
Supplementary Information

Au(I)-Catalyzed Triple Bond Alkoxylation/Vinyl-Vinyl Aromaticity- Driven Cascade Cyclization to Naphthalenes

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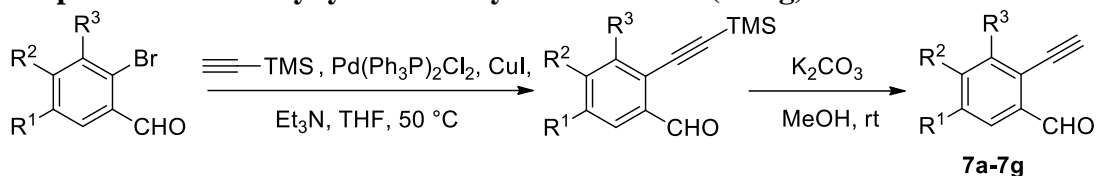
Table of Contents:

I.	General Information.....	S2
II.	General Preparation of 2-Ethynylbenzaldehyde Derivatives (7a-7g)	S3
III.	General Preparation of 2-Alkynylbenzaldehyde (7h-7l) and Characterization Data...S3	
IV.	General Preparation of 1, 5-Enyne Substrates (1-1k) and Characterization Data.....	S4
V.	Characterization Data of Naphthalenes.....	S7
VI.	References.....	S12
VII.	NMR Spectra.....	S13

I. General Information

Unless otherwise noted, reagents were obtained commercially and used without further purification. THF was distilled from sodium-benzophenone under a nitrogen atmosphere. TLC analysis of reaction mixtures was performed on Dynamicadsorbents silica gel F-254 TLC plates. Flash chromatography was carried out on Zeoprep 60 ECO silica gel. ^1H and ^{13}C NMR spectra were recorded with Bruker Avance-III 600 spectrometers and referenced to CDCl_3 . HR-ESI-MS was recorded on a Bruker micro-TOFQ-Q instrument. IR spectra were recorded on a Thermo Nicolet Avatar 370 FT-IR spectrometer. Melting points were tested on Thomas Hoover capillary melting point apparatus. Compounds were detected by monitoring UV absorbance at 254 nm.

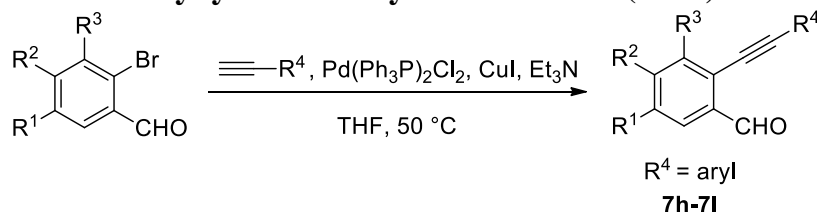
II. General Preparation of 2-Ethynylbenzaldehyde Derivatives (7a-7g)



To a solution of the corresponding 2-bromobenzaldehyde (1 mmol), Pd(PPh₃)₂Cl₂ (0.05 mmol, 35.1 mg), CuI (0.1 mmol, 19.1 mg) and Et₃N (5 mmol, 0.7 mL) in dry THF was added the appropriate acetylene (2 mmol, 0.3 mL). The resulting mixture was heated at 50 °C for 12 hours. After the reaction was completed, the reaction mixture was quenched with distilled water and extracted with CH₂Cl₂ (three times). The combined organic layer was washed with brine, dried over anhydrous Na₂SO₄, and concentrated *in vacuo*. The residue was purified by column chromatography on silica gel to afford the desired product 2-[(trimethylsilyl)ethynyl]benzaldehyde. Then the product obtained above was dissolved in MeOH and treated with K₂CO₃ (2 mmol, 276.4 mg). After being stirred at room temperature for 1 hour, the reaction mixture was diluted with water and extracted with CH₂Cl₂ (three times). The combined organic layer was dried over anhydrous Na₂SO₄ and concentrated *in vacuo*. The residue was purified by column chromatography on silica gel to yield products **7a-7g**.

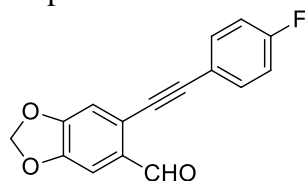
Spectral data were consistent with those reported in the literatures.¹⁻⁶

III. General Preparation of 2-Alkynylbenzaldehyde Derivatives (7h-7l) and Characterization Data



To a solution of the corresponding 2-bromobenzaldehyde (1 mmol), Pd(PPh₃)₂Cl₂ (0.05 mmol, 35.1 mg), CuI (0.1 mmol, 19.1 mg) and Et₃N (5 mmol, 0.7 mL) in dry THF was added the appropriate acetylene (1.2 mmol). The resulting mixture was heated at 50 °C for 12 hours. After the reaction was completed, the reaction mixture was quenched with distilled water and extracted with CH₂Cl₂ (three times). The combined organic layer was washed with brine, dried over anhydrous Na₂SO₄, and concentrated *in vacuo*. The residue was purified by column chromatography on silica gel to afford the desired products **7h-7l**.

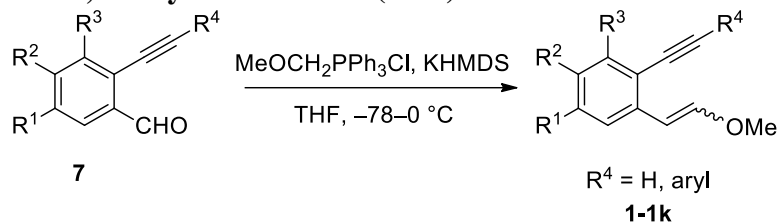
Spectral data were consistent with those reported in the literature.¹



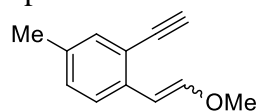
7l

4, 5-Methylenedioxy-2-(2-phenylethynyl) benzaldehyde (7l): TLC (petroleum ether: ethyl acetate, 30:1, v/v): R_f=0.3; yellowish solid, Mp 138–139 °C; 85%; ¹H NMR (600 MHz, CDCl₃) δ = 10.44 (s, 1H), 7.51 (dd, J = 8.4 Hz, 5.5 Hz, 2H), 7.35 (s, 1H), 7.06 (t, J = 8.6 Hz, 2H), 6.99 (s, 1H), 6.08 (s, 2H); ¹³C NMR (150 MHz, CDCl₃) δ = 190.0, 163.0 (d, J = 249.4 Hz), 152.5, 148.9, 133.7 (d, J = 8.4 Hz), 133.7 (d, J = 8.4 Hz), 132.3, 123.5, 118.6 (d, J = 3.5 Hz), 116.0 (d, J = 22.0 Hz), 116.0 (d, J = 22.0 Hz), 112.1, 106.3, 102.6, 94.2, 84.7; HRMS (ESI): m/z: Calcd for C₁₆H₁₀O₃F [M+H]⁺ 269.0608, Found 269.0608; IR (thin film, cm⁻¹): 3712, 3816, 3734, 3619, 1542, 1457, 805.

IV. General Preparation of 1, 5-Enyne Substrates (1-1k) and Characterization Data

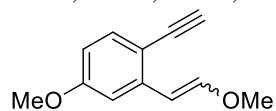


To a suspension of (methoxymethyl)triphenylphosphonium chloride (2 mmol, 685.6 mg) in anhydrous THF was added 1 M solution of KHMDS in anhydrous THF (1.8 mmol, 1.8 mL) at $-78\text{ }^\circ\text{C}$. The mixture was stirred at $-78\text{ }^\circ\text{C}$ for 0.5 h, and then a solution of 2-alkynylbenzaldehyde (1 mmol) in anhydrous THF was added. The reaction was allowed to warm up to $0\text{ }^\circ\text{C}$ over 3 h, and then hexane was added. The resulting mixture was filtered through Celite and thoroughly washed with hexane. The filtrate was concentrated *in vacuo* and the residue was diluted with hexane. The resulting mixture was filtered through Celite again to remove the remaining triphenylphosphine oxide. After evaporation to dryness, the crude vinyl ether was purified by silica gel chromatography eluting with petroleum ether/ethyl acetate to yield the products. Spectral data were consistent with those reported in the literature.⁷⁻⁸



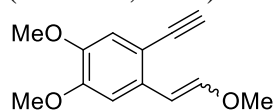
1a

2-Ethynyl-1-(2-methoxyvinyl)-4-methylbenzene (1a): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.2$; yellowish oil, 75%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 7.97$ (d, $J = 8.2$ Hz, 1H, Z), 7.29 (s, 1H, Z + 1H, E), 7.25 (d, $J = 8.1$ Hz, 1H, E), 7.13 – 7.09 (m, 1H, Z + 1H, E), 7.06 (d, $J = 8.0$ Hz, 1H, E), 6.24 (d, $J = 13.0$ Hz, 1H, E), 6.20 (d, $J = 7.2$ Hz, 1H, Z), 5.77 (d, $J = 7.2$ Hz, 1H, Z), 3.78 (s, 3H, Z), 3.72 (s, 3H, E), 3.28 (s, 1H, E), 3.26 (s, 1H, Z), 2.29 (s, 3H, Z), 2.29 (s, 3H, E); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 149.9$ (E), 148.6 (Z), 136.0 (E), 135.2 (Z), 135.2 (Z), 135.2 (E), 133.7 (E), 133.2 (Z), 130.2 (E), 129.8 (Z), 128.6 (Z), 123.6 (E), 119.7 (Z), 119.4 (E), 103.2 (E), 103.0 (Z), 83.0 (Z), 82.8 (Z), 81.1 (E), 80.8 (E), 60.9 (Z), 59.7 (E), 21.0 (Z), 20.9 (E); HRMS (ESI): m/z : Calcd for $\text{C}_{12}\text{H}_{13}\text{O}$ $[\text{M}+\text{H}]^+$ 173.0961, Found 173.0962; IR (thin film, cm^{-1}): 3854, 3807, 3675, 2923, 1700, 1652, 1638, 1635, 1558, 1465, 1457, 1090, 833, 748, 682.



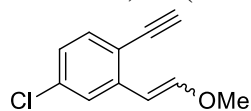
1b

1-Ethynyl-4-methoxy-2-(2-methoxyvinyl)benzene (1b): TLC (petroleum ether:ethyl acetate, 30:1, v/v): $R_f=0.25$; yellowish oil (1: 0.5 E/Z), 72%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 7.68$ (d, $J = 2.6$ Hz, 1H, Z), 7.40 (d, $J = 8.5$ Hz, 1H, E + 1H, Z), 7.15 (d, $J = 13.0$ Hz, 1H, E), 6.86 (d, $J = 2.5$ Hz, 1H, E), 6.66 (dd, $J = 8.5$ Hz, 2.4 Hz, 1H, Z + 1H, E), 6.24 (dd, $J = 10.1$ Hz, 5.5 Hz, 1H, Z + 1H, E), 5.79 (d, $J = 7.2$ Hz, 1H, Z), 3.82 (s, 3H, Z), 3.81 (s, 3H, E), 3.80 (s, 3H, Z), 3.73 (s, 3H, E), 3.24 (s, 1H, E), 3.22 (s, 1H, Z); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 160.1$ (E), 159.9 (Z), 150.6 (E), 149.6 (Z), 140.5 (E), 139.4 (Z), 134.7 (E), 134.0 (Z), 113.9 (Z), 112.5 (Z), 112.2 (E), 111.8 (Z), 111.7 (E), 108.8 (E), 103.4 (E), 103.1 (Z), 82.9 (Z), 82.7 (Z), 80.1 (E), 79.9 (E), 61.1 (Z), 56.7 (E), 55.4 (E), 55.3 (Z); HRMS (ESI): m/z : Calcd for $\text{C}_{12}\text{H}_{13}\text{O}_2$ $[\text{M}+\text{H}]^+$ 189.0910, Found 189.0909; IR (thin film, cm^{-1}): 3744, 3628, 1700, 1652, 1507, 720, 688, 676



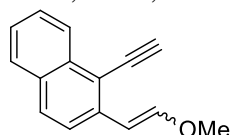
1c

1-Ethynyl-4,5-dimethoxy-2-(2-methoxyvinyl)benzene (1c): TLC (petroleum ether:ethyl acetate, 10:1): $R_f=0.3$; yellowish solid (1: 0.6 *E/Z*), Mp 80–82 °C; 71%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.68 (s, 1H, *Z*), 7.06 (d, J = 13.0 Hz, 1H, *E*), 6.94 (s, 1H, *Z*), 6.93 (s, 1H, *E*), 6.79 (s, 1H, *E*), 6.21 (d, J = 13.0 Hz, 1H, *E*), 6.16 (d, J = 7.2 Hz, 1H, *Z*), 5.74 (d, J = 7.2 Hz, 1H, *Z*), 3.89 (s, 3H, *E* + 3H, *Z*), 3.85 (s, 3H, *Z*), 3.85 (s, 3H, *E*), 3.79 (s, 3H, *Z*), 3.71 (s, 3H, *E*), 3.25 (s, 1H, *E*), 3.24 (s, 1H, *Z*); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 150.1 (*E*), 149.5 (*Z*), 149.4 (*E*), 147.9 (*E*), 147.1 (*Z*), 146.7 (*Z*), 132.7 (*E*), 132.2 (*Z*), 115.2 (*E*), 114.8 (*Z*), 112.1 (*Z*), 111.5 (*Z*), 111.5 (*E*), 106.4 (*E*), 103.4 (*E*), 103.1 (*Z*), 82.9 (*Z*), 82.8 (*Z*), 80.2 (*E*), 79.9 (*E*), 61.0 (*Z*), 56.6 (*E*), 56.1 (*E*), 56.0 (*Z*), 56.0 (*E*), 55.9 (*Z*); HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{15}\text{O}_3$ $[\text{M}+\text{H}]^+$ 219.1016, Found 219.1016; IR (thin film, cm^{-1}): 3874, 3850, 3821, 3750, 1685, 1652, 1560, 744, 683.



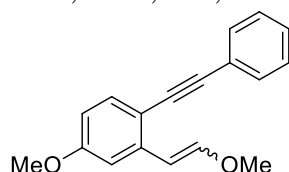
1c

4-Chloro-1-ethynyl-2-(2-methoxyvinyl) benzene (1e): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.3$; yellowish solid (1: 0.5 *E/Z*), Mp 91–93 °C; 70%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.09 (d, J = 2.1 Hz, 1H, *Z*), 7.37 (d, J = 8.3 Hz, 1H, *E* + 1H, *Z*), 7.33 (d, J = 2.0 Hz, 1H, *E*), 7.14 (d, J = 13.0 Hz, 1H, *E*), 7.06 (dt, J = 8.3 Hz, 2.3 Hz, 1H, *E* + 1H, *Z*), 6.28 (d, J = 7.2 Hz, 1H, *Z*), 6.19 (d, J = 13.0 Hz, 1H, *E*), 5.75 (d, J = 7.2 Hz, 1H, *Z*), 3.83 (s, 3H, *Z*), 3.73 (s, 3H, *E*), 3.33 (s, 1H, *E*), 3.31 (s, 1H, *Z*); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 151.4 (*E*), 150.4 (*Z*), 140.6 (*E*), 139.5 (*Z*), 135.1 (*E*), 134.8 (*Z*), 134.4 (*E*), 133.8 (*Z*), 128.5 (*Z*), 125.6 (*Z*), 125.6 (*E*), 123.6 (*E*), 118.2 (*Z*), 118.0 (*E*), 102.6 (*E*), 102.1 (*Z*), 82.3 (*Z* + *E*), 82.1 (*E*), 81.7 (*Z*), 61.3 (*Z*), 56.9 (*E*); HRMS (ESI): m/z : Calcd for $\text{C}_{11}\text{H}_{10}\text{OCl}$ $[\text{M}+\text{H}]^+$ 193.0414, Found 193.0415; IR (thin film, cm^{-1}): 3854, 3670, 1734, 1700, 1685, 1539, 841, 754, 676.



1e

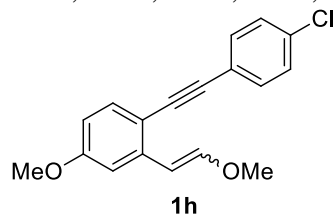
1-Ethynyl-2-(2-methoxyvinyl) naphthalene (1f): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.25$; yellowish oil (1: 0.5 *E/Z*), 74%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.37 (d, J = 8.6 Hz, 1H, *Z*), 8.35 (d, J = 8.4 Hz, 1H, *E*), 8.27 (d, J = 8.8 Hz, 1H, *Z*), 7.79 (d, J = 8.8 Hz, 1H, *Z*), 7.77 (d, J = 8.6 Hz, 1H, *E* + 1H, *Z*), 7.72 (d, J = 8.7 Hz, 1H, *E*), 7.58 – 7.53 (m, 1H, *E* + 1H, *Z*), 7.52 (d, J = 8.7 Hz, 1H, *E*), 7.45 (m, 1H, *E* + 1H, *Z*), 7.31 (d, J = 13.0 Hz, 1H, *E*), 6.59 (d, J = 13.0 Hz, 1H, *E*), 6.33 (d, J = 7.2 Hz, 1H, *Z*), 6.08 (d, J = 7.2 Hz, 1H, *Z*), 3.84 (s, 3H, *Z*), 3.80 (s, 3H, *E*), 3.78 (s, 1H, *E*), 3.77 (s, 1H, *Z*); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 151.4 (*E*), 149.9 (*Z*), 137.8 (*E*), 137.6 (*Z*), 134.3 (*E*), 134.0 (*Z*), 131.5 (*E*), 131.4 (*Z*), 129.1 (*E*), 128.5 (*Z*), 128.1 (*E*), 128.1 (*Z*), 127.3 (*E*), 127.0 (*Z*), 126.5 (*Z*), 126.4 (*Z*), 126.1 (*E*), 125.8 (*Z*), 125.6 (*E*), 121.6 (*E*), 116.0 (*Z*), 115.4 (*E*), 104.3 (*E*), 104.0 (*Z*), 87.2 (*E*), 87.1 (*E*), 80.8 (*Z*), 80.6 (*Z*), 61.1 (*Z*), 56.8 (*E*); HRMS (ESI): m/z : Calcd for $\text{C}_{15}\text{H}_{13}\text{O}$ $[\text{M}+\text{H}]^+$ 209.0961, Found 209.0962; IR (thin film, cm^{-1}): 3852, 3650, 1717, 1696, 1653, 1534, 1520, 720, 684.



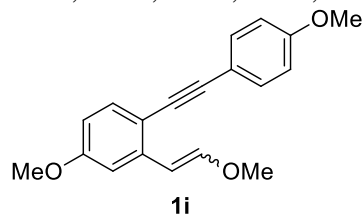
1f

4-Methoxy-2-(2-methoxyvinyl)-1-(phenylethynyl)benzene (1g): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.3$; yellowish oil (0.6: 1 *E/Z*), 74%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.72 (d, J = 2.6 Hz, 1H, *Z*), 7.56 – 7.49 (m, 2H, *Z* + 2H, *E*), 7.44 (d, J = 8.5 Hz, 1H, *Z* + 1H, *E*), 7.38 – 7.29 (m, 3H, *Z* + 3H, *E*), 7.20 (d, J = 13.0 Hz, 1H, *E*), 6.89 (d, J = 2.5 Hz, 1H, *E*), 6.72 – 6.70 (m, 1H, *Z* + 1H, *E*), 6.34 (d, J = 13.0 Hz, 1H, *E*),

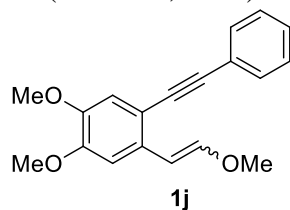
6.28 (d, $J = 7.2$ Hz, 1H, Z), 5.89 (d, $J = 7.2$ Hz, 1H, Z), 3.84 (s, 3H, Z), 3.83 (s, 3H, E), 3.82 (s, 3H, Z), 3.76 (s, 3H, E); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 159.9$ (E), 159.6 (Z), 150.5 (E), 149.5 (Z), 139.8 (E), 138.8 (Z), 134.0 (E), 133.4 (Z), 131.5 (Z), 131.5 (Z), 131.4 (E), 131.4 (E), 128.5 (E), 128.5 (E), 128.4 (Z), 128.4 (Z), 128.0 (E), 127.9 (Z), 124.0 (Z), 124.0 (E), 113.9 (Z), 113.7 (E), 113.4 (E), 111.9 (Z), 111.8 (E), 109.0 (Z), 103.7 (E), 103.4 (Z), 92.5 (Z), 92.2 (Z), 88.7 (E), 88.6 (E), 61.1 (Z), 56.7 (E), 55.4 (E), 55.4 (Z); HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{17}\text{O}_2$ $[\text{M}+\text{H}]^+$ 265.1223, Found 265.1221; IR (thin film, cm^{-1}): 3838, 3676, 2921, 1734, 1700, 1560, 1540, 767, 679.



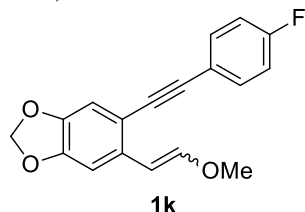
1-((4-Chlorophenyl)ethynyl)-4-methoxy-2-(2-methoxyvinyl)benzene (1h): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.2$; yellowish solid (1: 0.7 E/Z), Mp 77–79 °C; 71%; ^1H NMR (600 MHz, CDCl_3) $\delta = 7.72$ (d, $J = 2.5$ Hz, 1H, Z), 7.45–7.41 (m, 2H, E + 2H, Z), 7.37–7.29 (m, 3H, E + 3H, Z), 7.18 (d, $J = 12.9$ Hz, 1H, E), 6.89 (d, $J = 2.5$ Hz, 1H, E), 6.71 (ddd, $J = 8.5$ Hz, 2.4 Hz, 1.2 Hz, 1H, Z + 1H, E), 6.29 (d, $J = 12.0$ Hz, 7.7 Hz, 1H, E + 1H, Z), 5.84 (d, $J = 7.2$ Hz, 1H, Z), 3.84 (s, 3H, Z), 3.83 (s, 3H, E), 3.82 (s, 3H, Z), 3.75 (s, 3H, E); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 160.0$ (E), 159.8 (Z), 150.6 (E), 149.6 (Z), 139.9 (E), 138.8 (Z), 134.0 (E), 133.4 (Z), 132.7 (Z), 132.6 (E), 132.7 (Z), 132.6 (E), 128.8 (E), 128.7 (Z), 128.8 (E), 128.7 (Z), 128.6 (Z), 128.6 (E), 122.5 (Z), 122.5 (E), 114.0 (Z), 113.3 (Z), 113.0 (E), 111.9 (Z), 111.9 (E), 109.0 (E), 103.7 (E), 103.2 (Z), 91.4 (E), 91.1 (E), 89.7 (Z), 89.6 (Z), 61.1 (Z), 56.8 (E), 55.4 (E), 55.3 (Z); HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{16}\text{O}_2\text{Cl}$ $[\text{M}+\text{H}]^+$ 299.0833, Found 299.0856; IR (thin film, cm^{-1}): 3852, 3815, 3744, 3668, 3646, 1696, 1675, 1576, 1560, 1558, 696, 678.



4-Methoxy-1-((4-methoxyphenyl)ethynyl)-2-(2-methoxyvinyl)benzene (1i): TLC (petroleum ether:ethyl acetate, 15:1, v/v): $R_f=0.3$; yellowish solid (1: 0.5 E/Z), Mp 83–85 °C; 65%; ^1H NMR (600 MHz, CDCl_3) $\delta = 7.71$ (d, $J = 2.6$ Hz, 1H, Z), 7.47–7.44 (m, 2H, E + 2H, Z), 7.42 (d, $J = 8.5$ Hz, 1H, E + 1H, Z), 7.18 (d, $J = 13.0$ Hz, 1H, E), 6.91–6.85 (m, 3H, E + 2H, Z), 6.70 (dd, $J = 8.5$, 2.4 Hz, 1H, E + 1H, Z), 6.33 (d, $J = 13.0$ Hz, 1H, E), 6.27 (d, $J = 7.2$ Hz, 1H, Z), 5.88 (d, $J = 7.2$ Hz, 1H, Z), 3.83 (s, 3H, Z), 3.83 (s, 3H, Z), 3.82 (s, 6H, E), 3.81 (s, 3H, Z), 3.75 (s, 3H, E); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 159.6$ (E), 159.5 (E), 159.4 (Z), 159.4 (Z), 150.4 (E), 149.4 (Z), 139.5 (E), 138.6 (Z), 133.8 (E), 133.2 (Z), 132.9 (Z), 132.8 (E), 132.9 (Z), 132.8 (E), 116.2 (Z), 116.1 (E), 114.1 (E), 114.1 (Z), 114.1 (E), 114.1 (Z), 114.0 (Z), 113.9 (E), 113.7 (Z), 111.8 (Z), 111.6 (E), 108.9 (E), 103.8 (E), 103.5 (Z), 92.4 (E), 92.1 (Z), 87.2 (Z), 87.1 (E), 61.0 (Z), 56.7 (E), 55.4 (E + Z), 55.4 (E), 55.3 (Z); HRMS (ESI): m/z : Calcd for $\text{C}_{19}\text{H}_{19}\text{O}_3$ $[\text{M}+\text{H}]^+$ 295.1329, Found 295.1300; IR (thin film, cm^{-1}): 3891, 3854, 3744, 3735, 3674, 2920, 1701, 1695, 1685, 718, 676.

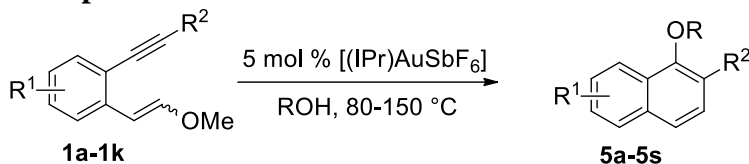


1, 2-Dimethoxy-4-(2-methoxyvinyl)-5-(phenylethynyl) benzene (1j): TLC (petroleum ether:ethyl acetate, 20:1, v/v): $R_f=0.25$; yellowish oil (1: 0.7 *E/Z*); 63% ^1H NMR (600 MHz, CDCl_3) $\delta = 7.72$ (s, 1H, *Z*), 7.54 – 7.49 (m, 5H, *Z*), 7.33 (m, 5H, *E*), 7.09 (d, $J = 13.0$ Hz, 1H, *E*), 6.98 (s, 1H, *Z*), 6.98 (s, 1H, *E*), 6.82 (s, 1H, *E*), 6.30 (d, $J = 13.0$ Hz, 1H, *E*), 6.18 (d, $J = 7.2$ Hz, 1H, *Z*), 5.83 (d, $J = 7.2$ Hz, 1H, *Z*), 3.90 (s, 3H, *E*), 3.90 (s, 3H, *Z*), 3.88 (s, 3H, *E*), 3.88 (s, 3H, *Z*), 3.80 (s, 3H, *Z*), 3.73 (s, 3H, *E*); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 149.8$ (*E*), 149.2 (*Z*), 149.2 (*E*), 147.8 (*E*), 147.2 (*Z*), 146.9 (*Z*), 132.0 (*E*), 131.7 (*Z*), 131.5 (*Z*), 131.5 (*Z*), 131.4 (*E*), 131.4 (*E*), 128.5 (*E*), 128.5 (*E*), 128.4 (*Z*), 128.4 (*Z*), 128.1 (*E*), 128.0 (*Z*), 123.9 (*Z*), 123.8 (*E*), 114.7 (*E*), 114.2 (*Z*), 113.3 (*Z*), 112.7 (*E*), 111.6 (*Z*), 106.7 (*E*), 103.8 (*E*), 103.5 (*Z*), 92.6 (*E*), 92.3 (*Z*), 88.7 (*E*), 88.6 (*Z*), 60.9 (*Z*), 56.6 (*E*), 56.1 (*E*), 56.0 (*Z*), 56.0 (*E*), 55.9 (*Z*); HRMS (ESI): m/z : Calcd for $\text{C}_{19}\text{H}_{19}\text{O}_3$ [$\text{M}+\text{H}$] $^+$ 295.1329, Found 295.1331; IR (thin film, cm^{-1}) 3838, 3816, 3676, 1700, 1696, 1576, 1560, 1540, 747, 683.

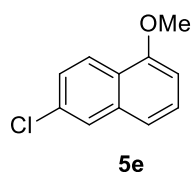


5-((4-Fluorophenyl)ethynyl)-6-(2-methoxyvinyl)benzo[*d*][1,3]dioxole (1k): TLC (petroleum ether:ethyl acetate, 30:1, v/v): $R_f=0.2$; yellowish solid (1: 0.4 *E/Z*), Mp 97–98 °C; 71%; ^1H NMR (600 MHz, CDCl_3) $\delta = 7.67$ (s, 1H, *Z*), 7.51 – 7.45 (m, 2H, *E* + 2H, *Z*), 7.07 – 7.00 (m, 3H, *E* + 2H, *Z*), 6.92 (s, 1H, *Z*), 6.91 (s, 1H, *E*), 6.83 (s, 1H, *E*), 6.31 (d, $J = 12.9$ Hz, 1H, *E*), 6.18 (d, $J = 7.2$ Hz, 1H, *Z*), 5.96 (s, 2H, *Z*), 5.95 (s, 2H, *E*), 5.81 (d, $J = 7.2$ Hz, 1H, *Z*), 3.79 (s, 3H, *Z*), 3.72 (s, 3H, *E*); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 162.5$ (d, $J = 247.8$ Hz, *E*), 149.5 (*E*), 148.6 (*E*), 148.1 (*Z*), 148.0 (*Z*), 145.7 (*E*), 145.3 (*Z*), 133.6 (*E*), 133.3 (d, $J = 8.3$ Hz, *Z*), 133.3 (d, $J = 8.3$ Hz, *Z*), 133.2 (d, $J = 8.3$ Hz, *E*), 133.2 (d, $J = 8.3$ Hz, *E*), 132.9 (*Z*), 119.9 (d, $J = 3.5$ Hz, *Z*), 119.8 (d, $J = 3.5$ Hz, *E*), 115.8 (d, $J = 21.9$ Hz, *E*), 115.8 (d, $J = 21.9$ Hz, *E*), 115.7 (d, $J = 21.9$ Hz, *Z*), 115.7 (d, $J = 21.9$ Hz, *Z*), 114.1 (*Z*), 113.5 (*E*), 111.6 (*E*), 111.3 (*Z*), 108.9 (*Z*), 103.9 (*E*), 103.8 (*E*), 103.4 (*Z*), 101.4 (*E*), 101.4 (*Z*), 91.6 (*E*), 91.3 (*Z*), 88.4 (*Z*), 88.1 (*E*), 60.9 (*Z*), 56.8 (*E*); HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{13}\text{O}_3\text{Na}$ [$\text{M}+\text{Na}$] $^+$ 319.0741, Found 319.0738; IR (thin film, cm^{-1}): 3854, 3821, 3802, 3752, 3671, 1700, 1684, 1653, 1635, 694, 686.

