Direct sp^3 C-H Bond Arylation, Alkylation, and Amidation of Tetrahydroisoquinolines Mediated by Hypervalent Iodine(III) under Mild Conditions

Supporting Information

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Contents

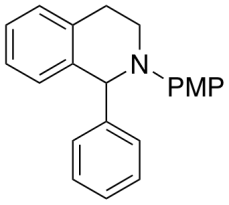
1. General

NMR spectra were recorded on a JEOL JNM-AL400 spectrometer operating at 400 MHz and 100 MHz for ^{1}H and ^{13}C acquisitions, respectively. Chemical shifts are reported in ppm with a solvent resonance as an internal standard (^{1}H-NMR; tetramethylsilane or chloroform as internal standards, indicating 0 or 7.26, respectively, ^{13}C-NMR; chloroform as internal standard, indicating 77.00). Data is reported as follows: s = singlet, br = broad, d = doublet, t = triplet, q = quartet, m = multiplet; coupling constants in Hz; integration. IR spectra were recorded with a SHIMADZU IRAffinity-1 spectrometer. Specific rotation was measured with a JASCO DIP-1000 digital polarimeter. MS spectra were recorded with a JEOL JMS-700N mass spectrometer with fast atom bombardment (FAB) and a double-focusing magnetic sector mass analyzer for MS and HRMS measurements. TLC analysis for the sp^3 C–H bond arylation and alkylation was performed on commercial glass plates bearing a 0.25 mm layer of Merck TLC Silica gel 60 F_{254}. TLC analysis for the sp^3 C–H bond amidation was performed on commercial glass plates bearing a 0.25 mm layer of Merck TLC Aluminium oxide 60 F_{254}, basic. Silica gel chromatography for the sp^3 C–H bond arylation and alkylation was carried out Merck Silica gel 60 (70-230 mesh). Silica gel chromatography for the sp^3 C–H bond amidation was carried out Merck Aluminium oxide 90 active nutral (70-230 mesh).

2. Experimental details and characterization data for all compounds

2-1. sp^3 C-H bond arylation and alkylation of THIQs

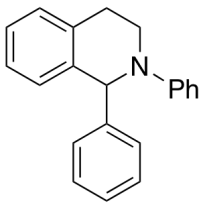
1-Phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (1)[1]



After stirring the mixture of 2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (95.7 mg, 0.4 mmol) and [bis(trifluoroacetoxy)iodo]benzene (172.1 mg, 0.40 mmol) in 2-MeTHF or 1,2-dichloroethane (4.0 mL) in a vial at room temperature for 10 min under Ar atmosphere, phenylmagnesium bromide (1.0 M in THF, 8.0 mL, 0.80 mmol) was added to the solution at 0 °C. After stirring vigorously for 3 hours at 0 °C, the reaction mixture was quenched with saturated aqueous NH_4Cl and saturated aqueous $NaHCO_3$, then extracted with ethyl acetate. The organic layer was washed with water and brine, dried over $MgSO_4$, filtrated, and concentrated in *vacuo*. The residue was purified by SiO_2 column chromatography (*n*-hexane/ether = 100/0-100/5) to give 1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline **1** (125.2 mg, 99%) as pale yellow solid.

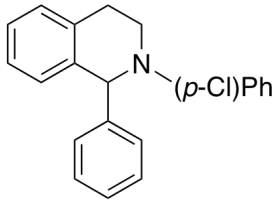
125.2 mg (99%). Pale yellow solid. R_f = 0.29 (AcOEt/*n*-Hexane, 1 : 10). M.p. 128–129 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30-7.10 (9H, m), 6.90-6.75 (4H, m), 5.66 (1H, s), 3.74 (3H, s), 3.65-3.53 (1H, m), 3.50-3.35 (1H, m), 3.05-2.85 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.9, 144.4, 143.2, 137.7, 135.5, 128.4, 128.1, 128.1, 128.0 (2C), 126.8, 126.7 (2C), 126.0, 117.7 (2C), 114.5 (2C), 64.3, 55.6, 44.5, 28.1. IR (solid) 3022, 2918, 2822, 1606, 1506, 1450, 1032, 826 cm^{-1}. MS (FAB) *m/z* (rel intensity) 316 ($M+H^+$, 25), 315 (M^+, 45), 307 (25), 289 (15), 238 (20), 154 (100), 136 (70), 107 (20). HRMS (FAB) Calcd for $C_{22}H_{22}NO$ ($M+H^+$): 316.1696, found, 316.1726. Anal Calcd for $C_{22}H_{21}NO$: C, 83.78; H, 6.71. Found: C, 83.70; H, 7.00.

1-Phenyl-2-phenyl-1,2,3,4-tetrahydroisoquinoline (2)[1]



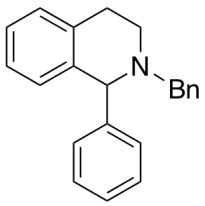
113.1 mg (99%). White solid. R_f = 0.27 (Et_2O/*n*-Hexane, 1 : 20). M.p. 62–64 °C (lit.[1] M.p. 62–64 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35-7.10 (11H, m), 6.85 (2H, d, *J* = 8.8 Hz), 6.75 (1H, t, *J* = 7.3 Hz), 5.83 (1H, s), 3.80-3.67 (1H, m), 3.55-3.45 (1H, m), 3.00-2.85 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 149.5, 143.1, 137.9, 135.7, 129.1 (3C), 128.2 (2C), 128.1, 127.8, 127.3 (2C), 127.0, 126.8, 126.1, 117.4, 113.8, 62.8, 43.8, 28.0. IR (solid) 3020, 2916, 2853, 1593, 1503, 1381, 1250, 746 cm^{-1}. MS (FAB) *m/z* (rel intensity) 286 (M+H$^+$, 40), 285 (M$^+$, 60), 208 (45), 154 (100), 136 (65), 107 (15). HRMS (FAB) Calcd for $C_{21}H_{20}N$ (M+H$^+$): 286.1590, found, 286.1574.

1-Phenyl-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (3)[2]



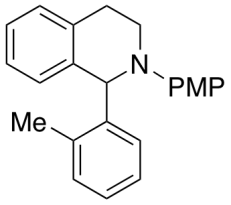
127.0 mg (>99%). Colorless viscous oil. R_f = 0.53 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35-7.10 (11H, m), 6.74 (2H, d, *J* = 9.0 Hz), 5.75 (1H, s), 3.69 (1H, dt, *J* = 11.2, 5.4 Hz), 3.46 (1H, ddd, *J* = 11.2, 8.3, 5.9 Hz), 3.00-2.85 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 148.1, 142.6, 137.6, 135.5, 128.2 (2C), 128.3, 128.1, 127.7, 127.2, 127.1 (2C), 126.9, 126.3 (2C), 122.2, 115.0 (2C), 62.9, 44.1, 28.0. IR (neat) 3024, 2909, 2843, 1593, 1491, 1383, 1331, 1217 cm^{-1}. MS (FAB) *m/z* (rel intensity) 320 (M+H$^+$, 65), 319 (M$^+$, 100), 242 (80), 179 (15), 165 (15), 115 (10). HRMS (FAB) Calcd for $C_{21}H_{19}ClN$ (M+H$^+$): 320.1201, found, 320.1207.

1-Phenyl-2-benzyl-1,2,3,4-tetrahydroisoquinoline (4)[1]



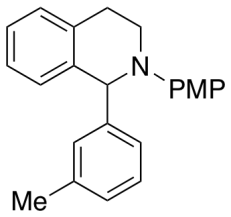
97.8 mg (82%). White solid. R_f = 0.48 (AcOEt/*n*-Hexane, 1 : 10). M.p. 106–109 °C (lit.[1] M.p. 106–109 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50-7.17 (10H, m), 7.17-7.05 (2H, m), 6.99 (1H, t, *J* = 7.8 Hz), 6.72 (1H, d, *J* = 7.8 Hz), 4.60 (1H, s), 3.81 (1H, d, *J* = 13.6 Hz), 3.24 (1H, d, *J* = 13.6 Hz), 3.15-3.00 (2H, m), 2.82-2.70 (1H, m), 2.60-2.45 (1H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.4, 139.6, 138.5, 134.8, 129.6 (2C), 128.8, 128.7 (2C), 128.4, 128.3 (2C), 128.1 (2C), 127.2, 126.8, 125.9, 125.6, 68.8, 58.8, 47.3, 29.2. IR (solid) 3027, 2930, 2808, 1598, 1489, 1450, 1256, 1123 cm^{-1}. MS (FAB) *m/z* (rel intensity) 300 ($M+H^+$, 40), 298 (65), 222 (95), 154 (20), 136 (20), 91 (100). HRMS (FAB) Calcd for $C_{22}H_{22}N$ ($M+H^+$): 300.1747, found, 300.1777.

1-(2-Tolyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (5)[1]



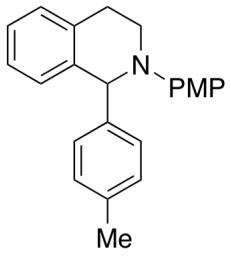
125.7 mg (95%). White solid. R_f = 0.40 (EtOAc/*n*-Hexane, 1 : 10). M.p. 124–126 °C (lit.[1] M.p. 124–126 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.05 (5H, m), 7.05-6.97 (1H, m), 6.97-6.90 (1H, m), 6.92 (2H, d, *J* = 8.9 Hz), 6.80-6.70 (1H, m), 6.74 (2H, d, *J* = 8.9 Hz), 5.65 (1H, s), 3.72 (3H, s), 3.52-3.35 (2H, m), 2.87 (1H, ddd, *J* = 16.4, 8.8, 5.9 Hz), 2.76 (1H, dt, *J* = 16.4, 4.4 Hz), 2.30 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.1, 144.7, 142.2, 137.7, 136.9, 135.9, 130.5, 130.1, 128.9, 128.5, 126.9, 126.3, 125.9, 125.2, 121.3 (2C), 114.2 (2C), 61.5, 55.4, 46.0, 26.3, 19.6. IR (solid) 3015, 2928, 2833, 1580, 1504, 1240, 1194, 1128 cm^{-1}. MS (FAB) *m/z* (rel intensity) 330 ($M+H^+$, 45), 329 (M^+, 100), 238 (60), 154 (25), 136 (20). HRMS (FAB) Calcd for $C_{23}H_{24}NO$ ($M+H^+$): 330.1852, found, 330.1860. Anal Calcd for $C_{23}H_{23}NO$: C, 83.85; H, 7.04. Found: C, 83.60; H, 7.38.

1-(3-Tolyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (6)[1]



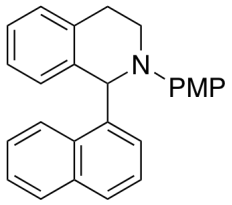
131.0 mg (99%). Colorless viscous oil. R_f = 0.39 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22-7.05 (5H, m), 7.05-6.90 (3H, m), 6.85-6.75 (4H, m), 5.62 (1H, s), 3.74 (3H, s), 3.59 (1H, ddd, *J* = 11.7, 6.3, 5.6 Hz), 3.41 (1H, ddd, *J* = 11.7, 6.8, 5.4 Hz), 3.05-2.85 (2H, m), 2.25 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.7, 144.4, 143.4, 137.7, 137.6, 135.5, 128.6, 128.3, 128.1, 127.9, 127.6, 126.6, 126.0, 125.1, 117.4 (2C), 114.5 (2C), 64.2, 55.6, 44.5, 28.0, 21.5. IR (neat) 3020, 2907, 2830, 1603, 1508, 1240, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 330 ($M+H^+$, 55), 329 (M^+, 100), 238 (65), 136 (10), 105 (5). HRMS (FAB) Calcd for $C_{23}H_{24}NO$ ($M+H^+$): 330.1852, found, 330.1829. Anal Calcd for $C_{23}H_{23}NO$: C, 83.85; H, 7.04. Found: C, 84.15; H, 7.13.

1-(4-Tolyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (7)[1]



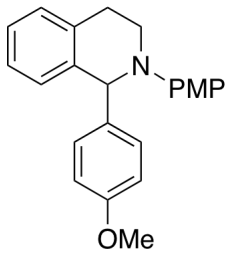
130.9 mg (99%). Colorless viscous oil. R_f = 0.45 (Et_2O/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22-7.10 (4H, m), 7.02 (4H, s), 6.85-6.75 (4H, m), 5.64 (1H, s), 3.74 (3H, s), 3.57 (1H, ddd, *J* = 11.7, 6.6, 5.4 Hz), 3.40 (1H, ddd, *J* = 11.7, 6.6, 5.4 Hz), 3.05-2.85 (2H, m), 2.27 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.8, 144.5, 140.2, 137.8, 136.3, 135.4, 128.7 (2C), 128.3, 128.1, 128.0, 126.6, 125.9 (2C), 117.7 (2C), 114.4 (2C), 64.0, 55.6, 44.4, 28.1, 21.0. IR (neat) 3022, 2926, 2841, 1665, 1510, 1258, 1175, 1130 cm^{-1}. MS (FAB) *m/z* (rel intensity) 330 ($M+H^+$, 65), 329 (M^+, 100), 238 (75), 147 (20), 73 (50). HRMS (FAB) Calcd for $C_{23}H_{24}NO$ ($M+H^+$): 330.1852, found, 330.1845.

1-(1-Naphthyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (8)[1]



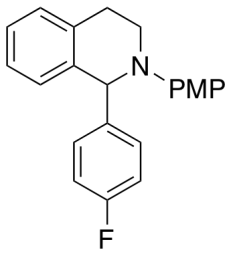
97.8 mg (67%). White solid. R_f = 0.31 (EtOAc/*n*-Hexane, 1 : 10). M.p. 172–174 °C (lit.[1] M.p. 172–174 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (1H, dd, *J* = 7.7, 1.7 Hz), 7.84 (1H, dd, *J* = 6.8, 2.4 Hz), 7.72 (1H, d, *J* = 8.1 Hz), 7.50-7.35 (2H, m), 7.30-7.10 (5H, m), 7.02 (1H, d, *J* = 8.1 Hz), 6.99 (2H, d, *J* = 9.0 Hz), 6.76 (2H, d, *J* = 9.0 Hz), 6.23 (1H, s), 3.74 (3H, s), 3.60-3.40 (2H, m), 2.91 (1H, dt, *J* = 16.6, 8.3 Hz), 2.76 (1H, dt, *J* = 16.6, 3.9 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.0, 144.3, 139.9, 136.7, 136.1, 134.0, 132.3, 129.0, 128.7, 128.6, 128.2, 128.0, 126.6, 126.1, 126.0, 125.5, 124.8, 124.7, 120.9 (2C), 114.4 (2C), 60.8, 55.4, 45.9, 25.8. IR (solid) 3046, 2914, 2830, 1595, 1510, 1506, 1238, 1032 cm^{-1}. MS (FAB) *m/z* (rel intensity) 366 ($M+H^+$, 5), 365 (M^+, 20), 307 (25), 154 (100), 136 (65). HRMS (FAB) Calcd for $C_{26}H_{24}NO$ ($M+H^+$): 366.1852, found, 366.1860.

1-(4-Methoxyphenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (9)[1]



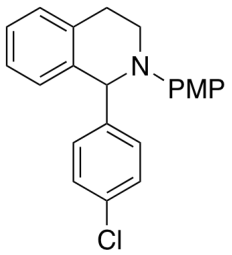
123.4 mg (89%). Colorless viscous oil. R_f = 0.24 (EtOAc/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.05 (4H, m), 7.02 (2H, d, *J* = 8.5 Hz), 6.85-6.74 (4H, m), 6.72 (2H, d, *J* = 8.5 Hz), 5.61 (1H, s), 3.70 (3H, s), 3.69 (3H, s), 3.51 (1H, ddd, *J* = 12.0, 6.8, 5.1 Hz), 3.36 (1H, ddd, *J* = 12.0, 6.6, 5.4 Hz), 3.00-2.83 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.4, 152.9, 144.5, 137.8, 135.3, 135.2, 129.2 (2C), 128.4, 128.0, 126.5, 125.8, 118.2 (2C), 114.4 (2C), 113.2 (2C), 63.9, 55.5, 55.1, 44.3, 28.1. IR (neat) 2995, 2930, 2832, 1607, 1504, 1238, 1169, 1032 cm^{-1}. MS (FAB) *m/z* (rel intensity) 346 ($M+H^+$, 65), 345 (M^+, 100), 344 (40), 238 (90), 136 (10). HRMS (FAB) Calcd for $C_{23}H_{24}NO_2$ ($M+H^+$): 346.1802, found, 346.1802. Anal Calcd for $C_{23}H_{23}NO_2$: C, 79.97; H, 6.71. Found: C, 74.66; H, 6.74.

1-(4-Fluorophenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (10)[1]



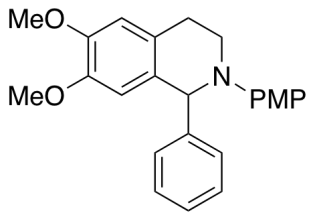
130.3 mg (98%). White solid. R_f = 0.50 (EtOAc/*n*-Hexane, 1 : 9). M.p. 107–109 °C (lit.[1] M.p. 107–109 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.10 (3H, m), 7.10-7.00 (3H, m), 6.90-6.75 (6H, m), 5.61 (1H, s), 3.74 (3H, s), 3.50 (1H, dd, *J* = 12.0, 6.8, 5.1 Hz), 3.38 (1H, ddd, *J* = 12.0, 6.6, 5.4 Hz), 3.05-2.85 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.7 (d, *J* = 245.0 Hz), 153.2, 144.3, 138.8 (d, *J* = 2.5 Hz), 137.4, 135.4, 129.7 (2C, d, *J* = 8.3 Hz), 128.5, 128.1, 126.8, 126.0, 118.5 (2C), 114.7 (2C, d, *J* = 21.5 Hz), 114.4 (2C), 64.0, 55.6, 44.6, 28.2. IR (solid) 3036, 2926, 2820, 1601, 1502, 1452, 1225, 1032 cm^{-1}. MS (FAB) *m/z* (rel intensity) 334 ($M+H^+$, 35), 333 (M^+, 100), 332 (20), 238 (40), 136 (5). HRMS (FAB) Calcd for $C_{22}H_{21}FNO$ ($M+H^+$): 334.1602, found, 334.1607. Anal Calcd for $C_{22}H_{20}FNO \cdot 1/4\ H_2O$: C, 78.20; H, 6.12. Found: C, 78.33; H, 6.18.

1-(4-Chlorophenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (11)[1]



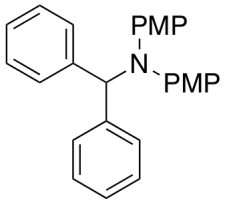
131.7 mg (94%). Colorless viscous oil. R_f = 0.30 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22-7.00 (8H, m), 6.80 (4H, d, *J* = 1.5 Hz), 5.60 (1H, s), 3.74 (3H, s), 3.51 (1H, ddd, *J* = 11.7, 6.6, 5.4 Hz), 3.38 (1H, ddd, *J* = 11.7, 6.6, 5.4 Hz), 3.05-2.85 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.2, 144.2, 141.7, 137.2, 135.4, 132.6, 129.5 (2C), 128.5, 128.1 (2C), 128.0, 126.9, 126.1, 118.3 (2C), 114.5 (2C), 64.0, 55.6, 44.7, 28.2. IR (neat) 3025, 2930, 2832, 1508, 1487, 1240, 1090, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 350 ($M+H^+$, 60), 349 (M^+, 100), 238 (75), 154 (20), 136 (20). HRMS (FAB) Calcd for $C_{22}H_{21}ClNO$ ($M+H^+$): 350.1306, found, 350.1327. Anal Calcd for $C_{22}H_{20}ClNO$: C, 75.53; H, 5.76. Found: C, 75.80; H, 5.78.

1-Phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (12)[1]



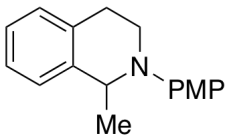
148.8 mg (99%). White solid. R_f = 0.24 (EtOAc/*n*-Hexane, 1 : 5). M.p. 112–114 °C (lit.[1] M.p. 112–114 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30-7.05 (5H, m), 6.85 (2H, d, *J* = 9.2 Hz), 6.78 (2H, d, *J* = 9.2 Hz), 6.65 (1H, s), 6.59 (1H, s), 5.58 (1H, s), 3.87 (3H, s), 3.79 (3H, s), 3.74 (3H, s), 3.50-3.30 (2H, m), 2.90 (1H, ddd, *J* = 15.9, 8.1, 5.9 Hz), 2.77 (1H, dt, *J* = 15.9, 5.1 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.2, 147.8, 147.2, 144.6, 143.2, 129.0, 128.4 (2C), 127.9 (2C), 127.6, 126.8, 118.7 (2C), 114.4 (2C), 111.3, 111.2, 64.0, 56.0, 55.9, 55.6, 44.1, 27.2. IR (solid) 2905, 2828, 1609, 1506, 1449, 1373, 1236, 1118 cm^{-1}. MS (FAB) *m/z* (rel intensity) 376 ($M+H^+$, 45), 375 (M^+, 100), 298 (70), 154 (10), 136 (10). HRMS (FAB) Calcd for $C_{24}H_{26}NO_3$ ($M+H^+$): 376.1907, found, 376.1919.

***N,N*-Di-(4-methoxyphenyl)-1,1-diphenylmethylamine (13)**[1]



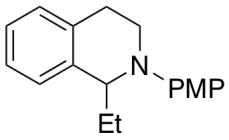
152.3 mg (96%). Pale yellow viscous oil. R_f = 0.28 (EtOAc/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30-7.10 (10H, m), 6.75 (4H, d, *J* = 7.7 Hz), 6.65 (4H, d, *J* = 7.7 Hz), 6.17 (1H, s), 3.69 (6H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.4 (2C), 141.7 (4C), 129.3 (4C), 128.0 (4C), 126.8 (2C), 124.5 (4C), 114.0 (4C), 69.5, 55.4 (2C). IR (neat) 3390, 3028, 2951, 2833, 1501, 1236, 1179, 1030 cm^{-1}. MS (FAB) *m/z* (rel intensity) 396 ($M+H^+$, 30), 395 (M^+, 70), 319 (30), 228 (100), 167 (65). HRMS (FAB) Calcd for $C_{27}H_{26}NO_2$ ($M+H^+$): 396.1958, found, 396.1928. Anal Calcd for $C_{27}H_{25}NO_2$•1/3H_2O: C, 80.77; H, 6.44. Found: C, 81.02; H, 6.38.

