

Iron-Catalyzed Aerobic C-H Functionalization of Pyrrolones

Li-wei Liu,^a Zhen-zhen Wang,^a Hui-hui Zhang,^a Wan-shu Wang,^a Ji-zong Zhang^a
and Yu Tang^{*,a}

^a*School of Pharmaceutical Science and Technology, Key Laboratory for Modern
Drug Delivery & High-Efficiency, Tianjin University, Tianjin, 300072 P. R.*

China

E-mail: yutang@tju.edu.cn

Supplementary Material

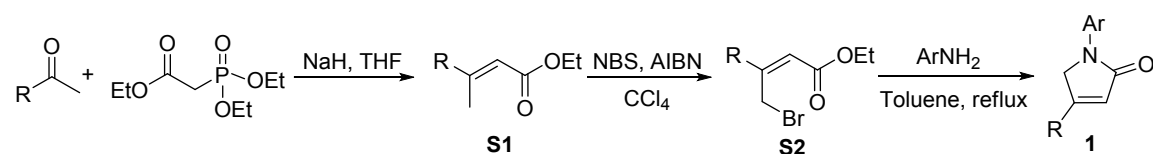
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1. General information

All reactions were performed in flame-dried glassware under nitrogen atmosphere. Solvents were distilled prior to use. Reagents were used as purchased from J&K, Beijing Ouhe, Aldrich, Acros, Alfa Aesar, or TCI unless otherwise noted. Chromatographic separations were performed using Kangbino 48-75 Å SiO₂. ¹H and ¹³C NMR spectra were obtained on 400, 600 MHz BRUKER AVANCE spectrometers using CDCl₃ with TMS or residual solvent as standard unless otherwise noted. Melting points were determined using a Laboratory Devices MEL-TEMP and were uncorrected/calibrated. Infrared spectra were obtained on Bruker TENSOR 27. TLC analysis was performed using Kangbino glass-backed plates (60 Å, 250 μm) and visualized using UV. Low-resolution mass spectra were obtained using an Agilent 1100 series LS/MSD.

2. Preparation and Characterization of Substrates

1) Synthesis of **1a-1g** and **1j** through a Three-Step Sequence.¹⁻³

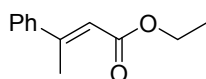


To a solution of NaH (6.0 g, 250 mmol) in THF (200 mL) a solution of ethyl(diethoxyphosphoryl) acetate (21 mL, 120 mmol) in THF (50 mL) was added dropwise in ice bath. After 30 min, acetophenone (11.7 mL, 100 mmol) was added to the reaction mixture, which was then stirred for 2-3 days at room temperature. After the reaction was completed, THF was evaporated under reduced pressure, and the residue was extracted with ethyl acetate. The organic layer was dried over Na₂SO₄ and evaporated. Crude product was purified by column chromatography on silica gel to give the α,β-unsaturated ester **S1**.

A solution of ester **S1** (12.2 g, 64.2 mmol), NBS (13.7 g, 77 mmol) and AIBN

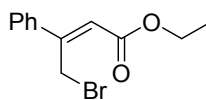
(0.42 g, 2.6 mmol) in dry CCl_4 (150 mL) was refluxed under nitrogen atmosphere for 20 h. Then the reaction mixture was cooled to room temperature and then filtered to separate succinimide formed during the reaction. The filtrate was concentrated under reduced pressure to afford the crude product. Crude product was purified by column chromatography on silica gel to give pure bromoester **S2**.

To a stirred solution of **S2** (5.6 g, 21 mmol) in toluene (30 mL) was added aniline (4 mL, 43 mmol) with stirring. Stirring was continued for a further 2 h, and after being diluted with additional toluene (70 mL), the mixture was heated under reflux for 29 h. The cooled reaction mixture was successively washed with 5% HCl, 2% NaOH and water. After drying over Na_2SO_4 , the solvent was evaporated. The residue was purified by column chromatography on silica gel followed with recrystallization from ethanol to give the pure product **1a**.



S1

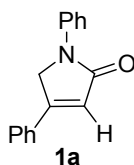
(E)-ethyl 3-phenylbut-2-enoate S1. Yellow oil (14 g, 74%); ^1H NMR (600 MHz, CDCl_3) δ 7.45-7.47 (m, 2H), 7.32-7.37 (m, 3H), 6.13 (s, 1H), 4.19 (q, $J = 7.2$ Hz, 2H), 2.57 (s, 3H), 1.29 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (150 MHz, CDCl_3) δ 166.8, 155.5, 142.2, 128.9, 128.5, 126.3, 117.2, 59.8, 17.9, 14.4; mass spectrum (ESI): m/e (% relative intensity) 212.7 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{12}\text{H}_{14}\text{O}_2$ ($\text{M}+\text{H}$) $^+$: 191.1072, found 191.1065; IR (KBr, neat) 2980, 1713, 1628, 1446, 1377, 1366, 1343, 1272, 1168, 1095, 1043, 872, 766, 694 cm^{-1} .



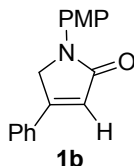
S2

(Z)-ethyl 4-bromo-3-phenylbut-2-enoate S2. Yellow oil (16.4 g, 95%); ^1H NMR (600 MHz, CDCl_3) δ 7.53-7.57 (m, 2H), 7.40-7.43 (m, 3H), 6.21 (s, 1H), 4.98 (s, 2H), 4.25 (q, $J = 7.2$ Hz, 2H), 1.33 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (150 MHz, CDCl_3) δ 165.6, 153.2, 138.5, 129.8, 128.8, 126.6, 119.8, 60.6, 26.6, 14.2. mass spectrum (ESI):

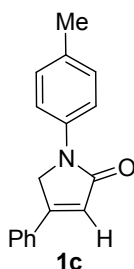
m/e (% relative intensity) 268.9 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₁₂H₁₃O₂Br (M+Na)⁺: 290.9997, found 290.9998; IR (KBr, neat) 2981, 2932, 2353, 2320, 1711, 1624, 1448, 1367, 1343, 1287, 1219, 1176, 1142, 1095, 1049, 1019, 880, 769, 695, 543, 418 cm⁻¹.



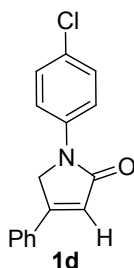
1,4-diphenyl-1H-pyrrol-2(5H)-one 1a. White solid (2.5 g, 51%); mp 172–174 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.78 (d, J = 12.0 Hz, 2H), 7.57-7.59 (m, 2H), 7.45-7.49 (m, 3H), 7.38 (t, J = 12.0 Hz, 2H), 7.12 (t, J = 10.8 Hz, 1H), 6.54 (s, 1H), 4.80 (s, 2H); ¹³C NMR (150 MHz, CDCl₃) δ 170.4, 153.6, 139.3, 131.4, 130.6, 129.1, 125.9, 124.0, 121.4, 118.7, 52.7; mass spectrum (ESI): m/e (% relative intensity) 258.2 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₁₆H₁₃NO (M+Na)⁺: 258.0895, found 258.0895; IR (KBr, neat) 1672, 1623, 1597, 1502, 1448, 1437, 1383, 1353, 1299, 1144, 846, 765, 755, 718, 689 cm⁻¹.



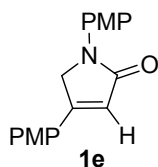
1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 1b. Brown solid (5.01 g, 31%); mp: 136-138 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.64 (d, J = 13.8 Hz, 2H), 7.55-7.57 (m, 2H), 7.43-7.47 (m, 3H), 6.93 (d, J = 13.2 Hz, 2H), 6.53 (s, 1H), 4.76 (s, 2H), 3.81 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 170.2, 156.4, 153.3, 132.4, 131.5, 130.5, 129.1, 125.9, 121.4, 120.9, 114.3, 55.5, 53.2; mass spectrum (ESI): m/e (% relative intensity) 288.4 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₁₇H₁₅NO₂ (M+Na)⁺: 288.1000, found 288.1007; IR (KBr, neat) 1713, 1671, 1513, 1445, 1388, 1347, 1299, 1244, 1181, 1143, 1036, 866, 830, 802, 761, 687 cm⁻¹.



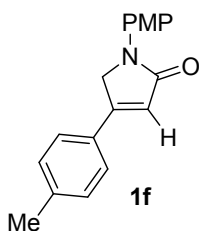
4-phenyl-1-(p-tolyl)-1H-pyrrol-2(5H)-one 1c. Brown solid (3.40 g, 74%); mp: 150-152 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.63 (d, $J = 8.4$ Hz, 2H), 7.55 (d, $J = 7.2$ Hz, 2H), 7.44-7.46 (m, 3H), 7.19 (d, $J = 8.4$ Hz, 2H), 6.52 (s, 1H), 4.76 (s, 2H), 2.23 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.2, 153.4, 136.8, 133.5, 131.4, 129.6, 129.1, 125.9, 121.2, 118.6, 118.5, 52.6, 20.8; mass spectrum (ESI): m/e (% relative intensity) 272.4 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{17}\text{H}_{15}\text{NO}$ ($\text{M}+\text{Na}$) $^+$: 272.1051, found 272.1049; IR (KBr, neat) 3150, 3080, 1668, 1616, 1513, 1498, 1439, 1384, 1351, 1299, 1207, 1195, 1144, 861, 815, 759, 718, 689, 663 cm^{-1} .



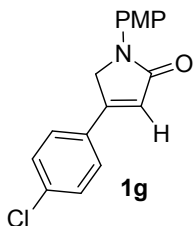
1-(4-chlorophenyl)-4-phenyl-1H-pyrrol-2(5H)-one 1d. Brown solid (2.70 g, 54%), mp: 190-192 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.71 (d, $J = 9.0$ Hz, 2H), 7.53-7.55 (m, 2H), 7.43-7.45 (m, 3H), 7.30 (d, $J = 9.0$ Hz, 2H), 6.47 (s, 1H), 4.71 (s, 2H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.3, 153.7, 137.9, 131.2, 130.7, 129.2, 129.0, 128.9, 125.9, 121.2, 119.7, 52.6; mass spectrum (ESI): m/e (% relative intensity) 292.0 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{16}\text{H}_{12}\text{NOCl}$ ($\text{M}+\text{H}$) $^+$: 270.0686, found 270.0681; IR (KBr, neat) 3150, 3080, 1666, 1596, 1495, 1437, 1416, 1379, 1348, 1301, 1198, 1144, 1091, 856, 829, 761, 686, 510 cm^{-1} .



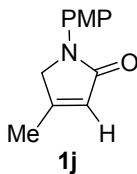
1,4-bis(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 1e. Brown solid (3.70 g, 32%), mp: 169-171 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.62 (d, $J = 9.0$ Hz, 2H), 7.47 (d, $J = 9.0$ Hz, 2H), 6.93 (d, $J = 9.0$ Hz, 2H), 6.90 (d, $J = 9.0$ Hz, 2H), 6.36 (s, 1H), 4.68 (s, 2H), 3.84 (s, 3H), 3.79 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.6, 161.4, 156.3, 153.1, 132.6, 130.6, 127.4, 124.2, 120.8, 119.1, 114.5, 114.3, 55.5, 53.2; mass spectrum (ESI): m/e (% relative intensity) 318.5 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_3$ ($\text{M}+\text{Na}$) $^+$: 318.1106, found 318.1112; IR (KBr, neat) 2933, 2833, 1665, 1607, 1511, 1440, 1386, 1347, 1297, 1255, 1208, 1195, 1176, 1144, 1112, 1043, 1027, 873, 823, 658, 590, 572, 519, 484 cm^{-1} .



1-(4-methoxyphenyl)-4-(p-tolyl)-1H-pyrrol-2(5H)-one 1f. Brown solid (0.14 g, 7.1%), mp: 172-174 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.64 (d, $J = 9.0$ Hz, 2H), 7.44 (d, $J = 7.8$ Hz, 2H), 7.24-7.26 (m, 2H), 6.92 (d, $J = 9.0$ Hz, 2H), 6.48 (s, 1H), 4.73 (s, 2H), 3.81 (s, 3H), 2.40 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.4, 156.3, 153.4, 140.9, 132.5, 129.8, 128.7, 125.8, 120.8, 120.4, 114.3, 55.5, 53.2, 21.5; mass spectrum (ESI): m/e (% relative intensity) 302.3 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_2$ ($\text{M}+\text{H}$) $^+$: 280.1338, found 280.1334; IR (KBr, neat) 2926, 2353, 2320, 1712, 1513, 1446, 1388, 1341, 1297, 1250, 1197, 1036, 829, 804, 453, 419 cm^{-1} .

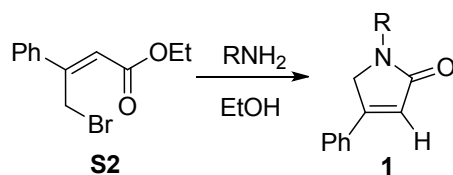


4-(4-chlorophenyl)-1-(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 1g. Brown solid (1.2 g, 45%), mp: 172-174 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.62 (d, $J = 9.0$ Hz, 2H), 7.47 (d, $J = 8.4$ Hz, 2H), 7.41 (d, $J = 8.4$ Hz, 2H), 6.92 (d, $J = 9.0$ Hz, 2H), 6.49 (s, 1H), 4.72 (s, 2H), 3.80 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 169.8, 156.5, 151.9, 136.4, 132.2, 129.9, 129.4, 127.1, 121.9, 120.9, 114.4, 55.5, 53.1; mass spectrum (ESI): m/e (% relative intensity) 322.0 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{17}\text{H}_{14}\text{NO}_2\text{Cl}$ ($\text{M}+\text{Na}$) $^+$: 322.0611, found 322.0614; IR (KBr, neat) 3066, 2928, 2900, 2832, 1710, 1666, 1514, 1494, 1445, 1408, 1299, 1248, 1094, 1042, 824, 814, 802, 709, 539, 451 cm^{-1} .

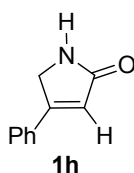


1-(4-methoxyphenyl)-4-methyl-1H-pyrrol-2(5H)-one 1j. Brown solid (1.5 g, 31%), mp: 96-98 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.55 (d, $J = 9.0$ Hz, 2H), 6.90 (d, $J = 9.0$ Hz, 2H), 5.96 (s, 1H), 4.27 (s, 2H), 3.81 (s, 3H), 2.14 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.5, 156.0, 154.6, 132.6, 123.8, 120.5, 114.2, 56.3, 55.4, 15.1; mass spectrum (ESI): m/e (% relative intensity) 204.4 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{12}\text{H}_{13}\text{NO}_2$ ($\text{M}+\text{Na}$) $^+$: 226.0844, found 226.0844; IR (KBr, neat) 2960, 2924, 2836, 1673, 1512, 1445, 1382, 1334, 1311, 1296, 1240, 1032, 828, 802, 568, 451 cm^{-1} .

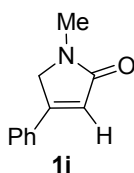
2) Synthesis of **1h** and **1i**⁴



Bromoester **S2** (5.38 g, 20 mmol) was dissolved in 70 mL of ethanol which had been saturated with gaseous ammonia, and the mixture was stirred at room temperature for 18 h. The reaction mixture was cooled to -15 °C and the resulting precipitate was collected and washed with ethanol to give **1h**.

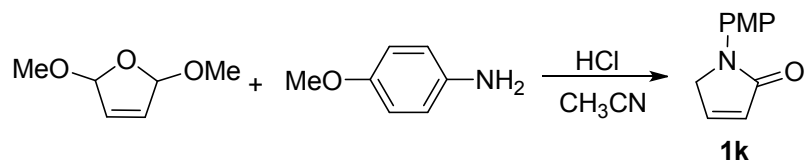


4-phenyl-1H-pyrrol-2(5H)-one 1h. Brown solid (3.1 g, 98%), mp: 128-130 °C. ¹H NMR (600 MHz, CDCl₃) δ 7.76 (s, 1H), 7.48-7.49 (m, 2H), 7.39-7.41 (m, 3H), 6.41 (s, 1H), 4.40 (s, 2H); ¹³C NMR (100 MHz, DMSO) δ 174.2, 157.6, 132.5, 130.4, 129.3, 126.6, 120.7, 48.1. mass spectrum (ESI): *m/e* (% relative intensity) 160.0 (100) (M+H)⁺; HRMS (ESI): *m/z* calcd for C₁₀H₉NO (M+Na)⁺: 182.0582, found 182.0581; IR (KBr, neat) 3175, 3080, 3030, 2916, 1681, 1653, 1493, 1448, 1400, 1350, 1324, 1223, 1209, 857, 761, 721, 685, 651 cm⁻¹.

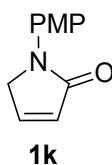


1-methyl-4-phenyl-1H-pyrrol-2(5H)-one 1i. Yellow solid (0.5 g, 27%), mp: 96-98 °C; ¹H NMR (600 MHz, DMSO) δ 7.64-7.65 (m, 2H), 7.42-7.45 (m, 3H), 6.59 (s, 1H), 4.46 (s, 2H), 2.96 (s, 3H). ¹³C NMR (150 MHz, DMSO) δ 170.6, 154.4, 131.8, 129.9, 128.9, 125.9, 119.9, 53.6, 28.5; mass spectrum (ESI): *m/e* (% relative intensity) 174.2 (100) (M+H)⁺; HRMS (ESI): *m/z* calcd for C₁₁H₁₁NO (M+H)⁺: 174.0919, found 174.0919; IR (KBr, neat) 3434, 3065, 2377, 2311, 1678, 1493, 1449, 1217, 903, 764, 421 cm⁻¹.

3) Synthesis of **1k**

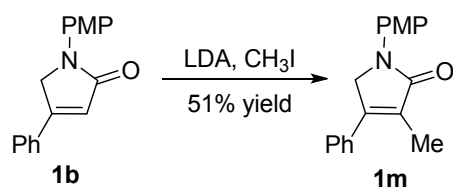


To a 200 mL solution of *p*-anisidine (4.62 g, 37.5 mmol) and 2,5-dimethoxy-2,5-dihydrofuran (9.75 g, 75 mmol) in acetonitrile, 150 mL of 0.4 N aqueous HCl solution was added. The reaction mixture was stirred at rt for 1 h, quenched with NaHCO₃, concentrated under reduced pressure and partitioned between EtOAc and H₂O. The aqueous phase was extracted with EtOAc and the combined organic extracts were washed with brine, dried over Na₂SO₄, concentrated and evaporated to give the residue. The crude product was purified by column chromatography to afford the product **1k**.



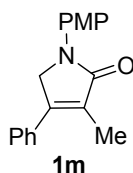
1-(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 1k. Brown solid (2.3 g, 32%), mp: 100-102 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.58 (d, *J* = 8.4 Hz, 2H), 7.15 (d, *J* = 5.4 Hz, 1H), 6.91 (d, *J* = 8.4 Hz, 2H), 6.25 (d, *J* = 3.6 Hz, 1H), 4.40 (s, 2H), 3.80 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 169.9, 156.4, 142.0, 132.3, 129.1, 121.1, 114.3, 55.5, 53.8; mass spectrum (ESI): *m/e* (% relative intensity) 190.0 (100) (M+H)⁺; HRMS (ESI): *m/z* calcd for C₁₁H₁₁NO₂ (M+Na)⁺: 212.0687, found 212.0687; IR (KBr, neat) 3089, 2953, 2836, 1681, 1512, 1441, 1378, 1279, 1250, 1214, 1147, 1033, 830 cm⁻¹.

4) Synthesis of **1l** and **1m**⁴

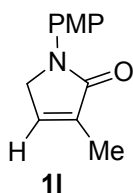


Lithium diisopropylamide was generated from 0.43 mL of diisopropylamine and

2.25 mL of a 1.6 M solution of *n*-butyllithium in hexane in 10 mL of tetrahydrofuran under a nitrogen atmosphere at -78 °C. Compound **1b** (0.66 g, 2.5 mmol) was added to this reaction, and the mixture was stirred for 30 min at -78 °C and 1 h at 0 °C. The solution was recooled to -78 °C and transferred by cannula into a solution of iodomethane (0.19 mL, 3.0 mmol) in tetrahydrofuran. Then the solution was stirred for 5 h at -45 °C and 30 min at 0 °C, after which it was poured onto 8 mL of 3 N HCl and stirred for 1 h. The mixture was extracted with methylene chloride, and the extracts were dried and evaporated. Recrystallization of the crude product from ethanol afforded a pale yellow solid **1m**.



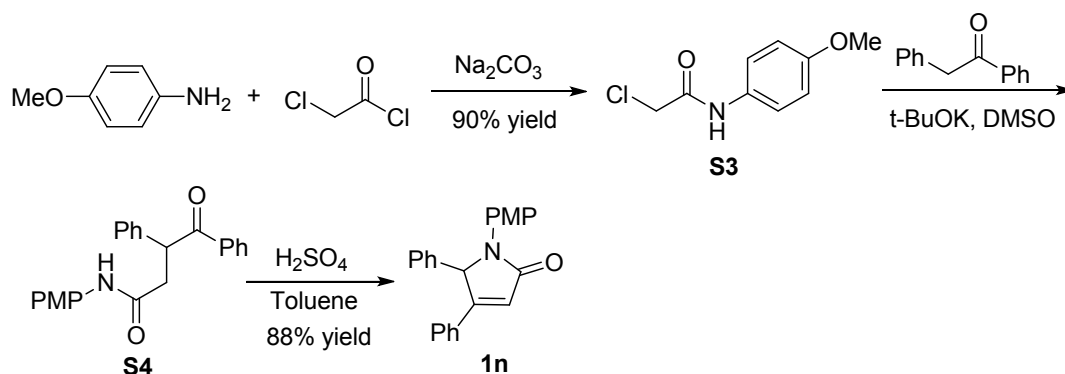
1-(4-methoxyphenyl)-3-methyl-4-phenyl-1H-pyrrol-2(5H)-one 1m. White solid (0.35 g, 51%), mp: 126-128 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.65 (d, *J* = 9.0 Hz, 2H), 7.42-7.47 (m, 4H), 7.36 (d, *J* = 7.2 Hz, 1H), 6.86 (d, *J* = 9.0 Hz, 2H), 4.48 (s, 2H), 3.74 (s, 3 H), 2.10 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 170.9, 156.1, 145.1, 133.3, 132.8, 130.3, 129.0, 128.9, 127.4, 120.2, 114.2, 55.4, 52.6, 10.6; mass spectrum (ESI): *m/e* (% relative intensity) 302.2 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₁₈H₁₇NO₂ (M+Na)⁺: 302.1157, found 302.1163; IR (KBr, neat) 1665, 1506, 1441, 1385, 1301, 1245, 1225, 1178, 1095, 1031, 831, 761, 689 cm⁻¹.



1-(4-methoxyphenyl)-3-methyl-1H-pyrrol-2(5H)-one 1l. Yellow solid (26 mg, 40%), mp: 79-81 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.61 (d, *J* = 9.0 Hz, 2H), 6.91 (d, *J* = 9.0 Hz, 2H), 6.75 (s, 1H), 4.24 (s, 2H), 3.79 (s, 3H), 1.95 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 170.6, 156.2, 136.6, 134.5, 132.8, 120.6, 114.2, 55.5, 51.4, 11.4; mass spectrum (ESI): *m/e* (% relative intensity) 204.5 (100) (M+H)⁺; HRMS (ESI): *m/z*

calcd for C₁₂H₁₃NO₂ (M+H)⁺: 204.1025, found 204.1017; IR (KBr, neat) 3432, 2918, 1673, 1513, 1446, 1383, 1248, 1164, 1033, 834, 812, 524 cm⁻¹.

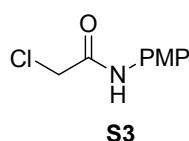
5) Synthesis of **1n**, **1p** and **1q**.⁵



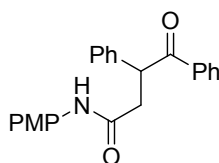
To a stirred solution of *p*-anisidine (3.94 g, 32 mmol) in toluene (15 mL), a solution of sodium carbonate (2.76 g, 26 mmol) in water (20 mL) was added. To this mixture dropwise chloroacetyl chloride (3.72 mL, 50 mmol) was added at 0 °C maintained with an ice bath. The reaction mixture was stirred at rt for an additional 2 h and the precipitate formed was separated by filtration and washed successively with H₂O and toluene to afford a purple solid **S3**.

To a solution of potassium *t*-butoxide (2.8 g, 25 mmol) in 20 mL of DMSO was added slowly 1,2-diphenylethanone (4.46 g, 23 mmol) at r.t. Subsequently 1.1 equiv of **S3** (5.0 g, 25 mmol) was added portion wise. The reaction mixture was stirred at 80 °C for 3 hours. After cooling, the mixture was poured into ice water and the resulting suspension was extracted with chloroform (3×20 mL). The combined extracts were washed with water and after drying (MgSO₄) and evaporation of the solvent, the crude product was purified by column chromatography to afford the product **S4**.

One drop of concentrated sulfuric acid was added to a solution of 1.0 g (2.8 mmol) of **S4** in 5 mL of toluene and the mixture was refluxed for 1.5 h. After cooling, the product **1n** was crystallized from the mixture.

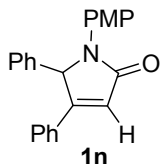


2-chloro-N-(4-methoxyphenyl)acetamide S3. Purple solid (5.75 g, 90%), mp: 118-120 °C; ¹H NMR (600 MHz, CDCl₃) δ 8.22 (s, 1H), 7.41 (d, *J* = 9.0 Hz, 2H), 6.86 (d, *J* = 9.0 Hz, 2H), 4.15 (s, 2H), 3.78 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 163.9, 157.1, 129.7, 122.2, 114.3, 55.5, 42.9; mass spectrum (ESI): *m/e* (% relative intensity) 221.5 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₉H₁₀NO₂Cl (M+Na)⁺: 222.0298, found 222.0302; IR (KBr, neat) 3295, 2957, 1664, 1603, 1548, 1511, 1465, 1443, 1413, 1300, 1248, 1179, 1152, 1030, 830, 789, 712, 689, 583, 533, 520 cm⁻¹.



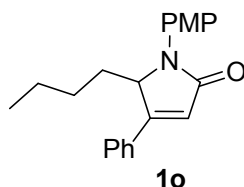
S4

N-(4-methoxyphenyl)-4-oxo-3,4-diphenylbutanamide S4. White solid (1.70 g, 19%), mp: 122-124 °C; ¹H NMR (600 MHz, DMSO) δ 9.92 (s, 1H), 8.05 (d, *J* = 5.4 Hz, 2H), 7.56 (d, *J* = 5.4 Hz, 1H), 7.46 (d, *J* = 7.2 Hz, 4H), 7.38 (s, 2H), 7.31 (s, 2H), 7.21 (s, 1H), 6.84-6.86 (m, 2H), 5.33 (d, *J* = 5.4 Hz, 1H), 3.69 (s, 3H), 3.32 (t, *J* = 12.6 Hz, 1H), 2.74 (d, *J* = 15.0 Hz, 1H). ¹³C NMR (150 MHz, DMSO) δ 198.7, 168.7, 154.9, 138.6, 135.9, 133.1, 132.3, 128.9, 128.6, 128.1, 127.1, 120.4, 113.8, 55.1, 55.0, 48.0, 40.5. mass spectrum (ESI): *m/e* (% relative intensity) 381.9 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₂₃H₂₁NO₃ (M+H)⁺: 360.1600, found 360.1593; IR (KBr, neat) 3341, 1686, 1664, 1604, 1549, 1510, 1444, 1408, 1342, 1247, 1198, 1174, 1033, 958, 828, 711, 696 cm⁻¹.

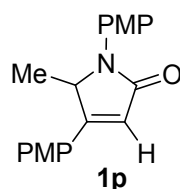


1-(4-methoxyphenyl)-4,5-diphenyl-1H-pyrrol-2(5H)-one 1n. White solid (0.83 g, 88%), mp: 148-150 °C; ¹H NMR (600 MHz, DMSO) δ 7.69 (d, *J* = 7.2 Hz, 2H), 7.52 (d, *J* = 8.4 Hz, 2H), 7.33-7.36 (m, 5H), 7.18 (t, *J* = 6.6 Hz, 2H), 7.09 (t, *J* = 6.6 Hz, 1H), 6.84-6.86 (m, 3H), 6.75 (s, 1H), 3.67 (s, 3H). ¹³C NMR (150 MHz, DMSO) δ 168.9, 158.9, 155.9, 136.6, 131.2, 130.2, 129.9, 128.7, 128.6, 128.0, 127.6, 127.3,

123.7, 120.6, 113.7, 65.6, 55.0; mass spectrum (ESI): m/e (% relative intensity) 364.1 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₂₃H₁₉NO₂ (M+H)⁺: 342.1494, found 342.1500; IR (KBr, neat) 1673, 1513, 1493, 1389, 1295, 1246, 1177, 1130, 1032, 839, 765, 738, 694, 665 cm⁻¹.



5-butyl-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 1o. Yellow solid (165 mg, 59%), mp: 97-99 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.50 (d, J = 6.9 Hz, 2H), 7.45 (m, 5H), 6.96 (d, J = 8.4 Hz, 2H), 6.45 (s, 1H), 5.29 (s, 1H), 3.80 (s, 3H), 1.81 (t, J = 12.6 Hz, 1H), 1.70 (t, J = 10.8 Hz, 1H), 0.98 (m, 3H), 0.77 (m, 1H), 0.61 (t, J = 6.6 Hz, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 169.8, 158.5, 157.2, 131.9, 130.0, 129.9, 129.1, 126.8, 124.8, 122.0, 114.4, 62.7, 55.5, 28.9, 23.2, 22.2, 13.7; mass spectrum (ESI): m/e (% relative intensity) 322.2 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₂₁H₂₃NO₂ (M+Na)⁺: 344.1626, found 344.1628; IR (KBr, neat) 2960, 2858, 1678, 1513, 1390, 1298, 1034, 829, 808, 696, 582 cm⁻¹.

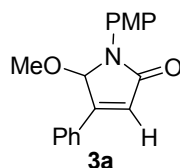


1-(4-methoxyphenyl)-5-methyl-4-phenyl-1H-pyrrol-2(5H)-one 1p. Yellow solid (35 mg, 31%), mp: 159-161 °C; ¹H NMR (600 MHz, DMSO) δ 7.68 (d, J = 8.4 Hz, 2H), 7.56 (d, J = 8.4 Hz, 2H), 7.07 (d, J = 8.4 Hz, 2H), 7.00 (d, J = 8.4 Hz, 2H), 6.47 (s, 1H), 5.57 (d, J = 6.6 Hz, 1H), 3.82 (s, 3H), 3.77 (s, 3H), 1.16 (t, J = 6.6 Hz, 3H); ¹³C NMR (150 MHz, DMSO) δ 168.3, 160.6, 160.2, 155.9, 130.4, 128.8, 123.7, 123.3, 117.7, 114.4, 113.9, 57.5, 55.2, 18.8; mass spectrum (ESI): m/e (% relative intensity) 310.1 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₁₉H₁₉NO₃ (M+H)⁺: 310.1443, found 310.1447; IR (KBr, neat) 3435, 2963, 2930, 1663, 1611, 1513, 1458, 1439, 1422, 1392, 1298, 1263, 1246, 1032, 836, 525 cm⁻¹.

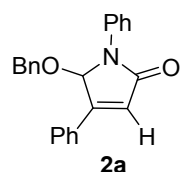
3. General Procedure for Fe(OTf)₃-Catalyzed Oxidative C-H Functionalization of *N*-Substituted 4-Arylpyrrolones with Alcohol in Acetonitrile.

To a solution of the *N*-substituted 4-arylpyrrolones (0.2 mmol) and alcohol (2.0 mmol, 10.0 equiv) in acetonitrile (1.0 mL) was added Fe(OTf)₃ (10.0 mol %, 0.1 equiv) at room temperature. The sealing tube was equipped with O₂, and the resulting solution was stirred at 70 °C before it was quenched with H₂O. The organic phase was then separated and the aqueous phase extracted with equal volume of EtOAc three times. The combined organic extract was dried over Na₂SO₄ and concentrated under reduced pressure. The resulting crude product was purified via flash column chromatography.

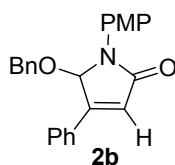
4. Characterization of products



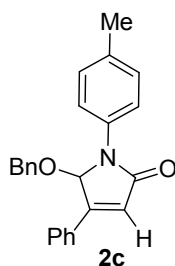
5-methoxy-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 3a. Yellow solid (48 mg, 89%), mp: 128-130 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.74-7.76 (m, 2H), 7.62 (d, *J* = 7.8 Hz, 2H), 7.45-7.46 (m, 3H), 6.94 (d, *J* = 7.8 Hz, 2H), 6.59 (s, 1H), 6.35 (s, 1H), 3.80 (s, 3H), 3.00 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 168.5, 156.9, 152.8, 130.8, 130.3, 130.1, 129.1, 126.9, 122.9, 122.5, 114.4, 88.6, 55.5, 48.8; mass spectrum (ESI): *m/e* (% relative intensity) 317.8 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₁₈H₁₇NO₃ (M+H)⁺: 296.1287, found 296.1278; IR (KBr, neat) 3447, 1687, 1515, 1398, 1250, 1133, 1099, 1031, 764, 688, 661, 582 cm⁻¹.



5-methoxy-1,4-diphenyl-1H-pyrrol-2(5H)-one 2a. Yellow solid (42 mg, 58%), mp: 135-137 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.80-7.84 (m, 4H), 7.46-7.48 (m, 3H), 7.40 (t, *J* = 8.4 Hz, 2H), 7.14-7.24 (m, 4H), 6.89 (d, *J* = 6.6 Hz, 2H), 6.66 (s, 1H), 6.59 (s, 1H), 4.28 (d, *J* = 10.8 Hz, 1H), 4.05 (d, *J* = 10.8 Hz, 1H). ¹³C NMR (150 MHz, CDCl₃) δ 168.5, 153.2, 137.2, 136.4, 131.1, 130.1, 129.2, 129.1, 128.3, 128.2, 127.9, 127.1, 124.8, 122.4, 120.6, 87.8, 63.8; mass spectrum (ESI): *m/e* (% relative intensity) 364.2 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₂₃H₁₉NO₂ (M+H)⁺: 342.1494, found 342.1497; IR (KBr, neat) 3432, 1688, 1626, 1597, 1497, 1450, 1377, 1359, 1342, 1313, 1292, 1129, 1100, 1020, 901, 768, 754, 737, 690, 502, 467 cm⁻¹.

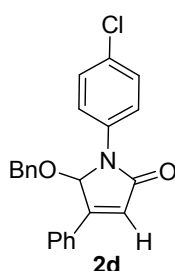


5-(benzyloxy)-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 2b. Yellow solid (58 mg, 83%), mp: 140-142 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.78-7.79 (m, 2H), 7.66 (d, *J* = 9.0 Hz, 2H), 7.45-7.46 (m, 3H), 7.16-7.18 (m, 3H), 6.93-6.95 (m, 4H), 6.64 (s, 1H), 6.49 (s, 1H), 4.30 (d, *J* = 10.2 Hz, 1H), 4.06 (d, *J* = 10.2 Hz, 1H), 3.81 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 168.4, 156.9, 153.1, 136.6, 130.9, 130.3, 130.2, 129.2, 128.3, 128.2, 127.9, 127.0, 122.9, 122.4, 114.4, 88.3, 63.9, 55.5; mass spectrum (ESI): *m/e* (% relative intensity) 394.2 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₂₄H₂₁NO₃ (M+Na)⁺: 394.1419, found 394.1428; IR (KBr, neat) 3080, 1686, 1515, 1400, 1380, 1246, 1204, 1171, 1136, 1091, 1032, 1016, 897, 834, 806, 766, 752, 743, 723, 689, 661 cm⁻¹.

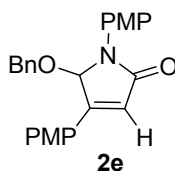


5-(benzyloxy)-4-phenyl-1-(p-tolyl)-1H-pyrrol-2(5H)-one 2c. Yellow solid (41 mg,

62%), mp: 109-111 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.80-7.81 (m, 2H), 7.68 (d, *J* = 12.6 Hz, 2H), 7.47 (m, 3H), 7.17-7.25 (m, 5H), 6.92-6.94 (m, 2H), 6.65 (s, 1H), 6.56 (s, 1H), 4.29 (d, *J* = 15.6 Hz, 1H), 4.06 (d, *J* = 15.6 Hz, 1H), 2.36 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 170.2, 153.4, 136.8, 133.5, 131.4, 130.5, 129.6, 129.0, 125.9, 121.2, 118.6, 118.5, 52.6, 20.8; mass spectrum (ESI): *m/e* (% relative intensity) 378.4 (100) (M+Na)⁺; HRMS (ESI): *m/z* calcd for C₂₄H₂₁NO₂ (M+H)⁺: 356.1651, found 356.1652; IR (KBr, neat) 3080, 1687, 1515, 1381, 1133, 1099, 1075, 1019, 809, 764, 737, 723, 690, 667, 647 cm⁻¹.

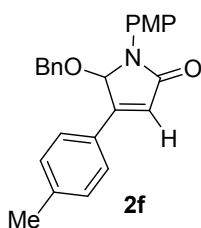


5-(benzyloxy)-1-(4-chlorophenyl)-4-phenyl-1H-pyrrol-2(5H)-one 2d. Yellow solid (50 mg, 77%), mp: 114-116 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.80-7.83 (m, 4H), 7.47-7.49 (m, 3H), 7.35 (d, *J* = 8.4 Hz, 2H), 7.18-7.21 (m, 3H), 6.91 (d, *J* = 5.4 Hz, 2H), 6.65 (s, 1H), 6.56 (s, 1H), 4.23 (d, *J* = 10.8 Hz, 1H), 4.06 (d, *J* = 10.8 Hz, 1H). ¹³C NMR (150 MHz, CDCl₃) δ 168.4, 153.4, 136.2, 135.9, 131.2, 129.9, 129.8, 129.2, 129.1, 128.4, 128.2, 128.0, 127.1, 122.2, 121.4, 87.8, 63.9; mass spectrum (ESI): *m/e* (% relative intensity) 376.0 (100) (M+H)⁺; HRMS (ESI): *m/z* calcd for C₂₃H₁₈NO₂Cl (M+H)⁺: 376.1104, found 376.1106; IR (KBr, neat) 3450, 1691, 1495, 1420, 1385, 1340, 1203, 1133, 1088, 1074, 1020, 1012, 832, 766, 735, 689, 500 cm⁻¹.

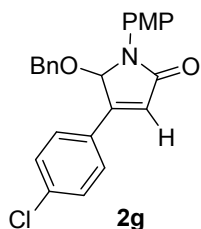


5-(benzyloxy)-1,4-bis(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 2e. Yellow solid (52 mg, 77%), mp: 102-104 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.74 (dd, *J* = 8.4, 2.4 Hz, 2H), 7.65 (dd, *J* = 9.0, 1.8 Hz, 2H), 7.18-7.19 (m, 3H), 6.92-6.97 (m, 6H), 6.50 (d,

$J = 1.8$ Hz, 1H), 6.44 (d, $J = 1.8$ Hz, 1H), 4.30 (d, $J = 9.6$ Hz, 1H), 4.05 (d, $J = 9.6$ Hz, 1H), 3.85 (d, $J = 2.4$ Hz, 3H), 3.80 (d, $J = 2.4$ Hz, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 168.9, 161.7, 156.8, 152.7, 136.7, 130.3, 128.7, 128.3, 128.2, 127.9, 122.9, 122.8, 119.9, 114.5, 114.3, 88.3, 63.7, 55.5, 55.4; mass spectrum (ESI): m/e (% relative intensity) 402.3 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{25}\text{H}_{23}\text{NO}_4$ ($\text{M}+\text{H}$) $^+$: 402.1705, found 402.1707; IR (KBr, neat) 3429, 1686, 1609, 1513, 1394, 1380, 1297, 1264, 1247, 1202, 1179, 1132, 1090, 1033, 832 cm^{-1} .

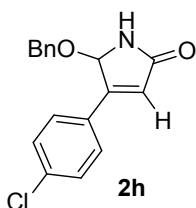


5-(benzyloxy)-1-(4-methoxyphenyl)-4-(p-tolyl)-1H-pyrrol-2(5H)-one 2f. Yellow solid (33 mg, 81%), mp: 142-144 $^{\circ}\text{C}$; ^1H NMR (600 MHz, CDCl_3) δ 7.70 (d, $J = 8.4$ Hz, 2H), 7.66 (d, $J = 9.0$ Hz, 2H), 7.26 (d, $J = 8.4$ Hz, 2H), 7.19-7.21 (m, 3H), 6.94-6.69 (m, 4H), 6.60 (s, 1H), 6.49 (s, 1H), 4.32 (d, $J = 10.8$ Hz, 1H), 4.06 (d, $J = 10.8$ Hz, 1H), 3.82 (s, 3H), 2.42 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 168.7, 156.9, 153.0, 141.4, 136.6, 129.9, 128.3, 128.1, 127.8, 127.5, 126.9, 122.9, 121.3, 114.4, 88.3, 63.8, 55.5, 21.6; mass spectrum (ESI): m/e (% relative intensity) 408.2 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{25}\text{H}_{23}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$: 386.1756, found 386.1757; IR (KBr, neat) 2377, 2311, 1683, 1512, 1454, 1388, 1329, 1244, 1188, 1130, 1080, 1036, 832, 817, 698, 513, 444, 419 cm^{-1} .

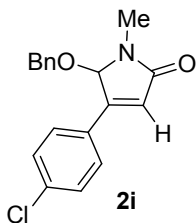


5-(benzyloxy)-4-(4-chlorophenyl)-1-(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 2g. Yellow solid (50 mg, 74%), mp: 142-144 $^{\circ}\text{C}$; ^1H NMR (600 MHz, CDCl_3) δ 7.73 (d, $J = 8.4$ Hz, 2H), 7.65 (d, $J = 9.0$ Hz, 2H), 7.43 (d, $J = 8.4$ Hz, 2H), 7.19-7.21 (m, 3H),

6.94 (d, $J = 9.0$ Hz, 4H), 6.64 (s, 1H), 6.48 (s, 1H), 4.43 (d, $J = 10.8$ Hz, 1H), 4.05 (d, $J = 10.8$ Hz, 1H), 3.83 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 168.1, 157.1, 151.8, 136.9, 136.4, 130.0, 129.4, 128.8, 128.4, 128.2, 128.1, 127.9, 122.9, 122.8, 114.4, 88.2, 64.0, 55.5; mass spectrum (ESI): m/e (% relative intensity) 406.1 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{24}\text{H}_{20}\text{NO}_3\text{Cl}$ ($\text{M}+\text{H}$) $^+$: 406.1210, found 406.1209; IR (KBr, neat) 3089, 2919, 1683, 1592, 1513, 1494, 1385, 1251, 1180, 1093, 823, 773, 744, 668, 511, 426 cm^{-1} .

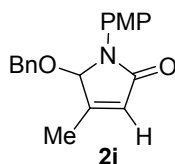


5-(benzyloxy)-4-phenyl-1H-pyrrol-2(5H)-one 2h. Yellow solid (21 mg, 26%), mp: 120-122 $^{\circ}\text{C}$; ^1H NMR (600 MHz, CDCl_3) δ 7.70-7.72 (m, 2H), 7.44-7.45 (m, 3H), 7.25-7.31 (m, 3H), 7.20 (d, $J = 6.6$ Hz, 2H), 6.55 (s, 1H), 6.49 (s, 1H), 6.13 (s, 1H), 4.54 (d, $J = 10.8$ Hz, 1H), 4.25 (d, $J = 10.8$ Hz, 1H). ^{13}C NMR (150 MHz, CDCl_3) δ 172.0, 156.7, 137.0, 130.7, 130.6, 129.0, 128.5, 128.1, 128.0, 127.1, 121.4, 84.8, 65.8; mass spectrum (ESI): m/e (% relative intensity) 288.2 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{17}\text{H}_{15}\text{NO}_2$ ($\text{M}+\text{H}$) $^+$: 266.1181, found 266.1184; IR (KBr, neat) 3209, 3084, 1693, 1452, 1378, 1361, 1337, 1214, 1088, 1072, 903, 766, 734, 688, 668, 649, 437 cm^{-1} .

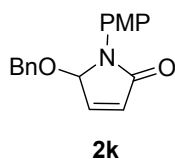


5-(benzyloxy)-1-methyl-4-phenyl-1H-pyrrol-2(5H)-one 2i. Yellow solid (16 mg, 34%), mp: 122-124 $^{\circ}\text{C}$; ^1H NMR (600 MHz, CDCl_3) δ 7.74-7.56 (m, 2H), 7.43-7.45 (m, 3H), 7.25-7.29 (m, 3H), 7.14 (d, $J = 6.6$ Hz, 2H), 6.56 (s, 1H), 5.91 (s, 1H), 4.19 (d, $J = 10.8$ Hz, 1H), 4.03 (d, $J = 10.8$ Hz, 1H), 3.03 (s, 3H). ^{13}C NMR (150 MHz,

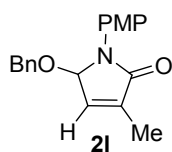
CDCl₃) δ 169.6, 153.5, 136.9, 130.6, 129.1, 128.4, 128.0, 127.9, 126.7, 122.2, 89.0, 63.8, 29.7, 26.4; mass spectrum (ESI): m/e (% relative intensity) 302.4 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₁₈H₁₇NO₂ (M+H)⁺: 280.1338, found 280.1335; IR (KBr, neat) 3079, 1688, 1450, 1436, 1395, 1386, 1341, 1273, 1216, 1092, 763, 749, 687, 488, 418 cm⁻¹.



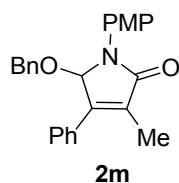
5-(benzyloxy)-1-(4-methoxyphenyl)-4-methyl-1H-pyrrol-2(5H)-one 2j. Yellow oil (46 mg, 65%); ¹H NMR (600 MHz, CDCl₃) δ 7.56 (d, J = 9.0 Hz, 2H), 7.24-7.29 (m, 3H), 7.13 (d, J = 7.2 Hz, 2H), 6.90 (d, J = 9.0 Hz, 2H), 6.07 (s, 1H), 5.82 (s, 1H), 4.28 (d, J = 10.8 Hz, 1H), 4.14 (d, J = 10.8 Hz, 1H), 3.79 (s, 3H), 2.09 (s, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 168.9, 156.9, 154.7, 136.8, 130.3, 128.5, 127.9, 125.4, 122.8, 114.3, 90.1, 64.4, 55.5, 13.8; mass spectrum (ESI): m/e (% relative intensity) 332.3 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₁₉H₁₉NO₃ (M+H)⁺: 310.1443, found 310.1444; IR (KBr, neat) 2935, 2912, 1704, 1513, 1464, 1386, 1247, 1159, 1127, 1033, 830, 668, 568, 521, 418 cm⁻¹.



