Supporting Information

An Active Catalytic System for Suzuki-Miyaura Cross-Coupling Reactions Using Low Level of Palladium Loadings

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General Considerations.

Unless otherwise noted, all reagents were purchased from commercial suppliers and used without purification. Phosphine ligands **1**, **2** and **3** were prepared according to the reported procedures.[1] Toluene and ^{i}PrOH were degassed by sparging with nitrogen for at least 15 min before use. Water was degassed by sparging with nitrogen for at least 30 min before use. All reactions were performed in a resealable screw cap Schlenk flask (approx. 15 mL volume) in the presence of a Teflon coated magnetic stirrer bar (3 mm × 50 mm). Silica gel (70-230 and 230-400 mesh) was used for column chromatography. ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded on a Mercury-Plus (400 MHz) spectrometer. HRMS were obtained on an IonSpec FT-ICR mass spectrometer with ESI resource. All yields reported refer to isolated yields of compounds estimated to be greater than 95% purity as determined by ^{1}H NMR. Compounds described in the literature were characterized by comparison of their ^{1}H NMR spectra to the previously reported.

General Procedures for Reaction Condition Screenings.

Stock Solution **A** (2.5×10^{-4} mmol [Pd]/0.3 mL toluene): toluene (15.0 mL) was added to the mixture of $Pd(OAc)_2$ (2.75 mg, 1.25×10^{-2} mmol) and phosphine (2.5×10^{-2} mmol). The resulting organge colored solution was stirred at room temperature for 1 h.

Stock Solution **B** (5.0×10^{-4} mmol [Pd]/0.3 mL toluene): toluene (7.5 mL) was added to the mixture of $Pd(OAc)_2$ (2.75 mg, 1.25×10^{-2} mmol) and phosphine (2.5×10^{-2} mmol). The resulting organge colored solution was stirred at room temperature for 1 h.

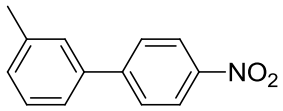
Stock Solution **C** (1.25×10^{-3} mmol [Pd]/0.3 mL toluene): toluene (3.0 mL) was added to the mixture of $Pd(OAc)_2$ (2.75 mg, 1.25×10^{-2} mmol) and phosphine (2.5×10^{-2} mmol). The resulting organge colored solution was stirred at room temperature for 1 h.

Aryl chlorides (2.5 mmol), Arylboronic acid (2.5 mmol), $K_3PO_4 \cdot 3H_2O$ (5.0 mmol) were added into a Schlenk tube equipped with a Teflon-coated magnetic stir bar. The mixture was pumped and refilled with nitrogen three times, then Stock Solution **A**, **B** or **C** (0.3 mL, as indicated in Table 1), degassed toluene (1.5 mL), H_2O (1.5 mL) and ^{i}PrOH (0.3 mL) were added. The reaction mixture was stirred at 90 ℃ under nitrogen for 16 h, and then cooled to room temperature. The reaction mixture was extracted with ethyl acetate (5 × 10 mL). The combined organic layers dried over anhydrous magnesium sulfate, filtered and concentrated in vacuo. The crude product was purified by column chromatography on silica gel to afford desired product.

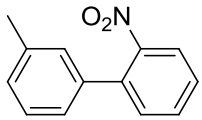
General Procedure for Suzuki-Miyaura Cross-Coupling Reaction.

A toluene solution (300 μL) containing $Pd(OAc)_2$ (1.25×10^{-3} mmol) and phosphine ligand **3** (2.5×10^{-3} mmol) was added to a Schlenk tube containing aryl chlorides (2.5 mmol), arylboronic acid (2.5 mmol), $K_3PO_4 \cdot 3H_2O$ (5.0 mmol), toluene (1.5 mL), H_2O (1.5 mL) and ^{i}PrOH (0.3 mL). The reaction mixture was stirred at 90 ℃ under nitrogen for 16 h, and then cooled to room temperature. The reaction mixture was extracted with ethyl acetate (5 × 10 mL). The combined organic layers dried over anhydrous magnesium sulfate, filtered and concentrated in vacuo. The crude product was purified by column chromatography on silica gel to afford desired product.

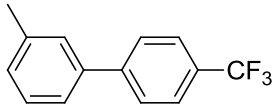
^{1}H NMR and ^{13}C NMR Spectrum for All Isolated Products



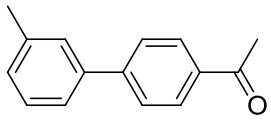
3-methyl-4'-nitro-1,1'-biphenyl.[4] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 – 8.25 (m, 2 H, Ar), 7.71 – 7.69 (m, 2 H, Ar), 7.41 – 7.36 (m, 3 H, Ar), 7.24 (d, *J* = 4 Hz, 1 H, Ar), 2.24 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.1 (s, Ar), 138.2 (s, Ar), 137.1 (s, Ar), 136.2 (s, Ar), 132.1 (s, Ar), 131.8 (s, Ar), 128.1 (s, Ar), 128.4 (s, Ar), 128.3 (s, Ar), 127.9 (s, Ar), 124.8 (s, Ar), 123.8 (s, Ar), 21.3 (s, *C*H$_3$).



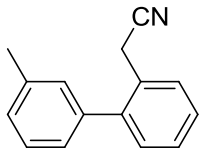
3'-methyl-2-nitro-1,1'-biphenyl.[3] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.81 (d, *J* = 8.0 Hz, 1 H, Ar), 7.60 –7.56 (m, 1 H, Ar), 7.44 – 7.40 (m, 2 H, Ar), 7.29 (t, *J* = 8.0 Hz, 1 H, Ar), 7.19 (d, *J* = 8.0 Hz, 1 H, Ar), 7.09 (d, *J* = 8.0 Hz, 2 H, Ar), 2.38 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 147.5 (s, Ar), 146.7 (s, Ar), 138.7 (s, Ar), 138.4 (s, Ar), 129.5 (s, Ar), 128.9 (s, Ar), 127.9 (s, Ar), 127.5 (s, Ar), 124.3 (s, Ar), 123.8 (s, Ar), 21.3 (s, *C*H$_3$).



3-methyl-4'-(trifluoromethyl)-1,1'-biphenyl.[5] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (s, 4 H, Ar), 7.38 (s, 1 H, Ar), 7.35 (d, *J* = 4.0 Hz, 1 H, Ar), 7.32 (d, *J* = 8.0 Hz, 1 H, Ar), 7.20 (d, *J* = 4.0 Hz, 1 H, Ar), 2.43 (s, 3 H, C*H*$_3$). ^{19}F NMR (376 MHz, $CDCl_3$): δ -64.0 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 144.8 (s, Ar), 139.6 (s, Ar), 138.6 (s, Ar), 129.1 (d, *J* = 2.2 Hz, *C*F$_3$), 128.9 (s, Ar), 128.8 (s, Ar), 127.9 (s, Ar), 127.3 (s, Ar), 125.5 (s, Ar), 124.3 (s, Ar), 21.3 (s, *C*H$_3$).

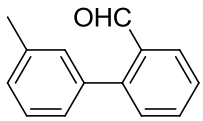


1-(3'-methyl-[1,1'-biphenyl]-4-yl)ethanone.[4] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.99 (d, *J* = 8.0 Hz, 2 H, Ar), 7.65 (d, *J* = 8.0 Hz, 2 H, Ar), 7.40 (d, *J* = 8.0 Hz, 2 H, Ar), 7.33 (t, *J* = 8.0 Hz, 1 H, Ar), 7.19 (d, *J* = 8.0 Hz, 1 H, Ar), 2.63 (s, 3 H, COC*H*$_3$), 2.43 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 197.5 (s, *C*=O), 147.6 (s, Ar), 139.6 (s, Ar), 138.4 (s, Ar), 135.5 (s, Ar), 128.8 (s, Ar), 128.7 (s, Ar), 127.8 (s, Ar), 127.0 (s, Ar), 124.2 (s, Ar), 26.4 (s, *C*H$_3$), 21.3 (s, *C*H$_3$).

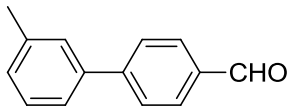


2-(3'-methyl-[1,1'-biphenyl]-2-yl)acetonitrile.[6] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (t, *J* = 8.0 Hz, 1 H, Ar), 7.37 – 7.33 (m, 2 H, Ar), 7.30 (d, *J* = 8.0 Hz, 1 H, Ar), 7.25 (t, *J* = 8.0 Hz, 1 H, Ar),

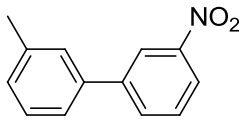
7.18 (d, *J* = 8.0 Hz, 1 H, Ar), 7.05 (t, *J* = 8.0 Hz, 2 H, Ar), 3.62 (s, 2 H, C*H*$_2$CN), 2.40 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 141.7 (s, Ar), 139.6 (s, Ar), 138.1 (s, Ar), 130.2 (s, Ar), 129.4 (s, Ar), 128.6 (s, Ar), 128.3 (s, Ar), 128.3 (s, Ar), 127.9 (s, Ar), 127.9 (s, Ar), 127.5 (s, Ar), 125.7 (s, Ar), 118.2 (s, *C*N), 21.8 (s, *C*H$_2$), 21.3 (s, *C*H$_3$).



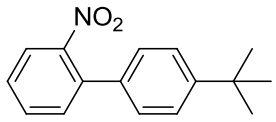
3'-methyl-[1,1'-biphenyl]-2-carbaldehyde.[15] ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.95 (s, 1 H, C*H*O), 7.99 (d, *J* = 8.0 Hz, 1 H, Ar), 7.62 – 7.58 (m, 2 H, Ar), 7.48 – 7.41 (m, 1 H, Ar), 7.33 (t, *J* = 8.0 Hz, 1 H, Ar), 7.16 (t, *J* = 8.0 Hz, 2 H, Ar), 2.42 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 192.3 (s, *C*HO), 146.0 (s, Ar), 137.9 (s, Ar), 137.5 (s, Ar), 133.5 (s, Ar), 133.3 (s, Ar), 130.6 (s, Ar), 130.6 (s, Ar), 128.7 (s, Ar), 128.1 (s, Ar), 127.5 (s, Ar), 127.3 (s, Ar), 127.1 (s, Ar), 21.3 (s, *C*H$_3$).



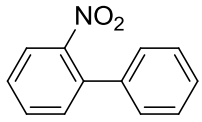
3'-methyl-[1,1'-biphenyl]-4-carbaldehyde.[9] ^{1}H NMR (400 MHz, $CDCl_3$): δ 10.01 (s, 1 H, C*H*O), 7.91 (d, *J* = 8.0 Hz, 2 H, Ar), 7.71 (d, *J* = 8.0 Hz, 2 H, Ar), 7.41 (d, *J* = 8.0 Hz, 2 H, Ar), 7.34 (t, *J* = 8.0 Hz, 1 H, Ar), 7.20 (d, *J* = 4.0 Hz, 1 H, Ar), 2.43 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 191.6 (s, *C*HO), 147.0 (s, Ar), 139.4 (s, Ar), 138.4 (s, Ar), 134.9 (s, Ar), 130.0 (s, Ar), 129.0 (s, Ar), 127.9 (s, Ar), 127.4 (s, Ar), 124.2 (s, Ar), 21.3 (s, *C*H$_3$).



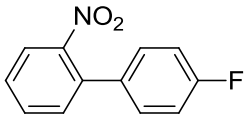
3-methyl-3'-nitro-1,1'-biphenyl.[16] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.41 (t, *J* = 4.0 Hz, 1 H, Ar), 8.17 –8.15 (m, 1 H, Ar), 7.88 (d, *J* = 8.0 Hz, 1 H, Ar), 7.57 (t, *J* = 8.0 Hz, 1 H, Ar), 7.41-7.35 (m, 3 H, Ar), 7.21 (s, 1 H, Ar), 2.44 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.4 (s, Ar), 142.6 (s, Ar), 138.6 (s, Ar), 138.3 (s, Ar), 132.8 (s, Ar), 129.4 (s, Ar), 129.1 (s, Ar), 128.8 (s, Ar), 127.6 (s, Ar), 124.0 (s, Ar), 121.7 (s, Ar), 121.6 (s, Ar), 21.3 (s, *C*H$_3$).



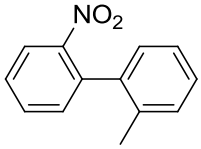
4'-(tert-butyl)-2-nitro-1,1'-biphenyl.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 – 7.77 (m, 1 H, Ar), 7.57 –7.55 (m, 1 H, Ar), 7.45 – 7.40 (m, 4 H, Ar), 7.24 (t, *J* = 4.0 Hz, 1 H, Ar), 7.22 (t, *J* = 4.0 Hz, 1 H, Ar), 1.35 (s, 9 H, C*Me*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 151.0 (s, Ar), 149.2 (s, Ar), 136.0 (s, Ar), 134.1 (s, Ar), 132.0 (s, Ar), 131.8 (s, Ar), 127.7 (s, Ar), 127.4 (s, Ar), 125.5 (s, Ar), 123.8 (s, Ar), 34.5 (s, *C*Me$_3$), 31.2 (s, *C*H$_3$).



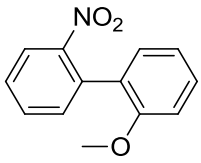
2-nitro-1,1'-biphenyl.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.83 – 7.81 (m, 1 H, Ar), 7.61 – 7.57 (m, 1 H, Ar), 7.45 – 7.38 (m, 5 H, Ar), 7.30 – 7.28 (m, 2 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.0 (s, Ar), 137.3 (s, Ar), 136.0 (s, Ar), 132.2 (s, Ar), 131.7 (s, Ar), 128.5 (s, Ar), 128.0 (s, Ar), 127.7 (s, Ar), 123.8 (s, Ar).



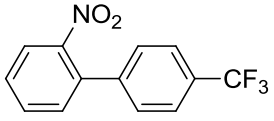
4'-fluoro-2-nitro-1,1'-biphenyl.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.85 – 7.82 (m, 1 H, Ar), 7.60 – 7.57 (m, 1 H, Ar), 7.48 (t, *J* = 4.0 Hz, 1 H, Ar), 7.40 – 7.38 (m, 1 H, Ar), 7.28 – 7.25 (m, 2 H, Ar), 7.12 – 7.07 (m, 2 H, Ar). ^{19}F NMR (376 MHz, $CDCl_3$): δ -114.7 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 163.3 (s, Ar), 161.7 (s, Ar), 149.0 (s, Ar), 135.0 (s, Ar), 133.2 (s, Ar), 132.3 (s, Ar), 131.8 (s, Ar), 129.5 (s, Ar), 128.2 (s, Ar), 124.0 (s, Ar), 115.5 (d, *J* = 1.4 Hz, Ar).



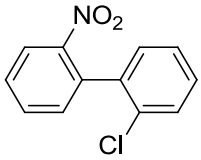
2-methyl-2'-nitro-1,1'-biphenyl.[3] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97 – 7.95 (m, 1 H, Ar), 7.63 – 7.59 (m, 1 H, Ar), 7.51 – 7.49 (m, 1 H, Ar), 7.32 – 7.25 (m, 3 H, Ar), 7.21 (d, *J* = 8.0 Hz, 1 H, Ar), 7.07 (d, *J* = 8.0 Hz, 1 H, Ar), 2.10 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.9 (s, Ar), 137.3 (s, Ar), 136.3 (s, Ar), 135.4 (s, Ar), 132.4 (s, Ar), 132.0 (s, Ar), 129.8 (s, Ar), 128.1 (s, Ar), 128.1 (s, Ar), 128.0 (s, Ar), 125.6 (s, Ar), 123.9 (s, Ar), 19.7 (s, *C*H$_3$).



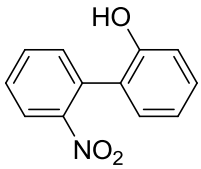
2-methoxy-2'-nitro-1,1'-biphenyl.[8] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.90 – 7.88 (m, 1 H, Ar), 7.62 –7.57 (m, 1 H, Ar), 7.45 – 7.41 (m, 1 H, Ar), 7.39 – 7.33 (m, 2 H, Ar), 7.29 – 7.27 (m, 1 H, Ar), 7.05 (t, *J* = 8.0 Hz, 1 H, Ar), 6.88 (d, *J* = 8.0 Hz, 1 H, Ar), 3.68 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 155.6 (s, Ar), 149.5 (s, Ar), 132.8 (s, Ar), 132.6 (s, Ar), 132.3 (s, Ar), 129.7 (s, Ar), 129.5 (s, Ar), 127.9 (s, Ar), 126.8 (s, Ar), 123.7 (s, Ar), 121.1 (s, Ar), 110.4 (s, Ar), 55.0 (s, O*C*H$_3$).



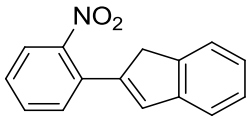
2-nitro-4'-(trifluoromethyl)-1,1'-biphenyl.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.92 (d, *J* = 8.0 Hz, 1 H, Ar), 7.67 – 7.62 (m, 3 H, Ar), 7.55 (t, *J* = 8.0 Hz, 1 H, Ar), 7.42 – 7.39 (m, 1 H, Ar). ^{19}F NMR (376 MHz, $CDCl_3$): δ -64.2 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.6 (s, Ar), 141.3 (s, Ar), 134.8 (s, Ar), 132.6 (s, Ar), 131.6 (s, Ar), 130.2-129.6 (m, *C*F$_3$), 128.9 (s, Ar), 128.2 (s, Ar), 125.4 (s, Ar), 124.2 (s, Ar), 123.0 (s, Ar).



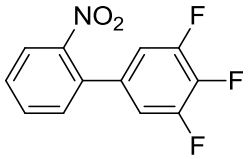
2-chloro-2'-nitro-1,1'-biphenyl.[8] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.08 – 8.06 (m, 1 H, Ar), 7.67 – 7.63 (m, 1 H, Ar), 7.54 (t, *J* = 8.0 Hz, 1 H, Ar), 7.44 – 7.42 (m, 1 H, Ar), 7.36 – 7.31 (m, 3 H, Ar), 7.24 – 7.23 (m, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.3 (s, Ar), 136.9 (s, Ar), 134.1 (s, Ar), 132.9 (s, Ar), 132.2 (s, Ar), 129.7 (s, Ar), 129.2 (s, Ar), 128.9 (s, Ar), 126.8 (s, Ar), 124.2 (s, Ar).



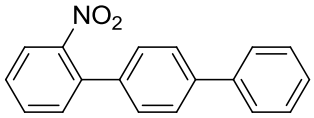
2'-nitro-[1,1'-biphenyl]-2-ol.[14] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95 (d, *J* = 8.0 Hz, 1 H, Ar), 7.63 (t, *J* = 6.0 Hz, 1 H, Ar), 7.49 (t, *J* = 8.0 Hz, 1 H, Ar), 7.41 (d, *J* = 8.0 Hz, 1 H, Ar), 7.26 – 7.20 (m, 2 H, Ar), 7.02 (t, *J* = 6.0 Hz, 1 H, Ar), 6.81 (d, *J* = 8.0 Hz, 1 H, Ar), 4.91 (s, 1 H, O*H*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 152.3 (s, Ar), 149.6 (s, Ar), 132.8 (s, Ar), 132.6 (s, Ar), 132.5 (s, Ar), 129.8 (s, Ar), 128.4 (s, Ar), 125.0 (s, Ar), 124.1 (s, Ar), 121.3 (s, Ar), 115.7 (s, Ar).



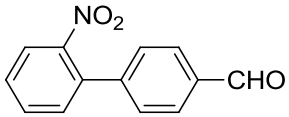
2-(2-nitrophenyl)-1*H*-indene. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.74 (d, *J* = 8.0 Hz, 1 H, Ar), 7.54 (d, *J* = 8.0 Hz, 1 H, Ar), 7.49 (d, *J* = 8.0 Hz, 1 H, Ar), 7.44 (d, *J* = 8.0 Hz, 1 H, Ar), 7.42 – 7.37 (m, 2 H, Ar), 7.27 (t, *J* = 8.0 Hz, 1 H, Ar), 7.20 (d, *J* = 8.0 Hz, 1 H, Ar), 6.95 (s, 1 H, =C*H*), 3.68 (s, 2 H, CH_2). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.7 (s, Ar), 144.1 (s, Ar), 143.3 (s, Ar), 142.1 (s, Ar), 132.0 (s, Ar), 131.3 (s, Ar), 130.6 (s, Ar), 127.9 (s, Ar), 126.5 (s, Ar), 125.3 (s, Ar), 123.7 (s, Ar), 123,5 (s, Ar), 121.4 (s, Ar), 40.4 (s, *C*H_2). HRMS (ESI): $[M+H]^+$ calcd. for $C_{15}H_{12}NO_2$: 238.0868; Found: 238.0860.



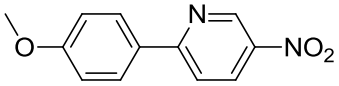
3',4',5'-trifluoro-2-nitro-1,1'-biphenyl.[24] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.91 (d, *J* = 8.0 Hz, 1 H, Ar), 7.63 (t, *J* = 8.0 Hz, 1 H, Ar), 7.54 (d, *J* = 8.0 Hz, 1 H, Ar), 7.36 (d, *J* = 8.0 Hz, 1 H, Ar), 6.92 (t, *J* = 8.0 Hz, 2 H, Ar) . ^{19}F NMR (376 MHz, $CDCl_3$): δ -137.8 (s), -164.7 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 151.8 (s, Ar), 150.1 (s, Ar), 148.5 (s, Ar), 133.3 (s, Ar), 132.8 (s, Ar), 131.5 (s, Ar), 129.3 (s, Ar), 124.4 (s, Ar), 112.5 (s, Ar), 112.4 (s, Ar).



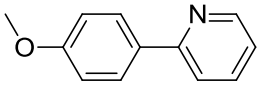
2-nitro-1,1':4',1''-terphenyl.[13] ^{1}H NMR (400 MHz, $CDCl_3$). δ 7.84 (d, *J* = 8.0 Hz, 1 H, Ar), 7.63 – 7.58 (m, 5 H, Ar), 7.48 – 7.51 (m, 4 H, Ar), 7.36 (t, *J* = 8.0 Hz, 3 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.1 (s, Ar), 140.9 (s, Ar), 140.2 (s, Ar), 136.1 (s, Ar), 135.8 (s, Ar), 132.2 (s, Ar), 131.8 (s, Ar), 128.7 (s, Ar), 128.2 (s, Ar), 128.1 (s, Ar), 127.5 (s, Ar), 127.3 (s, Ar), 127.0 (s, Ar), 124.0 (s, Ar).



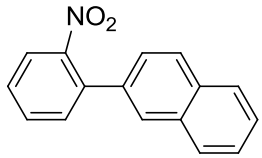
2'-nitro-[1,1'-biphenyl]-4-carbaldehyde.[9] ^{1}H NMR (400 MHz, $CDCl_3$): δ 10.03 (s, 1 H, C*H*O), 7.94 –7.91 (m, 3 H, Ar), 7.65 (t, *J* = 8.0 Hz, 1 H, Ar), 7.54 (t, *J* = 8.0 Hz, 1 H, Ar), 7.47 – 7.41 (m, 3 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 191.6 (s, *C*HO), 148.5 (s, Ar), 143.6 (s, Ar), 135.5 (s, Ar), 135.0 (s, Ar), 132.6 (s, Ar), 131.5 (s, Ar), 129.7 (s, Ar), 129.0 (s, Ar), 128.5 (s, Ar), 124.3 (s, Ar).



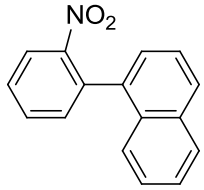
2-(4-methoxyphenyl)-5-nitropyridine.[22] ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.40 (s, 1 H, Ar), 8.45 – 8.42 (m, 1 H, Ar), 8.04 (d, *J* = 8.0 Hz, 2 H, Ar), 7.79 (d, *J* = 8.0 Hz, 1 H, Ar), 7.00 (t, *J* = 8.0 Hz, 2 H, Ar), 3.88 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 161.9 (s, Ar), 161.7 (s, Ar), 145.9 (s, Ar), 142.0 (s, Ar), 131.7 (s, Ar), 129.3 (s, Ar), 129.1 (s, Ar), 118.8 (s, Ar), 114.3 (s, Ar), 55.3 (s, O*C*H_3).



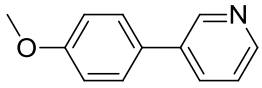
2-(4-methoxyphenyl)pyridine.[17] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.61 (d, *J* = 4.0 Hz, 1 H, Ar), 7.92 (d, *J* = 8.0 Hz, 2 H, Ar), 7.68 – 7.64 (m, 2 H, Ar), 7.16 – 7.12 (m, 1 H, Ar), 6.97 (d, *J* = 8.0 Hz, 2 H, Ar), 3.85 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.0 (s, Ar), 156.5 (s, Ar), 149.1 (s, Ar), 136.2 (s, Ar), 131.5 (s, Ar), 127.7 (s, Ar), 121.0 (s, Ar), 119.3 (s, Ar), 113.7 (s, Ar), 54.8 (s, O*C*H_3).



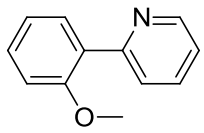
2-(2-nitrophenyl)naphthalene.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.89 – 7.78 (m, 5 H, Ar), 7.62 (d, *J* = 8.0 Hz, 1 H, Ar), 7.52 – 7.46 (m, 4 H, Ar), 7.39 – 7.36 (m, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.0 (s, Ar), 136.1 (s, Ar), 134.8 (s, Ar), 133.1 (s, Ar), 132.6 (s, Ar), 132.3 (s, Ar), 132.1 (s, Ar), 128.0 (s, Ar), 127.6 (s, Ar), 126.8 (s, Ar), 126.4 (s, Ar), 125.6 (s, Ar), 124.0 (s, Ar).



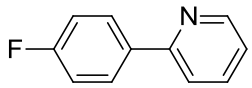
1-(2-nitrophenyl)naphthalene.[7] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.04 (d, *J* = 8.0 Hz, 1 H, Ar), 7.87 (d, *J* = 8.0 Hz, 2 H, Ar), 7.66 (t, *J* = 8.0 Hz, 1 H, Ar), 7.57 (t, *J* = 8.0 Hz, 1 H, Ar), 7.49 (d, *J* = 8.0 Hz, 1 H, Ar), 7.44 (t, *J* = 8.0 Hz, 2 H, Ar), 7.41 – 7.37 (m, 2 H, Ar), 7.31 (d, *J* = 8.0 Hz, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.5 (s, Ar), 135.3 (s, Ar), 135.0 (s, Ar), 133.2 (s, Ar), 132.9 (s, Ar), 132.4 (s, Ar), 131.2 (s, Ar), 128.4 (s, Ar), 126.4 (s, Ar), 125.9 (s, Ar), 125.1 (s, Ar), 124.68 (s, Ar), 124.0 (s, Ar).



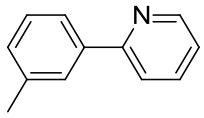
3-(4-methoxyphenyl)pyridine.[17] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.78 (s, 1 H, Ar), 8.51 (d, *J* = 4.0 Hz, 1 H, Ar), 7.80 (d, *J* = 8.0 Hz, 1 H, Ar), 7.49 (d, *J* = 8.0 Hz, 2 H, Ar), 7.31 (t, *J* = 8.0 Hz, 1 H, Ar), 6.99 (d, *J* = 8.0 Hz, 2 H, Ar), 3.85 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 159.3 (s, Ar), 147.5 (s, Ar), 135.8 (s, Ar), 133.5 (s, Ar), 133.4 (s, Ar), 129.7 (s, Ar), 127.8 (s, Ar), 123.1 (s, Ar), 114.2 (s, Ar), 54.9 (s, O*C*H_3).



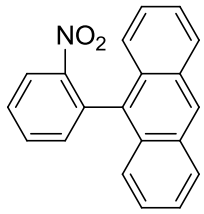
2-(2-methoxyphenyl)pyridine.[17] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.67 (t, *J* = 8.0 Hz, 1 H, Ar), 7.79 – 7.76 (m, 1 H, Ar), 7.74 – 7,72 (m, 1 H, Ar), 7.69 – 7.65 (m, 1 H, Ar), 7.37 – 7.32 (m, 1 H, Ar), 7.19 – 7.16 (m, 1 H, Ar), 7.07 – 7.03 (m, 1 H, Ar), 6.99 – 6.97 (m, 1 H, Ar), 3.84 (s, 3 H, OMe). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.3 (s, Ar), 155.4 (s, Ar), 148.8 (s, Ar), 135.0 (s, Ar), 130.5 (s, Ar), 129.4 (s, Ar), 128.4 (s, Ar), 124.5 (s, Ar), 121.1 (s, Ar), 120.4 (s, Ar), 110.7 (s, Ar), 54.9 (s, O*C*H_3).



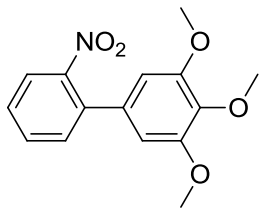
2-(4-fluorophenyl)pyridine.[18] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.64 (d, *J* = 8.0 Hz, 1 H, Ar), 7.96 – 7.93 (m, 2 H, Ar), 7.71 (t, *J* = 8.0 Hz, 1 H, Ar), 7.65 (d, *J* = 8.0 Hz, 1 H, Ar), 7.21 – 7.18 (m, 1 H, Ar), 7.12 (d, *J* = 8.0 Hz, 2 H, Ar). ^{19}F NMR (376 MHz, $CDCl_3$): δ -114.3 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 164.1 (s, Ar), 162.4 (s, Ar), 156.1 (s, Ar), 149.5 (s, Ar), 136.6 (s, Ar), 135.3 (s, Ar), 128.5 (s, Ar), 121.8 (s, Ar), 119.9 (s, Ar), 115.0 (d, *J* = 1.3 Hz, 1 C, Ar).



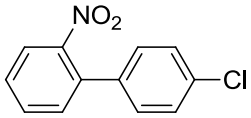
2-(m-tolyl)pyridine.[19] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.65 (d, *J* = 4.0 Hz, 1 H, Ar), 7.81 (s, 1 H, Ar), 7.73 – 7.69 (m, 3 H, Ar), 7.33 (t, *J* = 8.0 Hz, 1 H, Ar), 7.21 – 7.17 (m, 2 H, Ar), 2.43 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.9 (s, Ar), 149.0 (s, Ar), 138.8 (s, Ar), 137.7 (s, Ar), 136.1 (s, Ar), 129.2 (s, Ar), 128.1 (s, Ar), 127.1 (s, Ar), 123.5 (s, Ar), 120.0 (s, Ar), 21.0 (s, *C*H_3).



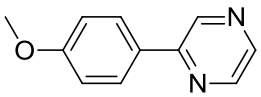
9-(2-nitrophenyl)anthracene.[12] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.49 (s, 1 H, Ar), 8.23 – 8.21 (m, 1 H, Ar), 8.02 (d, *J* = 8.0 Hz, 2 H, Ar), 7.78 – 7.74 (m, 1 H, Ar), 7.69 (d, *J* = 8.0 Hz, 1 H, Ar) 7.46 – 7.32 (m, 7 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 150.1 (s, Ar), 133.9 (s, Ar), 133.7 (s, Ar), 133.0 (s, Ar), 131.6 (s, Ar), 131.1 (s, Ar), 129.6 (s, Ar), 129.0 (s, Ar), 128.6 (s, Ar), 127.4 (s, Ar), 126.0 (s, Ar), 125.3 (s, Ar), 125.1 (s, Ar), 124.5 (s, Ar).



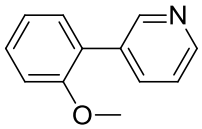
3',4',5'-trimethoxy-2-nitro-1,1'-biphenyl.[10] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.77 (d, *J* = 8.0 Hz, 1 H, Ar), 7.58 (t, *J* = 8.0 Hz, 1 H, Ar), 7.45 (t, *J* = 8.0 Hz, 2 H, Ar), 6.50 (s, 2 H, Ar), 3.88 (s, 3 H, O*Me*), 3.84 (s, 6 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 153.1 (s, Ar), 149.2 (s, Ar), 137.7 (s, Ar), 135.8 (s, Ar), 132.6 (s, Ar), 131.9 (s, Ar), 131.5 (s, Ar), 128.0 (s, Ar), 123.6 (s, Ar), 104.8 (s, Ar), 60.7 (s, O*C*H_3), 55.9 (s, O*C*H_3).



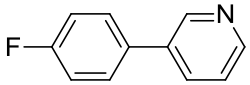
4'-chloro-2-nitro-1,1'-biphenyl.[9] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.87 – 7.84 (m, 1 H, Ar), 7.62 – 7.58 (m, 1 H, Ar), 7.50 – 7.46 (m, 1 H, Ar), 7.39 – 7.37 (m, 3 H, Ar), 7.23 (d, *J* = 4.0 Hz, 1 H, Ar), 7.21 (s, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.8 (s, Ar), 135.7 (s, Ar), 134.9 (s, Ar), 134.2 (s, Ar), 132.4 (s, Ar), 131.7 (s, Ar), 129.1 (s, Ar), 128.7 (s, Ar), 128.4 (s, Ar), 124.1 (s, Ar).



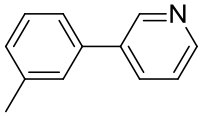
2-(4-methoxyphenyl)pyrazine.[19] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.95 (d, *J* = 4.0 Hz, 1 H, Ar), 8.55 (t, *J* = 4.0 Hz, 1 H, Ar), 8.40 (d, *J* = 4.0 Hz, 1 H, Ar), 7.95 (d, *J* = 8.0 Hz, 2 H, Ar), 7.01 (d, *J* = 8.0 Hz, 2 H, Ar), 3.87 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 160.8 (s, Ar), 152.0 (s, Ar), 143.6 (s, Ar), 141.7 (s, Ar), 141.2 (s, Ar), 128.4 (s, Ar), 127.9 (s, Ar), 114.1 (s, Ar), 55.0 (s, O*C*H_3).



3-(2-methoxyphenyl)pyridine.[17] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.74 (s, 1 H, Ar), 8.53 (d, *J* = 4.0 Hz, 1 H, Ar) , 7.85 (d, *J* = 8.0 Hz, 1 H, Ar), 7.36 (t, *J* = 8.0 Hz, 1 H, Ar), 7.32 (t, *J* = 8.0 Hz, 2 H, Ar), 7.05 (t, *J* = 8.0 Hz, 1 H, Ar), 6.70 (d, *J* = 4.0 Hz, 1 H, Ar), 3.83 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 156.2 (s, Ar), 149.9 (s, Ar), 147.6 (s, Ar), 136.5 (s, Ar), 133.9 (s, Ar), 130.3 (s, Ar), 129.3 (s, Ar), 126.6 (s, Ar), 122.6 (s, Ar), 120.7 (s, Ar), 110.9 (s, Ar), 55.2 (s, O*C*H_3).

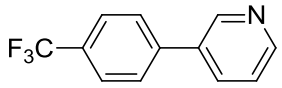


3-(4-fluorophenyl)pyridine.[20] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.77 (d, *J* = 4.0 Hz, 1 H, Ar) , 8.57 – 8.55 (m, 1 H, Ar), 7.82 – 7.79 (m, 1 H, Ar), 7.54 – 7.50 (m, 2 H, Ar), 7.35 – 7.32 (m, 1 H, Ar), 7.15 (t, *J* = 8.0 Hz, 2 H, Ar). ^{19}F NMR (376 MHz, $CDCl_3$): δ -115.3 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 162.9 (s, Ar), 161.3 (s, Ar), 147.6 (s, Ar), 147.2 (s, Ar), 134.8 (s, Ar), 133.2 (d, *J* = 3.7 Hz, 1 C, Ar), 128.0 (s, Ar), 128.0 (s, Ar), 122.9 (s, Ar), 115.3 (d, *J* = 3.7 Hz, 1 C, Ar).

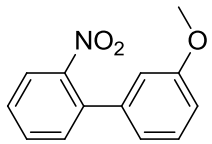


3-(m-tolyl)pyridine.[19] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.80 (d, *J* = 0.02 Hz, 1 H, Ar) , 8.55 – 8.54 (m, 1 H, Ar), 7.85 – 7.82 (m, 1 H, Ar), 7.36 – 7.31 (m, 4 H, Ar), 7.19 (d, *J* = 4.0 Hz, 1 H, Ar),

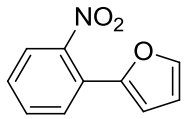
2.43 (s, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 147.7 (s, Ar), 138.2 (s, Ar), 137.2 (s, Ar), 136.2 (s, Ar), 133.8 (s, Ar), 128.5 (s, Ar), 128.4 (s, Ar), 127.3 (s, Ar), 123.7 (s, Ar), 123.0 (s, Ar), 21.0 (s, *C*H$_3$).



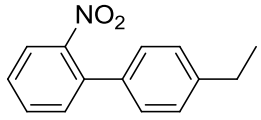
3-(4-(trifluoromethyl)phenyl)pyridine.[21] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.83 (s, 1 H, Ar), 8.62 (t, *J* = 4.0 Hz, 1 H, Ar) , 7.88 – 7.85 (m, 1 H, Ar), 7.73 – 7.66 (m, 4 H, Ar), 7.40 – 7.37 (m, 1 H, Ar). ^{19}F NMR (376 MHz, $CDCl_3$): δ -64.0 (s). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.7 (s, Ar), 147.6 (s, Ar), 140.6 (s, Ar), 134.4 (s, Ar), 133.7 (s, Ar), 129.7 – 129.0 (m, 1 C, *C*F$_3$), 126.7 (s, Ar), 125.3 (s, Ar), 124.5 (s, Ar), 123.0 (s, Ar), 21.3 (s, *C*H$_3$).



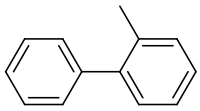
3'-methoxy-2-nitro-1,1'-biphenyl.[2] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.05 (d, *J* = 4.0 Hz, 1 H, Ar), 7.99 (s, 1 H, Ar), 7.90 (d, *J* = 8.0 Hz, 1 H, Ar), 7.62 (t, *J* = 8.0 Hz, 1 H, Ar), 7.52 – 7.41 (m, 4 H, Ar), 3.91 (s, 3 H, O*Me*). ^{13}C NMR (100 MHz, $CDCl_3$): δ 166.3 (s, Ar), 148.7 (s, Ar), 137.7 (s, Ar), 135.3 (s, Ar), 132.5 (s, Ar), 132.1 (s, Ar), 131.8 (s, Ar), 130.4 (s, Ar), 129.1 (s, Ar), 128.9 (s, Ar), 128.6 (s, Ar), 124.2 (s, Ar), 52.1 (s, O*C*H$_3$).