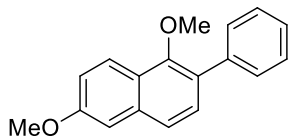
V. Characteration Data of Naphthalenes



General procedure for Au(I)-catalyzed cascade cyclization for the synthesis of naphthalenes: The 1,5-enyne substrate (1 mmol) and the [(IPr)AuSbF₆] (0.05 mmol, 36.9 mg) in ROH (2 mL) were placed in a screw-cap vial containing a stirring bar. The reaction vial was fitted with a cap, evacuated, filled with nitrogen, and heated with stirring at 80–150 °C for 30–120h. The reaction mixture was cooled, filtered through a plug of silica gel. The filtrate was concentrated and the obtained residue was purified by flash column chromatography to afford the naphthalene.

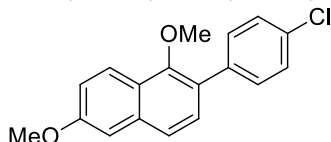


6-Chloro-1-methoxynaphthalene (5e): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.2$; white solid, Mp 46–47 °C; 75%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.20 (d, J = 8.9 Hz, 1H), 7.78 (d, J = 1.6 Hz, 1H), 7.41 (m, 2H), 7.33 (d, J = 8.3 Hz, 1H), 6.81 (d, J = 7.6 Hz, 1H), 4.00 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 155.6, 135.3, 132.5, 127.4, 126.3, 126.1, 124.1, 124.0, 119.4, 104.2, 55.7; HRMS (ESI): m/z : Calcd for $\text{C}_{11}\text{H}_{10}\text{OCl}$ $[\text{M}+\text{H}]^+$ 193.0414, Found 193.0417; IR (thin film, cm^{-1}): 3750, 3745, 1701, 1653, 1558, 1507, 761, 749, 676.



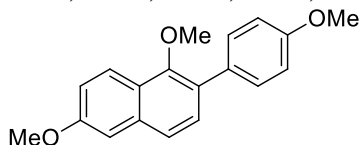
5g

1,6-Dimethoxy-2-phenylnaphthalene (5g): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.2$; yellowish solid, Mp 112–114 °C; 50%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.15 (d, J = 9.1 Hz, 1H), 7.68 (d, J = 7.8 Hz, 2H), 7.57 (d, J = 8.4 Hz, 1H), 7.48 – 7.45 (m, 3H), 7.36 (t, J = 7.3 Hz, 1H), 7.20 (dd, J = 9.1 Hz, 2.0 Hz, 1H), 7.17 (br.s, 1H), 3.95 (s, 3H), 3.57 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 158.2, 153.6, 139.0, 135.8, 129.5, 129.5, 129.5, 128.5, 128.5, 127.7, 127.0, 124.4, 123.9, 122.9, 119.0, 106.0, 61.3, 55.5; HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{17}\text{O}_2$ $[\text{M}+\text{H}]^+$ 265.1223, Found 265.1199; IR (thin film, cm^{-1}): 3854, 3821, 3752, 1700, 1685, 1653, 1635, 1507, 743, 728, 687.



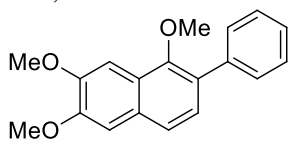
5h

2-(4-Chlorophenyl)-1,6-dimethoxynaphthalene (5h): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.3$; yellowish solid, Mp 118–120 °C; 51%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.13 (d, J = 9.1 Hz, 1H), 7.63 (d, J = 8.2 Hz, 2H), 7.56 (d, J = 8.4 Hz, 1H), 7.42 (m, 3H), 7.21 (dd, J = 9.1 Hz, 2.1 Hz, 1H), 7.16 (s, 1H), 3.95 (s, 3H), 3.57 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 158.4, 153.6, 137.3, 136.0, 133.0, 130.8, 130.8, 129.0, 128.7, 128.7, 126.5, 124.4, 123.9, 123.1, 119.2, 106.0, 61.4, 55.5; HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{16}\text{O}_2\text{Cl}$ $[\text{M}+\text{H}]^+$ 299.0833, Found 299.0728; IR (thin film, cm^{-1}): 3852, 3815, 3744, 3734, 3688, 3674, 1700, 1695, 1652, 1558, 1507, 714, 678.



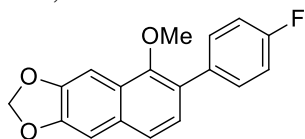
5i

1,6-Dimethoxy-2-(4-methoxyphenyl)naphthalene (5i): TLC (petroleum ether:ethyl acetate, 20:1, v/v): $R_f=0.2$; yellowish solid, Mp 107–108 °C; 30%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 8.13 (d, J = 9.1 Hz, 1H), 7.64 – 7.60 (dd, J = 8.4 Hz, 1.8 Hz, 2H), 7.54 (d, J = 8.4 Hz, 1H), 7.44 (d, J = 8.4 Hz, 1H), 7.19 (dd, J = 9.1 Hz, 2.5 Hz, 1H), 7.15 (d, J = 2.5 Hz, 1H), 7.02 – 6.97 (dd, J = 8.4 Hz, 1.8 Hz, 2H), 3.94 (s, 3H), 3.88 (s, 3H), 3.57 (s, 3H). $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 158.8, 158.1, 153.3, 135.5, 131.3, 130.5, 130.5, 129.5, 128.8, 124.3, 124.0, 122.9, 118.9, 114.0, 114.0, 106.0, 61.1, 55.5, 55.4; HRMS (ESI): m/z : Calcd for $\text{C}_{19}\text{H}_{19}\text{O}_3$ $[\text{M}+\text{H}]^+$ 295.1328, Found 295.1330; IR (thin film, cm^{-1}): 3837, 3832, 3647, 1696, 1675, 1558, 1542, 747, 728, 688.



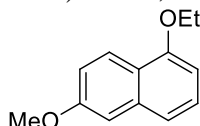
5j

1, 6, 7-Trimethoxy-2-phenylnaphthalene (5j): TLC (petroleum ether:ethyl acetate, 20:1, v/v): $R_f=0.3$; yellowish solid, Mp 101–103 °C; 50%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 7.68$ (d, $J = 7.4$ Hz, 2H), 7.52 (m, 2H), 7.46 (t, $J = 7.6$ Hz, 2H), 7.37 (m, 2H), 7.15 (s, 1H), 4.05 (s, 3H), 4.03 (s, 3H), 3.56 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 152.3, 150.1, 150.0, 139.1, 130.3, 129.5, 129.5, 128.5, 128.5, 128.3, 127.1, 127.0, 124.1, 122.5, 106.5, 101.3, 60.9, 56.1, 56.1$; HRMS (ESI): m/z : Calcd for $\text{C}_{19}\text{H}_{18}\text{O}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 317.1148, Found 317.1150; IR (thin film, cm^{-1}): 3891, 3854, 3821, 3752, 3744, 1700, 1685, 1653, 1635, 1506, 743, 745, 677.



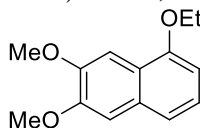
5k

6-(4-Fluorophenyl)-5-methoxynaphtho[2,3-d][1,3]dioxole (5k): TLC (petroleum ether:ethyl acetate, 40:1, v/v): $R_f=0.3$; yellow solid, Mp 120–122 °C; 50%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 7.64$ (m, 2H), 7.50 (s, 1H), 7.48 (d, $J = 8.4$ Hz, 1H), 7.29 (d, $J = 8.4$ Hz, 1H), 7.14 (m, 3H), 6.07 (s, 2H), 3.52 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 162.2$ (d, $J = 244.8$ Hz), 152.8, 148.4, 148.2, 134.8 (d, $J = 3.5$ Hz), 131.7, 131.0 (d, $J = 7.8$ Hz), 131.0 (d, $J = 7.8$ Hz), 127.8, 127.0, 125.5, 123.3, 115.4 (d, $J = 21.2$ Hz), 115.4 (d, $J = 21.2$ Hz), 104.1, 101.3, 99.2, 60.9; HRMS (ESI): m/z : Calcd for $\text{C}_{18}\text{H}_{14}\text{O}_3\text{F}$ $[\text{M}+\text{H}]^+$ 297.0921, Found 297.0915; IR (thin film, cm^{-1}): 3854, 3821, 3816, 3801, 3671, 1700, 1696, 1653, 1560, 1539, 835, 694, 686.



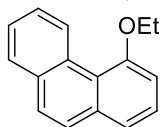
5l

1-Ethoxy-6-methoxynaphthalene (5l): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.2$; white solid, Mp 63–65 °C; 88%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 8.21$ (d, $J = 9.1$ Hz, 1H), 7.39 – 7.28 (m, 1H), 7.16 – 7.07 (m, 1H), 6.68 (dd, $J = 7.0$ Hz, 0.9 Hz, 1H), 4.20 (q, $J = 7.0$ Hz, 1H), 3.92 (s, 1H), 1.54 (t, $J = 7.0$ Hz, 1H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 158.2, 155.1, 136.0, 126.8, 124.0, 121.0, 119.2, 117.5, 105.8, 103.0, 63.8, 55.3, 15.0$; HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{15}\text{O}_2$ $[\text{M}+\text{H}]^+$ 203.1067, Found 203.1010; IR (thin film, cm^{-1}): 3854, 3821, 1685, 1653, 1617, 1596, 1432, 1373, 747, 696.



5m

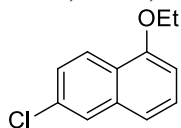
1-Ethoxy-6, 7-dimethoxynaphthalene (5m): TLC (petroleum ether:ethyl acetate, 15:1, v/v): $R_f=0.2$; white solid, Mp 103–104 °C; 80%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 7.56$ (s, 1H), 7.28 (d, $J = 8.1$ Hz, 1H), 7.23 (t, $J = 7.8$ Hz, 1H), 7.09 (s, 1H), 6.72 (d, $J = 7.5$ Hz, 1H), 4.21 (q, $J = 7.0$ Hz, 2H), 4.03 (s, 3H), 4.00 (s, 3H), 1.55 (d, $J = 6.9$ Hz, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) $\delta = 153.9, 149.9, 149.0, 130.5, 124.4, 120.9, 118.8, 106.4, 103.8, 101.2, 63.8, 56.0, 55.9, 15.1$; HRMS (ESI): m/z : Calcd for $\text{C}_{14}\text{H}_{17}\text{O}_3$ $[\text{M}+\text{H}]^+$ 233.1200, Found 233.1200; IR (thin film, cm^{-1}): 3860, 3854, 3836, 3732, 3611, 1683, 1558, 835, 743, 728, 681.



5n

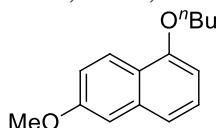
4-Ethoxyphenanthrene (5n): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.3$; colorless oil, 75%; $^1\text{H NMR}$ (600 MHz, CDCl_3) $\delta = 9.80$ (d, $J = 8.6$ Hz, 1H), 7.89 (dd, $J = 7.8$ Hz, 1.4 Hz, 1H), 7.74 (d, $J = 8.8$ Hz, 1H), 7.71 (d, $J = 8.8$ Hz, 1H), 7.64 (ddd, $J = 8.6$ Hz, 7.0 Hz, 1.6 Hz, 1H), 7.60 – 7.57 (m, 1H), 7.52 (d, $J =$

6.9 Hz, 2H), 7.16 (t, $J = 6.6$ Hz, 1H), 4.36 (q, $J = 6.9$ Hz, 2H), 1.72 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 158.3, 134.8, 132.9, 130.7, 128.8, 128.4, 128.1, 127.3, 126.6, 126.5, 125.9, 121.6, 120.9, 109.3, 64.8, 15.3$; HRMS (ESI): m/z : Calcd for $\text{C}_{16}\text{H}_{14}\text{OK}$ $[\text{M}+\text{K}]^+$ 261.1271, Found 261.1271; IR (thin film, cm^{-1}): 3881, 3854, 3749, 3646, 3612, 1675, 1559, 1539, 792, 683.



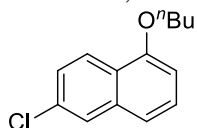
5o

6-Chloro-1-ethoxynaphthalene (5o): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.2$; white solid, Mp 51–52 °C; 82%; ^1H NMR (600 MHz, CDCl_3) $\delta = 8.23$ (d, $J = 8.9$ Hz, 1H), 7.77 (d, $J = 1.6$ Hz, 1H), 7.41 – 7.36 (m, 2H), 7.31 (d, $J = 8.2$ Hz, 1H), 6.79 (d, $J = 7.6$ Hz, 1H), 4.20 (q, $J = 6.9$ Hz, 2H), 1.55 (t, $J = 6.9$ Hz, 3H); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 155.0, 135.4, 132.4, 127.4, 126.2, 125.9, 124.2, 124.1, 119.2, 105.0, 63.9, 15.0$; HRMS (ESI): m/z : Calcd for $\text{C}_{12}\text{H}_{12}\text{OCl}$ $[\text{M}+\text{H}]^+$ 207.0571, Found 207.0571; IR (thin film, cm^{-1}): 3851, 3801, 3749, 3647, 1700, 1635, 1539, 1505, 746, 729, 679.



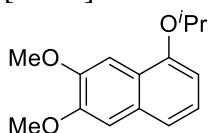
5p

1-Butoxy-6-methoxynaphthalene (5p): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.25$; white solid, Mp 46–47 °C; 65%; ^1H NMR (600 MHz, CDCl_3) $\delta = 8.20$ (d, $J = 9.0$ Hz, 1H), 7.35 – 7.28 (m, 1H), 7.11 (m, 1H), 6.69 – 6.67 (m, 1H), 4.13 (t, $J = 6.4$ Hz, 1H), 3.92 (s, 1H), 1.90 (tt, $J = 12.7$ Hz, 6.4 Hz, 1H), 1.65 – 1.56 (m, 1H), 1.03 (t, $J = 7.4$ Hz, 1H); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 158.2, 155.3, 136.0, 126.9, 124.0, 121.09, 119.1, 117.5, 105.8, 102.9, 67.9, 55.4, 31.6, 19.6, 14.1$; HRMS (ESI): m/z : Calcd for $\text{C}_{15}\text{H}_{19}\text{O}_2$ $[\text{M}+\text{H}]^+$ 231.1380, Found 231.1377; IR (thin film, cm^{-1}): 3870, 3807, 3801, 3750, 1653, 1557, 774, 685.



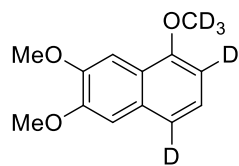
5q

1-Butoxy-6-chloronaphthalene (5q): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.2$; colorless oil, 60%; ^1H NMR (600 MHz, CDCl_3) $\delta = 8.22$ (d, $J = 9.0$ Hz, 1H), 7.77 (d, $J = 1.8$ Hz, 1H), 7.41 – 7.36 (m, 1H), 7.31 (d, $J = 8.2$ Hz, 1H), 6.79 (d, $J = 7.6$ Hz, 1H), 4.14 (t, $J = 6.4$ Hz, 1H), 1.97 – 1.82 (m, 1H), 1.60 (dd, $J = 15.0$ Hz, 7.5 Hz, 1H), 1.03 (t, $J = 7.4$ Hz, 1H); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 155.1, 135.4, 132.4, 127.5, 126.2, 125.9, 124.2, 124.1, 119.2, 104.9, 68.1, 31.5, 19.6, 14.1$; HRMS (ESI): m/z : Calcd for $\text{C}_{14}\text{H}_{16}\text{OCl}$ $[\text{M}+\text{H}]^+$ 235.0884, Found 235.0885; IR (thin film, cm^{-1}): 3815, 3743, 3674, 1652, 780, 675.



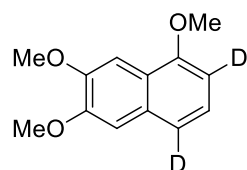
5r

1-Isopropoxy-6,7-dimethoxynaphthalene (5r): TLC (petroleum ether:ethyl acetate, 20:1, v/v): $R_f=0.2$; white solid, Mp 71–73 °C; 50%; ^1H NMR (600 MHz, CDCl_3) $\delta = 7.54$ (s, 1H), 7.27 (d, $J = 7.8$ Hz, 1H), 7.23 (t, $J = 7.8$ Hz, 1H), 7.09 (s, 1H), 6.76 (d, $J = 7.4$ Hz, 1H), 4.73 (dt, $J = 12.1$ Hz, 6.0 Hz, 1H), 4.02 (s, 3H), 3.99 (s, 3H), 1.46 (s, 3H), 1.45 (s, 3H); ^{13}C NMR (150 MHz, CDCl_3) $\delta = 152.9, 149.9, 149.0, 130.7, 124.4, 121.8, 118.7, 106.3, 105.6, 101.5, 70.6, 56.0, 55.9, 22.4, 22.4$; HRMS (ESI): m/z : Calcd for $\text{C}_{15}\text{H}_{18}\text{O}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 269.1148, Found 269.1152; IR (thin film, cm^{-1}): 3734, 3711, 1652, 1635, 1542, 1507, 841, 743.



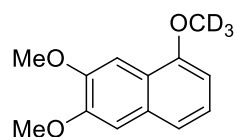
5c-D

d5-1,6,7-Trimethoxynaphthalene (5c-D): TLC (petroleum ether:ethyl acetate, 15:1, v/v): $R_f=0.3$; white solid, Mp 120–121 °C; 79%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.54 (s, 1H), 7.25 (s, 1H), 7.10 (s, 1H), 4.02 (s, 3H), 4.00 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 154.6, 149.9, 149.1, 130.4, 124.2, 120.7, 118.7 (t), 106.3, 102.5 (t), 101.1, 56.0, 55.9; HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{10}\text{O}_3\text{D}_5$ $[\text{M}+\text{H}]^+$ 224.1330, Found 224.1310; IR (thin film, cm^{-1}): 3891, 3854, 3821, 3752, 3744, 1700, 1653, 1635, 1506, 826, 745, 677.



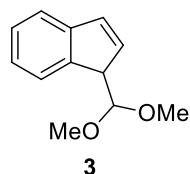
5c-D-1

d2-1,6,7-Trimethoxynaphthalene (5c-D-1): TLC (petroleum ether:ethyl acetate, 15:1, v/v): $R_f=0.3$; white solid, Mp 120–121 °C; 70%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.54 (s, 1H), 7.25 (s, 1H), 7.10 (s, 1H), 4.02 (s, 3H), 4.00 (s, 6H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 154.6, 149.9, 149.1, 130.4, 124.2, 120.7, 118.7 (t), 106.4, 102.5 (t), 101.1, 56.0, 55.9, 55.6; HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{13}\text{O}_3\text{D}_2$ $[\text{M}+\text{H}]^+$ 221.1147, Found 221.1151; IR (thin film, cm^{-1}): 3890, 3855, 3821, 3752, 3744, 1700, 1655, 1635, 1506, 826, 745, 679.



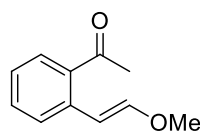
5c-D-2

d3-1,6,7-Trimethoxynaphthalene (5c-D-2): TLC (petroleum ether:ethyl acetate, 15:1, v/v): $R_f=0.3$; white solid, Mp 120–121 °C; 74%; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.54 (s, 1H), 7.29 (br.d, J = 8.0 Hz, 1H), 7.26 (m, 1H), 7.10 (s, 1H), 6.72 (dd, J = 7.4, 0.8 Hz, 1H), 4.02 (s, 3H), 4.00 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 154.6, 149.9, 149.1, 130.4, 124.4, 120.7, 118.79, 106.4, 102.8, 101.1, 56.0, 55.9, 54.8 (t); HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{12}\text{O}_3\text{D}_3$ $[\text{M}+\text{H}]^+$ 222.1209, Found 222.1211; IR (thin film, cm^{-1}): 3891, 3853, 3821, 3755, 3744, 1700, 1653, 1636, 1506, 826, 745, 677.



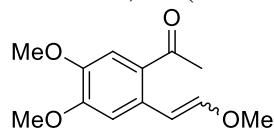
3

1-(Dimethoxymethyl)-1H-indene (3): TLC (petroleum ether:ethyl acetate, 100:1, v/v): $R_f=0.2$; yellowish oil, 42 %; $^1\text{H NMR}$ (600 MHz, CDCl_3) δ = 7.60 (d, J = 7.4 Hz, 1H), 7.35 (d, J = 7.4 Hz, 1H), 7.28 (t, J = 7.4 Hz, 1H), 7.20 (t, J = 7.4 Hz, 1H), 6.88 (dd, J = 5.5 Hz, 1.5 Hz, 1H), 6.48 (dd, J = 5.6 Hz, 1.8 Hz, 1H), 4.07 (d, J = 8.0 Hz, 1H), 3.83 (d, J = 8.0 Hz, 1H), 3.48 (s, 3H), 3.45 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, CDCl_3) δ = 145.1, 143.2, 135.0, 133.1, 127.2, 125.1, 125.0, 121.1, 105.7, 54.5, 53.8, 53.7; HRMS (ESI): m/z : Calcd for $\text{C}_{12}\text{H}_{14}\text{O}_2\text{Na}$ $[\text{M}+\text{Na}]^+$ 213.0886, Found 213.0874; IR (thin film, cm^{-1}): 3400, 2880, 2700, 1696, 1476, 1400, 748.



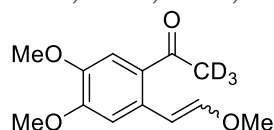
6

(E)-1-(2-(2-Methoxyvinyl) phenyl)ethanone (6): TLC (petroleum ether:ethyl acetate, 50:1, v/v): $R_f=0.25$; colorless oil, 61%; $^1\text{H NMR}$ (600 MHz, DMSO- d_6) $\delta = 7.71$ (dd, $J = 7.8$ Hz, 1.2 Hz, 1H), 7.51 (d, $J = 7.9$ Hz, 1H), 7.41 (td, $J = 7.8$ Hz, 1.1 Hz, 1H), 7.25 (td, $J = 7.7$ Hz, 1.1 Hz, 1H), 7.14 (d, $J = 12.9$ Hz, 1H), 6.38 (d, $J = 12.9$ Hz, 1H), 3.63 (s, 3H), 2.53 (s, 3H); $^{13}\text{C NMR}$ (150 MHz, DMSO- d_6) $\delta = 202.1, 150.9, 135.9, 134.8, 131.4, 129.3, 125.7, 125.4, 103.2, 56.5, 30.0$; HRMS (ESI): m/z : Calcd for $\text{C}_{11}\text{H}_{13}\text{O}_2$ $[\text{M}+\text{H}]^+$ 77.0910, Found 177.0913; IR (thin film, cm^{-1}): 3675, 3668, 3647, 1696, 1576, 1558, 1539, 748, 680.



6c

(E/Z)-1-(4, 5-Dimethoxy-2-(2-methoxyvinyl) phenyl)ethanone (6c): TLC (petroleum ether:ethyl acetate, 10:1, v/v): $R_f=0.3$; white solid (1: 0.4 E/Z), Mp 66–68 °C; 93%; $^1\text{H NMR}$ (600 MHz, CD_3OD) $\delta = 7.56$ (s, 1H, Z), 7.29 (s, 1H, E), 7.22 (s, 1H, Z), 6.98 (d, $J = 12.9$ Hz, 1H, E), 6.94 (s, 1H, E), 6.55 (d, $J = 12.8$ Hz, 1H, E), 6.19 (d, $J = 7.3$ Hz, 1H, Z), 5.83 (d, $J = 7.3$ Hz, 1H, Z), 3.88 (s, 3H, E), 3.85 (s, 3H, E), 3.85 (s, 3H, Z), 3.84 (s, 3H, Z), 3.74 (s, 3H, Z), 3.67 (s, 3H, E), 2.54 (s, 3H, E), 2.53 (s, 3H, Z); $^{13}\text{C NMR}$ (150 MHz, CD_3OD) $\delta = 203.7$ (Z), 202.9 (E), 153.6 (Z), 152.6 (Z), 151.5 (E), 149.4 (E), 148.2 (E), 147.8 (Z), 132.9 (E), 130.9 (Z), 130.8 (Z), 129.2 (E), 114.8 (E), 114.4 (Z), 113.8 (Z), 110.5 (E), 105.4 (E), 103.9 (Z), 60.9 (Z), 56.9 (E), 56.7 (E), 56.6 (Z), 56.4 (E), 56.2 (Z), 29.9 (E), 29.9 (Z); HRMS (ESI): m/z : Calcd for $\text{C}_{13}\text{H}_{16}\text{O}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 259.0941, Found 259.0939; IR (thin film, cm^{-1}): 3890, 3864, 3853, 3836, 3751, 3690, 3668, 3687, 1750, 1729, 1695, 1560, 1558, 1541, 786, 683.



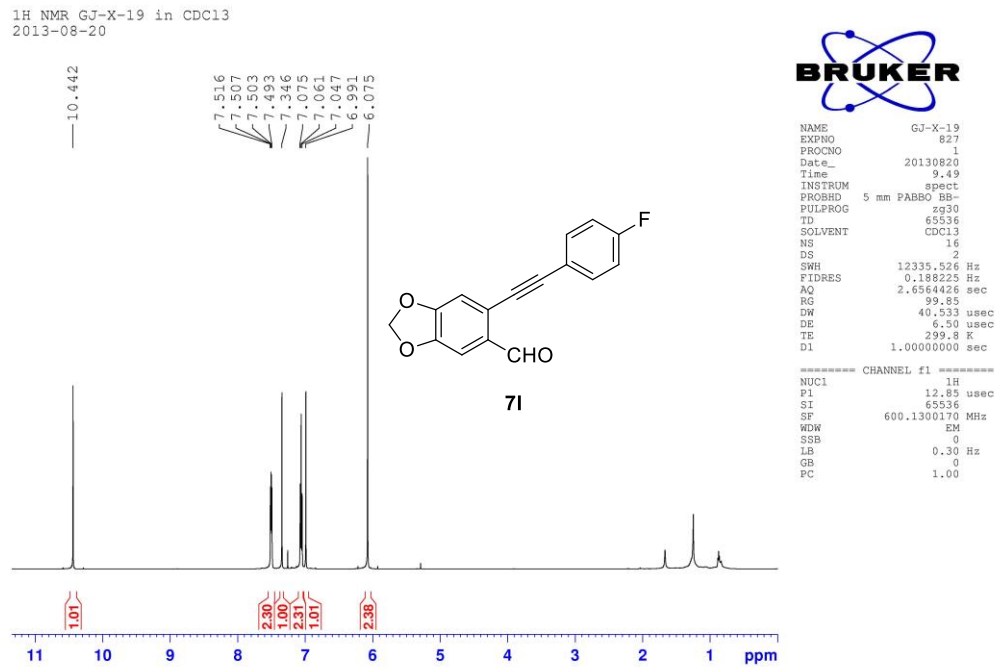
6c-D

d3-(E/Z)-1-(4,5-Dimethoxy-2-(2-methoxyvinyl)phenyl)ethanone (6c-D): TLC (petroleum ether:ethyl acetate, 10:1, v/v): $R_f=0.25$; white solid (1: 0.4 E/Z), Mp 58–59 °C; 90%; $^1\text{H NMR}$ (600 MHz, CD_3OD) $\delta = 7.56$ (s, 1H, Z), 7.29 (s, 1H, E), 7.22 (s, 1H, Z), 6.98 (d, $J = 12.9$ Hz, 1H, E), 6.94 (s, 1H, E), 6.56 (d, $J = 12.8$ Hz, 1H, E), 6.19 (d, $J = 7.3$ Hz, 1H, Z), 5.84 (d, $J = 7.3$ Hz, 1H, Z), 3.89 (s, 3H, E), 3.85 (s, 3H, E), 3.85 (s, 3H, Z), 3.84 (s, 3H, Z), 3.74 (s, 3H, Z), 3.68 (s, 3H, E); $^{13}\text{C NMR}$ (150 MHz, CD_3OD) $\delta = 203.8$ (Z), 203.0 (E), 153.7 (Z), 152.7 (Z), 151.5 (E), 149.4 (E), 148.2 (E), 147.8 (Z), 132.9 (E), 130.9 (Z), 130.7 (Z), 129.2 (E), 114.8 (E), 114.4 (Z), 113.8 (Z), 110.5 (E), 105.4 (E), 103.9 (Z), 60.9 (Z), 56.9 (E), 56.7 (E), 56.6 (Z), 56.4 (E), 56.2 (Z), 30.5 (hepta, E), 29.3 (hepta, Z); HRMS (ESI): M/Z : Calcd for $\text{C}_{13}\text{H}_{13}\text{O}_3\text{D}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 262.1129, Found 262.1125; IR (thin film, cm^{-1}): 3821, 3752, 1700, 1652, 1635, 706, 693.

