

**A multi-component reaction of electron-rich arenes,  
potassium metabisulfite, aldehydes and aryldiazonium  
tetrafluoroborates**

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**Supporting Information**

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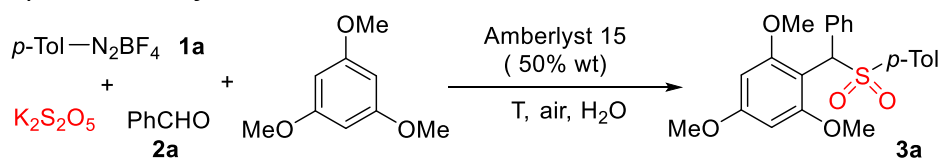
## General experimental methods

Unless otherwise stated, all commercial reagents were used as received. All solvents were dried and distilled according to standard procedures. Flash column chromatography was performed using silica gel (60-Å pore size, 32-63  $\mu\text{m}$ , standard grade). Analytical thin-layer chromatography was performed using glass plates pre-coated with 0.25 mm 230-400 mesh silica gel impregnated with a fluorescent indicator (254 nm). Thin layer chromatography plates were visualized by exposure to ultraviolet light. Organic solutions were concentrated on rotary evaporators at  $\sim 20$  Torr at 25-35  $^{\circ}\text{C}$ . Nuclear magnetic resonance (NMR) spectra are recorded in parts per million from internal tetramethylsilane on the  $\delta$  scale.  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra were recorded in  $\text{CDCl}_3$  on a Bruker DRX-400 spectrometer operating at 400 MHz and 100 MHz, respectively. All chemical shift values are quoted in ppm and coupling constants quoted in Hz. High resolution mass spectrometry (HRMS) spectra were obtained on a microTOF II Instrument.

### General procedure for the preparation of compound **3**.

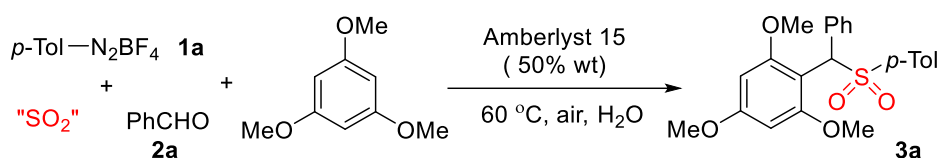
1,3,5-Trimethoxybenzene (0.5 mmol, 1.0 equiv), aryl diazonium salt (1.25 mmol, 2.5 equiv), potassium metabisulfite (1.25 mmol, 2.5 equiv), aldehyde (1.0 mmol, 2.0 equiv) and formic acid (1.0 mmol, 2.0 equiv) were dissolved in 2.5 mL of EtOH/ $\text{H}_2\text{O}$  (v = 4:1). The mixture was stirred overnight under air at 60  $^{\circ}\text{C}$ . After completion of reaction as indicated by TLC, the reaction mixture was extracted with ether ( $2 \times 10$  mL). The combined organic layers were washed with saturated brine solution ( $2 \times 100$  mL) and dried over  $\text{Na}_2\text{SO}_4$ . The solvent was evaporated and the residue was purified by flash column chromatography (*n*-hexane/ethyl acetate = 10:1) to give the corresponding product **3**.

### Table. Optimization of the reaction condition



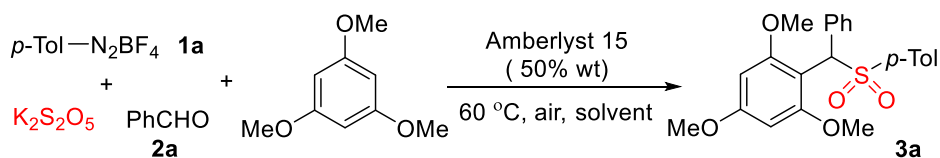
Entry	Temperature (°C)	Yield <sup>a</sup>
1	20	ND
2	40	15%
3	60	19%
4	80	10%
5	100	trace

Reaction conditions: 1,3,5-trimethoxybenzene (0.5 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>5</sub> (0.75 mmol, 1.5 equiv), 4-methylphenyldiazonium tetrafluoroborate **1a** (0.75 mmol, 1.5 equiv), benzaldehyde **2a** (1.0 mmol, 2.0 equiv), solvent (2.5 mL). <sup>a</sup> Isolated yield based on 1,3,5-trimethoxybenzene. Amberlyst 15 (50% weight percentage according to 1,3,5-trimethoxybenzene).



Entry	"SO <sub>2</sub> " source	Yield <sup>a</sup>
1	DABCO·(SO <sub>2</sub> ) <sub>2</sub>	15%
2	Na <sub>2</sub> S <sub>2</sub> O <sub>5</sub>	16%
3	K <sub>2</sub> S <sub>2</sub> O <sub>5</sub>	19%

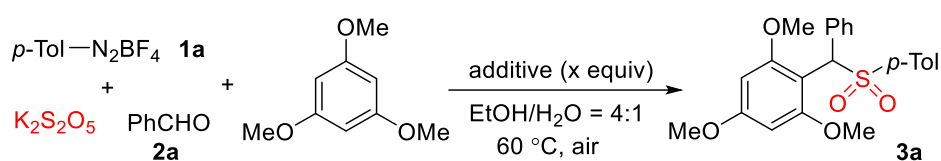
Reaction conditions: 1,3,5-trimethoxybenzene (0.5 mmol), "SO<sub>2</sub>" source (0.75 mmol, 1.5 equiv), 4-methylphenyldiazonium tetrafluoroborate **1a** (0.75 mmol, 1.5 equiv), benzaldehyde **2a** (1.0 mmol, 2.0 equiv), solvent (2.5 mL). <sup>a</sup> Isolated yield based on 1,3,5-trimethoxybenzene. Amberlyst 15 (50% weight percentage according to 1,3,5-trimethoxybenzene).



Entry	Solvent	Yield <sup>a</sup>
1	H <sub>2</sub> O	19%
2	EtOH	32%
3	MeOH	30%
4	DMSO	ND
5	THF	trace
6	DCE	trace
7	acetone	complex
8	EtOH/H <sub>2</sub> O = 1:1	36%
9	MeOH/H <sub>2</sub> O = 1:1	<10%
10	THF/H <sub>2</sub> O = 1:1	25%

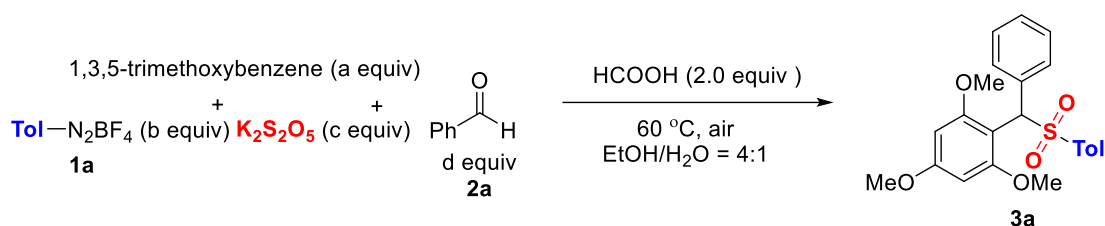
11	EtOH/H <sub>2</sub> O = 4:1	38%
12	EtOH/H <sub>2</sub> O = 1:2	30%
13	EtOH/H <sub>2</sub> O = 1:4	26%

Reaction conditions: 1,3,5-trimethoxybenzene (0.5 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>5</sub> (0.75 mmol, 1.5 equiv), 4-methylphenyldiazonium tetrafluoroborate **1a** (0.75 mmol, 1.5 equiv), benzaldehyde **2a** (1.0 mmol, 2.0 equiv), solvent (2.5 mL). <sup>a</sup> Isolated yield based on 1,3,5-trimethoxybenzene. Amberlyst 15 (50% weight percentage according to 1,3,5-trimethoxybenzene).



Entry	Additive (x equiv)	Yield <sup>a</sup>
1	HCl (2.0)	complex
2	H <sub>2</sub> SO <sub>4</sub> (2.0)	complex
3	HNO <sub>3</sub> (2.0)	complex
4	HCOOH (2.0)	70%
5	HCOOH (1.0)	57%
6	HCOOH (2.5)	68%
7	CH <sub>3</sub> COOH (2.0)	trace
8	CF <sub>3</sub> COOH (2.0)	35%

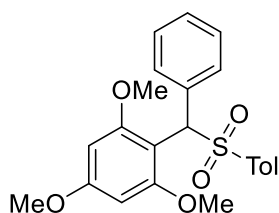
Reaction conditions: 1,3,5-trimethoxybenzene (0.5 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>5</sub> (0.75 mmol, 1.5 equiv), 4-methylphenyldiazonium tetrafluoroborate **1a** (0.75 mmol, 1.5 equiv), benzaldehyde **2a** (1.0 mmol, 2.0 equiv), solvent (2.5 mL). <sup>a</sup> Isolated yield based on 1,3,5-trimethoxybenzene.



Entry	a:b:c:d	Yield
1	1:1:1:1	33%
2	1:1.5:1.5:2	70%
3	1:2:2:2	77%
4	1:2.5:2.5:2	82%
5	1:3:3:2	73%
6	1:2.5:2.5:1	51%
7	1:2.5:2.5:1.5	63%

Reaction conditions: 1,3,5-trimethoxybenzene (0.5 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>5</sub> (c equiv),

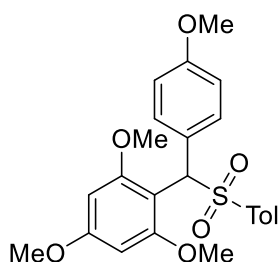
4-methylphenyldiazonium tetrafluoroborate **1a** (b equiv), benzaldehyde **2a** (d equiv), solvent (2.5 mL). <sup>a</sup> Isolated yield based on 1,3,5-trimethoxybenzene.



1,3,5-trimethoxy-2-(phenyl(tosyl)methyl)benzene (**3a**)

White solid, Mp: 121-122 °C;

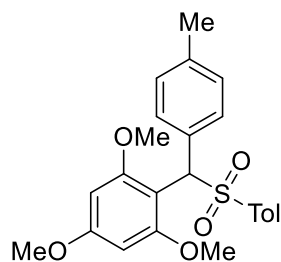
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.75-7.42 (m, 4H), 7.34-7.23 (m, 3H), 7.16 (d, *J* = 8.0 Hz, 2H), 6.15 (s, 1H), 6.05 (s, 2H), 3.77 (s, 3H), 3.64 (s, 6H), 2.37 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.7, 143.4, 138.3, 134.5, 130.2, 128.8, 128.7, 127.9, 127.6, 104.5, 91.1, 67.8, 55.6, 55.3, 21.5; HRMS calcd. for C<sub>23</sub>H<sub>24</sub>NaO<sub>5</sub>S (M+Na)<sup>+</sup>: 435.1237, found: 435.1254.



1,3,5-trimethoxy-2-((4-methoxyphenyl)(tosyl)methyl)benzene (**3b**)

White solid, Mp: 123-124 °C;

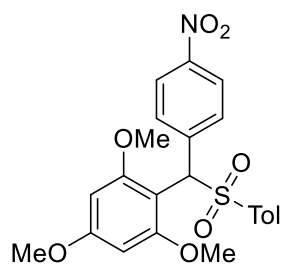
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.48 (dd, *J* = 16.9, 8.5 Hz, 4H), 7.17 (d, *J* = 8.0 Hz, 2H), 6.79 (d, *J* = 8.9 Hz, 2H), 6.10 (s, 1H), 6.06 (s, 2H), 3.78 (s, 3H), 3.77 (s, 3H), 3.67 (s, 6H), 2.38 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.6, 159.1, 143.3, 138.4, 131.6, 128.9, 128.7, 126.3, 113.4, 104.7, 91.1, 67.6, 55.7, 55.3, 55.2, 21.6; HRMS calcd. for C<sub>24</sub>H<sub>26</sub>NaO<sub>6</sub>S (M+Na)<sup>+</sup>: 465.1342, found: 465.1359.



1,3,5-trimethoxy-2-(p-tolyl(tosyl)methyl)benzene (**3c**)

White solid, Mp: 119-120 °C;

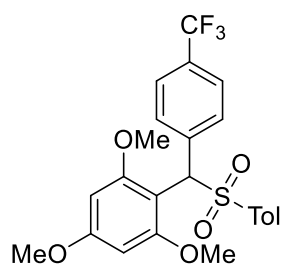
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.50 (d,  $J = 8.2$  Hz, 2H), 7.42 (d,  $J = 8.1$  Hz, 2H), 7.16 (d,  $J = 8.1$  Hz, 2H), 7.06 (d,  $J = 8.0$  Hz, 2H), 6.12 (s, 1H), 6.04 (s, 2H), 3.75 (s, 3H), 3.64 (s, 6H), 2.36 (s, 3H), 2.29 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  161.6, 143.4, 138.4, 137.4, 131.3, 130.2, 128.9, 128.7, 114.1, 104.5, 91.1, 67.7, 55.7, 55.4, 21.6, 21.2; HRMS calcd. for  $\text{C}_{24}\text{H}_{26}\text{NaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 449.1393, found: 449.1406.



1,3,5-trimethoxy-2-((4-nitrophenyl)(tosyl)methyl)benzene (**3d**)

Yellow solid, Mp: 127-128 °C;

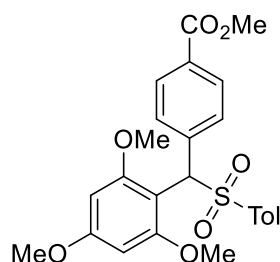
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.12 (d,  $J = 8.2$  Hz, 2H), 7.77 (d,  $J = 8.2$  Hz, 2H), 7.53 (d,  $J = 8.2$  Hz, 2H), 7.20 (d,  $J = 8.2$  Hz, 2H), 6.18 (s, 1H), 6.02 (s, 2H), 3.79 (s, 3H), 3.59 (s, 6H), 2.40 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  162.3, 147.0, 144.1, 142.4, 137.3, 130.9, 129.0, 128.8, 122.9, 102.8, 91.0, 66.4, 55.6, 55.4, 21.6; HRMS calcd. for  $\text{C}_{23}\text{H}_{23}\text{NNaO}_7\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 480.1087, found: 480.1105.



1,3,5-trimethoxy-2-(tosyl(4-(trifluoromethyl)phenyl)methyl)benzene (**3e**)

White solid, Mp: 108-109 °C;

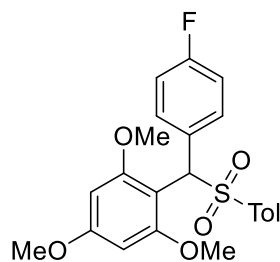
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.70 (d,  $J$  = 8.1 Hz, 2H), 7.52 (d,  $J$  = 8.2 Hz, 4H), 7.19 (d,  $J$  = 8.1 Hz, 2H), 6.17 (s, 1H), 6.03 (s, 2H), 3.78 (s, 3H), 3.61 (s, 6H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.1, 143.8, 138.8, 137.7, 130.4, 129.6, 129.3, 129.0, 128.7, 125.5, 124.8 (q,  $\text{CF}_3$ ), 122.8, 103.4, 91.0, 66.9, 55.6, 55.4, 21.6; HRMS calcd. for  $\text{C}_{24}\text{H}_{23}\text{F}_3\text{NaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 503.1111, found: 503.1122.



Methyl 4-(tosyl(2,4,6-trimethoxyphenyl)methyl)benzoate (**3f**)

Colorless oil ;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.93 (d,  $J$  = 8.4 Hz, 2H), 7.65 (d,  $J$  = 8.3 Hz, 2H), 7.52 (d,  $J$  = 8.2 Hz, 2H), 7.18 (d,  $J$  = 8.1 Hz, 2H), 6.17 (s, 1H), 6.03 (s, 2H), 3.90 (s, 3H), 3.79 (s, 3H), 3.60 (s, 6H), 2.38 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  167.0, 162.0, 143.7, 139.9, 137.8, 130.1, 129.1, 128.9, 128.8, 103.5, 91.0, 67.1, 55.6, 55.4, 52.1, 21.6; HRMS calcd. for  $\text{C}_{25}\text{H}_{26}\text{NaO}_7\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 493.1291, found: 493.1309.

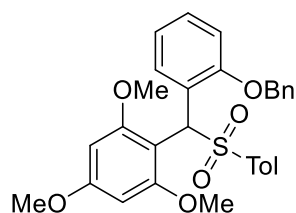


2-((4-fluorophenyl)(tosyl)methyl)-1,3,5-trimethoxybenzene (**3g**)

Colorless oil;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.59-7.44 (m, 4H), 7.18 (d,  $J$  = 8.0 Hz, 2H), 6.94 (t,  $J$  = 8.7 Hz, 2H), 6.11 (s, 1H), 6.05 (s, 2H), 3.78 (s, 3H), 3.65 (s, 6H), 2.38 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  163.5, 161.8, 161.1, 143.6, 138.0, 132.1, 132.0, 128.9, 128.7, 114.9, 114.7, 104.1,

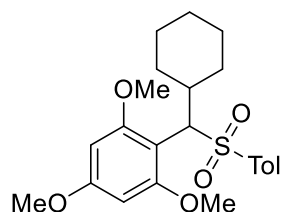
91.1, 67.0, 55.7, 55.3, 21.5; HRMS calcd. for  $C_{23}H_{23}FNaO_5S$  ( $M+Na$ )<sup>+</sup>: 453.1142, found: 453.1159.



2-((2-(benzyloxy)phenyl)(tosyl)methyl)-1,3,5-trimethoxybenzene (**3h**)

White solid, 161-162 °C;

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.37 (dd, *J* = 7.8, 1.5 Hz, 1H), 7.49 (d, *J* = 8.2 Hz, 2H), 7.33-7.19 (m, 4H), 7.17-7.11 (m, 2H), 7.09-6.98 (m, 3H), 6.79 (d, *J* = 8.2 Hz, 1H), 6.69 (s, 1H), 5.97 (s, 2H), 4.80 (d, *J* = 11.4 Hz, 1H), 4.67 (d, *J* = 11.4 Hz, 1H), 3.76 (s, 3H), 3.43 (s, 6H), 2.29 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.5, 156.0, 143.1, 138.5, 137.0, 132.8, 128.8, 128.8, 128.6, 128.2, 127.6, 127.3, 123.1, 120.3, 111.3, 104.0, 91.1, 69.9, 59.8, 55.3, 21.5; HRMS calcd. for  $C_{30}H_{30}NaO_6S$  ( $M+Na$ )<sup>+</sup>: 541.1655, found: 541.1664.

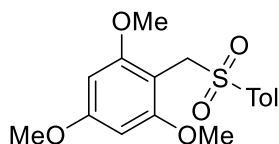


2-(cyclohexyl(tosyl)methyl)-1,3,5-trimethoxybenzene (**3i**)

Colorless oil;

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.51 (d, *J* = 8.2 Hz, 2H), 7.10 (d, *J* = 8.0 Hz, 2H), 5.98 (d, *J* = 2.0 Hz, 1H), 5.83 (d, *J* = 2.1 Hz, 1H), 4.84 (d, *J* = 10.4 Hz, 1H), 3.74 (d, *J* = 2.3 Hz, 6H), 3.57 (s, 3H), 2.97-2.73 (m, 1H), 2.62 (d, *J* = 12.6 Hz, 1H), 2.33 (s, 3H), 1.73 (d, *J* = 13.4 Hz, 1H), 1.68-1.48 (m, 2H), 1.27 (m, 6H), 0.83-0.61 (m, 1H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.4, 160.3, 159.1, 142.8, 138.8, 128.4, 128.1, 103.5, 90.7, 90.2, 69.1, 55.6, 55.4, 55.2, 35.8, 33.2, 31.5, 26.3, 25.7, 21.5; HRMS calcd. for  $C_{23}H_{30}NaO_5S$  ( $M+Na$ )<sup>+</sup>: 441.1706, found: 441.1711.

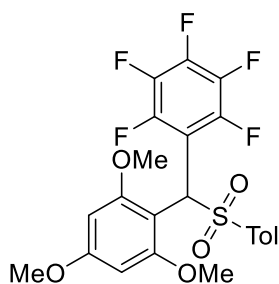




1,3,5-trimethoxy-2-(tosylmethyl)benzene (**3j**)

Colorless oil;

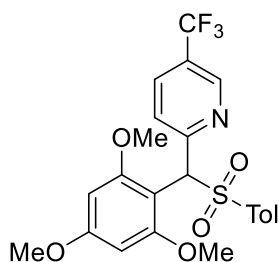
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.56 (d,  $J = 8.2$  Hz, 2H), 7.23 (d,  $J = 7.9$  Hz, 2H), 5.99 (s, 2H), 4.49 (s, 2H), 3.80 (d,  $J = 1.1$  Hz, 23H), 3.50 (s, 6H), 2.40 (s, 3H).  $^{13}\text{C}$  NMR (101 MHz,  $\text{CDCl}_3$ )  $\delta$  161.9, 159.6, 143.6, 137.3, 128.8, 128.7, 98.4, 90.2, 55.4, 55.3, 51.7, 21.5; HRMS calcd. for  $\text{C}_{17}\text{H}_{20}\text{NaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 359.0924, found: 359.0937.



1,2,3,4,5-pentafluoro-6-(tosyl(2,4,6-trimethoxyphenyl)methyl)benzene (**3k**)

White solid, Mp: 155-156 °C;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.53 (d,  $J = 8.2$  Hz, 2H), 7.34-7.16 (m, 2H), 6.26 (s, 1H), 5.98 (s, 2H), 3.79 (s, 3H), 3.48 (s, 6H), 2.42 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.6, 159.7, 144.2, 137.3, 129.3, 129.0, 110.0, 100.7, 90.7, 57.9, 55.6, 55.4, 21.6; HRMS calcd. for  $\text{C}_{23}\text{H}_{19}\text{F}_5\text{NaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 525.0766, found: 525.0781.

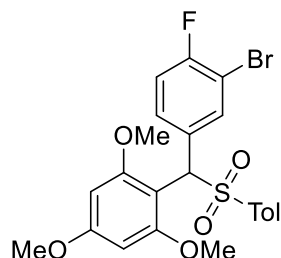


2-(tosyl(2,4,6-trimethoxyphenyl)methyl)-5-(trifluoromethyl)pyridine (**3l**)

White solid, Mp: 117-118 °C;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.73 (s, 1H), 8.21 (d,  $J = 8.4$  Hz, 1H), 7.91 (dd,  $J = 8.4, 2.1$  Hz, 1H), 7.60 (d,  $J = 8.2$  Hz, 2H), 7.22 (d,  $J = 8.0$  Hz, 2H), 6.36 (s, 1H), 6.01 (s, 2H), 3.79

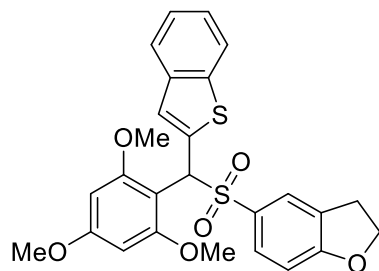
(s, 3H), 3.53 (s, 6H), 2.40 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.4, 159.8, 159.2, 145.5, 144.0, 137.6, 132.8, 129.1, 128.9, 125.1, 124.8, 122.2, 102.2, 91.0, 68.4, 55.6, 55.4, 21.6; HRMS calcd. for  $\text{C}_{23}\text{H}_{22}\text{F}_3\text{NNaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 504.1063, found: 504.1074.



2-((3-bromo-4-fluorophenyl)(tosyl)methyl)-1,3,5-trimethoxybenzene (**3m**)

Colorless oil;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.73 (dd,  $J$  = 6.6, 2.2 Hz, 1H), 7.64-7.46 (m, 3H), 7.20 (d,  $J$  = 8.0 Hz, 2H), 7.02 (t,  $J$  = 8.5 Hz, 1H), 6.06 (s, 1H), 6.03 (s, 2H), 3.78 (s, 3H), 3.64 (s, 6H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.0, 159.7, 157.2, 143.8, 137.6, 135.3, 131.9, 131.1, 129.0, 128.7, 115.8, 115.6, 108.3, 108.1, 103.3, 91.1, 66.2, 55.6, 55.4, 21.6; HRMS calcd. for  $\text{C}_{23}\text{H}_{22}\text{BrFNaO}_5\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 531.0248(533.0227), found: 531.0261(533.0244).

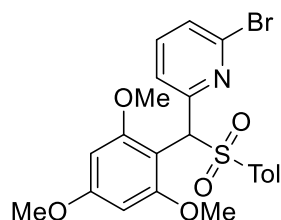


5-((benzo[b]thiophen-2-yl(2,4,6-trimethoxyphenyl)methyl)sulfonyl)-2,3-dihydrobenzofuran (**3n**)

Yellow solid, Mp: 95-96 °C;

$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.77-7.71 (m, 1H), 7.68 (dd,  $J$  = 6.4, 2.4 Hz, 1H), 7.50 (dd,  $J$  = 4.3, 2.5 Hz, 2H), 7.43 (s, 1H), 7.34-7.23 (m, 2H), 6.73 (d,  $J$  = 8.9 Hz, 1H), 6.51 (s, 1H), 6.09 (d,  $J$  = 27.2 Hz, 2H), 4.62 (t,  $J$  = 8.8 Hz, 2H), 3.80 (s, 3H), 3.73 (s, 6H), 3.13 (t,  $J$  = 8.8 Hz, 2H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  164.1, 162.1, 140.8, 138.8, 136.8, 132.1, 130.6, 127.4, 126.3, 126.1, 124.2, 124.0, 123.5, 121.9, 108.9, 103.3, 90.7, 72.3, 65.1,

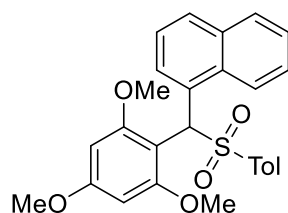
56.1, 55.4, 28.9; HRMS calcd. for C<sub>26</sub>H<sub>24</sub>NaO<sub>6</sub>S<sub>2</sub> (M+Na)<sup>+</sup>: 519.0907, found: 519.0915.



2-bromo-6-(tosyl(2,4,6-trimethoxyphenyl)methyl)pyridine (**3o**)

Yellow solid, Mp: 126-127 °C;

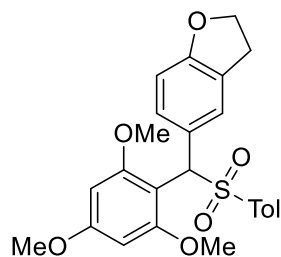
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.82 (d, *J* = 7.7 Hz, 1H), 7.68 (d, *J* = 8.2 Hz, 2H), 7.49 (t, *J* = 7.8 Hz, 1H), 7.33 (d, *J* = 7.8 Hz, 1H), 7.29-7.18 (m, 2H), 6.29 (s, 1H), 6.06 (s, 2H), 3.80 (s, 3H), 3.59 (s, 6H), 2.41 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 162.2, 160.0, 156.1, 143.8, 140.3, 138.5, 138.1, 129.3, 128.9, 126.7, 123.8, 102.2, 91.1, 68.6, 55.6, 55.4, 21.6; HRMS calcd. for C<sub>22</sub>H<sub>22</sub>BrNNaO<sub>5</sub>S (M+Na)<sup>+</sup>: 514.0294(516.0274), found: 514.0305(516.0287).



1-(tosyl(2,4,6-trimethoxyphenyl)methyl)naphthalene (**3p**)

White solid, Mp: 150-151 °C;

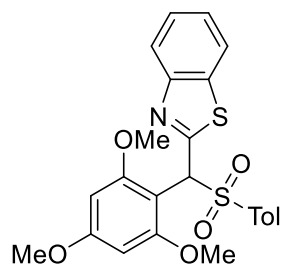
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 8.67 (d, *J* = 7.4 Hz, 1H), 7.77 (d, *J* = 8.1 Hz, 2H), 7.71 (d, *J* = 8.4 Hz, 1H), 7.58-7.51 (m, 3H), 7.38-7.27 (m, 2H), 7.15 (d, *J* = 8.0 Hz, 2H), 6.70 (s, 1H), 5.97 (s, 2H), 3.73 (s, 3H), 3.52 (s, 6H), 2.36 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.9, 143.5, 137.6, 133.7, 132.1, 129.9, 129.5, 129.1, 128.9, 128.8, 128.0, 126.1, 124.9, 124.9, 122.8, 103.5, 91.3, 63.0, 55.6, 55.3, 21.5; HRMS calcd. for C<sub>27</sub>H<sub>26</sub>NaO<sub>5</sub>S (M+Na)<sup>+</sup>: 485.1393, found: 485.1405.



5-(tosyl(2,4,6-trimethoxyphenyl)methyl)-2,3-dihydrobenzofuran (**3q**)

White solid, Mp: 114-115 °C;

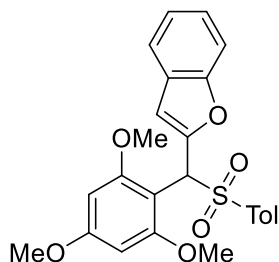
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.55-7.46 (m, 3H), 7.18 (d,  $J = 8.1$  Hz, 2H), 7.12 (dd,  $J = 8.3, 1.5$  Hz, 1H), 6.63 (d,  $J = 8.3$  Hz, 1H), 6.07 (s, 3H), 4.54 (t,  $J = 8.8$  Hz, 2H), 3.78 (s, 3H), 3.68 (s, 6H), 3.27-3.08 (m, 2H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  161.5, 159.8, 143.3, 138.4, 130.5, 128.8, 128.7, 127.1, 126.8, 126.0, 108.5, 105.0, 91.2, 71.4, 67.8, 55.7, 55.3, 29.8, 21.6; HRMS calcd. for  $\text{C}_{25}\text{H}_{26}\text{NaO}_6\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 477.1342, found: 477.1349.



2-(tosyl(2,4,6-trimethoxyphenyl)methyl)benzo[d]thiazole (**3r**)

Yellow solid, Mp: 105-106 °C;

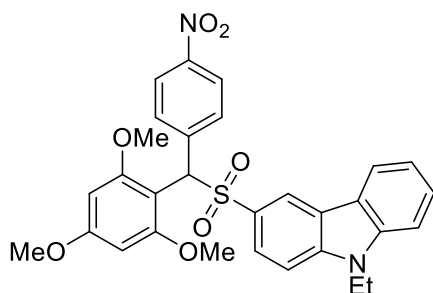
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.97 (d,  $J = 8.1$  Hz, 1H), 7.91-7.79 (m, 1H), 7.69 (d,  $J = 8.2$  Hz, 2H), 7.51-7.31 (m, 2H), 7.23 (d,  $J = 8.0$  Hz, 2H), 6.76 (s, 1H), 6.11 (s, 2H), 3.82 (s, 3H), 3.73 (s, 6H), 2.40 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  164.0, 162.6, 151.8, 144.1, 137.8, 136.4, 129.2, 129.0, 125.7, 125.2, 123.2, 121.3, 101.6, 90.9, 67.0, 55.4, 21.6; HRMS calcd. for  $\text{C}_{24}\text{H}_{23}\text{NNaO}_5\text{S}_2$  ( $\text{M}+\text{Na}$ ) $^+$ : 492.0910, found: 492.0923.



2-(tosyl(2,4,6-trimethoxyphenyl)methyl)-2,3-dihydrobenzofuran (**3s**)

Yellow solid, Mp: 110-111 °C;

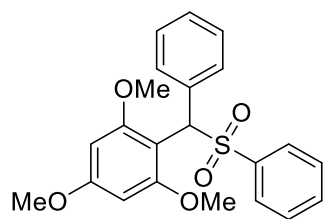
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.65 (d,  $J = 8.2$  Hz, 2H), 7.59-7.46 (m, 1H), 7.36 (d,  $J = 8.0$  Hz, 1H), 7.24-7.14 (m, 4H), 7.06 (s, 1H), 6.43 (s, 1H), 6.09 (s, 2H), 3.81 (s, 3H), 3.67 (s, 6H), 2.39 (s, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.2, 154.3, 150.1, 143.8, 137.8, 129.0, 128.9, 128.6, 124.0, 122.6, 121.1, 111.0, 107.8, 101.3, 91.0, 62.5, 55.7, 55.4, 21.6; HRMS calcd. for  $\text{C}_{25}\text{H}_{26}\text{NaO}_6\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 475.1186, found: 475.1197.



9-ethyl-3-(((4-nitrophenyl)(2,4,6-trimethoxyphenyl)methyl)sulfonyl)-9H-carbazole (**3t**)

Green solid, Mp: 173-174 °C;

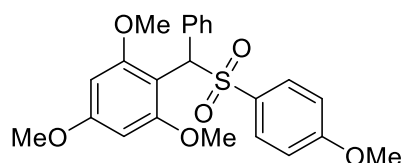
$^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.39 (d,  $J = 1.4$  Hz, 1H), 8.12 (d,  $J = 8.9$  Hz, 2H), 8.03 (d,  $J = 7.7$  Hz, 1H), 7.82 (d,  $J = 8.7$  Hz, 2H), 7.70 (dd,  $J = 8.7, 1.7$  Hz, 1H), 7.60-7.51 (m, 1H), 7.46 (d,  $J = 8.2$  Hz, 1H), 7.38-7.27 (m, 2H), 6.29 (s, 1H), 5.96 (s, 2H), 4.39 (q,  $J = 7.2$  Hz, 2H), 3.72 (s, 3H), 3.49 (s, 6H), 1.43 (t,  $J = 7.2$  Hz, 3H).  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  162.2, 147.0, 142.9, 142.2, 140.6, 130.9, 129.9, 127.0, 126.0, 122.9, 122.6, 122.4, 122.3, 120.8, 120.3, 109.1, 107.7, 103.3, 91.1, 67.0, 55.6, 55.3, 37.9, 13.8; HRMS calcd. for  $\text{C}_{30}\text{H}_{28}\text{N}_2\text{NaO}_7\text{S}$  ( $\text{M}+\text{Na}$ ) $^+$ : 583.1509, found: 583.1519.



1,3,5-trimethoxy-2-(phenyl(phenylsulfonyl)methyl)benzene (**3u**)

White solid, Mp: 105-106 °C;

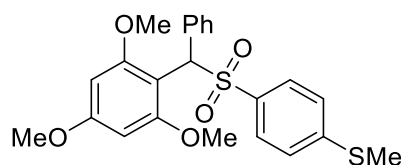
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.71-7.59 (m, 2H), 7.59-7.53 (m, 2H), 7.48 (d, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.7 Hz, 2H), 7.29-7.22 (m, 3H), 6.18 (s, 1H), 6.03 (s, 2H), 3.76 (s, 3H), 3.61 (s, 6H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.8, 141.1, 141.1, 134.3, 132.7, 129.2, 128.7, 128.2, 128.0, 127.7, 104.2, 91.1, 67.8, 55.6, 55.4; HRMS calcd. for C<sub>22</sub>H<sub>22</sub>NaO<sub>5</sub>S (M+Na)<sup>+</sup>: 421.1080, found: 421.1093.



