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SUPPORTING INFORMATION

Metal-free intramolecular hydroarylation of alkynes

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Part I Experimental Part

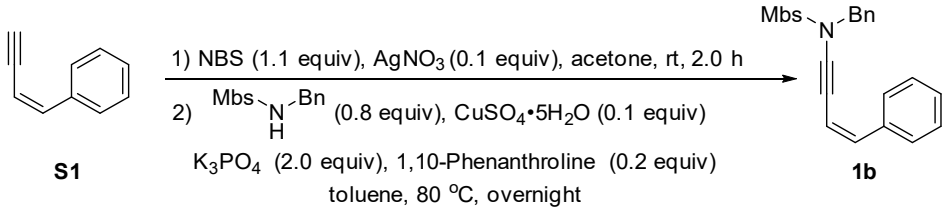
General Information

Unless otherwise indicated, all reactions were performed in oven-dried glassware under a nitrogen atmosphere. Solvents were distilled prior to use. Chromatographic separations were performed using 200~300 mesh silica gel. ^{1}H NMR and ^{13}C NMR spectra were obtained on Bruker's Ascend^{TM} 400 NMR spectrometer using $CDCl_3$ as solvent with TMS or residual solvent as standard unless otherwise noted. ^{13}C NMR (100 MHz) spectra were reported in ppm with the internal chloroform signal at 77.2 ppm as a standard. Infrared spectra were obtained on a PerkinElmer FT/IR spectrophotometer and relative intensities are expressed qualitatively as s (strong), m (medium), and w (weak). TLC analysis was performed using 254 nm polyester-backed plates and visualized using UV and $KMnO_4$ stain. High-resolution mass spectra (HRMS) were performed on a Bruker MicrOTOF-Q II mass spectrometer.

1.1 Synthesis of *C*-Terthered Arene-Ynamides 1.

C-Terthered arene-ynamides **1a**,[1] **1k**,[2] **1n**,[2] **1o**,[3] **1p**,[4] **1r**,[5] **1t**[2] and **1u**[1] were known compounds and synthesized according to corresponding literatures, the data were matched with reported values. *C*-Terthered arene-ynamides **1b**–**1j**, **1l**, **1m**, **1q**, **1s**, **1v** and **1w** was new compounds and synthesized according to Hsung's method.[4]

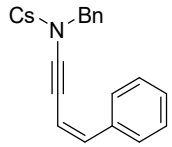
Synthesis of *C*-Terthered Arene-Ynamides 1b–1j, 1l, 1m, 1q, 1s, 1v and 1w.[4]



To an oven-dried round bottomed flask were added *Z*-phenylvinylacetylene (1.3 g, 10.0 mmol), acetone (25.0 mL, 0.4 *M*) and NBS (2.0 g, 11.0 mmol), then $AgNO_3$ (169.4 mg, 1.0 mmol) was added to the reaction mixture at rt. After the reaction mixture was stirred for 2.0 h, the acetone was removed under the reduced pressure. Then the reaction mixture was filtered through a pad of silica gel, washed with petroleum ether, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the Br-terminated enyne (2.1 g, 9.90 mmol, 99% yield). To an oven-dried round-bottomed flask was added amide (332.9 mg, 1.20 mmol), $CuSO_4 \cdot 5H_2O$ (37.5 mg, 0.15 mmol), 1,10-phenanthroline (54.2 mg, 0.3 mmol) , K_3PO_4 (636.9 mg,

3.0 mmol), toluene (15.0 mL, 0.1 *M*), and the Br-terminated enyne (310.7 mg, 1.5 mmol). Then the reaction mixture was stirred at 80 °C overnight. After the reaction was judged to be complete by TLC, the mixture was cooled to rt, filtered through a pad of silica gel, and purified by flash silica gel column chromatrography [isocratic eluent: 30:1 petroleum ether/EtOAc + 3% NEt_3] to afford terthered arene-ynamide **1b** (466.1 mg, 1.16 mmol, 77% yield).

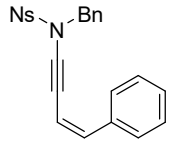
1b: R_f = 0.18 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 85–86 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79-7.76 (m, 2H), 7.69-7.66 (m, 2H), 7.33-7.27 (m, 6H), 7.26-7.23 (m, 2H), 6.92-6.88 (m, 2H), 6.46 (d, 1H, J = 12.0 Hz), 5.70 (d, 1H, J = 11.9 Hz), 4.59 (s, 2H), 3.84 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 136.6, 135.6, 134.7, 129.9, 129.4, 128.8, 128.6, 128.5, 128.4, 128.2, 114.5, 106.7, 89.6, 71.1, 55.85, 55.75, one carbon missing due to overlap; IR (neat) (cm^{-1}) 3069w, 2214w, 1594m, 1361s, 1267m, 1158s; HRMS (ESI): m/z calcd for $C_{24}H_{21}NO_3SNa$ $[M+Na]^+$ 426.1134, found 426.1136.



1c

C-Terthered arene-ynamide **1c** (562.9 mg, 1.38 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (338.1 mg, 1.20 mmol) in 92% yield.

1c: R_f = 0.45 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 54–55 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73-7.66 (m, 4H), 7.39-7.36 (m, 2H), 7.31-7.26 (m, 8H), 6.51 (d, 1H, J = 11.9 Hz), 5.70 (d, 1H, J = 11.9 Hz), 4.62 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.5, 136.5, 136.4, 136.3, 134.3, 129.6, 129.0, 128.9, 128.7, 128.5, 128.42, 128.37, 106.5, 88.6, 71.2, 56.1, one carbon missing due to overlap; IR (neat) (cm^{-1}) 3091w, 2215w, 1396w, 1166s, 1083m; HRMS (ESI): m/z calcd for $C_{23}H_{18}ClNO_2SNa$ $[M+Na]^+$ 430.0639, found 430.0632.

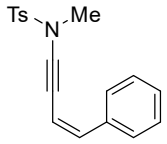


1d

C-Terthered arene-ynamide **1d** (470.8 mg, 1.13 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (350.8 mg, 1.20 mmol) in 75% yield.

1d: R_f = 0.27 [10:1 petroleum ether/EtOAc]; yellow solid; mp = 50–51 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19-8.16 (m, 2H), 7.89-7.86 (m, 2H), 7.69-7.66 (m, 2H), 7.34-7.27 (m, 8H), 6.57 (d, 1H, J = 11.9 Hz), 5.71 (d, 1H, J = 11.9 Hz), 4.68 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 150.6, 143.2, 137.3, 136.5, 134.0, 128.94, 128.86, 128.8, 128.6, 128.5, 124.3, 106.2, 87.6, 71.3, 56.5, two carbons

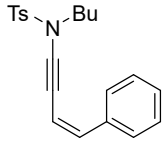
missing due to overlap; IR (neat) (cm^{-1}) 3101w, 2223w, 1808w, 1605w, 1346s, 1170s; HRMS (ESI): m/z calcd for $C_{23}H_{18}N_2O_4SNa$ $[M+Na]^+$ 441.0879, found 441.0872.



1e

C-Terthered arene-ynamide **1e** (191.5 mg, 0.62 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (222.3 mg, 1.20 mmol) in 41% yield.

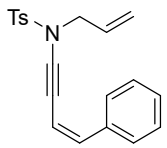
1e: R_f = 0.32 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 63–64 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83-7.77 (m, 4H), 7.37 (t, 2H, J = 7.5 Hz), 7.31-7.28 (m, 3H), 6.53 (d, 1H, J = 11.9 Hz), 5.74 (d, 1H, J = 11.9 Hz), 3.15 (s, 3H), 2.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.1, 136.7, 135.9, 133.5, 130.1, 128.5, 128.4, 128.3, 127.8, 106.7, 90.4, 69.2, 39.2, 21.8; IR (neat) (cm^{-1}) 2937w, 2219w, 1446w, 1361s, 1167s, 1028m; HRMS (ESI): m/z calcd for $C_{18}H_{17}NO_2SNa$ $[M+Na]^+$ 334.0872, found 334.0877.



1f

C-Terthered arene-ynamide **1f** (318.1 mg, 0.90 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (272.8 mg, 1.20 mmol) in 60% yield.

1f: R_f = 0.42 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 42–43 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.90-7.83 (m, 4H), 7.45 (d, 2H, J = 8.1 Hz), 7.40-7.29 (m, 3H), 6.60 (d, 1H, J = 12.0 Hz), 5.86 (d, 1H, J = 12.0 Hz), 3.47 (t, 2H, J = 7.1 Hz), 2.44 (s, 3H), 1.71-1.64 (m, 2H), 1.43-1.34 (m, 2H), 0.92 (t, 3H, J = 7.4 Hz); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 146.0, 137.6, 136.0, 135.7, 130.8, 129.2, 129.1, 129.0, 128.2, 107.3, 90.2, 71.2, 52.1, 30.7, 21.5, 20.0, 13.8; IR (neat) (cm^{-1}) 2955w, 2207m, 1493w, 1352s, 1168s; HRMS (ESI): m/z calcd for $C_{21}H_{23}NO_2SNa$ $[M+Na]^+$ 376.1342, found 376.1342.

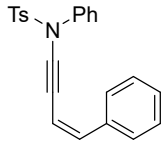


1g

C-Terthered arene-ynamide **1g** (308.8 mg, 0.92 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (253.5 mg, 1.20 mmol) in 61% yield.

1g: R_f = 0.33 [10:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ

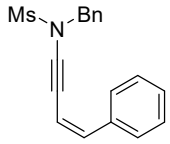
7.81-7.77 (m, 4H), 7.35-7.26 (m, 5H), 6.51 (d, 1H, J = 12.0 Hz), 5.82-5.72 (m, 2H), 5.31-5.22 (m, 2H), 4.05 (dt, 2H, J = 6.3, 1.2 Hz), 2.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.0, 136.7, 135.7, 135.0, 131.1, 130.0, 128.5, 128.4, 128.3, 127.7, 120.2, 106.8, 89.1, 70.9, 54.5, 21.8; IR (neat) (cm^{-1}) 2922w, 2211m, 1493w, 1365s, 1167s; HRMS (ESI): m/z calcd for $C_{20}H_{19}NO_2SNa$ $[M+Na]^+$ 360.1029, found 360.1029.



1h

C-Terthered arene-ynamide **1h** (140.1 mg, 0.38 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (296.8 mg, 1.20 mmol) in 25% yield.

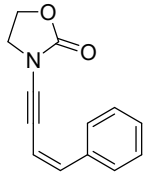
1h: R_f = 0.37 [10:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.87-7.84 (m, 2H), 7.62-7.59 (m, 2H), 7.49-7.39 (m, 5H), 7.36-7.30 (m, 5H), 6.67 (d, 1H, J = 12.0 Hz), 5.88 (d, 1H, J = 12.0 Hz), 2.43 (s, 3H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 146.6, 139.5, 137.4, 137.0, 134.0, 130.7, 130.2, 129.5, 129.2, 129.1, 129.0, 128.7, 127.1, 107.0, 90.4, 70.7, 21.5; IR (neat) (cm^{-1}) 3024w, 2211m, 1488m, 1371s, 1172s; HRMS (ESI): m/z calcd for $C_{23}H_{19}NO_2SNa$ $[M+Na]^+$ 396.1029, found 396.1025.



1i

C-Terthered arene-ynamide **1i** (369.0 mg, 1.19 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (222.3 mg, 1.20 mmol) in 79% yield.

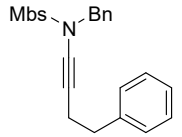
1i: R_f = 0.18 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 53–54 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, 2H, J = 7.2 Hz), 7.47-7.27 (m, 8H), 6.55 (d, 1H, J = 11.9 Hz), 5.77 (d, 1H, J = 11.9 Hz), 4.71 (s, 2H), 2.89 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 136.6, 136.3, 134.7, 129.1, 128.92, 128.86, 128.5, 128.4, 128.3, 106.5, 88.4, 71.5, 55.9, 39.3; IR (neat) (cm^{-1}) 3019w, 2209m, 1493w, 1349s, 1162s; HRMS (ESI): m/z calcd for $C_{18}H_{17}NO_2SNa$ $[M+Na]^+$ 334.0872, found 334.0878.



1j

C-Terthered arene-ynamide **1j** (73.6 mg, 0.35 mmol) was prepared from enyne **S1** (192.3 mg, 1.50 mmol) and the corresponding amide (104.5 mg, 1.20 mmol) in 23% yield.

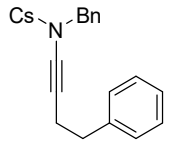
1j: R_f = 0.55 [1:1 petroleum ether/EtOAc]; pale yellow solid; mp = 43–44 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.98-7.96 (m, 2H), 7.39-7.35 (m, 2H), 7.32-7.27 (m, 1H), 6.64 (d, 1H, J = 12.0 Hz), 5.86 (d, 1H, J = 12.0 Hz), 4.59-4.55 (m, 2H), 4.12-4.08 (m, 2H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 156.6, 137.5, 136.4, 129.2, 129.1, 129.0, 107.0, 88.3, 71.3, 64.5, 47.2; IR (neat) (cm^{-1}) 2988w, 2224m, 1757s, 1474m, 1391s, 1178m; HRMS (ESI): m/z calcd for $C_{13}H_{11}NO_2Na$ $[M+Na]^+$ 236.0682, found 236.0690.



1l

C-Terthered arene-ynamide **1l** (590.0 mg, 1.46 mmol) was prepared from 4-phenyl-1-butyne (0.21 mL, 1.50 mmol) and the corresponding amide (332.8 mg, 1.20 mmol) in 97% yield.

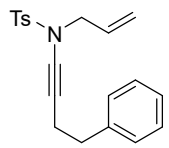
1l: R_f = 0.17 [10:1 petroleum ether/EtOAc]; white solid; mp = 42–43 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.80-7.76 (m, 2H), 7.34-7.09 (m, 12H), 4.40 (s, 2H), 3.92 (s, 3H), 2.68 (t, 2H, J = 7.1 Hz), 2.47 (t, 2H, J = 7.1 Hz); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 173.3, 164.6, 142.3, 138.6, 132.2, 131.1, 129.3, 129.2, 129.1, 128.1, 128.0, 126.6, 115.1, 56.2, 50.0, 35.8, 35.2, 26.9; IR (neat) (cm^{-1}) 3032w, 2248w, 1596m, 1261s, 1160s, 1024m; HRMS (ESI): m/z calcd for $C_{24}H_{23}NO_3SNa$ $[M+Na]^+$ 428.1291, found 428.1284.



1m

C-Terthered arene-ynamide **1m** (559.6 mg, 1.37 mmol) was prepared from 4-phenyl-1-butyne (0.21 mL, 1.50 mmol) and the corresponding amide (338.1 mg, 1.20 mmol) in 91% yield.

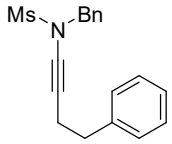
1m: R_f = 0.39 [10:1 petroleum ether/EtOAc]; white solid; mp = 38–39 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.82-7.78 (m, 2H), 7.63-7.60 (m, 2H), 7.32-7.14 (m, 10H), 4.46 (s, 2H), 2.70 (t, 2H, J = 7.1 Hz), 2.50 (t, 2H, J = 7.1 Hz); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 141.4, 140.3, 137.2, 135.9, 130.25, 130.16, 129.5, 129.34, 129.25, 129.1, 129.0, 126.9, 74.9, 70.9, 56.5, 35.5, 20.7; IR (neat) (cm^{-1}) 2934w, 2258w, 1477w, 1370m, 1171s; HRMS (ESI): m/z calcd for $C_{23}H_{20}ClNO_2SNa$ $[M+Na]^+$ 432.0795, found 432.0788.



1q

C-Terthered arene-ynamide **1q** (249.5 mg, 0.74 mmol) was prepared from 4-phenyl-1-butyne (0.21 mL, 1.50 mmol) and the corresponding amide (253.5 mg, 1.20 mmol) in 49% yield.

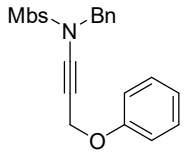
1q: R_f = 0.35 [10:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.75-7.73 (m, 2H), 7.44 (d, 2H, J = 8.1 Hz), 7.29-7.18 (m, 5H), 5.71-5.62 (m, 1H), 5.21-5.12 (m, 2H), 3.88 (dt, 2H, J = 6.2, 1.2 Hz), 2.76 (t, 2H, J = 7.2 Hz), 2.55 (t, 2H, J = 7.2 Hz), 2.46 (s, 3H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 145.5, 141.5, 135.6, 132.3, 130.6, 129.4,129.0, 128.5, 126.9, 119.7, 74.9, 70.1, 54.9, 35.8, 21.5, 20.9; IR (neat) (cm^{-1}) 2923w, 2252w, 1454w, 1362s, 1168s, 1090m; HRMS (ESI): m/z calcd for $C_{20}H_{21}NO_2SNa$ $[M+Na]^+$ 362.1185, found 362.1186.



1s

C-Terthered arene-ynamide **1s** (404.3 mg, 1.29 mmol) was prepared from 4-phenyl-1-butyne (0.21 mL, 1.50 mmol) and the corresponding amide (222.3 mg, 1.20 mmol) in 86% yield.

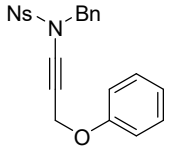
1s: R_f = 0.22 [10:1 petroleum ether/EtOAc]; white solid; mp = 35–36 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.41-7.33 (m, 5H), 7.29-7.16 (m, 5H), 4.52 (s, 2H), 2.91 (s, 3H), 2.74 (t, 2H, J = 7.1 Hz), 2.53 (t, 2H, J = 7.1 Hz); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 141.5, 136.4, 129.5,129.4, 129.3, 129.03, 128.99, 126.9, 75.2, 70.5, 56.0, 38.0, 35.6, 20.9; IR (neat) (cm^{-1}) 2932w, 2256w, 1454m, 1332s, 1154s; HRMS (ESI): m/z calcd for $C_{18}H_{19}NO_2SNa$ $[M+Na]^+$ 336.1029, found 336.1028.



1v

C-Terthered arene-ynamide **1v** (434.0 mg, 1.07 mmol) was prepared from phenyl propargyl ether (0.19 mL, 1.50 mmol) and the corresponding amide (332.8 mg, 1.20 mmol) in 71% yield.

1v: R_f = 0.17 [10:1 petroleum ether/EtOAc]; white solid; mp = 41–42 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66-7.62 (m, 2H), 7.30-7.22 (m, 7H), 6.99 (tt, 1H, J = 7.3, 1.1 Hz), 6.89-6.86 (m, 2H), 6.82-6.78 (m, 2H), 4.74 (s, 2H), 4.43 (s, 2H), 3.83 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.8, 157.6, 134.5, 129.9, 129.6, 129.1, 128.8, 128.7, 128.5, 121.3, 115.2, 114.4, 81.2, 67.4, 56.1, 55.8, 55.5; IR (neat) (cm^{-1}) 3034w, 2239w, 1593m, 1495s, 1362s, 1260s; HRMS (ESI): m/z calcd for $C_{23}H_{21}NO_4SNa$ $[M+Na]^+$ 430.1083, found 430.1065.



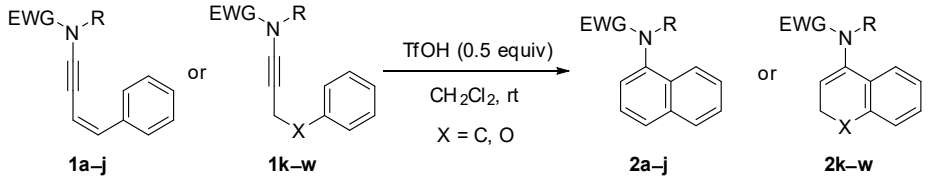
1w

C-Terthered arene-ynamide **1w** (411.9 mg, 0.98 mmol) was prepared from phenyl propargyl ether (0.19 mL, 1.50 mmol) and the corresponding amide (350.8 mg, 1.20 mmol) in 65% yield.

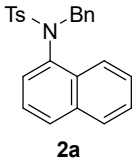
1w: R_f = 0.21 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 89–90 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 8.32-8.28 (m, 2H), 8.05-8.02 (m, 2H), 7.33-7.29 (m, 7H), 6.99 (tt, 1H, J = 7.3, 1.1 Hz), 6.93-6.91 (m, 2H), 4.87 (s, 2H), 4.64 (s, 2H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 158.3, 151.6, 143.3, 135.2, 130.3, 129.8, 129.6, 129.4, 129.3, 125.2, 121.9, 115.8, 80.6, 68.8, 56.6, 56.0; IR (neat) (cm^{-1}) 3098w, 2239w, 1598w, 1378m, 1348s, 1034m; HRMS (ESI): m/z calcd for $C_{22}H_{18}N_2O_5SNa$ $[M+Na]^+$ 445.0829, found 445.0828.

1.2 Hydroarylation of Terthered Arene-Ynamides (Table 1).

Terthered arene-ynamides **2j**,[6] **2t**[7] and **2t'**[8] were known compounds, the data were matched with reported values. Terthered arene-ynamides **2a**-**2i**, **2k**-**2s**, **2u**, **2v** and **2w** were new compounds.

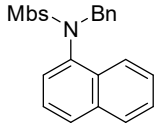


To an oven-dried sealed tube was added terthered arene-ynamide **1a** (77.5 mg, 0.20 mmol), CH_2Cl_2 (0.5 mL, 0.40 *M*) and TfOH (8.9 μL, 0.10 mmol). The reaction vessel was capped and stirred at rt for 10.0 minutes. After the reaction was judged to be complete by TLC, the mixture was quenched by Et_3N (13.9 μL, 0.10 mmol) and purified by flash silica gel column chromatography [gradient eluent: 20:1~10:1 petroleum ether/EtOAc] to afford **2a** (76.0 mg, 0.20 mmol) in 98% yield.



2a

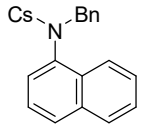
2a: R_f = 0.27 [10:1 petroleum ether/EtOAc]; white solid; mp = 96–97 °C ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, 1H, J = 9.6 Hz), 7.76-7.73 (m, 2H), 7.62-7.60 (m, 2H), 7.42-7.34 (m, 2H), 7.28-7.23 (m, 3H), 7.13-7.09 (m, 5H), 6.85 (dd, 1H, J = 7.4, 1.1 Hz), 4.99 (d, 1H, J = 13.9 Hz), 4.66 (d, 1H, J = 13.9 Hz), 2.44 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.7, 136.2, 136.03, 135.96, 134.7, 132.9, 129.7, 129.4, 129.1, 128.3, 128.2, 128.0, 127.9, 127.2, 126.6, 126.4, 124.9, 124.3, 56.5, 21.8; IR (neat) (cm^{-1}) 2849w, 1596w, 1494w, 1344s, 1156s, 1088m; HRMS (ESI): m/z calcd for $C_{24}H_{21}NO_2SNa$ $[M+Na]^+$ 410.1185, found 410.1187.



2b

Aminonaphthalene **2b** (79.1 mg, 0.20 mmol) was prepared from *C*-terthered arene-ynamide**1b** (80.7 mg, 0.20 mmol) in 98% yield after stirring at rt for 5.0 min.

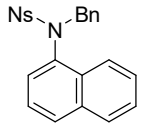
2b: R_f = 0.46 [4:1 petroleum ether/EtOAc]; pale yellow solid; mp = 115–116 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97-7.95 (m, 1H), 7.74-7.71 (m, 2H), 7.66-7.62 (m, 2H), 7.41-7.34 (m, 2H), 7.25-7.23 (m, 1H), 7.14-7.08 (m, 5H), 6.93-6.86 (m, 3H), 4.99 (d, 1H, J = 13.9 Hz), 4.65 (d, 1H, J = 13.9 Hz), 3.83 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1, 136.1, 135.9, 134.6, 132.9, 130.7, 130.2, 129.3, 129.0, 128.3, 127.9, 127.8, 127.0, 126.5, 126.4, 124.9, 124.3, 114.1, 56.4, 55.7; IR (neat) (cm^{-1}) 2923w, 1578w, 1495m, 1337m, 1155s, 1025m; HRMS (ESI): m/z calcd for $C_{24}H_{21}NO_3SNa$ $[M+Na]^+$ 426.1134, found 426.1129.



2c

Aminonaphthalene **2c** (66.1 mg, 0.16 mmol) was prepared from *C*-terthered arene-ynamide **1c** (81.6 mg, 0.20 mmol) in 81% yield after stirring at rt for 5.0 min.

2c: R_f = 0.32 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 143–144 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, 1H, J = 8.2 Hz), 7.75 (d, 2H, J = 8.1 Hz), 7.64-7.60 (m, 2H), 7.43-7.34 (m, 4H), 7.28-7.24 (m, 1H), 7.12 (s, 5H), 6.85 (dd, 1H, J = 7.3, 0.9 Hz), 4.94 (d, 1H, J = 13.9 Hz), 4.73 (d, 1H, J = 13.9 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.3, 137.7, 135.6, 135.5, 134.7, 132.6, 129.5, 129.4, 129.35, 129.30,128.4, 128.11, 128.05, 127.4, 126.8, 126.5, 125.0, 123.9, 56.5; IR (neat) (cm^{-1}) 3063w, 1585w, 1394w, 1344s, 1164s, 1084m; HRMS (ESI): m/z calcd for $C_{23}H_{18}ClNO_2SNa$ $[M+Na]^+$ 430.0639, found 430.0635.

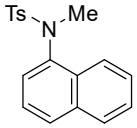


2d

Aminonaphthalene **2d** (58.6 mg, 0.14 mmol) was prepared from *C*-terthered arene-ynamide **1d** (83.7 mg, 0.20 mmol) in 70% yield after stirring at rt for 5.0 min.

2d: R_f = 0.19 [10:1 petroleum ether/EtOAc]; yellow solid; mp = 148–149 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27-8.23 (m, 2H), 7.85-7.76 (m, 5H), 7.45-7.34 (m, 2H), 7.30-7.26 (m, 1H), 7.18-7.12 (m, 5H), 6.85 (dd, 1H, J = 7.4, 0.9 Hz), 4.92 (d, 1H, J = 14.0 Hz), 4.86 (d, 1H, J = 14.0 Hz); ^{13}C NMR

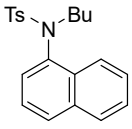
(100 MHz, $CDCl_3$) δ 150.1, 145.2, 135.3, 134.9, 134.8, 132.2, 129.8, 129.4, 129.2, 128.6, 128.35, 128.33, 127.8, 127.0, 126.7, 125.1, 124.2, 123.5, 56.8; IR (neat) (cm^{-1}) 2921w, 1595w, 1524s, 1348s, 1029m; HRMS (ESI): m/z calcd for $C_{23}H_{18}N_2O_4SNa$ $[M+Na]^+$ 441.0879, found 441.0867.



2e

Aminonaphthalene **2e** (59.8 mg, 0.19 mmol) was prepared from *C*-terthered arene-ynamide **1e** (62.3 mg, 0.20 mmol) in 96% yield after stirring at rt for 5.0 min.

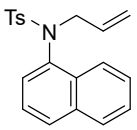
2e: R_f = 0.23 [10:1 petroleum ether/EtOAc]; white solid; mp = 118–119 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29-8.26 (m, 1H), 7.85-7.79 (m, 2H), 7.64-7.61 (m, 2H), 7.57-7.49 (m, 2H), 7.33-7.29 (m, 3H), 6.85 (dd, 1H, J = 7.4, 0.9 Hz), 3.29 (s, 3H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.8, 138.6, 134.81, 134.77, 132.4, 129.7, 128.9, 128.3, 128.1, 127.0, 126.7, 125.1, 124.9, 124.2, 39.9, 21.7; IR (neat) (cm^{-1}) 2923w, 1596w, 1342s, 1327w, 1176m, 1003m; HRMS (ESI): m/z calcd for $C_{18}H_{17}NO_2SNa$ $[M+Na]^+$ 334.0872, found 334.0876.



2f

Aminonaphthalene **2f** (63.6 mg, 0.18 mmol) was prepared from *C*-terthered arene-ynamide **1f** (70.7 mg, 0.20 mmol) in 90% yield after stirring at rt for 5.0 min.

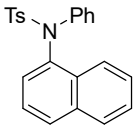
2f: R_f = 0.33 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 45–46 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24-8.22 (m, 1H), 7.84-7.80 (m, 2H), 7.59-7.57 (m, 2H), 7.54-7.47 (m, 2H), 7.34-7.30 (m, 1H), 7.25-7.24 (m, 2H), 6.86 (dd, 1H, J = 7.4, 0.8 Hz), 3.91-3.84 (m, 1H), 3.43-3.37 (m, 1H), 2.42 (s, 3H), 1.53-1.44 (m, 1H), 1.33-1.21 (m, 3H), 0.79 (t, 3H, J = 7.2 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.5, 136.6, 135.7, 134.7, 133.6, 129.6, 129.0, 128.1, 128.0, 126.8, 126.6, 125.9, 125.1, 124.5, 52.5, 30.7, 21.7, 20.1, 13.8; IR (neat) (cm^{-1}) 2871w, 1595w, 1394w, 1343s, 1163s, 1089m; HRMS (ESI): m/z calcd for $C_{21}H_{23}NO_2SNa$ $[M+Na]^+$ 376.1342, found 376.1344.



2g

Aminonaphthalene **2g** (64.1 mg, 0.19 mmol) was prepared from *C*-terthered arene-ynamide **1g** (67.5 mg, 0.20 mmol) in 95% yield after stirring at rt for 5.0 min.

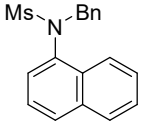
2g: R_f = 0.30 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 80–81 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20-8.17 (m, 1H), 7.84-7.79 (m, 2H), 7.63-7.60 (m, 2H), 7.54-7.47 (m, 2H), 7.33-7.26 (m, 3H), 6.88 (dd, 1H, J = 7.4, 1.2 Hz), 5.82-5.72 (m, 1H), 4.95-4.90 (m, 2H), 4.42 (tdd, 1H, J = 14.3, 6.1, 1.4 Hz), 4.14 (tdd, 1H, J = 14.3, 7.2, 1.1 Hz), 2.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.7, 136.0, 134.8, 133.3, 132.7, 129.7, 129.1, 128.14, 128.13, 126.9, 126.62, 126.59, 125.0, 124.3, 119.4, 55.3, 21.7, one carbon missing due to overlap; IR (neat) (cm^{-1}) 2920w, 1595w, 1394w, 1342s, 1156s, 1088m; HRMS (ESI): m/z calcd for $C_{20}H_{19}NO_2SNa$ $[M+Na]^+$ 360.1029, found 360.1030.



2h

Aminonaphthalene **2h** (69.5 mg, 0.19 mmol) was prepared from *C*-terthered arene-ynamide **1h** (74.7 mg, 0.20 mmol) in 93% yield after stirring at rt for 10.0 min.

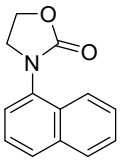
2h: R_f = 0.27 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 55–56 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36-8.33 (m, 1H), 7.83 (dd, 2H, J = 7.9, 4.3 Hz), 7.63-7.60 (m, 2H), 7.55-7.45 (m, 4H), 7.40 (t, 1H, J = 7.8 Hz), 7.33-7.23 (m, 5H), 7.19-7.14 (m, 1H), 2.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.9, 141.6, 137.4, 137.3, 135.0, 132.6, 129.7, 129.4, 129.2, 128.3, 128.2, 127.5, 127.3, 127.0, 126.9, 126.7, 125.2, 124.0, 21.7; IR (neat) (cm^{-1}) 2922w, 1594w, 1348s, 1167m, 1157s; HRMS (ESI): m/z calcd for $C_{23}H_{19}NO_2SNa$ $[M+Na]^+$ 396.1029, found 396.1025.



2i

Aminonaphthalene **2i** (59.2 mg, 0.19 mmol) was prepared from *C*-terthered arene-ynamide **1i** (62.3 mg, 0.20 mmol) in 95% yield after stirring at rt for 5.0 min.

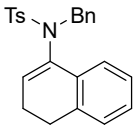
2i: R_f = 0.24 [4:1 petroleum ether/EtOAc]; white solid; mp = 88–89 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08-8.06 (m, 1H), 7.85-7.81 (m, 2H), 7.55-7.47 (m, 2H), 7.40-7.36 (m, 1H), 7.25-7.19 (m, 6H), 5.11 (d, 1H, J = 14.4 Hz), 4.69 (d, 1H, J = 14.4 Hz), 2.96 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 136.3, 135.7, 135.0, 132.1, 129.51, 129.48, 128.6, 128.5, 128.2, 128.1, 127.2, 126.7, 125.3, 123.6, 56.0, 39.8; IR (neat) (cm^{-1}) 2928w, 1595w, 1456w, 1331s, 1147s, 1040m; HRMS (ESI): m/z calcd for $C_{18}H_{17}NO_2SNa$ $[M+Na]^+$ 334.0872, found 334.0874.



2j

Aminonaphthalene **2j** (33.7 mg, 0.16 mmol) was prepared from *C*-terthered arene-ynamide **1j** (42.6 mg, 0.20 mmol) in 79% yield after stirring at rt for 10.0 min.

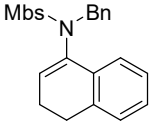
2j: R_f = 0.30 [1:1 petroleum ether/EtOAc]; white solid; mp = 118–119 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91-7.84 (m, 3H), 7.58-7.46 (m, 4H), 4.62 (t, 2H, J = 7.8 Hz), 4.07 (t, 2H, J = 7.8 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.7, 134.7, 134.1, 130.0, 128.9, 128.8, 127.1, 126.7, 125.8, 124.7, 122.5, 62.7, 49.2; IR (neat) (cm^{-1}) 2988w, 1699w, 1488m, 1415s, 1081m; HRMS (ESI): m/z calcd for $C_{13}H_{11}NO_2Na$ $[M+Na]^+$ 236.0682, found 236.0692. Spectral data are in agreement with literature values.[6]



2k

Amino-substituted dihydronaphthalene **2k** (70.9 mg, 0.18 mmol) was prepared from *C*-terthered arene-ynamide **1k** (77.9 mg, 0.20 mmol) in 91% yield after stirring at rt for 0.5 h.

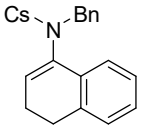
2k: R_f = 0.30 [10:1 petroleum ether/EtOAc]; white solid; mp = 61–62 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, 2H, J = 7.9 Hz), 7.27-7.19 (m, 7H), 7.11-7.01 (m, 4H), 5.60 (t, 1H, J = 4.7 Hz), 4.59 (s, 2H), 2.63 (s, 2H), 2.40 (s, 3H), 2.20 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.4, 136.7, 136.5, 136.21, 136.18, 132.3, 130.0, 129.5, 129.3, 128.3, 127.9, 127.8, 127.6, 127.4, 126.3, 123.6, 53.9, 27.3, 23.0, 21.6; IR (neat) (cm^{-1}) 2940w, 1634w, 1452w, 1336s, 1161m, 1061m; HRMS (ESI): m/z calcd for $C_{24}H_{23}NO_2SNa$ $[M+Na]^+$ 412.1342, found 412.1341.



2l

Amino-substituted dihydronaphthalene **2l** (73.0 mg, 0.18 mmol) was prepared from *C*-terthered arene-ynamide **1l** (81.1 mg, 0.20 mmol) in 90% yield after stirring at rt for 0.5 h.

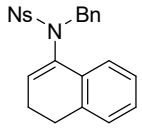
2l: R_f = 0.16 [10:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78-7.75 (m, 2H), 7.24-7.01 (m, 9H), 6.95-6.92 (m, 2H), 5.62 (t, 1H, J = 4.7 Hz), 4.58 (s, 2H), 3.84 (s, 3H), 2.64 (s, 2H), 2.21 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.9, 136.5, 136.3, 136.2, 132.4, 131.3, 130.0, 129.9, 129.3, 128.3, 127.8, 127.6, 127.4, 126.4, 123.6, 114.0, 55.7, 53.9, 27.3, 23.0; IR (neat) (cm^{-1}) 2936w, 1734w, 1595m, 1342s, 1153s; HRMS (ESI): m/z calcd for $C_{24}H_{23}NO_3SNa$ $[M+Na]^+$ 428.1291, found 428.1284.



2m

Amino-substituted dihydronaphthalene **2m** (68.9 mg, 0.17 mmol) was prepared from *C*-terthered arene-ynamide **1m** (82.0 mg, 0.20 mmol) in 84% yield after stirring at rt for 0.5 h.

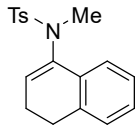
2m: (68.9 mg, 84%); R_f = 0.43 [10:1 petroleum ether/EtOAc]; white solid; mp = 107–108 °C;^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76-7.73 (m, 2H), 7.45-7.43 (m, 2H), 7.24-7.19 (m, 5H), 7.13-7.02 (m, 4H), 5.61 (t, 1H, J = 4.7 Hz), 4.63 (s, 1H), 4.58 (s, 1H), 2.66 (s, 2H), 2.23 (s, 2H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 139.3, 138.5, 137.2, 137.1, 136.9, 133.6, 130.5, 130.3, 130.1, 130.0, 129.0, 128.5, 128.2, 127.9, 126.7, 124.4, 55.0, 27.6, 23.4; IR (neat) (cm^{-1}) 3032w, 1583w, 1474w, 1339m, 1161m, 1090w; HRMS (ESI): m/z calcd for $C_{23}H_{20}ClNO_2SNa$ $[M+Na]^+$ 432.0795, found 432.0796.



2n

Amino-substituted dihydronaphthalene **2n** (69.0 mg, 0.16 mmol) was prepared from *C*-terthered arene-ynamide **1n** (84.1 mg, 0.20 mmol) in 82% yield after stirring at rt for 0.25 h.

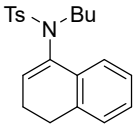
2n: R_f = 0.23 [10:1 petroleum ether/EtOAc]; yellow solid; mp = 126–127 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29-8.27 (m, 2H), 7.97-7.94 (m, 2H), 7.26-7.21 (m, 5H), 7.14-7.03 (m, 3H), 6.97 (d, 1H, J = 7.5 Hz), 5.61 (t, 1H, J = 4.7 Hz), 4.78 (s, 1H), 4.54 (s, 1H), 2.69 (s, 2H), 2.26 (s, 2H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 151.1, 145.2, 137.1, 137.0, 136.7, 133.3, 130.9, 130.21, 130.16, 129.1, 128.7, 128.4, 128.0, 126.8, 125.1, 124.3, 55.2, 27.6, 23.5; IR (neat) (cm^{-1}) 2932w, 1526s, 1455w, 1350s, 1169s, 1091m; HRMS (ESI): m/z calcd for $C_{23}H_{20}N_2O_4SNa$ $[M+Na]^+$ 443.1036, found 443.1035.



2o

Amino-substituted dihydronaphthalene **2o** (53.9 mg, 0.17 mmol) was prepared from *C*-terthered arene-ynamide **1o** (62.7 mg, 0.20 mmol) in 86% yield after stirring at rt for 0.25 h.

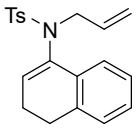
2o: R_f = 0.23 [10:1 petroleum ether/EtOAc]; white solid; mp = 89–90 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74-7.72 (m, 2H), 7.43-7.41 (m, 1H), 7.31 (d, 2H, J = 8.0 Hz), 7.22-7.10 (m, 3H), 5.57 (t, 1H, J = 4.7 Hz), 3.07 (s, 3H), 2.77 (t, 2H, J = 8.0 Hz), 2.44 (s, 3H), 2.32-2.27 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.5, 139.4, 136.3, 135.2, 132.6, 129.5, 128.1, 128.0, 127.6, 126.74, 126.68, 123.5, 38.6, 27.4, 23.0, 21.7; IR (neat) (cm^{-1}) 2938w, 1453w, 1339s, 1154s, 1008s; HRMS (ESI): m/z calcd for $C_{18}H_{19}NO_2SNa$ $[M+Na]^+$ 336.1029, found 336.1029.



2p

Amino-substituted dihydronaphthalene **2p** (62.6 mg, 0.18 mmol) was prepared from *C*-terthered arene-ynamide **1p** (71.1 mg, 0.20 mmol) in 88% yield after stirring at rt for 0.25 h.

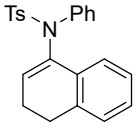
2p: R_f = 0.62 [10:1 petroleum ether/EtOAc]; white solid; mp = 57–58 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73-7.71 (m, 2H), 7.33-7.27 (m, 3H), 7.17-7.09 (m, 3H), 5.63 (t, 1H, J = 4.7 Hz), 3.51 (s, 1H), 3.28 (s, 1H), 2.78 (q, 2H, J = 8.9 Hz), 2.42 (s, 3H), 2.36-2.29 (m, 2H), 1.52-1.44 (m, 2H), 1.32-1.23 (m, 2H), 0.84 (t, 3H, J = 7.3 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.3, 137.0, 136.34, 136.29, 133.2, 129.5, 128.5, 128.0, 127.8, 127.5, 126.6, 123.8, 50.5, 30.6, 27.5, 23.2, 21.7, 20.1, 13.9; IR (neat) (cm^{-1}) 2953w, 1462w, 1339s, 1154s, 1088m, 1034m; HRMS (ESI): m/z calcd for $C_{21}H_{25}NO_2SNa$ $[M+Na]^+$ 378.1498, found 378.1499.



2q

Amino-substituted dihydronaphthalene **2q** (58.4 mg, 0.17 mmol) was prepared from *C*-terthered arene-ynamide **1q** (67.9 mg, 0.20 mmol) in 86% yield after stirring at rt for 20.0 min.

2q: R_f = 0.30 [10:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74-7.72 (m, 2H), 7.33-7.28 (m, 3H), 7.18-7.08 (m, 3H), 5.81-5.71 (m, 1H), 5.62 (t, 1H, J = 4.7 Hz), 5.07-5.03 (m, 2H), 4.04 (d, 2H, J = 6.1 Hz), 2.77 (t, 2H, J = 8.6 Hz), 2.43 (s, 3H), 2.31 (q, 2H, J = 7.3 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.5, 136.5, 136.42, 136.40, 133.0, 129.6, 129.3, 128.0, 127.9, 127.5, 126.6, 123.6, 119.1, 53.3, 27.4, 23.1, 21.7, one carbon missing due to overlap; IR (neat) (cm^{-1}) 2831w, 1598w, 1451w, 1343s, 1161s, 1036m; HRMS (ESI): m/z calcd for $C_{20}H_{21}NO_2SNa$ $[M+Na]^+$ 362.1185, found 362.1181.

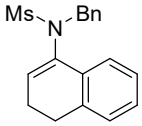


2r

Amino-substituted dihydronaphthalene **2r** (64.6 mg, 0.17 mmol) was prepared from *C*-terthered arene-ynamide **1r** (75.1 mg, 0.20 mmol) in 86% yield after stirring at rt for 0.5 h.

2r: R_f = 0.27 [10:1 petroleum ether/EtOAc]; pale yellow solid; mp = 150–151 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63-7.61 (m, 2H), 7.56 (d, 1H, J = 7.5 Hz), 7.47-7.45 (m, 2H), 7.29-7.25 (m, 2H), 7.24-7.04 (m, 6H), 5.98 (t, 1H, J = 4.7 Hz), 2.75 (t, 2H, J = 8.1 Hz), 2.42-2.36 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 143.6, 140.5, 138.4, 137.7, 136.7, 132.7, 129.6, 129.2, 129.0, 128.01, 127.98,

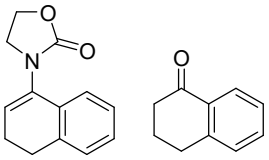
127.6, 127.1, 127.0, 126.7, 123.8, 27.2, 23.3, 21.7; IR (neat) (cm^{-1}) 2927w, 1484w, 1349s, 1165s, 1092s; HRMS (ESI): m/z calcd for $C_{23}H_{21}NO_2SNa$ $[M+Na]^+$ 398.1185, found 398.1181.



2s

Amino-substituted dihydronaphthalene **2s** (57.0 mg, 0.18 mmol) was prepared from *C*-terthered arene-ynamide **1s** (62.7 mg, 0.20 mmol) in 91% yield after stirring at rt for 0.25 h.

2s: R_f = 0.32 [4:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34-7.27 (m, 5H), 7.24-7.11 (m, 4H), 5.92 (t, 1H, J = 4.7 Hz), 4.94 (s, 1H), 4.36 (s, 1H), 2.92 (s, 3H), 2.74 (t, 2H, J = 8.0 Hz), 2.34 (s, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 136.9, 136.5, 136.2, 131.8, 130.2, 129.4, 128.6, 128.11, 128.09, 127.9, 126.8, 123.1, 53.4, 40.5, 27.3, 23.1; IR (neat) (cm^{-1}) 2934w, 1495w, 1332s, 1147s, 1057m; HRMS (ESI): m/z calcd for $C_{18}H_{19}NO_2SNa$ $[M+Na]^+$ 336.1029, found 336.1028.

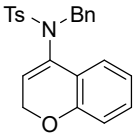


2t *and* **2t'**

Amino-substituted dihydronaphthalene **2t** (36.6 mg, 0.17 mmol) and 3,4-dihydronaphthalen-1(2*H*)-one **2t'** (3.2 mg, 0.02 mmol) were prepared from *C*-terthered arene-ynamide **1t** (43.1 mg, 0.20 mmol) in 85% yield and 11% yield, respectively, after stirring at rt for 0.5 h.

2t: R_f = 0.36 [1:1 petroleum ether/EtOAc]; pale yellow oil; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.21-7.18 (m, 4H), 6.13 (t, 1H, J = 4.7 Hz), 4.50 (t, 2H, J = 7.8 Hz), 3.91 (t, 2H, J = 7.8 Hz), 2.81-2.76 (m, 2H), 2.40-2.35 (m, 2H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 157.2, 137.3, 135.8, 131.8, 128.5, 128.4, 127.2, 125.1, 123.2, 62.8, 48.0, 27.9, 23.1; IR (neat) (cm^{-1}) 2933w, 1744s, 1484w, 1409m, 1034m; HRMS (ESI): m/z calcd for $C_{13}H_{13}NO_2Na$ $[M+Na]^+$ 238.0838, found 238.0834. Spectral data are in agreement with literature values.[7]

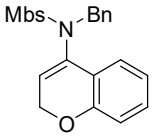
2t': R_f = 0.42 [10:1 petroleum ether/EtOAc]; white solid; mp = 58–59 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (dd, 1H, J = 7.8, 0.9 Hz), 7.47 (td, 1H, J = 7.5, 1.4 Hz), 7.33-7.25 (m, 2H), 2.98 (t, 2H, J = 6.2 Hz), 2.67 (t, 2H, J = 6.5 Hz), 2.18-2.12 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 198.6, 144.7, 133.6, 132.8, 129.0, 127.4, 126.8, 39.4, 29.9, 23.5; IR (neat) (cm^{-1}) 3066w, 2867w, 1600s, 1323s, 1115m; HRMS (ESI): m/z calcd for $C_{10}H_{11}O$ $[M+H]^+$ 147.0804, found 147.0806. Spectral data are in agreement with literature values.[8]



2u

Amino-2*H*-chromene **2u** (63.4 mg, 0.16 mmol) was prepared from *C*-terthered arene-ynamide **1u** (78.3 mg, 0.20 mmol) in 81% yield after stirring at rt for 0.5 h.

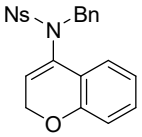
2u: R_f = 0.22 [10:1 petroleum ether/EtOAc]; white solid; mp = 74–75 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.82-7.80 (m, 2H), 7.45 (d, 2H, J = 8.0 Hz), 7.33-7.19 (m, 5H), 7.10-7.04 (m, 2H), 6.76 (dt, 1H, J = 7.6, 0.9 Hz), 6.67 (dd, 1H, J = 8.1, 1.1 Hz), 5.51 (t, 1H, J = 3.9 Hz), 4.69 (d, 2H, J = 3.7 Hz), 4.61 (s, 2H), 2.45 (s, 3H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 155.9, 144.7, 137.0, 136.7, 134.9, 130.5, 130.3, 129.9, 129.1, 128.8, 128.5, 125.2, 123.6, 122.9, 121.6, 116.3, 65.9, 54.8, 21.4; IR (neat) (cm^{-1}) 2921w, 1602w, 1452w, 1348m, 1159m, 1091m; HRMS (ESI): m/z calcd for $C_{23}H_{21}NO_3SNa$ $[M+Na]^+$ 414.1134, found 414.1136.



2v

Amino-2*H*-chromene **2v** (65.2 mg, 0.16 mmol) was prepared from *C*-terthered arene-ynamide **1v** (81.5 mg, 0.20 mmol) in 80% yield after stirring at rt for 0.5 h.

2v: R_f = 0.31 [4:1 petroleum ether/EtOAc]; colourless oil; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 7.88-7.85 (m, 2H), 7.34-7.32 (m, 2H), 7.28-7.21 (m, 3H), 7.16-7.13 (m, 3H), 7.06 (dt, 1H, J = 7.8, 1.5 Hz), 6.78 (dt, 1H, J = 7.6, 0.9 Hz), 6.67 (dd, 1H, J = 8.0, 1.2 Hz), 5.53 (t, 1H, J = 3.9 Hz), 4.69 (d, 2H, J = 3.4 Hz), 4.60 (s, 2H), 3.93 (s, 3H); ^{13}C NMR (100 MHz, CD_3COCD_3) δ 164.2, 155.9, 137.1, 135.0, 131.0, 130.2, 129.9, 129.0, 128.5, 125.3, 123.4, 123.0, 121.6, 116.2, 115.0, 65.8, 56.1, 54.7, one carbon missing due to overlap; IR (neat) (cm^{-1}) 2925w, 1594m, 1496m, 1259s, 1153s, 1067m; HRMS (ESI): m/z calcd for $C_{23}H_{21}NO_4SNa$ $[M+Na]^+$ 430.1083, found 430.1076.



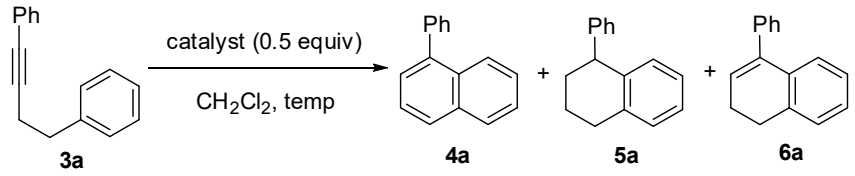
2w

Amino-2*H*-chromene **2w** (73.5 mg, 0.17 mmol) was prepared from *C*-terthered arene-ynamide **1w** (84.5 mg, 0.20 mmol) in 87% yield after stirring at rt for 10.0 min.

2w: R_f = 0.16 [10:1 petroleum ether/EtOAc]; yellow solid; mp = 133–134 °C; ^{1}H NMR (400 MHz, CD_3COCD_3) δ 8.50-8.46 (m, 2H), 8.22-8.19 (m, 2H), 7.36-7.24 (m, 6H), 7.09-7.04 (m, 1H), 6.78 (dt, 1H, J = 7.6, 0.9 Hz), 6.69 (dd, 1H, J = 8.1, 1.2 Hz), 5.61 (t, 1H, J = 3.9 Hz), 4.73 (s, 4H); ^{13}C NMR

(100 MHz, CD_3COCD_3) δ 155.9, 151.3, 144.8, 136.5, 134.4, 130.6, 130.2, 130.0, 129.2, 128.8, 125.2, 125.0, 124.5, 122.4, 121.7, 116.4, 65.8, 55.2; IR (neat) (cm^{-1}) 3100w, 1529s, 1347s, 1162s, 1013m; HRMS (ESI): m/z calcd for $C_{22}H_{18}N_2O_5SNa$ $[M+Na]^+$ 445.0829, found 445.0820.

1.3 Condition Optimization of the Hydroarylation (Table 2).



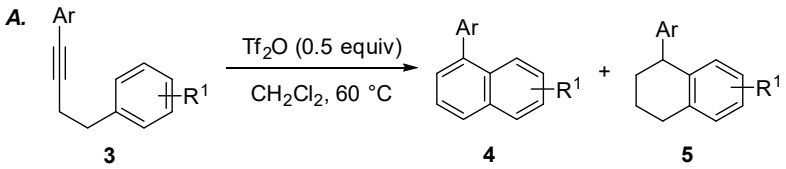
Entry[a]	Catalyst	CH_2Cl_2 (mL)	Temp (^oC)	Time (h)	Yield (%)[b] **4a** and **5a**	Yield (%)[b] **6a**
1	TfOH	0.5	rt	0.5	88 (1:1)	5
2	Tf_2O	0.5	60	3.5	90 (1:1)	0
3	Tf_2O	1.0	60	3.5	99 (1:1)	0
4	TfOH	1.0	rt	0.5	91 (1:1)	6

[a]Unless otherwise noted, reactions were carried out using **3a** (0.20 mmol) with catalyst (0.10 mmol) in CH_2Cl_2 under N_2. [b]Isolated yields. The ratio of **4a** to **5a** in parenthesis was determined by ^1H NMR spectroscopy of the unpurified reaction mixture.

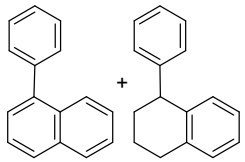
To an oven-dried sealed tube was added methylene-tethered arylalkyne **3a** (41.3 mg, 0.20 mmol), CH_2Cl_2 and catalyst (0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at the specified temperature. After the reaction was judged to be complete by TLC, the reaction mixture was filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford an unseparable mixture of **4a** and **5a**.

1.4 Hydroarylation of Methylene-Tethered Arylalkynes (Table 3).

Naphthalenes (**4a**, **4b**, **4g**),[9] (**4c**, **4d**),[10] (**4e**, **4i**),[11] **4f**,[12] **4h**,[13] **4j**,[14] **4k**,[15] (**4l**, **4m**, **4n**),[16] **4o**,[17] tetrahydronaphthalenes **5a**,[18] **(5b**, **5d**, **5g**, **5h**, **5j)**[19], **5f**,[20] **5k**,[21] **5m**,[22] dihydronaphalenes **6b**[23] and **6d**[24] were known compounds, the data were matched with reported values. Tetrahydronaphthalenes **5c**, **5e**, **5i**, **5l**, **5n**, **5o**, dihydronaphalenes **6c** and **6e** were new compounds.

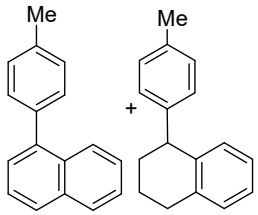


To an oven-dried sealed tube was added methylene-tethered arylalkyne **3a** (41.3 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 3.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford an unseparable mixture of **4a** and **5a** (41.2 mg, 0.20 mmol) in 99% yield.



4a + 5a

4a and **5a:** R_f = 0.63 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.90-7.88 (m, 2H), 7.85 (d, 1H, *J* = 8.2 Hz), 7.52-7.39 (m, 9H), 7.28-7.24 (m, 2H), 7.20-7.18 (m, 1H), 7.12-7.08 (m, 4H), 7.03-6.99 (m, 1H), 6.83 (d, 1H, *J* = 8.0 Hz), 4.10 (t, 1H, *J* = 6.7 Hz), 2.95-2.80 (m, 2H), 2.17-2.12 (m, 1H), 1.93-1.82 (m, 2H), 1.77-1.72 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.7, 140.9, 140.4, 139.5, 137.7, 133.9, 131.8, 130.3, 130.2, 129.1, 129.0, 128.42, 128.39, 127.8, 127.4, 127.1, 126.2, 126.10, 126.06, 125.9, 125.8, 125.5, 45.8, 33.4, 30.0, 21.1, two carbons missing due to overlap, overlapped signals at 130.2 and 128.38 ppm. Spectral data are in agreement with literature values.[9,18]

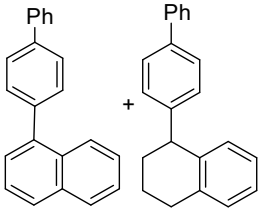


4b + 5b

To a solution of **3b** (44.1 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4b** and **5b** (44.5 mg, 0.20 mmol) in 99% yield.

4b and **5b:** R_f = 0.48 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.94-7.82 (m, 3H), 7.52-7.38 (m, 6H), 7.30-7.28 (m, 2H), 7.11-6.97 (m, 7H), 6.84 (d, 1H, *J* = 7.5 Hz), 4.07 (t, 1H, *J* = 6.8 Hz), 2.94-2.78 (m, 2H), 2.45 (s, 3H), 2.31 (s, 3H), 2.17-2.10 (m, 1H), 1.93-1.69 (m, 3H); ^{13}C

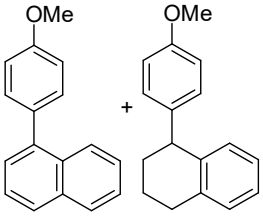
NMR (100 MHz, $CDCl_3$) δ 144.7, 140.4, 139.8, 138.0, 137.7, 137.1, 135.6, 134.0, 131.9, 130.3, 130.1, 129.14, 129.10, 128.9, 128.4, 127.6, 127.0, 126.3, 126.1, 126.0, 125.9, 125.8, 125.6, 45.4, 33.5, 30.0, 21.4, 21.19, 21.17, one carbon missing due to overlap, overlapped signal at 129.10 ppm. Spectral data are in agreement with literature values.[9,19]



4c + 5c

To a solution of **3c** (56.5 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4c** and **5c** (51.5 mg, 0.18 mmol) in 92% yield.

4c and **5c:** R_f = 0.27 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, 1H, J = 8.4 Hz), 7.91-7.84 (m, 2H), 7.72-7.66 (m, 4H), 7.58-7.27 (m, 16H), 7.16-7.01 (m, 5H), 6.89 (d, 1H, J = 7.7 Hz), 4.15 (t, 1H, J = 6.7 Hz), 2.94-2.78 (m, 2H), 2.17-2.10 (m, 1H), 1.93-1.69 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.9, 141.2, 141.0, 140.3, 140.0, 139.9, 139.4, 139.0, 137.8, 134.0, 131.8, 130.7, 130.4, 129.4, 129.2, 129.0, 128.9, 128.5, 127.9, 127.6, 127.3, 127.2, 127.1, 126.3, 126.2, 126.1, 126.0, 125.9, 125.6, 45.4, 33.4, 30.0, 21.1, three carbons missing due to overlap, overlapped signals at 129.0, 127.3 and 127.2 ppm; IR (neat) (cm^{-1}) 3054w, 3024w, 2935w, 1590m, 1578m, 1505m, 1485s, 1393s, 1175m, 1005s; HRMS of **4c** (ESI): m/z calcd for $C_{22}H_{16}Na$ $[M+Na]^+$ 303.1144, found 303.1152; HRMS of **5c** (ESI): m/z calcd for $C_{22}H_{19}$ $[M-H]^-$ 283.1492, found 283.1485.

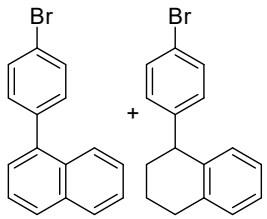


4d + 5d

To a solution of **3d** (47.3 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered

through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [gradient eluent: 30:1 petroleum ether/EtOAc] to afford the desired mixture of **4d** and **5d** (38.8 mg, 0.17 mmol) in 82% yield.

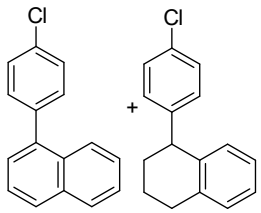
4d and **5d:** R_f = 0.51 [20:1 petroleum ether/EtOAc]; pale yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93-7.81 (m, 3H), 7.52-7.39 (m, 6H), 7.13-6.98 (m, 7H), 6.85-6.79 (m, 3H), 4.05 (t, 1H, J = 6.7 Hz), 3.87 (s, 3H), 3.77 (s, 3H), 2.94-2.78 (m, 2H), 2.16-2.09 (m, 1H), 1.92-1.68 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.1, 157.9, 140.0, 139.9, 139.8, 137.7, 134.0, 133.3, 132.0, 131.3, 130.3, 129.9, 129.1, 128.4, 127.5, 127.1, 126.2, 126.1, 126.0, 125.9, 125.8, 125.6, 113.9, 113.7, 55.5, 55.4, 44.9, 33.5, 29.9, 21.1. Spectral data are in agreement with literature values.[10,19]



4e + **5e**

To a solution of **3e** (57.2 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4e** and **5e** (57.2 mg, 0.20 mmol) in 99% yield.

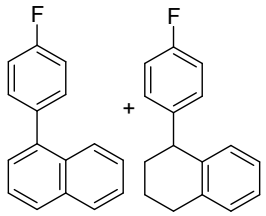
4e and **5e:** R_f = 0.47 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91-7.82 (m, 3H), 7.62-7.58 (m, 2H), 7.52-7.34 (m, 8H), 7.13-7.11 (m, 2H), 7.04-6.99 (m, 1H), 6.96-6.94 (m, 2H), 6.79 (d, 1H, J = 7.7 Hz), 4.06 (t, 1H, J = 6.4 Hz), 2.93-2.78 (m, 2H), 2.17-2.09 (m, 1H), 1.89-1.68 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.7, 139.8, 139.1, 138.8, 137.7. 133.9, 131.9, 131.6, 131.49, 131.45, 130.7, 130.2, 129.2, 128.5, 128.2, 127.0, 126.4, 126.3, 126.1, 125.9, 125.8, 125.5, 121.6, 119.9, 45.2, 33.3, 29.8, 21.0; IR (neat) (cm^{-1}) 2924w, 2878w, 1591m, 1507m, 1343s, 1111s; HRMS (ESI) of **4e**: m/z calcd for $C_{16}H_{12}Br$ $[M+H]^+$ 283.0117, found 283.0115; HRMS (ESI) of **5e**: m/z calcd for $C_{16}H_{16}Br$ $[M+H]^+$ 287.0430, found 287.0427.



4f+ 5f

To a solution of **3f** (44.9 mg, 0.2 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4f** and **5f** (44.8 mg, 0.20 mmol) in 99% yield.

4f and **5f:** R_f = 0.53 [petroleum ether]; white solid; ^1H NMR (400 MHz, $CDCl_3$) δ 7.90-7.82 (m, 3H), 7.52-7.36 (m, 8H), 7.24-7.20 (m, 2H), 7.12-7.09 (m, 2H), 7.04-6.98 (m, 3H), 6.79 (d, 1H, J = 7.8 Hz), 4.08 (t, 1H, J = 6.6 Hz), 2.93-2.78 (m, 2H), 2.17-2.08 (m, 1H), 1.89-1.67 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.2, 139.3, 139.1, 138.9, 137.7, 133.9, 133.5, 131.8, 131.6, 131.5, 130.3, 130.2, 129.2, 128.6, 128.53, 128.51, 128.2, 127.1, 126.4, 126.3, 126.1, 125.9, 125.8, 125.5, 45.2, 33.4, 29.8, 21.0. Spectral data are in agreement with literature values.[12,20]

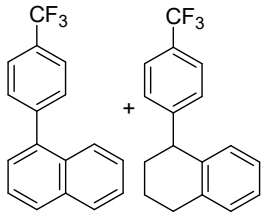


4g + 5g

To a solution of **3g** (44.9 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 3 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4g** and **5g** (44.8 mg, 0.20mmol) in 99% yield.

4g and **5g:** R_f = 0.50 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.90-7.82 (m, 3H), 7.52-7.37 (m, 6H), 7.18-7.10 (m, 4H), 7.04-7.01 (m, 3H), 6.96-6.92 (m, 2H), 6.80 (d, 1H, J = 7.7 Hz), 4.08 (t, 1H, J = 6.7 Hz), 2.93-2.78 (m, 2H), 2.16-2.09 (m, 1H), 1.90-1.68 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4 (d, J = 244.6 Hz), 161.4 (d, J = 243.8 Hz), 143.3 (d, J = 3.2 Hz), 139.3, 137.7, 136.8 (d, J = 3.5 Hz), 134.0, 131.8, 131.7 (d, J = 7.9 Hz), 130.3 (d, J = 7.7 Hz), 130.2, 129.2,

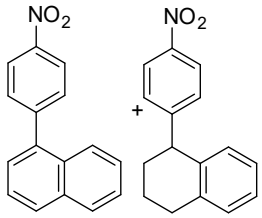
128.5,128.0, 127.2, 126.3, 126.2, 126.0, 125.93, 125.88, 125.5, 115.4 (d, J = 21.2 Hz), 115.2, 115.0, 45.0, 33.5, 29.9, 21.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -115.5, -117.6. Spectral data are in agreement with literature values.[9,19]



4h + 5h

To a solution of **3h** (54.9 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 30. h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4h** and **5h** (51.1 mg, 0.19 mmol) in 93% yield.

4h and **5h:** R_f = 0.28 [petroleum ether]; white solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92-7.87 (m, 2H), 7.80 (d, 1H, J = 8.4 Hz), 7.74 (d, 2H, J = 8.0 Hz), 7.59 (d, 2H, J = 7.9 Hz), 7.54-7.38 (m, 6H), 7.20-7.11 (m, 4H), 7.05-7.01 (m, 1H), 6.77 (d, 1H, J = 7.6 Hz), 4.17 (t, 1H, J = 6.7 Hz), 2.95-2.80 (m, 2H), 2.20-2.12 (m, 1H), 1.90-1.69 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.8 (q, J = 1.2 Hz), 144.6 (q, J = 1.2 Hz), 138.9, 138.5, 137.8. 134.0, 131.4, 130.6, 130.2, 129.6 (q, J = 32.3 Hz), 129.4, 129.3, 128.61, 128.57, 128.4 (q, J = 32.0 Hz), 127.2, 126.6, 126.5, 126.2, 126.0, 125.7, 125.5, 125.42 (q, J = 3.7 Hz), 125.36 (q, J = 3.9 Hz), 124.54 (q, J = 270.1 Hz), 124.52 (q, J = 270.3 Hz), 45.6, 33.3, 29.8, 20.9; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.2, -62.3. Spectral data are in agreement with literature values.[13,19]

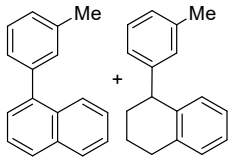


4i + 5i

To a solution of **3i** (50.3 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column

chromatography [isocratic eluent: 30:1 petroleum ether/EtOAc] to afford the desired mixture of **4i** and **5i** (45.0 mg, 0.18 mmol) in 90% yield.

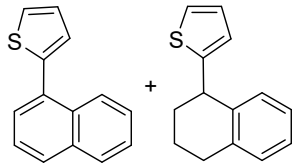
4i and **5i:** R_f = 0.50 [20:1 petroleum ether/EtOAc]; pale yellow solid; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36-8.33 (m, 2H), 8.14-8.12 (m, 2H), 7.95-7.92 (m, 2H), 7.78 (d, 1H, J = 8.4 Hz), 7.68-7.64 (m, 2H), 7.57-7.41 (m, 4H), 7.25-7.23 (m, 2H), 7.17-7.15 (m, 2H), 7.07-7.03 (m, 1H), 6.75 (d, 1H, J = 7.6 Hz), 4.24 (t, 1H, J = 6.0 Hz), 2.97-2.82 (m, 2H), 2.24-2.17 (m, 1H), 1.90-1.72 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.5, 147.8, 147.3, 146.5, 137.9, 137.7, 133.9, 131.0, 130.1, 129.7, 129.5, 129.1, 128.7, 127.3, 126.9, 126.7, 126.4, 126.1, 125.5, 125.3, 123.74, 123.72, 45.7, 33.2, 29.7, 20.8, two carbons missing due to overlap, overlapped signals at 131.0 and 129.7 ppm; IR (neat) (cm^{-1}) 3072w, 3056w, 2920w, 2856w, 1597s, 1514s, 1488s, 1347s, 1106w, 1014w; HRMS of **4i** (ESI): m/z calcd for $C_{16}H_{12}NO_2$ $[M+H]^+$ 250.0863; found 250.0863; HRMS of **5i**: m/z calcd for $C_{16}H_{16}NO_2$ $[M+H]^+$ 254.1176, found 254.1168.



4j + 5j

To a solution of **3j** (44.1 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4j** and **5j** (44.1 mg, 0.20 mmol) in 99% yield.

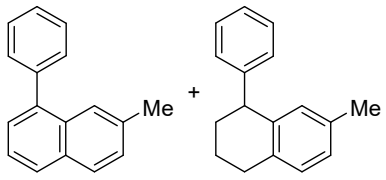
4j and **5j:** R_f = 0.27 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92-7.82 (m, 3H), 7.51-7.22 (m, 8H), 7.17-7.08 (m, 3H), 7.03-6.99 (m, 2H), 6.93-6.83 (m, 3H), 4.06 (t, 1H, J = 6.8 Hz), 2.95-2.79 (m, 2H), 2.43 (s, 3H), 2.30 (s, 3H), 2.19-2.10 (m, 1H), 1.94-1.67 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.6, 140.8, 140.5, 139.7, 138.0, 137.9, 137.6, 133.9, 131.8, 130.9, 130.4, 129.7, 129.1, 128.4, 128.28, 128.26, 128.1, 127.7, 127.3, 127.0, 126.9, 126.3, 126.15, 126.11, 126.0, 125.9, 125.8, 125.5, 45.8, 33.5, 30.0, 21.70, 21.65, 21.3. Spectral data are in agreement with literature values.[14,19]



4k + 5k

To a solution of **3k** (42.4 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 3.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4k** and **5k** (8.9 mg, 0.04 mmol) in 21% yield.

4k and **5k:** R_f = 0.32 [petroleum ether]; pale yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 8.25-8.19 (m, 2H), 7.92-7.82 (m, 2H), 7.85 (d, 2H, *J* = 8.2 Hz), 7.57 (dd, 2H, *J* = 7.1 Hz, 1.3 Hz), 7.53-7.47 (m, 6H), 7.43 (dd, 2H, *J* = 5.1 Hz, 1.3 Hz), 7.26 (d, 1H, *J* = 1.2 Hz), 7.25 (d, 1H, *J* = 1.2 Hz), 7.19 (d, 1H, *J* = 3.5 Hz), 7.18 (d, 1H, *J* = 3.5 Hz), 7.16-7.14 (m, 1H), 7.08-7.03 (m, 2H), 7.13-7.09 (m, 2H), 6.91 (dd, 1H, *J* = 5.1 Hz, 3.4 Hz), 6.69 (dt, 1H, *J* = 3.4 Hz, 1.0 Hz), 4.40 (t, 1H, *J* = 6.1 Hz), 2.92-2.78 (m, 2H), 2.23-2.16 (m, 1H), 2.05-1.96 (m, 1H), 1.96-1.87 (m, 1H), 1.82-1.73 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.3, 141.9, 138.9, 137.1, 134.0, 132.6, 132.0, 130.2, 129.3, 128.6, 128.5, 128.4, 127.6, 127.4, 126.6, 126.53, 126.51, 126.2, 125.9, 125.80, 125.79, 125.4, 125.3, 123.7, 40.6, 33.5, 29.6, 20.6. Spectral data are in agreement with literature values.[15,21]

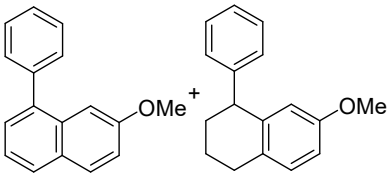


4l + 5l

To a solution of **3l** (44.1 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^1H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4l** and **5l** (43.2 mg, 0.20 mmol) in 98% yield.

4l and **5l:** R_f = 0.44 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, 2H, *J* =

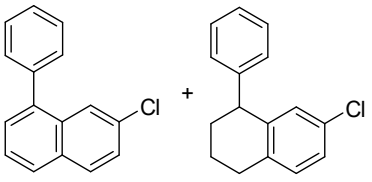
8.3 Hz), 7.66 (s, 1H), 7.49-7.40 (m, 6H), 7.38-7.25 (m, 4H), 7.20-7.18 (m, 1H), 7.08 (d, 2H, J = 7.2 Hz), 7.02 (d, 1H, J = 7.7 Hz), 6.93 (d, 1H, J = 7.6 Hz), 6.66 (s, 1H), 4.07 (t, 1H, J = 6.7 Hz), 2.90-2.74 (m, 2H), 2.42 (s, 3H), 2.21-2.09 (m, 1H), 2.17 (s, 3H), 1.87-1.80 (m, 2H), 1.75-1.66 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.8, 141.1, 139.7, 139.2, 135.9, 135.2, 134.7, 132.2, 131.9, 130.8, 130.2, 129.03, 129.01, 128.4, 128.34, 128.29, 128.2, 127.5, 127.3, 127.2, 127.0, 126.0, 125.0, 124.6, 45.7, 33.5, 29.6, 22.1, 21.15, 21.07; IR (neat) (cm^{-1}) 3050w, 3027w, 2925w, 2857w, 1602w, 1492s, 1447s, 1367s, 1028w; HRMS of **4l** (ESI): m/z calcd for $C_{17}H_{15}$ $[M+H]^+$ 219.1168, found 219.1177; HRMS of **5l** (ESI): m/z calcd for $C_{17}H_{19}$ $[M+H]^+$ 223.1482, found 223.1473.



4m + 5m

To a solution of **3m** (47.3 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 M) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 12 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4m** and **5m** (44.4 mg, 0.19 mmol) in 94% yield.

4m and **5m:** R_f = 0.33 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80-7.75 (m, 2H), 7.51-7.46 (m, 4H), 7.42-7.36 (m, 3H), 7.28-7.26 (m, 3H), 7.20-7.14 (m, 2H), 7.09 (d, 2H, J = 7.1 Hz), 7.04 (d, 1H, J = 8.4 Hz), 6.70 (dd, 1H, J = 8.4 Hz, 2.7Hz), 6.38 (d, 1H, J = 2.6 Hz), 4.07 (t, 1H, J = 6.6 Hz), 3.73 (s, 3H), 3.62 (s, 3H), 2.87-2.72 (m, 2H), 2.15-2.09 (m, 1H), 1.89-1.80 (m, 2H), 1.75-1.65 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.9, 157.6, 147.4, 141.1, 140.5, 139.2, 132.8, 130.02, 129.96, 129.9, 129.5, 129.0, 128.5, 128.4, 127.7, 127.5, 127.3, 126.1, 123.3, 118.4, 115.0, 112.4, 104.6, 55.32, 55.28, 46.0, 33.4, 29.1, 21.2, one carbon missing due to overlap, overlapped signal at 129.96 ppm. Spectral data are in agreement with literature values.[16,22]

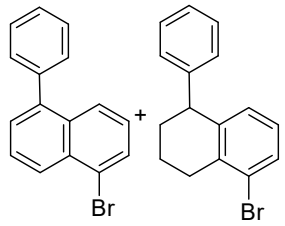


4n + 5n

To a solution of **3n** (48.1 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 M) was added Tf_2O (16.8 μL,

0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 17.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4n** and **5n** (43.3 mg, 0.18 mmol) in 90% yield.

4n and **5n:** R_f = 0.53 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, 1H, J = 2.1 Hz), 7.83 (d, 1H, J = 2.7 Hz), 7.80 (d, 1H, J = 1.9 Hz), 7.52-7.40 (m, 8H), 7.30-7.26 (m, 2H), 7.22-7.18 (m, 1H), 7.07-7.02 (m, 4H), 6.82 (s, 1H), 4.04 (t, 1H, J = 6.8 Hz), 2.89-2.73 (m, 2H), 2.15-2.08 (m, 1H), 1.91-1.79 (m, 2H), 1.76-1.66 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.8, 141.4, 140.2, 139.8, 136.1, 132.5, 132.19, 132.16, 131.3, 130.4, 130.1, 130.0, 129.9, 128.9, 128.63, 128.56, 128.1, 127.7, 127.6, 126.9, 126.4, 126.3, 125.8, 125.0, 45.7, 33.1, 29.4, 20.9; IR (neat) (cm^{-1}) 3058w, 3020w, 2936w, 2852w, 1589s, 1492s, 1484s, 1447s, 1122s, 1082w; HRMS of **4n** (ESI): m/z calcd for $C_{16}H_{11}NaCl$ $[M+Na]^+$ 261.0441, found 261.0448; HRMS of **5n** (ESI): m/z calcd for $C_{16}H_{16}Cl$ $[M+H]^+$ 243.0935, found 243.0939.



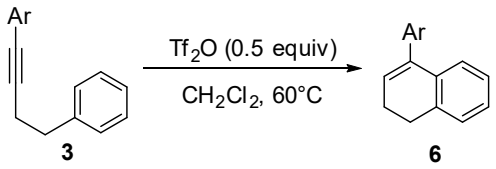
4o + 5o

'To a solution of **3o** (57.0 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel and concentrated *in vacuo*. After the ratio of the crude product was confirmed by ^{1}H NMR spectroscopy, the mixture was purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired mixture of **4o** and **5o** (52.5 mg, 0.18 mmol) in 92% yield.

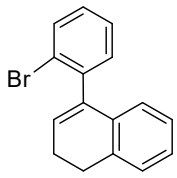
4o and **5o:** R_f = 0.52 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, 1H, J = 8.6 Hz), 7.85 (d, 1H, J = 8.5 Hz), 7.78 (d, 1H, J = 7.4 Hz), 7.62 (dd, 1H, J = 8.5, 7.1 Hz), 7.50-7.39 (m, 7H), 7.28-7.17 (m, 4H), 7.05 (d, 2H, J = 7.1 Hz), 6.89 (t, 1H, J = 7.7 Hz), 6.80 (d, 1H, J = 7.7 Hz), 4.11 (t, 1H, J = 6.5 Hz), 2.84 (t, 2H, J = 6.5 Hz), 2.13-2.05 (m, 1H), 1.93-1.87 (m, 2H), 1.79-1.70 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.0, 142.2, 140.9, 140.5, 137.2, 133.2, 132.4, 130.4, 130.2, 130.1, 129.7, 128.9, 128.48, 128.45, 128.0, 127.6, 127.0, 126.91, 126.89, 126.33,

126.29, 125.9, 123.4, 46.1, 32.6, 30.8, 20.7, one carbon missing due to overlap, overlapped signal at 126.29 ppm; IR (neat) (cm^{-1}) 3055w, 3025w, 2930w, 2856w, 1591w, 1555s, 1490s, 1450s, 1391s, 1119w, 1029w; HRMS of **4o** (ESI): m/z calcd for $C_{16}H_{12}Br$ $[M+H]^+$ 283.0117, found 283.0126; HRMS of **5o** (ESI): m/z calcd for $C_{16}H_{16}Br$ $[M+H]^+$ 287.0430, found 287.0436.

B.

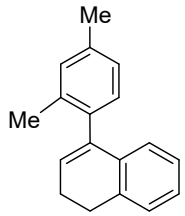


To an oven-dried sealed tube was added **3p** (57.2 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*) and Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 7.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo* and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **6b** (57.1 mg, 0.20 mmol) in 99% yield.



6b

6b: R_f = 0.50 [petroleum ether]; yellow oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.61 (dd, 1H, *J* = 8.0, 1.1 Hz), 7.33 (td, 1H, *J*= 7.4, 1.2 Hz), 7.27 (dd, 1H, *J* = 7.5, 1.9 Hz), 7.21-7.17 (m, 2H), 7.13 (td, 1H, *J* = 7.3, 1.3 Hz), 7.05 (td, 1H, *J* = 7.5, 1.4 Hz), 6.61 (d, 1H, *J* = 7.5 Hz), 5.97 (t, 1H, *J* = 4.5 Hz), 2.99-2.81 (m, 2H), 2.52-2.34 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.7, 139.6, 135.8, 134.6, 132.9, 131.8, 129.0, 128.9, 127.7, 127.5, 127.2, 126.5, 124.9, 124.2, 28.1, 23.6. Spectral data are in agreement with literature values.[23]

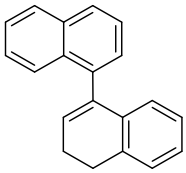


6c

To a solution of **3q** (46.9 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 4.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered

through a pad of silica gel, concentrated *in vacuo* and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired product **6c** (46.0 mg, 0.19 mmol) in 98% yield.

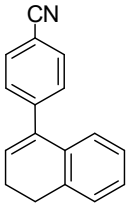
6c: R_f = 0.45 [petroleum ether]; colorless oil; ^{1}H NMR(400MHz,$CDCl_3$) δ 7.18-7.01 (m, 6H), 6.64 (d, 1H, J = 7.5 Hz), 5.93-5.90 (m, 1H), 2.91-2.84 (m, 2H), 2.42-2.38 (m, 2H), 2.36 (s, 3H), 2.07 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.4, 137.6, 136.9, 136.5, 136.0, 135.5, 130.8, 130.1, 127.8, 127.6, 126.9, 126.6, 126.5, 125.0, 28.4, 23.6, 21.3, 20.0; IR (neat) (cm^{-1}) 2932w, 2926w, 2829w, 2358s, 1748m, 1483m, 1448m, 1376s, 1253s, 1151s, 1099s; HRMS (ESI): m/z calcd for $C_{18}H_{19}$ $[M+H]^+$ 235.1481, found 235.1477.



6d

To a solution of **3r** (51.3 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 3 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo* and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford the desired product **6d** (51.1 mg, 0.20 mmol) in 99% yield.

6d: R_f = 0.42 [petroleum ether]; white solid; mp = 116–117 °C; ^{1}H NMR(400MHz,$CDCl_3$) δ 7.83 (t, 2H, J = 8.5 Hz), 7.73 (d, 1H, J = 8.5 Hz), 7.50-7.37 (m, 3H), 7.33-7.29 (m, 1H), 7.20 (d, 1H, J = 7.3 Hz), 7.09 (td, 1H, J = 7.4, 1.1 Hz), 6.91 (t, 1H, J = 7.5 Hz), 6.52 (d, 1H, J = 7.6 Hz), 6.11 (t, 1H, J = 4.5 Hz), 3.08-2.89 (m, 2H), 2.53-2.47 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.9, 138.5, 136.0, 135.7, 133.7, 132.5, 129.5, 128.3, 127.8, 127.6, 127.3, 127.1, 126.58, 126.55, 125.90, 125.85, 125.8, 125.7, 28.4, 23.8. Spectral data are in agreement with literature values.[24]



6e

To a solution of **3s** (46.2 mg, 0.20 mmol) in CH_2Cl_2 (1.0 mL, 0.20 *M*) was added Tf_2O (16.8 μL, 0.10 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 24 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered

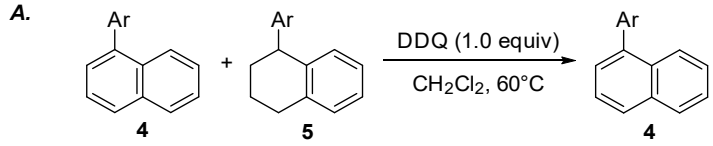
through a pad of silica gel, concentrated *in vacuo* and purified by flash silica gel column chromatography [isocratic eluent: 30:1 petroleum ether/EtOAc] to afford the desired product **6e** (40.2 mg, 0.17 mmol) in 87% yield.

6e: R_f = 0.28 [20:1 petroleum ether/EtOAc]; white solid; mp = 161–162 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 7.67 (d, 2H, J = 8.4 Hz), 7.46 (d, 2H, J = 8.4 Hz), 7.22-7.10 (m, 3H), 6.89 (d, 1H, J = 7.5 Hz), 6.15 (t, 1H, J = 4.8 Hz), 2.86 (t, 2H, J = 7.9 Hz), 2.46-2.41 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 139.0, 136.9, 134.2, 132.3, 129.9, 129.5, 128.0, 127.7, 126.6, 125.2, 119.2, 111.0, 28.2, 23.7; IR (neat) (cm^{-1}) 3402w, 3023w, 2947w, 2877w, 2823w, 2224m, 1604m, 1500m, 1448m, 1402m, 1273s, 1179s, 1108s, 1020s; HRMS (ESI): m/z calcd for $C_{17}H_{14}N$ $[M+H]^+$ 232.1121, found 232.1119.

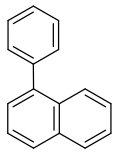
1.5 Applications toward 1-Aryl Naphthalene Syntheses (Table 4).

Naphthalenes (**4a**, **4b**, **4g**),[9] (**4c**, **4d**),[10] (**4e**, **4i**),[11] **4f**,[12] **4h**,[13] **4j**,[14] **4k**,[15] (**4l**, **4m**, **4n**),[16] **4o**[17] **4p**[25] **4q**,[26] **4r**,[27] and **4s**[28] were known compounds,

the data were matched with reported values.

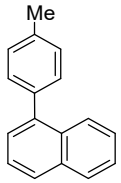


To an oven-dried sealed tube was added the mixture of **4a** and **5a** (41.2 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 3.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4a** (40.4 mg, 0.20 mmol) in 98% yield.



4a

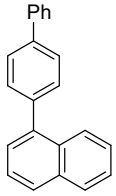
4a: R_f = 0.63 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (dt, 2H, J = 8.2, 1.6 Hz), 7.84 (m, 1H), 7.52-7.39 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.9, 140.4, 133.9, 131.8, 130.2, 128.4, 127.8, 127.4, 127.1, 126.2, 125.9, 125.5, two carbons missing due to overlap, overlapped signals at 130.2 and 128.4 ppm; Spectral data are in agreement with literature values.[9]



4b

To an oven-dried sealed tube was added the mixture of **4b** and **5b** (44.0 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4b** (42.7 mg, 0.20 mmol) in 98% yield.

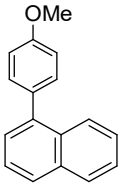
4b: R_f = 0.48[petroleum ether]; white solid; mp = 50–51 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.93-7.82 (m, 3H), 7.52-7.37 (m, 6H), 7.29 (d, 2H, J = 7.8 Hz), 2.44 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.4, 138.0, 137.1, 134.0, 131.9, 130.1, 129.1, 128.4, 127.6, 127.1, 126.3, 126.1, 125.9, 125.6, 21.4. Spectral data are in agreement with literature values.[9]



4c

To an oven-dried sealed tube was added the mixture of **4c** and **5c** (56.4 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4c** (52.1 mg, 0.19 mmol) in 93% yield.

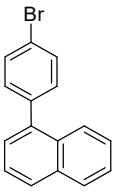
4c: R_f = 0.30 [petroleum ether]; white solid; mp = 143–144 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, 1H, J = 8.4 Hz), 7.91 (d, 1H, J = 7.5 Hz), 7.86 (d, 1H, J = 8.1 Hz), 7.72-7.67 (m, 4H), 7.58-7.42 (m, 8H), 7.39-7.35 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.0, 140.3, 140.0, 139.9, 134.0, 131.8, 130.7, 129.0, 128.5, 127.9, 127.5, 127.3, 127.2, 127.1, 126.3, 126.2, 125.9, 125.5. Spectral data are in agreement with literature values.[10]



4d

To an oven-dried sealed tube was added the mixture of **4d** and **5d** (47.3 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 2.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: 30:1 petroleum ether/EtOAc] to afford **4c** (42.8 mg, 0.18 mmol) in 88% yield.

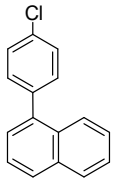
4d: R_f = 0.51 [20:1 petroleum ether/EtOAc]; white solid; mp = 123–124 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93-7.87 (m, 2H), 7.82 (d, 1H, J = 8.2 Hz), 7.51-7.38 (m, 6H), 7.02 (dt, 2H, J = 8.7, 2.5 Hz), 3.87 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.1, 140.1, 134.0, 133.3, 132.0, 131.3, 128.4, 127.5, 127.1, 126.2, 126.1, 125.9, 125.6, 113.9, 55.5. Spectral data are in agreement with literature values.[10]



4e

To an oven-dried sealed tube was added the mixture of **4e** and **5e** (56.6 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 5.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4e** (54.4 mg, 0.19 mmol) in 96% yield.

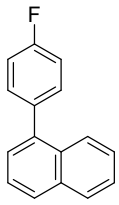
4e: R_f = 0.47 [petroleum ether]; white solid; mp = 73–74 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91-7.82 (m, 3H), 7.60 (dt, 2H, J = 8.4, 2.1 Hz), 7.52-7.47 (m, 2H), 7.44-7.40 (m, 1H), 7.38-7.33 (m 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.8, 139.1, 133.9, 131.9, 131.6, 131.5, 128.5, 128.2, 127.0, 126.4, 126.1, 125.8, 125.5, 121.6. Spectral data are in agreement with literature values.[11]



4f

To an oven-dried sealed tube was added the mixture of **4f** and **5f** (44.0 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 3.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4f** (41.0 mg, 0.19 mmol) in 93% yield.

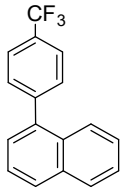
4f: R_f = 0.53 [petroleum ether]; white solid; mp = 31–32 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.91-7.82 (m, 3H), 7.52-7.37 (m, 8H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.3, 139.1, 133.9, 133.5, 131.6, 131.5, 128.6, 128.5, 128.2, 127.1, 126.4, 126.1, 125.8, 125.5. Spectral data are in agreement with literature values.[12]



4g

To an oven-dried sealed tube was added the mixture of **4g** and **5g** (44.5 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4g** (42.7 mg, 0.19 mmol) in 96% yield.

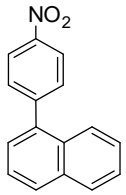
4g: R_f = 0.50 [petroleum ether]; white solid; mp = 69–70 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, 1H, J = 8.2 Hz), 7.85 (t, 2H, J = 8.3 Hz), 7.53-7.38 (m, 6H), 7.18 (t, 2H, J = 8.7 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4 (d, J = 244.5 Hz), 139.3, 136.8 (d, J = 3.4 Hz), 134.0, 131.8, 131.7 (d, J = 7.8 Hz), 128.5, 128.0, 127.2, 126.3, 126.0, 125.9, 125.5, 115.4 (d, J = 21.2 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -115.5. Spectral data are in agreement with literature values.[9]



4h

To an oven-dried sealed tube was added the mixture of **4h** and **5h** (54.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 5.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4h** (49.0 mg, 0.18 mmol) in 90% yield.

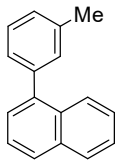
4h: R_f = 0.62 [petroleum ether]; white solid; mp = 43–44 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92-7.87 (m, 2H), 7.80 (d, 1H, J = 8.6 Hz), 7.74 (d, 2H, J = 8.0 Hz), 7.59 (d, 2H, J = 7.9 Hz), 7.54-7.48 (m, 2H), 7.46-7.44 (m, 1H), 7.39 (dd, 1H, J = 7.0, 1.2 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.6 (q, J = 1.2 Hz), 138.9, 133.9, 131.4, 130.6, 129.6 (q, J = 32.1 Hz), 128.61, 128.56, 127.2, 126.6, 126.2, 125.7, 125.5, 125.4 (q, J = 3.8 Hz), 124.5 (q, J = 272.0 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.3. Spectral data are in agreement with literature values.[13]



4i

To an oven-dried sealed tube was added the mixture of **4i** and **5i** (49.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 5.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: 30:1 petroleum ether/EtOAc] to afford **4i** (46.0 mg, 0.18 mmol) in 92% yield.

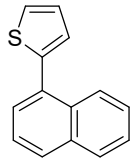
4i: R_f = 0.50 [20:1 petroleum ether/EtOAc]; yellow solid; mp = 115–116 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, 2H, J = 8.8 Hz), 7.94 (dd, 2H, J = 7.9 Hz, 3.1 Hz), 7.79 (d, 1H, J = 8.4 Hz), 7.68 (d, 2H, J = 8.8 Hz), 7.58-7.52 (m, 2H), 7.50-7.46 (m, 1H), 7.43 (dd, 1H, J = 7.0, 1.0 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.8, 147.3, 137.9, 133.9, 131.10, 131.07, 129.1, 128.8, 127.3, 126.9, 126.4, 125.5 ,125.3, 123.8. Spectral data are in agreement with literature values.[11]



4j

To an oven-dried sealed tube was added the mixture of **4j** and **5j** (44.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 4.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4j** (44.1 mg, 0.20 mmol) in 99% yield.

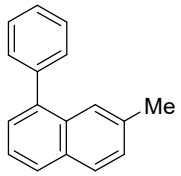
4j: R_f = 0.41 [petroleum ether]; white solid; mp = 62–63 °C; ^1H NMR (400 MHz, $CDCl_3$) δ 7.93-7.87 (m, 2H), 7.83 (d, 1H, J = 8.2 Hz), 7.52-7.35 (m, 5H), 7.31-7.28 (m, 2H), 7.24-7.22 (m, 1H), 2.43 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.9, 140.6, 138.0, 134.0, 131.8, 131.0, 128.4, 128.3, 128.1, 127.7, 127.3, 127.0, 126.3, 126.1, 125.9, 125.5, 21.7. Spectral data are in agreement with literature values.[14]



4k

To an oven-dried sealed tube was added **4k** and **5k** (42.3 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 19.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4k** (38.0 mg, 0.18 mmol) in 90% yield.

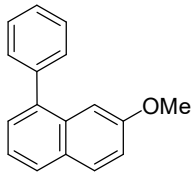
4k: R_f = 0.32 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 8.23-8.20 (m, 1H), 7.91-7.87 (m, 1H), 7.85 (d, 1H, J = 8.2 Hz), 7.57 (dd, 1H, J = 7.1 Hz, 1.3 Hz), 7.52-7.46 (m, 3H), 7.42 (dd, 1H, J = 5.1Hz, 1.2 Hz), 7.24 (dd, 1H, J = 3.4 Hz, 1.2 Hz), 7.18 (dd, 1H, J = 5.1 Hz, 3.5 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.9, 134.0, 132.6, 132.0, 128.6, 128.5, 128.4, 127.6, 127.4, 126.6, 126.2, 125.9, 125.8, 125.4. Spectral data are in agreement with literature values.[15]



4l

To an oven-dried sealed tube was added **4l** and **5l** (43.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4l** (42.1 mg, 0.19 mmol) in 96% yield.

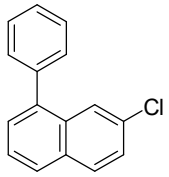
4l: R_f = 0.44 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.80 (d, 2H, J = 8.4 Hz), 7.66 (s, 1H), 7.49-7.40 (m, 6H), 7.37 (dd, 1H, J = 7.1 Hz, 1.3 Hz), 7.32 (dd, 1H, J = 8.3 Hz, 1.7 Hz), 2.42 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.1, 139.7, 135.9, 132.2, 131.9, 130.2, 128.4, 128.3, 128.2, 127.6, 127.3, 127.2, 125.0, 124.7, 22.2. Spectral data are in agreement with literature values.[16]



4m

To an oven-dried sealed tube was added **4m** and **5m** (47.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^oC for 5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4m** (47.0 mg, 0.20 mmol) in 99% yield.

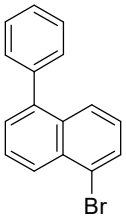
4m: *Rf* = 0.33 [petroleum ether]; colorless oil; ^1H NMR (400 MHz, $CDCl_3$) δ 7.80-7.75 (m, 2H), 7.52-7.45 (m, 4H), 7.42-7.34 (m, 3H), 7.22 (d, 1H, J = 2.6 Hz), 7.15 (dd, 1H, J = 8.9 Hz, 2.6 Hz), 3.74 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.9, 141.2, 139.2, 132.8, 130.03, 129.97, 129.5, 128.5, 127.7, 127.5, 127.3, 123.3, 118.4, 104.6, 55.3. Spectral data are in agreement with literature values.[16]



4n

To an oven-dried sealed tube was added **4n** and **5n** (47.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4n** (47.2 mg, 0.20 mmol) in 99% yield.

4n: *Rf* = 0.53 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, 1H, *J* = 2.1 Hz), 7.82 (dd, 2H, *J* = 8.6 Hz, 2.9 Hz), 7.53-7.41 (m, 8H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.2, 139.8, 132.5, 132.20, 132.17, 130.1, 130.0, 128.6, 128.1, 127.7, 127.6, 126.9, 125.8, 125.1. Spectral data are in agreement with literature values.[16]

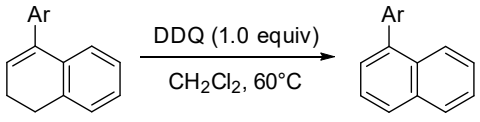


4o

To an oven-dried sealed tube was added **4o** and **5o** (57.2 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4o** (54.9 mg, 0.19 mmol) in 96% yield.

4o: *Rf* = 0.52 [petroleum ether]; colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, 1H, *J* = 8.6 Hz), 7.85 (d, 1H, *J* = 8.5 Hz), 7.78 (d, 1H, *J* = 8.2 Hz), 7.62 (dd, 1H, *J* = 8.6Hz, 7.0 Hz), 7.50-7.41 (m, 6H), 7.23 (dd, 1H, *J* = 8.5Hz, 7.5 Hz); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.9, 140.5, 133.2, 132.4, 130.2, 130.1, 128.5, 128.0, 127.6, 127.0, 126.9, 126.4, 126.3, 123.4. Spectral data are in agreement with literature values.[17]

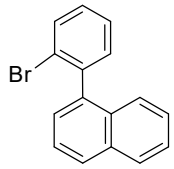
B.



6 **4**

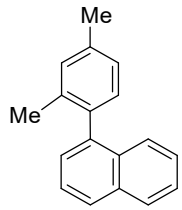
To an oven-dried sealed tube was added **6b** (57.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 3.0 h. After the reaction was judged to be complete by TLC, the

reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4p** (55.7 mg, 0.20 mmol) in 99% yield.



4p

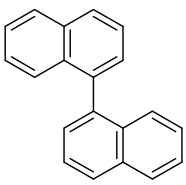
4p: R_f = 0.47 [petroleum ether]; yellow solid; mp = 71–72 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (dd, 2H, J = 8.0, 1.3 Hz), 7.72 (dd, 1H, J = 8.0, 1.2 Hz), 7.54-7.45 (m, 3H), 7.41-7.33 (m, 4H), 7.30-7.26 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.5, 139.2, 133.6, 132.9, 132.1, 131.7, 129.3, 128.4, 128.35, 127.3, 127.1, 126.3, 126.1, 126.0, 125.3, 124.5. Spectral data are in agreement with literature values.[25]



4q

To an oven-dried sealed tube was added **6c** (46.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 ^{o}C for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4q** (41.3 mg, 0.18 mmol) in 88% yield.

4q: R_f = 0.49 [petroleum ether]; colorless oil; ^{1}H NMR (400MHz, $CDCl_3$) δ 7.88 (d, 1H, J = 8.1 Hz), 7.84 (d, 1H, J = 8.3 Hz), 7.52-7.43 (m, 3H), 7.37-7.31 (m, 2H), 7.15-7.09 (m, 3H), 2.42 (s, 3H), 1.99 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.0, 137.5, 137.3, 136.8, 133.7, 132.3, 130.8, 130.5, 128.4, 127.5, 127.0, 126.44, 126.35, 126.1, 125.8, 125.6, 21.4, 20.2. Spectral data are in agreement with literature values.[26]

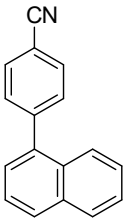


4r

To an oven-dried sealed tube was added **6d** (51.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn*

= 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: petroleum ether] to afford **4r** (51.0 mg, 0.20 mmol) in 99% yield

4r: R_f = 0.49 [petroleum ether]; yellow solid; mp = 138–139 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 7.97-7.93 (m, 4H), 7.61-7.57 (m, 2H), 7.50-7.45 (m, 4H), 7.39 (d, 2H, *J* = 8.4 Hz), 7.31-7.27 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.6, 133.7, 133.0, 128.3, 128.1, 128.0, 126.7, 126.1, 126.0, 125.6. Spectral data are in agreement with literature values.[27]



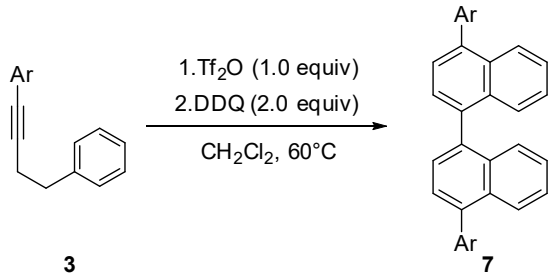
4s

To an oven-dried sealed tube was added **6e** (46.3 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, alkyne *concn* = 0.20 *M*), and DDQ (45.4 mg, 0.20 mmol) in the glove box at rt. Then the reaction vessel was capped and stirred at 60 °C for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, filtered through a pad of silica gel, concentrated *in vacuo*, and purified by flash silica gel column chromatography [isocratic eluent: 30:1 petroleum ether/EtOAc] to afford **4s** (42.2 mg, 0.18 mmol) in 92% yield.

4s: R_f = 0.35 [20:1 petroleum ether/EtOAc]; white solid; mp = 65–66 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 7.94-7.90 (m, 2H), 7.79-7.76 (m, 3H), 7.61-7.58 (m, 2H), 7.56-7.50 (m, 2H), 7.48-7.44 (m, 1H), 7.39 (dd, 1H, *J* = 7.1, 1.2 Hz),; ^{13}C NMR (100 MHz, $CDCl_3$) δ 145.8, 138.3, 133.9, 132.3, 131.1, 131.0, 128.9, 128.7, 127.2, 126.8, 126.3, 125.5, 125.3, 119.1, 111.3. Spectral data are in agreement with literature values.[28]

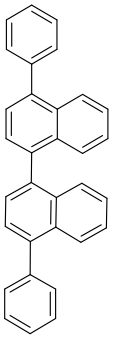
1.6 Synthesis of 4,4'-Disubstituted-1,1'-Binaphthyls (Table 5).

4,4'-Disubstituted-1,1'-binaphthyl **7a**[29] was known compound, the data were matched with reported values. 4,4'-Disubstituted-1,1'-binaphthyl **7b**-**7h** were new compounds.



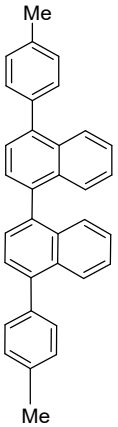
3 **7**

To an oven-dried sealed tube was added **3a** (41.3 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 3.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 15:1 petroleum ether/CH_2Cl_2] to afford **7a** (40.8 mg, 0.10 mmol) in 99% yield.