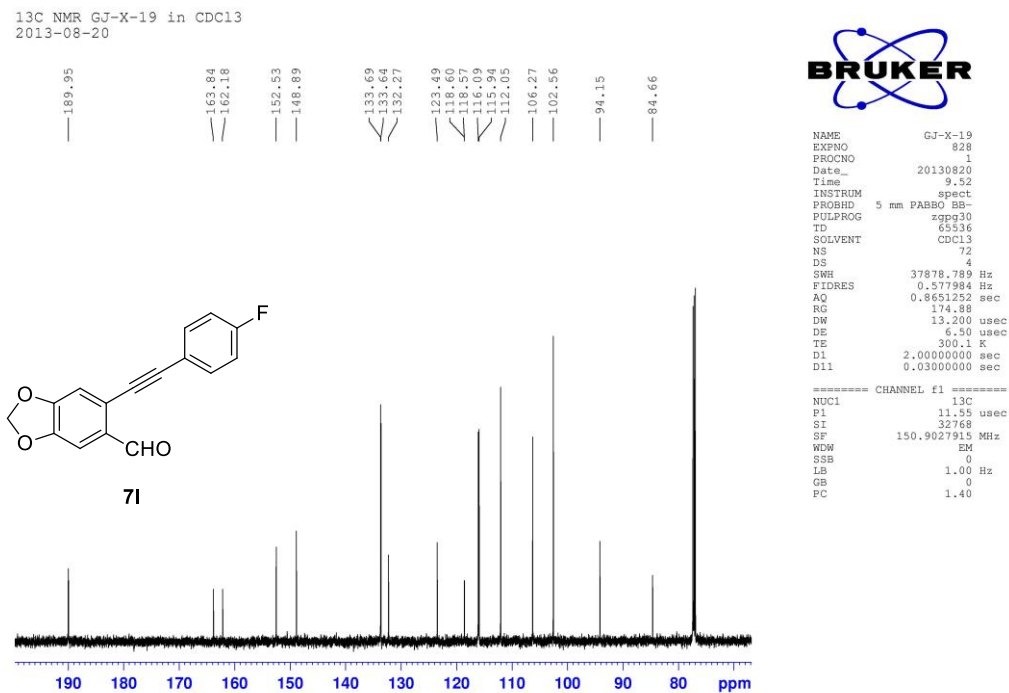
References

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VII.NMR Spectra

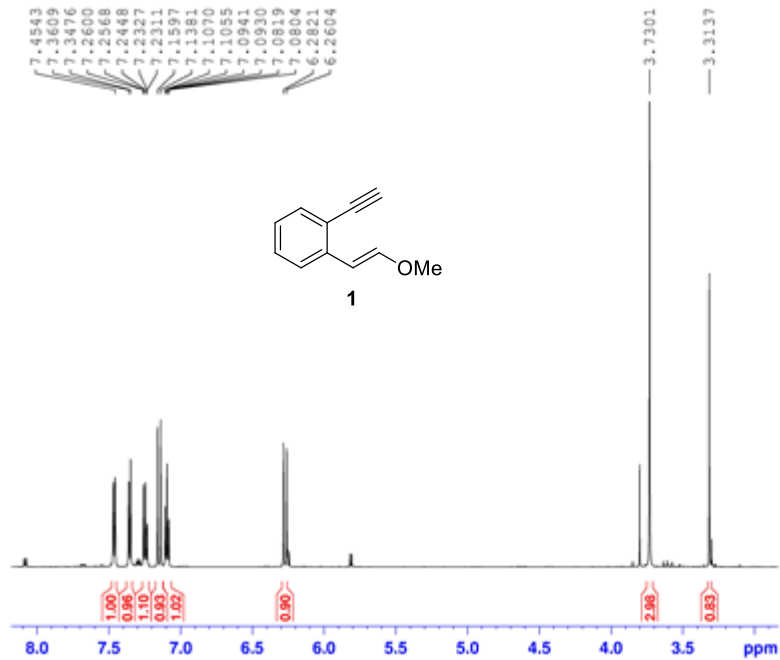


¹H NMR Spectrum of Compound **71** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **71** (CDCl₃, 150 MHz)

¹H NMR GJ-2-1 in CDCl₃
2013-06-06

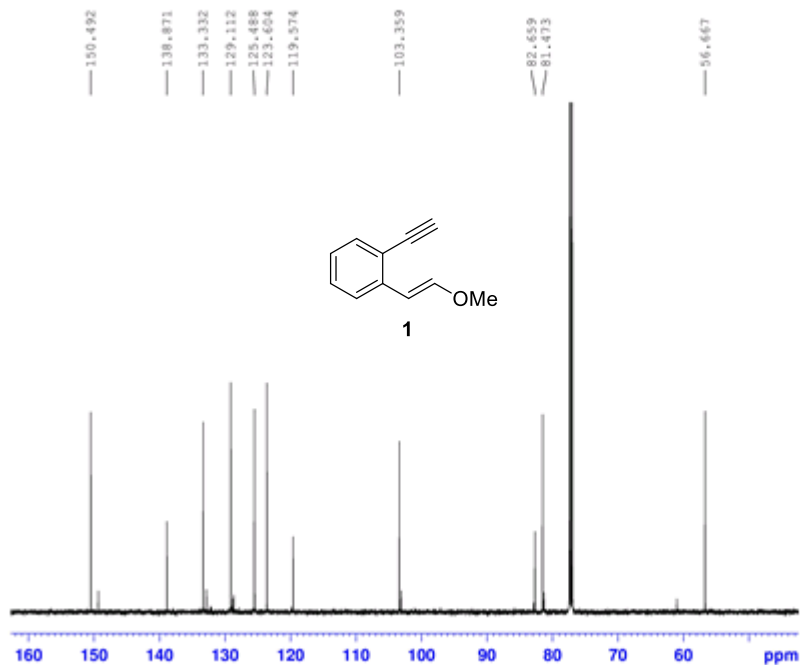


NAME GJ-2-1
EXPNO 610
PROCNO 1
Date_ 20130606
Time 14.54
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 157.22
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.00000000 sec

----- CHANNEL f1 -----
NUC1 ¹H
P1 12.85 usec
SI 65536
SF 600.1350172 MHz
WEN EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound 1 (CDCl₃, 600 MHz)

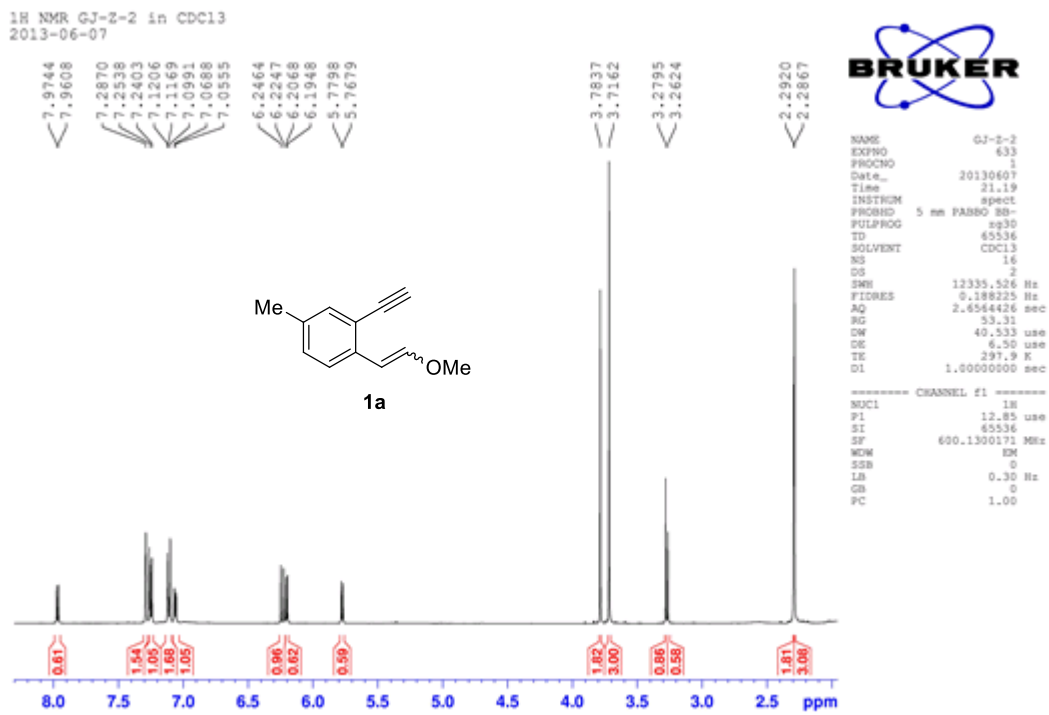
¹³C NMR GJ-2-1 in CDCl₃
2013-06-06



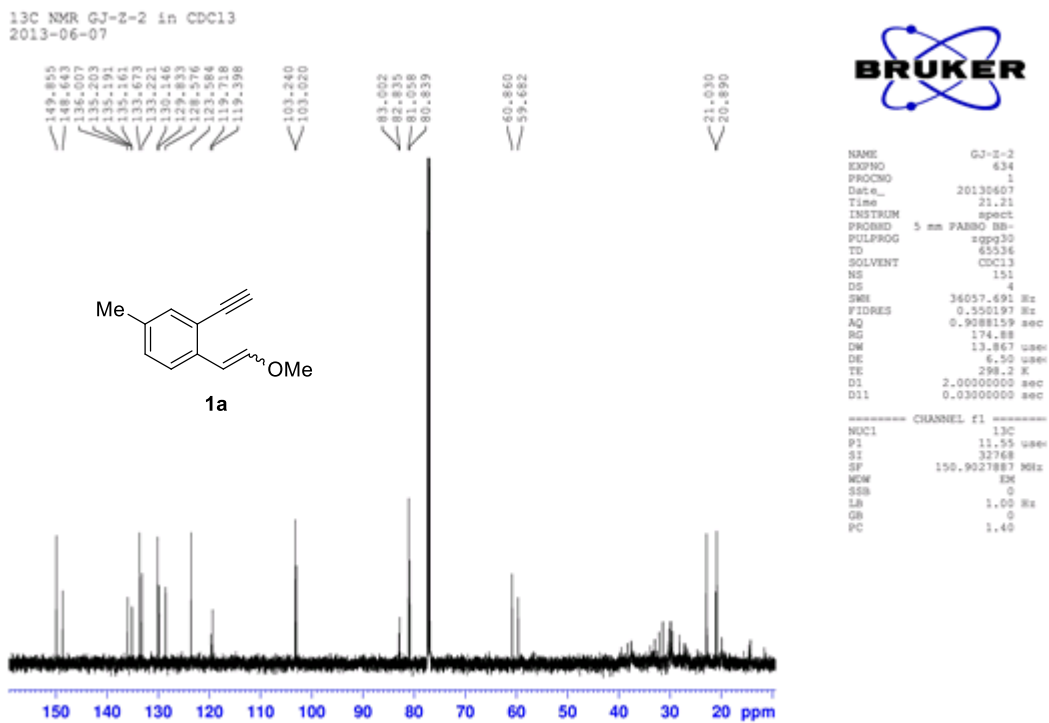
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EXPNO 611
PROCNO 1
Date_ 20130606
Time 15.18
INSTRUM spect
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PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 454
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec

----- CHANNEL f1 -----
NUC1 ¹³C
P1 11.55 usec
SI 32768
SF 150.9027897 MHz
WEN EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound 1 (CDCl₃, 150 MHz)

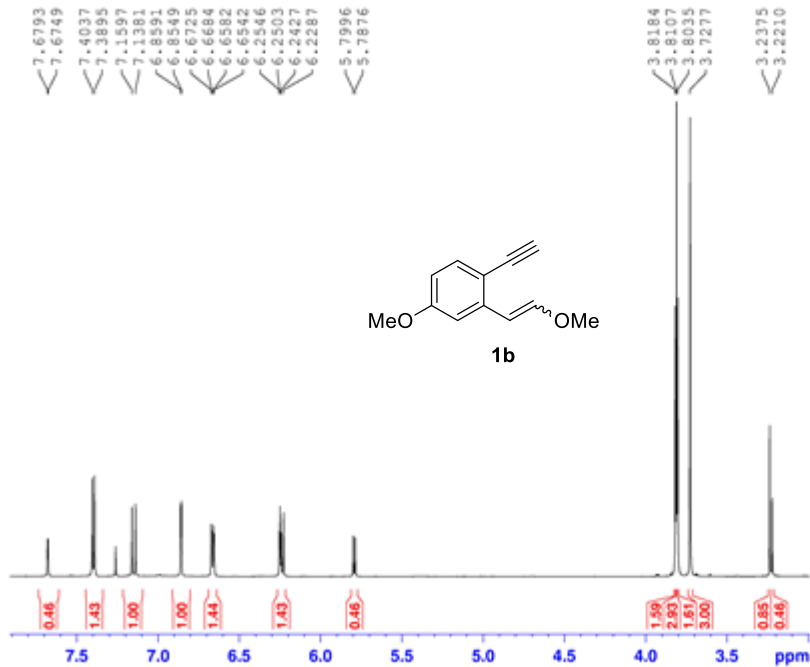


¹H NMR Spectrum of Compound **1a** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **1a** (CDCl₃, 150 MHz)

¹H NMR GJ-2-3 in CDCl₃
2013-06-07



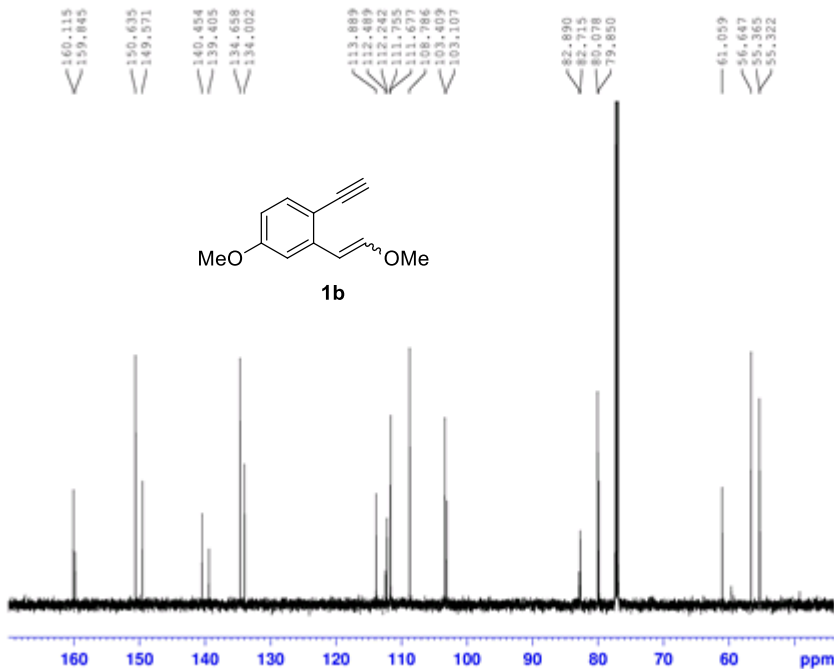
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PROCNO    1
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PULPROG   zgpg30
TD        65536
SOLVENT   CDCl3
NS        16
DS        2
SWH       12335.526 Hz
FIDRES    0.188225 Hz
AQ        2.6544426 sec
RG        30.26
DW        40.533 usec
DE        6.50 usec
TE        297.9 K
D1        1.00000000 sec

----- CHANNEL f1 -----
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300171 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
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¹H NMR Spectrum of Compound **1b** (CDCl₃, 600 MHz)

¹³C NMR GJ-2-3 in CDCl₃
2013-06-07



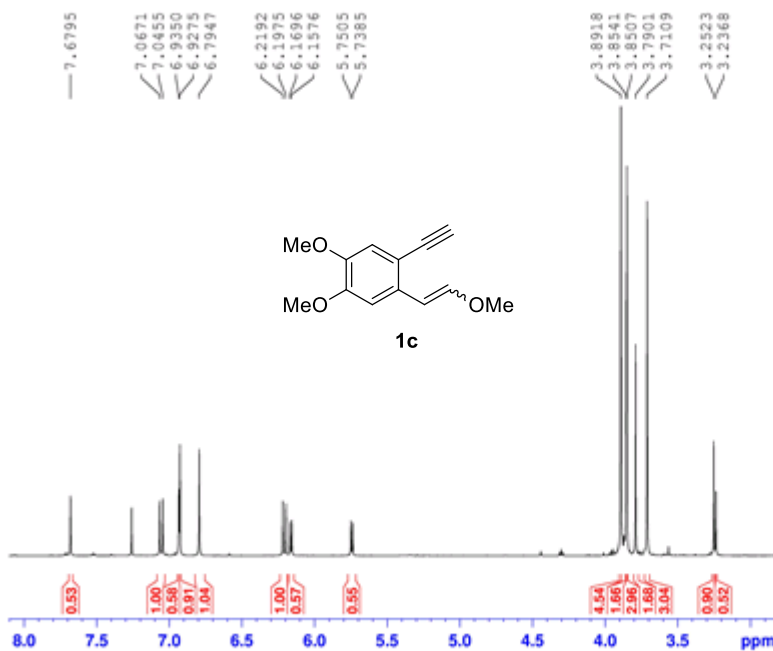
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NAME      GJ-2-3
EXPNO     628
PROCNO    1
Date_    20130607
Time     20.43
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD        65536
SOLVENT   CDCl3
NS        99
DS        4
SWH       36057.691 Hz
FIDRES    0.550197 Hz
AQ        0.9088159 sec
RG        174.88
DW        13.867 usec
DE        6.50 usec
TE        297.9 K
D1        2.00000000 sec
D11       0.03000000 sec

----- CHANNEL f1 -----
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027909 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR Spectrum of Compound **1b** (CDCl₃, 150 MHz)

¹H NMR GJ-Z-4 in CDCl₃
2013-06-06



```

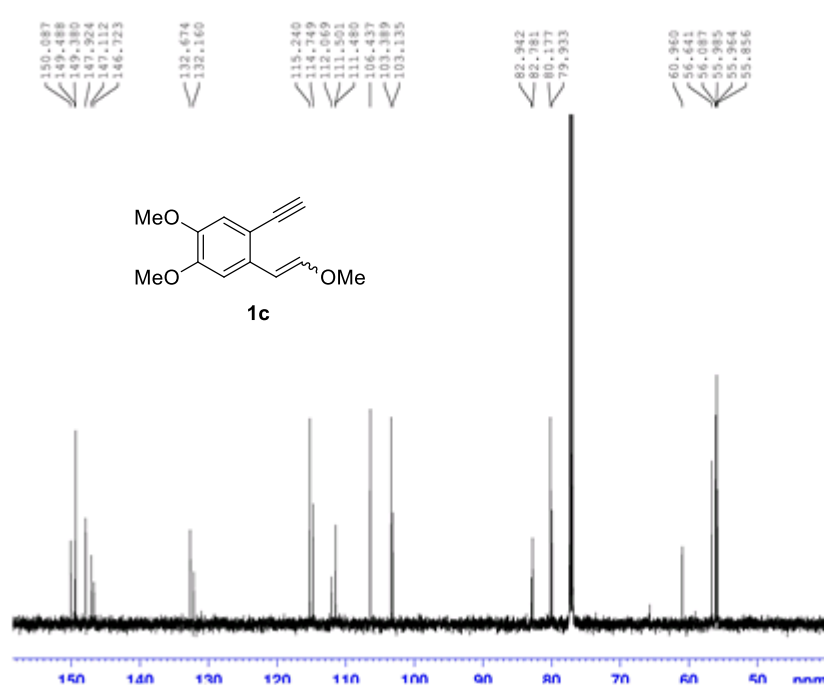
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Time     15.24
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PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      12335.526 Hz
FIDRES   0.188225 Hz
AQ       2.6564426 sec
RG       141.71
DM       40.533 usec
DE       6.50 usec
TE       297.9 K
D1       1.0000000 sec
  
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```

----- CHANNEL f1 -----
NUC1     1H
P1       12.85 usec
SI       65536
SF       600.130132 MHz
RGW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
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¹H NMR Spectrum of Compound **1c** (CDCl₃, 600 MHz)

¹³C NMR GJ-Z-4 in CDCl₃
2013-06-06



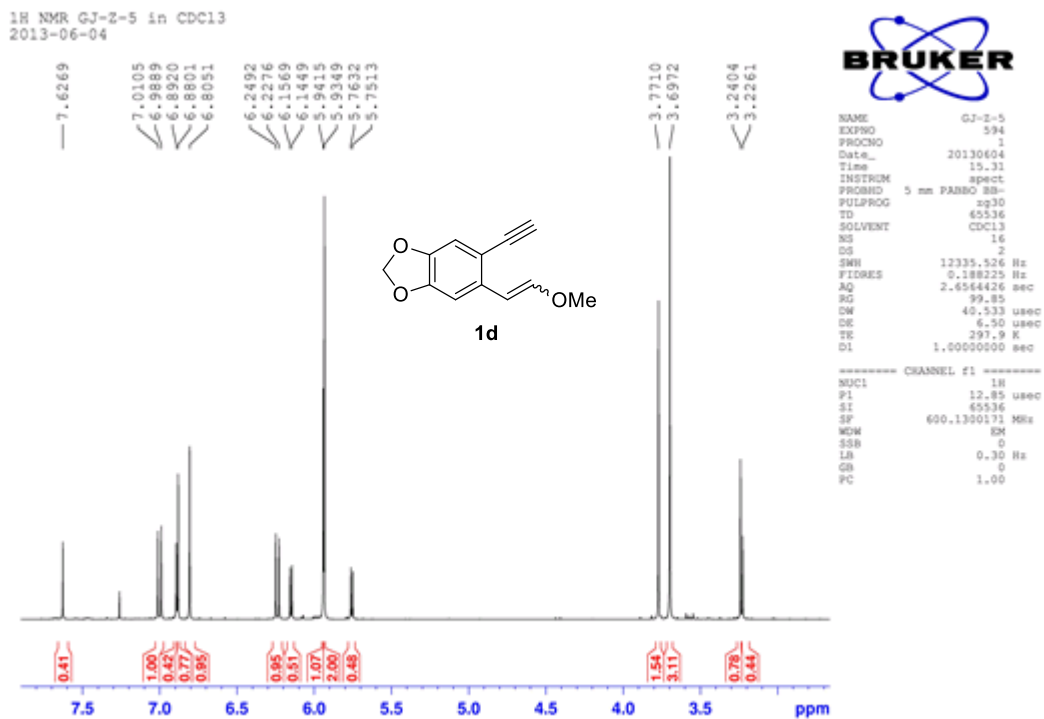
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NAME      GJ-Z-4
EXPNO    613
PROCNO   1
Date_    20130606
Time     15.38
INSTRUM  spect
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PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       264
DS       4
SWH      37878.789 Hz
FIDRES   0.577984 Hz
AQ       0.8651252 sec
RG       174.88
DM       13.200 usec
DE       6.50 usec
TE       297.9 K
D1       2.0000000 sec
D11      0.0300000 sec
  
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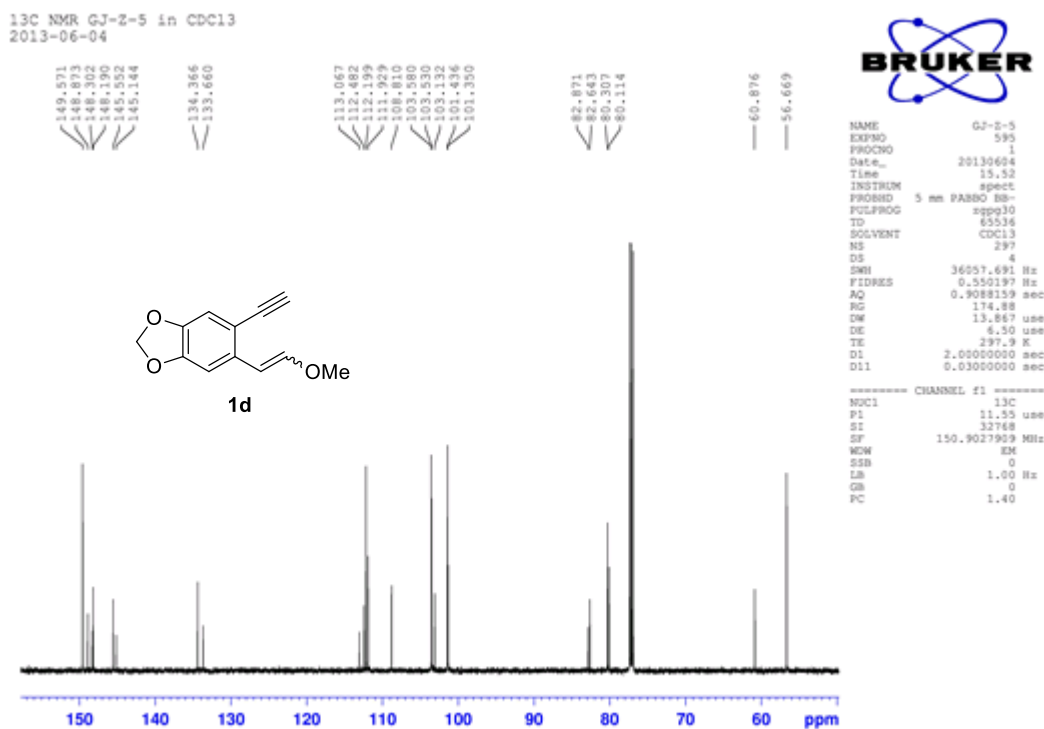
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----- CHANNEL f1 -----
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SF       150.9027908 MHz
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SSB      0
LB       1.00 Hz
GB       0
PC       1.40
  
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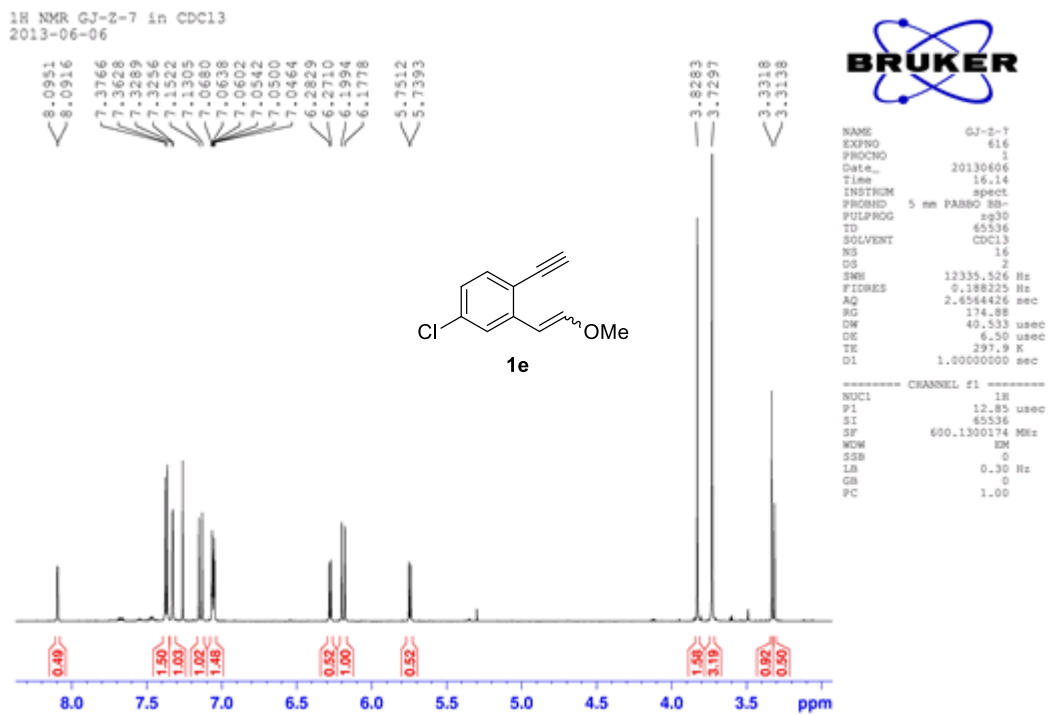
¹³C NMR Spectrum of Compound **1c** (CDCl₃, 150 MHz)



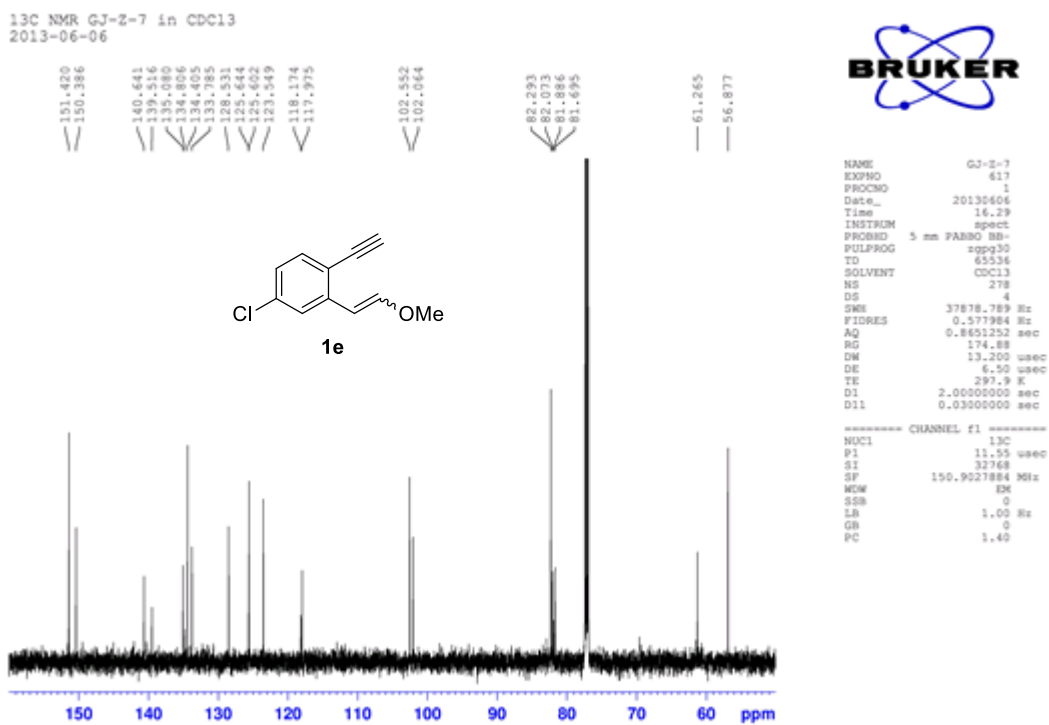
¹H NMR Spectrum of Compound **1d** (CDCl₃, 600 MHz)



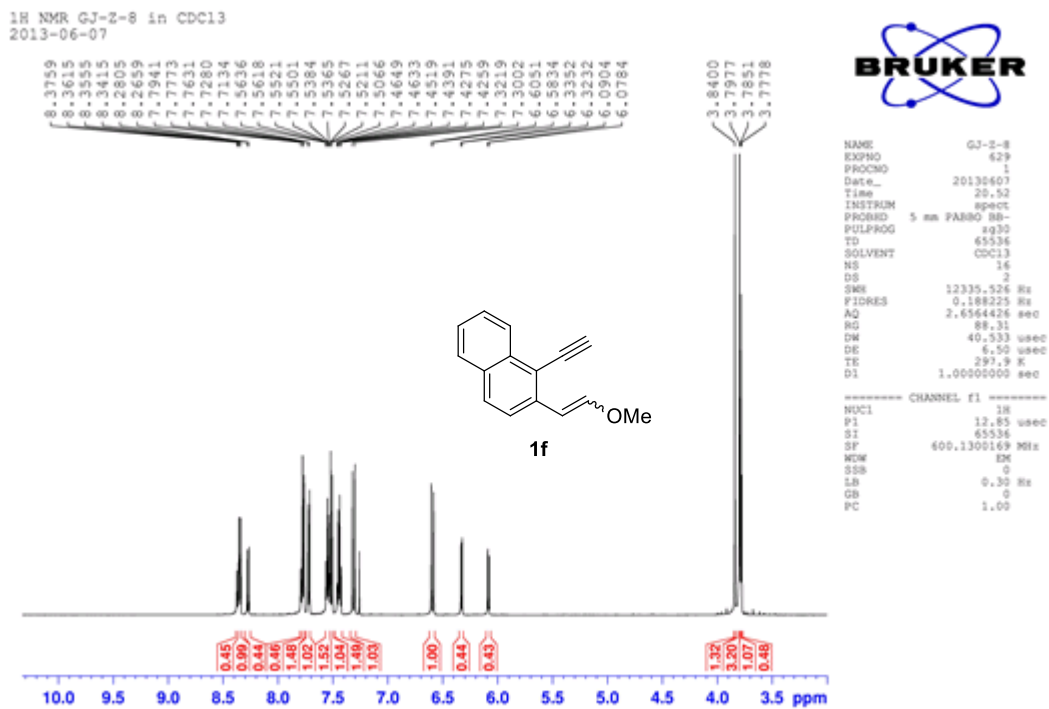
¹³C NMR Spectrum of Compound **1d** (CDCl₃, 150 MHz)



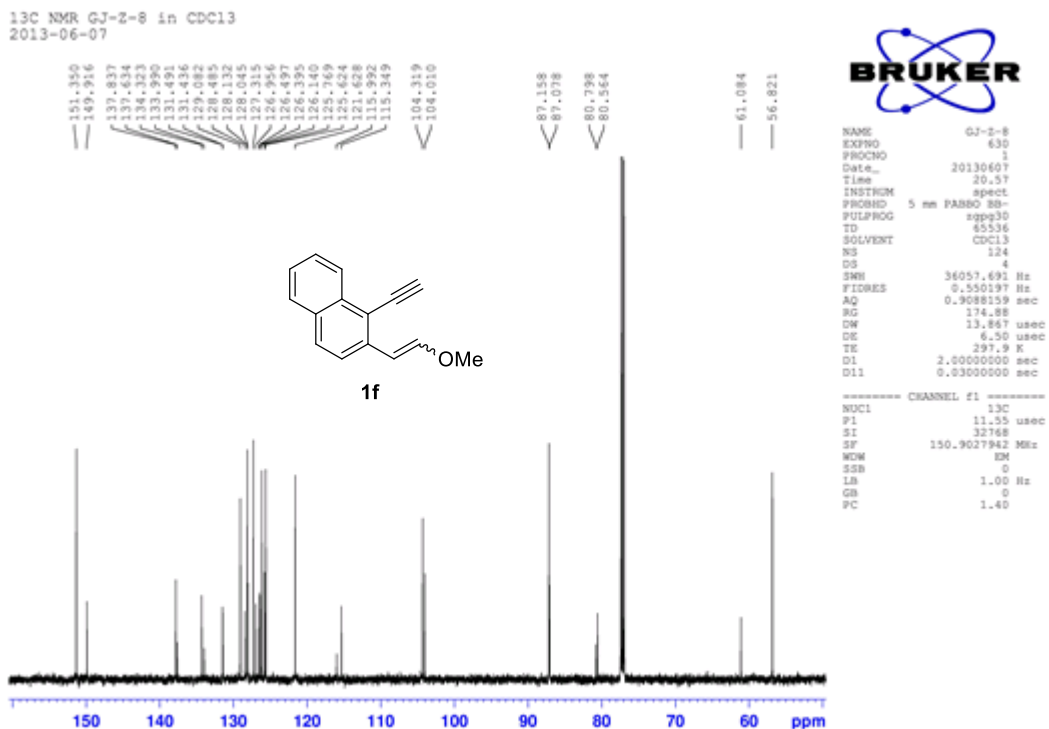
¹H NMR Spectrum of Compound **1e** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **1e** (CDCl₃, 150 MHz)

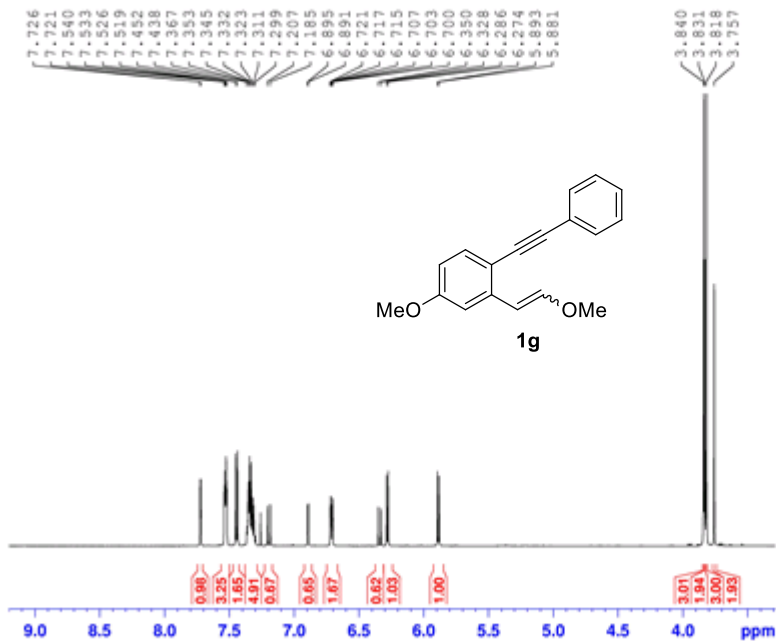


¹H NMR Spectrum of Compound **1f** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **1f** (CDCl₃, 150 MHz)

¹H NMR GJ-Z-14 in CDCl₃
2013-06-07



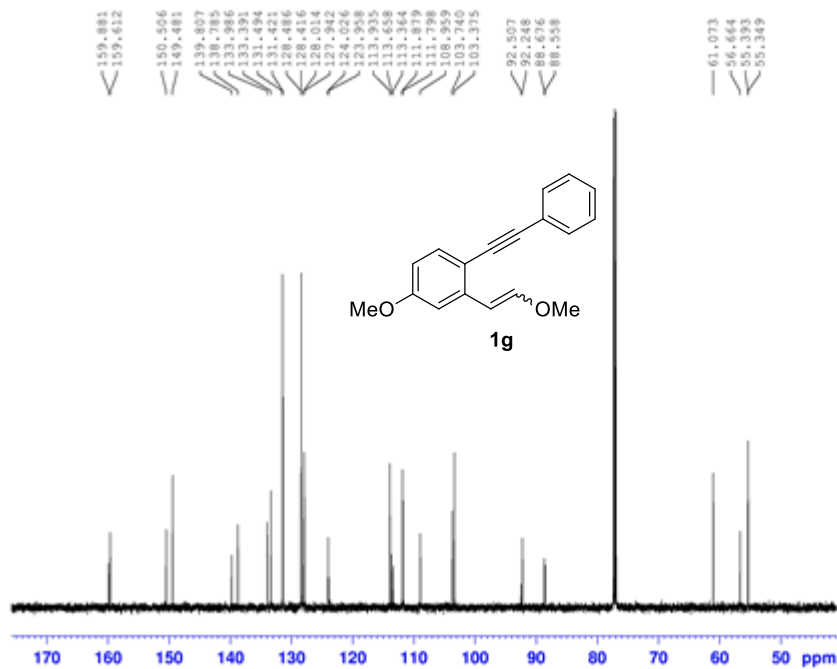
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EXPNO    635
PROCNO   1
Date_    20130607
Time     21.34
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        56
DS        2
SWH       12335.526 Hz
FIDRES   0.188225 Hz
AQ        2.4556426 sec
RG        66.78
DW        40.533 usec
DE        6.50 usec
TE        297.9 K
D1        1.05000000 sec

----- CHANNEL f1 -----
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300171 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **1g** (CDCl₃, 600 MHz)

¹³C NMR GJ-Z-14 in CDCl₃
2013-06-07



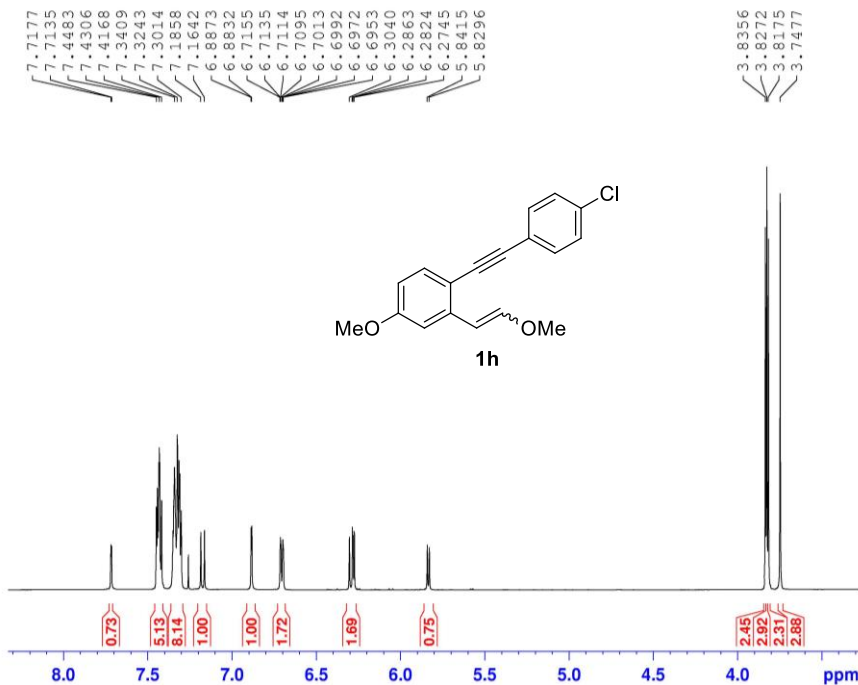
```

