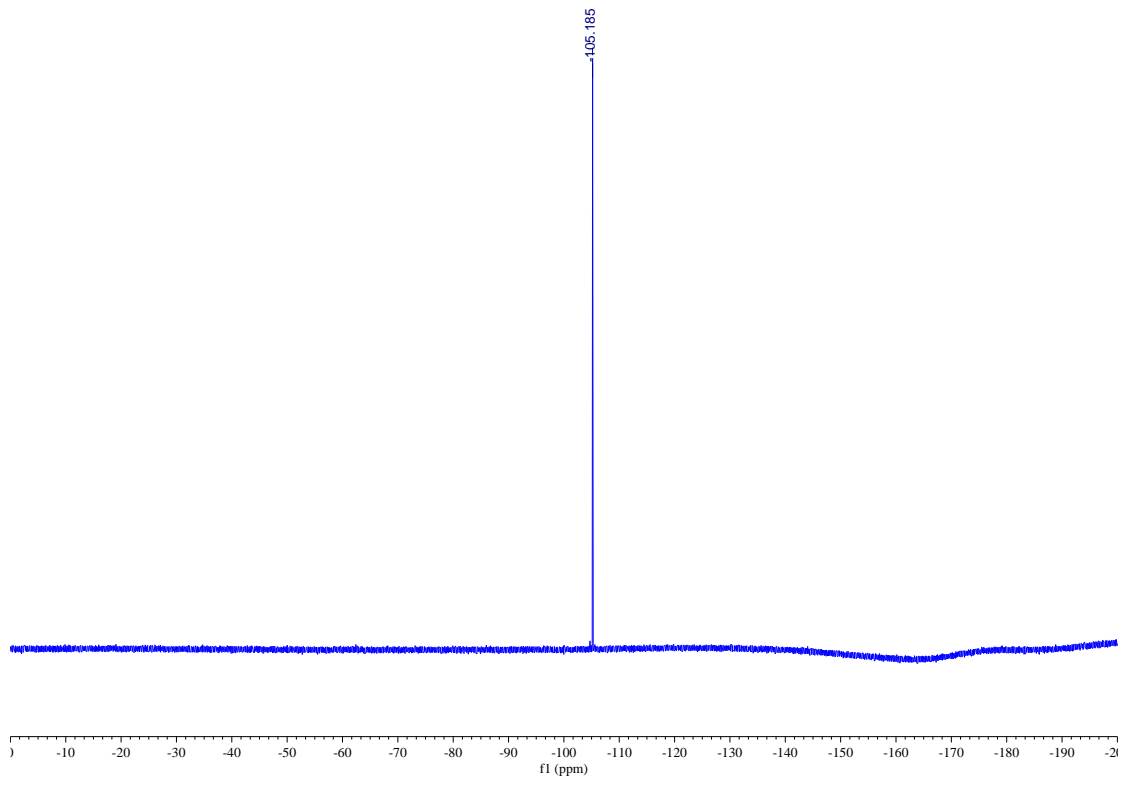
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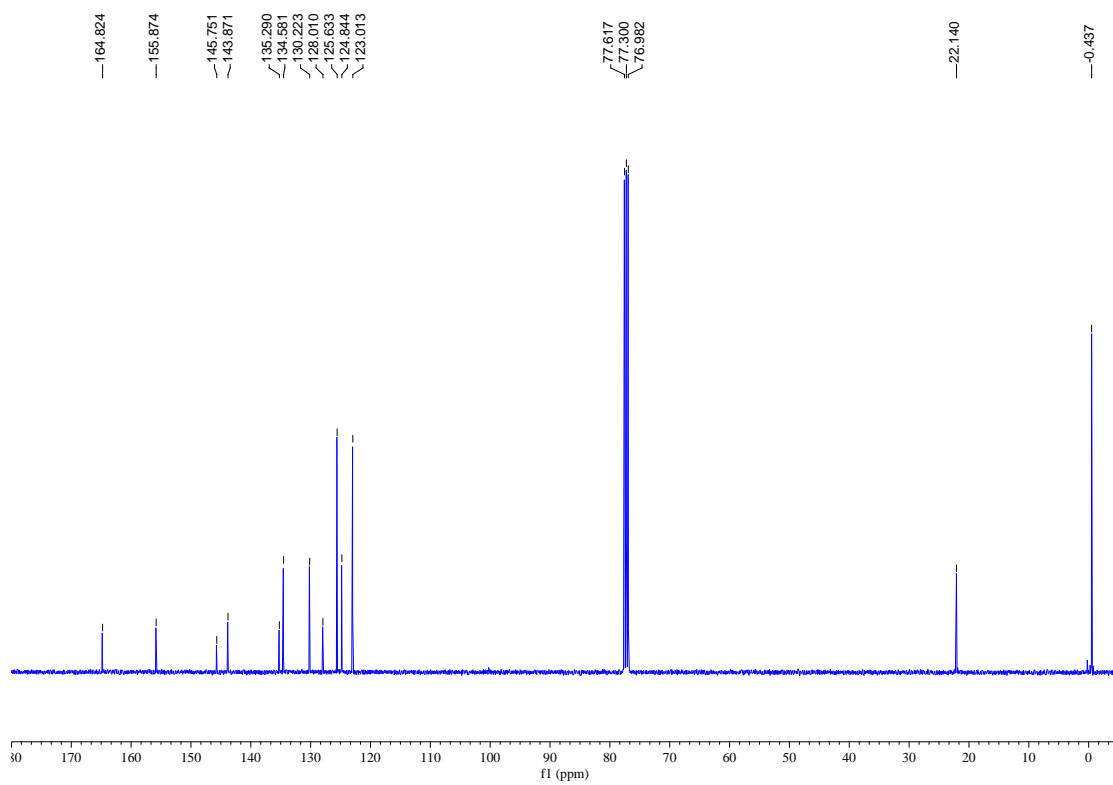
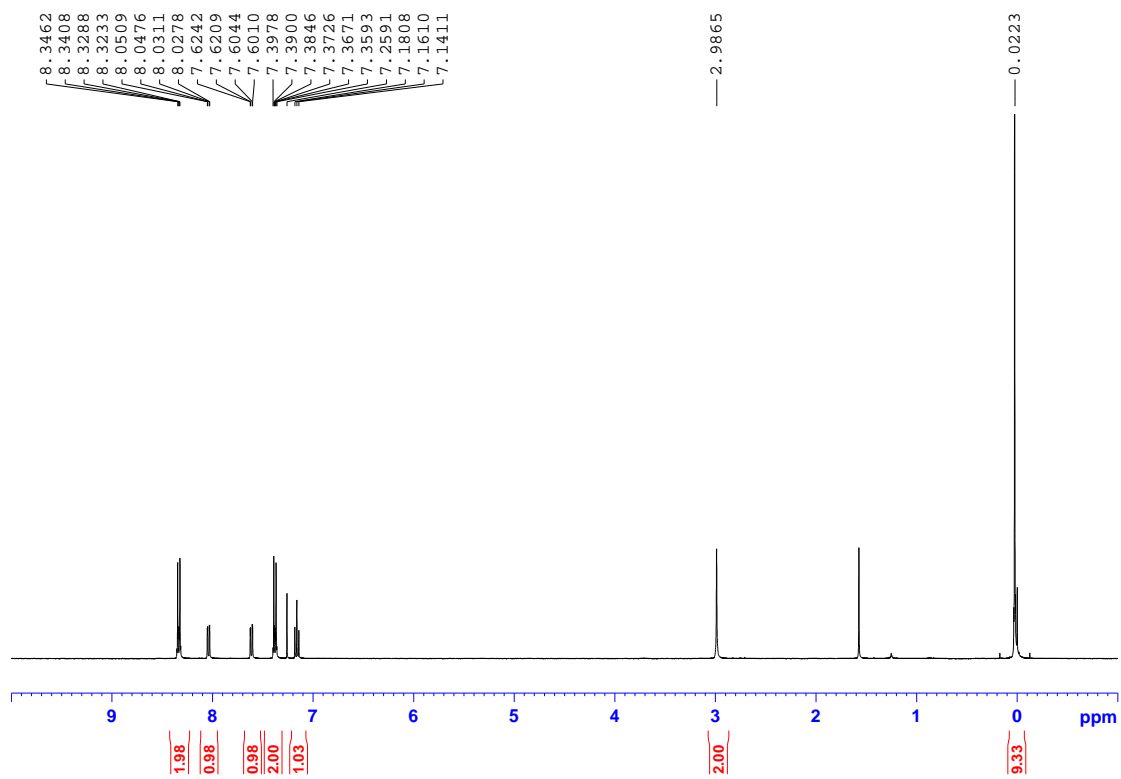
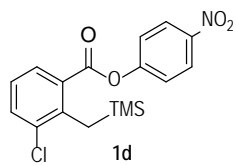


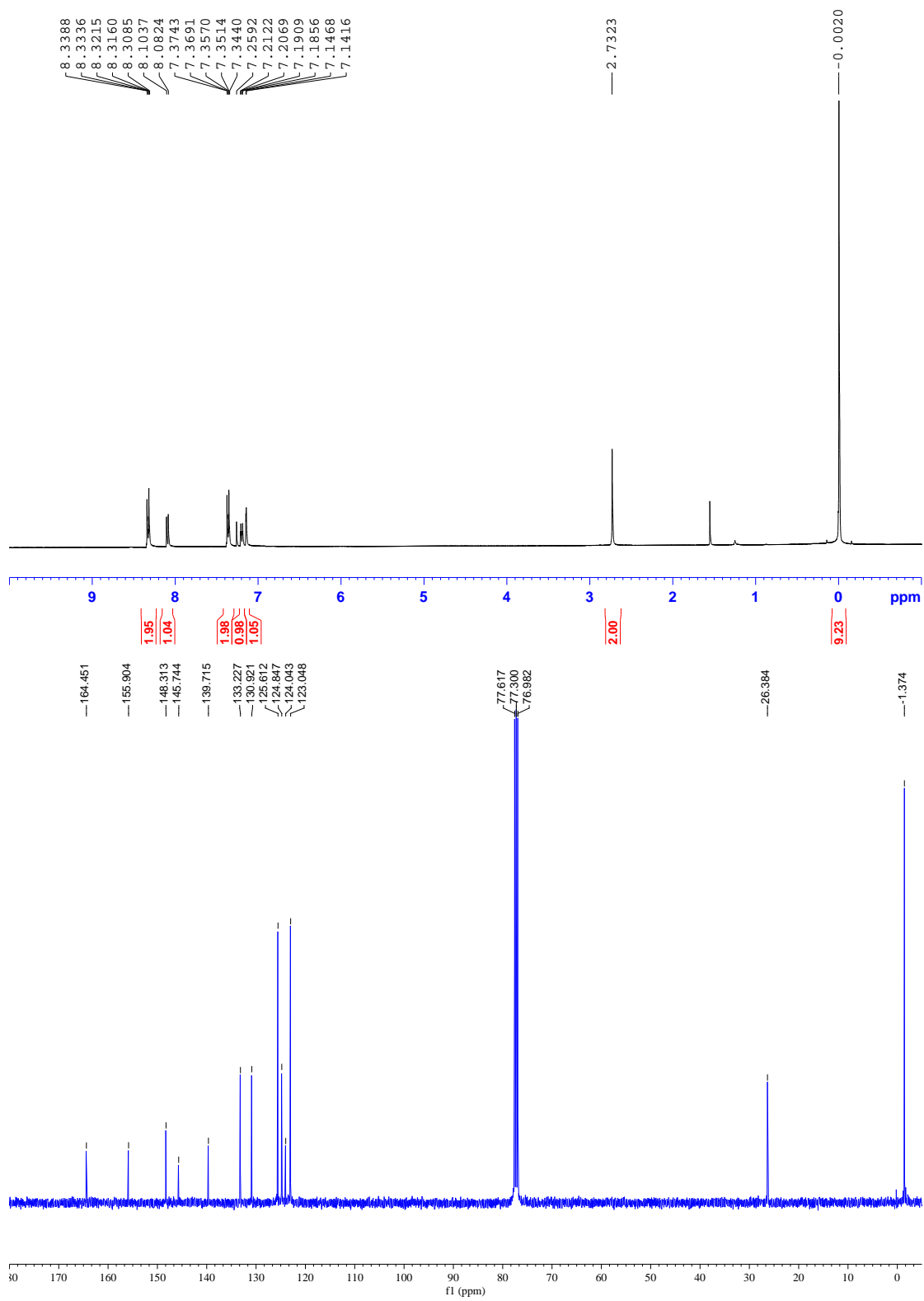
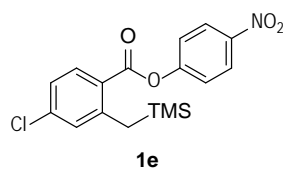


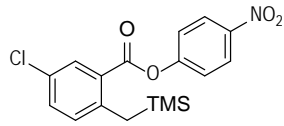




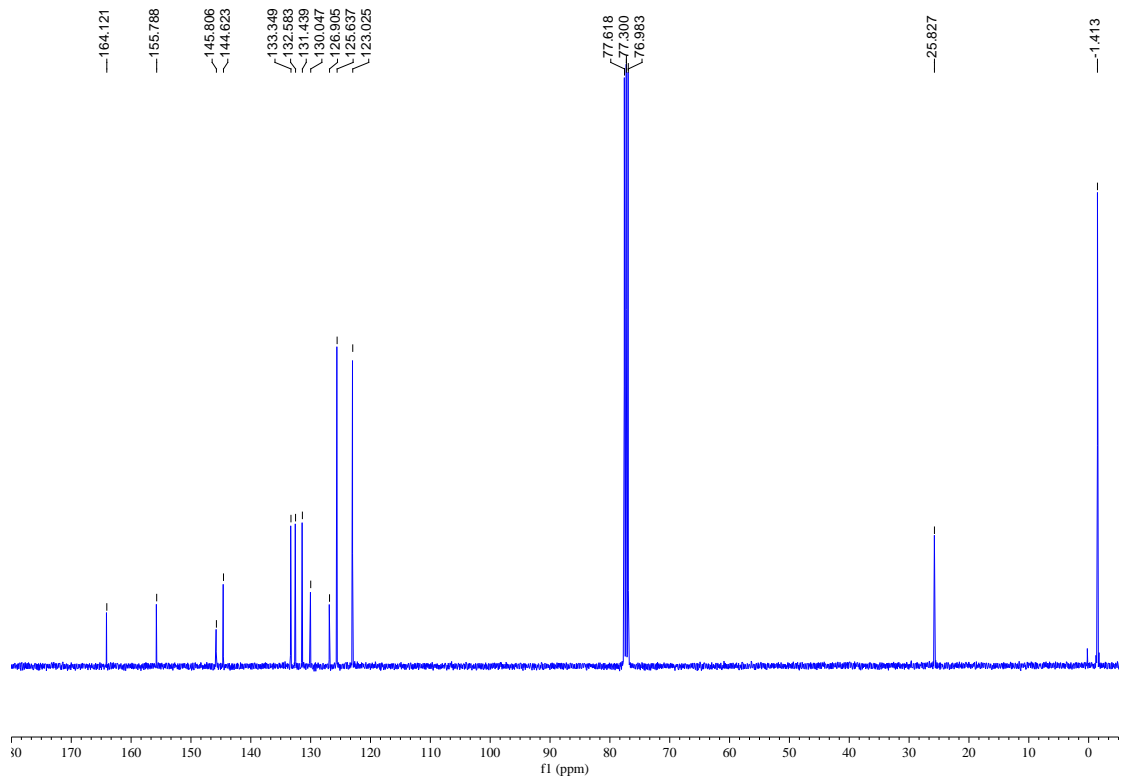
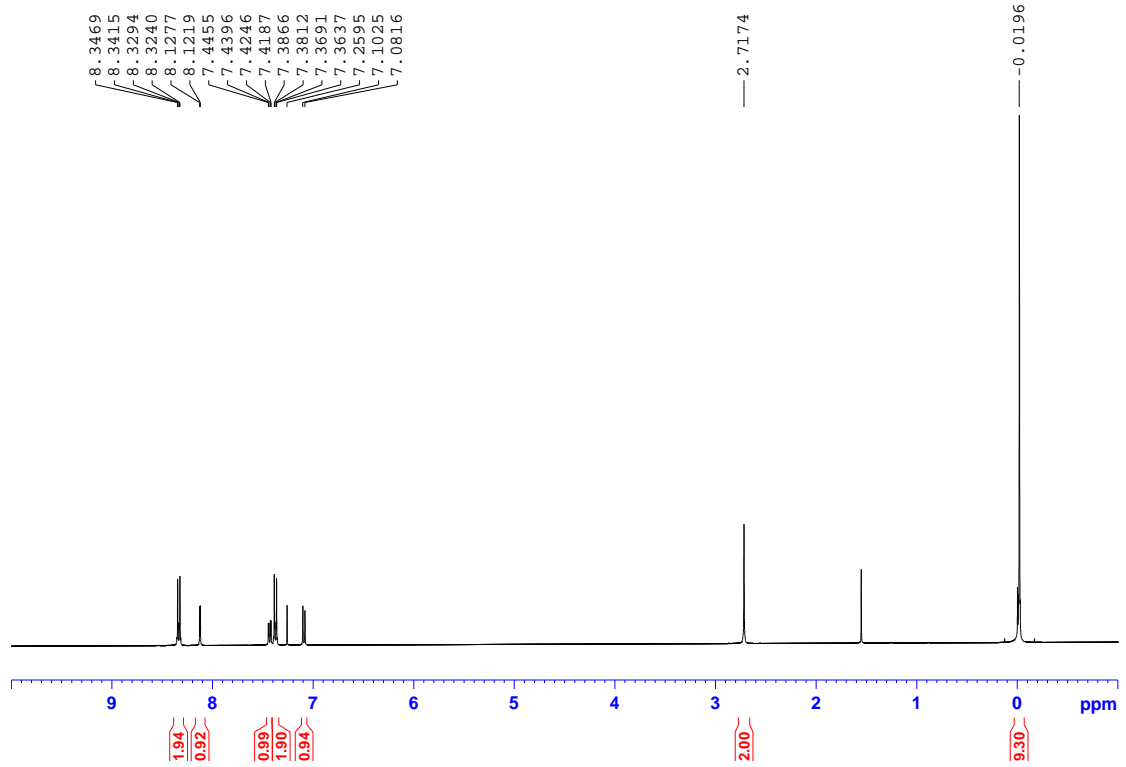


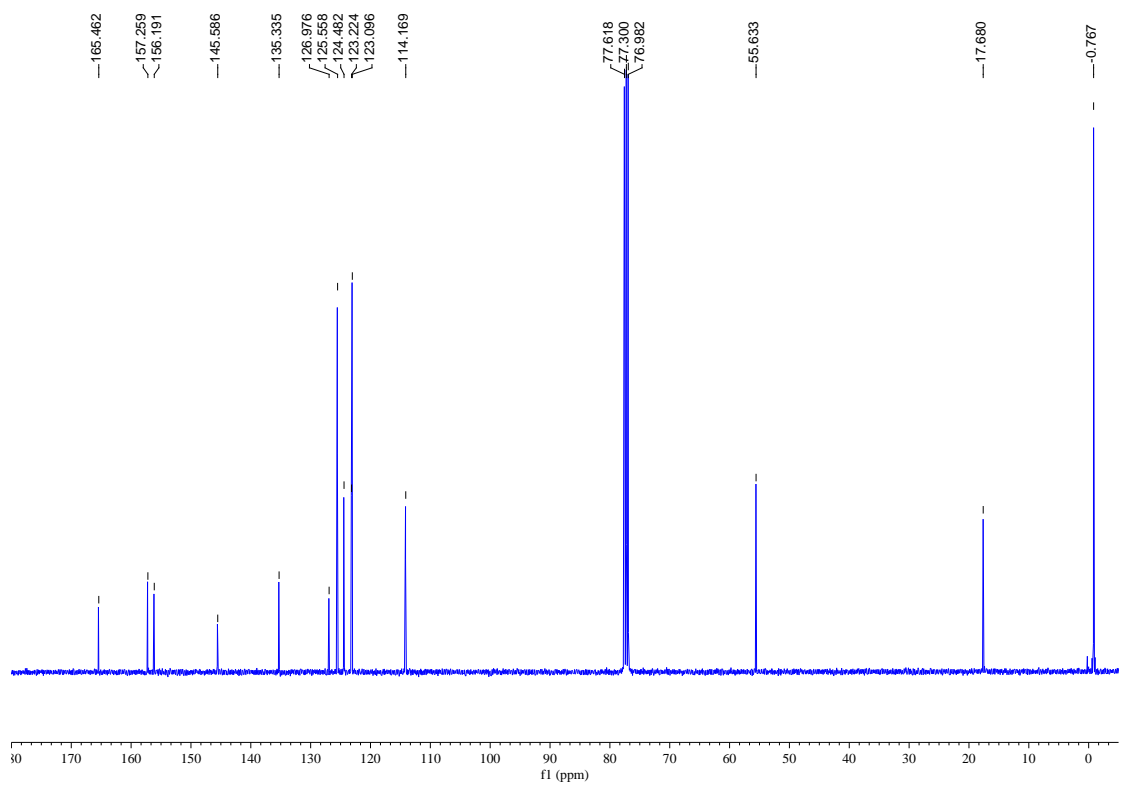
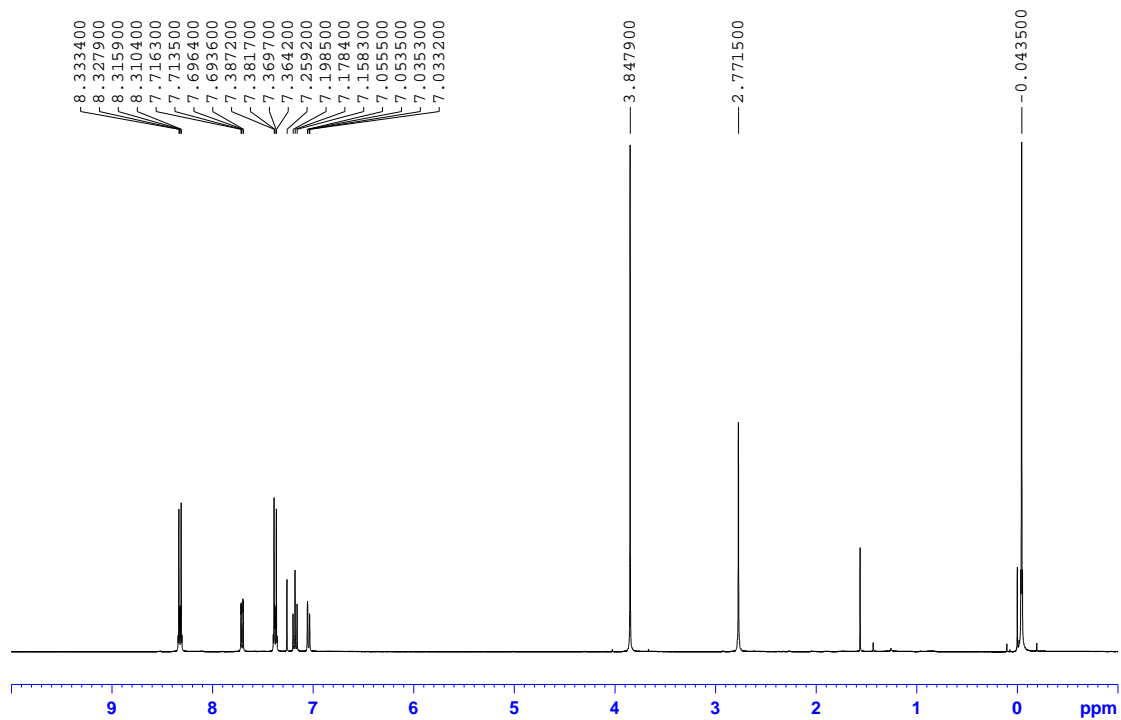
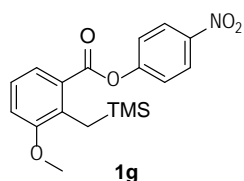