1-Methyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (14)[3]



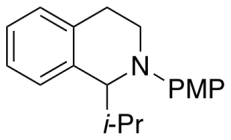
99.7 mg (98%). Colorless oil. R_f = 0.39 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.10 (4H, m), 6.92 (2H, d, *J* = 9.0 Hz), 6.85 (2H, d, *J* = 9.0 Hz), 4.77 (1H, q, *J* = 6.6 Hz), 3.77 (3H, s), 3.49 (1H, ddd, *J* = 12.5, 6.1, 3.9 Hz), 3.42 (1H, ddd, *J* = 12.5, 9.5, 4.2 Hz), 3.01 (1H, ddd, *J* = 16.1, 9.5, 6.1 Hz), 2.83 (1H, ddd, *J* = 16.1, 4.2, 3.9 Hz), 1.33 (3H, d, *J* = 6.6 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.0, 144.5, 140.1, 134.3, 128.8, 126.9, 126.1, 125.8, 118.4 (2C), 114.6 (2C), 55.6 (2C), 42.0, 28.4, 20.1. IR (neat) 2967, 2830, 1508, 1464, 1383, 1240, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 254 ($M+H^+$, 50), 253 (M^+, 100), 252 (25), 238 (75), 136 (10). HRMS (FAB) Calcd for $C_{17}H_{20}NO$ ($M+H^+$): 254.1539, found, 254.1546.

1-Ethyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (15)



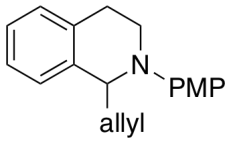
106.3 mg (99%). Colorless oil. R_f = 0.55 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.05 (4H, m), 6.90-6.75 (4H, m), 4.40 (1H, t, *J* = 6.8 Hz), 3.74 (3H, s), 3.60-3.45 (2H, m), 2.95 (1H, ddd, *J* = 16.1, 8.9, 5.7 Hz), 2.75 (1H, dm, *J* = 16.1 Hz), 2.00-1.85 (1H, m), 1.80-1.65 (1H, m), 0.98 (3H, t, *J* = 7.3 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.2, 144.7, 139.0, 134.9, 128.6, 127.3, 126.1, 125.6, 116.9 (2C), 114.6 (2C), 61.3, 55.7, 42.9, 29.4, 26.8, 11.4. IR (neat) 2930, 2830, 1506, 1464, 1391, 1238, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 268 ($M+H^+$, 30), 267 (M^+, 50), 266 (25), 238 (100), 136 (5). HRMS (FAB) Calcd for $C_{18}H_{22}NO$ ($M+H^+$): 268.1696, found, 268.1699.

1-Isopropyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (16)



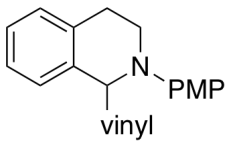
108.9 mg (97%). Colorless oil. R_f = 0.58 (EtOAc/*n*-Hexane, 1 : 9). M.p. 59–60 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.00 (4H, m), 6.90-6.70 (4H, m), 4.20 (1H, d, *J* = 8.1 Hz), 3.73 (3H, s), 3.69 (1H, ddd, *J* = 12.7, 6.6, 6.1 Hz), 3.44 (1H, ddd, *J* = 12.7, 6.3, 6.1 Hz), 3.00-2.80 (2H, m), 2.10 (1H, dq, *J* = 8.1, 6.8 Hz), 1.06 (3H, d, *J* = 6.8 Hz), 0.93 (3H, d, *J* = 6.8 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.7, 145.1, 137.8, 135.4, 128.4, 128.4, 126.4, 125.1, 115.8 (2C), 114.6 (2C), 65.4, 55.7, 43.6, 34.3, 26.9, 20.6, 20.2. IR (neat) 2953, 2830, 1506, 1464, 1382, 1240, 1180, 1038 cm^{-1}. MS (FAB) *m/z* (rel intensity) 282 ($M+H^+$, 20), 281 (M^+, 20), 280 (20), 238 (100), 236 (10). HRMS (FAB) Calcd for $C_{19}H_{24}NO$ ($M+H^+$): 282.1852, found, 282.1852.

1-Allyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (17)[4]



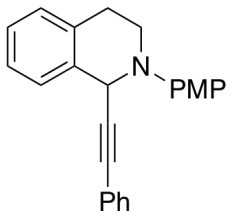
79.6 mg (71%). Colorless oil. R_f = 0.44 (EtOAc/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.00 (4H, m), 6.88 (2H, d, *J* = 9.0 Hz), 6.82 (2H, d, *J* = 9.0 Hz), 5.95-5.75 (1H, m), 5.10-4.95 (2H, m), 4.61 (1H, t, *J* = 6.6 Hz), 3.75 (3H, s), 3.65-3.45 (2H, m), 2.98 (1H, ddd, *J* = 16.1, 9.3, 6.1 Hz), 2.78 (1H, ddd, *J* = 16.1, 4.6, 4.4 Hz), 2.72-2.60 (1H, m), 2.53-2.40 (1H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.5, 144.4, 138.3, 136.1, 134.9, 128.7, 127.3, 126.3, 125.6, 117.3 (2C), 116.6, 114.6 (2C), 60.1, 55.7, 42.8, 40.6, 27.1. IR (neat) 3022, 2909, 2832, 1506, 1464, 1240, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 280 ($M+H^+$, 15), 279 (M^+, 15), 238 (100), 154 (15), 136 (10). HRMS (FAB) Calcd for $C_{19}H_{22}NO$ ($M+H^+$): 280.1696, found, 280.1696.

1-Vinyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (18)



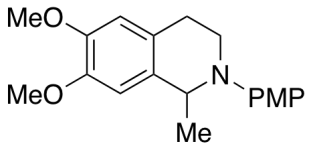
103.9 mg (98%). Colorless oil. R_f = 0.40 (EtOAc/*n*-Hexane, 1 : 90). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22-7.10 (4H, m), 6.89 (2H, d, *J* = 9.0 Hz), 6.83 (2H, d, *J* = 9.0 Hz), 5.94 (1H, ddd, *J* = 17.1, 10.3, 5.6 Hz), 5.11 (1H, d, *J* = 10.3 Hz), 5.07 (1H, d, *J* = 5.6 Hz), 5.04 (1H, d, *J* = 17.1 Hz), 3.76 (3H, m), 3.60-3.40 (2H, m), 2.98 (1H, ddd, *J* = 15.9, 8.1, 5.6 Hz), 2.86 (1H, dt, *J* = 15.9, 5.1 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.8, 144.3, 138.6, 136.3, 135.2, 128.5, 127.8, 126.6, 125.9, 117.6 (2C), 116.1, 114.5 (2C), 63.0, 55.6, 43.7, 28.3. IR (neat) 3001, 2905, 2830, 1508, 1462, 1240, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 266 ($M+H^+$, 40), 265 (M^+, 100), 238 (55), 136 (10), 91 (5). HRMS (FAB) Calcd for $C_{18}H_{20}NO$ ($M+H^+$): 266.1539, found, 266.1540.

1-Phenylethynyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (19)[5]



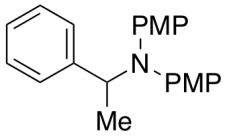
62.6 mg (46%). Pale yellow solid. R_f = 0.30 (EtOAc/*n*-Hexane, 1 : 10). M.p. 103–104 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40-7.15 (9H, m), 7.11 (2H, d, *J* = 9.0 Hz), 6.89 (2H, d, *J* = 9.0 Hz), 5.50 (1H, s), 3.78 (3H, s), 3.63 (1H, ddd, *J* = 12.2, 10.7, 4.2 Hz), 3.54 (1H, ddd, *J* = 12.2, 6.1, 3.2 Hz), 3.14 (3H, ddd, *J* = 15.6, 10.7, 6.1 Hz), 2.92 (1H, ddd, *J* = 15.6, 4.2, 3.2 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.2, 144.1, 135.4, 134.0, 131.7 (2C), 129.0, 128.0 (2C), 127.9, 127.5, 127.1, 126.1, 123.0, 120.2 (2C), 114.3 (2C), 88.4, 85.5, 55.5, 54.4, 44.2, 20.0. IR (solid) 3022, 2907, 2832, 1506, 1441, 1240, 1180, 1034 cm^{-1}. MS (FAB) *m/z* (rel intensity) 340 ($M+H^+$, 45), 339 (M^+, 100), 238 (15), 154 (45), 136 (30). HRMS (FAB) Calcd for $C_{24}H_{22}NO$ ($M+H^+$): 340.1696, found, 340.1693.

1-Methyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (20)



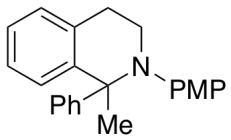
119.5 mg (95%). White solid. R_f = 0.33 (EtOAc/*n*-Hexane, 1 : 3). M.p. 83–85 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.92 (2H, d, *J* = 9.0 Hz), 6.84 (2H, d, *J* = 9.0 Hz), 6.61 (2H, d, *J* = 3.7 Hz), 4.69 (1H, q, *J* = 6.8 Hz), 3.87 (3H, s), 3.85 (3H, s), 3.76 (3H, s), 3.48 (1H, ddd, *J* = 12.4, 5.9, 3.4 Hz), 3.40 (1H, ddd, *J* = 12.4, 10.3, 4.2 Hz), 2.92 (1H, ddd, *J* = 15.9, 10.3, 5.9 Hz), 2.70 (1H, ddd, *J* = 15.9, 4.2, 3.4 Hz), 1.32 (3H, d, *J* = 6.8 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.0, 147.4, 147.2, 144.5, 131.9, 126.1, 118.7 (2C), 114.5 (2C), 111.3, 109.8, 55.9, 55.8, 55.6, 55.2, 42.0, 27.8, 20.0. IR (solid) 2961, 2832, 1611, 1508, 1464, 1383, 1244, 1126 cm^{-1}. MS (FAB) *m/z* (rel intensity) 314 ($M+H^+$, 40), 313 (M^+, 50), 298 (50), 154 (100), 137 (70). HRMS (FAB) Calcd for $C_{19}H_{24}NO_3$ ($M+H^+$): 314.1751, found, 314.1758. Anal Calcd for $C_{19}H_{23}NO_3$•1/4H_2O: C, 71.79; H, 7.45. Found: C, 72.00; H, 7.69.

***N,N*-Di-(4-methoxyphenyl)-1-phenylethylamine (21)**



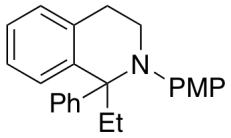
127.0 mg (95%). Colorless oil. R_f = 0.38 (EtOAc/*n*-Hexane, 1 : 9). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40-7.15 (5H, m), 7.85-7.70 (8H, m), 5.13 (1H, q, *J* = 6.8 Hz), 3.75 (6H, s), 1.42 (3H, d, *J* = 6.8 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.5 (2C), 144.5, 141.2 (2C), 128.3 (2C), 127.0 (2C), 126.6, 124.1 (4C), 114.2 (4C), 58.0 (2C), 55.5, 20.2. IR (neat) 3040, 2932, 2833, 1501, 1464, 1281, 1236, 1034 cm^{-1}. MS (FAB) *m/z* (rel intensity) 334 ($M+H^+$, 30), 333 (M^+, 100), 228 (55), 214 (5), 105 (30). HRMS (FAB) Calcd for $C_{22}H_{24}NO_2$ ($M+H^+$): 334.1802, found, 334.1807. Anal Calcd for $C_{22}H_{23}NO_2$•1/4H_2O: C, 78.19; H, 7.01. Found: C, 78.33; H, 7.10.

1-Methyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (22)



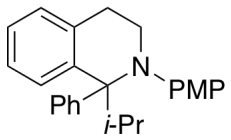
130.1 mg (99%). White solid. R_f = 0.53 (EtOAc/*n*-Hexane, 1 : 10). M.p. 107–108 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.00 (8H, m), 6.83 (1H, d, *J* = 7.8 Hz), 6.60 (2H, d, *J* = 9.0 Hz), 6.53 (2H, d, *J* = 9.0 Hz), 3.72 (3H, s), 3.44 (1H, ddd, *J* = 12.0, 8.8, 4.2 Hz), 3.32 (1H, ddd, *J* = 12.0, 5.1, 4.9 Hz), 3.17 (1H, ddd, *J* = 16.1, 8.8, 4.9 Hz), 2.97 (1H, ddd, *J* = 16.1, 5.1, 4.2 Hz), 1.70 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.8, 148.4, 144.5, 143.2, 134.5, 129.0, 128.7 (2C), 128.4, 127.8 (2C), 127.4 (2C), 126.4, 125.7, 125.6, 112.8 (2C), 64.9, 55.2, 46.6, 30.6, 23.3. IR (solid) 2930, 2832, 1508, 1443, 1373, 1244, 1179, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 330 ($M+H^+$, 60), 329 (M^+, 100), 252 (35), 154 (35), 136 (50). HRMS (FAB) Calcd for $C_{23}H_{24}NO$ ($M+H^+$): 330.1852, found, 330.1857.

1-Ethyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (23)



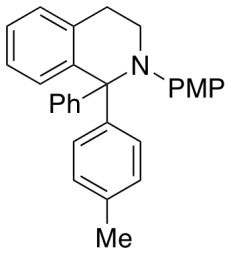
134.8 mg (98%). Colorless oil. R_f = 0.55 (EtOAc/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.20-7.00 (6H, m), 6.95-6.85 (3H, m), 6.62 (2H, d, *J* = 9.0 Hz), 6.49 (2H, d, *J* = 9.0 Hz), 3.74 (3H, s), 3.52 (1H, ddd, *J* = 11.6, 10.3, 3.2 Hz), 3.18 (1H, ddd, *J* = 11.5, 10.3, 5.1 Hz), 3.04 (1H, ddd, *J* = 11.6, 5.1, 3.4 Hz), 2.85 (1H, ddd, *J* = 11.5, 3.4, 3.2 Hz), 2.56 (1H, dq, *J* = 13.9, 7.1 Hz), 2.05 (1H, dq, *J* = 13.9, 7.1 Hz), 0.86 (3H, d, *J* = 7.1 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.0, 145.6, 143.0, 141.5, 136.8, 128.5 (2C), 128.4, 128.1, 128.1 (2C), 126.9 (2C), 126.2, 125.9, 125.5, 112.8 (2C), 67.8, 55.3, 46.7, 31.2, 31.0, 8.7. IR (neat) 2932, 2832, 1506, 1443, 1368, 1242, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 344 ($M+H^+$, 35), 343 (M^+, 50), 314 (100), 266 (20), 136 (20). HRMS (FAB) Calcd for $C_{24}H_{26}NO$ ($M+H^+$): 344.2009, found, 344.2011.

1-Isopropyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (24)



93.8 mg (66%). White Solid. R_f = 0.63 (EtOAc/*n*-Hexane, 1 : 10). M.p. 119–122 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.00 (6H, m), 6.89 (1H, d, *J* = 8.1 Hz), 6.74 (2H, d, *J* = 7.1 Hz), 6.56 (2H, d, *J* = 9.0 Hz), 6.41 (2H, d, *J* = 8.8 Hz), 3.73 (3H, s), 3.40-3.20 (2H, m), 2.94 (1H, septet, *J* = 7.1 Hz), 2.90-2.80 (1H, m), 2.75-2.65 (1H, m), 0.99 (3H, d, *J* = 7.1 Hz), 0.99 (3H, d, *J* = 7.1 Hz). ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.4, 143.1, 142.1, 139.1, 138.8, 130.2, 129.5 (2C), 129.4 (2C), 128.0, 126.6 (2C), 126.0, 125.7, 124.1, 112.6 (2C), 72.4, 55.3, 47.7, 33.3, 32.4, 19.5, 17.9. IR (solid) 2949, 2832, 1504, 1443, 1362, 1242, 1182, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 358 ($M+H^+$, 15), 357 (M^+, 10), 314 (100), 154 (35), 136 (30). HRMS (FAB) Calcd for $C_{25}H_{28}NO$ ($M+H^+$): 358.2165, found, 358.2162.

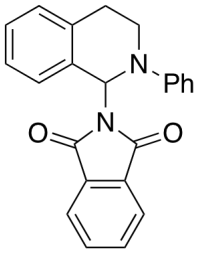
1-(4-Tolyl)-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (25)



82.8 mg (51%). Colorless oil. R_f = 0.60 (EtOAc/*n*-Hexane, 1 : 10). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.25-7.00 (9H, m), 7.00-6.90 (3H, m), 6.64 (1H, d, *J* = 7.3 Hz), 6.48 (2H, d, *J* = 8.9 Hz), 6.42 (2H, d, *J* = 8.9 Hz), 3.67 (3H, s), 3.42 (2H, t, *J* = 5.6 Hz), 3.10 (2H, t, *J* = 5.6 Hz), 2.30 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.3, 144.5, 144.0, 143.9, 140.6, 135.9, 135.1, 130.8 (2C), 130.7 (2C), 130.7, 127.9, 127.6 (2C), 126.8 (2C), 126.4, 125.7, 125.5, 125.0 (2C), 112.7 (2C), 74.5, 55.3, 47.2, 31.0, 21.0. IR (neat) 3021, 2918, 2832, 1609, 1506, 1443, 1244, 1180, 1036 cm^{-1}. MS (FAB) *m/z* (rel intensity) 406 ($M+H^+$, 35), 405 (M^+, 75), 307 (20), 154 (100), 136 (70). HRMS (FAB) Calcd for $C_{29}H_{28}NO$ ($M+H^+$): 406.2165, found, 406.2175.

2-2. sp^3 C-H bond amidation of THIQs

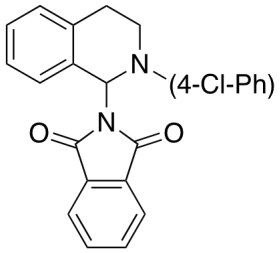
1-(Indene-1,3-dionyl)-2-phenyl-1,2,3,4-tetrahydroisoquinoline (26)



After stirring the mixture of 2-phenyl-1,2,3,4-tetrahydroisoquinoline (83.7 mg, 0.4 mmol) and [bis(trifluoroacetoxy)iodo]benzene (172.1 mg, 0.40 mmol) in 2-MeTHF (4.0 mL) in a vial at room temperature for 10 min under Ar atmosphere, phthalimide (61.8 mg, 0.42 mmol) was added to the solution at room temperature. After stirring vigorously for 3 hours at room temperature, the reaction mixture was quenched with saturated aqueous $NaHCO_3$, and extracted with ethyl acetate. The organic layer was washed with water and brine, dried over Na_2SO_4, filtrated, and concentrated in *vacuo*. The residue was purified by Al_2O_3 column chromatography (*n*-hexane/ethyl acetate = 90/10-70/30) to give 1-(indene-1,3-dionyl)-2-phenyl-1,2,3,4-tetrahydroisoquinoline **26** (141.5 mg, >99%) as pale yellow solid.

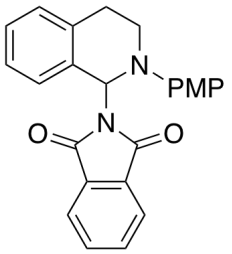
141.5 mg (>99%). Pale yellow solid. R_f = 0.59 (EtOAc/*n*-Hexane, 3 : 7). M.p. 138–139 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80-7.70 (2H, m), 7.70-7.60 (2H, m), 7.30-7.05 (9H, m), 6.82 (1H, d, *J* = 7.3 Hz), 4.11 (2H, ddd, *J* = 12.0, 9.0, 5.9 Hz), 3.82 (1H, ddd, *J* = 12.0, 5.1, 3.9 Hz), 2.20-2.05 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.5 (2C), 147.8, 135.8, 134.0 (2C), 132.6, 131.8 (2C), 129.1 (2C), 128.5, 127.9, 126.4, 126.4, 123.6, 123.3, 119.8, 116.4 (2C), 63.7, 42.1, 29.0. IR (solid) 3059, 2922, 2851, 1701, 1599, 1497, 1342, 1308, 1219 cm^{-1}. MS (FAB) *m/z* (rel intensity) 355 ($M+H^+$, 5), 354 (M^+, 10), 208 (100), 136 (10), 77 (10). HRMS (FAB) Calcd for $C_{23}H_{19}N_2O_2$ ($M+H^+$): 355.1441, found, 355.1434.

1-(Indene-1,3-dionyl)-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (27)



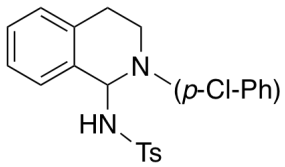
152.9 mg (98%). Pale yellow solid. R_f = 0.47 (EtOAc/*n*-Hexane, 1 : 3). M.p. 57–60 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (2H, d, *J* = 5.4, 2.9 Hz), 7.65 (2H, d, *J* = 5.4, 2.9 Hz), 7.30-6.95 (9H, m), 4.07 (1H, ddd, *J* = 11.7, 7.3, 4.6 Hz), 3.74 (1H, dt, *J* = 11.7, 4.3 Hz), 3.20-3.00 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.4 (2C), 146.4, 135.5, 134.1 (2C), 132.2, 131.6 (2C), 129.0 (2C), 128.5, 128.0, 126.5, 126.3, 124.7, 123.4 (2C), 117.7 (2C), 63.4, 42.3, 28.9. IR (solid) 3028, 2926, 1705, 1595, 1495, 1346, 1288, 1225, 1103 cm^{-1}. MS (FAB) *m/z* (rel intensity) 389 ($M+H^+$, 2), 388 (M^+, 5), 242 (100), 154 (30), 136 (30). HRMS (FAB) Calcd for $C_{23}H_{18}ClN_2O_2$ ($M+H^+$): 389.1051, found, 389.1039.

1-(Indene-1,3-dionyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (28)



>99% (NMR yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80-7.60 (4H, m), 7.30-7.20 (2H, m), 7.20-7.05 (4H, m), 7.00 (1H, s), 6.79 (2H, d, *J* = 9.0 Hz), 4.10-4.00 (1H, m), 3,71 (3H, s), 3.65-3.55 (1H, m), 3.20-3.05 (2H, m). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.6 (2C), 154.1, 142.0, 137.4, 135.8, 133.9 (2C), 130.2 (2C), 128.5, 127.8, 126.4, 126.2, 123.3 (2C), 119.7 (2C), 114.3 (2C), 64.9, 55.4, 43.2, 29.3. IR (neat) 2928, 2833, 1709, 1508, 1464, 1398, 1242, 1036, 941 cm^{-1}. MS (FAB) *m/z* (rel intensity) 385 ($M+H^+$, 5), 384 (M^+, 10), 239 (25), 238 (100), 136 (5). HRMS (FAB) Calcd for $C_{24}H_{21}N_2O_3$ ($M+H^+$): 385.1547, found, 385.1542.

1-(*N*-*p*-Tosyl)-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (29)



95% (NMR yield). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40-7.00 (10H, m), 6.76 (2H, d, *J* = 9.3 Hz), 6.22 (1H, d, *J* = 7.1 Hz), 5.48 (1H, d, *J* = 7.1 Hz), 3.30-3.20 (2H, m), 2.95 (1H, ddd, *J* = 16.6, 8.5, 7.6 Hz), 2.67 (1H, dt, *J* = 16.6, 3.4 Hz), 2.38 (3H, s). ^{13}C NMR (100 MHz, $CDCl_3$) δ 146.7, 142.8, 138.4, 134.6, 133.9, 129.1 (2C), 128.9 (2C), 128.8, 128.4, 128.2, 126.7, 126.5 (2C), 125.5, 119.0 (2C), 69.6, 40.4, 26.8, 21.5. IR (solid) 3265, 3026, 2933, 2859, 1595, 1493, 1425, 1327, 1144 cm^{-1}. MS (FAB) *m/z* (rel intensity) 413 ($M+H^+$, 1), 394 (15), 244 (40), 242 (100), 136 (15). HRMS (FAB) Calcd for $C_{22}H_{22}ClN_2O_2S$ ($M+H^+$): 413.1085, found, 413.1089.

