Supporting Information

Ruthenium-catalyzed coupling of α-carbonyl phosphoniums with sulfoxonium ylides *via* C-H activation/Wittig reaction sequences

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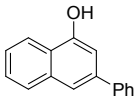
I. General Information

All reagents and solvents used in this work were obtained from commercial sources and were used without further purification. Thin-layer chromatography (TLC) was performed on silica gel GF254 (0.25 mm thickness) plates and visualized under UV light. Organic solutions were concentrated under reduced pressure at 40 °C (water bath temperature) using a Büchi rotary evaporator, unless otherwise noted. Column chromatography was performed on silica gel (200-300 mesh). ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded with Bruker Avance III HD (400 MHz, 101 MHz and 376 MHz respectively) spectrometers. NMR spectra are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quarter, m = multiplet, br = broad), coupling (*J*) constant and integration. High resolution mass spectra (HRMS) were recorded on a Waters TOFMS GCT Premier using ESI ionization. All phosphonium salts **1** were prepared according to literature reports[1].

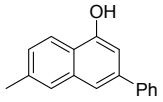
II. General Procedures for the Synthesis of 3

A suspension of arylacyl phosphonium salts **1** (0.10 mmol), sulfoxonium ylides **2** (0.15 mmol), $[RuCl_2(p\text{-cymene})]_2$ (3.1 mg, 5.0 mol %), and NaOAc (2.0 equiv.) in EtOH (1.0 mL) was stirred at 120 °C for 10 h under an ambient atmosphere of N_2. After completion, the solvent was removed under vacuum and the residue was purified by column chromatography on silica gel (n-hexane/EtOAc: 30/1~10/1) to yield the corresponding products.



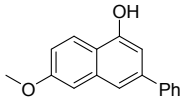
3aa: 96% yield

3-Phenylnaphthalen-1-ol (3aa): known compound[2], 21.1 mg, 96% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 7.7 Hz, 1H), 7.92 – 7.85 (m, 1H), 7.70 – 7.66 (m, 3H), 7.53 – 7.45 (m, 4H), 7.38 (t, *J* = 7.4 Hz, 1H), 7.10 (d, *J* = 1.5 Hz, 1H), 5.43 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.7, 140.9, 138.9, 134.9, 128.8, 128.0, 127.4, 127.3, 126.9, 125.3, 123.5, 121.5, 118.7, 108.4.



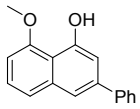
3ba: 94% yield

6-Methyl-3-phenylnaphthalen-1-ol (3ba): unknown compound, 22.0 mg, 94% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.6 Hz, 1H), 7.69-7.66 (m, 2H), 7.64 (s, 1H), 7.57 (s, 1H), 7.47 (t, *J* = 7.3 Hz, 2H), 7.38 (d, *J* = 8.1 Hz, 1H), 7.33 (d, *J* = 8.5 Hz, 1H), 7.02 (s, 1H), 5.43 (s, 1H), 2.53 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.7, 141.0, 138.9, 136.6, 135.2, 128.8, 127.6, 127.3, 127.3, 127.0, 121.7, 121.3, 118.2, 107.6, 21.7. HRMS (ESI) m/z: calcd for $C_{17}H_{14}NaO$ $[M+Na]^+$: 257.0937, found: 257.0921.



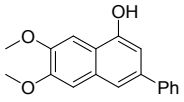
3ca: 90% yield

6-Methoxy-3-phenylnaphthalen-1-ol (3ca): unknown compound, 22.5 mg, 90% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.9 Hz, 1H), 7.67 (d, *J* = 7.2 Hz, 2H), 7.55 (s, 1H), 7.51-7.44 (m, 2H), 7.42-7.34 (m, 1H), 7.14 (d, *J* = 13.2 Hz, 2H), 6.94 (s, 1H), 3.94 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 158.5, 151.9, 141.0, 139.7, 136.4, 128.8, 127.4, 127.3, 123.3, 118.8, 117.8, 117.8, 106.5, 106.1, 55.3. HRMS (ESI) m/z: calcd for $C_{17}H_{14}NaO_2$ $[M+Na]^+$: 273.0886, found: 273.0875.



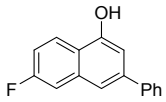
3da: 72% yield

8-Methoxy-3-phenylnaphthalen-1-ol (3da): known compound[3], 18.0 mg, 72% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.36 (s, 1H), 7.72 (d, *J* = 7.1 Hz, 2H), 7.53 (d, *J* = 1.7 Hz, 1H), 7.50-7.45 (m, 3H), 7.35 (dt, *J* = 16.0, 7.7 Hz, 2H), 7.19 (d, *J* = 1.7 Hz, 1H), 6.78 (d, *J* = 7.7 Hz, 1H), 4.08 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 156.1, 154.8, 140.6, 140.4, 136.9, 128.7, 127.5, 127.3, 126.1, 122.1, 116.9, 114.2, 109.8, 103.9, 56.1.



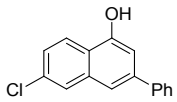
3ea: 92% yield

6,7-Dimethoxy-3-phenylnaphthalen-1-ol (3ea): unknown compound, 25.8 mg, 92% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 12.0 Hz, 2H), 7.43 (t, *J* = 7.5 Hz, 2H), 7.34 (t, *J* = 7.2 Hz, 1H), 7.16 (s, 1H), 6.97 (s, 1H), 4.05 (br, 1H), 4.02 (s, 3H), 4.01 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.0, 150.0, 148.9, 141.1, 137.3, 130.9, 128.7, 127.0, 124.9, 118.8, 117.1, 107.0, 106.6, 100.7, 55.8, 55.8. HRMS (ESI) m/z: calcd for $C_{18}H_{17}O_3$ $[M+H]^+$: 281.1172, found: 281.1190.



3fa: 83% yield

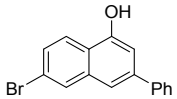
6-Fluoro-3-phenylnaphthalen-1-ol (3fa): known compound[4], 20.0 mg, 83% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19-8.15 (m, 1H), 7.62 (d, *J* = 8.0 Hz, 2H), 7.53 (s, 1H), 7.46-7.42 (m, 3H), 7.38-7.33 (m, 1H), 7.24-7.19 (m, 1H), 6.97 (s, 1H), 5.54 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 161.5 (*J* = 246.6 Hz), 151.9, 140.4 (*J* = 23.0 Hz), 136.0 (*J* = 9.7 Hz), 128.8, 127.7, 127.3, 124.5 (*J* = 9.3 Hz), 120.6, 118.0, 118.0, 115.4 (*J* = 25.2 Hz), 111.0 (*J* = 20.6 Hz), 107.7 (*J* = 2.2 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -114.0.



3ga: 85% yield

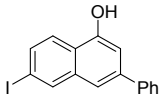
6-Chloro-3-phenylnaphthalen-1-ol (3ga): unknown compound, 21.6 mg, 85% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.9 Hz, 1H), 7.84-7.82 (m, 1H), 7.65 (d, *J* = 7.4 Hz, 2H), 7.54 (s, 1H), 7.49-7.45 (m, 2H), 7.43-7.30 (m, 2H), 7.04 (s, 1H), 5.52 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.8, 140.4, 140.3, 135.7, 132.8,

128.9, 127.7, 127.3, 126.5, 126.0, 123.5, 121.8, 117.8, 108.6. HRMS (ESI) m/z: calcd for $C_{16}H_{13}ClO$ $[M+H]^+$: 255.0571, found: 255.0580.



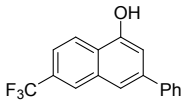
3ha: 93% yield

6-Bromo-3-phenylnaphthalen-1-ol (3ha): known compound[4], 28.0 mg, 93% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.9 Hz, 1H), 8.01 (d, *J* = 2.0 Hz, 1H), 7.66-7.64 (m, 2H), 7.56-7.52 (m, 2H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.42-7.36 (m, 1H), 7.08 (d, *J* = 1.6 Hz, 1H), 5.46 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 140.5, 140.3, 136.1, 129.9, 128.9, 128.5, 127.8, 127.3, 123.6, 122.0, 121.2, 117.7, 108.8.



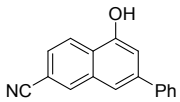
3ia: 81% yield

6-Iodo-3-phenylnaphthalen-1-ol (3ia): unknown compound, 28.0 mg, 81% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26-8.23 (m, 1H), 7.92 (d, *J* = 8.8 Hz, 1H), 7.71 (dd, *J* = 8.8, 1.7 Hz, 1H), 7.67-7.62 (m, 2H), 7.51-7.44 (m, 3H), 7.41-7.36 (m, 1H), 7.08 (d, *J* = 1.5 Hz, 1H), 5.47 (br, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 140.4, 140.0, 136.5, 136.5, 133.7, 128.9, 127.7, 127.3, 123.4, 122.3, 117.5, 108.9, 93.1. HRMS (ESI) m/z: calcd for $C_{16}H_{12}IO$ $[M+H]^{+\cdot}$: 346.9927, found: 346.9939.



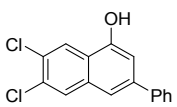
3ja: 66% yield

3-Phenyl-6-(trifluoromethyl)naphthalen-1-ol (3ja): unknown compound, 19.0 mg, 66% yield, yellow solid; ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.31 (d, *J* = 8.5 Hz, 1H), 8.16 (s, 1H), 7.72 (s, 1H), 7.69-7.60 (m, 3H), 7.52-7.47 (m, 2H), 7.43-7.39 (m, 1H), 7.19-7.17 (m, 1H), 5.55 (s, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ13C NMR (101 MHz, cdcl3) δ 151.7, 140.4, 140.2, 133.8, 129.0, 128.6, 127.9, 127.3, 125.7, 125.57 (q, *J* = 4.6 Hz), 124.7, 123.1, 120.74 (q, *J* = 3.0 Hz), 119.3, 110.3. HRMS (ESI) m/z: calcd for $C_{17}H_{12}F_3O$ $[M+H]^+$: 289.0835, found: 289.0834.



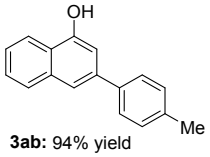
3ka: 78% yield

5-Hydroxy-7-phenyl-2-naphthonitrile (3ka): unknown compound, 19.1 mg, 78% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.76 (s, 1H), 8.53 (s, 1H), 8.26 (d, *J* = 8.9 Hz, 1H), 7.80 (s, 1H), 7.73-7.68 (m, 3H), 7.55-7.49 (m, 2H), 7.44 (d, *J* = 6.8 Hz, 1H), 7.34 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 153.8, 140.2, 139.7, 134.3, 133.6, 129.1, 128.0, 126.9, 125.1, 125.0, 123.6, 119.3, 116.7, 110.2, 109.1. HRMS (ESI) m/z: calcd for $C_{17}H_{12}NO$ $[M+H]^+$: 246.0913, found: 246.0912.



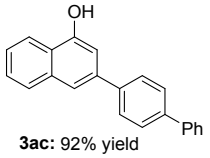
3la: 54% yield

6,7-Dichloro-3-phenylnaphthalen-1-ol (3la): unknown compound, 15.6 mg, 54% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 9.0 Hz, 1H), 8.06 (s, 1H), 7.70 (d, *J* = 7.4 Hz, 2H), 7.52-7.46 (m, 3H), 7.41 (t, *J* = 7.3 Hz, 1H), 7.13 (s, 1H), 5.46 (br, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.0, 140.3, 139.4, 132.4, 130.7, 128.4, 128.0, 127.0, 126.5, 125.4, 121.9, 120.8, 114.6, 108.2. HRMS (ESI) m/z: calcd for $C_{16}H_9Cl_2O$ [M-H]$^-$: 287.0030, found: 287.0036.



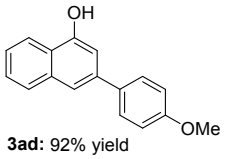
3ab: 94% yield

3-(*p*-Tolyl)naphthalen-1-ol (3ab): known compound[2], 22.0 mg, 94% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18-8.15 (m, 1H), 7.87-7.83 (m, 1H), 7.64-7.64 (m, 1H), 7.61-7.56 (m, 2H), 7.54-7.45 (m, 2H), 7.32-7.26 (m, 2H), 7.09 (d, *J* = 1.6 Hz, 1H), 5.36 (br, 1H), 2.42 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.7, 138.8, 138.0, 137.3, 135.0, 129.5, 127.9, 127.1, 126.8, 125.1, 123.4, 121.4, 118.4, 108.3, 21.1.



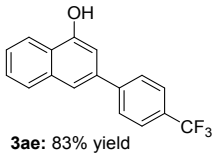
3ac: 92% yield

3-([1,1'-Biphenyl]-4-yl)naphthalen-1-ol (3ac): known compound[4], 27.3 mg, 92% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, *J* = 8.0 Hz, 1H), 7.92-7.84 (m, 1H), 7.79-7.74 (m, 2H), 7.73-7.64 (m, 5H), 7.56-7.45 (m, 4H), 7.39-7.35 (m, 1H), 7.15 (s, 1H), 5.49 (br, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.8, 140.6, 140.3, 139.8, 138.3, 135.0, 128.8, 128.0, 127.6, 127.5, 127.4, 127.0, 126.9, 125.3, 123.6, 121.5, 118.6, 108.2.



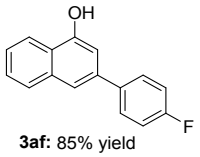
3ad: 92% yield

3-(4-Methoxyphenyl)naphthalen-1-ol (3ad): known compound[2], 23.0 mg, 92% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 7.9 Hz, 1H), 7.85 (d, *J* = 7.7 Hz, 1H), 7.61 (d, *J* = 8.8 Hz, 3H), 7.53-7.44 (m, 2H), 7.09-6.98 (m, 3H), 5.57 (br, 1H), 3.87 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.2, 151.7, 138.5, 135.0, 133.4, 128.4, 127.9, 126.8, 125.0, 123.3, 121.4, 117.9, 114.3, 108.2, 55.4.



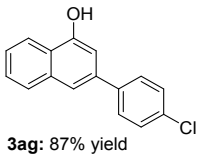
3ae: 83% yield

3-(4-(Trifluoromethyl)phenyl)naphthalen-1-ol (3ae): known compound[2], 23.9 mg, 83% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23-8.17 (m, 1H), 7.90-7.85 (m, 1H), 7.78 (d, *J* = 8.2 Hz, 2H), 7.72 (d, *J* = 8.3 Hz, 2H), 7.67 (s, 1H), 7.57-7.49 (m, 2H), 7.08 (d, *J* = 1.6 Hz, 1H), 5.43 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 152.0, 144.4, 137.3, 134.8, 129.4 (q, *J* = 32.5Hz), 128.1, 127.5, 127.1, 125.9, 125.73 (q, *J* = 3.8 Hz), 123.9, 122.9, 121.5, 119.3, 108.0. ^{19}F NMR (377 MHz, $CDCl_3$) δ -62.4.



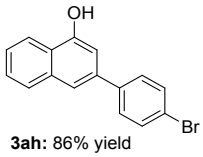
3af: 85% yield

3-(4-Fluorophenyl)naphthalen-1-ol (3af): known compound[2], 20.3 mg, 85% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ1H NMR (400 MHz, Chloroform-d) δ 8.20-8.13 (m, 1H), 7.89-7.83 (m, 1H), 7.67-7.57 (m, 3H), 7.54-7.45 (m, 2H), 7.20-7.12 (m, 2H), 7.04 (d, *J* = 1.5 Hz, 1H), 5.40 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ162.5 (d, *J* = 246.7 Hz), 151.8, 137.9, 137.0, 134.9, 128.8, 128.8 (d, *J* = 8.1 Hz), 128.0, 127.0, 125.4, 123.5, 121.4, 118.6, 115.7 (d, *J* = 21.4 Hz), 108.2. ^{19}F NMR (377 MHz, $CDCl_3$) δ -115.4.



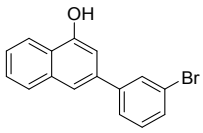
3ag: 87% yield

3-(4-Chlorophenyl)naphthalen-1-ol (3ag): known compound[2], 22.2 mg, 87% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.18 (d, *J* = 7.9 Hz, 1H), 7.86 (d, *J* = 7.7 Hz, 1H), 7.60 (d, *J* = 9.2 Hz, 3H), 7.55-7.47 (m, 2H), 7.46-7.40 (m, 2H), 7.03 (s, 1H), 5.46 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 139.3, 137.6, 134.9, 133.5, 129.0, 128.5, 128.0, 127.1, 125.5, 123.6, 121.5, 118.7, 108.0.



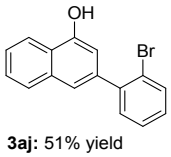
3ah: 86% yield

3-(4-Bromophenyl)naphthalen-1-ol (3ah): known compound[4], 25.7 mg, 86% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ1H NMR (400 MHz, Chloroform-d) δ 8.17 (d, *J* = 8.4 Hz, 1H), 7.87-7.82 (m, 1H), 7.62-7.57 (m, 3H), 7.56-7.47 (m, 4H), 7.04 (d, *J* = 1.6 Hz, 1H), 5.37 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 139.8, 137.6, 134.9, 131.9, 128.9, 128.0, 127.1, 125.6, 123.7, 121.7, 121.5, 118.7, 107.9.



3ai: 80% yield

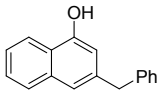
3-(3-Bromophenyl)naphthalen-1-ol (3ai): known compound[2], 23.9 mg, 80% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22-8.14 (m, 1H), 7.89-7.79 (m, 2H), 7.66-7.44 (m, 5H), 7.37-7.29 (m, 1H), 7.05 (d, *J* = 1.6 Hz, 1H), 5.42 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.9, 143.1, 137.3, 134.8, 130.4, 130.3, 130.3, 128.1, 127.1, 125.9, 125.7, 123.8, 122.9, 121.5, 118.9, 108.0.



3aj: 51% yield

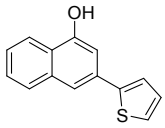
3-(2-Bromophenyl)naphthalen-1-ol (3aj): known compound[5], 15.3 mg, 51% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22-8.18 (m, 1H), 7.71-7.67 (m, 1H), 7.69 (d, *J* = 7.6 Hz, 1H), 7.54-7.50 (m, 2H), 7.44 (s, 1H),

7.42-7.35 (m, 2H), 7.25-7.20 (m, 1H), 6.92 (d, J = 1.3 Hz, 1H), 5.38 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 150.8, 142.2, 138.8, 134.4, 133.1, 131.4, 128.9, 128.0, 127.4, 126.8, 125.6, 123.6, 121.6, 121.2, 110.5.



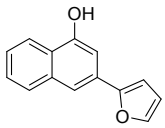
3ak: 84% yield

3-Benzylnaphthalen-1-ol (3ak): known compound[6], 19.7 mg, 84% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12-8.09 (m, 1H), 7.76-7.7 (m, 1H), 7.50-7.41 (m, 2H), 7.32-7.27 (m, 3H), 7.24-7.20 (m, 3H), 6.63 (d, J = 1.4 Hz, 1H), 5.15 (s, 1H), 4.07 (s, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.4, 140.8, 139.0, 134.8, 129.0, 128.5, 127.3, 126.6, 126.2, 124.8, 123.1, 121.4, 120.0, 110.1, 42.1.



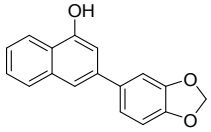
3al: 90% yield

3-(Thiophen-2-yl)naphthalen-1-ol (3al): known compound[2], 20.4 mg, 90% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, J = 8.0 Hz, 1H), 7.84 (d, J = 8.0 Hz, 1H), 7.61 (d, J = 8.0 Hz, 3H), 7.50 – 7.44 (m, 2H), 7.06 – 6.99 (m, 3H), 5.57 (br, 1H), 3.87 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 159.2, 151.7, 138.5, 135.0, 133.4, 128.3, 127.9, 126.8, 125.0, 123.3, 121.4, 118.0, 114.3, 108.2, 55.4.



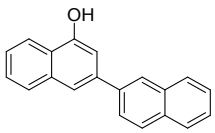
3am: 87% yield

3-(Turan-2-yl)naphthalen-1-ol (3am): known compound[2], 18.3 mg, 87% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, J = 8.1 Hz, 1H), 7.84-7.79 (m, 1H), 7.76 (s, 1H), 7.52-7.42 (m, 3H), 7.15-7.12 (m, 1H), 6.72 (d, J = 3.4 Hz, 1H), 6.53-6.49 (m, 1H), 5.38 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 153.8, 151.7, 142.3, 134.9, 128.4, 128.0, 127.0, 125.3, 123.8, 121.5, 115.3, 111.8, 105.6, 104.9.



3an: 88% yield

3-(Benzo[*d*][1,3]dioxol-5-yl)naphthalen-1-ol (3an): unknown compound, 23.3 mg, 88% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.59-7.43 (m, 3H), 7.16-7.13 (m, 2H), 7.04-6.98 (m, 1H), 6.91 (d, J = 7.9 Hz, 1H), 6.02 (s, 2H), 5.42 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.7, 148.1, 147.2, 138.6, 135.3, 134.9, 127.9, 126.9, 125.1, 123.4, 121.4, 120.8, 118.2, 108.6, 108.3, 107.8, 101.2. HRMS (ESI) m/z: calcd for $C_{17}H_{11}O_3$ $[M-H]^-$: 263.0708, found: 263.0713.

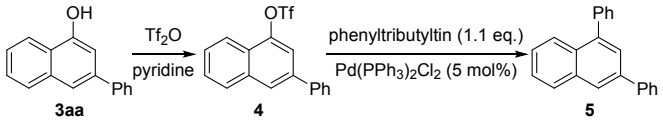


3ao: 90% yield

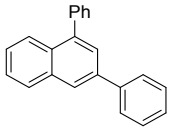
[2,2'-Binaphthalen]-4-ol (3ao): known compound[2], 24.3 mg, 90% yield, yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22-8.19 (m, 1H), 8.13 (d, *J* = 1.7 Hz, 1H), 7.96-7.88 (m, 4H), 7.86-7.83 (m, 1H), 7.79 (s, 1H), 7.57-7.48 (m, 4H), 7.23 (d, *J* = 1.6 Hz, 1H), 5.49 (s, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.8, 138.8, 138.2, 135.0, 133.7, 132.7, 128.5, 128.2, 128.1, 127.7, 127.0, 126.4, 126.0, 126.0, 125.6, 125.4, 123.6, 121.5, 119.1, 108.5.

III. Larger-scale Synthesis and Derivatization of 3aa.

Larger-scale synthesis. A suspension of arylacyl phosphonium salt **1b** (1.061 g, 2.00 mmol), sulfoxonium ylides **2a** (0.432 g, 2.2mmol), $[RuCl_2(p\text{-cymene})]_2$ (61.2 mg, 5.0 mol %), and NaOAc (0.544 g, 2.0 equiv.) in EtOH (10.0 mL) was stirred at 120 °C for 10 h under an ambient atmosphere of N_2. After completion, the solvent was removed under vacuum and the residue was purified by column chromatography on silica gel (n-hexane/EtOAc: 30/1~10/1) to yield the corresponding product **3aa** (400.9 mg, 91% yield).



Derivatization of 3aa.[7] To a solution of 3-phenylnaphthalen-1-ol (**3aa**) (22 mg, 1 mmol, 1.0 eq.) in 2 mL DCM was added pyridine (0.16 mL, 2 mmol, 2.0 eq.) and the solution was cooled to 0 °C. Trifluoromethanesulfonic anhydride (0.2 mL, 1.2 mmol, 1.2 eq.) was added dropwise and the mixture was warmed to room temperature. The reaction was complete within 5 min as shown by TLC. The mixture was diluted with Et_2O, quenched with 1 M aq. HCl and washed successively with sat. $NaHCO_3$ and brine. After drying over Na_2SO_4, the solvent was removed under reduced pressure and the residue was purified by flash column chromatography on silica gel to afford the triflate as a light yellow liquid (35.2 mg, 100%). A 25-mL, one-necked, round-bottomed flask equipped with a rubber septum was charged with the obtained 3-phenylnaphthalen-1-yl trifluoromethanesulfonate (35.2 mg, 0.1 mmol) and tributylphenyltin (40 mg, 0.11 mmol) in 1 mL of DMF. Bis(triphenylphosphine)palladium(II) chloride (3.5 mg, 0.005 mmol) was added and the resulting yellow suspension was stirred at room temperature for 30 min. The reaction mixture was then heated at 60 °C for an additional 8 h. The reaction mixture was allowed to cool and then filtered through silica gel in a short column with the aid of Et_2O to remove the majority of the residual palladium. The filtrate was then washed with 1 N aq HCl solution, water, and saturated NaCl solution, dried over Na_2SO_4, filtered, and concentrated to afford a dark brown oily mixture. Column chromatography silica gel (elution with petroleum ether) furnished the desired compound as a colorless oily product.