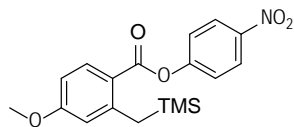




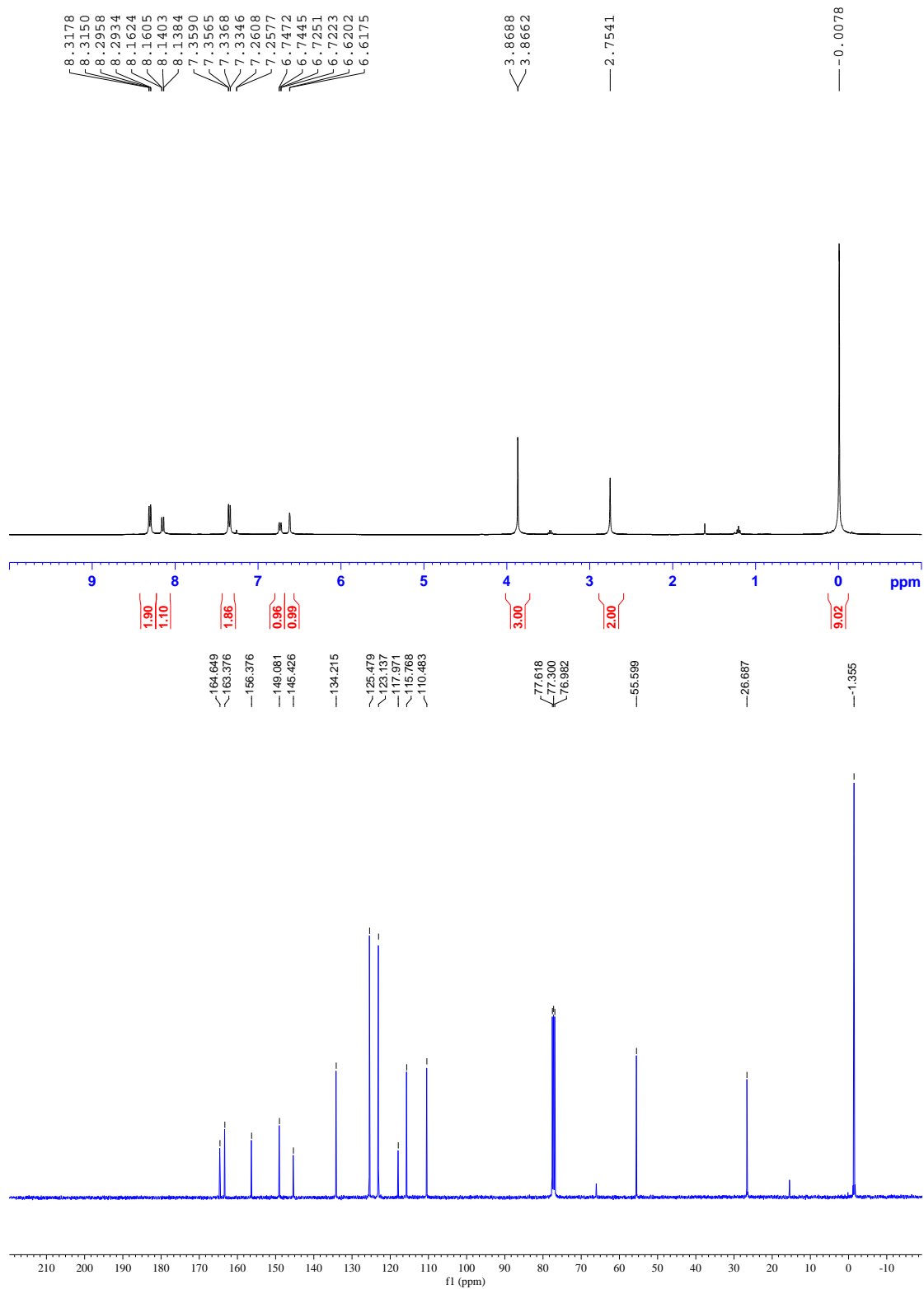
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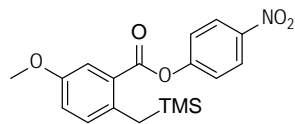




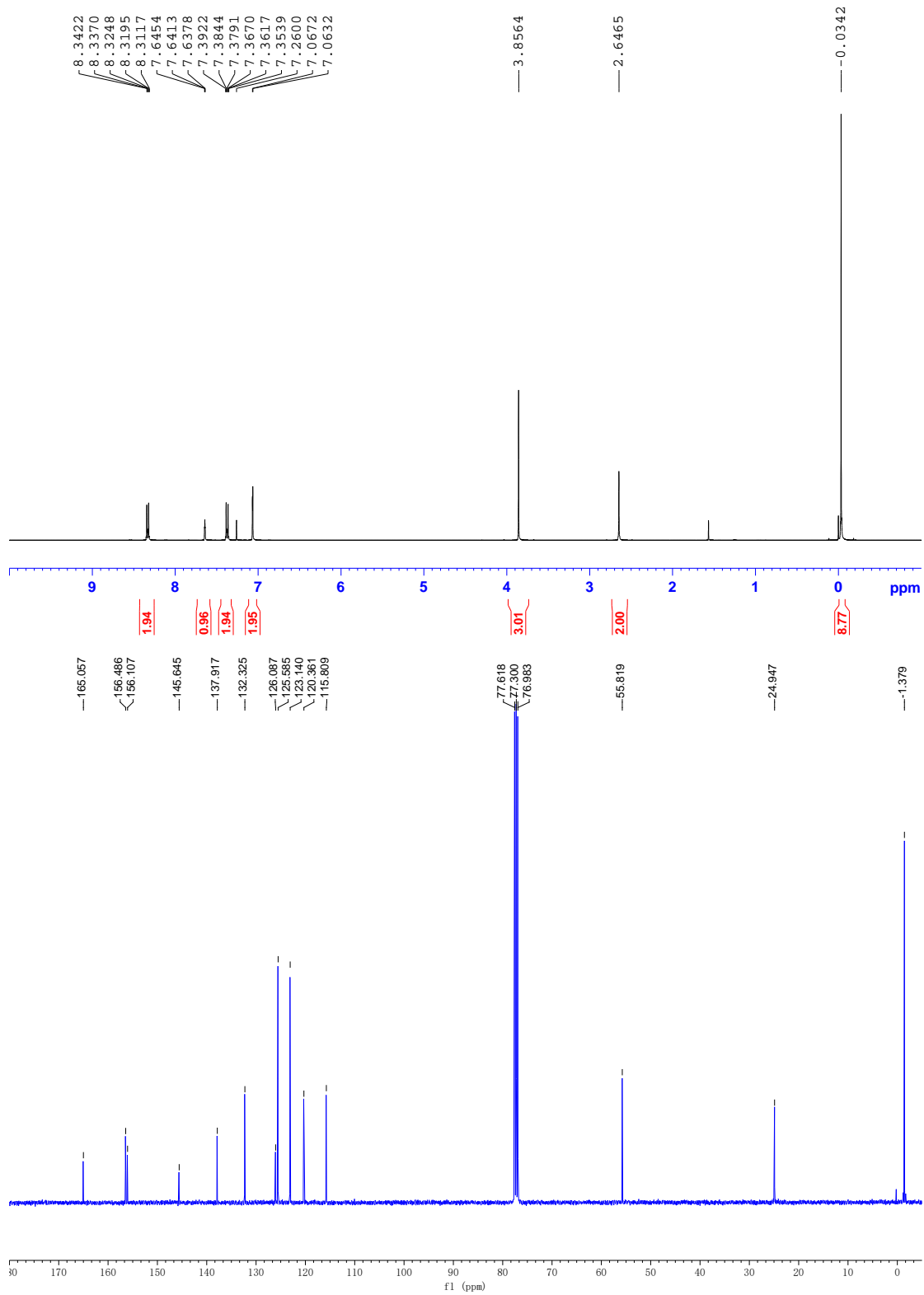


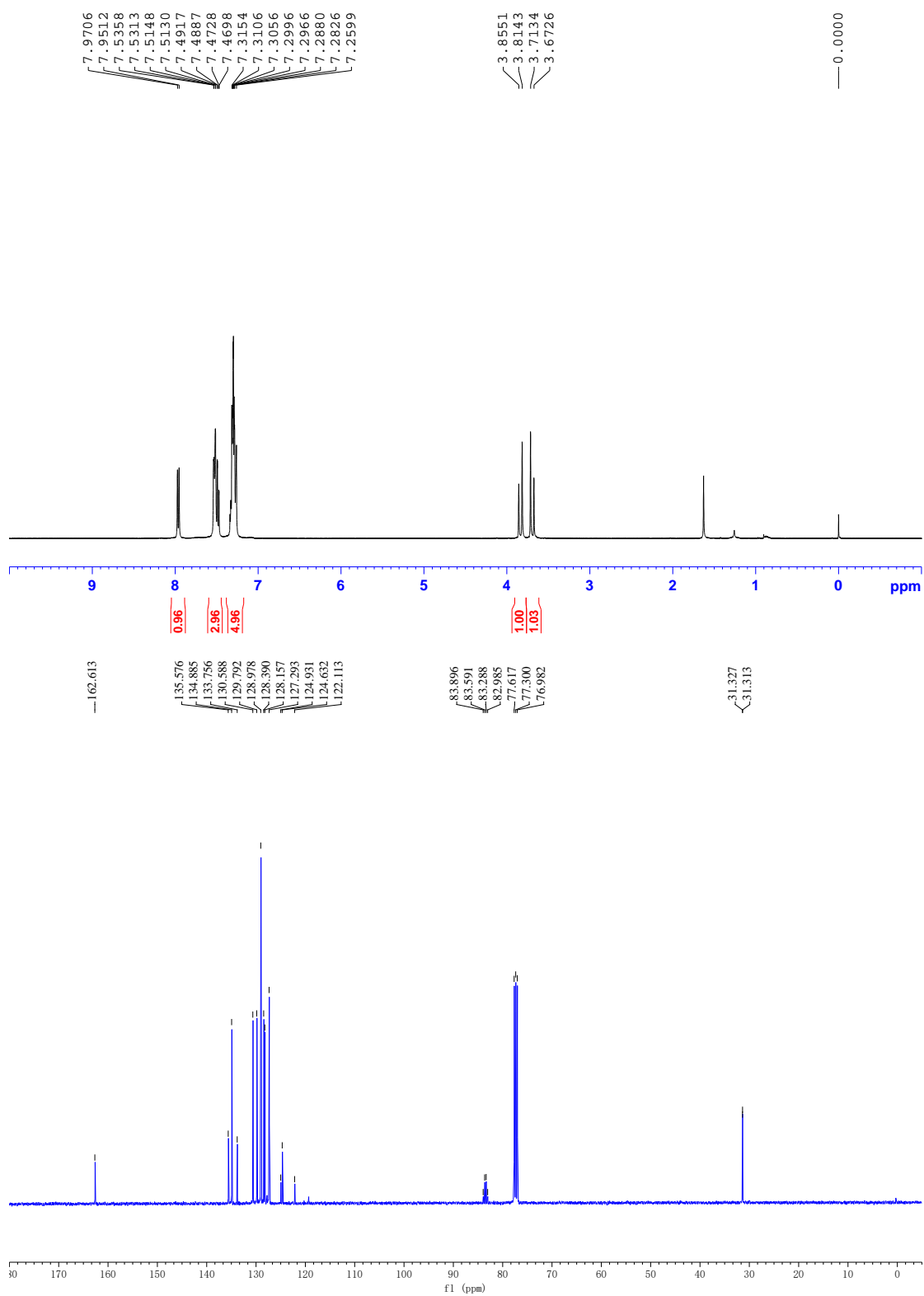
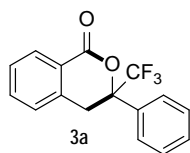
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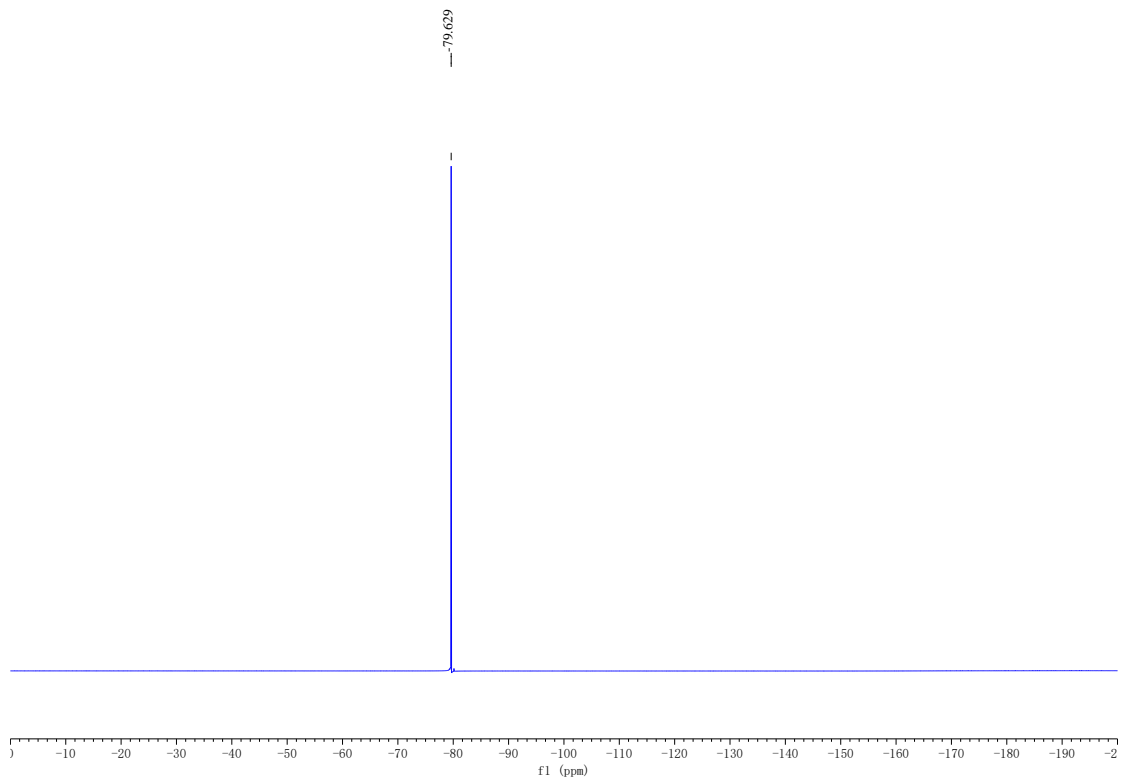


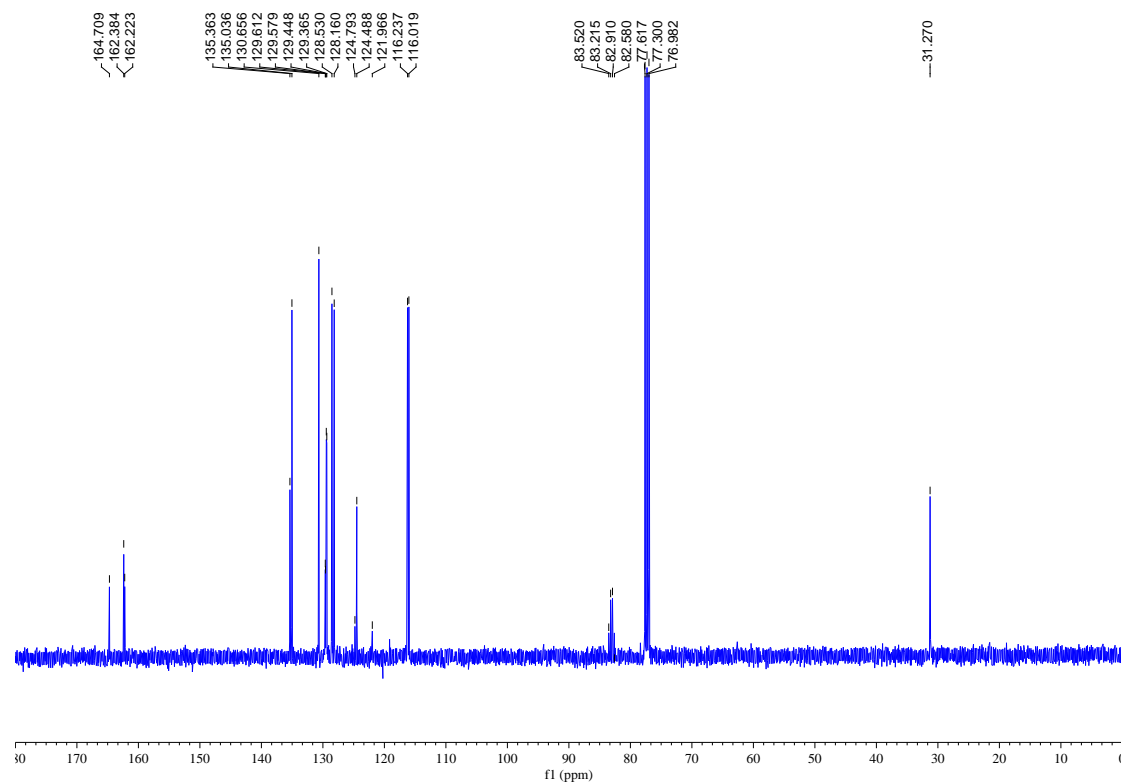
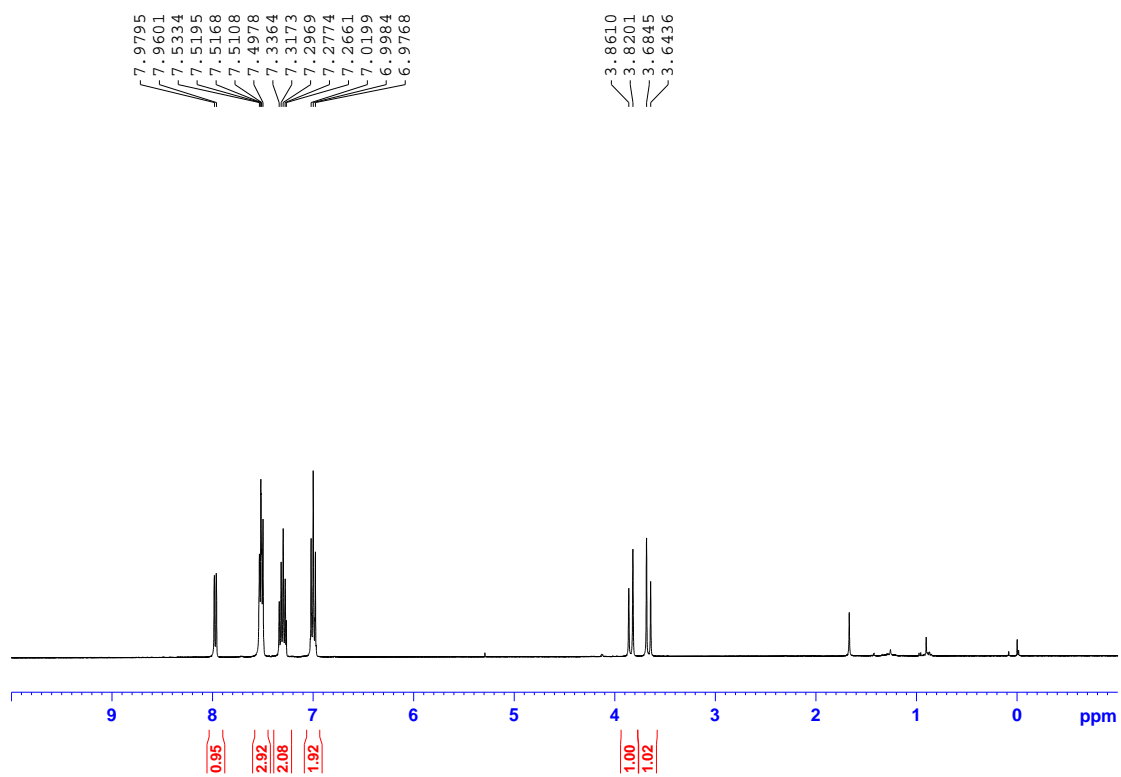
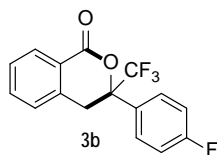