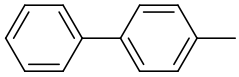
2-(2-nitrophenyl)furan.[10] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.70 – 7.64 (m, 2 H, Ar), 7.57 – 7.49 (m, 2 H, Ar), 7.38 (t, *J* = 8.0 Hz, 1 H, Ar), 6.64 (d, *J* = 8.0 Hz, 1 H, Ar), 6.48 (t, *J* = 2.0 Hz, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.2 (s, Ar), 147.3 (s, Ar), 143.6 (s, Ar), 131.7 (s, Ar), 128.7 (s, Ar), 128.1 (s, Ar), 123.9 (s, Ar), 123.6 (s, Ar), 111.7 (s, Ar), 109.5 (s, Ar).



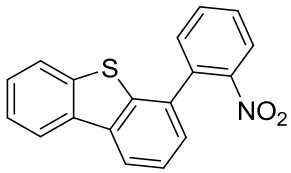
4'-ethyl-2-nitro-1,1'-biphenyl.[11] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.80 (d, *J* = 8.0 Hz, 1 H, Ar), 7.56 (t, *J* = 8.0 Hz, 1 H, Ar), 7.42 (t, *J* = 8.0 Hz, 2 H, Ar), 7.24 – 7.20 (m, 4 H, Ar), 2.72 – 2.66 (m, 2 H, C*H*$_2$), 1.27 (t, *J* = 8.0 Hz, 3 H, C*H*$_3$). ^{13}C NMR (100 MHz, $CDCl_3$): δ 149.1 (s, Ar), 144.1 (s, Ar), 136.0 (s, Ar), 134.4 (s, Ar), 132.0 (s, Ar), 131.7 (s, Ar), 128.0 (s, Ar), 127.7 (s, Ar), 127.6 (s, Ar), 123.8 (s, Ar), 28.3 (s, *C*H$_2$), 15.2 (s, *C*H$_3$).



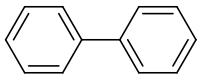
2-methyl-1,1'-biphenyl.[26] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.40 – 7.36 (m, 2 H, Ar), 7.33 – 7.29 (m, 3 H, Ar), 7.25 – 7.23 (m, 2 H, Ar), 7.22 – 7.21 (m, 2 H, Ar), 2.27 (s, 3 H, CH_3). ^{13}C NMR (100 MHz, $CDCl_3$): δ 141.8 (s, Ar), 141.8 (s, Ar), 135.1 (s, Ar), 130.2 (s, Ar), 129.7 (s, Ar), 129.0 (s, Ar), 127.9 (s, Ar), 127.1 (s, Ar), 126.6 (s, Ar), 125.7 (s, Ar), 20.3 (s, *C*H_3).



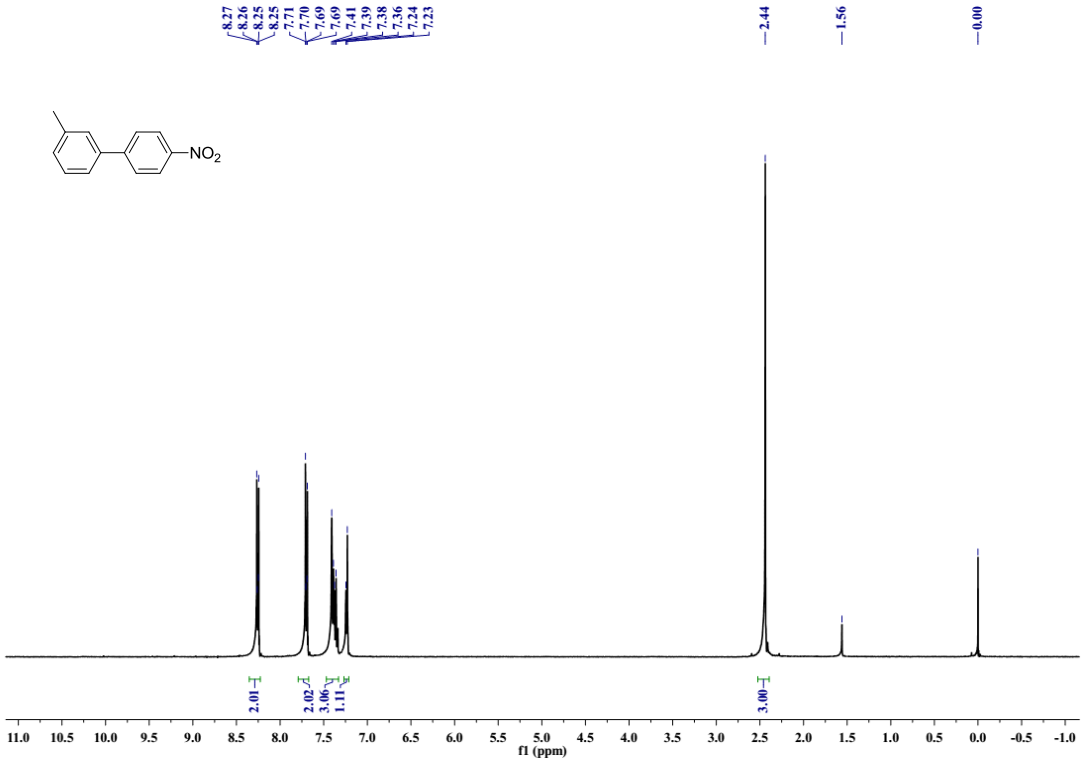
4-methyl-1,1'-biphenyl.[7] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.54 (d, *J* = 8.0 Hz, 2 H, Ar), 7.46 (d, *J* = 8.0 Hz, 2 H, Ar), 7.39 (t, *J* = 8.0 Hz, 2 H, Ar), 7.28 (t, *J* = 8.0 Hz, 1 H, Ar), 7.21 (t, *J* = 4.0 Hz, 2 H, Ar), 2.38 (s, 3 H, CH_3). ^{13}C NMR (100 MHz, $CDCl_3$): δ 141.0 (s, Ar), 138.2 (s, Ar), 136.8 (s, Ar), 129.4 (s, Ar), 128.6 (s, Ar), 126.8 (s, Ar), 21.0 (s, *C*H_3).



4-(2-nitrophenyl)dibenzo[b,d]thiophene.[23] ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.16 – 8.14 (m, 2 H, Ar), 8.05 (d, *J* = 8.0 Hz, 1 H, Ar), 7.74 (t, *J* = 4.0 Hz, 1 H, Ar), 7.70 – 7.66 (m, 1 H, Ar), 7.58 (t, *J* = 8.0 Hz, 2 H, Ar), 7.50 (t, *J* = 8.0 Hz, 1 H, Ar), 7.44 – 7.41 (m, 2 H, Ar), 7.30 – 7.28 (dd, *J* = 1.2 Hz, *J* = 0.8 Hz, 1 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 148.6 (s, Ar), 139.0 (s, Ar), 138.8 (s, Ar), 135.9 (s, Ar), 135.5 (s, Ar), 134.6 (s, Ar), 133.0 (s, Ar), 132.5 (s, Ar), 131.9 (s, Ar), 129.1 (s, Ar), 126.9 (s, Ar), 126.1 (s, Ar), 124.8 (s, Ar), 124.6 (s, Ar), 124.5 (s, Ar), 122.6 (s, Ar), 121.8 (s, Ar), 121.2 (s, Ar).



1,1'-biphenyl.[25] ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.57 (d, *J* = 8.0 Hz, 4 H, Ar), 7.41 (t, *J* = 8.0 Hz, 4 H, Ar), 7.34 – 7.29 (m, 2 H, Ar). ^{13}C NMR (100 MHz, $CDCl_3$): δ 141.1 (s, Ar), 128.7 (s, Ar), 127.2 (s, Ar), 127.1 (s, Ar).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8.25
8.25
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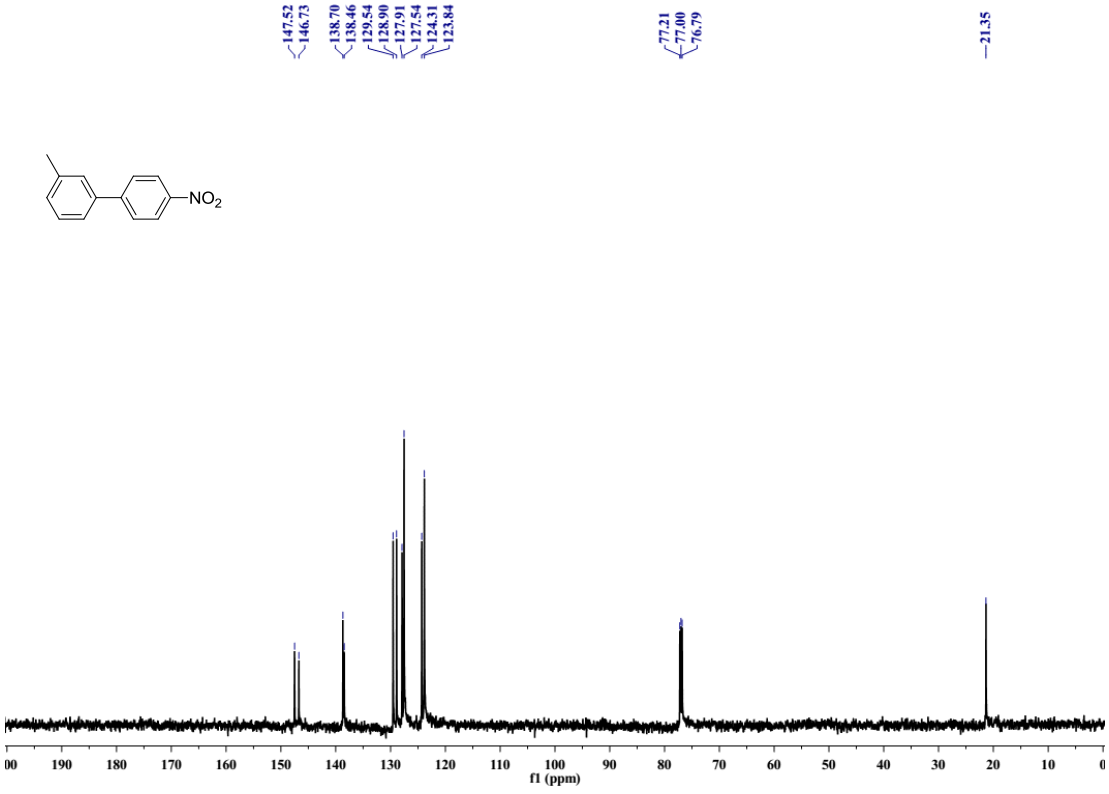
7.70
7.69
7.69
7.41
7.39
7.38
7.36
7.24
7.23
2.44
1.56
0.00
NO2
2.01
2.02
3.06
1.11
3.00
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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138.46
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128.90
127.91
127.54
124.31
123.84
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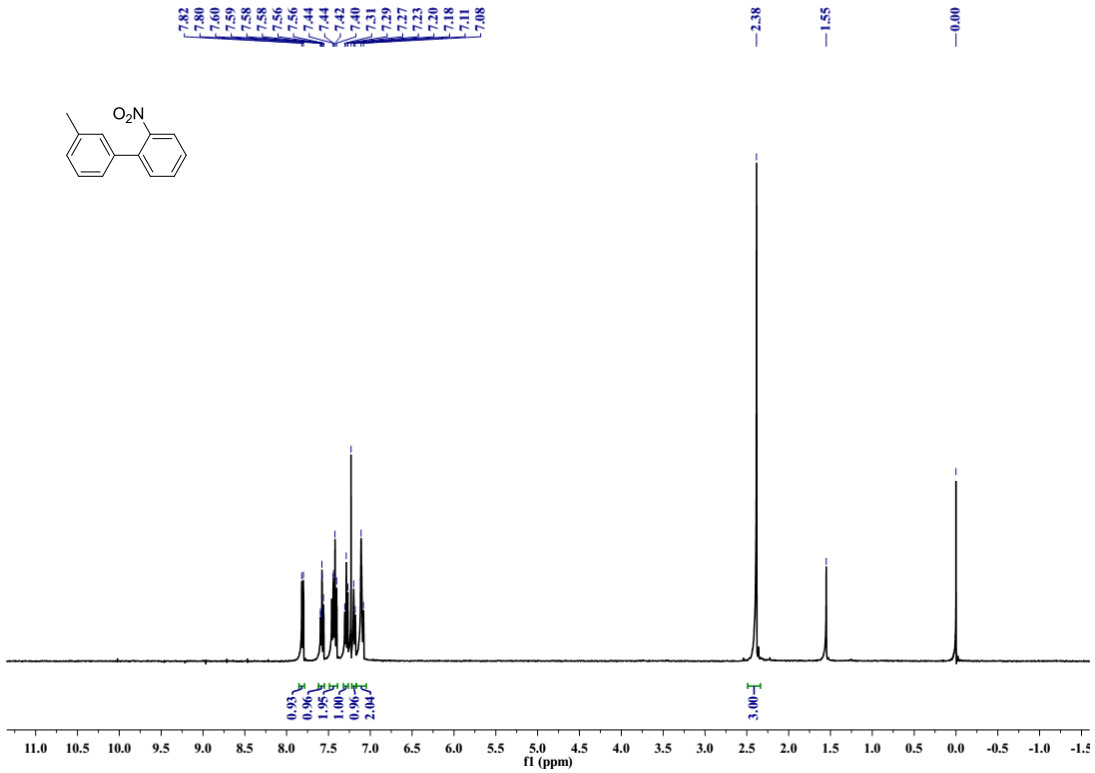
77.00
76.79
21.35
NO2
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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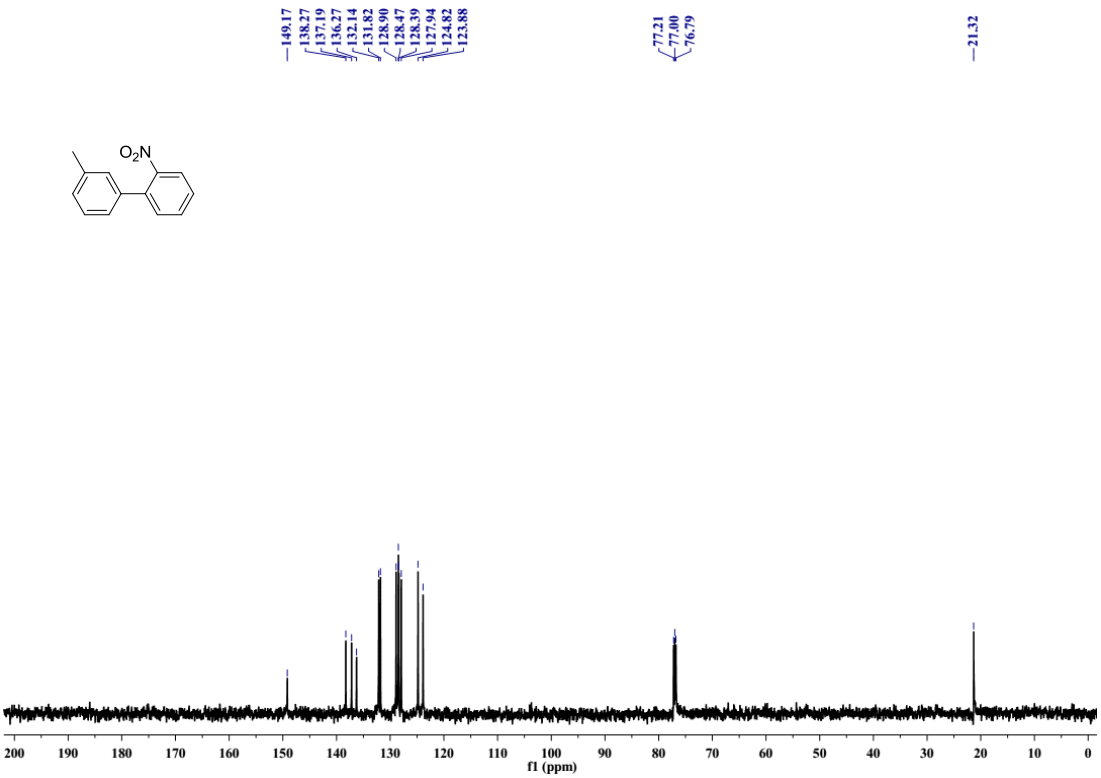
7.80
7.60
7.59
7.58
7.58
7.56
7.56
7.44
7.44
7.42
7.40
7.31
7.29
7.27
7.23
7.20
7.18
7.11
7.08
2.38
1.55
0.00
O2N
0.93
0.96
1.95
1.00
0.96
2.04
3.00
f1 (ppm)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137.19
136.27
132.14
131.82
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128.47
128.39
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124.82
123.88
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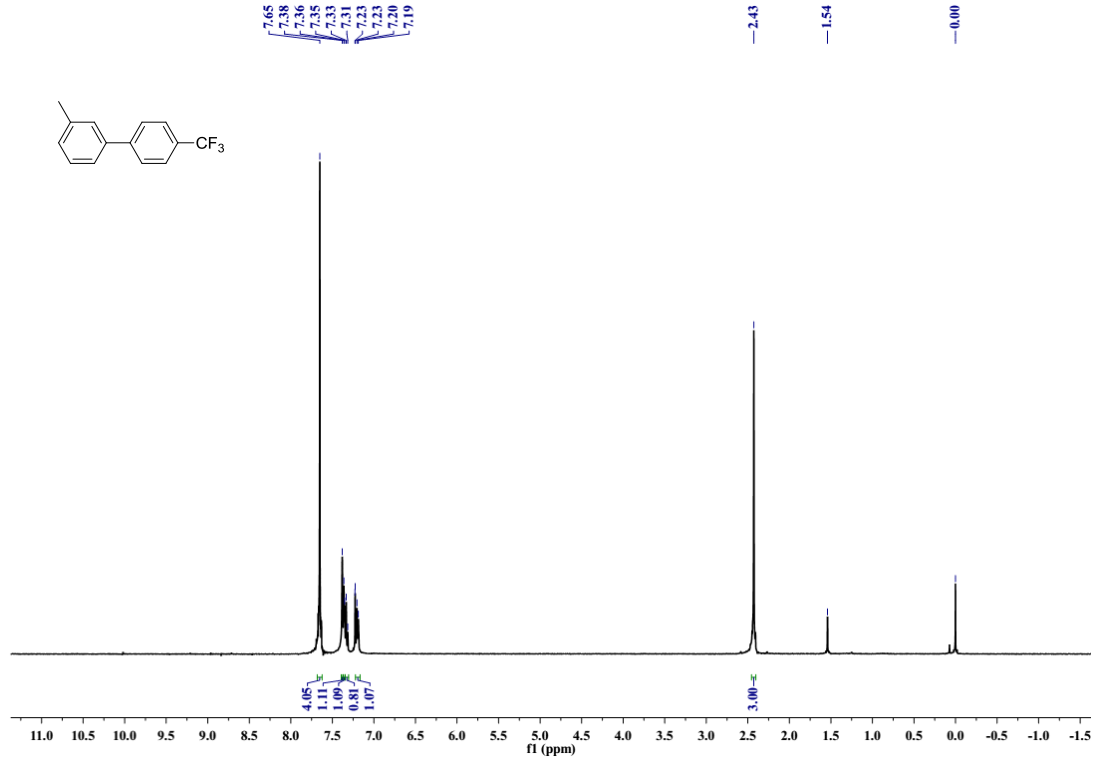
77.00
76.79
21.32
O2N
f1 (ppm)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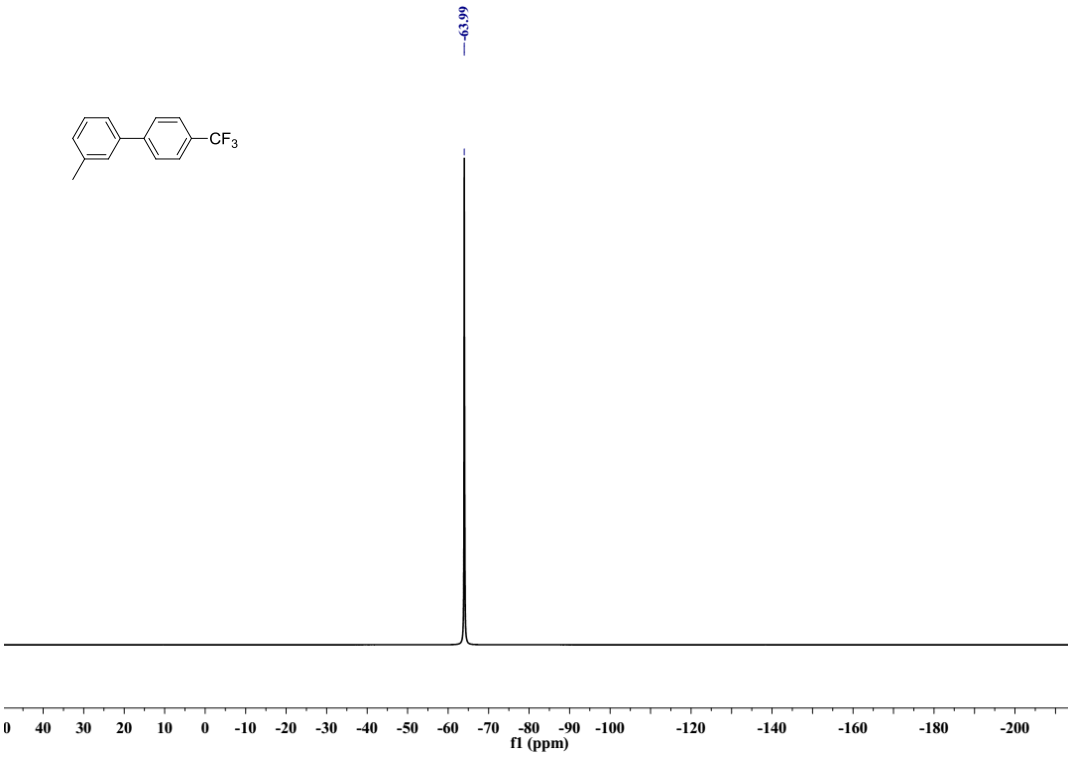
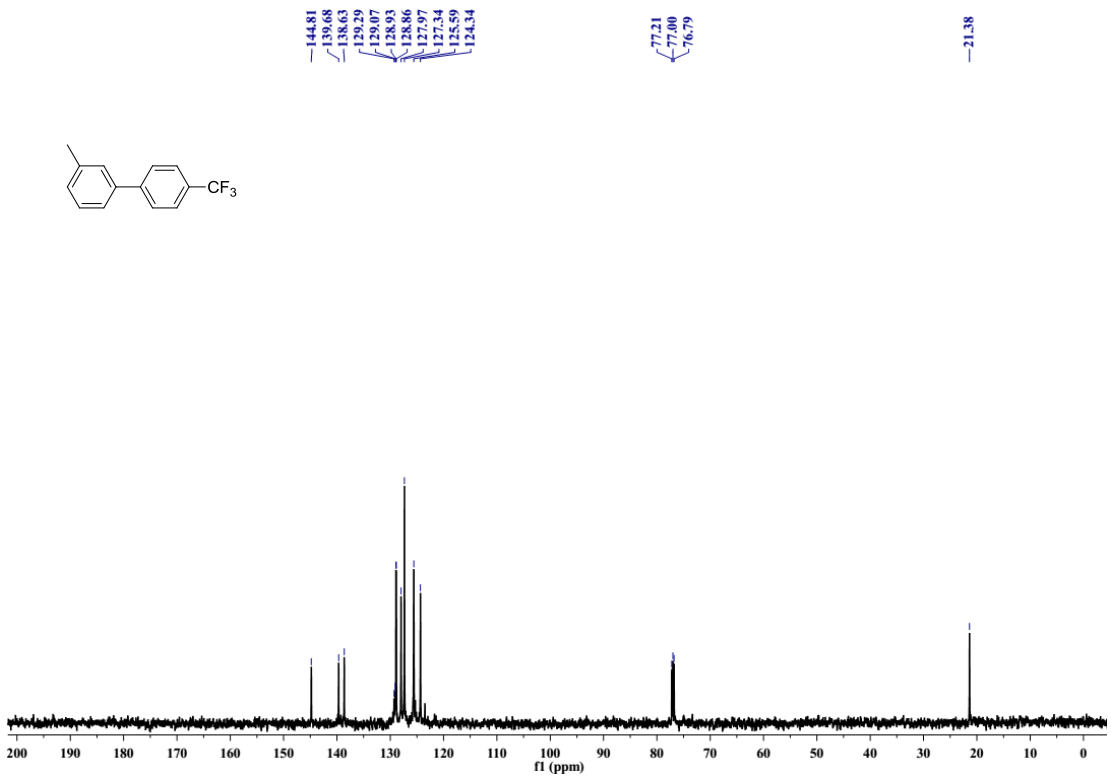
7.38
7.36
7.35
7.33
7.31
7.23
7.23
7.20
7.19
2.43
1.54
0.00
CF3
4.05
1.11
1.09
0.81
1.07
3.00
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5
f1 (ppm)


