Supporting Information

$B(C_6F_5)_3$ catalysed 1,6-conjugate allylation of *para*-Quinone Methides: Expedient Access to Allyl Diarylmethanes

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General methods: Most of the reagents and starting materials used were purchased from commercial sources and used as such. All the *p*-Quinone methides were prepared by following a known literature procedure.[1] All the substituted allyltrimethylsilanes were prepared by following a literature method.[2] Melting points were recorded on SMP20 Melting point apparatus and are uncorrected. ^{1}H, ^{13}C and ^{19}F spectra were recorded in $CDCl_3$ (400, 100, 376 MHz respectively) on Brucker FT-NMR spectrometer. Chemical shifts values are reported in parts per million relative to TMS (for ^{1}H and ^{13}C), $BF_3.Et_2O$ (for ^{19}F). High resolution mass spectra were recorded on Waters Q-TOF Premier-HAB213 spectrometer. FT-IR spectra were recorded on a Perkin – Elmer FT-IR spectrometer. Thin layer chromatography was performed on Merck silica gel 60 F_{254} TLC plates using EtOAc/Haxane as an eluent. column chromatography was carried out through silica gel (100-200 mesh) using ethyl acetate/hexane mixture as an eluent.

General procedure for the allylation of *p*-quinone methides: Allyltrimethisilane (0.15 mmol) was added to a solution of *p*-quinone methide (0.1 mmol) and $B(C_6F_5)_3$ (0.01 mmol) in 1.5 ml of CH_2Cl_2 and the resultant mixture was stirred at room temperature until the *p*-quinone methide was completely consumed (by T.L.C.). The reaction mixture was then quenched with tetrabutylammoniumfluoride (0.15 mmol) at rt. The solvent was removed under reduced pressure and the residue was directly loaded on a silica gel column and purified using 0.5-1% ethyl acetate/hexane mixture as an eluent to get the pure allyl diarymethane.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)but-3-en-1-yl)phenol (3): Yellow oil; yield 98% (35.4 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3641, 2958, 2915, 2873 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.18 (d, J = 8.6 Hz, 2H), 7.03 (s, 2H), 6.85 (d, J = 8.7 Hz, 2H), 5.73 (ddt, J = 17.0, 10.2, 6.9 Hz, 1H), 5.07-5.02(m, 1H), 5.05 (s, 1H), 4.97–4.94 (m, 1H), 3.91–3.87 (m, 1H), 3.79 (s, 3H), 2.79–2.75 (m, 2H), 1.42 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.9, 152.0,

137.6, 137.3, 135.7, 135.6, 129.0, 124.3, 116.0, 113.8, 55.3, 50.6, 41.0, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{25}H_{33}O_2$ $[M-H]^+$: 365.2480; found: 365.2471.

2,6-Di-tert-butyl-4-(1-(4-(tert-butyl)phenyl)but-3-en-1-yl)phenol (3a): Yellow oil; yield 88% (34.5 mg); R_f = 0.6 (5% EtOAc in hexane); FT-IR 3646, 2958, 2911, 2873 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.30 (d, *J* = 8.4 Hz, 2H), 7.18 (d, *J* = 8.3 Hz, 2H), 7.04 (s, 2H), 5.72 (ddt, *J* = 17.0, 10.2, 6.9 Hz, 1H), 5.06-5.01(m, 1H), 5.03 (s, 1H), 4.95–4.92 (m, 1H), 3.88 (t, *J* = 7.8 Hz, 1H), 2.80–2.75 (m, 2H), 1.41 (s, 18H), 1.30 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 148.7, 142.2, 137.7, 135.5, 135.4, 127.5, 125.3, 124.5, 115.9, 51.1, 41.0, 34.5, 34.4, 31.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{28}H_{41}O$ $[M+H]^+$: 393.3158; found: 393.3150.

2,6-Di-tert-butyl-4-(1-(4-ethylphenyl)but-3-en-1-yl)phenol (3b): Yellow oil; yield 98% (35.7 mg); R_f = 0.8 (5% EtOAc in hexane); FT-IR 3644, 2961, 2927, 2872 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.20 (d, *J* = 8.1 Hz, 2H), 7.14 (d, *J* = 8.1 Hz, 2H), 7.07 (s, 2H), 5.75 (ddt, *J* =17.0, 10.2, 6.9 Hz, 1H), 5.08-5.04 (m, 1H), 5.05 (s, 1H), 4.98–4.95 (m, 1H), 3.91 (t, *J* = 7.8 Hz, 1H), 2.86–2.76 (m, 2H), 2.64 (q, *J* = 7.6 Hz, 2H), 1.44 (s, 18H), 1.24 (t, *J* = 7.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 142.4, 141.8, 137.7, 135.6, 135.5, 127.92, 127.90, 124.4, 115.9, 51.2, 40.9, 34.5, 30.5, 28.5, 15.7; HRMS (ESI): *m/z* calcd for $C_{26}H_{35}O$ $[M-H]^+$: 363.2687; found: 363.2677.

2,6-Di-tert-butyl-4-(1-(2,3-dimethoxyphenyl)but-3-en-1-yl)phenol (3c): Yellow solid; yield 80% (31.7 mg); R_f = 0.2 (5% EtOAc in hexane); M.P. 88-90 °C; FT-IR 3642, 3077, 2958, 2915, 2877 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.08 (s, 2H), 7.00 (t, *J* = 8.0 Hz, 1H), 6.88 (dd, *J* = 7.9, 1.4 Hz, 1H), 6.75 (dd, *J* = 8.1, 1.4 Hz, 1H), 5.72 (ddt, *J* = 17.0, 10.2, 6.8 Hz 1H), 5.04–4.99 (m, 1H), 5.00 (s, 1H), 4.93–4.90 (m, 1H), 4.43 (t, *J* = 8.0 Hz, 1H), 3.84 (s, 3H), 3.68 (s, 3H), 2.77–2.73 (m, 2H), 1.40 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.8, 152.0, 146.9, 139.1,

137.6, 135.5, 135.3, 124.6, 123.9, 120.1, 115.9, 109.9, 60.7, 55.7, 43.4, 40.2, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{26}H_{35}O_3$ $[M-H]^+$: 395.2585; found: 395.2575.

4-(1-(2-(Allyloxy)phenyl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3d): Yellow oil; yield 85% (33.3 mg); R_f = 0.3 (5% EtOAc in hexane); FT-IR 3646, 2965, 2915, 2877 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.22 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.14–7.10 (m, 1H), 7.08 (s, 2H), 6.91 (td, *J* = 7.4, 0.9 Hz, 1H), 6.82–6.80 (m, 1H), 6.02 (ddt, *J* = 17.2, 12.3, 3.2 Hz, 1H), 5.74 (ddt, 17.0, 10.2, 6.8 Hz, 1H), 5.38 (dq, *J* = 17.3, 1.7 Hz, 1H), 5.24 (dq, *J* = 10.6, 1.5 Hz, 1H), 5.05–4.99 (m, 1H), 4.99 (s, 1H), 4.93–4.90 (m, 1H), 4.56–4.44 (m, 3H), 2.86–2.70 (m, 2H), 1.40 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 156.0, 151.9, 137.9, 135.3, 135.0, 134.0, 133.7, 128.1, 126.8, 124.8, 120.8, 116.9, 115.7, 112.0, 68.9, 43.3, 39.6, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{27}H_{35}O_2$ $[M-H]^+$: 391.2636; found: 391.2623.

2,6-Di-tert-butyl-4-(1-phenylbut-3-en-1-yl)phenol (3e): Yellow semi solid; yield 94% (31.6 mg); R_f = 0.8 (5% EtOAc in hexane); FT-IR 3646, 2954, 2923, 2858 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.31–7.25 (m, 4H), 7.20–7.15 (m, 1H), 7.04 (s, 2H), 5.76 (ddt, *J* = 17.0, 10.2, 6.9 Hz, 1H), 5.06–5.01 (m, 1H), 5.04 (s, 1H), 4.96–4.93 (m, 1H), 3.93 (t, *J* = 7.8 Hz, 1H), 2.85–2.74 (m, 2H), 1.42 ppm (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 145.1, 137.5, 135.6, 135.3, 128.4, 128.1, 126.1, 124.5, 116.0, 51.4, 40.8, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{24}H_{31}O$ $[M-H]^+$: 335.2374; found: 335.2362.

2,6-Di-tert-butyl-4-(1-(2-fluorophenyl)but-3-en-1-yl)phenol (3f): Yellow oil; yield 70% (24.8 mg); R_f = 0.6 (5% EtOAc in hexane); FT-IR 3646, 2958, 2919, 2873 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.26 (td, *J* = 7.5, 1.8 Hz, 1H), 7.18–7.13 (m, 1H), 7.10–7.06 (m, 1H), 7.08 (s, 2H), 7.03–6.98 (m, 1H), 5.74 (ddt, *J* = 17.0, 10.2, 6.8 Hz, 1H), 5.07 (s, 1H), 5.07–5.02 (m, 1H), 4.97–4.94 (m, 2H), 4.31 (t, *J* = 7.9 Hz, 1H), 2.87–2.75 (m, 2H), 1.42 (s, 18H); ^{13}C NMR (100 MHz,

$CDCl_3$) δ = 160.8 (d, J = 244.0 Hz), 152.2, 137.0, 135.7, 134.0, 132.0 (d, J = 15.0 Hz), 129.1 (d, J = 5.0 Hz), 127.5 (d, J = 9.0 Hz), 124.6, 124.1 (d, J = 4.0 Hz), 116.3, 115.5 (d, J = 22.0 Hz), 43.6 (d, J = 2.0 Hz), 39.6, 34.5, 30.5; ^{19}F NMR (376 MHz, $CDCl_3$), δ = -117.7; HRMS (ESI): *m/z* calcd for $C_{24}H_{30}FO$ $[M-H]^+$: 353.2280; found: 353.2272.

4-(1-(2-Bromophenyl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3g): Yellow oil; yield 60% (24.8 mg); R_f = 0.6 (5% EtOAc in hexane); FT-IR 3638, 2958, 2931, 2869 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.53 (d, J = 7.8 Hz, 1H), 7.25–7.24 (m, 2H), 7.09 (s, 2H), 7.04–7.00 (m, 1H), 5.73 (ddt, J = 17.0, 10.2, 6.8 Hz, 1H), 5.07-5.02(m, 1H), 5.05 (s, 1H), 4.96–4.93 (m, 1H), 4.52 (t, J = 7.8 Hz, 1H), 2.79–2.75 (m, 2H), 1.41 ppm (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.2, 144.3, 136.8, 135.6, 133.7, 133.0, 129.0, 127.6, 127.5, 125.3, 124.8, 116.4, 48.9, 40.0, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{24}H_{30}BrO$ $[M-H]^+$: 413.1479; found: 413.1470.

2,6-Di-tert-butyl-4-(1-(4-(trifluoromethyl)phenyl)but-3-en-1-yl)phenol (3h): Colourless oil; yield 65% (26.3 mg); R_f = 0.8 (5% EtOAc in hexane); FT-IR 3646, 2958, 2927, 2858 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.54 (d, J = 8.2 Hz, 2H), 7.35 (d, J = 8.1 Hz, 2H), 7.02 (s, 2H), 5.70 (ddt, J = 17.0, 10.2, 6.9 Hz, 1H), 5.09 (s, 1H), 5.06–5.02 (m, 1H), 4.98–4.95 (m, 1H), 3.99 (t, J = 7.9 Hz, 1H), 2.82–2.78 (m, 2H), 1.42 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.4, 149.3 (d, J = 1,2 Hz), 136.8, 135.9, 134.2, 128.4, 128.3 (q, J = 32.0 Hz), 125.4 (q, J = 3.7 Hz), 124.5 (q, J = 270.0 Hz), 124.4, 116.6, 51.2, 40.4, 34.5, 30.4; ^{19}F NMR (376 MHz, $CDCl_3$), δ = -62.3 ppm; HRMS (ESI): *m/z* calcd for $C_{25}H_{30}F_3O$ $[M-H]^+$: 403.2248; found: 403.2234.

2,6-Di-tert-butyl-4-(1-(4-(trifluoromethoxy)phenyl)but-3-en-1-yl)phenol (3i): Yellow color semi solid; yield 85% (35.7 mg); R_f = 0.8 (5% EtOAc in hexane); FT-IR 3646, 2958, 2927, 2858 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.26–7.23 (m, 2H), 7.14–7.11 (m, 2H), 7.0 (s, 2H), 5.69 (ddt, J = 17.0, 10.2, 6.9 Hz, 1H), 5.1 (s, 1H), 5.06–5.00 (m, 1H), 4.97–4.94 (m, 1H), 3.93 (t, J =

8.0 Hz, 1H), 2.78–2.74 (m, 2H), 1.41 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.3, 147.5 (q, J = 1.5 Hz), 143.9, 137.0, 135.8, 134.7, 129.3, 124.4, 120.9, 120.6 (q, J = 257.8 Hz,), 116.4, 50.7, 40.8, 34.5, 30.5 ppm; ^{19}F NMR (376 MHz, $CDCl_3$) δ = -57.9; HRMS (ESI): *m/z* calcd for $C_{25}H_{30}F_3O_2$ $[M-H]^+$: 419.2197; found: 419.2184.

2-(1-(3,5-Di-tert-butyl-4-hydroxyphenyl)but-3-en-1-yl)phenyl acetate (3j): Yellow oil; yield 86% (33.9 mg); R_f = 0.4 (5% EtOAc in hexane); FT-IR 3642, 2961, 2923, 2873, 1761 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.33–7.30 (m, 1H), 7.24–7.18 (m, 2H), 7.05–7.01 (m, 1H), 6.98 (s, 2H), 5.73 (ddt, J = 17.0, 10.2, 6.8 Hz, 1H), 5.07–5.02 (m, 1H), 5.05 (s, 1H), 4.98–4.95 (m, 1H), 4.11 (t, J = 7.9 Hz, 1H), 2.76 (t, J = 7.1 Hz, 2H), 2.21 (s, 3H), 1.40 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.2, 152.1, 148.7, 137.1, 136.8, 135.6, 134.1, 128.7, 127.0, 126.1, 124.5, 122.8, 116.2, 44.3, 39.6, 34.5, 30.4, 21.1; HRMS (ESI): *m/z* calcd for $C_{26}H_{33}O_3Na$ $[M + Na]^+$: 417.2408; found: 417.2400.

4-(1-(2-Bromo-5-fluorophenyl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3k): Yellow colour solid; yield 63% (27.2 mg); R_f = 0.6 (5% EtOAc in hexane); M.P. 83-85 °C; FT-IR 3646, 2958, 2927, 2858 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.48 (dd, J = 8.8, 5.5 Hz, 1H), 7.07 (s, 2H), 6.94 (dd, J = 10.0, 3.0 Hz, 1H), 6.78–6.74 (m, 1H), 5.71 (ddt, J = 16.9, 10.2, 6.8 Hz, 1H), 5.08 (s, 1H), 5.07–5.03 (m, 1H), 4.98–4.95 (m, 1H), 4.48 (t, J = 7.7 Hz, 1H), 2.76–2.72 (m, 2H), 1.41 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3 (d, J = 245.0 Hz), 152.5, 146.7 (d, J = 6.0 Hz), 136.3, 135.8, 134.0 (d, J = 8.0 Hz), 132.9, 124.7, 119.1 (d, J = 3.0 Hz), 116.8, 116.0 (d, J = 23.0 Hz), 114.8 (d, J = 23.0 Hz), 49.1 (d, J = 1.0 Hz), 39.8, 34.5, 30.5; ^{19}F NMR (376 MHz, $CDCl_3$) δ = -114.4; HRMS (ESI): *m/z* calcd for $C_{24}H_{29}BrFO$ $[M-H]^+$: 431.1385; found: 431.1372.

4-(1-(6-Bromobenzo[d][1,3]dioxol-5-yl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3l): Yellow oil; yield 70% (32.2 mg); R_f = 0.4 (5% EtOAc in hexane); FT-IR 3641, 2957, 2914, 2872 cm^{-1};

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.09 (s, 2H), 6.99 (s, 1H), 6.69 (s, 1H), 5.92 (dd, *J* = 10.6, 1.2 Hz, 2H), 5.73 (ddt, *J* = 16.9, 10.2, 6.8 Hz, 1H), 5.10 (s, 1H), 5.08–5.03 (m, 1H), 4.98–4.95 (m, 1H), 4.48 (t, *J* = 7.9 Hz, 1H), 2.78–2.66 (m, 2H), 1.42 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.3, 147.6, 146.4, 137.9, 136.7, 135.7, 133.8, 124.5, 116.4, 114.9, 112.6, 108.5, 101.7, 48.6, 39.8, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{25}H_{30}BrO_3$ $[M-H]^+$: 457.1378; found: 457.1369.

2,6-Di-tert-butyl-4-(1-(4-(phenylethynyl)phenyl)but-3-en-1-yl)phenol (3m): Yellow oil; yield 80% (35 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3634, 2958, 2923, 2873 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.53–7.51 (m, 2H), 7.46 (d, *J* = 8.2 Hz, 2H), 7.37–7.31 (m, 3H), 7.23 (d, *J* = 8.2 Hz, 2H), 7.02 (s, 2H), 5.72 (ddt, *J* = 17.0, 10.2, 6.9 Hz, 1H), 5.06 (s, 1H), 5.06–5.01 (m, 1H), 4.97–4.94 (m, 1H), 3.94 (t, *J* = 7.8 Hz, 1H), 2.78 (t, *J* = 7.2 Hz, 2H), 1.41 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.2, 145.6, 137.2, 135.7, 134.8, 131.8, 131.7, 128.5, 128.3, 128.2, 124.4, 123.6, 120.9, 116.3, 89.7, 89.0, 51.2, 40.6, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{32}H_{37}O$ $[M+H]^+$: 437.2845; found: 437.2829.

2,6-Di-tert-butyl-4-(1-(pyren-1-yl)but-3-en-1-yl)phenol (3n): Yellow soild; yield 72% (33.1 mg); R_f = 0.5 (5% EtOAc in hexane); M.P. 129-131°C; FT-IR 3634, 2958, 2916, 2872 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.50 (d, *J* = 9.4 Hz, 1H), 8.17 (d, *J* = 8.0 Hz, 1H), 8.16 (d, *J* = 7.6 Hz, 1H), 8.11 (d, *J* = 9.4 Hz, 1H), 8.03 (s, 2H), 8.00–7.97 (m, 2H), 7.18 (s, 2H), 5.81 (ddt, *J* = 16.9, 10.2, 6.8 Hz, 1H), 5.16–5.08 (m, 2H), 5.04 (s, 1H), 4.96–4.92 (m, 1H), 3.14–3.03 (m, 2H), 1.38 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 139.2, 137.4, 135.7, 135.2, 131.6, 130.9, 129.7, 128.9, 127.7, 127.4, 126.9, 125.9, 125.4, 125.3, 125.2, 125.1, 125.0, 124.8, 124.7, 123.4, 116.3, 46.0, 41.2, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{34}H_{35}O$ $[M-H]^+$: 459.2687; found: 459.2681.

4-(1-(3,5-Di-tert-butyl-4-hydroxyphenyl)but-3-en-1-yl)-2-methoxyphenyl acetate (3o): Yellow soild; yield 93% (39.4 mg); R_f = 0.2 (5% EtOAc in hexane); FT-IR 3638, 2958, 2915, 2873, 1765 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.03 (s, 2H), 6.94 (d, J = 7.9 Hz, 1H), 6.83 (s, 1H) 6.83–6.81 (m, 1H), 5.73 (ddt, J = 16.9, 10.2, 6.8 Hz, 1H), 5.06 (s, 1H), 5.06–5.02 (m, 1H), 4.97–4.94 (m, 1H), 3.89 (t, J = 7.8 Hz, 1H), 3.79 (s, 3H), 2.78–2.74 (m, 2H), 2.30 (s, 3H), 1.41 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 169.3, 152.2, 150.8, 144.1, 137.9, 137.3, 135.7, 134.7, 124.4, 122.5, 120.1, 116.2, 112.4, 55.9, 51.4, 41.0, 34.5, 30.5, 20.9; HRMS (ESI): *m/z* calcd for $C_{27}H_{37}O_4$ $[M+H]^+$: 425.2693; found: 425.2680.

Cyclopentyl(2-[1-{3,5-di-tert-butyl-4-hydroxyphenyl}but-3-en-1-yl]cyclopentyl)iron (3p): Yellow oil; yield 76% (33.7 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3642, 3084, 2958, 2915 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 6.99 (s, 2H), 5.72 (ddt, J = 17.1, 9.8, 7.1 Hz, 1H), 5.03 (s, 1H), 5.02–4.97 (m, 1H), 4.94–4.91 (m, 1H), 4.11-4.03 (m, 3H), 4.0 (s, 5H), 3.92 (bs, 1H), 3.55 (dd, J = 9.3, 5.8 Hz, 1H), 2.75–2.69 (m, 1H), 2.63–2.55 (m,1H), 1.43 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.0, 137.9, 135.4, 135.3, 124.6, 115.6, 94.9, 68.6, 67.54, 67.48, 67.4, 66.9, 46.0, 42.2, 34.5, 30.6; HRMS (ESI): *m/z* calcd for $C_{28}H_{37}FeO$ $[M+H]^+$: 445.2195; found: 445.2180.

4-(1-([1,1'-Biphenyl]-4-yl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3q): Yellow semi soild; yield 85% (35 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3642, 2956, 2924, 2855 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.60–7.58 (m, 4H), 7.53 (d, J = 8.2 Hz, 1H), 7.43 (t, J = 7.4 Hz, 2H), 7.34–7.31 (m, 3H), 7.08 (s, 2H), 5.77 (ddt, J = 17.0, 10.2, 6.9 Hz, 1H), 5.10–5.05 (m, 1H), 5.06 (s, 1H), 4.99–4.96 (m, 1H), 3.97 (t, J = 7.8 Hz, 1H), 2.89–2.77 (m, 2H), 1.43 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.2, 144.3, 141.2, 138.9, 137.5, 135.7, 135.2, 128.8, 128.5,

127.2, 127.12, 127.10, 124.5, 116.2, 51.2, 40.8, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{30}H_{35}O$ $[M-H]^+$: 411.2687; found: 411.2676.

4-(1-(Anthracen-9-yl)but-3-en-1-yl)-2,6-di-tert-butylphenol (3r): Yellow semi soild; yield 62% (27 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3627, 2958, 2931, 2865 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.74–7.72 (m, 1H), 7.43–7.41 (m, 1H), 7.31–7.19 (m, 8H), 7.17–7.13 (m, 1H), 6.99 (td, *J* = 7.6, 1.3 Hz, 1H), 6.94 (s, 1H), 5.78 (ddt, *J* = 17.2, 10.0, 7.0 Hz, 1H), 5.21 (s, 1H), 4.96–4.94 (m, 1H), 4.91–4.87 (m, 1H), 3.92 (t, *J* = 7.4 Hz, 1H), 2.50 (t, *J* = 7.2 Hz, 2H), 1.34 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 153.2, 141.1, 139.5, 139.4, 136.5, 135.5, 135.0, 133.8, 128.8, 128.4, 128.3, 127.4, 127.2, 126.8, 126.63, 126.59, 126.5, 125.2, 123.7, 116.8, 48.6, 43.6, 34.4, 30.3; HRMS (ESI): *m/z* calcd for $C_{32}H_{37}O$ $[M+H]^+$: 437.2845; found: 437.2831.

2,6-Di-tert-butyl-4-(1-(naphthalen-2-yl)but-3-en-1-yl)phenol (3s): Yellow oil; yield 89% (34.3 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3640, 2957, 2925, 2872 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 8.21 (d, *J* = 8.5 Hz, 1H); 7.86–7.84 (m, 1H), 7.72 (d, *J* = 7.8 Hz, 1H), 7.52–7.41 (m, 4H), 7.10 (s, 2H), 5.80 (ddt, *J* = 17.0, 10.2, 6.8 Hz, 1H), 5.11–5.05 (m, 1H), 5.03 (s, 1H), 4.96–4.93 (m, 1H), 4.79 (t, *J* = 7.7 Hz, 1H), 2.99–2.84 (m, 2H), 1.39 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 140.9, 137.6, 135.6, 134.7, 134.2, 132.1, 129.0, 126.8, 125.9, 125.6, 125.3, 124.8, 124.7, 123.9, 116.1, 46.0, 41.0, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{28}H_{33}O$ $[M-H]^+$: 385.2531; found: 385.2515.

2,6-Di-tert-butyl-4-(1-(4-nitrophenyl)but-3-en-1-yl)phenol (3u): Yellow oil; yield 97% (37 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3642, 2954, 2927, 2854 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 8.15 (d, *J* = 8.7 Hz, 2H), 7.39 (d, *J* = 8.8 Hz, 2H), 6.99 (s, 2H), 5.68 (ddt, *J* = 17.0, 10.2, 6.8 Hz, 1H), 5.11 (s, 1H), 5.05–5.01 (m, 1H), 4.99–4.96 (m, 1H), 4.04 (t, *J* = 8.2 Hz, 1H), 2.87–2.74 (m, 2H), 1.41 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 153.0, 152.6, 146.4, 136.3,

136.1, 133.5, 129.0, 124.3, 123.8, 117.0, 51.2, 40.3, 34.5, 30.4; HRMS (ESI): *m/z* calcd for $C_{24}H_{30}NO_3$ $[M-H]^+$: 380.2225; found: 380.2218.

Methyl 4-(1-(3,5-di-tert-butyl-4-hydroxyphenyl)but-3-en-1-yl)benzoate (3v): Yellow oil; yield 89% (35.1 mg); R_f = 0.4 (5% EtOAc in hexane); FT-IR 3642, 2954, 2923, 2873, 1723 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.96 (d, *J* = 8.3 Hz, 2H), 7.31 (d, *J* = 8.2 Hz, 2H), 7.01 (s, 2H), 5.69 (ddt, *J* = 17.0, 10.2, 6.9 Hz, 1H), 5.07 (s, 1H), 5.05–5.00 (m, 1H), 4.96–4.93 (m, 1H), 3.98 (t, *J* = 7.8 Hz, 1H), 3.89 (s, 3H), 2.79 (t, *J* = 7.0 Hz, 2H), 1.40 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 167.3, 152.3, 150.6, 136.9, 135.8, 134.4, 129.8, 128.2, 128.0, 124.4, 116.5, 52.1,51.3, 40,4, 34.5, 30.4; HRMS (ESI): *m/z* calcd for $C_{26}H_{35}O_3$ $[M+H]^+$: 395.2587; found: 395.2575.

2,6-Diisopropyl-4-(1-phenylbut-3-en-1-yl)phenol (3w): Yellow oil; yield 65% (20 mg); R_f = 0.4 (10% EtOAc in hexane); FT-IR 3584, 2961, 2931, 2869 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.29–7.22 (m, 4H), 7.18–7.14 (m,1H), 6.91 (s, 2H), 5.72 (ddt, *J* = 17.0, 10.2, 6.9 Hz, 1H), 5.05–5.00 (m, 1H), 4.95-4.92 (m, 1H), 4.64 (s, 1H), 3.93 (t, *J* = 7.9 Hz, 1H), 3.11 (sept, *J* = 6.8 Hz, 2H), 2.80–2.76 (m, 2H), 1.24 (d, *J* = 2.9 Hz, 6H), 1.22 (d, *J* = 2.8 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 148.4, 145.3, 137.4, 136.4, 133.5, 128.4, 128.0, 126.1, 123.0, 116.1, 51.2, 40.7, 27.5, 22.9; HRMS (ESI): *m/z* calcd for $C_{22}H_{29}O$ $[M+H]^+$: 309.2219; found: 309.2207.

2,6-Dimethyl-4-(1-phenylbut-3-en-1-yl)phenol (3x): Yellow oil; yield 50% (12.6 mg); R_f = 0.2 (5% EtOAc in hexane); FT-IR 3569, 3027, 2923, 2854 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.29–7.21 (m, 5H), 7.18–7.14 (m, 1H), 6.84 (s, 2H), 5.71 (ddt, *J* = 17.0, 10.2, 6.8 Hz, 1H), 5.02 (dq, *J* = 17.1, 1.9 Hz, 1H), 4.95–4.92 (m, 1H), 4.47 (s, 1H), 3.89–3.85 (m , 1H), 2.78–2.74 (m, 2H), 2.2 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 150.6, 145.2, 137.3, 136.3, 128.5, 128.1,

127.9, 126.1, 122.9, 116.2, 50.7, 40.3, 16.2; HRMS (ESI): *m/z* calcd for $C_{18}H_{19}ONa$ $[M+Na]^+$: 275.1414; found: 275.1405.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)-3-(4-(2-phenylpropan-2-yl)phenyl)but-3-en-1-yl)phenol (4a): Yellow oil; yield 72% (40.3 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3642, 2961, 2915, 2881 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.32–7.17 (m, 9H), 7.12 (d, *J* = 8.5 Hz, 2H), 6.94 (s, 2H), 6.81 (d, *J* = 8.6 Hz, 2H), 5.13 (s, 1H), 5.02 (s, 1H), 4.80 (s, 1H), 3.98 (t, *J* = 7.8 Hz, 1H), 3.78 (s, 3H), 3.18 (d, *J* = 7.8 Hz, 2H), 1.71 (s, 6H), 1.40 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.8, 151.9, 150.7, 149.8, 146.5, 138.6, 137.3, 135.6, 135.4, 129.1, 128.1, 126.9, 126.8, 126.1, 125.8, 124.6, 114.2, 113.6, 55.3, 48.7, 42.9, 42.5, 34.5, 30.9, 30.5; HRMS (ESI): *m/z* calcd for $C_{40}H_{47}O_2$ $[M-H]^+$: 559.3575; found: 559.3553.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)-3-(2-(phenylethynyl)phenyl)but-3-en-1-yl)phenol (4b): Yellow oil; yield 85% (46.1 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3641, 2957, 2914, 2880 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.55–7.52 (m, 1H), 7.40–7.37 (m, 2H), 7.33–7.31 (m, 3H), 7.25–7.18 (m, 2H), 7.13 (d, *J* = 8.6 Hz, 2H), 6.95 (s, 2H), 6.91–6.89 (m, 1H), 6.76 (d, *J* = 8.6 Hz, 2H), 5.16 (s, 1H), 5.07 (s, 1H), 4.99 (s, 1H), 3.86 (t, *J* = 7.8 Hz, 1H), 3.73 (s, 3H), 3.50–3.37 (m, 2H), 1.36 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.7, 151.9, 148.0, 144.9, 137.2, 135.39, 135.36, 132.6, 131.6, 129.2, 129.1, 128.4, 128.2, 128.1, 126.8, 124.6, 123.7, 121.1, 117.4, 113.6, 92.8, 89.3, 55.2, 49.2, 43.7, 34.4, 30.4; HRMS (ESI): *m/z* calcd for $C_{39}H_{41}O_2$ $[M-H]^+$: 541.3106; found: 541.3120.