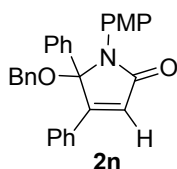
5-(benzyloxy)-1-(4-methoxyphenyl)-1H-pyrrol-2(5H)-one 2k. White solid (25 mg, 35%); ¹H NMR (600 MHz, CDCl₃) δ 7.56 (d, J = 8.4 Hz, 2H), 7.26-7.29 (m, 3H), 7.16 (d, J = 6.6 Hz, 2H), 6.99 (d, J = 5.4 Hz, 1H), 6.95 (d, J = 8.4 Hz, 2H), 6.37 (d, J = 5.4 Hz, 1H), 6.06 (s, 1H), 4.36 (q, J = 11.4 Hz, 2H), 3.82 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 168.5, 157.2, 143.4, 137.0, 130.5, 129.8, 128.5, 128.0, 127.9, 123.4, 114.4, 88.7, 65.6, 55.5; mass spectrum (ESI): m/e (% relative intensity) 296.1 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₁₈H₁₇NO₃ (M+H)⁺: 296.1287, found 296.1280; IR (KBr, neat) 3441, 2936, 1693, 1512, 1395, 1247, 1101, 1033, 700 cm⁻¹.



5-(benzyloxy)-1-(4-methoxyphenyl)-3-methyl-1H-pyrrol-2(5H)-one 2l. Yellow oil (75 mg, 49%); ^1H NMR (600 MHz, CDCl_3) δ 7.60 (d, $J = 8.4$ Hz, 2H), 7.29 (m, 3H), 7.15 (d, $J = 6.9$ Hz, 2H), 6.94 (d, $J = 8.4$ Hz, 2H), 6.61 (s, 1H), 5.95 (s, 1H), 4.31 (s, 2H), 3.82 (s, 3H), 2.01 (s, 3H); ^{13}C NMR (150 MHz, CDCl_3) δ 169.4, 156.9, 138.9, 137.3, 135.9, 130.3, 128.5, 127.9, 122.9, 114.3, 86.9, 65.1, 55.5, 11.2; mass spectrum (ESI): m/e (% relative intensity) 310.1 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{19}\text{H}_{19}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$: 310.1443, found 310.1437; IR (KBr, neat) 3433, 1688, 1655, 1511, 1248, 1084, 1071, 827, 735, 601, 571 cm^{-1} .

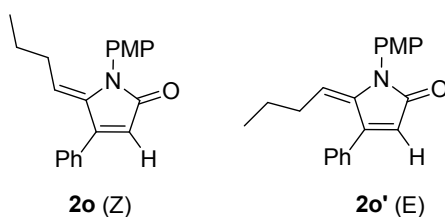


5-(benzyloxy)-1-(4-methoxyphenyl)-3-methyl-4-phenyl-1H-pyrrol-2(5H)-one 2m. Yellow oil (33 mg, 81%); ^1H NMR (600 MHz, CDCl_3) δ 7.70 (d, $J = 9.0$ Hz, 2H), 7.63 (d, $J = 7.8$ Hz, 2H), 7.47 (t, $J = 7.8$ Hz, 2H), 7.41 (t, $J = 7.2$ Hz, 1H), 7.12-7.16 (m, 3H), 6.93 (d, $J = 9.0$ Hz, 2H), 6.83 (d, $J = 6.6$ Hz, 2H), 6.42 (s, 1H), 4.21 (d, $J = 10.8$ Hz, 1H), 4.05 (d, $J = 10.8$ Hz, 1H), 3.82 (s, 3H), 2.24 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 169.5, 156.9, 145.5, 136.8, 132.2, 131.9, 130.5, 129.3, 128.9, 128.3, 128.2, 128.0, 127.7, 122.6, 114.4, 87.6, 63.9, 55.5, 10.5; mass spectrum (ESI): m/e (% relative intensity) 408.0 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{25}\text{H}_{23}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$: 386.1756, found 386.1759; IR (KBr, neat) 2377, 2320, 1696, 1512, 1454, 1386, 1247, 1039, 829, 697, 420 cm^{-1} .



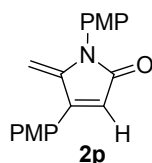
5-(benzyloxy)-1-(4-methoxyphenyl)-4,5-diphenyl-1H-pyrrol-2(5H)-one 2n.

Yellow oil (48 mg, 82%); ^1H NMR (600 MHz, CDCl_3) δ 7.66 (d, $J = 6.9$ Hz, 2H), 7.48 (d, $J = 5.4$ Hz, 2H), 7.28-7.37 (m, 8H), 7.16-7.23 (m, 3H), 7.08 (d, $J = 8.4$ Hz, 2H), 6.89 (s, 1H), 6.69 (d, $J = 8.4$ Hz, 2H), 4.78 (d, $J = 10.8$ Hz, 1H), 4.42 (d, $J = 10.8$ Hz, 1H), 3.69 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 169.3, 157.8, 156.6, 137.6, 136.9, 130.5, 129.9, 128.9, 128.6, 128.5, 128.4, 128.1, 127.9, 127.8, 127.5, 127.1, 126.1, 122.0, 114.0, 98.2, 64.9, 55.3; mass spectrum (ESI): m/e (% relative intensity) 470.0 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{30}\text{H}_{25}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$:448.1913, found 448.1923; IR (KBr, neat) 3061, 2932, 2311, 1702, 1609, 1512, 1447, 1362, 1296, 1249, 1028, 823, 695, 667, 516 cm^{-1} .

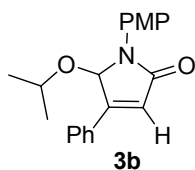


5-butylidene-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 2o. Yellow oil (29 mg, 66%); Singals of compound **2o**: ^1H NMR (600 MHz, CDCl_3) δ 7.43-7.46 (m, 5H), 7.25-7.27 (m, 2H), 6.99 (d, $J = 8.4$ Hz, 2H), 6.21 (s, 1H), 5.33 (t, $J = 7.8$ Hz, 1H), 3.86 (s, 3H), 1.69 (q, $J = 7.2$ Hz, 2H), 1.25 (q, $J = 7.2$ Hz, 2H) 0.70 (t, $J = 7.2$ Hz, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.4, 159.3, 152.4, 139.2, 132.7, 129.8, 129.6, 129.1, 129.0, 128.6, 119.9, 119.0, 114.5, 55.5, 28.8, 22.8, 13.7; Singals of compound **2o'**: ^1H NMR (600 MHz, CDCl_3) δ 7.39-7.46 (m, 5H), 7.26-7.27 (m, 2H), 7.02 (d, $J = 8.4$ Hz, 2H), 6.21 (s, 1H), 5.33 (t, $J = 7.8$ Hz, 1H), 3.86 (s, 3H), 1.75 (q, $J = 7.2$ Hz, 2H), 1.25 (q, $J = 7.2$ Hz, 2H) 0.69 (t, $J = 7.2$ Hz, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 168.2, 159.1, 149.7, 140.1, 134.8, 130.1, 128.7, 128.3, 128.2, 127.1, 123.8, 120.2, 114.7, 29.7, 29.0, 23.2, 13.6; mass spectrum (ESI): m/e (% relative intensity) 350.0 (100)

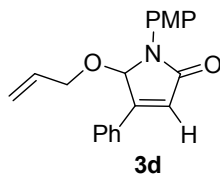
(M+H)⁺; HRMS (ESI): m/z calcd for C₂₁H₂₁NO₂ (M+H)⁺: 320.1651, found 320.1655; IR (KBr, neat) 3441, 2958, 1685, 1512, 1248, 1031, 832, 700 cm⁻¹.



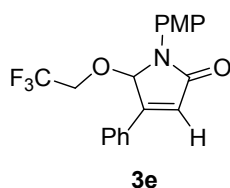
1-(4-methoxyphenyl)-5-methylene-4-phenyl-1H-pyrrol-2(5H)-one 2p. Yellow solid (12 mg, 81%), mp: 154-156 °C; ¹H NMR (600 MHz, CDCl₃) δ 7.45 (d, *J* = 7.8 Hz, 2H), 7.26 (d, *J* = 7.2 Hz, 2H), 7.02 (t, *J* = 8.4 Hz, 4H), 6.27 (s, 1H), 5.01 (s, 1H), 4.94 (s, 1H), 3.87 (s, 3H), 3.85 (s, 3H); ¹³C NMR (150 MHz, CDCl₃) δ 169.2, 160.7, 159.1, 149.8, 147.0, 130.0, 129.3, 127.2, 124.5, 119.9, 114.7, 114.3, 98.4, 55.5, 55.4; mass spectrum (ESI): *m/e* (% relative intensity) 308.1 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₁₉H₁₇NO₃ (M+Na)⁺: 330.1106, found 330.1096; IR (KBr, neat) 3440, 1698, 1631, 1612, 1513, 1392, 1295, 1250, 1168, 1025, 830, 535 cm⁻¹.



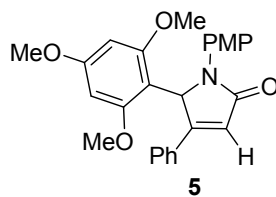
5-isopropoxy-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 3b. Yellow oil (33 mg, 55%); ¹H NMR (600 MHz, CDCl₃) δ 7.75 (d, *J* = 6.4 Hz, 2H), 7.68 (d, *J* = 9.0 Hz, 2H), 7.45 (m, 3H), 6.94 (t, *J* = 8.9 Hz, 2H), 6.56 (s, 1H), 6.48 (s, 1H), 3.81 (s, 3H), 3.68 (quint, *J* = 6.0 Hz, 1H), 0.84 (d, *J* = 6.0 Hz, 3H), 0.74 (d, *J* = 6.0 Hz, 3H). ¹³C NMR (150 MHz, CDCl₃) δ 168.3, 156.6, 153.9, 130.8, 130.7, 130.6, 128.9, 127.2, 122.3, 122.1, 114.2, 87.7, 66.5, 55.4, 23.6. mass spectrum (ESI): *m/e* (% relative intensity) 345.5 (100) (M+Na)⁺; HRMS (ESI): m/z calcd for C₂₀H₂₁NO₃ (M+Na)⁺: 346.1419, found 346.1423; IR (KBr, neat) 3080, 2931, 2837, 2377, 1696, 1606, 1512, 1382, 1268, 1251, 1179, 1134, 1071, 1021, 835, 583, 419 cm⁻¹.



5-(allyloxy)-1-(4-methoxyphenyl)-4-phenyl-1H-pyrrol-2(5H)-one 3d. Yellow oil (50 mg, 82%); ^1H NMR (600 MHz, CDCl_3) δ 7.74-7.76 (m, 2H), 7.61 (d, $J = 9.0$ Hz, 2H), 7.44-7.45 (m, 3H), 6.93 (d, $J = 9.0$ Hz, 2H), 6.58 (s, 1H), 6.39 (s, 1H), 5.59-5.66 (m, 1H), 5.04 (dd, $J = 1.2$ Hz, 17.4 Hz, 1H), 4.99 (dd, $J = 1.2, 10.2$ Hz, 1H), 3.81 (dd, $J = 5.4, 12.0$ Hz, 1H), 3.80 (s, 3H), 3.60 (dd, $J = 5.4, 12.0$ Hz, 1H). ^{13}C NMR (150 MHz, CDCl_3) δ 168.4, 157.1, 153.1, 133.3, 130.8, 130.4, 130.2, 129.1, 126.9, 123.2, 122.3, 117.4, 114.4, 88.4, 62.8, 55.5. mass spectrum (ESI): m/e (% relative intensity) 344.3 (100) ($\text{M}+\text{Na}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{20}\text{H}_{19}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$: 322.1443, found 322.1441; IR (KBr, neat) 3083, 2954, 2832, 1687, 1613, 1515, 1397, 1247, 1171, 1135, 1104, 1035, 765, 688, 663, 441 cm^{-1} .

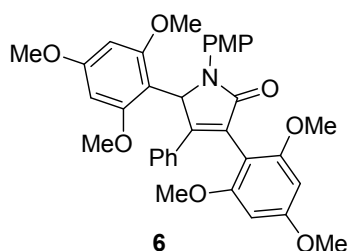


1-(4-methoxyphenyl)-4-phenyl-5-(2,2,2-trifluoroethoxy)-1H-pyrrol-2(5H)-one 3e. Yellow oil (10 mg, 15%); ^1H NMR (600 MHz, CDCl_3) δ 7.74-7.76 (m, 2H), 7.60 (d, $J = 9.0$ Hz, 2H), 7.48-7.49 (m, 3H), 6.95 (d, $J = 9.0$ Hz, 2H), 6.65 (s, 1H), 6.49 (s, 1H), 3.83 (s, 3H), 3.63-3.71 (m, 1H), 3.39-3.45 (m, 1H). ^{19}F NMR (564 MHz, CDCl_3) δ -73.4550 (t, $J = 8.4$ Hz, 3F). ^{13}C NMR (150 MHz, CDCl_3) δ 168.2, 157.3, 151.8, 131.3, 129.7, 129.4, 129.3, 126.9, 122.8, 127.7, 114.5, 88.1, 59.5, 59.3, 55.5. mass spectrum (ESI): m/e (% relative intensity) 364.1 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{19}\text{H}_{16}\text{NO}_3\text{F}_3$ ($\text{M}+\text{H}$) $^+$: 364.1161, found 364.1161; IR (KBr, neat) 2936, 2377, 2311, 1708, 1689, 1514, 1391, 1286, 1245, 1166, 1099, 1033, 830, 767, 667, 524, 419 cm^{-1} .



1-(4-methoxyphenyl)-4-phenyl-5-(2,4,6-trimethoxyphenyl)-1H-pyrrol-2(5H)-one

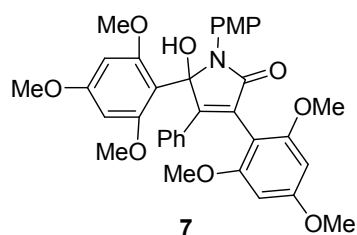
5. Yellow oil; ^1H NMR (600 MHz, CDCl_3) δ 7.47-7.49 (m, 2H), 7.36 (d, $J = 9.0$ Hz, 2H), 7.26-7.28 (m, 3H), 6.75 (d, $J = 9.0$ Hz, 2H), 6.69 (d, $J = 1.2$ Hz, 1H), 6.55 (d, $J = 1.8$ Hz, 1H), 6.02 (d, $J = 2.4$ Hz, 1H), 5.81 (d, $J = 1.8$ Hz, 1H), 3.94 (s, 3H), 3.72 (s, 3H), 3.66 (s, 3H), 3.55 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.6, 161.3, 160.7, 159.0, 158.5, 156.4, 132.5, 130.9, 129.4, 128.6, 126.6, 124.1, 121.1, 113.7, 103.8, 91.4, 90.5, 58.7, 56.2, 55.5, 55.3, 55.1; mass spectrum (ESI): m/e (% relative intensity) 454.5 (100) ($\text{M}+\text{Na}^+$); HRMS (ESI): m/z calcd for $\text{C}_{26}\text{H}_{25}\text{NO}_5$ ($\text{M}+\text{Na}^+$): 454.1630, found 454.1630; IR (KBr, neat) 2954, 2937, 2834, 1672, 1607, 1592, 1514, 1381, 1243, 1231, 1157, 1117, 1035, 827, 769, 521 cm^{-1} .



1-(4-methoxyphenyl)-4-phenyl-3,5-bis(2,4,6-trimethoxyphenyl)-1H-pyrrol-2(5H)-one

6. Yellow oil; ^1H NMR (600 MHz, CDCl_3) δ 7.49 (d, $J = 9.0$ Hz, 2H), 7.27-7.28 (m, 2H), 7.08-7.09 (m, 3H), 6.76 (d, $J = 6.0$ Hz, 2H), 6.75 (s, 1H), 6.27 (s, 1H), 6.07 (s, 1H), 5.99 (s, 1H), 5.83 (s, 1H), 3.93 (s, 3H), 3.89 (s, 3H), 3.83 (s, 3H), 3.72 (s, 3H), 3.66 (s, 3H), 3.64 (s, 3H), 3.42 (s, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 169.9, 161.4, 160.9, 160.7, 160.4, 159.3, 158.7, 155.8, 153.2, 134.4, 131.9, 127.8, 127.7, 127.4, 127.3, 123.3, 113.5, 104.7, 104.1, 91.4, 91.3, 91.2, 90.3, 57.8, 56.1, 55.7, 55.4, 55.3, 55.2, 55.0; mass spectrum (ESI): m/e (% relative intensity) 598.2 (100) ($\text{M}+\text{H}^+$); HRMS (ESI): m/z calcd for $\text{C}_{35}\text{H}_{35}\text{NO}_8$ ($\text{M}+\text{Na}^+$): 620.2260, found 620.2250; IR (KBr, neat) 3446, 3398, 2377, 2311, 1683, 1608, 1513, 1456, 1205, 1154, 1125, 668,

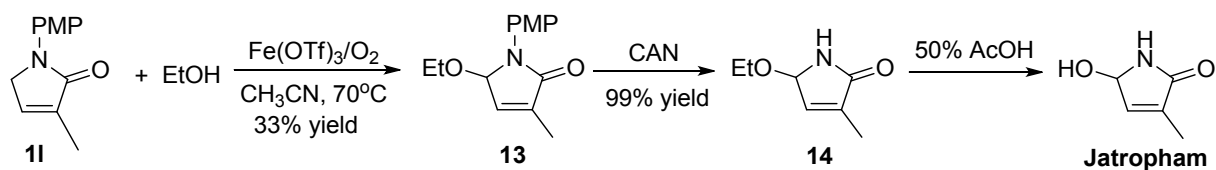
443, 419 cm^{-1} .

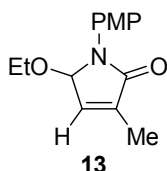


5-hydroxy-1-(4-methoxyphenyl)-4-phenyl-3,5-bis(2,4,6-trimethoxyphenyl)-1H-pyrrol-2(5H)-one 7. Brown solid, mp: 110-112 °C; ^1H NMR (600 MHz, CDCl_3) δ 7.64 (s, 1H), 7.32 (d, $J = 6.6$ Hz, 2H), 7.15 (d, $J = 9.0$ Hz, 2H), 7.06-7.11 (m, 3H), 6.76 (d, $J = 9.0$ Hz, 2H), 6.16 (d, $J = 1.8$ Hz, 1H), 6.10 (d, $J = 1.8$ Hz, 1H), 6.02 (d, $J = 1.8$ Hz, 1H), 5.98 (d, $J = 1.8$ Hz, 1H), 3.81 (s, 3H), 3.74 (s, 6H), 3.69 (s, 3H), 3.67 (s, 3H), 3.55-3.56 (d, $J = 3.1$ Hz, 6H). ^{13}C NMR (150 MHz, CDCl_3) δ 170.0, 161.5, 160.8, 160.4, 159.8, 159.5, 158.5, 157.9, 155.5, 134.4, 129.9, 129.0, 127.8, 127.7, 127.4, 125.5, 113.6, 106.9, 103.6, 94.4, 92.2, 92.1, 91.5, 91.4, 57.2, 55.9, 55.8, 55.4, 55.3, 55.2, 55.2; mass spectrum (ESI): m/e (% relative intensity) 614.6 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{35}\text{H}_{35}\text{NO}_9$ ($\text{M}+\text{H}$) $^+$: 614.2390, found 614.2389; IR (KBr, neat) 3440, 1693, 1608, 1586, 1512, 1470, 1456, 1413, 1245, 1226, 1206, 1154, 1127, 1031, 816 cm^{-1} .

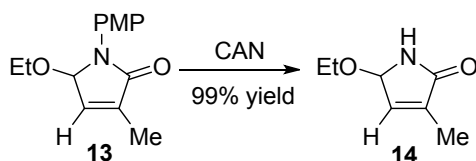
5. Application of the methodology

We synthesized substrate **11**, and it reacted with ethanol under the general procedure to give **13**, then cleavage of 4-methoxyphenyl group afforded **14**, and **14** could easily be transformed to **Jatropham** under the conditions given in the literature⁷.

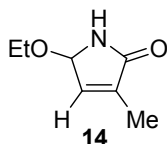




5-ethoxy-1-(4-methoxyphenyl)-3-methyl-1H-pyrrol-2(5H)-one 13. Yellow oil (10 mg, 33%); ^1H NMR (600 MHz, CDCl_3) δ 7.57 (d, $J = 8.4$ Hz, 2H), 6.94 (d, $J = 8.4$ Hz, 2H), 6.61 (s, 1H), 5.81 (s, 1H), 3.82 (s, 3H), 3.34 (q, $J = 6.9$ Hz, 2H), 1.99 (s, 3H), 1.09 (t, $J = 6.9$ Hz, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 169.5, 156.8, 138.5, 136.1, 130.4, 122.9, 114.2, 87.1, 58.6, 55.5, 15.2, 11.1. mass spectrum (ESI): m/e (% relative intensity) 248.1 (100) ($\text{M}+\text{H}$) $^+$; HRMS (ESI): m/z calcd for $\text{C}_{14}\text{H}_{17}\text{NO}_3$ ($\text{M}+\text{H}$) $^+$: 248.1287, found 248.1286; IR (KBr, neat) 2979, 2929, 1701, 1513, 1389, 1248, 1075, 912, 829, 743 cm^{-1} .



To a solution of **13** (8 mg, 0.03 mmol) in CH_3CN (0.2 mL) was added a solution of CAN (48 mg, 0.09 mmol) in H_2O (0.4 mL) and 0°C quickly but dropwise, while keep temperature of the reaction mixture at 0°C for 1 h. Then the reaction mixture was quenched by addition of saturated aqueous NaHCO_3 , and the residue was extracted with CH_2Cl_2 . The organic layer was dried over Na_2SO_4 and evaporated. Crude product was purified by column chromatography on silica gel to give **14**.



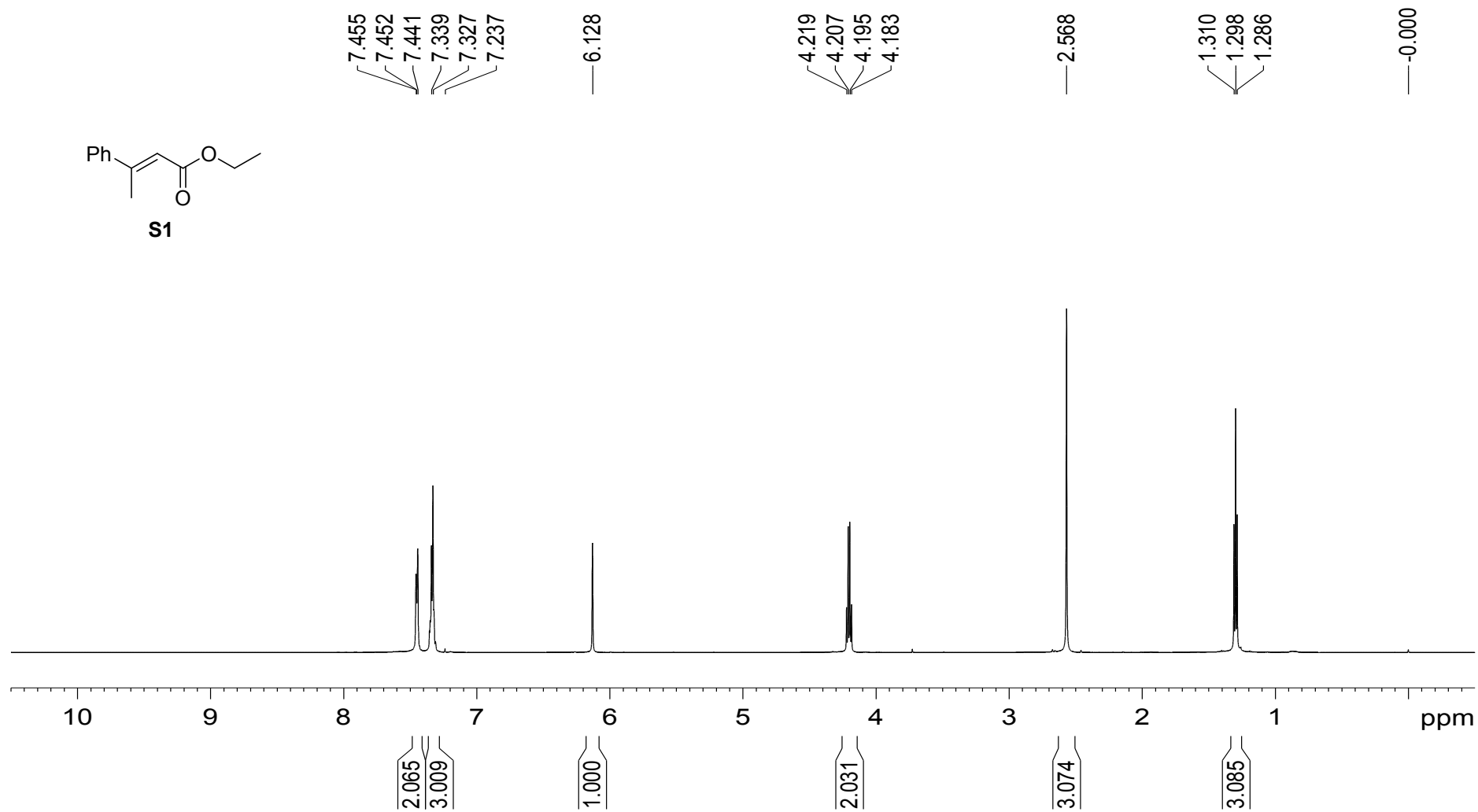
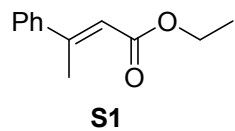
5-ethoxy-3-methyl-1H-pyrrol-2(5H)-one 14. Yellow oil (4.5mg, 99%); ^1H NMR (600 MHz, CDCl_3) δ 6.57 (s, 1H), 6.15 (s, 1H), 5.40 (s, 1H), 3.57 (dq, $J = 10.8, 2.4$ Hz, 2H), 1.91 (s, 3H), 1.23 (t, $J = 10.8$ Hz, 3H). ^{13}C NMR (150 MHz, CDCl_3) δ 173.1, 139.0, 137.7, 83.6, 61.3, 15.4, 10.7. mass spectrum (ESI): m/e (% relative intensity)

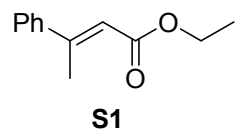
142.0 (100) (M+H)⁺; HRMS (ESI): m/z calcd for C₇H₁₁NO₂ (M+H)⁺: 142.0868, found 142.0870; IR (KBr, neat) 3512, 3270, 1706, 1655, 1092, 1070, 912, 742, 434 cm⁻¹.

6. References

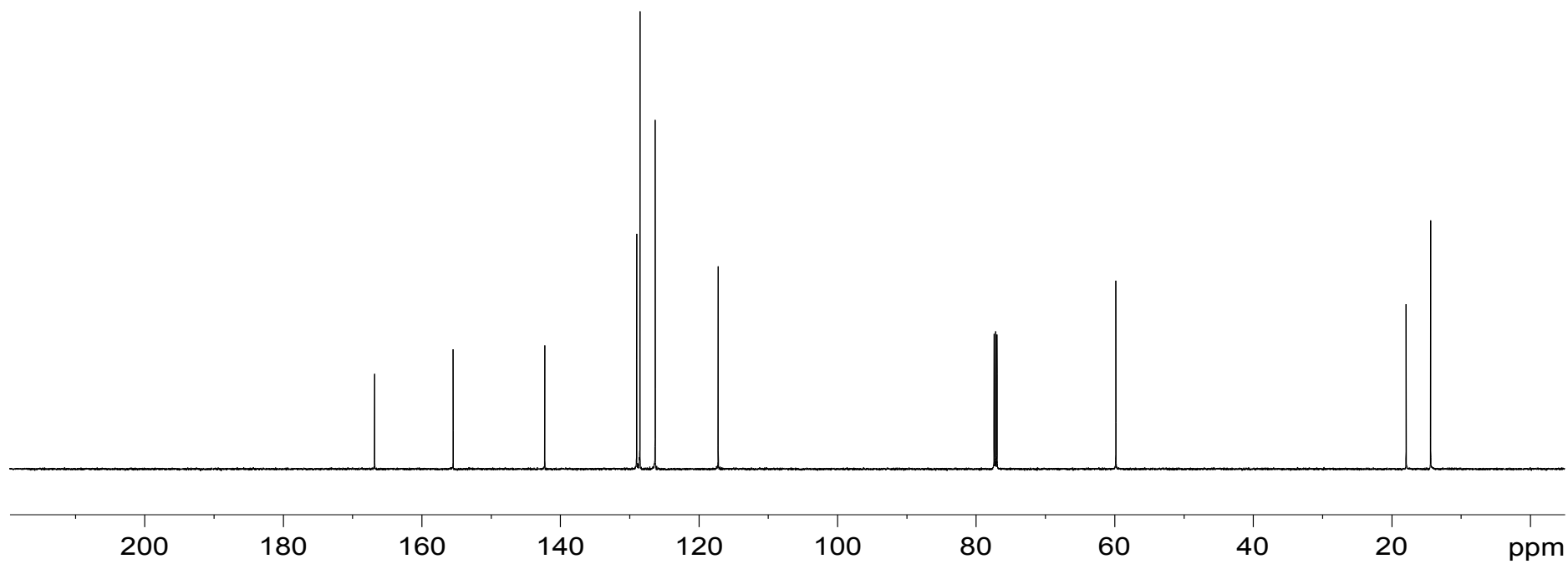
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- 6 Y. Z. Jin, D.X. Fu, N. Ma, Z. C. Li, Q. H. Liu, L. Xiao and R. H. Zhang. *Molecules* 2011, **16**, 9368.
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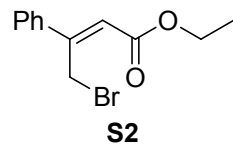
7. ^1H NMR, ^{19}F and ^{13}C NMR Spectra





166.796
155.463
142.236
128.973
128.498
126.300
117.206
77.378
77.166
76.954
59.796
17.902
14.357





7.551
7.421
7.260

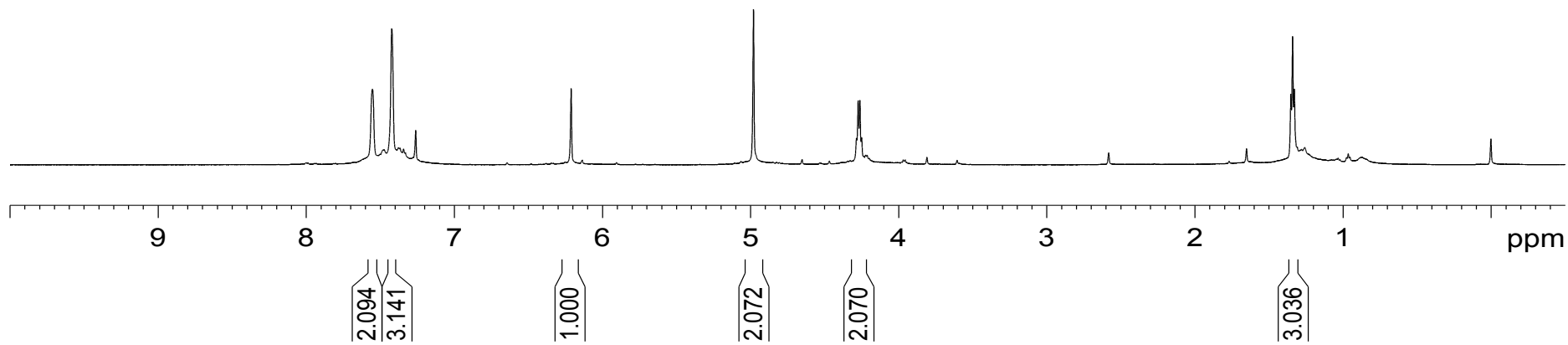
6.210

4.979

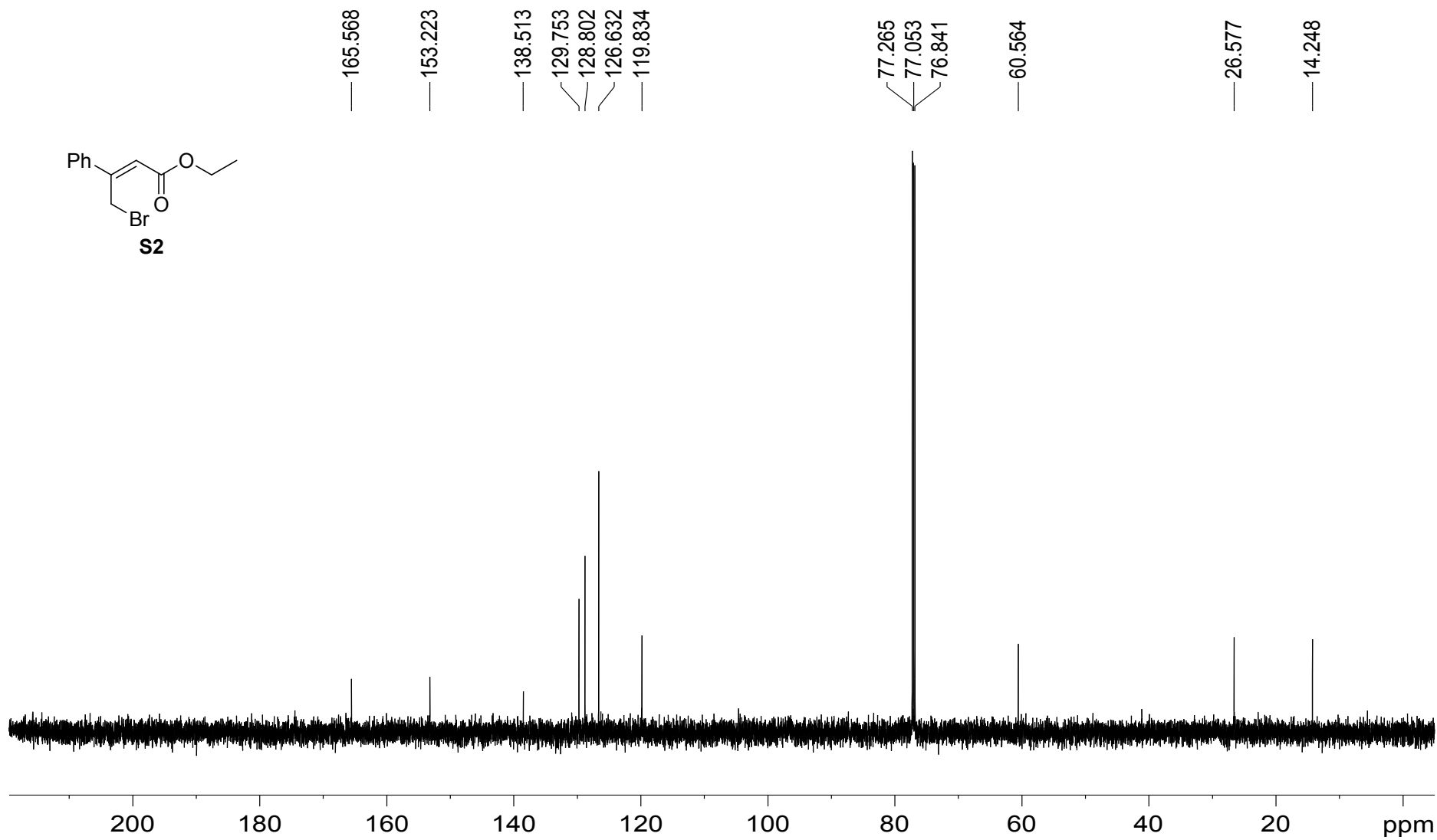
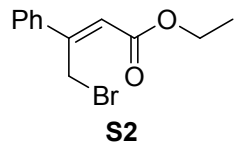
4.284
4.272
4.261
4.249

1.351
1.339
1.327

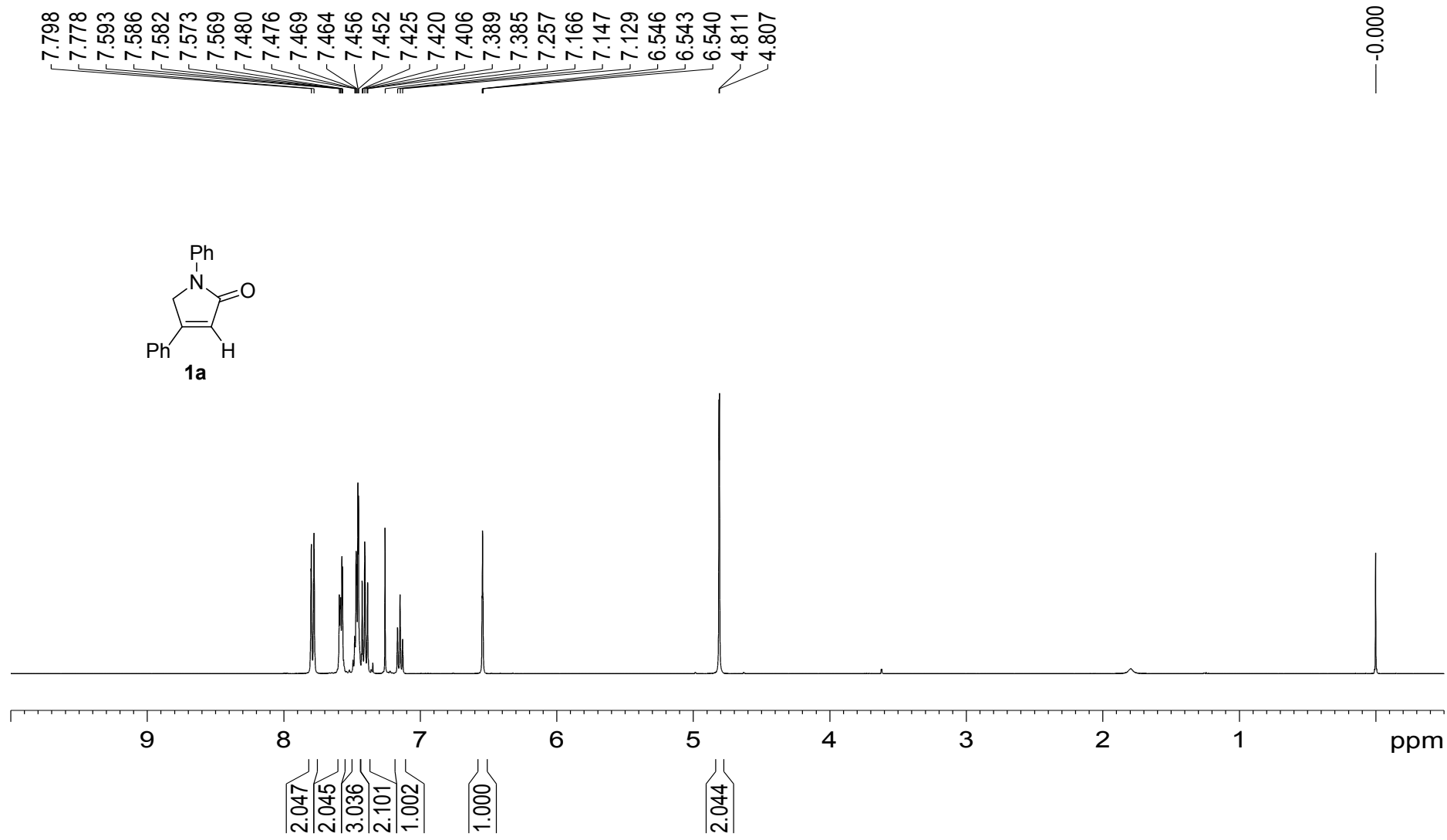
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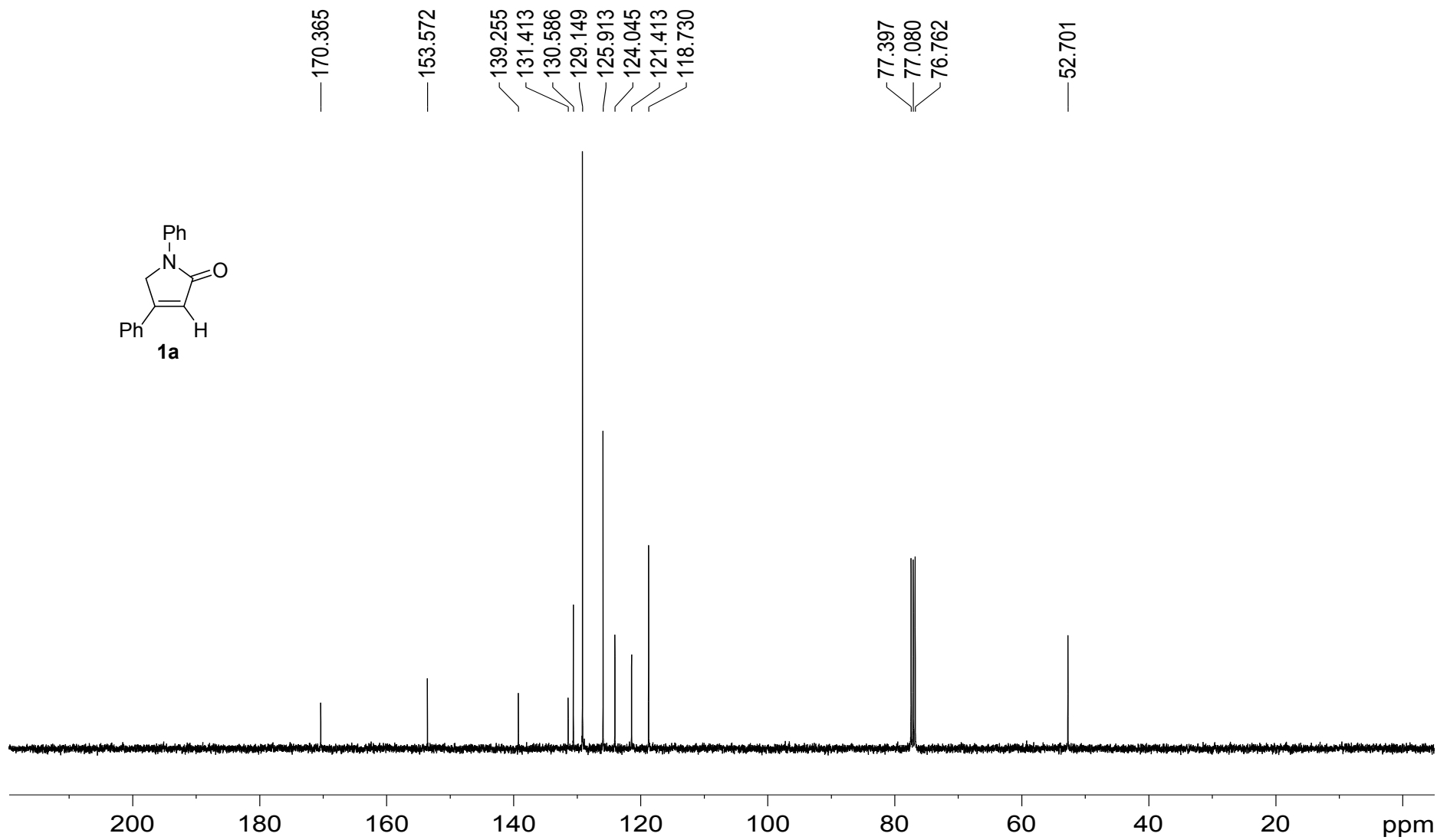
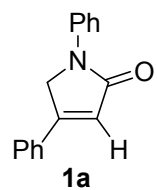


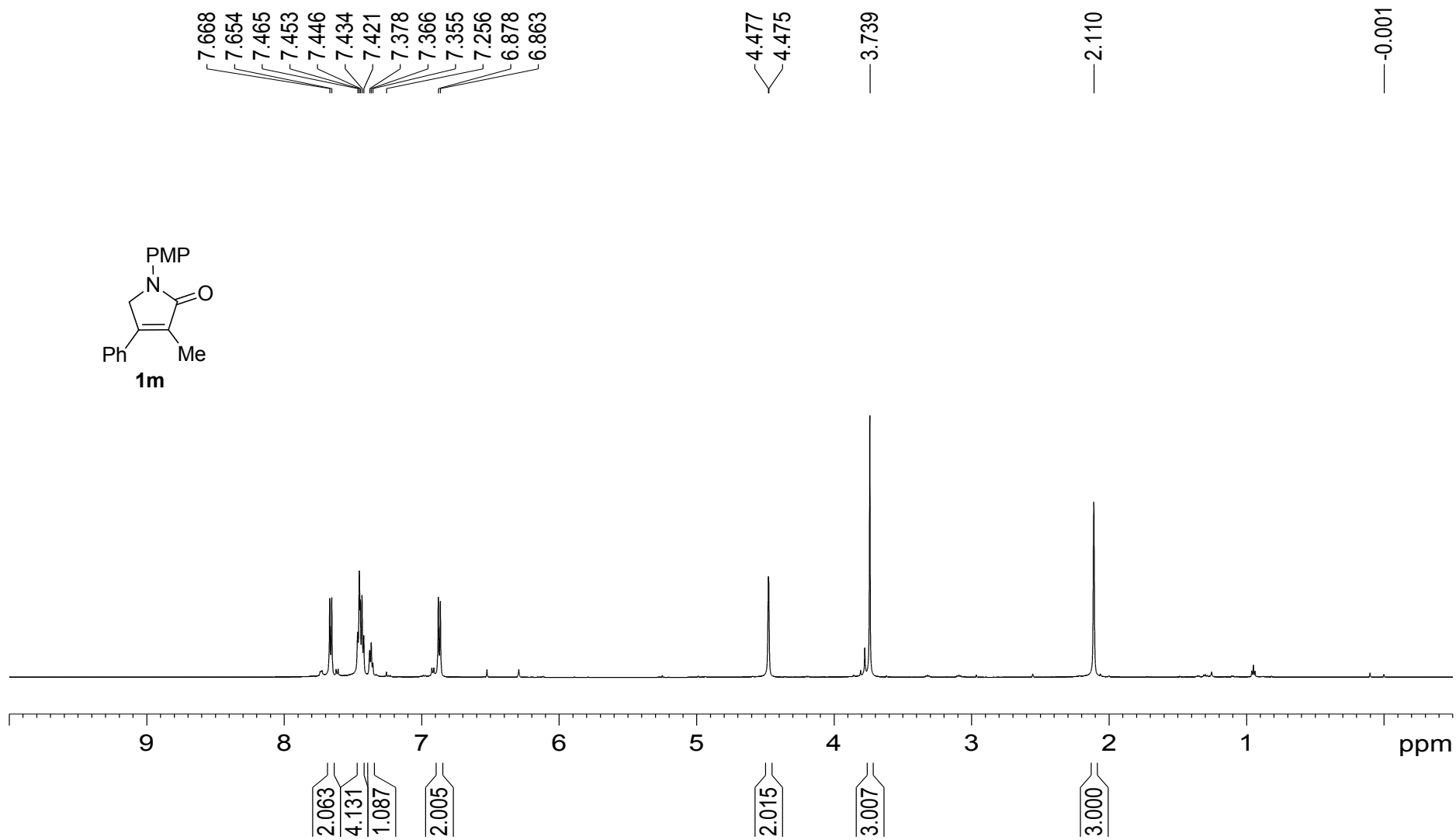
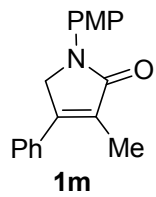
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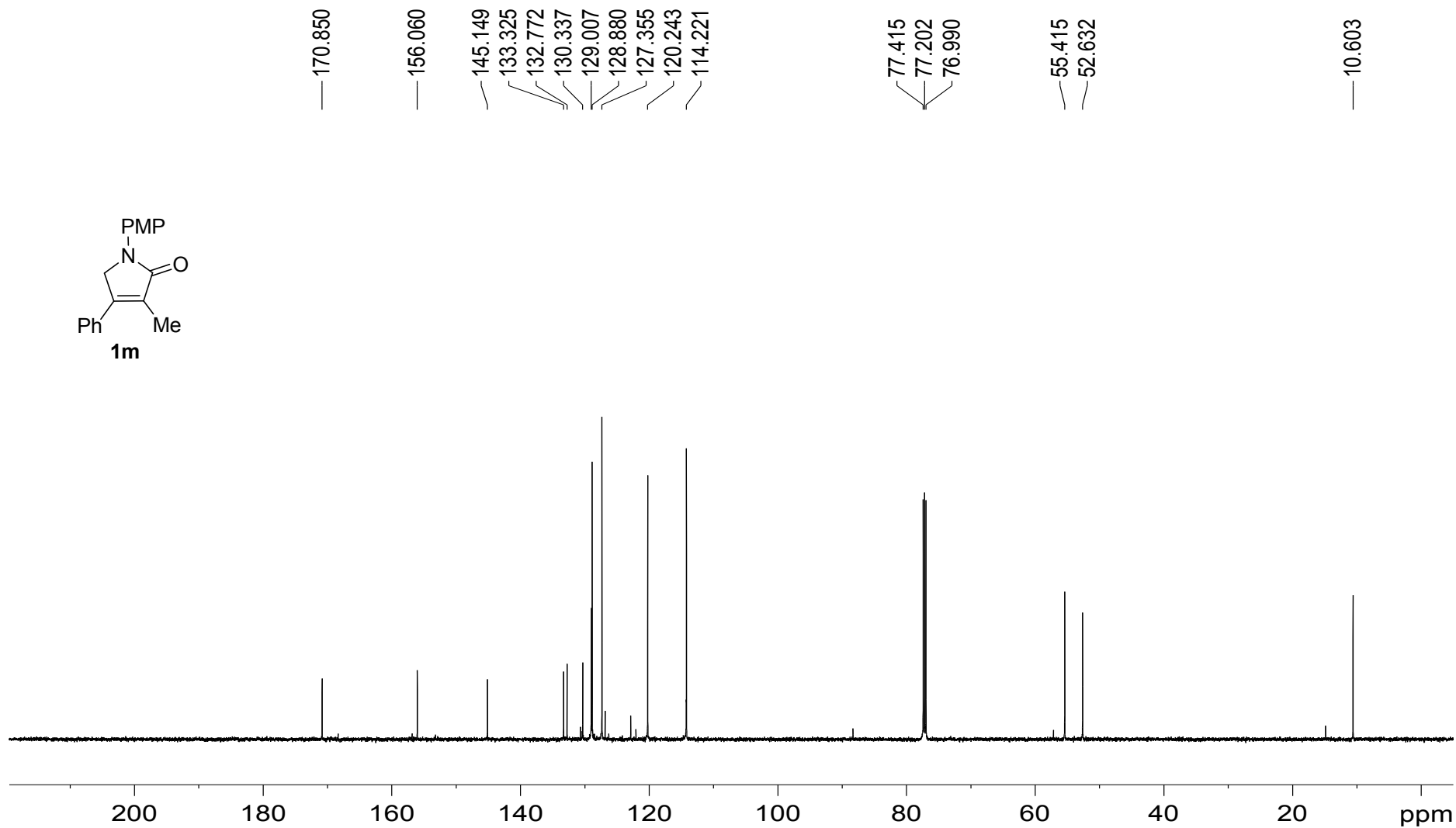
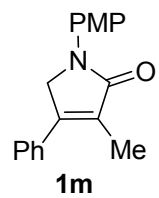