-63.99
CF3
0 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140 -160 -180 -200
f1 (ppm)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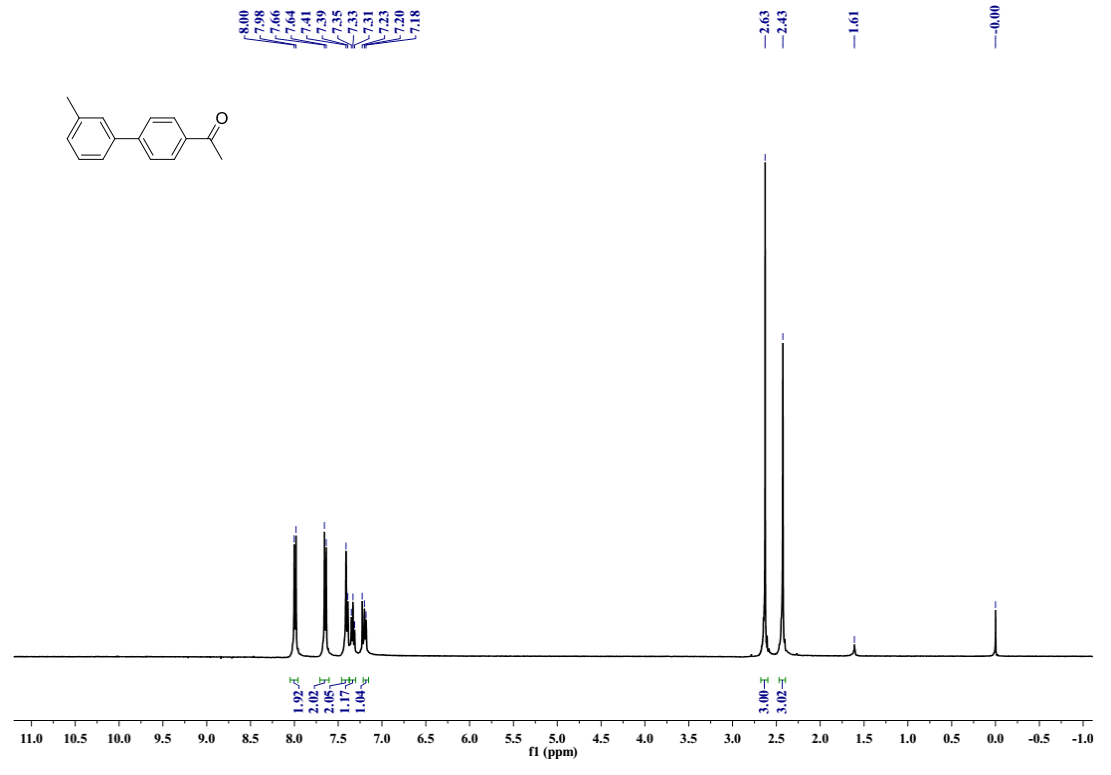
139.68
138.63
129.29
129.07
128.93
128.86
127.97
127.34
125.59
124.34
77.21
77.00
76.79
21.38
CF3
f1 (ppm)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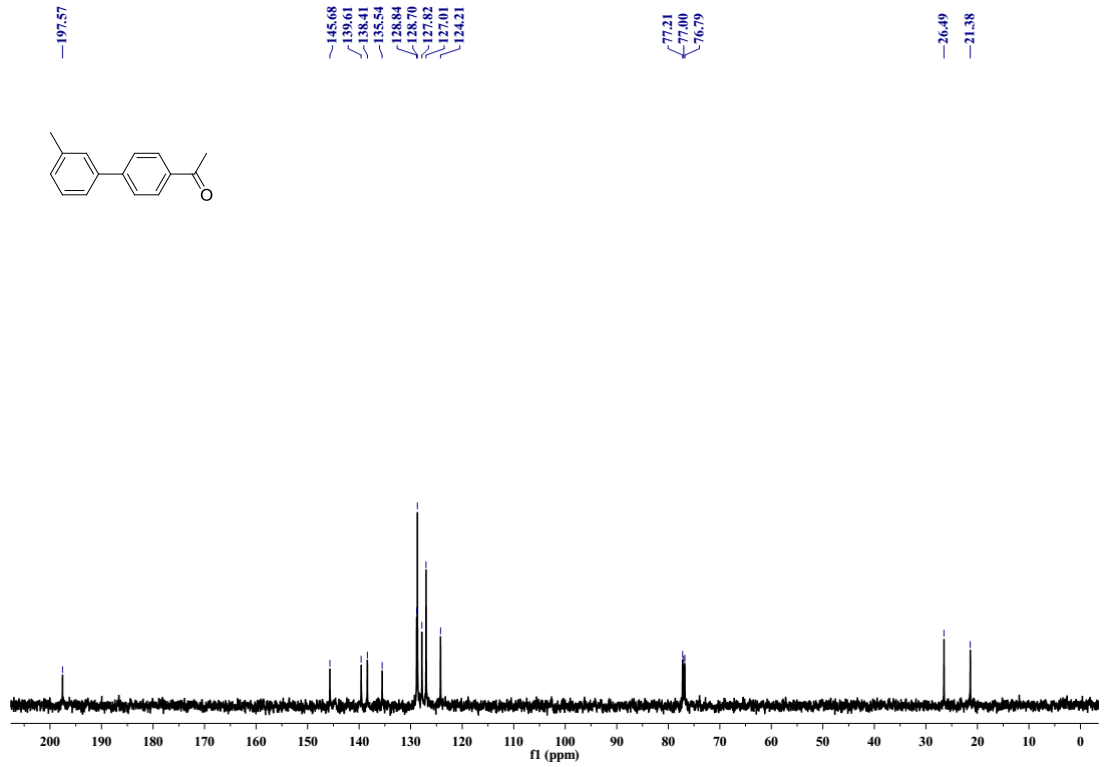
7.66
7.64
7.41
7.39
7.35
7.33
7.31
7.23
7.20
7.18
2.63
2.43
1.61
0.00
O
1.92
2.02
2.05
1.17
1.04
3.00
3.02
f1 (ppm)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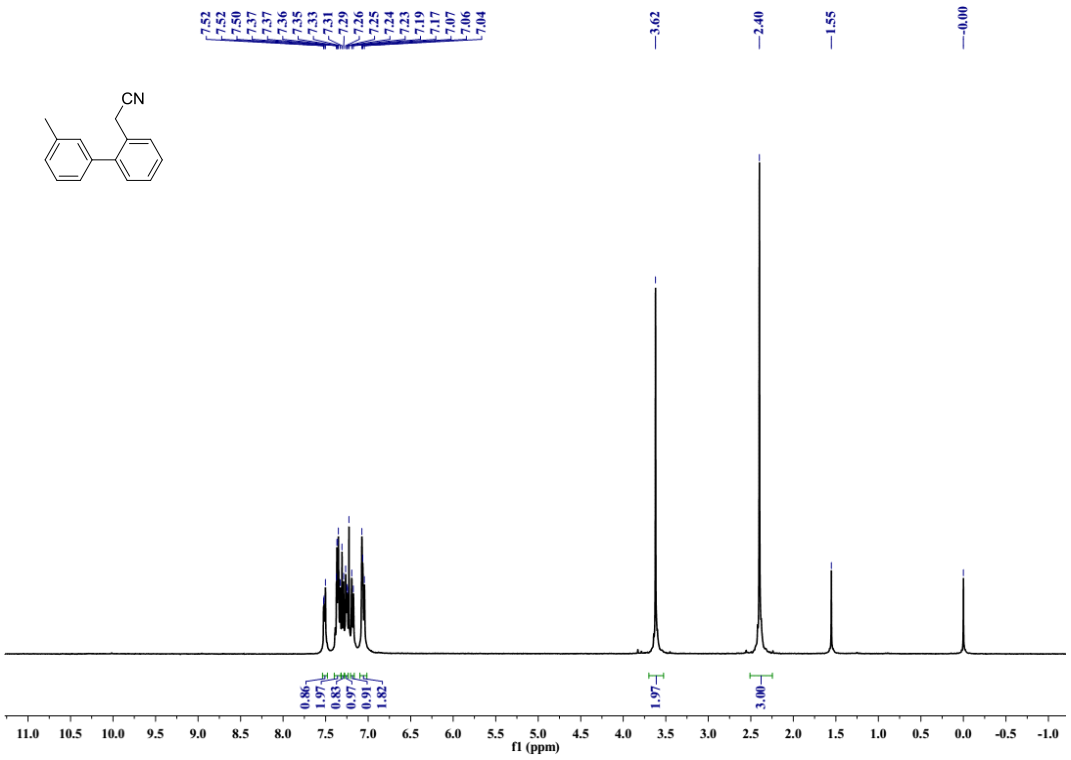
127.82
127.01
124.21
77.21
77.00
76.79
26.49
21.38
O
f1 (ppm)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7.50
7.37
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7.36
7.35
7.33
7.31
7.29
7.26
7.25
7.24
7.23
7.19
7.17
7.07
7.06
7.04
3.62
2.40
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CN
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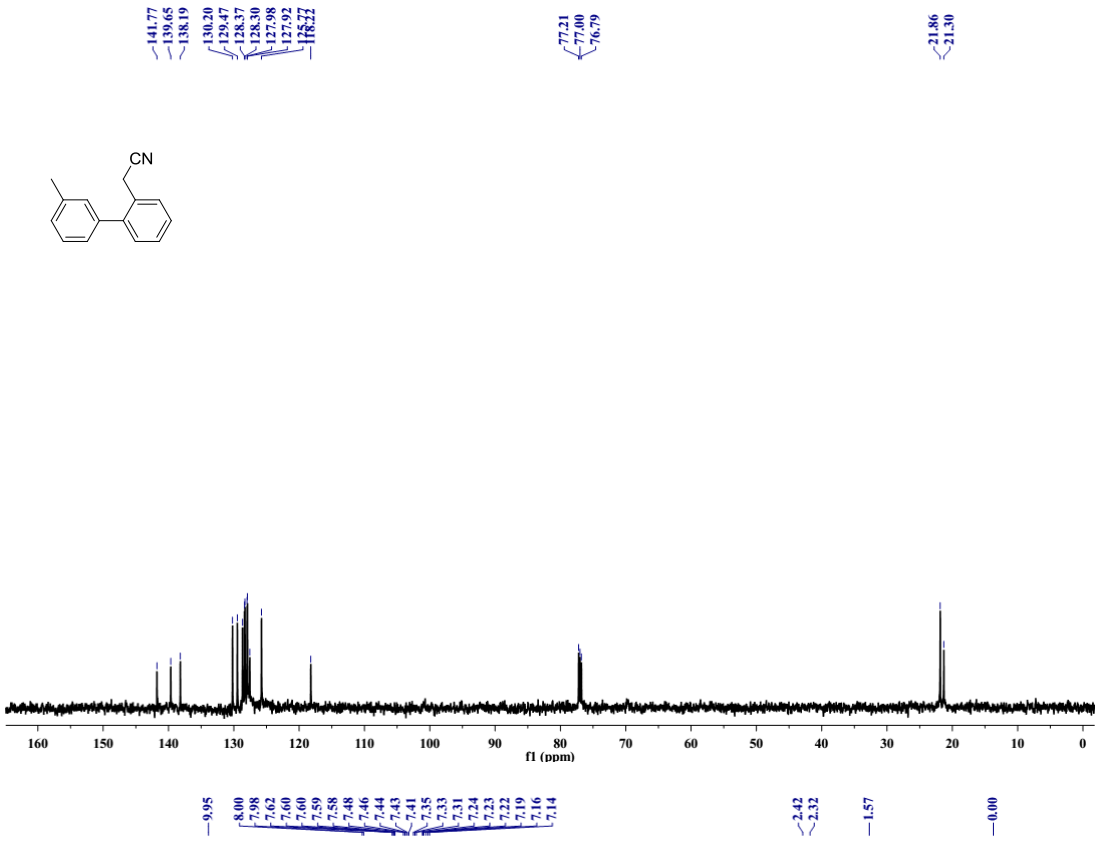
1.97
0.83
0.97
0.91
1.82
1.97
3.00
f1 (ppm)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128.30
127.98
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77.21
77.00
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21.86
21.30
CN
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)
9.95
8.00
7.98
7.62
7.60
7.60
7.59
7.58
7.48
7.46
7.44
7.43
7.41
7.35
7.33
7.31
7.24
7.23
7.22
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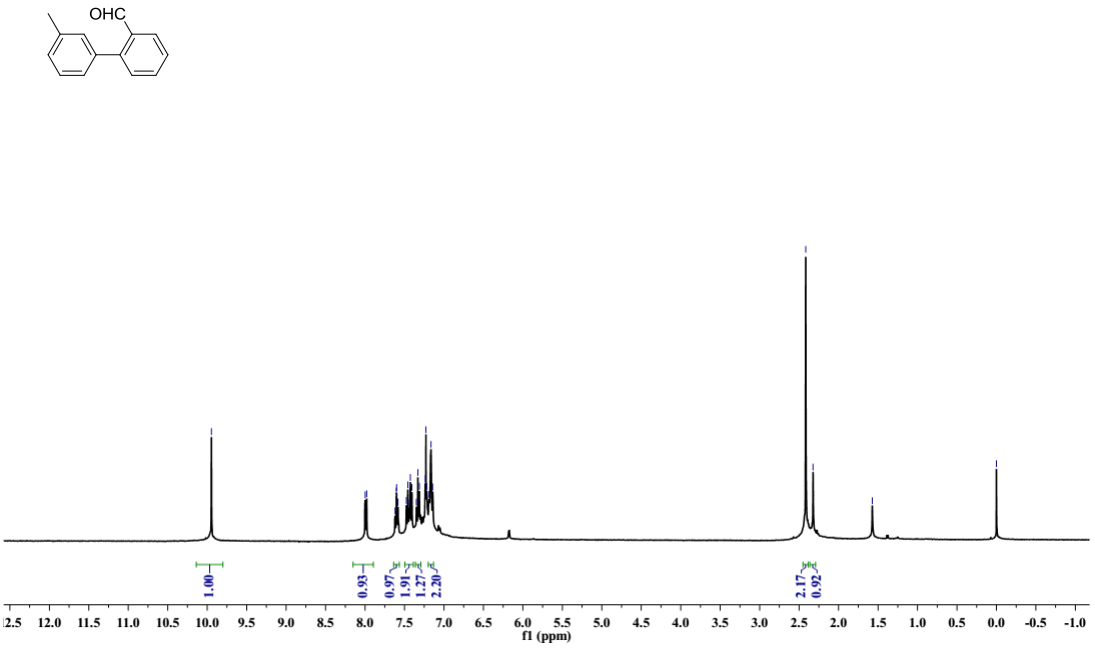
7.16
7.14
2.42
2.32
1.57
0.00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1.27
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2.17
0.92
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12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
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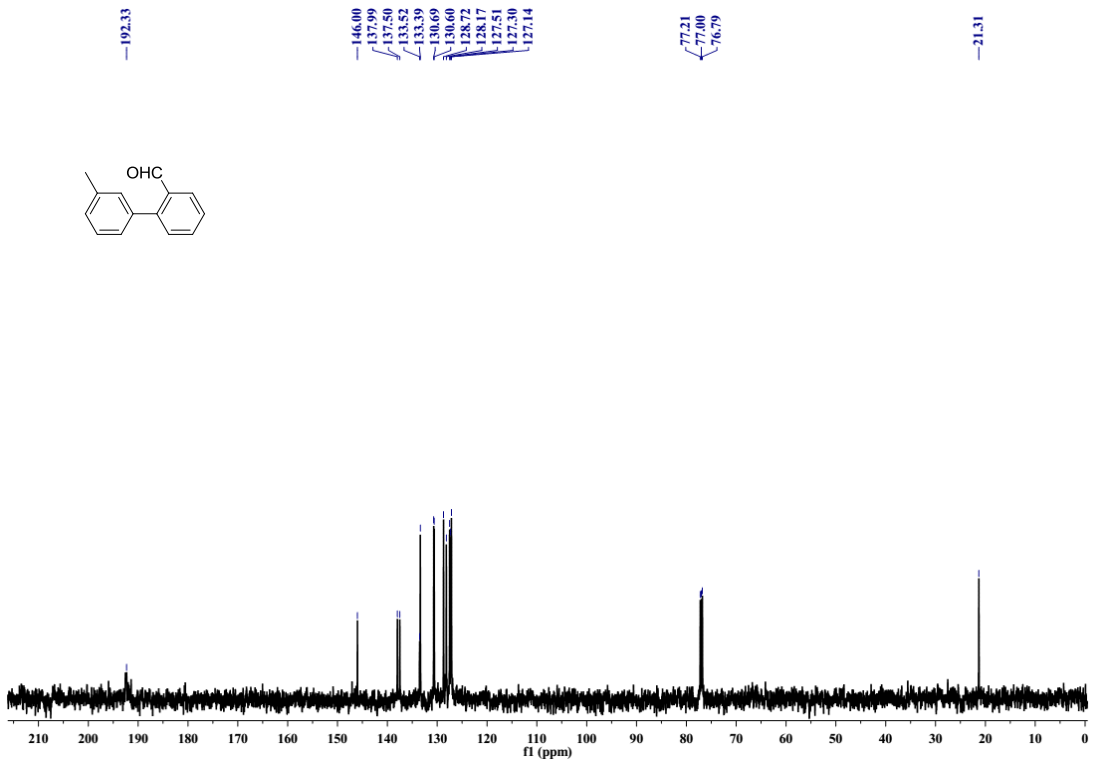
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)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137.50
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133.39
130.69
130.60
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127.51
127.30
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77.00
76.79
21.31
OHC
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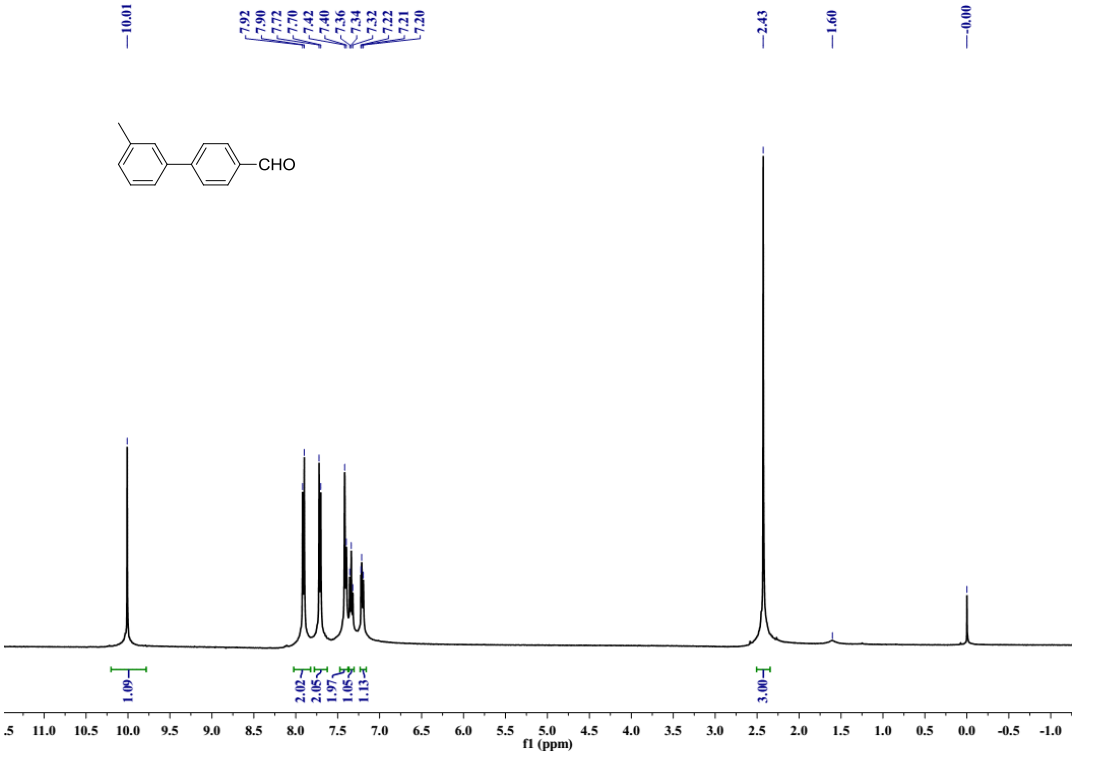
f1 (ppm)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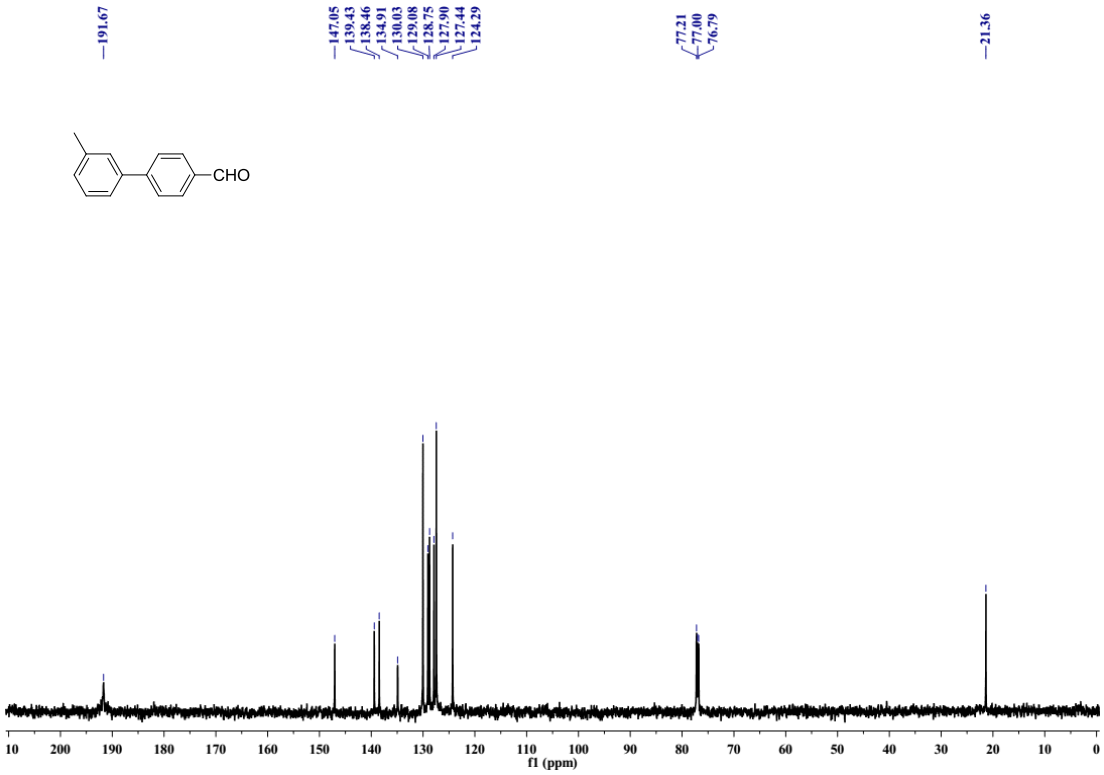
7.32
7.22
7.21
7.20
2.43
1.60
0.00
CHO
1.09
2.02
2.05
1.97
1.05
1.13
3.00
.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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124.29
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77.00
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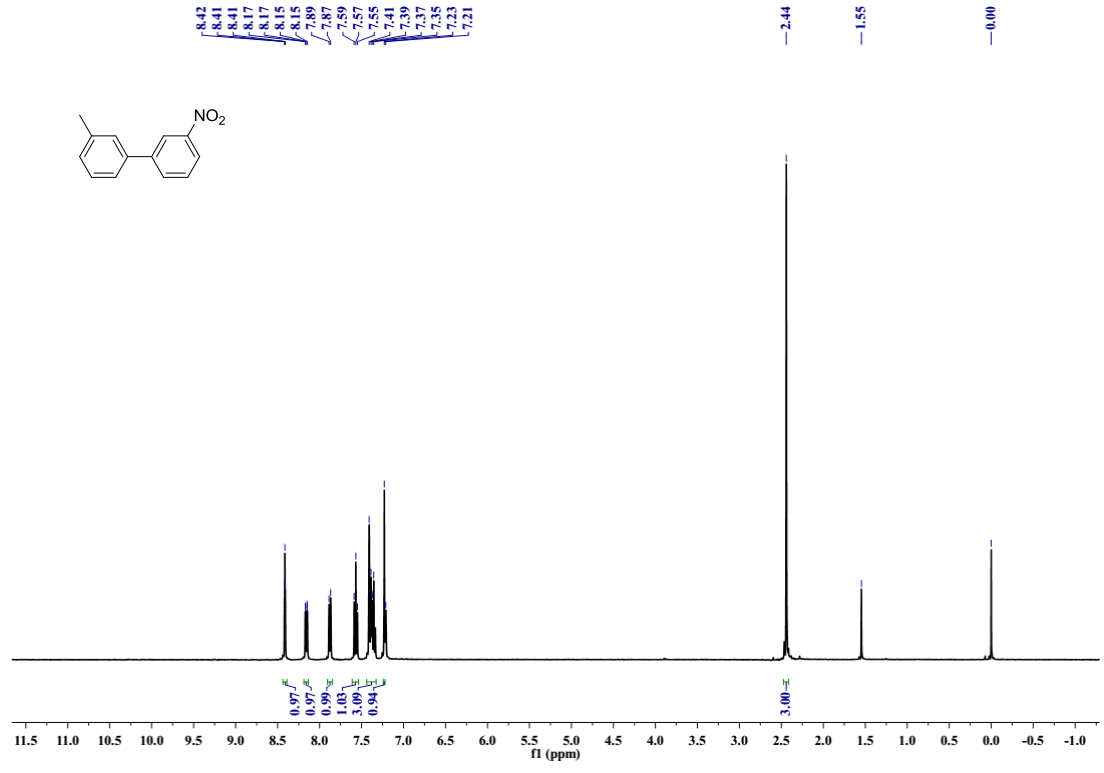
CHO
f1 (ppm)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7.41
7.39
7.37
7.35
7.23
7.21
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NO2
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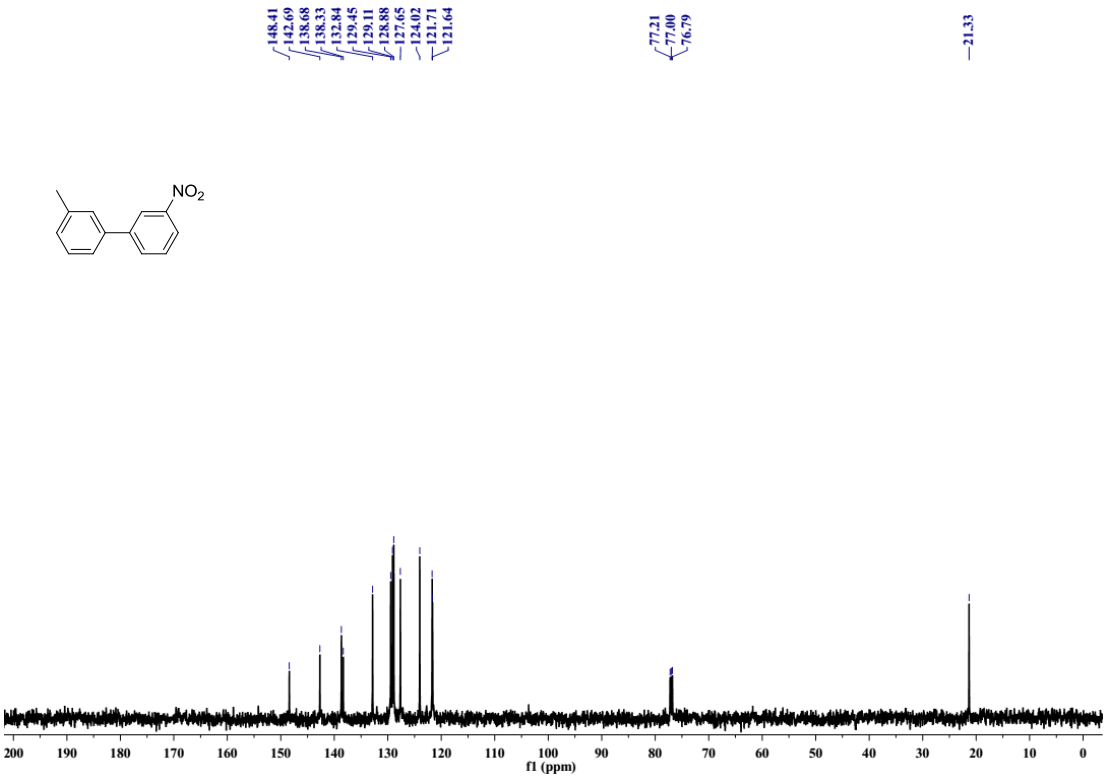
0.97
0.99
1.03
3.09
0.94
3.00
f1 (ppm)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124.02
121.71
121.64
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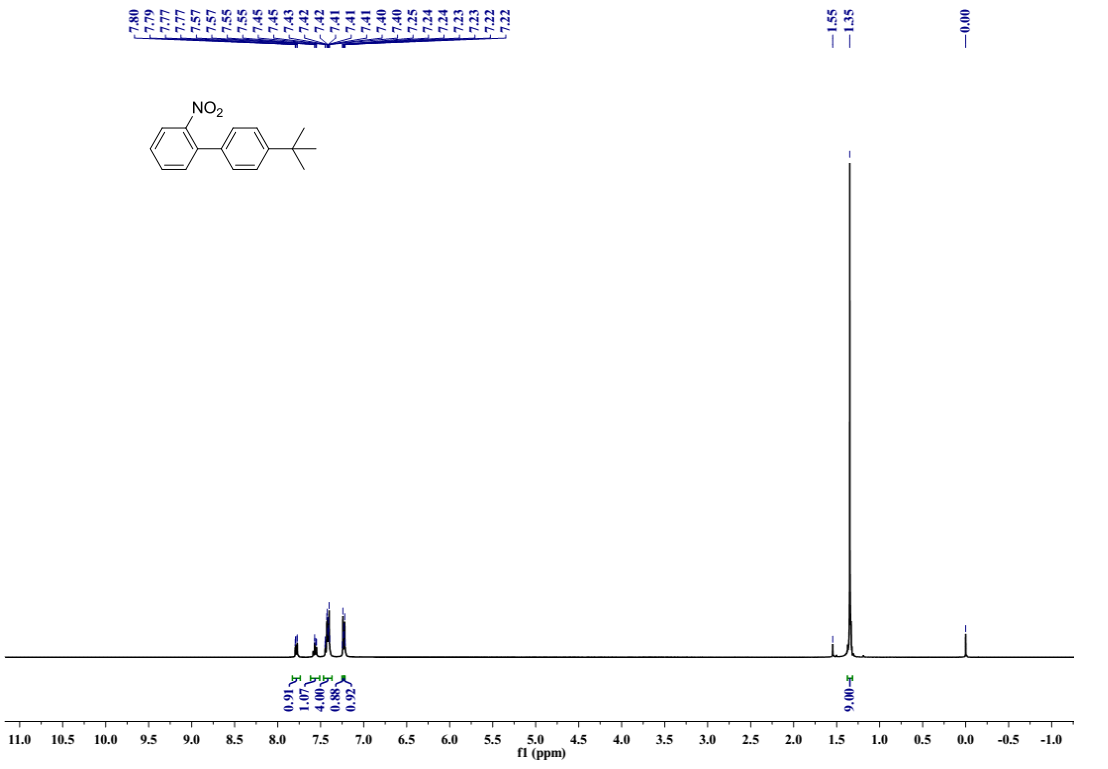
77.00
76.79
21.33
NO2
f1 (ppm)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7.40
7.25
7.24
7.24
7.23
7.23
7.22
7.22
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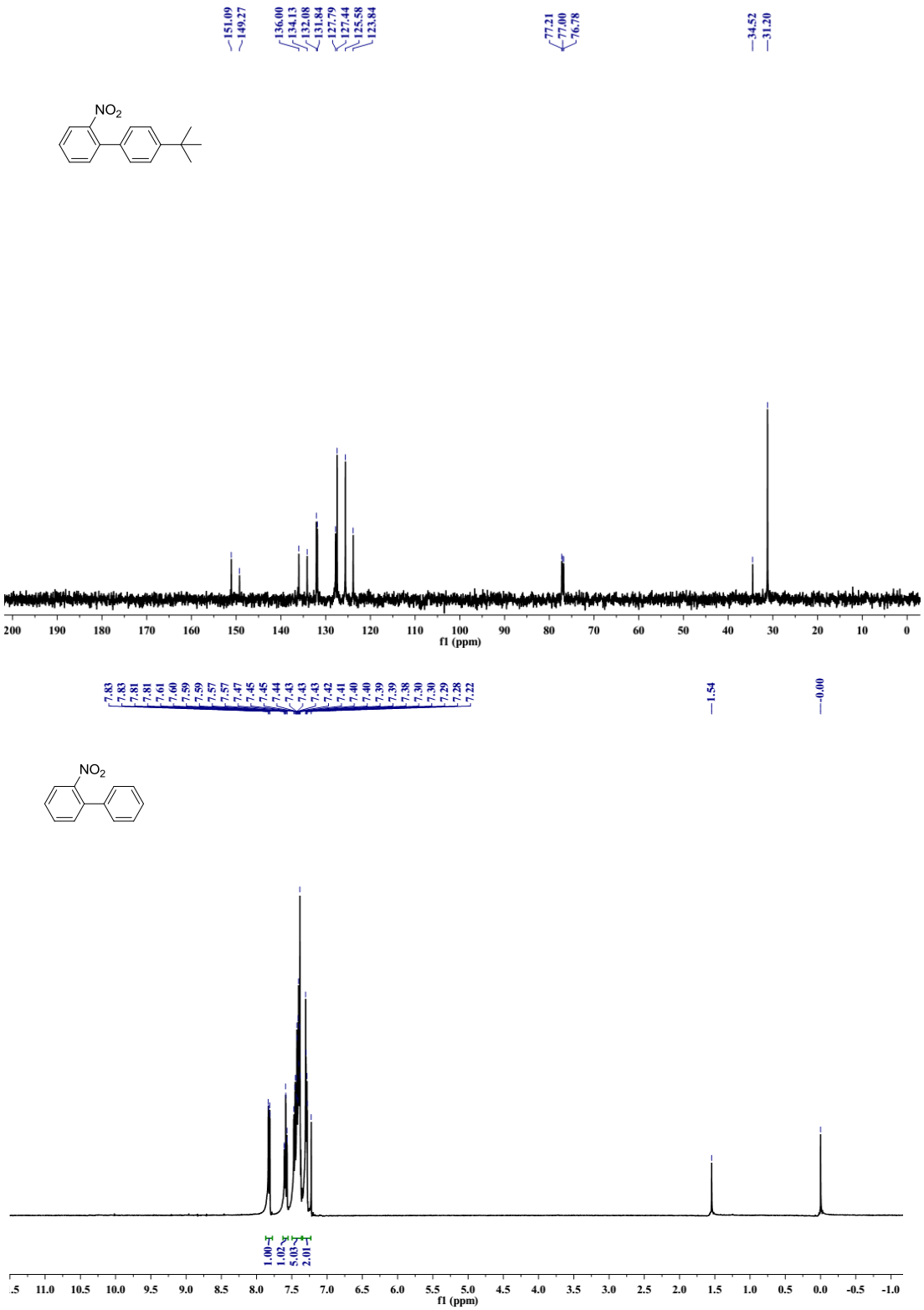
0.00
NO2
0.91
1.07
4.00
0.88
0.92
9.00
f1 (ppm)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132.08
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127.44
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123.84
77.21
77.00
76.78
34.52
31.20
NO2
f1 (ppm)
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7.83
7.81
7.81
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7.59
7.59
7.57
7.57
7.47
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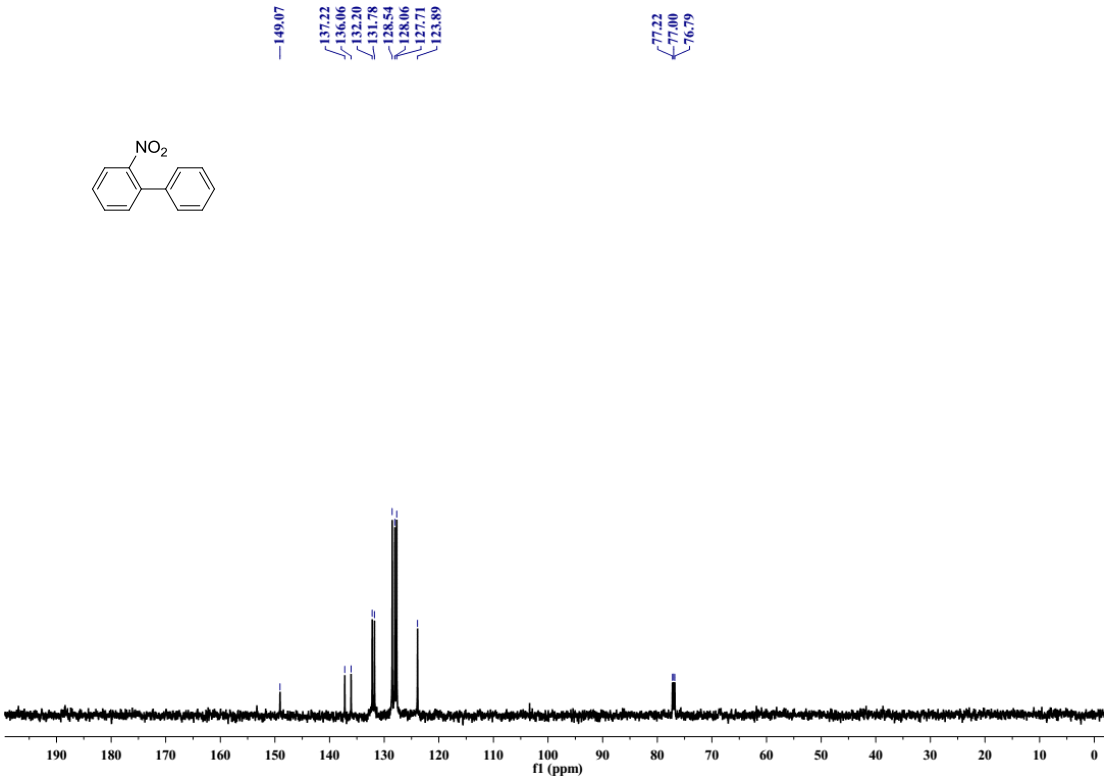
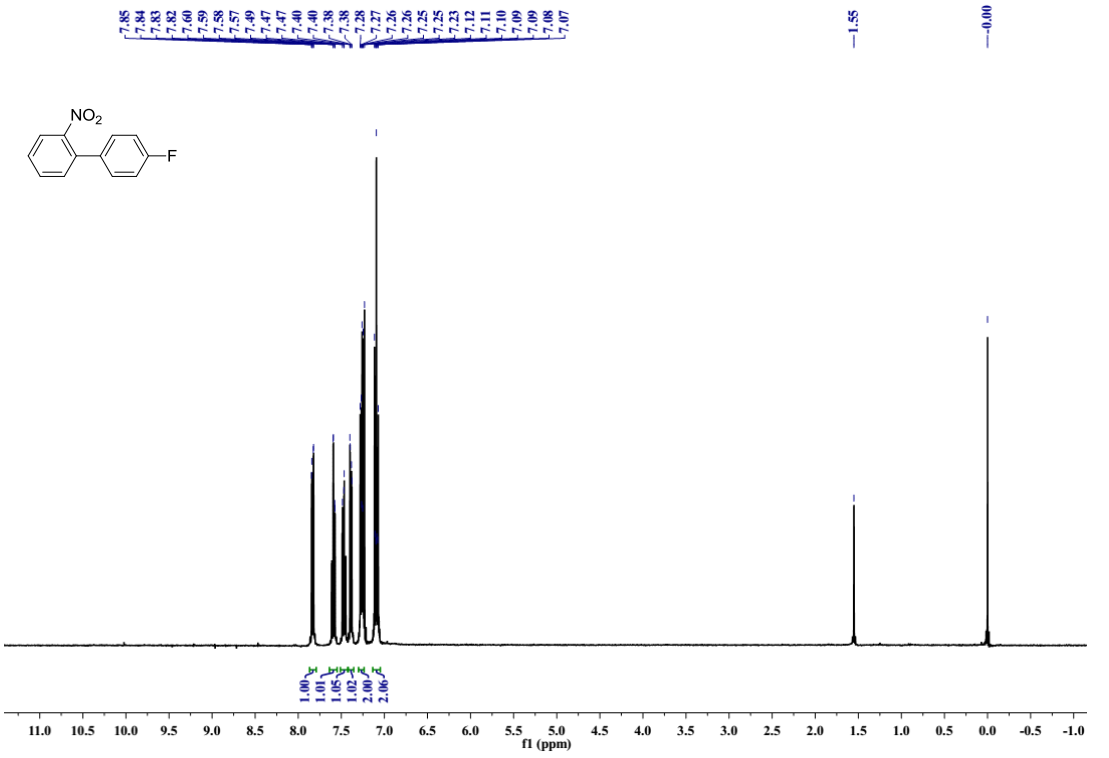
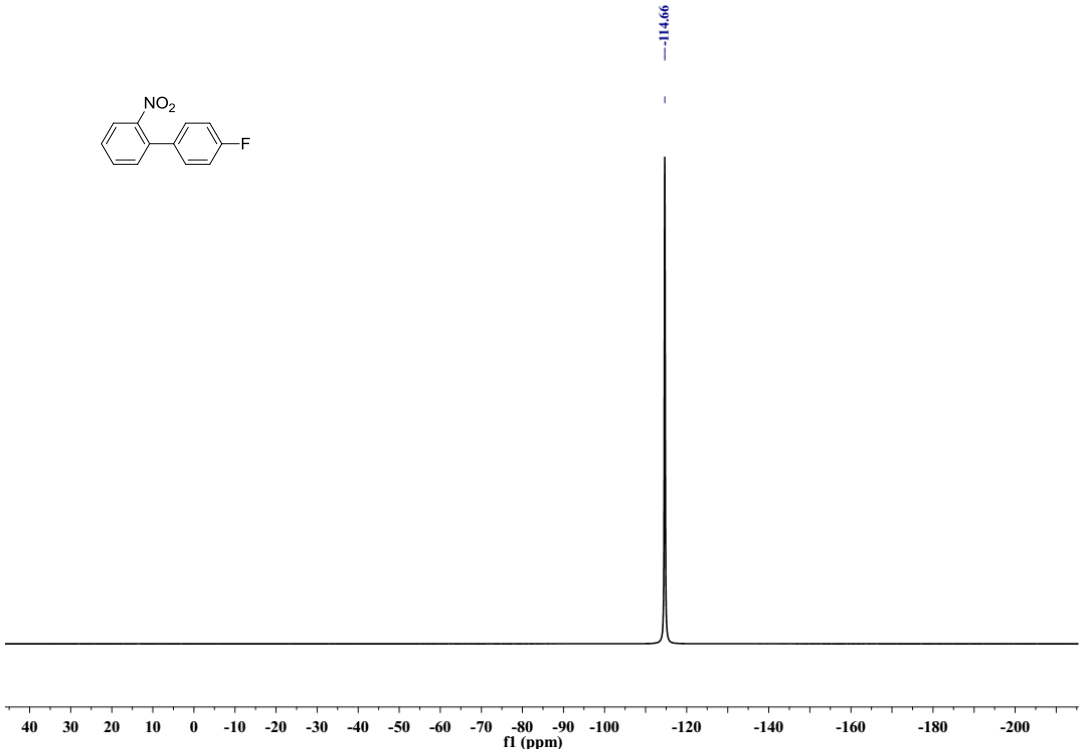
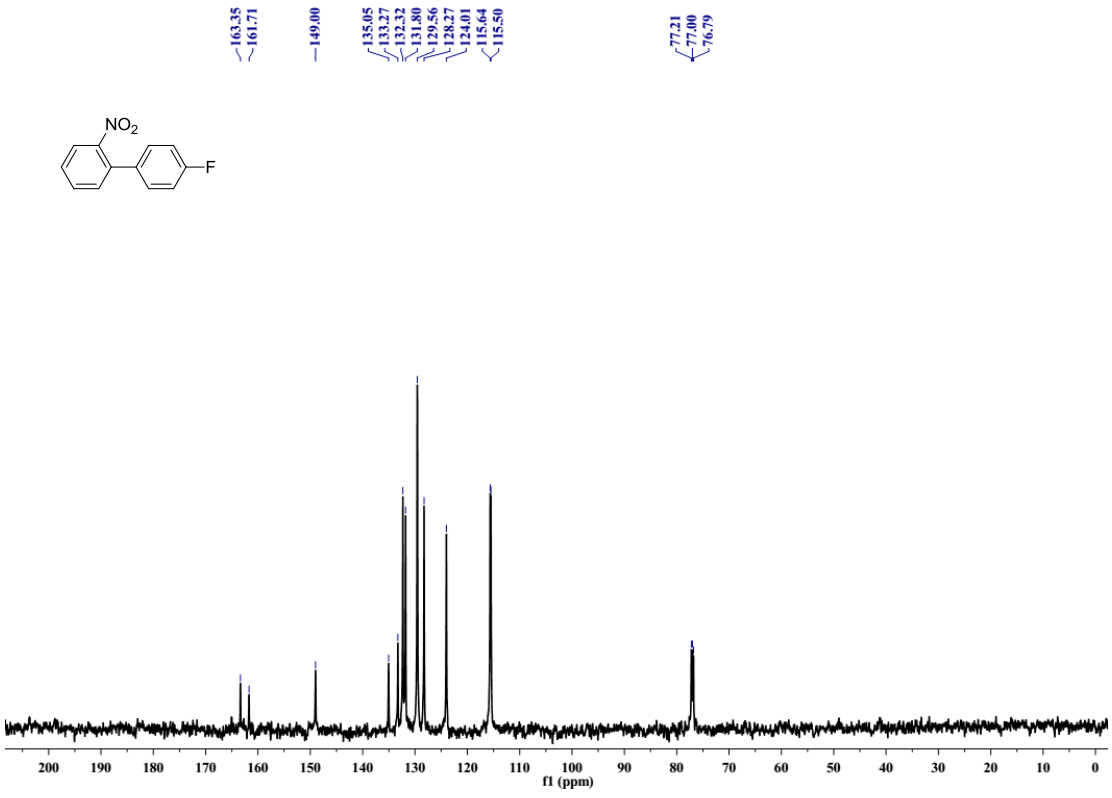
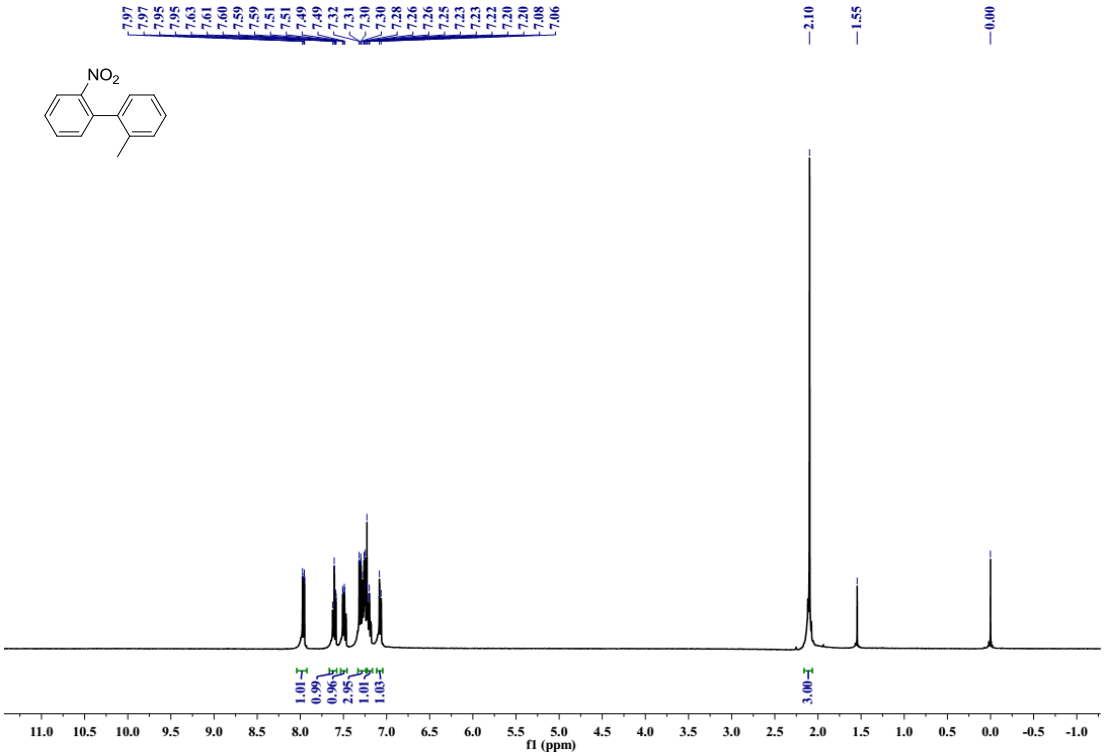
7.41
7.40
7.40
7.39
7.39
7.38
7.30
7.30
7.29
7.28
7.22
1.54
0.00
NO2
1.00
1.02
5.03
2.01
f1 (ppm)

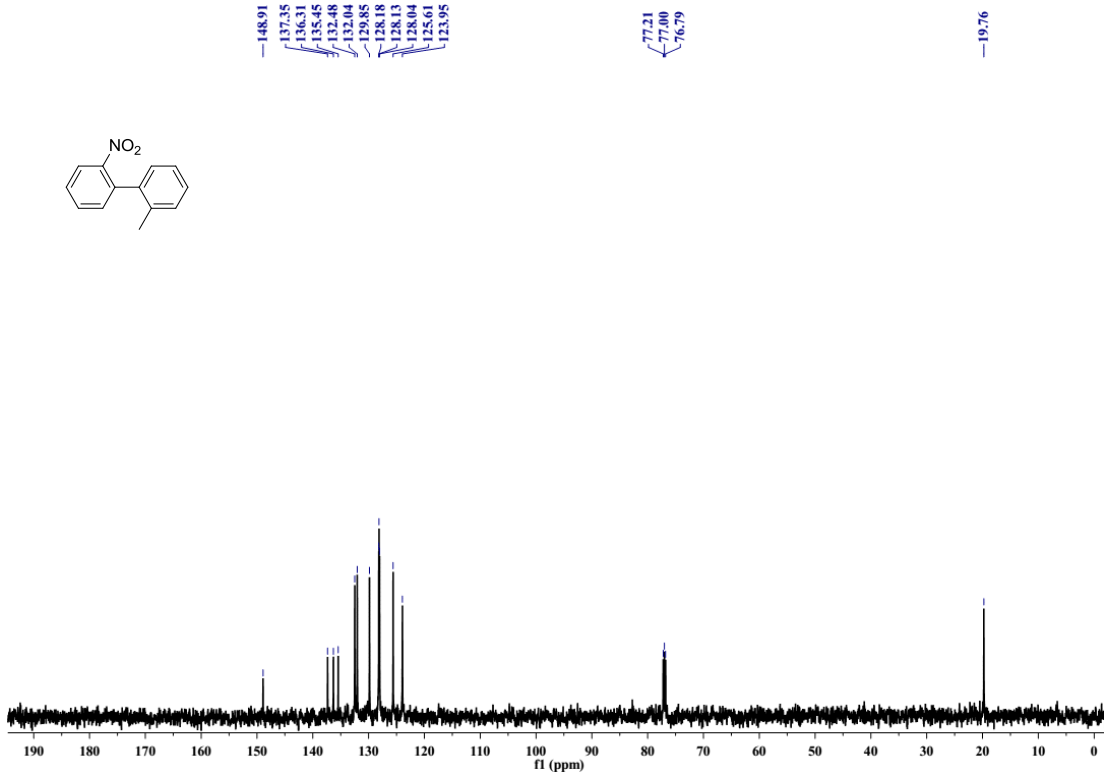

149.07
137.22
136.06
132.20
131.78
128.54
128.06
127.71
123.89
77.22
77.00
76.79
NO2
f1 (ppm)

