

Experimental section

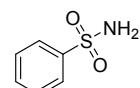
General comments

All reactions were carried out under air. Reactions were monitored by TLC analysis (pre-coated silica gel plates with fluorescent indicator UV254, 0.2 mm) and visualized with 254 nm UV light. Chemicals were purchased from Aldrich, Alfa-Asar, TCI and unless otherwise noted were used without further purification. All compounds were characterized by ^1H NMR and ^{13}C NMR spectroscopy and recorded on Bruker AV 300 and AV 400 spectrometers. Gas-chromatography-mass-analysis was performed using an Agilent HP-5890 with an Agilent HP-5973 Mass Selective Detector (EI) and an HP-5-capillary column using helium as a carrier gas.

General procedure for the synthesis of benzenesulfonamide

Benzenethiol (1 mmol), I₂ (20 mol%) were added in a 25 mL tube equipped with a stirring bar. 1 mL of acetonitrile, 5 equiv. of NH₃ (25% NH₃ in H₂O) and 5 equiv. of TBHP (70 wt. % in H₂O) were injected by syringe. After that, closed the tube and heated up to 100 °C for 16 h. When the reaction completed, cool the reaction mixture to room temperature. The reaction was quenched with distilled water and the solution was extracted with ethyl acetate. The crude product was purified by column chromatography (ethyl acetate/pentane = 1:4).

Benzenesulfonamide

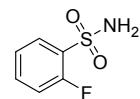


^1H NMR (300 MHz, Chloroform-*d*) δ 7.97 – 7.91 (m, 2H), 7.63 (d, *J* = 1.3 Hz, 0H), 7.62 – 7.49 (m, 3H), 4.83 (s, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 132.82, 129.16, 126.43.

GC-MS (EI, 70ev): m/z (%) = 77 (M+, 100), 157 (44), 141 (26), 94 (16), 93 (42), 51 (45), 50 (15).

2-Fluorobenzenesulfonamide

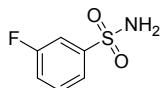


^1H NMR (300 MHz, DMSO-*d*₆) δ 7.81 (td, *J* = 7.7, 1.8 Hz, 1H), 7.67 (dd, *J* = 8.3, 7.4, 5.1, 1.8 Hz, 3H), 7.49 – 7.31 (m, 2H).

^{13}C NMR (75 MHz, DMSO-*d*₆) δ 158.03 (d, *J* = 252.3 Hz), 134.49 (d, *J* = 8.3 Hz), 131.49 (d, *J* = 14.2 Hz), 128.35, 124.54 (d, *J* = 3.9 Hz), 116.96 (d, *J* = 21.0 Hz).

GC-MS (EI, 70ev): m/z (%) = 95 (M+, 100), 175 (49), 159 (42), 112 (41), 111 (45), 75 (50), 69 (12), 64 (15), 50 (10).

3-Fluorobenzenesulfonamide

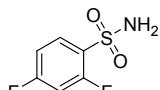


¹H NMR (300 MHz, DMSO-d₆) δ 7.71 – 7.57 (m, 3H), 7.55 – 7.43 (m, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 163.19, 146.12 (d, *J* = 6.5 Hz), 131.37 (d, *J* = 8.1 Hz), 121.75 (d, *J* = 3.2 Hz), 118.89 (d, *J* = 21.1 Hz), 112.63 (d, *J* = 24.1 Hz).

GC-MS (EI, 70ev): m/z (%) = 95 (M+, 100), 175 (30), 159 (14), 112 (14), 111 (50), 75 (36).

2,4-Difluorobenzenesulfonamide

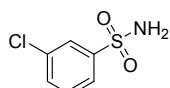


¹H NMR (300 MHz, DMSO-d₆) δ 7.86 (td, *J* = 8.7, 6.4 Hz, 1H), 7.73 (s, 2H), 7.52 (ddd, *J* = 10.6, 9.2, 2.5 Hz, 1H), 7.26 (dddd, *J* = 8.8, 8.3, 2.5, 1.1 Hz, 1H).

¹³C NMR (75 MHz, DMSO-d₆) δ 130.28 (d, *J* = 10.4 Hz), 128.48, 128.24, 111.91 (d, *J* = 3.9 Hz), 111.62 (d, *J* = 3.6 Hz), 106.68 – 104.83 (m).

GC-MS (EI, 70ev): m/z (%) = 113 (M+, 100), 193 (57), 177 (68), 130 (49), 129 (63), 101 (19), 64 (20), 63 (57).

3-Chlorobenzenesulfonamide

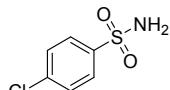


¹H NMR (300 MHz, DMSO-d₆) δ 7.84 (ddd, *J* = 2.2, 1.7, 0.5 Hz, 1H), 7.78 (ddd, *J* = 7.6, 1.7, 1.2 Hz, 1H), 7.70 (ddd, *J* = 8.0, 2.1, 1.3 Hz, 1H), 7.62 (ddd, *J* = 8.0, 7.6, 0.5 Hz, 1H), 7.52 (s, 2H).

¹³C NMR (75 MHz, DMSO-d₆) δ 145.86, 133.44, 131.73, 131.09, 125.35, 124.21.

GC-MS (EI, 70ev): m/z (%) = 111 (M+, 100), 193 (14), 191 (37), 175 (16), 129 (24), 128 (16), 127 (71), 113 (32), 76 (11), 75 (59), 74 (16), 64 (11), 50 (20).

4-Chlorobenzenesulfonamide

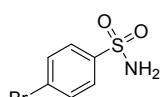


¹H NMR (300 MHz, DMSO-d₆) δ 7.91 – 7.78 (m, 2H), 7.72 – 7.60 (m, 2H), 7.48 (s, 2H).

¹³C NMR (75 MHz, DMSO-d₆) δ 142.92, 136.51, 129.03, 127.55.

GC-MS (EI, 70ev): m/z (%) = 111 (M+, 100), 193 (14), 191 (39), 177 (15), 175 (40), 129 (10), 128 (29), 127 (27), 113 (31), 76 (11), 75 (56), 74 (17), 64 (10), 50 (21).

4-Bromobenzenesulfonamide

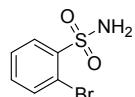


¹H NMR (300 MHz, DMSO-d₆) δ 7.83 – 7.78 (m, 1H), 7.78 – 7.73 (m, 1H), 7.48 (s, 1H).

¹³C NMR (75 MHz, DMSO-d₆) δ 143.32, 131.96, 127.67, 125.39.

GC-MS (EI, 70ev): m/z (%) = 155 (M+, 100), 237 (53), 235 (51), 221 (40), 219 (40) 174 (33), 173 (35), 172 (35), 171 (35), 157 (97), 76 (76), 75 (86), 74 (41), 65 (16), 64 (21), 63 (11), 51 (10), 50 (64).

2-Bromobenzenesulfonamide

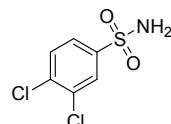


¹H NMR (300 MHz, DMSO-d₆) δ 8.06 – 7.97 (m, 1H), 7.83 (dd, *J* = 7.7, 1.5 Hz, 1H), 7.63 – 7.44 (m, 4H).

¹³C NMR (75 MHz, DMSO-d₆) δ 142.62, 134.94, 133.30, 129.07, 127.93, 118.80.

GC-MS (EI, 70ev): m/z (%) = 155 (M+, 100), 237 (64), 235 (63), 221 (18), 219 (18) 174 (48), 173 (40), 172 (50), 171 (40), 157 (99), 156 (18), 108 (19), 92 (51), 80 (10), 77 (15), 76 (85), 75 (94), 74 (42), 65 (26), 64 (36), 63 (13), 51 (14), 50 (73).

3,4-Dichlorobenzenesulfonamide

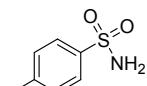


¹H NMR (300 MHz, DMSO-d₆) δ 8.01 (d, *J* = 2.1 Hz, 1H), 7.87 (d, *J* = 8.4 Hz, 1H), 7.77 (ddd, *J* = 8.4, 2.1, 0.5 Hz, 1H), 7.60 (s, 2H).

¹³C NMR (75 MHz, DMSO-d₆) δ 144.27, 134.73, 131.70, 131.43, 127.54, 125.76.

GC-MS (EI, 70ev): m/z (%) = 145 (M+, 100), 227 (30), 225 (44), 211 (24), 209 (35), 164 (18), 163 (36), 162 (28), 161 (56), 149 (11), 147 (63), 111 (22), 110 (15), 109 (58), 84 (13), 75 (38), 74 (46), 73 (13), 64 (19), 50 (10).

4-Methylbenzenesulfonamide

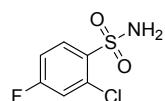


¹H NMR (300 MHz, DMSO-d₆) δ 7.81 – 7.57 (m, 2H), 7.42 – 7.32 (m, 1H), 7.29 (s, 2H), 2.37 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 141.82, 141.36, 129.25, 125.57, 20.87.

GC-MS (EI, 70ev): m/z (%) = 91 (M+, 100), 171 (37), 155 (32), 108 (14), 107 (23), 89 (10), 65 (30), 63 (11), 39 (11).

2-Chloro-4-fluorobenzenesulfonamide

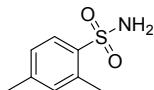


¹H NMR (300 MHz, DMSO-d₆) δ 8.04 (dd, *J* = 8.9, 6.0 Hz, 1H), 7.72 – 7.64 (m, 3H), 7.41 (ddd, *J* = 8.9, 8.2, 2.6 Hz, 1H).

¹³C NMR (75 MHz, DMSO-d₆) δ 163.28 (d, *J* = 253.3 Hz), 137.71 (d, *J* = 3.6 Hz), 132.09 (d, *J* = 11.5 Hz), 131.19 (d, *J* = 9.9 Hz), 118.89 (d, *J* = 25.8 Hz), 114.51 (d, *J* = 21.7 Hz).

GC-MS (EI, 70ev): m/z (%) = 129 (M+, 100), 211 (19), 209 (50), 195 (17), 193 (47), 148 (18), 147 (21), 146 (56), 145 (53), 131 (33), 117 (10), 109 (26), 94 (27), 93 (29), 74 (19), 64 (23), 50 (12).

2,4-Dimethylbenzenesulfonamide

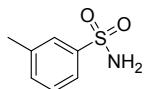


¹H NMR (300 MHz, DMSO-d₆) δ 7.74 (d, *J* = 7.9 Hz, 1H), 7.30 (s, 2H), 7.22 – 7.07 (m, 2H), 2.56 (s, 3H), 2.32 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 141.73, 139.41, 135.65, 132.63, 127.12, 126.29, 20.61, 19.70.

GC-MS (EI, 70ev): m/z (%) = 104 (M+, 100), 185 (23), 151 (10), 120 (36), 103 (23), 105 (62), 91 (11), 79 (24), 78 (29), 77 (41), 51 (12), 39 (10).

3-Methylbenzenesulfonamide

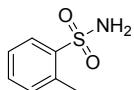


¹H NMR (300 MHz, DMSO-d₆) δ 7.72 – 7.57 (m, 2H), 7.50 – 7.37 (m, 2H), 7.31 (s, 2H), 2.39 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 144.00, 138.45, 132.30, 128.76, 125.81, 122.69, 20.84.

GC-MS (EI, 70ev): m/z (%) = 91 (M+, 100), 171 (30), 155 (12), 107 (28), 106 (30), 89 (11), 65 (33), 63 (12), 39 (13).

2-Methylbenzenesulfonamide

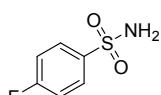


¹H NMR (300 MHz, DMSO-d₆) δ 7.87 (dd, *J* = 8.2, 1.5 Hz, 1H), 7.55 – 7.44 (m, 1H), 7.44 – 7.28 (m, 4H), 2.60 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 142.07, 135.80, 132.11, 131.78, 126.92, 125.97, 19.79.

GC-MS (EI, 70ev): m/z (%) = 90 (M+, 100), 171 (21), 137 (17), 107 (13), 106 (69), 89 (35), 77 (12), 65 (40), 63 (18), 51 (10), 39 (16).

4-Fluorobenzenesulfonamide

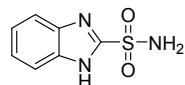


¹H NMR (300 MHz, DMSO-d₆) δ 7.95 – 7.82 (m, 2H), 7.52 – 7.32 (m, 4H).

¹³C NMR (75 MHz, DMSO-d₆) δ 163.63 (d, *J* = 249.8 Hz), 140.52 (d, *J* = 3.1 Hz), 128.49 (d, *J* = 9.6 Hz), 115.96 (d, *J* = 22.7 Hz).

GC-MS (EI, 70ev): m/z (%) = 95 (M+, 100), 175 (38), 159 (47), 112 (17), 111 (18), 75 (35).

1H-benzo[d]imidazole-2-sulfonamide

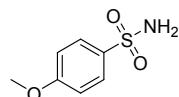


¹H NMR (300 MHz, DMSO-d₆) δ 13.46 (s, 1H), 8.05 (s, 2H), 7.75 (d, *J* = 7.9 Hz, 1H), 7.56 (d, *J* = 7.9 Hz, 1H), 7.43 – 7.25 (m, 2H).

¹³C NMR (75 MHz, DMSO-d₆) δ 151.59, 141.90, 133.61, 124.61, 122.89, 120.13, 112.64.

HRMS(ESI): calcd. for [C₇H₇N₃O₂S + H]⁺: 198.03317; fond: 198.03356.

4-Methoxybenzenesulfonamide

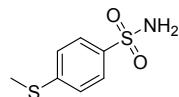


¹H NMR (300 MHz, DMSO-d₆) δ 7.82 – 7.70 (m, 2H), 7.22 (s, 2H), 7.15 – 7.03 (m, 2H), 3.82 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 161.57, 136.12, 127.62, 113.95, 55.54.

GC-MS (EI, 70ev): m/z (%) = 171 (M+, 100), 187 (81), 123 (33), 107 (53), 92 (50), 77 (77), 64 (36), 63 (30), 50 (12).

4-(Methylthio)benzenesulfonamide

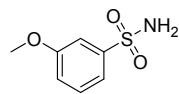


¹H NMR (300 MHz, DMSO-d₆) δ 7.78 – 7.67 (m, 2H), 7.50 – 7.36 (m, 2H), 7.32 (s, 2H), 2.53 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 143.47, 140.07, 126.05, 125.17, 14.08.

GC-MS (EI, 70ev): m/z (%) = 203 (M+, 100), 187 (34), 140 (14), 139 (40), 124 (11), 123 (39), 108 (23), 79 (23), 77 (20), 69 (16), 63 (12), 50 (11), 45 (38).

3-Methoxybenzenesulfonamide

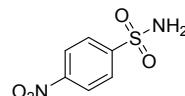


¹H NMR (300 MHz, DMSO-d₆) δ 7.49 (t, *J* = 7.9 Hz, 1H), 7.43 – 7.32 (m, 4H), 7.17 (ddd, *J* = 8.1, 2.6, 1.1 Hz, 1H), 3.82 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 159.19, 145.31, 130.10, 117.57, 110.72, 55.49.

GC-MS (EI, 70ev): m/z (%) = 108 (M+, 100), 187 (95), 107 (100), 95 (10), 94 (18), 93 (22), 92 (75), 80 (19), 78 (10), 77 (99), 76 (15), 64 (51), 63 (43), 51 (10), 50 (15).

4-Nitrobenzenesulfonamide

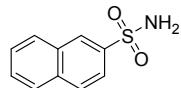


¹H NMR (300 MHz, DMSO-d₆) δ 8.66 – 8.27 (m, 1H), 8.25 – 7.94 (m, 1H), 7.74 (s, 1H).

¹³C NMR (75 MHz, DMSO-d₆) δ 149.33, 149.13, 127.17, 124.40.

GC-MS (EI, 70ev): m/z (%) = 138 (M+, 100), 202 (76), 186 (37), 156 (16), 139 (41), 122 (46), 109 (24) , 108 (36), 92 (33), 80 (20), 76 (61), 75 (99) , 74 (41), 65 (22), 64 (55), 63 (26), 51 (12), 50 (65), 39 (12), 30 (15).

Naphthalene-2-sulfonamide

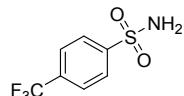


¹H NMR (300 MHz, DMSO-d₆) δ 8.50 – 8.39 (m, 1H), 8.18 – 8.08 (m, 2H), 8.07 – 7.99 (m, 1H), 7.89 (dd, *J* = 8.7, 1.9 Hz, 1H), 7.74 – 7.60 (m, 2H), 7.47 (s, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 141.11, 133.82, 131.63, 129.00, 128.35, 127.74, 127.44, 125.64, 122.04.

GC-MS (EI, 70ev): m/z (%) = 127 (M+, 100), 207 (55), 144 (14), 143 (46), 128 (12), 126 (27), 115 (26) , 77 (12).

4-(Trifluoromethyl)benzenesulfonamide

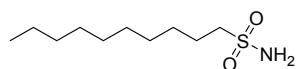


¹H NMR (300 MHz, DMSO-d₆) δ 8.10 – 8.01 (m, 1H), 8.01 – 7.92 (m, 1H), 7.64 (s, 1H).

¹³C NMR (75 MHz, DMSO-d₆) δ 147.75, 131.66 (q, *J* = 32.2 Hz), 126.57, 126.19 (q, *J* = 3.8 Hz), 123.52 (d, *J* = 272.6 Hz).

GC-MS (EI, 70ev): m/z (%) = 145 (M+, 100), 225 (26), 209 (14), 206 (10), 162 (20), 125 (14), 95 (16) , 75 (15).

Decane-1-sulfonamide



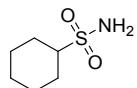
¹H NMR (300 MHz, DMSO-d₆) δ 6.71 (s, 2H), 2.99 – 2.87 (m, 2H), 1.67 (tt, *J* = 7.9, 6.1 Hz, 2H), 1.44 – 1.20 (m, 15H), 0.92 – 0.80 (m, 3H).

¹³C NMR (75 MHz, DMSO-d₆) δ 54.37, 31.27, 28.91, 28.77, 28.67, 28.59, 27.58, 23.47, 22.07, 13.90.

GC-MS (EI, 70ev): m/z (%) = 82 (M+, 100), 140 (62), 112 (42), 111 (37), 108 (34), 98 (30), 97 (59), 95 (15), 85 (21), 84 (58), 83 (68), 71 (28), 70 (67), 69 (71), 68 (28), 67(14), 64(10), 57(63), 56(64), 55(69), 54(11), 44(13), 43(66), 42(36), 41(71), 39(20).

HRMS(ESI): calcd. for [C₁₀H₂₃NO₂S -H] ⁻: 220:13767; fond: 220:13777.

Cyclohexanesulfonamide

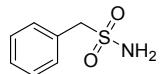


¹H NMR (300 MHz, DMSO-d₆) δ 6.62 (s, 2H), 2.74 (tt, *J* = 11.6, 3.5 Hz, 1H), 2.13 – 1.94 (m, 2H), 1.79 (dt, *J* = 12.6, 3.2 Hz, 2H), 1.63 (dq, *J* = 12.4, 3.1, 1.4 Hz, 1H), 1.42 – 0.99 (m, 5H).

¹³C NMR (75 MHz, DMSO-d₆) δ 61.26, 26.28, 24.90, 24.52.

GC-MS (EI, 70ev): m/z (%) = 55 (M+, 100), 84 (33), 83 (98), 82 (50), 81 (21), 79 (12), 67 (43), 56 (24), 54 (19), 53 (16), 43 (11), 41 (88), 39 (34).

Phenylmethanesulfonamide

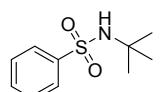


¹H NMR (300 MHz, DMSO-d₆) δ 7.46 – 7.28 (m, 5H), 6.85 (s, 2H), 4.27 (s, 2H).

¹³C NMR (75 MHz, DMSO-d₆) δ 130.73, 128.23, 127.84, 60.16.

GC-MS (EI, 70ev): m/z (%) = 91 (M+, 100), 65 (15).

N-(tert-Butyl)benzenesulfonamide



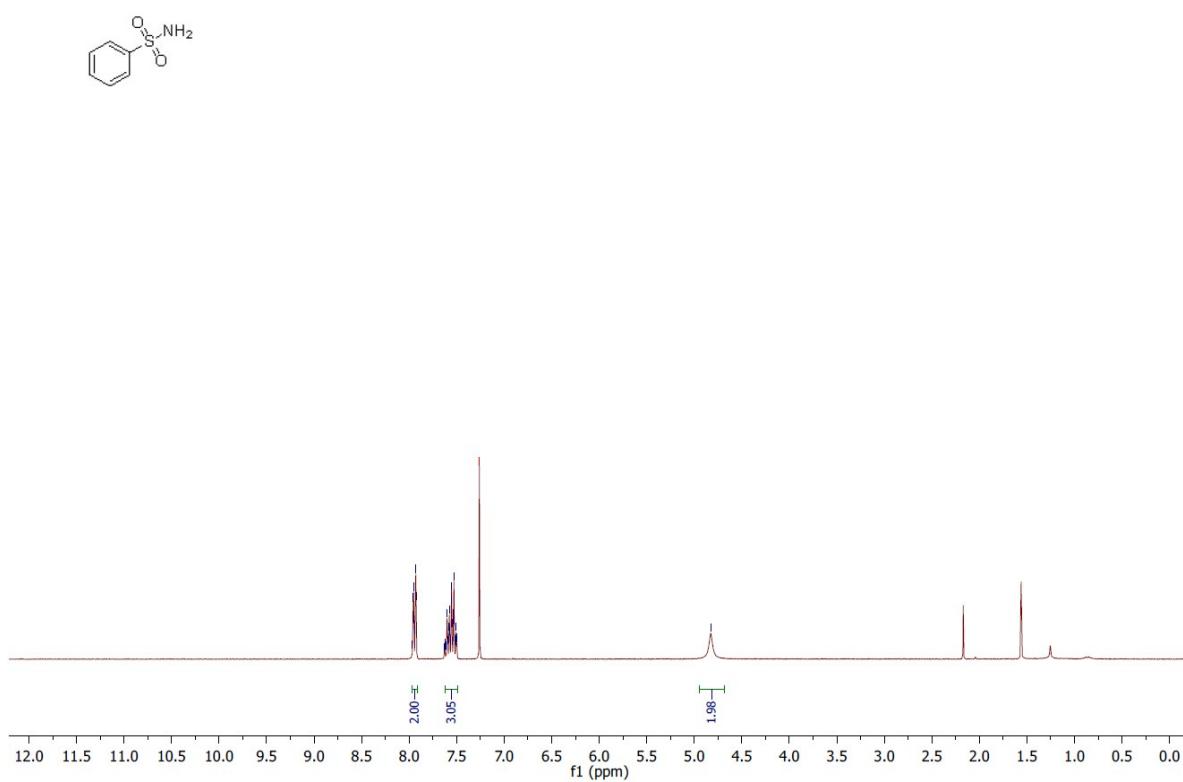
¹H NMR (300 MHz, DMSO-d₆) δ 7.90 – 7.78 (m, 2H), 7.64 – 7.48 (m, 3H), 1.08 (s, 9H).