NAME      GJ-Z-12
EXPNO    636
PROCNO   1
Date_    20130607
Time     21.36
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        106
DS        4
SWH       36057.691 Hz
FIDRES   0.550197 Hz
AQ        0.9088159 sec
RG        174.88
DW        13.867 usec
DE        6.50 usec
TE        297.9 K
D1        2.00000000 sec
D11       0.03000000 sec

----- CHANNEL f1 -----
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027931 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR Spectrum of Compound **1g** (CDCl₃, 150 MHz)

¹H NMR GJ-Z-13 in CDCl₃
2013-06-04



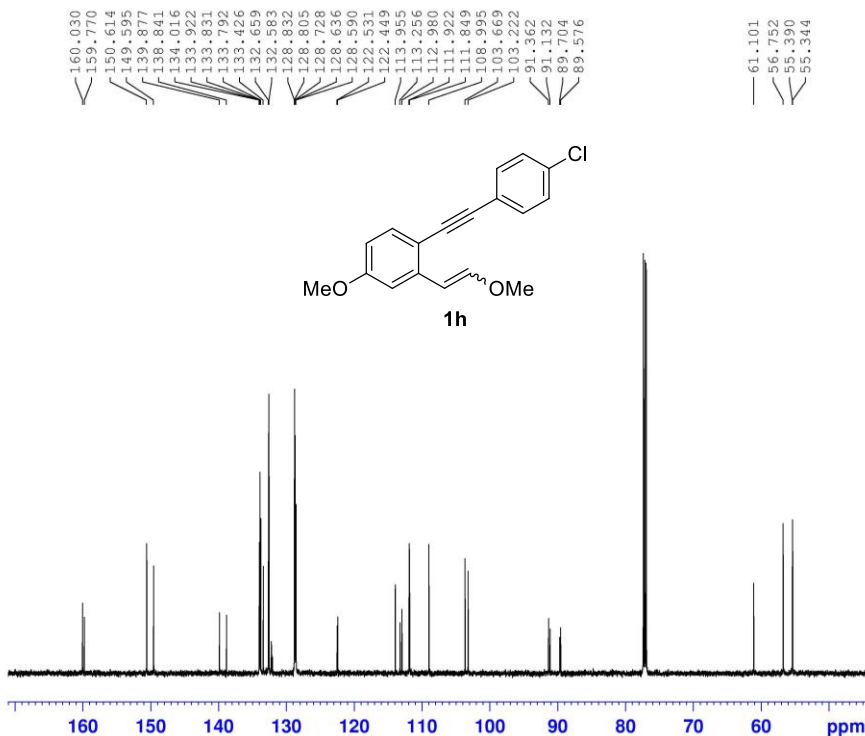
¹H NMR Spectrum of Compound **1h** (CDCl₃, 600 MHz)



```
NAME          GJ-Z-13
EXPNO         596
PROCNO        1
Date_         20130604
Time          15.14
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           12335.526 Hz
FIDRES        0.188225 Hz
AQ            2.6564426 sec
RG            73.82
DW            40.533 usec
DE            6.50 usec
TE            297.9 K
D1            1.00000000 sec
```

```
===== CHANNEL f1 =====
NUC1          1H
P1            12.85 usec
SI            65536
SF            600.1300171 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```

¹³C NMR GJ-Z-13 in CDCl₃
2013-06-04



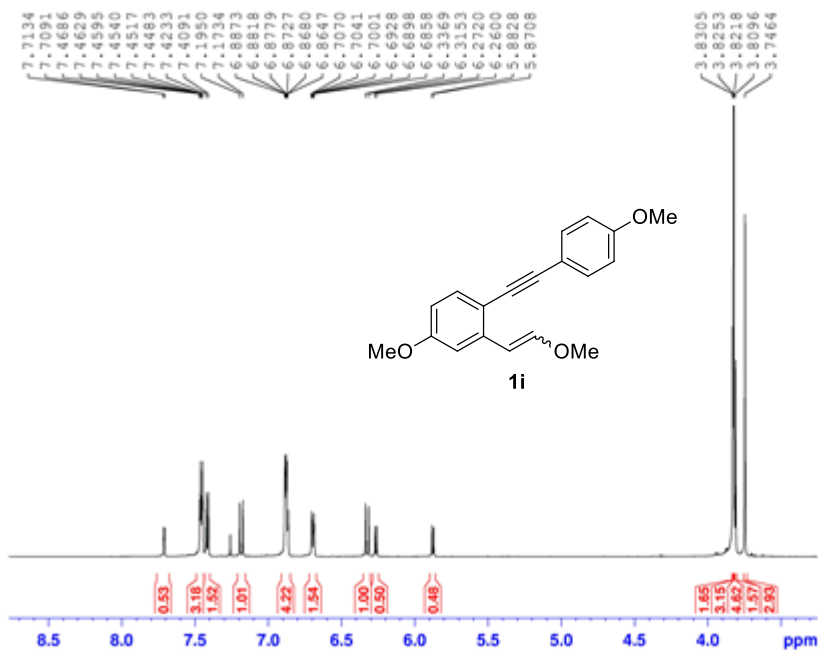
¹³C NMR Spectrum of Compound **1h** (CDCl₃, 150 MHz)



```
NAME          GJ-Z-13
EXPNO         597
PROCNO        1
Date_         20130604
Time          16.36
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            4
DS            4
SWH           37878.789 Hz
FIDRES        0.577984 Hz
AQ            0.8651252 sec
RG            174.88
DW            13.200 usec
DE            6.50 usec
TE            297.9 K
D1            2.00000000 sec
D11           0.03000000 sec
```

```
===== CHANNEL f1 =====
NUC1          13C
P1            11.55 usec
SI            32768
SF            150.9027943 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

¹H NMR GJ-Z-12 in CDCl₃
2013-06-07



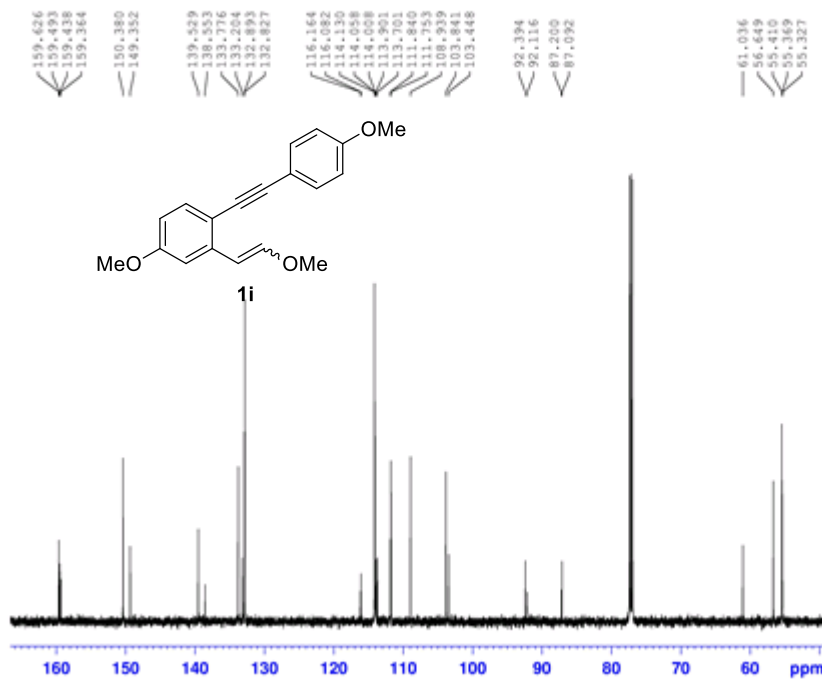
```

NAME      GJ-Z-12
EXPNO    625
PROCNO   1
Date_    20130607
Time     20.27
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        16
DS        2
SWEH     12335.526 Hz
FIDRES   0.188225 Hz
AQ        2.6564426 sec
RG        66.78
DM        40.533 usec
DE        6.50 usec
TE        297.9 K
D1        1.00000000 sec

----- CHANNEL f1 -----
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300170 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **1i** (CDCl₃, 600 MHz)

¹³C NMR GJ-Z-12 in CDCl₃
2013-06-07



```

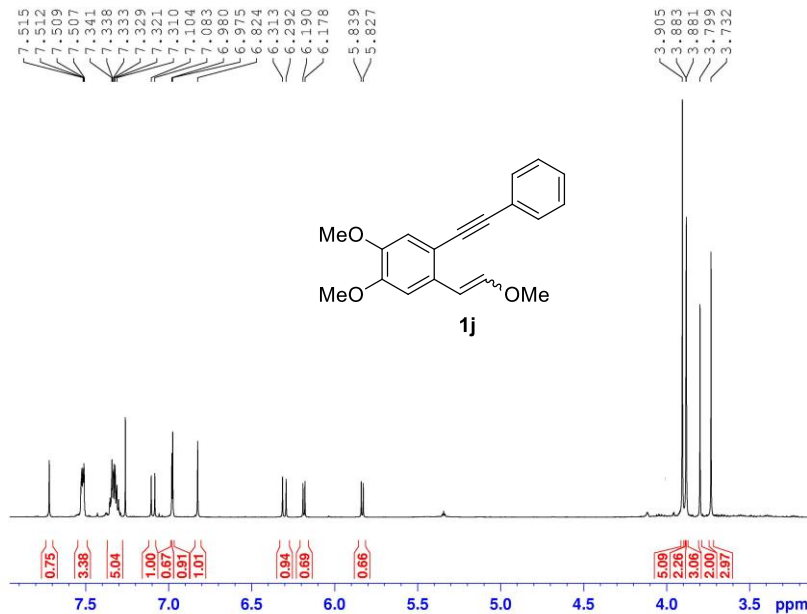
NAME      GJ-Z-12
EXPNO    626
PROCNO   1
Date_    20130607
Time     20.32
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        89
DS        4
SWEH     34057.691 Hz
FIDRES   0.550197 Hz
AQ        0.9388159 sec
RG        174.88
DM        13.867 usec
DE        6.50 usec
TE        297.9 K
D1        2.00000000 sec
D11       0.03000000 sec

----- CHANNEL f1 -----
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027943 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR

Spectrum of Compound **1i** (CDCl₃, 150 MHz)

¹H NMR GJ-Z-1P in CDCl₃
2013-08-19

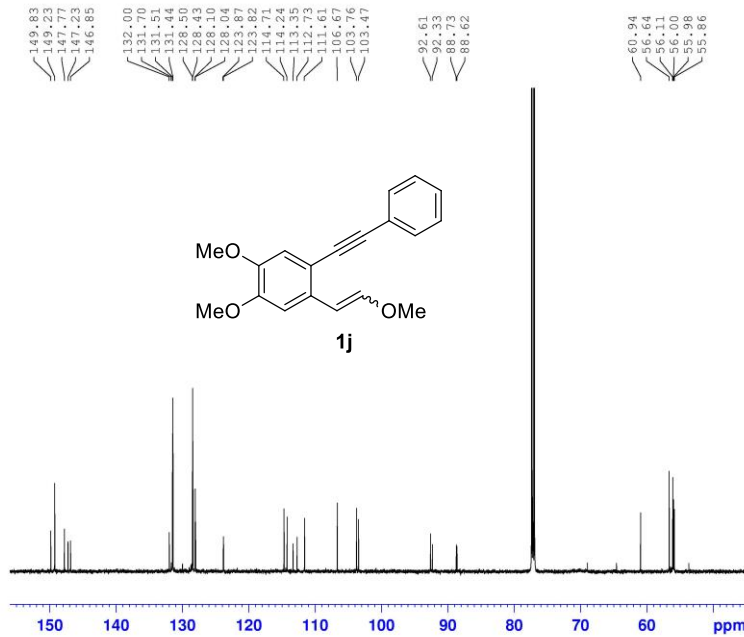


NAME GJ-Z-15
EXPNO 822
PROCNO 1
Date_ 20130819
Time 10.49
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 30.26
DW 40.533 usec
DE 6.50 usec
TE 299.8 K
D1 1.00000000 sec

===== CHANNEL f1 =====
NUC1 ¹H
P1 12.85 usec
SI 65536
SF 600.1300171 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
FC 1.00

¹H NMR Spectrum of Compound **1j** (CDCl₃, 600 MHz)

¹³C NMR GJ-Z-1P in CDCl₃
2013-08-19

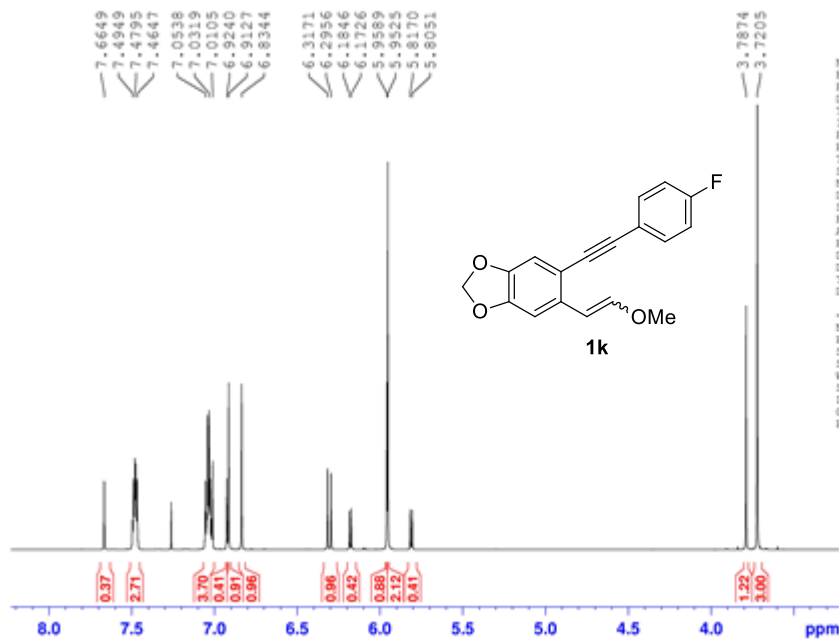


NAME GJ-Z-15
EXPNO 823
PROCNO 1
Date_ 20130819
Time 11.28
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 3220
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 299.9 K
D1 2.00000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====
NUC1 ¹³C
P1 11.35 usec
SI 32768
SF 150.9027896 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
FC 1.40

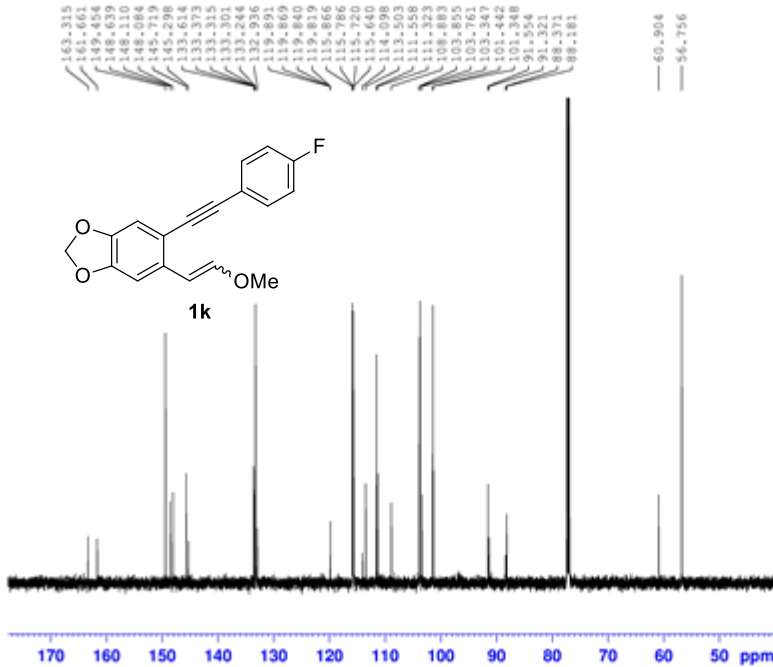
¹³C NMR Spectrum of Compound **1j** (CDCl₃, 150 MHz)

¹H NMR GJ-Z-19 in CDCl₃
2013-06-07



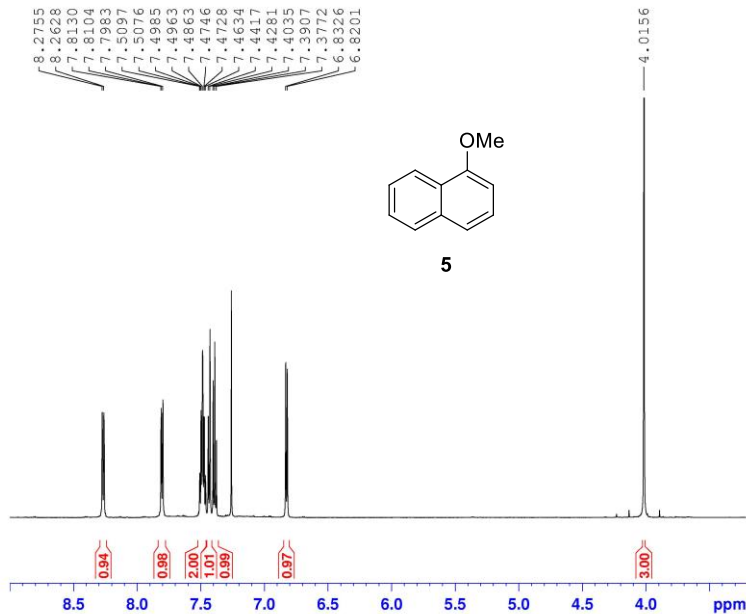
```
NAME      GJ-Z-19
EXPNO     631
PROCNO    1
Date_     20130607
Time      21.05
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         2
SWH        12335.526 Hz
FIDRES     0.189225 Hz
AQ         2.656422 sec
RG         115.06
DM         40.533 usec
DE         6.50 usec
TE         297.9 K
D1         1.0000000 sec
----- CHANNEL f1 -----
NUC1       1H
P1         12.85 usec
SI         65536
SF         600.1300172 MHz
MCHW       RM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
```

¹³C NMR GJ-Z-19 in CDCl₃
2013-06-07



```
NAME      GJ-Z-19
EXPNO     432
PROCNO    1
Date_     20130607
Time      21.09
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         152
DS         4
SWH        36057.691 Hz
FIDRES     0.350197 Hz
AQ         0.9088159 sec
RG         174.88
DM         13.867 usec
DE         6.50 usec
TE         297.9 K
D1         3.0000000 sec
D11        0.0300000 sec
----- CHANNEL f1 -----
NUC1       13C
P1         11.55 usec
SI         32768
SF         150.9027910 MHz
MCHW       RM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
```

¹H NMR GJ-N-1 in CDCl₃
2013-04-15



```

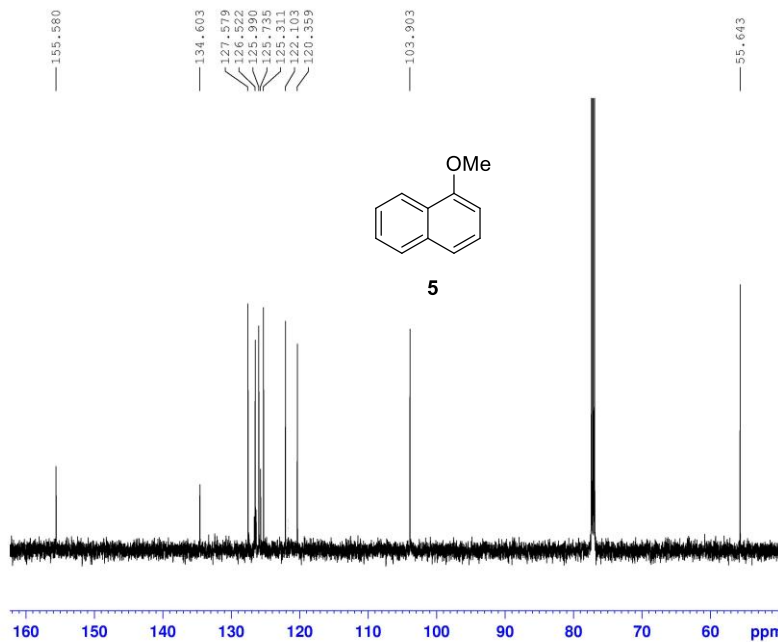
NAME      GJ-N-1
EXPNO     435
PROCNO    1
Date_     20130415
Time      17.45
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         2
SWH        12335.526 Hz
FIDRES     0.188225 Hz
AQ         2.6564426 sec
RG         157.22
DW         40.533 usec
DE         6.50 usec
TE         297.9 K
D1         1.00000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300169 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **5** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-1 in CDCl₃
2013-04-15



```

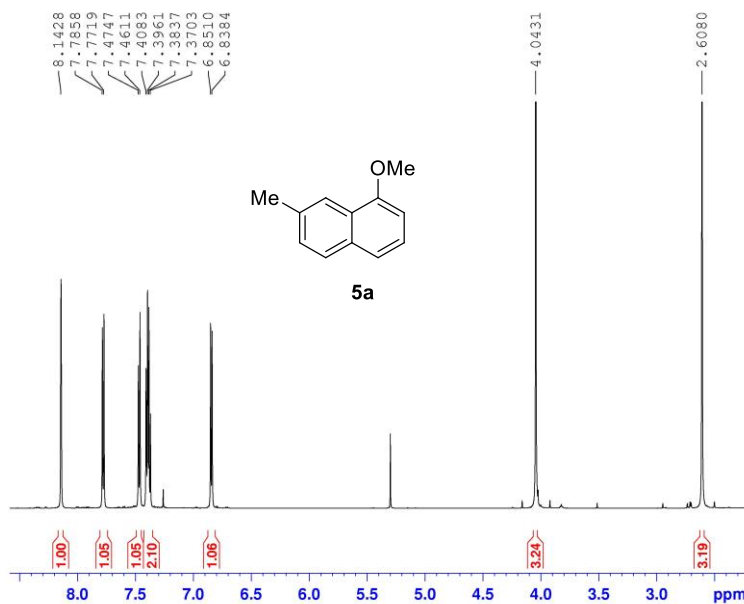
NAME      GJ-N-1
EXPNO     436
PROCNO    1
Date_     20130415
Time      17.55
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         204
DS         4
SWH        36057.691 Hz
FIDRES     0.550197 Hz
AQ         0.9088159 sec
RG         174.88
DW         33.867 usec
DE         6.50 usec
TE         297.9 K
D1         2.00000000 sec
D11        0.03000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027896 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR Spectrum of Compound **5** (CDCl₃, 150 MHz)

¹H NMR GJ-N-2 in CDCl₃
2013-04-22

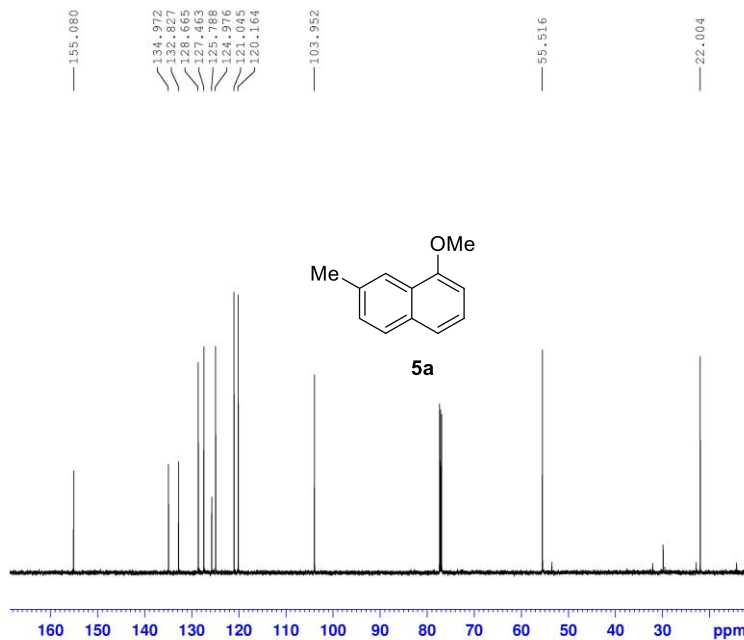


```
NAME          GJ-N-2
EXPNO         455
PROCNO        1
Date_         20130422
Time         19.59
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           12335.526 Hz
FIDRES        0.188225 Hz
AQ            2.6564426 sec
RG            30.26
DW            40.533 usec
DE            6.50 usec
TE            297.3 K
D1            1.00000000 sec

===== CHANNEL f1 =====
NUC1          1H
P1            12.85 usec
SI            65536
SF            600.1300163 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
```