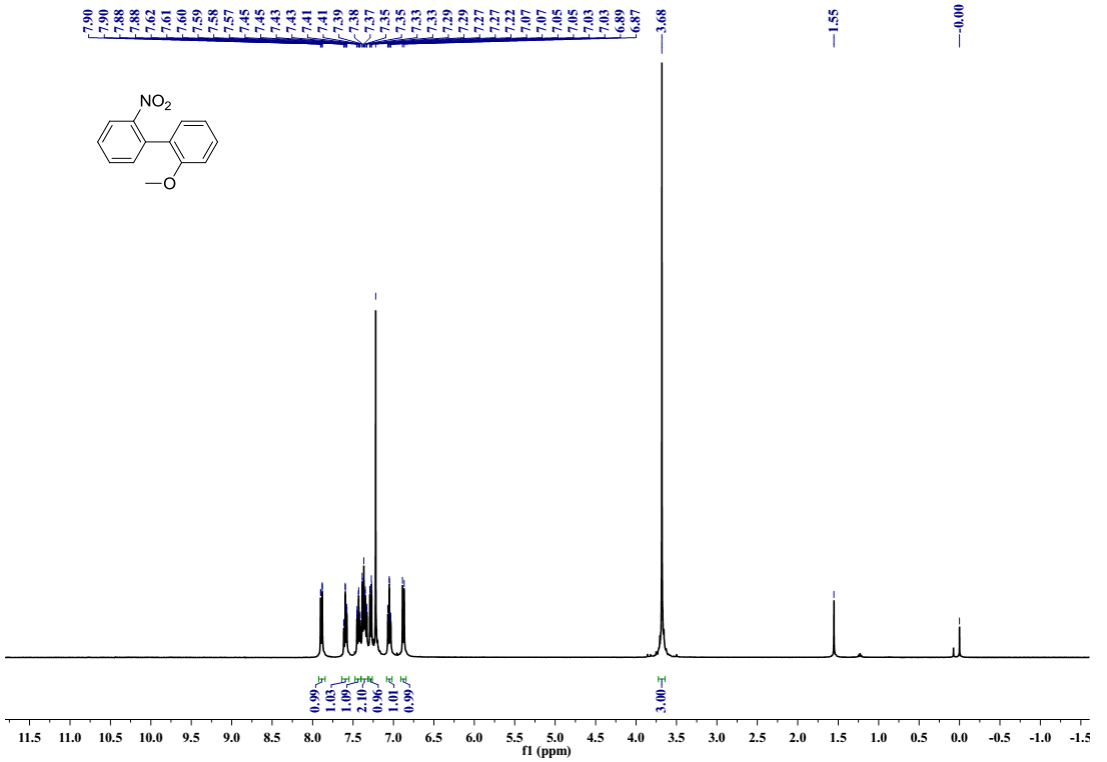

7.85
7.84
7.83
7.82
7.60
7.59
7.58
7.57
7.49
7.47
7.47
7.40
7.40
7.40
7.38
7.38
7.28
7.27
7.26
7.26
7.25
7.25
7.23
7.12
7.11
7.10
7.09
7.09
7.08
7.07
1.55
0.00
NO2
F
1.00
1.01
1.05
1.02
2.00
2.06
f1 (ppm)

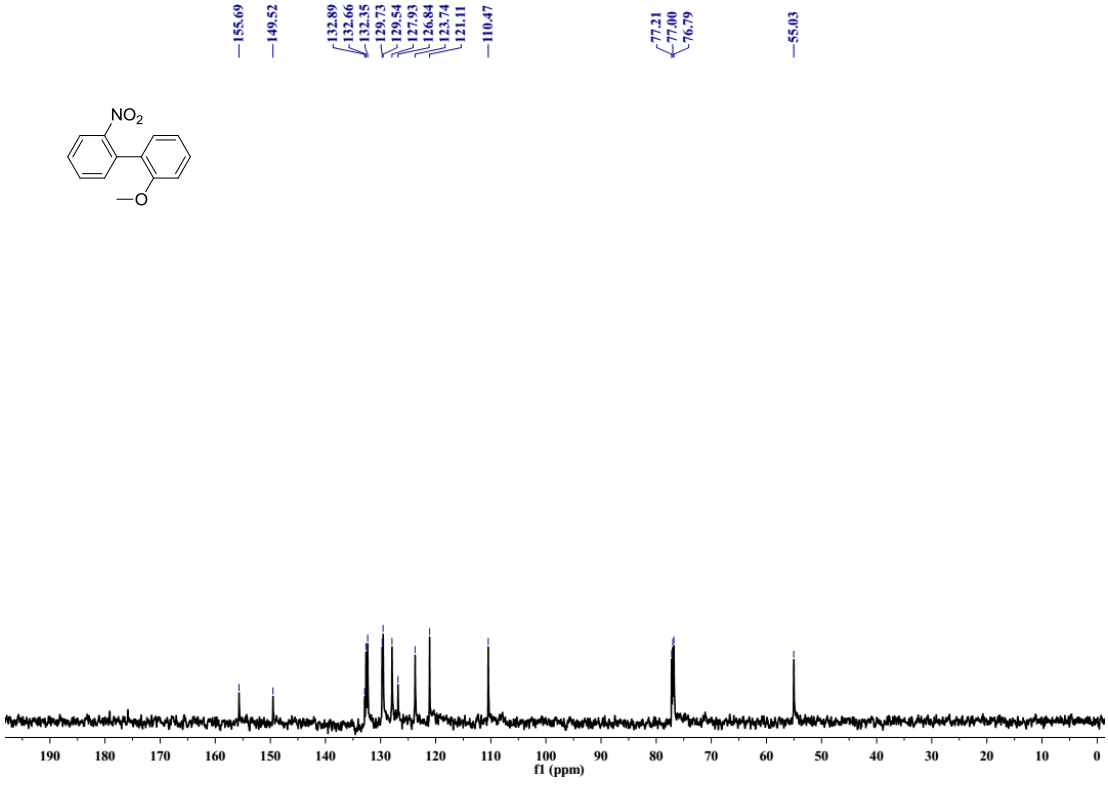

NO2
F
-114.66
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140 -160 -180 -200
f1 (ppm)

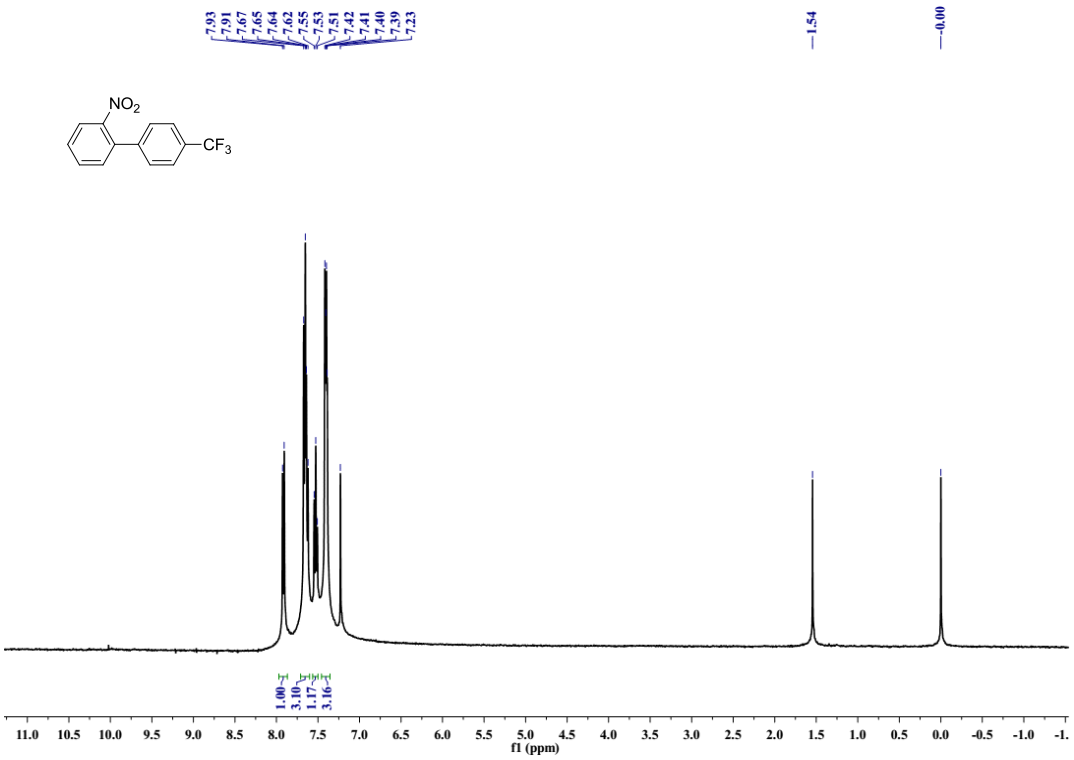

163.35
161.71
149.00
135.05
133.27
132.32
131.80
129.56
128.27
124.01
115.64
115.50
77.21
77.00
76.79
NO2
F
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

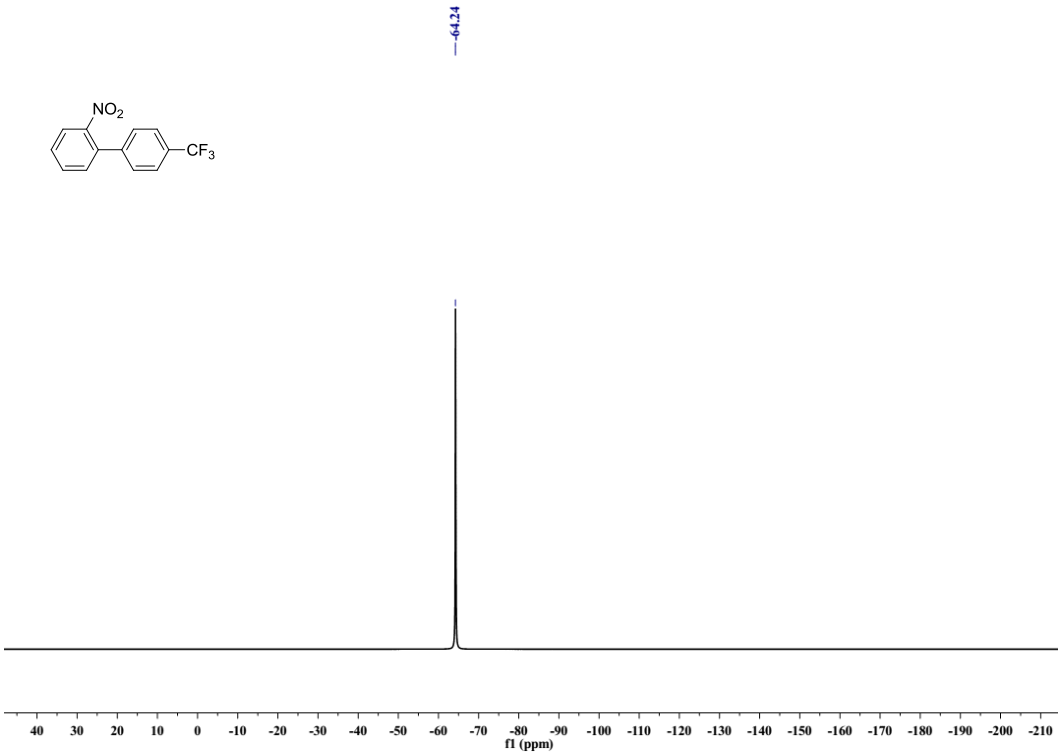

7.97
7.97
7.95
7.95
7.63
7.61
7.60
7.59
7.59
7.51
7.51
7.49
7.49
7.32
7.31
7.30
7.30
7.28
7.26
7.26
7.25
7.23
7.23
7.22
7.20
7.20
7.08
7.06
2.10
1.55
0.00
NO2
1.01
0.99
0.96
2.95
1.01
1.03
3.00
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

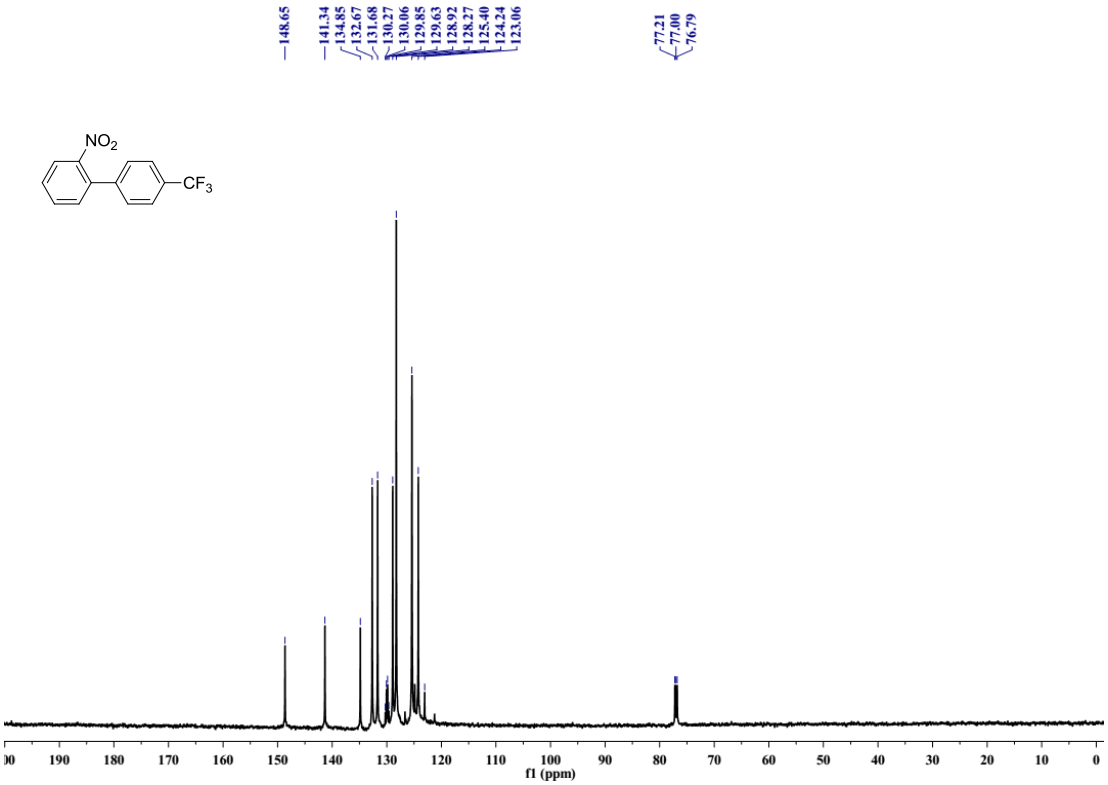

148.91
137.35
136.31
135.45
132.48
132.04
129.85
128.18
128.13
128.04
125.61
123.95
77.21
77.00
76.79
19.76
NO2
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

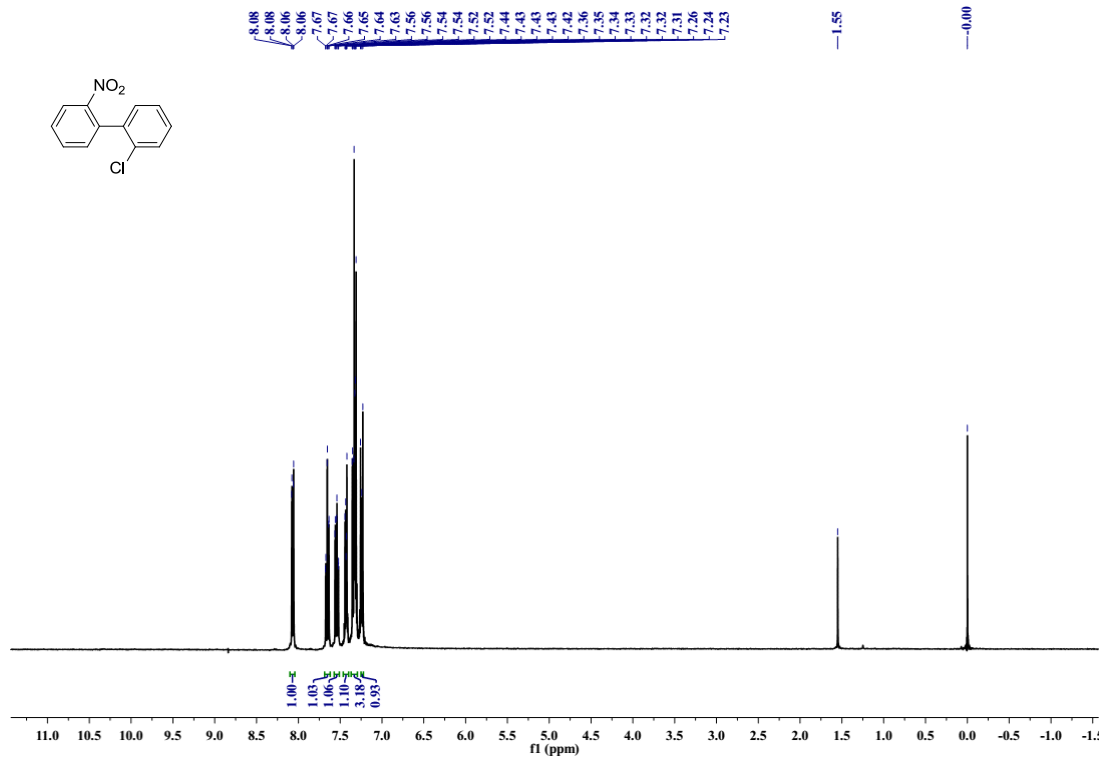

7.90
7.90
7.88
7.88
7.62
7.61
7.60
7.59
7.58
7.57
7.45
7.45
7.43
7.43
7.41
7.41
7.39
7.38
7.37
7.35
7.35
7.33
7.33
7.29
7.29
7.27
7.27
7.22
7.07
7.07
7.05
7.05
7.03
7.03
6.89
6.87
3.68
1.55
0.00
NO2
O
0.99
1.03
1.09
2.10
0.96
1.01
0.99
3.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5
f1 (ppm)

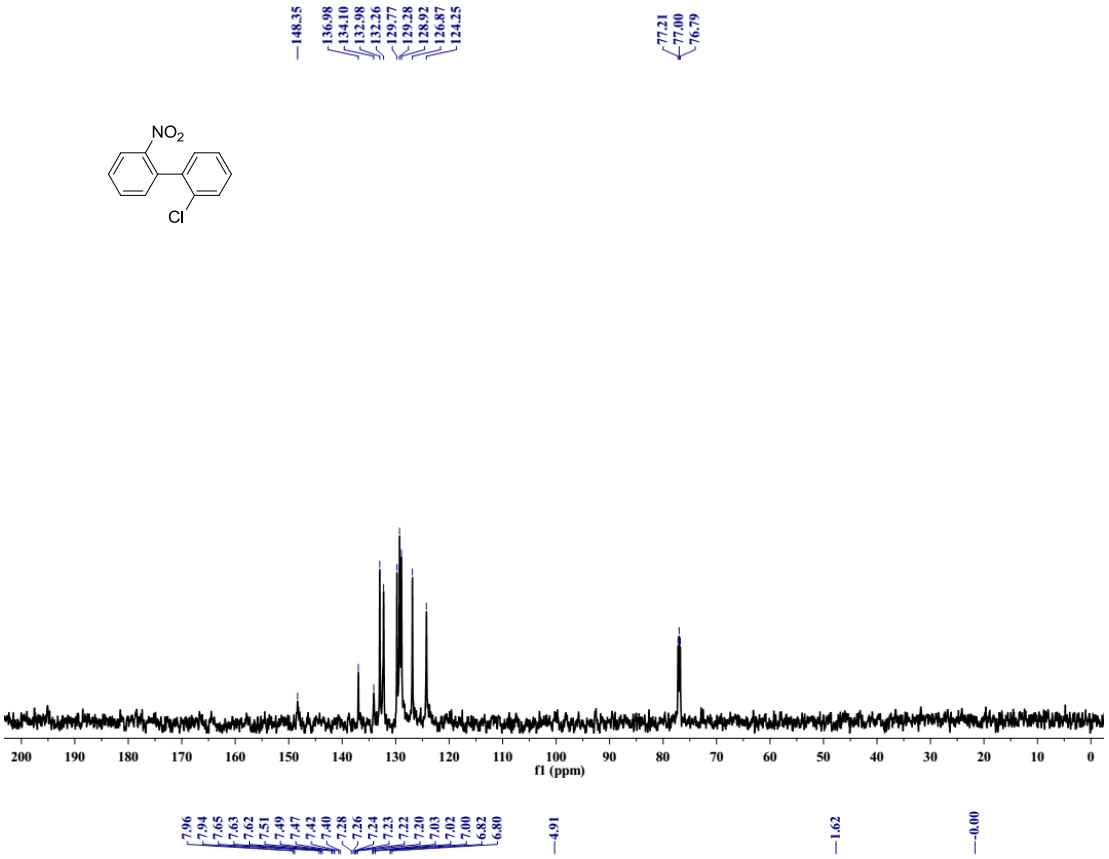

155.69
149.52
132.89
132.66
132.35
129.73
129.54
127.93
126.84
123.74
121.11
110.47
77.21
77.00
76.79
55.03
NO2
O
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

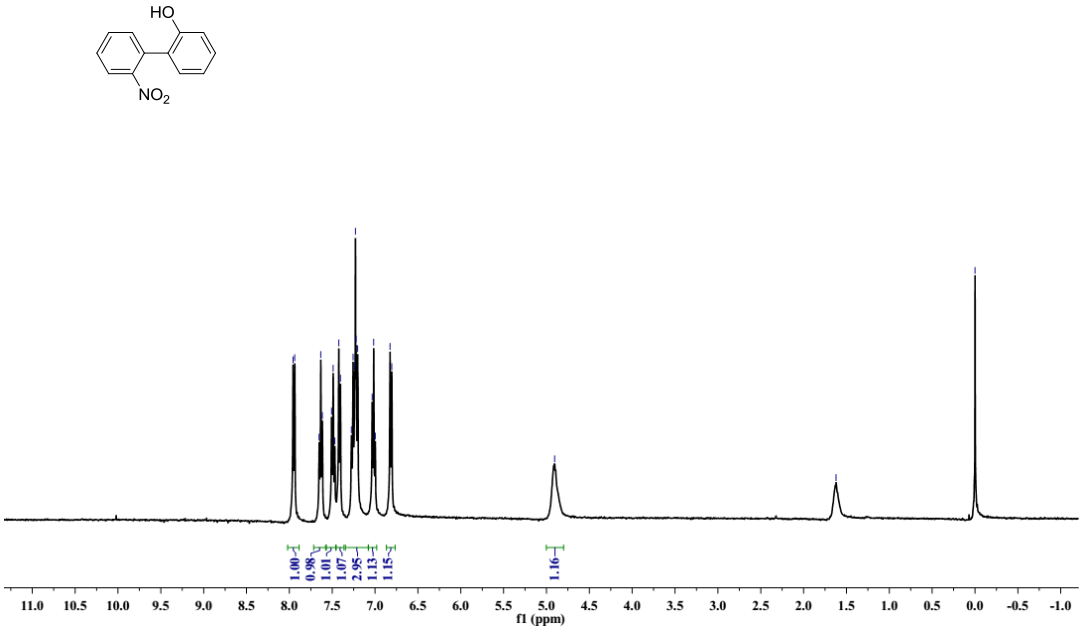

7.93
7.91
7.67
7.65
7.64
7.62
7.55
7.53
7.51
7.42
7.41
7.40
7.39
7.23
1.54
0.00
NO2
CF3
1.00
3.10
1.17
3.16
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.
f1 (ppm)

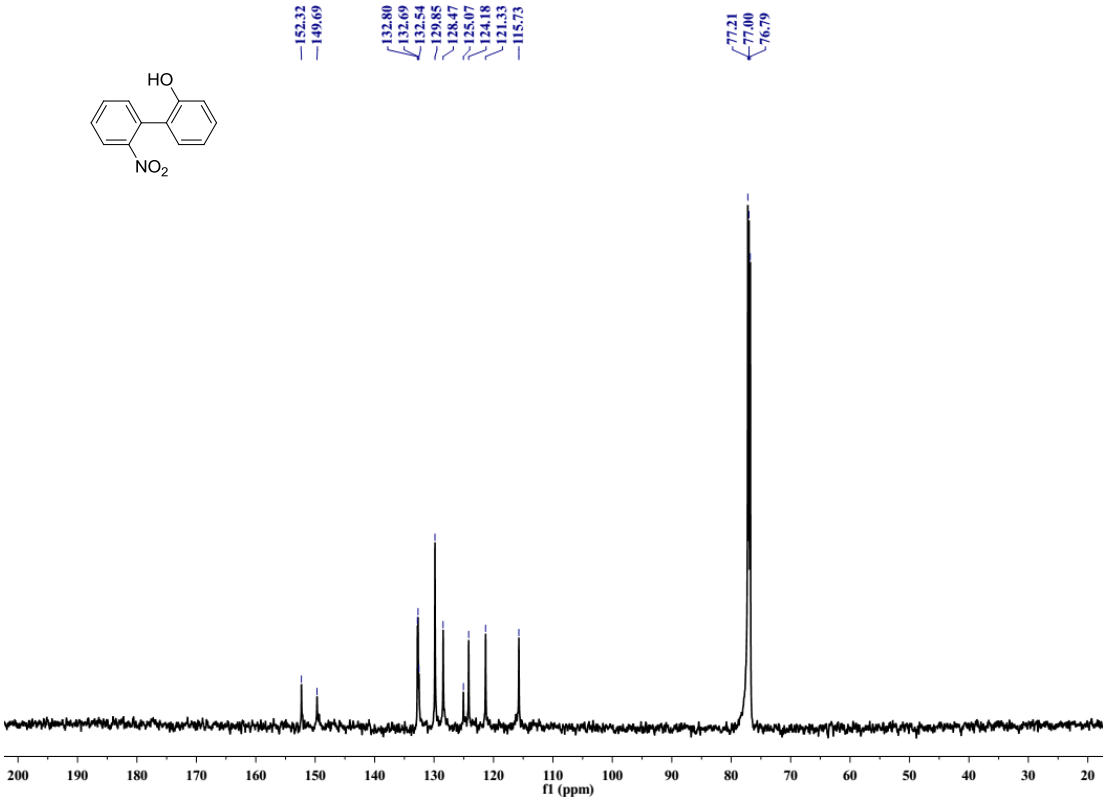

-64.24
NO2
CF3
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

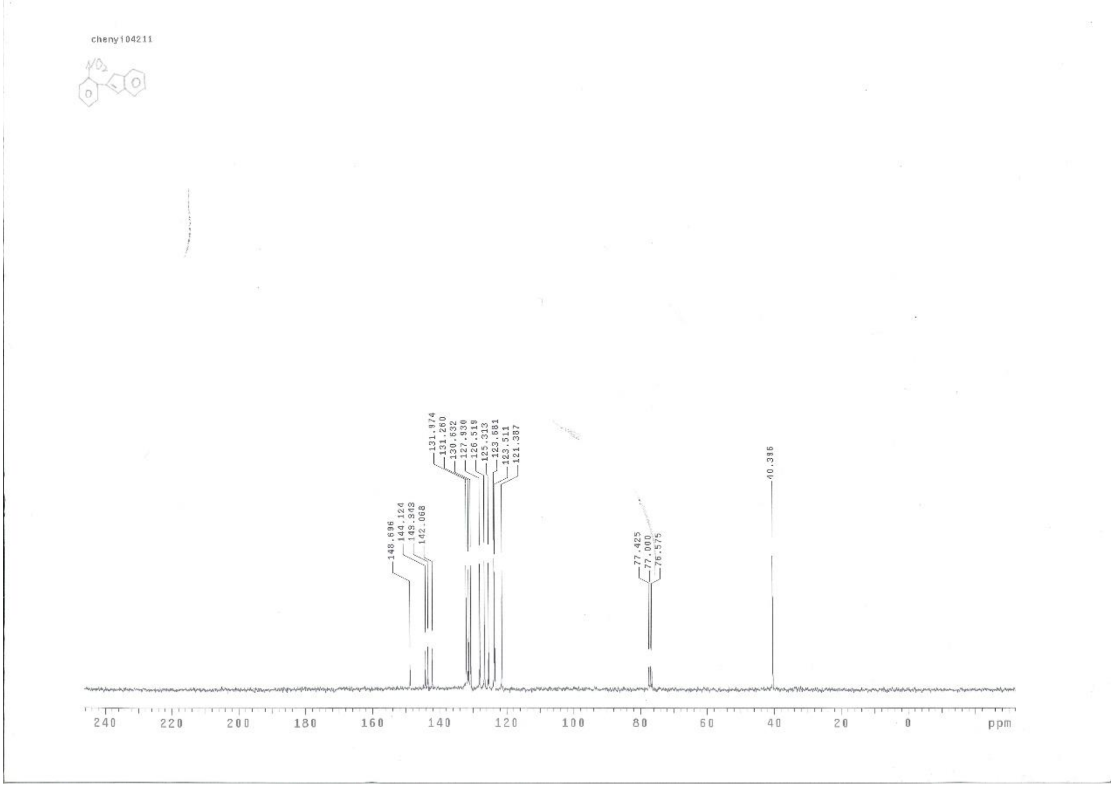

148.65
141.34
134.85
132.67
131.68
130.27
130.06
129.85
129.63
128.92
128.27
125.40
124.24
123.06
77.21
77.00
76.79
NO2
CF3
f1 (ppm)

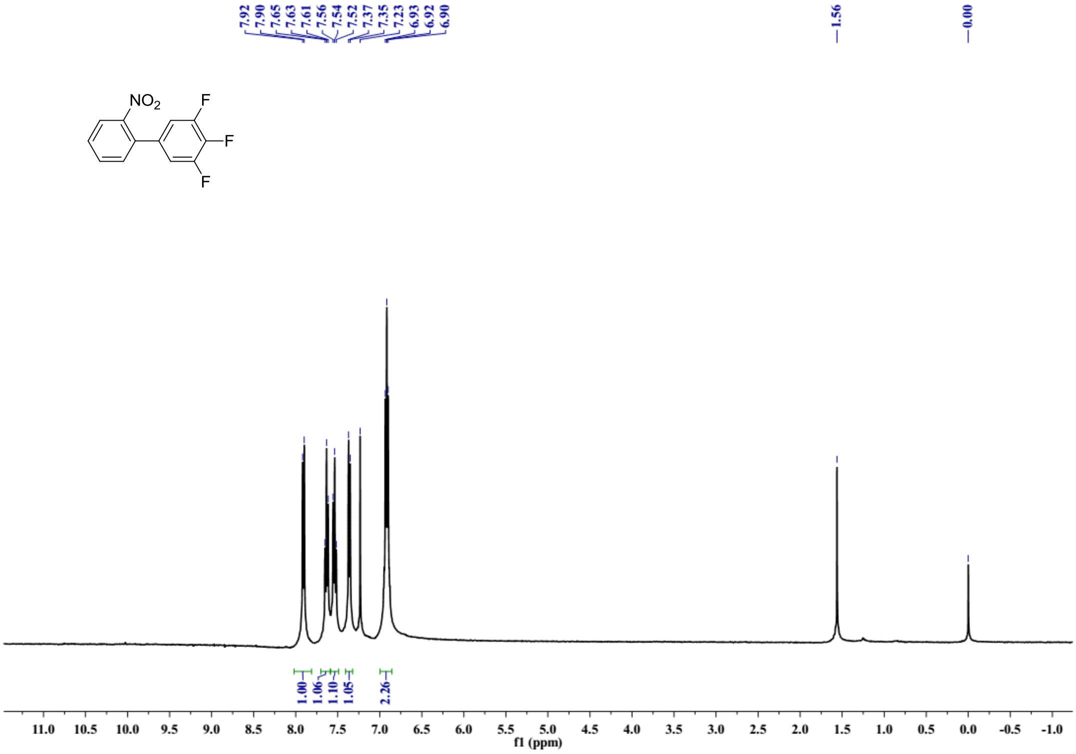

8.08
8.08
8.06
8.06
7.67
7.67
7.66
7.65
7.64
7.63
7.56
7.56
7.54
7.54
7.52
7.52
7.44
7.43
7.43
7.43
7.42
7.36
7.35
7.34
7.33
7.32
7.32
7.31
7.26
7.24
7.23
1.55
0.00
NO2
Cl
1.00
1.03
1.06
1.10
3.18
0.93
f1 (ppm)

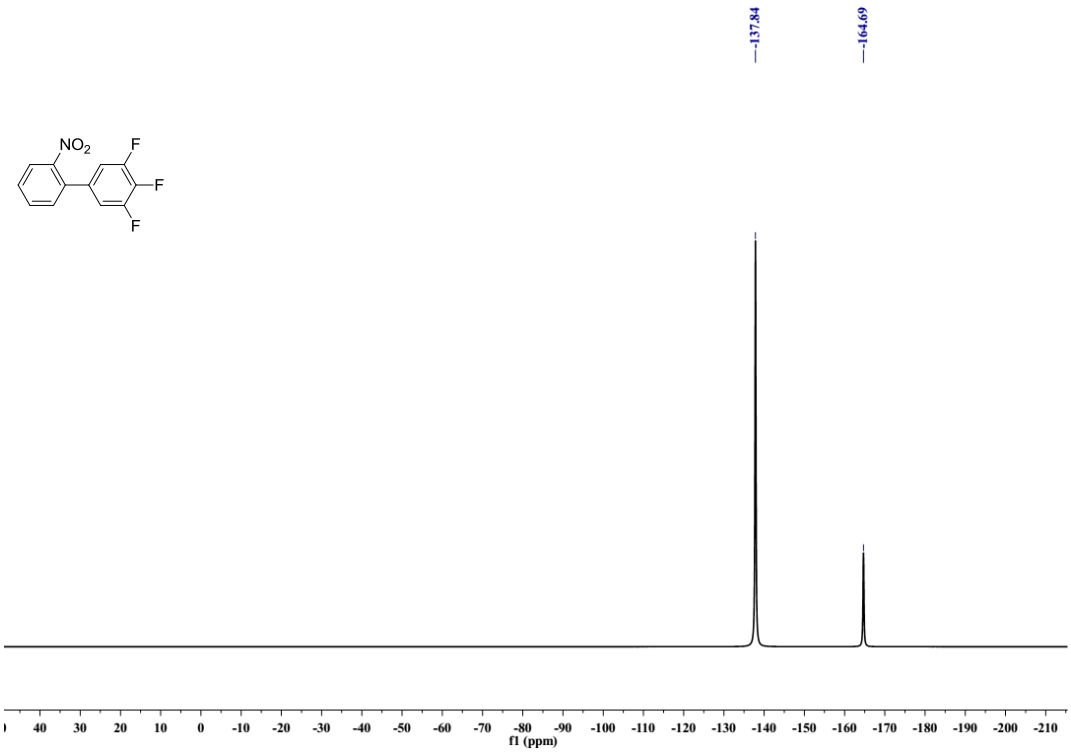

148.35
136.98
134.10
132.98
132.26
129.77
129.28
128.92
126.87
124.25
77.21
77.00
76.79
NO2
Cl
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
7.96
7.94
7.65
7.63
7.62
7.51
7.49
7.47
7.42
7.40
7.28
7.26
7.24
7.23
7.22
7.20
7.03
7.02
7.00
6.82
6.80
4.91
1.62
0.00

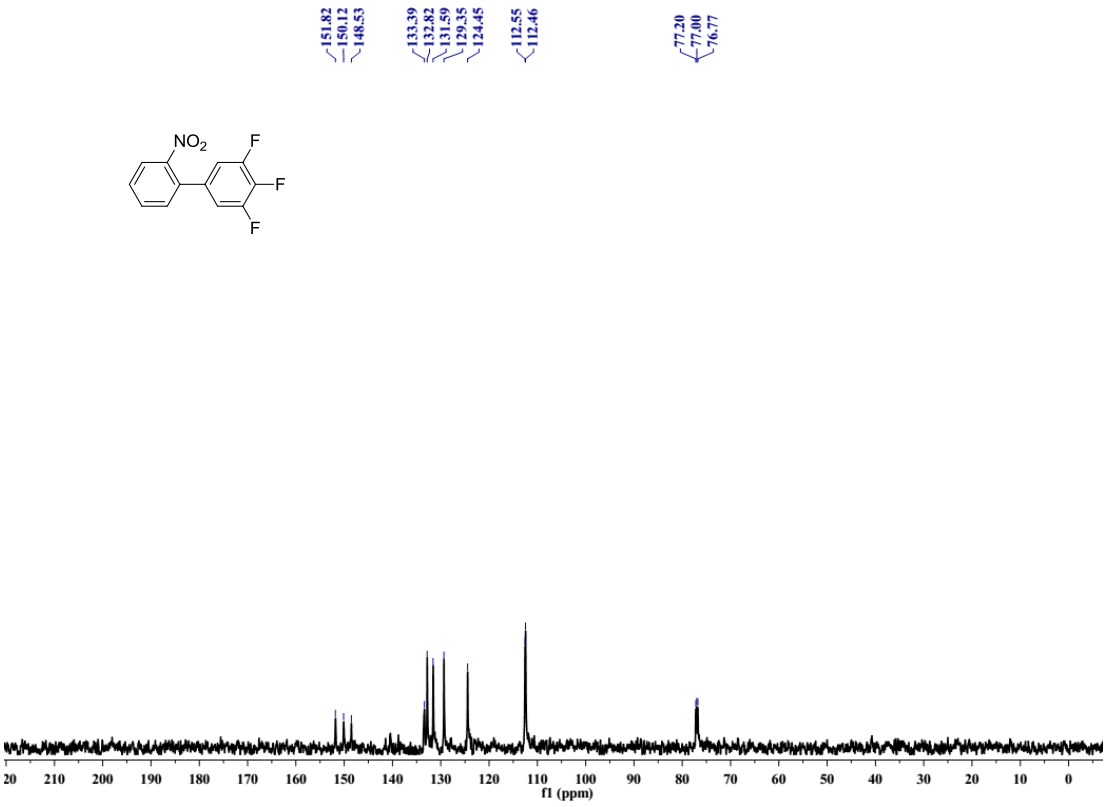

HO
NO2
1.00
0.98
1.01
1.07
2.95
1.13
1.15
1.16
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