Reference

1. W. Muramatsu, K. Nakano, C.-J. Li, *Org. Lett.,* 2013, **15**, 3650.

2. J. A. Cambell, T. D. Greenwood, S. B. Hendi, M. S. Hendi, P. Hguyen, J. F. Wolfe, *Heterocycl. Comm.,* 1996, **2**, 339.

3. D. Taniyama, M. Hasegawa, K. Tomioka, *Tetrahedron: Asymmetry,* 1999, **10**, 221.

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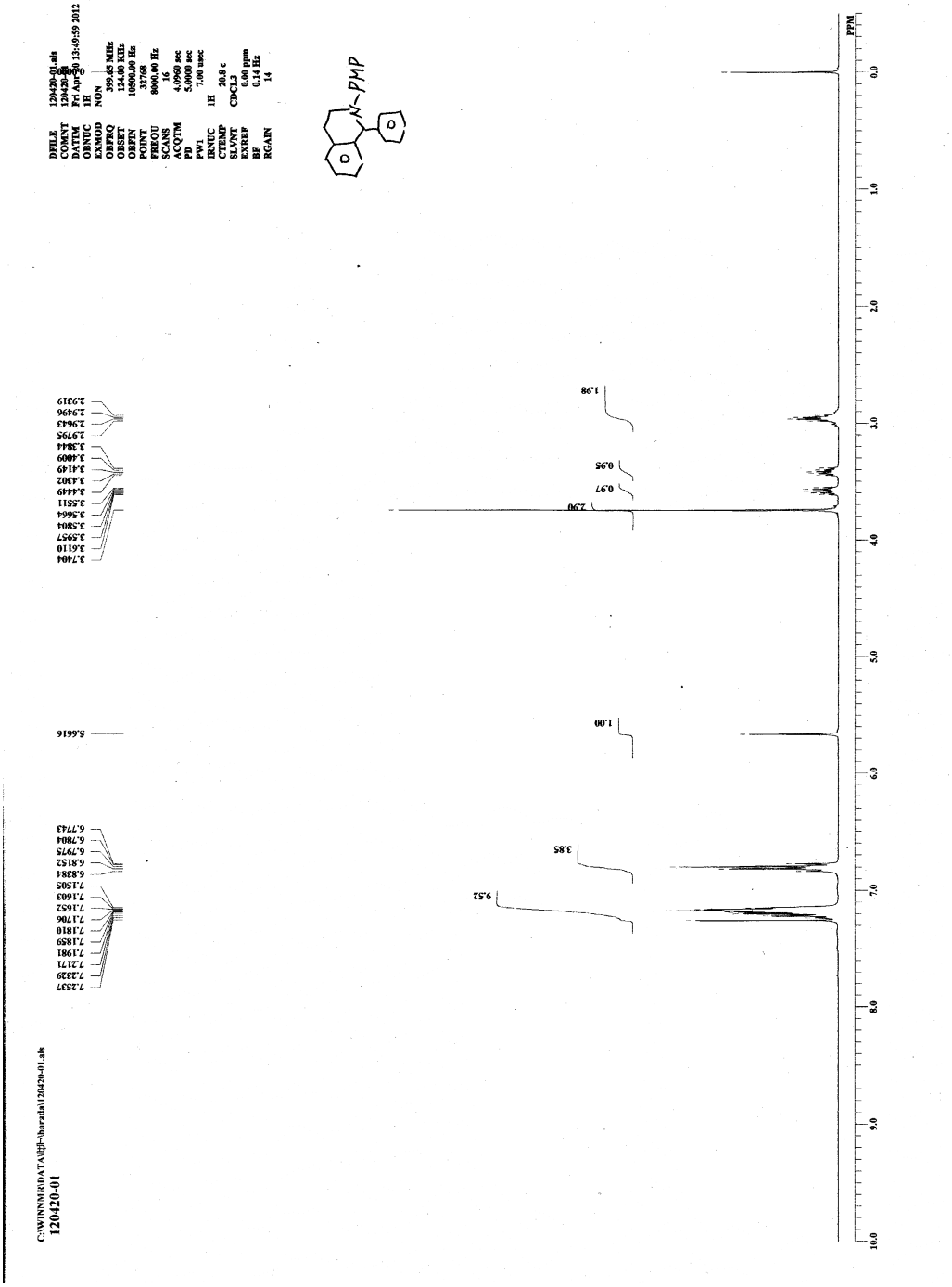
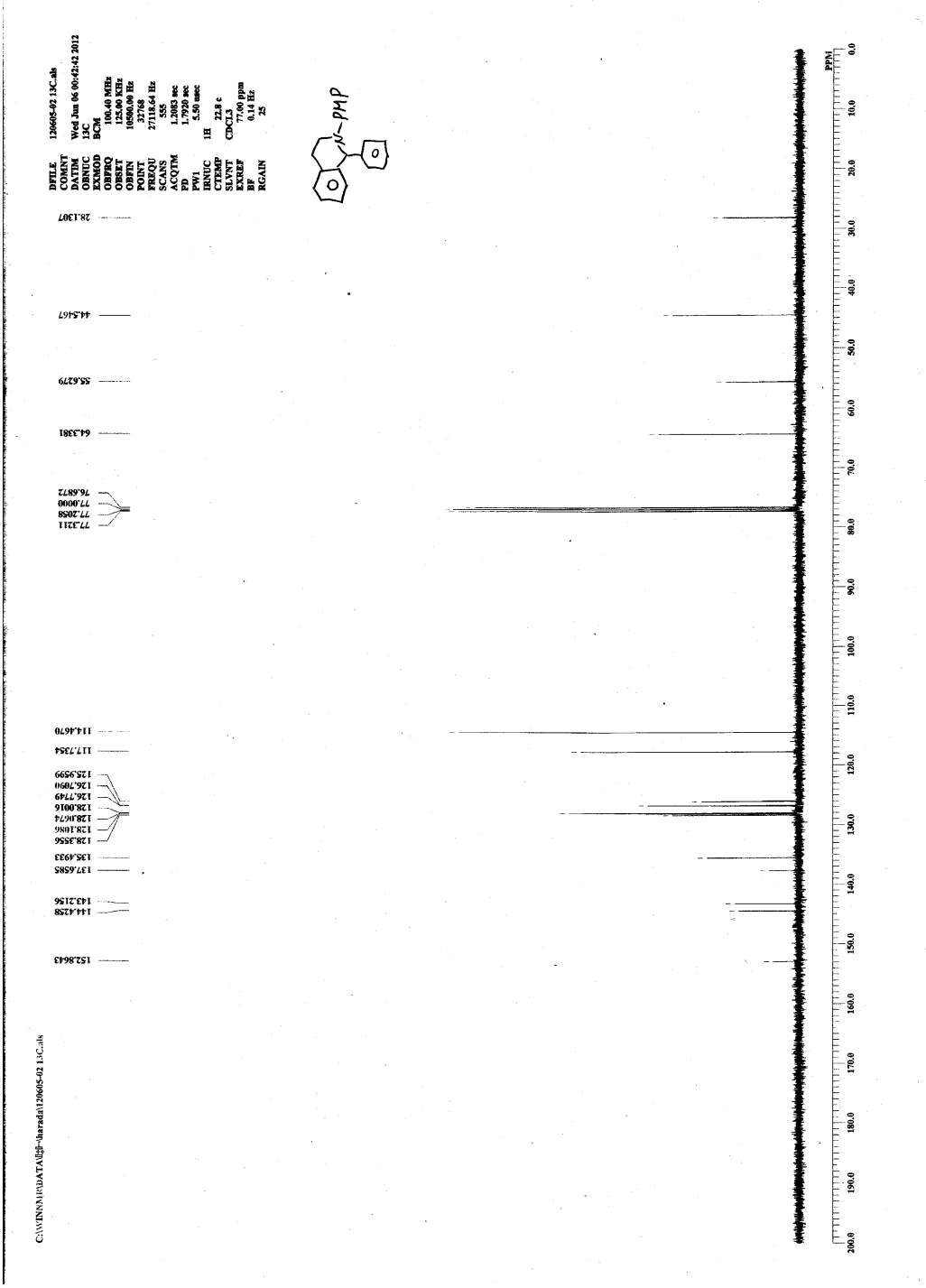
5. Z. Li, C.-J. Li. *Org. Lett.,* 2004, **6**, 4997.

4. PDF file of copies of ^{1}H NMR and ^{13}C NMR spectra for new compounds

1-Phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (1)

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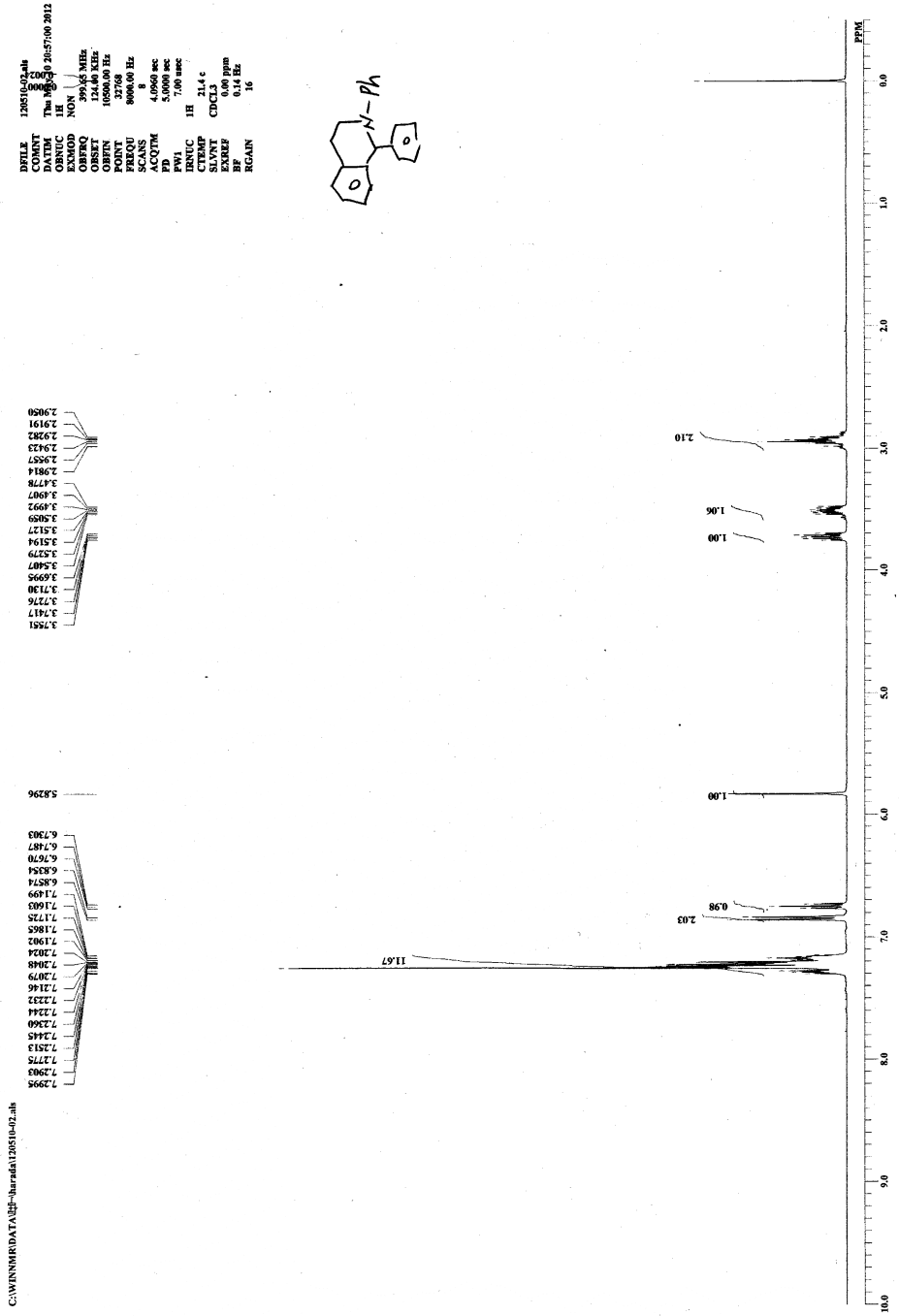
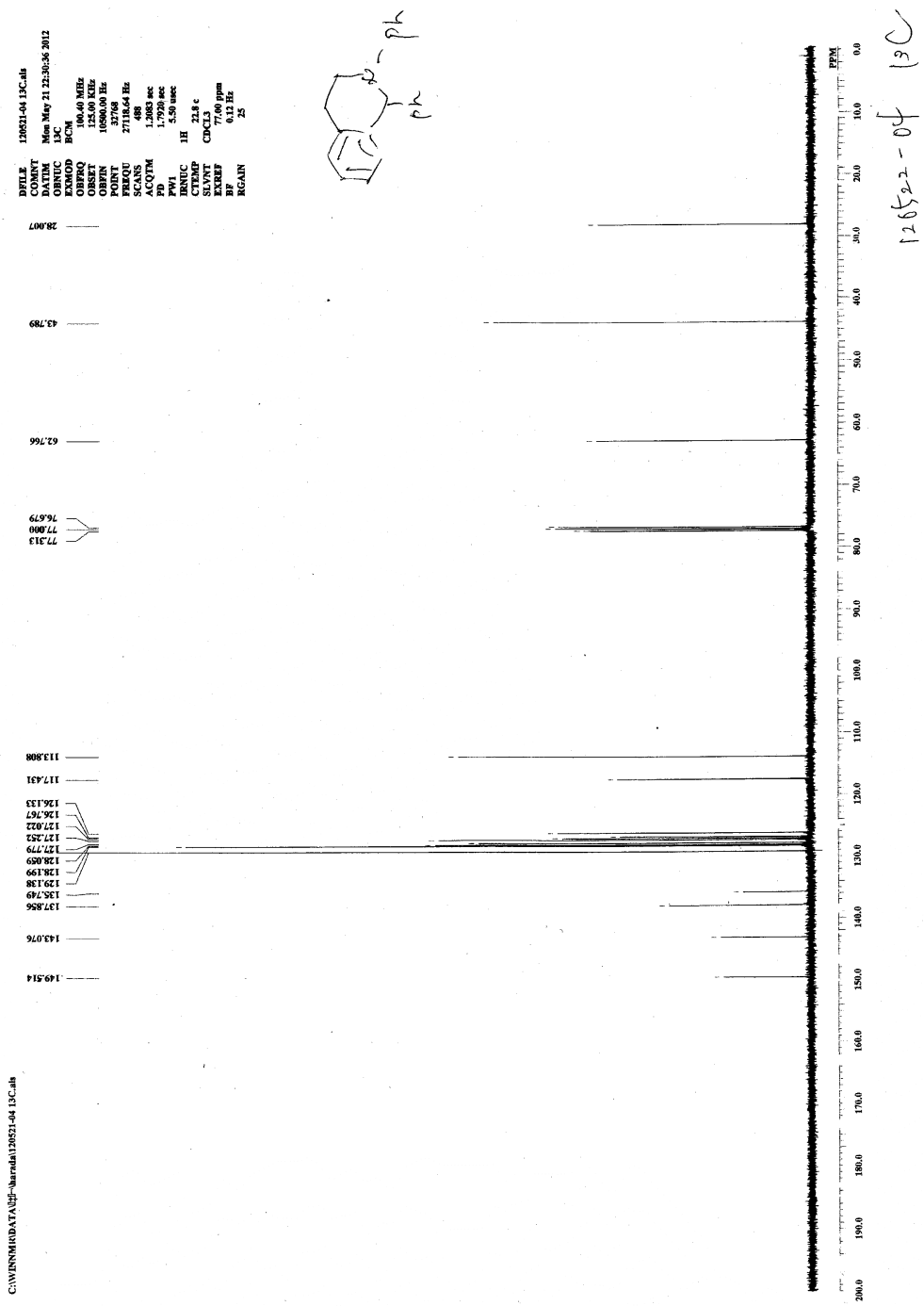
1-Phenyl-2-phenyl-1,2,3,4-tetrahydroisoquinoline (2)

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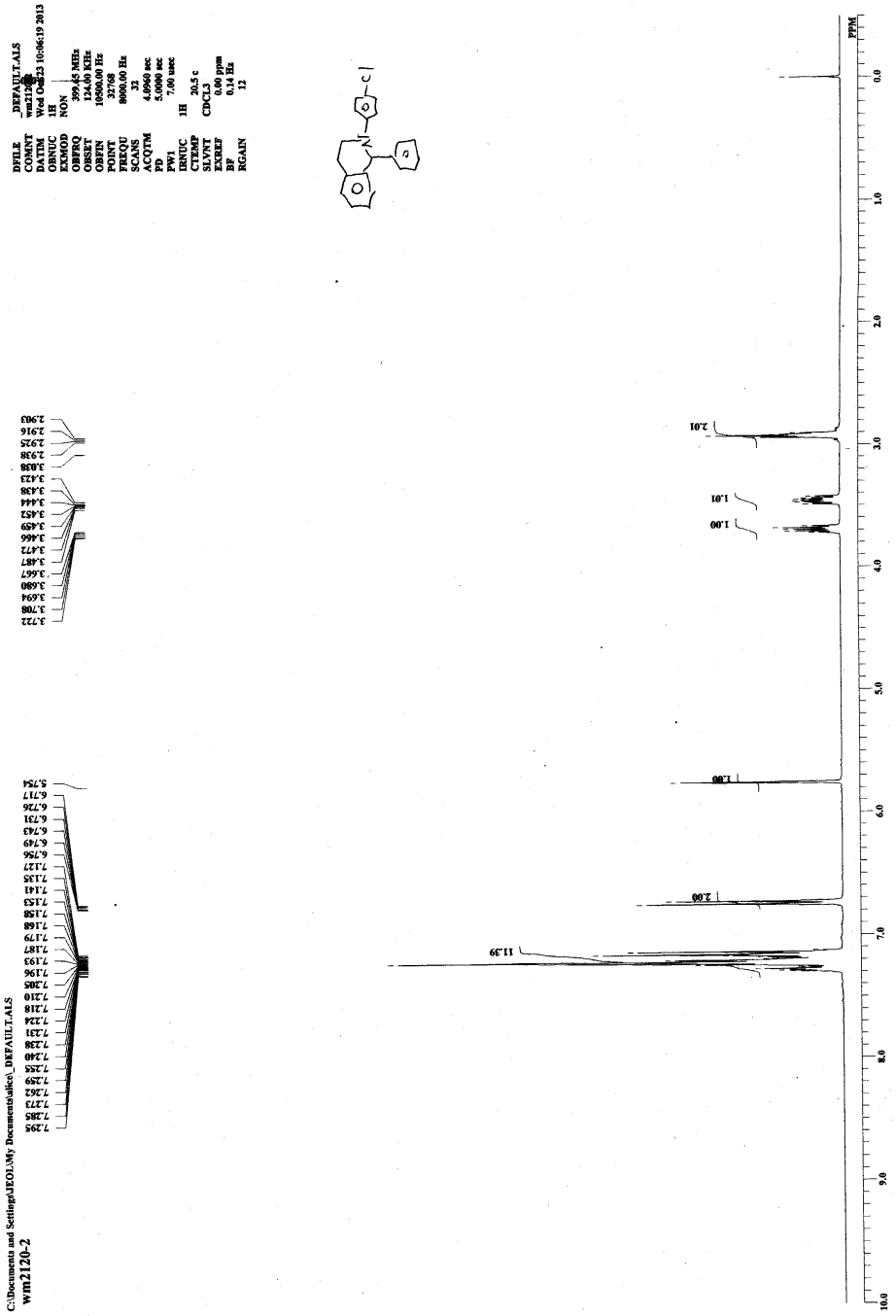
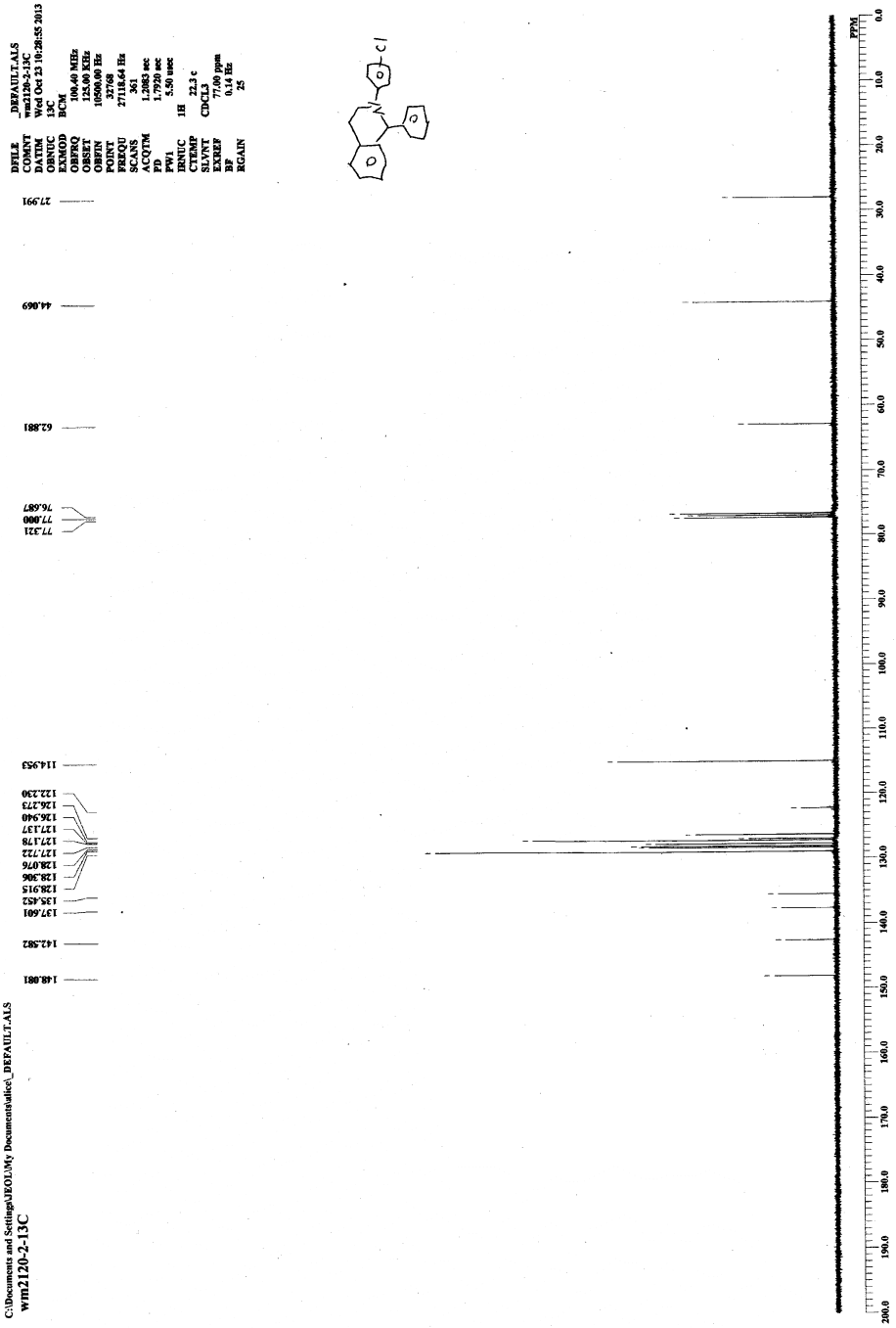
1-Phenyl-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (3)

