Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry.

Supporting Information

1,6-Addition of vinyl *p*-quinone methides with cyclic sulfamidate imines: Access to 4-hydroxyaryl-2,6-diarylpyridines

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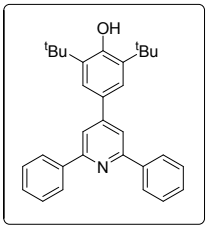
General Information: All reactions were carried out either under inert atmosphere or air and monitored by TLC using Merck 60 F254 pre coated silica gel plates (0.25 mm thickness) and the products were visualized by UV detection. Flash chromatography was carried out with silica gel (200-300 mesh). ^{1}H and ^{13}C NMR spectra were recorded on a Bruker Avance (III) 400 MHz spectrometer. Data for ^{1}H NMR are reported as a chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, q = quartet, m = multiplet), coupling constant J (Hz), integration, and assignment, data for ^{13}C are reported as a chemical shift (δ ppm). High resolutions mass spectral analyses (HRMS) were carried out using ESI-TOF-MS. Melting points were recorded on an Electrothermal melting points apparatus and are uncorrected.

The vinylogous-*para*-quinone methides (**2aa-2ad**)[1]and 4-aryl-*5H*-1,2,3-oxathiazole-2,2-dioxides(**1a-i**)[2] were prepared according to literature procedures. All chemicals were purchased from commercial suppliers and used without further purification unless otherwise stated.

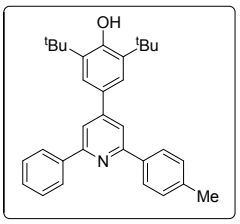
Representative procedure for the synthesis of 2,6-di-*tert*-butyl-4-(2,6-diphenylpyridin-4-yl)phenol (3aaa): To a stirred solution of compounds **1a** (29.6 mg, 0.15 mmol) and **2aa** (57.6 mg, 0.18 mmol) in dry 2-MeTHF (1.5 mL) was added DABCO (25.2 mg, 0.225 mmol) at room temperature. The reaction mixture was then heated under air at 60 °C for 10-15 h (monitored by TLC). Upon completion of the reaction, the reaction mixture was extracted with ethyl acetate (3 × 10 mL), washed with water and brine, respectively, and dried over Na_2SO_4. The combined organic phases were evaporated under reduced pressure to afford the crude product. Finally, the product was obtained in pure form (52.3 mg, 80%) through column chromatography over silica gel using a mixture of EtOAc/hexane (1:19, v/v) as the eluent. The product was fully characterized by its spectroscopic data (IR, $^{1}HNMR$, ^{13}C NMR, and HRMS).
All the prepared products in Table 2 and Scheme 3 were followed the above procedure which were characterized by their corresponding spectroscopic data (^{1}H NMR, ^{13}C NMR, and HRMS).

2,6-Di-*tert*-butyl-4-(2,6-diphenylpyridin-4-yl)phenol (3aaa): Colorless solid; yield 80 % (52.3 mg); mp 157-159 °C; R_f = 0.86 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz;

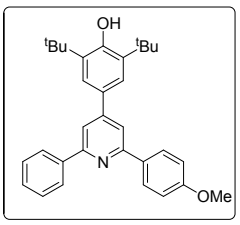


$CDCl_3$): δ_H 8.19 (d, J = 7.5 Hz, 4H), 7.82 (s, 2H), 7.60 – 7.48 (m, 6H), 7.44 (t, J = 7.2 Hz, 2H), 5.43 (s, 1H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.4, 154.9, 151.3, 139.9, 136.7, 130.4, 129.0, 128.7, 127.2, 124.1, 117.1, 34.6, 31.0 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{34}NO[M+H]^+$ 436.2635, found 436.2638.

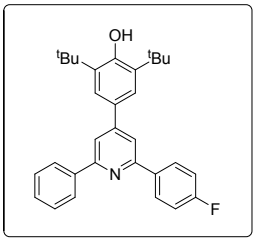
2,6-Di-*tert*-butyl-4-(2-phenyl-6-(4-methylphenyl)pyridin-4-yl)phenol (3baa): Colorless solid; yield 81% (54.6 mg); mp 163-165 °C; R_f = 0.85 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.19 (d, J = 6.9 Hz, 2H), 8.10 (s, 1H), 8.08 (s, 1H), 7.79 (s, 2H), 7.59 – 7.47 (m, 4H), 7.44 (d, J = 6.5 Hz, 1H), 7.32 (d, J = 7.1 Hz, 2H), 5.42 (s, 1H), 2.43 (s, 3H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 157.4, 154.9, 151.3, 140.1, 139.0, 137.2, 136.7, 130.5, 129.5, 129.0, 128.8, 127.3, 127.2, 124.2, 117.0, 116.9, 34.6, 30.4, 21.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{35}NONa[M+Na]^+$ 472.2611, found 472.2612.



2,6-Di-*tert*-butyl-4-(2-(4-methoxyphenyl)-6-phenylpyridin-4-yl)phenol (3caa): Light yellow solid; yield 80% (55.9 mg); mp 170-172 °C; R_f = 0.81 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.17 (t, J = 8.7 Hz, 4H), 7.76 (s, 2H), 7.57 – 7.47 (m, 4H), 7.44 (d, J = 7.2 Hz, 1H), 7.04 (d, J = 8.6 Hz, 2H), 5.42 (s, 1H), 3.88 (s, 3H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.6, 157.3, 157.1, 154.9, 151.3, 140.1, 136.7, 132.6, 130.6, 129.0, 128.8, 128.5, 127.3, 124.1, 116.6, 116.5, 114.2, 55.5, 34.6, 30.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{35}NO_2Na[M+Na]^+$ 488.2560, found 488.2569.

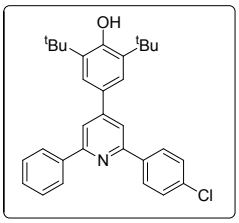


2,6-Di-*tert*-butyl-4-(2-(4-fluorophenyl)-6-phenylpyridin-4-yl)phenol (3daa): Light brown solid; yield 69% (46.9 mg); mp 170-172 °C; R_f = 0.83 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.10 (t, J = 7.4 Hz, 4H), 7.80 – 7.65 (m, 2H), 7.50 – 7.33 (m, 6H), 7.12 (t, J = 8.6 Hz, 1H), 5.36 (s, 1H), 1.46 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 162.5 (d, J_{C-F} = 248.3 Hz), 156.35, 155.26, 153.89, 150.36, 138.85, 135.67, 134.93, 129.20, 127.9 (d, J_{C-F} = 8.4 Hz), 127.68, 126.11 ,123.00, 116.04, 116.09, 115.70, 114.5 (d, J_{C-F} = 21.5 Hz), 33.51,



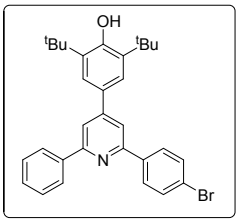
29.27 ppm; ^{19}F NMR (376 MHz; $CDCl_3$): δ_F -113.3 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{33}FNO[M+H]^+$ 454.2541, found 454.2548.

2,6-Di-*tert*-butyl-4-(2-(4-chlorophenyl)-6-phenylpyridin-4-yl)phenol (3eaa): Colorless solid;



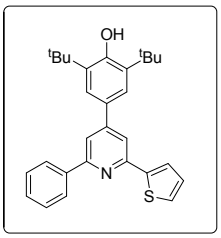
yield 67% (47.3 mg); mp 160-162 °C; R_f = 0.82 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.15 (dd, J = 11.8Hz, 8.3 Hz, 4H), 7.82 (s, 1H), 7.78 (s, 1H), 7.62 – 7.38 (m, 7H), 5.44 (s, 1H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 156.1, 155.0, 151.5, 139.7, 138.7, 136.7, 131.8, 131.1, 130.1, 129.0, 128.7, 127.1, 124.0, 123.4, 117.4, 116.83, 34.6, 30.3 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{32}ClNONa[M+Na]^+$ 492.2065, found 492.2071.

4-(2-(4-Bromophenyl)-6-phenylpyridin-4-yl)-2,6-di-*tert*-butylphenol (3faa): Light yellow



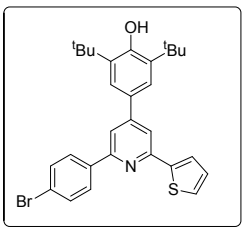
solid; yield 70 % (54.1 mg); mp 159-161°C; R_f = 0.81 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.17 (d, J = 7.5 Hz, 2H), 8.08 (s, 1H), 8.06 (s, 1H), 7.83 (s, 1H), 7.78 (s, 1H), 7.63 (d, J = 8.3 Hz, 2H), 7.56 – 7.48 (m, 4H), 7.46 (d, J = 7.1 Hz, 1H), 5.44 (s, 1H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 156.1, 155.0, 151.5, 139.7, 138.7, 136.7, 131.8, 131.1, 130.1, 129.1, 128.7, 127.2, 124.0, 123.4, 117.4, 116.8, 34.6, 30.3 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{32}{}^{79}BrNONa[M+Na]^+$ 536.1559, found 536.1563; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{32}{}^{81}BrNONa[M+Na]^+$ 538.1539, found 538.1543.

2,6-Di-*tert*-butyl-4-(2-phenyl-6-(thiophen-2-yl)pyridin-4-yl)phenol (3haa): Light brown solid;



yield 74 % (49.1 mg); mp 164-166 °C; R_f = 0.75 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.03 (d, J = 8.4 Hz, 2H), 7.72 (s, 1H), 7.70 (d, J = 3.6 Hz, 1H), 7.69 (s, 1H), 7.63 (s, 1H), 7.61 (s, 1H), 7.49 (s, 2H), 7.42 (d, J = 4.8 Hz, 1H), 7.17 – 7.11 (m, 1H), 5.44 (s, 1H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 156.0, 155.1, 152.7, 151.5, 145.5, 138.3, 136.8, 131.9, 130.0, 128.7, 128.0, 127.8, 124.7, 124.1, 123.5, 116.6, 115.6, 34.6, 30.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{29}H_{31}NOS[M+H]^+$ 442.2199, found 442.2203.

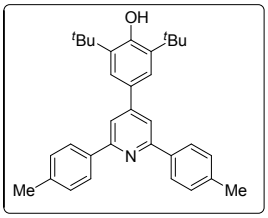
4-(2-(4-Bromophenyl)-6-(thiophen-2-yl)pyridin-4-yl)-2,6-di-*tert*-butylphenol (3hda): Brown



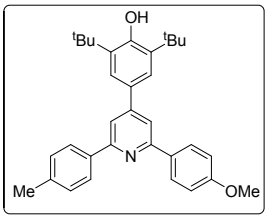
solid; yield 72% (56.2 mg); mp 147-149 °C; R_f = 0.72 (EtOAc:hexane =

1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.16 (d, J = 7.5 Hz, 2H), 7.74 (s, 1H), 7.72 (s, 1H), 7.71 (s, 1H), 7.55 – 7.48 (m, 4H), 7.43 (dd, J_1= 13.0 Hz, J_2 = 5.9 Hz, 2H), 7.19 – 7.09 (m, 1H), 5.43 (s, 1H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.2, 155.0, 152.6, 151.3, 145.8, 139.4, 136.8, 130.2, 129.1, 128.8, 128.0, 127.6, 127.2, 124.6, 124.1, 116.9, 115.4, 34.6, 30.4 ppm; HRMS (ESI) m/z calcd for $C_{29}H_{30}{}^{79}BrNOSNa[M+Na]^+$ 542.1124, found 542.1132; HRMS (ESI-TOF) m/z calcd for $C_{29}H_{30}{}^{81}BrNOSNa[M+Na]^+$ 544.1103, found 544.1112.

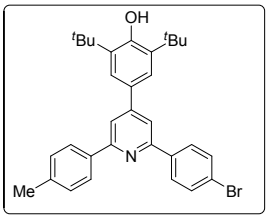
2,6-Di-*tert*-butyl-4-(2,6-dimethylphenyl)pyridin-4-yl)phenol (3bba): Colorless solid; yield 75 % (52.2 mg); mp 139-141 °C; R_f = 0.86(EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.08 (d, J = 8.0 Hz, 4H), 7.76 (s, 2H), 7.52 (s, 2H), 7.31 (d, J = 7.9 Hz, 4H), 5.41 (s, 1H), 2.43 (s, 6H), 1.52 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.29, 154.80, 151.09, 138.82, 137.21, 136.63, 130.56, 129.40, 127.06, 124.06, 116.59, 34.55, 30.33, 21.34ppm; HRMS (ESI-TOF) m/z calcd for $C_{33}H_{38}NO[M+H]^+$ 464.2948, found 464.2949.



2,6-Di-*tert*-butyl-4-(2-(4-methoxyphenyl)-6-(4-methylphenyl)pyridin-4-yl)phenol (3cba): Light yellow solid; yield 78 % (56.1 mg); mp 141-143 °C; R_f = 0.79 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.15 (d, J = 7.0 Hz, 2H), 8.08 (s, 1H), 8.07 (s, 1H), 7.73 (s, 2H), 7.52 (s, 2H), 7.31 (d, J = 7.0 Hz, 2H), 7.04 (d, J = 7.0 Hz, 2H), 5.41 (s, 1H), 3.88 (s, 3H), 2.43 (s, 3H), 1.52 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.5, 157.3, 156.9, 154.8, 151.1, 138.8, 137.3, 136.7, 132.7, 130.6, 129.4, 128.5, 127.1, 124.1, 116.3, 116.2, 114.1, 55.4, 34.6, 30.4, 21.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{33}H_{37}NO_2Na[M+Na]^+$ 502.2717, found 502.2721.

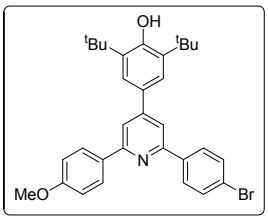


4-(2-(4-Bromophenyl)-6-(4-methylphenyl)pyridin-4-yl)-2,6-di-*tert*-butylphenol (3fba): Colorless solid; yield 65% (51.5 mg); mp 182-184 °C; R_f = 0.82 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.06 (d, J = 8.1 Hz, 4H), 7.80 (s, 1H), 7.75 (s, 1H), 7.63 (d, J = 8.3 Hz, 2H), 7.51 (s, 2H), 7.32 (d, J = 7.9 Hz, 2H), 5.43 (s, 1H), 2.43 (s, 3H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 156.0, 154.9, 151.4, 139.0, 138.8,



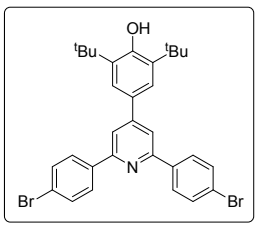
136.9, 136.7, 131.8, 130.3, 129.5, 128.8, 127.0, 124.0, 123.3, 117.2, 116.6, 34.6, 30.3, 21.4 ppm; HRMS (ESI) m/z calcd for $C_{32}H_{35}{}^{79}BrNO[M+H]^+$ 528.1897, found 528.1903; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{35}{}^{81}BrNO[M+H]^+$ 530.1876, found 530.1882.

4-(2-(4-Bromophenyl)-6-(4-methoxyphenyl)pyridin-4-yl)-2,6-di-*tert*-butylphenol (3fca):

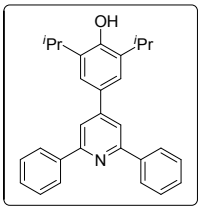


Light yellow solid; yield 61% (49.8 mg); mp 169-171 °C; R_f = 0.76 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.13 (d, J = 8.3 Hz, 2H), 8.06 (d, J = 8.1 Hz, 2H), 7.76 (s, 1H), 7.72 (s, 1H), 7.63 (d, J = 8.1 Hz, 2H), 7.51 (s, 2H), 7.04 (d, J = 8.3 Hz, 2H), 5.43 (s, 1H), 3.89 (s, 3H), 1.53 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.7, 157.3, 156.1, 155.1, 151.5, 139.0, 136.9, 132.5, 131.9, 130.5, 128.9, 128.6, 124.2, 123.4, 116.8, 116.4, 114.3, 55.6, 34.7, 30.5 ppm; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{35}{}^{79}BrNO_2[M+H]^+$ 544.1846, found 544.1858; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{35}{}^{81}BrNO_2[M+H]^+$ 546.1825, found 546.1837.

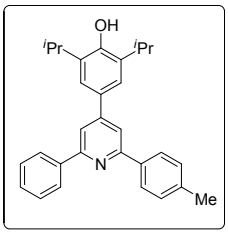
4-(2,6-Di(4-bromophenyl)pyridin-4-yl)-2,6-di-*tert*-butylphenol (3fda): Light yellow solid; yield 72% (64.1 mg); mp 180-182 °C; R_f = 0.76 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.10 (d, J = 7.3 Hz, 4H), 7.74 (s, 2H), 7.42 (t, J = 7.5 Hz, 4H), 7.35 (d, J = 7.3 Hz, 2H), 5.33 (s, 1H), 1.44 (d, J = 4.7 Hz, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.4, 155.0, 151.3, 140.0, 130.4, 136.7, 129.0, 128.8, 127.2, 124.1, 117.2, 34.6, 30.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{31}{}^{79}Br_2NONa[M+Na]^+$ 614.0665, found 614.0668; HRMS (ESI-TOF) m/z calcd for $C_{32}H_{31}{}^{81}Br_2NONa[M+H]^+$ 618.0624, found 618.0627.



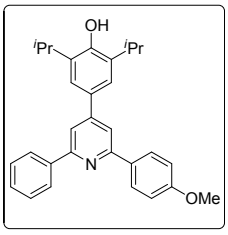
4-(2,6-Diphenylpyridin-4-yl)-2,6-diisopropylphenol (3aab): Colorless solid; yield 80% (48.9 mg); mp 149-151 °C; R_f = 0.73 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.20 (d, J = 7.4 Hz, 4H), 7.83 (s, 2H), 7.52 (t, J = 7.3 Hz, 4H), 7.47 – 7.39 (m, 4H), 5.01 (s, 1H), 3.19-3.21 (m, 2H), 1.37 (s, 6H), 1.36 (s, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.5, 151.1, 150.9, 139.9, 134.5, 131.5, 129.0, 128.7, 127.2, 122.6, 117.1, 27.5, 22.8 ppm; HRMS (ESI-TOF) m/z calcd for $C_{29}H_{29}NONa[M+Na]^+$ 430.2141, found 430.2150.



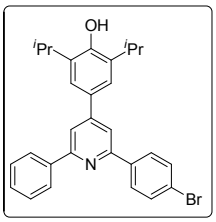
2,6-Diisopropyl-4-(2-phenyl-6-(4-methylphenyl)pyridin-4-yl)phenol (3bab): light yellow solid; yield 78% (49.4 mg); mp 156-158 °C; R_f = 0.74 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.19 (d, J = 7.5 Hz, 2H), 8.09 (d, J = 7.7 Hz, 2H), 7.80 (s, 2H), 7.51 (t, J = 7.4 Hz, 2H), 7.46 – 7.39 (m, 3H), 7.32 (d, J = 7.7 Hz, 2H), 5.01 (s, 1H), 3.19-3.25 (m, 2H), 2.43 (s, 3H), 1.36 (s, 6H), 1.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 157.4, 151.1, 150.8, 140.0, 138.9, 137.2, 134.5, 131.6, 129.5, 128.9, 128.7, 127.2, 127.1, 122.6, 116.8, 116.8, 27.5, 22.8, 21.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{32}NO[M+H]^+$ 422.2478, found 422.2485.



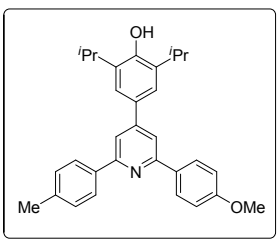
2,6-Diisopropyl-4-(2-(4-methoxyphenyl)-6-phenylpyridin-4-yl)phenol (3cab): pale yellow solid; yield 82% (53.8 mg); mp 159-161 °C; R_f = 0.69 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.17 (t, J = 8.7 Hz, 4H), 7.77 (s, 2H), 7.51 (t, J = 7.3 Hz, 2H), 7.48 – 7.38 (m, 3H), 7.04 (d, J = 8.3 Hz, 2H), 5.03 (s, 1H), 3.88 (s, 3H), 3.19-3.24 (m, 2H), 1.36 (s, 6H), 1.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.5, 157.3, 157.1, 151.1, 150.8, 140.1, 134.5, 132.6, 131.6, 128.9, 128.7, 128.5, 127.2, 122.6, 116.5, 116.3, 114.1, 55.45, 27.5, 22.8 ppm; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{31}NO_2Na[M+Na]^+$ 460.2247, found 460.2258.



4-(2-(4-Bromophenyl)-6-phenylpyridin-4-yl)-2,6-diisopropylphenol (3fab): Yellow solid; yield 67% (48.9 mg); mp 145-147 °C; R_f = 0.72 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.17 (d, J = 7.6 Hz, 2H), 8.08 (d, J = 8.1 Hz, 2H), 7.84 (s, 1H), 7.79 (s, 1H), 7.63 (d, J = 8.1 Hz, 2H), 7.52 (t, J = 7.3 Hz, 2H), 7.49 – 7.38 (m, 3H), 5.02 (s, 1H), 3.19-3.24 (m, 2H), 1.37 (s, 6H), 1.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.6, 156.2, 151.3, 151.1, 139.7, 138.8, 134.6, 131.9, 131.3, 129.1, 128.8, 128.8, 127.2, 123.4, 122.6, 117.4, 116.8, 27.5, 22.8 ppm; HRMS (ESI-TOF) m/z calcd for $C_{29}H_{29}{}^{79}BrNO[M+H]^+$ 486.1427, found 486.1431; HRMS (ESI-TOF) m/z calcd for $C_{29}H_{29}{}^{81}BrNO[M+H]^+$ 488.1407, found 488.1412.

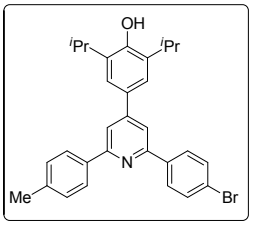


2,6-Diisopropyl-4-(2-(4-methoxyphenyl)-6-(4-methyl)pyridin-4-yl)phenol (3cbb): Brown solid; yield 77% (52.2 mg); mp 138-140 °C; R_f = 0.69 (EtOAc:hexane =

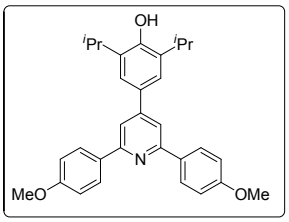


1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.16 (d, J = 8.5 Hz, 2H), 8.08 (d, J = 7.9 Hz, 2H), 7.74 (s, 2H), 7.40 (s, 2H), 7.31 (d, J = 7.8 Hz, 2H), 7.04 (d, J = 8.5 Hz, 2H), 5.02 (s, 1H), 3.88 (s, 3H), 3.19-3.24 (m, 2H), 2.43 (s, 3H), 1.36 (s, 6H), 1.34 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.5, 157.3, 157.0, 151.1, 150.8, 138.9, 137.3, 134.5, 132.7, 131.8, 129.5, 128.5, 127.1, 122.6, 116.2, 116.1, 114.1, 55.46, 27.5, 22.8, 21.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{33}NO_2Na[M+Na]^+$ 474.2404, found 474.2415.

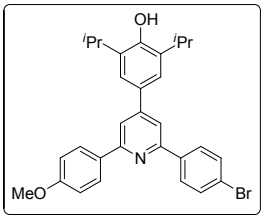
4-(2-(4-Bromophenyl)-6-(4-methylphenyl)pyridin-4-yl)-2,6-diisopropylphenol (3fbb): Light brown solid; yield 66% (49.5 mg); mp 151-153 °C; R_f = 0.71 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.07 (d, J = 7.8 Hz, 4H), 7.81 (s, 1H), 7.75 (s, 1H), 2H), 7.62 (d, J = 8.2 Hz, 2H), 7.39 (s, 2H), 7.32 (d, J = 7.6 Hz, 2H), 5.02 (s, 1H), 3.19-3.24 (m, 2H), 2.43 (s, 3H), 1.36 (s, 6H), 1.34 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.6, 156.2, 151.2, 151.1, 139.1, 138.9, 136.9, 134.5, 131.8, 131.4, 129.5, 129.4, 128.8, 127.1, 123.4, 122.6, 117.0, 116.5, 27.5, 22.8, 21.4 ppm; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{31}{}^{79}BrNO[M+H]^+$ 500.1584, found 500.1589; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{31}{}^{81}BrNO[M+H]^+$ 502.1563, found 502.1567.



4-(2,6-Di(4-methoxyphenyl)pyridin-4-yl)-2,6-diisopropylphenol (3ccb): Yellow solid; yield 70% (49.1mg); mp 160-162 °C; R_f = 0.65 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.15 (d, J = 8.5 Hz, 4H), 7.71 (s, 2H), 7.40 (s, 2H), 7.04 (d, J = 8.5 Hz, 4H), 5.01 (s, 1H), 3.88 (s, 6H), 3.19-3.24 (m, 2H), 1.36 (s, 6H), 1.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C δ 160.5, 156.9, 151.1, 150.7, 134.4, 132.7, 131.8, 128.5, 122.6, 115.7, 114.1, 55.4, 27.5, 22.8 ppm; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{33}NO_3Na[M+Na]^+$ 490.2353, found 490.2364.

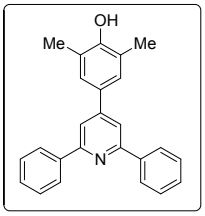


4-(2-(4-Bromophenyl)-6-(4-methoxyphenyl)pyridin-4-yl)-2,6-diisopropylphenol (3fcb): Brown solid; yield 59% (45.7 mg); mp 150-152 °C; R_f = 0.69 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.14 (d, J = 8.5 Hz, 2H), 8.06 (d, J = 8.2 Hz, 2H), 7.77 (s, 1H), 7.73 (s, 1H), 7.63 (d, J =

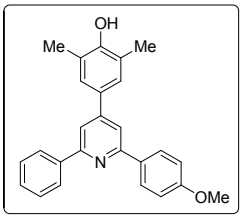


8.2 Hz, 2H), 7.39 (s, 2H), 7.04 (d, J = 8.5 Hz, 2H), 5.03 (s, 1H), 3.88 (s, 3H), 3.19-3.24 (m, 2H), 1.36 (s, 6H), 1.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.6, 157.2, 156.1, 151.2, 151.0, 138.9, 134.5, 132.3, 131.8, 131.4, 128.8, 128.5, 123.3, 122.6, 116.6, 116.1, 114.1, 55.5, 27.5, 22.8 ppm; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{30}{}^{79}BrNO_2Na[M+Na]^+$ 538.1352, found 538.1354; HRMS (ESI-TOF) m/z calcd for $C_{30}H_{30}{}^{81}BrNO_2Na[M+Na]^+$ 540.1332, found 540.1334.

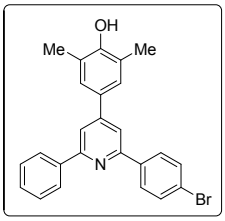
4-(2,6-Diphenylpyridin-4-yl)-2,6-dimethylphenol (3aac): Light yellowish solid; yield 77% (40.6 mg); mp 148-150 °C; R_f = 0.63 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.20 (d, J = 7.6 Hz, 4H), 7.84 (s, 2H), 7.51 (t, J = 7.4 Hz, 4H), 7.47 – 7.37 (m, 4H), 4.81 (d, J = 4.2 Hz, 1H), 2.36 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.4, 153.3, 150.0, 139.9, 130.9, 129.0, 128.7, 127.5, 127.2, 123.8, 116.7, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{25}H_{22}NO[M+H]^+$ 352.1696, found 352.1701.



4-(2-(4-Methoxyphenyl)-6-phenylpyridin-4-yl)-2,6-dimethylphenol (3cac): yellowish solid; yield 76% (43.5 mg); mp 165-167 °C; R_f = 0.58 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.21 – 8.13 (m, 4H), 7.77 (d, J = 1.7 Hz, 2H), 7.50 (t, J = 7.4 Hz, 2H), 7.42 (s, 1H), 7.37 (s, 2H), 7.03 (d, J = 8.7 Hz, 2H), 4.83 (s, 1H), 3.87 (s, 3H), 2.34 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.5, 157.2, 157.0, 153.3, 149.9, 140.0, 132.5, 131.1, 128.9, 128.7, 128.4, 127.4, 127.2, 123.8, 116.1, 115.9, 114.1, 55.4, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{26}H_{23}NO_2Na[M+Na]^+$ 404.1621, found 404.1622.

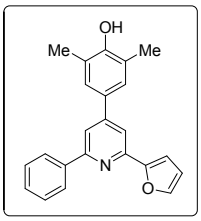


4-(2-(4-Bromophenyl)-6-phenylpyridin-4-yl)-2,6-dimethylphenol (3fac): Brown solid; yield 65% (42.1 mg); mp 162-164 °C; R_f = 0.61 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.16 (d, J = 7.6 Hz, 2H), 8.06 (d, J = 8.3 Hz, 2H), 7.82 (s, 1H), 7.76 (s, 1H), 7.61 (d, J = 8.3 Hz, 2H), 7.50 (t, J = 7.4 Hz, 2H), 7.44 (d, J = 7.0 Hz, 1H), 7.36 (d, J = 8.4 Hz, 2H), 4.86 (s, 1H), 2.33 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.5, 156.2, 153.4, 150.2, 139.6, 138.7, 131.8, 130.7, 129.1, 128.9, 128.7 127.4, 127.2, 123.9, 123.4, 117.0, 116.4, 16.1 ppm; HRMS (ESI)

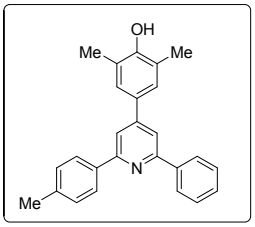


m/z calcd for $C_{25}H_{21}{}^{79}BrNO[M+H]^+$ 430.0801, found 430.0812; HRMS (ESI-TOF) m/z calcd for $C_{25}H_{21}{}^{81}BrNO[M+H]^+$ 432.0781, found 432.0793.

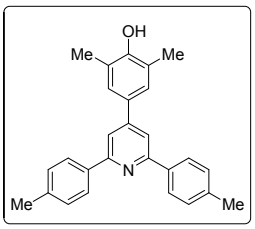
4-(2-(Furan-2-yl)-6-phenylpyridin-4-yl)-2,6-dimethylphenol (3gac): Brown solid; yield 62% (31.8 mg); mp 152-154 °C; R_f = 0.60 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.13 (d, J = 7.4 Hz, 2H), 7.81 (s, 1H), 7.75 (s, 1H), 7.56 (s, 1H), 7.49 (t, J = 7.3 Hz, 2H), 7.45 – 7.35 (m, 3H), 7.26 – 7.20 (m, 1H), 6.57 (s, 1H), 4.86 (s, 1H), 2.34 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.6, 154.3, 153.4, 149.8, 149.6, 143.1, 139.6, 130.5, 129.0, 128.7, 127.4, 127.2, 123.8, 116.5, 114.5, 112.1, 108.9, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{23}H_{19}NO_2Na[M+Na]^+$ 364.1308, found 364.1311.



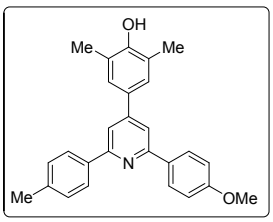
4-(2-(4-Bromophenyl)-6-phenylpyridin-4-yl)-2,6-dimethylphenol (3abc): Colorless solid; yield 77% (42.2 mg); mp 161-163 °C; R_f = 0.61 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.19 (d, J = 7.5 Hz, 2H), 8.10 (d, J = 7.8 Hz, 2H), 7.80 (s, 2H), 7.50 (t, J = 7.4 Hz, 2H), 7.43 (t, J = 7.2 Hz, 1H), 7.38 (s, 2H), 7.31 (d, J = 7.7 Hz, 2H), 4.90 (s, 1H), 2.43 (s, 3H), 2.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.4, 157.3, 153.3, 149.9, 139.9, 139.0, 137.0, 131.0, 129.4, 128.9, 128.7, 127.5, 127.2, 127.1, 123.8, 116.5, 116.4, 21.4, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{26}H_{23}NONa[M+Na]^+$ 388.1672, found 388.1679.



4-(2,6-Di(4-methylphenyl)pyridin-4-yl)-2,6-dimethylphenol (3bbc): Colorless solid; yield 72% (41.0 mg); mp 148-150°C; R_f = 0.64 (EtOAc:hexane = 1:9) ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.09 (d, J = 7.9 Hz, 4H), 7.78 (s, 2H), 7.37 (s, 2H), 7.31 (d, J = 7.8 Hz, 4H), 4.88 (s, 1H), 2.42 (s, 6H), 2.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.3, 153.2, 149.8, 138.9, 137.1, 131.1, 129.4, 127.5, 127.1, 123.8, 116.2, 21.4, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{27}H_{25}NONa[M+Na]^+$ 402.1828, found 402.1830.

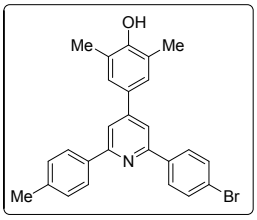


4-(2-(4-Methoxyphenyl)-6-(4-methylphenyl)pyridin-4-yl)-2,6-dimethylphenol (3cbc): Light yellowish solid; yield 74% (43.9 mg); mp 165-167 °C; R_f =

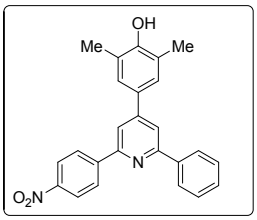


0.59(EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.15 (d, J = 8.6 Hz, 2H), 8.09 (d, J = 7.9 Hz, 2H), 7.75 (s, 1H), 7.74 (s, 1H), 7.37 (s, 2H), 7.31 (d, J = 7.8 Hz, 2H), 7.03 (d, J = 8.6 Hz, 2H), 4.88 (s, 1H), 3.88 (s, 3H), 2.43 (s, 3H), 2.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 160.5, 157.3, 157.0, 153.2, 149.8, 138.9, 137.2, 132.6, 131.2, 129.4, 128.5, 127.5, 127.1, 123.8, 115.8, 115.7, 114.1, 55.5, 21.4, 16.2 ppm; HRMS (ESI-TOF) m/z calcd for $C_{27}H_{26}NO_2[M+H]^+$ 396.1958, found 396.1965.