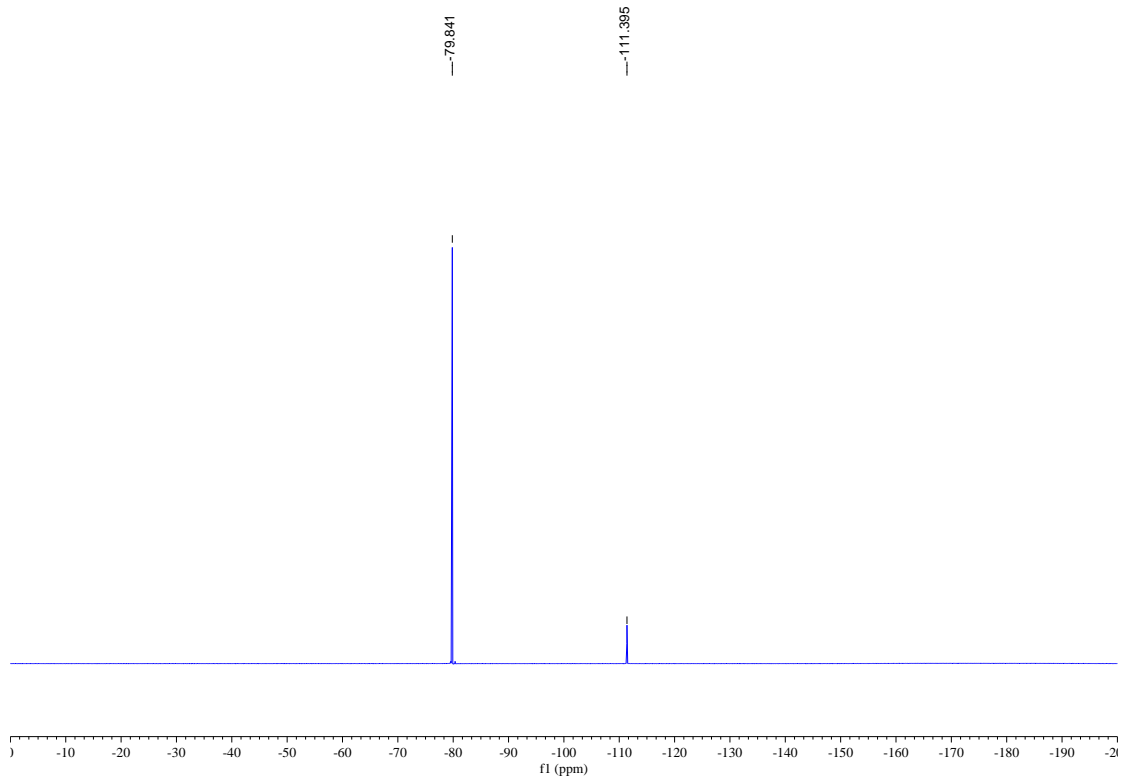
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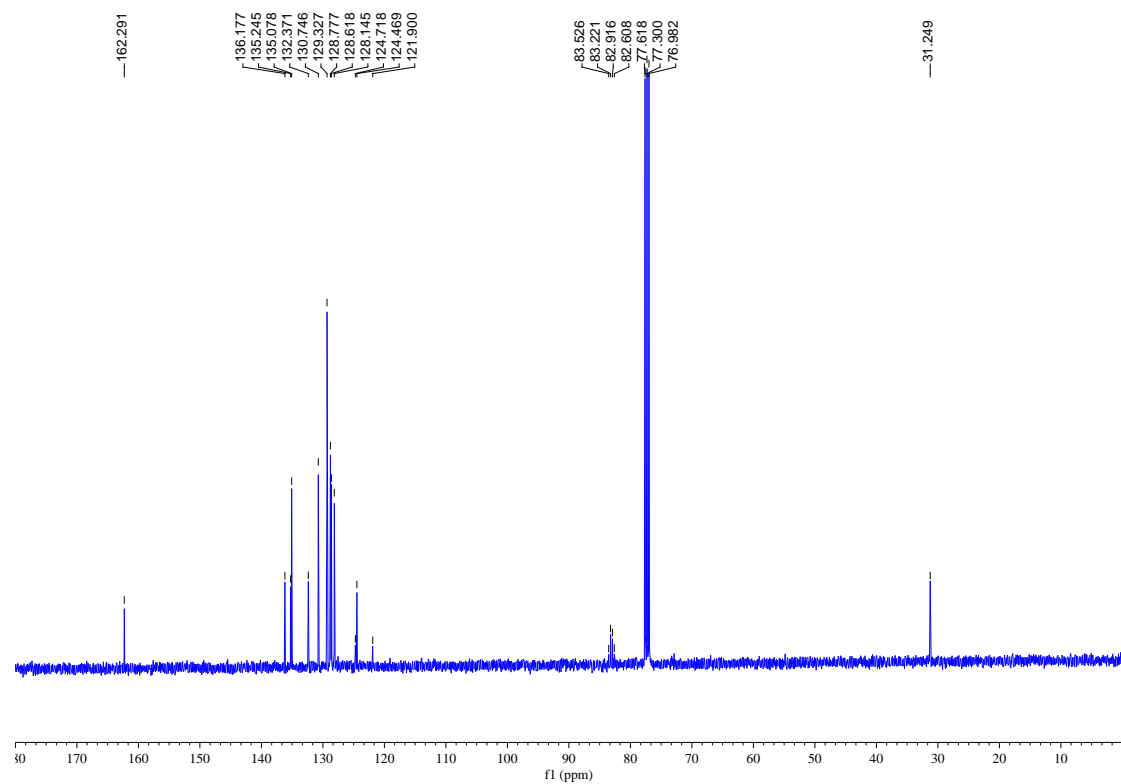
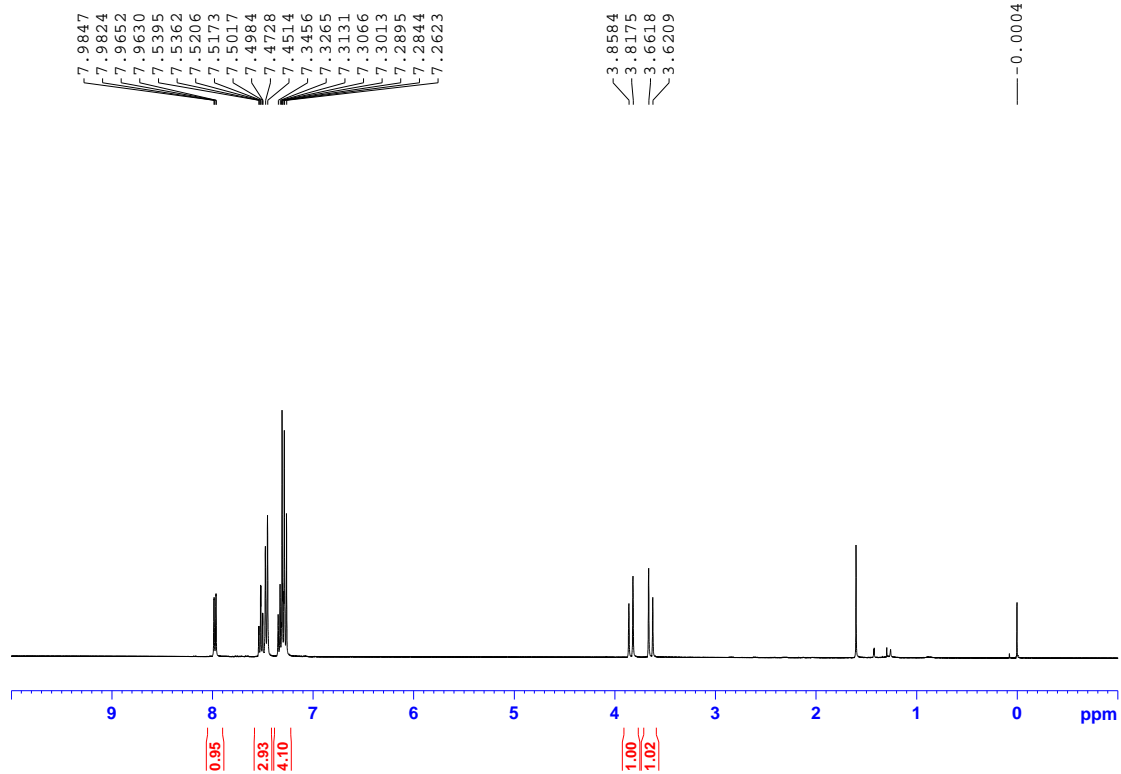
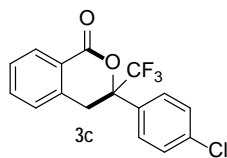


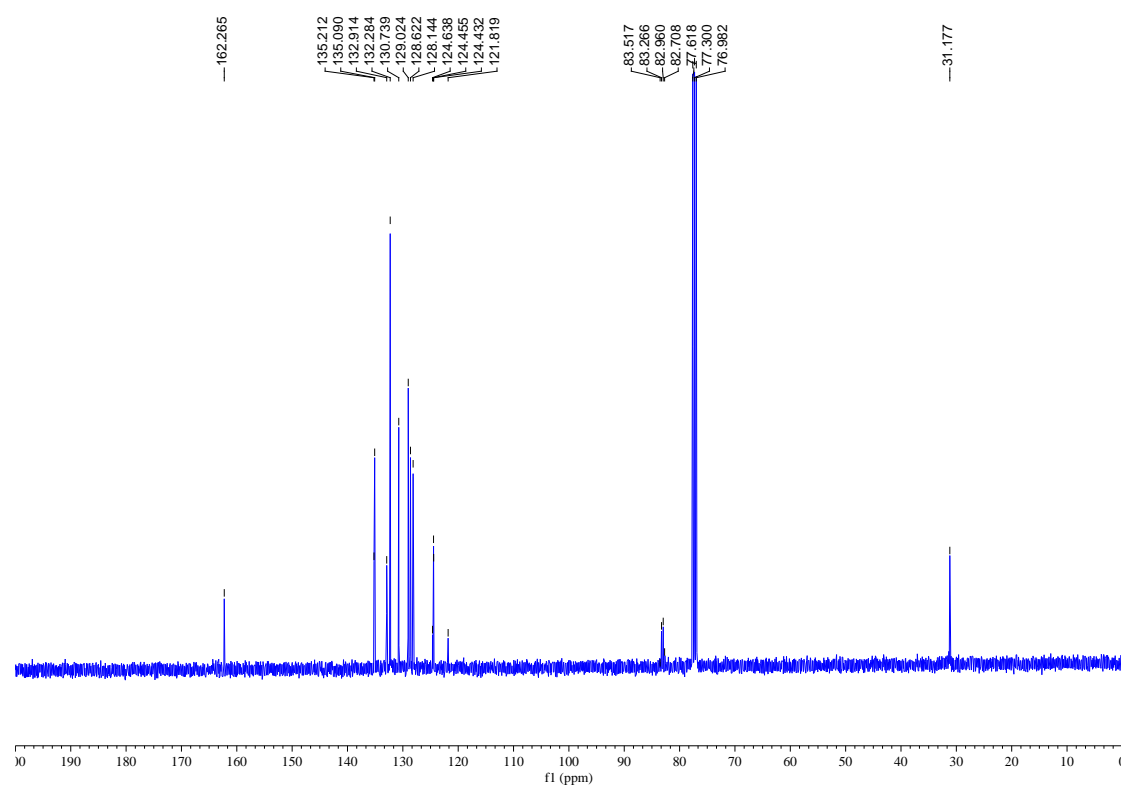
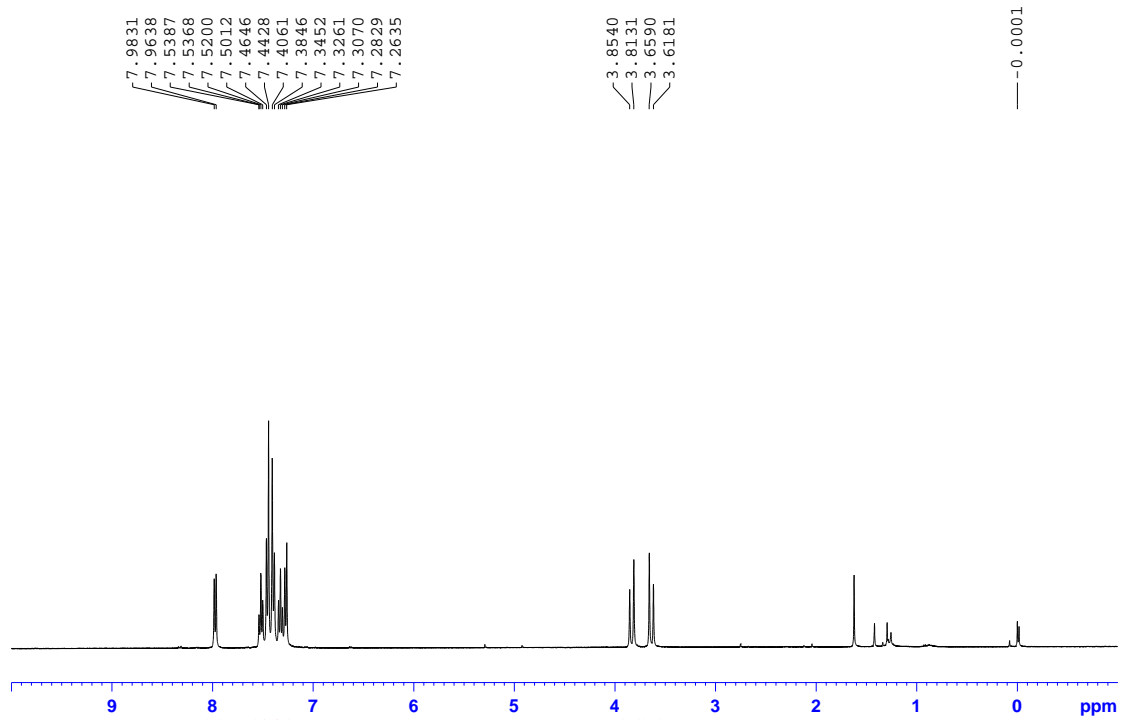
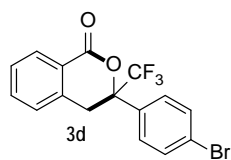


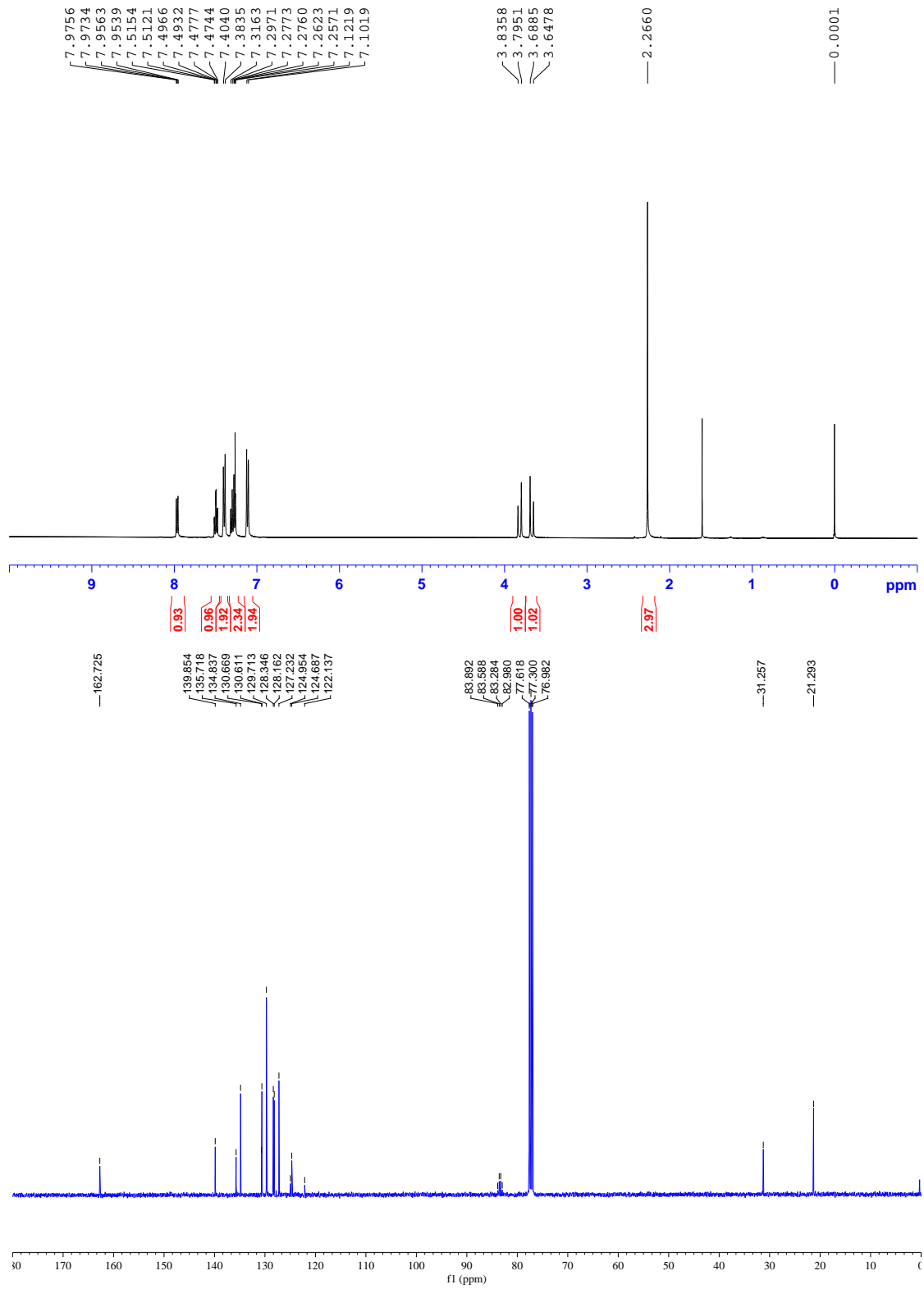
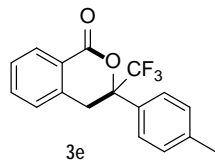


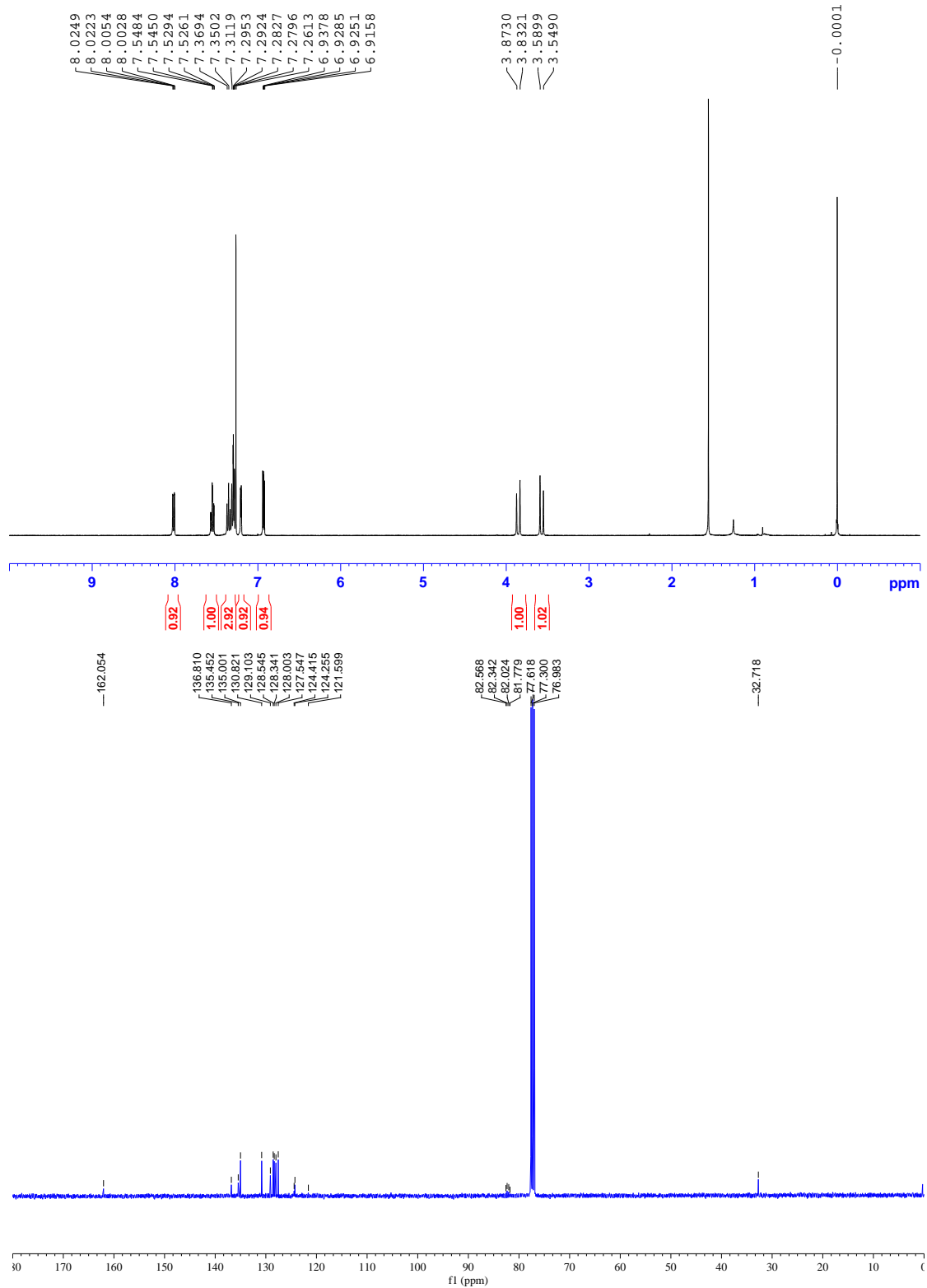
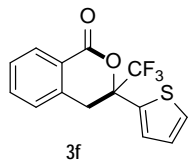


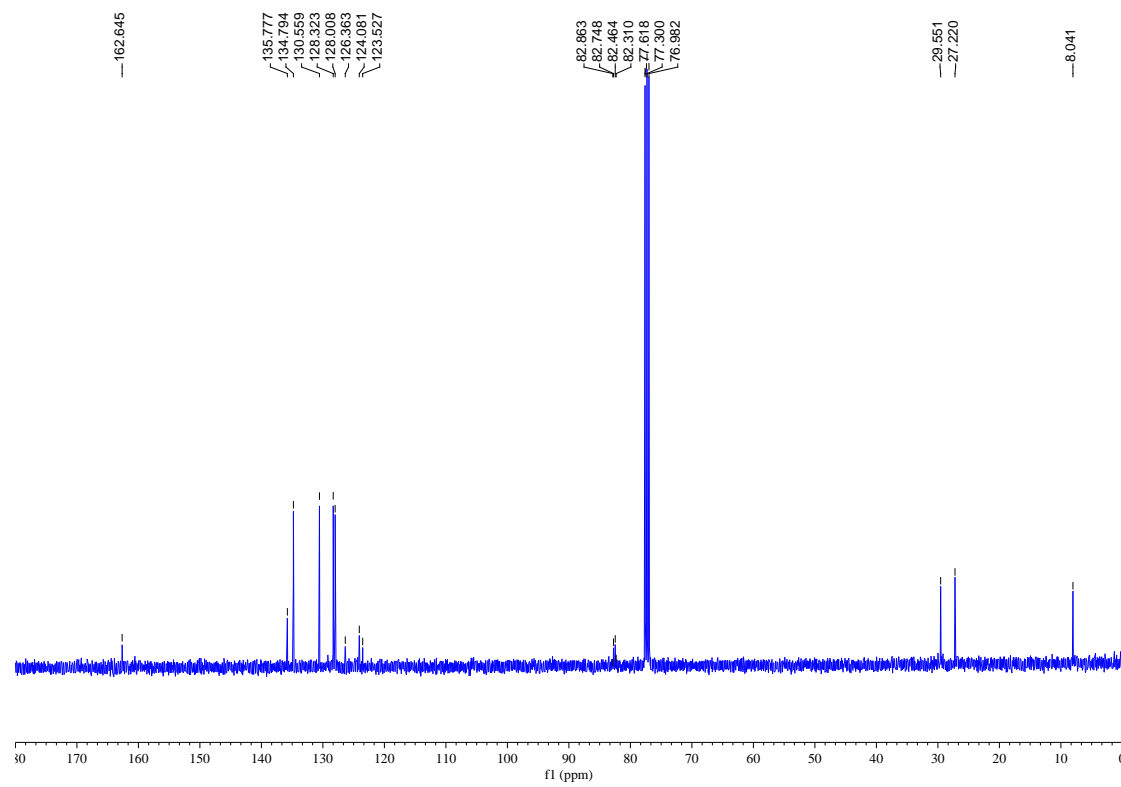
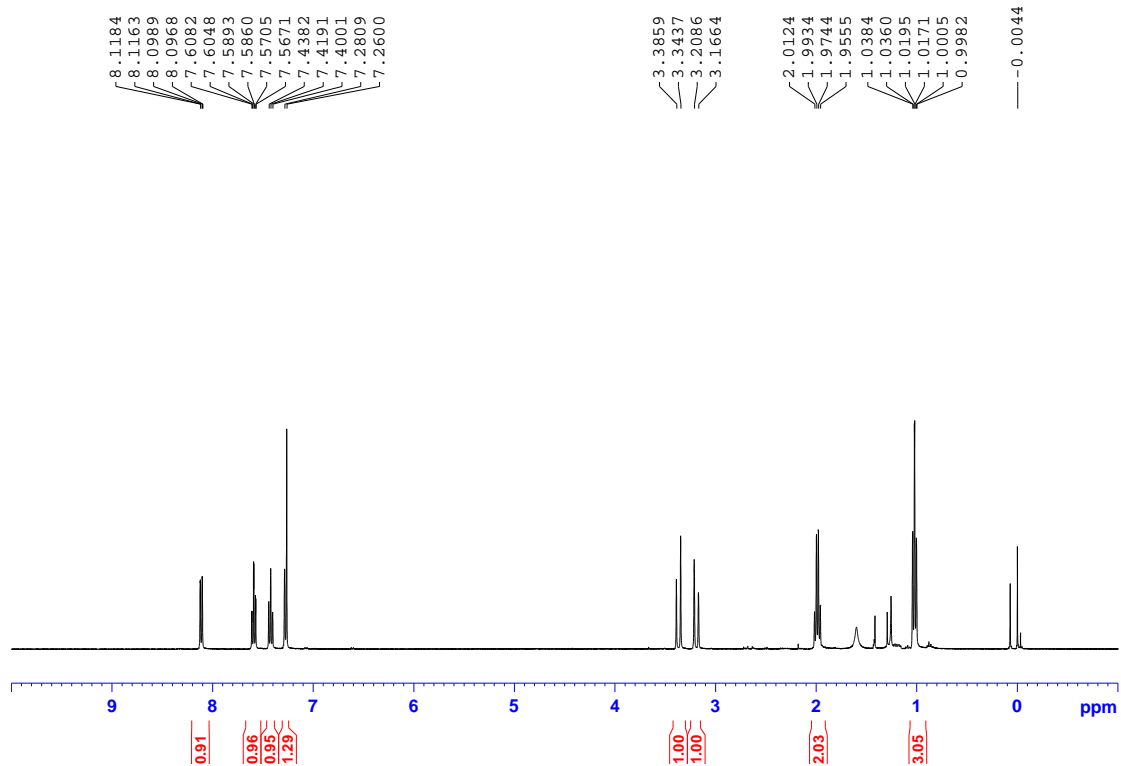
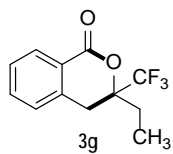


