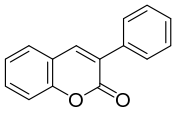
Synthesis of 2*H*-Chromenones from Salicylaldehydes and Arylacetonitriles

Chengcai Li [1], Hailin Zhu [1,2,*], Hang Zhang [1], Yongfeng Yang [1] and Feng Wang [1,2]

3-Phenyl-2*H*-chromen-2-one

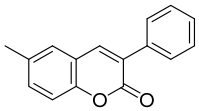


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.74 (d, *J* = 0.6 Hz, 1H), 7.66 – 7.60 (m, 2H), 7.50 – 7.41 (m, 2H), 7.41 – 7.32 (m, 3H), 7.29 (dq, *J* = 7.7, 0.9 Hz, 1H), 7.25 – 7.19 (m, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.55, 153.48, 139.83, 134.67, 131.36, 128.83, 128.49, 128.44, 128.33, 127.87, 124.46, 119.64, 116.42.

GC-MS (EI, 70ev): m/z(%) = 222 (M+, 100), 195 (14), 194 (93), 166 (12), 165 (89), 164 (16), 163 (10), 82 (11).

6-Methyl-3-phenyl-2*H*-chromen-2-one

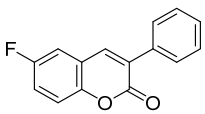


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.70 (s, 1H), 7.67 – 7.58 (m, 2H), 7.48 – 7.33 (m, 3H), 7.31 – 7.24 (m, 2H), 7.23 – 7.14 (m, 1H), 2.36 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.74, 151.61, 139.84, 134.81, 134.11, 132.40, 128.71, 128.48, 128.40, 128.14, 127.65, 119.36, 116.11, 20.76.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 100), 209 (10), 208 (67), 207 (62), 179 (24), 178 (40), 152 (16), 139 (10), 89 (12), 77 (13), 76 (12), 51 (11).

6-Fluoro-3-phenyl-2*H*-chromen-2-one



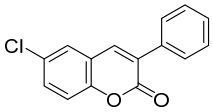
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.75 (s, 1H), 7.73 – 7.67 (m, 2H), 7.50 – 7.41 (m, 3H), 7.35 (dddd, *J* = 8.8, 4.5, 1.8, 1.1 Hz, 1H), 7.29 – 7.19 (m, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.17, 149.63, 138.73, 134.28, 129.52, 129.16, 128.54, 128.53, 120.28, 118.76 (d, *J* = 24.6 Hz), 118.05, 117.94, 113.05 (d, *J* = 23.9 Hz).

GC-MS (EI, 70ev): m/z(%) = 240 (M+, 94), 213 (15), 212 (96), 184 (15),183 (100), 182 (12), 181 (10), 163 (11), 157 (13), 91 (10).

HRMS(EI): Calcd. for $[(M+H)^+$: $C_{15}H_9FO_2]^+$:241.06593, found: 241.06566.

6-Chloro-3-phenyl-2*H*-chromen-2-one

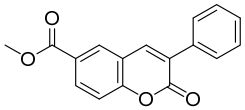


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.73 (t, *J* = 0.5 Hz, 1H), 7.72 – 7.66 (m, 2H), 7.53 (d, *J* = 2.4 Hz, 1H), 7.50 – 7.41 (m, 4H), 7.31 (dt, *J* = 8.8, 0.6 Hz, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.02, 151.88, 138.45, 134.25, 131.31, 129.75, 128.69 – 128.43 (m), 129.56, 129.25, 128.58, 127.10, 120.73, 117.93.

GC-MS (EI, 70ev): m/z(%) = 256 (M+, 100), 230 (30), 229 (15), 166 (10), 165 (77), 164 (20), 163 (28), 139 (18), 82 (18), 63 (15).

Methyl 2-oxo-3-phenyl-2*H*-chromene-6-carboxylate

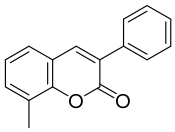


^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.28 (d, *J* = 2.0 Hz, 1H), 8.19 (dd, *J* = 8.7, 2.0 Hz, 1H), 7.89 – 7.84 (m, 1H), 7.76 – 7.65 (m, 2H), 7.55 – 7.34 (m, 5H), 3.96 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 165.70, 159.85, 156.21, 139.23, 134.17, 132.28, 129.94, 129.19, 128.56, 128.50, 128.35, 126.59, 119.39, 116.65, 52.47.

GC-MS (EI, 70ev): m/z(%) = 280 (M+, 100), 252 (11), 249 (30), 221 (45), 193 (29), 165 (27), 164 (12), 163 (14), 139 (22), 83 (15).

8-Methyl-3-phenyl-2*H*-chromen-2-one

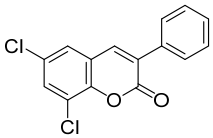


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.79 (s, 1H), 7.75 – 7.64 (m, 2H), 7.51 – 7.27 (m, 5H), 7.19 (dd, *J* = 8.1, 7.0 Hz, 1H), 2.49 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.59, 151.78, 140.19, 134.76, 132.61, 129.02, 128.64, 128.43, 128.35, 127.80, 125.78, 125.56, 123.97, 119.29, 15.38.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 100), 209 (12), 208 (76), 207 (45), 179 (19), 178 (36), 165 (30), 152 (12), 89 (14), 77 (10), 76 (12).

6,8-Dichloro-3-phenyl-2*H*-chromen-2-one

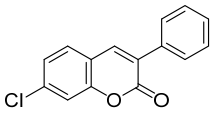


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.75 – 7.63 (m, 3H), 7.57 (d, *J* = 2.3 Hz, 1H), 7.48 – 7.39 (m, 4H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 158.81, 147.77, 137.89, 133.72, 131.20, 130.23, 129.50, 129.48, 128.60, 128.51, 125.61, 122.27, 121.44.

GC-MS (EI, 70ev): m/z(%) = 291 (M+, 63), 290 (94), 266 (11), 265 (10), 264 (65), 263 (16), 262 (100), 201 (20), 200 (10), 199 (62), 164 (28), 163 (60), 162 (10), 139 (10), 99 (16), 87 (11), 81 (19), 63 (10).

7-Chloro-3-phenyl-2*H*-chromen-2-one



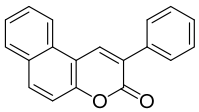
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.66 (s, 1H), 7.61 – 7.52 (m, 2H), 7.44 – 7.30 (m, 4H), 7.28 – 7.24 (m, 1H), 7.21 – 7.09 (m, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 159.84, 153.66, 138.90, 137.23, 134.30, 129.03, 128.64, 128.49, 128.44, 128.26, 125.08, 124.91, 118.21, 116.73.

GC-MS (EI, 70ev): m/z(%) = 256 (M+, 100), 230 (16), 228 (100), 166 (12), 165 (85), 164 (27), 163 (28), 139 (16), 115 (14), 114 (12), 82 (11), 63 (15).

HRMS(EI): Calcd. for $[(M+H)^+$: $C_{15}H_9ClO_2]^+$:257.03638, found: 257.03614.

2-Phenyl-3*H*-benzo[*f*]chromen-3-one

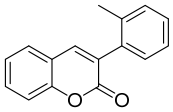


^{1}H NMR (300 MHz, Chloroform-*d*)δ 8.36 (d, *J* = 1.7 Hz, 1H), 8.09 (d, *J* = 8.4 Hz, 1H), 7.83 – 7.68 (m, 2H), 7.67 – 7.59 (m, 2H), 7.50 (ddd, *J* = 8.4, 7.0, 1.4 Hz, 1H), 7.42 – 7.26 (m, 5H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.55, 153.04, 135.60, 135.00, 132.62, 130.23, 129.01, 128.80, 128.50 (d, *J* = 2.1 Hz), 128.12, 127.10, 125.96, 121.34, 116.58, 113.65.

GC-MS (EI, 70ev): m/z(%) = 272 (M+, 92), 245 (23), 244 (100), 243 (23), 215 (60), 213 (27), 189 (10), 122 (10), 107 (25), 94 (18).

3-(*o*-Tolyl)-2*H*-chromen-2-one

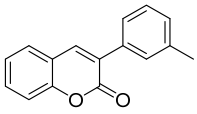


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.65 (s, 1H), 7.60 – 7.46 (m, 2H), 7.39 (ddt, *J* = 8.2, 1.2, 0.6 Hz, 1H), 7.36 – 7.28 (m, 3H), 7.28 – 7.22 (m, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.21, 153.80, 141.59, 136.82, 134.66, 131.41, 130.30, 129.73, 128.81, 127.81, 125.85, 124.43, 119.28, 116.55, 19.92.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 100), 220 (12), 219 (64), 208 (37), 207 (86), 189 (27), 179 (26), 178 (53), 177 (10), 176 (11), 165 (24), 152 (21), 117 (12), 115 (23), 89 (18), 76 (14), 63 (18), 39 (11).

3-(*m*-Tolyl)-2*H*-chromen-2-one

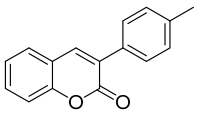


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.76 (s, 1H), 7.55 – 7.43 (m, 4H), 7.37 – 7.22 (m, 3H), 7.22 – 7.16 (m, 1H), 2.39 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.55, 153.42, 139.70, 138.03, 134.59, 131.24, 129.59, 129.09, 128.44, 128.32, 127.81, 125.60, 124.40, 119.65, 116.36, 21.45.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 100), 209 (14), 208 (81), 207 (18), 179 (14), 178 (30), 165 (38), 152 (13), 117 (11), 89 (13), 63 (10).

3-(*p*-Tolyl)-2*H*-chromen-2-one

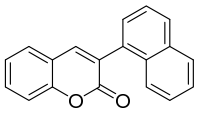


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.67 (s, 1H), 7.55 – 7.47 (m, 2H), 7.45 – 7.35 (m, 2H), 7.25 (dt, *J* = 7.8, 0.9 Hz, 1H), 7.21 – 7.09 (m, 3H), 2.29 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.60, 153.32, 139.12, 138.82, 131.71, 131.10, 129.09, 128.31, 128.17, 127.74, 124.36, 119.68, 116.30, 21.23.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 100), 209 (10), 208 (62), 207 (37), 179 (13), 178 (28), 165 (26), 152 (12), 89 (11), 63 (10), 114 (12), 82 (11), 63 (15).

3-(Naphthalen-1-yl)-2*H*-chromen-2-one

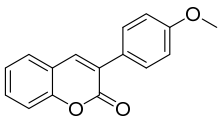


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.97 – 7.87 (m, 2H), 7.84 – 7.76 (m, 2H), 7.64 – 7.41 (m, 7H), 7.38 – 7.30 (m, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.77, 153.97, 142.77, 133.66, 132.64, 131.65, 131.53, 129.36, 128.53, 128.37, 127.93, 127.63, 126.48, 126.07, 125.23, 124.54, 119.32, 116.68.

GC-MS (EI, 70ev): m/z(%) = 272 (M+, 100), 273 (19), 271 (79), 255 (11), 244 (24), 243 (50), 216 (11), 215 (58), 214 (10), 213 (28), 189 (17), 107 (18), 95 (17), 63 (11).

3-(4-Methoxyphenyl)-2*H*-chromen-2-one

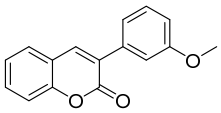


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.75 (s, 1H), 7.71 – 7.63 (m, 2H), 7.56 – 7.44 (m, 2H), 7.34 (ddd, *J* = 8.0, 1.3, 0.7 Hz, 1H), 7.31 – 7.23 (m, 1H), 7.02 – 6.90 (m, 2H), 3.85 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.74, 160.10, 153.24, 138.43, 130.95, 129.78, 127.81, 127.65, 127.02, 124.38, 119.79, 116.32, 113.87, 55.32.

GC-MS (EI, 70ev): m/z(%) = 252 (M+, 100), 224 (10), 210 (10), 209 (65), 181 (41), 152 (35).

3-(3-Methoxyphenyl)-2*H*-chromen-2-one

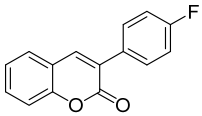


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.81 (s, 1H), 7.53 (td, *J* = 7.4, 1.6 Hz, 2H), 7.40 – 7.32 (m, 2H), 7.32 – 7.25 (m, 3H), 6.95 (ddd, *J* = 8.1, 2.6, 1.2 Hz, 1H), 3.85 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.41, 159.48, 153.45, 139.94, 135.96, 131.40, 129.43, 128.09, 127.89, 124.44, 120.86, 119.55, 116.38, 114.47, 114.16, 55.32.

GC-MS (EI, 70ev): m/z(%) = 252 (M+, 100), 224 (46), 194 (10), 182 (10), 181 (68), 167 (10), 165 (21), 153 (13), 152 (62),151 (16), 127 (10), 126 (14), 63 (16), 39 (10).

3-(4-Fluorophenyl)-2*H*-chromen-2-one

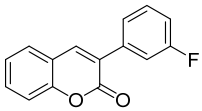


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.79 (s, 1H), 7.75 – 7.64 (m, 2H), 7.54 (ddt, *J* = 7.6, 6.0, 1.8 Hz, 2H), 7.37 (dt, *J* = 8.8, 0.8 Hz, 1H), 7.34 – 7.27 (m, 1H), 7.19 – 7.06 (m, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 164.70, 160.51, 153.47, 139.65, 131.48, 130.70, 130.39 (d, *J* = 8.3 Hz), 127.87, 127.30, 124.56, 119.54, 116.47, 115.46 (d, *J* = 21.6 Hz).

GC-MS (EI, 70ev): m/z(%) = 240 (M+, 93), 212 (100), 184 (14), 183 (81), 181 (14), 157 (19), 107 (12), 106 (21), 92 (12), 91 (13).

3-(3-Fluorophenyl)-2*H*-chromen-2-one

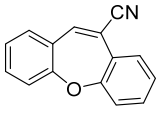


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.79 (s, 1H), 7.56 – 7.47 (m, 2H), 7.47 – 7.38 (m, 2H), 7.38 – 7.28 (m, 2H), 7.27 – 7.19 (m, 1H), 7.05 (tdd, *J* = 8.3, 2.6, 1.1 Hz, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 164.24, 160.57 (d, *J* = 61.2 Hz), 153.54, 140.38, 136.63 (d, *J* = 8.1 Hz), 131.78, 129.95 (d, *J* = 8.4 Hz), 128.04, 126.99 (d, *J* = 2.4 Hz), 124.61, 124.13 (d, *J* = 3.1 Hz), 119.36, 116.49, 115.84 (d, *J* = 7.0 Hz), 115.55 (d, *J* = 8.9 Hz).

GC-MS (EI, 70ev): m/z(%) = 240 (M+, 80), 212 (90), 183 (100),157 (10), 63 (10).

Dibenzo[*b,f*]oxepine-10-carbonitrile

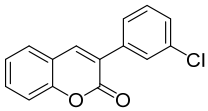


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.62 (dd, *J* = 8.1, 1.7 Hz, 1H), 7.54 – 7.41 (m, 3H), 7.35 – 7.18 (m, 5H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 158.30, 157.43, 142.37, 132.86, 131.91, 130.42, 128.29, 128.03, 126.17, 125.60, 125.41, 121.91, 121.67, 118.46, 113.99.

GC-MS (EI, 70ev): m/z(%) = 219 (M+, 100), 191 (25), 190 (93), 165 (12), 164 (30), 163 (25), 82 (10), 63 (12).