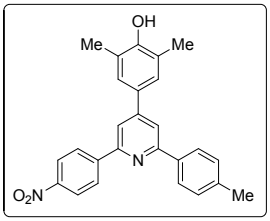
4-(2-(4-Bromophenyl)-6-(4-methylphenyl)pyridin-4-yl)-2,6-dimethylphenol (3fbc): Brownish solid; yield 62% (41.3 mg); mp 162-164 °C; R_f = 0.62(EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.07 (d, J = 7.6 Hz, 4H), 7.81 (s, 1H), 7.76 (s, 1H), 7.62 (d, J = 7.9 Hz, 2H), 7.37 (s, 2H), 7.31 (d, J = 7.4 Hz, 2H), 4.89 (s, 1H), 2.43 (s, 3H), 2.35 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.6, 156.1, 153.4, 150.1, 139.1, 138.8, 136.9, 131.8, 130.8, 129.5, 128.8, 127.5, 127.1, 123.9, 123.4, 116.7, 116.2, 21.4, 16.2 ppm; HRMS (ESI-TOF) m/z calcd for $C_{26}H_{22}{}^{79}BrNONa[M+Na]^+$ 466.0777, found 466.0780; HRMS (ESI-TOF) m/z calcd for $C_{26}H_{22}{}^{81}BrNONa[M+Na]^+$ 468.0757, found 468.0760.



2,6-Dimethyl-4-(2-(4-nitrophenyl)-6-phenylpyridin-4-yl)phenol (3aec): gray solid; yield 83% (49.3 mg); mp 175-177 °C; R_f = 0.58 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.01 (d, J = 7.4 Hz, 2H), 7.85 (s, 2H), 7.73 (d, J = 7.5 Hz, 1H), 7.61 (dd, J = 14.6, 6.5 Hz, 2H), 7.52 – 7.37 (m, 4H), 7.33 (s, 2H), 5.04 (s, 1H), 2.29 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.7, 155.3, 153.7, 150.4, 149.9, 139.2, 135.5, 132.1, 131.1, 129.2, 128.8, 127.5, 127.2, 124.4, 124.0, 118.5, 117.4, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{25}H_{21}N_2O_3[M+H]^+$ 397.1547, found 397.1555.

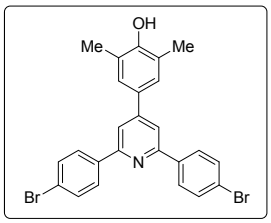


2,6-Dimethyl-4-(2-(4-nitrophenyl)-6-(4-methylphenyl)pyridin-4-yl)phenol (3bec): Yellow solid; yield 84% (51.7 mg); mp 181-183 °C; R_f = 0.59 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 7.92 (d, J = 7.6 Hz, 2H), 7.87 (s, 1H), 7.84 (s, 1H), 7.75 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 7.4 Hz, 1H), 7.58 (s, 1H), 7.53 (t, J = 7.6 Hz, 1H), 7.36 (s, 2H), 7.27 (d, J = 7.8 Hz, 2H),

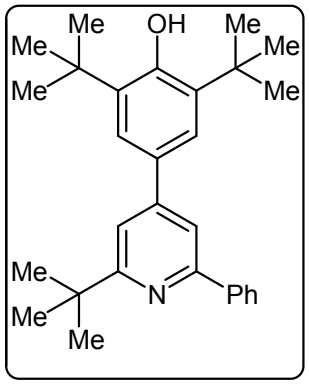


4.88 (s, 1H), 2.40 (s, 3H), 2.33 (s, 6H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.7, 155.1, 153.5, 150.2, 149.9, 139.2, 136.4, 135.6, 132.0, 131.1, 129.5, 127.5, 127.1, 124.3, 123.9, 118.2, 117.1, 21.4, 16.1 ppm; HRMS (ESI-TOF) m/z calcd for $C_{26}H_{23}N_2O_3[M+H]^+$ 411.1703, found 411.1704.

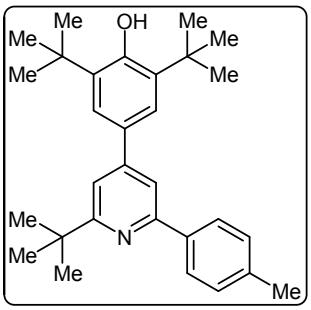
4-(2,6-Di(4-bromophenyl)pyridin-4-yl)-2,6-dimethylphenol (3fdc): brownish solid; yield 70% (53.5 mg); mp 182-184 °C; R_f = 0.60 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; DMSO-d6): δ_H 8.68 (s, 1H), 8.26 (d, J = 7.2 Hz, 4H), 8.13 (s, 2H), 7.73 – 7.63 (m, 6H), 2.30 (s, 6H); ^{13}C NMR (100 MHz; DMSO-d6): δ_C 155.5, 155.4, 150.3, 138.4, 132.0, 129.4, 128.2, 127.7, 125.2, 123.2, 116.3, 17.2 ppm; HRMS (ESI-TOF) m/z calcd for $C_{25}H_{19}{}^{79}Br_2NONa[M+Na]^+$ 529.9726, found 529.9727; HRMS (ESI-TOF) m/z calcd for $C_{25}H_{19}{}^{81}Br_2NONa[M+Na]^+$ 533.9685, found 533.9687.



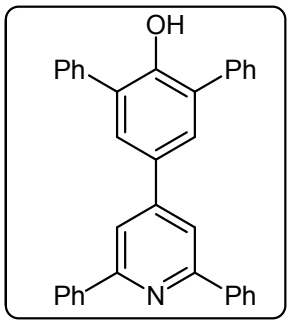
2,6-Di-*tert*-butyl-4-(2-(*tert*-butyl)-6-phenylpyridin-4-yl)phenol (3afa): Gummy liquid; yield 64% (39.9 mg); R_f = 0.89 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.06 (d, J = 7.3 Hz, 2H), 7.60 (s, 1H), 7.40 (d, J = 11.0 Hz, 3H), 7.32 (s, 1H), 7.19 (s, 2H), 5.31 (s, 1H), 1.44 (s, 18H), 1.40 (s, 9H); ^{13}C NMR (400 MHz; $CDCl_3$): δ_C169.3, 155.9, 154.6, 150.5, 140.3, 136.5, 131.0, 130.2, 128.6, 127.1, 124.1, 115.7, 115.5, 37.5, 34.0, 30.4, 30.3 ppm; HRMS (ESI) m/z calcd for $C_{29}H_{38}NO[M+H]^+$ 416.2948, found 416.2951



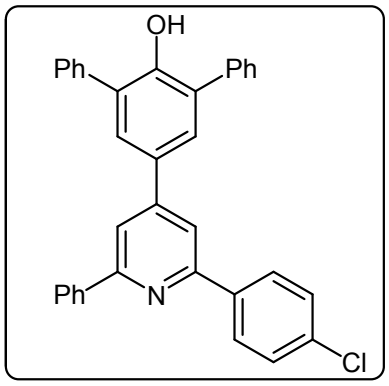
2,6-Di-*tert*-butyl-4-(2-(*tert*-butyl)-6-(4-methylphenylpyridin-4-yl)phenol (3bfa): Gummy liquid; yield 62% (40.0 mg); R_f = 0.88 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$) δ_H 8.02 (d, J = 7.8 Hz, 2H), 7.63 (s, 1H), 7.45 (s, 2H), 7.36 (s, 1H), 7.31 – 7.24 (m, 2H), 5.37 (s, 1H), 2.41 (s, 3H), 1.51 (s, 18H), 1.46 (s, 9H)ppm;^{13}C NMR (100 MHz; $CDCl_3$) δ_C 169.2, 156.0, 154.6, 150.5, 138.5, 137.6, 136.5, 131.2, 130.2, 129.3, 127.0, 124.1, 115.4, 37.8, 34.5, 30.4, 30.3, 21.3ppm; HRMS (ESI) m/z calcd for $C_{30}H_{40}NO[M+H]^+$ 430.3104, found 430.3108.



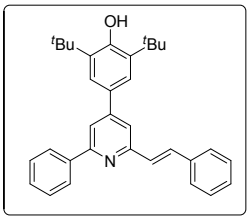
5′-(2,6-Diphenylpyridin-4-yl)-[1,1′:3,1″-terphenyl]-2′-ol (3aad): Colorless solid; yield 81% (57.7 mg); mp 181-183 °C; R_f = 0.61 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.18 (t, J = 13.2 Hz, 4H), 7.96 – 7.86 (m, 2H), 7.68 (d, J = 10.8 Hz, 2H), 7.64 (d, J = 7.3 Hz, 4H), 7.58 – 7.47 (m, 8H), 7.44 (dd, J = 13.2, 6.9 Hz, 4H), 5.57 (d, J = 14.0 Hz, 1H); ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.6, 150.4, 149.4, 139.7, 137.1, 131.5, 129.7, 129.4, 129.1, 129.1, 128.7, 128.7, 128.2, 127.2, 116.6 ppm; HRMS (ESI) m/z calcd for $C_{35}H_{26}NO[M+H]^+$ 476.2009, found 476.2013.



5′-(2-(4-chlorophenyl)-6-phenylpyridin-4-yl)-[1,1′:3′,1″-terphenyl]-2′-ol (3ead): Colorless solid; yield 72% (55.1 mg); mp 187-189 °C; R_f = 0.63 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.16 (dd, J = 10.3, 8.5 Hz, 4H), 7.92 (s, 1H), 7.87 (s, 1H), 7.68 (s, 2H), 7.64 (d, J = 7.3 Hz, 4H), 7.53 (dd, J = 13.6, 6.3 Hz, 5H), 7.50 – 7.38 (m, 6H), 5.60 (s, 1H) ppm;^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.7, 156.3, 150.5, 149.6, 139.5, 138.1, 137.1, 135.2, 131.3, 129.7, 129.4, 129.2, 129.1, 128.9, 128.8, 128.7, 128.5, 128.2, 127.2, 116.9, 116.4 ppm; HRMS (ESI) m/z calcd for $C_{35}H_{25}ClNO[M+H]^+$ 510.1619, found 510.1621.

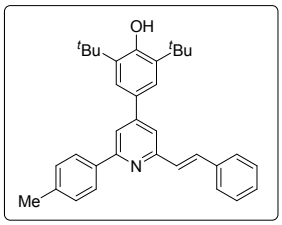


(*E*)-2,6-Di-*tert*-butyl-4-(2-phenyl-6-styrylpyridin-4-yl)phenol (3afa): Light yellowish solid; yield 69% (47.8 mg); mp 168-170 °C; R_f = 0.81 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 8.06 (d, J = 7.5 Hz, 2H), 7.78 (d, J = 16.0 Hz, 1H), 7.66 (s, 1H), 7.57 (d, J = 7.6 Hz, 2H), 7.45 (d, J = 8.6 Hz, 4H), 7.38 (d, J = 6.8 Hz, 2H), 7.32 (t, J = 7.0 Hz, 2H), 7.24 – 7.16 (m, 2H), 5.35 (s, 1H), 1.45 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 156.6, 154.6,



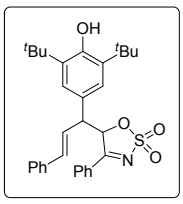
153.9, 149.9, 139.0, 135.9, 135.6, 131.8, 129.0, 127.9, 127.7, 127.7, 127.5, 127.2, 126.2, 126.2, 122.9, 117.9, 116.2, 33.5, 29.3 ppm; HRMS (ESI-TOF) m/z calcd for $C_{33}H_{35}NONa[M+Na]^+$ 484.2611, found 484.2613.

(*E*)-2,6-Di-*tert*-butyl-4-(2-styryl-6-(4-methylphenyl)pyridin-4-yl)phenol (3bfa): Colorless



solid; yield 67% (47.8 mg); mp 172-174 °C; R_f = 0.83 (EtOAc:hexane = 1:9); ^{1}H NMR (400 MHz; $CDCl_3$): δ_H 7.95 (d, J = 7.4 Hz, 2H), 7.77 (d, J = 16.0 Hz, 1H), 7.63 (s, 1H), 7.57 (d, J = 7.2 Hz, 2H), 7.43 (s, 2H), 7.36 (s, 1H), 7.30 (d, J = 7.2 Hz, 2H), 7.26 – 7.19 (m, 4H), 5.34 (s, 1H), 2.36 (s, 3H), 1.45 (s, 18H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C 157.8, 155.7, 155.0, 151.0, 139.0, 137.3, 137.1, 136.8, 132.9, 130.3, 129.6, 128.8, 128.8, 128.3, 127.3, 127.3, 124.1, 118.8, 117.2, 34.7, 30.5, 21.5 ppm; HRMS (ESI-TOF) m/z calcd for $C_{34}H_{38}NO[M+H]^+$ 476.2948, found 476.2949.

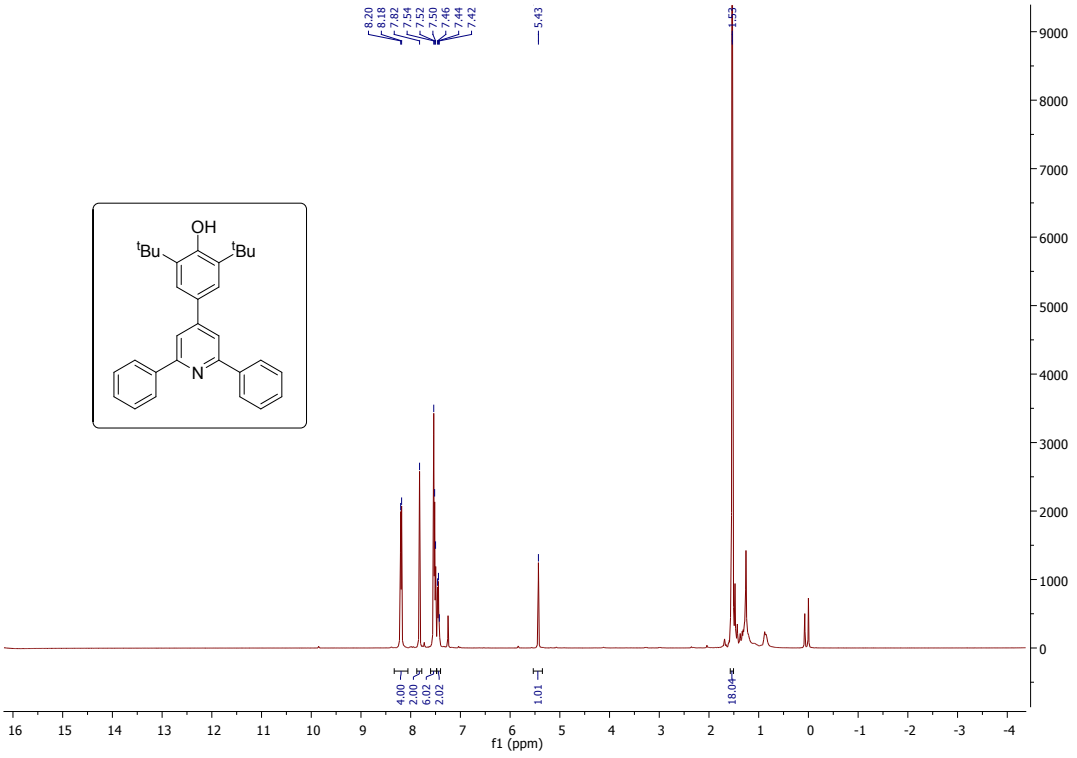
(*E*)-5-(1-(3,5-Di-*tert*-butyl-4-hydroxyphenyl)-3-phenylallyl)-4-phenyl-5*H*-1,2,3-oxathiazole

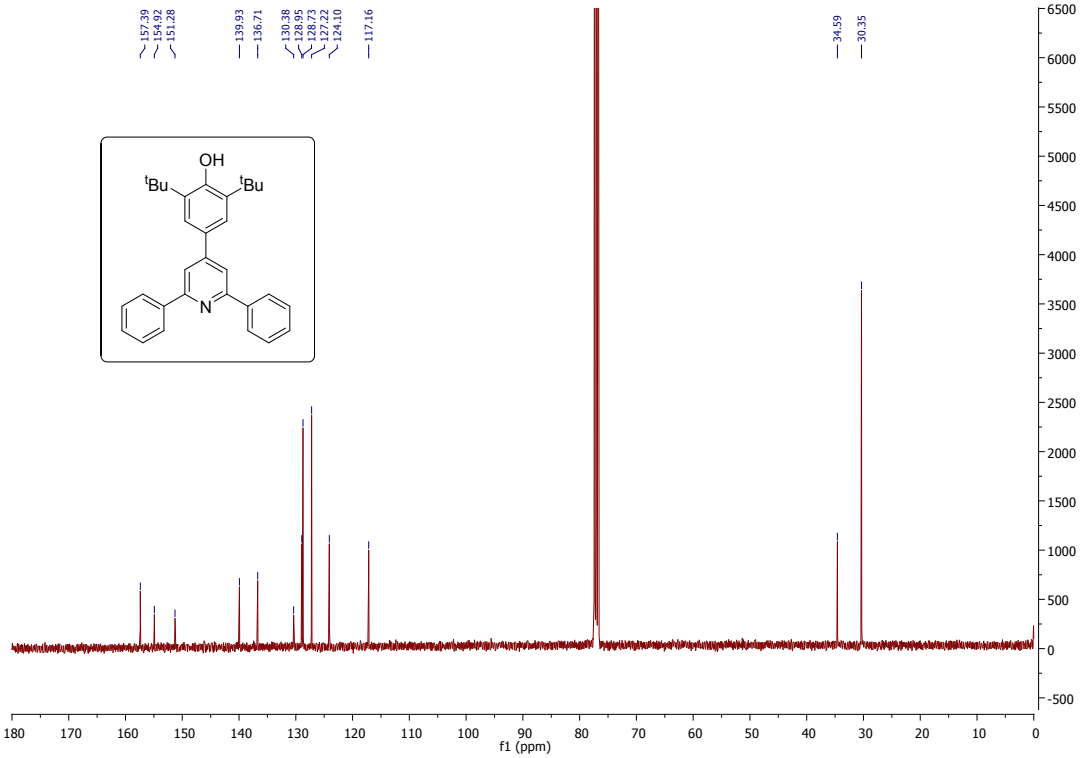


2,2-dioxide (4aaa): Colorless solid; R_f = 0.20 (EtOAc:hexane = 1:9); dr = 52:48; ^{1}H NMR (400 MHz; $CDCl_3$): δ_H (mixture of two diastereomers) 7.82 (d, J = 7.6 Hz, 1.04H), 7.77 (d, J = 7.6 Hz, 0.96H), 7.75 – 7.68 (m, 1H), 7.58 (dt, J = 15.2, 7.7 Hz, 2H), 7.40 (d, J = 7.4 Hz, 0.96H), 7.34 (t, J = 7.4 Hz, 1.04H), 7.27 (d, J = 4.1 Hz, 2H), 7.16 (s, 1H), 6.70 (d, J = 15.9 Hz, 0.48H), 6.65 – 6.52 (m, 1.33H), 6.37 (dd, J = 15.7, 9.4 Hz, 0.55H), 6.22 (t, J = 2.8 Hz, 0.96H), 6.02 (d, J = 15.8 Hz, 0.50H), 5.23 (s, 0.52H), 5.14 (s, 0.48H), 4.22 – 4.14 (m, 0.48H), 3.99 (m, 0.52H), 1.44 (s, 9.36H), 1.27 (s, 8.64H) ppm; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C (major isomer) 178.40, 153.81, 136.60, 135.72, 134.84, 132.75, 129.60, 129.50, 129.27, 128.74, 128.10, 127.47, 126.76, 125.95, 124.57, 91.38, 52.72, 34.50, 30.31; ^{13}C NMR (100 MHz; $CDCl_3$): δ_C (minor isomer) 177.58, 153.50, 136.38, 135.05, 134.10, 132.75, 129.57, 129.33, , 128.79, , 128.61, 128.00, 127.47, 126.59, 124.79, 124.32, , 91.10, 51.87, 34.22, 29.97; HRMS (ESI-TOF) m/z calcd for $C_{31}H_{35}NO_4SNa[M+Na]^+$ 540.2179, found 540.2180.

References:

1. Wang, Y.-Q.; Yu, C.-B.; Wang, D.-W.; Wang, X.-B.; Zhou, Y.-G. *Org. Lett.* **2008**, *10*, 2071-2074.
2. Zhang, X.-Z.; Deng, Y.-H.; Gan K.-J.; Yan X.; Yu K.-Y.; Wang F.-X.; Fan, C.-A.; *Org. Lett.*, **2017**, *19*, 1752-1755.

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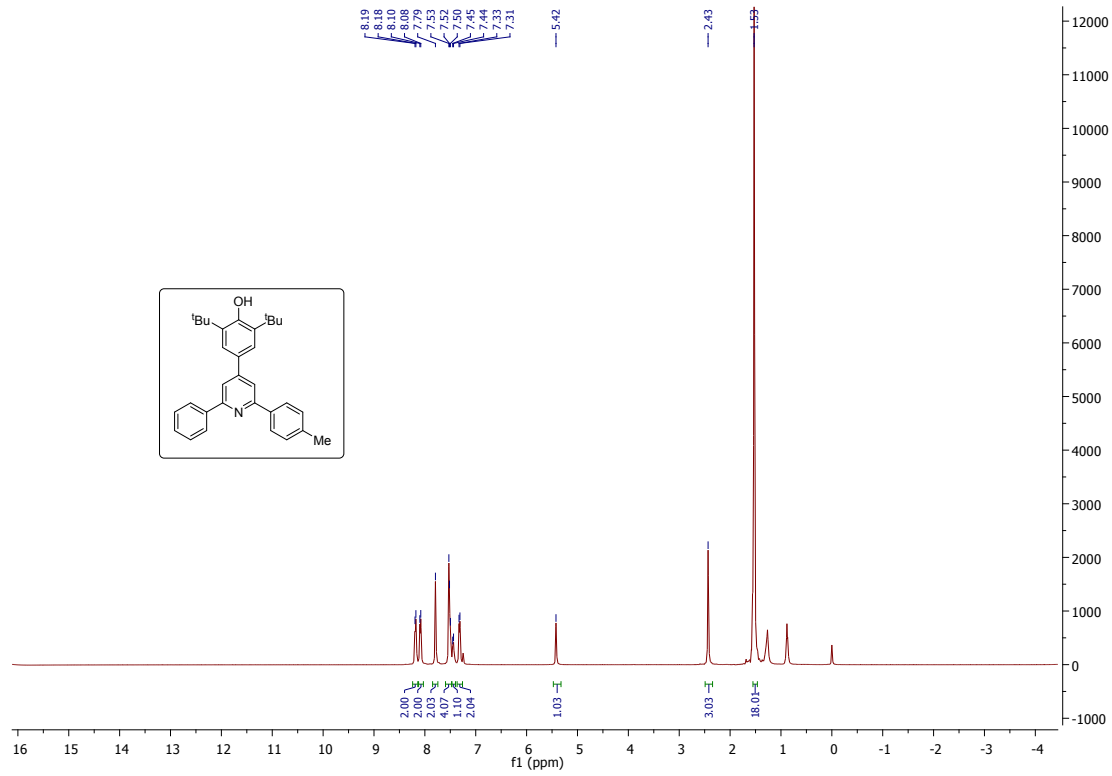
f1 (ppm)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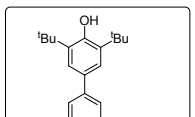
f1 (ppm)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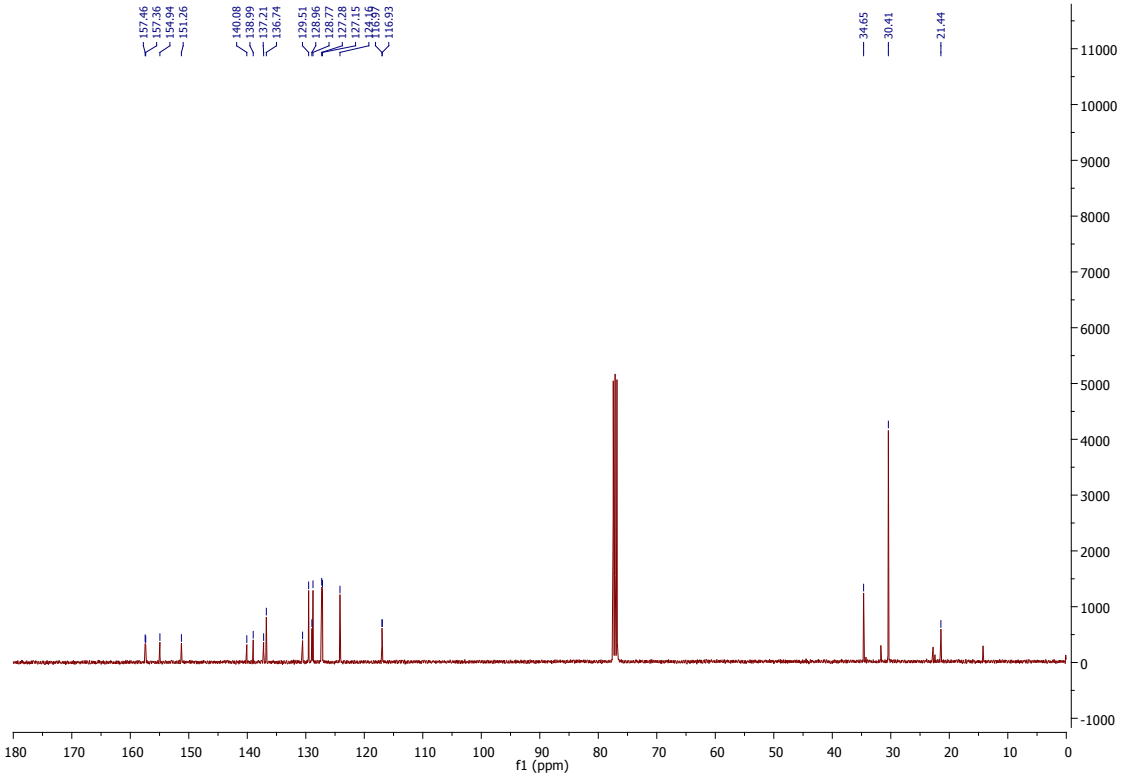
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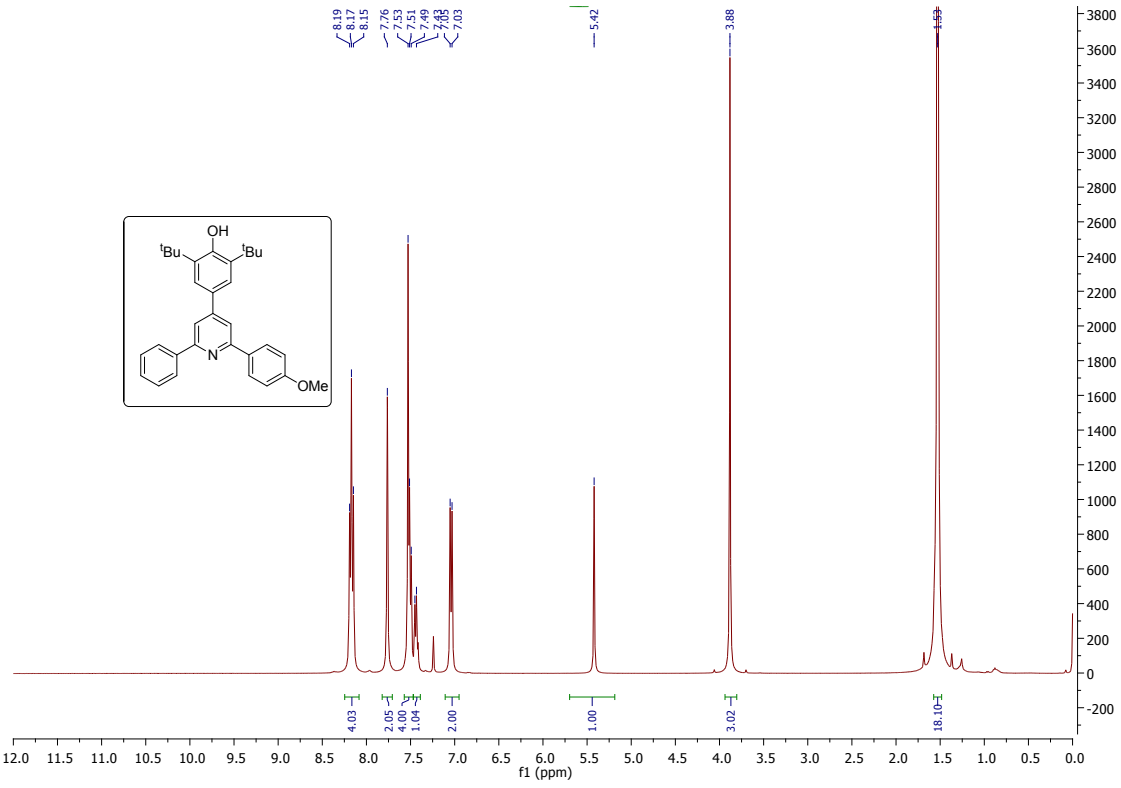
21.44
f1 (ppm)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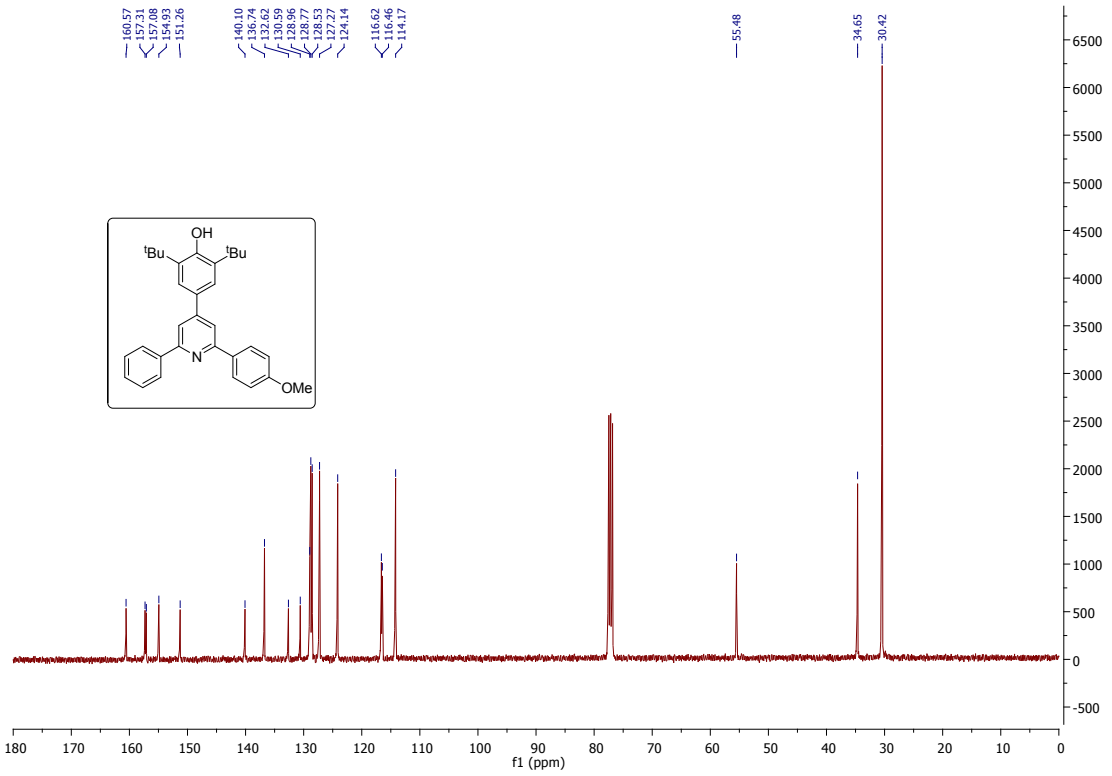
f1 (ppm)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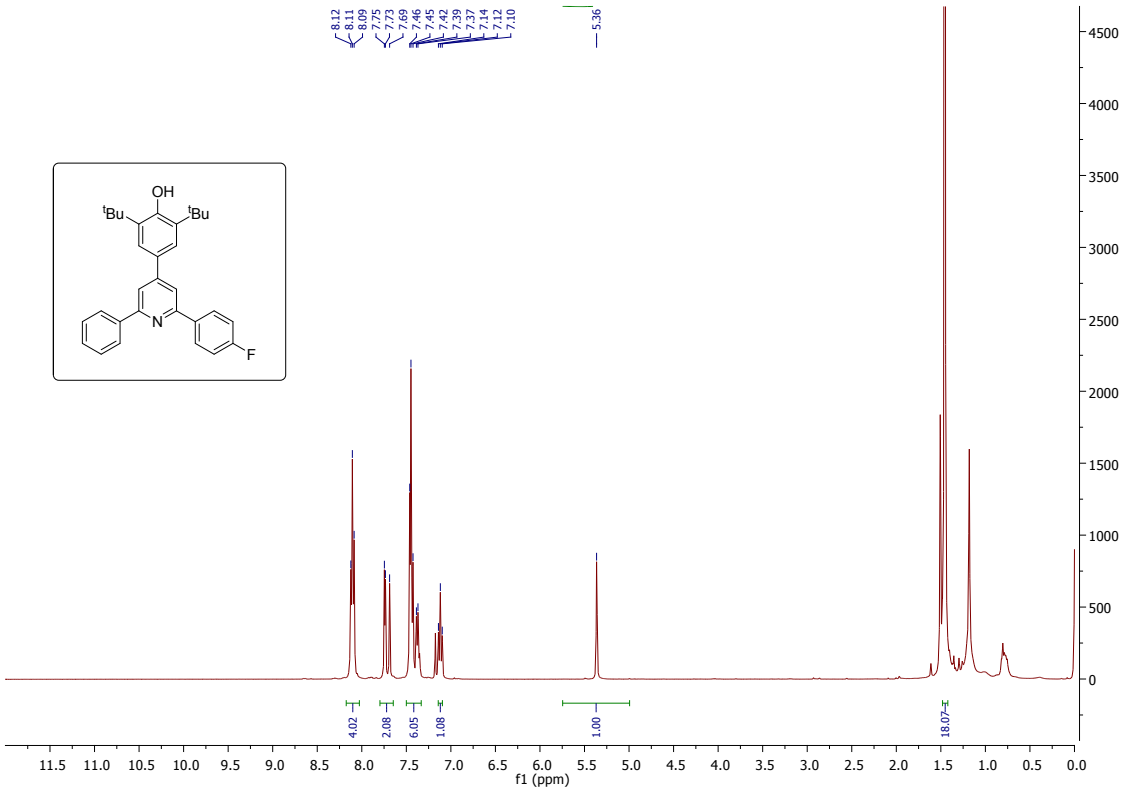
f1 (ppm)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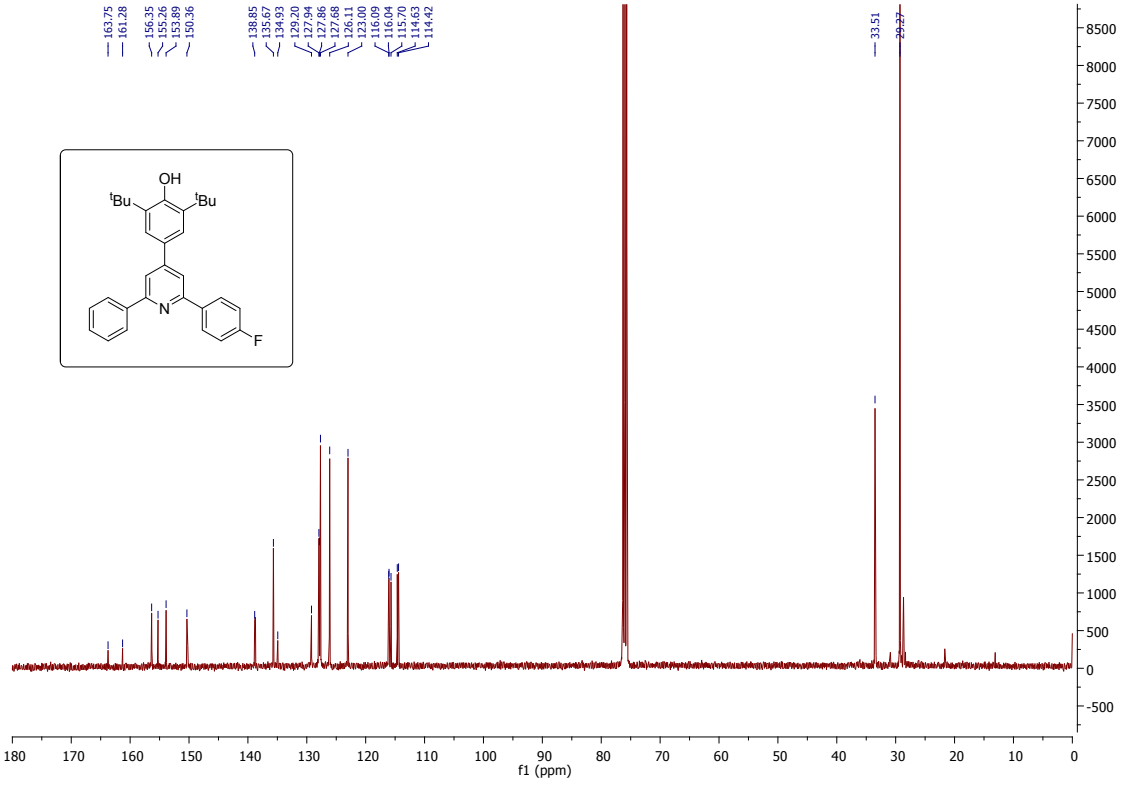
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OH
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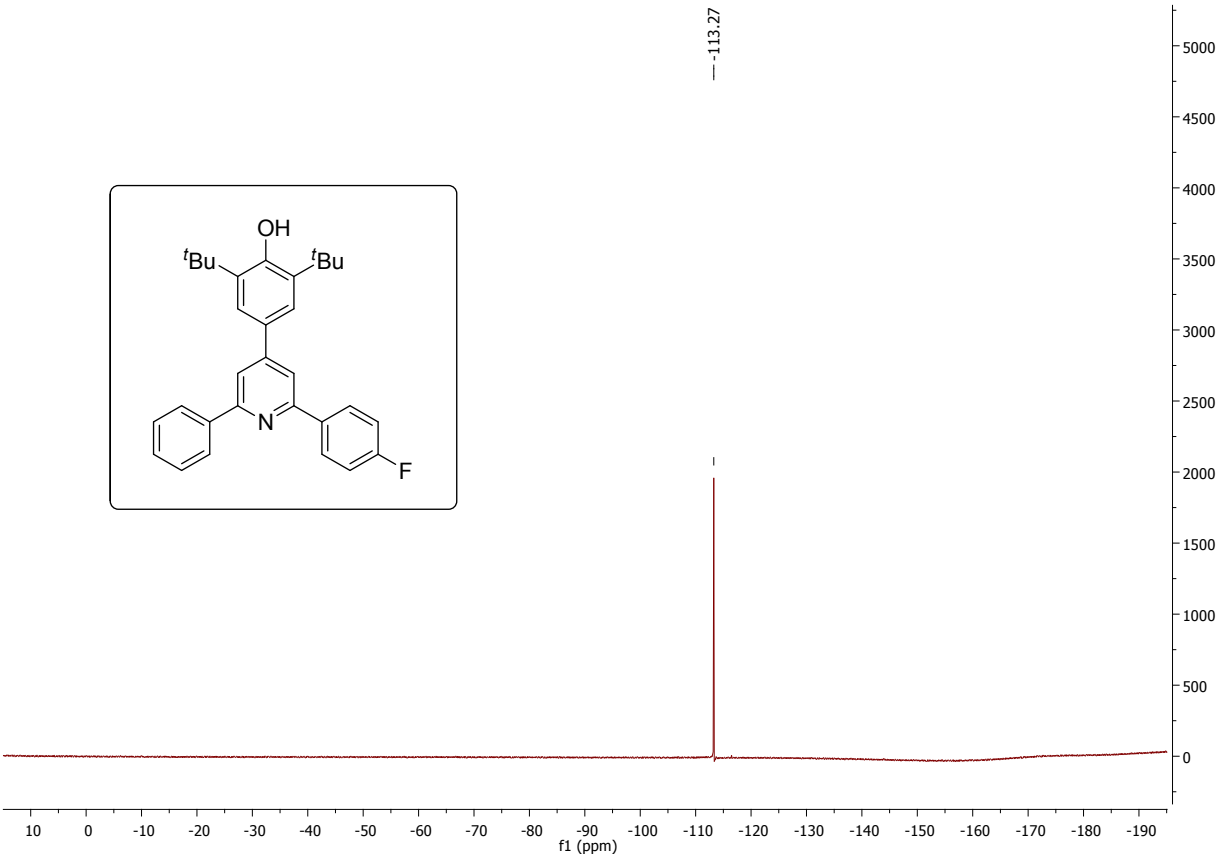
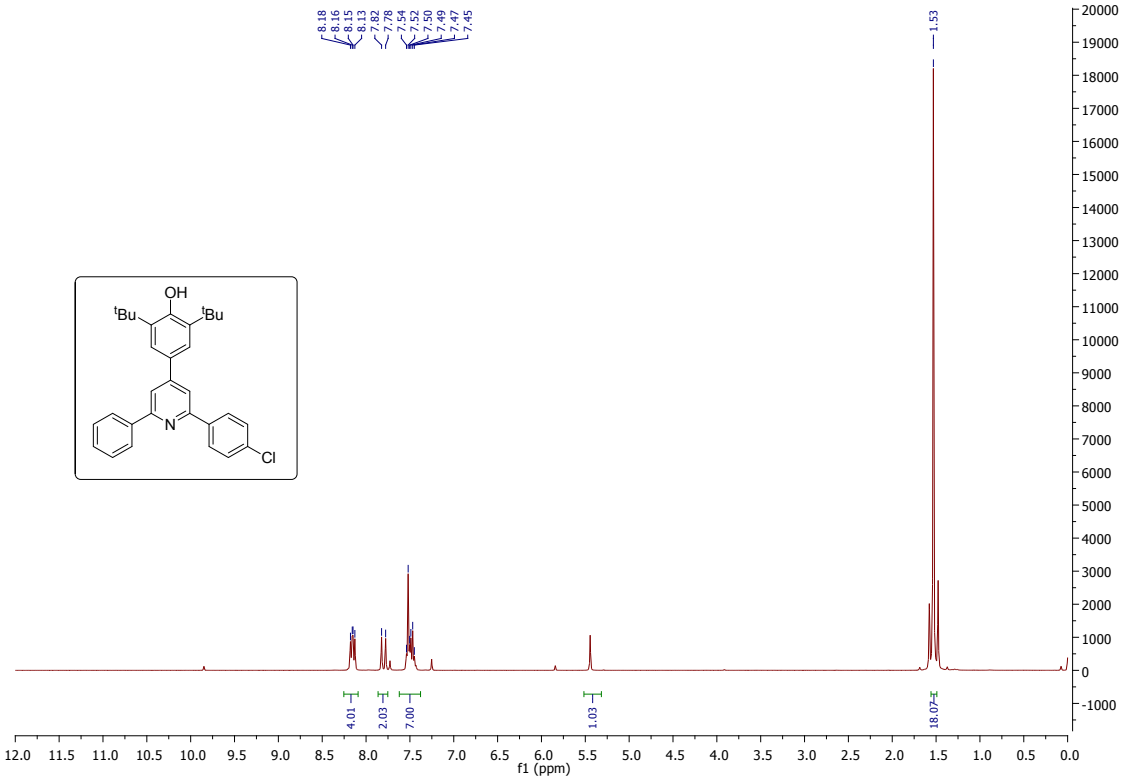
f1 (ppm)