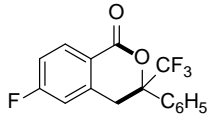




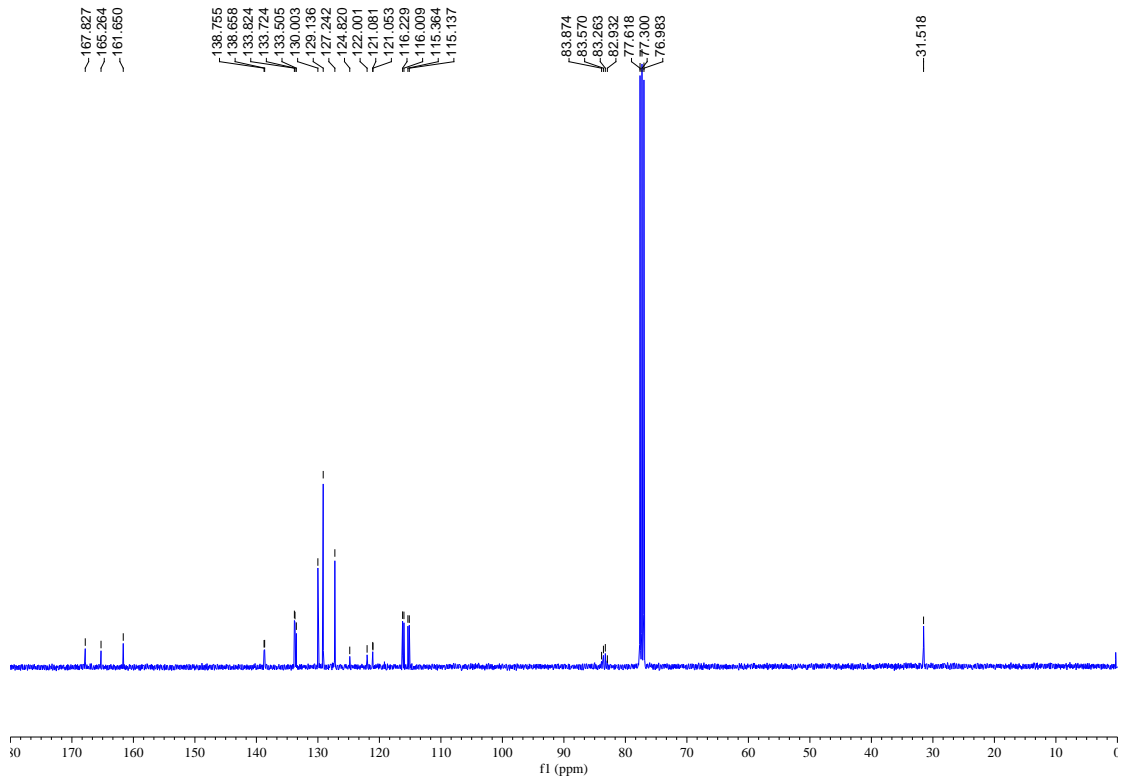
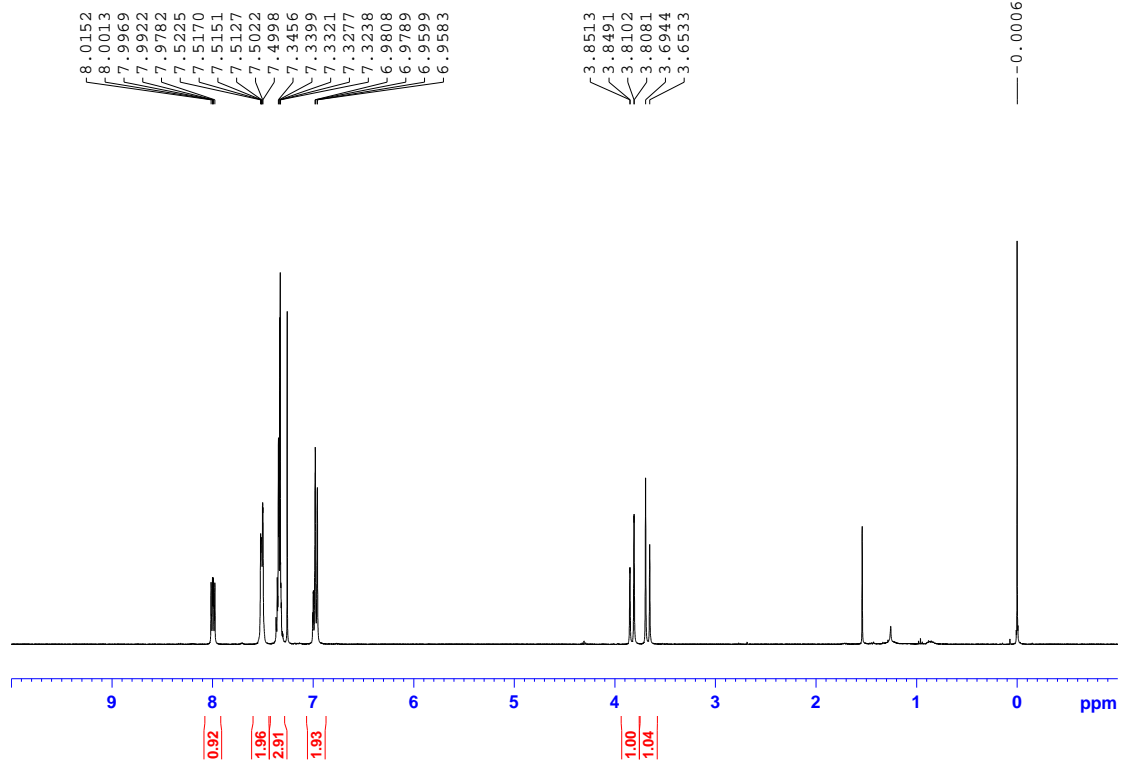


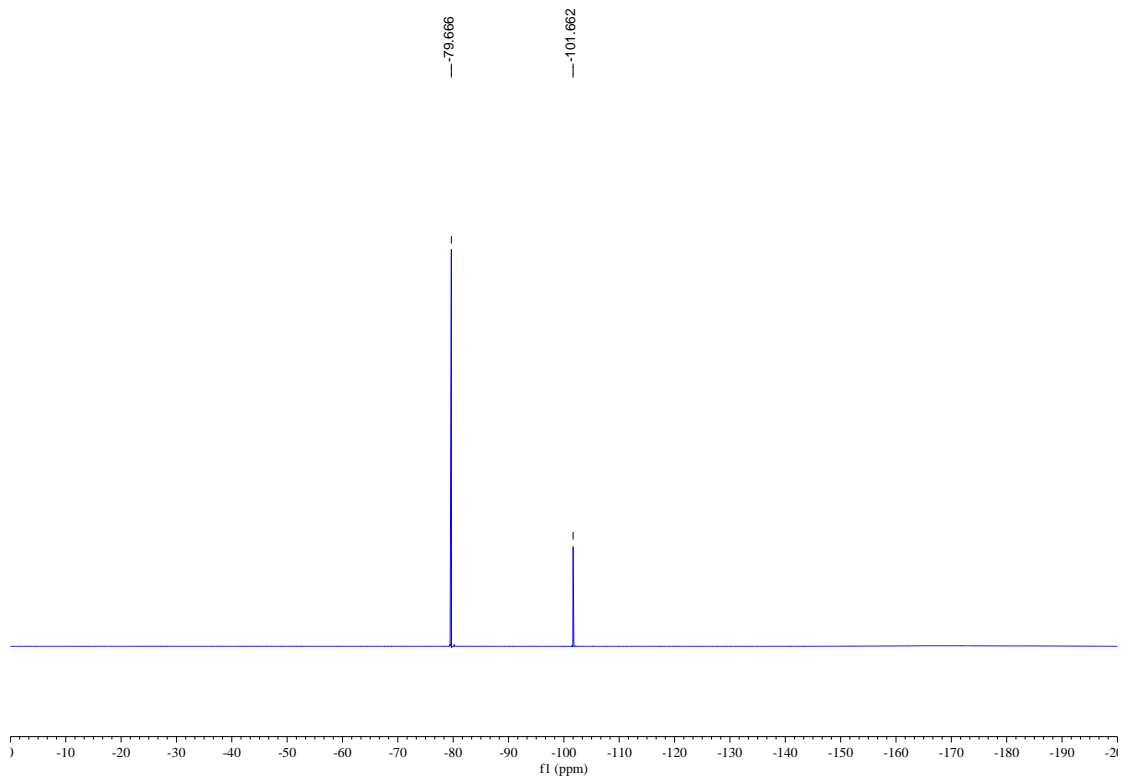


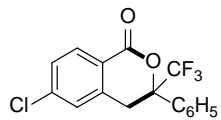




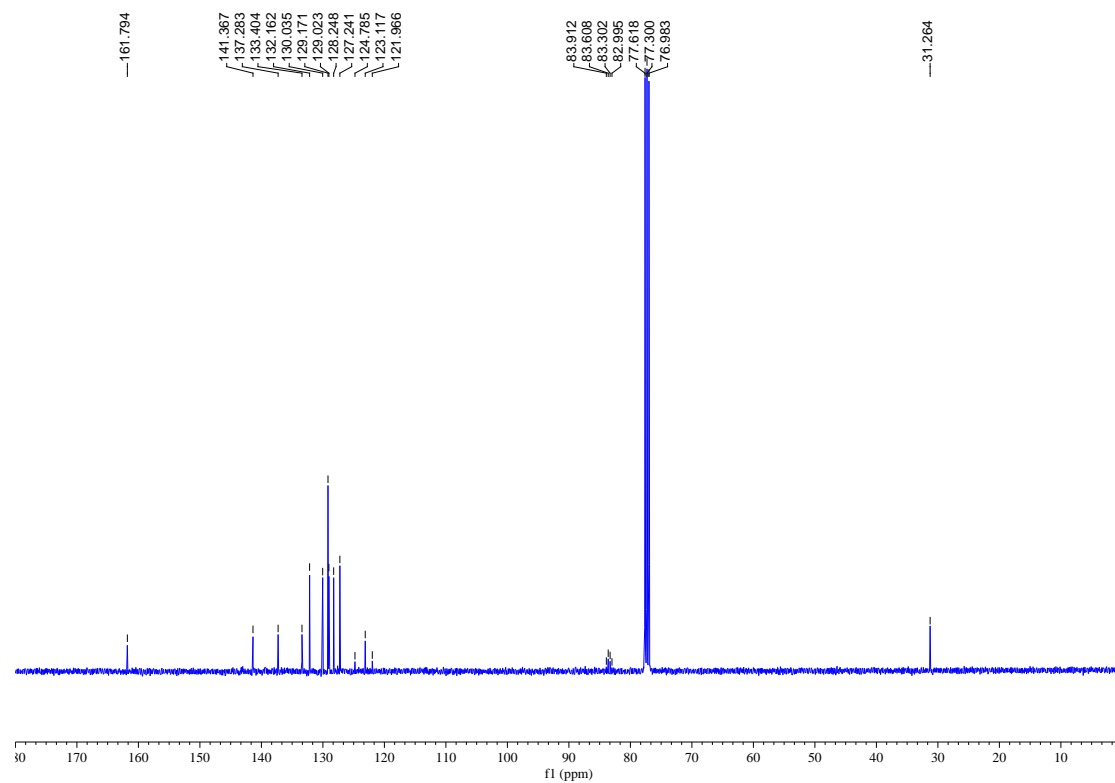
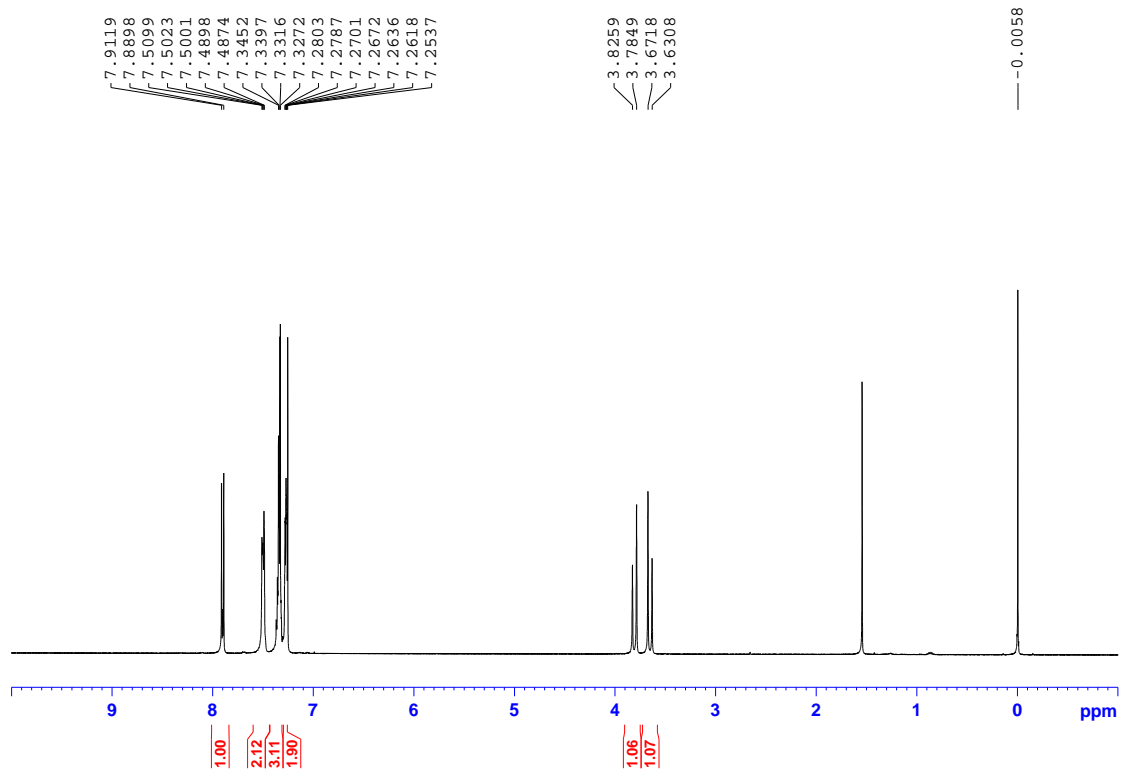
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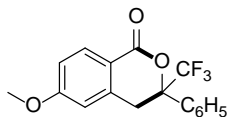




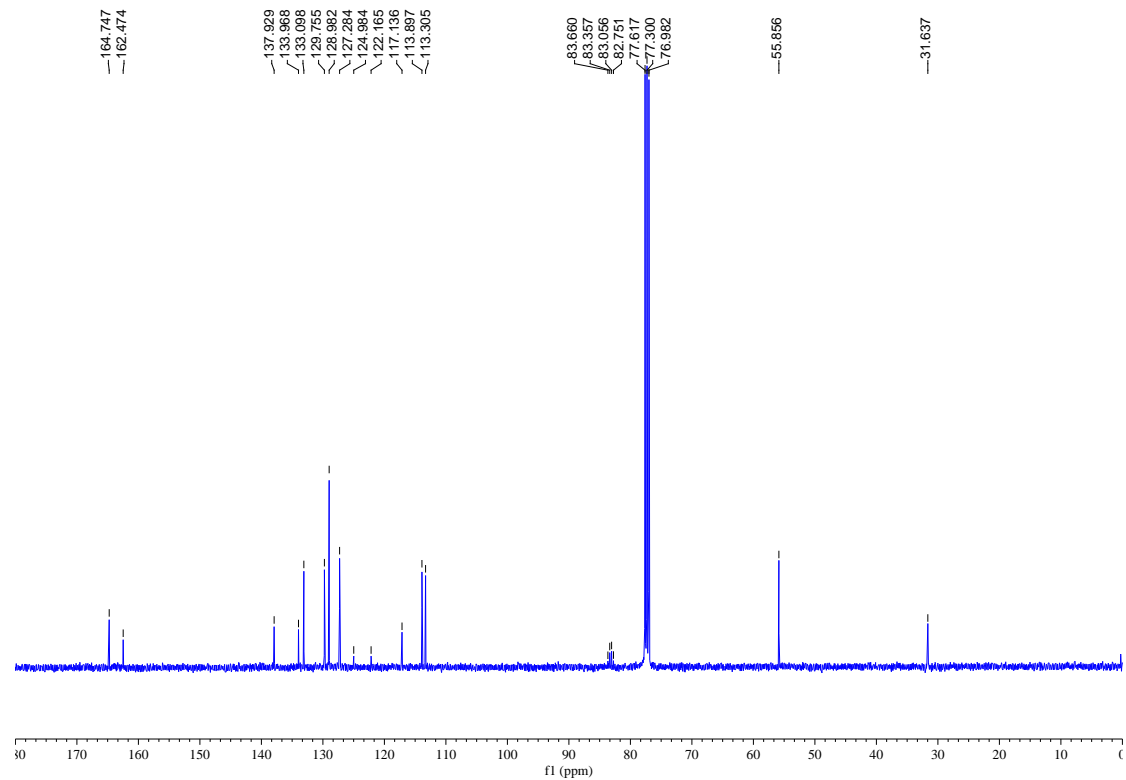
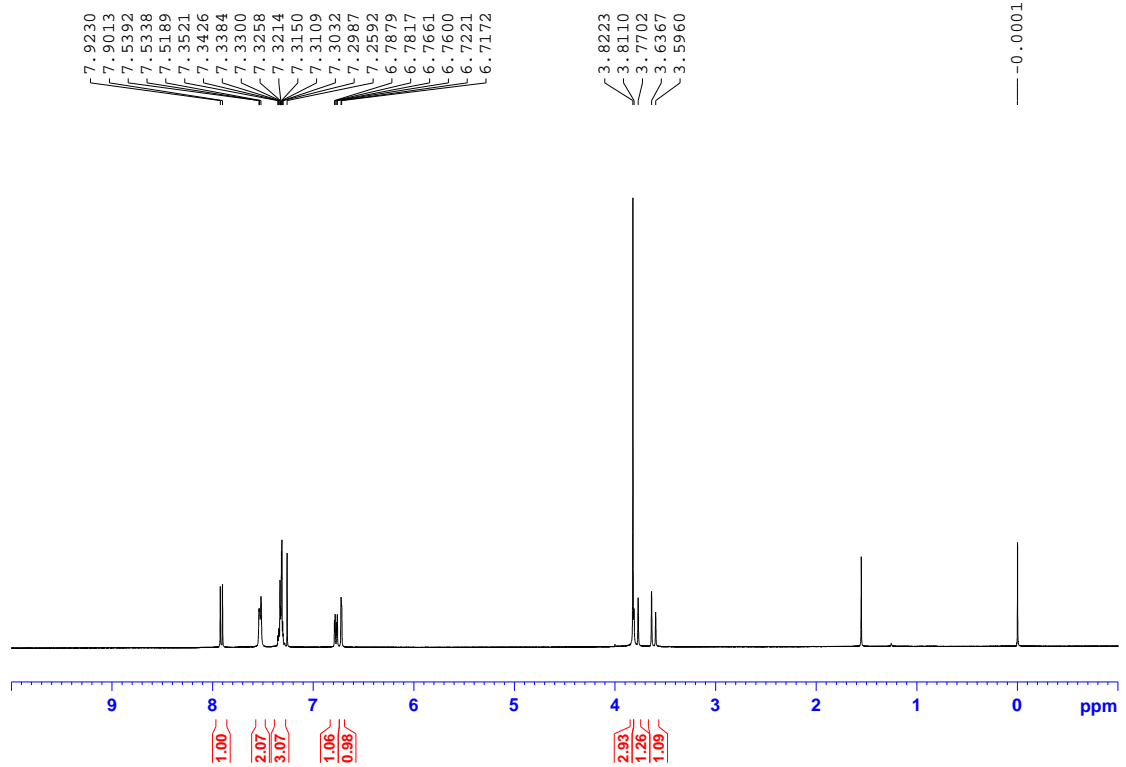