3-(3-Chlorophenyl)-2*H*-chromen-2-one



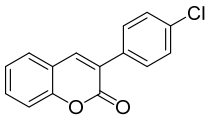
^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.83 (s, 1H), 7.70 (td, *J* = 1.7, 1.0 Hz, 1H), 7.64 – 7.59 (m, 1H), 7.59 – 7.51 (m, 2H), 7.42 – 7.37 (m, 2H), 7.37 – 7.28 (m, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.15, 153.59, 140.43, 136.35, 134.38, 131.82, 129.68, 128.89, 128.54, 128.05, 126.96, 126.74, 124.63, 119.37, 116.53.

GC-MS (EI, 70ev): m/z(%) = 256 (M+, 100), 230 (27), 229 (17), 228 (95), 166 (10), 165 (80), 164 (22), 163 (27), 139 (12), 110 (10), 82 (13), 75 (12), 63 (12).

HRMS(EI): Calcd. for $[(M+H)^+$: $C_{15}H_9ClO_2]^+$:257.03638, found: 257.03633.

3-(4-Chlorophenyl)-2*H*-chromen-2-one

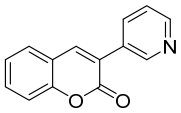


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.82 (d, *J* = 0.6 Hz, 1H), 7.71 – 7.62 (m, 2H), 7.59 – 7.50 (m, 2H), 7.46 – 7.40 (m, 2H), 7.37 (dt, *J* = 8.9, 0.8 Hz, 1H), 7.34 – 7.28 (m, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.32, 153.52, 139.91, 134.92, 133.05, 131.66, 129.82, 128.67, 127.95, 127.15, 124.60, 119.46, 116.50.

GC-MS (EI, 70ev): m/z(%) = 256 (M+, 100), 230 (24), 229 (10), 228 (73), 165 (60), 164 (18), 163 (20).

3-(Pyridin-3-yl)-2*H*-chromen-2-one

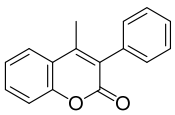


^{1}H NMR (300 MHz, Chloroform-*d*) δ 8.80 (d, *J* = 2.4 Hz, 1H), 8.61 (dd, *J* = 4.9, 1.7 Hz, 1H), 8.05 (d, *J* = 8.5 Hz, 1H), 7.28 – 7.22 (m, 1H), 7.44 – 7.31 (m, 3H), 7.25 (s, 1H), 7.14 (td, *J* = 7.6, 1.0 Hz, 2H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 153.33, 149.55, 149.14, 136.43, 134.27, 132.25, 130.90, 127.68, 123.61, 122.92, 119.62, 115.38.

GC-MS (EI, 70ev): m/z(%) = 221 (M+, 100), 222 (26), 139 (12).

4-Methyl-3-phenyl-2*H*-chromen-2-one

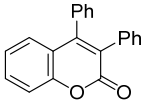


^{1}H NMR (300 MHz, Chloroform-*d*)δ 7.69 (dd, *J* = 8.0, 1.5 Hz, 1H), 7.55 (ddd, *J* = 8.6, 7.2, 1.5 Hz, 1H), 7.50 – 7.36 (m, 4H), 7.36 – 7.28 (m, 3H), 2.32 (s, 3H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.93, 152.66, 147.59, 134.42, 131.29, 129.99, 128.40, 128.18, 127.33, 125.08, 124.22, 120.54, 116.85, 16.56.

GC-MS (EI, 70ev): m/z(%) = 236 (M+, 96), 235 (82), 208 (60), 207 (100), 179 (24), 178 (62), 177 (11), 176 (13), 165 (22), 152 (22), 151 (10), 139 (15), 131 (28), 115 (20), 102 (12), 89 (23), 77 (21), 75 (10), 63 (21), 51 (17), 50 (10), 39 (15).

3,4-Diphenyl-2*H*-chromen-2-one

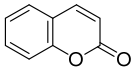


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.54 (ddd, *J* = 8.6, 6.6, 2.2 Hz, 1H), 7.44 (ddd, *J* = 8.3, 1.2, 0.6 Hz, 1H), 7.34 – 7.28 (m, 3H), 7.23 – 7.10 (m, 9H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 161.26, 153.22, 151.57, 134.46, 133.84, 131.43, 130.51, 129.35, 128.33, 128.25, 127.78, 127.73, 127.63, 126.99, 124.11, 120.51, 116.76.

GC-MS (EI, 70ev): m/z(%) = 298 (M+, 100), 297 (90), 281 (11), 270 (28), 269 (28), 268 (16), 255 (13), 253 (17), 252 (11), 241 (32), 240 (10), 239 (47), 165 (12), 119 (19).

2*H*-Chromen-2-one

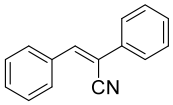


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.62 (d, *J* = 9.6 Hz, 1H), 7.50 – 7.35 (m, 2H), 7.30 – 7.13 (m, 2H), 6.34 (d, *J* = 9.5 Hz, 1H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 160.74, 154.03, 143.39, 131.80, 127.83, 124.39, 118.81, 116.88, 116.69.

GC-MS (EI, 70ev): m/z(%) = 146 (M+, 56), 118 (100), 90 (44), 89 (41), 64 (10), 63 (28), 62 (12).

(*Z*)-2,3-Diphenylacrylonitrile

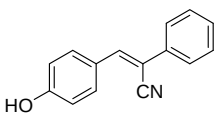


^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.98 – 7.85 (m, 2H), 7.73 – 7.64 (m, 2H), 7.55 (s, 1H), 7.52 – 7.39 (m, 6H).

^{13}C NMR (75 MHz, Chloroform-*d*) δ 142.20, 134.41, 133.66, 130.49, 129.22, 129.16, 129.02, 128.91, 125.95, 117.95, 111.64.

GC-MS (EI, 70ev): m/z(%) = 205 (M+, 100), 204 (92), 203 (26), 190 (52), 178 (23), 177 (27), 176 (24), 165 (13), 151 (13), 102 (12), 89 (14), 88 (11), 77 (11), 76 (16), 75 (11), 63 (13), 51 (22), 50 (14), 39 (11).

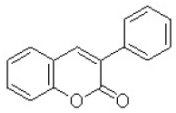
(*Z*)-3-(4-Hydroxyphenyl)-2-phenylacrylonitrile

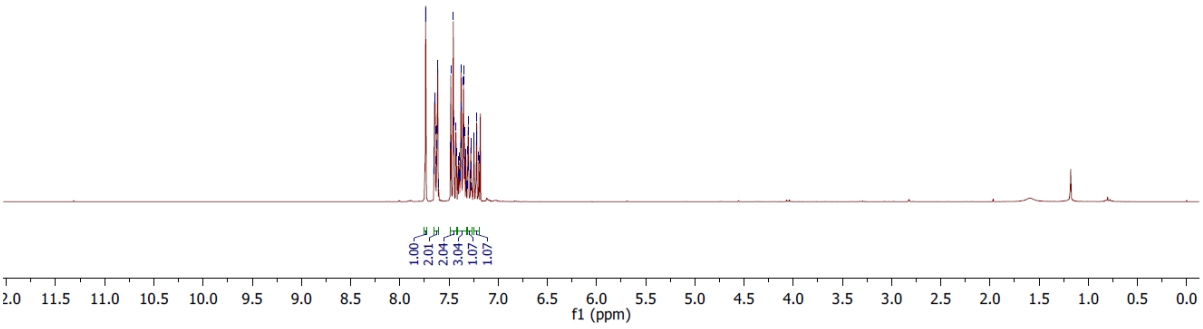


^{1}H NMR (300 MHz, DMSO-d_6) δ 10.29 (s, 1H), 7.93 – 7.76 (m, 3H), 7.75 – 7.64 (m, 2H), 7.54 – 7.43 (m, 2H), 7.42 – 7.31 (m, 1H), 6.92 (d, *J* = 8.7 Hz, 2H).

^{13}C NMR (75 MHz, DMSO-d_6) δ 160.02, 142.91, 134.37, 131.44, 129.14, 128.61, 125.41, 124.79, 118.64, 115.89, 105.85.

GC-MS (EI, 70ev): m/z(%) = 221 (M+, 100), 206 (18), 204 (10), 203 (11), 202 (24), 192 (11), 191 (14) 190 (19), 177 (11), 165 (40), 164 (13), 63 (12), 51 (16), 39 (10).





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Jian-Bo Feng 94a178-2-1
Au13C CDCl3 /opt/topspin 1606 29

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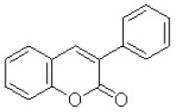
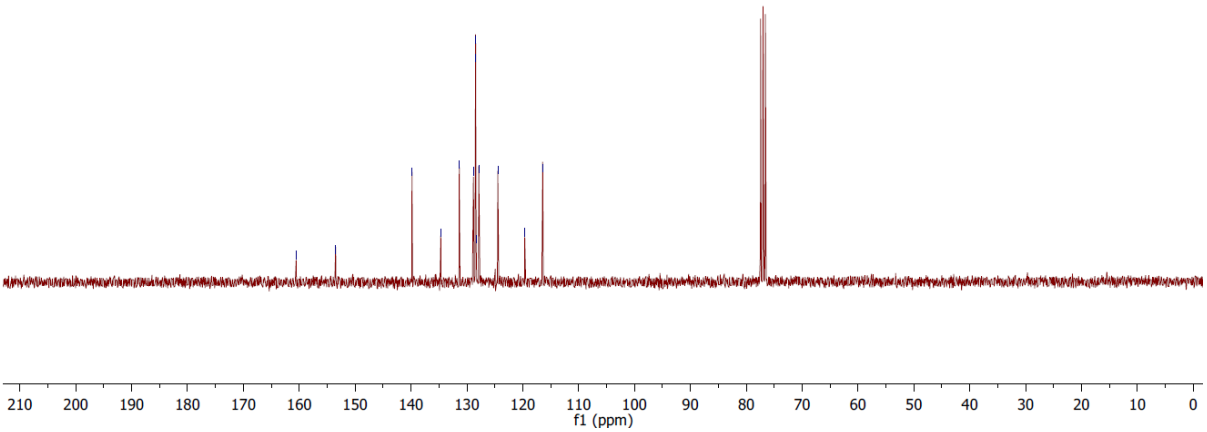
128.33
127.87
124.46
119.64
116.42





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Jian-Bo Feng 94a241
Au1H CDCl3 /opt/topspin 1606 4

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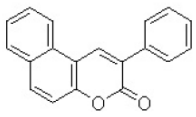

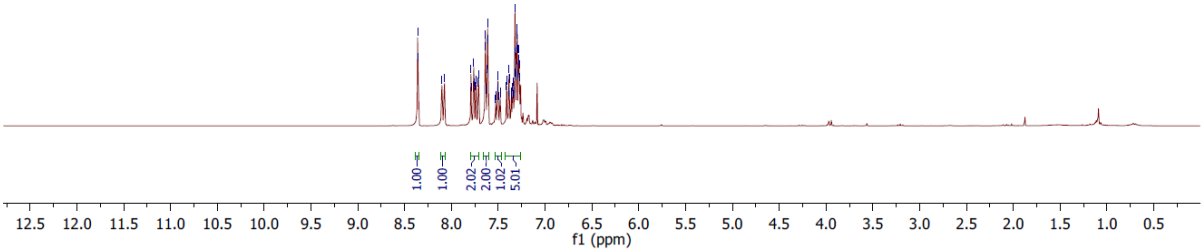

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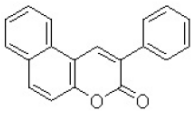
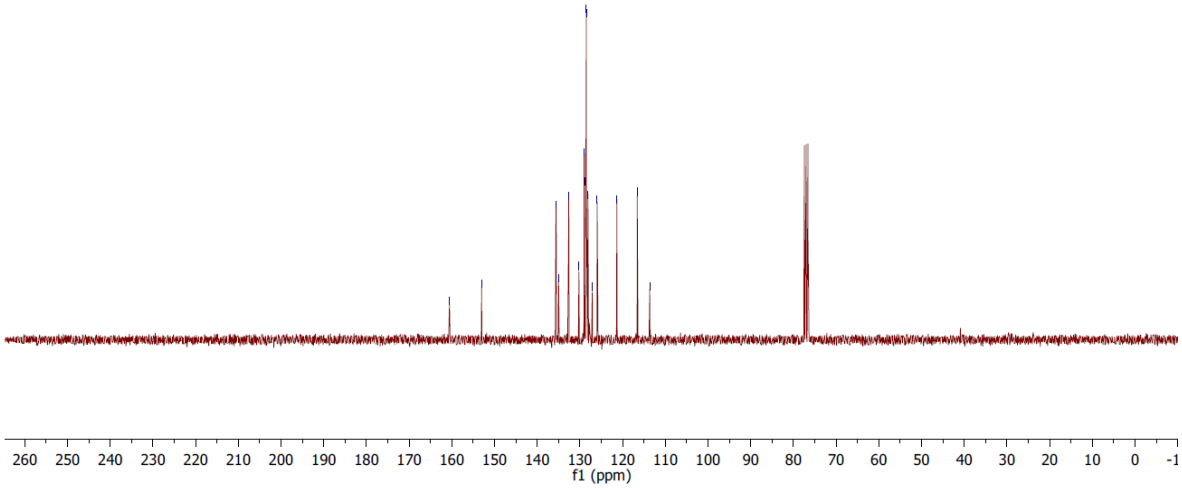
Jian-Bo Feng 94a24-1
Au13C CDCl3 /opt/topspin 1606 4





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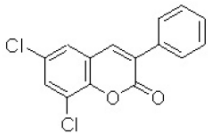

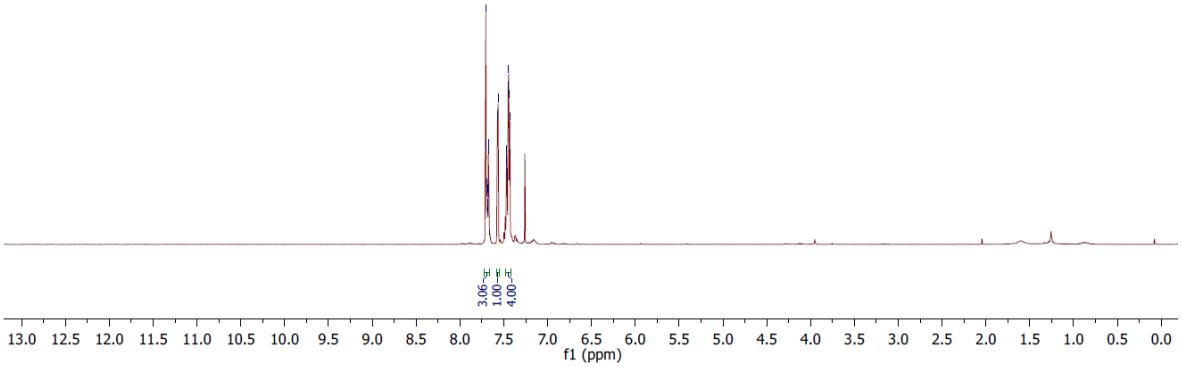

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Jian-Bo Feng 94a24-2
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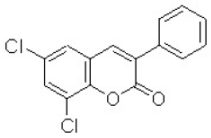