1,3,5-trimethoxy-2-(((4-methoxyphenyl)sulfonyl)(phenyl)methyl)benzene (**3v**)

White solid, Mp: 124-125 °C;

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.59-7.52 (m, 4H), 7.25 (dd, *J* = 5.4, 3.7 Hz, 3H), 6.87-6.80 (m, 2H), 6.14 (s, 1H), 6.05 (s, 2H), 3.83 (s, 3H), 3.78 (s, 3H), 3.65 (s, 6H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 162.9, 161.6, 134.5, 132.9, 130.8, 130.2, 127.9, 127.6, 113.3, 104.5, 91.1, 67.9, 55.7, 55.6, 55.3; HRMS calcd. for C<sub>23</sub>H<sub>24</sub>NaO<sub>6</sub>S (M+Na)<sup>+</sup>: 451.1186, found: 451.1194.

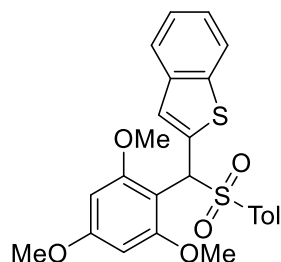


Methyl(4-((phenyl(2,4,6-trimethoxyphenyl)methyl)sulfonyl)phenyl)sulfane (**3w**)

White solid, Mp: 130-131 °C;

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.55 (dd, *J* = 7.2, 2.3 Hz, 2H), 7.49 (d, *J* = 8.6 Hz, 2H), 7.26 (dd, *J* = 4.7, 2.3 Hz, 3H), 7.16 (d, *J* = 8.5 Hz, 2H), 6.14 (s, 1H), 6.05 (s, 2H), 3.78 (s, 3H), 3.64 (s, 6H), 2.48 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 161.8, 145.6, 137.0, 134.4,

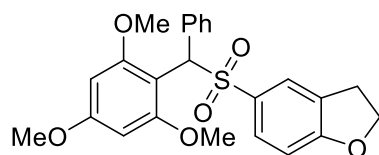
130.2, 129.0, 128.0, 127.7, 124.5, 104.3, 91.1, 68.0, 55.7, 55.3, 14.8; HRMS calcd. for  $C_{23}H_{24}NaO_5S_2$  ( $M+Na$ )<sup>+</sup>: 467.0957, found: 467.0966.



2-(tosyl(2,4,6-trimethoxyphenyl)methyl)benzo[b]thiophene (**3z**)

Yellow solid, Mp: 135-136 °C;

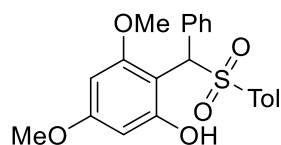
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.75-7.71 (m, 1H), 7.68 (dd, *J* = 6.3, 2.4 Hz, 1H), 7.60 (d, *J* = 8.2 Hz, 2H), 7.41 (s, 1H), 7.32-7.24 (m, 3H), 7.19 (d, *J* = 8.0 Hz, 2H), 6.53 (s, 1H), 6.08 (d, *J* = 27.3 Hz, 2H), 3.80 (s, 3H), 3.70 (s, 6H), 2.39 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 162.1, 143.7, 140.8, 138.8, 137.7, 136.6, 129.0, 128.9, 126.4, 124.3, 124.0, 123.5, 121.9, 103.2, 90.8, 64.9, 55.4, 21.6; HRMS calcd. for  $C_{25}H_{24}NaO_6S_2$  ( $M+Na$ )<sup>+</sup>: 491.0957, found: 491.0970.



5-((phenyl(2,4,6-trimethoxyphenyl)methyl)sulfonyl)-2,3-dihydrobenzofuran (**3-1**)

Yellow oil;

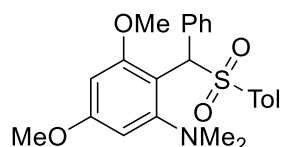
<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.63-7.53 (m, 2H), 7.41 (d, *J* = 6.0 Hz, 2H), 7.28-7.21 (m, 3H), 6.76-6.65 (m, 1H), 6.13 (s, 1H), 6.05 (s, 2H), 4.60 (t, *J* = 8.8 Hz, 2H), 3.76 (s, 3H), 3.65 (s, 6H), 3.12 (t, *J* = 8.7 Hz, 2H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 163.8, 161.7, 159.6, 134.6, 132.7, 130.3, 130.2, 127.9, 127.6, 127.3, 125.9, 108.7, 104.6, 91.1, 72.2, 68.0, 55.7, 55.4, 28.9; HRMS calcd. for  $C_{24}H_{24}NaO_6S$  ( $M+Na$ )<sup>+</sup>: 463.1186, found: 463.1196.



3,5-dimethoxy-2-(phenyl(tosyl)methyl)phenol (**3-2**)

White solid, Mp: 127-128 °C;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.47 (s, 1H), 7.64 (dd, *J* = 13.2, 5.5 Hz, 4H), 7.34 (d, *J* = 5.6 Hz, 3H), 7.19 (d, *J* = 8.1 Hz, 2H), 6.31 (s, 1H), 6.19 (s, 1H), 5.82 (s, 1H), 3.75 (s, 3H), 3.45 (s, 3H), 2.38 (s, 3H). **<sup>13</sup>C NMR** (101 MHz, CDCl<sub>3</sub>) δ 161.8, 158.5, 157.8, 144.8, 134.6, 131.0, 130.0, 129.1, 128.6, 128.5, 101.2, 96.0, 91.8, 66.4, 55.7, 55.3, 21.6; **HRMS** calcd. for C<sub>22</sub>H<sub>22</sub>NaO<sub>5</sub>S (M+Na)<sup>+</sup>: 421.1080, found: 421.1086.

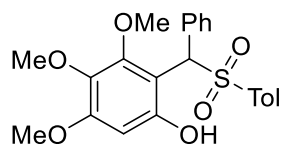


**3,5-dimethoxy-N,N-dimethyl-2-(phenyl(tosyl)methyl)aniline(3-3)**

White solid, Mp: 105-106 °C

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 7.66 – 7.46 (m, 4H), 7.34 – 7.21 (m, 3H), 7.16 (d, *J* = 8.0 Hz, 2H), 6.15 (s, 1H), 5.79 (s, 2H), 3.63 (s, 6H), 2.94 (s, 6H), 2.37 (s, 3H). **<sup>13</sup>C NMR** (100 MHz, CDCl<sub>3</sub>) δ 159.5, 152.3, 143.1, 138.6, 135.0, 130.3, 128.9, 128.8, 127.8, 127.4, 100.0, 89.2, 68.1, 55.5, 40.5, 21.6.

**HRMS** calcd. for C<sub>24</sub>H<sub>27</sub>NNaO<sub>4</sub>S (M+Na)<sup>+</sup>:448.1553, found: 448.1556.



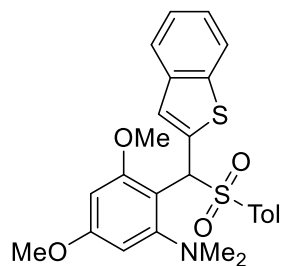
**3,4,5-trimethoxy-2-(phenyl(tosyl)methyl)phenol(3-4)**

White solid, Mp: 137-138 °C;

**<sup>1</sup>H NMR** (400 MHz, CDCl<sub>3</sub>) δ 8.55 (s, 1H), 7.65 (t, *J* = 7.6 Hz, 4H), 7.35 (d, *J* = 4.8 Hz, 3H), 7.22 (d, *J* = 8.1 Hz, 2H), 6.38 (s, 1H), 6.20 (s, 1H), 3.82 (s, 3H), 3.58 (s, 3H), 3.48 (s, 3H), 2.37 (s, 3H). **<sup>13</sup>C NMR** (101 MHz, CDCl<sub>3</sub>) δ 154.8, 152.4, 152.0, 145.1, 135.7, 134.4, 131.1, 130.2, 129.5, 128.8, 128.7, 105.6, 98.8, 68.1, 61.2, 60.7, 55.8, 21.6;

**HRMS** calcd. for C<sub>23</sub>H<sub>24</sub>NaO<sub>6</sub>S (M+Na)<sup>+</sup>: 451.1186, found: 451.1196.





2-(benzo[b]thiophen-2-yl(tosyl)methyl)-3,5-dimethoxy-N,N-dimethylaniline(**3-5**)

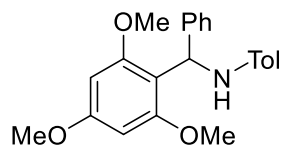
White solid, Mp: 113-114 °C;

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.72 (d,  $J$  = 7.1 Hz, 1H), 7.67 (d,  $J$  = 6.8 Hz, 1H), 7.61 (d,  $J$  = 8.2 Hz, 2H), 7.41 (s, 1H), 7.31 – 7.22 (m, 2H), 7.18 (d,  $J$  = 8.0 Hz, 2H), 6.52 (s, 1H), 5.81 (d,  $J$  = 26.0 Hz, 2H), 3.69 (d,  $J$  = 6.8 Hz, 6H), 2.97 (s, 6H), 2.38 (s, 3H).  $^{13}\text{C NMR}$  (100 MHz,  $\text{CDCl}_3$ )  $\delta$  159.7, 158.9, 152.5, 143.4, 140.8, 138.9, 137.9, 137.4, 128.9, 128.8, 126.0, 124.0, 123.8, 123.4, 121.8, 98.4, 88.9, 88.5, 65.2, 55.8, 54.7, 40.4, 21.6.

**HRMS** calcd. for  $\text{C}_{26}\text{H}_{27}\text{NNaO}_4\text{S}_2$  ( $\text{M}+\text{Na}$ ) $^+$ : 504.1274, found: 504.1282.

*General procedure for the preparation of compound 5.*

Compound **3u** (0.2 mmol, 1.0 equiv), 4-methylbenzeneamine **4a** (0.6 mmol, 3.0 equiv), and  $\text{FeCl}_3$  (0.03 mmol, 15 mol%) were dissolved in 2 mL of DCM. The solution was stirred 24 hours under air at 40 °C. After completion of reaction as indicated by TLC, the reaction mixture was extracted with DCM (2 × 10 mL). The combined organic layers were washed with saturated brine solution (2 × 100 mL) and dried over  $\text{Na}_2\text{SO}_4$ . The solvent was evaporated and the residue was purified by flash column chromatography (*n*-hexane/ethyl acetate = 1:30) to give the corresponding product **5**.



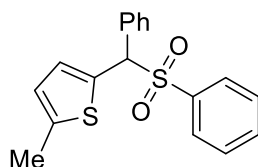
4-methyl-N-(phenyl(2,4,6-trimethoxyphenyl)methyl)aniline (**5**)

White solid, Mp: 157-158 °C;

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.34 (d,  $J$  = 7.9 Hz, 2H), 7.26-7.20 (m, 2H), 7.14 (t,  $J$  = 7.2 Hz, 1H), 6.92 (d,  $J$  = 8.1 Hz, 2H), 6.61 (d,  $J$  = 8.4 Hz, 2H), 6.28 (s, 1H), 6.12 (s, 2H), 5.13 (s, 1H), 3.77 (s, 3H), 3.75 (s, 6H), 2.19 (s, 3H).  $^{13}\text{C NMR}$  (100 MHz,  $\text{CDCl}_3$ )  $\delta$  160.3, 158.8, 145.9, 143.8, 129.6, 127.8, 126.6, 126.0, 113.5, 112.2, 91.4, 55.9, 55.3, 51.2, 20.4; **HRMS** calcd. for  $\text{C}_{23}\text{H}_{25}\text{NNaO}_3$  ( $\text{M}+\text{Na}$ ) $^+$ : 386.1727, found: 386.1738.

*General procedure for the preparation of compound 7.*

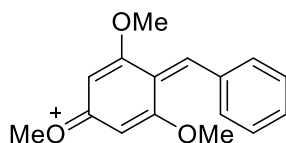
Substituted **3u** (0.2 mmol, 1.0 equiv), 2-methylthiophene **6a** (0.6 mmol, 3.0 equiv), and FeCl<sub>3</sub> (0.03 mmol, 15 mol%) were dissolved in 2 mL of DCM. The solution was stirred 24 hours under air at room temperature. After completion of reaction as indicated by TLC, the reaction mixture was extracted with DCM (2 × 10 mL). The combined organic layers were washed with saturated brine solution (2 × 100 mL) and dried over Na<sub>2</sub>SO<sub>4</sub>. The solvent was evaporated and the residue was purified by flash column chromatography (*n*-hexane/ethyl acetate = 10:1) to give the corresponding product **7**.



2-methyl-5-(phenyl(phenylsulfonyl)methyl)thiophene (**7**)

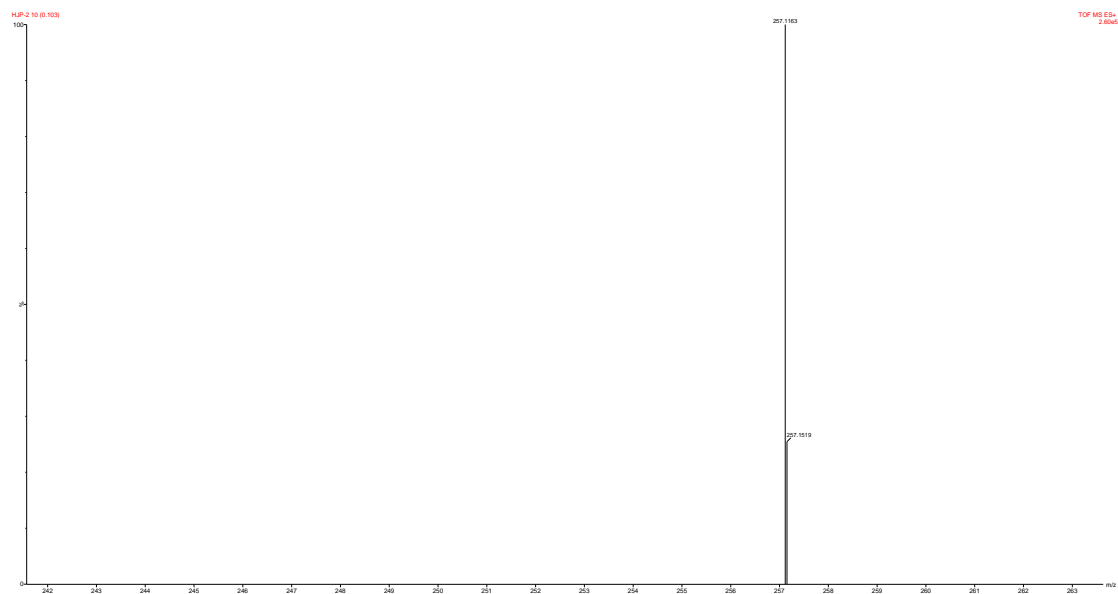
White solid, Mp: 152-153 °C;

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.70-7.59 (m, 2H), 7.57-7.44 (m, 3H), 7.37 (q, *J* = 7.6 Hz, 2H), 7.33-7.27 (m, 3H), 6.96 (d, *J* = 3.5 Hz, 1H), 6.70-6.55 (m, 1H), 5.44 (s, 1H), 2.44 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 142.1, 137.6, 133.6, 132.7, 131.0, 130.0, 129.8, 129.2, 129.0, 128.6, 128.6, 125.1, 72.6, 15.3; HRMS calcd. for C<sub>18</sub>H<sub>16</sub>NaO<sub>2</sub>S<sub>2</sub> (M+Na)<sup>+</sup>: 351.0484, found: 351.0490.

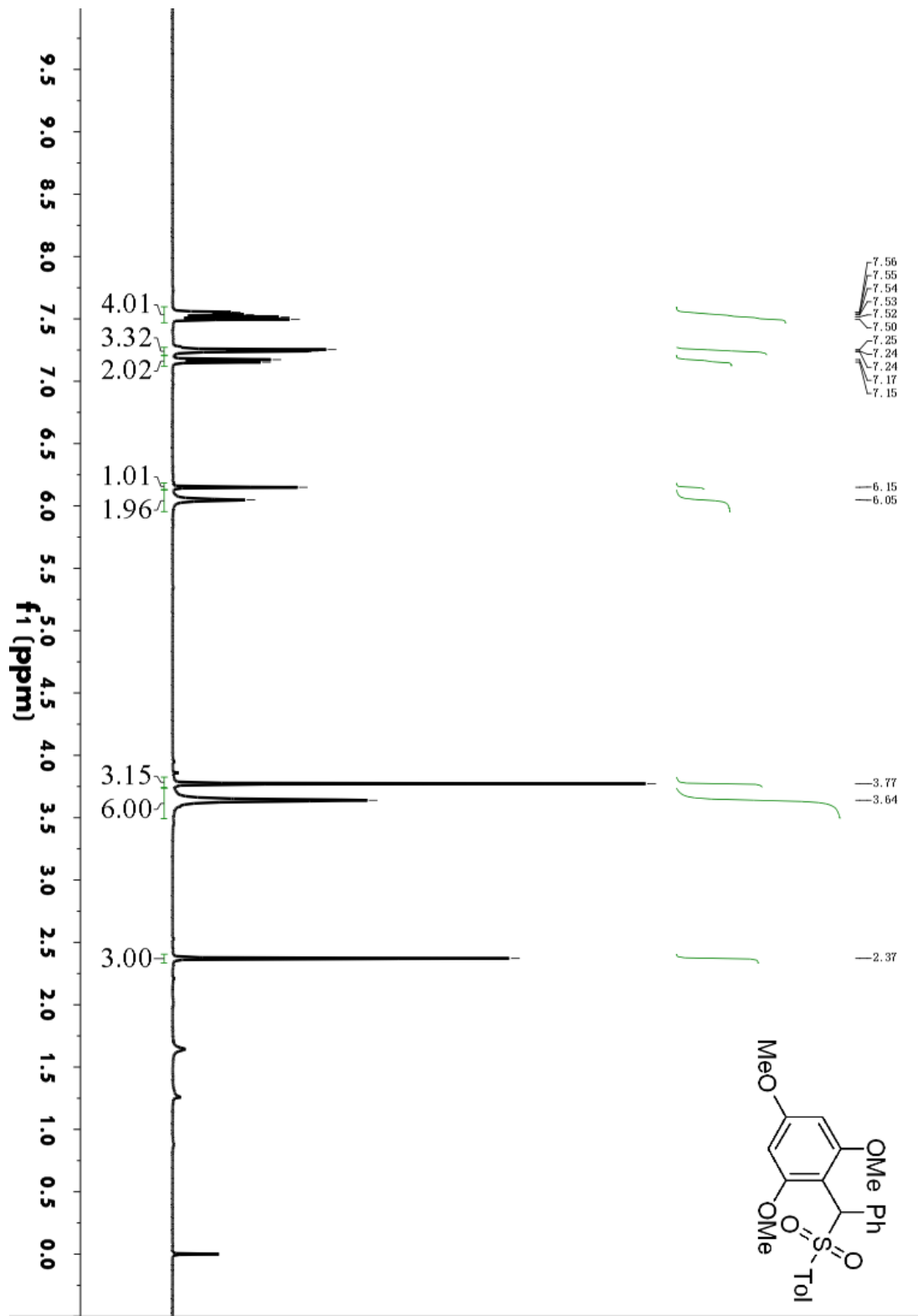


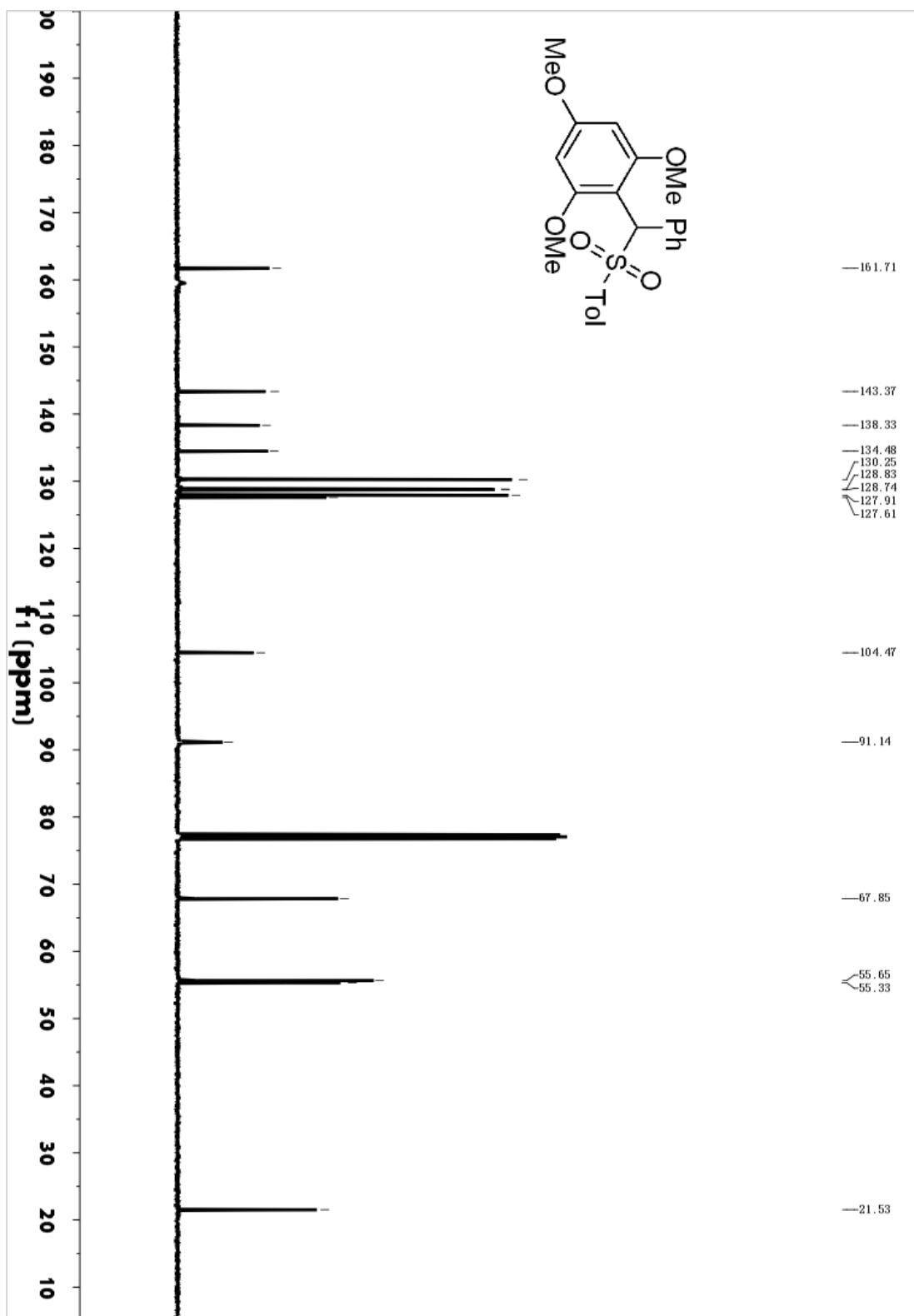
Intermediate **A**

HRMS (ESI): calculated for C<sub>16</sub>H<sub>17</sub>O<sub>3</sub><sup>+</sup>[M]<sup>+</sup> = 257.1172, found C<sub>16</sub>H<sub>17</sub>O<sub>3</sub><sup>+</sup>[M]<sup>+</sup> = 257.1163.

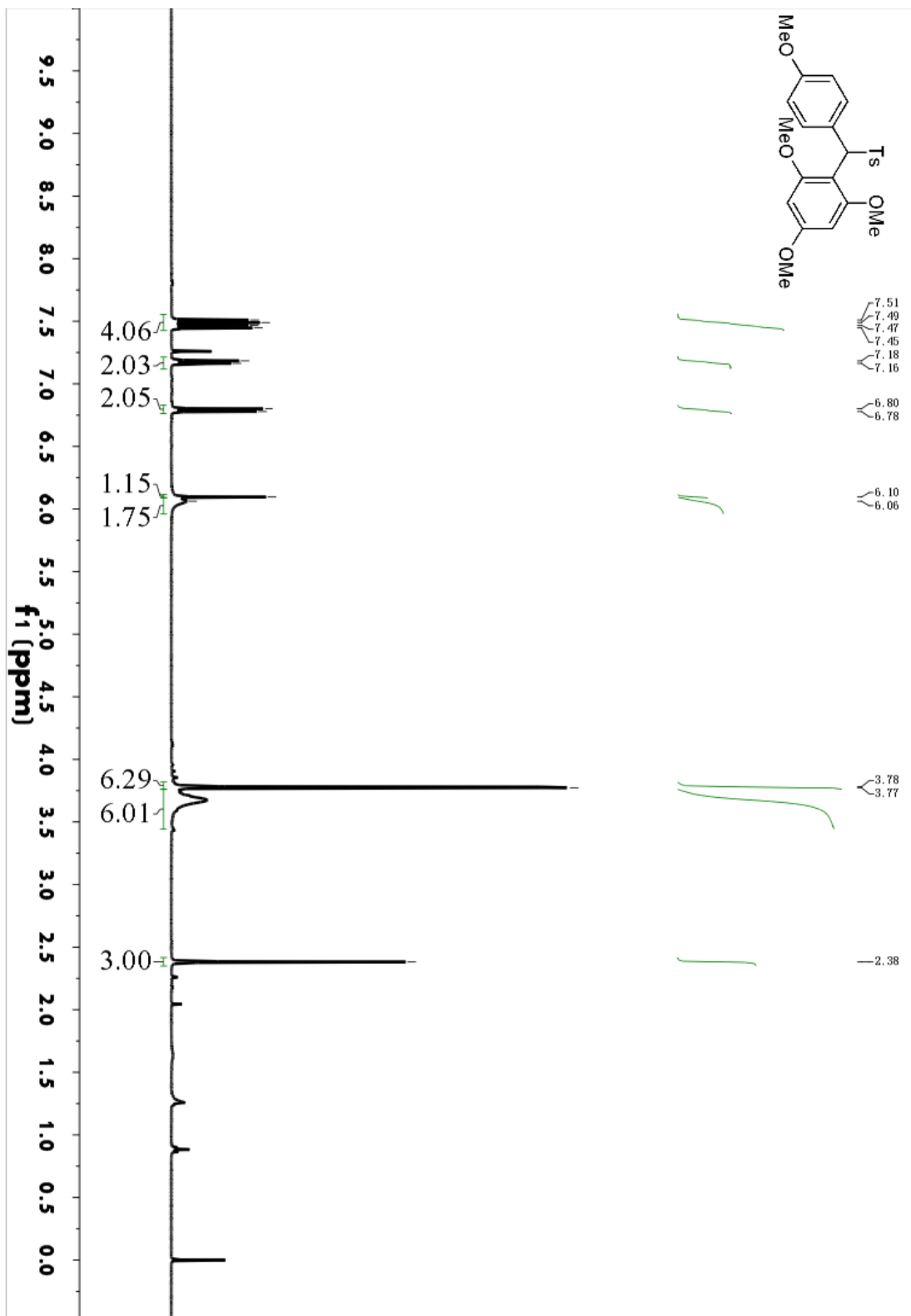


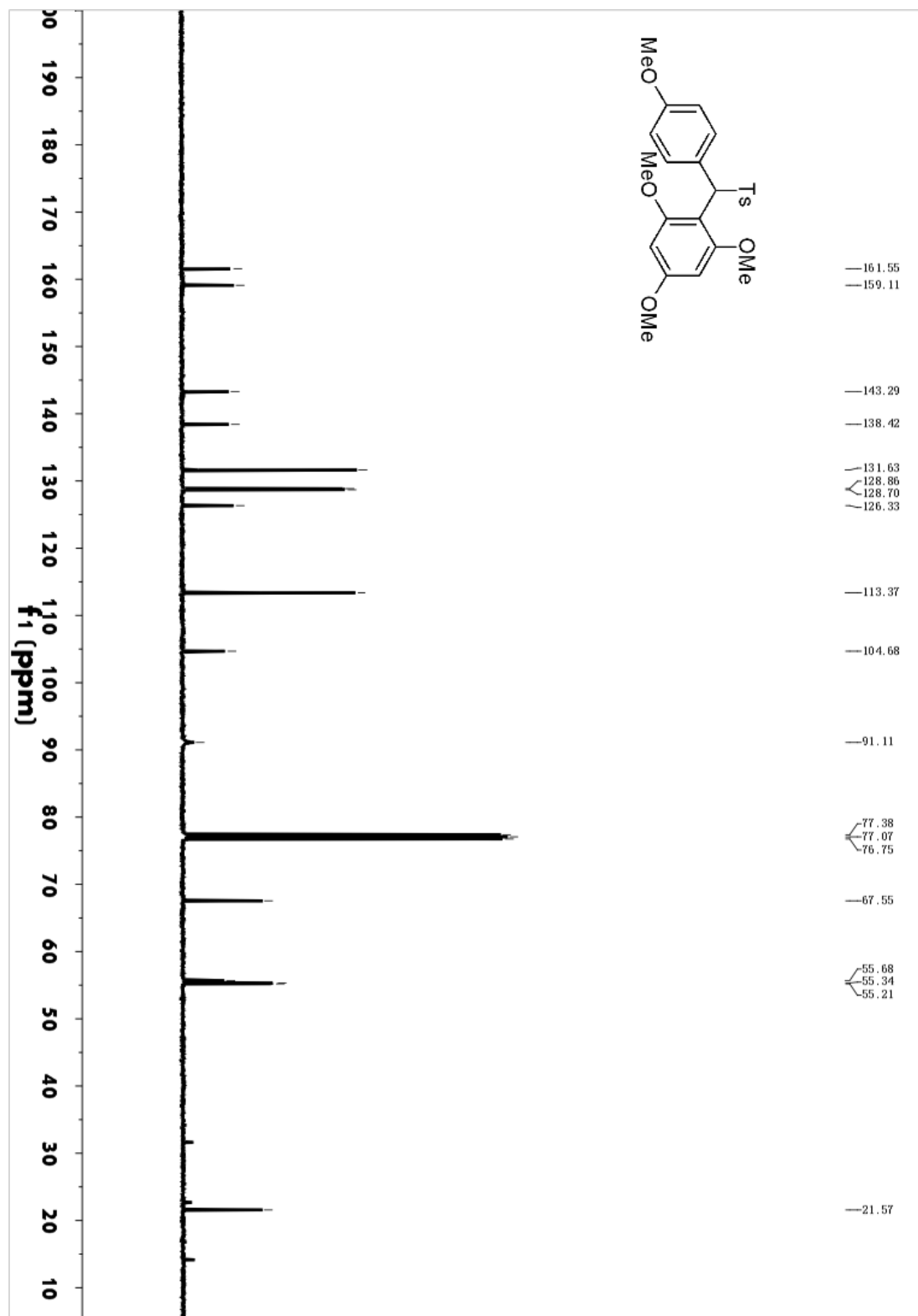
**$^1\text{H}$  and  $^{13}\text{C}$  NMR spectra of compounds 3, 5 and 7.**  
**3a**