^{19}F NMR (376 MHz)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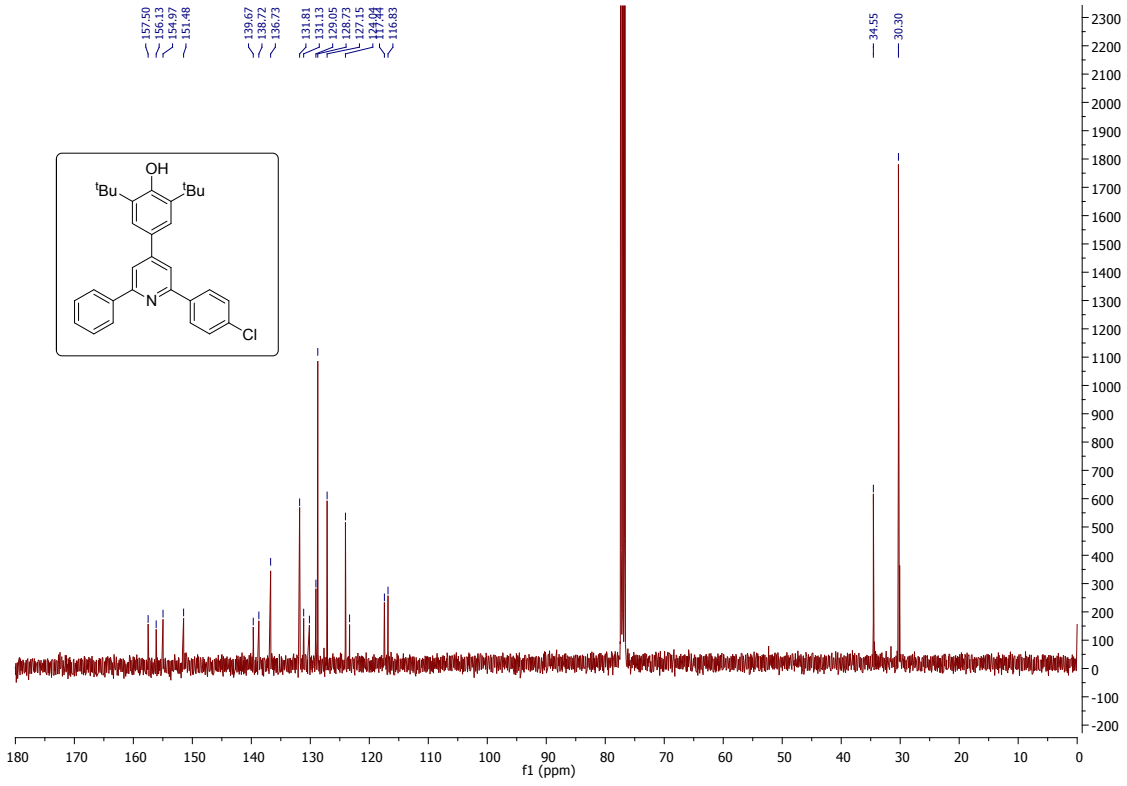
18.07
f1 (ppm)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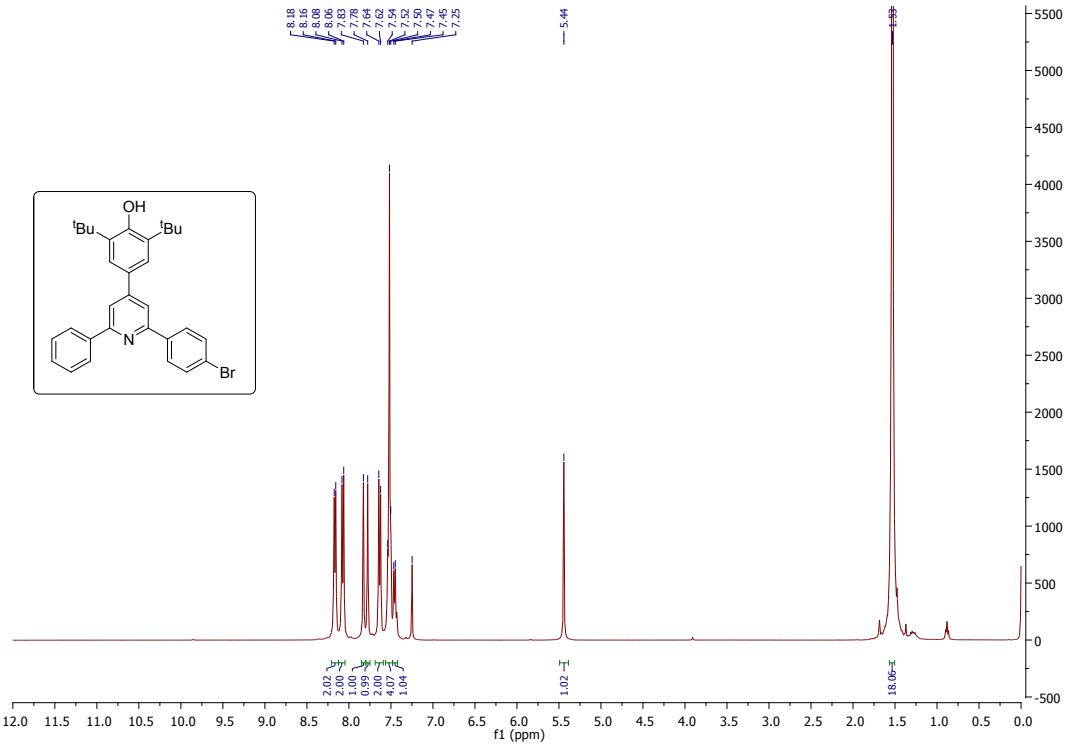
Cl
f1 (ppm)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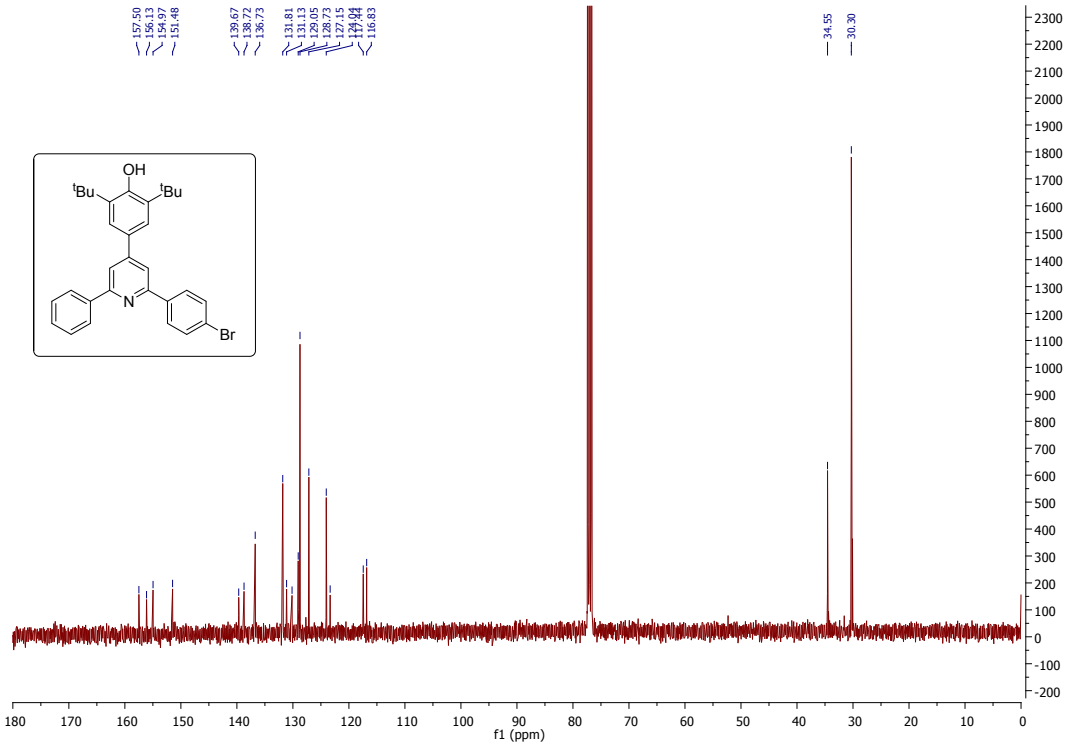
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OH
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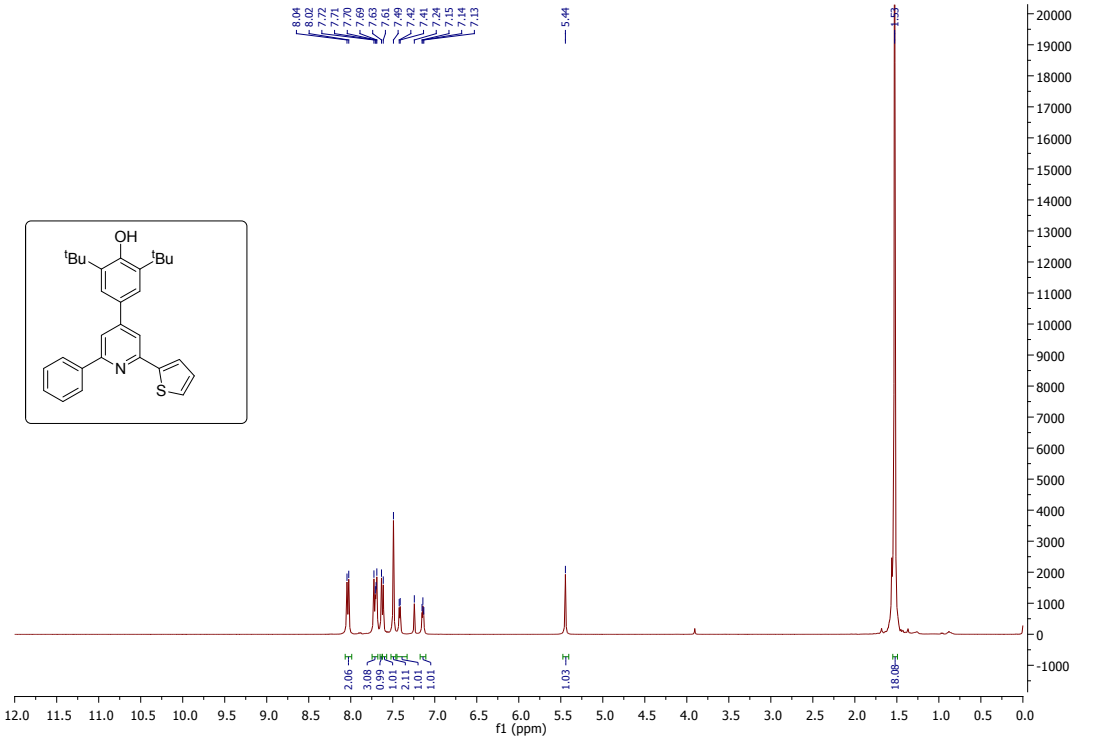
Br
f1 (ppm)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7.24
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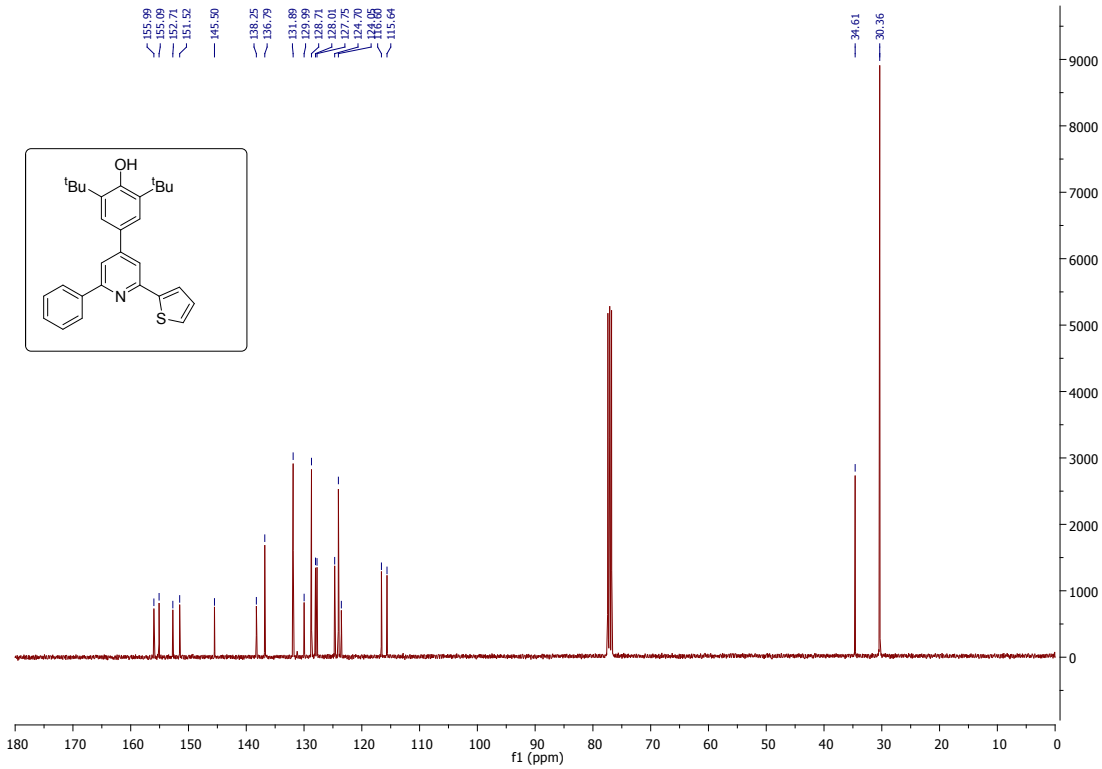
1.01
1.01
1.03
18.08
f1 (ppm)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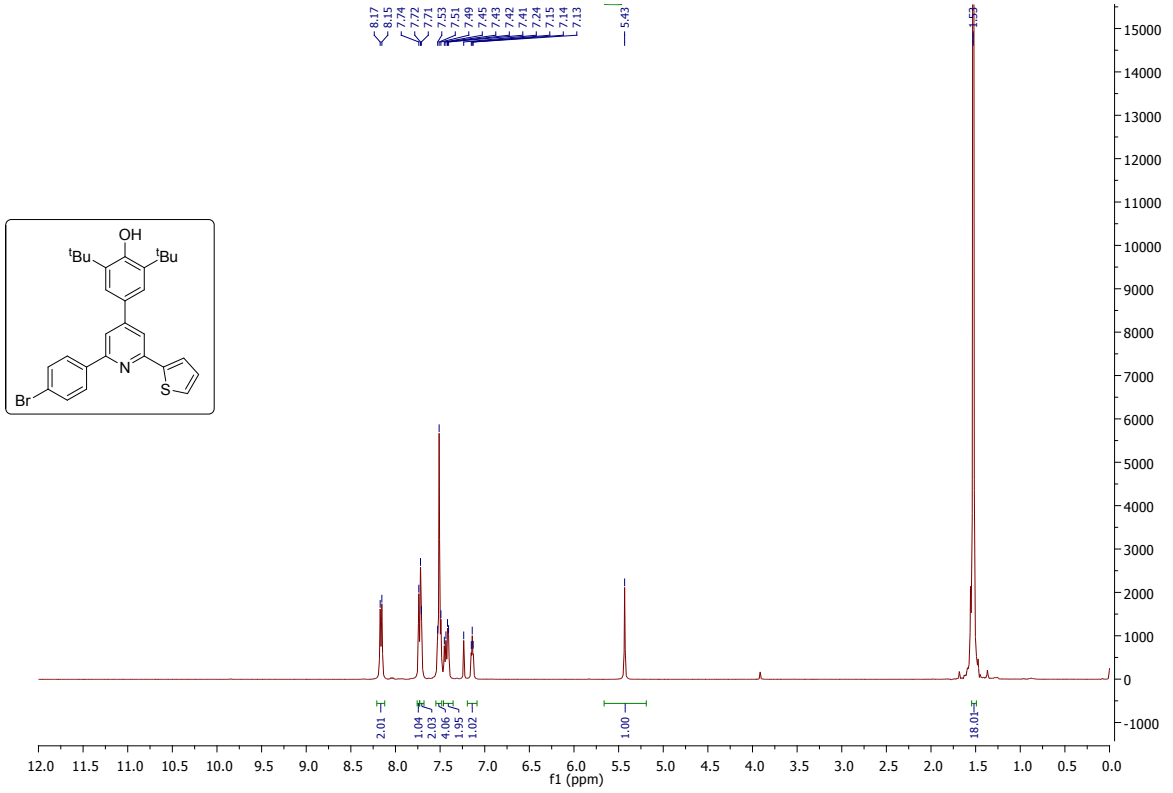
tBu
tBu
N
S
155.99
155.09
152.71
151.52
145.50
138.25
136.79
131.89
129.99
128.71
128.01
127.75
124.70
124.05
116.88
115.64
34.61
30.36
f1 (ppm)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tBu
tBu
N
S
Br
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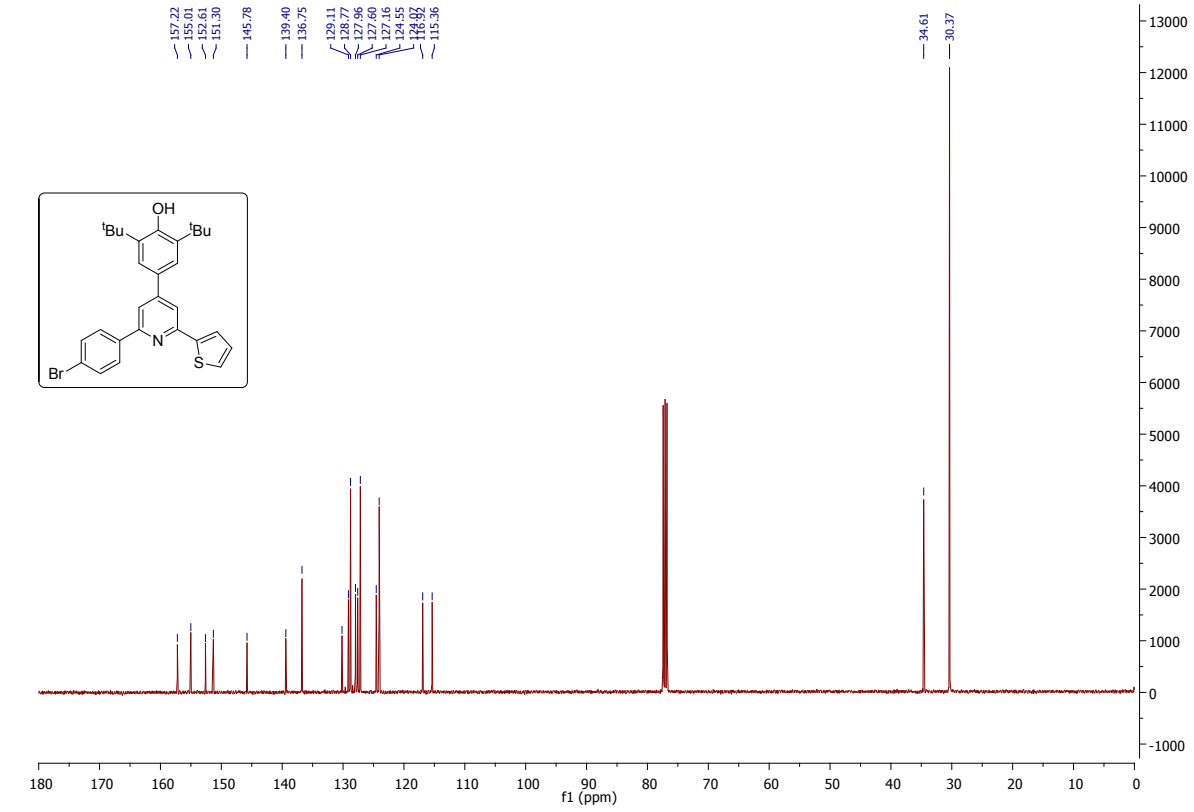
8.15
7.74
7.72
7.71
7.53
7.51
7.49
7.45
7.43
7.42
7.41
7.24
7.15
7.14
7.13
5.43
1.53
2.01
1.04
2.03
4.06
1.95
1.02
1.00
18.01
f1 (ppm)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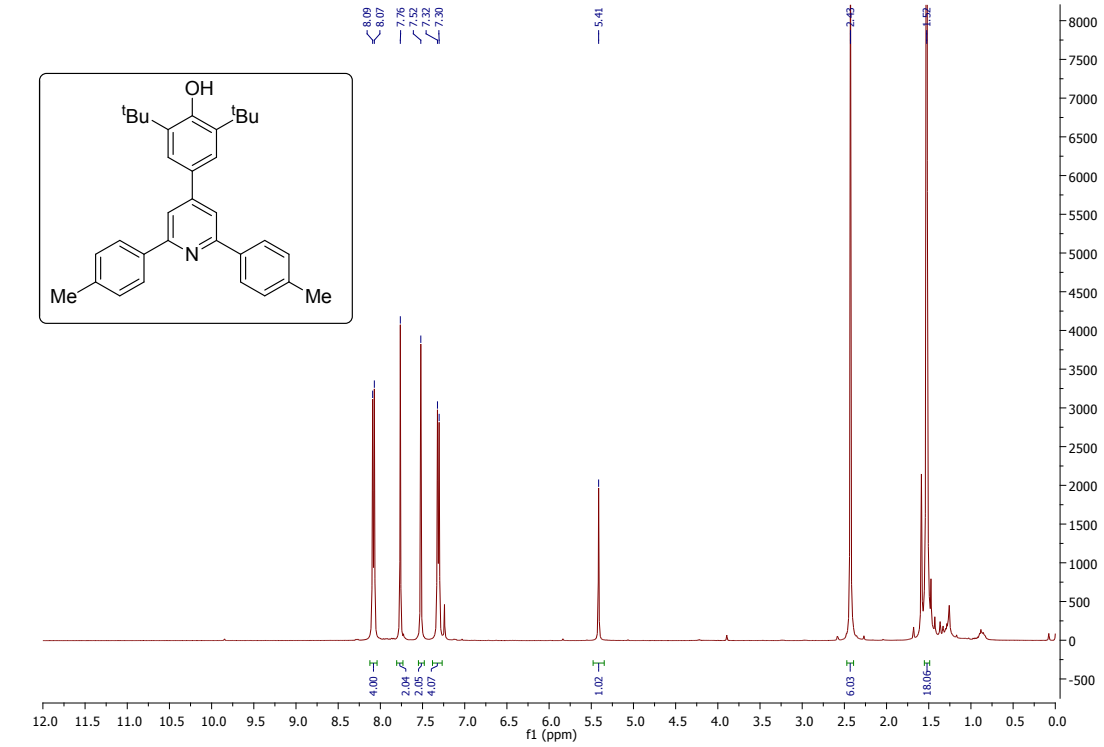
tBu
tBu
N
S
Br
157.22
155.01
152.61
151.30
145.78
139.40
136.75
129.11
128.77
127.96
127.60
127.16
124.55
115.36
34.61
30.37
f1 (ppm)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tBu
tBu
N
Me
Me
8.09
8.07
7.76
7.52
7.32
7.30
5.41
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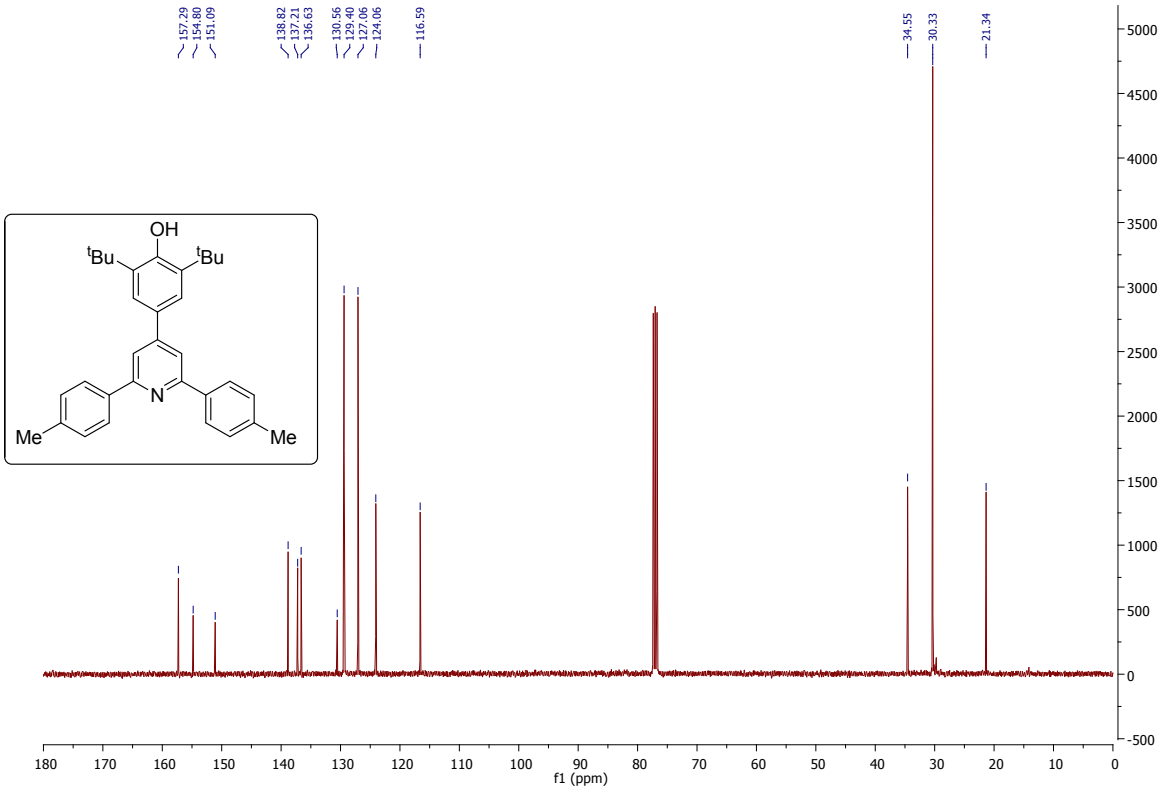
1.52
4.00
2.04
2.05
4.07
1.02
6.03
18.06
f1 (ppm)