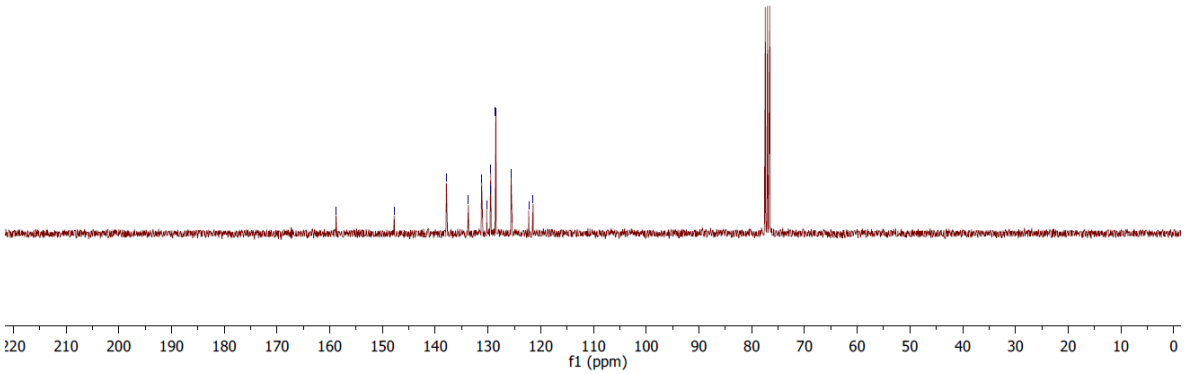

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Jian-Bo Feng 94a24-3
Au1H CDCl3 /opt/topspin 1606 5

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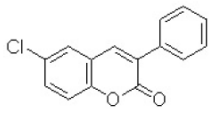

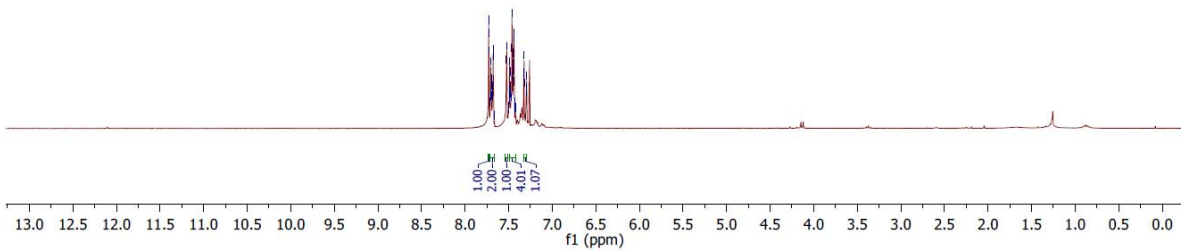

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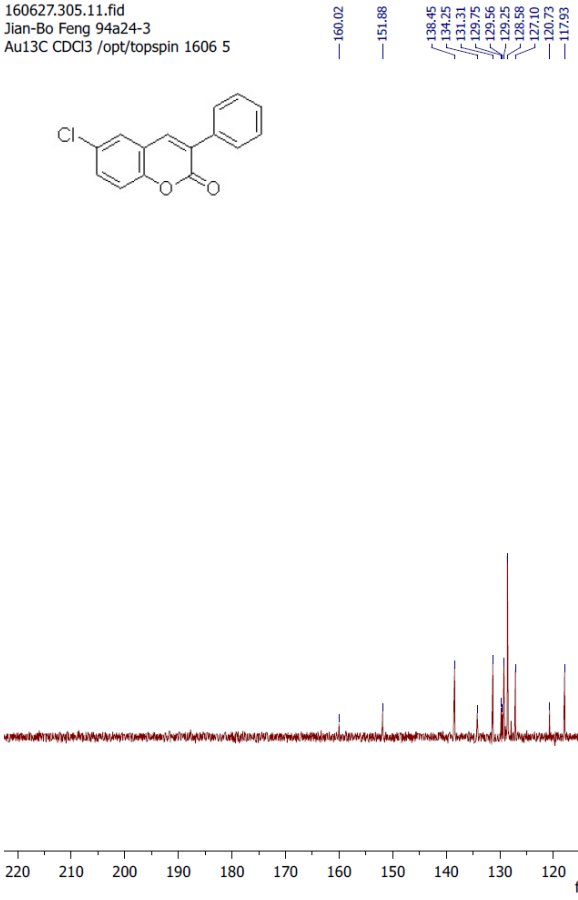
Jian-Bo Feng 94a24-3
Au13C CDCl3 /opt/topspin 1606 5



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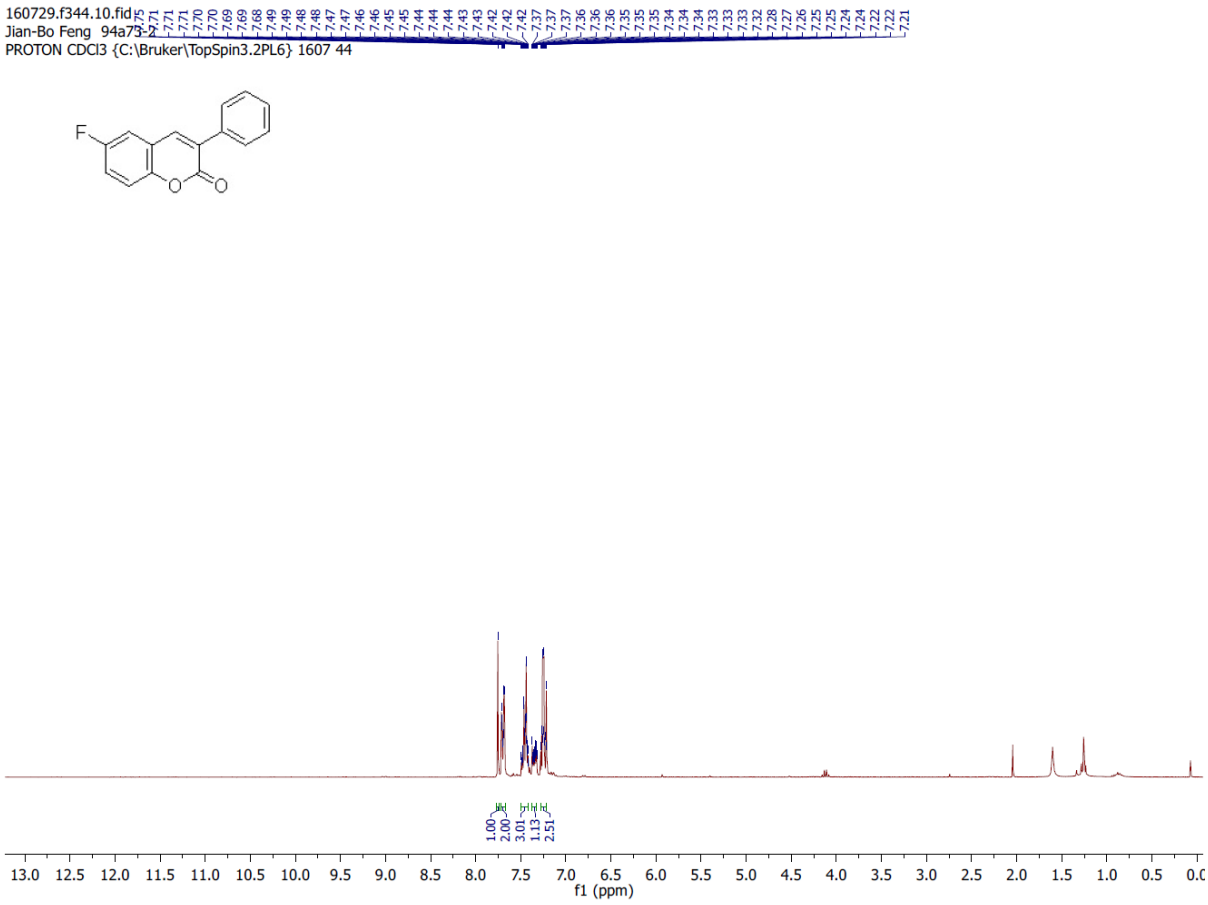

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Jian-Bo Feng 94a73-2
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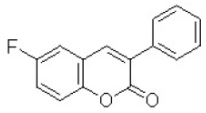
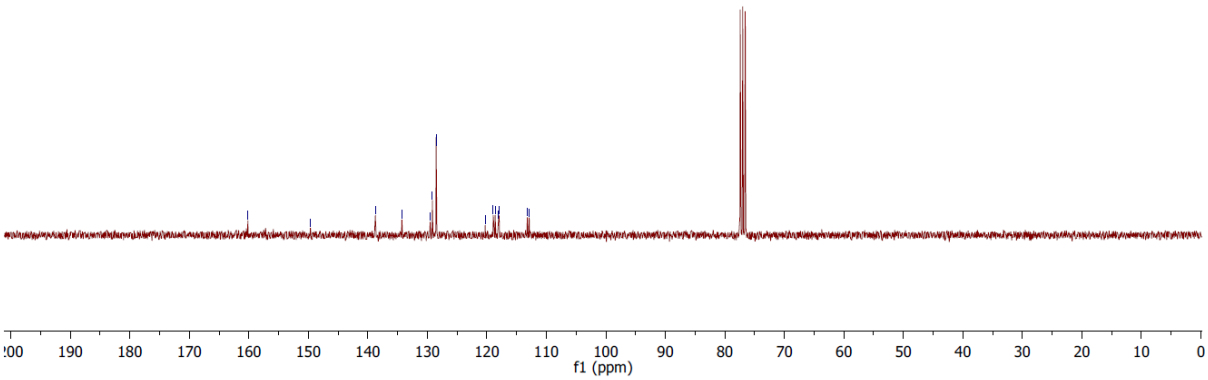
160.17 149.63 138.73 134.28 129.52 129.16 128.54 128.53 120.28 118.93 118.60 118.05 117.94 113.21 112.89





f1 (ppm)

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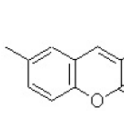
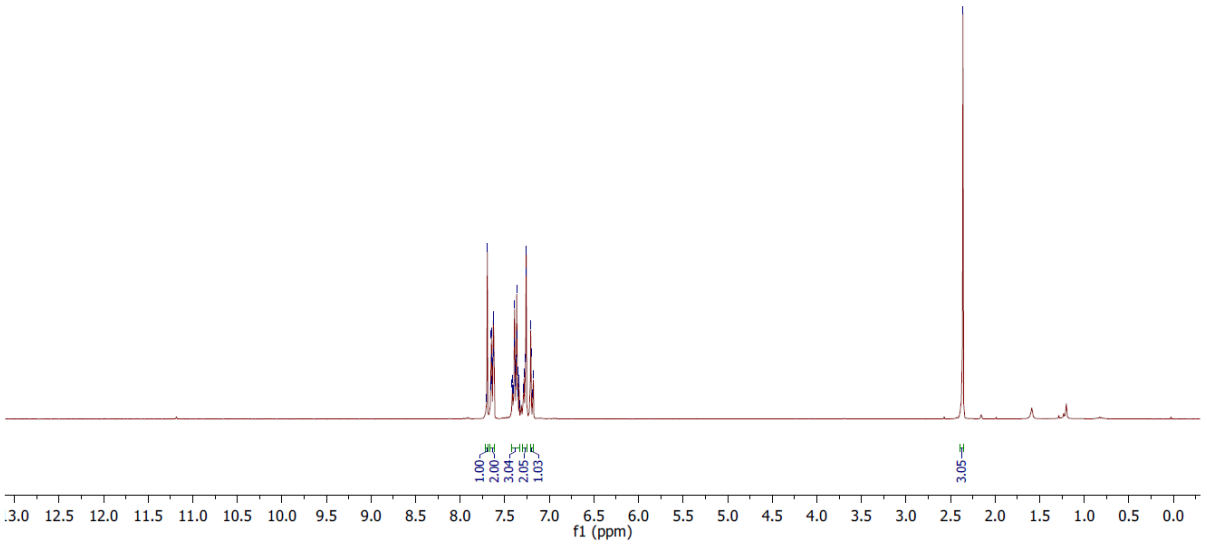
Jian-Bo Feng 94a24-5-1
Au1H CDCl3 /opt/topspin 1606 7

7.70 7.70 7.66 7.65 7.65 7.64 7.63 7.63 7.63 7.62 7.42 7.41 7.41 7.41 7.40 7.39 7.39 7.39 7.38 7.37 7.37 7.36 7.36 7.35 7.34 7.34 7.33 7.29 7.28 7.27 7.26 7.26 7.21 7.20 7.19 7.18

2.36





1.00 2.00 3.04 2.05 1.03

3.05

f1 (ppm)

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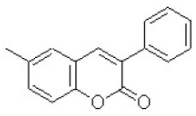
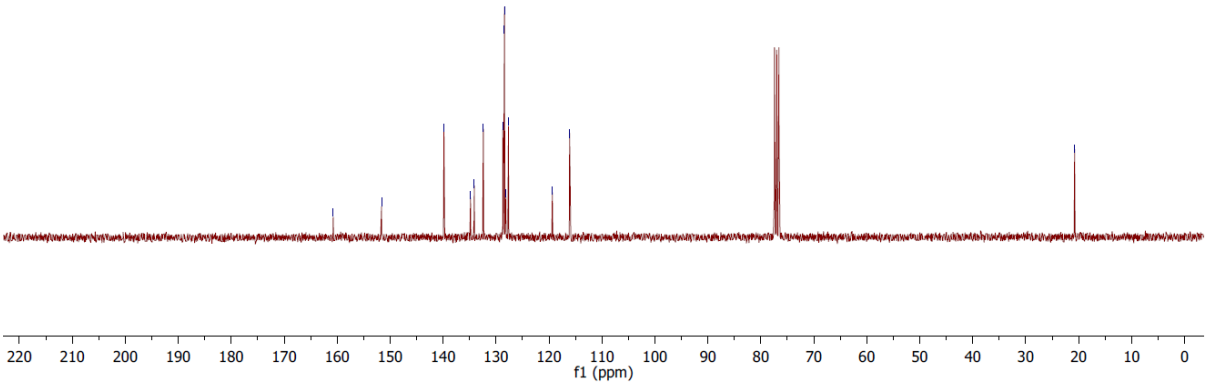
Jian-Bo Feng 94a24-5-1
Au13C CDCl3 /opt/topspin 1606 7





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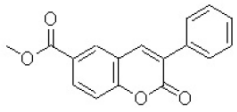
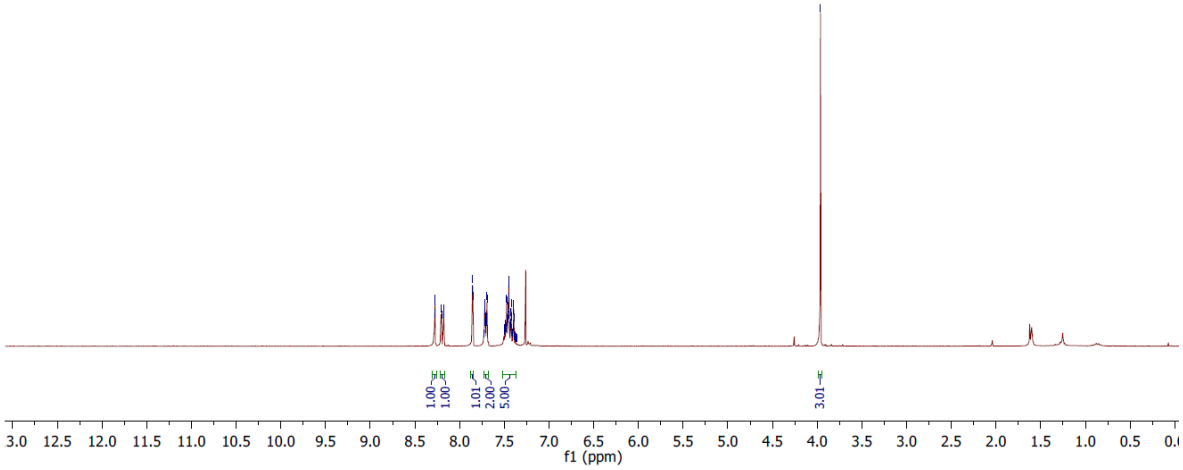
Jian-Bo Feng 94a26-1
Au1H CDCl3 /opt/topspin 1606 36