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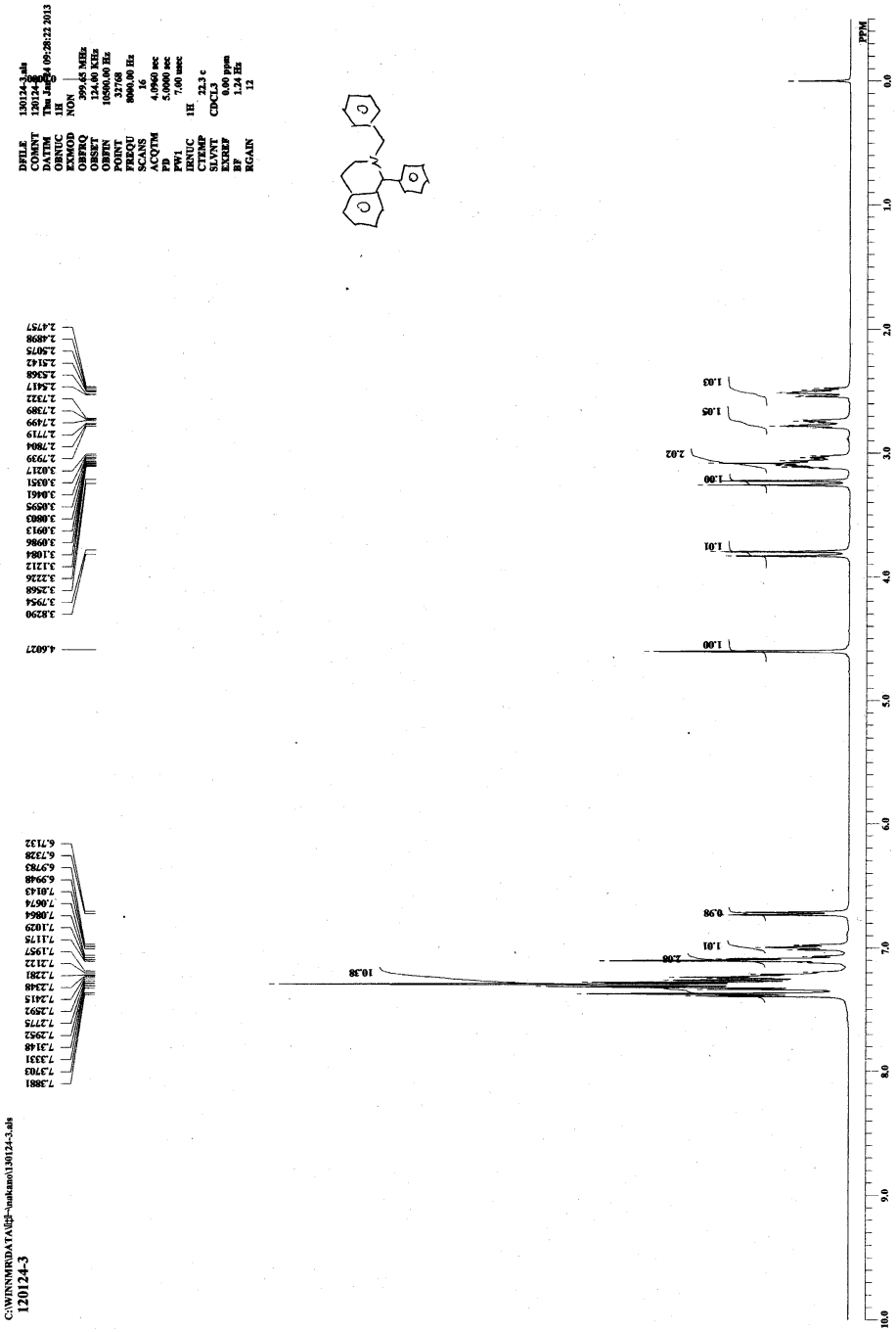
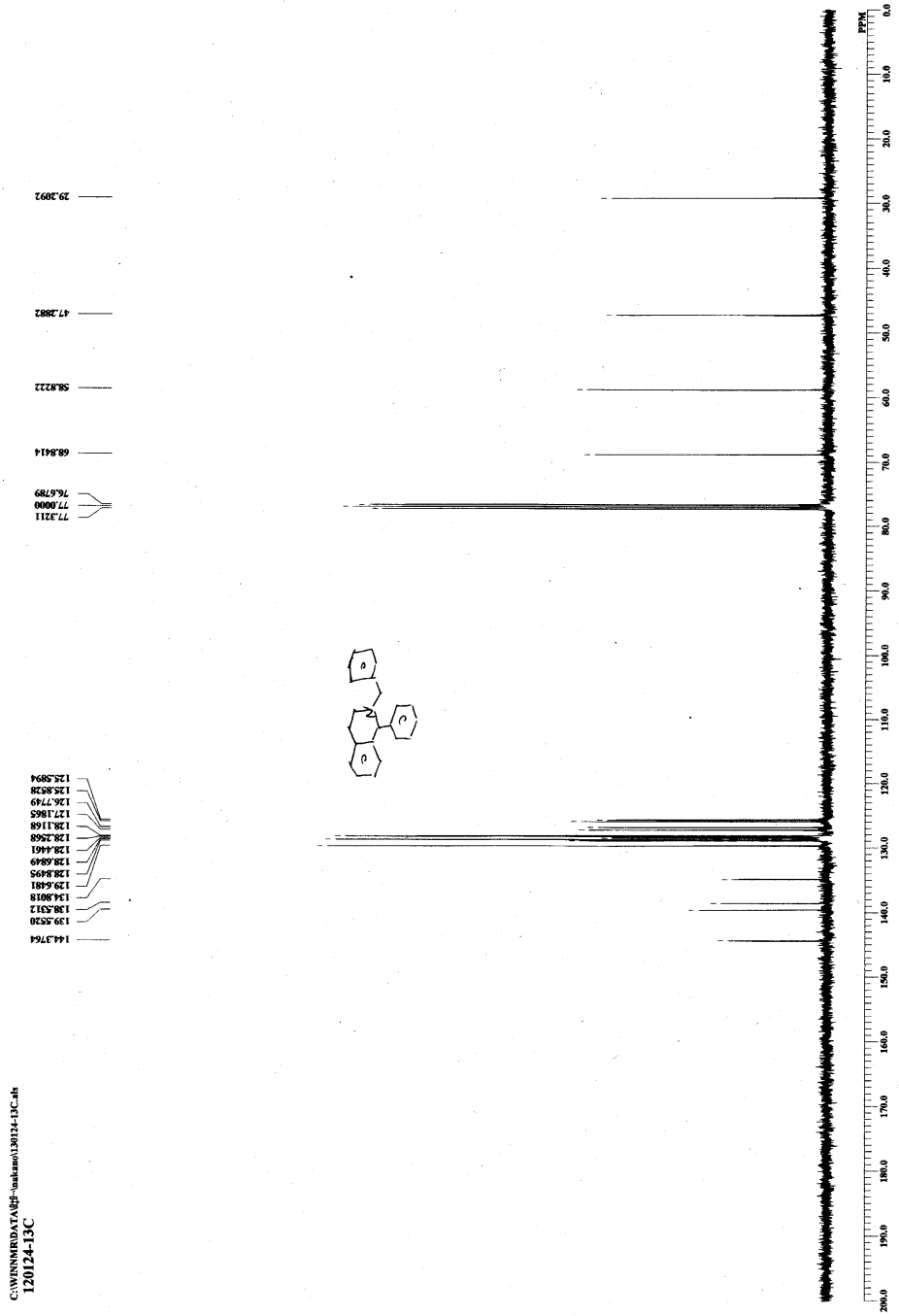
1-Phenyl-2-benzyl-1,2,3,4-tetrahydroisoquinoline (4)

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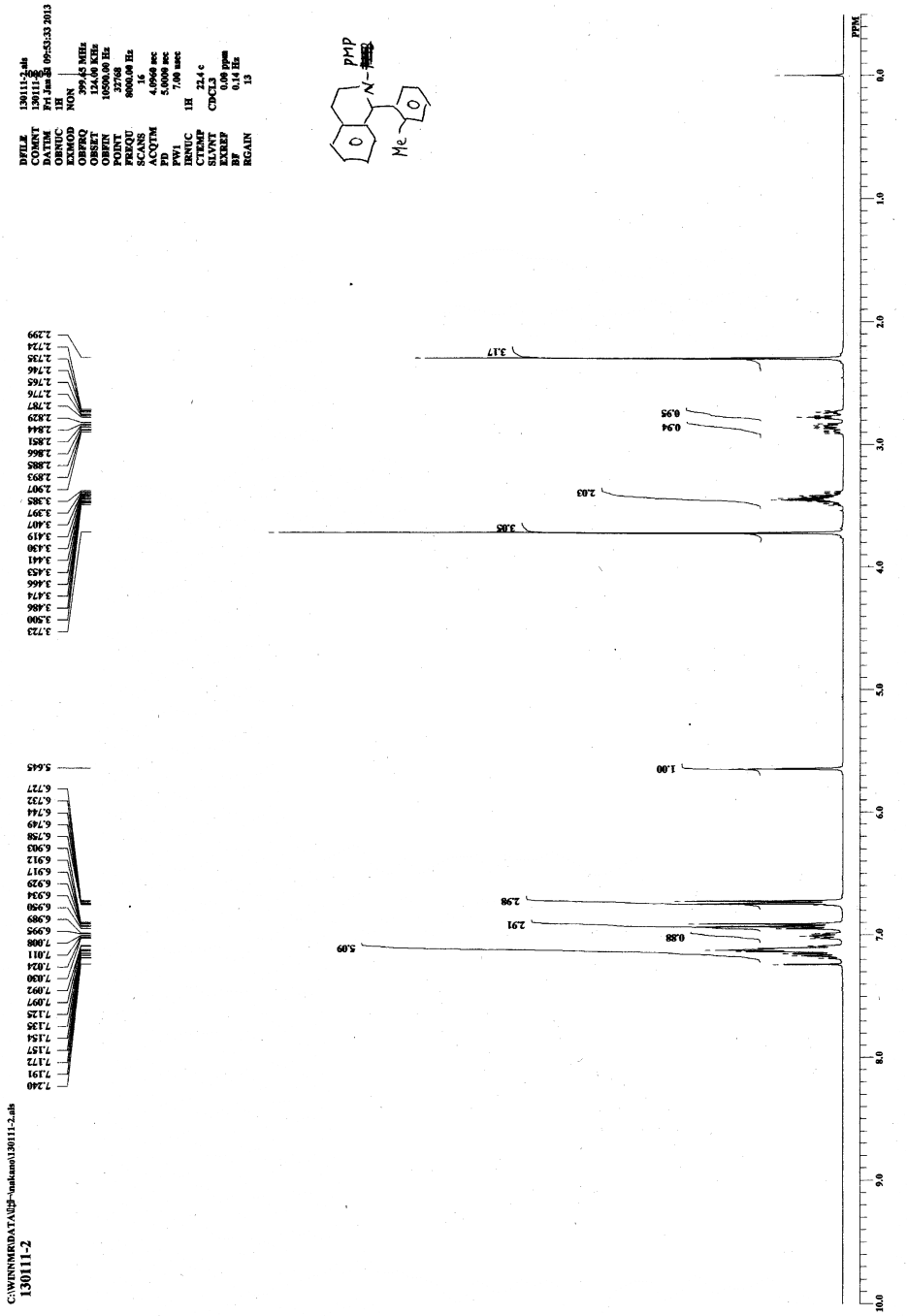
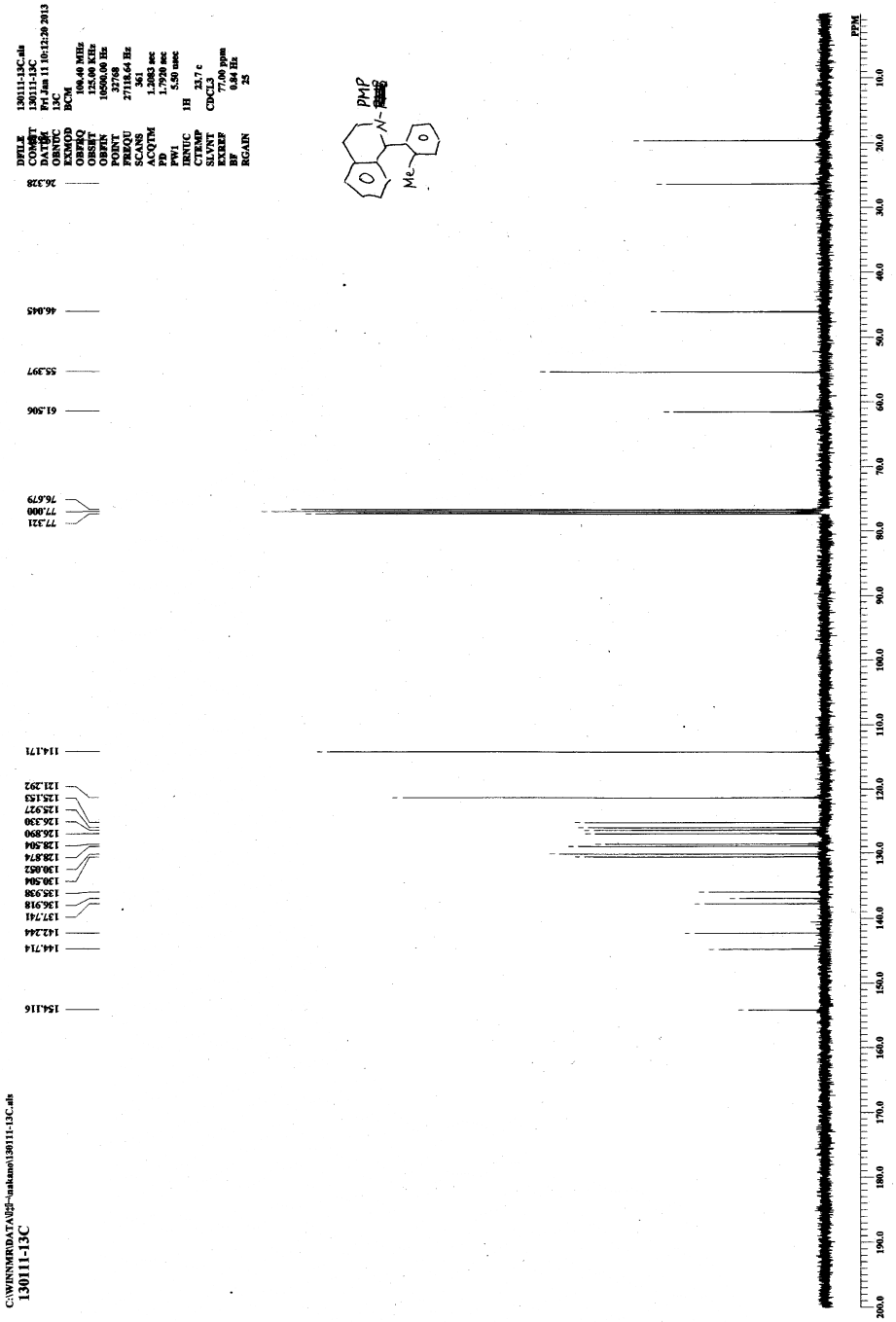
1-(2-Tolyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (5)

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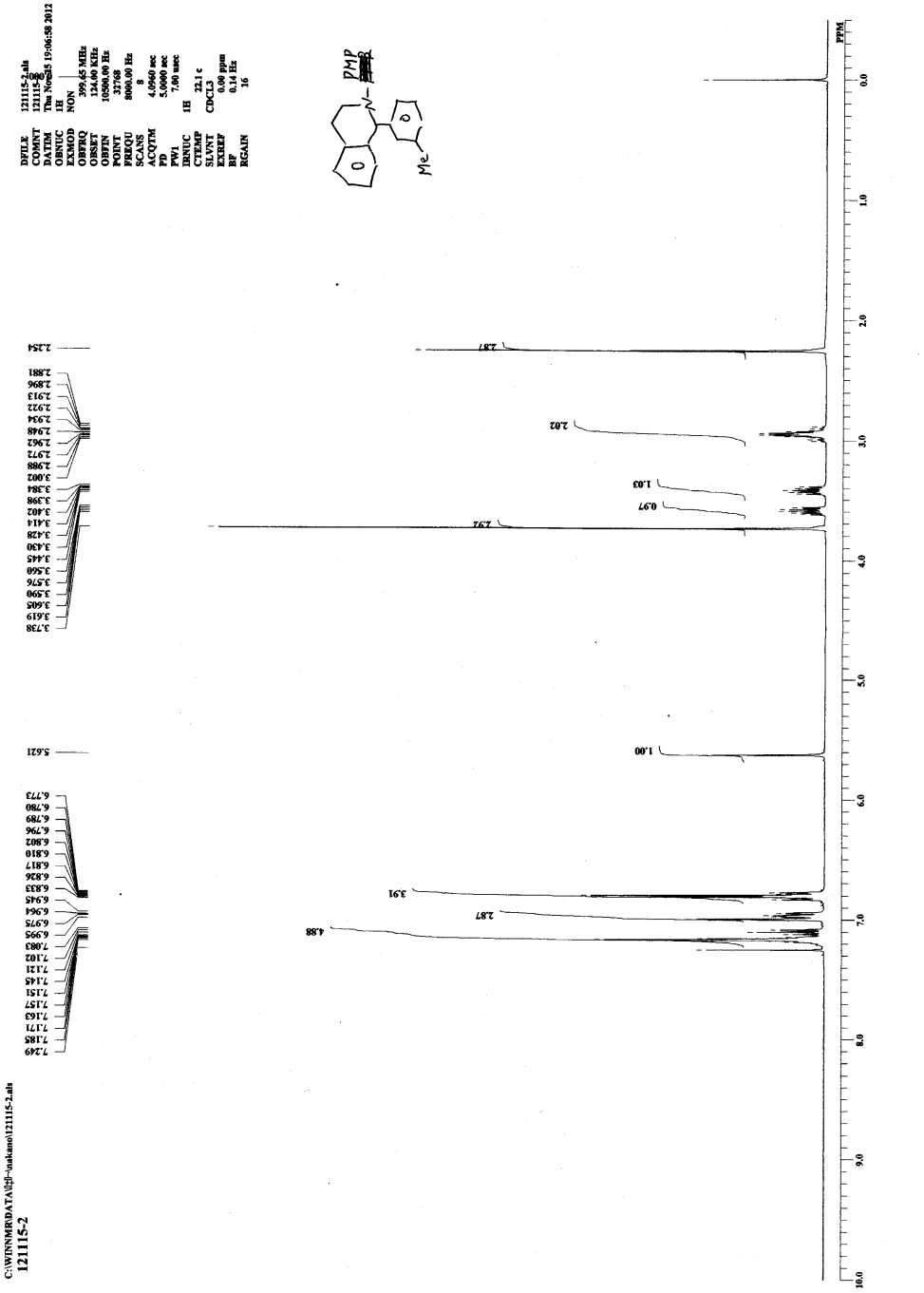
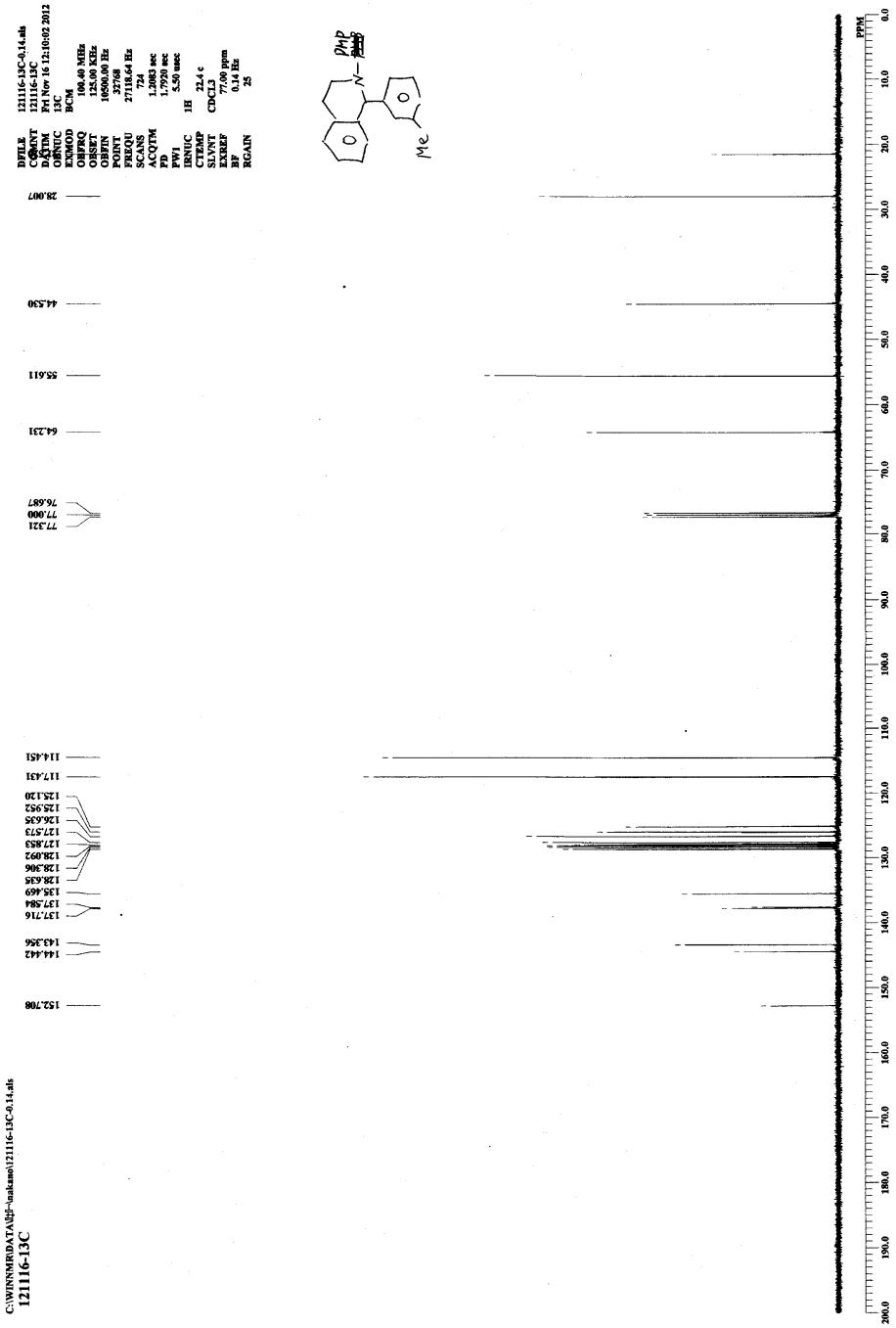
1-(3-Tolyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (6)