OH
tBu
tBu
N
Me
Me
157.29
154.80
151.09
138.82
137.21
136.63
130.56
129.40
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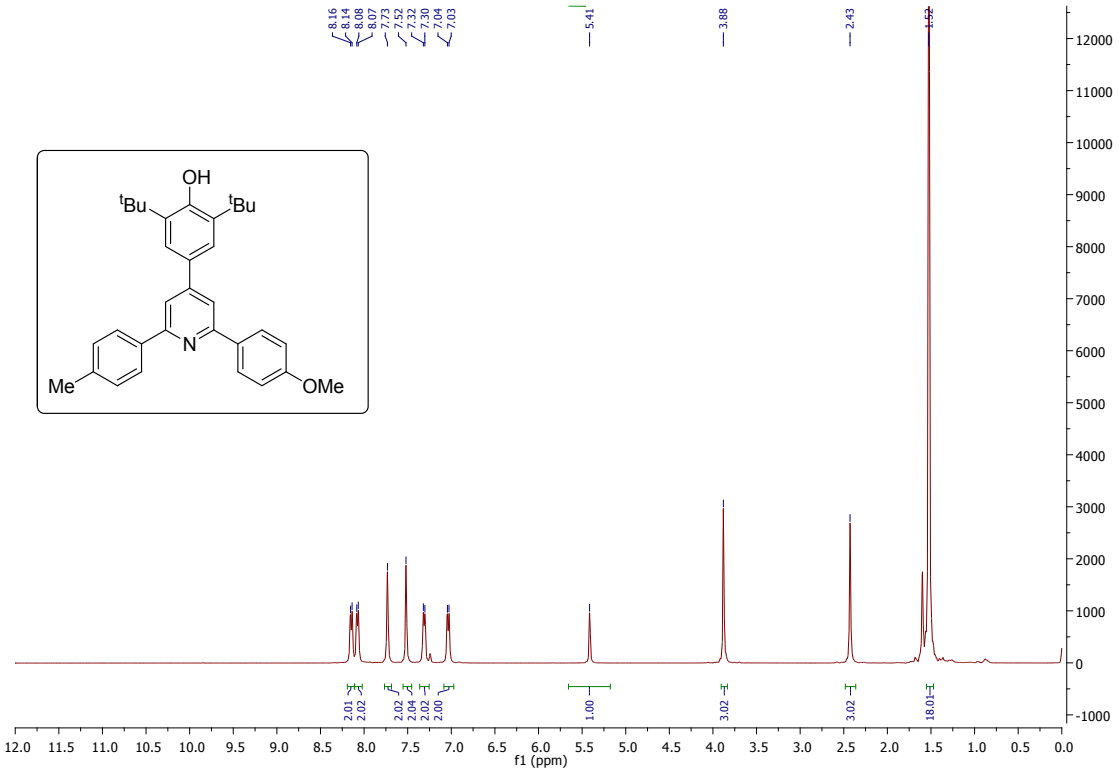
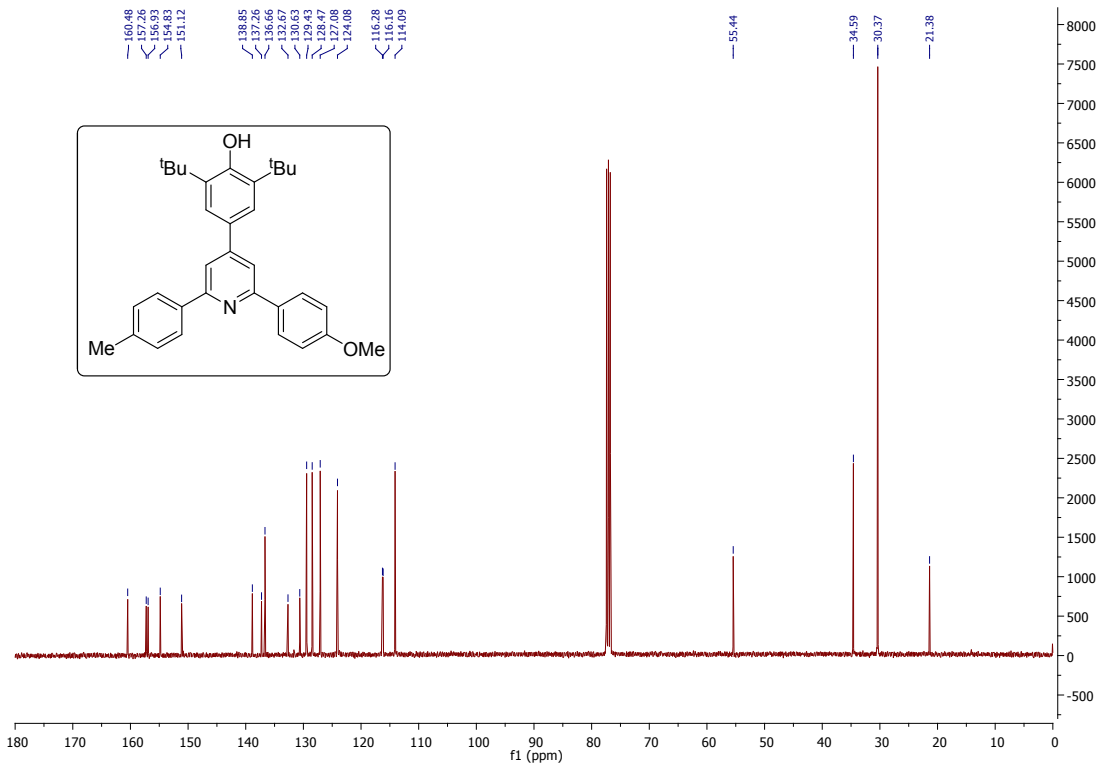
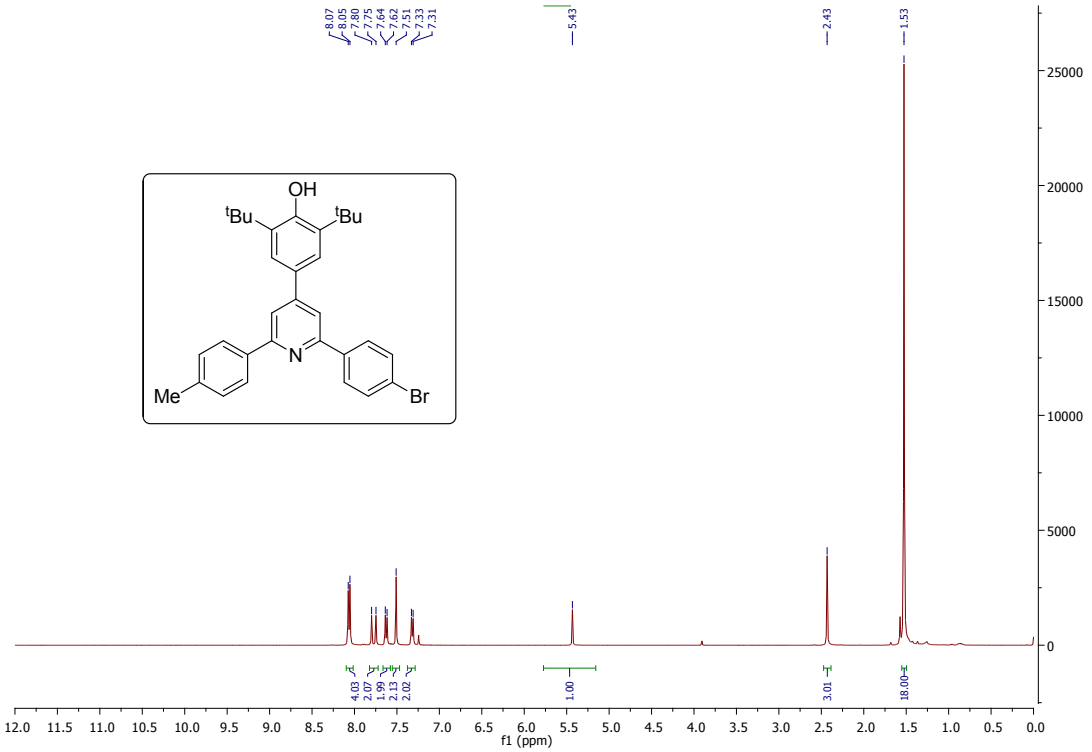
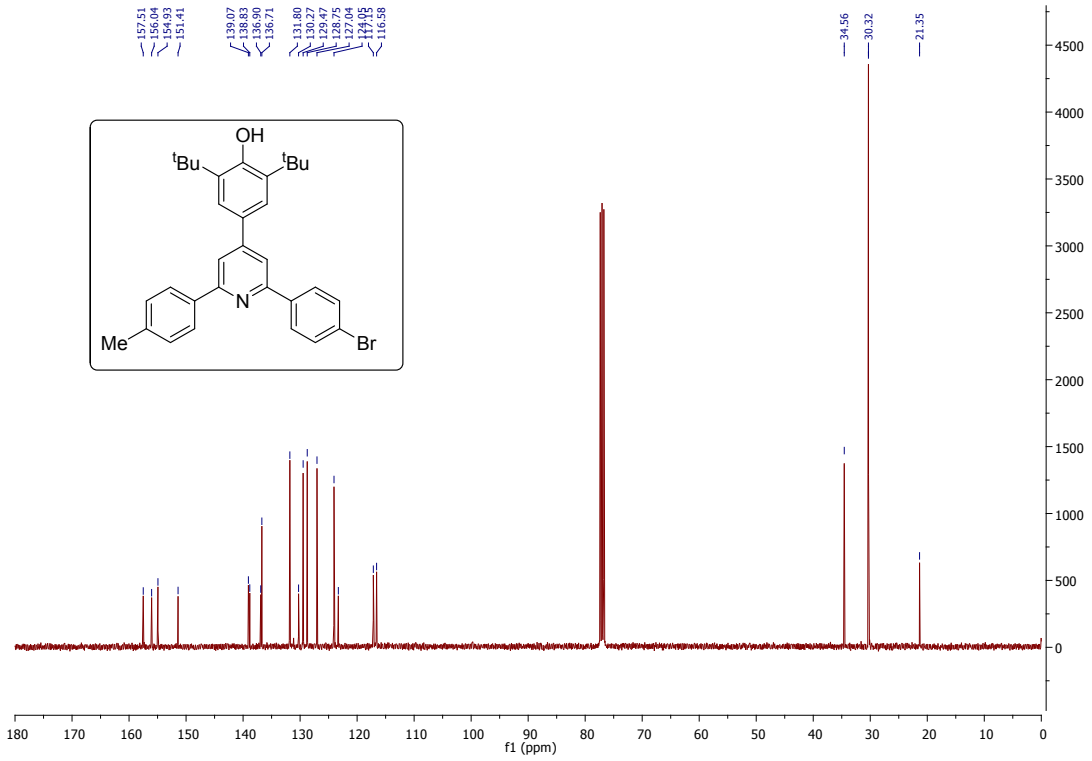
116.59
34.55
30.33
21.34
f1 (ppm)


8.16
8.14
8.08
8.07
7.73
7.52
7.32
7.30
7.04
7.03
5.41
3.88
2.43
1.52
OH
tBu
tBu
N
Me
OMe
2.01
2.02
2.02
2.04
2.02
2.00
1.00
3.02
3.02
18.01
f1 (ppm)


160.48
157.26
156.93
154.83
151.12
138.85
137.26
136.66
132.67
130.63
129.43
128.47
127.08
124.08
116.28
116.16
114.09
55.44
34.59
30.37
21.38
OH
tBu
tBu
N
Me
OMe
f1 (ppm)


8.07
8.05
7.80
7.75
7.64
7.62
7.51
7.33
7.31
5.43
2.43
1.53
OH
tBu
tBu
N
Me
Br
25000
20000
15000
10000
5000
0
4.03
2.07
1.99
2.13
2.02
1.00
3.01
18.00
12.0 11.5 11.0 10.5 10.0 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)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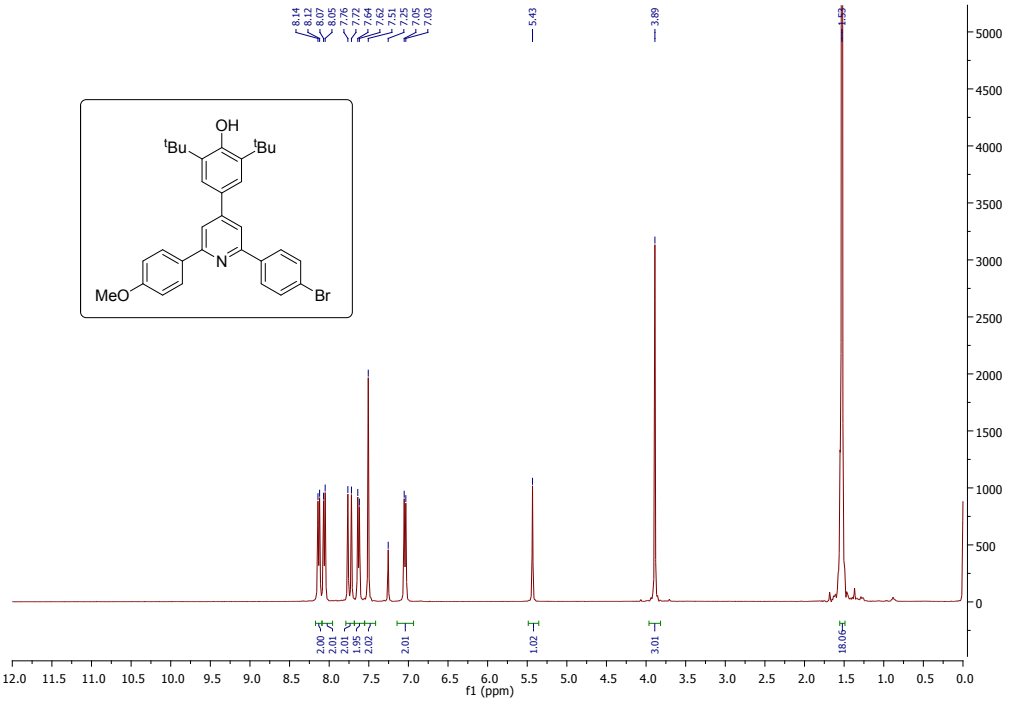
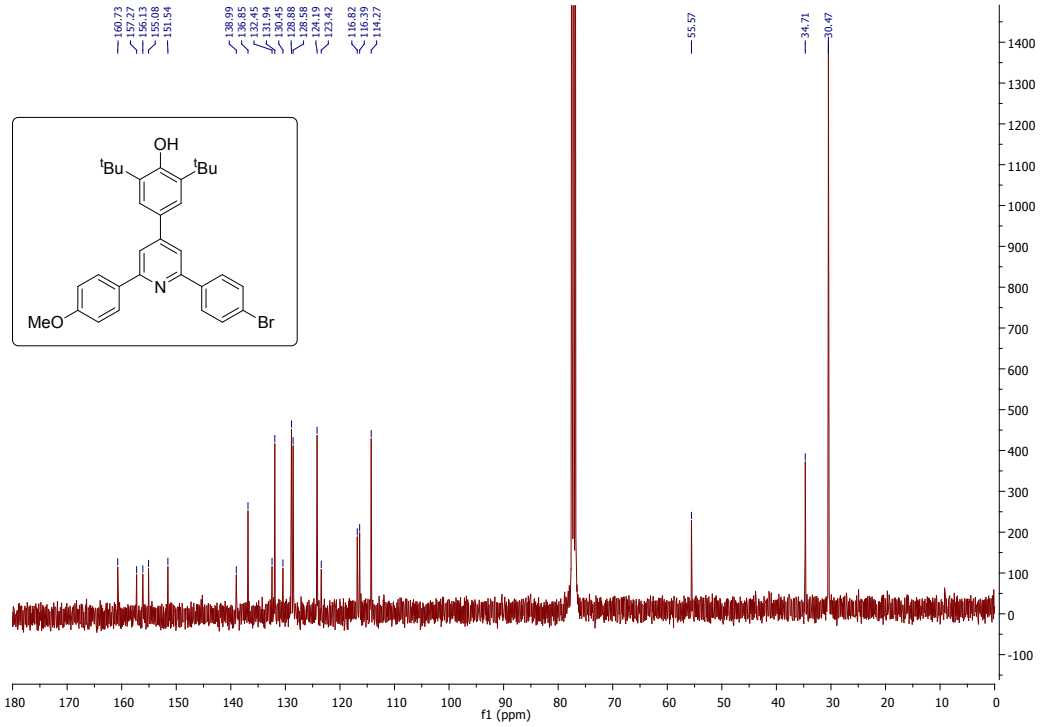
156.04
154.93
151.41
139.07
138.83
136.90
136.71
131.80
130.27
129.47
128.75
127.04
116.58
34.56
30.32
21.35
OH
tBu
tBu
N
Me
Br
4500
4000
3500
3000
2500
2000
1500
1000
500
0
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


8.14
8.12
8.07
8.05
7.76
7.72
7.64
7.62
7.51
7.25
7.05
7.03
5.43
3.89
1.53
OH
tBu
tBu
N
MeO
Br
2.00
2.01
2.01
1.05
2.02
2.01
1.02
3.01
18.06
f1 (ppm)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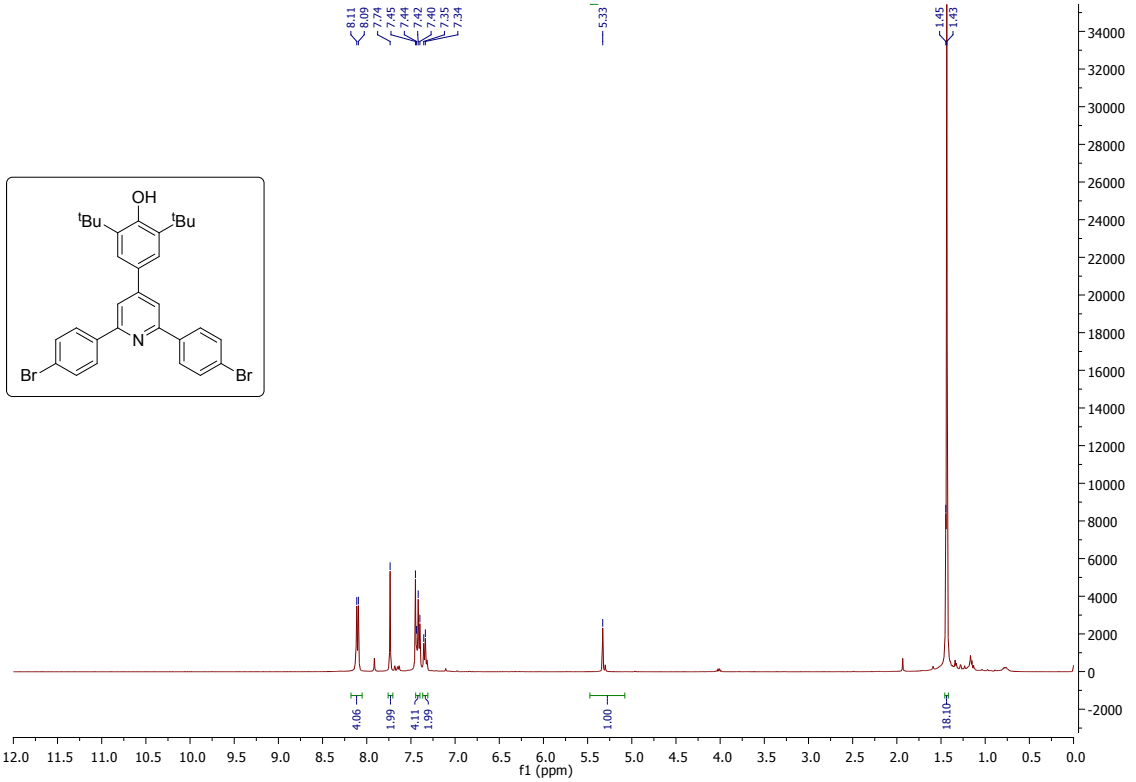
157.27
156.13
155.08
151.54
138.99
136.85
132.45
131.94
130.45
128.88
128.58
124.19
123.42
116.82
116.39
114.27
55.57
34.71
30.47
OH
tBu
tBu
N
MeO
Br
f1 (ppm)


OH
tBu
tBu
N
Br
Br
8.11
8.09
7.74
7.45
7.44
7.42
7.40
7.35
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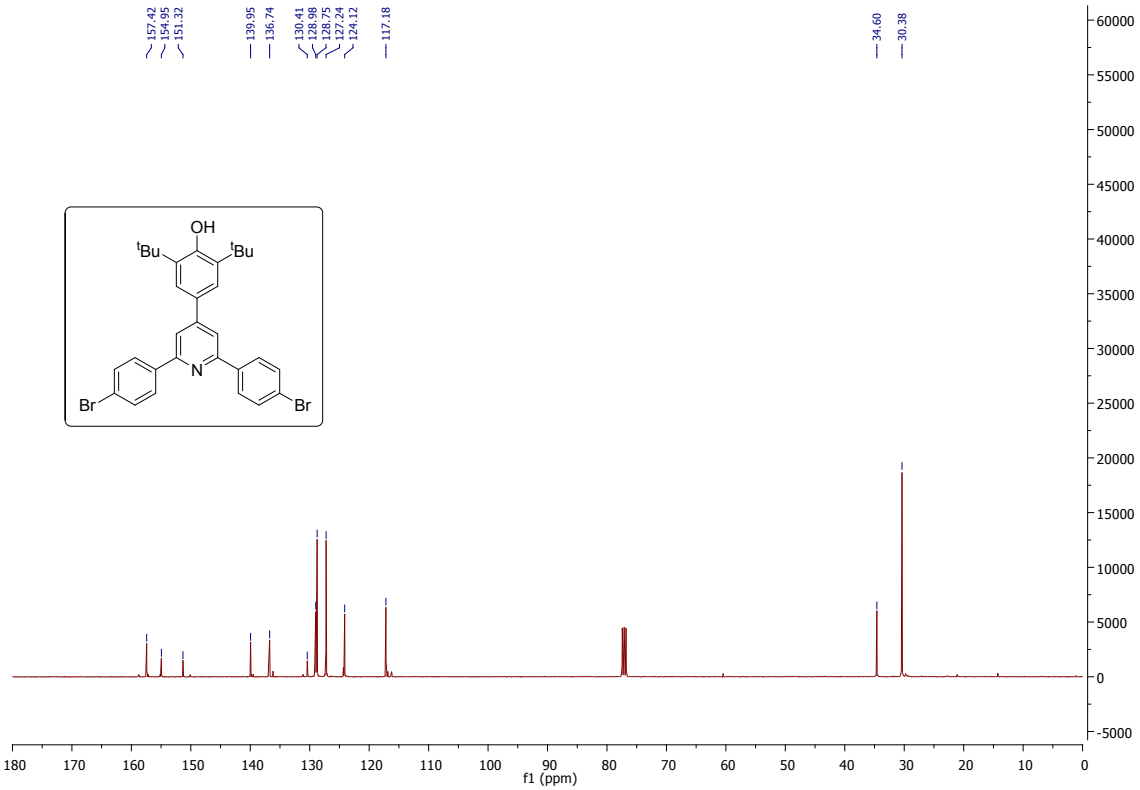
1.99
4.11
1.99
1.00
18.10
f1 (ppm)


OH
tBu
tBu
N
Br
Br
157.42
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139.95
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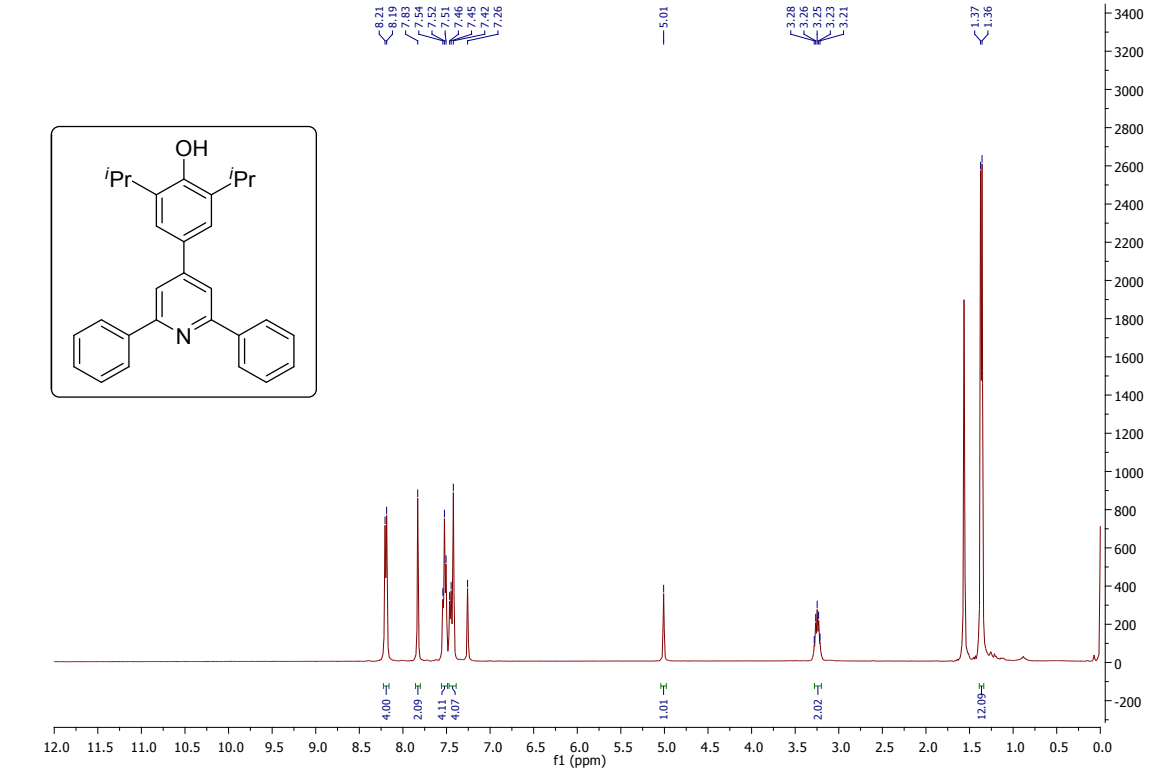
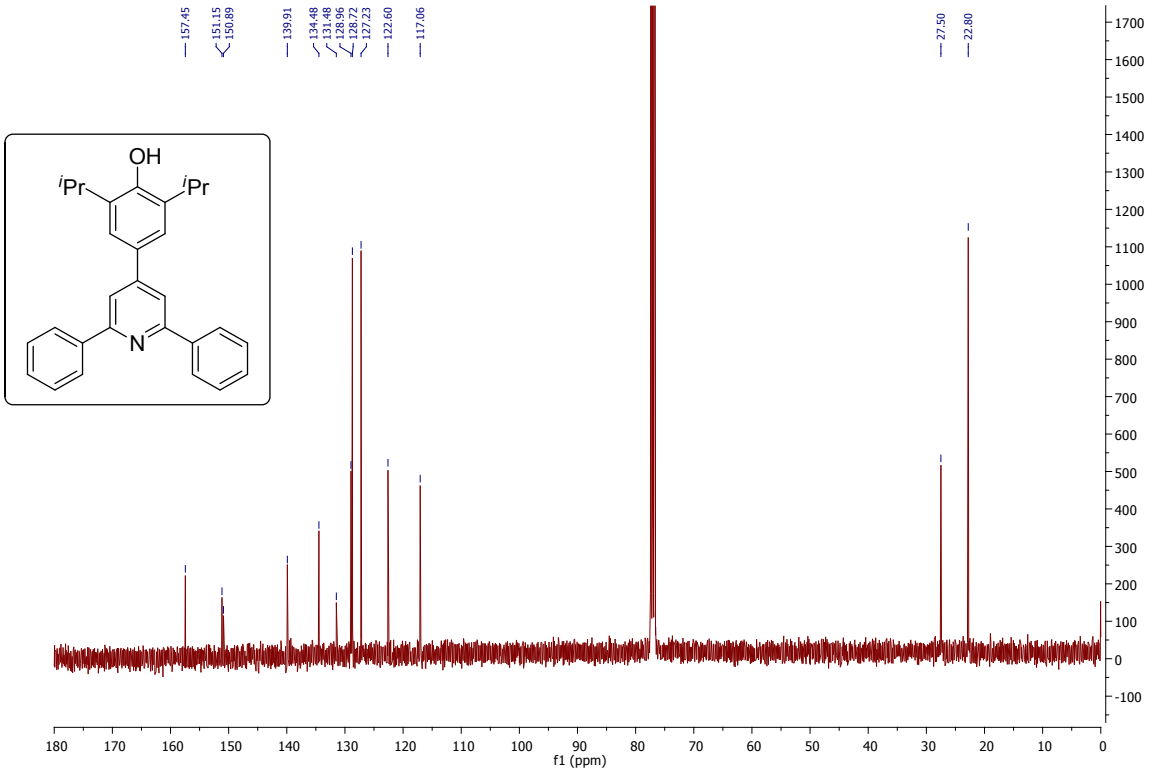
130.41
128.98
128.75
127.24
124.12
117.18
34.60
30.38
f1 (ppm)


OH
iPr
iPr
N
8.21
8.19
7.83
7.54
7.52
7.51
7.46
7.45
7.42
7.26
5.01
3.28
3.26
3.25
3.23
3.21
1.37
1.36
4.00
2.09
4.11
4.07
1.01
2.02
12.09
f1 (ppm)