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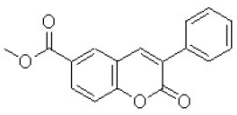
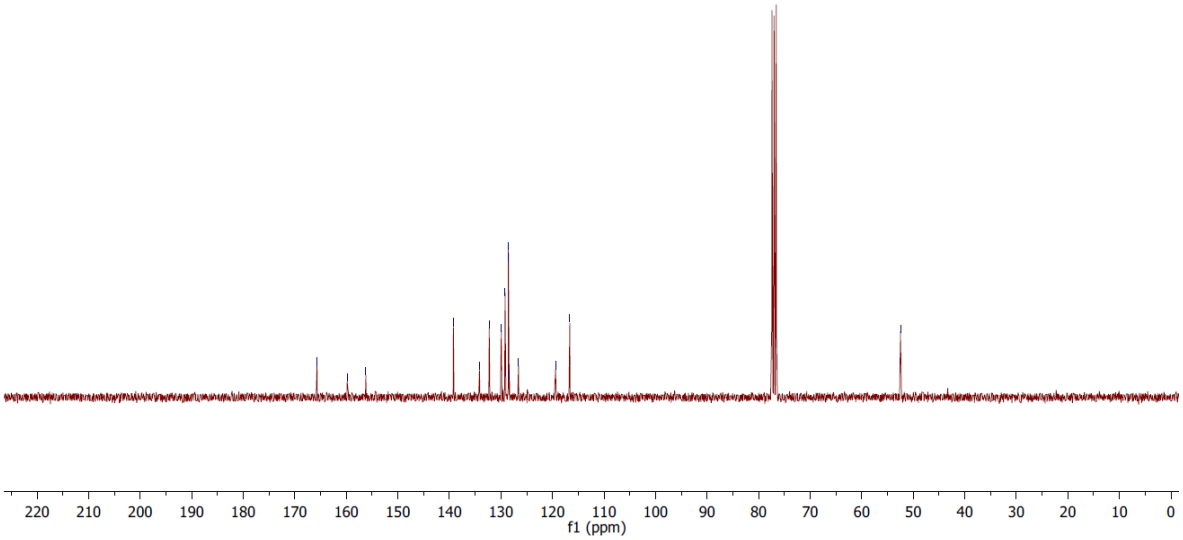
Au13C CDCl3 /opt/topspin 1606 36





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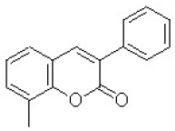
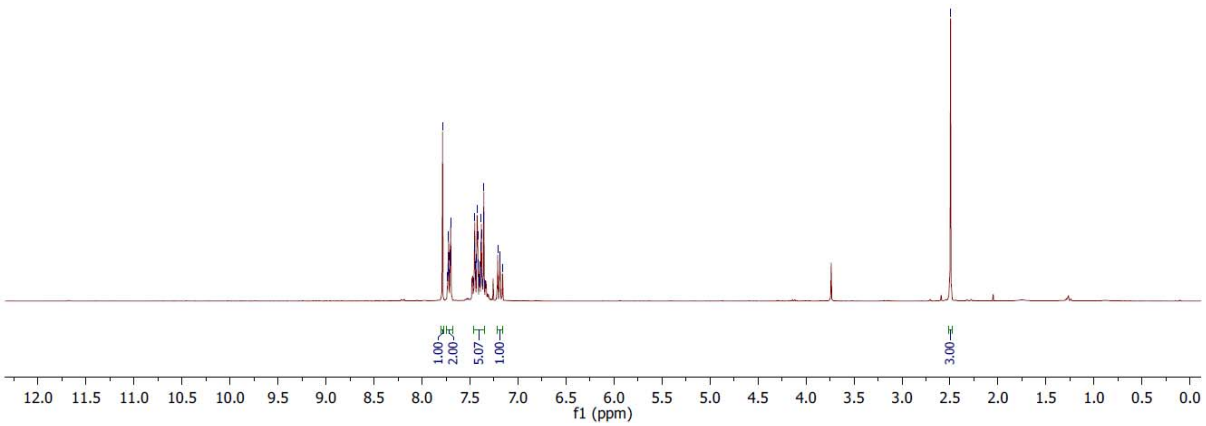
Jian-Bo Feng 94a26-2
Au1H CDCl3 /opt/topspin 1606 37





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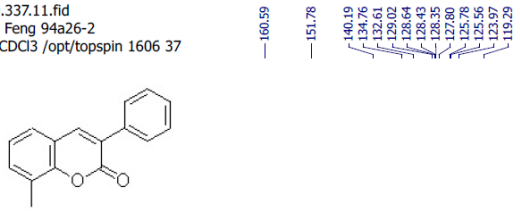
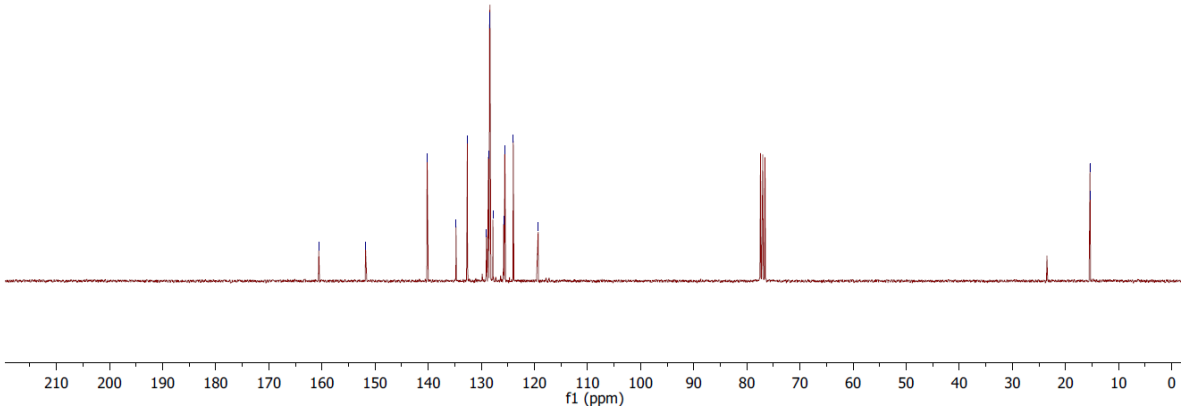
Jian-Bo Feng 94a26-2
Au13C CDCl3 /opt/topspin 1606 37





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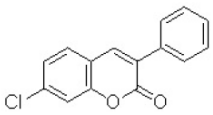
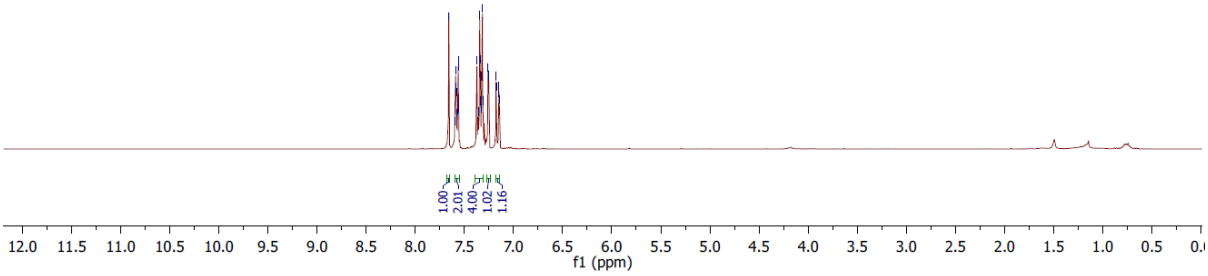
Jian-Bo Feng 94a42-2
Au1H CDCl3 /opt/topspin 1607 6





160707.306.11.fid
Jian-Bo Feng 94a42-2
Au13C CDCl3 /opt/topspin 1607 6

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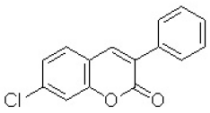

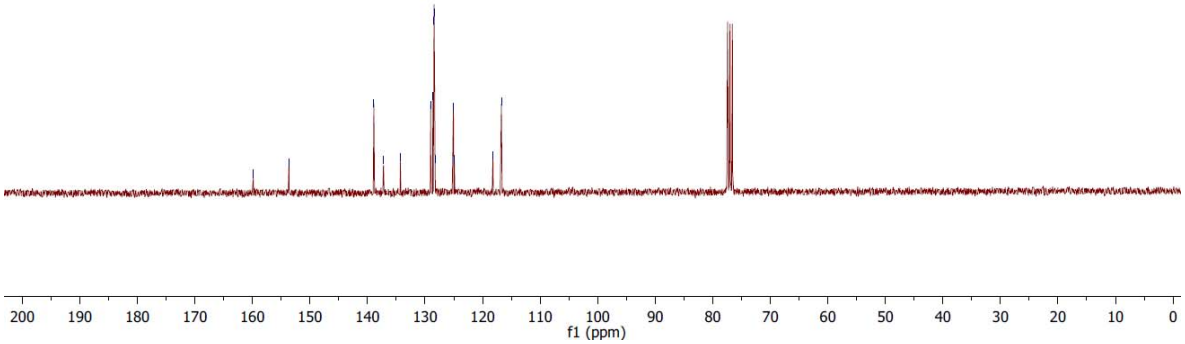

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Jian-Bo Feng 94a53-2
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 35

7.75
7.70
7.69
7.68
7.67
7.67
7.66
7.65
7.54
7.53
7.53
7.52
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7.48
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7.30
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7.28
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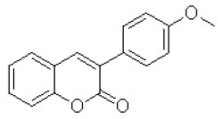
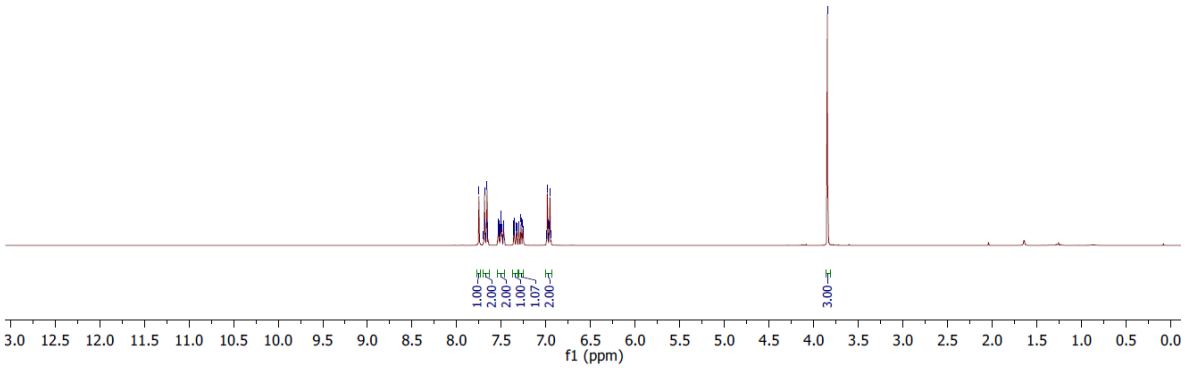
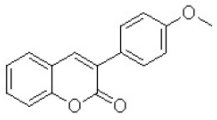
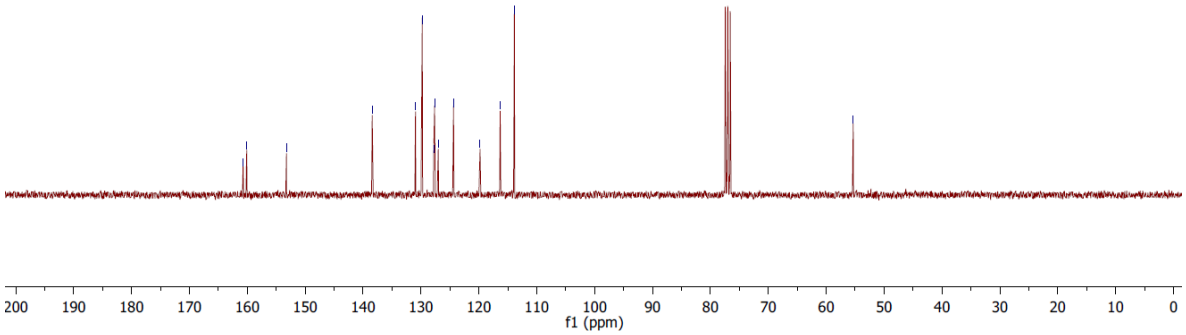
6.96
6.95
3.85



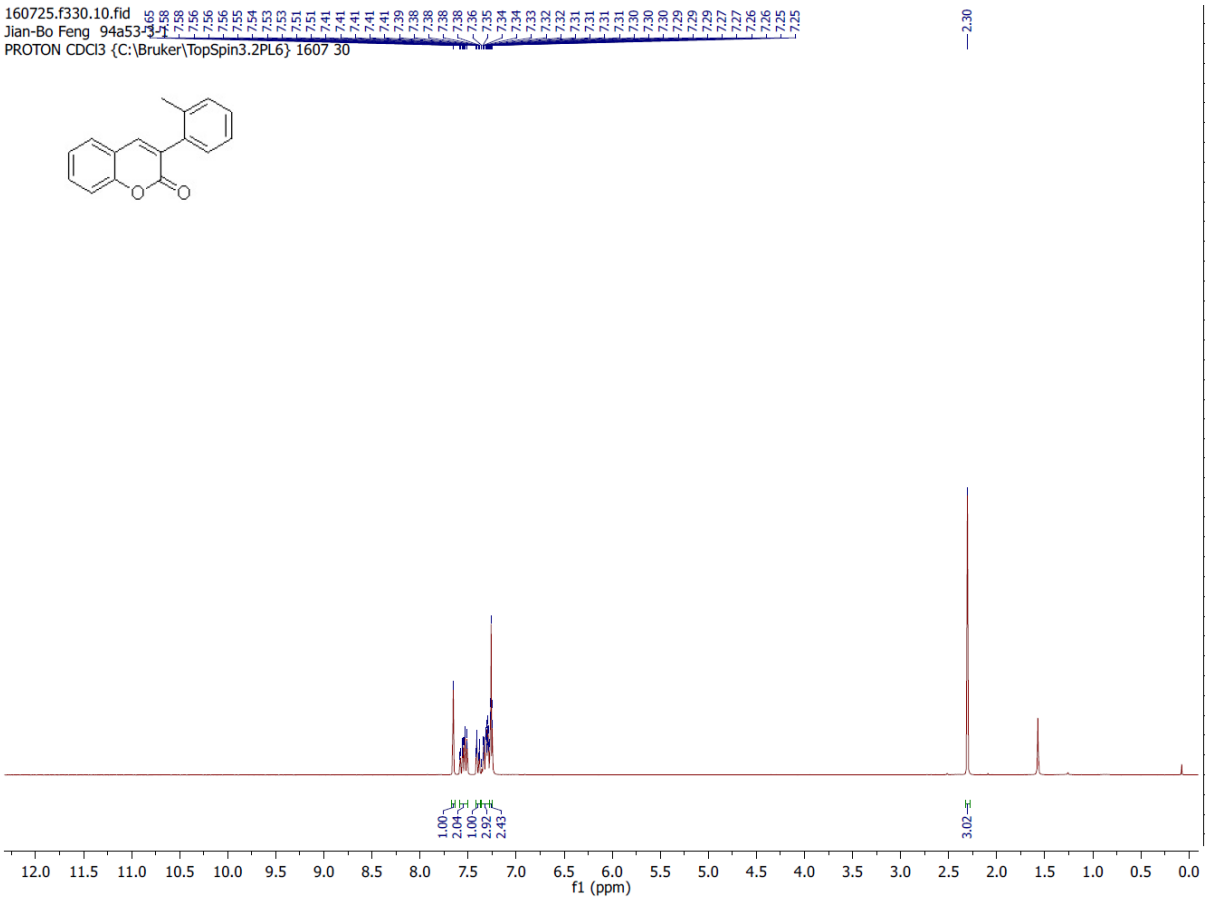


160722.f335.11.fid
Jian-Bo Feng 94a53-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 35