7a

7a: R_f = 0.59 [20:1 petroleum ether/EtOAc]; pale yellow solid; mp = 178–179 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 8.01 (d, 2H, *J*= 8.2 Hz), 7.61-7.50 (m, 14H), 7.47-7.38 (m, 4H), 7.32-7.27 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.0, 140.3, 138.3, 133.4, 131.9, 130.4, 128.5, 127.7, 127.5, 127.2, 126.7, 126.5, 126.1, 126.0. Spectral data are in agreement with literature values.[29]

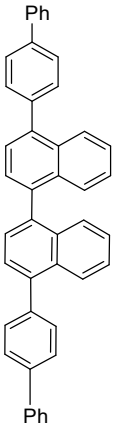


7b

To an oven-dried sealed tube was added **3b** (44.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and

Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 3.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 10:1 petroleum ether/CH_2Cl_2] to afford **7b (**30.3 mg, 0.07 mmol) in 70% yield.

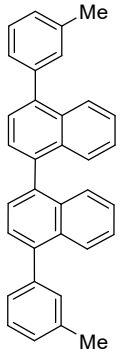
7b: R_f = 0.58 [20:1 petroleum ether/EtOAc]; pale yellow solid; mp = 115–116 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (d, 2H, J = 8.5 Hz), 7.57-7.50 (m, 10H), 7.43-7.40 (m, 2H), 7.35 (d, 4H, J = 8.0 Hz), 7.33-7.30 (m, 2H), 2.49 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 140.3, 138.12, 138.08, 137.2, 133.4, 132.0, 130.3, 129.2, 127.7, 127.2, 126.6, 126.5, 125.97, 125.94, 21.5; IR (neat) (cm^{-1}) 2919w, 1513m, 1502m, 1423m, 1379s, 1182s, 1157s, 1022s; HRMS (ESI): m/z calcd for $C_{34}H_{27}$ $[M+H]^+$ 435.2107, found 435.2127.



7c

To an oven-dried sealed tube was added **3c** (56.5 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 M), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 5.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 15:1 petroleum ether/CH_2Cl_2] to afford **7c** (40.2 mg, 0.07 mmol) in 72% yield.

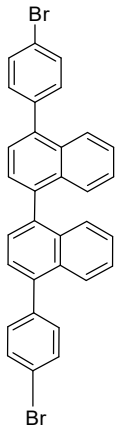
7c: R_f = 0.42 [20:1 petroleum ether/EtOAc]; pale yellow solid; mp = 285–286 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 8.11 (d, 2H, J = 8.4 Hz,), 7.81-7.70 (m 12H), 7.62-7.59 (m, 6H), 7.53-7.34 (m, 10H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.0, 140.4, 140.0, 139.9, 138.4, 133.4, 131.9, 130.9, 129.1, 127.7, 127.6, 127.4, 127.3, 126.7, 126.5, 126.2, 126.1, one carbon missing due to overlap, overlapped signal at 127.4 ppm; IR (neat) (cm^{-1}) 3029w, 2955w, 2919w, 2849w, 1486m, 1399m, 1079m, 1005m, 966s; HRMS (ESI): m/z calcd for $C_{44}H_{30}Na$ $[M+Na]^+$ 581.2240, found 581.2235.



7d

To an oven-dried sealed tube was added **3j** (44.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 2.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 15:1 petroleum ether/CH_2Cl_2] to afford **7d** (33.1 mg, 0.08 mmol) in 76% yield.

7d: R_f = 0.57 [20:1 petroleum ether/EtOAc]; pale yellow solid; mp = 178–179 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 8.03 (d, 2H, J = 8.4 Hz), 7.58-7.53 (m, 6H), 7.46-7.41 (m, 8H), 7.33-7.28 (m, 4H), 2.49 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.0, 140.4, 138.2, 138.1, 133.4, 131.9, 131.1, 128.4, 128.2, 127.6, 127.5, 127.2, 126.58, 126.57, 126.0, 125.96, 21.8; IR (neat) (cm^{-1}) 2921w, 2851w, 1601m, 1508m, 1490m, 1508m, 1442m, 1379s, 1072s, 1028s; HRMS (ESI): m/z calcd for $C_{34}H_{27}$ $[M+H]^+$ 435.2107; found 435.2127.

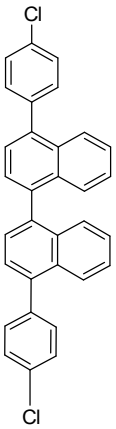


7e

To an oven-dried sealed tube was added **3e** (57.0 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 3.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina

column chromatography [isocratic eluent: 30:1 petroleum ether/CH_2Cl_2] to afford **7e** (55.8 mg, 0.10 mmol) in 99% yield.

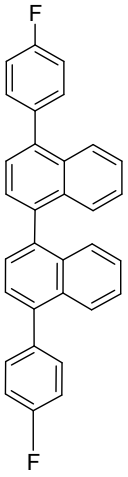
7e: R_f = 0.28 [petroleum ether]; white solid; mp = 173–174 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, 2H, J = 8.4 Hz), 7.67 (d, 4H, J = 8.4 Hz), 7.55-7.42 (m, 12H), 7.34-7.30 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.8, 139.1, 138.5, 133.3, 132.0, 131.7, 131.6, 127.6, 127.2, 126.6, 126.4, 126.2, 126.1, 121.8; IR (neat) (cm^{-1}) 2922w, 2851w, 1508m, 1486m, 1423m, 1378s, 1070s, 1010s; HRMS (ESI): m/z calcd for $C_{32}H_{20}Br_2K$ $[M+K]^+$ 600.9563, found 600.9563.



7f

To an oven-dried sealed tube was added **3f** (48.1 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^{o}C for 3.5 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^{o}C for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 30:1 petroleum ether/ EtOAc] to afford **7f (**47.1 mg, 0.10 mmol) in 99% yield.

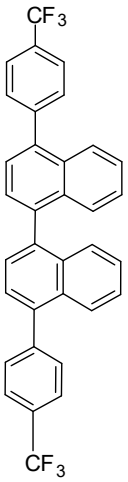
7f: R_f = 0.52 [20:1 petroleum ether/EtOAc]; white solid; mp = 215–216 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, 2H, J = 8.4 Hz), 7.56-7.51 (m, 14H), 7.45 (t, 2H, J = 7.4 Hz), 7.35-7.31 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.4, 139.1, 138.5, 133.6, 133.3, 131.71, 131.66, 128.8, 127.6, 127.2, 126.7, 126.3, 126.21, 126.17; IR (neat) (cm^{-1}) 1594m, 1577m, 1508m, 1488m, 1424m, 1379s, 1247s, 1094s, 1014s; HRMS (ESI): m/z calcd for $C_{32}H_{20}Cl_2K$ $[M+K]^+$ 513.0574, found 513.0582.



7g

To an oven-dried sealed tube was added **3g** (44.8 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 5.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 4.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 30:1 petroleum ether/CH_2Cl_2] to afford **7g** (41.8 mg, 0.10 mmol) in 94% yield.

7g: R_f = 0.52 [20:1 petroleum ether/EtOAc]; white solid; mp = 215–216 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, 2H, J = 8.4 Hz), 7.59-7.52 (m, 10H), 7.47-7.43 (m, 2H), 7.36-7.31 (m, 2H), 7.26-7.22 (m, 4H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5 (d, J = 244.8 Hz), 139.2, 138.3, 136.86 (d, J = 3.3 Hz), 133.3, 131.90, 131.88 (d, J = 7.9 Hz), 127.6, 127.2, 126.8, 126.3, 126.1, 115.4 (d, J = 21.2 Hz), one carbon missing due to overlap, overlapped signal at 126.3 ppm; ^{19}F NMR (376 MHz, $CDCl_3$) δ -115.3; IR (neat) (cm^{-1}) 1604m, 1511m, 1501m, 1455m, 1426m, 1379s, 1229s, 1157s, 1096s, 1015s; HRMS (ESI): m/z calcd for $C_{32}H_{21}F_2$ $[M+H]^+$ 443.1606, found 443.1614.



7h

To an oven-dried sealed tube was added **3h** (54.9 mg, 0.20 mmol), CH_2Cl_2 (1.0 mL, 0.20 *M*), and Tf_2O (33.6 μL, 0.20 mmol) in the glove box at rt. The reaction vessel was capped and stirred at 60 ^oC for 5.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was cooled to rt, DDQ (90.8 mg, 0.40 mmol) was added. Then the reaction mixture was stirred at 60 ^oC for 5.0 h. After the reaction was judged to be complete by TLC, the reaction mixture was purified by alumina column chromatography [isocratic eluent: 15:1 petroleum ether/CH_2Cl_2] to afford **7h** (47.7 mg, 0.09 mmol) in 88% yield.

7h: R_f = 0.57 [petroleum ether]; pale yellow solid; mp = 198–199 °C; ^{1}H NMR (400MHz, $CDCl_3$) δ 7.93 (d, 2H, J = 8.5 Hz), 7.82 (d, 4H, J = 8.0 Hz), 7.73 (d, 4H, J = 7.80 Hz), 7.60-7.53 (m, 6H), 7.47-7.44 (m, 2H), 7.37-7.33 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.6, 138.9, 138.8, 133.3, 131.5, 130.7, 129.8 (q, J = 32.5 Hz), 127.6, 127.3, 126.8, 126.6, 126.4, 126.0, 125.5 (q, J = 3.7 Hz), 124.5 (q, J = 272.0 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.3; IR (neat) (cm^{-1}) 3025w, 2922m, 2851m, 1616m, 1570m, 1405m, 1324s, 1129s, 1157s, 1064s, 1019s; HRMS (ESI): m/z calcd for $C_{34}H_{19}F_6$ $[M-H]^-$ 541.1396, found 541.1395.

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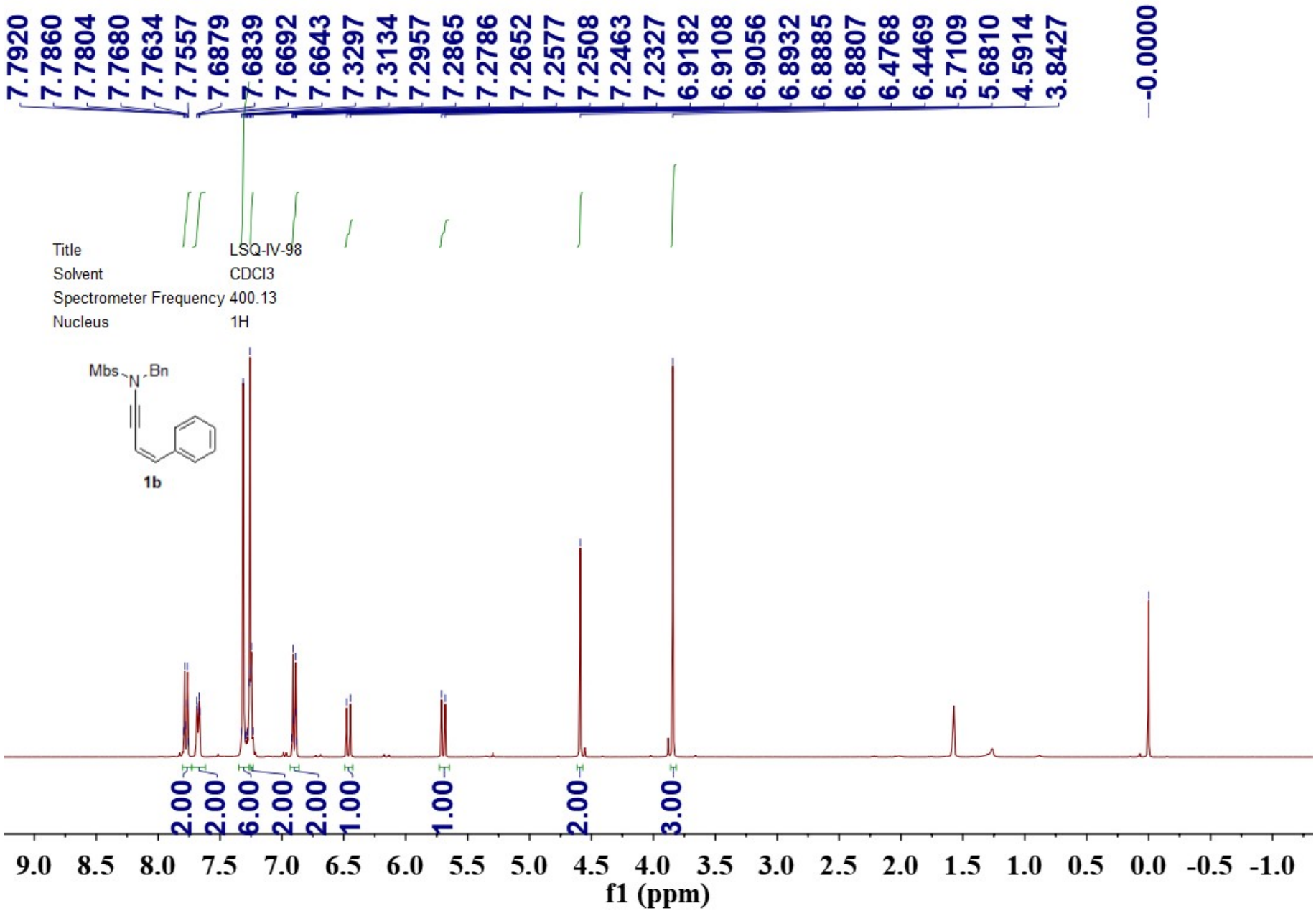
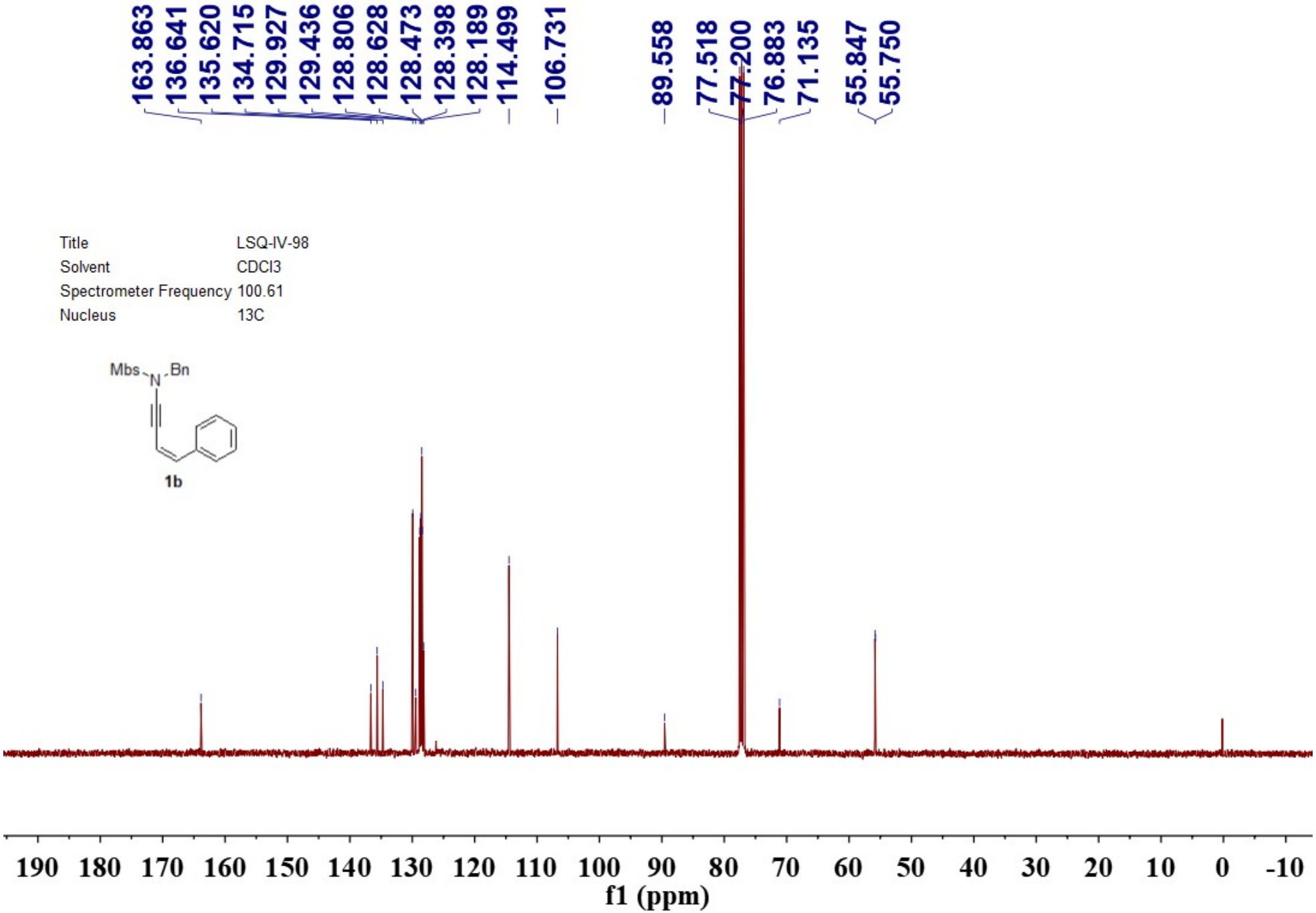
Part II Copies of ^{1}H NMR, ^{13}C NMR, and ^{19}F NMR Spectra

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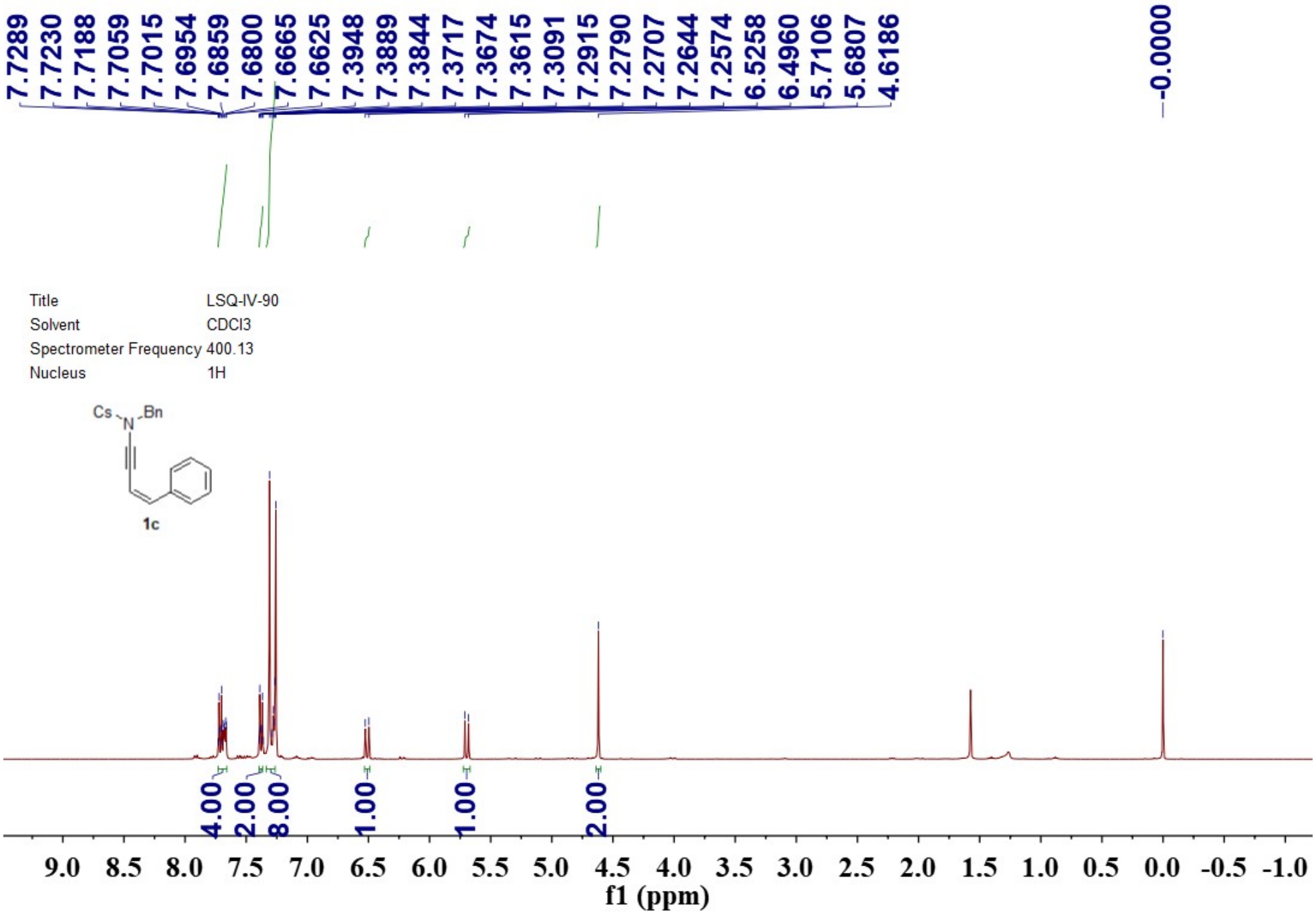
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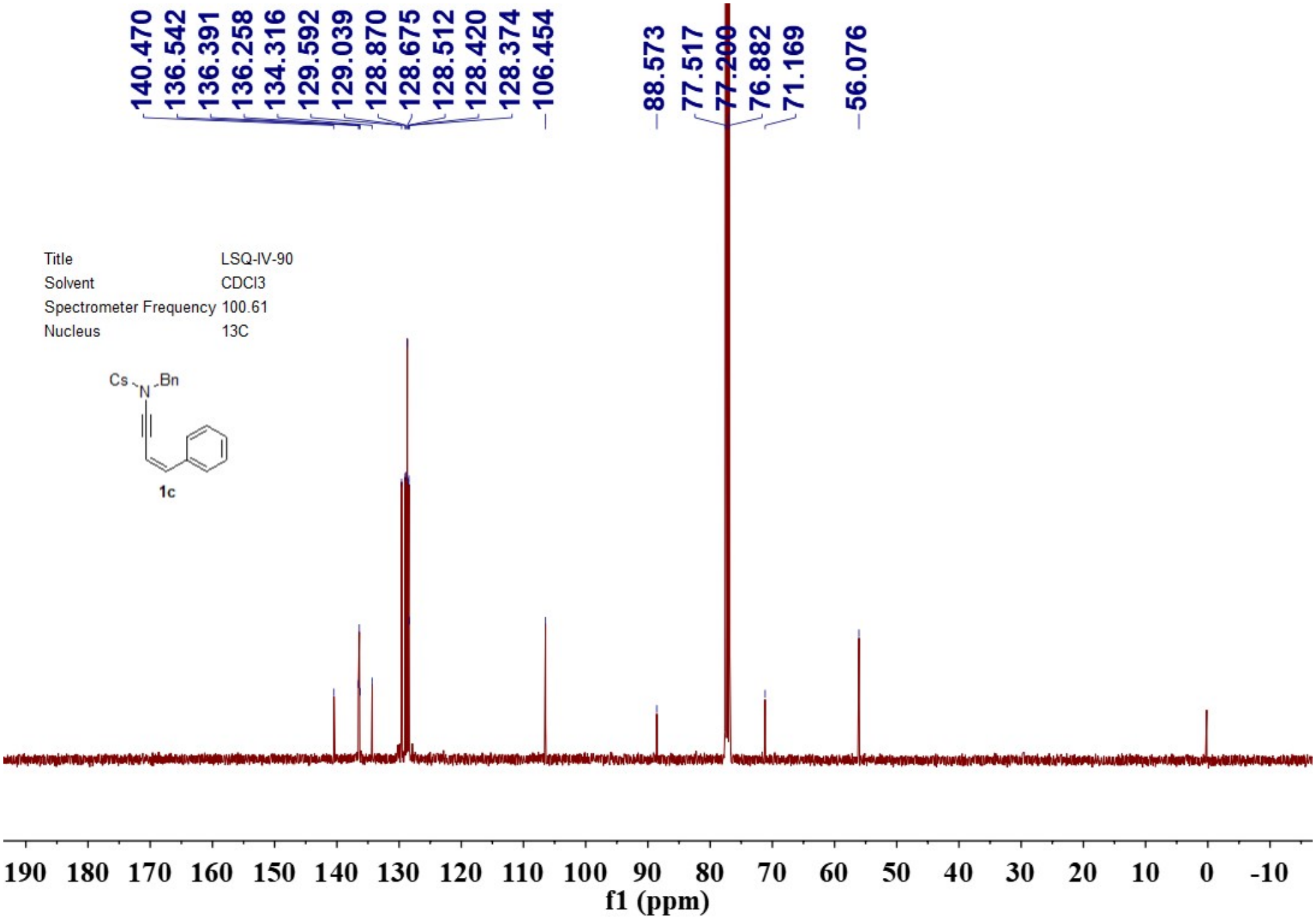
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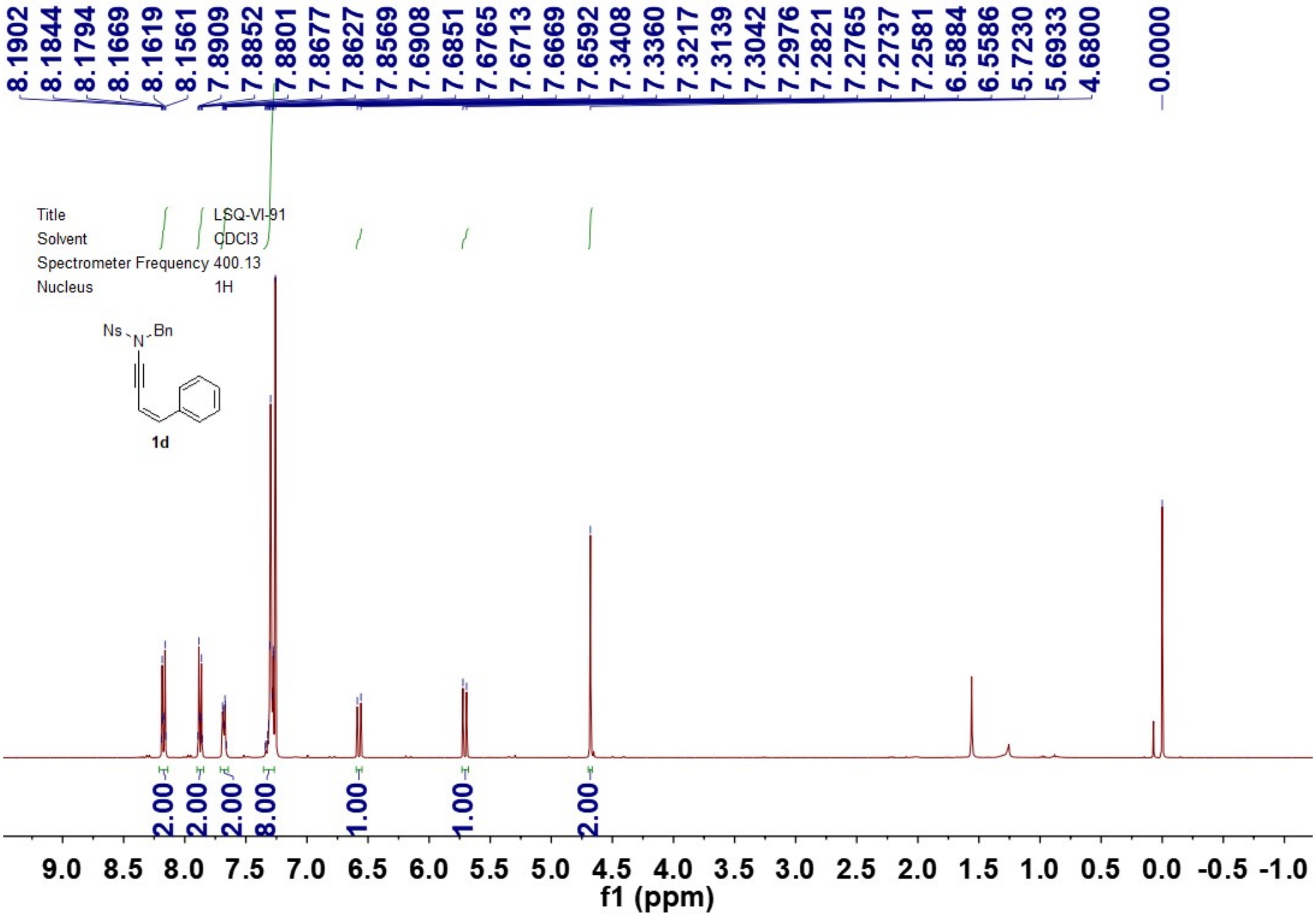
Cs
N
Bn
1c
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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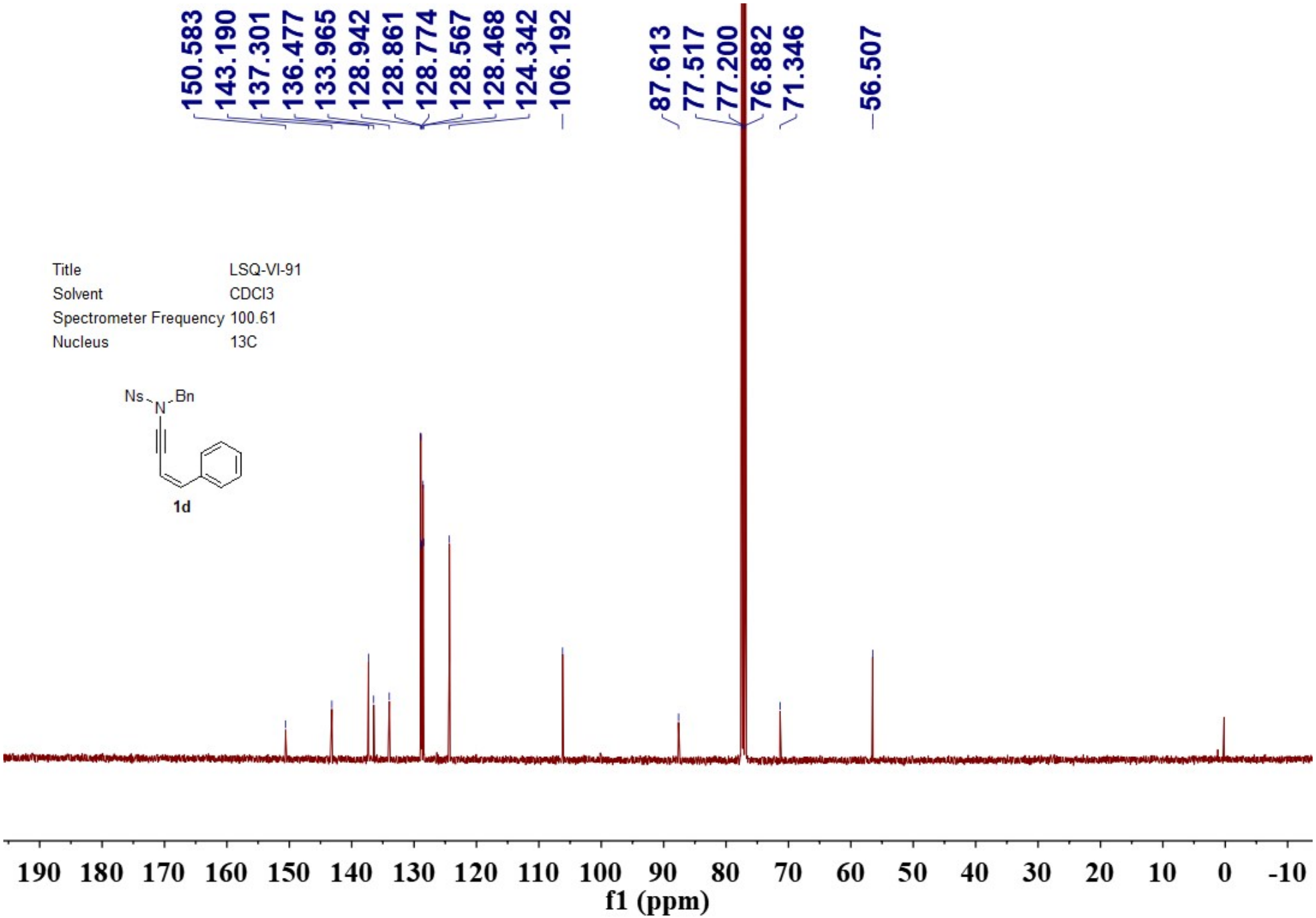
8.1844
8.1794
8.1669
8.1619
8.1561
7.8909
7.8852
7.8801
7.8677
7.8627
7.8569
7.6908
7.6851
7.6765
7.6713
7.6669
7.6592
7.3408
7.3360
7.3217
7.3139
7.3042
7.2976
7.2821
7.2765
7.2737
7.2581
6.5884
6.5586
5.7230
5.6933
4.6800
0.0000
Title LSQ-VI-91
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ns
N
Bn
1d
2.00
2.00
2.00
8.00
1.00
1.00
2.00
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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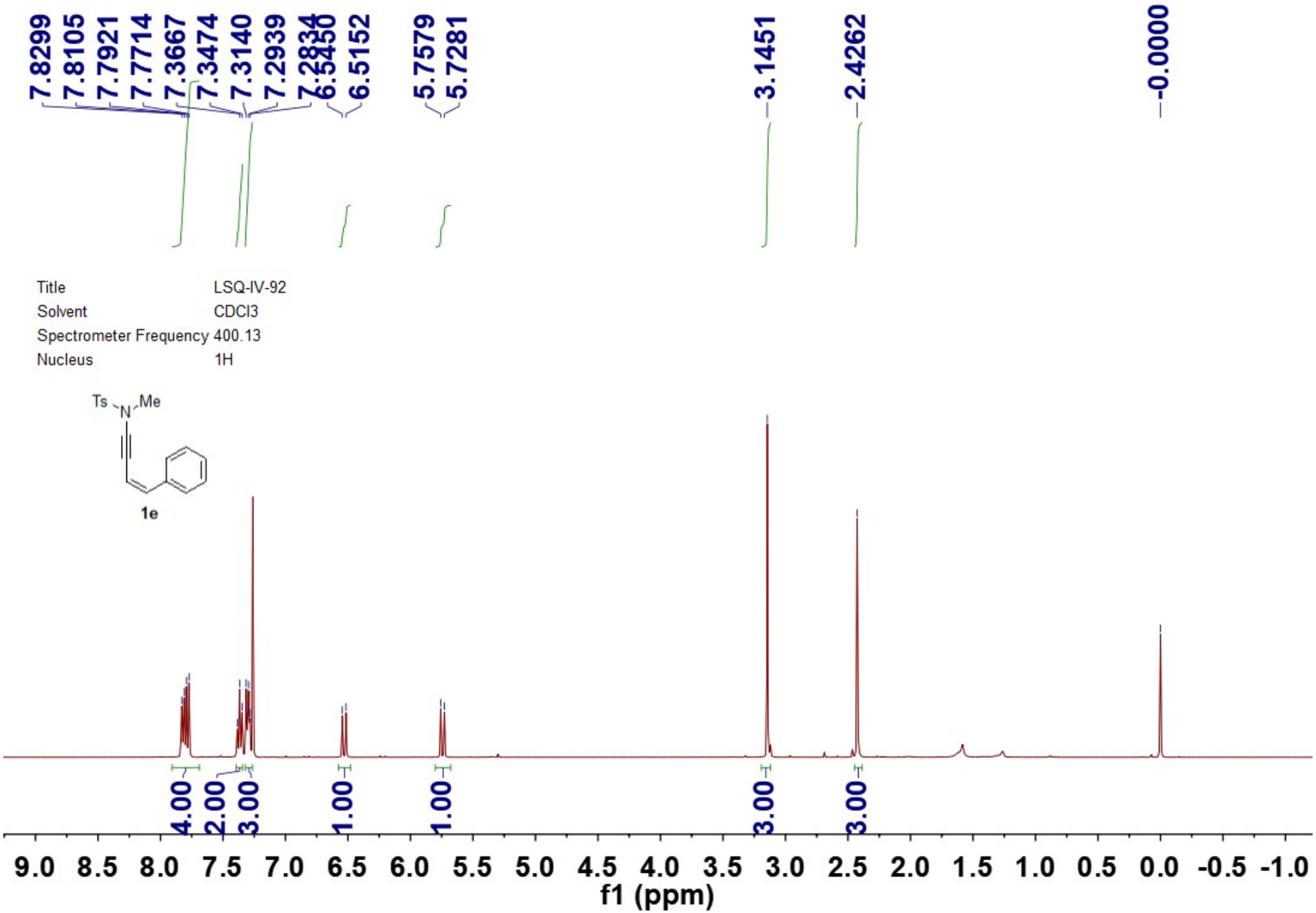
143.190
137.301
136.477
133.965
128.942
128.861
128.774
128.567
128.468
124.342
106.192
87.613
77.517
77.200
76.882
71.346
56.507
Title LSQ-VI-91
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ns
N
Bn
1d
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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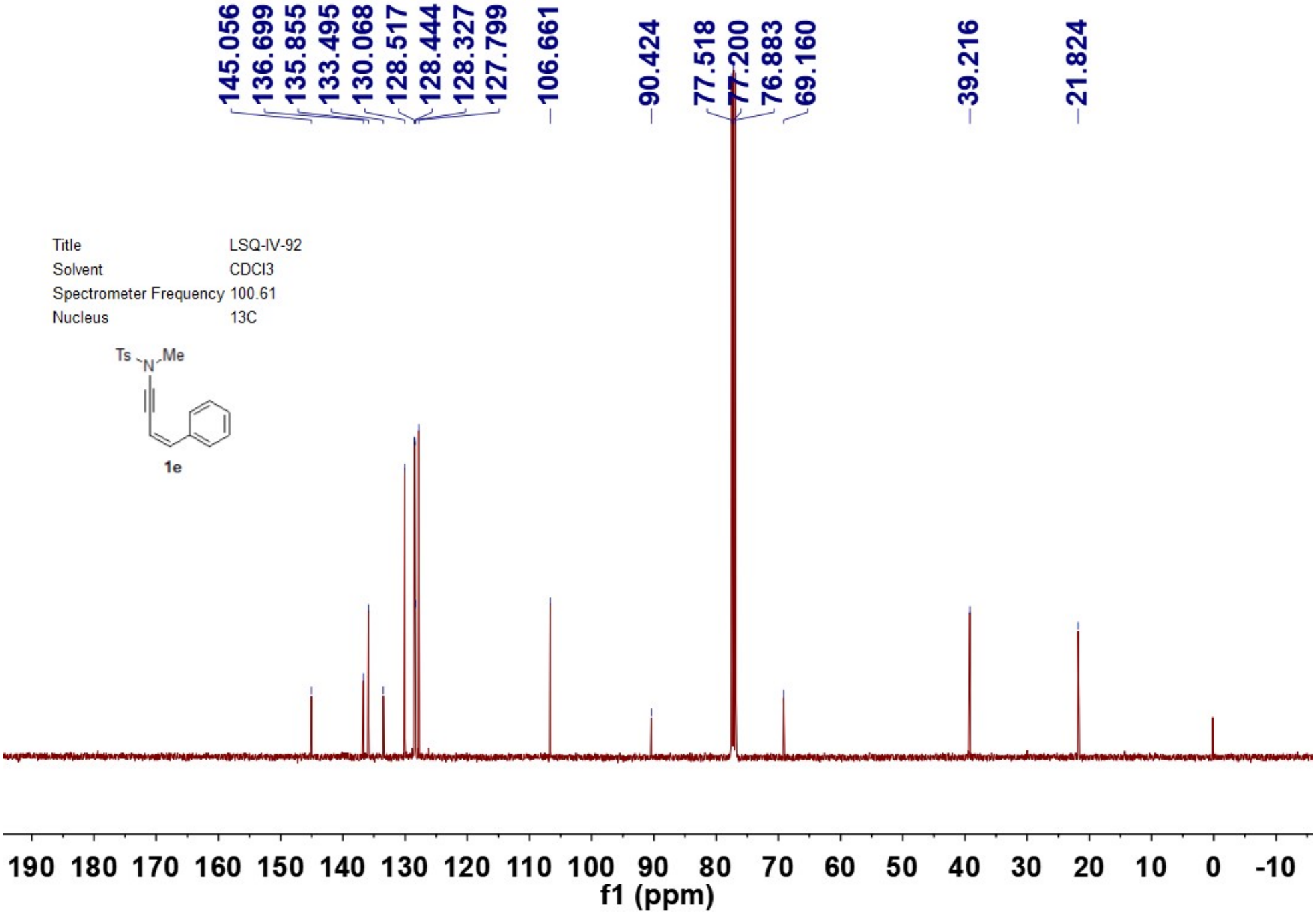
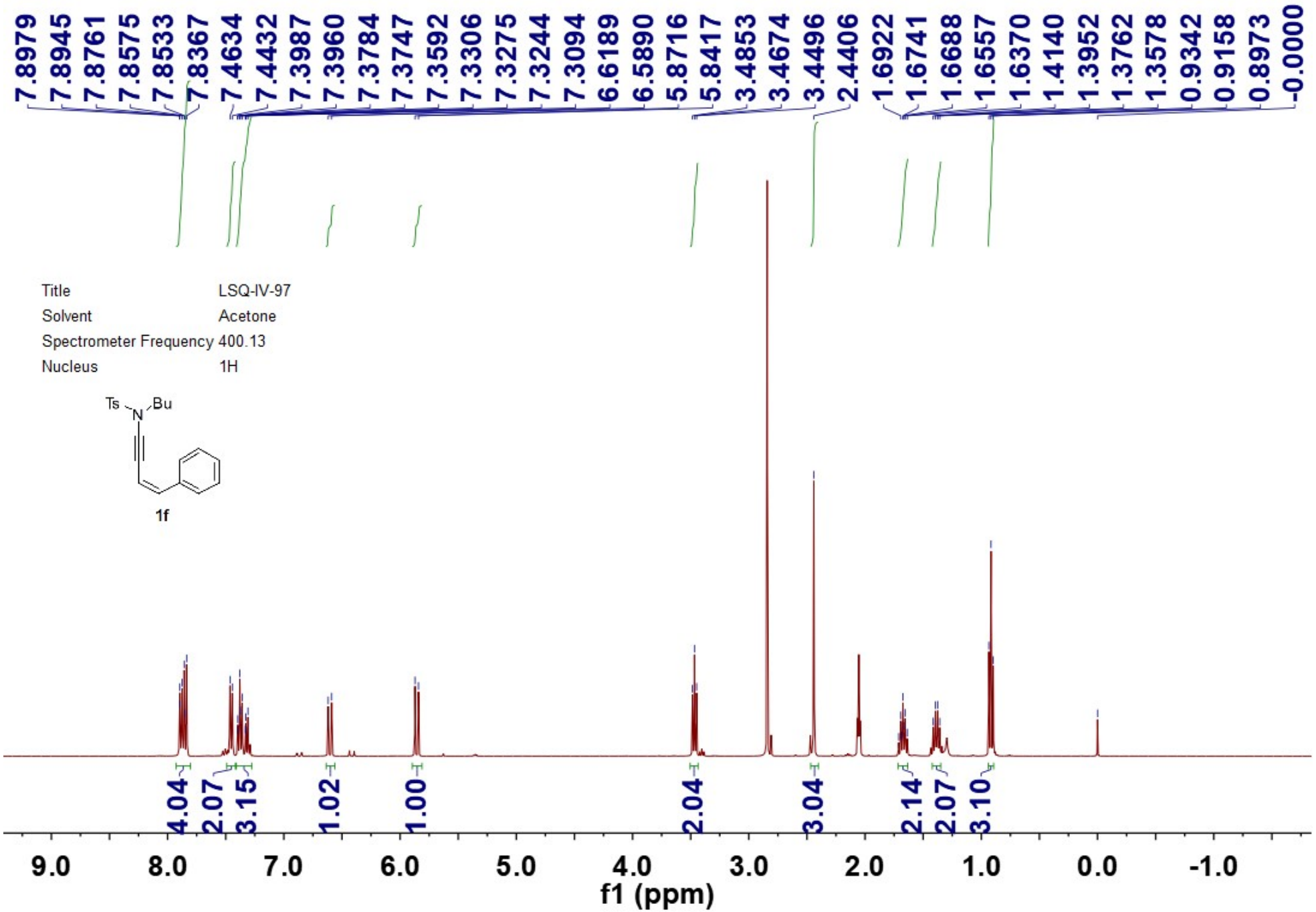
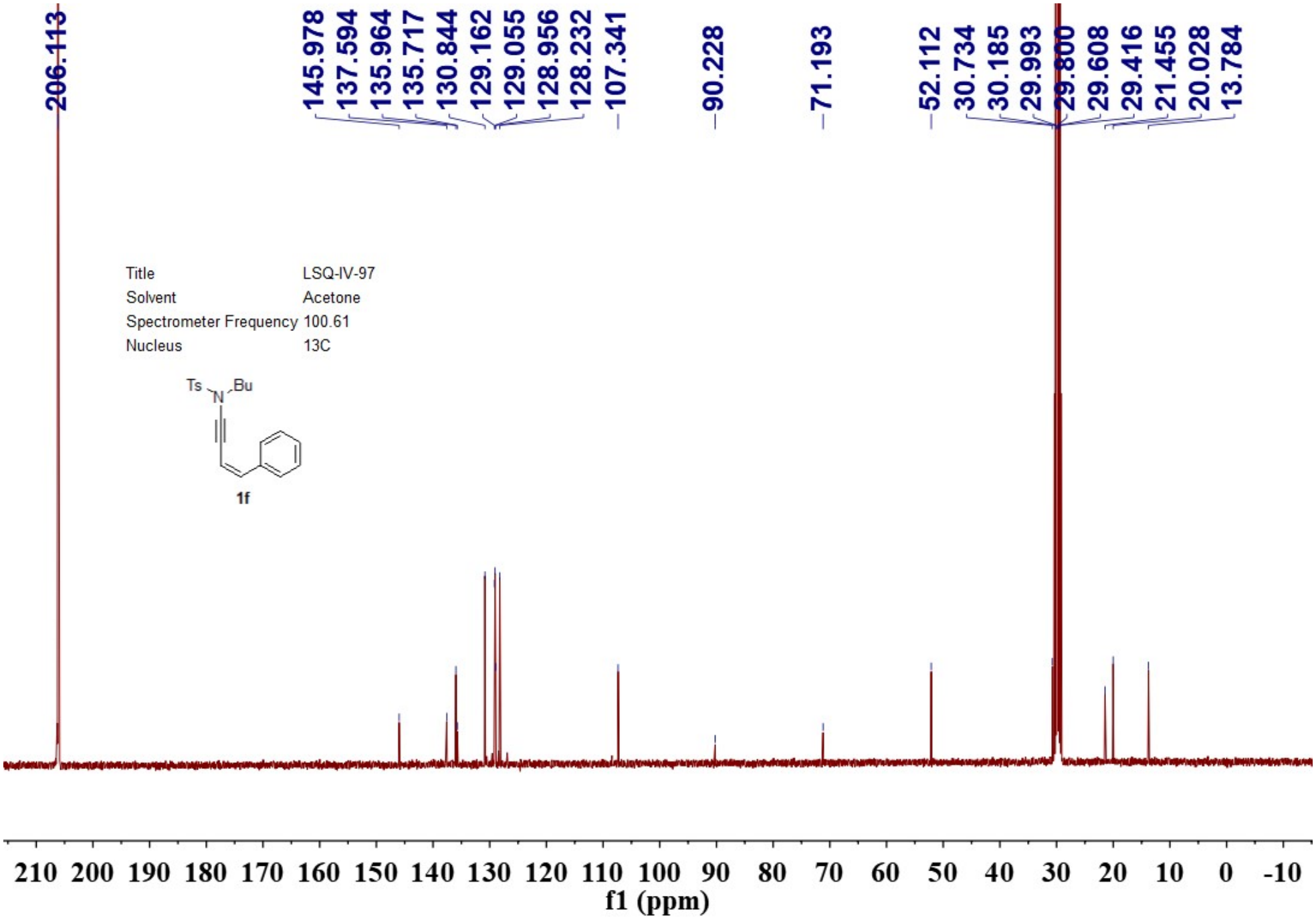
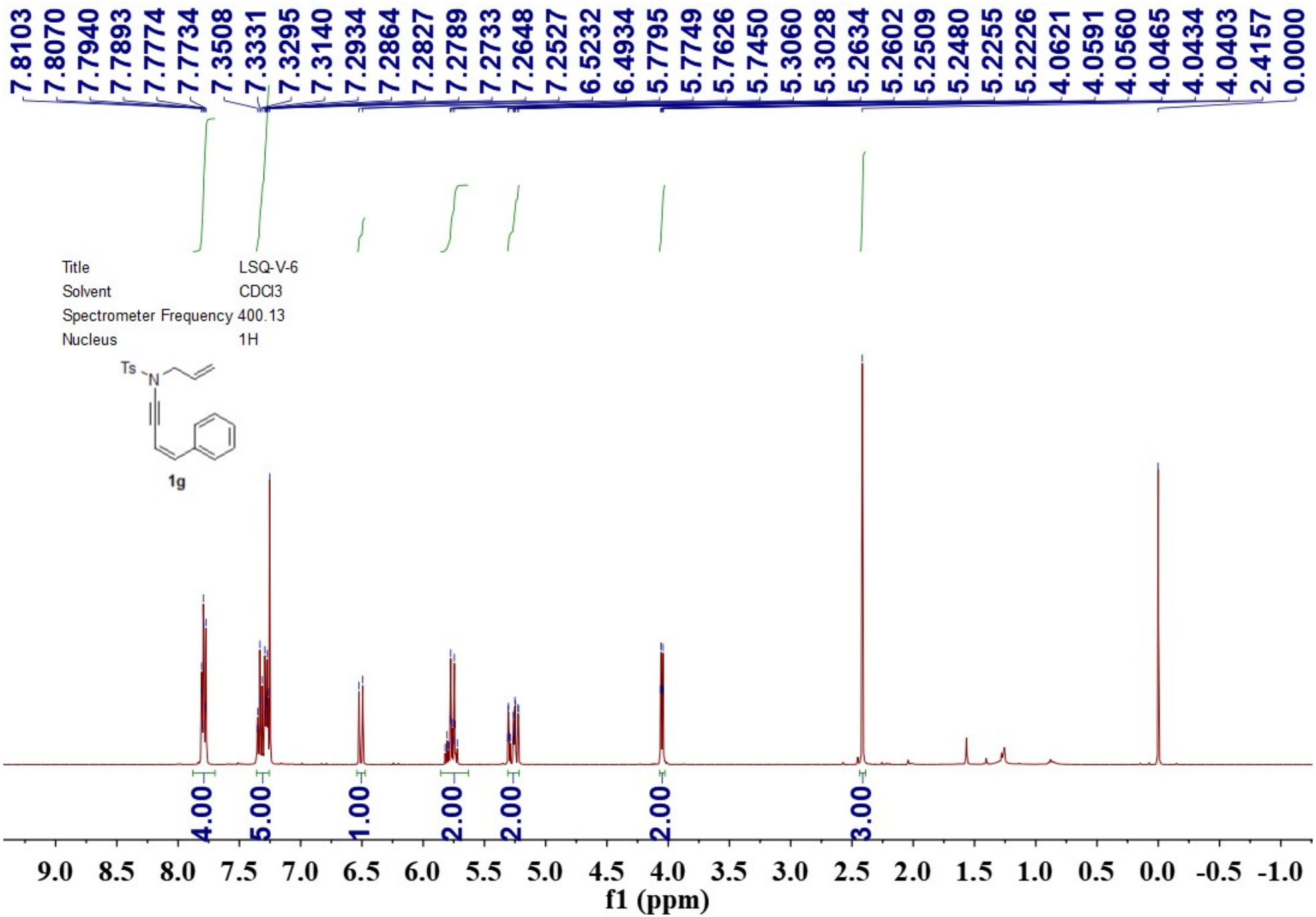
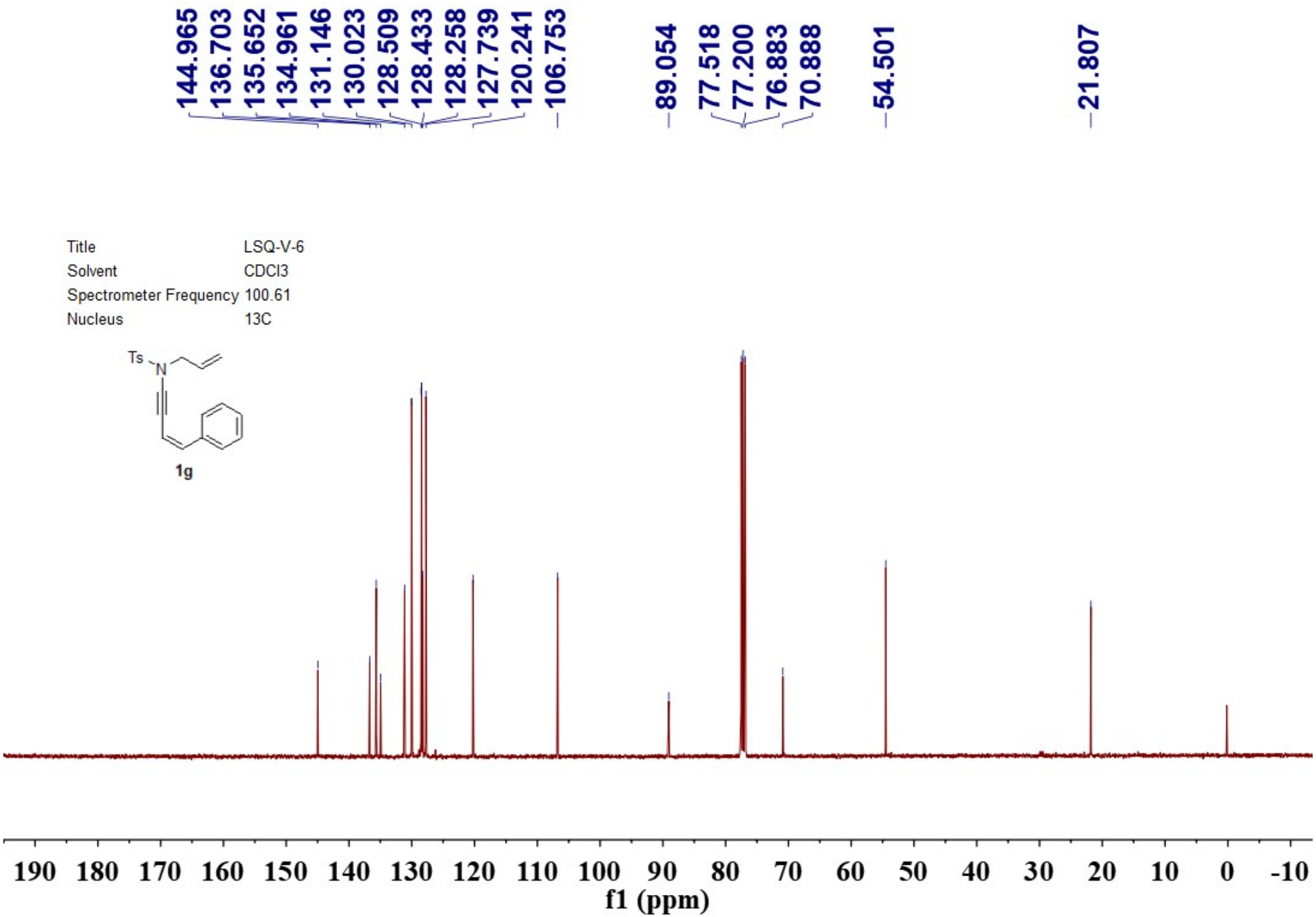
7.8105
7.7921
7.7714
7.3667
7.3474
7.3140
7.2939
7.2834
7.2450
6.5152
5.7579
5.7281
3.1451
2.4262
-0.0000
Title LSQ-IV-92
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Me
1e
4.00
2.00
3.00
1.00
1.00
3.00
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

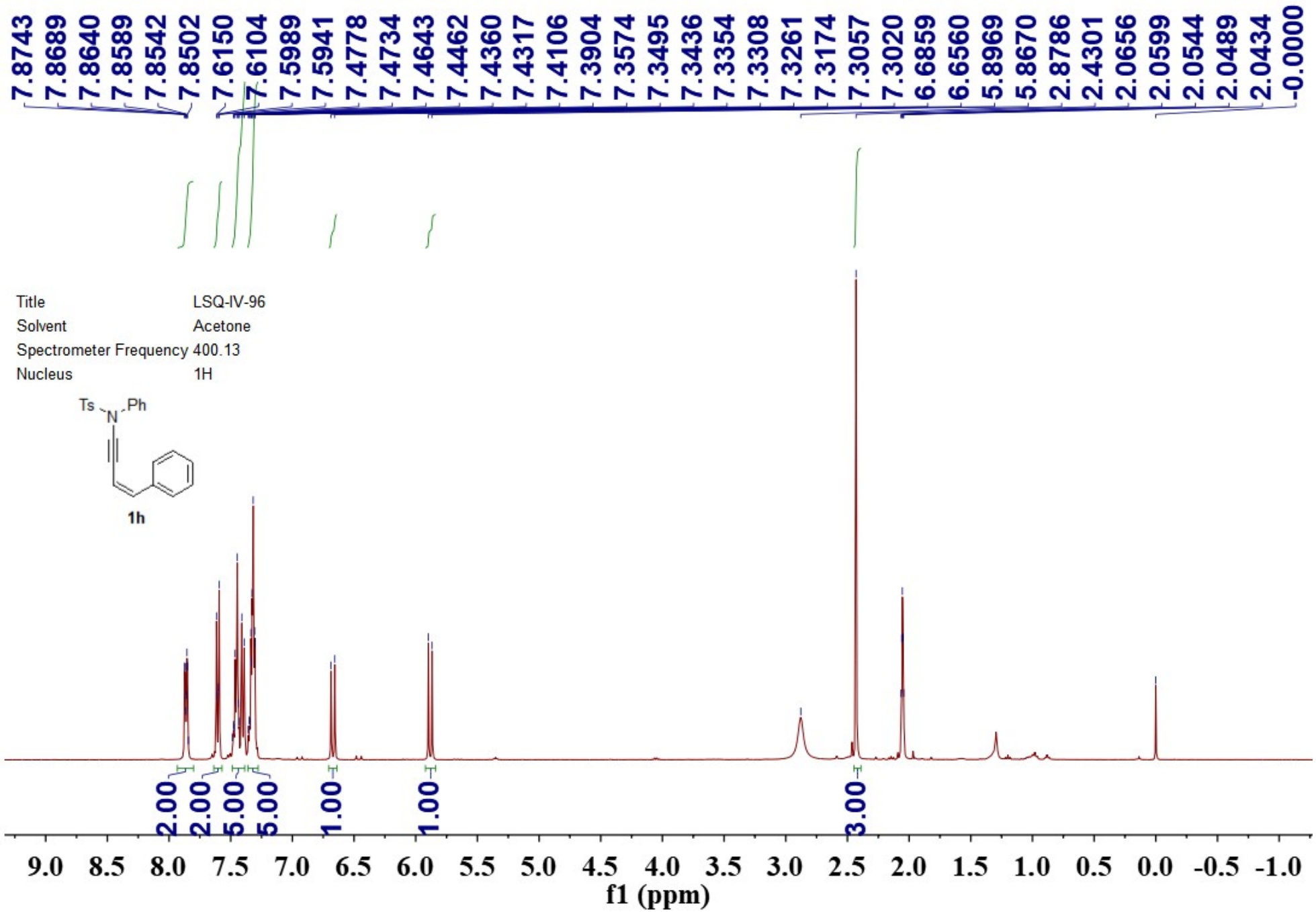

145.056
136.699
135.855
133.495
130.068
128.517
128.444
128.327
127.799
106.661
90.424
77.518
77.200
76.883
69.160
39.216
21.824
Title LSQ-IV-92
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Me
1e
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

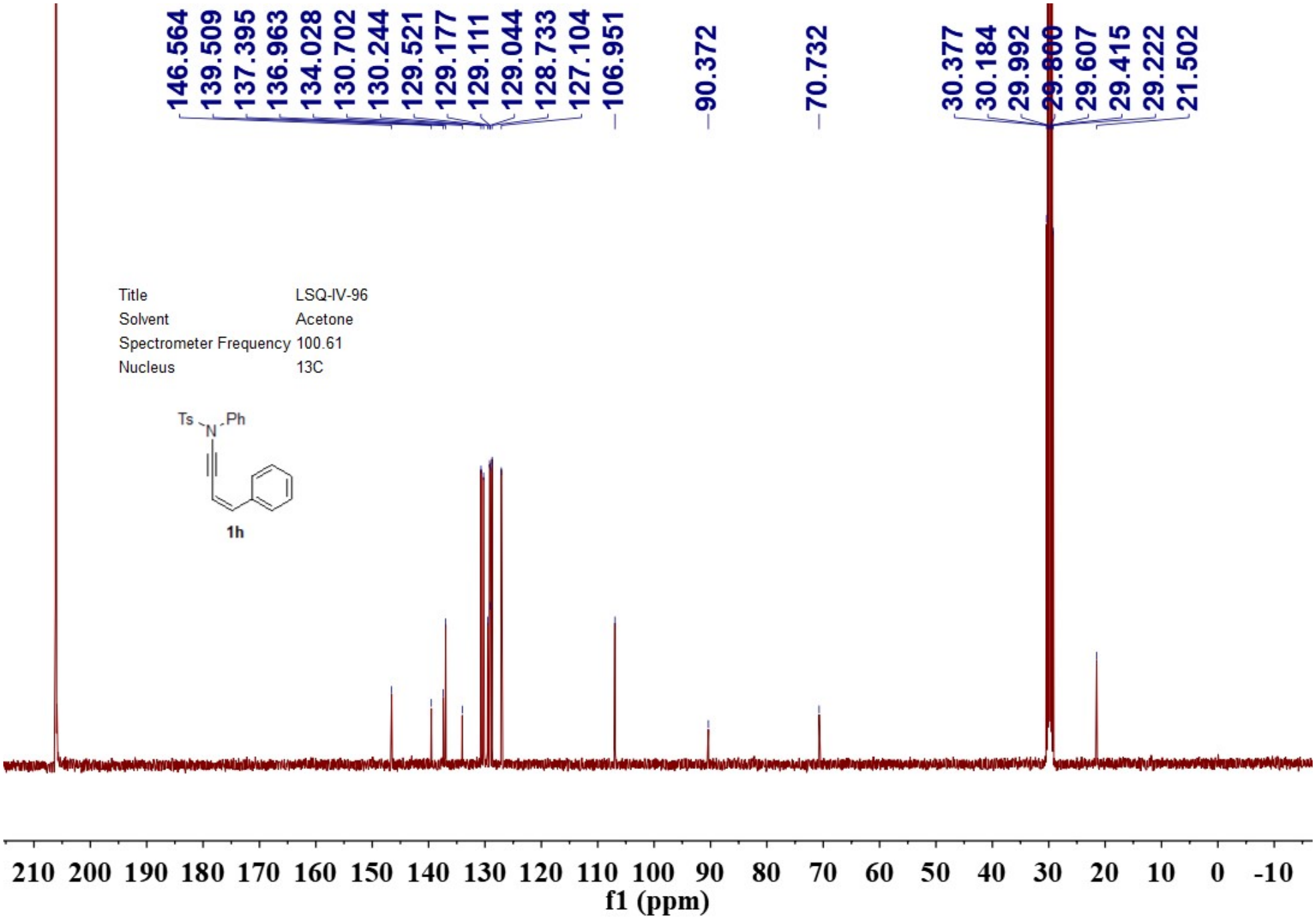

7.8979
7.8945
7.8761
7.8575
7.8533
7.8367
7.4634
7.4432
7.3987
7.3960
7.3784
7.3747
7.3592
7.3306
7.3275
7.3244
7.3094
6.6189
6.5890
5.8716
5.8417
3.4853
3.4674
3.4496
2.4406
1.6922
1.6741
1.6688
1.6557
1.6370
1.4140
1.3952
1.3762
1.3578
0.9342
0.9158
0.8973
-0.0000
Title LSQ-IV-97
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Bu
1f
4.04
2.07
3.15
1.02
1.00
2.04
3.04
2.14
2.07
3.10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

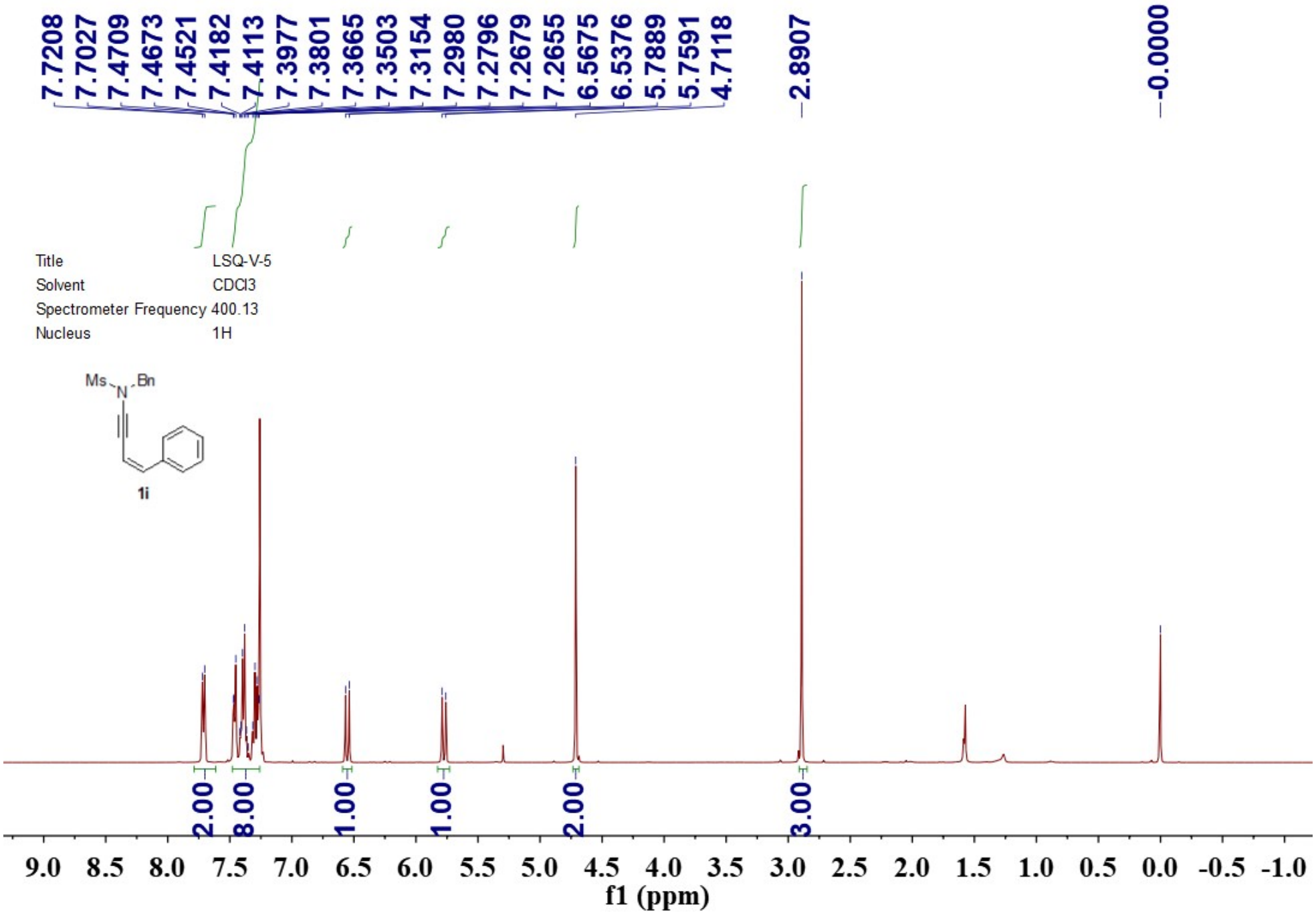

206.113
145.978
137.594
135.964
135.717
130.844
129.162
129.055
128.956
128.232
107.341
90.228
71.193
52.112
30.734
30.185
29.993
29.800
29.608
29.416
21.455
20.028
13.784
Title LSQ-IV-97
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Bu
1f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

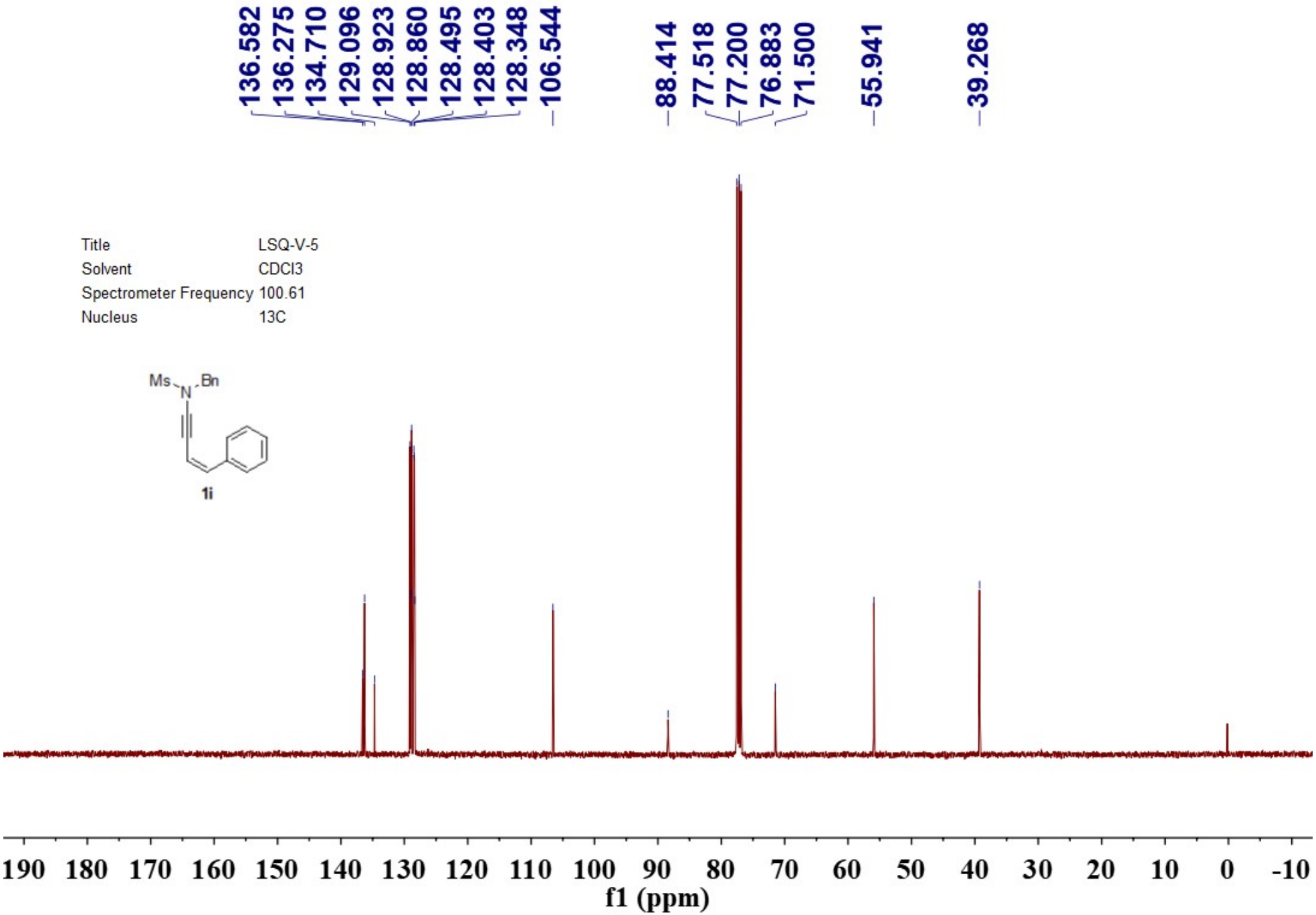

7.8103
7.8070
7.7940
7.7893
7.7774
7.7734
7.3508
7.3331
7.3295
7.3140
7.2934
7.2864
7.2827
7.2789
7.2733
7.2648
7.2527
6.5232
6.4934
5.7795
5.7749
5.7626
5.7450
5.3060
5.3028
5.2634
5.2602
5.2509
5.2480
5.2255
5.2226
4.0621
4.0591
4.0560
4.0465
4.0434
4.0403
2.4157
0.0000
Title LSQ-V-6
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
1g
4.00
5.00
1.00
2.00
2.00
2.00
3.00
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)

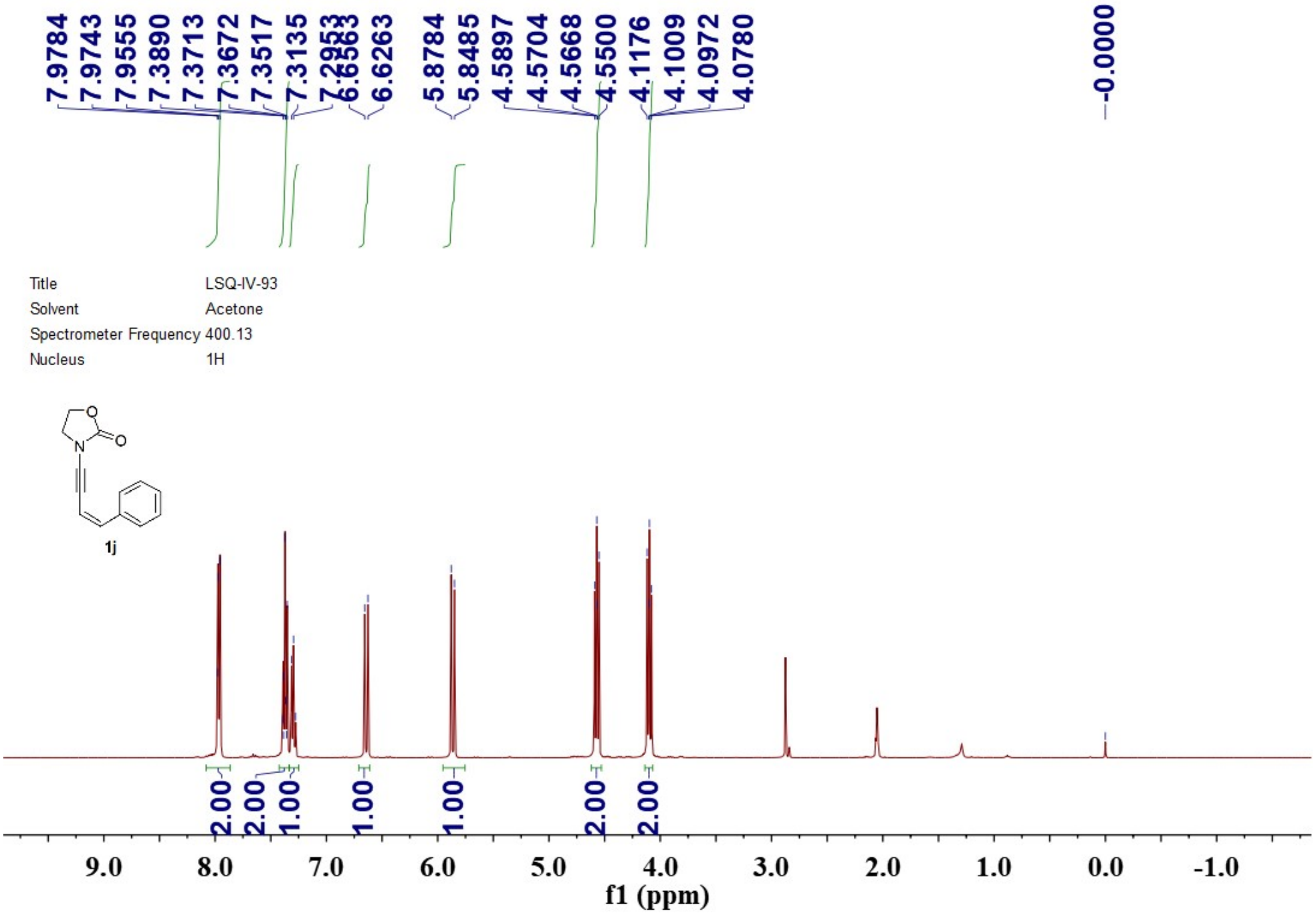

144.965
136.703
135.652
134.961
131.146
130.023
128.509
128.433
128.258
127.739
120.241
106.753
89.054
77.518
77.200
76.883
70.888
54.501
21.807
Title LSQ-V-6
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
1g
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

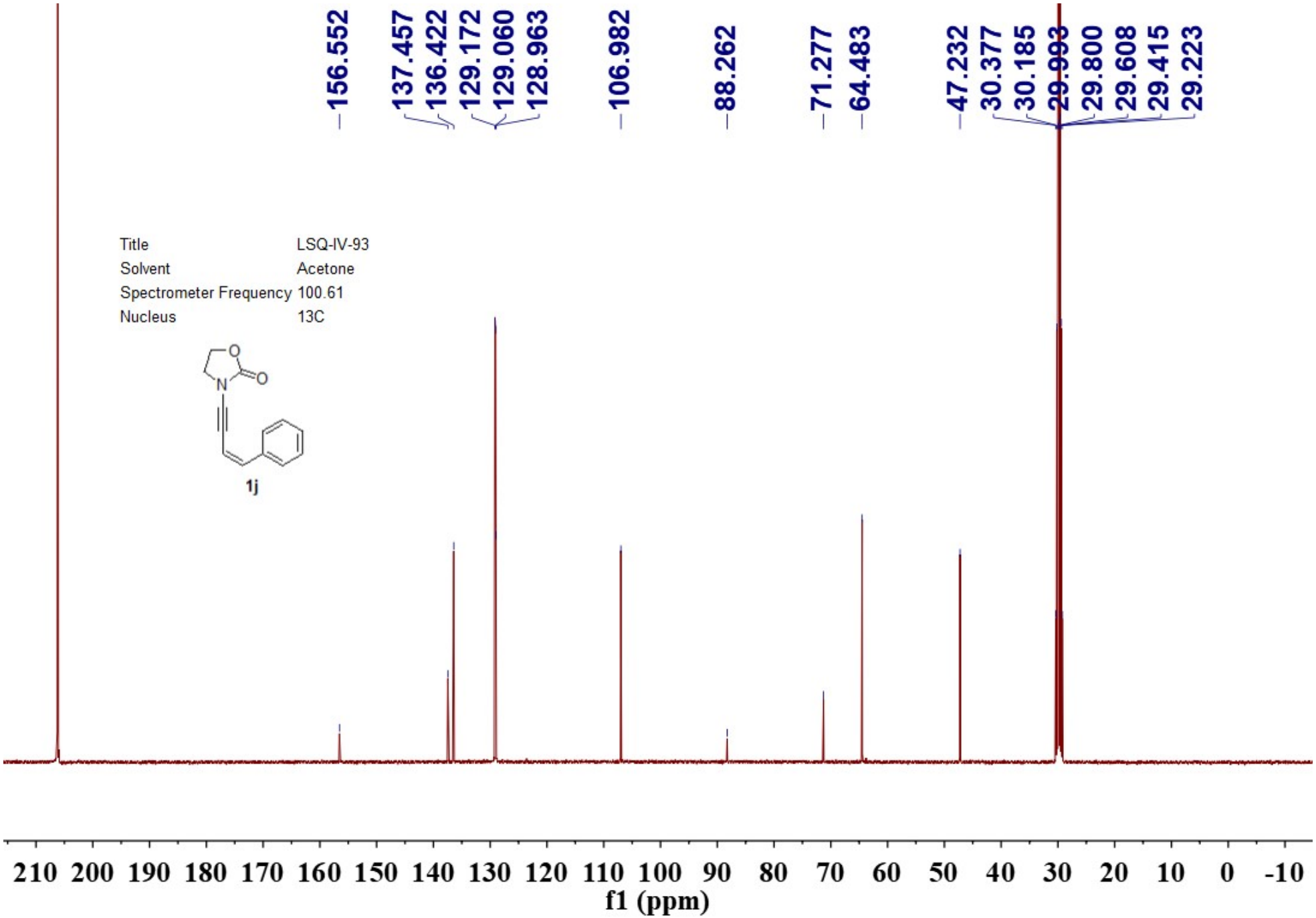

7.8743
7.8689
7.8640
7.8589
7.8542
7.8502
7.6150
7.6104
7.5989
7.5941
7.4778
7.4734
7.4643
7.4462
7.4360
7.4317
7.4106
7.3904
7.3574
7.3495
7.3436
7.3354
7.3308
7.3261
7.3174
7.3057
7.3020
6.6859
6.6560
5.8969
5.8670
2.8786
2.4301
2.0656
2.0599
2.0544
2.0489
2.0434
-0.0000
Title LSQ-IV-96
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Ph
1h
2.00
2.00
5.00
5.00
1.00
1.00
3.00
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)

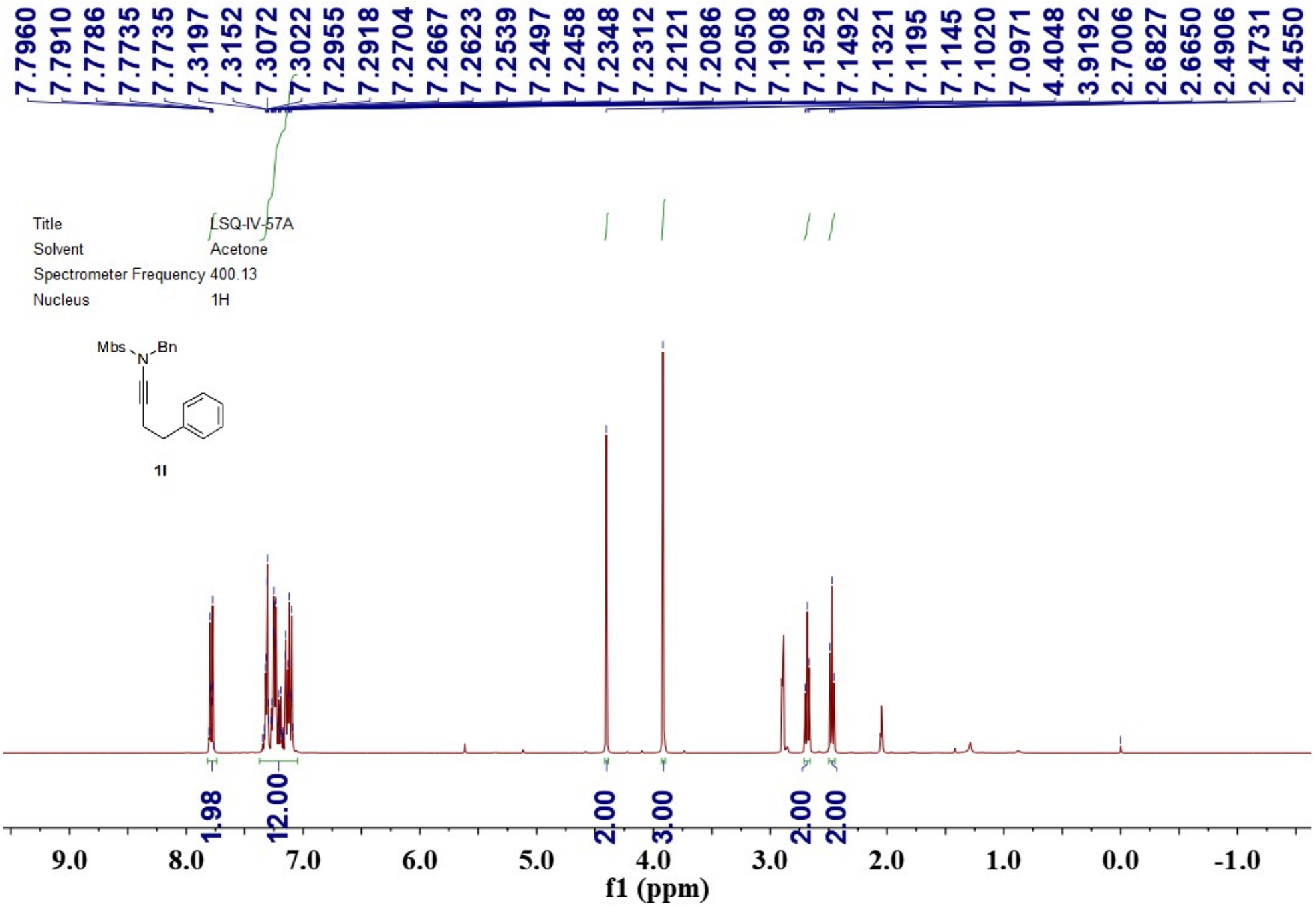

146.564
139.509
137.395
136.963
134.028
130.702
130.244
129.521
129.177
129.111
129.044
128.733
127.104
106.951
90.372
70.732
30.377
30.184
29.992
29.800
29.607
29.415
29.222
21.502
Title LSQ-IV-96
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Ph
1h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

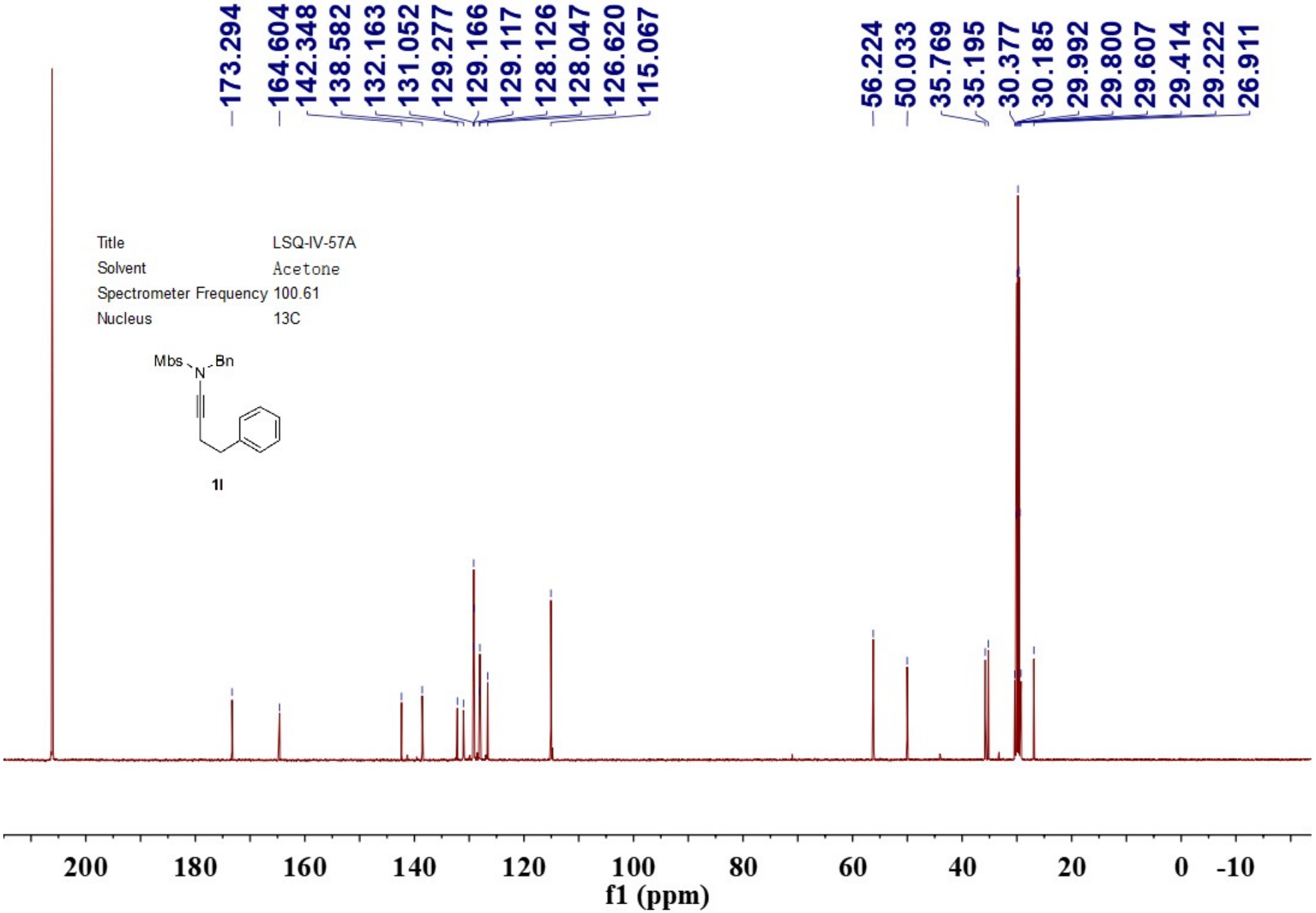

7.7208
7.7027
7.4709
7.4673
7.4521
7.4182
7.4113
7.3977
7.3801
7.3665
7.3503
7.3154
7.2980
7.2796
7.2679
7.2655
6.5675
6.5376
5.7889
5.7591
4.7118
2.8907
0.0000
Title LSQ-V-5
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ms
N
Bn
1i
2.00
8.00
1.00
1.00
2.00
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 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)

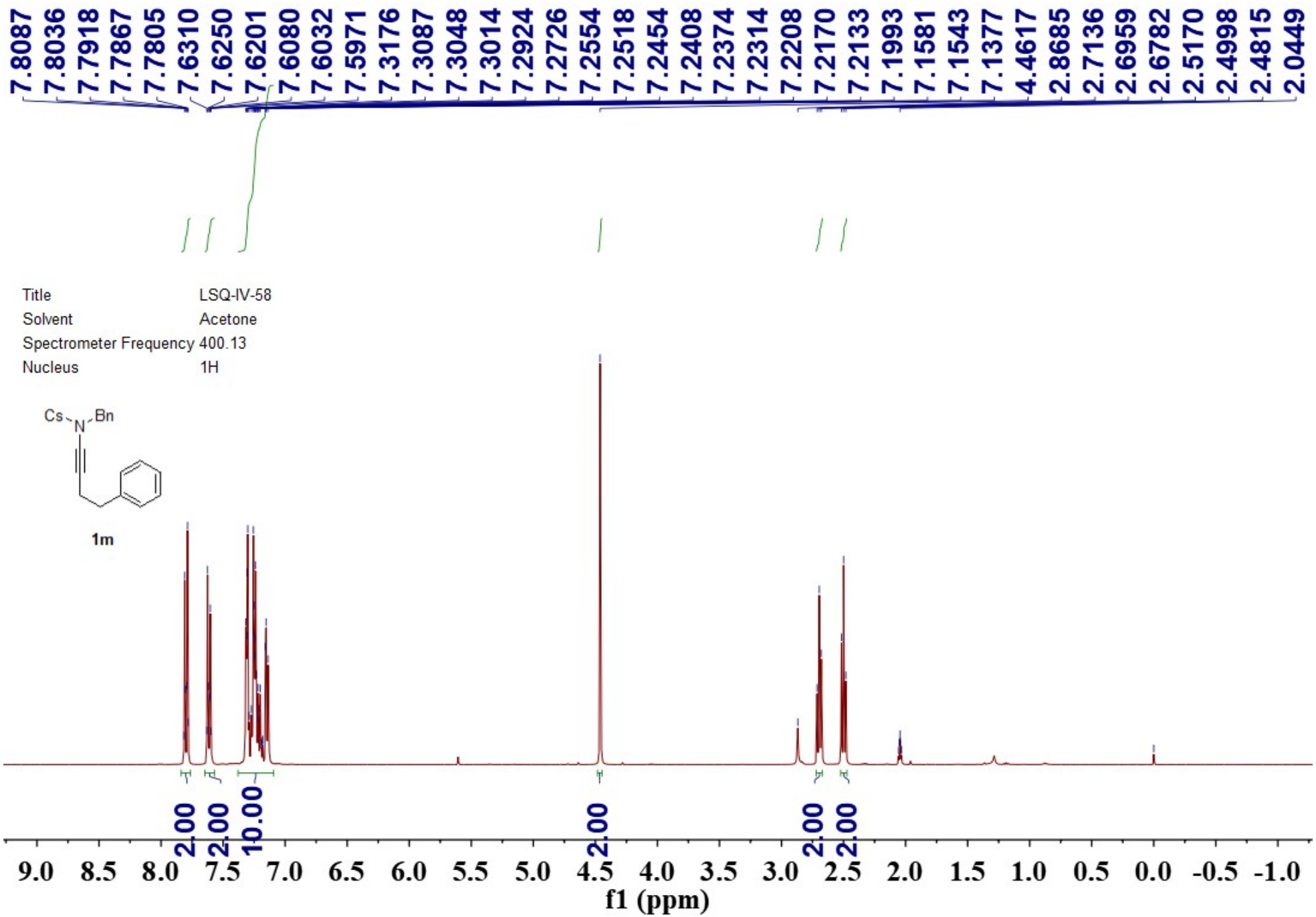

136.582
136.275
134.710
129.096
128.923
128.860
128.495
128.403
128.348
106.544
88.414
77.518
77.200
76.883
71.500
55.941
39.268
Title LSQ-V-5
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ms
N
Bn
1i
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.9784
7.9743
7.9555
7.3890
7.3713
7.3672
7.3517
7.3135
6.6263
5.8784
5.8485
4.5897
4.5704
4.5668
4.5500
4.1176
4.1009
4.0972
4.0780
-0.0000
Title LSQ-IV-93
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
1j
2.00
2.00
1.00
1.00
1.00
2.00
2.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


156.552
137.457
136.422
129.172
129.060
128.963
106.982
88.262
71.277
64.483
47.232
30.377
30.185
29.993
29.800
29.608
29.415
29.223
Title LSQ-IV-93
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
1j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7960
7.7910
7.7786
7.7735
7.7735
7.7735
7.3197
7.3152
7.3072
7.3022
7.2955
7.2918
7.2704
7.2667
7.2623
7.2539
7.2497
7.2458
7.2348
7.2312
7.2121
7.2086
7.2050
7.1908
7.1529
7.1492
7.1321
7.1195
7.1145
7.1020
7.0971
4.4048
3.9192
2.7006
2.6827
2.6650
2.4906
2.4731
2.4550
Title LSQ-IV-57A
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Mbs
N
Bn
1l
1.98
12.00
2.00
3.00
2.00
2.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