OH
iPr
iPr
N
157.45
151.15
150.89
139.91
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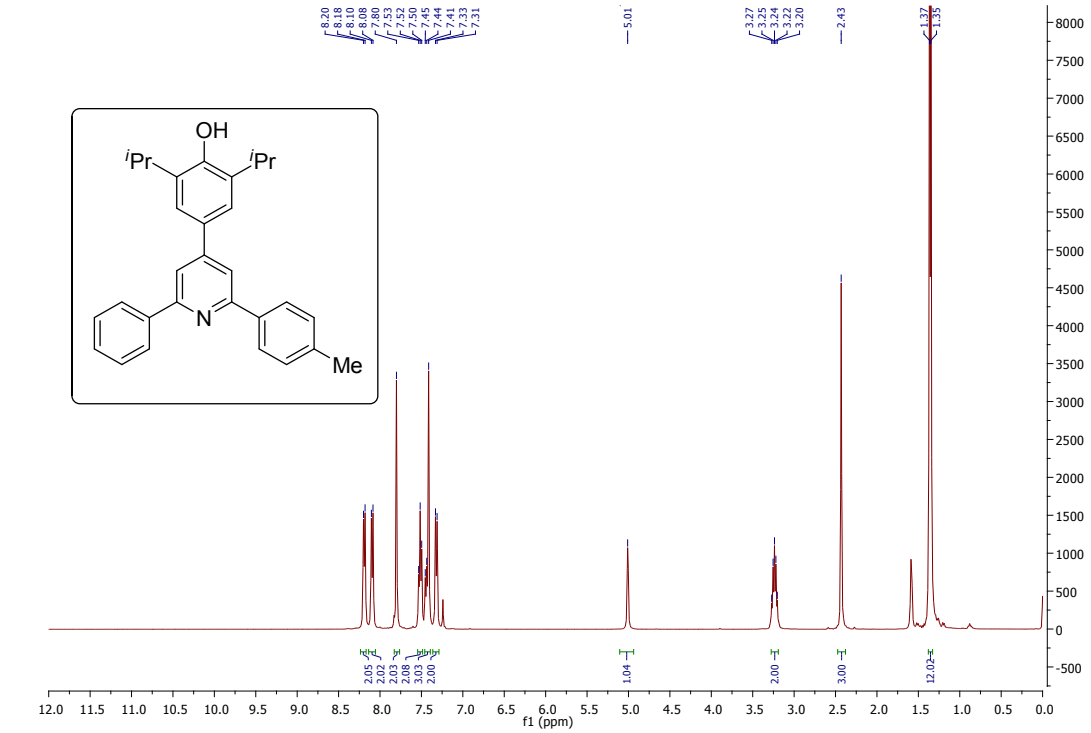
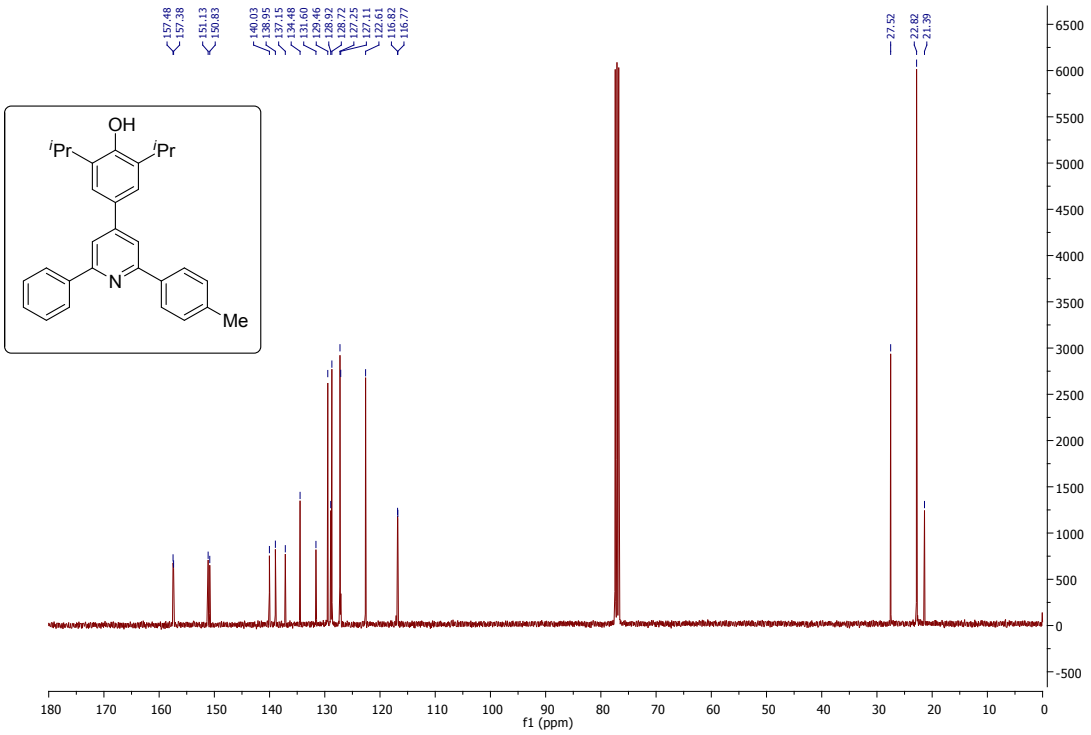
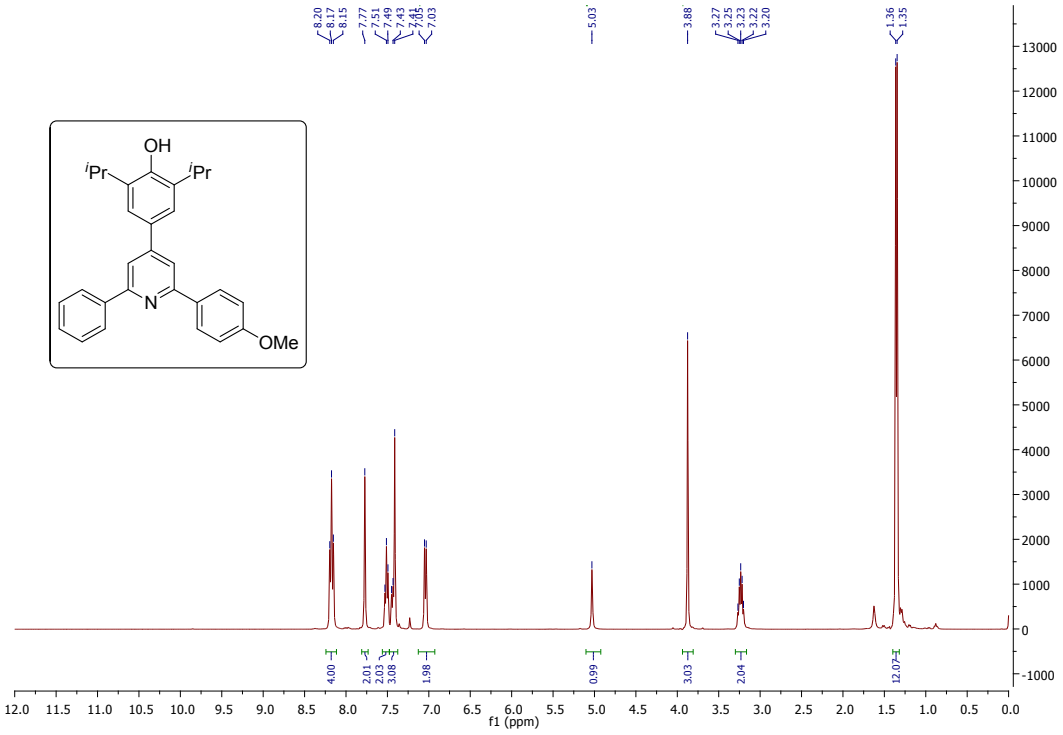
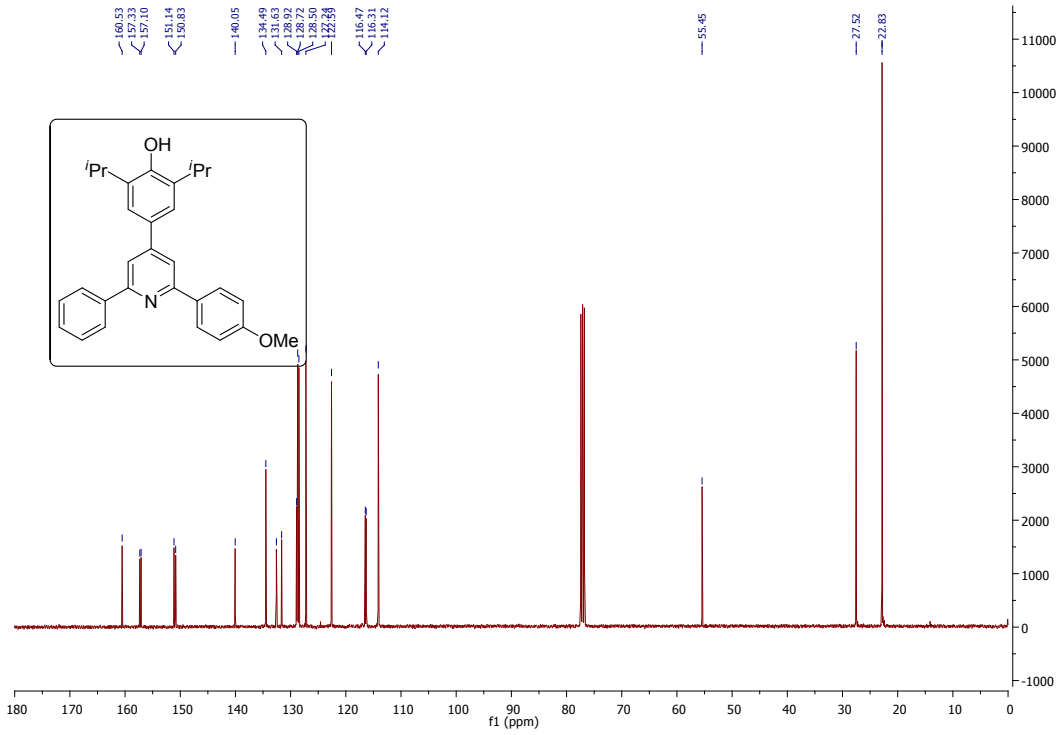
131.48
128.96
128.72
127.23
122.60
117.06
27.50
22.80
f1 (ppm)


OH
iPr
iPr
N
Me
f1 (ppm)


OH
iPr
iPr
N
Me
f1 (ppm)


OH
iPr
iPr
N
OMe
8.20
8.17
8.15
7.77
7.51
7.49
7.43
7.41
7.03
5.03
3.88
3.27
3.25
3.23
3.22
3.20
1.36
1.35
4.00
2.01
2.03
3.08
1.98
0.99
3.03
2.04
12.07
f1 (ppm)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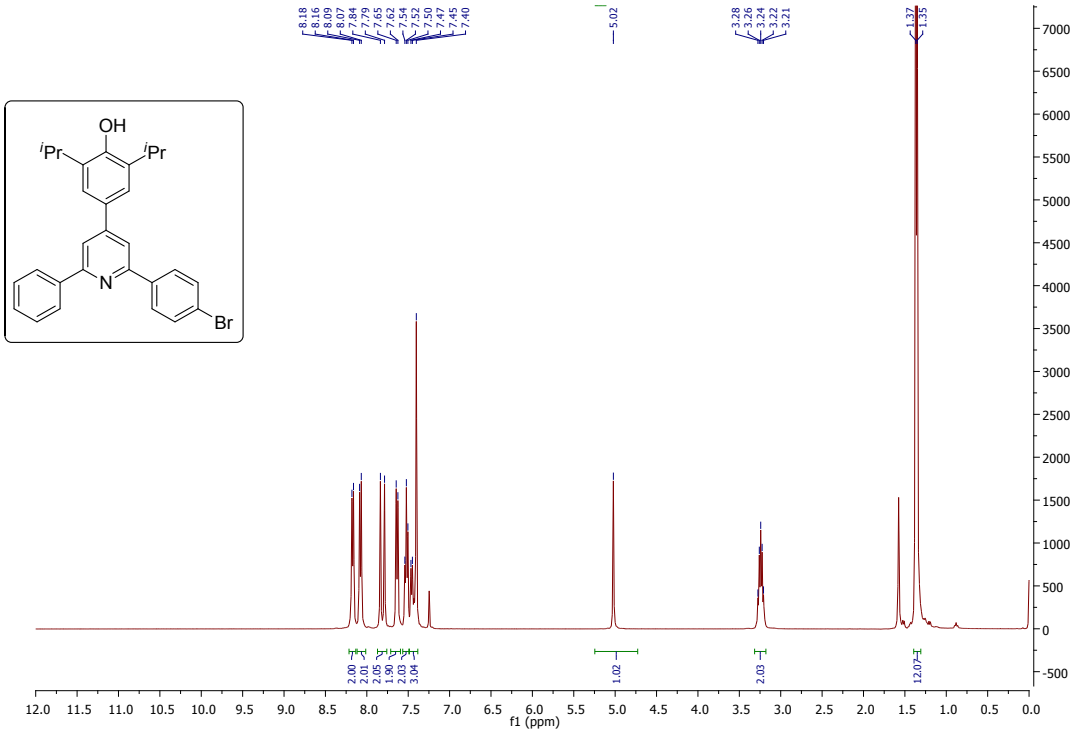
iPr
iPr
N
OMe
160.53
157.33
157.10
151.14
150.83
140.05
134.49
131.63
128.92
128.72
128.50
122.59
116.47
116.31
114.12
55.45
27.52
22.83
f1 (ppm)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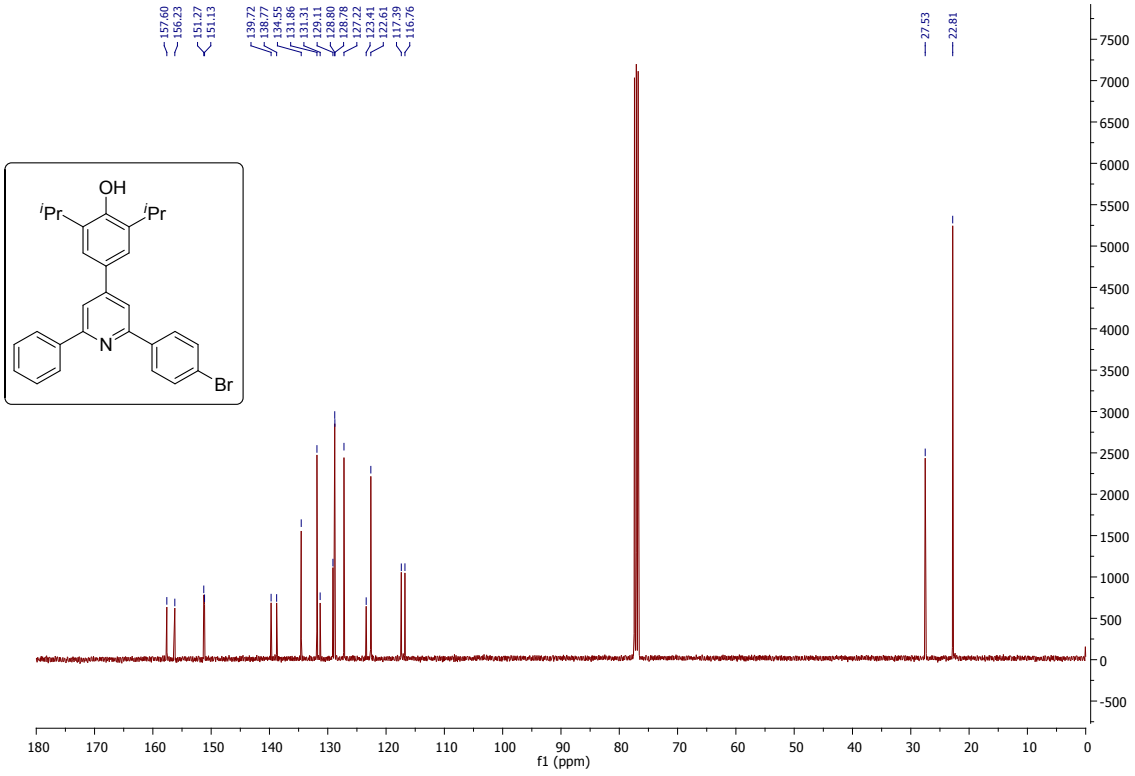
iPr
iPr
N
Br
8.18
8.16
8.09
8.07
7.84
7.79
7.65
7.62
7.54
7.52
7.50
7.47
7.45
7.40
5.02
3.28
3.26
3.24
3.22
3.21
1.37
1.35
2.00
2.01
2.05
1.90
2.03
3.04
1.02
2.03
12.07
f1 (ppm)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iPr
iPr
N
Br
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151.27
151.13
139.72
138.77
134.55
131.86
131.31
129.11
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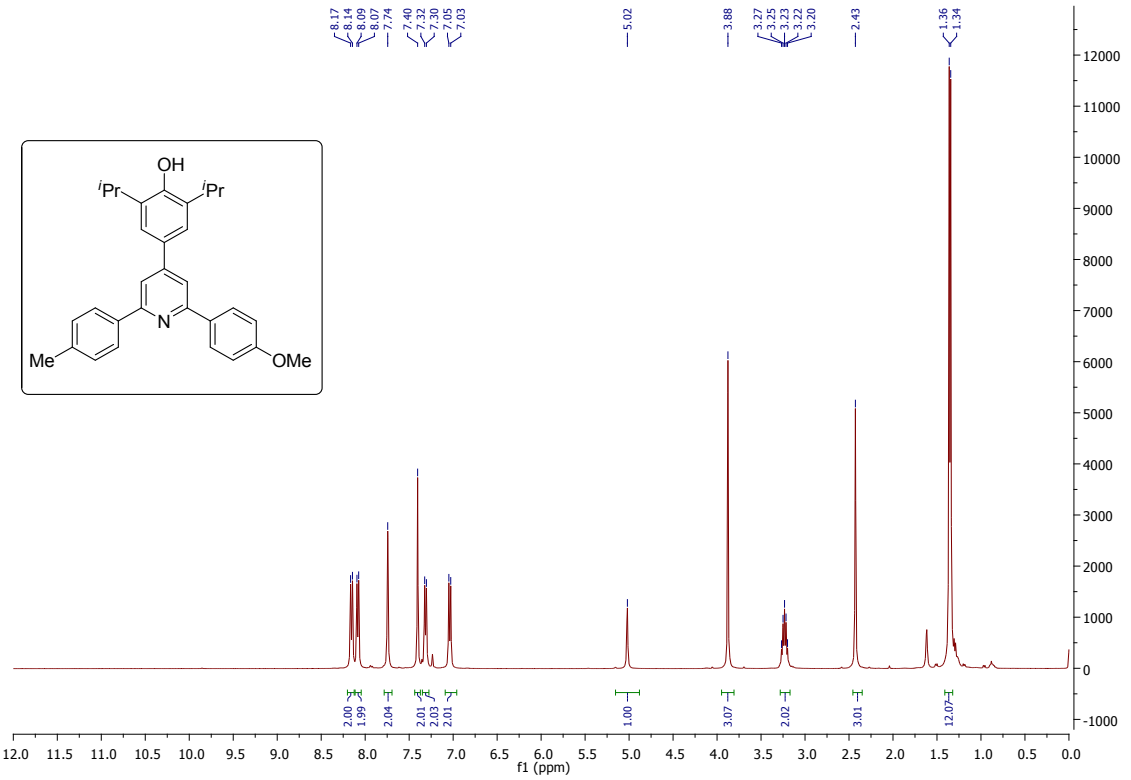
128.78
127.22
123.41
122.61
117.39
116.76
27.53
22.81
f1 (ppm)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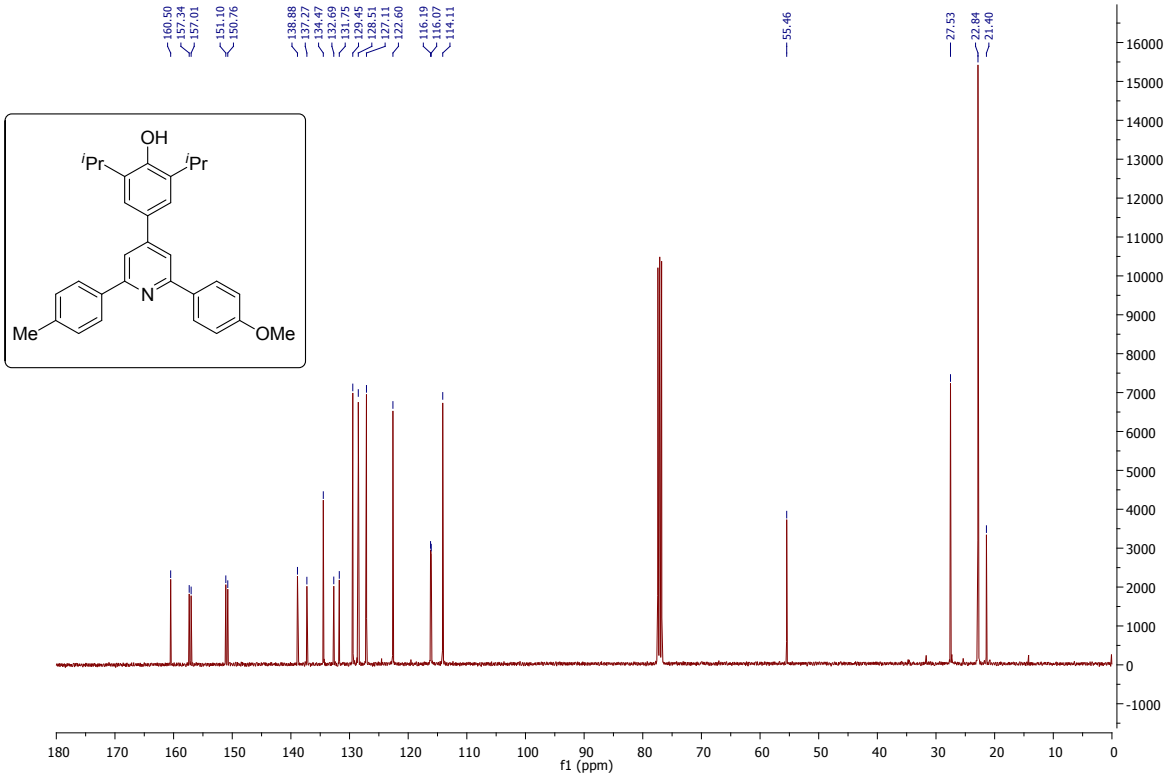
8.14
8.09
8.07
7.74
7.40
7.32
7.30
7.05
7.03
5.02
3.88
3.27
3.25
3.23
3.22
3.20
2.43
1.36
1.34
OH
iPr
iPr
N
Me
OMe
2.00
1.99
2.04
2.01
2.03
2.01
1.00
3.07
2.02
3.01
12.07
f1 (ppm)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157.01
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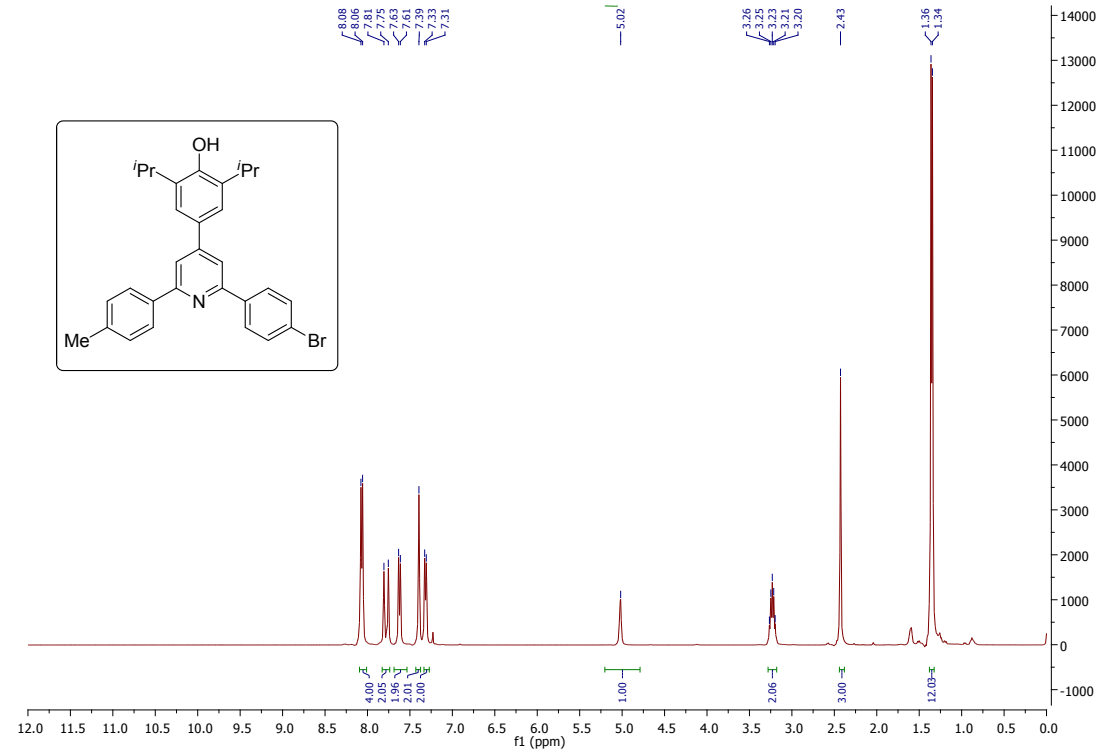
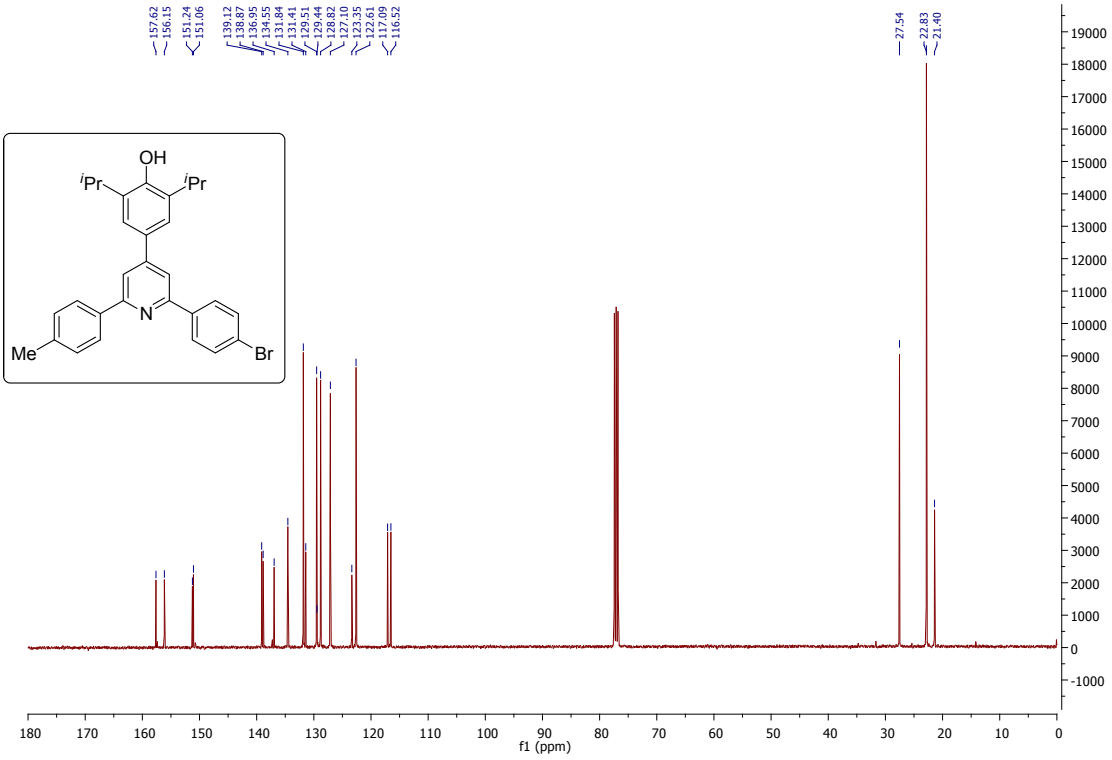
150.76
138.88
137.27
134.47
132.69
131.75
129.45
128.51
127.11
122.60
116.19
116.07
114.11
55.46
27.53
22.84
21.40
OH
iPr
iPr
N
Me
OMe
f1 (ppm)


OH
iPr
iPr
N
Me
Br
8.08
8.06
7.81
7.75
7.63
7.61
7.39
7.33
7.31
5.02
3.26
3.25
3.23
3.21
3.20
2.43
1.36
1.34
4.00
2.05
1.96
2.01
2.00
1.00
2.06
3.00
12.03
f1 (ppm)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iPr
iPr
N
Me
Br
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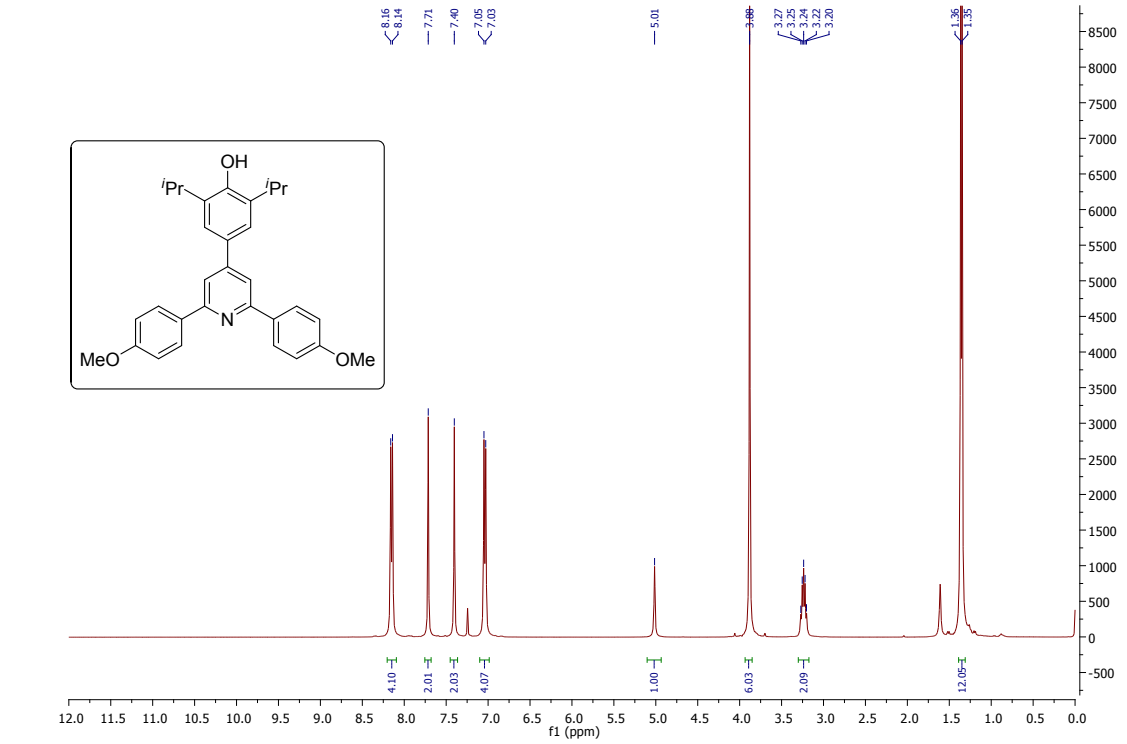
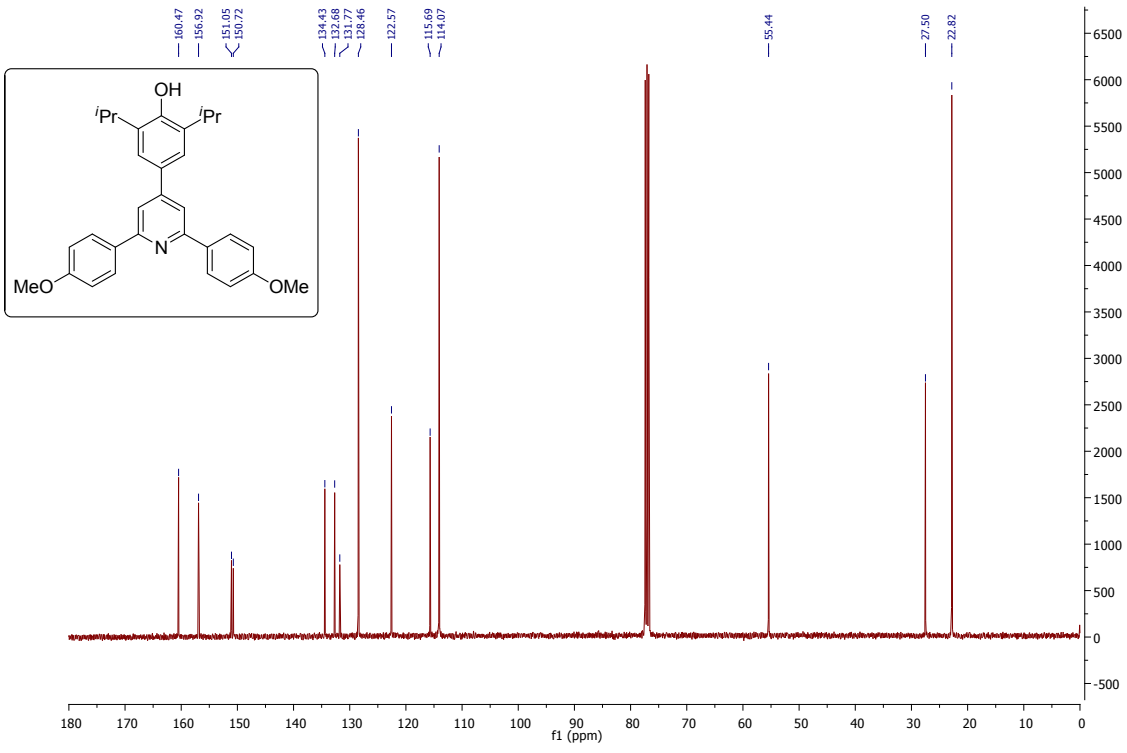
156.15
151.24
151.06
139.12
138.87
136.95
134.55
131.84
131.41
129.51
129.44
128.82
127.10
123.35
122.61
117.09
116.52
27.54
22.83
21.40
f1 (ppm)