160725.f330.10.fid
Jian-Bo Feng 94a53-3-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 30



160725.f330.11.fid
Jian-Bo Feng 94a53-3-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 30

153.85
141.61
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134.70
131.44
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129.77
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125.90
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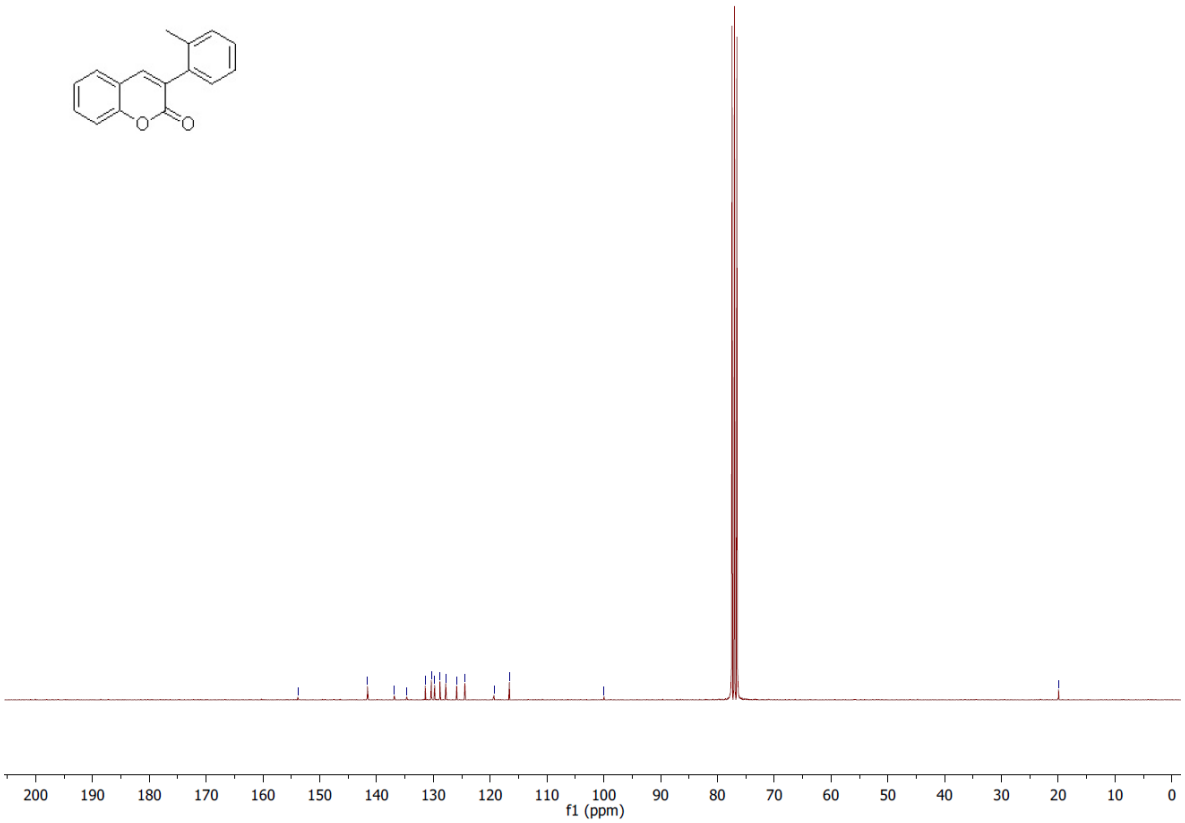
116.62
99.95
19.96



160718.f307.10.fid
Jian-Bo Feng, 94a53-5-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 7

7.67
7.53
7.52
7.52
7.50
7.49
7.49
7.44
7.44
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7.43
7.41
7.40
7.38
7.38
7.26
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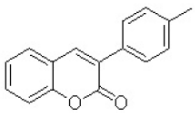
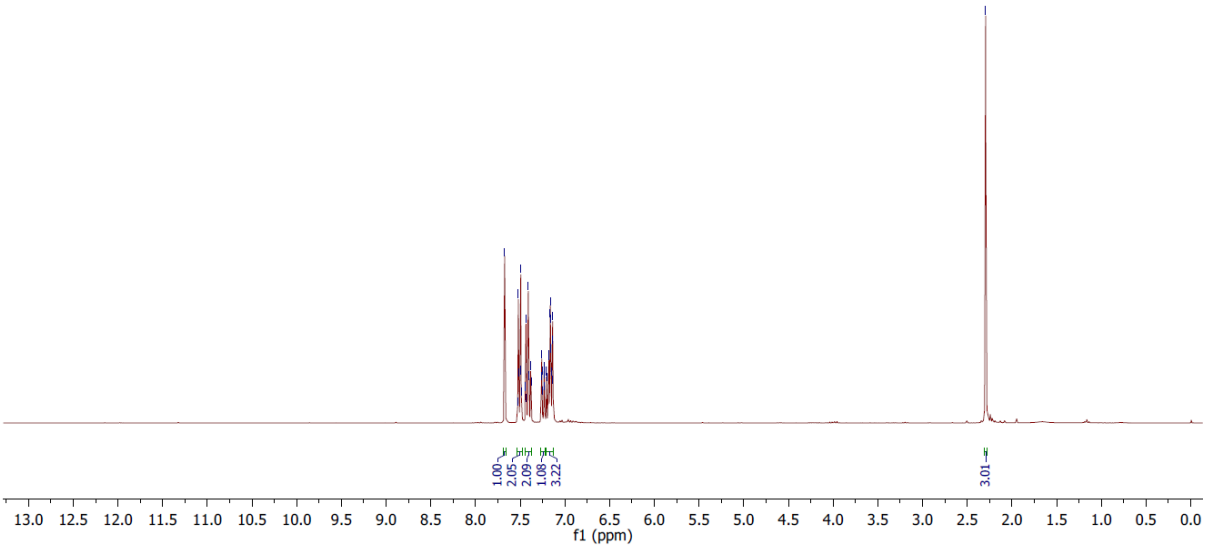
7.14
2.29





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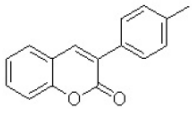
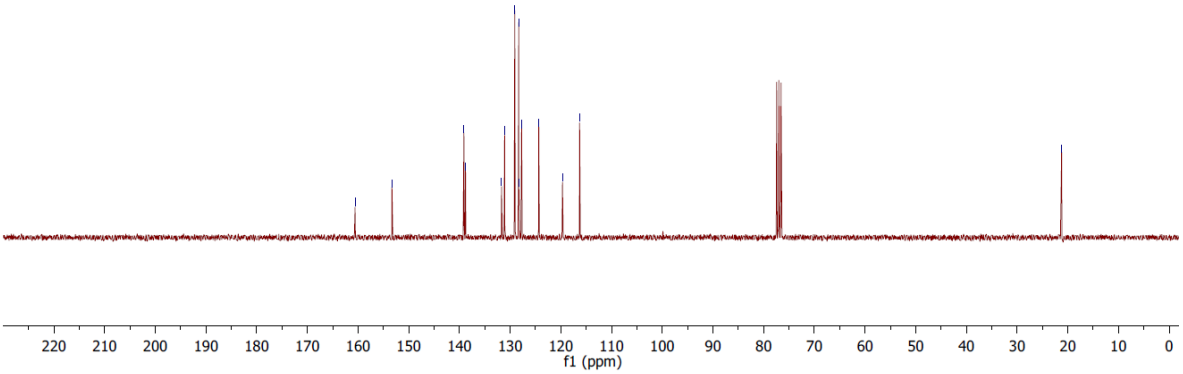
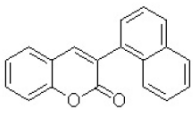
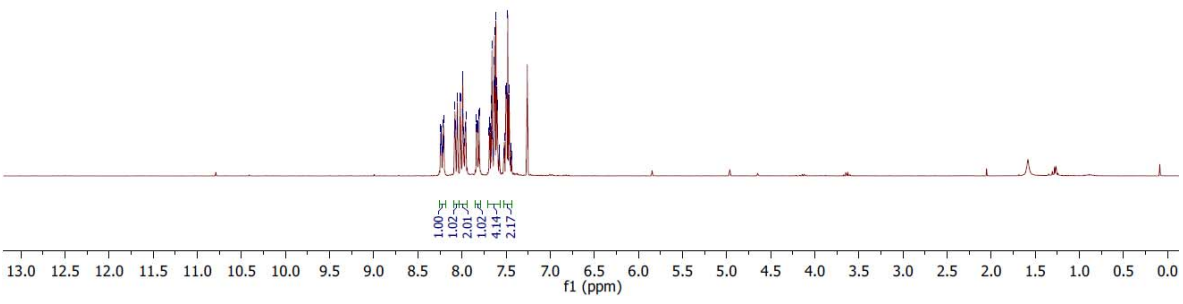
Jian-Bo Feng, 94a53-5-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 7



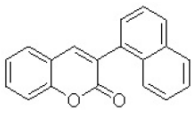


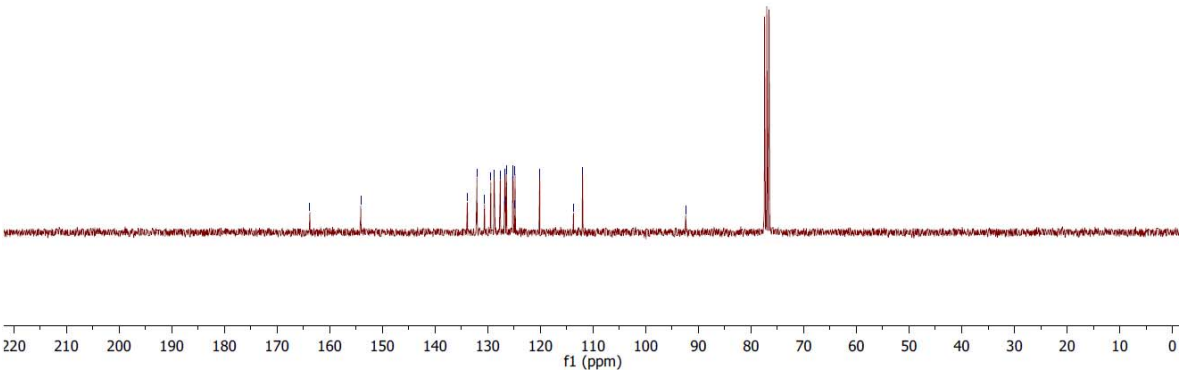
160718.f308.10.fid
Jian-Bo Feng, 94a53-6-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 8



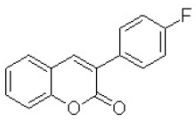


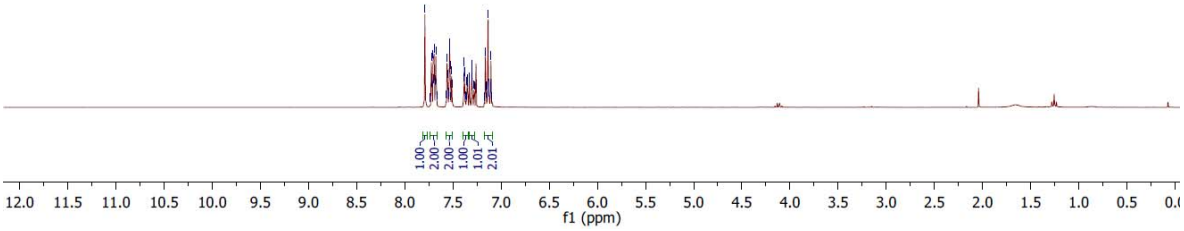
160718.f308.11.fid
Jian-Bo Feng, 94a53-6-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 8





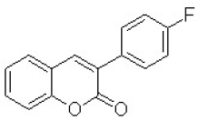
160725.f334.10.fid
Jian-Bo Feng 94a62-3-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 34

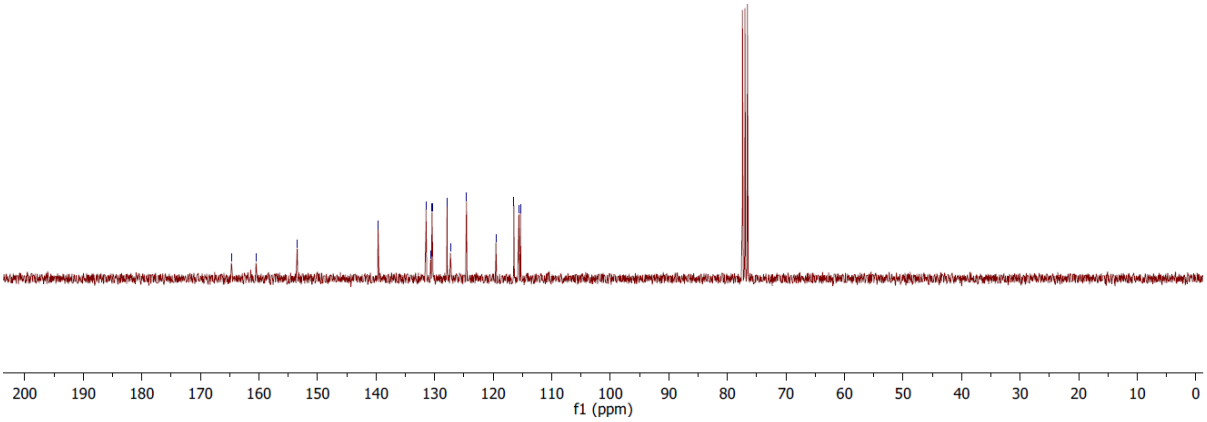




160725.f334.11.fid
Jian-Bo Feng 94a62-3-3
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 34

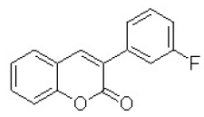
164.70 160.51 153.47 139.65 131.48 130.70 130.44 130.33 127.87 127.30 124.56 119.54 116.47 115.61 115.32

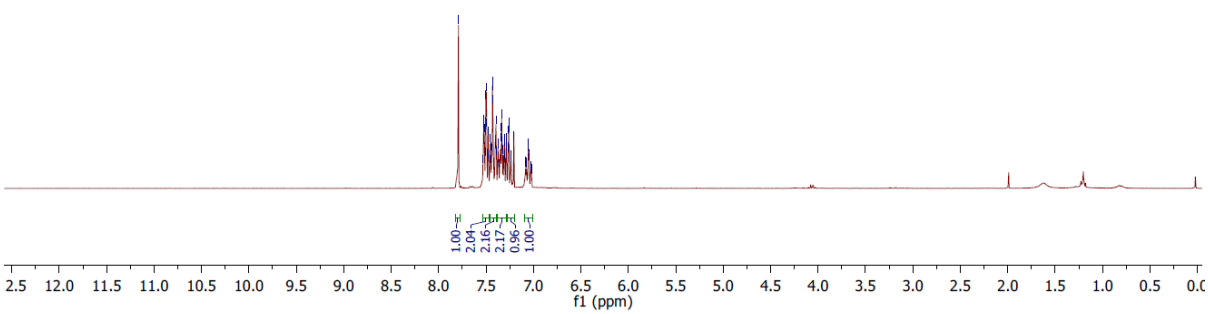




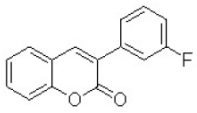
160808.330.10.fid
Jian-Bo Feng 94a862
Au1H CDCl3 /opt/topspin 1608 30