173.294
164.604
142.348
138.582
132.163
131.052
129.277
129.166
129.117
128.126
128.047
126.620
115.067
56.224
50.033
35.769
35.195
30.377
30.185
29.992
29.800
29.607
29.414
29.222
26.911
Title LSQ-IV-57A
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Mbs
N
Bn
1l
200
180
160
140
120
100
80
60
40
20
0
-10
f1 (ppm)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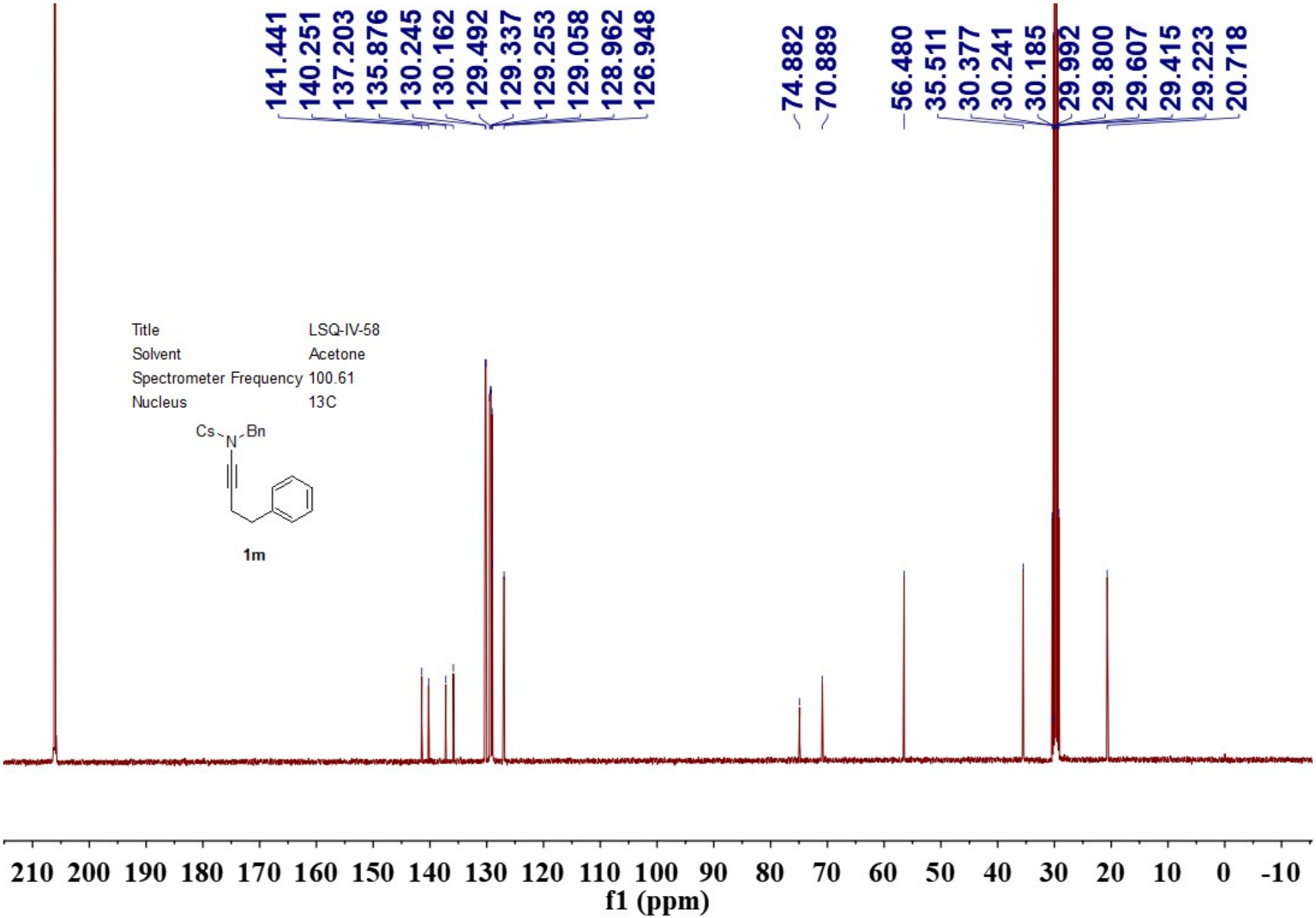
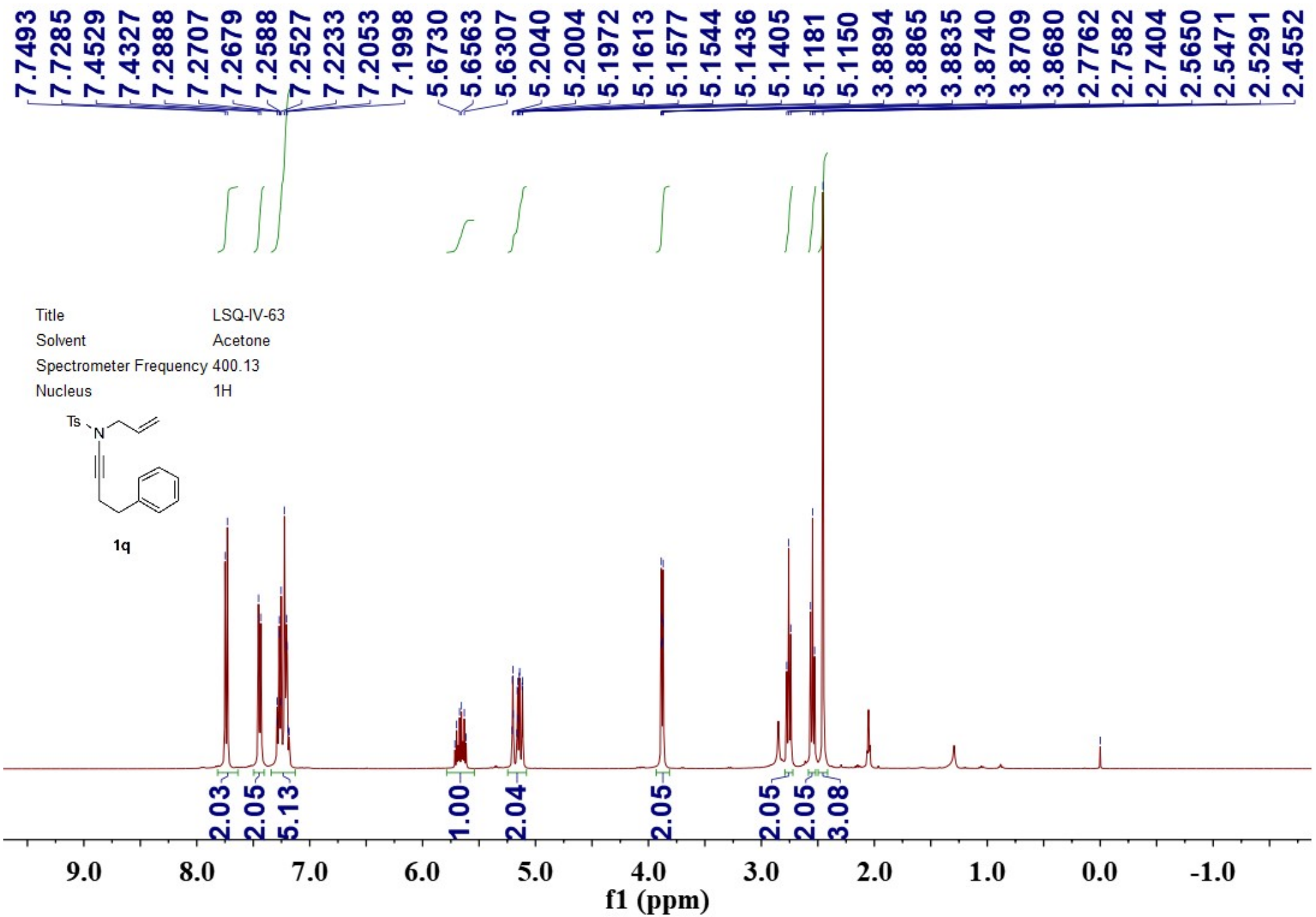
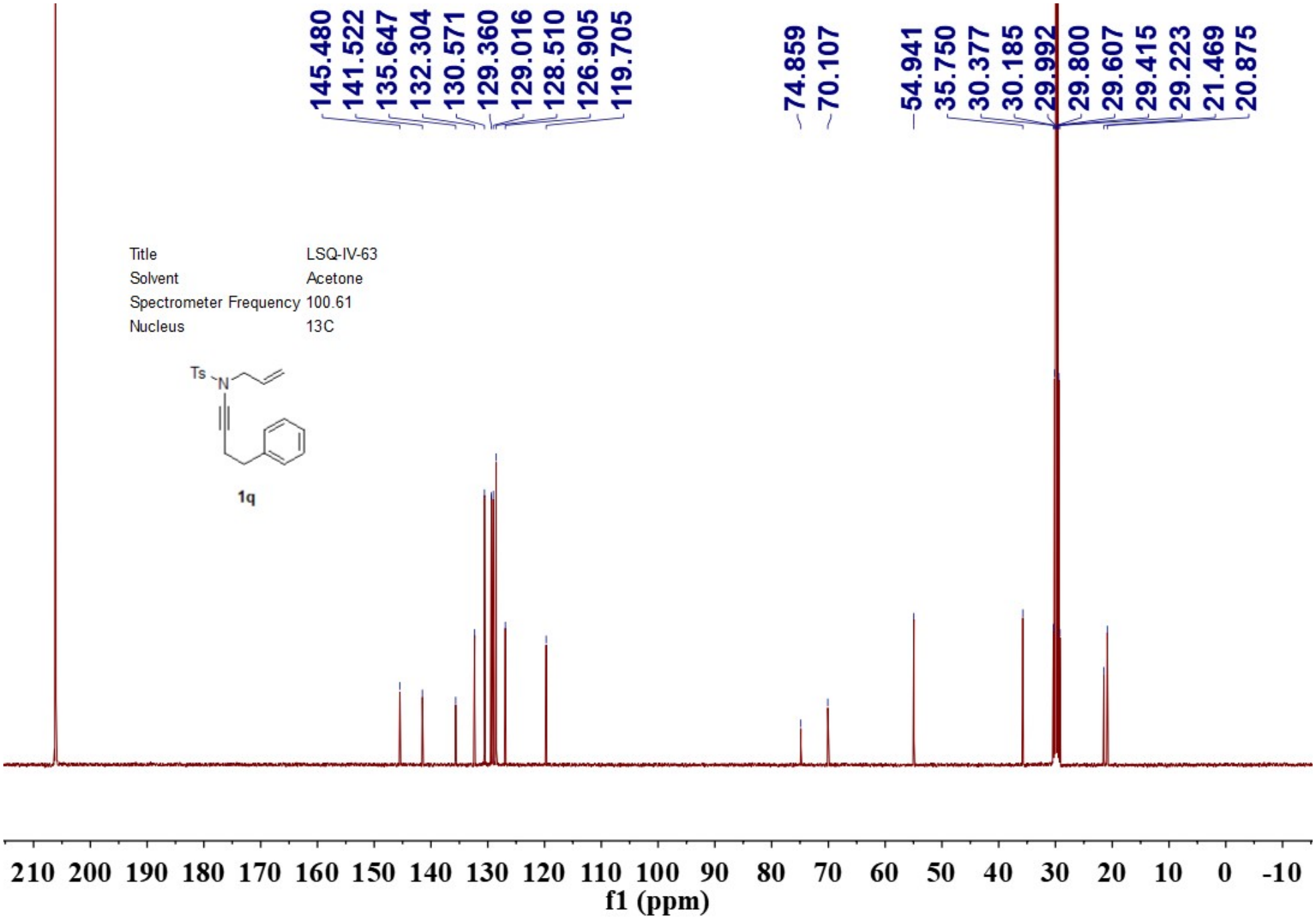
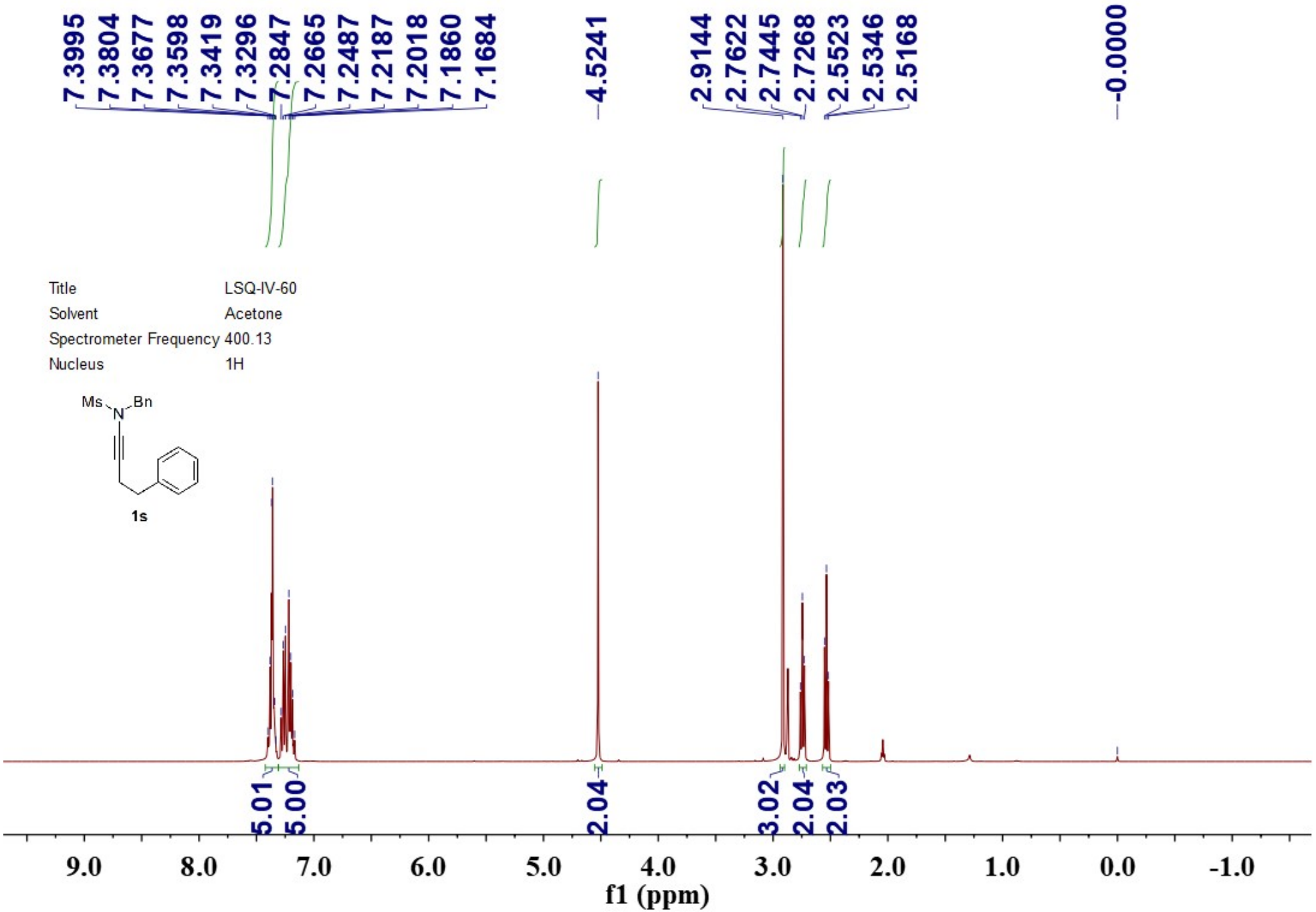
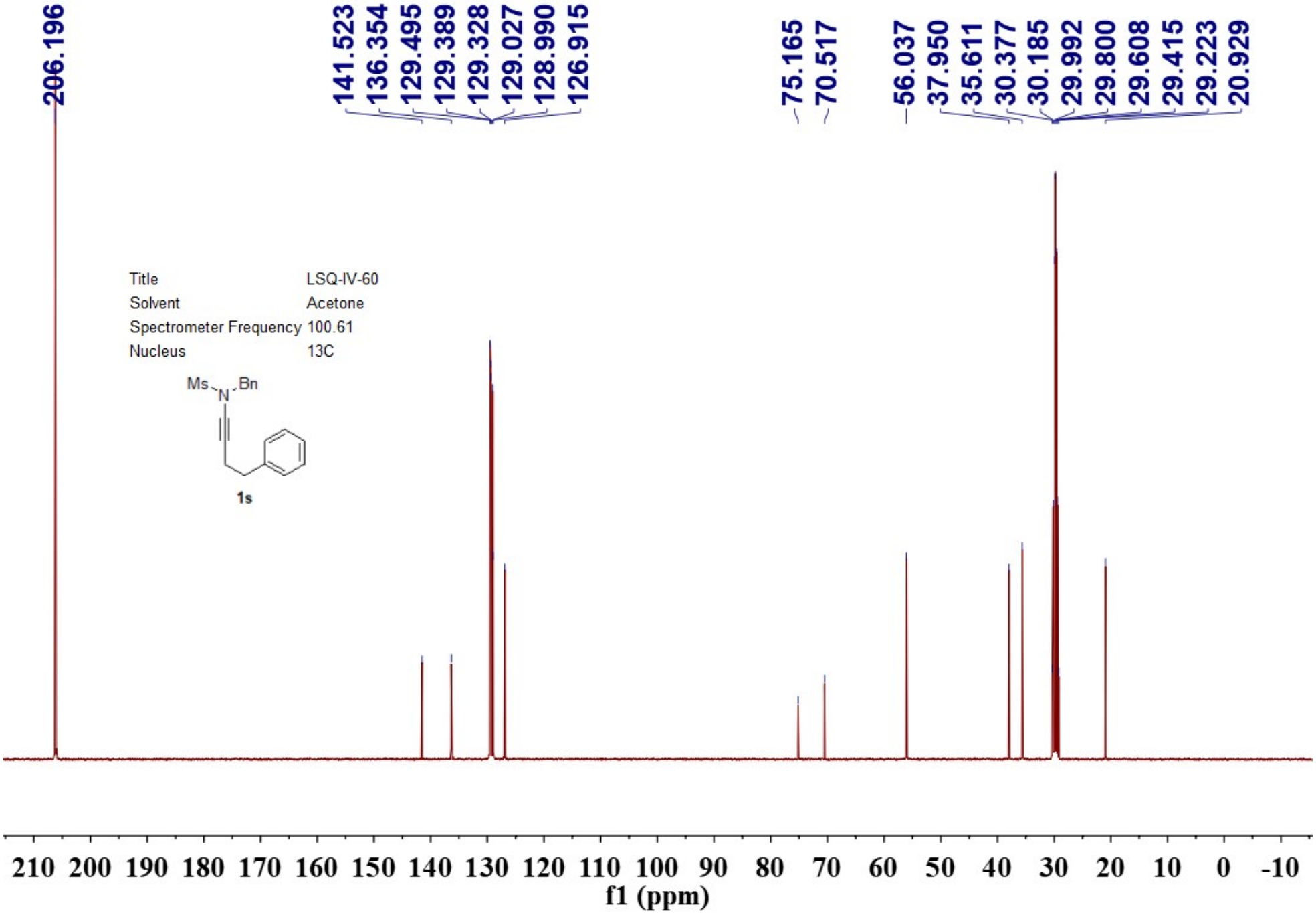
7.8036
7.7918
7.7867
7.7805
7.6310
7.6250
7.6201
7.6080
7.6032
7.5971
7.3176
7.3087
7.3048
7.3014
7.2924
7.2726
7.2554
7.2518
7.2454
7.2408
7.2374
7.2314
7.2208
7.2170
7.2133
7.1993
7.1581
7.1543
7.1377
4.4617
2.8685
2.7136
2.6959
2.6782
2.5170
2.4998
2.4815
2.0449
Title LSQ-IV-58
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Cs
N
Bn
1m
2.00
2.00
10.00
2.00
2.00
2.00
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)


141.441
140.251
137.203
135.876
130.245
130.162
129.492
129.337
129.253
129.058
128.962
126.948
74.882
70.889
56.480
35.511
30.377
30.241
30.185
29.992
29.800
29.607
29.415
29.223
20.718
Title LSQ-IV-58
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Cs
N
Bn
1m
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7493
7.7285
7.4529
7.4327
7.2888
7.2707
7.2679
7.2588
7.2527
7.2233
7.2053
7.1998
5.6730
5.6563
5.6307
5.2040
5.2004
5.1972
5.1613
5.1577
5.1544
5.1436
5.1405
5.1181
5.1150
3.8894
3.8865
3.8835
3.8740
3.8709
3.8680
2.7762
2.7582
2.7404
2.5650
2.5471
2.5291
2.4552
Title LSQ-IV-63
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
1q
2.03
2.05
5.13
1.00
2.04
2.05
2.05
2.05
3.08
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


145.480
141.522
135.647
132.304
130.571
129.360
129.016
128.510
126.905
119.705
74.859
70.107
54.941
35.750
30.377
30.185
29.992
29.800
29.607
29.415
29.223
21.469
20.875
Title LSQ-IV-63
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
1q
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.3995
7.3804
7.3677
7.3598
7.3419
7.3296
7.2847
7.2665
7.2487
7.2187
7.2018
7.1860
7.1684
4.5241
2.9144
2.7622
2.7445
2.7268
2.5523
2.5346
2.5168
-0.0000
Title LSQ-IV-60
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ms
N
Bn
1s
5.01
5.00
2.04
3.02
2.04
2.03
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)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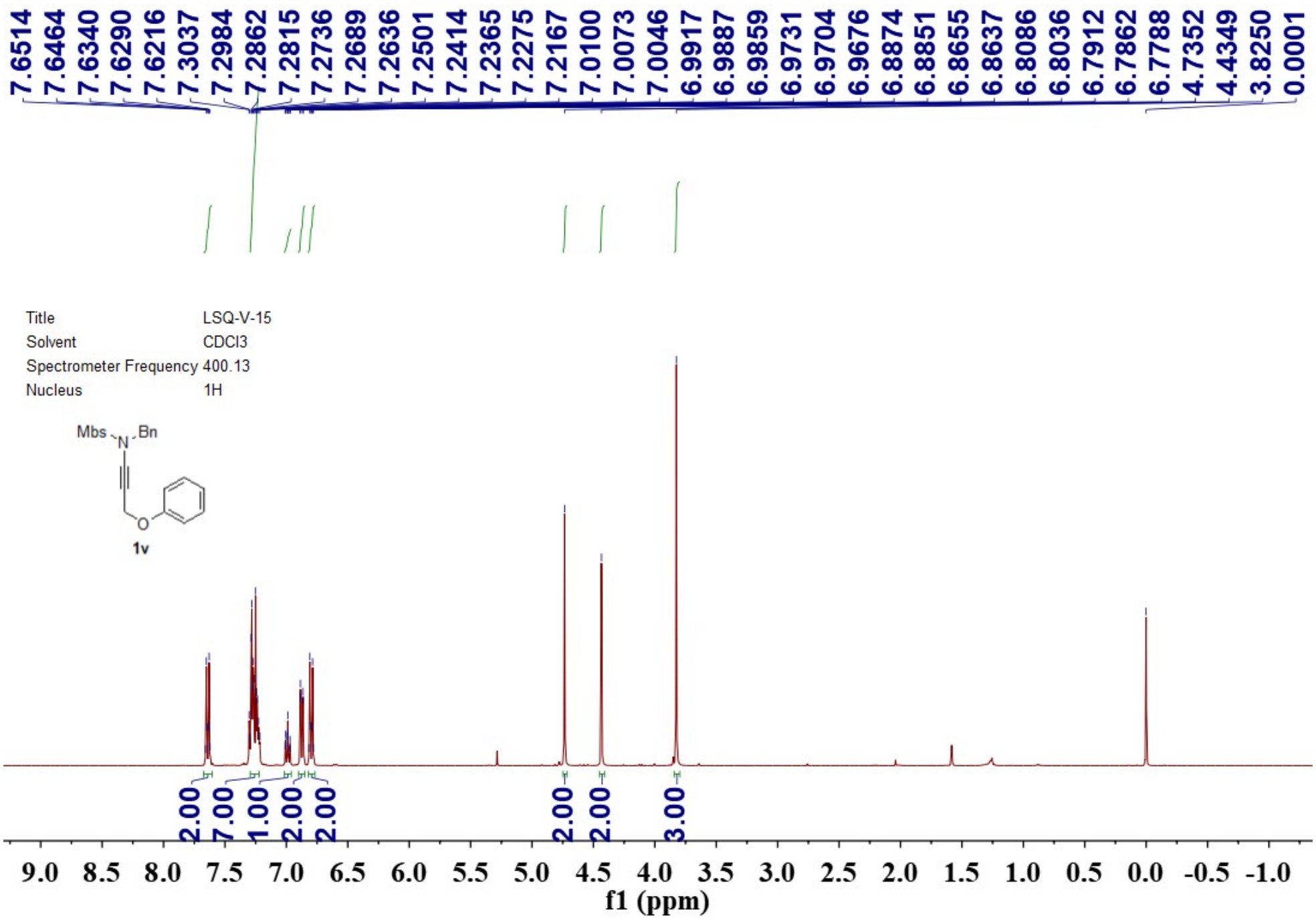
141.523
136.354
129.495
129.389
129.328
129.027
128.990
126.915
75.165
70.517
56.037
37.950
35.611
30.377
30.185
29.992
29.800
29.608
29.415
29.223
20.929
Title LSQ-IV-60
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ms
N
Bn
1s
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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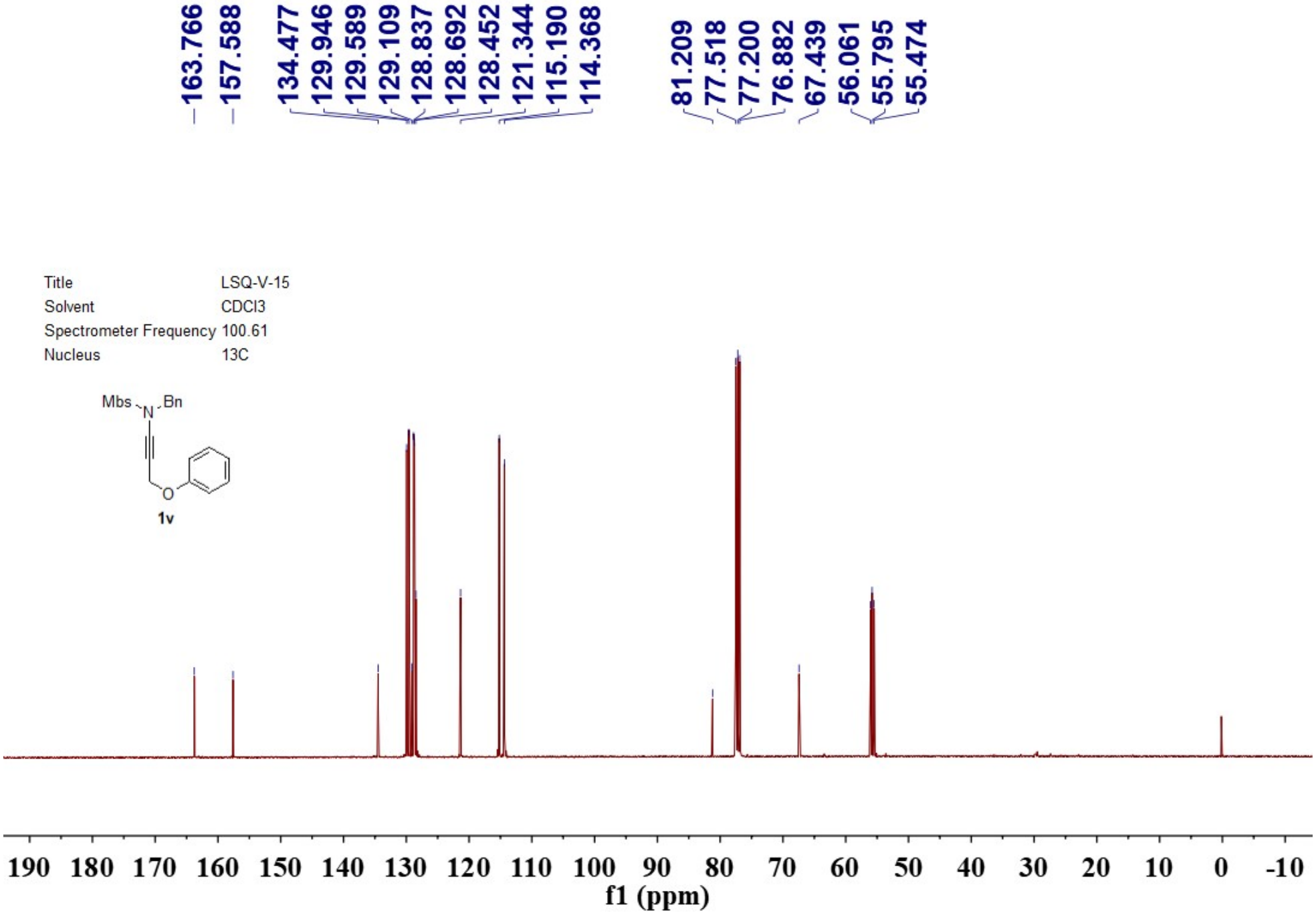
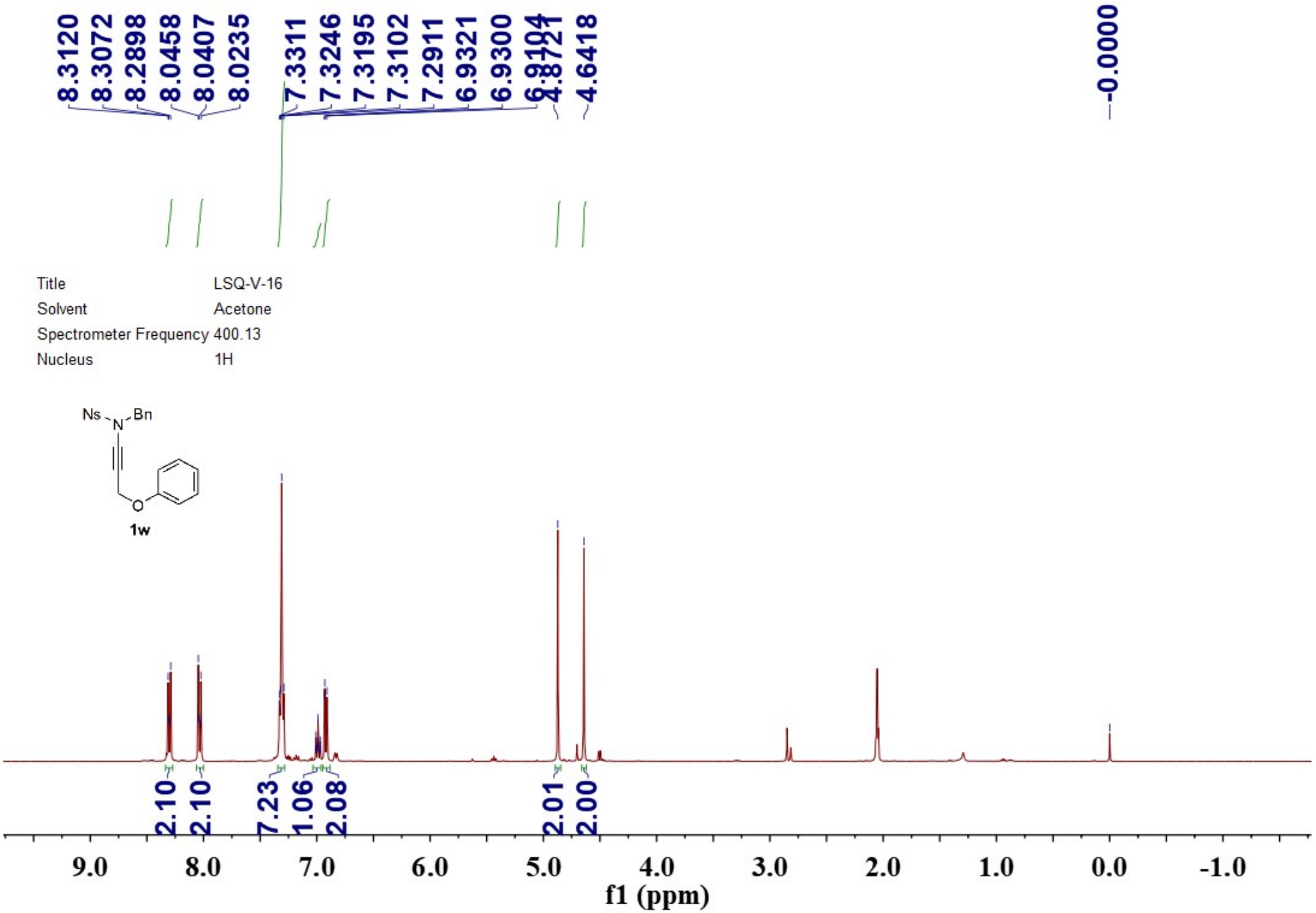
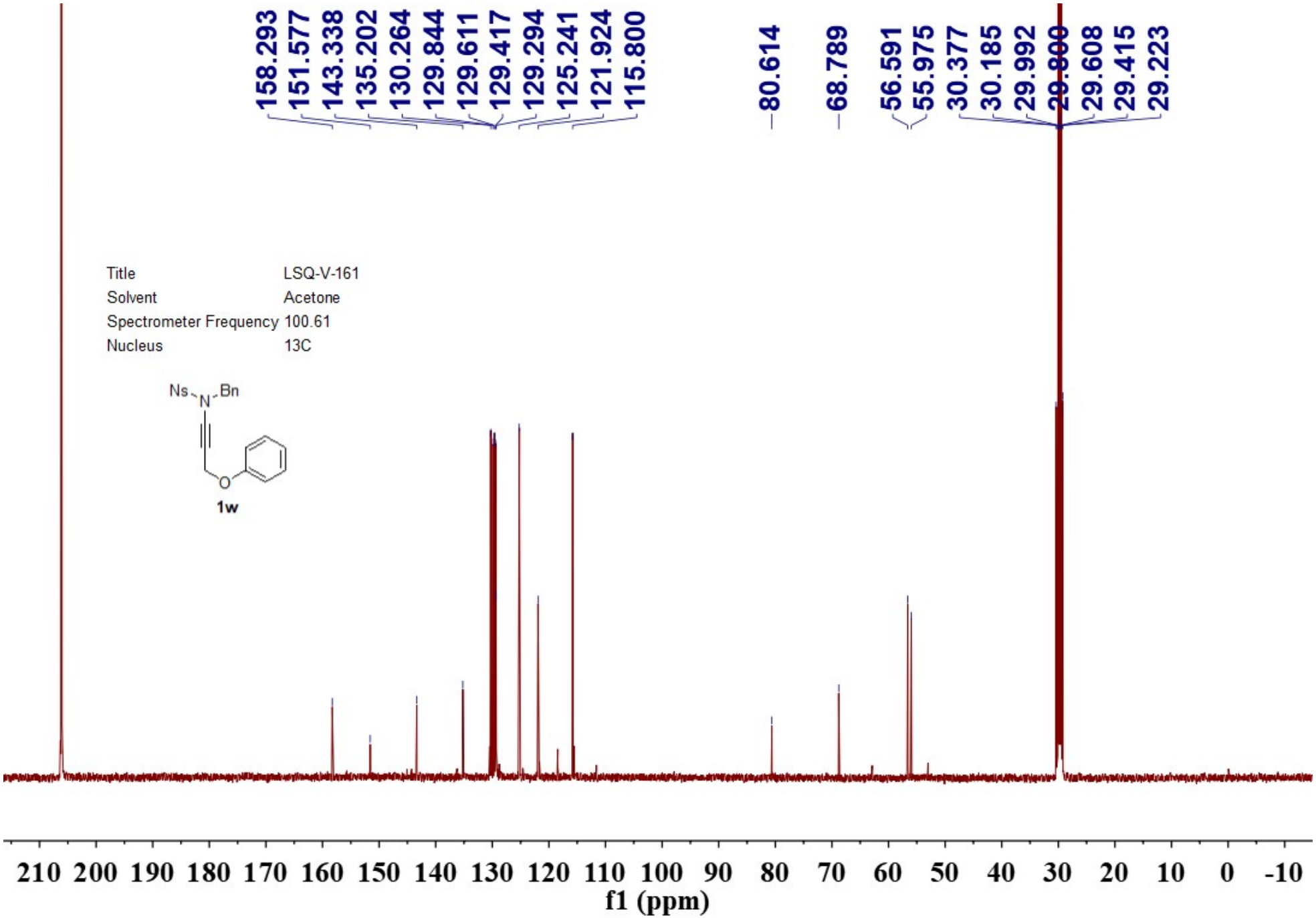
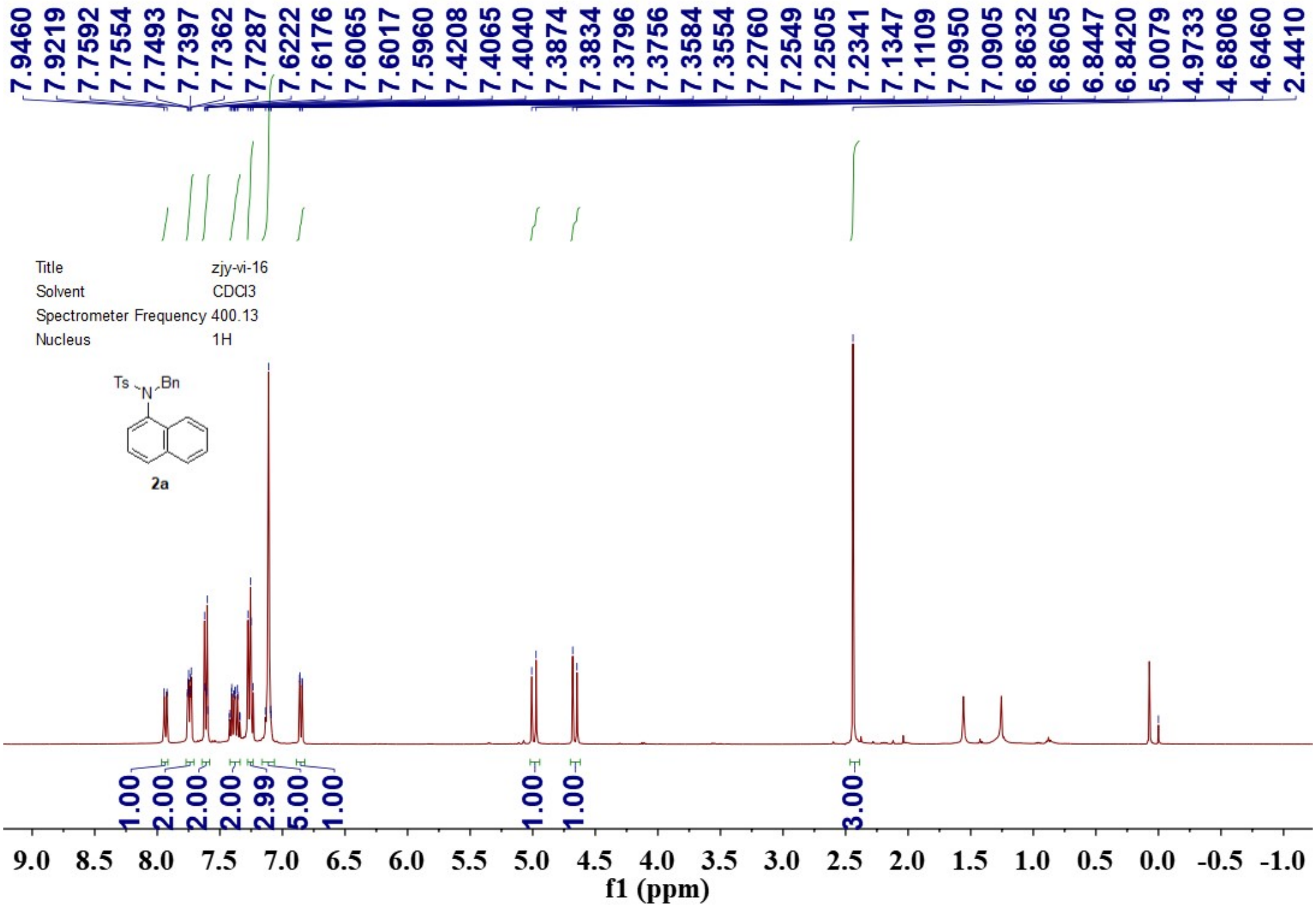
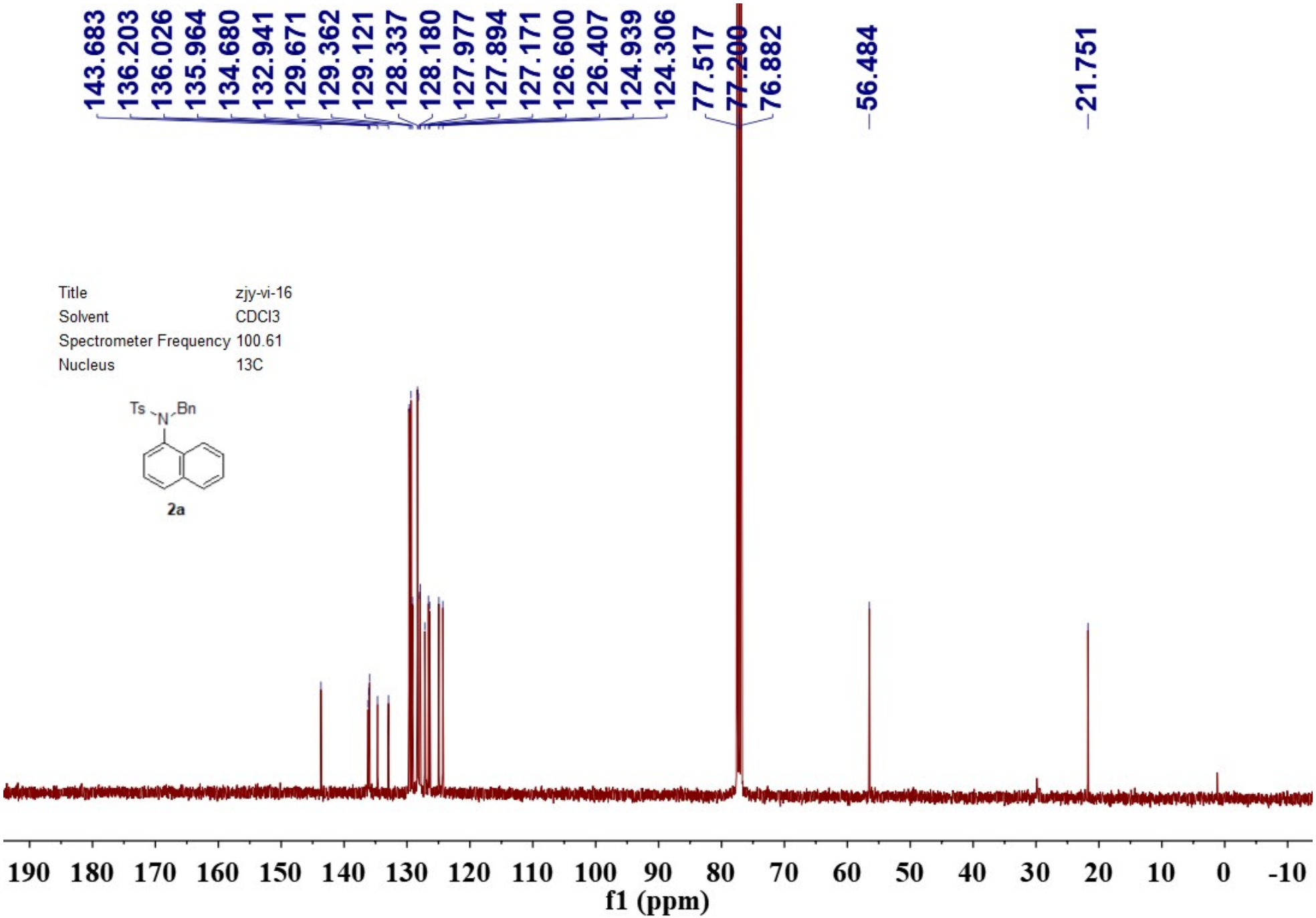
7.6464
7.6340
7.6290
7.6216
7.3037
7.2984
7.2862
7.2815
7.2736
7.2689
7.2636
7.2501
7.2414
7.2365
7.2275
7.2167
7.0100
7.0073
7.0046
6.9917
6.9887
6.9859
6.9731
6.9704
6.9676
6.8874
6.8851
6.8655
6.8637
6.8086
6.8036
6.7912
6.7862
6.7788
4.7352
4.4349
3.8250
0.0001
Title LSQ-V-15
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Mbs
N
Bn
O
1v
2.00
7.00
1.00
2.00
2.00
2.00
2.00
3.00
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)

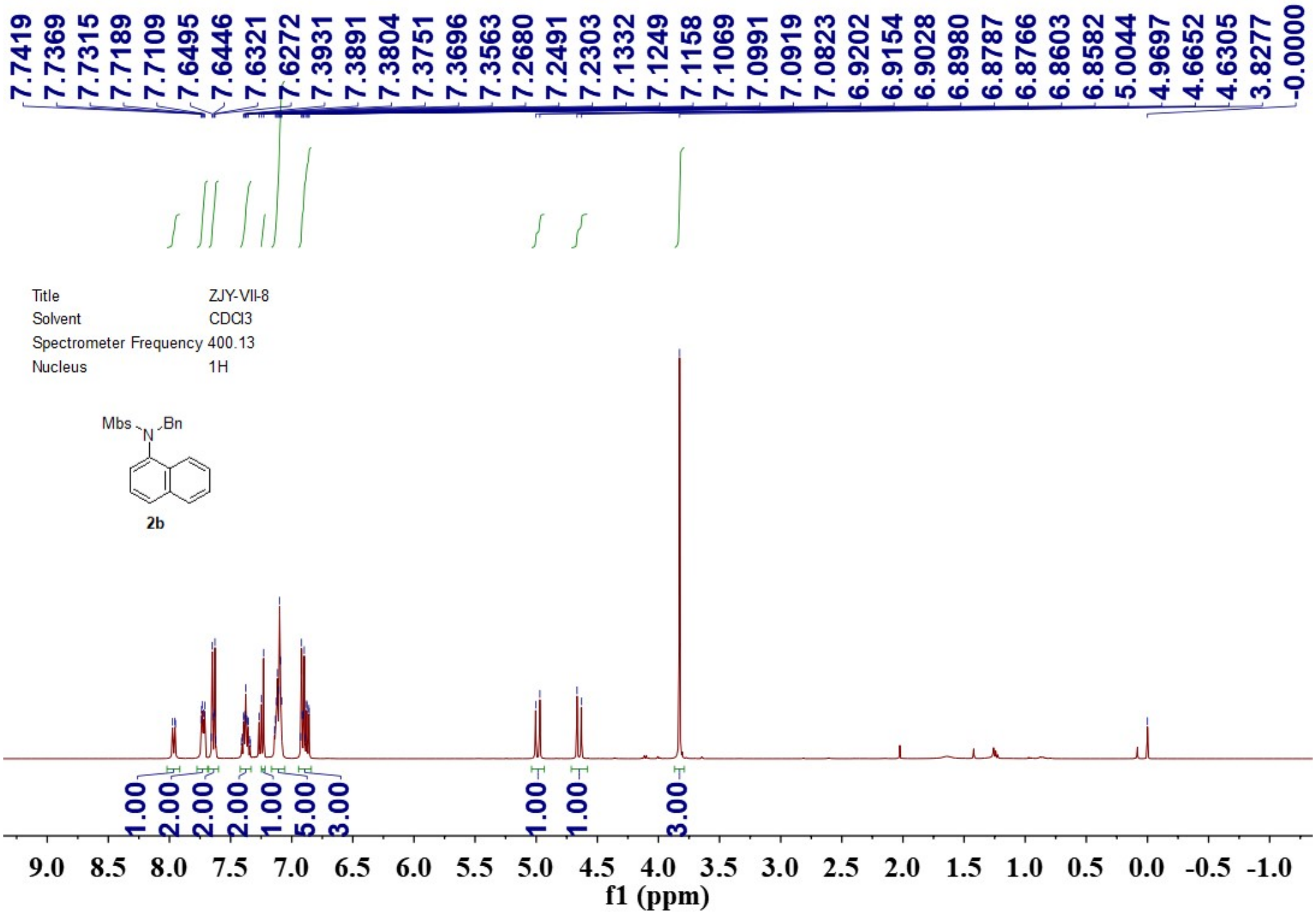

163.766
157.588
134.477
129.946
129.589
129.109
128.837
128.692
128.452
121.344
115.190
114.368
81.209
77.518
77.200
76.882
67.439
56.061
55.795
55.474
Title LSQ-V-15
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Mbs
N
Bn
O
1v
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

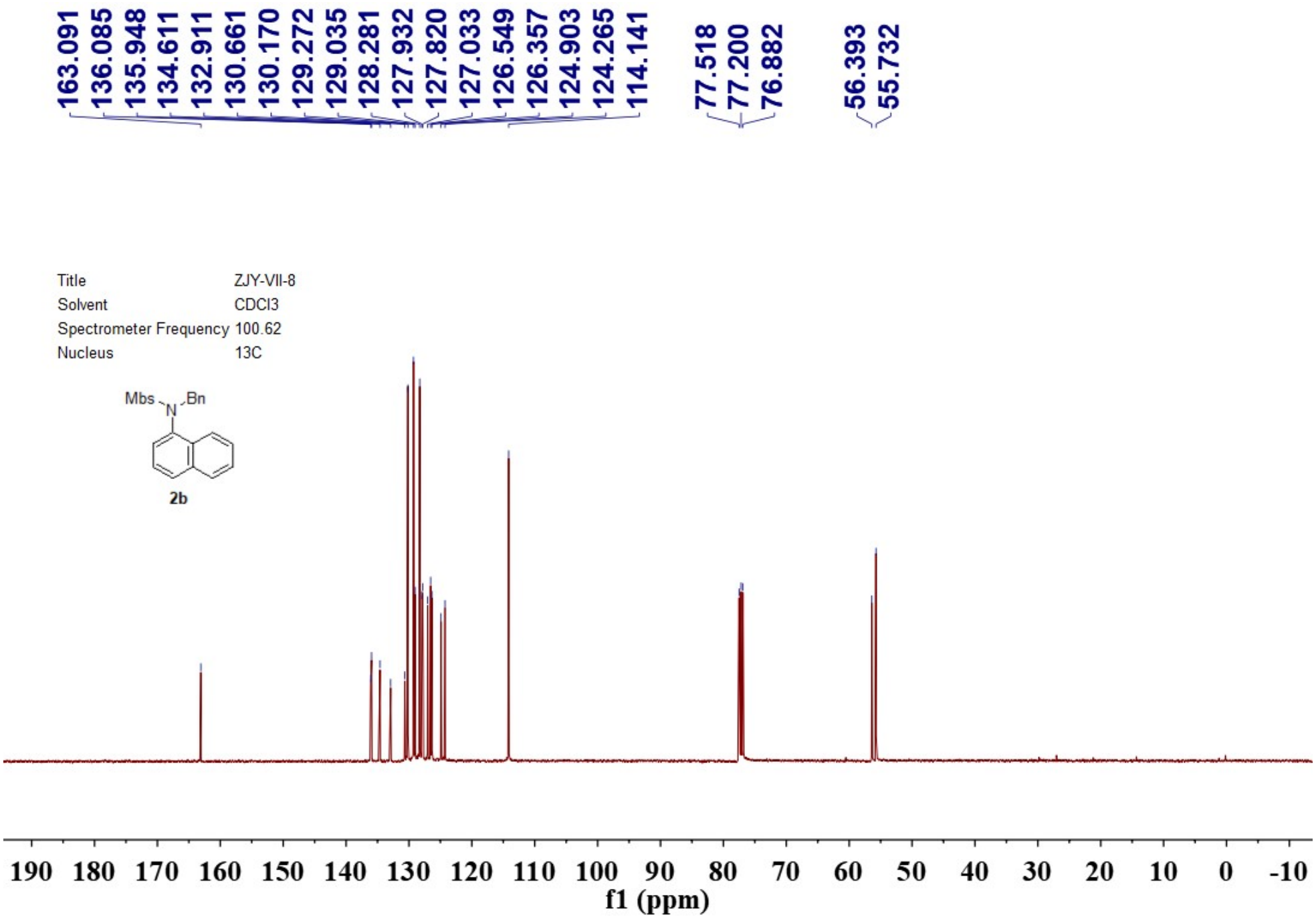

8.3120
8.3072
8.2898
8.0458
8.0407
8.0235
7.3311
7.3246
7.3195
7.3102
7.2911
6.9321
6.9300
6.9104
4.8721
4.6418
-0.0000
Title LSQ-V-16
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ns
N
Bn
O
1w
2.10
2.10
7.23
1.06
2.08
2.01
2.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


158.293
151.577
143.338
135.202
130.264
129.844
129.611
129.417
129.294
125.241
121.924
115.800
80.614
68.789
56.591
55.975
30.377
30.185
29.992
29.800
29.608
29.415
29.223
Title LSQ-V-161
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ns
N
Bn
O
1w
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.9460
7.9219
7.7592
7.7554
7.7493
7.7397
7.7362
7.7287
7.6222
7.6176
7.6065
7.6017
7.5960
7.4208
7.4065
7.4040
7.3874
7.3834
7.3796
7.3756
7.3584
7.3554
7.2760
7.2549
7.2505
7.2341
7.1347
7.1109
7.0950
7.0905
6.8632
6.8605
6.8447
6.8420
5.0079
4.9733
4.6806
4.6460
2.4410
Title zjy-vi-16
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Bn
2a
1.00
2.00
2.00
2.00
2.99
5.00
1.00
1.00
1.00
3.00
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)


143.683
136.203
136.026
135.964
134.680
132.941
129.671
129.362
129.121
128.337
128.180
127.977
127.894
127.171
126.600
126.407
124.939
124.306
77.517
77.200
76.882
56.484
21.751
Title zjy-vi-16
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Bn
2a
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7419
7.7369
7.7315
7.7189
7.7109
7.6495
7.6446
7.6321
7.6272
7.3931
7.3891
7.3804
7.3751
7.3696
7.3563
7.2680
7.2491
7.2303
7.1332
7.1249
7.1158
7.1069
7.0991
7.0919
7.0823
6.9202
6.9154
6.9028
6.8980
6.8787
6.8766
6.8603
6.8582
5.0044
4.9697
4.6652
4.6305
3.8277
-0.0000
Title ZJY-VII-8
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Mbs
N
Bn
2b
1.00
2.00
2.00
2.00
1.00
5.00
3.00
1.00
1.00
3.00
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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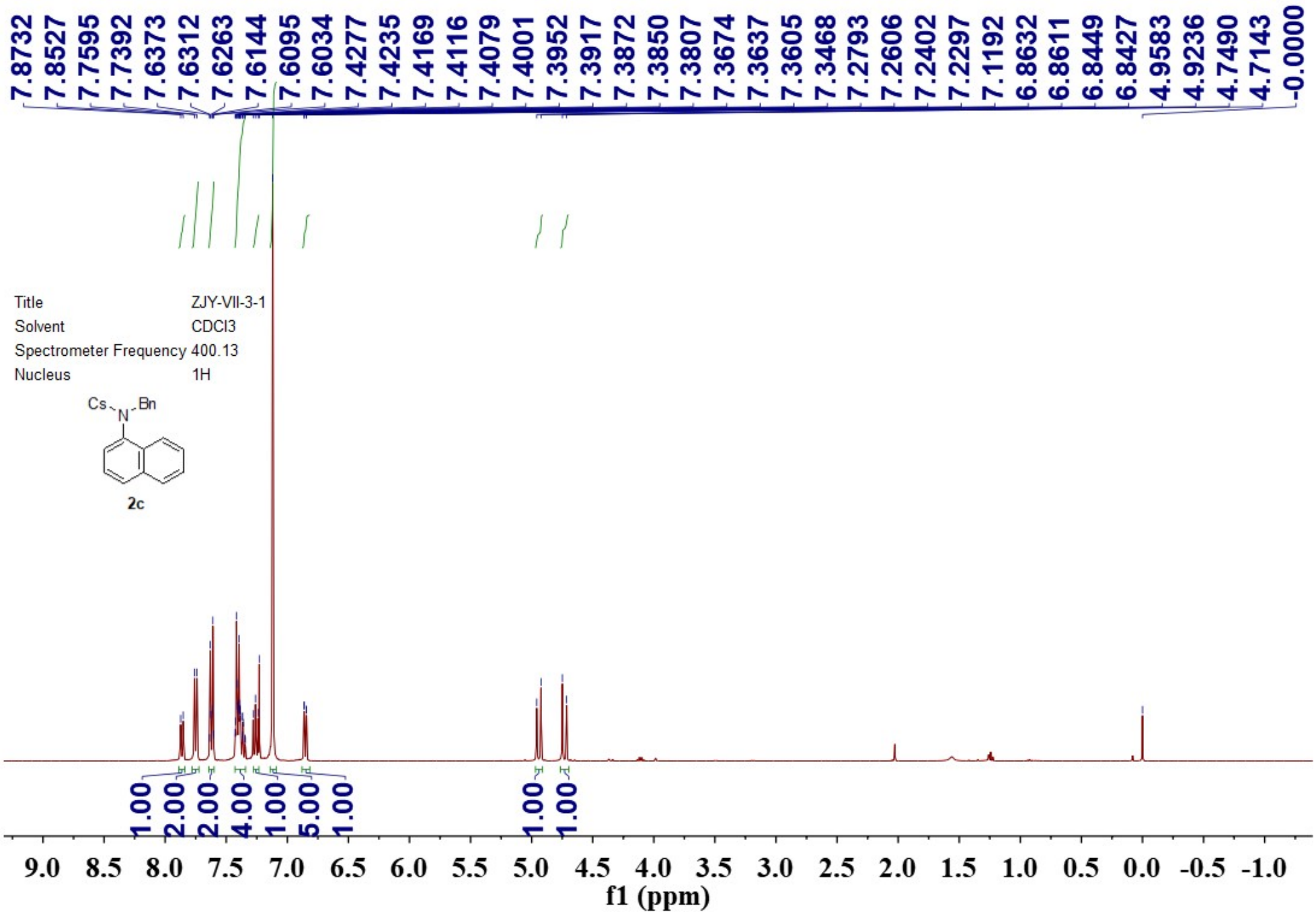
136.085
135.948
134.611
132.911
130.661
130.170
129.272
129.035
128.281
127.932
127.820
127.033
126.549
126.357
124.903
124.265
114.141
77.518
77.200
76.882
56.393
55.732
Title ZJY-VII-8
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Mbs
N
Bn
2b
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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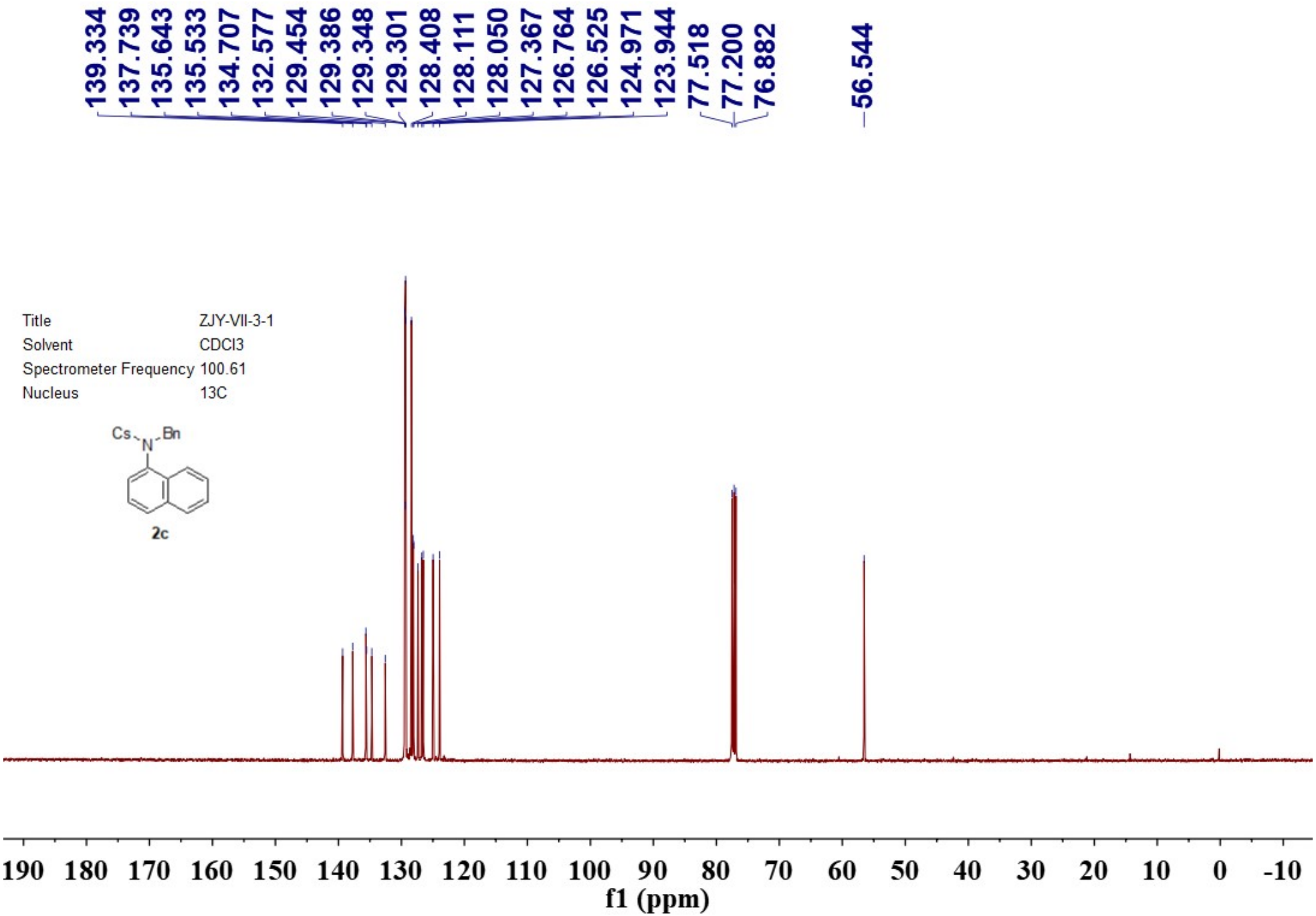
7.8527
7.7595
7.7392
7.6373
7.6312
7.6263
7.6144
7.6095
7.6034
7.4277
7.4235
7.4169
7.4116
7.4079
7.4001
7.3952
7.3917
7.3872
7.3850
7.3807
7.3674
7.3637
7.3605
7.3468
7.2793
7.2606
7.2402
7.2297
7.1192
6.8632
6.8611
6.8449
6.8427
4.9583
4.9236
4.7490
4.7143
-0.0000
Title ZJY-VII-3-1
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cs
N
Bn
2c
1.00
2.00
2.00
4.00
1.00
5.00
1.00
1.00
1.00
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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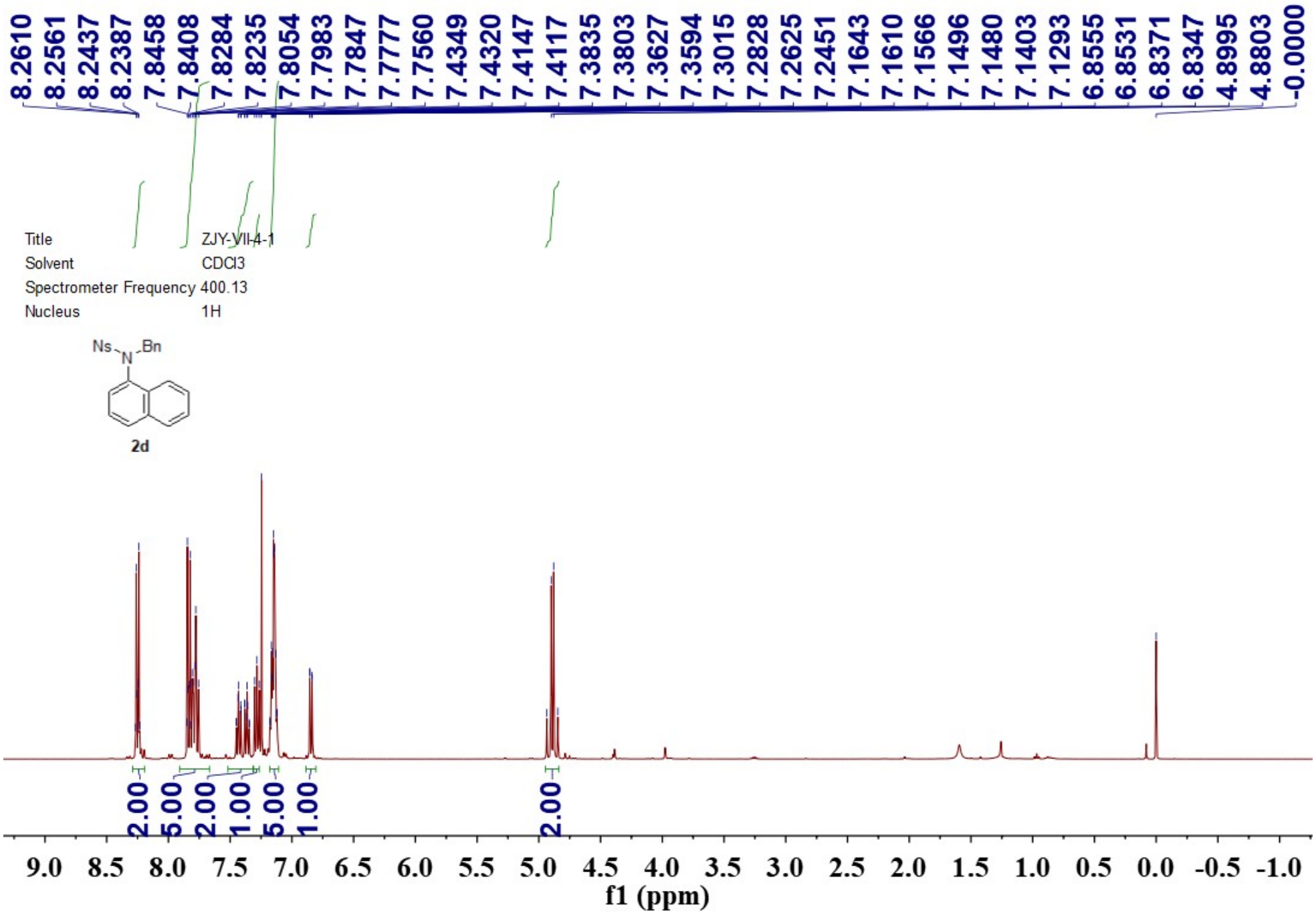
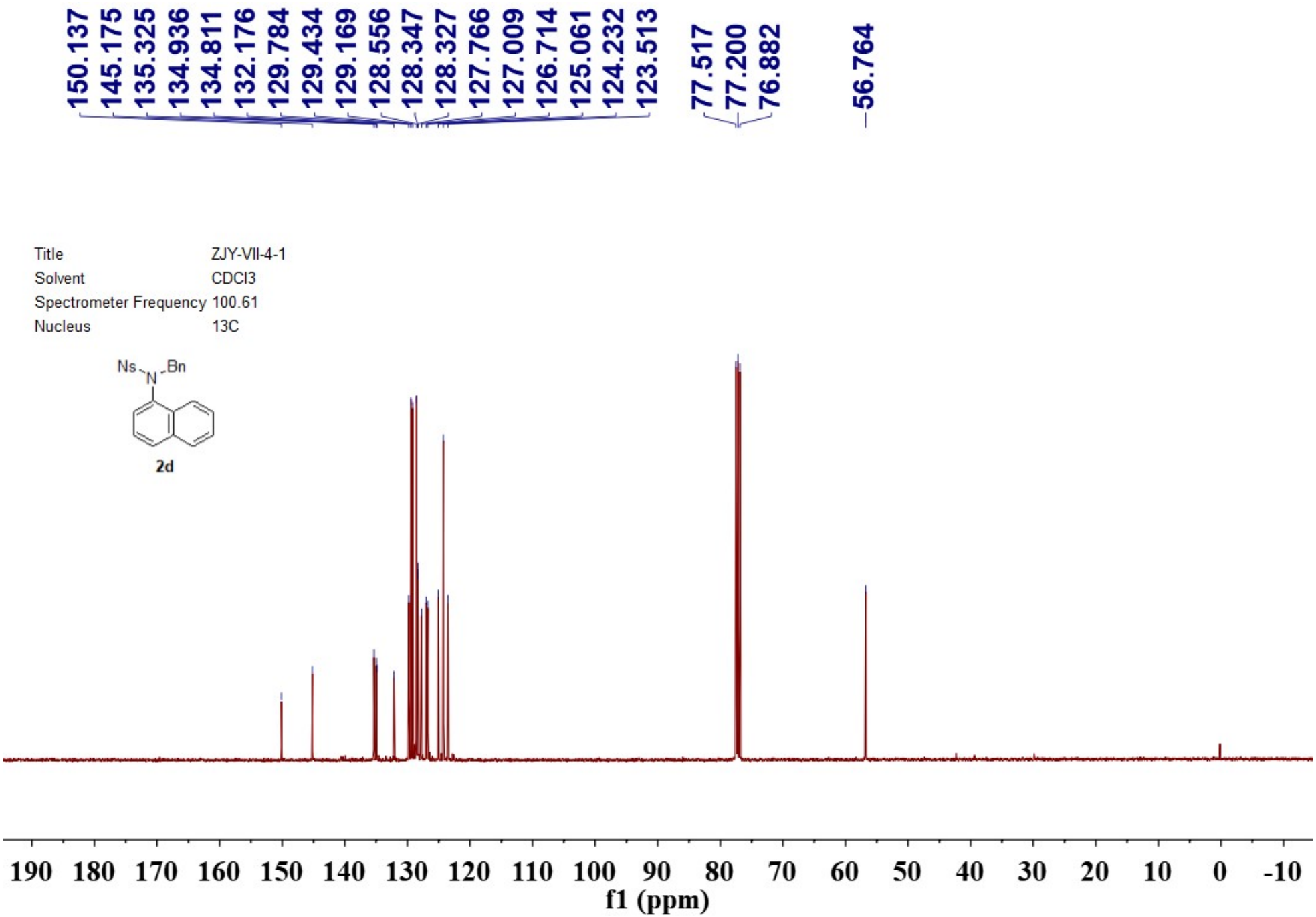
137.739
135.643
135.533
134.707
132.577
129.454
129.386
129.348
129.301
128.408
128.111
128.050
127.367
126.764
126.525
124.971
123.944
77.518
77.200
76.882
56.544
Title ZJY-VII-3-1
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Cs
N
Bn
2c
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.2610
8.2561
8.2437
8.2387
7.8458
7.8408
7.8284
7.8235
7.8054
7.7983
7.7847
7.7777
7.7560
7.4349
7.4320
7.4147
7.4117
7.3835
7.3803
7.3627
7.3594
7.3015
7.2828
7.2625
7.2451
7.1643
7.1610
7.1566
7.1496
7.1480
7.1403
7.1293
6.8555
6.8531
6.8371
6.8347
4.8995
4.8803
-0.0000
Title ZJY-VII-4-1
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ns
N
Bn
2d
2.00
5.00
2.00
1.00
5.00
1.00
2.00
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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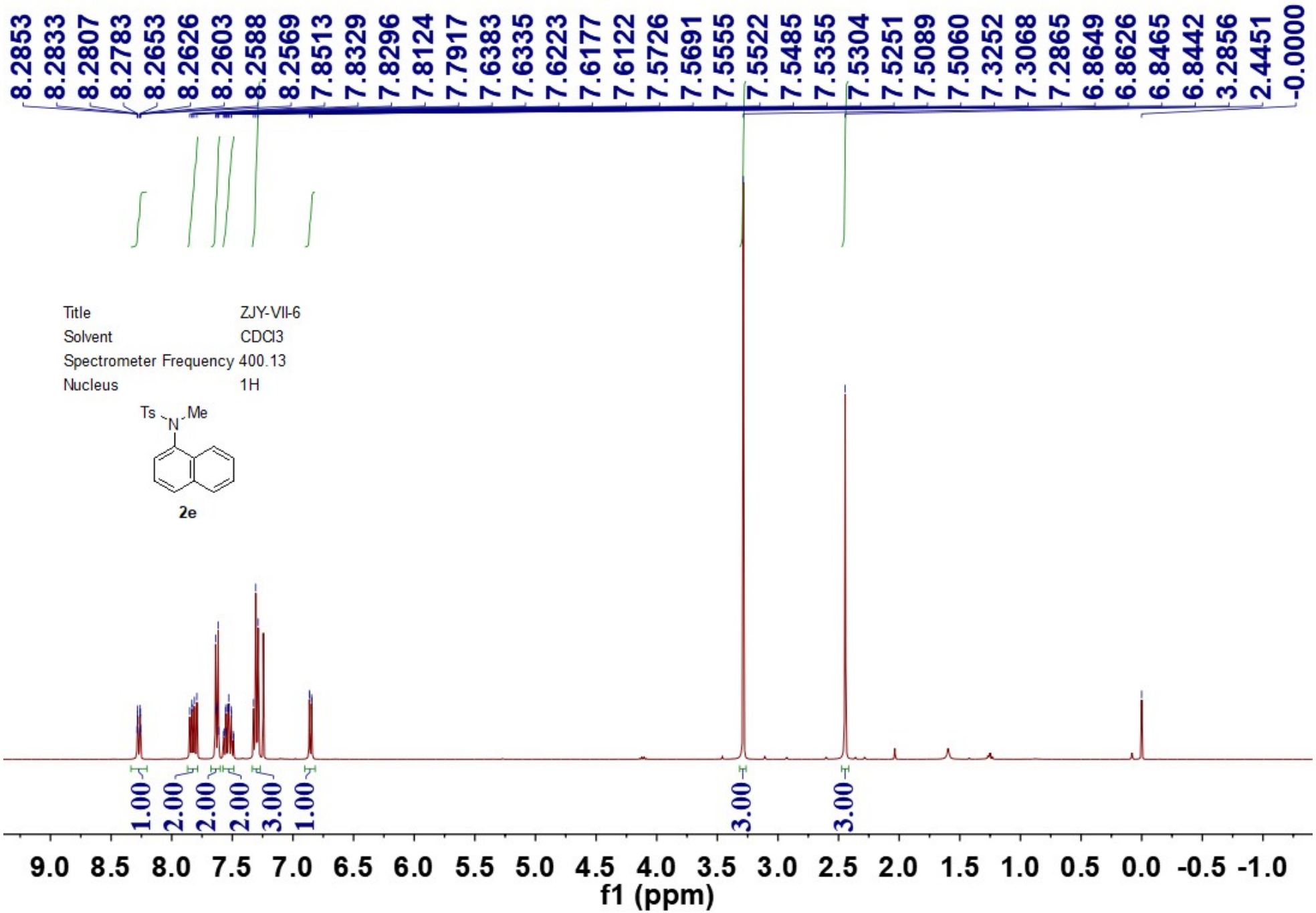
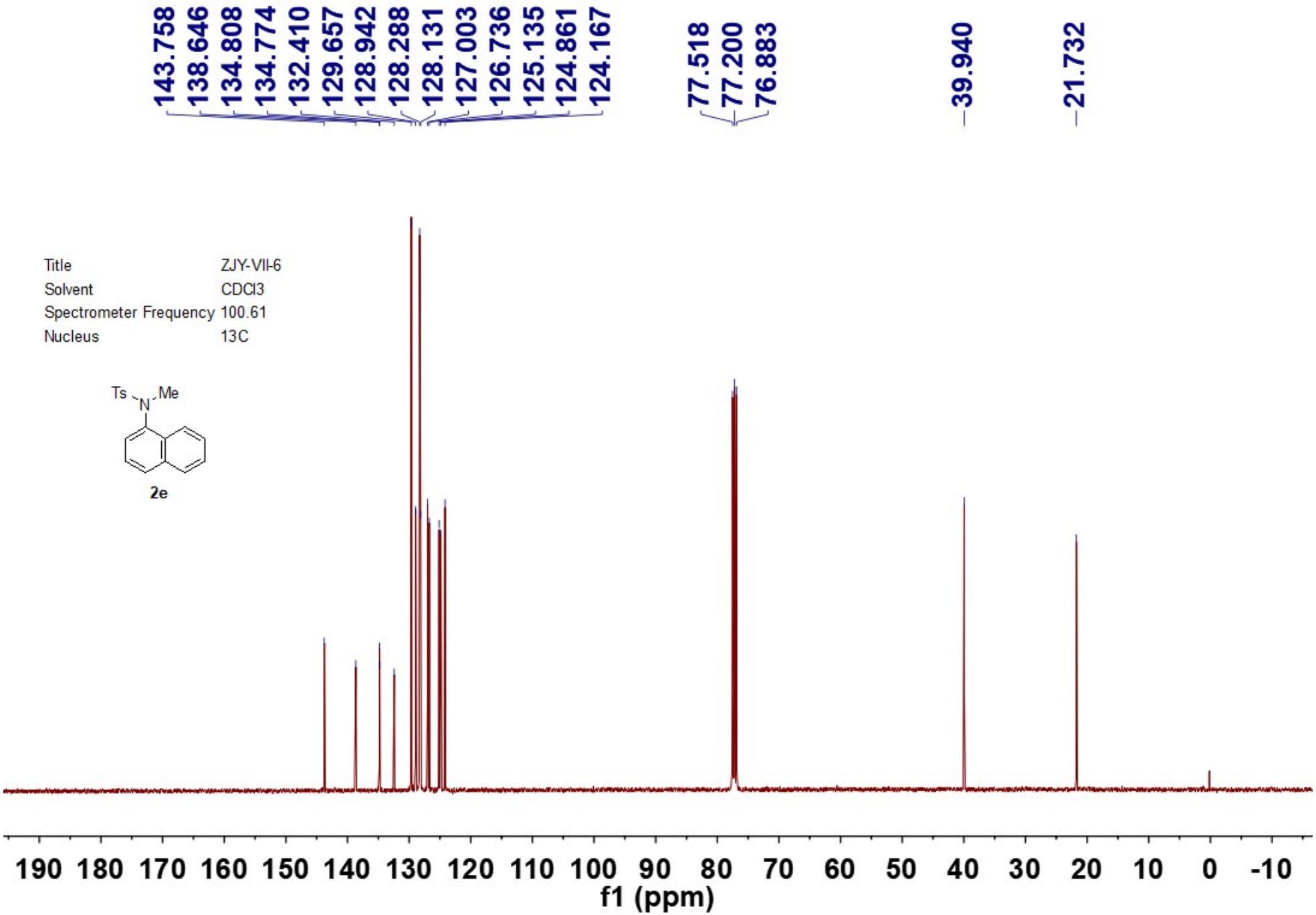
145.175
135.325
134.936
134.811
132.176
129.784
129.434
129.169
128.556
128.347
128.327
127.766
127.009
126.714
125.061
124.232
123.513
77.517
77.200
76.882
56.764
Title ZJY-VII-4-1
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ns
N
Bn
2d
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.2853
8.2833
8.2807
8.2783
8.2653
8.2626
8.2603
8.2588
8.2569
7.8513
7.8329
7.8296
7.8124
7.7917
7.6383
7.6335
7.6223
7.6177
7.6122
7.5726
7.5691
7.5555
7.5522
7.5485
7.5355
7.5304
7.5251
7.5089
7.5060
7.3252
7.3068
7.2865
6.8649
6.8626
6.8465
6.8442
3.2856
2.4451
-0.0000
Title ZJY-VII-6
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Me
2e
1.00
2.00
2.00
2.00
3.00
1.00
3.00
3.00
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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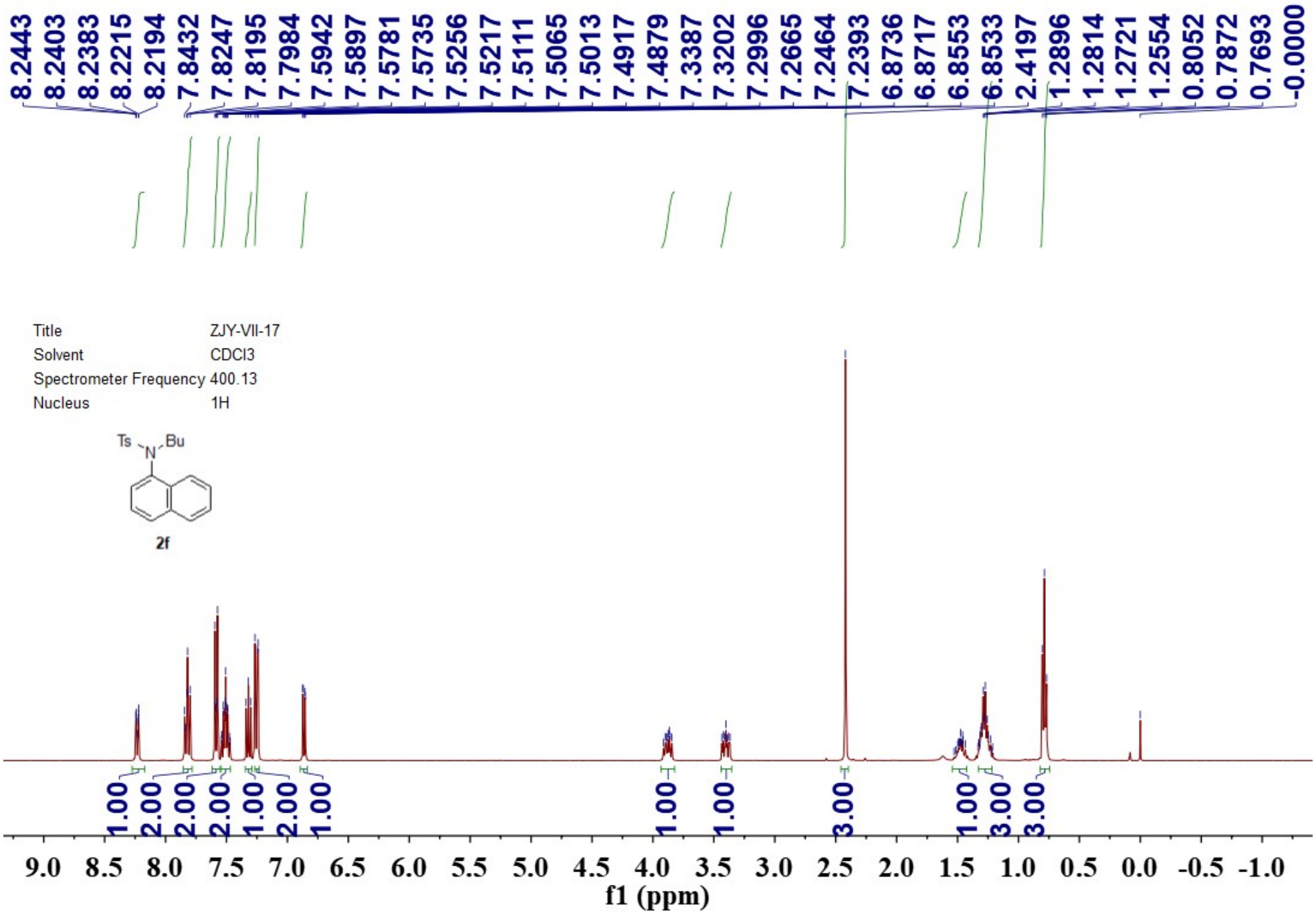
134.808
134.774
132.410
129.657
128.942
128.288
128.131
127.003
126.736
125.135
124.861
124.167
77.518
77.200
76.883
39.940
21.732
Title ZJY-VII-6
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Me
2e
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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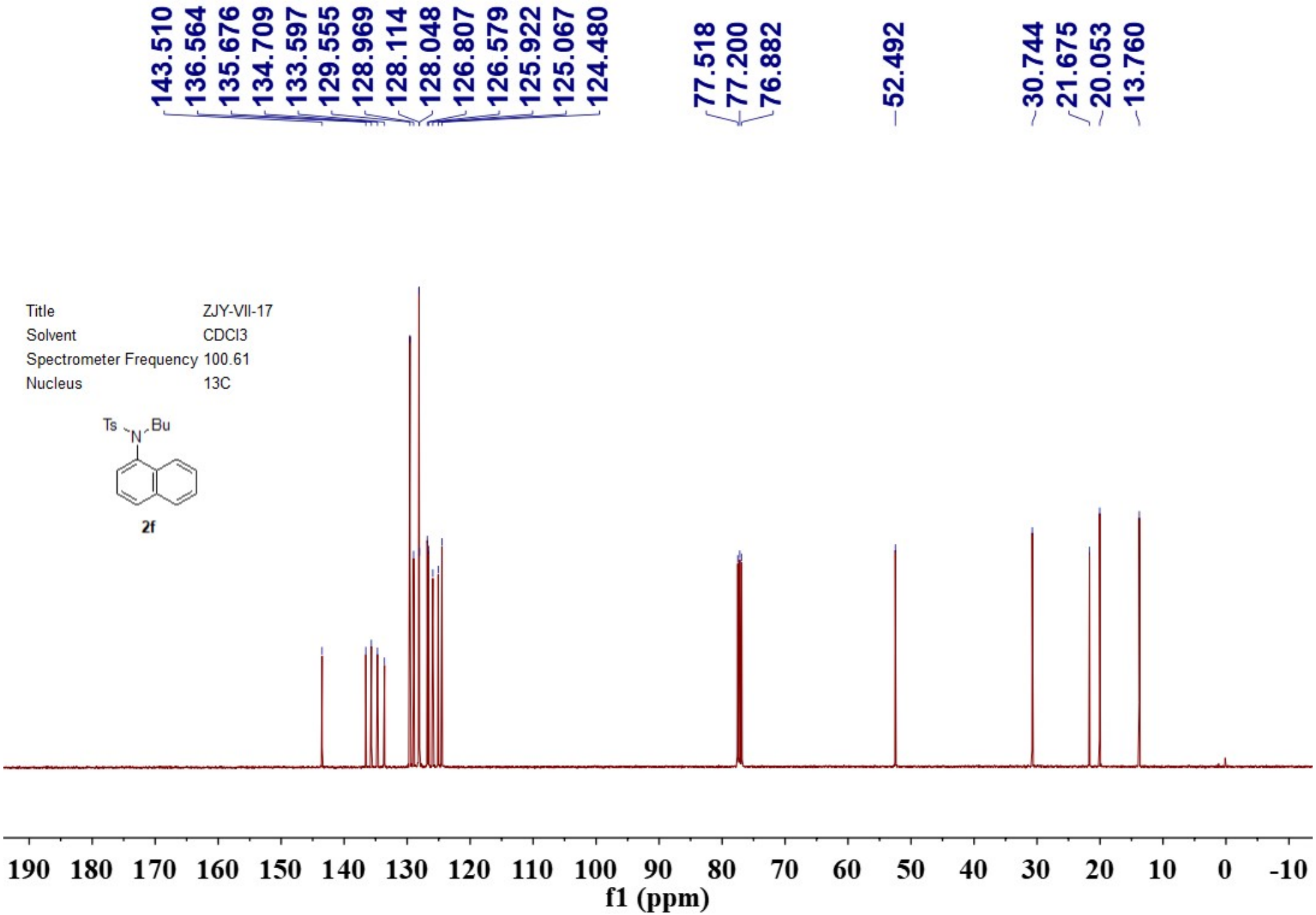
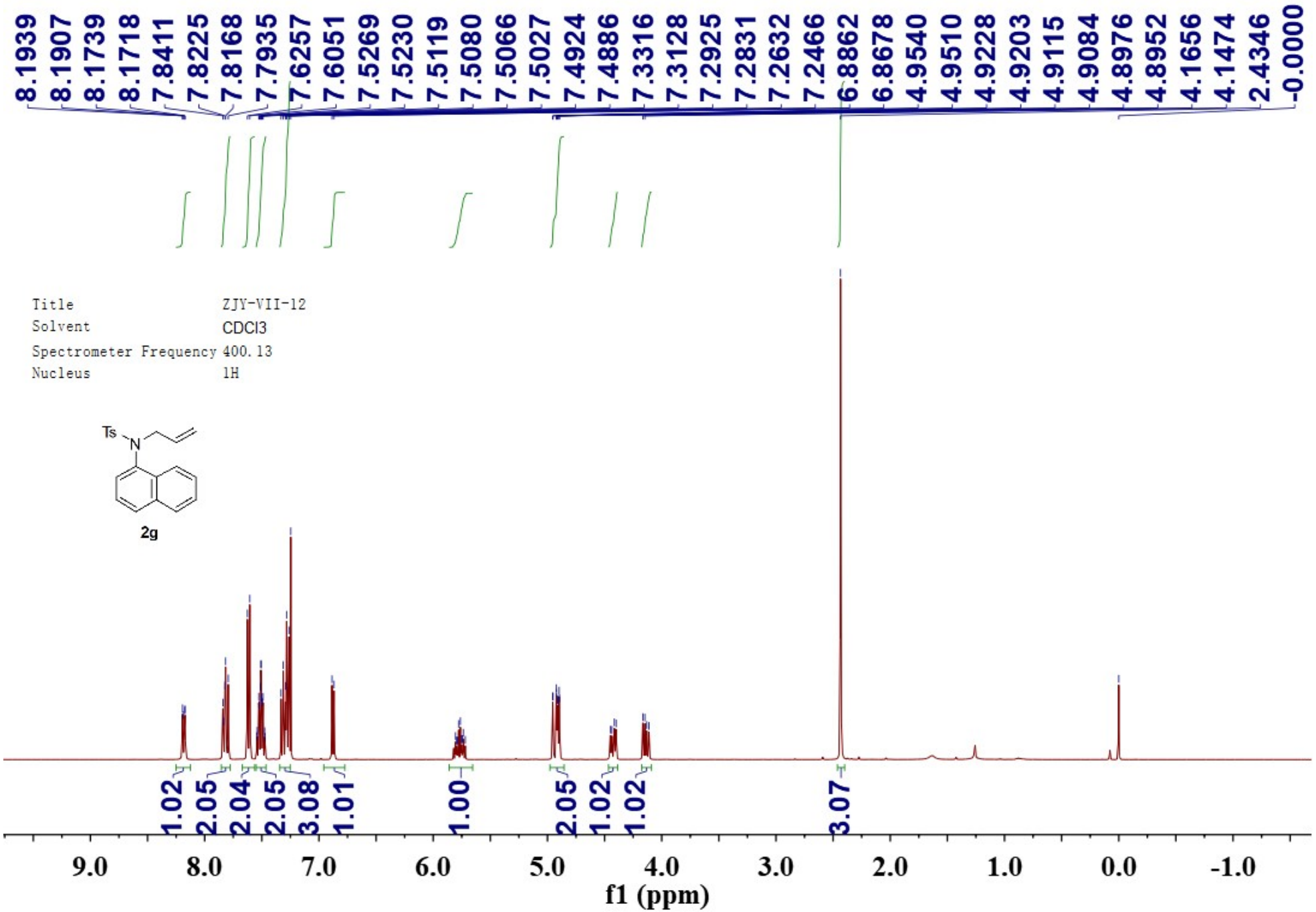
8.2403
8.2383
8.2215
8.2194
7.8432
7.8247
7.8195
7.7984
7.5942
7.5897
7.5781
7.5735
7.5256
7.5217
7.5111
7.5065
7.5013
7.4917
7.4879
7.3387
7.3202
7.2996
7.2665
7.2464
7.2393
6.8736
6.8717
6.8553
6.8533
2.4197
1.2896
1.2814
1.2721
1.2554
0.8052
0.7872
0.7693
-0.0000
Title ZJY-VII-17
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Bu
2f
1.00
2.00
2.00
2.00
1.00
2.00
1.00
1.00
1.00
3.00
1.00
3.00
3.00
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)


143.510
136.564
135.676
134.709
133.597
129.555
128.969
128.114
128.048
126.807
126.579
125.922
125.067
124.480
77.518
77.200
76.882
52.492
30.744
21.675
20.053
13.760
Title ZJY-VII-17
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Bu
2f
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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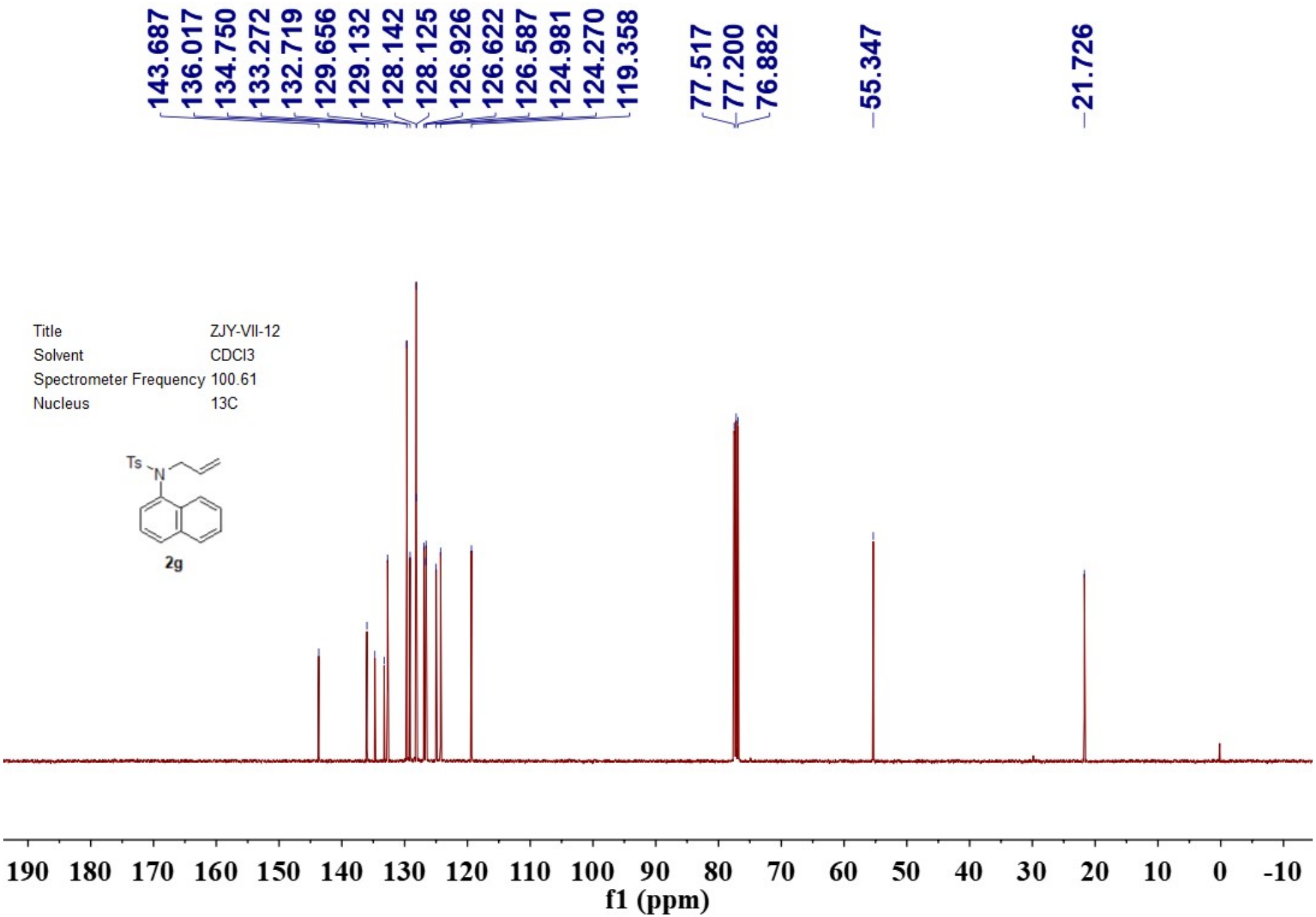
8.1739
8.1718
7.8411
7.8225
7.8168
7.7935
7.6257
7.6051
7.5269
7.5230
7.5119
7.5080
7.5066
7.5027
7.4924
7.4886
7.3316
7.3128
7.2925
7.2831
7.2632
7.2466
6.8862
6.8678
4.9540
4.9510
4.9228
4.9203
4.9115
4.9084
4.8976
4.8952
4.1656
4.1474
2.4346
-0.0000
Title ZJY-VII-12
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
2g
1.02
2.05
2.04
2.05
3.08
1.01
1.00
2.05
1.02
1.02
3.07
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)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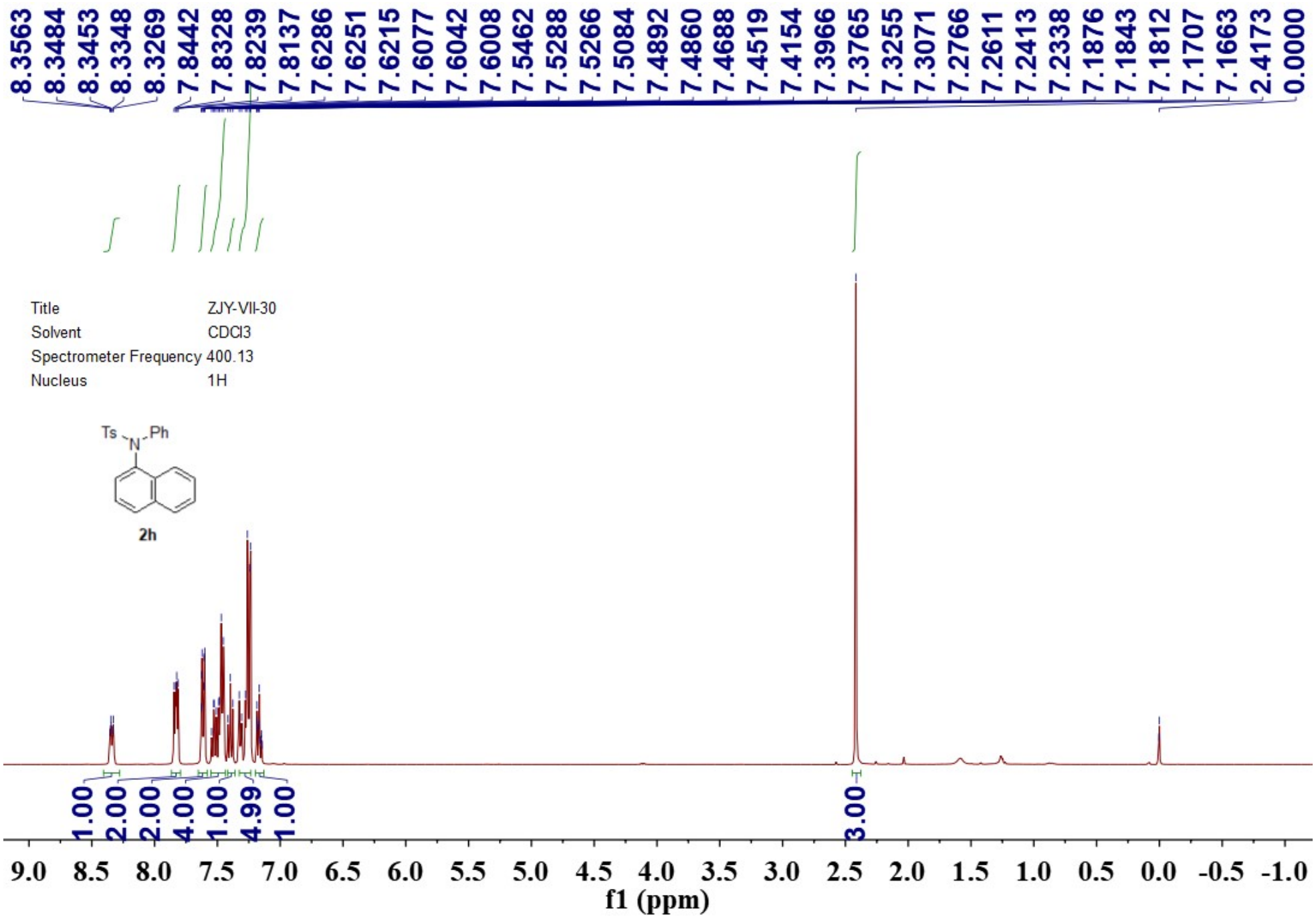
134.750
133.272
132.719
129.656
129.132
128.142
128.125
126.926
126.622
126.587
124.981
124.270
119.358
77.517
77.200
76.882
55.347
21.726
Title ZJY-VII-12
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
2g
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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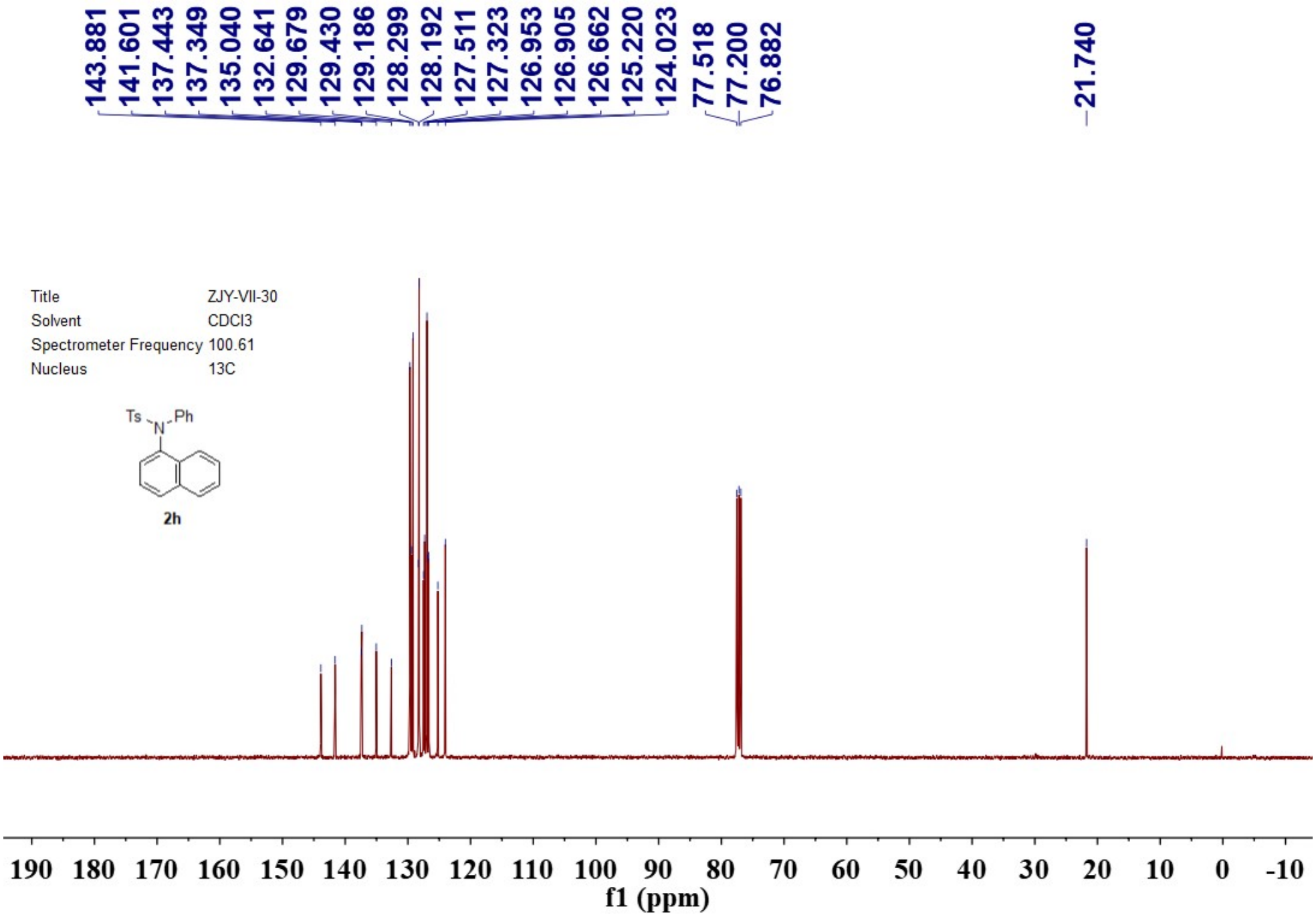
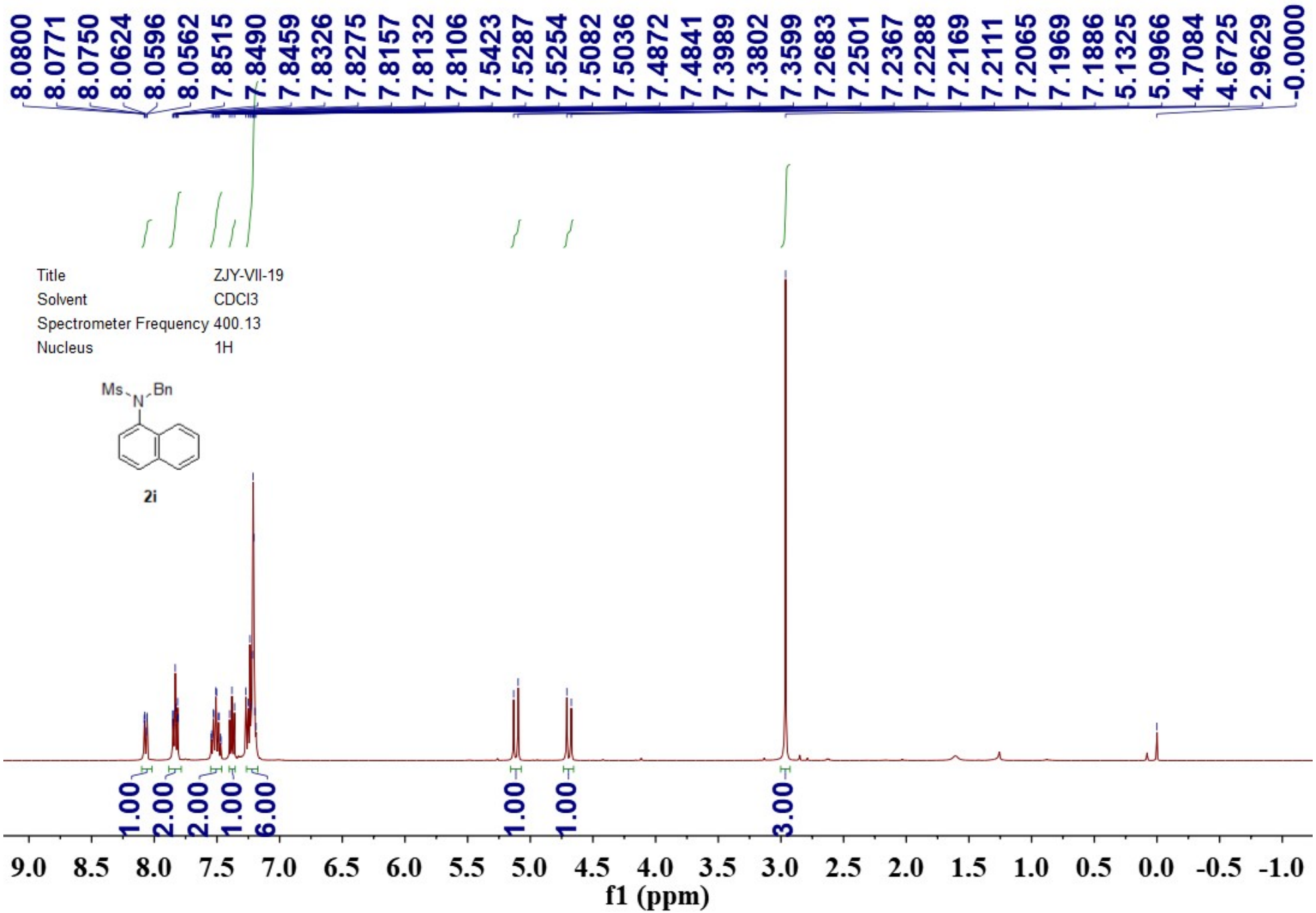
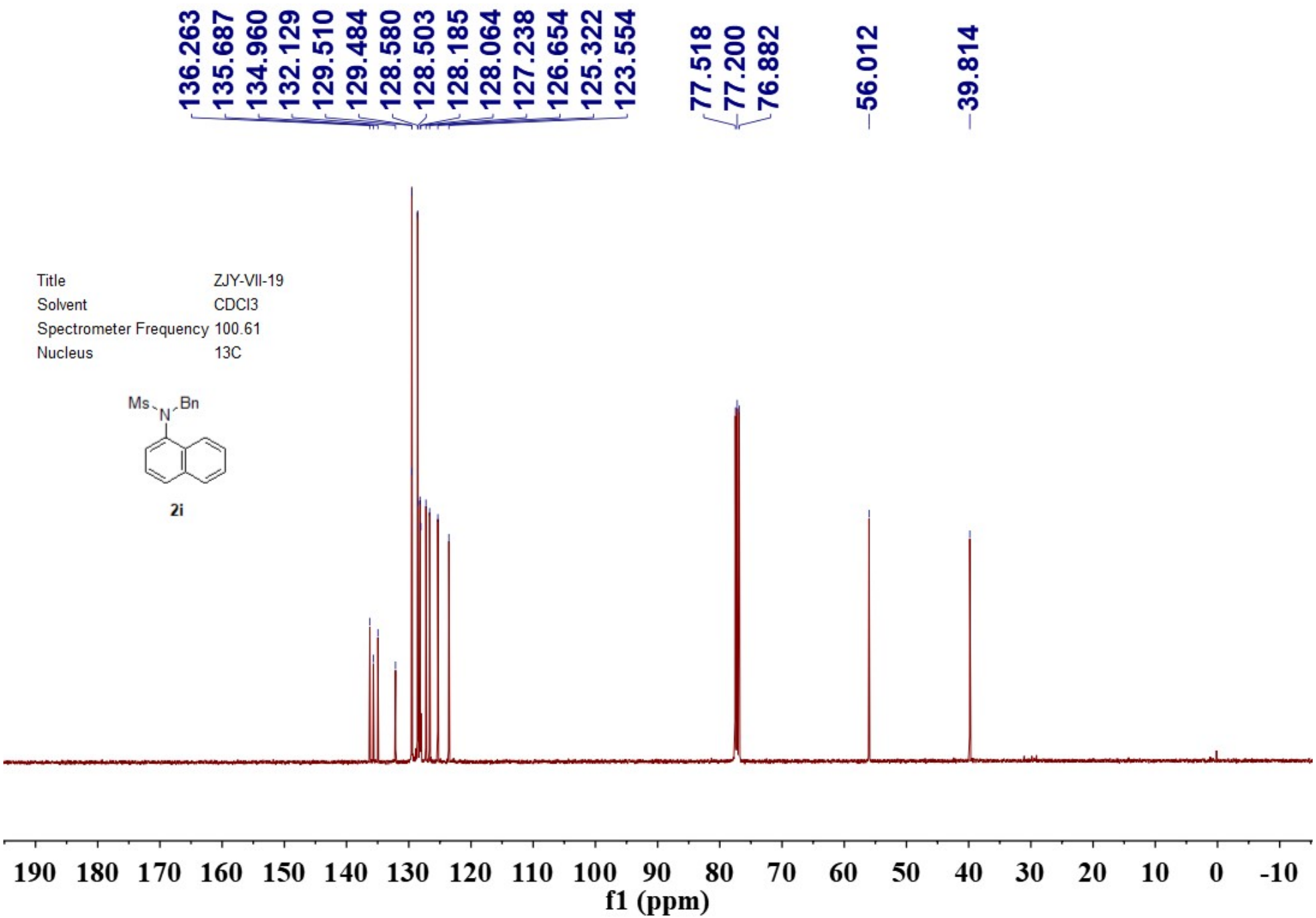
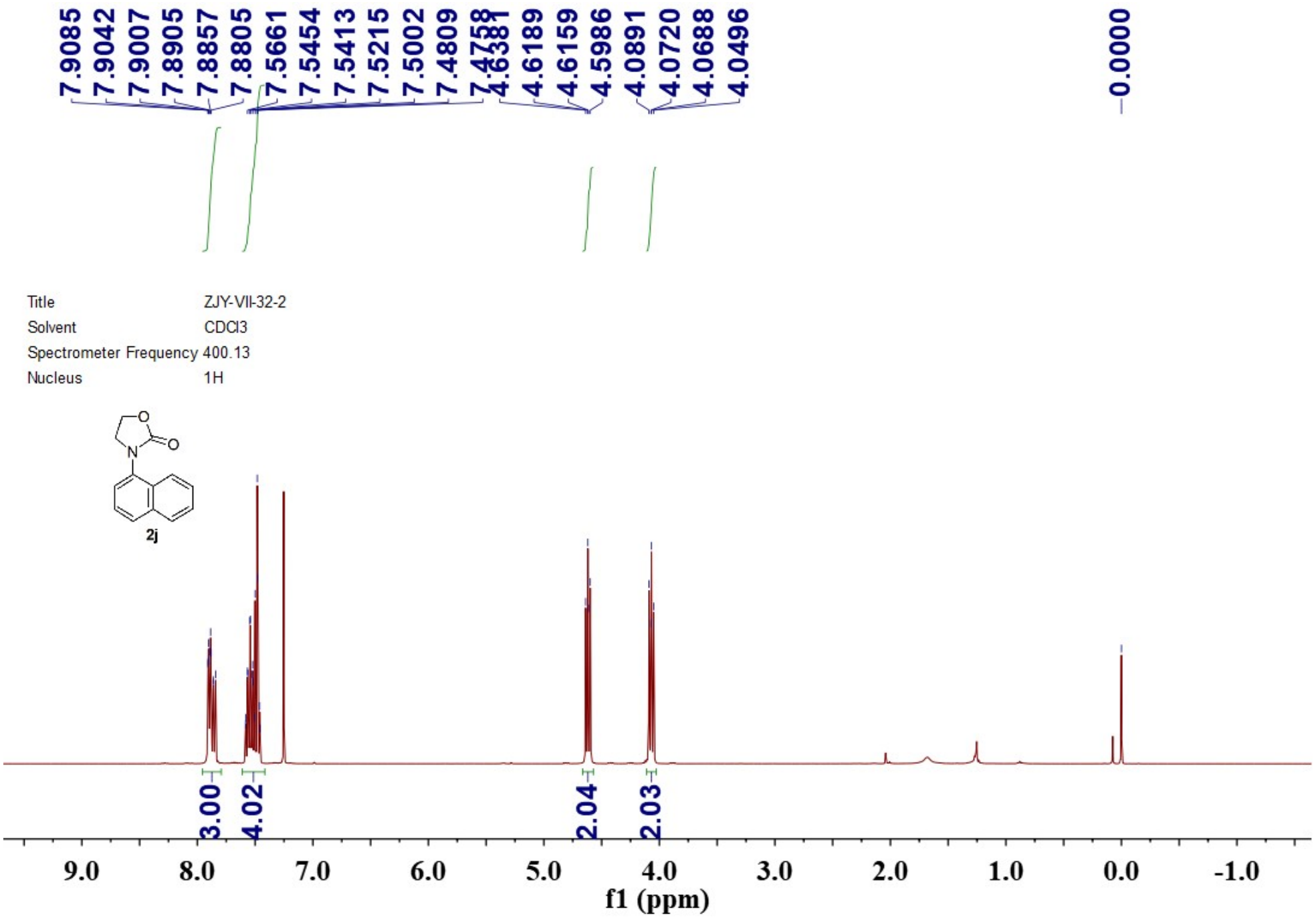
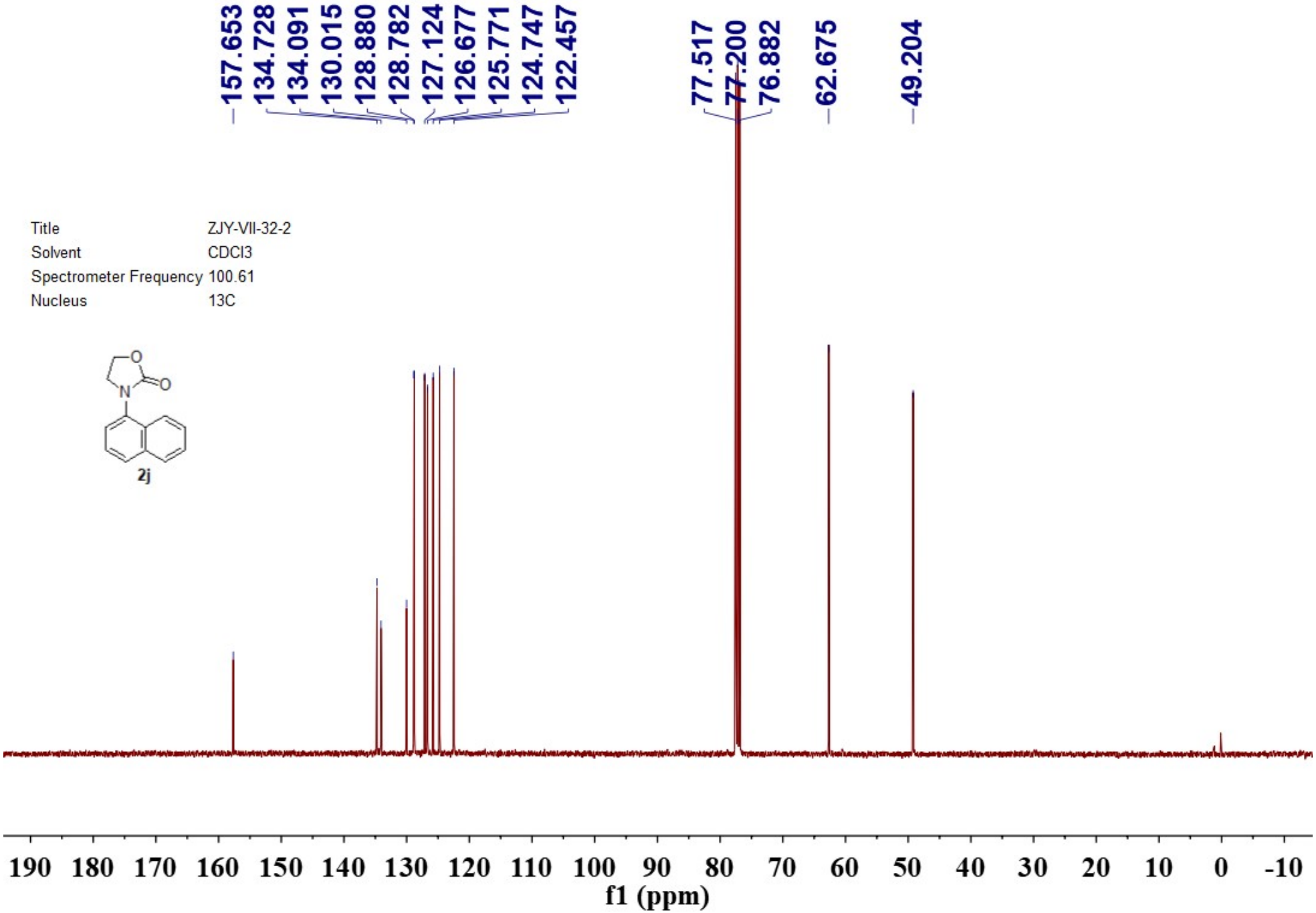
8.3484
8.3453
8.3348
8.3269
7.8442
7.8328
7.8239
7.8137
7.6286
7.6251
7.6215
7.6077
7.6042
7.6008
7.5462
7.5288
7.5266
7.5084
7.4892
7.4860
7.4688
7.4519
7.4154
7.3966
7.3765
7.3255
7.3071
7.2766
7.2611
7.2413
7.2338
7.1876
7.1843
7.1812
7.1707
7.1663
2.4173
0.0000
Title ZJY-VII-30
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Ph
2h
1.00
2.00
2.00
4.00
1.00
4.99
1.00
3.00
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)