¹H NMR Spectrum of Compound **5a** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-2 in CDCl₃
2013-04-22

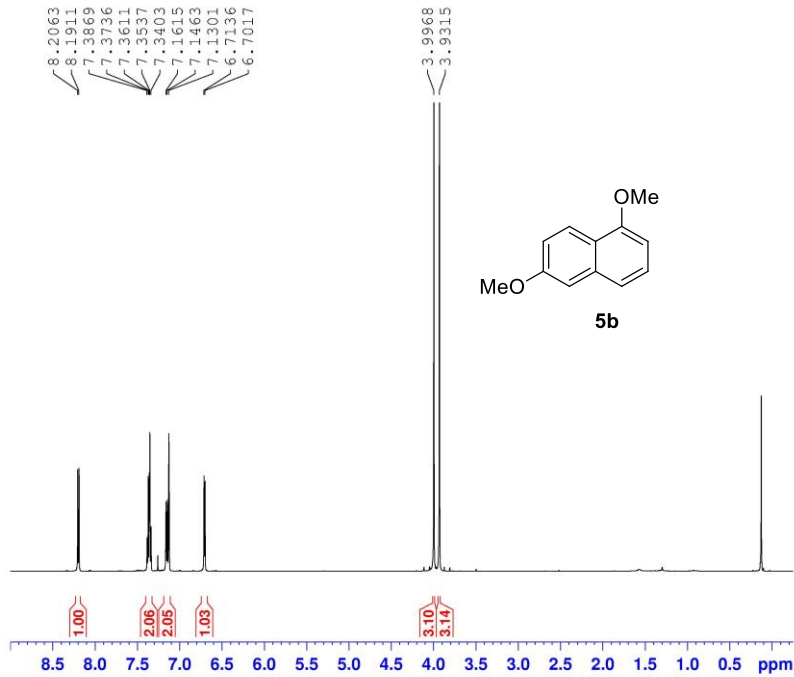


```
NAME          GJ-N-2
EXPNO         456
PROCNO        1
Date_         20130422
Time         20.01
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            53
DS            4
SWH           37878.789 Hz
FIDRES        0.577984 Hz
AQ            0.8651252 sec
RG            174.88
DW            13.200 usec
DE            6.50 usec
TE            297.3 K
D1            2.00000000 sec
D11           0.03000000 sec

===== CHANNEL f1 =====
NUC1          13C
P1            11.55 usec
SI            32768
SF            150.9028060 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
```

¹³C NMR Spectrum of Compound **5a** (CDCl₃, 150 MHz)

¹H NMR GJ-N-3 in CDCl₃
2013-04-22

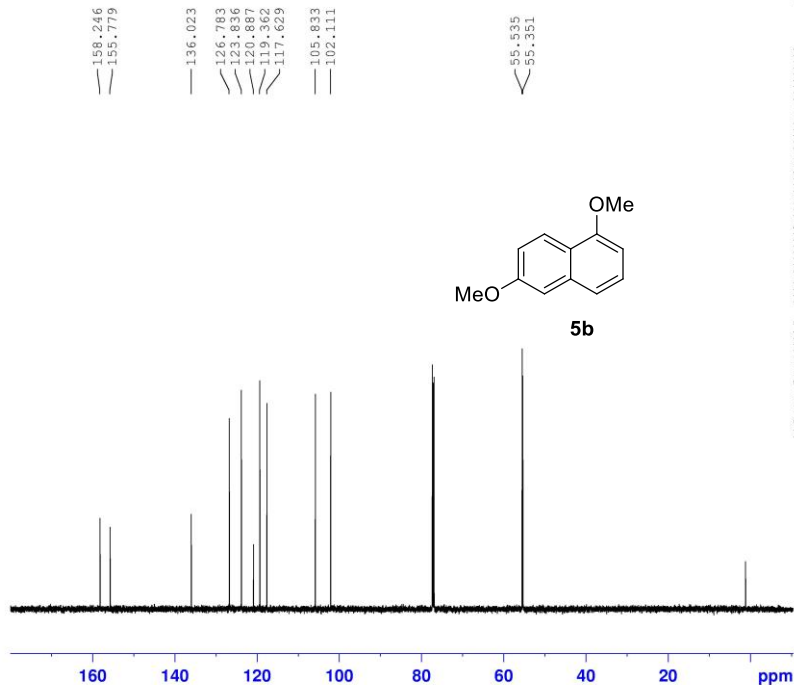


NAME GJ-N-3
EXPNO 460
PROCNO 1
Date_ 20130422
Time 20.25
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 66.78
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.00000000 sec

===== CHANNEL f1 =====
NUC1 ¹H
P1 12.85 usec
SI 65536
SF 600.1300167 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound **5b** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-3 in CDCl₃
2013-04-22

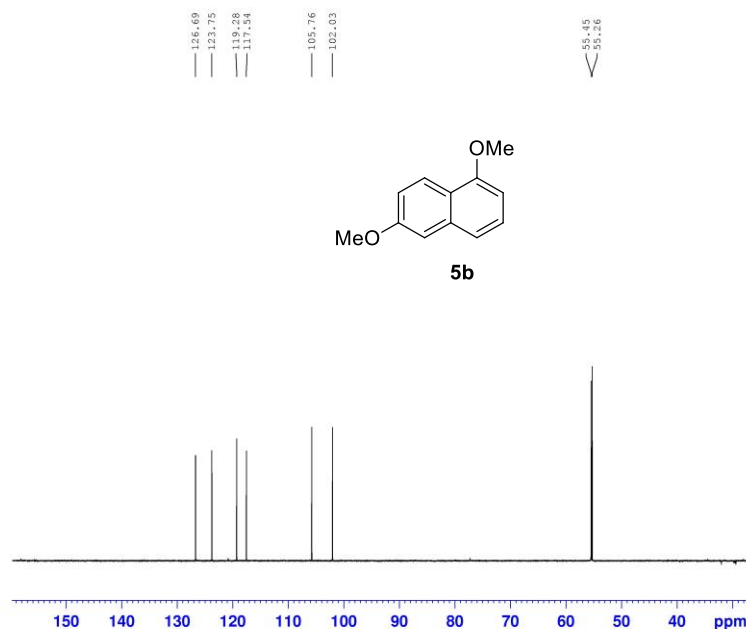


NAME GJ-N-3
EXPNO 461
PROCNO 1
Date_ 20130422
Time 20.29
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 54
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====
NUC1 ¹³C
P1 11.55 usec
SI 32768
SF 150.9027964 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound **5b** (CDCl₃, 150 MHz)

Dept135 GJ-N-3 in CDCl3
2013-08-05

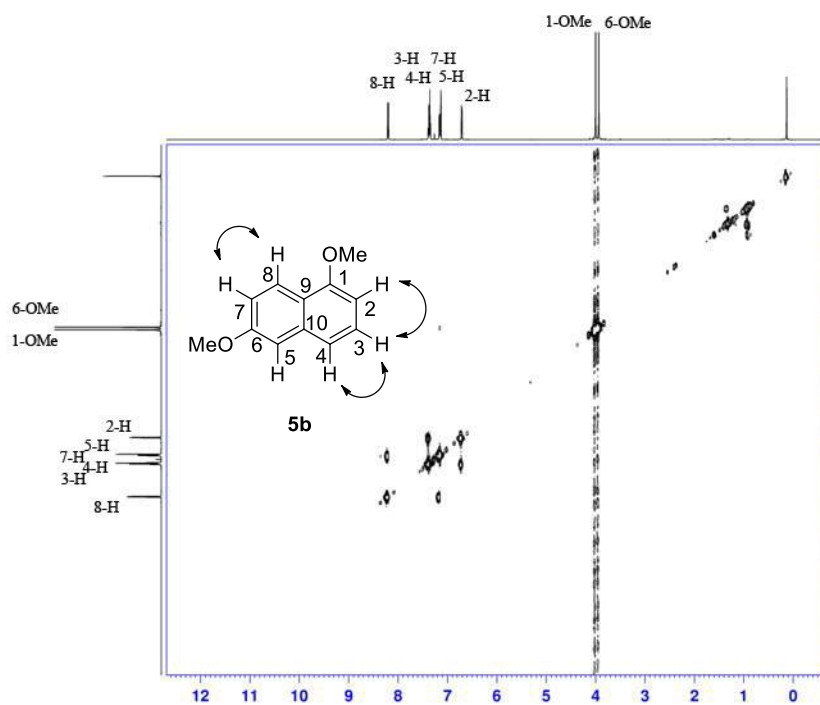


```

NAME      GJ-N-3
EXPNO     788
PROCNO    1
Date_     20130805
Time      15.40
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   deptap135
TD         65536
SOLVENT   CDCl3
NS         256
DS         4
SWH        24038.461 Hz
FIDRES     0.366798 Hz
AQ         1.3631988 sec
RG         174.88
DW         20.800 usec
DE         6.50 usec
TE         299.8 K
CNST2     145.0000000
D1         2.0000000 sec
D2         0.03344828 sec
D12        0.00002000 sec

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
P13       2000.00 usec
SI        32768
SF        150.9028090 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
    
```

Dept135 ¹³C NMR Spectrum of Compound **5b** (CDCl₃, 150 MHz)

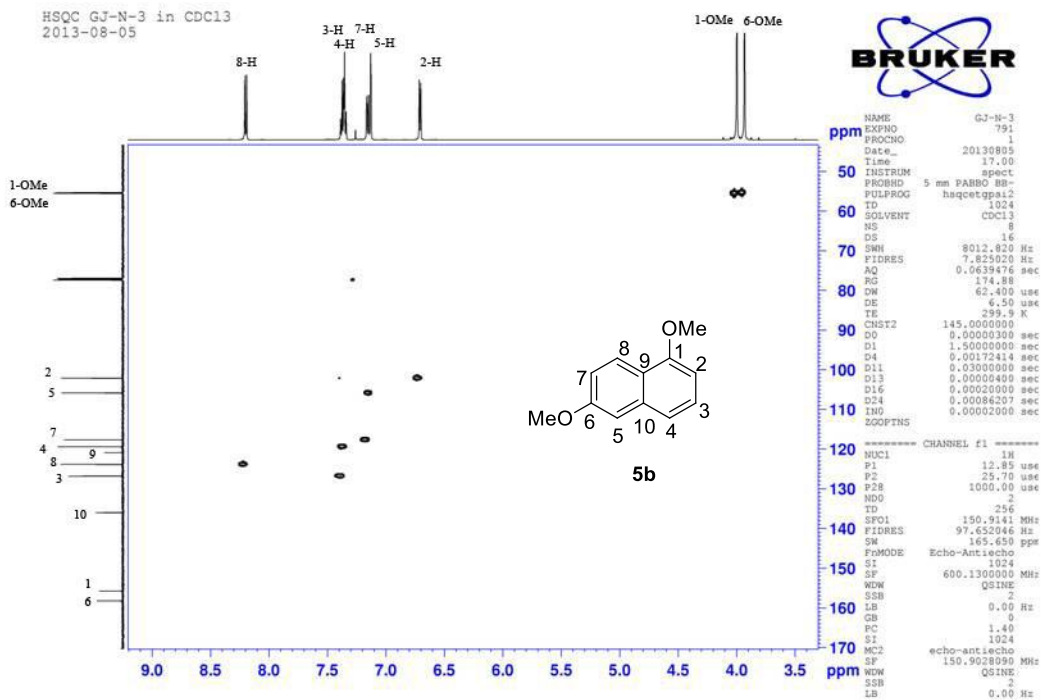


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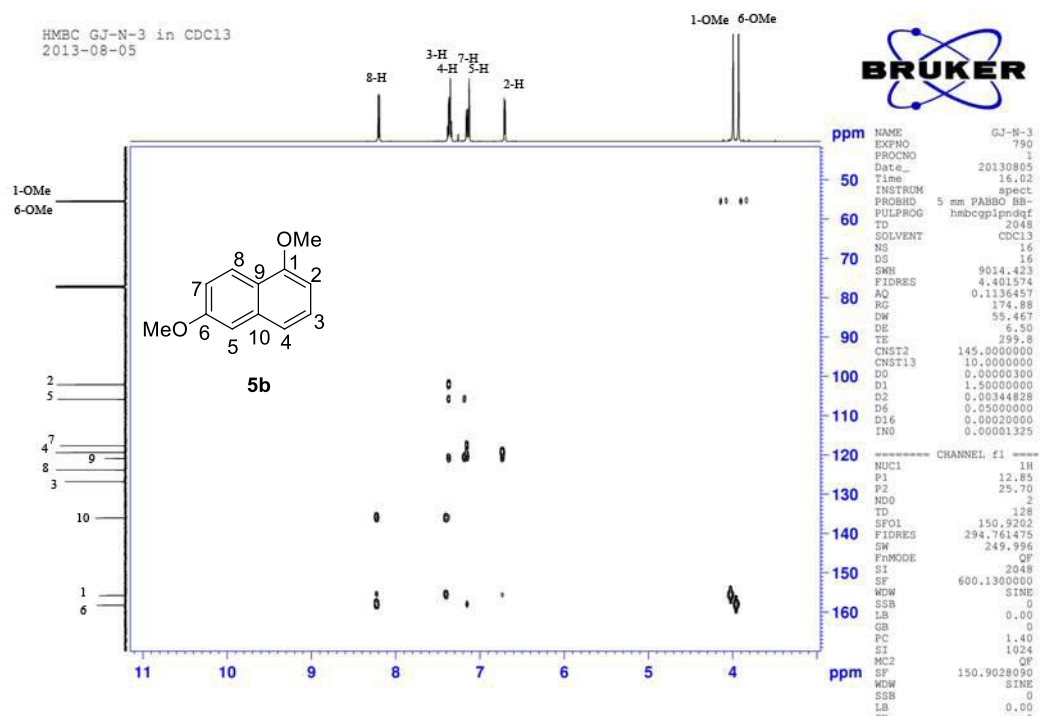
ppm NAME      GJ-N-3
EXPNO     785
PROCNO    1
Date_     20130805
Time      15.42
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   cosypppqf
TD         2048
SOLVENT   CDCl3
NS         4
DS         8
SWH        8012.820 Hz
FIDRES     3.912510 Hz
AQ         0.1278452 se
RG         128.27
DW         62.400 us
DE         6.50 us
TE         299.8 K
DO         0.00000000 se
D1         2.00000000 se
D11        0.03000000 se
D12        0.00002000 se
D13        0.00004000 se
D16        0.00020000 se
IN0        0.00012480 se

===== CHANNEL f1 =====
NUC1      1H
P0        12.85 us
P1         12.85 us
P17       2500.00 us
ND0       1
TD         128
SFO1     600.1336 MH
FIDRES    62.600159 Hz
SW        13.352 pf
FAMODE    QF
SI         1024
SF        600.1300000 MH
WDW       QF
SSB       0
LB        0.00 Hz
GB        0
PC        1.40
SI         1024
MC2       QF
SF        600.1300000 MH
WDW       QF
SSB       0
LB        0.00 Hz
    
```

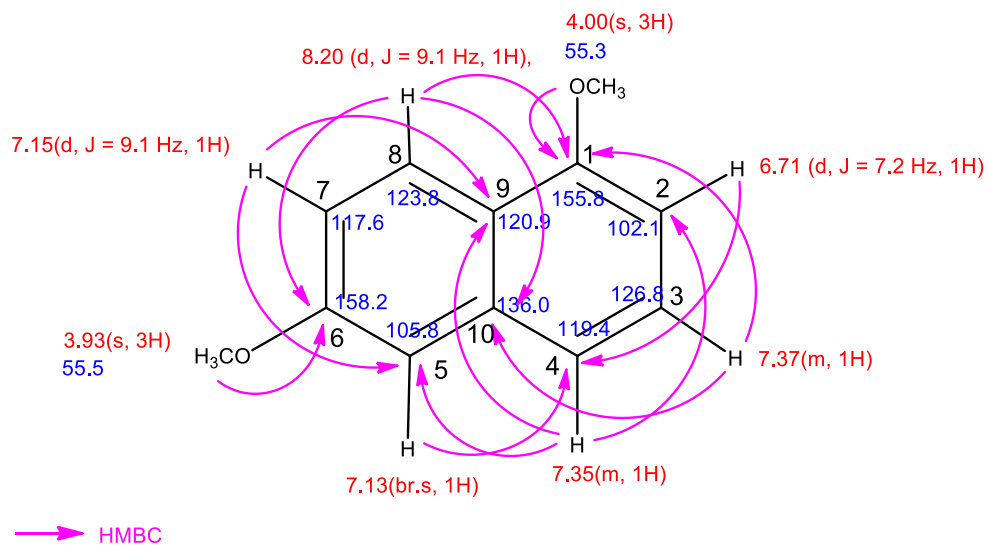
H-H COSY Spectrum of Compound **5b** (CDCl₃, 600 MHz)



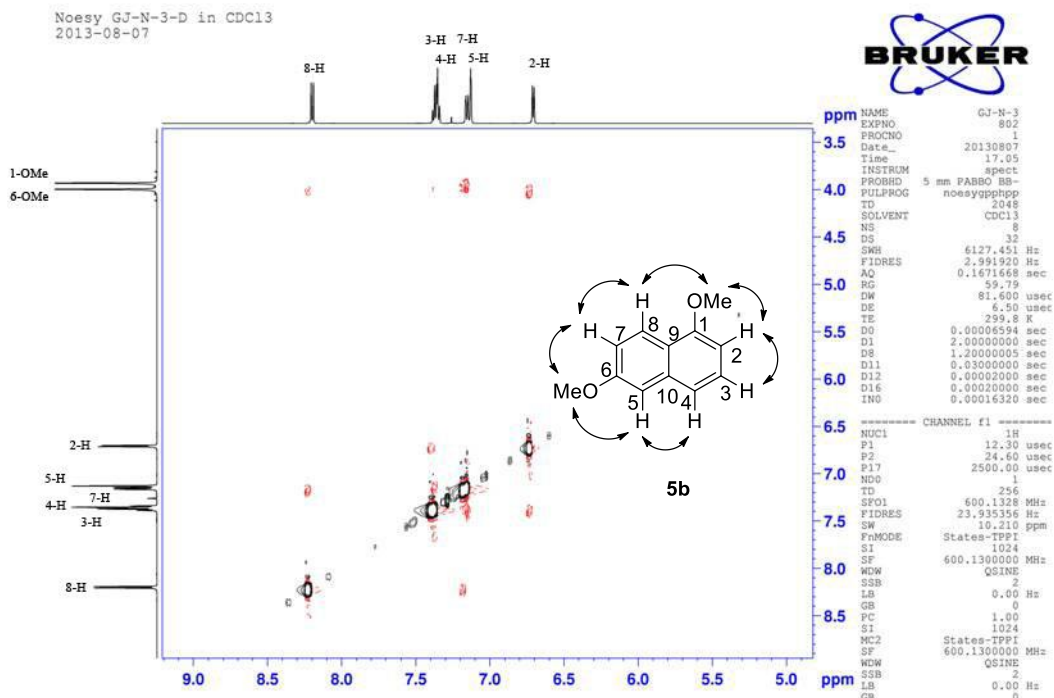
HSQC Spectrum of Compound **5b** (CDCl₃, 600 MHz)



HMBC Spectrum of Compound **5b** (CDCl₃, 600 MHz)

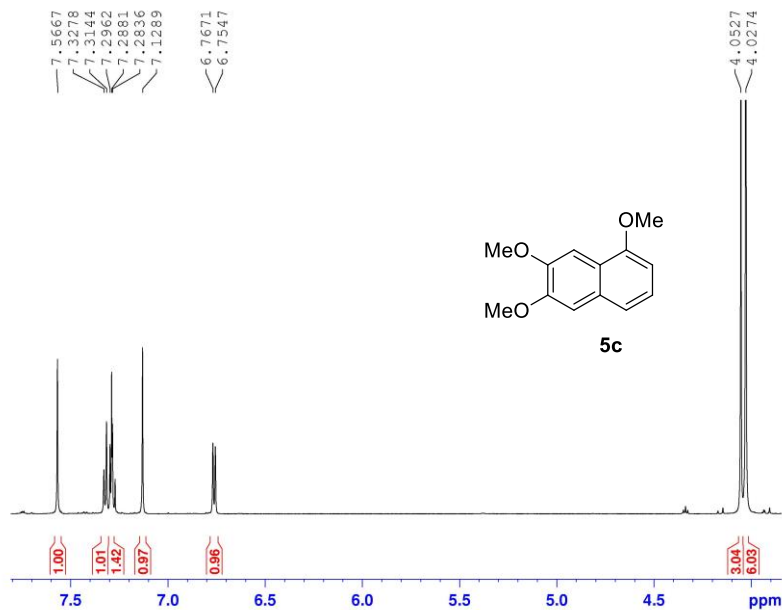


HMBC Spectrum of Compound **5b** (CDCl₃, 600 MHz)



NOESY Spectrum of Compound **5b** (CDCl₃, 600 MHz)

¹H NMR GJ-N-4 in CDCl₃
2013-04-15

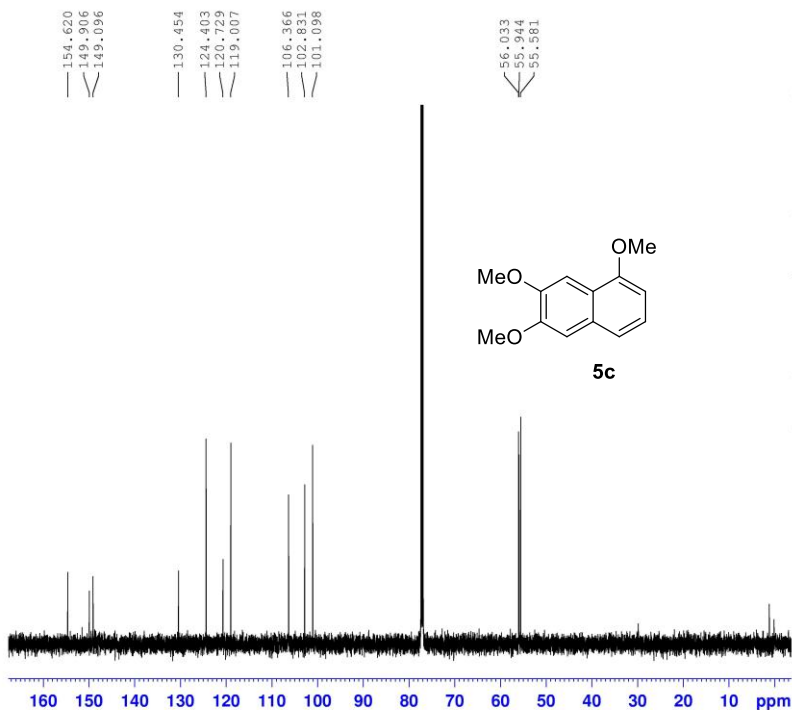


NAME GJ-N-4
EXPNO 437
PROCNO 1
Date_ 20130415
Time 18.03
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 174.88
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.00000000 sec

===== CHANNEL f1 =====
NUCL 1H
P1 12.85 usec
SI 65536
SF 600.1300000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound 5c (CDCl₃, 600 MHz)

¹³C NMR GJ-N-4 in CDCl₃
2013-04-15

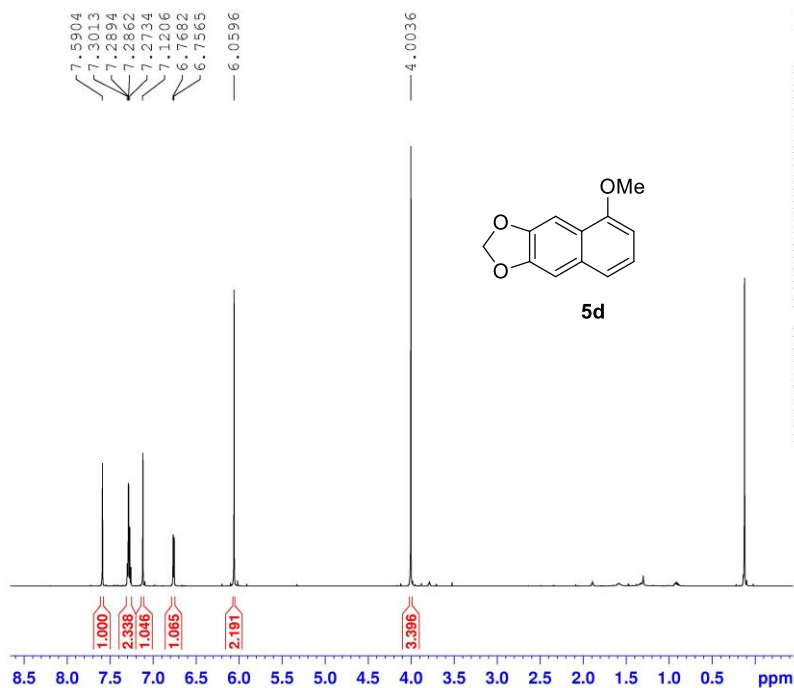


NAME GJ-N-4
EXPNO 438
PROCNO 1
Date_ 20130415
Time 18.16
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 231
DS 4
SWH 36057.691 Hz
FIDRES 0.550197 Hz
AQ 0.9088159 sec
RG 174.88
DW 13.867 usec
DE 6.50 usec
TE 297.9 K
D1 2.00000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====
NUCL 13C
P1 11.55 usec
SI 32768
SF 150.9027890 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound 5c (CDCl₃, 150 MHz)

¹H NMR GJ-N-5 in CDCl₃
2013-04-22



```

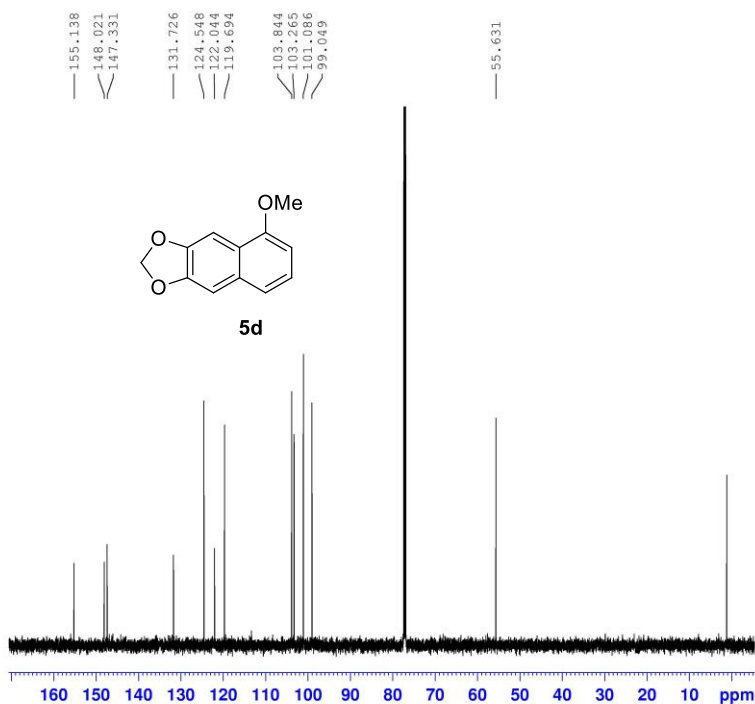
NAME      GJ-N-5
EXPNO    458
PROCNO   1
Date_    20130422
Time     20.14
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        16
DS        2
SWH       12335.526 Hz
FIDRES    0.188225 Hz
AQ        2.6564426 sec
RG        115.06
DW        40.533 usec
DE        6.50 usec
TE        297.9 K
D1        1.0000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1299985 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **5d** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-5 in CDCl₃
2013-04-22



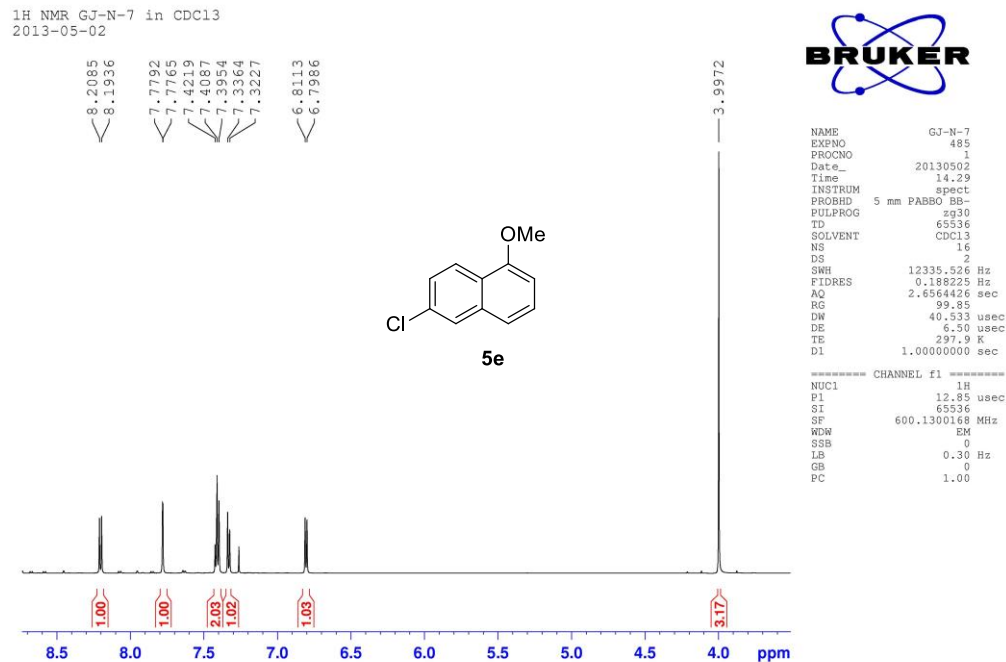
```

NAME      GJ-N-5
EXPNO    459
PROCNO   1
Date_    20130422
Time     20.18
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        81
DS        4
SWH       37878.789 Hz
FIDRES    0.577984 Hz
AQ        0.8651252 sec
RG        174.88
DW        13.200 usec
DE        6.50 usec
TE        297.9 K
D1        2.0000000 sec
D11       0.0300000 sec
  