4-(3-([1,1'-Biphenyl]-4-yl)-1-(4-methoxyphenyl)but-3-en-1-yl)-2,6-di-tert-butylphenol (4c): Yellow oil; yield 77% (39.9 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3638, 2961, 2923, 2877 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.63–7.61 (m, 2H), 7.55 (d, *J* = 8.4 Hz, 2H), 7.47–7.44 (m, 2H), 7.39–7.33 (m, 3H), 7.11 (d, *J* = 8.6 Hz, 2H), 6.96 (s, 2H), 6.83–6.79 (m, 2H), 5.18 (d, *J*

= 1.2 Hz, 1H), 5.02 (s, 1H), 4.86 (s, 1H), 3.96 (t, J = 8.0 Hz, 1H), 3.78 (s, 3H), 3.27–3.16 (m, 2H), 1.39 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.8, 152.0, 146.5, 140.9, 140.4, 140.1, 137.3, 135.6, 135.5, 129.1, 128.9, 127.4, 127.1, 127.04, 127.02, 124.5, 114.9, 113.7, 55.3, 48.8, 42.6, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{37}H_{41}O_2$ $[M-H]^+$: 517.3106; found: 517.3085.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)-2-phenylbut-3-en-1-yl)phenol (4d): Yellow oil; yield 79% (34.9 mg); R_f = 0.6 (5% EtOAc in hexane); FT-IR 3642, 2961, 2919, 2873 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.27 (d, J = 9.2 Hz, 2H major), 7.18–6.98 (m, 9H major & minor), 6.86 (d, J = 8.7 Hz, 2H major), 6.74 (s, 2H major), 6.63 (d, J = 8.8 Hz, 1H minor), 6.02–5.88 (m, 1.5H major & minor), 5.01 (s, 0.5H minor), 4.97–4.89 (m, 2.5H major & minor), 4.86–4.81 (m, 0.5H minor), 4.85 (s, 1H major), 4.15–3.93 (m, 3H major & minor), 3.79 (s, 3H major), 3.68 (s, 1.5H minor), 1.42 (s, 9H minor), 1.27 (s, 18H major); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.9 (major), 157.4 (minor), 152.0 (minor), 151.6 (major), 143.7 (major), 143.5 (minor), 141.5 (minor), 141.0 (major), 136.5 (minor), 135.9 (major), 135.4 (minor), 135.0 (major), 133.9 (major), 132.4 (minor), 129.8 (major), 129.2 (minor), 128.6 (minor) 128.5 (major), 128.2 (minor), 128.1 (major), 126.0 (minor), 125.9 (major), 125.3 (minor), 125.1 (major), 116.0 (major), 115.6 (minor), 113.7 (major), 113.4 (minor), 56.7 (major), 56.5 (minor), 55.8 (major), 55.5 (minor), 55.3 (major), 55.2 (minor), 34.5 (minor), 34.3 (major), 30.5 (minor), 30.3 (major); HRMS (ESI): *m/z* calcd for $C_{31}H_{37}O_2$ $[M-H]^+$: 441.2793; found: 441.2776.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)-3-(naphthalen-2-yl)but-3-en-1-yl)phenol (4e): Yellow oil; yield 71% (36.9 mg); R_f = 0.5 (5% EtOAc in hexane); FT-IR 3638, 2961, 2873, 3061; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.84–7.78 (m, 3H), 7.73 (s, 1H), 7.49–7.44 (m, 3H), 7.09 (d, J = 8.6 Hz, 2H), 6.95 (s, 2H), 6.80 (d, J = 8.6 Hz), 5.24 (d, J = 1.1 Hz, 1H), 5.02 (s, 1H), 4.93 (s,1H), 3.96 (t, J = 8.2 Hz, 1H), 3.77 (s, 3H), 3.36–3.23 (m, 2H), 1.38 (s, 18H); ^{13}C NMR (100

MHz, $CDCl_3$) δ = 157.8, 152.0, 146.9, 138.8, 137.2, 135.6, 135.5, 133.5, 132.9, 129.1, 128.3, 127.9, 127.7, 126.2, 125.9, 125.3, 125.2, 124.5, 115.5, 113.7, 55.3, 48.8, 42.8, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{35}H_{39}O_2$ $[M-H]^+$: 491.2949; found: 491.2932.

2,6-Di-tert-butyl-4-(1-(4-methoxyphenyl)-3-(quinolin-6-yl)but-3-en-1-yl)phenol (4f): Yellow oil; yield 20% (9.8 mg); R_f = 0.2 (20% EtOAc in hexane); FT-IR 3638, 2961, 2927, 2858 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 8.89 (d, *J* = 3.0 Hz, 1H), 8.11 (d, *J* = 8.2 Hz, 1H), 8.05 (d, *J* = 8.7 Hz, 1H), 7.70–7.67 (m, 2H), 7.40 (dd, *J* = 8.2, 4.2 Hz, 1H), 7.08 (d, *J* = 8.6 Hz, 2H), 6.94 (s, 2H), 6.79 (d, *J* = 8.5 Hz, 2H), 5.27 (s, 1H), 5.02 (s, 1H), 5.00 (s, 1H), 3.93 (t, *J* = 7.9 Hz, 1H), 3.77 (s, 3H), 3.35–3.24 (m, 2H), 1.36 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.9, 152.1, 150.2, 147.7, 146.4, 139.7, 137.1, 136.5, 135.6, 135.4, 129.2, 129.0, 128.9, 128.3, 124.9, 124.5, 121.4, 116.4, 113.7, 55.3, 49.0, 42.7, 34.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{34}H_{40}NO_2$ $[M+H]^+$: 494.3060; found: 494.3042.

Methyl 3-(4-(3,5-di-tert-butyl-4-hydroxyphenyl)-4-(4-methoxyphenyl)but-1-en-2-yl)-2-naphthoate (4g): Yellow soild; yield 80% (43.8 mg); R_f = 0.2 (10% EtOAc in hexane); M.P. 148-150°C; FT-IR 3634, 2955, 2873, 2834 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 8.41 (s, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.56–7.48 (m, 2H), 7.15 (s, 1H), 7.10 (d, *J* = 8.6 Hz, 2H), 6.91 (s, 2H), 6.77 (d, *J* = 8.7 Hz, 2H), 5.13 (d, *J* = 1.2 Hz, 1H), 5.00 (d, *J* = 1.7 Hz, 1H), 4.96 (s, 1H), 3.89 (s, 3H), 3.78 (t, *J* = 8.0 Hz, 1H), 3.74 (s, 3H), 3.16 (d, *J* = 8.0 Hz, 2H), 1.34 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 168.2, 157.8, 151.9, 149.7, 140.4, 137.3, 135.4, 135.2, 134.6, 131.6, 131.4, 129.7, 129.0, 128.8, 128.2, 127.8, 127.4, 126.5, 124.5, 115.5, 113.7, 55.3, 52.3, 50.0, 44.2, 34.4, 30.4; HRMS (ESI): *m/z* calcd for $C_{37}H_{41}O_4$ $[M-H]^+$: 549.3004; found: 549.2984.

4-(1-(2-Bromophenyl)-3-(4-(tert-butyl)phenyl)but-3-en-1-yl)-2,6-di-tert-butylphenol (4h): Yellow oil; yield 72% (39.3 mg); R_f = 0.6 (5% EtOAc in hexane); FT-IR 3641, 2961, 2911, 2872.0 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.50 (dd, J = 7.9, 0.8 Hz, 1H), 7.36–7.29 (m, 3H), 7.26–7.22 (m, 3H), 7.04 (s, 2H), 7.04–6.99 (m, 1H), 5.17 (s, 1H), 5.03 (s, 1H), 4.90 (s, 1H), 4.66 (t, J = 7.8 Hz, 1H), 3.27–3.15 (m, 2H), 1.39 (s, 18H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 152.1, 150.3, 146.4, 144.1, 138.7, 135.4, 133.7, 133.0, 128.9, 127.51, 127.50, 126.1, 125.4, 125.1, 125.0, 114.0, 47.7, 41.3, 34.6, 34.5, 31.5, 30.5; HRMS (ESI): *m/z* calcd for $C_{34}H_{42}BrO$ $[M-H]^+$: 545.2418; found: 545.2402.

2,6-Di-tert-butyl-4-(5,6-dihydro-2H-benzo[b]oxocin-6-yl)phenol (5): The second generation Grubbs catalyst (9 mg, 0.01 mmol) was added to a solution of **3d** (40 mg, 0.1 mmol) in CH_2Cl_2 (1.5 mL) under inert atmosphere and the resultant mixture was stirred at 40 °C until **3d** was completely consumed (by T.L.C.). The solvent was removed under reduced pressure and the residue was directly loaded on a silica gel column and purified using 0.5-1% ethyl acetate/hexane mixture as an eluent to get the pure product **5**. Yellow oil; yield 54% (19.7 mg); R_f = 0.2 (5% EtOAc in hexane); FT-IR 3638, 2958, 2926, 2873 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ = 7.20–7.15 (m, 1H), 7.08–7.05 (m, 2H), 7.07 (s, 2H), 7.03–6.99 (m, 1H), 5.92–5.84 (m, 1H), 5.42–5.38 (m, 1H), 5.05–5.01 (m, 1H), 5.02 (s, 1H), 4.45 (dd, J = 15.6, 4.6 Hz, 1H); 4.07 (dd, J = 12.3, 5.9 Hz, 1H), 3.56–3.47 (m, 1H), 2.49–2.43 (m, 1H), 1.39 (s, 18H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.0, 152.1, 137.5, 137.4, 135.8, 132.1, 131.9, 127.8, 126.8, 124.8, 124.4, 123.3, 73.5, 52.2, 37.0, 34.5, 30.5 ppm; HRMS (ESI): *m/z* calcd for $C_{25}H_{31}O_2$ $[M-H]^+$: 363.2323; found: 363.2311.

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1) (a) W. –D. Chu, L. –F. Zhang, X. Bao, X. –H. Zhao, C. Zeng, J. –Y. Du, G. –B. Zhang, F. –X. Wang, X. –Y. Ma and C. –A. Fan, *Angew. Chem. Int. Ed.*, 2013, **52**, 9229; (b) V. Reddy and R. V. Anand, *Org. Lett*., 2015, **17**, 3390.
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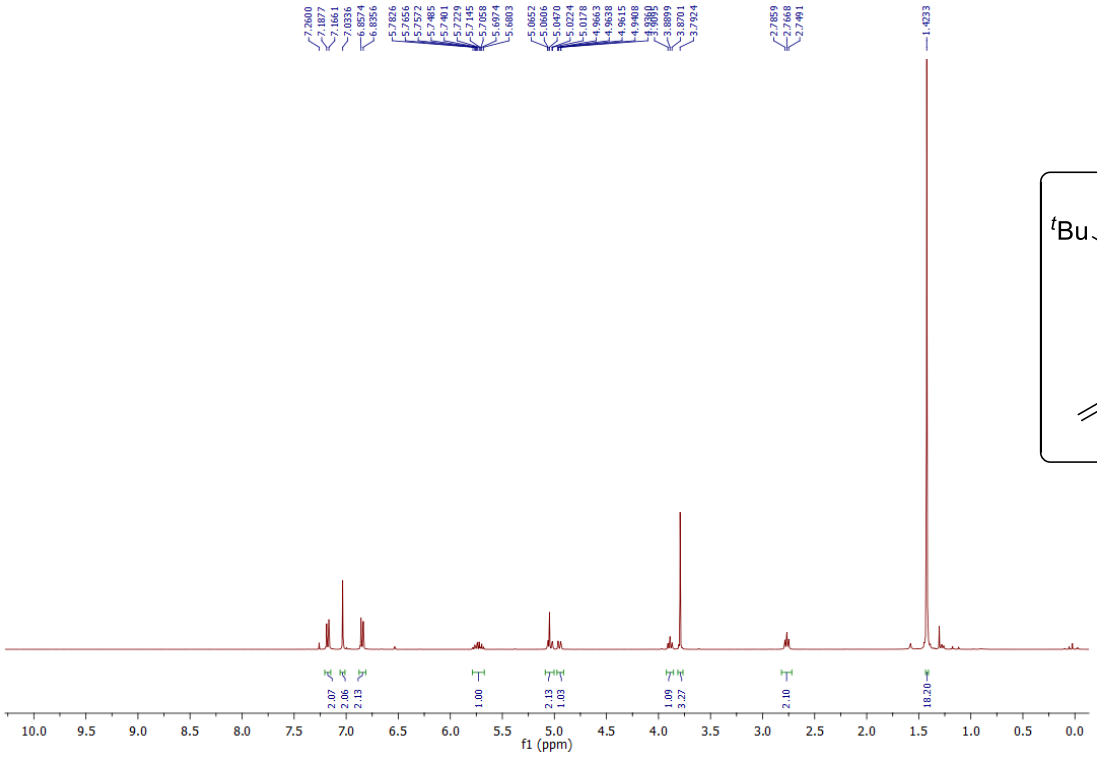
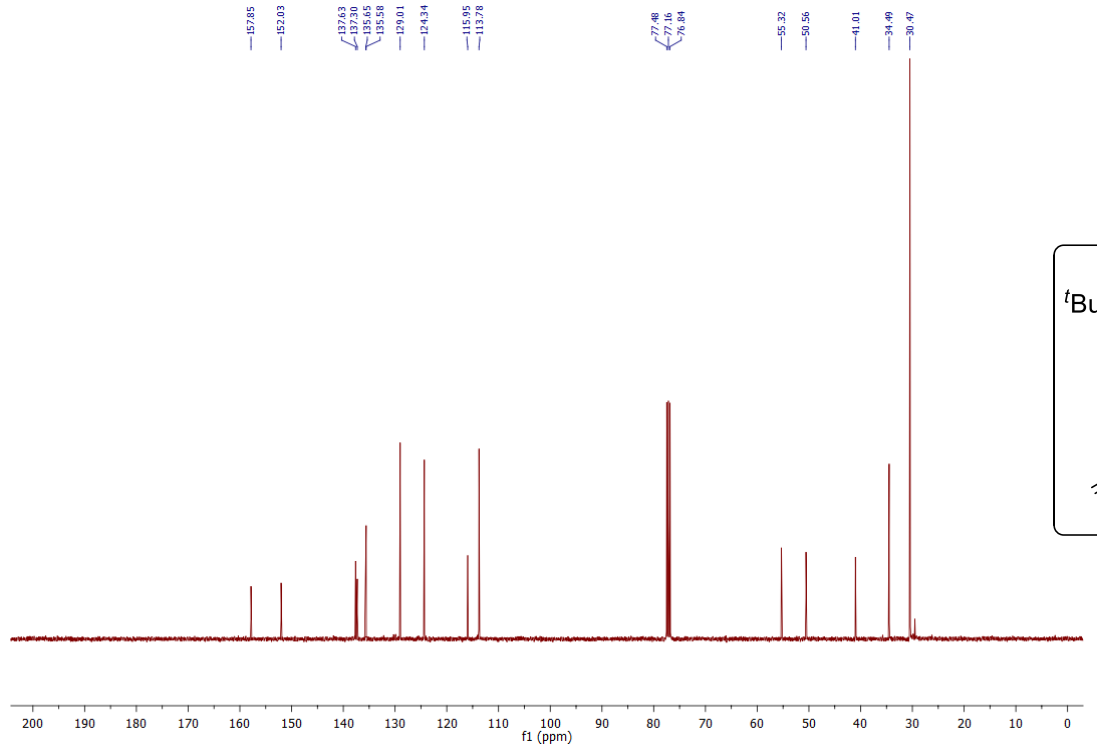
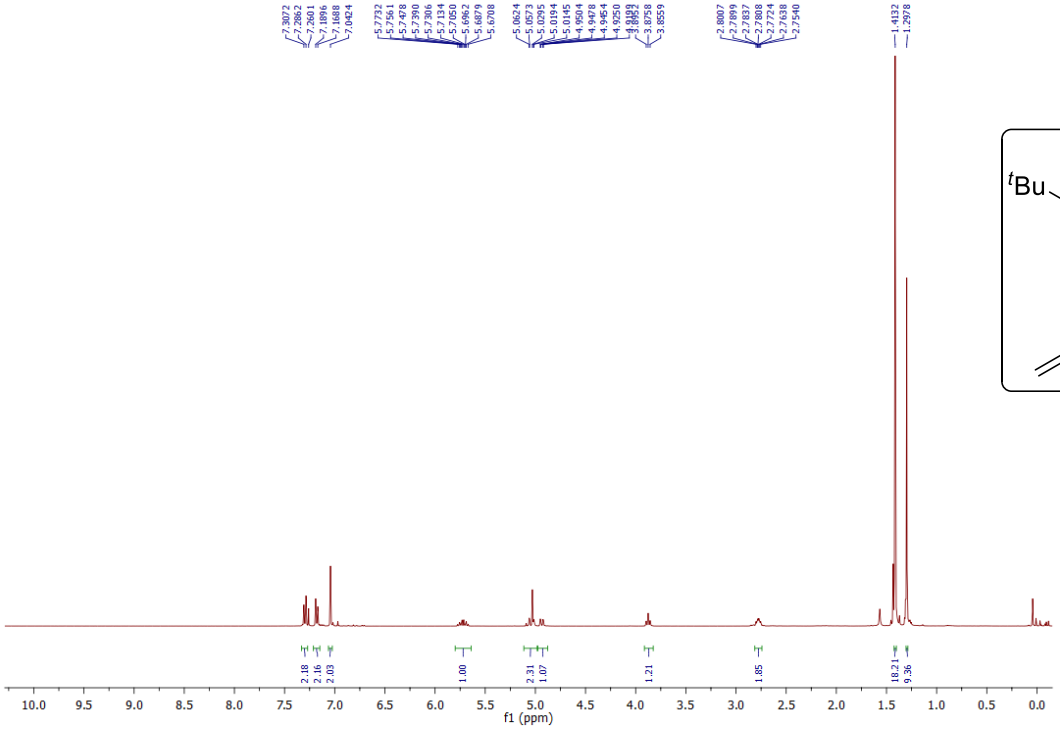
^{1}H NMR Spectrum of **3**