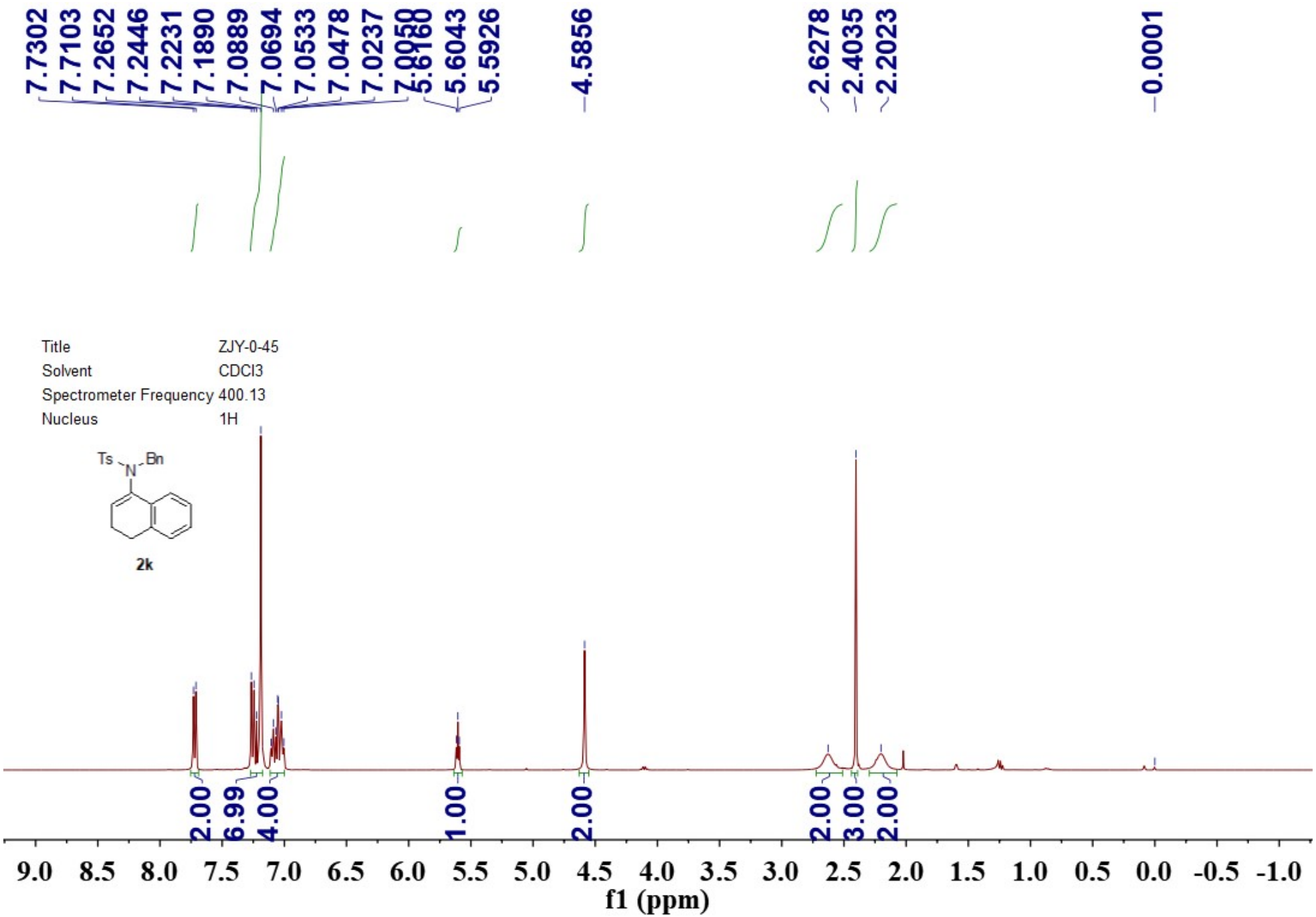

143.881
141.601
137.443
137.349
135.040
132.641
129.679
129.430
129.186
128.299
128.192
127.511
127.323
126.953
126.905
126.662
125.220
124.023
77.518
77.200
76.882
21.740
Title ZJY-VII-30
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Ph
2h
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

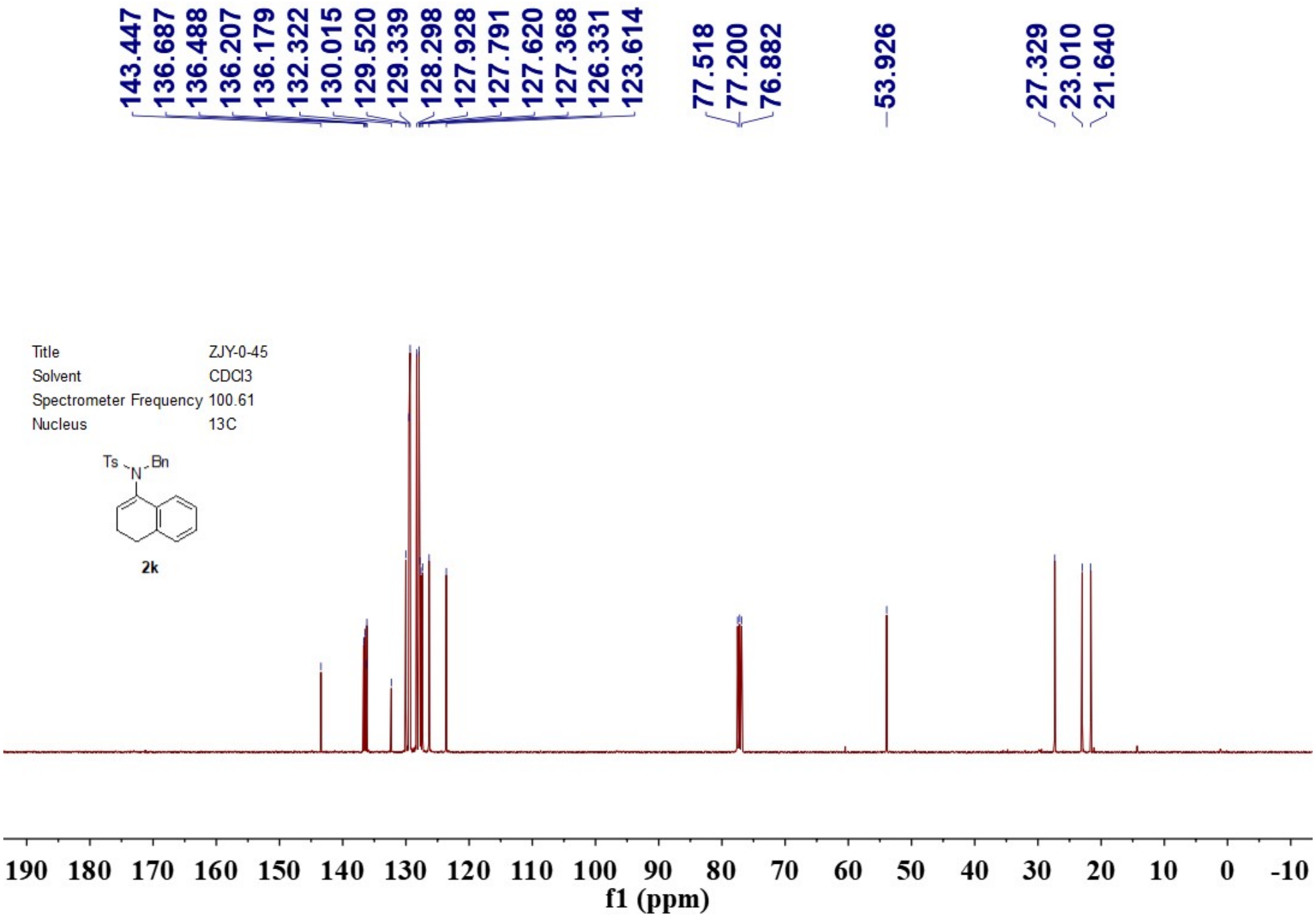

8.0800
8.0771
8.0750
8.0624
8.0596
8.0562
7.8515
7.8490
7.8459
7.8326
7.8275
7.8157
7.8132
7.8106
7.5423
7.5287
7.5254
7.5082
7.5036
7.4872
7.4841
7.3989
7.3802
7.3599
7.2683
7.2501
7.2367
7.2288
7.2169
7.2111
7.2065
7.1969
7.1886
5.1325
5.0966
4.7084
4.6725
2.9629
-0.0000
Title ZJY-VII-19
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ms
N
Bn
2i
1.00
2.00
2.00
1.00
6.00
1.00
1.00
3.00
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)

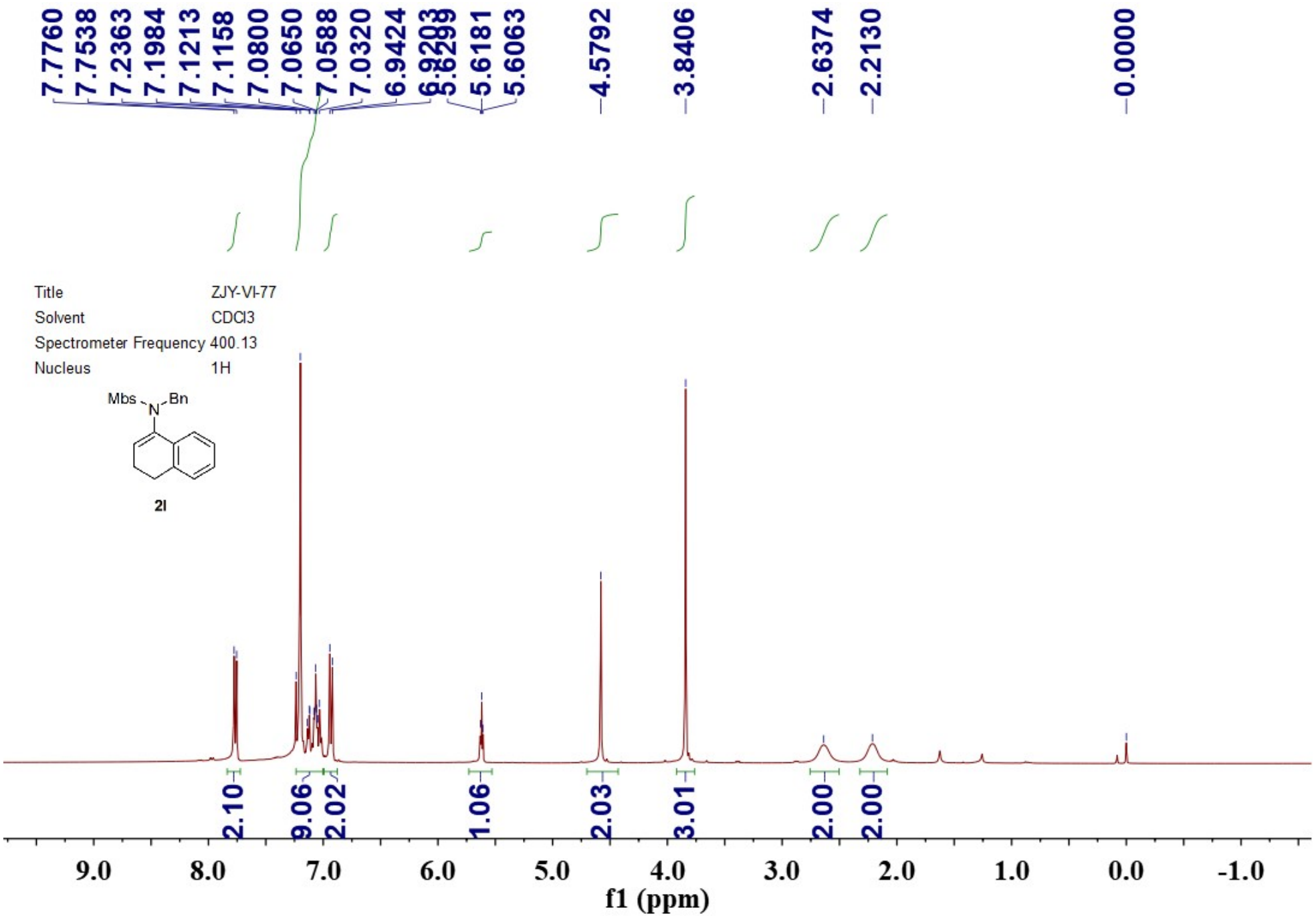

136.263
135.687
134.960
132.129
129.510
129.484
128.580
128.503
128.185
128.064
127.238
126.654
125.322
123.554
77.518
77.200
76.882
56.012
39.814
Title ZJY-VII-19
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ms
N
Bn
2i
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

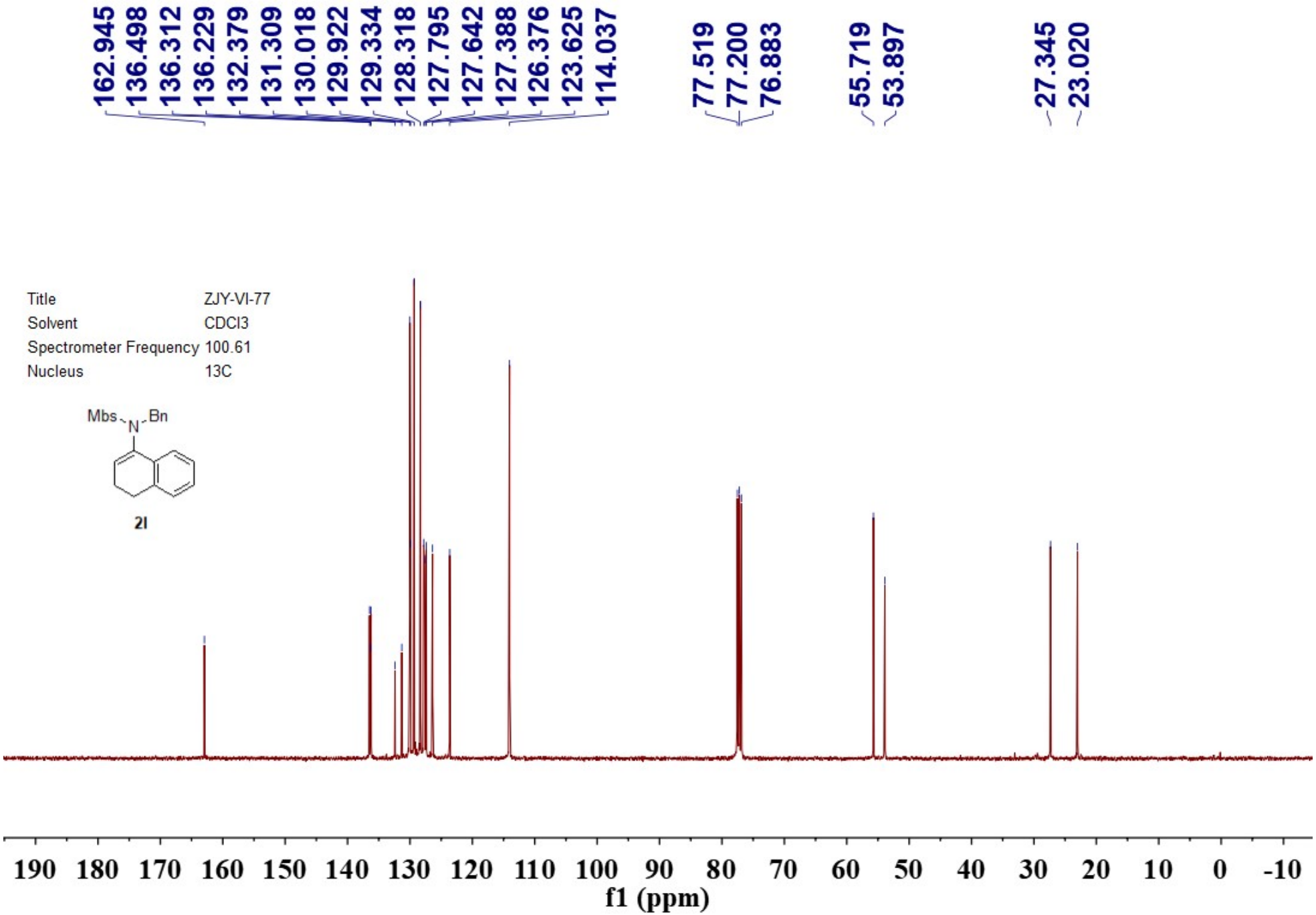

7.9085
7.9042
7.9007
7.8905
7.8857
7.8805
7.5661
7.5454
7.5413
7.5215
7.5002
7.4809
7.4758
7.4381
4.6189
4.6159
4.5986
4.0891
4.0720
4.0688
4.0496
0.0000
Title ZJY-VII-32-2
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
2j
3.00
4.02
2.04
2.03
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

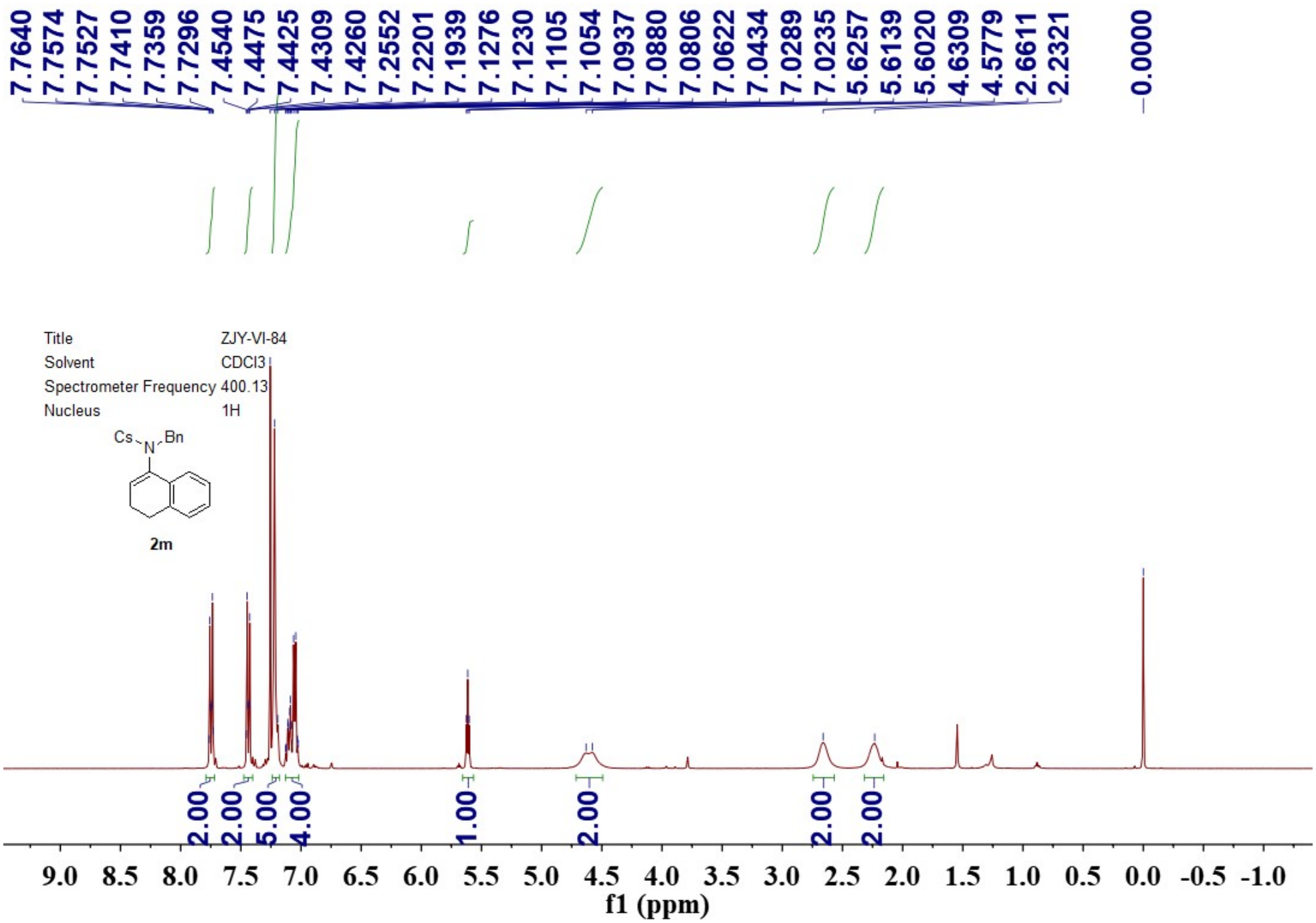

157.653
134.728
134.091
130.015
128.880
128.782
127.124
126.677
125.771
124.747
122.457
77.517
77.200
76.882
62.675
49.204
Title ZJY-VII-32-2
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
2j
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

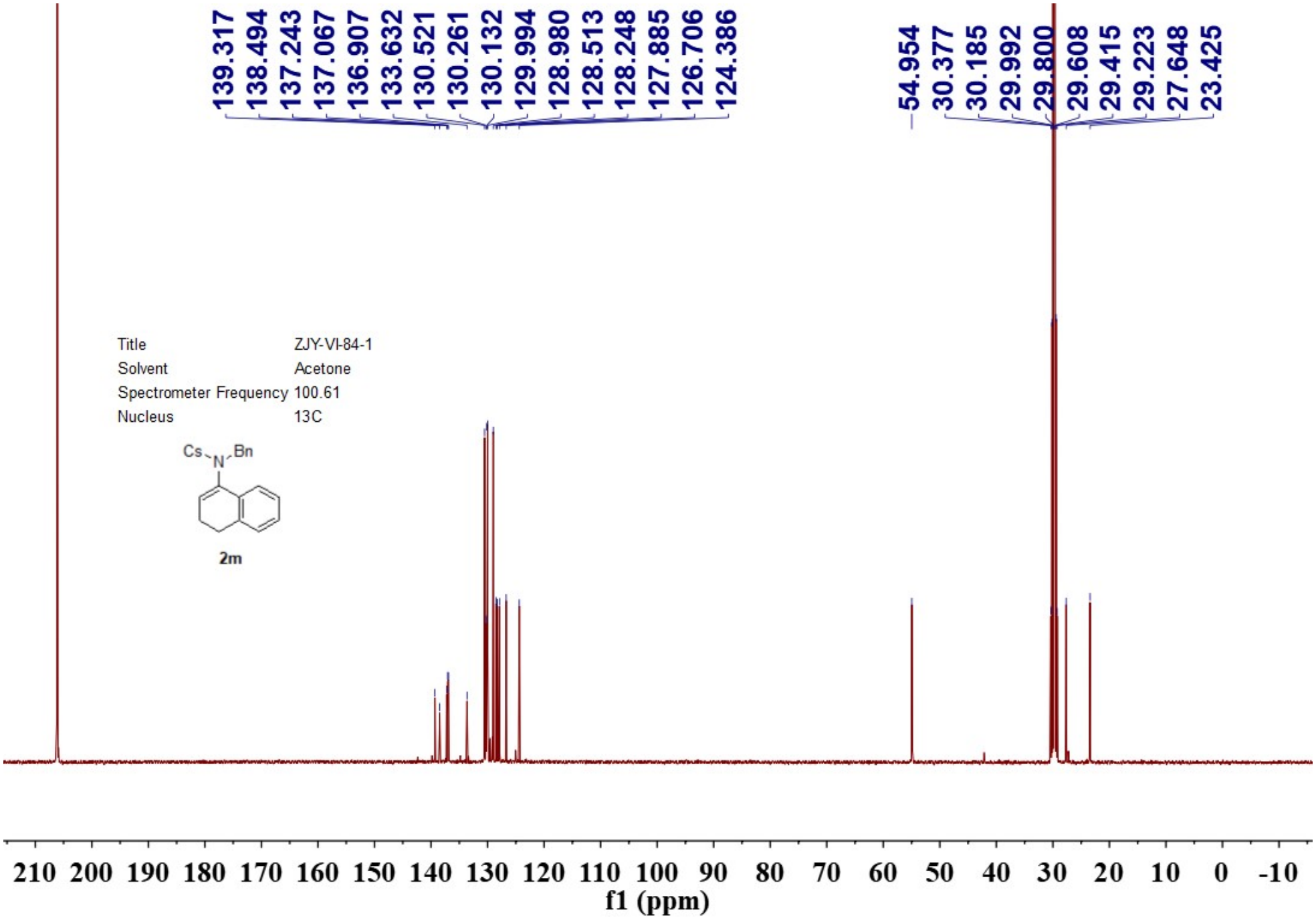

7.7302
7.7103
7.2652
7.2446
7.2231
7.1890
7.0889
7.0694
7.0533
7.0478
7.0237
5.6160
5.6043
5.5926
4.5856
2.6278
2.4035
2.2023
0.0001
Title ZJY-0-45
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Bn
2k
2.00
6.99
4.00
1.00
2.00
2.00
3.00
2.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

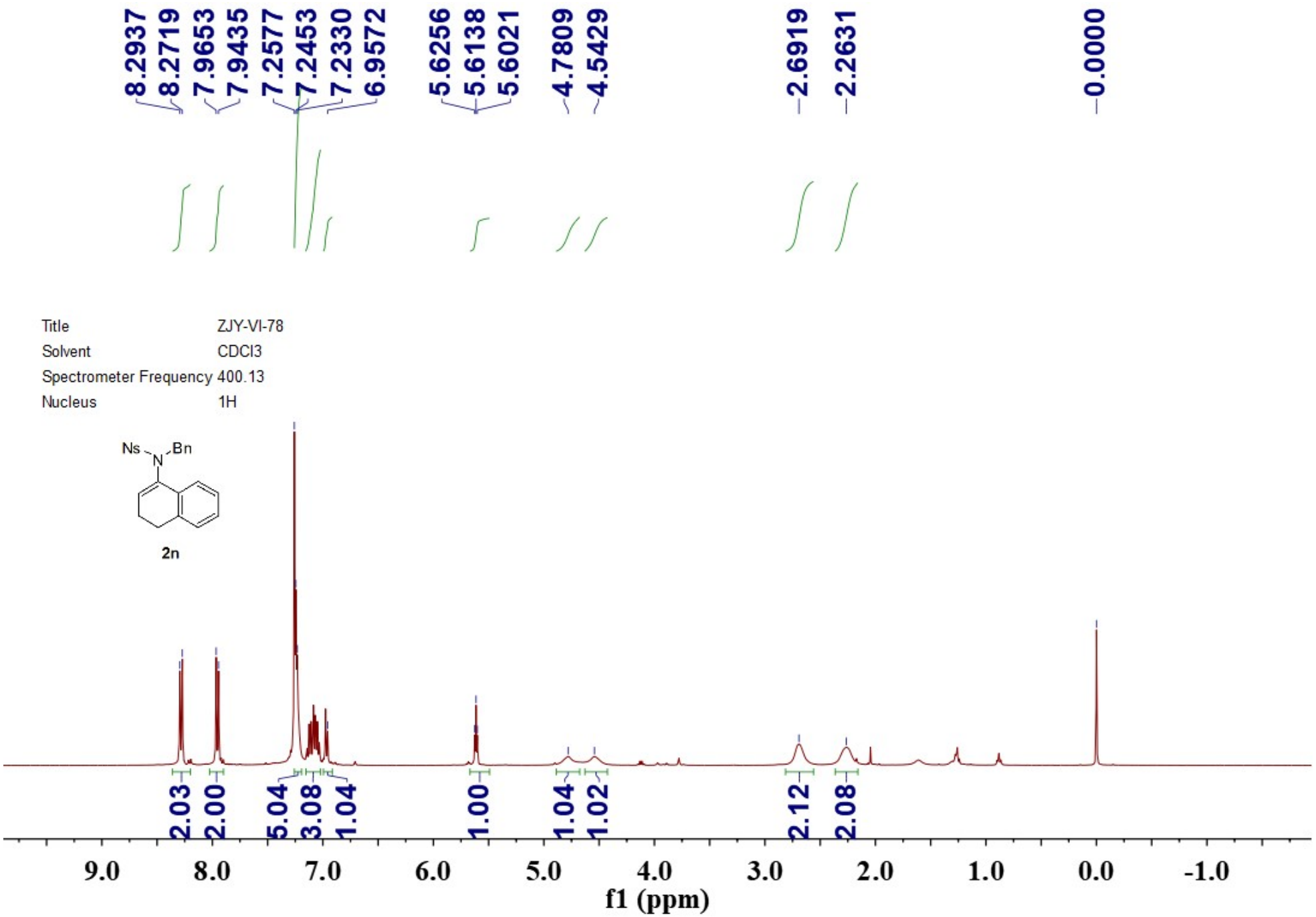

143.447
136.687
136.488
136.207
136.179
132.322
130.015
129.520
129.339
128.298
127.928
127.791
127.620
127.368
126.331
123.614
77.518
77.200
76.882
53.926
27.329
23.010
21.640
Title ZJY-0-45
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Bn
2k
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

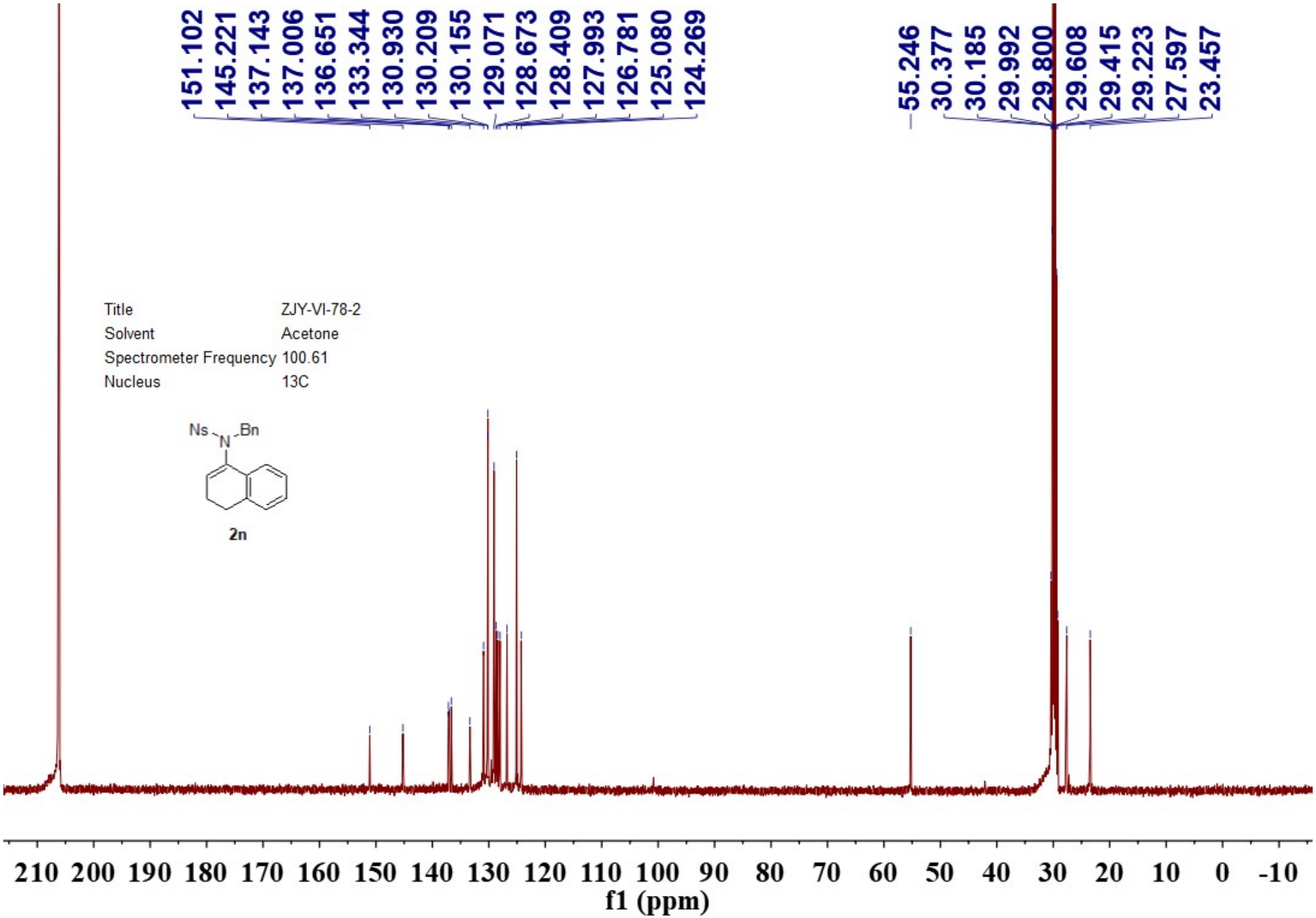

7.7760
7.7538
7.2363
7.1984
7.1213
7.1158
7.0800
7.0650
7.0588
7.0320
6.9424
5.6181
5.6063
4.5792
3.8406
2.6374
2.2130
0.0000
Title ZJY-VI-77
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Mbs
N
Bn
2l
2.10
9.06
2.02
1.06
2.03
3.01
2.00
2.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

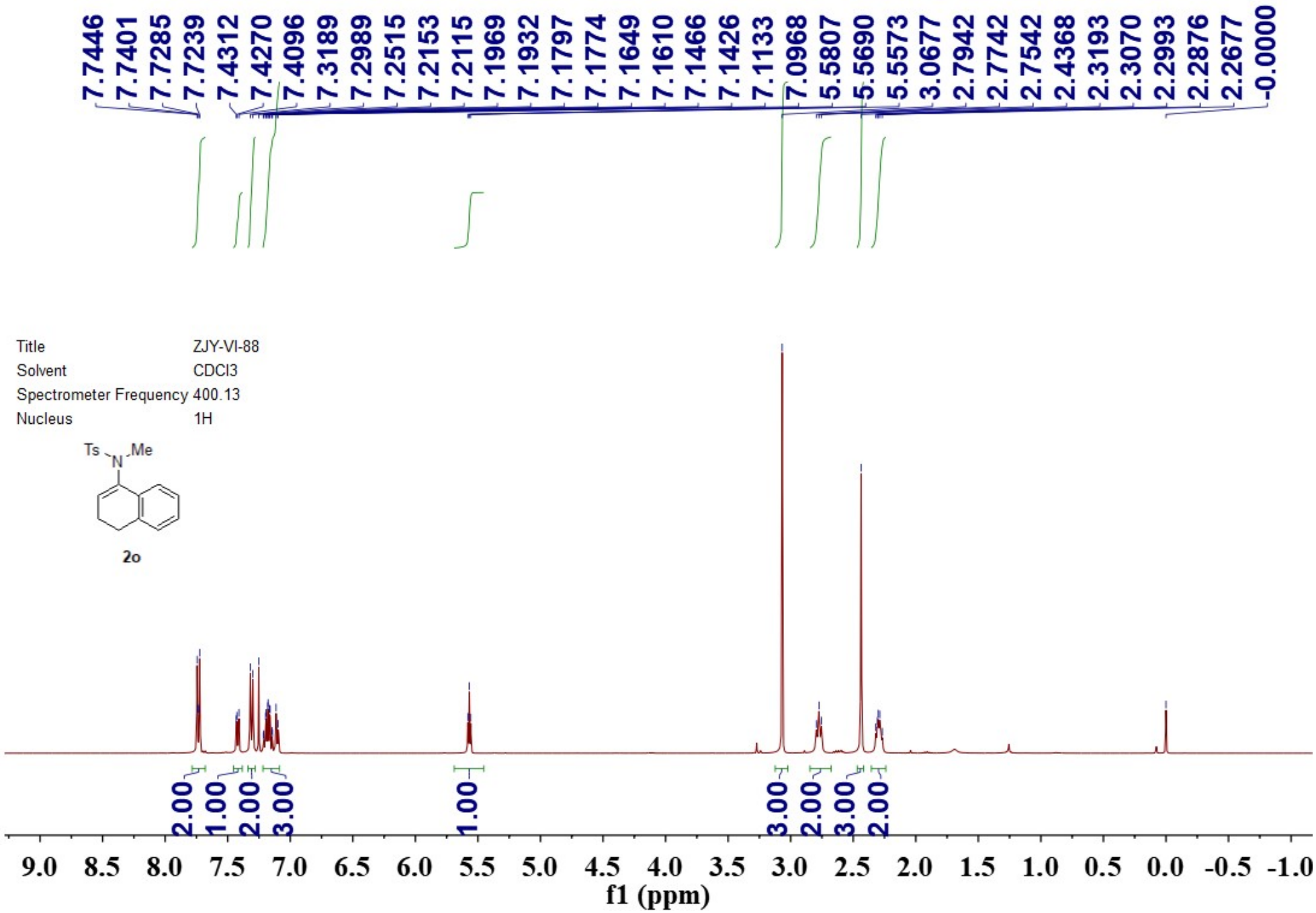

162.945
136.498
136.312
136.229
132.379
131.309
130.018
129.922
129.334
128.318
127.795
127.642
127.388
126.376
123.625
114.037
77.519
77.200
76.883
55.719
53.897
27.345
23.020
Title ZJY-VI-77
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Mbs
N
Bn
2l
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

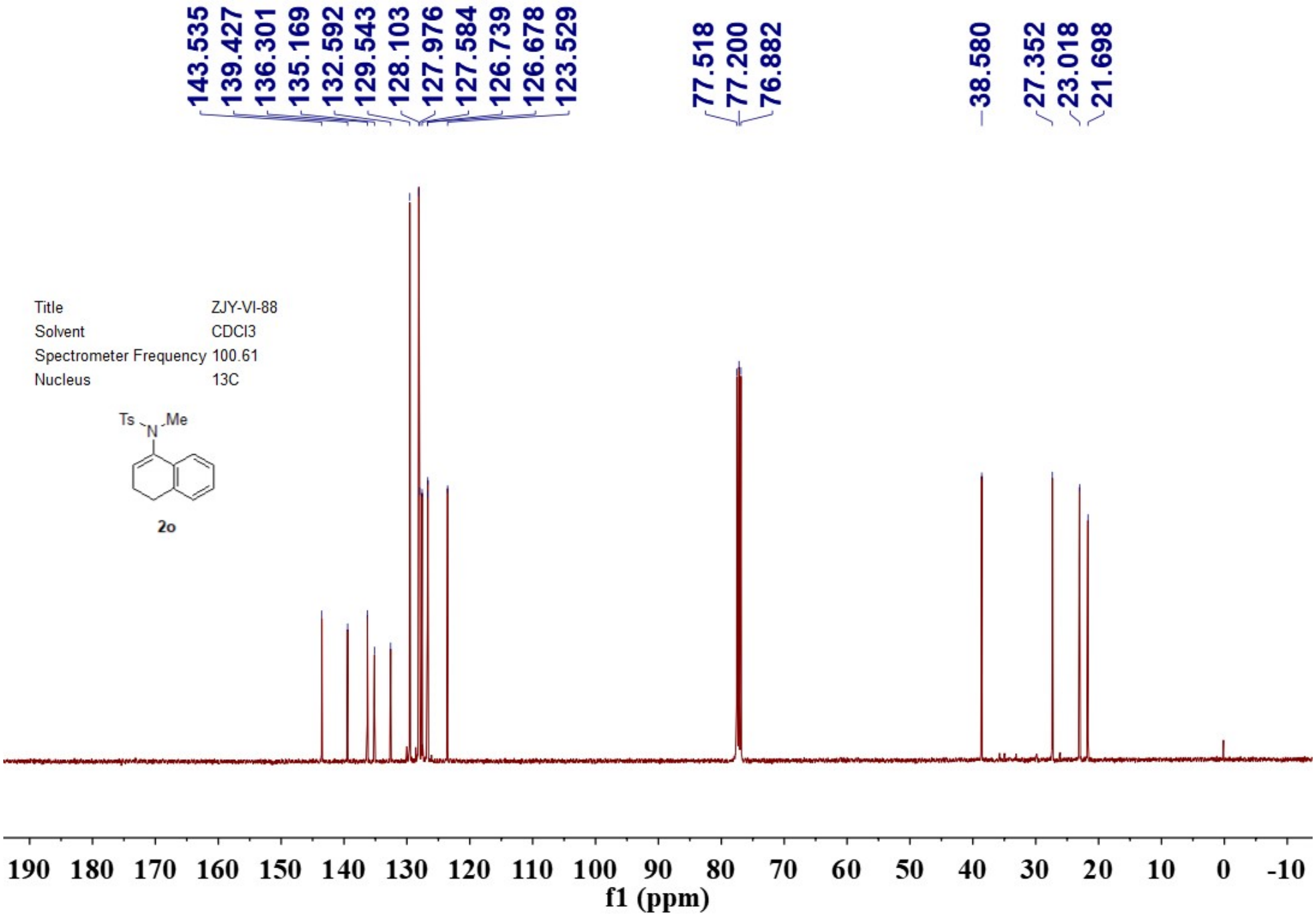

7.7640
7.7574
7.7527
7.7410
7.7359
7.7296
7.4540
7.4475
7.4425
7.4309
7.4260
7.2552
7.2201
7.1939
7.1276
7.1230
7.1105
7.1054
7.0937
7.0880
7.0806
7.0622
7.0434
7.0289
7.0235
5.6257
5.6139
5.6020
4.6309
4.5779
2.6611
2.2321
0.0000
Title ZJY-VI-84
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cs
N
Bn
2m
2.00
2.00
5.00
4.00
1.00
2.00
2.00
2.00
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)


139.317
138.494
137.243
137.067
136.907
133.632
130.521
130.261
130.132
129.994
128.980
128.513
128.248
127.885
126.706
124.386
54.954
30.377
30.185
29.992
29.800
29.608
29.415
29.223
27.648
23.425
Title ZJY-VI-84-1
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Cs
N
Bn
2m
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.2937
8.2719
7.9653
7.9435
7.2577
7.2453
7.2330
6.9572
5.6256
5.6138
5.6021
4.7809
4.5429
2.6919
2.2631
0.0000
Title ZJY-VI-78
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ns
N
Bn
2n
2.03
2.00
5.04
3.08
1.04
1.00
1.04
1.02
2.12
2.08
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


151.102
145.221
137.143
137.006
136.651
133.344
130.930
130.209
130.155
129.071
128.673
128.409
127.993
126.781
125.080
124.269
55.246
30.377
30.185
29.992
29.800
29.608
29.415
29.223
27.597
23.457
Title ZJY-VI-78-2
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ns
N
Bn
2n
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7446
7.7401
7.7285
7.7239
7.4312
7.4270
7.4096
7.3189
7.2989
7.2515
7.2153
7.2115
7.1969
7.1932
7.1797
7.1774
7.1649
7.1610
7.1466
7.1426
7.1133
7.0968
5.5807
5.5690
5.5573
3.0677
2.7942
2.7742
2.7542
2.4368
2.3193
2.3070
2.2993
2.2876
2.2677
-0.0000
Title ZJY-VI-88
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Me
2o
2.00
1.00
2.00
3.00
1.00
3.00
2.00
3.00
2.00
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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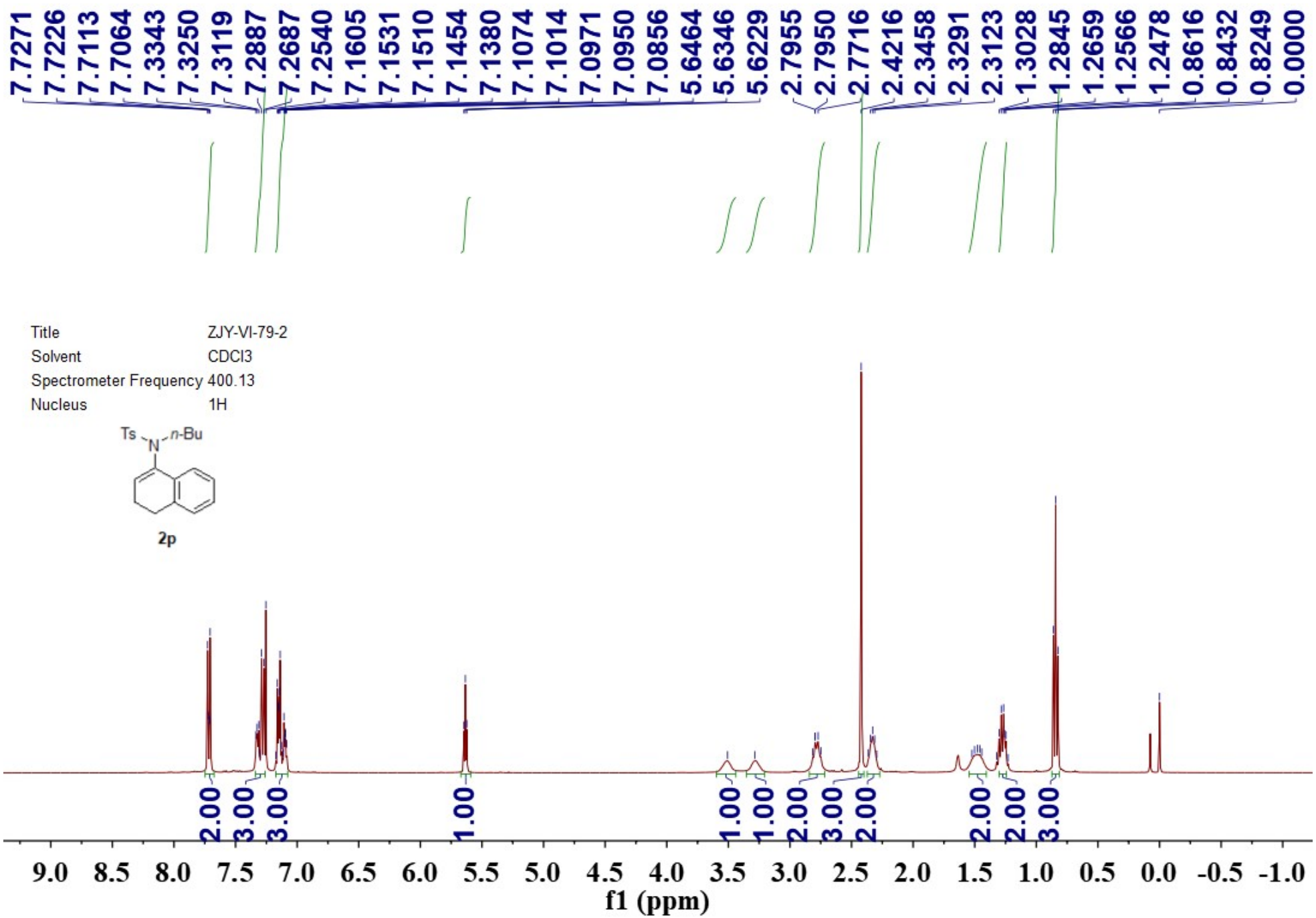
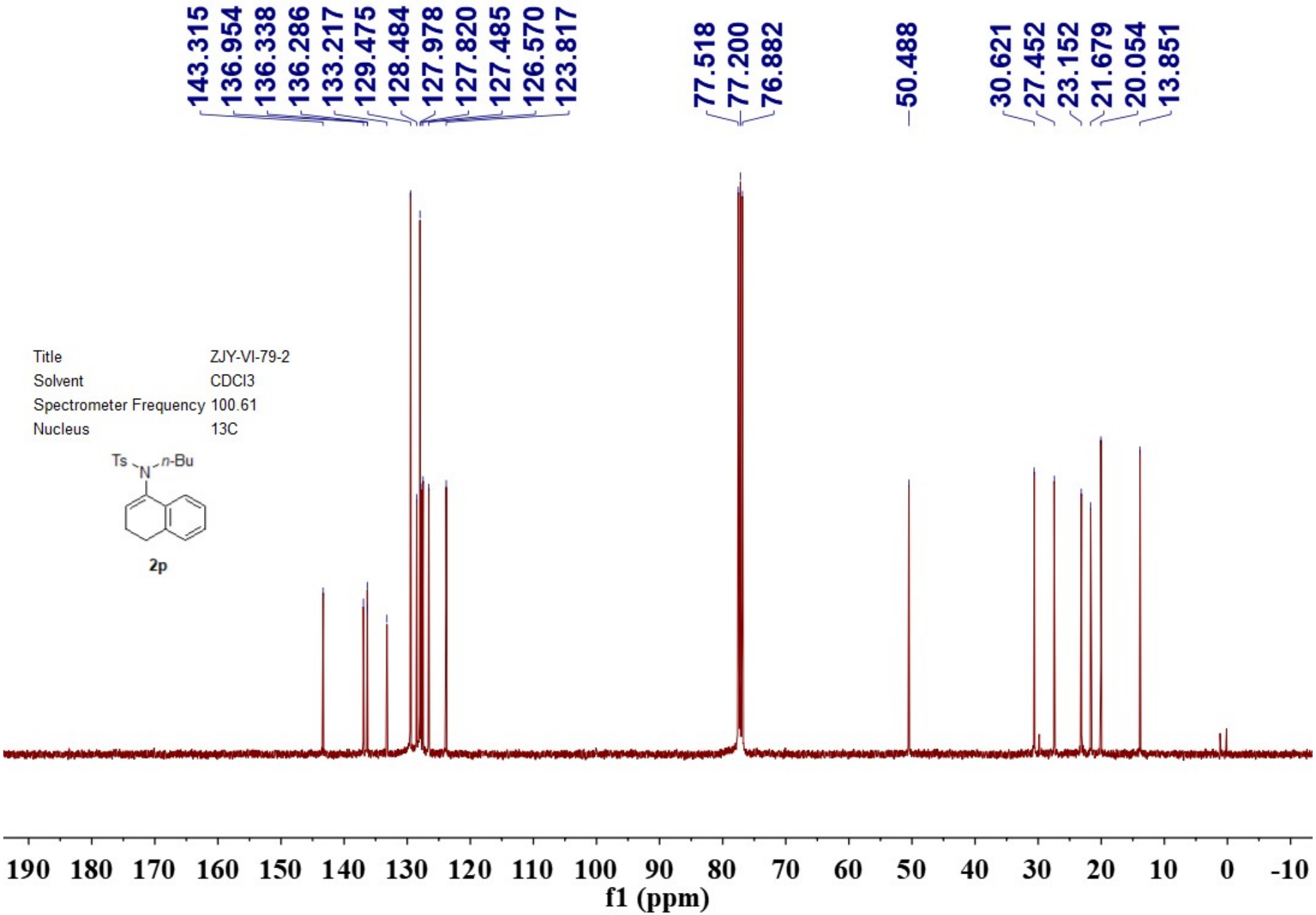
139.427
136.301
135.169
132.592
129.543
128.103
127.976
127.584
126.739
126.678
123.529
77.518
77.200
76.882
38.580
27.352
23.018
21.698
Title ZJY-VI-88
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Me
2o
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7271
7.7226
7.7113
7.7064
7.3343
7.3250
7.3119
7.2887
7.2687
7.2540
7.1605
7.1531
7.1510
7.1454
7.1380
7.1074
7.1014
7.0971
7.0950
7.0856
5.6464
5.6346
5.6229
2.7955
2.7950
2.7716
2.4216
2.3458
2.3291
2.3123
1.3028
1.2845
1.2659
1.2566
1.2478
0.8616
0.8432
0.8249
0.0000
Title ZJY-VI-79-2
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
n-Bu
2p
2.00
3.00
3.00
1.00
1.00
1.00
2.00
3.00
2.00
2.00
2.00
3.00
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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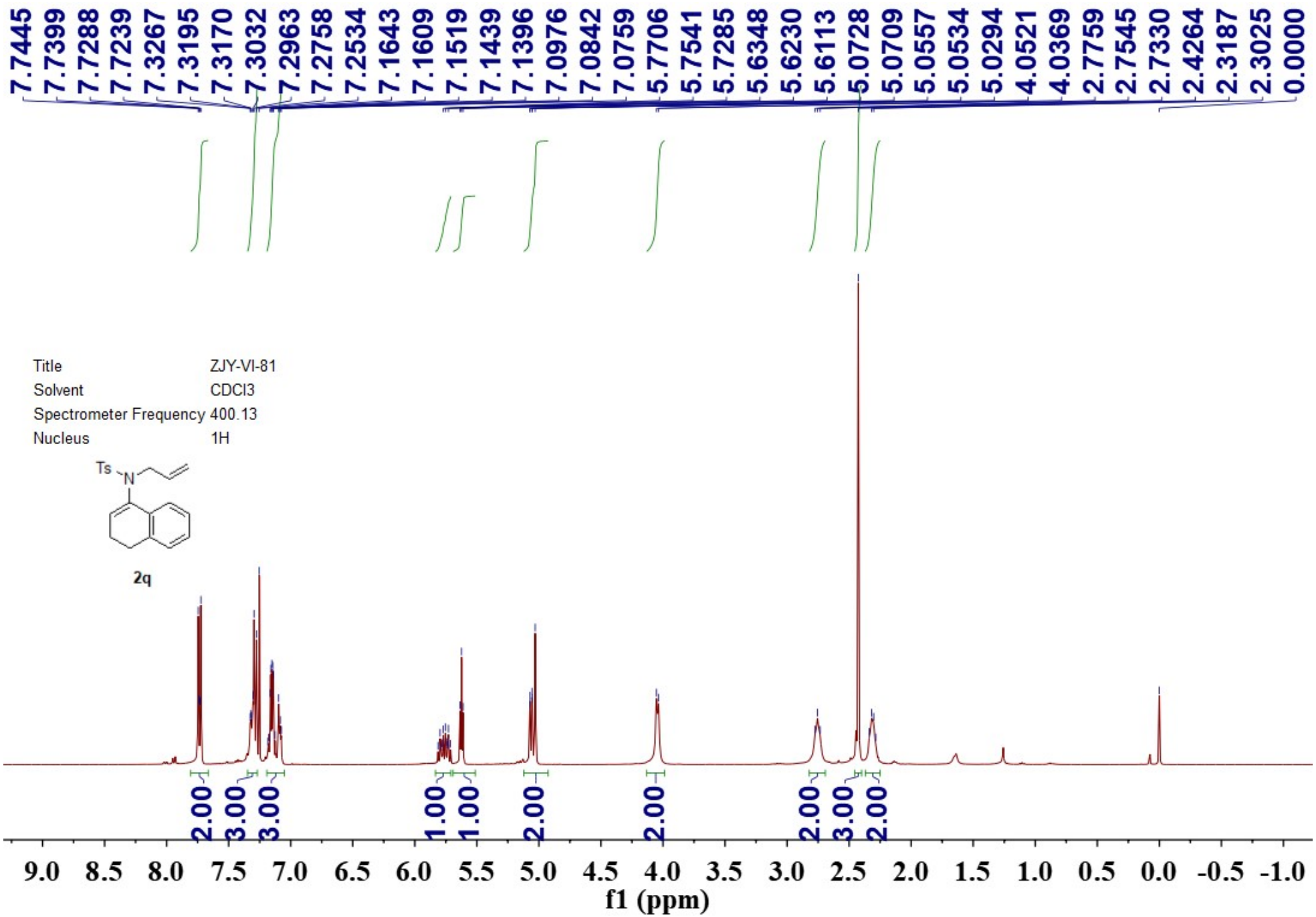
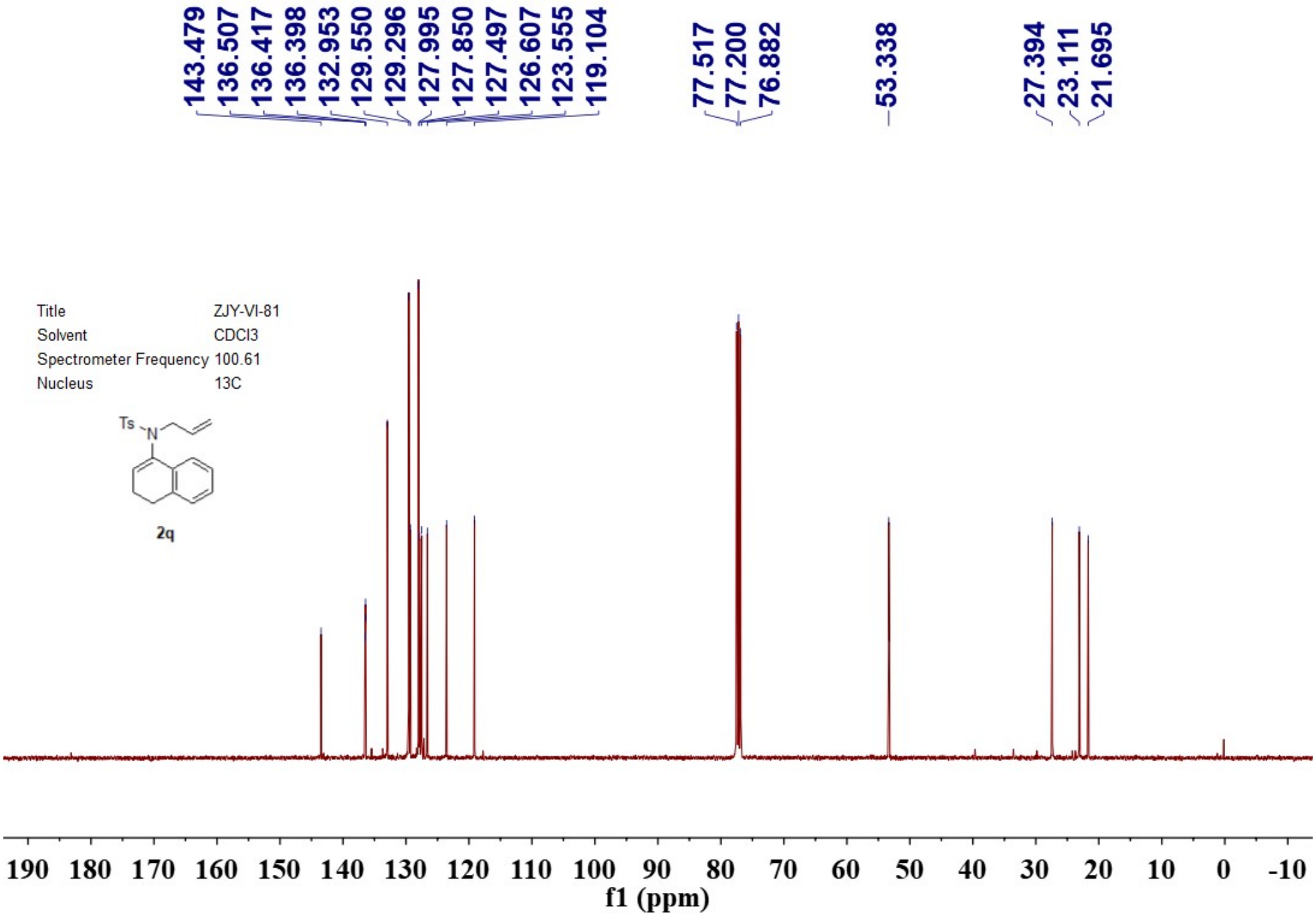
136.954
136.338
136.286
133.217
129.475
128.484
127.978
127.820
127.485
126.570
123.817
77.518
77.200
76.882
50.488
30.621
27.452
23.152
21.679
20.054
13.851
Title ZJY-VI-79-2
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
n-Bu
2p
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.7445
7.7399
7.7288
7.7239
7.3267
7.3195
7.3170
7.3032
7.2963
7.2758
7.2534
7.1643
7.1609
7.1519
7.1439
7.1396
7.0976
7.0842
7.0759
5.7706
5.7541
5.7285
5.6348
5.6230
5.6113
5.0728
5.0709
5.0557
5.0534
5.0294
4.0521
4.0369
2.7759
2.7545
2.7330
2.4264
2.3187
2.3025
0.0000
Title ZJY-VI-81
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
2q
2.00
3.00
3.00
1.00
1.00
2.00
2.00
2.00
3.00
2.00
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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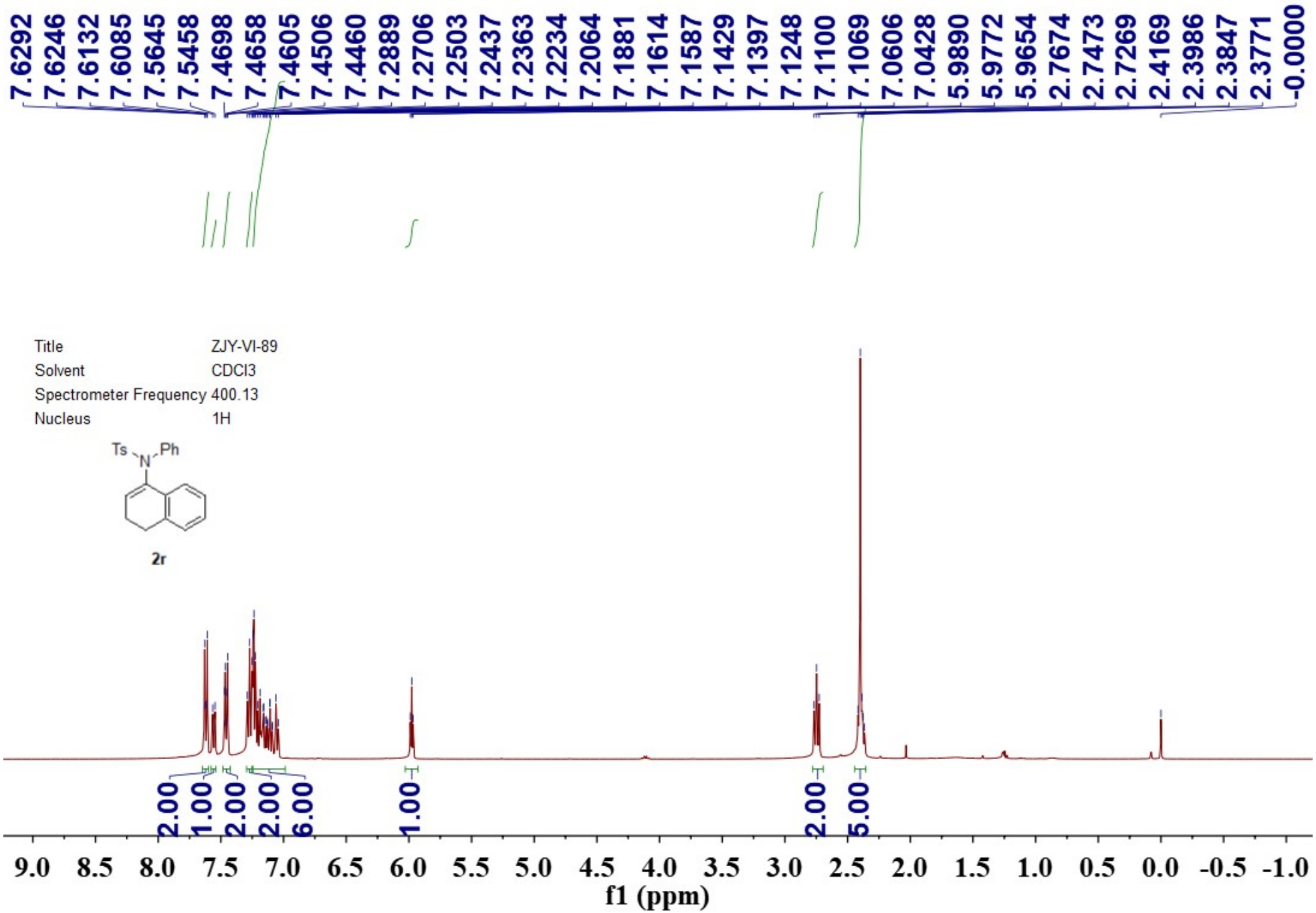
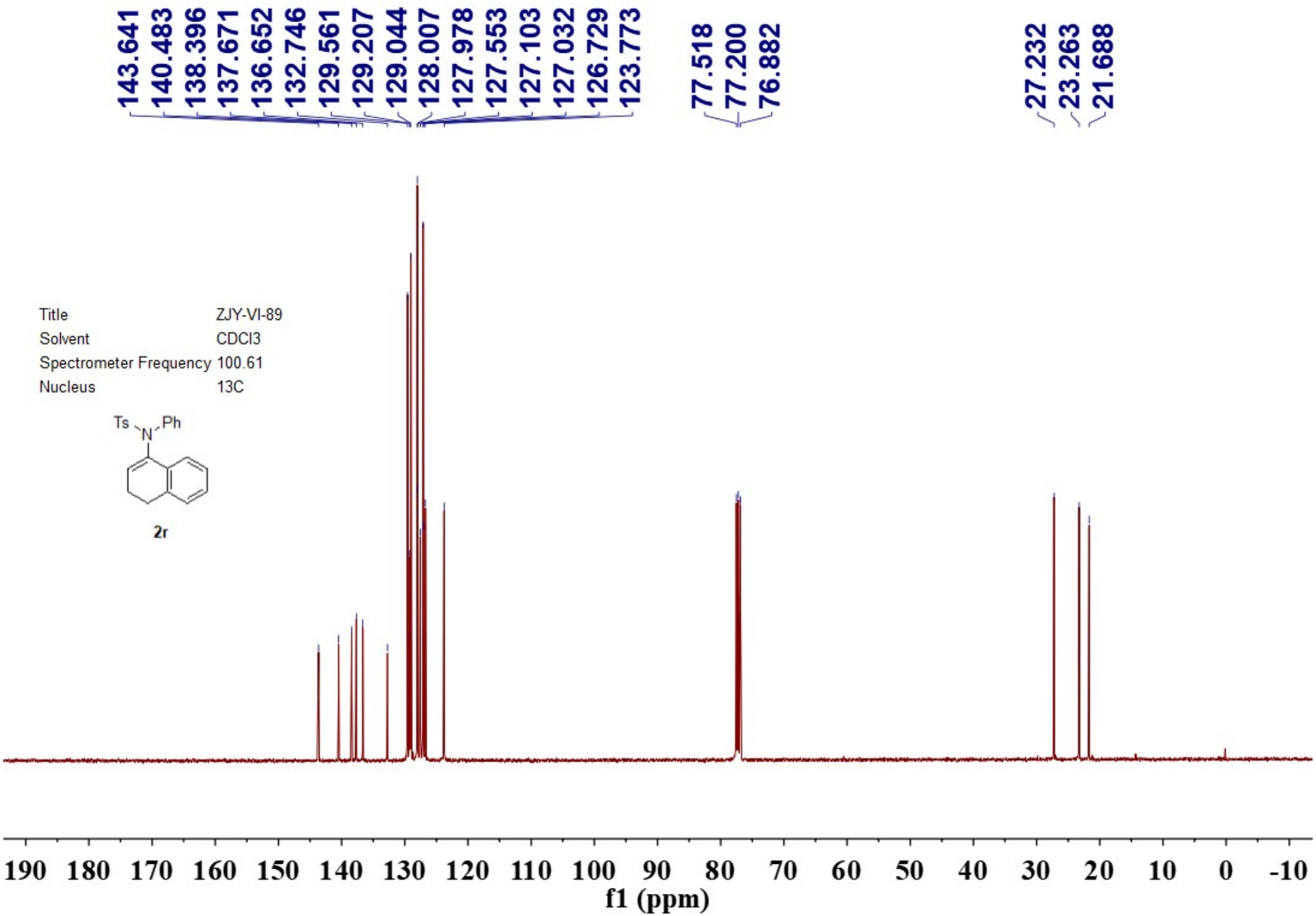
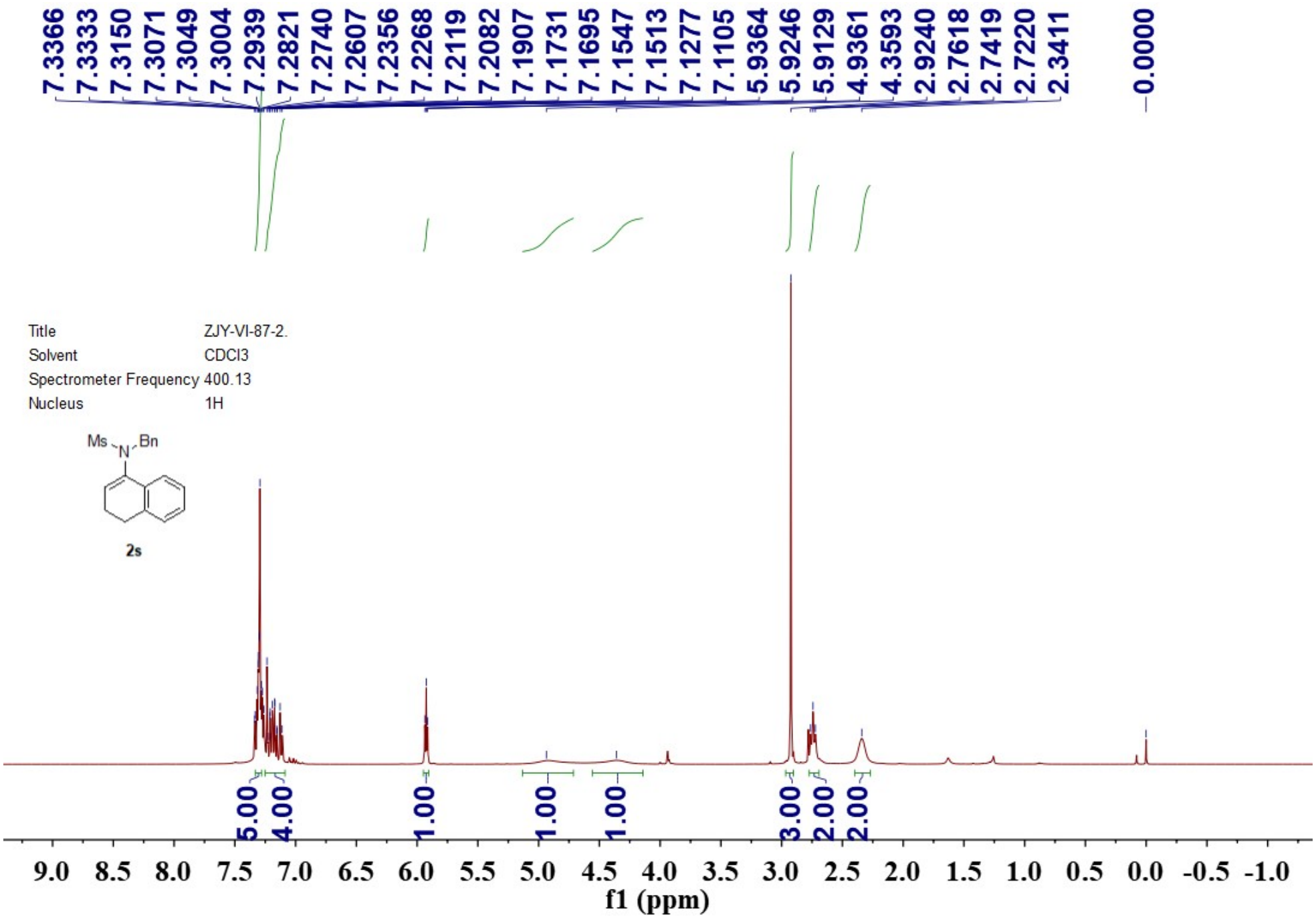
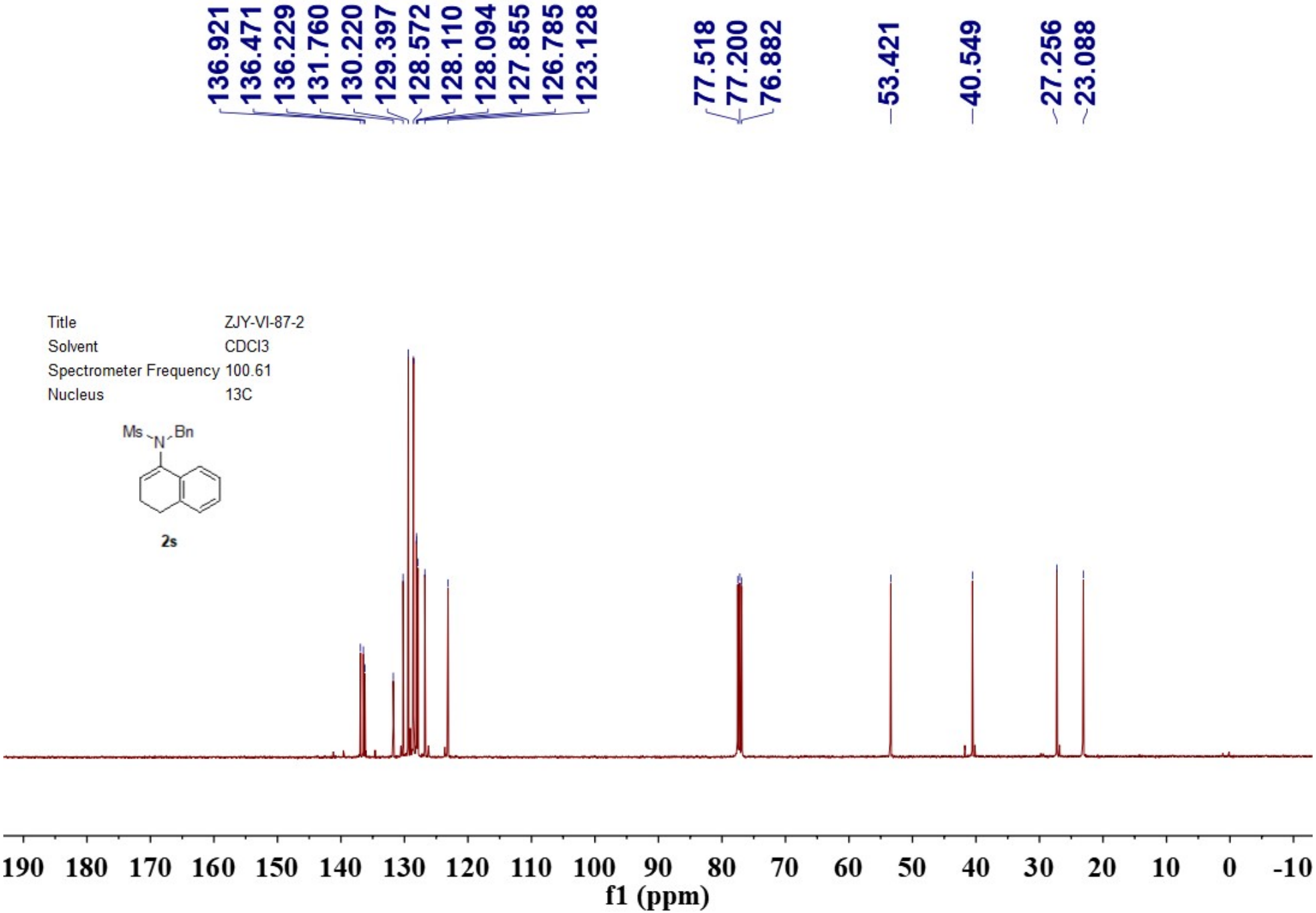
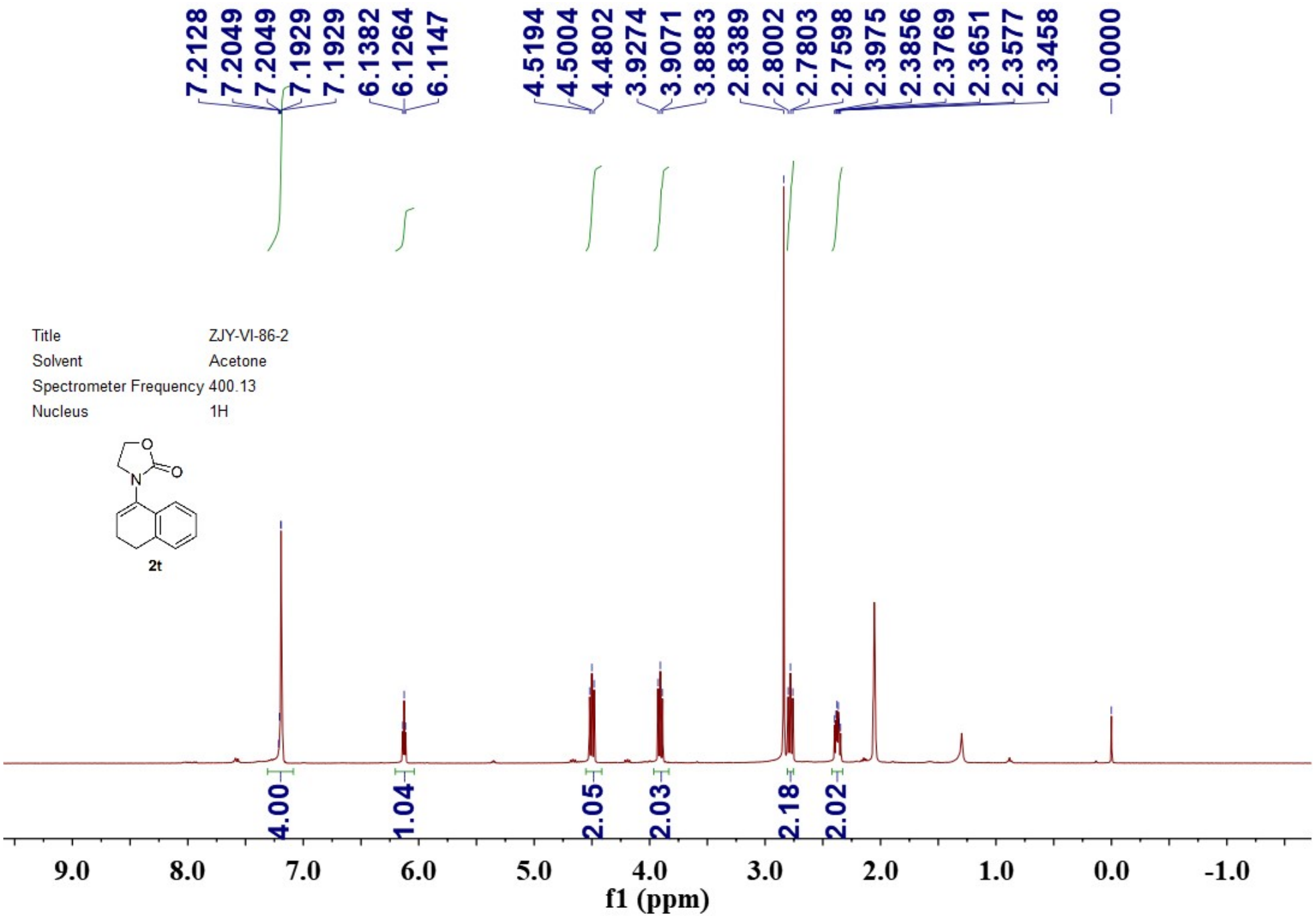
136.417
136.398
132.953
129.550
129.296
127.995
127.850
127.497
126.607
123.555
119.104
77.517
77.200
76.882
53.338
27.394
23.111
21.695
Title ZJY-VI-81
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
2q
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

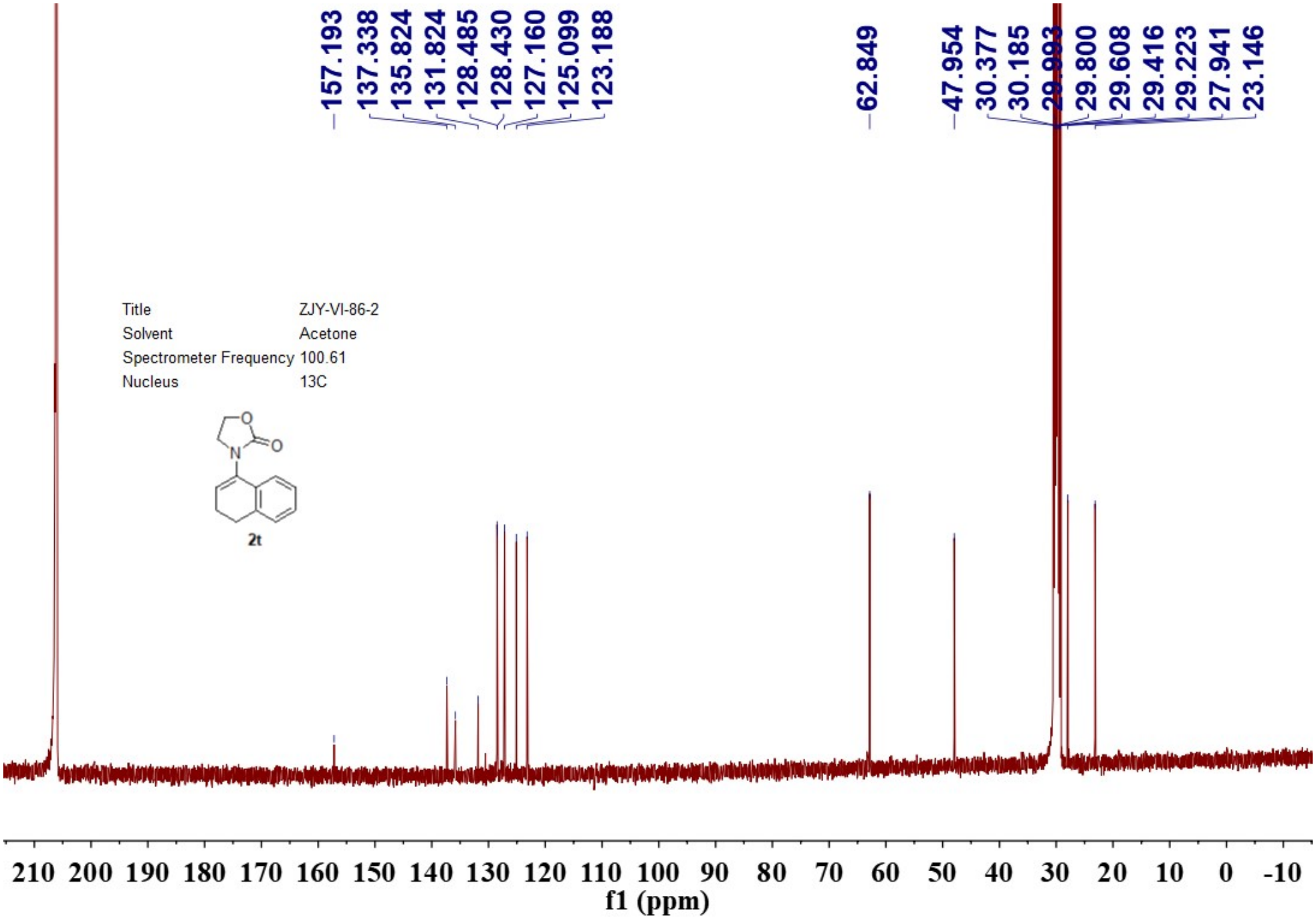

7.6292
7.6246
7.6132
7.6085
7.5645
7.5458
7.4698
7.4658
7.4605
7.4506
7.4460
7.2889
7.2706
7.2503
7.2437
7.2363
7.2234
7.2064
7.1881
7.1614
7.1587
7.1429
7.1397
7.1248
7.1100
7.1069
7.0606
7.0428
5.9890
5.9772
5.9654
2.7674
2.7473
2.7269
2.4169
2.3986
2.3847
2.3771
-0.0000
Title ZJY-VI-89
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Ph
2r
2.00
1.00
2.00
2.00
6.00
1.00
2.00
5.00
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)

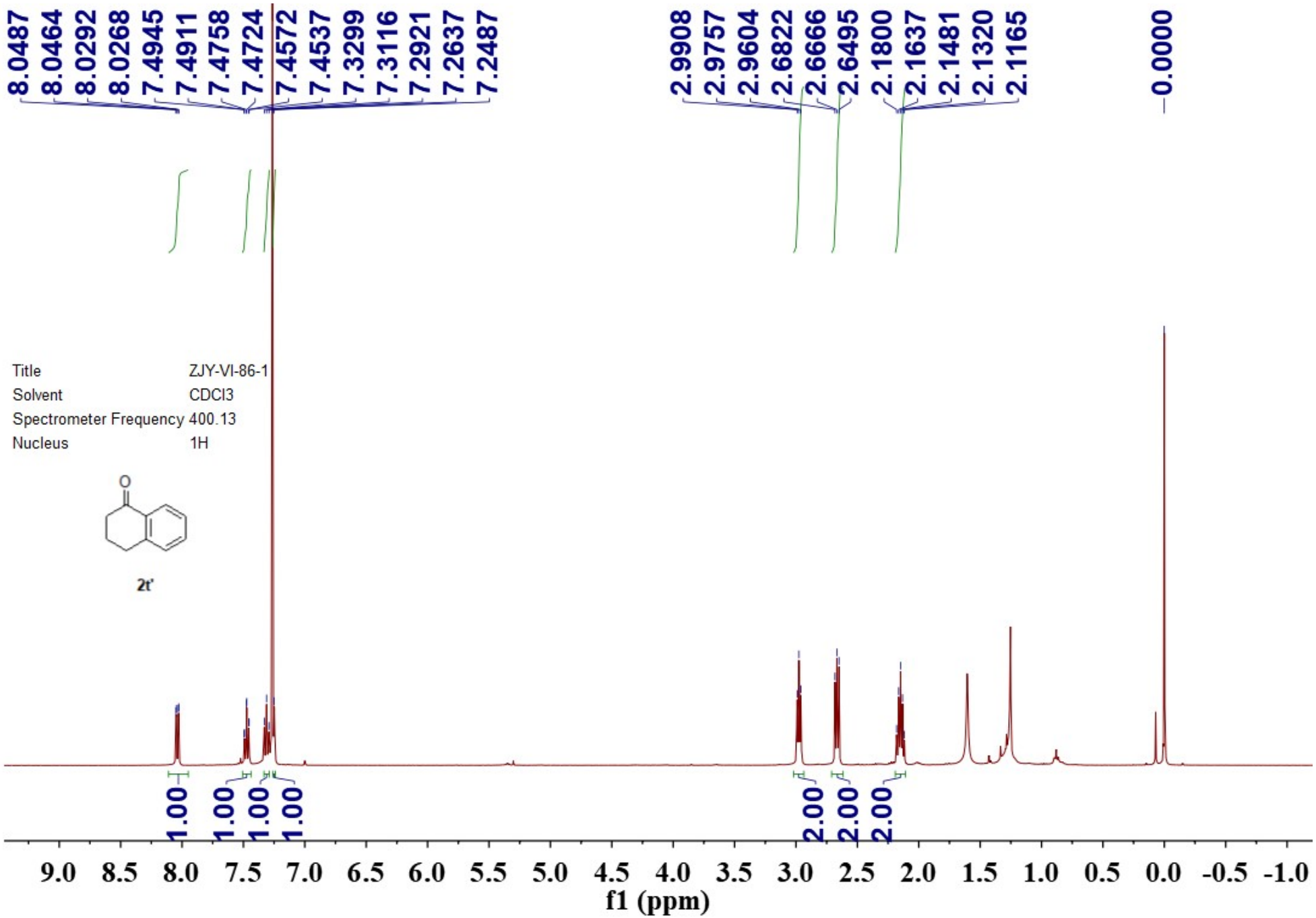

143.641
140.483
138.396
137.671
136.652
132.746
129.561
129.207
129.044
128.007
127.978
127.553
127.103
127.032
126.729
123.773
77.518
77.200
76.882
27.232
23.263
21.688
Title ZJY-VI-89
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Ph
2r
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

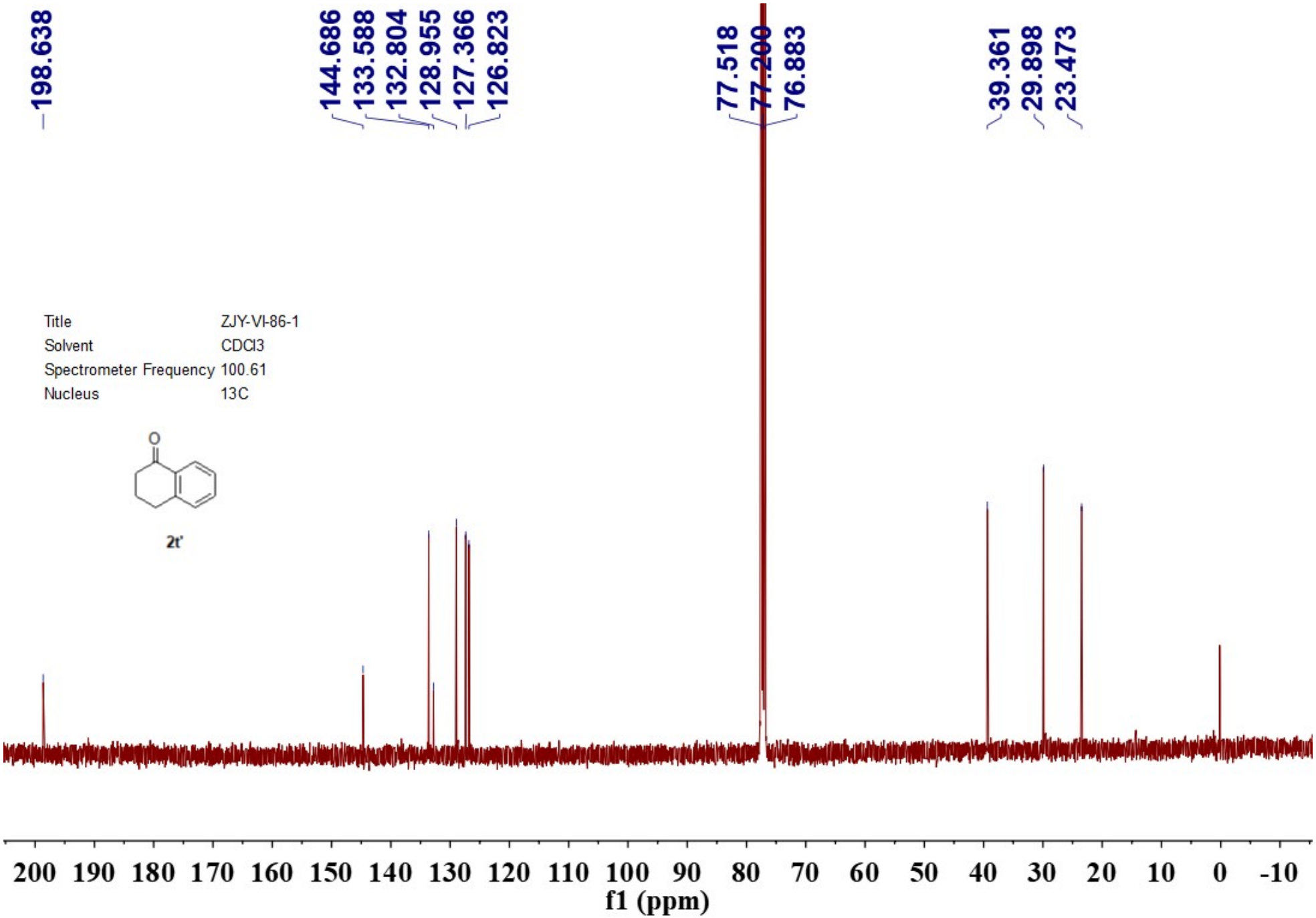

7.3366
7.3333
7.3150
7.3071
7.3049
7.3004
7.2939
7.2821
7.2740
7.2607
7.2356
7.2268
7.2119
7.2082
7.1907
7.1731
7.1695
7.1547
7.1513
7.1277
7.1105
5.9364
5.9246
5.9129
4.9361
4.3593
2.9240
2.7618
2.7419
2.7220
2.3411
0.0000
Title ZJY-VI-87-2.
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ms
N
Bn
2s
5.00
4.00
1.00
1.00
1.00
3.00
2.00
2.00
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)

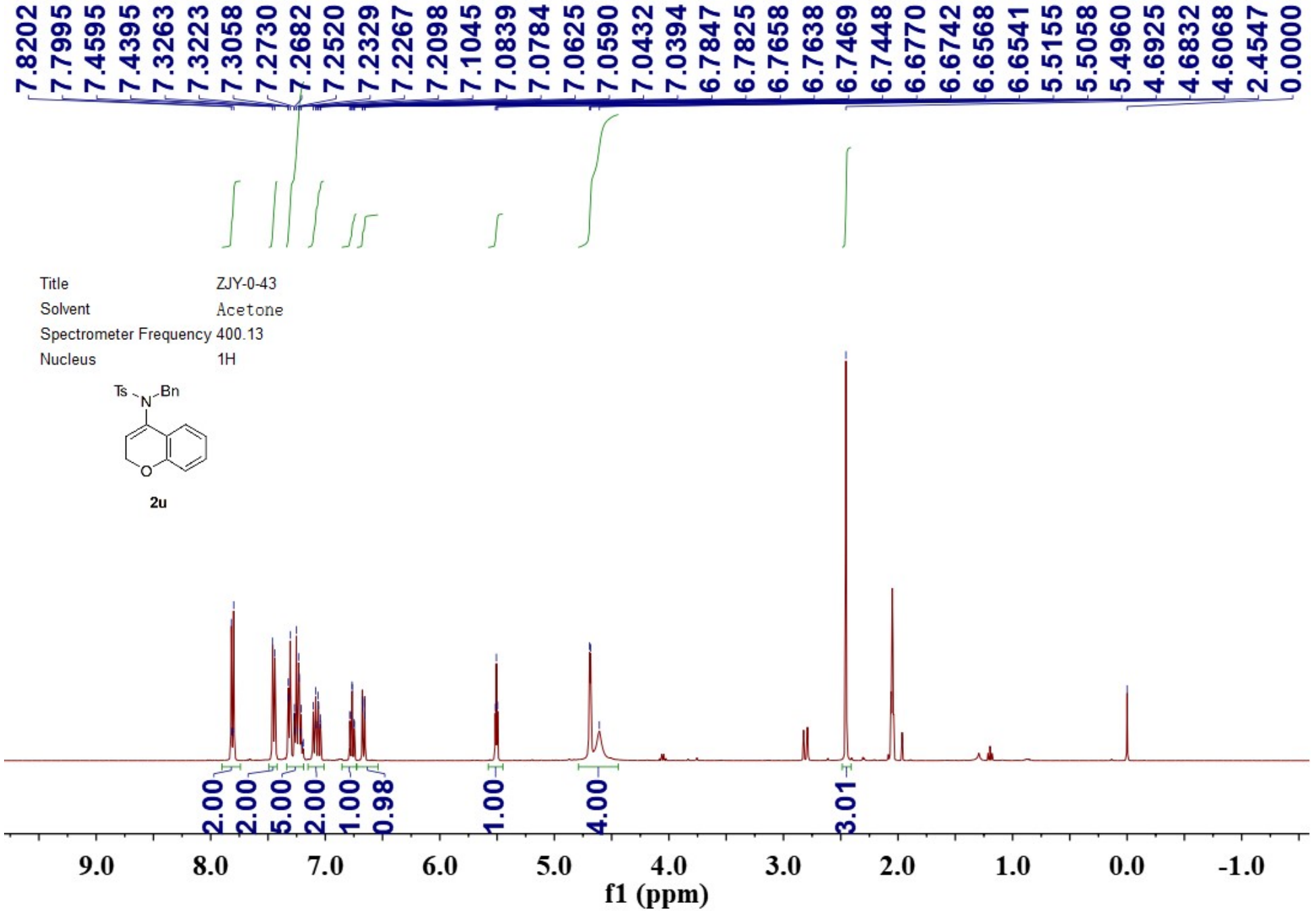

136.921
136.471
136.229
131.760
130.220
129.397
128.572
128.110
128.094
127.855
126.785
123.128
77.518
77.200
76.882
53.421
40.549
27.256
23.088
Title ZJY-VI-87-2
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
Ms
N
Bn
2s
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