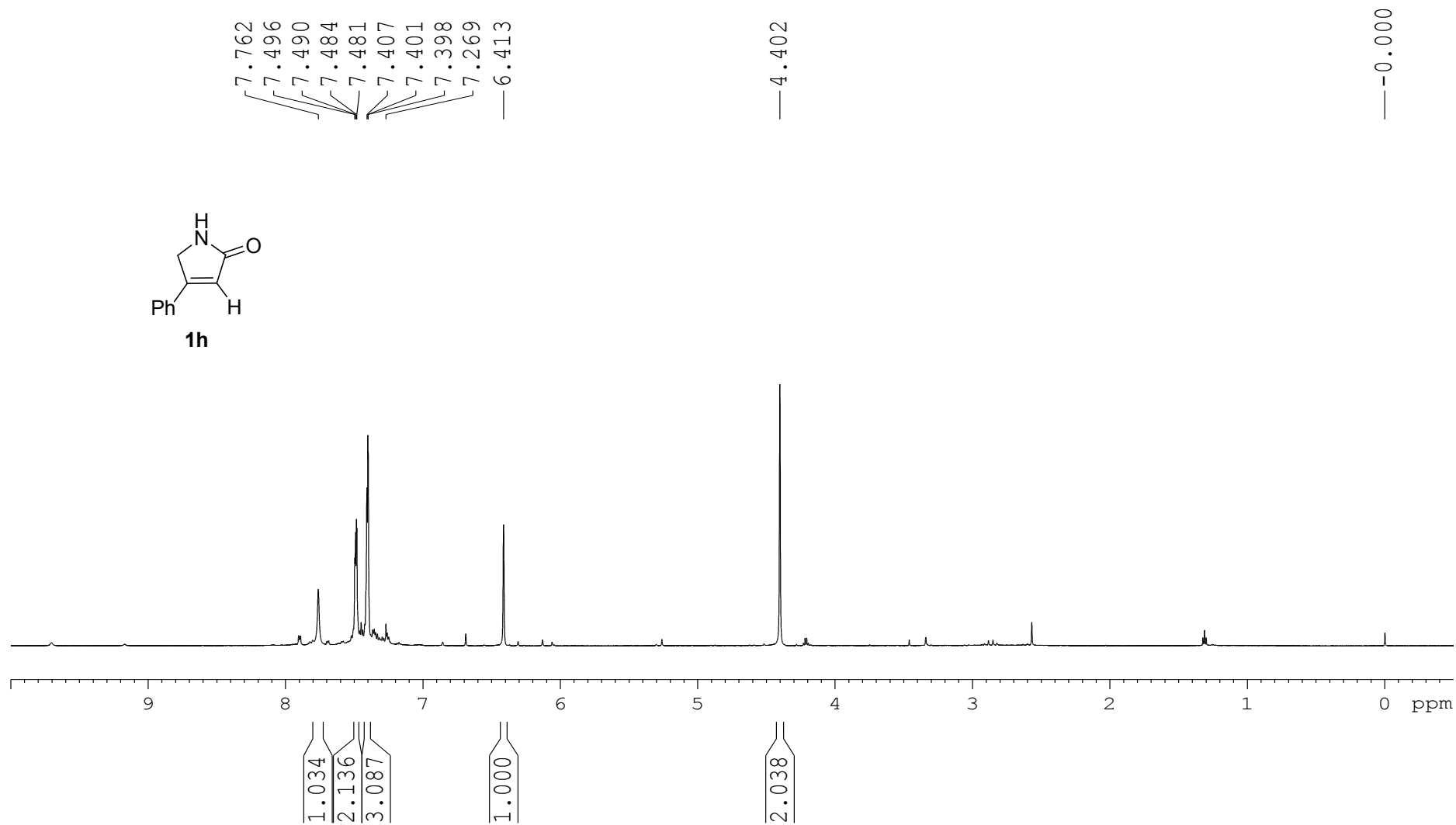
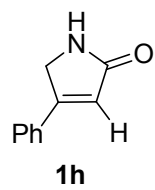
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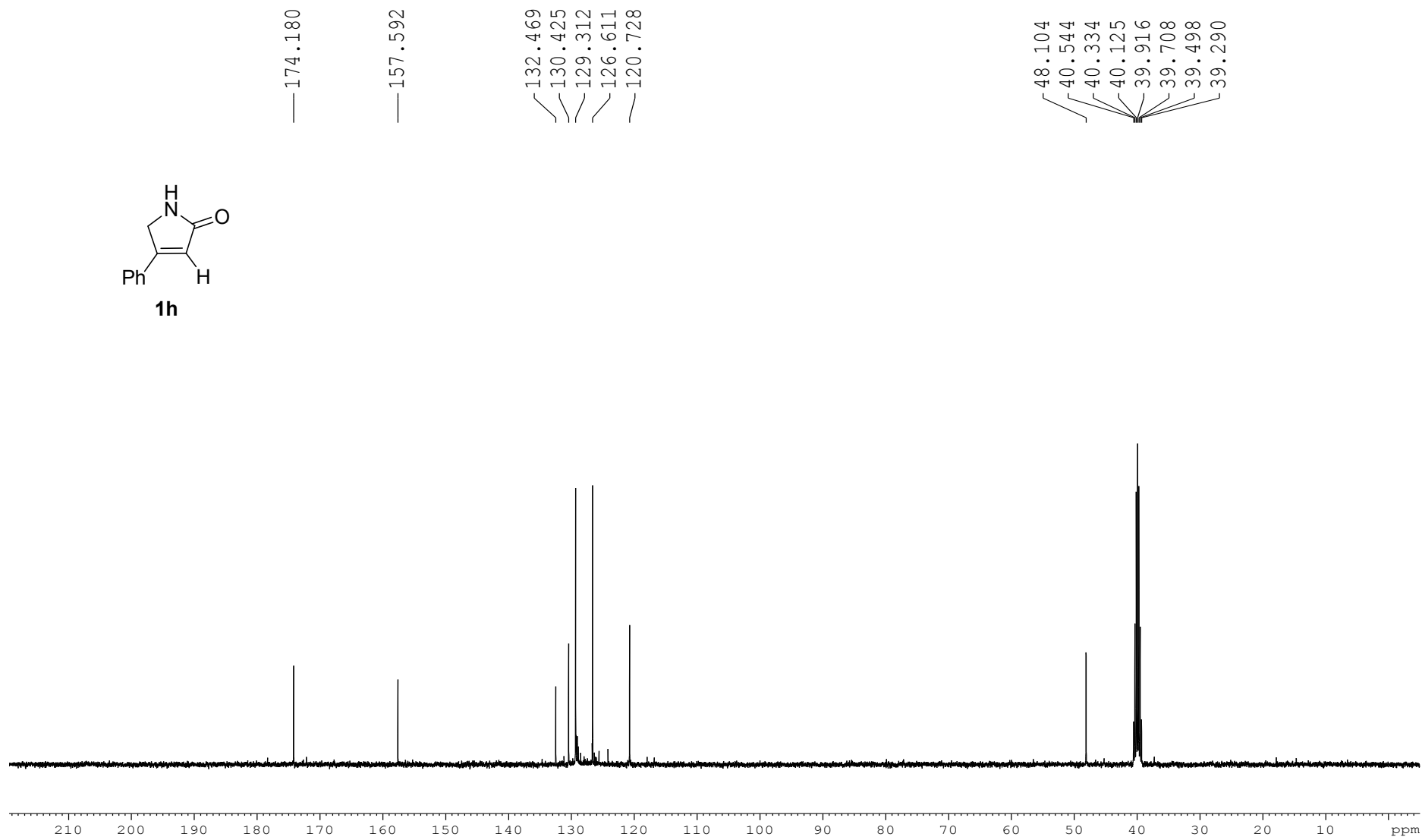
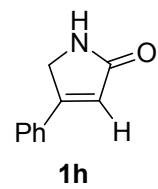


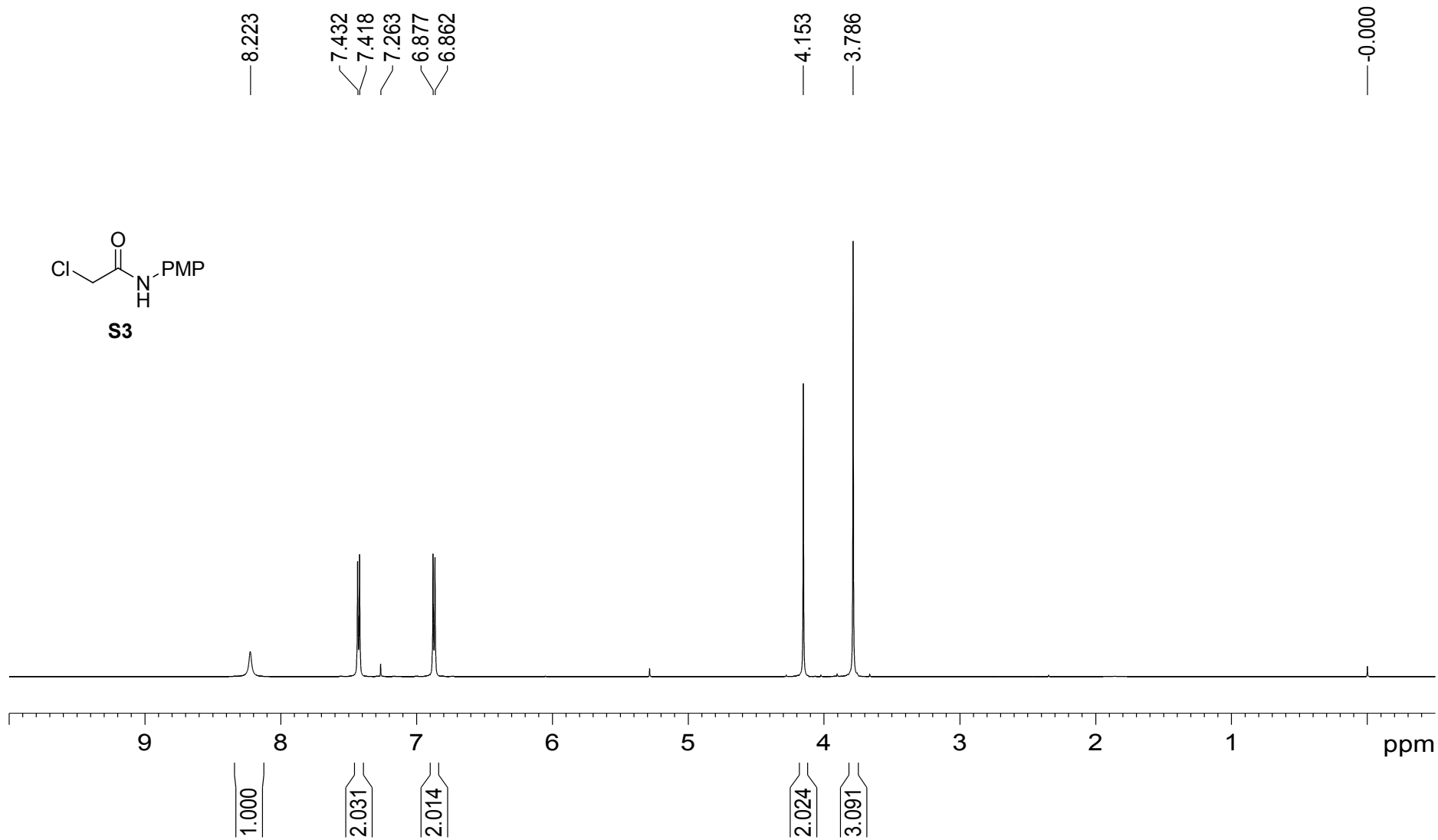
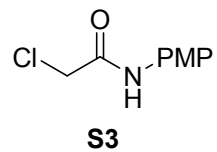


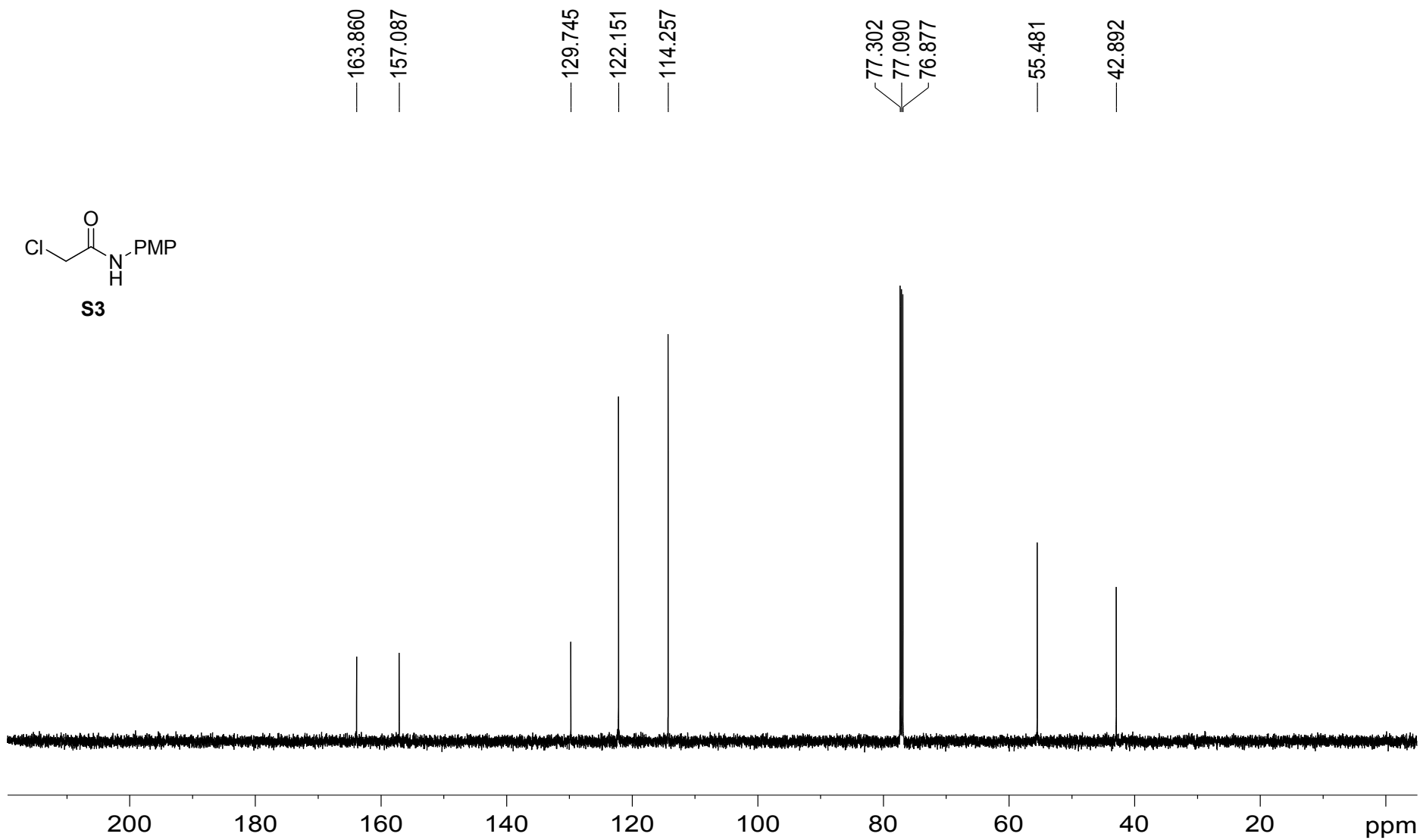
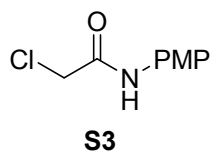




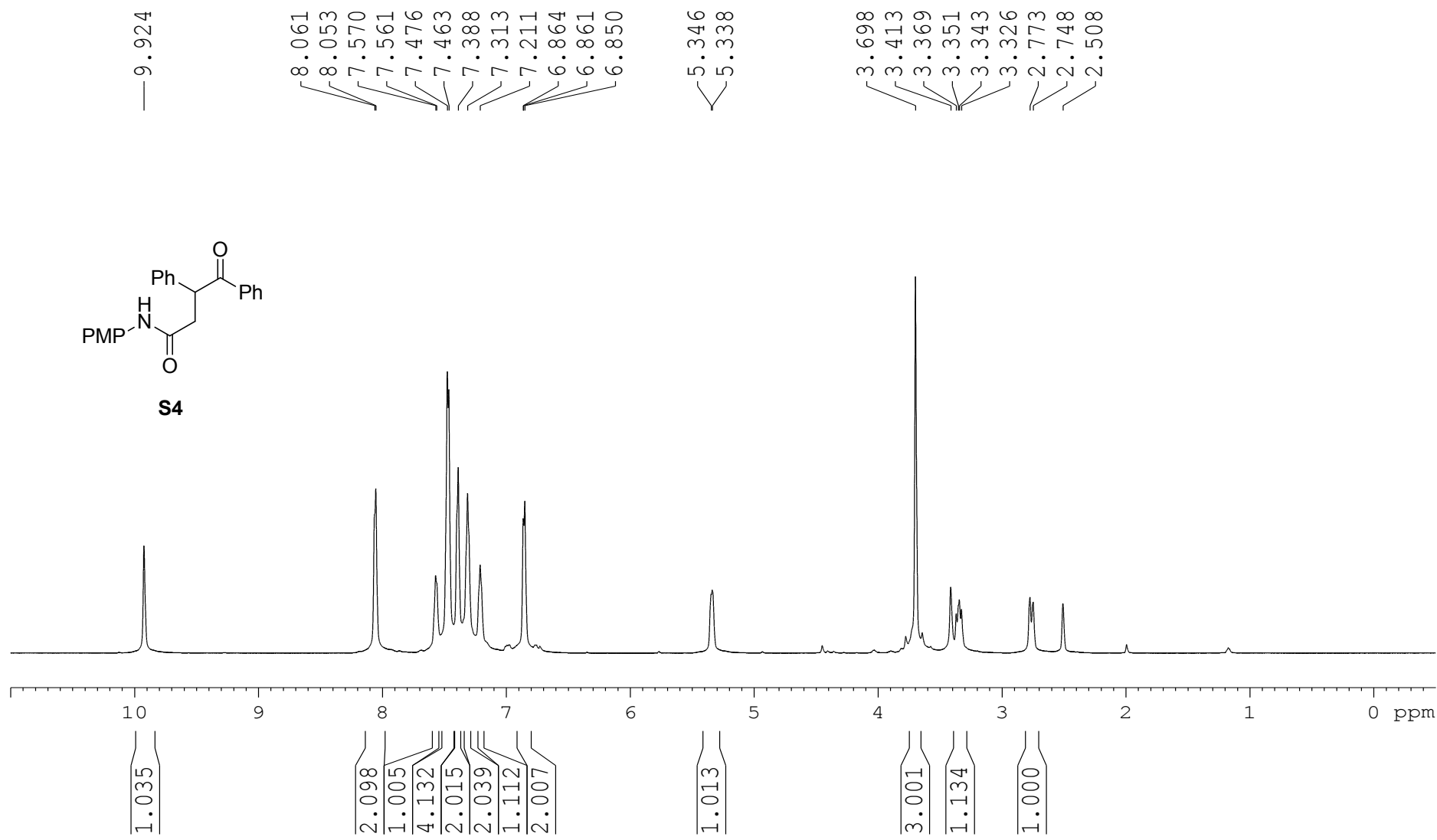
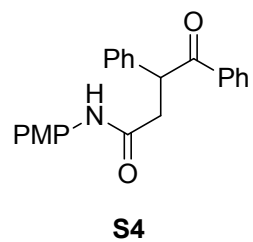


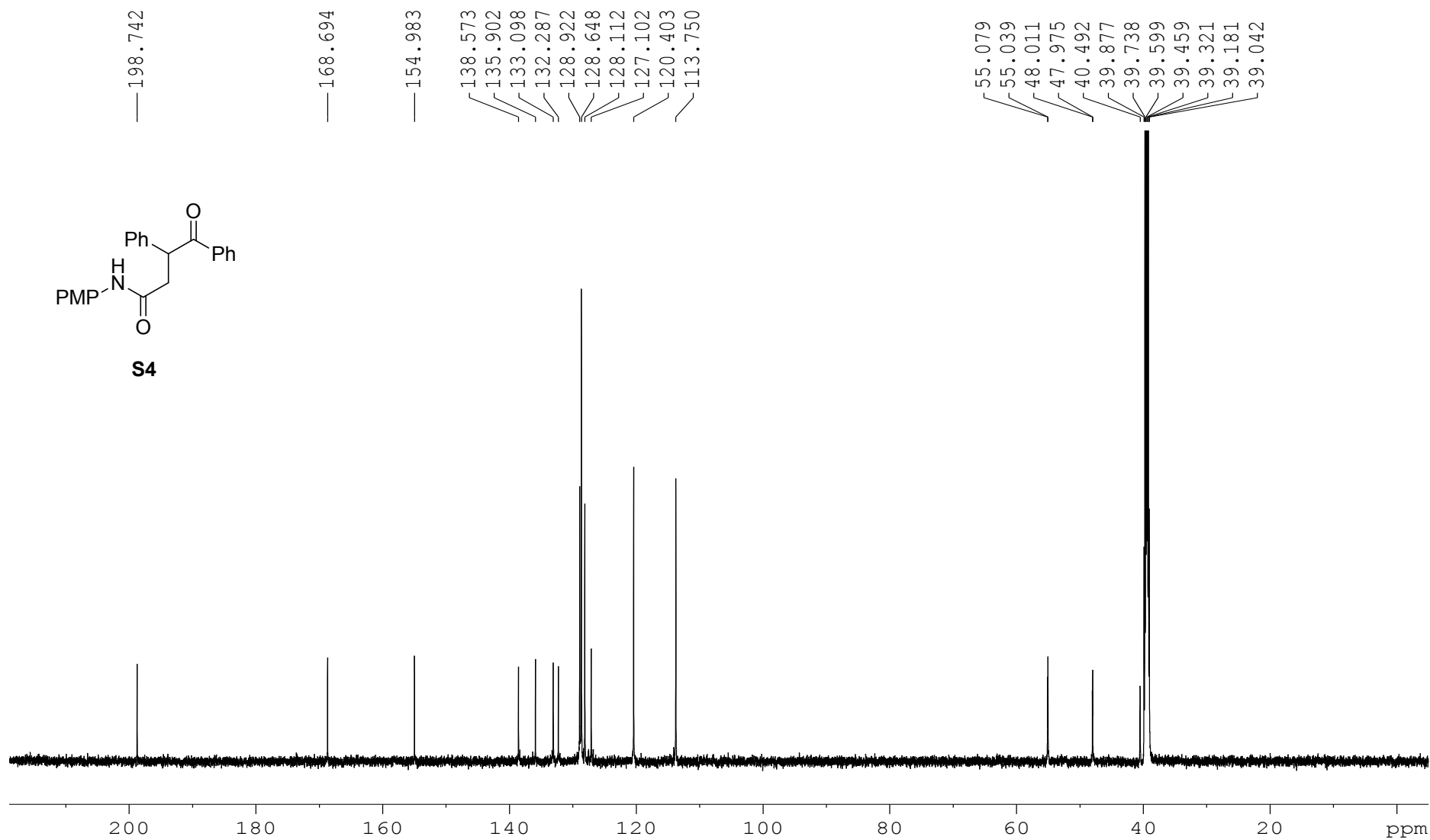
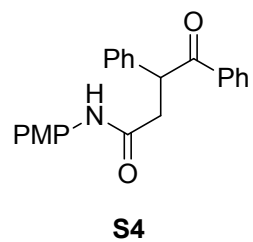




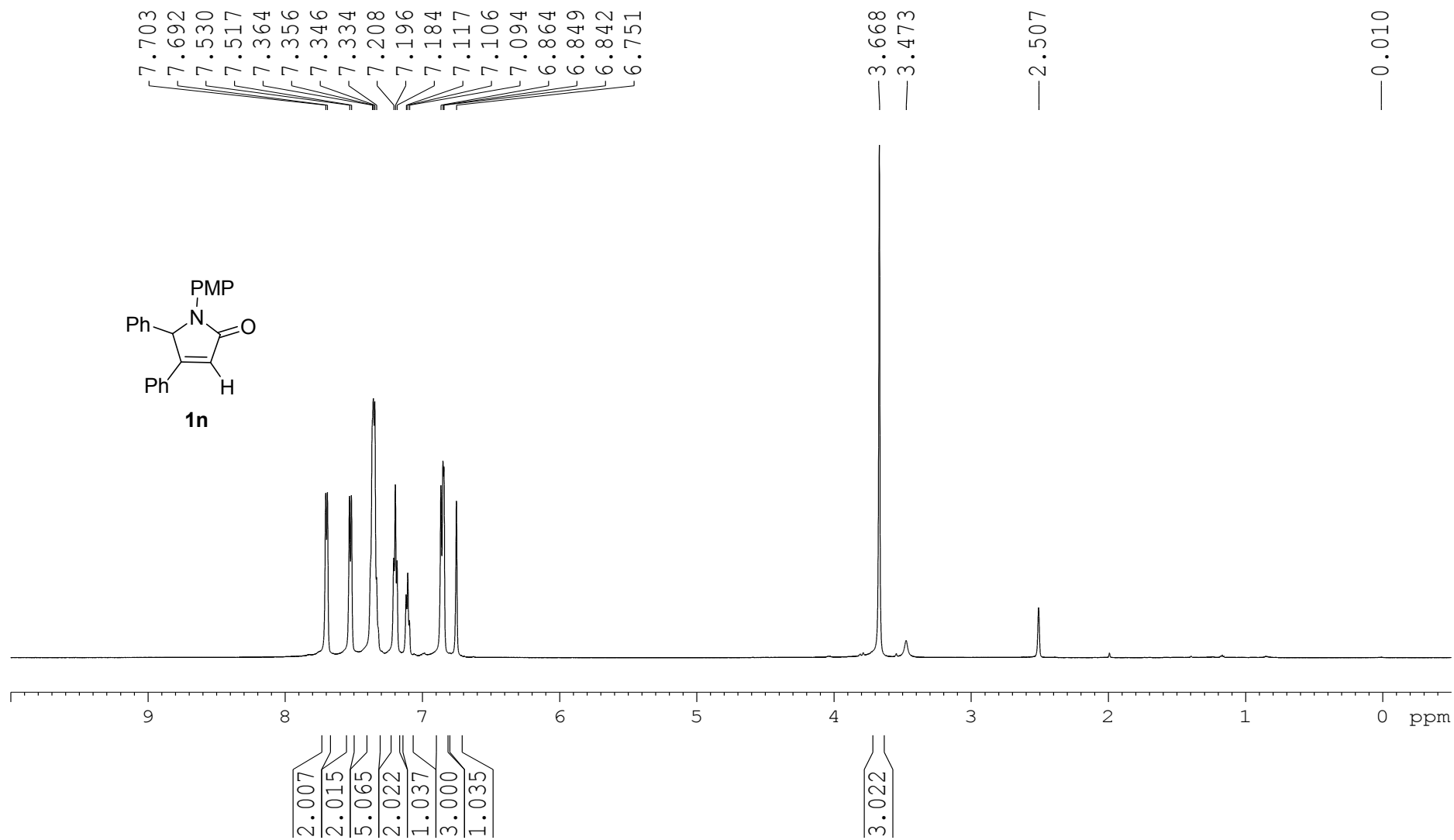


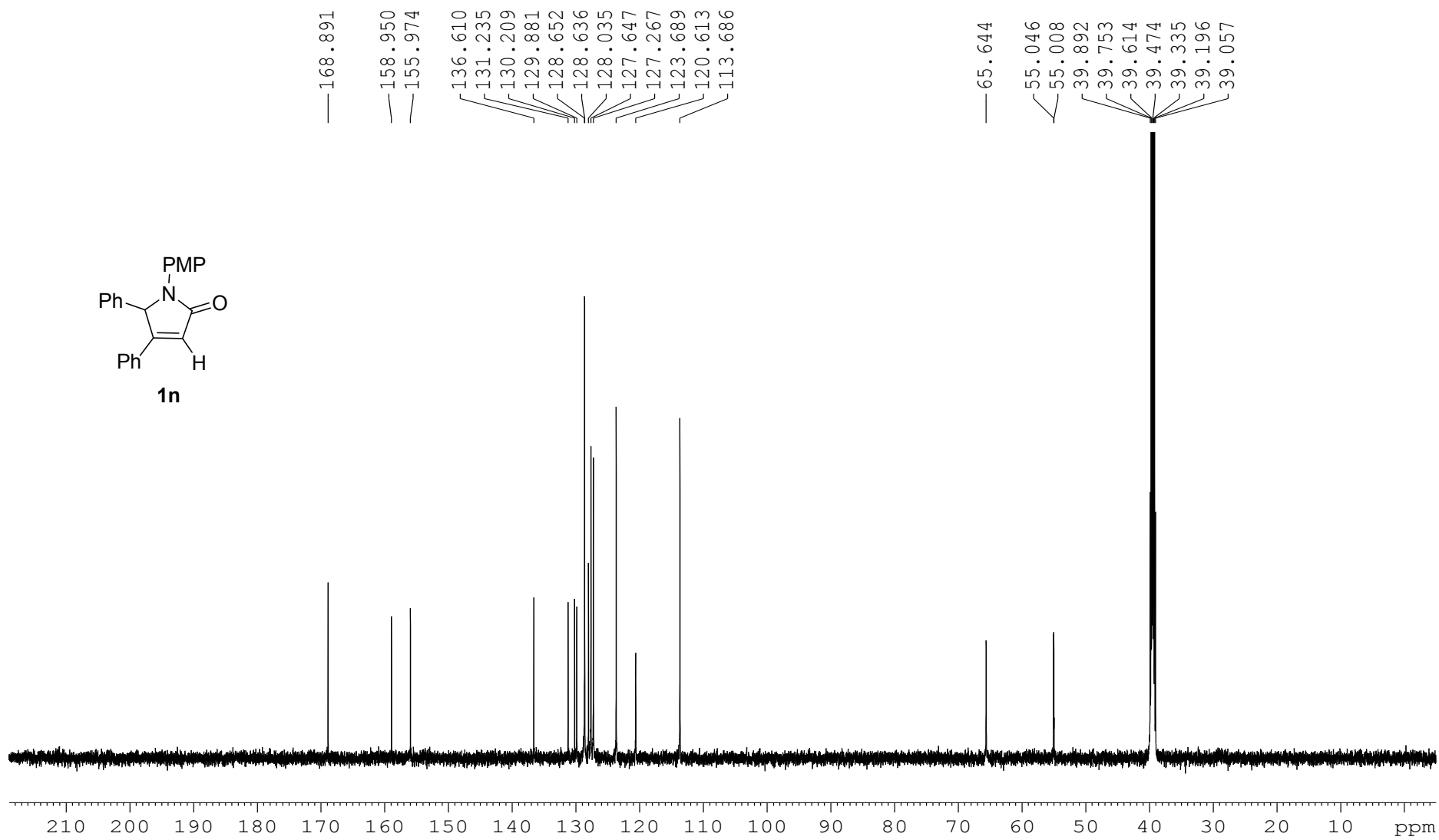
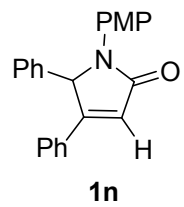
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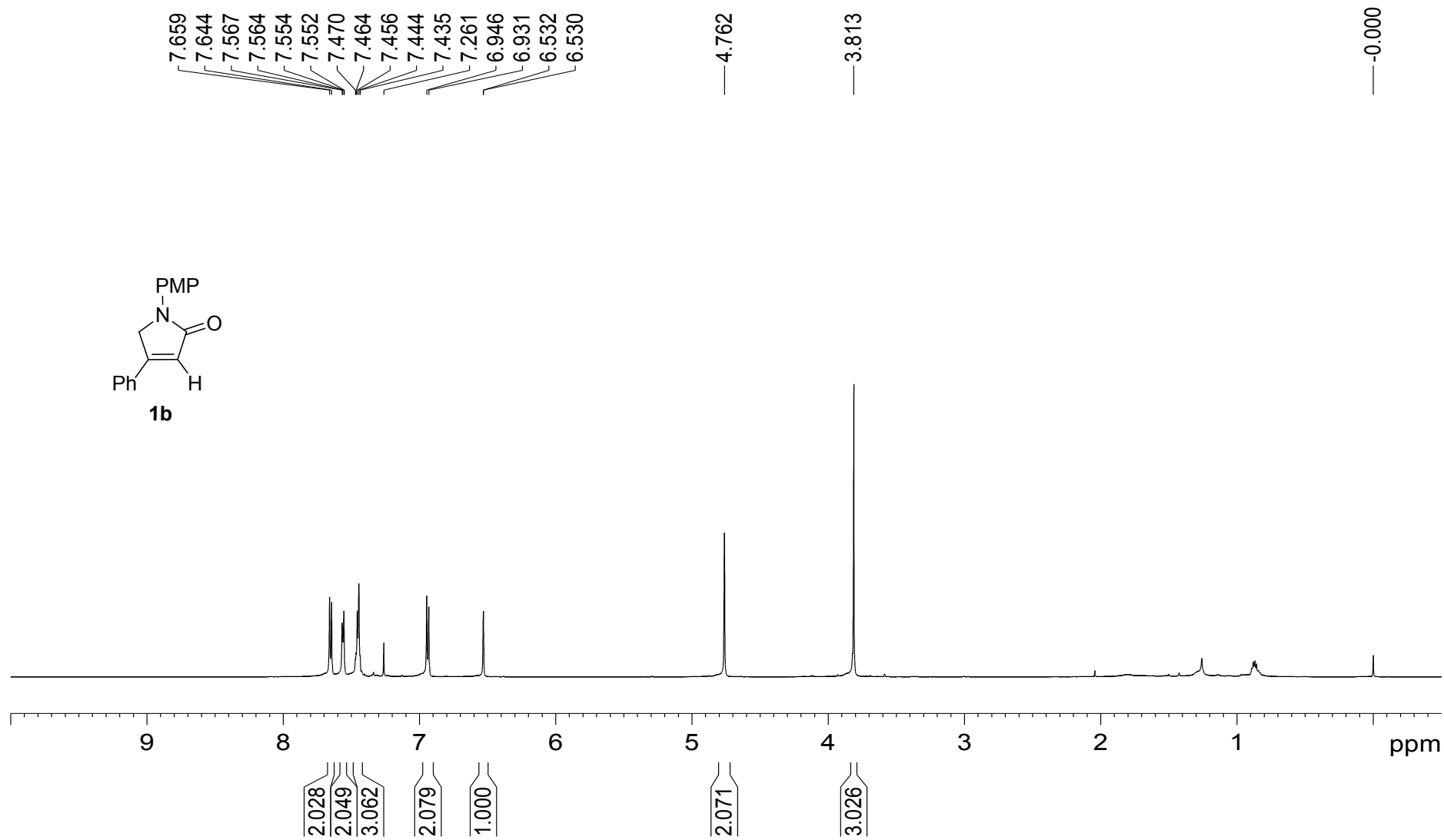
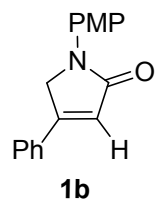


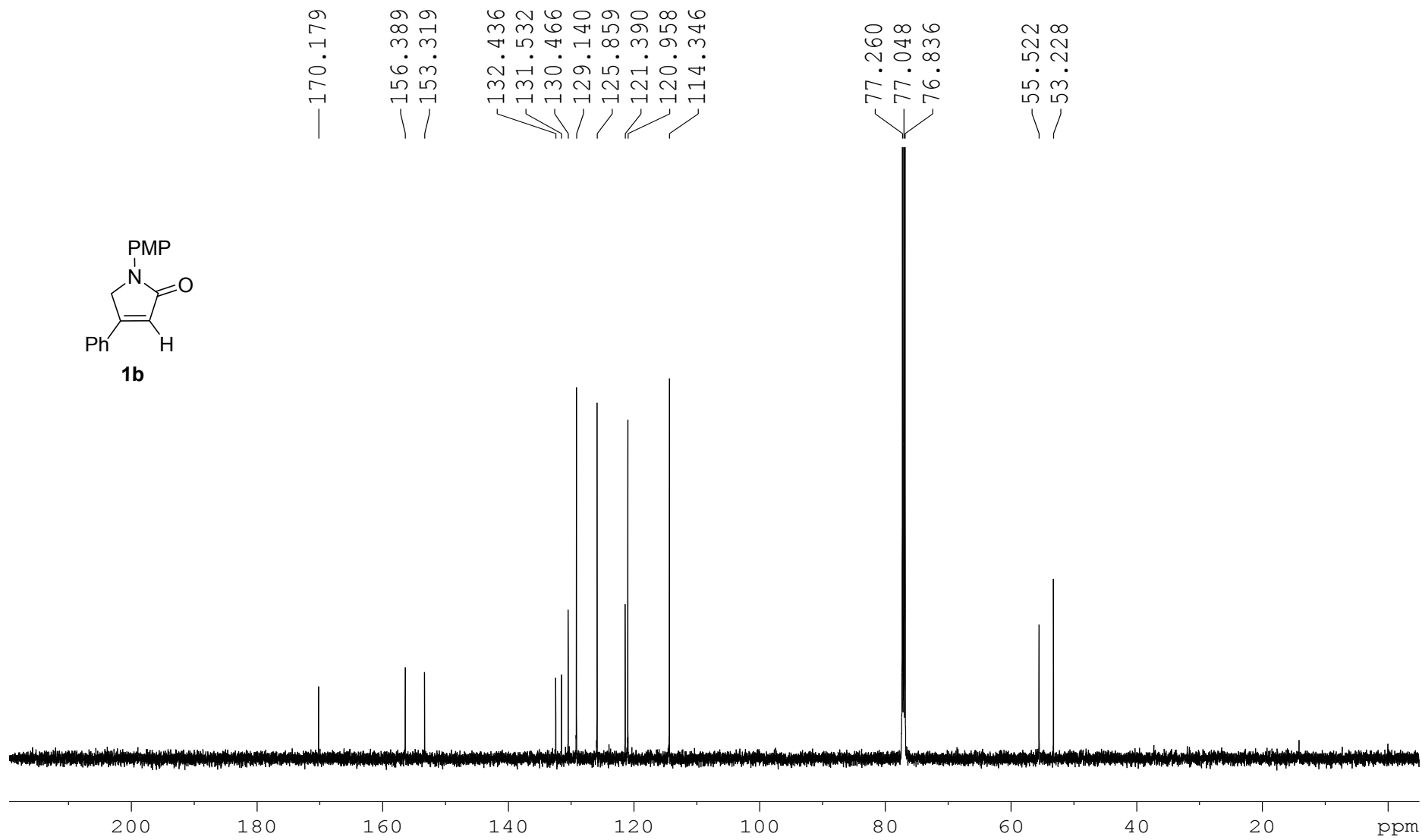
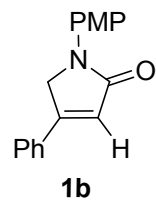


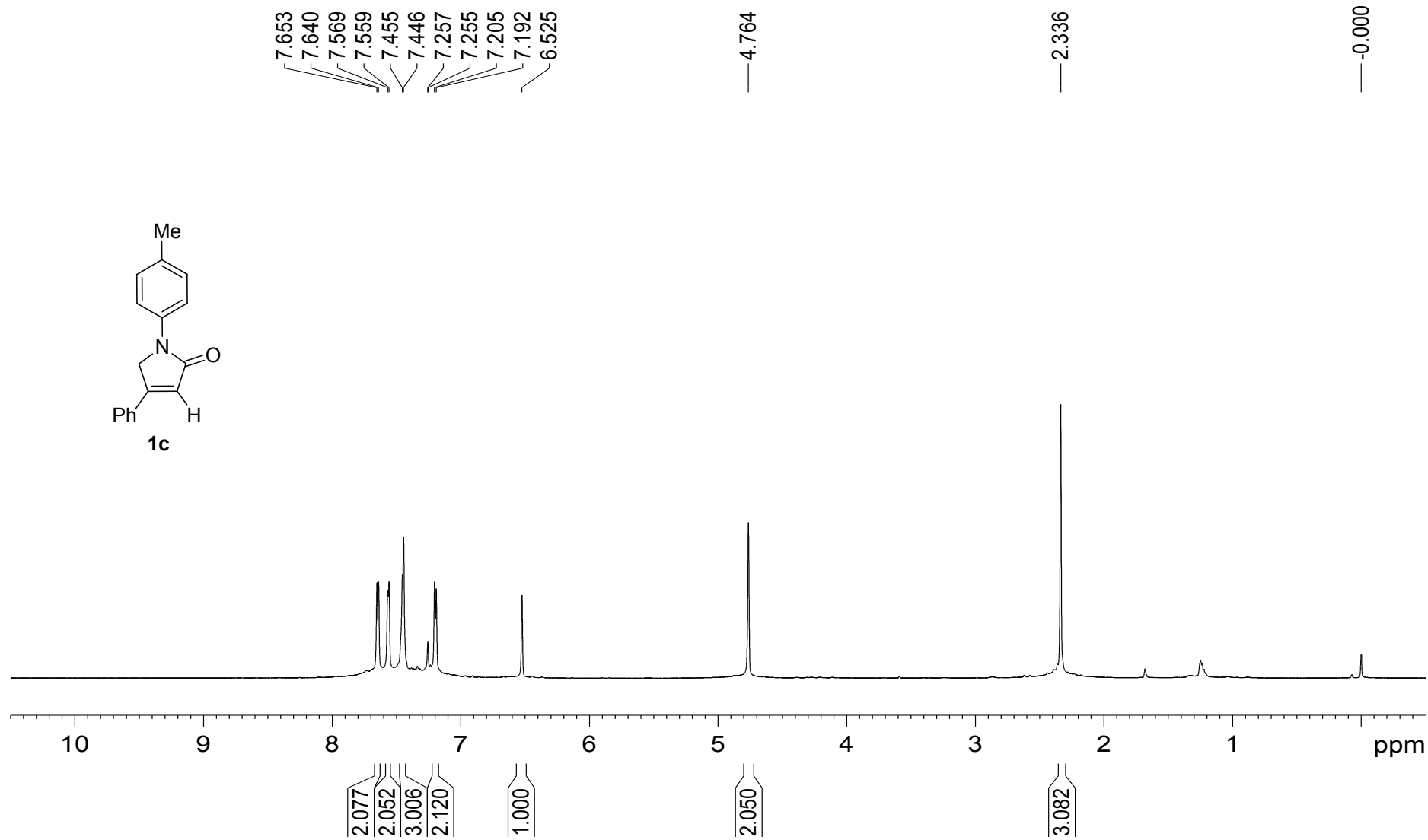
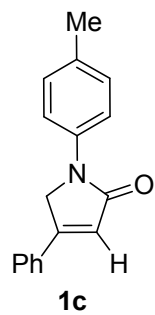
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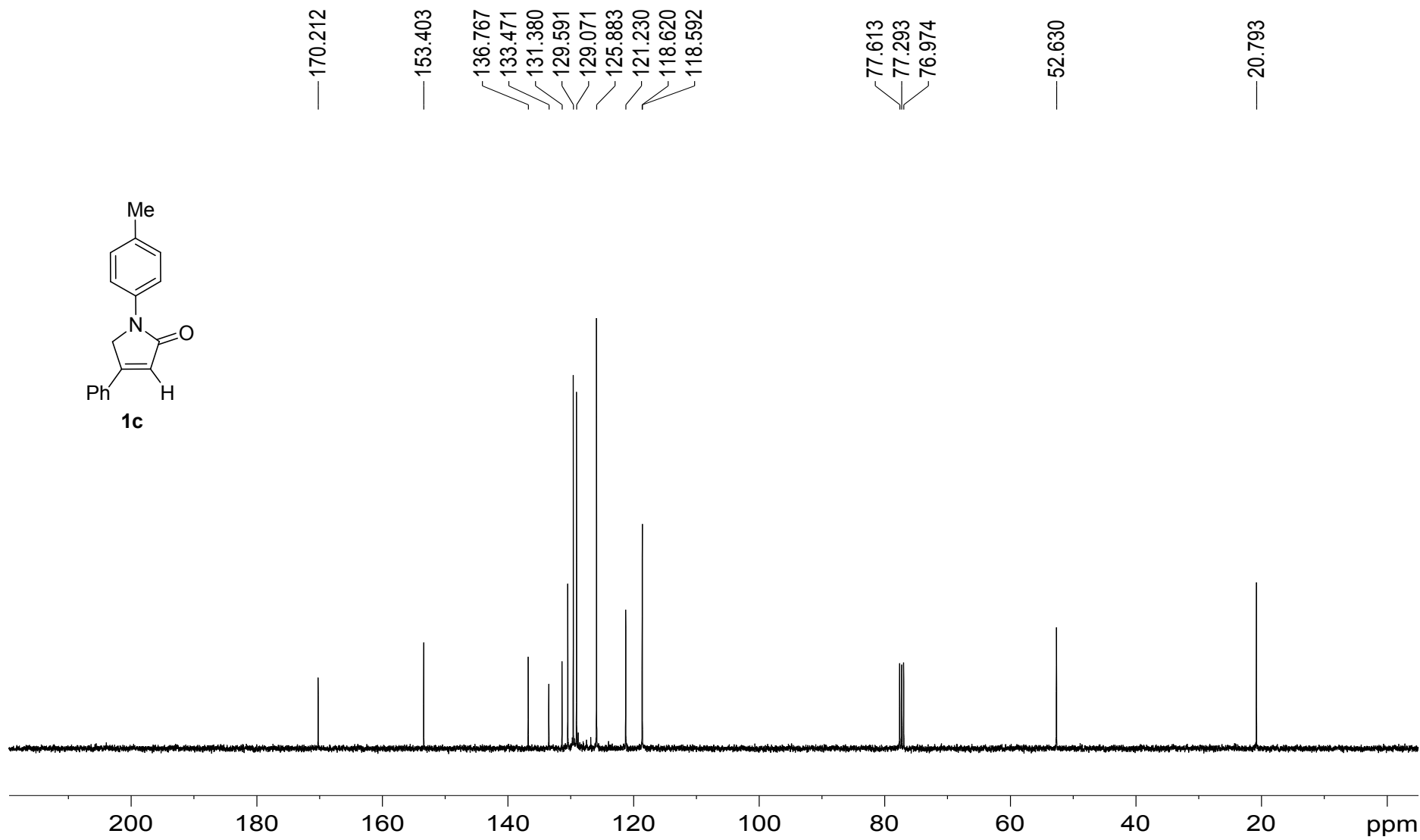
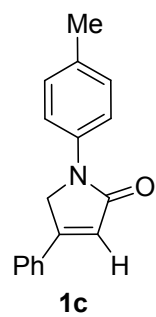