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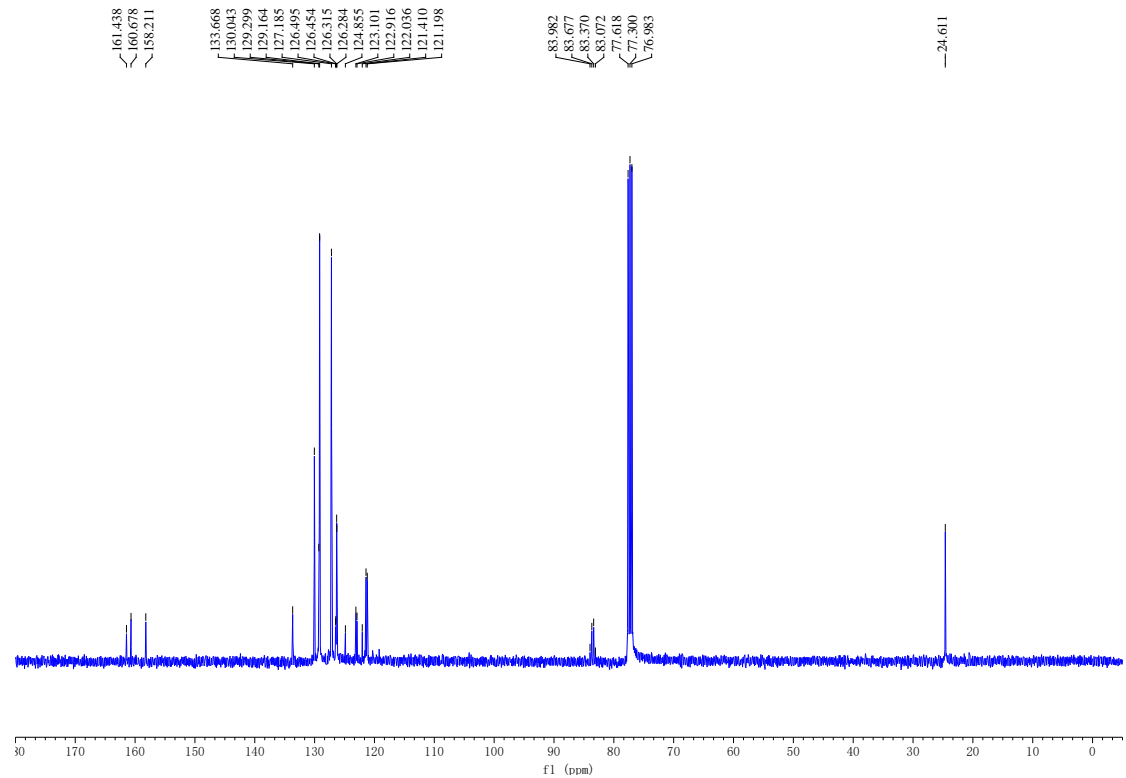
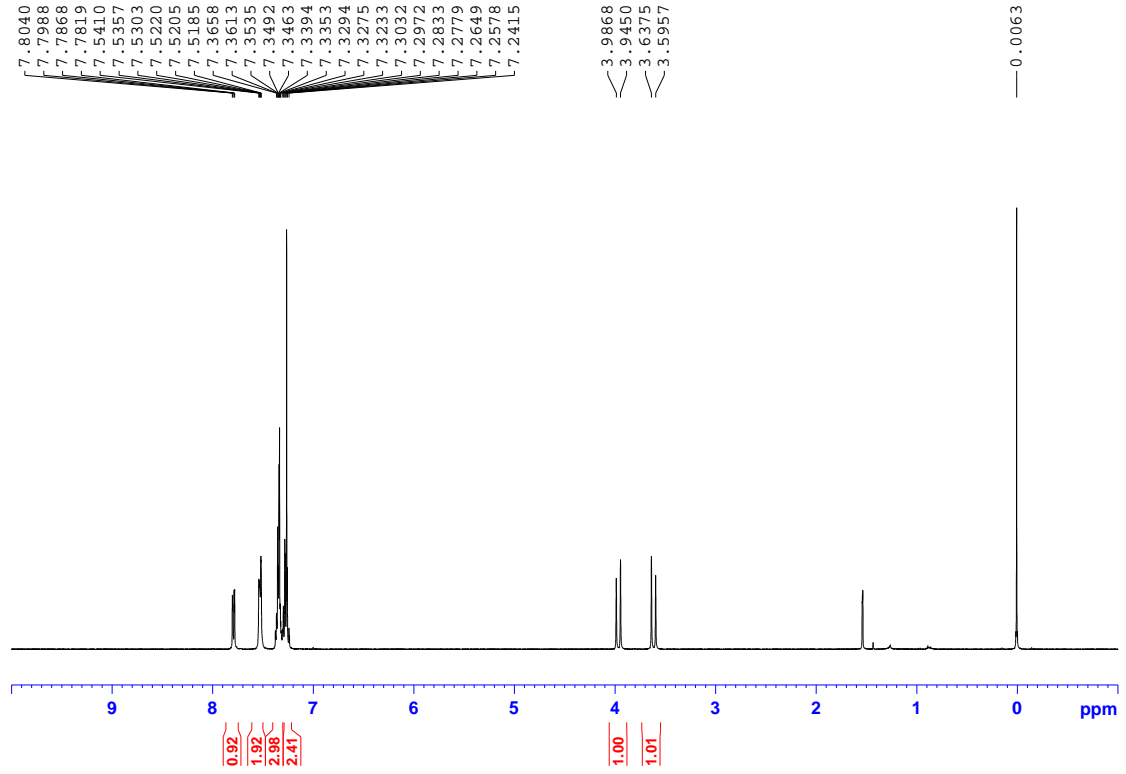
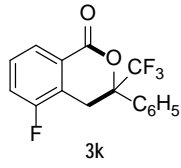


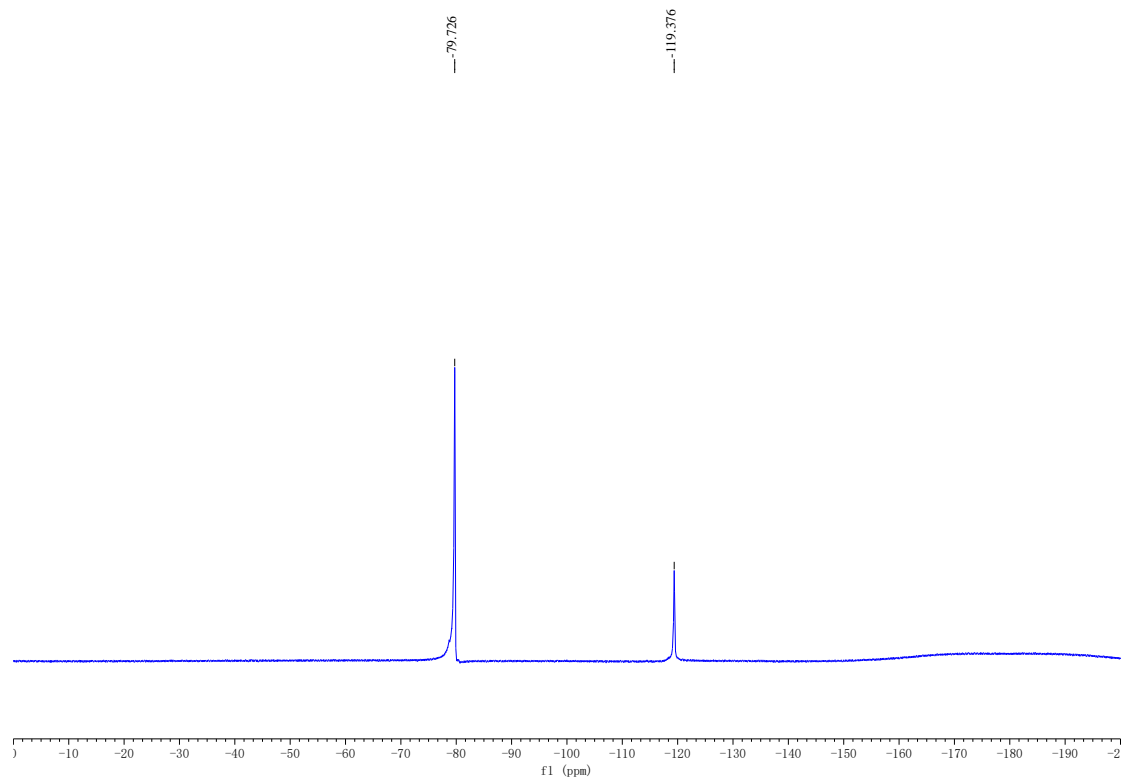


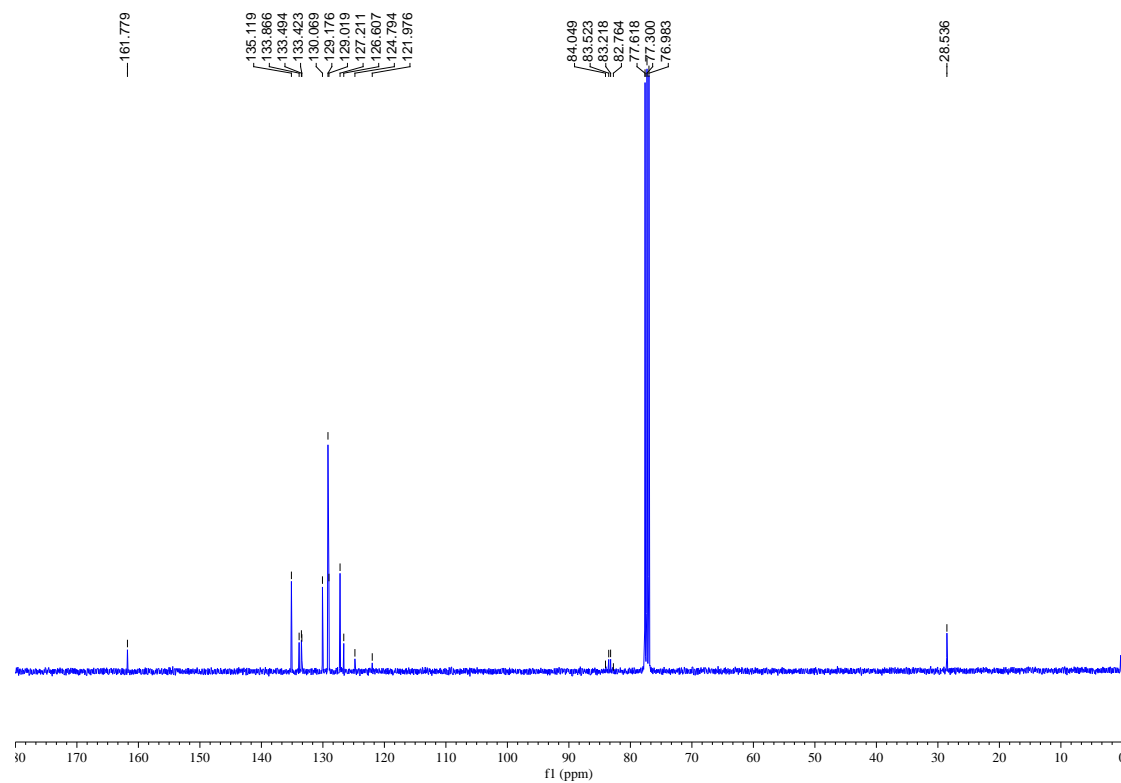
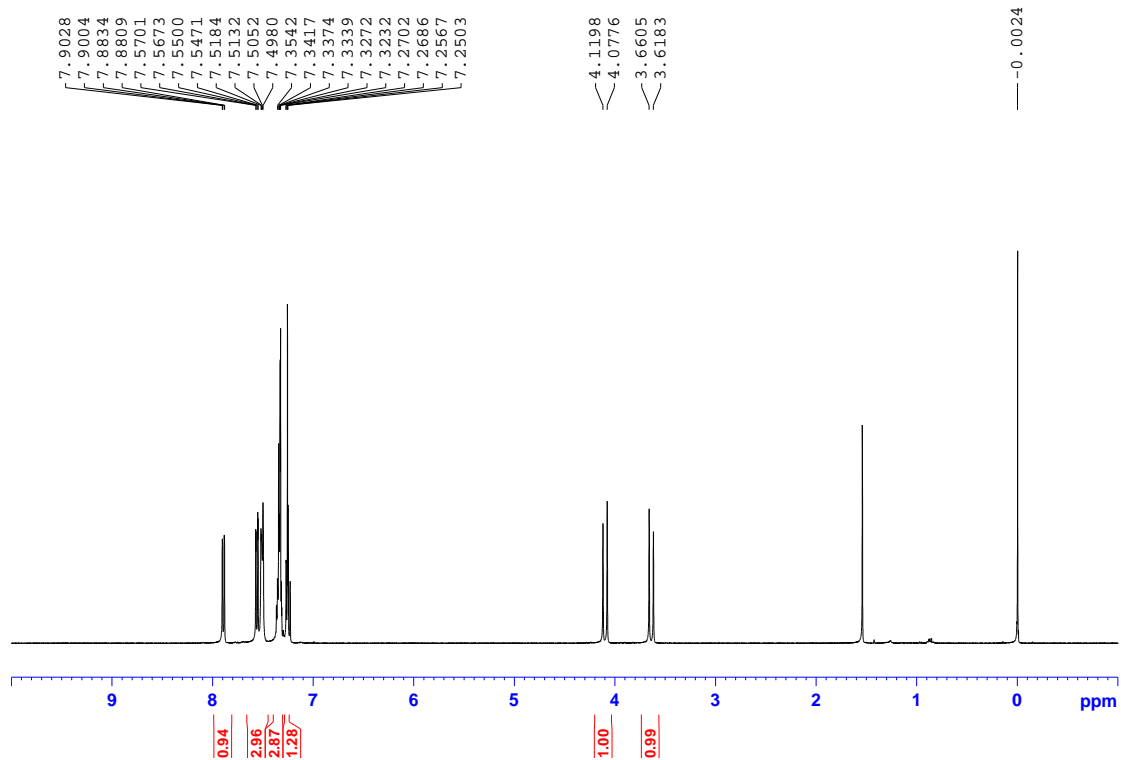
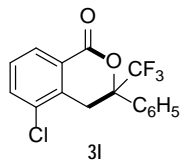
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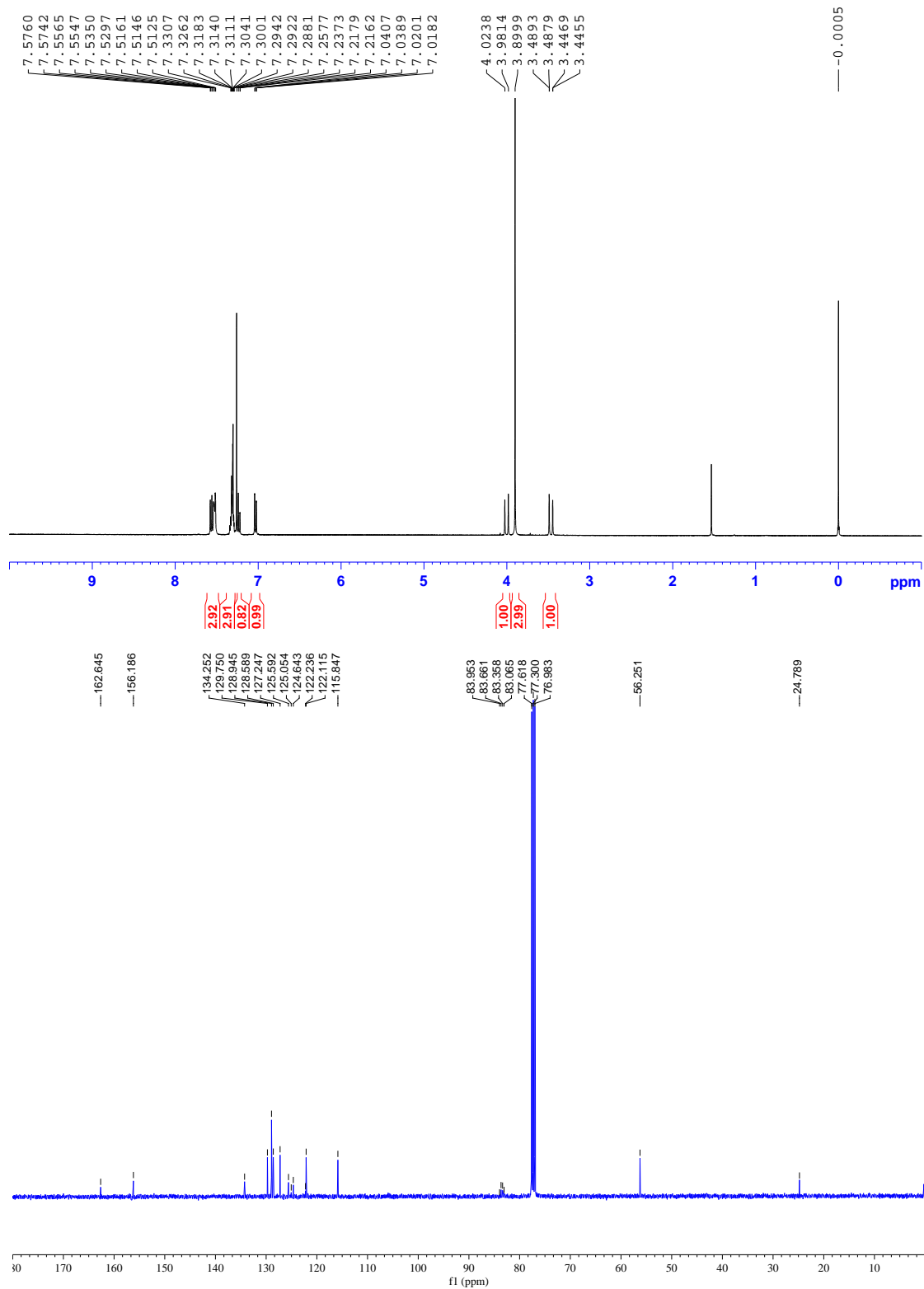
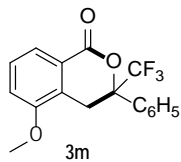


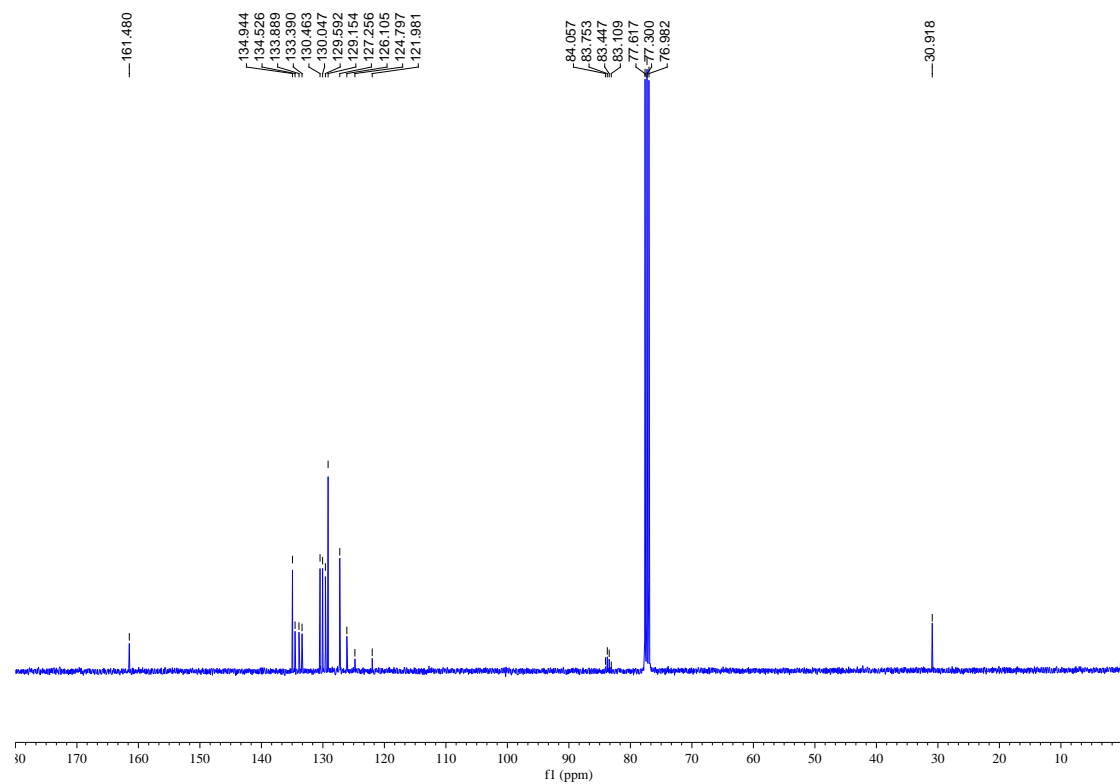
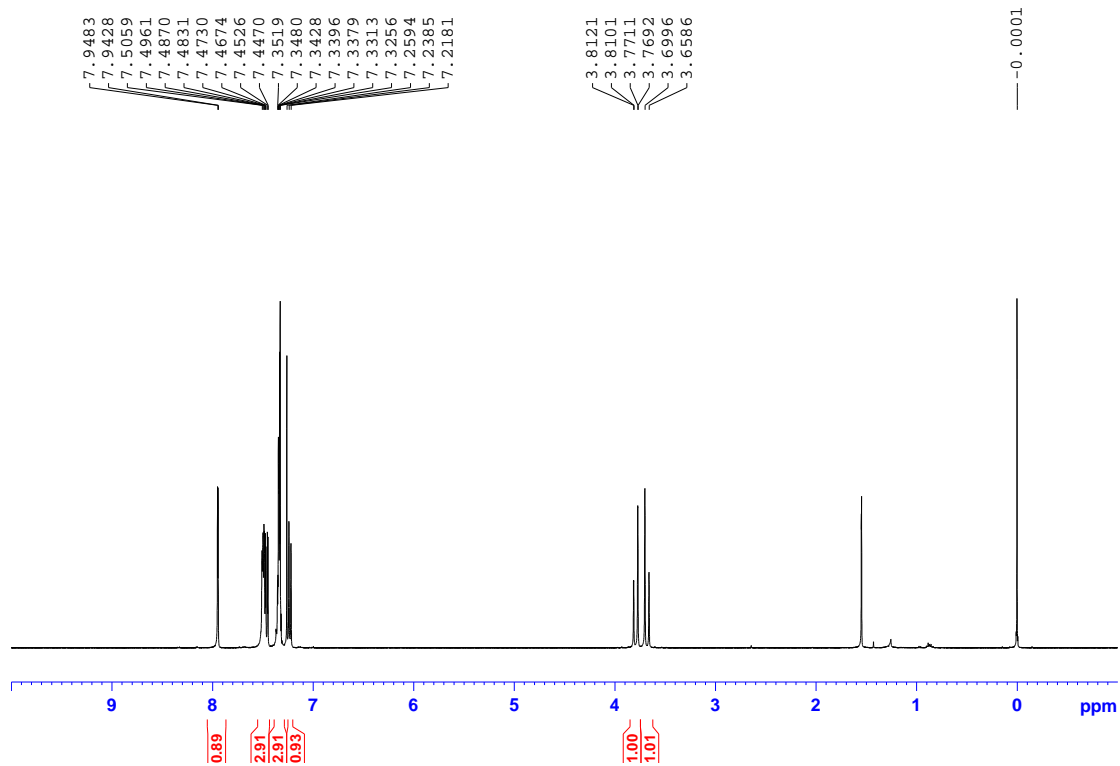
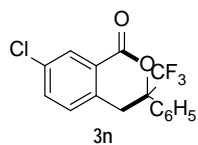
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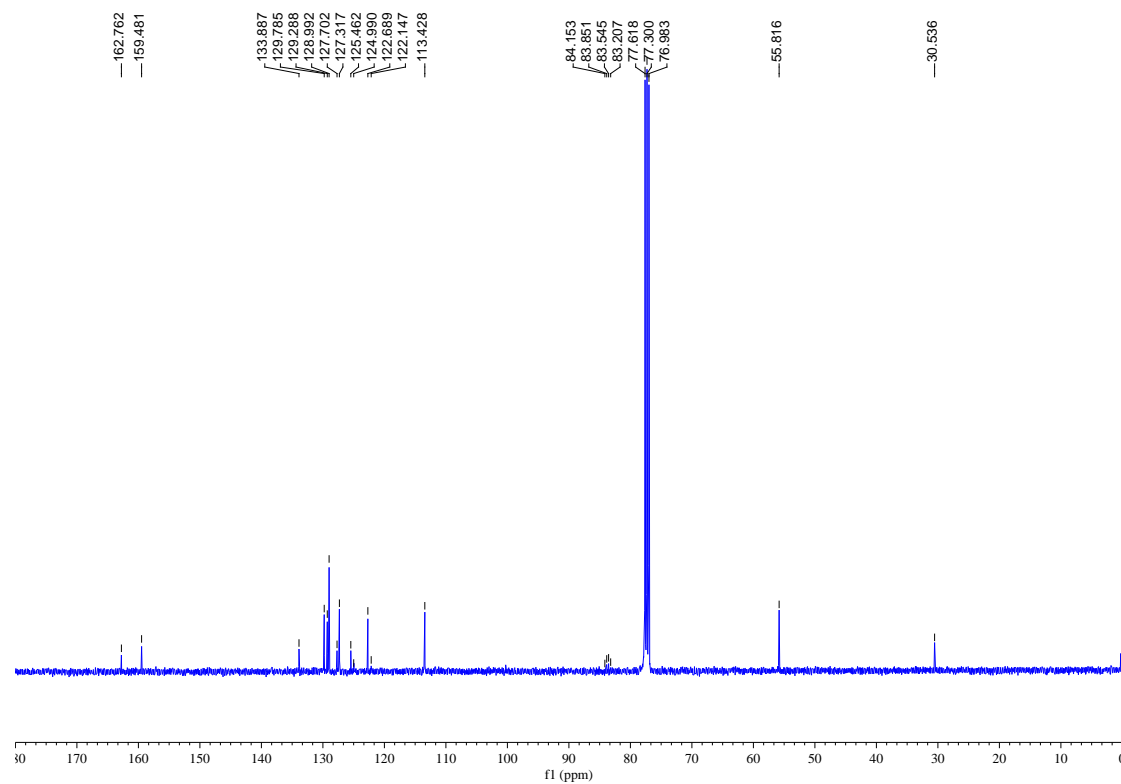
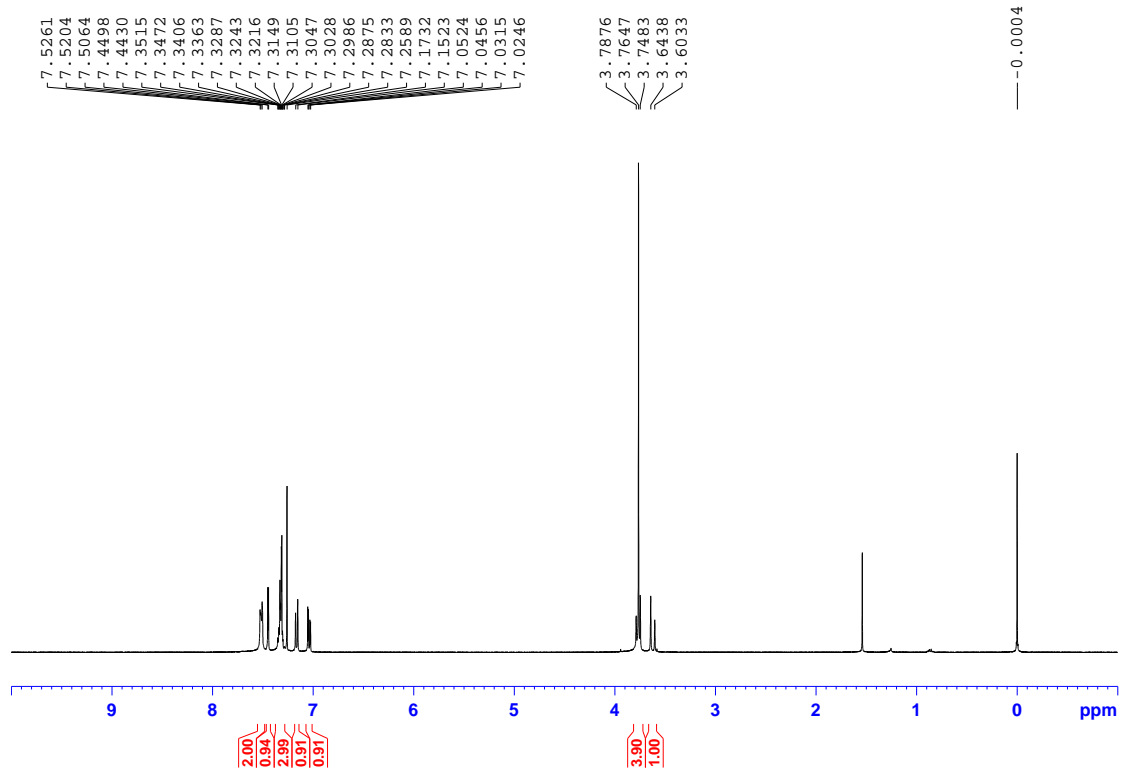
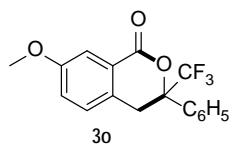