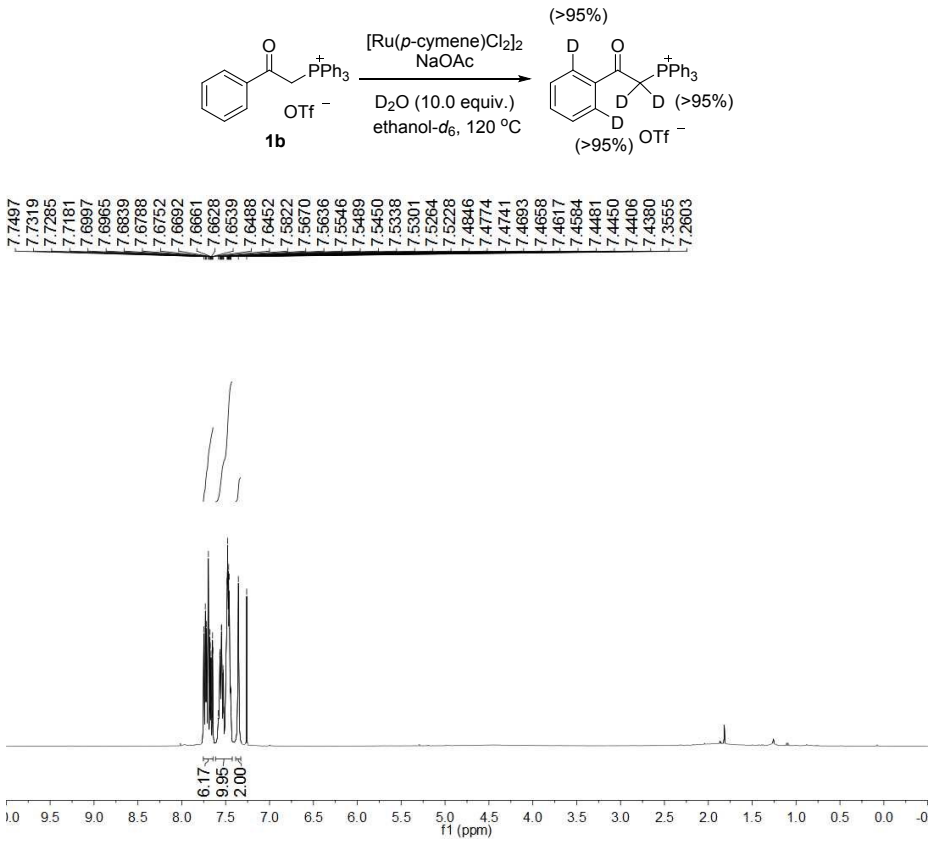
5: 78% yield

1,3-Diphenylnaphthalene (5): known compound[8], 21.8 mg, 78% yield, yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.98 (d, *J* = 8.1 Hz, 1H), 7.93 (d, *J* = 8.3 Hz, 1H), 7.78 (d, *J* = 8.0 Hz, 2H), 7.73 (s, 1H), 7.59-7.36 (m,

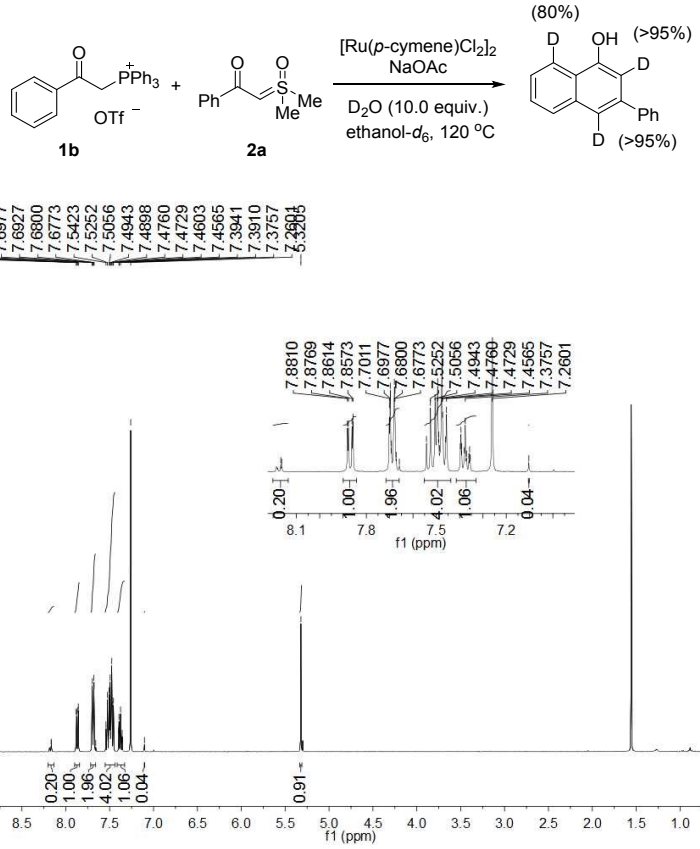
10H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.9, 140.8, 140.6, 138.0, 134.1, 130.8, 130.1, 128.9, 128.6, 128.3, 127.4, 127.4, 126.7, 126.7, 126.2, 126.1, 125.9, 125.4.

IV Mechanistic Studies

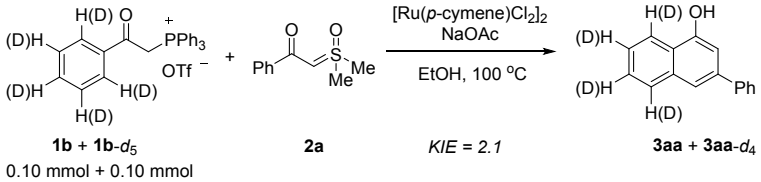
H/D Exchange Experiments. Under N_2, a suspension of phenacyl phosphonium salt **1b** (53.0 mg, 0.10 mmol), $[RuCl_2(p\text{-cymene})]_2$ (3.1 mg, 5.0 mol %), D_2O (18 μL, 1.0 mmol), and NaOAc (27.2 mg, 0.2 mmol) in ethanol-d_6 (1.0 mL) was stirred at 120 °C for 10 h. At ambient temperature, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using n-hexane/EtOAc to afford a yellow solid product, which was characterized by ^{1}H NMR spectroscopy.

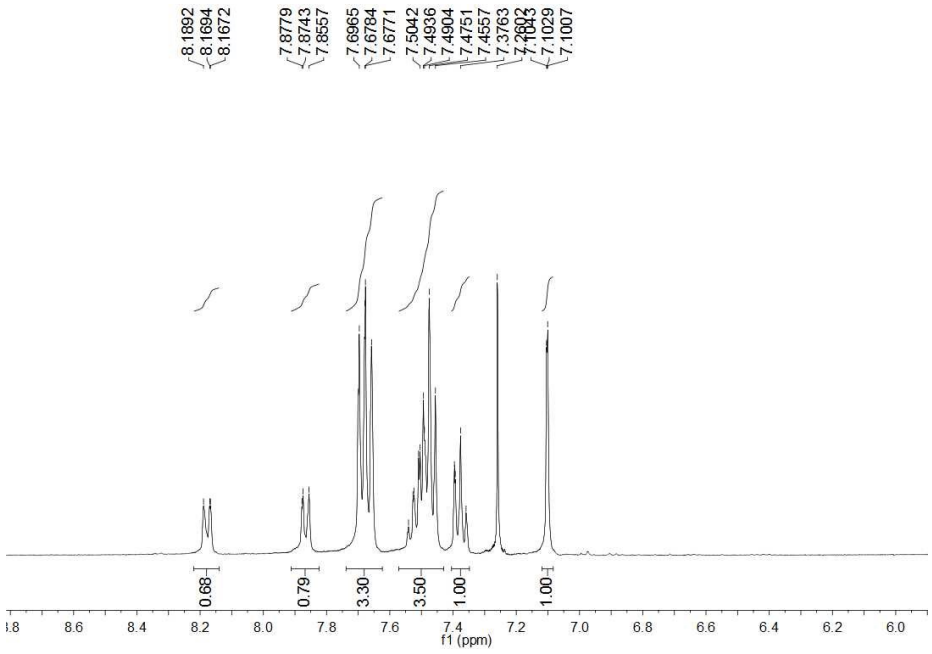


A suspension of phenacyl phosphonium salt **1b** (53.0 mg, 0.10 mmol), sulfoxonium ylides **2** (29.4 mg, 0.15 mmol), $[RuCl_2(p\text{-cymene})]_2$ (3.1 mg, 5.0 mol %), D_2O (18 μL, 1.0 mmol), and NaOAc (27.2 mg, 0.2 mmol) in ethanol-d_6 (1.0 mL) was stirred at 120 °C for 10 h under an ambient atmosphere of N_2. At ambient temperature, the solvent was removed under reduced pressure and the residue was purified by silica gel chromatography using n-hexane/EtOAc to afford a white solid product, which was characterized by ^{1}H NMR spectroscopy.



Kinetic Isotope Effect Experiments. Two pressure tubes were separately charged with **1b** (0.10 mmol) and **1b-*d*$_5$** (0.1 mmol), and to each tube was added sulfoxonium ylides **2** (0.15 mmol), [$RuCl_2$(*p*-cymene)]$_2$ (3.1 mg, 5.0 mol %), NaOAc (2.0 equiv.), and EtOH (1.0 mL). The two reaction mixtures were stirred side by side in an oil bath preheated at 100 °C for 30 min. After that, the reaction was quenched in an ice bath and n-hexane was rapidly added to each tube. The two mixtures were combined and the solvent was removed under vacuum and the residue was purified by silica gel chromatography using n-hexane/EtOAc: 30/1~10/1 to yield the product **3aa** and **3aa-*d*$_4$** as white solid (2.6 mg, 12% yield). The KIE value was determined to be k_H/k_D = 2.1 on the basis of ^{1}H NMR analysis.





V. References

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2. (a) Z. Lou, S. Zhang, C. Chen, X. Pang, M. Li, L. Wen, *Adv. Synth. Catal.,* **2014**, *356*, 153-159; (b) Y. Guan, Z. Lu, X. Yin, A. Mohammadlou, R. J. Staples, W. D. Wulff, *Synthesis*, **2020**, *52*, 2073-2091.
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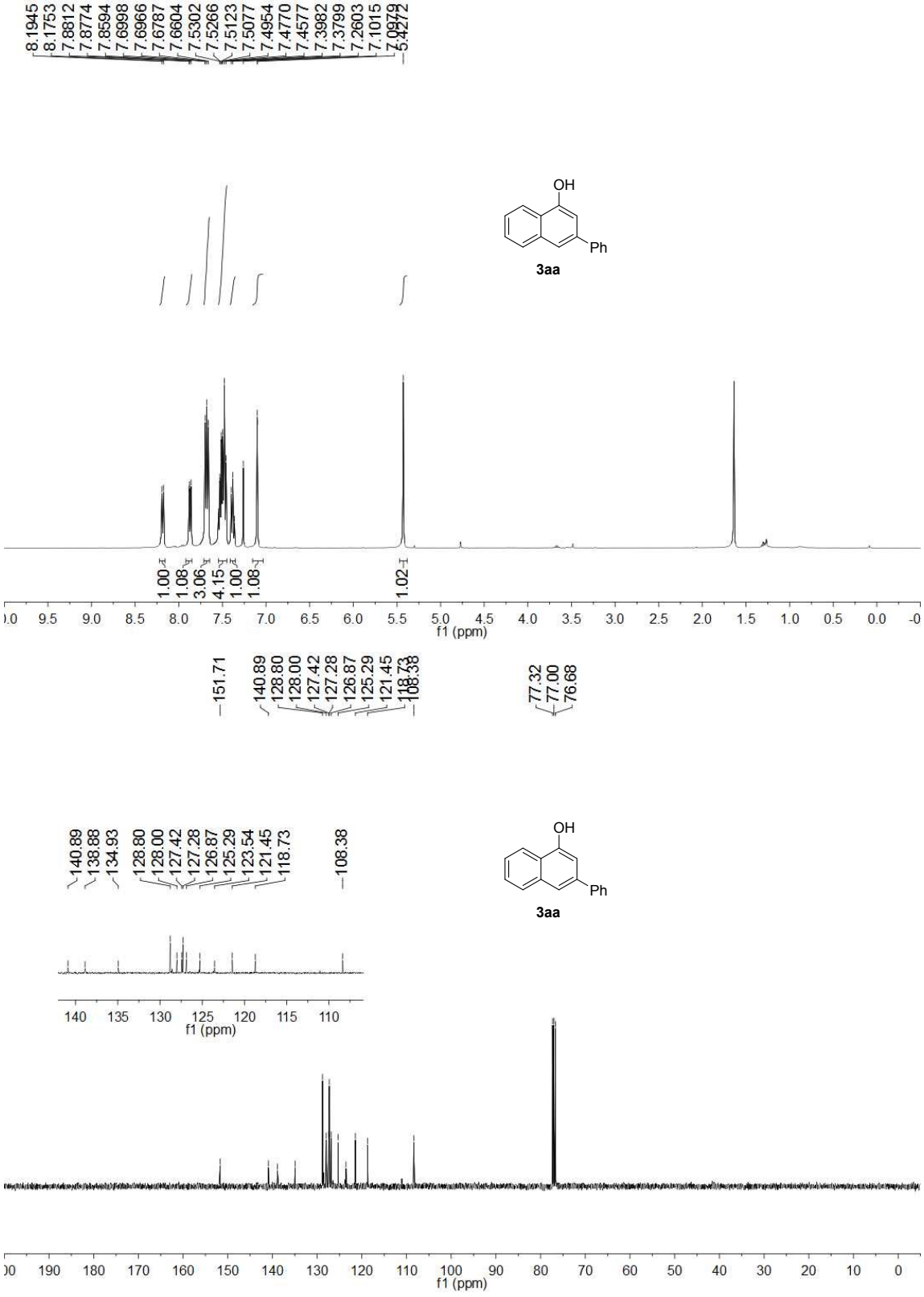
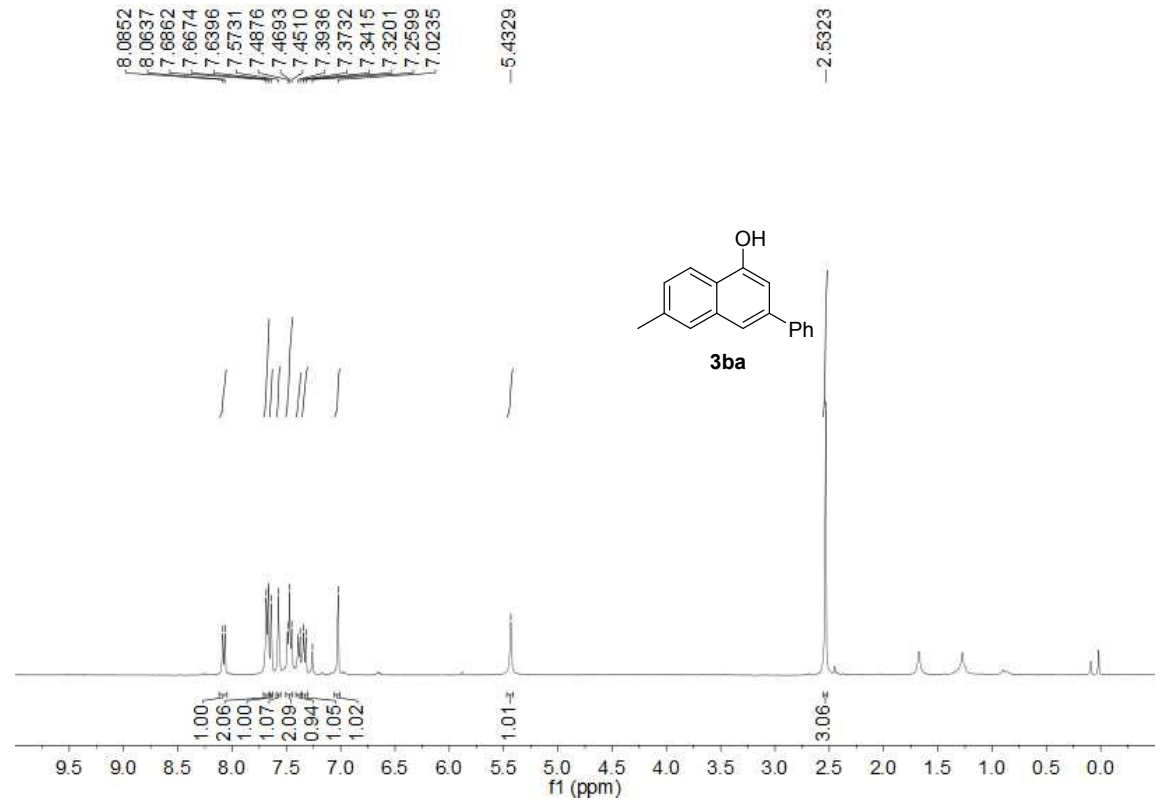
8. C. Ge, G. Wang, P. Wu, C. Chen, *Org. Lett.,* **2019**, *21*, 13, 5010-5014.