¹³C NMR (75 MHz, DMSO-d₆) δ 144.23, 131.75, 128.88, 126.18, 53.16, 29.69.

HRMS(ESI): calcd. for [C₁₀H₁₅NO₂S + Na]⁺: 236.07157; fond: 236.07166.

150731.f335.10.fid
Jian-Bo Feng 38a26-1-3

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150731.f335.11.fid
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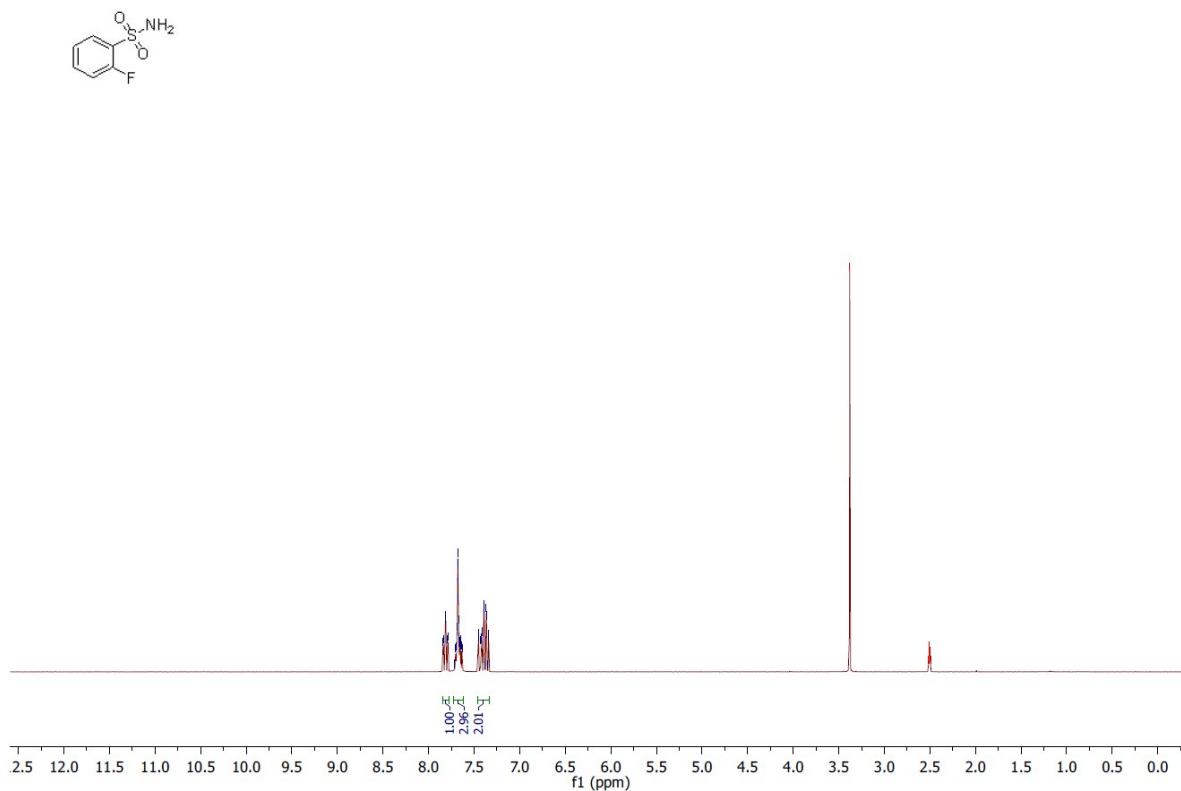