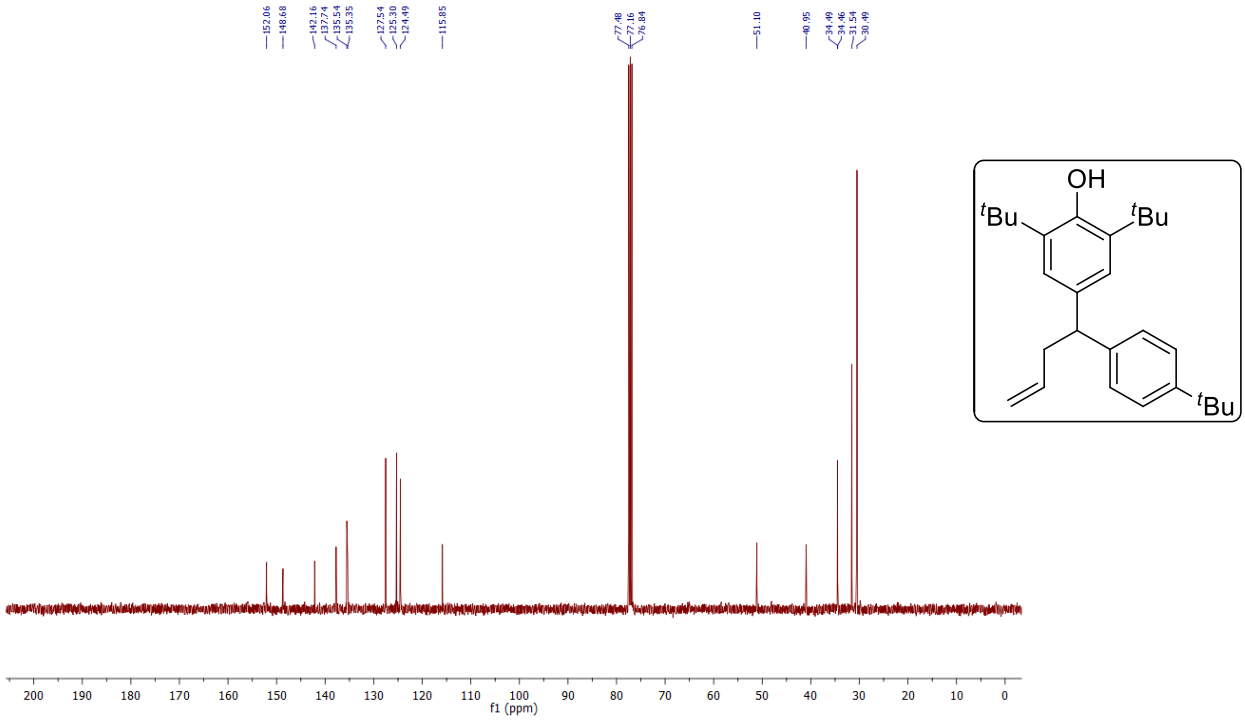
^{13}C NMR Spectrum of **3**



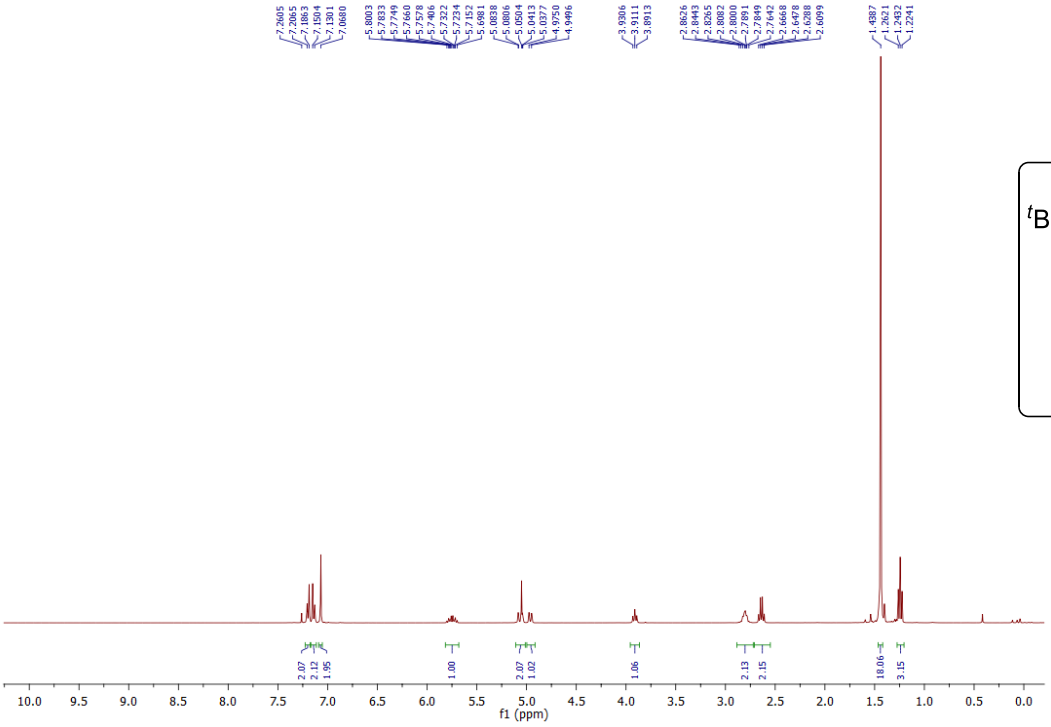
^{1}H NMR Spectrum of **3a**



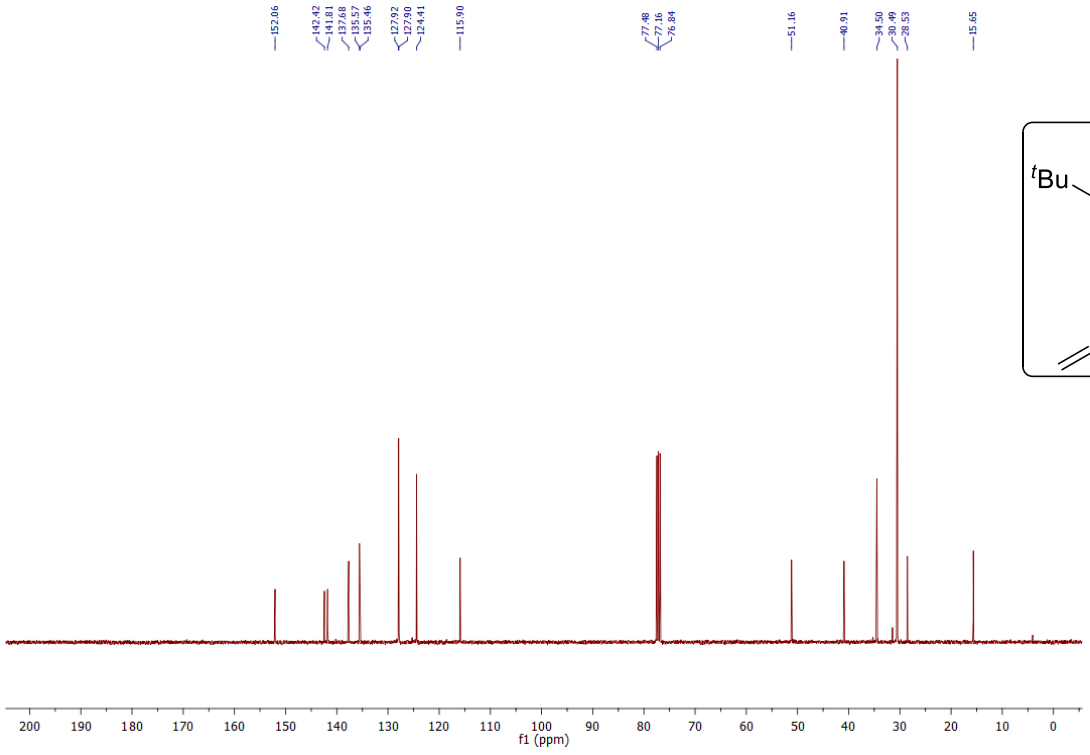
^{13}CNMR Spectrum of **3a**



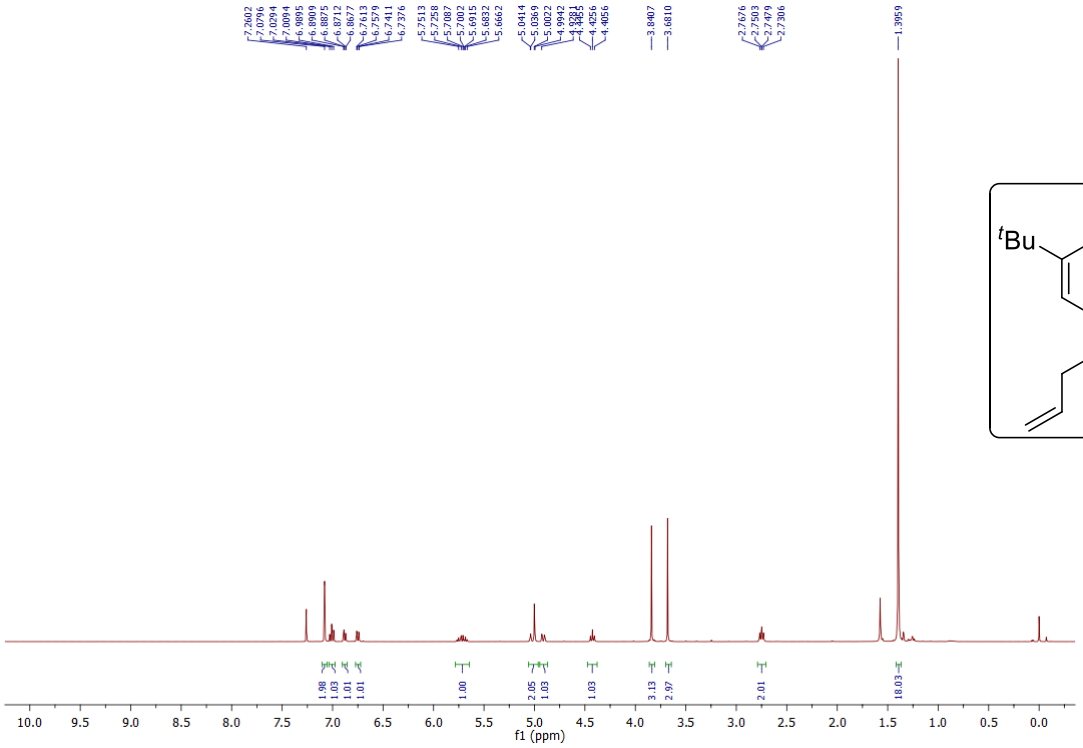
^{1}H NMR Spectrum of **3b**

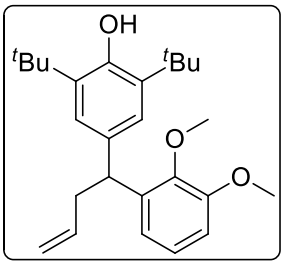


^{13}C NMR Spectrum of **3b**

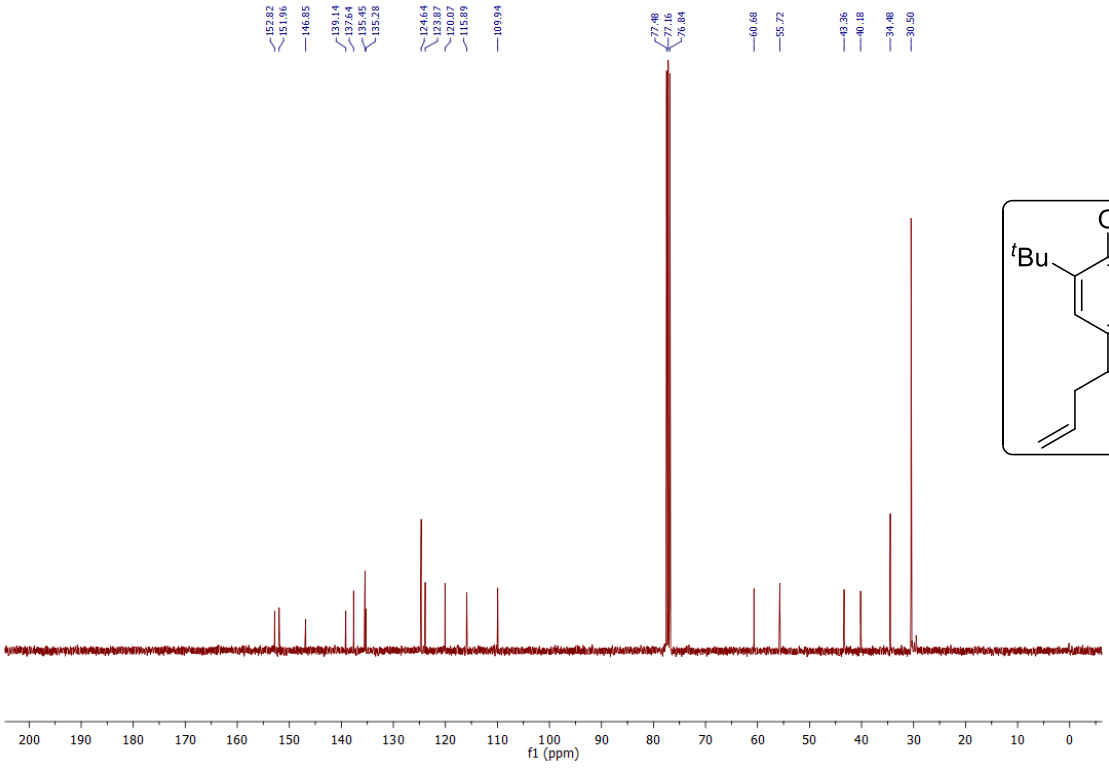


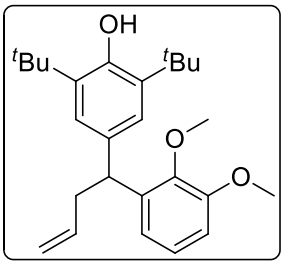
^{1}H NMR Spectrum of **3c**



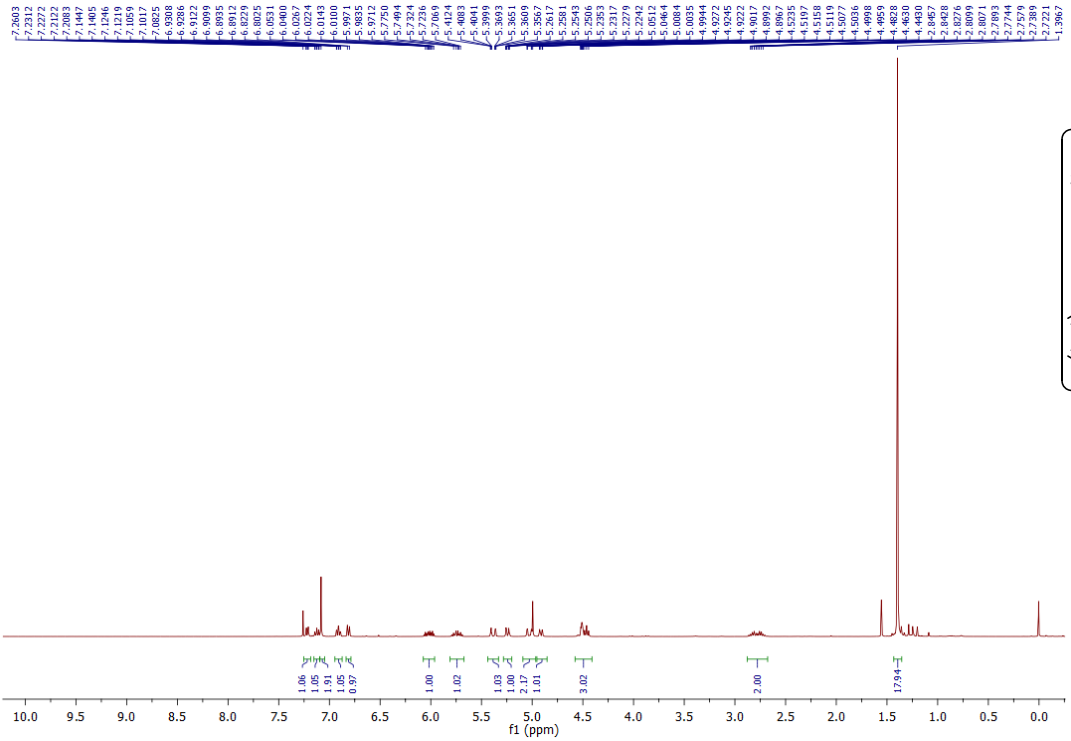


^{13}C NMR Spectrum of **3c**

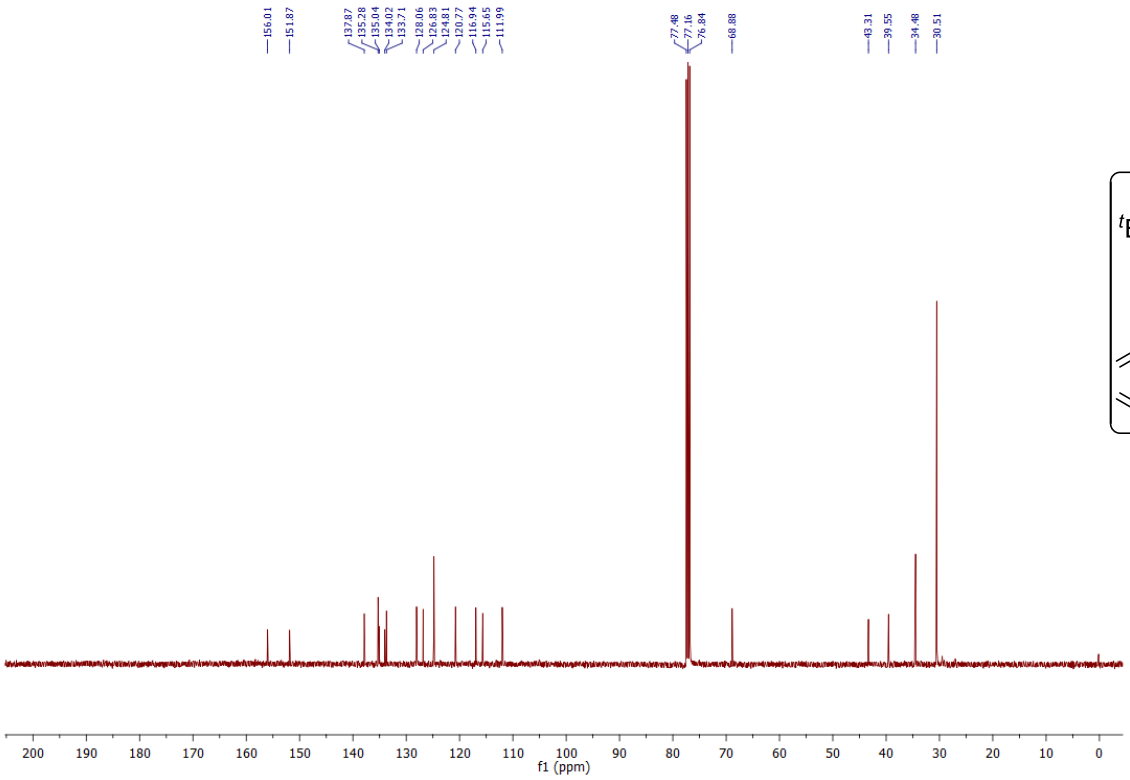




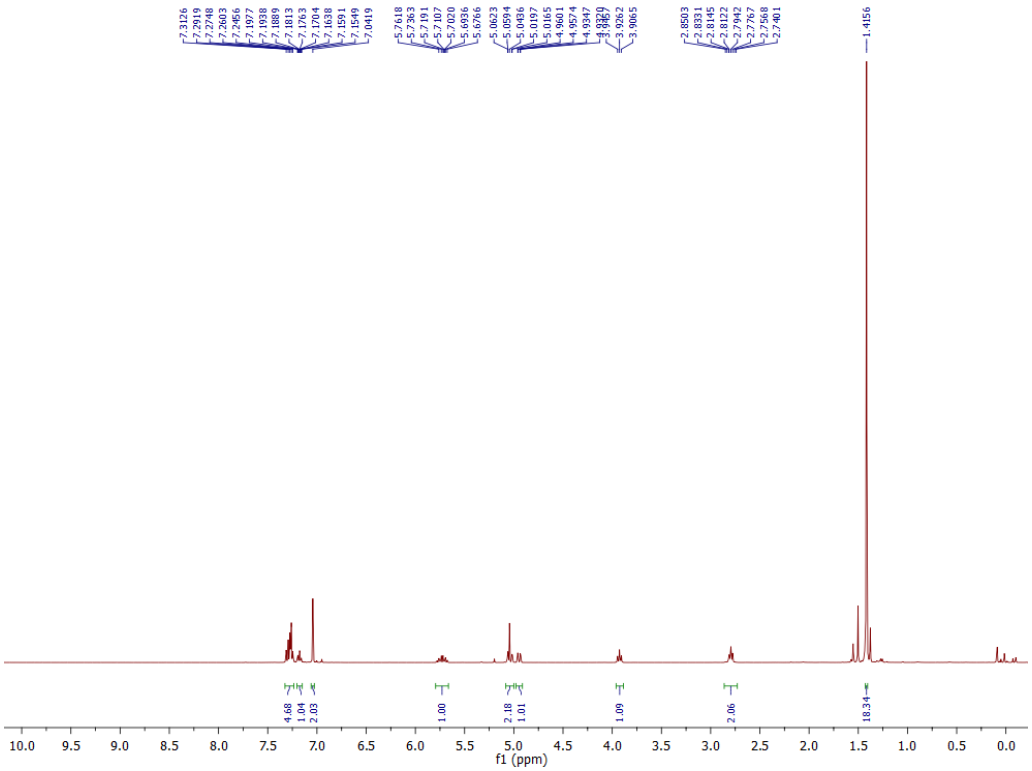
^{1}H NMR Spectrum of **3d**

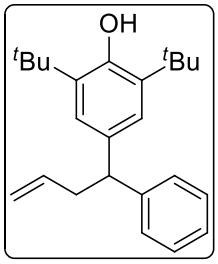


^{13}C NMR Spectrum of **3d**

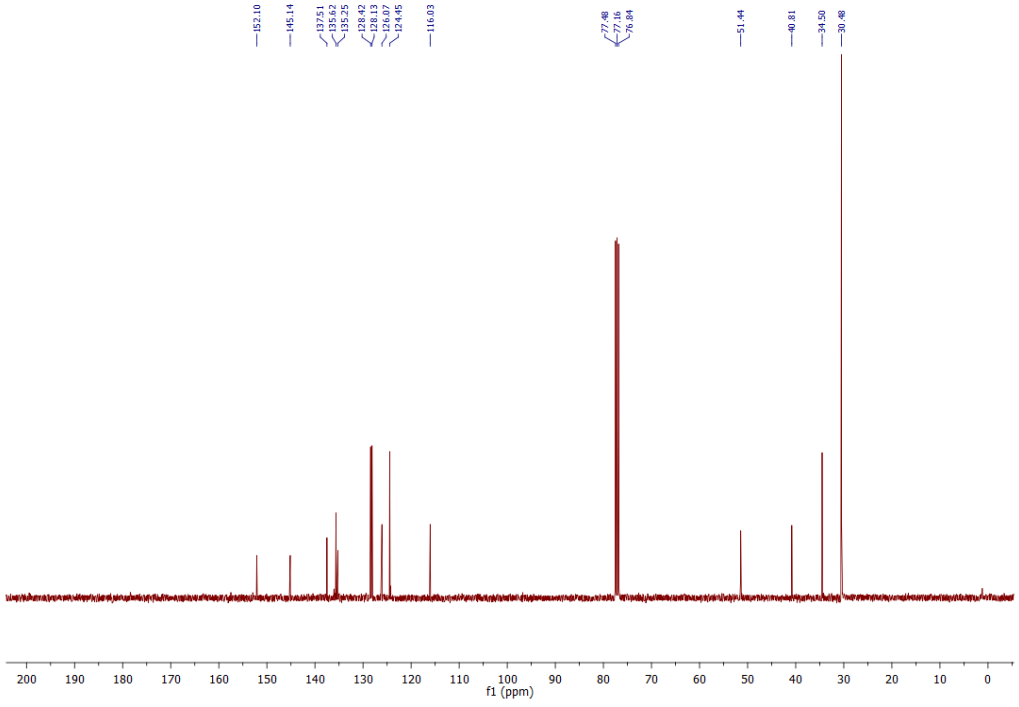


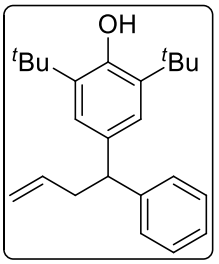
^{1}H NMR Spectrum of **3e**



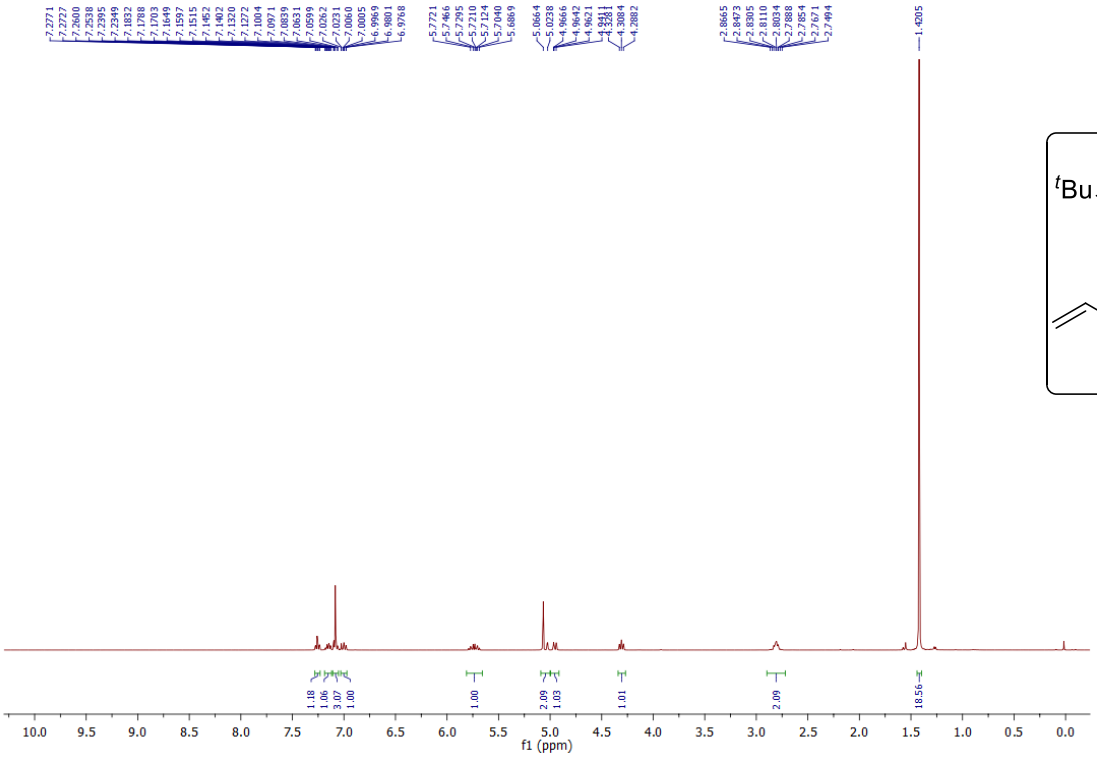


^{13}C NMR Spectrum of **3e**

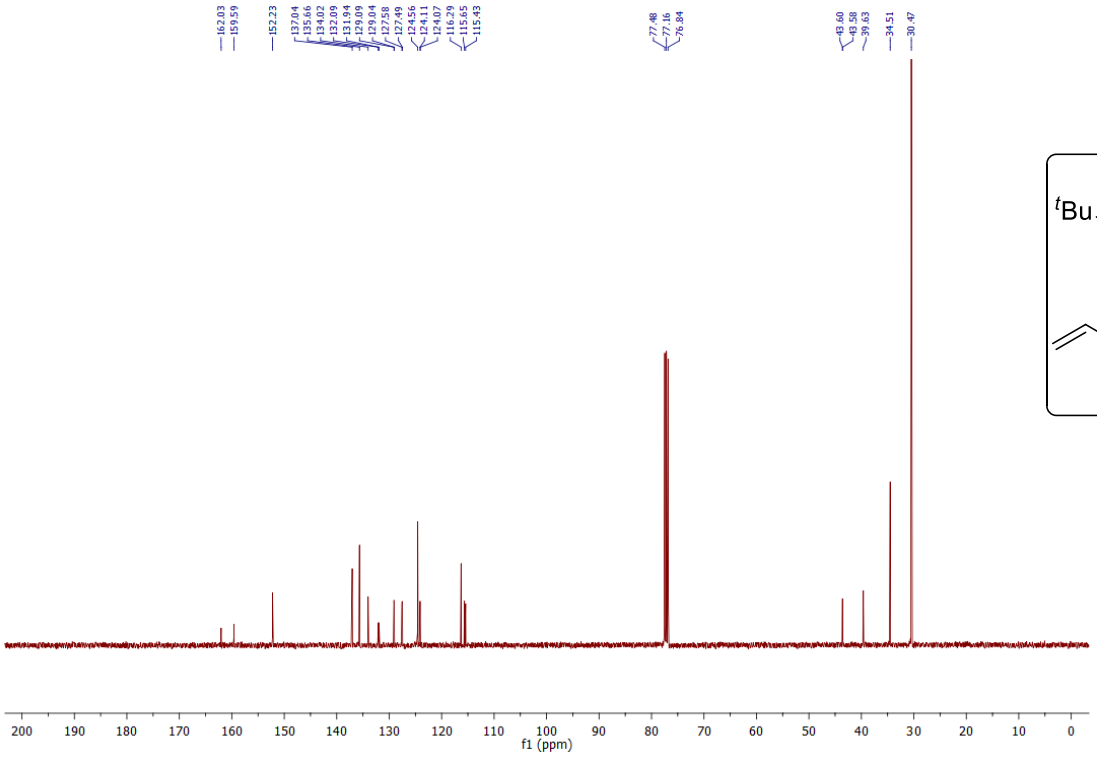