VI. Spectral Data for Representative Compounds

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Ph
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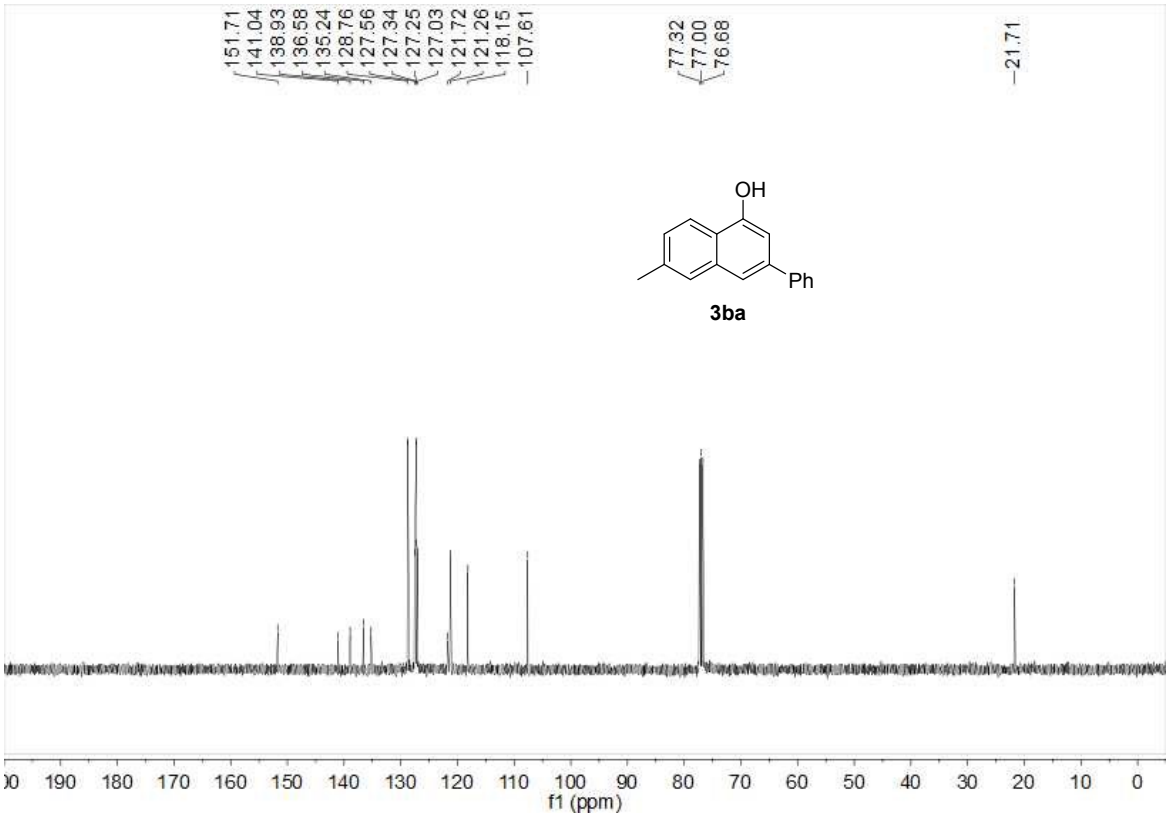
3.06
f1 (ppm)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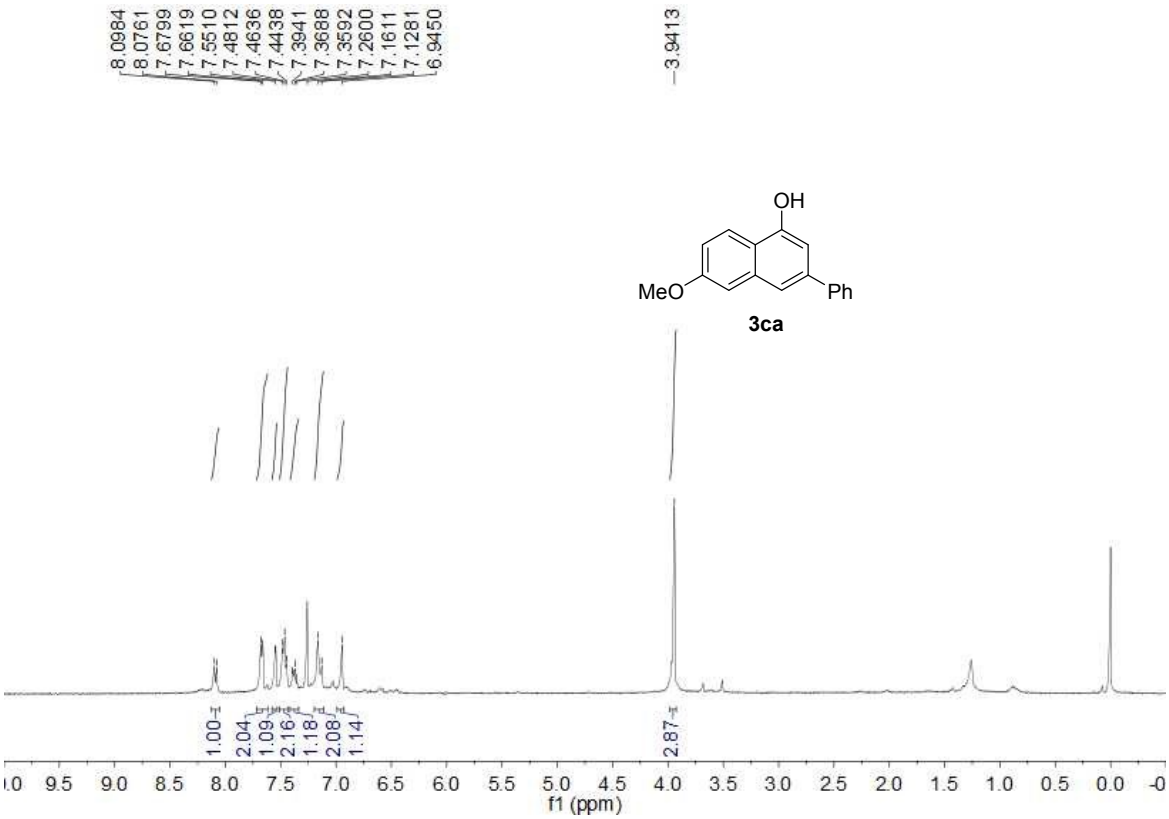
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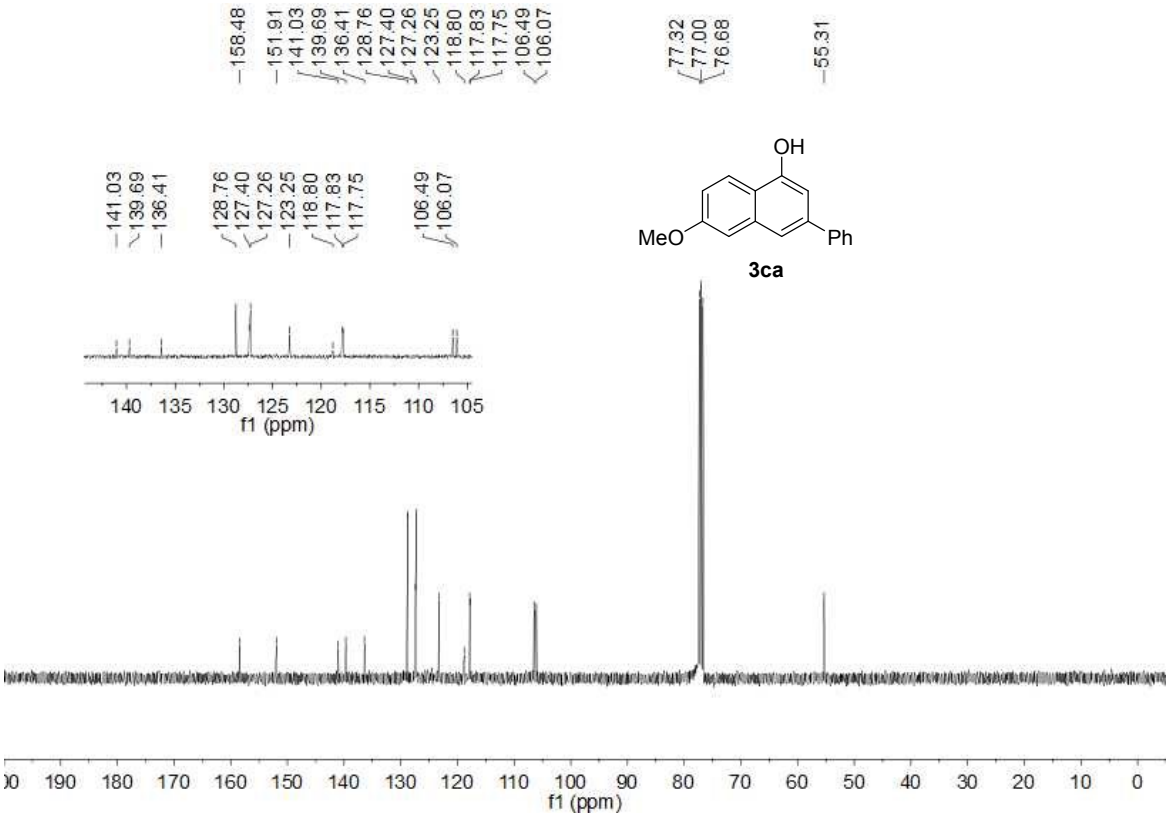
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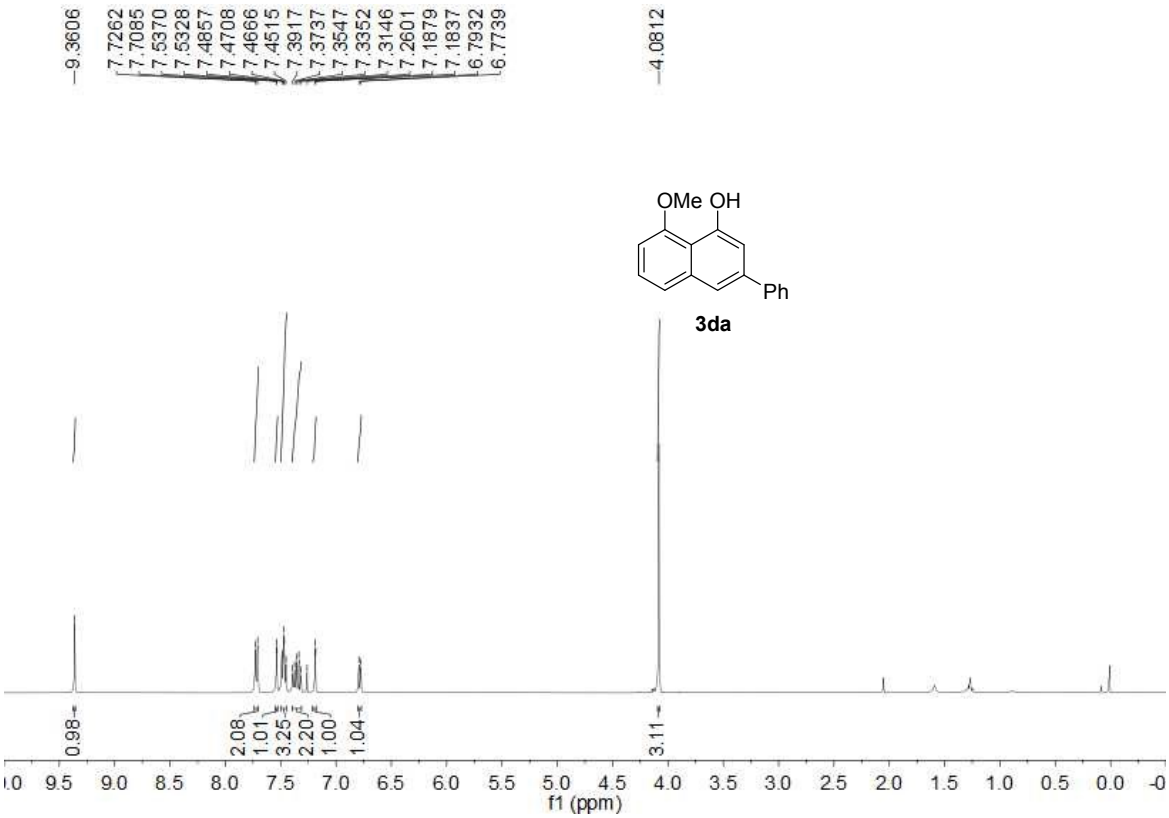
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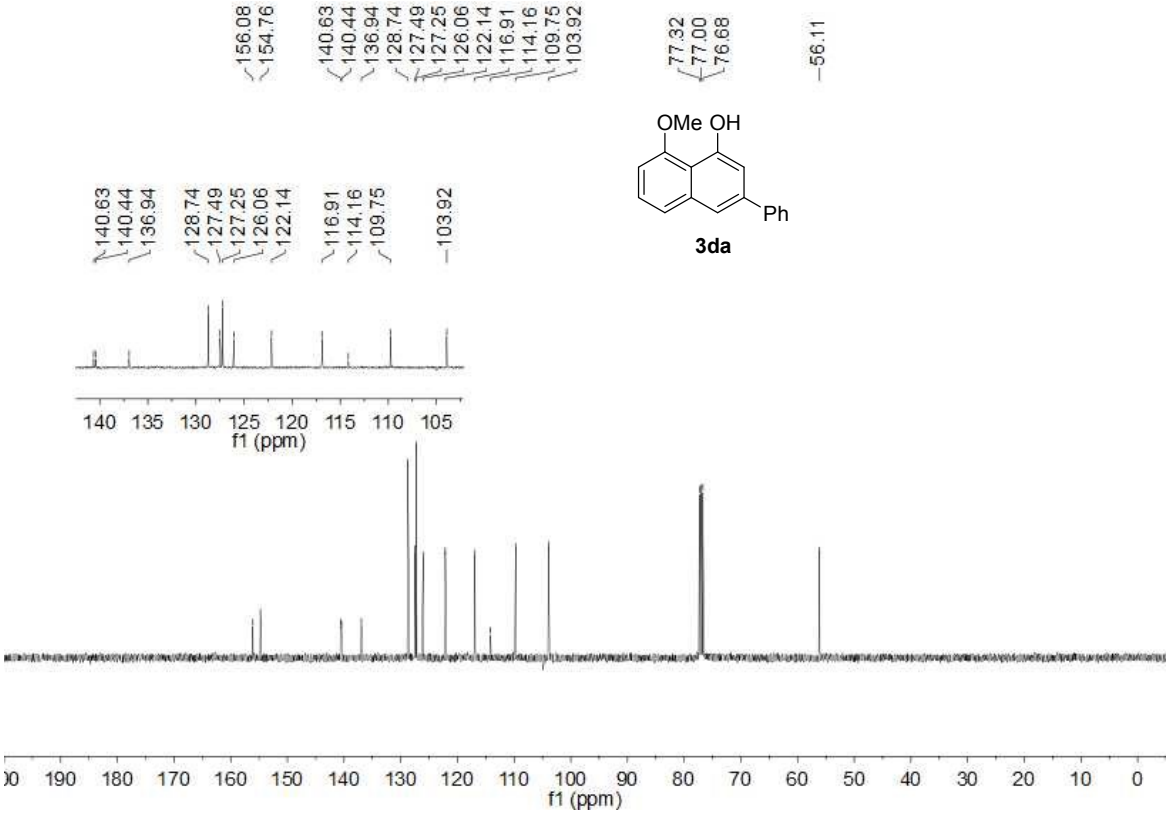
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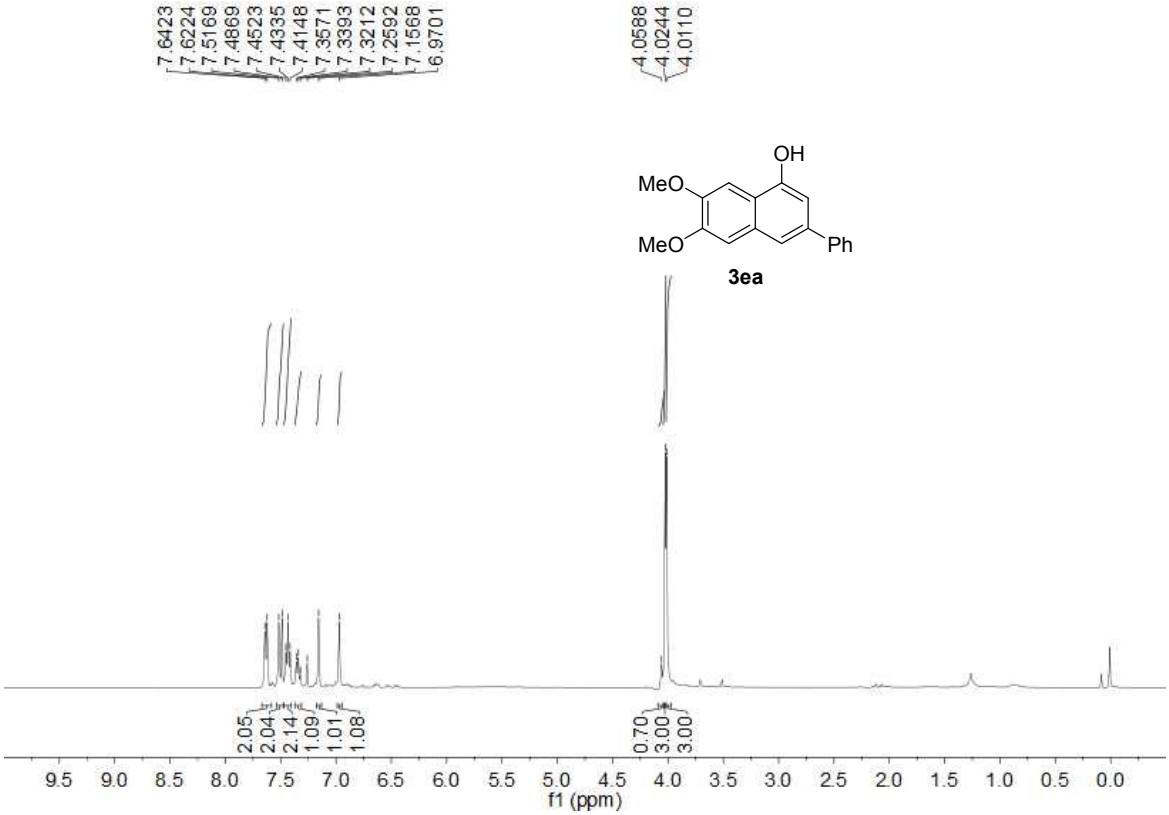
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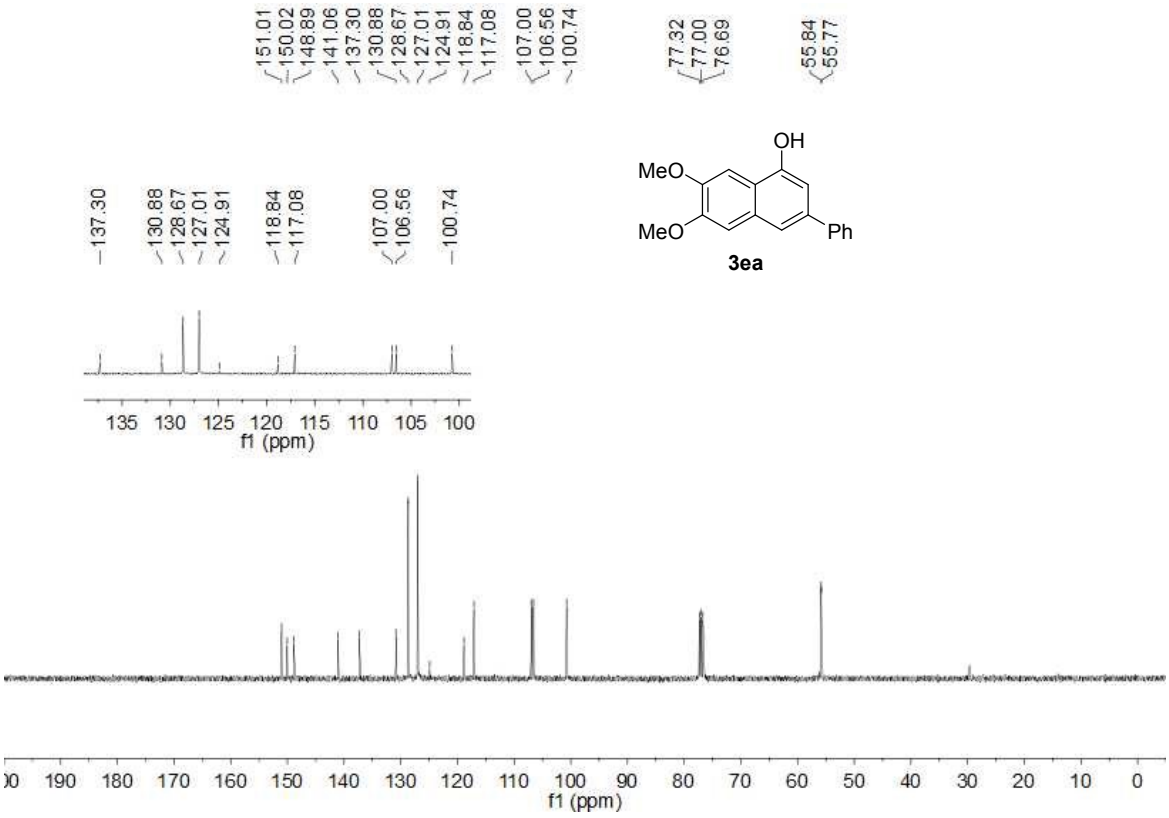
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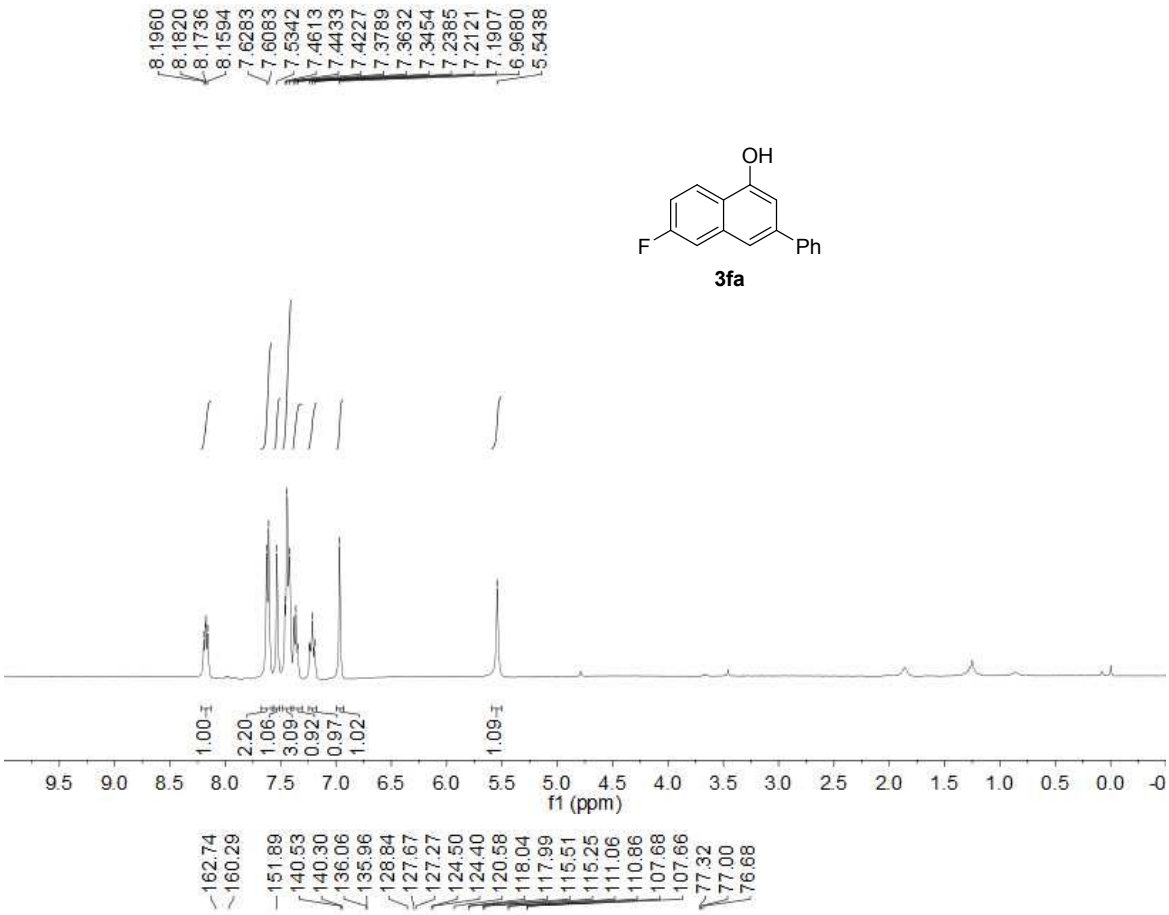
100.74
f1 (ppm)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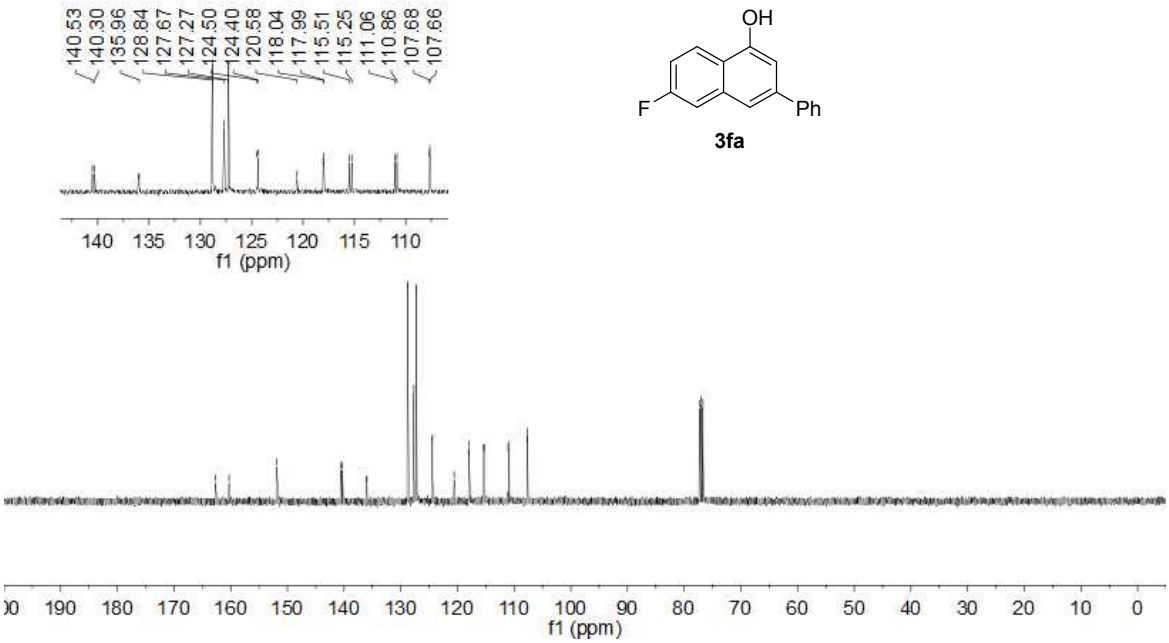
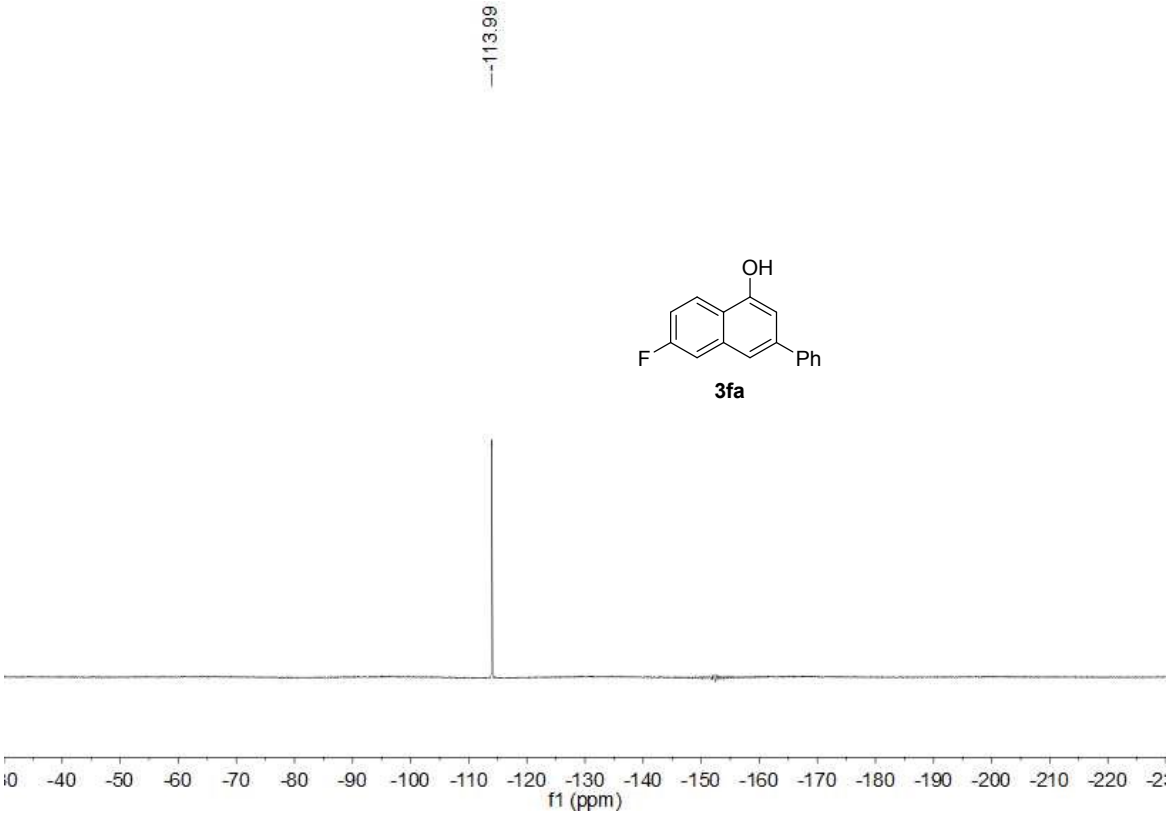
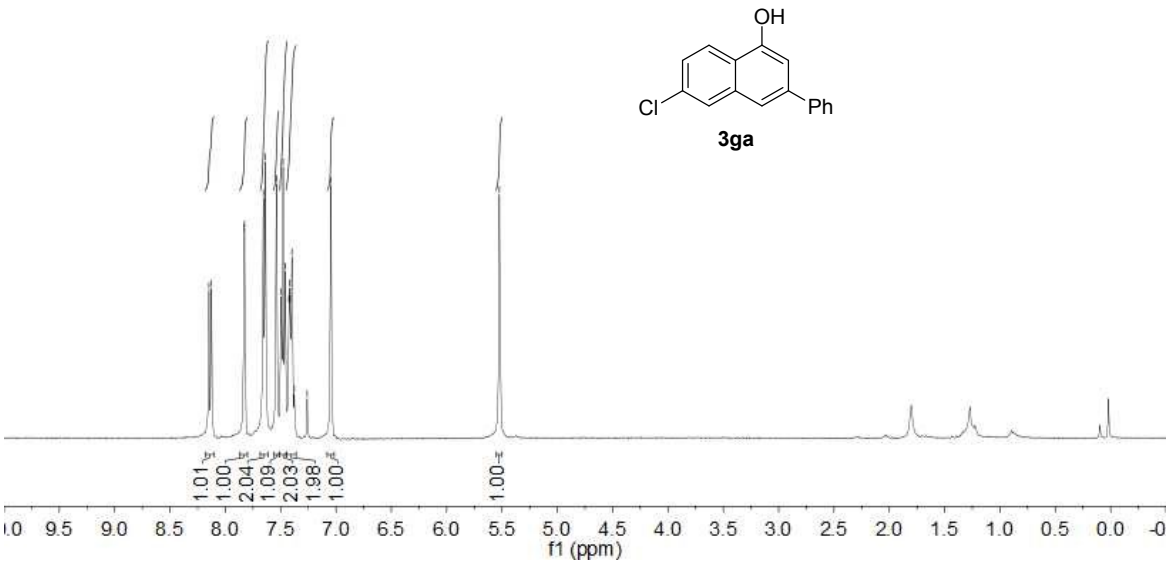
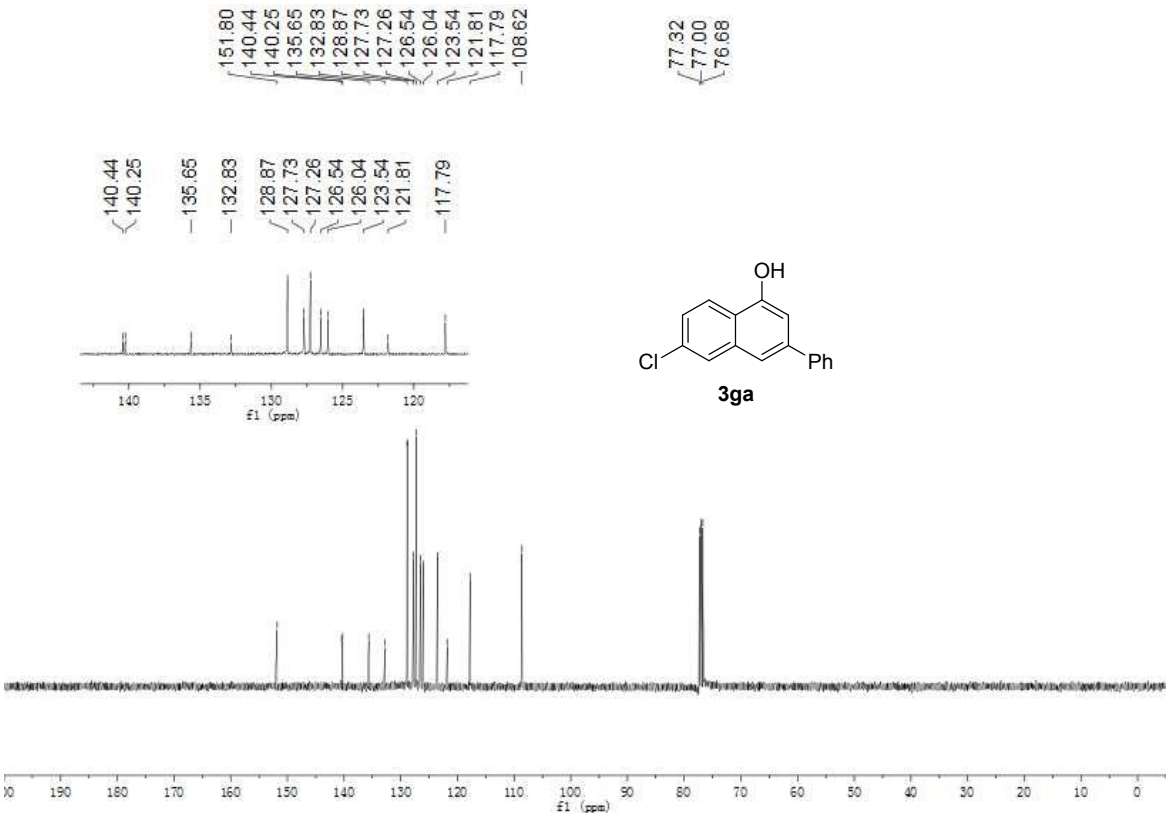
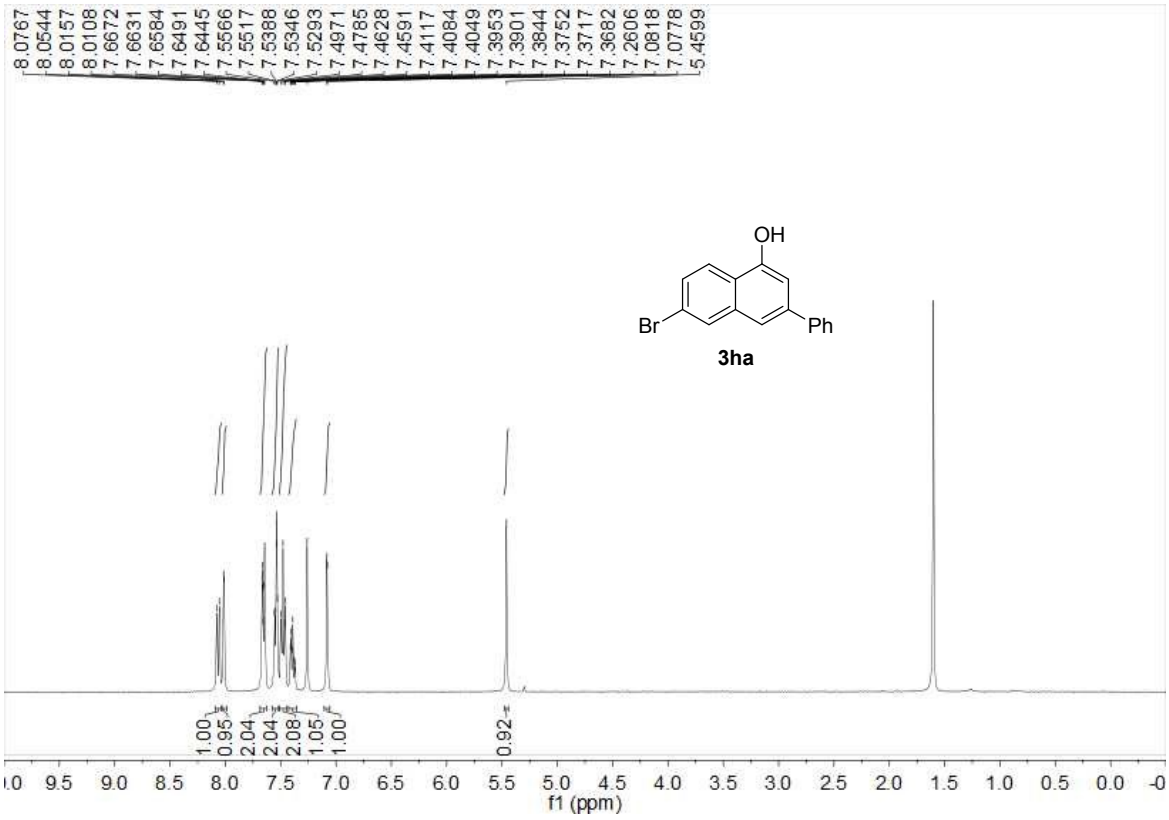
8.1820
8.1736
8.1594
7.6283
7.6083
7.5342
7.4613
7.4433
7.4227
7.3789
7.3632
7.3454
7.2385
7.2121
7.1907
6.9680
5.5438
OH
F
Ph
3fa
1.00
2.20
1.06
3.09
0.92
0.97
1.02
1.09
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)
162.74
160.29
151.89
140.53
140.30
136.06
135.96
128.84
127.67
127.27
124.50
124.40
120.58
118.04
117.99
115.51
115.25
111.06
110.86
107.68
107.66
77.32
77.00
76.68