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Feng/ 96a132-1

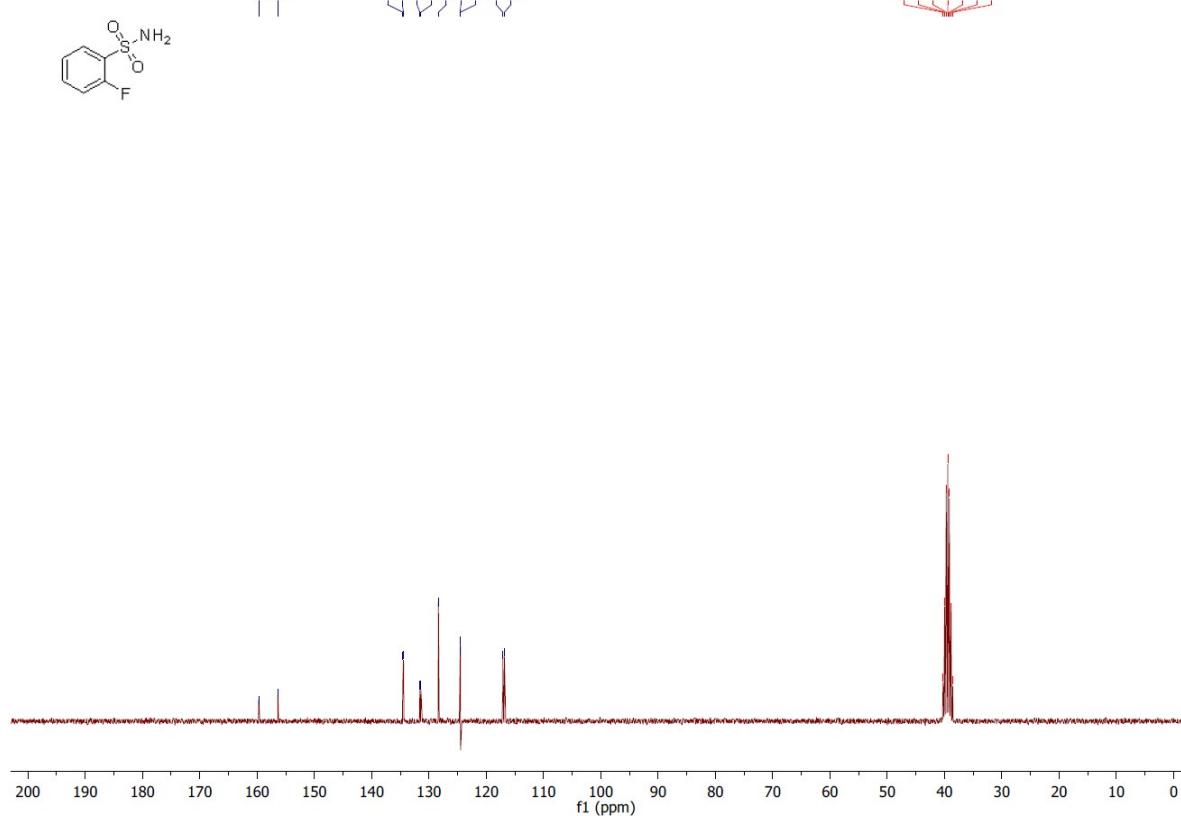
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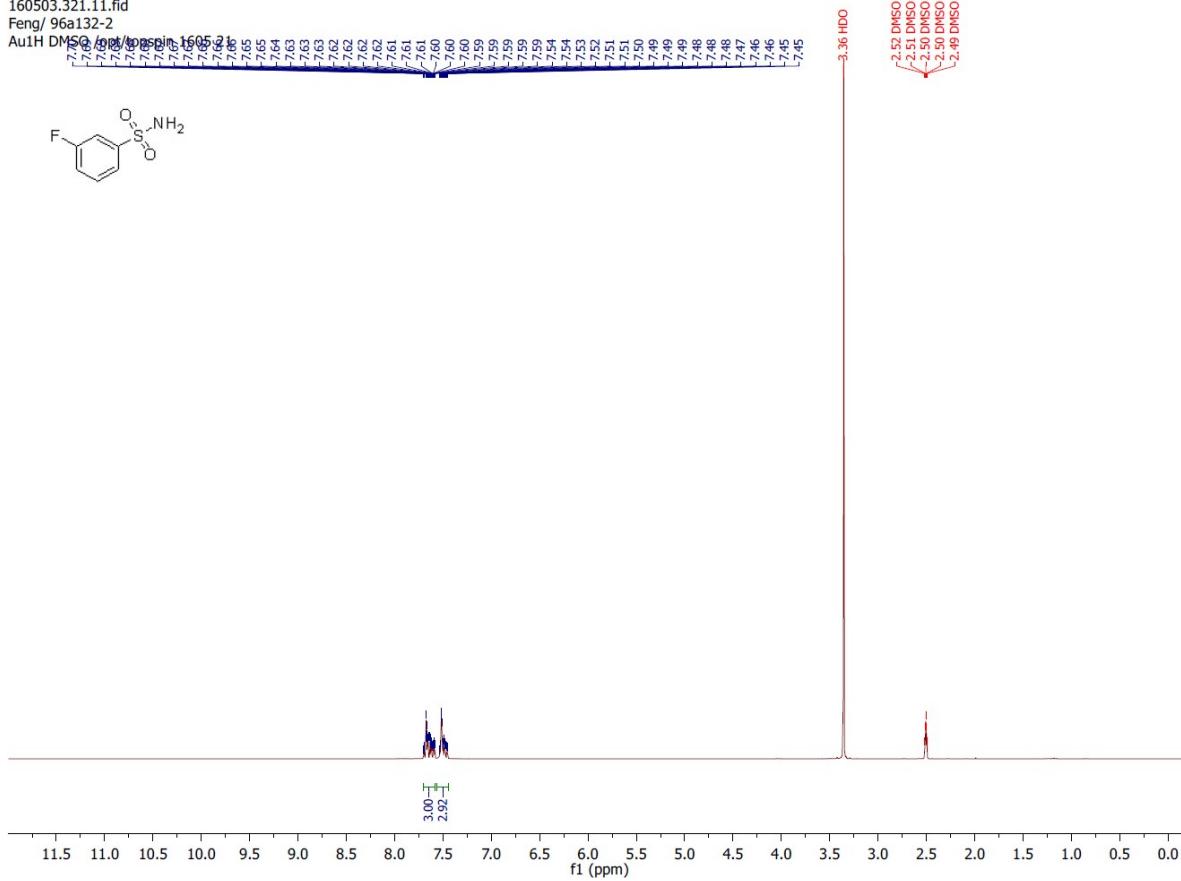
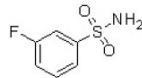
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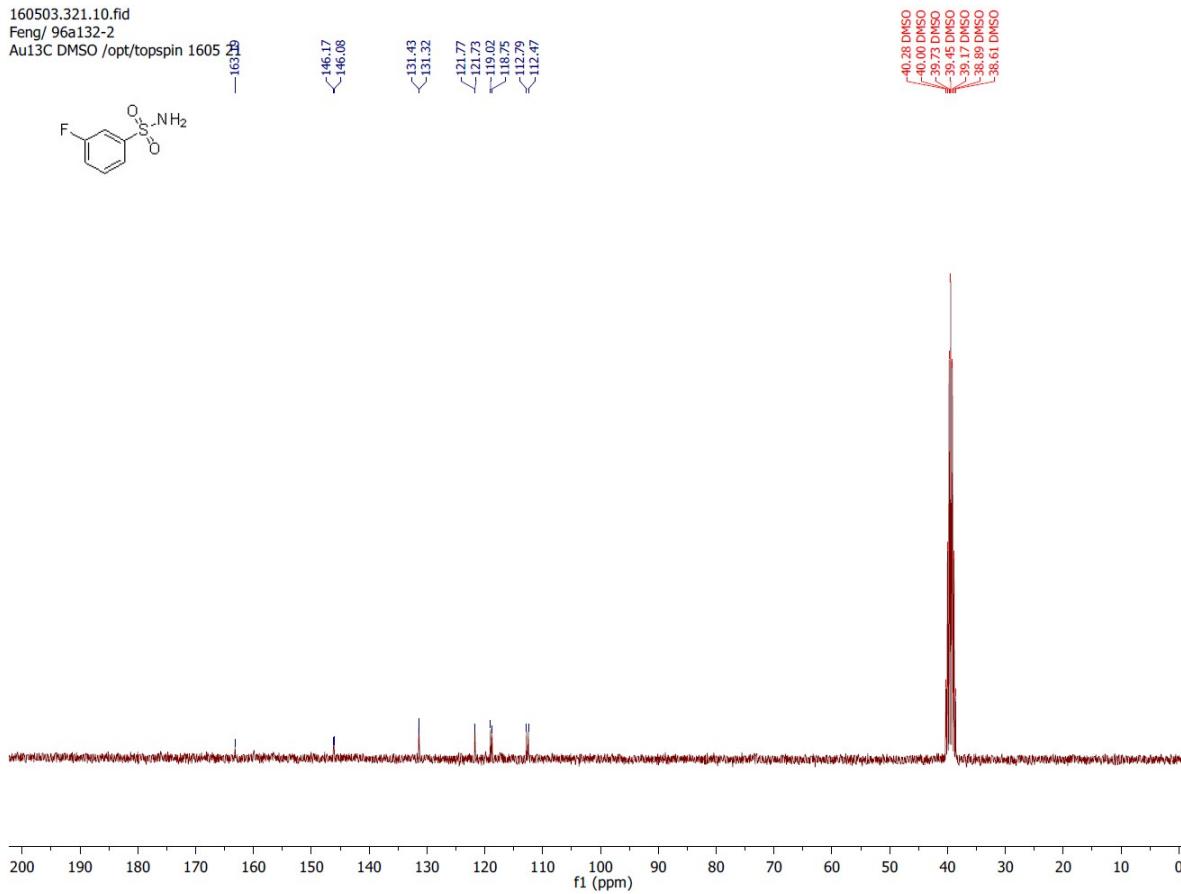
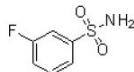
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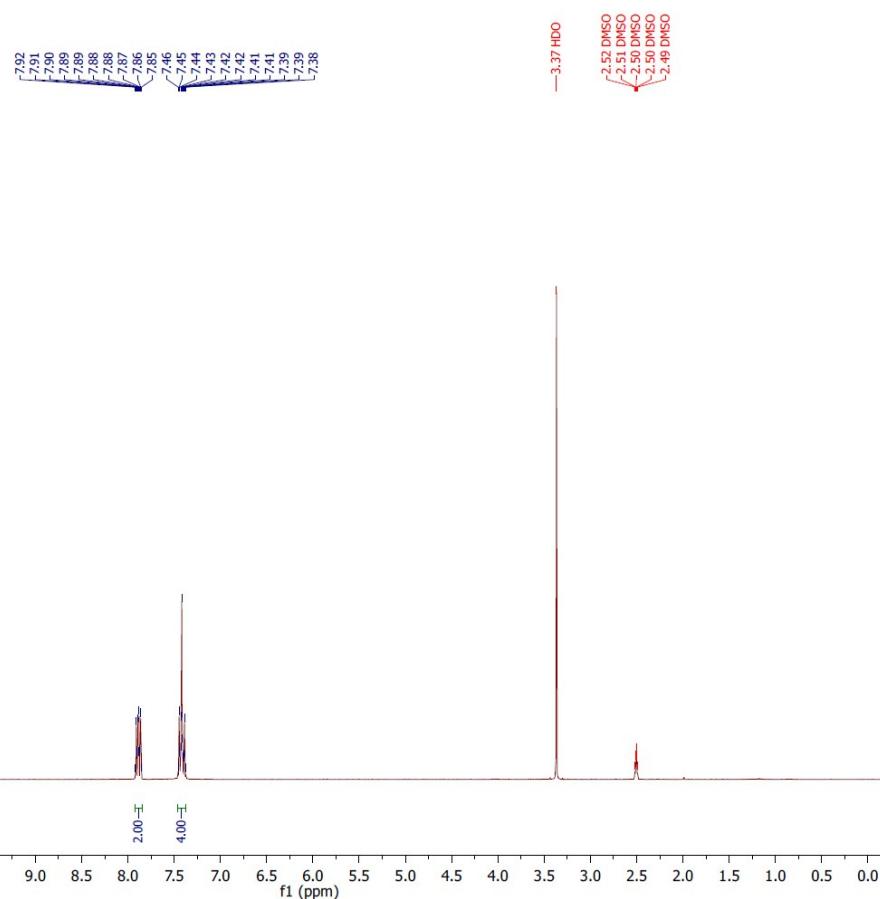
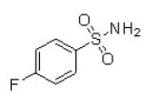
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Feng/ 96a132-2
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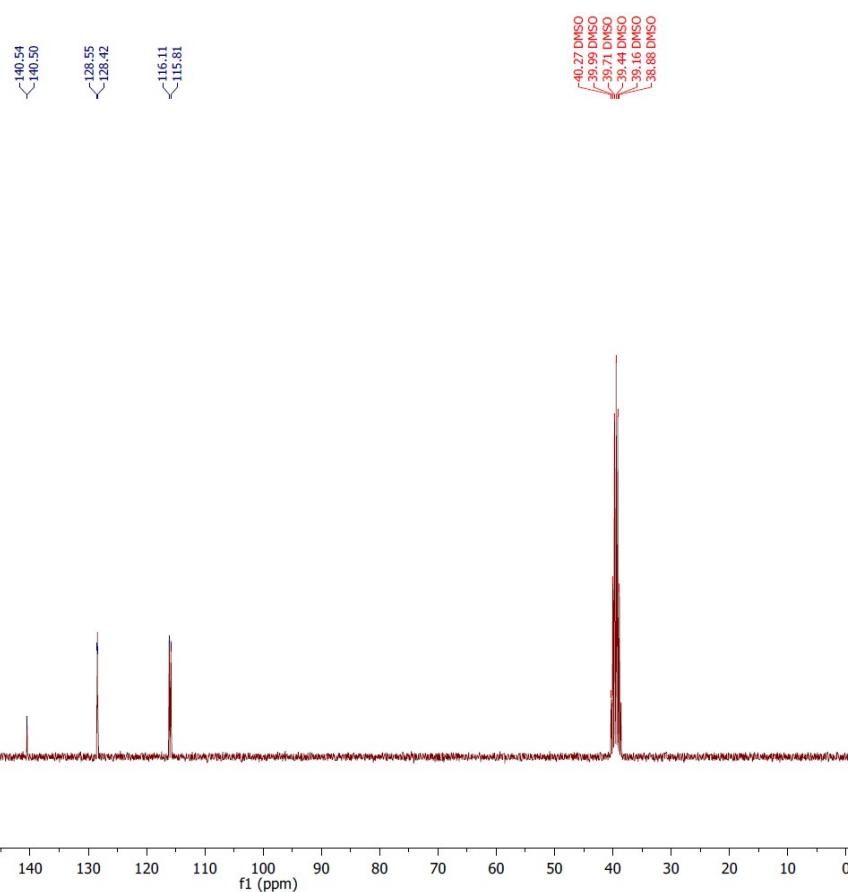
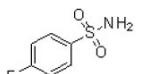
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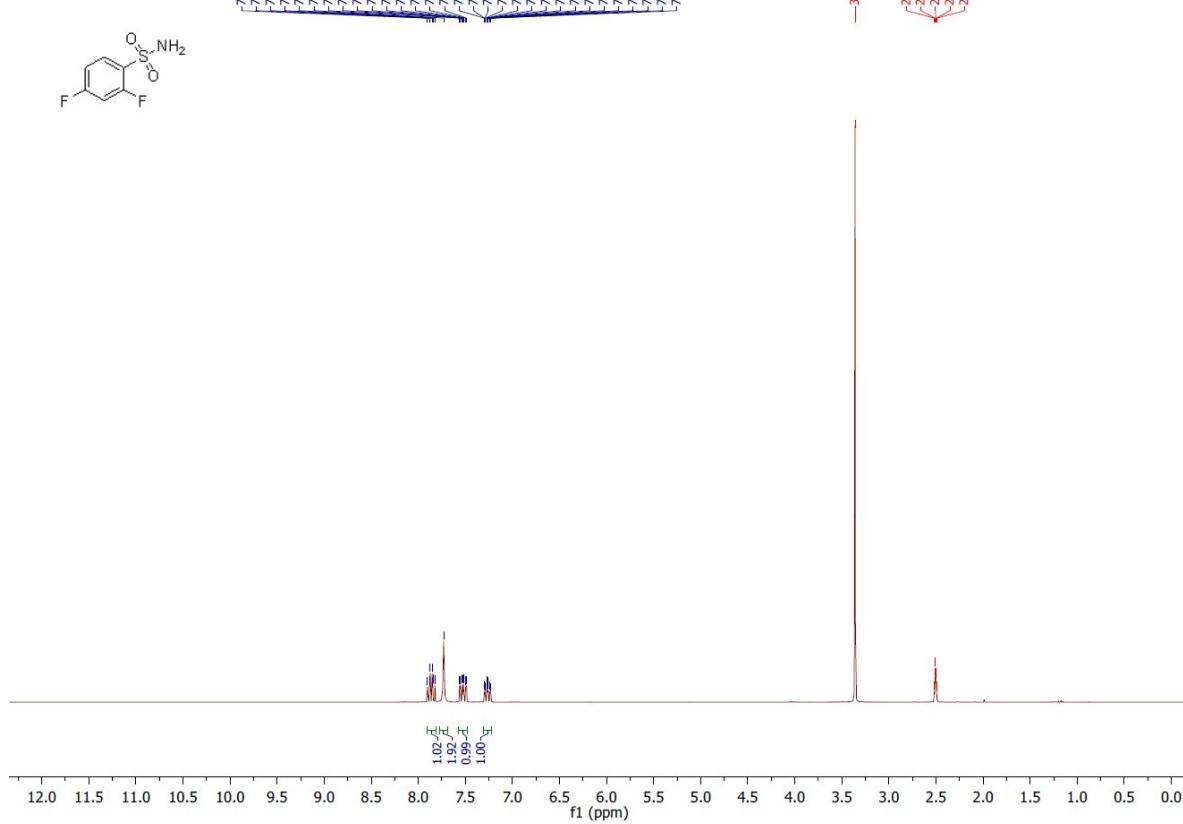
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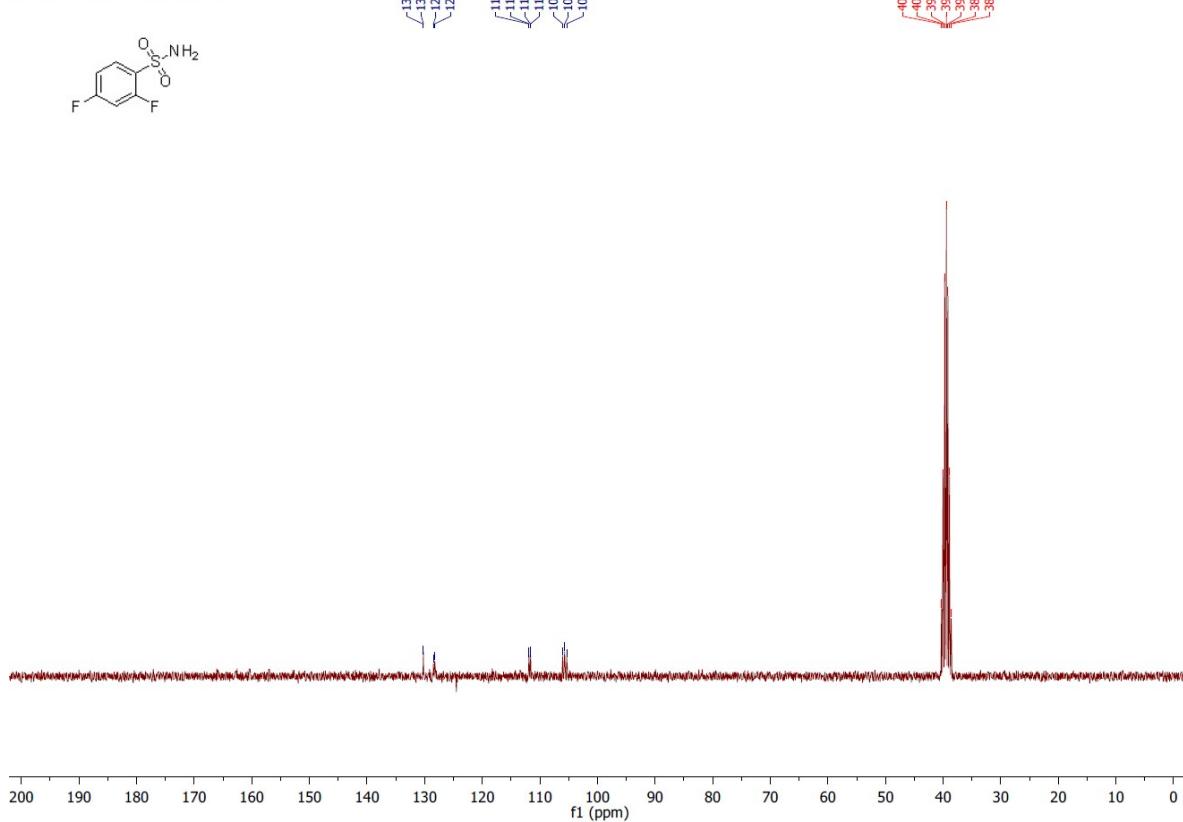
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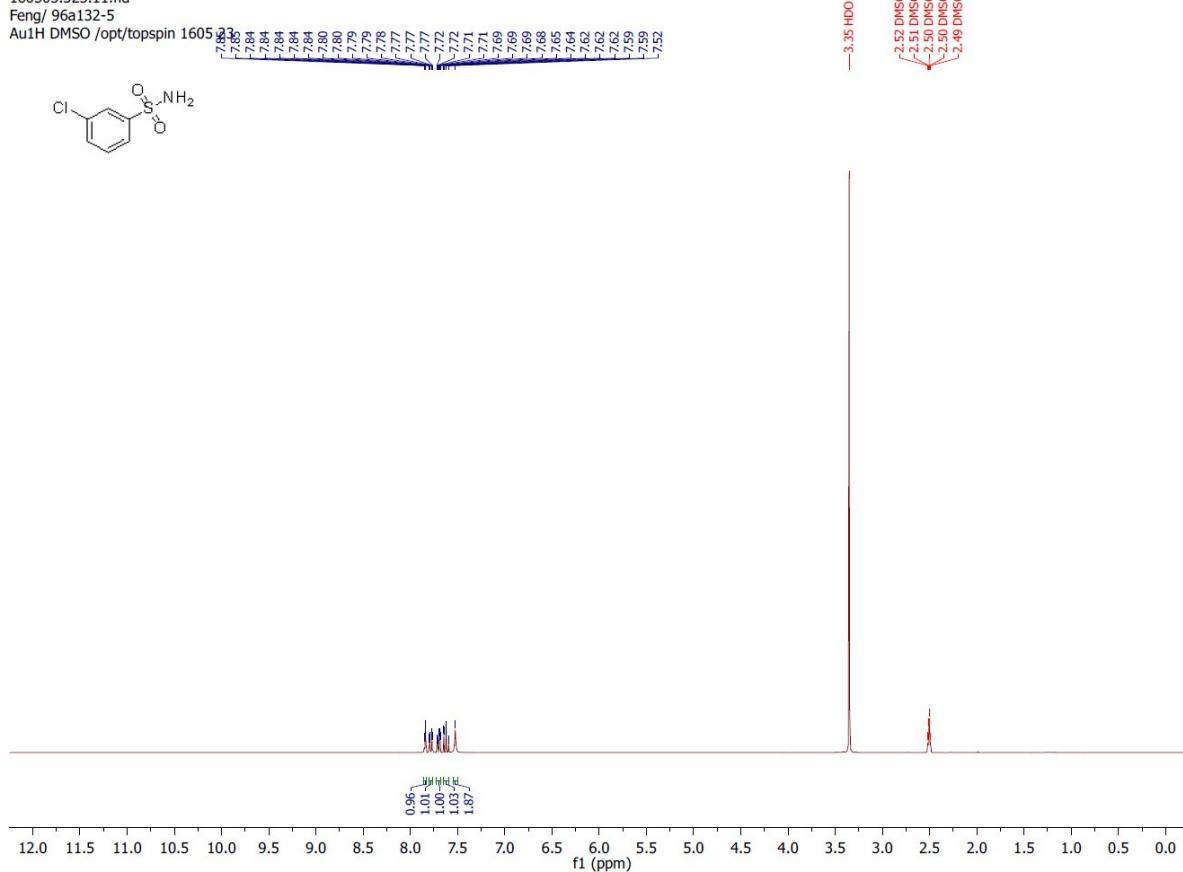