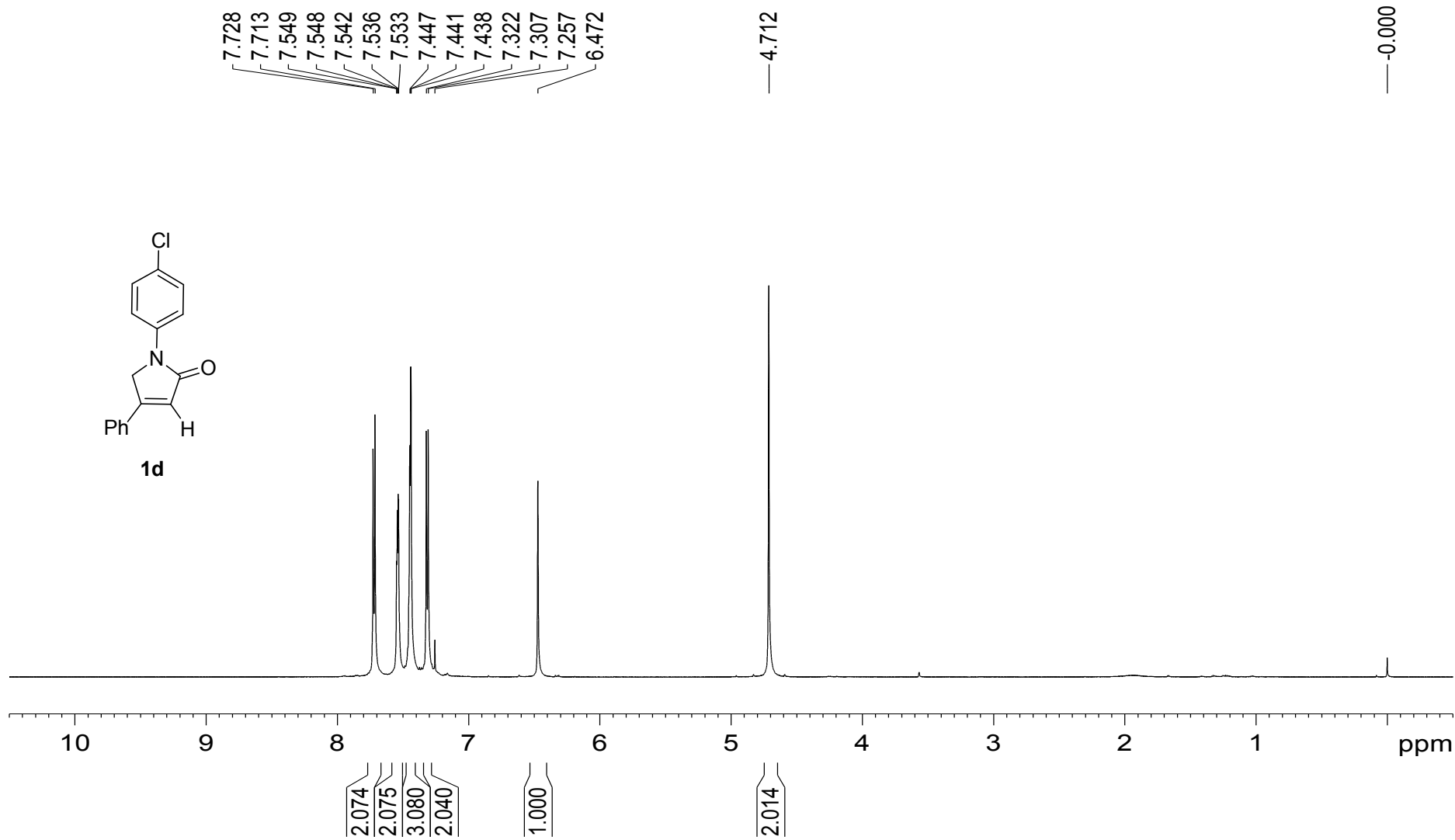
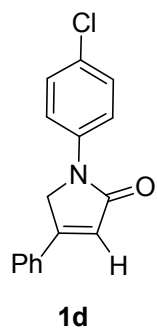


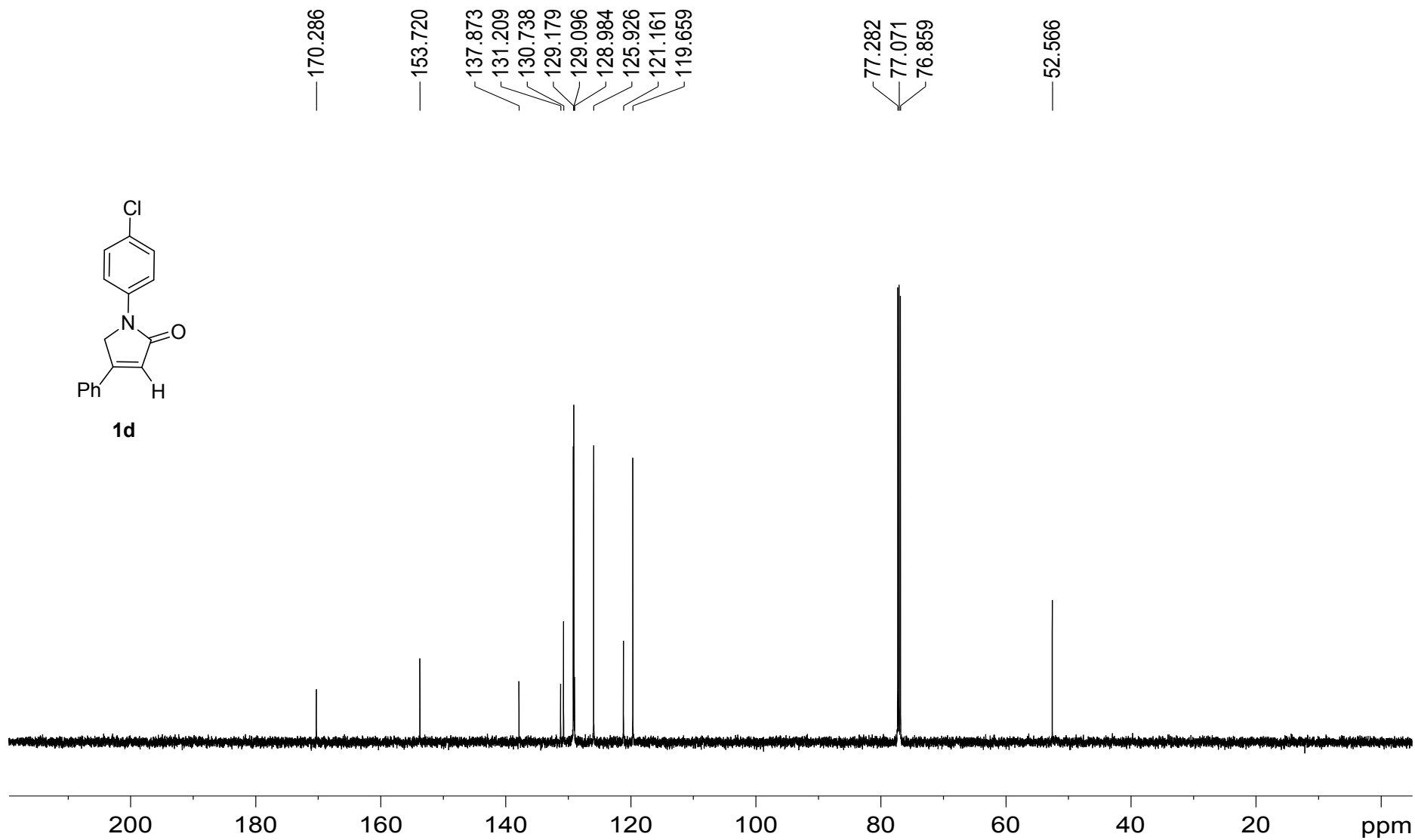
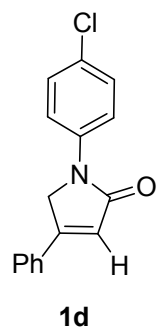


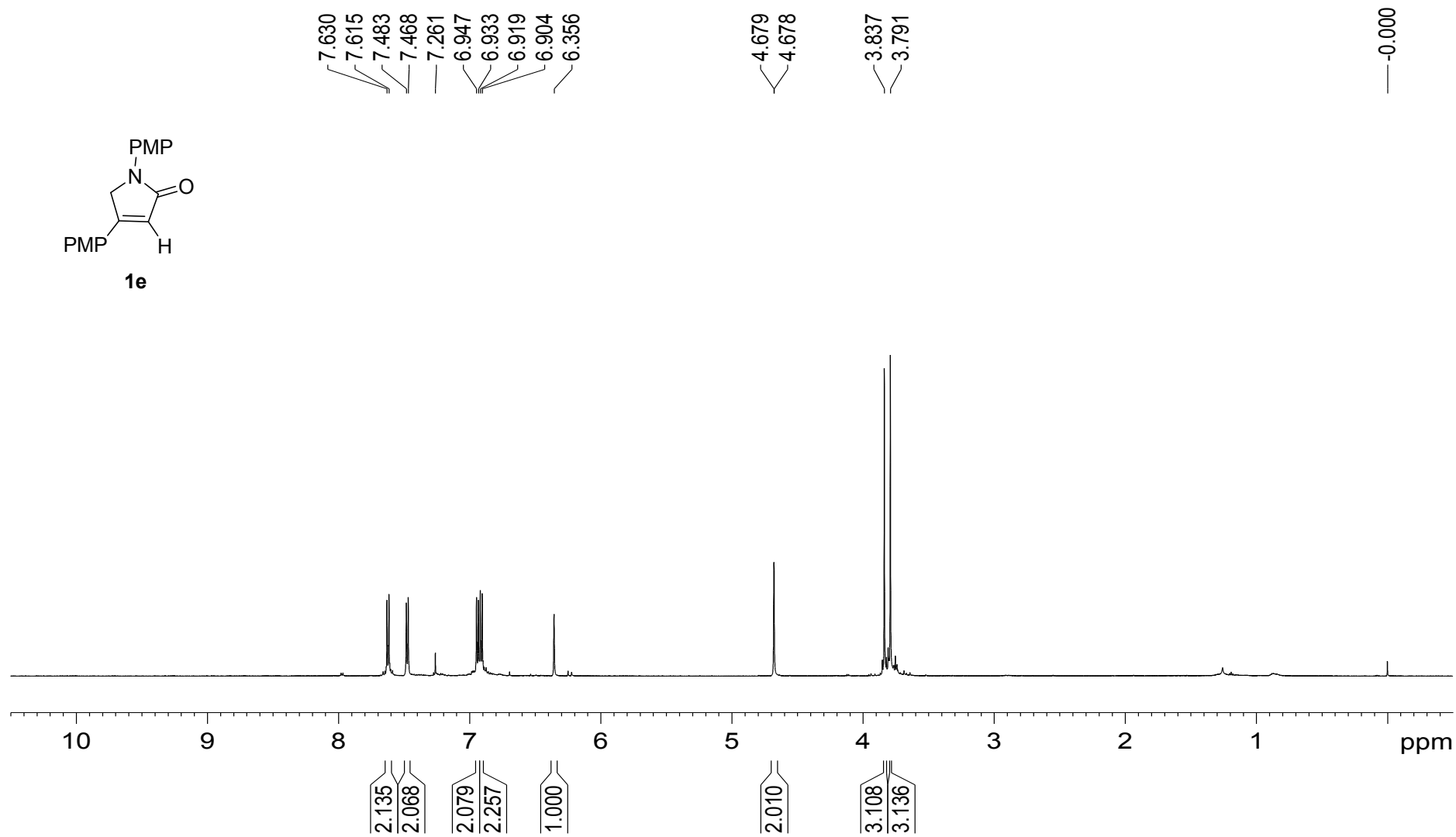
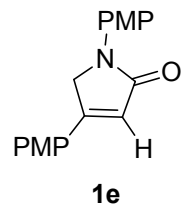


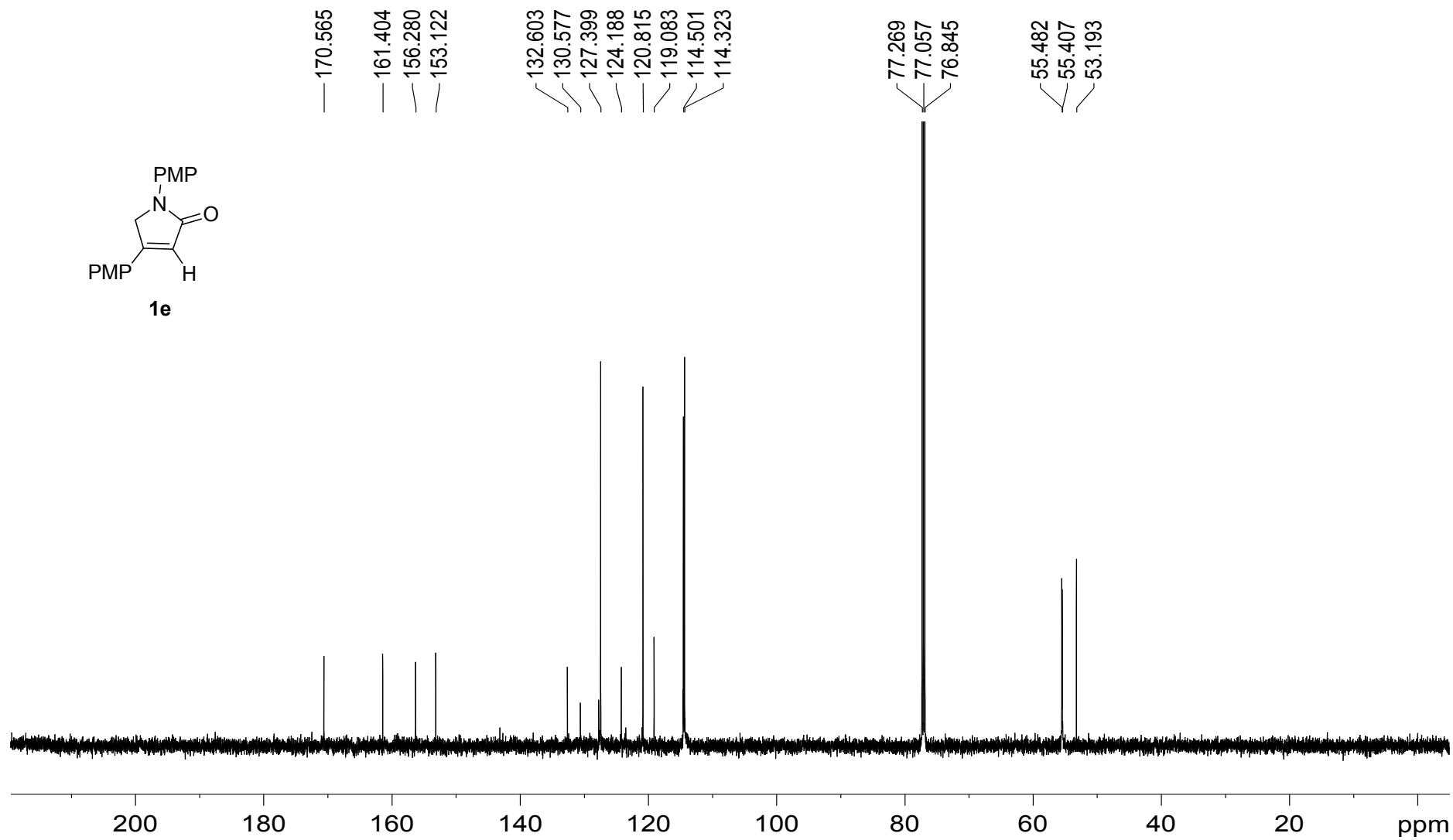
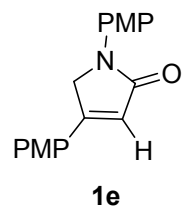


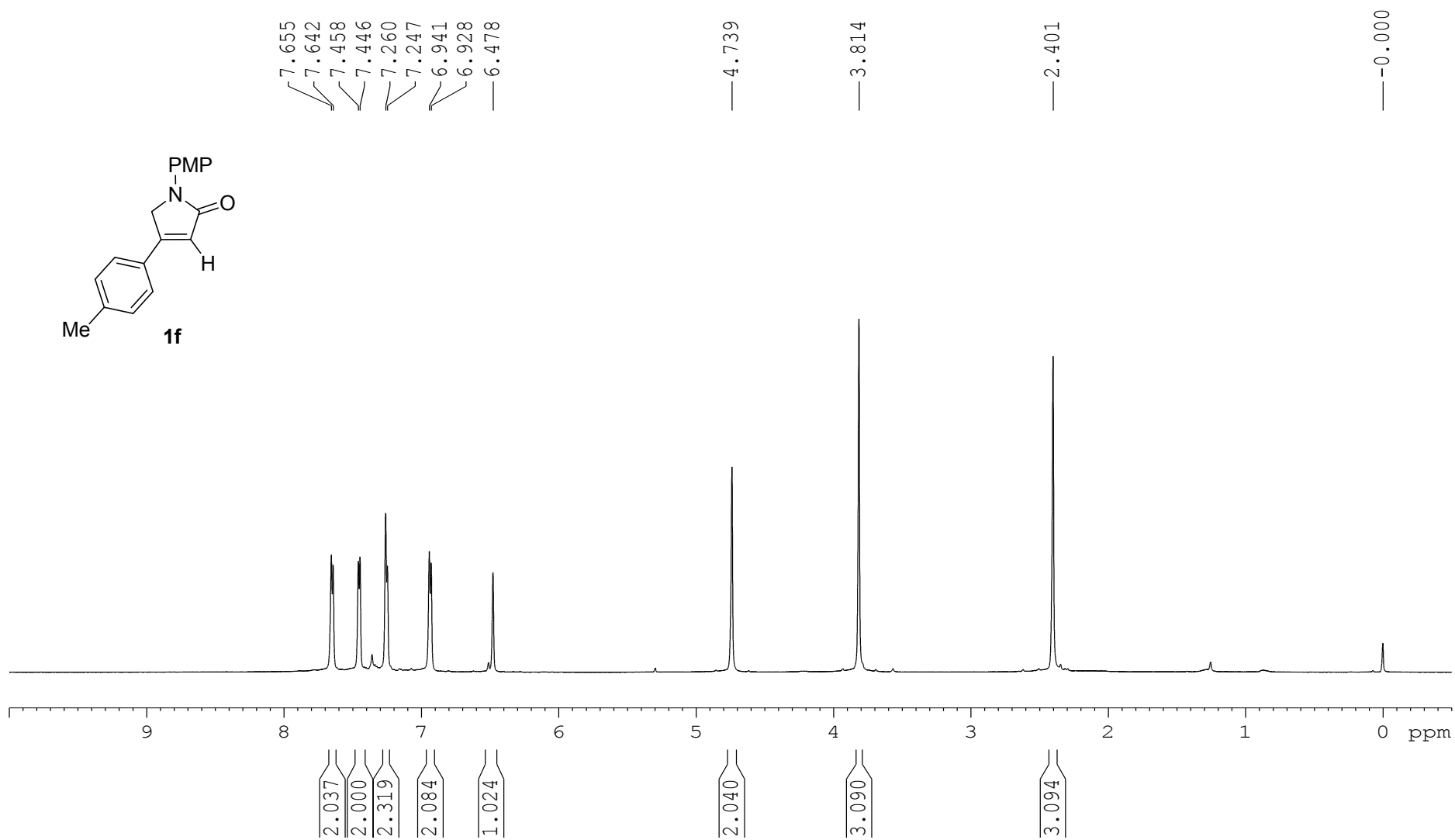
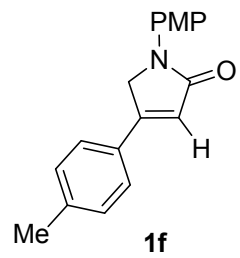


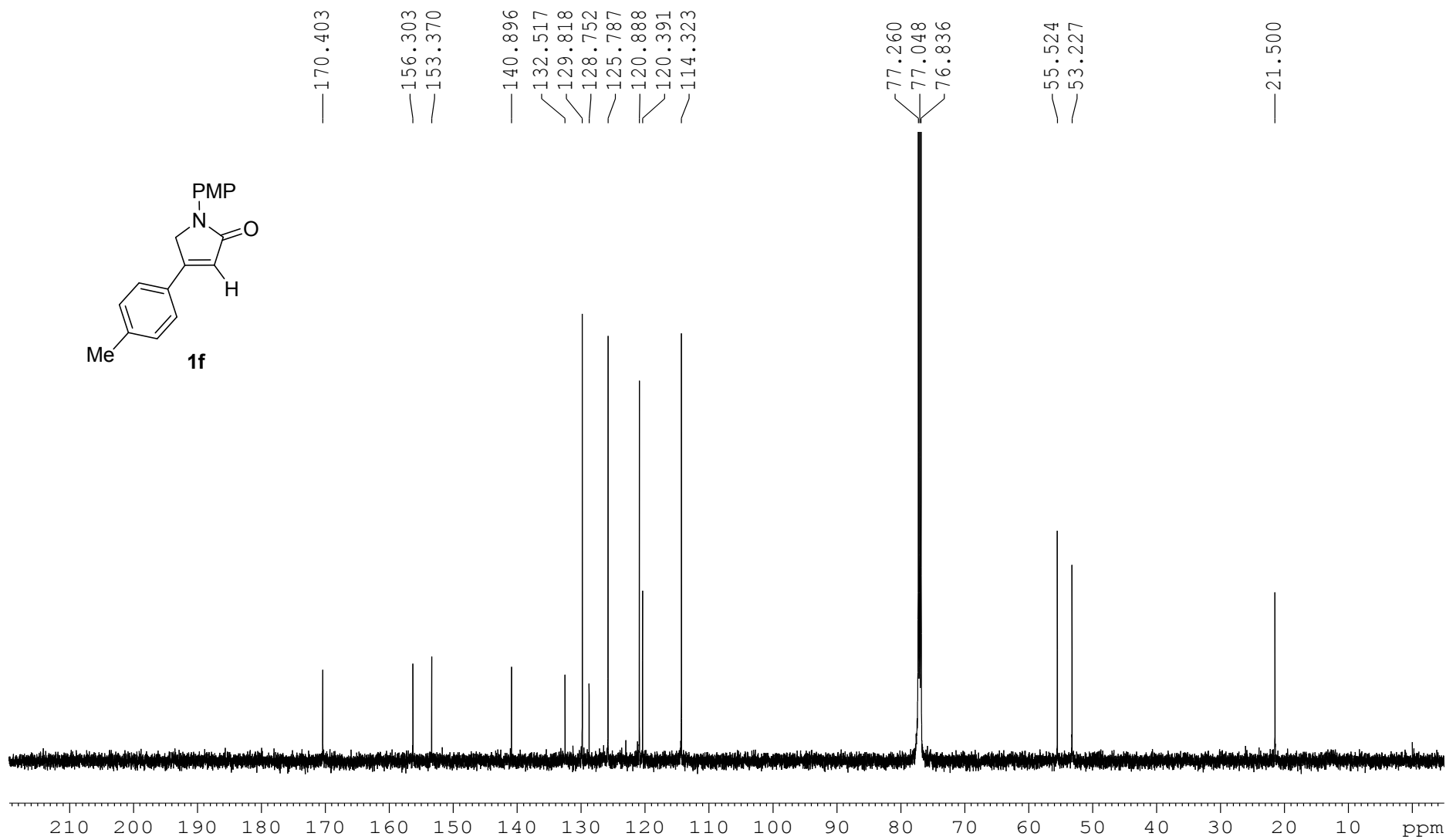
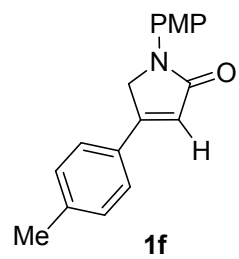


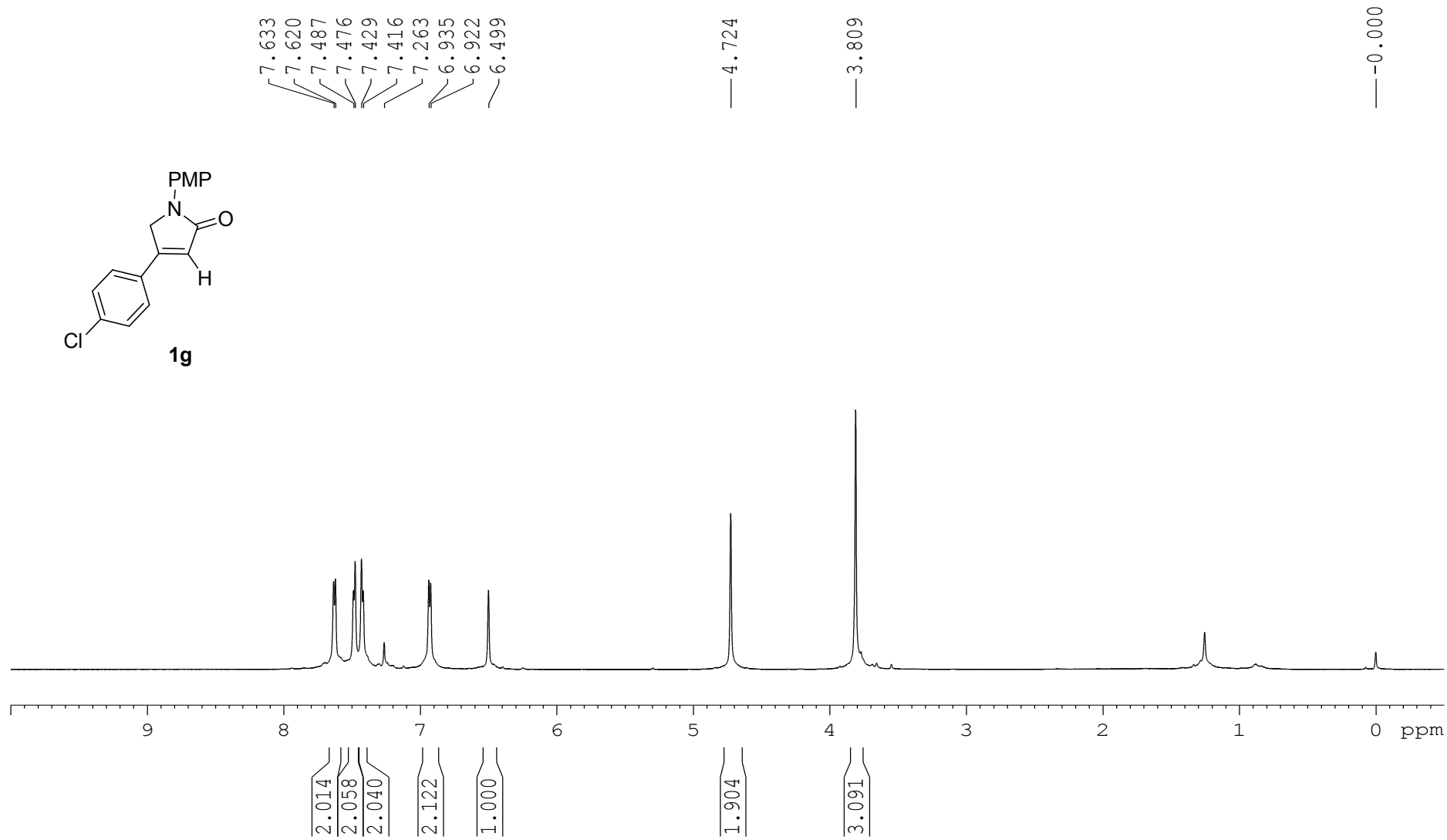
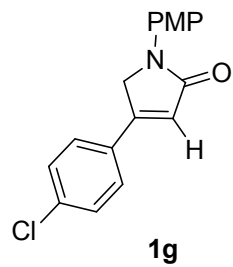


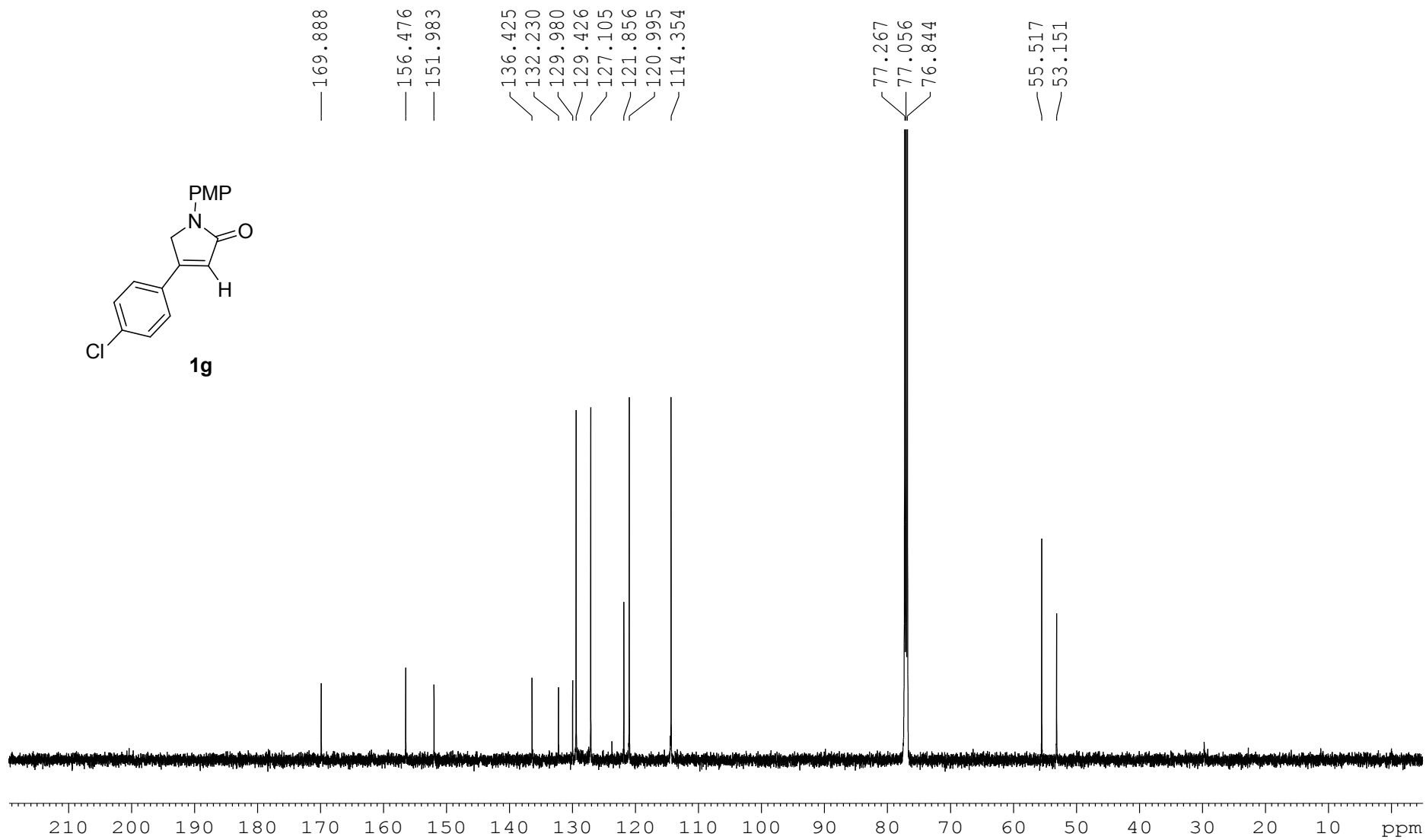
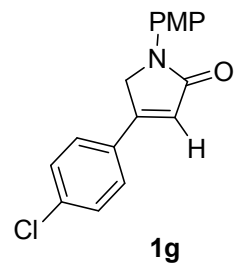


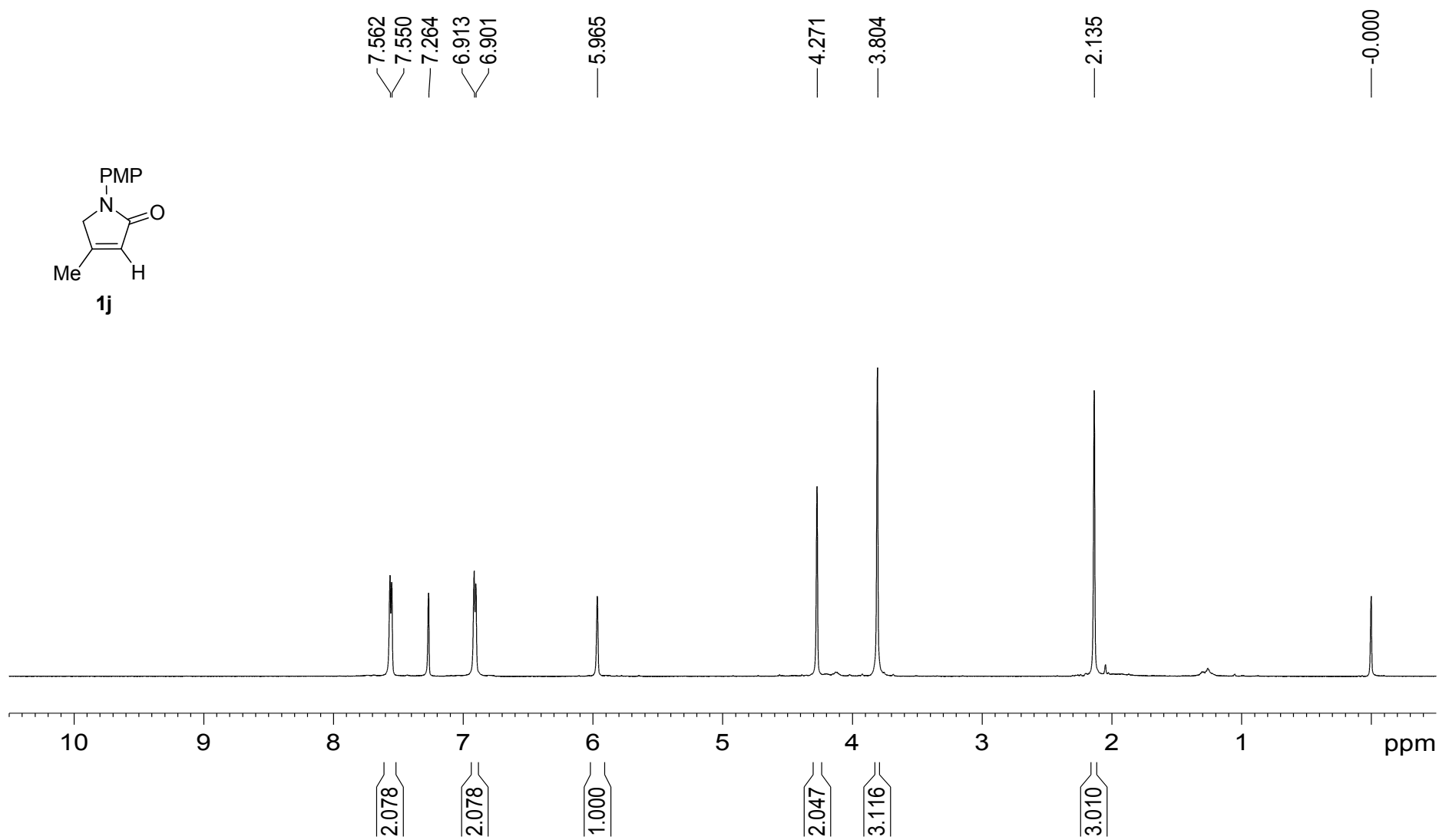
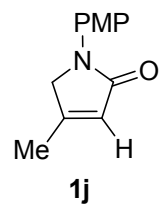


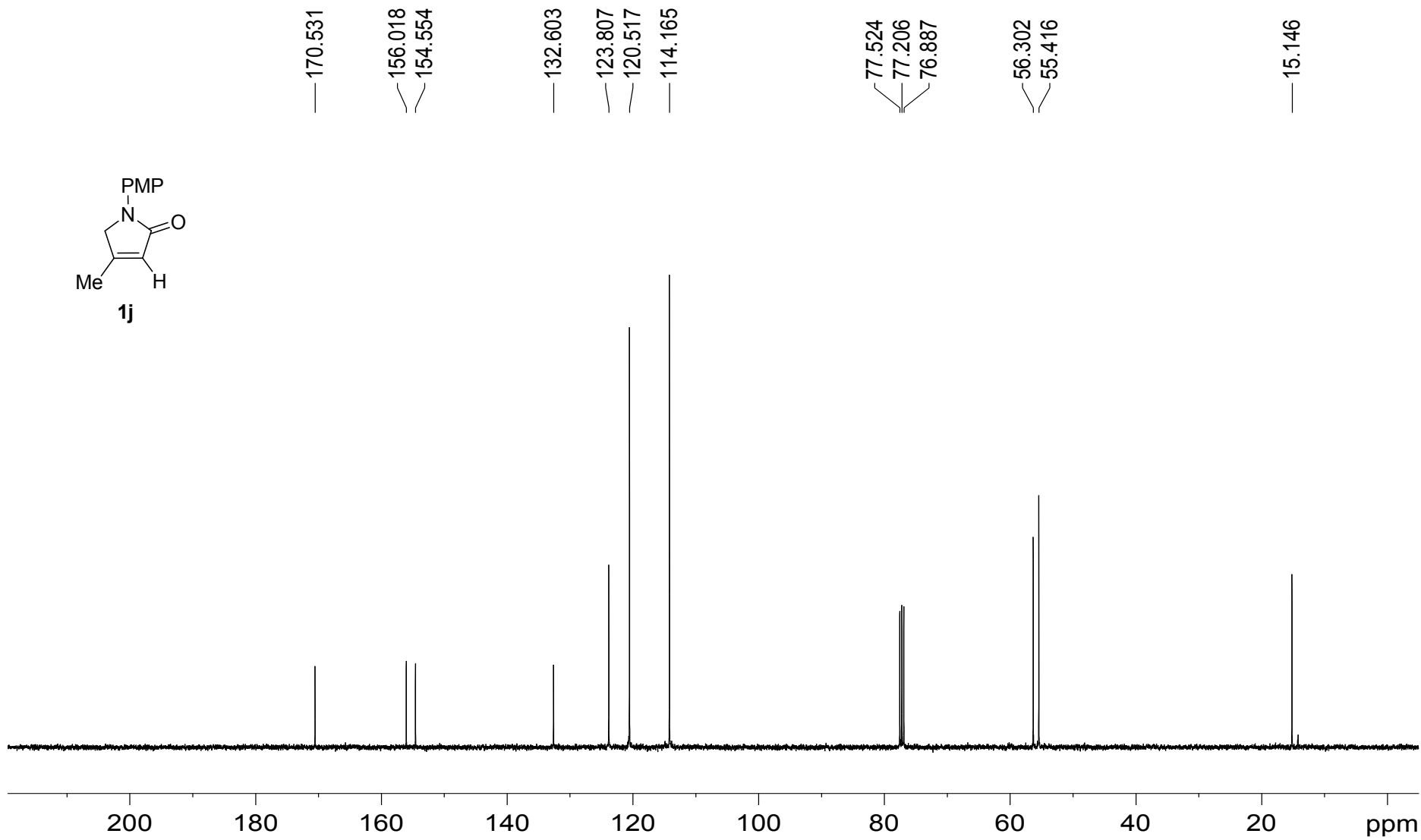
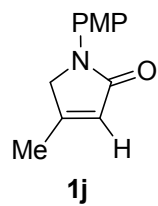


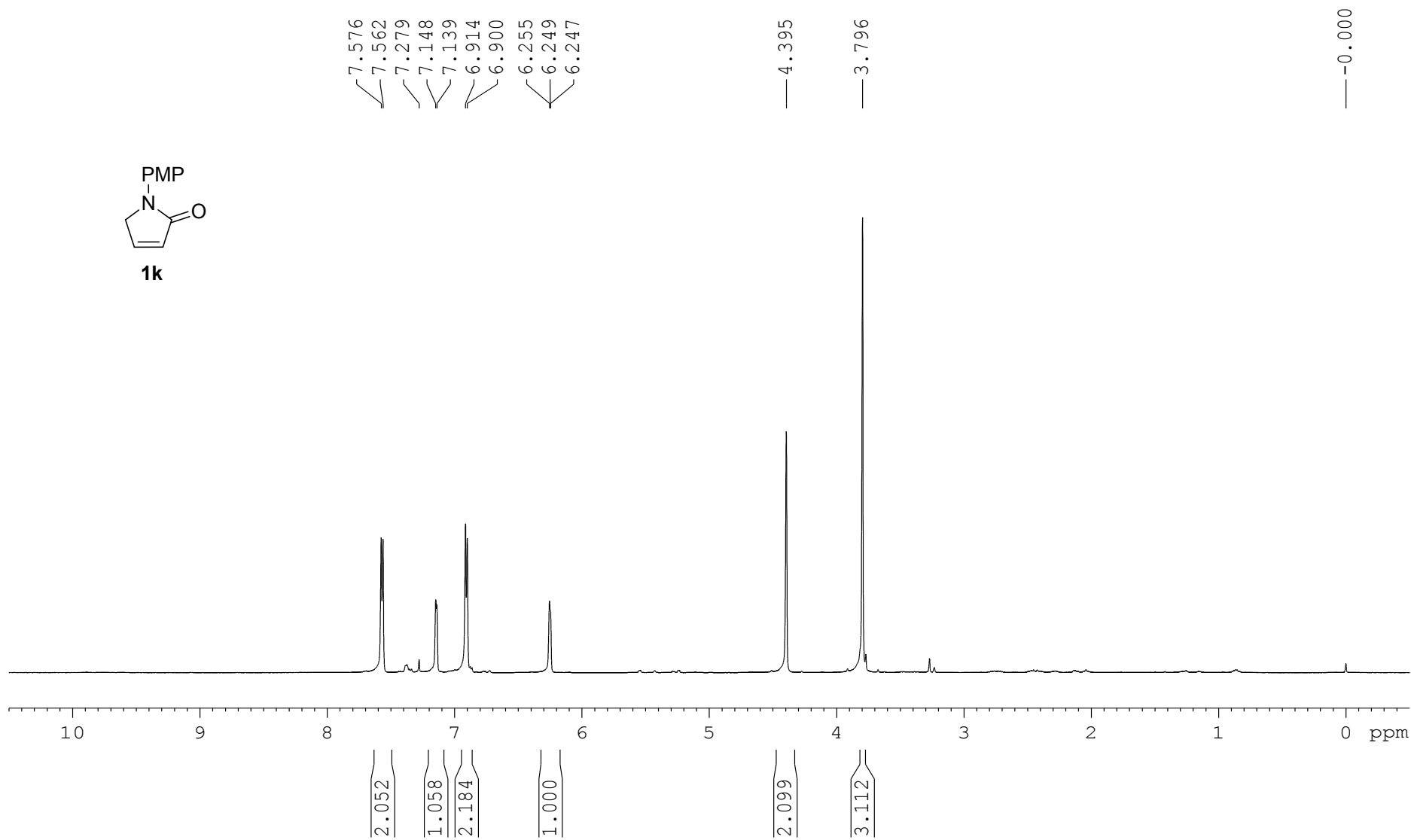
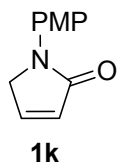