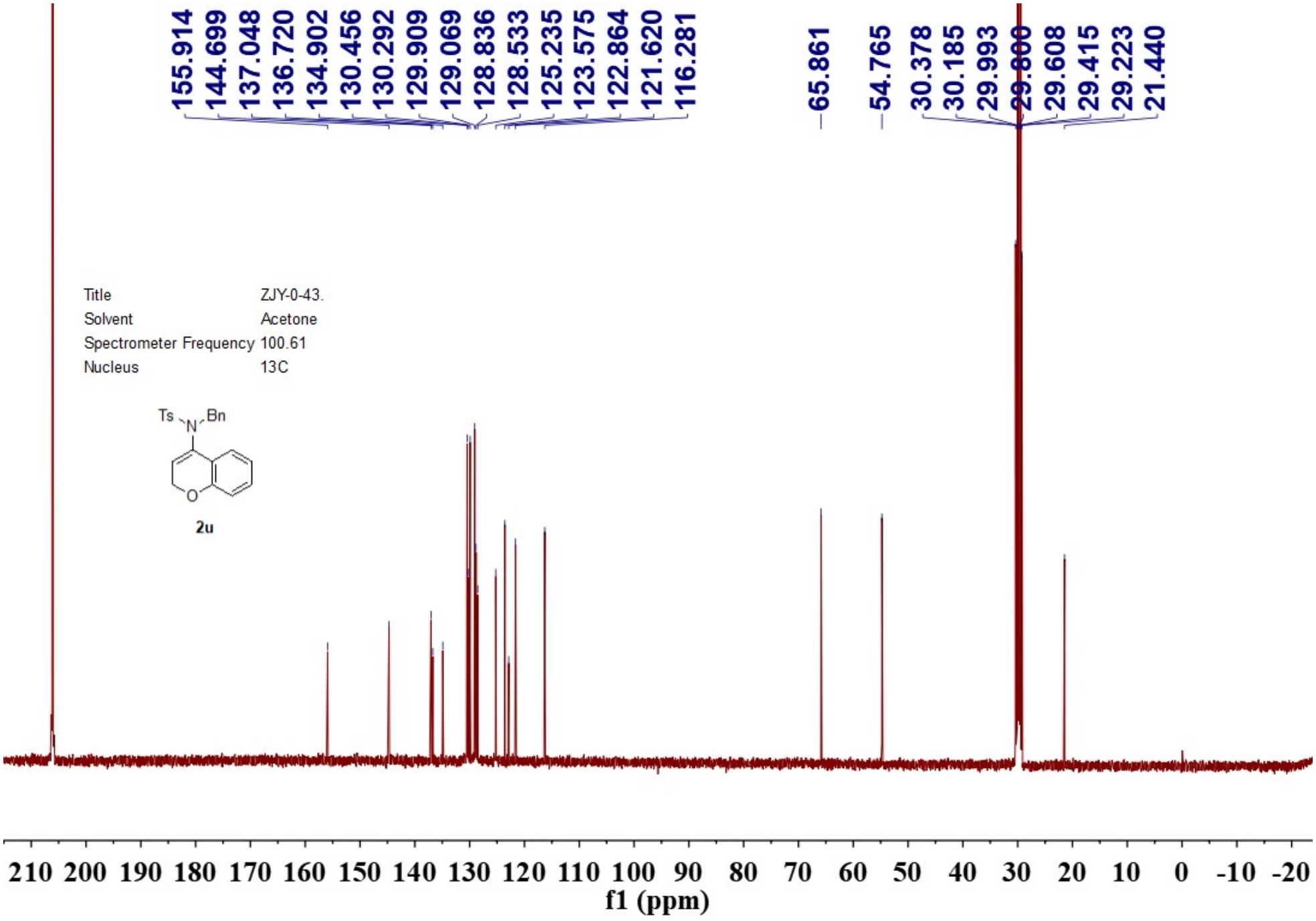

7.2128
7.2049
7.2049
7.1929
7.1929
6.1382
6.1264
6.1147
4.5194
4.5004
4.4802
3.9274
3.9071
3.8883
2.8389
2.8002
2.7803
2.7598
2.3975
2.3856
2.3769
2.3651
2.3577
2.3458
0.0000
Title ZJY-VI-86-2
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
2t
4.00
1.04
2.05
2.03
2.18
2.02
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

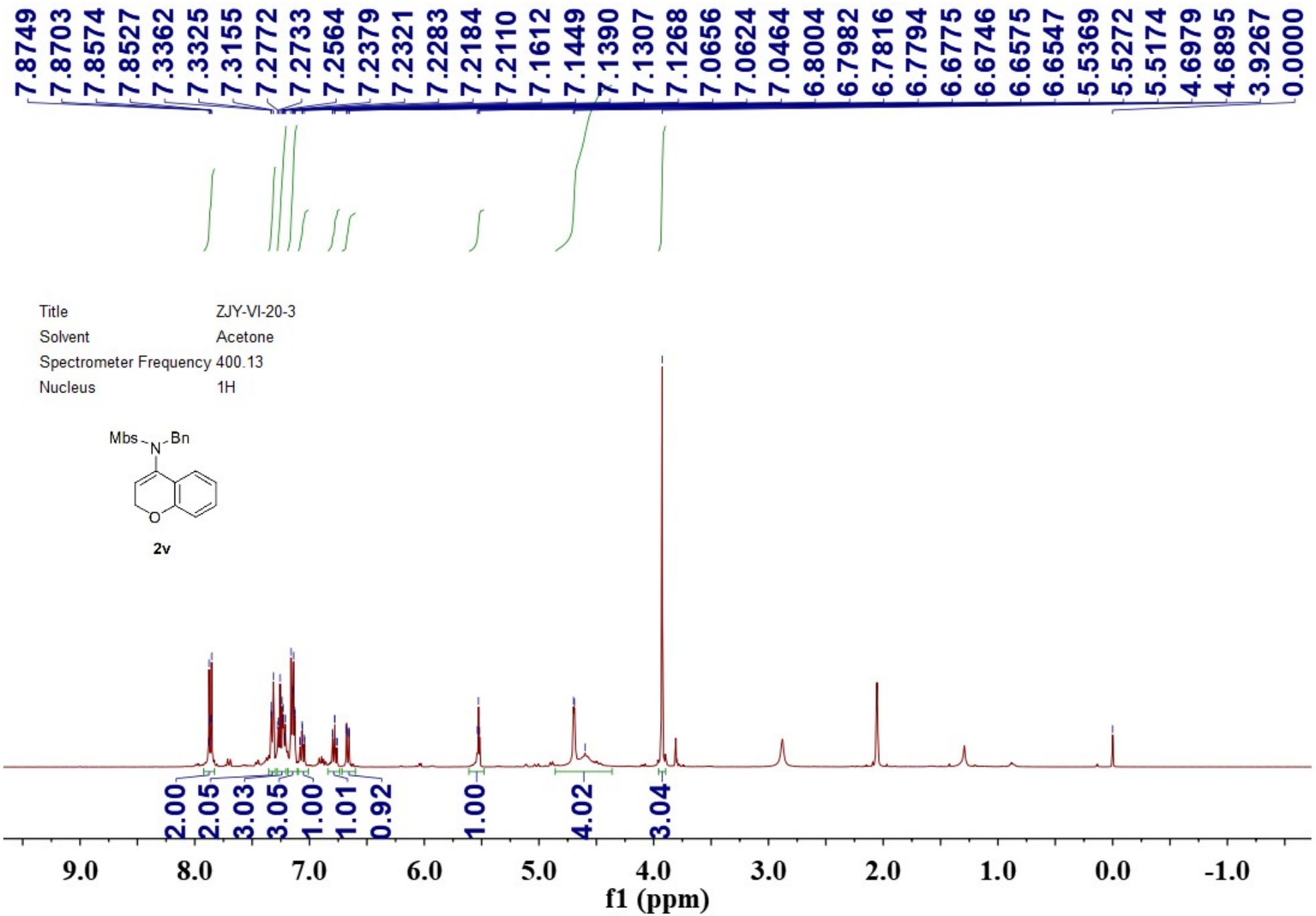

157.193
137.338
135.824
131.824
128.485
128.430
127.160
125.099
123.188
62.849
47.954
30.377
30.185
29.993
29.800
29.608
29.416
29.223
27.941
23.146
Title ZJY-VI-86-2
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
2t
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

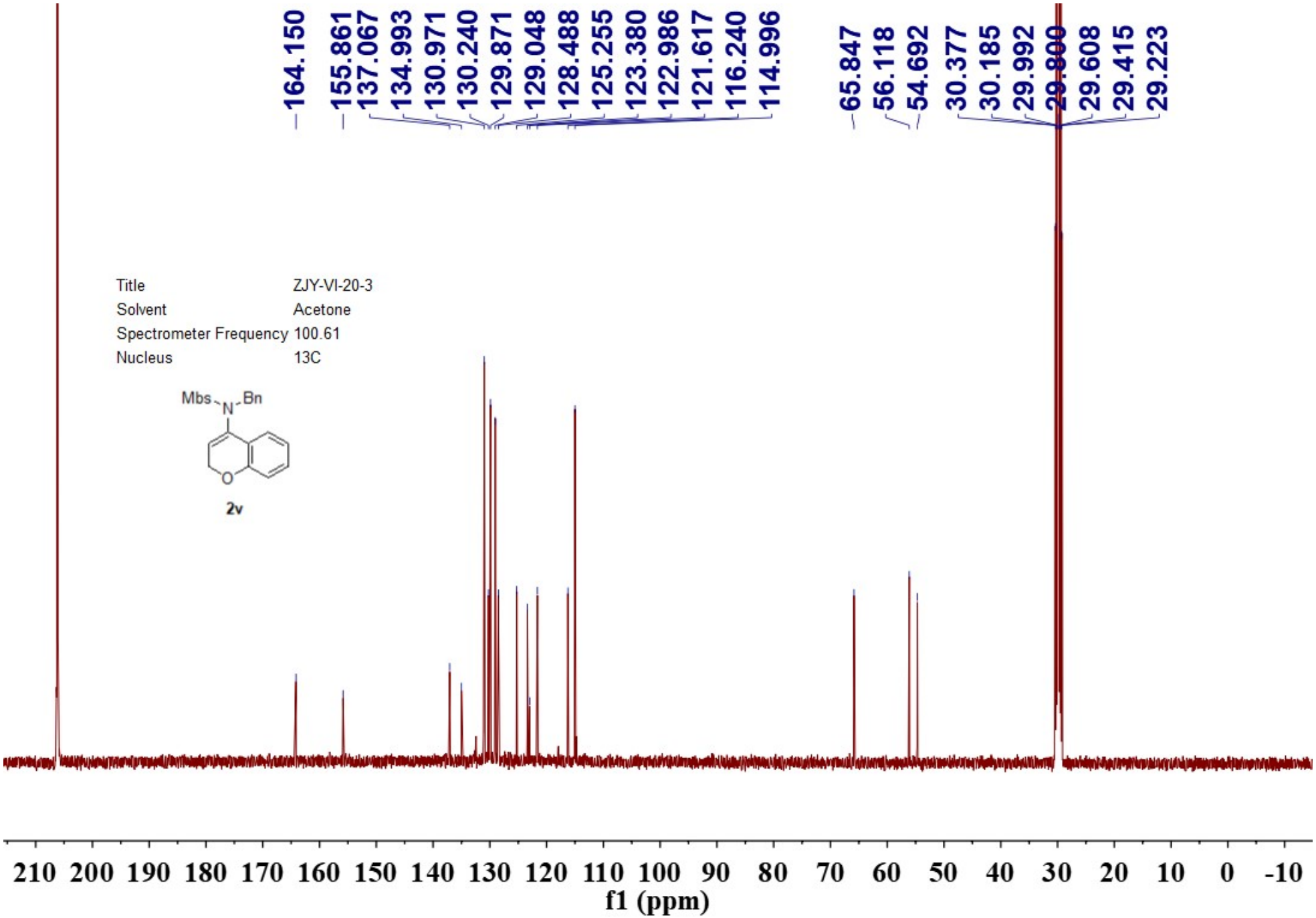

8.0487
8.0464
8.0292
8.0268
7.4945
7.4911
7.4758
7.4724
7.4572
7.4537
7.3299
7.3116
7.2921
7.2637
7.2487
2.9908
2.9757
2.9604
2.6822
2.6666
2.6495
2.1800
2.1637
2.1481
2.1320
2.1165
0.0000
Title ZJY-VI-86-1
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
O
2t'
1.00
1.00
1.00
1.00
2.00
2.00
2.00
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)

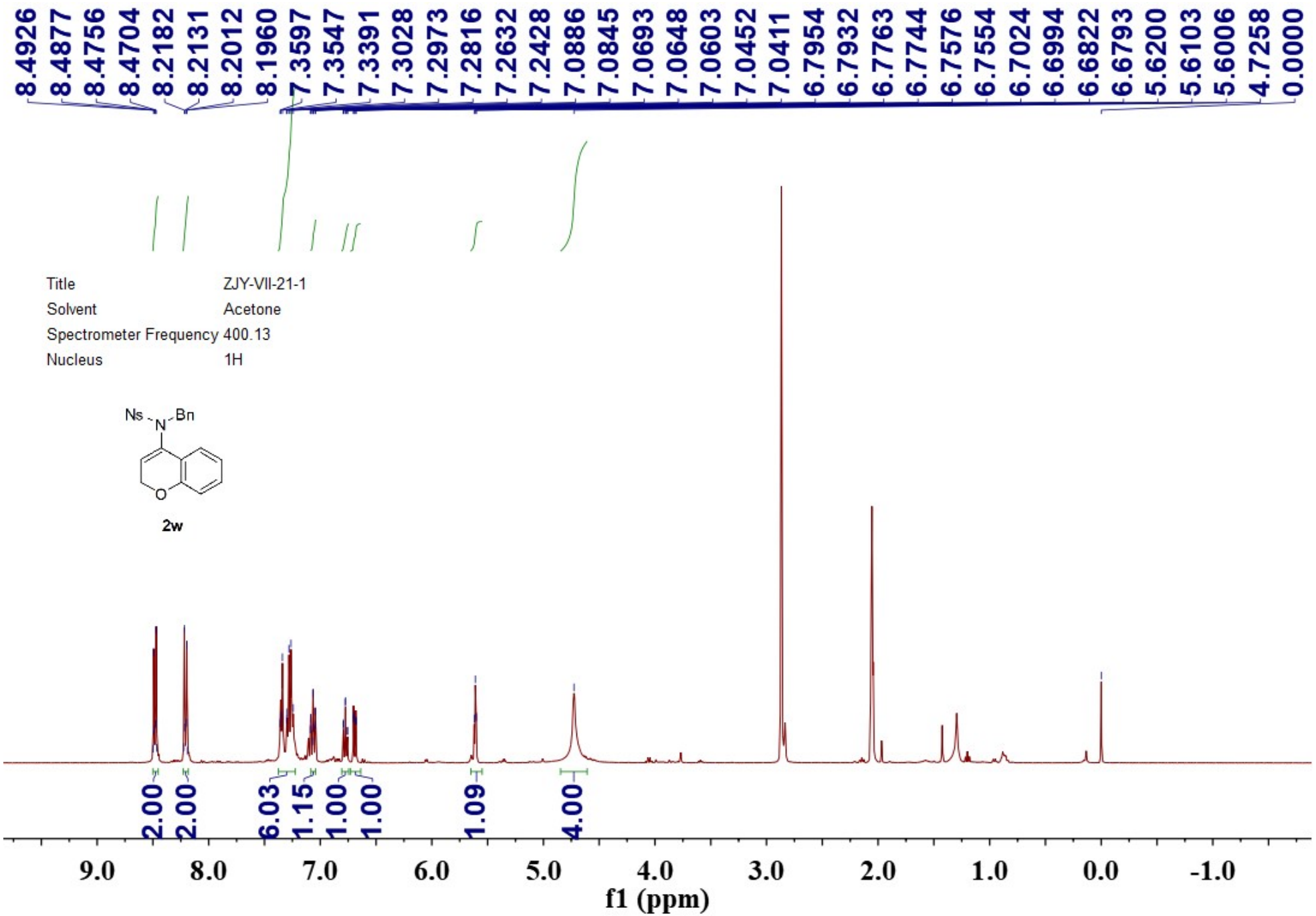

198.638
144.686
133.588
132.804
128.955
127.366
126.823
77.518
77.200
76.883
39.361
29.898
23.473
Title ZJY-VI-86-1
Solvent CDCl3
Spectrometer Frequency 100.61
Nucleus 13C
O
2t'
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

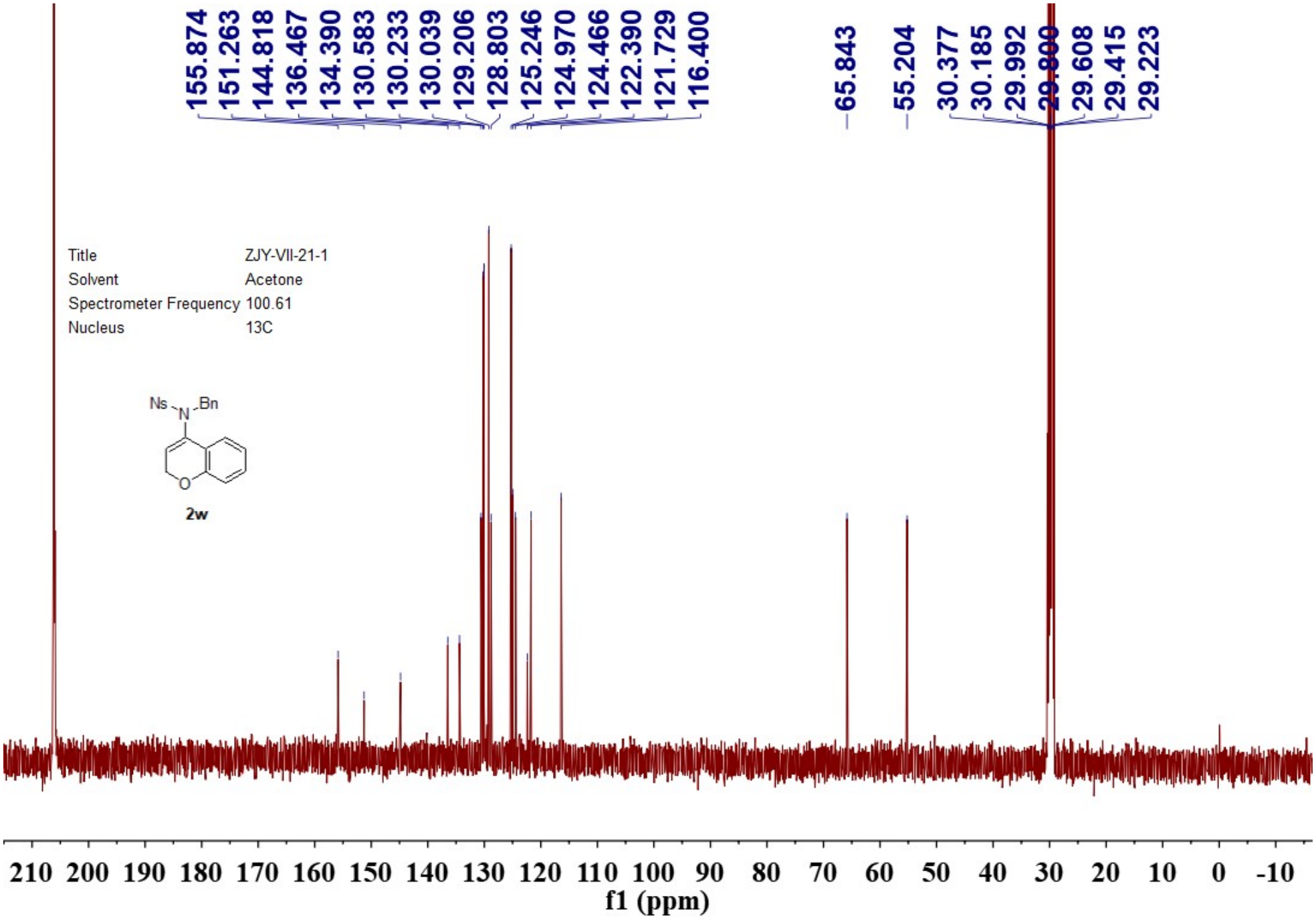

7.8202
7.7995
7.4595
7.4395
7.3263
7.3223
7.3058
7.2730
7.2682
7.2520
7.2329
7.2267
7.2098
7.1045
7.0839
7.0784
7.0625
7.0590
7.0432
7.0394
6.7847
6.7825
6.7658
6.7638
6.7469
6.7448
6.6770
6.6742
6.6568
6.6541
5.5155
5.5058
5.4960
4.6925
4.6832
4.6068
2.4547
0.0000
Title ZJY-0-43
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ts
N
Bn
O
2u
2.00
2.00
5.00
2.00
1.00
0.98
1.00
4.00
3.01
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

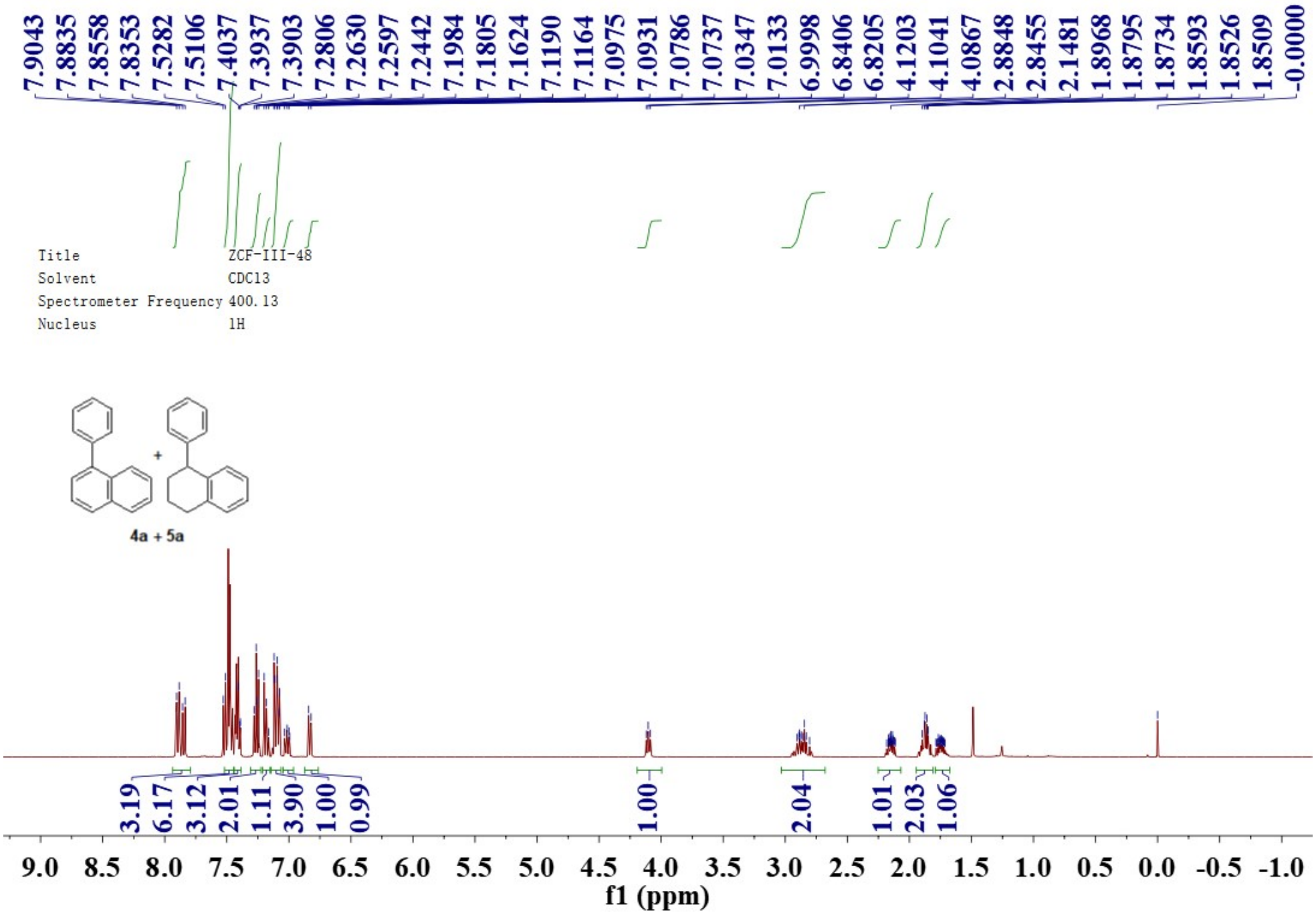

155.914
144.699
137.048
136.720
134.902
130.456
130.292
129.909
129.069
128.836
128.533
125.235
123.575
122.864
121.620
116.281
65.861
54.765
30.378
30.185
29.993
29.800
29.608
29.415
29.223
21.440
Title ZJY-0-43.
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ts
N
Bn
O
2u
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)


7.8749
7.8703
7.8574
7.8527
7.3362
7.3325
7.3155
7.2772
7.2733
7.2564
7.2379
7.2321
7.2283
7.2184
7.2110
7.1612
7.1449
7.1390
7.1307
7.1268
7.0656
7.0624
7.0464
6.8004
6.7982
6.7816
6.7794
6.6775
6.6746
6.6575
6.6547
5.5369
5.5272
5.5174
4.6979
4.6895
3.9267
0.0000
Title ZJY-VI-20-3
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Mbs
N
Bn
O
2v
2.00
2.05
3.03
3.05
1.00
1.01
0.92
1.00
4.02
3.04
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


164.150
155.861
137.067
134.993
130.971
130.240
129.871
129.048
128.488
125.255
123.380
122.986
121.617
116.240
114.996
65.847
56.118
54.692
30.377
30.185
29.992
29.800
29.608
29.415
29.223
Title ZJY-VI-20-3
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Mbs
N
Bn
O
2v
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

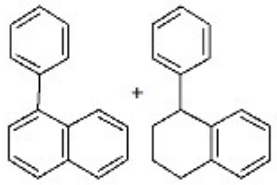

8.4926
8.4877
8.4756
8.4704
8.2182
8.2131
8.2012
8.1960
7.3597
7.3547
7.3391
7.3028
7.2973
7.2816
7.2632
7.2428
7.0886
7.0845
7.0693
7.0648
7.0603
7.0452
7.0411
6.7954
6.7932
6.7763
6.7744
6.7576
6.7554
6.7024
6.6994
6.6822
6.6793
5.6200
5.6103
5.6006
4.7258
0.0000
Title ZJY-VII-21-1
Solvent Acetone
Spectrometer Frequency 400.13
Nucleus 1H
Ns
N
Bn
O
2w
2.00
2.00
6.03
1.15
1.00
1.00
1.09
4.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


155.874
151.263
144.818
136.467
134.390
130.583
130.233
130.039
129.206
128.803
125.246
124.970
124.466
122.390
121.729
116.400
65.843
55.204
30.377
30.185
29.992
29.800
29.608
29.415
29.223
Title ZJY-VII-21-1
Solvent Acetone
Spectrometer Frequency 100.61
Nucleus 13C
Ns
N
Bn
O
2w
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

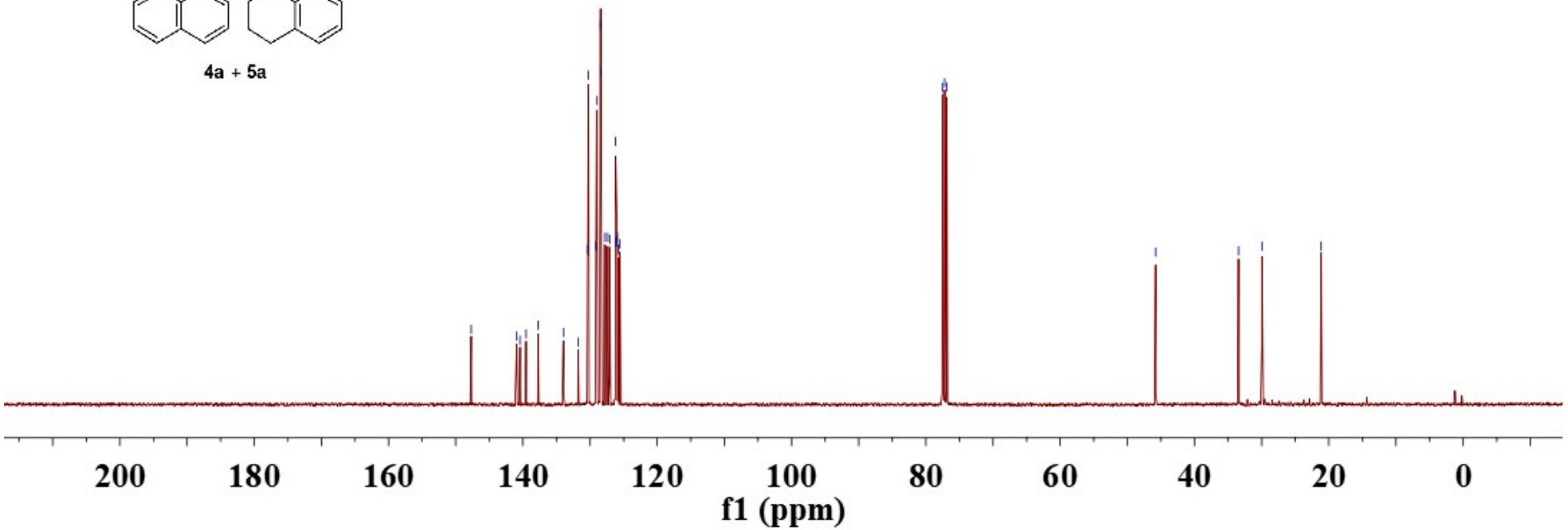

7.9043
7.8835
7.8558
7.8353
7.5282
7.5106
7.4037
7.3937
7.3903
7.2806
7.2630
7.2597
7.2442
7.1984
7.1805
7.1624
7.1190
7.1164
7.0975
7.0931
7.0786
7.0737
7.0347
7.0133
6.9998
6.8406
6.8205
4.1203
4.1041
4.0867
2.8848
2.8455
2.1481
1.8968
1.8795
1.8734
1.8593
1.8526
1.8509
-0.0000
Title ZCF-III-48
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
4a + 5a
3.19
6.17
3.12
2.01
1.11
3.90
1.00
0.99
1.00
2.04
1.01
2.03
1.06
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)

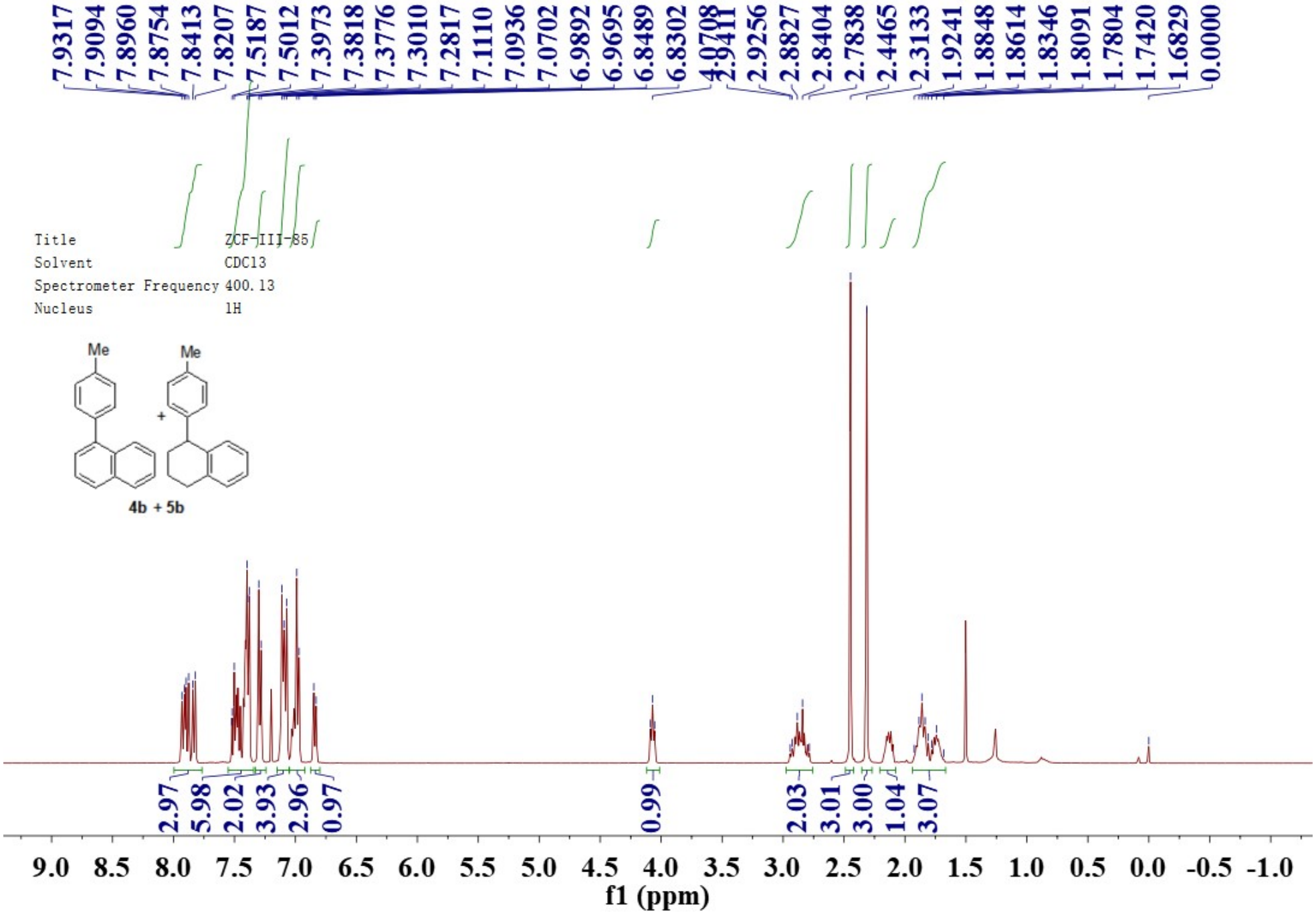
147.6827
140.9139
140.4141
139.5388
137.7459
133.9478
131.7710
130.3499
130.2397
129.1249
129.0149
128.4211
128.3858
127.7941
127.3962
127.0904
126.1864
126.0995
126.0600
125.9277
125.8013
125.5447
77.5179
77.2000
76.8827
45.7871
33.4350
29.9570
21.1366

Title ZCF-III-48
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C



4a + 5a

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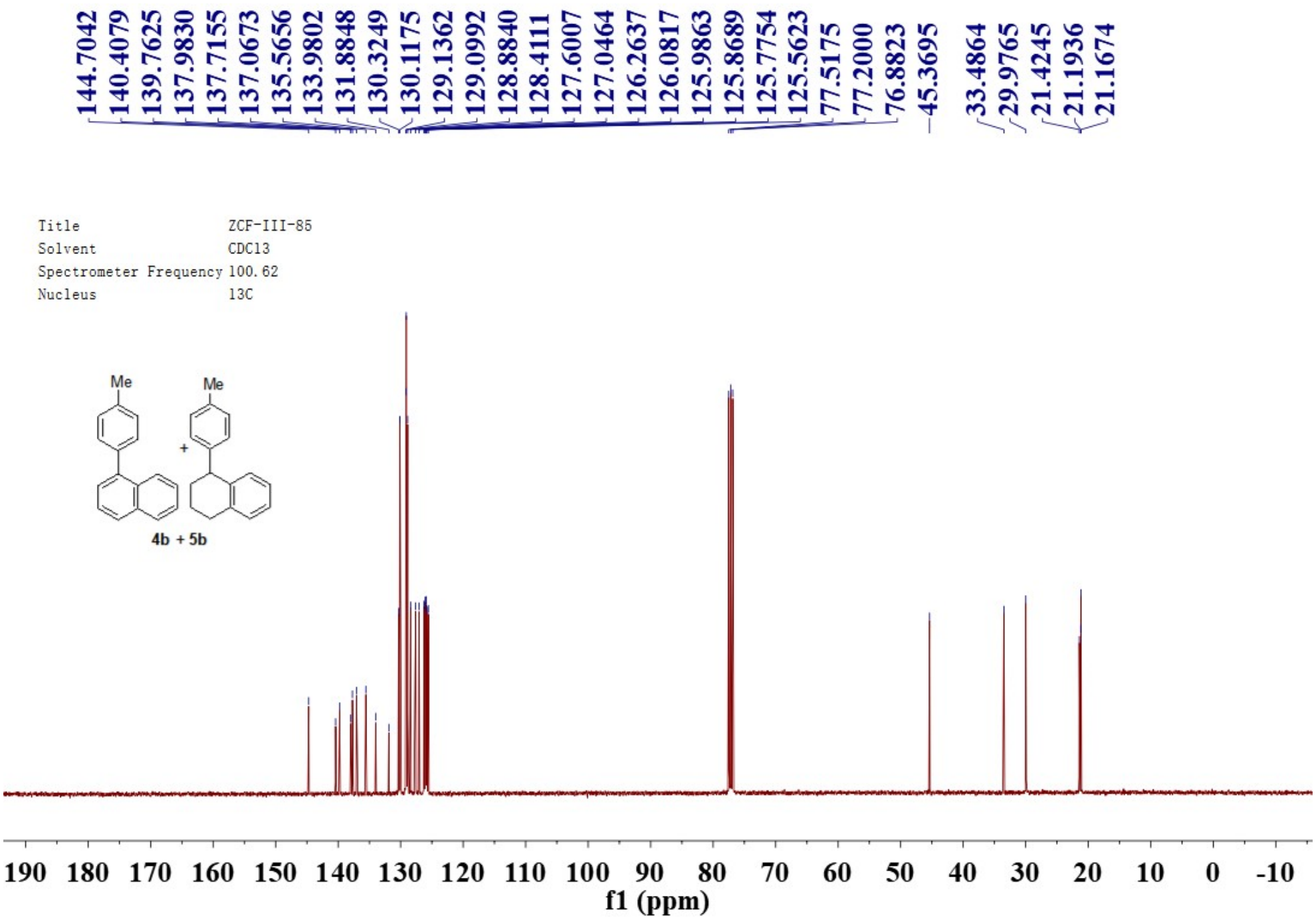
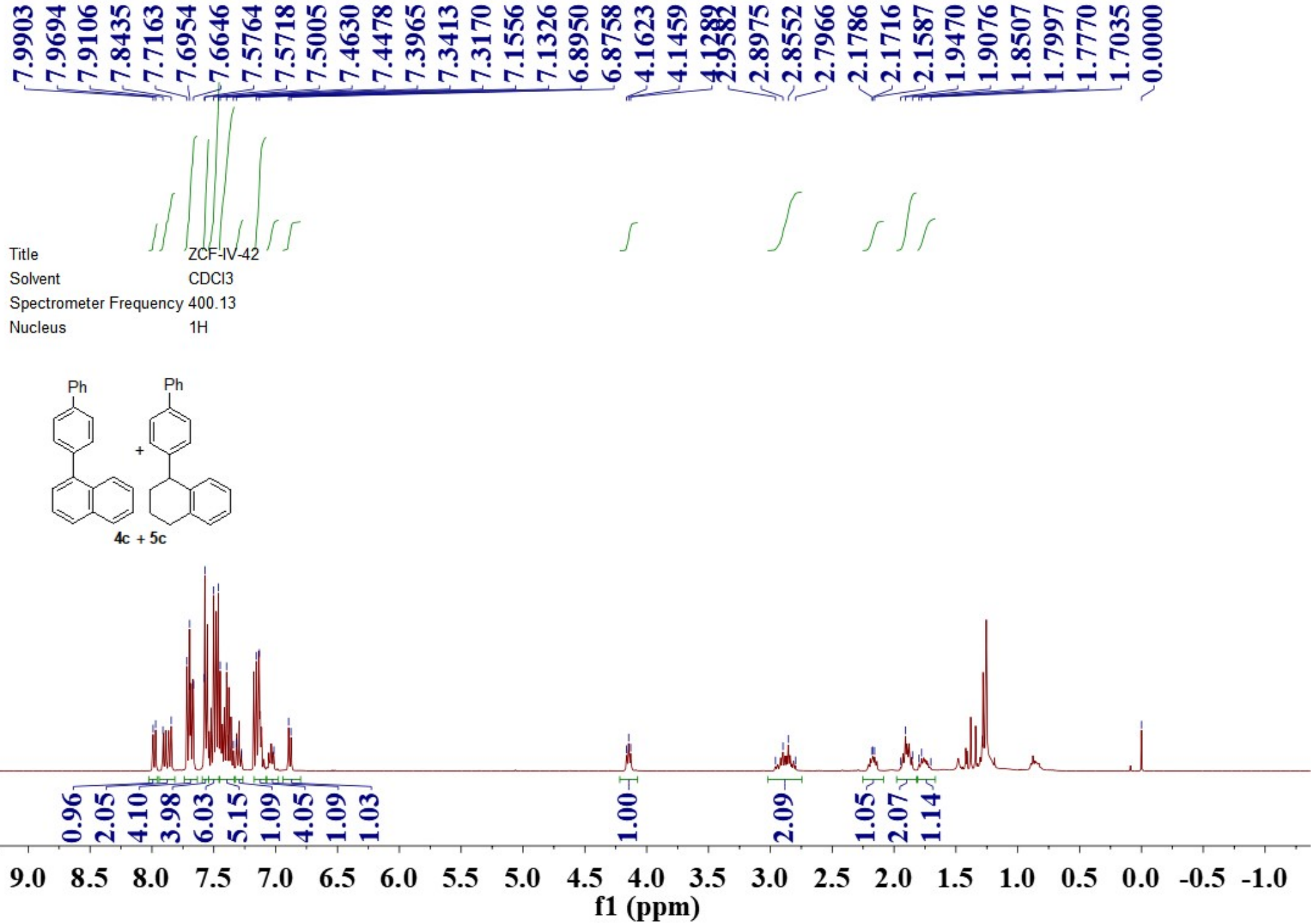
7.9094
7.8960
7.8754
7.8413
7.8207
7.5187
7.5012
7.3973
7.3818
7.3776
7.3010
7.2817
7.1110
7.0936
7.0702
6.9892
6.9695
6.8489
6.8302
4.0708
2.9411
2.9256
2.8827
2.8404
2.7838
2.4465
2.3133
1.9241
1.8848
1.8614
1.8346
1.8091
1.7804
1.7420
1.6829
0.0000
Title ZCF-III-85
Solvent CDC13
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
4b + 5b
2.97
5.98
2.02
3.93
2.96
0.97
0.99
2.03
3.01
3.00
1.04
3.07
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)


144.7042
140.4079
139.7625
137.9830
137.7155
137.0673
135.5656
133.9802
131.8848
130.3249
130.1175
129.1362
129.0992
128.8840
128.4111
127.6007
127.0464
126.2637
126.0817
125.9863
125.8689
125.7754
125.5623
77.5175
77.2000
76.8823
45.3695
33.4864
29.9765
21.4245
21.1936
21.1674
Title ZCF-III-85
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
+
4b + 5b
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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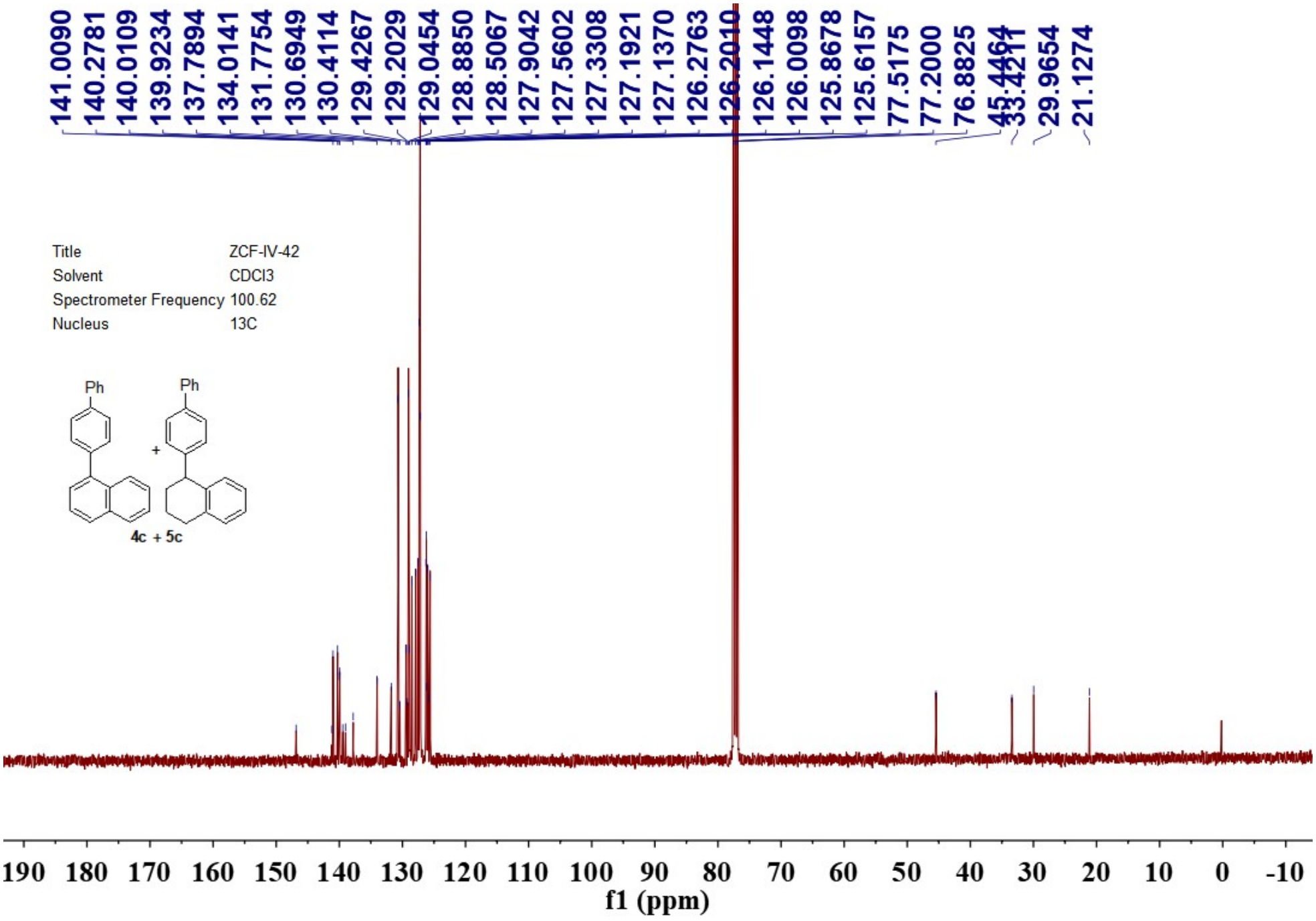
7.9694
7.9106
7.8435
7.7163
7.6954
7.6646
7.5764
7.5718
7.5005
7.4630
7.4478
7.3965
7.3413
7.3170
7.1556
7.1326
6.8950
6.8758
4.1623
4.1459
2.8975
2.8552
2.7966
2.1786
2.1716
2.1587
1.9470
1.9076
1.8507
1.7997
1.7770
1.7035
0.0000
Title ZCF-IV-42
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ph
Ph
+
4c + 5c
0.96
2.05
4.10
3.98
6.03
5.15
1.09
4.05
1.09
1.03
1.00
2.09
1.05
2.07
1.14
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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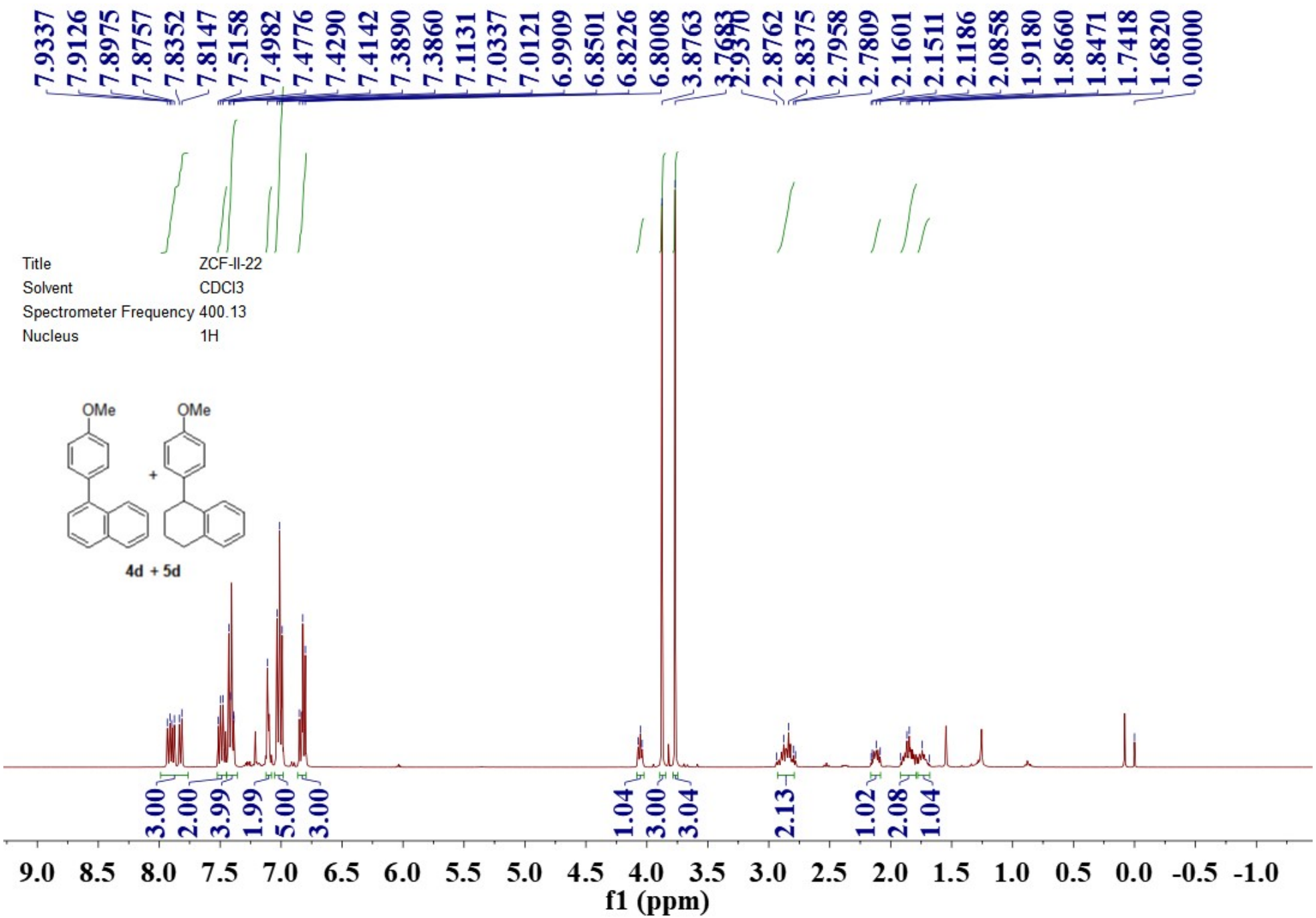
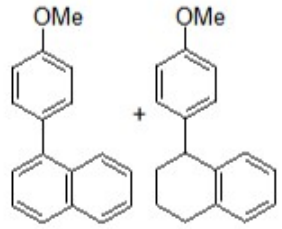
140.2781
140.0109
139.9234
137.7894
134.0141
131.7754
130.6949
130.4114
129.4267
129.2029
129.0454
128.8850
128.5067
127.9042
127.5602
127.3308
127.1921
127.1370
126.2763
126.2010
126.1448
126.0098
125.8678
125.6157
77.5175
77.2000
76.8825
45.4464
33.4211
29.9654
21.1274
Title ZCF-IV-42
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Ph
Ph
4c + 5c
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

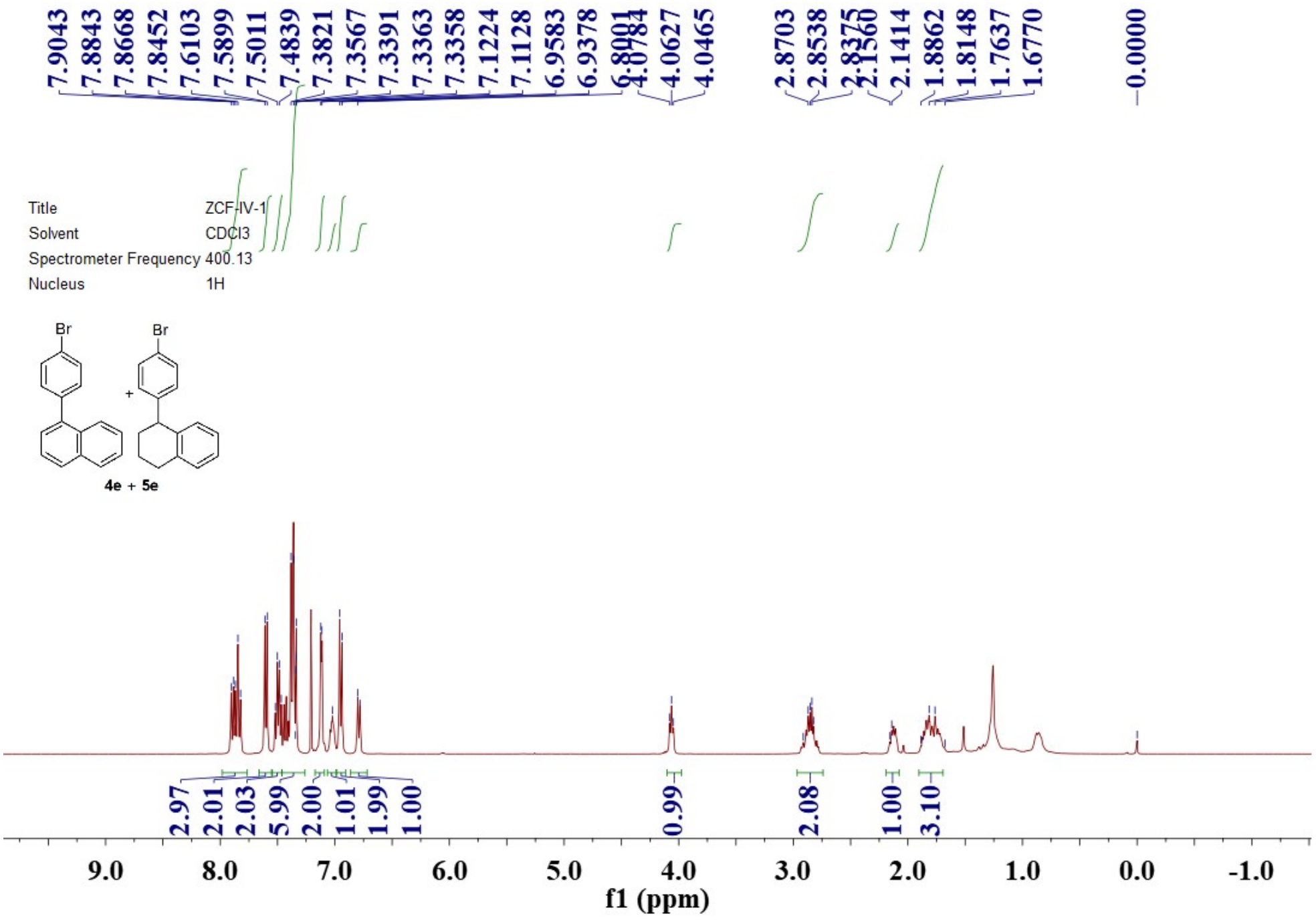

7.9337
7.9126
7.8975
7.8757
7.8352
7.8147
7.5158
7.4982
7.4776
7.4290
7.4142
7.3890
7.3860
7.1131
7.0337
7.0121
6.9909
6.8501
6.8226
6.8008
3.8763
3.7683
2.9370
2.8762
2.8375
2.7958
2.7809
2.1601
2.1511
2.1186
2.0858
1.9180
1.8660
1.8471
1.7418
1.6820
0.0000
Title ZCF-II-22
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
OMe
OMe
+
4d + 5d
3.00
2.00
3.99
1.99
5.00
3.00
1.04
3.00
3.04
2.13
1.02
2.08
1.04
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)

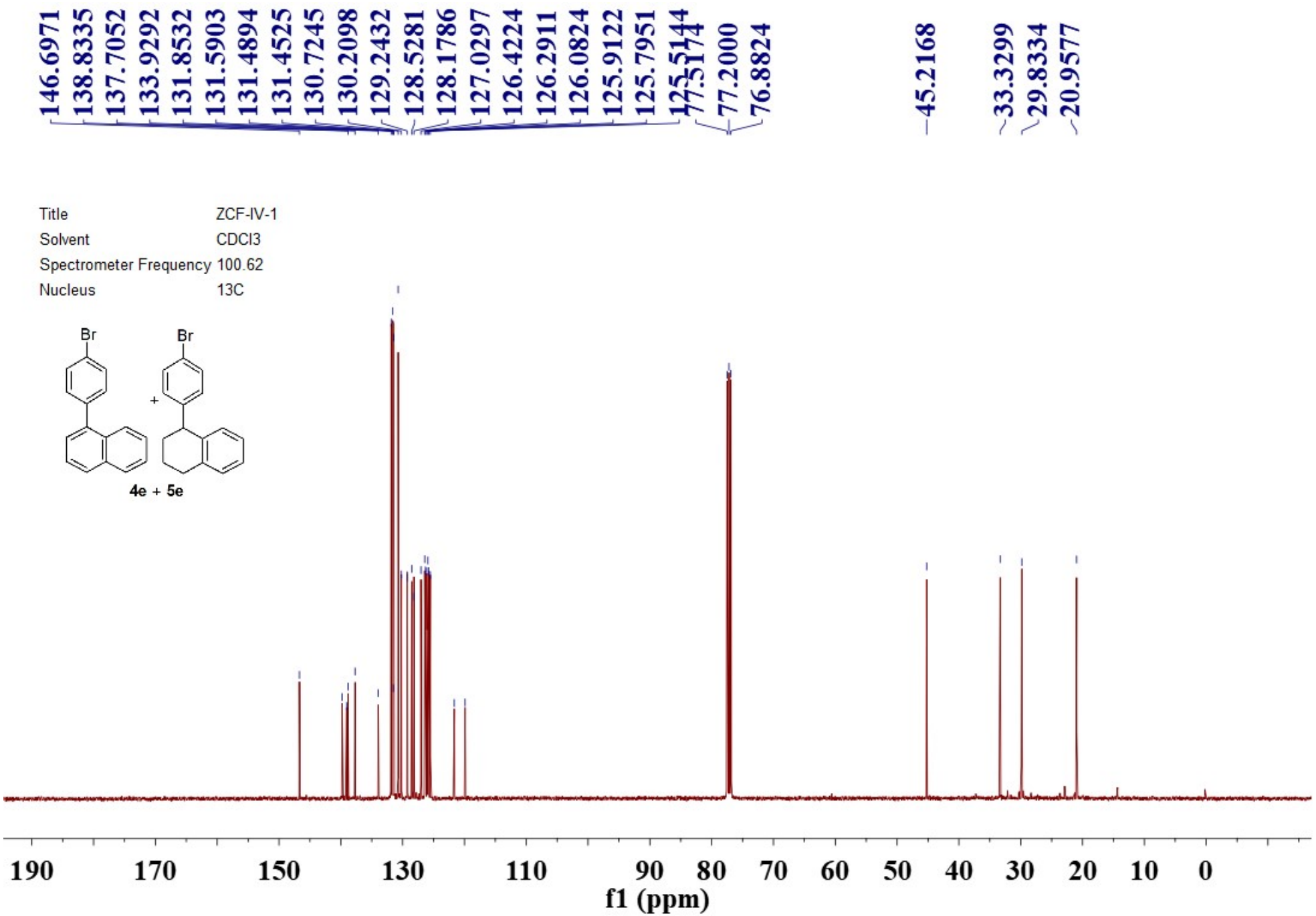
159.0744
157.9395
140.0488
139.8820
139.8121
137.6748
133.9845
133.2586
131.9668
131.2701
130.2783
129.8525
129.0916
128.4166
127.4884
127.0662
126.2186
126.0800
125.9779
125.8605
125.7586
125.5662
113.8607
113.7442
77.5171
77.2000
76.8819
55.5075
55.3700
44.8995
33.4965
29.9417
21.1171

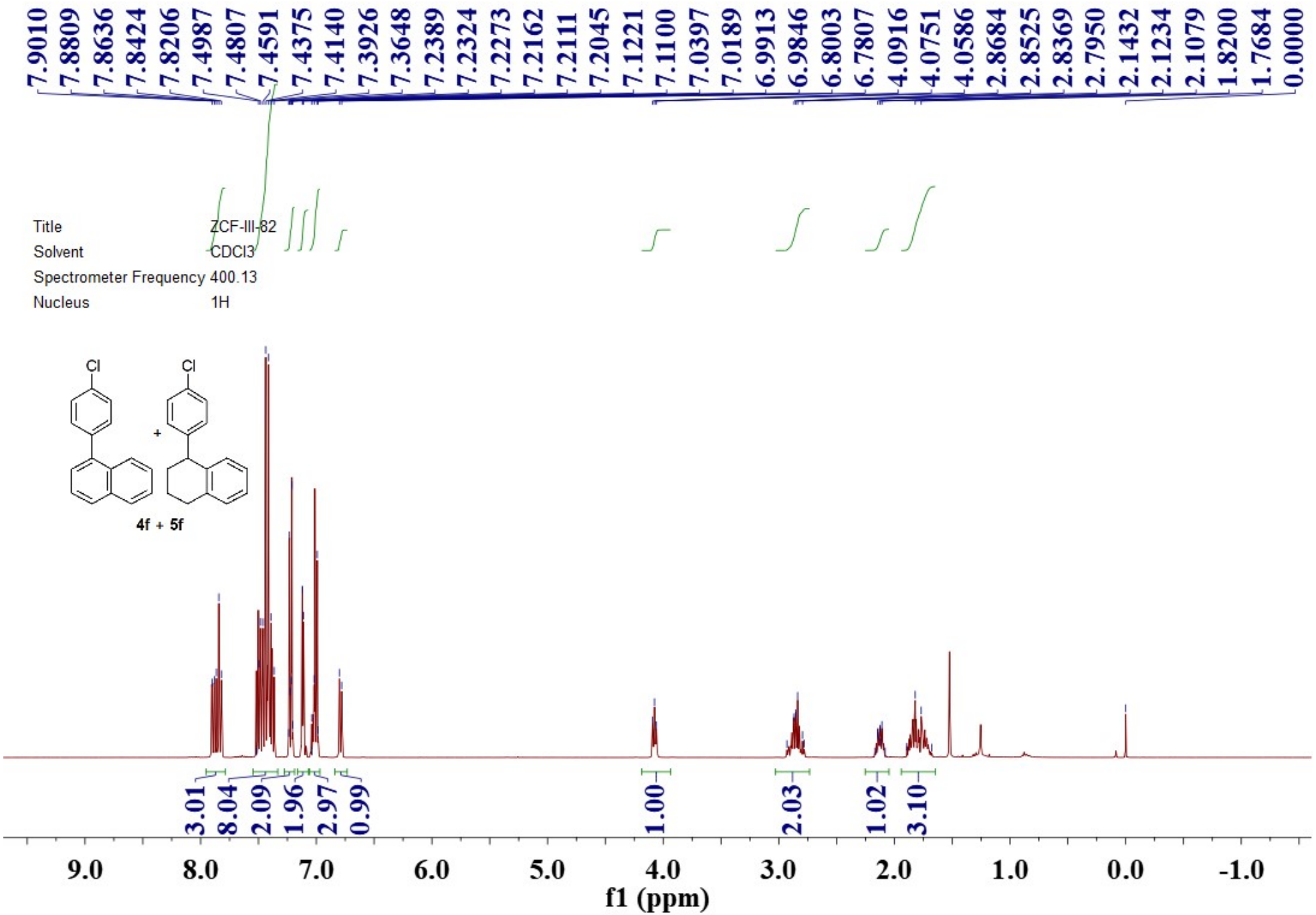
Title ZCF-II-22
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C

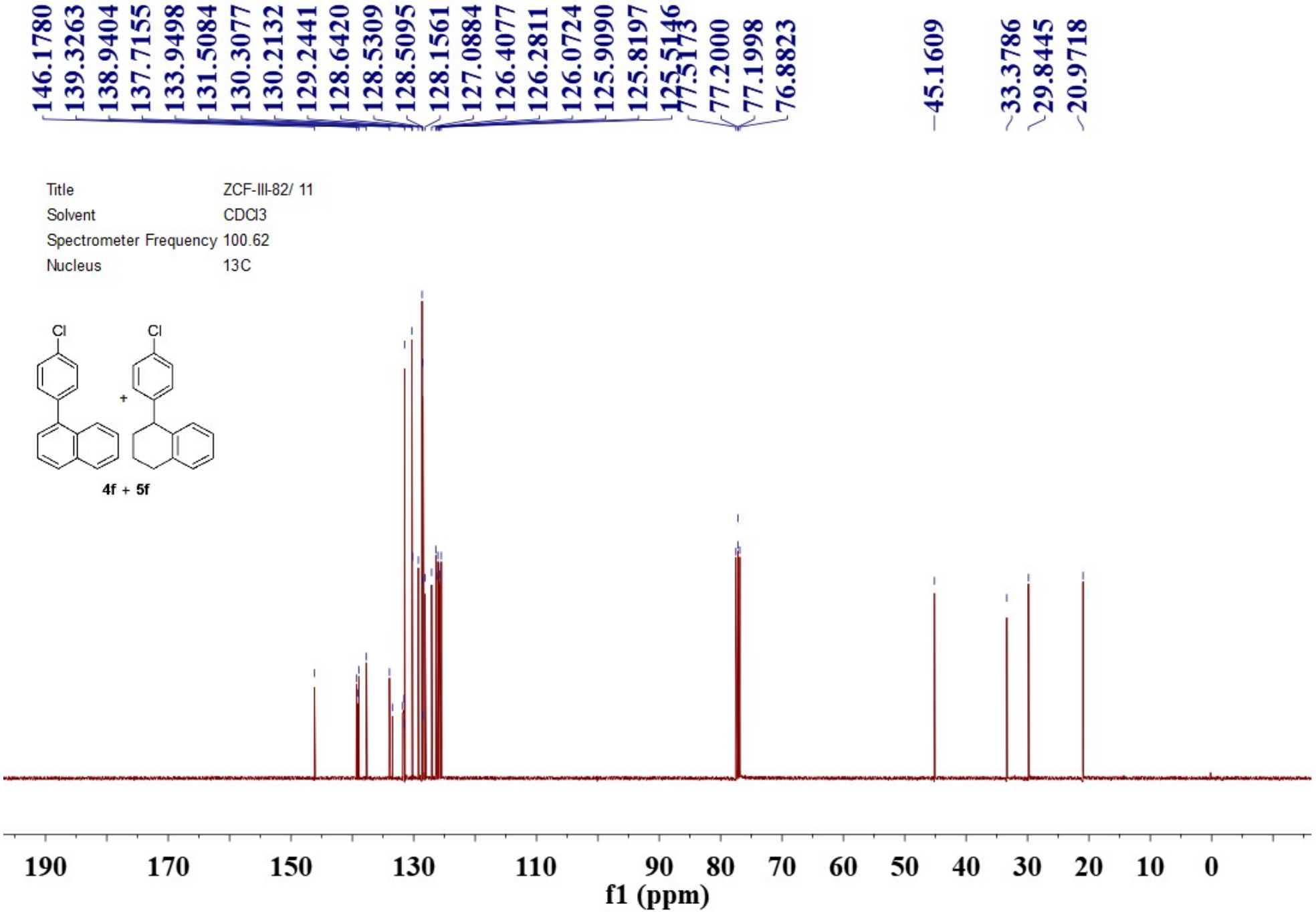


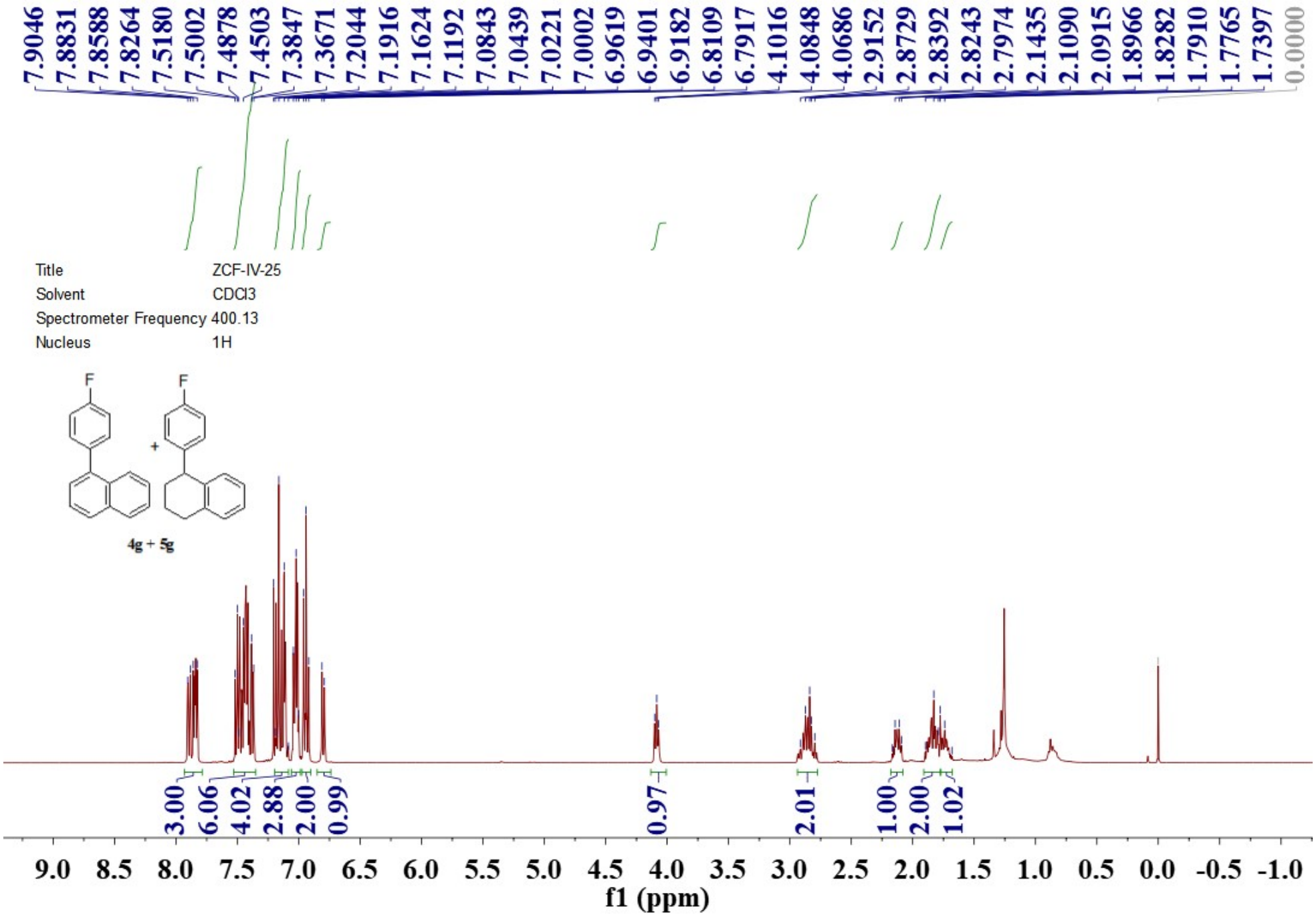
4d + 5d


7.9043
7.8843
7.8668
7.8452
7.6103
7.5899
7.5011
7.4839
7.3821
7.3567
7.3391
7.3363
7.3358
7.1224
7.1128
6.9583
6.9378
4.0627
4.0465
2.8703
2.8538
2.1414
1.8862
1.8148
1.7637
1.6770
0.0000
Title ZCF-IV-1
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
Br
4e + 5e
2.97
2.01
2.03
5.99
2.00
1.01
1.99
1.00
0.99
2.08
1.00
3.10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

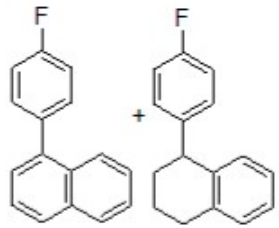

146.6971
138.8335
137.7052
133.9292
131.8532
131.5903
131.4894
131.4525
130.7245
130.2098
129.2432
128.5281
128.1786
127.0297
126.4224
126.2911
126.0824
125.9122
125.7951
125.5144
77.5174
77.2000
76.8824
45.2168
33.3299
29.8334
20.9577
Title ZCF-IV-1
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
Br
4e + 5e
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.9010
7.8809
7.8636
7.8424
7.8206
7.4987
7.4807
7.4591
7.4375
7.4140
7.3926
7.3648
7.2389
7.2324
7.2273
7.2162
7.2111
7.2045
7.1221
7.1100
7.0397
7.0189
6.9913
6.9846
6.8003
6.7807
4.0916
4.0751
4.0586
2.8684
2.8525
2.8369
2.7950
2.1432
2.1234
2.1079
1.8200
1.7684
0.0000
Title ZCF-III-82
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cl
Cl
+
4f + 5f
3.01
8.04
2.09
1.96
2.97
0.99
1.00
2.03
1.02
3.10
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

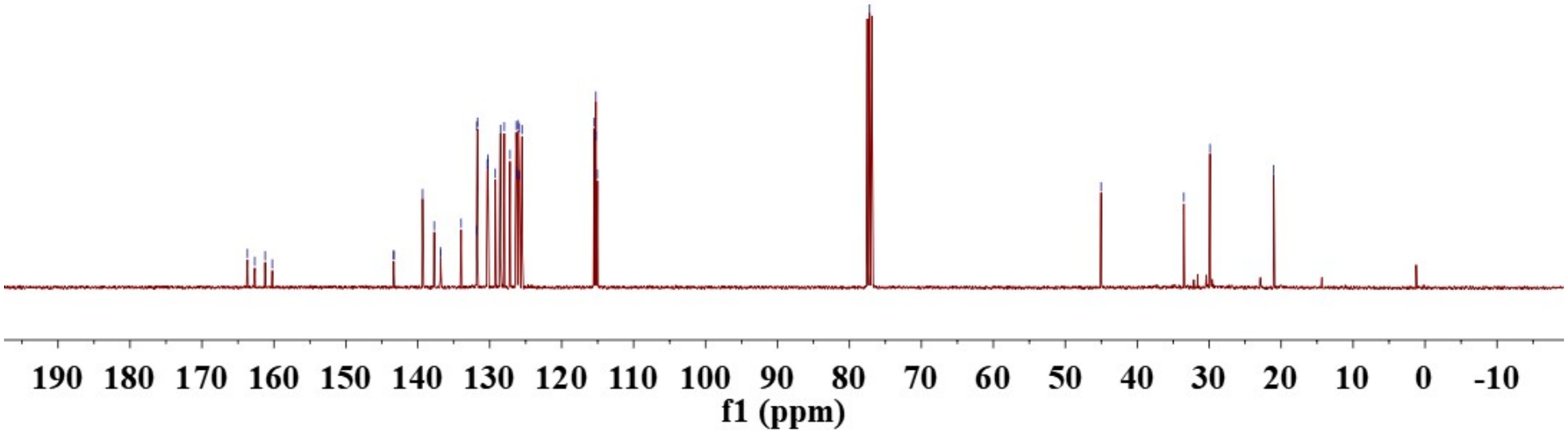

146.1780
139.3263
138.9404
137.7155
133.9498
131.5084
130.3077
130.2132
129.2441
128.6420
128.5309
128.5095
128.1561
127.0884
126.4077
126.2811
126.0724
125.9090
125.8197
125.5146
77.5173
77.2000
77.1998
76.8823
45.1609
33.3786
29.8445
20.9718
Title ZCF-III-82/ 11
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Cl
Cl
4f + 5f
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.9046
7.8831
7.8588
7.8264
7.5180
7.5002
7.4878
7.4503
7.3847
7.3671
7.2044
7.1916
7.1624
7.1192
7.0843
7.0439
7.0221
7.0002
6.9619
6.9401
6.9182
6.8109
6.7917
4.1016
4.0848
4.0686
2.9152
2.8729
2.8392
2.8243
2.7974
2.1435
2.1090
2.0915
1.8966
1.8282
1.7910
1.7765
1.7397
0.0000
Title ZCF-IV-25
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
F
F
+
4g + 5g
3.00
6.06
4.02
2.88
2.00
0.99
0.97
2.01
1.00
2.00
1.02
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)

Title	ZCF-IV-25
Solvent	CDCl3
Spectrometer Frequency	100.62
Nucleus	13C

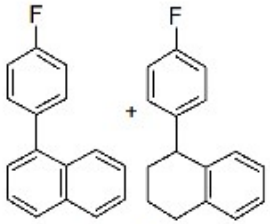


4g + 5g

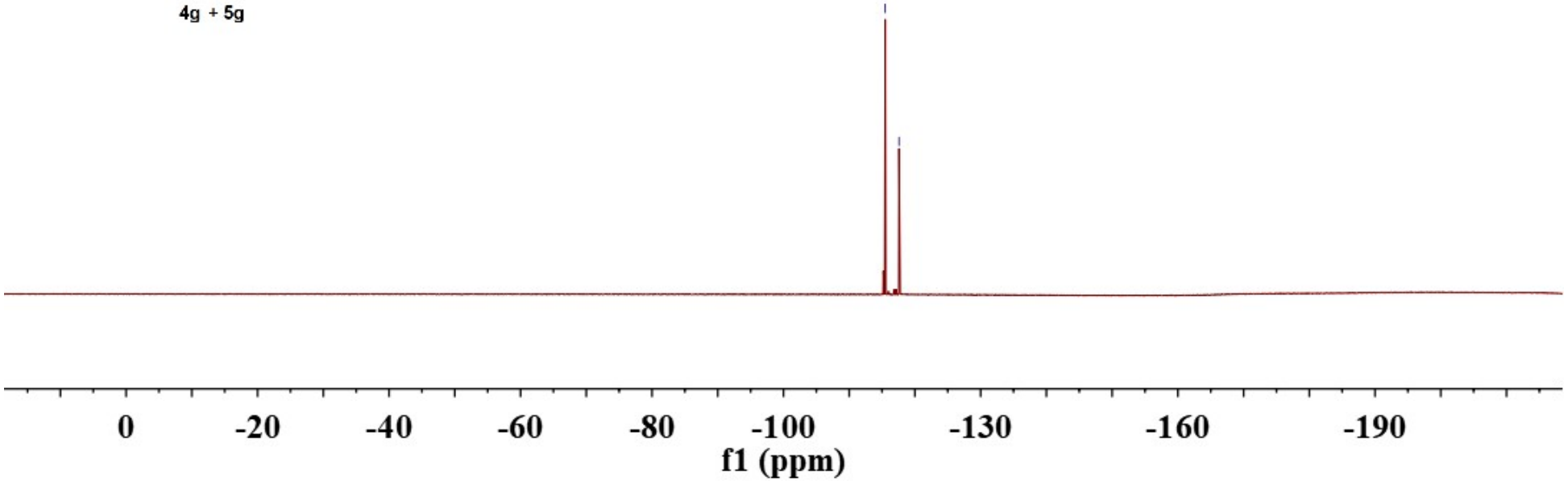


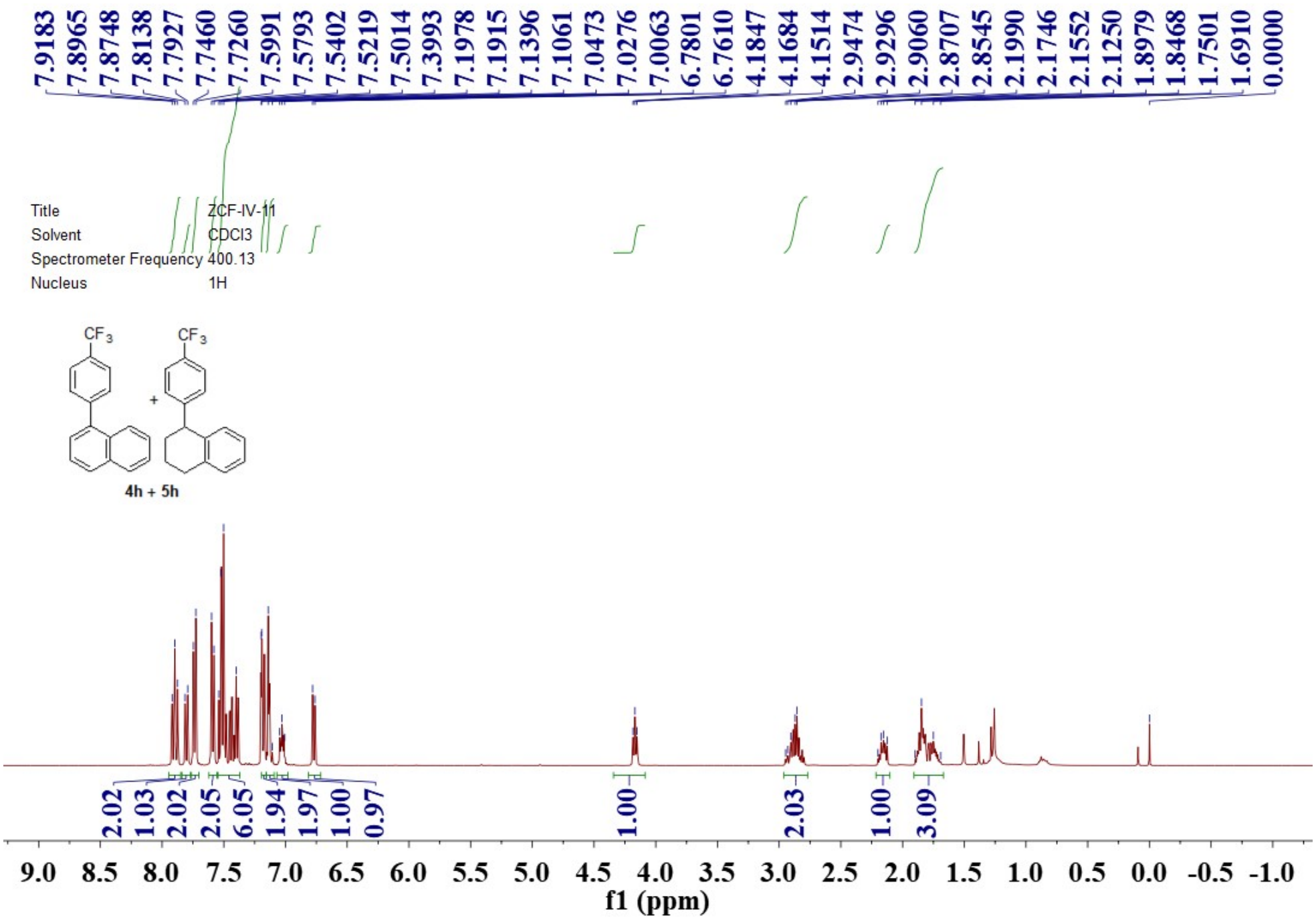
-115.487
-117.576

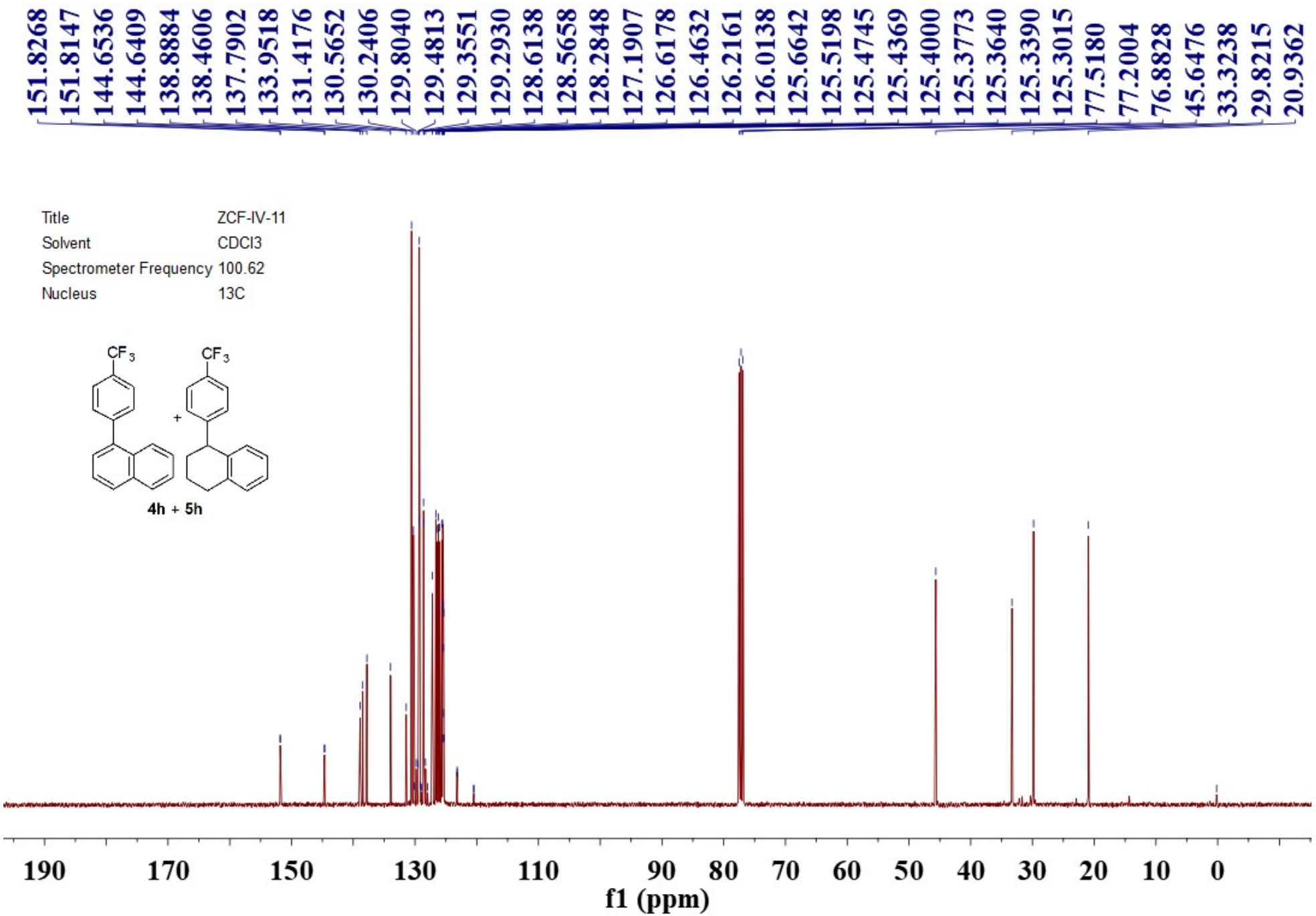
Title ZCF-IV-25
Solvent CDCl3
Spectrometer Frequency 376.46
Nucleus 19F



4g + 5g

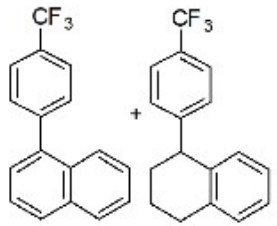



7.9183
7.8965
7.8748
7.8138
7.7927
7.7460
7.7260
7.5991
7.5793
7.5402
7.5219
7.5014
7.3993
7.1978
7.1915
7.1396
7.1061
7.0473
7.0276
7.0063
6.7801
6.7610
4.1847
4.1684
4.1514
2.9474
2.9296
2.9060
2.8707
2.8545
2.1990
2.1746
2.1552
2.1250
1.8979
1.8468
1.7501
1.6910
0.0000
Title ZCF-IV-11
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
CF3
CF3
4h + 5h
2.02
1.03
2.02
2.05
6.05
1.94
1.97
1.00
0.97
1.00
2.03
1.00
3.09
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)

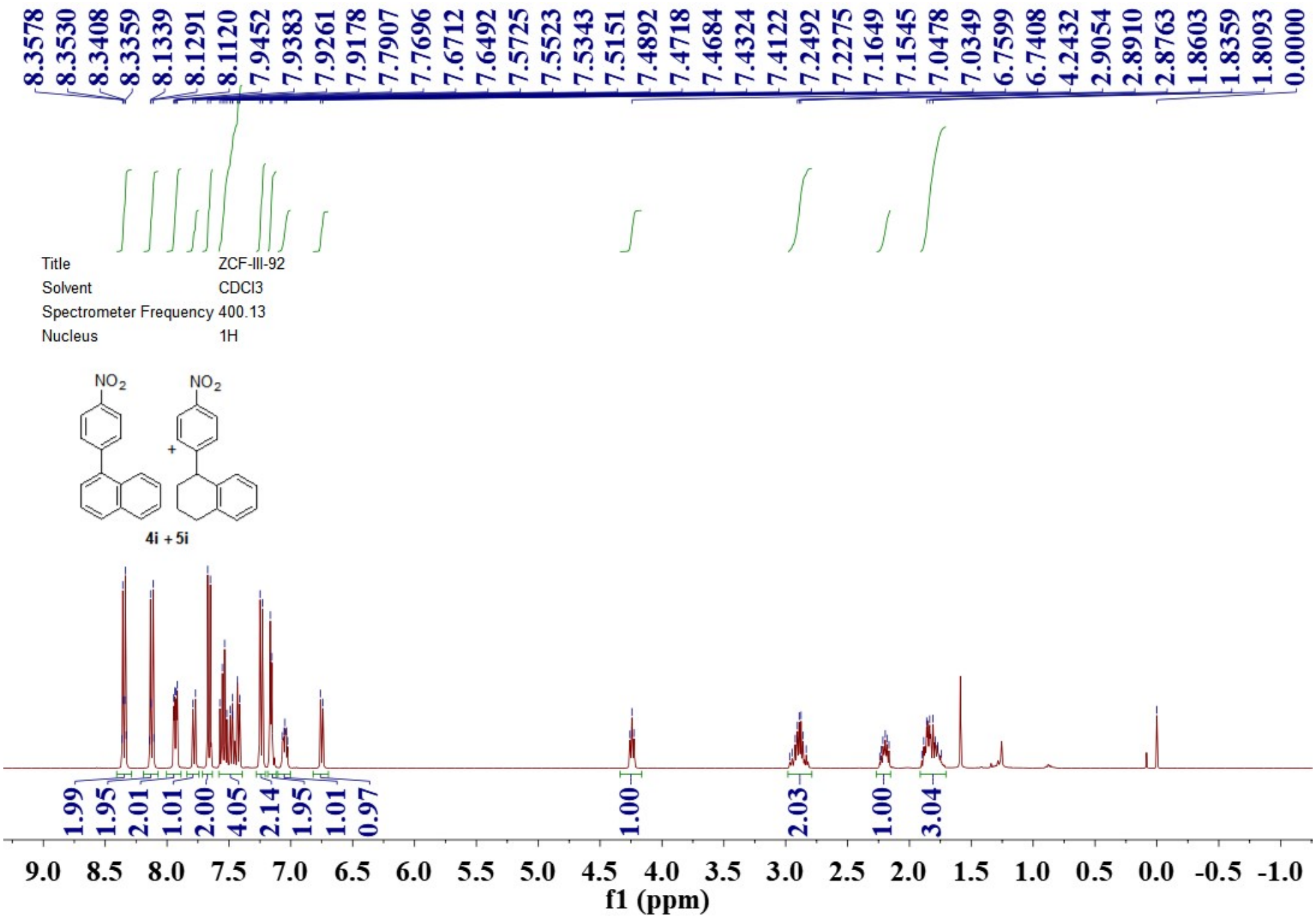

151.8268
151.8147
144.6536
144.6409
138.8884
138.4606
137.7902
133.9518
131.4176
130.5652
130.2406
129.8040
129.4813
129.3551
129.2930
128.6138
128.5658
128.2848
127.1907
126.6178
126.4632
126.2161
126.0138
125.6642
125.5198
125.4745
125.4369
125.4000
125.3773
125.3640
125.3390
125.3015
77.5180
77.2004
76.8828
45.6476
33.3238
29.8215
20.9362
Title ZCF-IV-11
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
CF3
CF3
4h + 5h
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

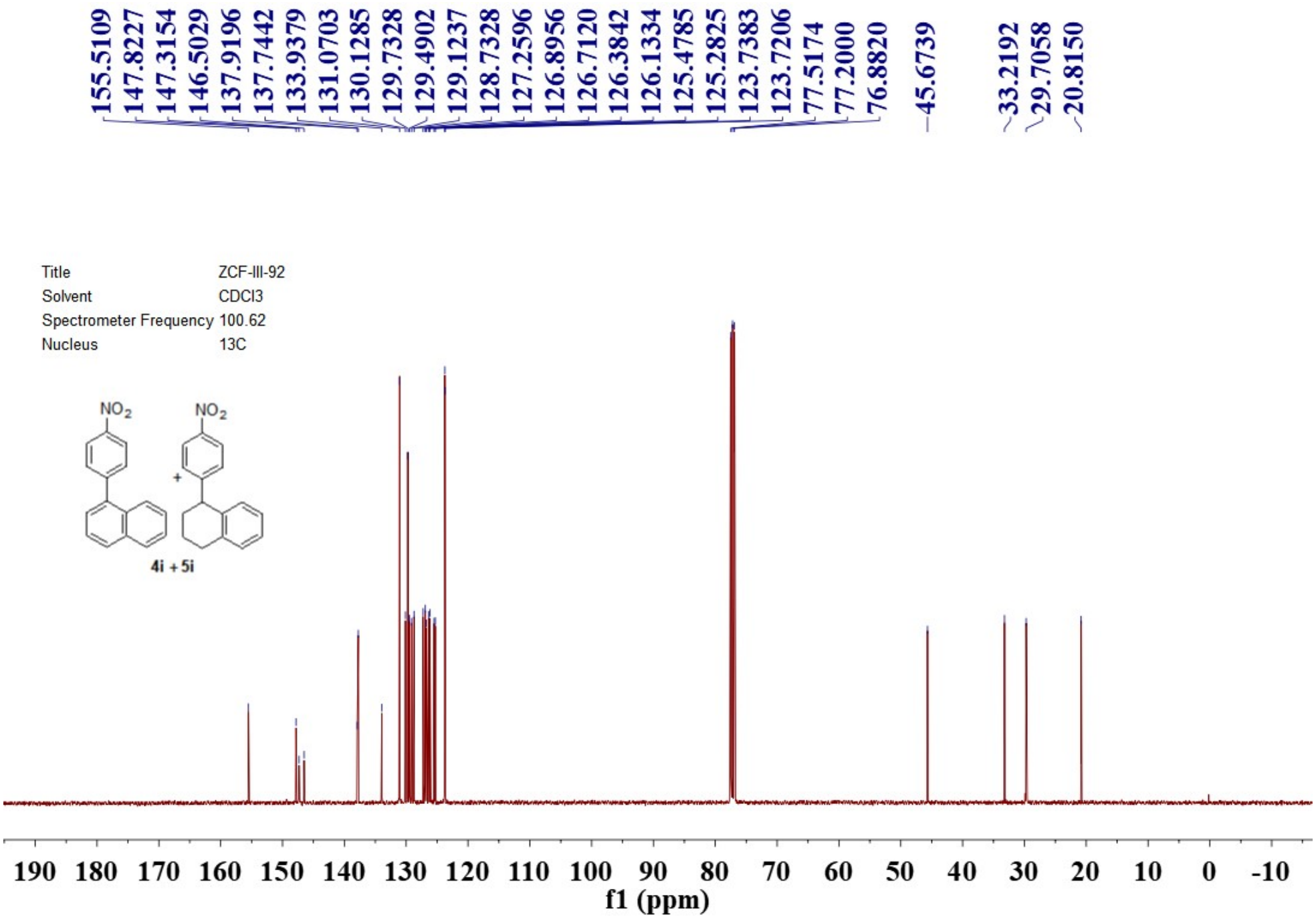
-62.197
-62.304

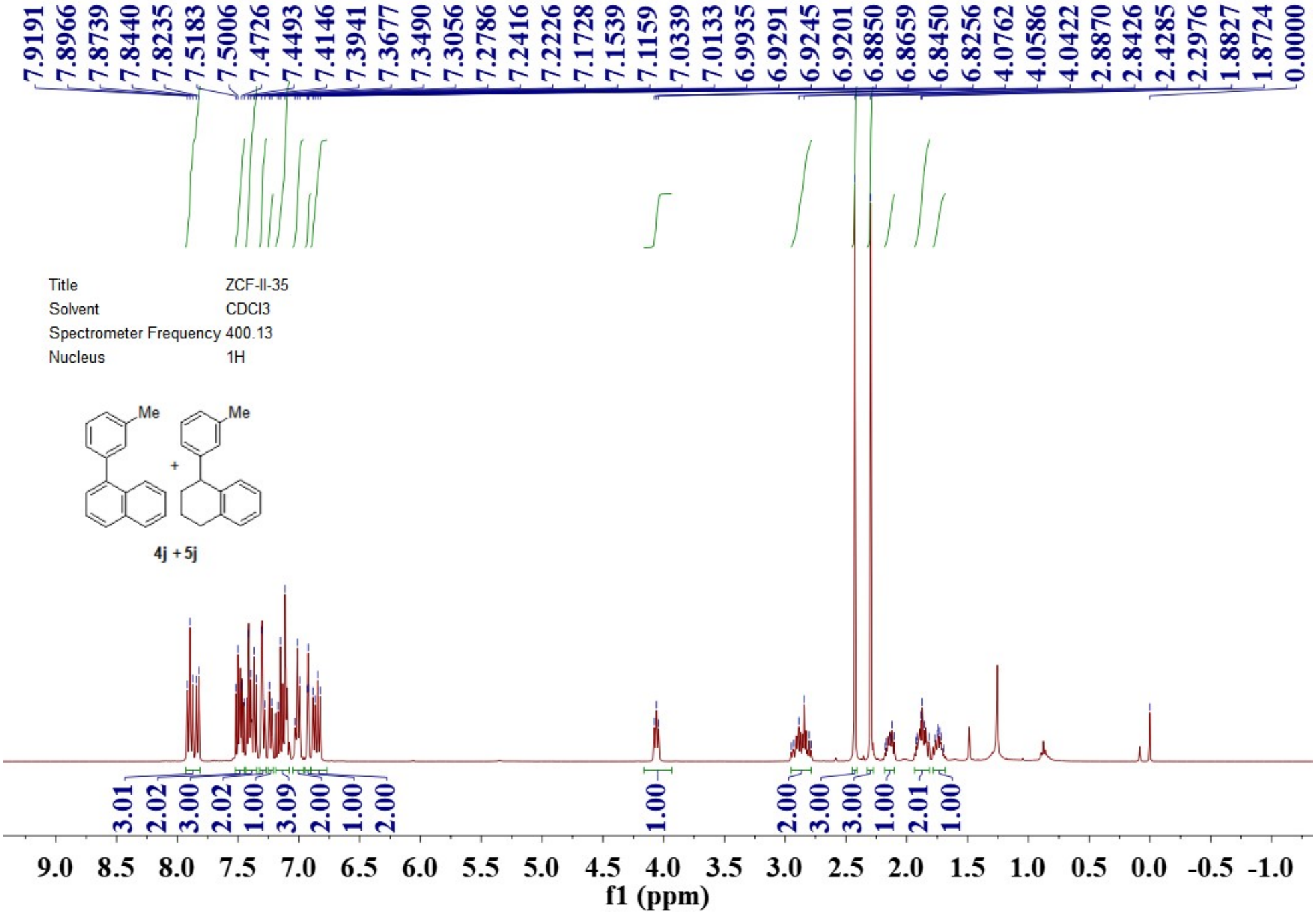
Title	ZCF-IV-11
Solvent	CDCl3
Spectrometer Frequency	376.46
Nucleus	19F