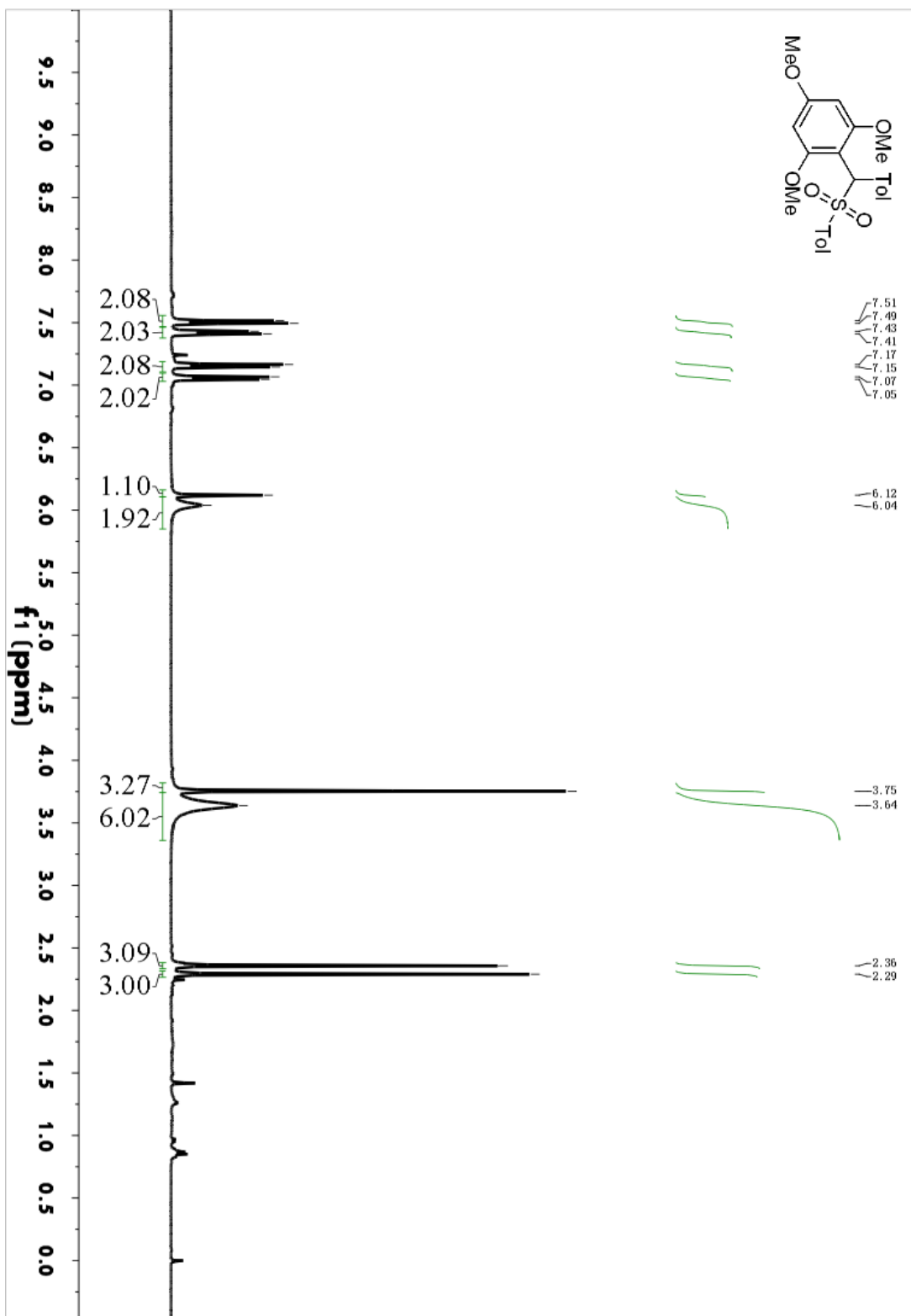


3b

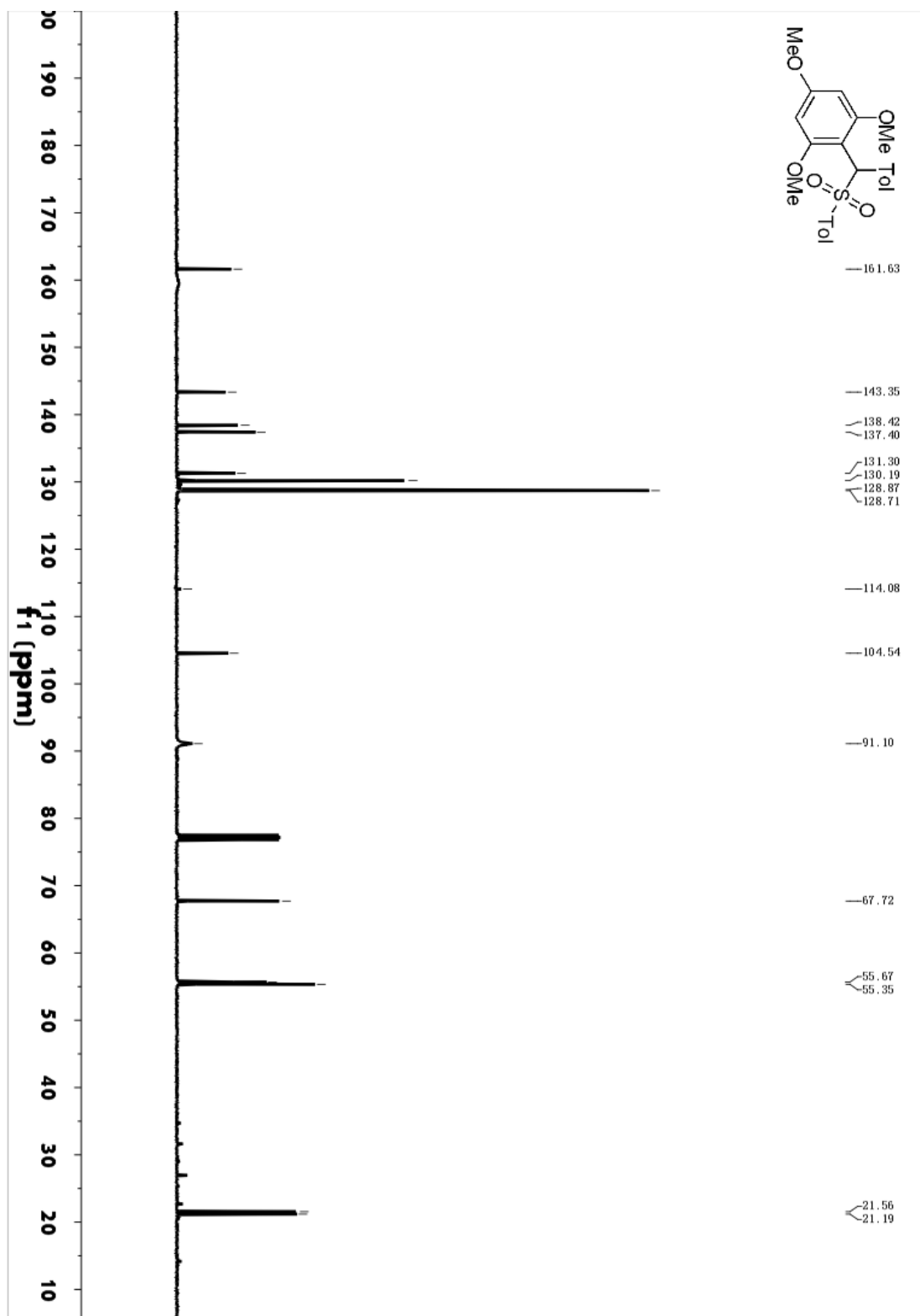




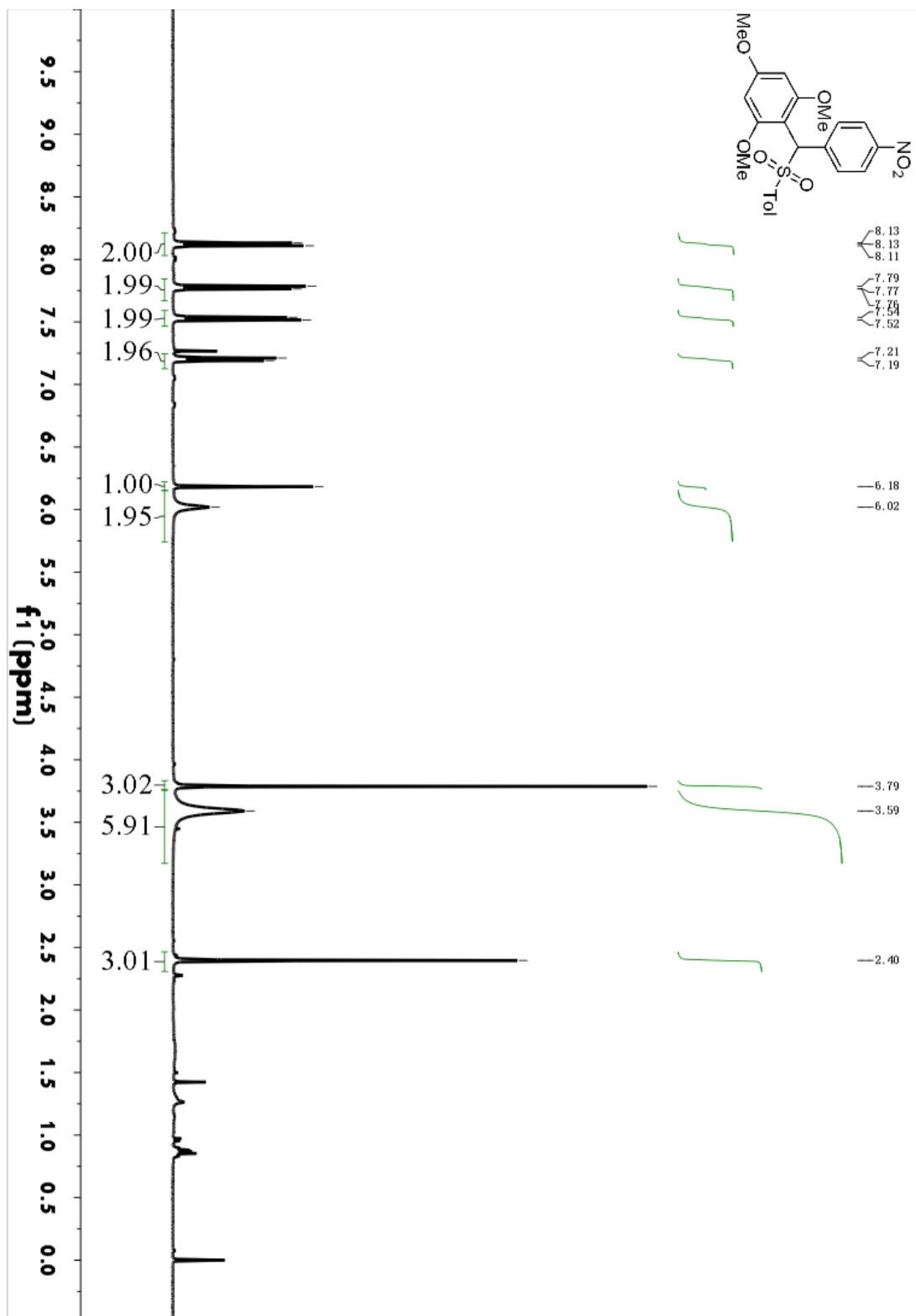
3c

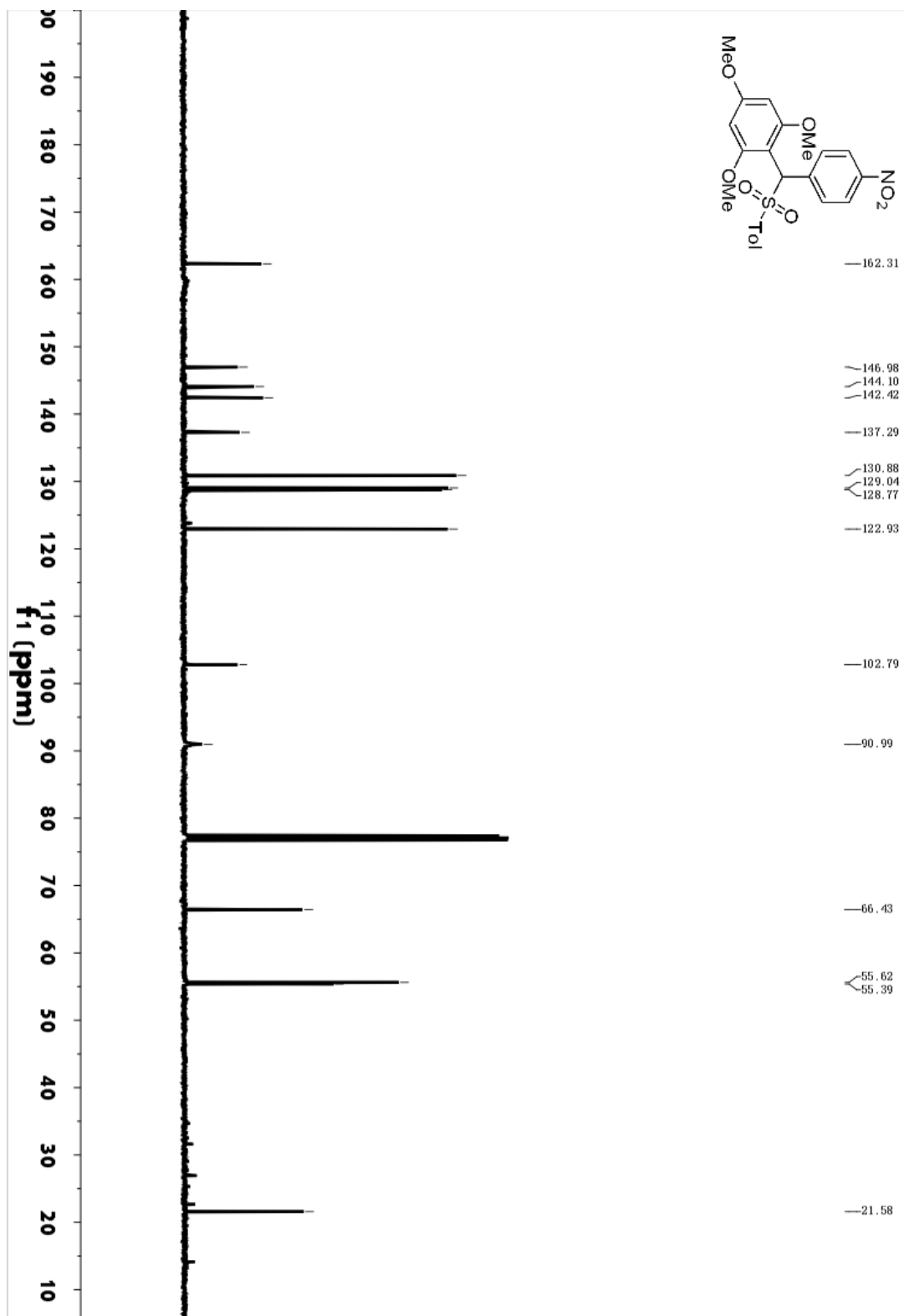




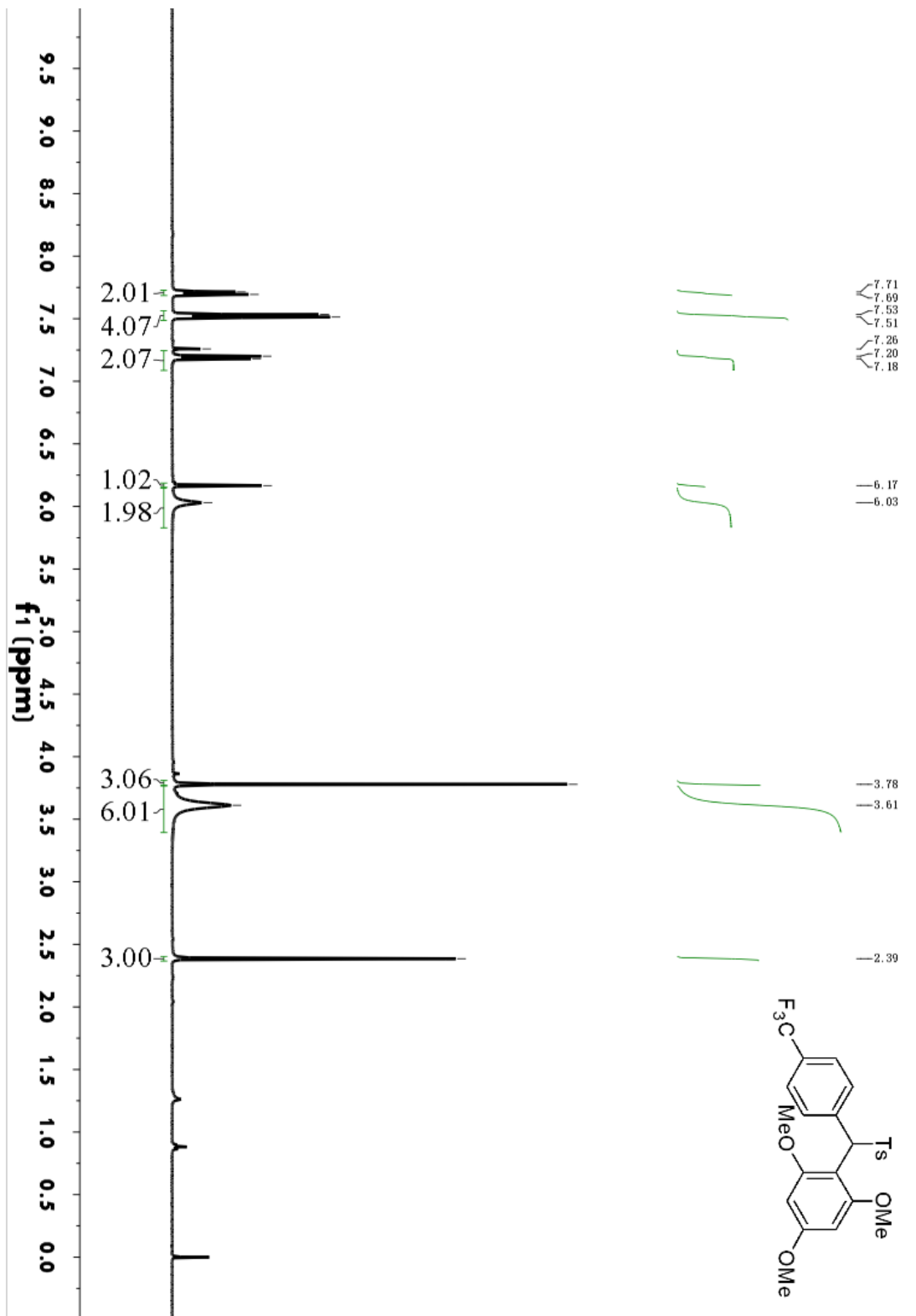


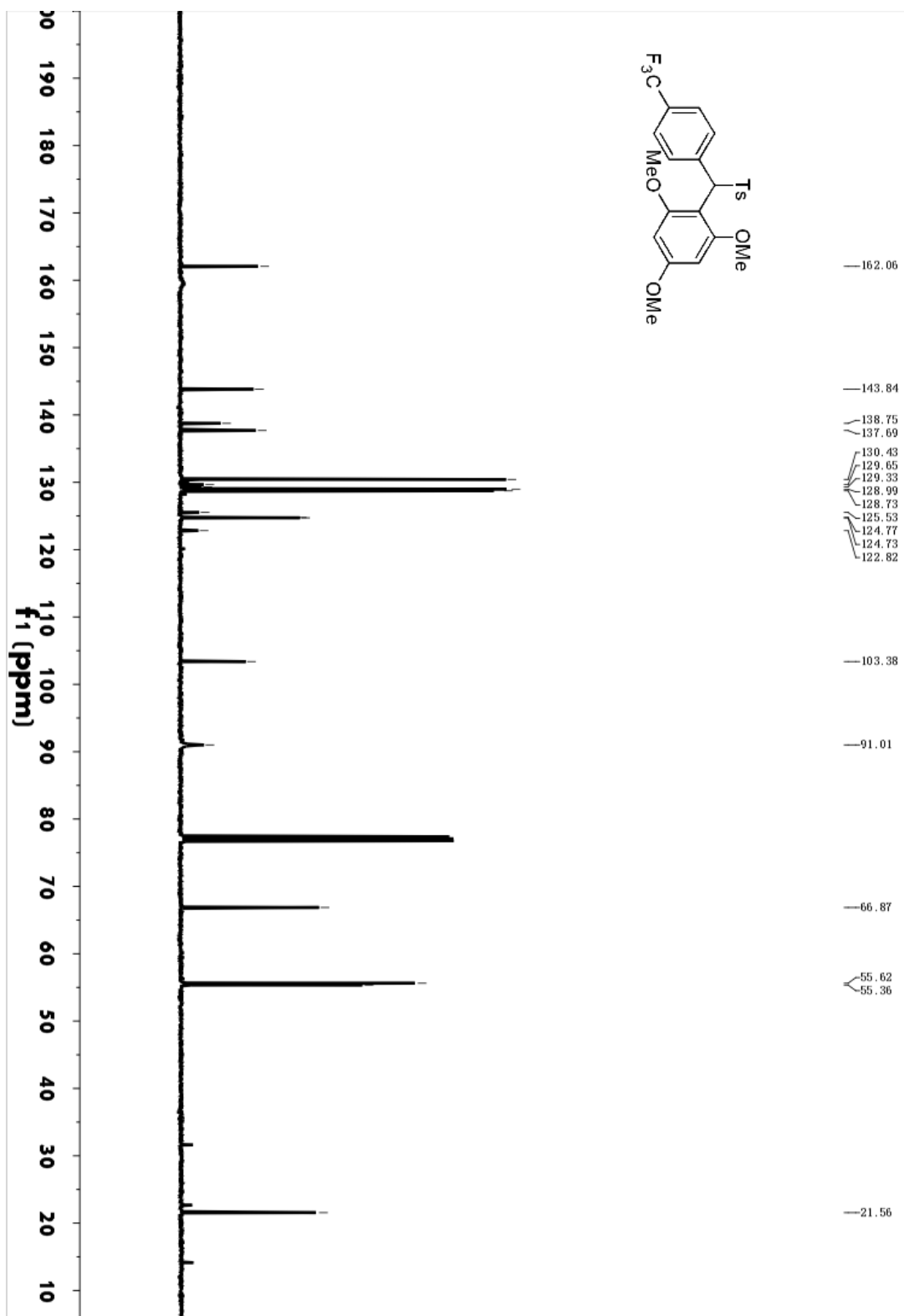
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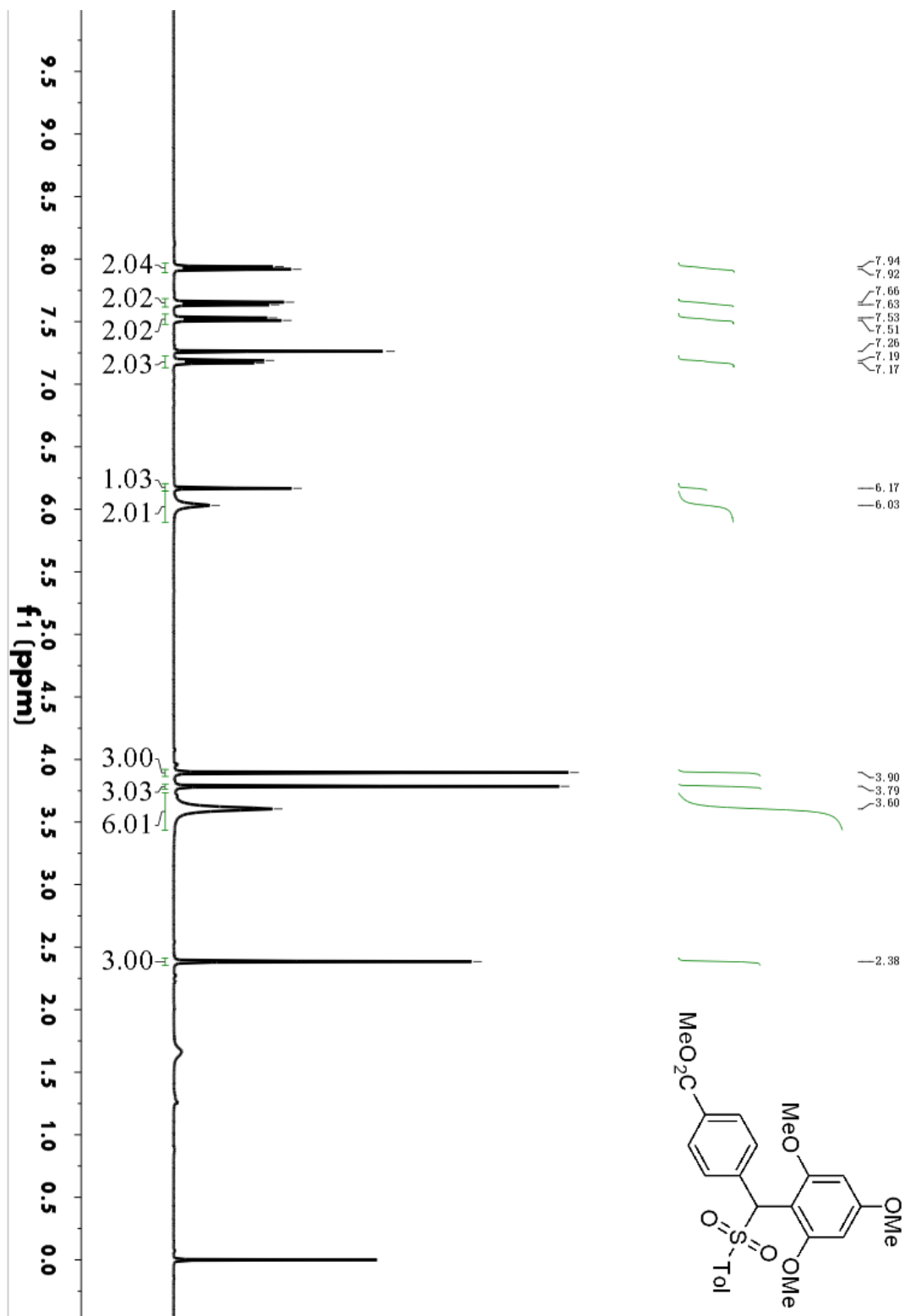


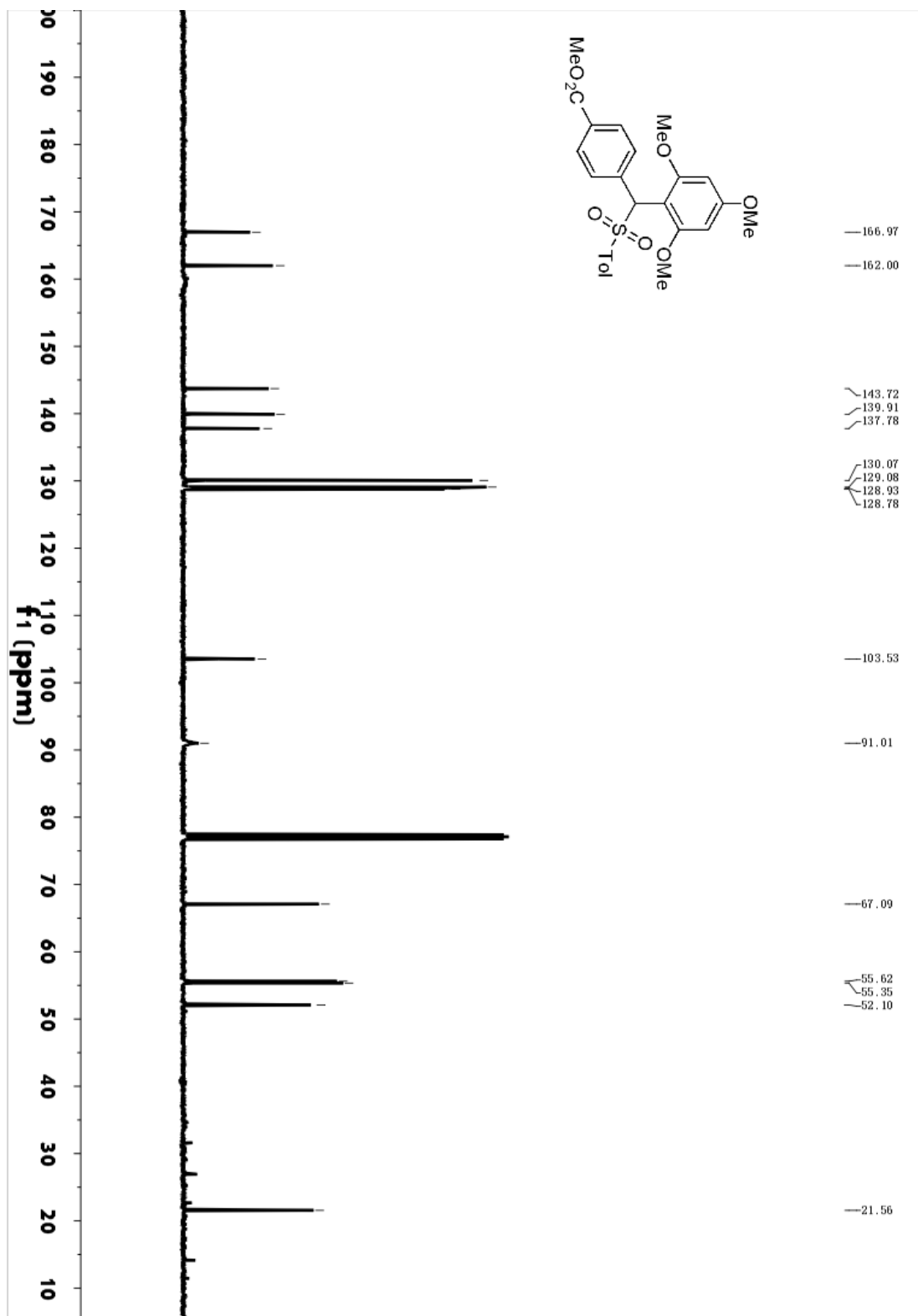
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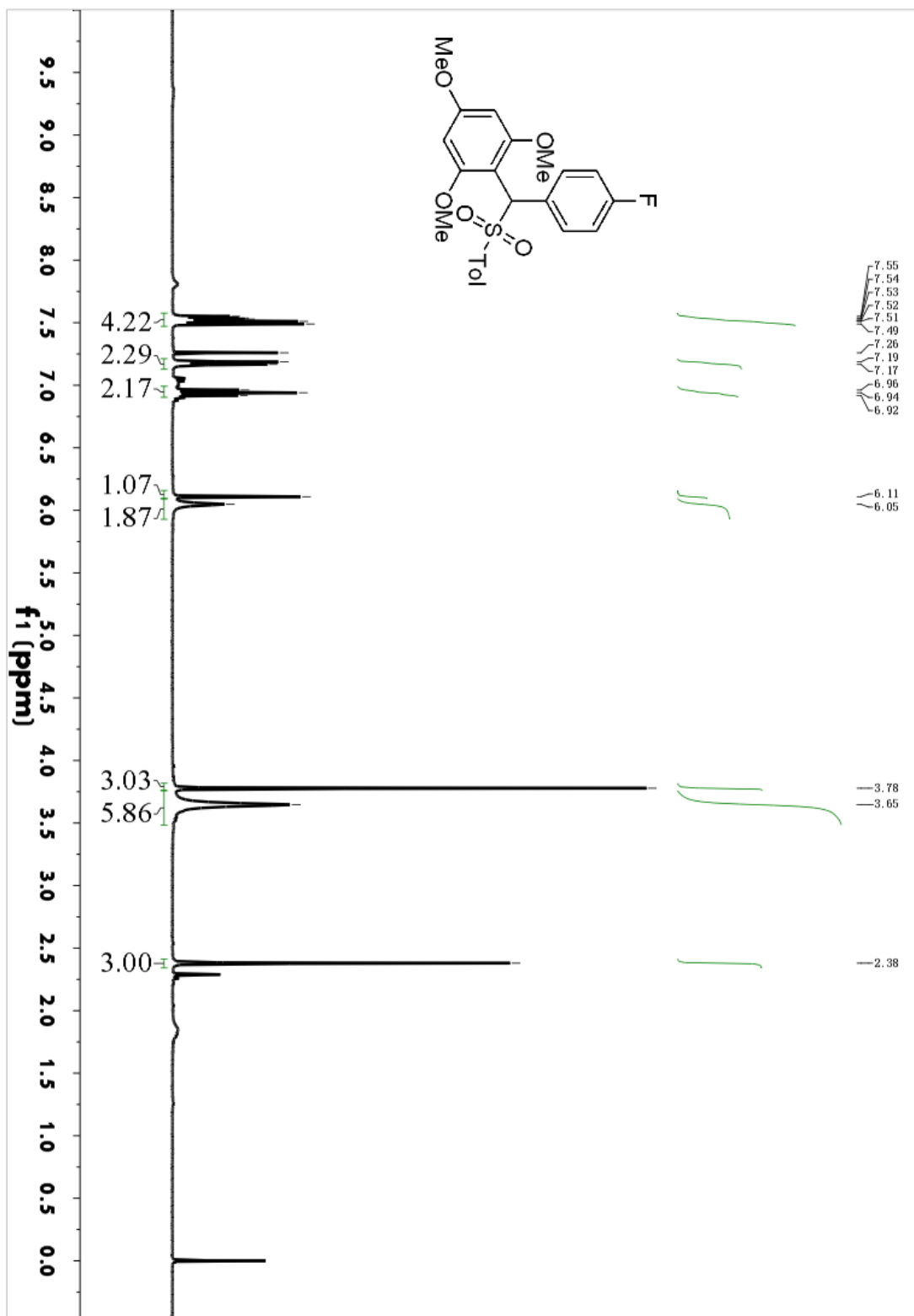


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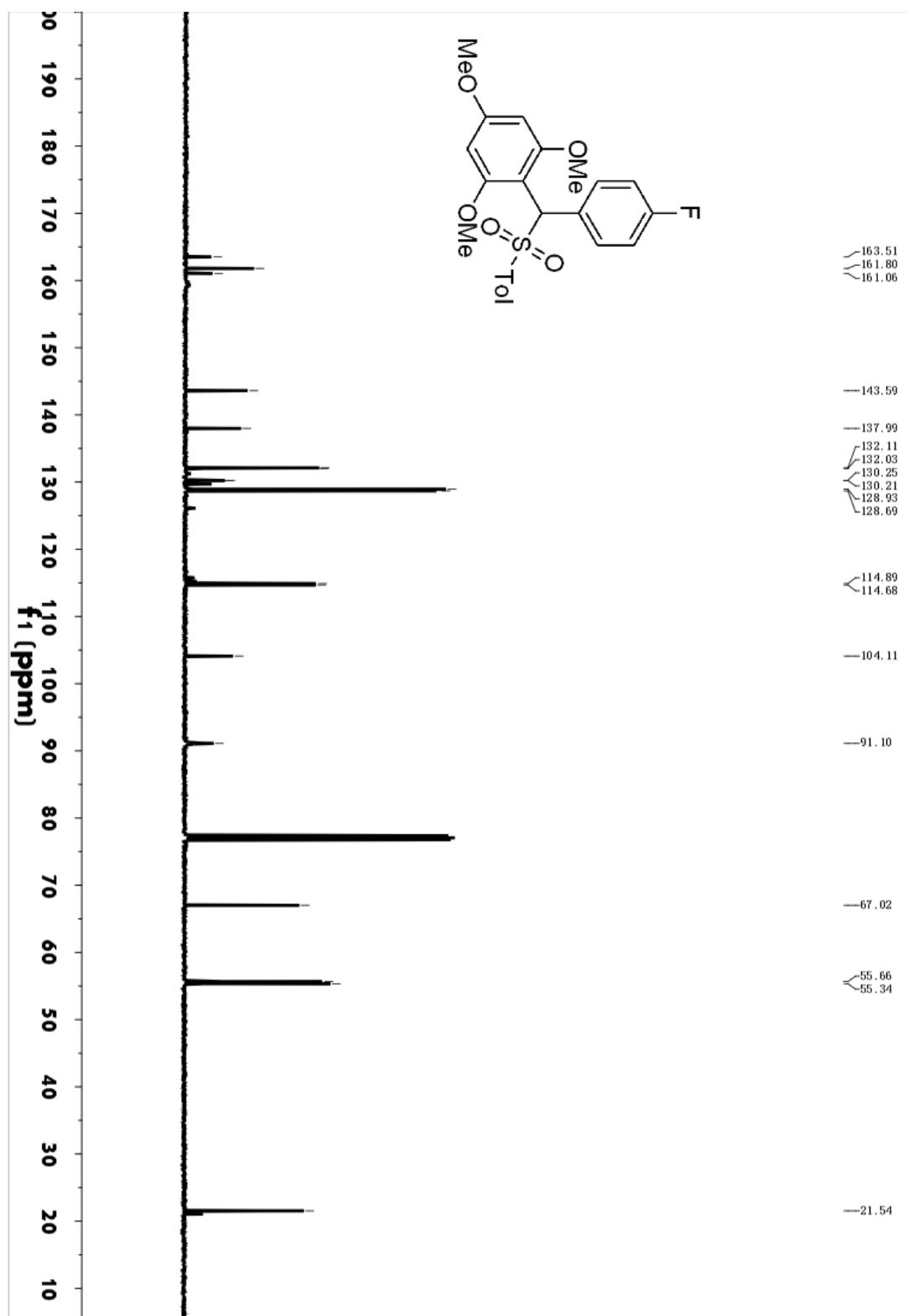