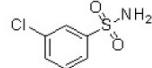
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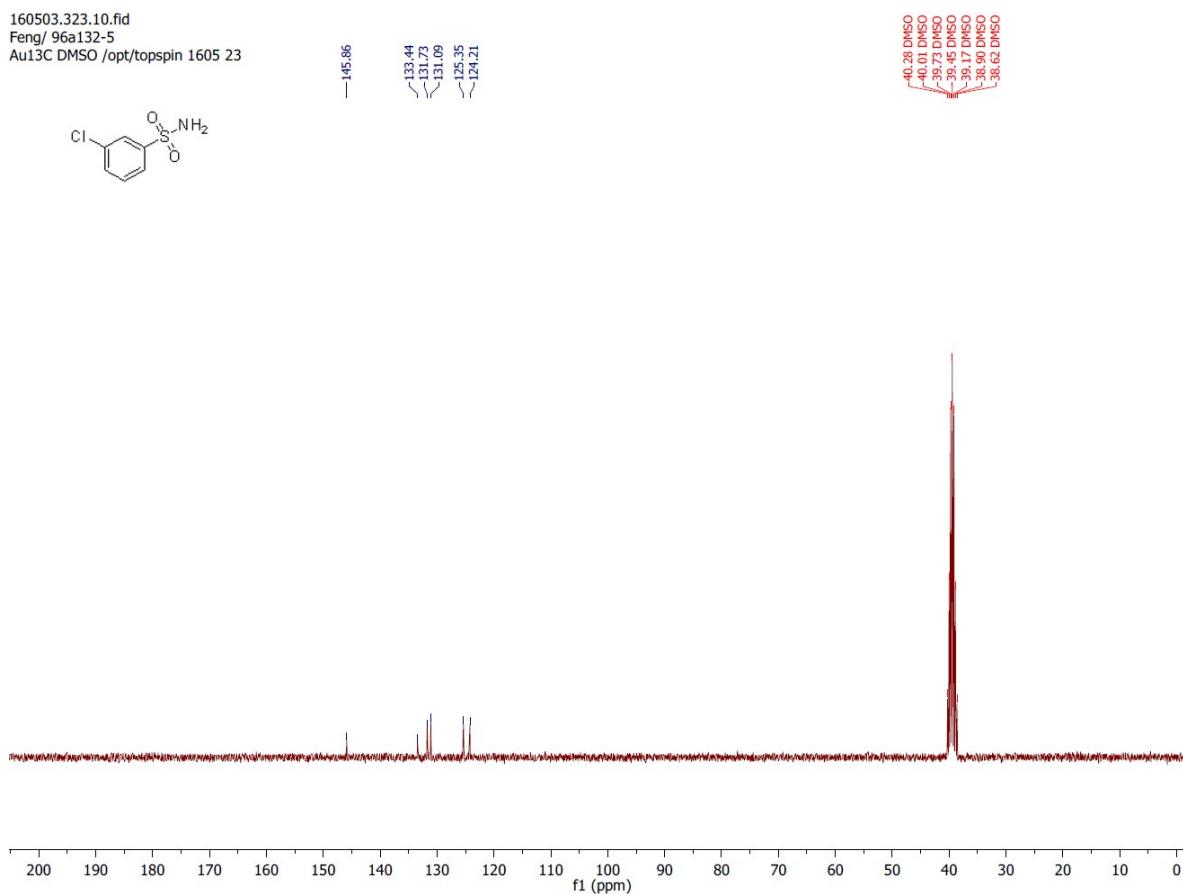
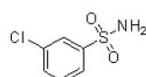
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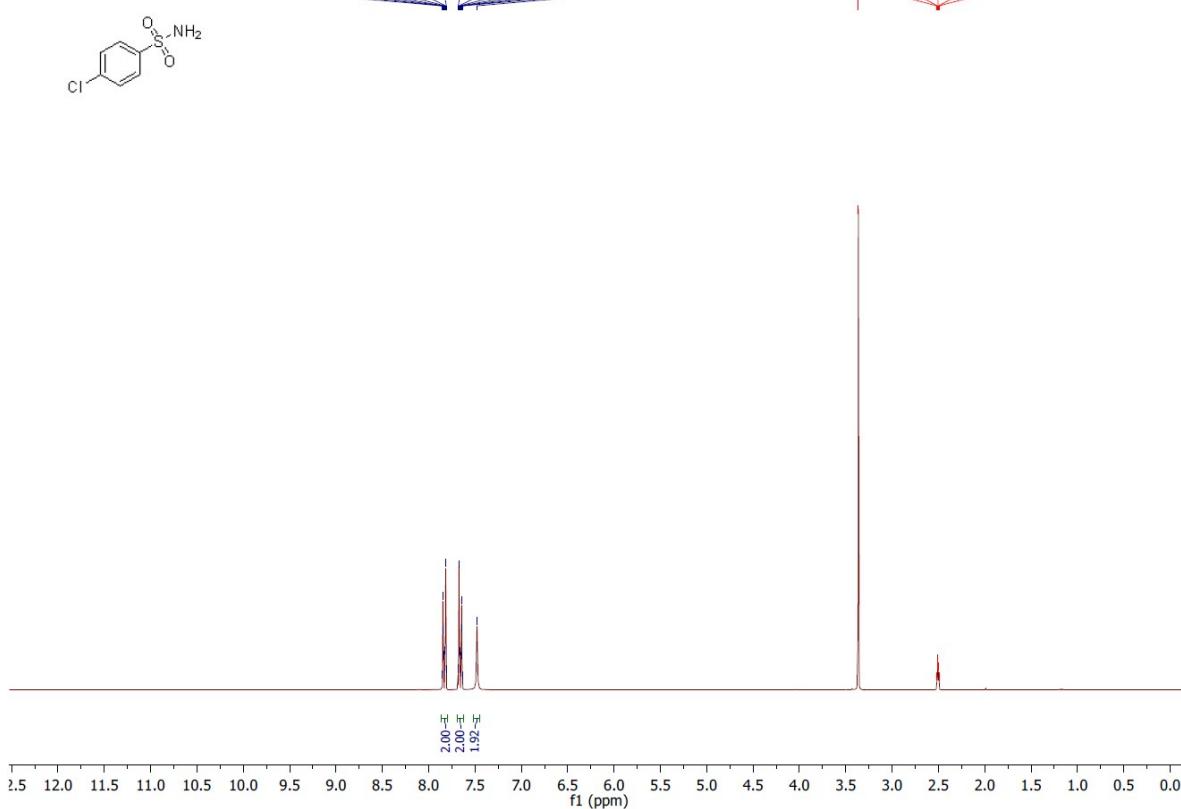
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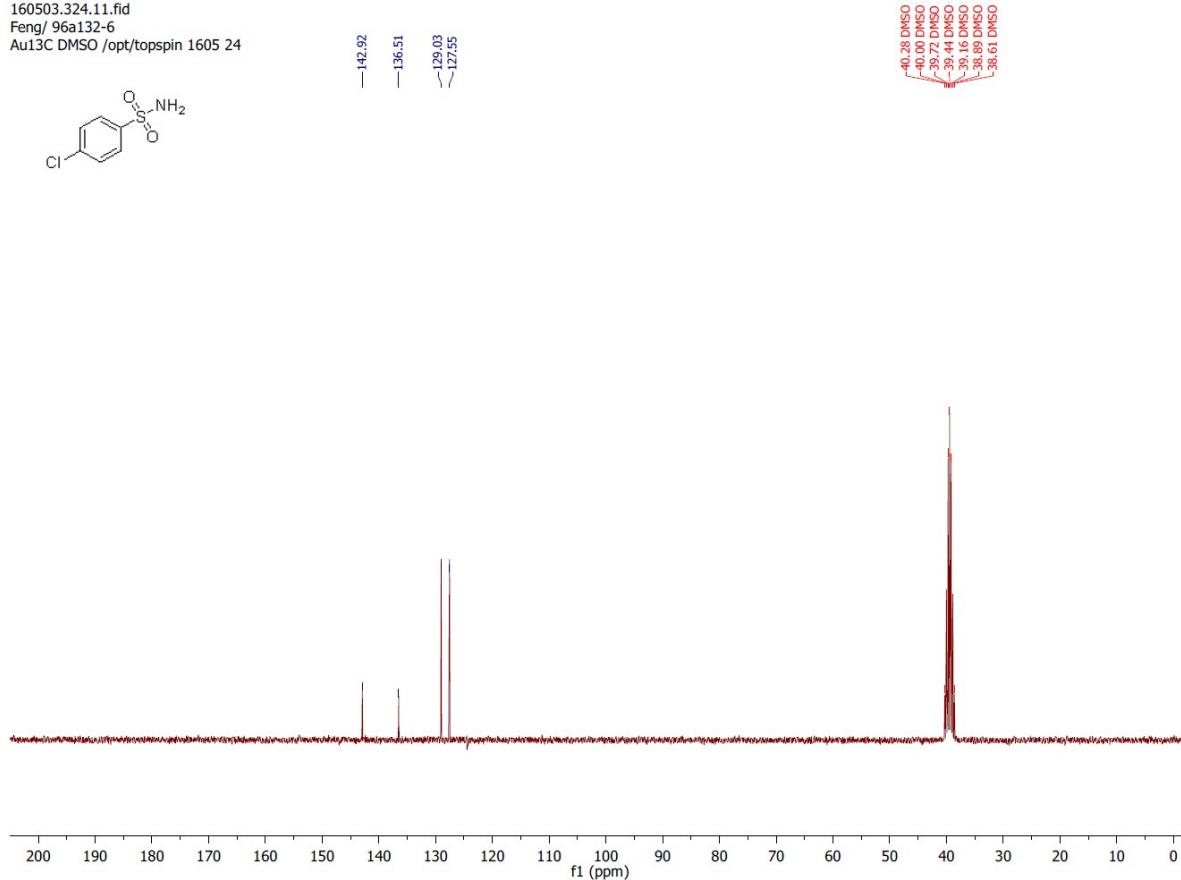
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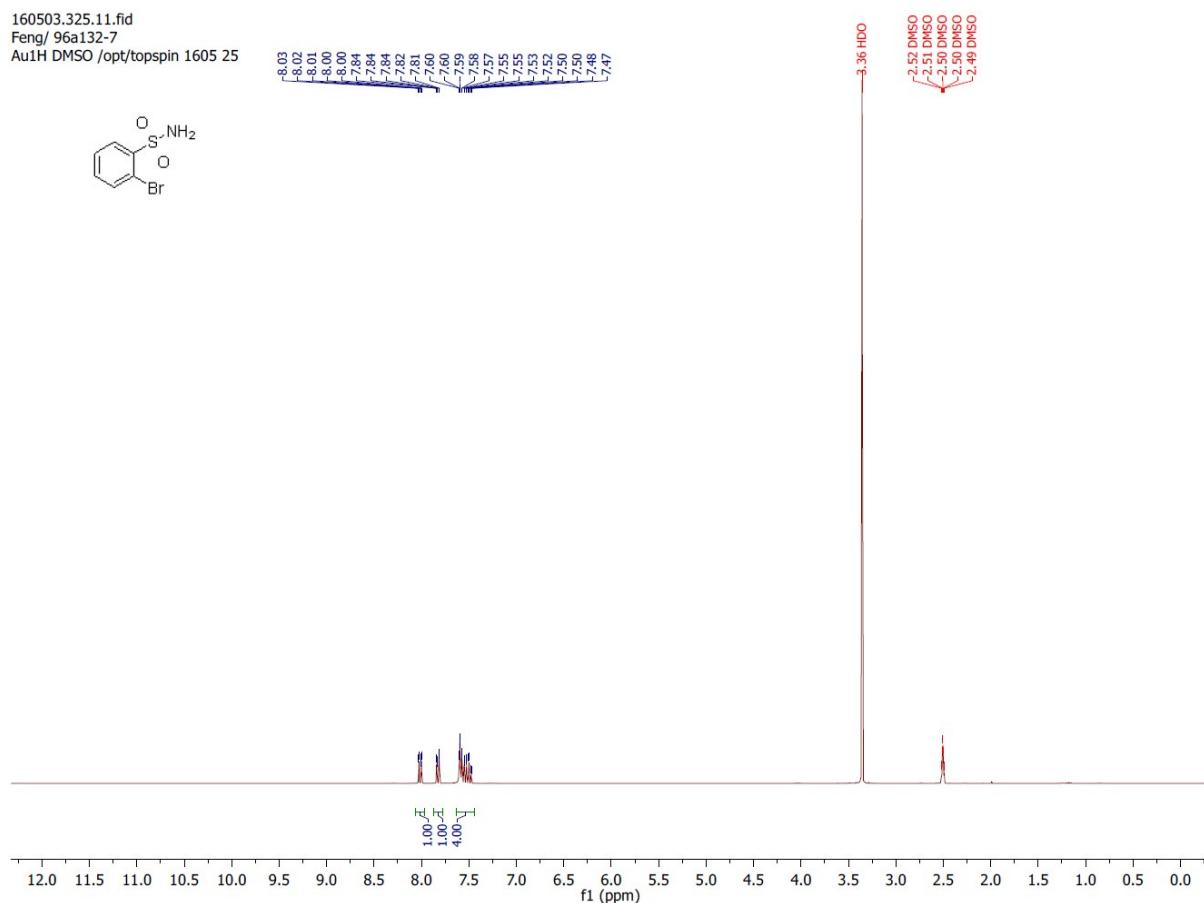
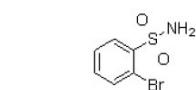
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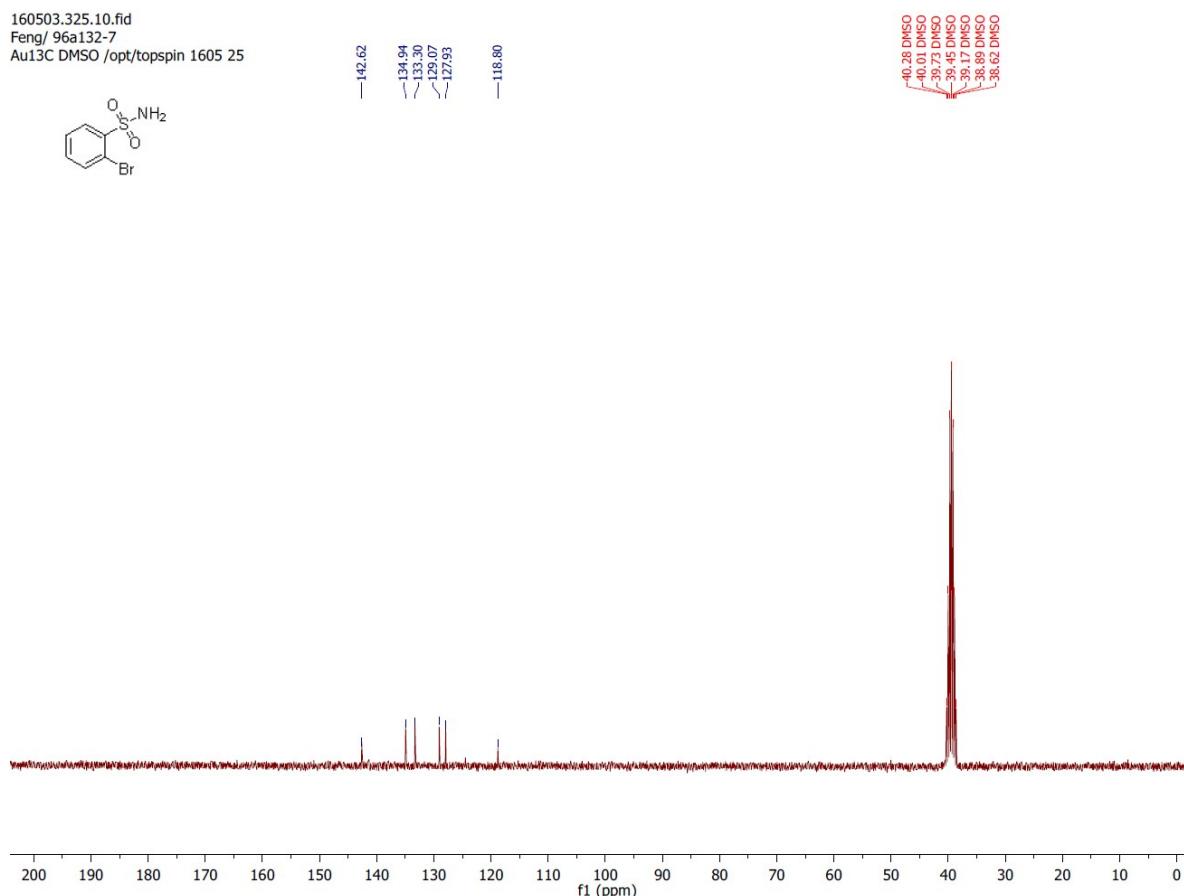
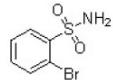
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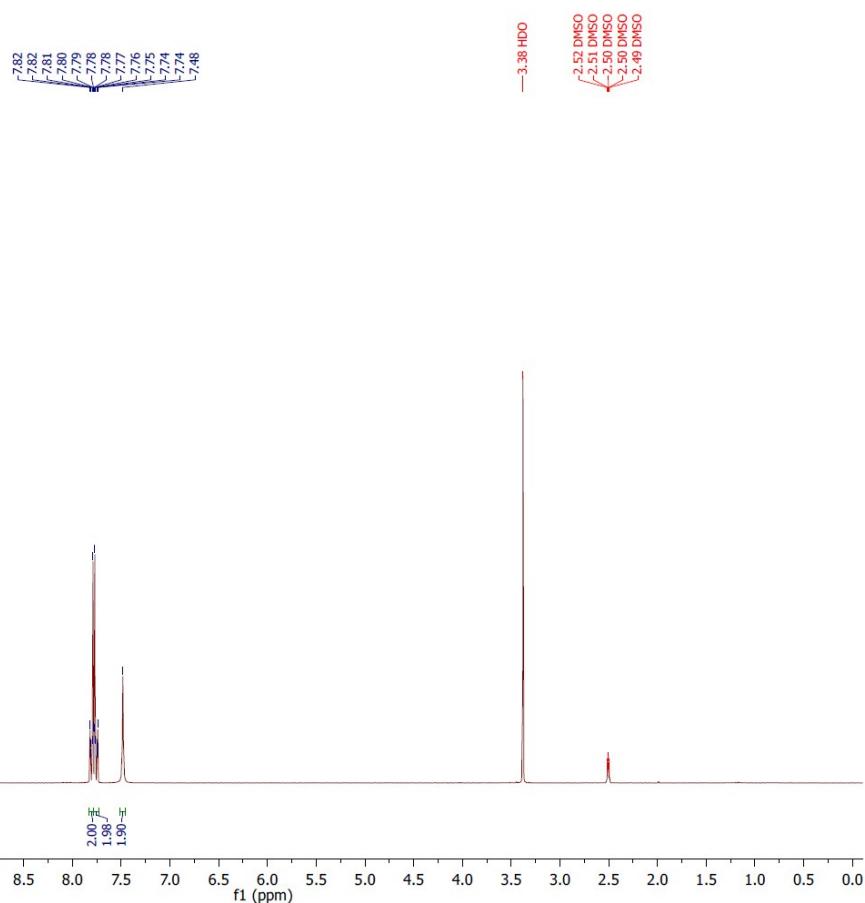
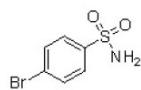
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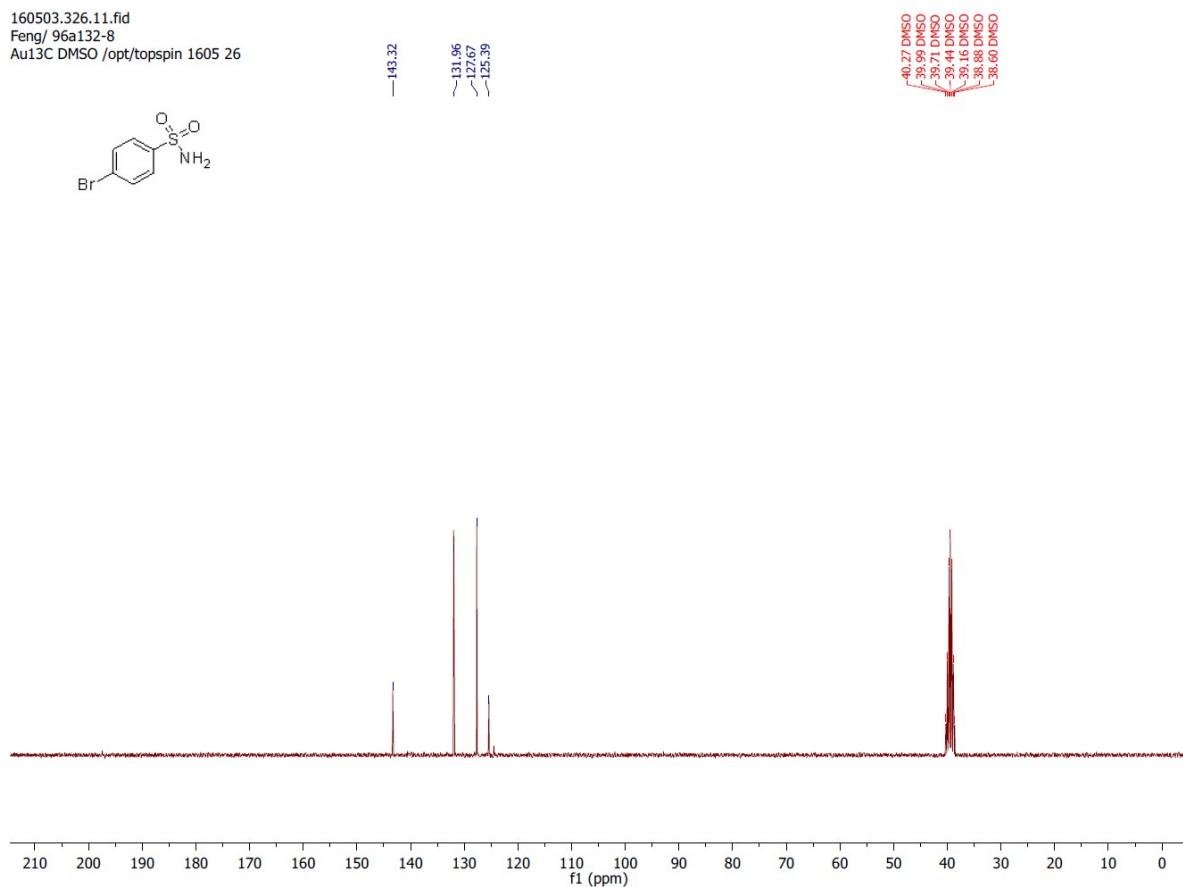
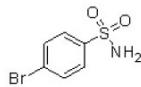
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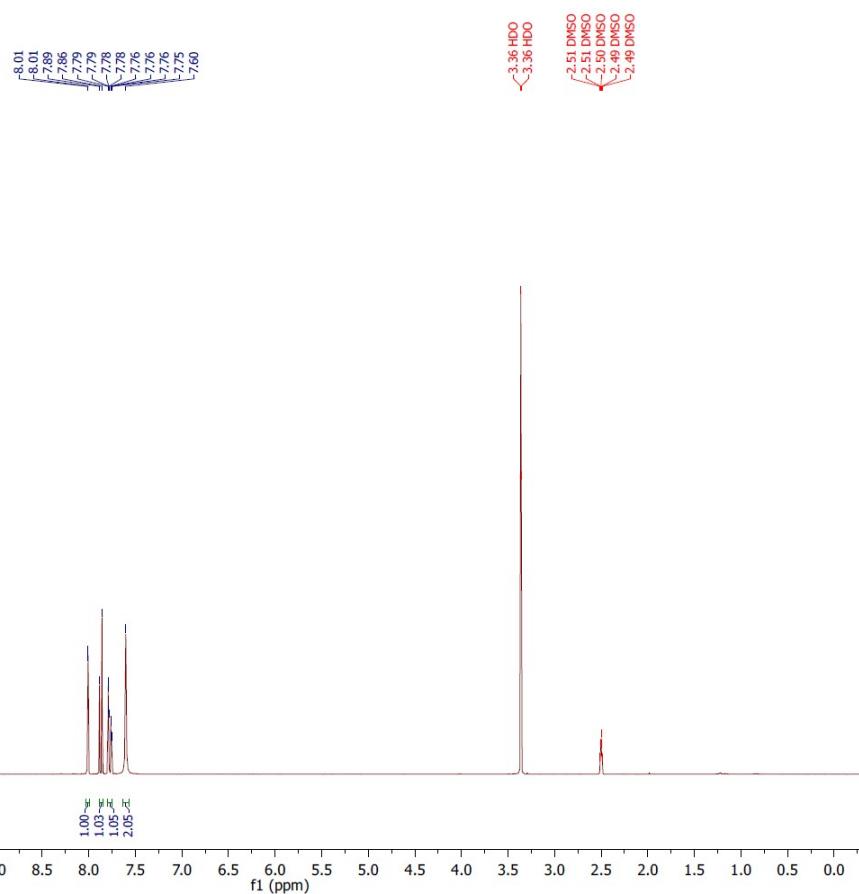