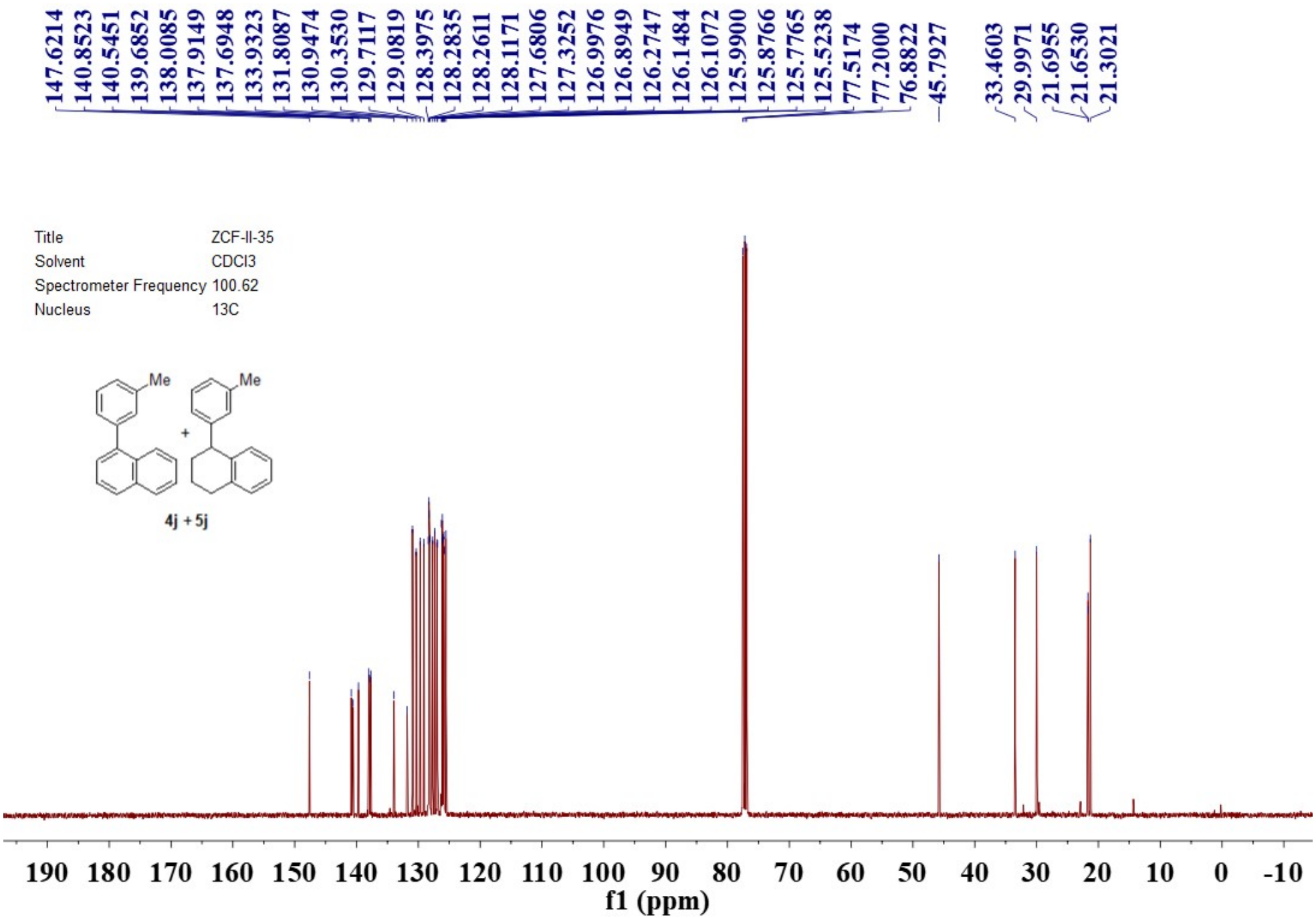


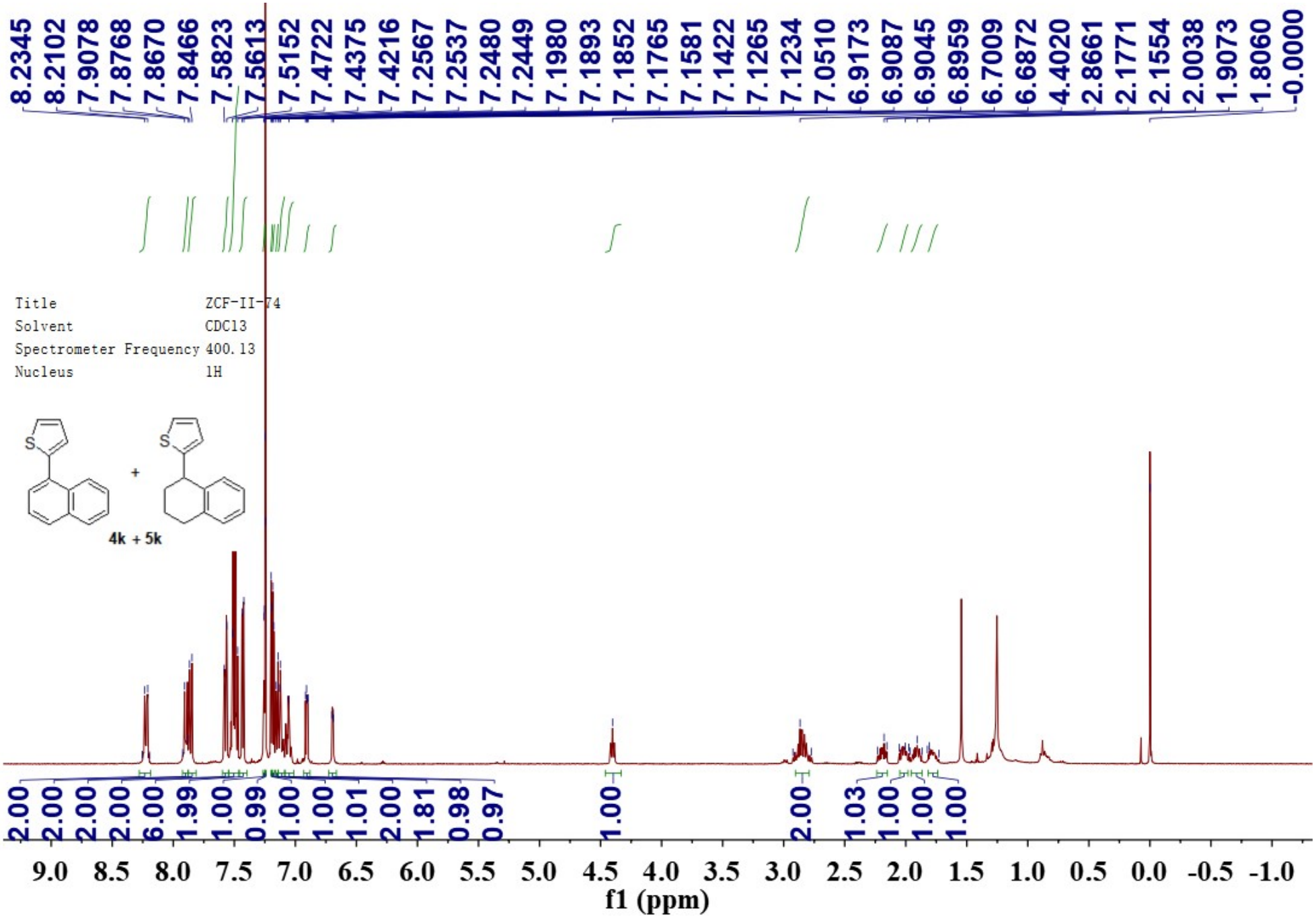
4h + 5h


8.3578
8.3530
8.3408
8.3359
8.1339
8.1291
8.1120
7.9452
7.9383
7.9261
7.9178
7.7907
7.7696
7.6712
7.6492
7.5725
7.5523
7.5343
7.5151
7.4892
7.4718
7.4684
7.4324
7.4122
7.2492
7.2275
7.1649
7.1545
7.0478
7.0349
6.7599
6.7408
4.2432
2.9054
2.8910
2.8763
1.8603
1.8359
1.8093
0.0000
Title ZCF-III-92
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
NO2
NO2
4i + 5i
1.99
1.95
2.01
1.01
2.00
4.05
2.14
1.95
1.01
0.97
1.00
2.03
1.00
3.04
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)


155.5109
147.8227
147.3154
146.5029
137.9196
137.7442
133.9379
131.0703
130.1285
129.7328
129.4902
129.1237
128.7328
127.2596
126.8956
126.7120
126.3842
126.1334
125.4785
125.2825
123.7383
123.7206
77.5174
77.2000
76.8820
45.6739
33.2192
29.7058
20.8150
Title ZCF-III-92
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
NO2
NO2
4i + 5i
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.9191
7.8966
7.8739
7.8440
7.8235
7.5183
7.5006
7.4726
7.4493
7.4146
7.3941
7.3677
7.3490
7.3056
7.2786
7.2416
7.2226
7.1728
7.1539
7.1159
7.0339
7.0133
6.9935
6.9291
6.9245
6.9201
6.8850
6.8659
6.8450
6.8256
4.0762
4.0586
4.0422
2.8870
2.8426
2.4285
2.2976
1.8827
1.8724
0.0000
Title ZCF-II-35
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
+
4j + 5j
3.01
2.02
3.00
2.02
1.00
3.09
2.00
1.00
2.00
1.00
2.00
3.00
3.00
1.00
2.01
1.00
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)


147.6214
140.8523
140.5451
139.6852
138.0085
137.9149
137.6948
133.9323
131.8087
130.9474
130.3530
129.7117
129.0819
128.3975
128.2835
128.2611
128.1171
127.6806
127.3252
126.9976
126.8949
126.2747
126.1484
126.1072
125.9900
125.8766
125.7765
125.5238
77.5174
77.2000
76.8822
45.7927
33.4603
29.9971
21.6955
21.6530
21.3021
Title ZCF-II-35
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
+
4j + 5j
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.2345
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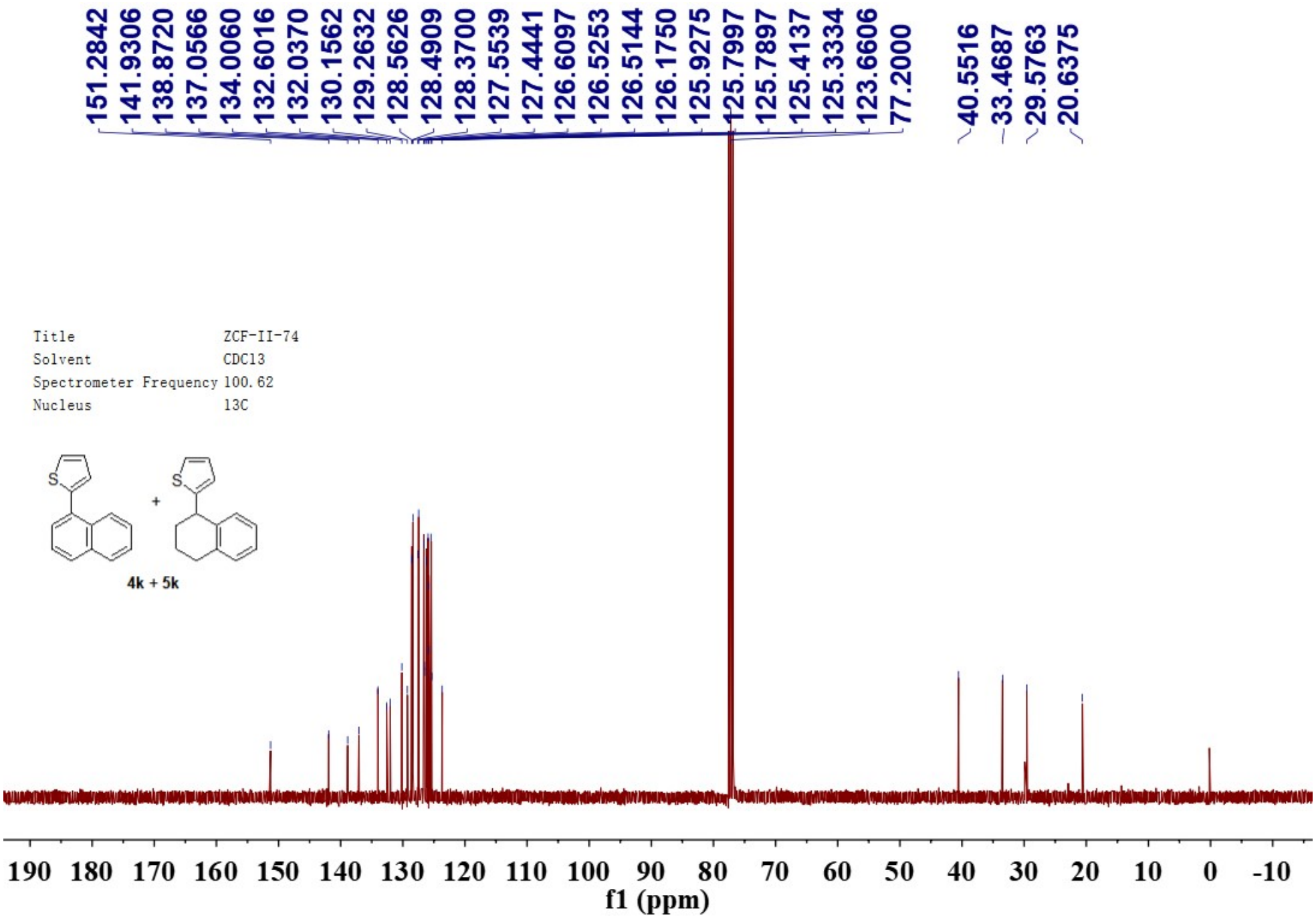
7.9078
7.8768
7.8670
7.8466
7.5823
7.5613
7.5152
7.4722
7.4375
7.4216
7.2567
7.2537
7.2480
7.2449
7.1980
7.1893
7.1852
7.1765
7.1581
7.1422
7.1265
7.1234
7.0510
6.9173
6.9087
6.9045
6.8959
6.7009
6.6872
4.4020
2.8661
2.1771
2.1554
2.0038
1.9073
1.8060
-0.0000
Title ZCF-II-74
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
S
+
S
4k + 5k
2.00
2.00
2.00
2.00
6.00
1.99
1.00
0.99
1.00
1.00
1.01
2.00
1.81
0.98
0.97
1.00
2.00
1.03
1.00
1.00
1.00
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)


151.2842
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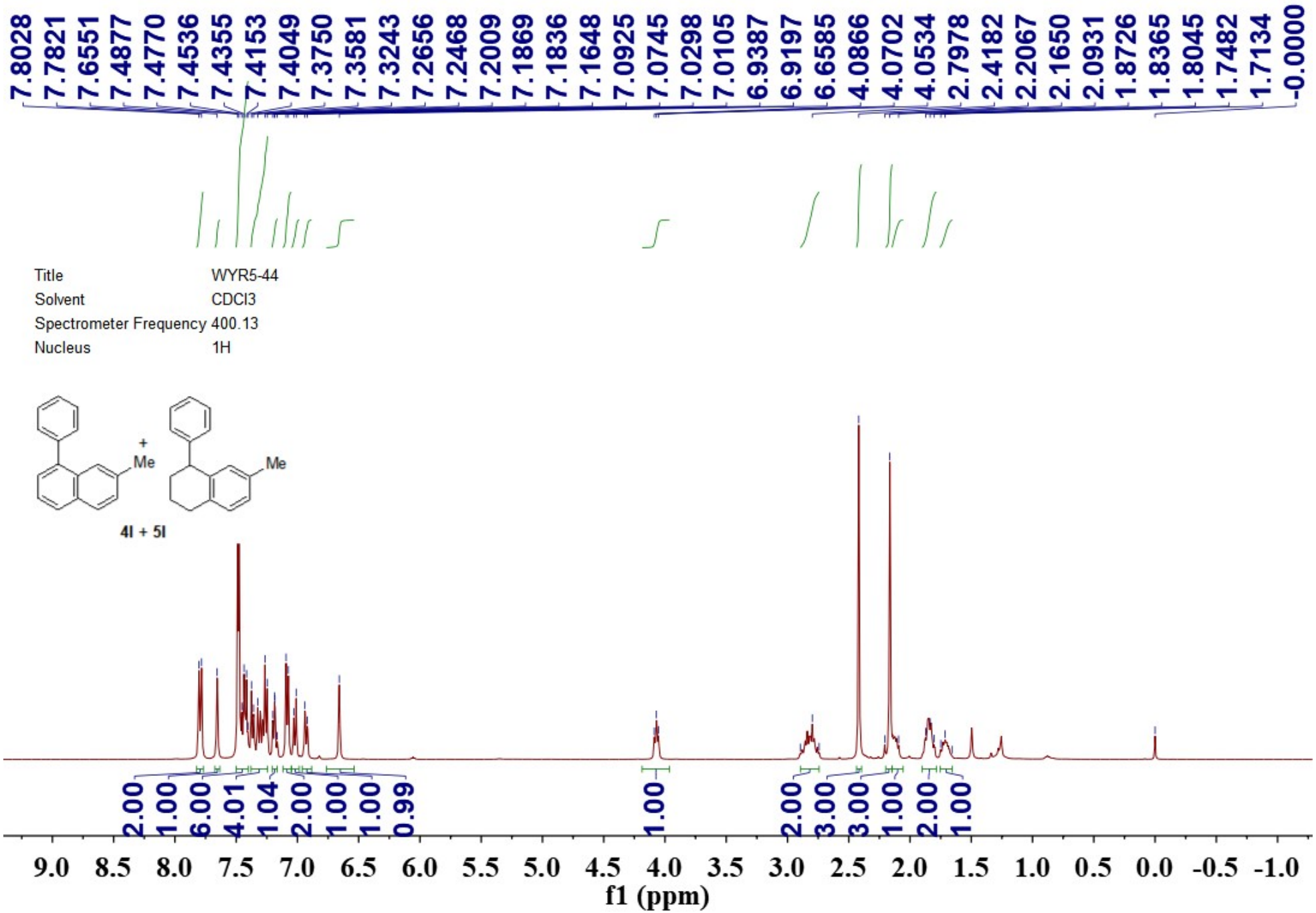
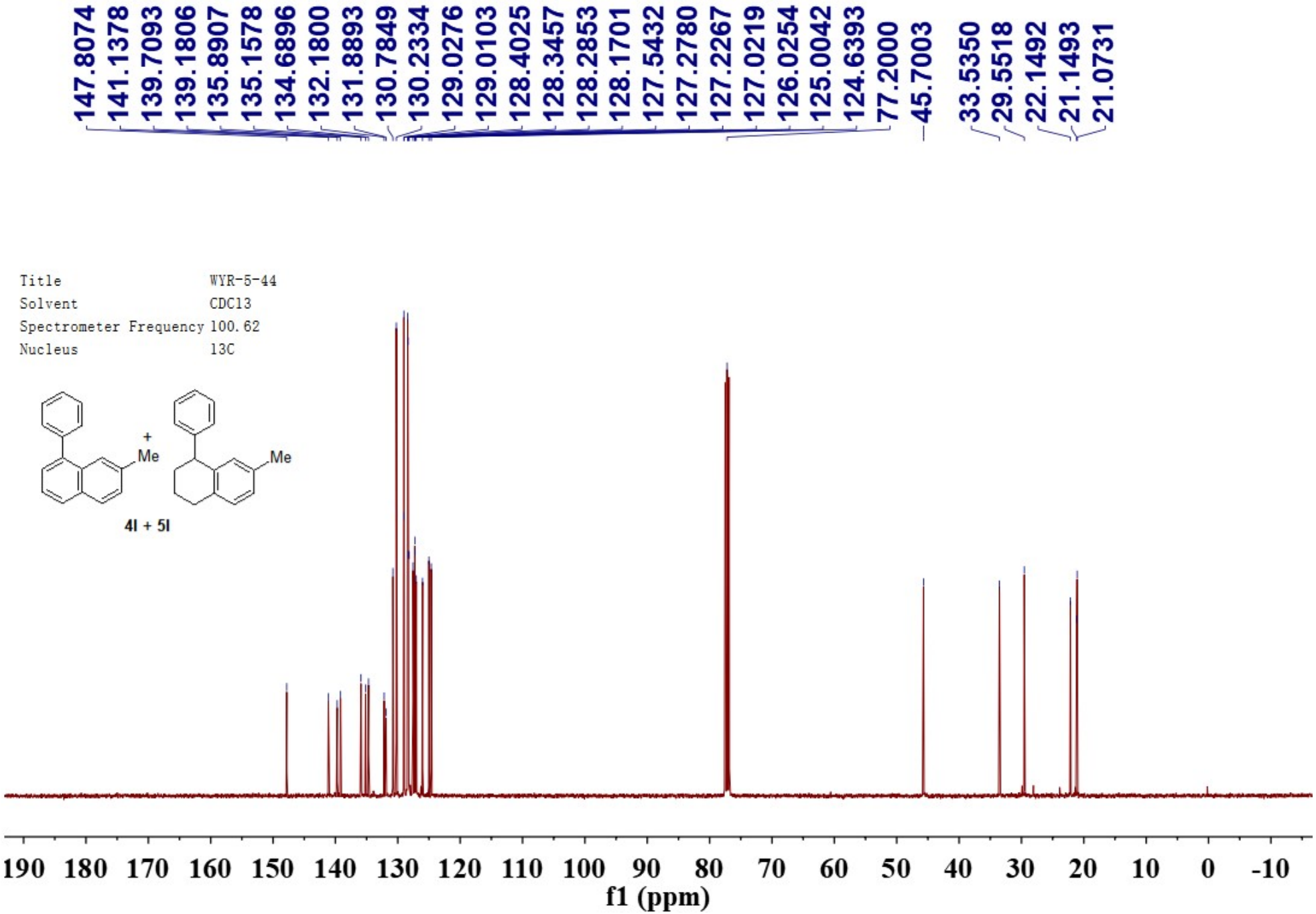
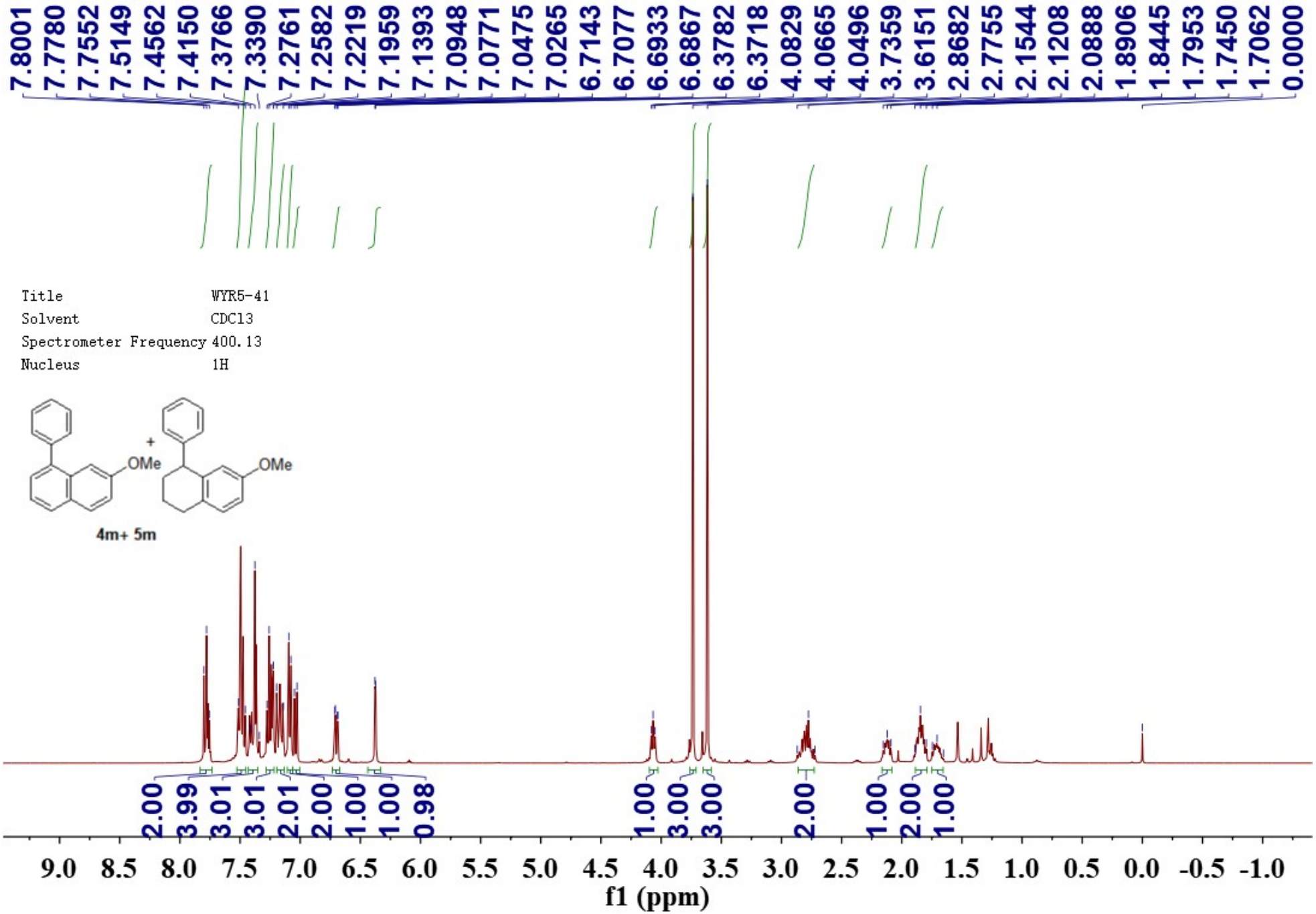
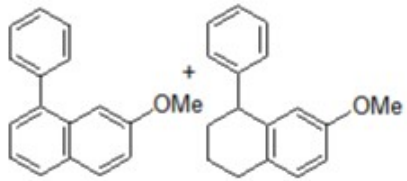
138.8720
137.0566
134.0060
132.6016
132.0370
130.1562
129.2632
128.5626
128.4909
128.3700
127.5539
127.4441
126.6097
126.5253
126.5144
126.1750
125.9275
125.7997
125.7897
125.4137
125.3334
123.6606
77.2000
40.5516
33.4687
29.5763
20.6375
Title ZCF-II-74
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
S
+
S
4k + 5k
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.8028
7.7821
7.6551
7.4877
7.4770
7.4536
7.4355
7.4153
7.4049
7.3750
7.3581
7.3243
7.2656
7.2468
7.2009
7.1869
7.1836
7.1648
7.0925
7.0745
7.0298
7.0105
6.9387
6.9197
6.6585
4.0866
4.0702
4.0534
2.7978
2.4182
2.2067
2.1650
2.0931
1.8726
1.8365
1.8045
1.7482
1.7134
-0.0000
Title WYR5-44
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
4l + 5l
2.00
1.00
6.00
4.01
1.04
2.00
1.00
1.00
0.99
1.00
2.00
3.00
3.00
1.00
2.00
1.00
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)

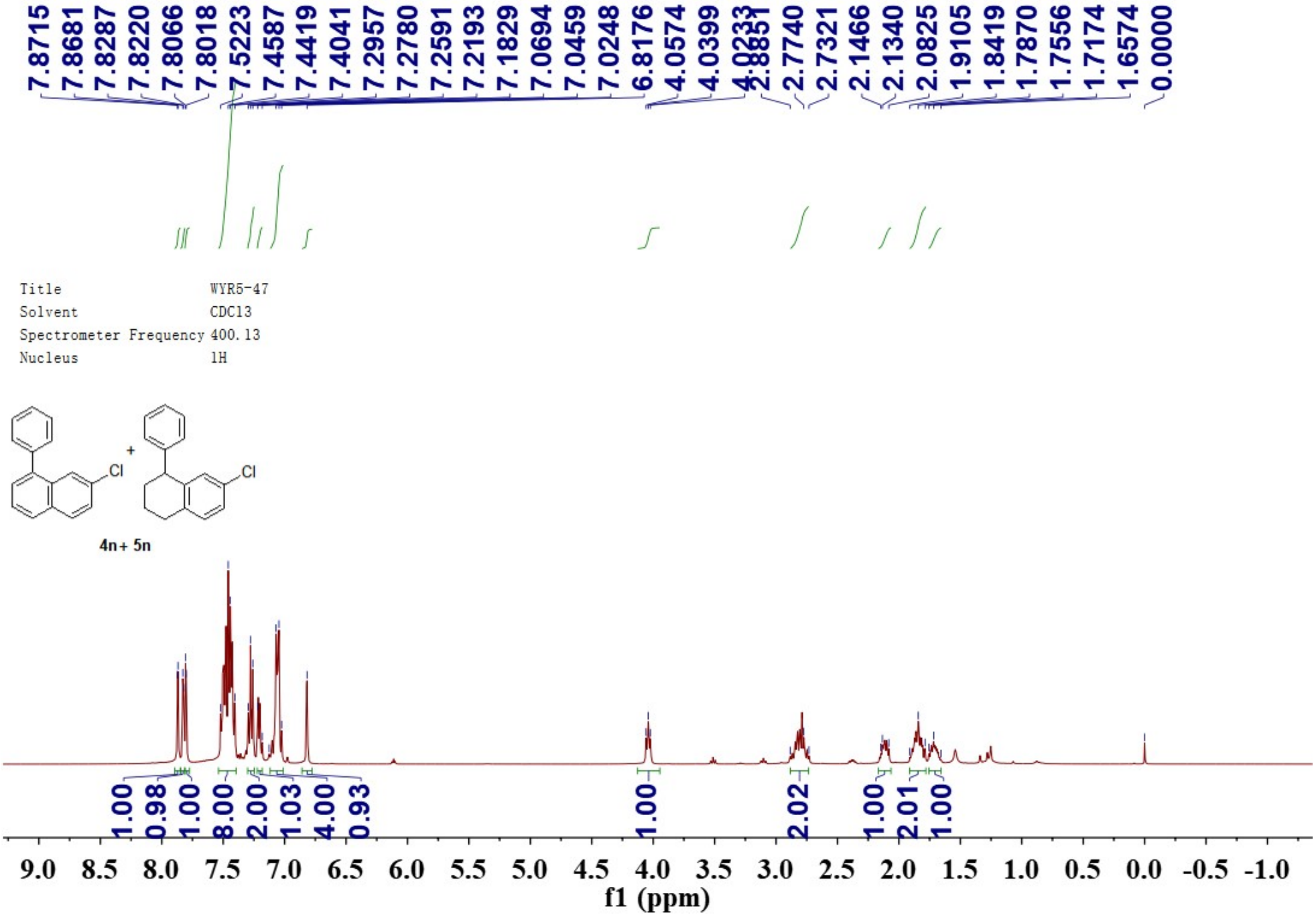

147.8074
141.1378
139.7093
139.1806
135.8907
135.1578
134.6896
132.1800
131.8893
130.7849
130.2334
129.0276
129.0103
128.4025
128.3457
128.2853
128.1701
127.5432
127.2780
127.2267
127.0219
126.0254
125.0042
124.6393
77.2000
45.7003
33.5350
29.5518
22.1492
21.1493
21.0731
Title WYR-5-44
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
+
Me
4l + 5l
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

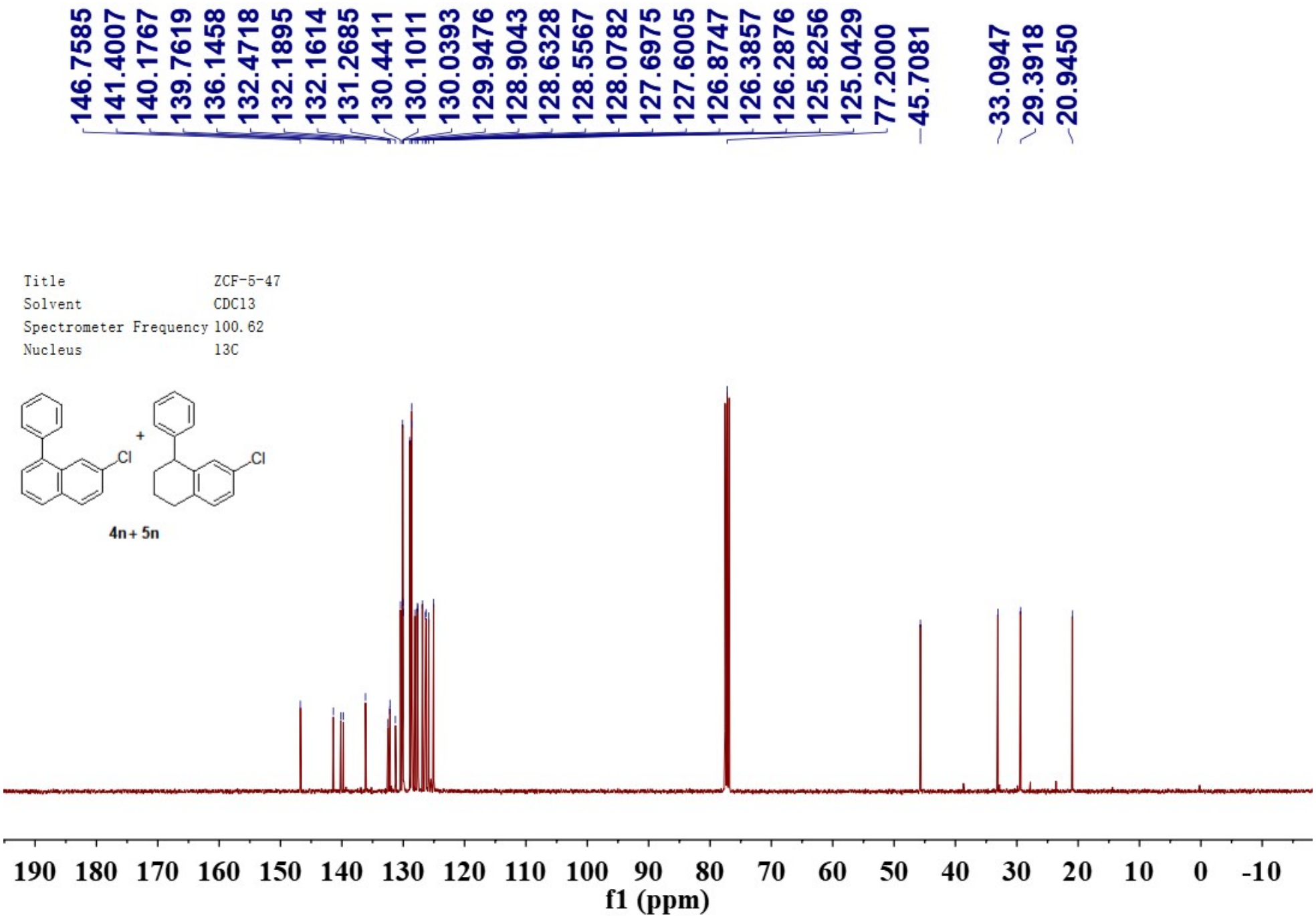

7.8001
7.7780
7.7552
7.5149
7.4562
7.4150
7.3766
7.3390
7.2761
7.2582
7.2219
7.1959
7.1393
7.0948
7.0771
7.0475
7.0265
6.7143
6.7077
6.6933
6.6867
6.3782
6.3718
4.0829
4.0665
4.0496
3.7359
3.6151
2.8682
2.7755
2.1544
2.1208
2.0888
1.8906
1.8445
1.7953
1.7450
1.7062
0.0000
Title WYR5-41
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
OMe
+
OMe
4m+ 5m
2.00
3.99
3.01
3.01
2.01
2.00
1.00
1.00
0.98
1.00
3.00
3.00
2.00
1.00
2.00
1.00
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)

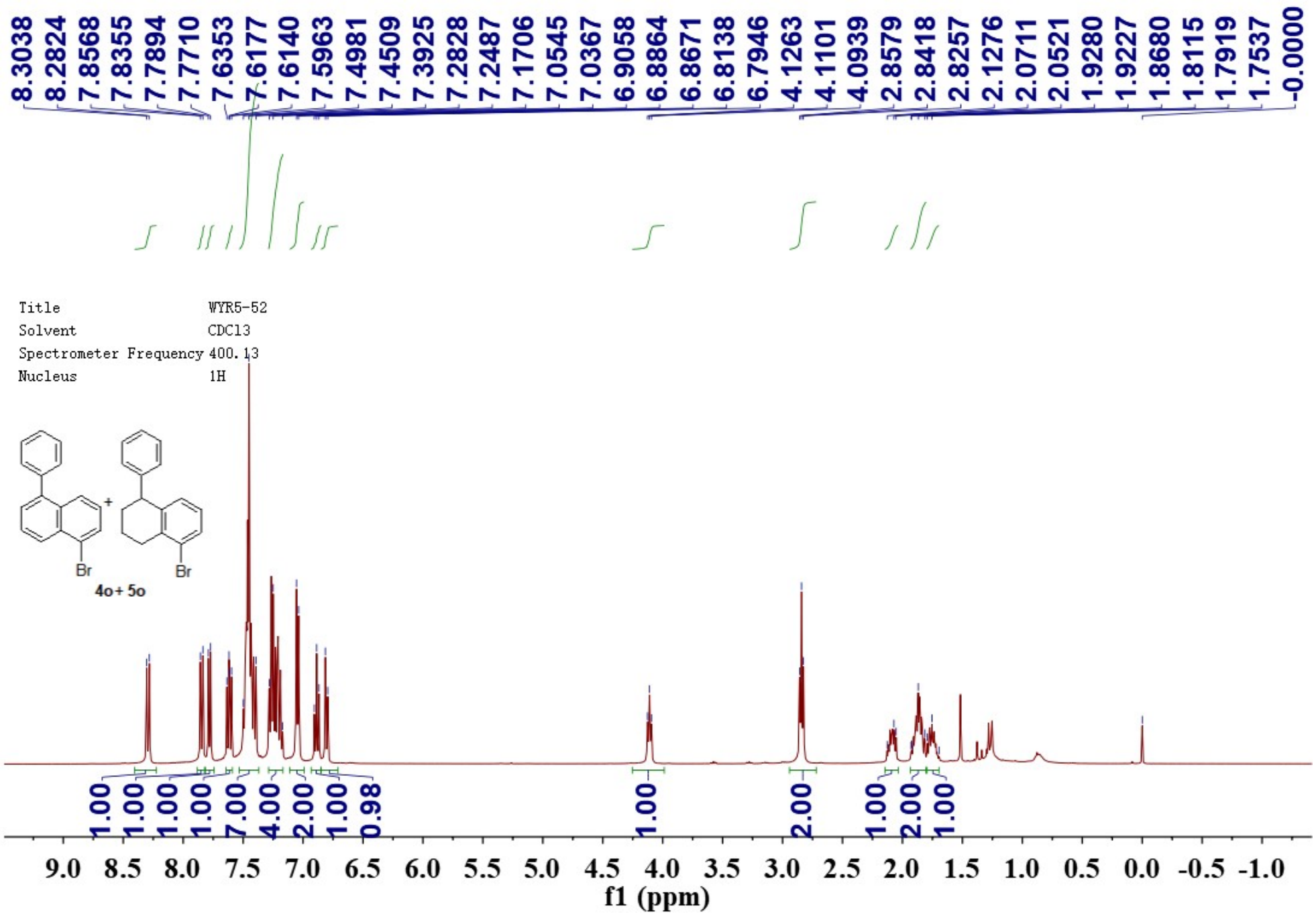
Title WYR4-41
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C

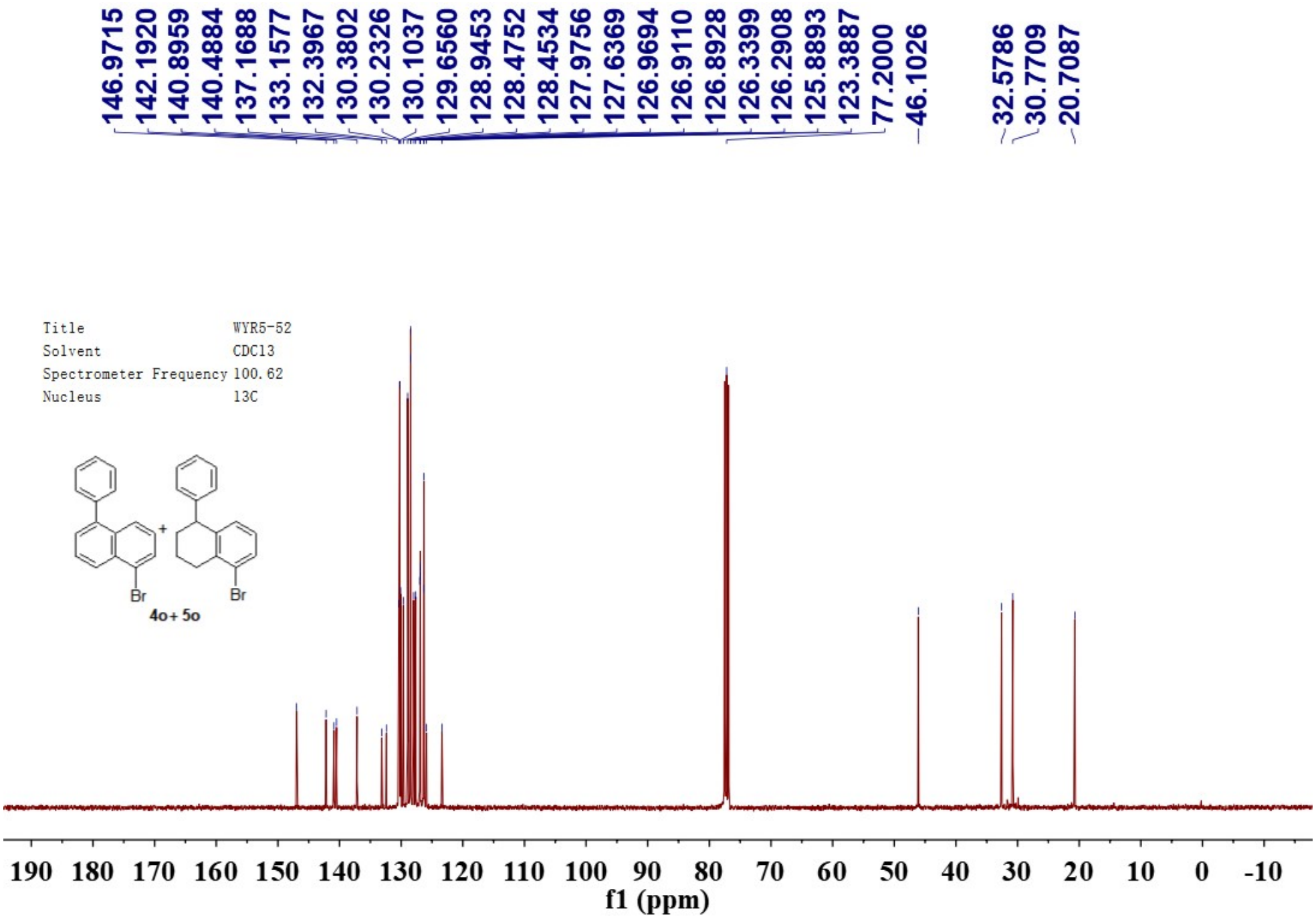


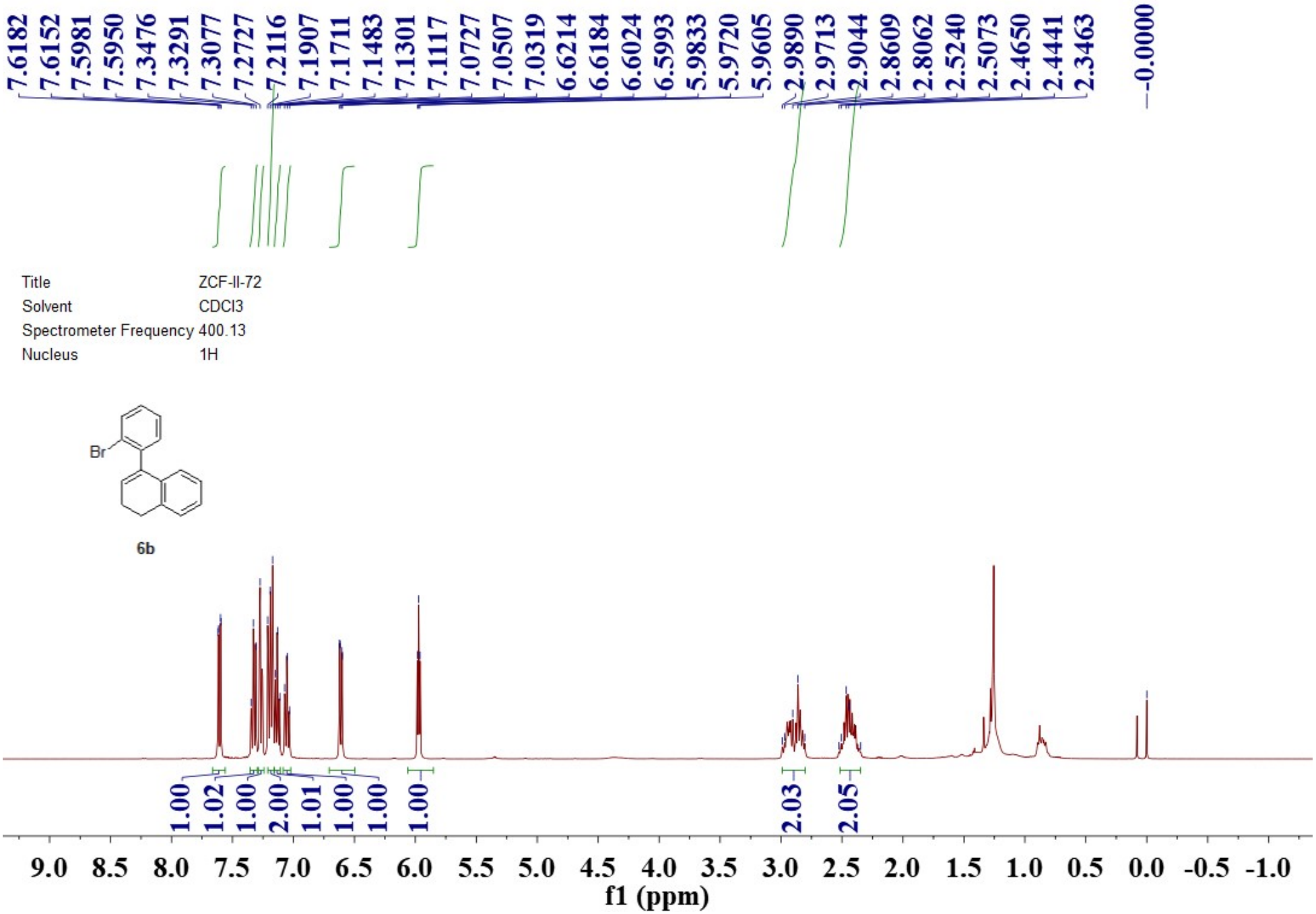
4m+ 5m

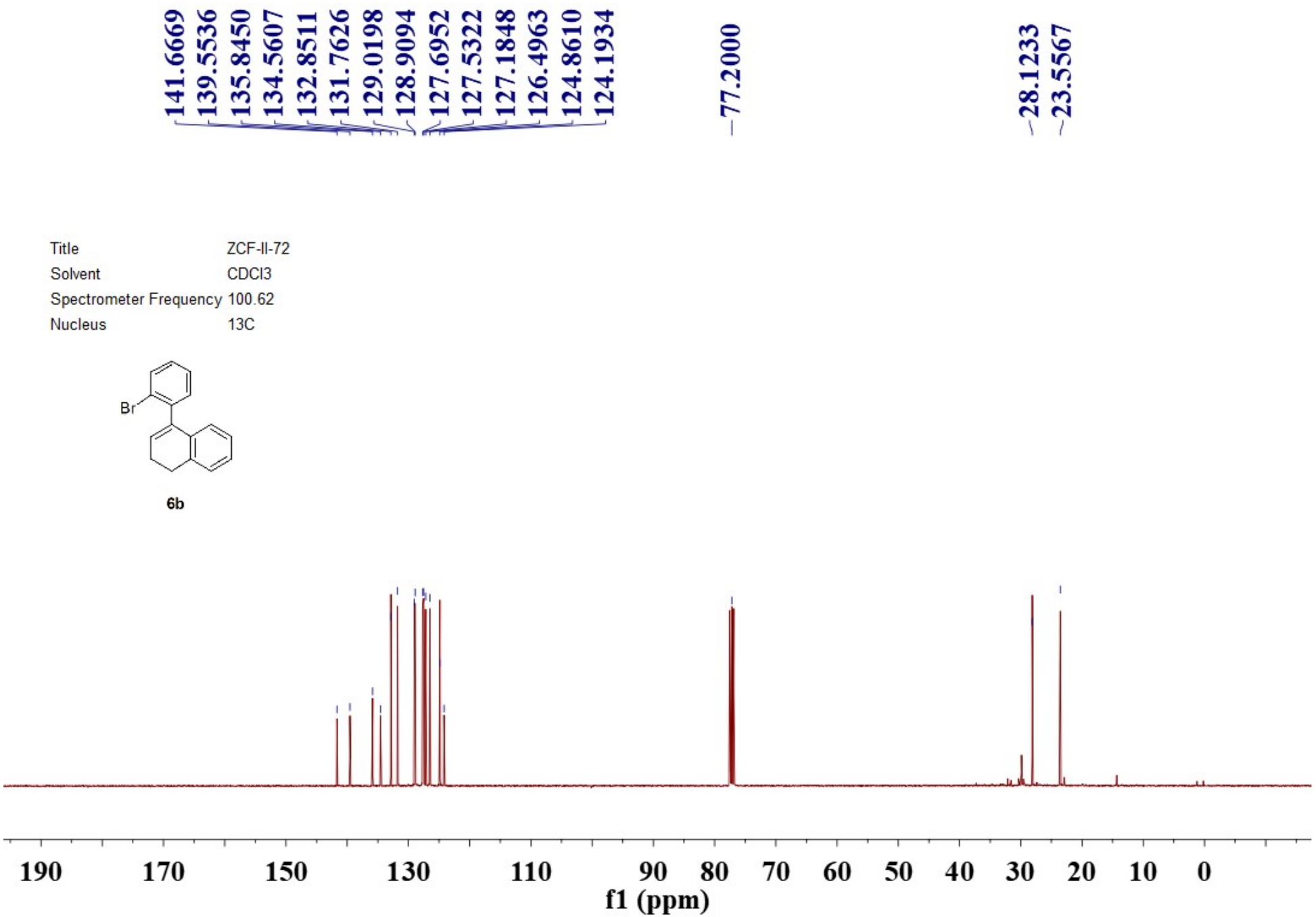

7.8715
7.8681
7.8287
7.8220
7.8066
7.8018
7.5223
7.4587
7.4419
7.4041
7.2957
7.2780
7.2591
7.2193
7.1829
7.0694
7.0459
7.0248
6.8176
4.0574
4.0399
2.8851
2.7740
2.7321
2.1466
2.1340
2.0825
1.9105
1.8419
1.7870
1.7556
1.7174
1.6574
0.0000
Title WYR5-47
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cl
Cl
4n + 5n
1.00
0.98
1.00
8.00
2.00
1.03
4.00
0.93
1.00
2.02
1.00
2.01
1.00
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)

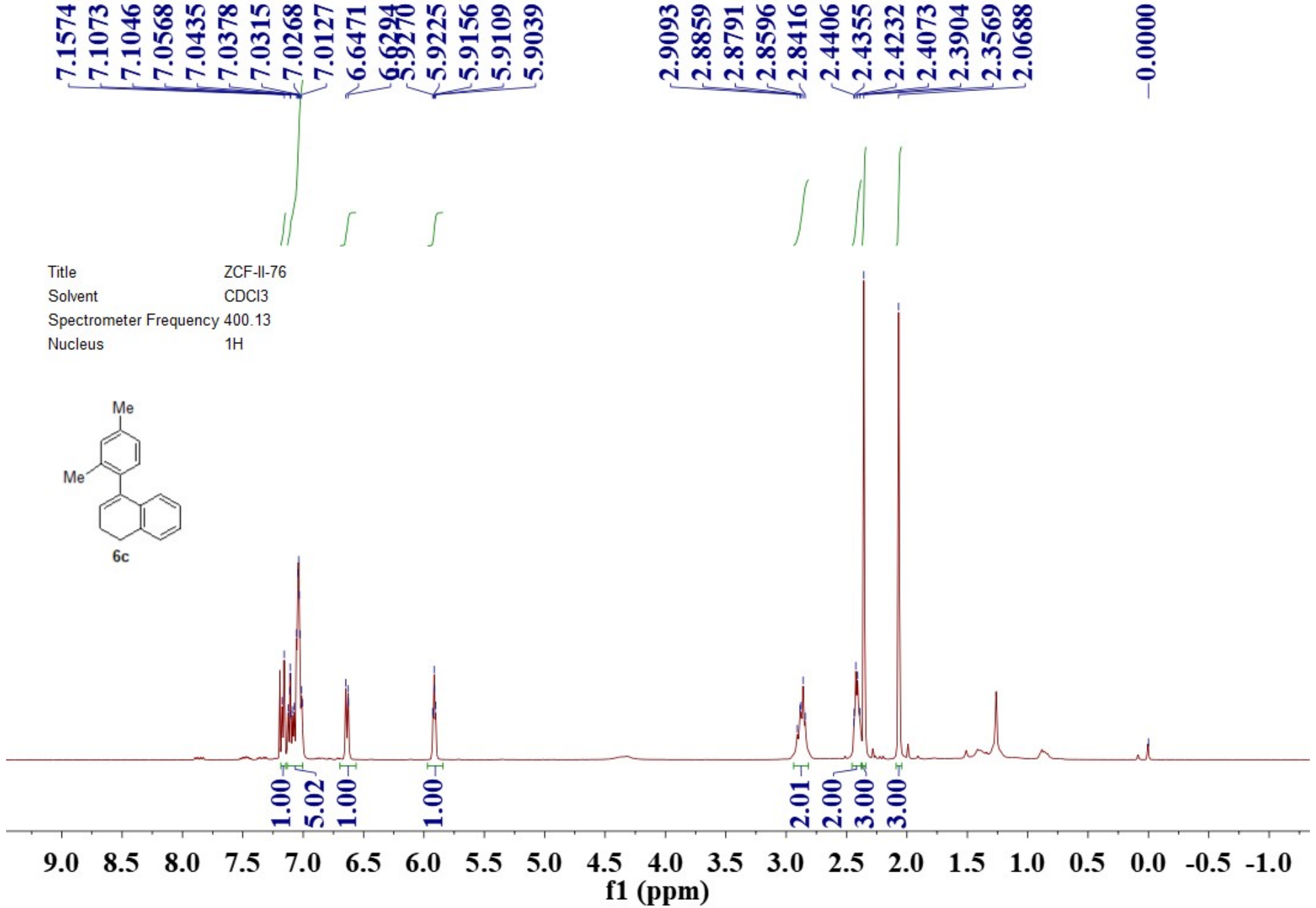

146.7585
141.4007
140.1767
139.7619
136.1458
132.4718
132.1895
132.1614
131.2685
130.4411
130.1011
130.0393
129.9476
128.9043
128.6328
128.5567
128.0782
127.6975
127.6005
126.8747
126.3857
126.2876
125.8256
125.0429
77.2000
45.7081
33.0947
29.3918
20.9450
Title ZCF-5-47
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Cl
+
Cl
4n + 5n
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

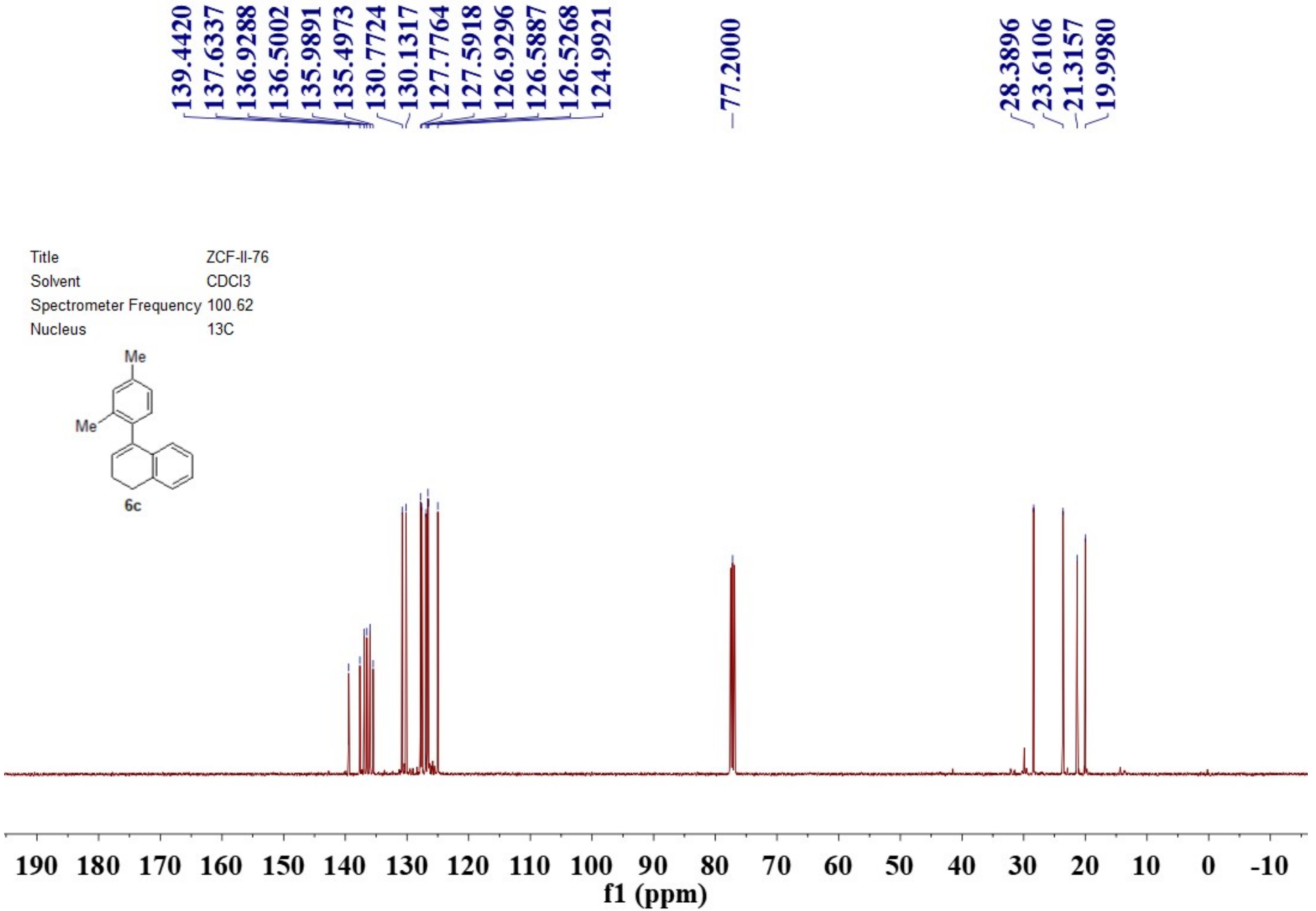

8.3038
8.2824
7.8568
7.8355
7.7894
7.7710
7.6353
7.6177
7.6140
7.5963
7.4981
7.4509
7.3925
7.2828
7.2487
7.1706
7.0545
7.0367
6.9058
6.8864
6.8671
6.8138
6.7946
4.1263
4.1101
4.0939
2.8579
2.8418
2.8257
2.1276
2.0711
2.0521
1.9280
1.9227
1.8680
1.8115
1.7919
1.7537
-0.0000
Title WYR5-52
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
Br
4o+5o
1.00
1.00
1.00
1.00
7.00
4.00
2.00
1.00
0.98
1.00
2.00
1.00
2.00
1.00
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)

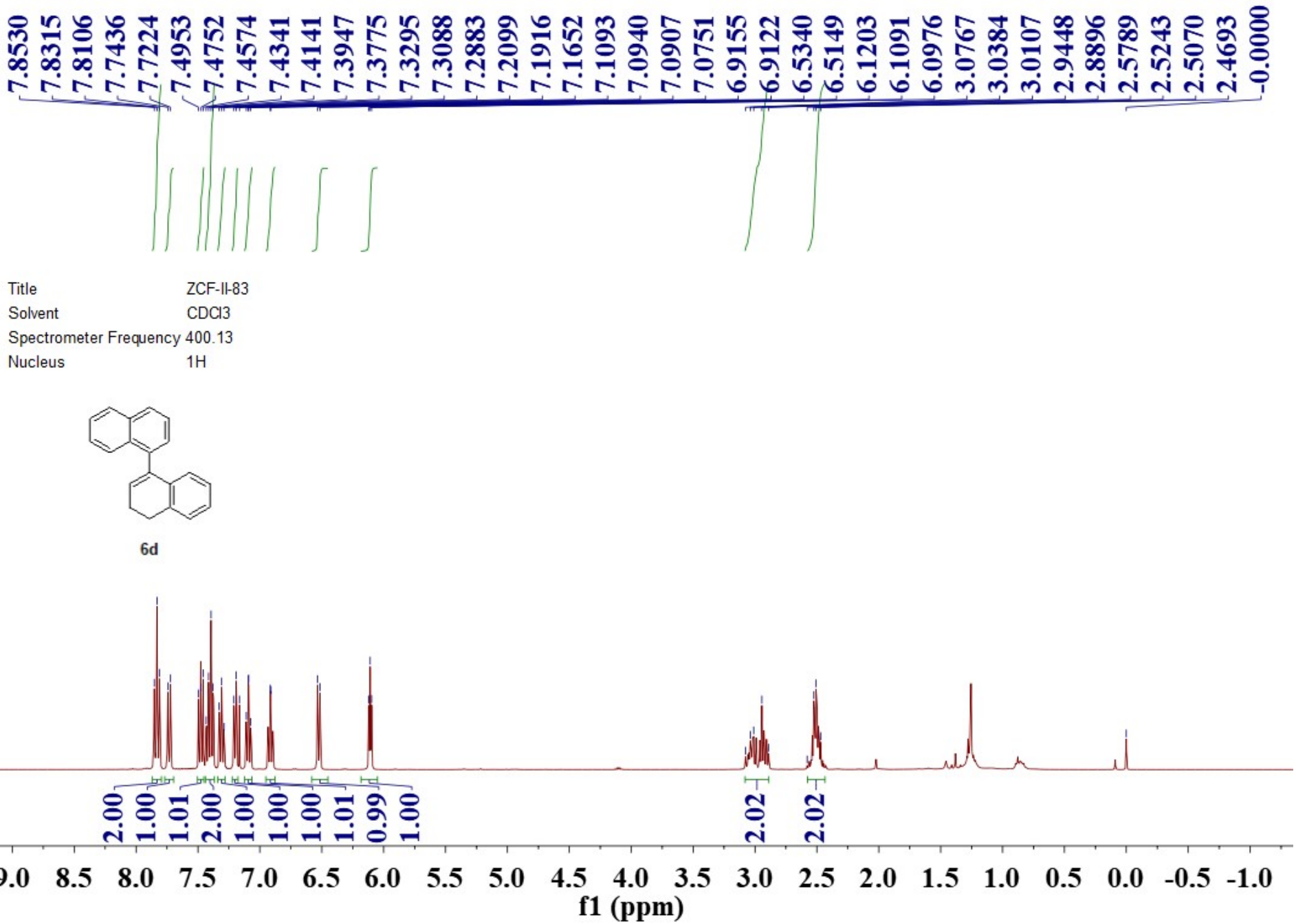

146.9715
142.1920
140.8959
140.4884
137.1688
133.1577
132.3967
130.3802
130.2326
130.1037
129.6560
128.9453
128.4752
128.4534
127.9756
127.6369
126.9694
126.9110
126.8928
126.3399
126.2908
125.8893
123.3887
77.2000
46.1026
32.5786
30.7709
20.7087
Title WYR5-52
Solvent CDC13
Spectrometer Frequency 100.62
Nucleus 13C
Br
Br
4o+5o
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

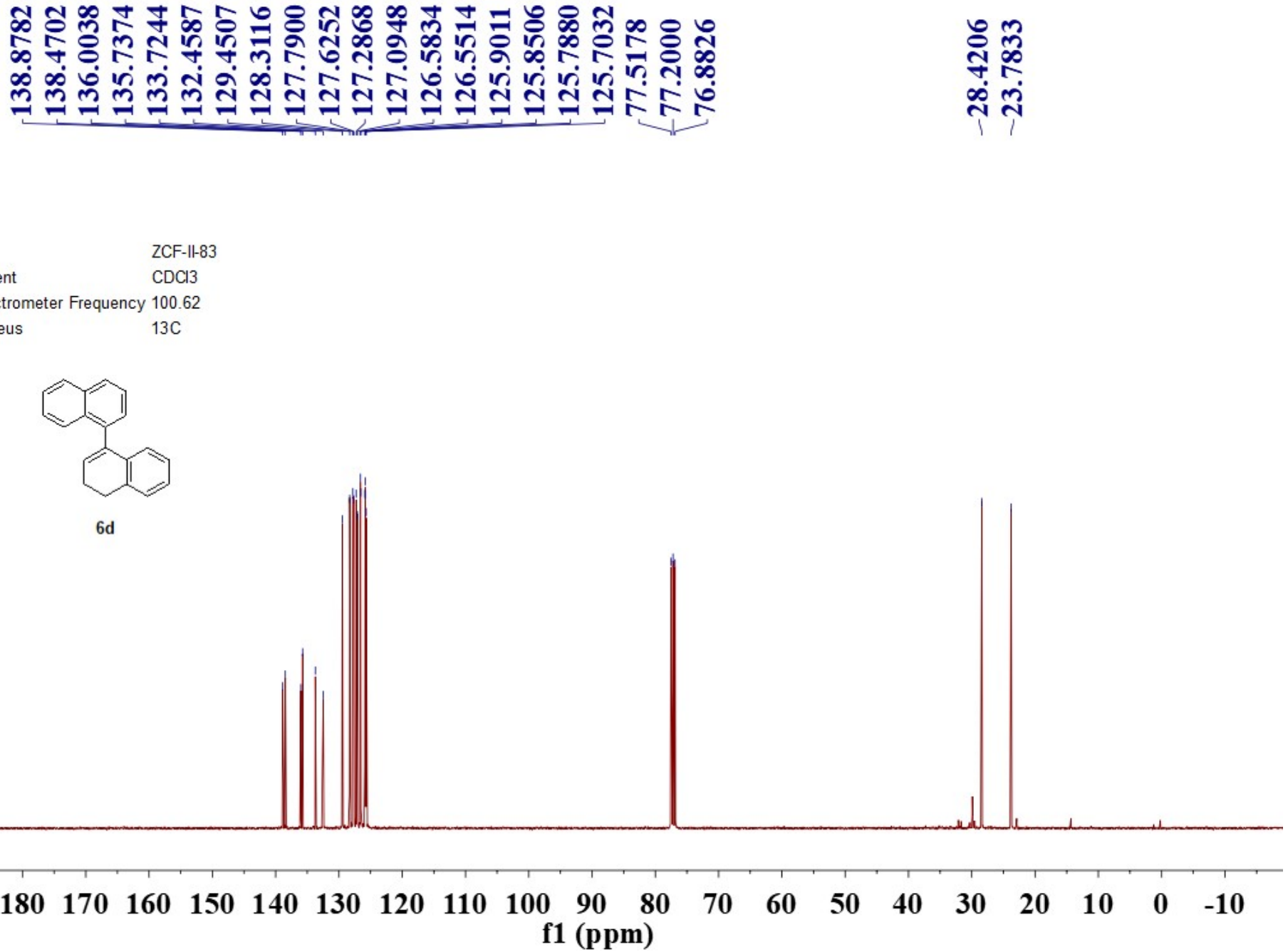

7.6182
7.6152
7.5981
7.5950
7.3476
7.3291
7.3077
7.2727
7.2116
7.1907
7.1711
7.1483
7.1301
7.1117
7.0727
7.0507
7.0319
6.6214
6.6184
6.6024
6.5993
5.9833
5.9720
5.9605
2.9890
2.9713
2.9044
2.8609
2.8062
2.5240
2.5073
2.4650
2.4441
2.3463
-0.0000
Title ZCF-II-72
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
6b
1.00
1.02
1.00
2.00
1.01
1.00
1.00
1.00
2.03
2.05
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)


141.6669
139.5536
135.8450
134.5607
132.8511
131.7626
129.0198
128.9094
127.6952
127.5322
127.1848
126.4963
124.8610
124.1934
77.2000
28.1233
23.5567
Title ZCF-II-72
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
6b
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.1574
7.1073
7.1046
7.0568
7.0435
7.0378
7.0315
7.0268
7.0127
6.6471
6.6294
6.6270
5.9225
5.9156
5.9109
5.9039
2.9093
2.8859
2.8791
2.8596
2.8416
2.4406
2.4355
2.4232
2.4073
2.3904
2.3569
2.0688
0.0000
Title ZCF-II-76
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
6c
1.00
5.02
1.00
1.00
2.01
2.00
3.00
3.00
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)


139.4420
137.6337
136.9288
136.5002
135.9891
135.4973
130.7724
130.1317
127.7764
127.5918
126.9296
126.5887
126.5268
124.9921
77.2000
28.3896
23.6106
21.3157
19.9980
Title ZCF-II-76
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
6c
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.8530
7.8315
7.8106
7.7436
7.7224
7.4953
7.4752
7.4574
7.4341
7.4141
7.3947
7.3775
7.3295
7.3088
7.2883
7.2099
7.1916
7.1652
7.1093
7.0940
7.0907
7.0751
6.9155
6.9122
6.5340
6.5149
6.1203
6.1091
6.0976
3.0767
3.0384
3.0107
2.9448
2.8896
2.5789
2.5243
2.5070
2.4693
-0.0000
Title ZCF-II-83
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
6d
2.00
1.00
1.01
2.00
1.00
1.00
1.00
1.01
0.99
1.00
2.02
2.02
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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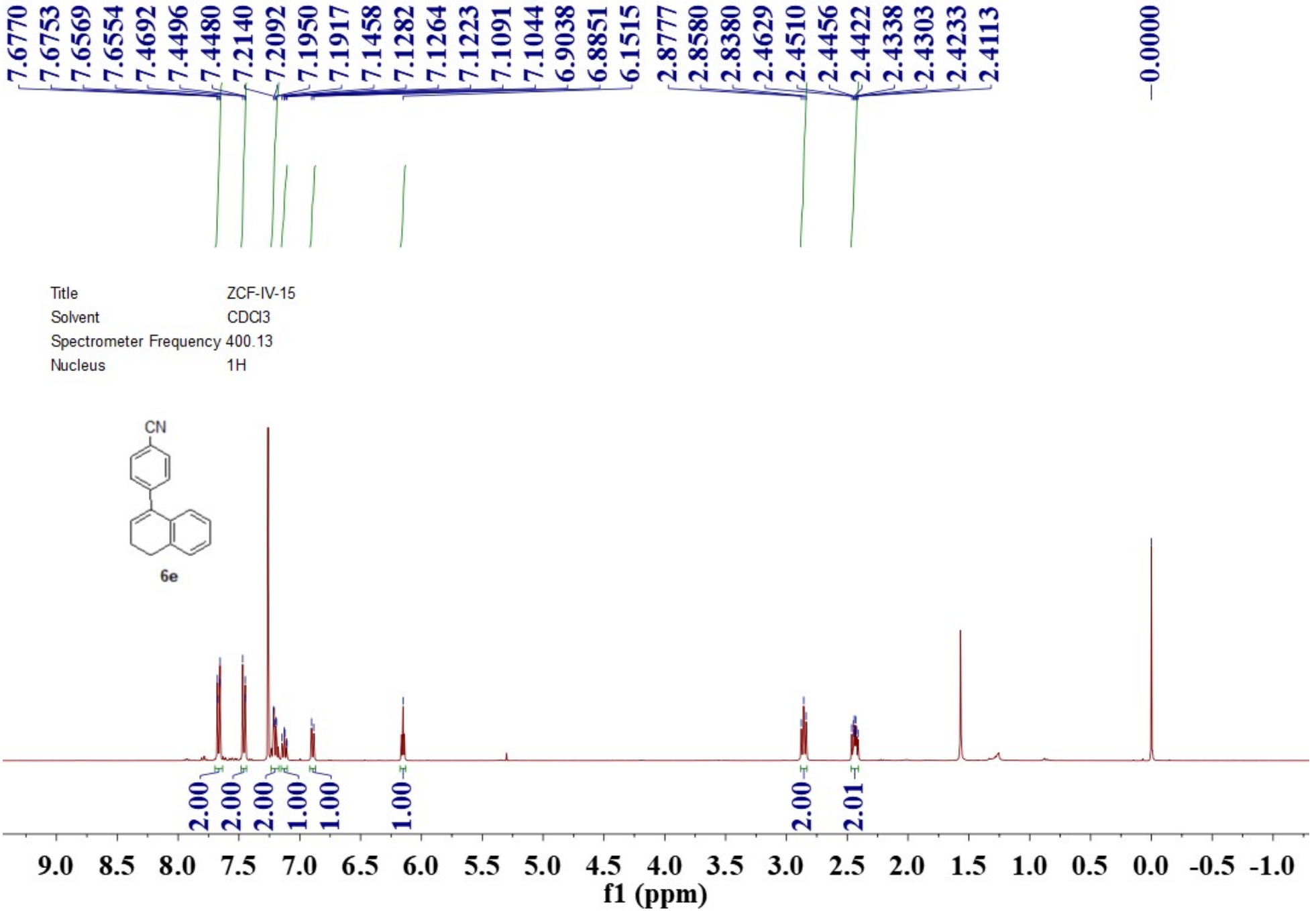
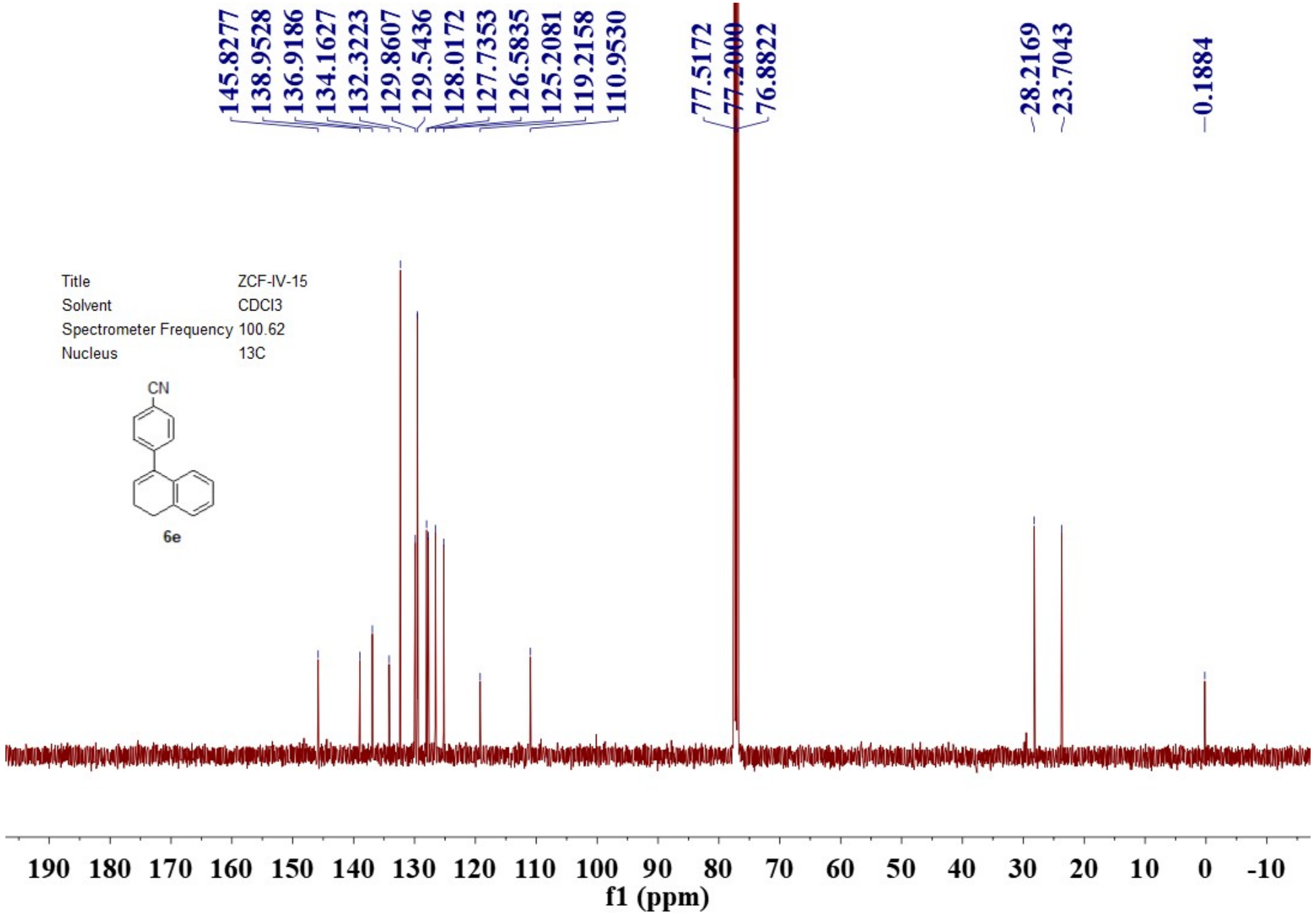
138.4702
136.0038
135.7374
133.7244
132.4587
129.4507
128.3116
127.7900
127.6252
127.2868
127.0948
126.5834
126.5514
125.9011
125.8506
125.7880
125.7032
77.5178
77.2000
76.8826
28.4206
23.7833
Title ZCF-II-83
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
6d
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.6770
7.6753
7.6569
7.6554
7.4692
7.4496
7.4480
7.2140
7.2092
7.1950
7.1917
7.1458
7.1282
7.1264
7.1223
7.1091
7.1044
6.9038
6.8851
6.1515
2.8777
2.8580
2.8380
2.4629
2.4510
2.4456
2.4422
2.4338
2.4303
2.4233
2.4113
0.0000
Title ZCF-IV-15
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
CN
6e
2.00
2.00
2.00
1.00
1.00
1.00
2.00
2.01
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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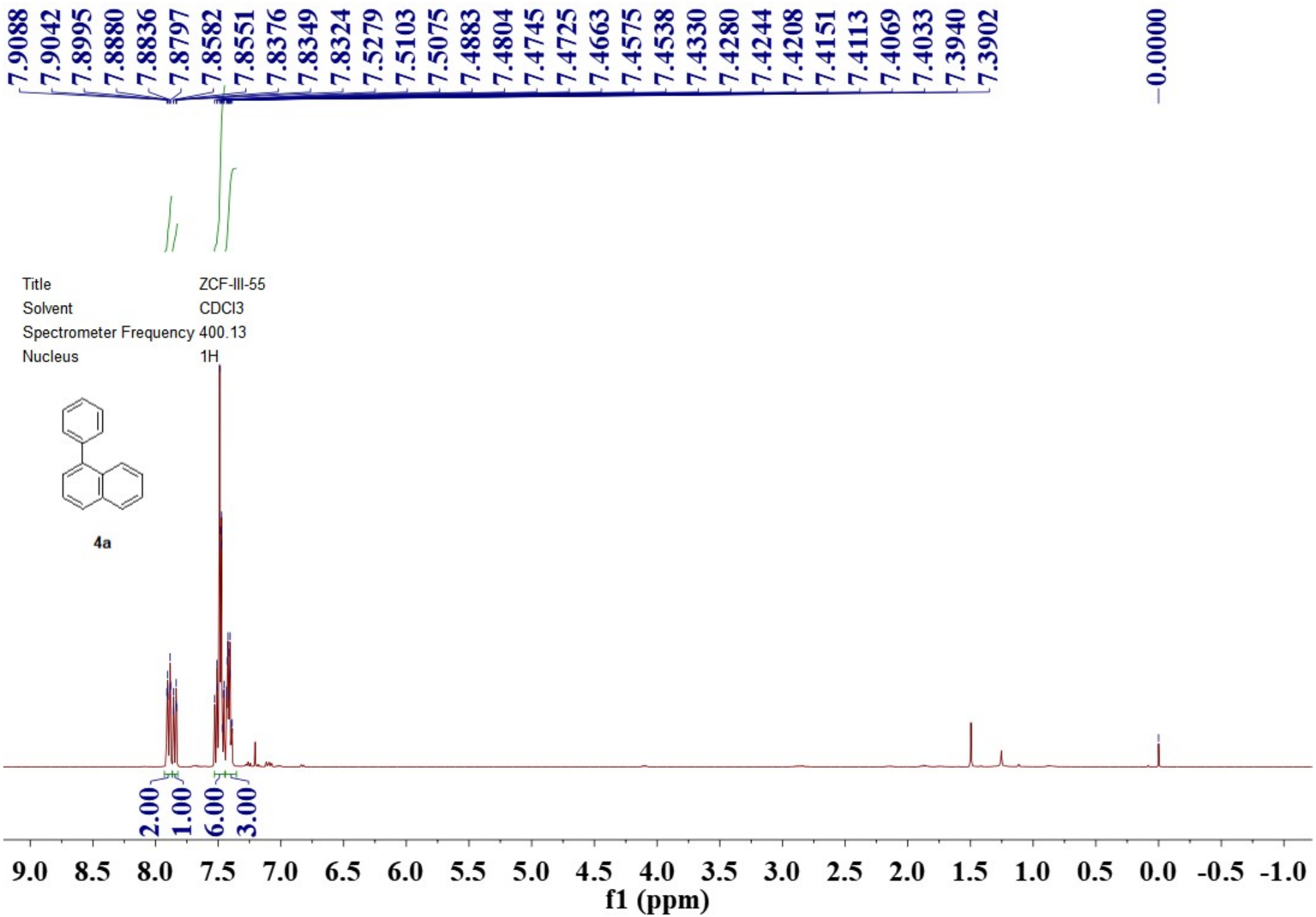
134.1627
132.3223
129.8607
129.5436
128.0172
127.7353
126.5835
125.2081
119.2158
110.9530
77.5172
77.2000
76.8822
28.2169
23.7043
0.1884
Title ZCF-IV-15
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
CN
6e
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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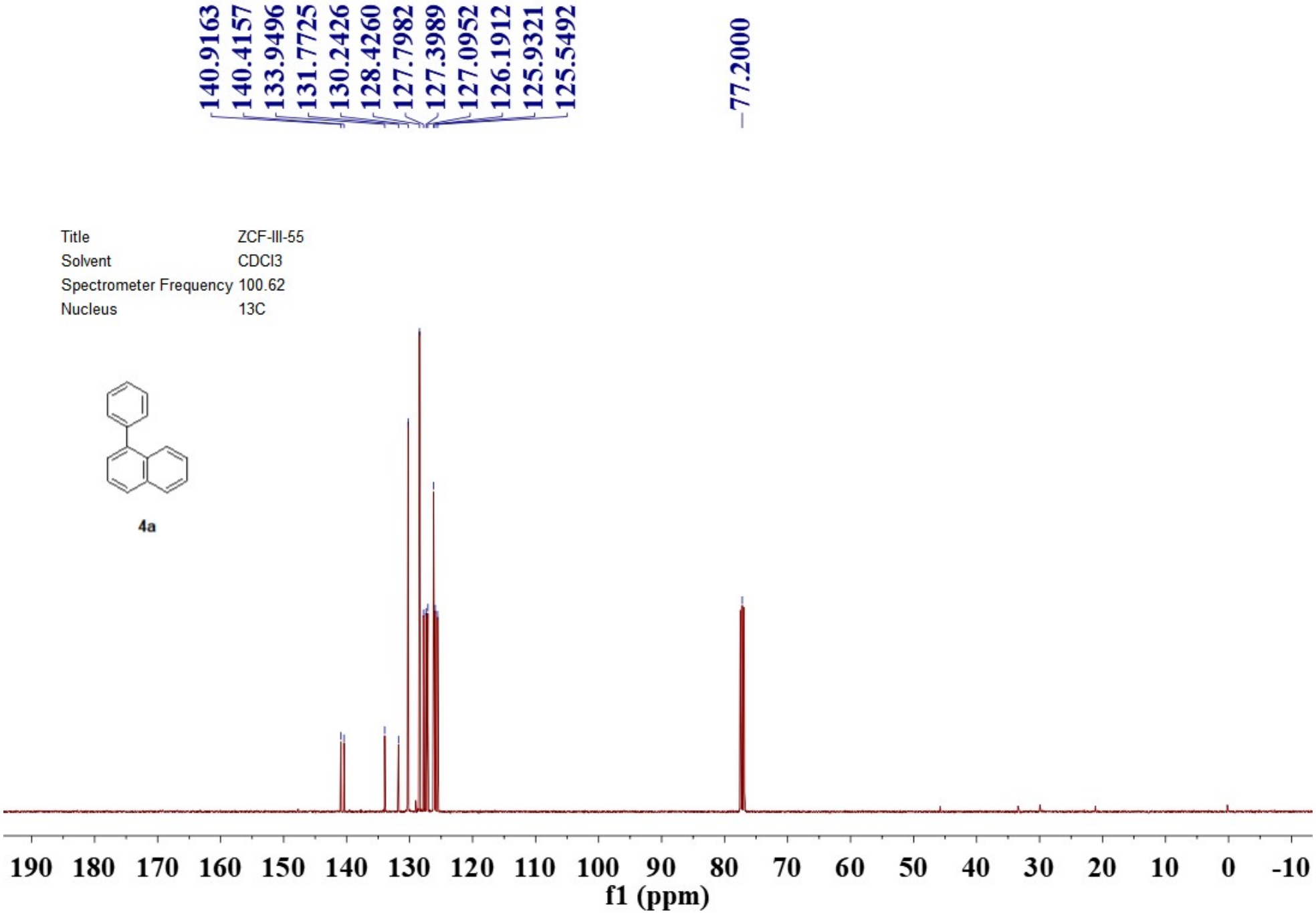
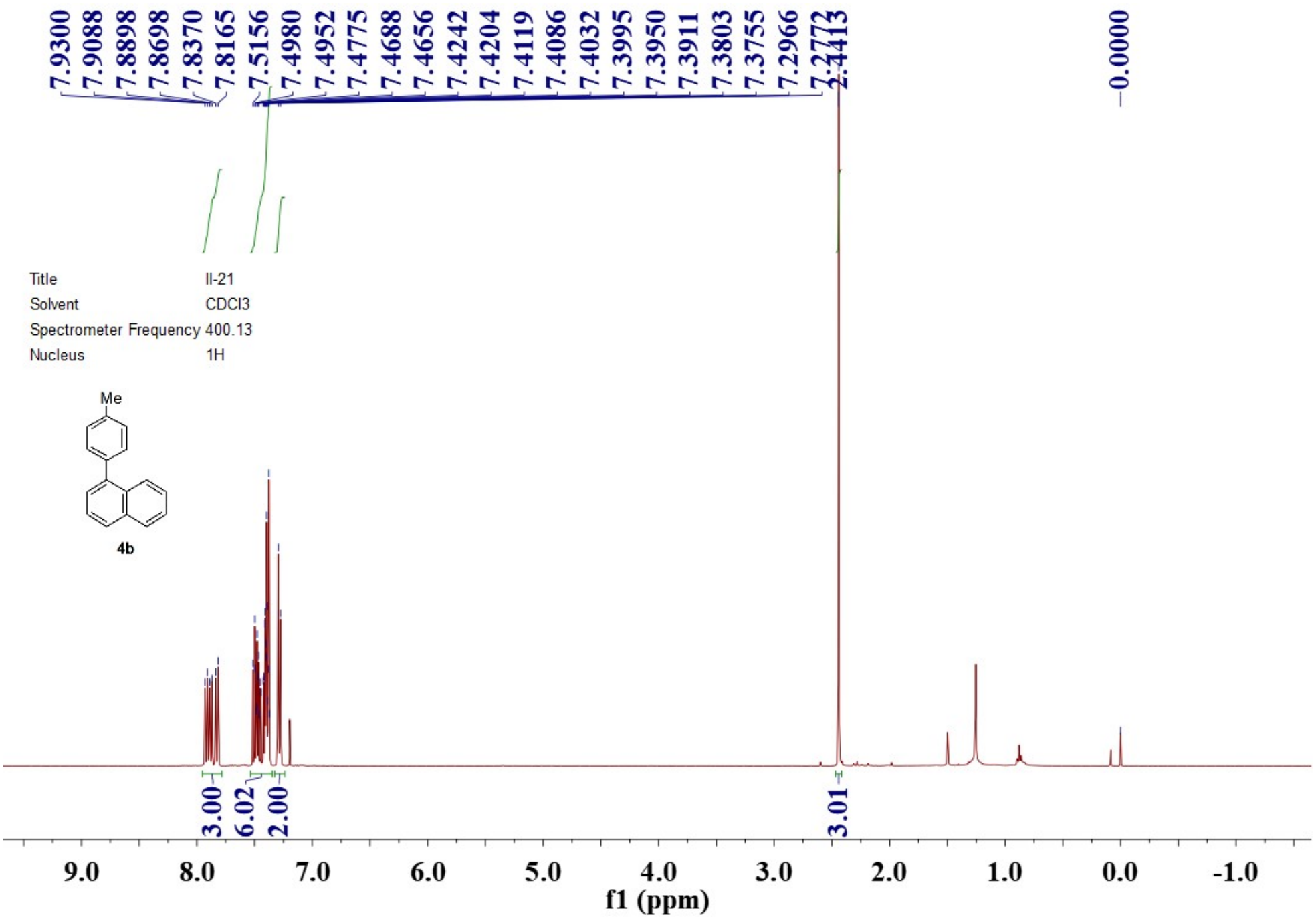
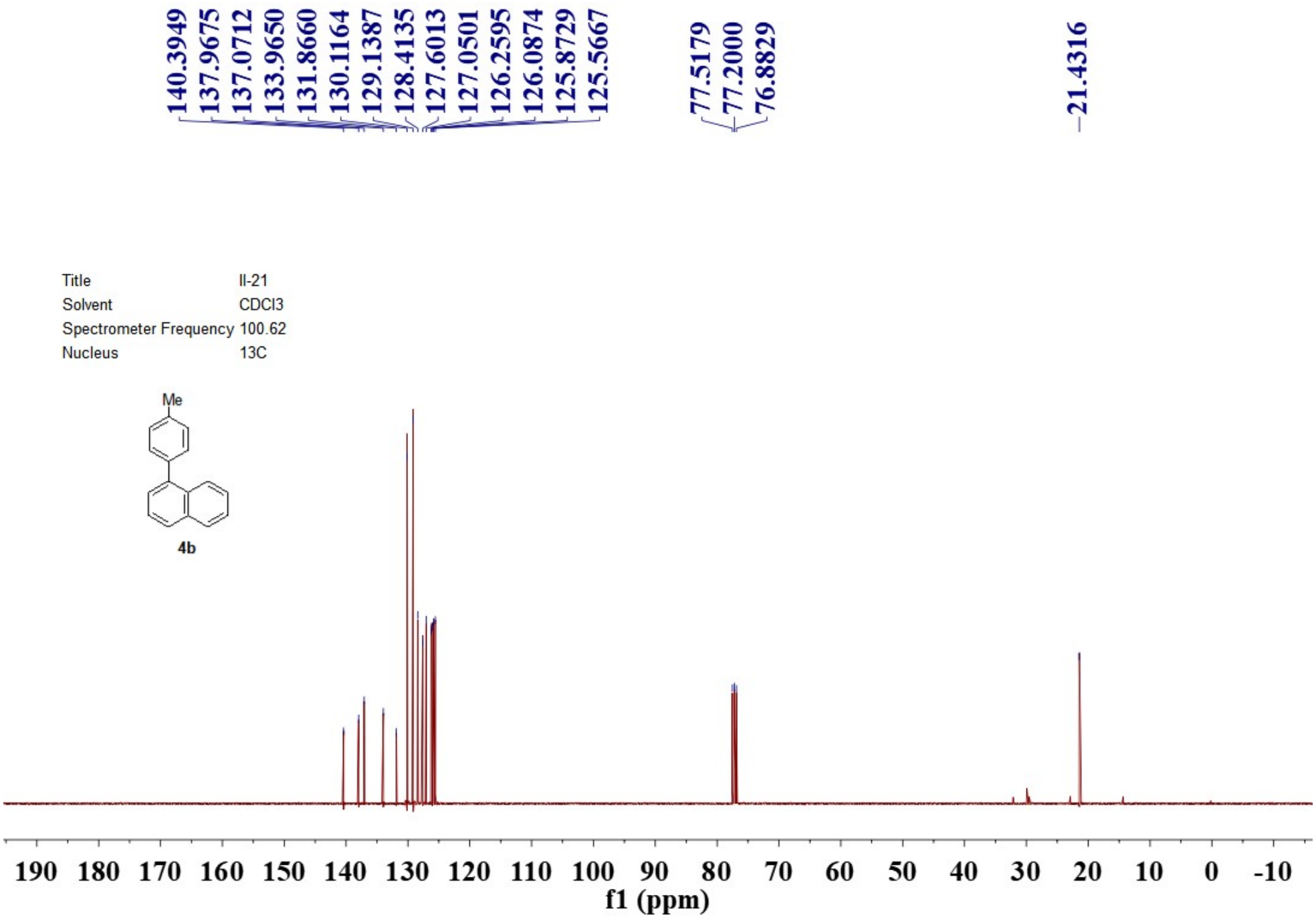
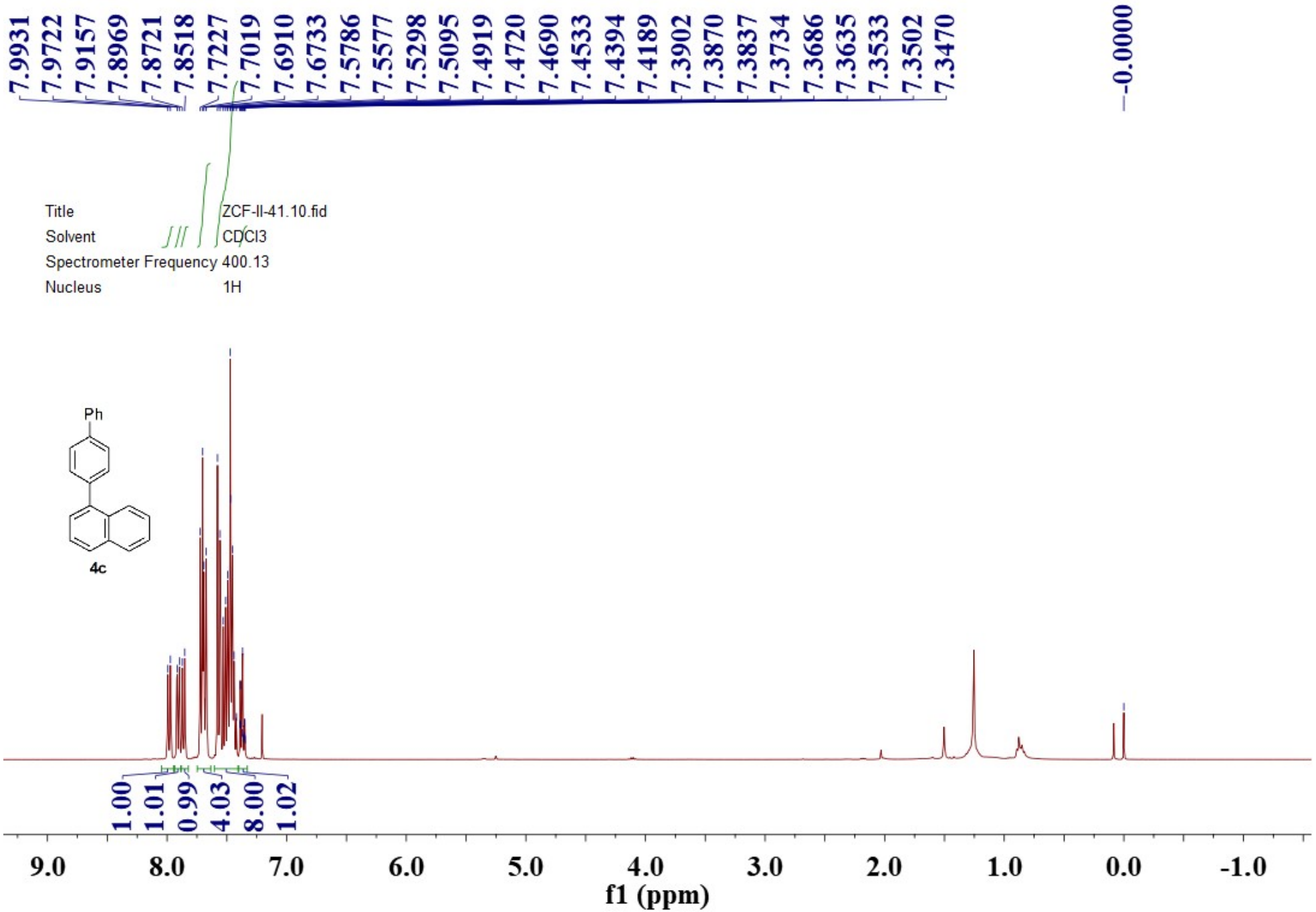
7.9042
7.8995
7.8880
7.8836
7.8797
7.8582
7.8551
7.8376
7.8349
7.8324
7.5279
7.5103
7.5075
7.4883
7.4804
7.4745
7.4725
7.4663
7.4575
7.4538
7.4330
7.4280
7.4244
7.4208
7.4151
7.4113
7.4069
7.4033
7.3940
7.3902
0.0000
Title ZCF-III-55
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
4a
2.00
1.00
6.00
3.00
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)


140.9163
140.4157
133.9496
131.7725
130.2426
128.4260
127.7982
127.3989
127.0952
126.1912
125.9321
125.5492
77.2000
Title ZCF-III-55
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
4a
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

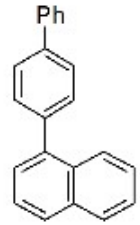

7.9300
7.9088
7.8898
7.8698
7.8370
7.8165
7.5156
7.4980
7.4952
7.4775
7.4688
7.4656
7.4242
7.4204
7.4119
7.4086
7.4032
7.3995
7.3950
7.3911
7.3803
7.3755
7.2966
7.2772
2.3413
0.0000
Title II-21
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
4b
3.00
6.02
2.00
3.01
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)


140.3949
137.9675
137.0712
133.9650
131.8660
130.1164
129.1387
128.4135
127.6013
127.0501
126.2595
126.0874
125.8729
125.5667
77.5179
77.2000
76.8829
21.4316
Title II-21
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
4b
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

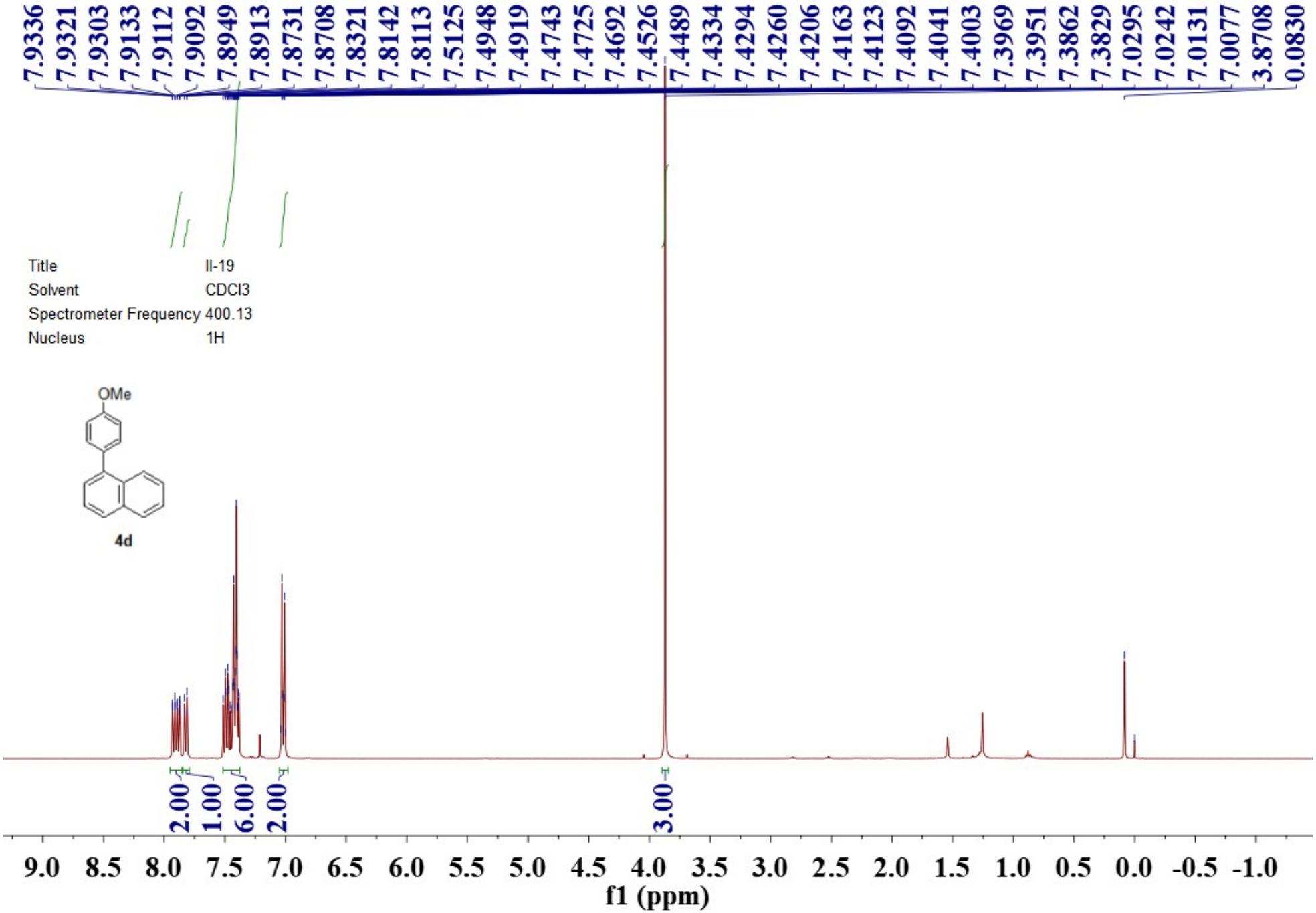

7.9931
7.9722
7.9157
7.8969
7.8721
7.8518
7.7227
7.7019
7.6910
7.6733
7.5786
7.5577
7.5298
7.5095
7.4919
7.4720
7.4690
7.4533
7.4394
7.4189
7.3902
7.3870
7.3837
7.3734
7.3686
7.3635
7.3533
7.3502
7.3470
-0.0000
Title ZCF-II-41.10.fid
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ph
4c
1.00
1.01
0.99
4.03
8.00
1.02
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