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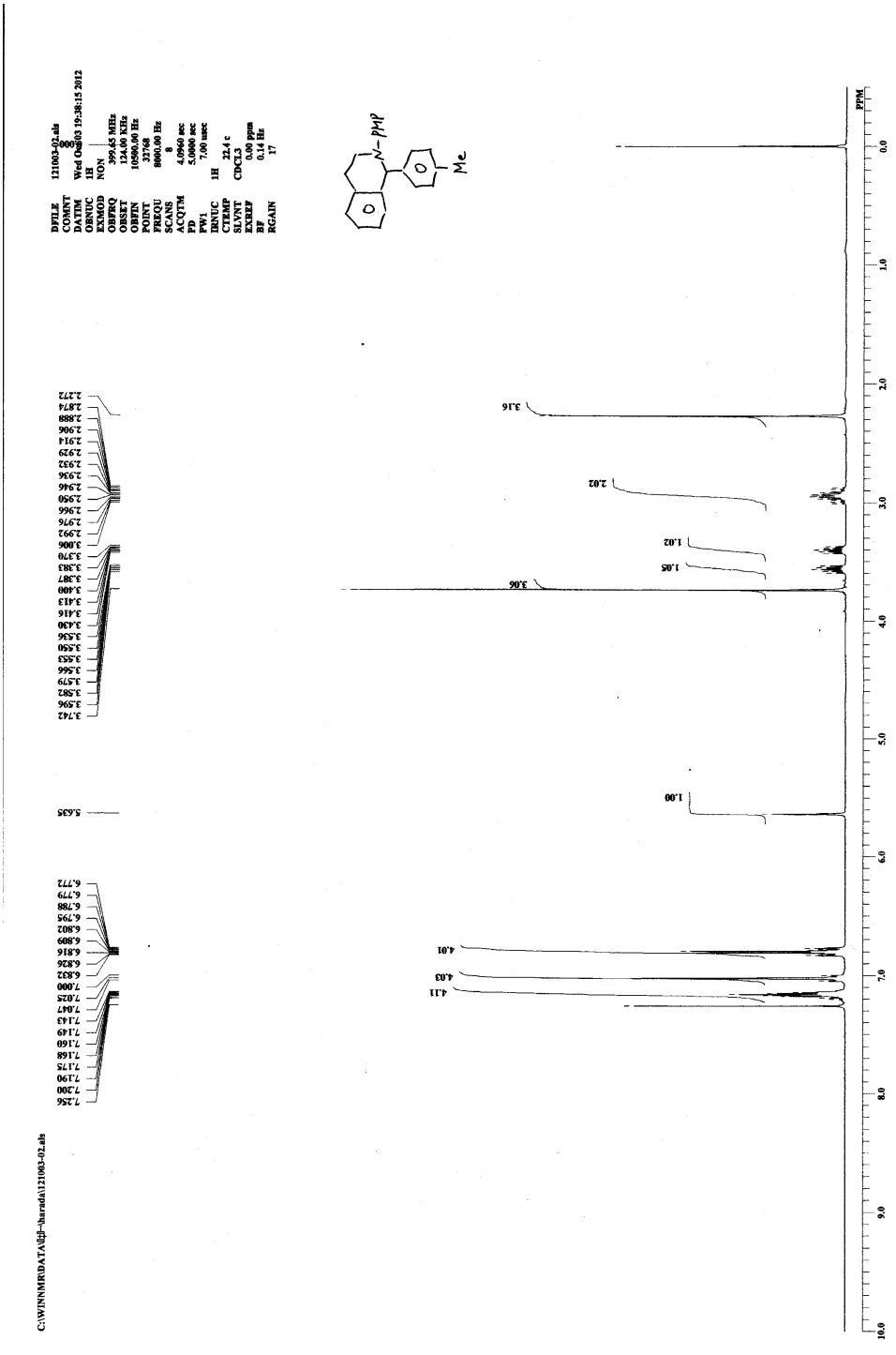

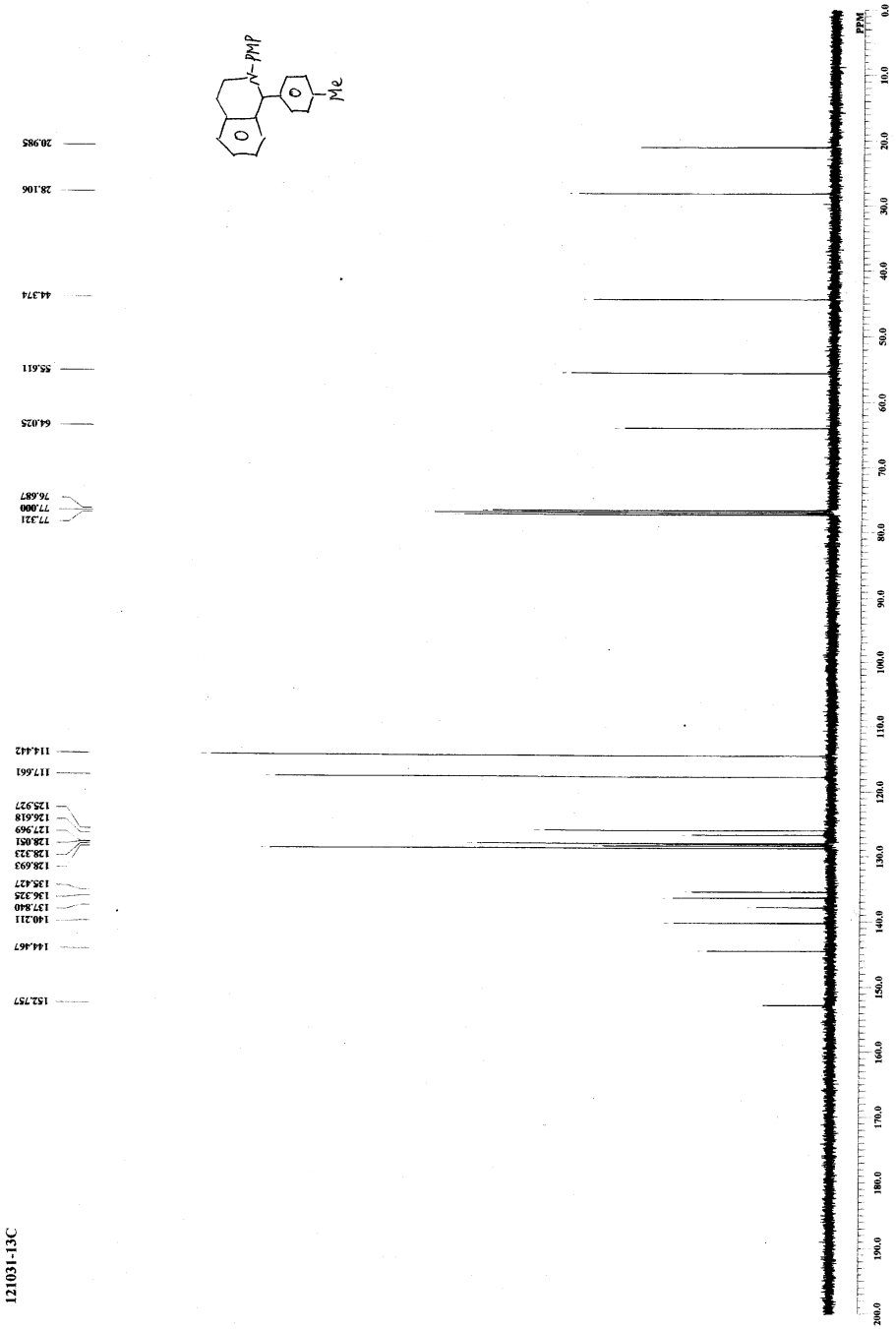
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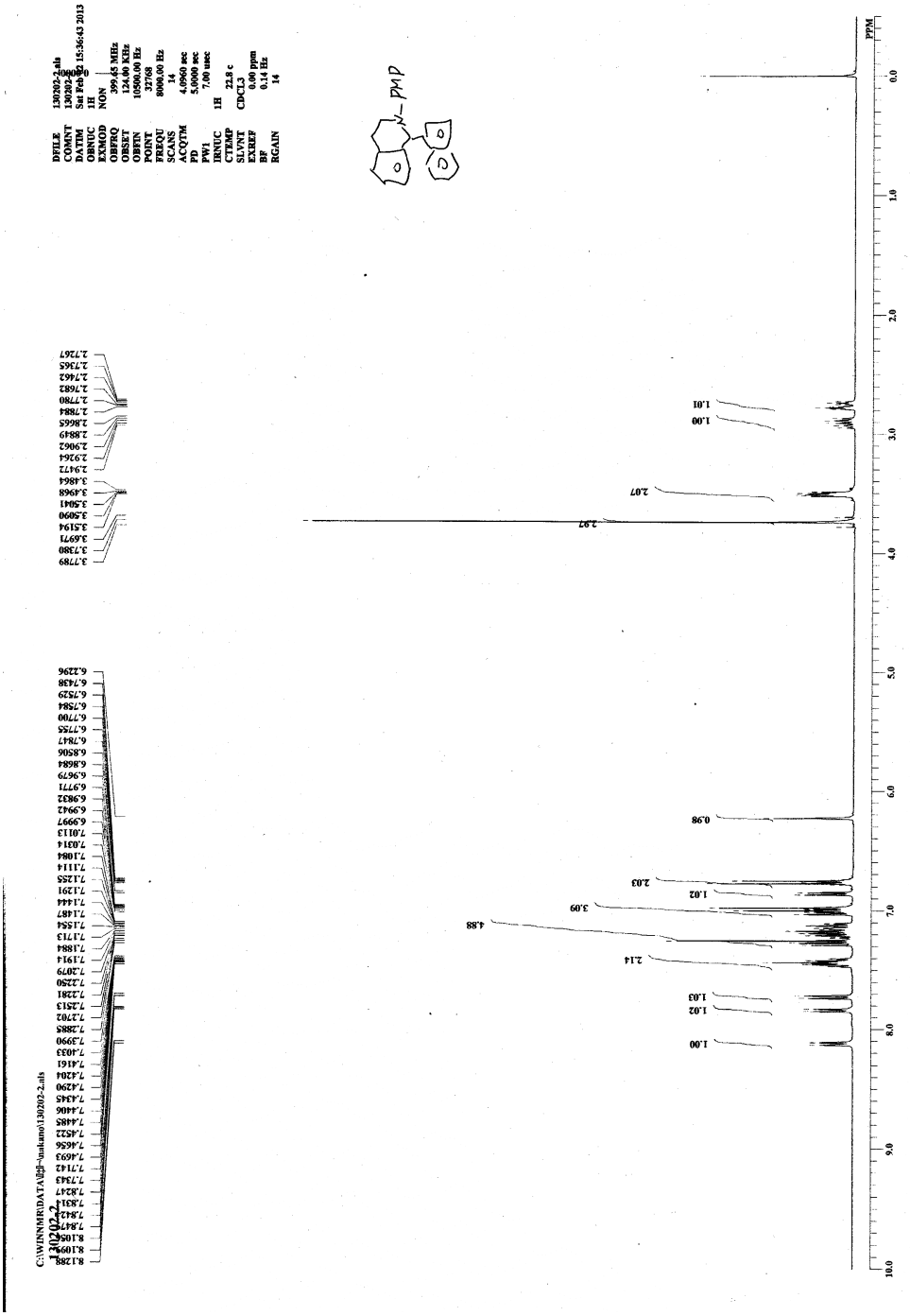
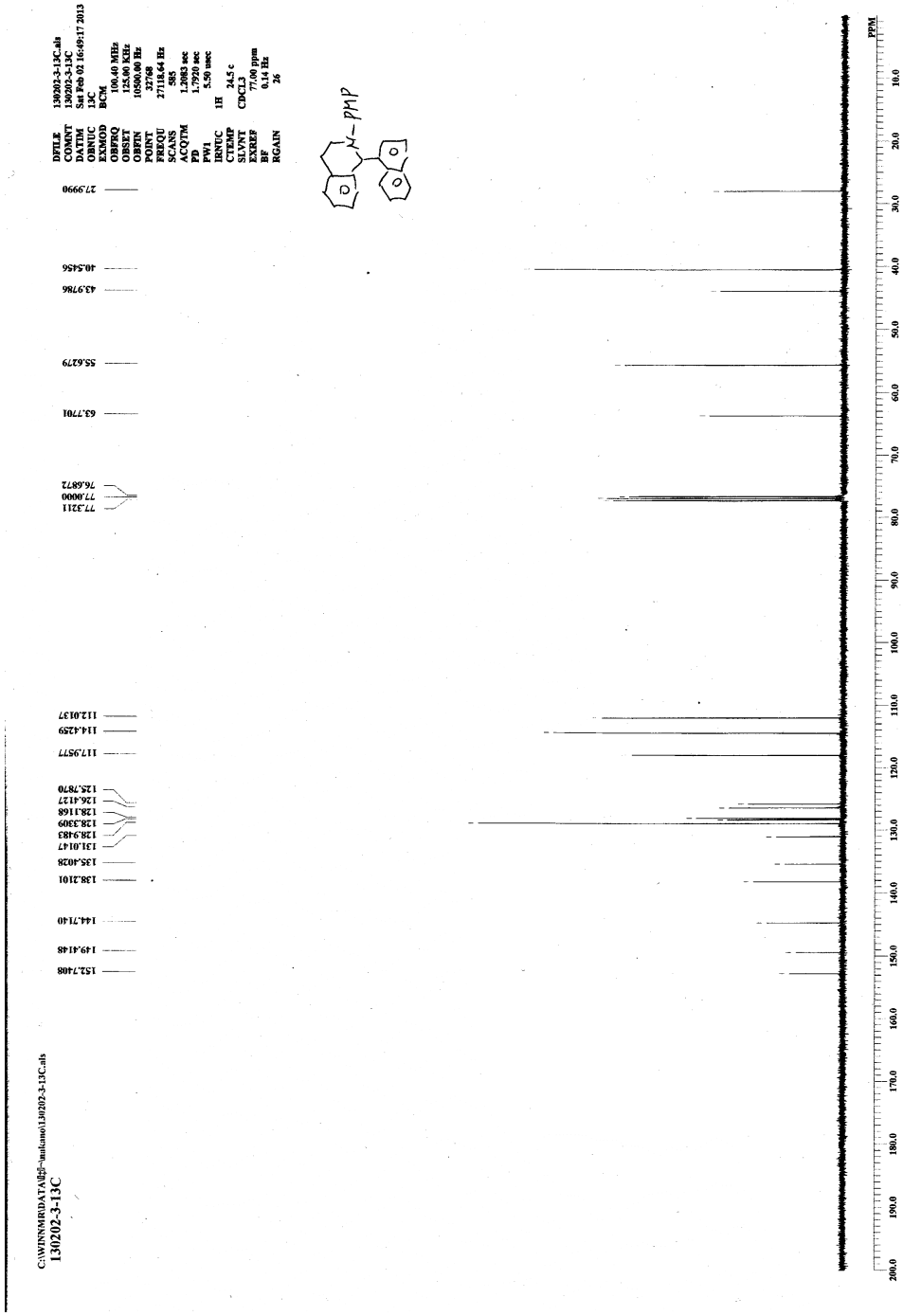
1-(1-Naphthyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (8)

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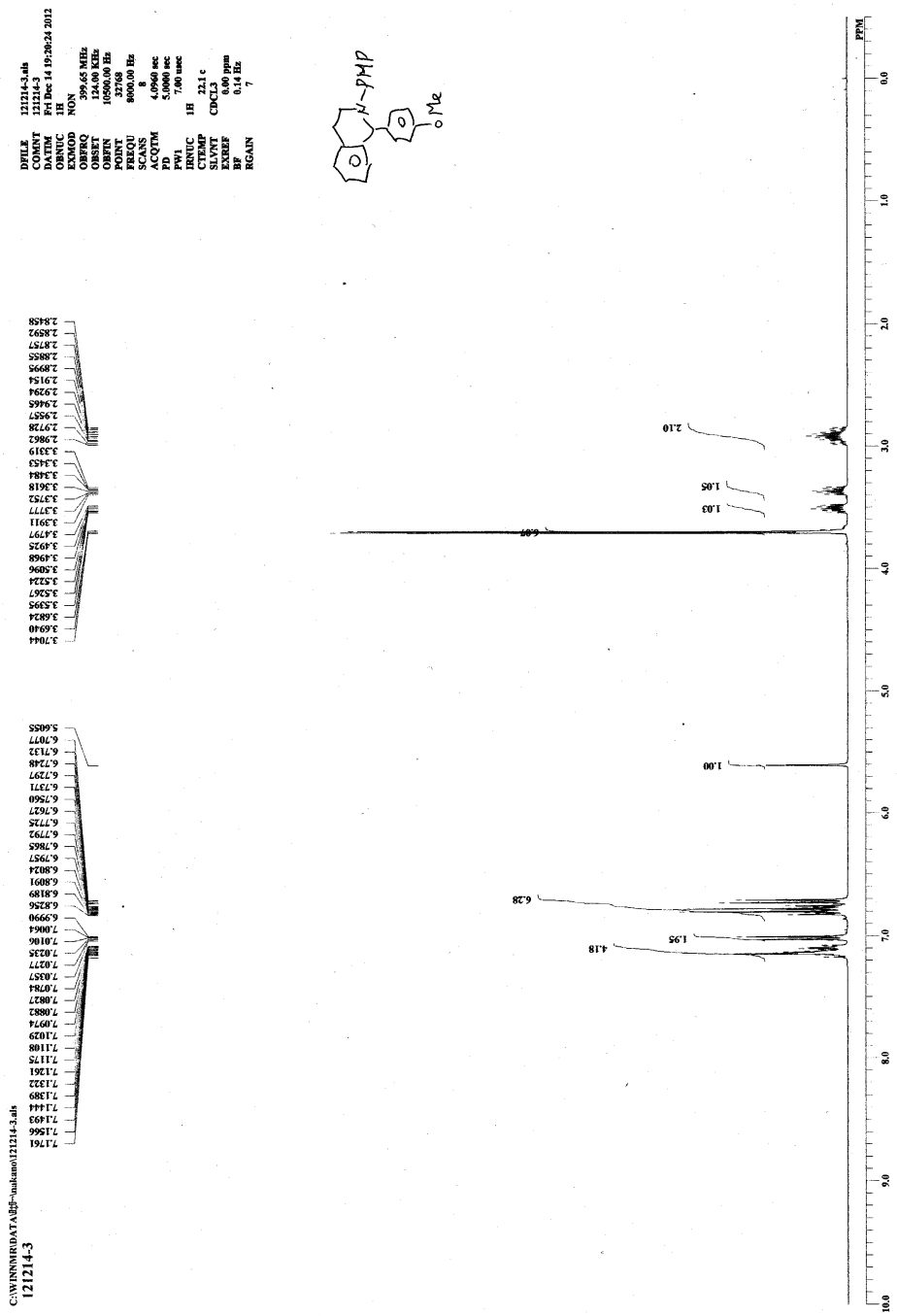
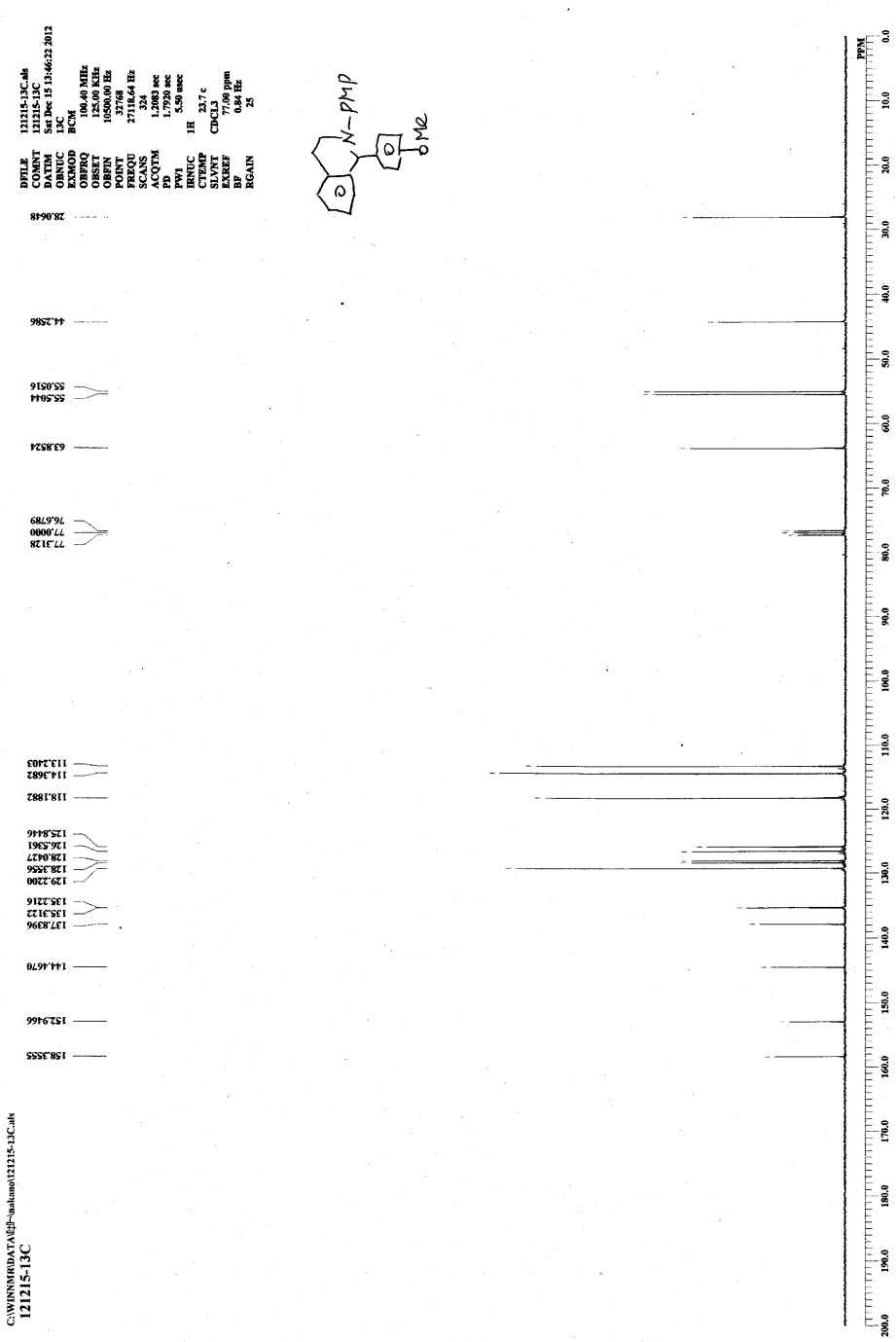
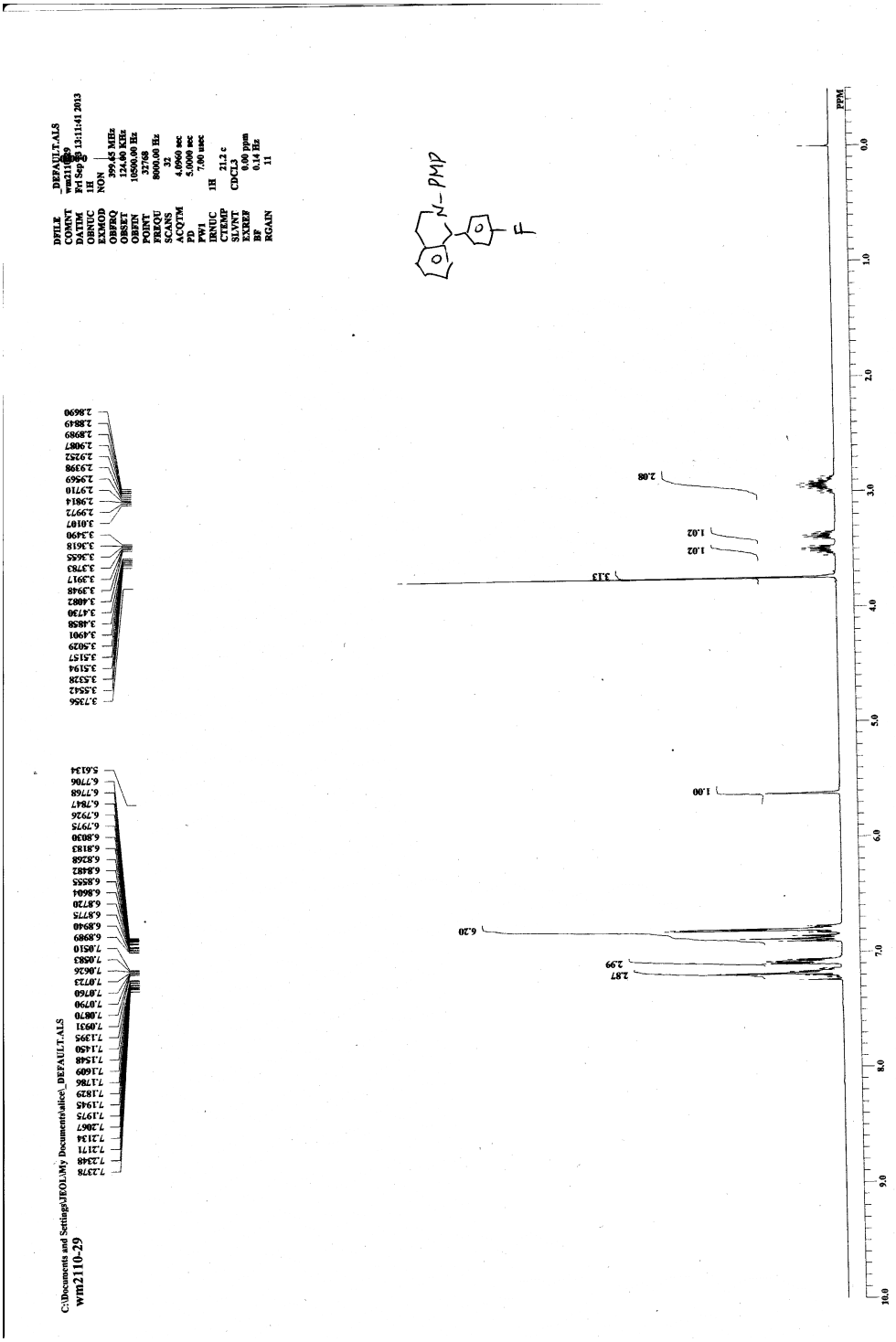
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.60 MHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 585
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 24.5 c
SLVNT CDCl3
EXREF 77.00 ppm
BF 0.14 Hz
RGAIN 26
N-PMP
27.9990
40.5456
43.9786
55.6279
63.7701
76.6872
77.0000
77.3211
112.0137
114.4259
117.9577
125.7870
126.4127
128.1168
128.3309
128.9485
131.0147
135.4028
138.2101
144.7140
149.4148
152.7408
PPM