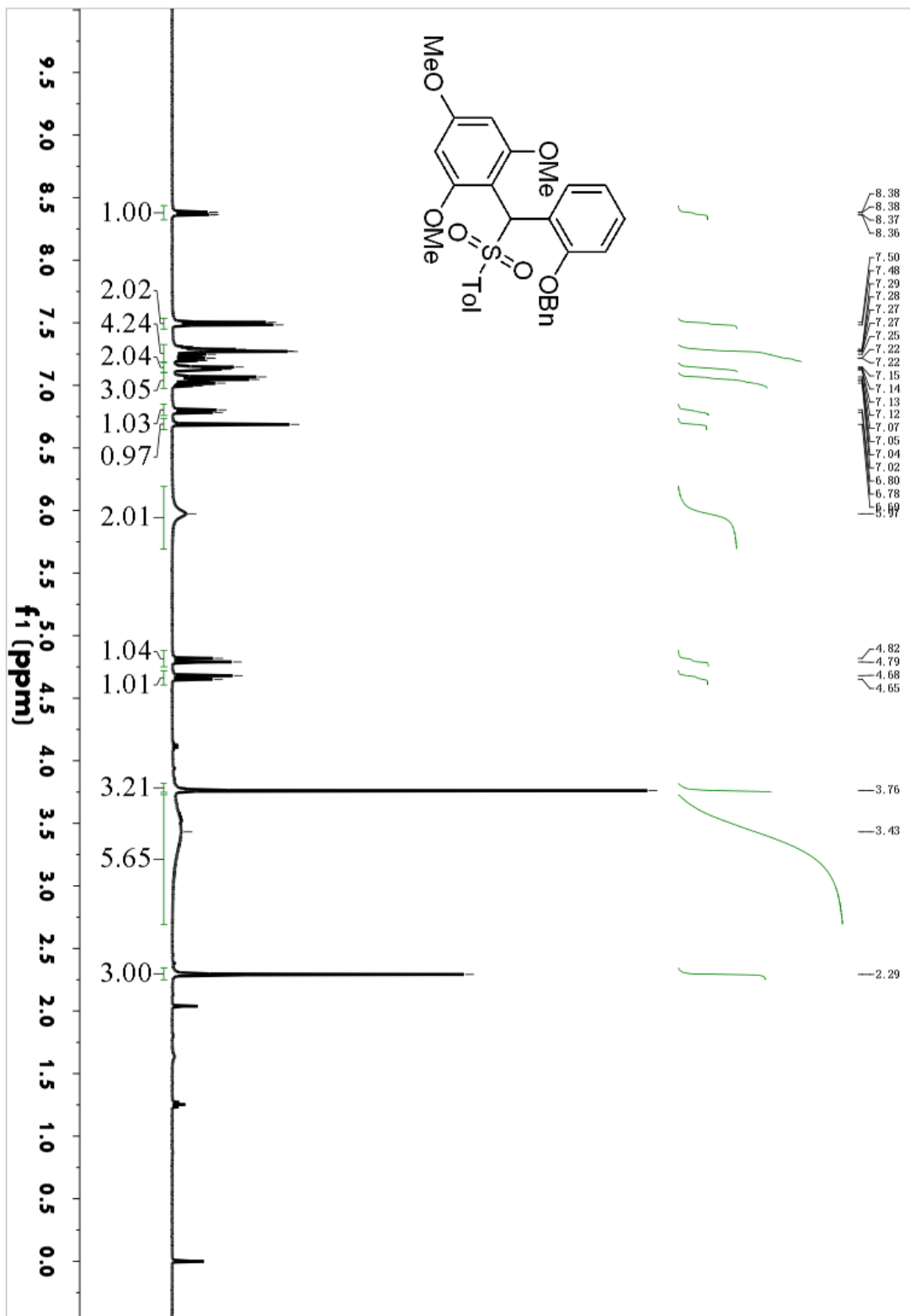
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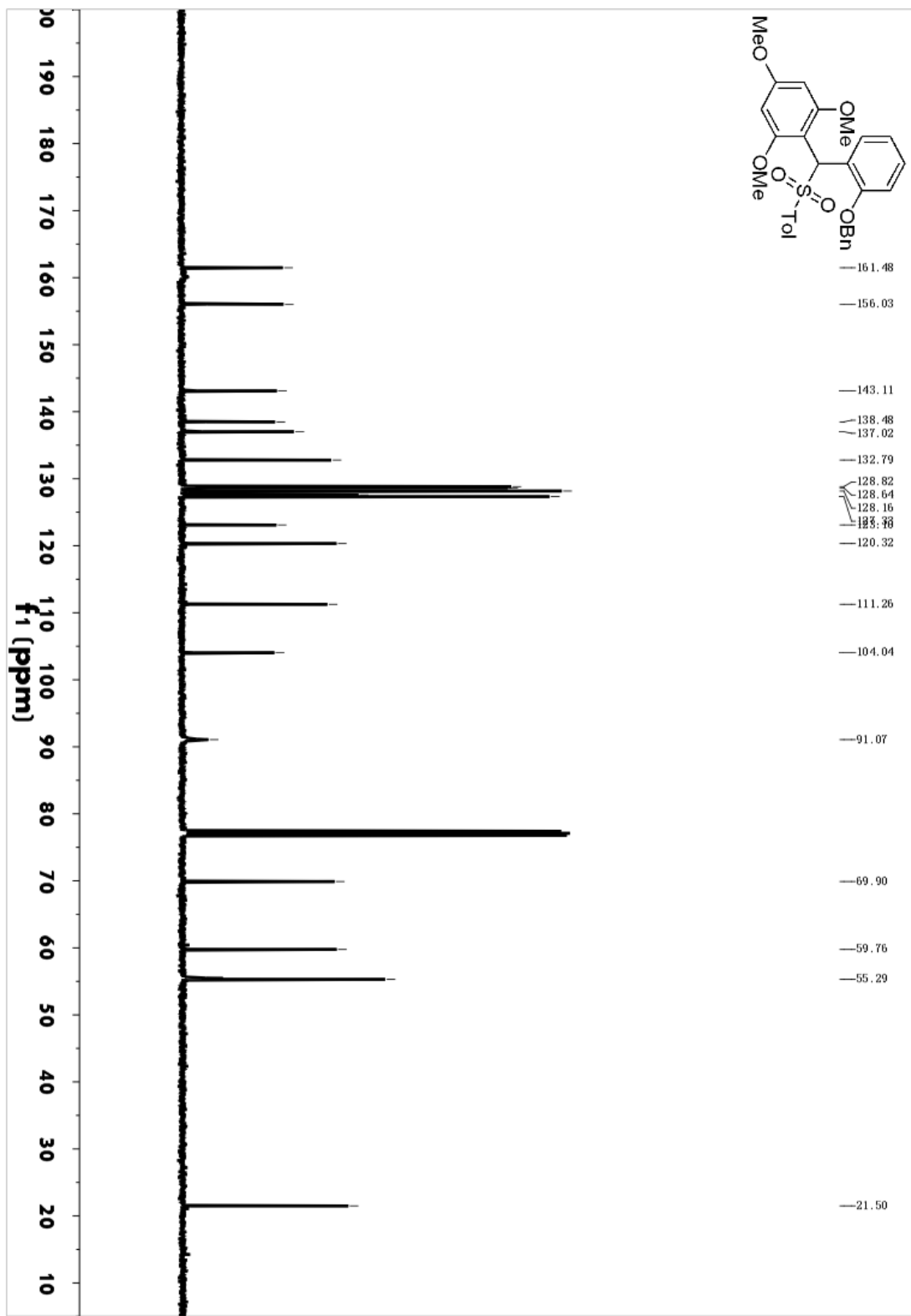




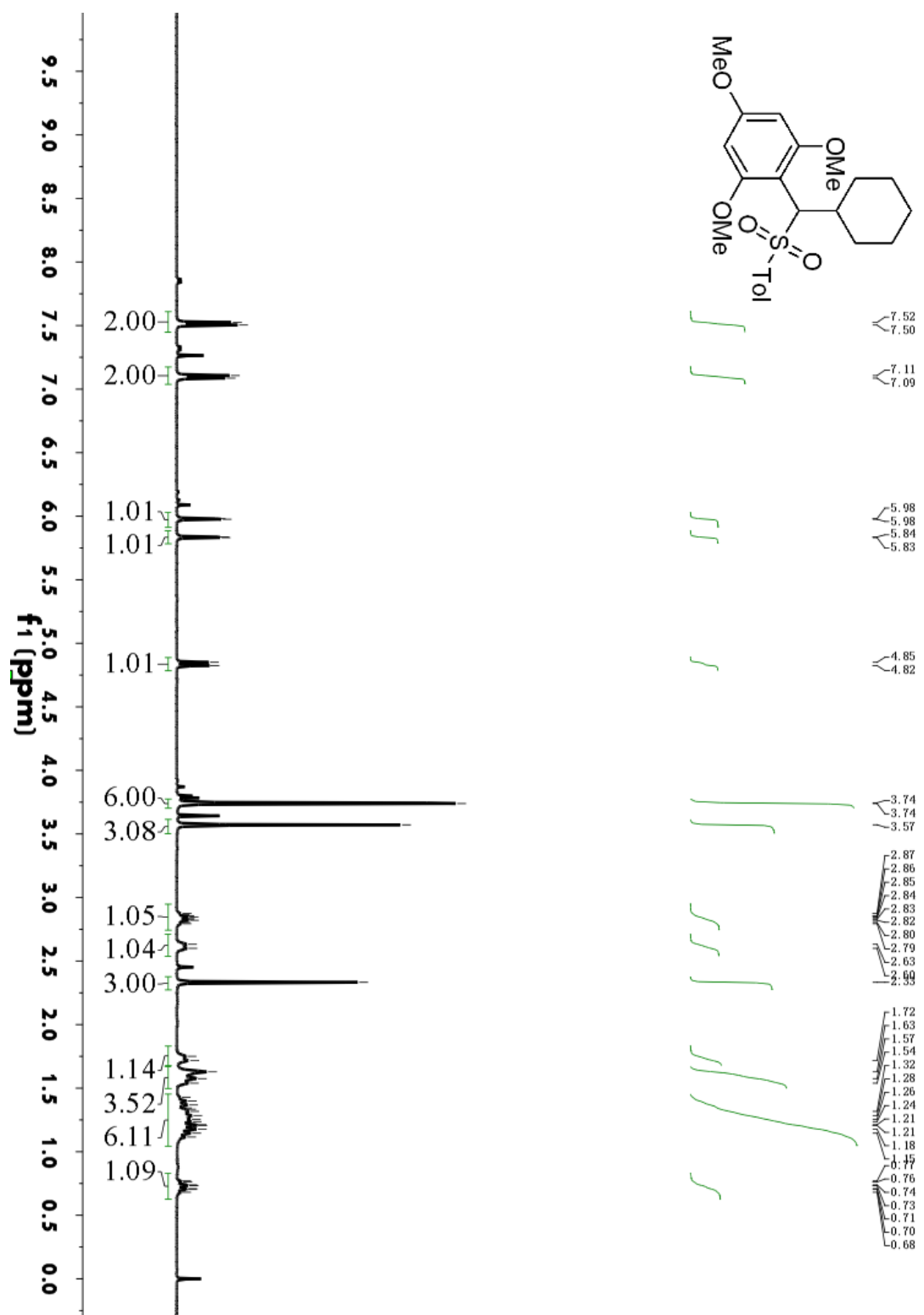


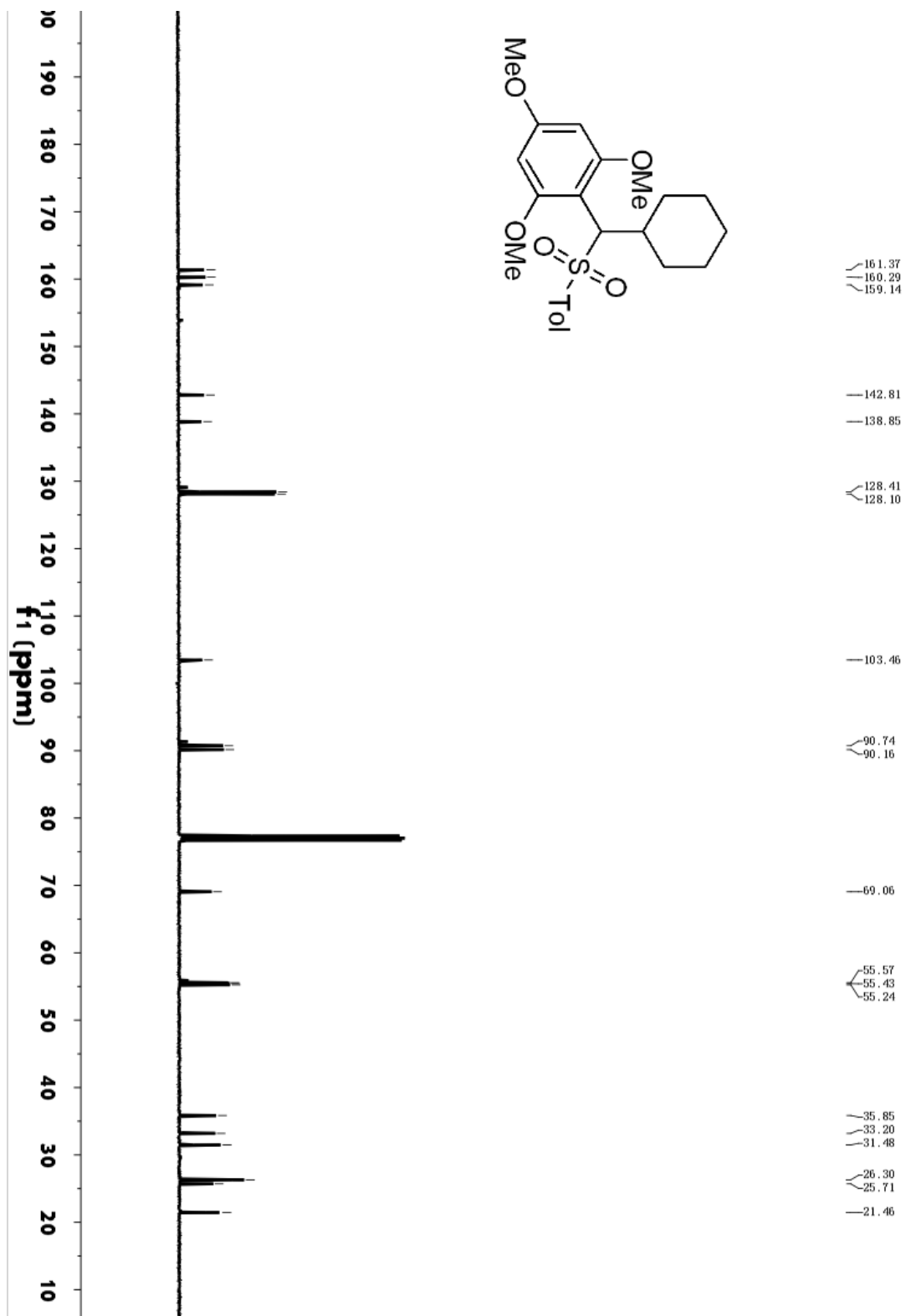
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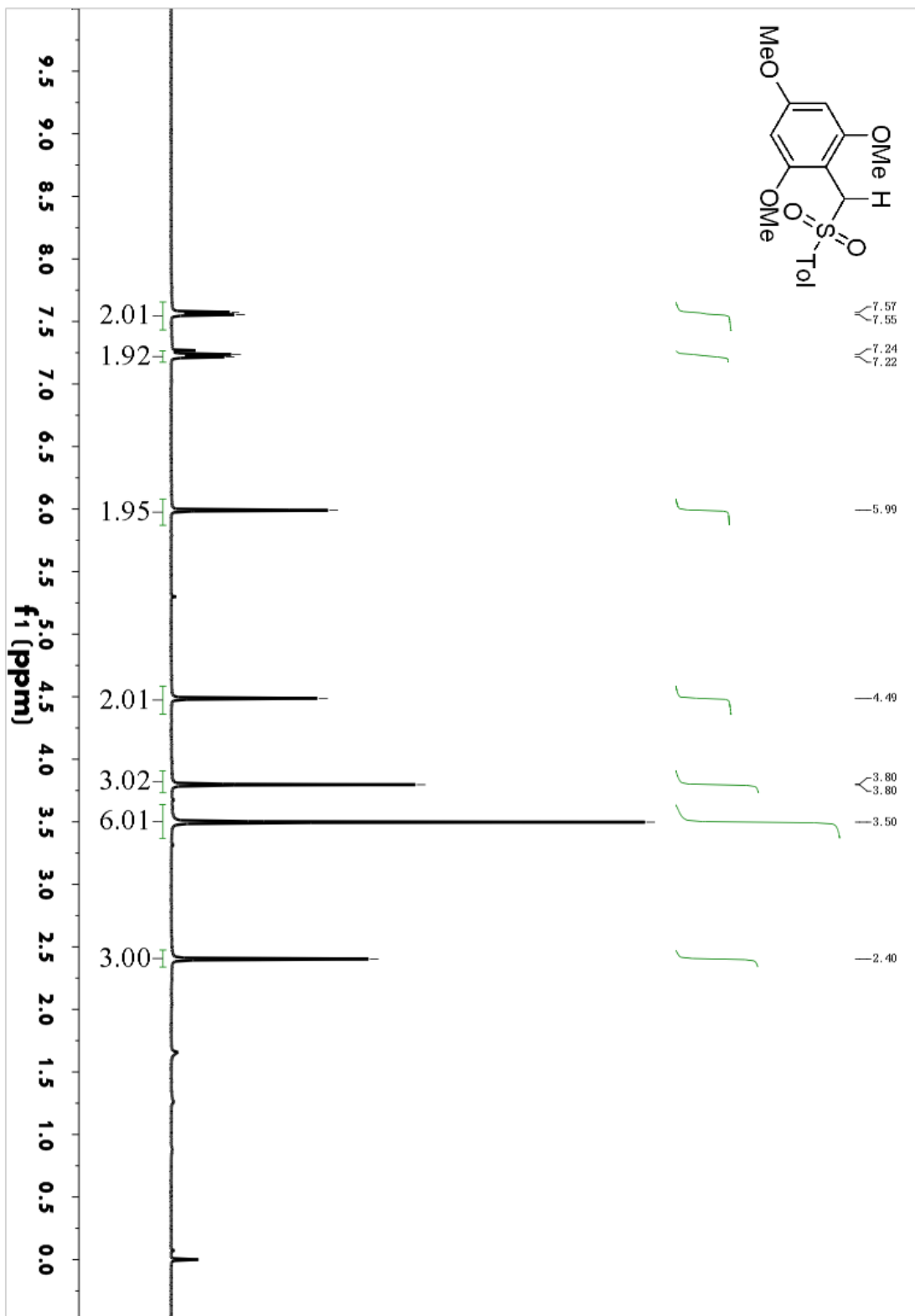


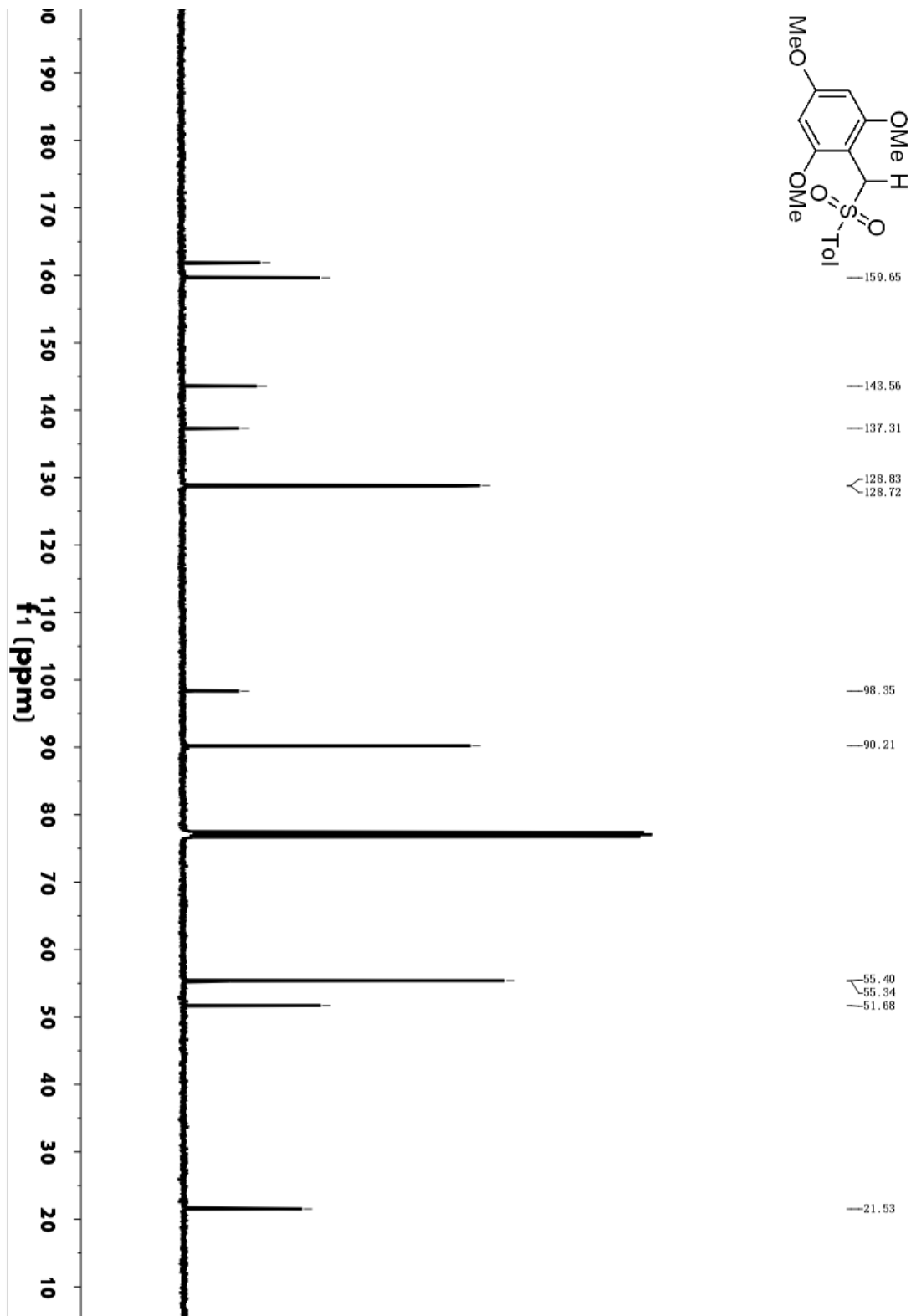
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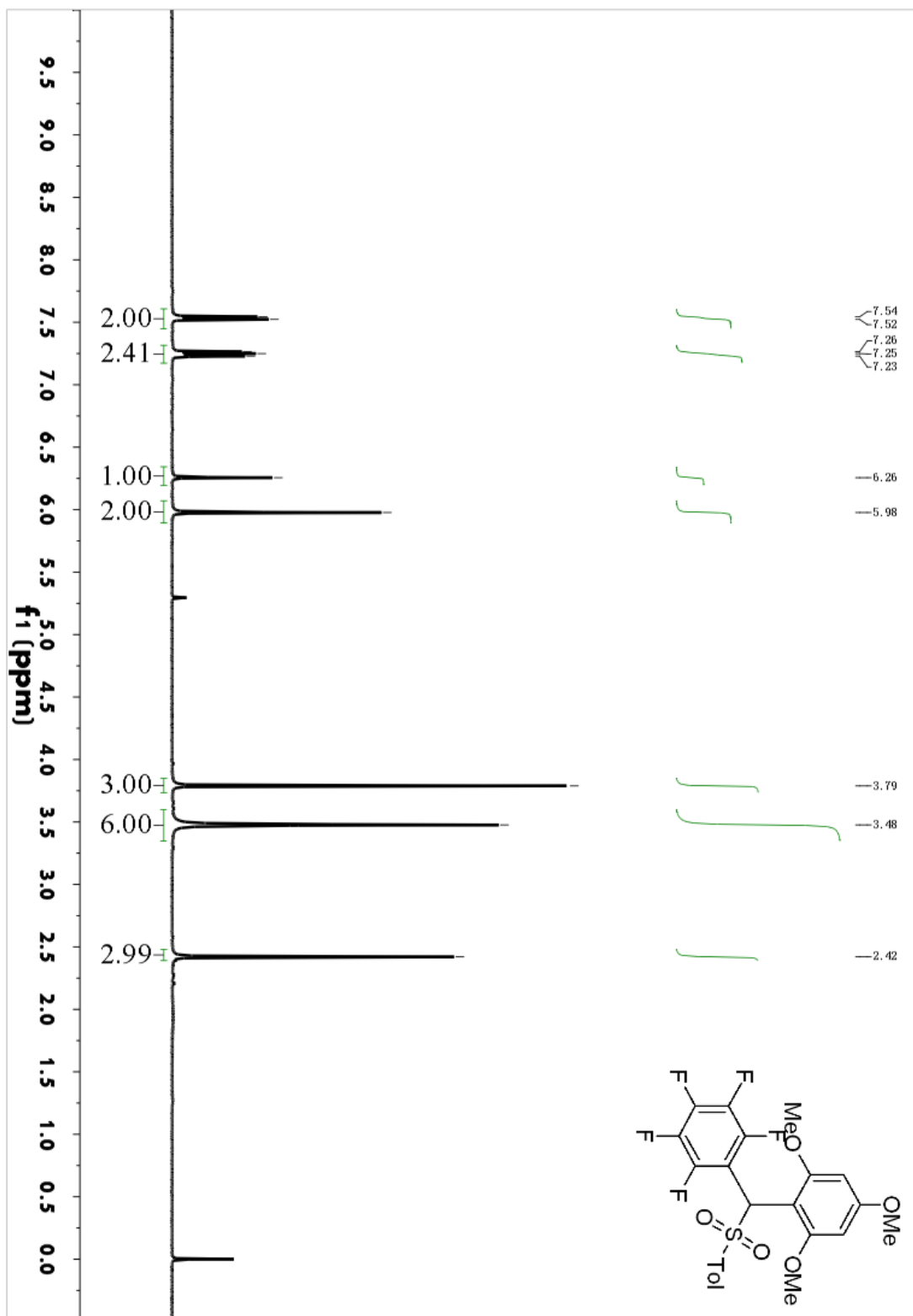


3j

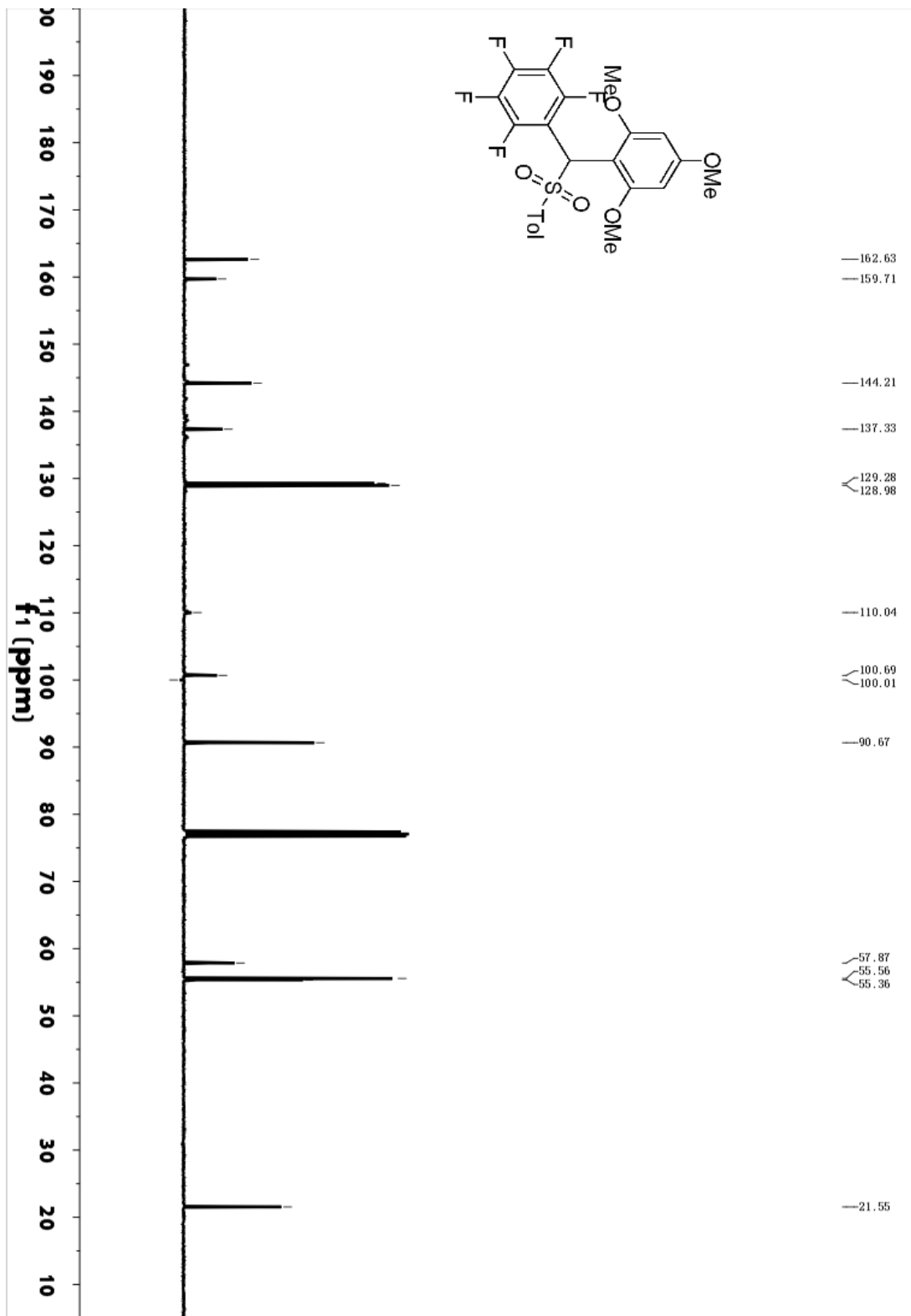




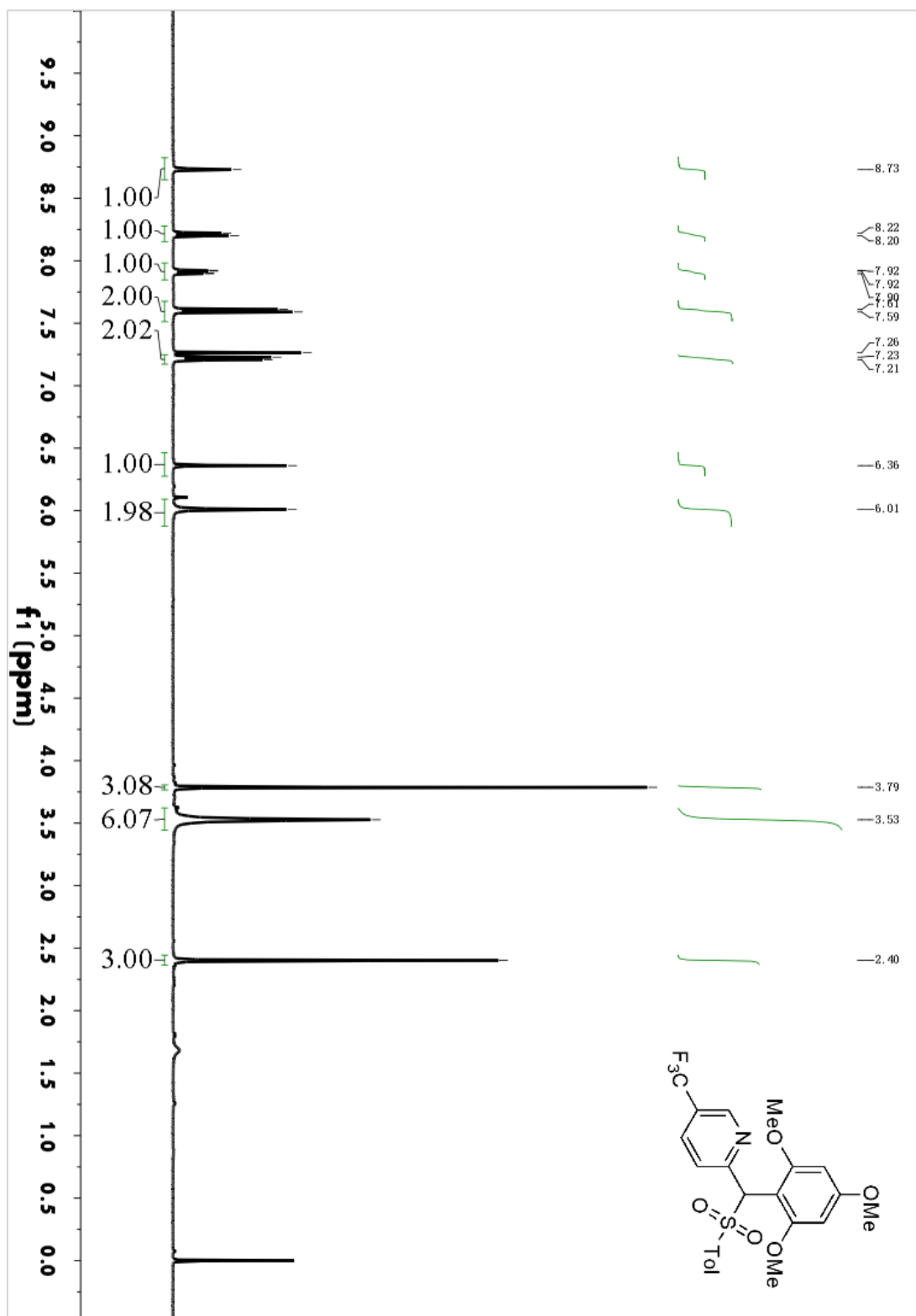
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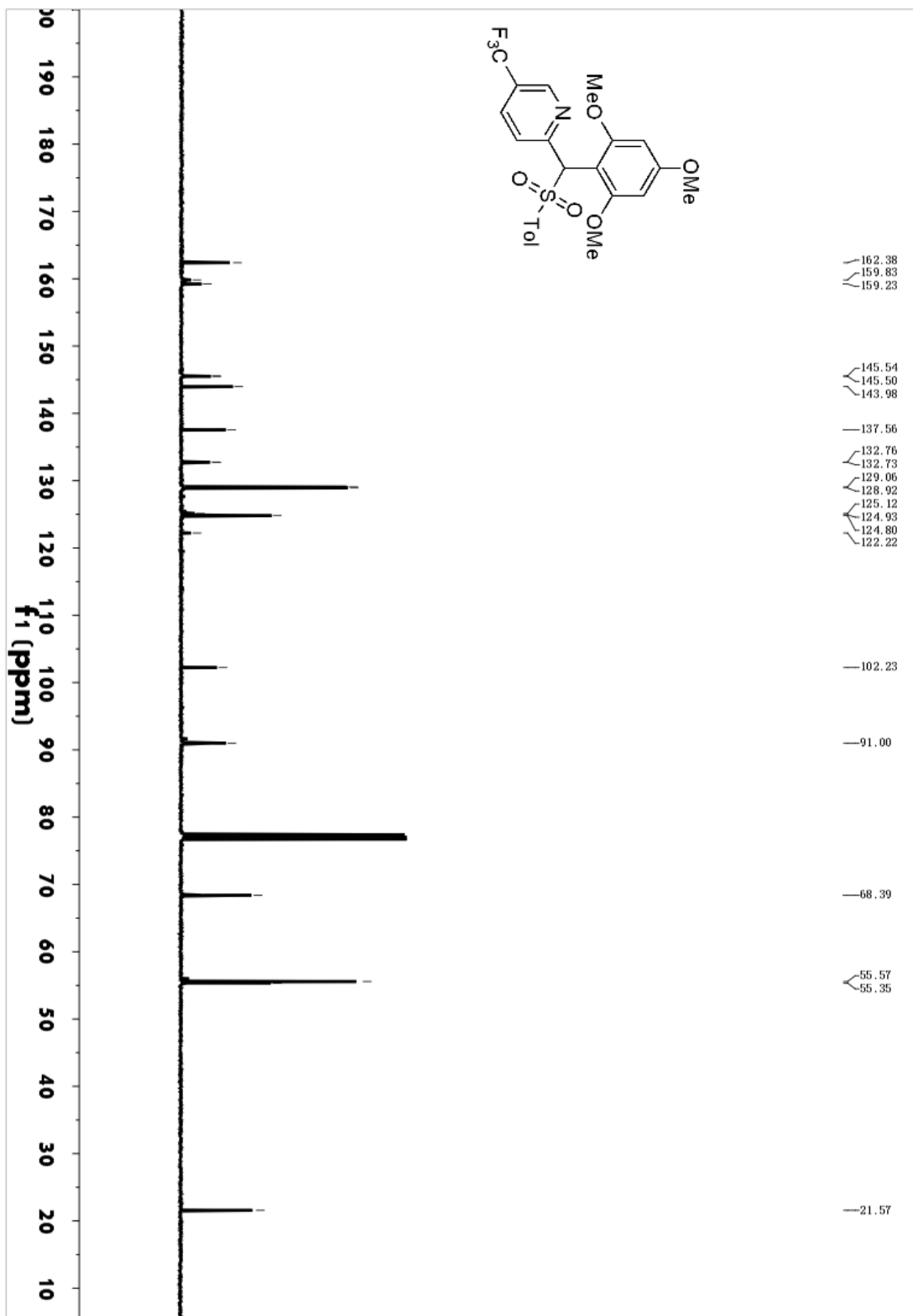