140.9802
140.2505
139.9904
139.8998
133.9944
131.7558
130.6665
129.0194
128.4832
127.8820
127.5356
127.3021
127.1639
127.1208
126.2562
126.1822
125.9848
125.5893
77.5178
77.2000
76.8827

Title	ZCF-II-41.10.fid
Solvent	CDCl3
Spectrometer Frequency	100.62
Nucleus	13C



4c

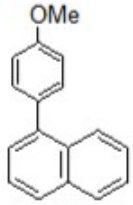

7.9336
7.9321
7.9303
7.9133
7.9112
7.9092
7.8949
7.8913
7.8731
7.8708
7.8321
7.8142
7.8113
7.5125
7.4948
7.4919
7.4743
7.4725
7.4692
7.4526
7.4489
7.4334
7.4294
7.4260
7.4206
7.4163
7.4123
7.4092
7.4041
7.4003
7.3969
7.3951
7.3862
7.3829
7.0295
7.0242
7.0131
7.0077
3.8708
0.0830
Title II-19
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
OMe
4d
2.00
1.00
6.00
2.00
3.00
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)

159.0815
140.0555
133.9921
133.2673
131.9746
131.2744
128.4218
127.4931
127.0720
126.2257
126.0855
125.8648
125.5725
113.8677

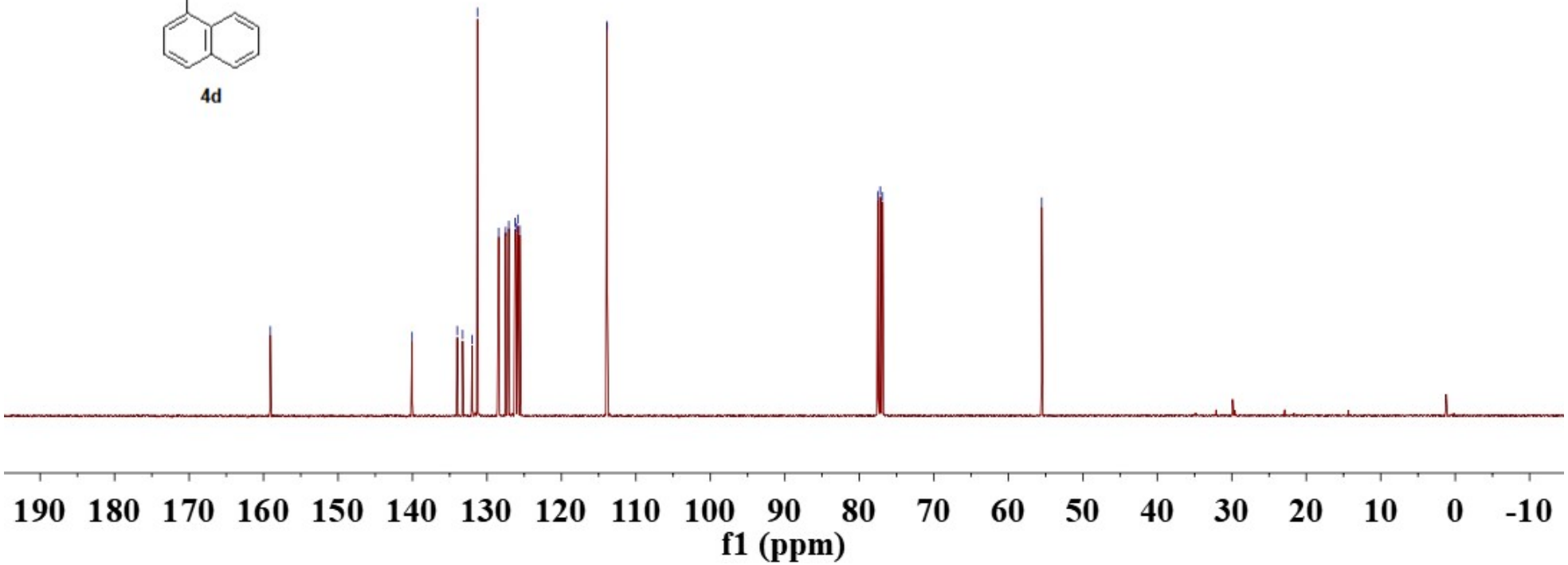
77.5170
77.2000
76.8822

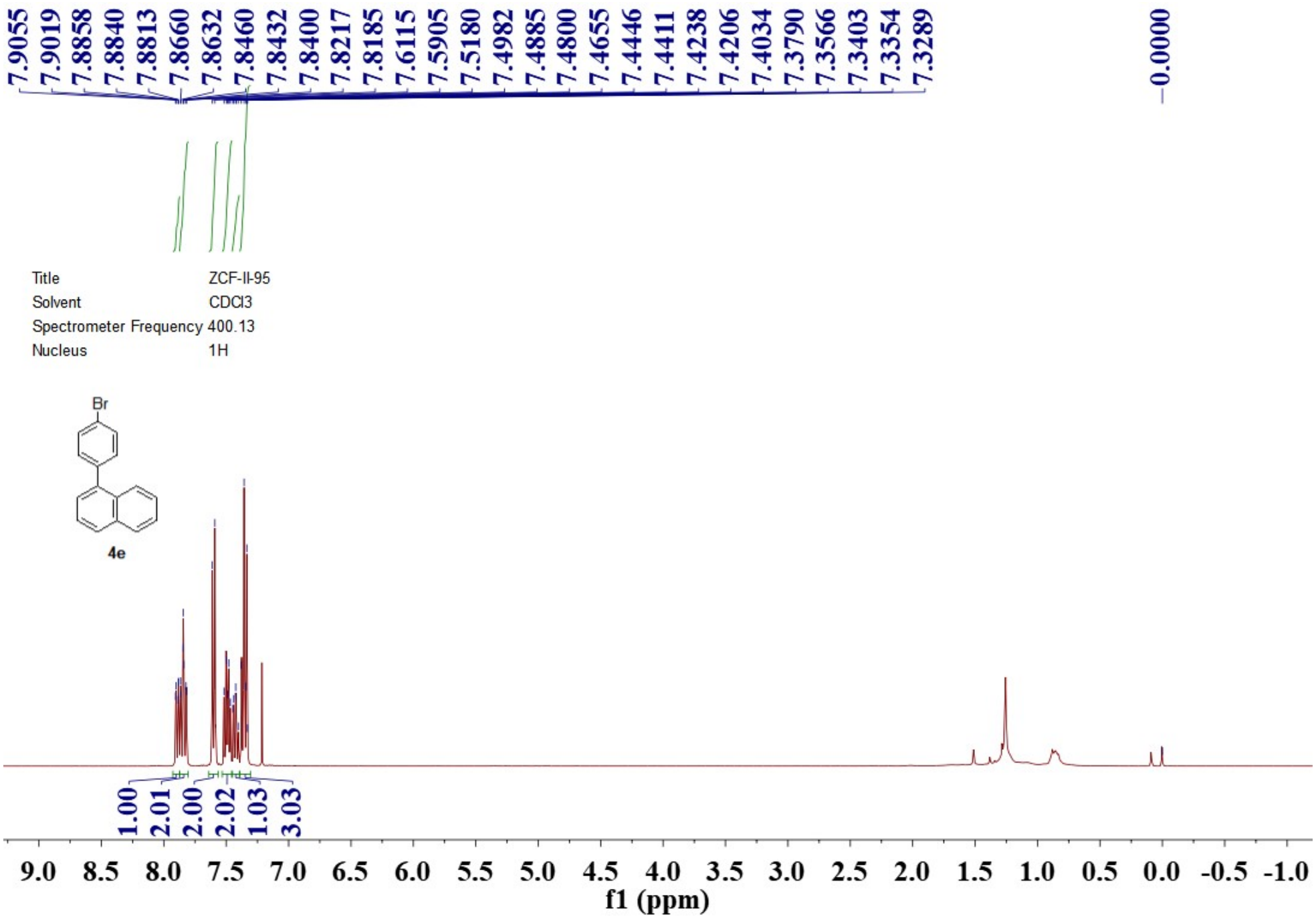
55.5108

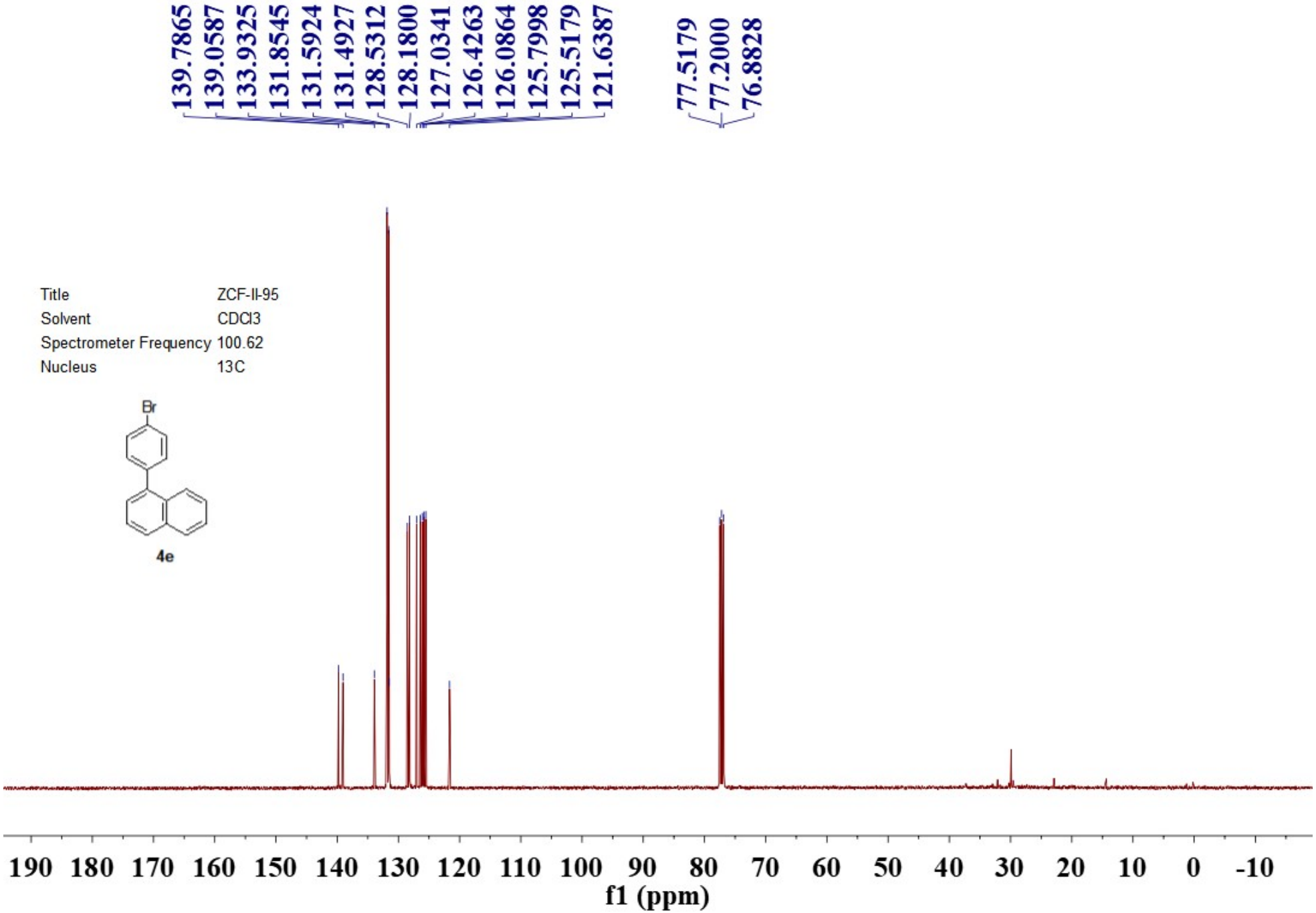
Title ZCF-II-19
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C

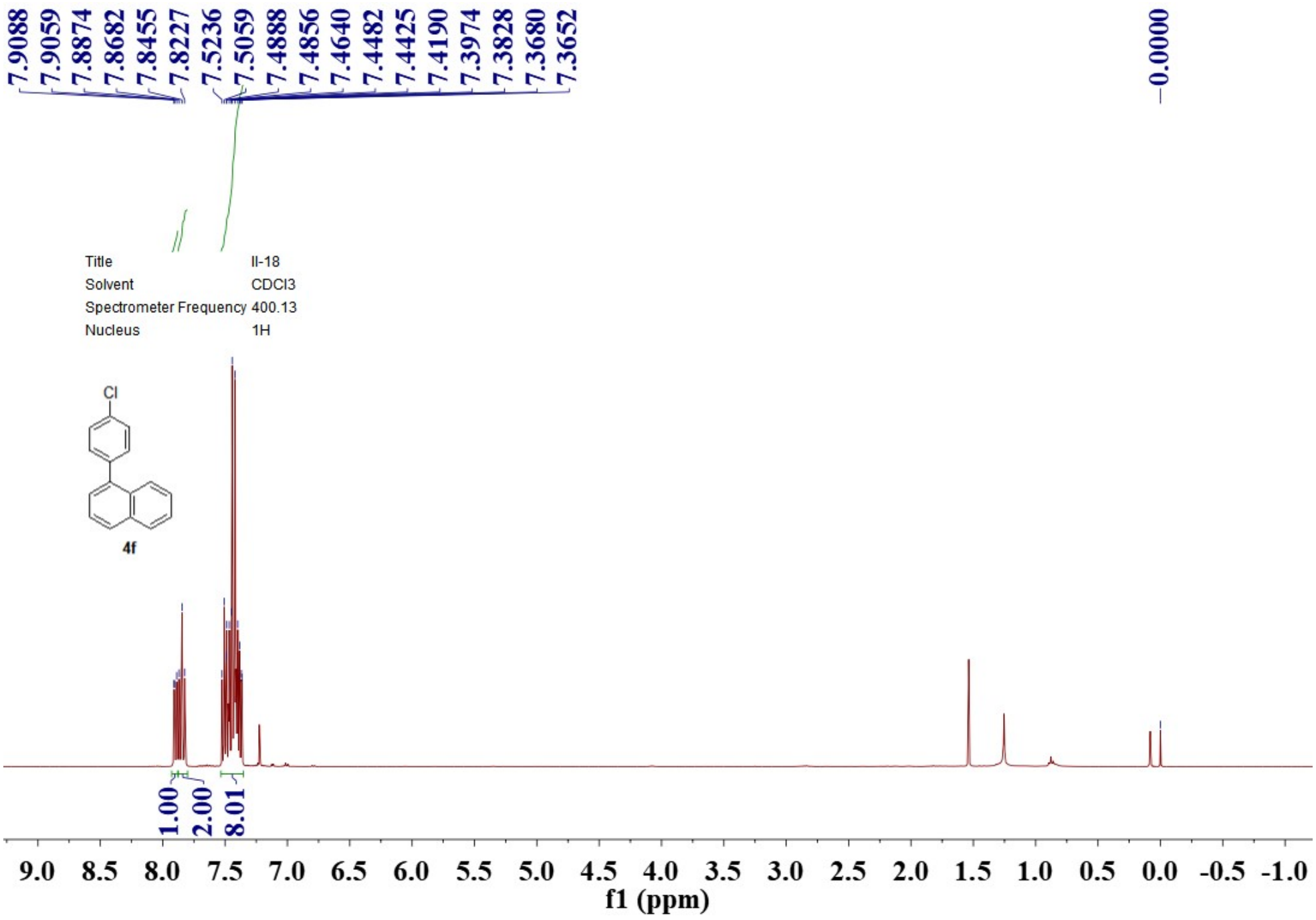


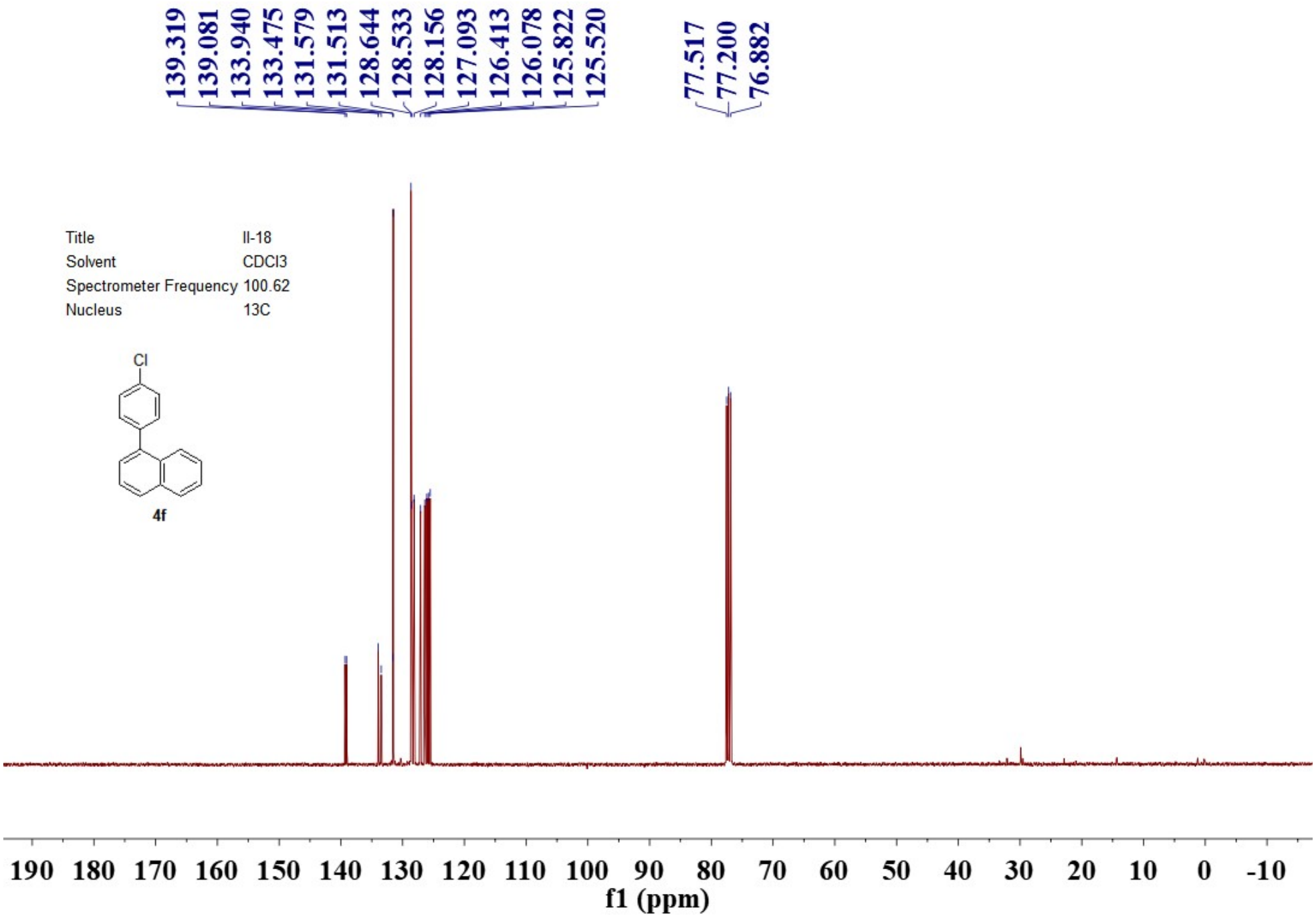
4d

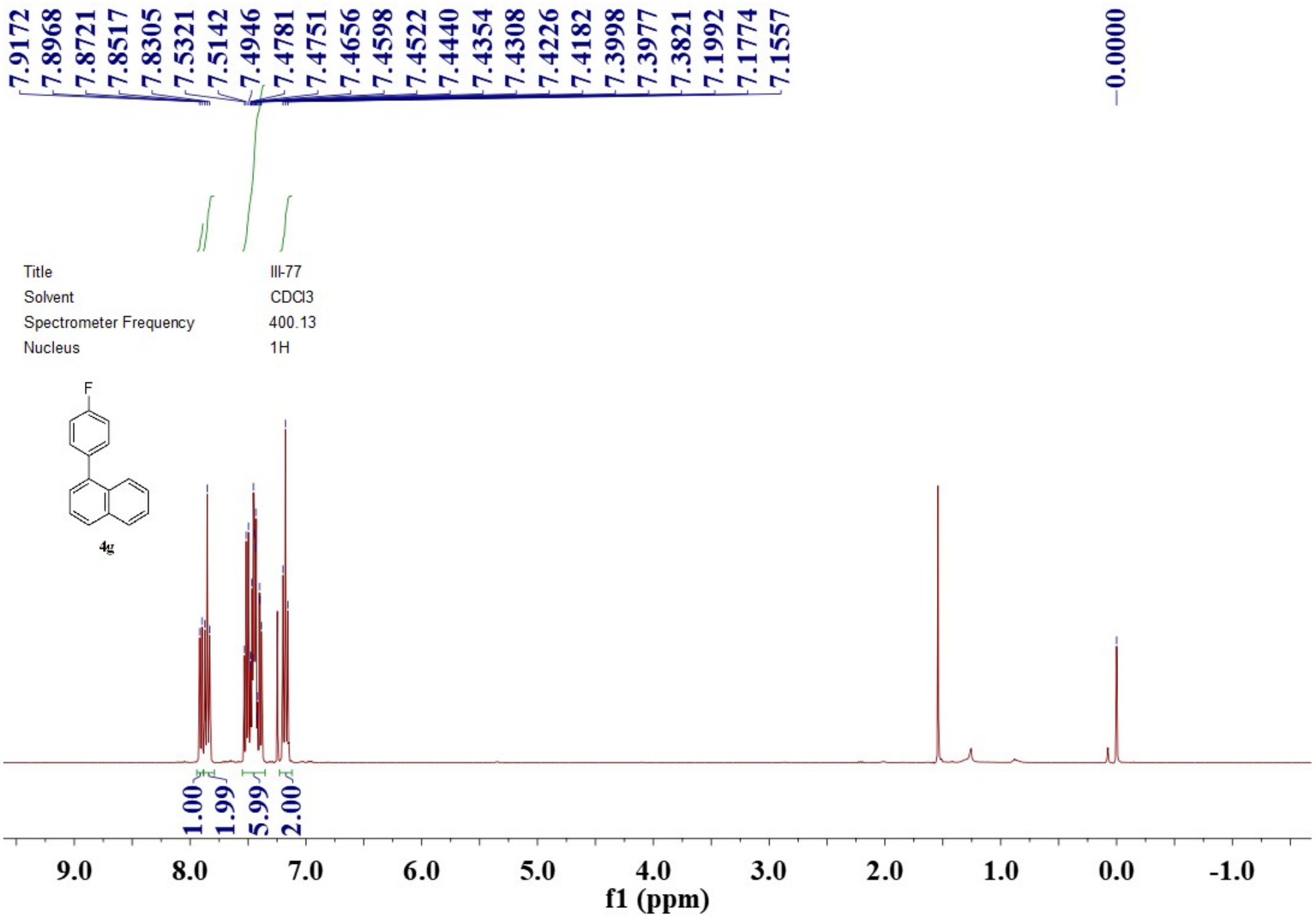


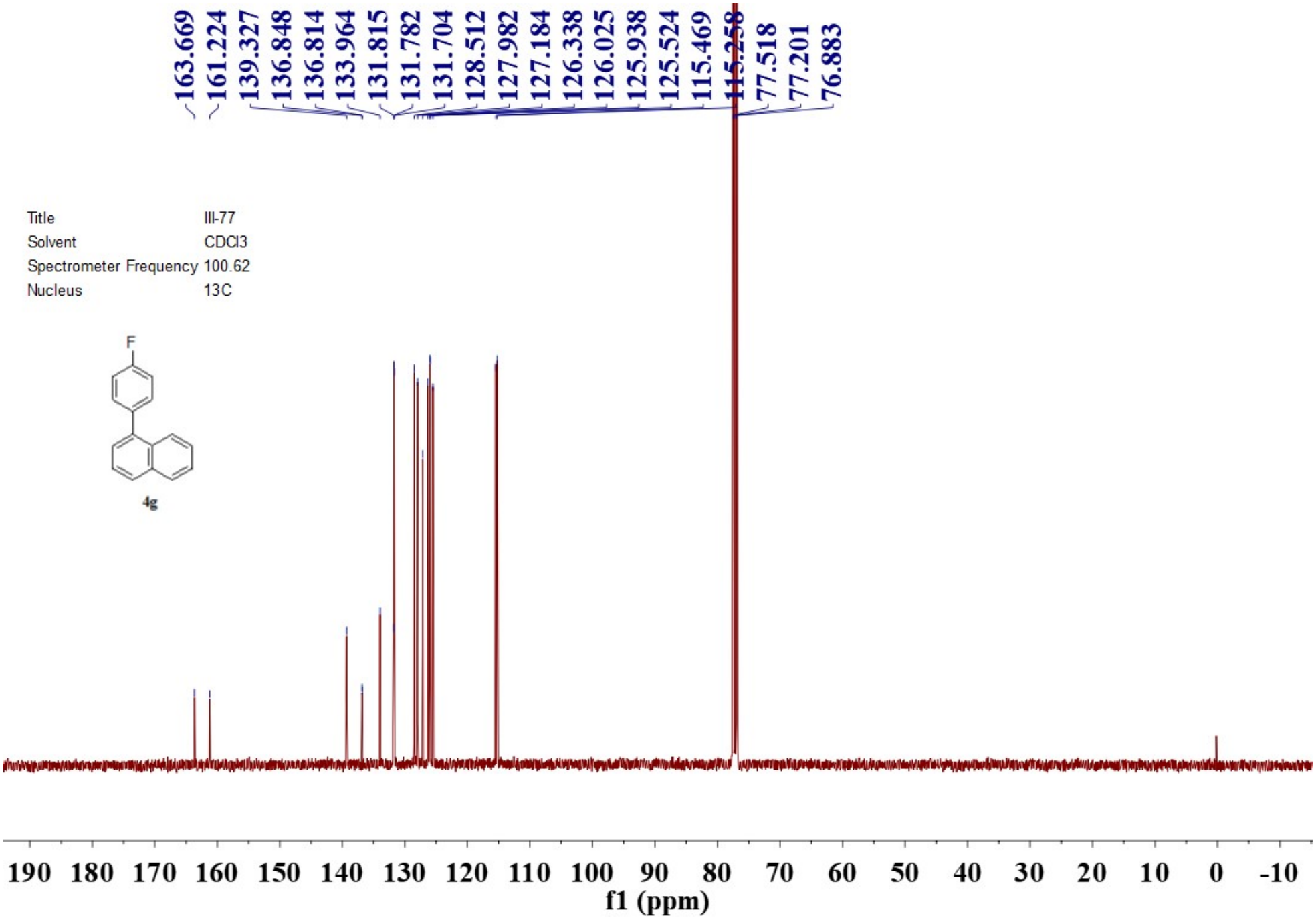

7.9055
7.9019
7.8858
7.8840
7.8813
7.8660
7.8632
7.8460
7.8432
7.8400
7.8217
7.8185
7.6115
7.5905
7.5180
7.4982
7.4885
7.4800
7.4655
7.4446
7.4411
7.4238
7.4206
7.4034
7.3790
7.3566
7.3403
7.3354
7.3289
0.0000
Title ZCF-II-95
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
4e
1.00
2.01
2.00
2.02
1.03
3.03
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)

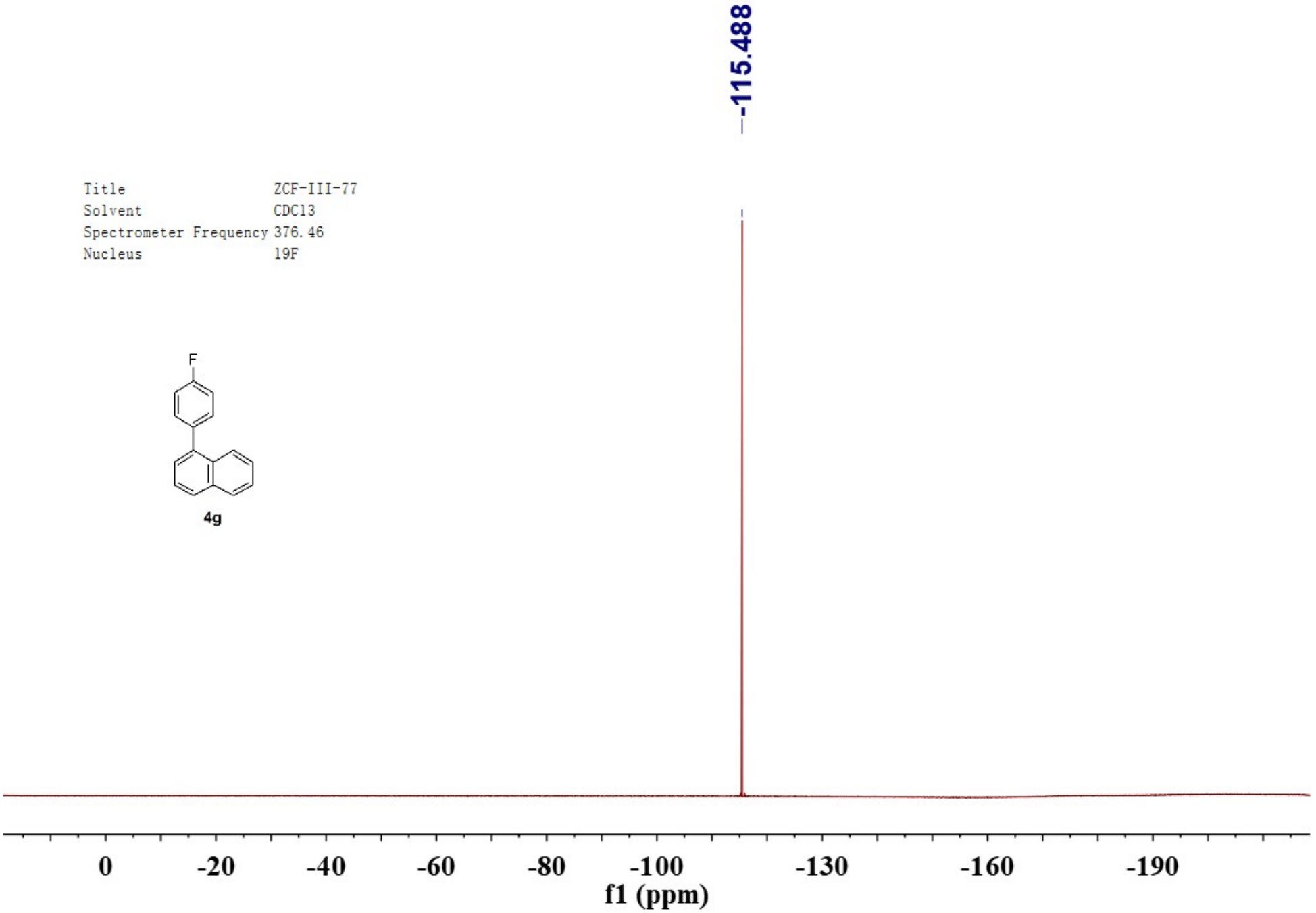

139.7865
139.0587
133.9325
131.8545
131.5924
131.4927
128.5312
128.1800
127.0341
126.4263
126.0864
125.7998
125.5179
121.6387
77.5179
77.2000
76.8828
Title ZCF-II-95
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
4e
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

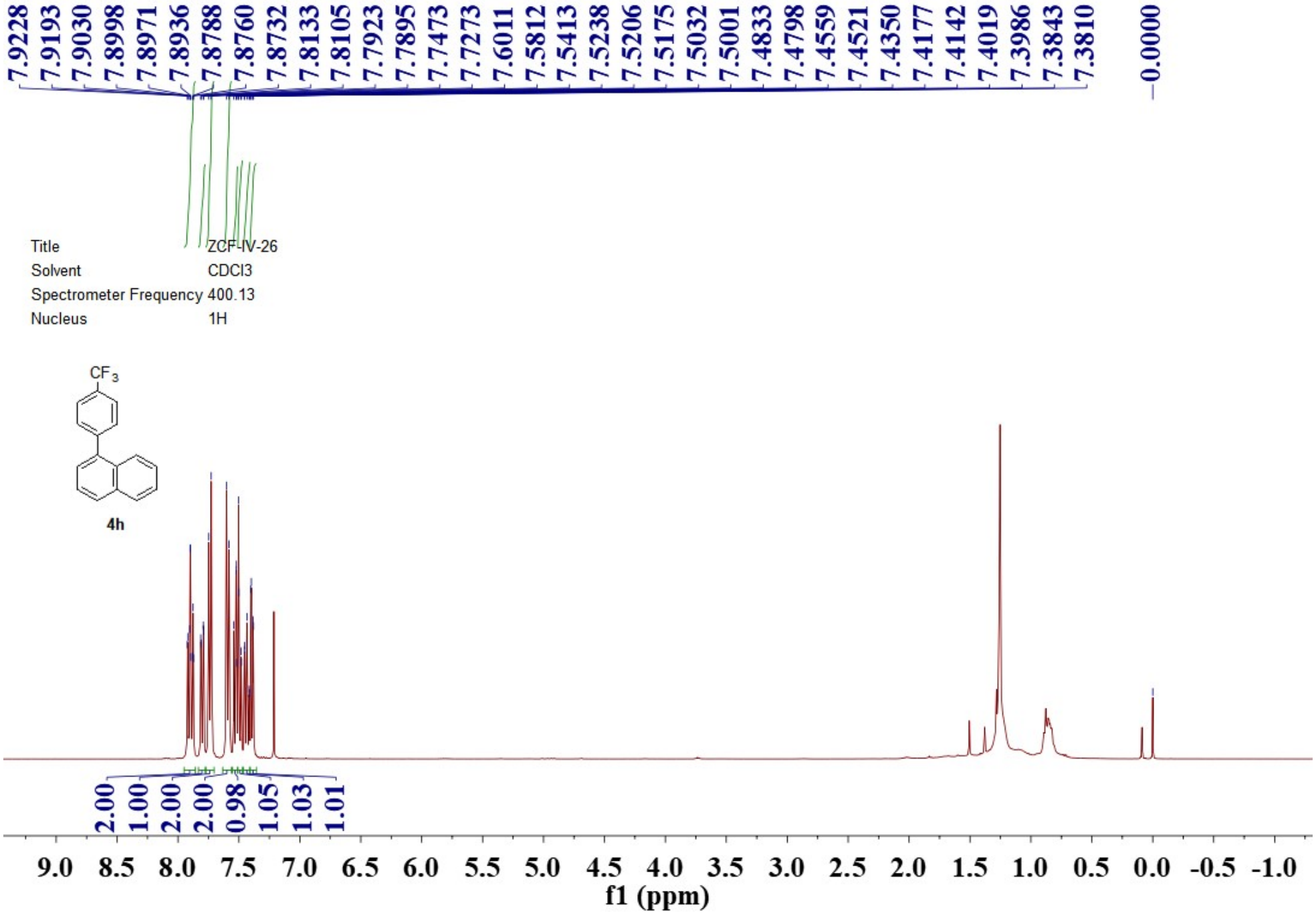

7.9088
7.9059
7.8874
7.8682
7.8455
7.8227
7.5236
7.5059
7.4888
7.4856
7.4640
7.4482
7.4425
7.4190
7.3974
7.3828
7.3680
7.3652
0.0000
Title II-18
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cl
4f
1.00
2.00
8.01
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)


139.319
139.081
133.940
133.475
131.579
131.513
128.644
128.533
128.156
127.093
126.413
126.078
125.822
125.520
77.517
77.200
76.882
Title II-18
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Cl
4f
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.9172
7.8968
7.8721
7.8517
7.8305
7.5321
7.5142
7.4946
7.4781
7.4751
7.4656
7.4598
7.4522
7.4440
7.4354
7.4308
7.4226
7.4182
7.3998
7.3977
7.3821
7.1992
7.1774
7.1557
0.0000
Title III-77
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
F
4g
1.00
1.99
5.99
2.00
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

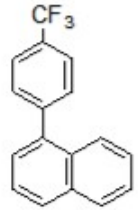

163.669
161.224
139.327
136.848
136.814
133.964
131.815
131.782
131.704
128.512
127.982
127.184
126.338
126.025
125.938
125.524
115.469
115.258
77.518
77.201
76.883
Title III-77
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
F
4g
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-115.488
Title ZCF-III-77
Solvent CDCl3
Spectrometer Frequency 376.46
Nucleus 19F
F
4g
0
-20
-40
-60
-80
-100
-130
-160
-190
f1 (ppm)

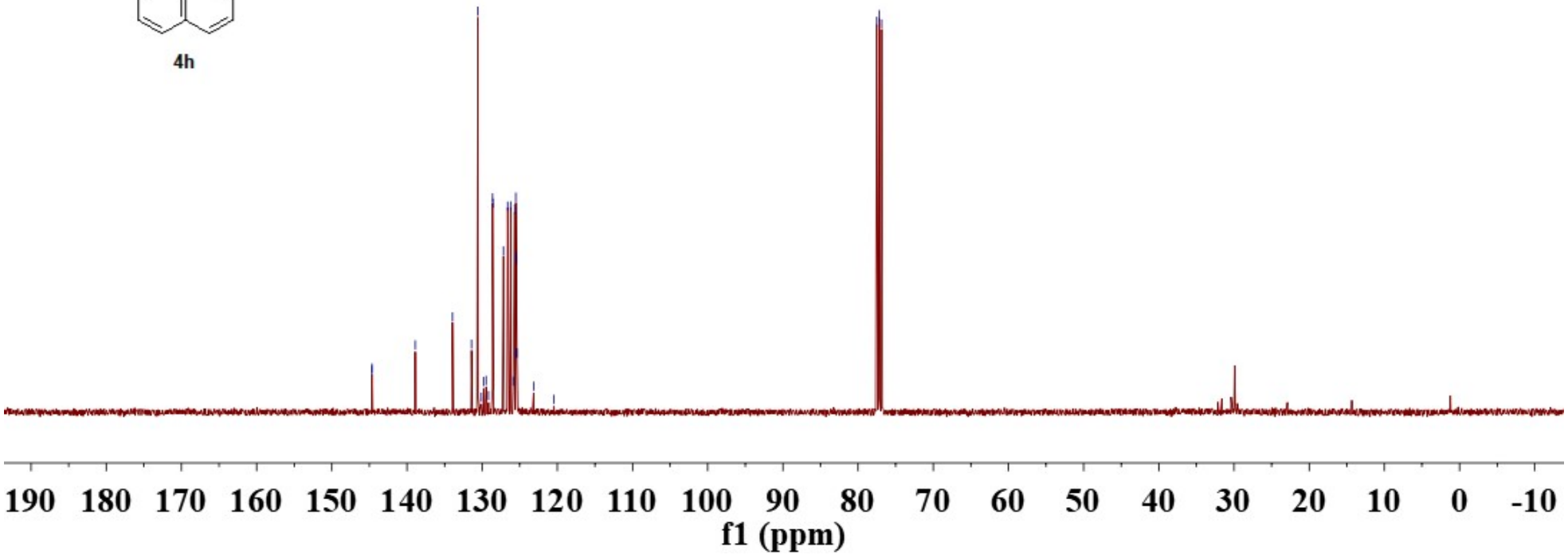

7.9228
7.9193
7.9030
7.8998
7.8971
7.8936
7.8788
7.8760
7.8732
7.8133
7.8105
7.7923
7.7895
7.7473
7.7273
7.6011
7.5812
7.5413
7.5238
7.5206
7.5175
7.5032
7.5001
7.4833
7.4798
7.4559
7.4521
7.4350
7.4177
7.4142
7.4019
7.3986
7.3843
7.3810
0.0000
Title ZCF-IV-26
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
CF3
4h
2.00
1.00
2.00
2.00
0.98
1.05
1.03
1.01
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)

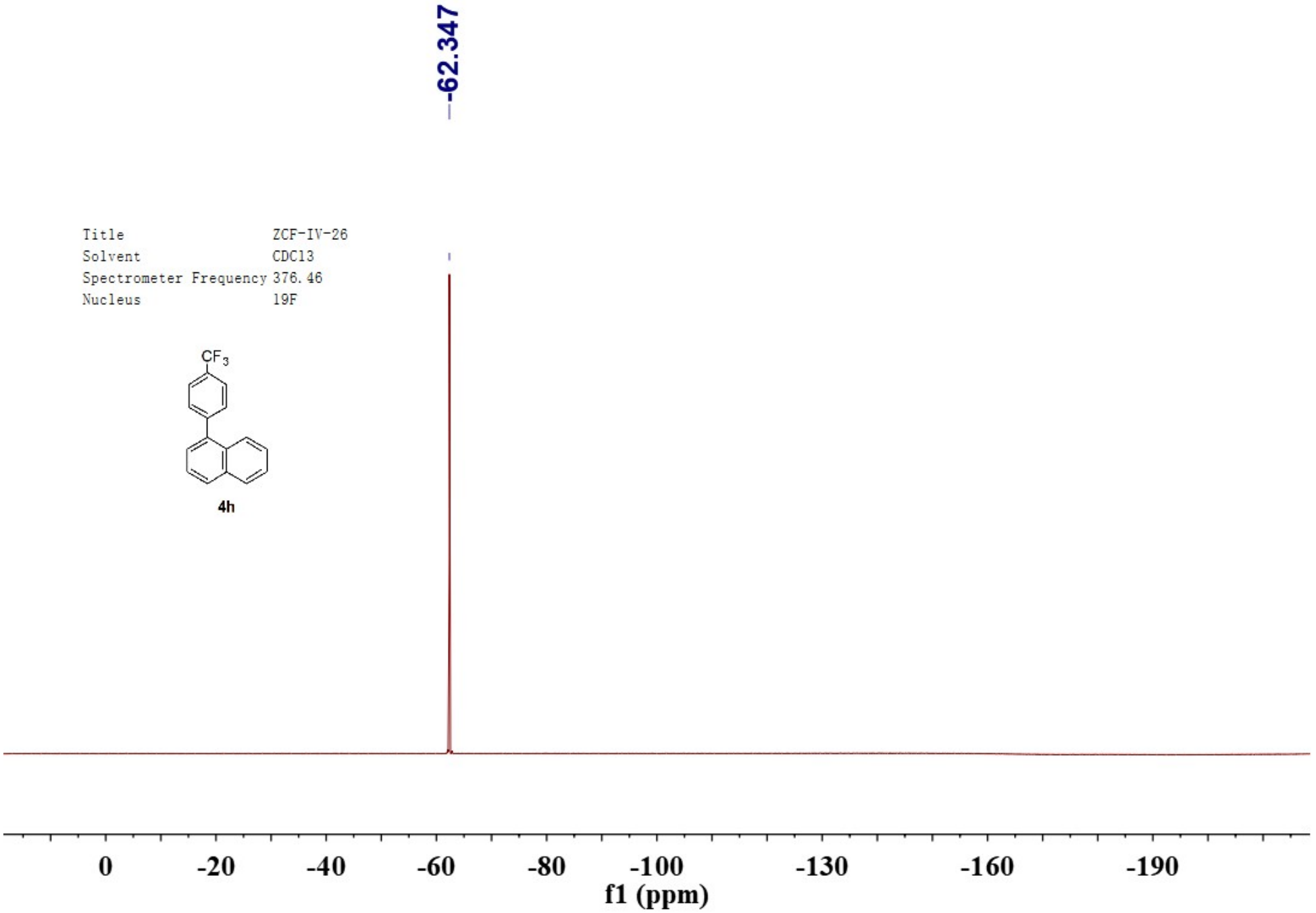
144.6516
144.6399
138.8901
133.9431
131.4149
130.5660
130.1272
129.8058
129.4825
129.1605
128.6102
128.5612
127.1879
126.6154
126.2145
125.8601
125.6672
125.5192
125.4764
125.4388
125.4015
125.3636
123.1567
120.4540
77.5173
77.2000
76.8823

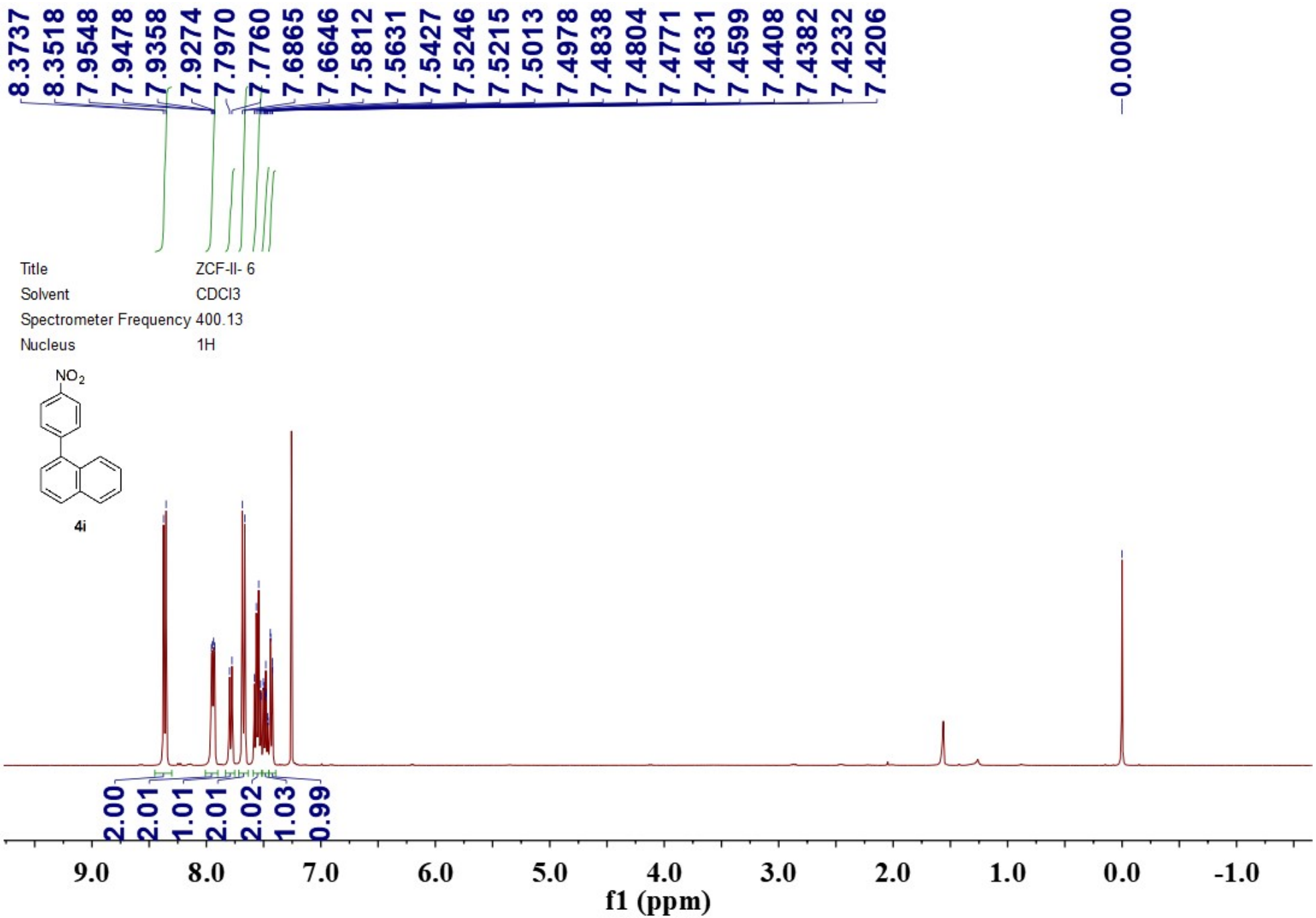
Title	ZCF-IV-26
Solvent	CDCl3
Spectrometer Frequency	100.62
Nucleus	13C

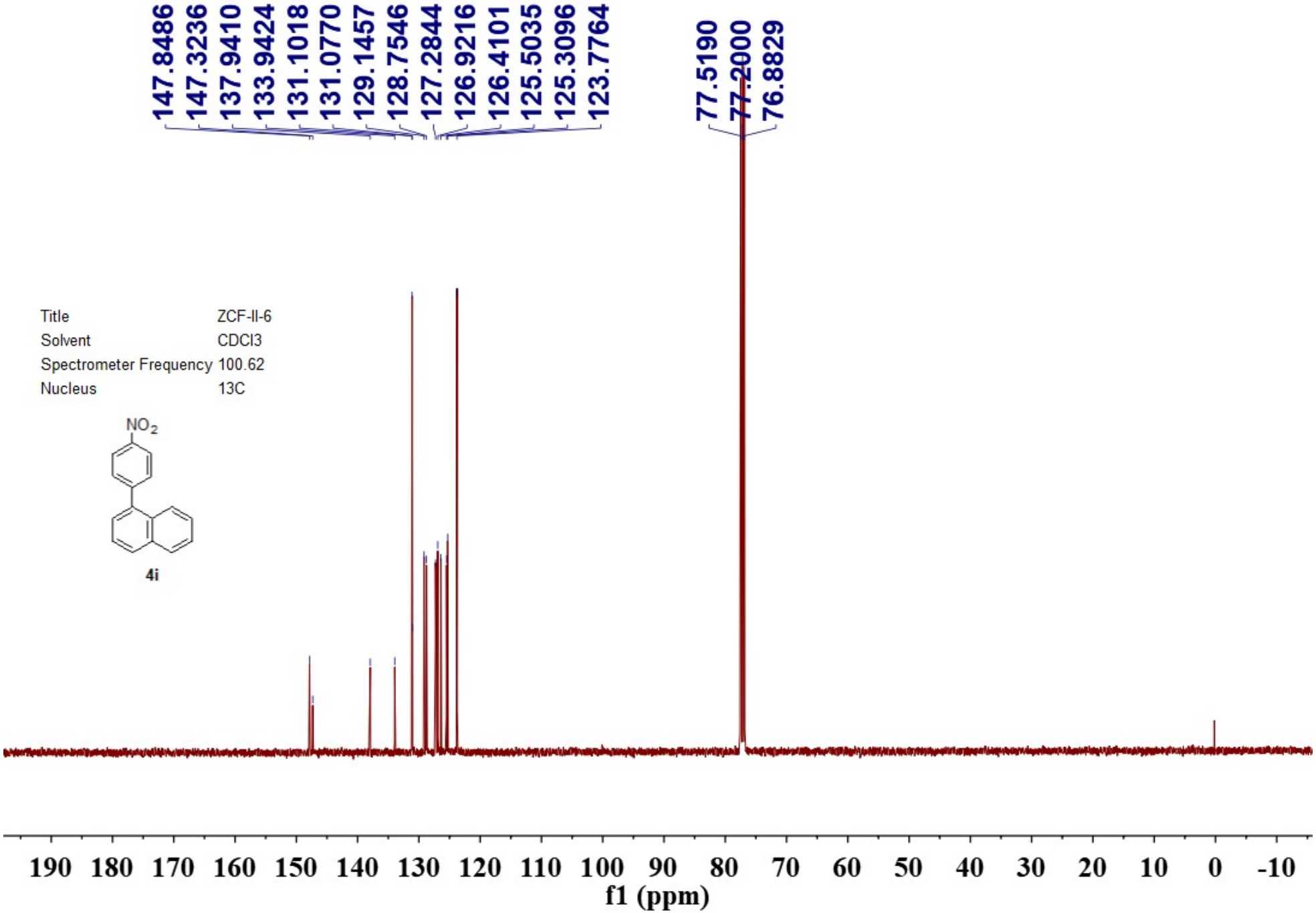


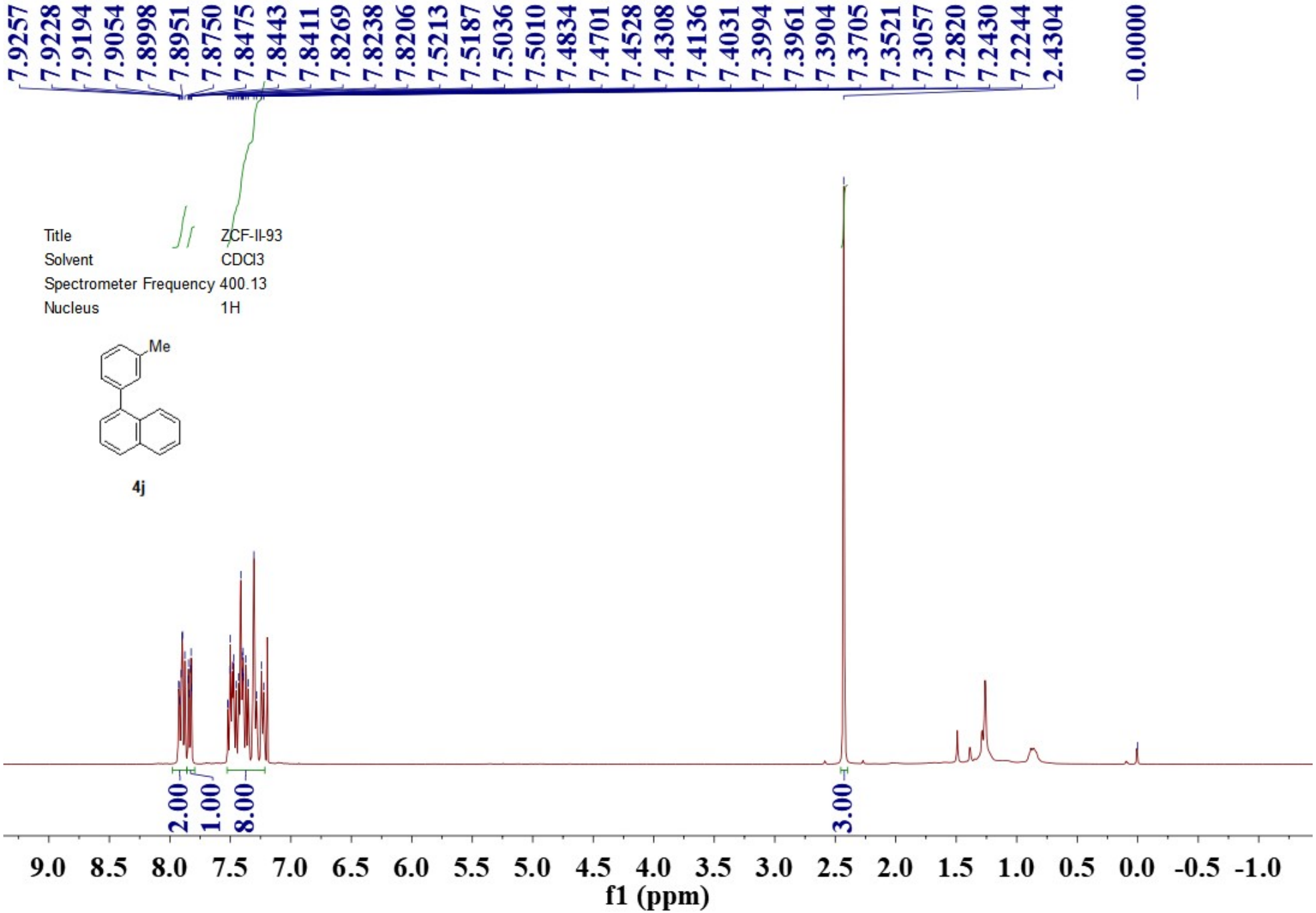
4h

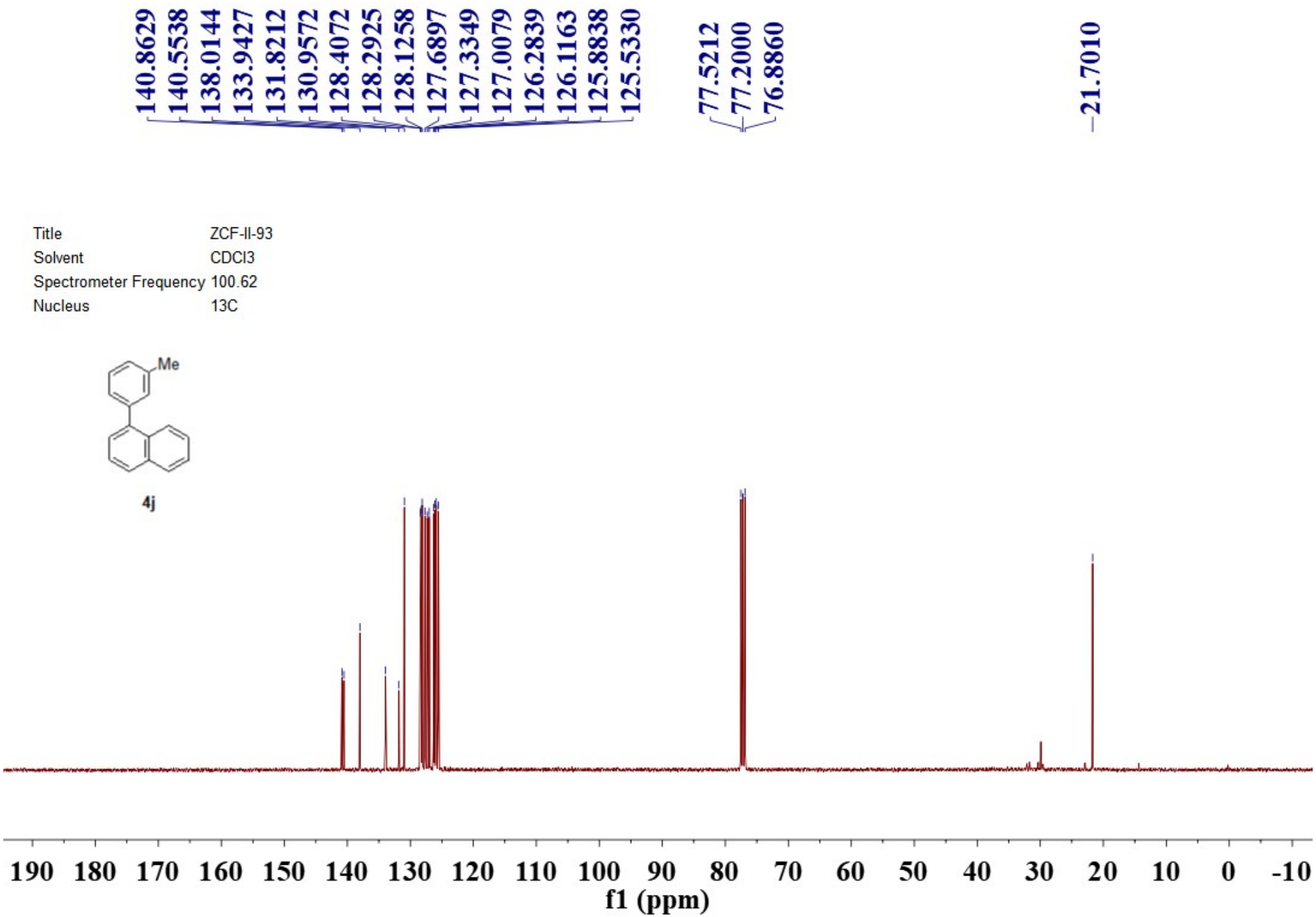


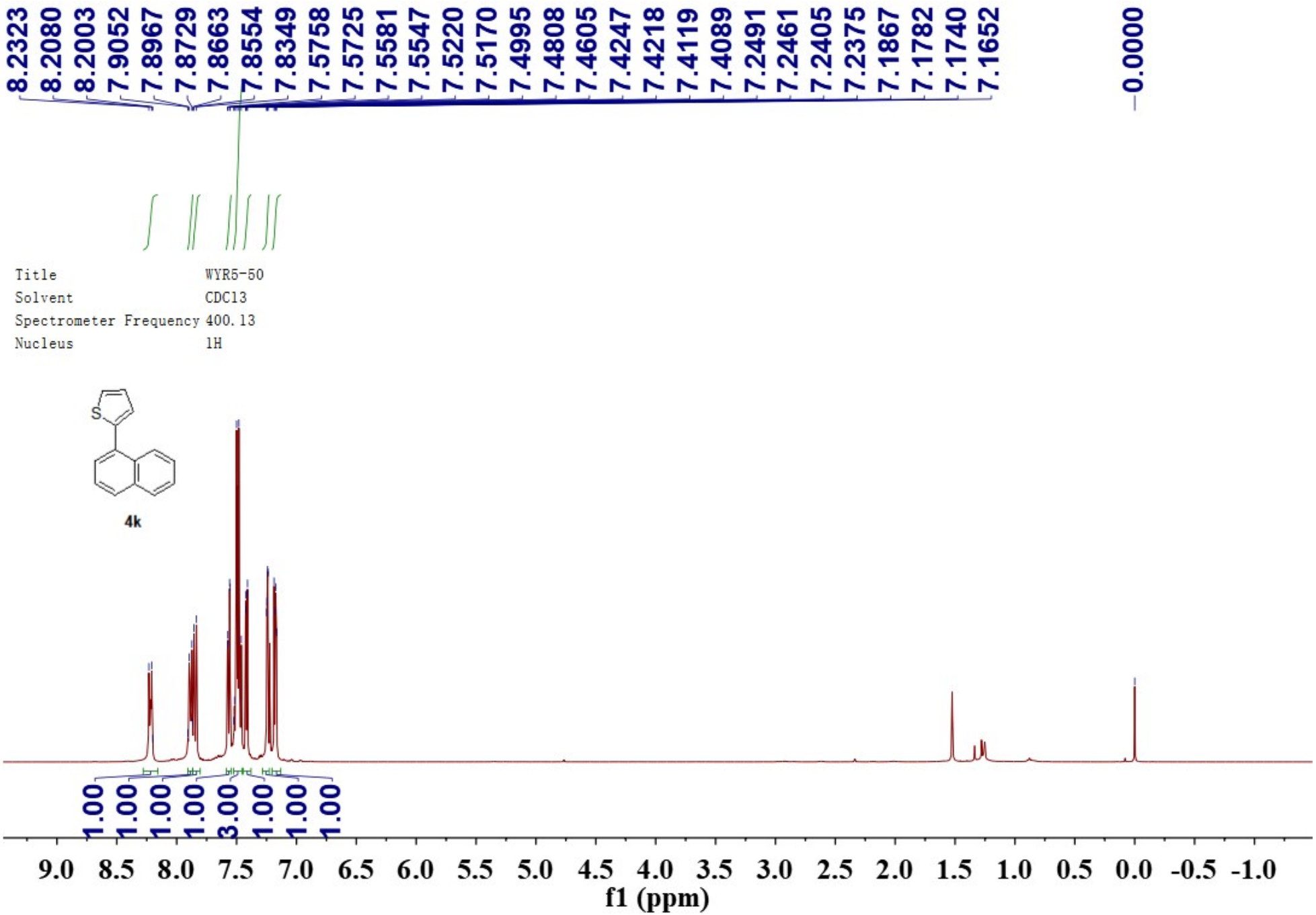

-62.347
Title ZCF-IV-26
Solvent CDCl3
Spectrometer Frequency 376.46
Nucleus 19F
CF3
4h
0
-20
-40
-60
-80
-100
-130
-160
-190
f1 (ppm)

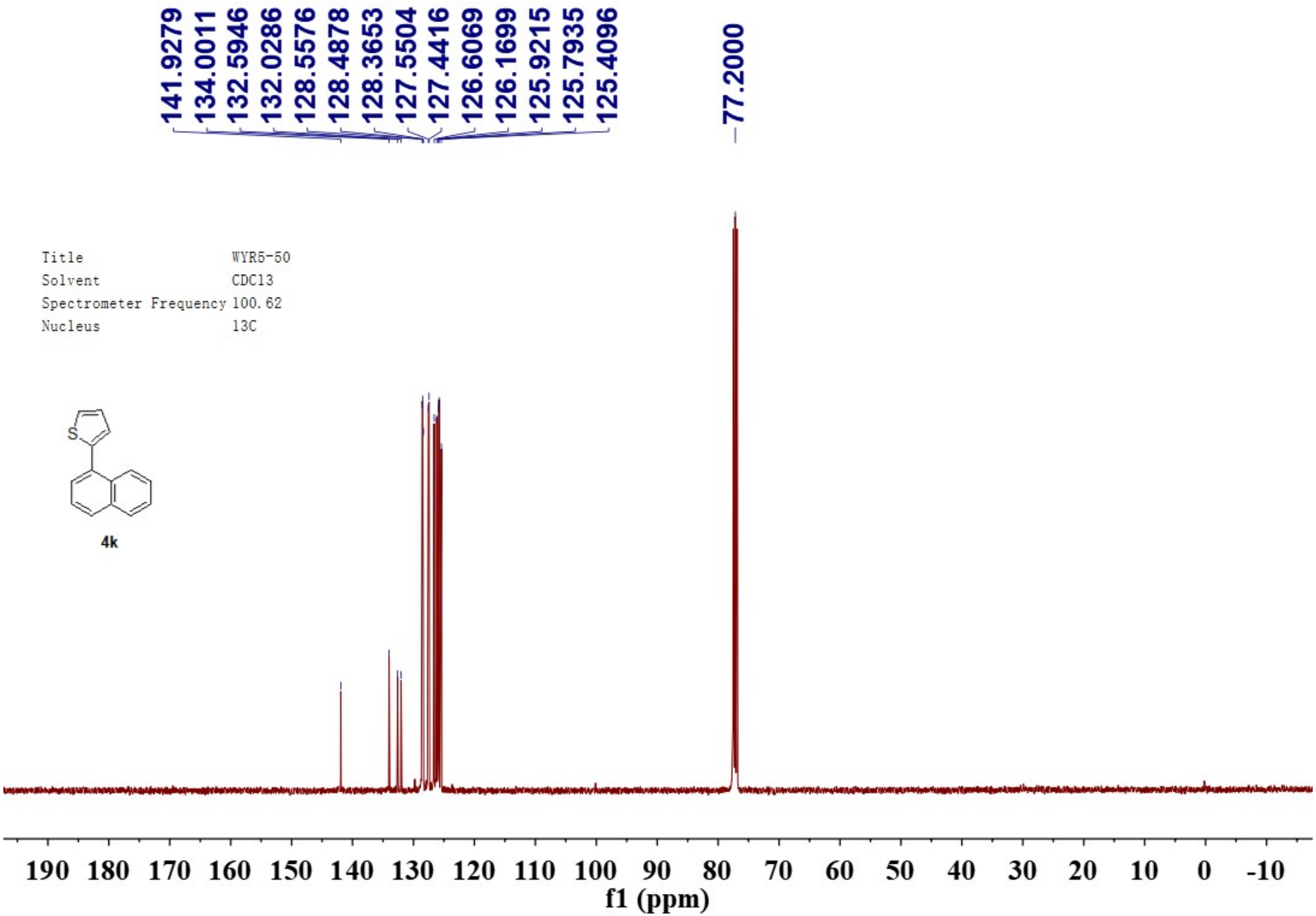

8.3737
8.3518
7.9548
7.9478
7.9358
7.9274
7.7970
7.7760
7.6865
7.6646
7.5812
7.5631
7.5427
7.5246
7.5215
7.5013
7.4978
7.4838
7.4804
7.4771
7.4631
7.4599
7.4408
7.4382
7.4232
7.4206
0.0000
Title ZCF-II- 6
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
NO2
4i
2.00
2.01
1.01
2.01
2.02
1.03
0.99
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

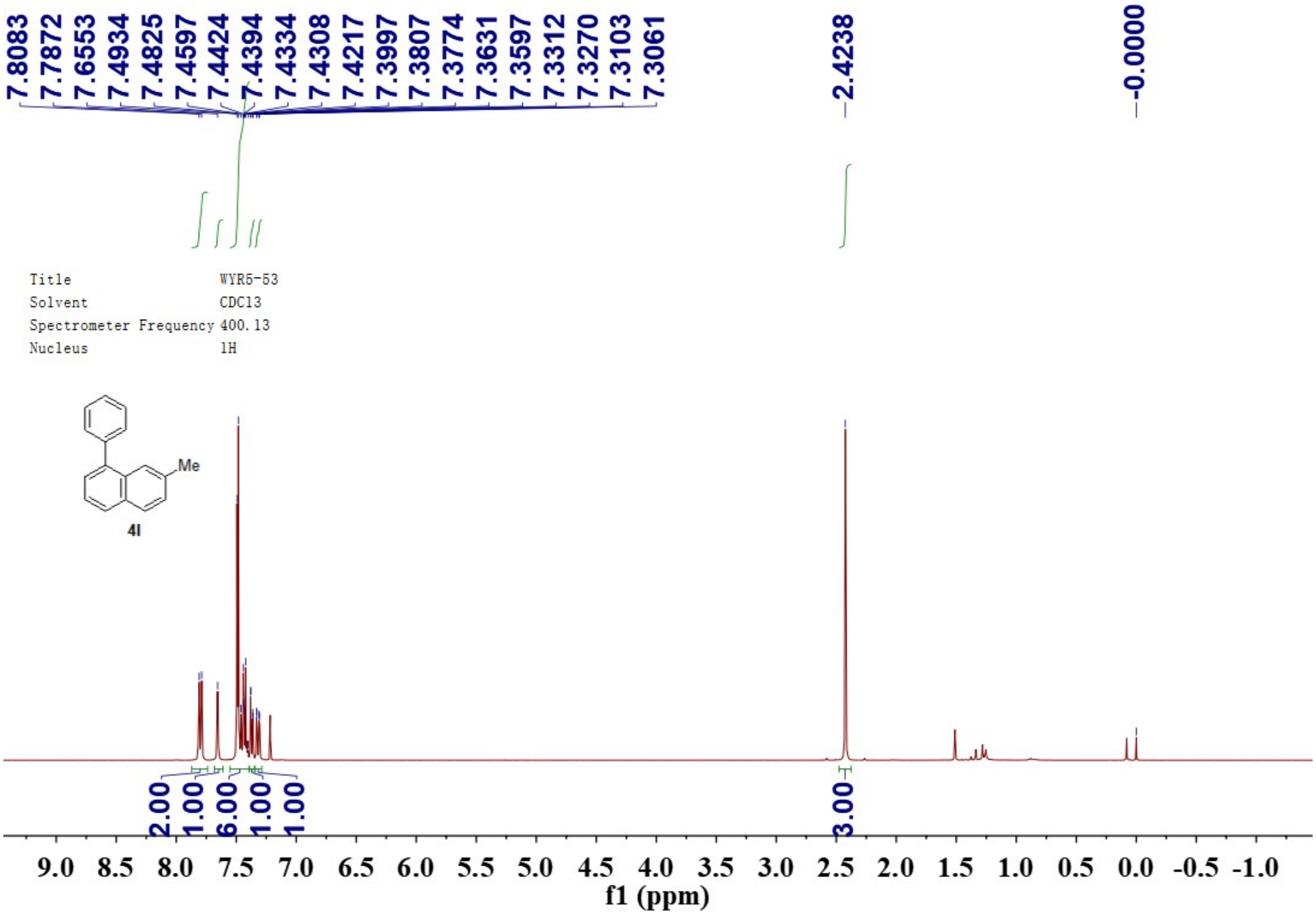

147.8486
147.3236
137.9410
133.9424
131.1018
131.0770
129.1457
128.7546
127.2844
126.9216
126.4101
125.5035
125.3096
123.7764
77.5190
77.2000
76.8829
Title ZCF-II-6
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
NO2
4i
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

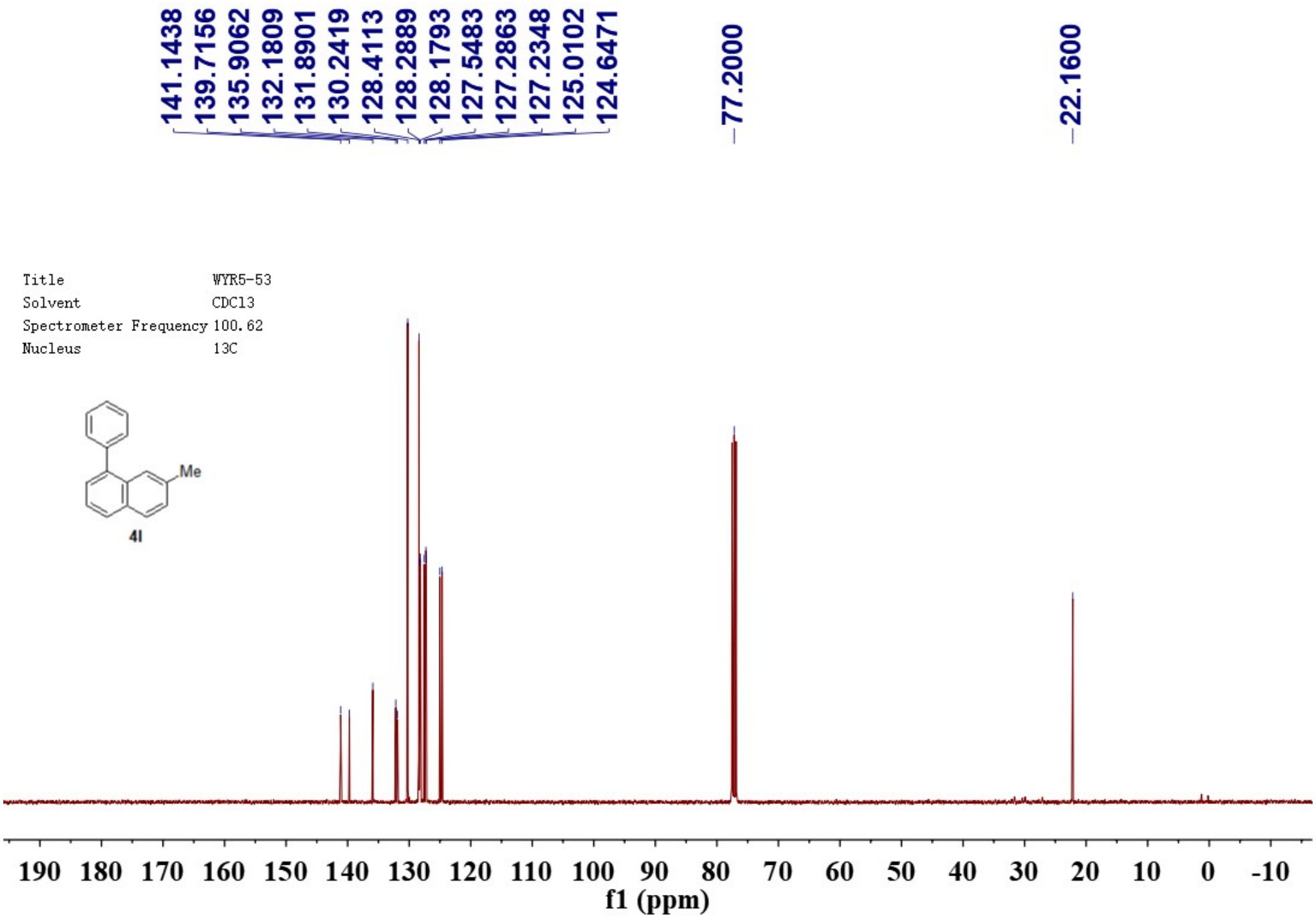

7.9257
7.9228
7.9194
7.9054
7.8998
7.8951
7.8750
7.8475
7.8443
7.8411
7.8269
7.8238
7.8206
7.5213
7.5187
7.5036
7.5010
7.4834
7.4701
7.4528
7.4308
7.4136
7.4031
7.3994
7.3961
7.3904
7.3705
7.3521
7.3057
7.2820
7.2430
7.2244
2.4304
0.0000
Title ZCF-II-93
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
4j
2.00
1.00
8.00
3.00
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)

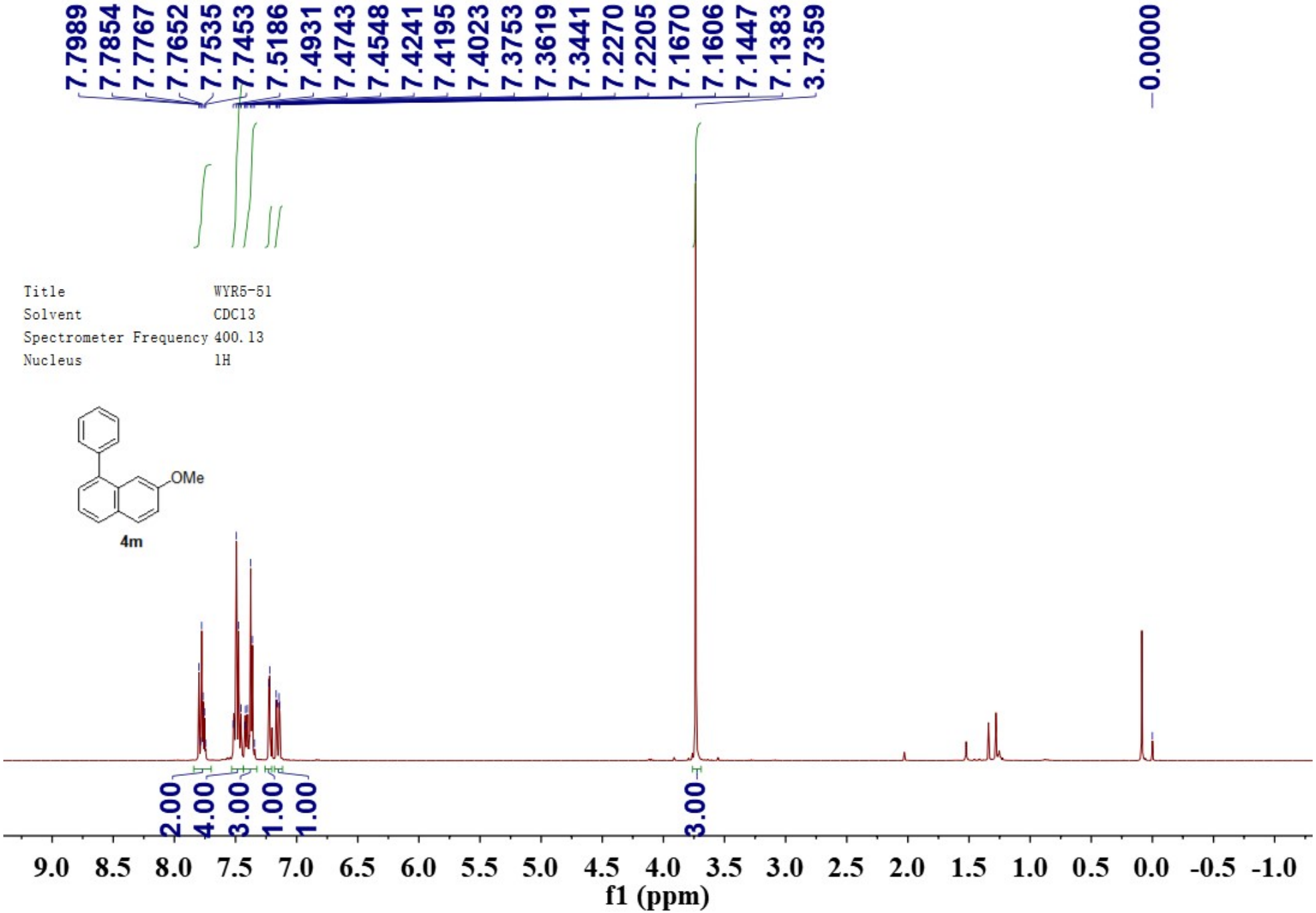

140.8629
140.5538
138.0144
133.9427
131.8212
130.9572
128.4072
128.2925
128.1258
127.6897
127.3349
127.0079
126.2839
126.1163
125.8838
125.5330
77.5212
77.2000
76.8860
21.7010
Title ZCF-II-93
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
4j
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

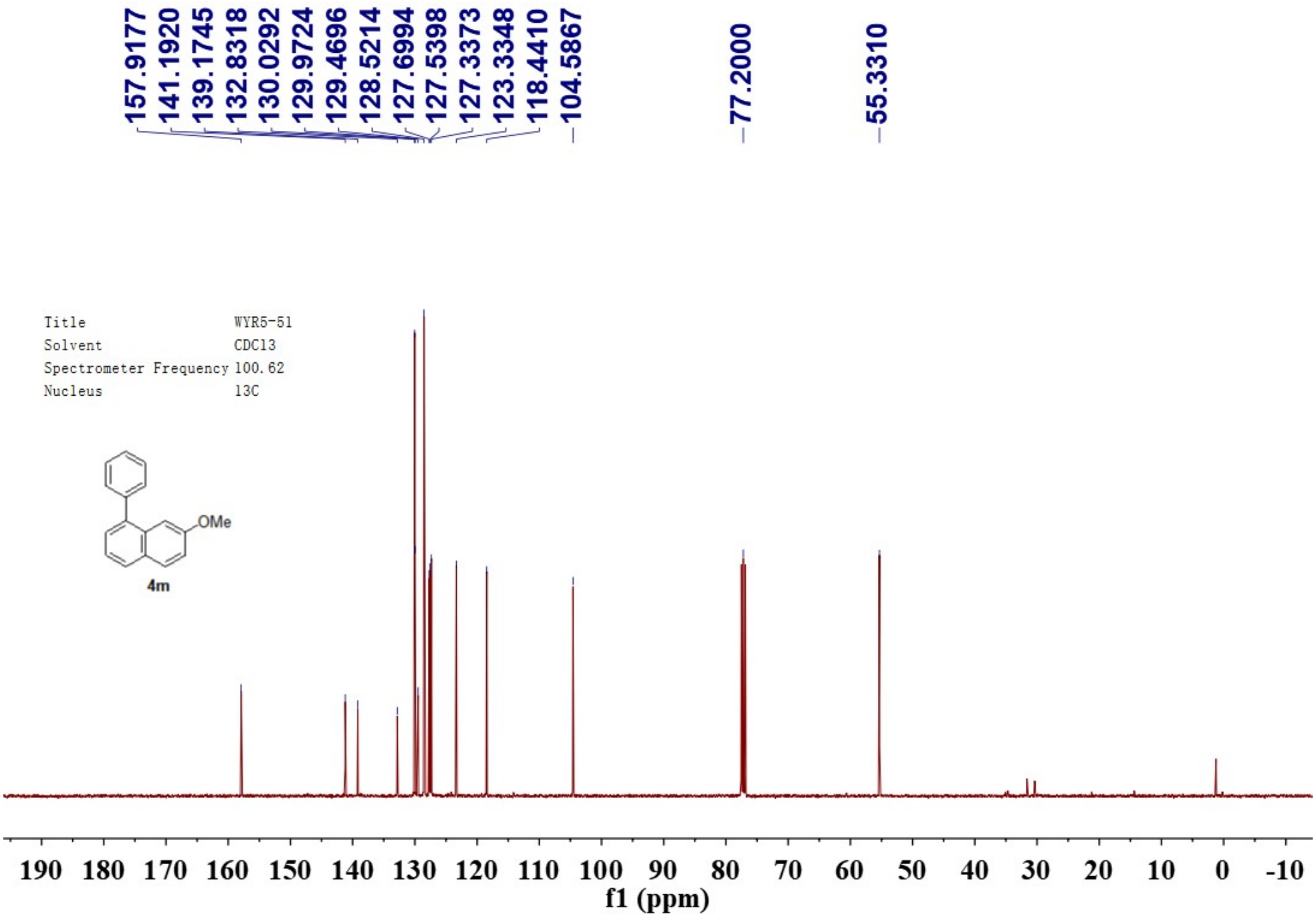

8.2323
8.2080
8.2003
7.9052
7.8967
7.8729
7.8663
7.8554
7.8349
7.5758
7.5725
7.5581
7.5547
7.5220
7.5170
7.4995
7.4808
7.4605
7.4247
7.4218
7.4119
7.4089
7.2491
7.2461
7.2405
7.2375
7.1867
7.1782
7.1740
7.1652
0.0000
Title WYR5-50
Solvent CDC13
Spectrometer Frequency 400.13
Nucleus 1H
S
4k
1.00
1.00
1.00
1.00
3.00
1.00
1.00
1.00
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)

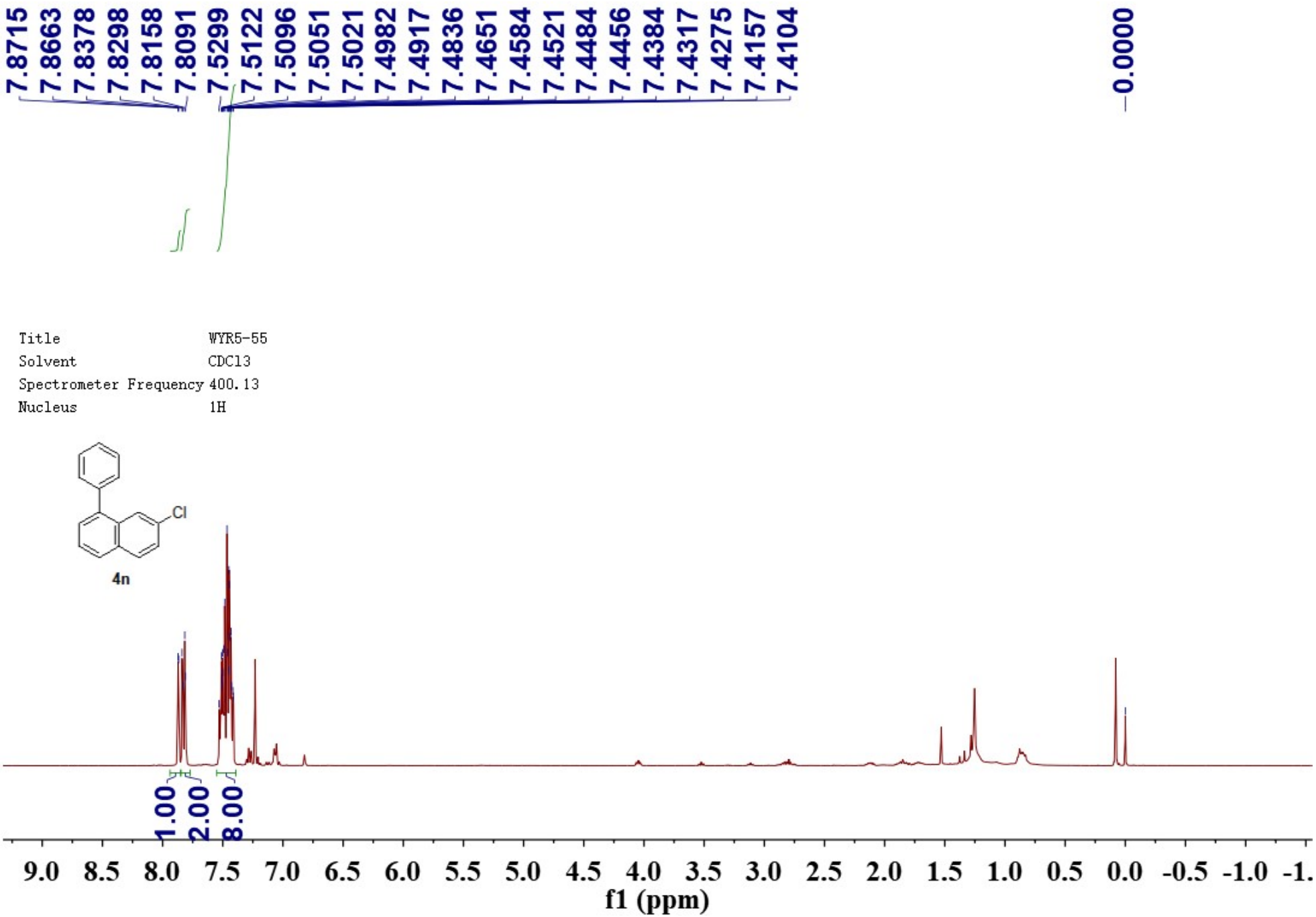

141.9279
134.0011
132.5946
132.0286
128.5576
128.4878
128.3653
127.5504
127.4416
126.6069
126.1699
125.9215
125.7935
125.4096
77.2000
Title WYR5-50
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
S
4k
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

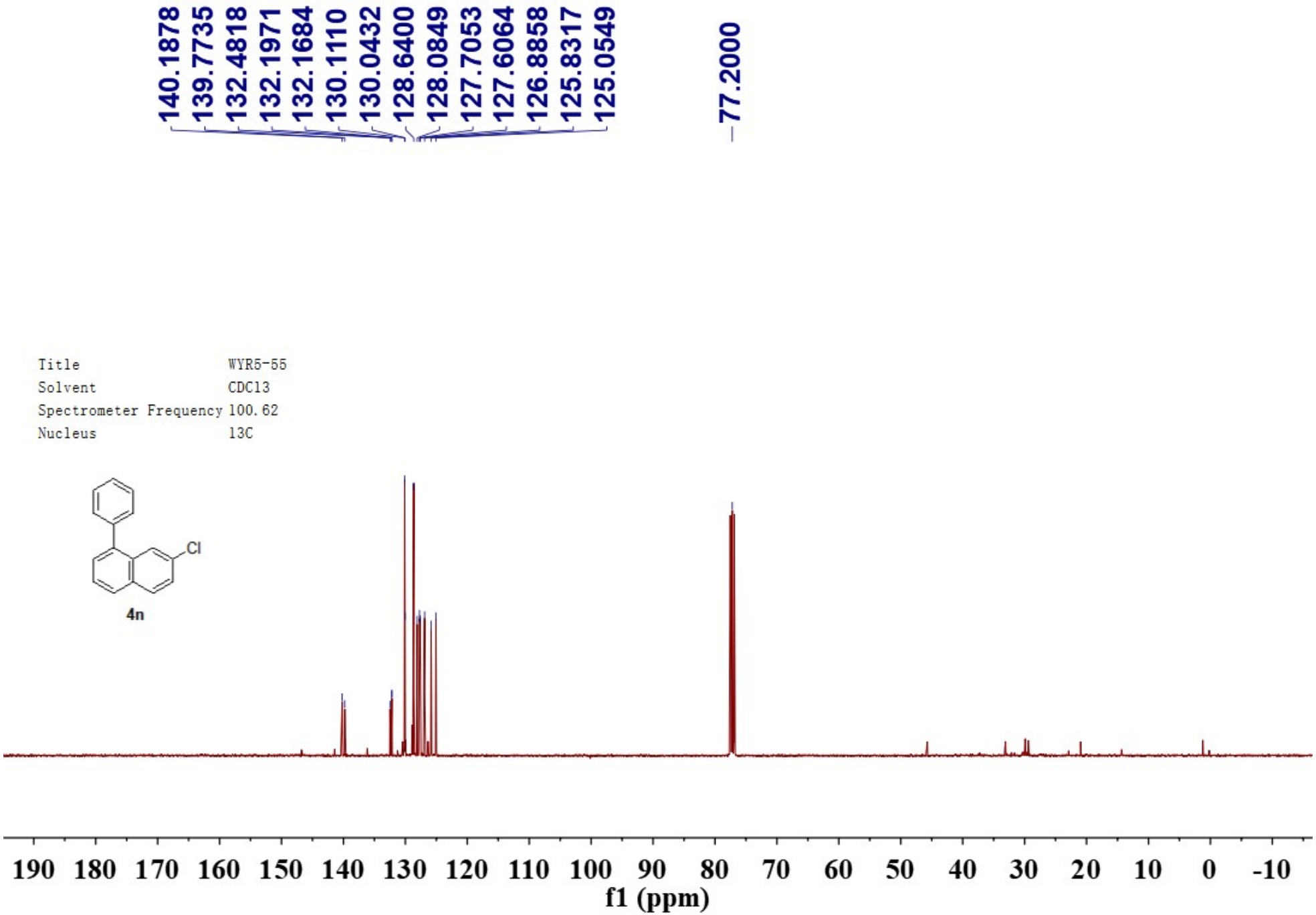

7.8083
7.7872
7.6553
7.4934
7.4825
7.4597
7.4424
7.4394
7.4334
7.4308
7.4217
7.3997
7.3807
7.3774
7.3631
7.3597
7.3312
7.3270
7.3103
7.3061
2.4238
0.0000
Title WYR5-53
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
4l
2.00
1.00
6.00
1.00
1.00
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

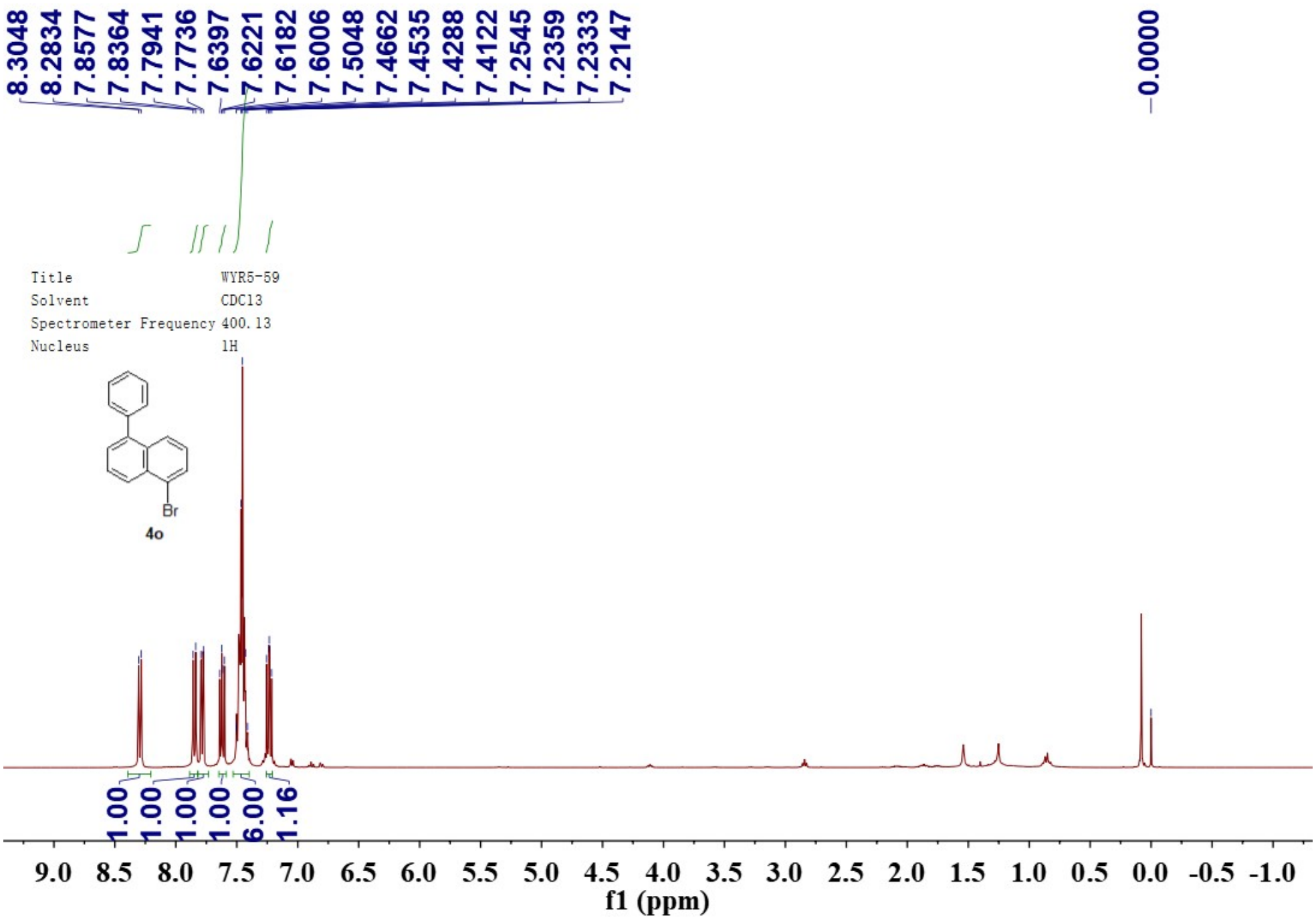

141.1438
139.7156
135.9062
132.1809
131.8901
130.2419
128.4113
128.2889
128.1793
127.5483
127.2863
127.2348
125.0102
124.6471
77.2000
22.1600
Title WYR5-53
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
4l
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

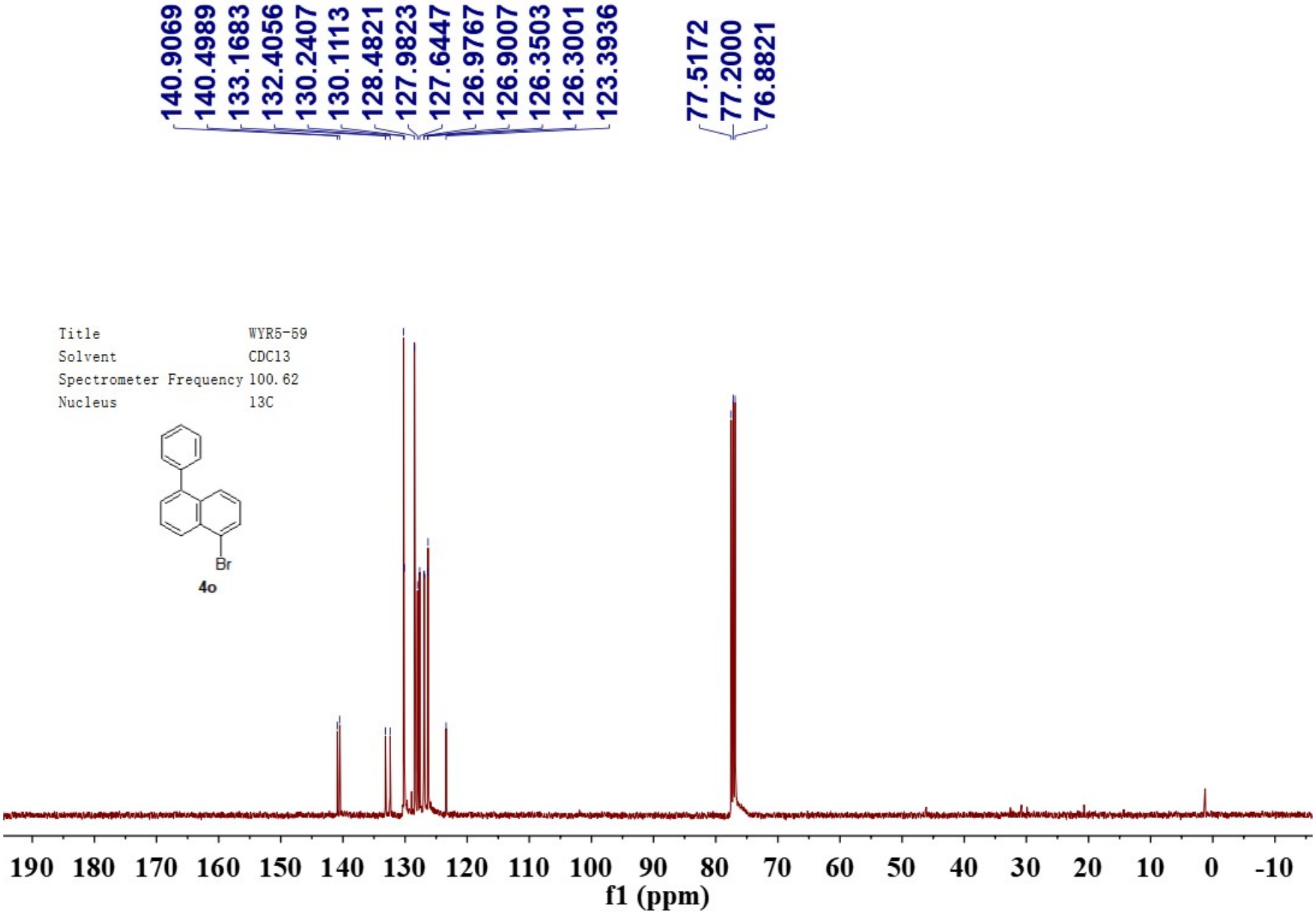

7.7989
7.7854
7.7767
7.7652
7.7535
7.7453
7.5186
7.4931
7.4743
7.4548
7.4241
7.4195
7.4023
7.3753
7.3619
7.3441
7.2270
7.2205
7.1670
7.1606
7.1447
7.1383
3.7359
0.0000
Title WYR5-51
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
OMe
4m
2.00
4.00
3.00
1.00
1.00
3.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 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)

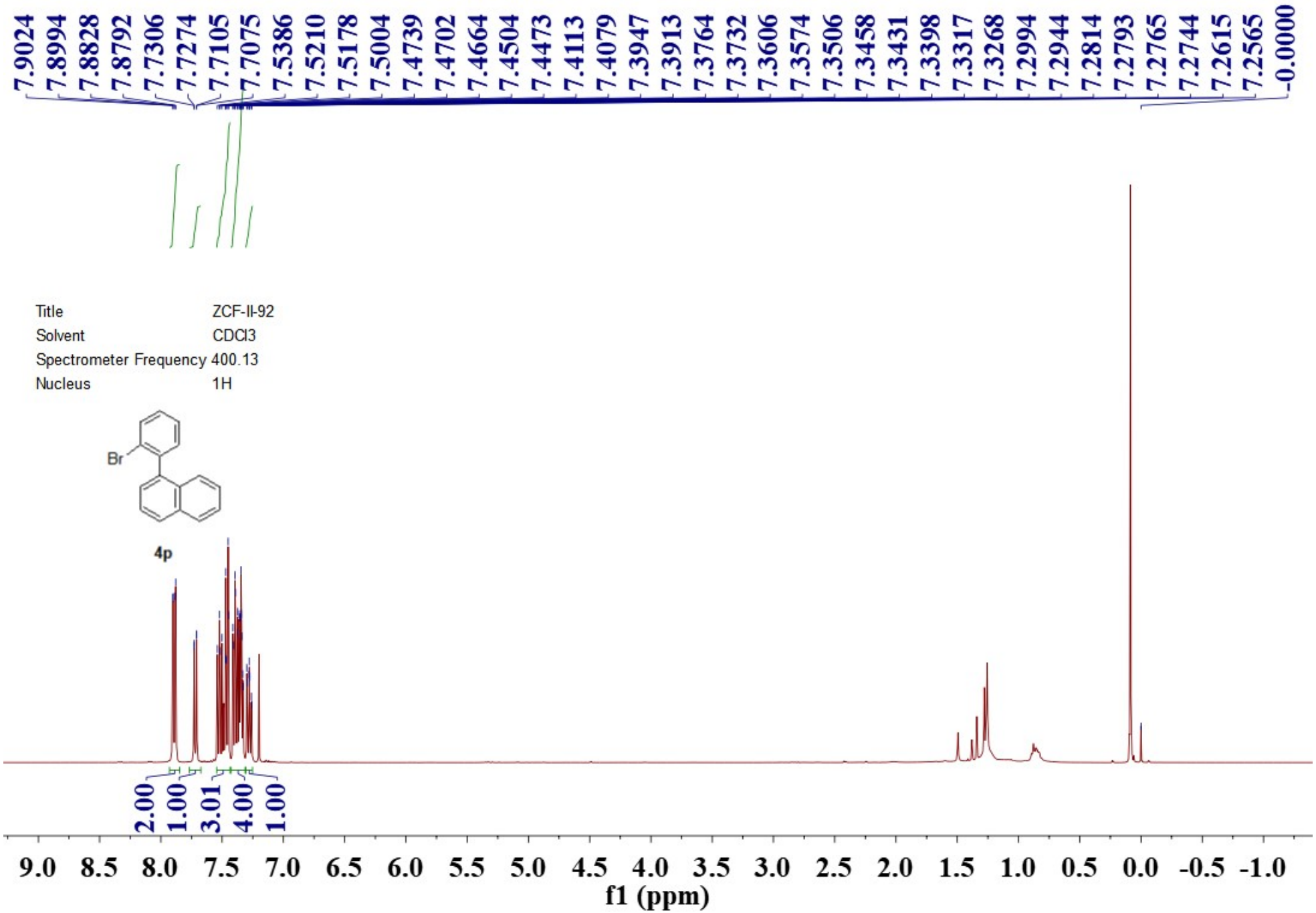

157.9177
141.1920
139.1745
132.8318
130.0292
129.9724
129.4696
128.5214
127.6994
127.5398
127.3373
123.3348
118.4410
104.5867
77.2000
55.3310
Title WYR5-51
Solvent CDC13
Spectrometer Frequency 100.62
Nucleus 13C
OMe
4m
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