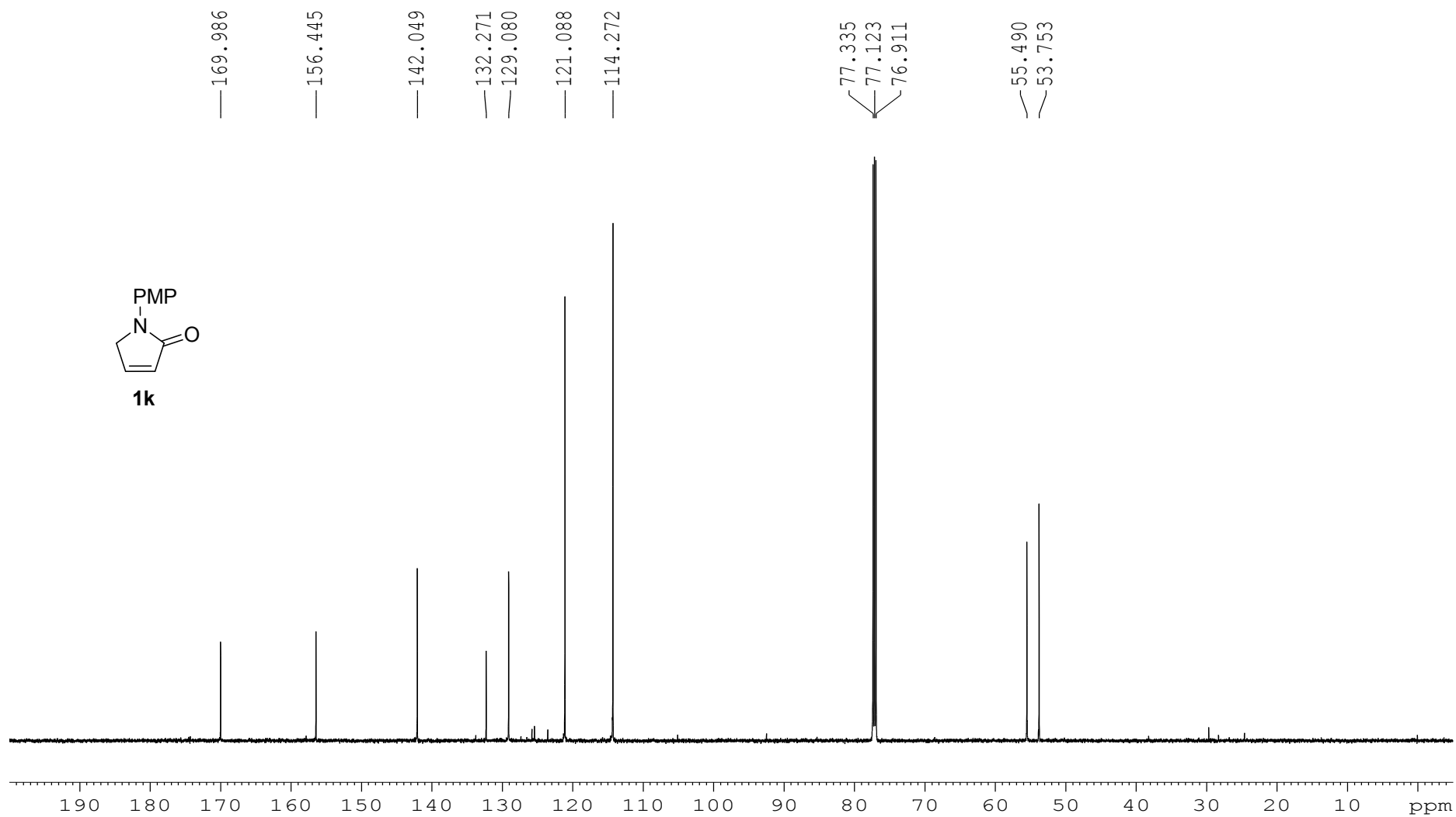
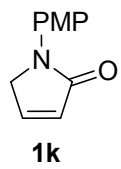


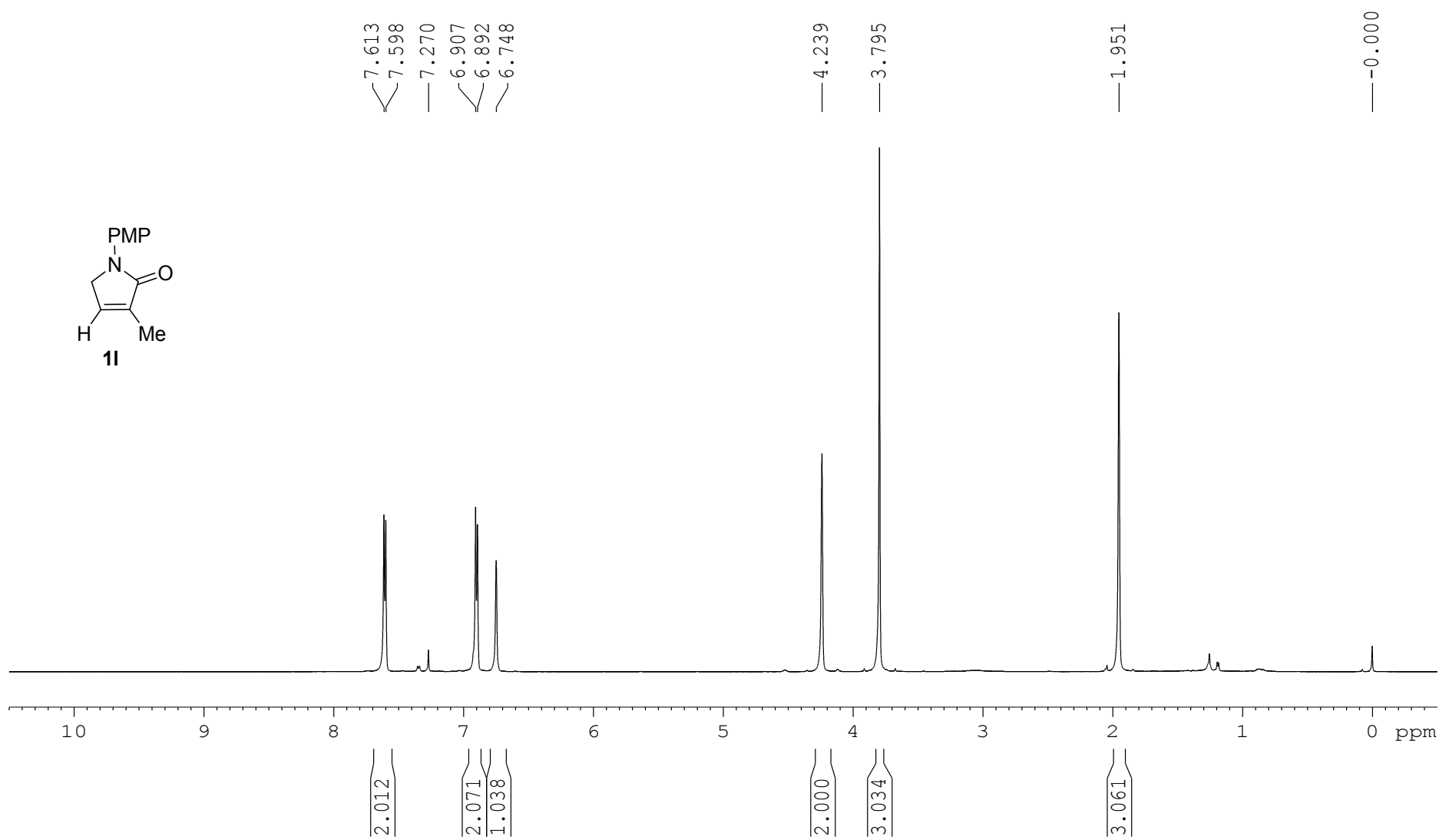
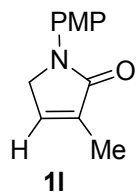


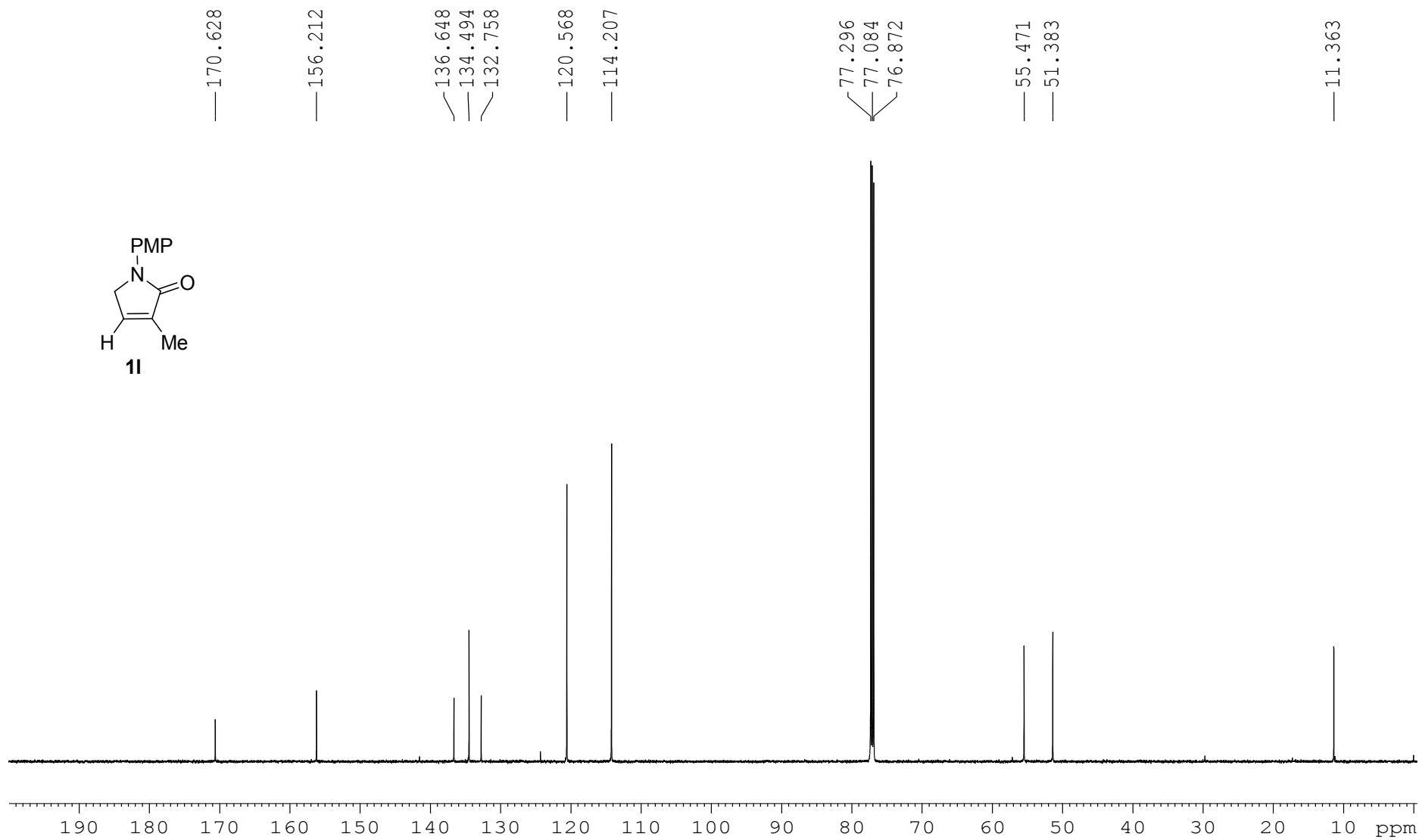
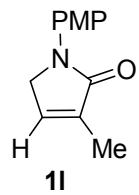


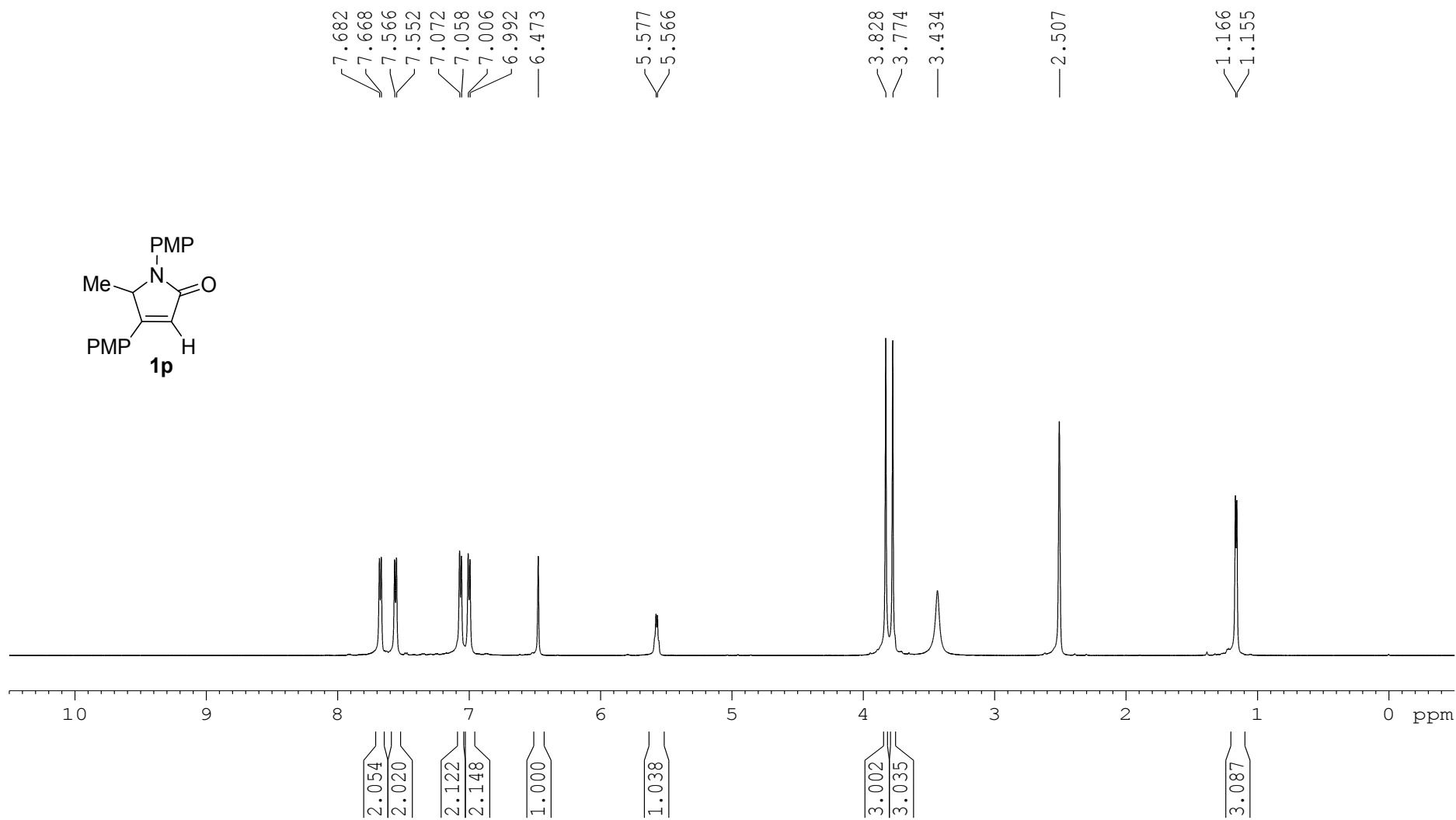
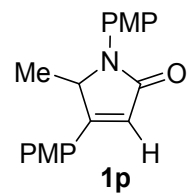


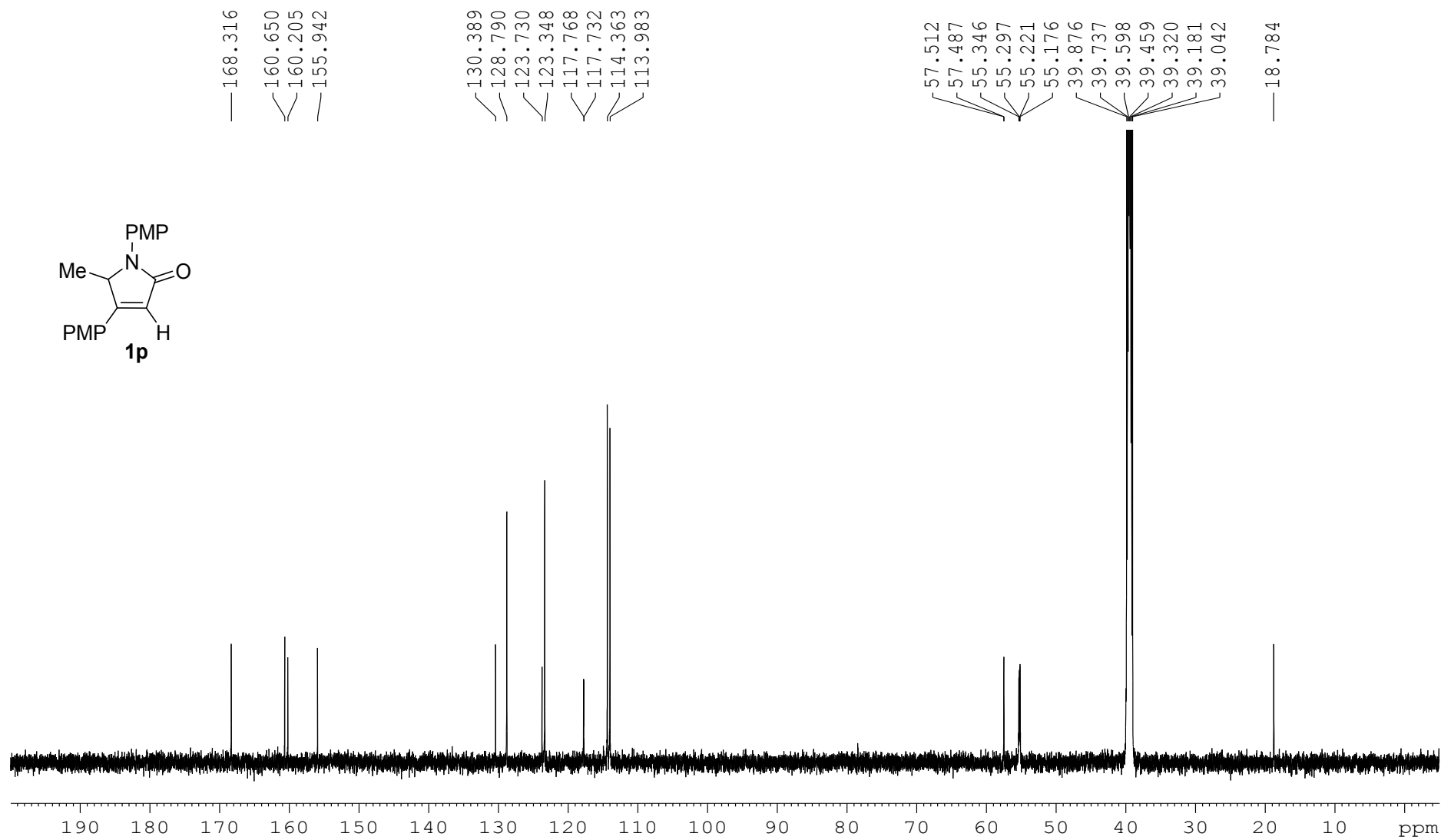
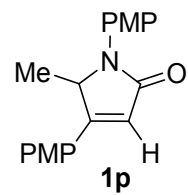


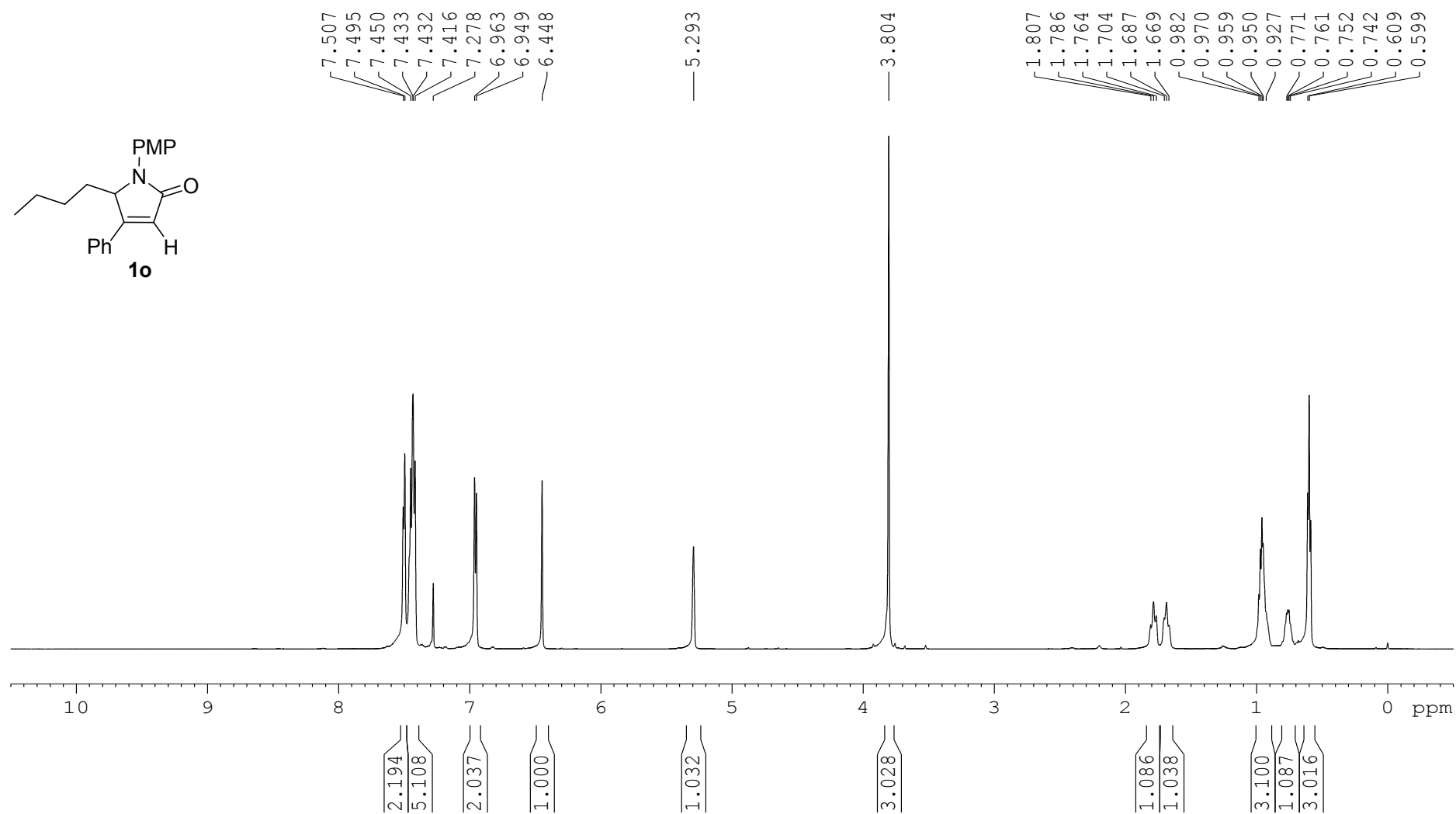
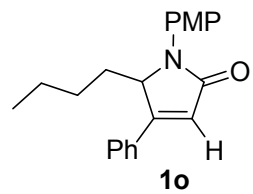


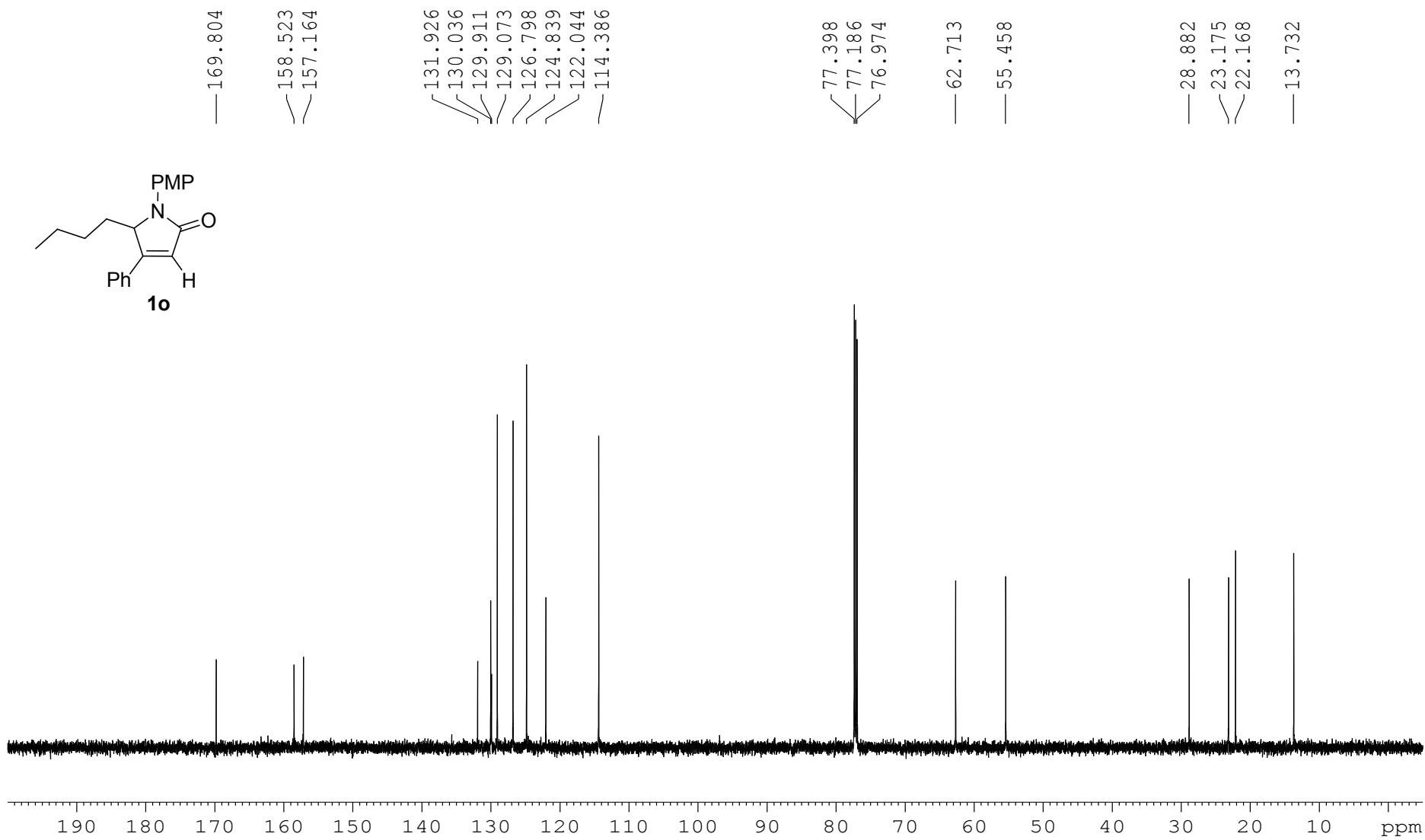


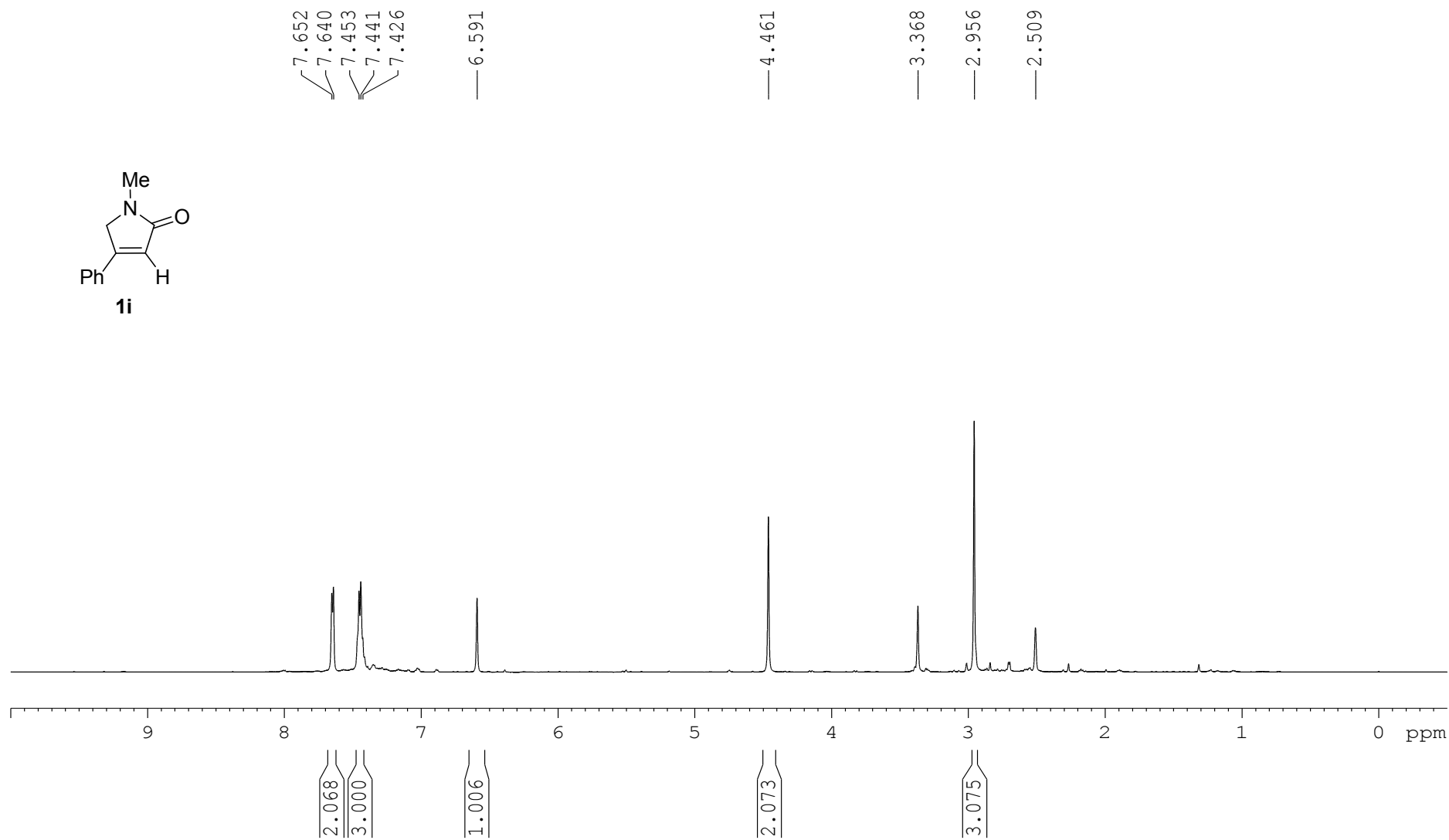
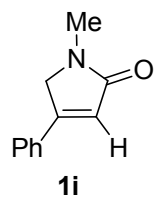


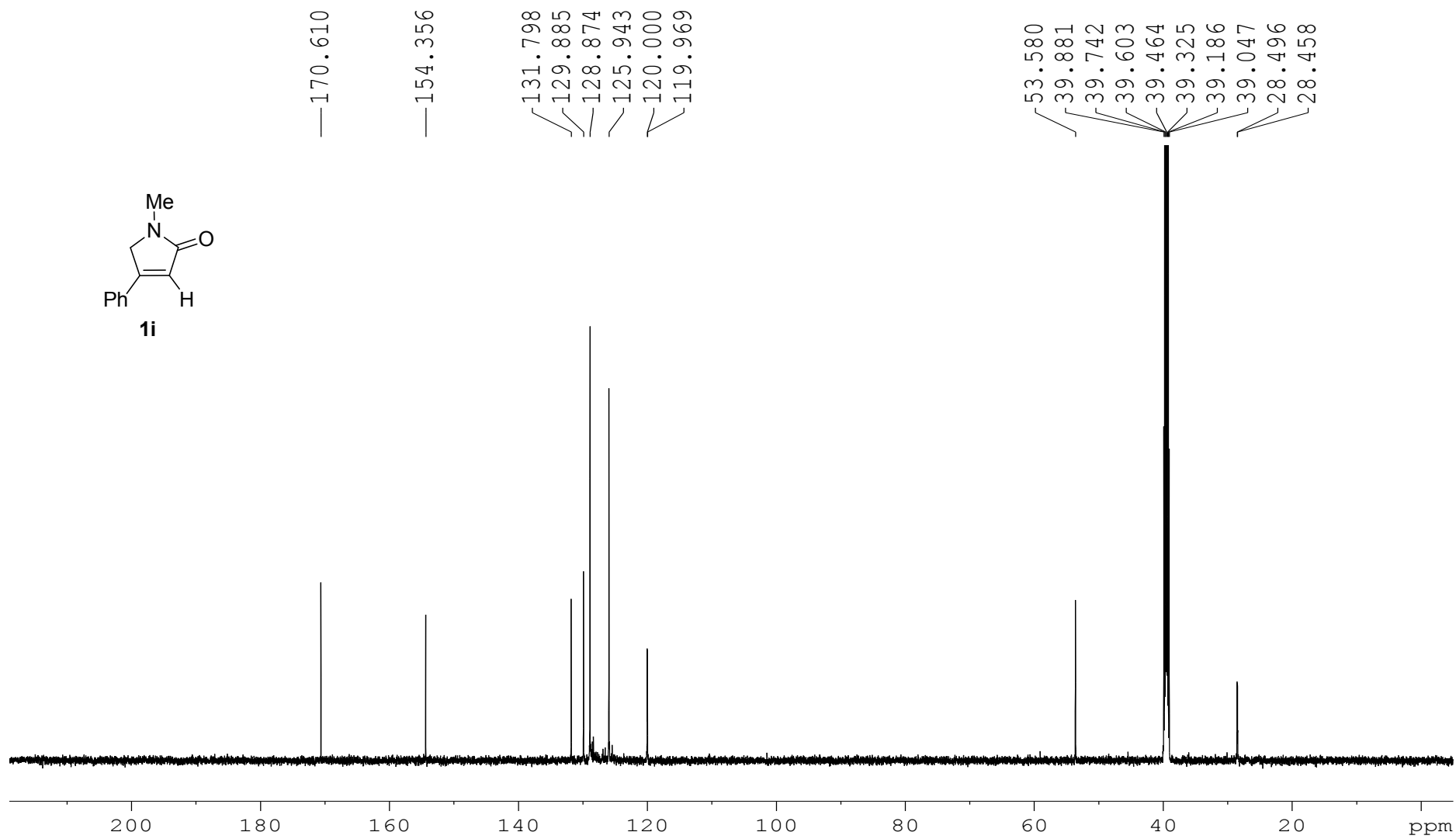
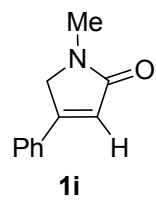


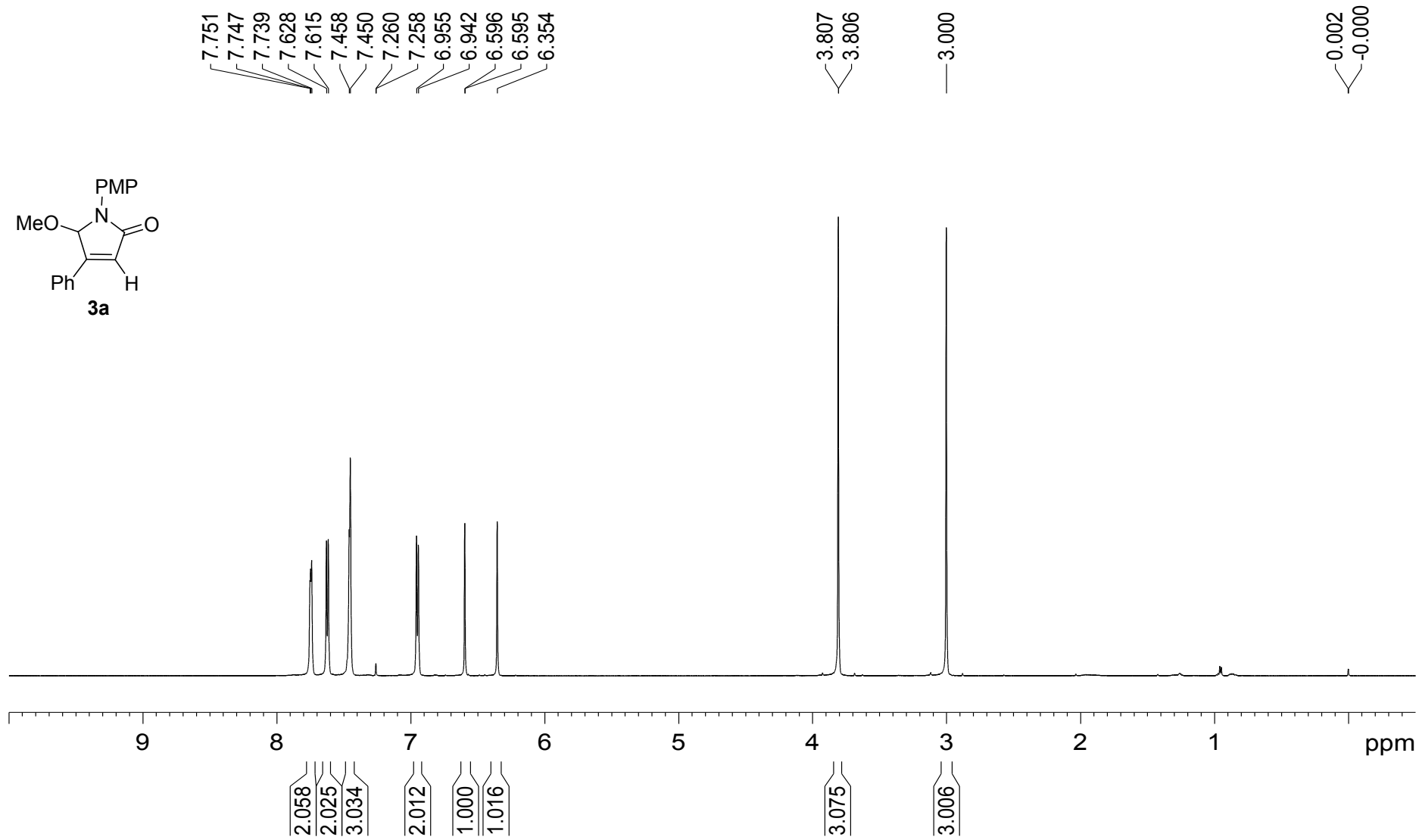
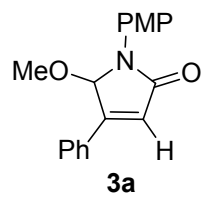


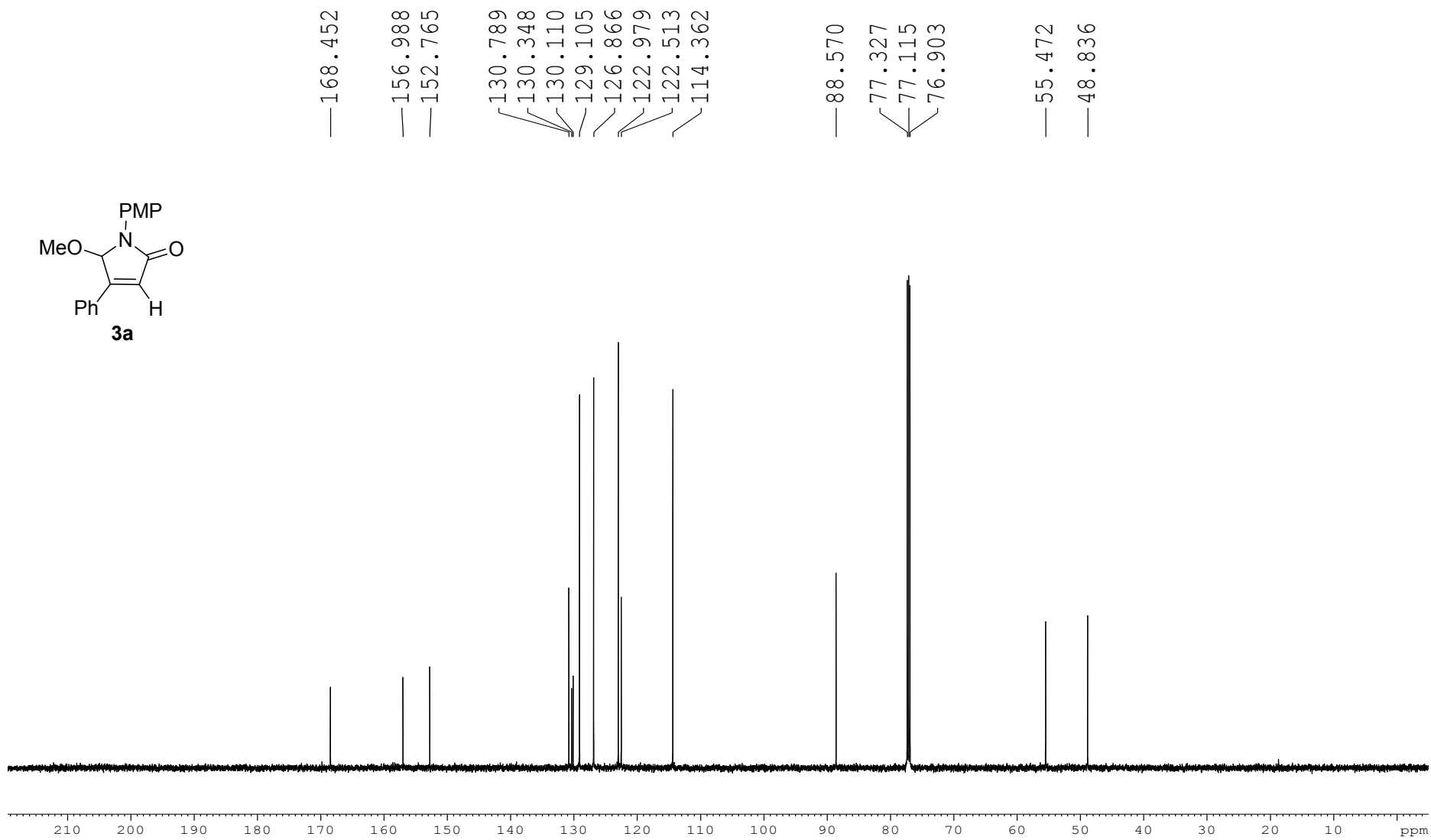


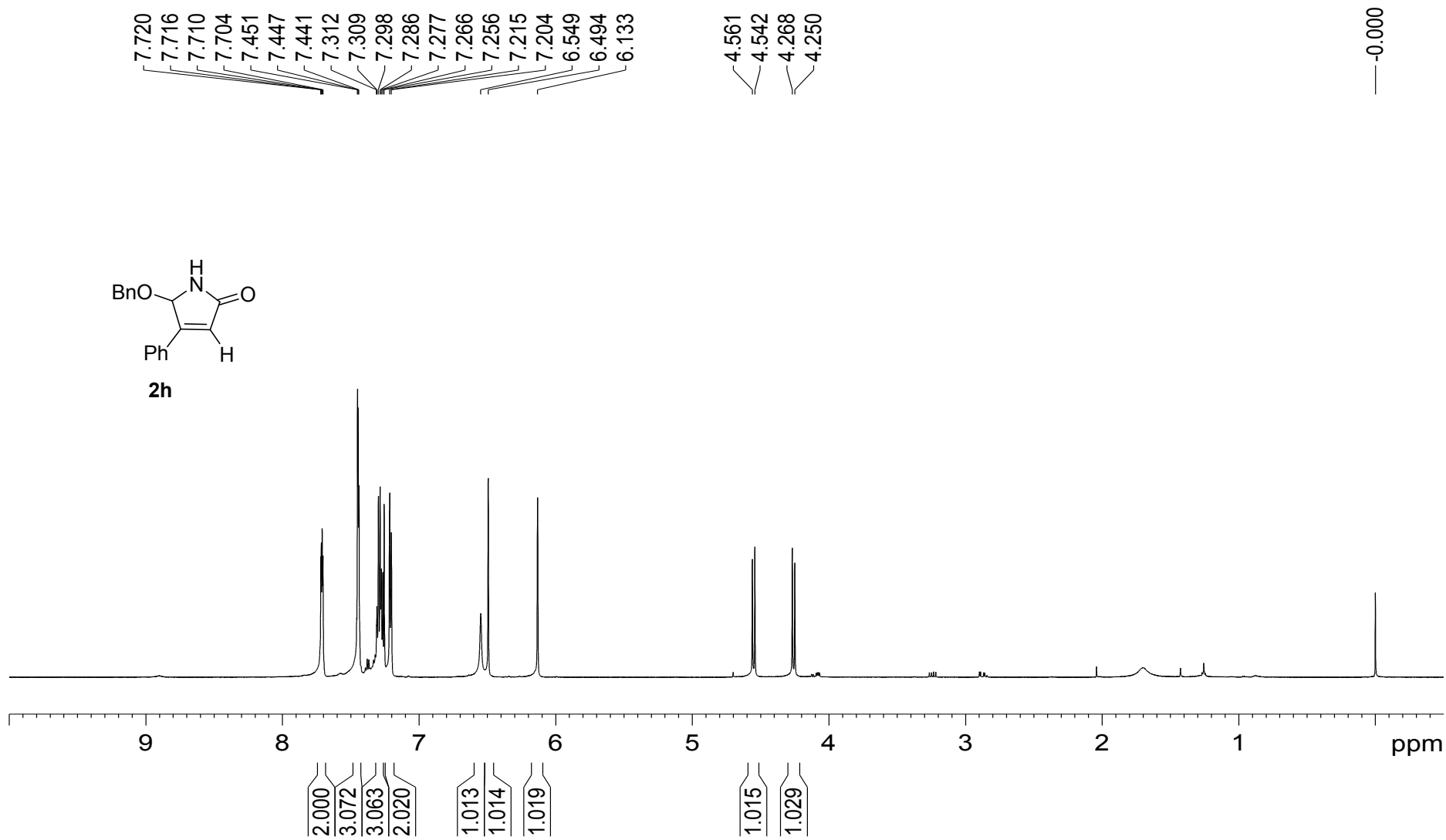
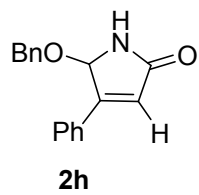


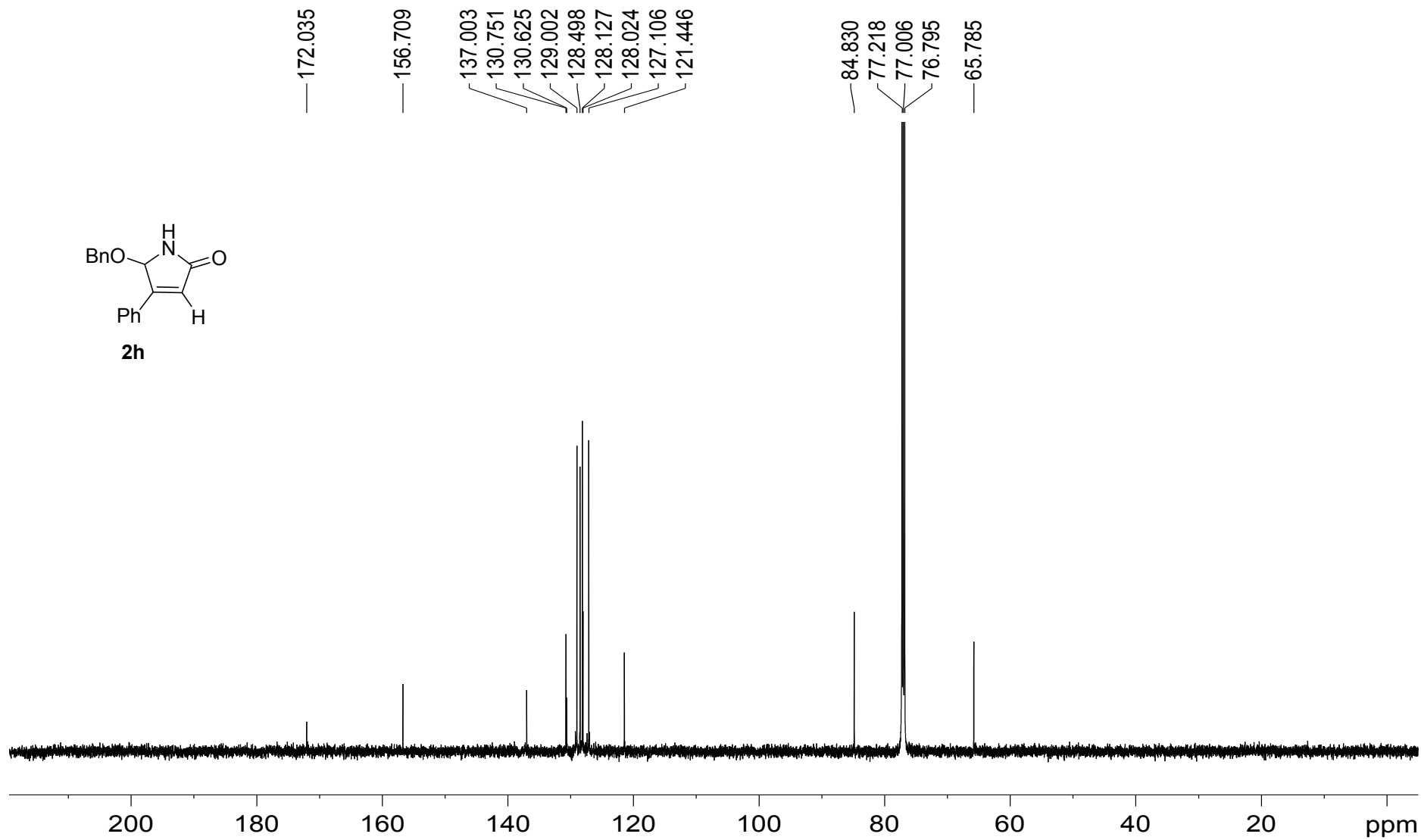
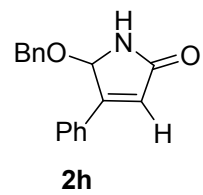