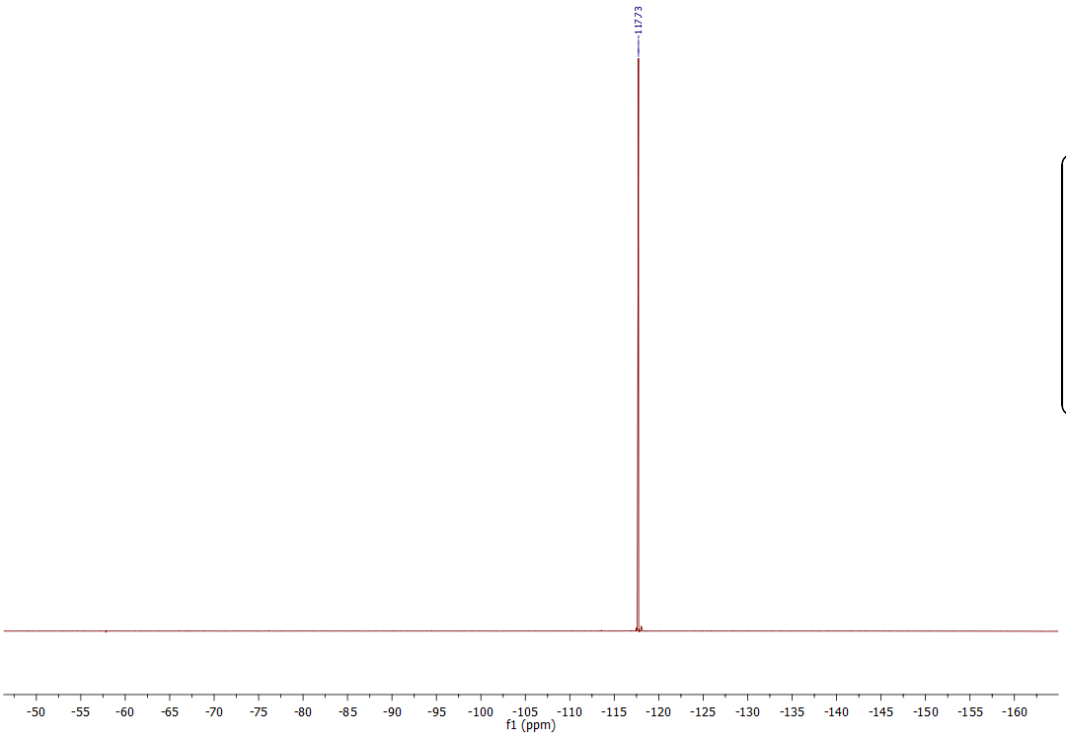
^{1}H NMR Spectrum of **3f**

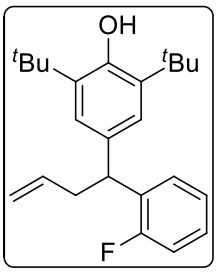


^{13}C NMR Spectrum of **3f**

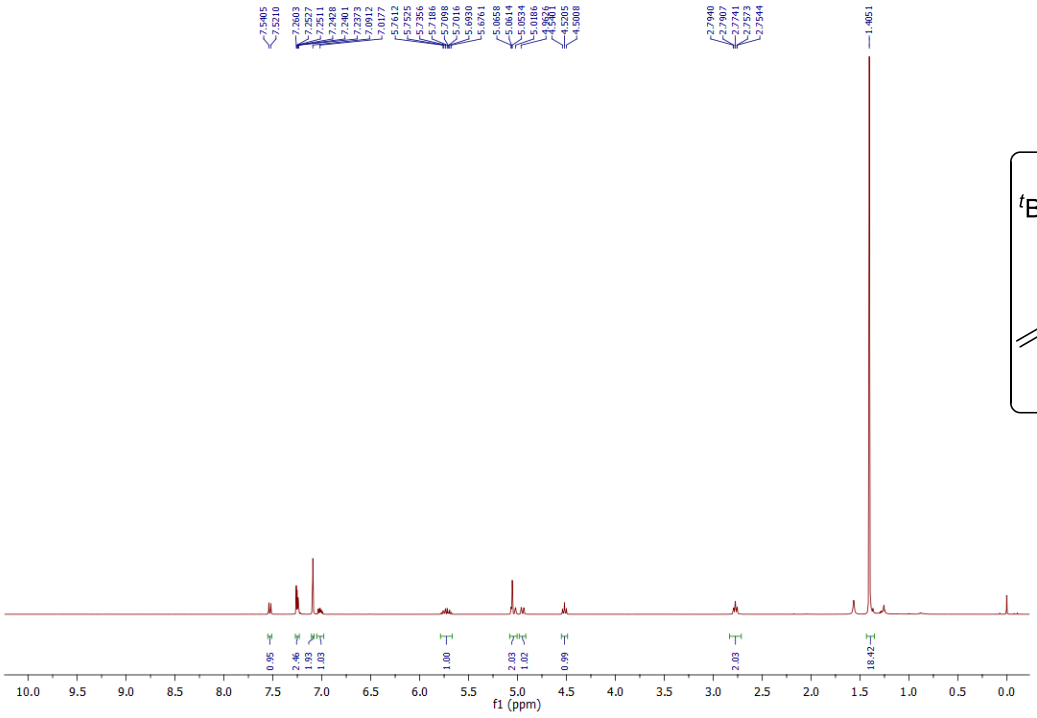


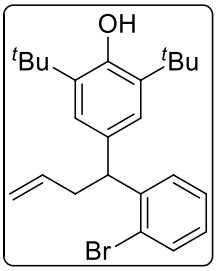
^{19}F NMR Spectrum of **3f**



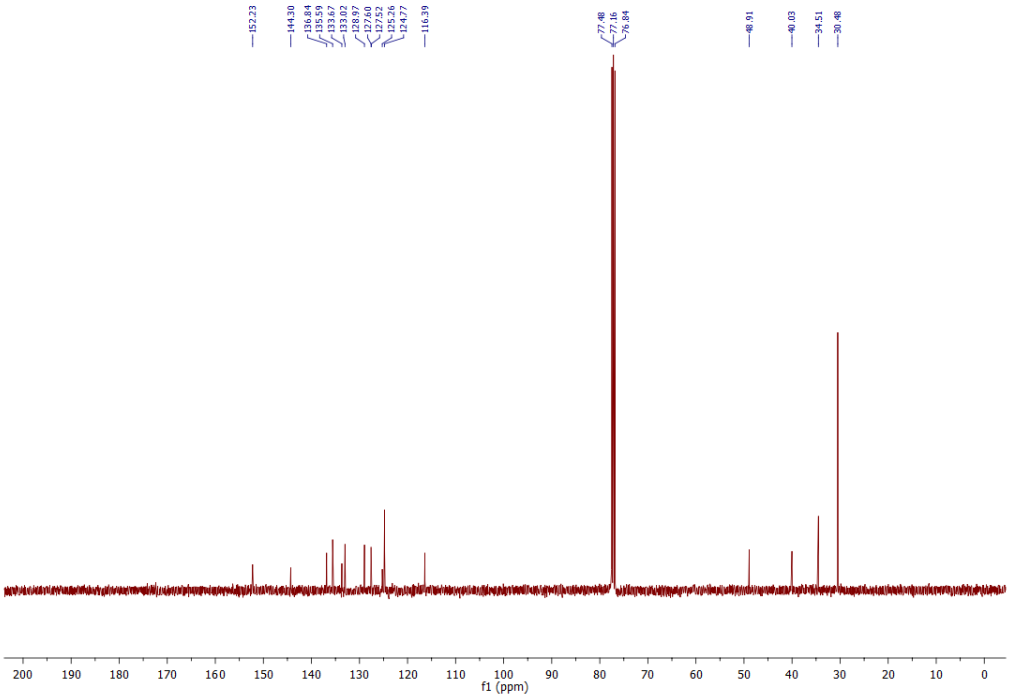


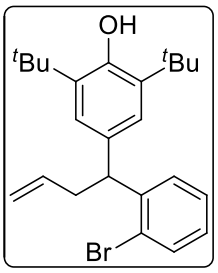
^{1}H NMR Spectrum of **3g**



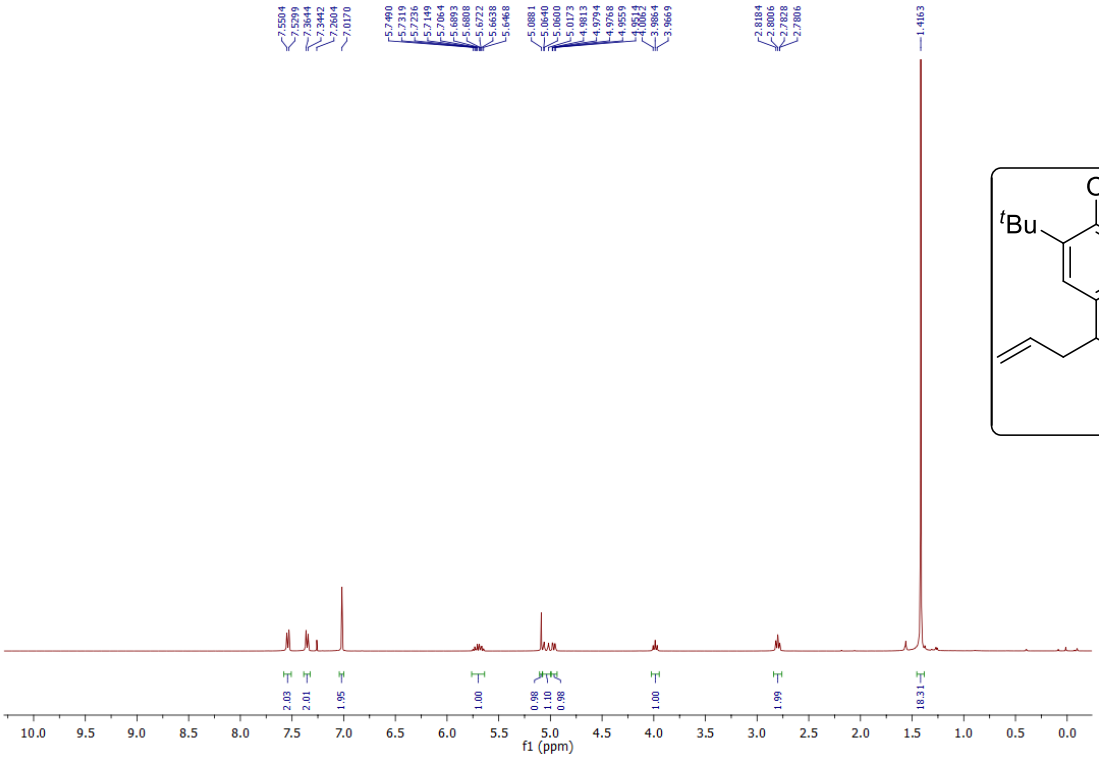


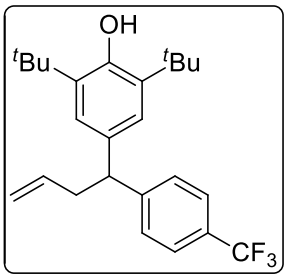
^{13}C NMR Spectrum of **3g**



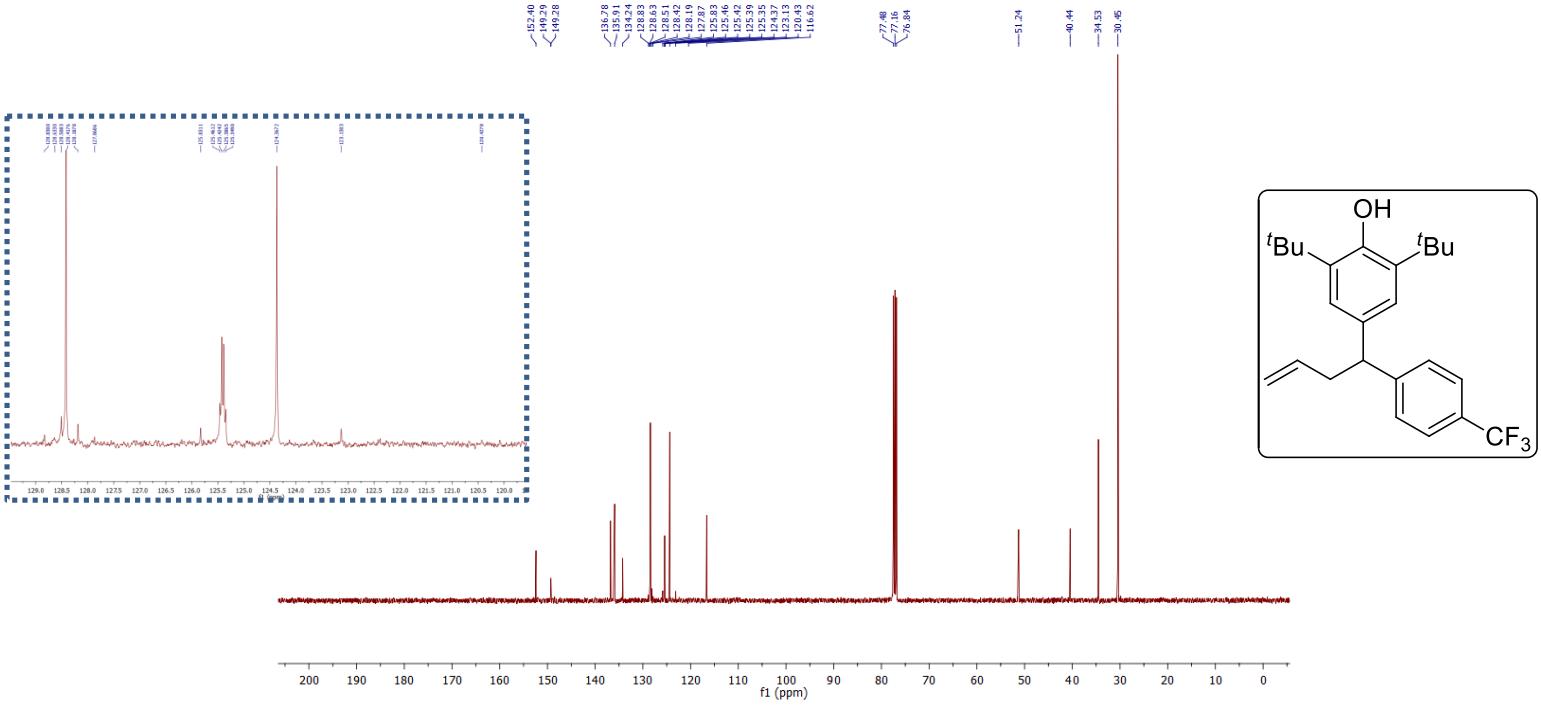


^{1}H NMR Spectrum of **3h**

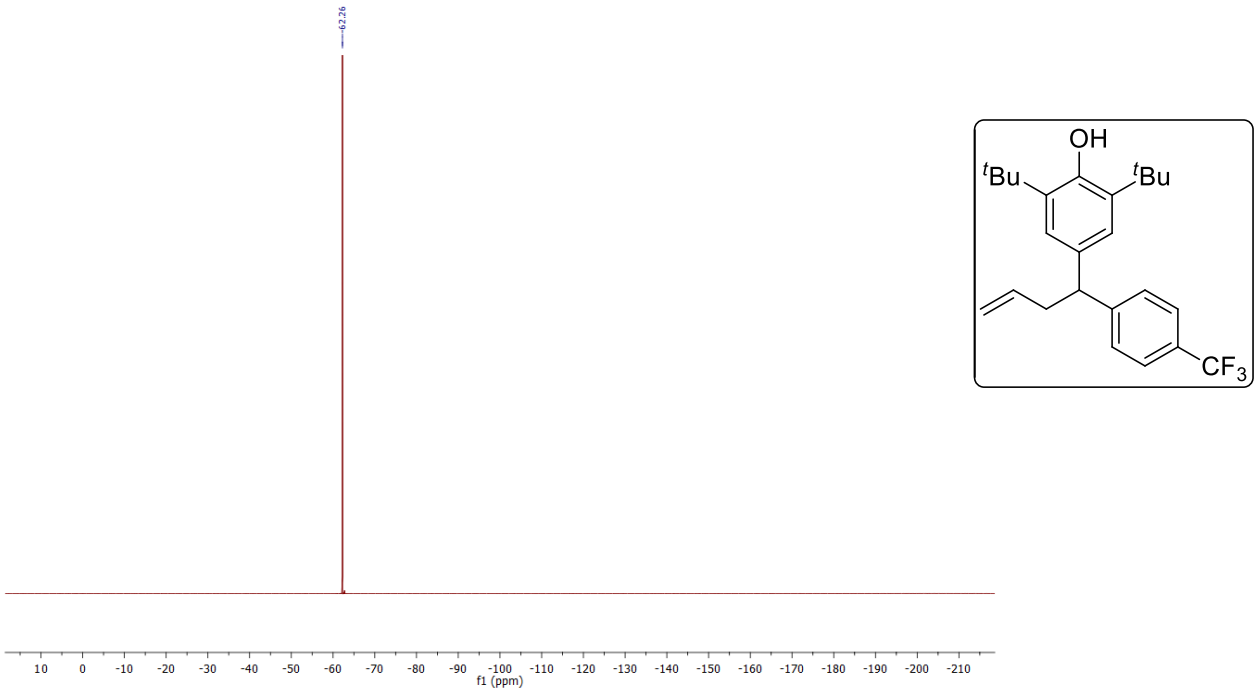




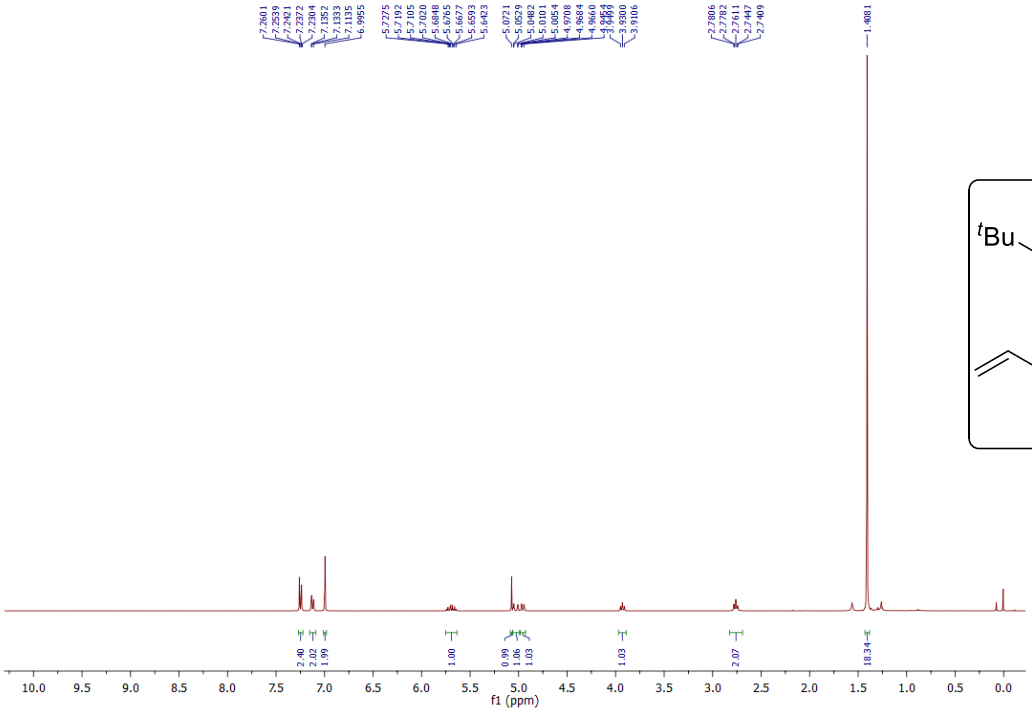
^{13}C NMR Spectrum of **3h**

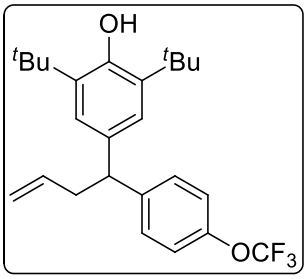


^{19}F NMR Spectrum of **3h**

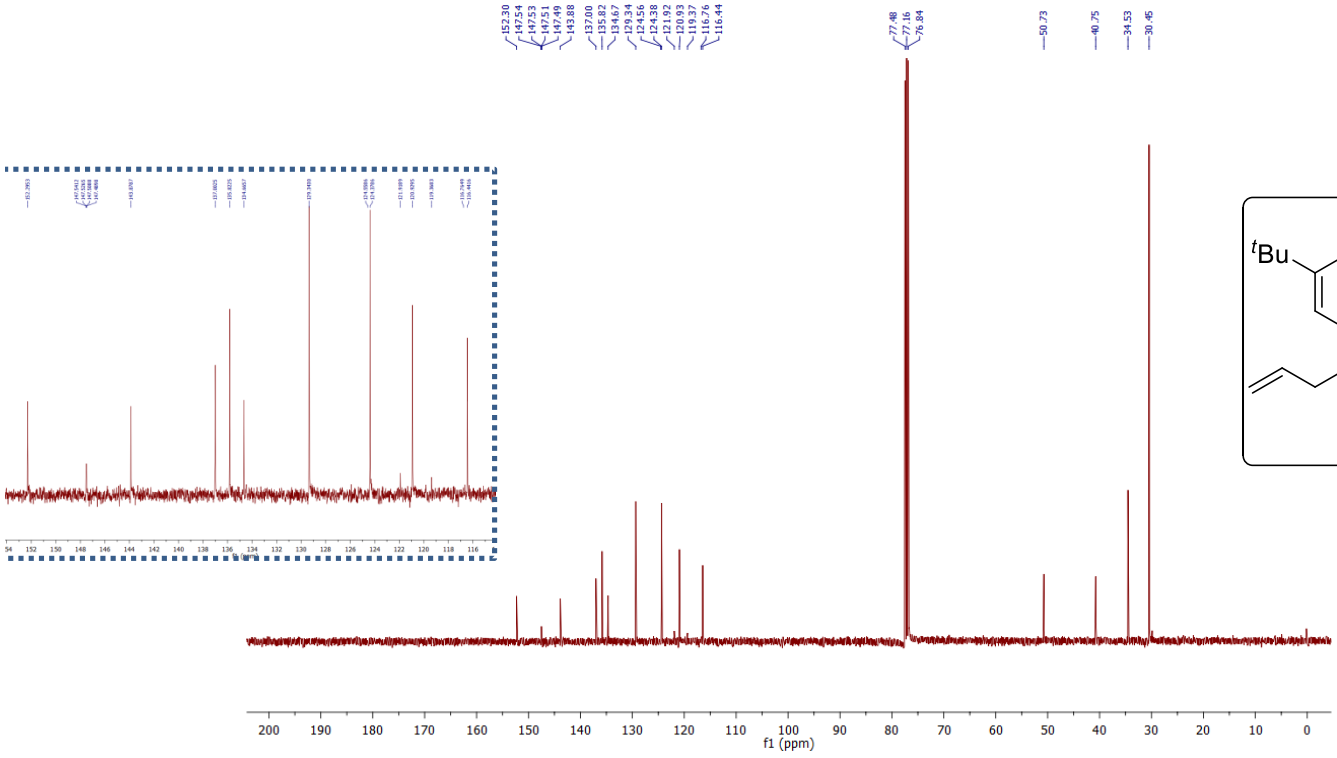


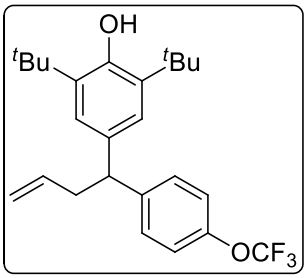
^{1}H NMR Spectrum of **3i**



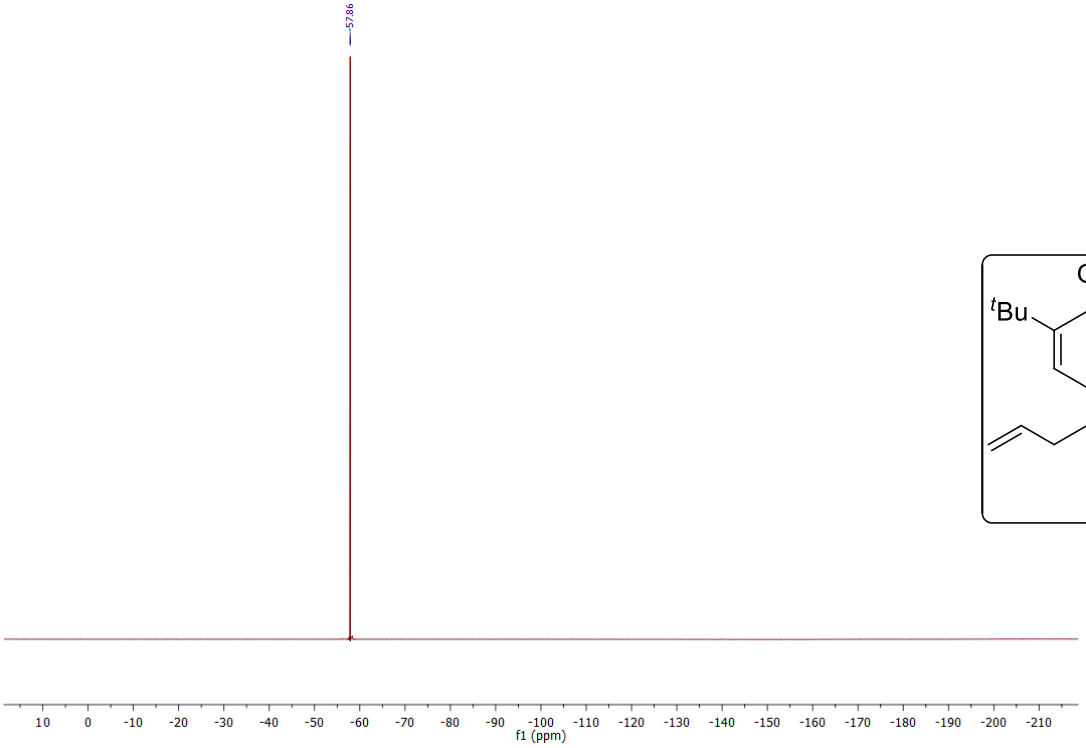


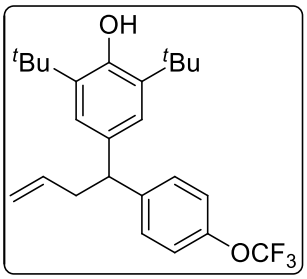
^{13}C NMR Spectrum of **3i**