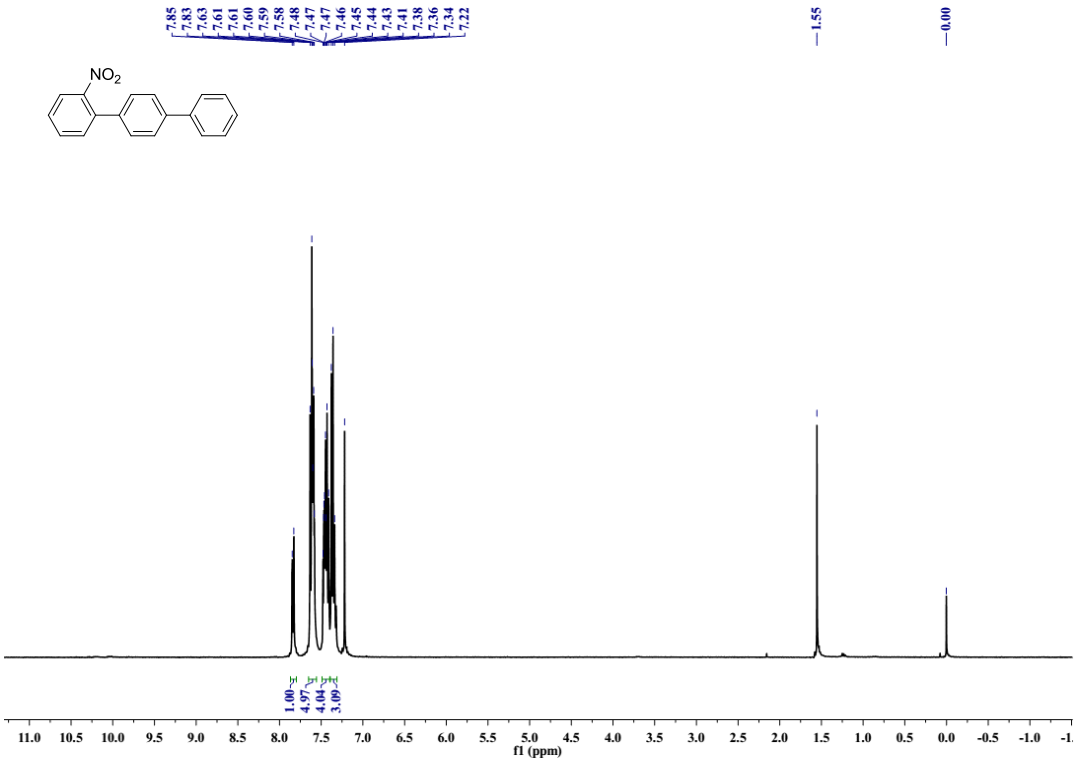

HO
NO2
152.32
149.69
132.80
132.69
132.54
129.85
128.47
125.07
124.18
121.33
115.73
77.21
77.00
76.79
f1 (ppm)
7.75
7.73
7.56
7.54
7.53
7.50
7.48
7.45
7.43
7.42
7.40
7.38
7.38
7.37
7.29
7.27
7.25
7.22
7.20
6.95
3.68
1.54
0.00
NO2
0.98
0.96
0.92
0.98
1.87
0.94
0.92
1.00
2.00
f1 (ppm)

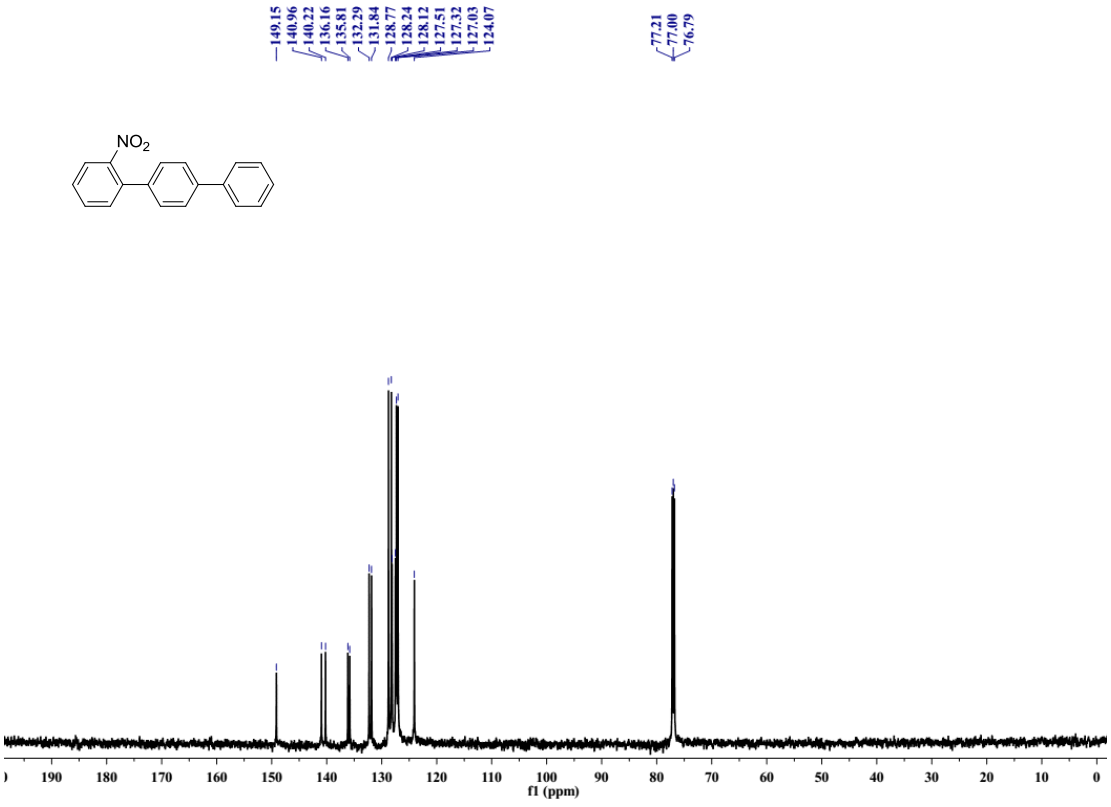

chenyi04211
148.696
144.124
143.843
142.068
131.974
131.260
130.632
127.930
126.518
125.313
123.681
123.511
121.387
77.425
77.000
76.575
40.398
240 220 200 180 160 140 120 100 80 60 40 20 0 ppm

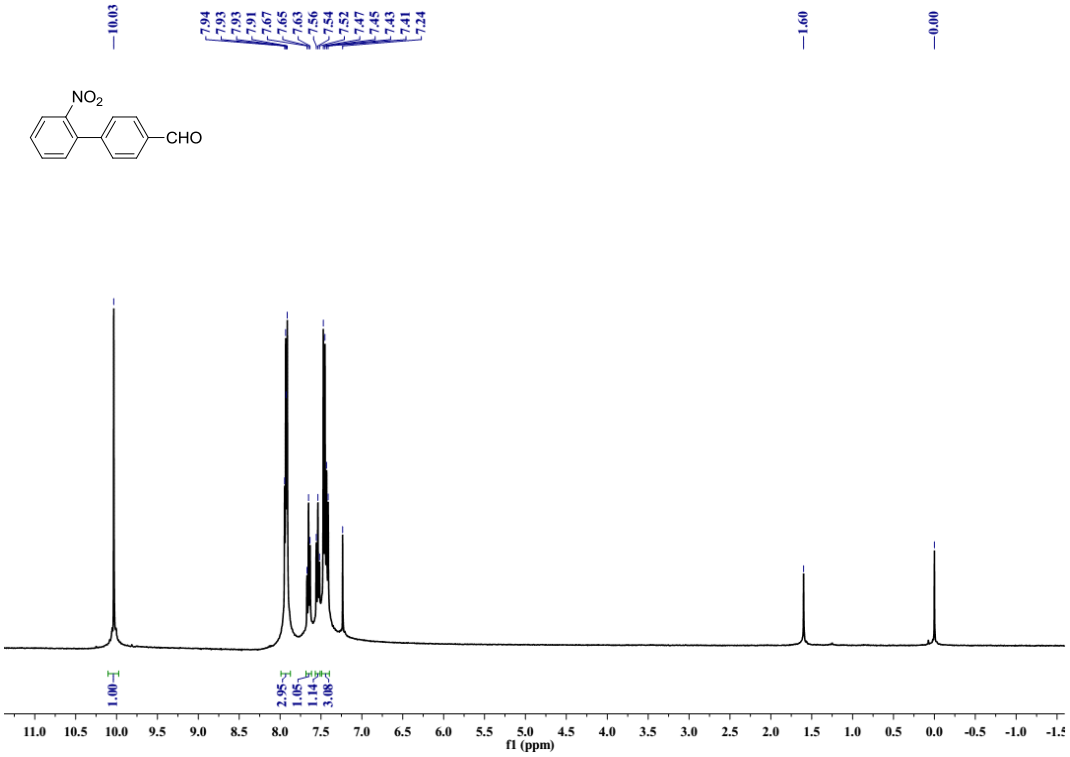

7.92
7.90
7.65
7.63
7.61
7.56
7.54
7.52
7.37
7.35
7.23
6.93
6.92
6.90
1.56
0.00
NO2
F
F
F
1.00
1.06
1.10
1.05
2.26
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

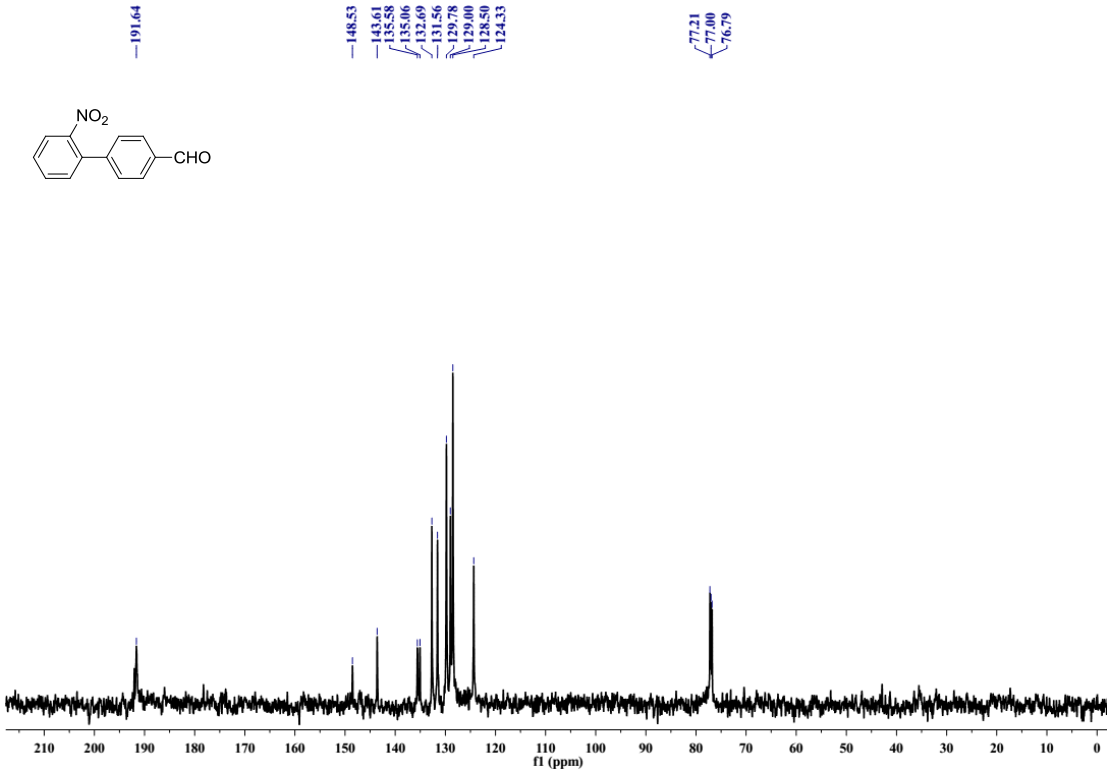

-137.84
-164.69
NO2
F
F
F
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

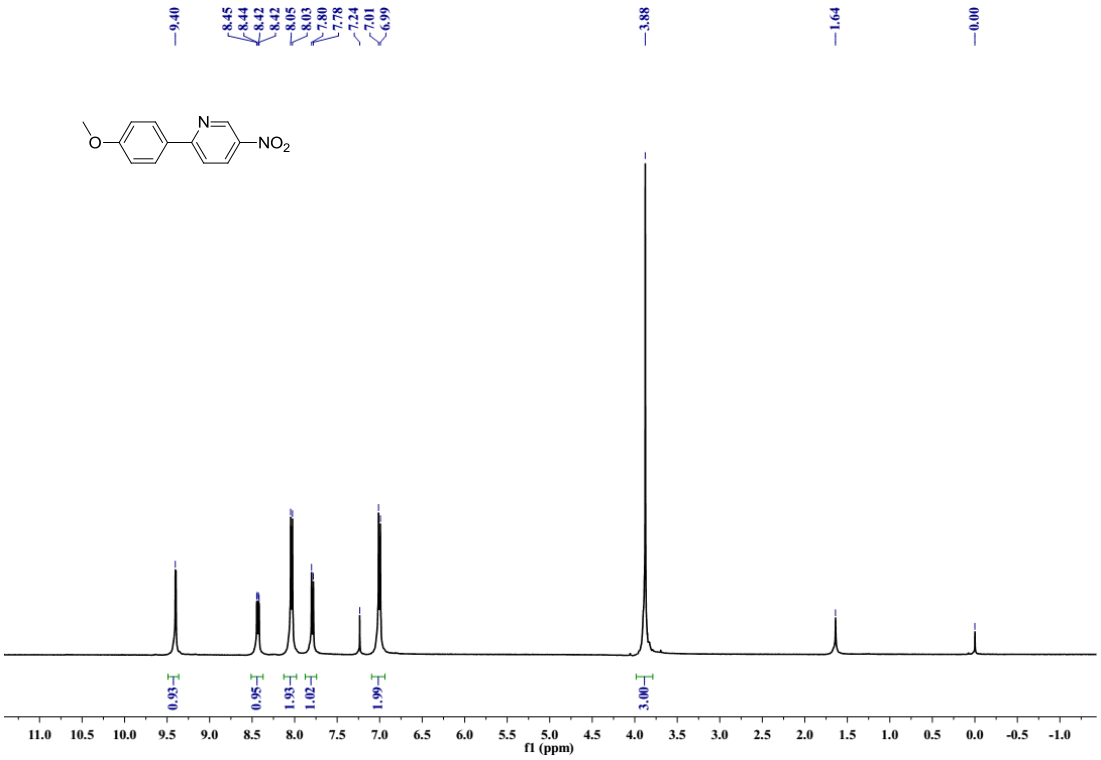

151.82
150.12
148.53
133.39
132.82
131.59
129.35
124.45
112.55
112.46
77.20
77.00
76.77
NO2
F
F
F
20 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

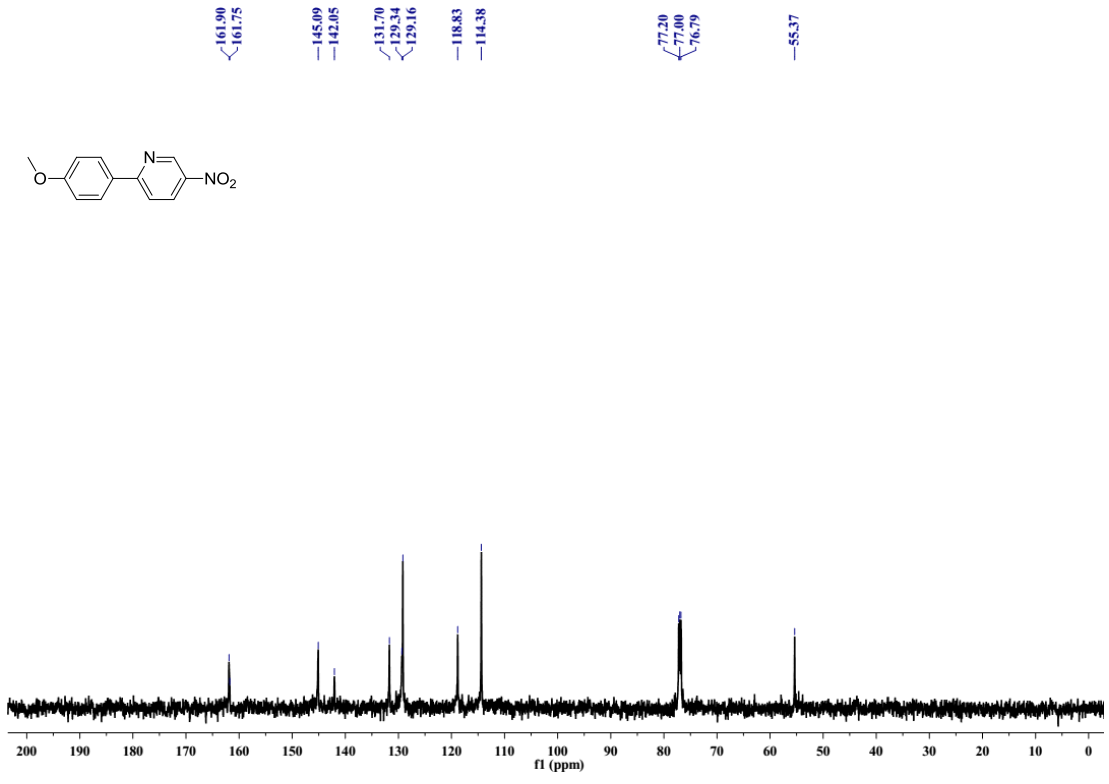

7.85
7.83
7.63
7.61
7.61
7.60
7.59
7.58
7.48
7.47
7.47
7.46
7.45
7.44
7.43
7.41
7.38
7.36
7.34
7.22
1.55
0.00
NO2
1.00
4.97
4.04
3.09
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

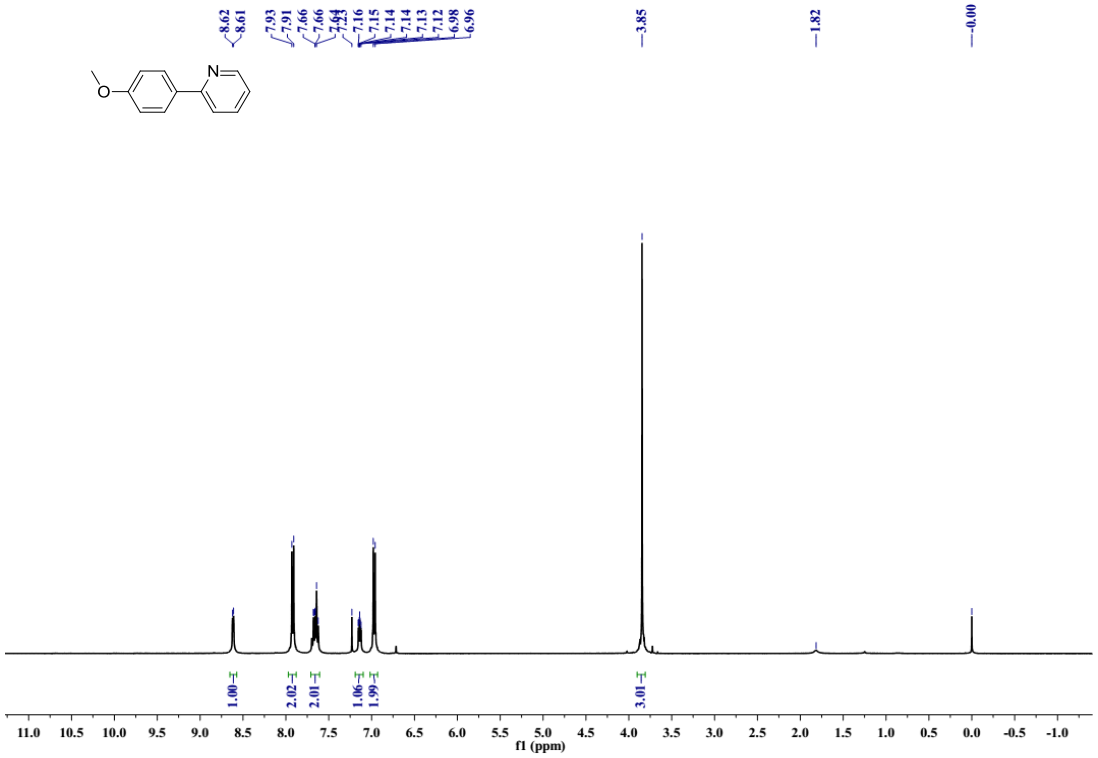

149.15
140.96
140.22
136.16
135.81
132.29
131.84
128.77
128.24
128.12
127.51
127.32
127.03
124.07
77.21
77.00
76.79
NO2
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

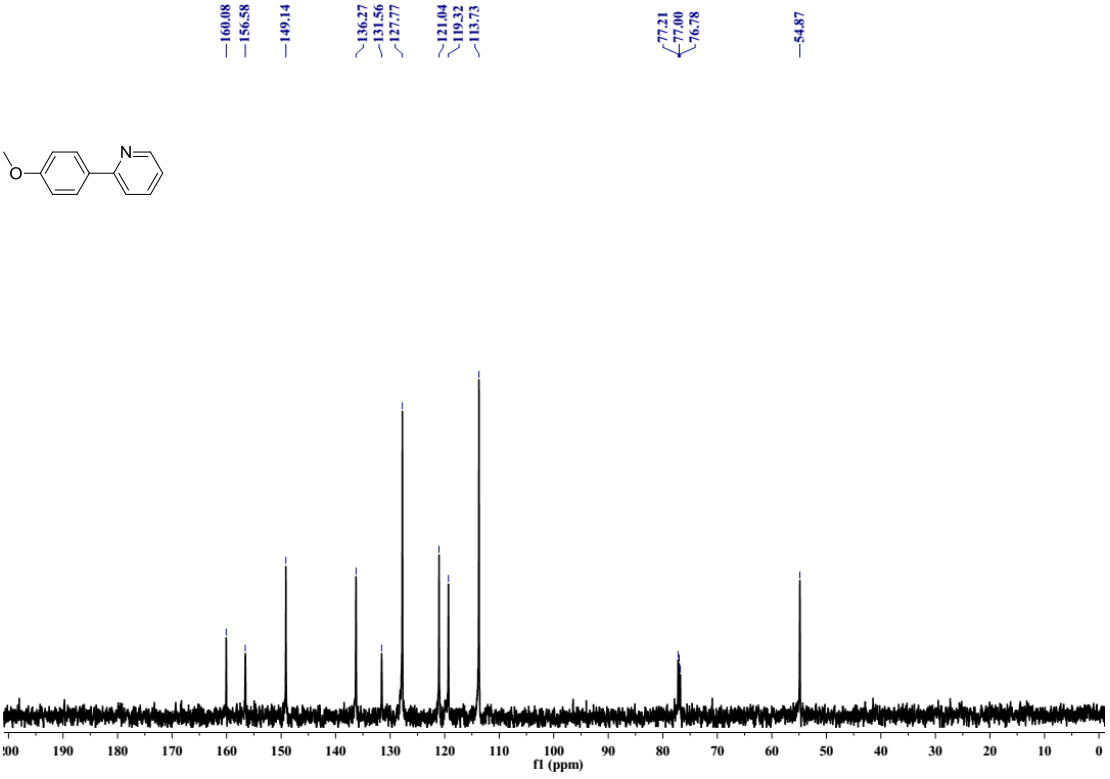

10.03
7.94
7.93
7.93
7.91
7.67
7.65
7.63
7.56
7.54
7.52
7.47
7.45
7.43
7.41
7.24
1.60
0.00
NO2
CHO
1.00
2.95
1.05
1.14
3.08
f1 (ppm)

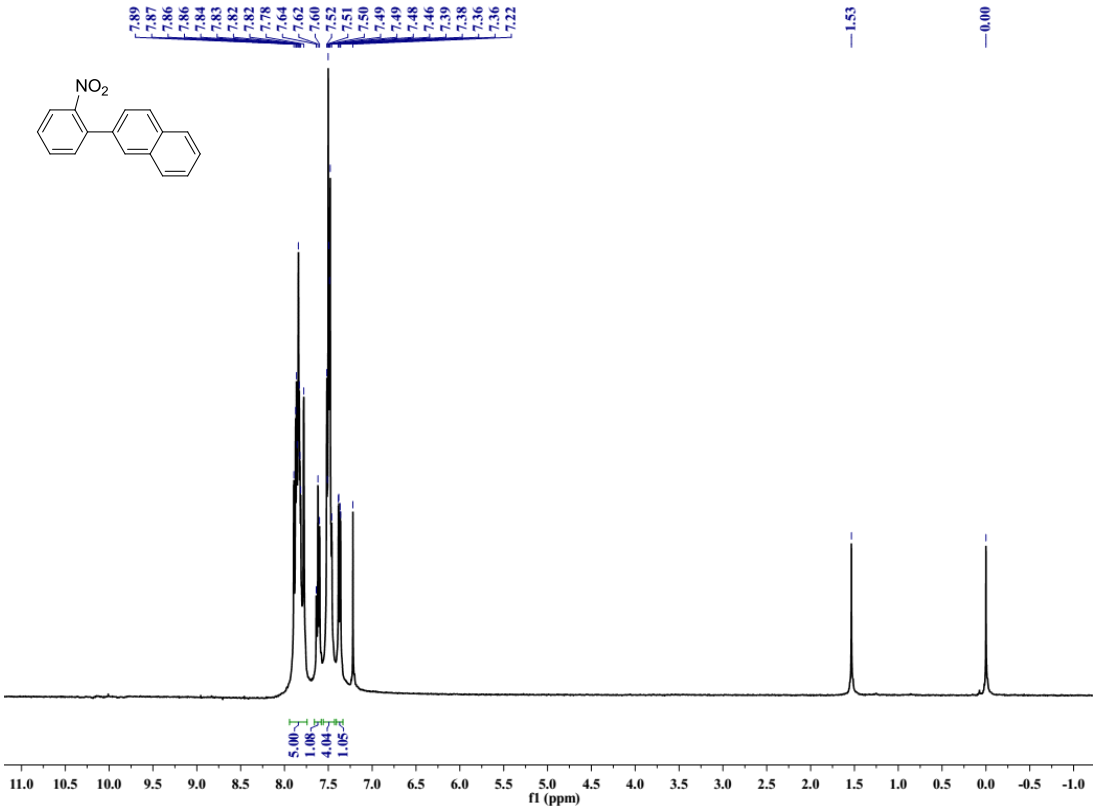

191.64
148.53
143.61
135.58
135.06
132.69
131.56
129.78
129.00
128.50
124.33
77.21
77.00
76.79
NO2
CHO
f1 (ppm)

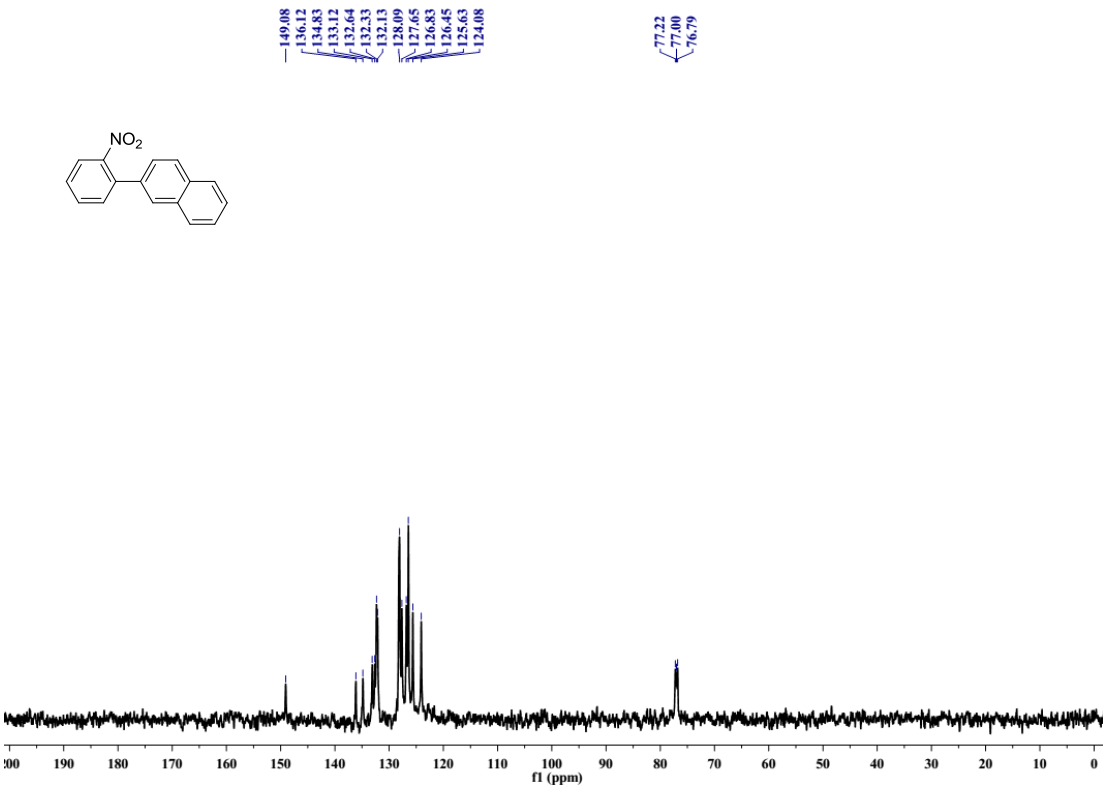

9.40
8.45
8.44
8.42
8.42
8.05
8.03
7.80
7.78
7.24
7.01
6.99
3.88
1.64
0.00
O
N
NO2
0.93
0.95
1.93
1.02
1.99
3.00
f1 (ppm)

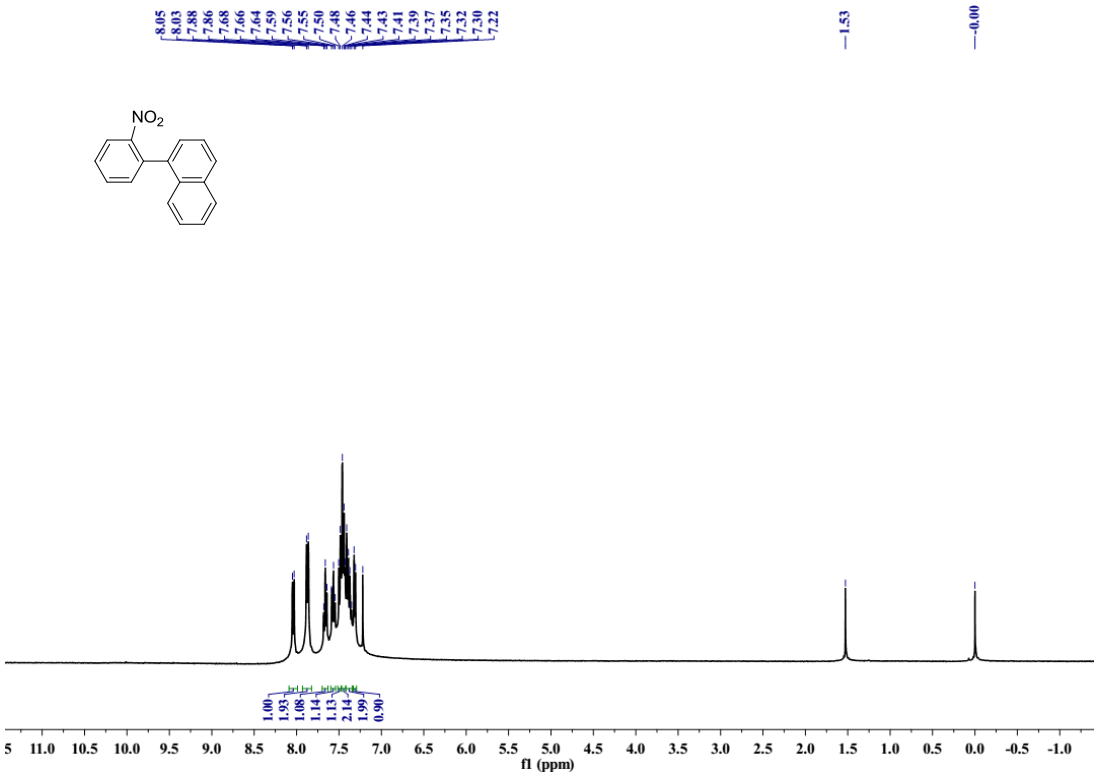

161.90
161.75
145.09
142.05
131.70
129.34
129.16
118.83
114.38
77.20
77.00
76.79
55.37
O
N
NO2
f1 (ppm)

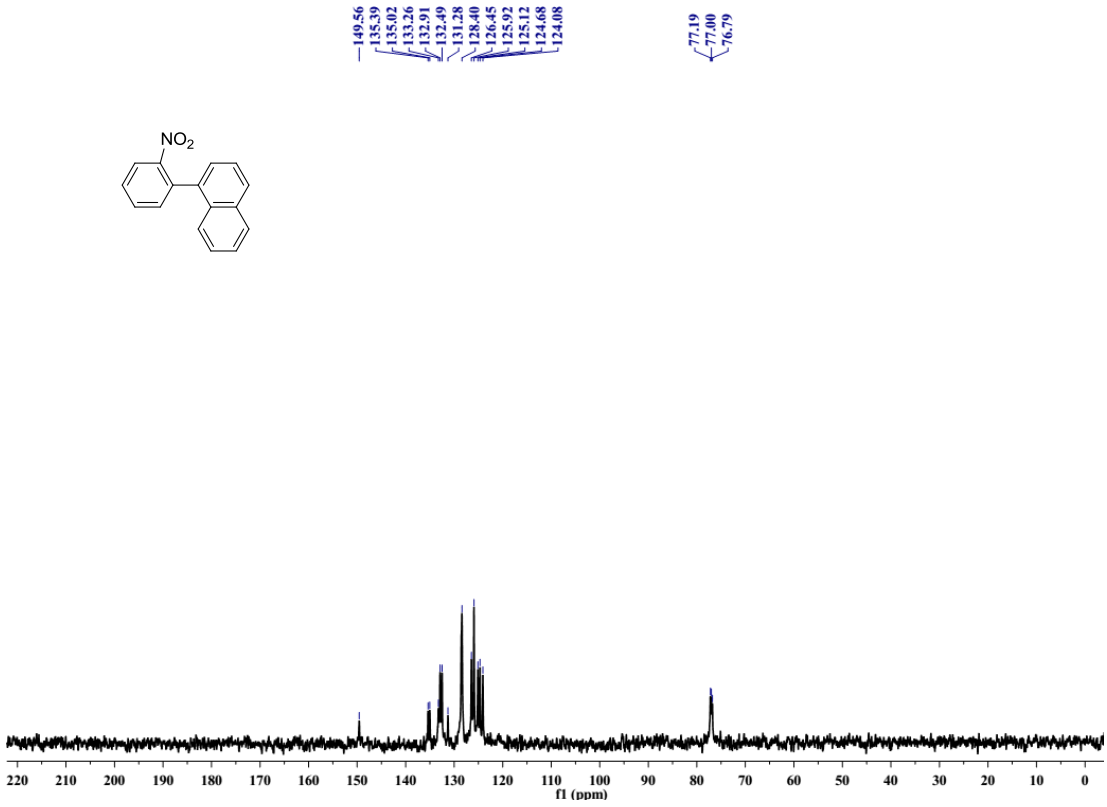

8.62
8.61
7.93
7.91
7.66
7.66
7.64
7.64
7.16
7.15
7.14
7.14
7.13
7.12
6.98
6.96
3.85
1.82
0.00
1.00
2.02
2.01
1.06
1.99
3.01
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)


160.08
156.58
149.14
136.27
131.56
127.77
121.04
119.32
113.73
77.21
77.00
76.78
54.87
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


7.89
7.87
7.86
7.86
7.84
7.83
7.82
7.82
7.78
7.64
7.62
7.60
7.52
7.51
7.50
7.49
7.49
7.48
7.46
7.39
7.38
7.36
7.36
7.22
1.53
0.00
NO2
5.00
1.08
4.04
1.05
f1 (ppm)


149.08
136.12
134.83
133.12
132.64
132.33
132.13
128.09
127.65
126.83
126.45
125.63
124.08
77.22
77.00
76.79
NO2
f1 (ppm)