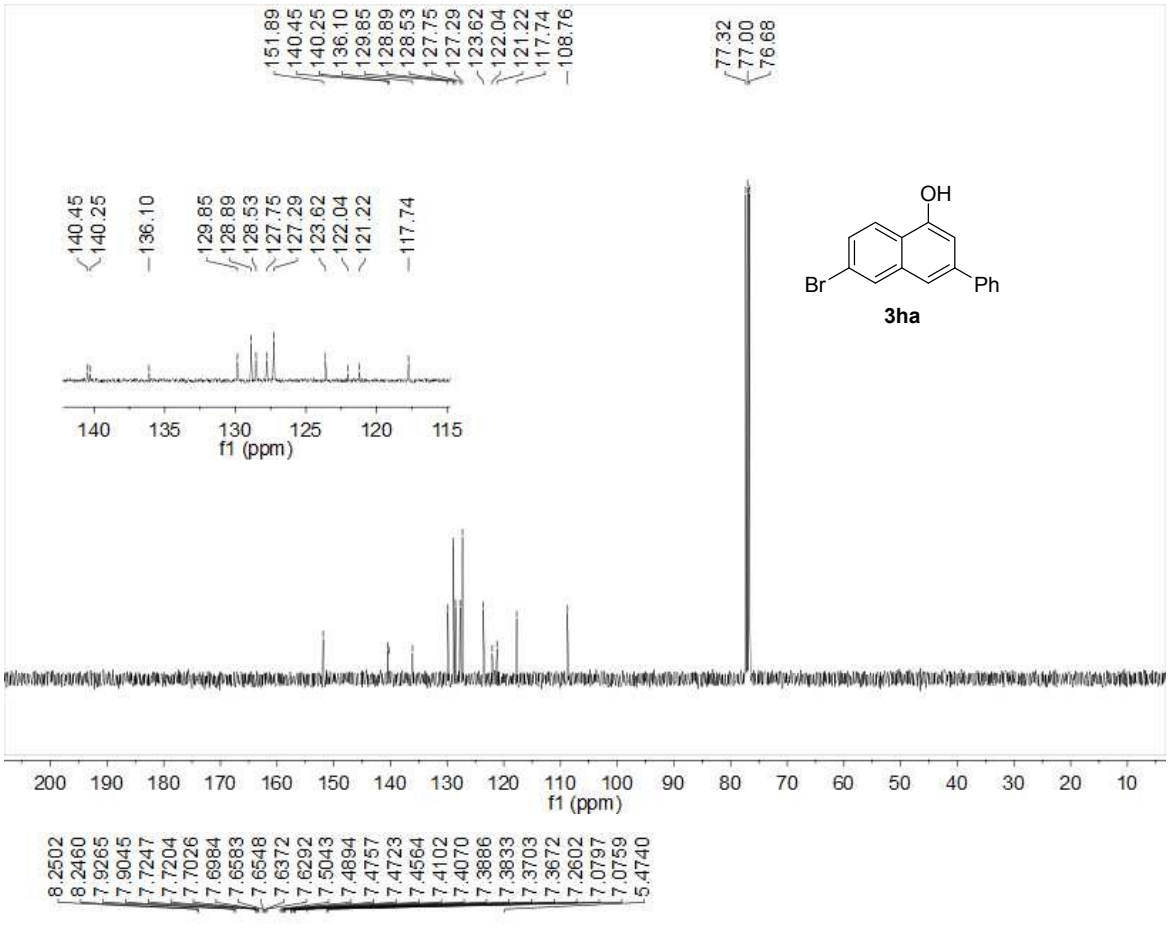

140.53
140.30
135.96
128.84
127.67
127.27
124.50
124.40
120.58
118.04
117.99
115.51
115.25
111.06
110.86
107.68
107.66
140 135 130 125 120 115 110
f1 (ppm)
OH
F
Ph
3fa
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


-113.99
OH
F
Ph
3fa
-40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220
f1 (ppm)
8.1477
8.1254
7.8298
7.8263
7.6561
7.6376
7.5373
7.4959
7.4777
7.4584
7.4257
7.4213
7.4138
7.3986
7.3772
7.2602
7.0445
5.5232

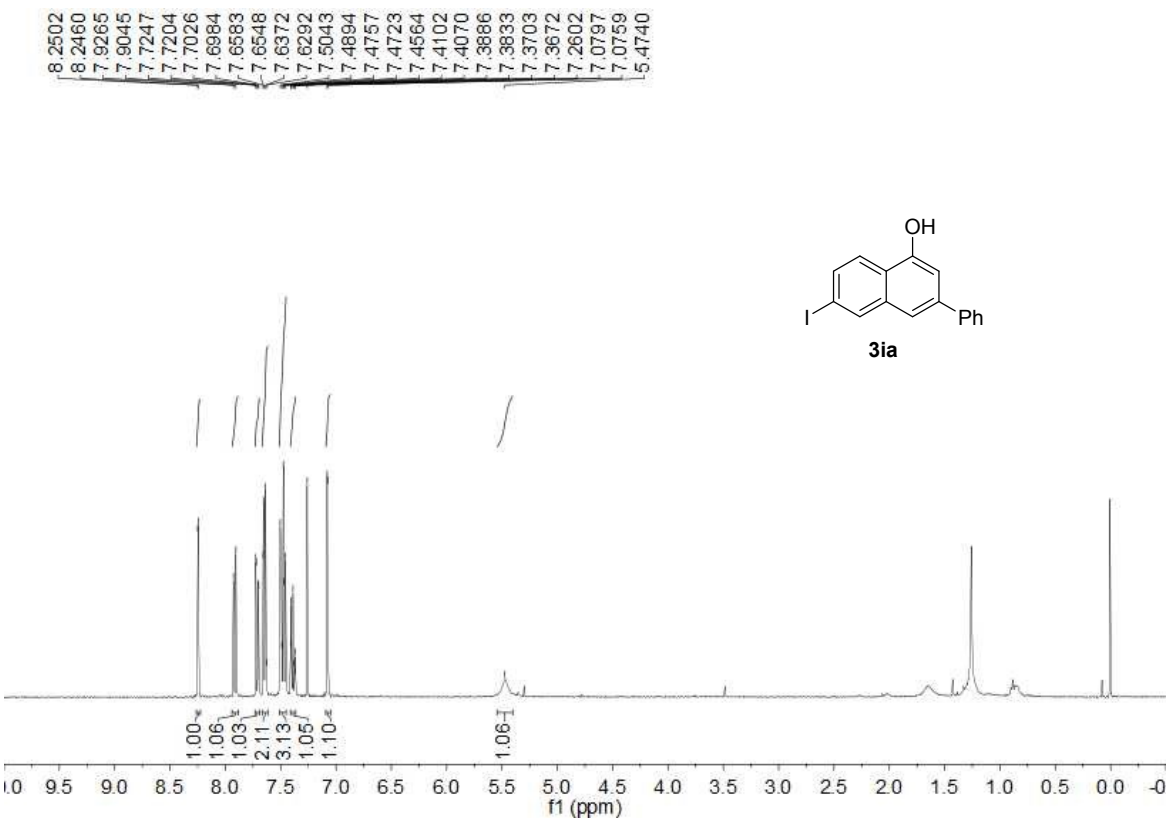

OH
Cl
Ph
3ga
1.01
1.00
2.04
1.09
2.03
1.98
1.00
1.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


151.80
140.44
140.25
135.65
132.83
128.87
127.73
127.26
126.54
126.04
123.54
121.81
117.79
108.62
77.32
77.00
76.68
140.44
140.25
135.65
132.83
128.87
127.73
127.26
126.54
126.04
123.54
121.81
117.79
f1 (ppm)
OH
Cl
Ph
3ga
f1 (ppm)

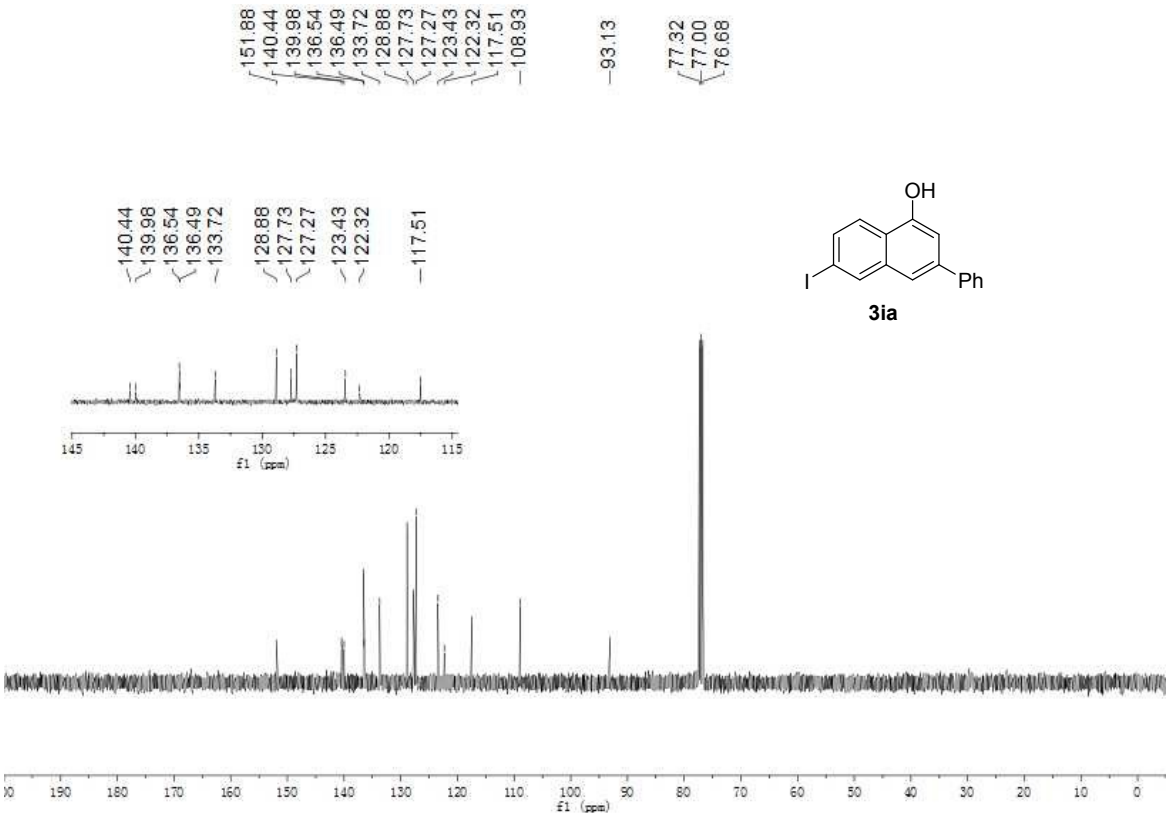

8.0767
8.0544
8.0157
8.0108
7.6672
7.6631
7.6584
7.6491
7.6445
7.5566
7.5517
7.5388
7.5346
7.5293
7.4971
7.4785
7.4628
7.4591
7.4117
7.4084
7.4049
7.3953
7.3901
7.3844
7.3752
7.3717
7.3682
7.2606
7.0818
7.0778
5.4599
OH
Br
Ph
3ha
1.00
0.95
2.04
2.04
2.08
1.05
1.00
0.92
f1 (ppm)

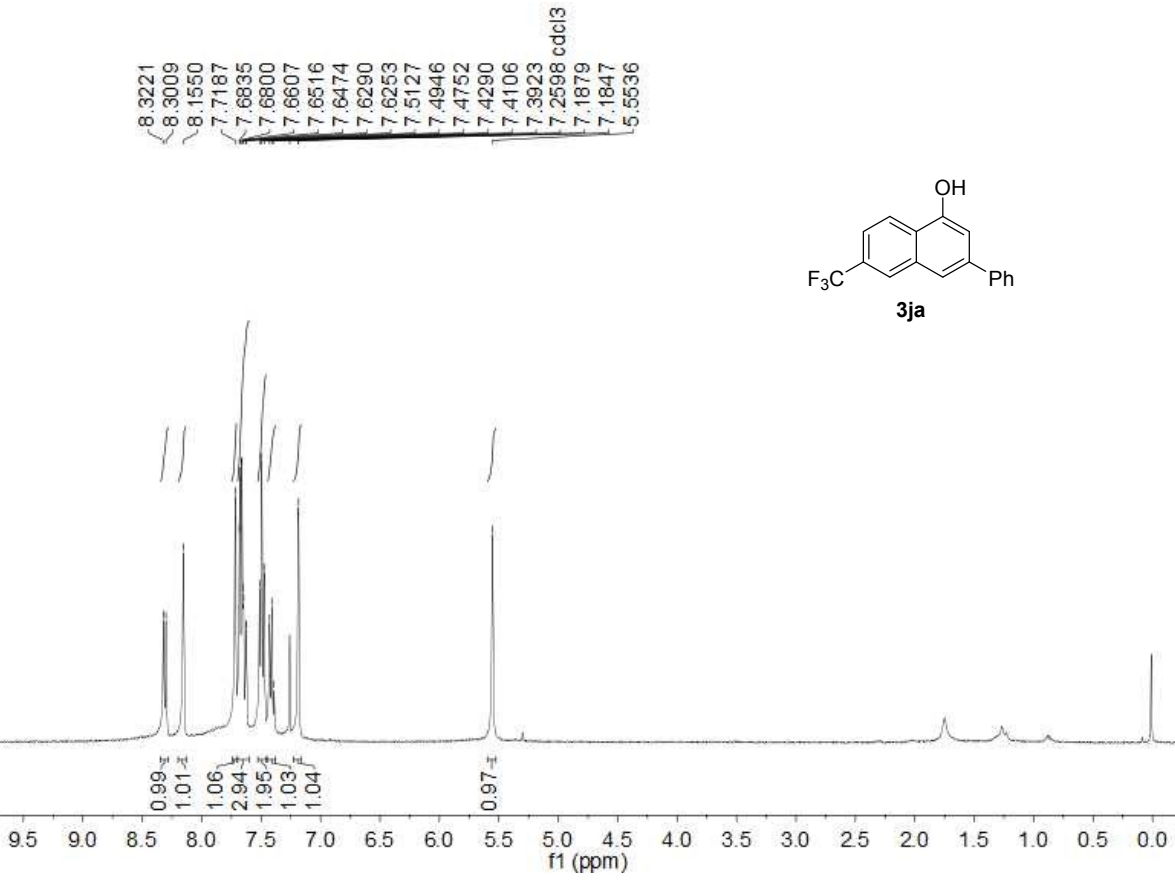

151.89
140.45
140.25
136.10
129.85
128.89
128.53
127.75
127.29
123.62
122.04
121.22
117.74
108.76
77.32
77.00
76.68
OH
Br
Ph
f1 (ppm)

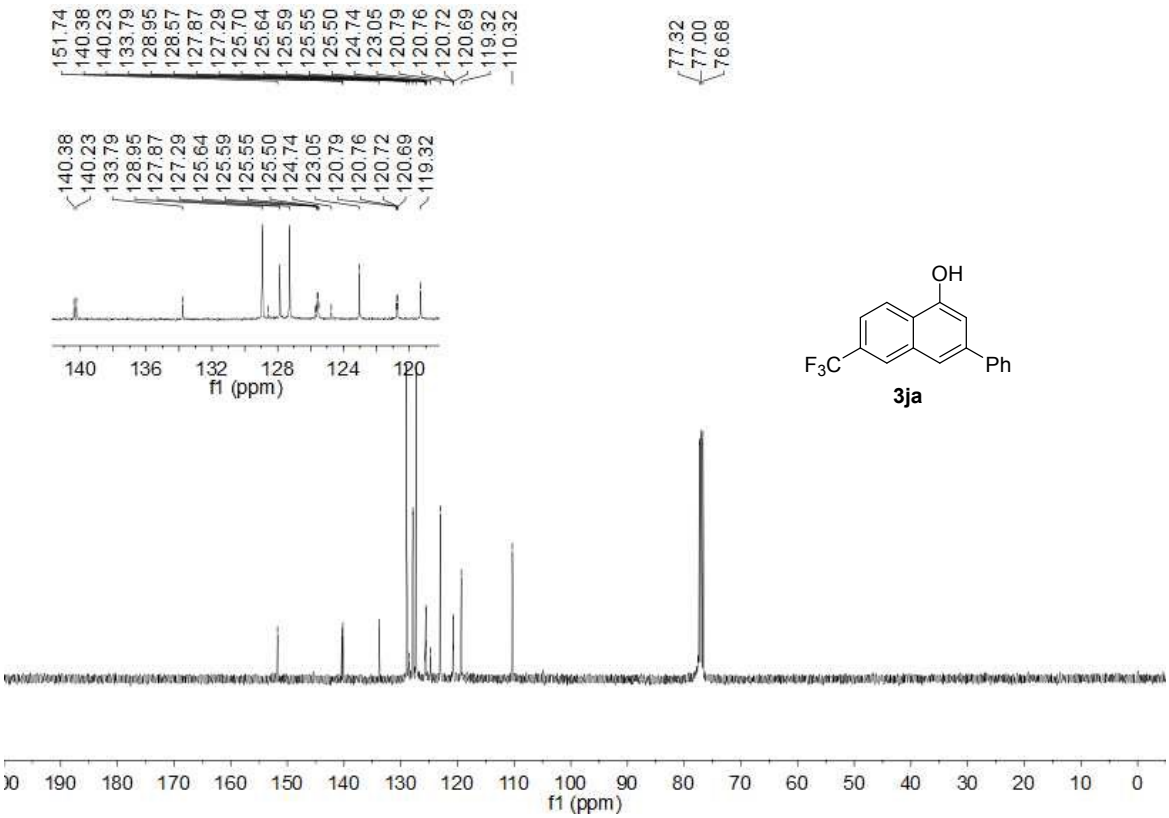
3ha

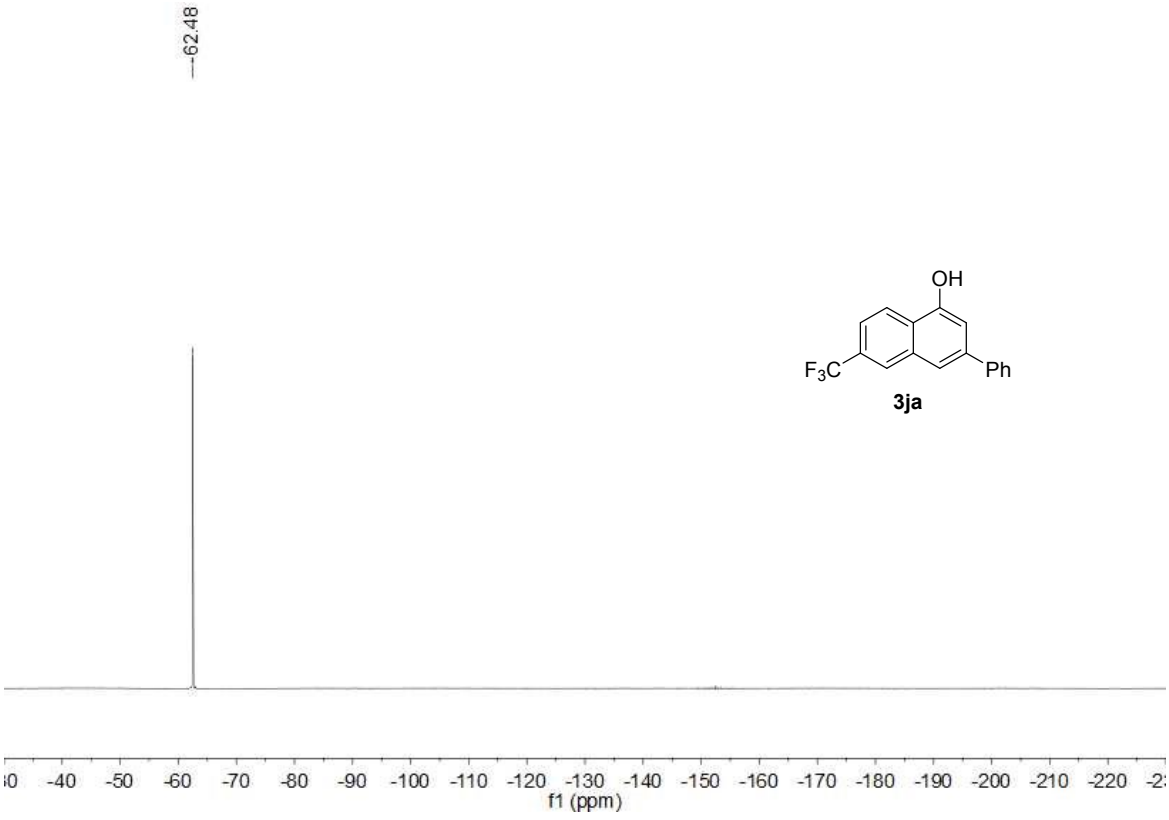

8.2502
8.2460
7.9265
7.9045
7.7247
7.7204
7.7026
7.6984
7.6583
7.6548
7.6372
7.6292
7.5043
7.4894
7.4757
7.4723
7.4564
7.4102
7.4070
7.3886
7.3833
7.3703
7.3672
7.2602
7.0797
7.0759
5.4740
OH
I
Ph
1.00
1.06
1.03
2.11
3.13
1.05
1.10
1.06
f1 (ppm)

3ia


151.88
140.44
139.98
136.54
136.49
133.72
128.88
127.73
127.27
123.43
122.32
117.51
108.93
93.13
77.32
77.00
76.68
OH
I
Ph
3ia
f1 (ppm)


8.3221
8.3009
8.1550
7.7187
7.6835
7.6800
7.6607
7.6516
7.6474
7.6290
7.6253
7.5127
7.4946
7.4752
7.4290
7.4106
7.3923
7.2598 cdcl3
7.1879
7.1847
5.5536
OH
F3C
Ph
3ja
0.99
1.01
1.06
2.94
1.95
1.03
1.04
0.97
f1 (ppm)


151.74
140.38
140.23
133.79
128.95
128.57
127.87
127.29
125.70
125.64
125.59
125.55
125.50
124.74
123.05
120.79
120.76
120.72
120.69
119.32
110.32
77.32
77.00
76.68
140.38
140.23
133.79
128.95
127.87
127.29
125.64
125.59
125.55
125.50
124.74
123.05
120.79
120.76
120.72
120.69
119.32
140
136
132
128
124
120
f1 (ppm)
OH
F3C
Ph
3ja
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