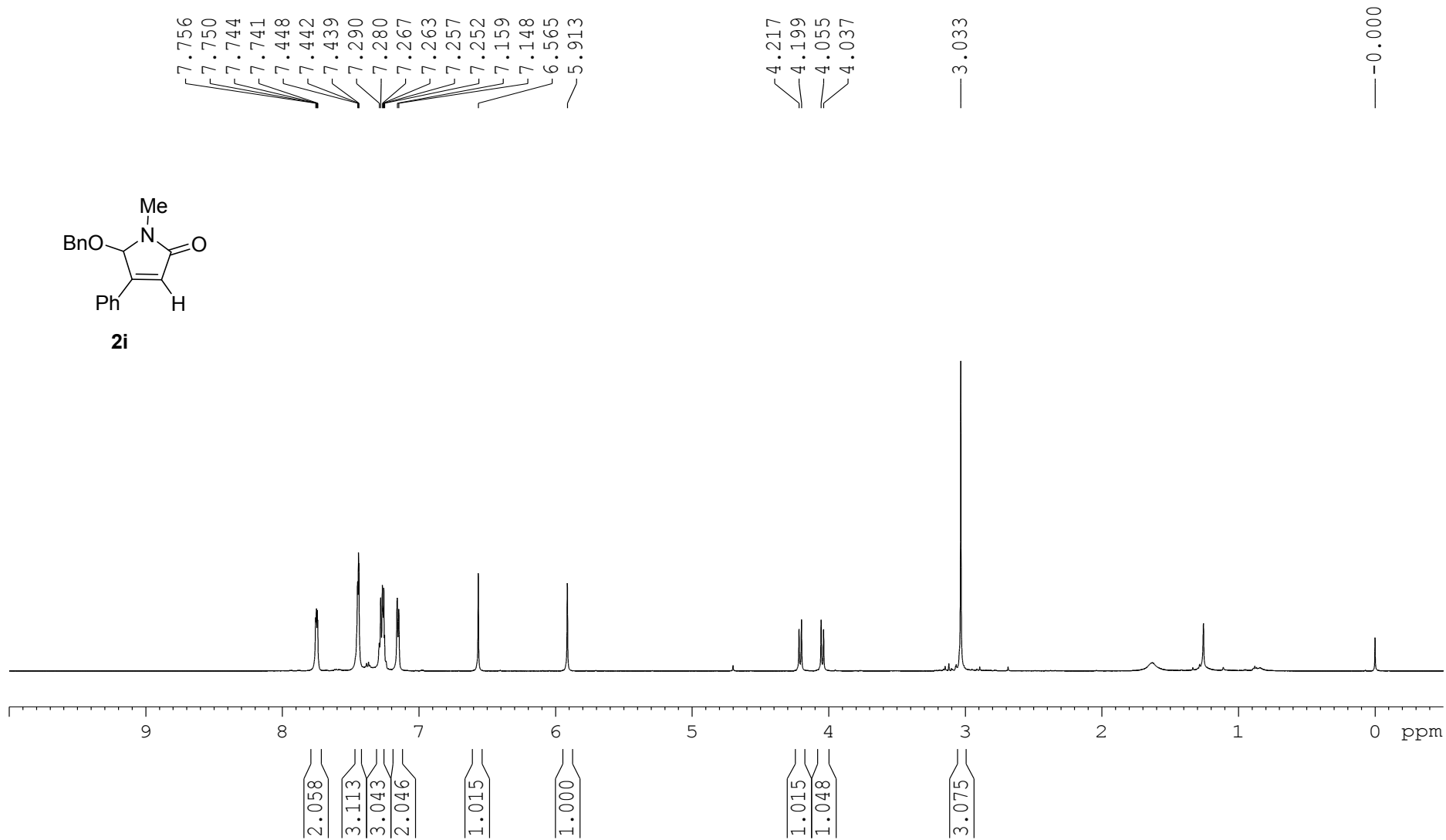
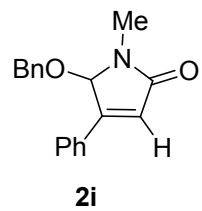


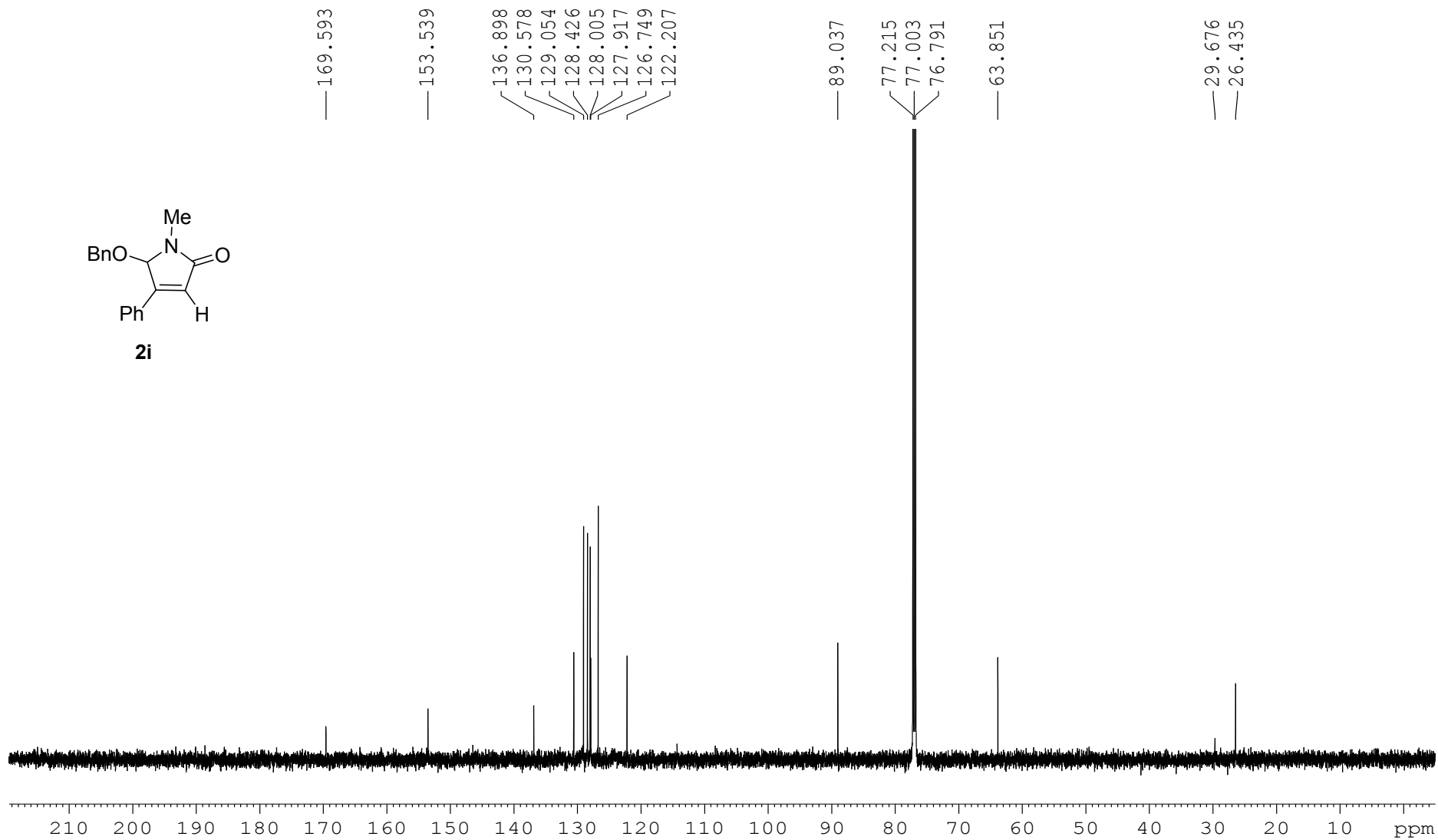
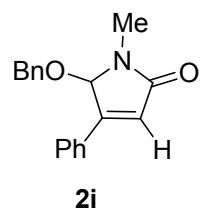


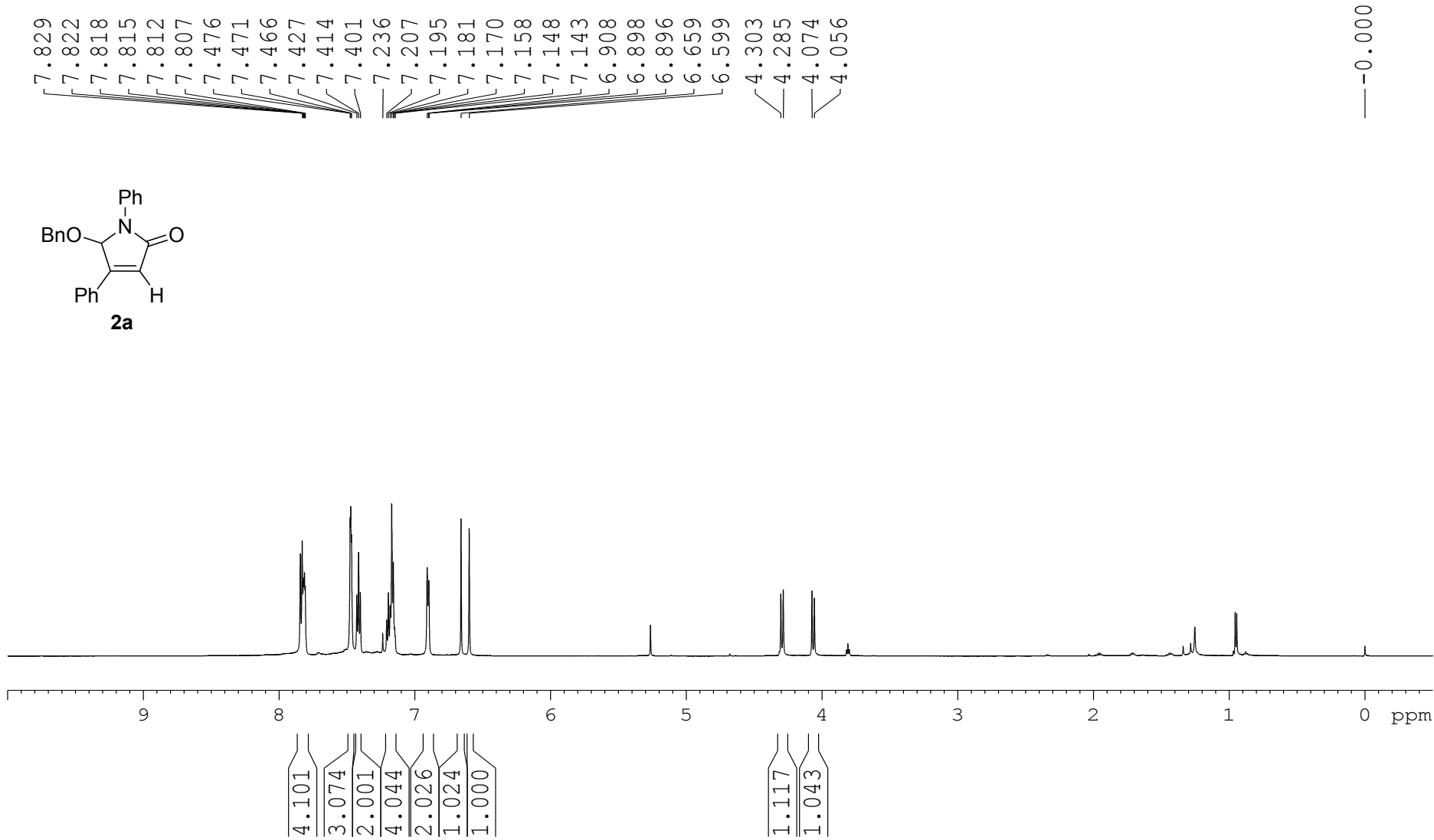


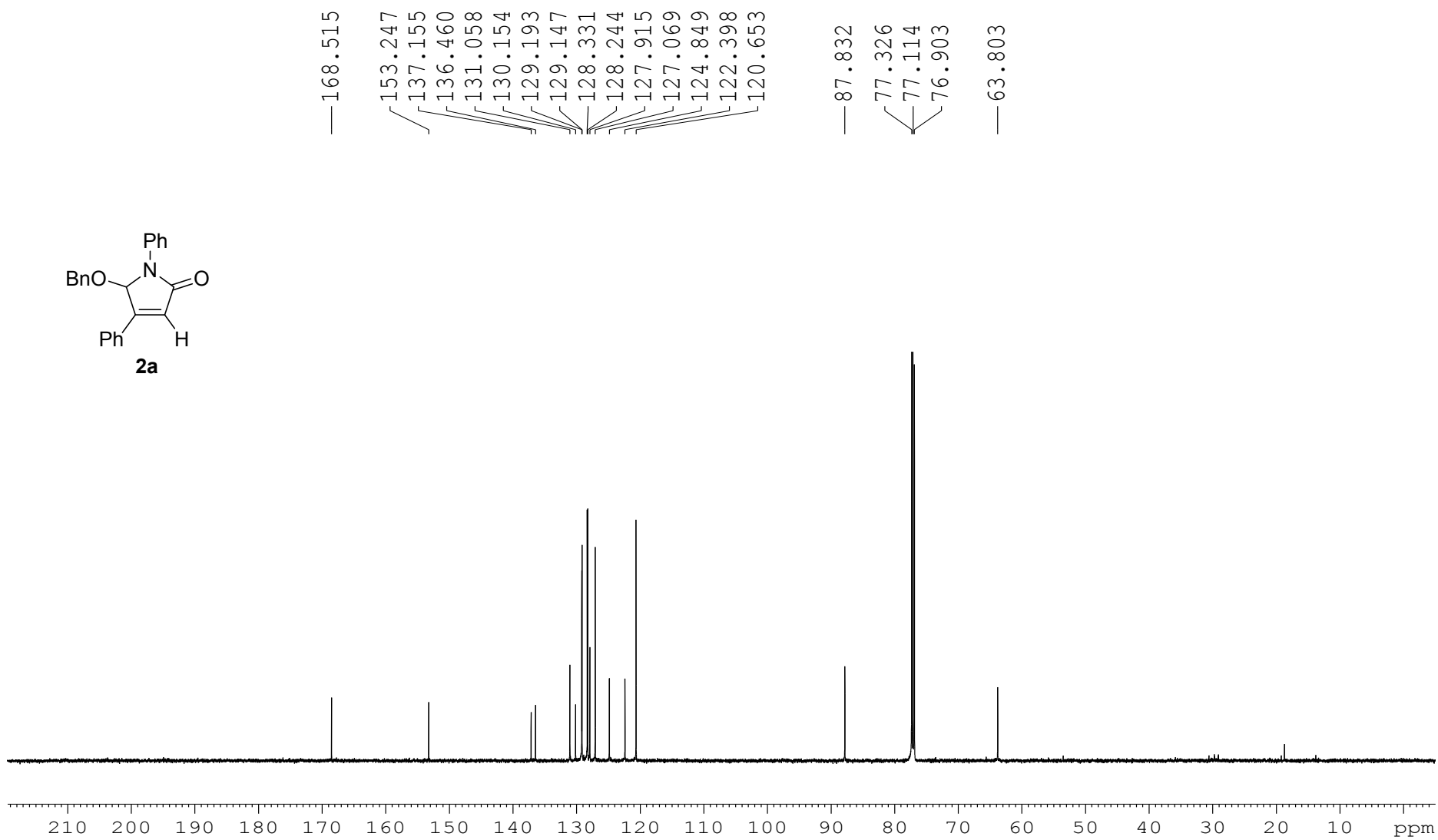
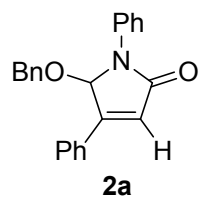


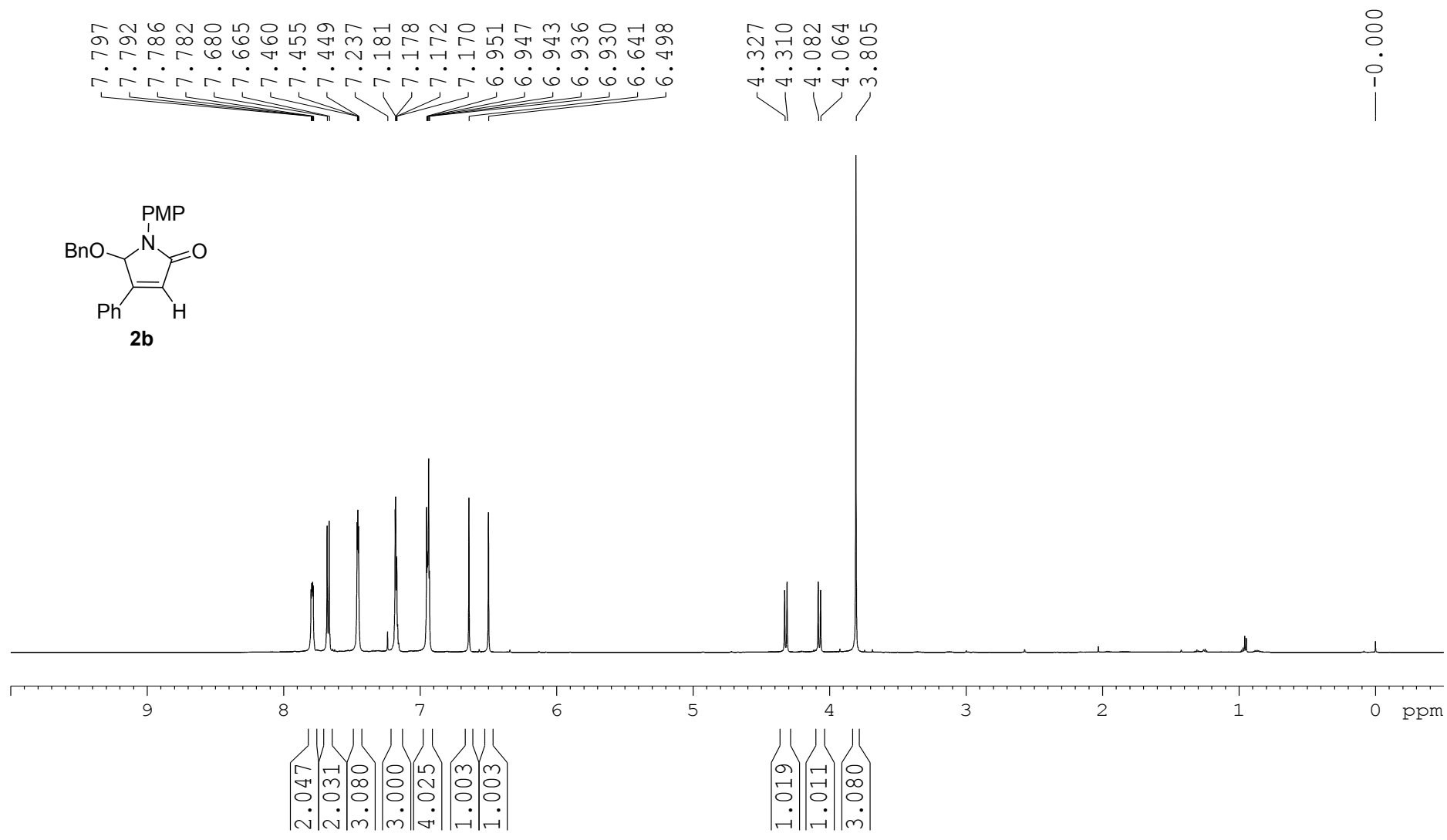
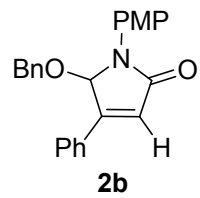


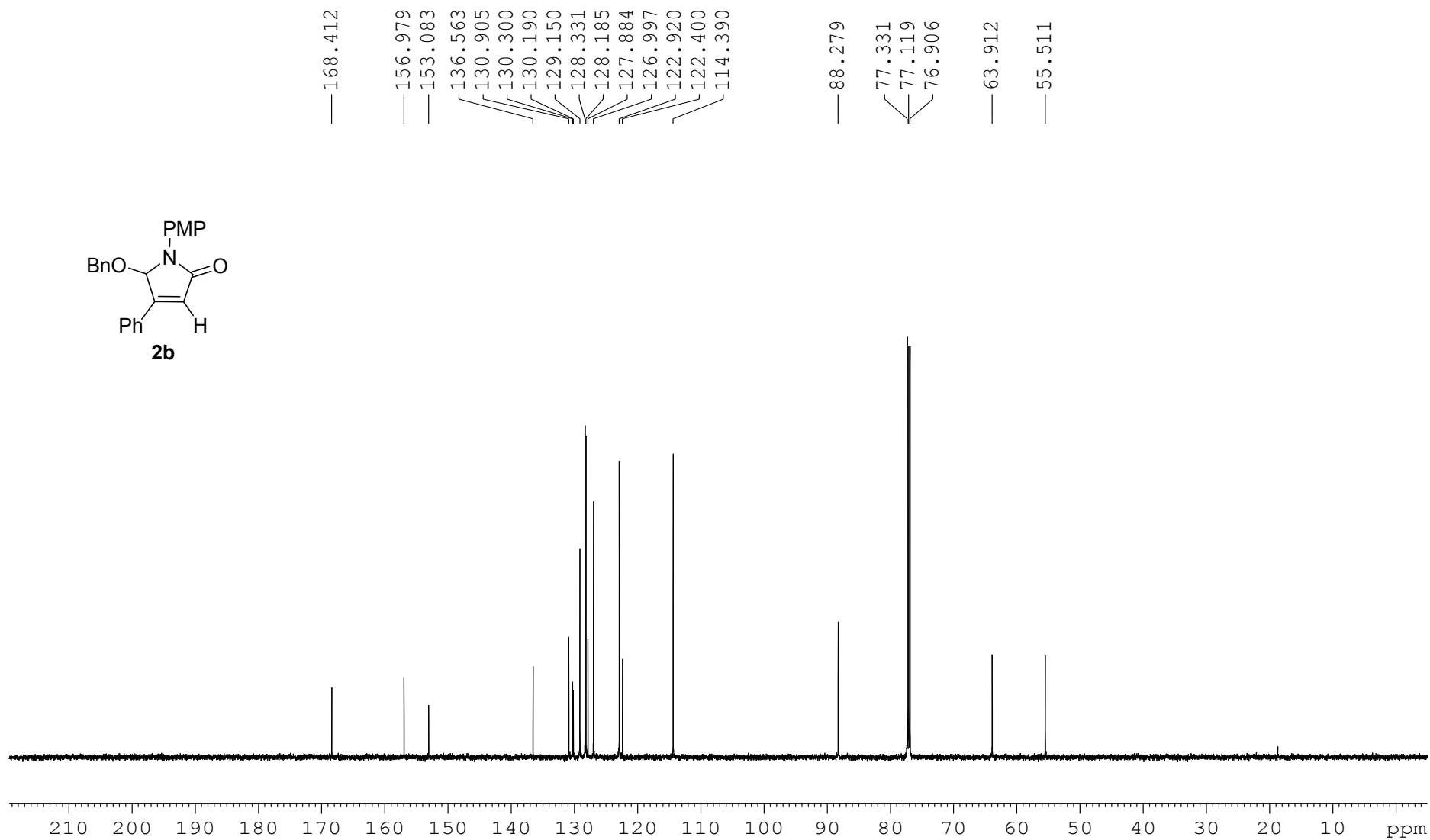
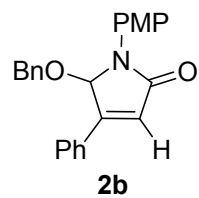


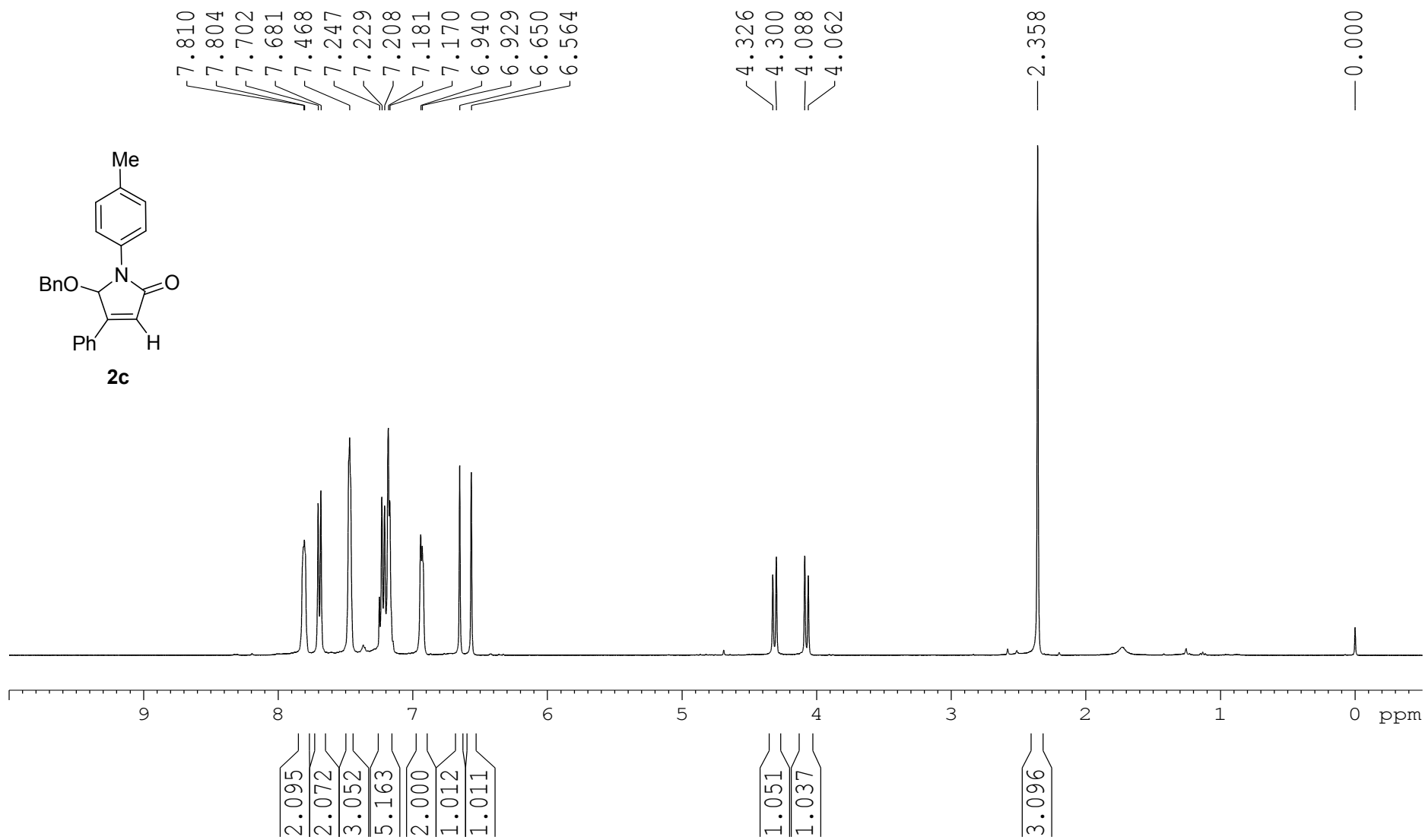


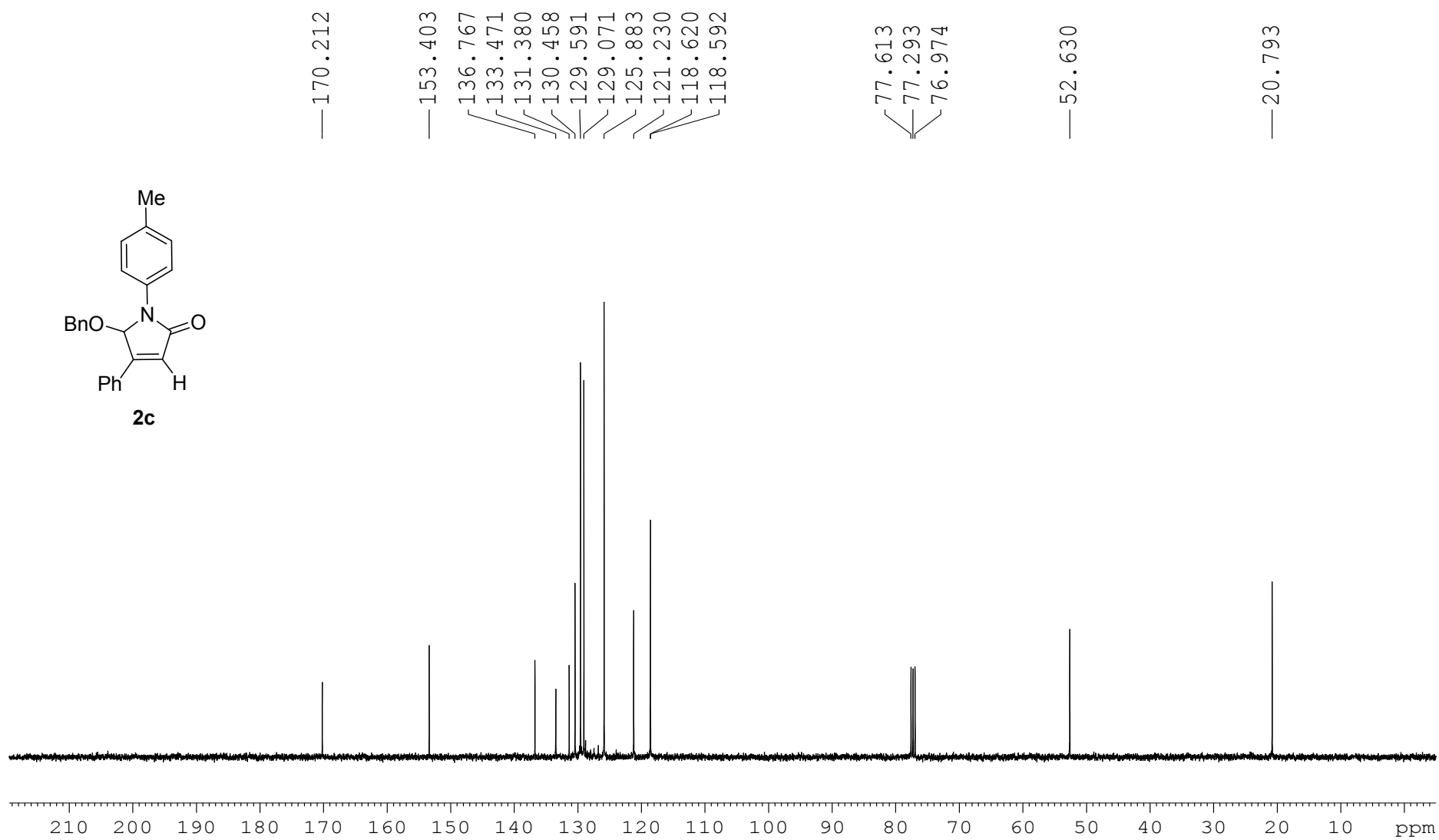
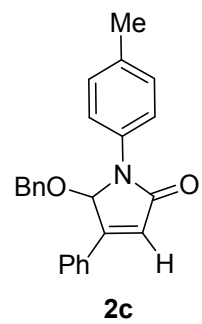


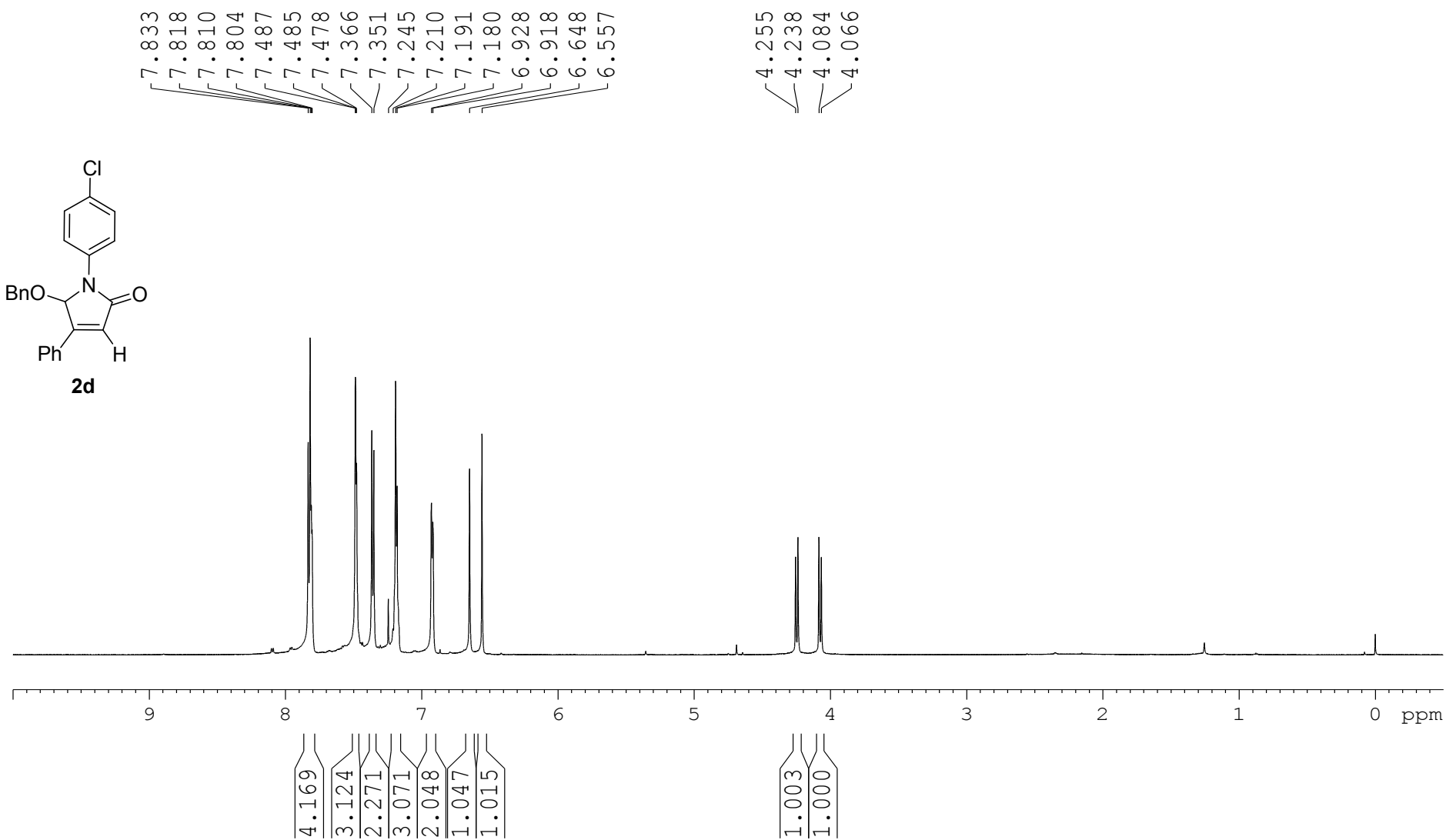
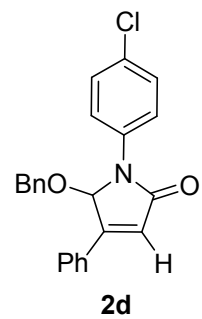


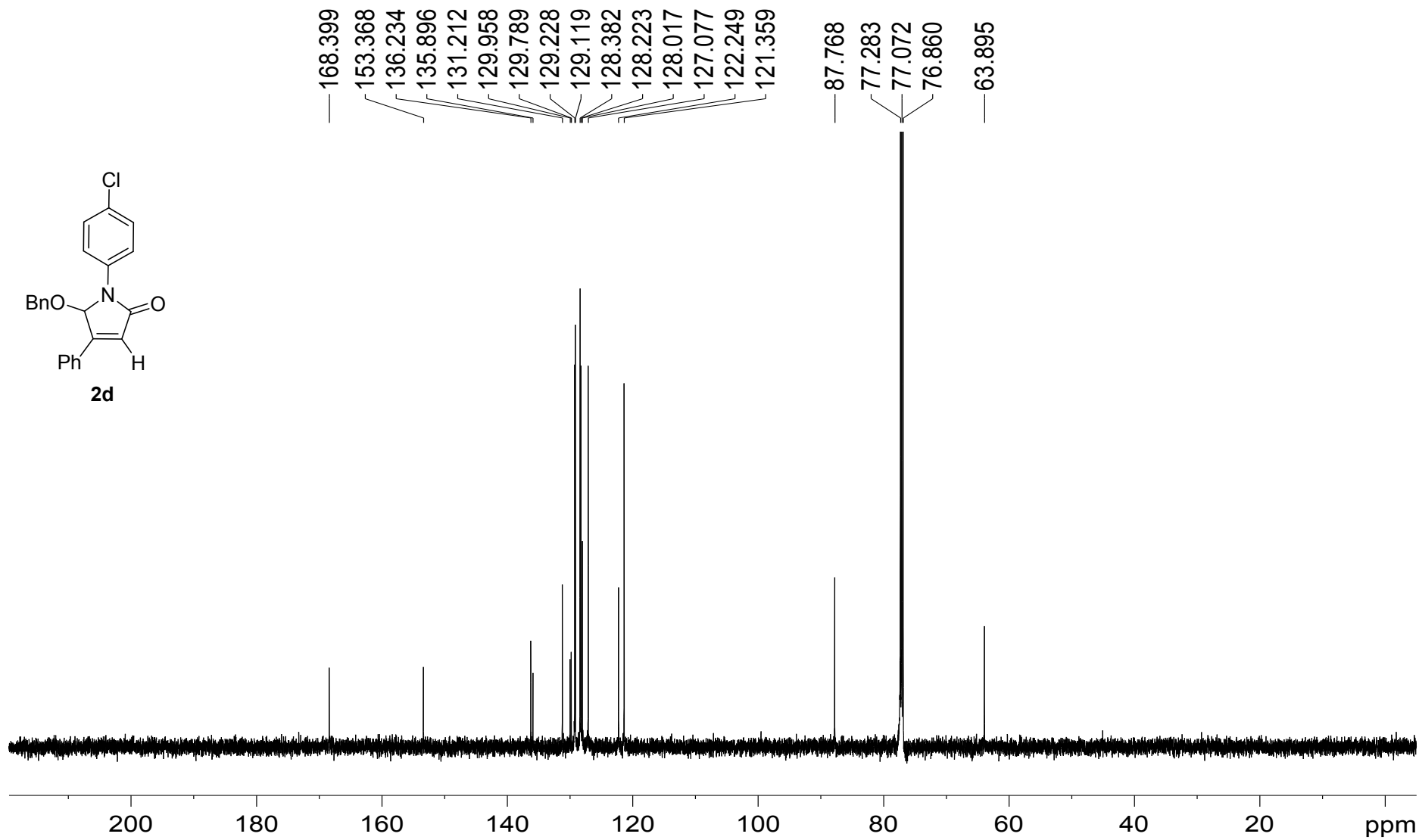


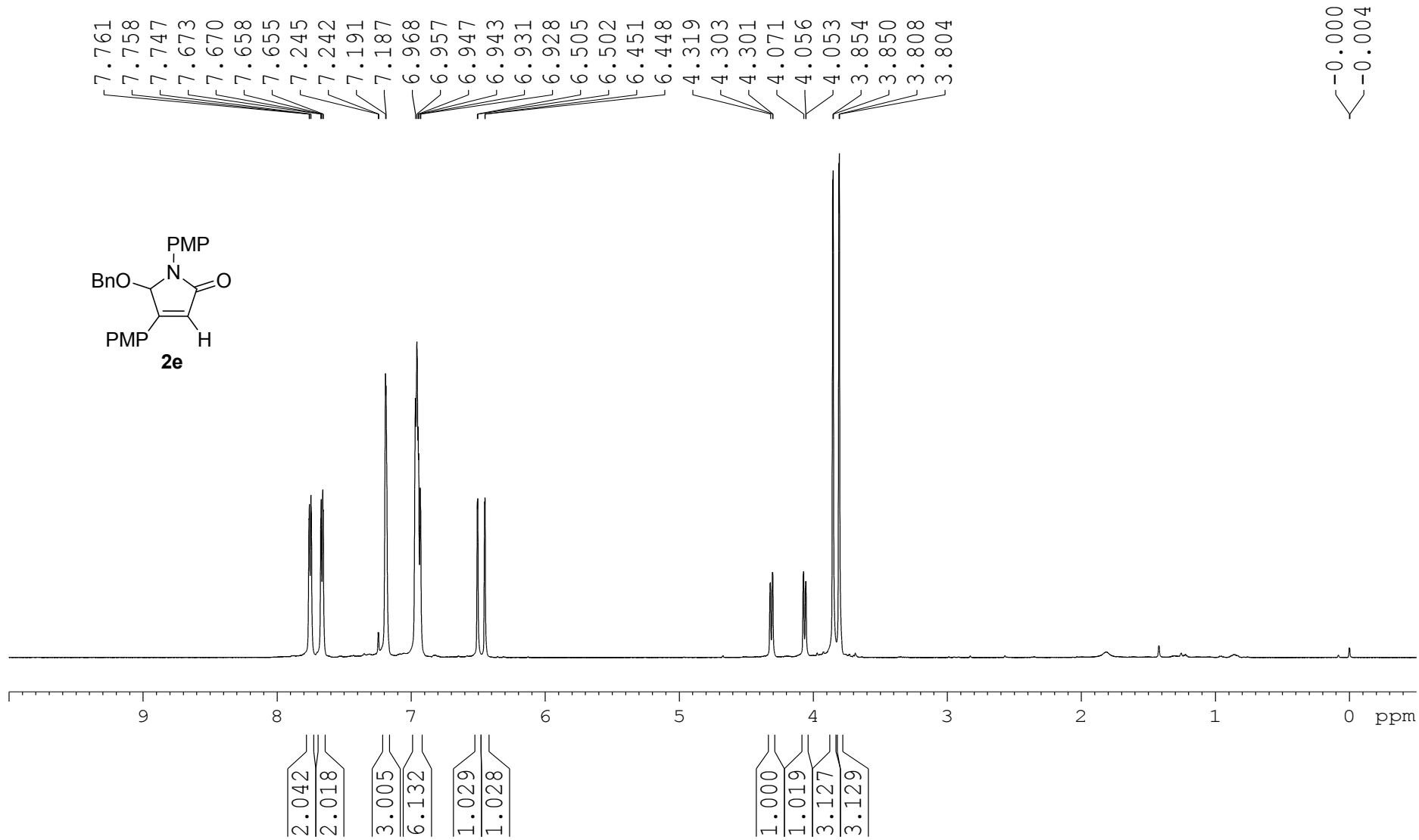


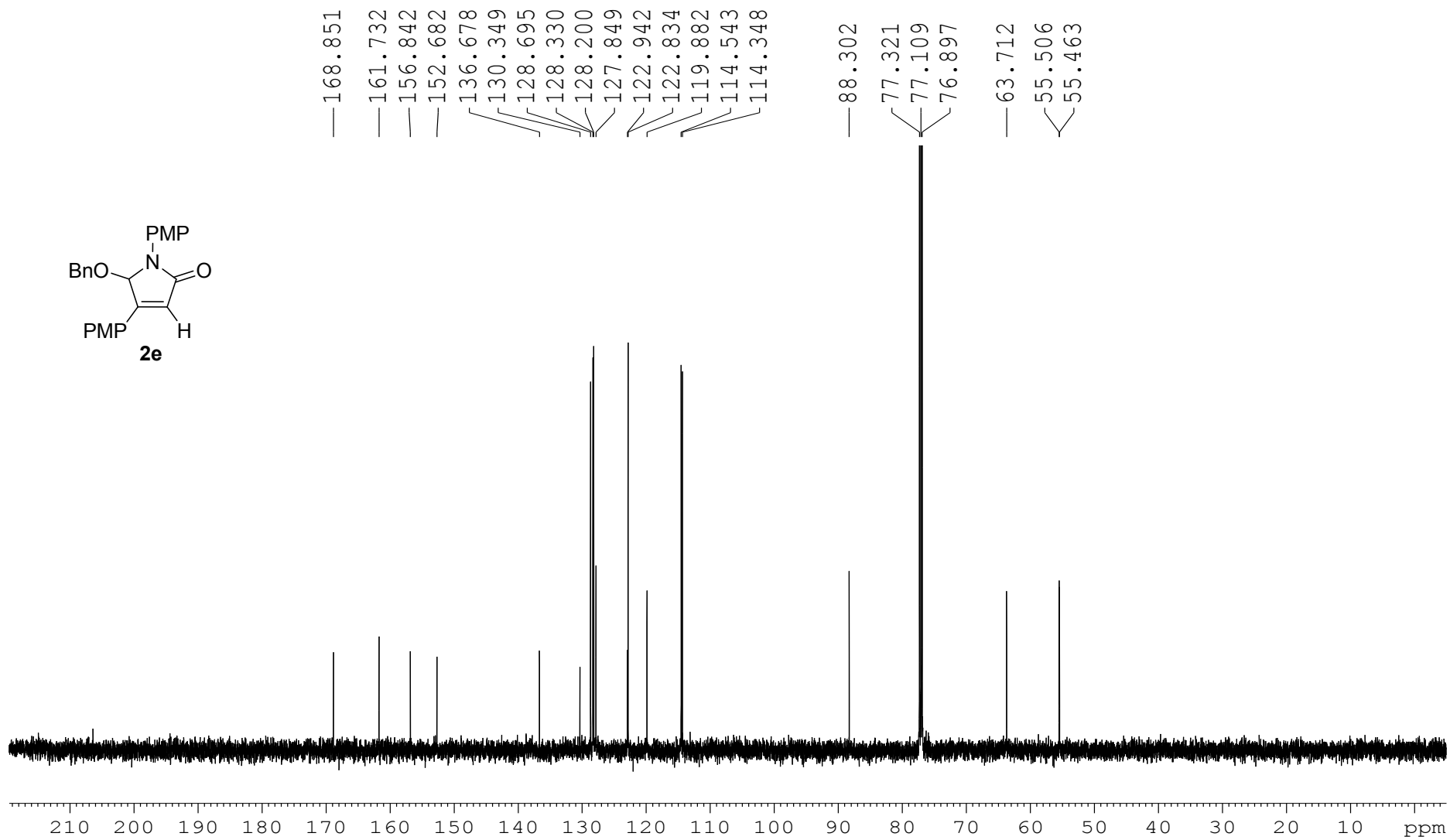
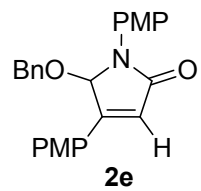