8.16
8.14
7.71
7.40
7.05
7.03
5.01
3.88
3.27
3.25
3.24
3.22
3.20
1.36
1.35
OH
iPr
iPr
N
MeO
OMe
4.10
2.01
2.03
4.07
1.00
6.03
2.09
12.06
f1 (ppm)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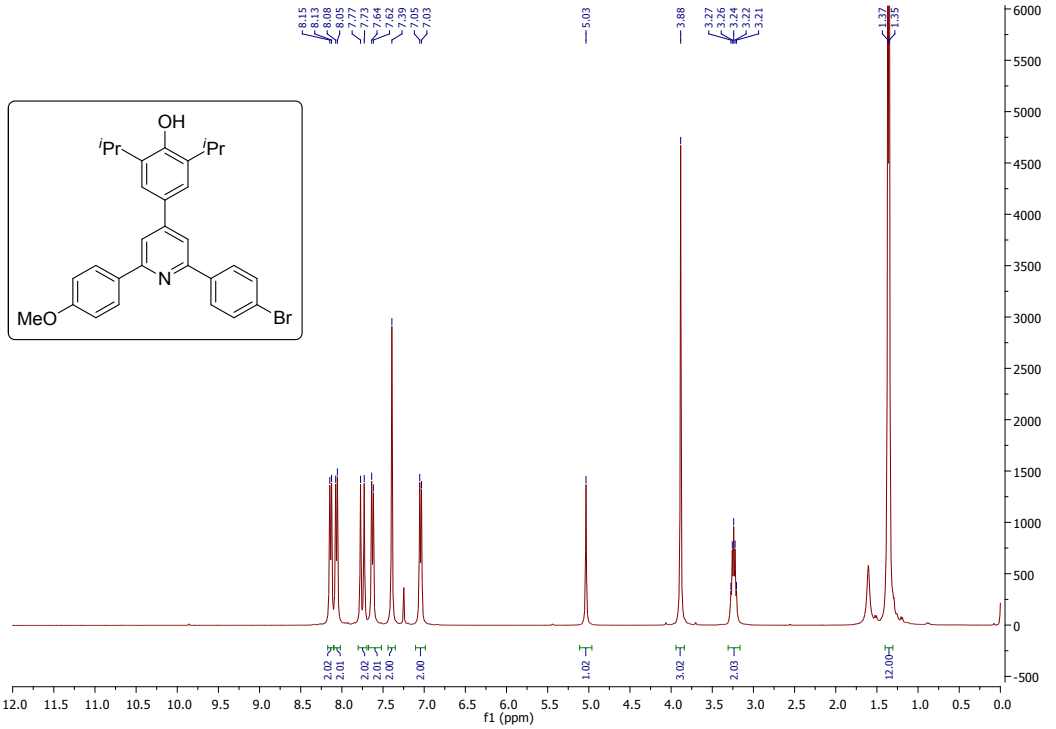
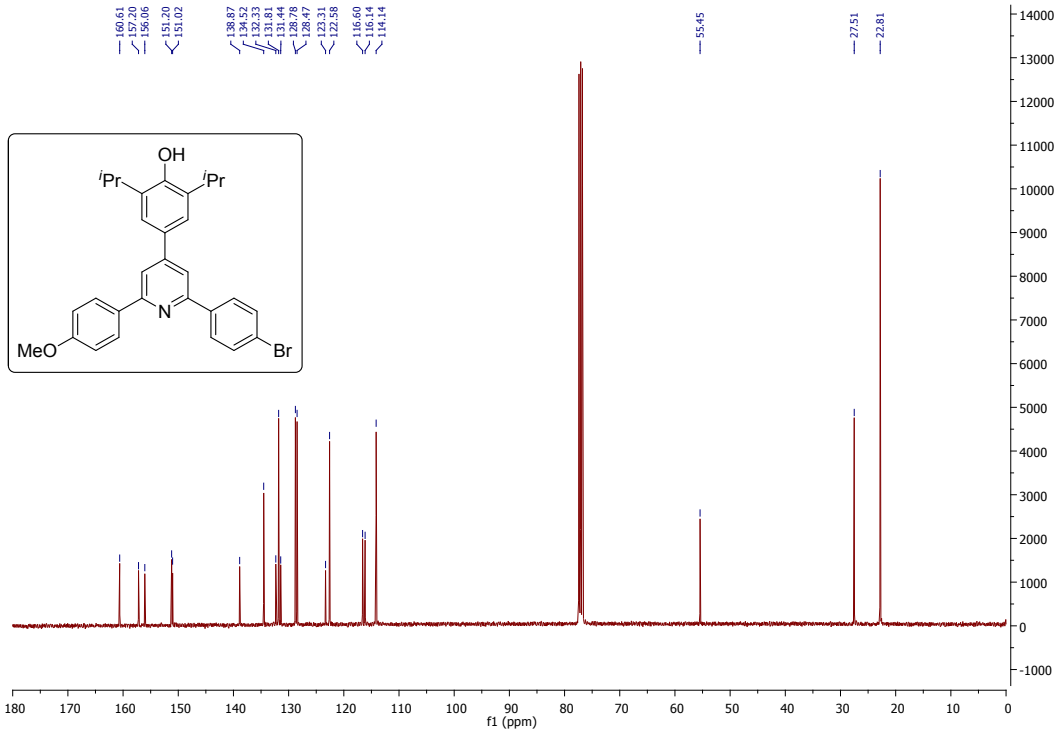
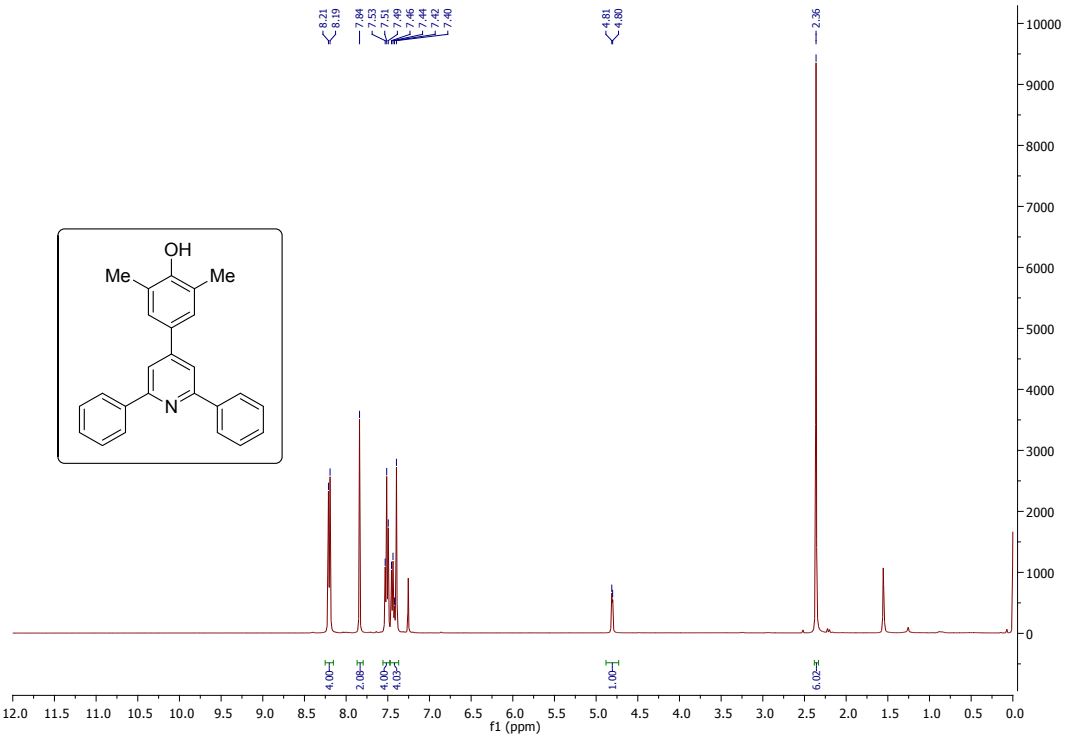
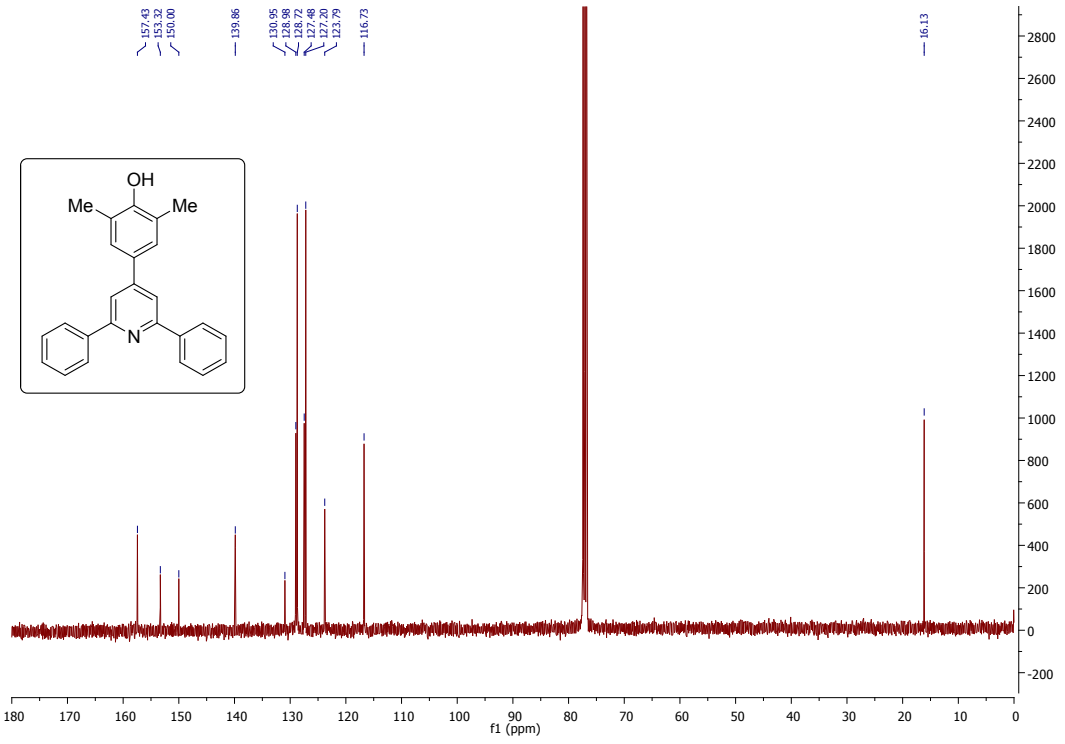
151.05
150.72
134.43
132.68
131.77
128.46
122.57
115.69
114.07
55.44
27.50
22.82
OH
iPr
iPr
N
MeO
OMe
f1 (ppm)


OH
iPr
iPr
N
MeO
Br
8.15
8.13
8.08
8.05
7.77
7.73
7.64
7.62
7.39
7.05
7.03
5.03
3.88
3.27
3.26
3.24
3.22
3.21
1.37
1.35
2.02
2.01
2.02
2.01
2.00
2.00
1.02
3.02
2.03
12.00
f1 (ppm)


OH
iPr
iPr
N
MeO
Br
160.61
157.70
156.06
151.20
151.02
138.87
134.52
132.33
131.81
131.44
128.78
128.47
123.31
122.58
116.60
116.14
114.14
55.45
27.51
22.81
f1 (ppm)


8.21
8.19
7.84
7.53
7.51
7.48
7.46
7.44
7.42
7.40
4.81
4.80
2.36
OH
Me
Me
N
4.00
2.08
4.00
4.03
1.00
6.02
f1 (ppm)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153.32
150.00
139.86
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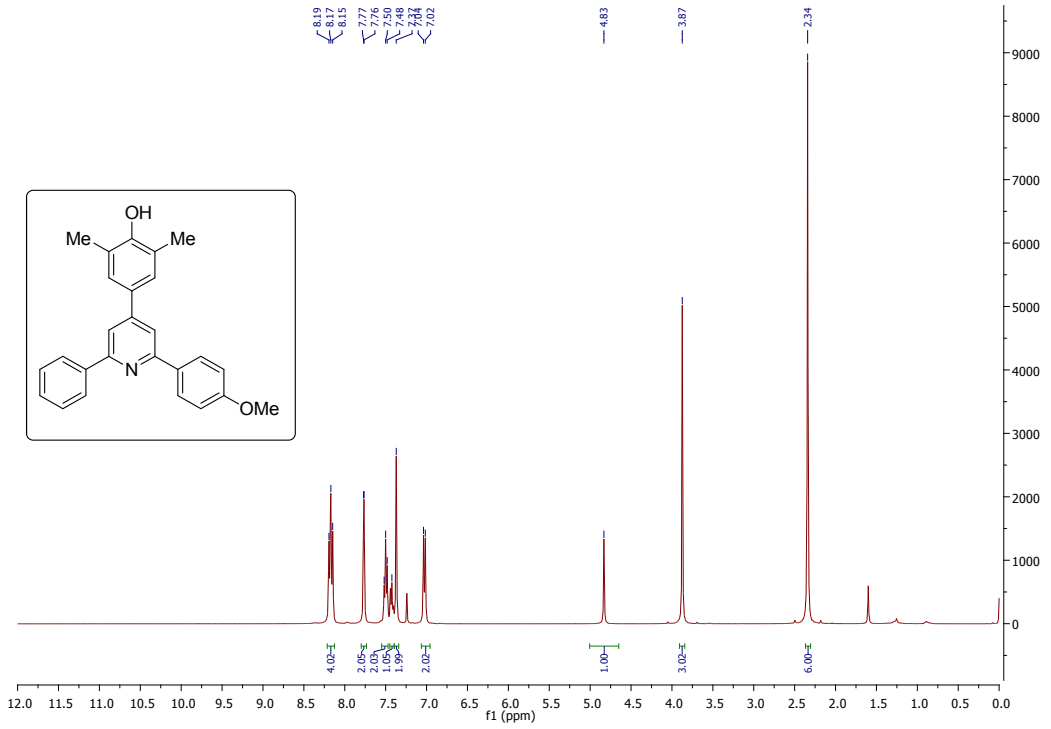
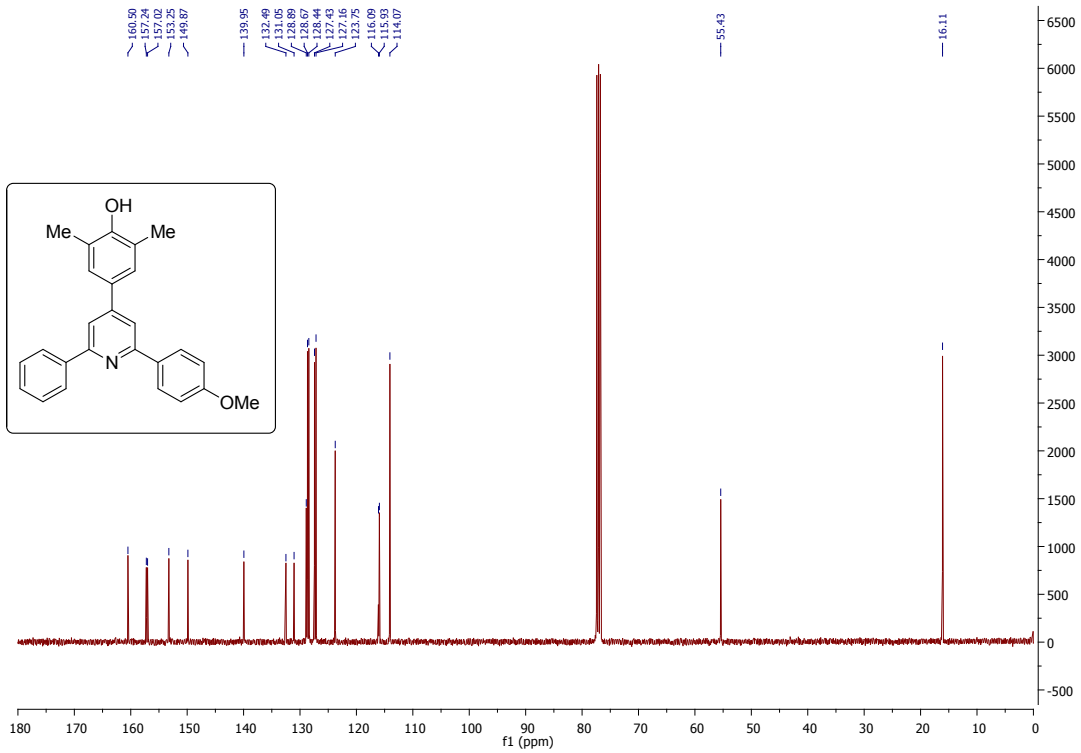
128.72
127.48
127.20
123.79
116.73
16.13
OH
Me
Me
N
f1 (ppm)


8.19
8.17
8.15
7.77
7.76
7.50
7.48
7.37
7.34
7.02
4.83
3.87
2.34
OH
Me
Me
N
OMe
4.02
2.05
2.03
1.05
1.99
2.02
1.00
3.02
6.00
f1 (ppm)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157.02
153.25
149.87
139.95
132.49
131.05
129.89
128.67
128.44
127.43
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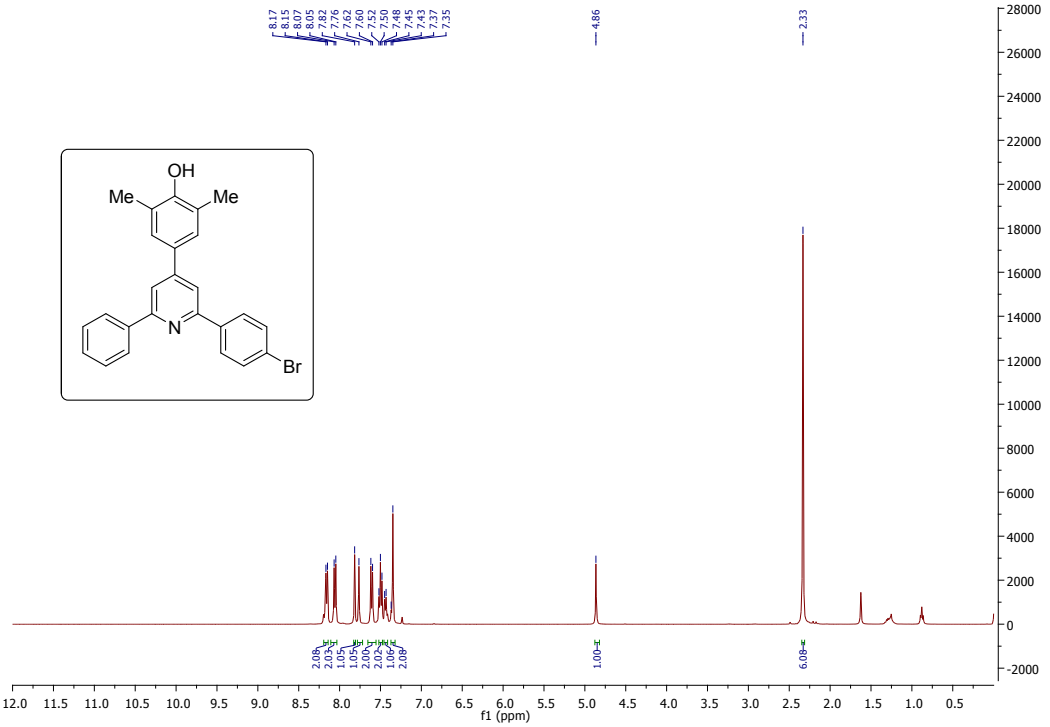
123.75
116.09
115.93
114.07
55.43
16.11
OH
Me
Me
N
OMe
f1 (ppm)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Me
Me
N
Br
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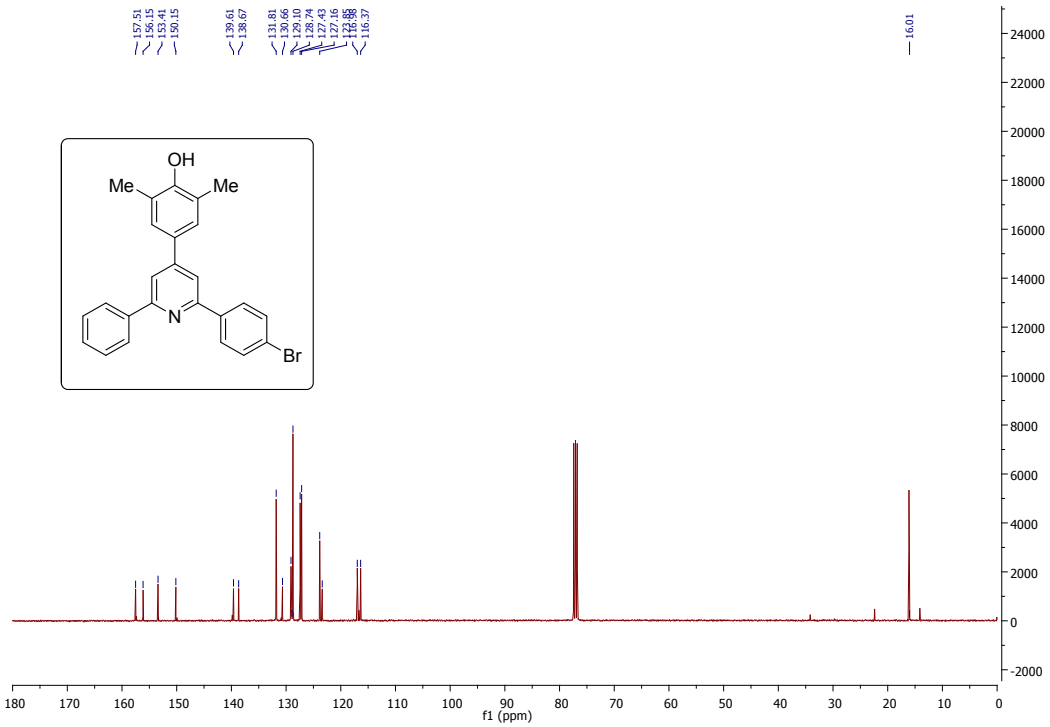
8.07
8.05
7.82
7.76
7.62
7.60
7.52
7.50
7.48
7.45
7.43
7.37
7.35
4.86
2.33
2.08
2.23
1.05
1.15
2.00
2.02
1.06
2.08
1.00
6.08
f1 (ppm)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Me
Me
N
Br
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153.41
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139.61
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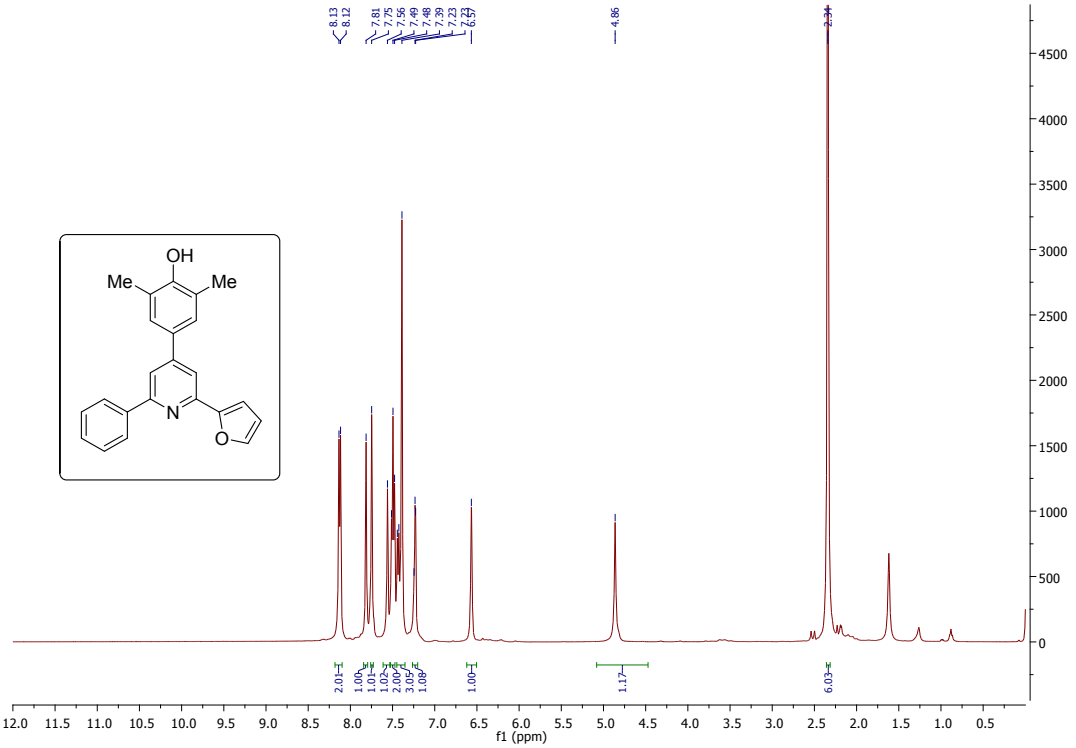
129.10
128.74
127.43
127.16
116.37
16.01
f1 (ppm)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Me
N
O
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7.75
7.56
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7.48
7.39
7.23
7.23
6.57
4.86
2.31
2.01
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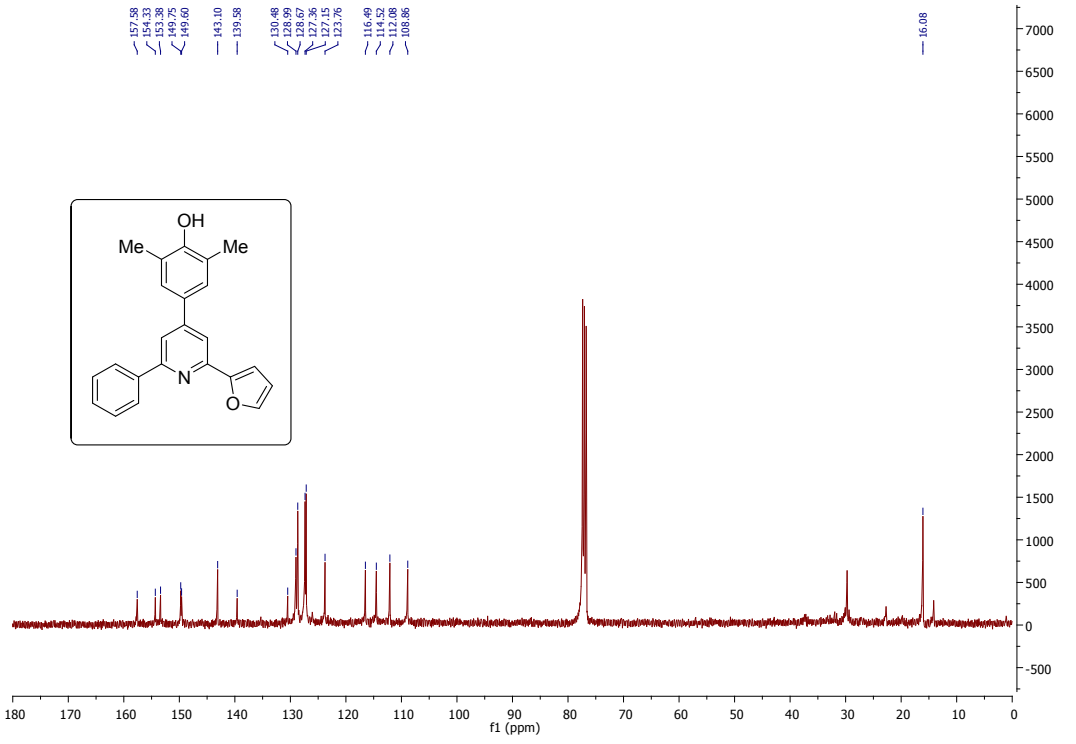
1.01
1.02
2.00
3.05
1.08
1.00
1.17
6.03
f1 (ppm)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O
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153.38
149.75
149.60
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139.58
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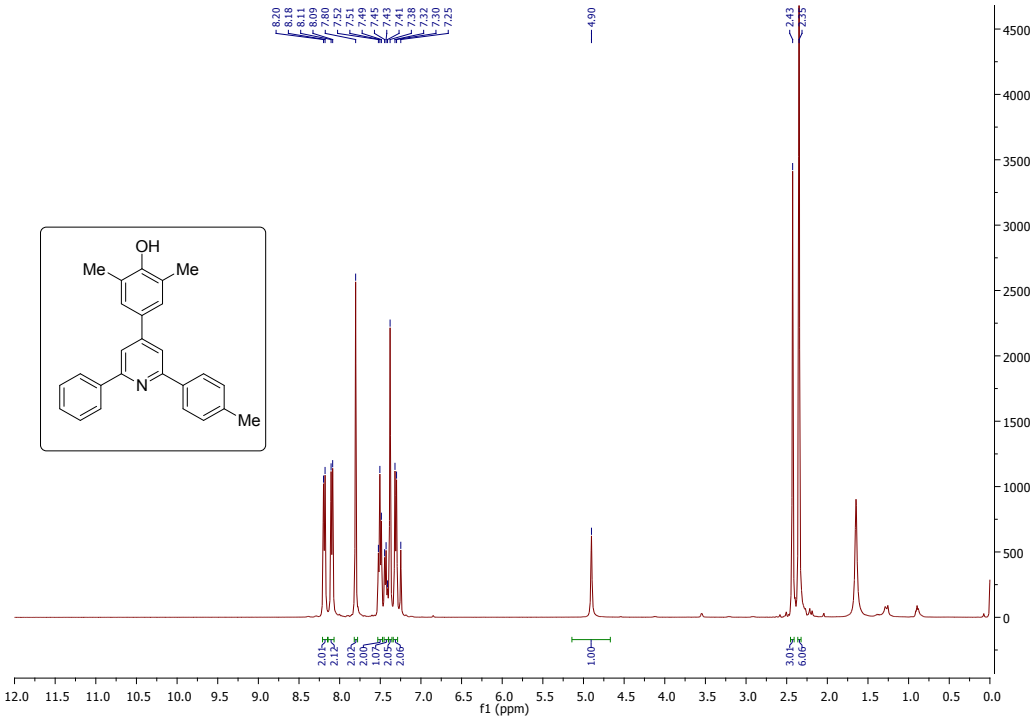
123.76
116.49
114.52
112.08
108.86
16.08
f1 (ppm)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8.11
8.09
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7.52
7.51
7.49
7.45
7.43
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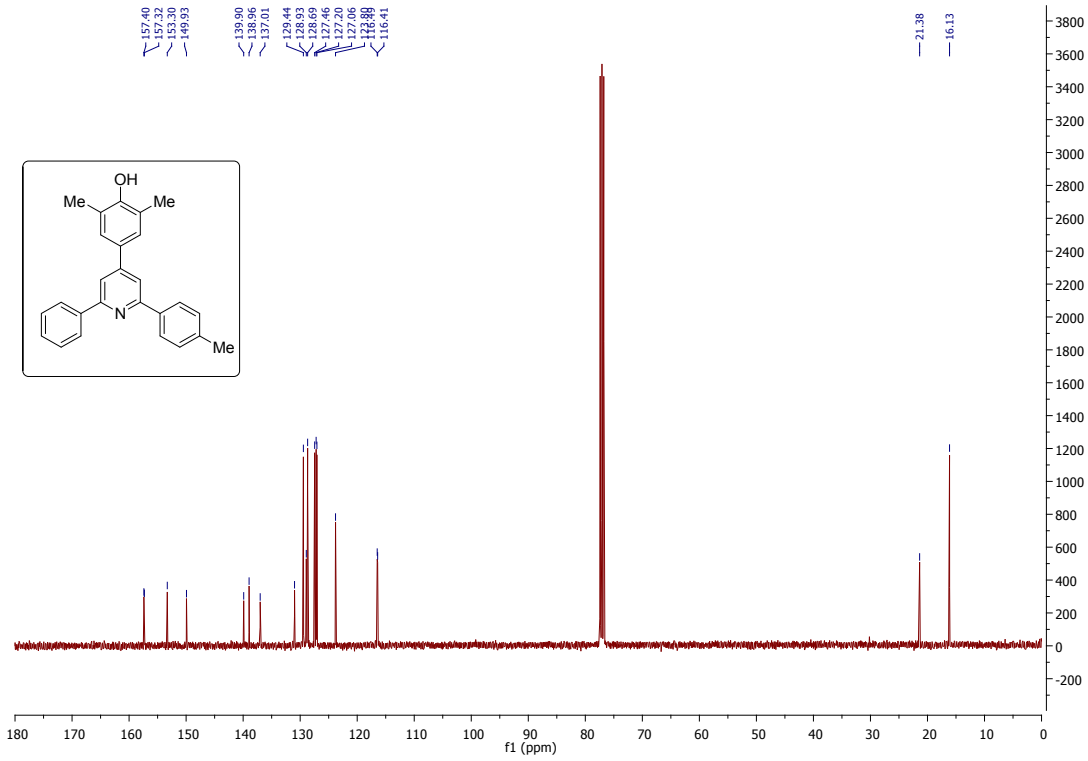
7.30
7.25
4.90
2.43
2.35
OH
Me
Me
N
Me
f1 (ppm)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157.32
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139.90
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137.01
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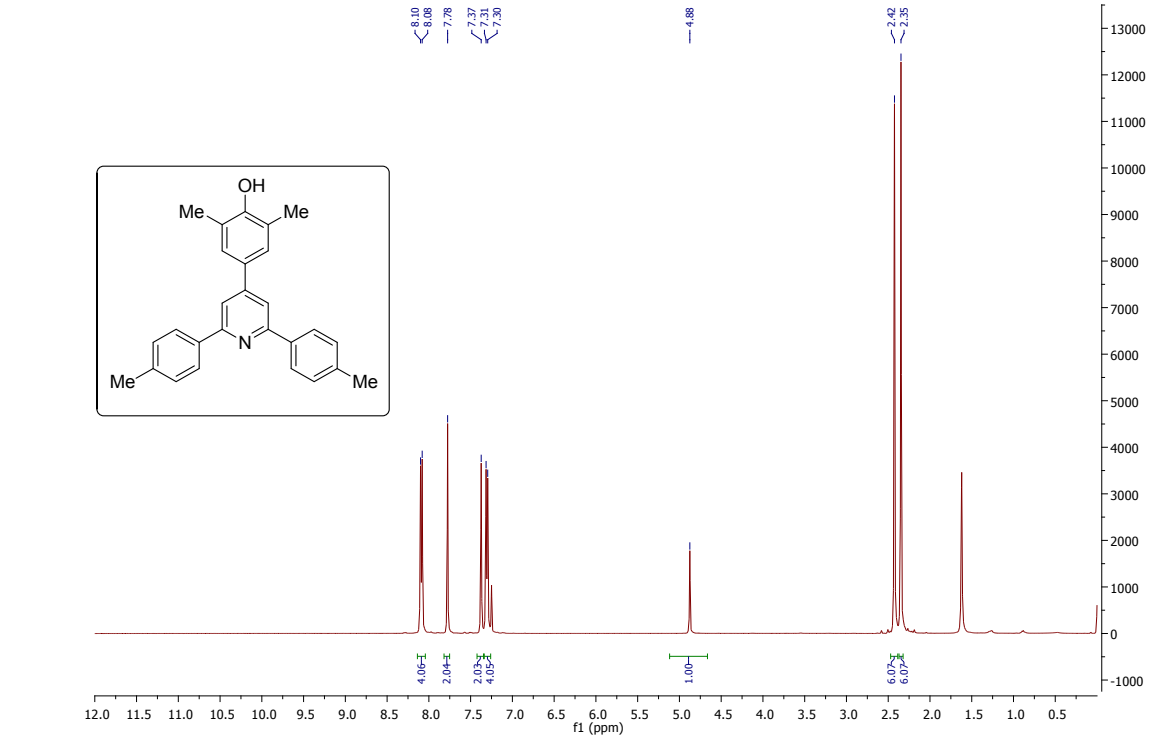
127.06
116.41
21.38
16.13
OH
Me
Me
N
Me
f1 (ppm)