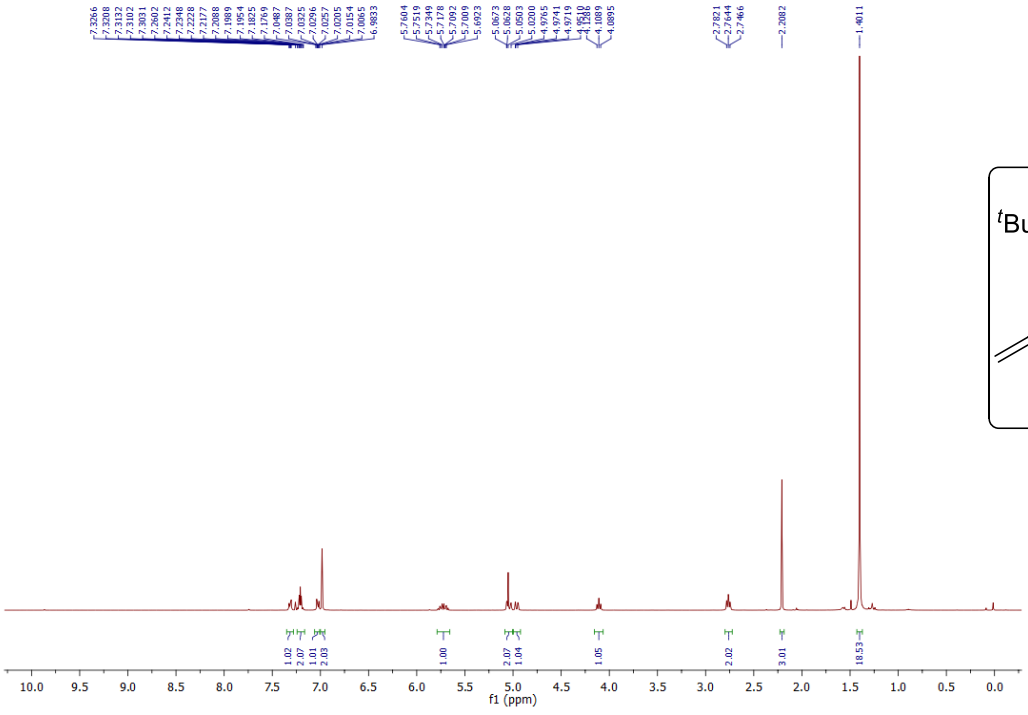


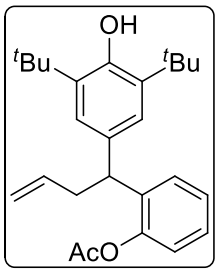
^{19}F NMR Spectrum of **3i**



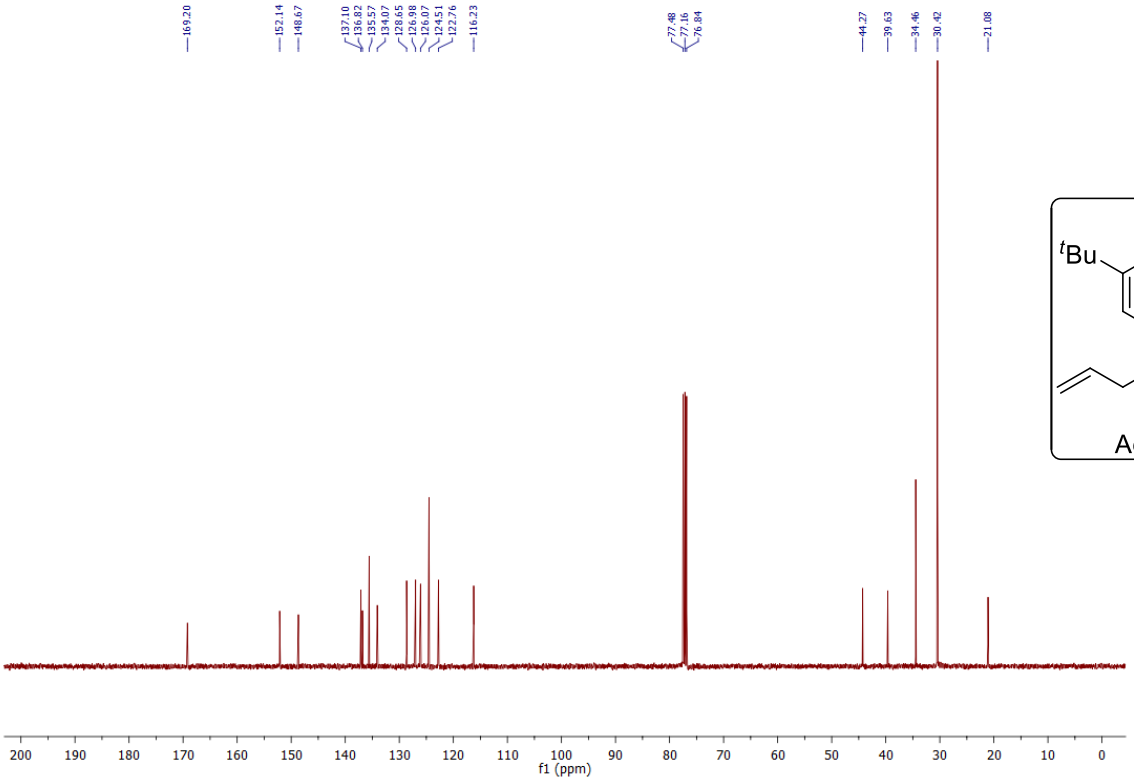


^{1}H NMR Spectrum of **3j**

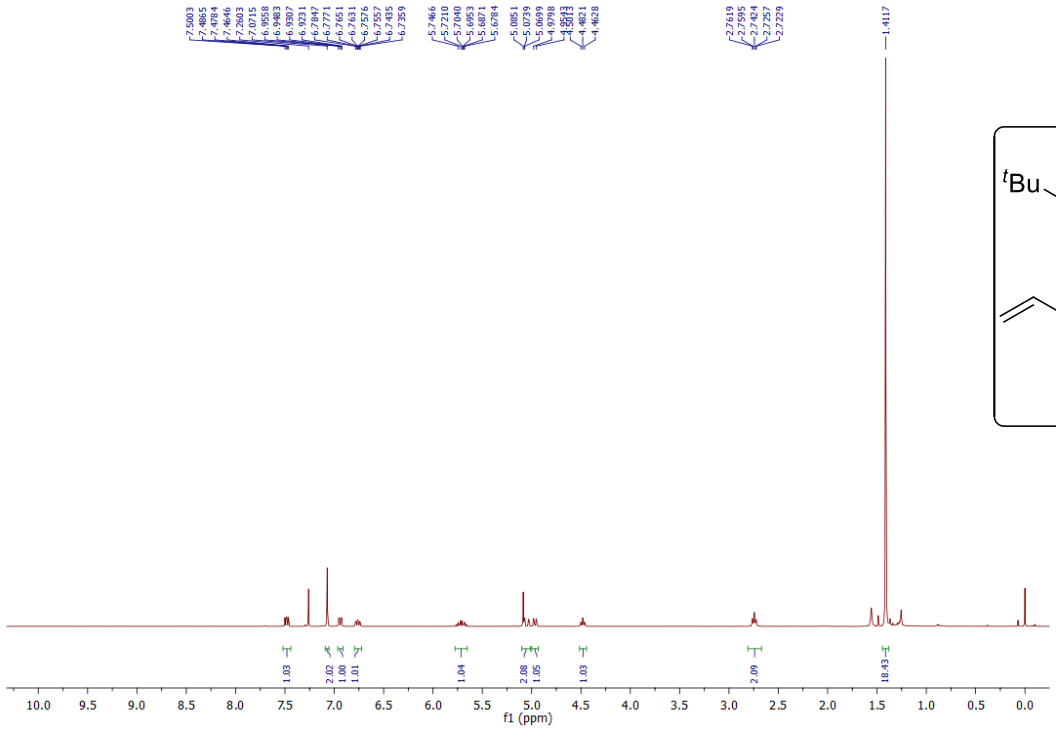




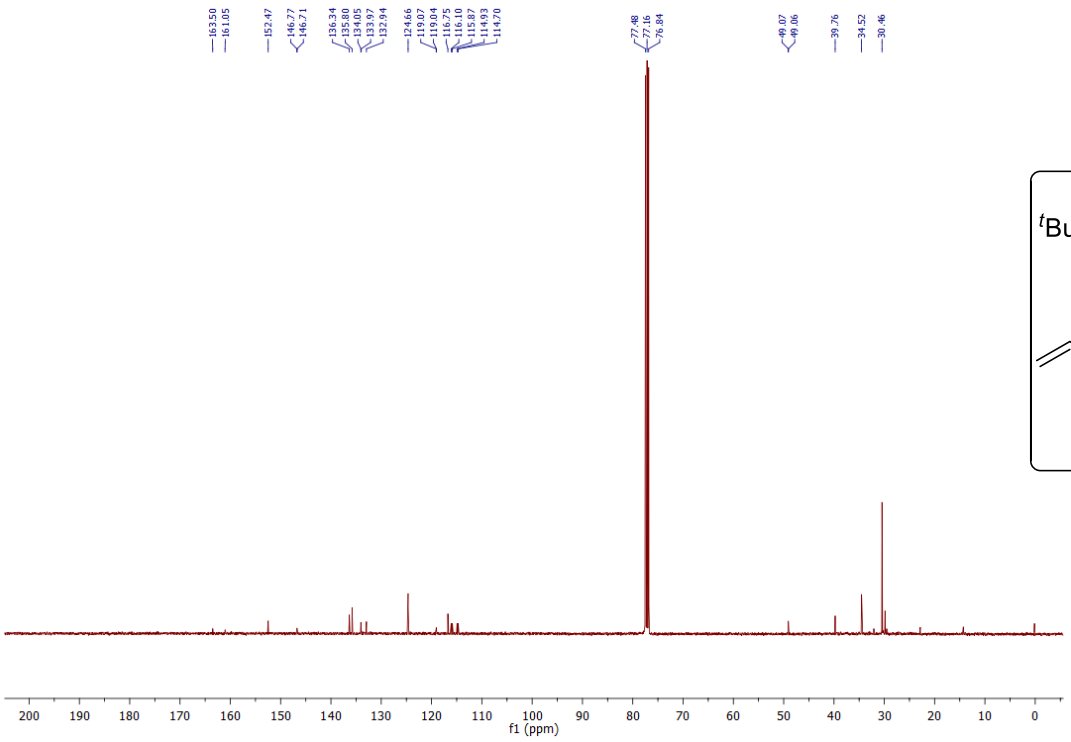
^{13}C NMR Spectrum of **3j**



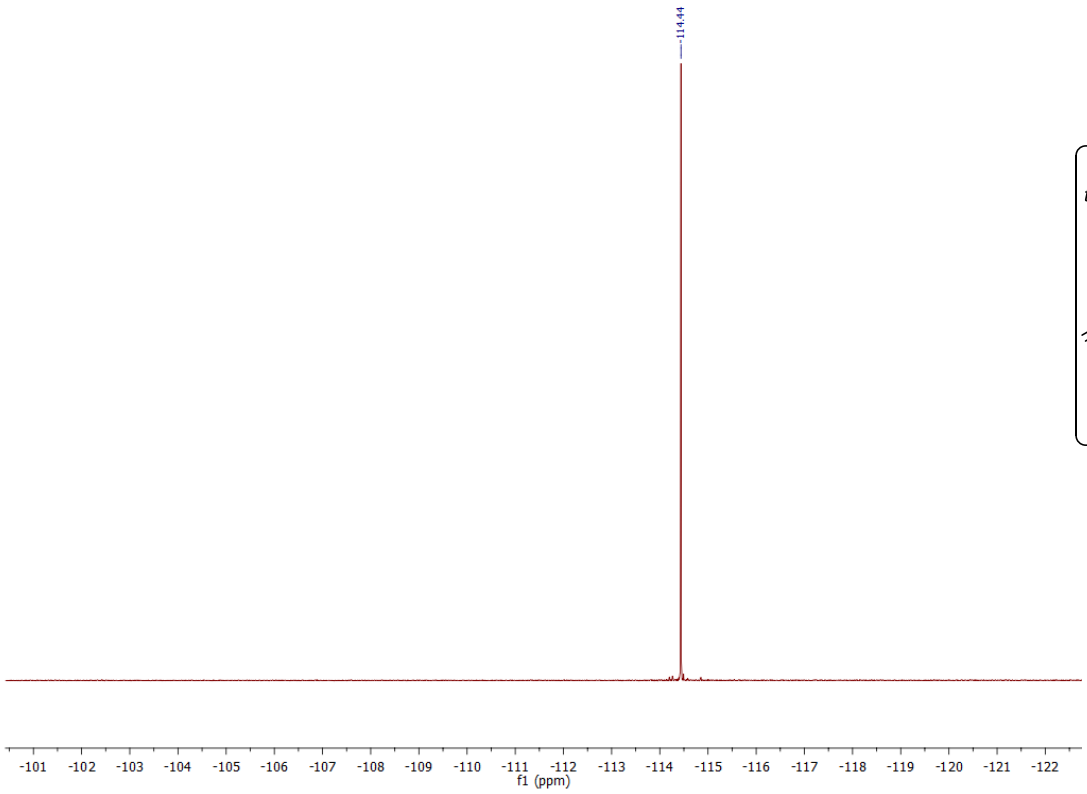
^{1}H NMR Spectrum of **3k**



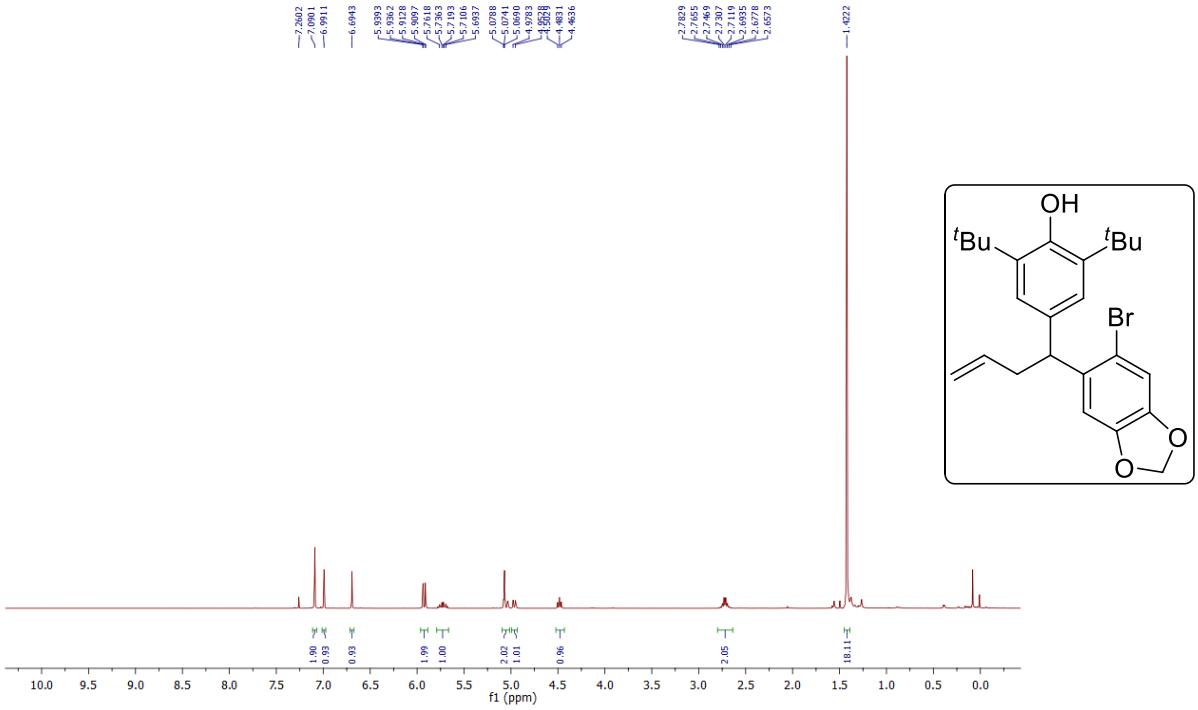
^{13}C NMR Spectrum of **3k**



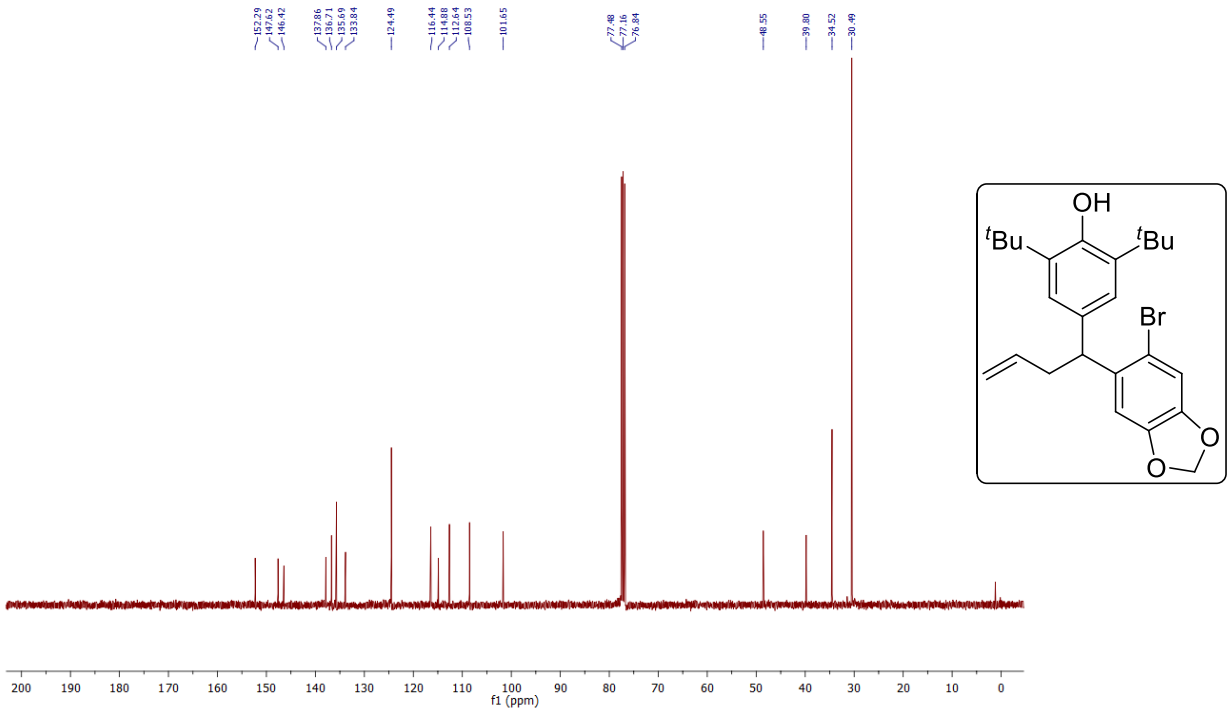
^{19}F NMR Spectrum of **3k**



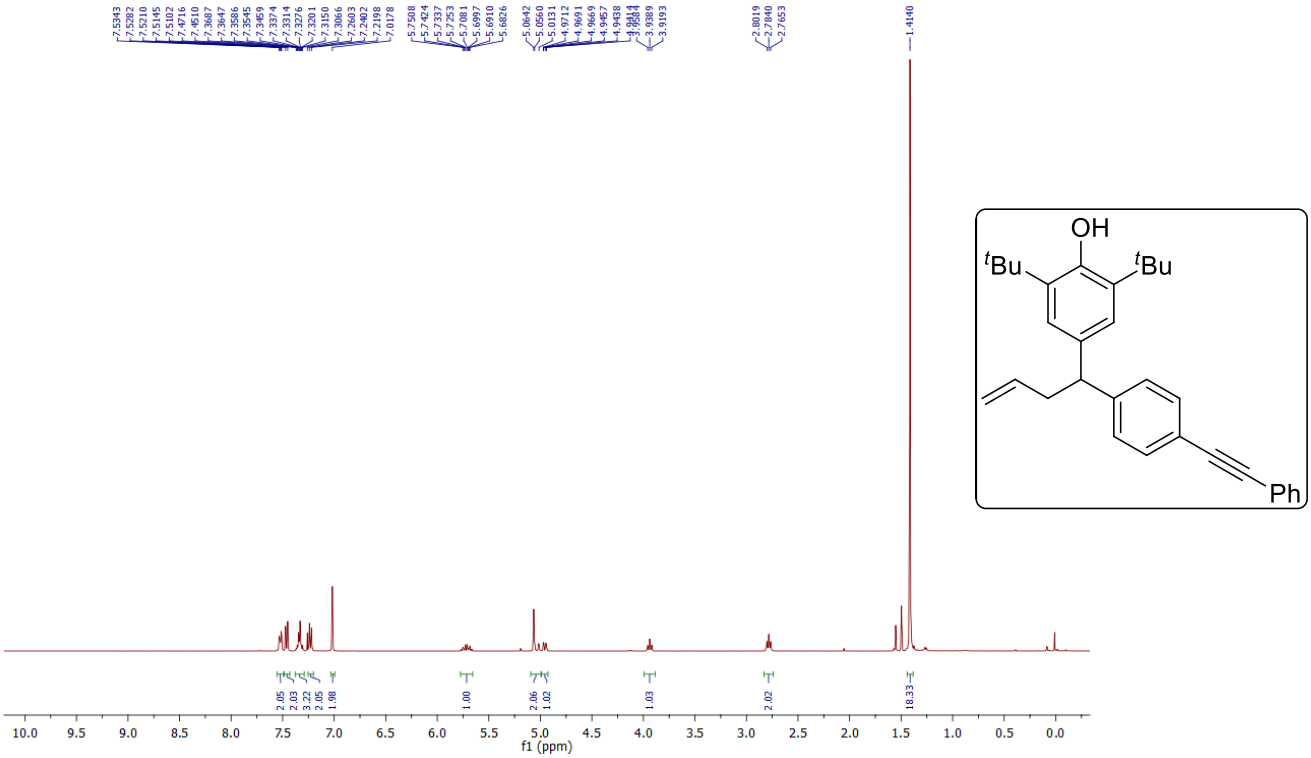
^{1}H NMR Spectrum of **3l**



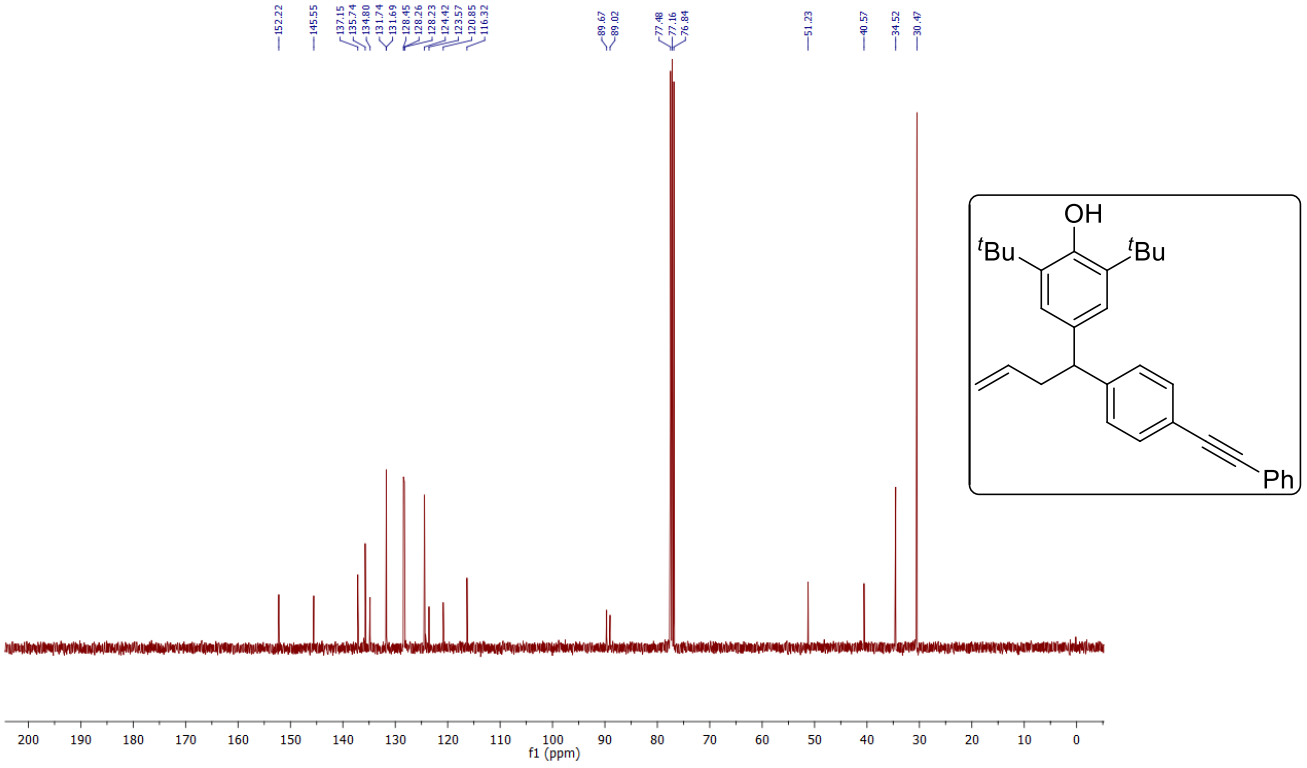
^{13}C NMR Spectrum of **3l**



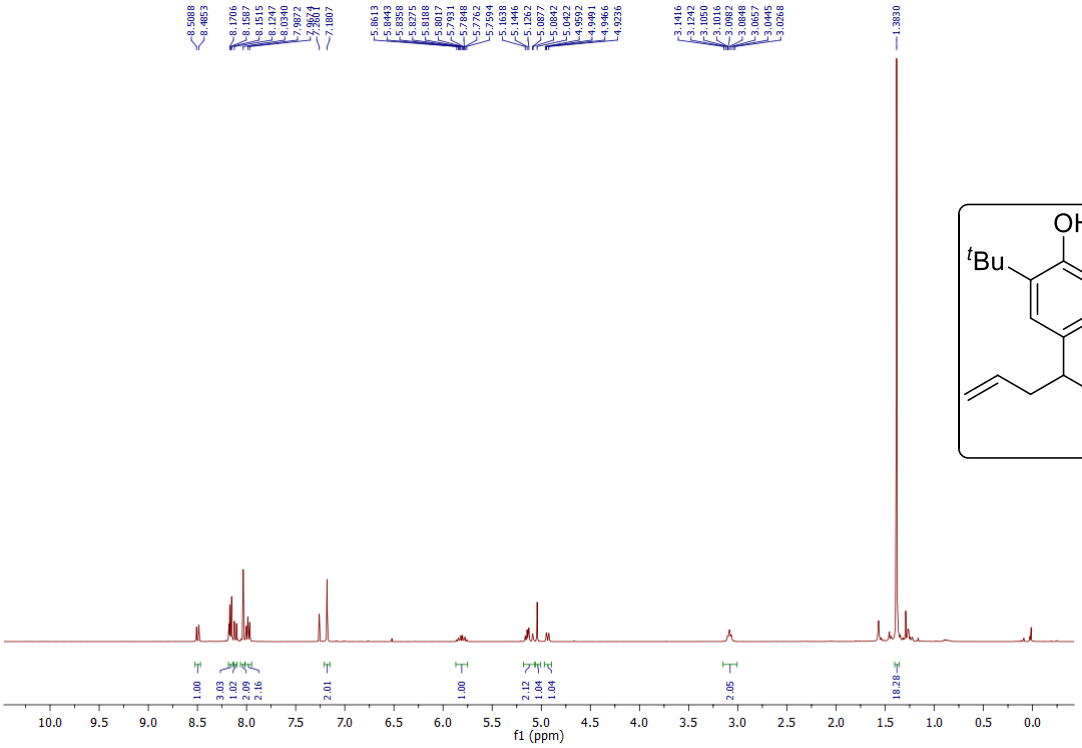
^{1}H NMR Spectrum of **3m**



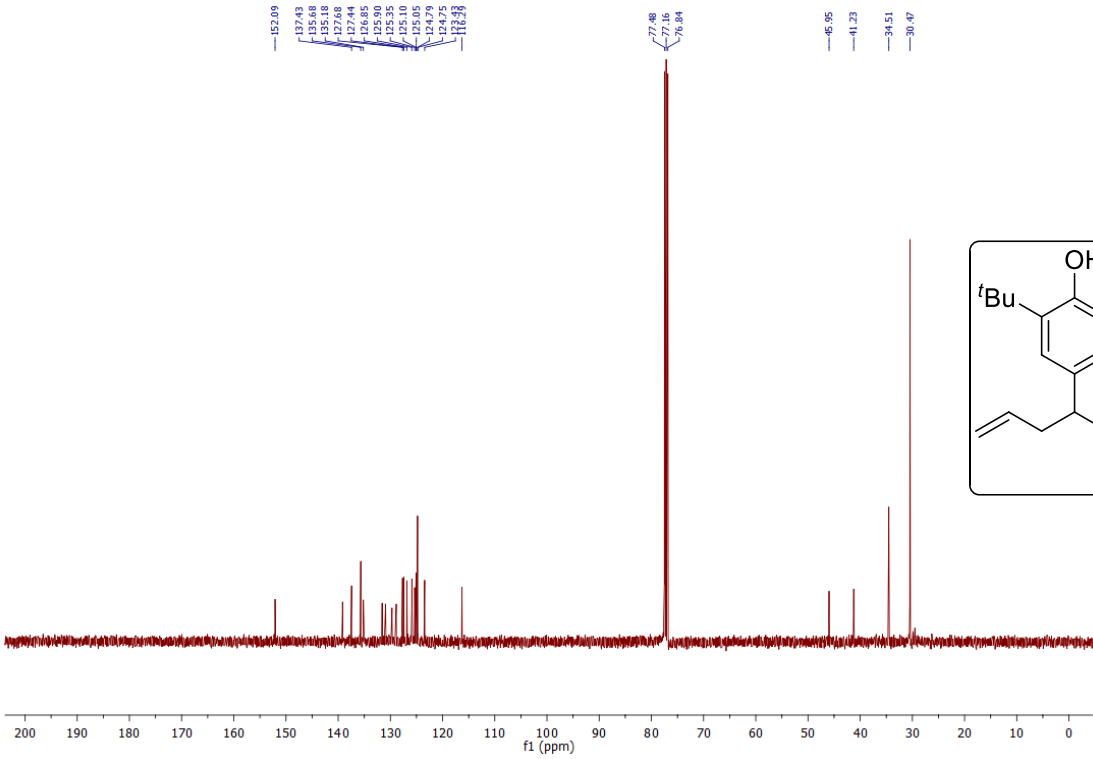
^{13}C NMR Spectrum of **3m**



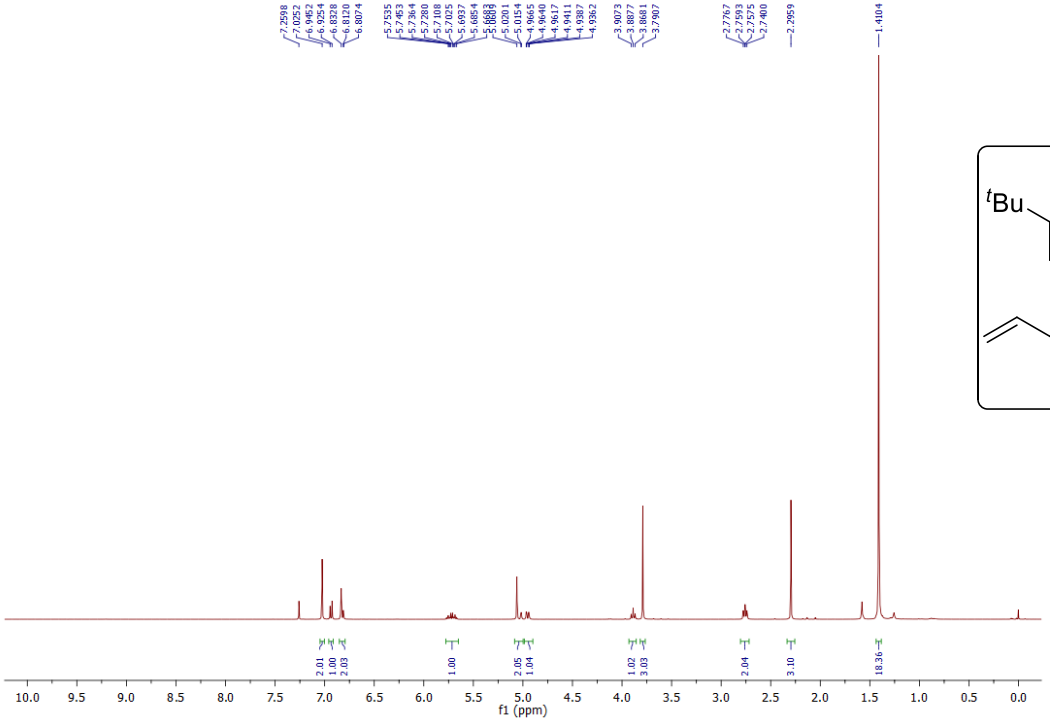
^{1}H NMR Spectrum of **3n**



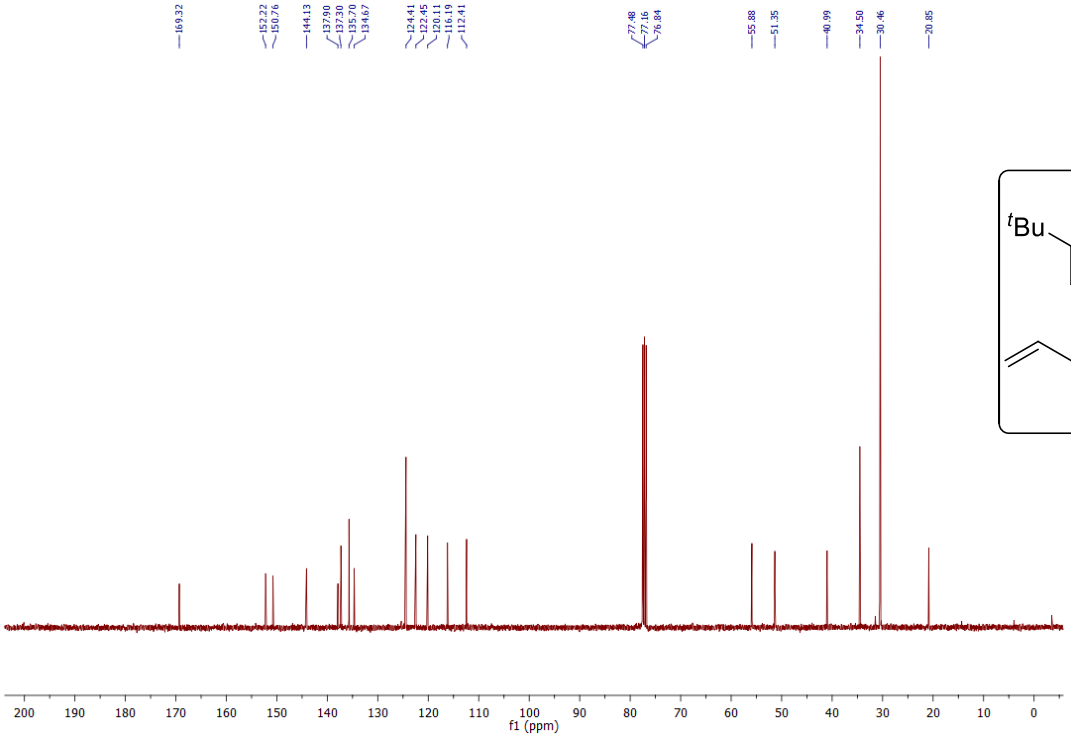
^{13}C NMR Spectrum of **3n**



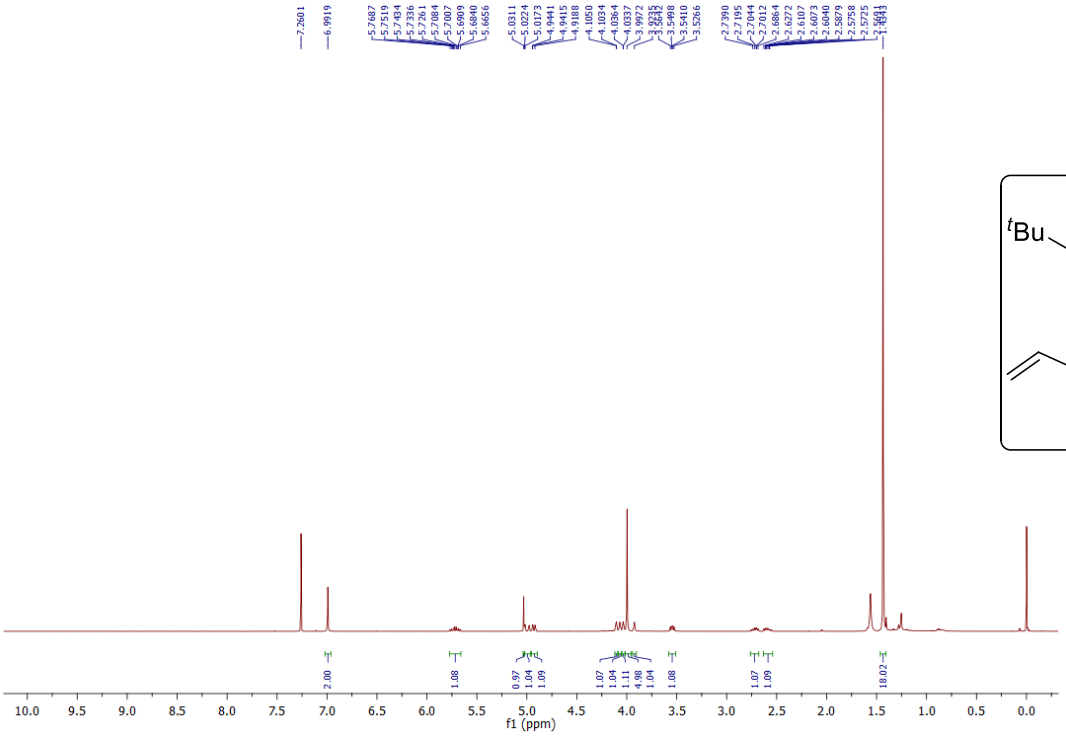