8.05
8.03
7.88
7.86
7.68
7.66
7.64
7.59
7.56
7.55
7.50
7.48
7.46
7.44
7.43
7.41
7.39
7.37
7.35
7.32
7.30
7.22
1.53
0.00
NO2
1.00
1.93
1.08
1.14
1.13
2.14
1.99
0.90
f1 (ppm)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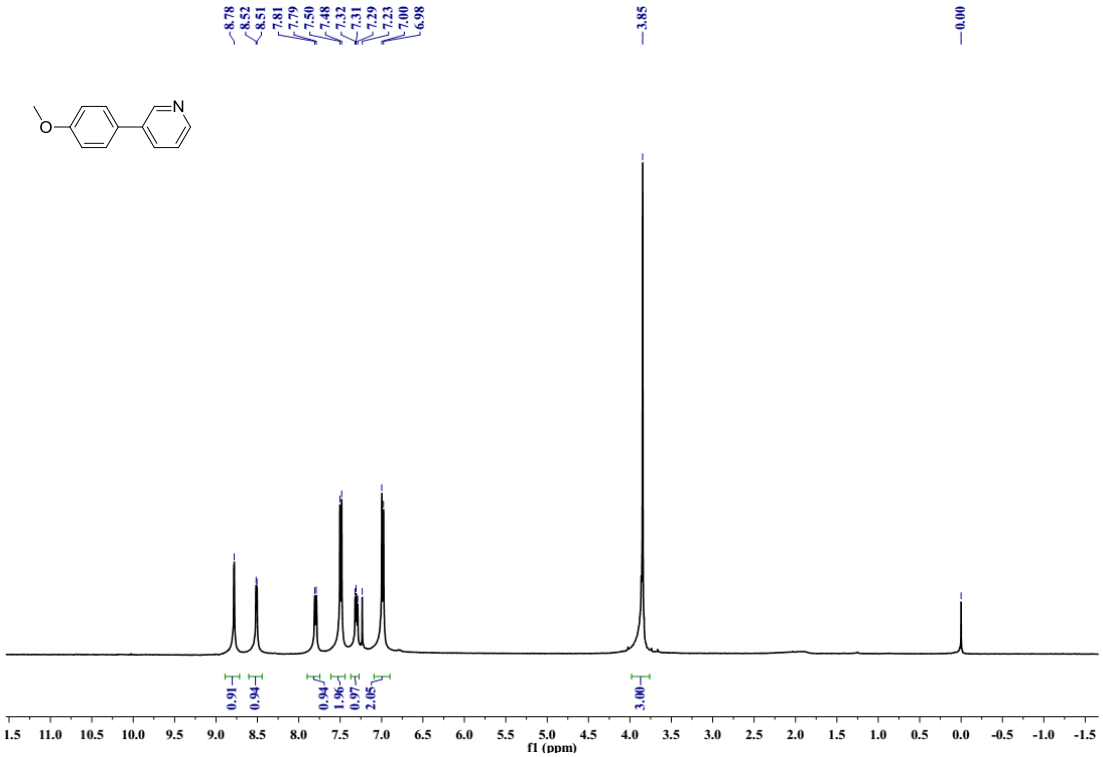
135.02
133.26
132.91
132.49
131.28
128.40
126.45
125.92
125.12
124.68
124.08
77.19
77.00
76.79
NO2
f1 (ppm)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8.51
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7.79
7.50
7.48
7.32
7.31
7.29
7.23
7.00
6.98
3.85
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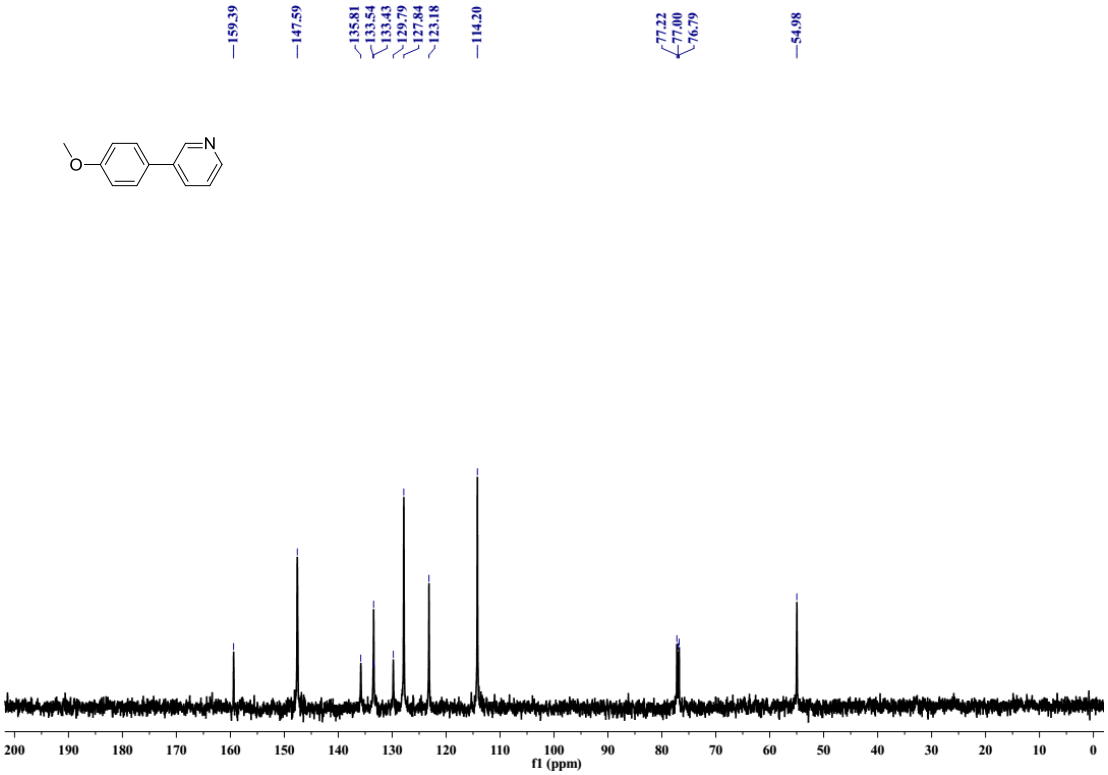
O
N
0.91
0.94
0.94
1.96
0.97
2.05
3.00
f1 (ppm)


159.39
147.59
135.81
133.54
133.43
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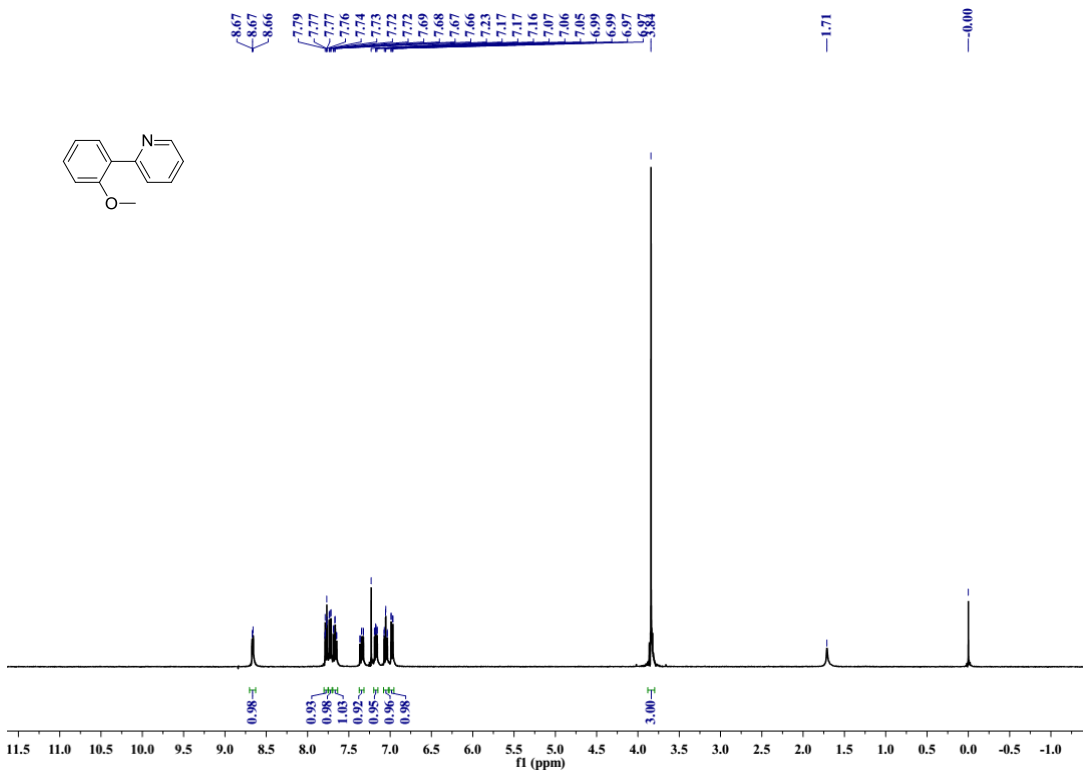
127.84
123.18
114.20
77.22
77.00
76.79
54.98
O
N
f1 (ppm)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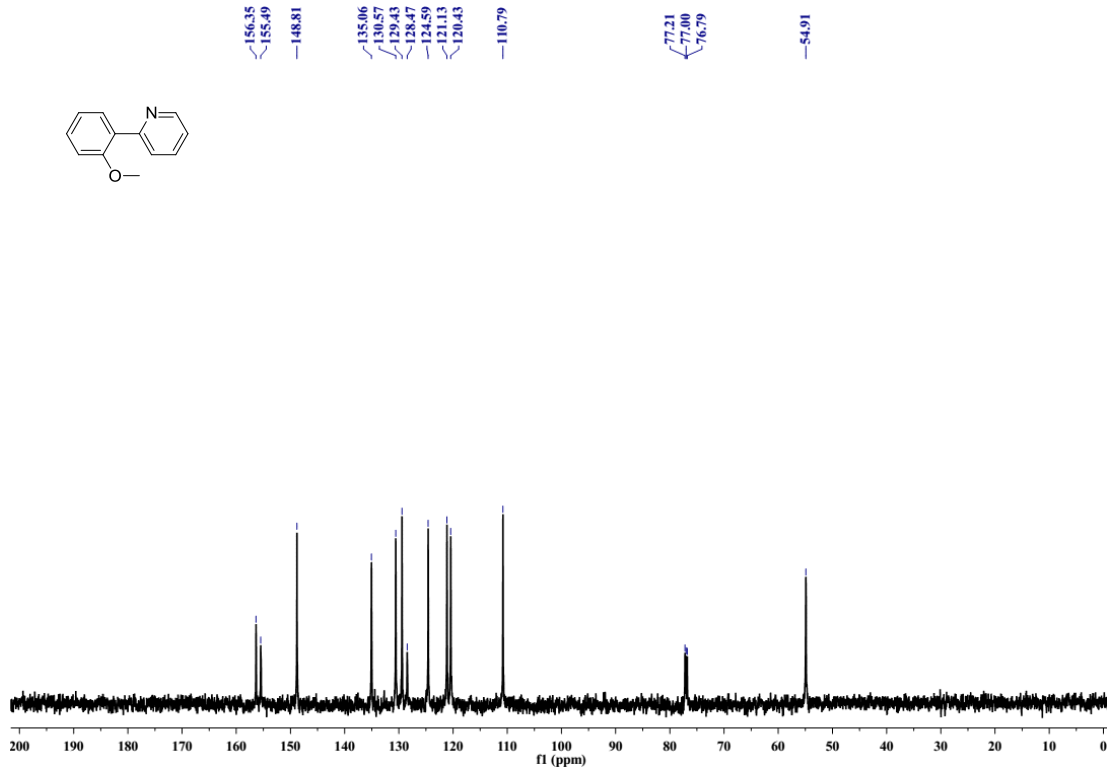
8.67
8.66
7.79
7.77
7.77
7.76
7.74
7.73
7.72
7.72
7.69
7.68
7.67
7.66
7.23
7.17
7.17
7.16
7.07
7.06
7.05
6.99
6.99
6.97
6.97
3.84
1.71
0.00
N
O
0.98
0.93
0.98
1.03
0.92
0.95
0.96
0.98
3.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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155.49
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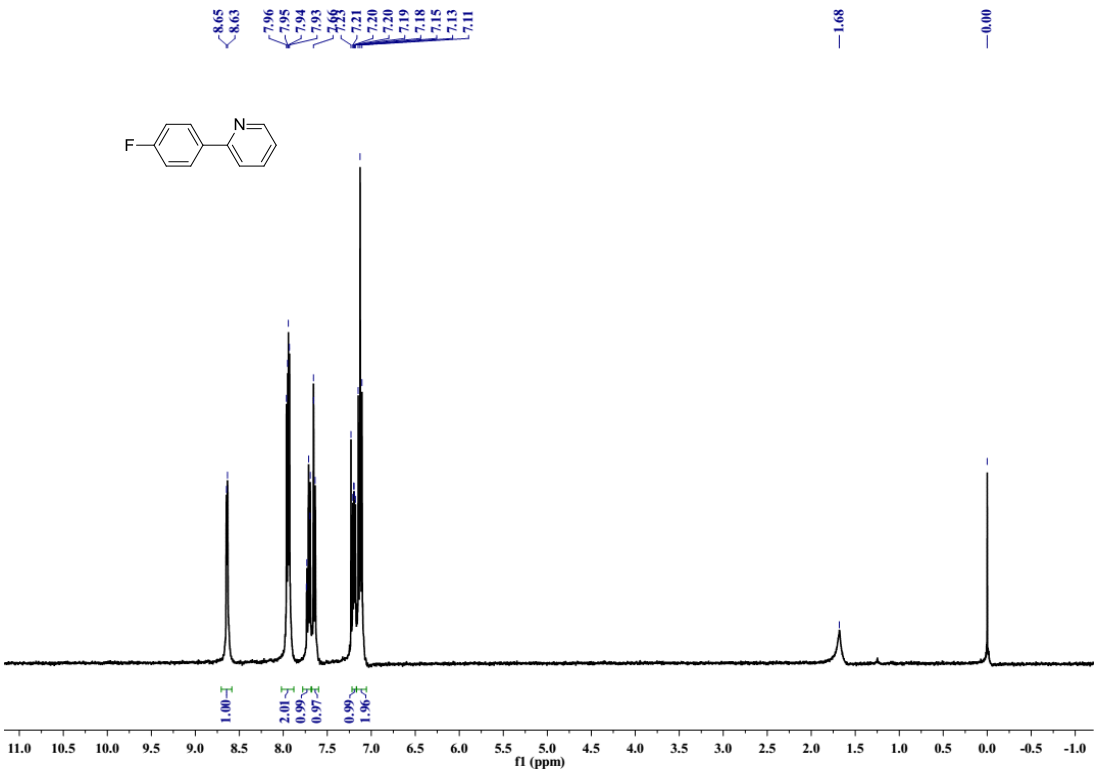
135.06
130.57
129.43
128.47
124.59
121.13
120.43
110.79
77.21
77.00
76.79
54.91
N
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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8.63
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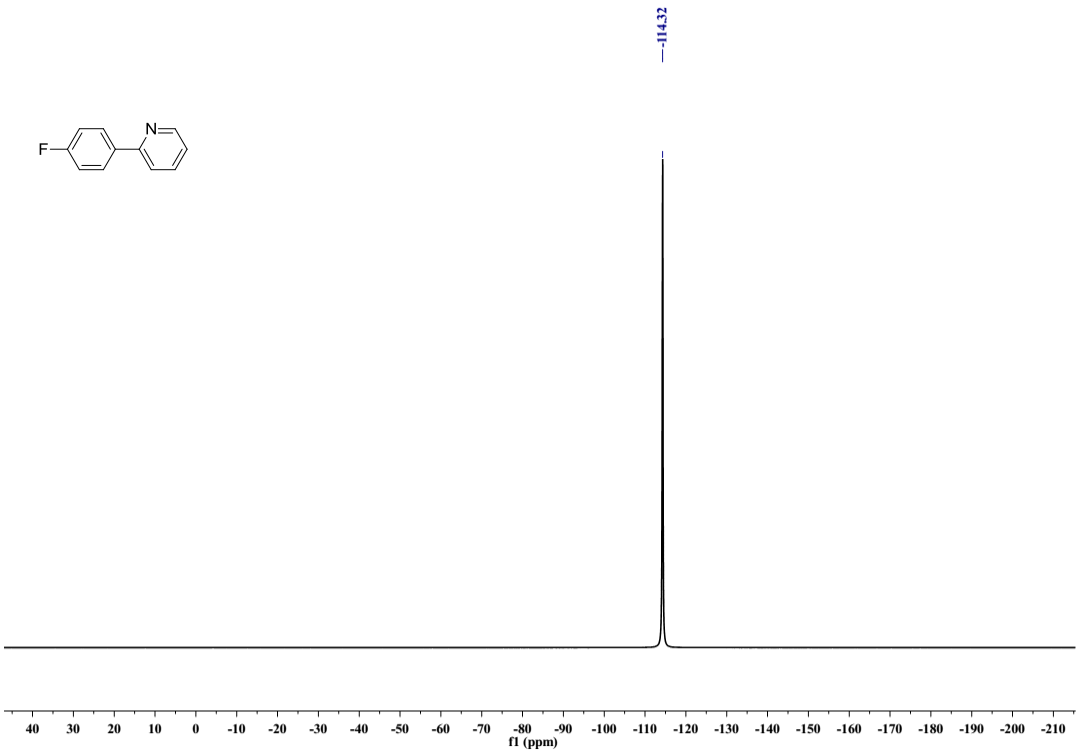
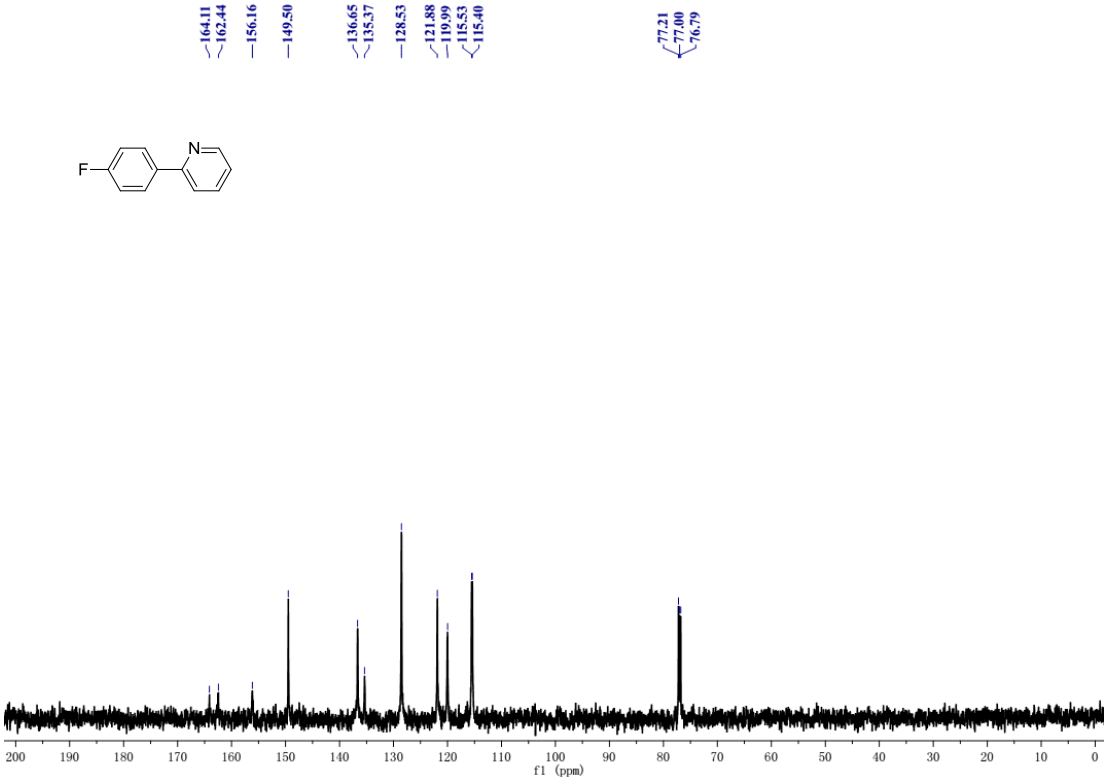
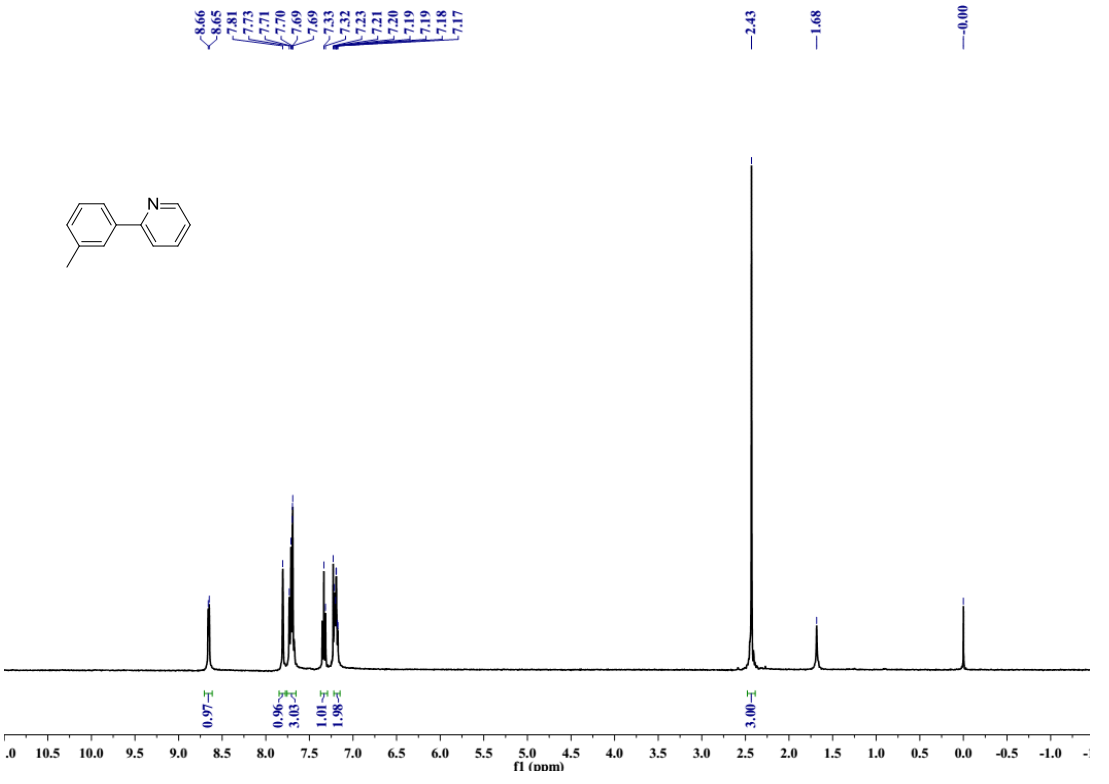
7.95
7.94
7.93
7.66
7.23
7.21
7.20
7.20
7.19
7.18
7.15
7.13
7.11
1.68
0.00
F
N
1.00
2.01
0.99
0.97
0.99
1.96
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)


-114.32
F
N
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


164.11
162.44
156.16
149.50
136.65
135.37
128.53
121.88
119.99
115.53
115.40
77.21
77.00
76.79
F
N
f1 (ppm)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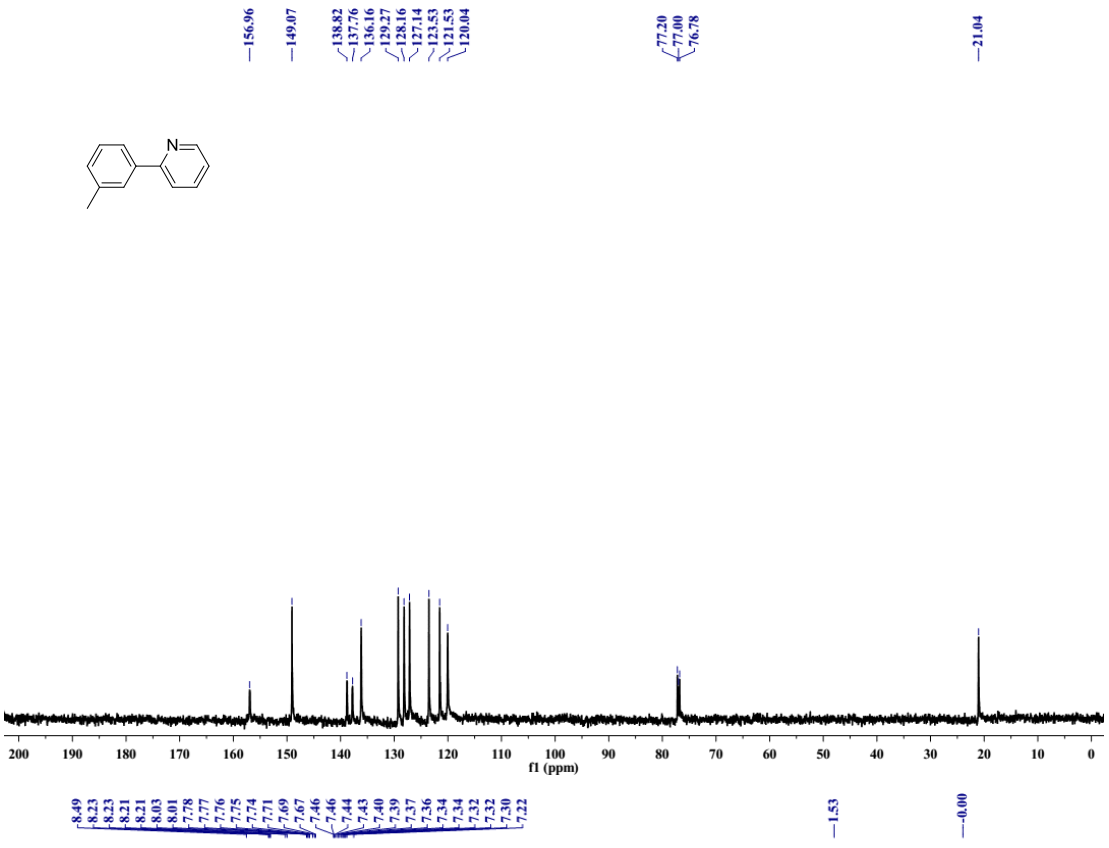
8.65
7.81
7.73
7.71
7.70
7.69
7.69
7.33
7.32
7.23
7.21
7.20
7.19
7.19
7.18
7.17
2.43
1.68
0.00
N
0.97
0.96
3.03
1.01
1.98
3.00
f1 (ppm)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138.82
137.76
136.16
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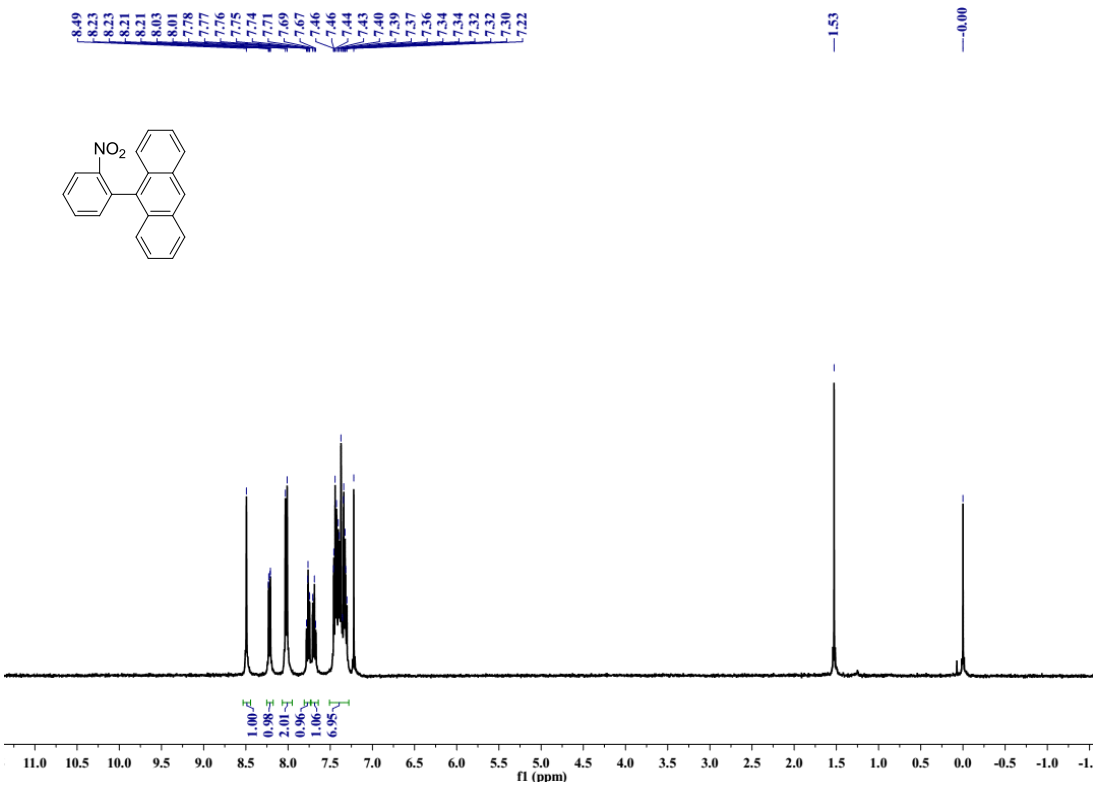
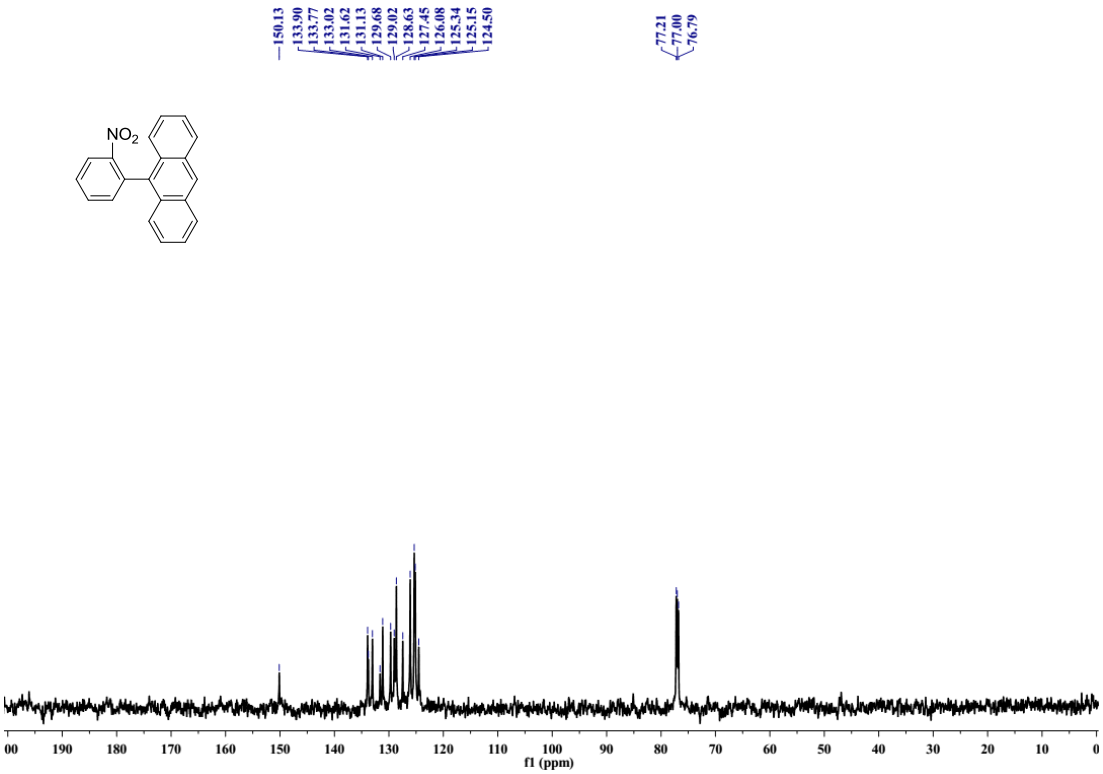
127.14
123.53
121.53
120.04
77.20
77.00
76.78
21.04
N
f1 (ppm)


8.49
8.23
8.23
8.21
8.21
8.03
8.01
7.78
7.77
7.76
7.75
7.74
7.71
7.69
7.67
7.46
7.46
7.44
7.43
7.40
7.39
7.37
7.36
7.34
7.34
7.32
7.32
7.30
7.22
1.53
0.00
NO2
1.00
0.98
2.01
0.96
1.06
6.95
f1 (ppm)


150.13
133.90
133.77
133.02
131.62
131.13
129.68
129.02
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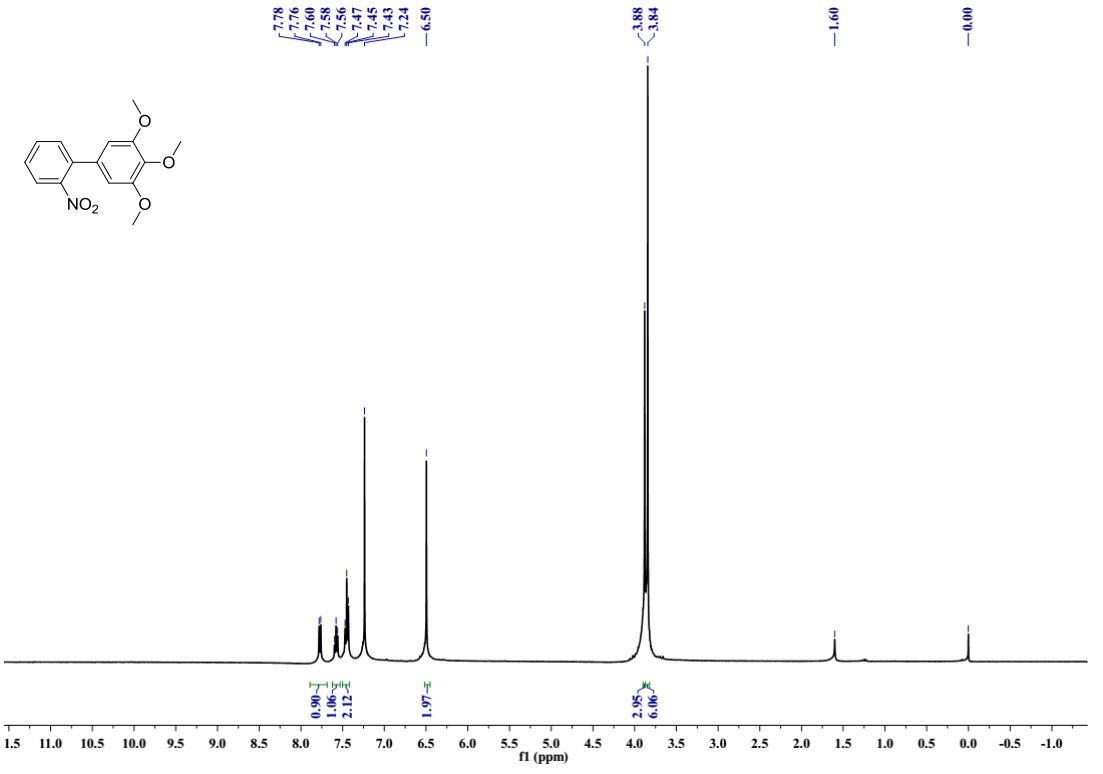
126.08
125.34
125.15
124.50
77.21
77.00
76.79
NO2
f1 (ppm)