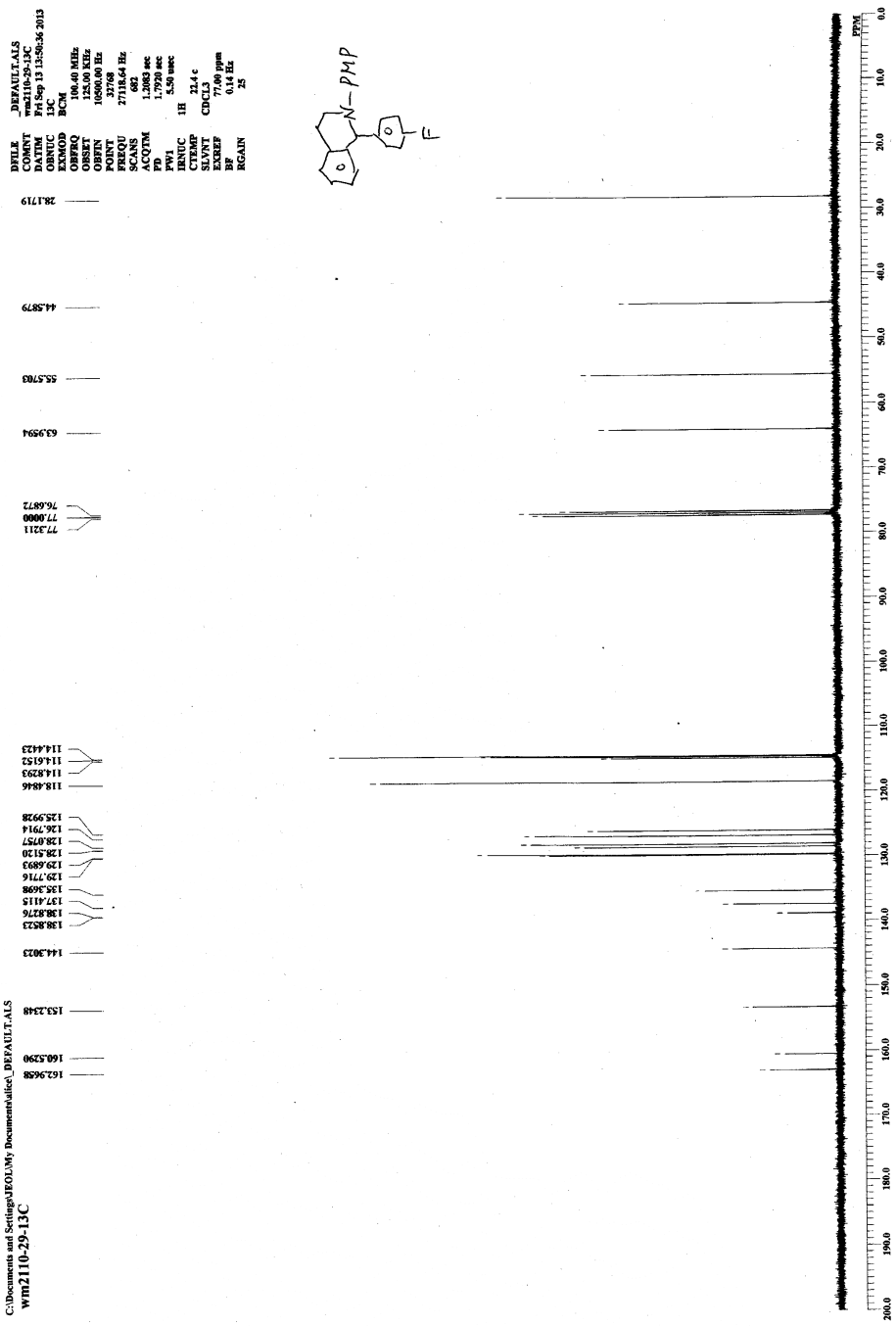
1-(4-Methoxyphenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (9)



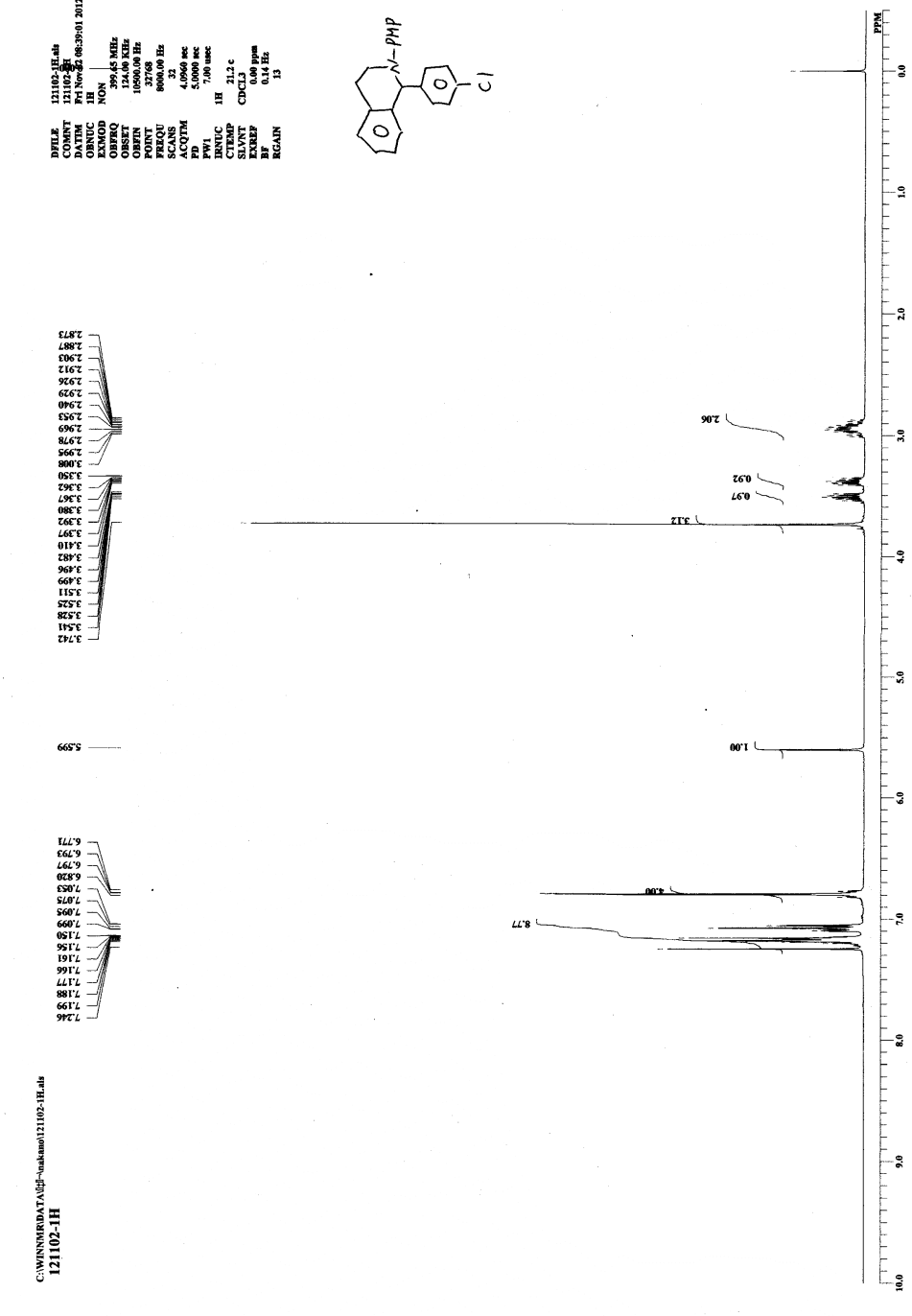

DFILE 121215-13C.als
COMNT 121215-13C
DATIM Sat Dec 15 13:46:22 2012
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 160000.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 324
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H 23.7 c
CTEMP
SLVNT CDCl3 77.00 ppm
EXREF 0.84 Hz
BF 25
RGAIN
28.0648
44.2586
55.0516
55.5044
63.8524
76.6789
77.0000
77.3128
113.2403
114.3682
118.1882
125.8446
126.5361
128.0427
128.3556
129.2200
135.2216
135.3122
137.8396
144.4670
152.9466
158.3555
N-PMP
OMe
PPM
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
C:\WINNMR\DATA\伊-tsuhano\121215-13C.als
121215-13C

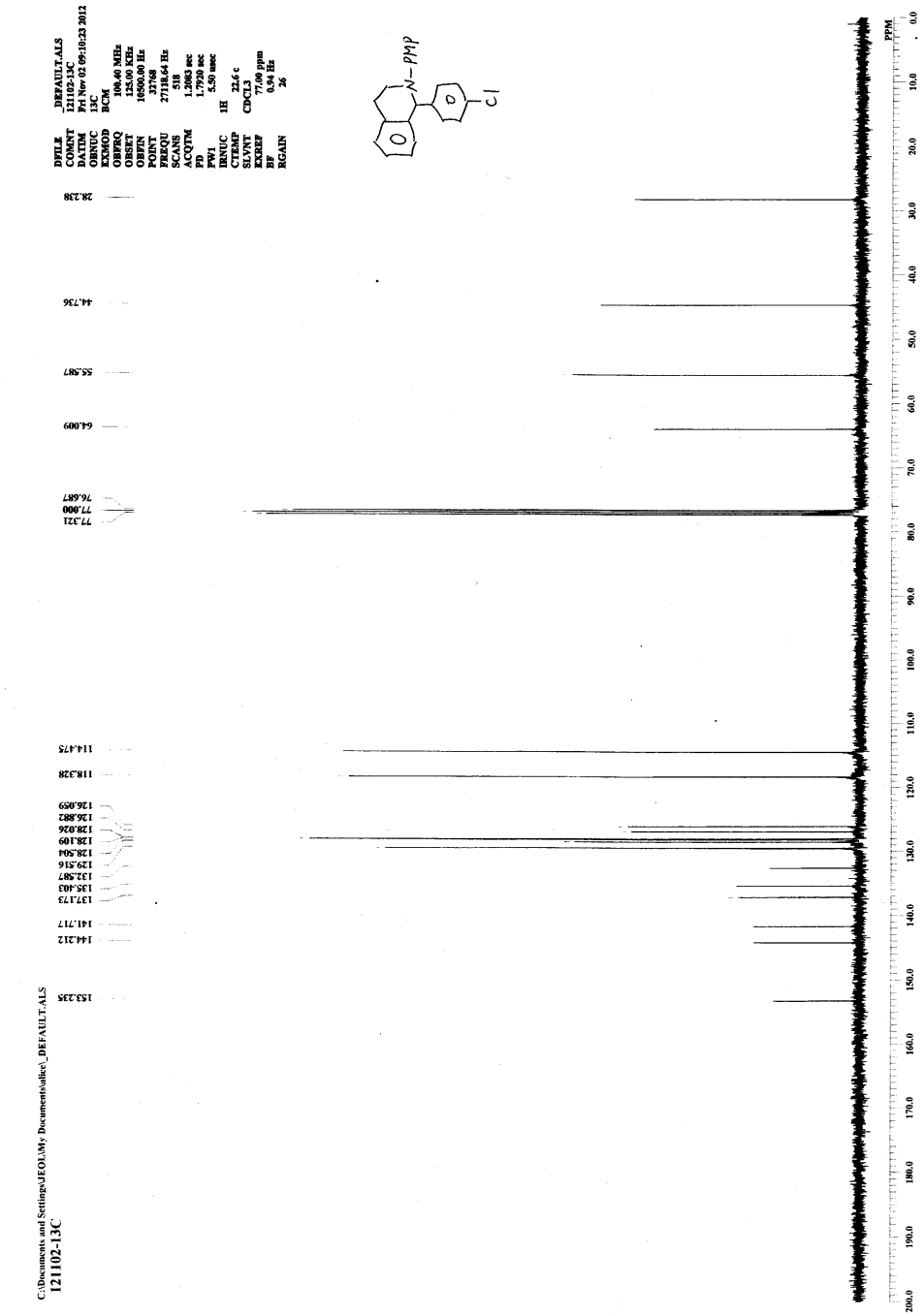
1-(4-Fluorophenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (10)



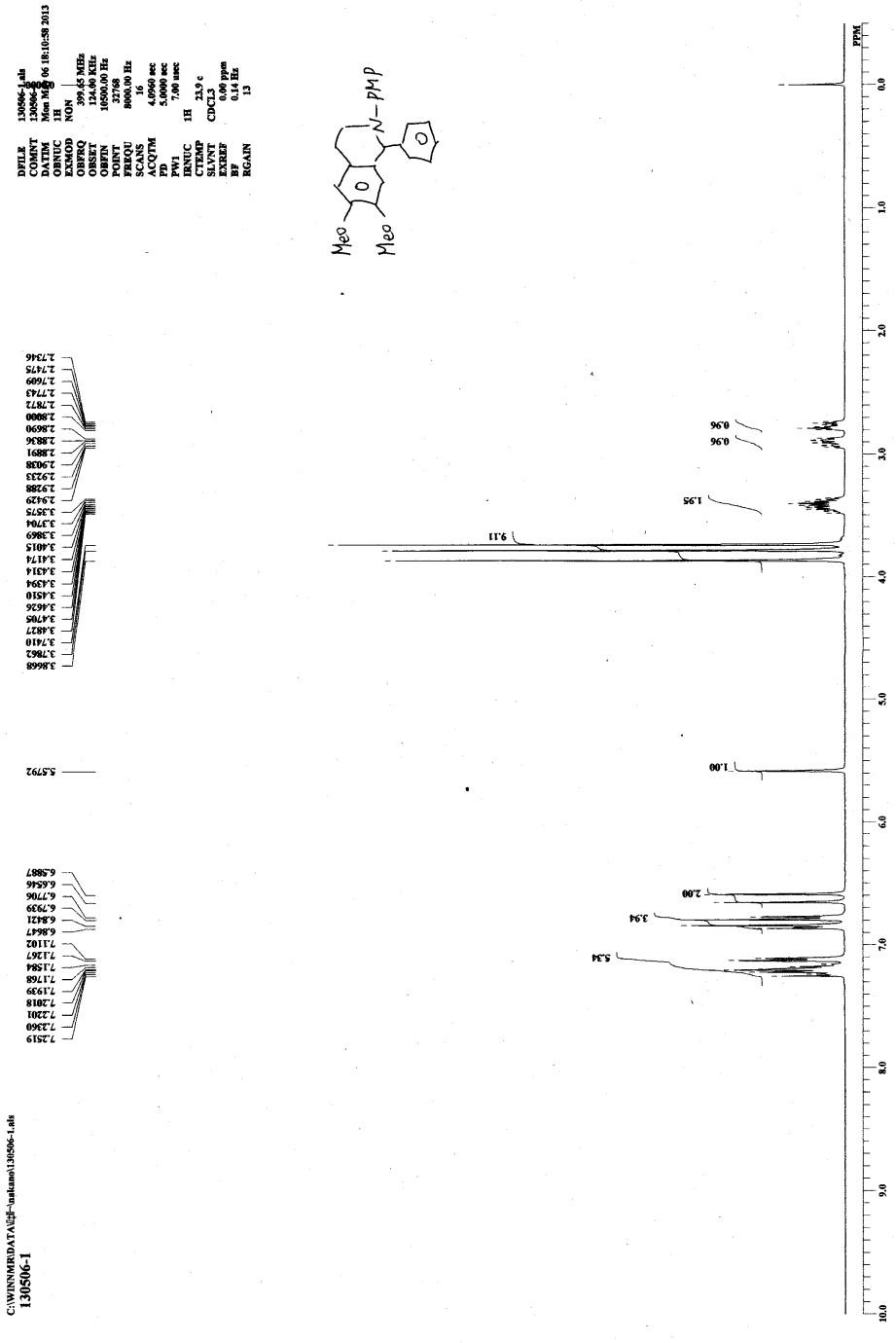

DFILE _DEFAULT.ALS
COMNT wm2110-29-13C
DATIM Fri Sep 13 13:50:56 2013
OBNUC 13C
EXMOD BCM
OBSFRQ 100.40 MHz
OBSET 125.90 MHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 682
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.14 Hz
RGAIN 25
28.1719
44.5879
55.5703
63.9594
76.6872
77.0000
77.3211
114.4123
114.6152
114.8293
118.4846
125.9928
126.7914
128.0757
128.5120
129.6893
129.7716
132.3698
137.4115
138.8776
138.8523
144.3023
153.2348
160.5290
162.9658
N-PMP
F
C:\Documents and Settings\JEOL\My Documents\tallet_DEFAULT.ALS
wm2110-29-13C
PPM
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0

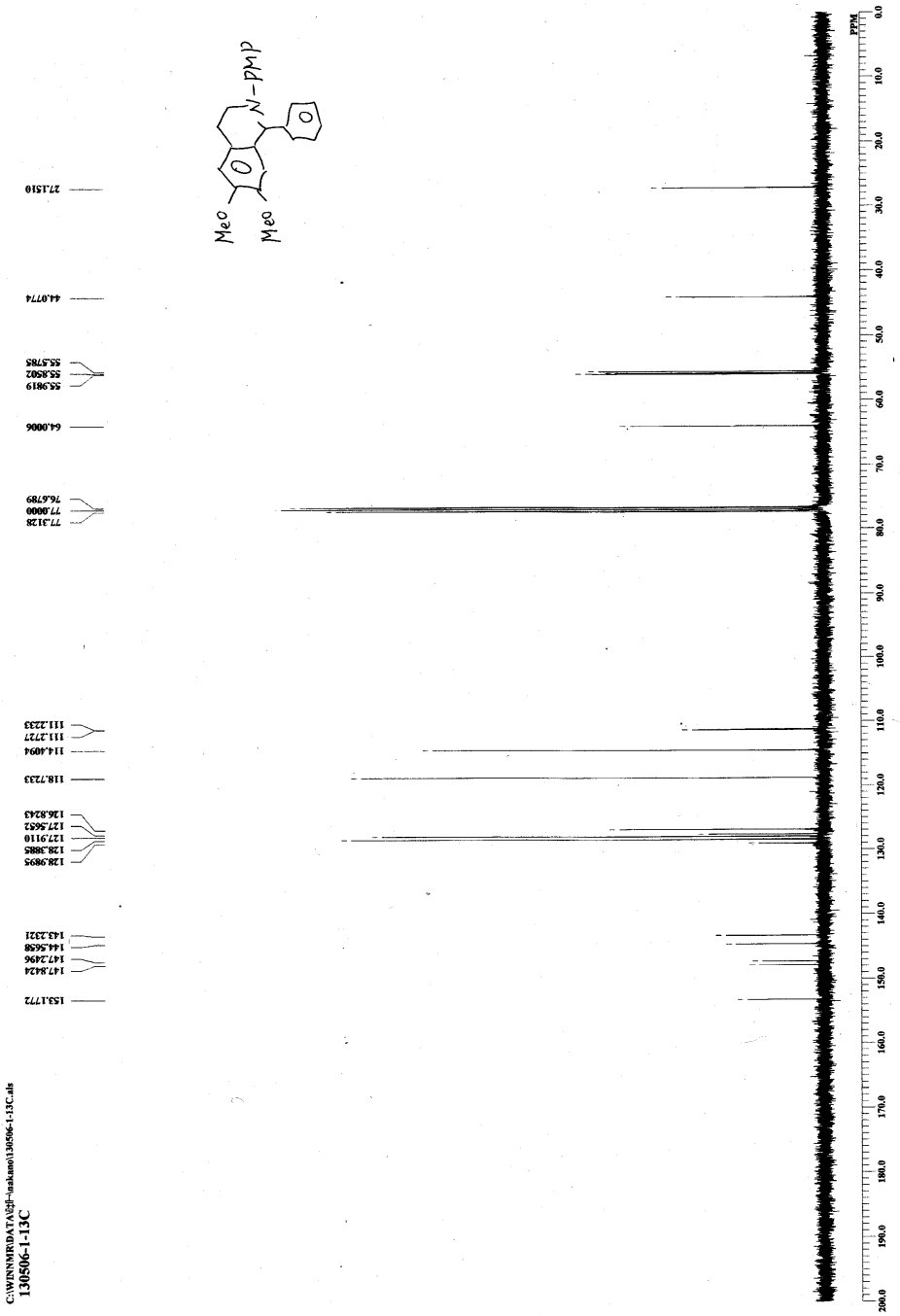
1-(4-Chlorophenyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (11)