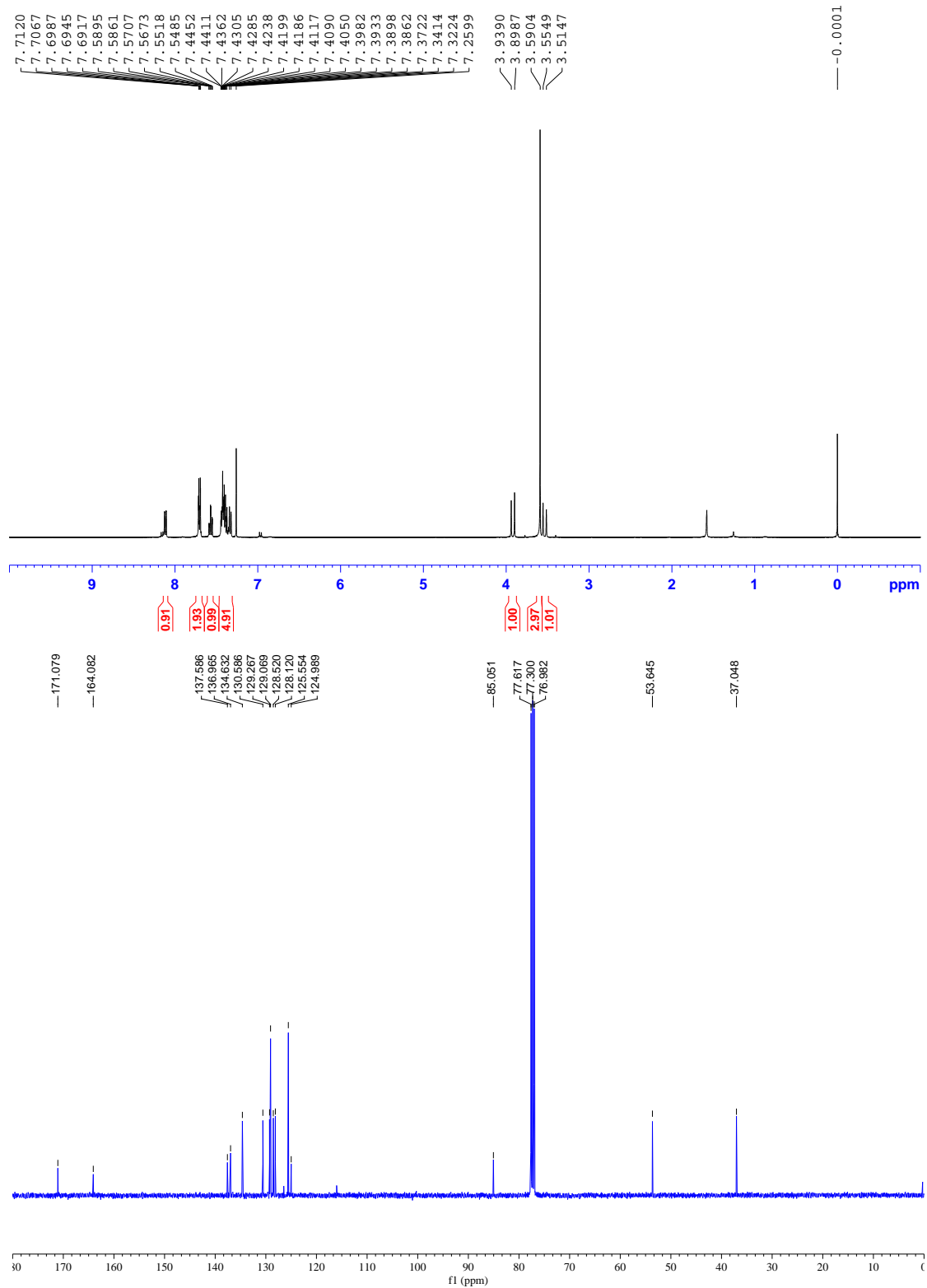
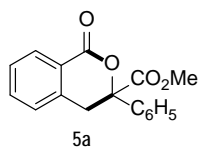


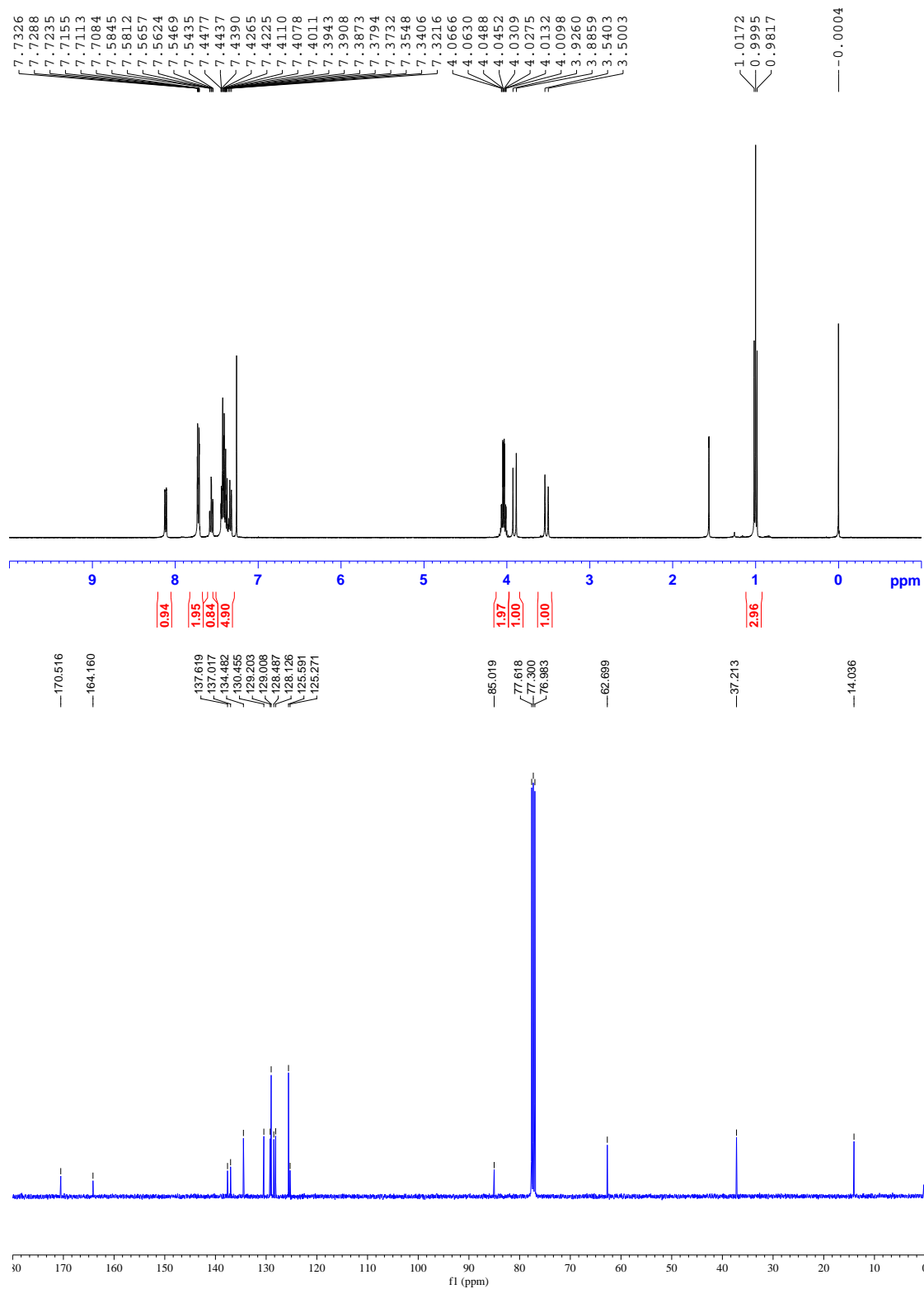
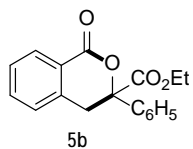


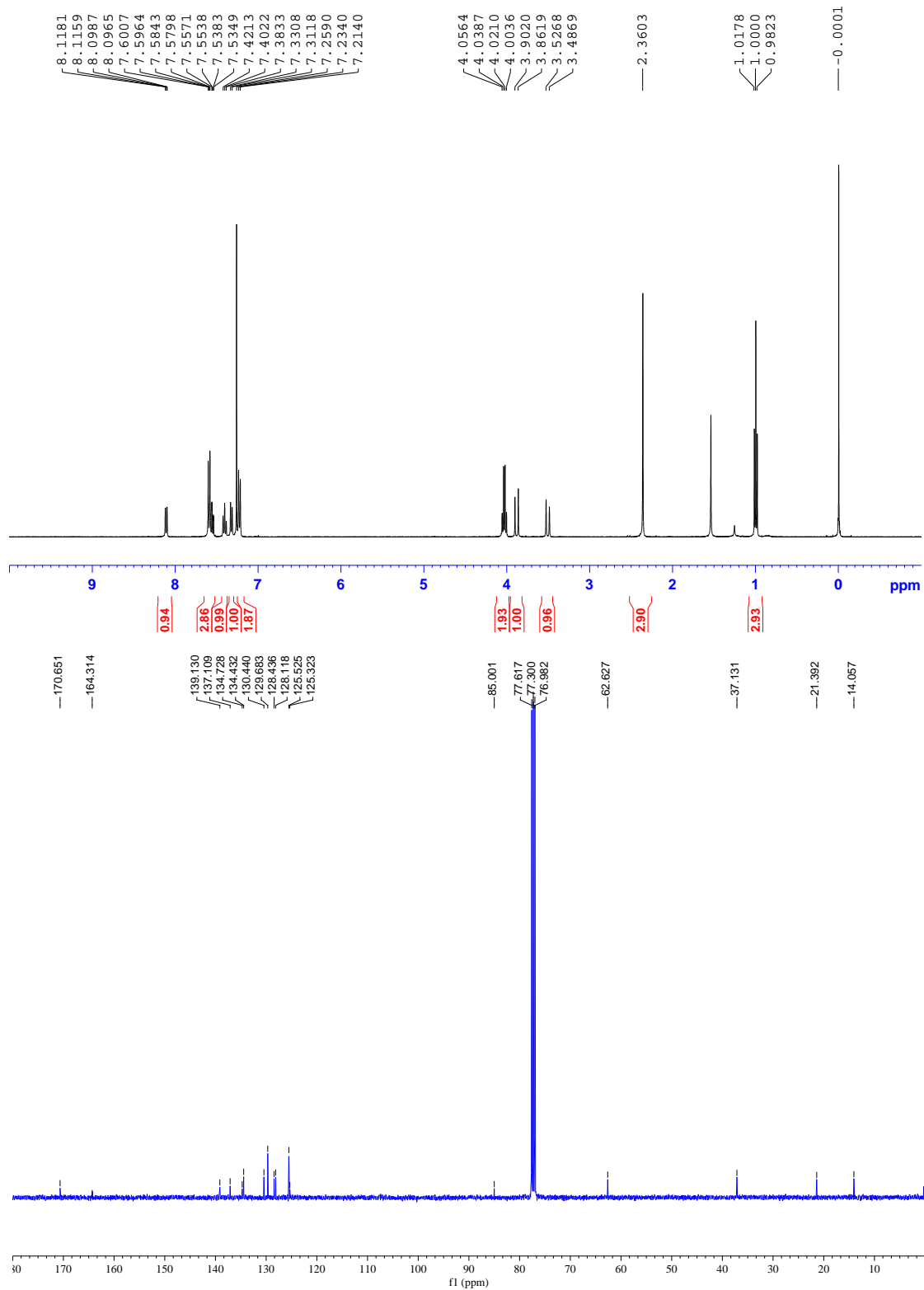
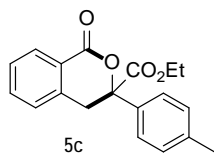


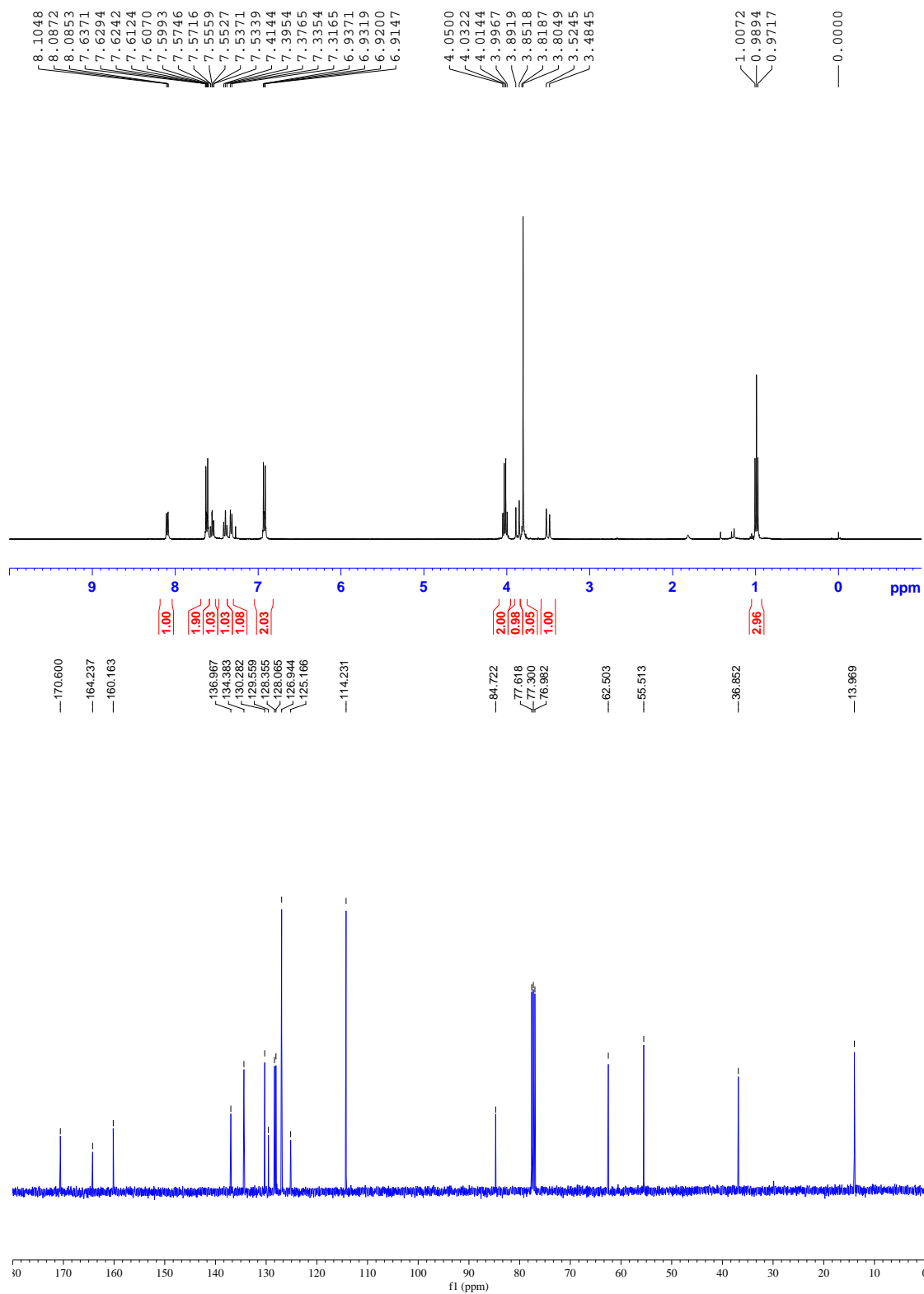
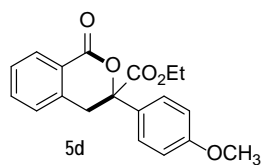


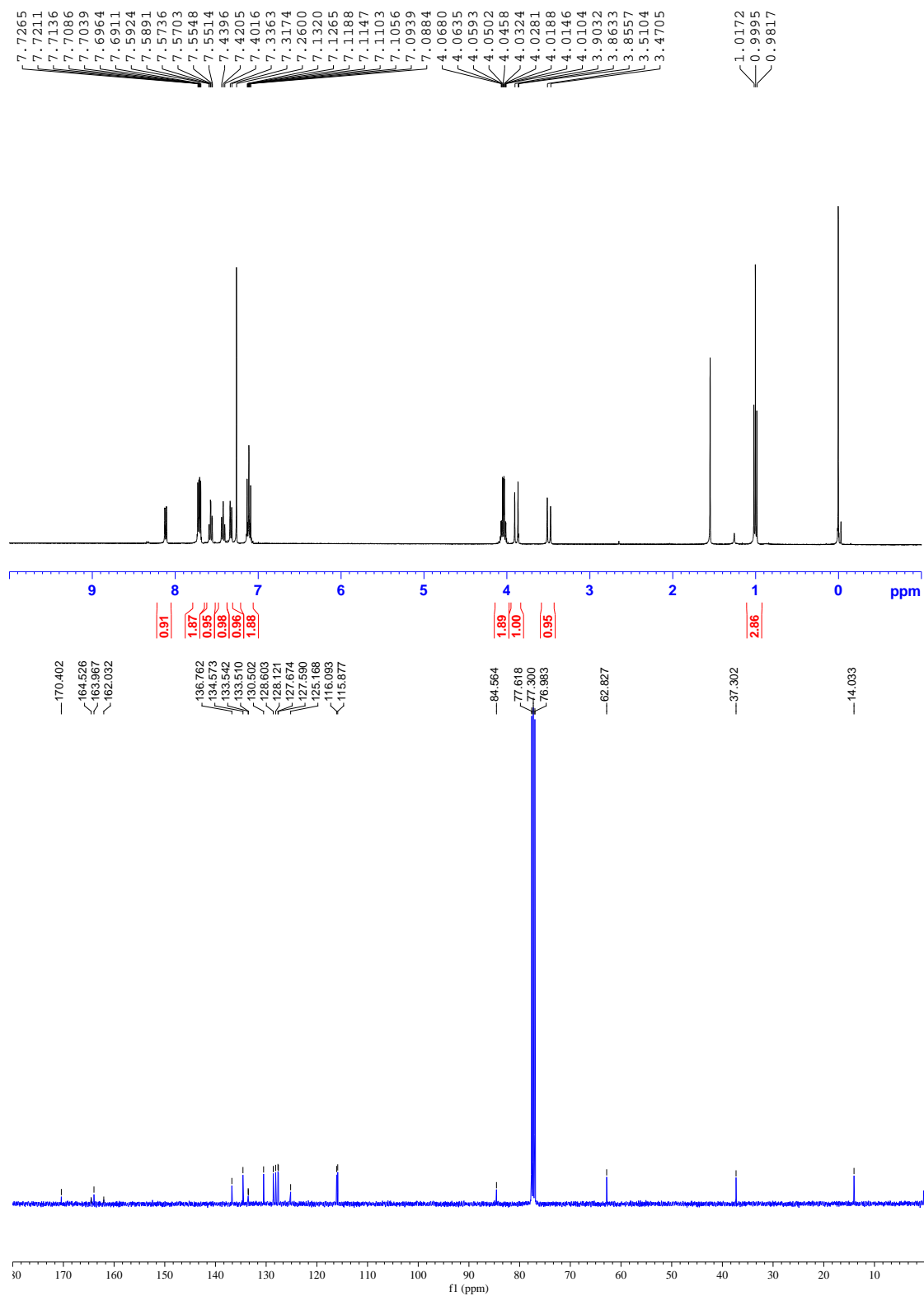
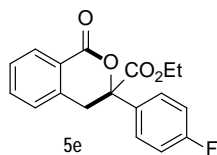