-62.48
OH
F3C
Ph
3ja
-40
-50
-60
-70
-80
-90
-100
-110
-120
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-140
-150
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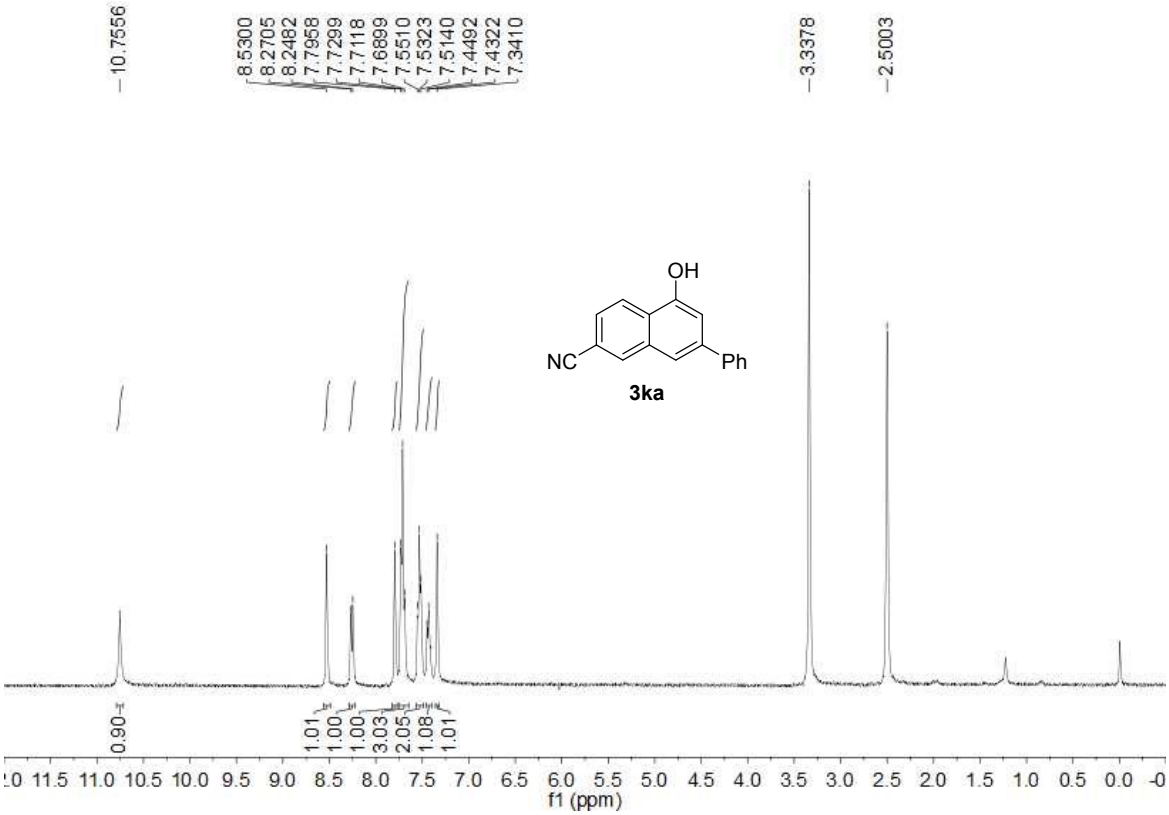
-170
-180
-190
-200
-210
-220
f1 (ppm)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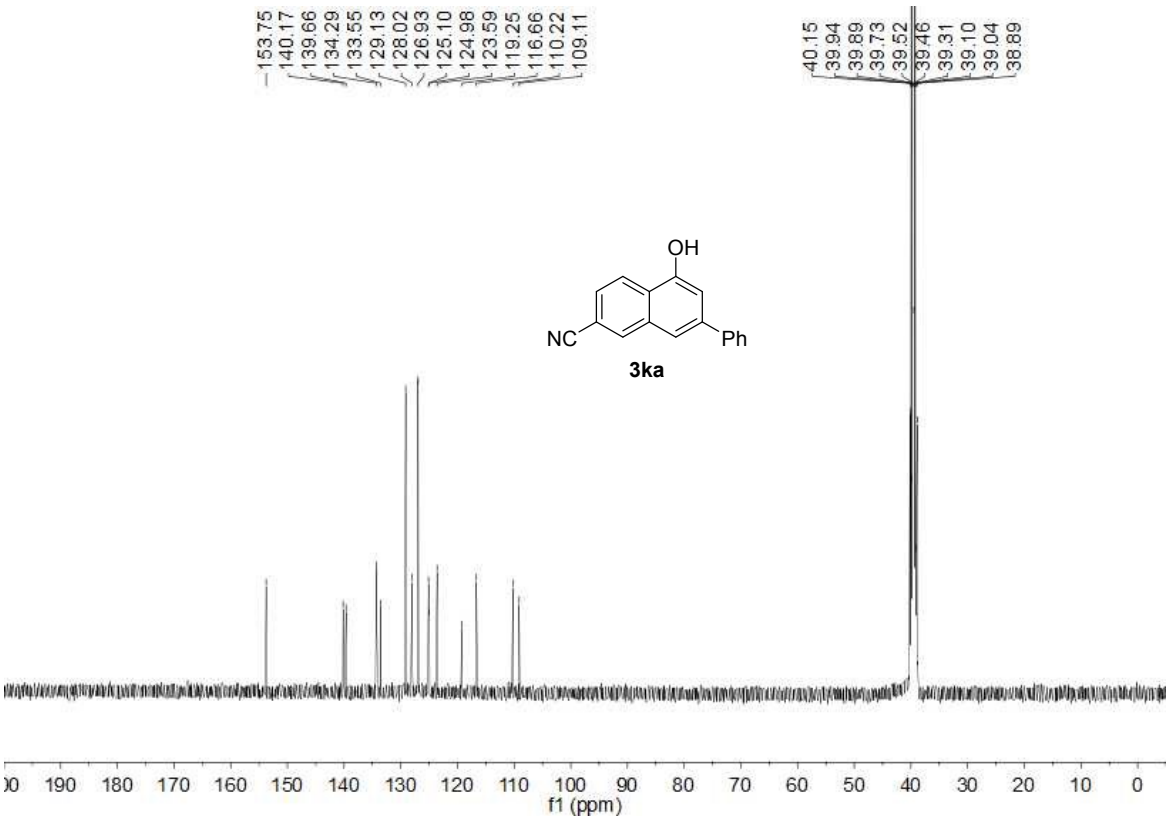
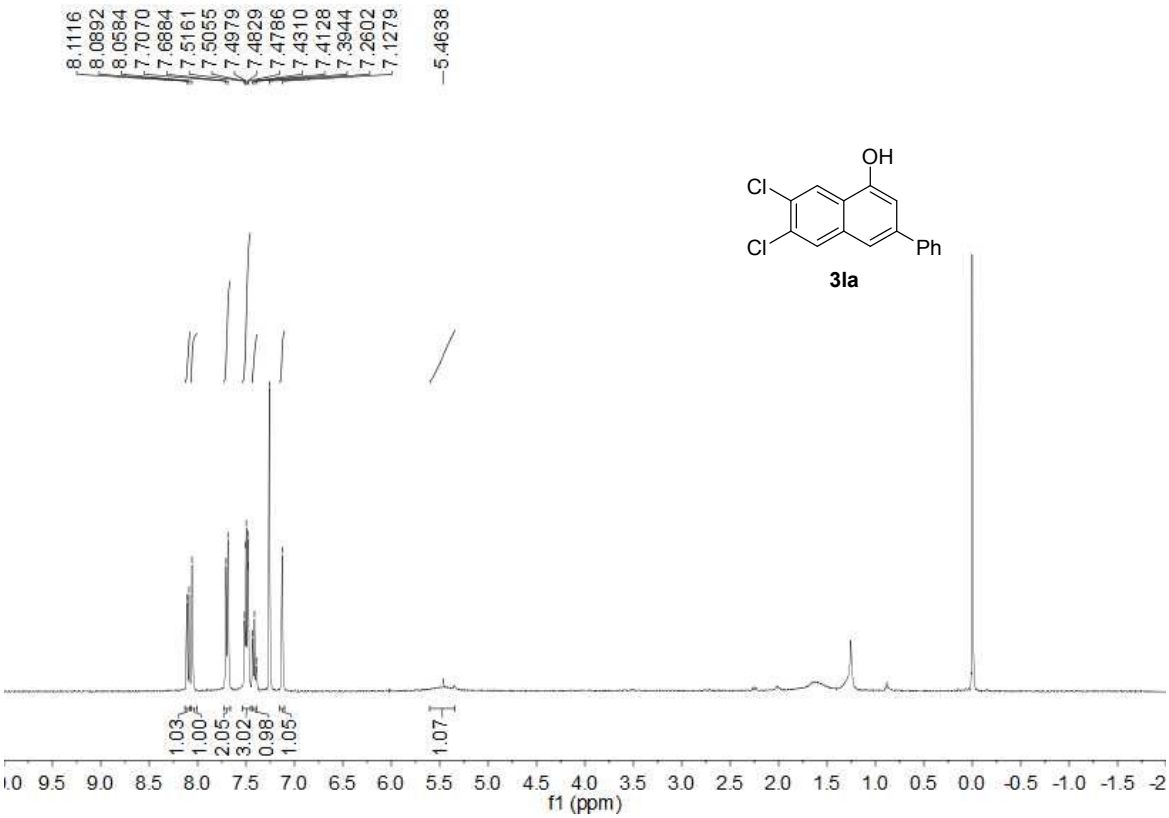
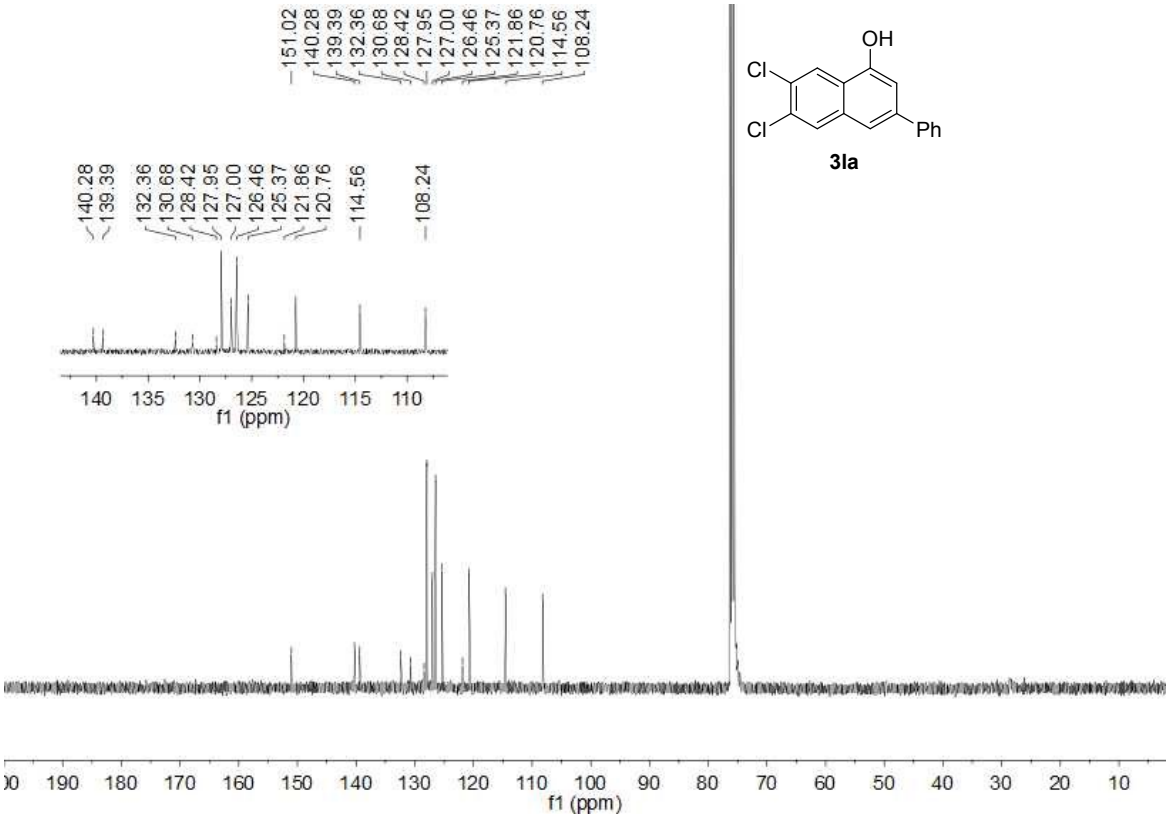
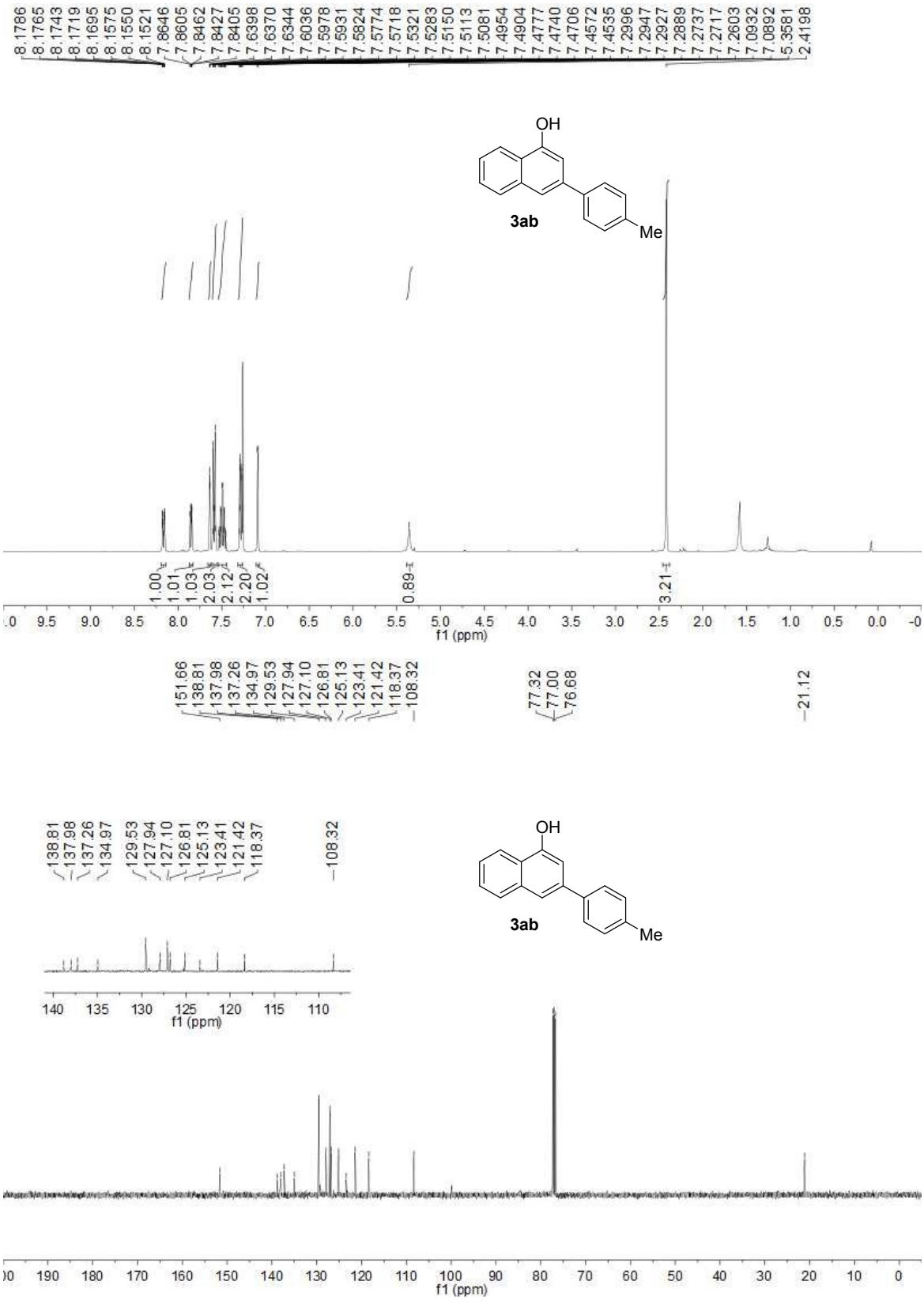
8.5300
8.2705
8.2482
7.7958
7.7299
7.7118
7.6899
7.5510
7.5323
7.5140
7.4492
7.4322
7.3410
3.3378
2.5003
OH
NC
Ph
3ka
0.90
1.01
1.00
1.00
3.03
2.05
1.08
1.01
f1 (ppm)


153.75
140.17
139.66
134.29
133.55
129.13
128.02
126.93
125.10
124.98
123.59
119.25
116.66
110.22
109.11
40.15
39.94
39.89
39.73
39.52
39.46
39.31
39.10
39.04
38.89
OH
NC
Ph
3ka
f1 (ppm)


8.1116
8.0892
8.0584
7.7070
7.6884
7.5161
7.5055
7.4979
7.4829
7.4786
7.4310
7.4128
7.3944
7.2602
7.1279
5.4638
OH
Cl
Cl
Ph
3la
1.03
1.00
2.05
3.02
0.98
1.05
1.07
f1 (ppm)


151.02
140.28
139.39
132.36
130.68
128.42
127.95
127.00
126.46
125.37
121.86
120.76
114.56
108.24
OH
Cl
Cl
Ph
3la
f1 (ppm)


8.1786
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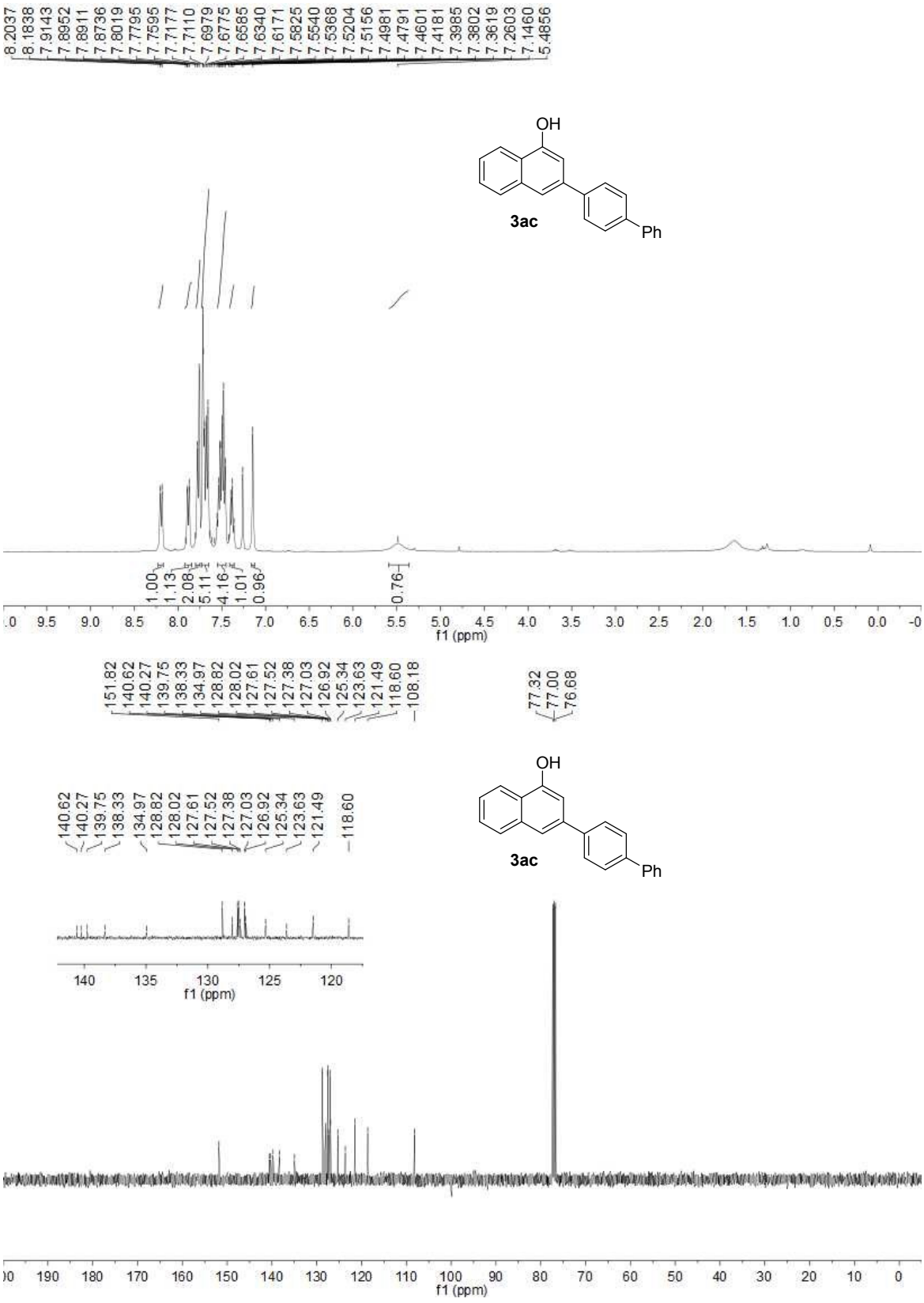
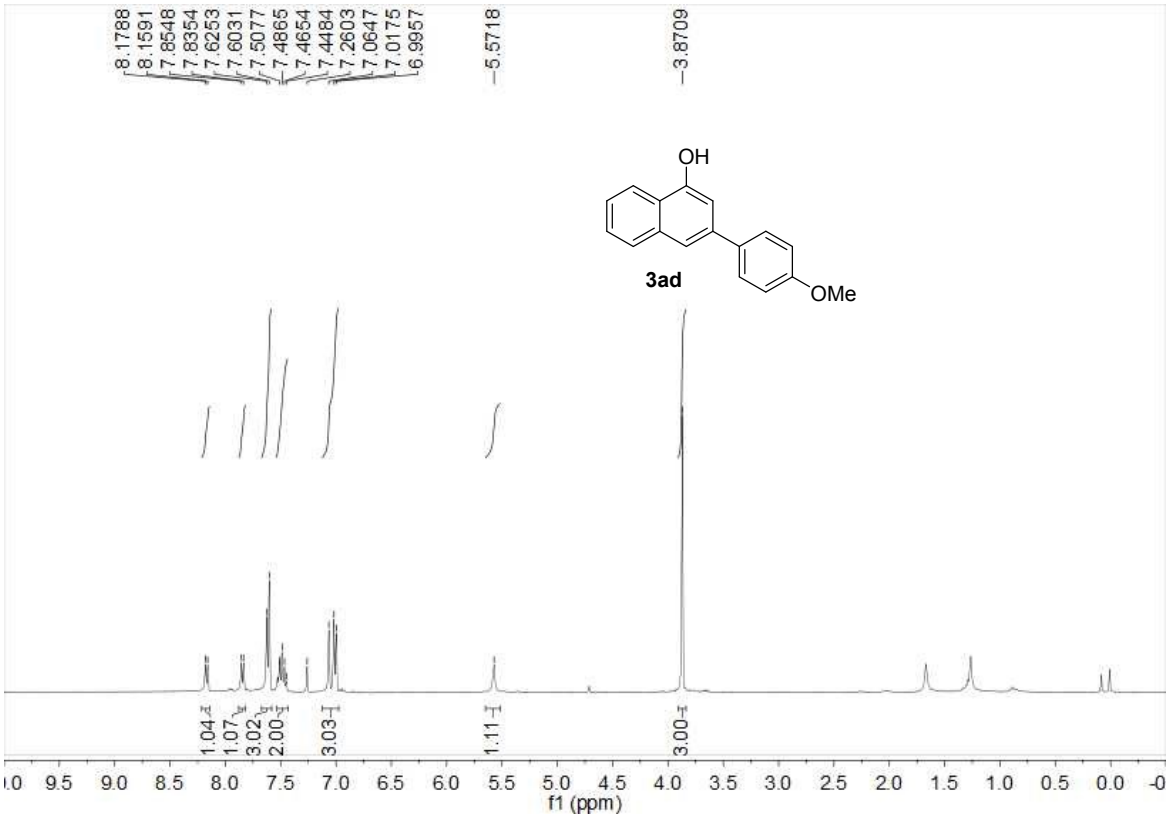
8.1743
8.1719
8.1695
8.1575
8.1550
8.1521
7.8646
7.8605
7.8462
7.8427
7.8405
7.6398
7.6370
7.6344
7.6036
7.5978
7.5931
7.5824
7.5774
7.5718
7.5321
7.5283
7.5150
7.5113
7.5081
7.4954
7.4904
7.4777
7.4740
7.4706
7.4572
7.4535
7.2996
7.2947
7.2927
7.2889
7.2737
7.2717
7.2603
7.0932
7.0892
5.3581
2.4198
OH
3ab
Me
1.00
1.01
1.03
2.03
2.12
2.20
1.02
0.89
3.21
f1 (ppm)
151.66
138.81
137.98
137.26
134.97
129.53
127.94
127.10
126.81
125.13
123.41
121.42
118.37
108.32
77.32
77.00
76.68
21.12
OH
3ab
Me
f1 (ppm)
f1 (ppm)


8.2037
8.1838
7.9143
7.8952
7.8911
7.8736
7.8019
7.7795
7.7595
7.7177
7.7110
7.6979
7.6775
7.6585
7.6340
7.6171
7.5825
7.5540
7.5368
7.5204
7.5156
7.4981
7.4791
7.4601
7.4181
7.3985
7.3802
7.3619
7.2603
7.1460
5.4856
OH
3ac
Ph
1.00
1.13
2.08
5.11
4.16
1.01
0.96
0.76
f1 (ppm)
151.82
140.62
140.27
139.75
138.33
134.97
128.82
128.02
127.61
127.52
127.38
127.03
126.92
125.34
123.63
121.49
118.60
108.18
77.32
77.00
76.68
OH
3ac
Ph
140.62
140.27
139.75
138.33
134.97
128.82
128.02
127.61
127.52
127.38
127.03
126.92
125.34
123.63
121.49
118.60
140
135
130
125
120
f1 (ppm)
f1 (ppm)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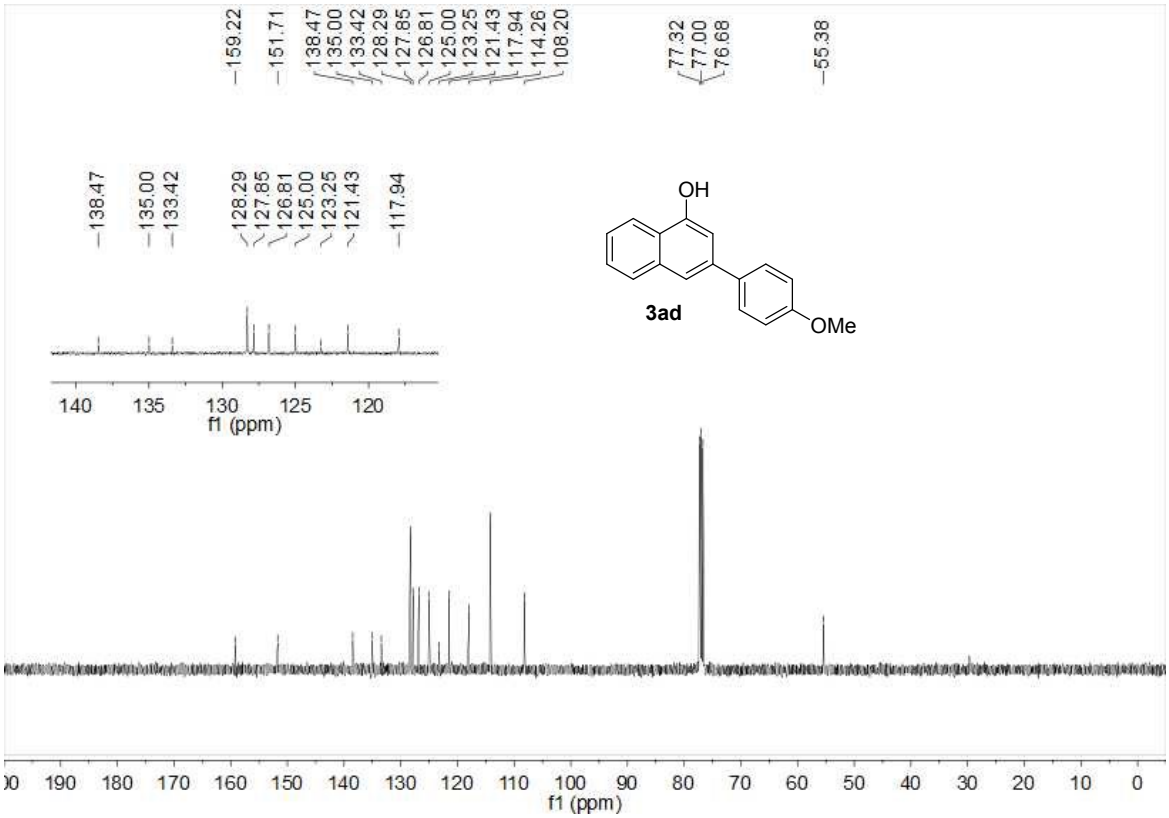
7.8354
7.6253
7.6031
7.5077
7.4865
7.4654
7.4484
7.2603
7.0647
7.0175
6.9957
5.5718
3.8709
OH
3ad
OMe
1.04
1.07
3.02
2.00
3.03
1.11
3.00
f1 (ppm)