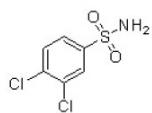
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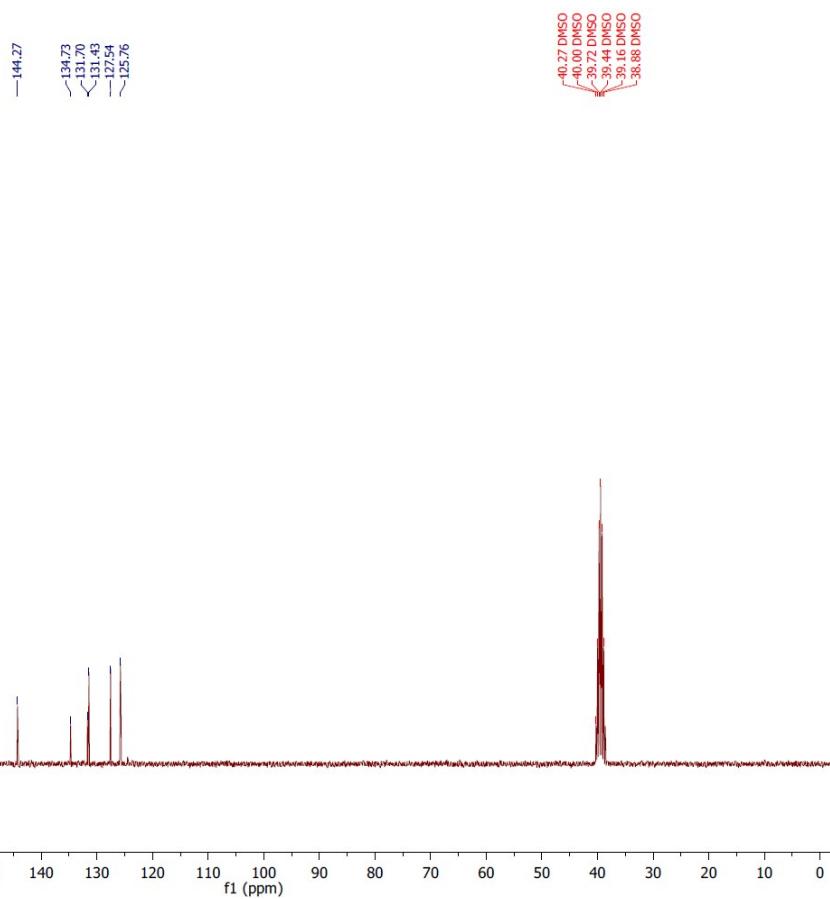
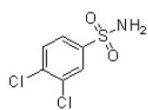
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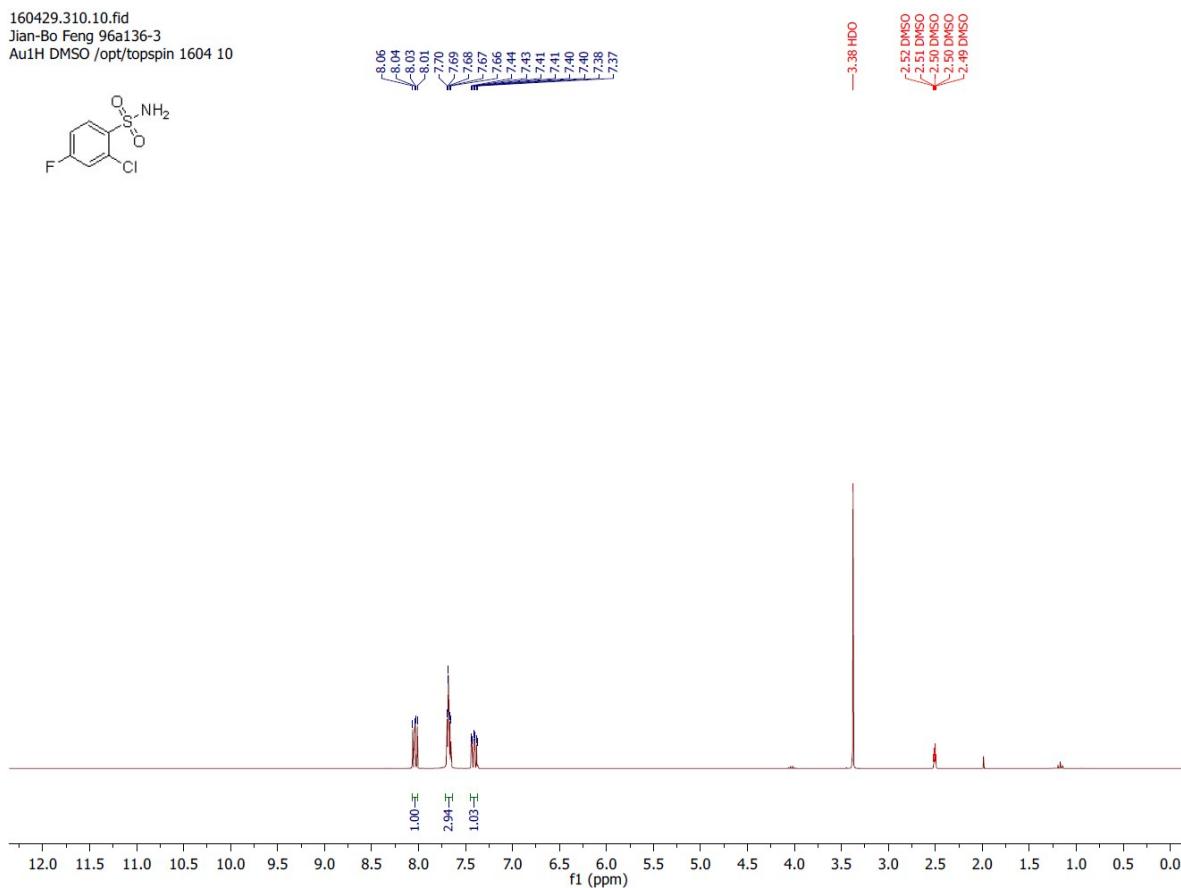
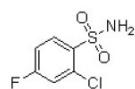
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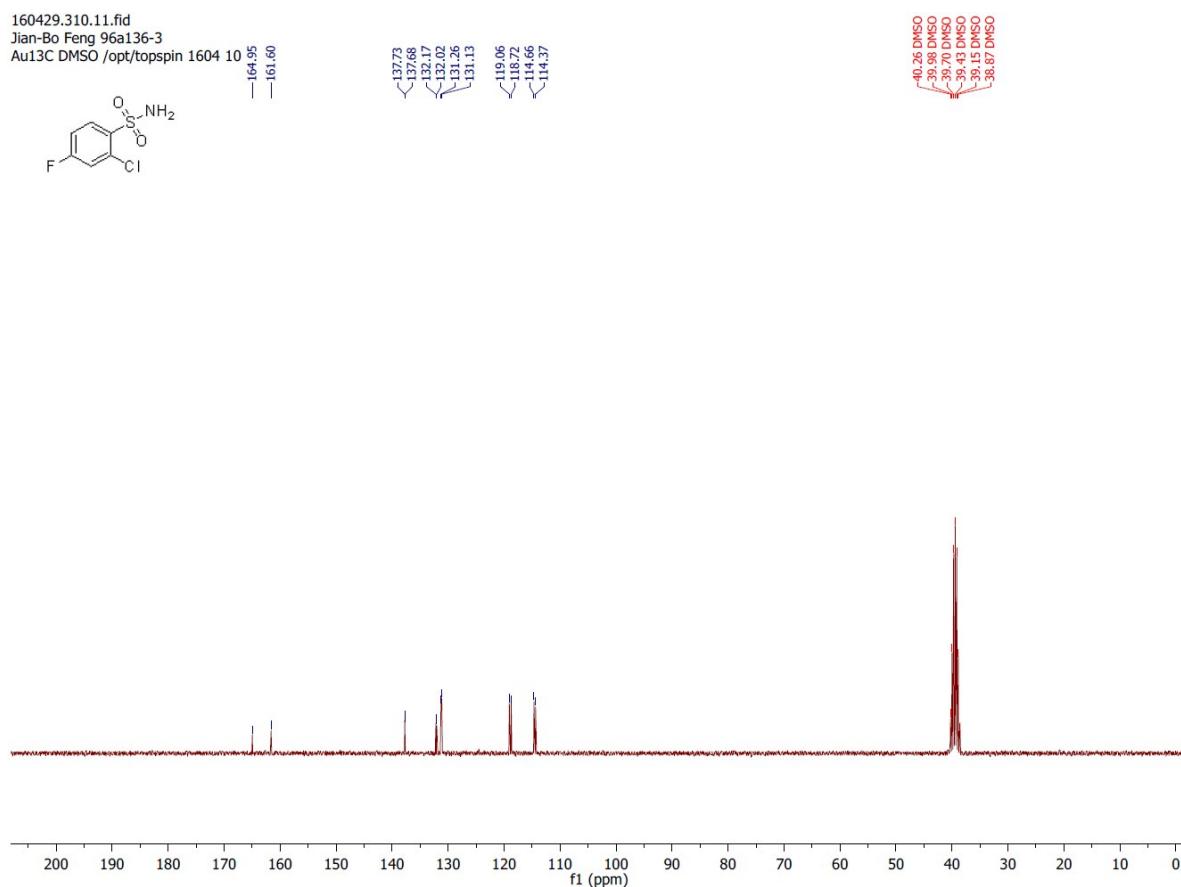
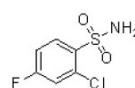
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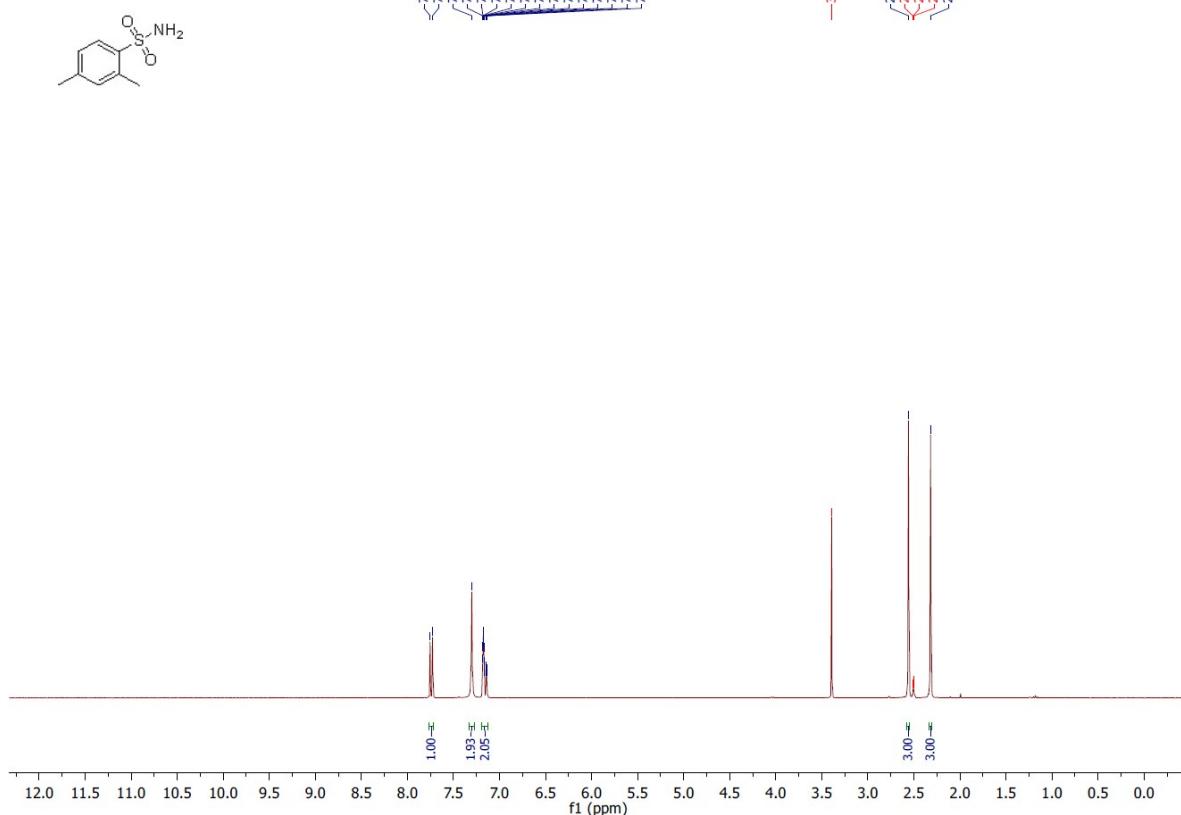
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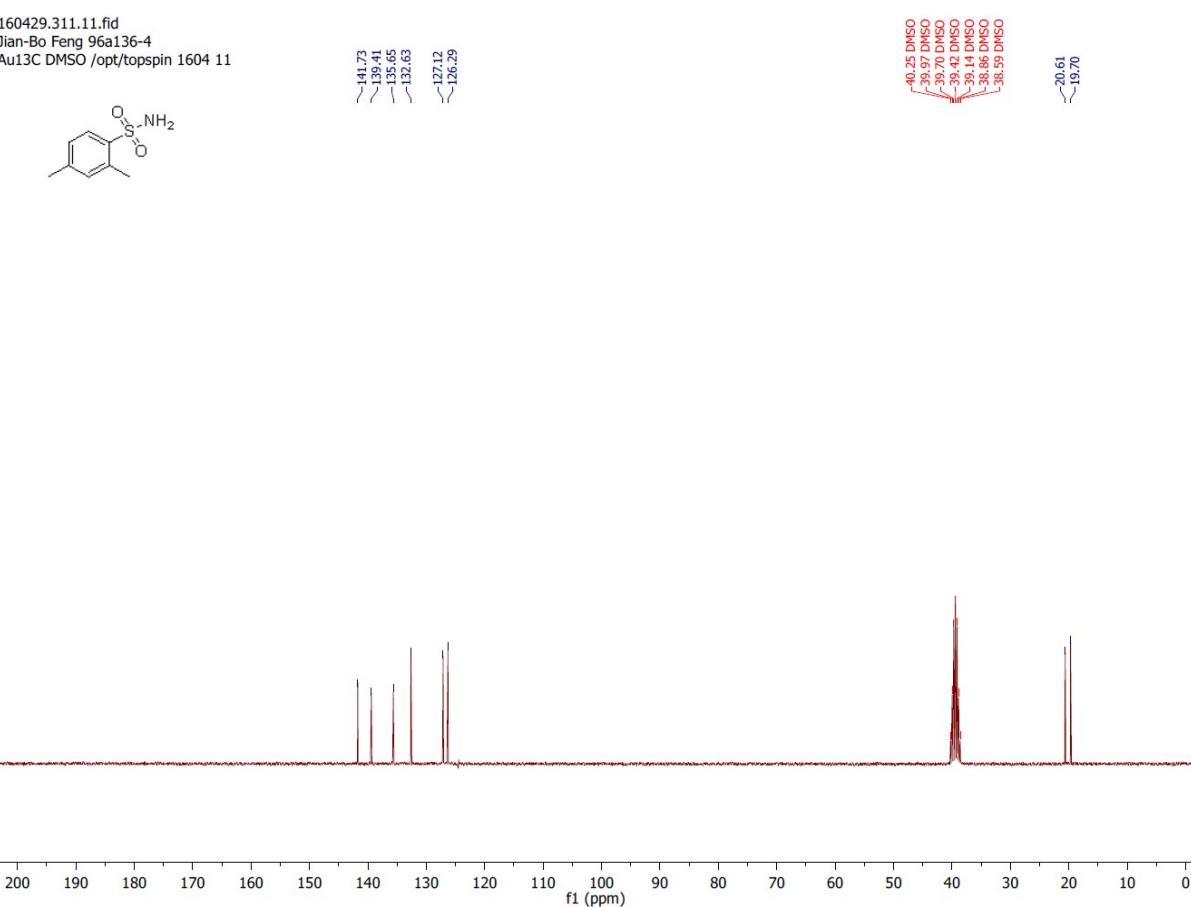
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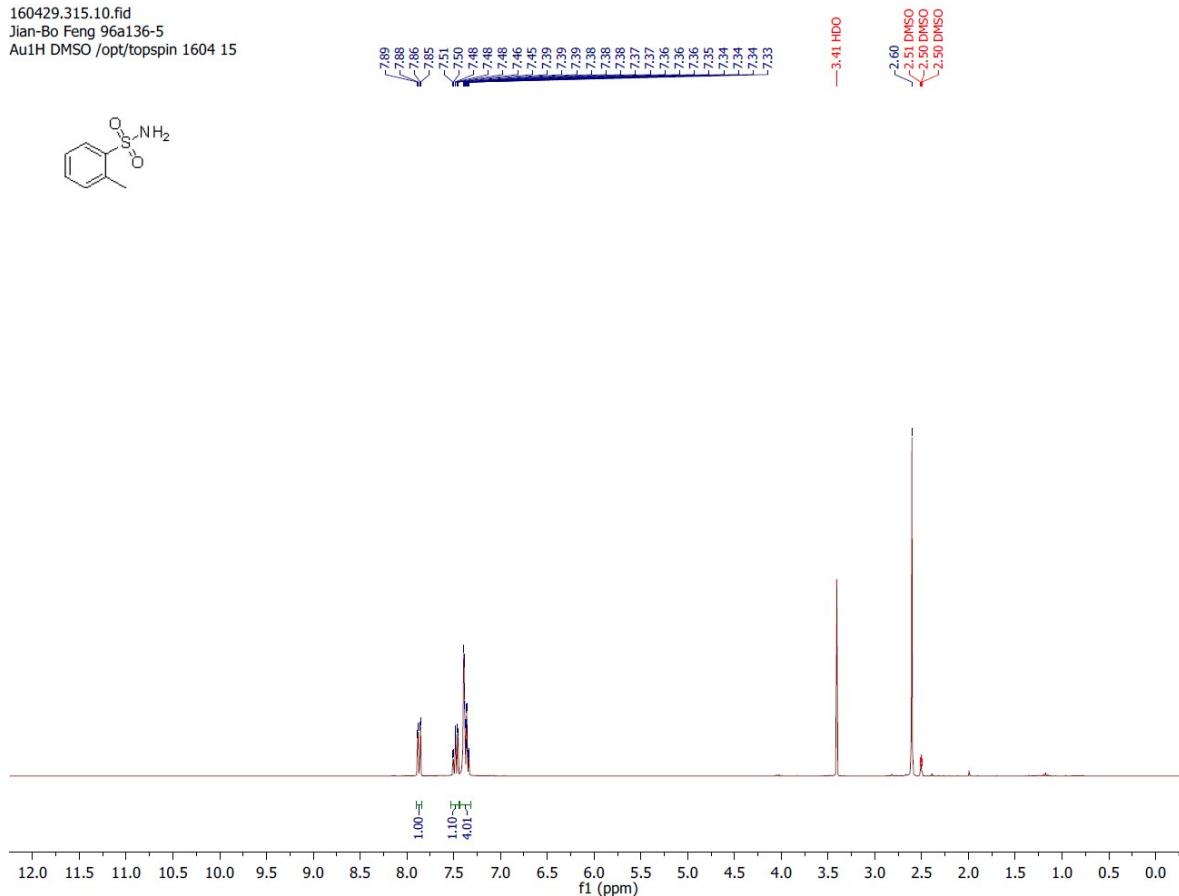
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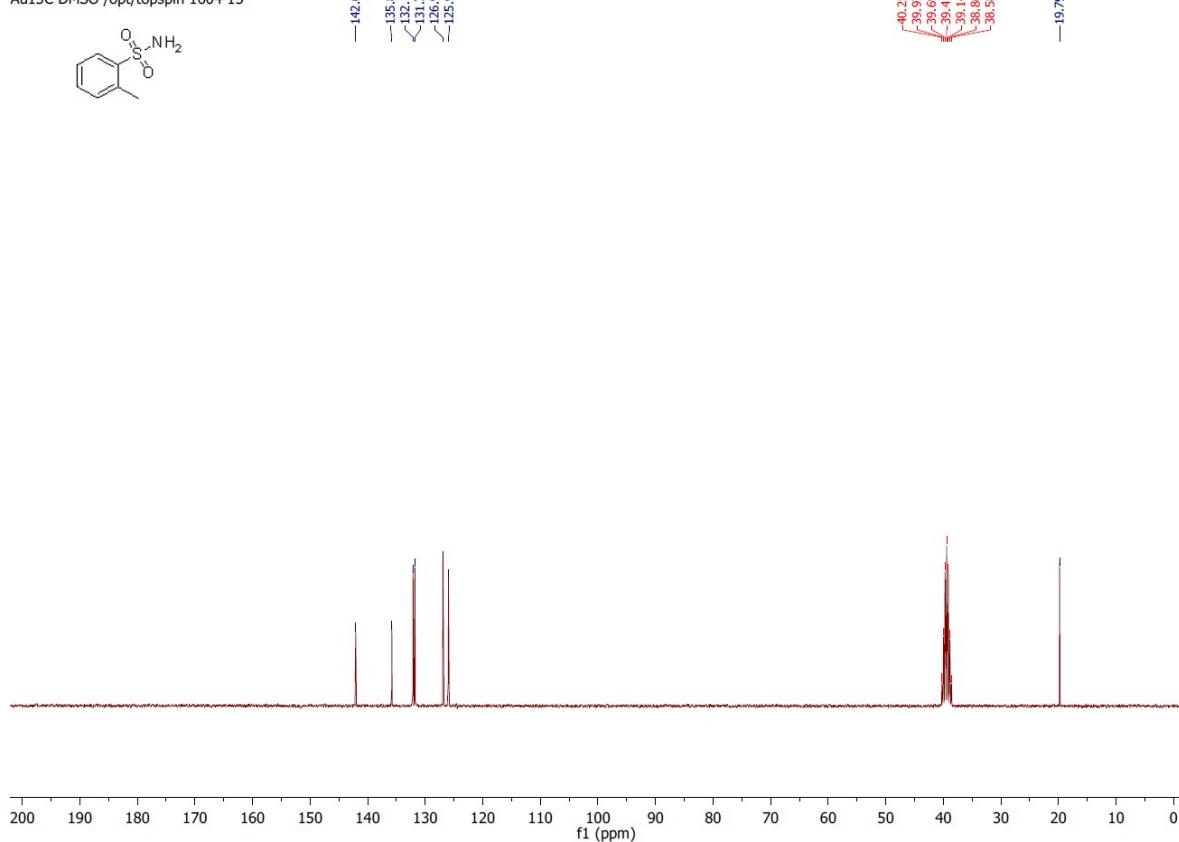
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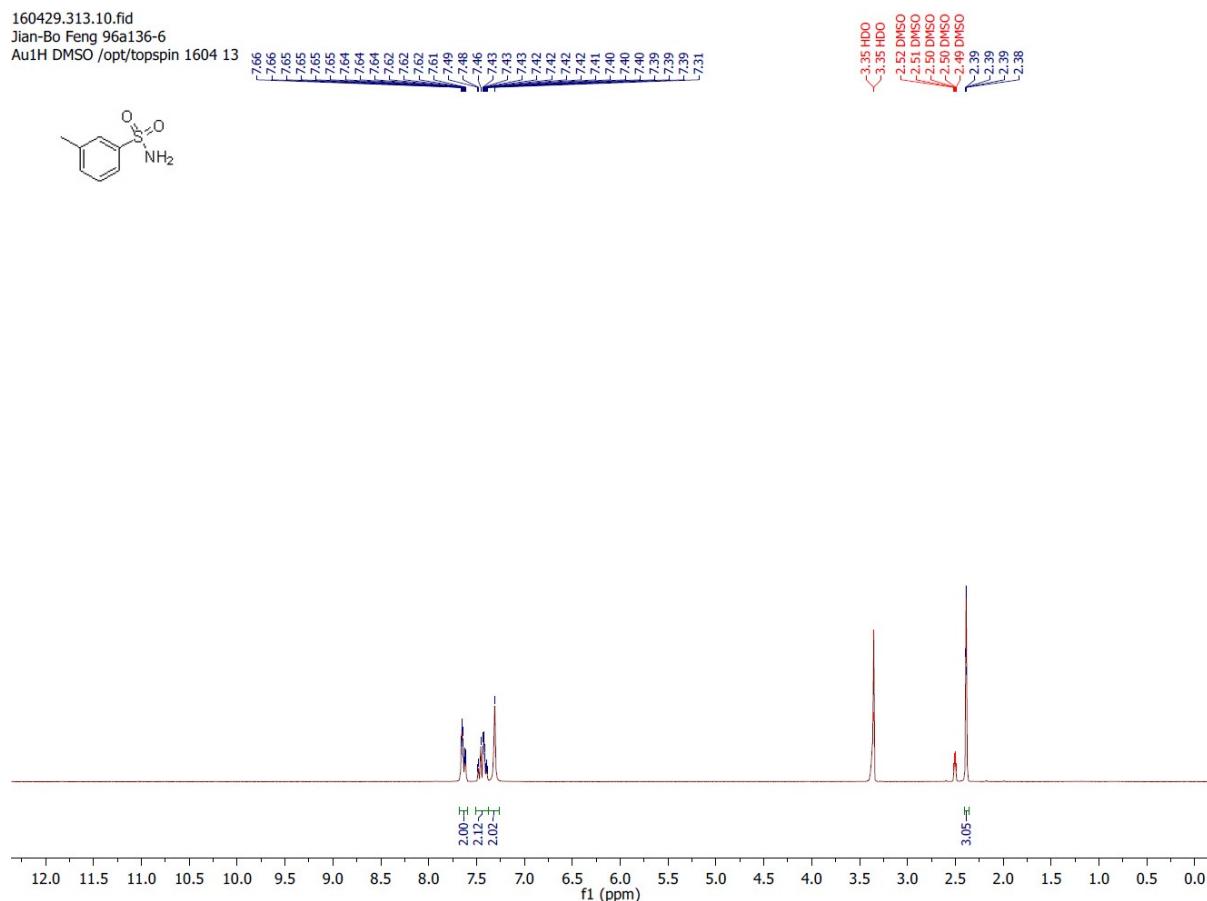
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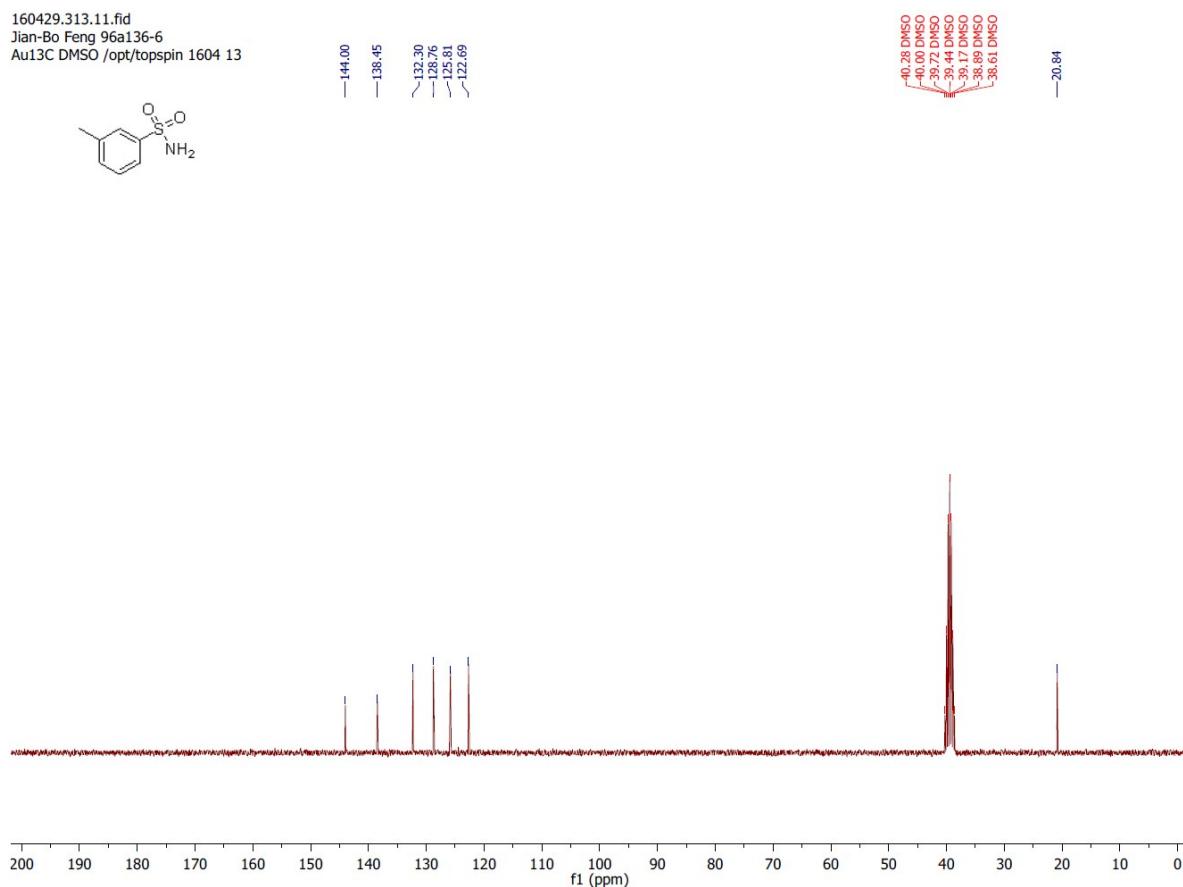