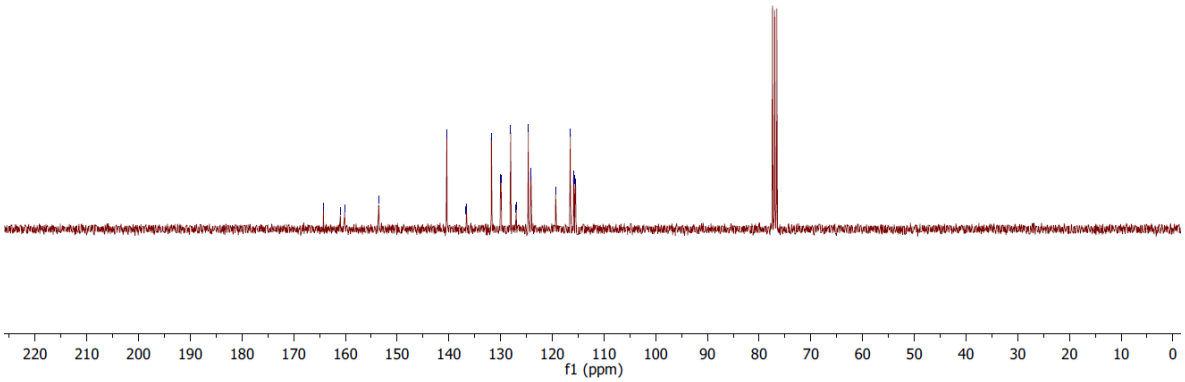
7.52 7.51 7.50 7.50 7.49 7.48 7.47 7.46 7.45 7.45 7.44 7.43 7.43 7.42 7.40 7.40 7.39 7.39 7.37 7.37 7.36 7.35 7.34 7.34 7.33 7.33 7.32 7.31 7.31 7.30 7.30 7.29 7.28 7.26 7.26 7.26 7.26 7.24 7.23 7.21 7.09 7.08 7.08 7.07 7.06 7.05 7.05 7.04 7.03 7.03 7.02 7.02



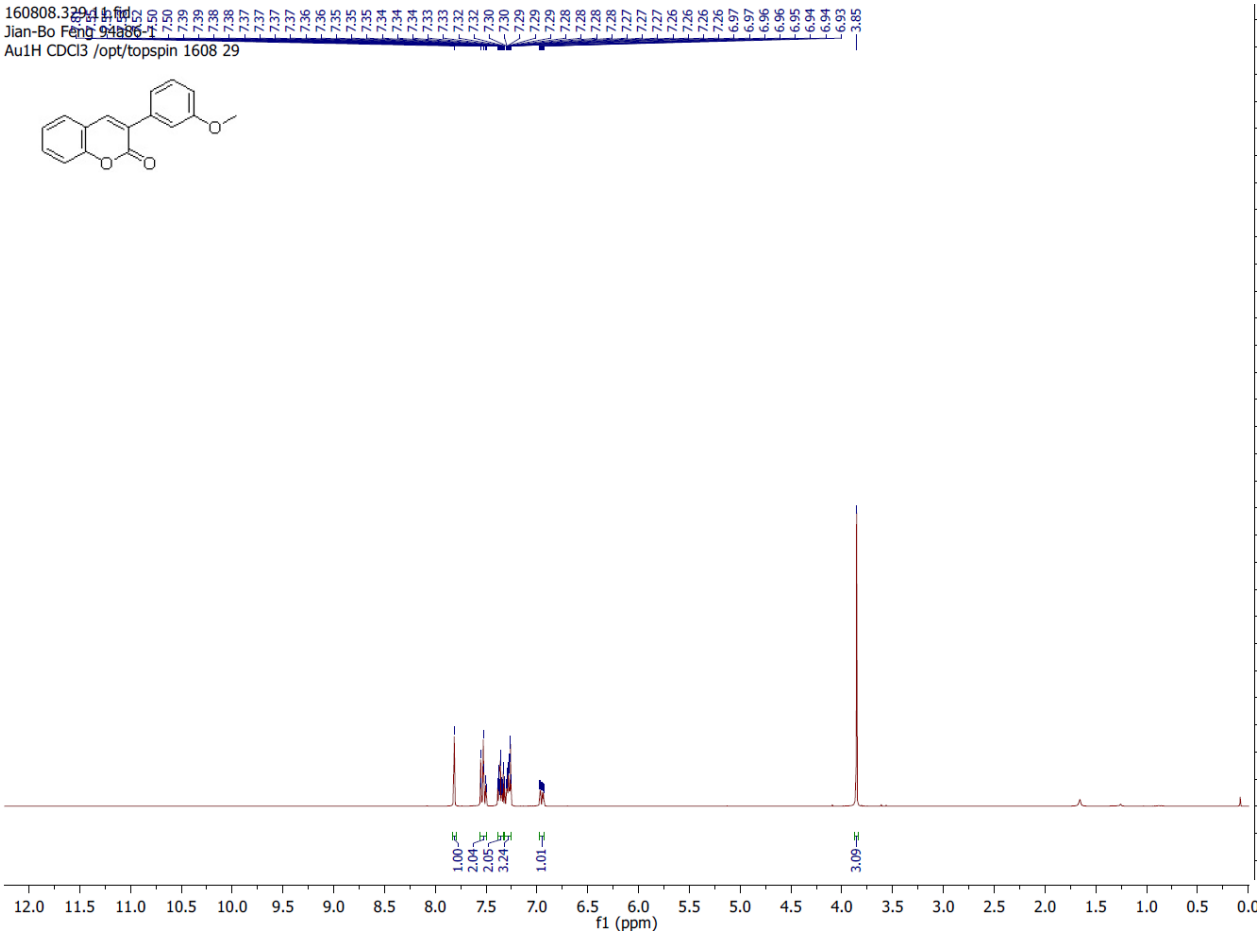


160808.330.11.fid
Jian-Bo Feng 94a86-2
Au13C CDCl3 /opt/topspin 1608 30





160808.329.11.fid
Jian-Bo Feng 94a86-1
Au1H CDCl3 /opt/topspin 1608 29



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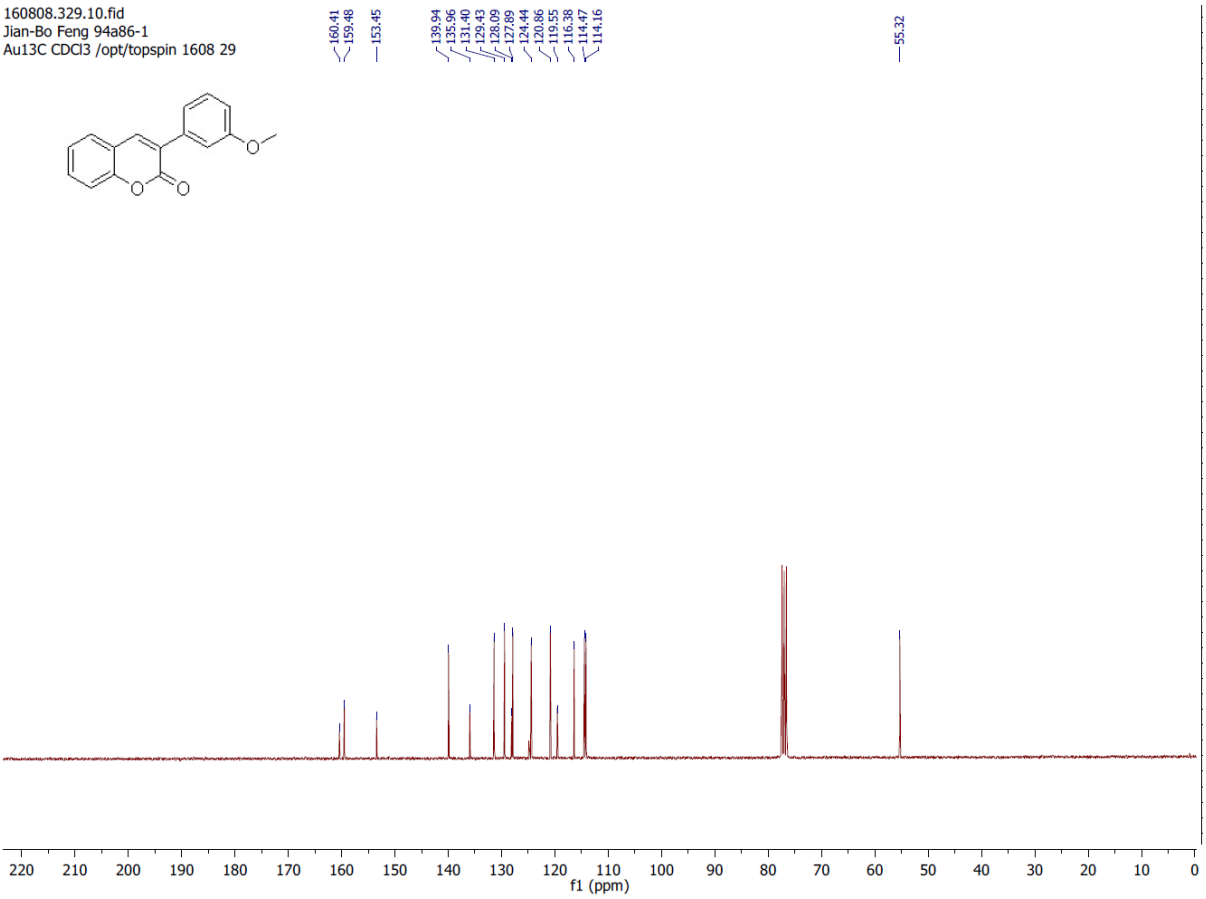
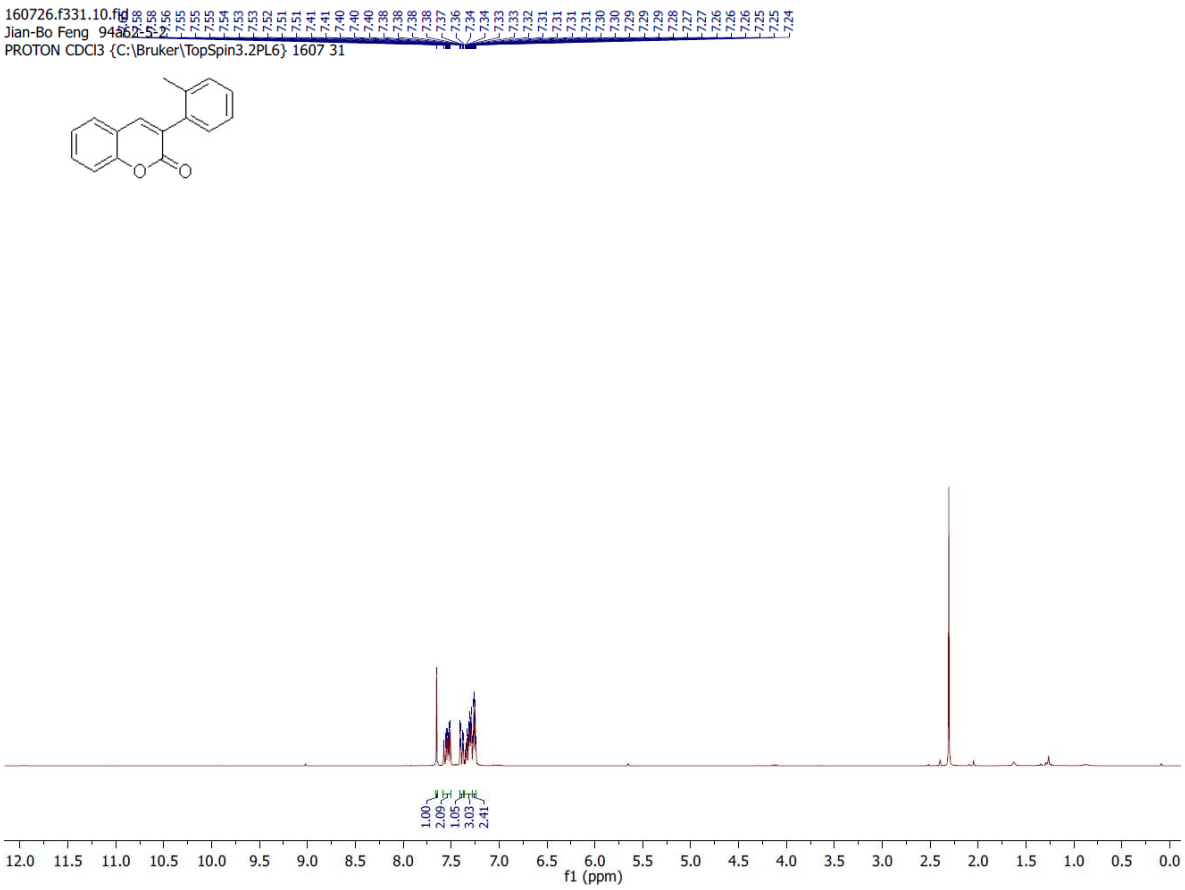
Jian-Bo Feng 94a86-1
Au13C CDCl3 /opt/topspin 1608 29



160726.f331.10.fid
Jian-Bo Feng 94a62-5-2
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 31



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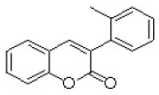
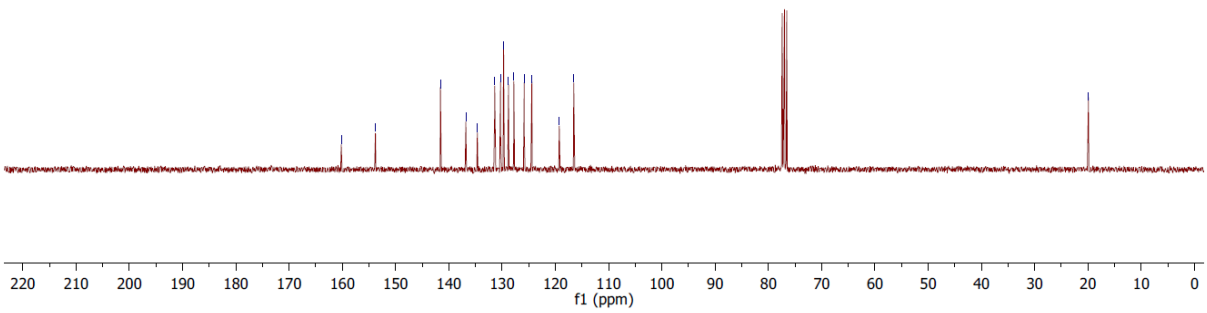
Jian-Bo Feng 94a62-5-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 31