159.22
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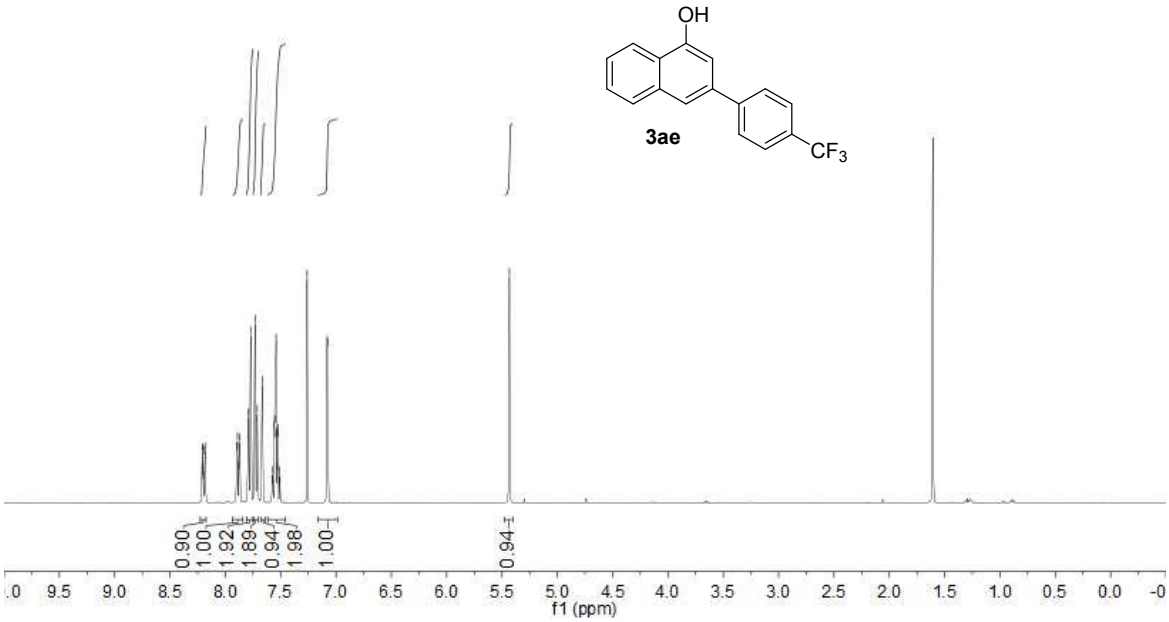
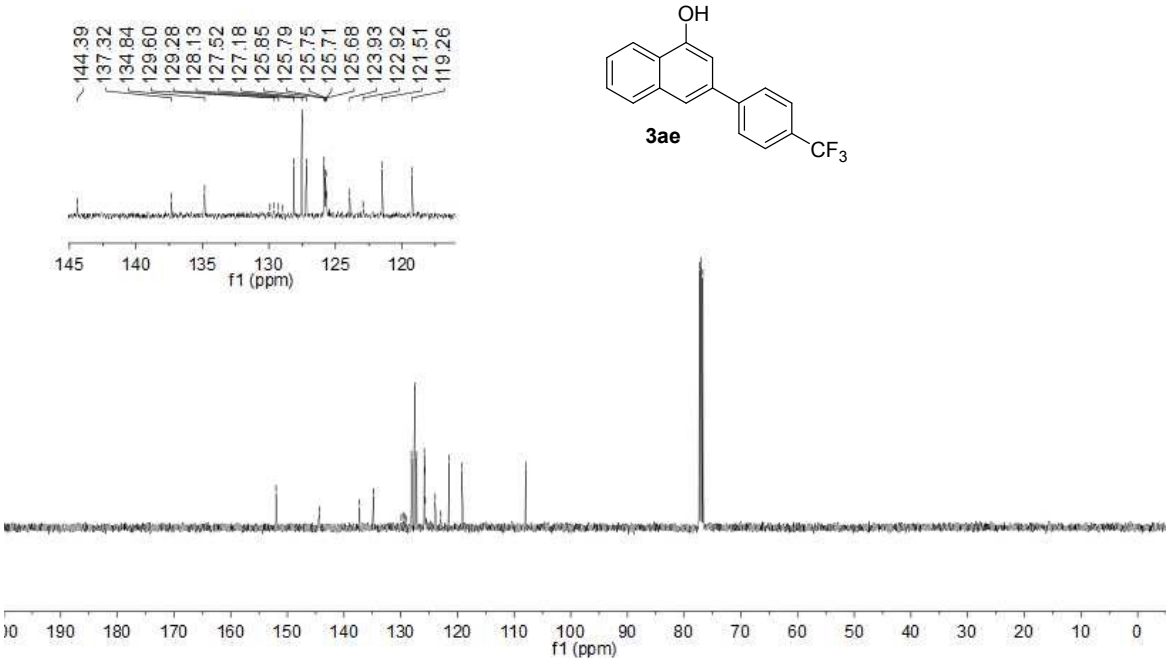
135.00
133.42
128.29
127.85
126.81
125.00
123.25
121.43
117.94
114.26
108.20
77.32
77.00
76.68
55.38
OH
3ad
OMe
f1 (ppm)

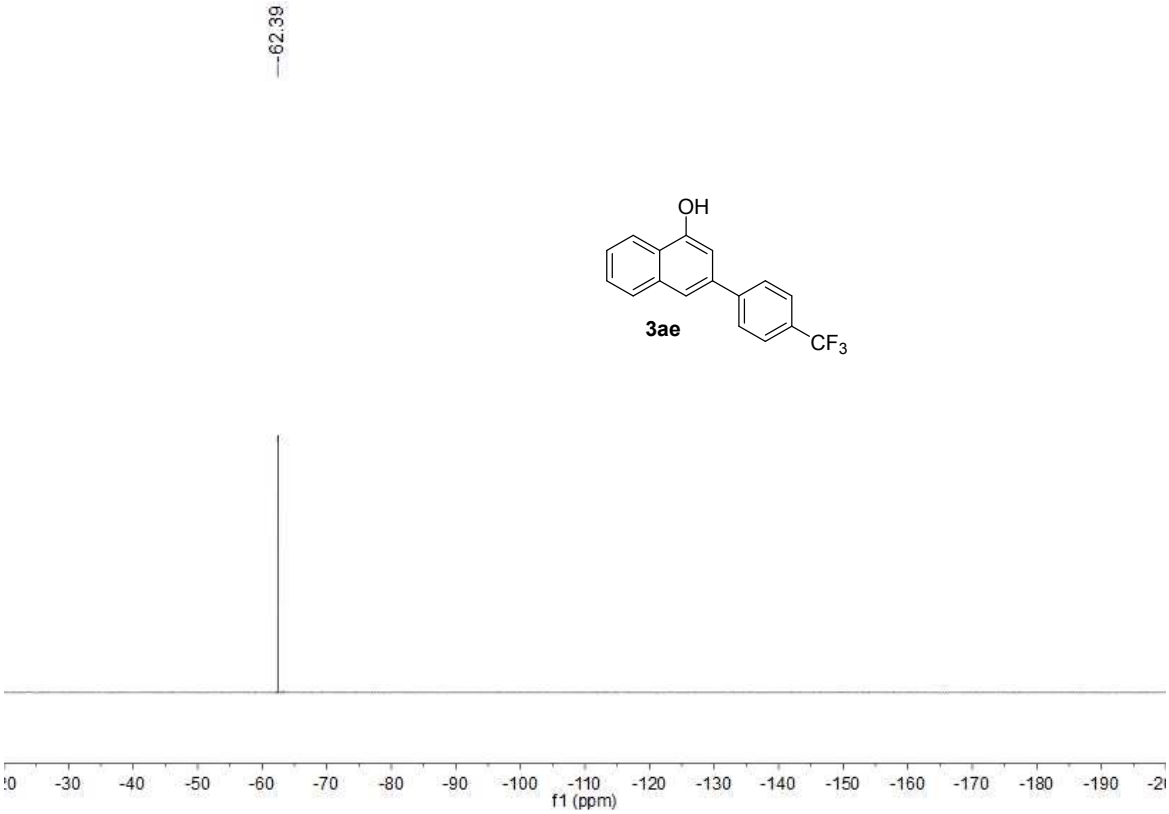

8.2073
8.2054
8.2031
8.2009
8.1984
8.1884
8.1833
7.8952
7.8898
7.8789
7.8718
7.7915
7.7710
7.7320
7.7113
7.6674
7.5752
7.5709
7.5581
7.5538
7.5476
7.5410
7.5343
7.5304
7.5278
7.5236
7.5107
7.5065
7.2603
7.0797
7.0758
5.4326

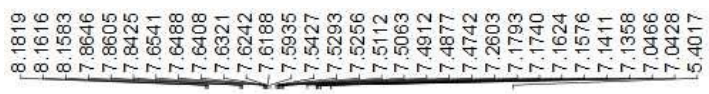

OH
3ae
CF3
0.90
1.00
1.92
1.89
0.94
1.98
1.00
0.94
f1 (ppm)


152.00
144.39
137.32
134.84
129.92
129.60
129.28
128.96
128.13
127.52
127.18
125.85
125.79
125.75
125.71
125.68
123.93
122.92
121.51
119.26
107.97

77.32
77.00
76.68


144.39
137.32
134.84
129.60
129.28
128.13
127.52
127.18
125.85
125.79
125.75
125.71
125.68
123.93
122.92
121.51
119.26
145
140
135
130
125
120
f1 (ppm)
OH
3ae
CF3
f1 (ppm)


-62.39
OH
3ae
CF3
f1 (ppm)


8.1819
8.1616
8.1583
7.8646
7.8605
7.8425
7.6541
7.6488
7.6408
7.6321
7.6242
7.6188
7.5935
7.5427
7.5293
7.5256
7.5112
7.5063
7.4912
7.4877
7.4742
7.2603
7.1793
7.1740
7.1624
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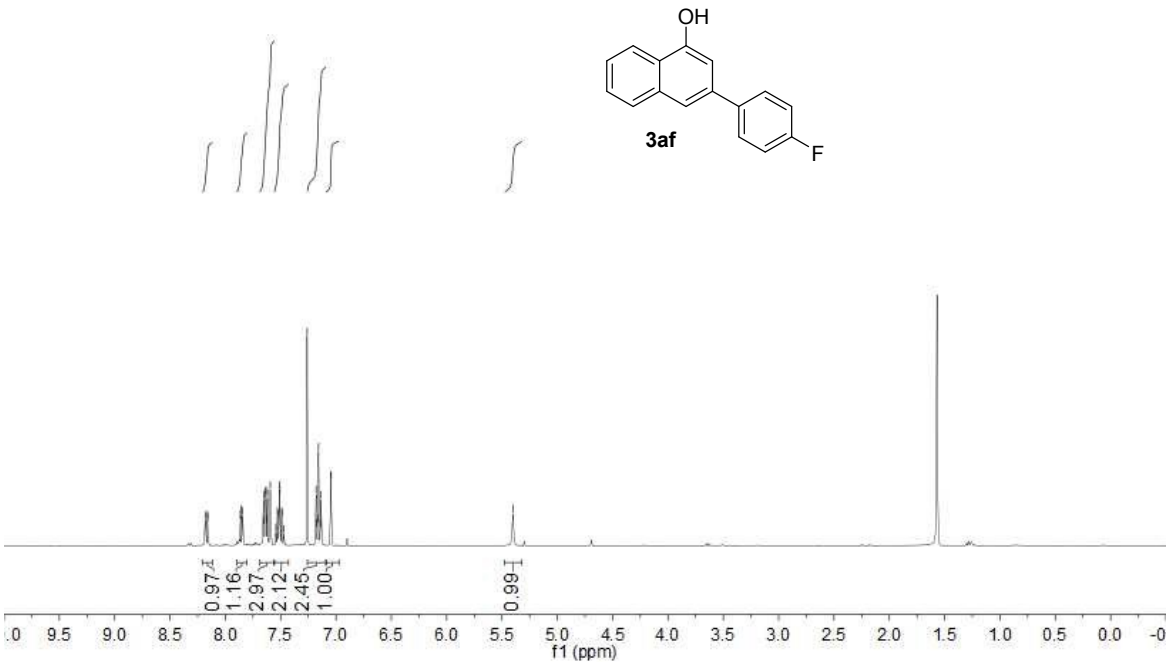
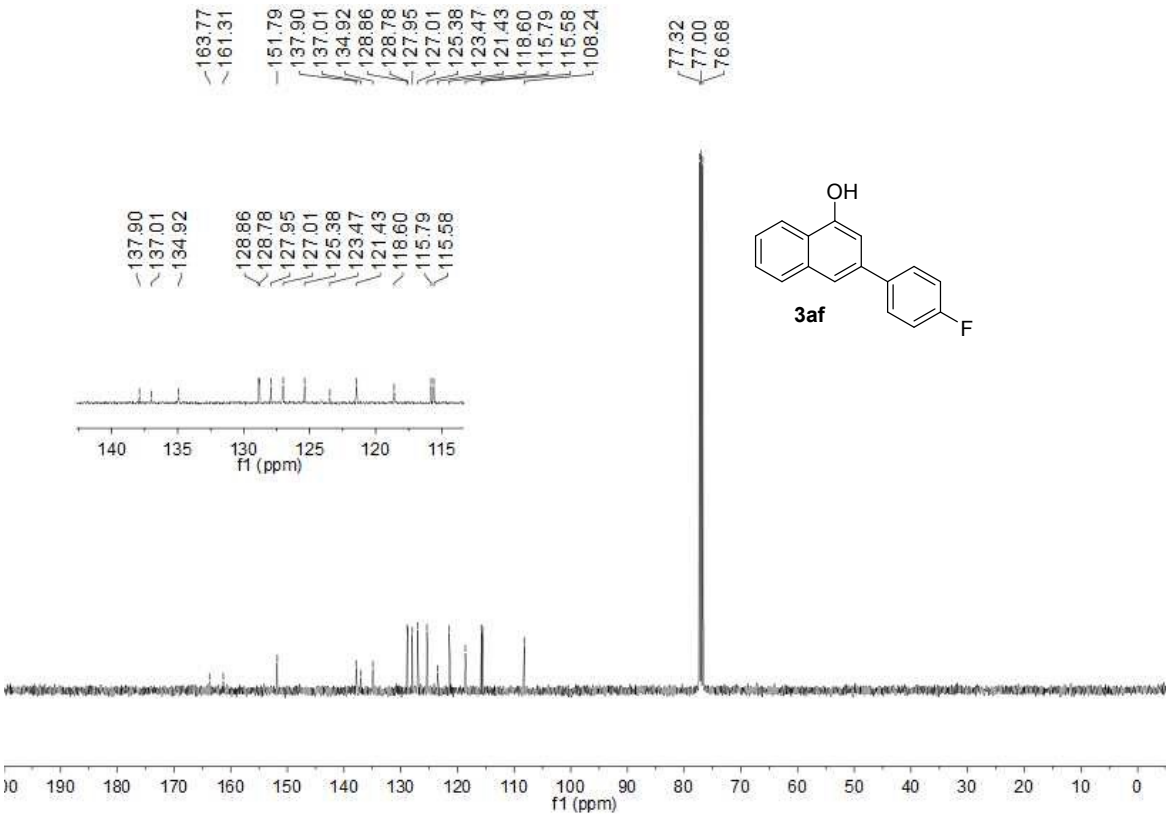
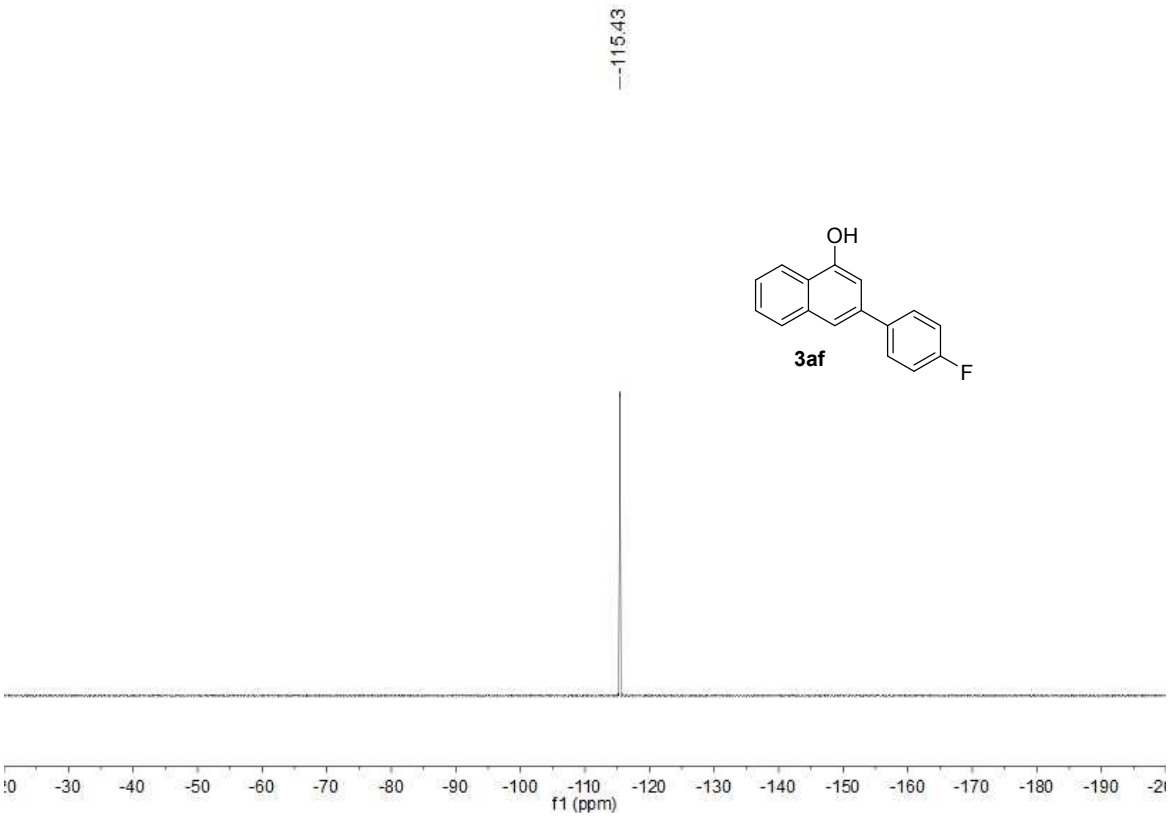
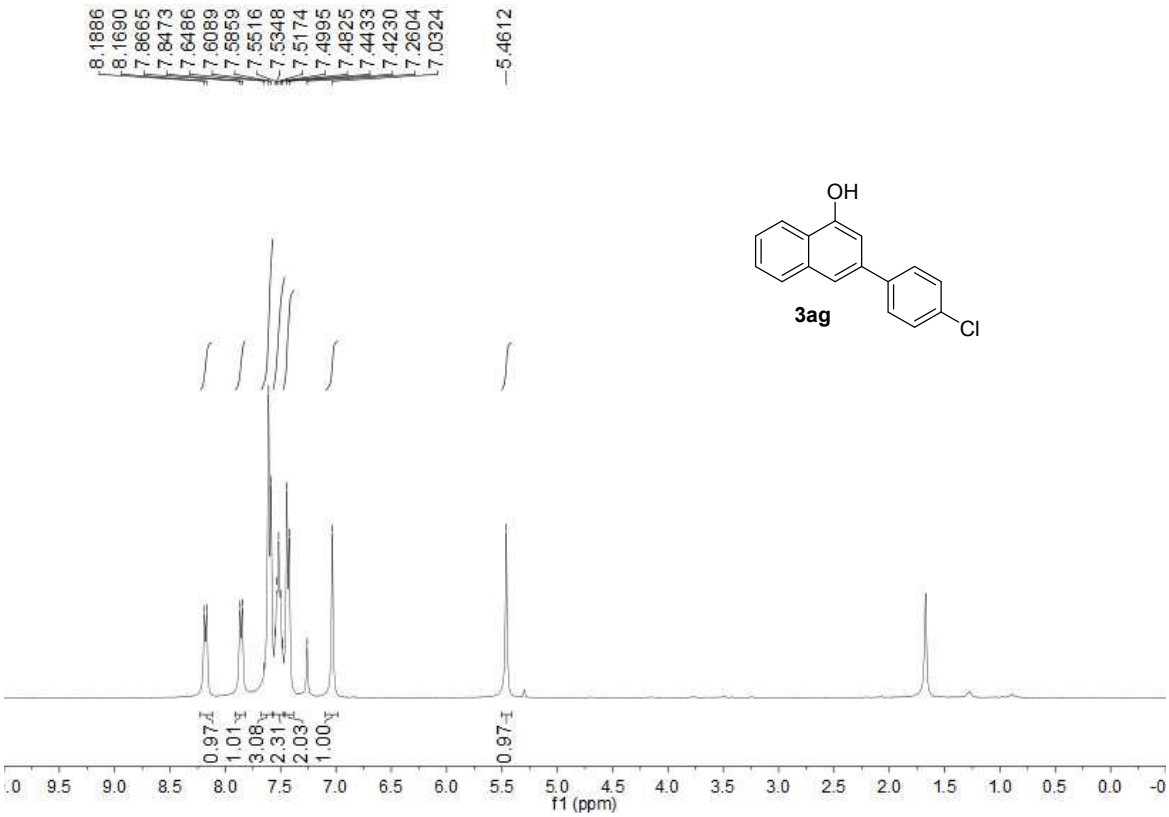
7.0466
7.0428
5.4017


OH
3af
F
0.97
1.16
2.97
2.12
2.45
1.00
0.99
f1 (ppm)


163.77
161.31
151.79
137.90
137.01
134.92
128.86
128.78
127.95
127.01
125.38
123.47
121.43
118.60
115.79
115.58
108.24
77.32
77.00
76.68
OH
3af
F
f1 (ppm)