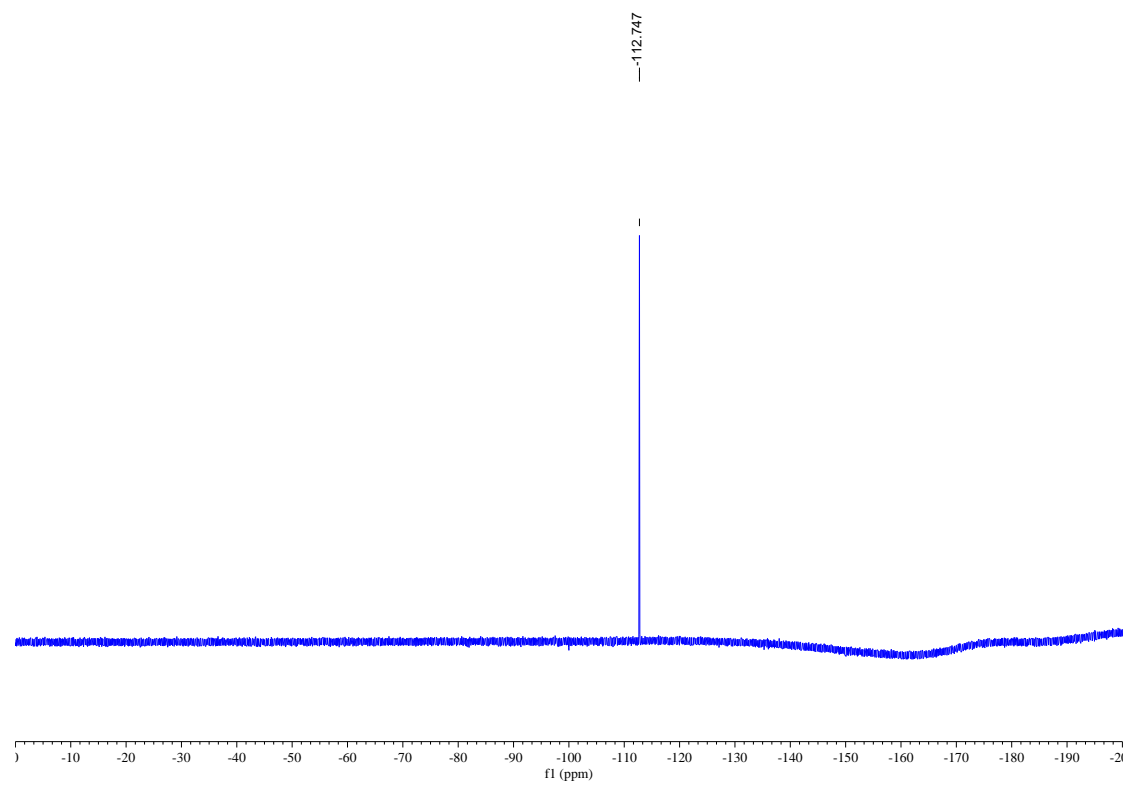


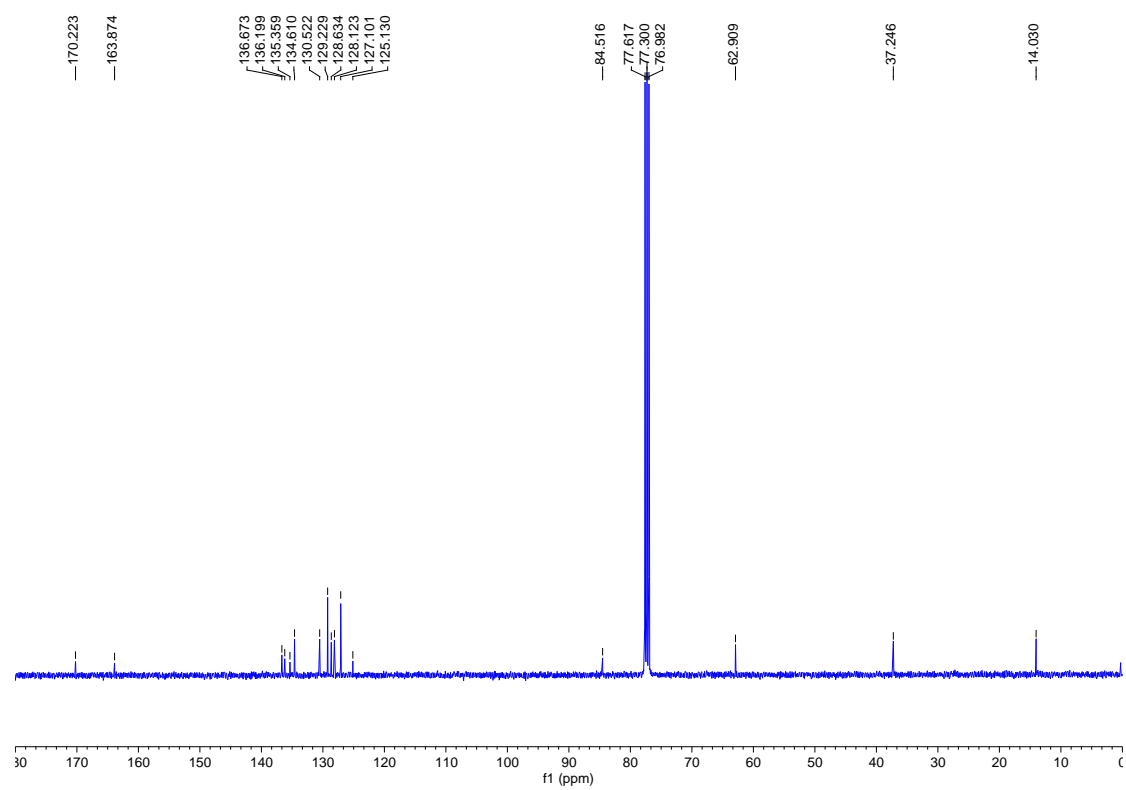
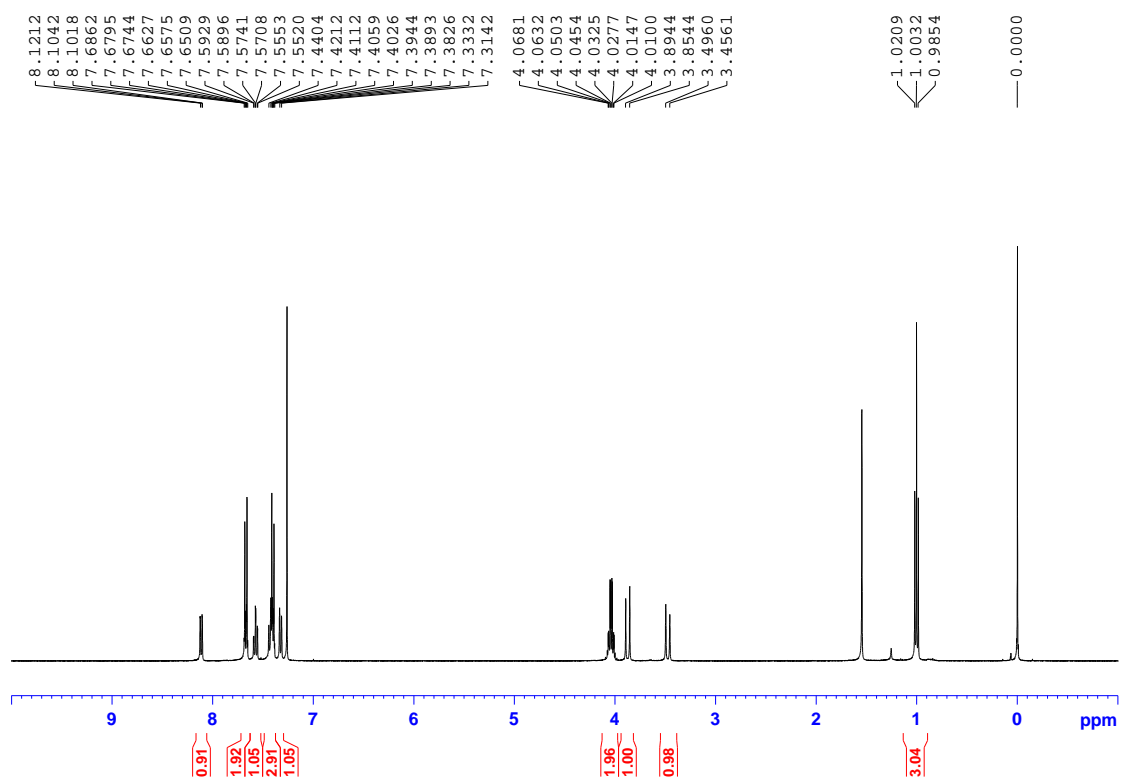
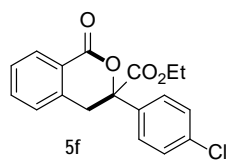


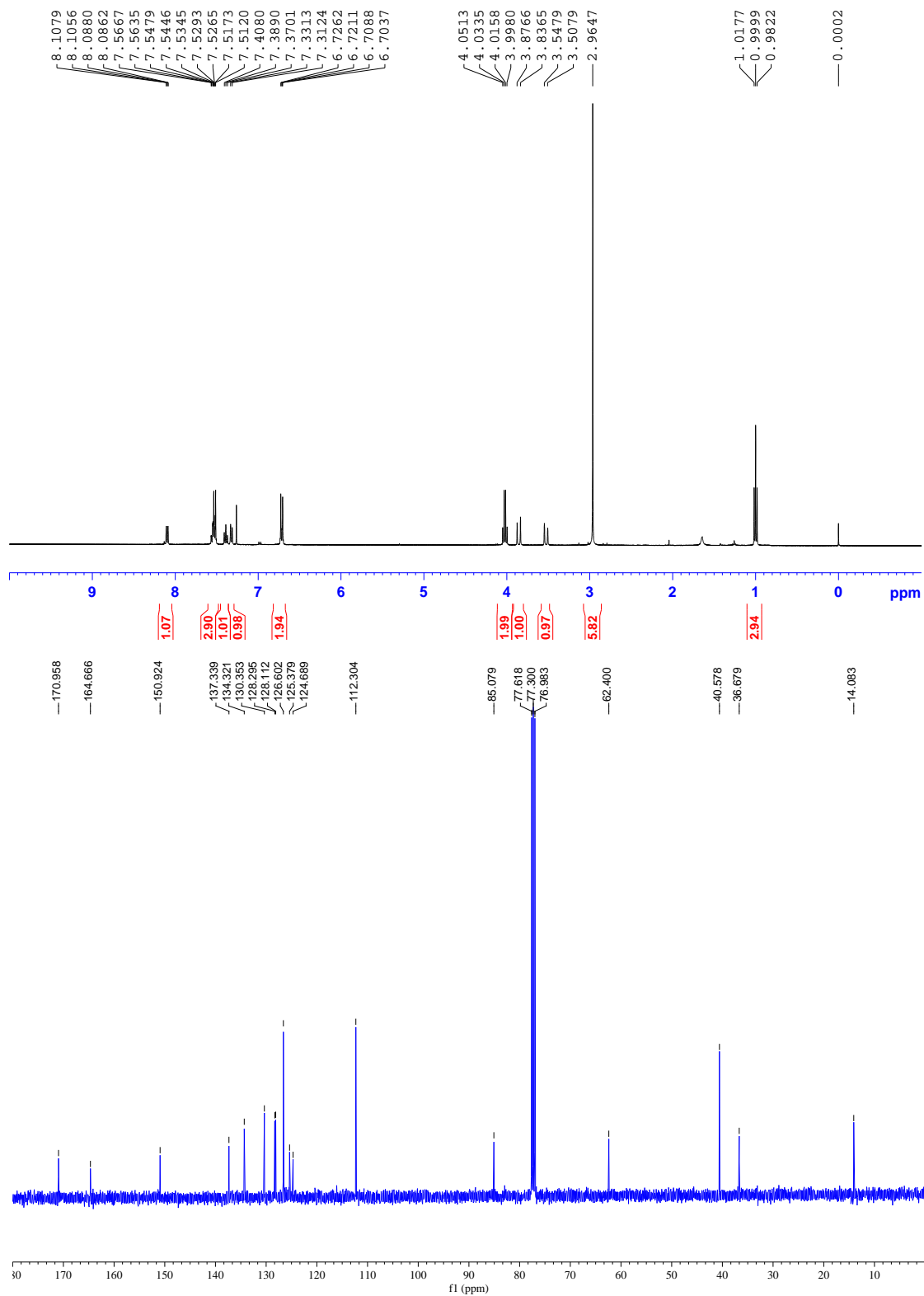
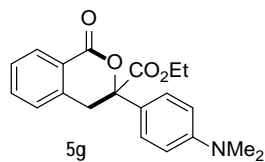


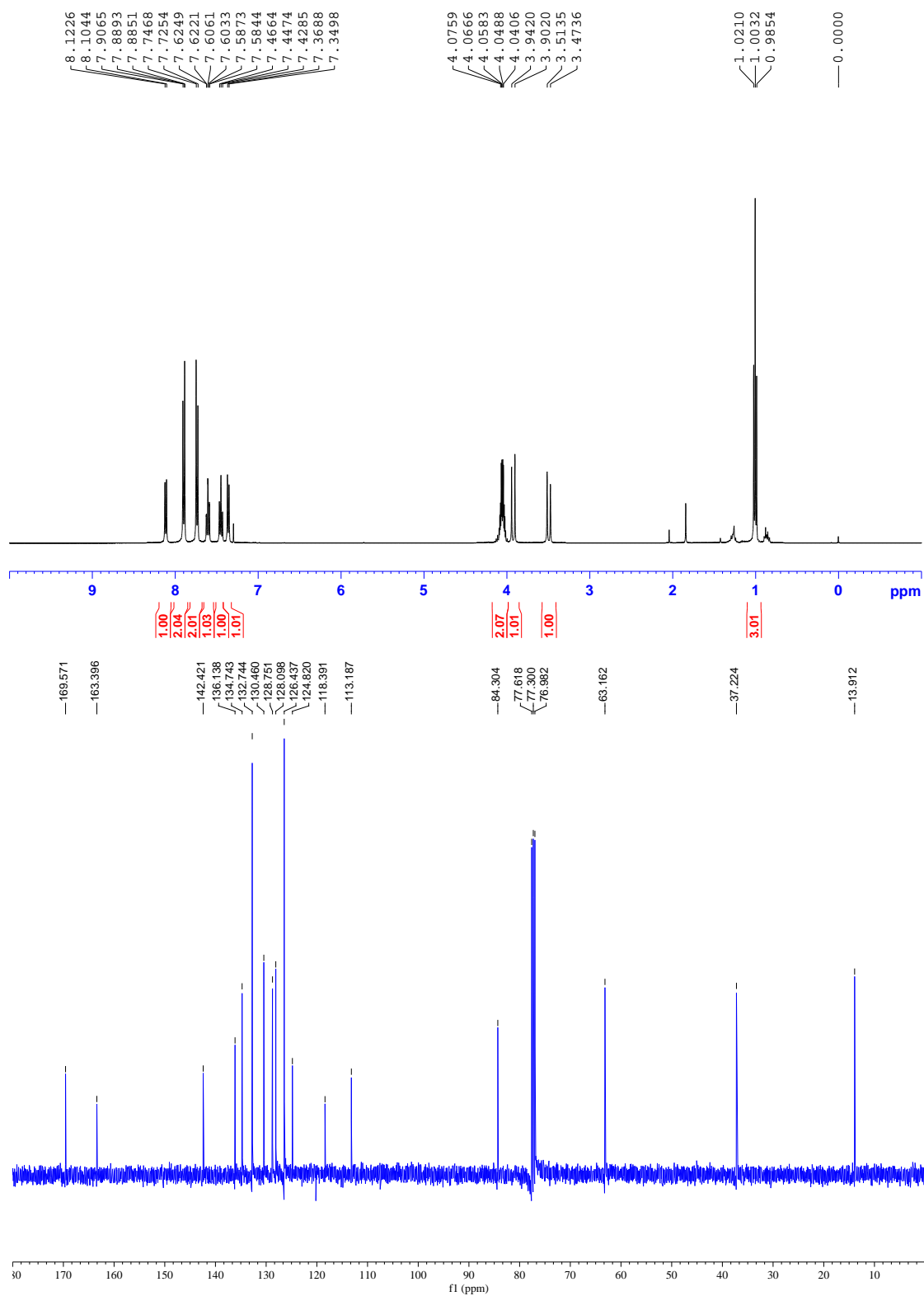
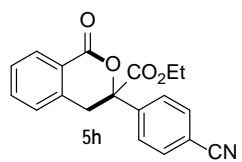


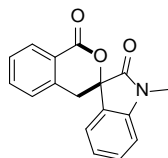




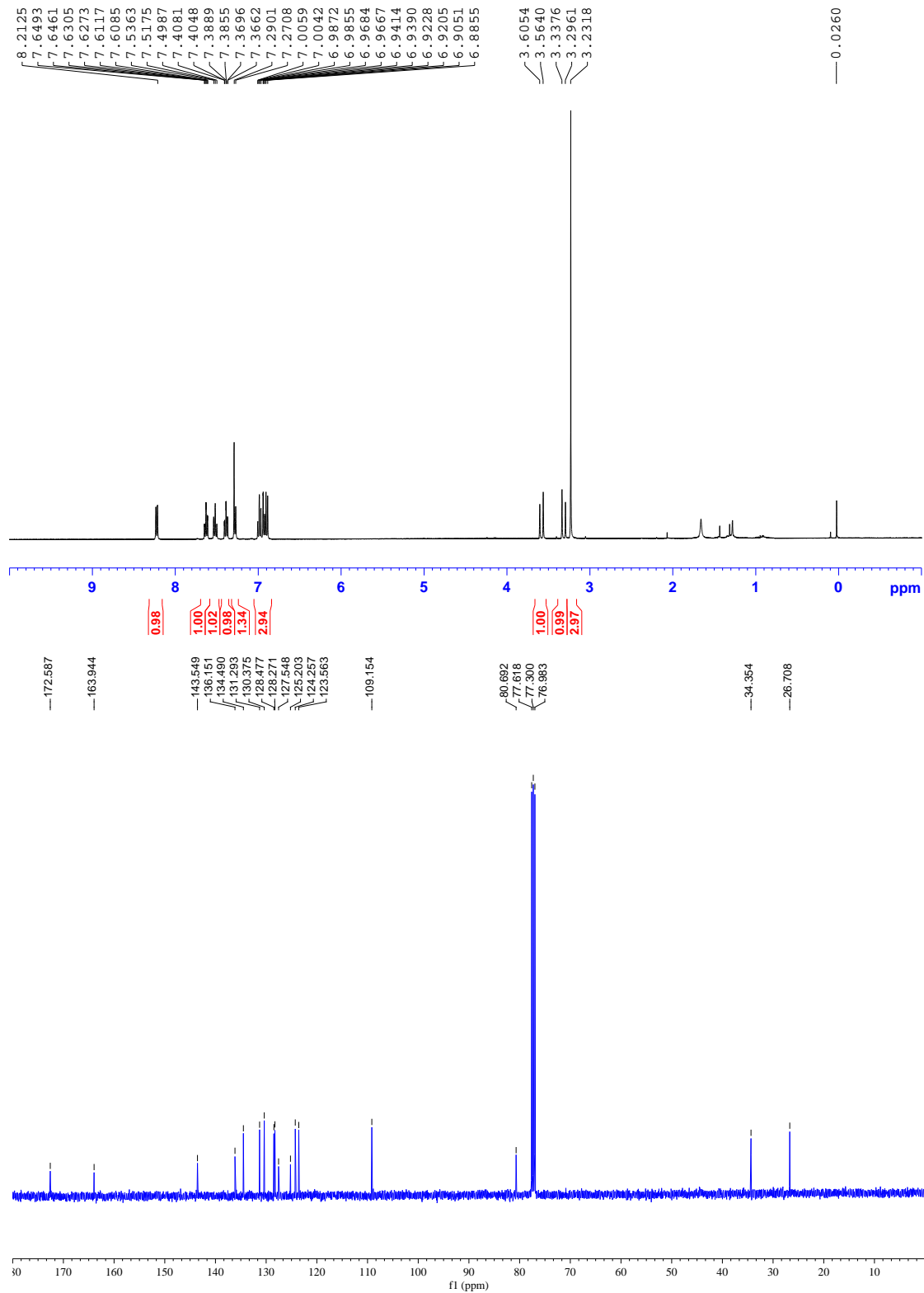


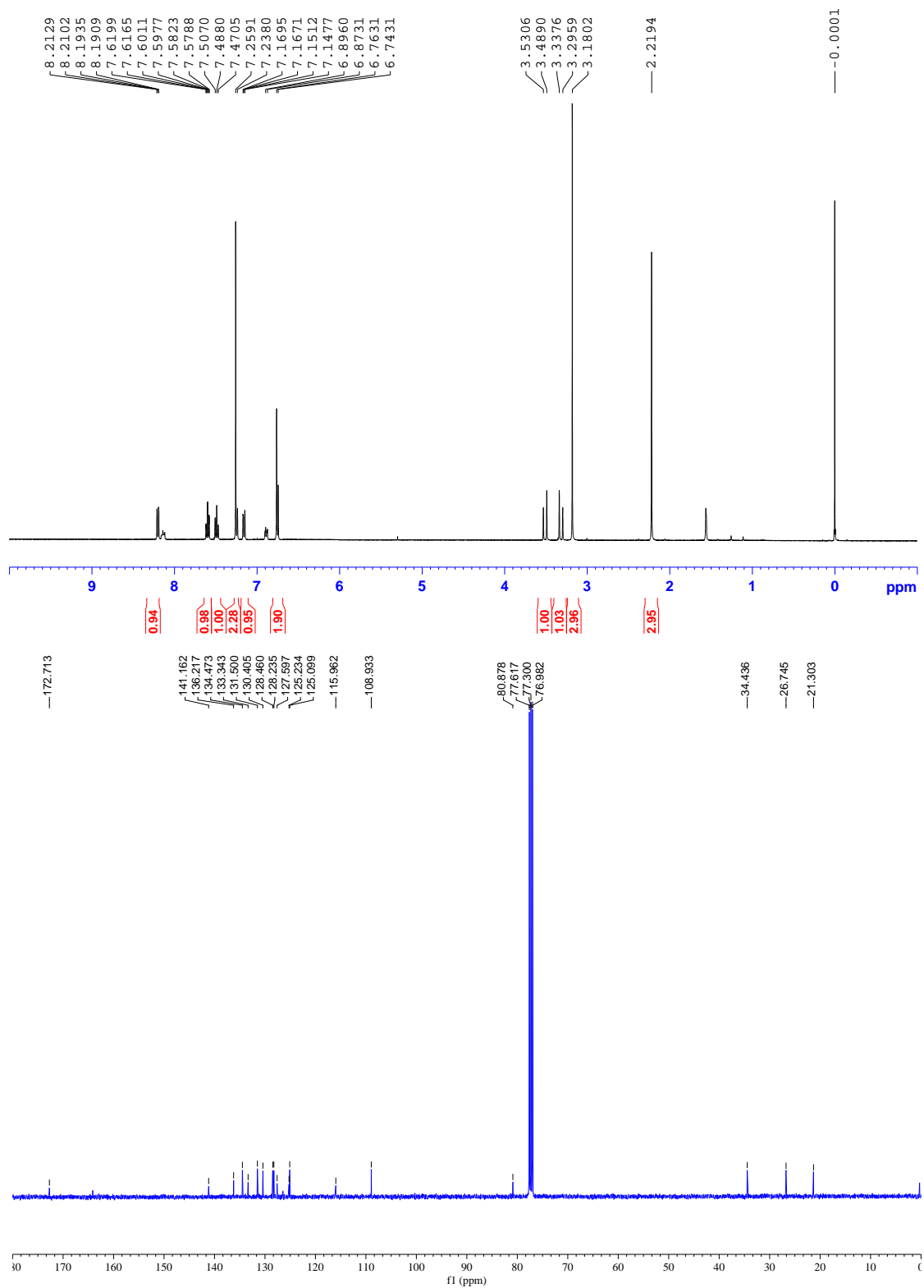
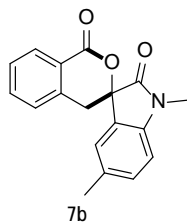