^{1}H NMR Spectrum of **3o**



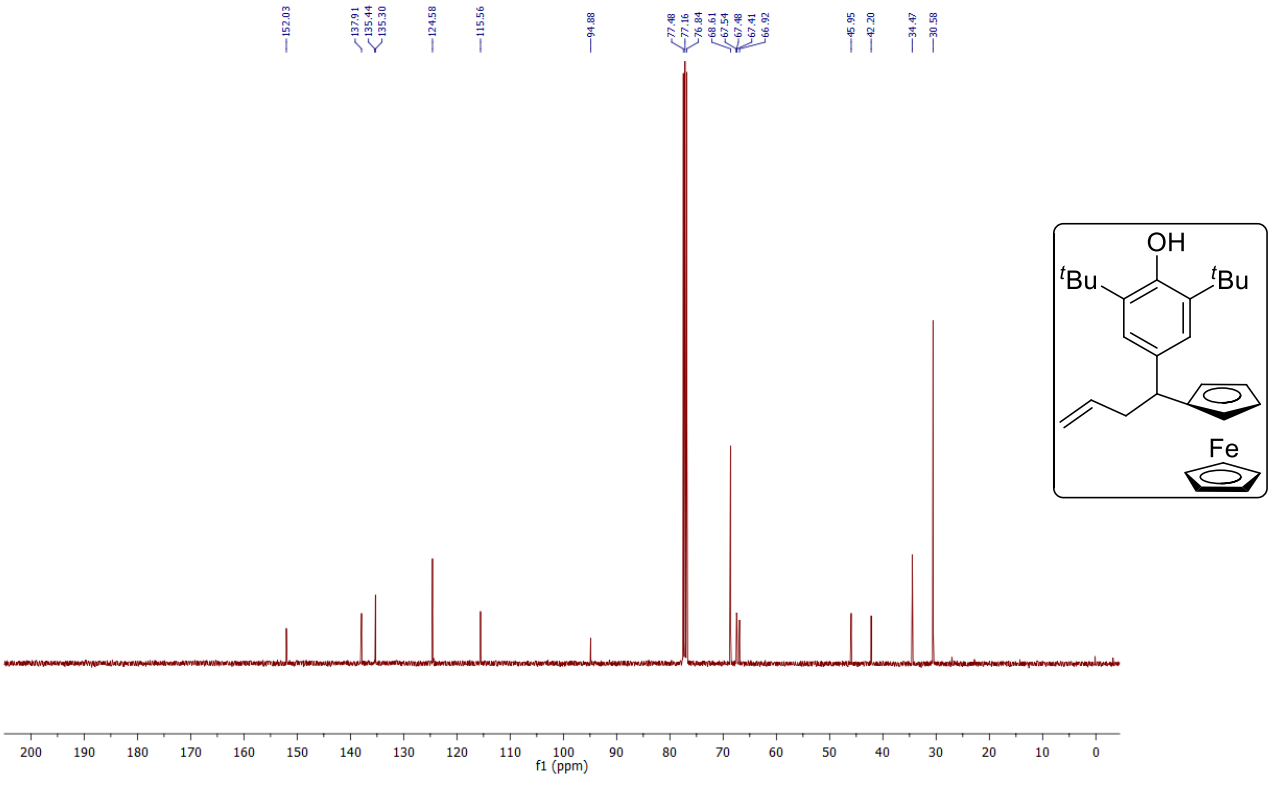
^{13}C NMR Spectrum of **3o**



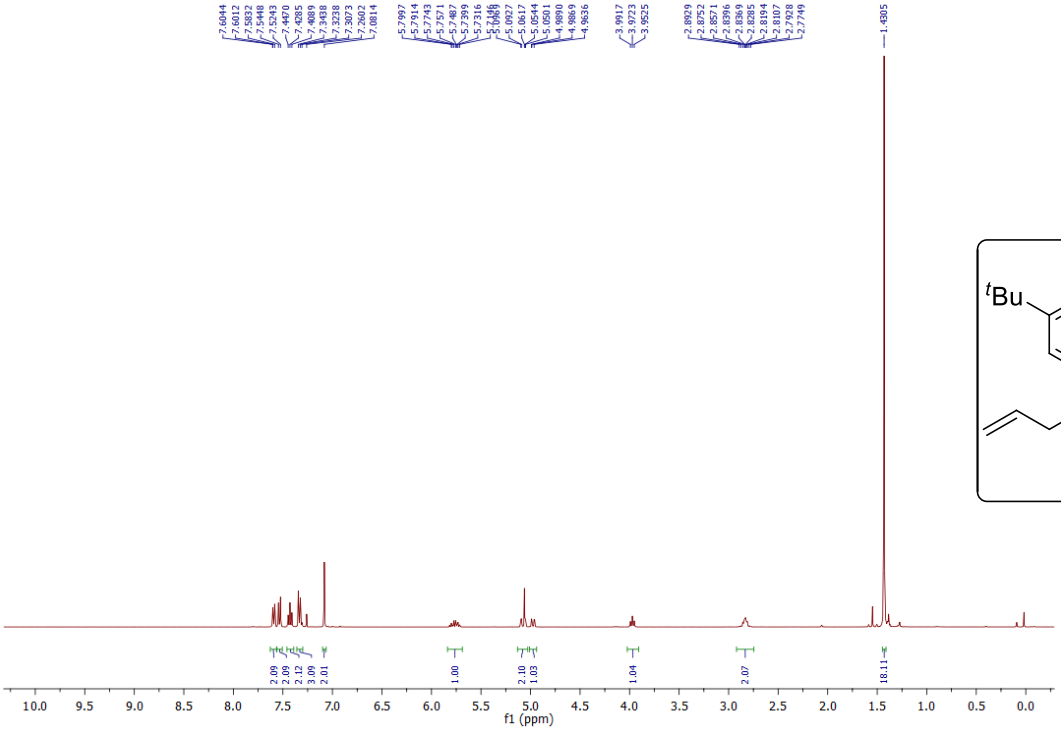
^{1}H NMR Spectrum of **3p**



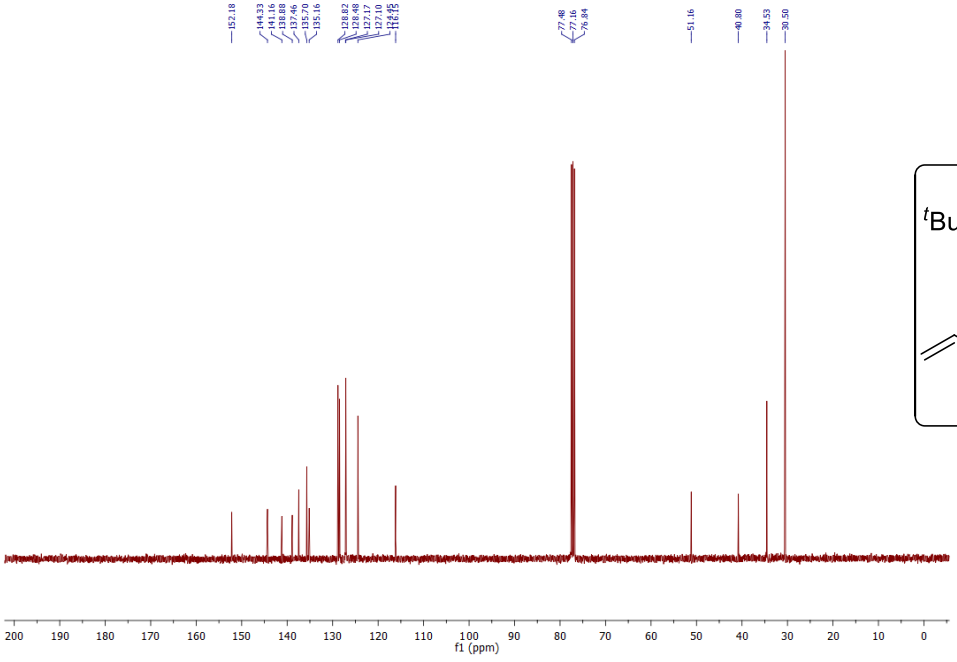
^{13}C NMR Spectrum of **3p**



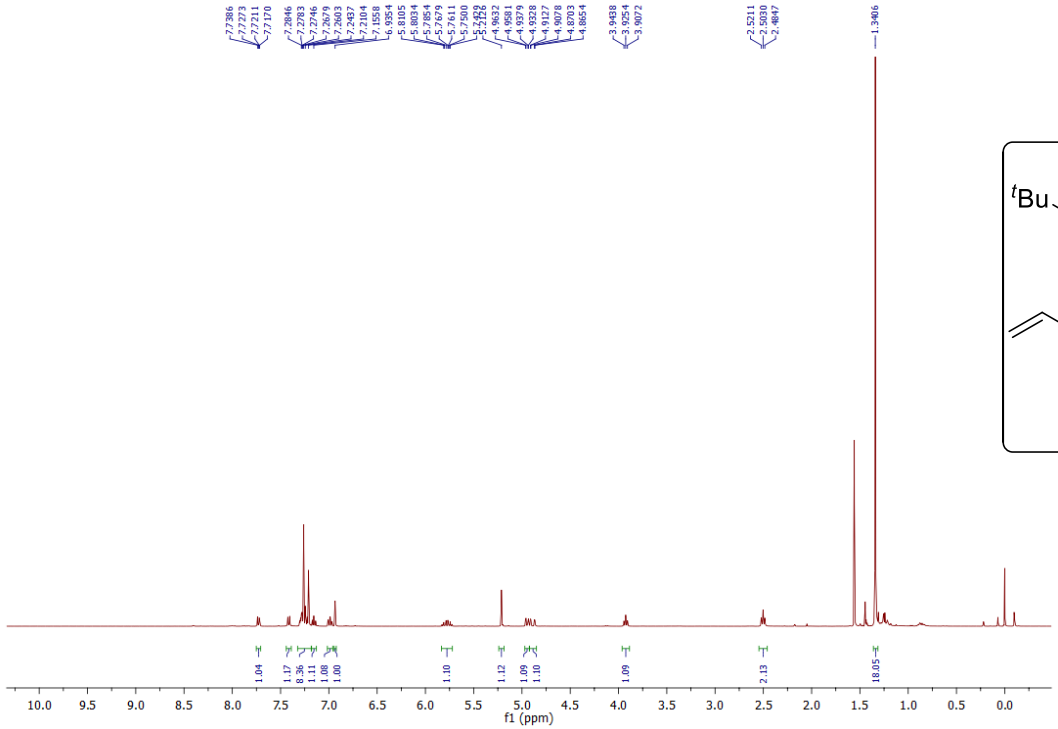
^{1}H NMR Spectrum of **3q**

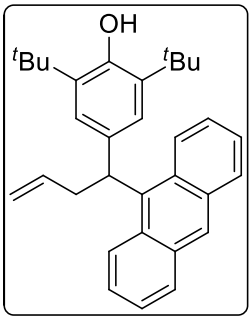


^{13}C NMR Spectrum of **3q**

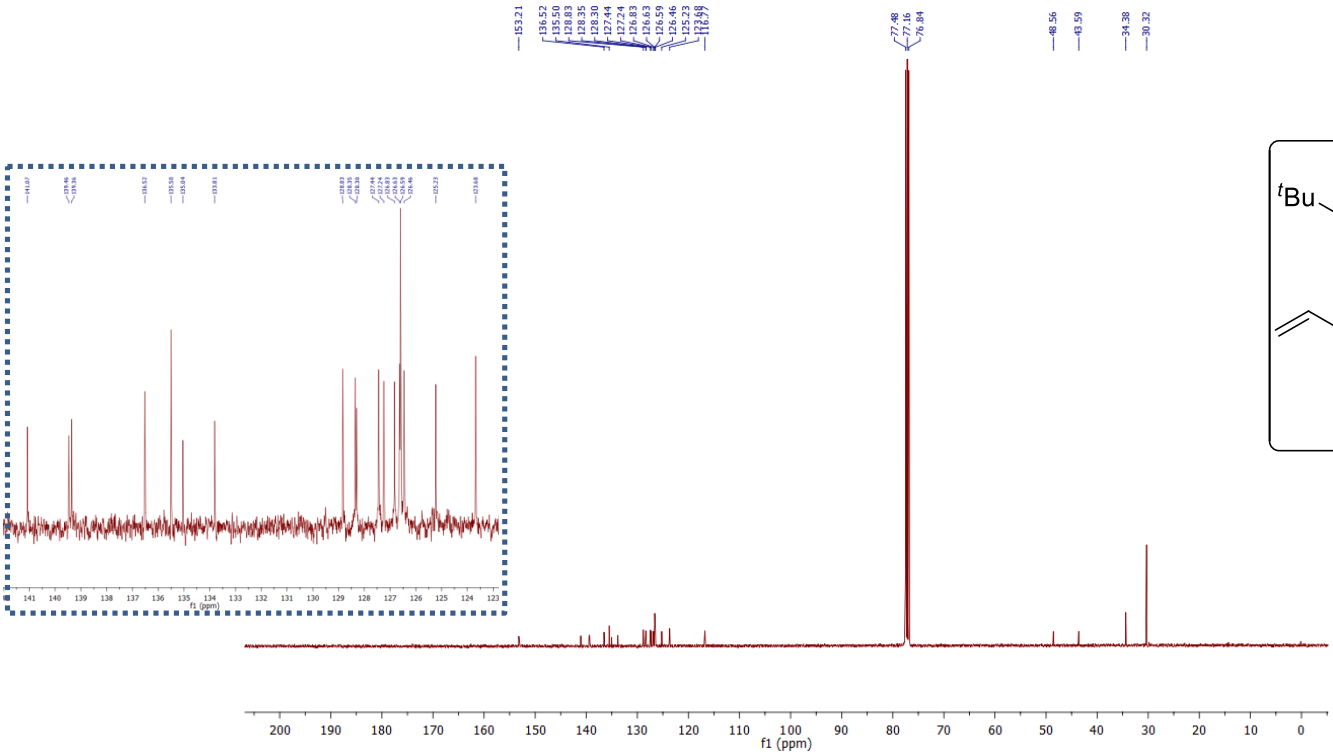


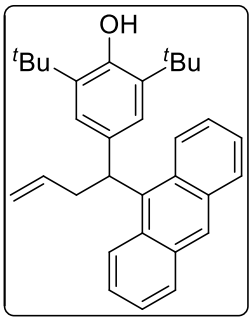
^{1}H NMR Spectrum of **3r**



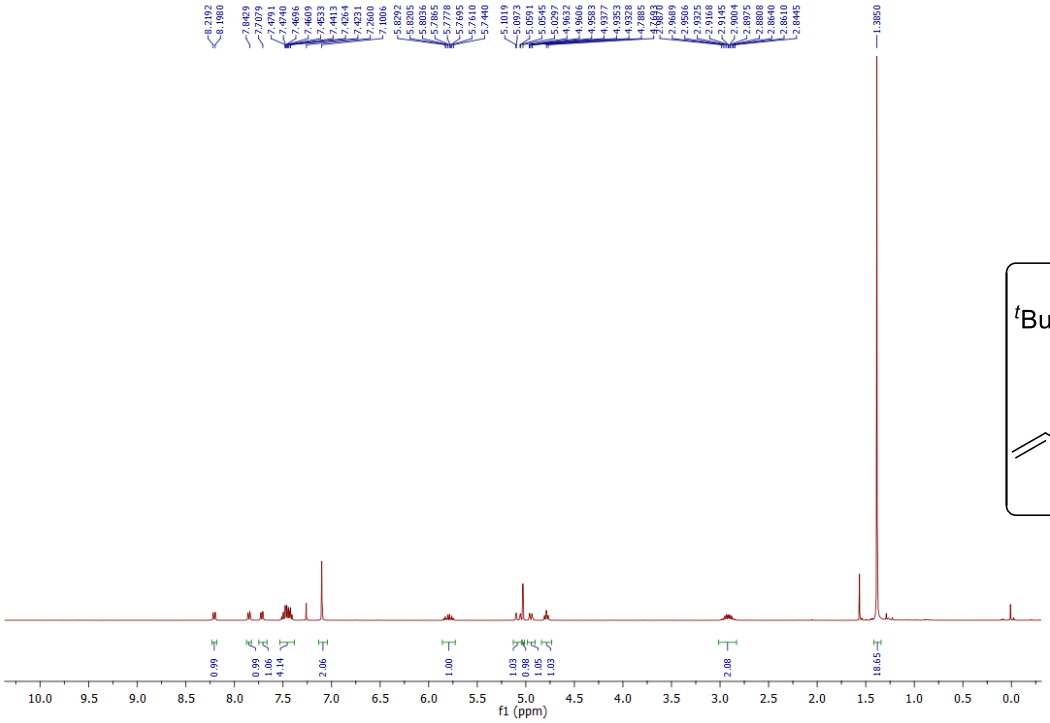


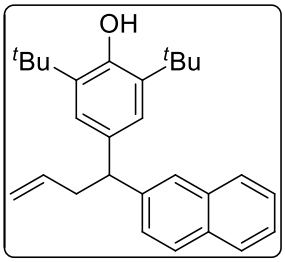
^{13}C NMR Spectrum of **3r**



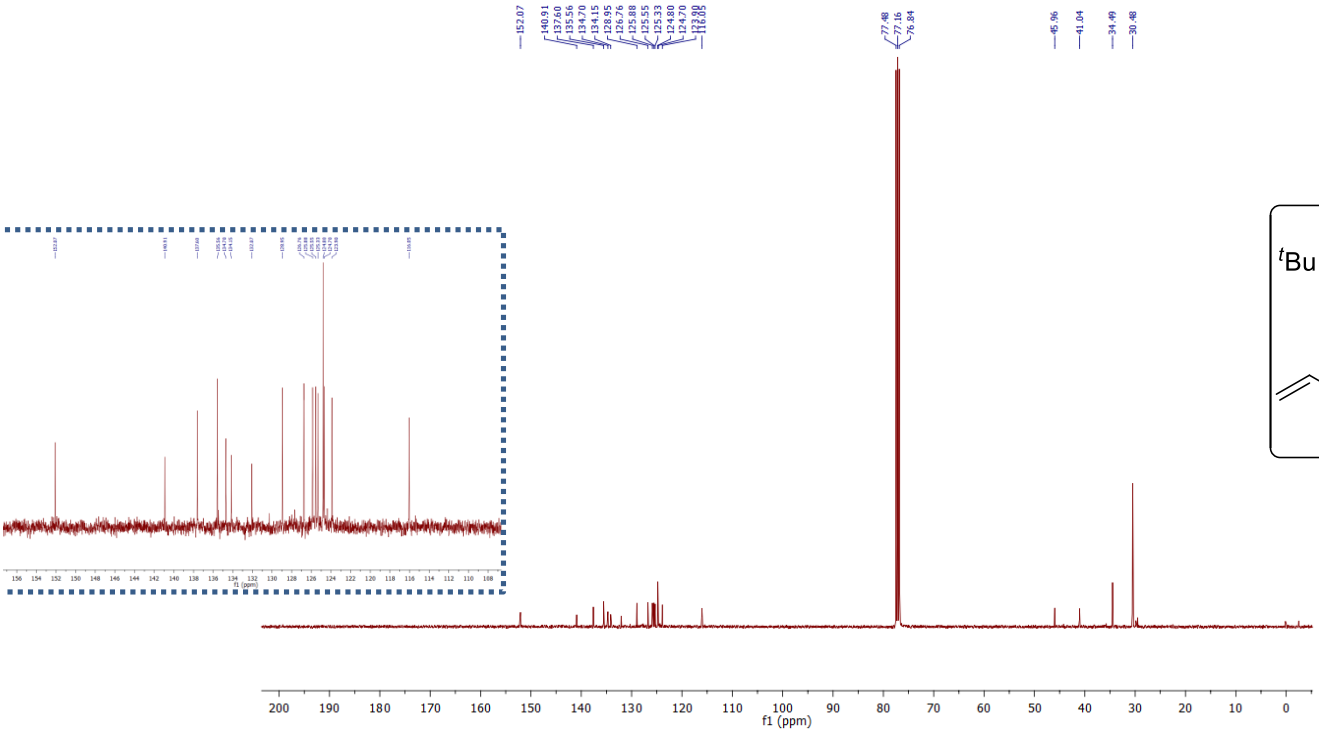


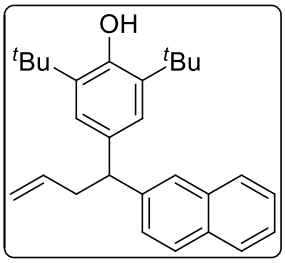
^{1}H NMR Spectrum of **3s**



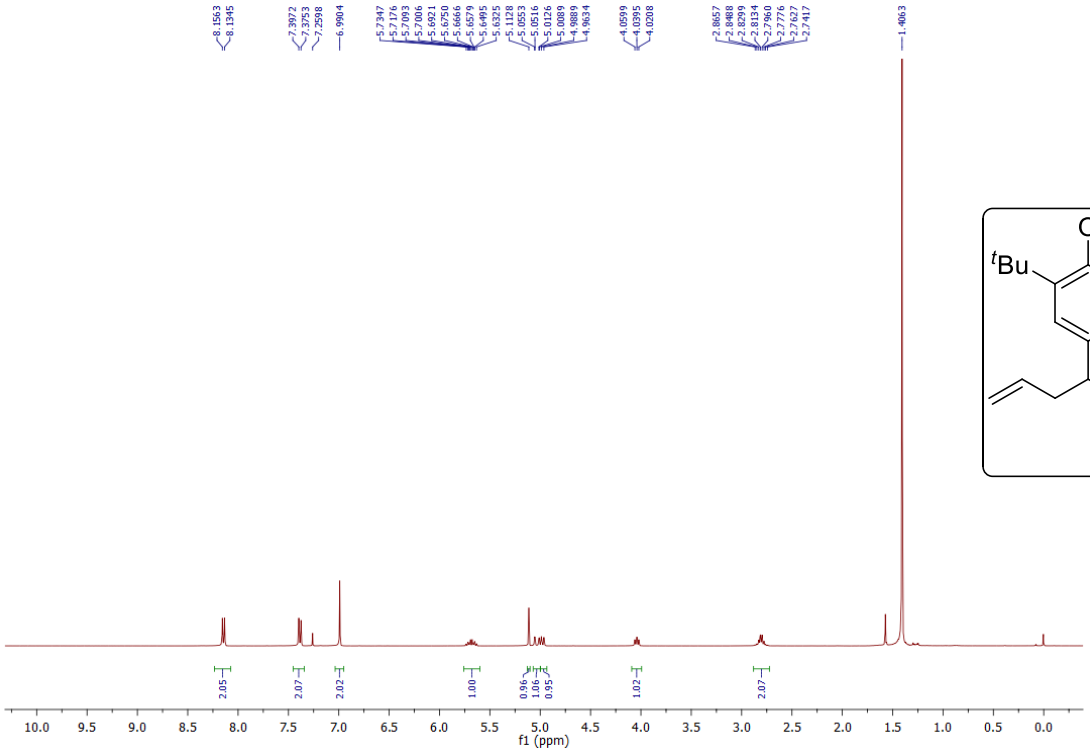


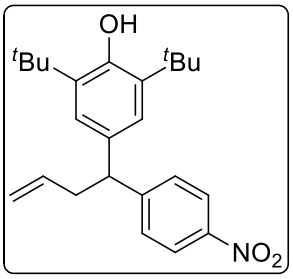
^{13}C NMR Spectrum of **3s**



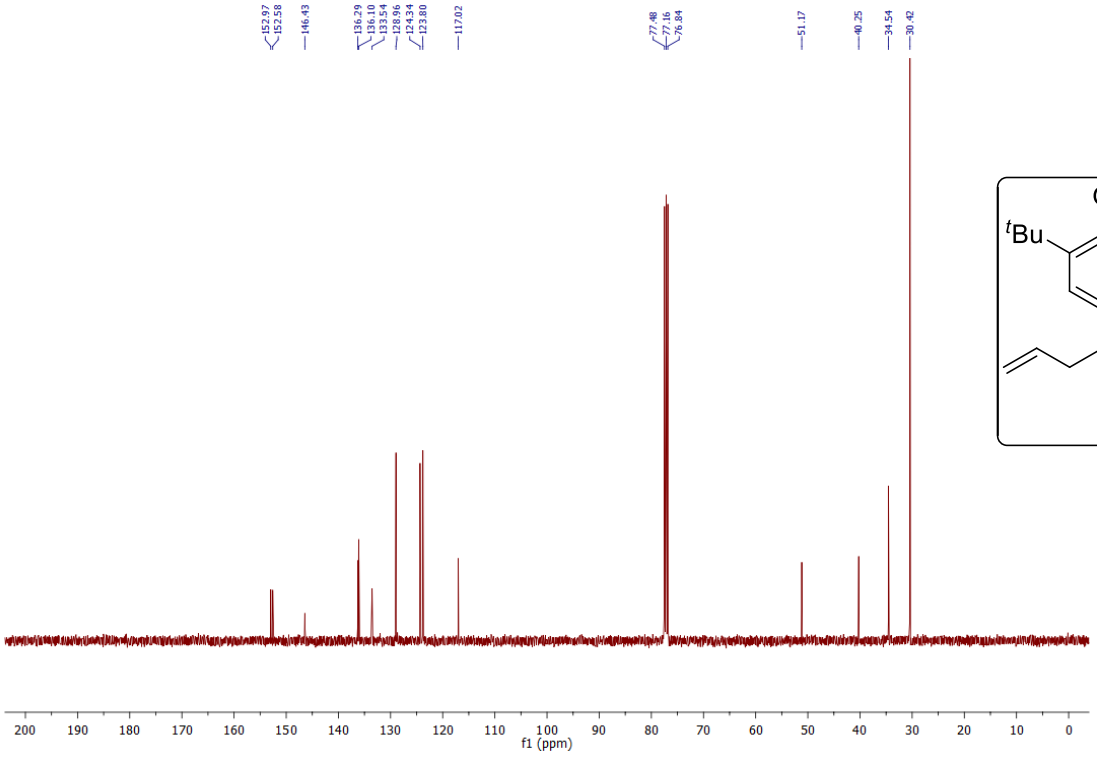


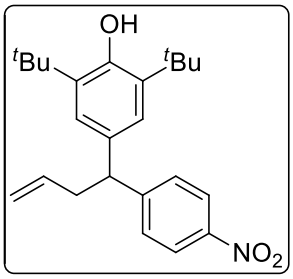
^{1}H NMR Spectrum of **3u**