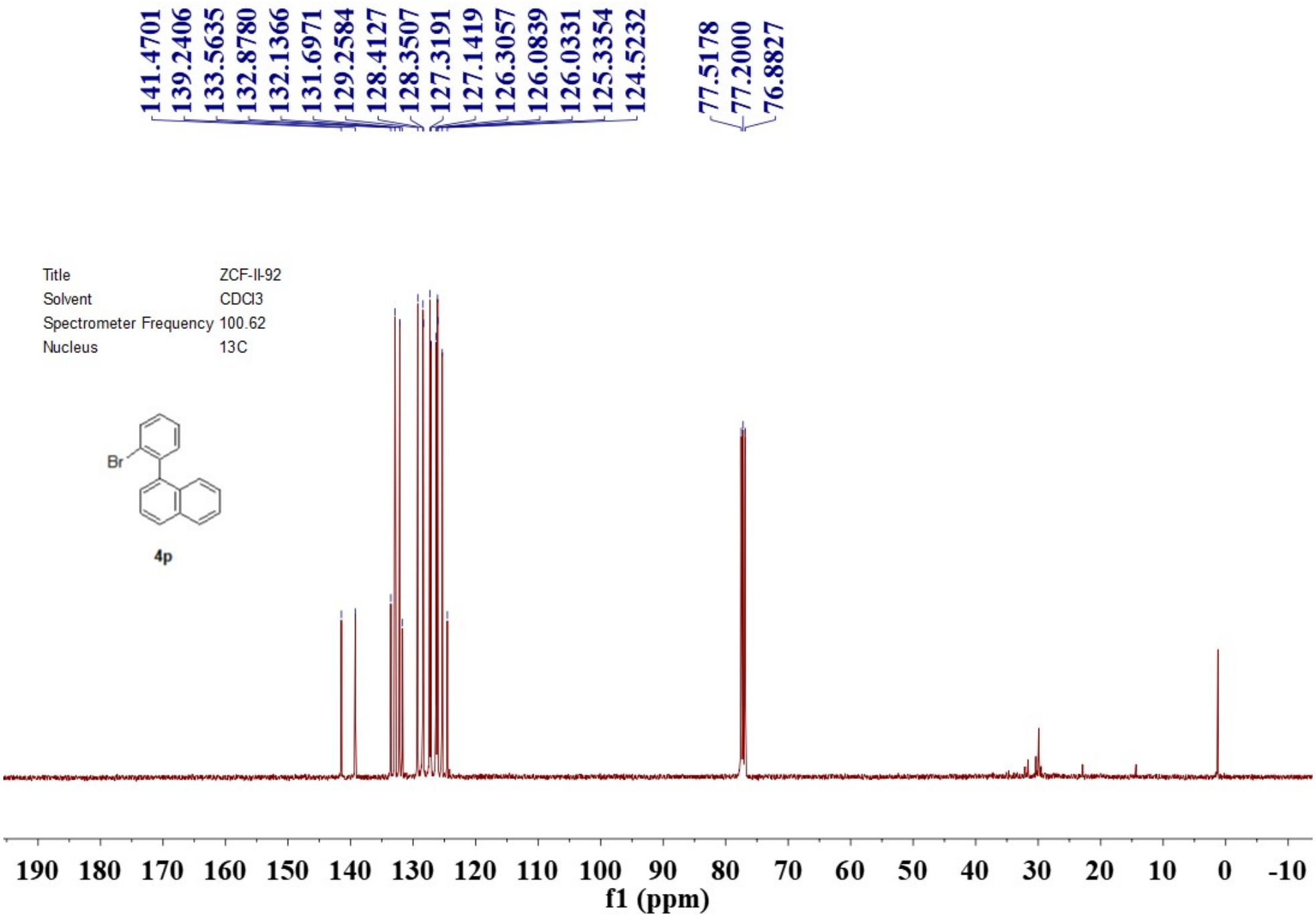

7.8715
7.8663
7.8378
7.8298
7.8158
7.8091
7.5299
7.5122
7.5096
7.5051
7.5021
7.4982
7.4917
7.4836
7.4651
7.4584
7.4521
7.4484
7.4456
7.4384
7.4317
7.4275
7.4157
7.4104
0.0000
Title WYR5-55
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cl
4n
1.00
2.00
8.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 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)

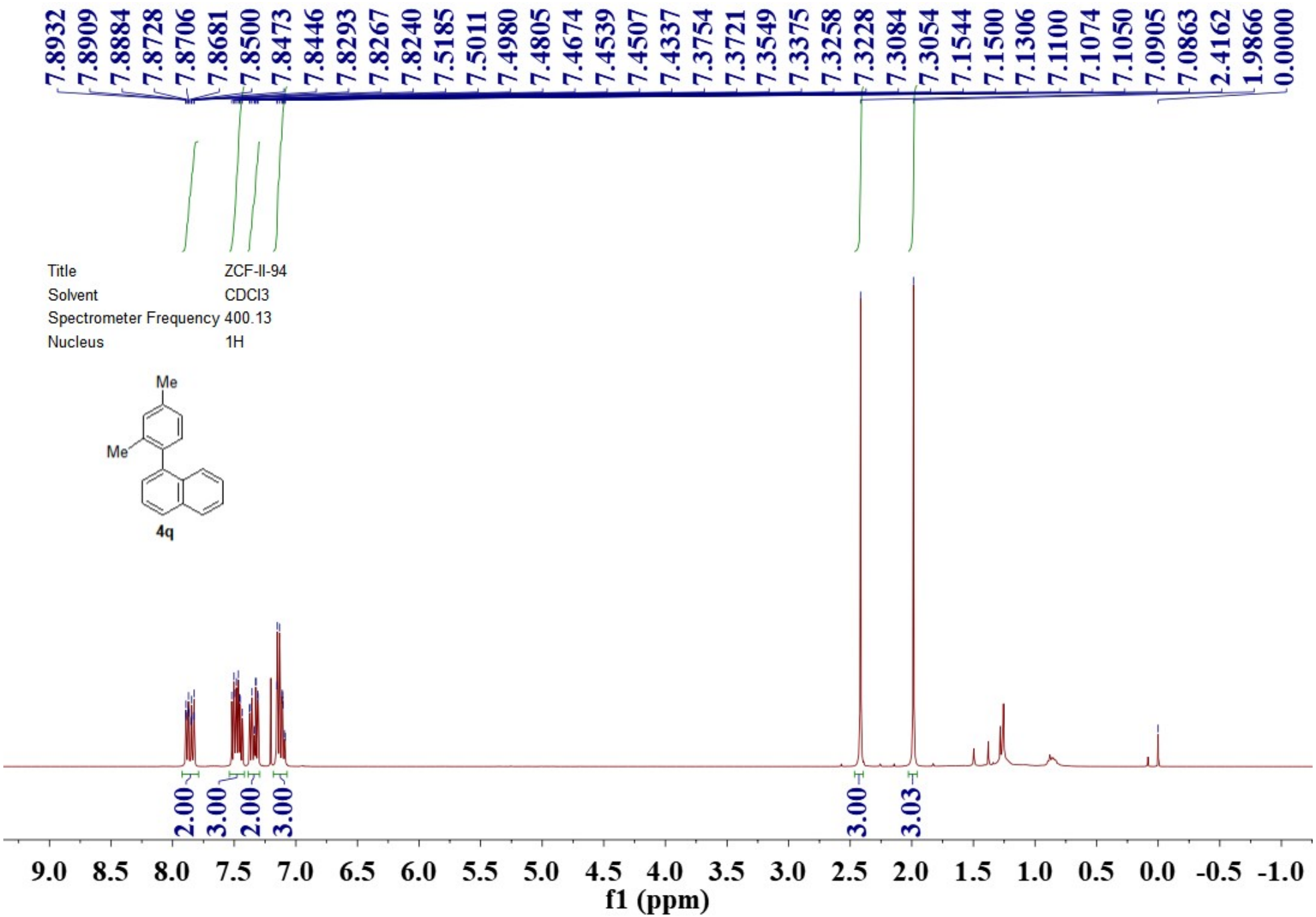

140.1878
139.7735
132.4818
132.1971
132.1684
130.1110
130.0432
128.6400
128.0849
127.7053
127.6064
126.8858
125.8317
125.0549
77.2000
Title WYR5-55
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Cl
4n
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

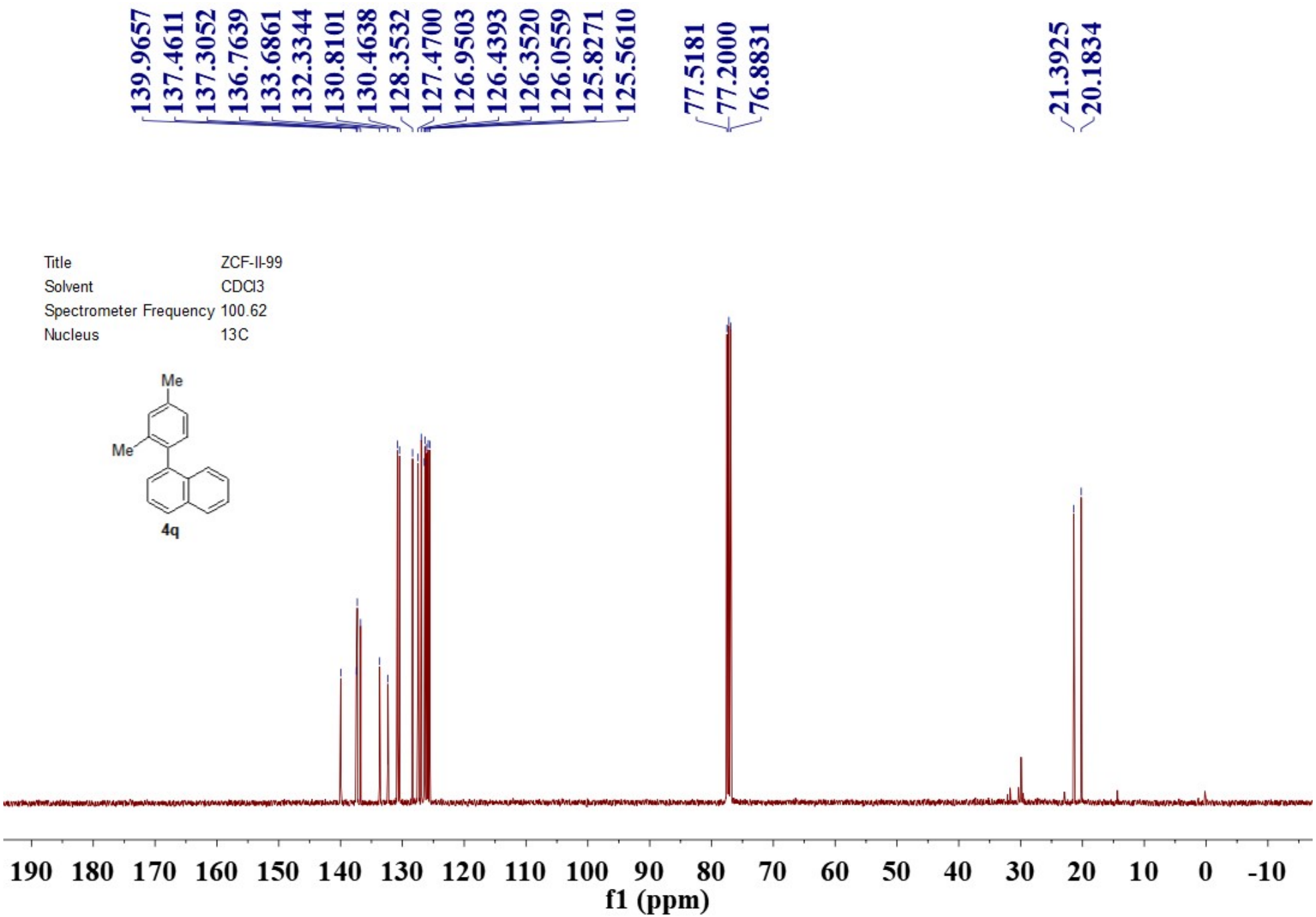

8.3048
8.2834
7.8577
7.8364
7.7941
7.7736
7.6397
7.6221
7.6182
7.6006
7.5048
7.4662
7.4535
7.4288
7.4122
7.2545
7.2359
7.2333
7.2147
0.0000
Title WYR5-59
Solvent CDC13
Spectrometer Frequency 400.13
Nucleus 1H
Br
4o
1.00
1.00
1.00
1.00
6.00
1.16
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

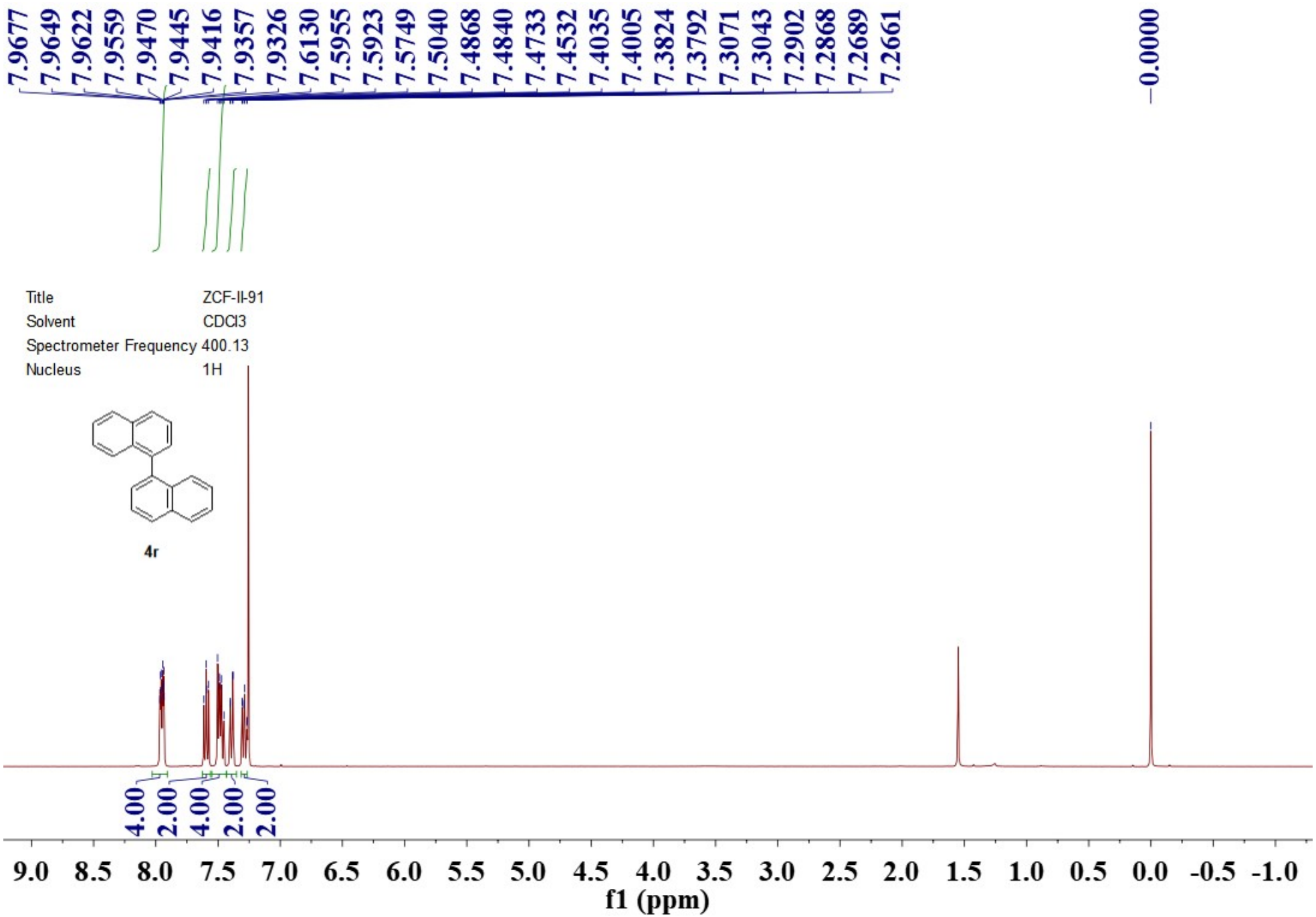

140.9069
140.4989
133.1683
132.4056
130.2407
130.1113
128.4821
127.9823
127.6447
126.9767
126.9007
126.3503
126.3001
123.3936
77.5172
77.2000
76.8821
Title WYR5-59
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
4o
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

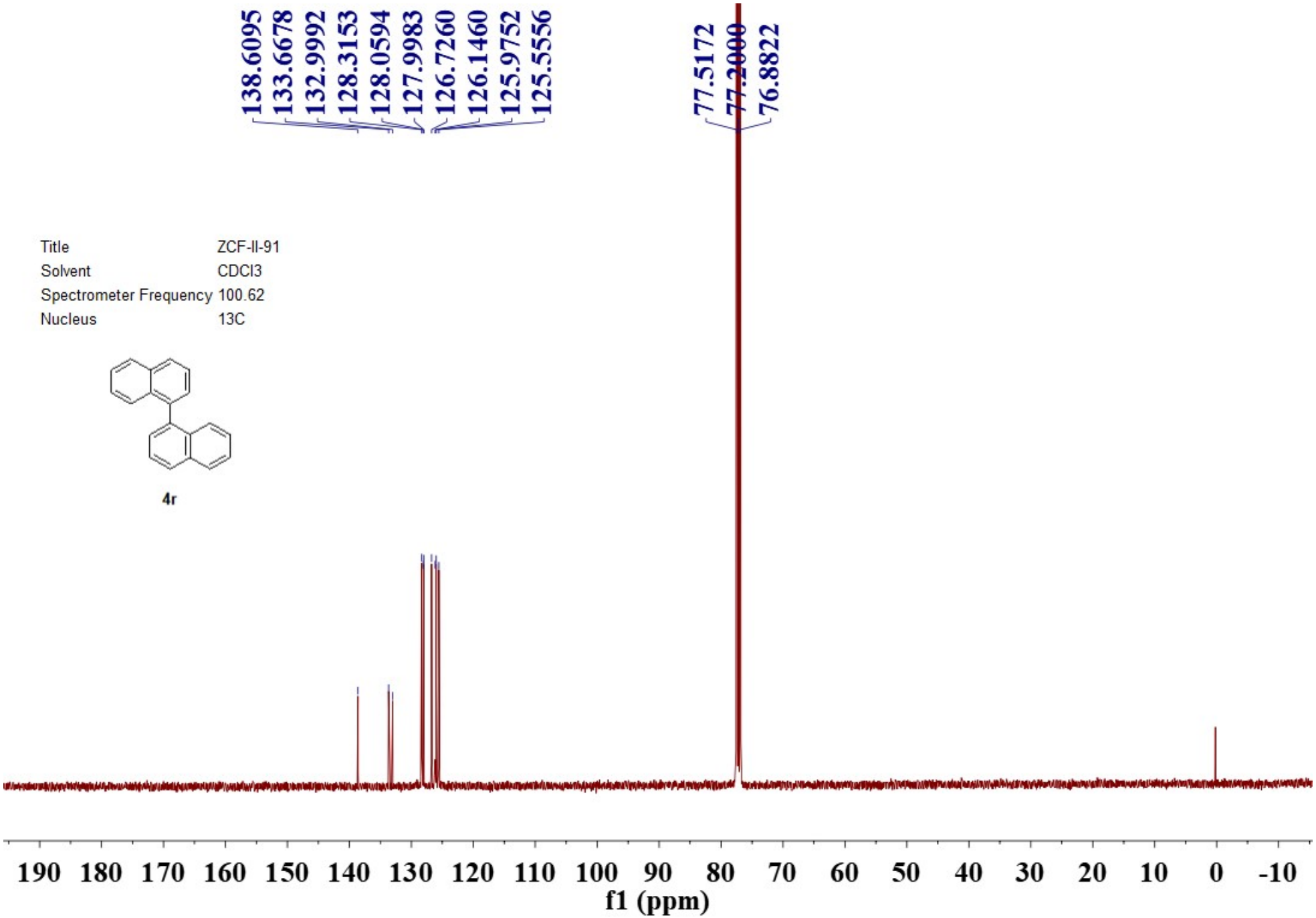

7.9024
7.8994
7.8828
7.8792
7.7306
7.7274
7.7105
7.7075
7.5386
7.5210
7.5178
7.5004
7.4739
7.4702
7.4664
7.4504
7.4473
7.4113
7.4079
7.3947
7.3913
7.3764
7.3732
7.3606
7.3574
7.3506
7.3458
7.3431
7.3398
7.3317
7.3268
7.2994
7.2944
7.2814
7.2793
7.2765
7.2744
7.2615
7.2565
-0.0000
Title ZCF-II-92
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
4p
2.00
1.00
3.01
4.00
1.00
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)

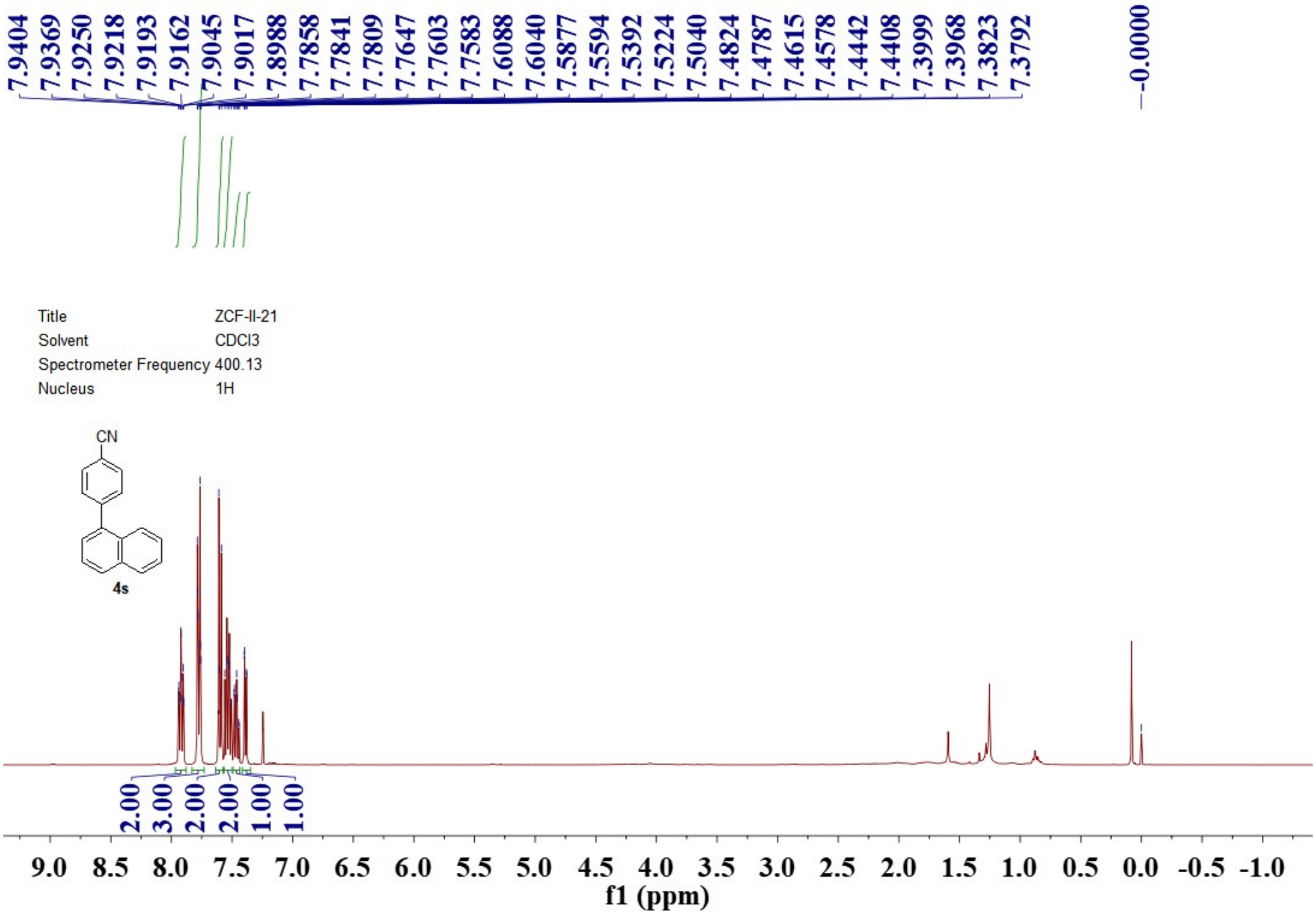

141.4701
139.2406
133.5635
132.8780
132.1366
131.6971
129.2584
128.4127
128.3507
127.3191
127.1419
126.3057
126.0839
126.0331
125.3354
124.5232
77.5178
77.2000
76.8827
Title ZCF-II-92
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
4p
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.8932
7.8909
7.8884
7.8728
7.8706
7.8681
7.8500
7.8473
7.8446
7.8293
7.8267
7.8240
7.5185
7.5011
7.4980
7.4805
7.4674
7.4539
7.4507
7.4337
7.3754
7.3721
7.3549
7.3375
7.3258
7.3228
7.3084
7.3054
7.1544
7.1500
7.1306
7.1100
7.1074
7.1050
7.0905
7.0863
2.4162
1.9866
0.0000
Title ZCF-II-94
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
4q
2.00
3.00
2.00
3.00
3.00
3.03
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)


139.9657
137.4611
137.3052
136.7639
133.6861
132.3344
130.8101
130.4638
128.3532
127.4700
126.9503
126.4393
126.3520
126.0559
125.8271
125.5610
77.5181
77.2000
76.8831
21.3925
20.1834
Title ZCF-II-99
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
4q
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.9677
7.9649
7.9622
7.9559
7.9470
7.9445
7.9416
7.9357
7.9326
7.6130
7.5955
7.5923
7.5749
7.5040
7.4868
7.4840
7.4733
7.4532
7.4035
7.4005
7.3824
7.3792
7.3071
7.3043
7.2902
7.2868
7.2689
7.2661
0.0000
Title ZCF-II-91
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
4r
4.00
2.00
4.00
2.00
2.00
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)


138.6095
133.6678
132.9992
128.3153
128.0594
127.9983
126.7260
126.1460
125.9752
125.5556
77.5172
77.2000
76.8822
Title ZCF-II-91
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
4r
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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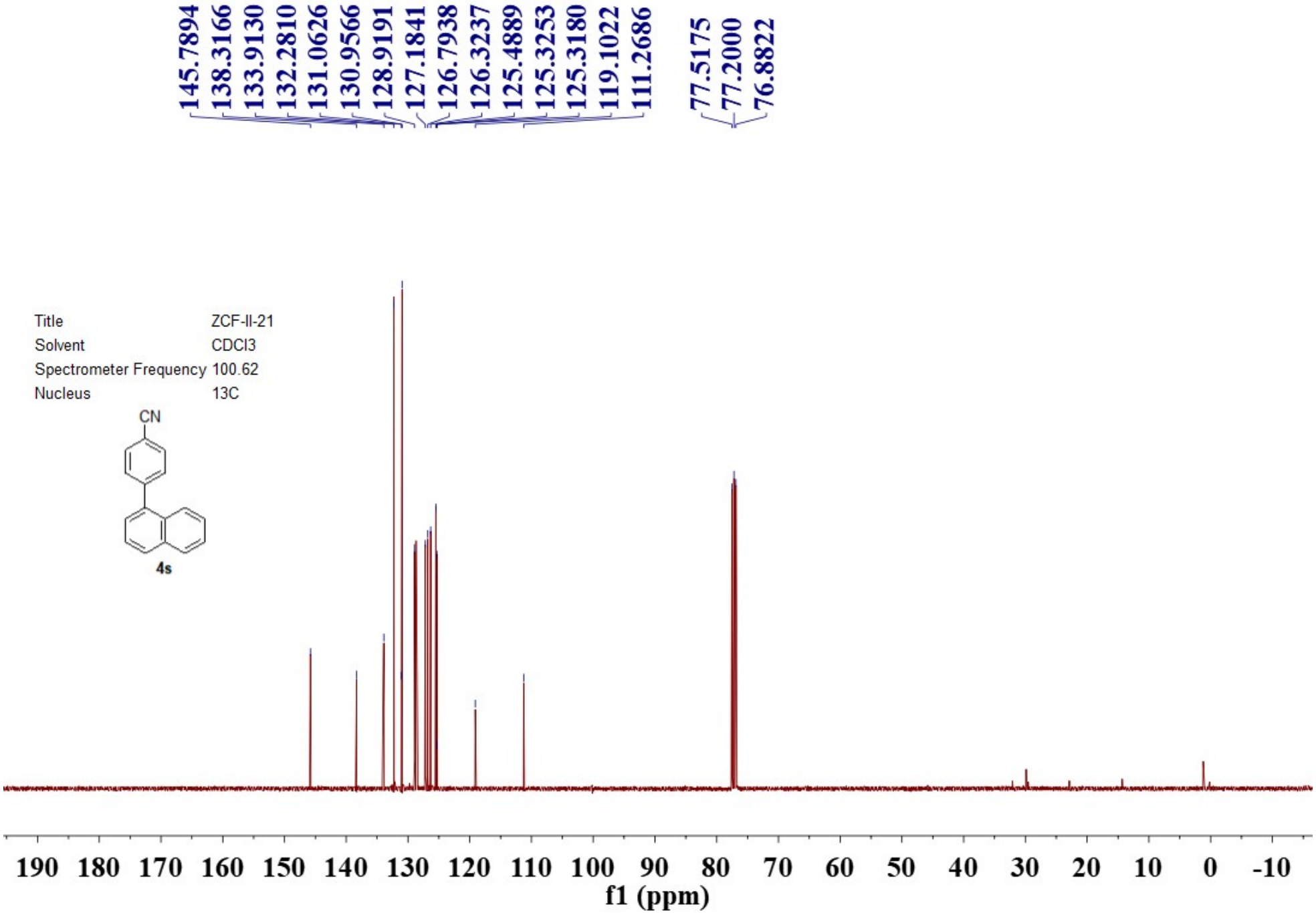
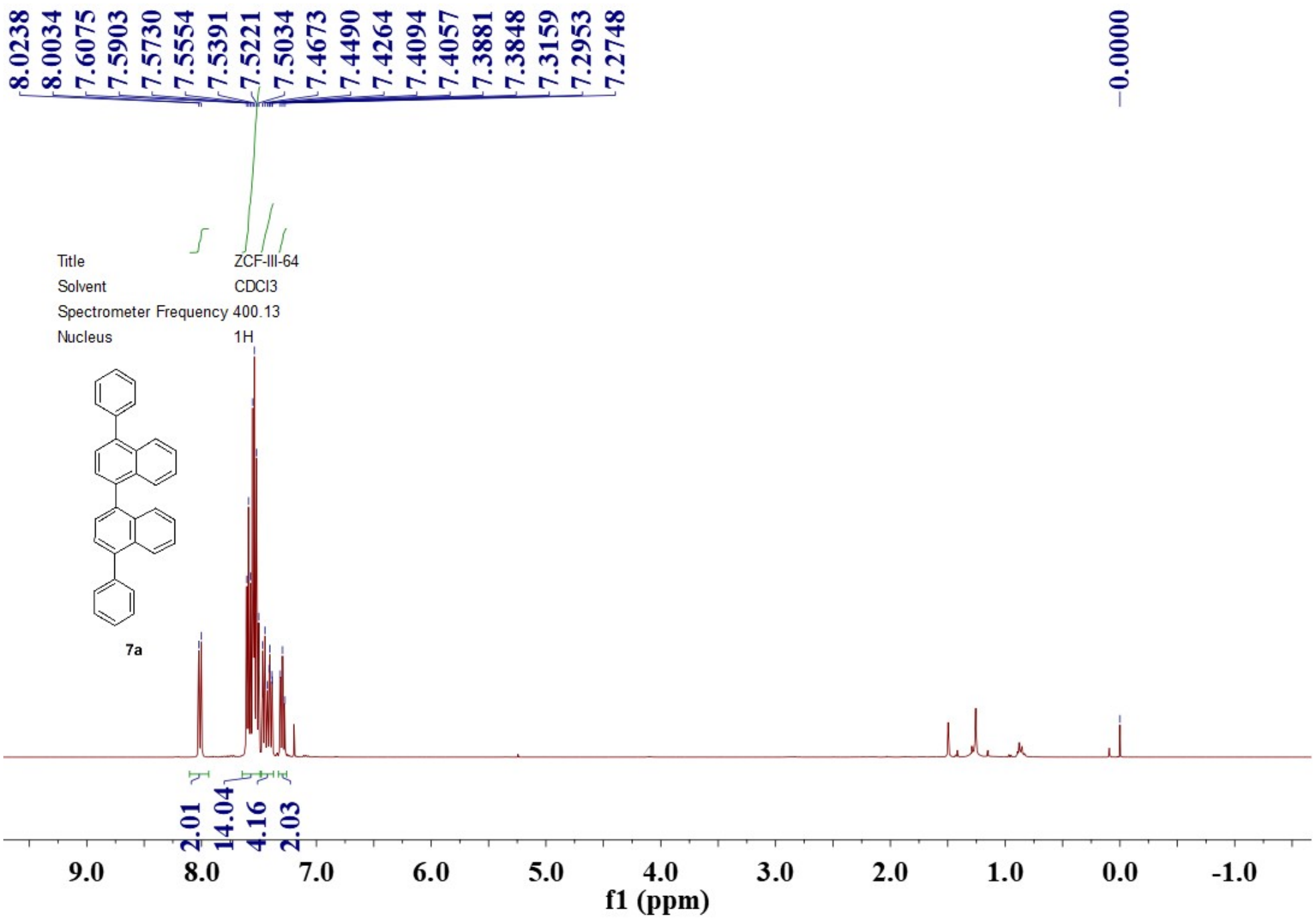
7.9369
7.9250
7.9218
7.9193
7.9162
7.9045
7.9017
7.8988
7.7858
7.7841
7.7809
7.7647
7.7603
7.7583
7.6088
7.6040
7.5877
7.5594
7.5392
7.5224
7.5040
7.4824
7.4787
7.4615
7.4578
7.4442
7.4408
7.3999
7.3968
7.3823
7.3792
-0.0000
Title ZCF-II-21
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
CN
4s
2.00
3.00
2.00
2.00
1.00
1.00
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)

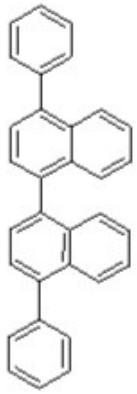

145.7894
138.3166
133.9130
132.2810
131.0626
130.9566
128.9191
127.1841
126.7938
126.3237
125.4889
125.3253
125.3180
119.1022
111.2686
77.5175
77.2000
76.8822
Title ZCF-II-21
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
CN
4s
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.0238
8.0034
7.6075
7.5903
7.5730
7.5554
7.5391
7.5221
7.5034
7.4673
7.4490
7.4264
7.4094
7.4057
7.3881
7.3848
7.3159
7.2953
7.2748
0.0000
Title ZCF-III-64
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
7a
2.01
14.04
4.16
2.03
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)

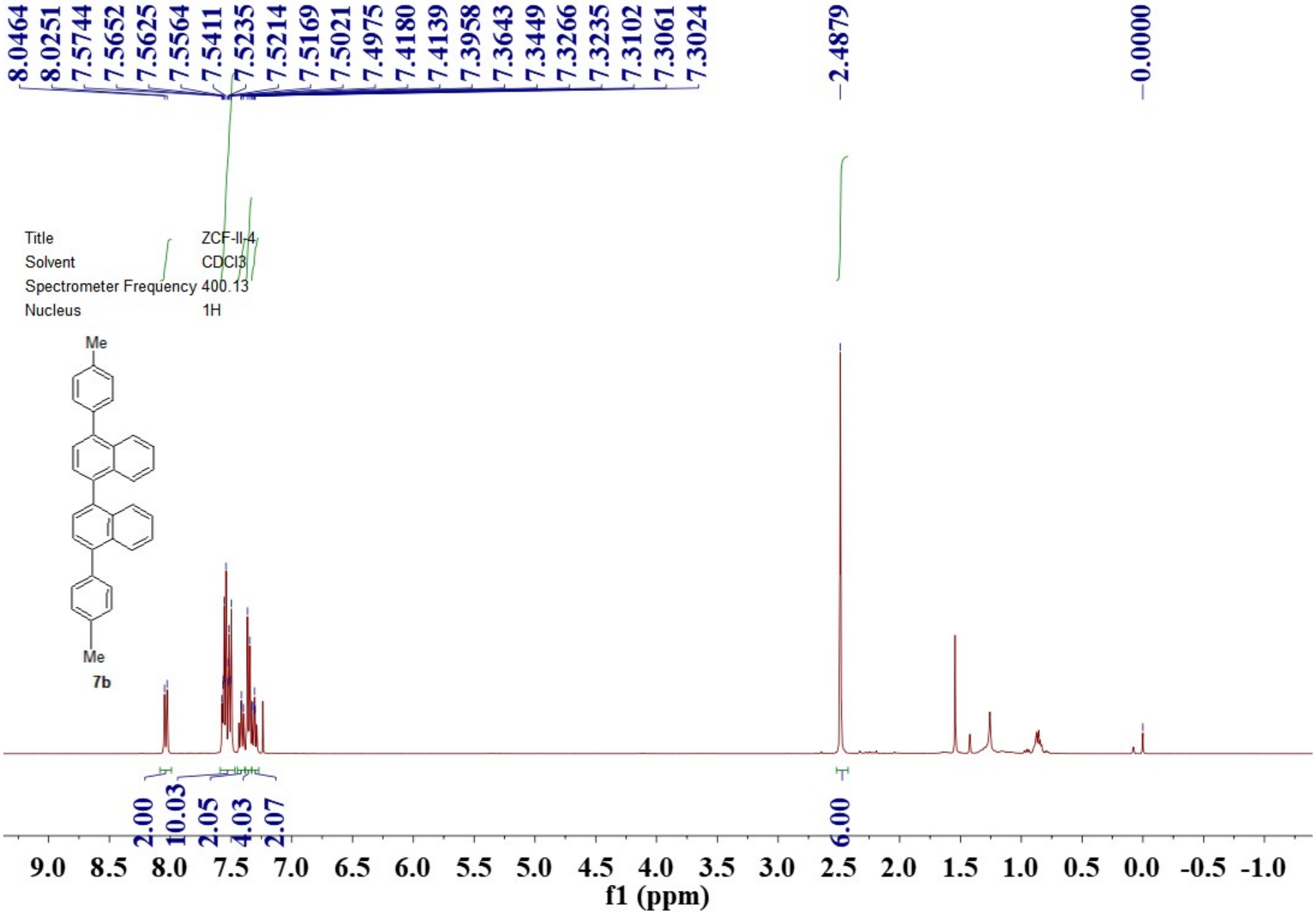
141.0007
140.3216
138.2599
133.3739
131.8671
130.3860
128.5090
127.6621
127.4913
127.1914
126.6699
126.4824
126.0792
126.0187

77.5168
77.2000
76.8819

Title ZCF-III-64
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C



7a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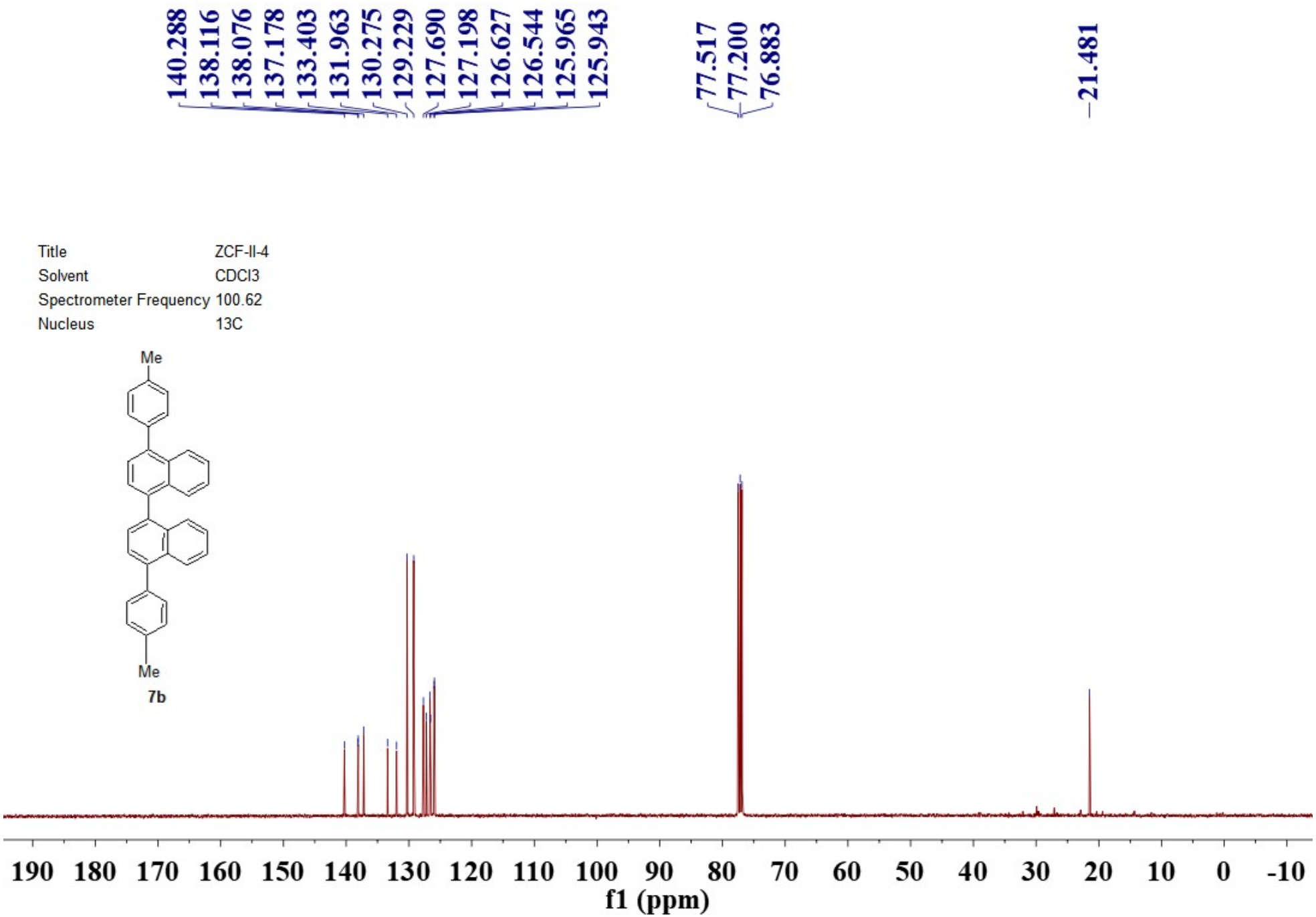
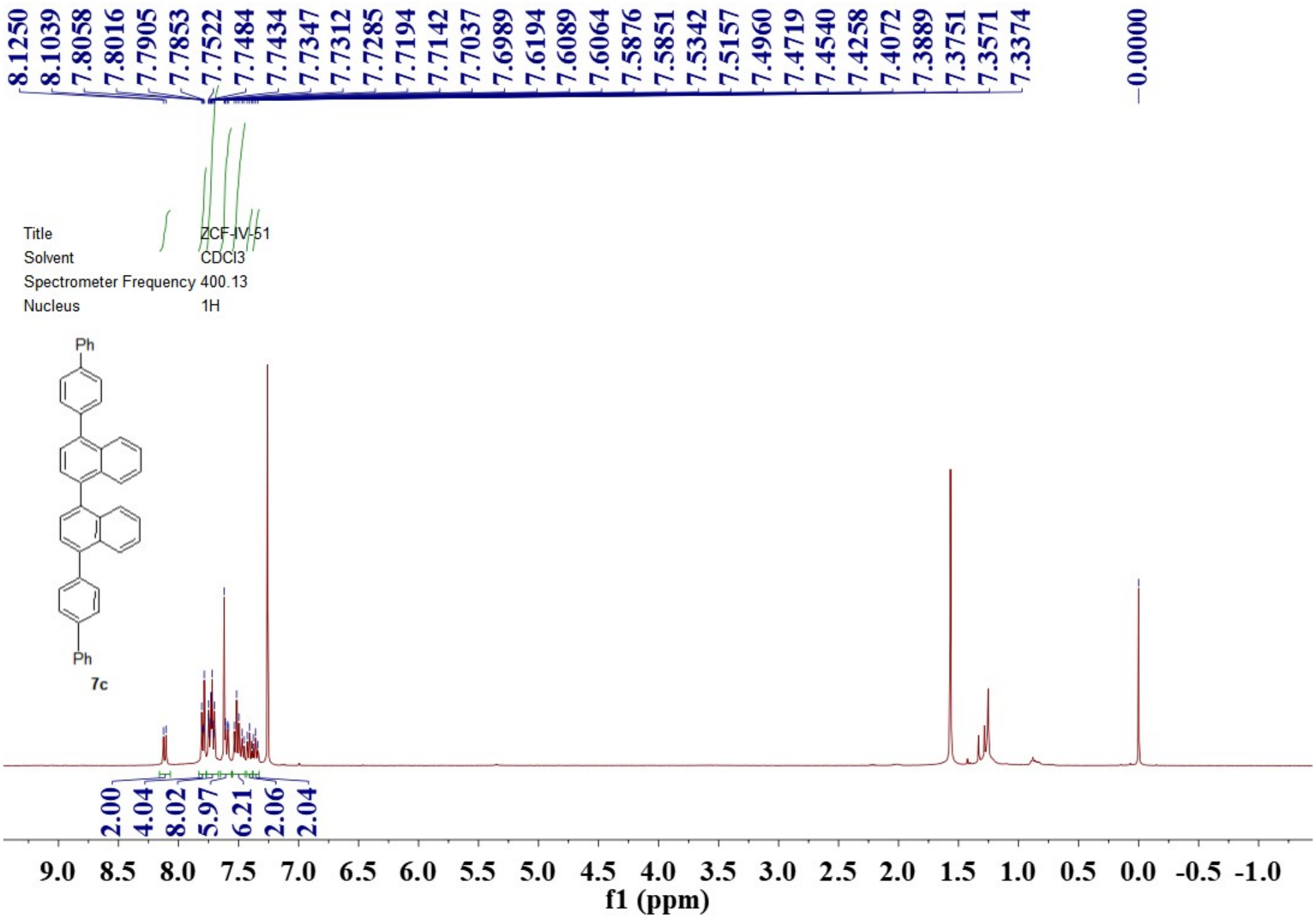
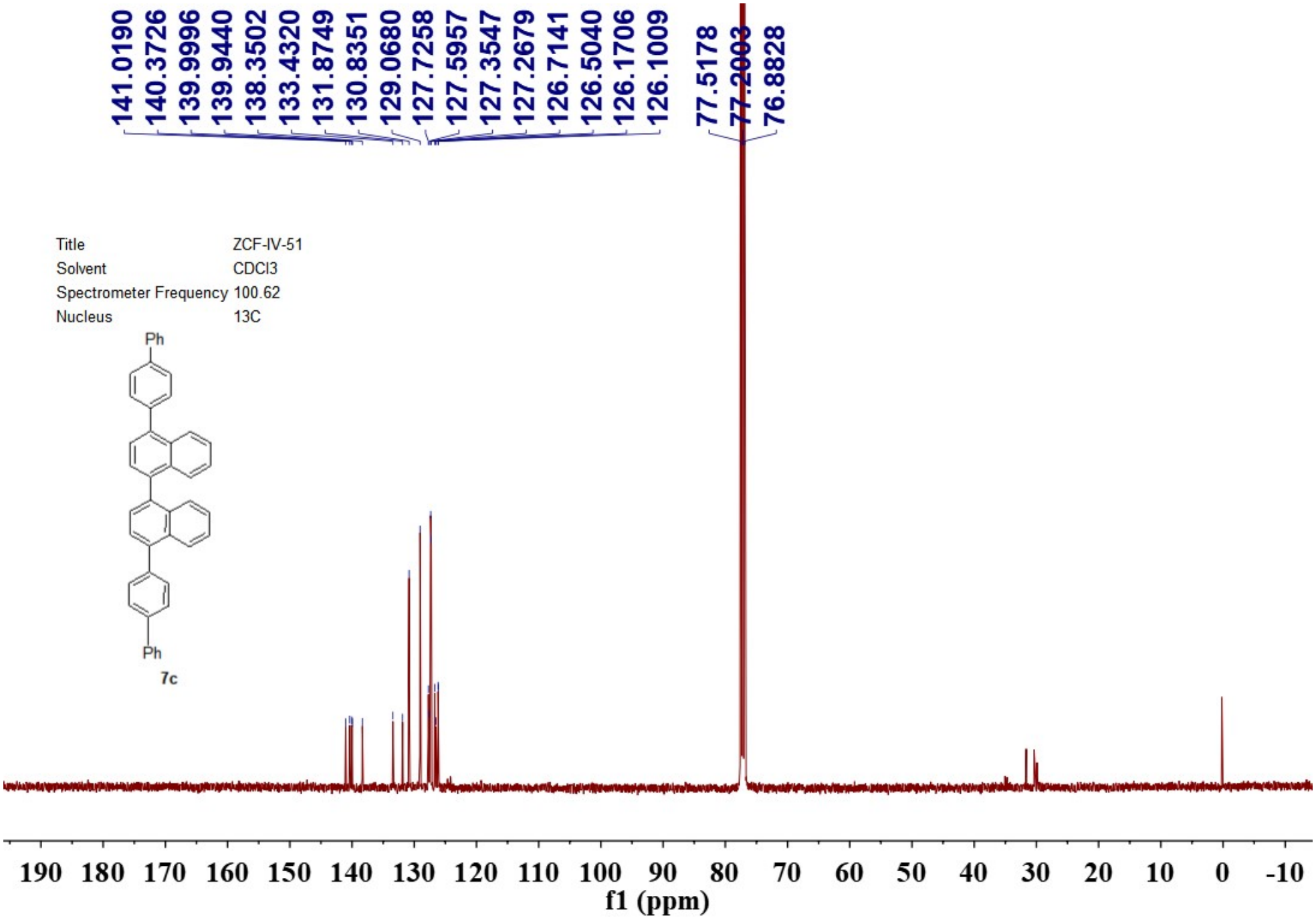
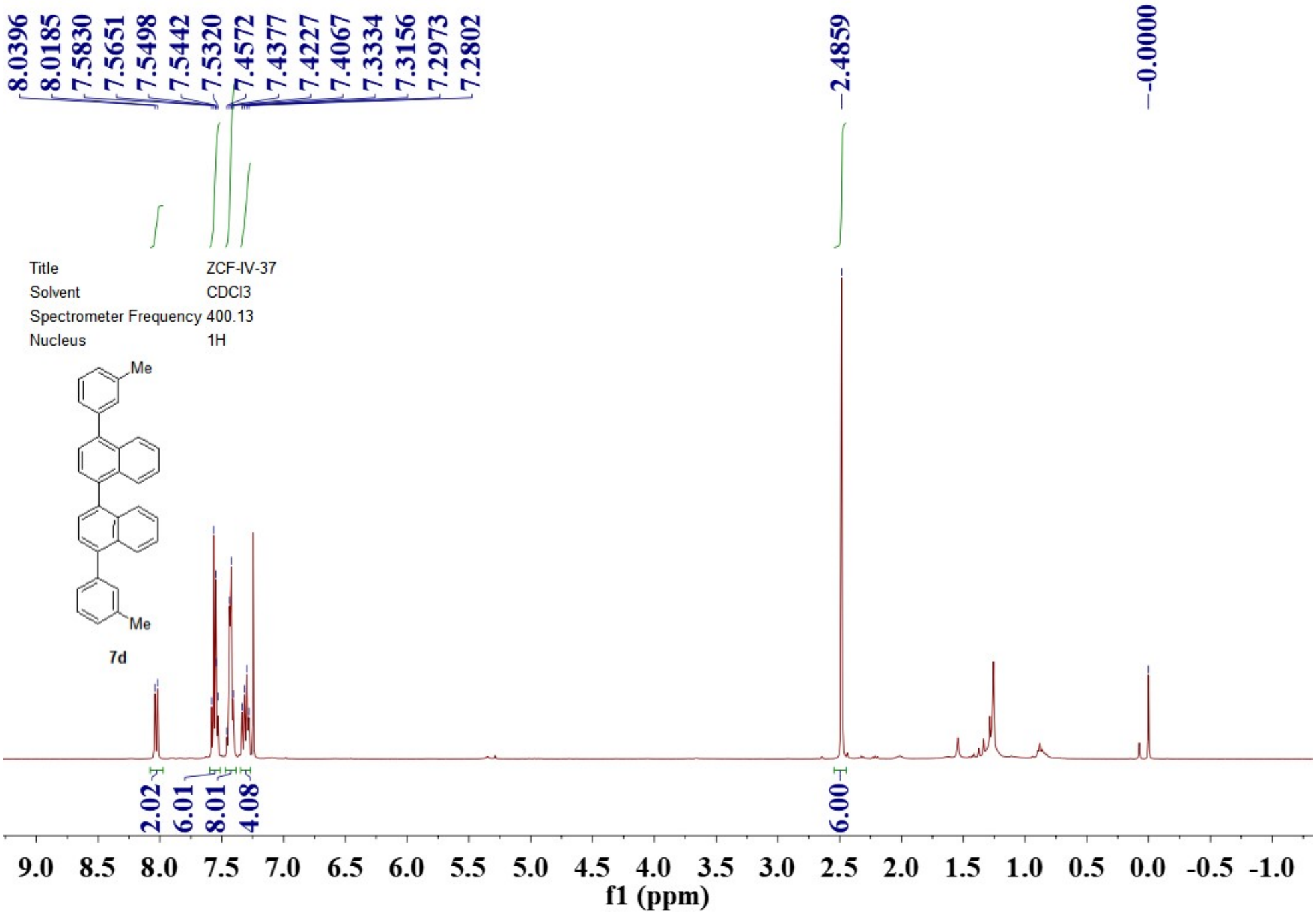
8.0251
7.5744
7.5652
7.5625
7.5564
7.5411
7.5235
7.5214
7.5169
7.5021
7.4975
7.4180
7.4139
7.3958
7.3643
7.3449
7.3266
7.3235
7.3102
7.3061
7.3024
2.4879
0.0000
Title ZCF-II-4
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
7b
2.00
10.03
2.05
4.03
2.07
6.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 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)


140.288
138.116
138.076
137.178
133.403
131.963
130.275
129.229
127.690
127.198
126.627
126.544
125.965
125.943
77.517
77.200
76.883
21.481
Title ZCF-II-4
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
7b
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.1250
8.1039
7.8058
7.8016
7.7905
7.7853
7.7522
7.7484
7.7434
7.7347
7.7312
7.7285
7.7194
7.7142
7.7037
7.6989
7.6194
7.6089
7.6064
7.5876
7.5851
7.5342
7.5157
7.4960
7.4719
7.4540
7.4258
7.4072
7.3889
7.3751
7.3571
7.3374
0.0000
Title ZCF-IV-51
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Ph
Ph
7c
2.00
4.04
8.02
5.97
6.21
2.06
2.04
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)


141.0190
140.3726
139.9996
139.9440
138.3502
133.4320
131.8749
130.8351
129.0680
127.7258
127.5957
127.3547
127.2679
126.7141
126.5040
126.1706
126.1009
77.5178
77.2003
76.8828
Title ZCF-IV-51
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Ph
Ph
7c
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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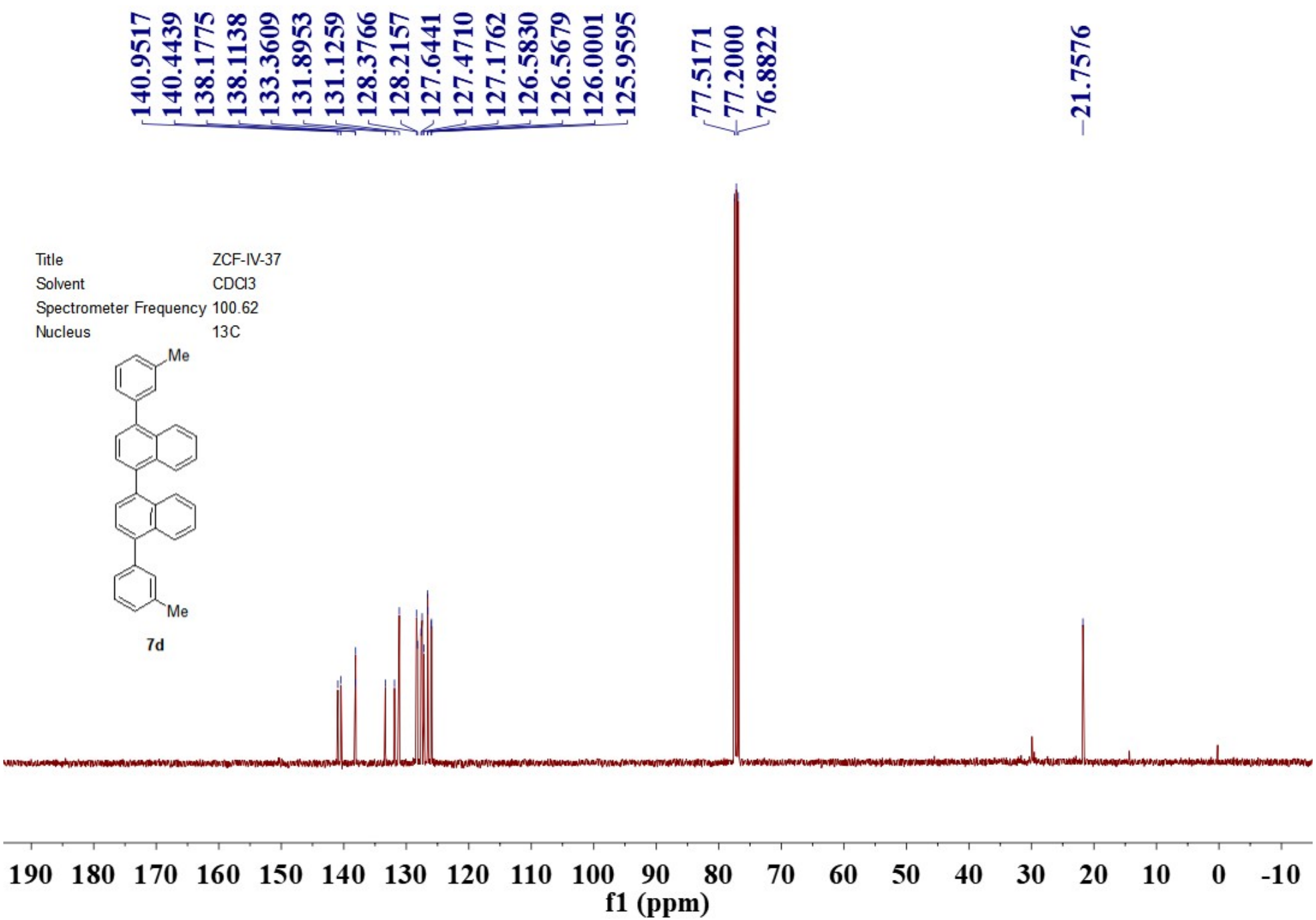
8.0185
7.5830
7.5651
7.5498
7.5442
7.5320
7.4572
7.4377
7.4227
7.4067
7.3334
7.3156
7.2973
7.2802
2.4859
-0.0000
Title ZCF-IV-37
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Me
Me
7d
2.02
6.01
8.01
4.08
6.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)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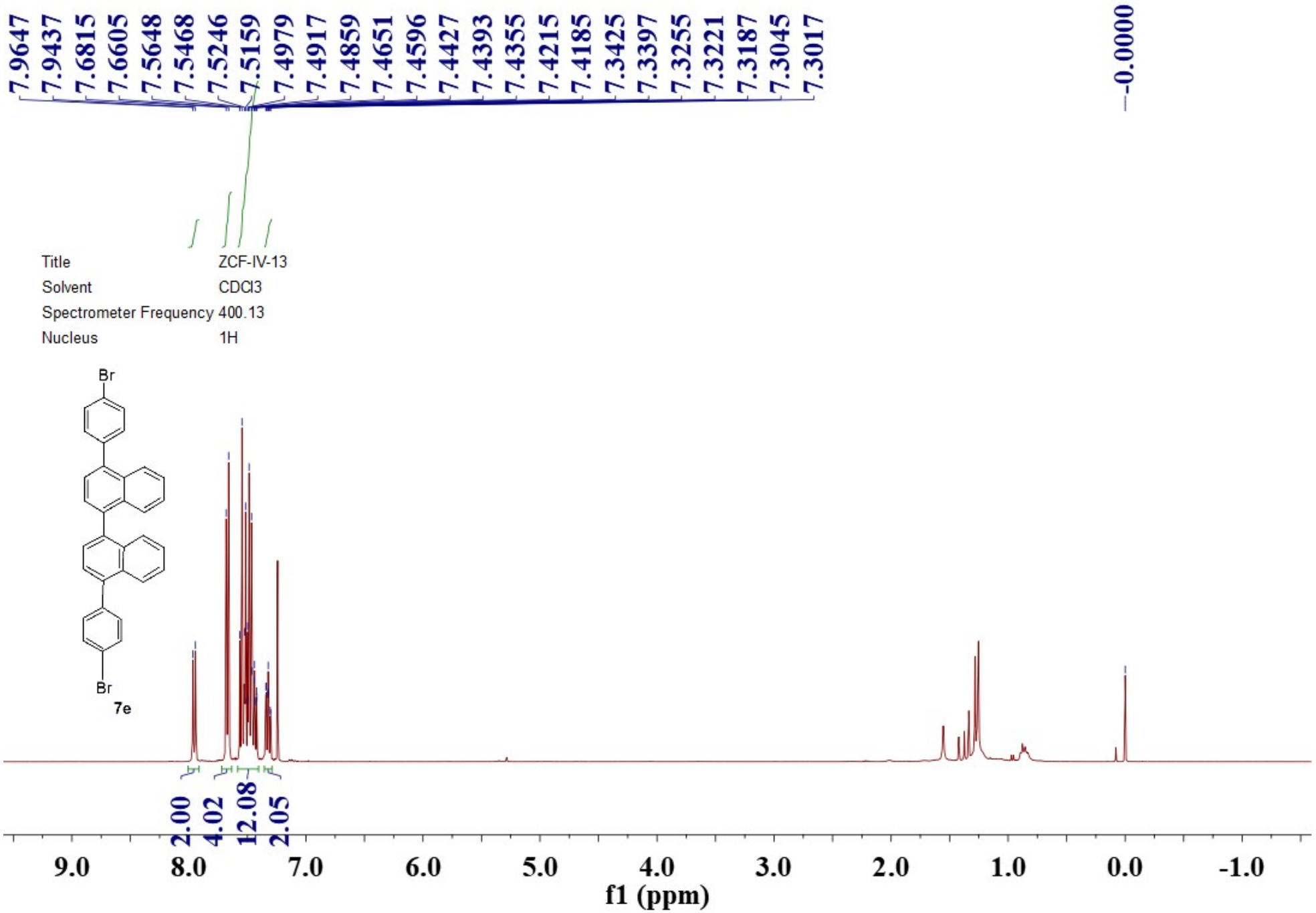
140.4439
138.1775
138.1138
133.3609
131.8953
131.1259
128.3766
128.2157
127.6441
127.4710
127.1762
126.5830
126.5679
126.0001
125.9595
77.5171
77.2000
76.8822
21.7576
Title ZCF-IV-37
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Me
Me
7d
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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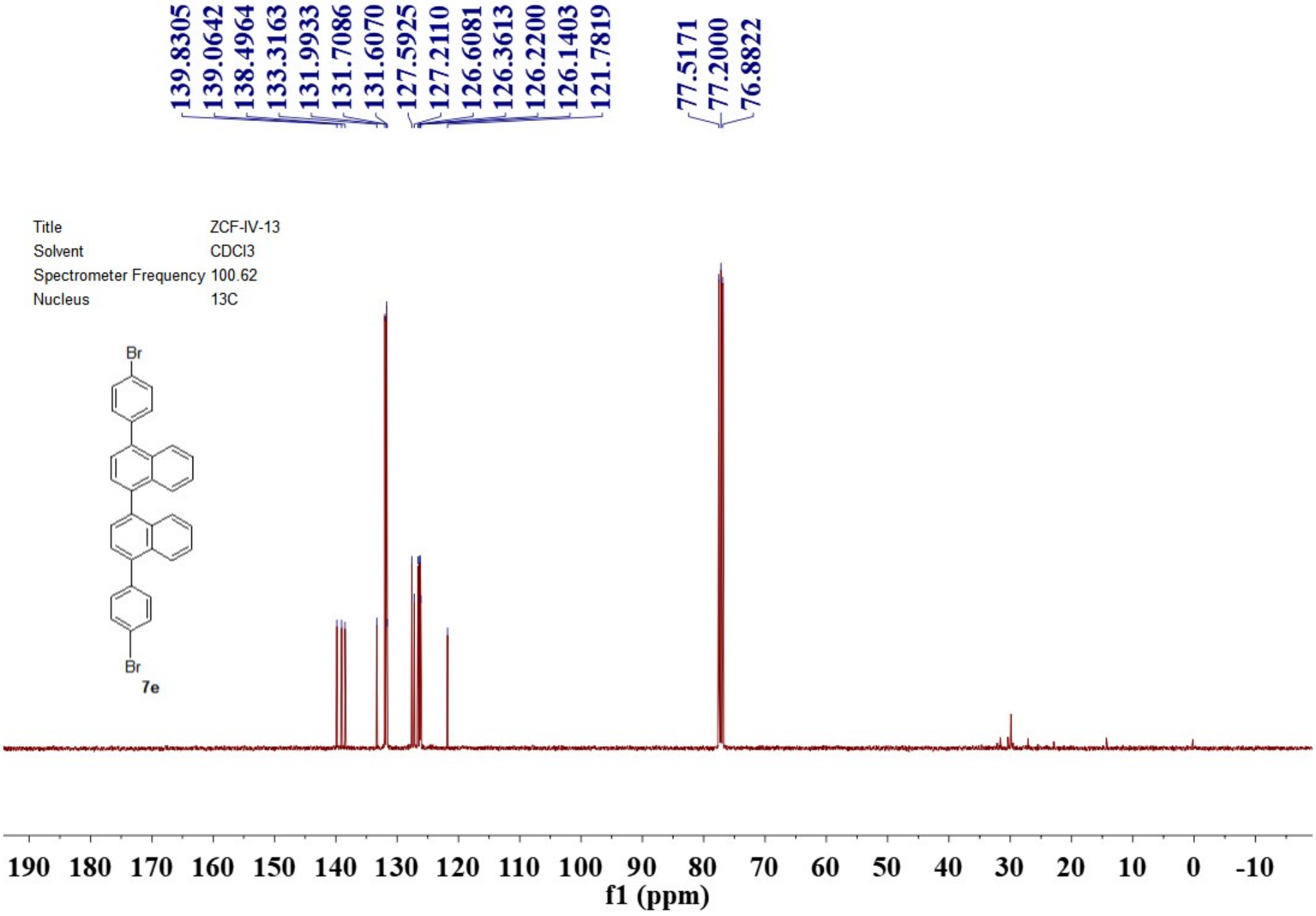
7.9437
7.6815
7.6605
7.5648
7.5468
7.5246
7.5159
7.4979
7.4917
7.4859
7.4651
7.4596
7.4427
7.4393
7.4355
7.4215
7.4185
7.3425
7.3397
7.3255
7.3221
7.3187
7.3045
7.3017
-0.0000
Title ZCF-IV-13
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Br
Br
7e
2.00
4.02
12.08
2.05
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
f1 (ppm)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138.4964
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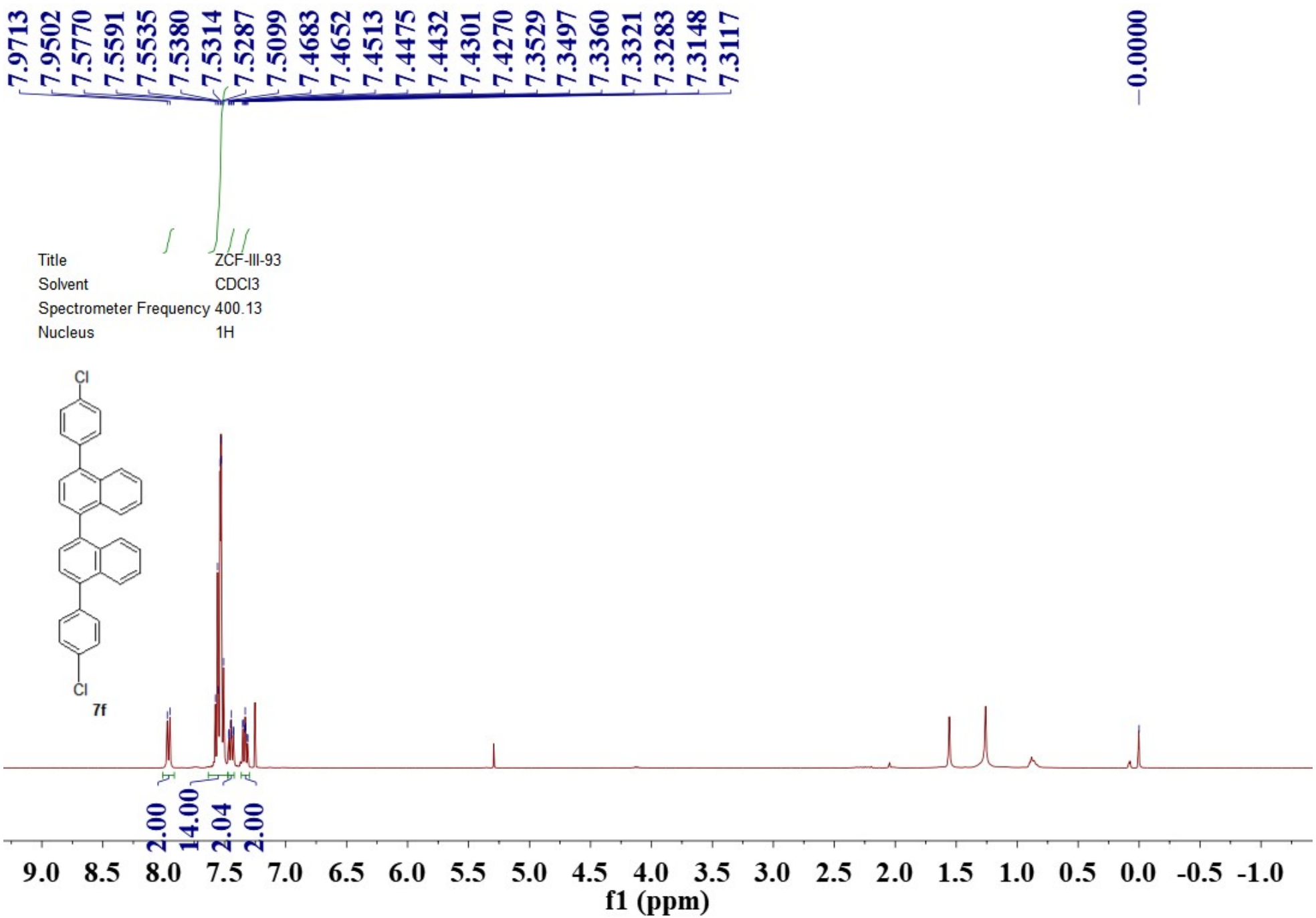
131.9933
131.7086
131.6070
127.5925
127.2110
126.6081
126.3613
126.2200
126.1403
121.7819
77.5171
77.2000
76.8822
Title ZCF-IV-13
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Br
Br
7e
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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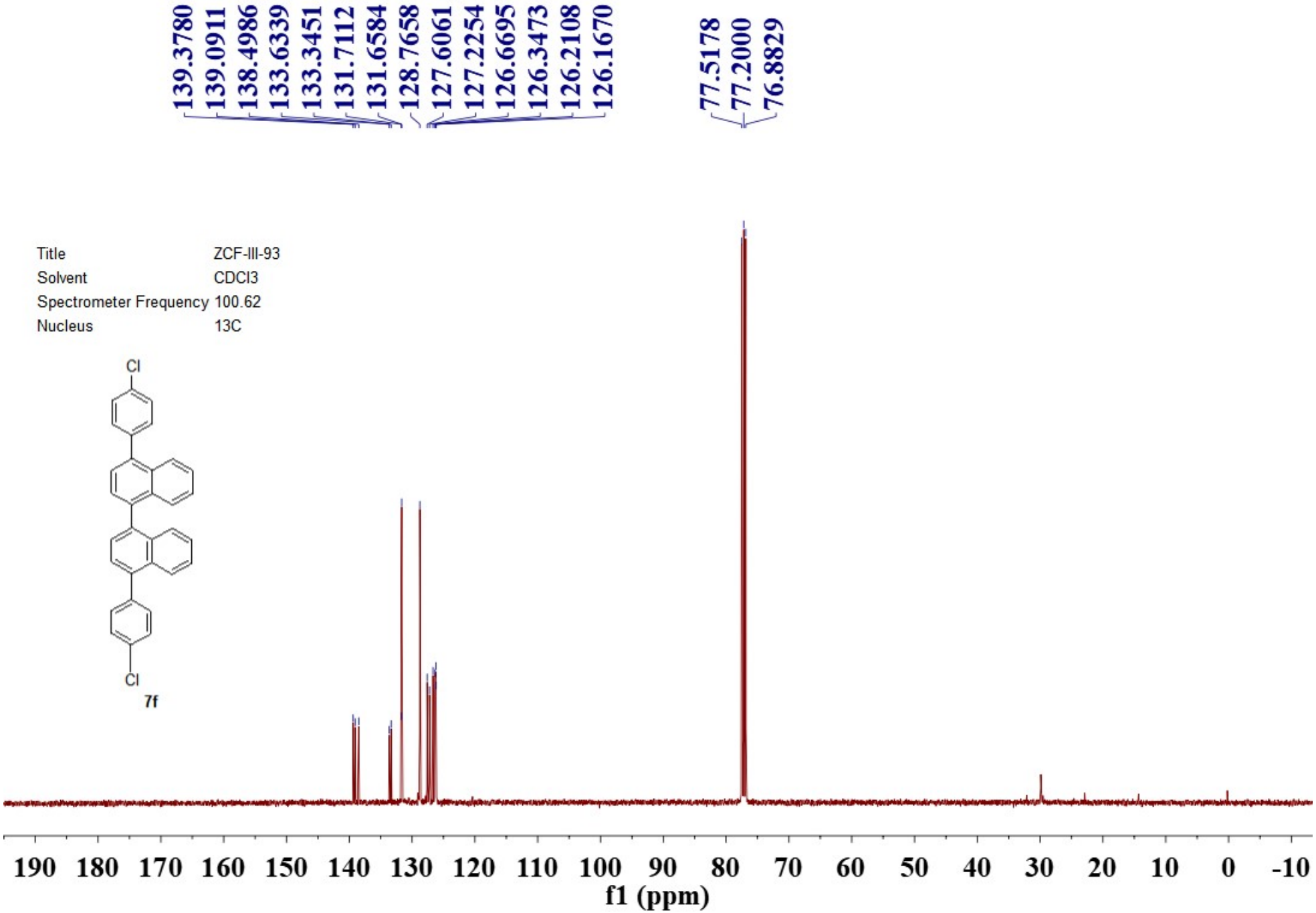
7.9502
7.5770
7.5591
7.5535
7.5380
7.5314
7.5287
7.5099
7.4683
7.4652
7.4513
7.4475
7.4432
7.4301
7.4270
7.3529
7.3497
7.3360
7.3321
7.3283
7.3148
7.3117
0.0000
Title ZCF-III-93
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
Cl
Cl
7f
2.00
14.00
2.04
2.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 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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139.0911
138.4986
133.6339
133.3451
131.7112
131.6584
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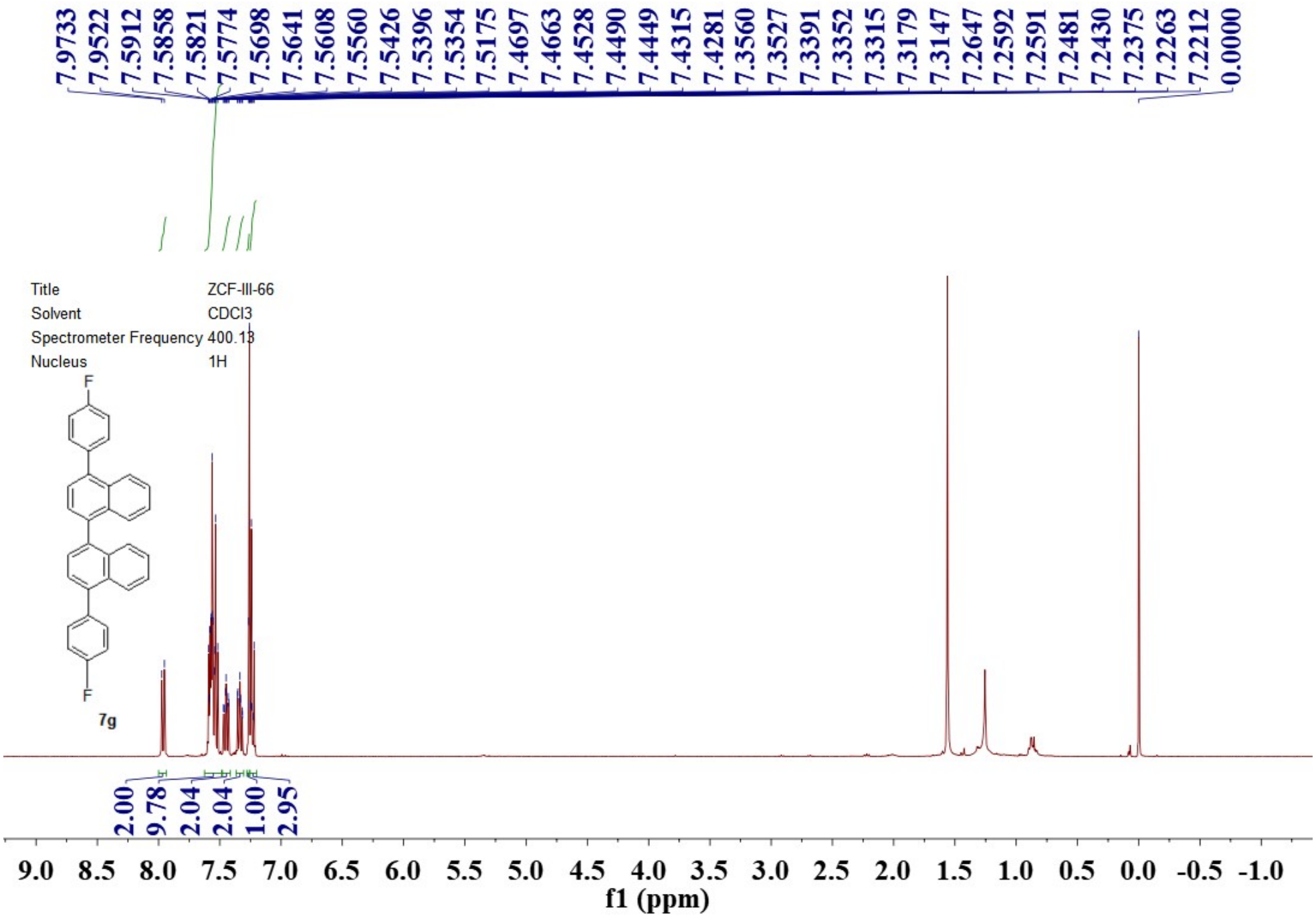
127.6061
127.2254
126.6695
126.3473
126.2108
126.1670
77.5178
77.2000
76.8829
Title ZCF-III-93
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
Cl
Cl
7f
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.5912
7.5858
7.5821
7.5774
7.5698
7.5641
7.5608
7.5560
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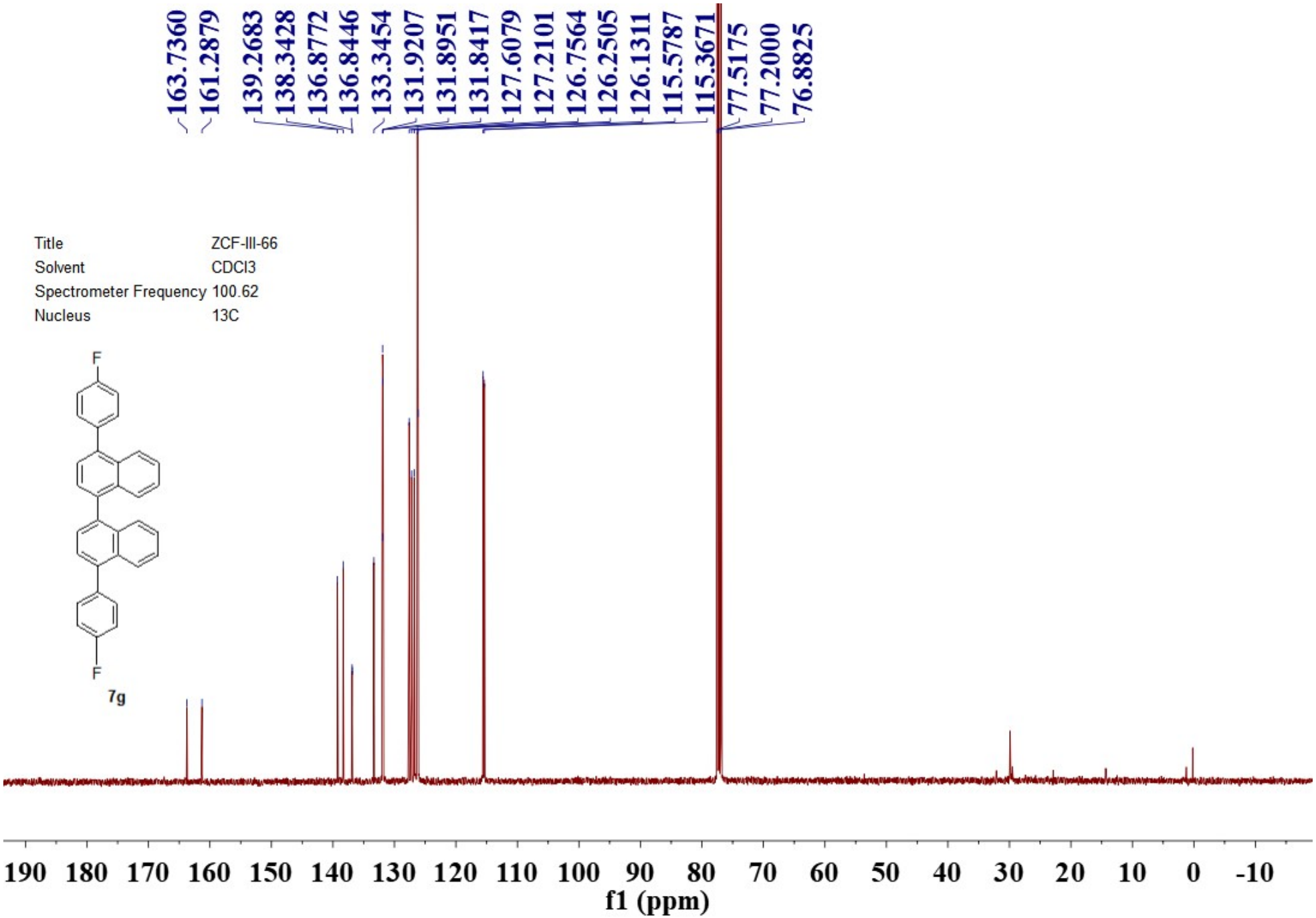
7.5396
7.5354
7.5175
7.4697
7.4663
7.4528
7.4490
7.4449
7.4315
7.4281
7.3560
7.3527
7.3391
7.3352
7.3315
7.3179
7.3147
7.2647
7.2592
7.2591
7.2481
7.2430
7.2375
7.2263
7.2212
0.0000
Title ZCF-III-66
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
F
F
7g
2.00
9.78
2.04
2.04
1.00
2.95
9.0 8.5 8.0 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)


163.7360
161.2879
139.2683
138.3428
136.8772
136.8446
133.3454
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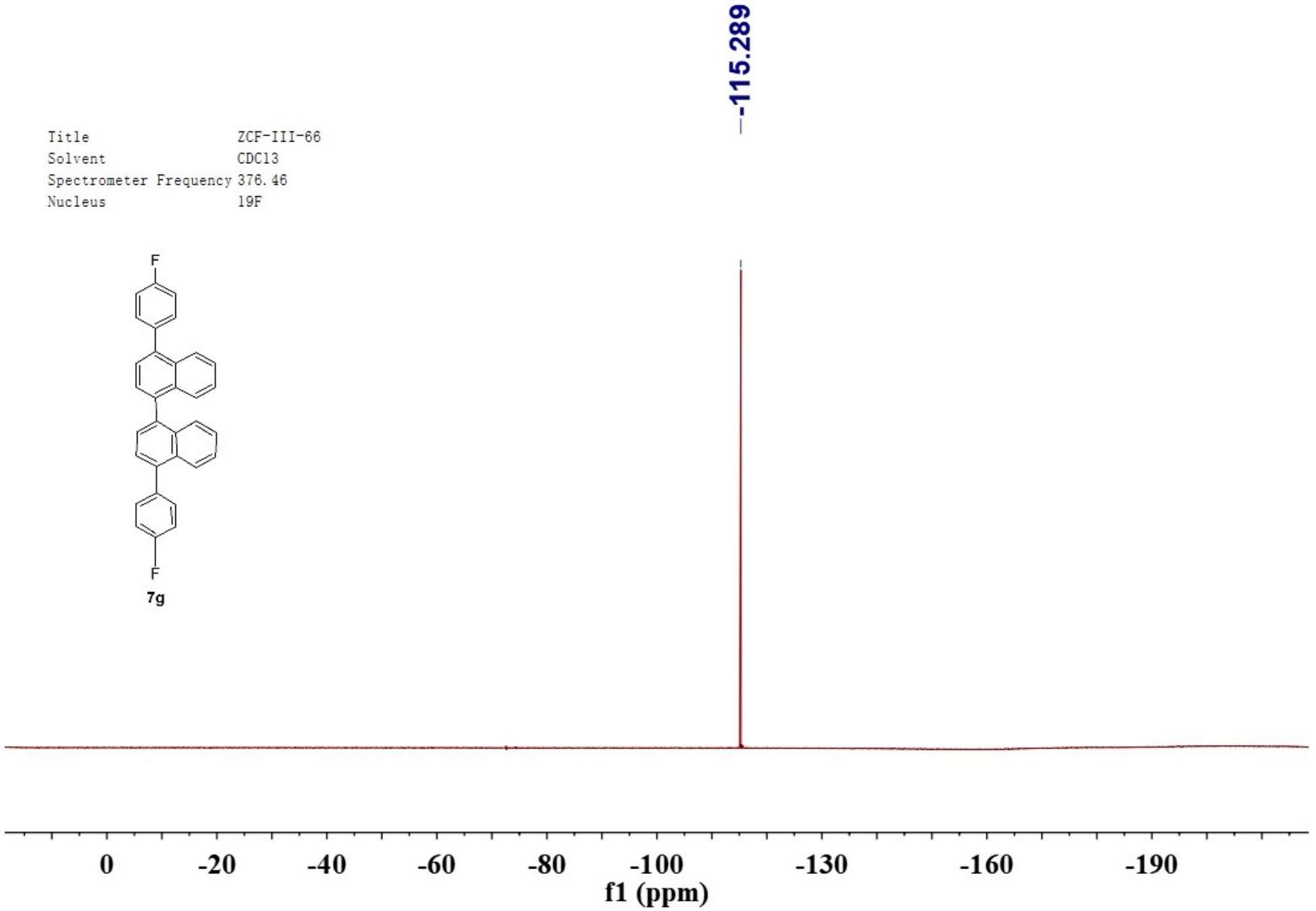
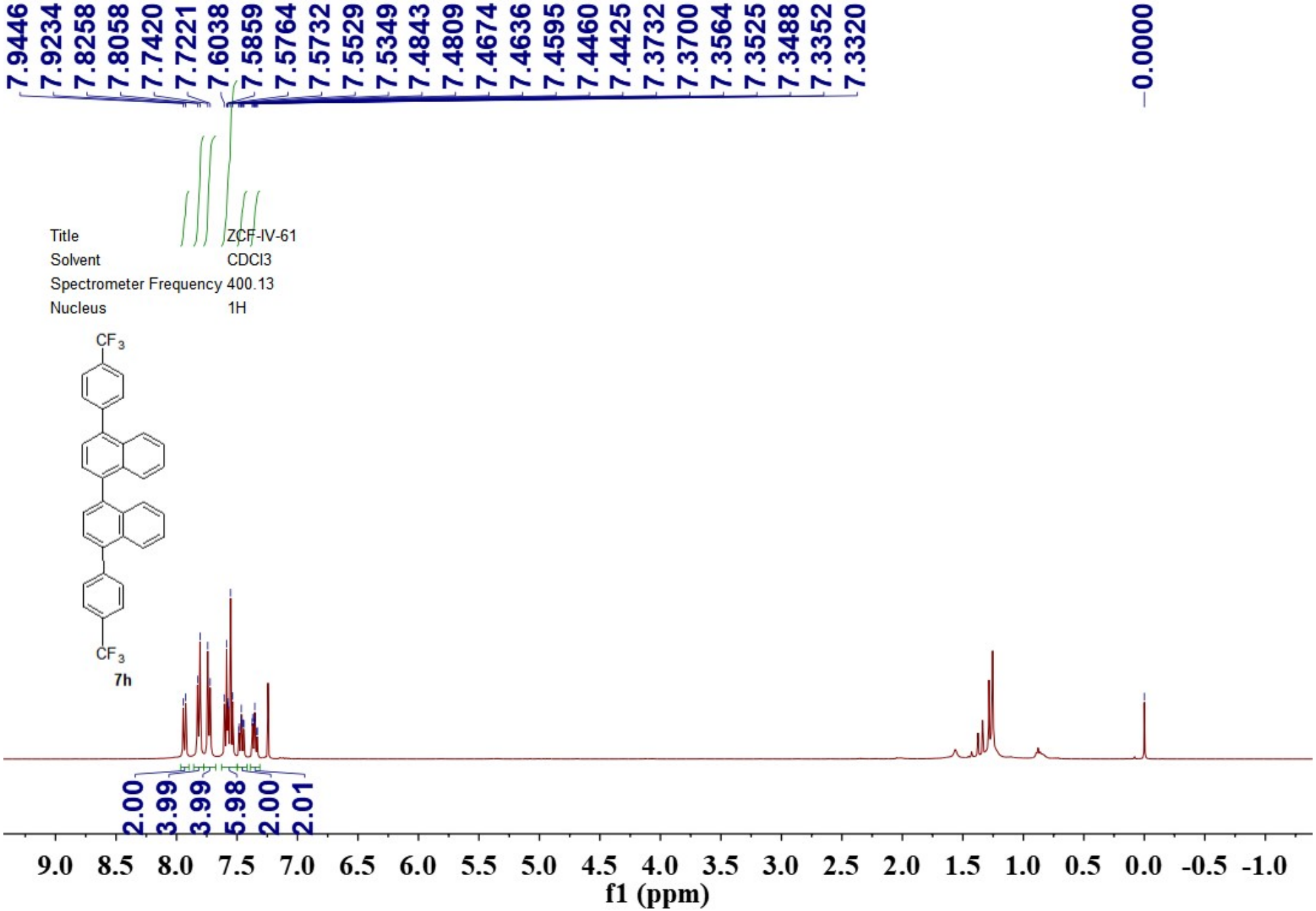
131.8951
131.8417
127.6079
127.2101
126.7564
126.2505
126.1311
115.5787
115.3671
77.5175
77.2000
76.8825
Title ZCF-III-66
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
F
F
7g
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-115.289
Title ZCF-III-66
Solvent CDCl3
Spectrometer Frequency 376.46
Nucleus 19F
F
F
7g
0
-20
-40
-60
-80
-100
-130
-160
-190
f1 (ppm)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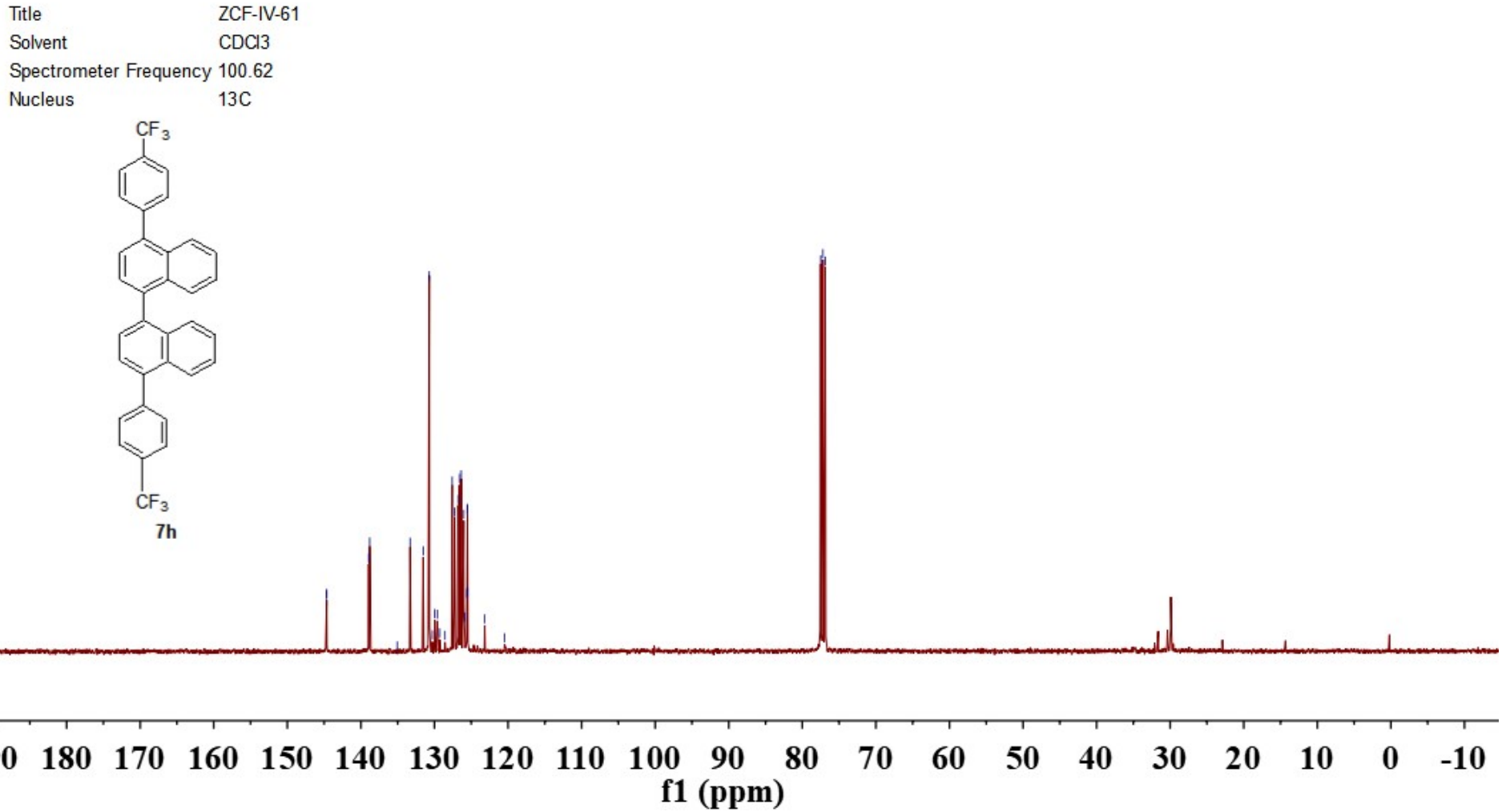
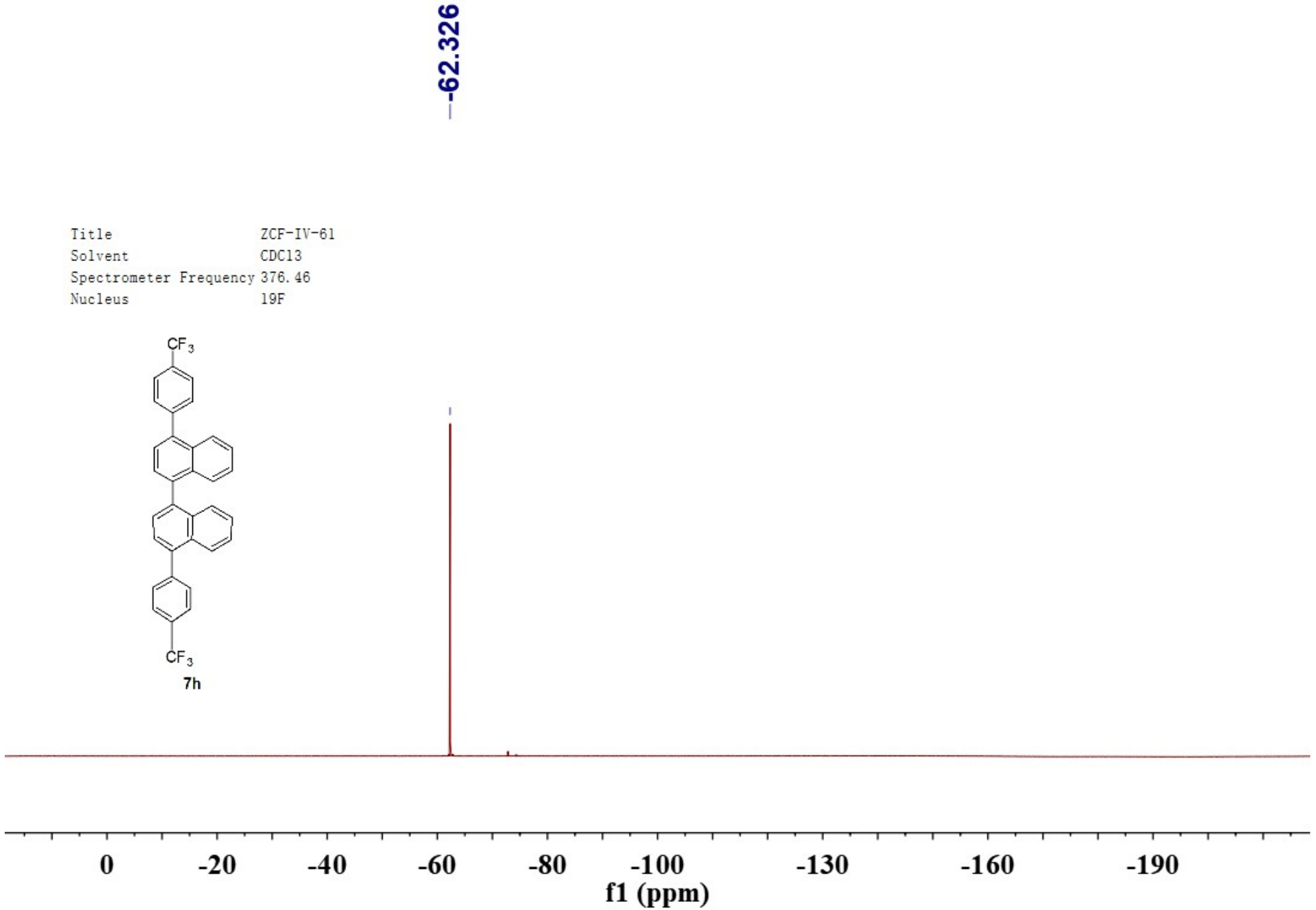
7.9234
7.8258
7.8058
7.7420
7.7221
7.6038
7.5859
7.5764
7.5732
7.5529
7.5349
7.4843
7.4809
7.4674
7.4636
7.4595
7.4460
7.4425
7.3732
7.3700
7.3564
7.3525
7.3488
7.3352
7.3320
0.0000
Title ZCF-IV-61
Solvent CDCl3
Spectrometer Frequency 400.13
Nucleus 1H
CF3
CF3
7h
2.00
3.99
3.99
5.98
2.00
2.01
9.0 8.5 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)


144.6571
144.6470
138.9382
138.7969
135.0671
133.3088
131.5419
130.7007
130.2642
129.9421
129.6194
129.2965
128.5734
127.5824
127.2545
126.7546
126.5755
126.3797
126.0324
125.8686
125.5887
125.5536
125.5169
125.4797
123.1649
120.4620
77.5178
77.2000
76.8828


Title ZCF-IV-61
Solvent CDCl3
Spectrometer Frequency 100.62
Nucleus 13C
CF3
CF3
7h
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-62.326
Title ZCF-IV-61
Solvent CDCl3
Spectrometer Frequency 376.46
Nucleus 19F
CF3
CF3
7h
0
-20
-40
-60
-80
-100
-130
-160
-190
f1 (ppm)