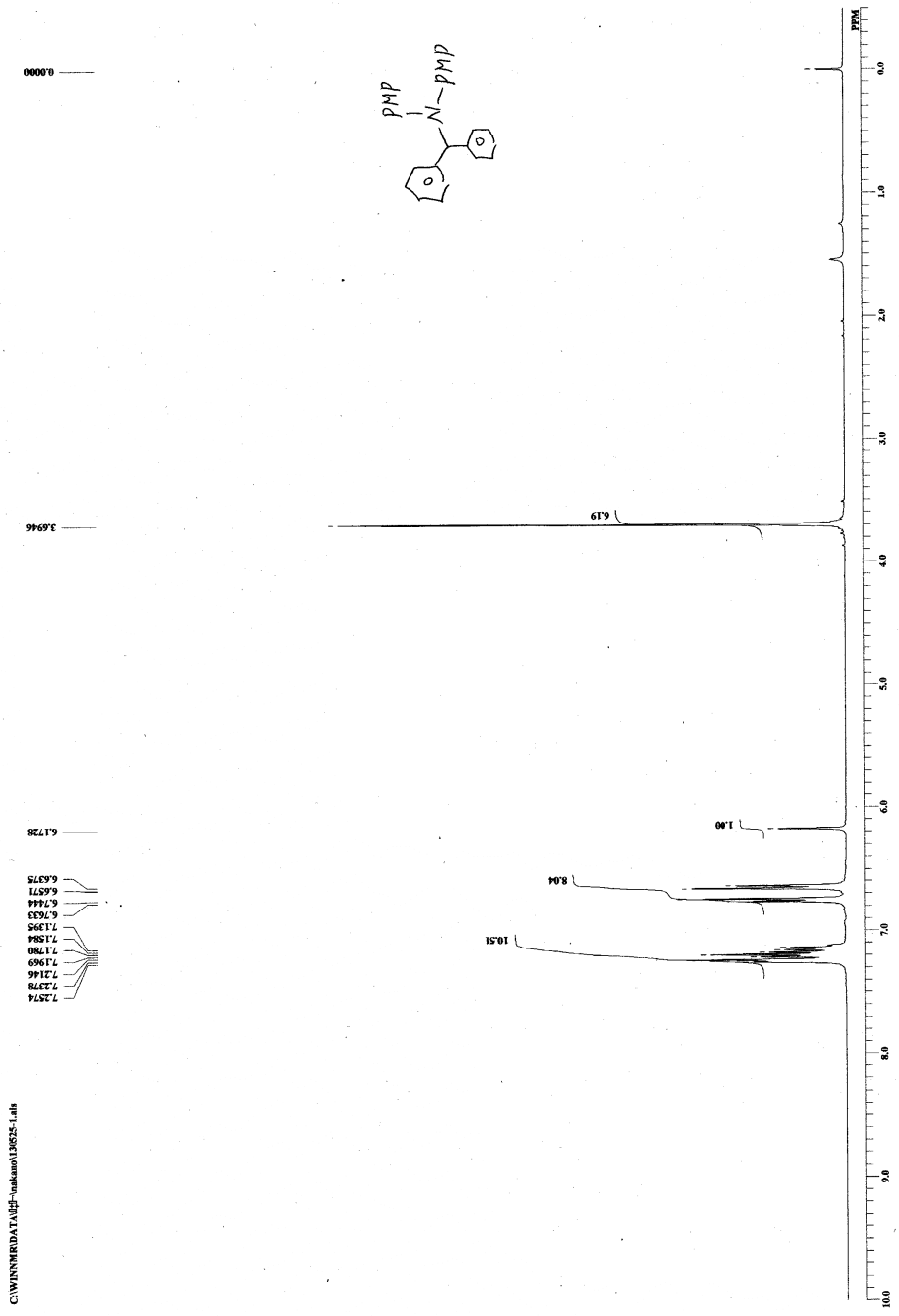

DFILE DEFAULT.ALS
COMNT 121102-13C
DATIM Fri Nov 02 09:10:23 2012
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.60 MHz
OBFIN 16500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 518
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H 22.6 c
CTEMP
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.94 Hz
RGAIN 26
N-PMP
Cl
28.238
44.736
55.587
64.009
76.687
77.000
77.321
114.475
118.328
126.059
126.882
128.026
128.109
128.504
129.516
132.587
135.403
137.173
141.717
144.212
153.385
PPM
C:\Documents and Settings\JEOL\My Documents\salke_DEFAULT.ALS
121102-13C

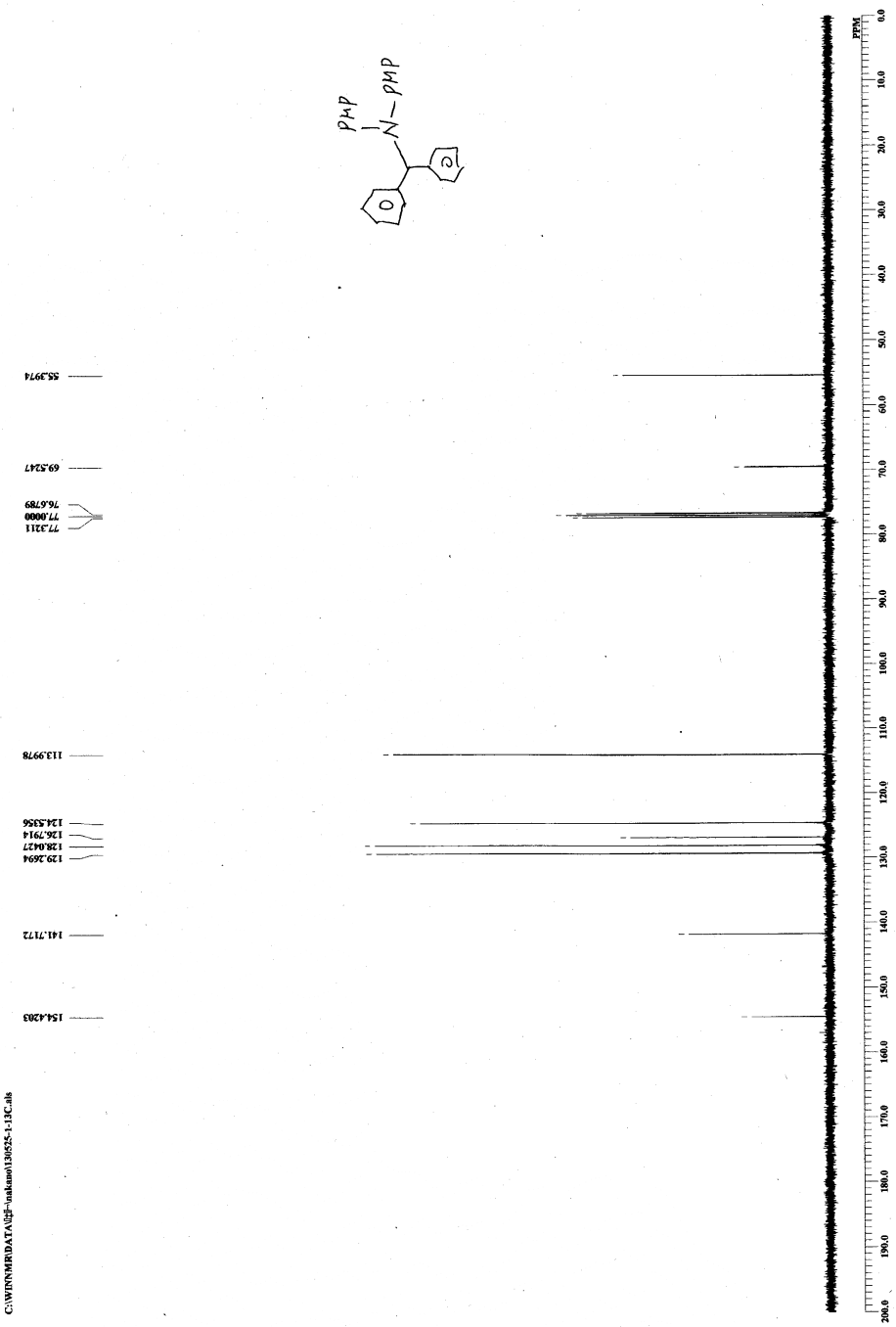
1-Phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (12)




N-PMP
MeO
MeO
27.1510
44.0774
55.5785
55.8502
55.9819
64.0006
76.6789
77.0000
77.3128
111.2333
111.2727
114.4094
118.7233
136.8243
127.5652
127.9110
128.3885
128.9895
143.3321
144.5658
147.2496
147.8424
153.1772
PPM
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
C:\WINNMR\DATA\井-nakano\130506-1-13C.als
130506-1-13C

***N,N*-Di-(4-methoxyphenyl)-1,1-diphenylmethylamine (13)**




PMP
N
PMP
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69.5247
76.6789
77.0000
77.3211
113.9978
124.3356
126.7914
128.0427
129.3694
141.7172
154.4203
C:\WINNMR\DATA\tgf=tnakano\130525-1-13C.als
PPM
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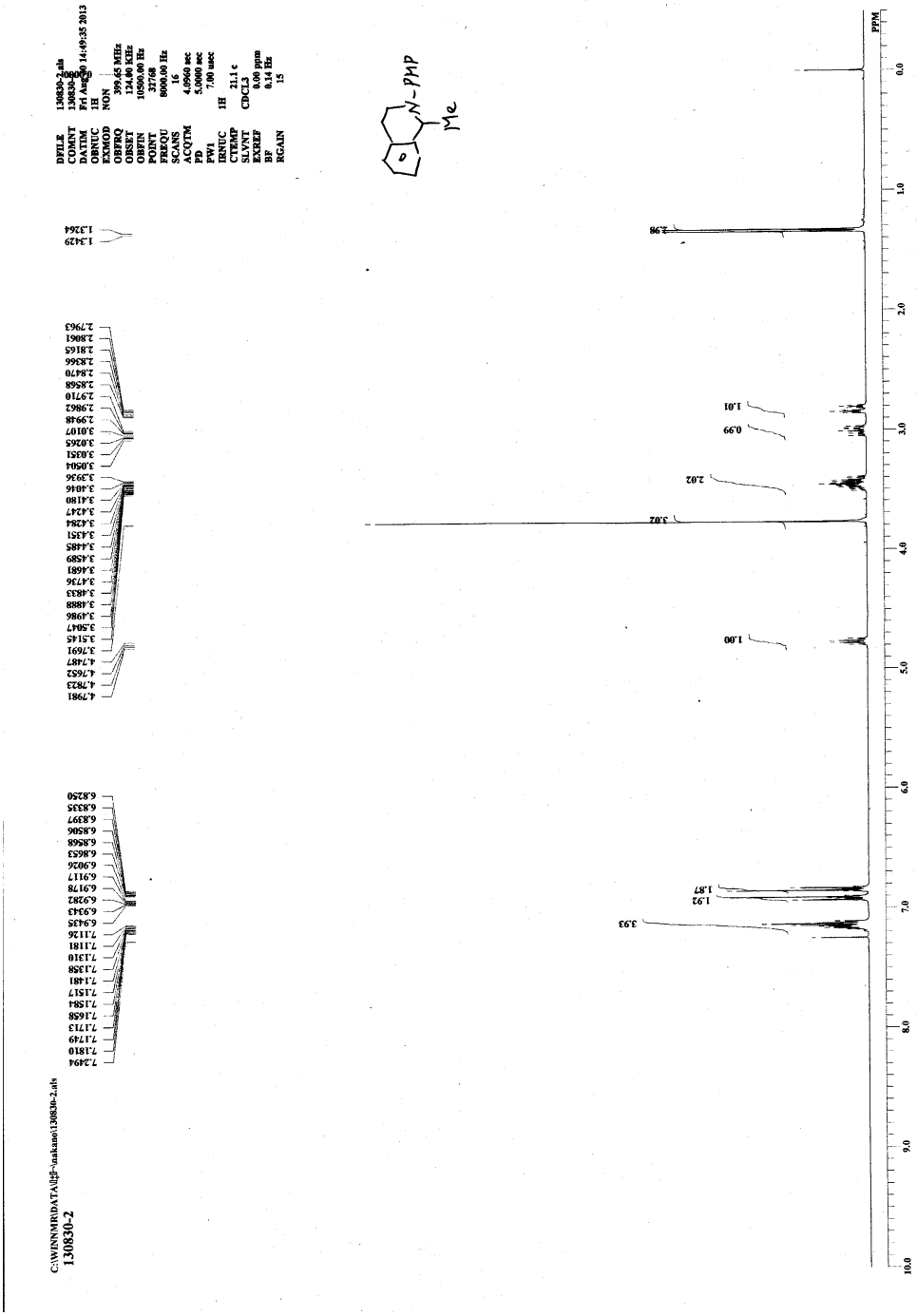
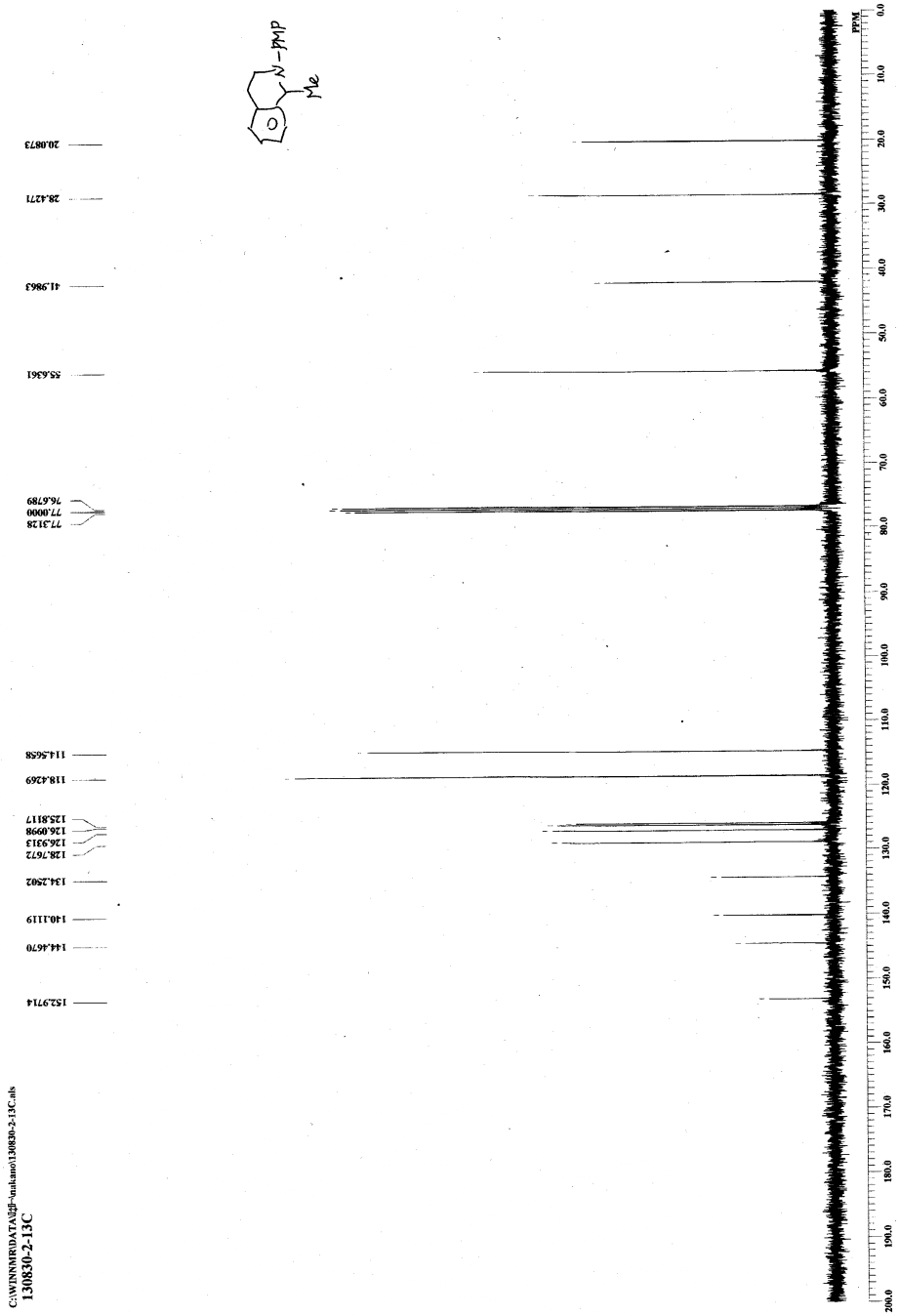
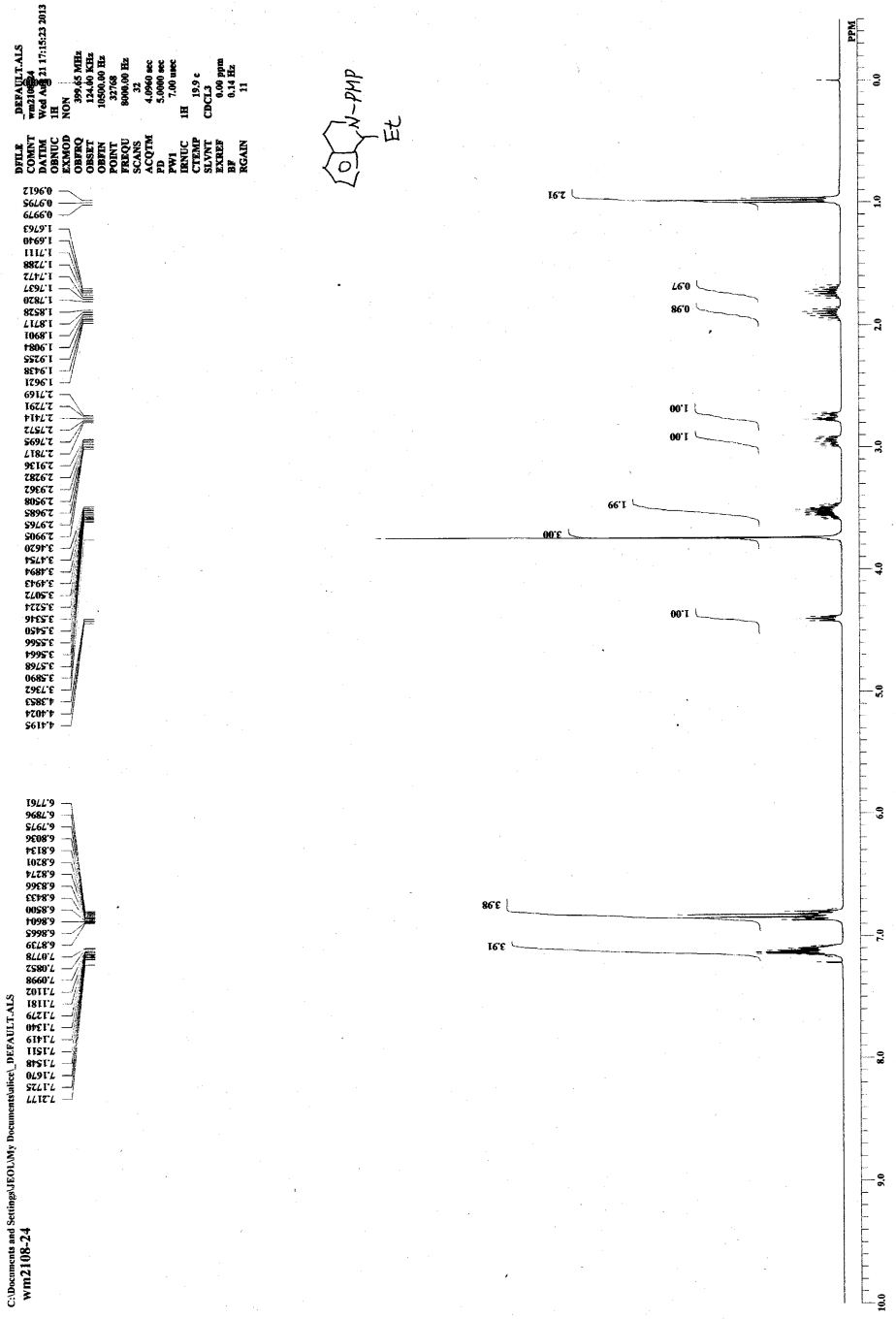
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0