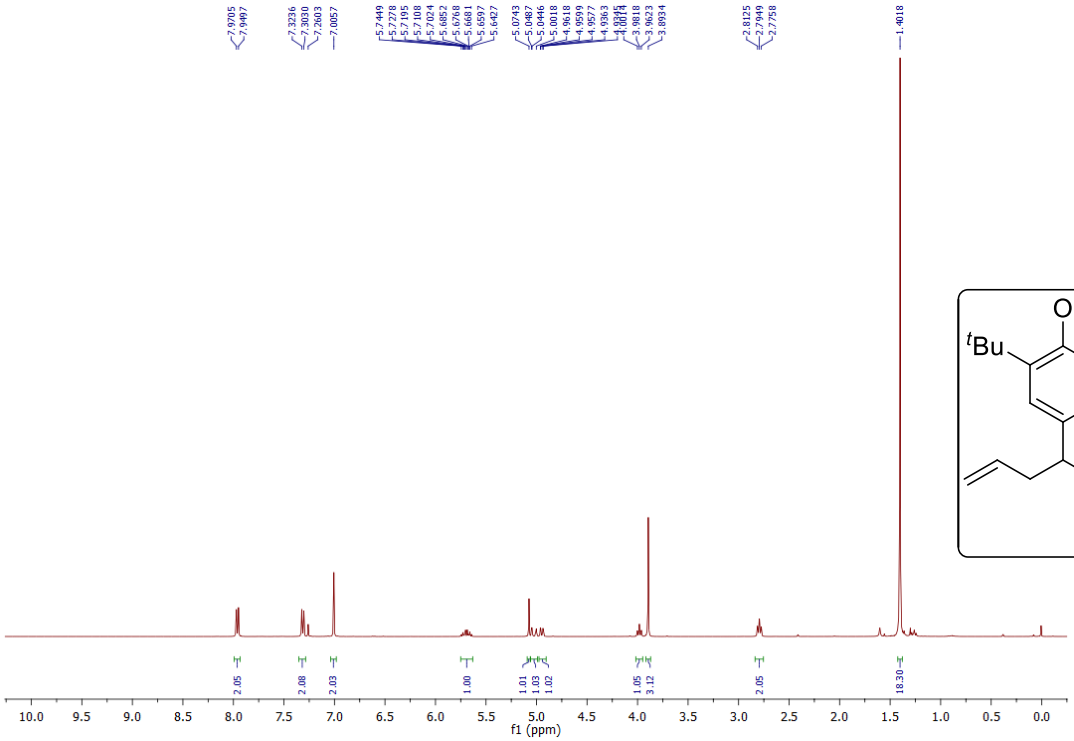


^{13}C NMR Spectrum of **3u**

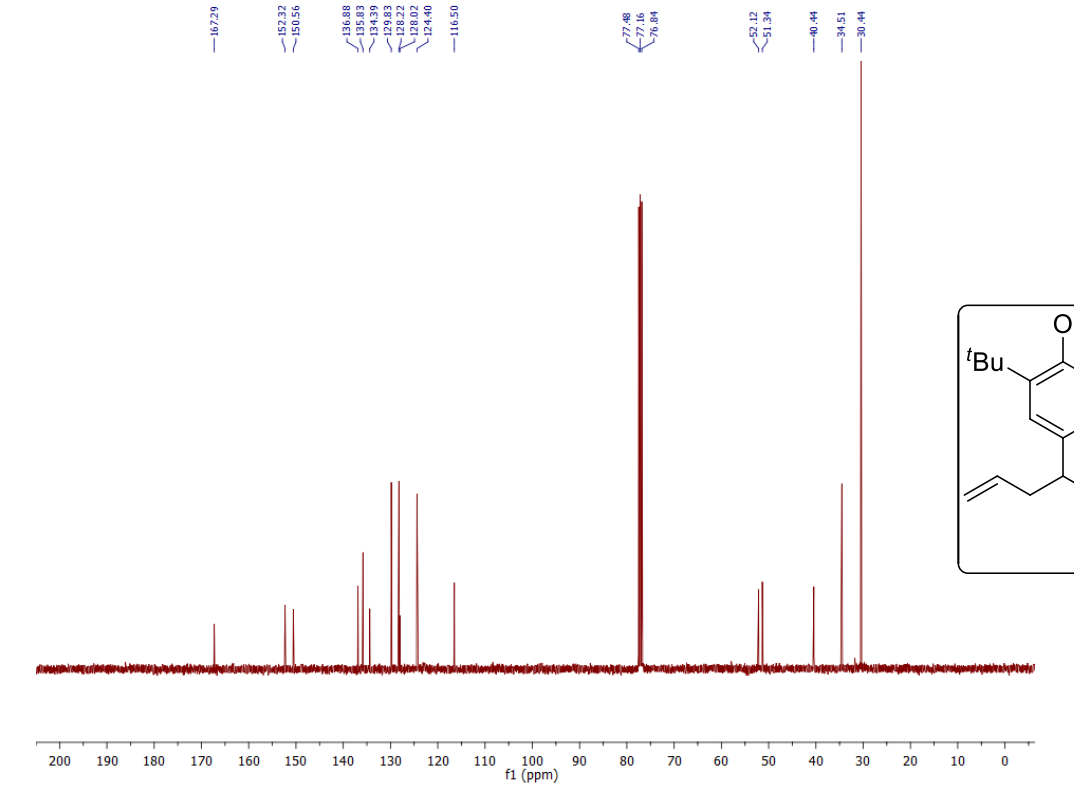




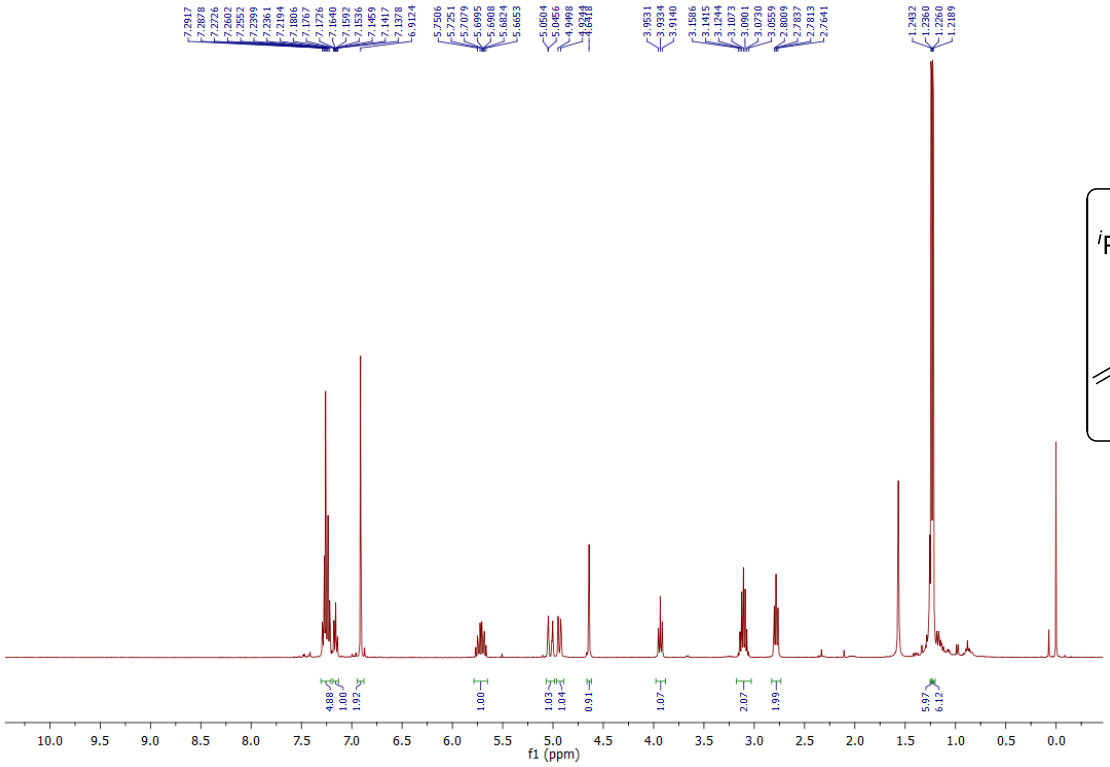
^{1}H NMR Spectrum of **3v**



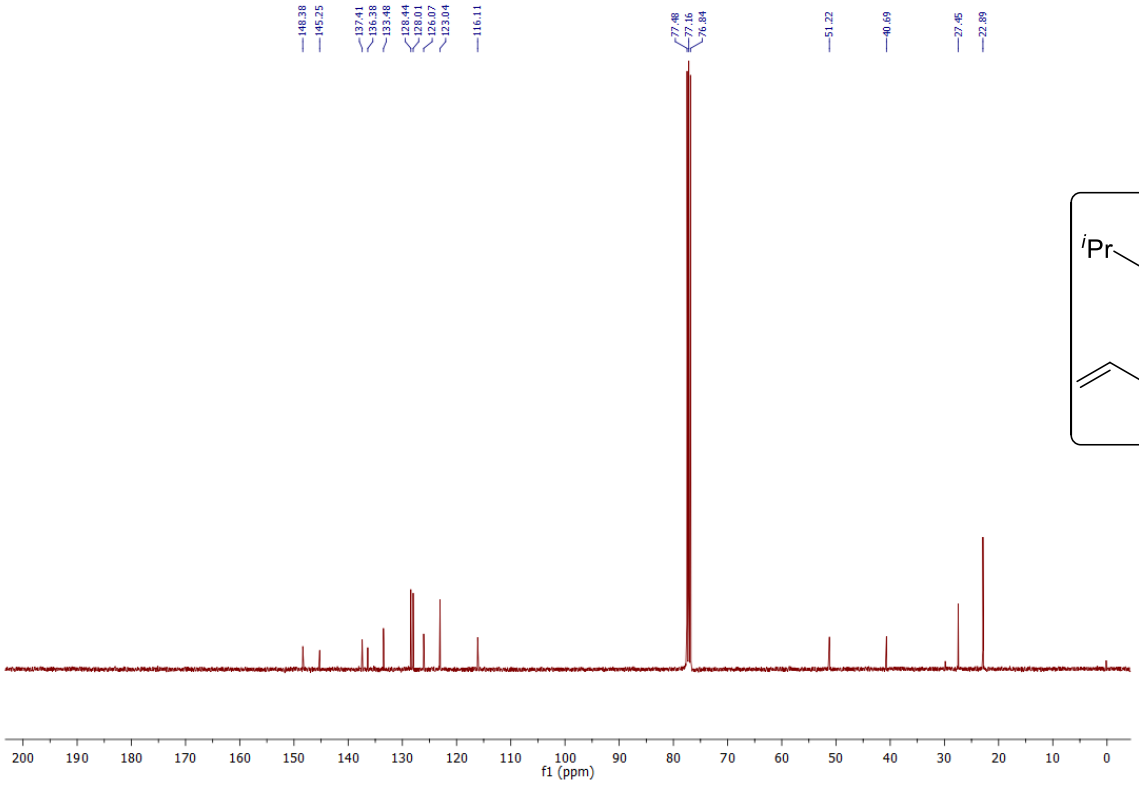
^{13}C NMR Spectrum of **3v**



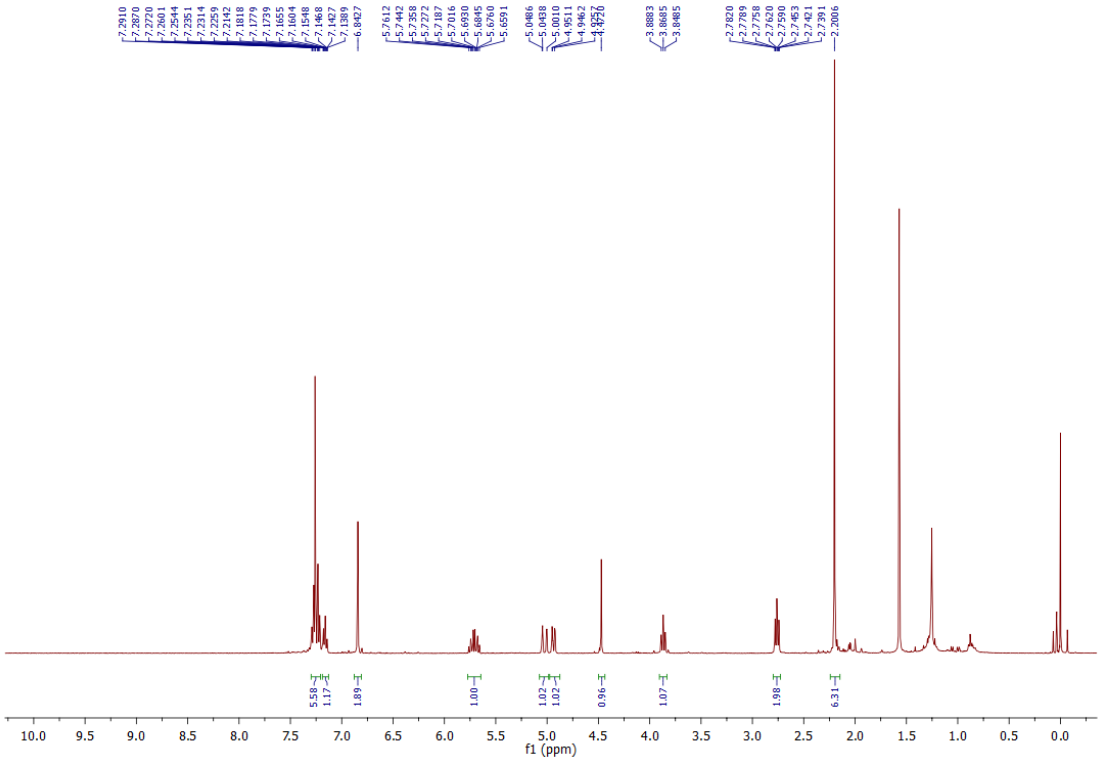
^{1}H NMR Spectrum of **3w**



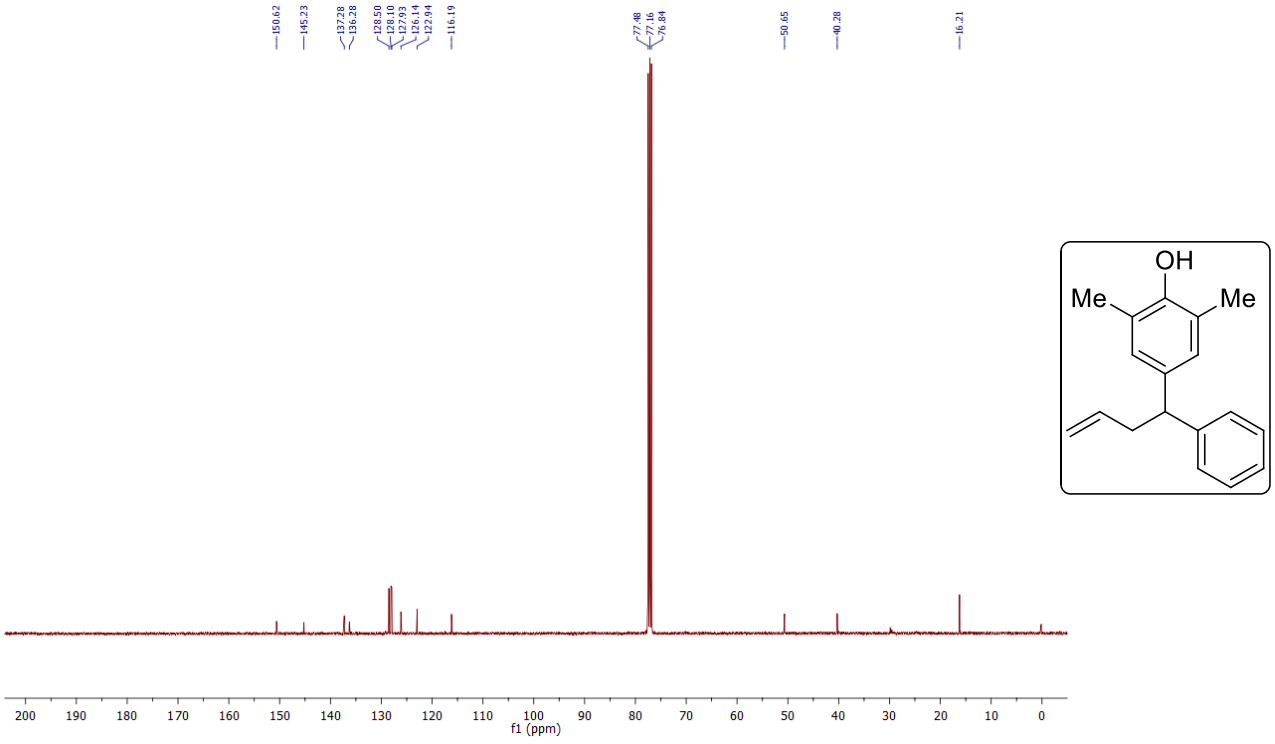
^{13}C NMR Spectrum of **3w**



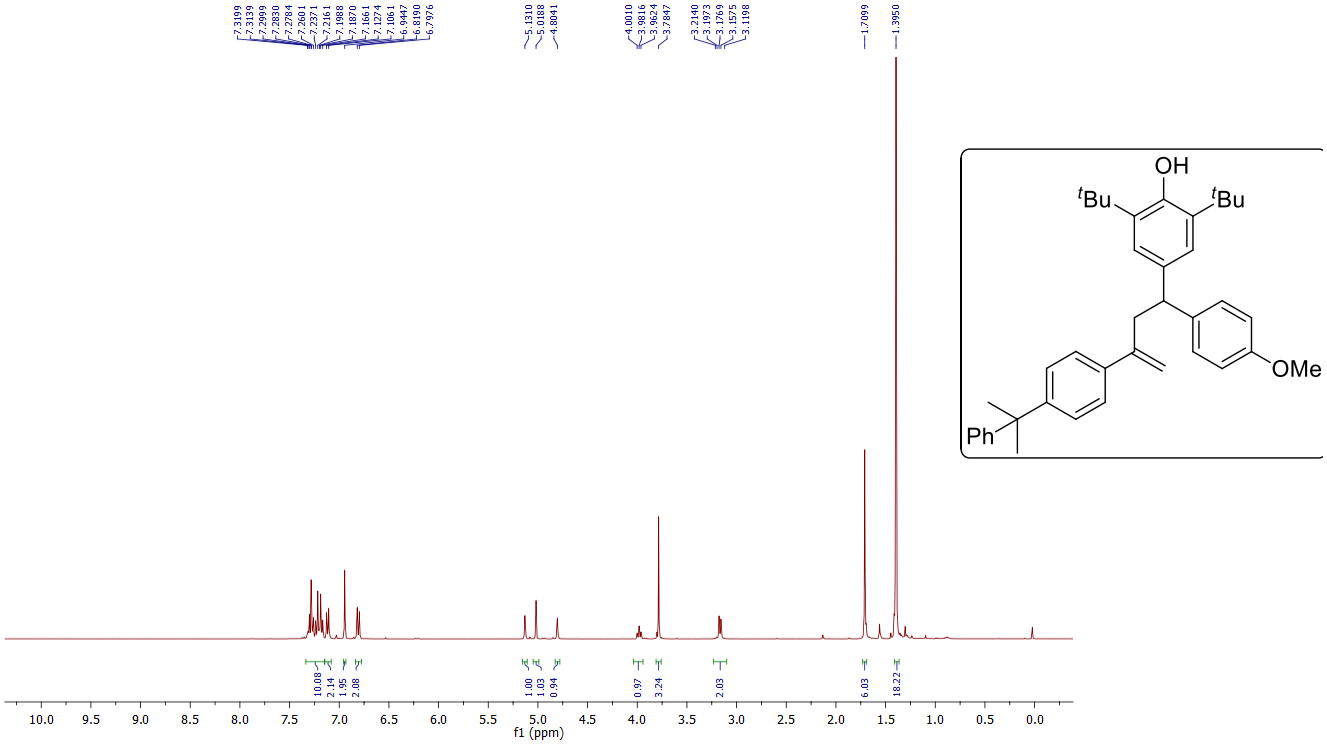
^{1}H NMR Spectrum of **3x**



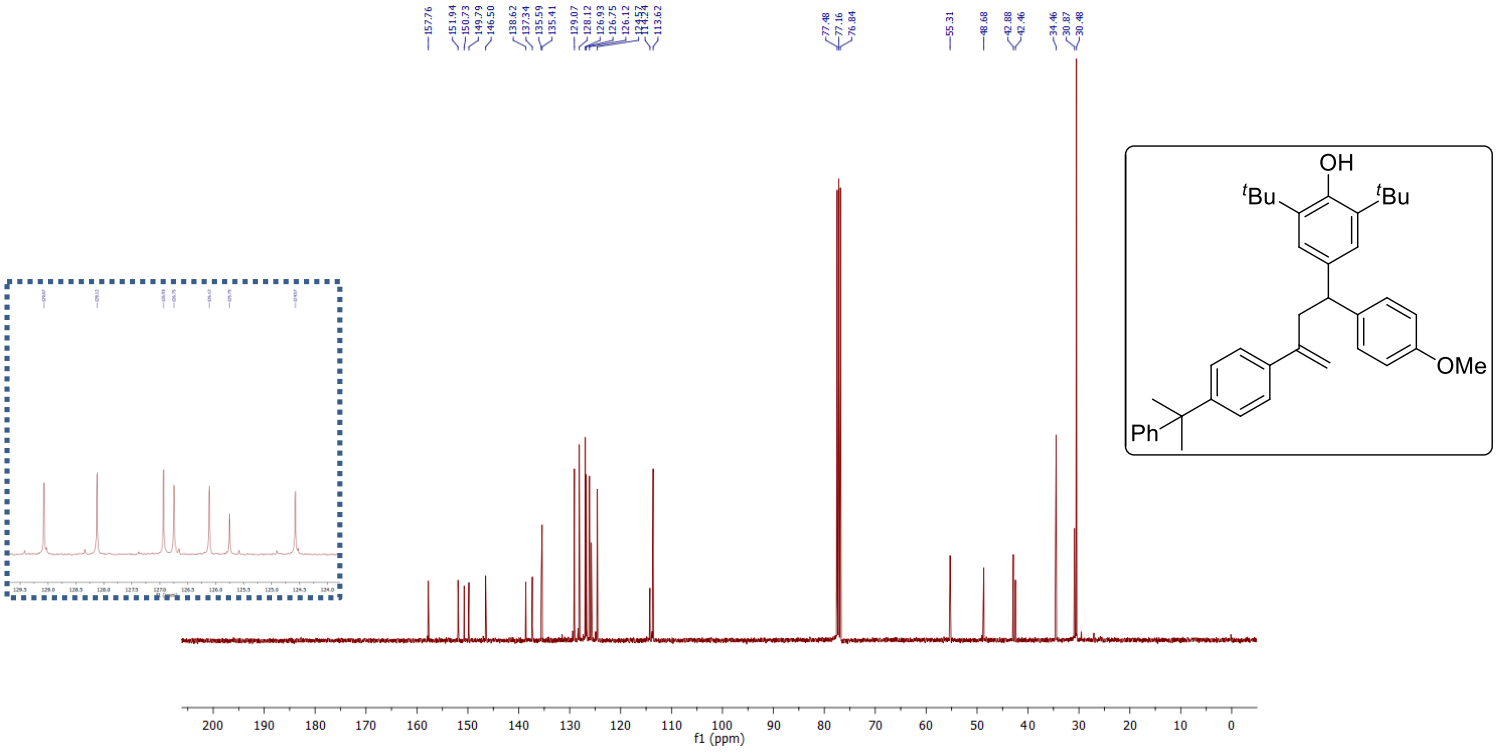
^{13}C NMR Spectrum of **3x**



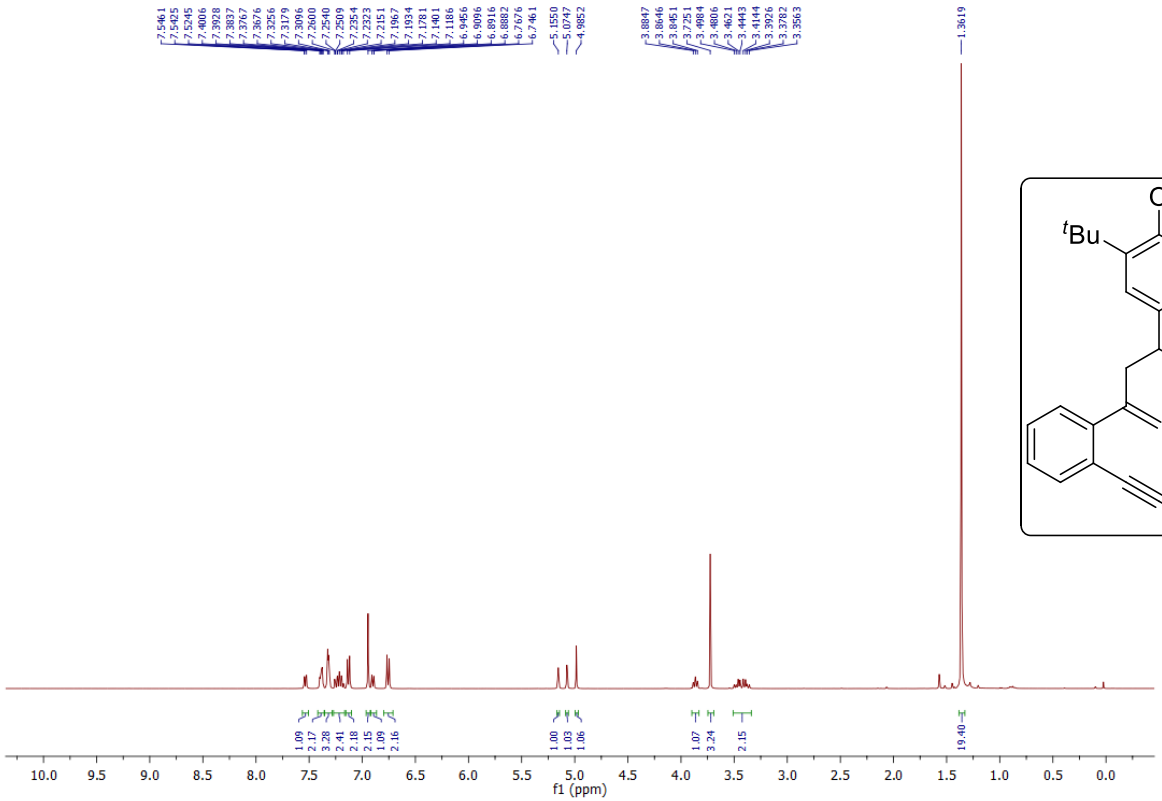
^{1}H NMR Spectrum of **4a**

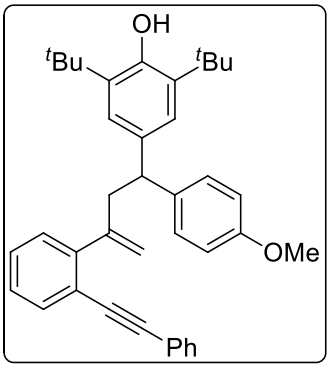


^{13}C NMR Spectrum of **4a**

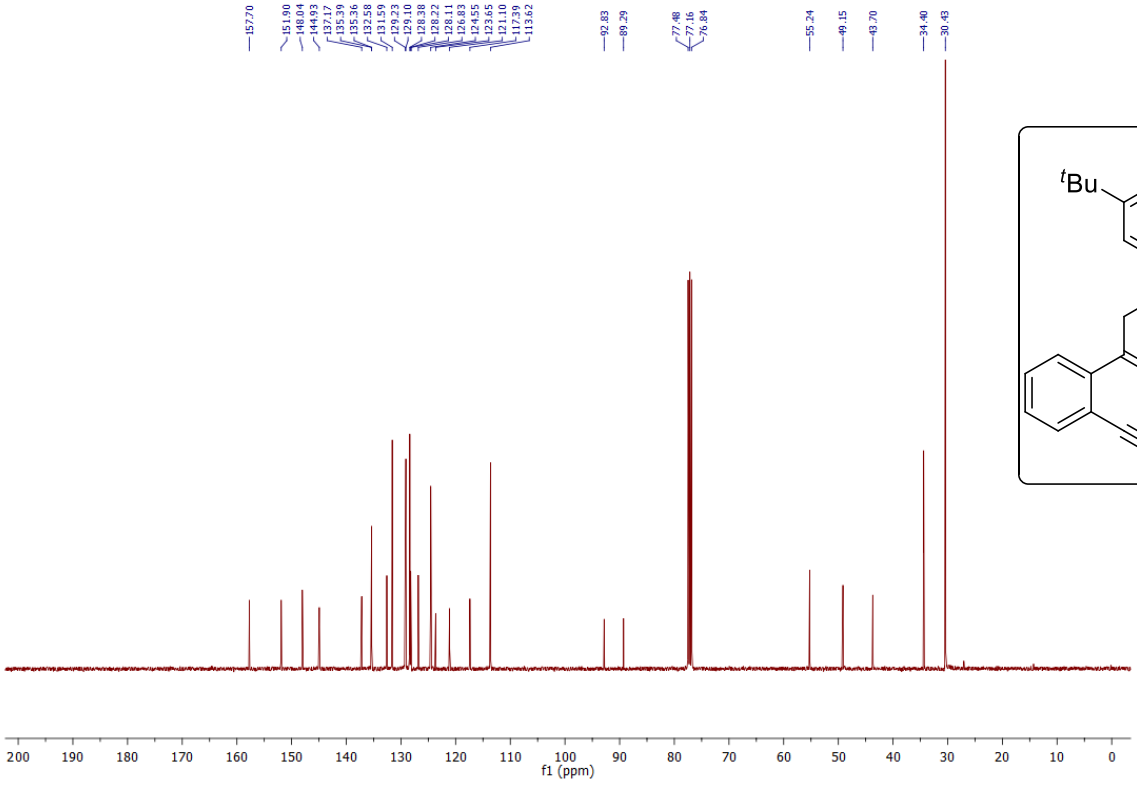


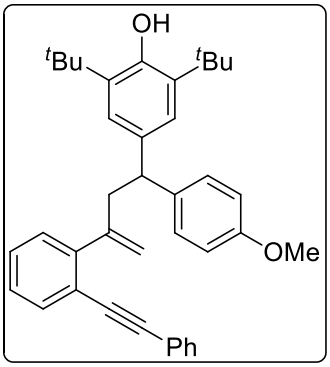
^{1}H NMR Spectrum of **4b**



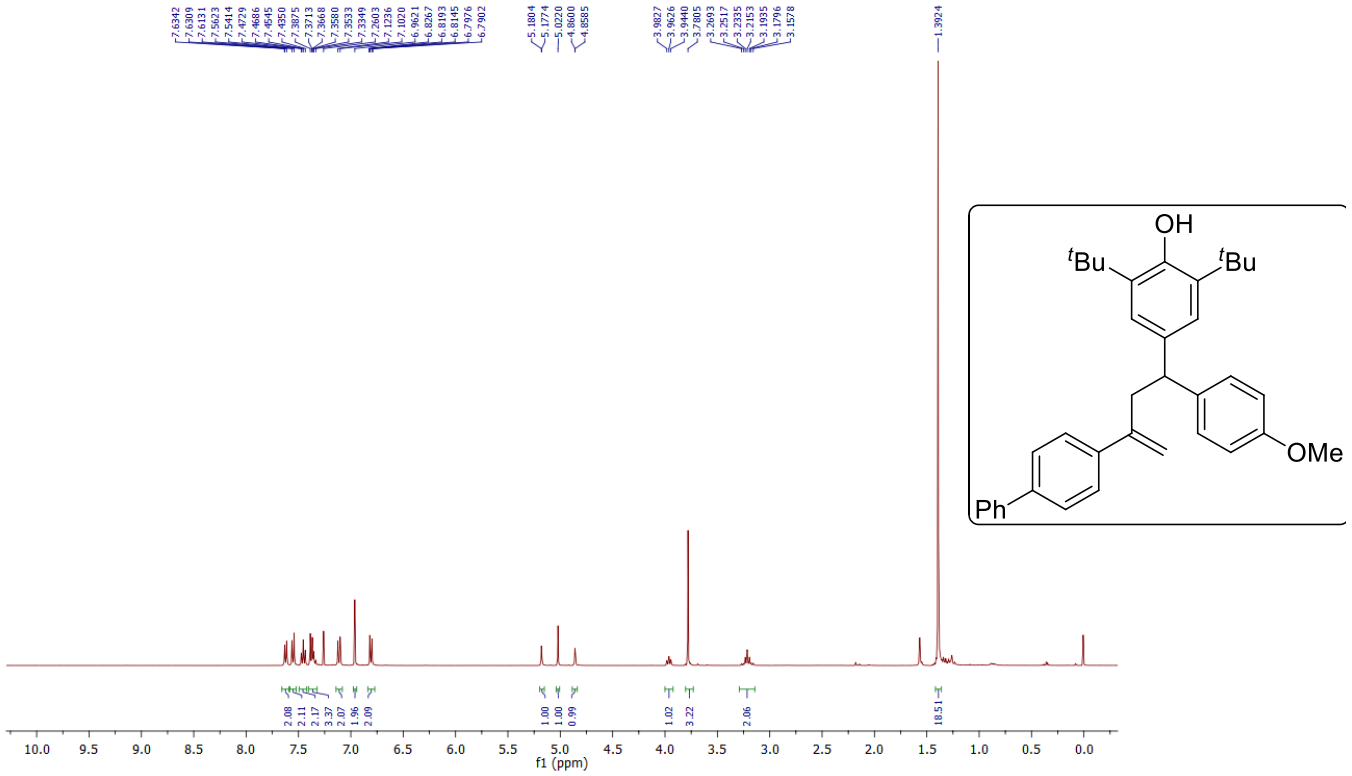


^{13}C NMR Spectrum of **4b**

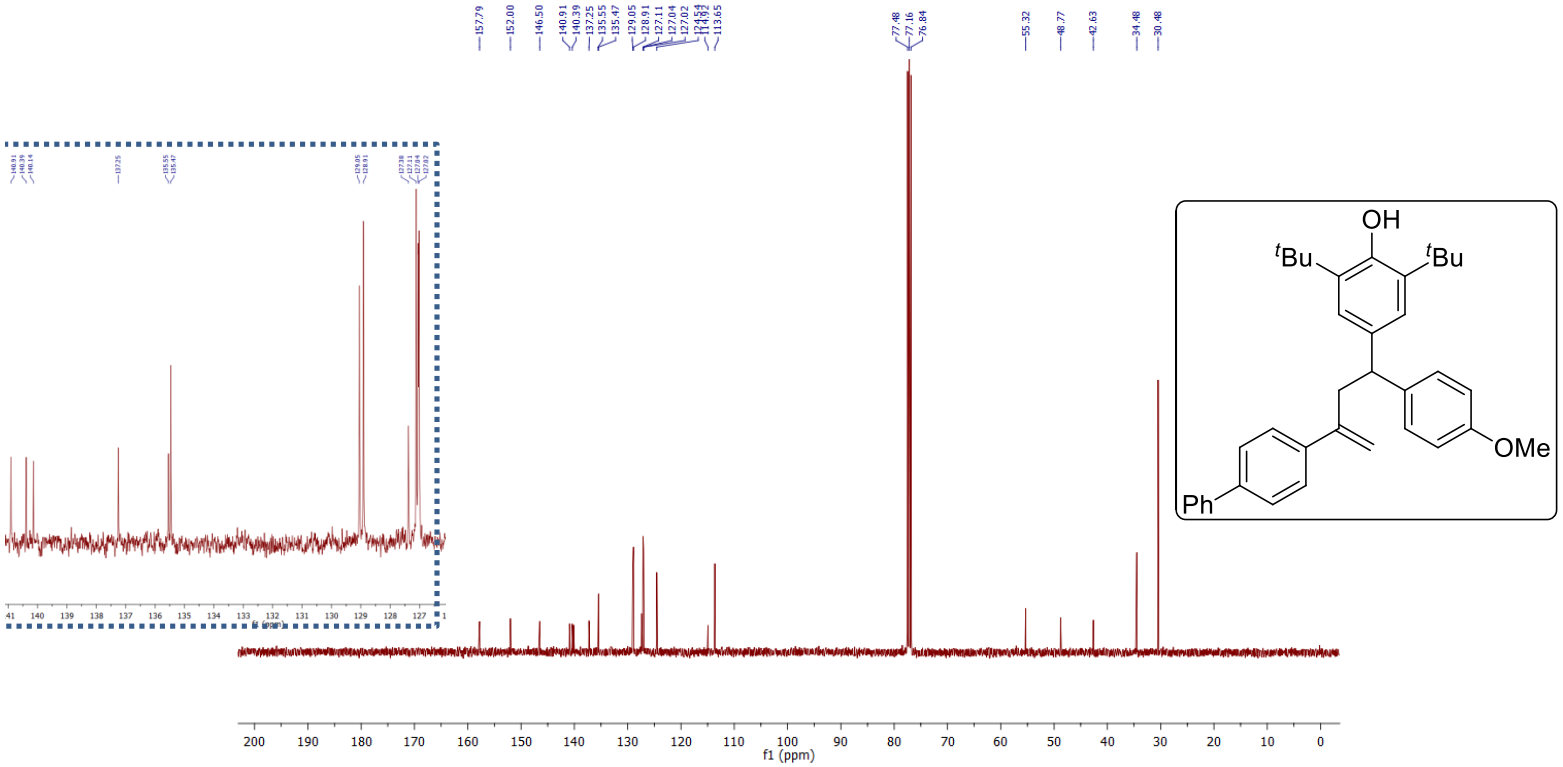




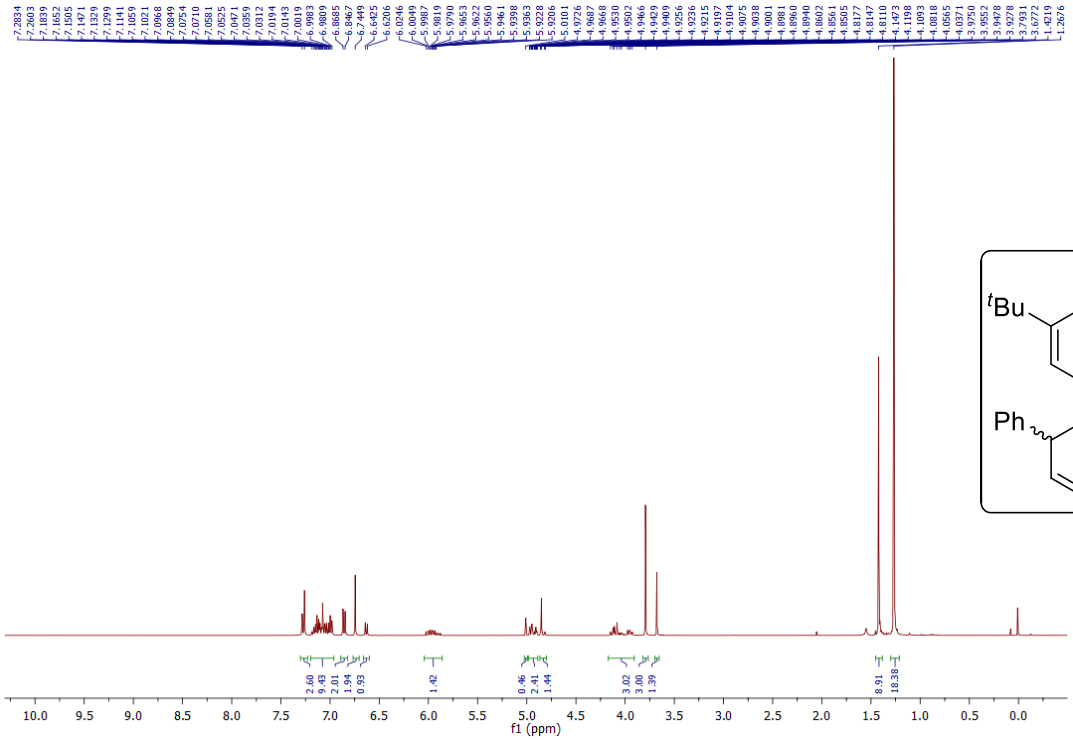
^{1}H NMR Spectrum of **4c**