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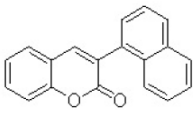
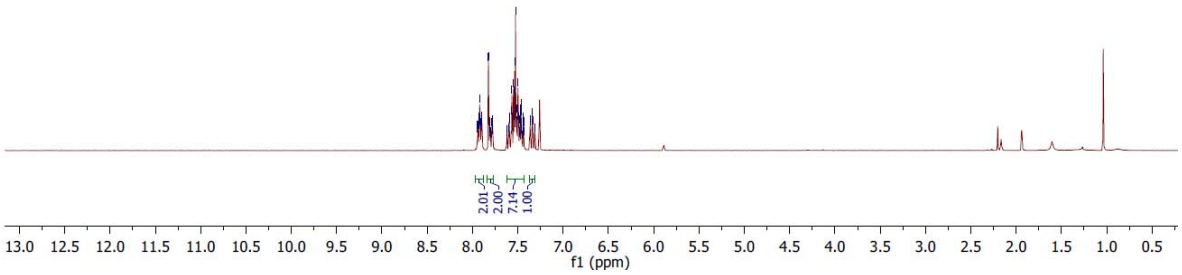
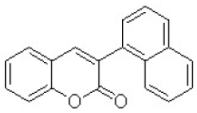
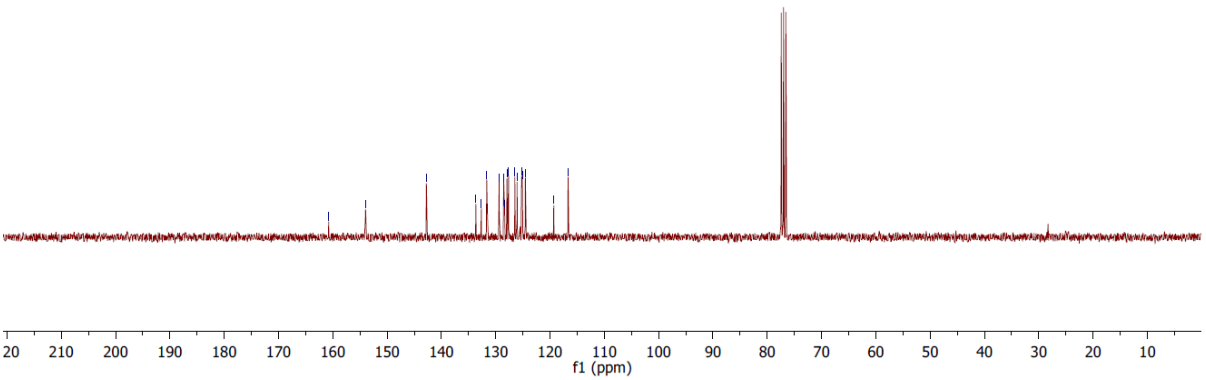
Jian-Bo Feng 94a69-1-2
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 26





160728.f326.11.fid
Jian-Bo Feng 94a69-1-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 26





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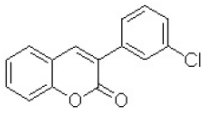
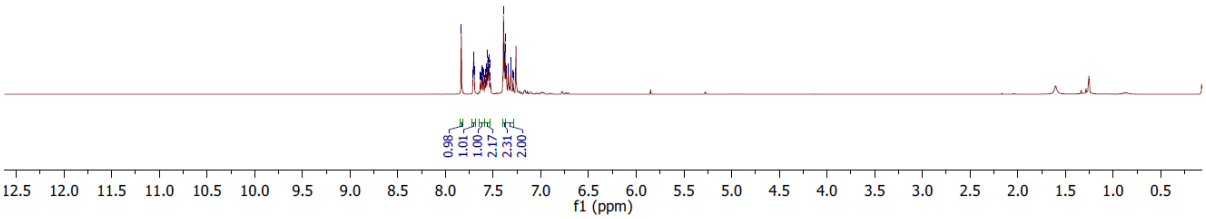
Jian-Bo Feng 94a69-2-2
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 36





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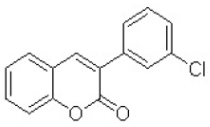
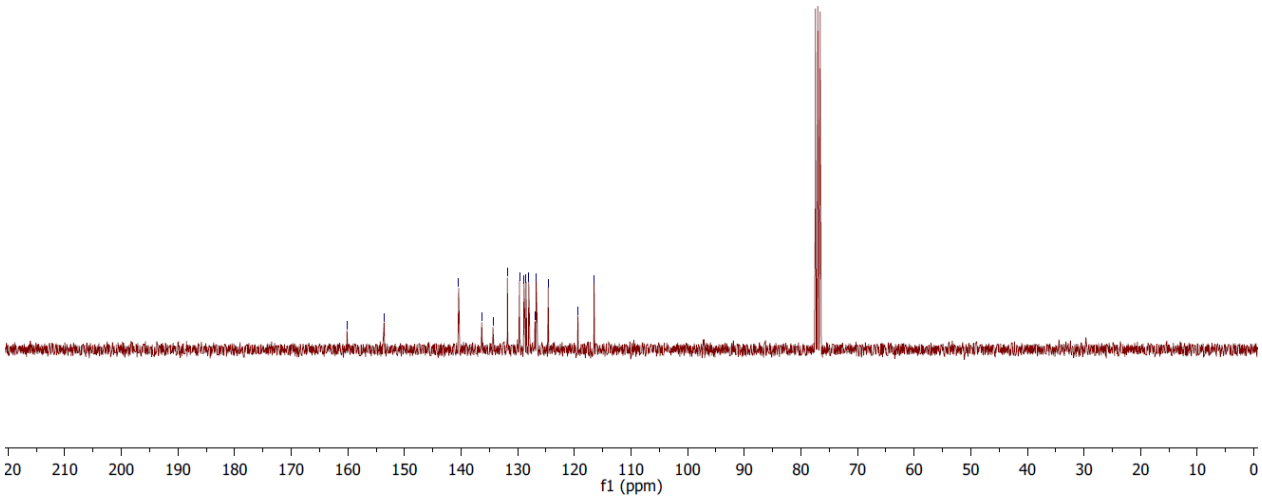
Jian-Bo Feng 94a69-2-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 36





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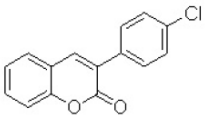
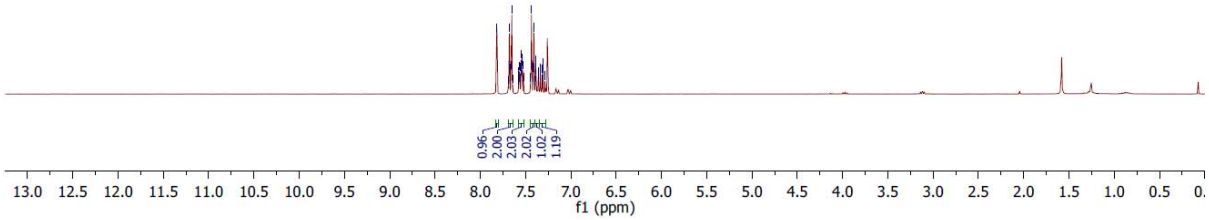
Feng/ 94a125-1
Au1H CDCl3 /opt/topspin 1609 20





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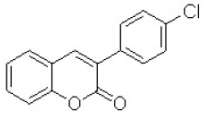
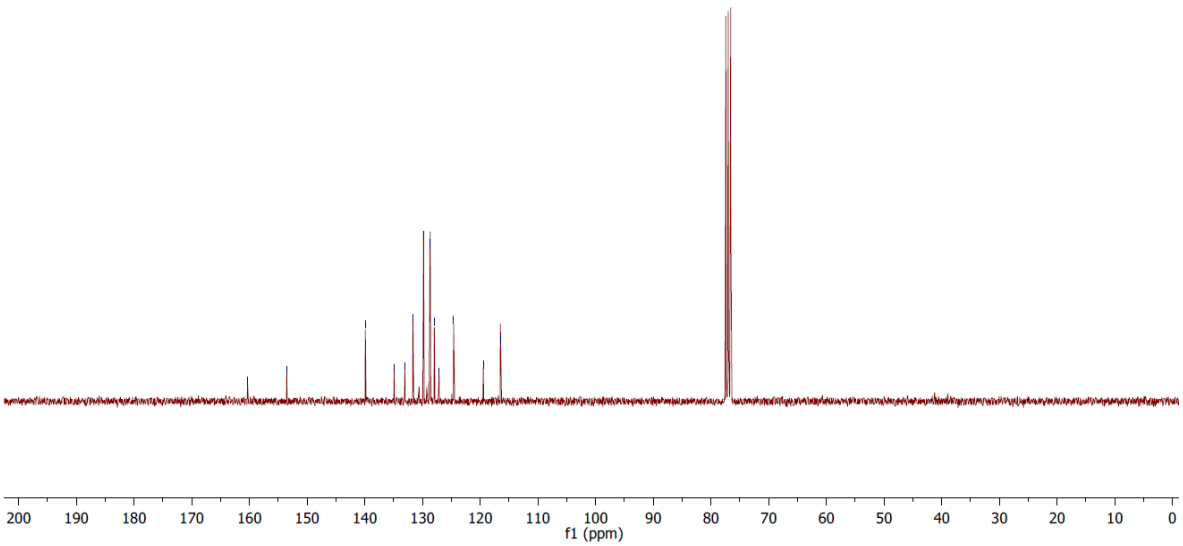
Feng/ 94a125-1
Au13C CDCl3 /opt/topspin 1609 20





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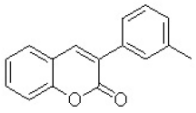
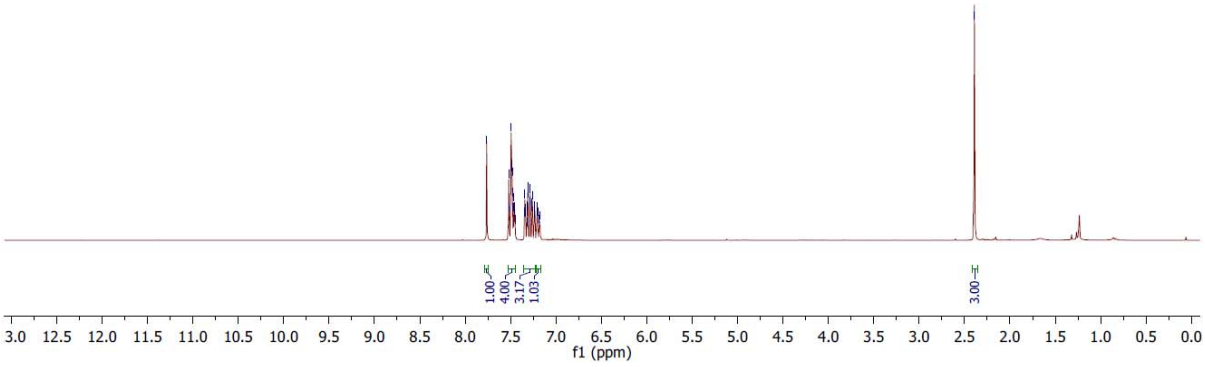
Jian-Bo Feng 94a69-3-2
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 41





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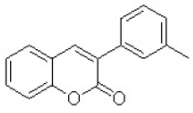
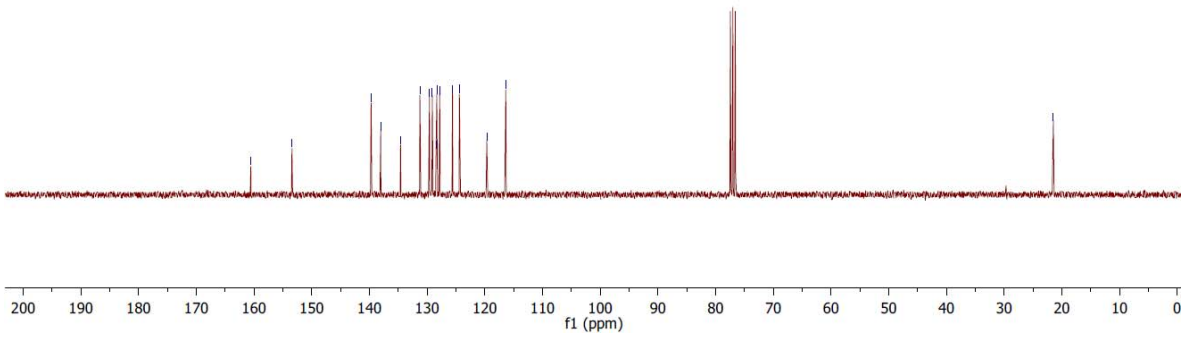
Jian-Bo Feng 94a69-3-2
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1607 41





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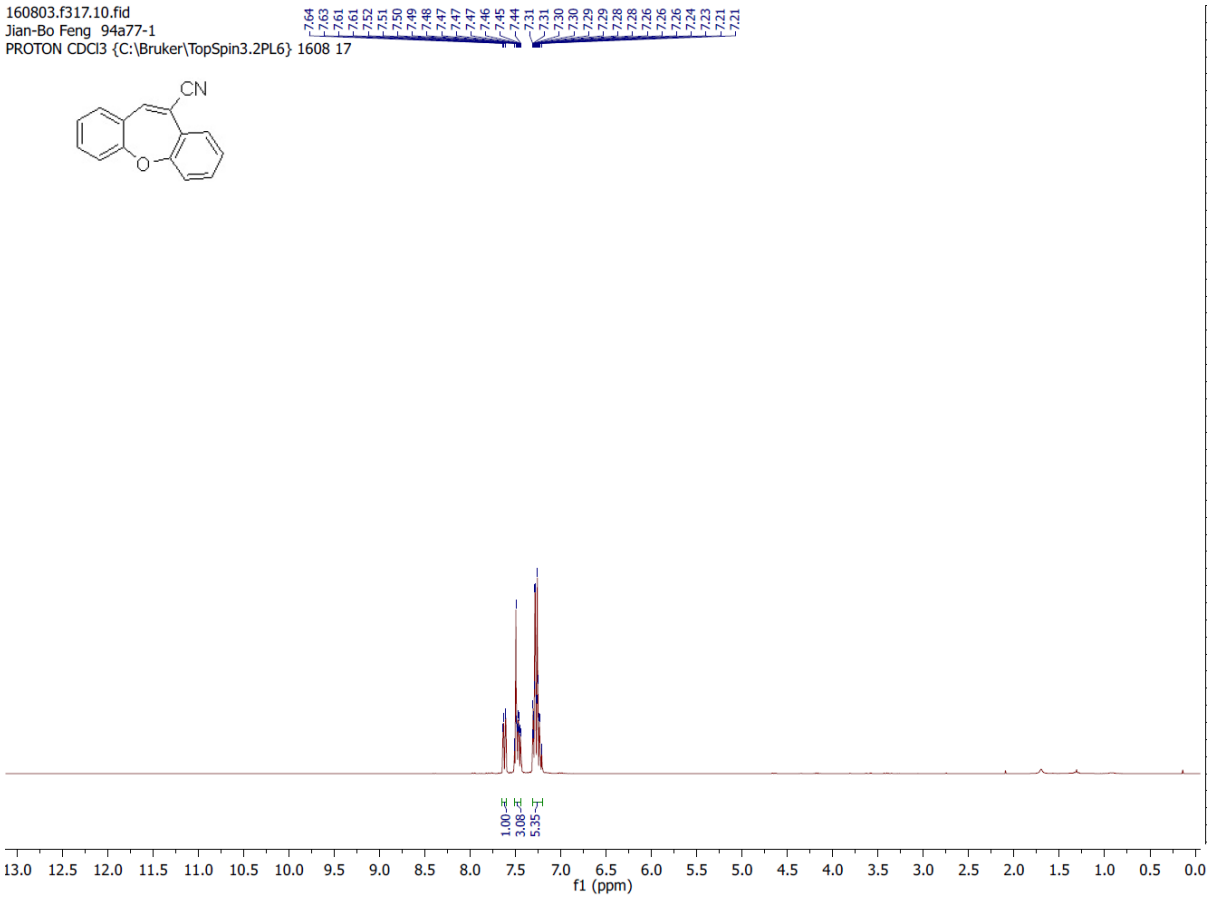
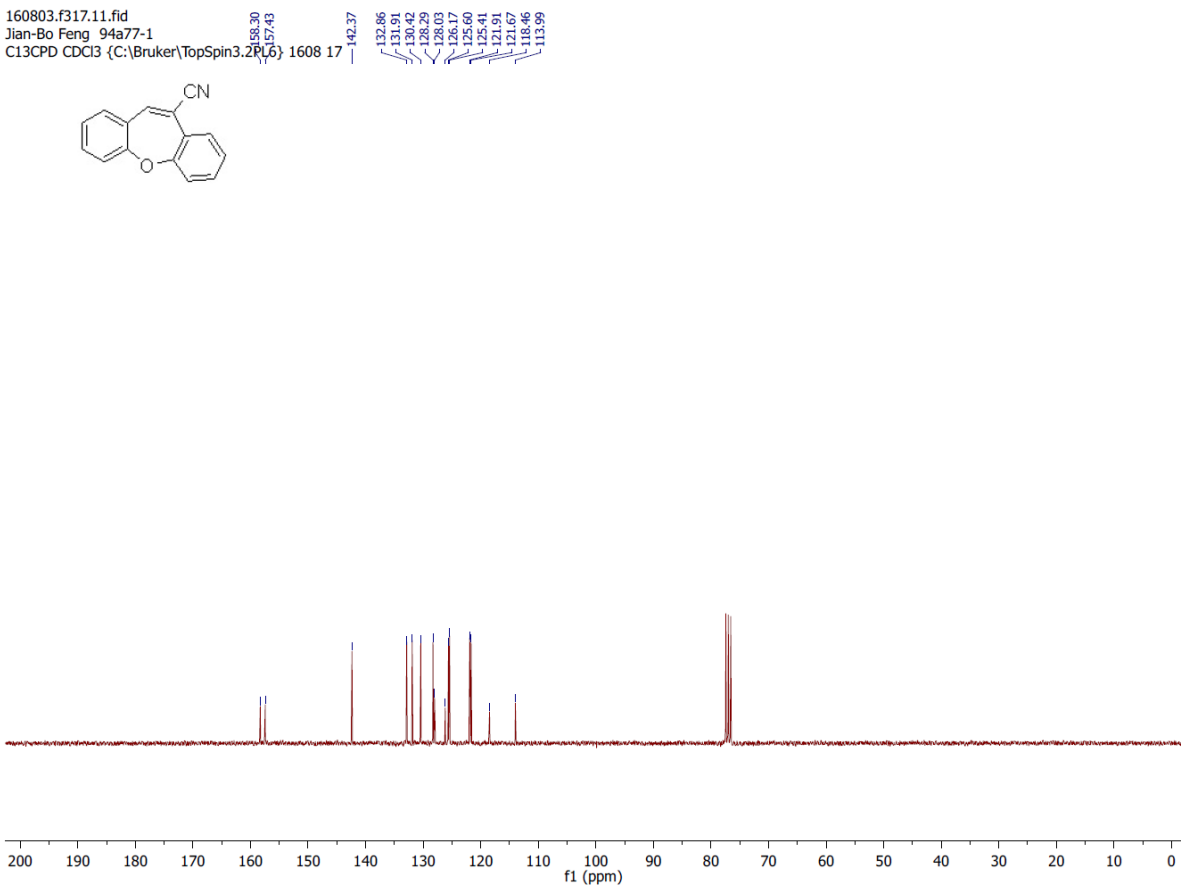
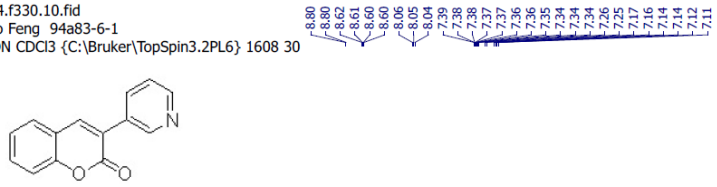
Jian-Bo Feng 94a77-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1608 17