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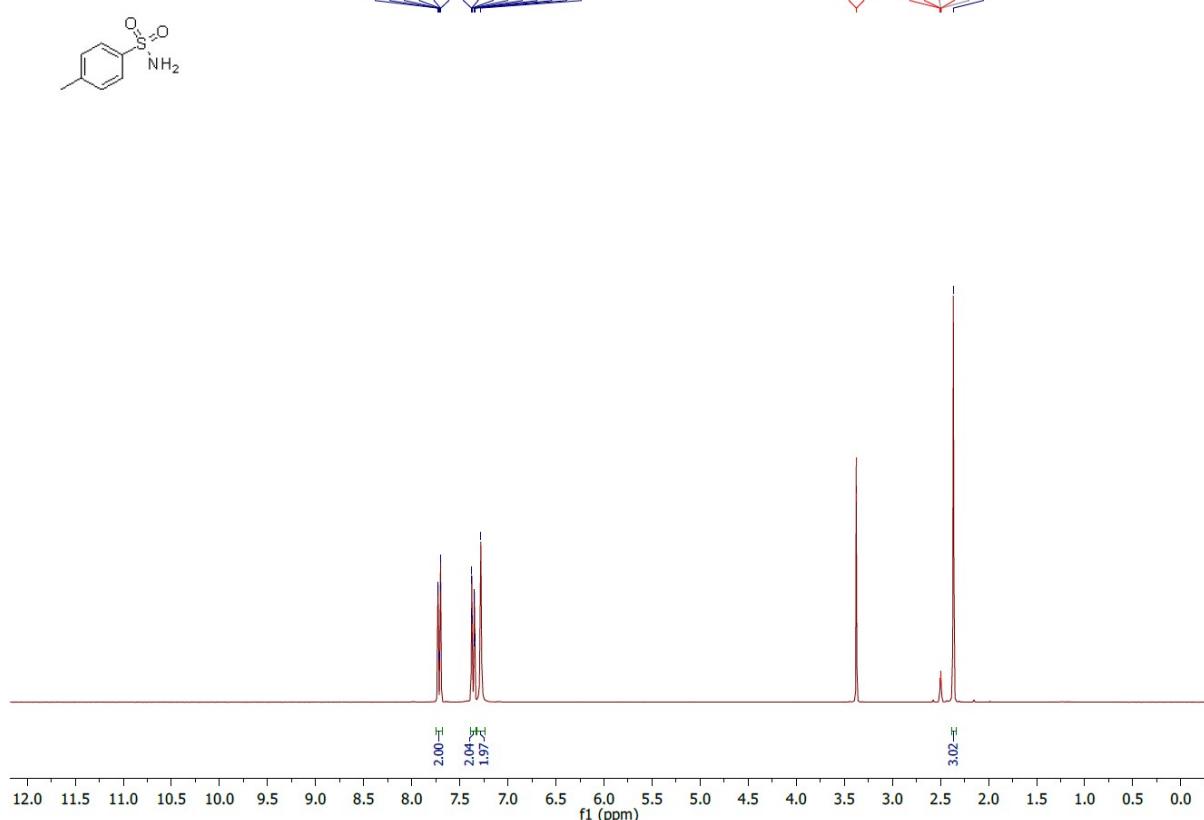
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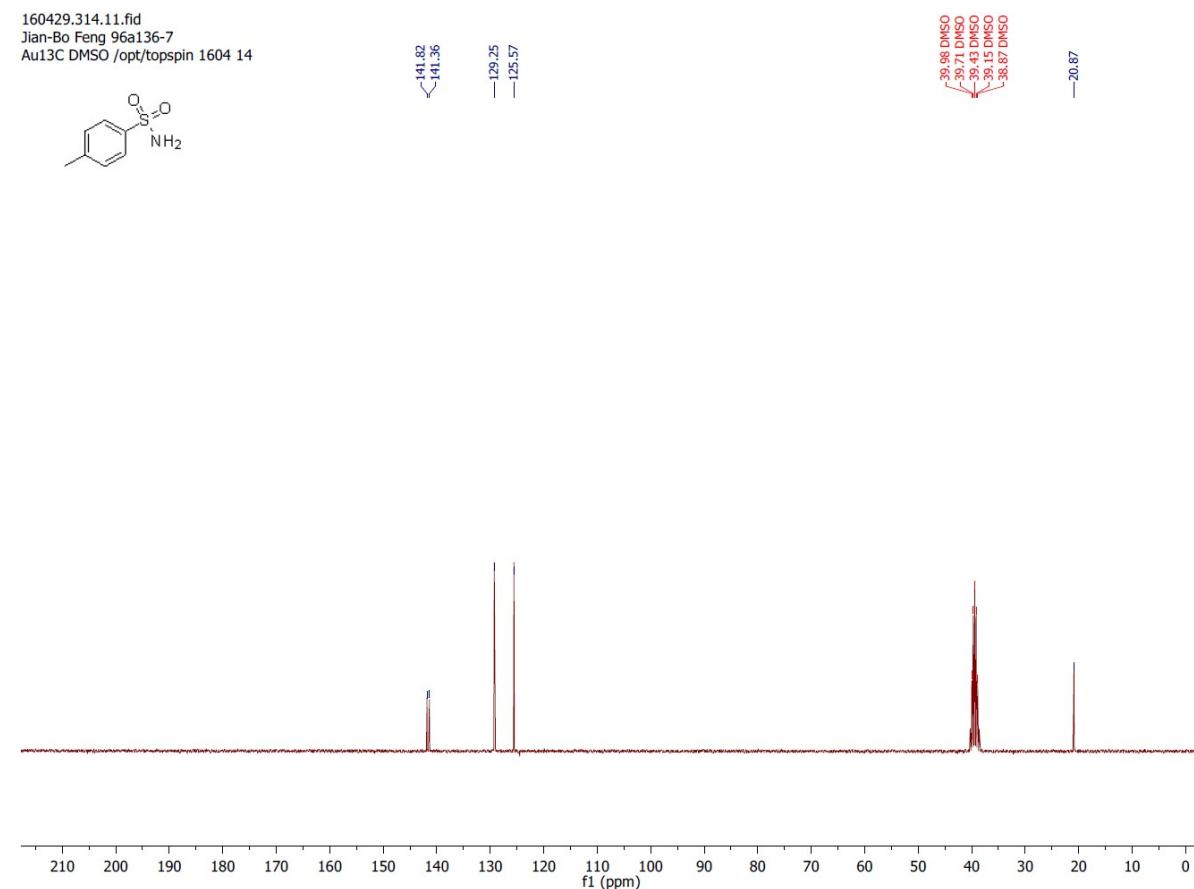
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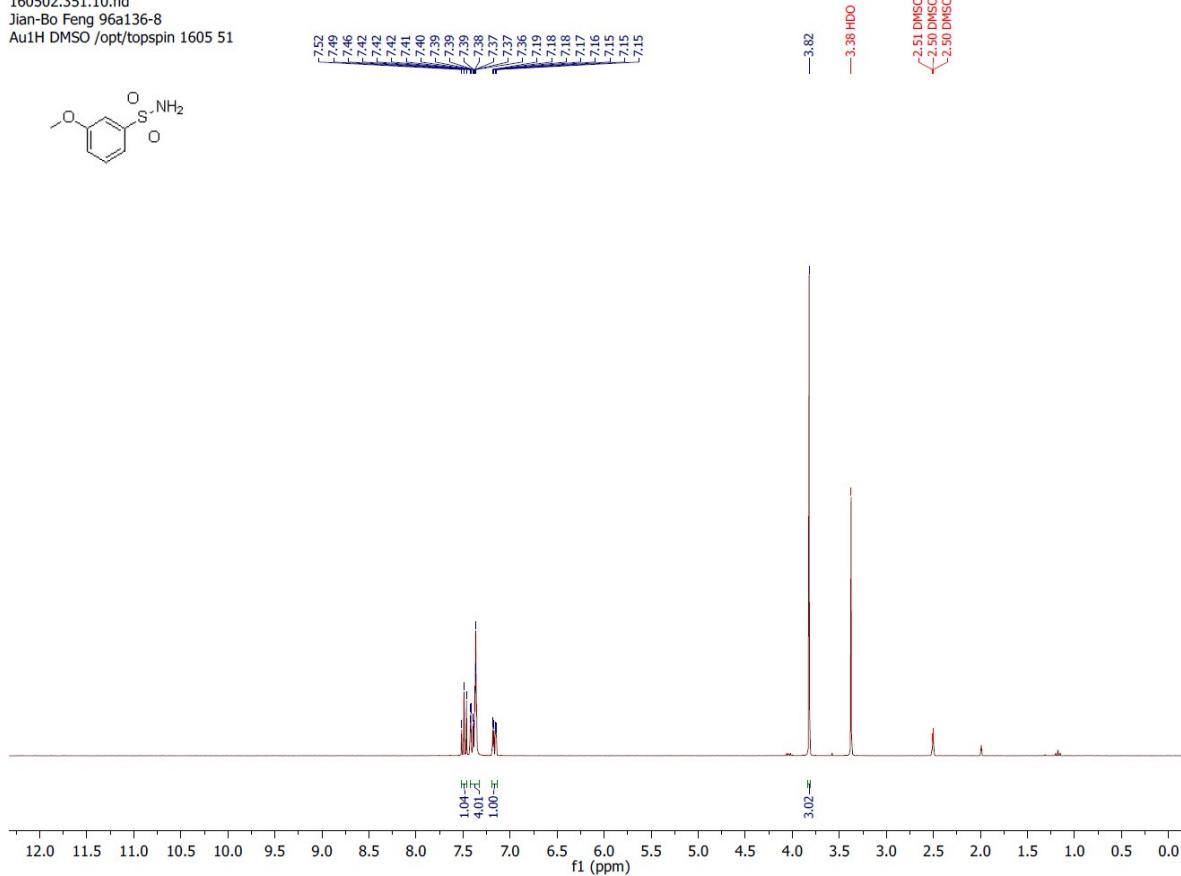
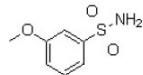
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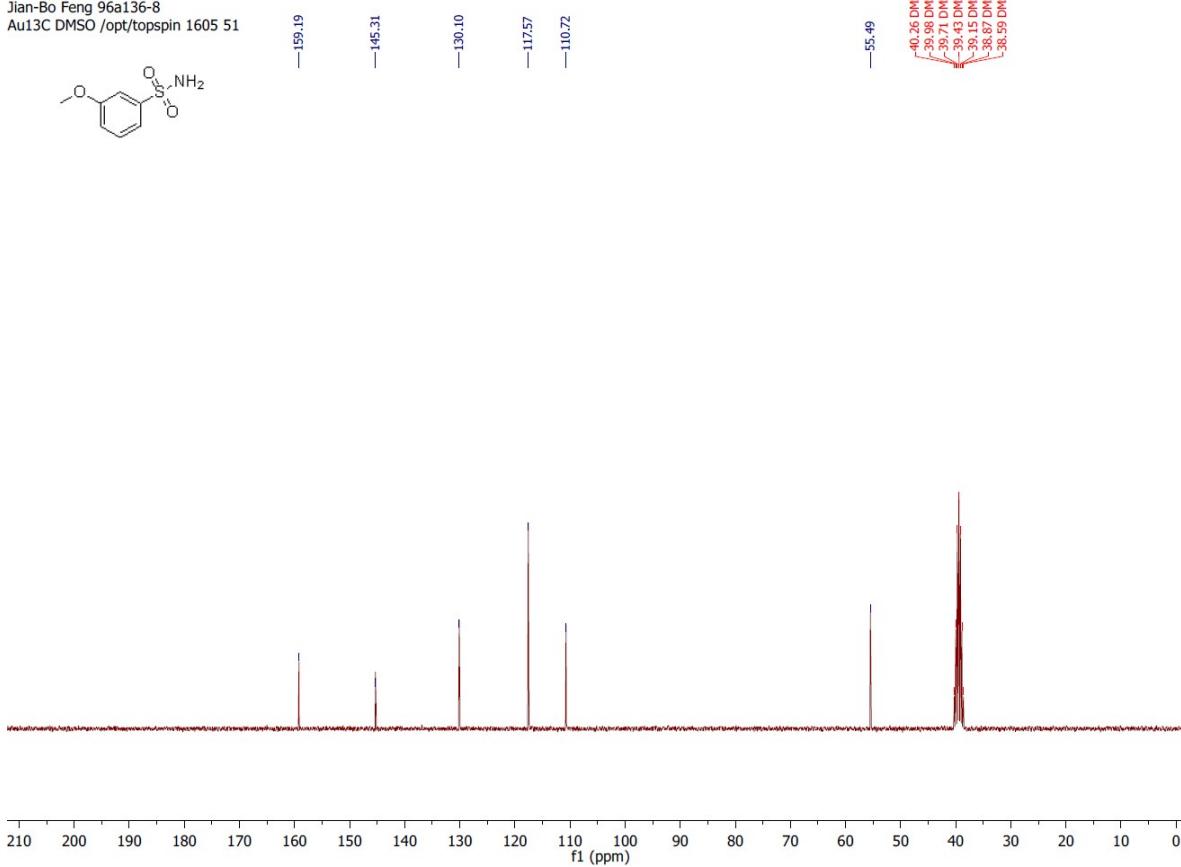
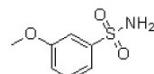
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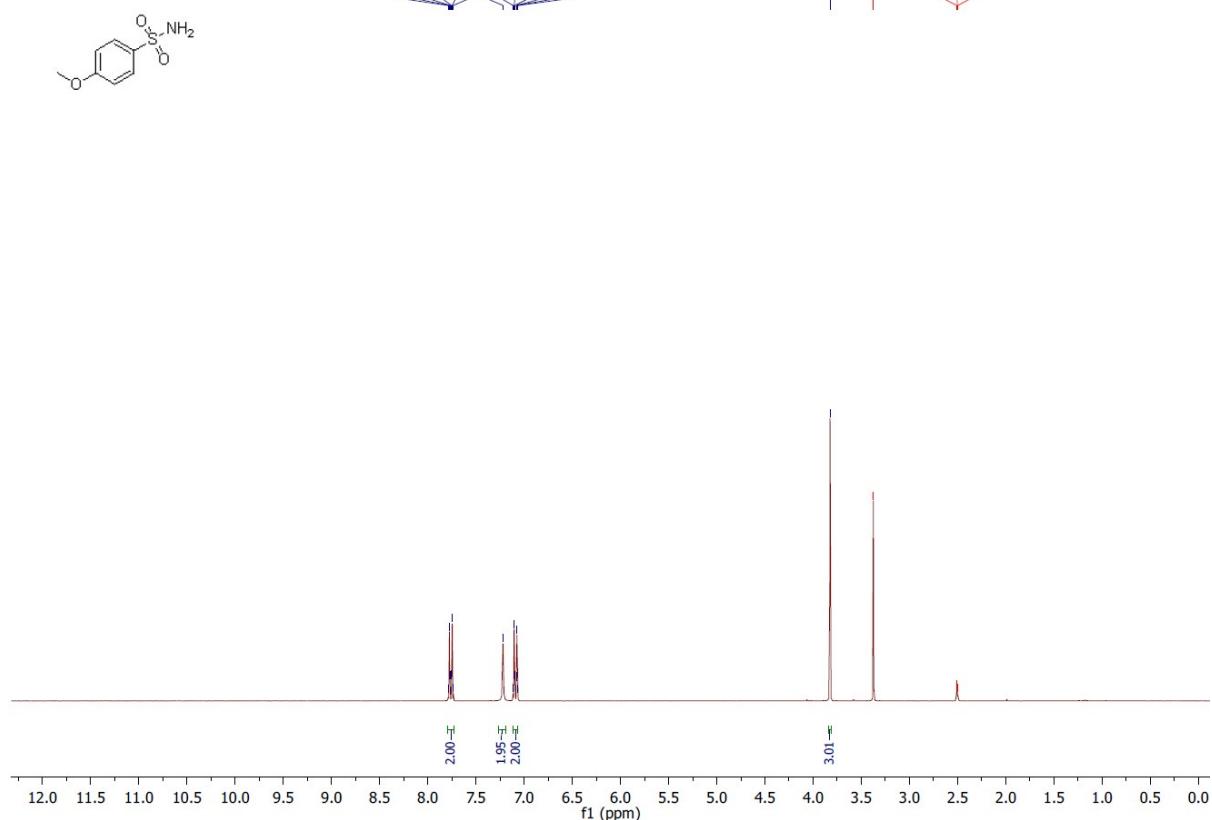
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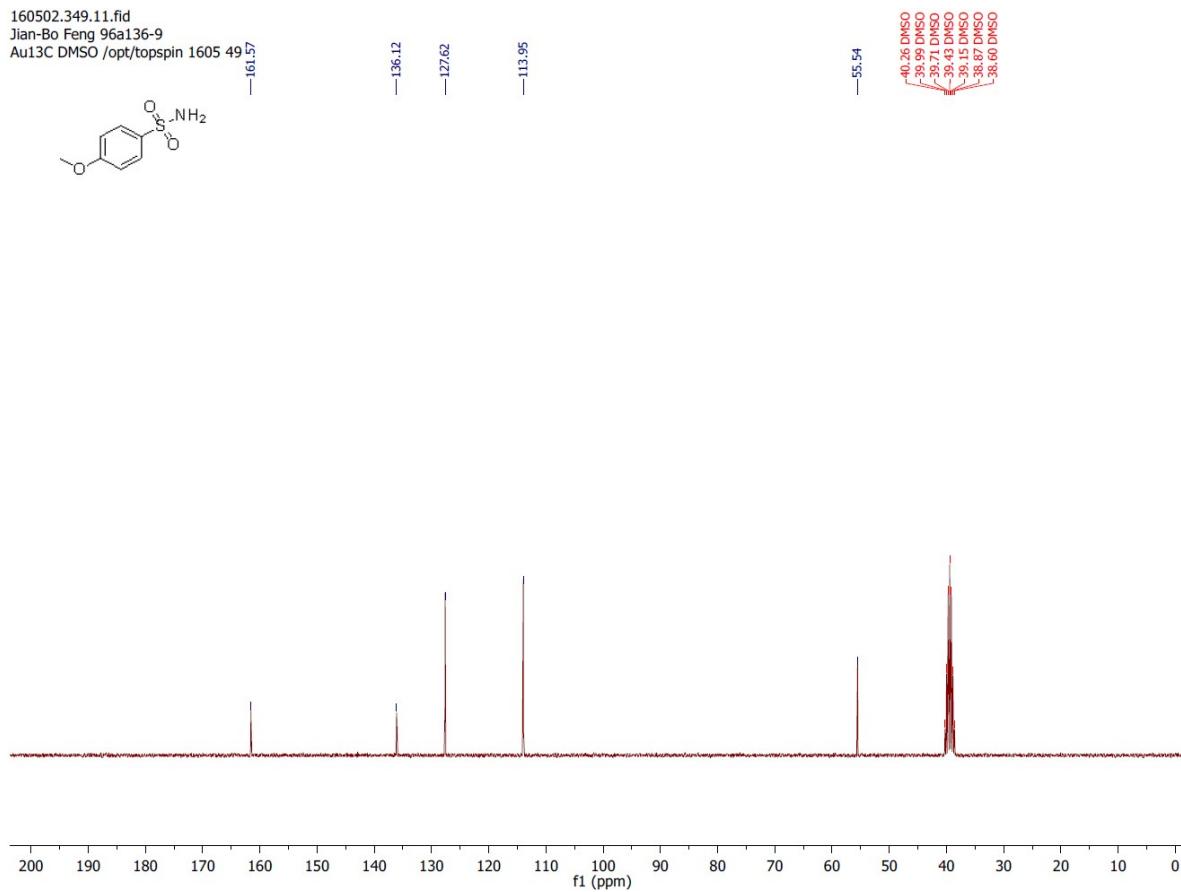
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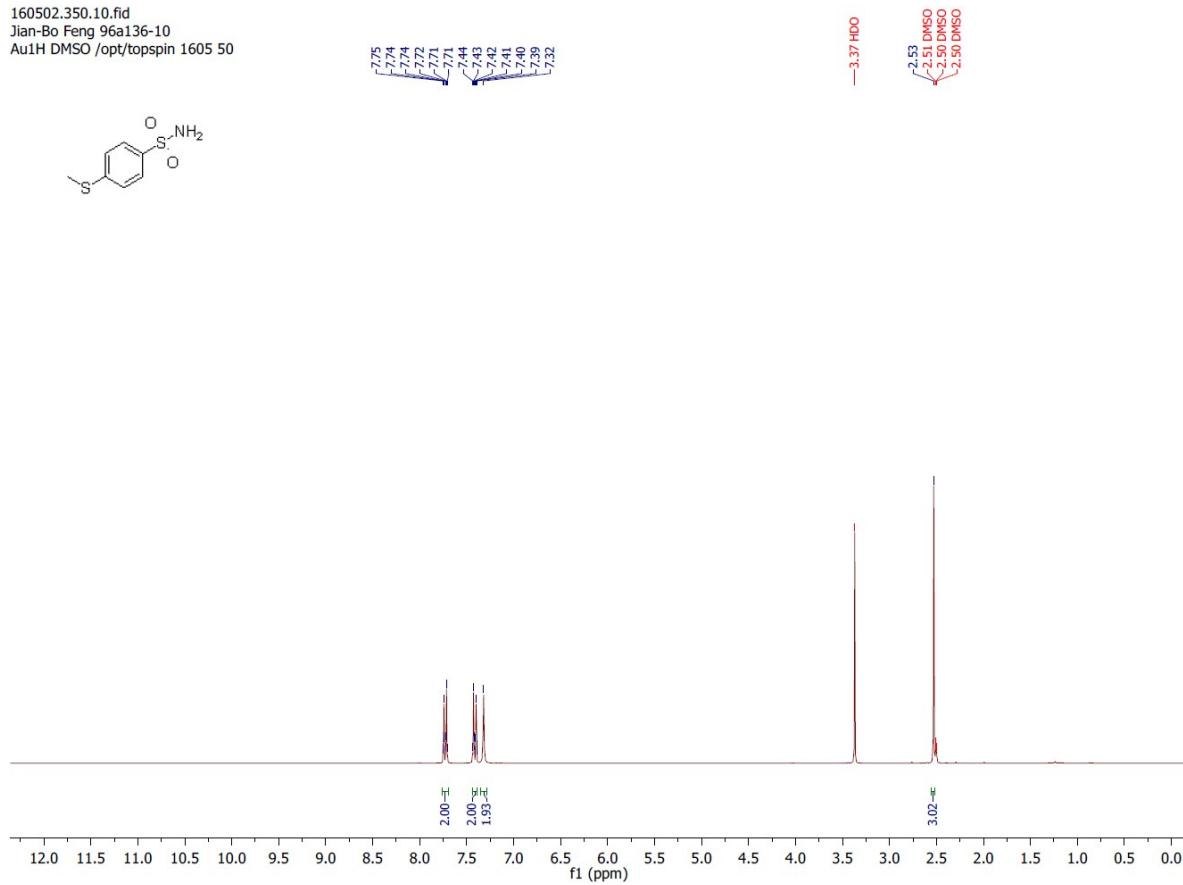
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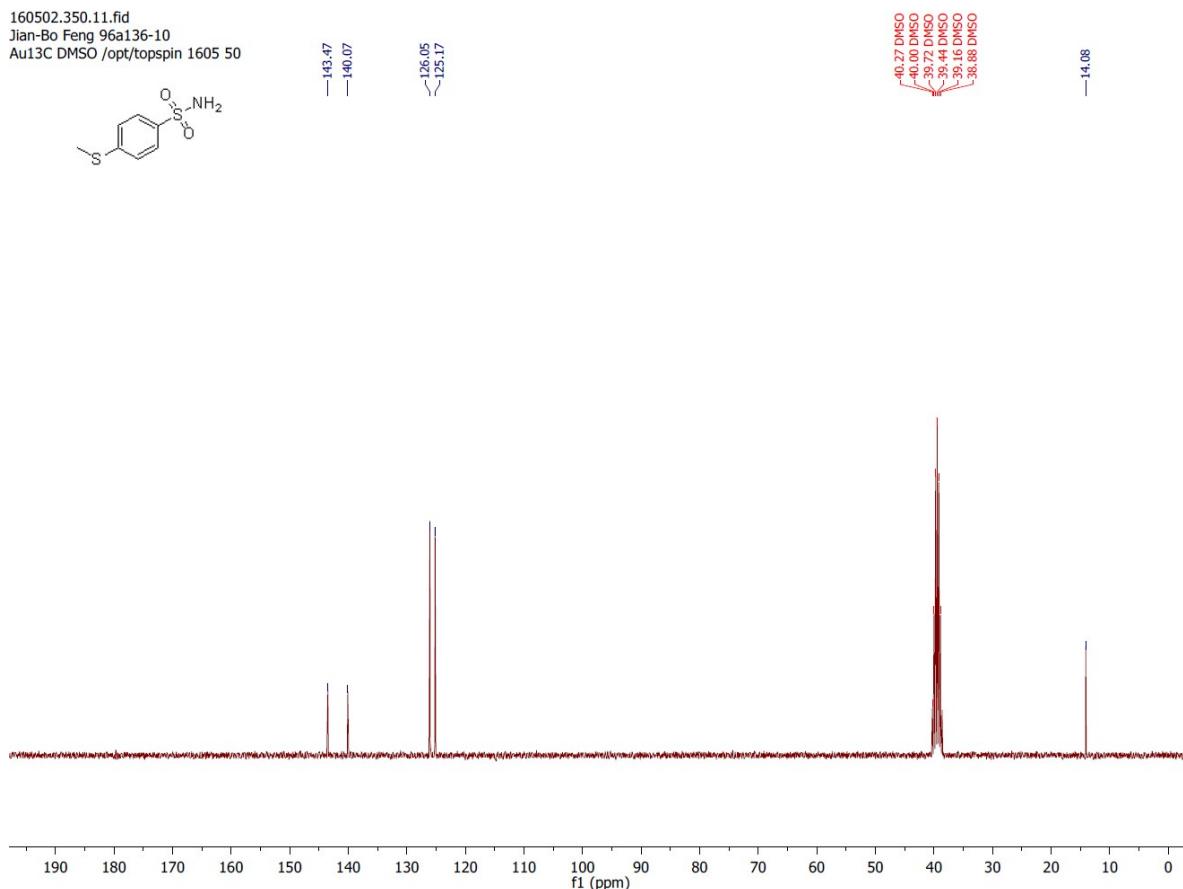
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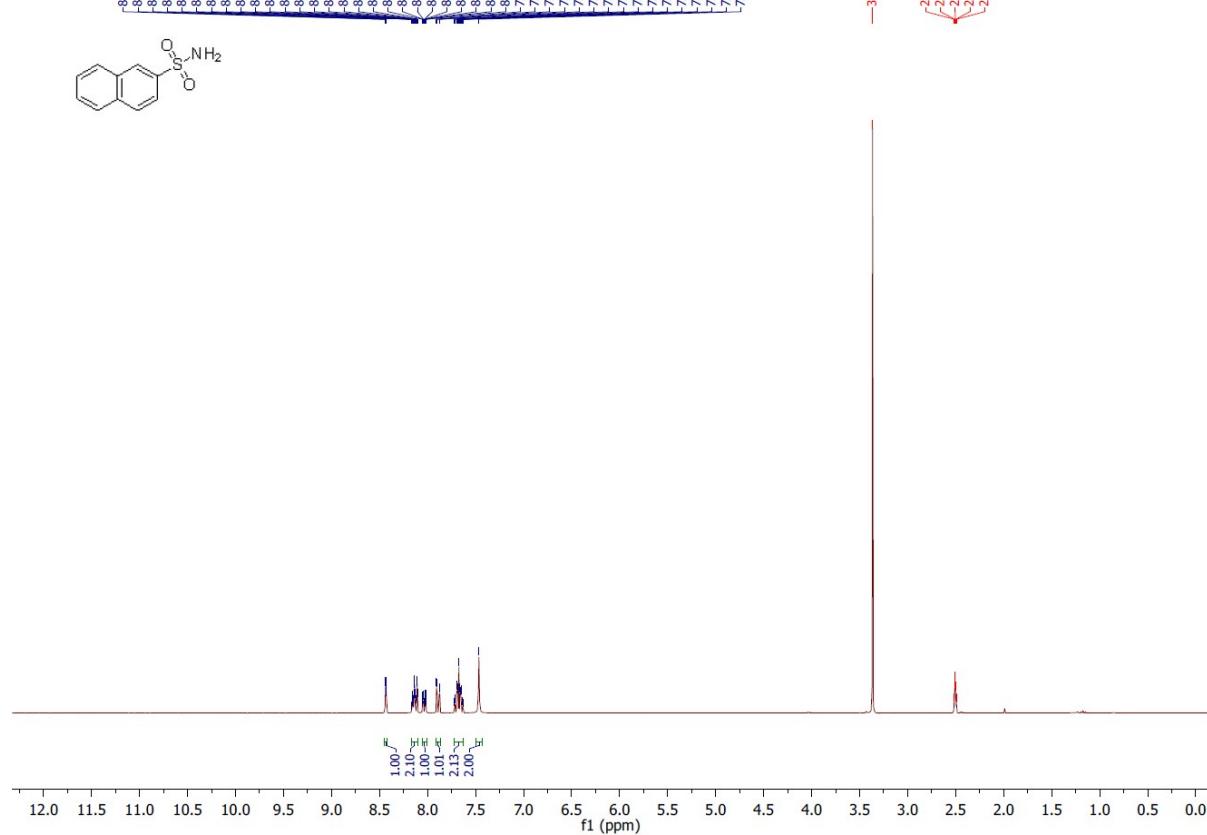