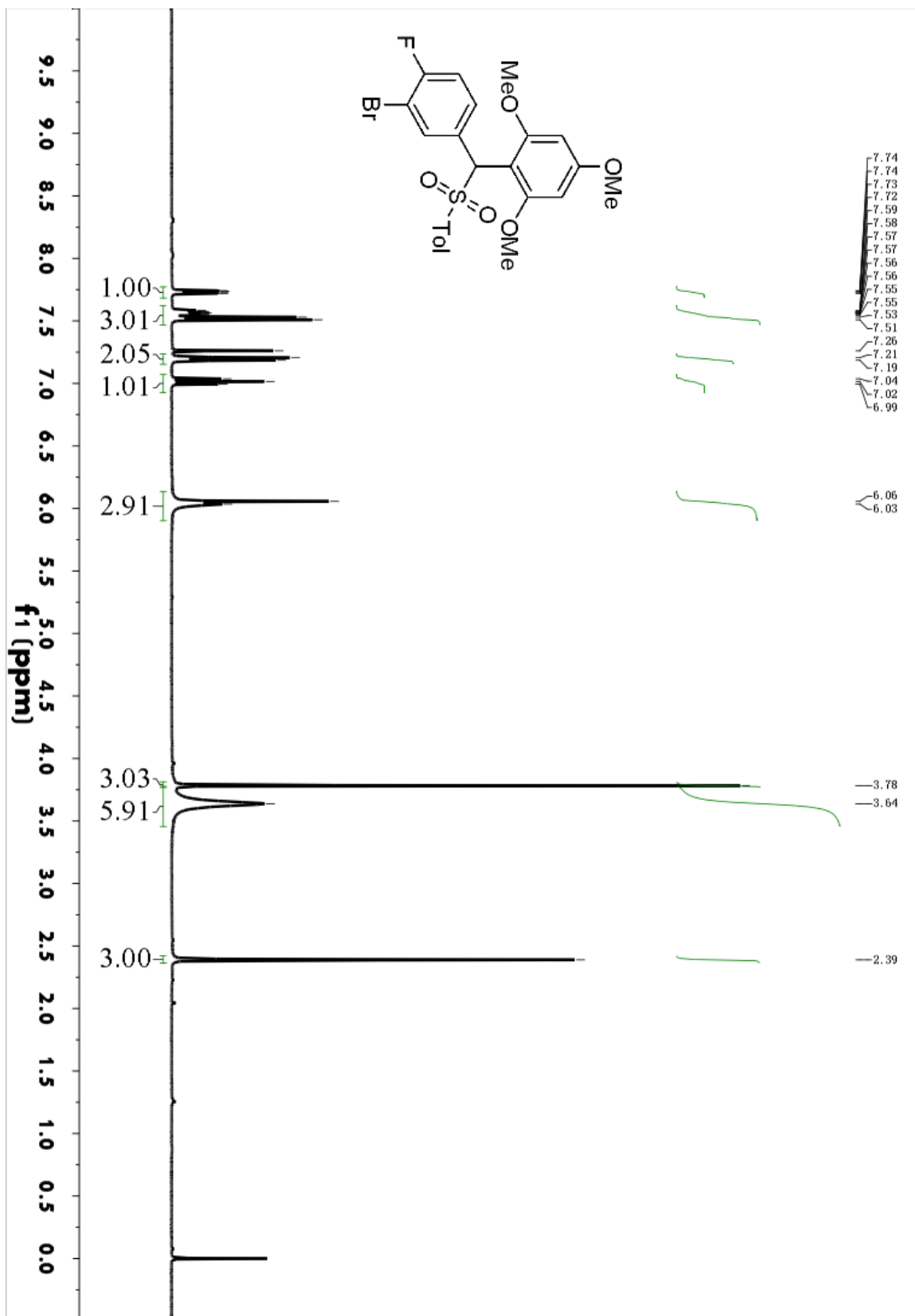


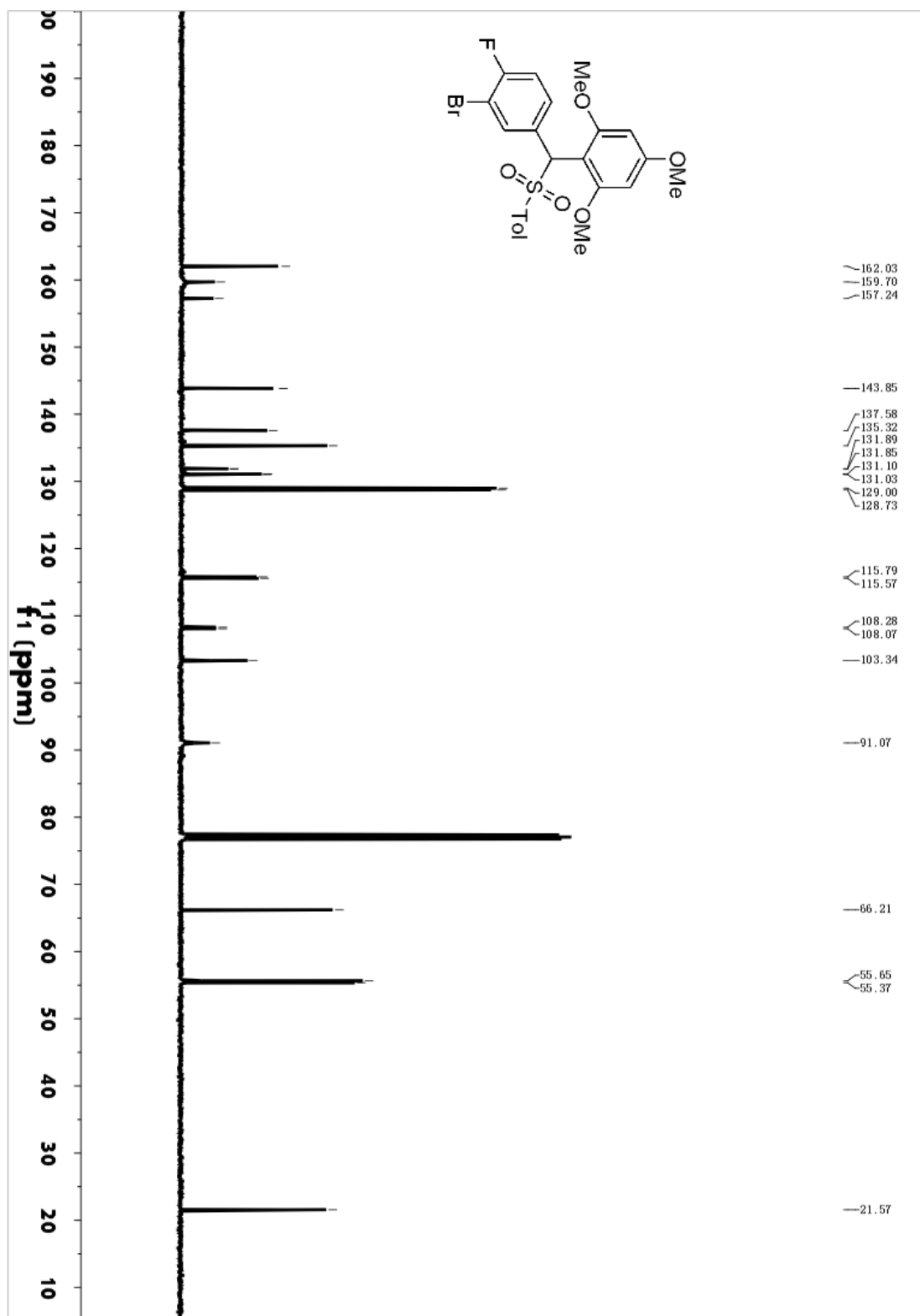
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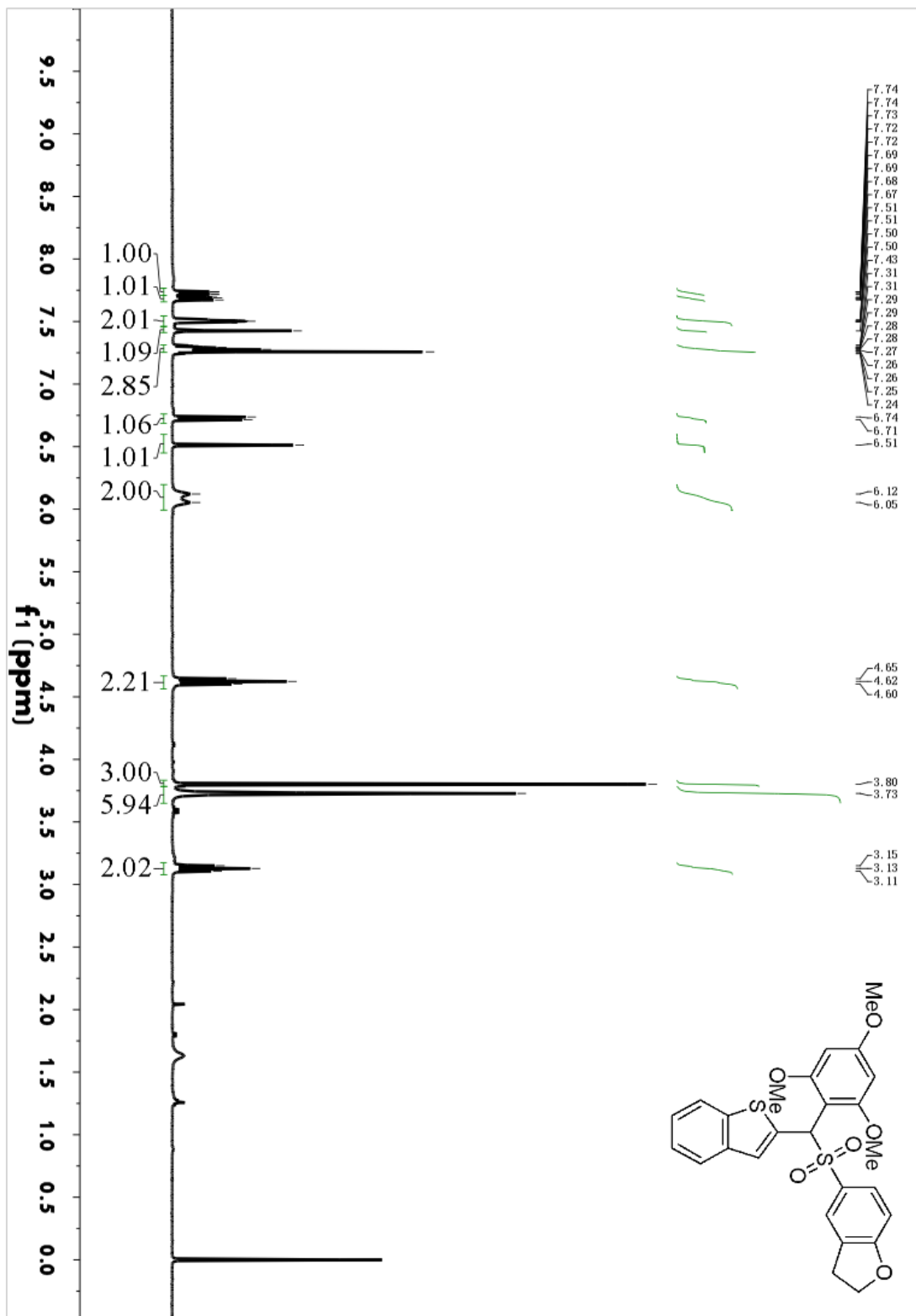


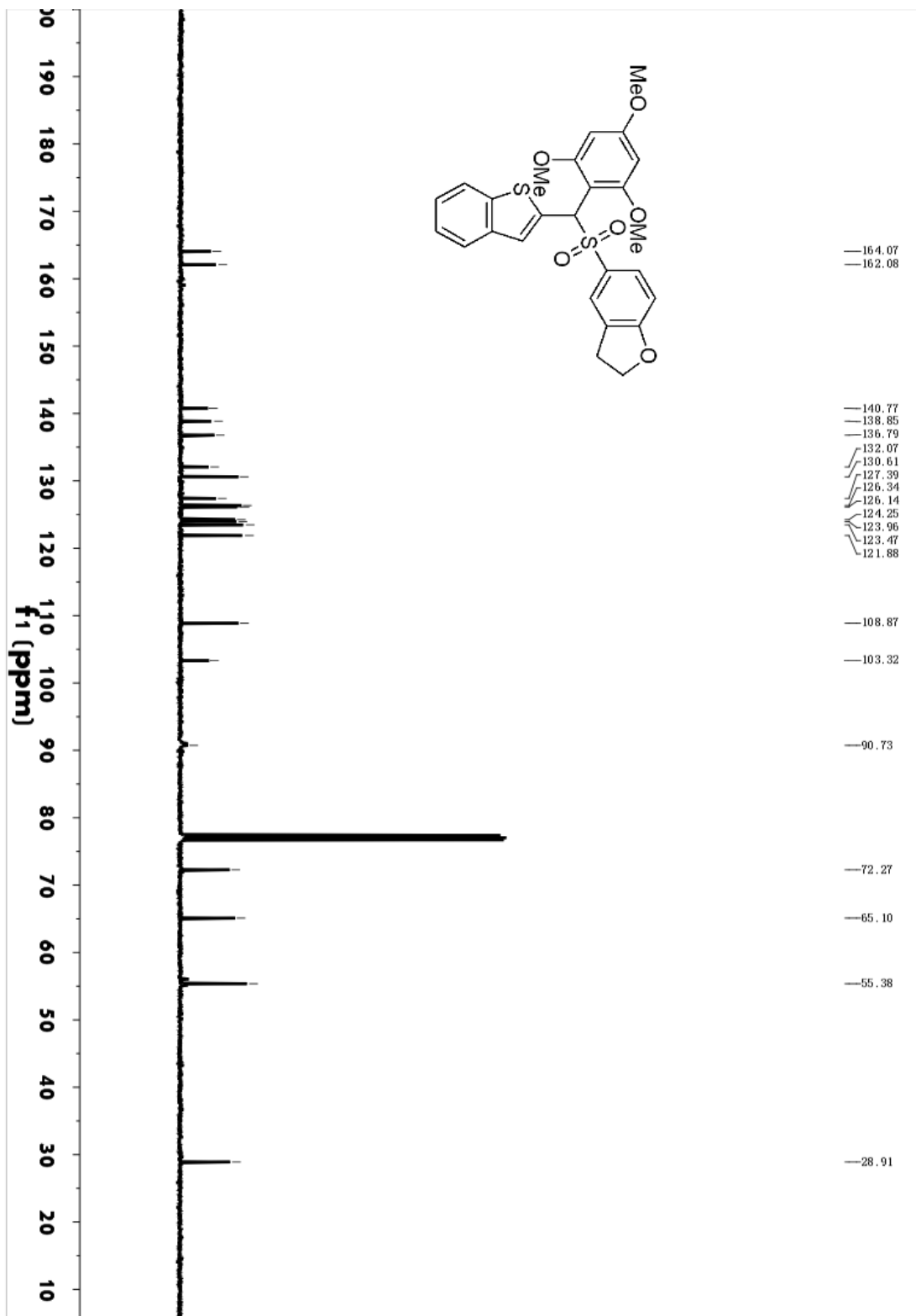
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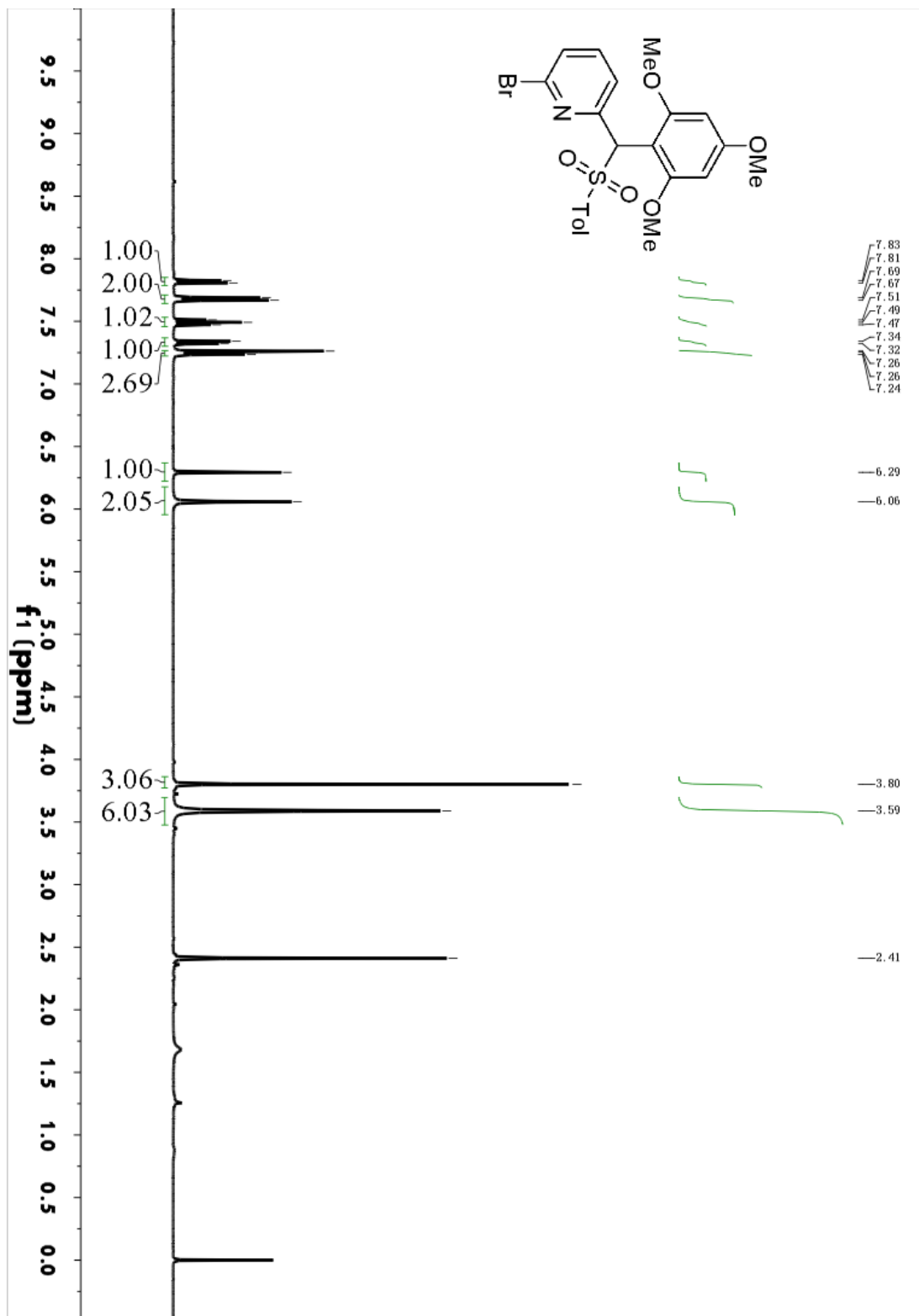




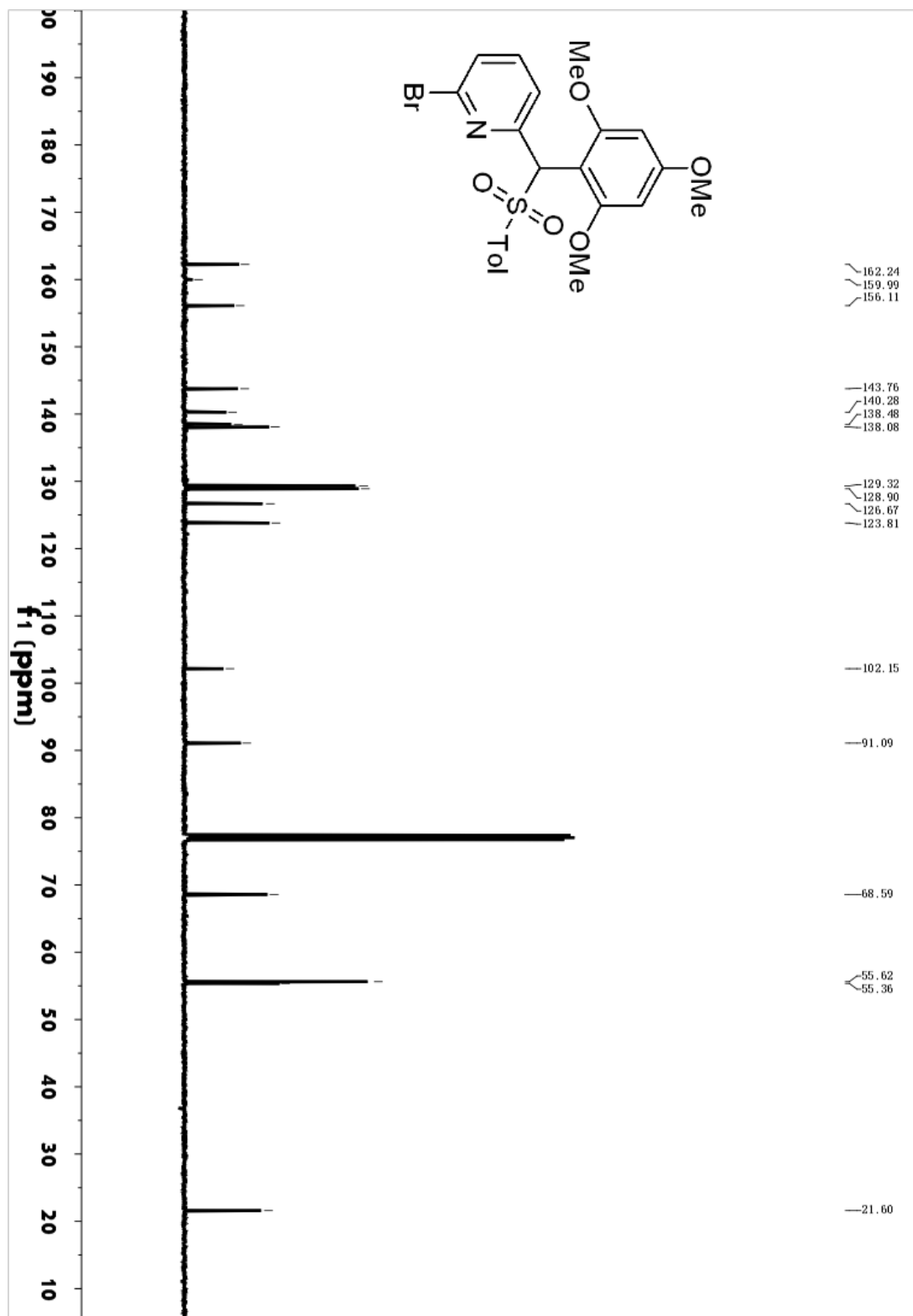
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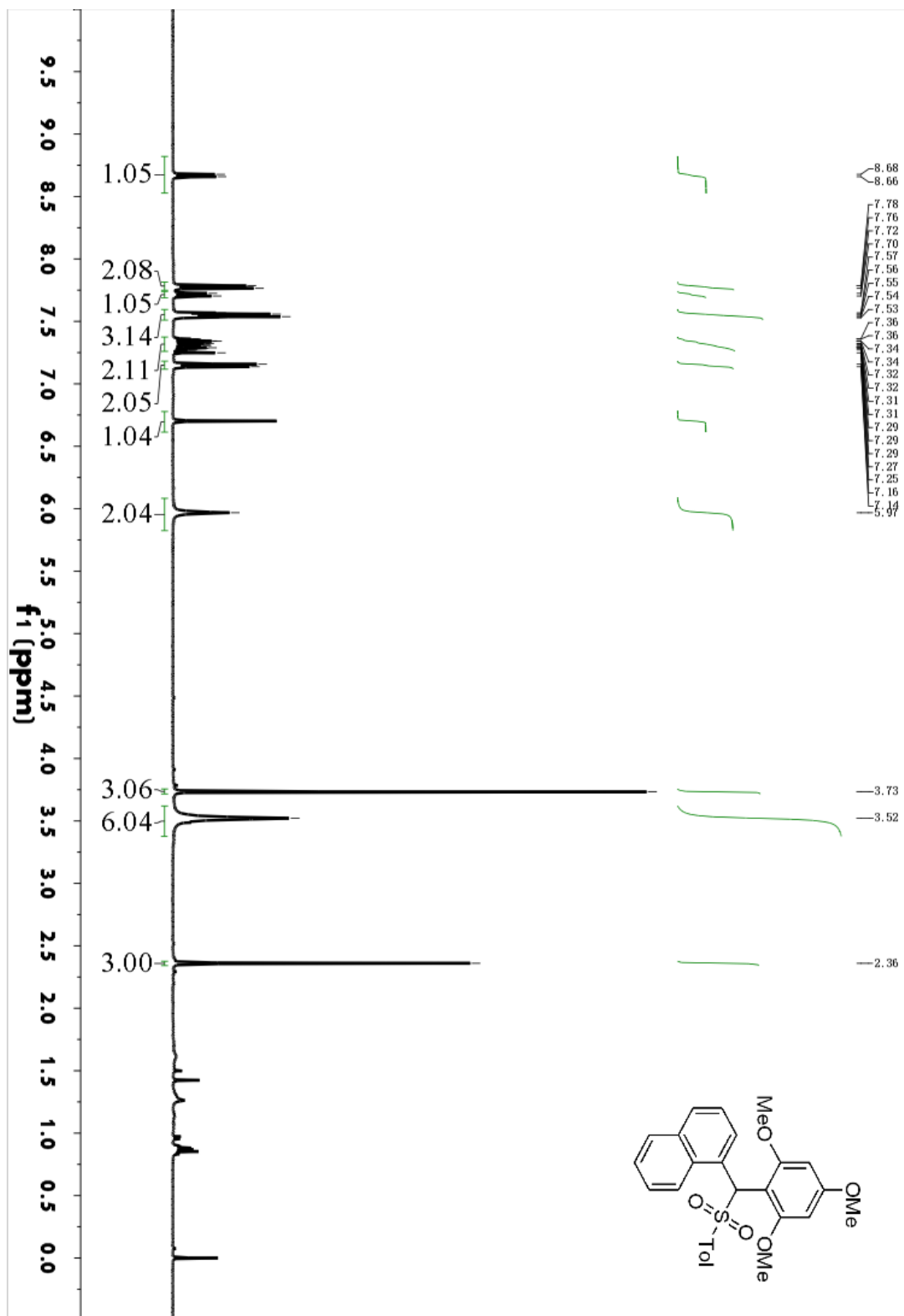