```

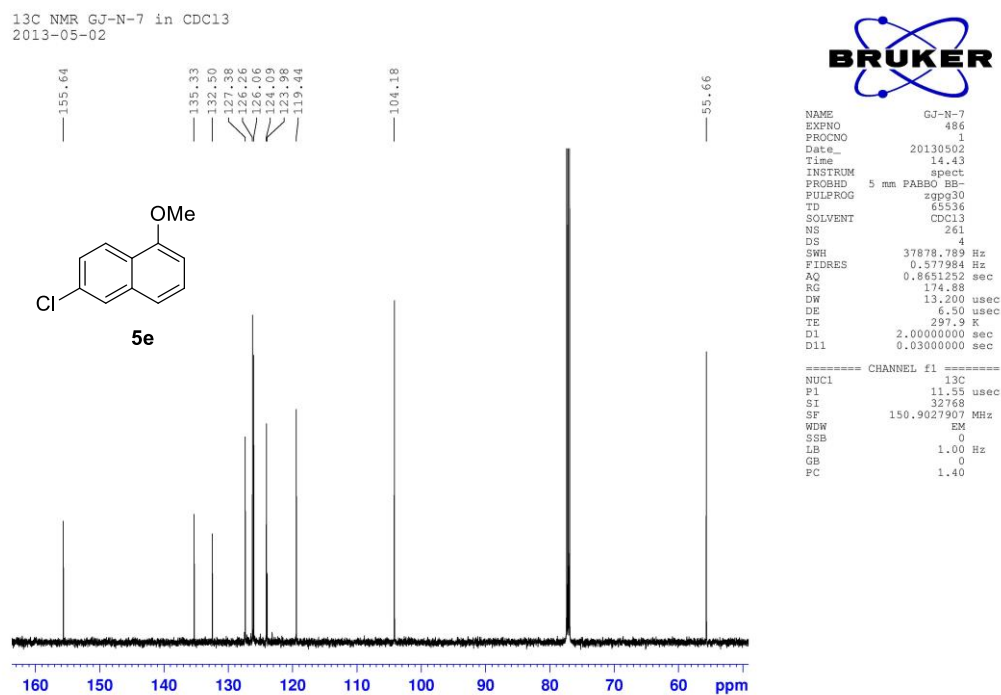
```

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027916 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR Spectrum of Compound **5d** (CDCl₃, 150 MHz)

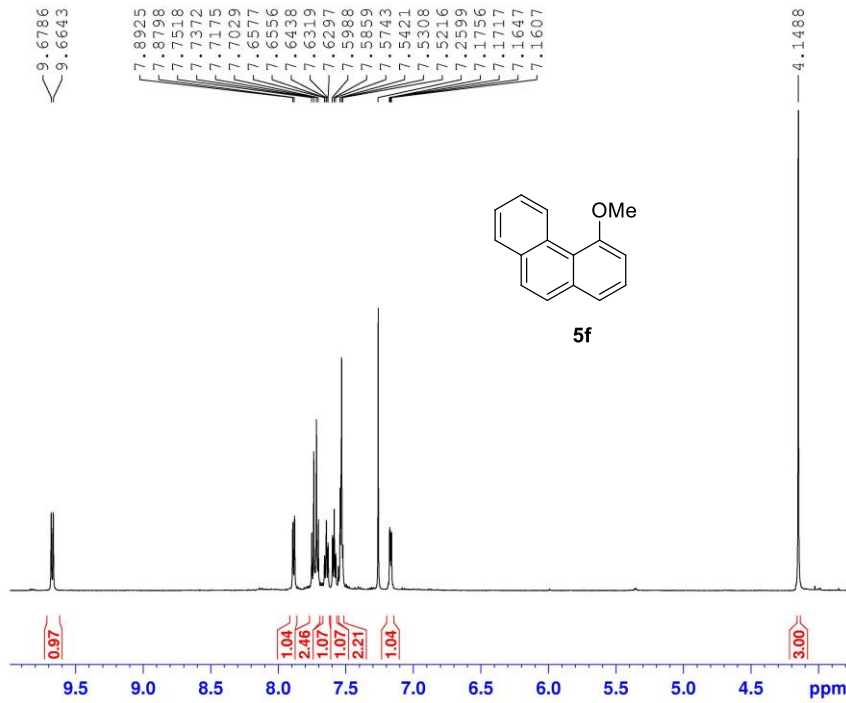


¹H NMR Spectrum of Compound **5e** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **5e** (CDCl₃, 150 MHz)

¹H NMR GJ-N-8-1 in CDCl₃
2013-04-27



```

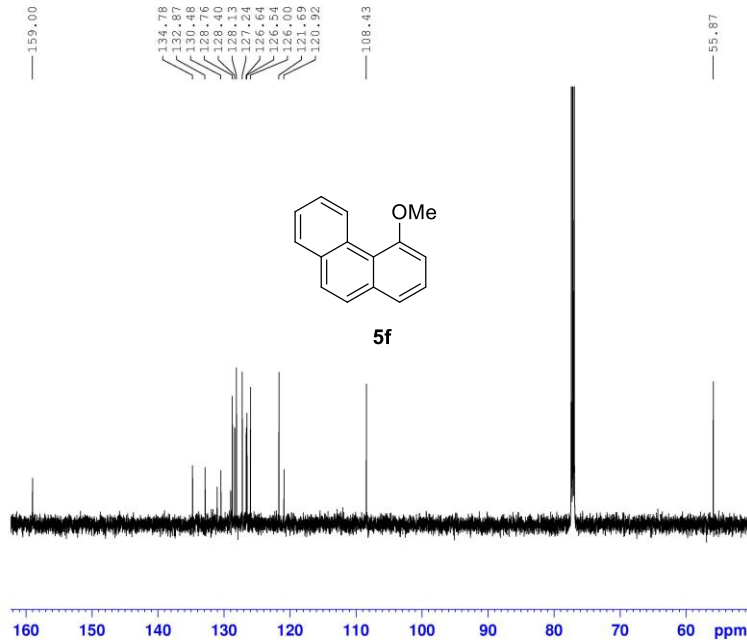
NAME      GJ-N-8
EXPNO     479
PROCNO    1
Date_     20130427
Time      21.30
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         2
SWH        12335.526 Hz
FIDRES     0.188225 Hz
AQ         2.6564426 sec
RG         157.22
DW         40.533 usec
DE         6.50 usec
TE         297.9 K
D1         1.00000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300170 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **5f** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-8-1 in CDCl₃
2013-04-27



```

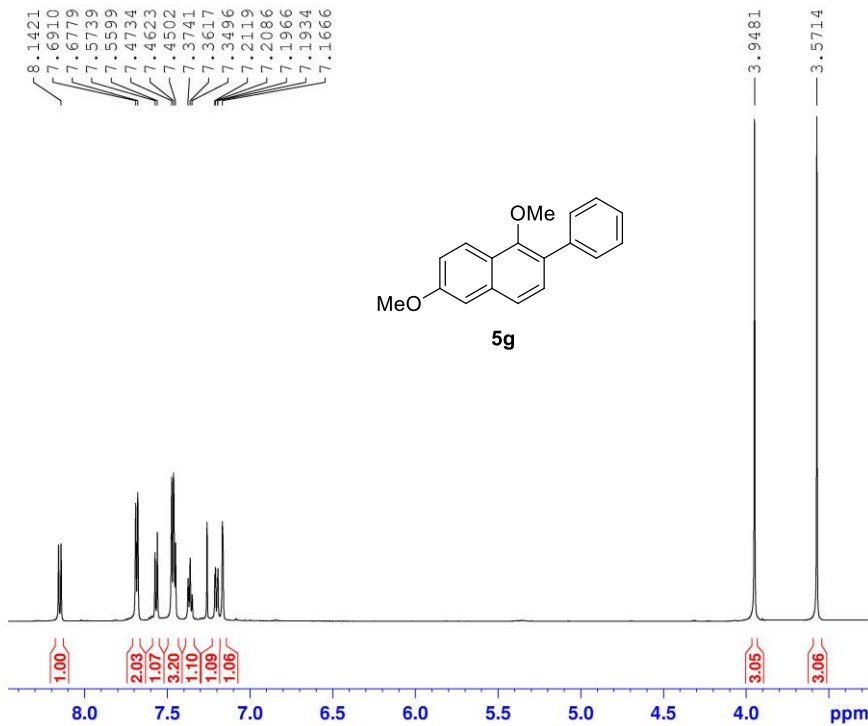
NAME      GJ-N-8
EXPNO     480
PROCNO    1
Date_     20130427
Time      21.37
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         437
DS         4
SWH        37878.789 Hz
FIDRES     0.577984 Hz
AQ         0.8651252 sec
RG         174.88
DW         13.200 usec
DE         6.50 usec
TE         297.9 K
D1         2.00000000 sec
D11        0.03000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027883 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

¹³C NMR Spectrum of Compound **5f** (CDCl₃, 150 MHz)

¹H NMR GJ-N-12 in CDCl₃
2013-04-24

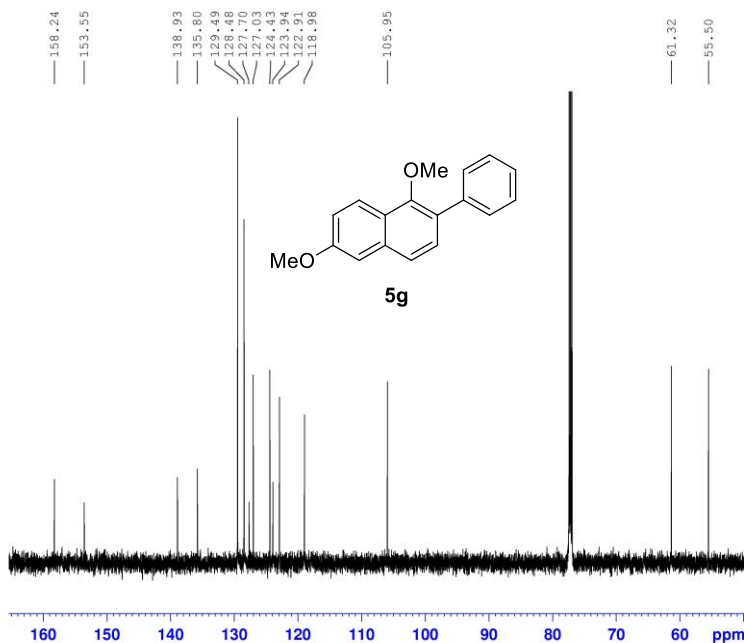


NAME GJ-N-12
EXPNO 467
PROCNO 1
Date_ 20130424
Time 10.42
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 141.71
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.0000000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 12.85 usec
SI 65536
SF 600.1300173 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound **5g** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-12 in CDCl₃
2013-04-24

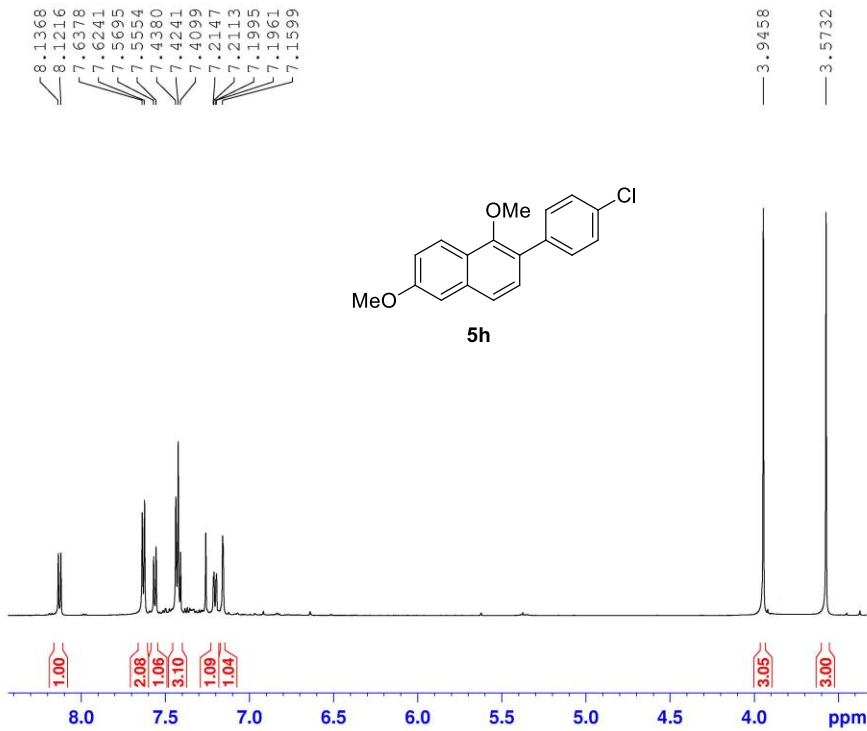


NAME GJ-N-12
EXPNO 468
PROCNO 1
Date_ 20130424
Time 10.45
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 201
DS 4
SWH 36057.691 Hz
FIDRES 0.550197 Hz
AQ 0.9088159 sec
RG 174.88
DW 13.867 usec
DE 6.50 usec
TE 297.9 K
D1 2.0000000 sec
D11 0.0300000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 11.55 usec
SI 32768
SF 150.9027895 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound **5g** (CDCl₃, 150 MHz)

1H NMR GJ-N-13 in CDCl3
2013-04-24



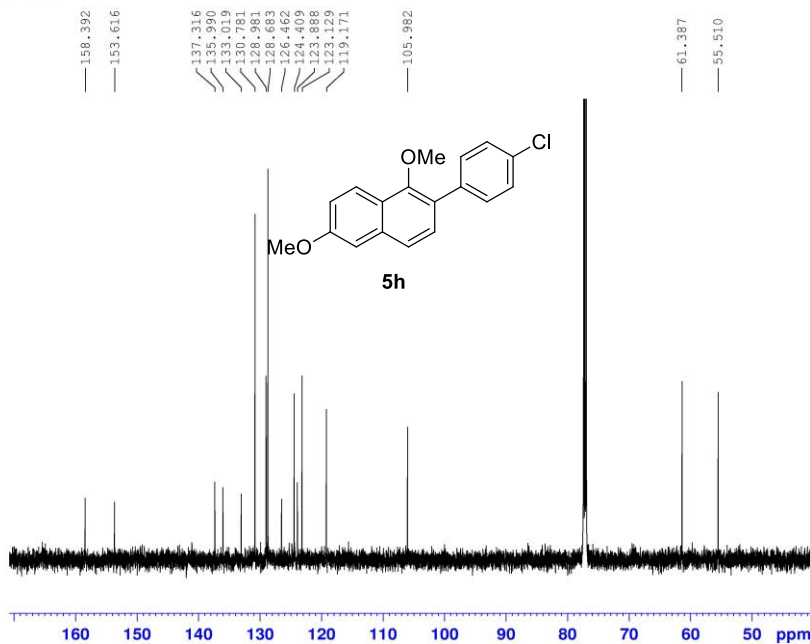
```

NAME          GJ-N-13
EXPNO         470
PROCNO        1
Date_         20130424
Time         14.37
INSTRUM      spect
PROBHD       5 mm PABBO BB-
PULPROG      zg30
TD           65536
SOLVENT      CDCl3
NS           16
DS           2
SWH          12335.526 Hz
FIDRES       0.188225 Hz
AQ           2.6564426 sec
RG           141.71
DW           40.533 usec
DE           6.50 usec
TE           297.9 K
D1           1.00000000 sec

===== CHANNEL f1 =====
NUC1         1H
P1           12.85 usec
SI           65536
SF           600.1300170 MHz
WDW          EM
SSB          0
LB           0.30 Hz
GB           0
PC           1.00
  
```

¹H NMR Spectrum of Compound **5h**(CDCl₃, 600 MHz)

13C NMR GJ-N-13 in CDCl3
2013-04-24



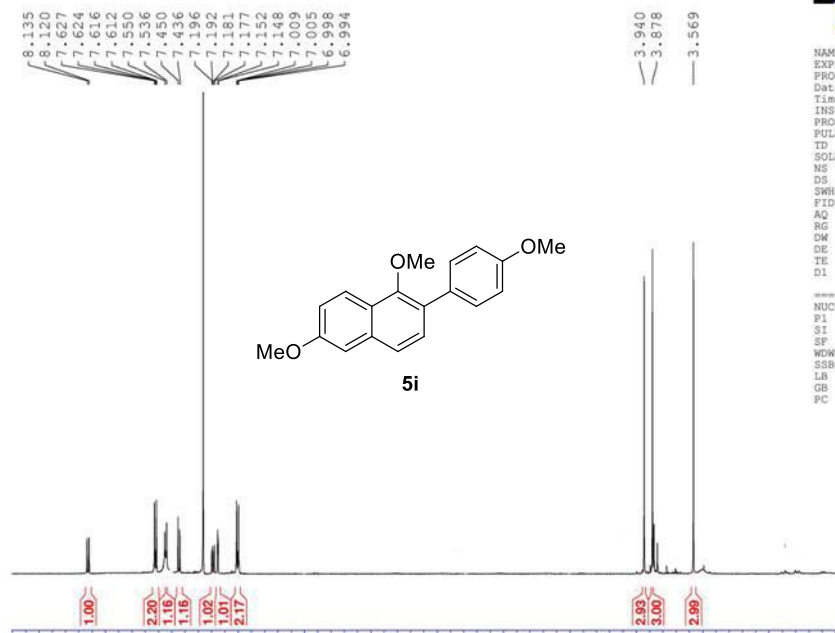
```

NAME          GJ-N-13
EXPNO         471
PROCNO        1
Date_         20130424
Time         14.40
INSTRUM      spect
PROBHD       5 mm PABBO BB-
PULPROG      zgpg30
TD           65536
SOLVENT      CDCl3
NS           305
DS           4
SWH          37878.789 Hz
FIDRES       0.577984 Hz
AQ           0.8651252 sec
RG           174.88
DW           13.200 usec
DE           6.50 usec
TE           298.2 K
D1           2.00000000 sec
D11          0.03000000 sec

===== CHANNEL f1 =====
NUC1         13C
P1           11.55 usec
SI           32768
SF           150.9027886 MHz
WDW          EM
SSB          0
LB           1.00 Hz
GB           0
PC           1.40
  
```

¹³C NMR Spectrum of Compound **5h** (CDCl₃, 150 MHz)

¹H NMR GJ-0819-2 in CDCl₃
2013-08-19

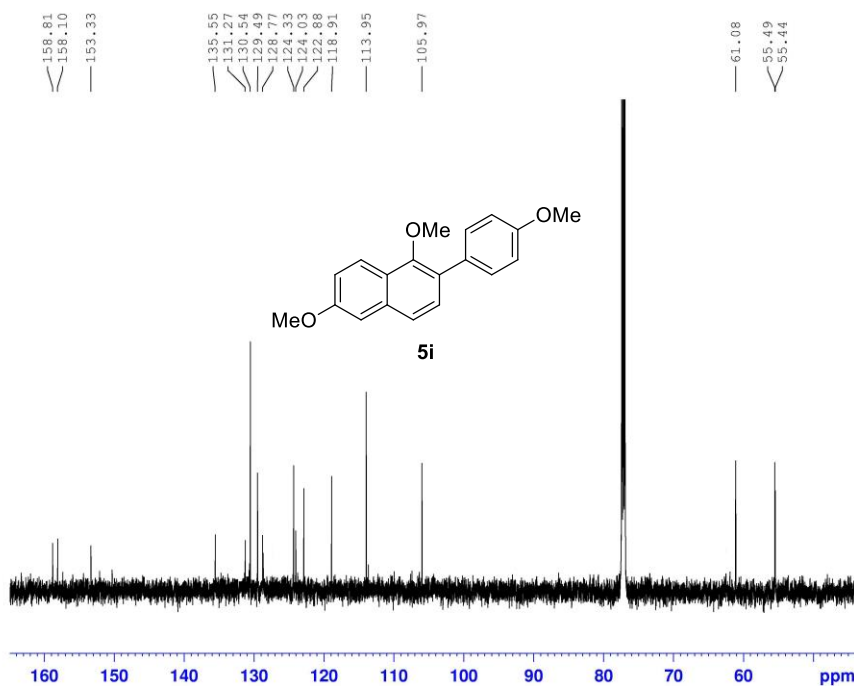


```
NAME      GJ-N-14
EXPNO     824
PROCNO    1
Date_     20130819
Time      13.33
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD        65536
SOLVENT   CDCl3
NS        16
DS        2
SWH       12335.526 Hz
FIDRES    0.188225 Hz
AQ        2.6564426 sec
RG        174.88
DW        40.533 usec
DE        6.50 usec
TE        299.8 K
D1        1.00000000 sec

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300173 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
```

¹H NMR Spectrum of Compound **5i** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-14 in CDCl₃
2013-08-21

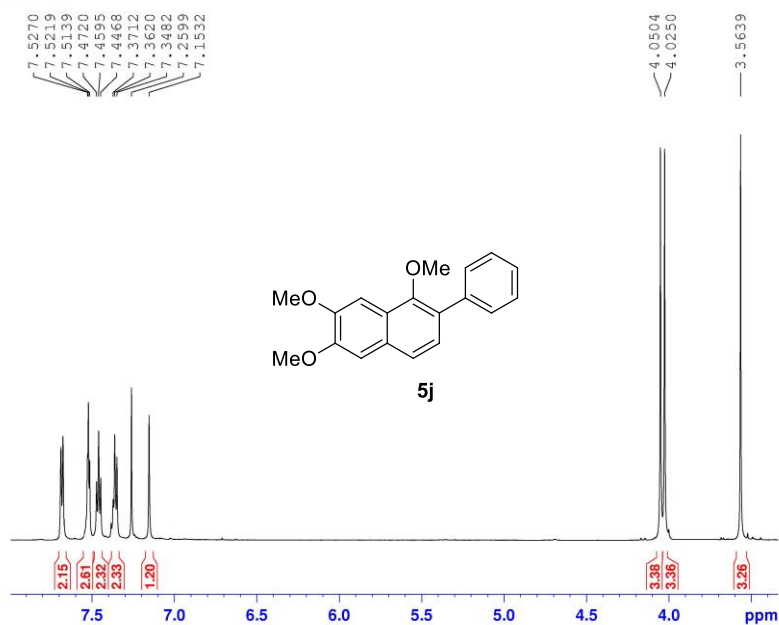


```
NAME      GJ-N-14
EXPNO     830
PROCNO    1
Date_     20130821
Time      9.34
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD        65536
SOLVENT   CDCl3
NS        5567
DS        4
SWH       37878.789 Hz
FIDRES    0.577984 Hz
AQ        0.8651252 sec
RG        174.88
DW        13.200 usec
DE        6.50 usec
TE        299.8 K
D1        2.00000000 sec
D11       0.03000000 sec

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027873 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
```

¹³C NMR Spectrum of Compound **5i** (CDCl₃, 150 MHz)

¹H NMR GJ-N-15 in CDCl₃
2013-04-27



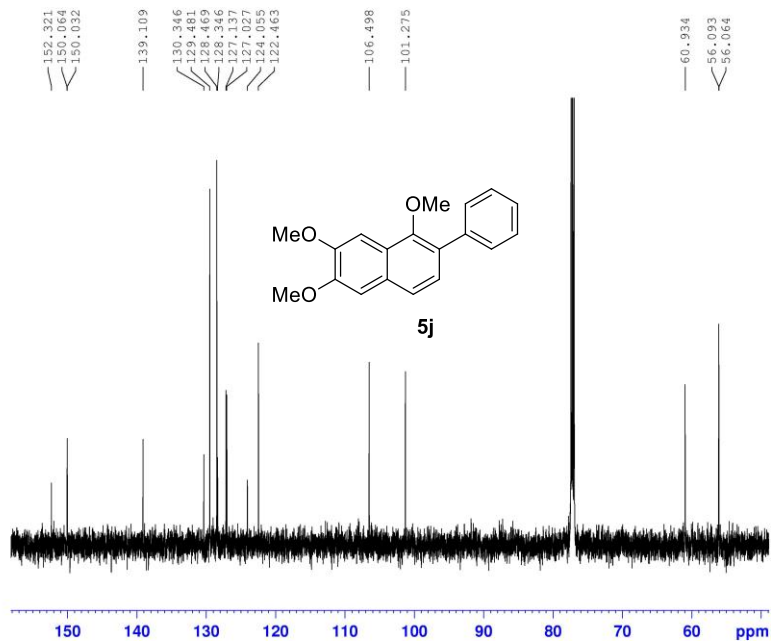
```

NAME          GJ-N-15
EXPNO         475
PROCNO        1
Date_         20130427
Time          9.24
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           12335.526 Hz
FIDRES        0.188225 Hz
AQ            2.6554426 sec
RG            141.71
DM            40.533 usec
DE            6.50 usec
TE            297.9 K
D1            1.0000000 sec

===== CHANNEL f1 =====
NUC1          1H
P1            12.85 usec
SI            65536
SF            600.1300169 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

¹H NMR Spectrum of Compound **5j** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-15 in CDCl₃
2013-04-27



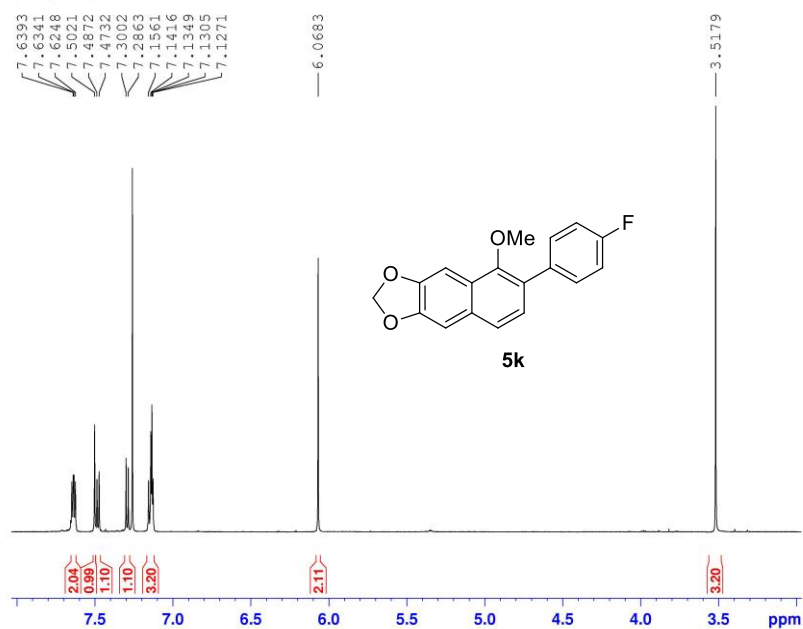
```

NAME          GJ-N-15
EXPNO         476
PROCNO        1
Date_         20130427
Time          9.30
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            306
DS            4
SWH           37878.789 Hz
FIDRES        0.577984 Hz
AQ            0.8651252 sec
RG            174.88
DM            13.200 usec
DE            6.50 usec
TE            297.9 K
D1            2.0000000 sec
D11           0.0300000 sec

===== CHANNEL f1 =====
NUC1          13C
P1            11.55 usec
SI            32768
SF            150.9027885 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```

¹³C NMR Spectrum of Compound **5j** (CDCl₃, 150 MHz)

¹H NMR GJ-N-19 in CDCl₃
2013-04-24



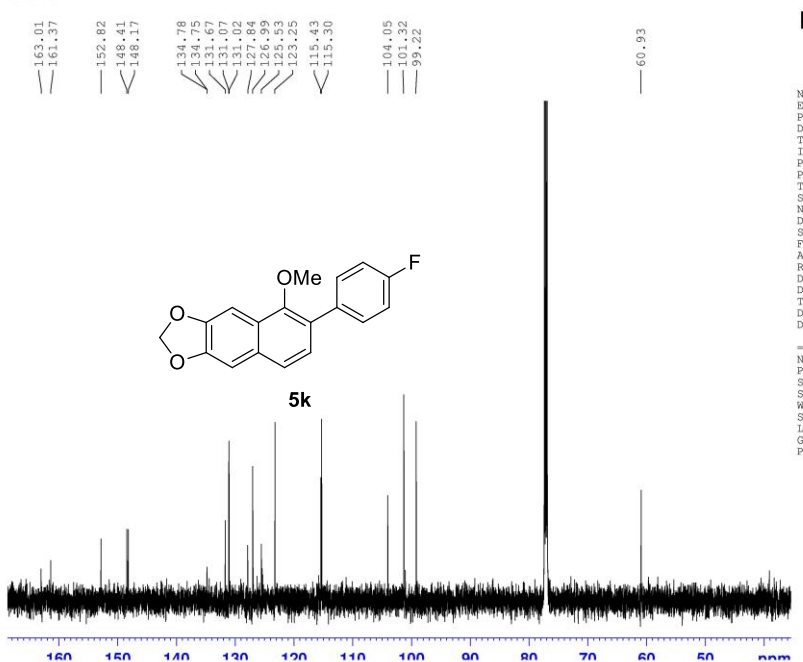
```

NAME      GJ-N-19
EXPNO    472
PROCNO   1
Date_    20130424
Time     19.57
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD       65536
SOLVENT  CDCl3
NS       16
DS       2
SWH      12335.526 Hz
FIDRES   0.188225 Hz
AQ       2.6564426 sec
RG       174.88
DW       49.533 use
DE       6.50 use
TE       297.9 K
D1       1.0000000 sec

===== CHANNEL f1 =====
NUC1     1H
P1       12.85 use
SI       65536
SF       600.1300170 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
```

¹H NMR Spectrum of Compound **5k** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-19 in CDCl₃
2013-04-24



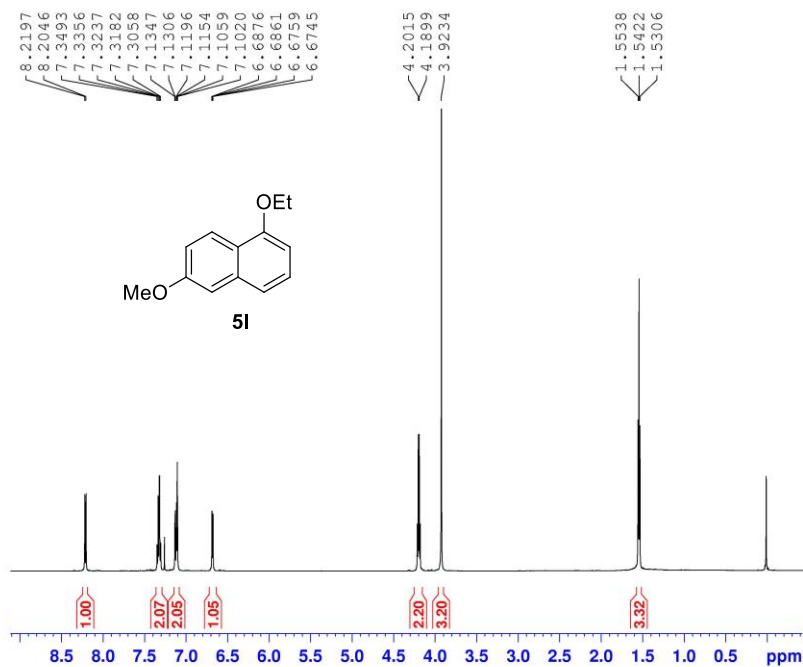
```

NAME      GJ-N-19
EXPNO    473
PROCNO   1
Date_    20130424
Time     20.05
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  CDCl3
NS       907
DS       4
SWH      37878.789 Hz
FIDRES   0.577984 Hz
AQ       0.8651252 sec
RG       174.88
DW       13.200 usec
DE       6.50 usec
TE       297.9 K
D1       2.0000000 sec
D11      0.0300000 sec