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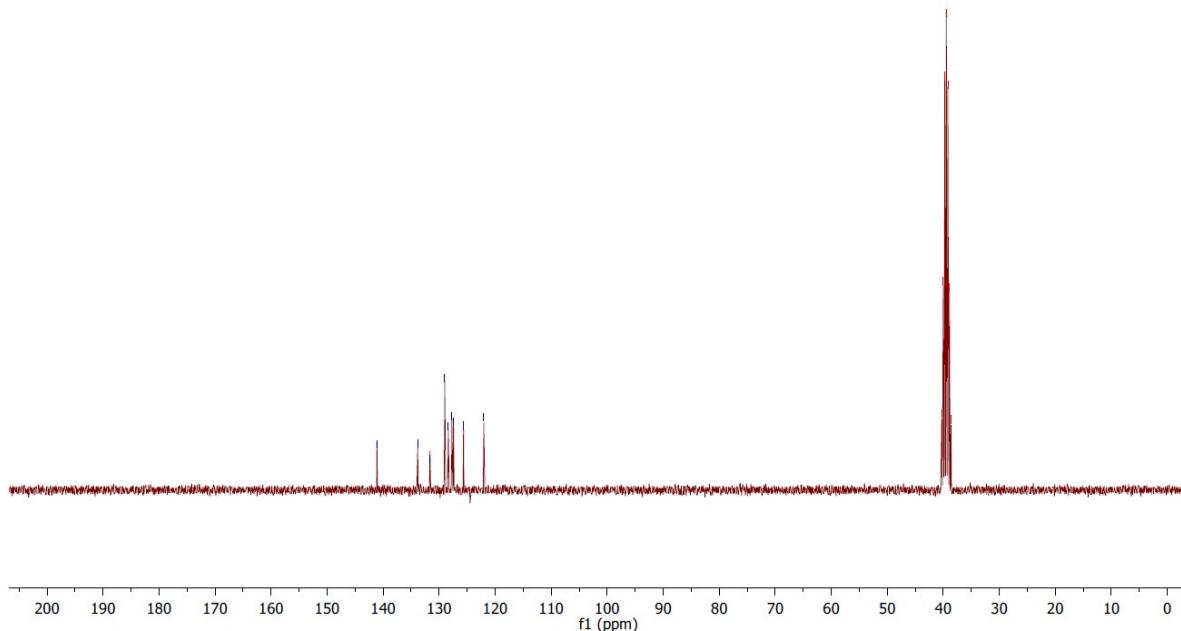
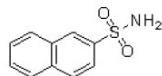
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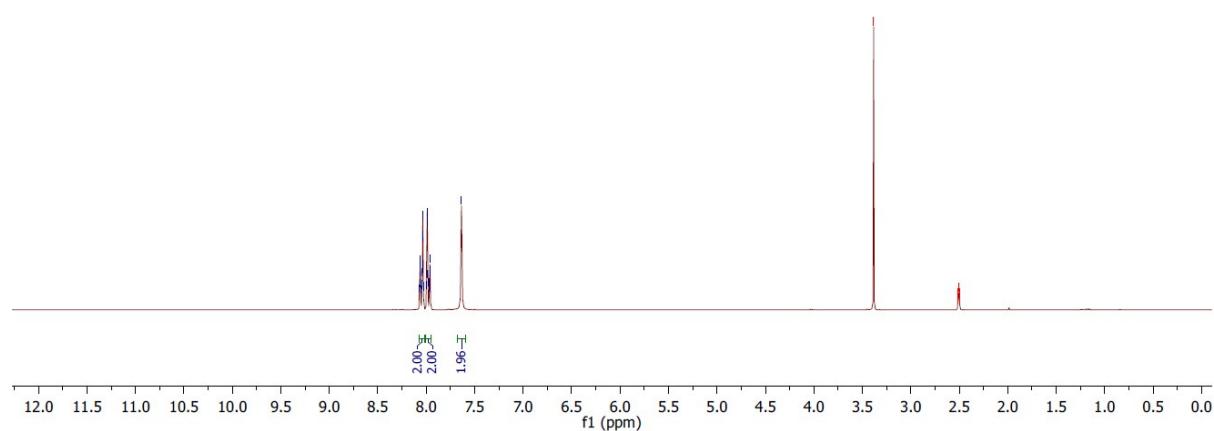
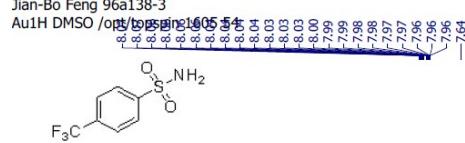
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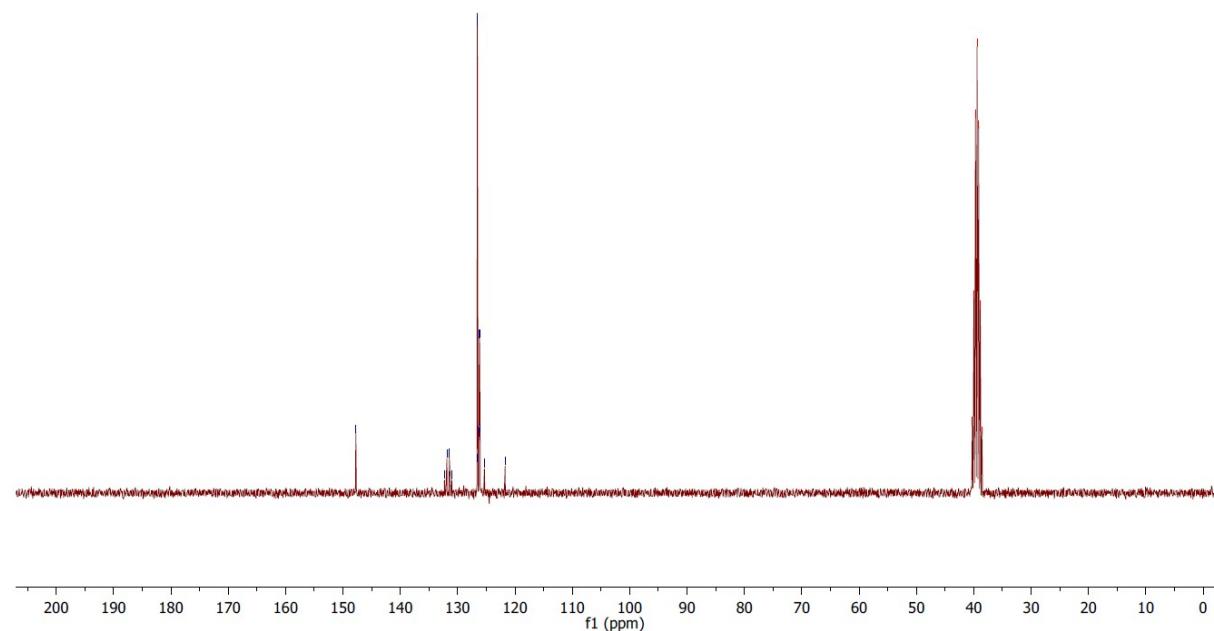
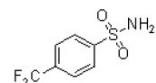
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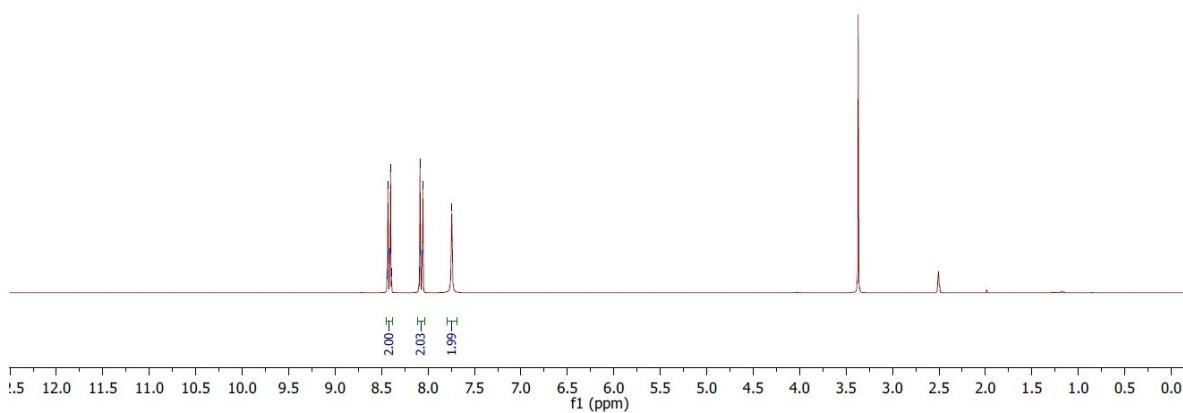
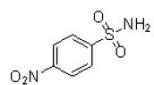
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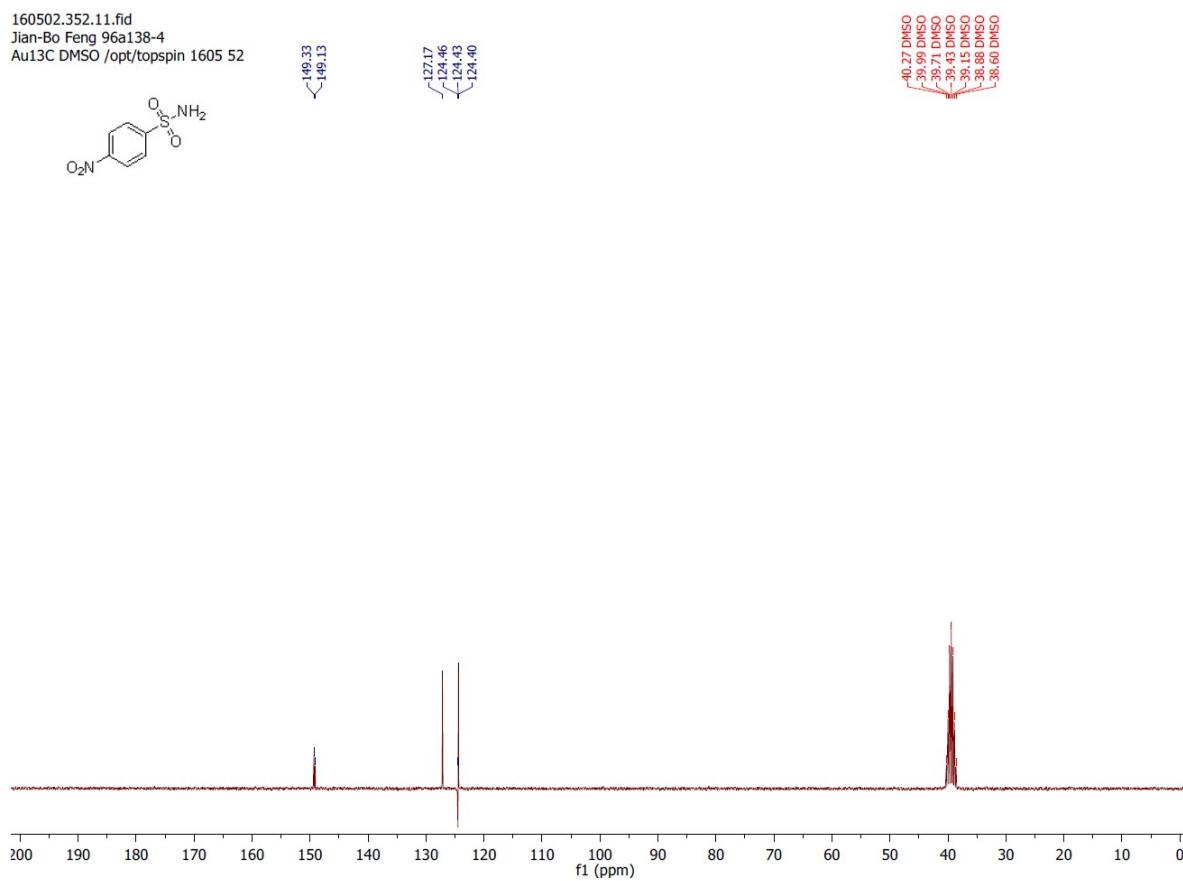
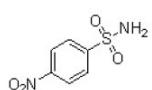
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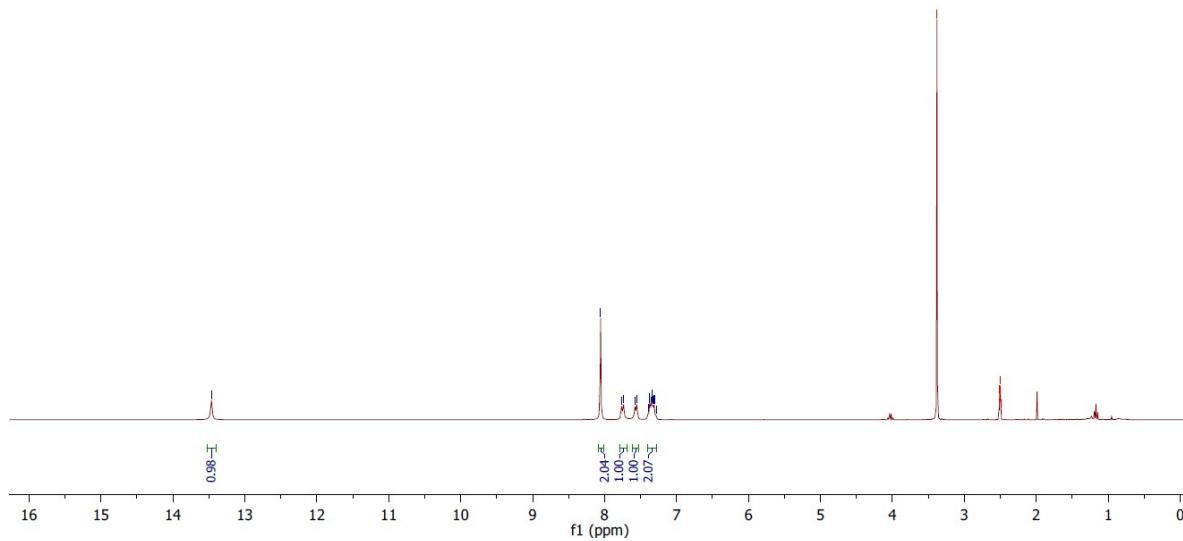
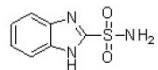
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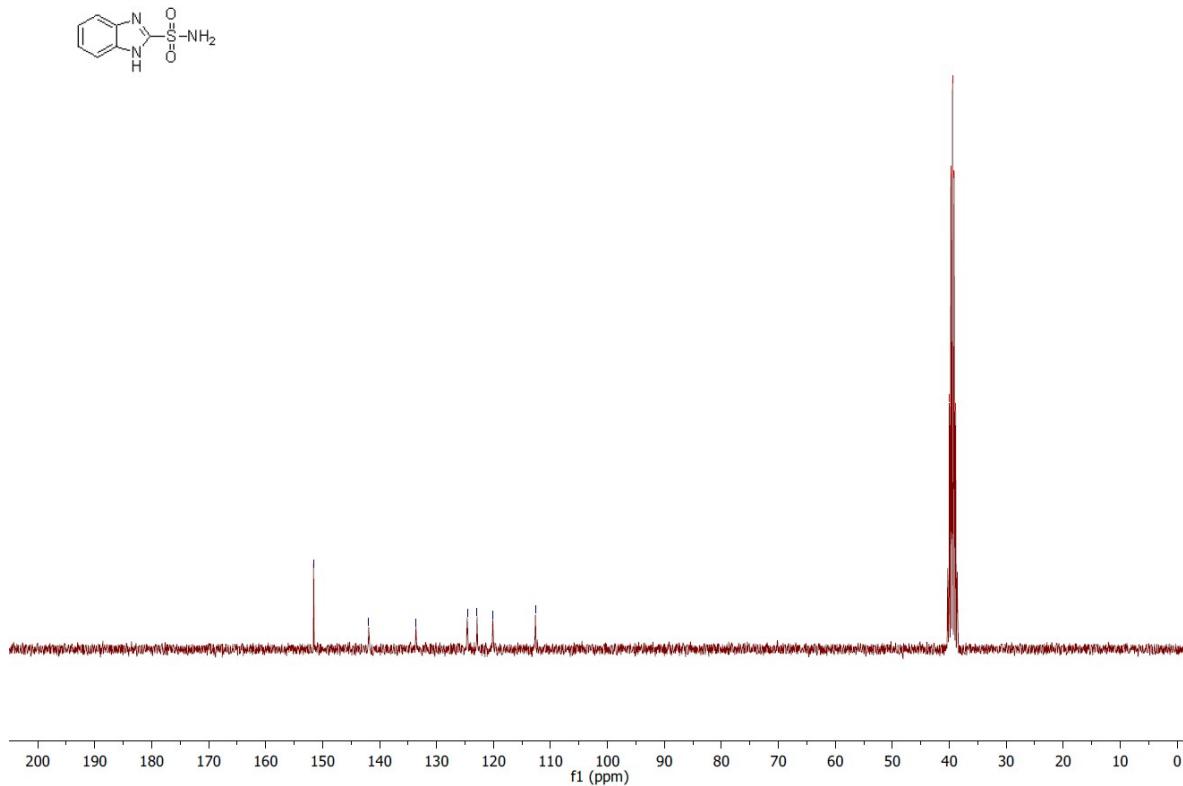
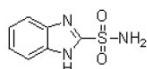
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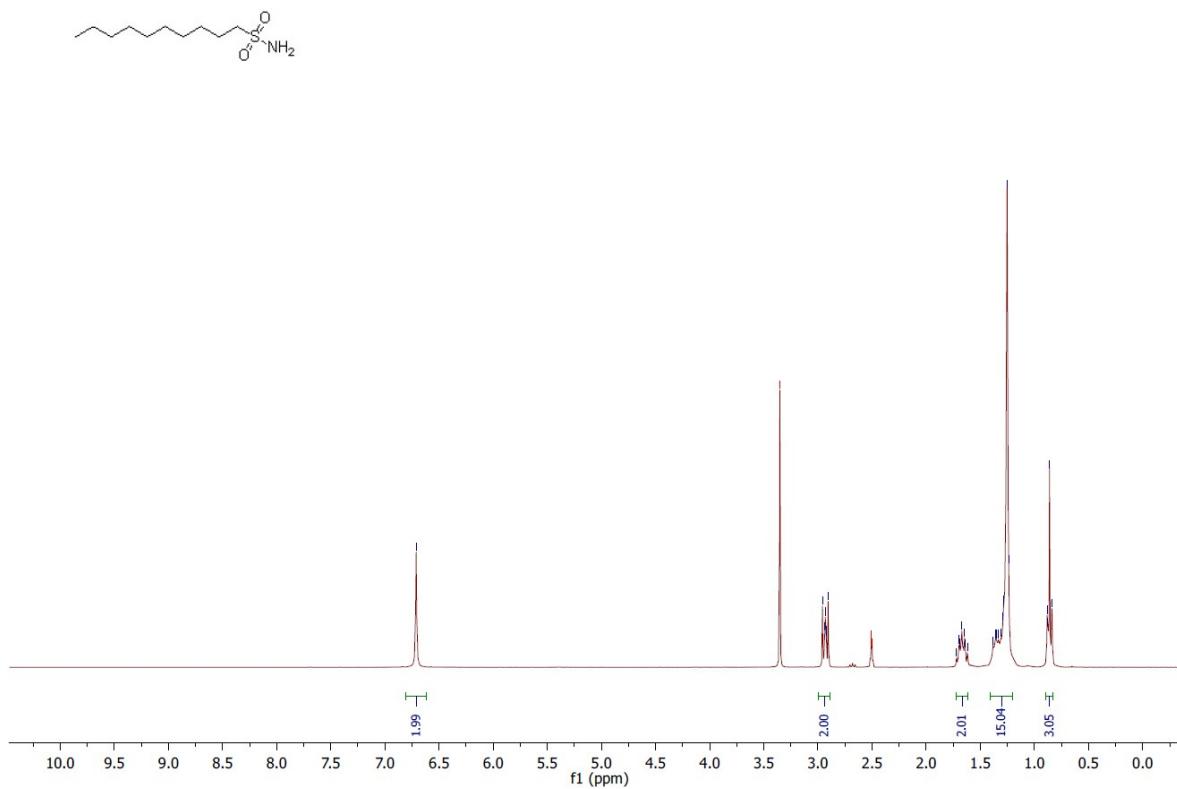