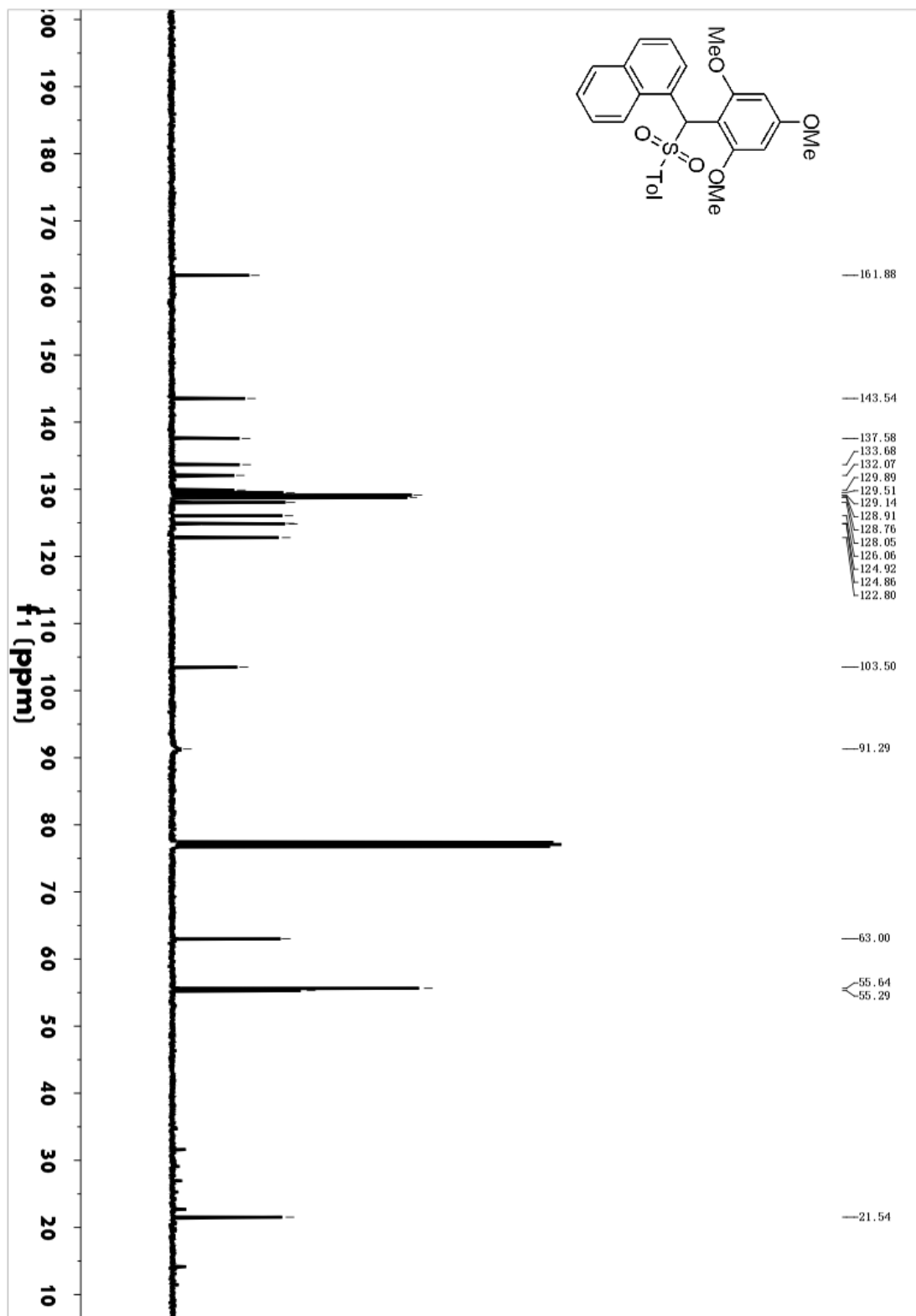




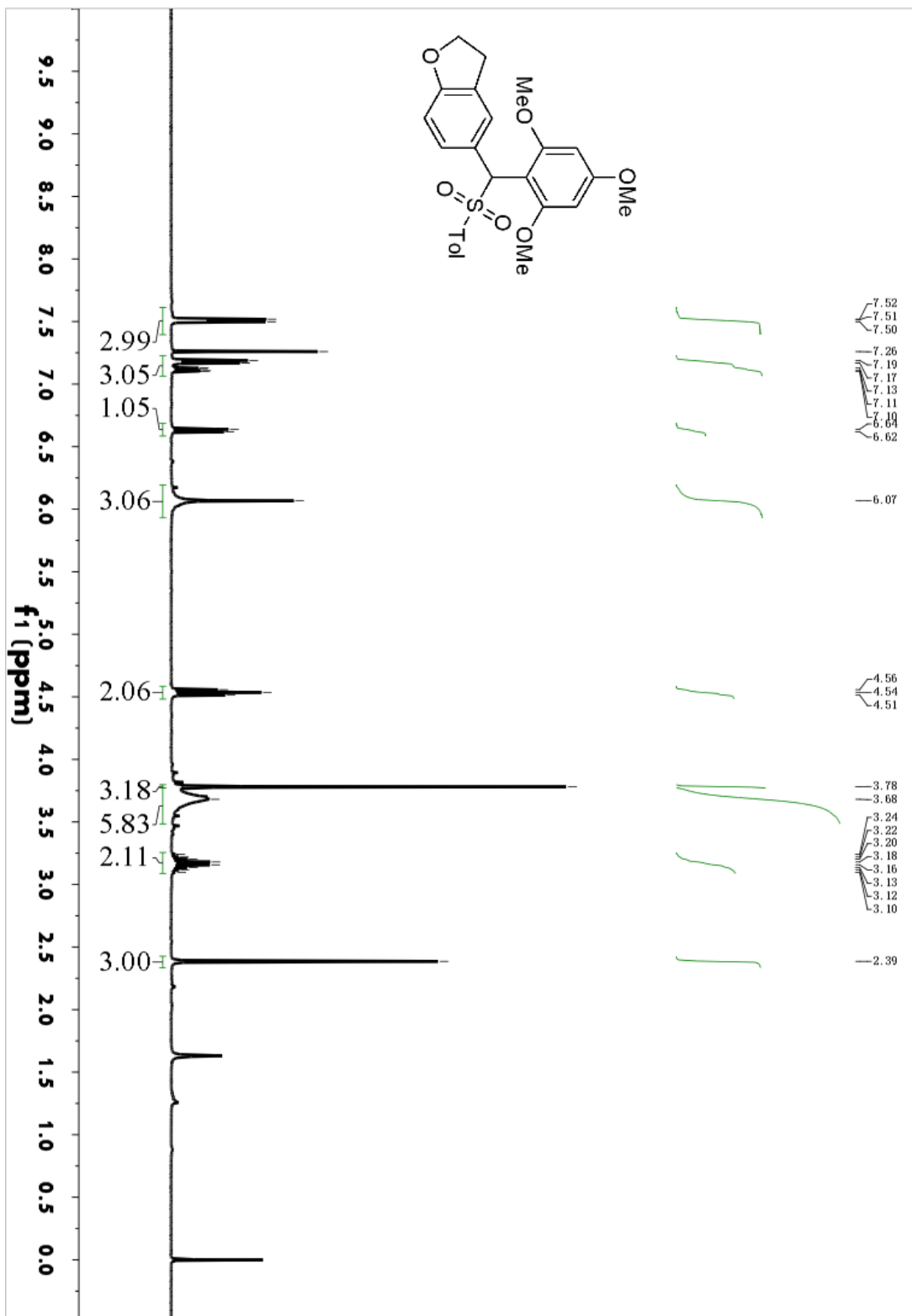


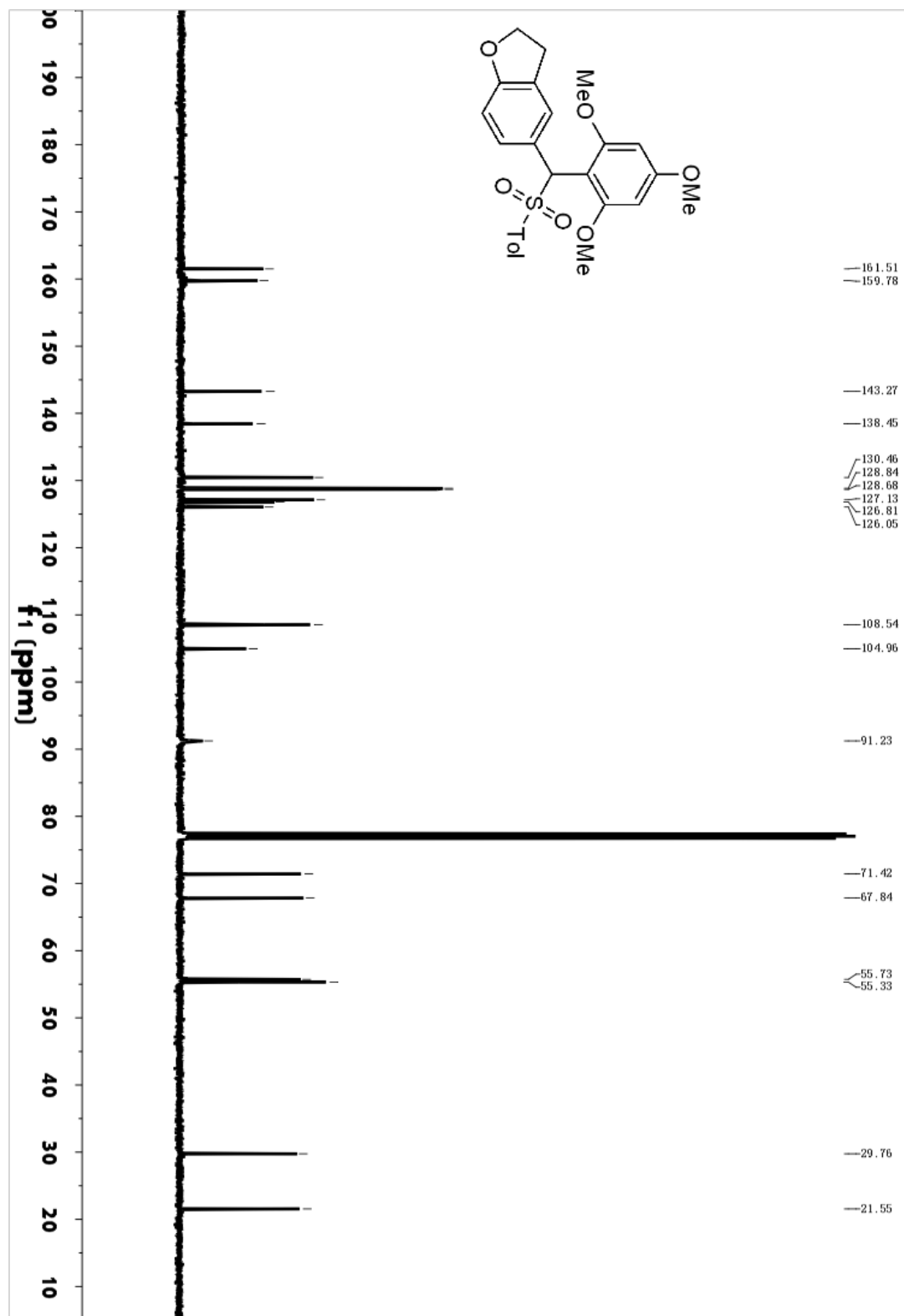
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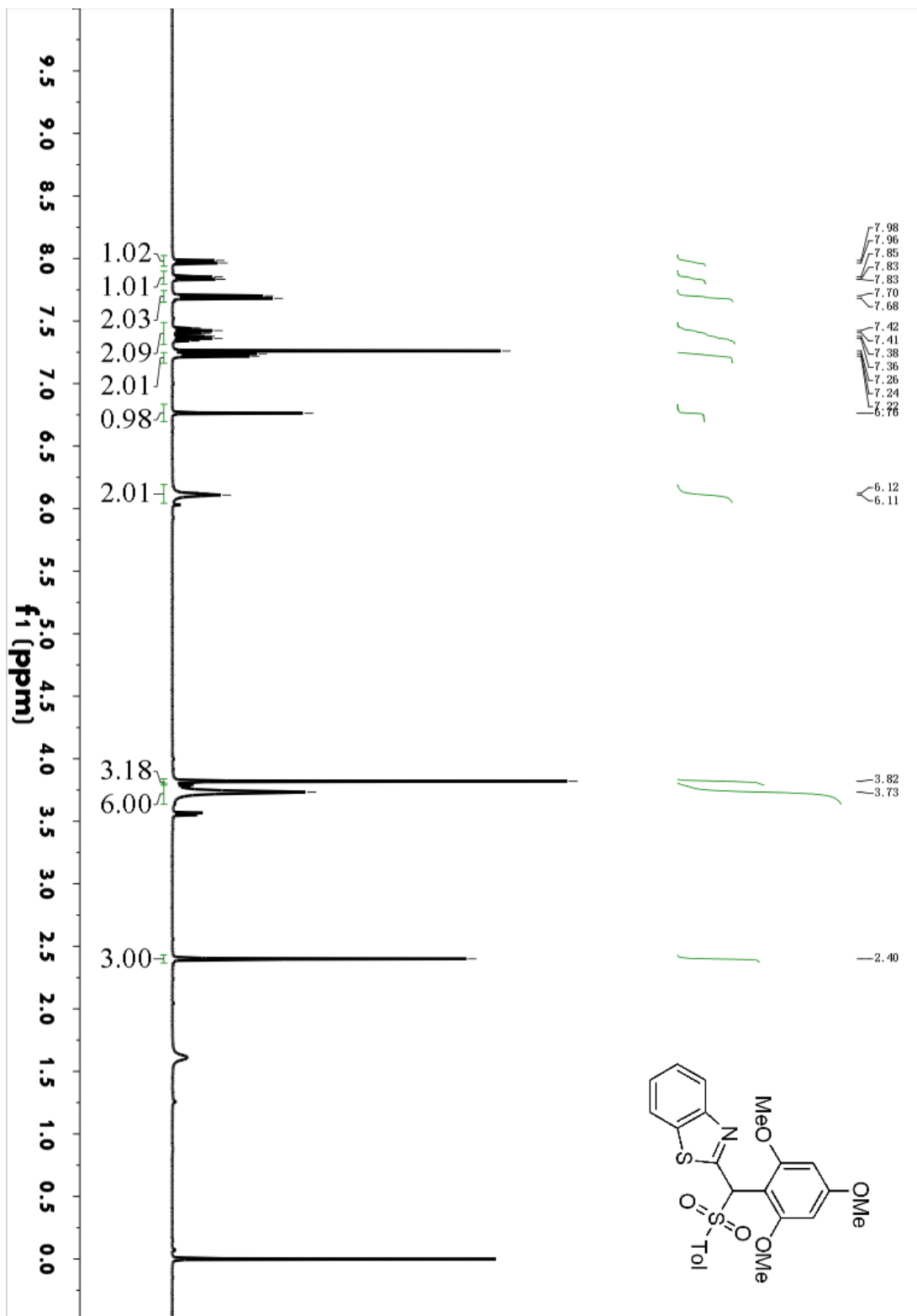


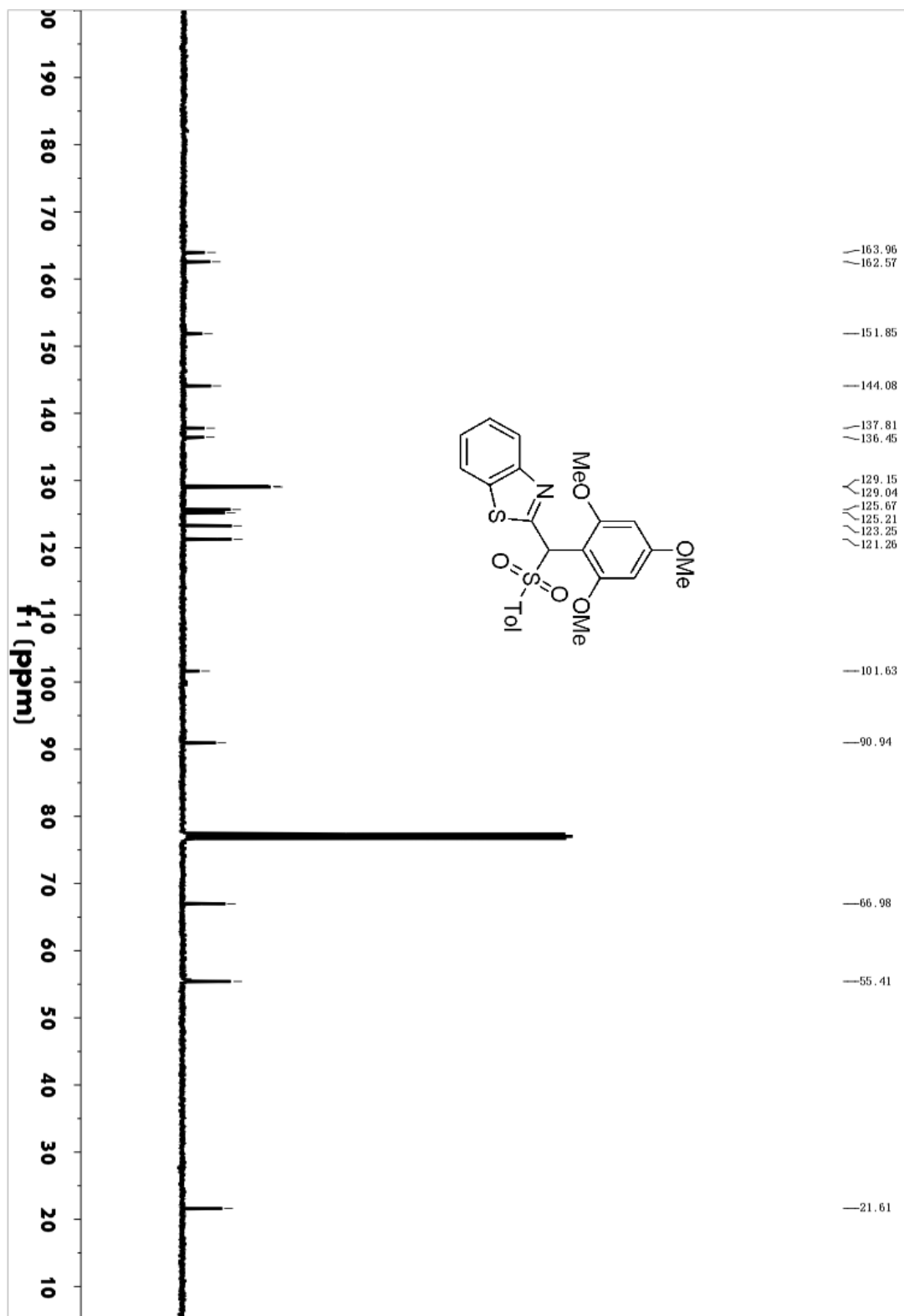
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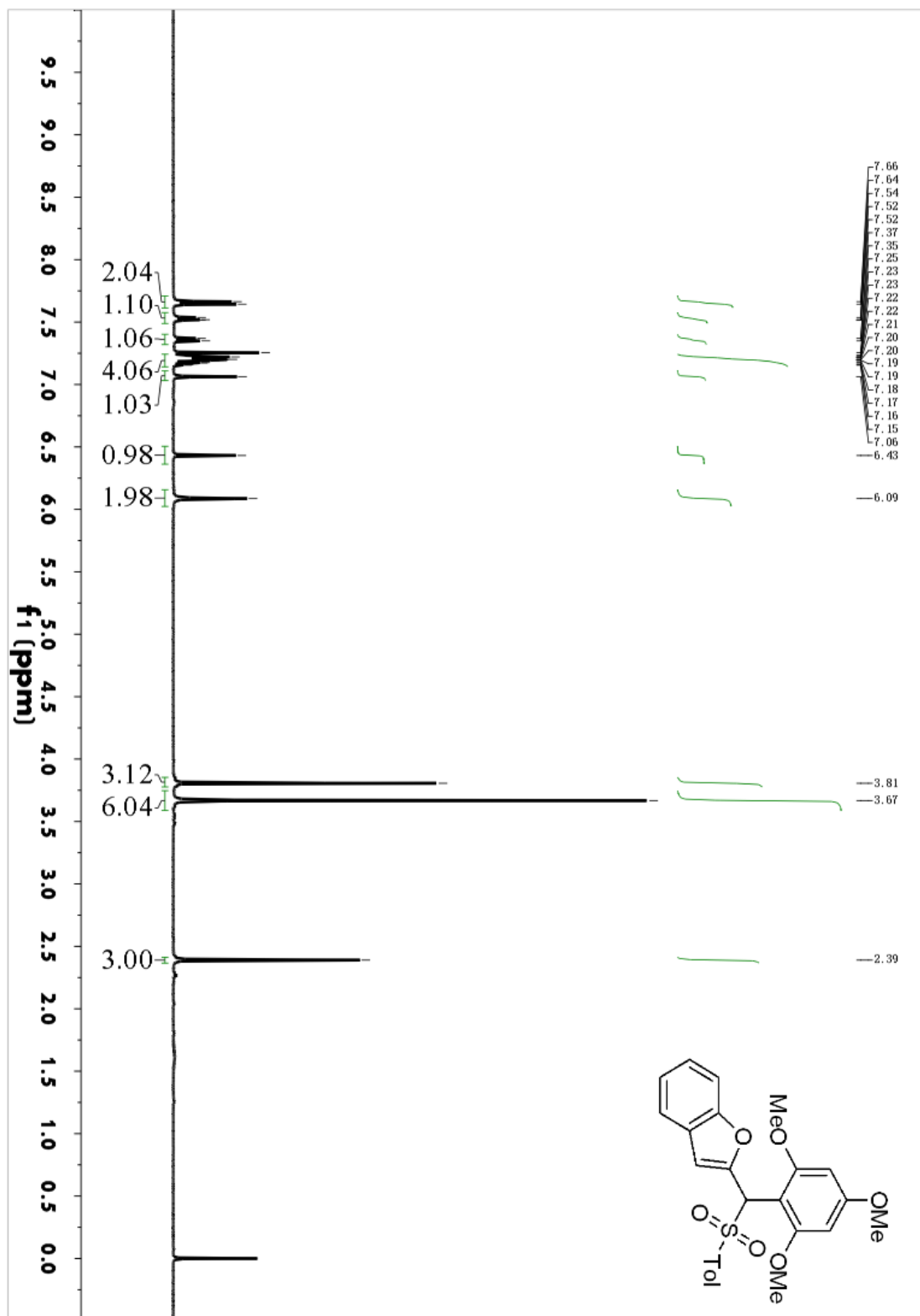


3r

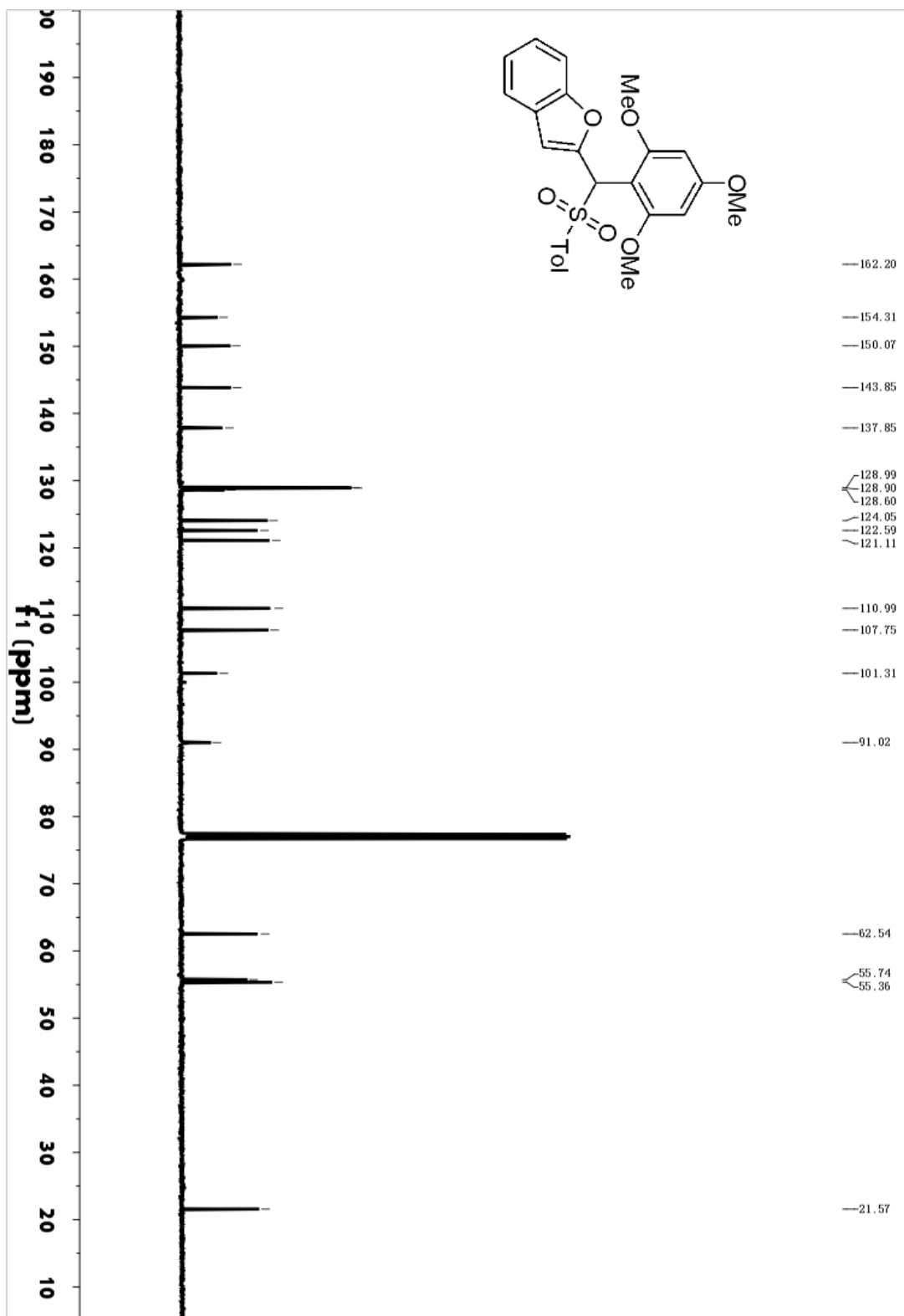




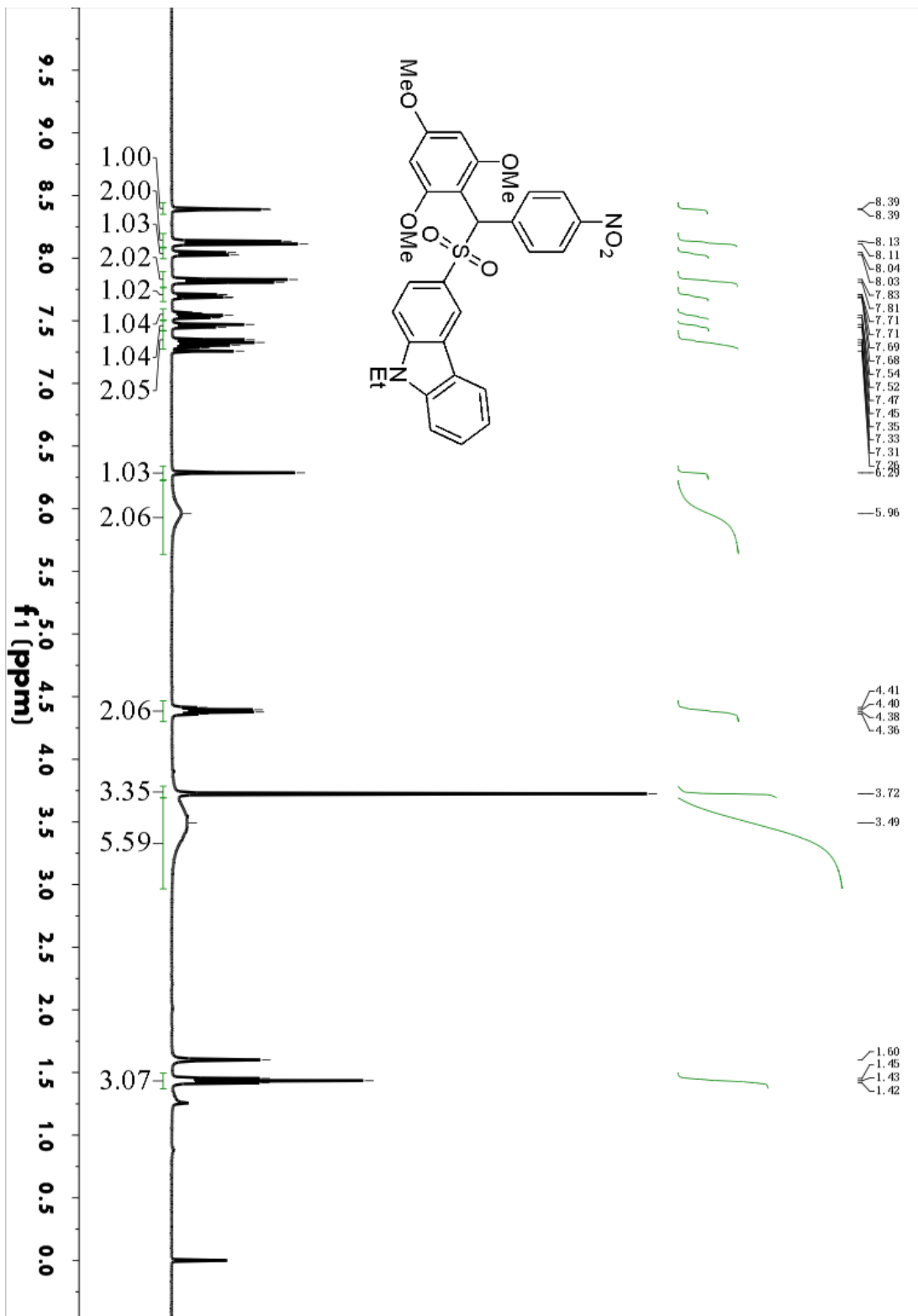
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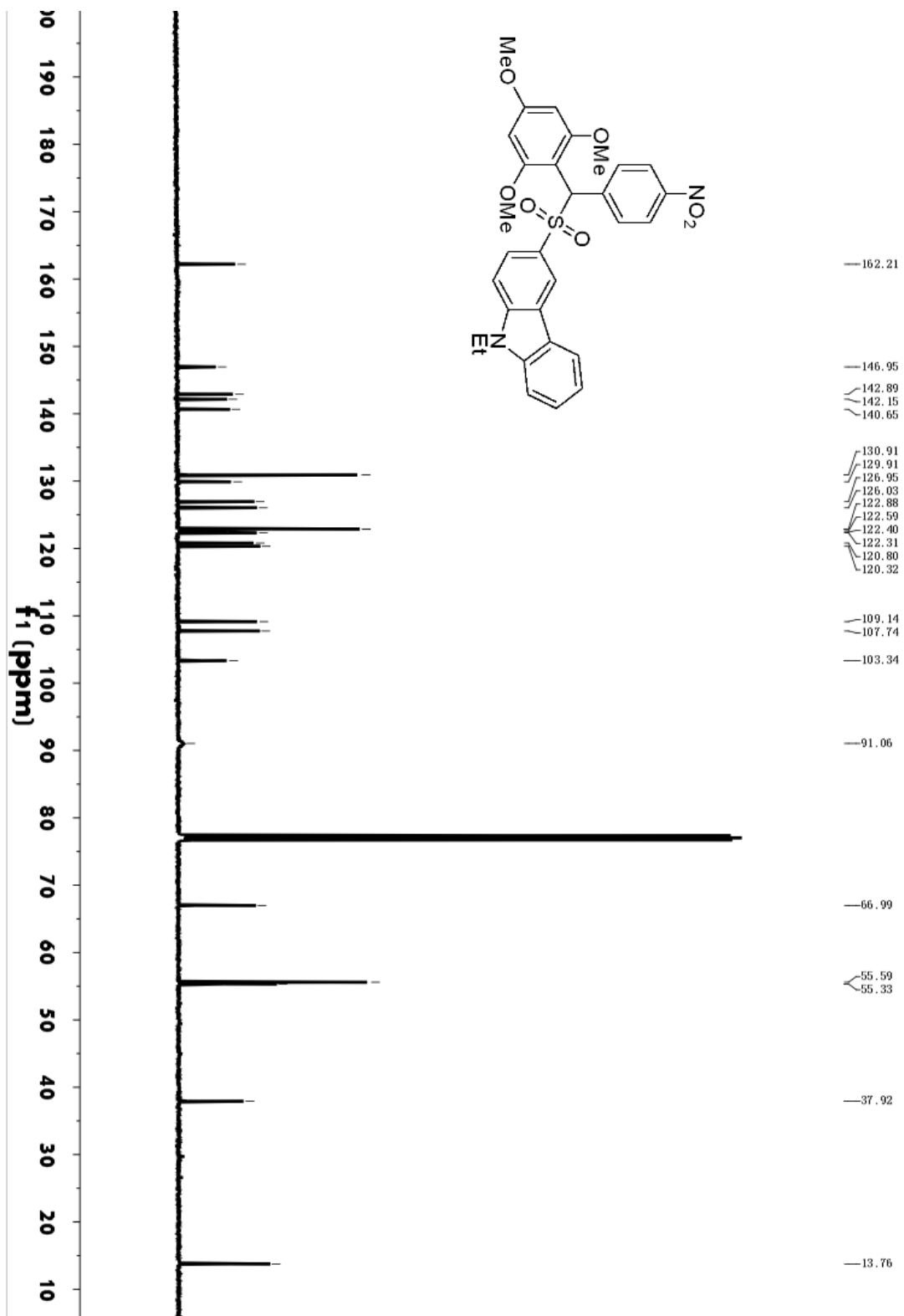




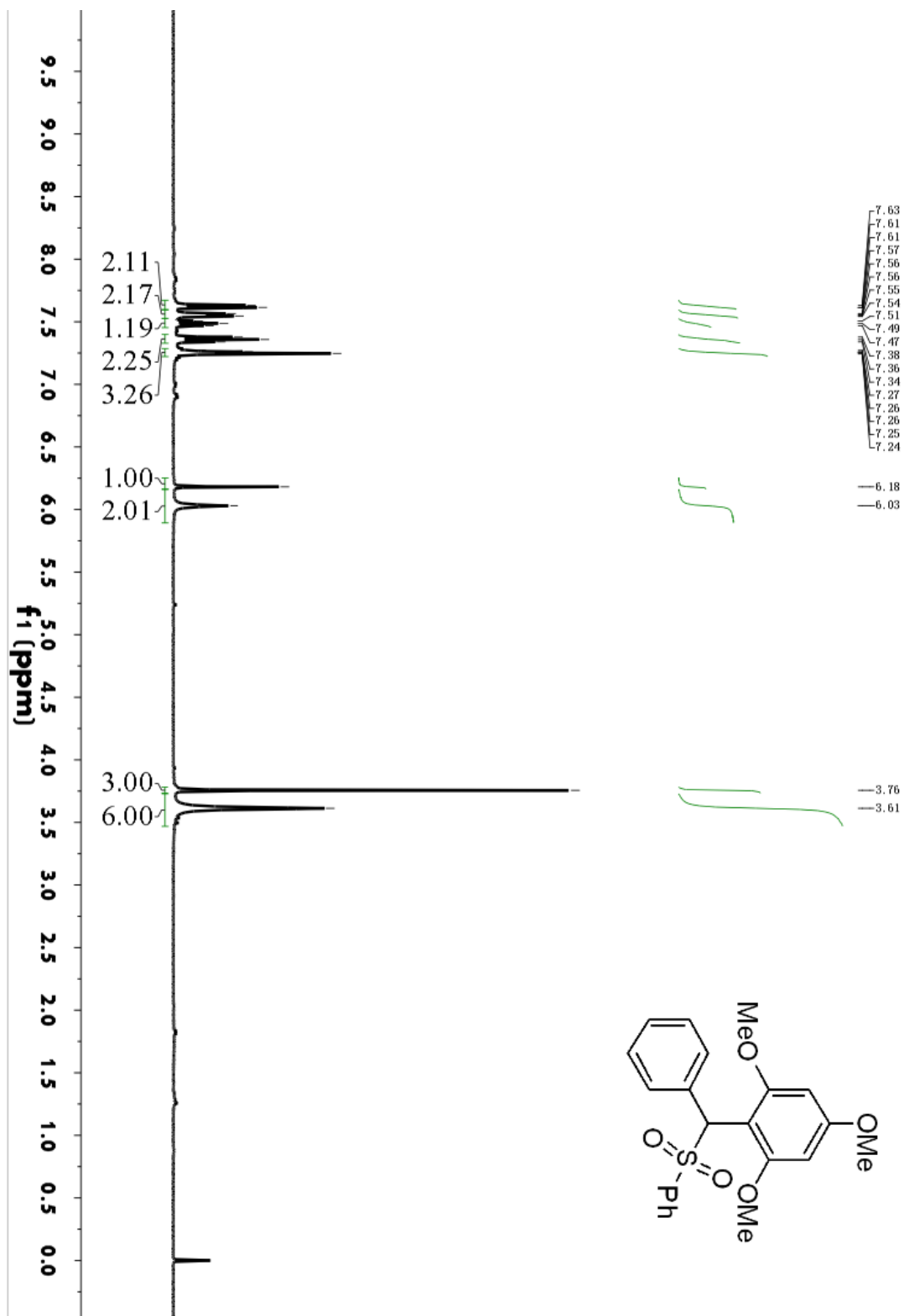


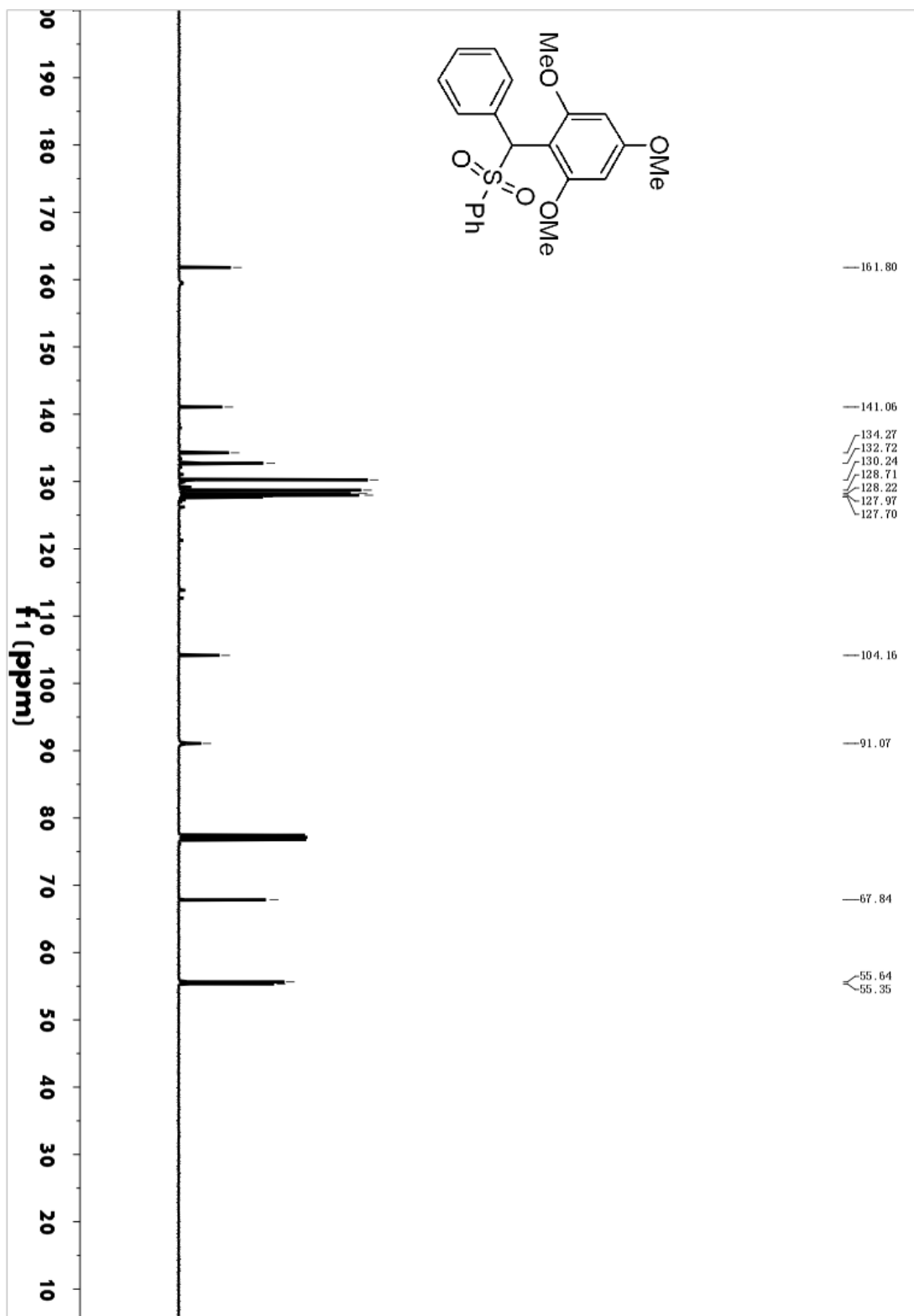
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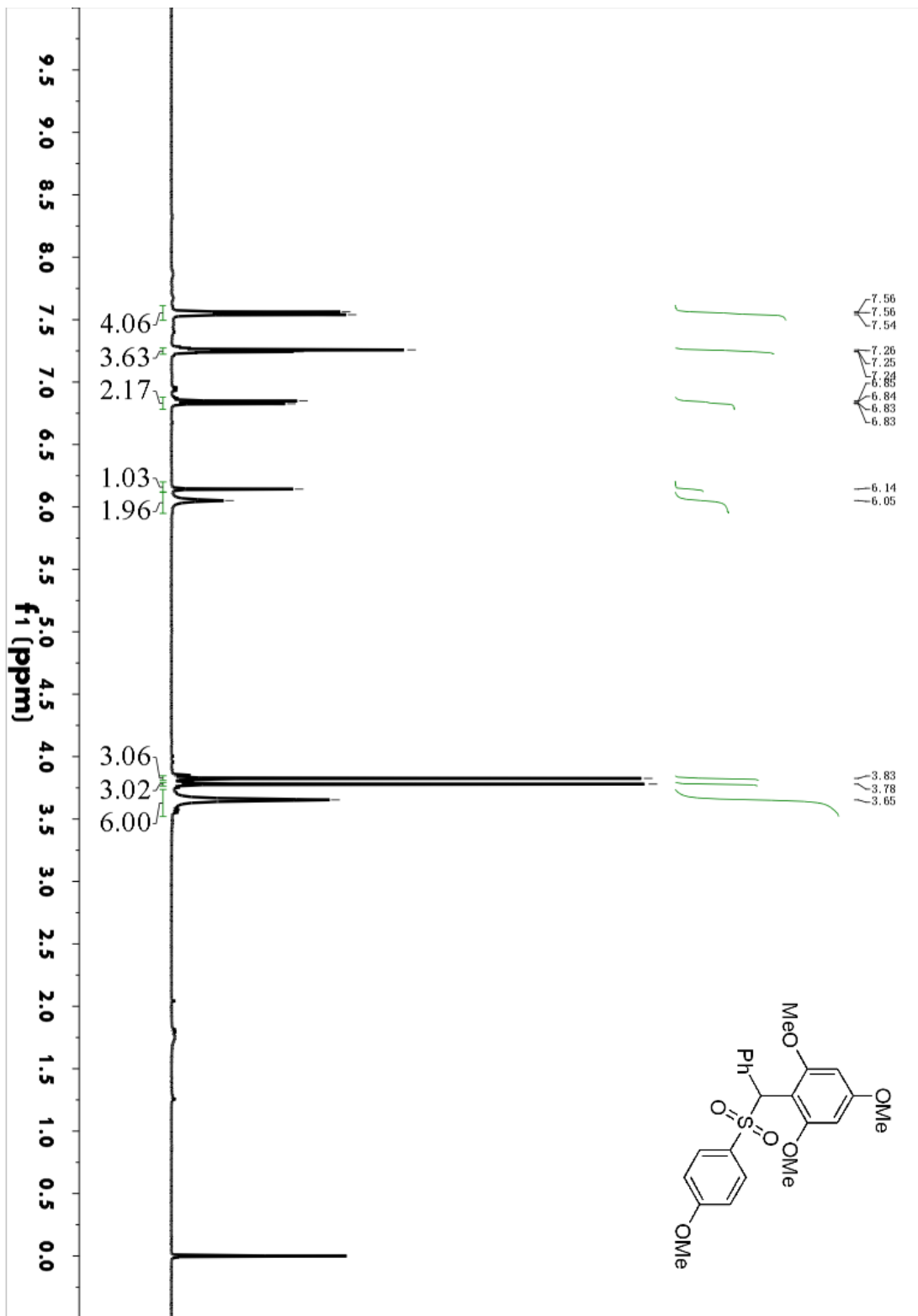