115.43
OH
3af
F
f1 (ppm)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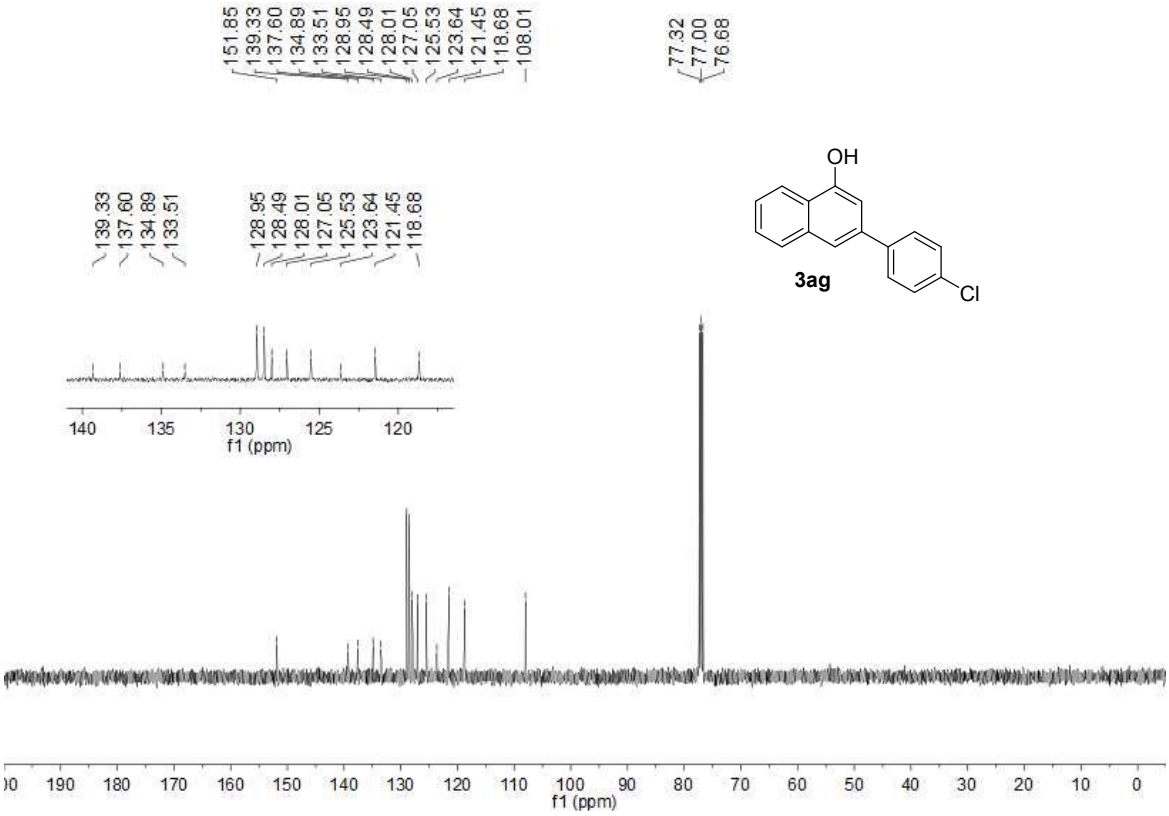
8.1690
7.8665
7.8473
7.6486
7.6089
7.5859
7.5516
7.5348
7.5174
7.4995
7.4825
7.4433
7.4230
7.2604
7.0324
5.4612
OH
Cl
3ag
0.97
1.01
3.08
2.31
2.03
1.00
0.97
f1 (ppm)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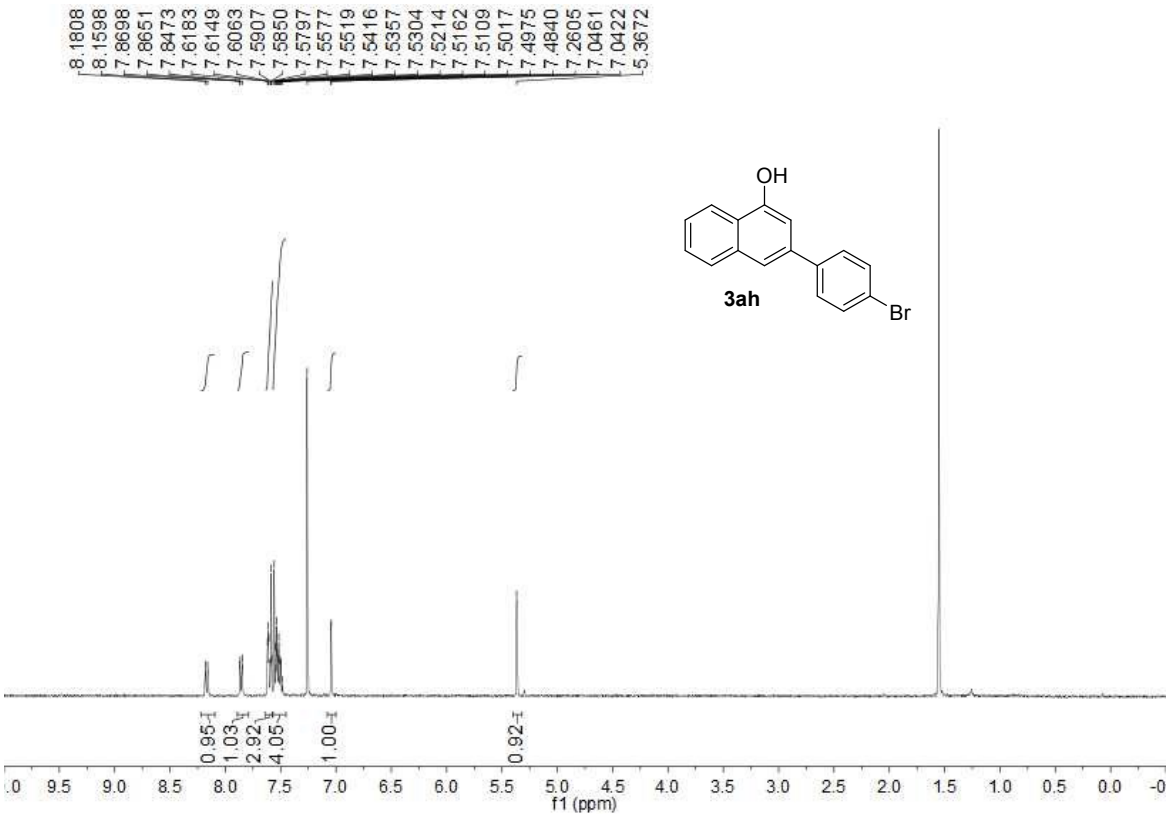
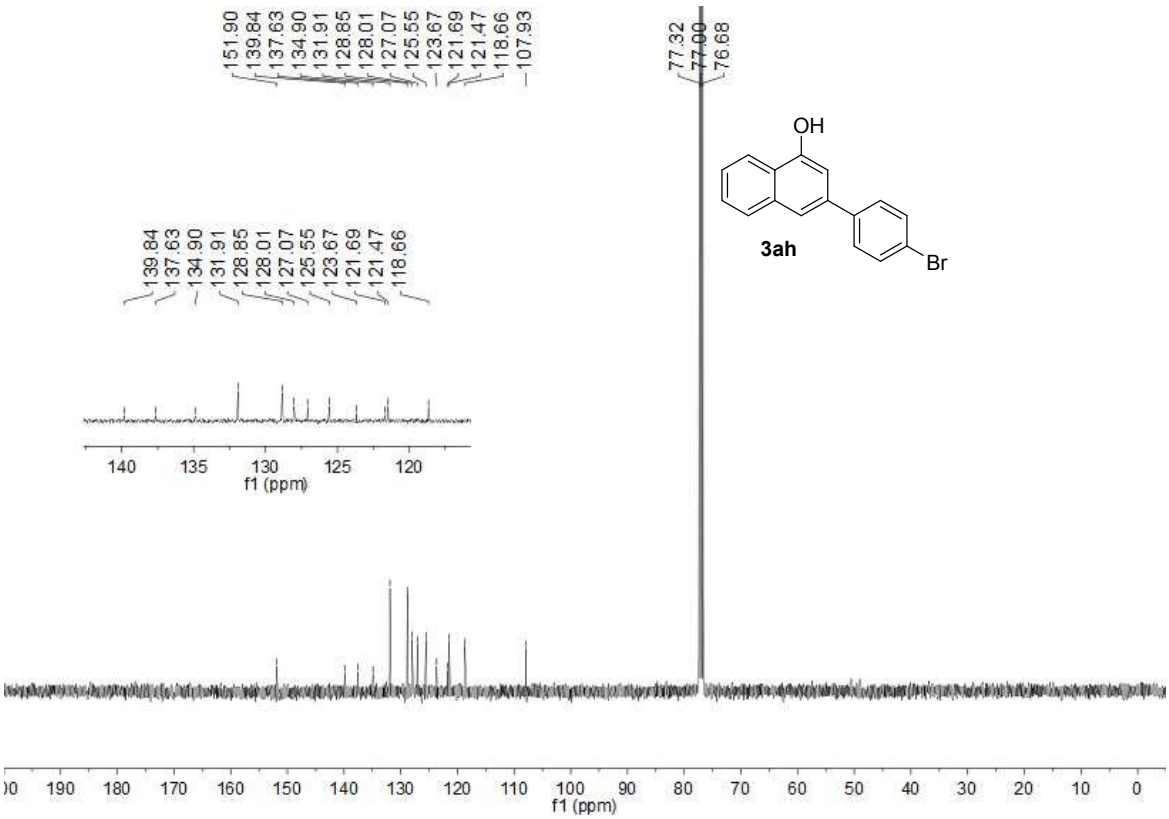
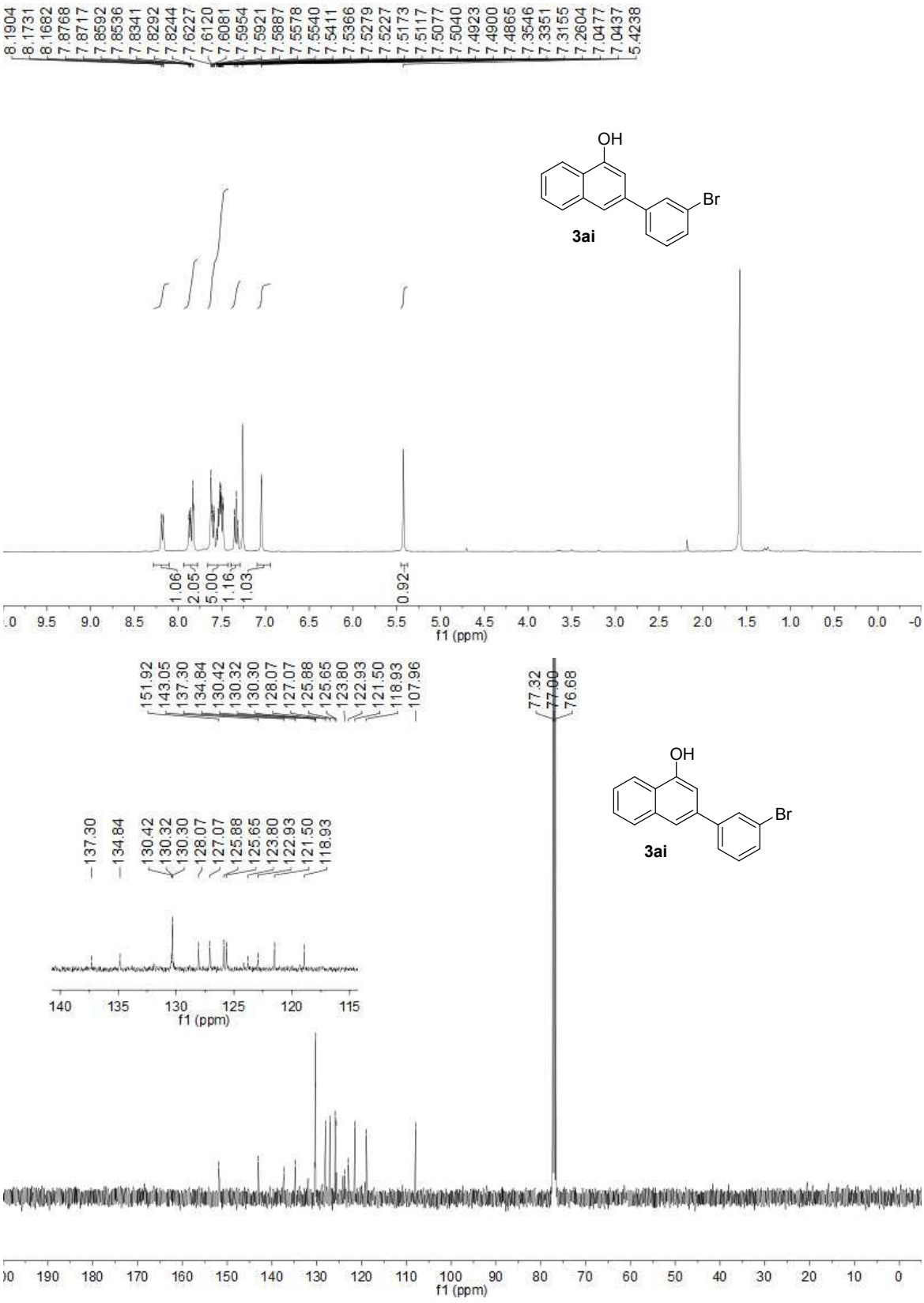
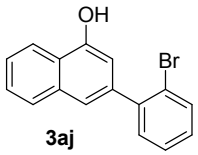
139.33
137.60
134.89
133.51
128.95
128.49
128.01
127.05
125.53
123.64
121.45
118.68
108.01
77.32
77.00
76.68
OH
Cl
3ag
f1 (ppm)


8.1808
8.1598
7.8698
7.8651
7.8473
7.6183
7.6149
7.6063
7.5907
7.5850
7.5797
7.5577
7.5519
7.5416
7.5357
7.5304
7.5214
7.5162
7.5109
7.5017
7.4975
7.4840
7.2605
7.0461
7.0422
5.3672
OH
3ah
Br
0.95
1.03
2.92
4.05
1.00
0.92
f1 (ppm)

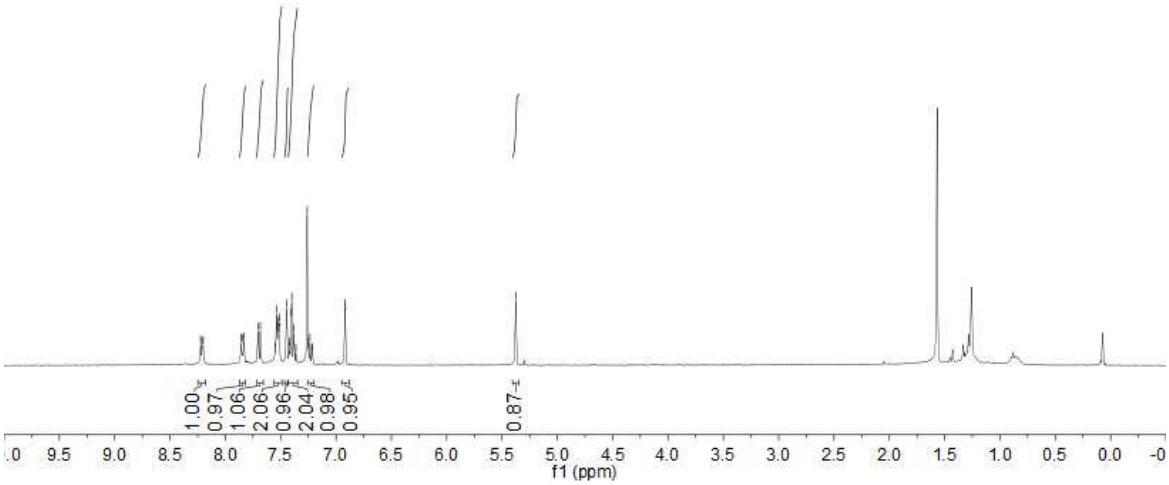

151.90
139.84
137.63
134.90
131.91
128.85
128.01
127.07
125.55
123.67
121.69
121.47
118.66
107.93
77.32
77.00
76.68
OH
3ah
Br
f1 (ppm)
f1 (ppm)

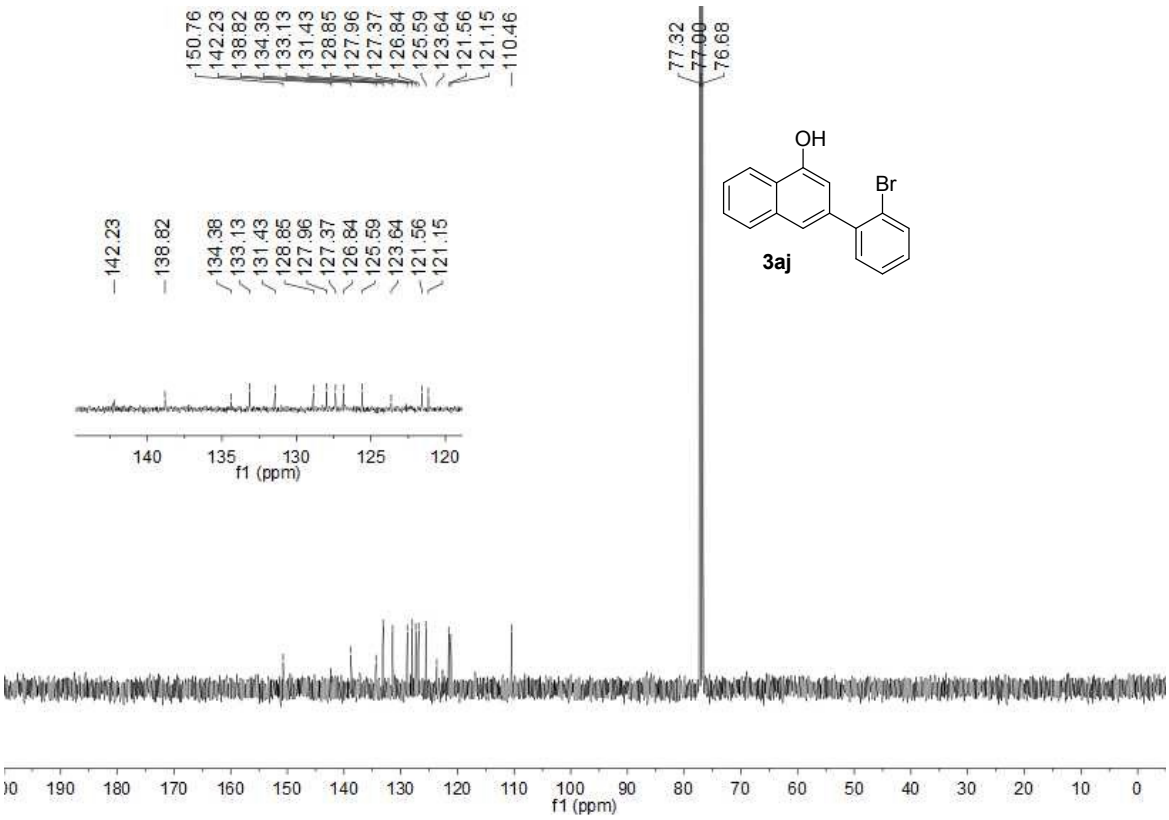

8.1904
8.1731
8.1682
7.8768
7.8717
7.8592
7.8536
7.8341
7.8292
7.8244
7.6227
7.6120
7.6081
7.5954
7.5921
7.5887
7.5578
7.5540
7.5411
7.5366
7.5279
7.5227
7.5173
7.5117
7.5077
7.5040
7.4923
7.4900
7.4865
7.3546
7.3351
7.3155
7.2604
7.0477
7.0437
5.4238
OH
Br
3ai
1.06
2.05
5.00
1.16
1.03
0.92
f1 (ppm)
151.92
143.05
137.30
134.84
130.42
130.32
130.30
128.07
127.07
125.88
125.65
123.80
122.93
121.50
118.93
107.96
77.32
77.00
76.68
OH
Br
3ai
137.30
134.84
130.42
130.32
130.30
128.07
127.07
125.88
125.65
123.80
122.93
121.50
118.93
f1 (ppm)
f1 (ppm)

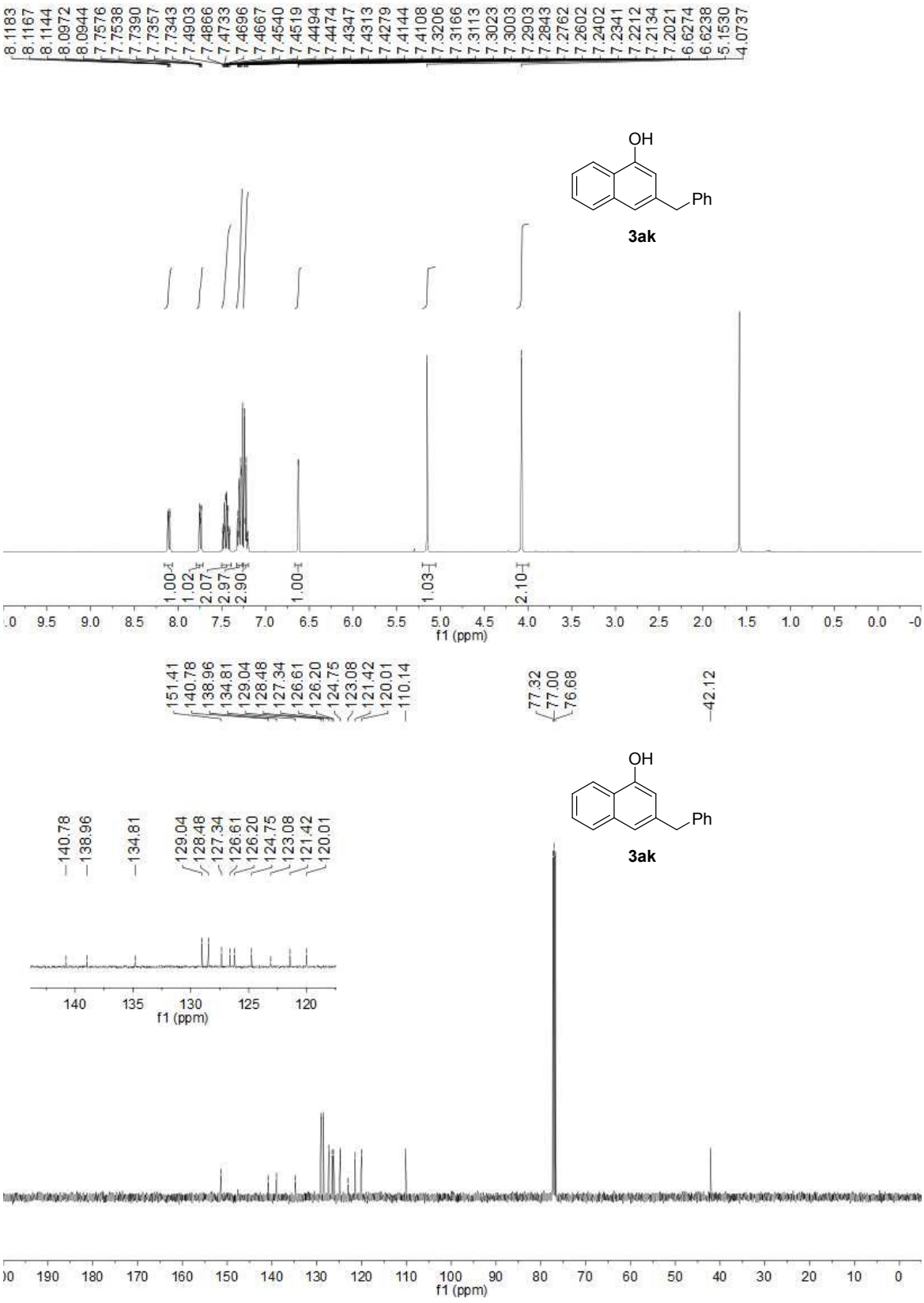

8.2232
8.2104
8.1993
7.8559
7.8450
7.8326
7.7026
7.6836
7.5487
7.5370
7.5319
7.5259
7.5182
7.5132
7.4446
7.4244
7.4187
7.4054
7.3996
7.3814
7.3624
7.2601
7.2496
7.2351
7.2178
7.2125
6.9171
6.9140
5.3756

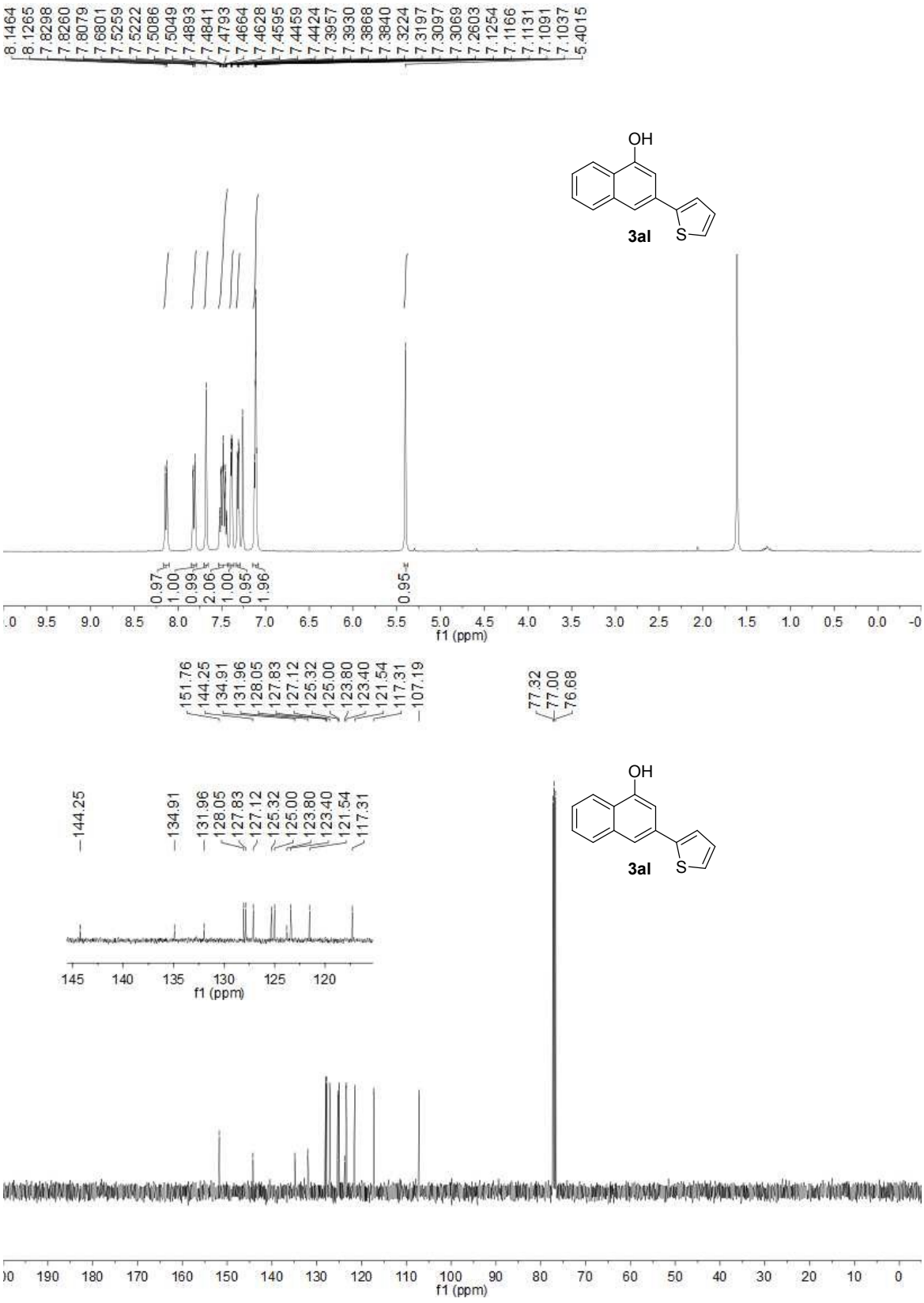

OH
Br

3aj


1.00
0.97
1.06
2.06
0.96
2.04
0.98
0.95
0.87
f1 (ppm)


150.76
142.23
138.82
134.38
133.13
131.43
128.85
127.96
127.37
126.84
125.59
123.64
121.56
121.15
110.46
77.32
77.00
76.68
OH
Br
3aj
142.23
138.82
134.38
133.13
131.43
128.85
127.96
127.37
126.84
125.59
123.64
121.56
121.15
140
135
130
125
120
f1 (ppm)
f1 (ppm)