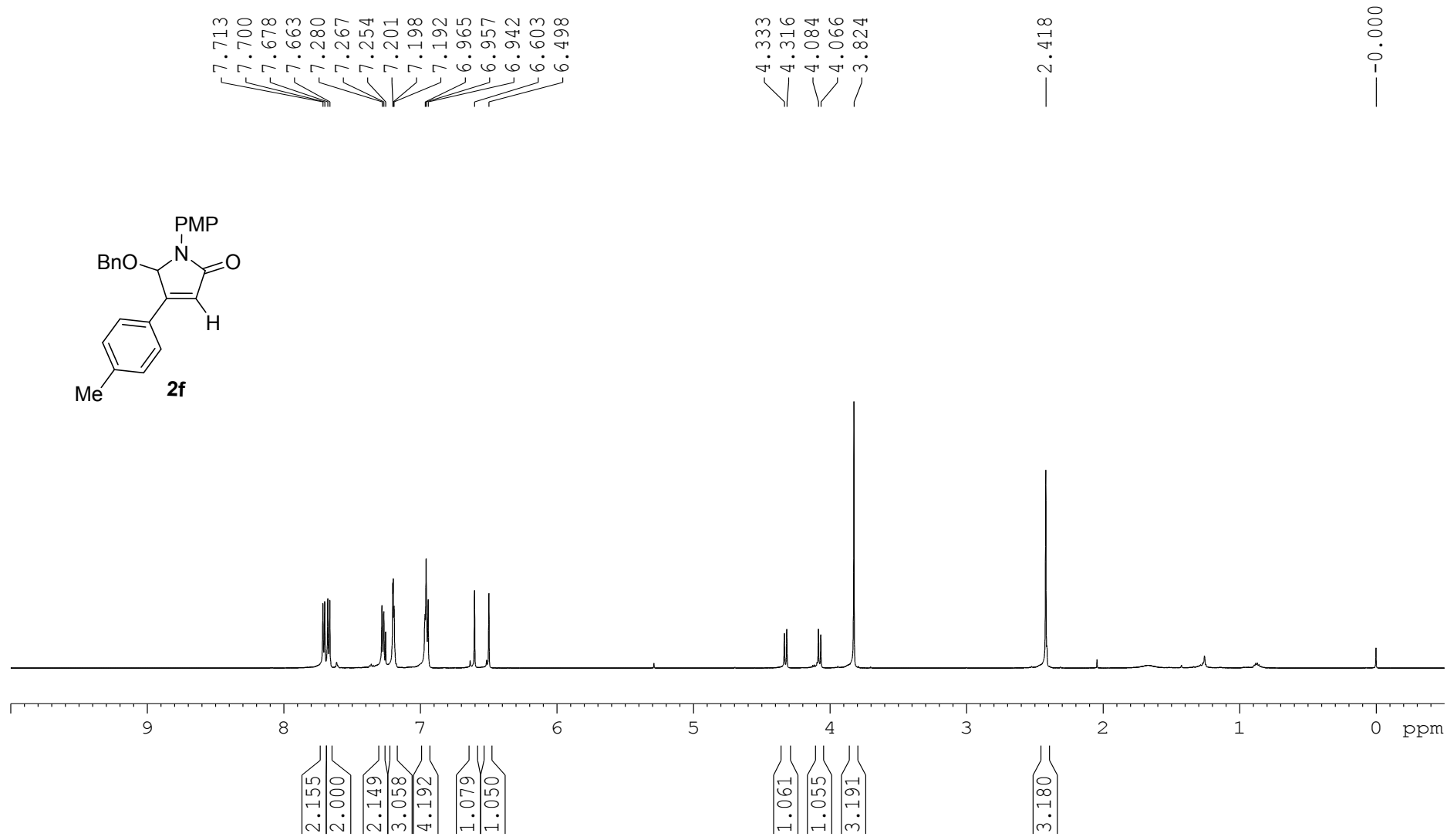
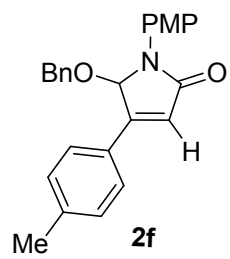


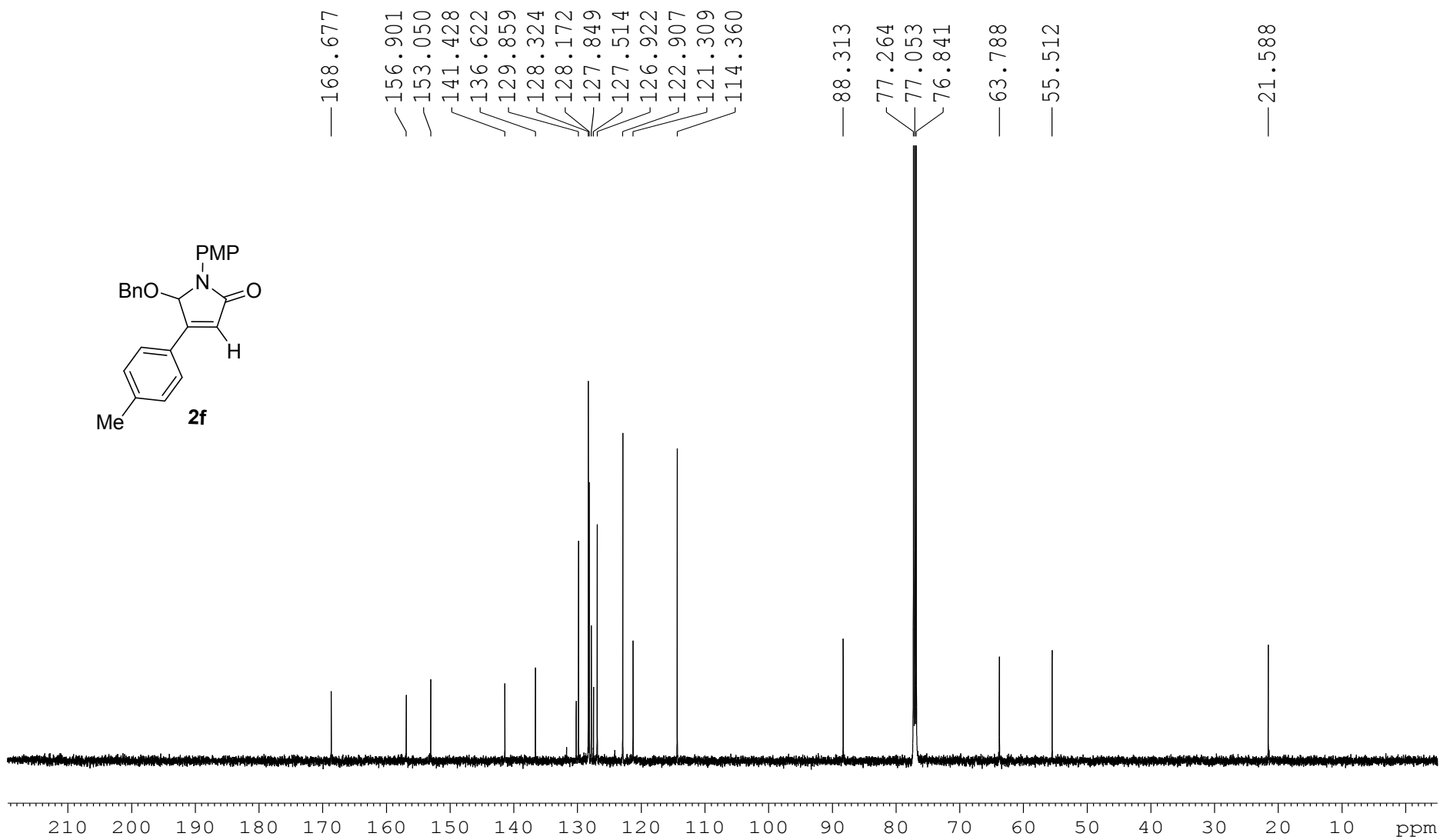
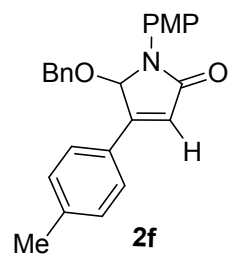


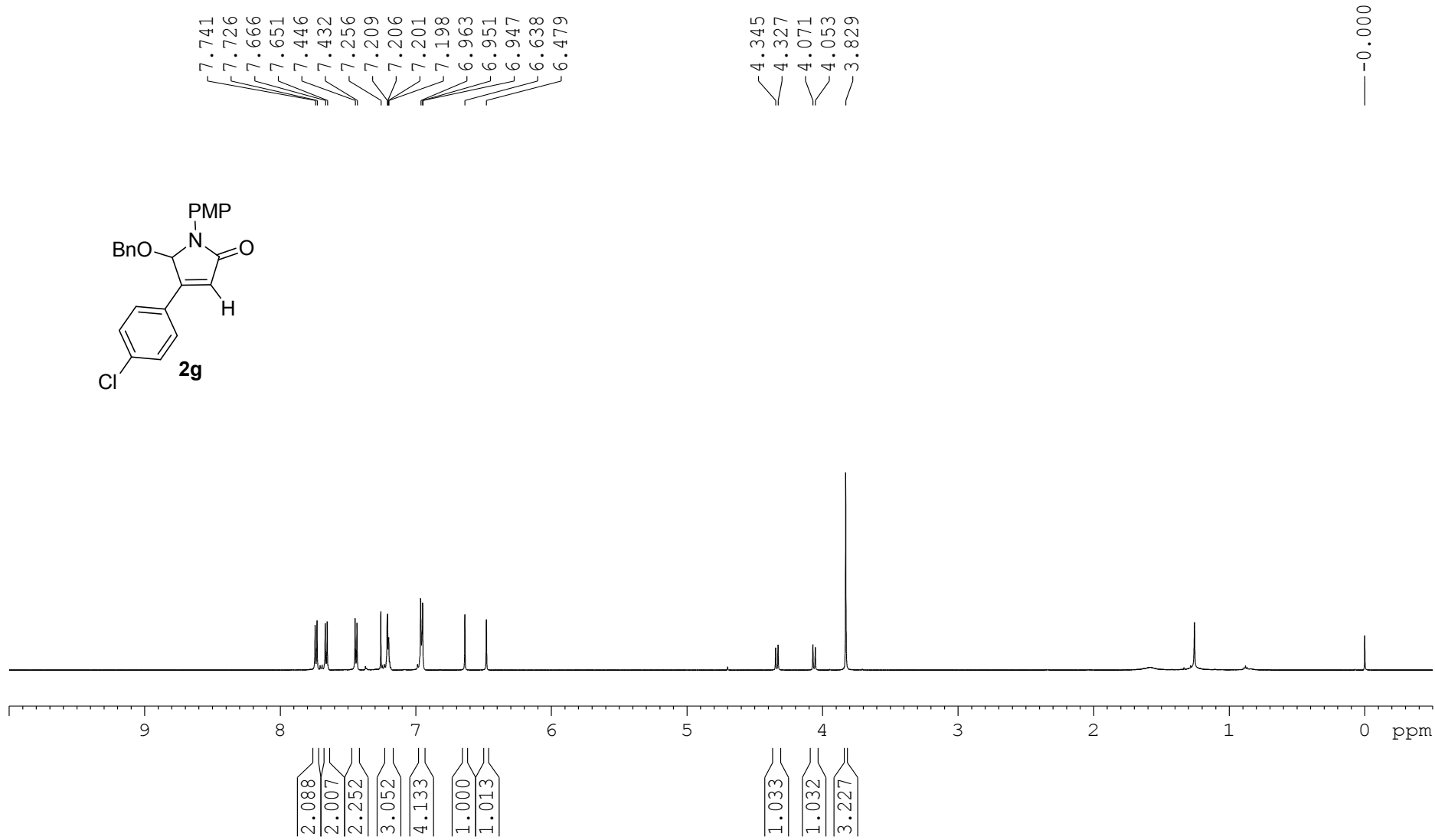
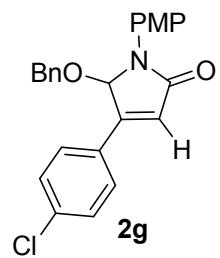


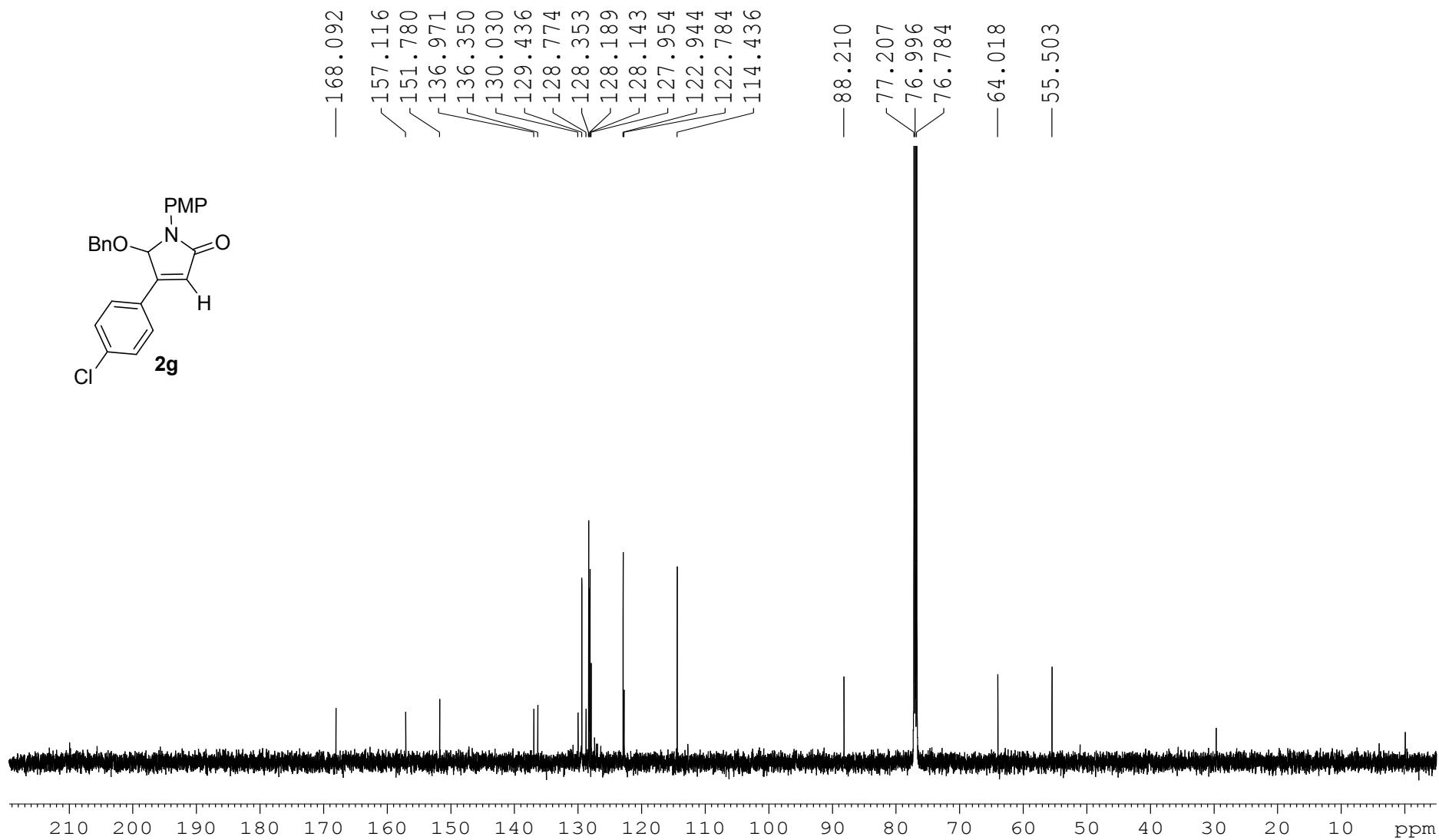
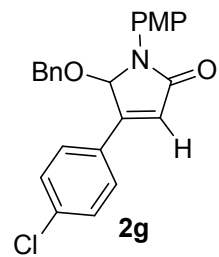


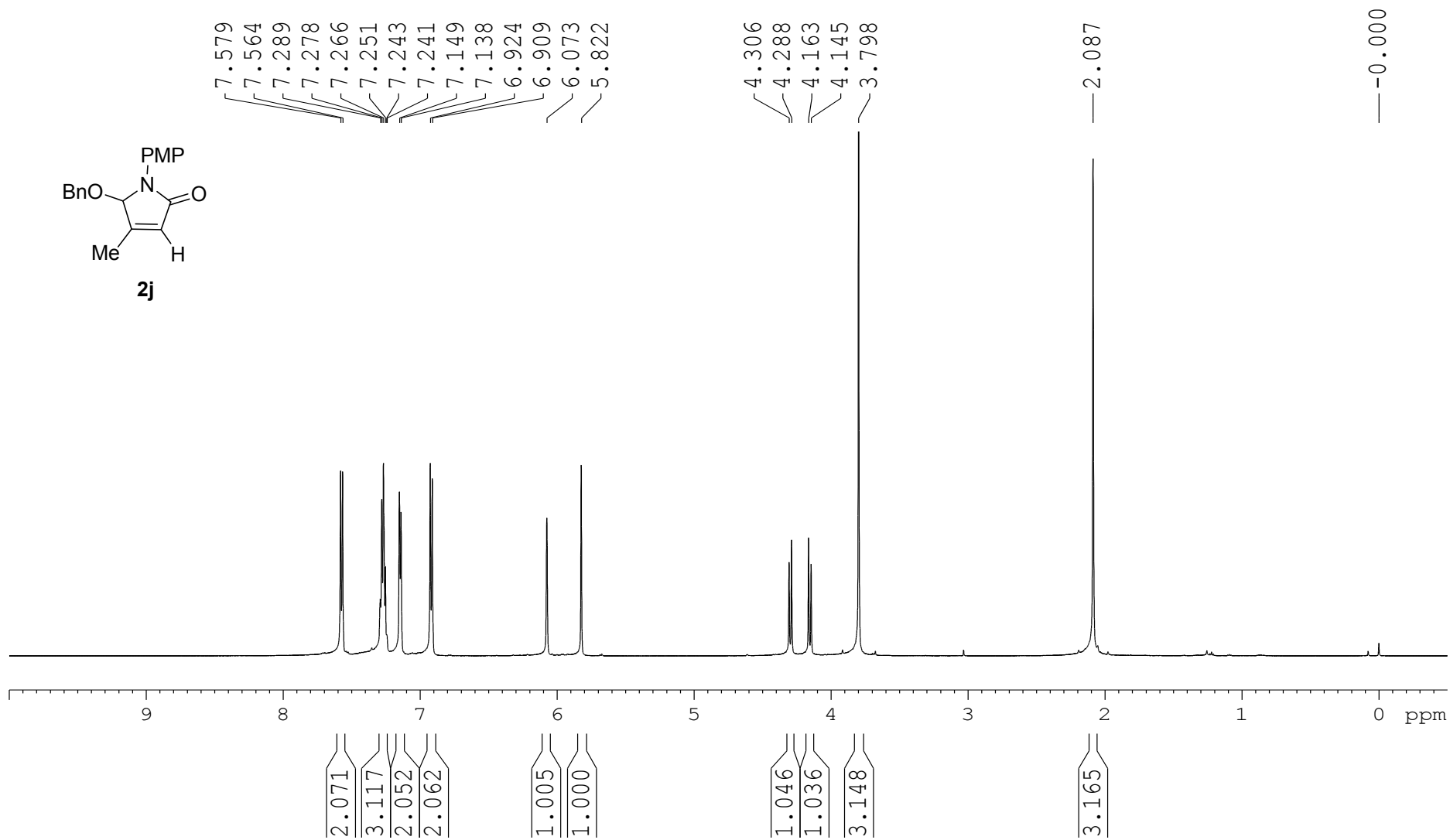
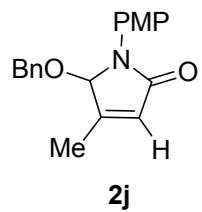


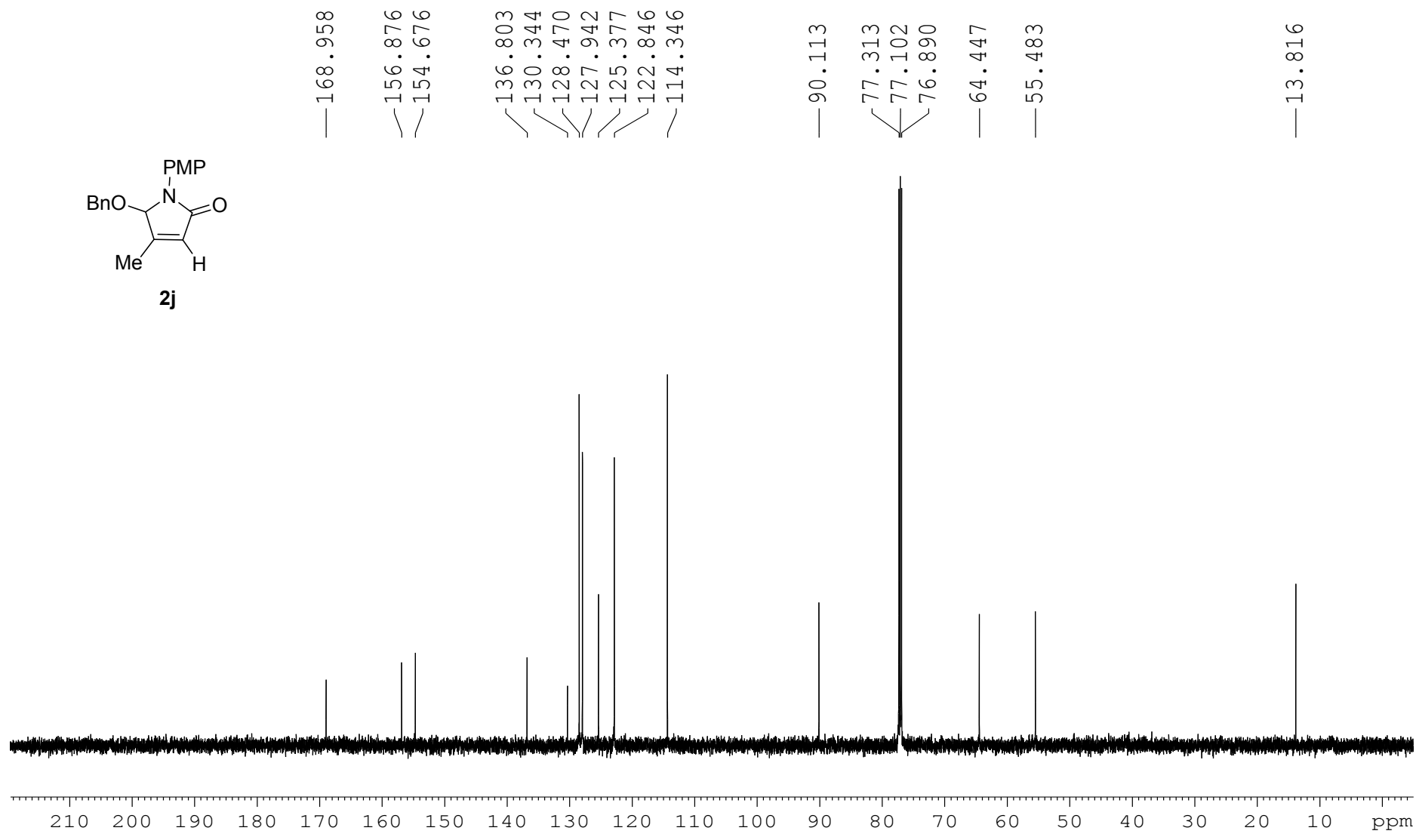
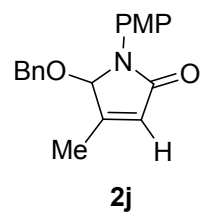


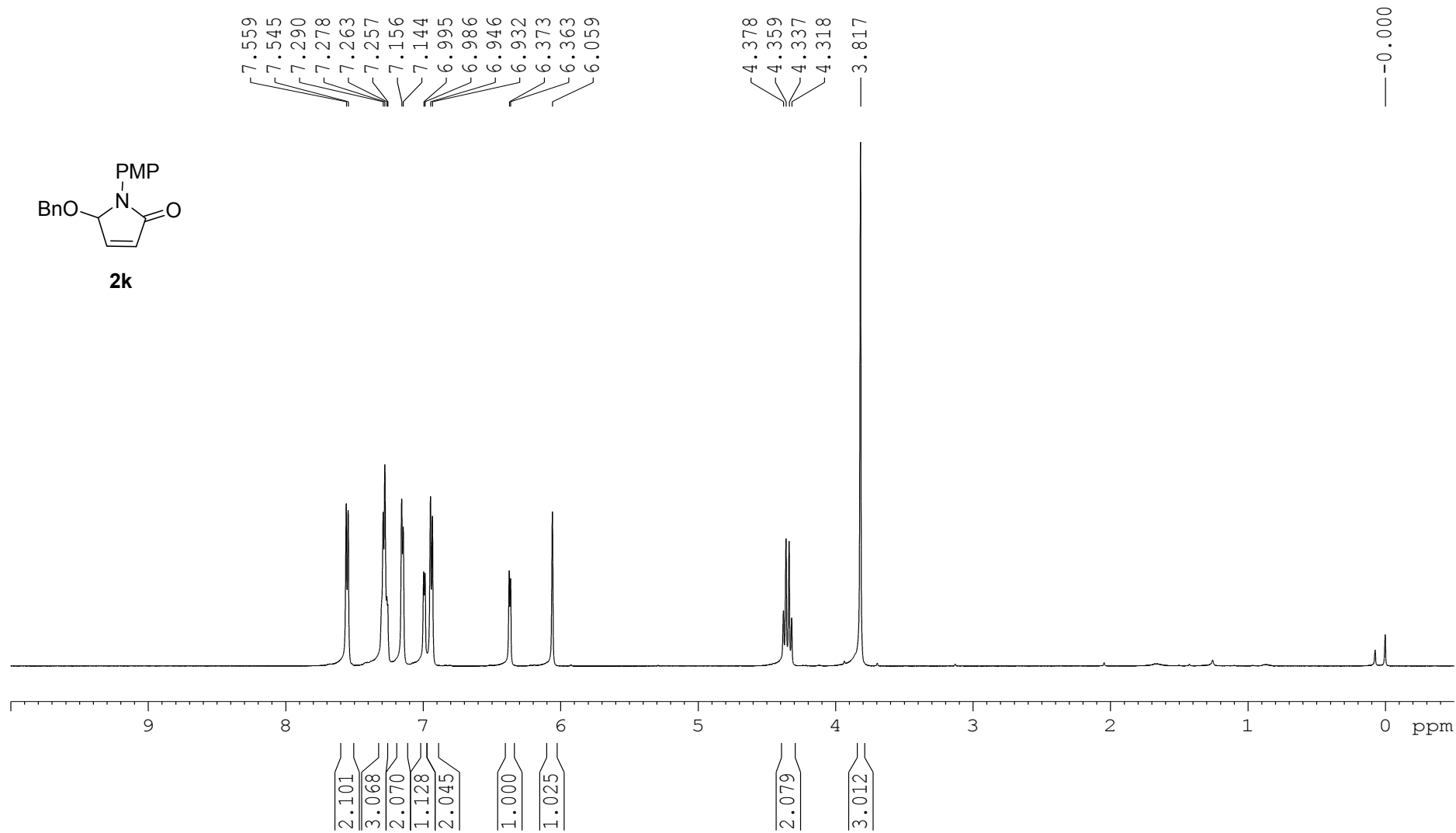
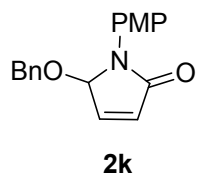


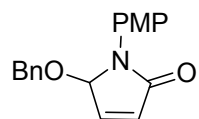




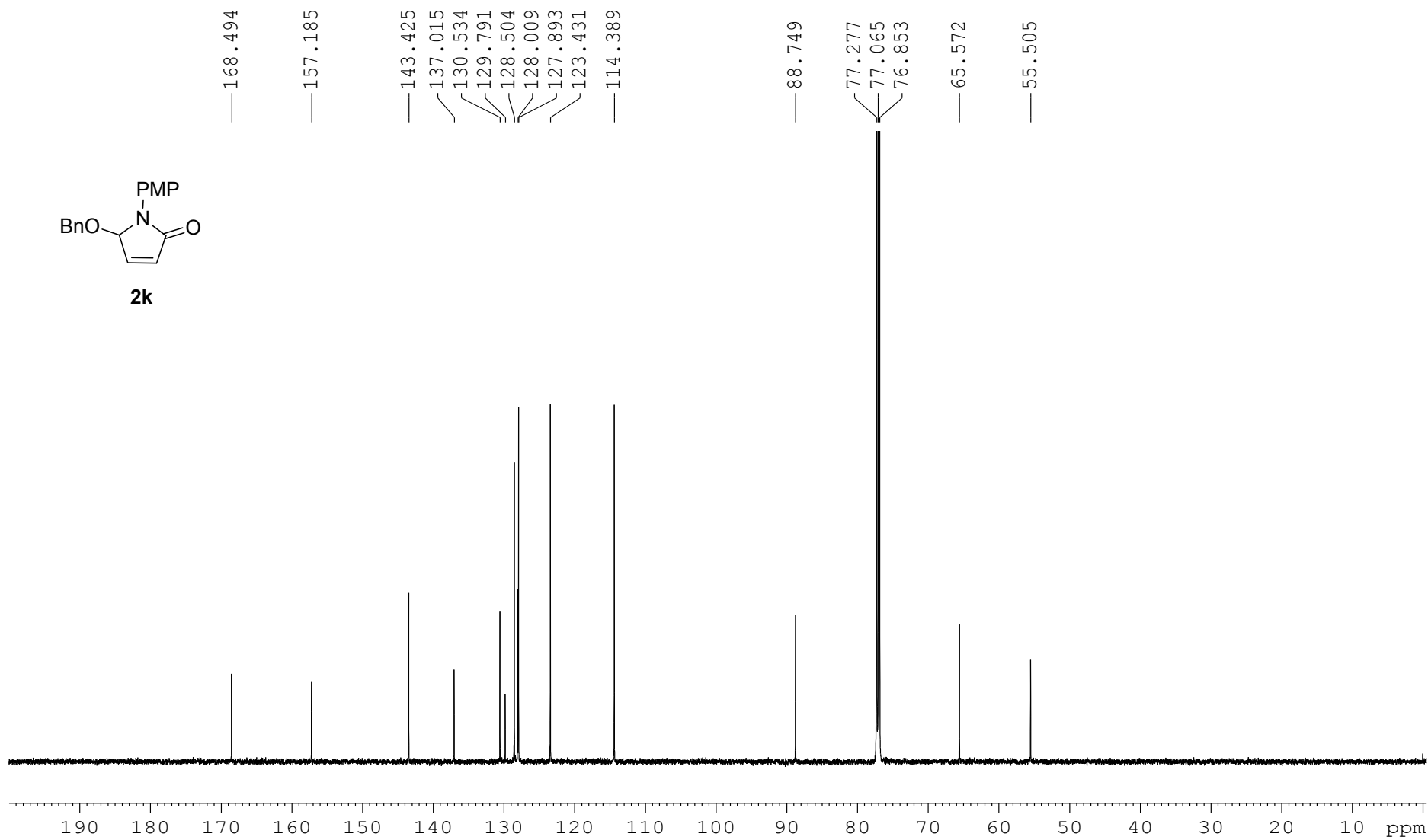


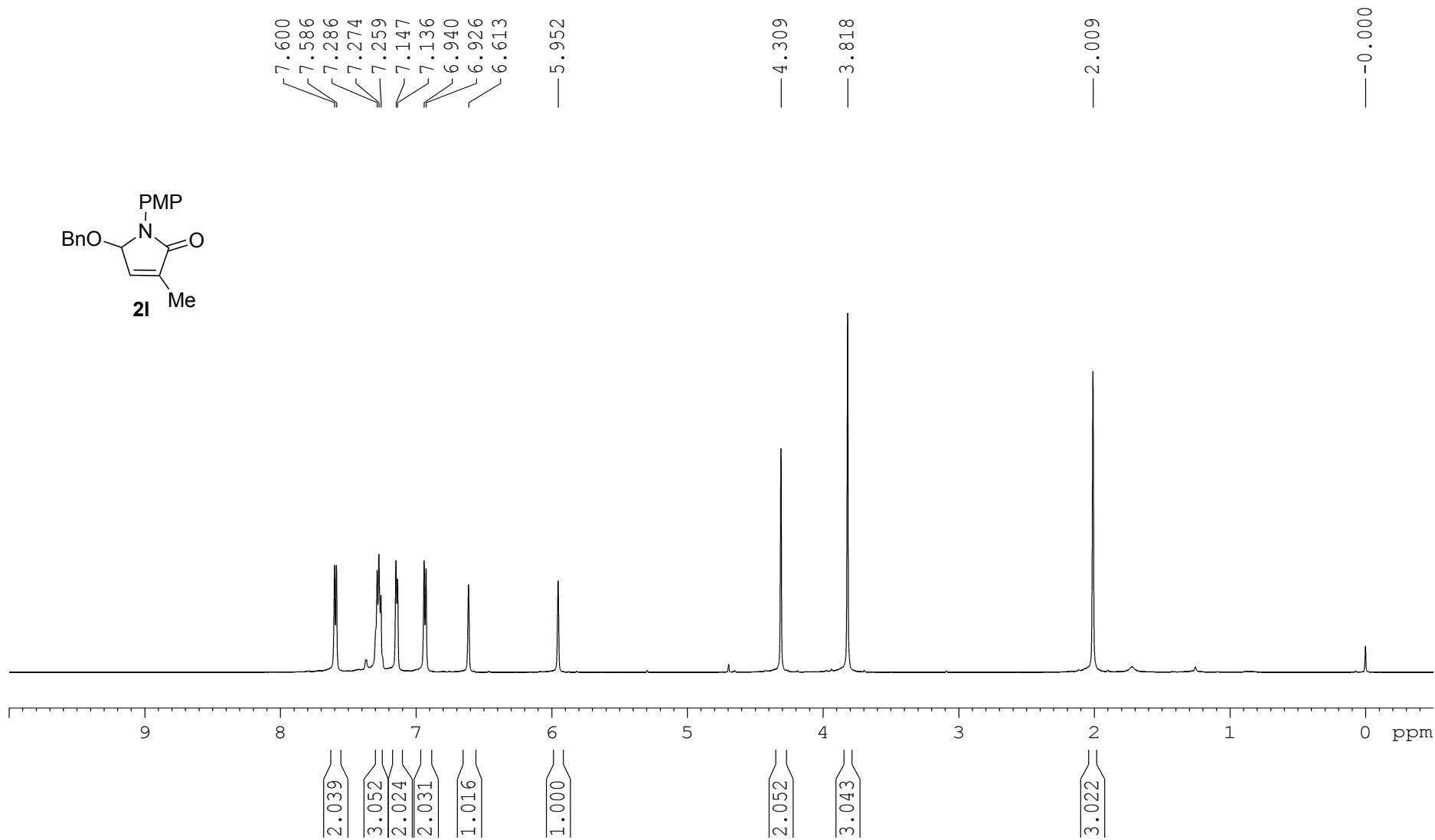
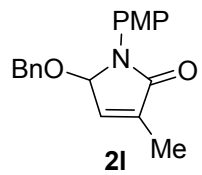


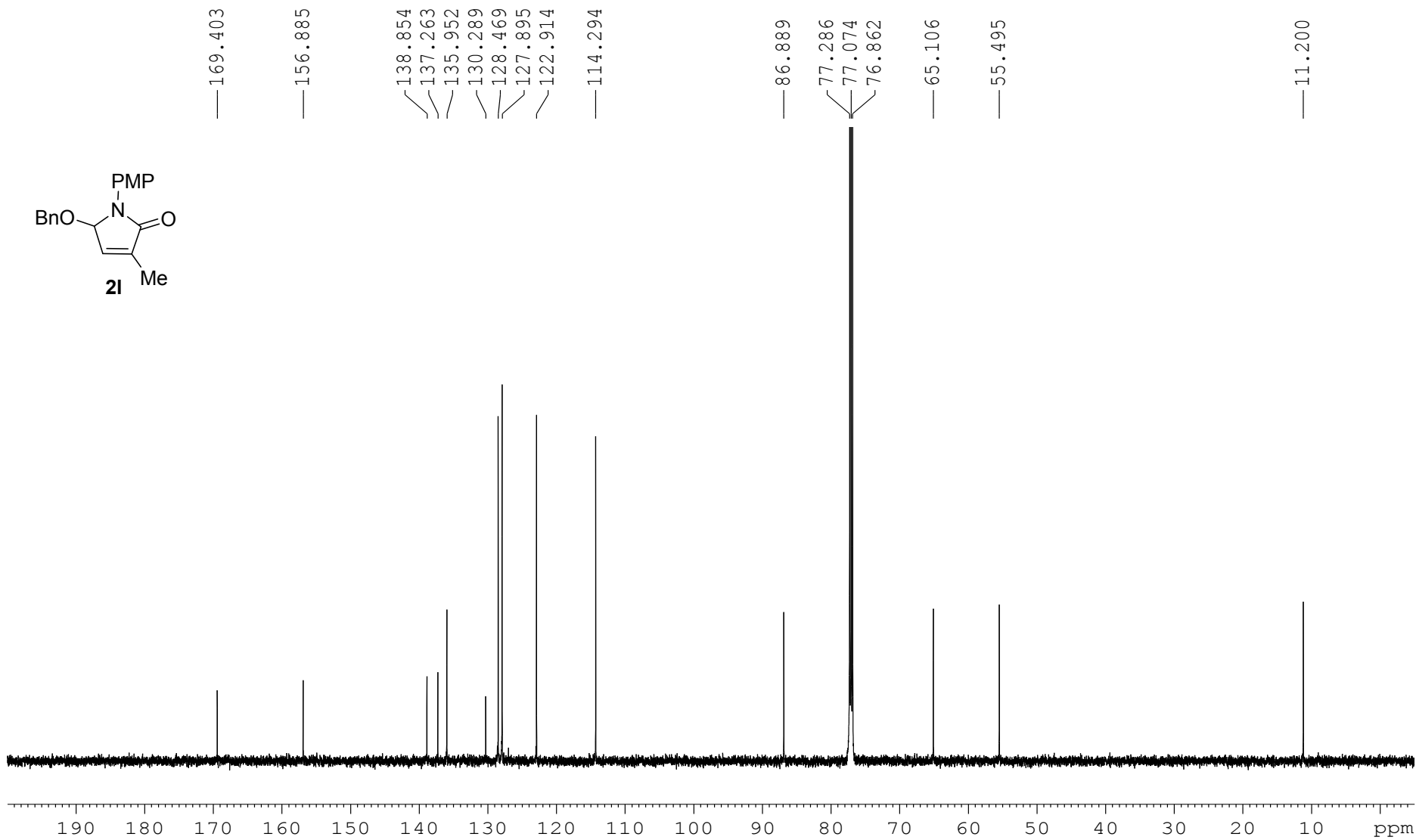
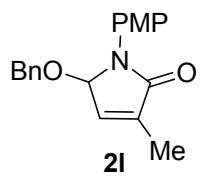


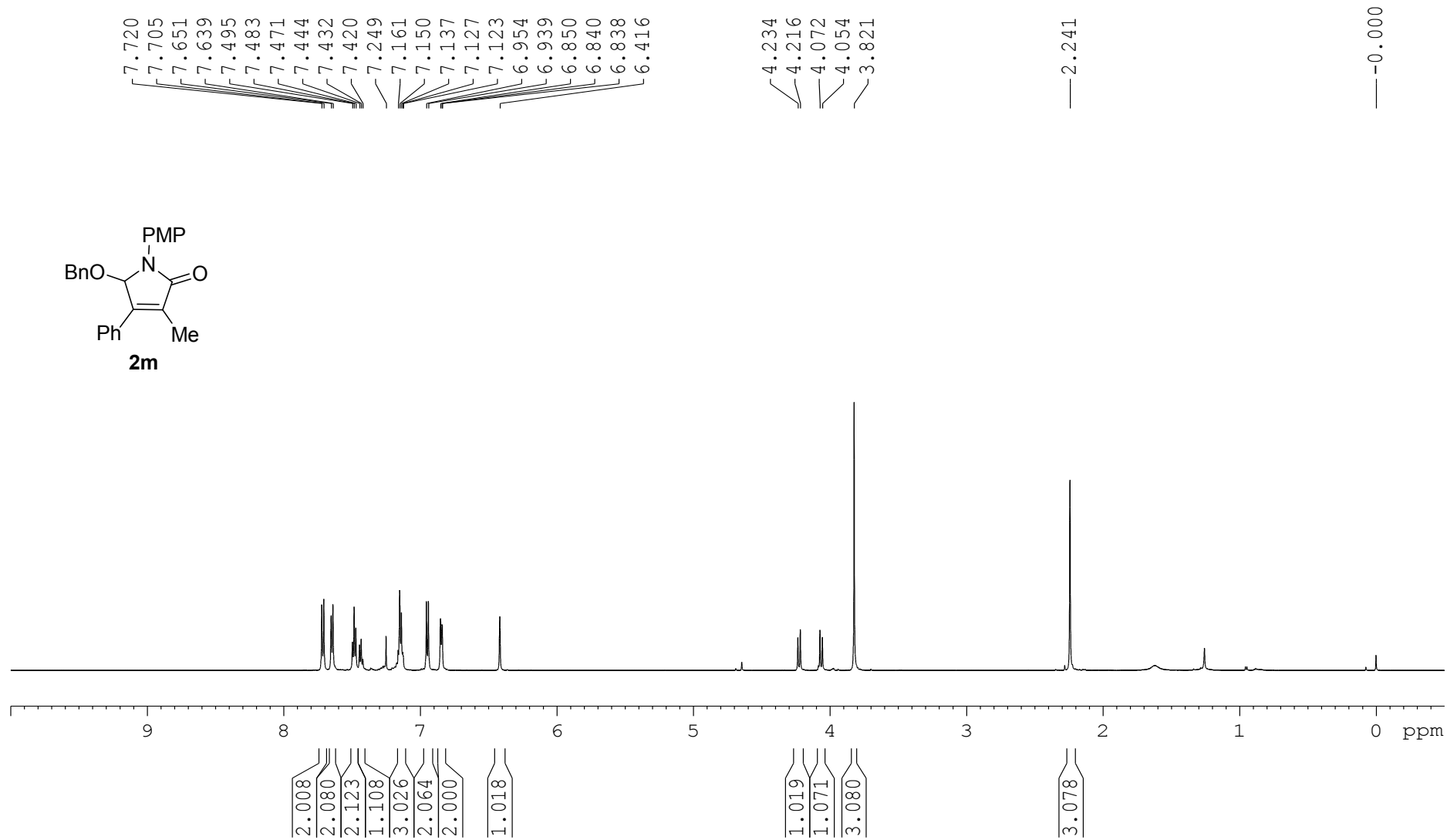
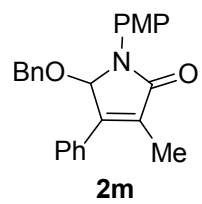