===== CHANNEL f1 =====
NUC1     13C
P1       11.55 usec
SI       32768
SF       150.9027879 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.40
  
```

¹³C NMR Spectrum of Compound **5k** (CDCl₃, 150 MHz)

¹H NMR GJ-N-3-1 in CDCl₃
2013-06-03

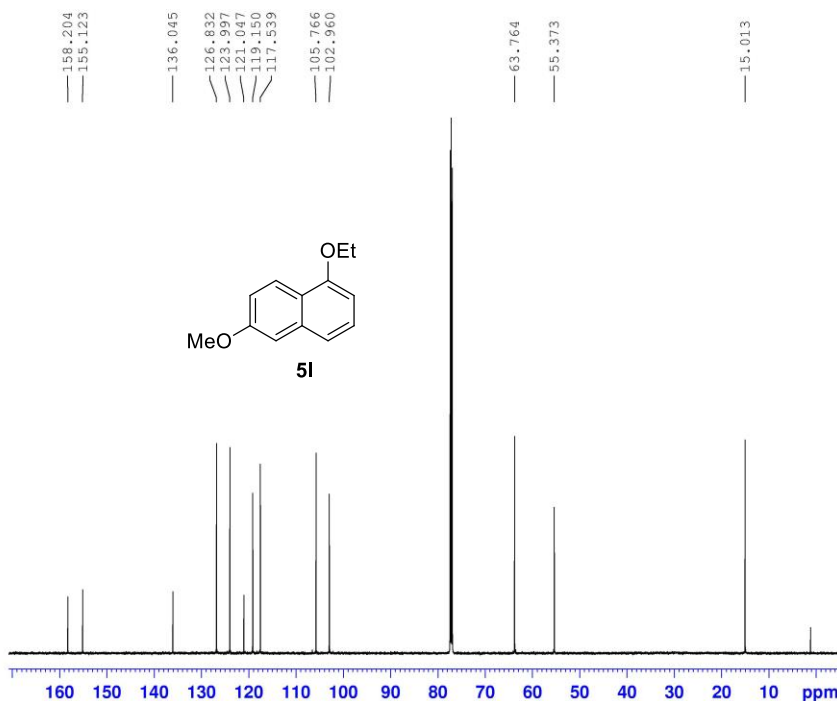


NAME GJ-N-3-1
EXPNO 585
PROCNO 1
Date_ 20130603
Time 10.52
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.656426 sec
RG 99.85
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.0000000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 12.85 usec
SI 65536
SF 600.1300172 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound **5I** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-3-1 in CDCl₃
2013-06-03

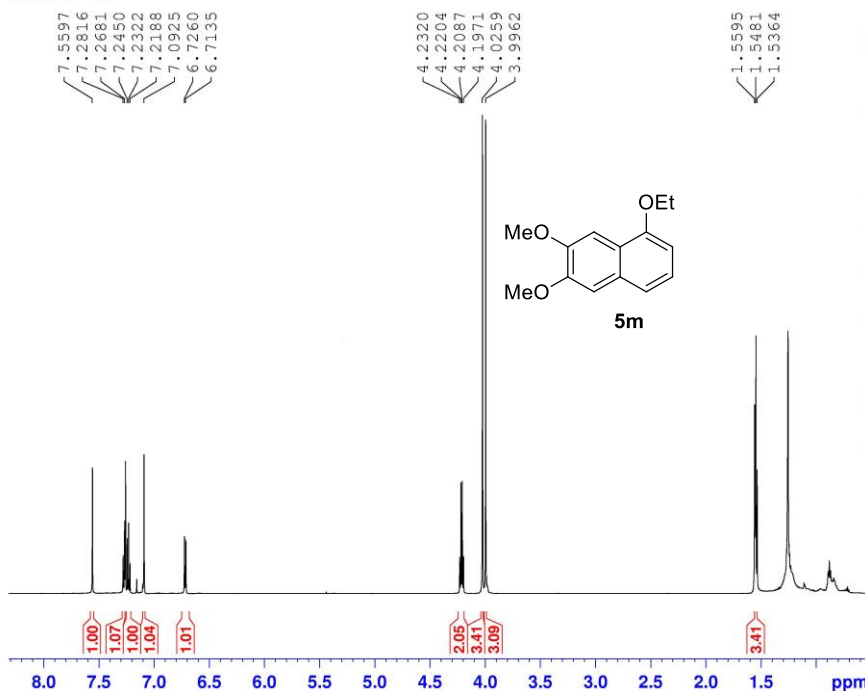


NAME GJ-N-3-1
EXPNO 590
PROCNO 1
Date_ 20130603
Time 20.39
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 2009
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 297.9 K
D1 2.0000000 sec
D11 0.0300000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 11.55 usec
SI 32768
SF 150.9027916 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound **5I** (CDCl₃, 150 MHz)

¹H NMR GJ-N-4-1 in CDCl₃
2013-07-03



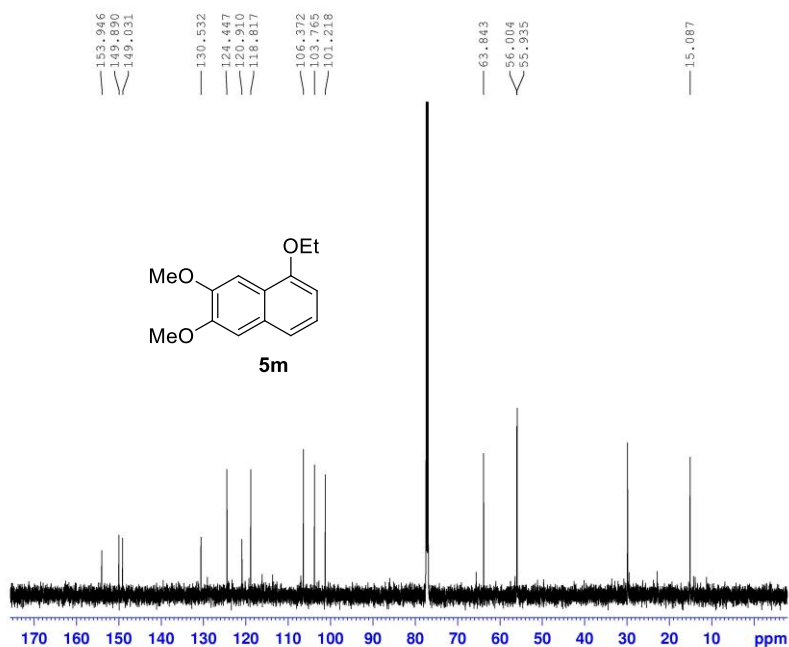
```

NAME      GJ-N-4-1
EXPNO    690
PROCNO   1
Date_    20130703
Time     11.01
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD        65536
SOLVENT  CDCl3
NS        16
DS         2
SWH      12335.526 Hz
FIDRES   0.188225 Hz
AQ        2.6564426 sec
RG         174.88
DW        40.533 usec
DE         6.50 usec
TE         299.8 K
D1        1.00000000 sec

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 usec
SI        65536
SF        600.1300175 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB         0
PC         1.00
  
```

¹H NMR Spectrum of Compound **5m** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-4-1 in CDCl₃
2013-07-24



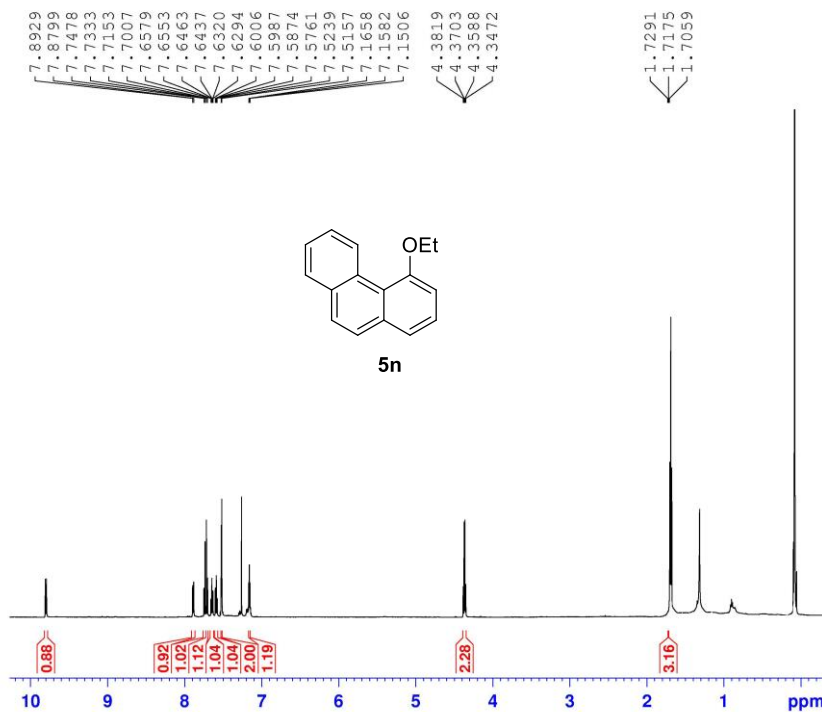
```

NAME      GJ-N-4-1
EXPNO    756
PROCNO   1
Date_    20130724
Time     13.21
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD        65536
SOLVENT  CDCl3
NS        676
DS         4
SWH      37878.789 Hz
FIDRES   0.577984 Hz
AQ        0.8651252 sec
RG         174.88
DW        13.200 usec
DE         6.50 usec
TE         299.8 K
D1        2.00000000 sec
D11       0.03000000 sec

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 usec
SI        32768
SF        150.9027893 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB         0
PC         1.40
  
```

¹³C NMR Spectrum of Compound **5m** (CDCl₃, 150 MHz)

¹H NMR GJ-N-8-1 in CDCl₃
2013-06-04



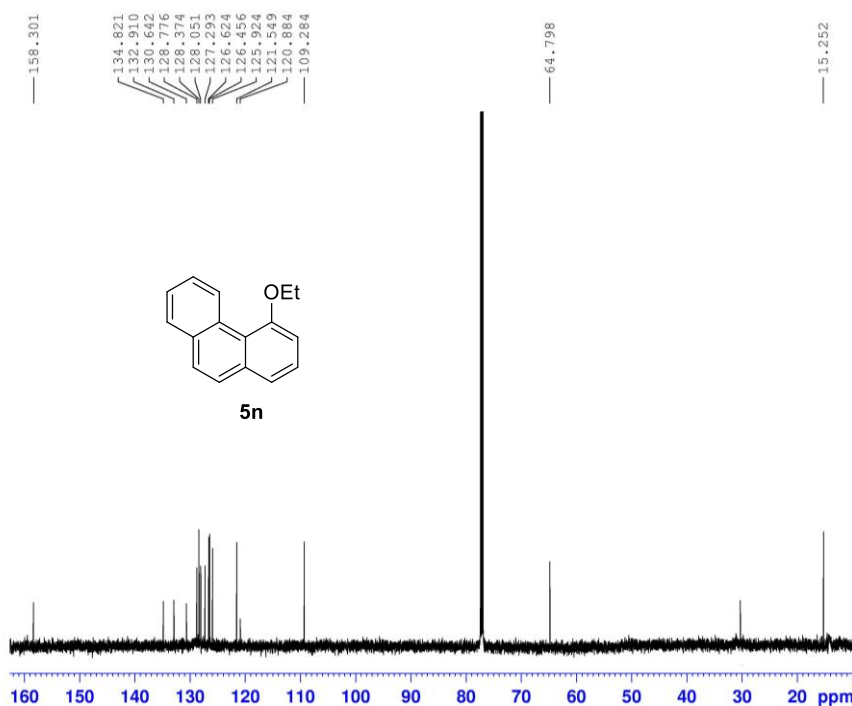
```

NAME          GJ-N-8-1
EXPNO         592
PROCNO        1
Date_         20130604
Time          13.54
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           12335.526 Hz
FIDRES        0.188225 Hz
AQ            2.6564426 sec
RG            30.26
DW            40.533 usec
DE            6.50 usec
TE            297.9 K
D1            1.00000000 sec

===== CHANNEL f1 =====
NUC1          1H
P1            12.85 usec
SI            65536
SF            600.1300174 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

¹H NMR Spectrum of Compound **5n** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-8-1 in CDCl₃
2013-06-04



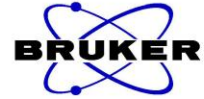
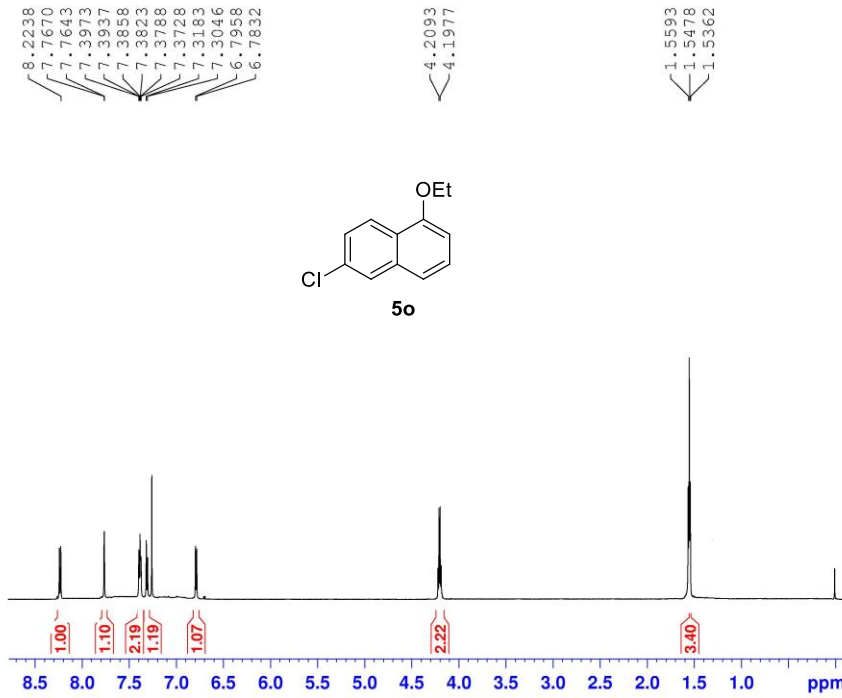
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NAME          GJ-N-8-1
EXPNO         593
PROCNO        1
Date_         20130604
Time          15.27
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            381
DS            4
SWH           36057.691 Hz
FIDRES        0.550197 Hz
AQ            0.9088159 sec
RG            174.88
DW            13.867 usec
DE            6.50 usec
TE            297.9 K
D1            2.00000000 sec
D11           0.03000000 sec

===== CHANNEL f1 =====
NUC1          13C
P1            11.55 usec
SI            32768
SF            150.9027885 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```

¹³C NMR Spectrum of Compound **5n** (CDCl₃, 150 MHz)

¹H NMR GJ-N-7-1 in CDCl₃
2013-06-03



```

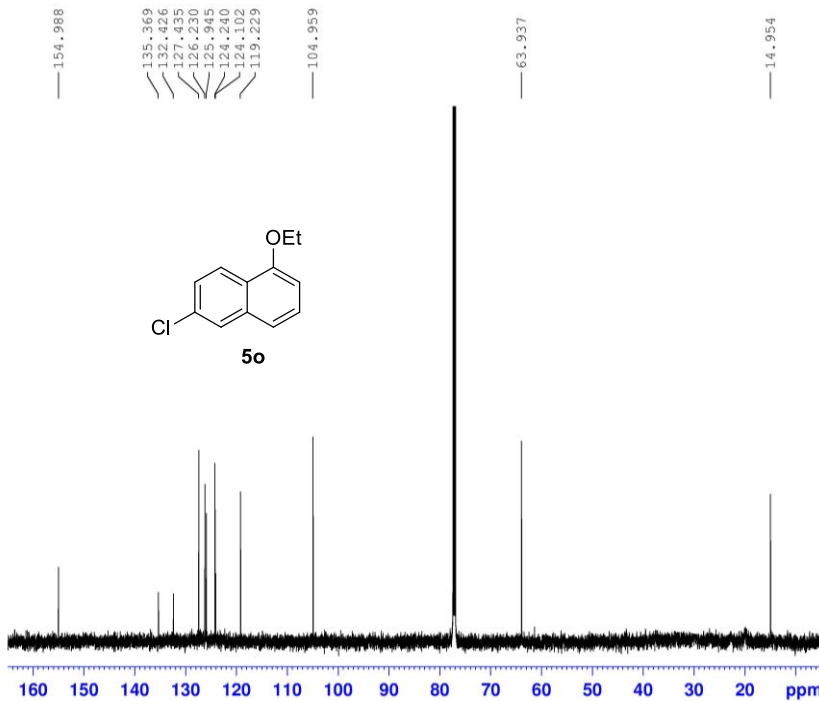
NAME          GJ-N-7-1
EXPNO         587
PROCNO        1
Date_         20130603
Time         11.07
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zg30
TD            65536
SOLVENT       CDCl3
NS            16
DS            2
SWH           12335.526 Hz
FIDRES        0.188225 Hz
AQ            2.6564426 sec
RG            129.27
DW            40.533 usec
DE            6.50 usec
TE            297.9 K
D1            1.00000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1          1H
P1            12.85 usec
SI            65536
SF            600.1300172 MHz
WDW           EM
SSB           0
LB            0.30 Hz
GB            0
PC            1.00
  
```

¹H NMR Spectrum of Compound **5o** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-7-1 in CDCl₃
2013-06-03



```

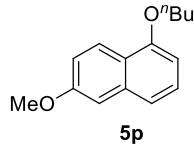
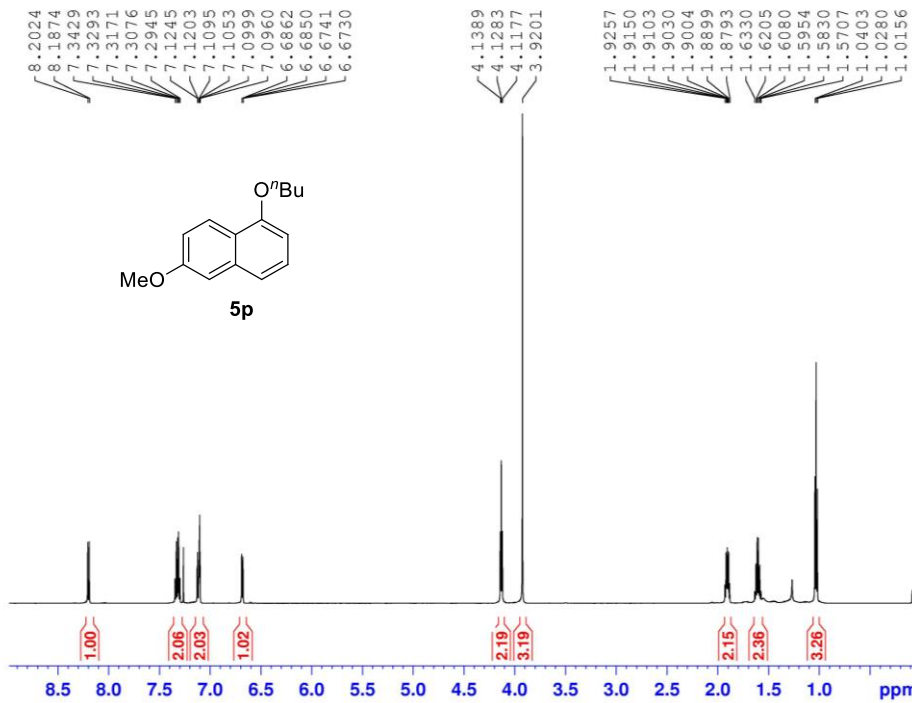
NAME          GJ-N-7-1
EXPNO         589
PROCNO        1
Date_         20130603
Time         18.56
INSTRUM       spect
PROBHD        5 mm PABBO BB-
PULPROG       zgpg30
TD            65536
SOLVENT       CDCl3
NS            861
DS            4
SWH           37878.789 Hz
FIDRES        0.577984 Hz
AQ            0.8651252 sec
RG            174.88
DW            13.200 usec
DE            6.50 usec
TE            297.9 K
D1            2.00000000 sec
D11           0.03000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1          13C
P1            11.55 usec
SI            32768
SF            150.9027885 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```

¹³C NMR Spectrum of Compound **5o** (CDCl₃, 150 MHz)

¹H NMR GJ-N-3-3 in CDCl₃
2013-05-24



```

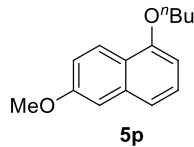
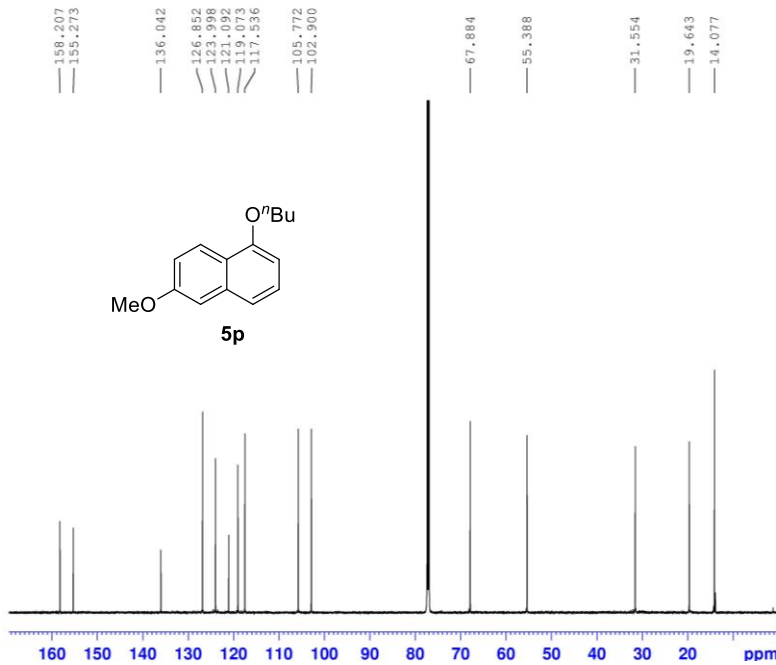
NAME      GJ-N-3-3
EXPNO     558
PROCNO    1
Date_     20130524
Time      8.19
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   CDCl3
NS         16
DS         2
SWH        12335.526 Hz
FIDRES    0.188225 Hz
AQ         2.6564426 sec
RG         141.71
DW         40.533 usec
DE         6.50 usec
TE         297.9 K
D1         1.00000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      1H
P1         12.85 usec
SI         65536
SF         600.1300171 MHz
WDW        EM
SSB        0
LB         0.30 Hz
GB         0
PC         1.00
  
```

¹H NMR Spectrum of Compound **5p** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-3-3 in CDCl₃
2013-05-24



```

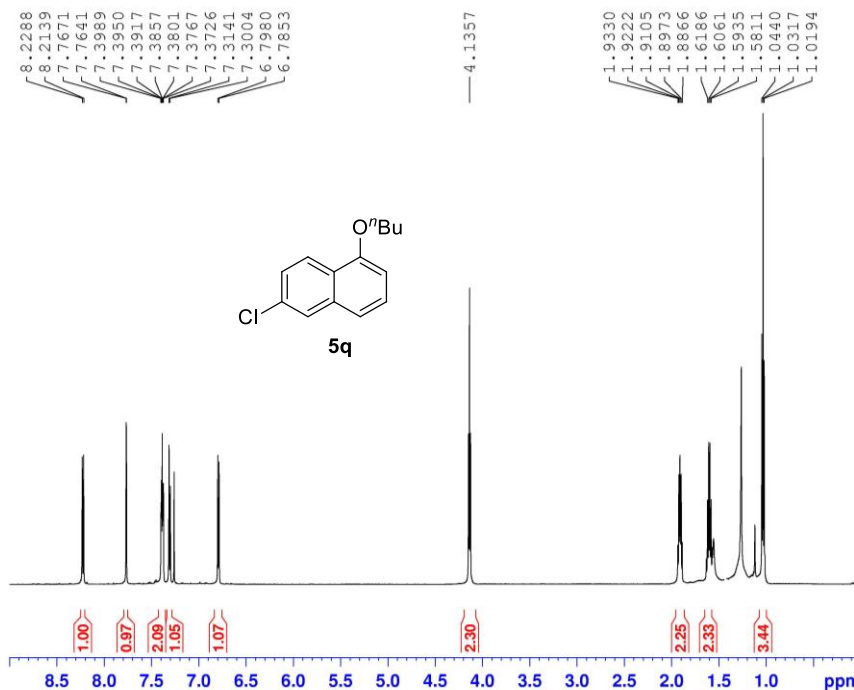
NAME      GJ-N-3-3
EXPNO     559
PROCNO    1
Date_     20130524
Time      16.24
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   CDCl3
NS         9919
DS         4
SWH        37878.789 Hz
FIDRES    0.577984 Hz
AQ         0.8651252 sec
RG         174.88
DW         13.200 usec
DE         6.50 usec
TE         297.9 K
D1         2.00000000 sec
D11        0.03000000 sec
  
```

```

===== CHANNEL f1 =====
NUC1      13C
P1         11.55 usec
SI         32768
SF         150.9027897 MHz
WDW        EM
SSB        0
LB         1.00 Hz
GB         0
PC         1.40
  
```

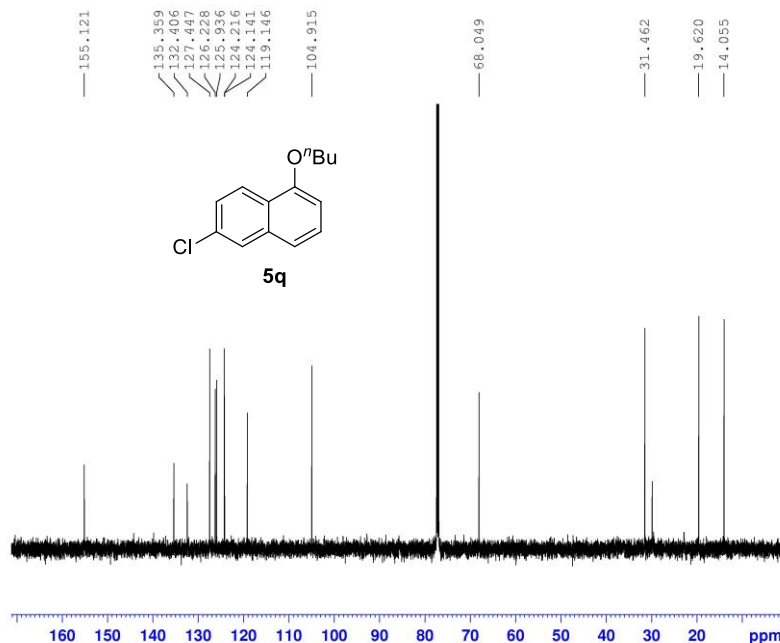
¹³C NMR Spectrum of Compound **5p** (CDCl₃, 150 MHz)

1H NMR GJ-N-3-7 in CDCl3
2013-05-28



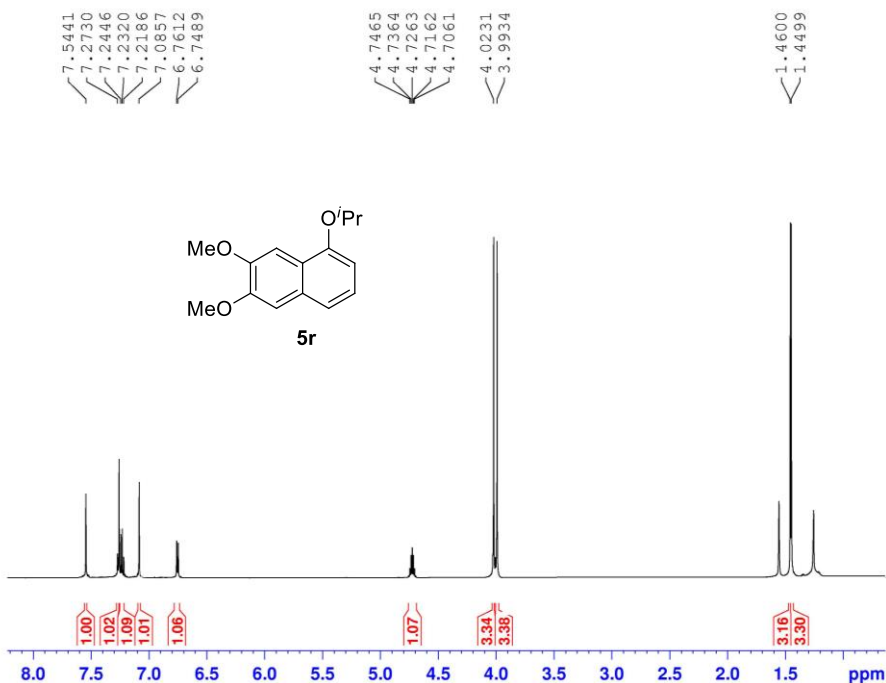
¹H NMR Spectrum of Compound **5q** (CDCl₃, 600 MHz)

13C NMR GJ-N-3-7 in CDCl3
2013-05-28



¹³C NMR Spectrum of Compound **5q** (CDCl₃, 150 MHz)

¹H NMR GJ-N-4-2 in CDCl₃
2013-07-04

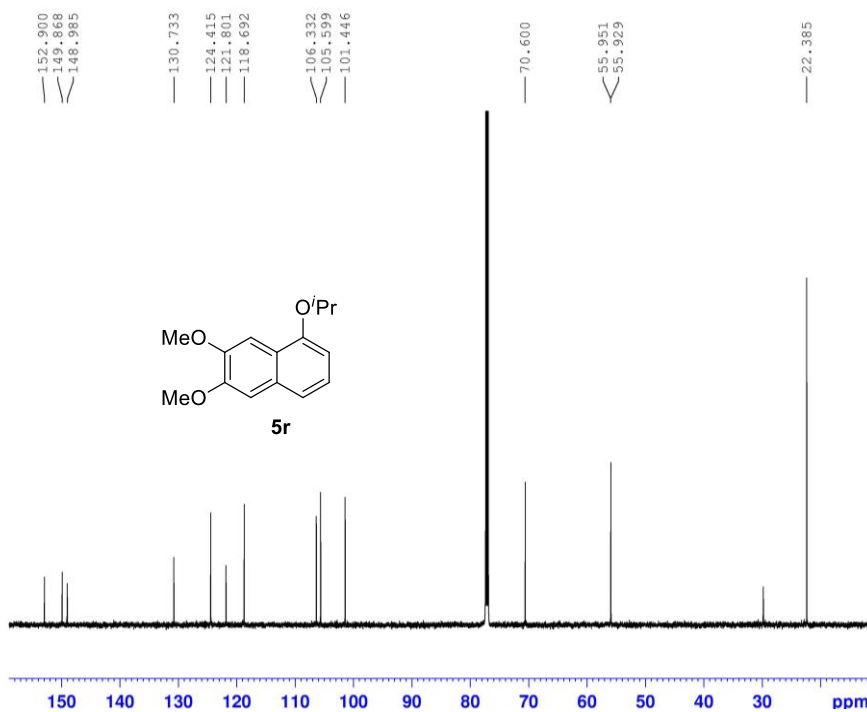


NAME GJ-N-4-2
EXPNO 702
PROCNO 1
Date_ 20130704
Time 14.52
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 174.88
DW 40.533 usec
DE 6.50 usec
TE 299.8 K
D1 1.00000000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 12.85 usec
SI 65536
SF 600.1300171 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00

¹H NMR Spectrum of Compound **5r** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-4-2 in CDCl₃
2013-07-09



NAME GJ-N-4-2
EXPNO 719
PROCNO 1
Date_ 20130709
Time 9.32
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 1498
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 299.8 K
D1 2.00000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 11.55 usec
SI 32768
SF 150.9027902 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound **5r** (CDCl₃, 150 MHz)

¹H NMR GJ-121203-1 in CDCl₃
2012-12-03

7.629
7.617
7.380
7.368
7.322
7.310
7.297
7.237
7.224
7.212
6.913
6.911
6.904
6.902
6.515
6.512
6.406
6.303

4.104
4.091

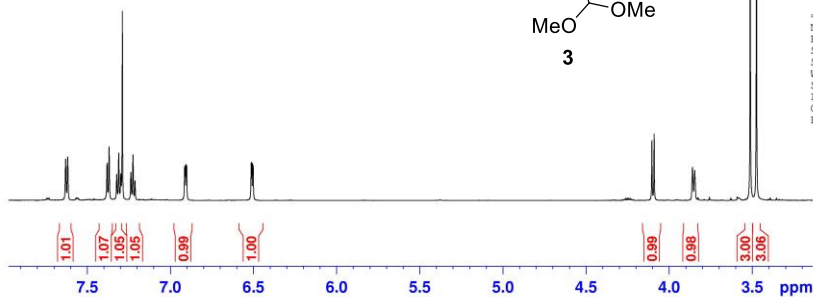
3.660
3.647

3.513
3.475



NAME GJ-N-M-2
EXPNO 313
PROCNO 1
Date_ 20121203
Time 18.00
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl₃
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 174.88
DW 40.533 usec
DE 6.50 usec
TE 297.9 K
D1 1.00000000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 12.85 usec
SI 65536
SF 600.130000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



¹H NMR Spectrum of Compound **3** (CDCl₃, 600 MHz)

¹³C NMR GJ-N-M-1 in CDCl₃
2013-08-27

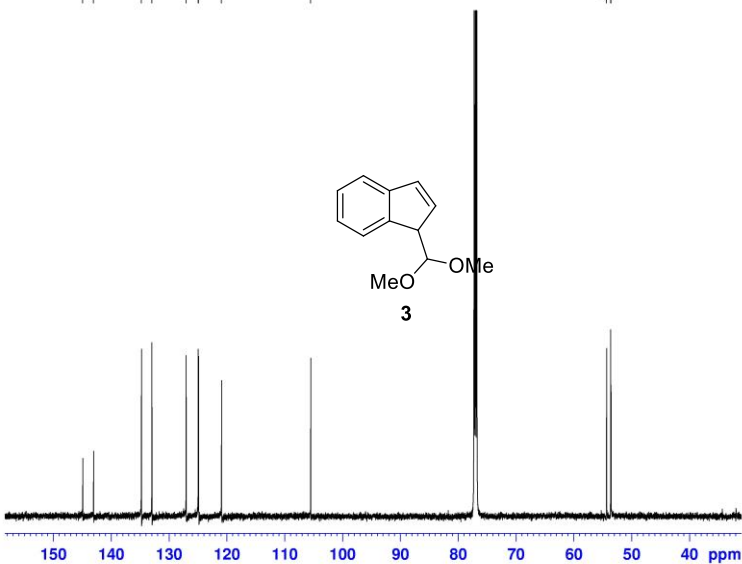
144.94
143.07
134.81
132.99
127.07
124.97
124.89
120.94
105.51

54.33
53.63
53.57



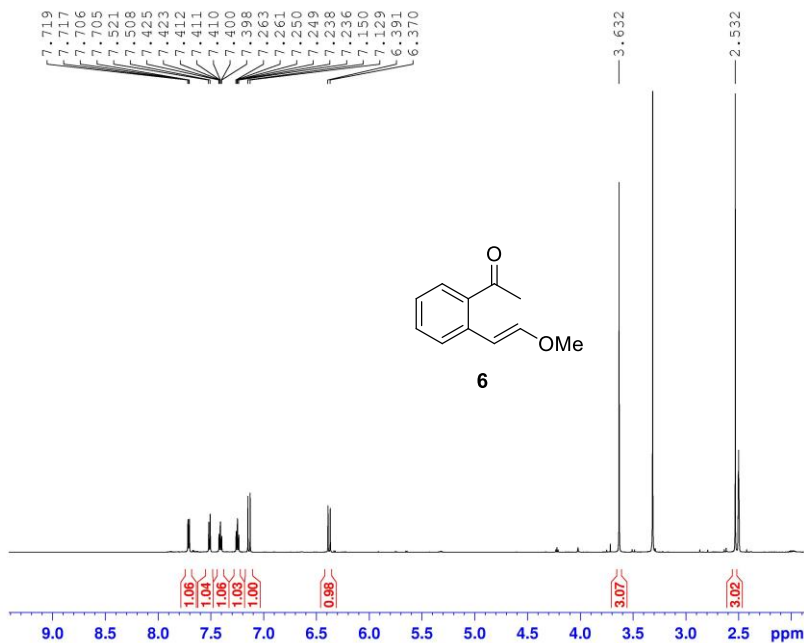
NAME GJ-N-M-1
EXPNO 842
PROCNO 1
Date_ 20130828
Time 9.25
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl₃
NS 20480
DS 4
SWH 37876.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
DW 13.200 usec
DE 6.50 usec
TE 299.8 K
D1 2.00000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 11.55 usec
SI 32768
SF 150.9028090 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



¹³C NMR Spectrum of Compound **3** (CDCl₃, 150 MHz)

¹H NMR GJ-M-1-1 in DMSO
2013-07-24

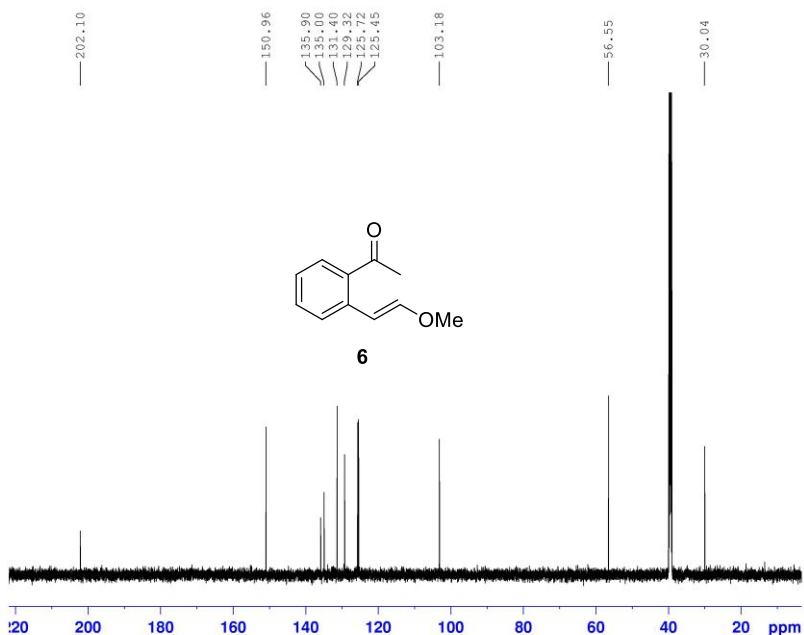