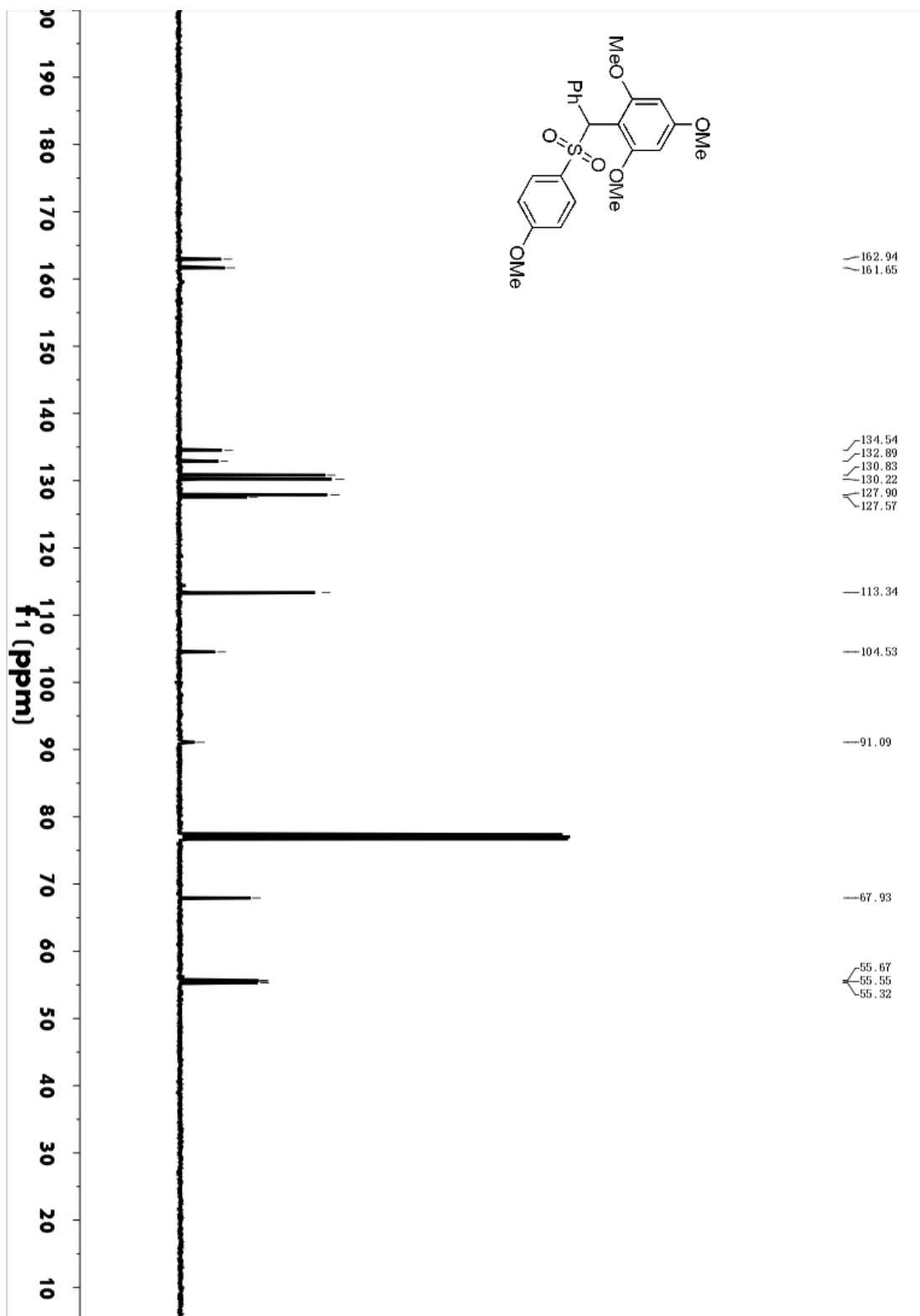
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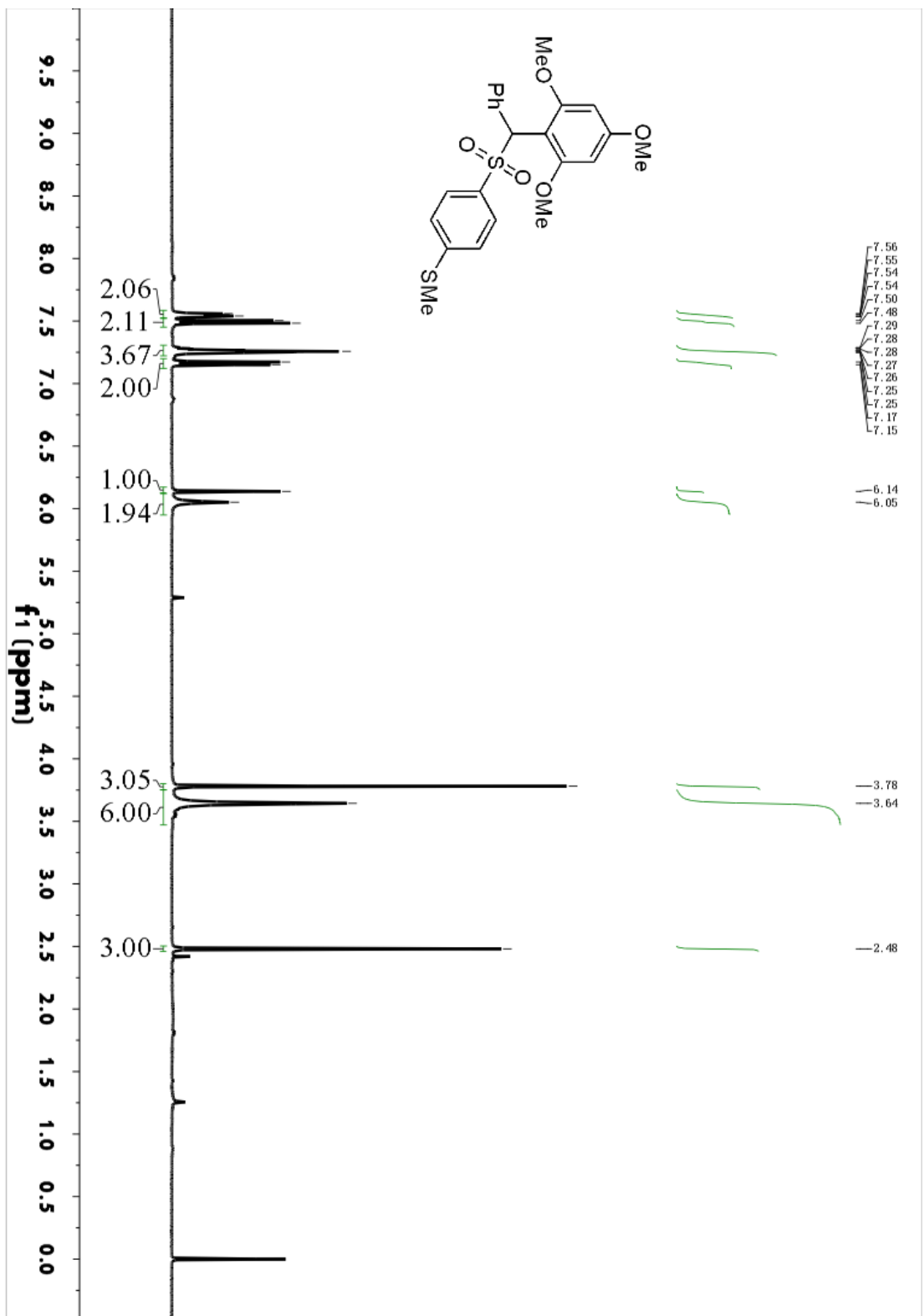


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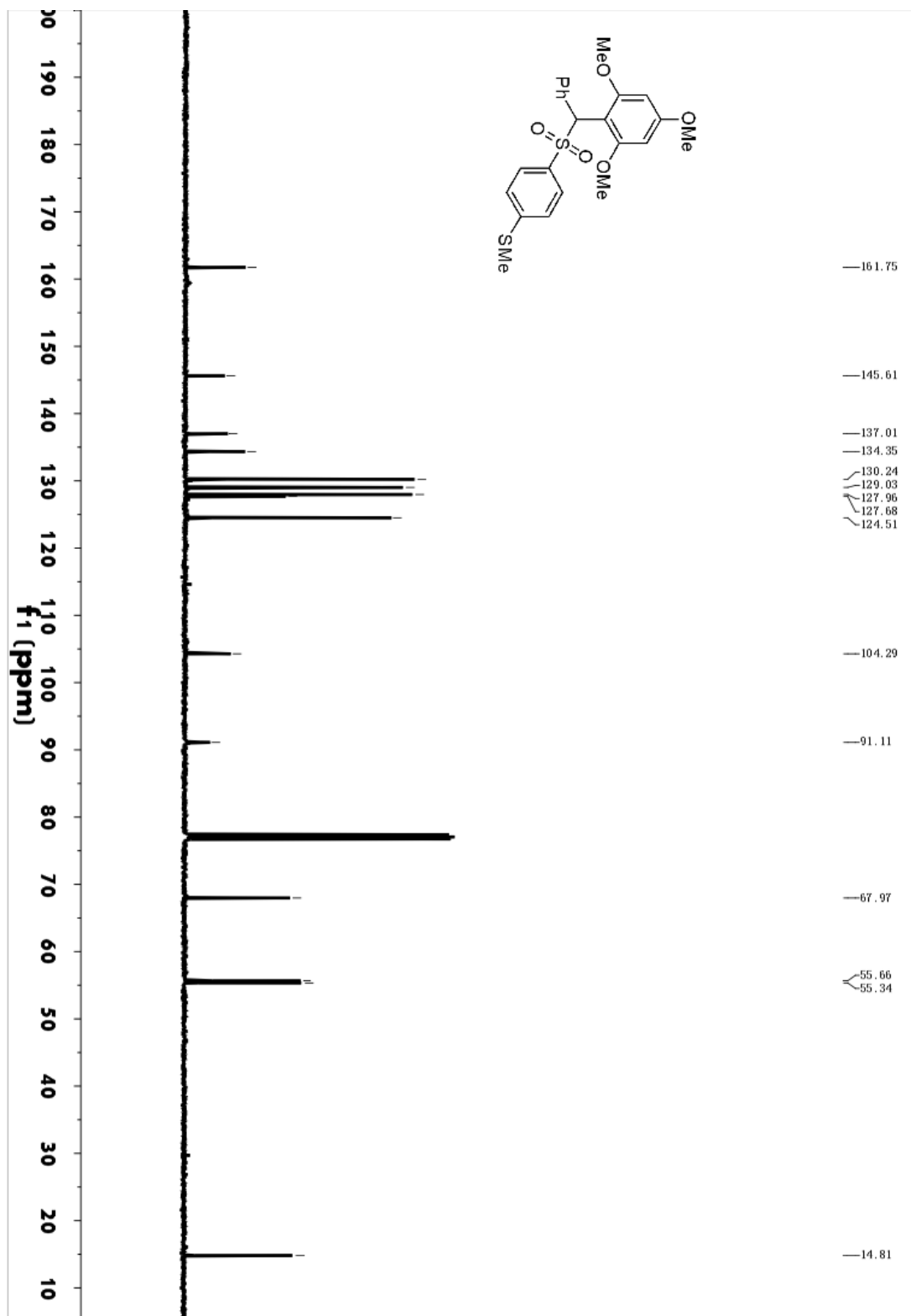




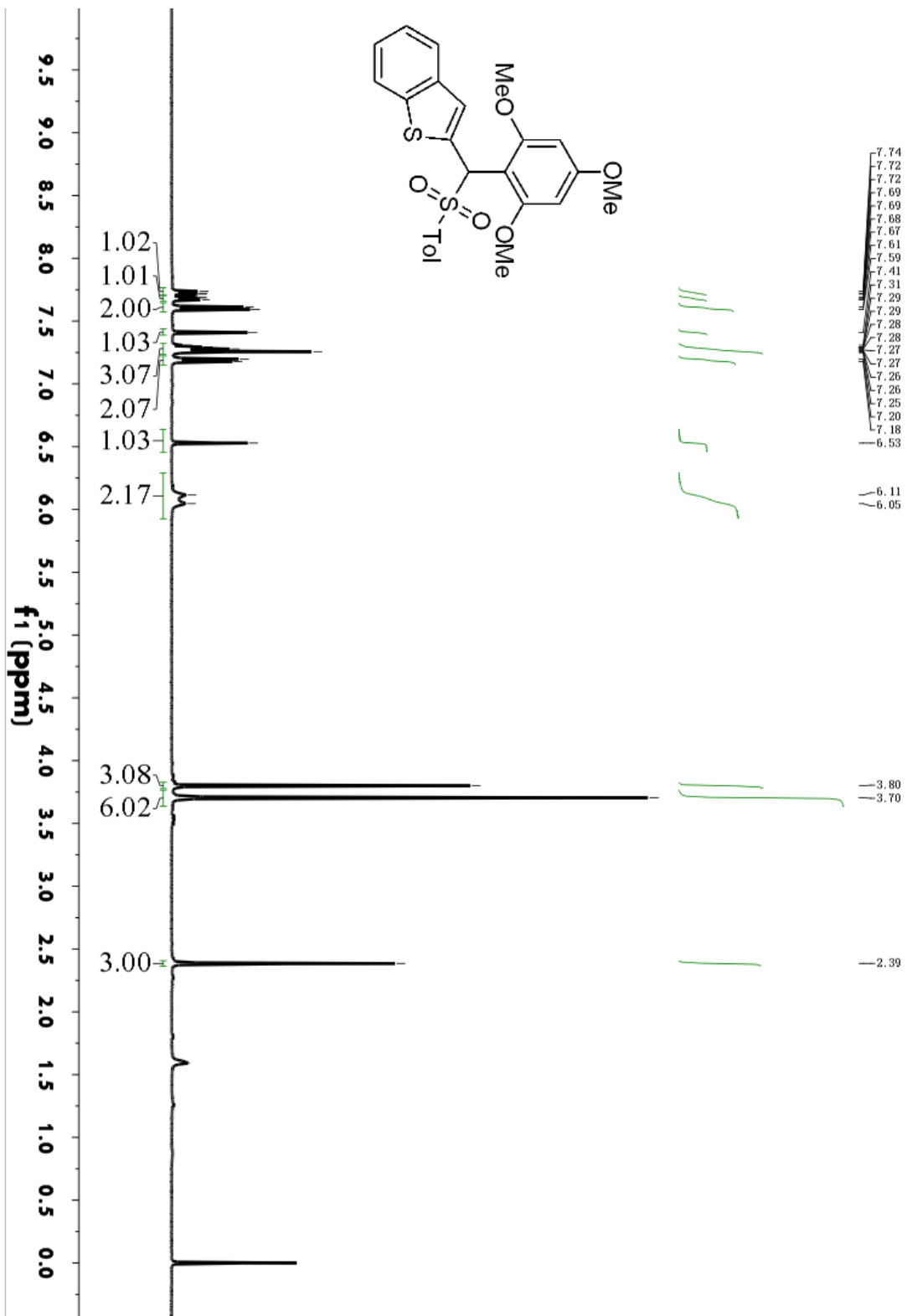
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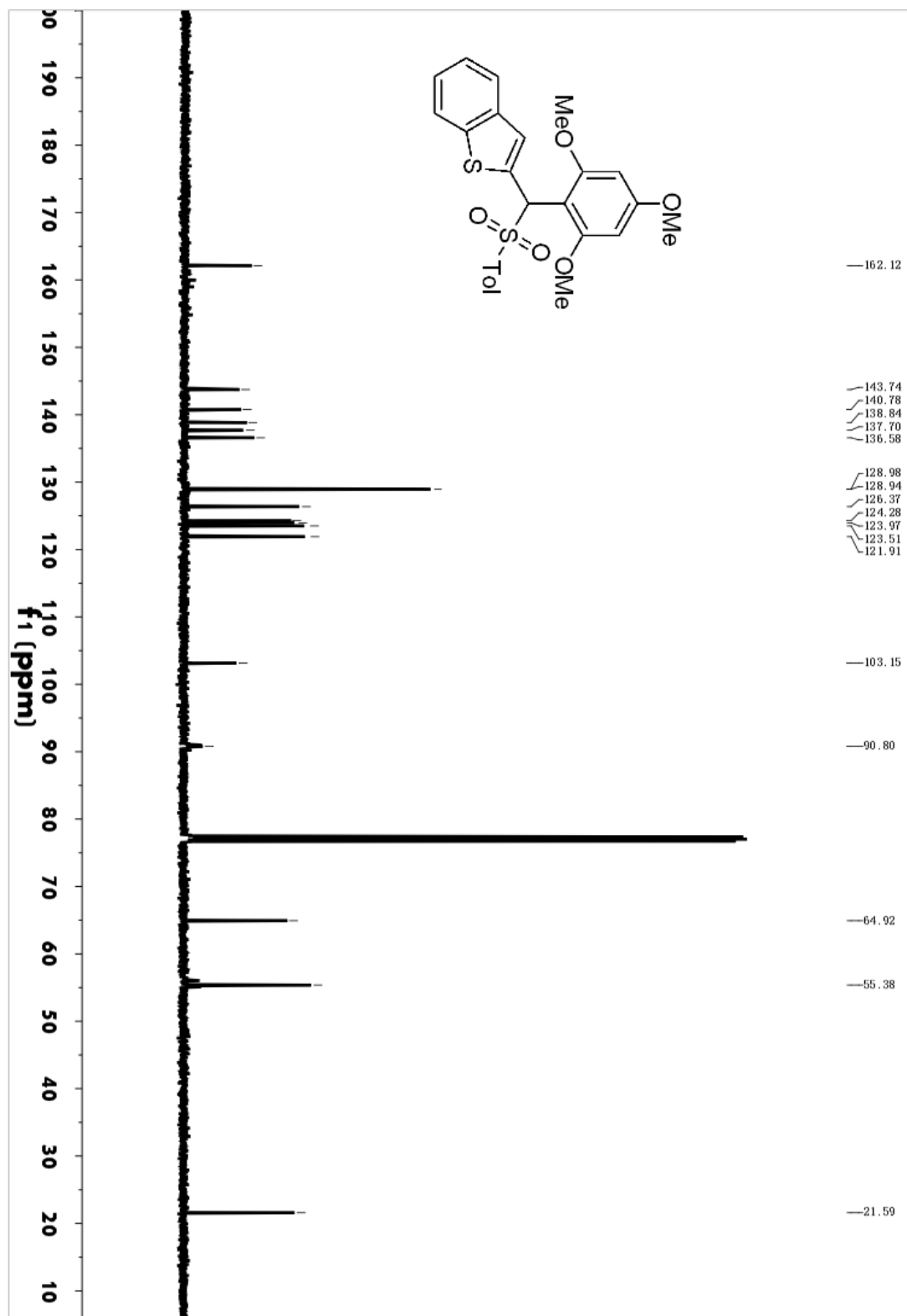




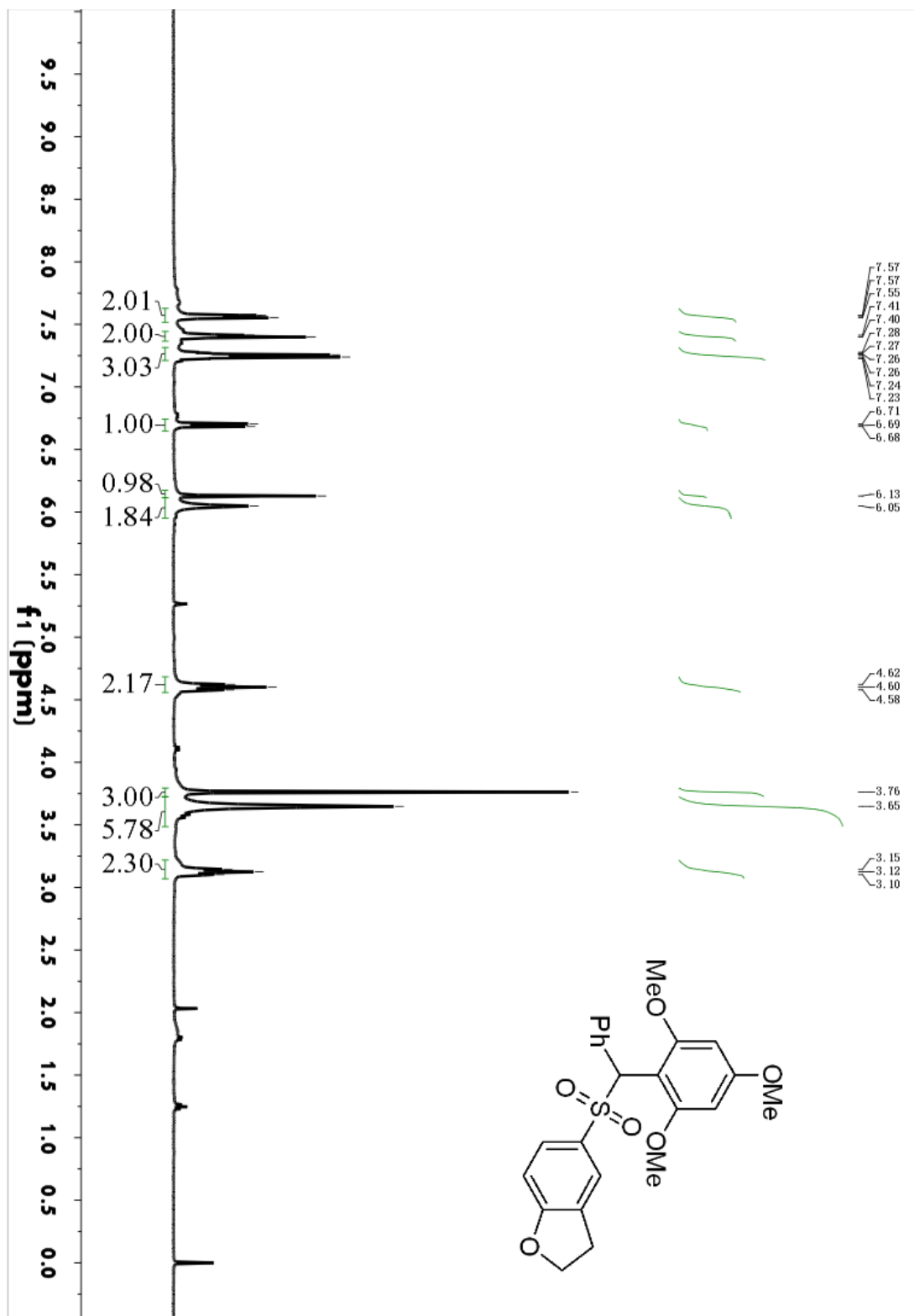


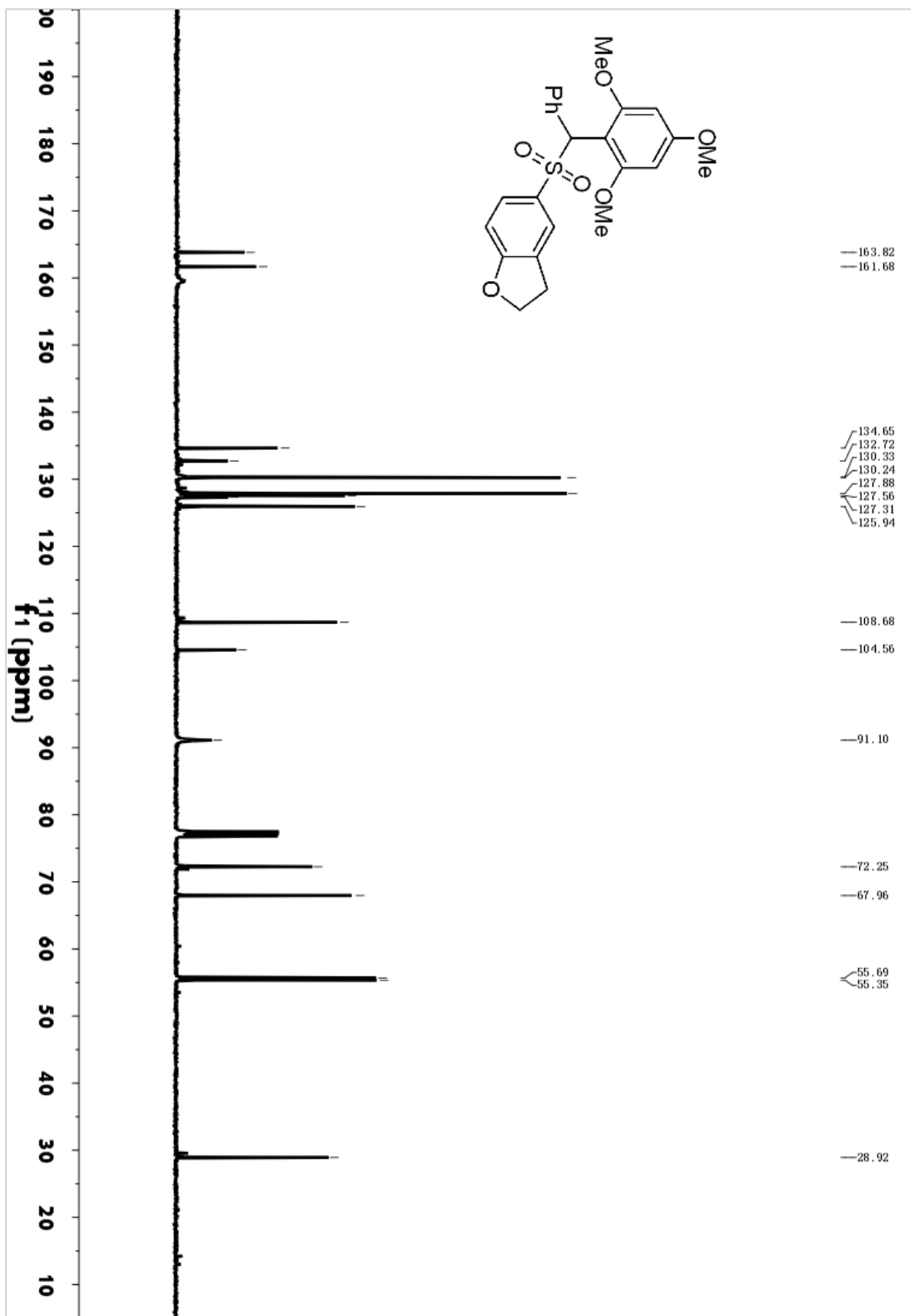
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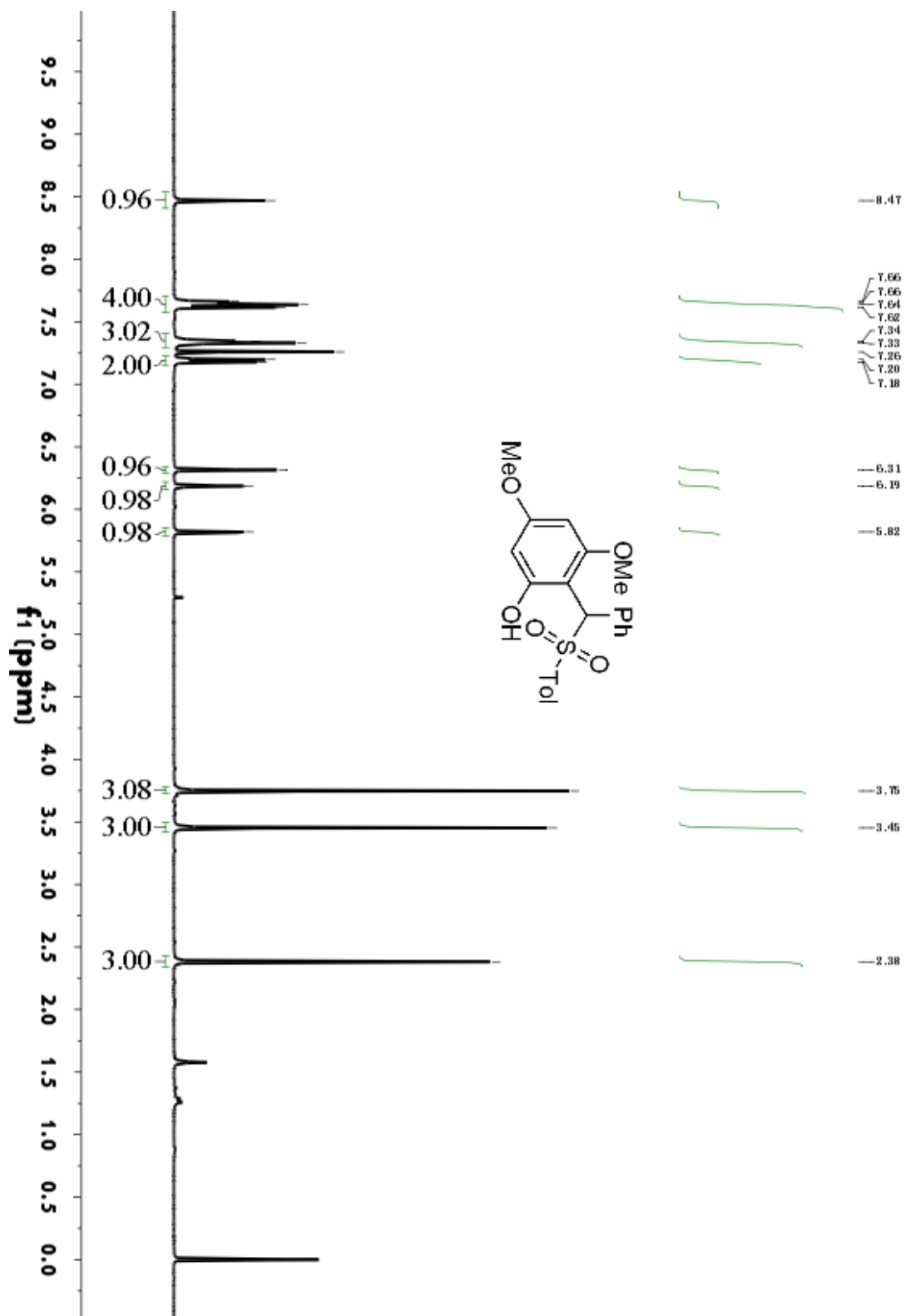