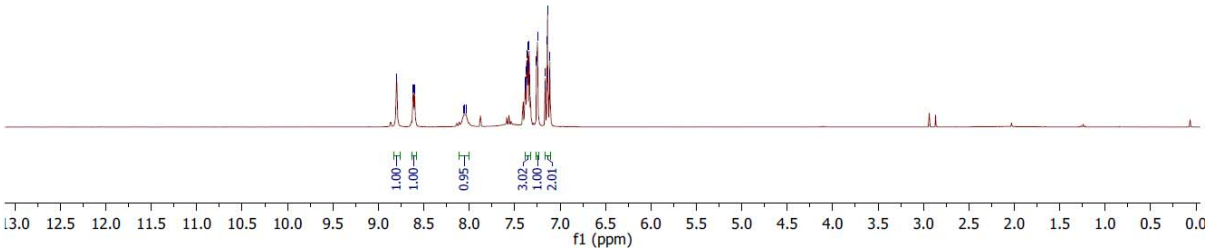


160803.f317.11.fid
Jian-Bo Feng 94a77-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1608 17

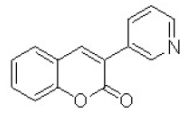


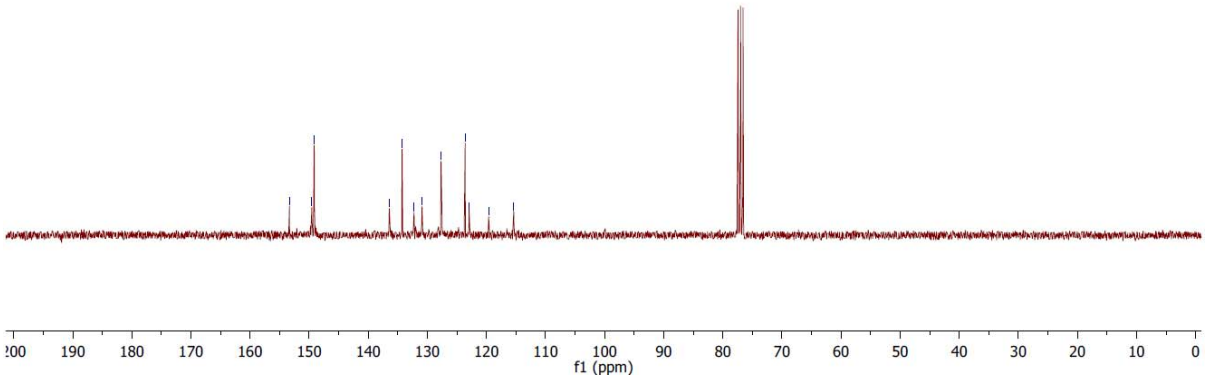
160804.f330.10.fid
Jian-Bo Feng 94a83-6-1
PROTON CDCl3 {C:\Bruker\TopSpin3.2PL6} 1608 30





160804.f330.11.fid
Jian-Bo Feng 94a83-6-1
C13CPD CDCl3 {C:\Bruker\TopSpin3.2PL6} 1608 30





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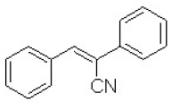

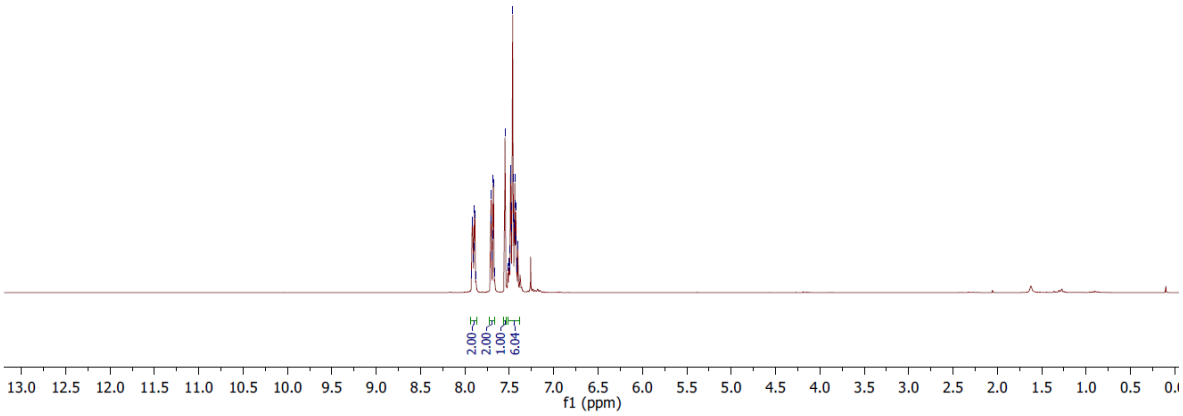

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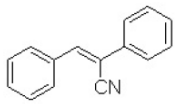

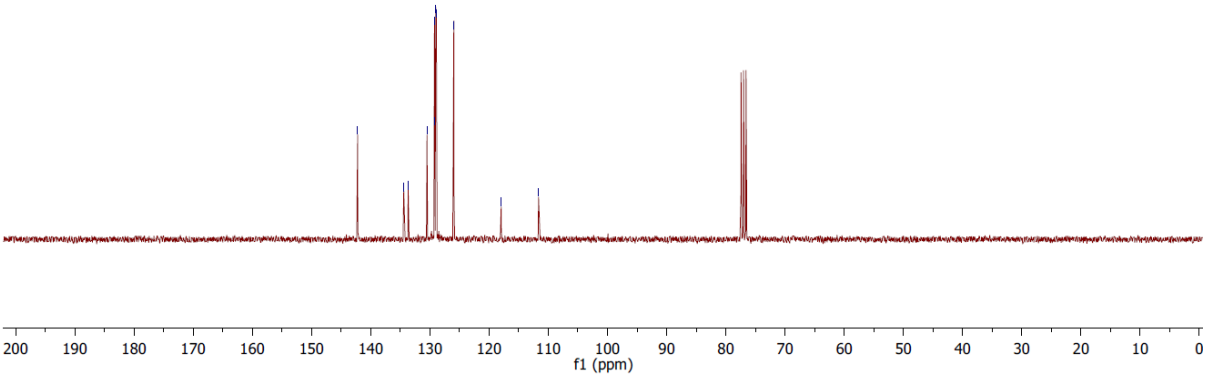

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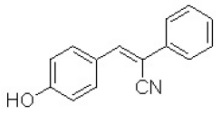

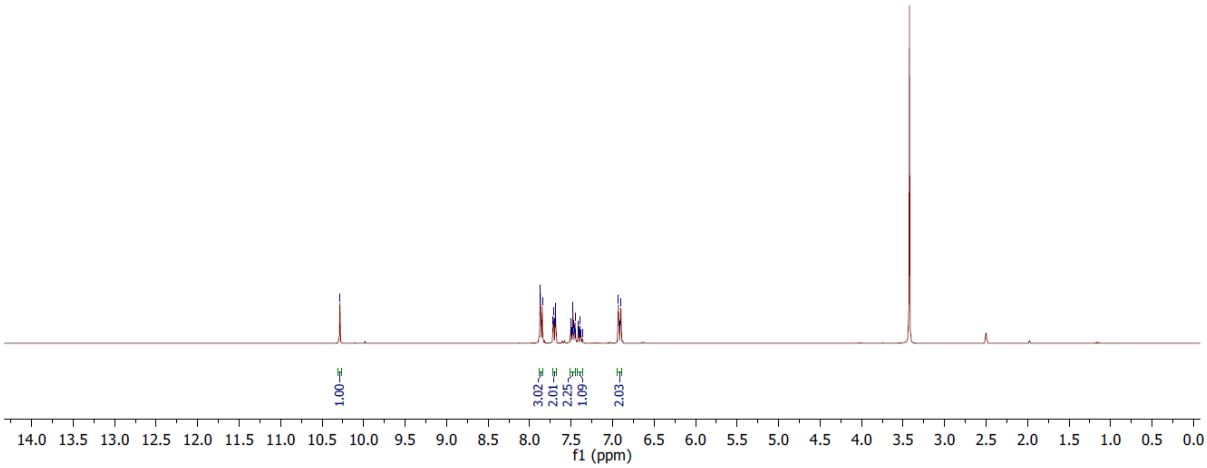

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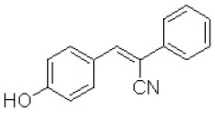

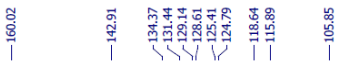

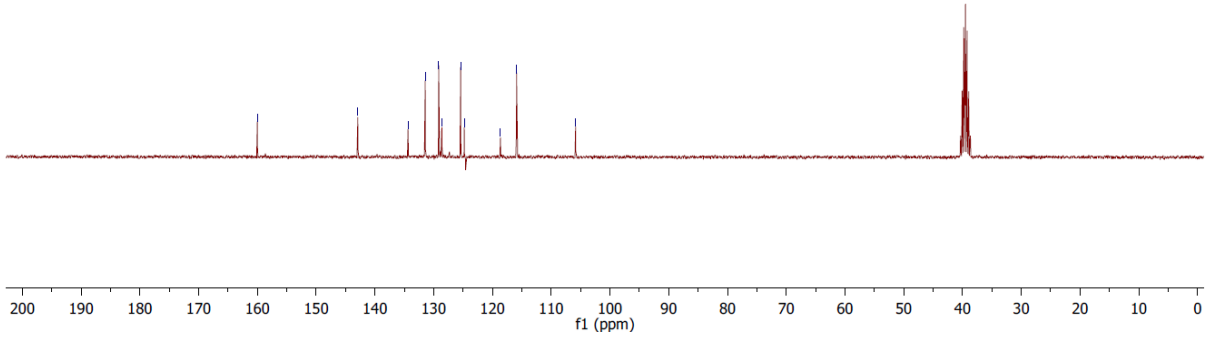

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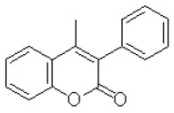

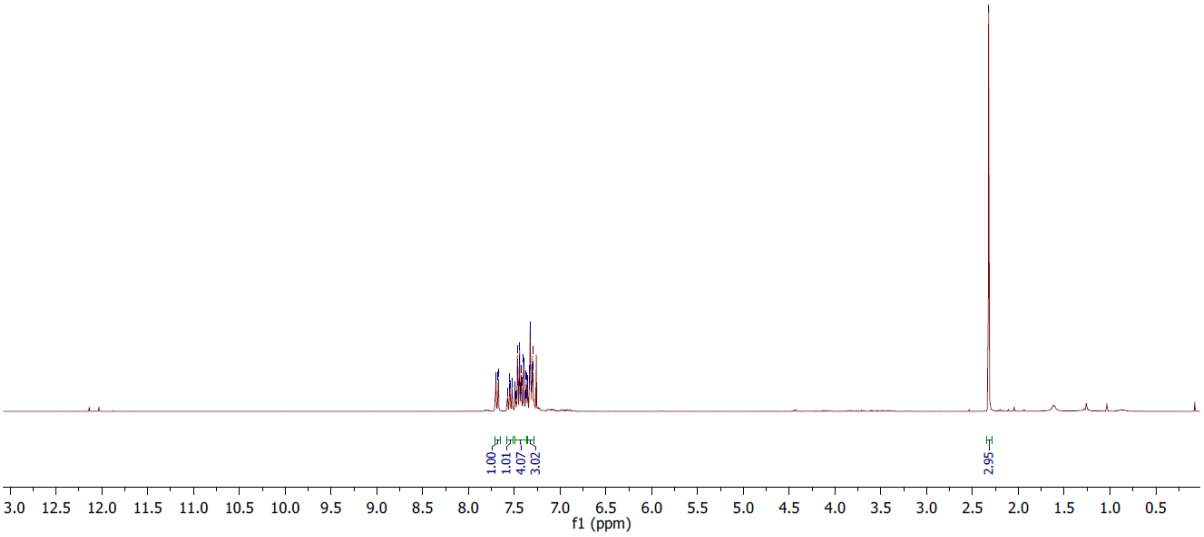

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