```
NAME GJ-M-1-1
EXPNO 755
PROCNO 1
Date_ 20130724
Time 13.15
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT DMSO
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 174.88
SW 40.533 usec
DE 6.50 usec
TE 299.8 K
D1 1.0000000 sec

===== CHANNEL f1 =====
NUC1 1H
P1 12.85 usec
SI 65536
SF 600.1300075 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00
```

¹H NMR Spectrum of Compound 6 (DMSO-*d*₆, 600 MHz)

¹³C NMR GJ-M-1-1 in DMSO
2013-07-31

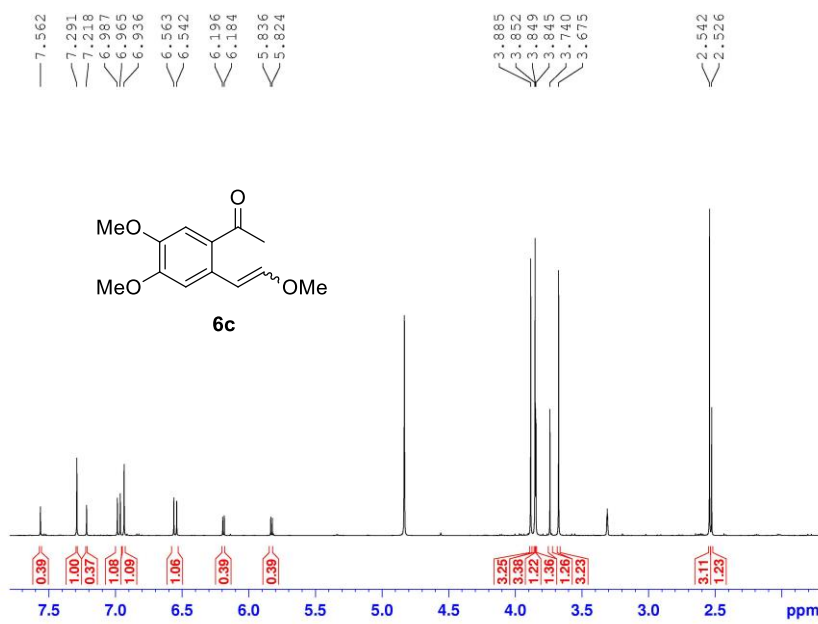


```
NAME GJ-M-1-1
EXPNO 774
PROCNO 1
Date_ 20130731
Time 13.30
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT DMSO
NS 663
DS 4
SWH 37878.789 Hz
FIDRES 0.577984 Hz
AQ 0.8651252 sec
RG 174.88
SW 13.200 usec
DE 6.50 usec
TE 299.8 K
D1 2.0000000 sec
D11 0.0300000 sec

===== CHANNEL f1 =====
NUC1 13C
P1 11.55 usec
SI 32768
SF 150.9028826 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40
```

¹³C NMR Spectrum of Compound 6 (DMSO-*d*₆, 150 MHz)

¹H NMR GJ-M-4-1 in MeOD
2013-08-16



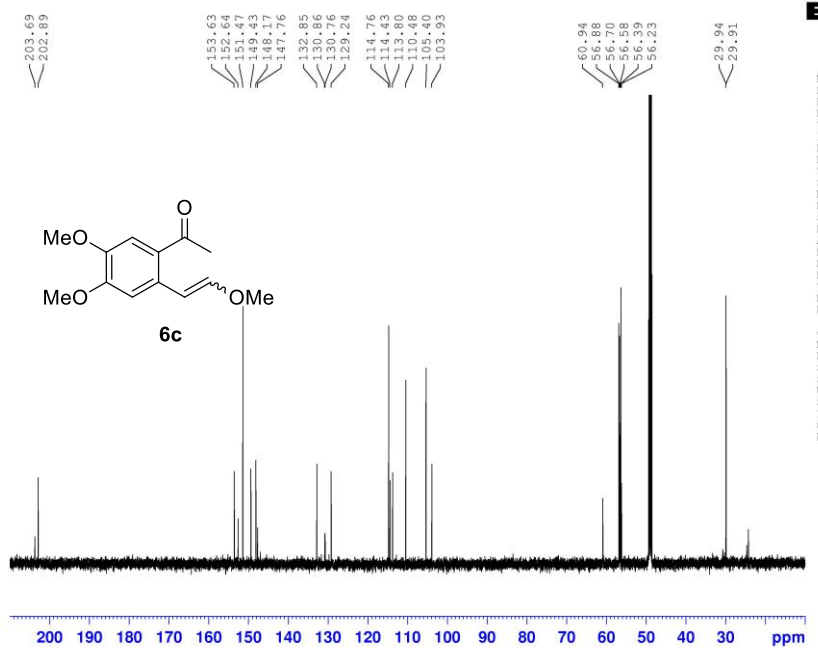
```

NAME      GJ-M-4-1
EXPNO    820
PROCNO   1
Date_    20130816
Time     16.14
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zg30
TD       65536
SOLVENT  MeOD
NS       16
DS       2
SWH      12335.526 Hz
FIDRES   0.188225 Hz
AQ       2.6564426 se
RG       115.06
DW       40.533 us
DE       6.50 us
TE       299.8 K
D1       1.00000000 se

===== CHANNEL f1 =====
NUC1     1H
P1       12.85 us
SI       65536
SF       600.1300141 MHz
WDW      EM
SSB      0
LB       0.30 Hz
GB       0
PC       1.00
  
```

¹H NMR Spectrum of Compound **6c** (CD₃OD, 600 MHz)

¹³C NMR GJ-M-4-1 in MeOD
2013-08-16



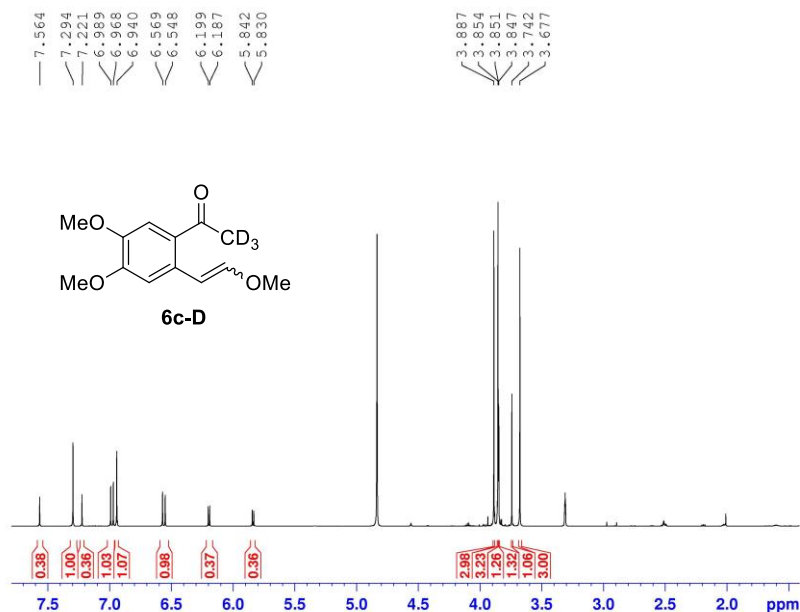
```

NAME      GJ-M-4-1
EXPNO    821
PROCNO   1
Date_    20130816
Time     16.18
INSTRUM  spect
PROBHD   5 mm PABBO BB-
PULPROG  zgpg30
TD       65536
SOLVENT  MeOD
NS       327
DS       4
SWH      37878.789 Hz
FIDRES   0.577984 Hz
AQ       0.8651252 sec
RG       174.88
DW       13.200 usec
DE       6.50 usec
TE       300.1 K
D1       2.00000000 sec
D11      0.03000000 sec

===== CHANNEL f1 =====
NUC1     13C
P1       11.55 usec
SI       32768
SF       150.9025990 MHz
WDW      EM
SSB      0
LB       1.00 Hz
GB       0
PC       1.40
  
```

¹³C NMR Spectrum of Compound **6c** (CD₃OD, 150 MHz)

¹H NMR GJ-M-4-1-D in MeOD
2013-08-16



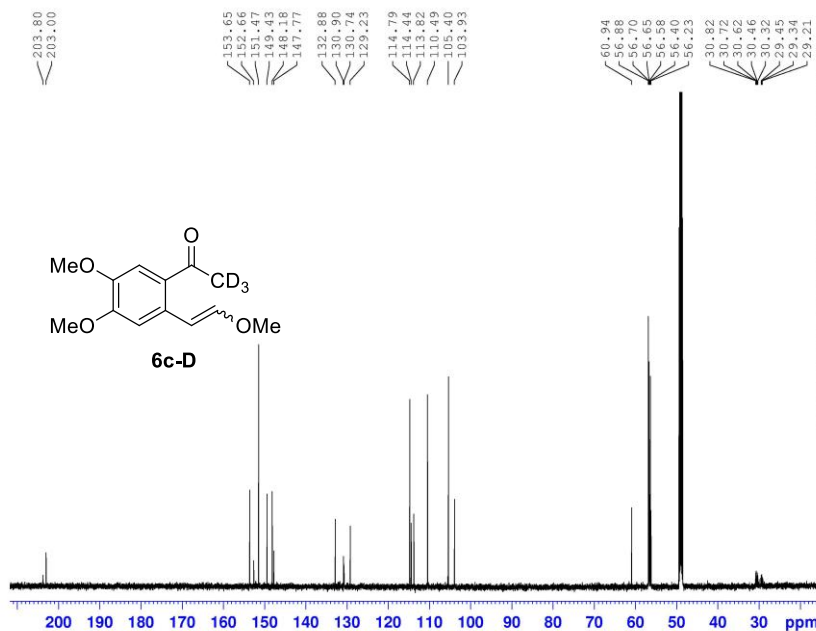
```

NAME      GJ-M-4-1-D
EXPNO     818
PROCNO    1
Date_     20130816
Time      14.45
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zg30
TD         65536
SOLVENT   MeOD
NS         16
DS         2
SWH        12335.526 Hz
FIDRES     0.188225 Hz
AQ         2.6564426 sec
RG         128.27
DW         40.533 use
DE         6.50 use
TE         299.8 K
D1         1.00000000 sec

===== CHANNEL f1 =====
NUC1      1H
P1        12.85 use
SI        65536
SF        600.1300141 MHz
WDW       EM
SSB       0
LB        0.30 Hz
GB        0
PC        1.00
  
```

¹H NMR Spectrum of Compound **6c-D** (CD₃OD, 600 MHz)

¹³C NMR GJ-M-4-1-D in MeOD
2013-08-16



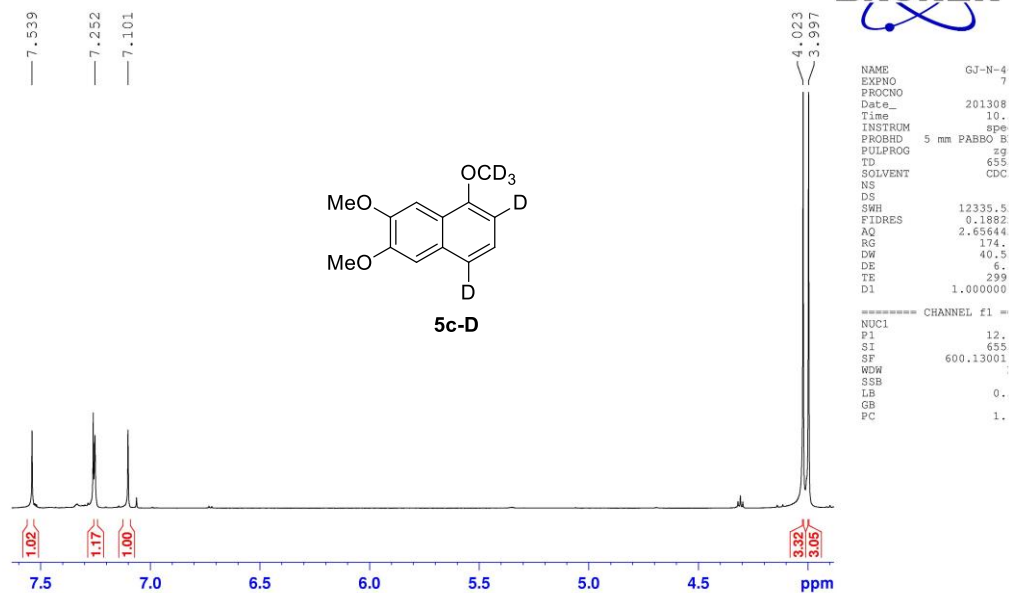
```

NAME      GJ-M-4-1-D
EXPNO     819
PROCNO    1
Date_     20130816
Time      14.49
INSTRUM   spect
PROBHD    5 mm PABBO BB-
PULPROG   zgpg30
TD         65536
SOLVENT   MeOD
NS         1661
DS         4
SWH        37878.789 Hz
FIDRES     0.577984 Hz
AQ         0.8651252 sec
RG         174.88
DW         13.200 use
DE         6.50 use
TE         300.2 K
D1         2.00000000 sec
D11        0.03000000 sec

===== CHANNEL f1 =====
NUC1      13C
P1        11.55 use
SI        32768
SF        150.9025987 MHz
WDW       EM
SSB       0
LB        1.00 Hz
GB        0
PC        1.40
  
```

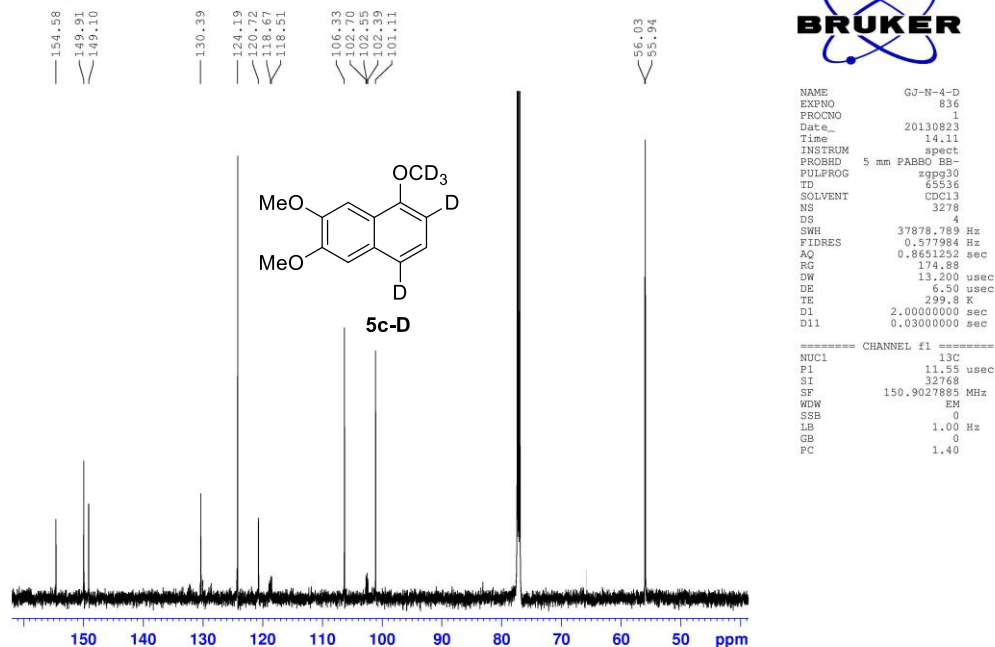
¹³C NMR Spectrum of Compound **6c-D** (CD₃OD, 600 MHz)

¹H NMR GJ-N-4-D in CDCl₃
2013-08-07

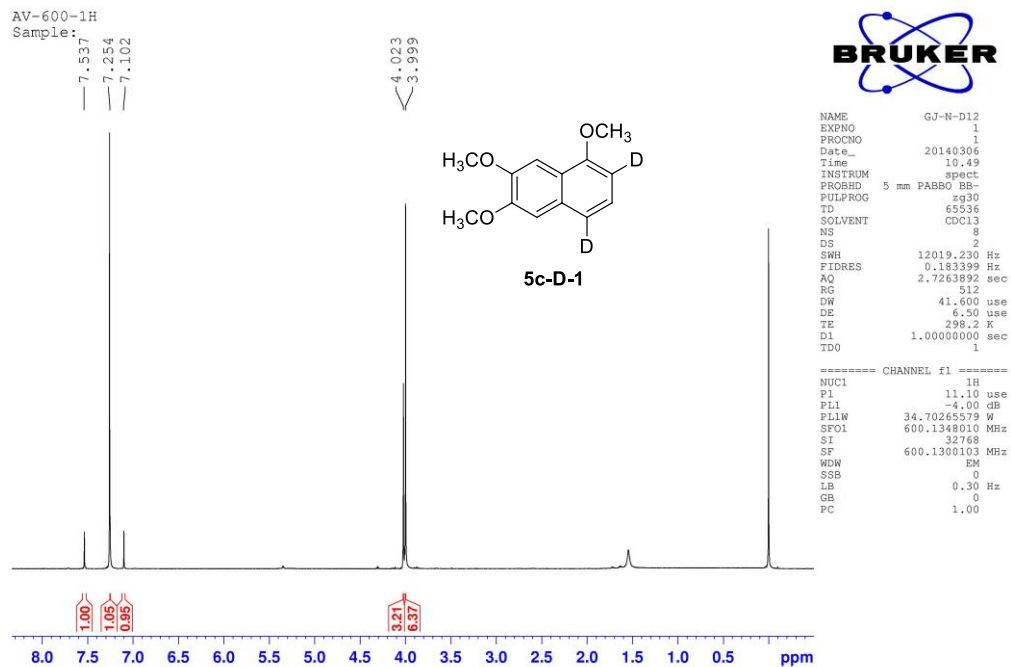


¹H NMR Spectrum of Compound **5c-D** (CDCl₃, 600 MHz)

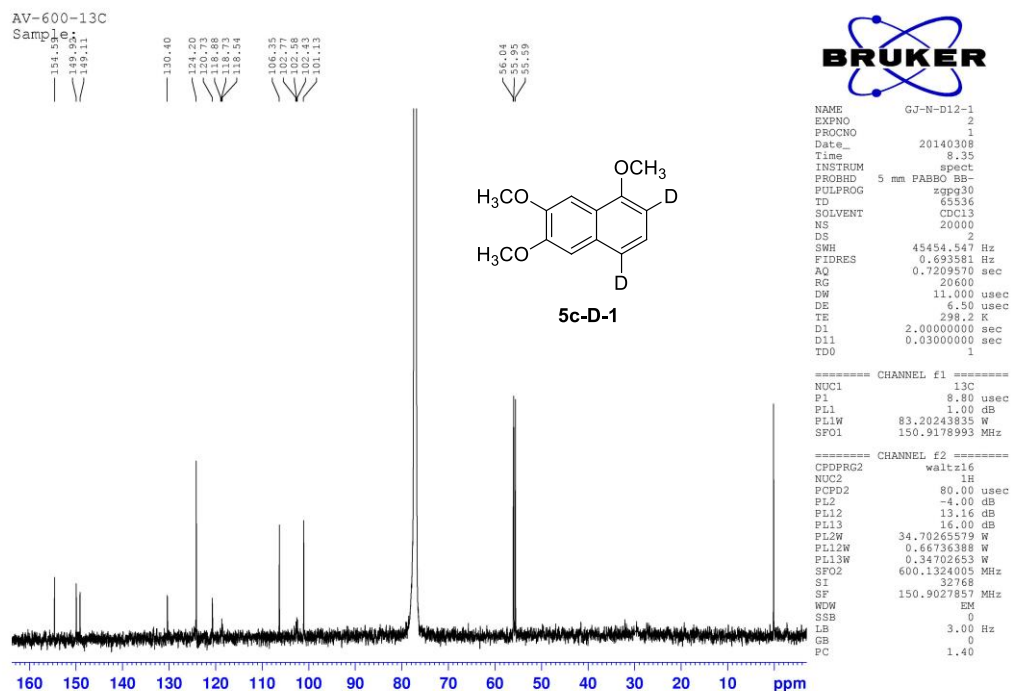
¹³C NMR GJ-N-4-D in CDCl₃
2013-08-23



¹³C NMR Spectrum of Compound **5c-D** (CDCl₃, 150 MHz)



¹H NMR Spectrum of Compound **5c-D-1** (CDCl₃, 600 MHz)



¹³C NMR Spectrum of Compound **5c-D-1** (CDCl₃, 150 MHz)

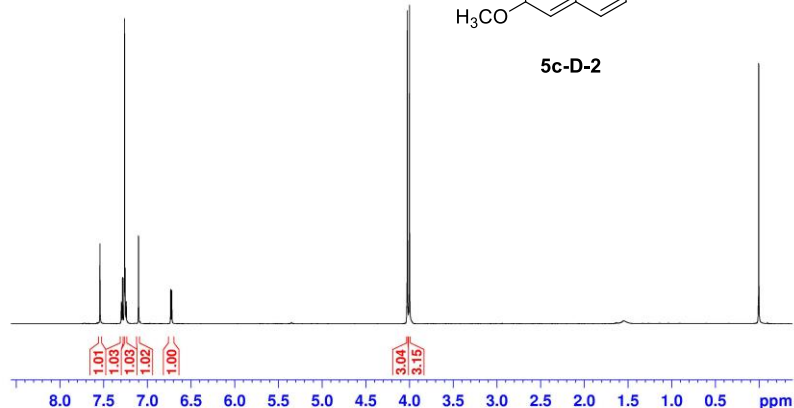
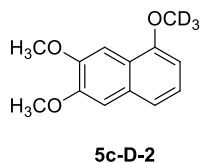
AV-600-1H
Sample:

7.539
7.297
7.284
7.266
7.253
7.240
7.100
6.733
6.721
6.719

4.024
3.999



NAME GJ-N-D32
EXPNO 1
PROCNO 1
Date_ 20140306
Time 10.41
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 8
DS 2
SWH 12019.230 Hz
FIDRES 0.183399 Hz
AQ 2.7263892 sec
RG 512
DW 41.600 usec
DE 6.50 usec
TE 298.2 K
D1 1.00000000 sec
TD0 1



¹H NMR Spectrum of Compound **5c-D-2** (CDCl₃, 600 MHz)

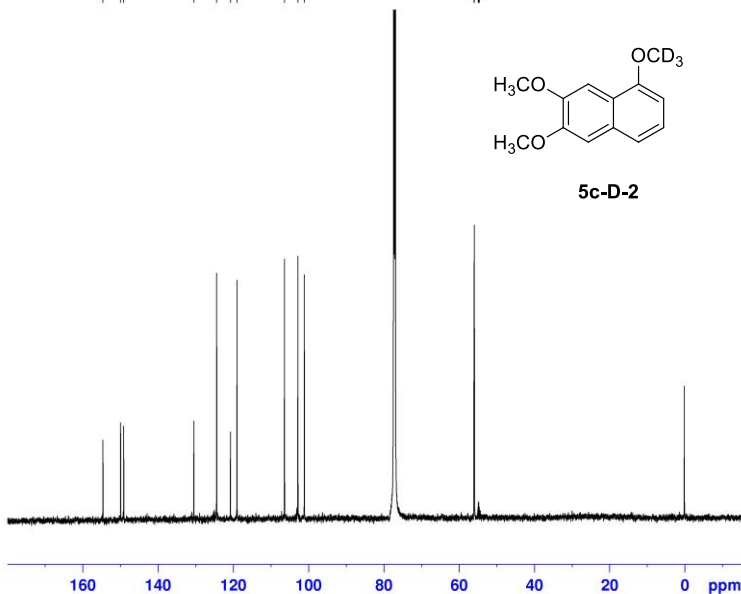
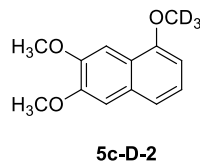
AV-600-13C
Sample:

154.63
149.93
149.11
130.47
124.41
120.25
118.99
106.38
101.42

56.04
55.95
55.92
55.87
55.82



NAME GJ-N-D32
EXPNO 2
PROCNO 1
Date_ 20140307
Time 8.14
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 19270
DS 2
SWH 45454.547 Hz
FIDRES 0.693581 Hz
AQ 0.7209570 sec
RG 20500
DW 11.000 usec
DE 6.50 usec
TE 298.2 K
D1 2.00000000 sec
D11 0.03000000 sec
TD0 1



===== CHANNEL f1 =====
NUC1 13C
P1 8.80 usec
PL1 1.00 dB
PL1W 83.20243835 W
SFO1 150.9178993 MHz
===== CHANNEL f2 =====
CDPRG2 waltz16
NUC2 1H
PCPD2 80.00 usec
PL2 -4.00 dB
PL12 13.16 dB
PL13 16.00 dB
PL2W 34.70265579 W
PL12W 0.66736388 W
PL13W 0.34702653 W
SFO2 600.1324005 MHz
SI 32768
SF 150.9027856 MHz
WDW EM
SSB 0
LB 3.00 Hz
GB 0
PC 1.40

¹³C NMR Spectrum of Compound **5c-D-2** (CDCl₃, 150 MHz)