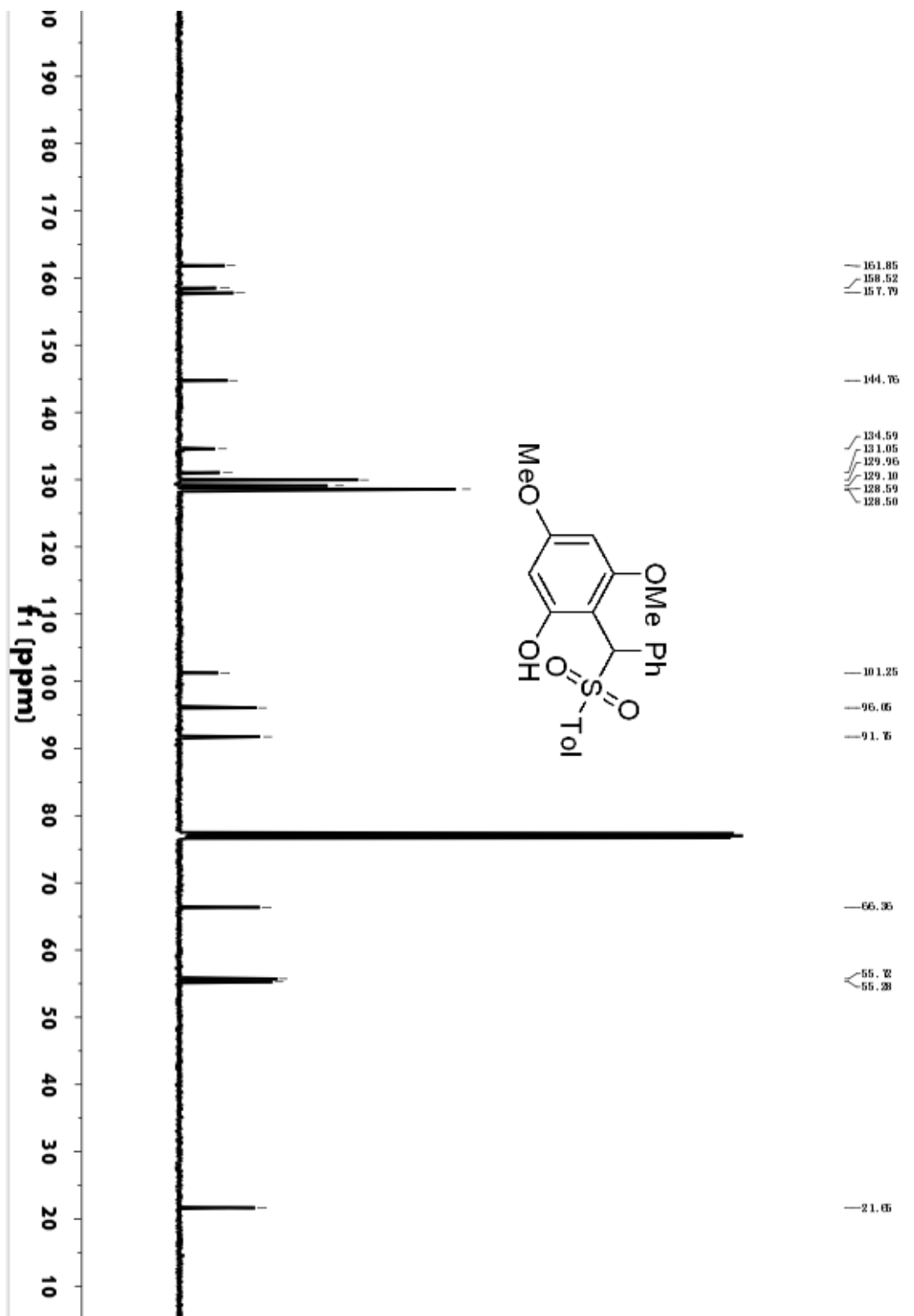
3-1



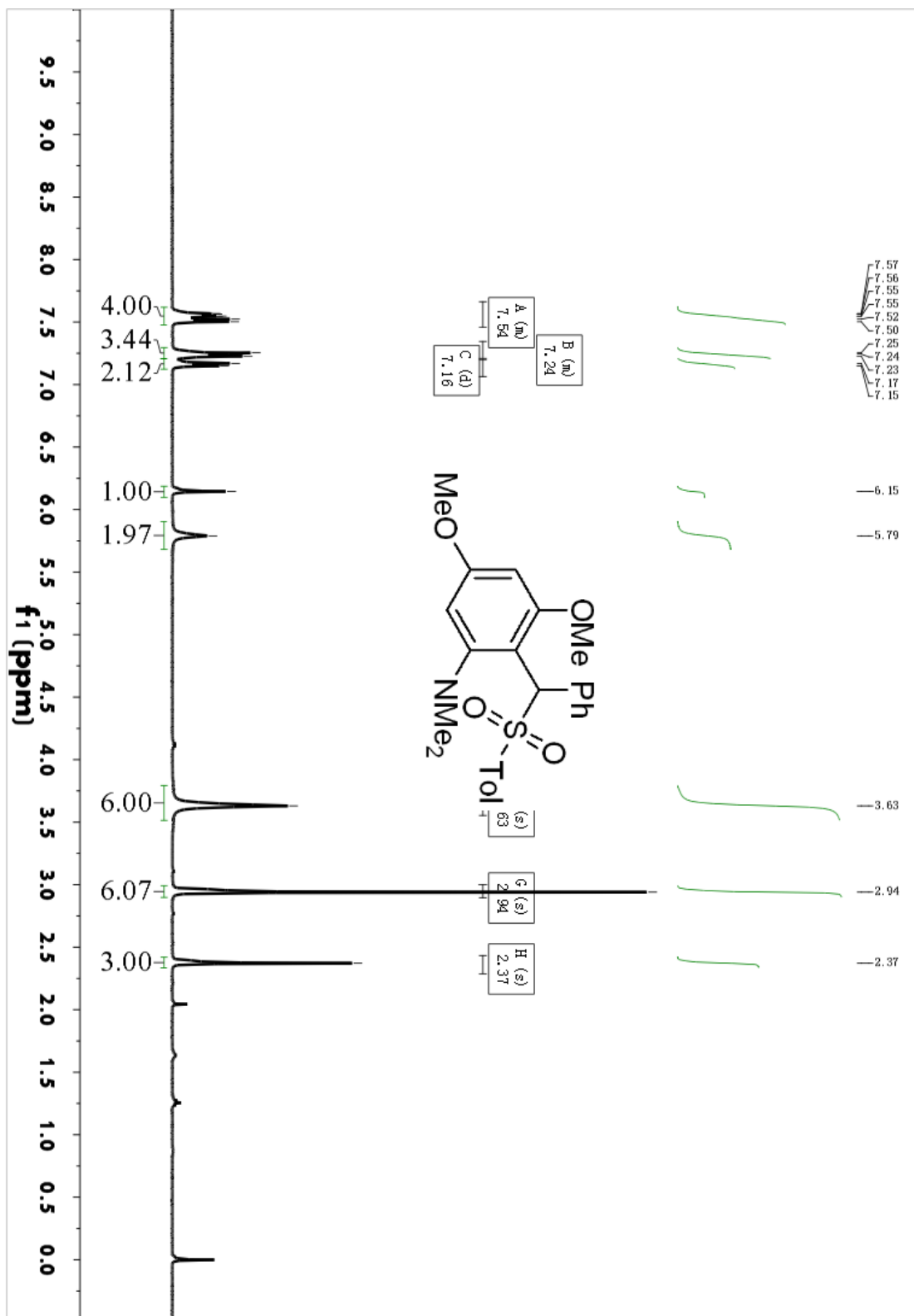


3-2

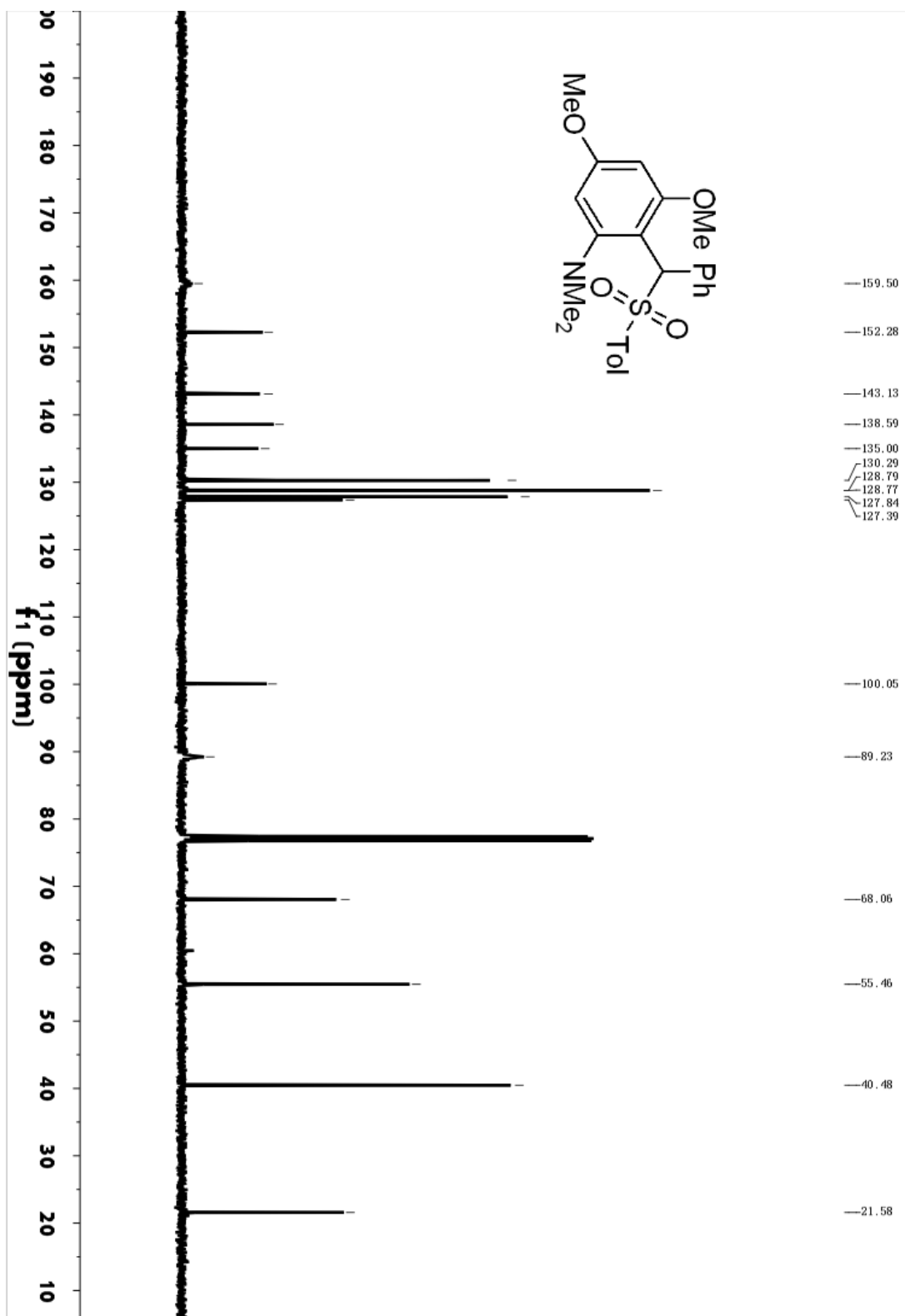




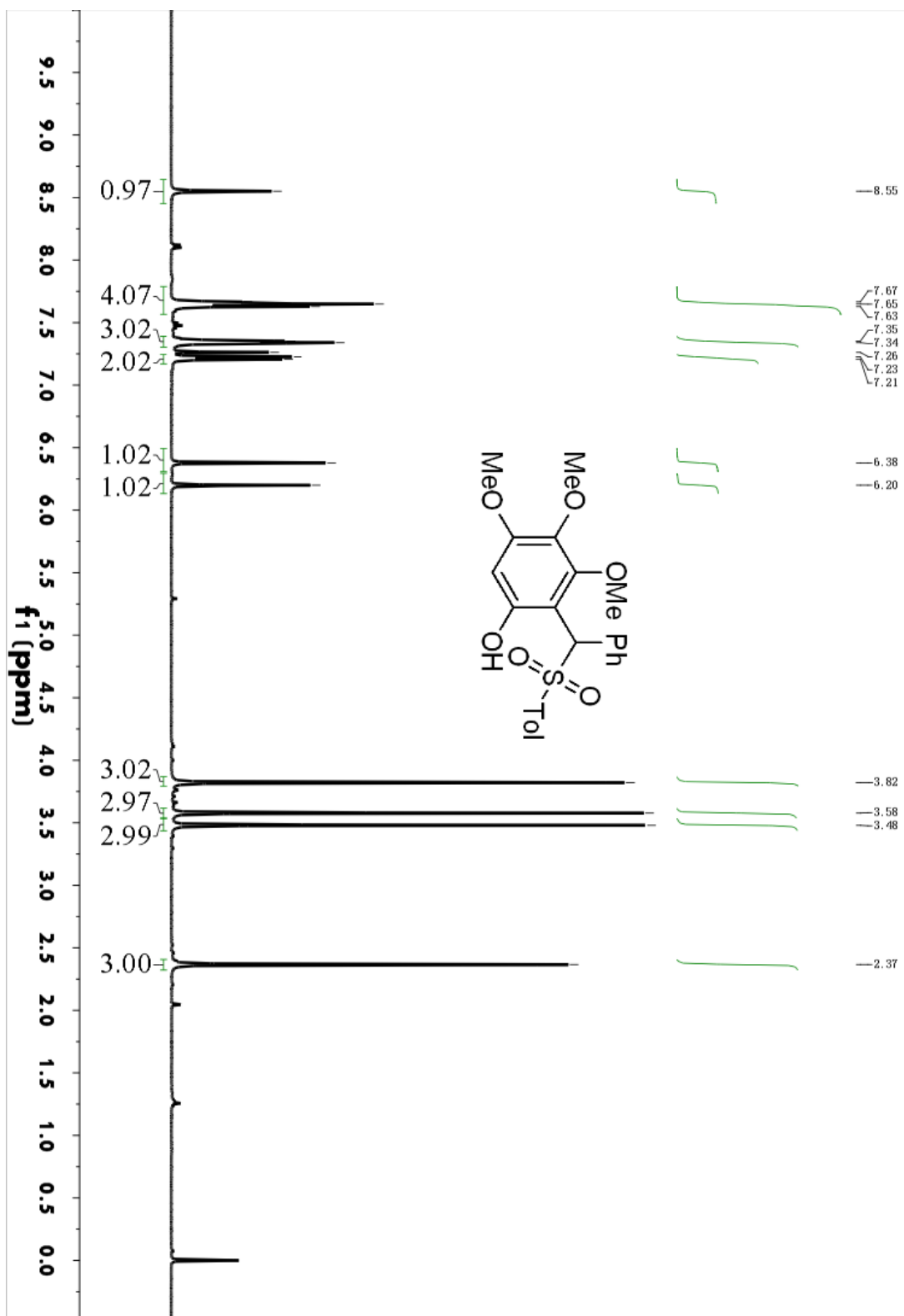
3-3

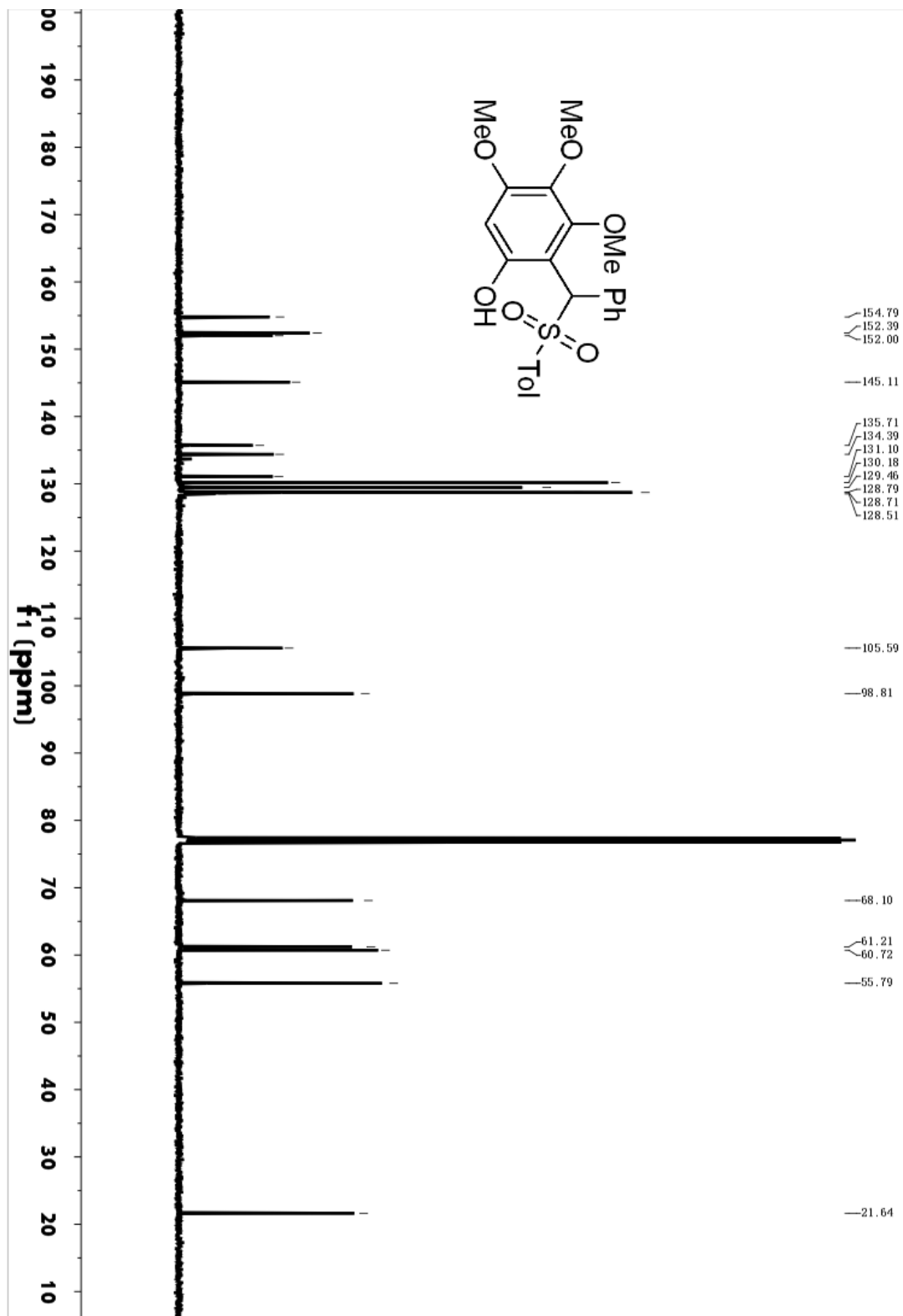




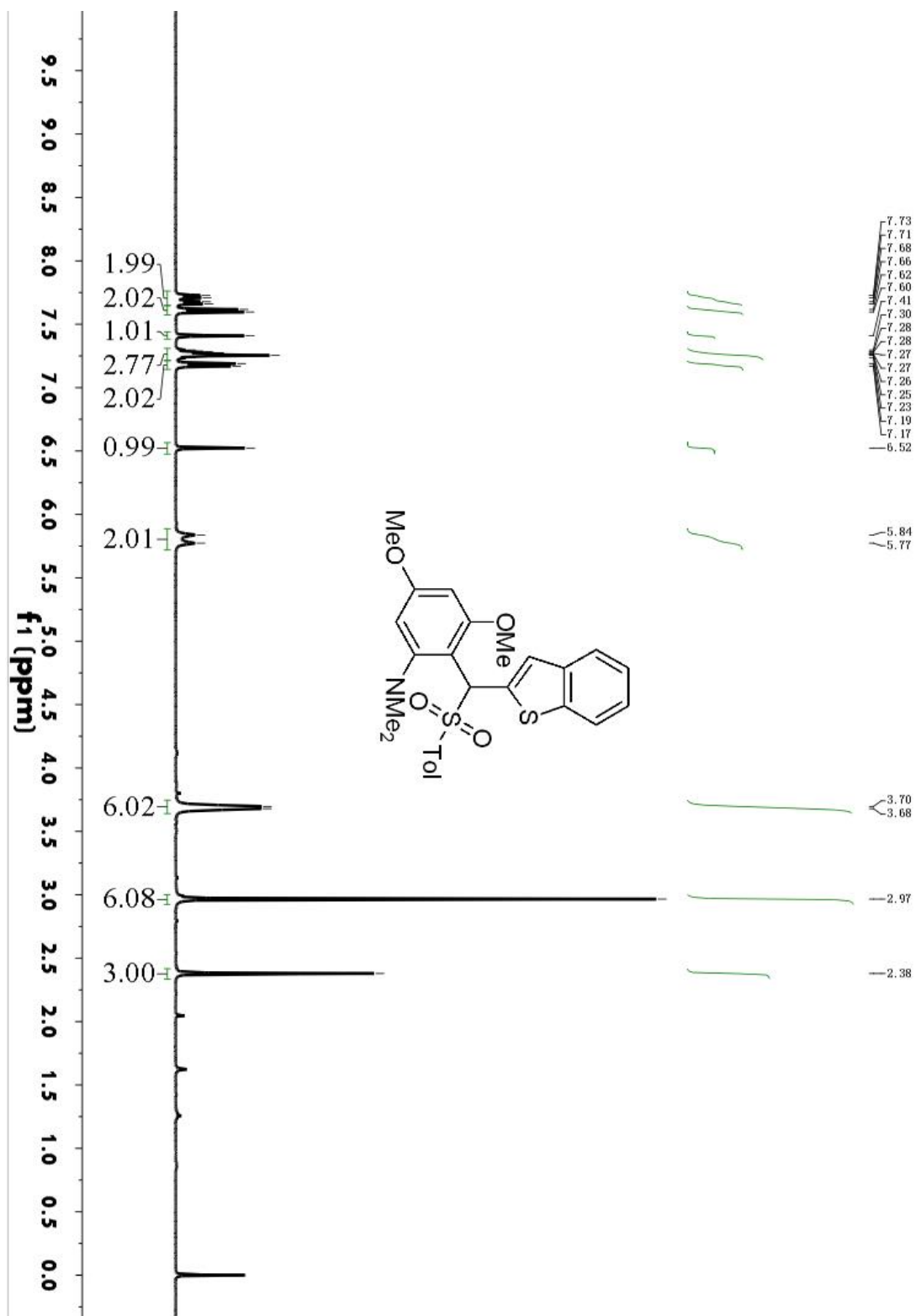


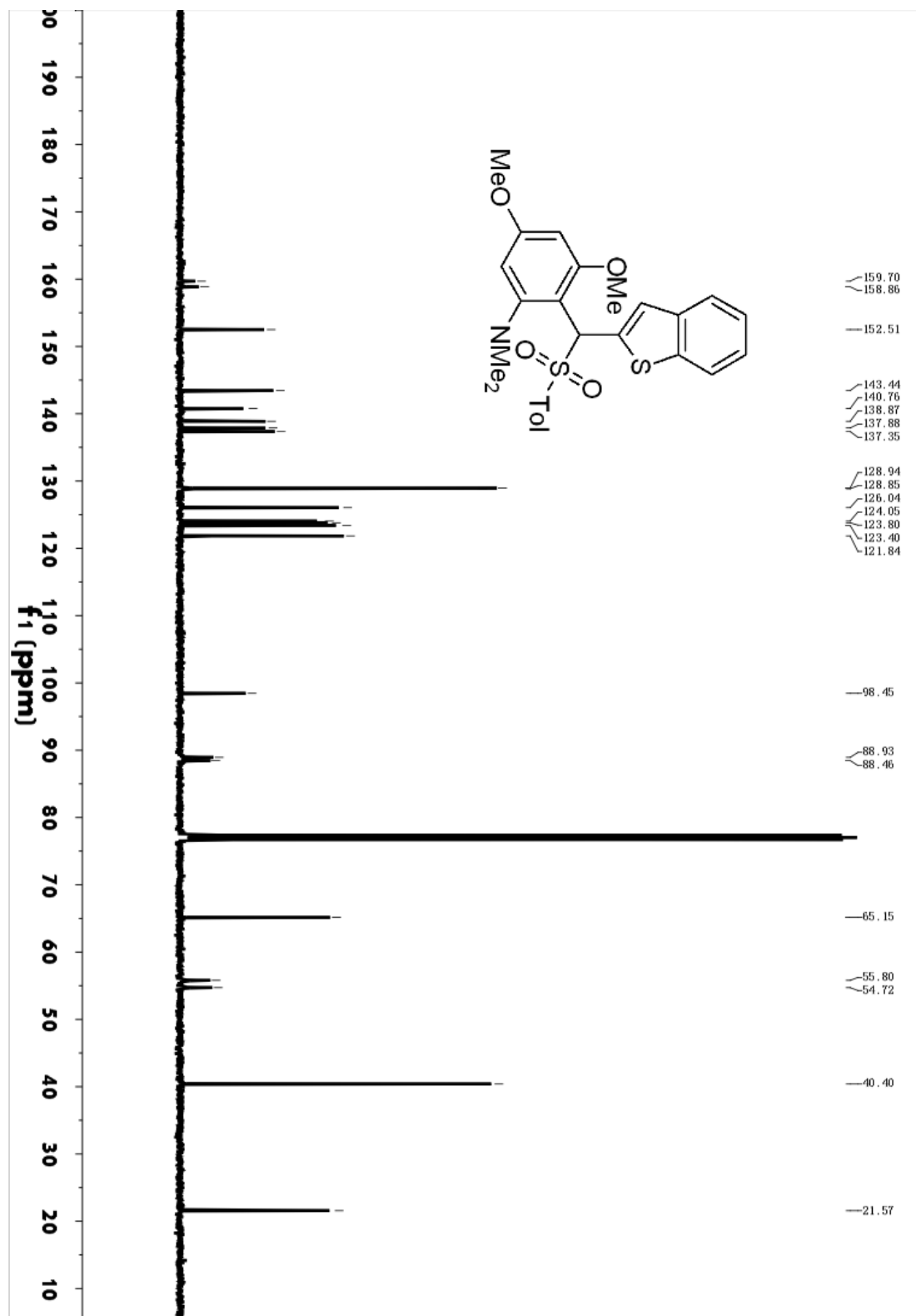
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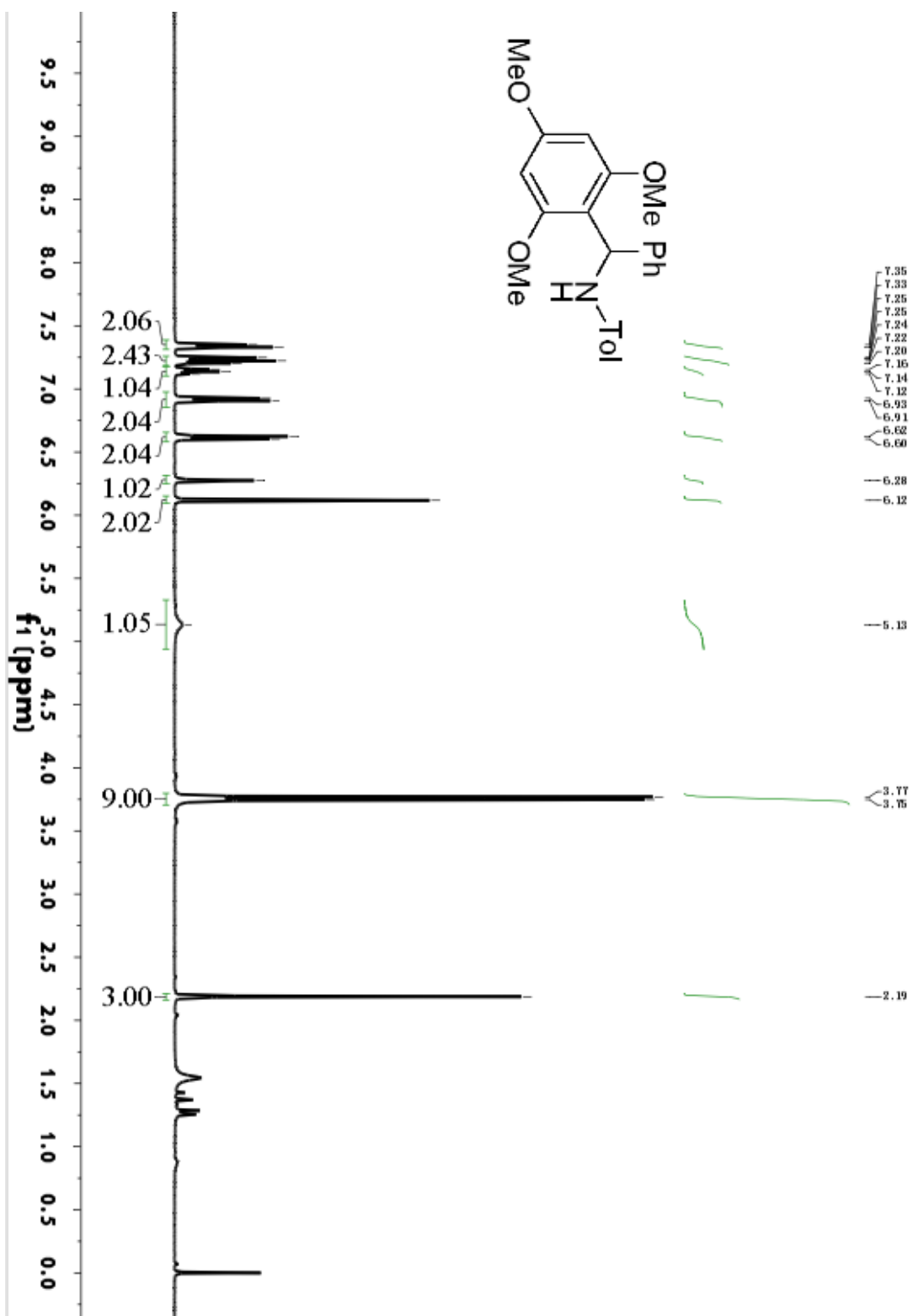


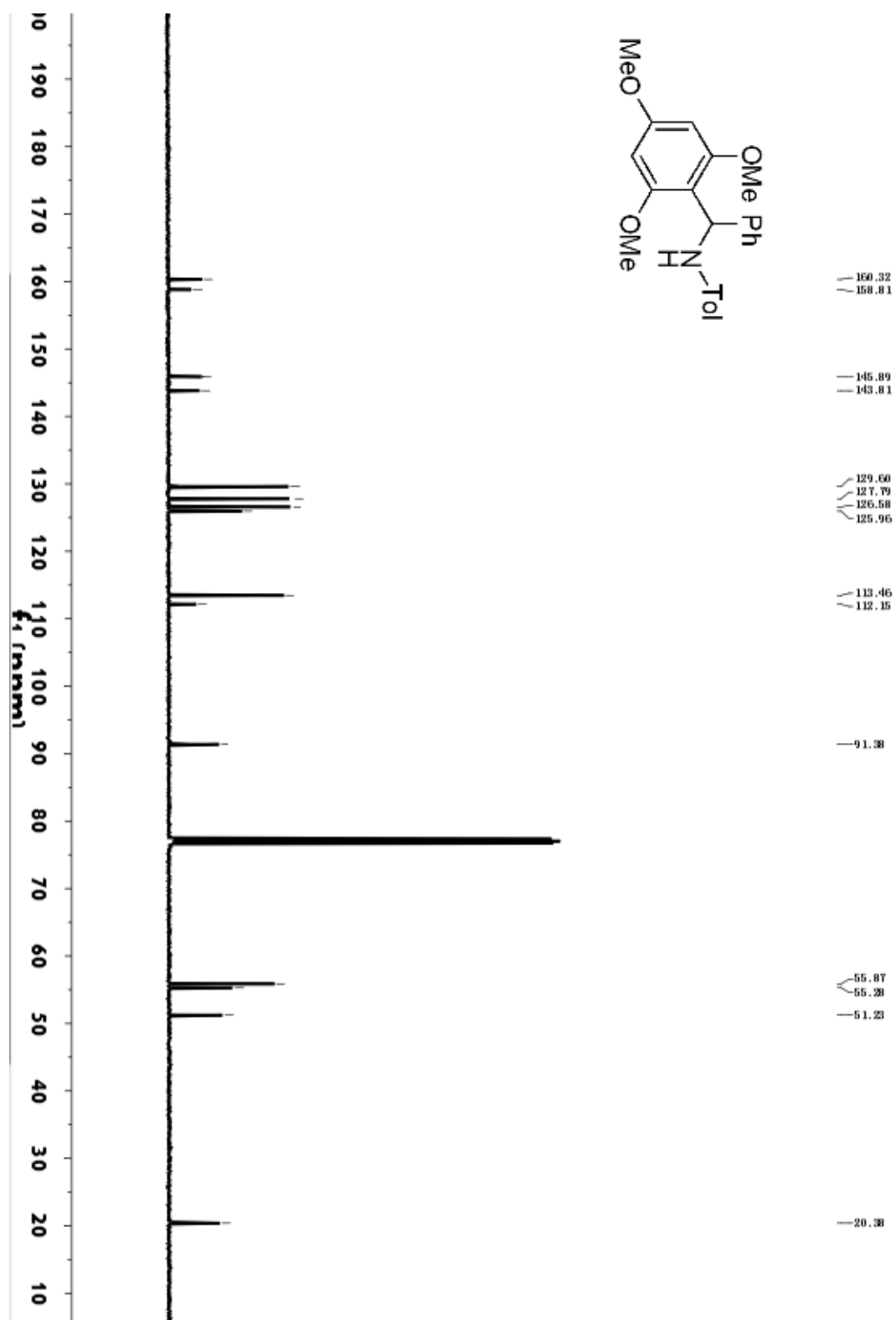
3-5





5





7