8.10
8.08
7.78
7.37
7.31
7.30
4.88
2.42
2.35
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Me
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4.05
1.00
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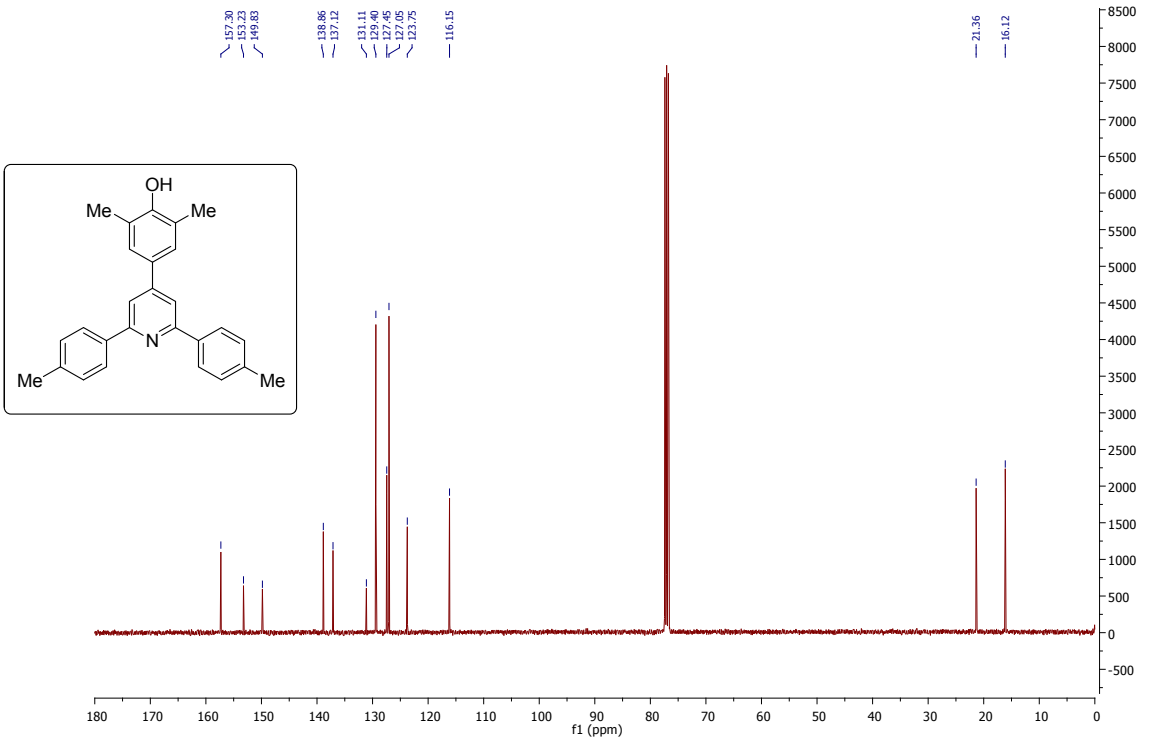
6.07
f1 (ppm)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137.12
131.11
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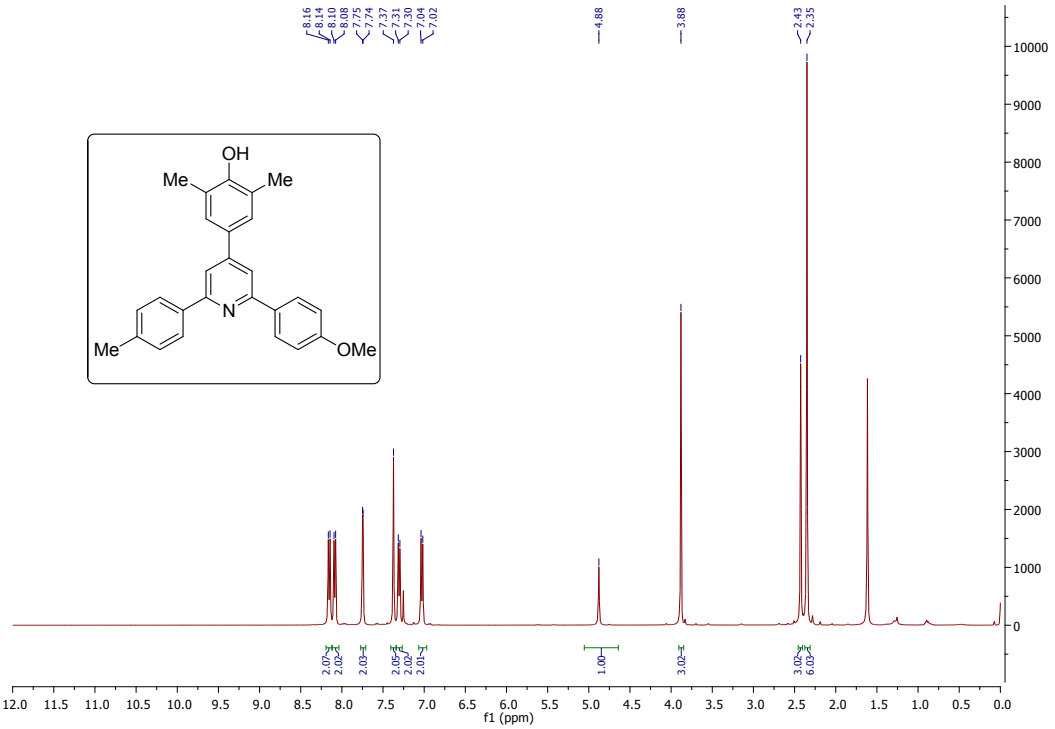
127.05
123.75
116.15
21.36
16.12
OH
Me
Me
N
Me
Me
f1 (ppm)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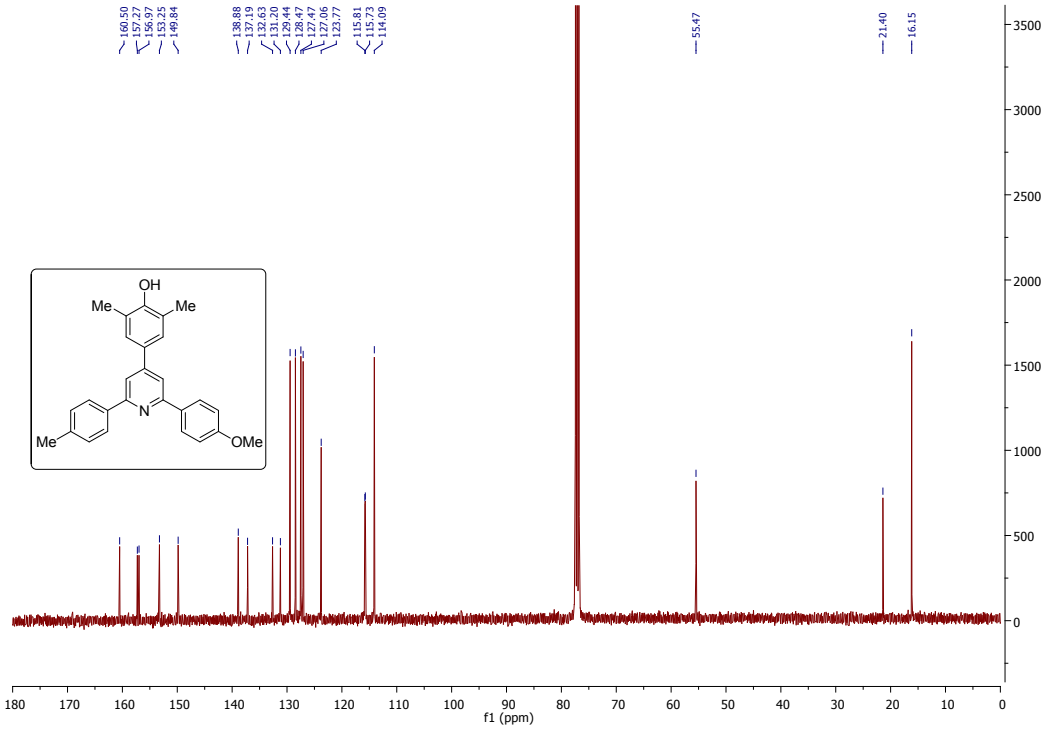
8.14
8.10
8.08
7.75
7.74
7.37
7.31
7.30
7.04
7.02
4.88
3.88
2.43
2.35
OH
Me
Me
N
Me
OMe
2.07
2.02
2.03
2.05
2.02
2.01
1.00
3.02
3.02
6.03
f1 (ppm)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137.19
132.63
131.20
129.44
128.47
127.47
127.06
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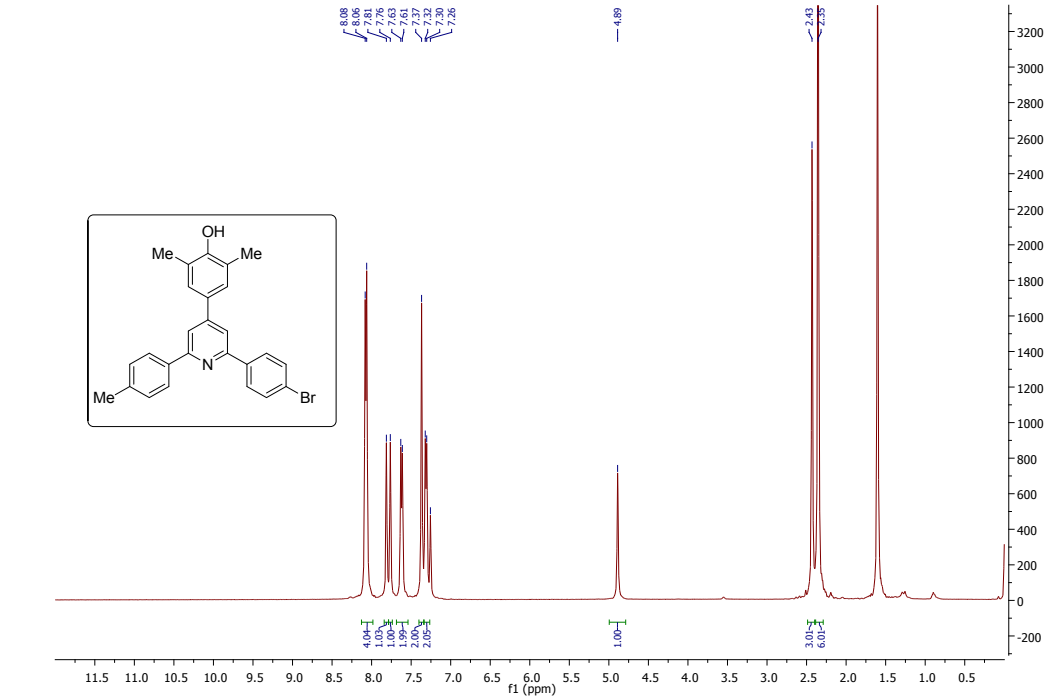
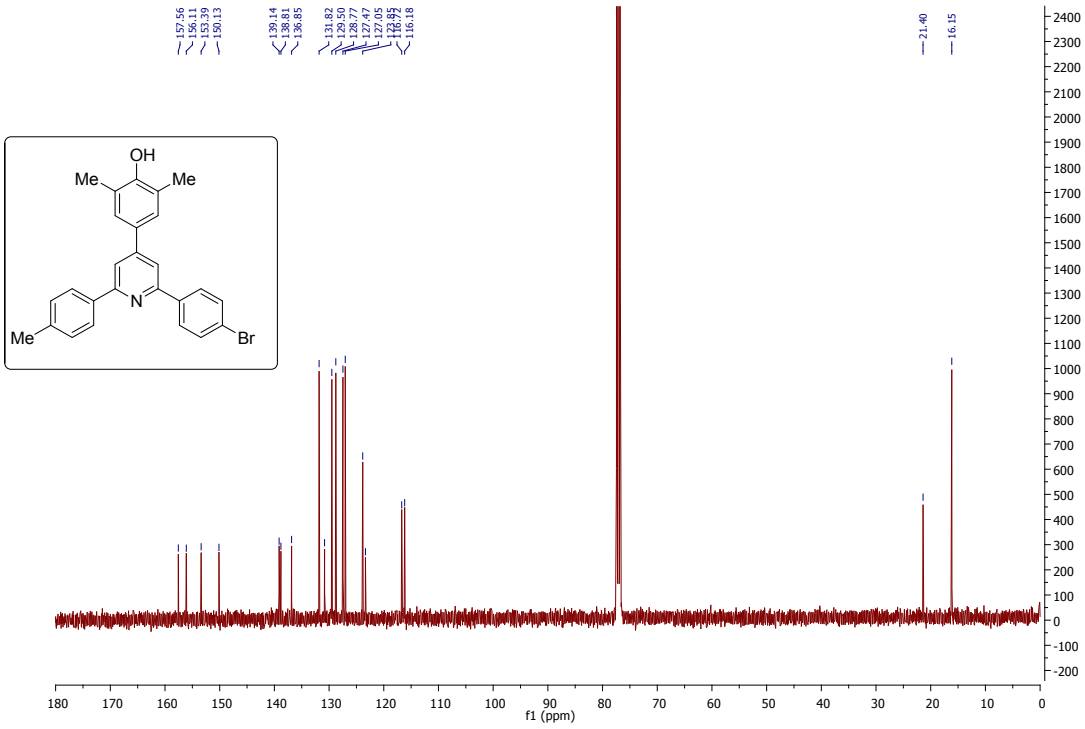
115.81
115.73
114.09
55.47
21.40
16.15
OH
Me
Me
N
Me
OMe
f1 (ppm)