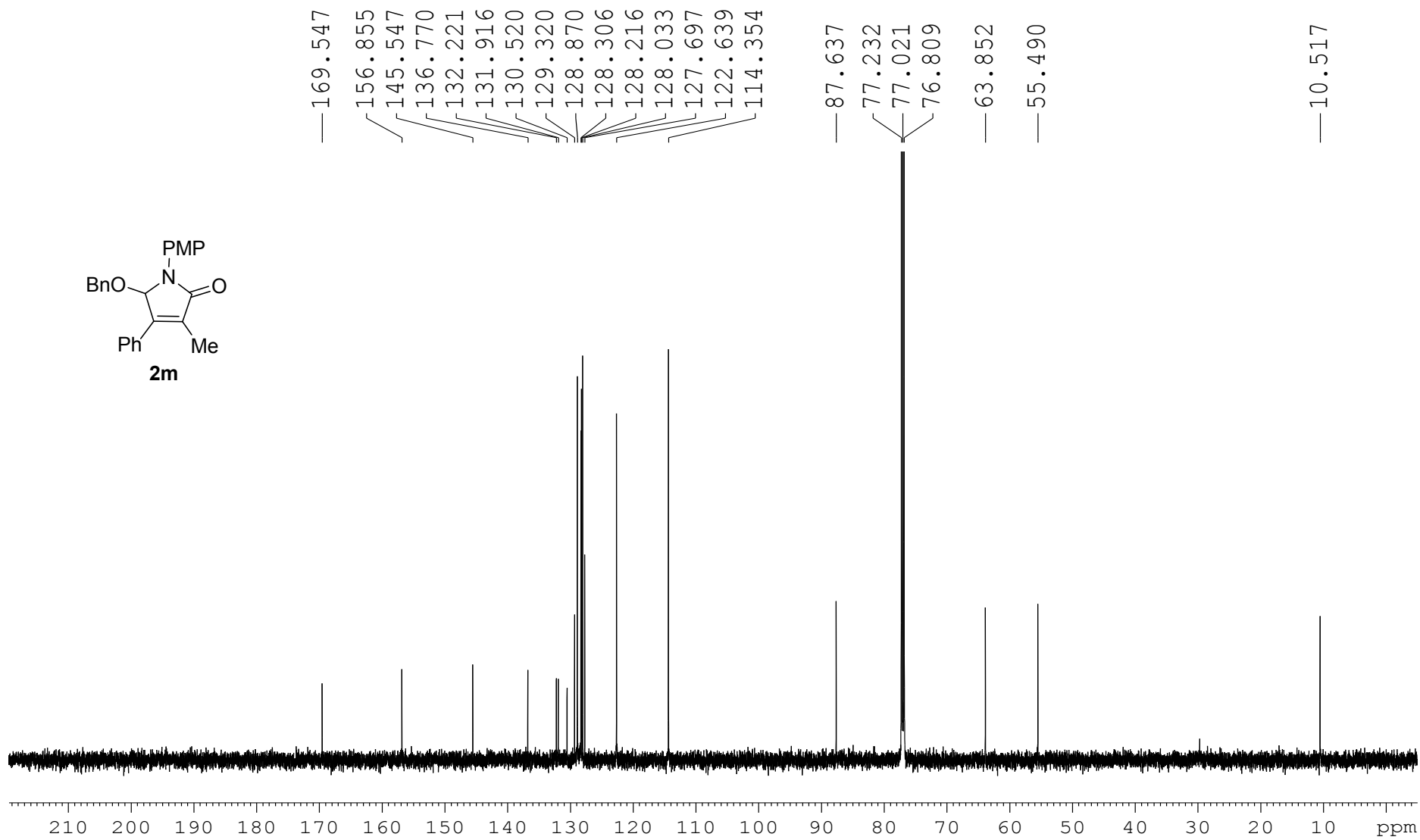
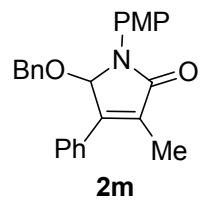
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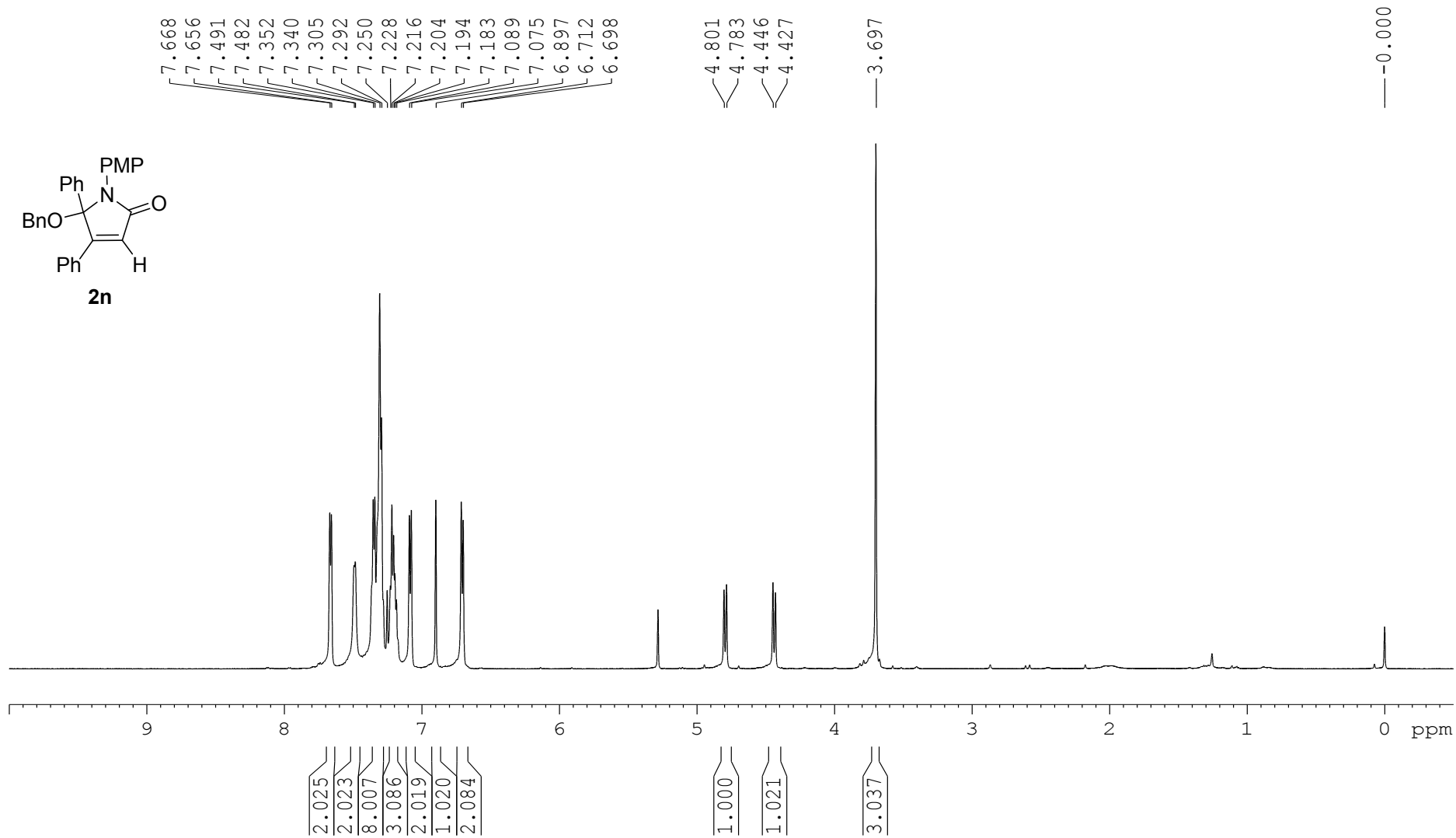
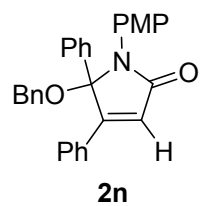


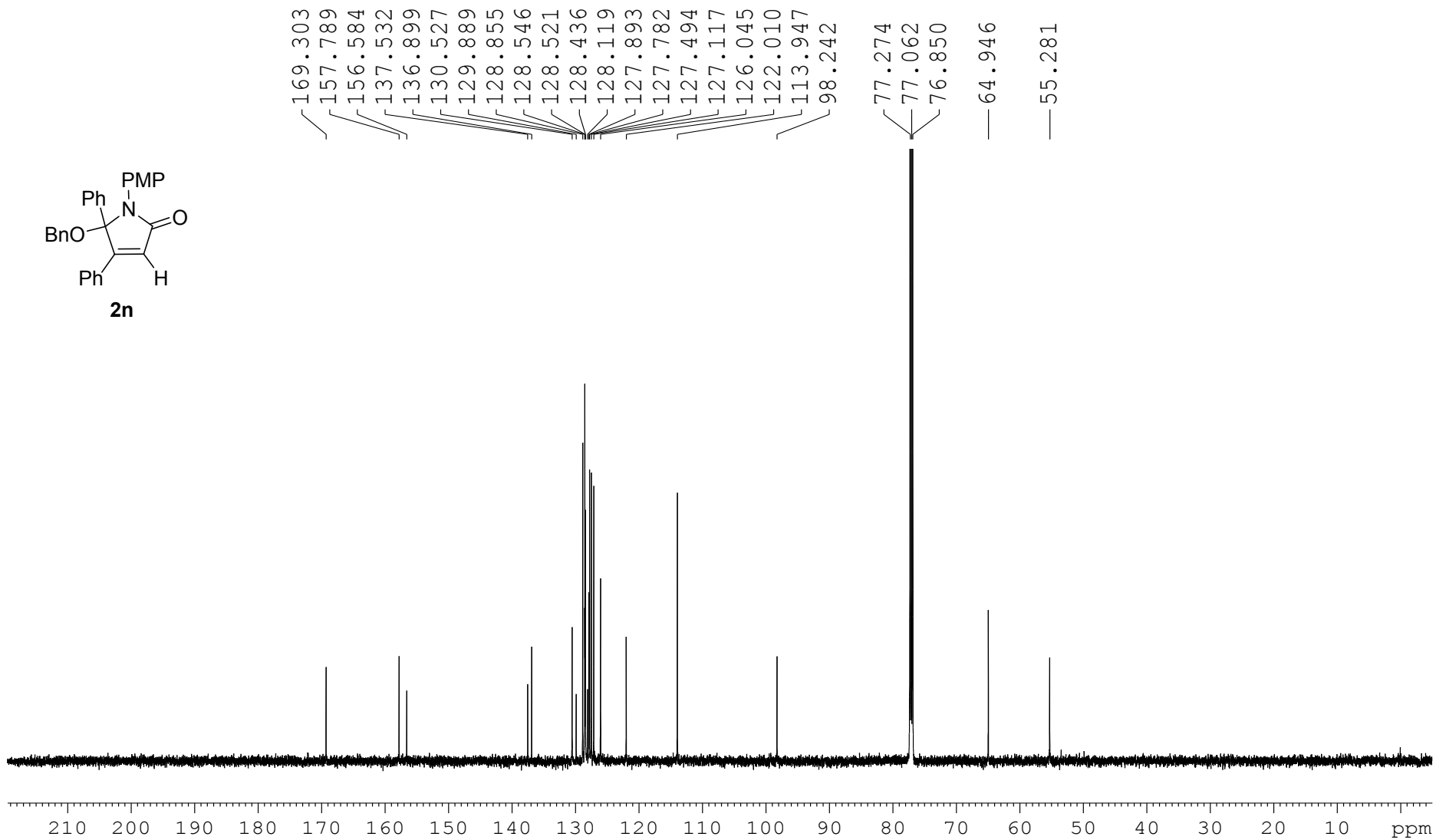
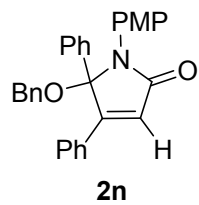


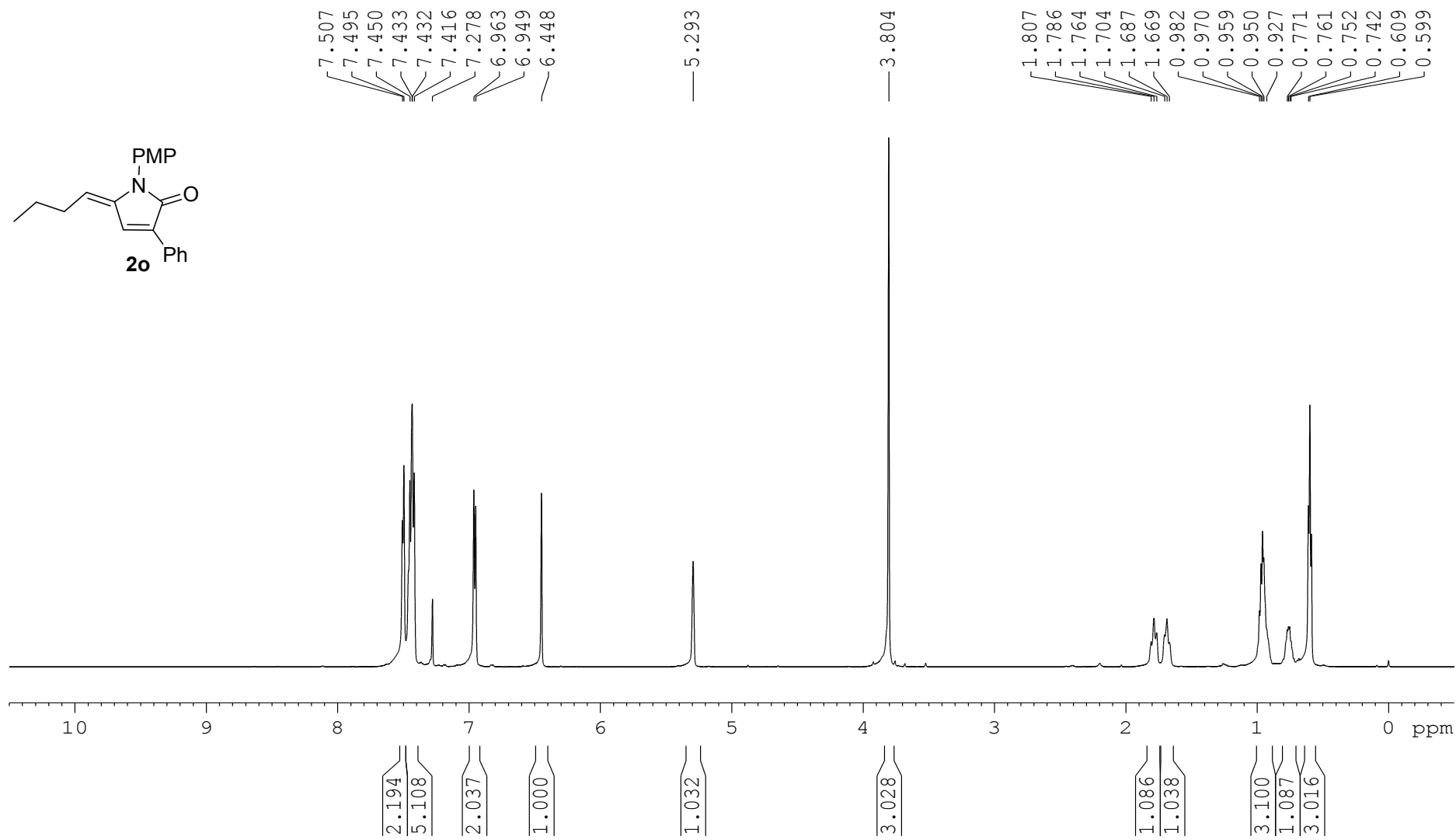
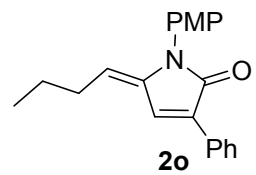


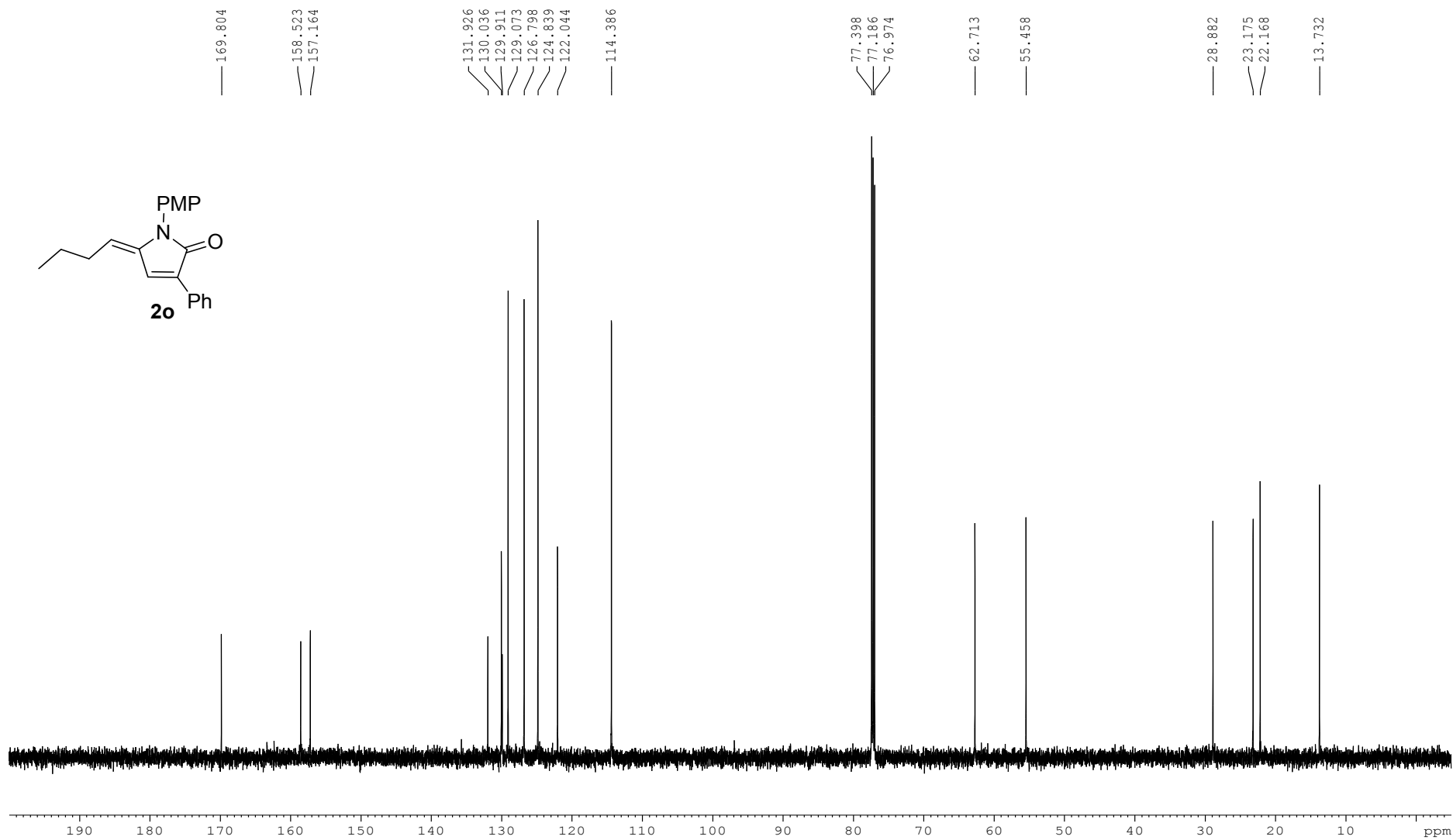


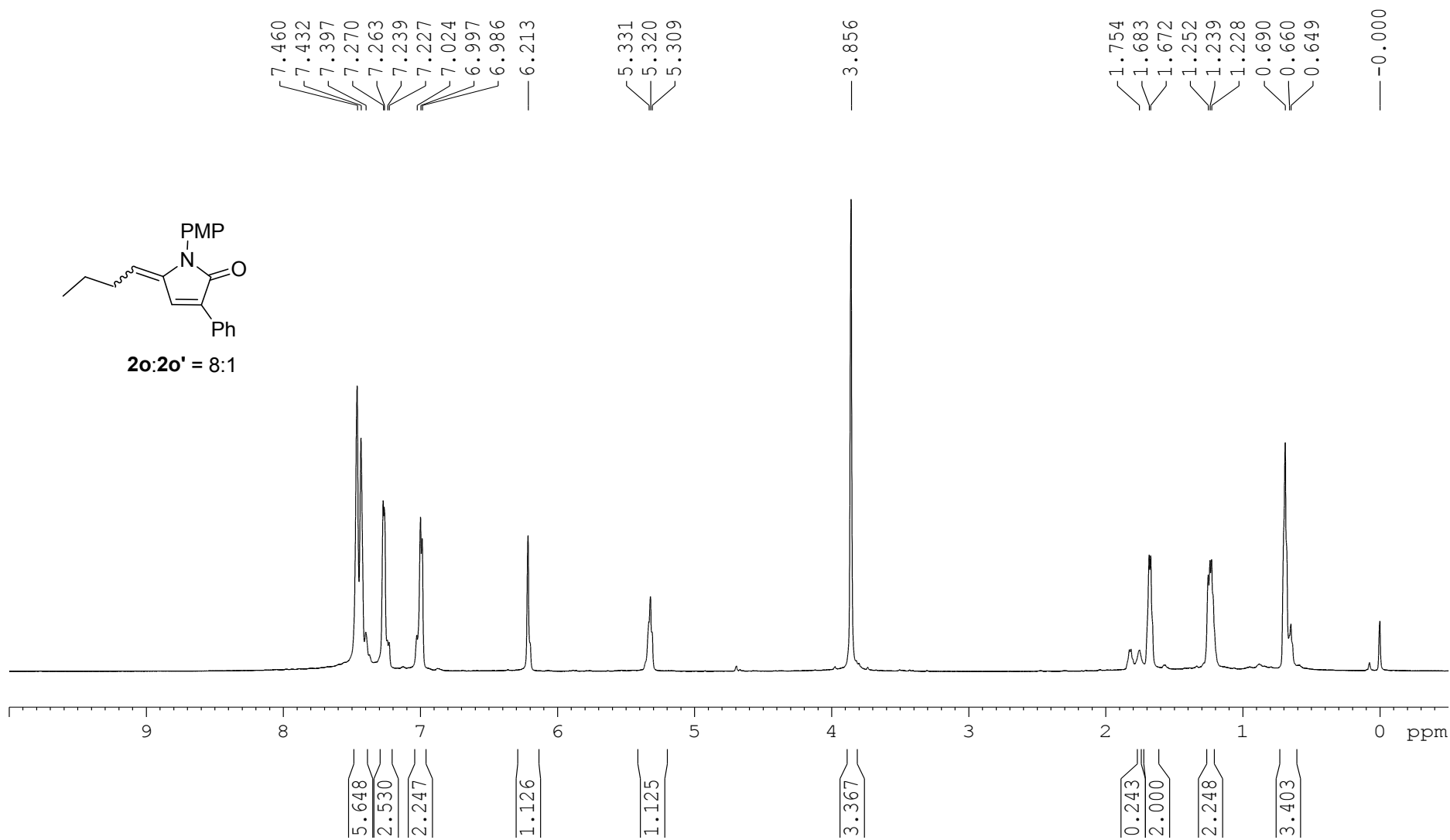
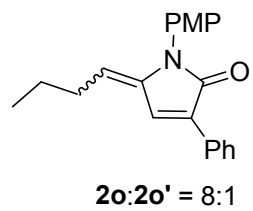


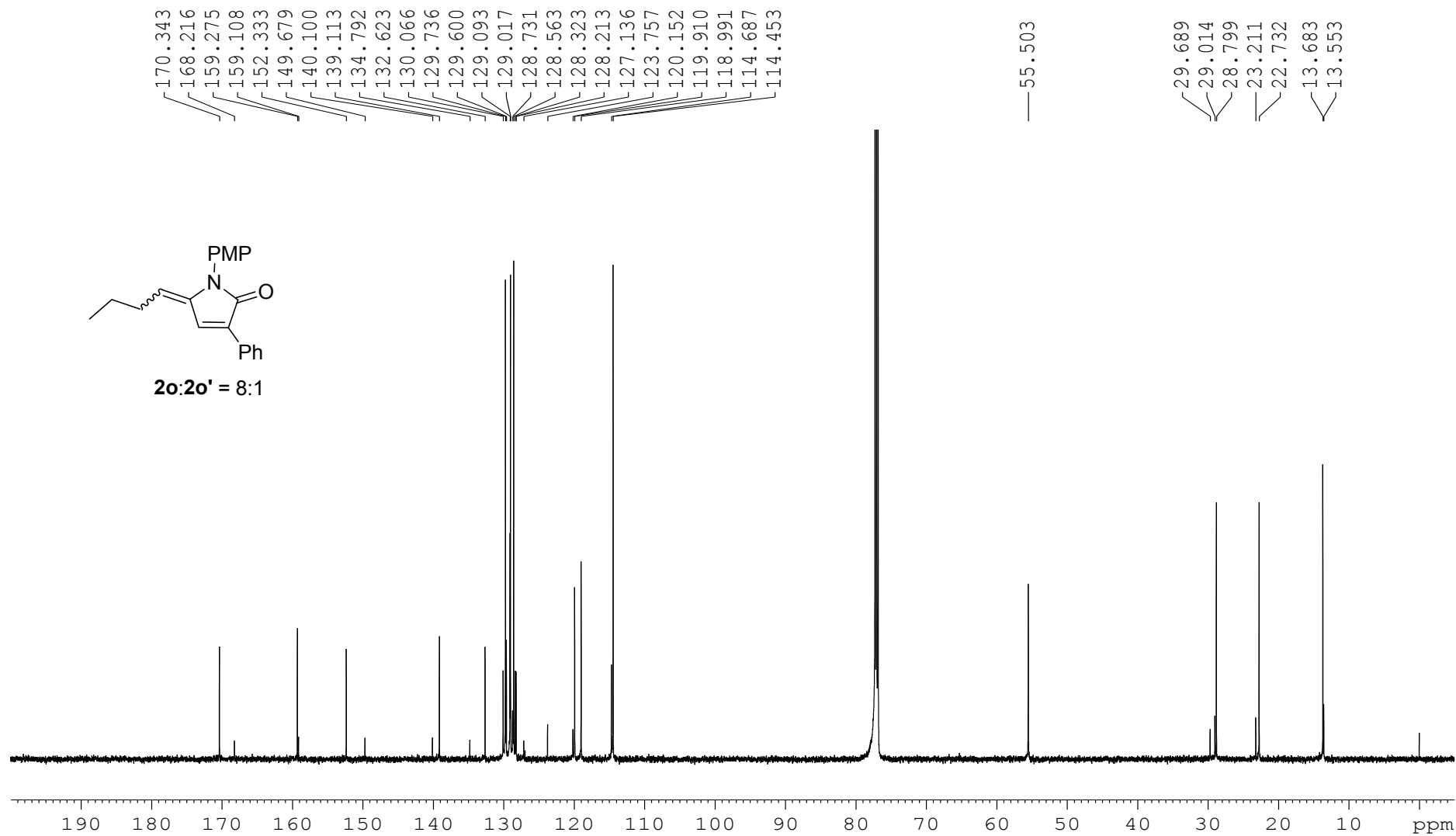
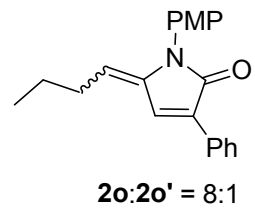


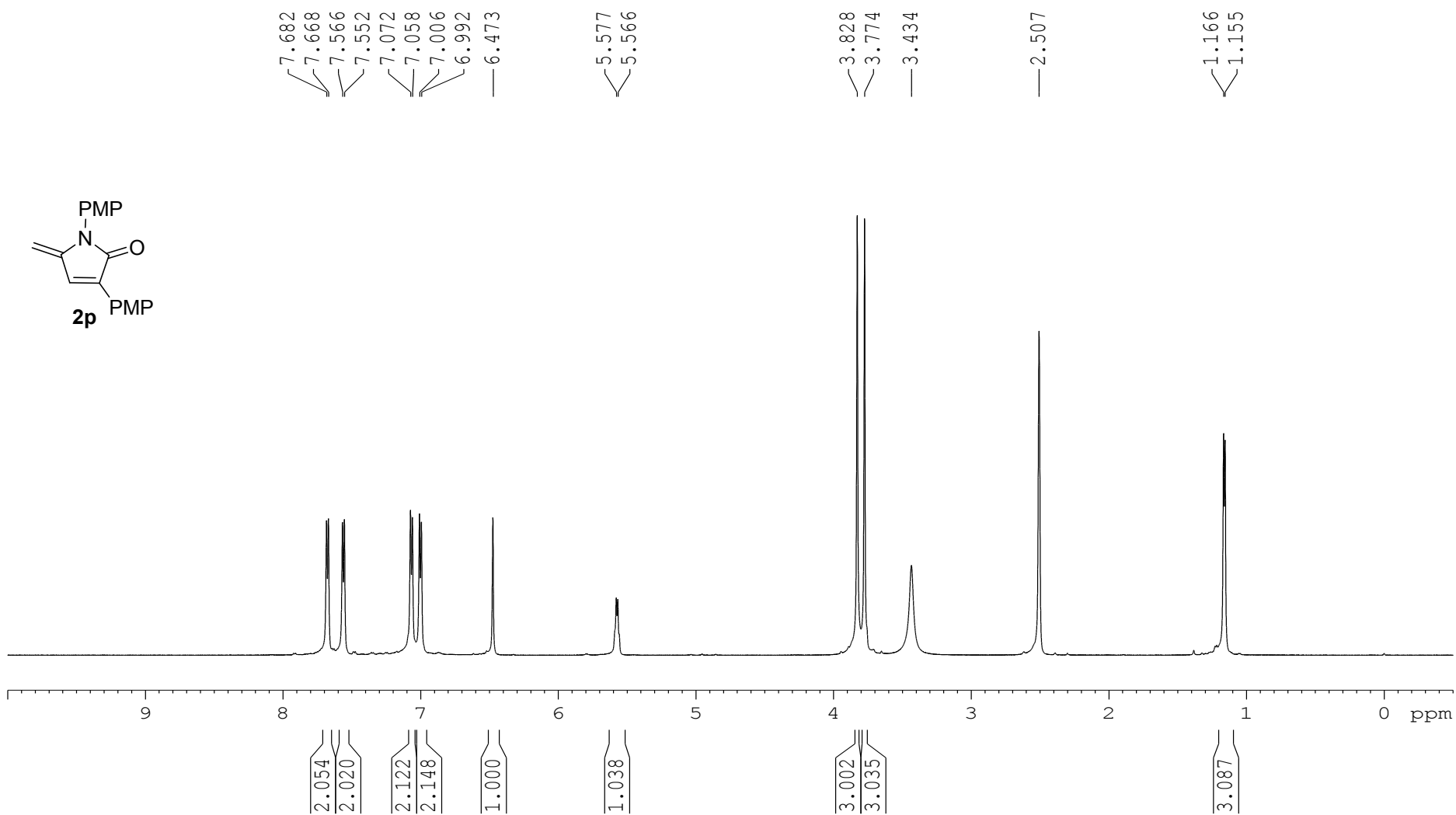


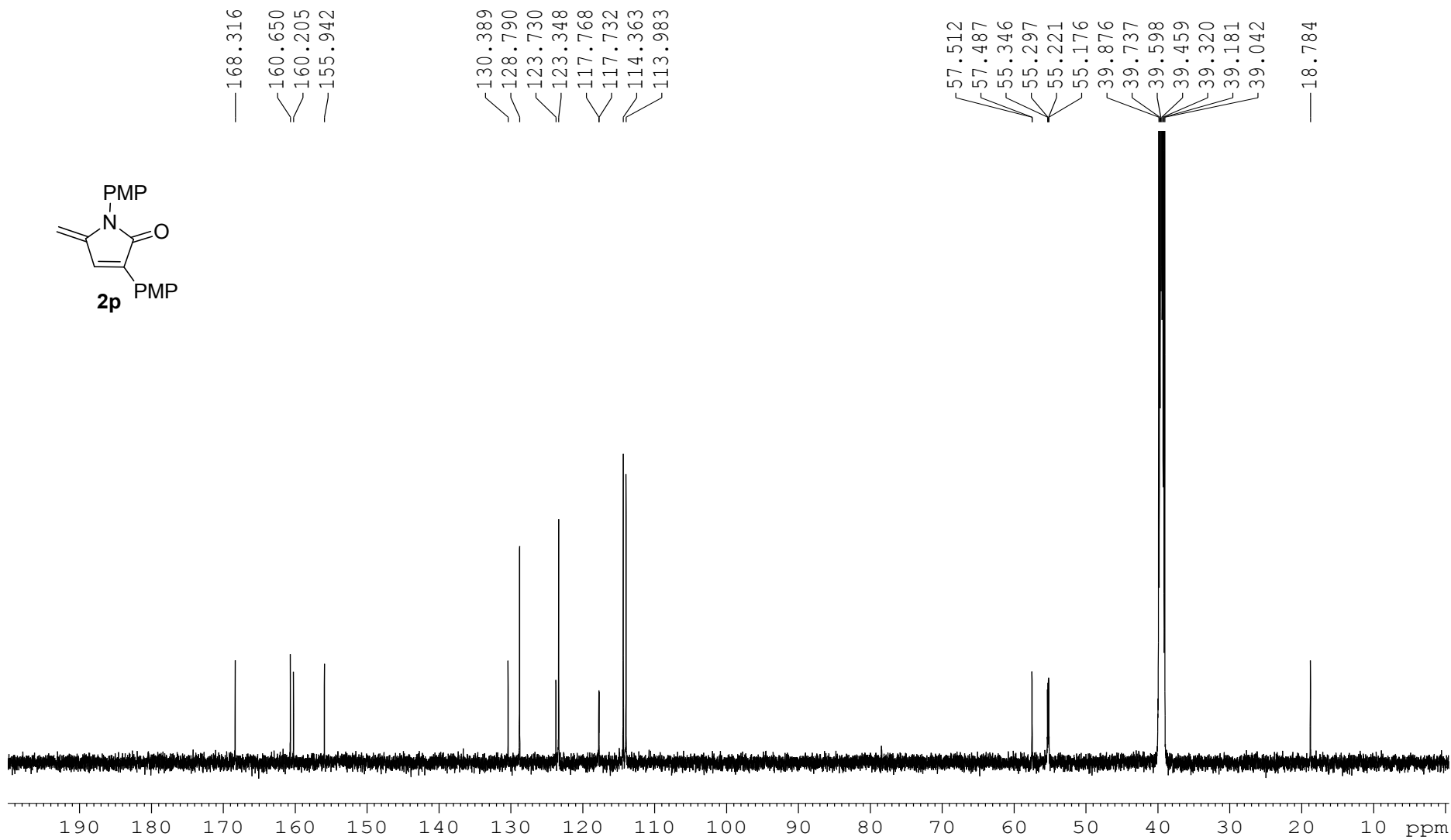
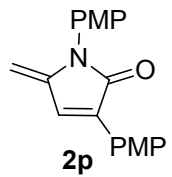


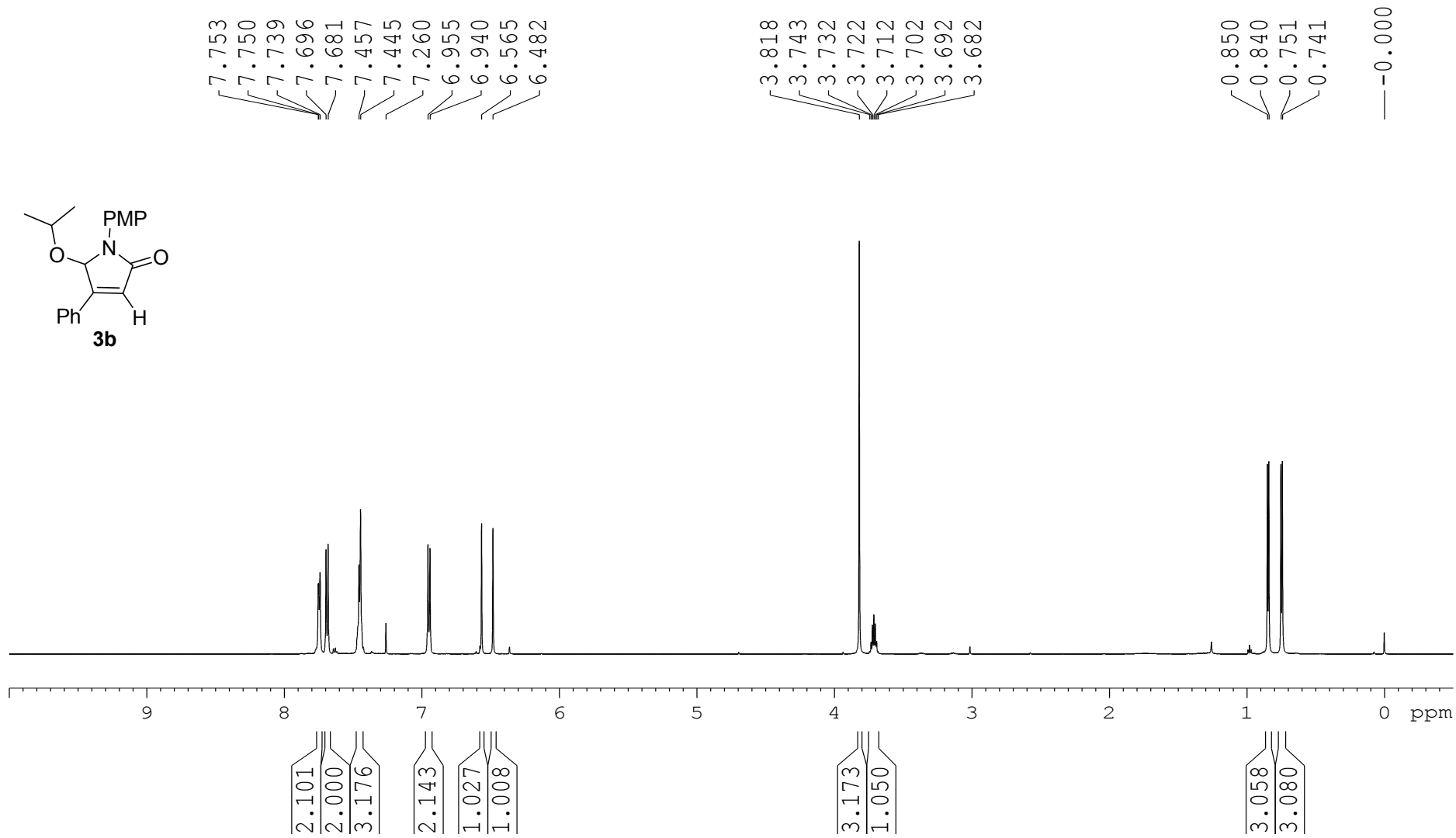


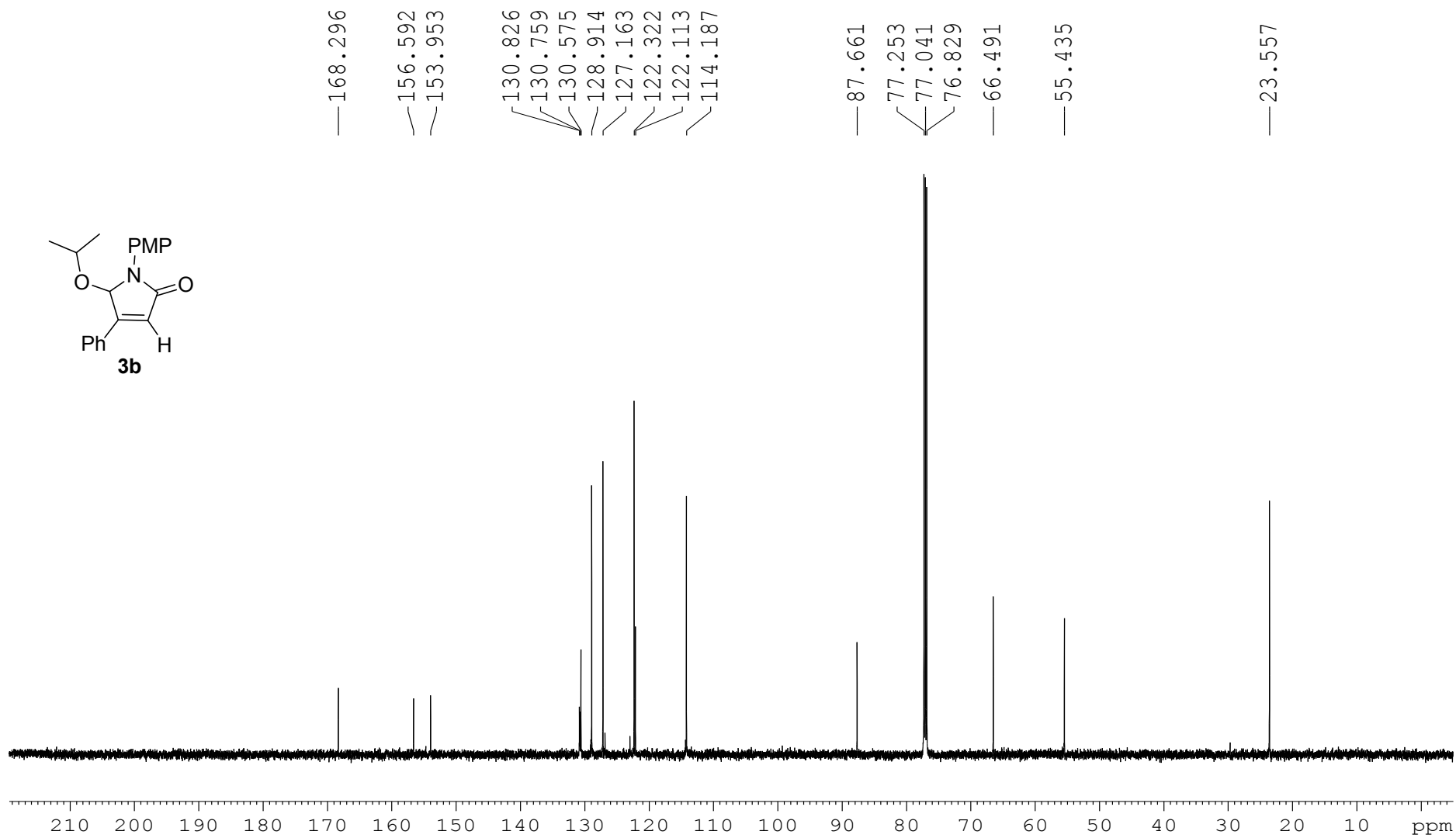
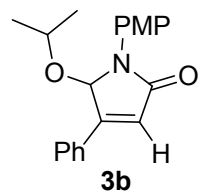


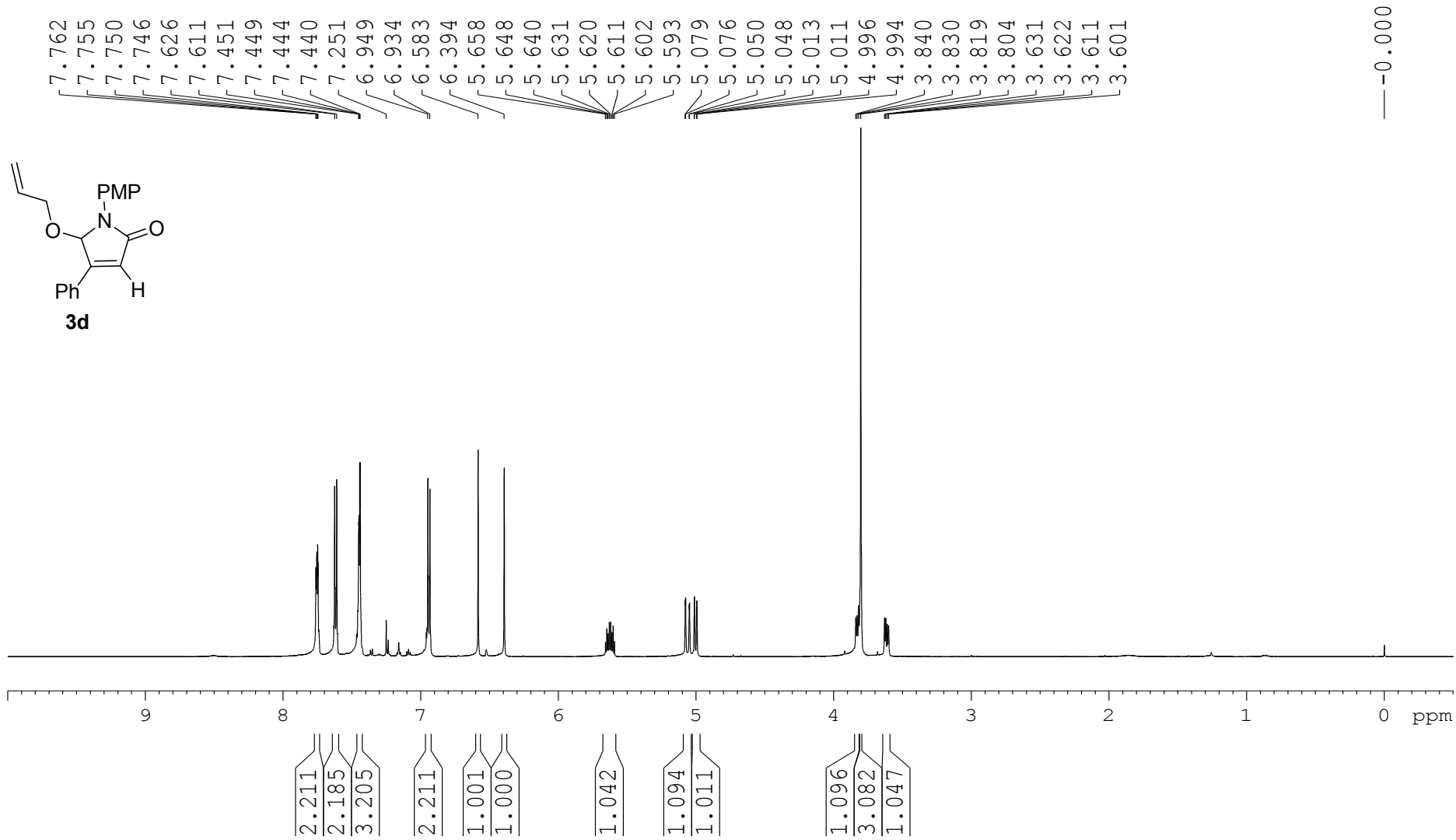


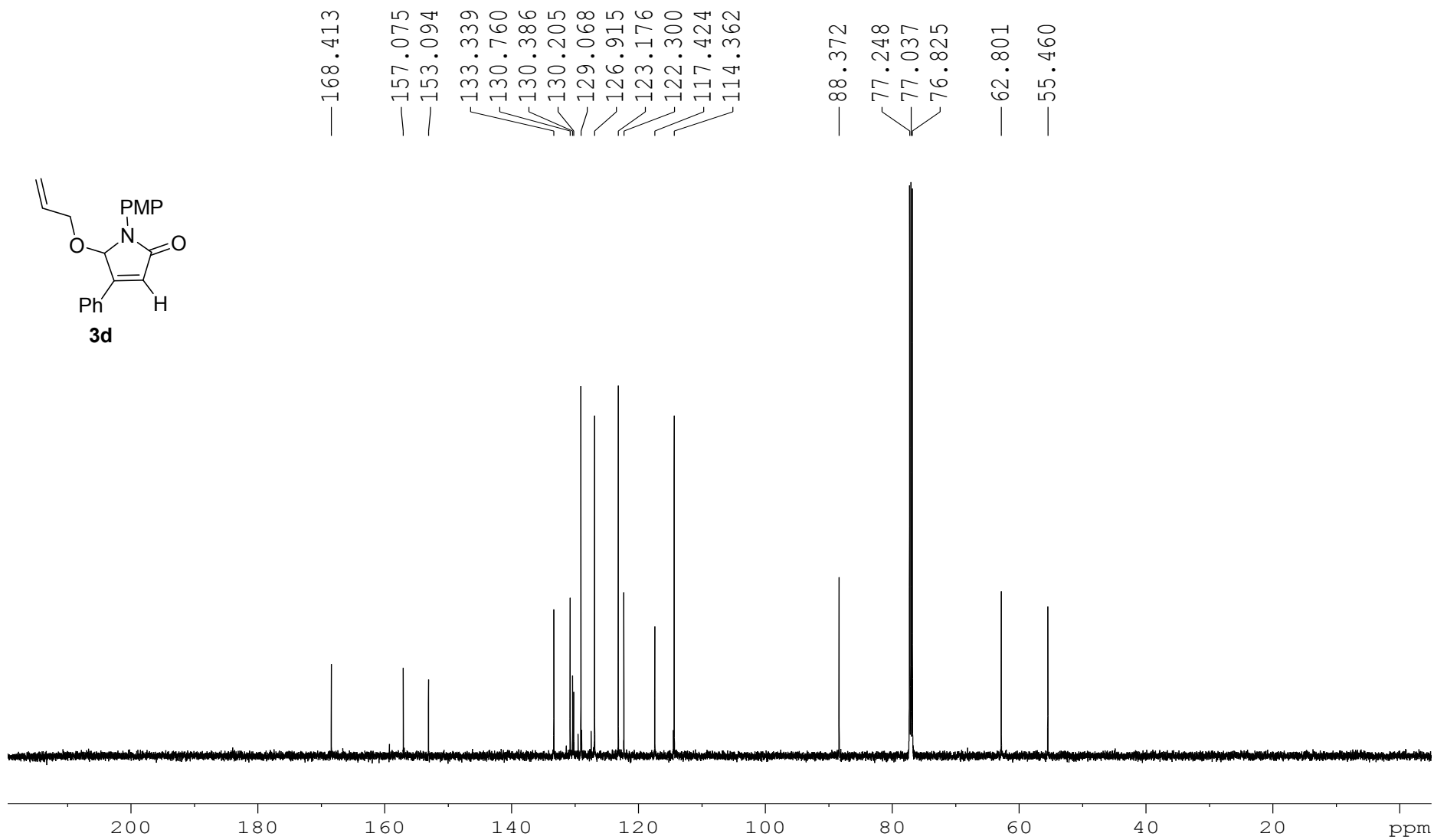












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