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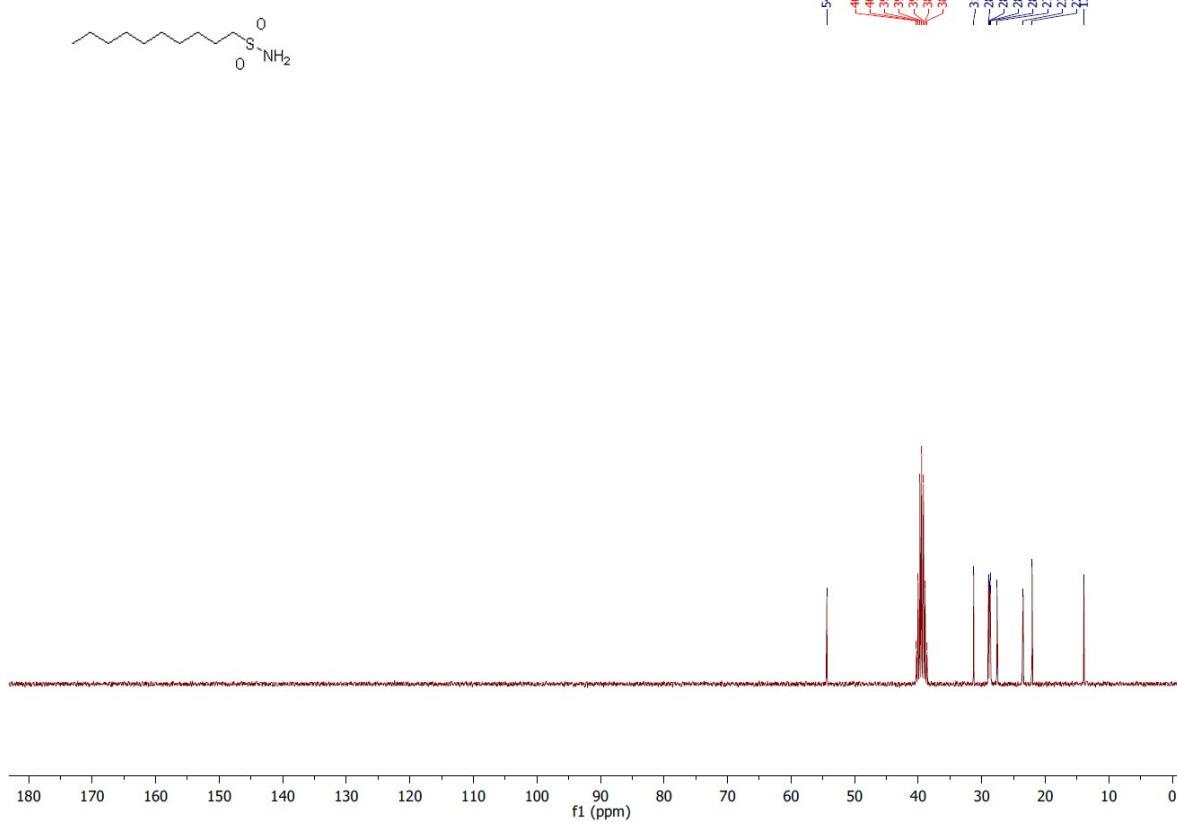
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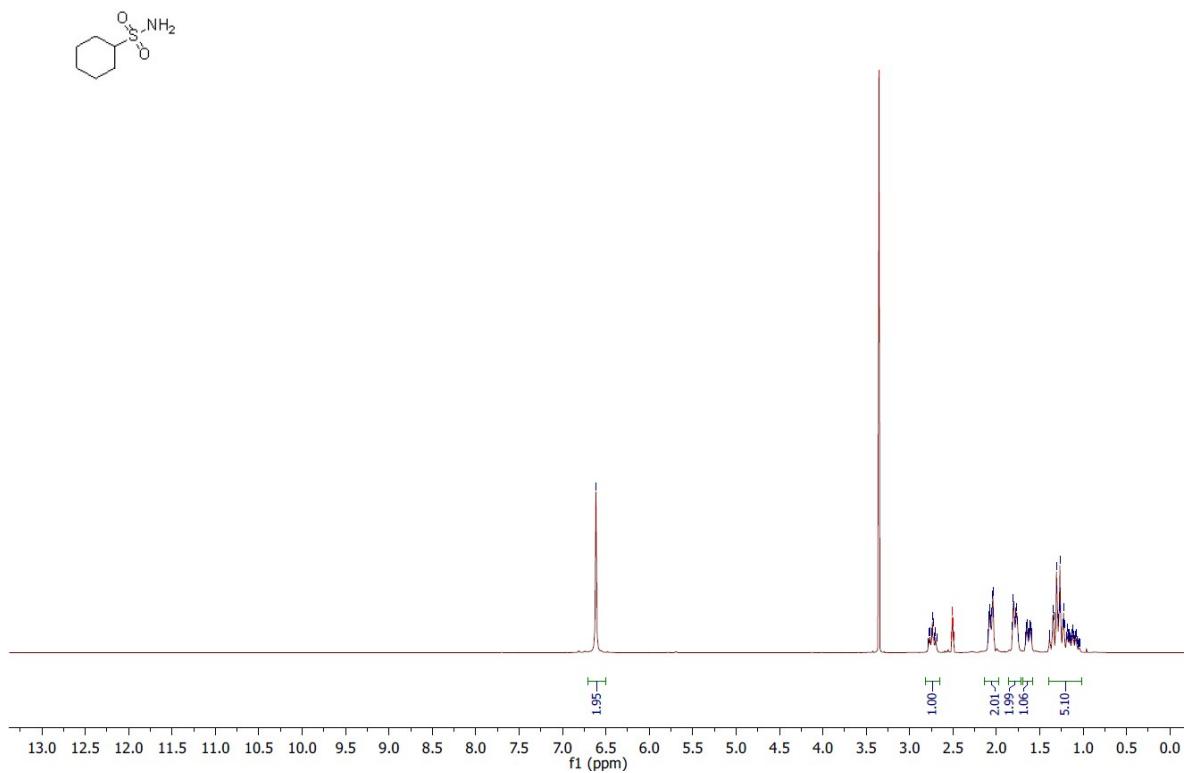
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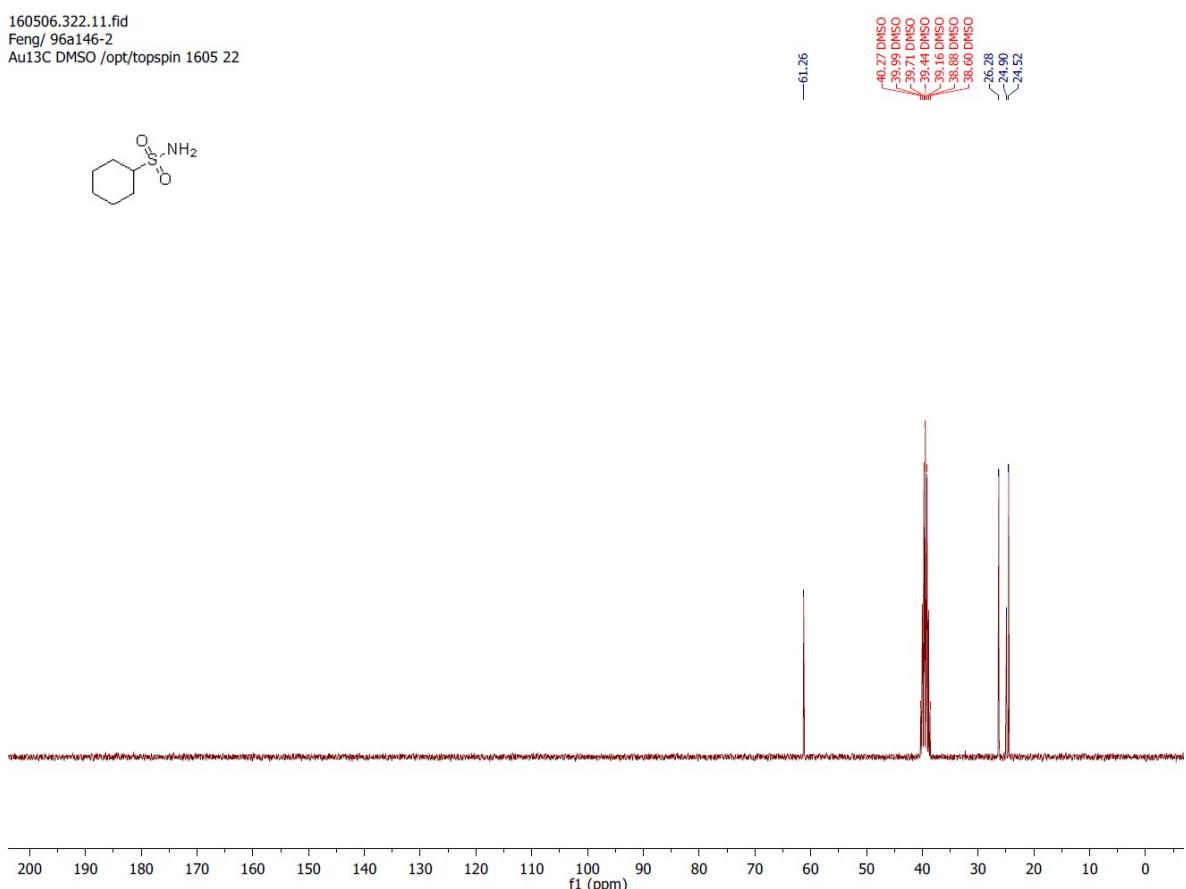
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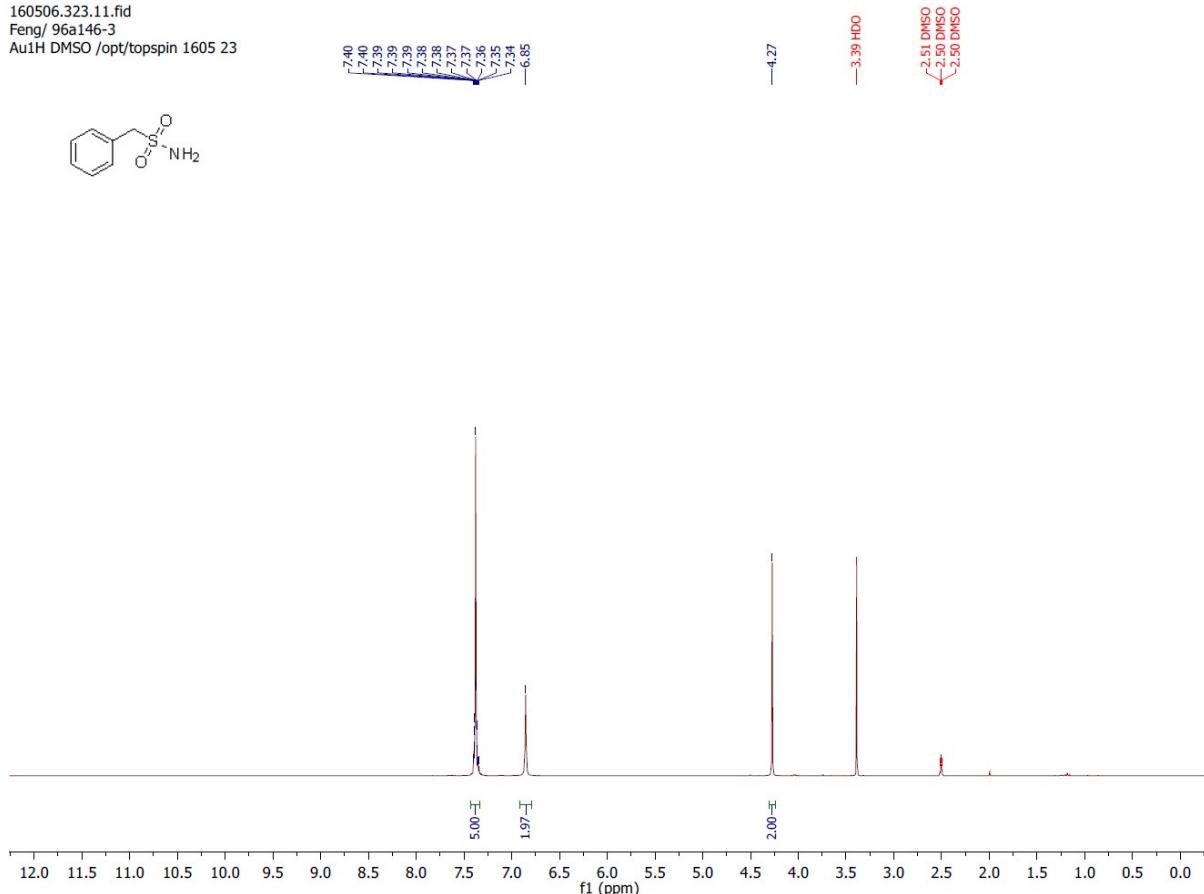
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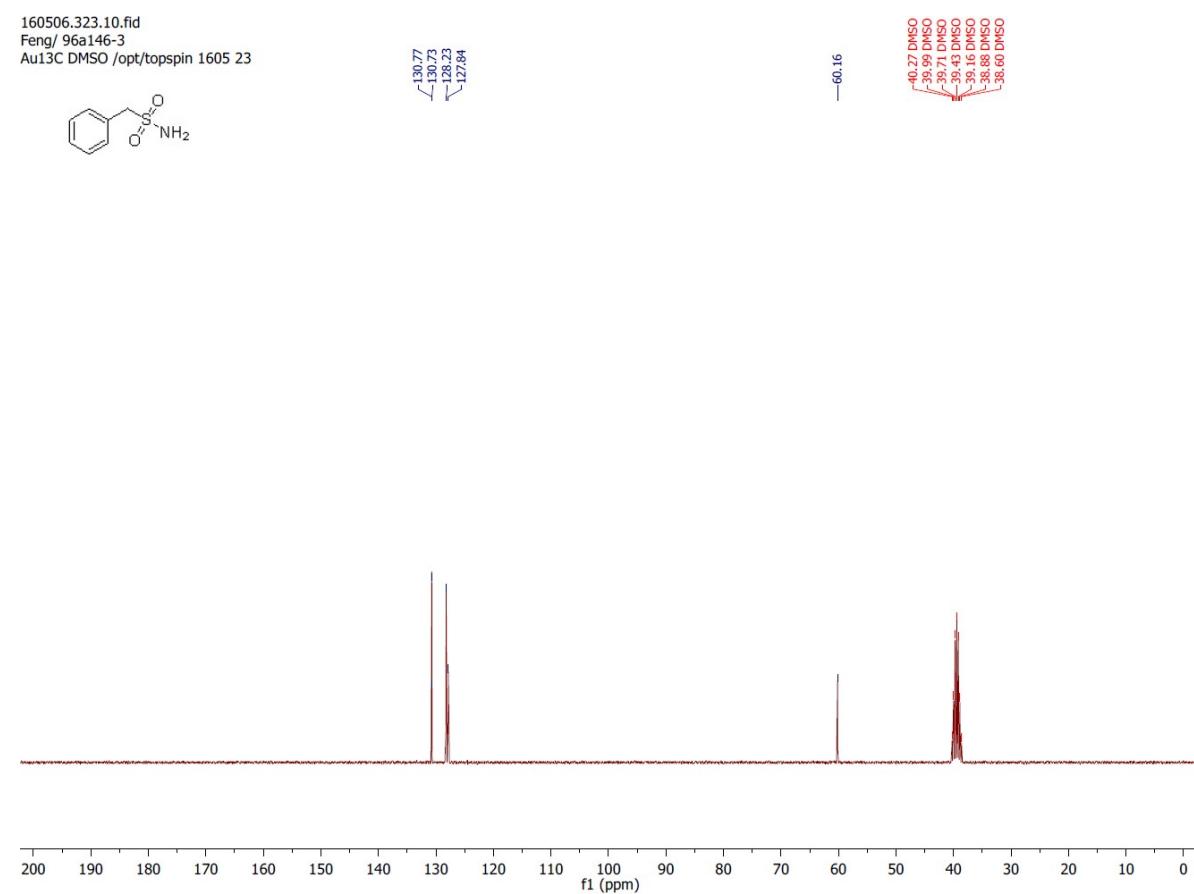
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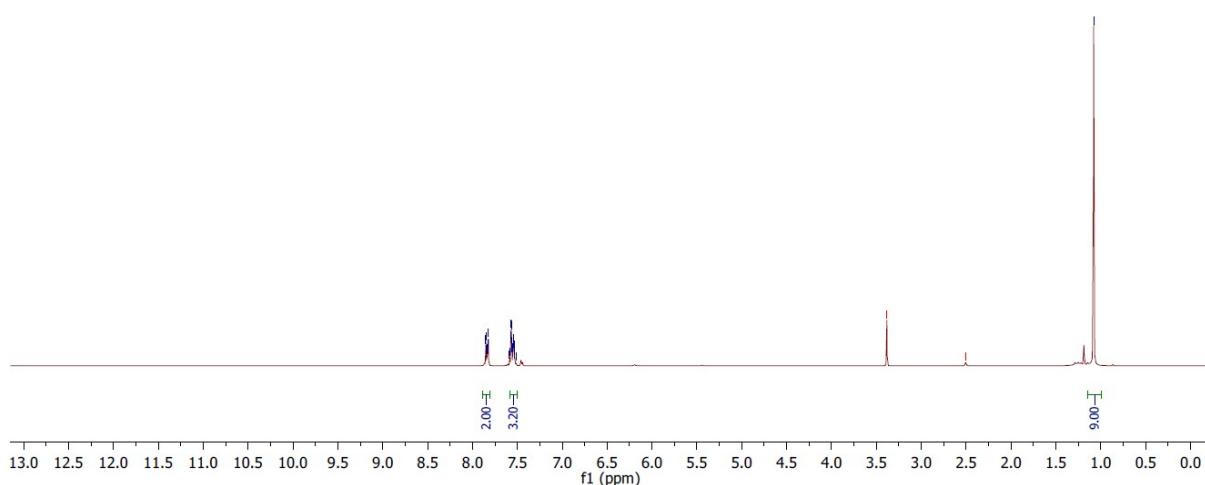
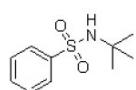
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Feng/ 96a146-3
Au1H DMSO /opt/topspin 1605 23



160506.323.10.fid
Feng/ 96a146-3
Au13C DMSO /opt/topspin 1605 23



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Jian-Bo Feng 96a151
Au1H DMSO /opt/topspin 1605 18



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Jian-Bo Feng 96a151
Au13C DMSO /opt/topspin 1605 18