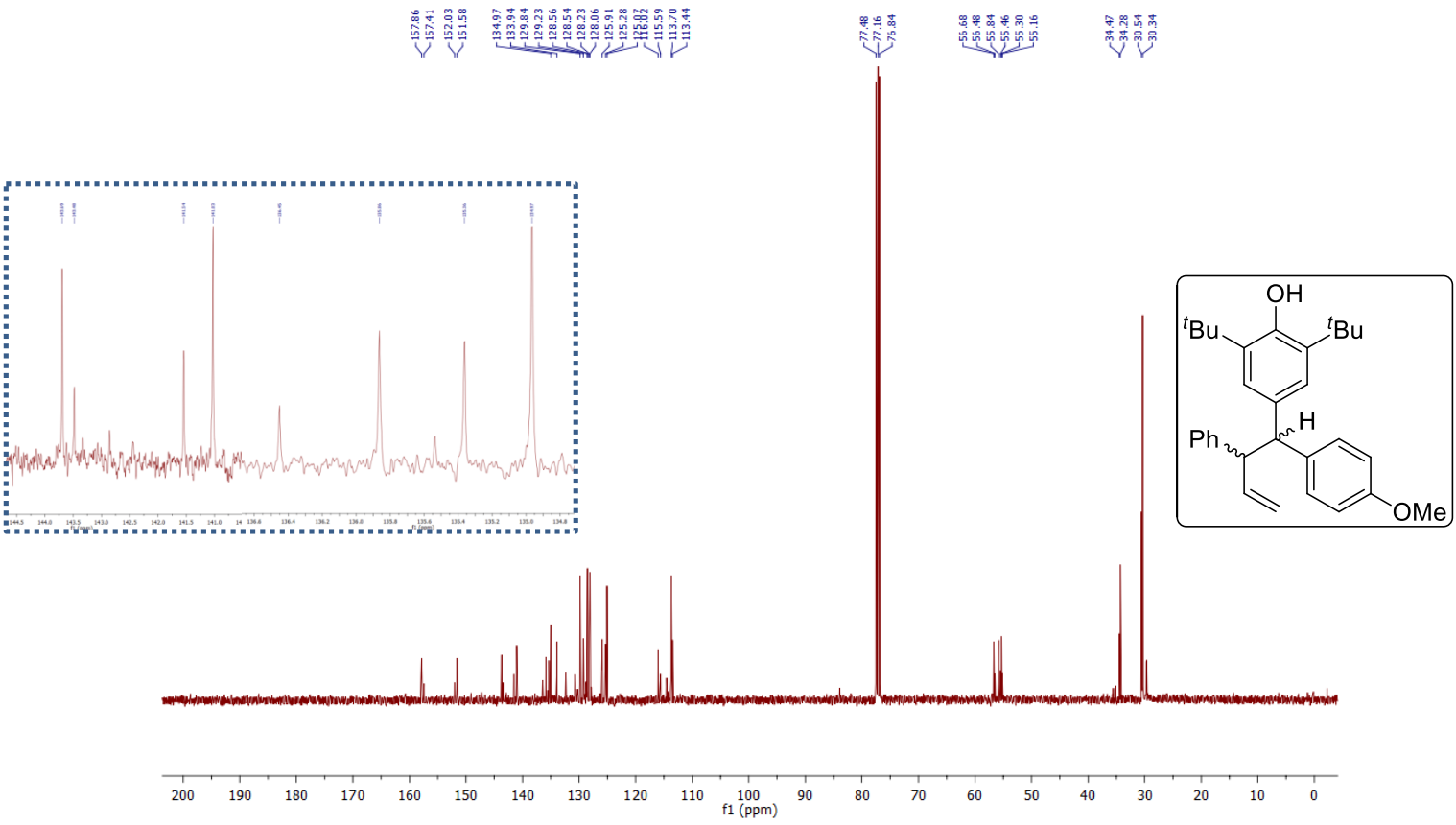
^{13}C NMR Spectrum of **4c**



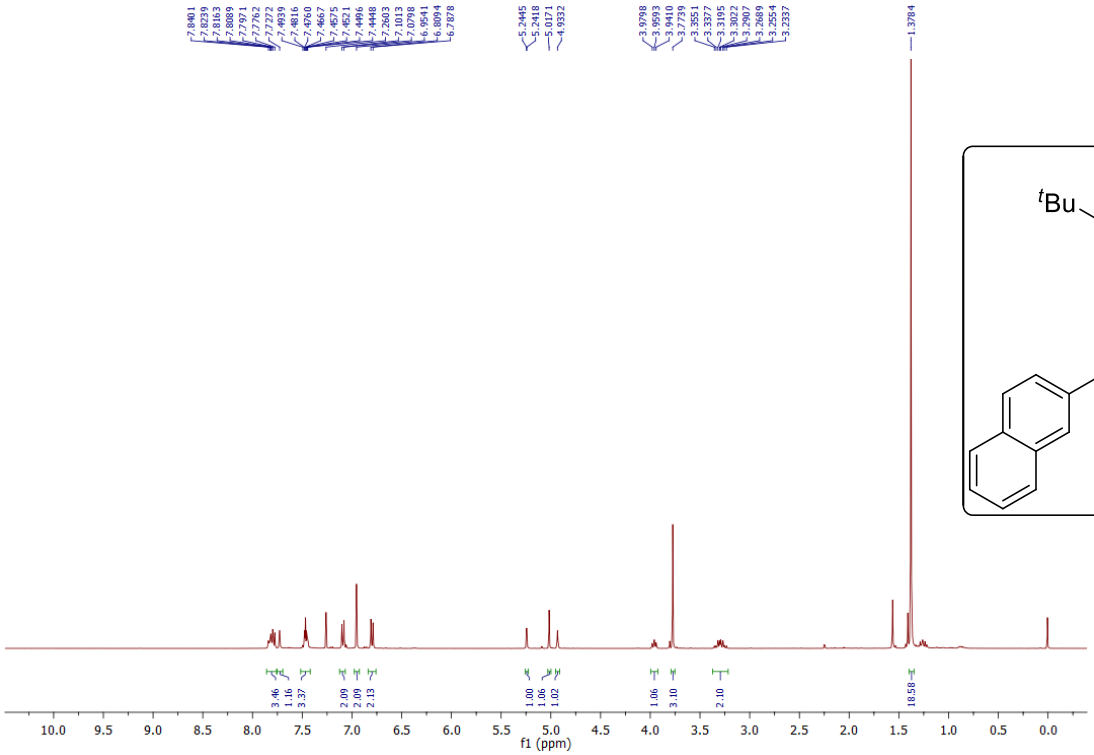
^{1}H NMR Spectrum of **4d**

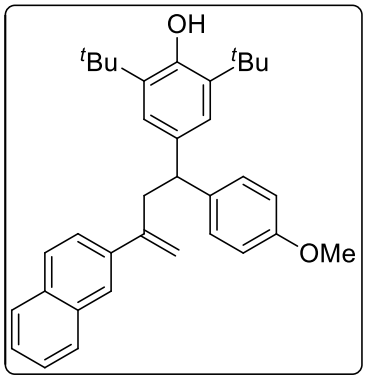


^{13}C NMR Spectrum of **4d**

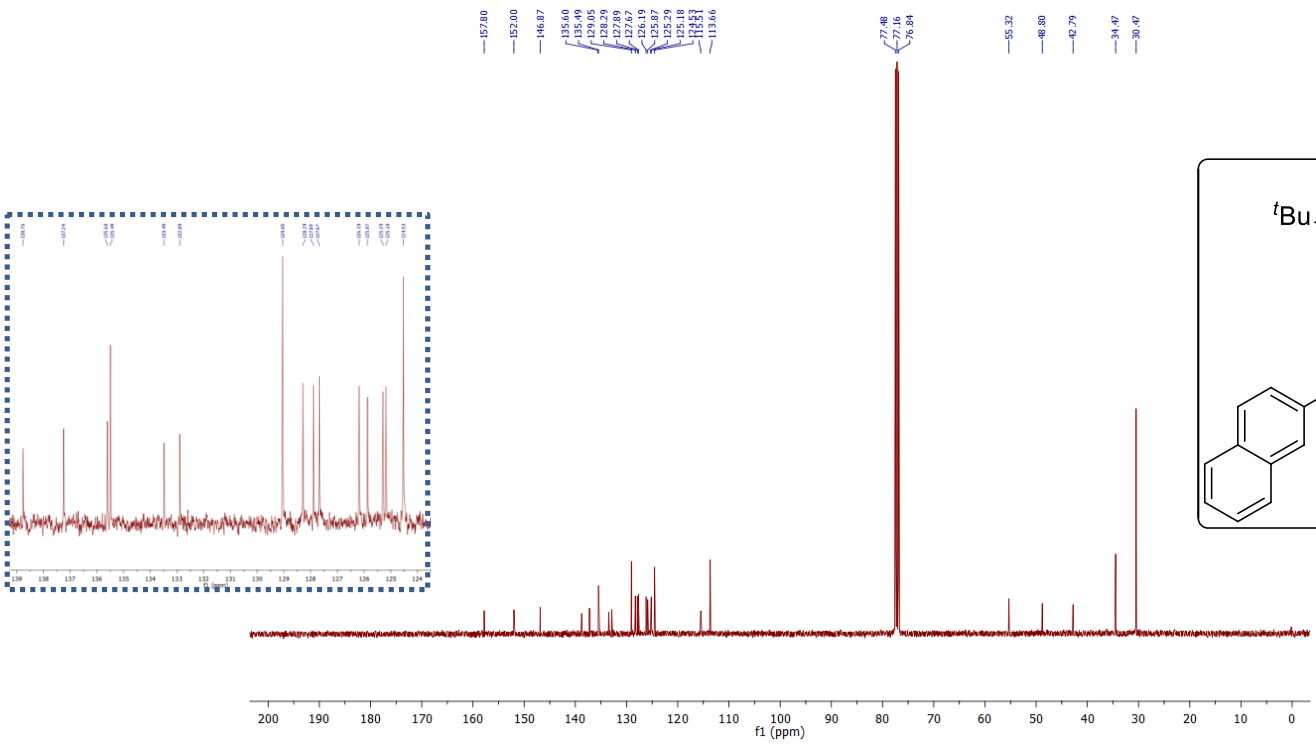


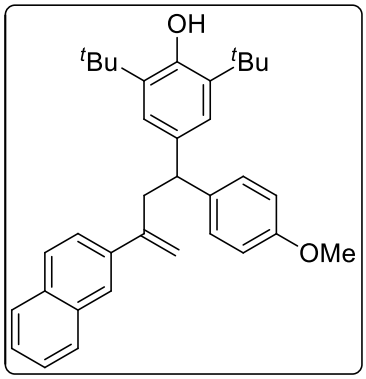
^{1}H NMR Spectrum of **4e**



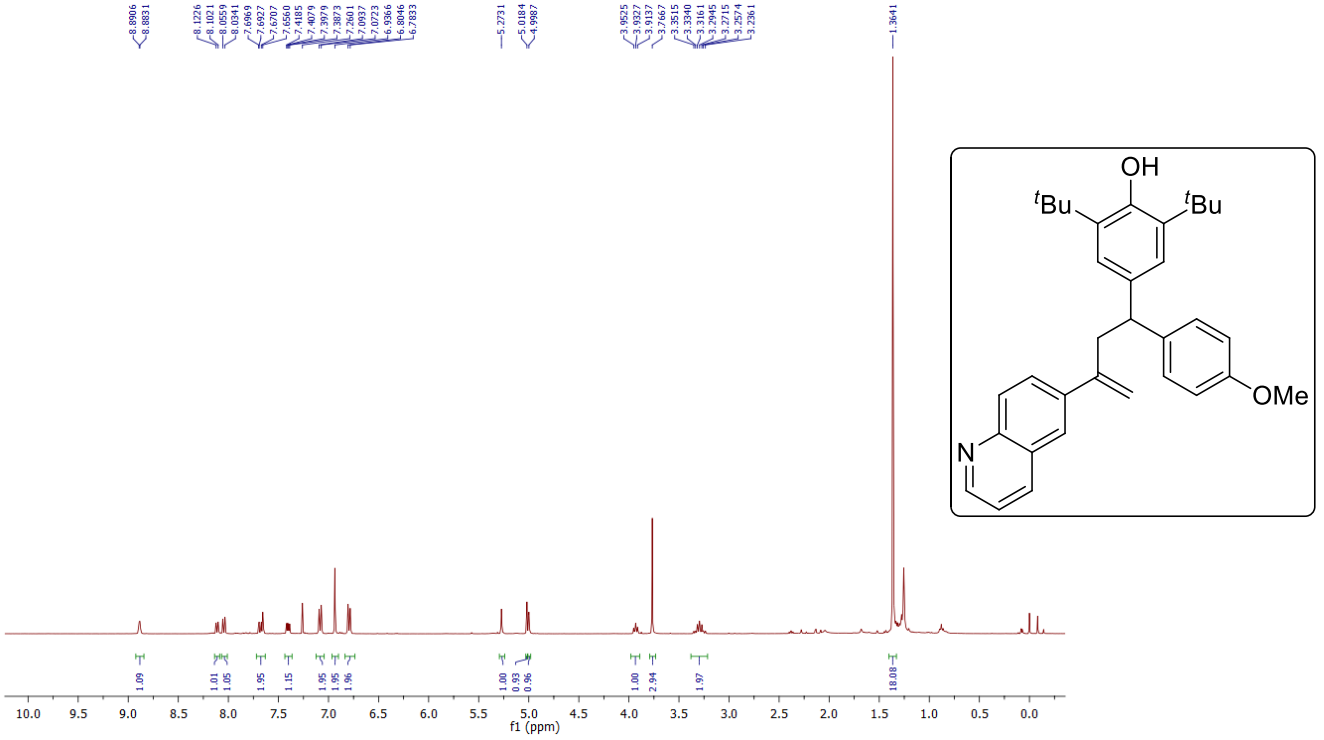


^{13}C NMR Spectrum of **4e**

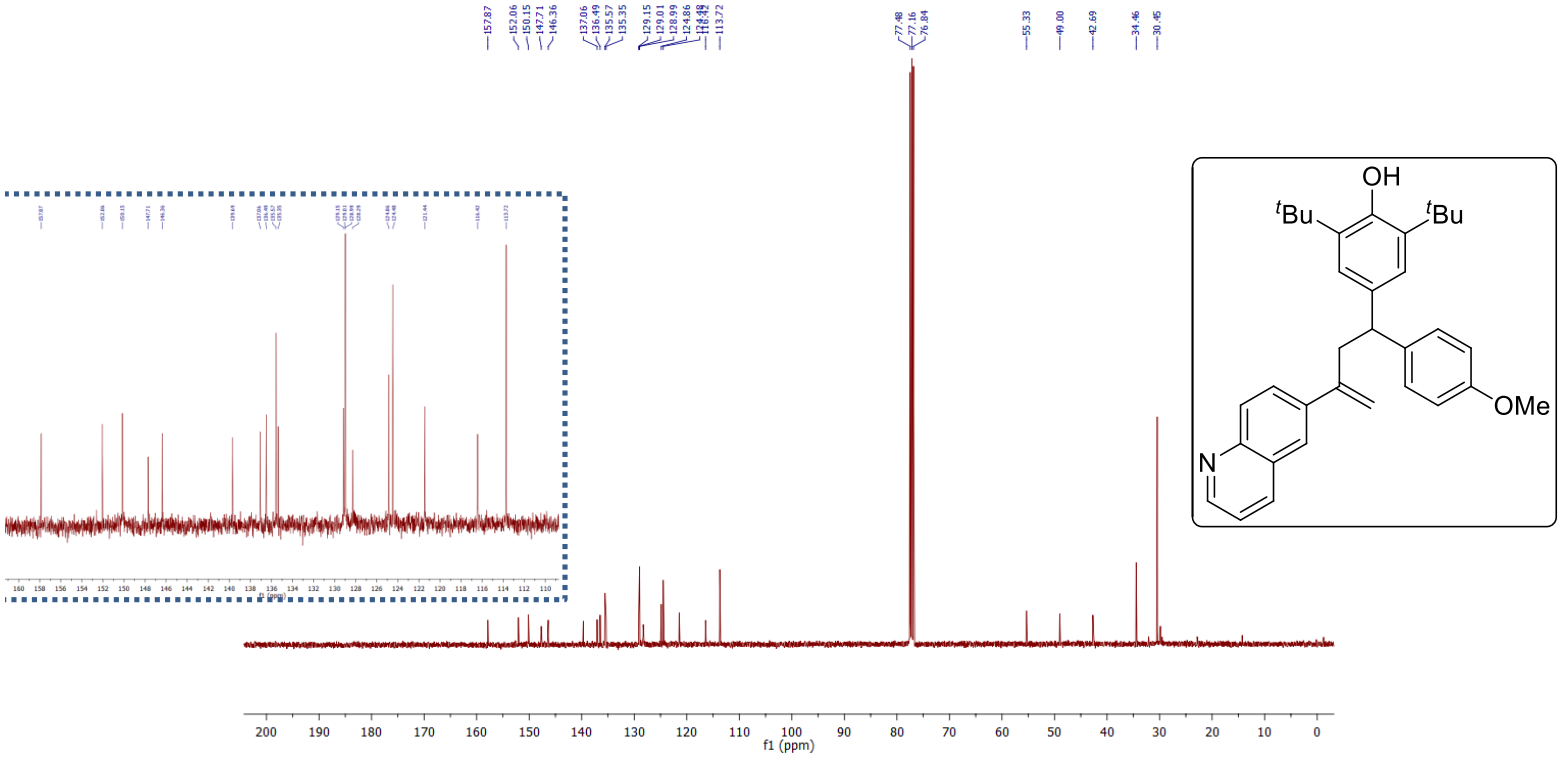




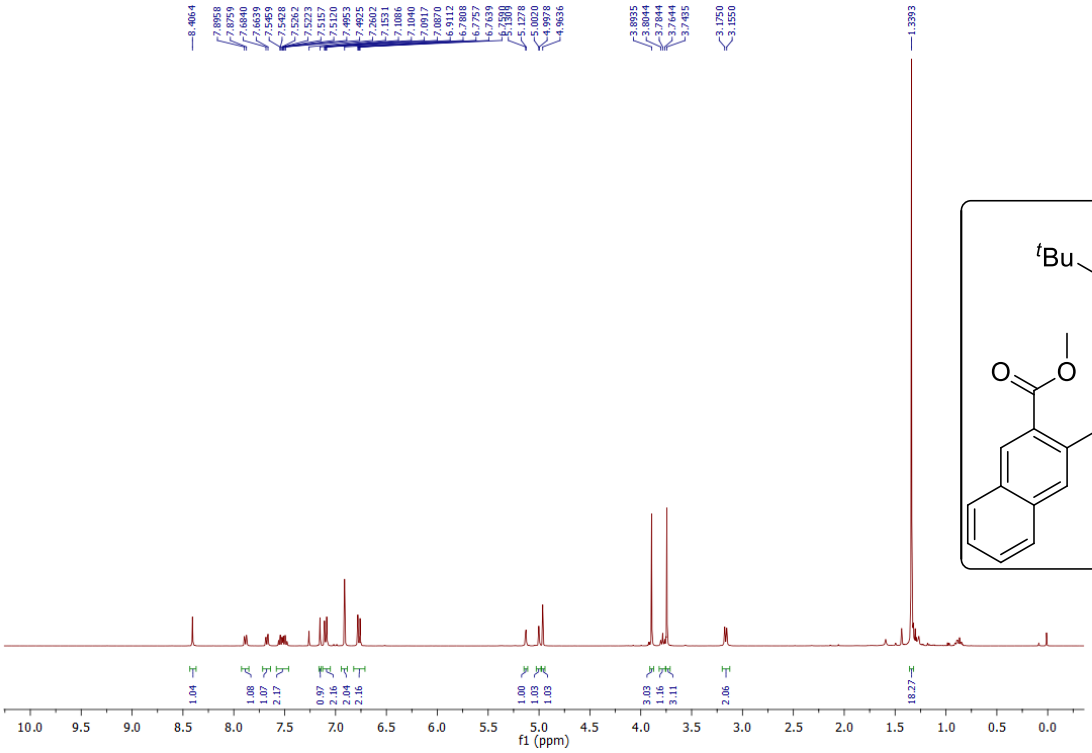
^{1}H NMR Spectrum of **4f**

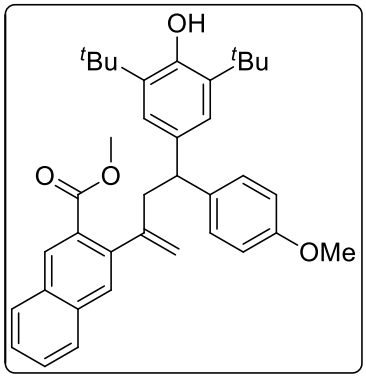


^{13}C NMR Spectrum of **4f**

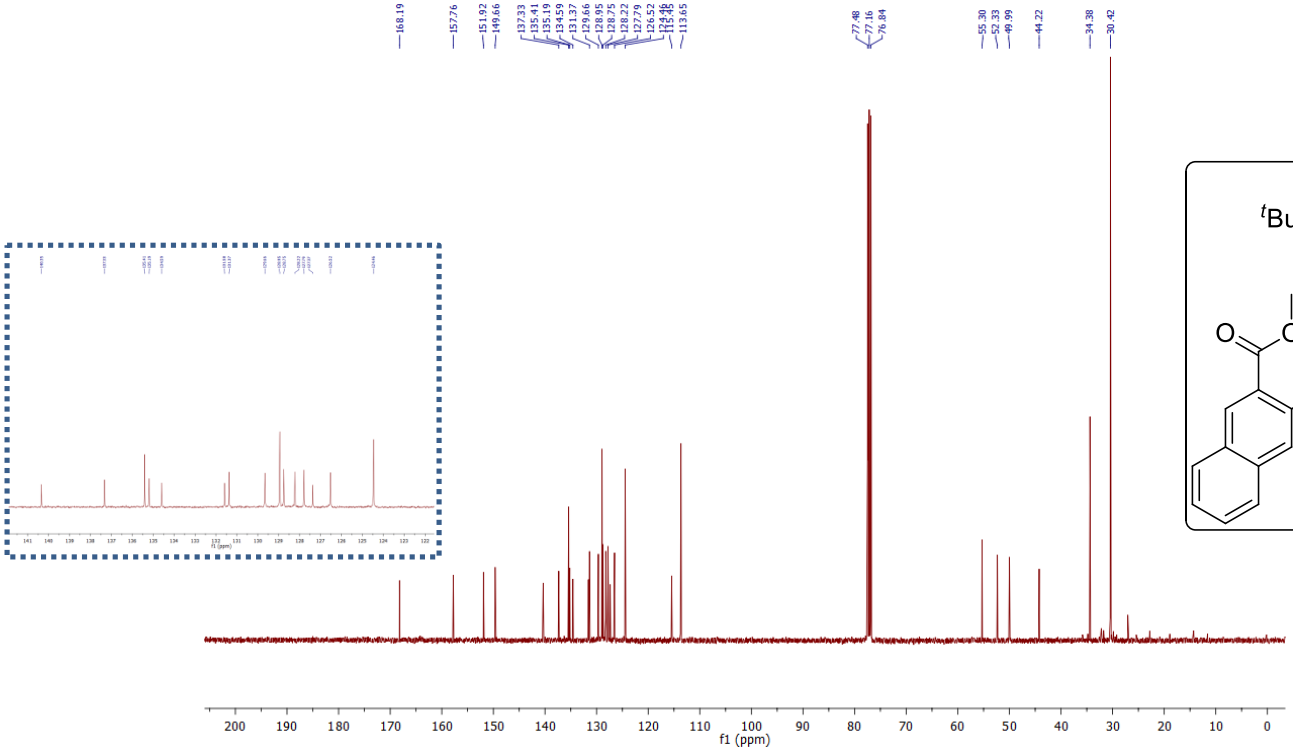


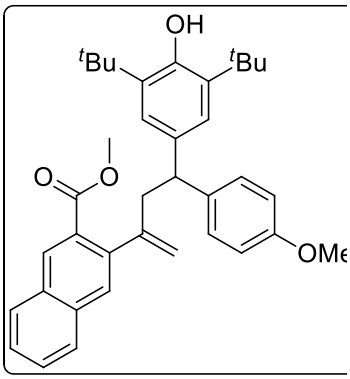
^{1}H NMR Spectrum of **4g**



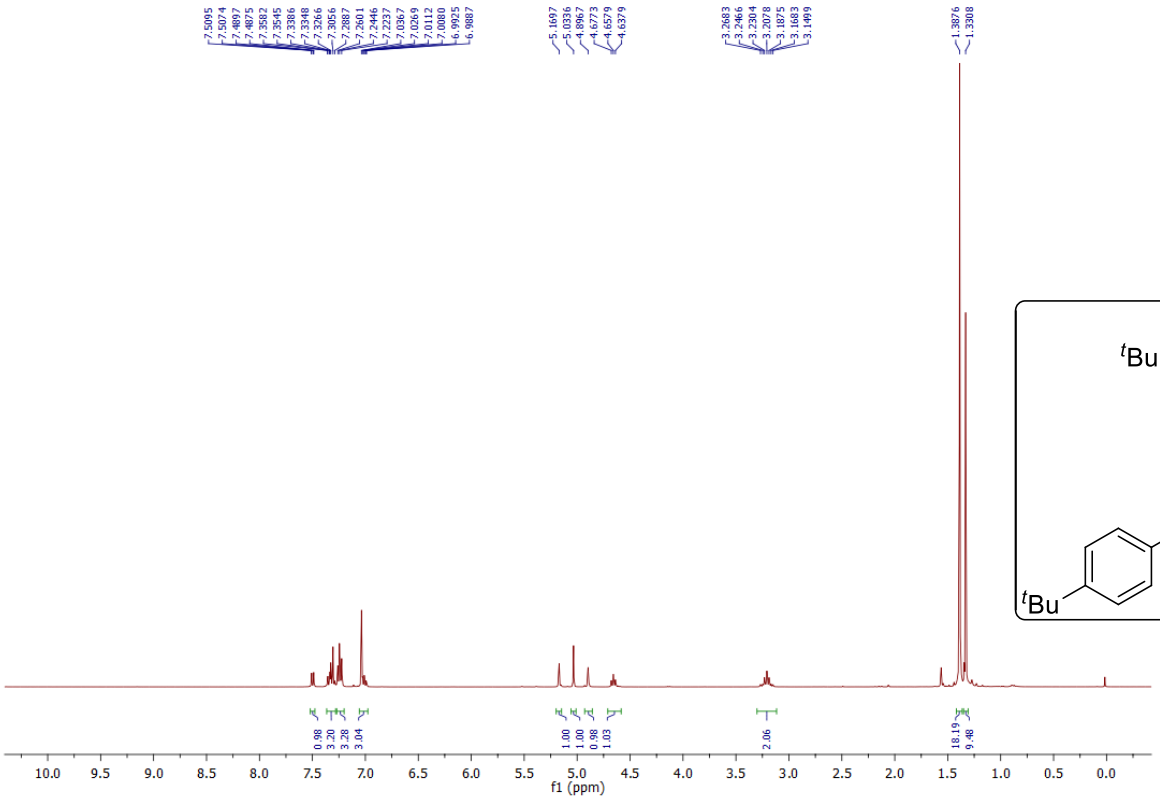


^{13}C NMR Spectrum of **4g**

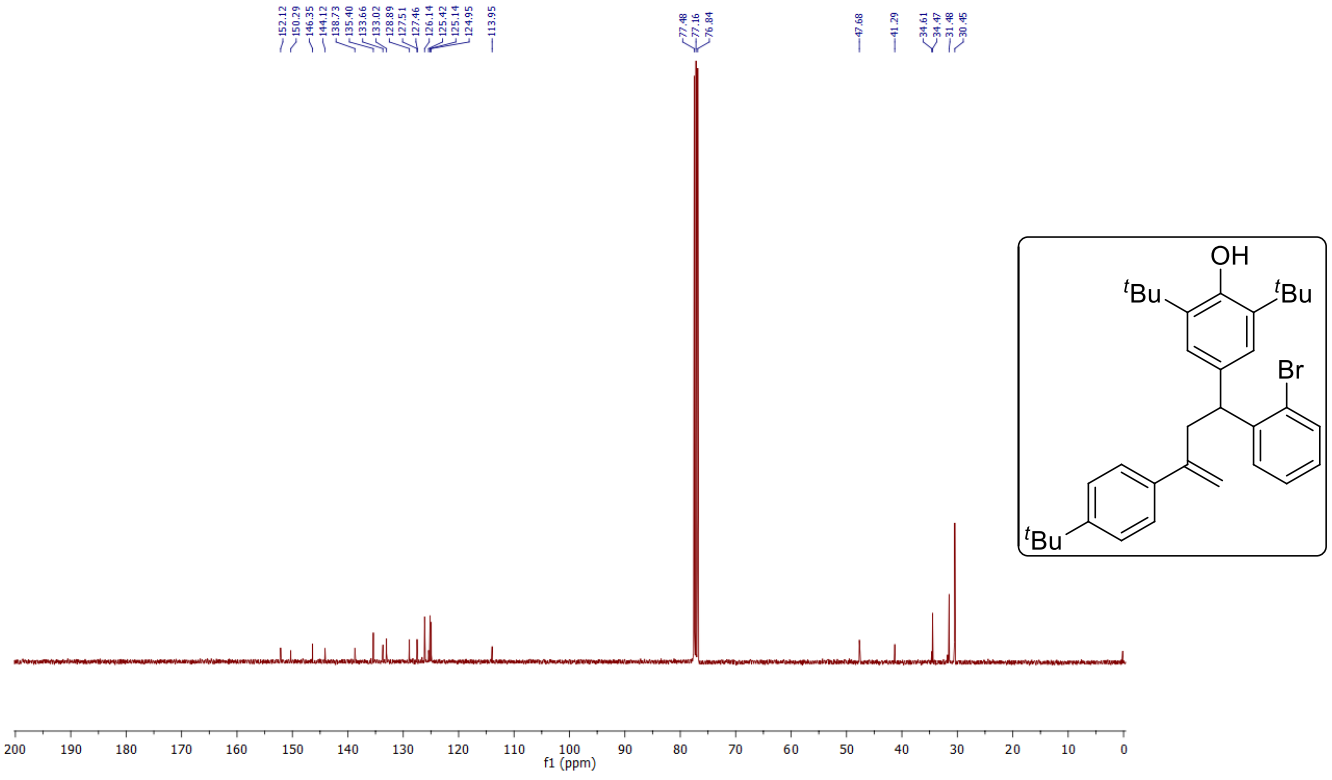




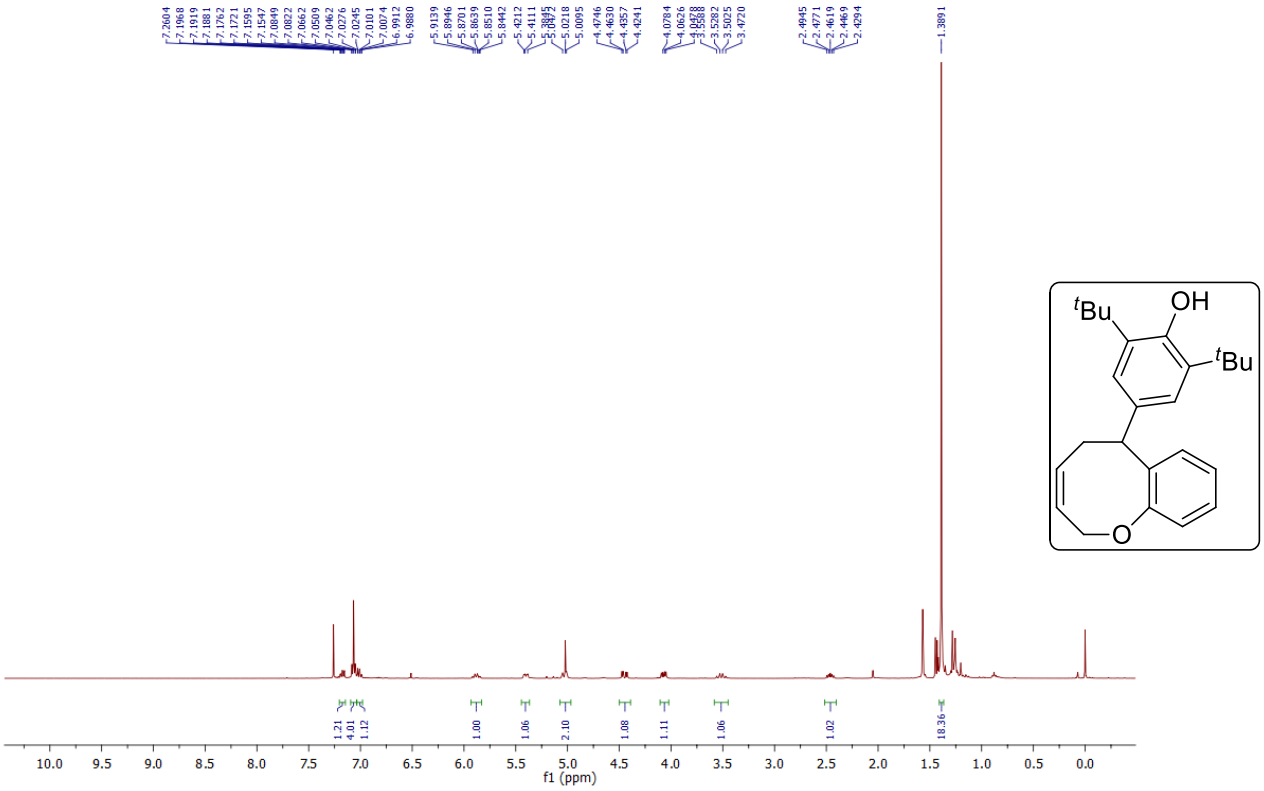
^{1}H NMR Spectrum of **4h**



^{13}C NMR Spectrum of **4h**



^{1}H NMR Spectrum of **5**



^{13}C NMR Spectrum of **5**