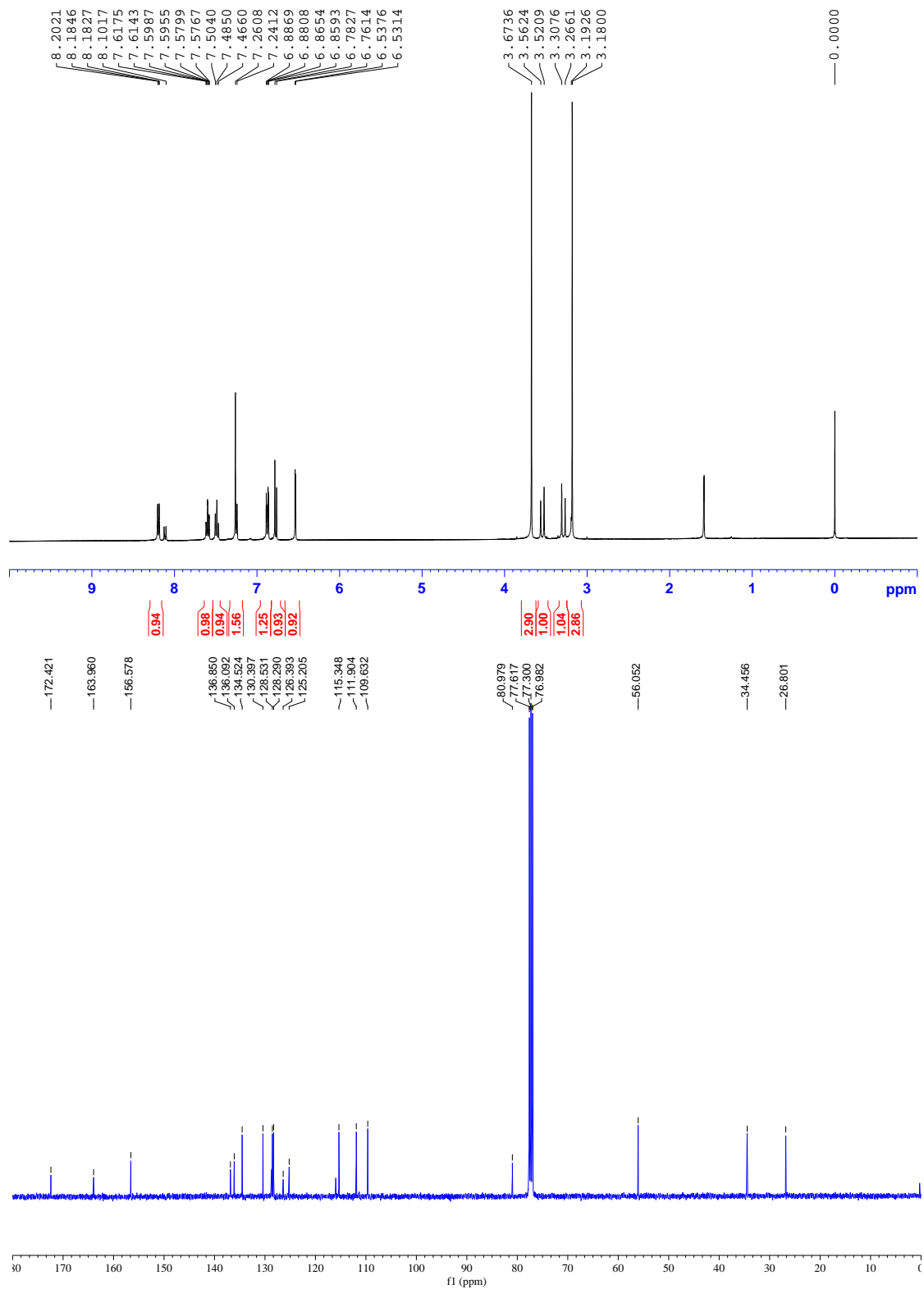
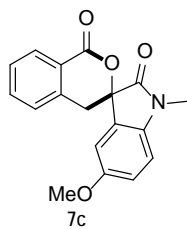


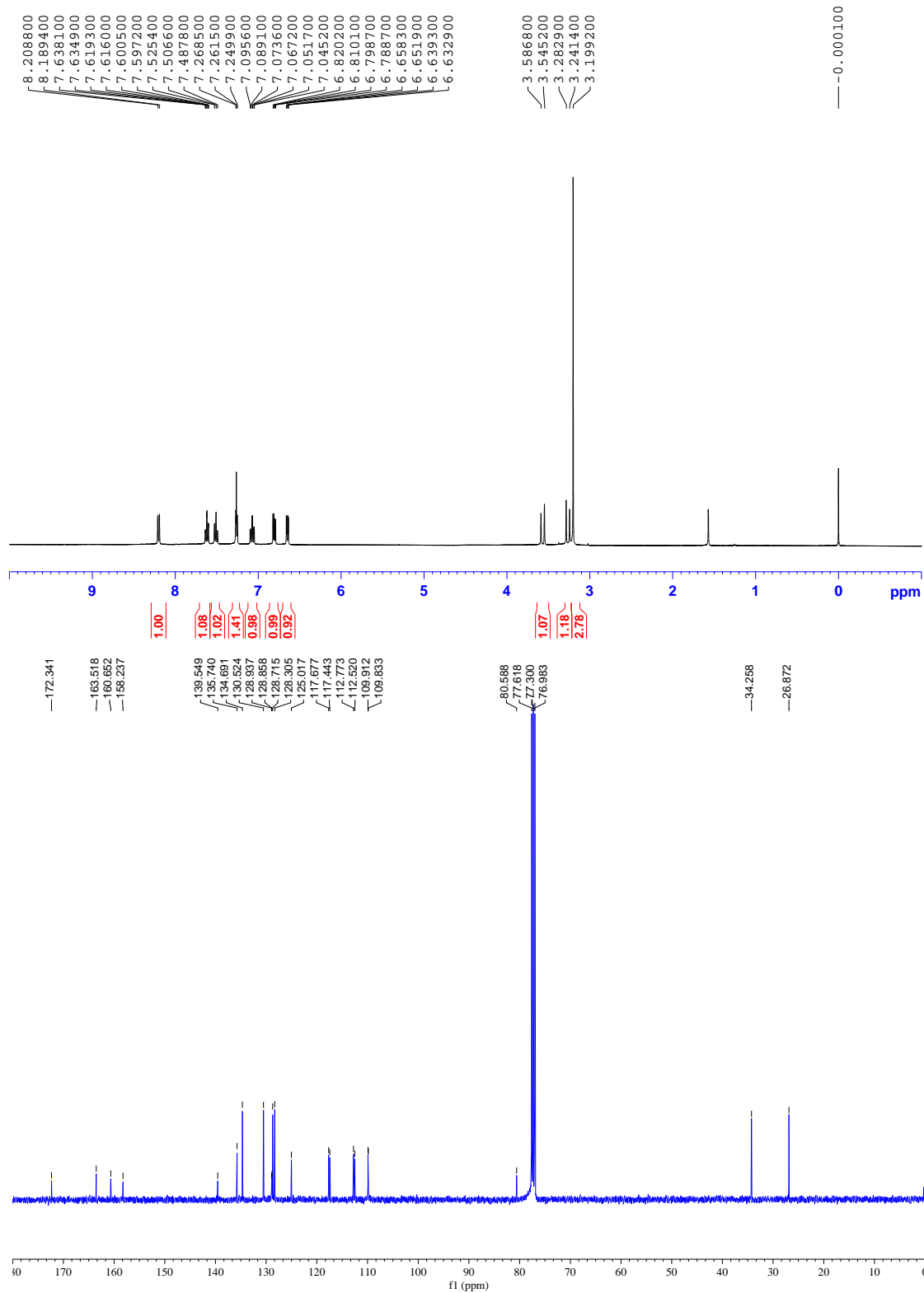
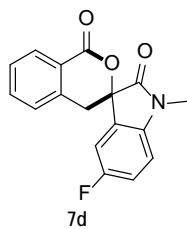


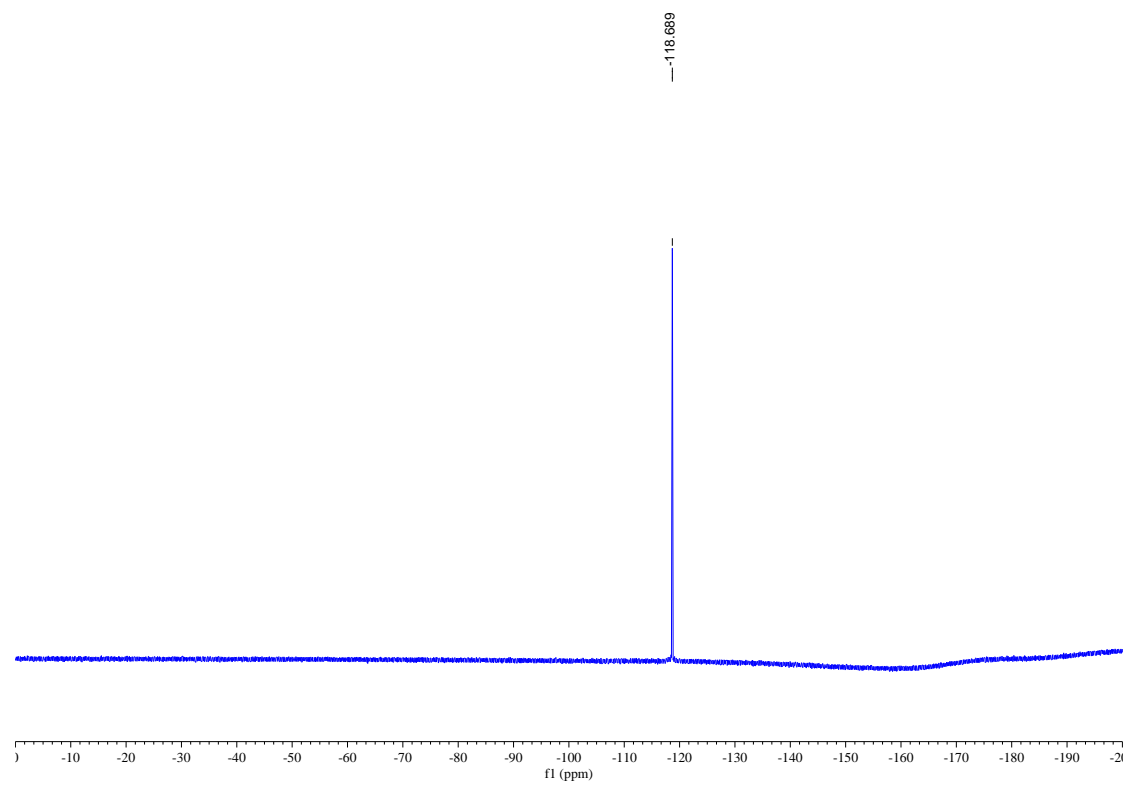
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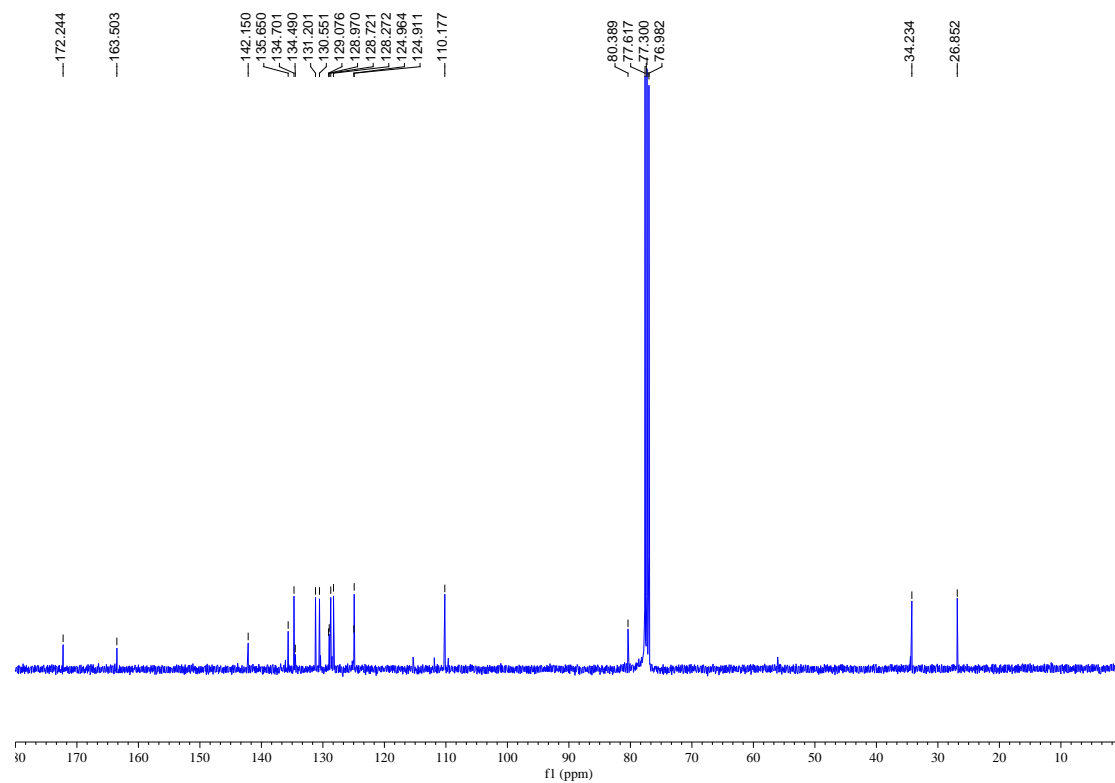
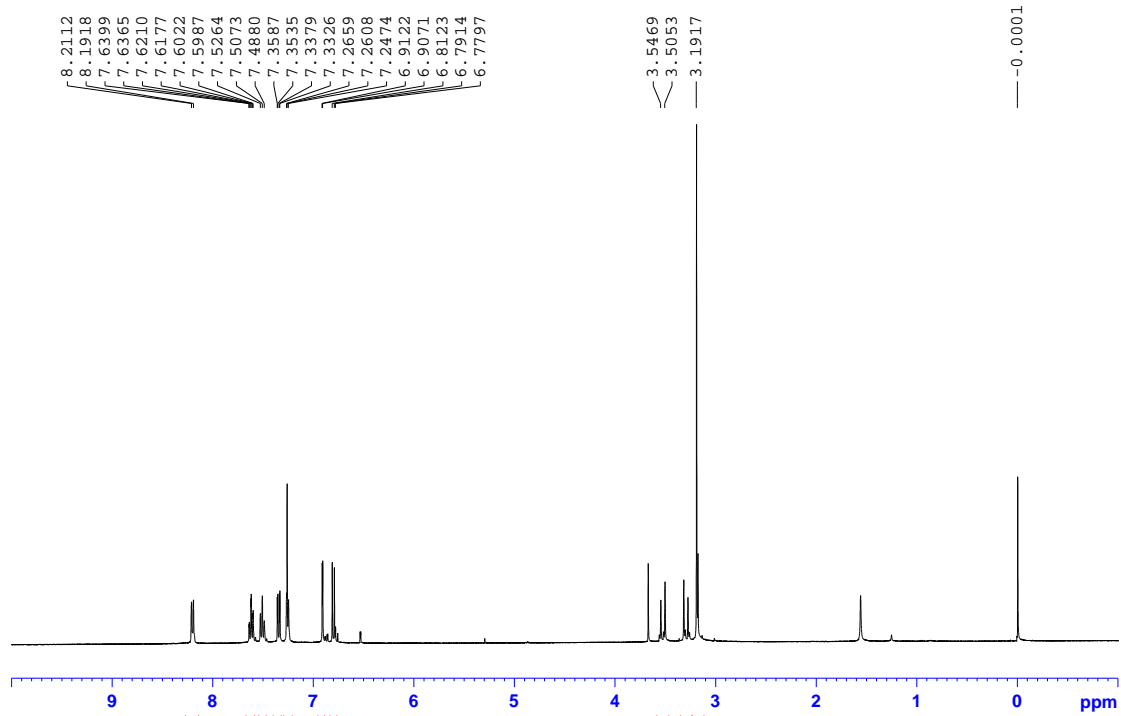
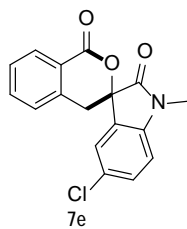


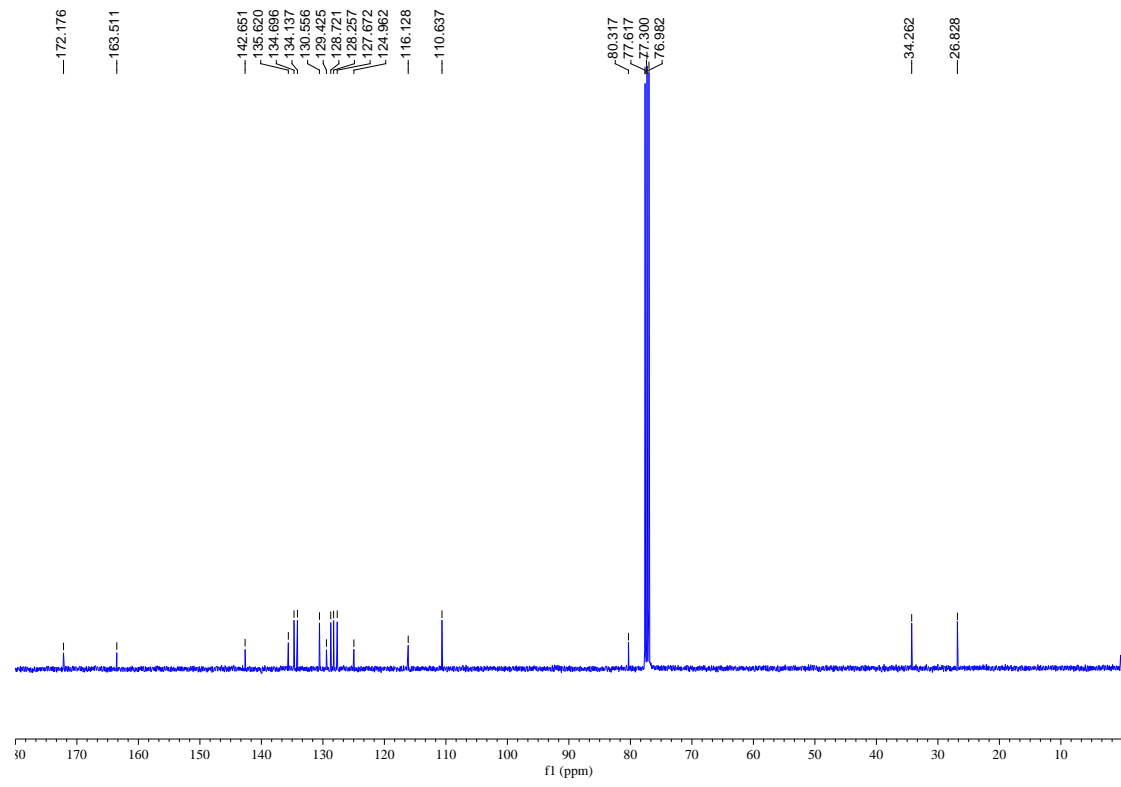
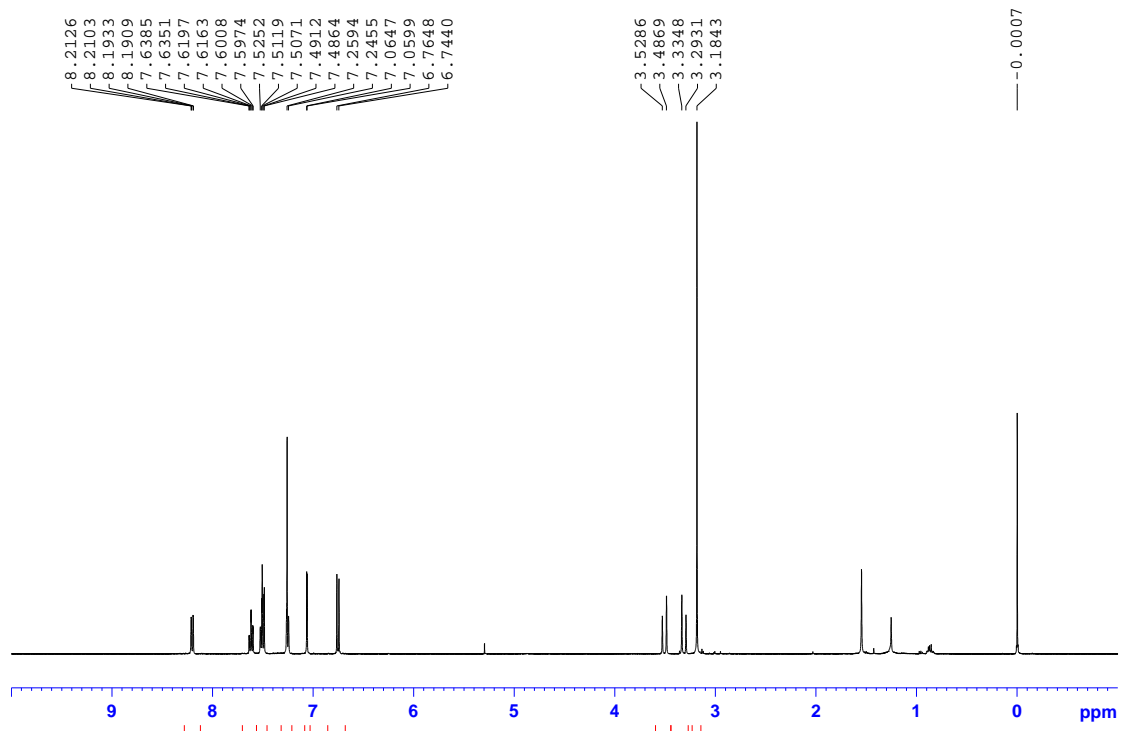
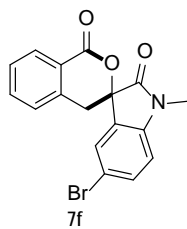


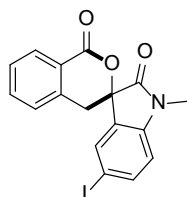












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