7.78
7.76
7.60
7.58
7.56
7.47
7.45
7.43
7.24
6.50
3.88
3.84
1.60
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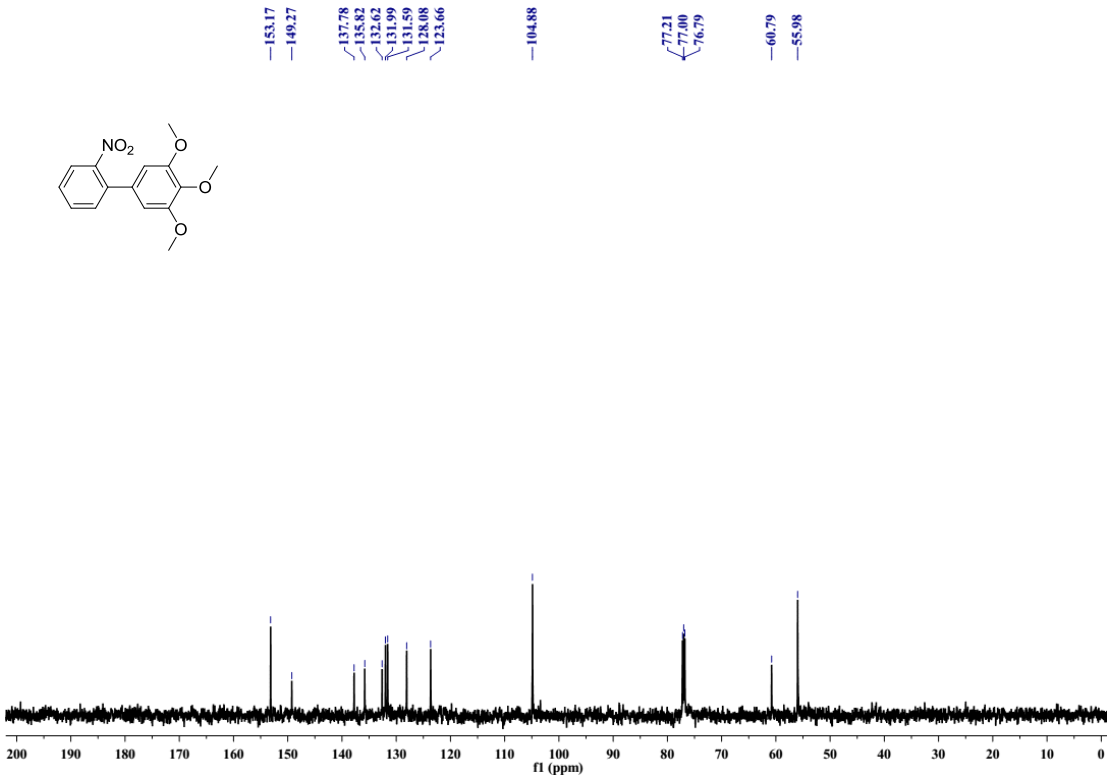
O
O
O
NO2
0.90
1.06
2.12
1.97
2.95
6.06
f1 (ppm)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149.27
137.78
135.82
132.62
131.99
131.59
128.08
123.66
104.88
77.21
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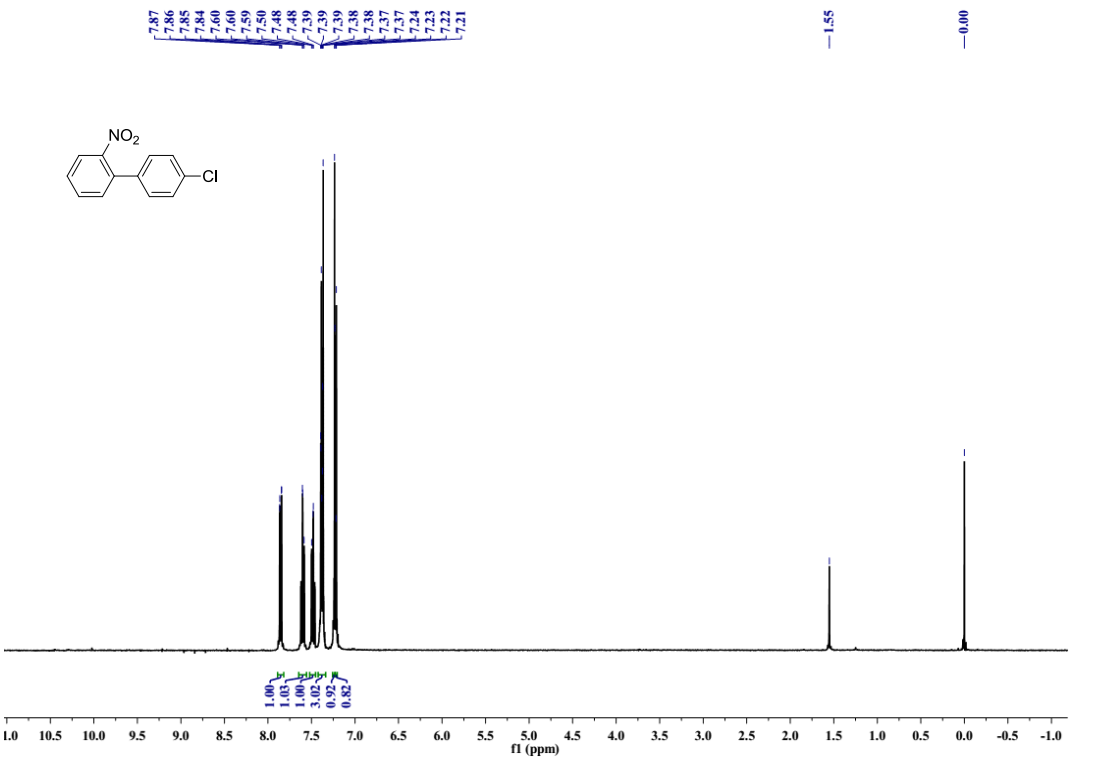
76.79
60.79
55.98
NO2
O
O
O
f1 (ppm)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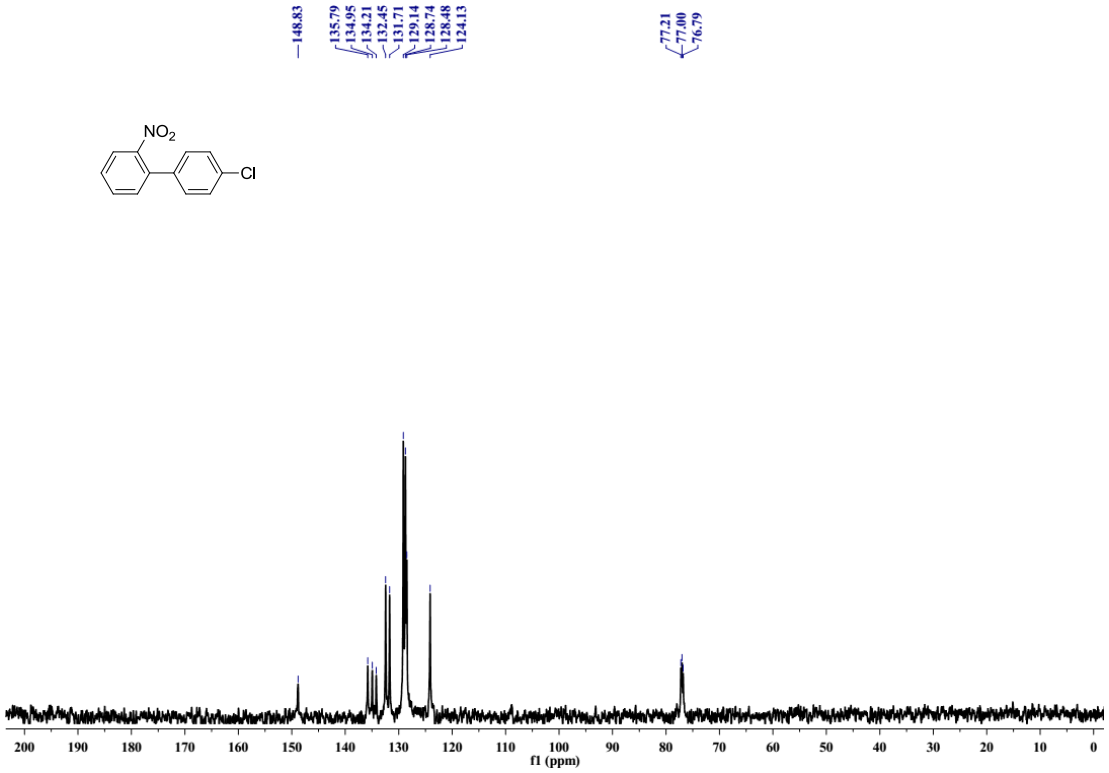
7.86
7.85
7.84
7.60
7.60
7.59
7.50
7.48
7.48
7.39
7.39
7.39
7.38
7.38
7.37
7.37
7.24
7.23
7.22
7.21
1.55
0.00
NO2
Cl
1.00
1.03
1.00
3.02
0.92
0.82
f1 (ppm)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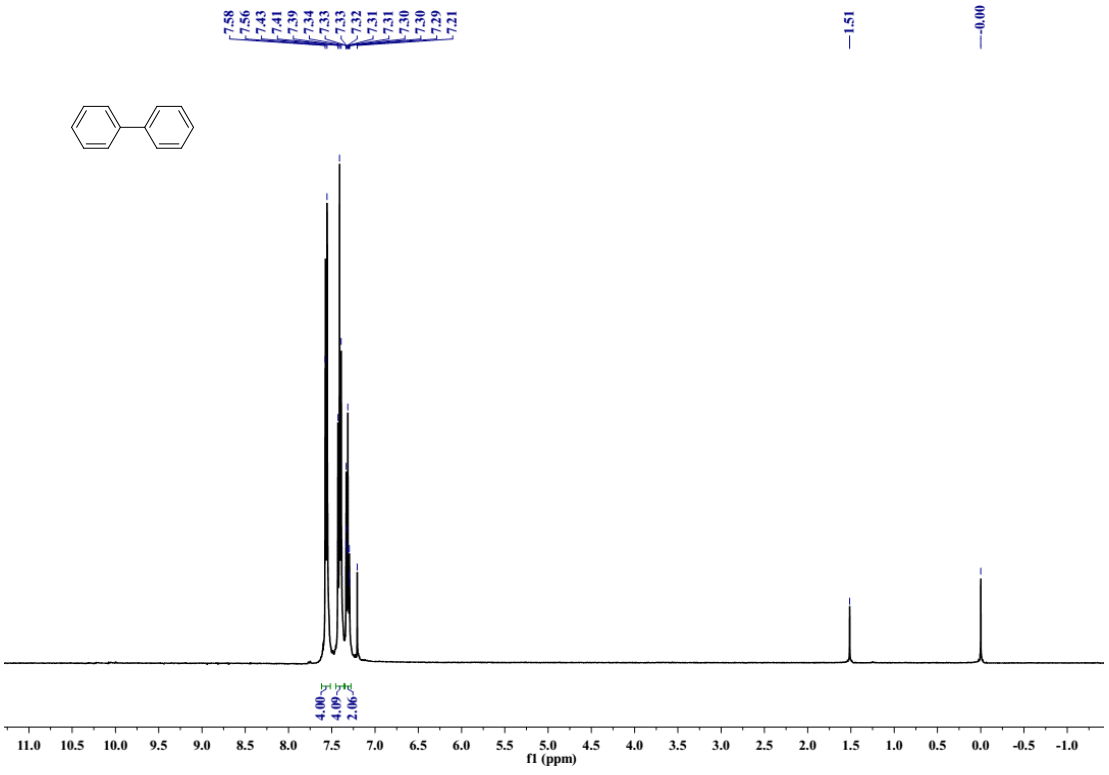
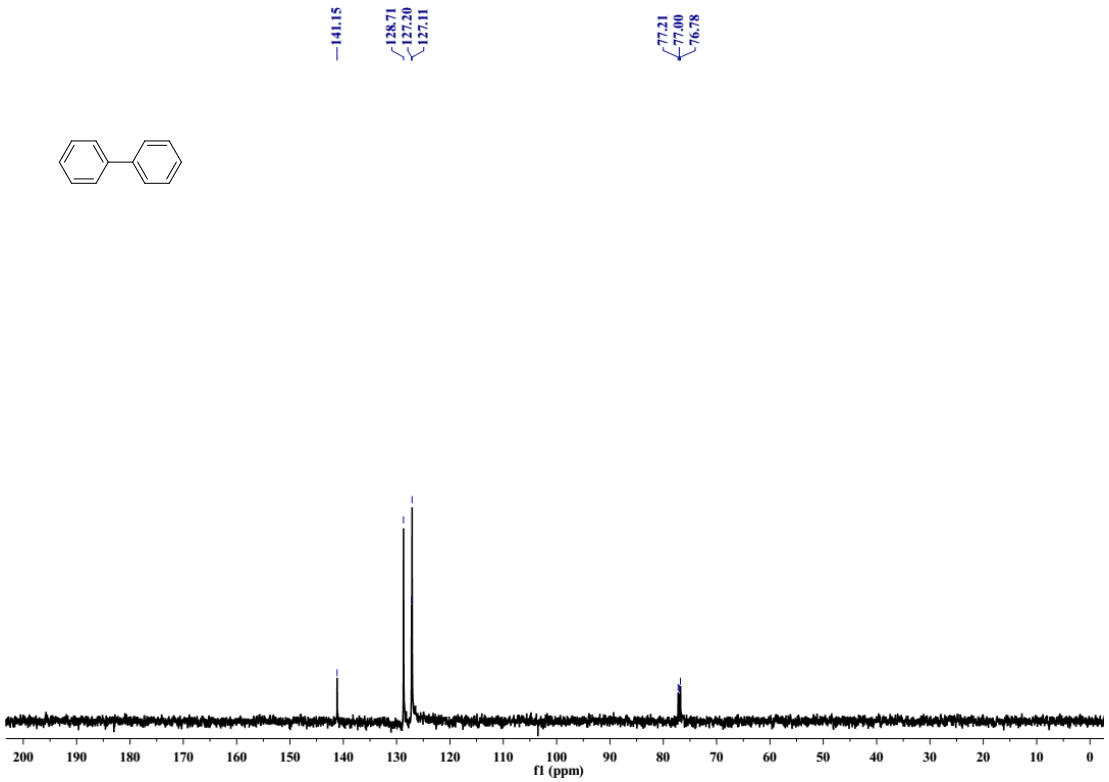
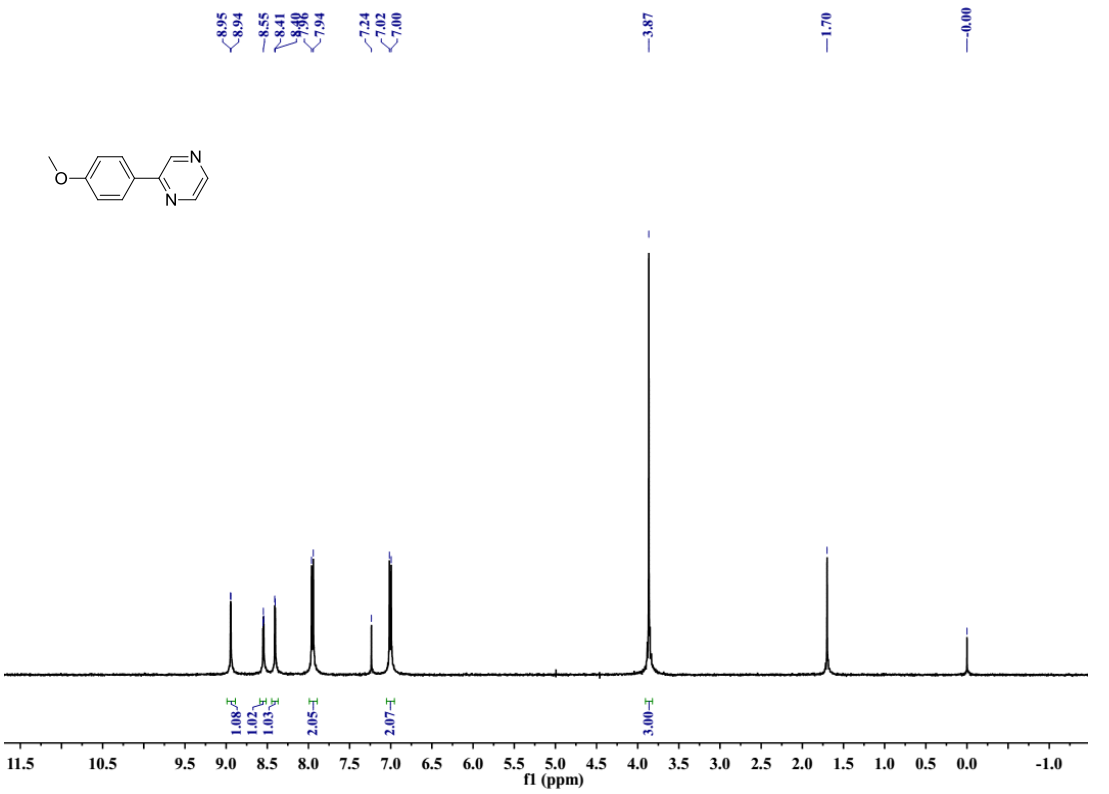
135.79
134.95
134.21
132.45
131.71
129.14
128.74
128.48
124.13
77.21
77.00
76.79
NO2
Cl
f1 (ppm)


7.58
7.56
7.43
7.41
7.39
7.34
7.33
7.33
7.32
7.31
7.31
7.30
7.30
7.29
7.21
1.51
0.00
4.00
4.09
2.06
f1 (ppm)


141.15
128.71
127.20
127.11
77.21
77.00
76.78
f1 (ppm)


8.95
8.94
8.55
8.41
7.94
7.24
7.02
7.00
3.87
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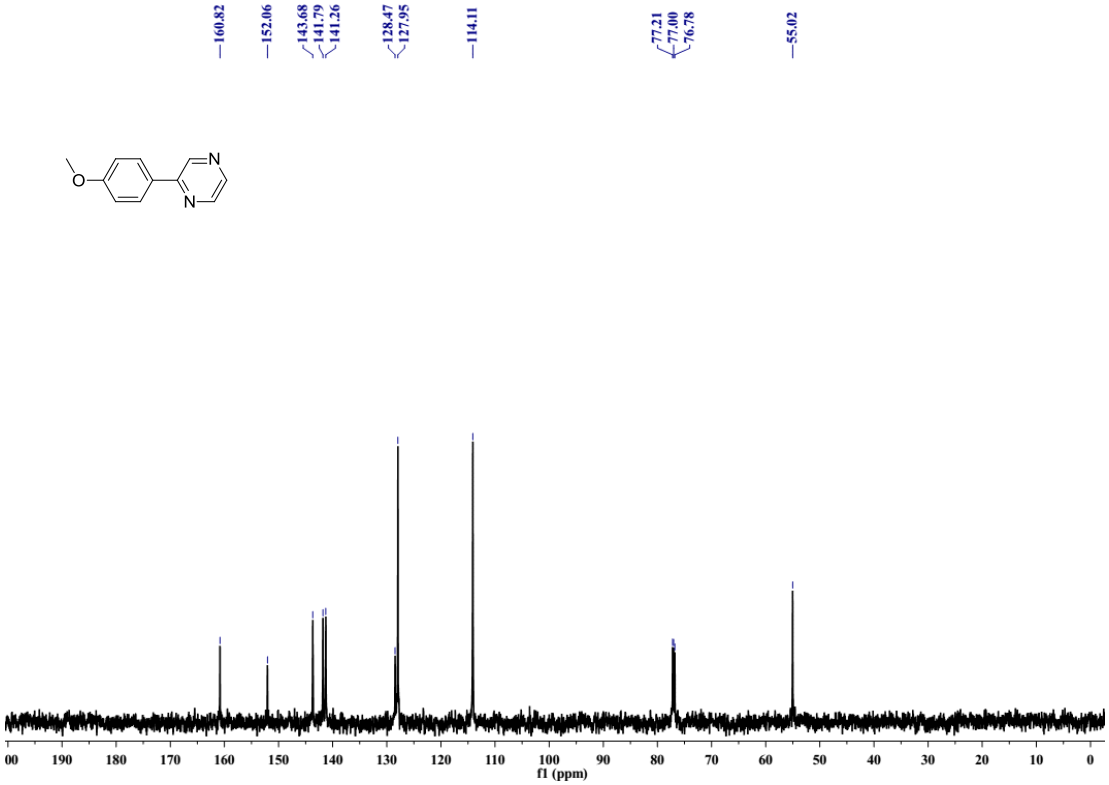
N
O
N
1.08
1.02
1.03
2.05
2.07
3.00
f1 (ppm)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152.06
143.68
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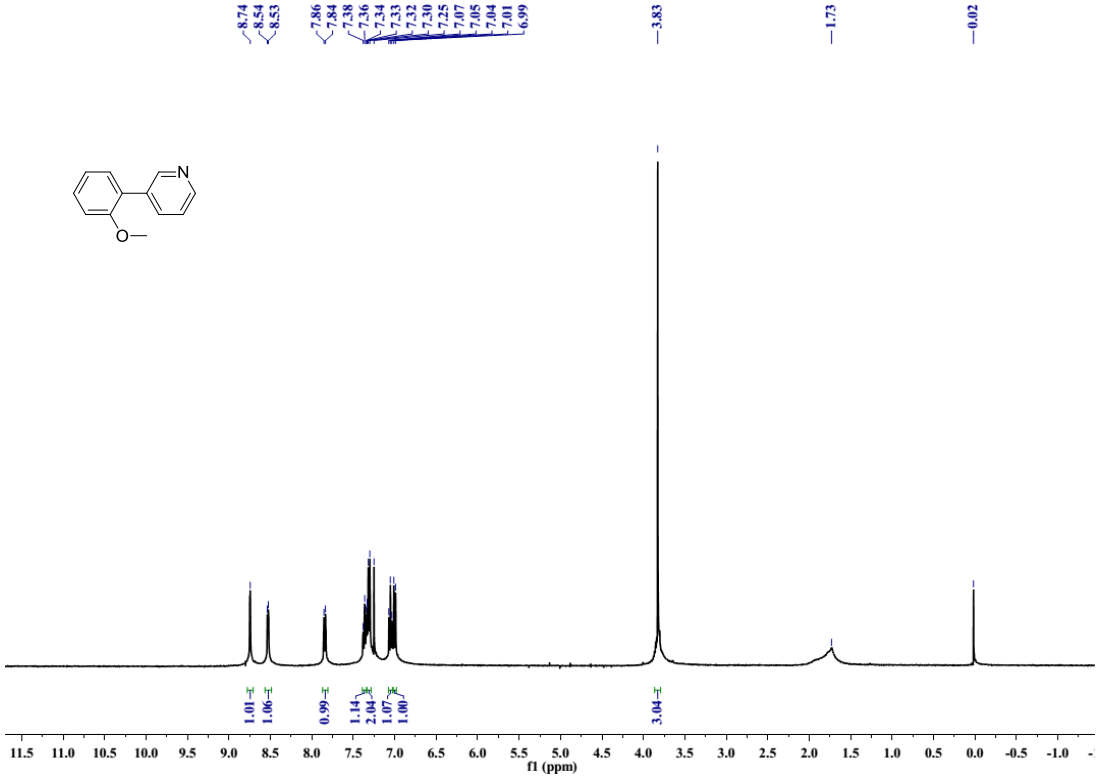
141.26
128.47
127.95
114.11
77.21
77.00
76.78
55.02
O
N
N
f1 (ppm)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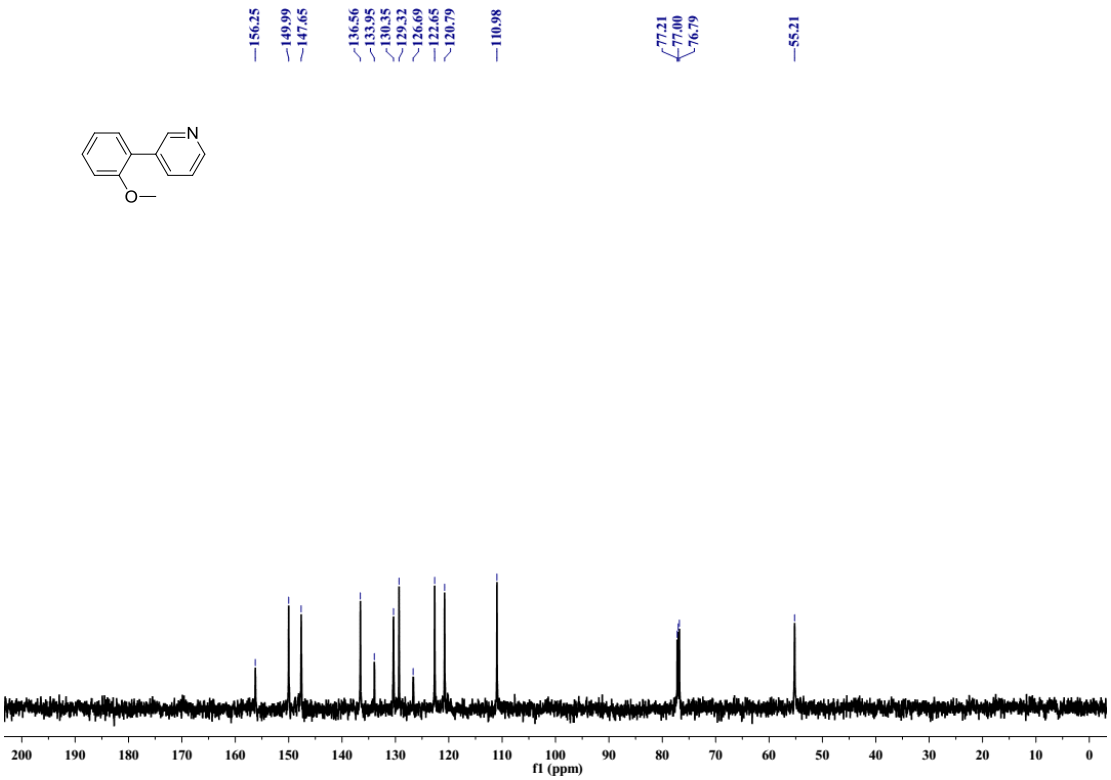
7.84
7.38
7.36
7.34
7.33
7.32
7.30
7.25
7.07
7.05
7.04
7.01
6.99
3.83
1.73
0.02
N
O
1.01
1.06
0.99
1.14
2.04
1.07
1.00
3.04
f1 (ppm)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147.65
136.56
133.95
130.35
129.32
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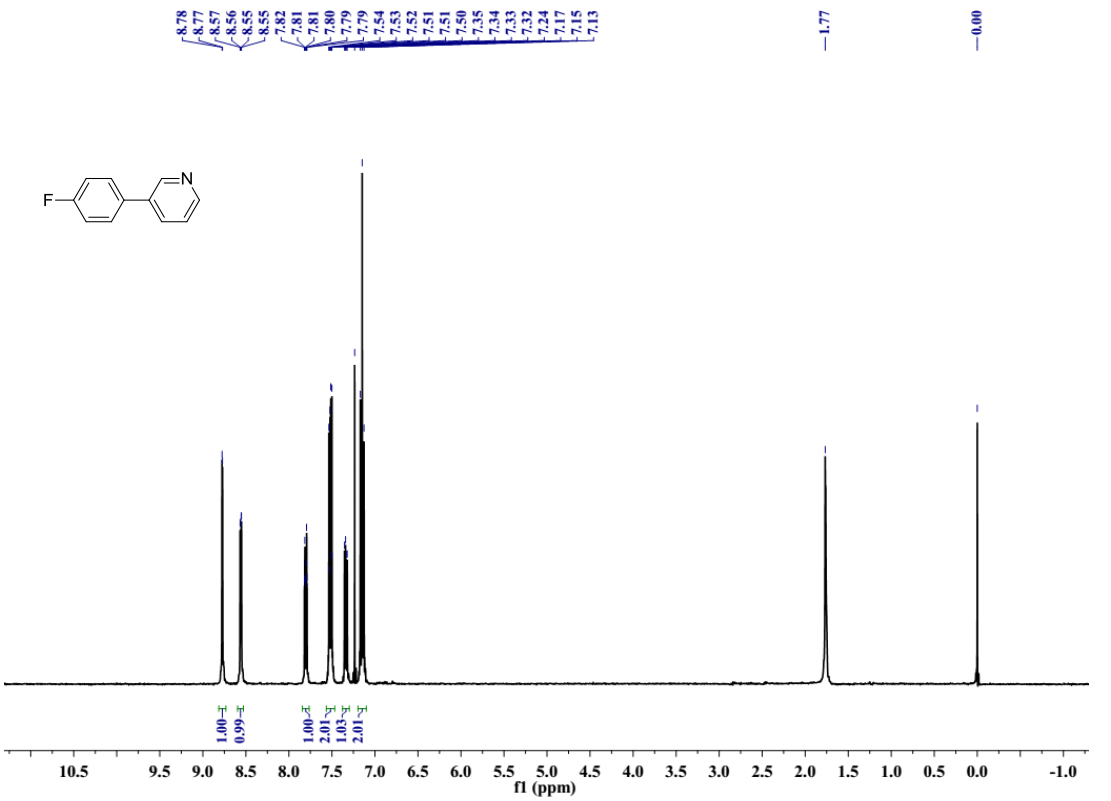
122.65
120.79
110.98
77.21
77.00
76.79
55.21
N
O
f1 (ppm)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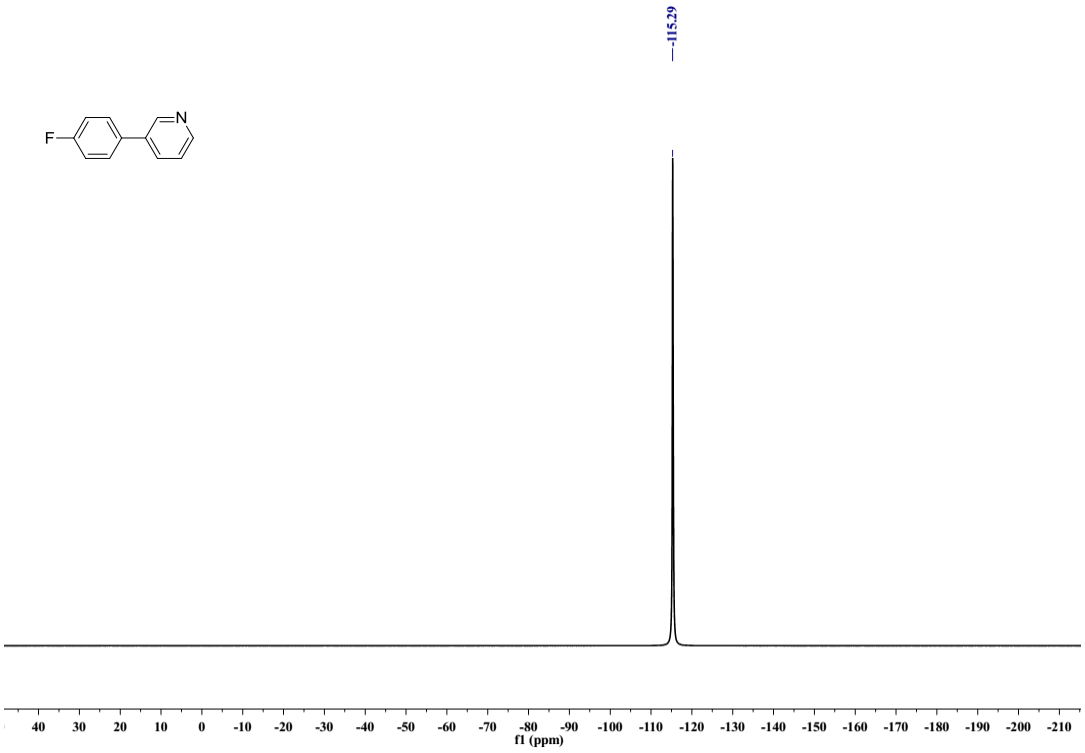
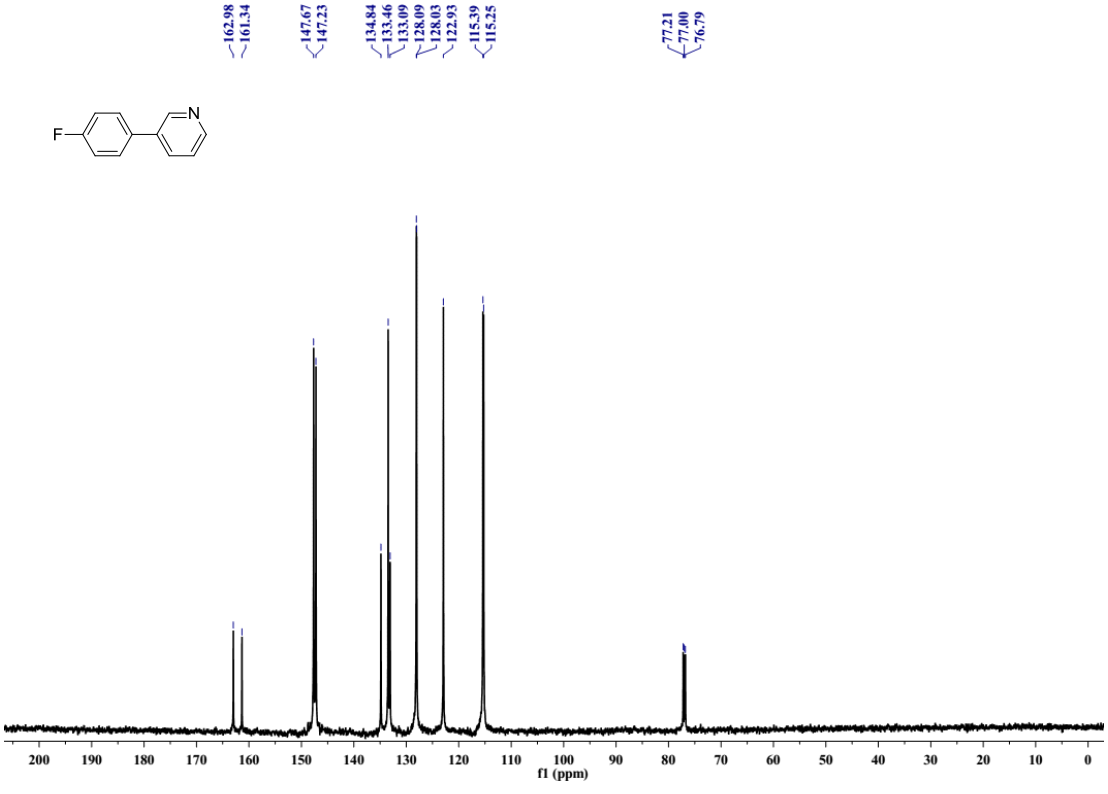
8.77
8.57
8.56
8.55
8.55
7.82
7.81
7.81
7.80
7.79
7.79
7.54
7.53
7.52
7.51
7.51
7.50
7.35
7.34
7.33
7.32
7.24
7.17
7.15
7.13
1.77
0.00
F
N
1.00
0.99
1.00
2.01
1.03
2.01
f1 (ppm)


F
N
-115.29
40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


162.98
161.34
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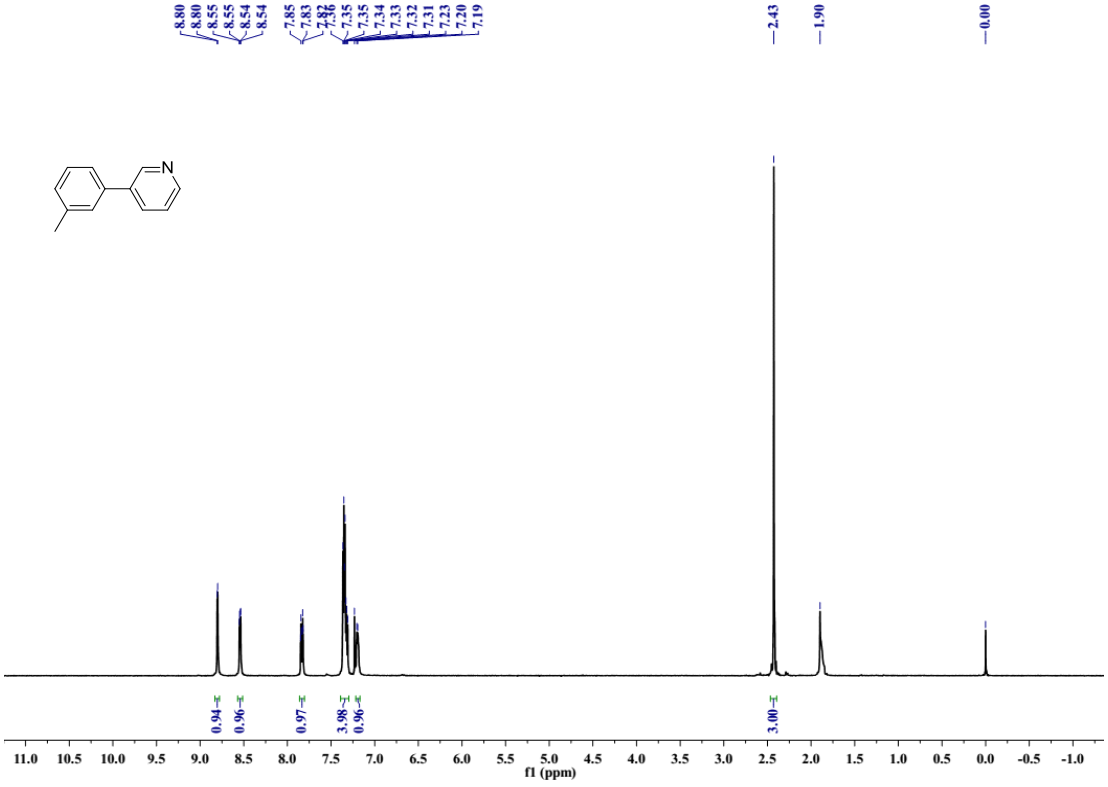
147.23
134.84
133.46
133.09
128.09
128.03
122.93
115.39
115.25
77.21
77.00
76.79
F
N
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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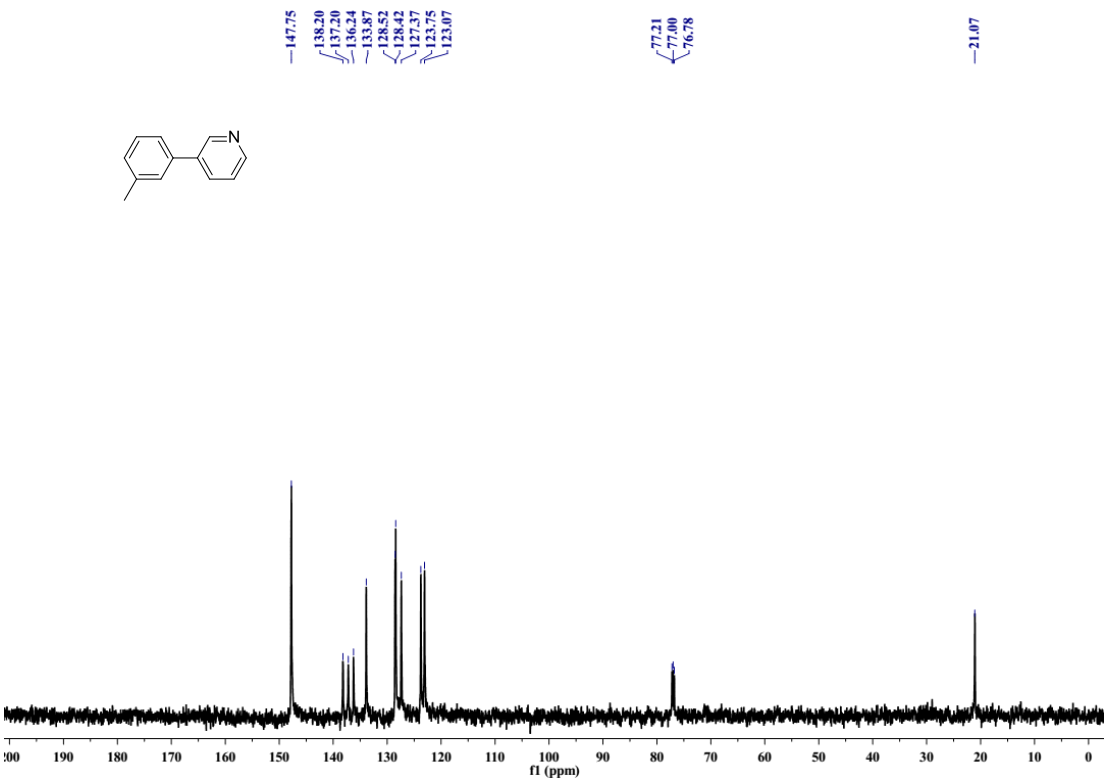
8.80
8.55
8.55
8.54
8.54
7.85
7.83
7.35
7.35
7.34
7.33
7.32
7.31
7.23
7.20
7.19
2.43
1.90
0.00
N
0.94
0.96
0.97
3.98
0.96
3.00
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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137.20
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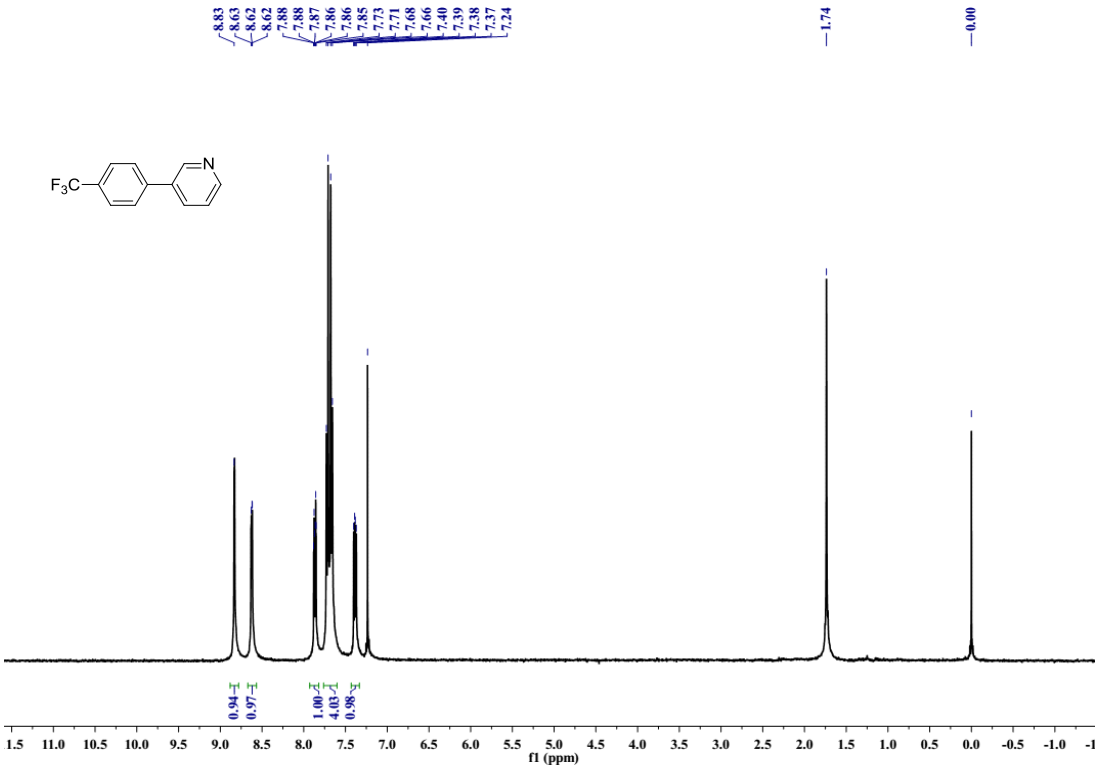
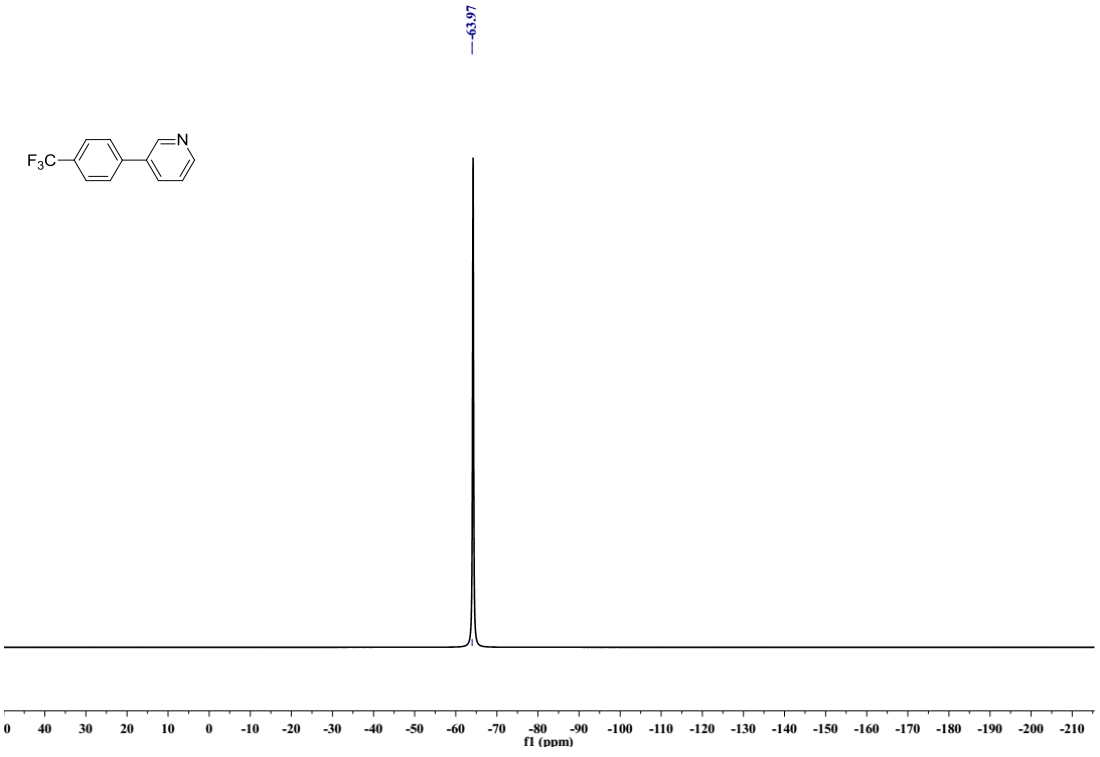
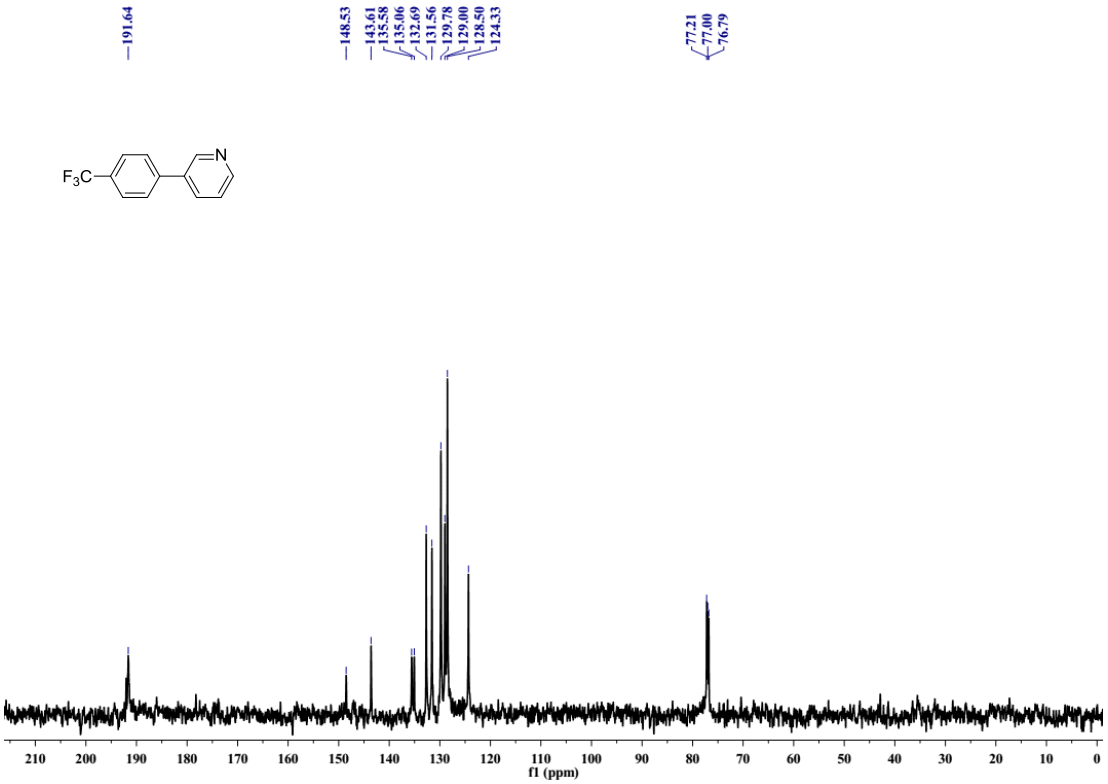
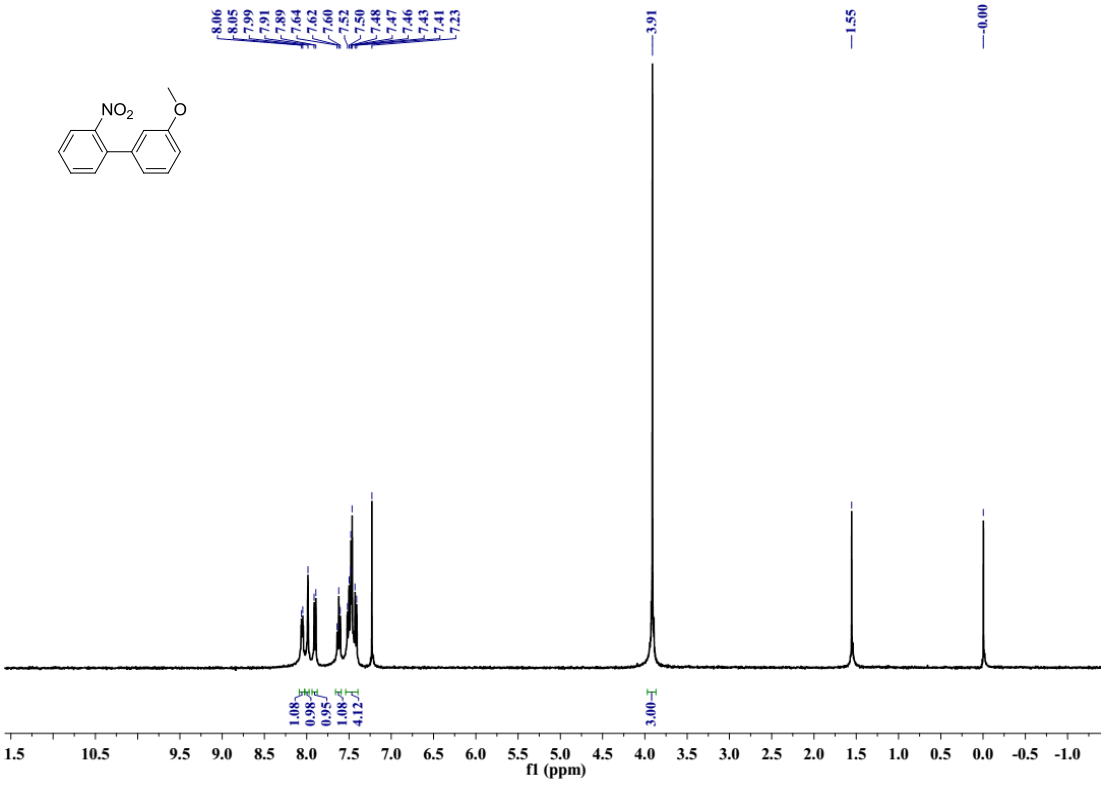
133.87
128.52
128.42
127.37
123.75
123.07
77.21
77.00
76.78
21.07
N
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