8.1183
8.1167
8.1144
8.0972
8.0944
7.7576
7.7538
7.7390
7.7357
7.7343
7.4903
7.4866
7.4733
7.4696
7.4667
7.4540
7.4519
7.4494
7.4474
7.4347
7.4313
7.4279
7.4144
7.4108
7.3206
7.3166
7.3113
7.3023
7.3003
7.2903
7.2843
7.2762
7.2602
7.2402
7.2341
7.2212
7.2134
7.2021
6.6274
6.6238
5.1530
4.0737
OH
Ph
3ak
1.00
1.02
2.07
2.97
2.90
1.00
1.03
2.10
f1 (ppm)
151.41
140.78
138.96
134.81
129.04
128.48
127.34
126.61
126.20
124.75
123.08
121.42
120.01
110.14
77.32
77.00
76.68
42.12
OH
Ph
3ak
140.78
138.96
134.81
129.04
128.48
127.34
126.61
126.20
124.75
123.08
121.42
120.01
f1 (ppm)
f1 (ppm)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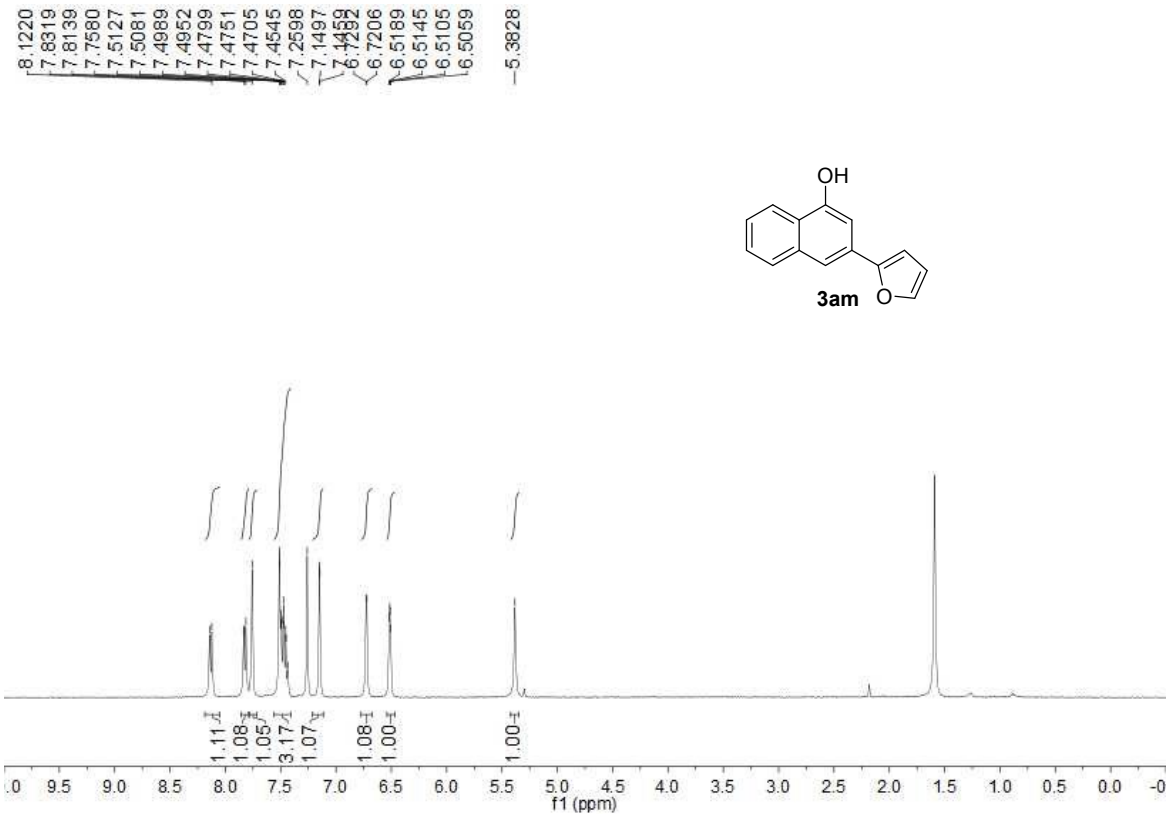
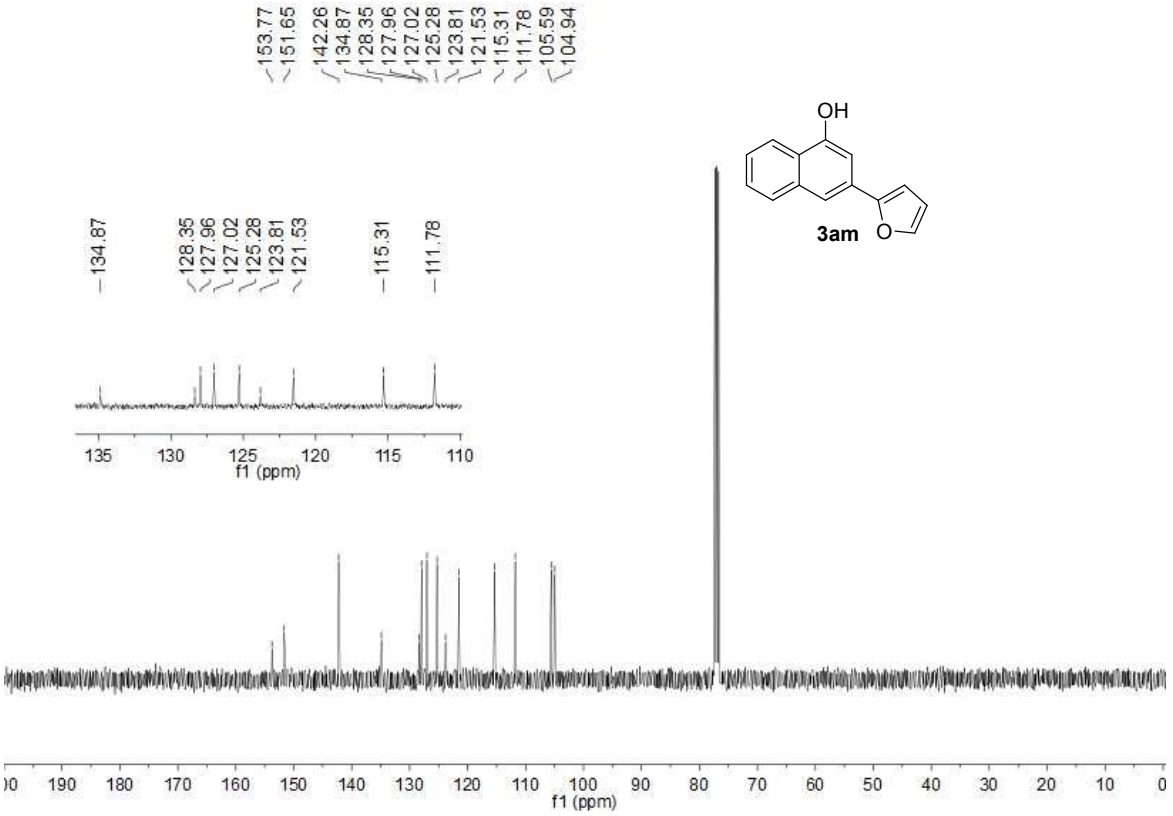
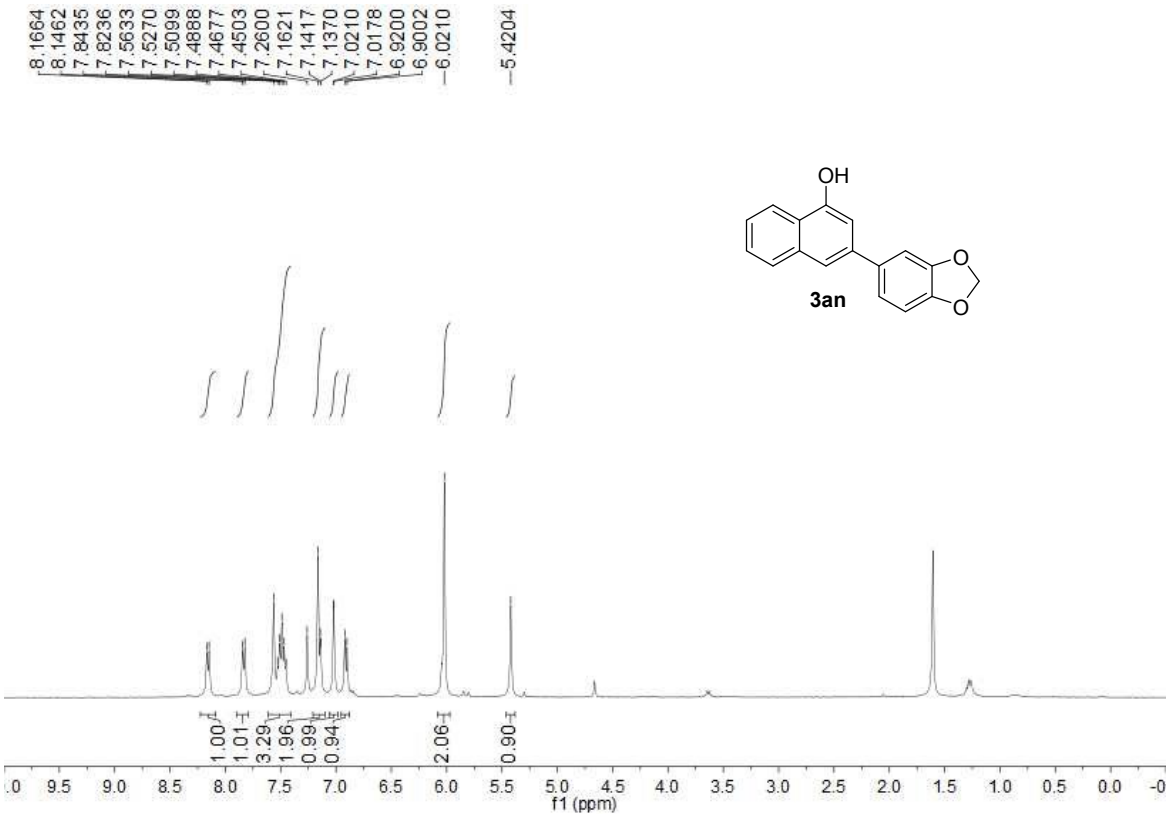
8.1265
7.8298
7.8260
7.8079
7.6801
7.5259
7.5222
7.5086
7.5049
7.4893
7.4841
7.4793
7.4664
7.4628
7.4595
7.4459
7.4424
7.3957
7.3930
7.3868
7.3840
7.3224
7.3197
7.3097
7.3069
7.2603
7.1254
7.1166
7.1131
7.1091
7.1037
5.4015
OH
S
3al
0.97
1.00
0.99
2.06
1.00
0.95
1.96
0.95
f1 (ppm)
151.76
144.25
134.91
131.96
128.05
127.83
127.12
125.32
125.00
123.80
123.40
121.54
117.31
107.19
77.32
77.00
76.68
OH
S
3al
144.25
134.91
131.96
128.05
127.83
127.12
125.32
125.00
123.80
123.40
121.54
117.31
f1 (ppm)
f1 (ppm)


8.1220
7.8319
7.8139
7.7580
7.5127
7.5081
7.4989
7.4952
7.4799
7.4751
7.4705
7.4545
7.2598
7.1497
6.7206
6.5189
6.5145
6.5105
6.5059
5.3828
OH
3am
O
1.11
1.08
1.05
3.17
1.07
1.08
1.00
1.00
f1 (ppm)


153.77
151.65
142.26
134.87
128.35
127.96
127.02
125.28
123.81
121.53
115.31
111.78
105.59
104.94
OH
3am
O
134.87
128.35
127.96
127.02
125.28
123.81
121.53
115.31
111.78
135
130
125
120
115
110
f1 (ppm)
f1 (ppm)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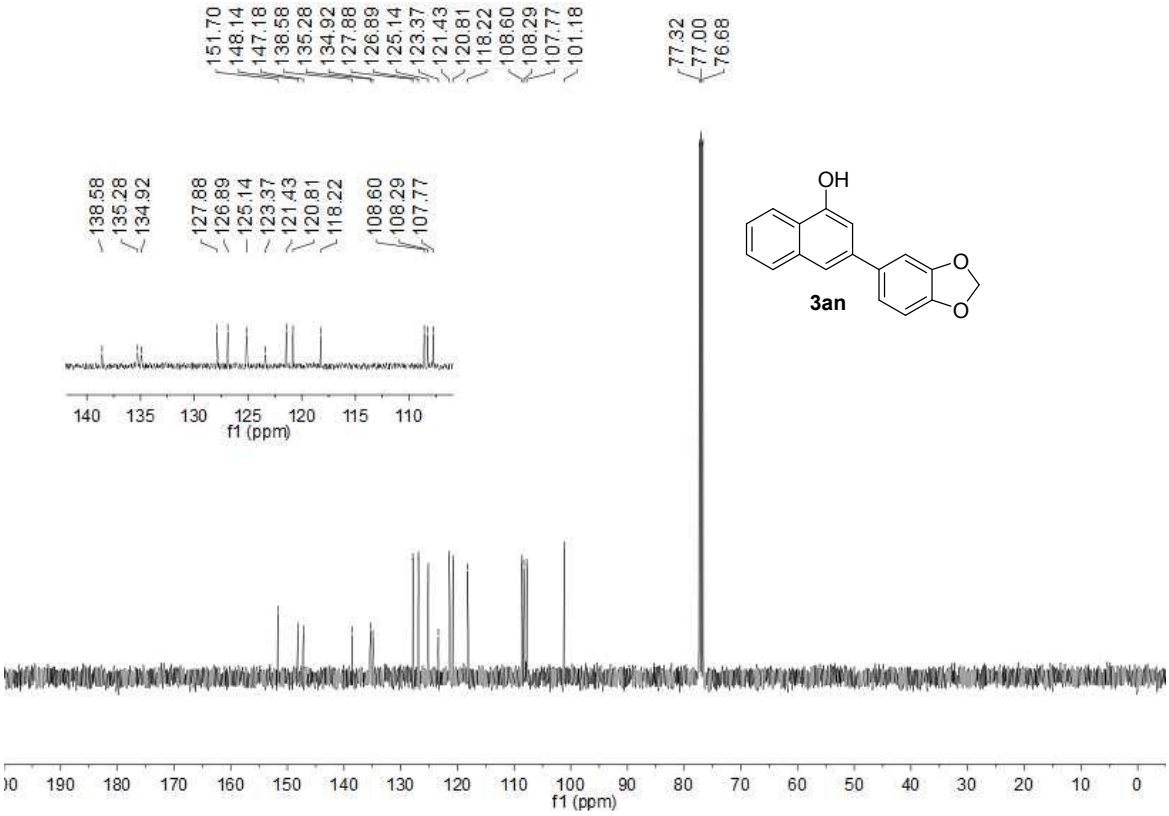
8.1462
7.8435
7.8236
7.5633
7.5270
7.5099
7.4888
7.4677
7.4503
7.2600
7.1621
7.1417
7.1370
7.0210
7.0178
6.9200
6.9002
6.0210
5.4204
OH
O
O
3an
1.00
1.01
3.29
1.96
0.99
0.94
2.06
0.90
f1 (ppm)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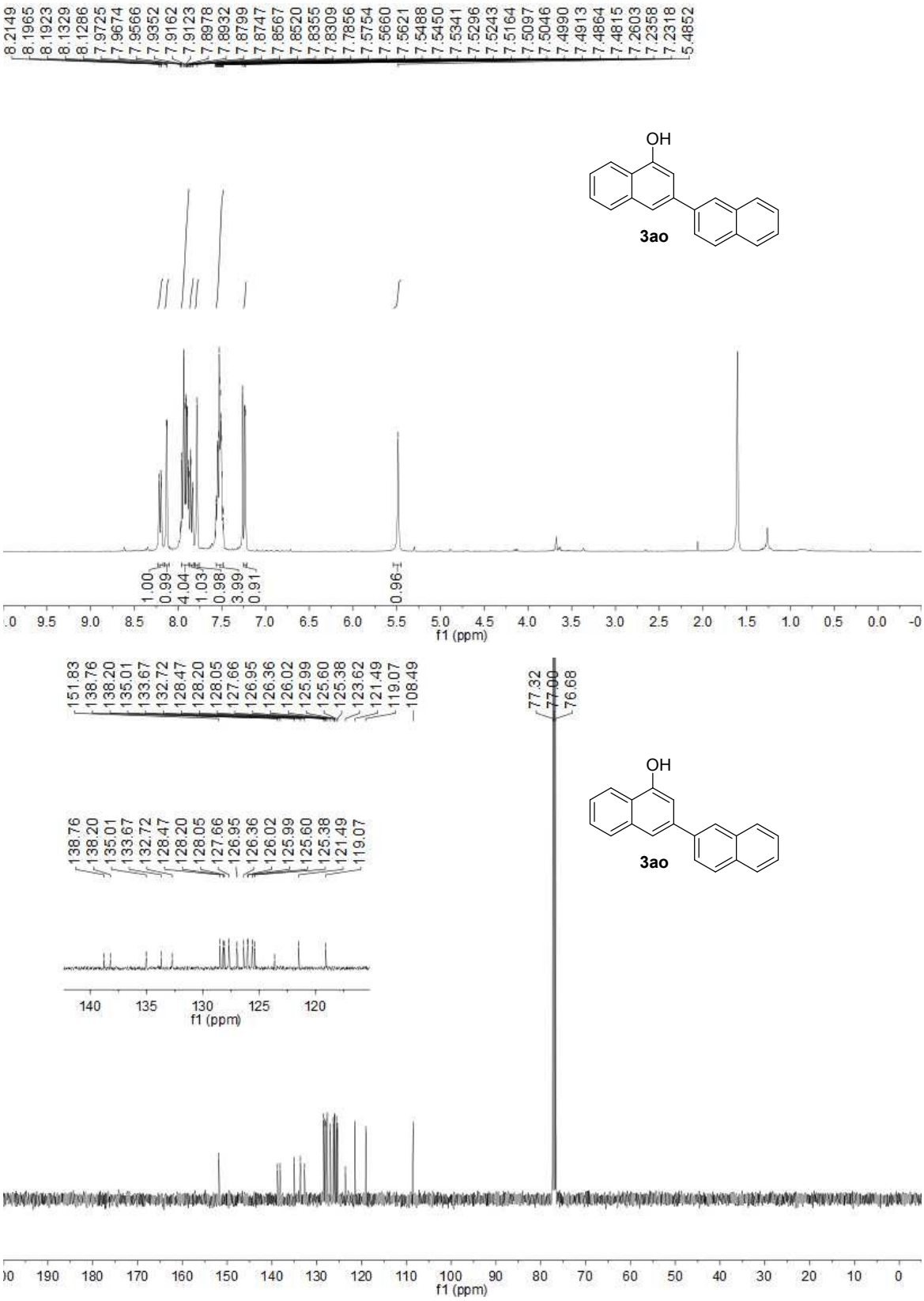
148.14
147.18
138.58
135.28
134.92
127.88
126.89
125.14
123.37
121.43
120.81
118.22
108.60
108.29
107.77
101.18
77.32
77.00
76.68
OH
O
O
3an
f1 (ppm)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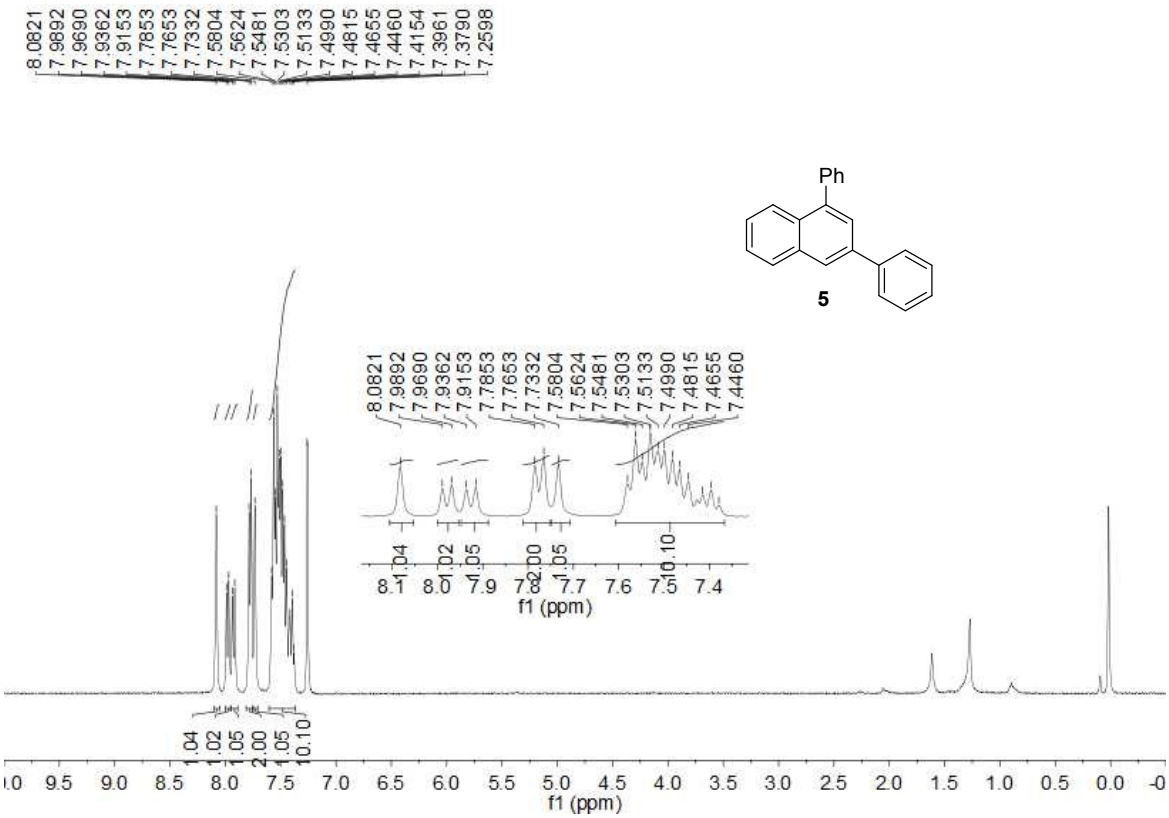
8.1965
8.1923
8.1329
8.1286
7.9725
7.9674
7.9566
7.9352
7.9162
7.9123
7.8878
7.8832
7.8799
7.8747
7.8567
7.8520
7.8355
7.8309
7.7856
7.5754
7.5660
7.5621
7.5488
7.5450
7.5341
7.5296
7.5243
7.5164
7.5097
7.5046
7.4990
7.4913
7.4864
7.4815
7.2603
7.2358
7.2318
5.4852
OH
3ao
1.00
0.99
4.04
1.03
0.98
3.99
0.91
0.96
f1 (ppm)
151.83
138.76
138.20
135.01
133.67
132.72
128.47
128.20
128.05
127.66
126.95
126.36
126.02
125.99
125.60
125.38
123.62
121.49
119.07
108.49
77.32
77.00
76.68
OH
3ao
138.76
138.20
135.01
133.67
132.72
128.47
128.20
128.05
127.66
126.95
126.36
126.02
125.99
125.60
125.38
121.49
119.07
140
135
130
125
120
f1 (ppm)
f1 (ppm)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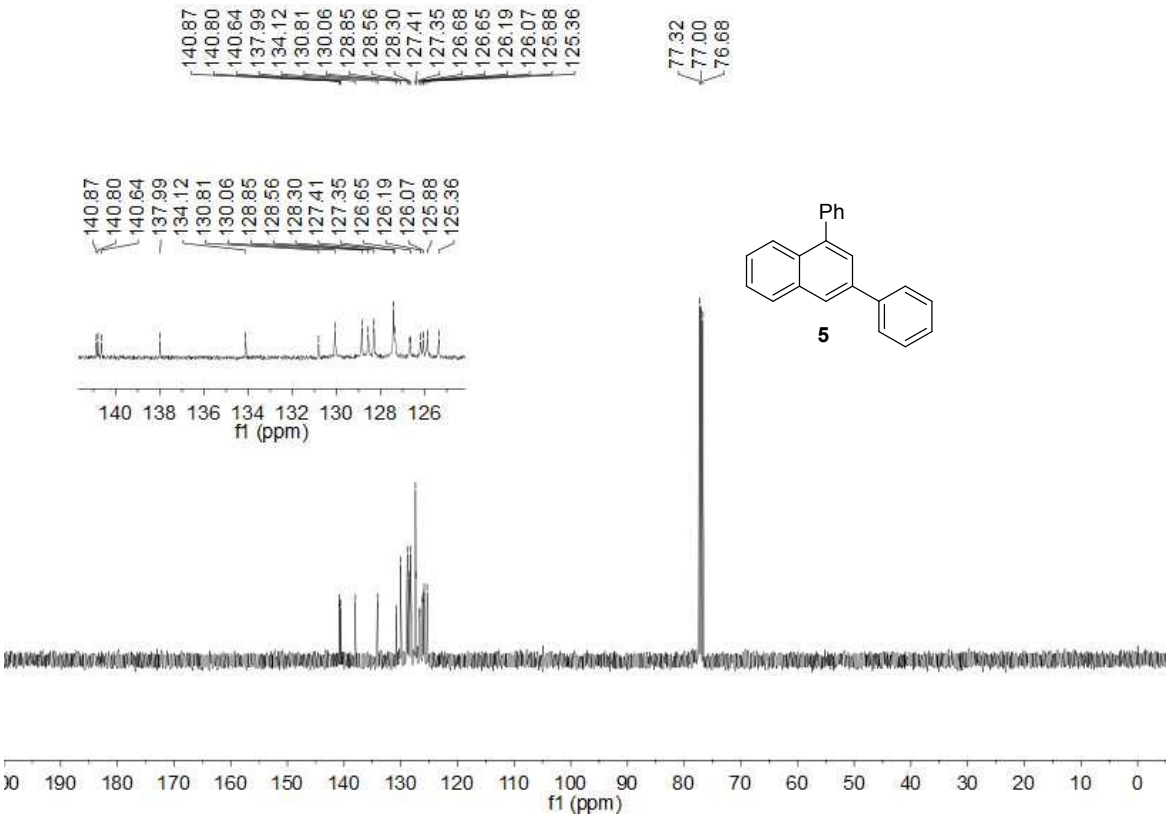
7.9690
7.9362
7.9153
7.7853
7.7653
7.7332
7.5804
7.5624
7.5481
7.5303
7.5133
7.4990
7.4815
7.4655
7.4460
7.4154
7.3961
7.3790
7.2598
Ph
5
1.04
1.02
1.05
2.00
1.05
10.10
f1 (ppm)


140.87
140.80
140.64
137.99
134.12
130.81
130.06
128.85
128.56
128.30
127.41
127.35
126.68
126.65
126.19
126.07
125.88
125.36
77.32
77.00
76.68
Ph
5
f1 (ppm)