OH
Me
Me
N
Me
Br
8.08
8.06
7.81
7.76
7.63
7.61
7.37
7.33
7.30
7.26
4.89
2.43
2.35
4.04
1.03
1.00
1.99
2.00
2.05
1.00
3.01
6.01
f1 (ppm)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Me
Me
N
Me
Br
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156.11
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150.13
139.14
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131.82
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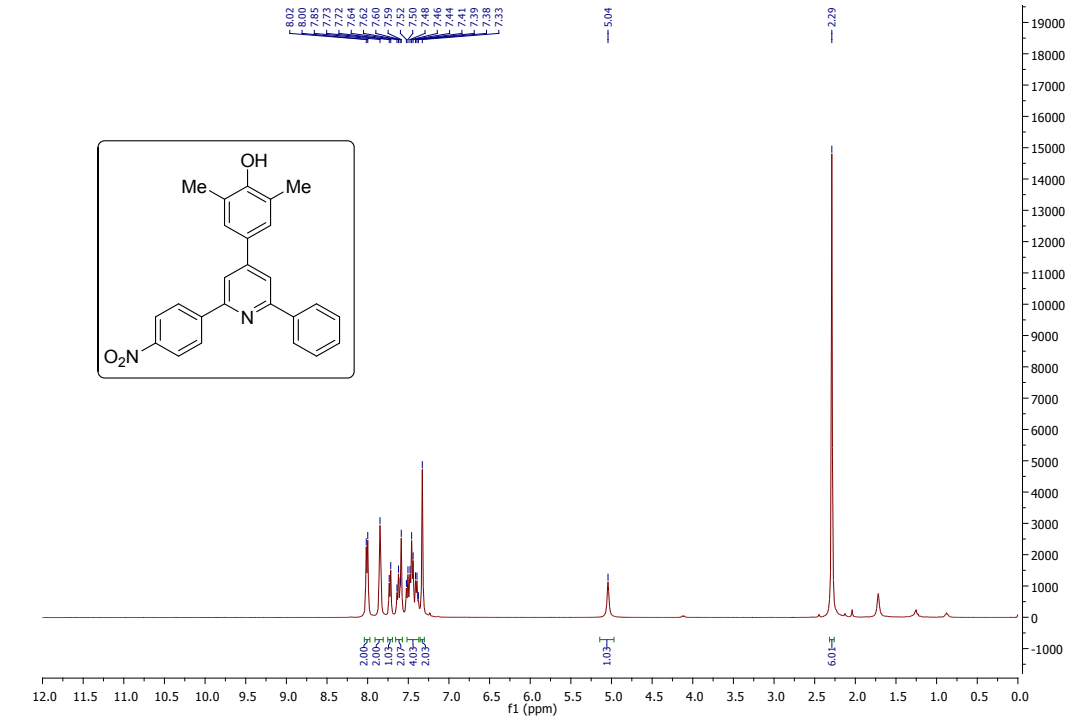
127.05
116.18
21.40
16.15
f1 (ppm)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Me
Me
N
O2N
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7.72
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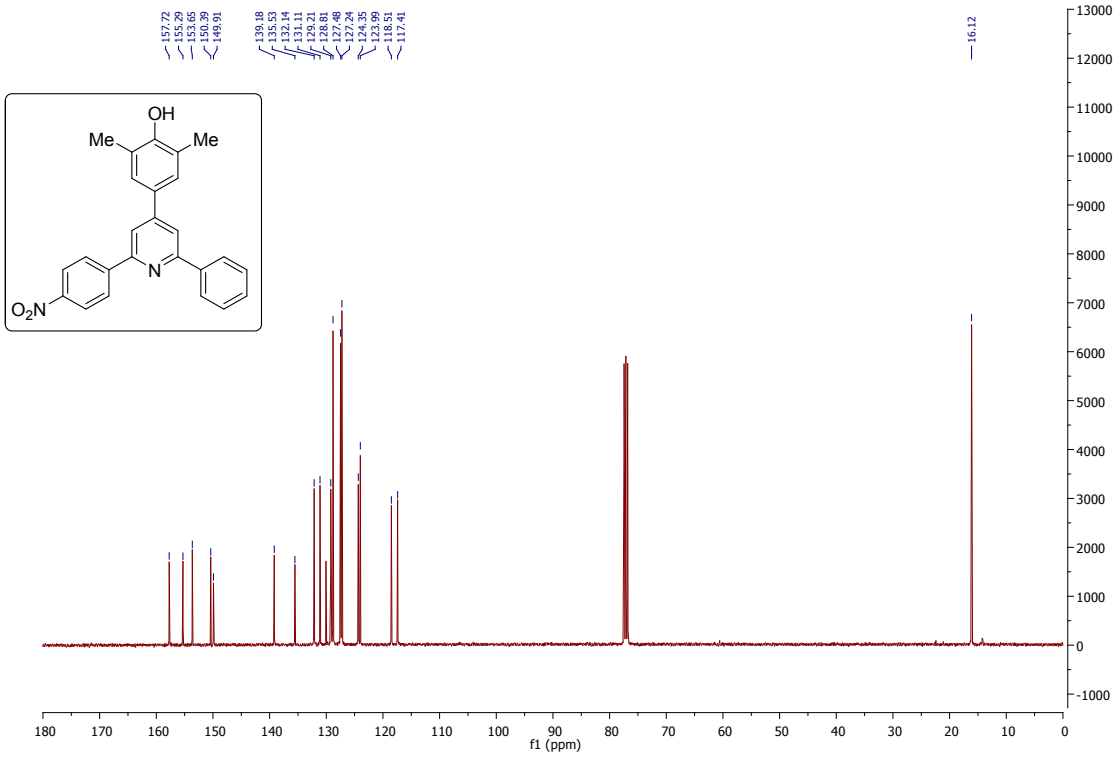
7.60
7.59
7.53
7.50
7.48
7.46
7.44
7.41
7.39
7.38
7.33
5.04
2.29
2.00
2.00
1.03
2.22
4.03
2.03
1.03
6.01
f1 (ppm)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Me
N
O2N
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153.65
150.39
149.91
139.18
135.53
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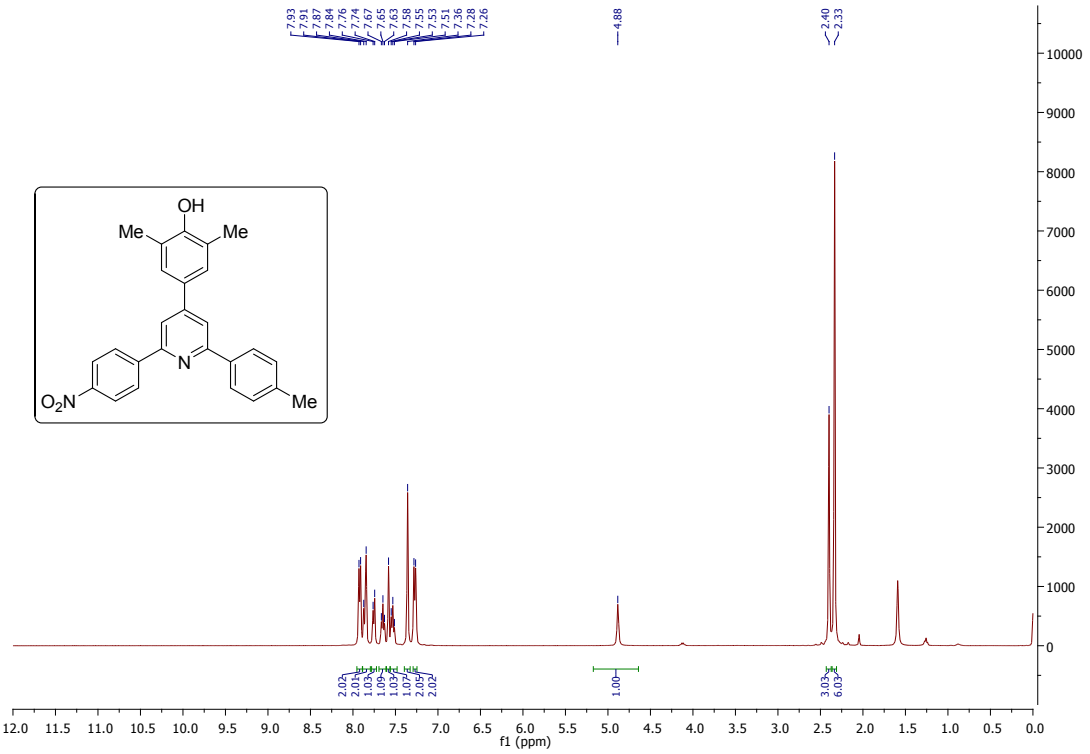
128.81
127.48
127.24
124.35
123.99
116.51
117.41
16.12
f1 (ppm)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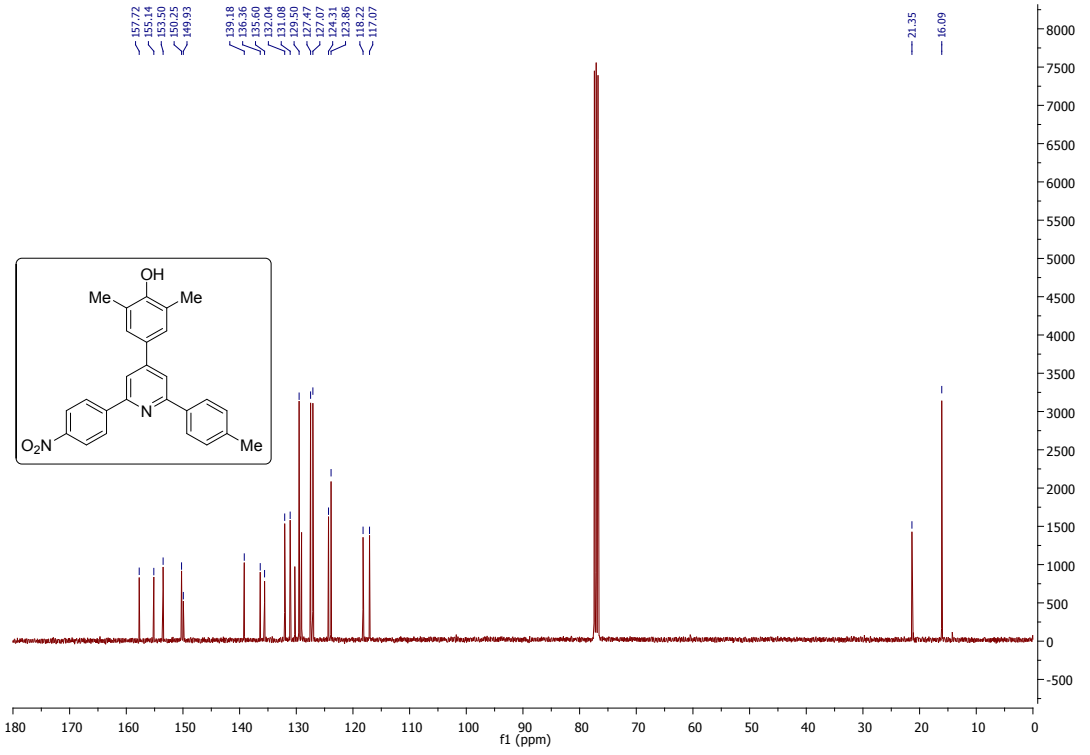
7.58
7.55
7.53
7.51
7.36
7.28
7.26
4.88
2.40
2.33
OH
Me
Me
N
O2N
Me
2.03
2.01
1.03
1.09
1.03
1.07
2.05
2.02
1.00
3.03
6.03
f1 (ppm)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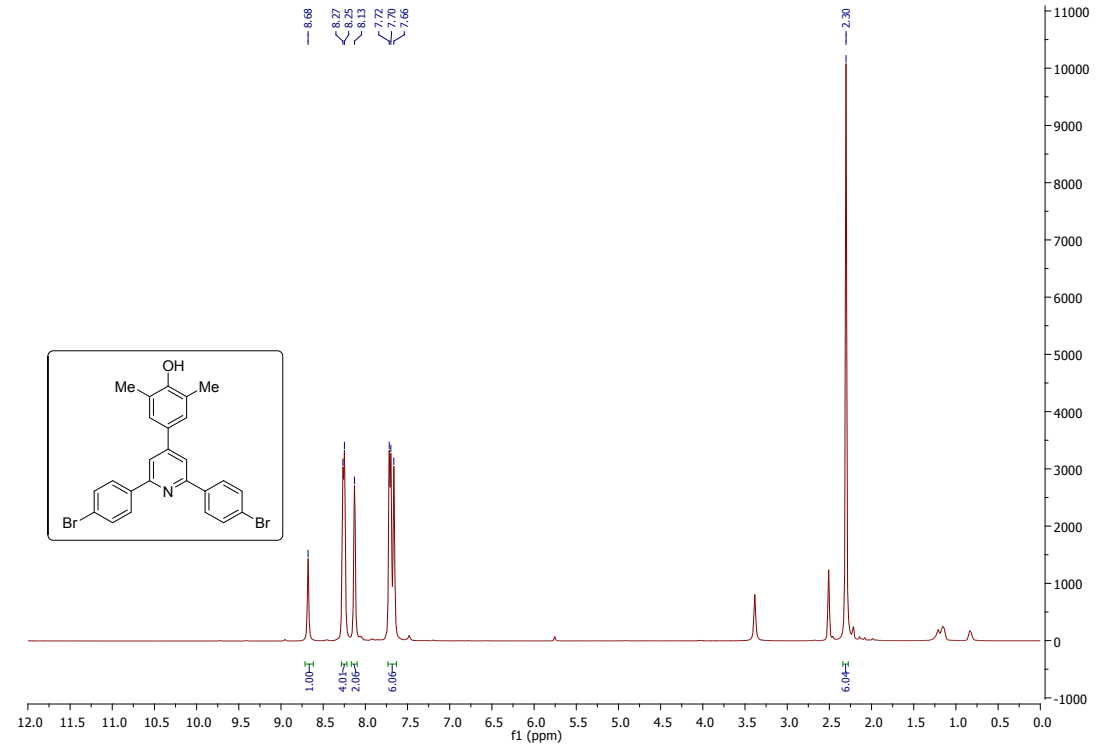
155.14
155.50
150.35
149.93
139.18
136.36
135.60
132.04
131.08
129.50
127.47
127.07
124.31
123.86
118.22
117.07
21.35
16.09
OH
Me
Me
N
O2N
Me
f1 (ppm)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Me
Me
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Br
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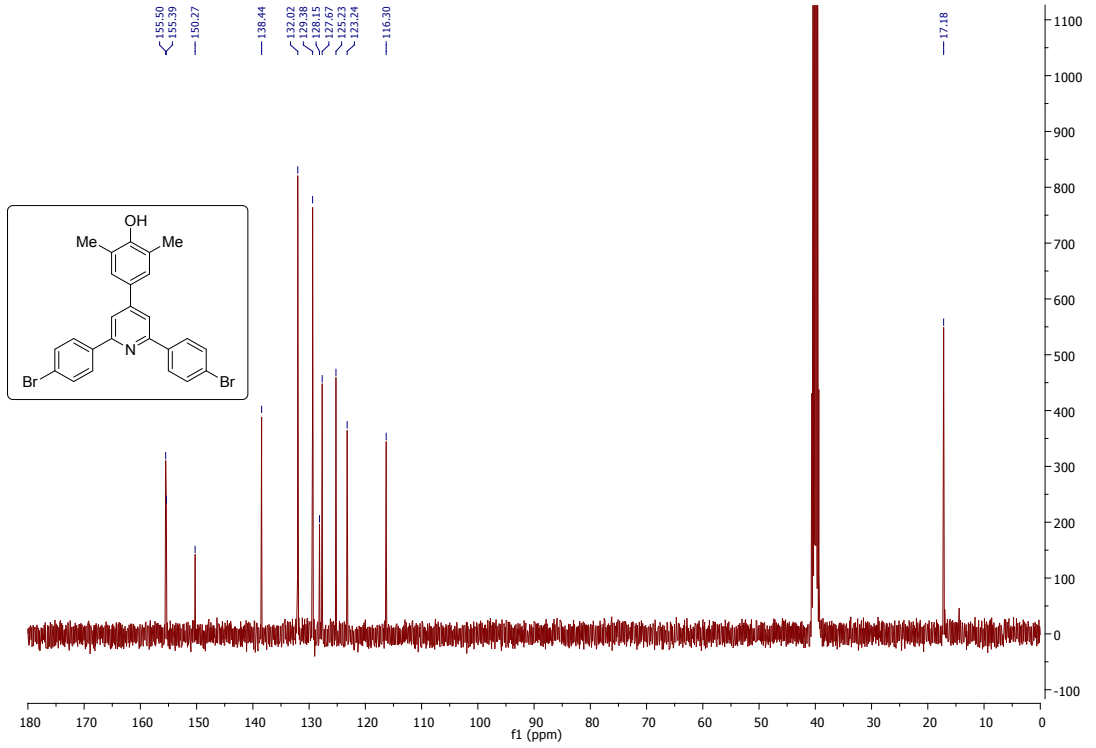
2.06
6.06
6.04
f1 (ppm)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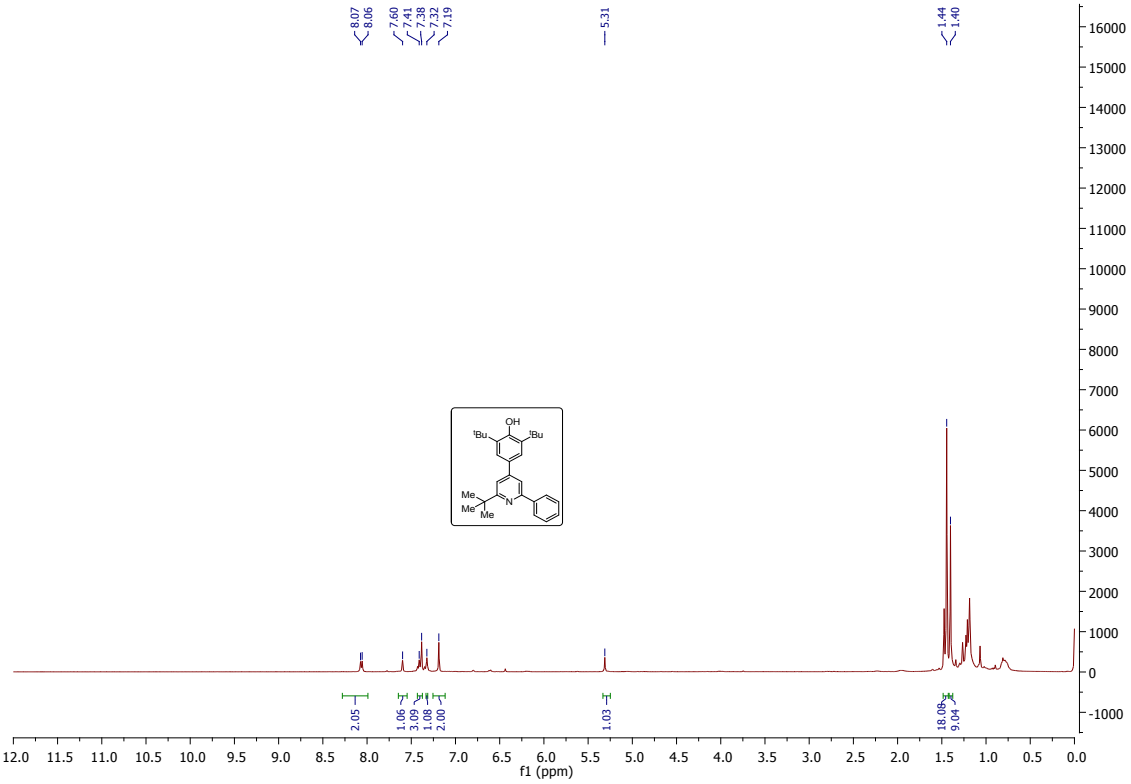
155.39
150.27
138.44
132.02
129.38
129.15
127.67
125.23
123.24
116.30
17.18
OH
Me
Me
N
Br
Br
f1 (ppm)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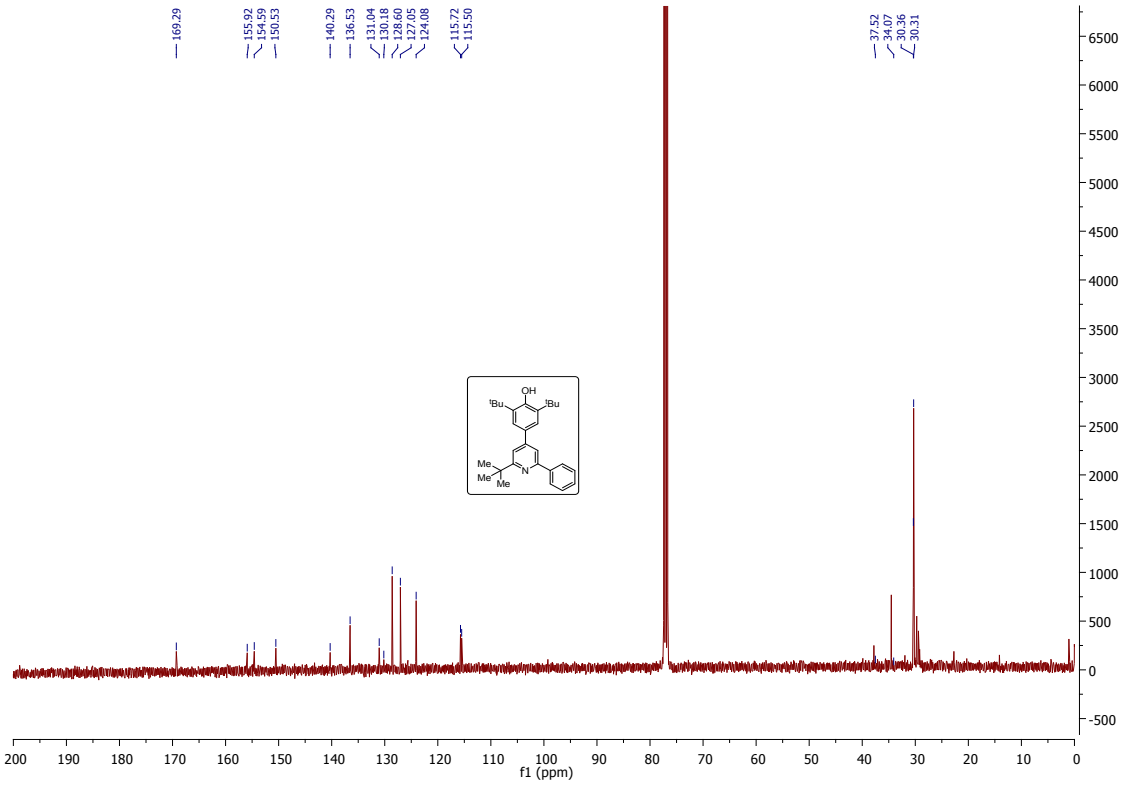
8.06
7.60
7.41
7.38
7.32
7.19
5.31
1.44
1.40
OH
tBu
tBu
Me
Me
Me
N
2.05
1.06
3.09
1.08
2.00
1.03
18.08
9.04
f1 (ppm)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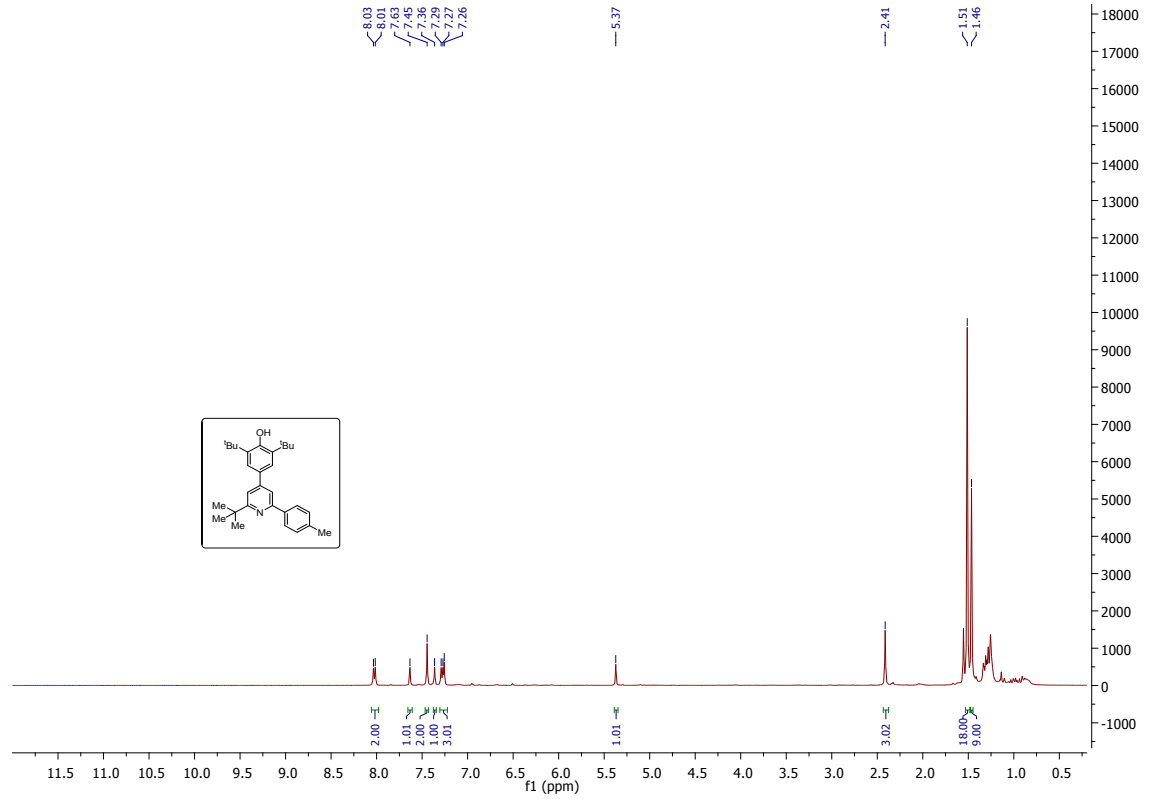
150.53
140.29
136.53
131.04
130.18
128.60
127.05
124.08
115.72
115.50
37.52
34.07
30.36
30.31
OH
tBu
tBu
Me
Me
Me
N
f1 (ppm)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8.01
7.63
7.45
7.36
7.29
7.27
7.26
5.37
2.41
1.51
1.46
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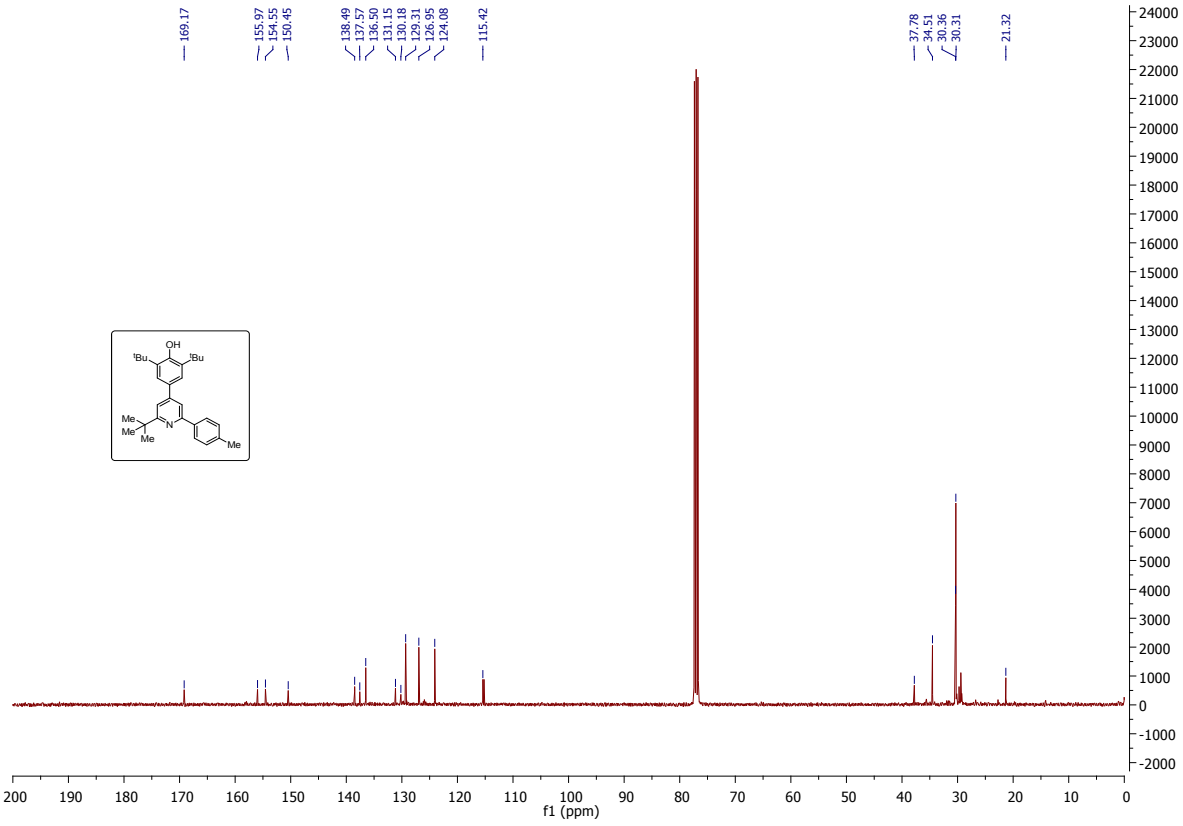
1.01
2.00
1.00
3.01
1.01
3.02
18.00
9.00
f1 (ppm)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126.95
124.08
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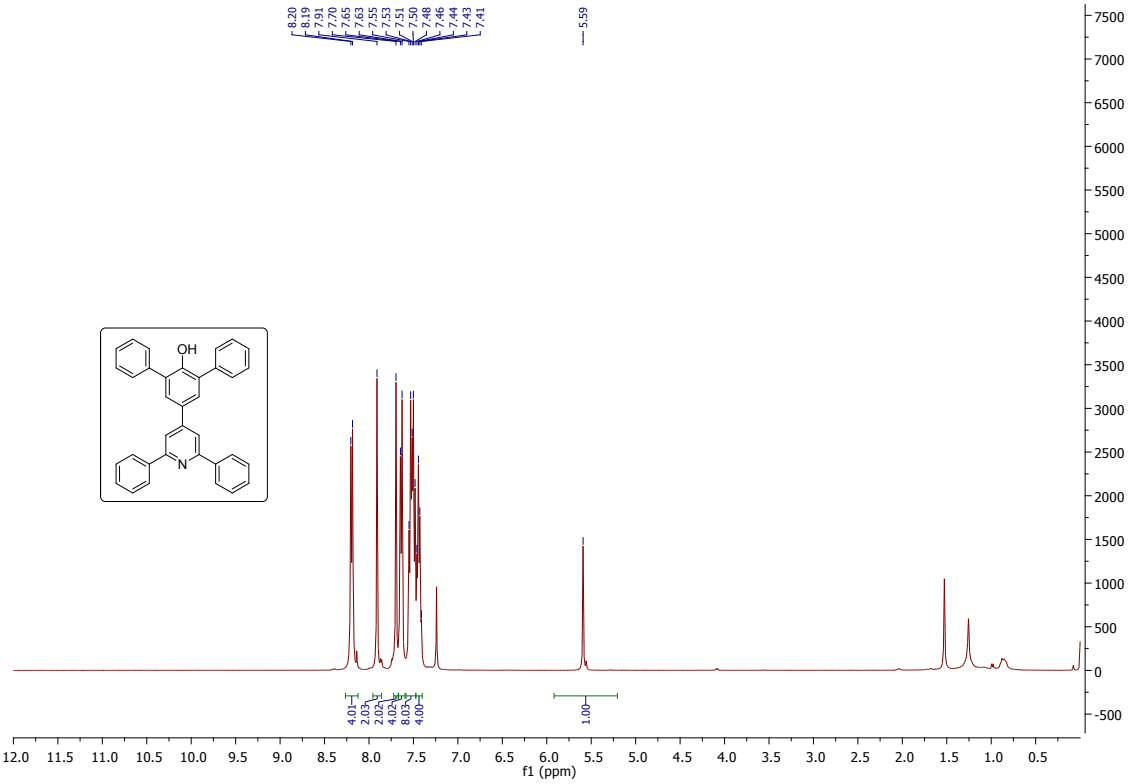
30.36
30.31
21.32
f1 (ppm)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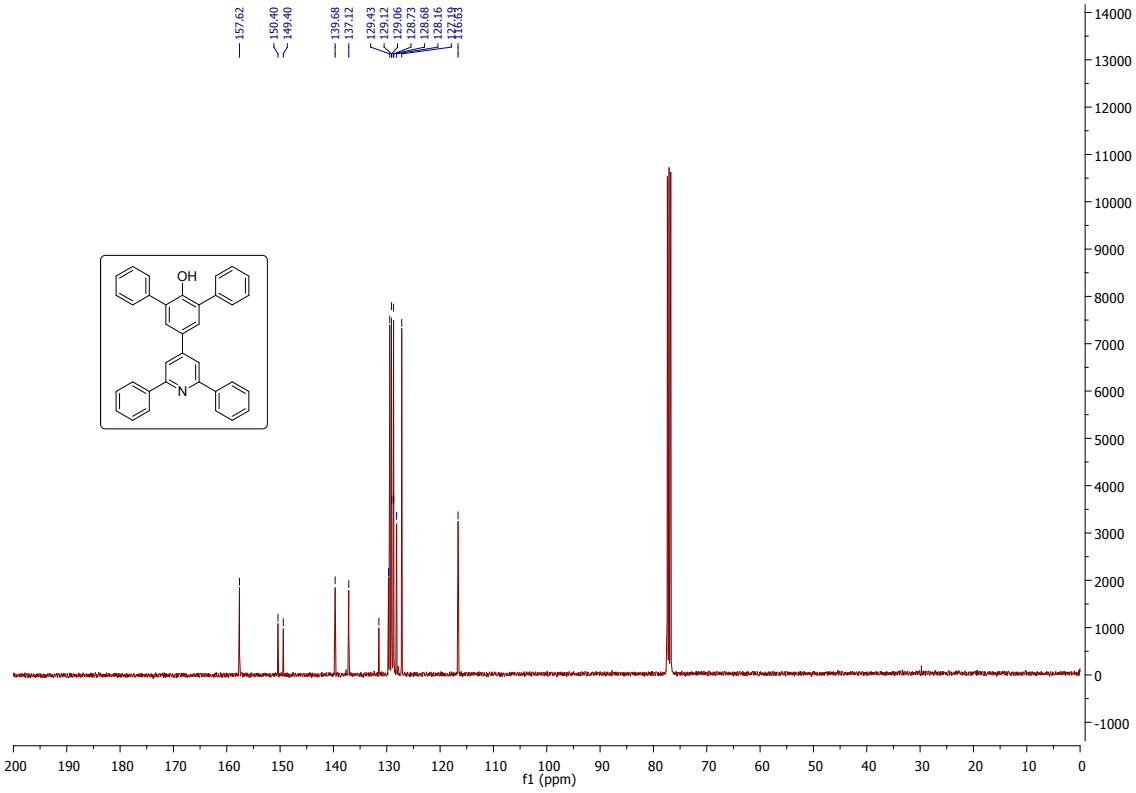
7.63
7.55
7.53
7.51
7.50
7.48
7.46
7.44
7.43
7.41
5.59
OH
N
4.01
2.03
2.02
4.02
8.03
4.00
1.00
f1 (ppm)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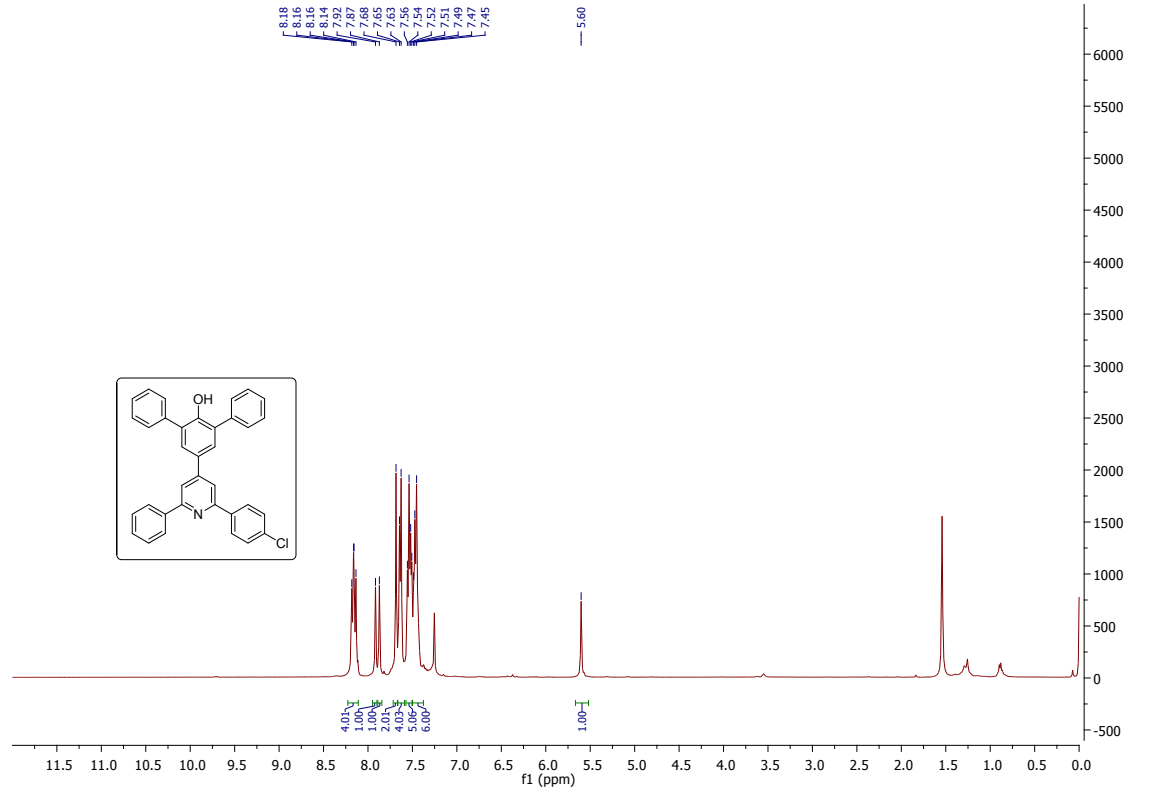
127.19
116.83
OH
N
f1 (ppm)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7.87
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7.65
7.63
7.56
7.54
7.52
7.51
7.49
7.47
7.45
5.60
OH
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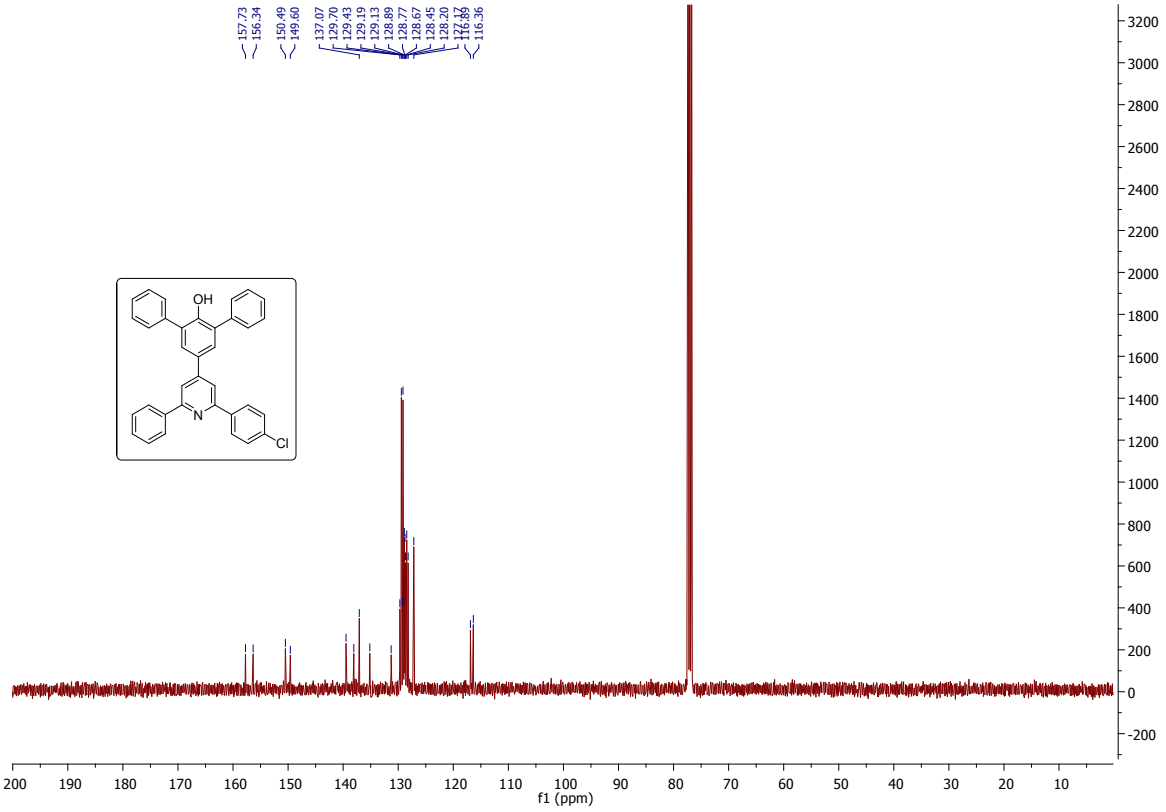
Cl
4.01
1.00
1.00
2.01
4.03
5.06
6.00
1.00
f1 (ppm)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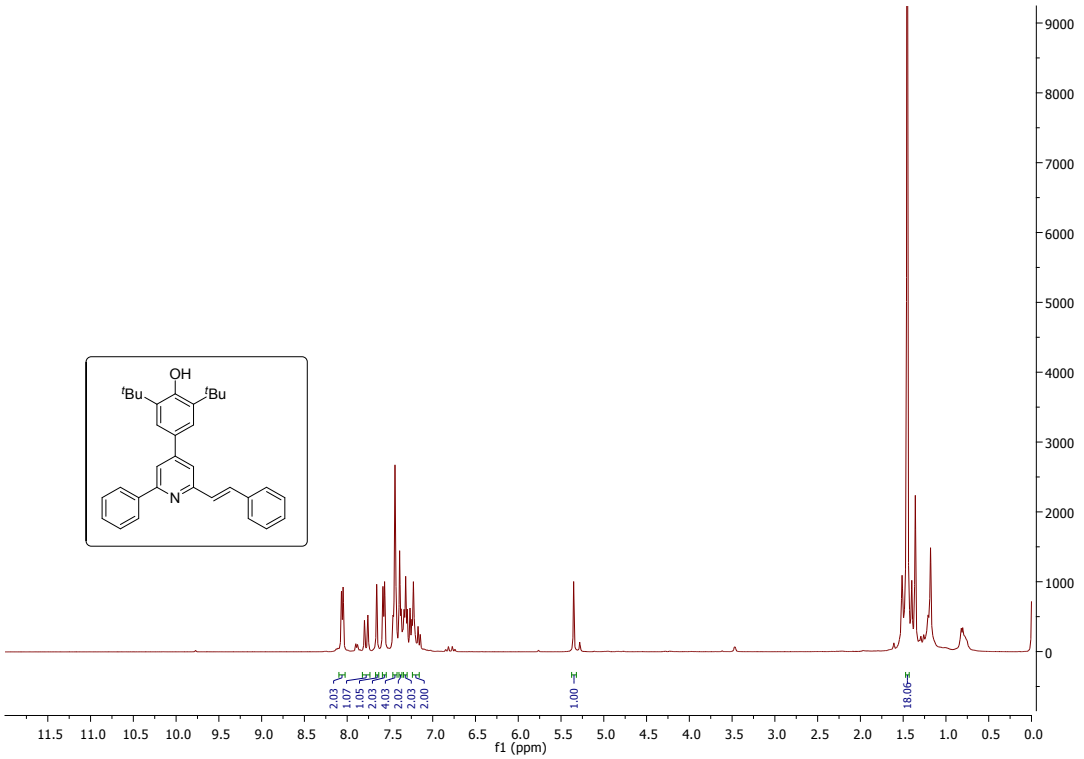
128.45
128.20
116.36
OH
N
Cl
f1 (ppm)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tBu
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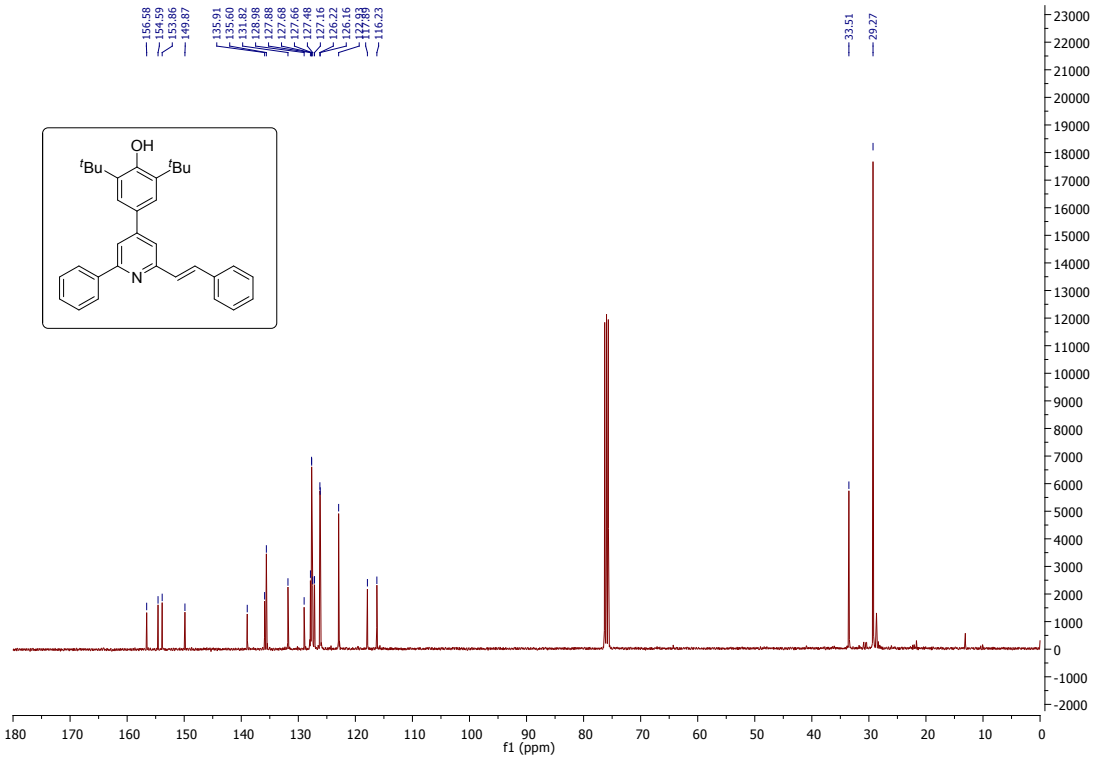
2.03
4.03
2.02
2.03
2.00
1.00
18.06
f1 (ppm)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127.66
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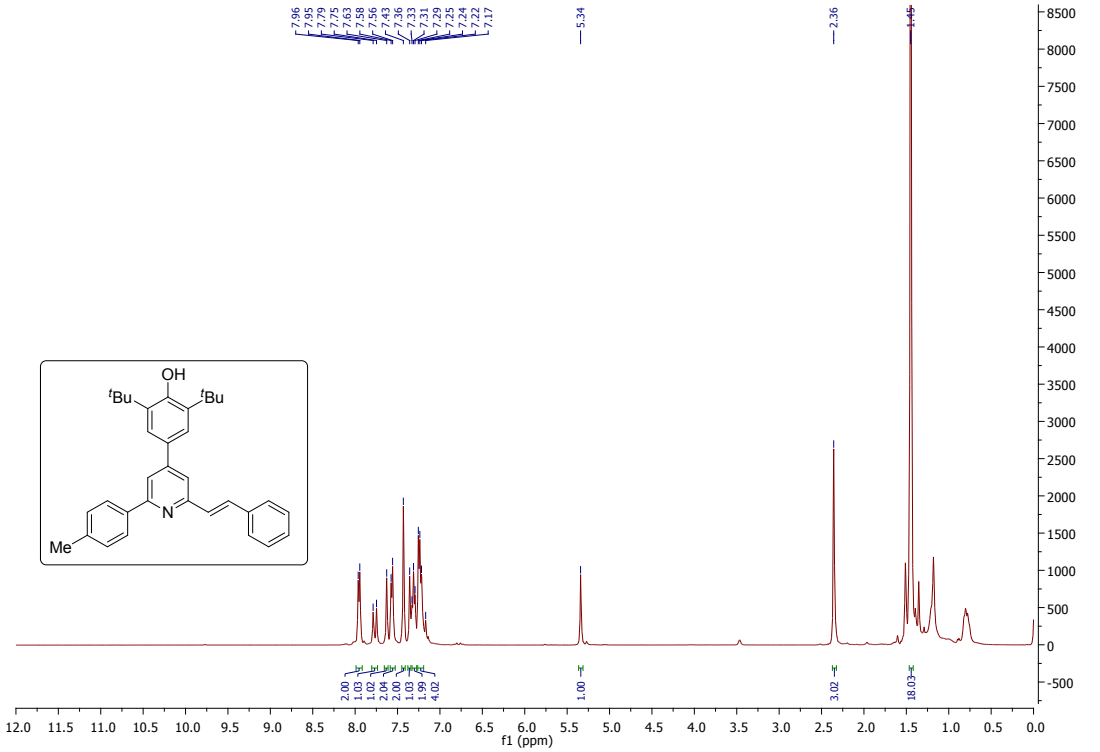
126.22
126.16
117.83
116.23
33.51
29.27
OH
tBu
tBu
N
f1 (ppm)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7.58
7.56
7.43
7.36
7.33
7.31
7.29
7.25
7.24
7.22
7.17
5.34
2.36
1.45
OH
tBu
tBu
N
Me
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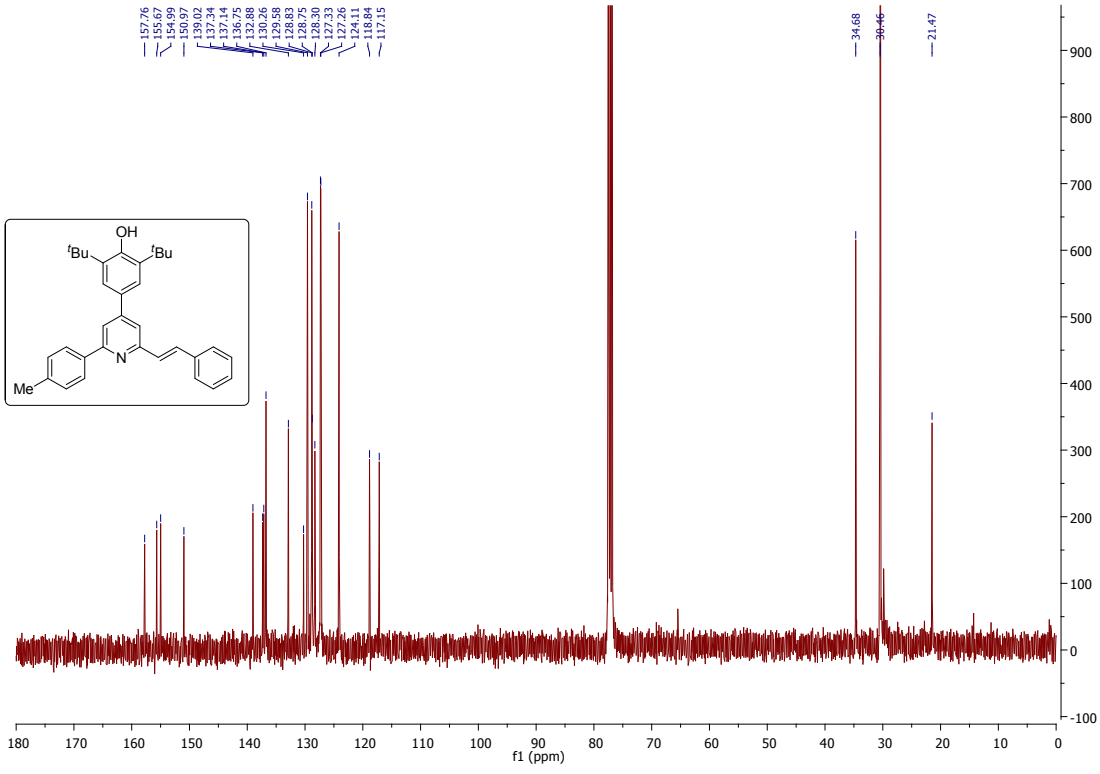
1.03
1.02
2.04
2.00
1.03
1.99
4.02
1.00
3.02
18.03
f1 (ppm)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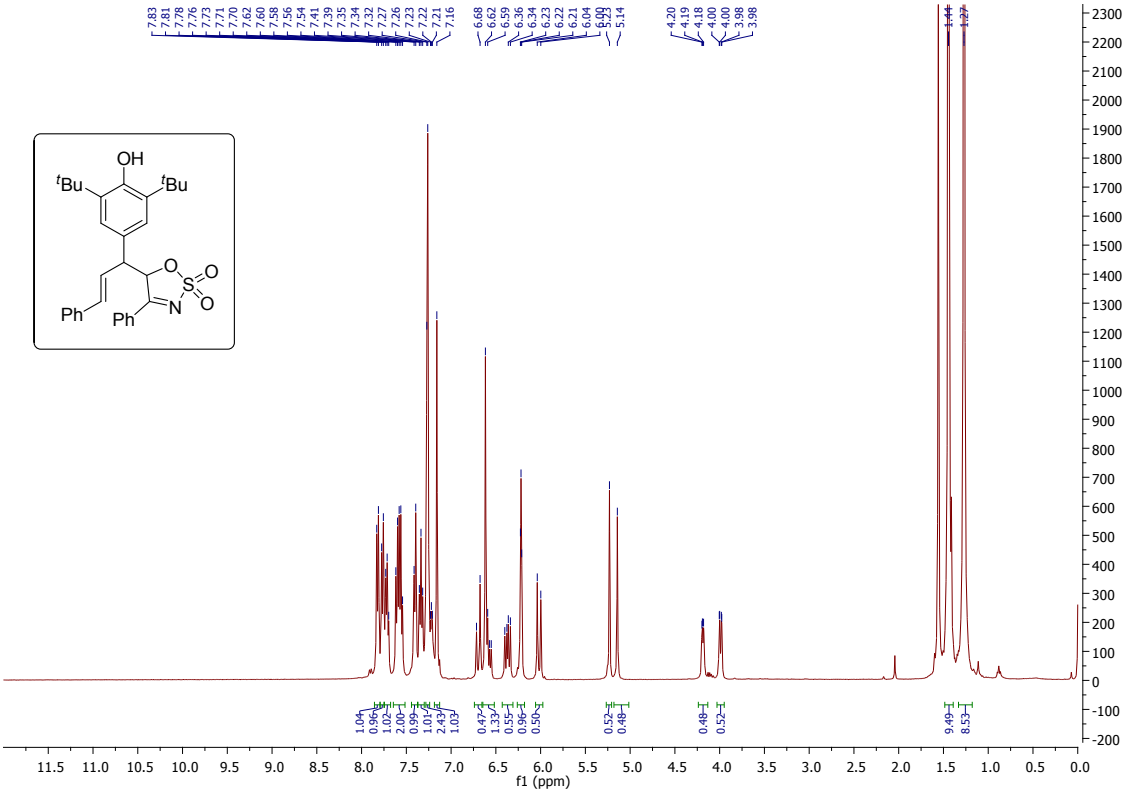
137.14
136.75
132.88
130.26
129.88
129.83
128.75
128.30
127.33
127.26
124.11
118.84
117.15
34.68
30.46
21.47
OH
tBu
tBu
N
Me
f1 (ppm)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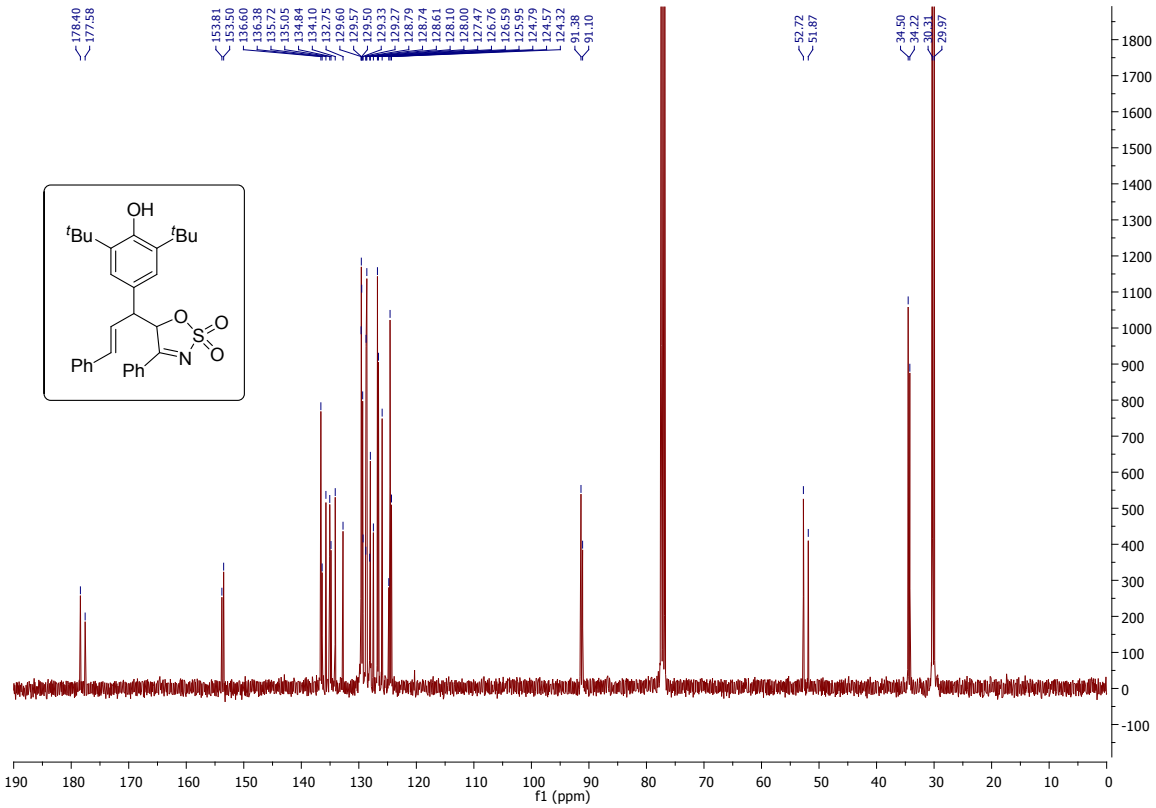
tBu
tBu
O
S
O
O
N
Ph
Ph
f1 (ppm)


OH
tBu
tBu
O
S
O
O
N
Ph
Ph
f1 (ppm)