8.83
8.63
8.62
8.62
7.88
7.87
7.86
7.86
7.85
7.73
7.71
7.68
7.66
7.40
7.39
7.38
7.37
7.24
1.74
0.00
F3C
N
0.94
0.97
1.00
4.03
0.98
f1 (ppm)


-63.97
F3C
N
f1 (ppm)


191.64
148.53
143.61
135.58
135.06
132.69
131.56
129.78
129.00
128.50
124.33
77.21
77.00
76.79
F3C
N
f1 (ppm)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7.89
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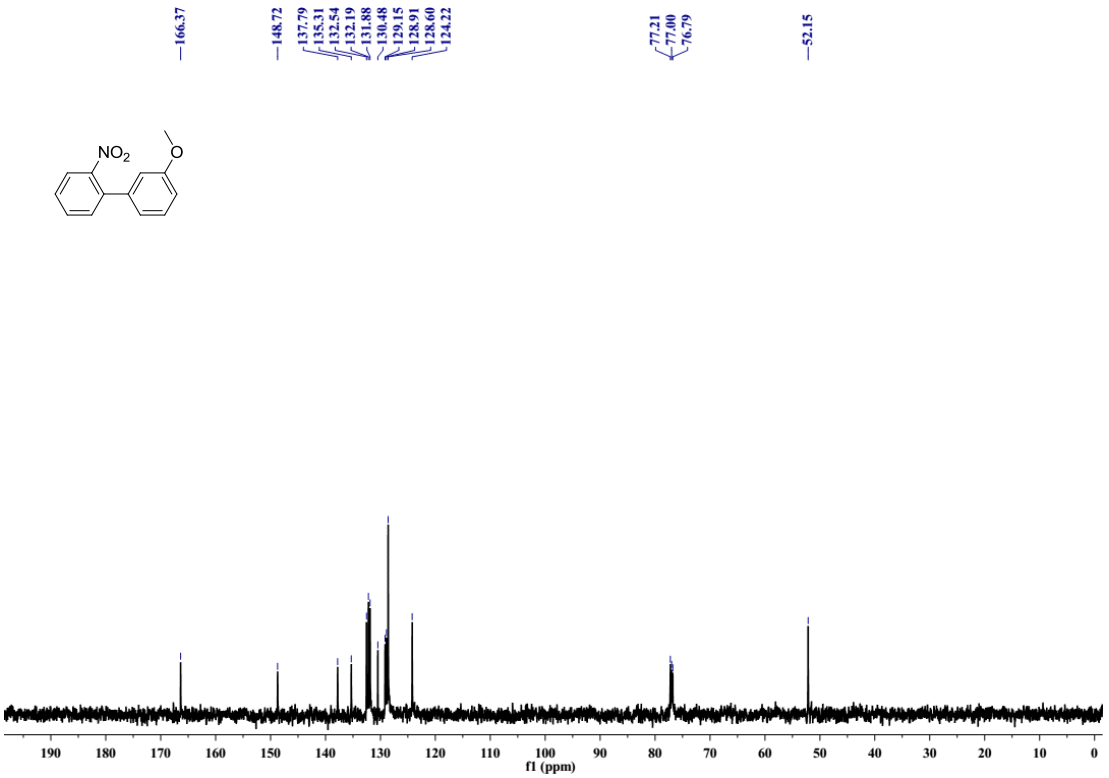
7.62
7.60
7.52
7.50
7.48
7.47
7.46
7.43
7.41
7.23
3.91
1.55
0.00
NO2
O
1.08
0.98
0.95
1.08
4.12
3.00
f1 (ppm)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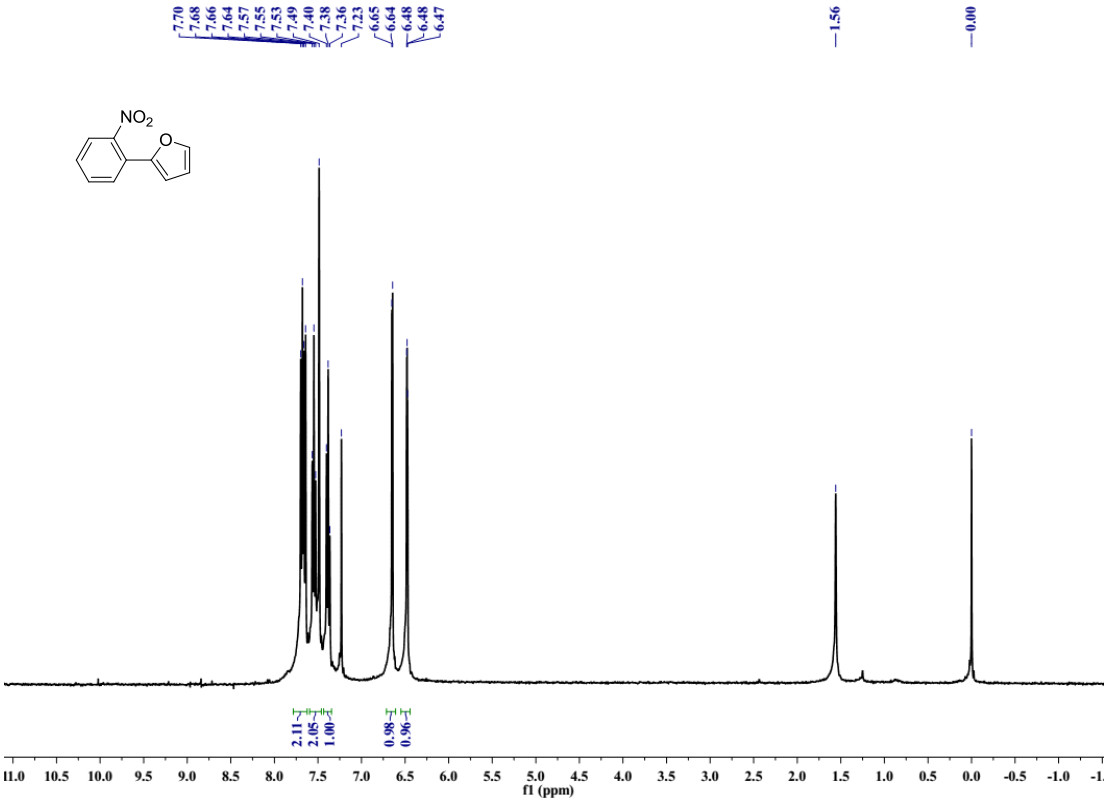
135.31
132.54
132.19
131.88
130.48
129.15
128.91
128.60
124.22
77.21
77.00
76.79
52.15
NO2
O
f1 (ppm)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7.66
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7.57
7.55
7.53
7.49
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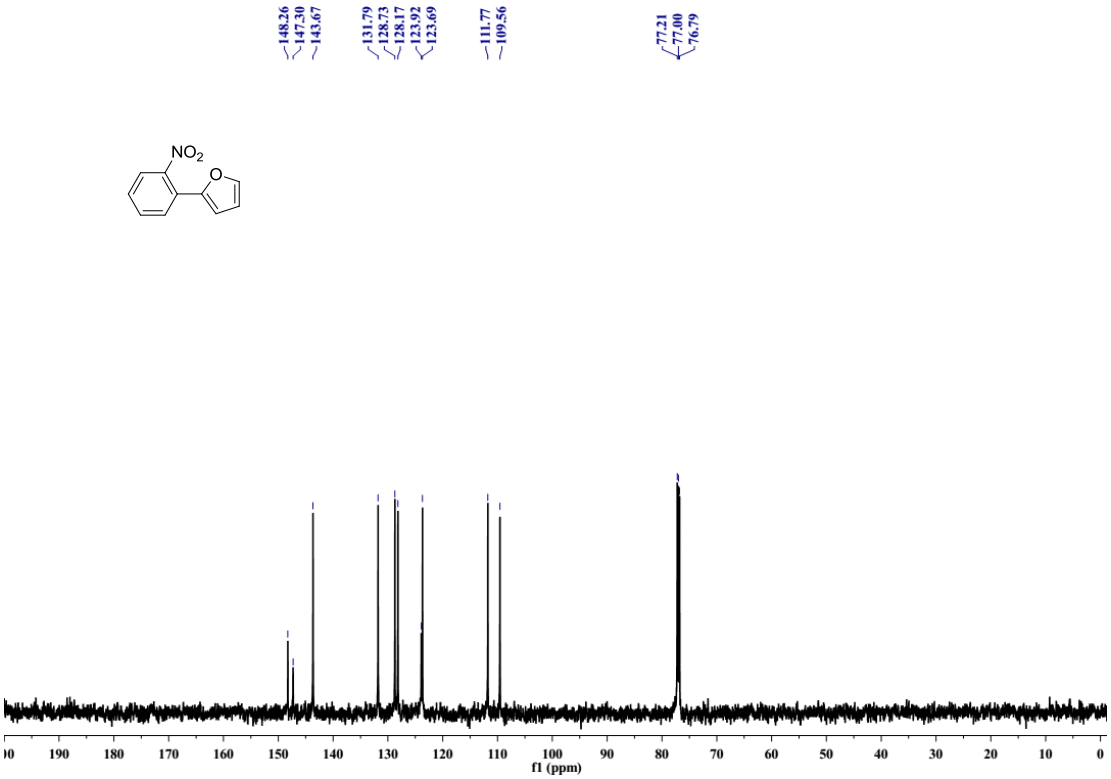
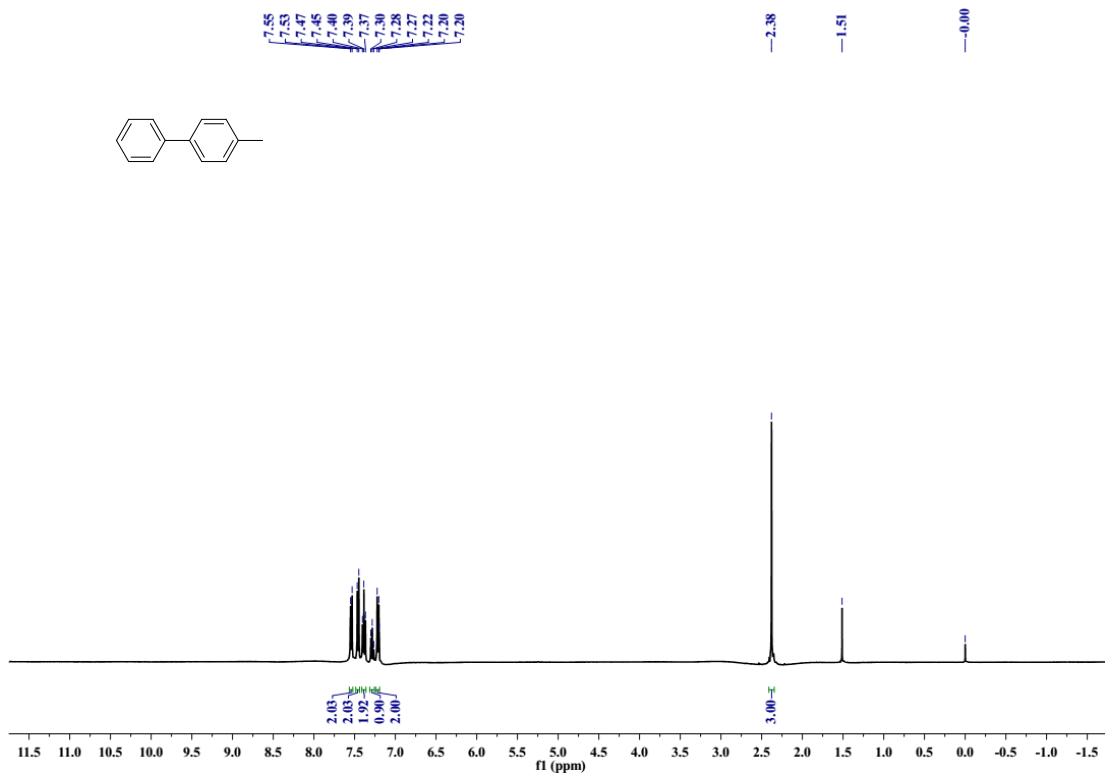
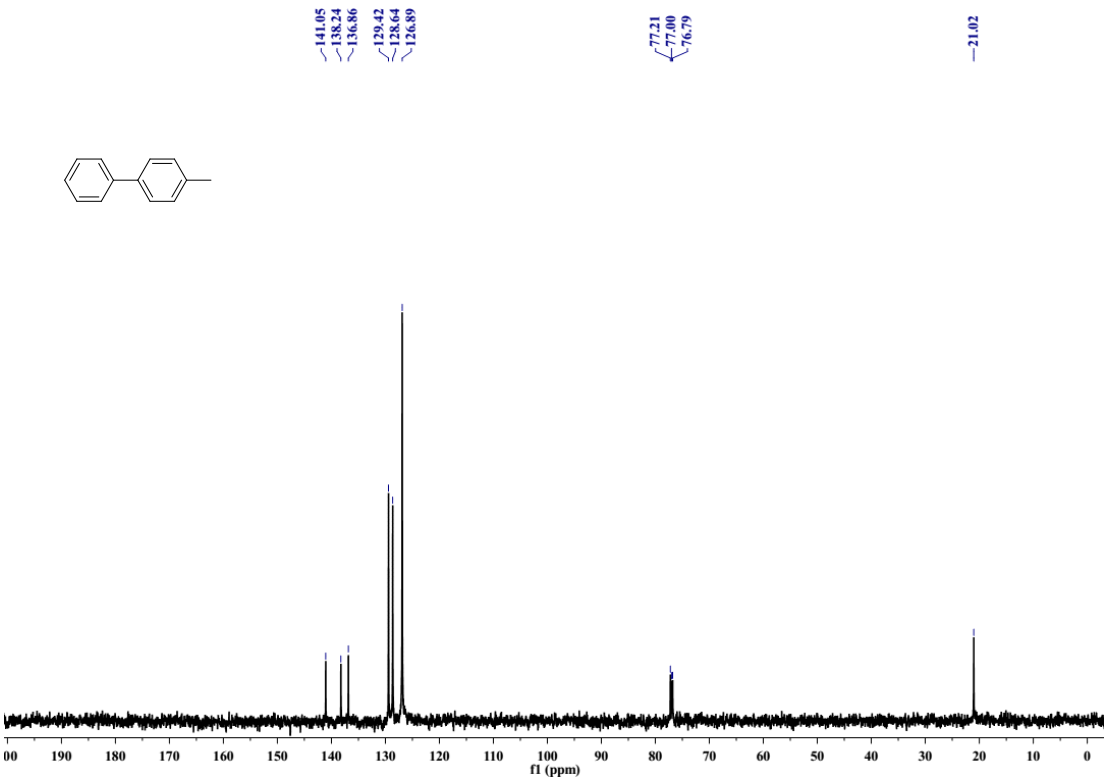
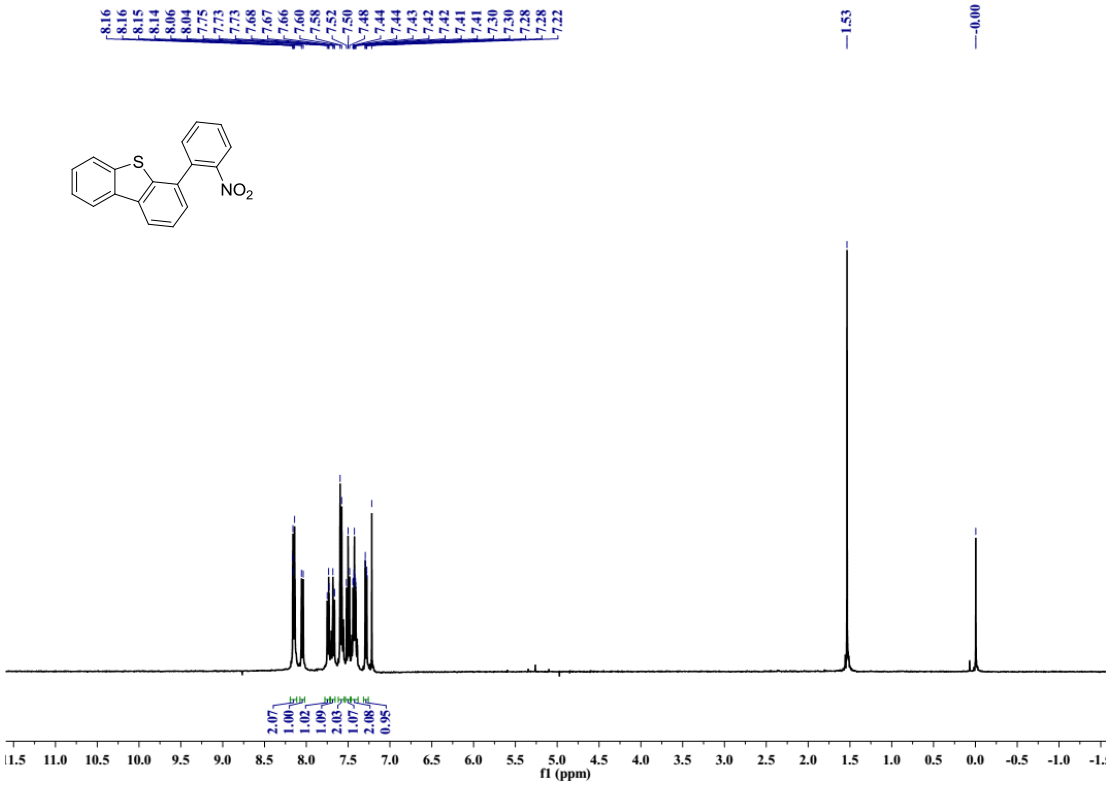
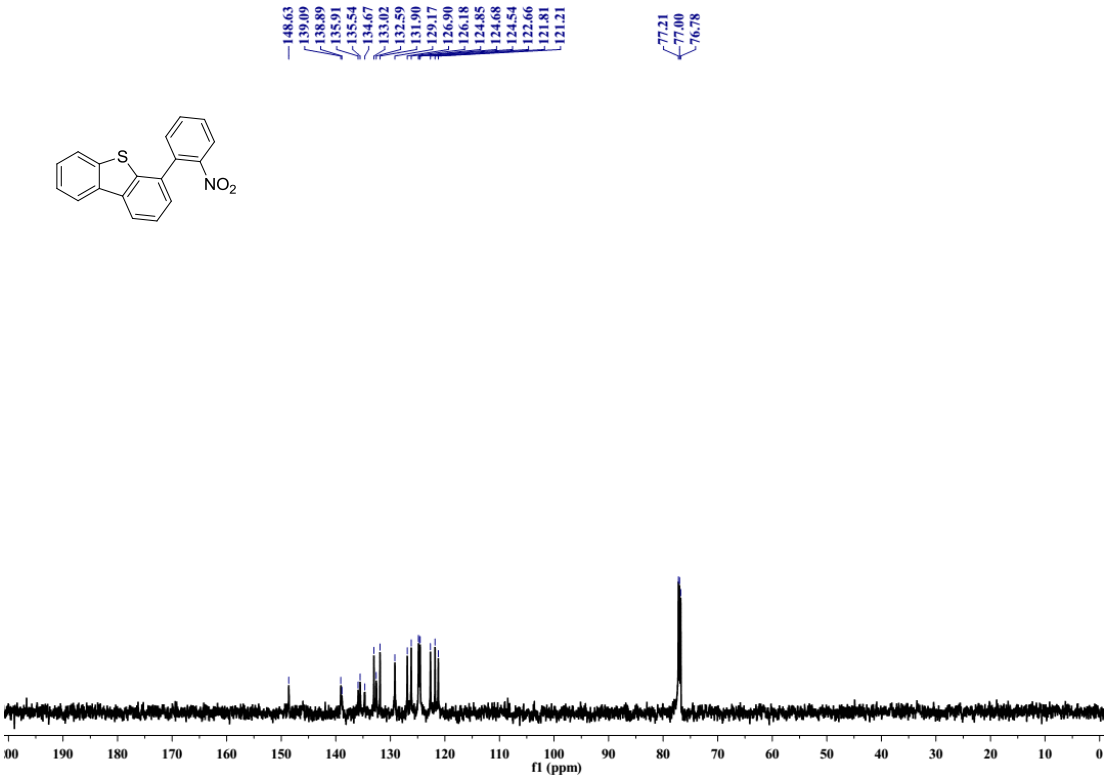
7.38
7.36
7.23
6.65
6.64
6.48
6.47
1.56
0.00
NO2
O
2.11
2.05
1.00
0.98
0.96
f1 (ppm)


148.26
147.30
143.67
131.79
128.73
128.17
123.92
123.69
111.77
109.56
77.21
77.00
76.79
NO2
O
f1 (ppm)


7.55
7.53
7.47
7.45
7.40
7.39
7.37
7.30
7.28
7.27
7.22
7.20
7.20
2.38
1.51
0.00
2.03
2.03
1.92
0.90
2.00
3.00
f1 (ppm)


141.05
138.24
136.86
129.42
128.64
126.89
77.21
77.00
76.79
21.02
f1 (ppm)


8.16
8.16
8.15
8.14
8.06
8.04
7.75
7.73
7.73
7.68
7.67
7.66
7.60
7.58
7.52
7.50
7.48
7.44
7.44
7.43
7.42
7.42
7.41
7.41
7.30
7.30
7.28
7.28
7.22
1.53
0.00
S
NO2
2.07
1.00
1.02
1.09
2.03
1.07
2.08
0.95
f1 (ppm)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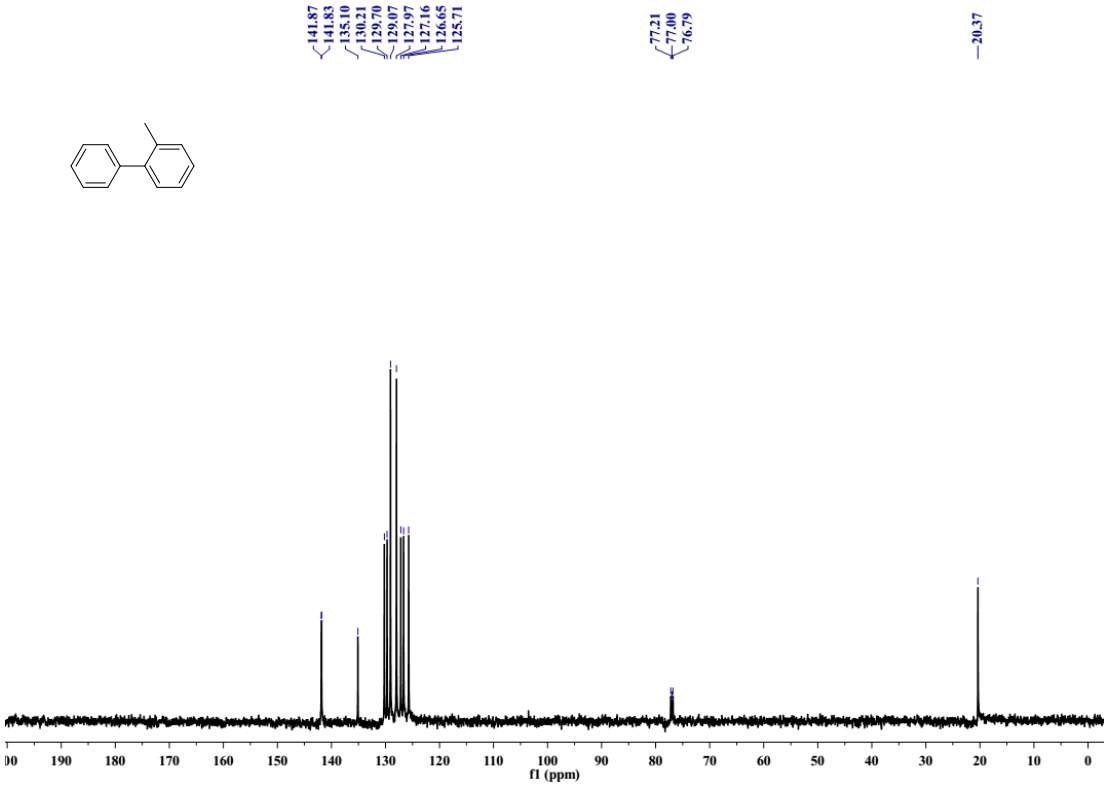
139.09
138.89
135.91
135.54
134.67
133.02
132.59
131.90
129.17
126.90
126.18
124.85
124.68
124.54
122.66
121.81
121.21
77.21
77.00
76.78
S
NO2
f1 (ppm)
7.40
7.40
7.39
7.38
7.37
7.37
7.36
7.33
7.32
7.31
7.30
7.29
7.29
7.25
7.24
7.24
7.24
7.23
7.22
7.22
7.21
7.21
7.21
2.27
1.53
0.00
2.03
3.00
2.09
2.02
3.04
f1 (ppm)


141.87
141.83
135.10
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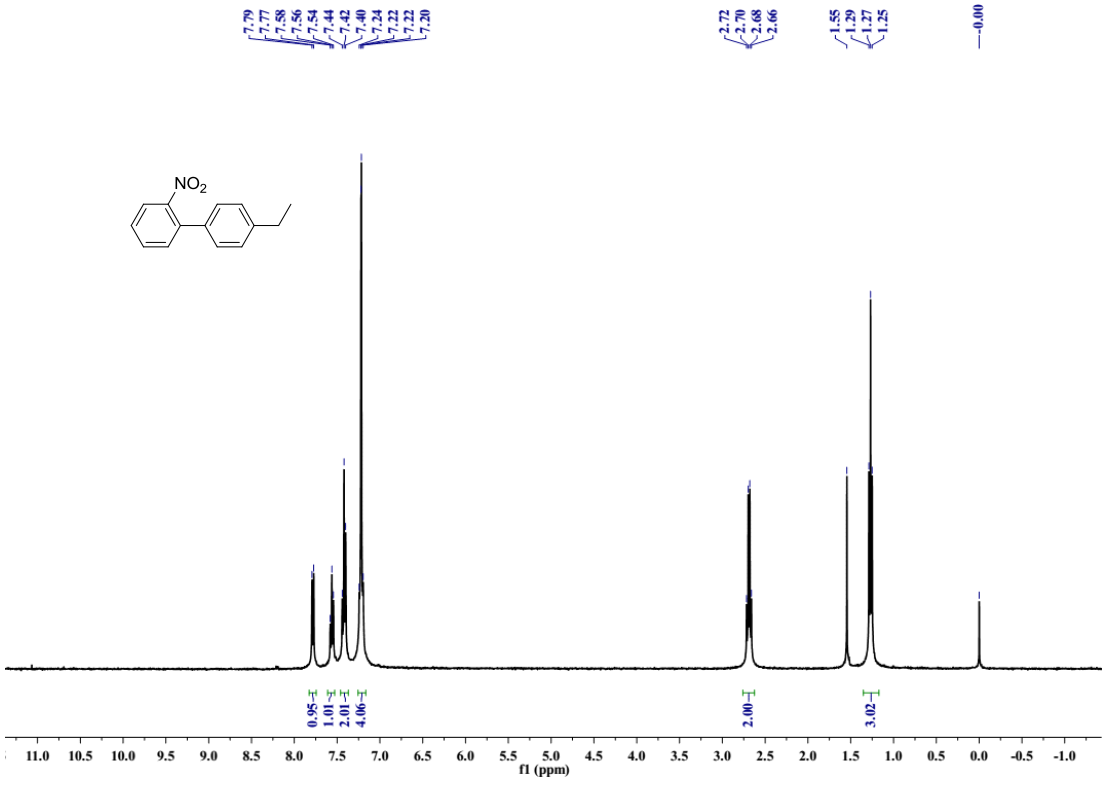
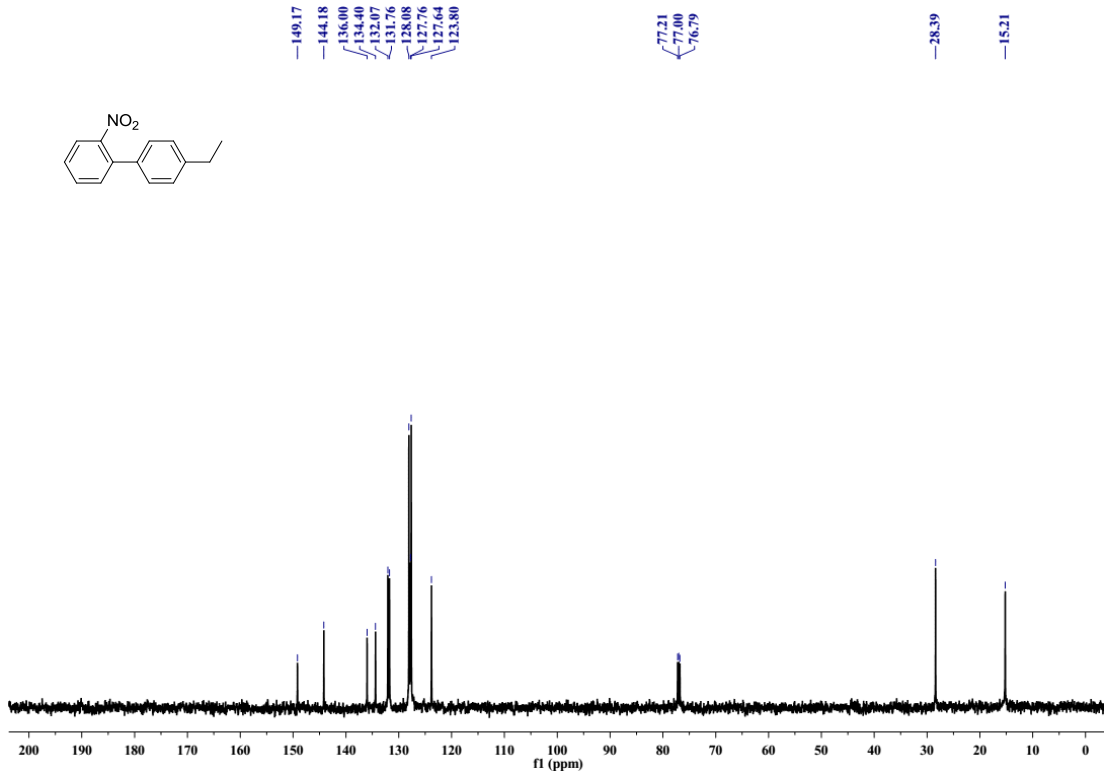
129.70
129.07
127.97
127.16
126.65
125.71
77.21
77.00
76.79
20.37
f1 (ppm)


7.79
7.77
7.58
7.56
7.54
7.44
7.42
7.40
7.24
7.22
7.22
7.20
2.72
2.70
2.68
2.66
1.55
1.29
1.27
1.25
0.00
NO2
0.95
1.01
2.01
4.06
2.00
3.02
f1 (ppm)



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