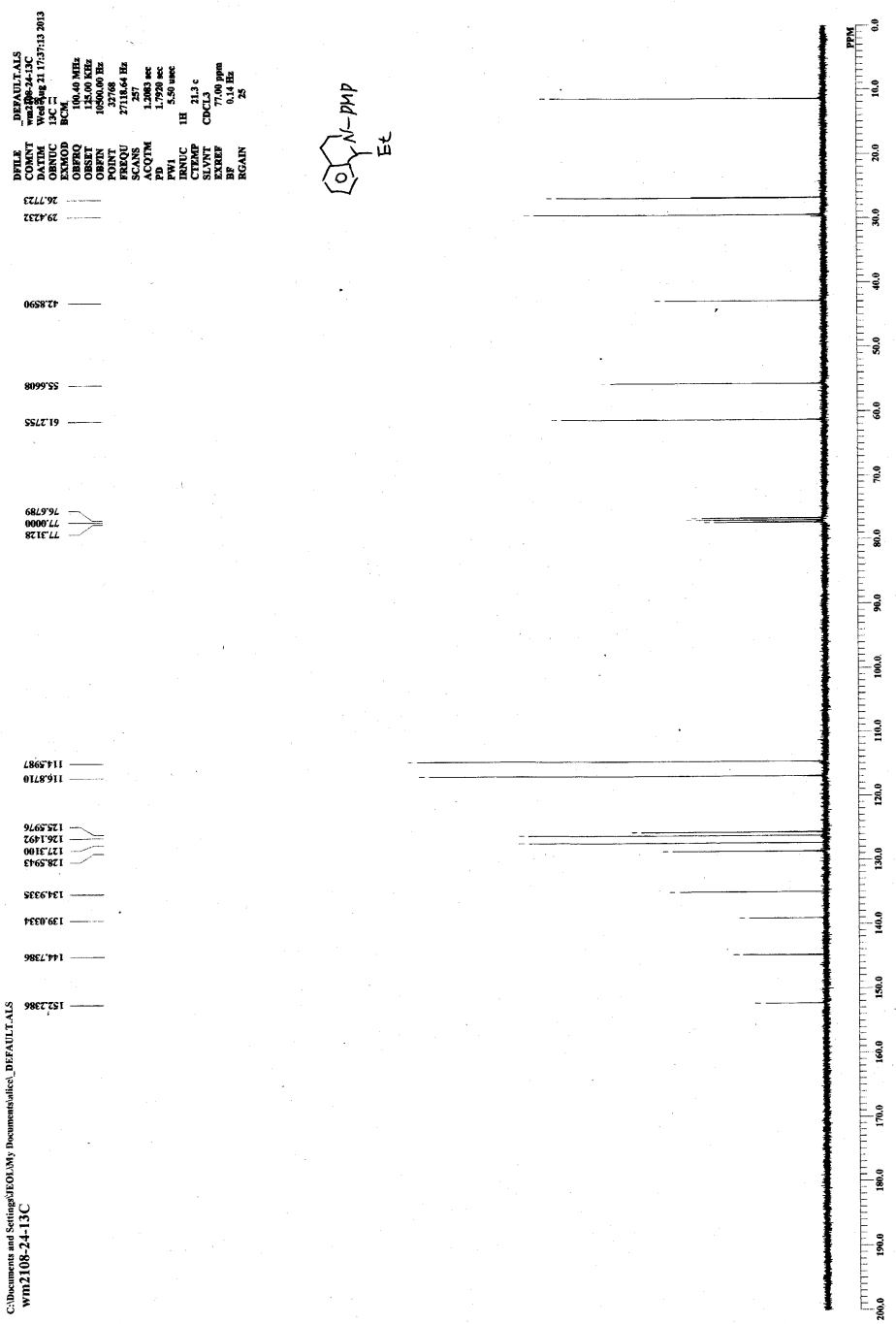
1-Methyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (14)



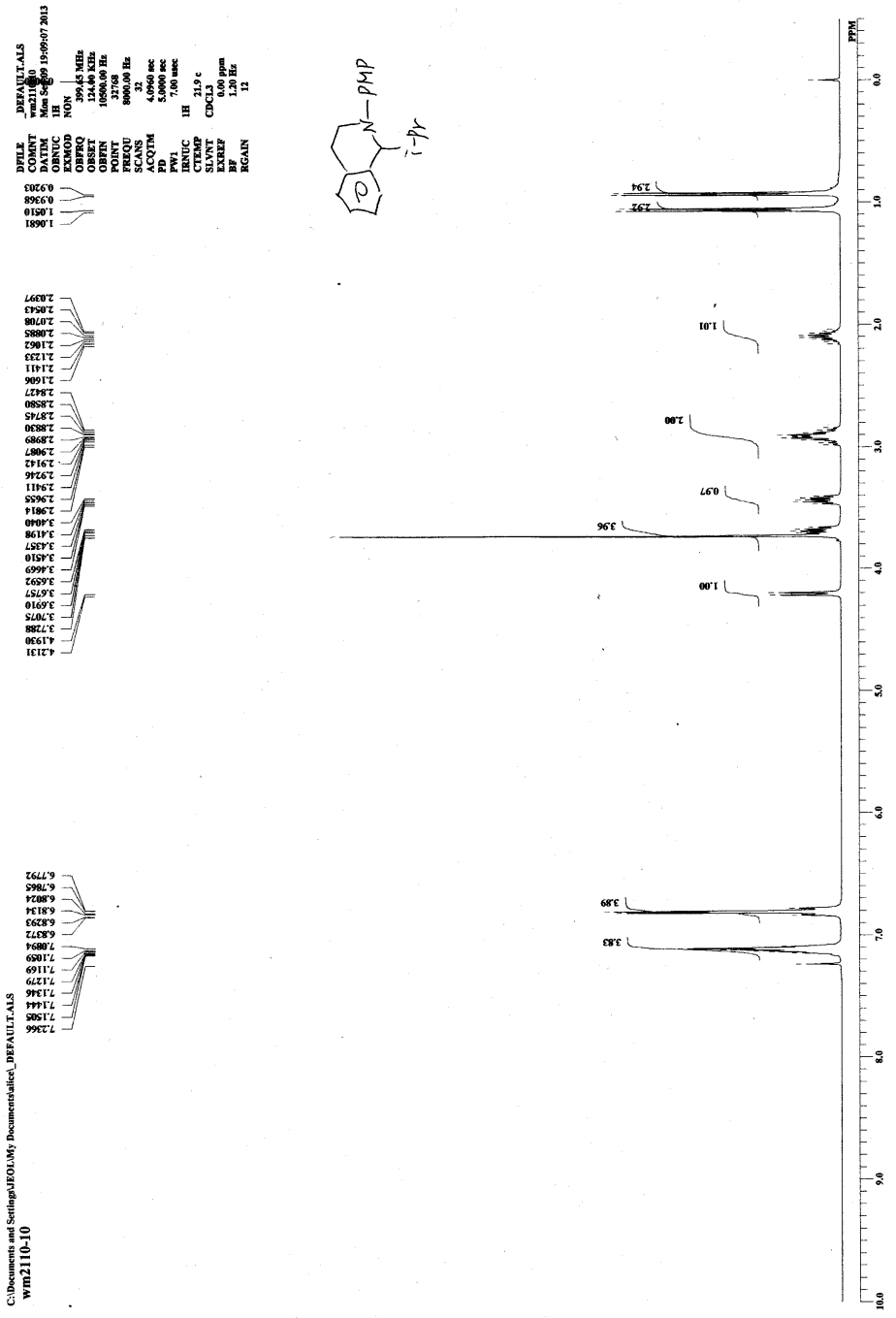

C:\WINNMR\DATA\jjp-tnakano\130830-2-13C.nls
130830-2-13C
20.0873
28.4271
41.9863
55.6361
76.6789
77.0000
77.3128
114.6658
118.4269
125.8117
126.0998
126.9313
128.7672
134.2502
140.1119
144.4670
152.9714
N-PMP
Me
PPM
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0

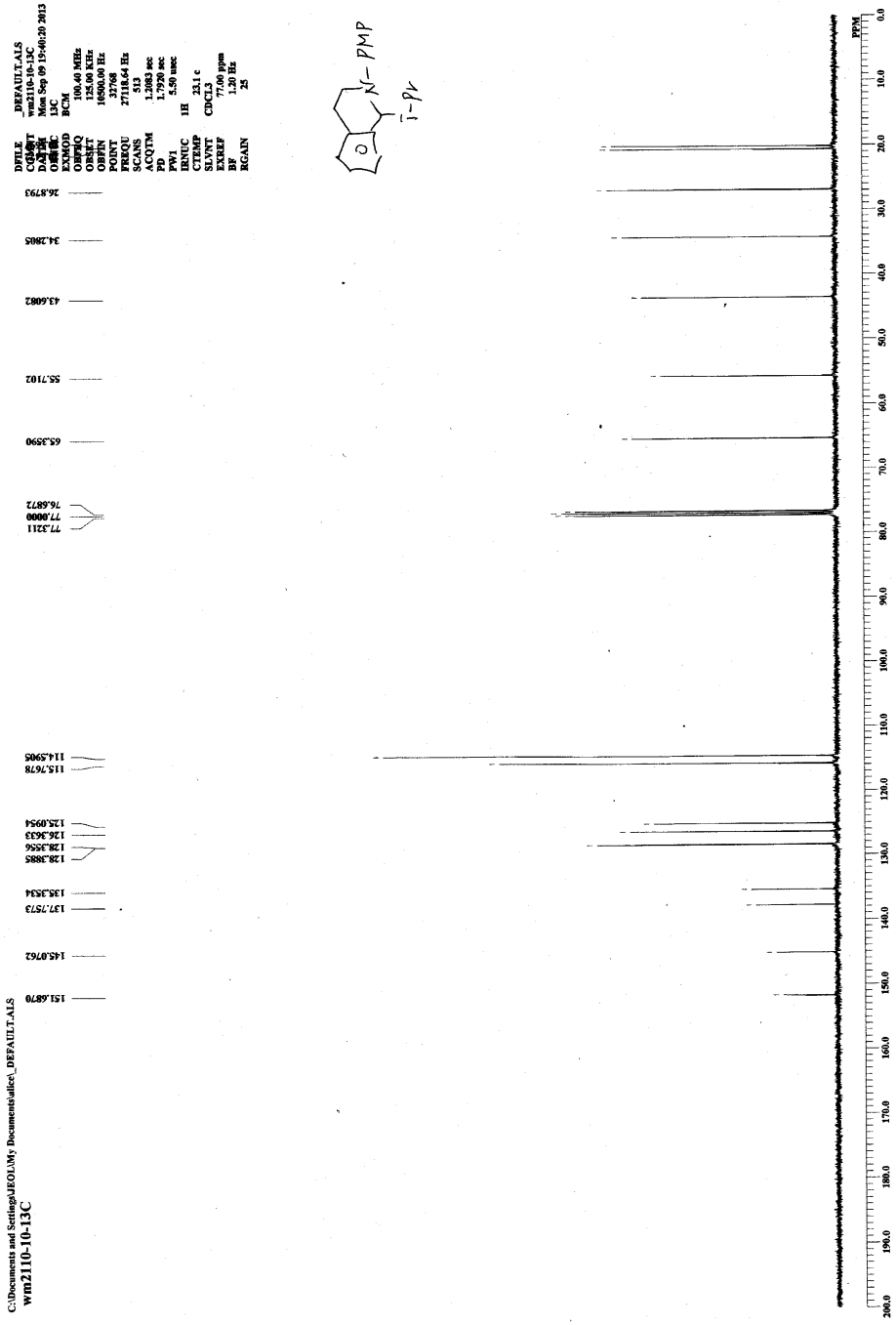
1-Ethyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (15)



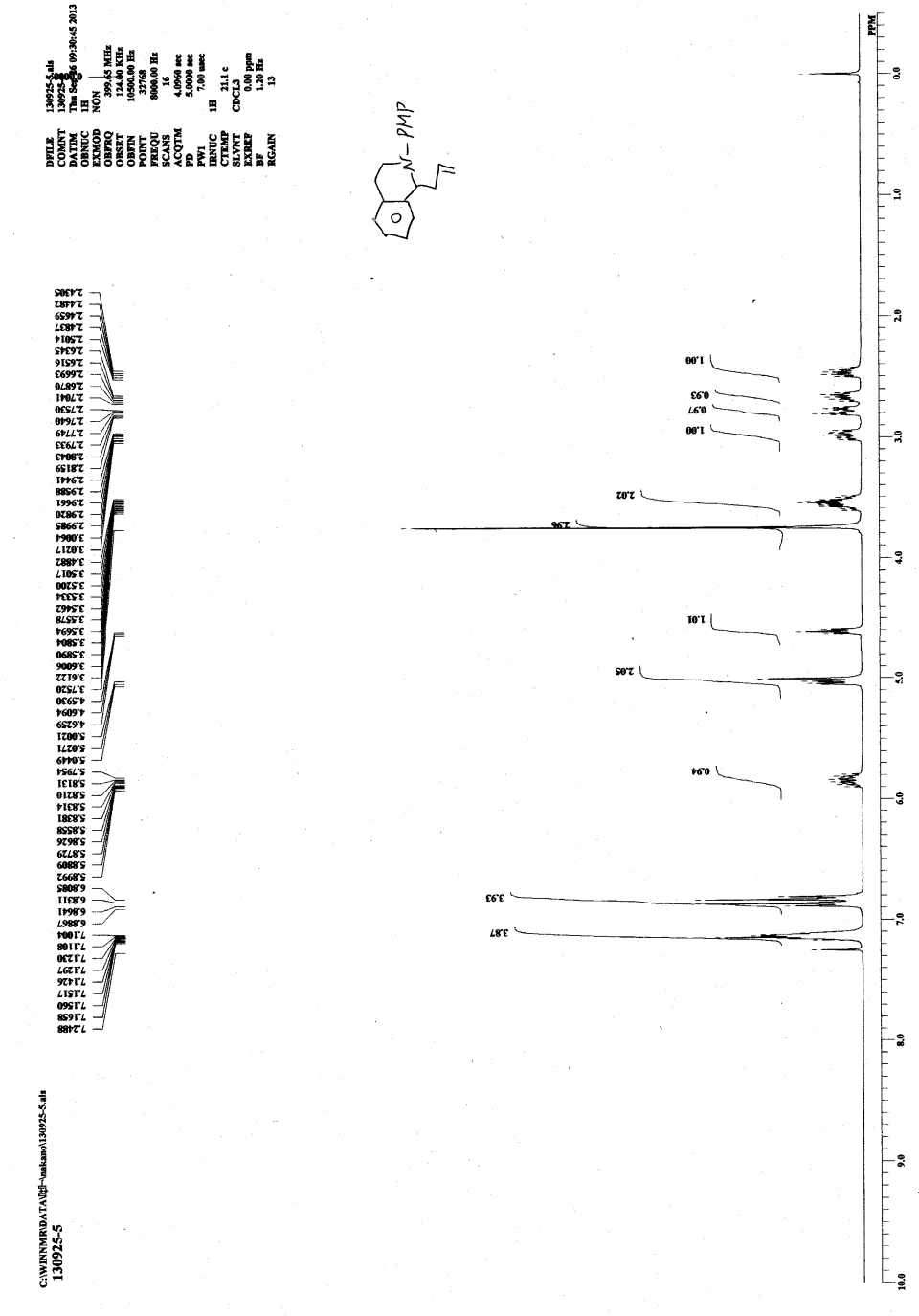

C:\Documents and Settings\JEOL\My Documents\alice_DEFAULT.ALS
wm2108-24-13C
DFILE _DEFAULT.ALS
COMNT wm2108-24-13C
DATIM Wed Aug 21 17:57:13 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 16500.00 Hz
POINT 32768
FREQU 27116.64 Hz
SCANS 257
ACQTM 1.2083 sec
PD 1.7920 sec
FW1 5.50 usec
IRNUC 1H
CTEMP 21.3 c
SLVNT CDCL3
EXREF 77.00 ppm
RR 0.14 Hz
RGAIN 25
N-DMP
Et
26.7723
29.4232
42.8590
55.6608
61.2755
76.6789
77.0000
77.3128
114.5987
116.8710
125.5976
126.1492
127.3100
128.5943
134.9335
139.0334
144.7386
152.2386
PPM

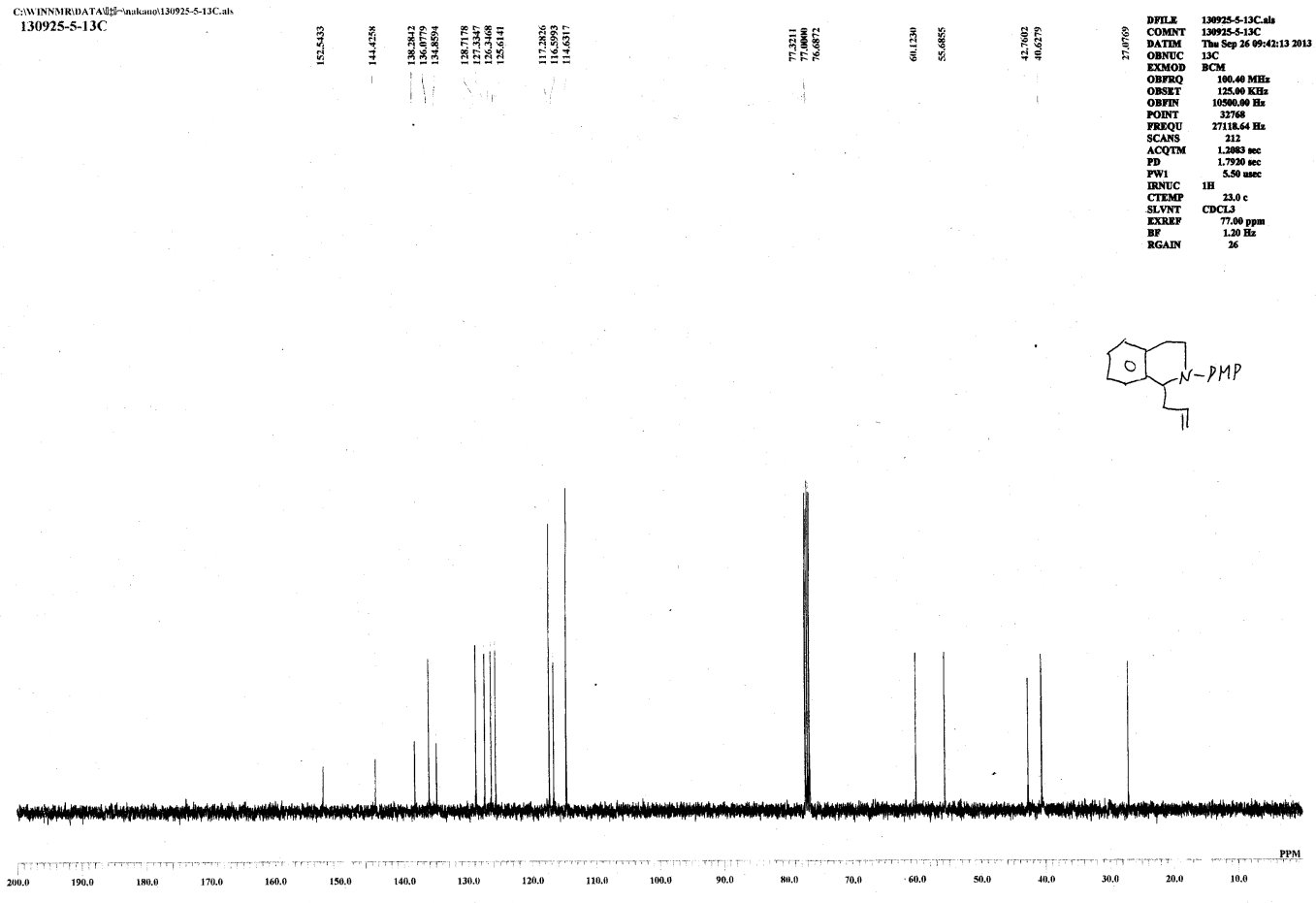
1-Isopropyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (16)



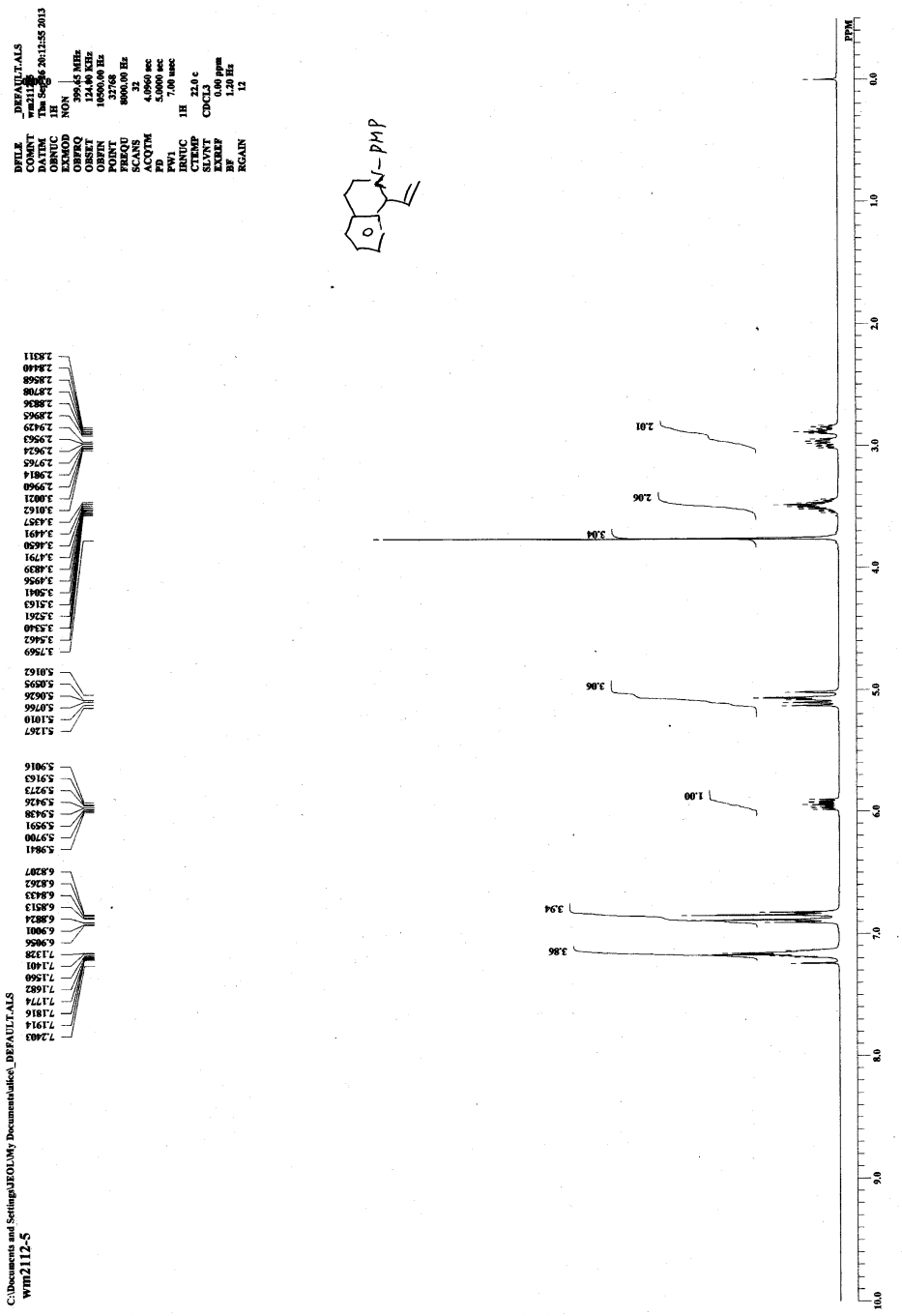

DFILE _DEFAULT.AIS
wm2110-10-13C
Mon Sep 09 19:40:20 2013
13C
BCM
100.40 MHz
125.00 KHz
16500.00 Hz
32768
27118.64 Hz
513
1.2360 sec
1.7920 sec
5.50 usec
1H
23.1 c
CDCl3
77.00 ppm
1.20 Hz
25
76.8793
34.2805
43.6082
55.7102
65.3590
77.3211
77.0000
76.6872
114.5905
115.7678
125.0954
126.3633
128.3556
128.3885
135.3534
137.7573
145.0762
151.4870
N- PMP
i-Pr
PPM
C:\Documents and Settings\JEOL\My Documents\alice_DEFAULT.AIS
wm2110-10-13C

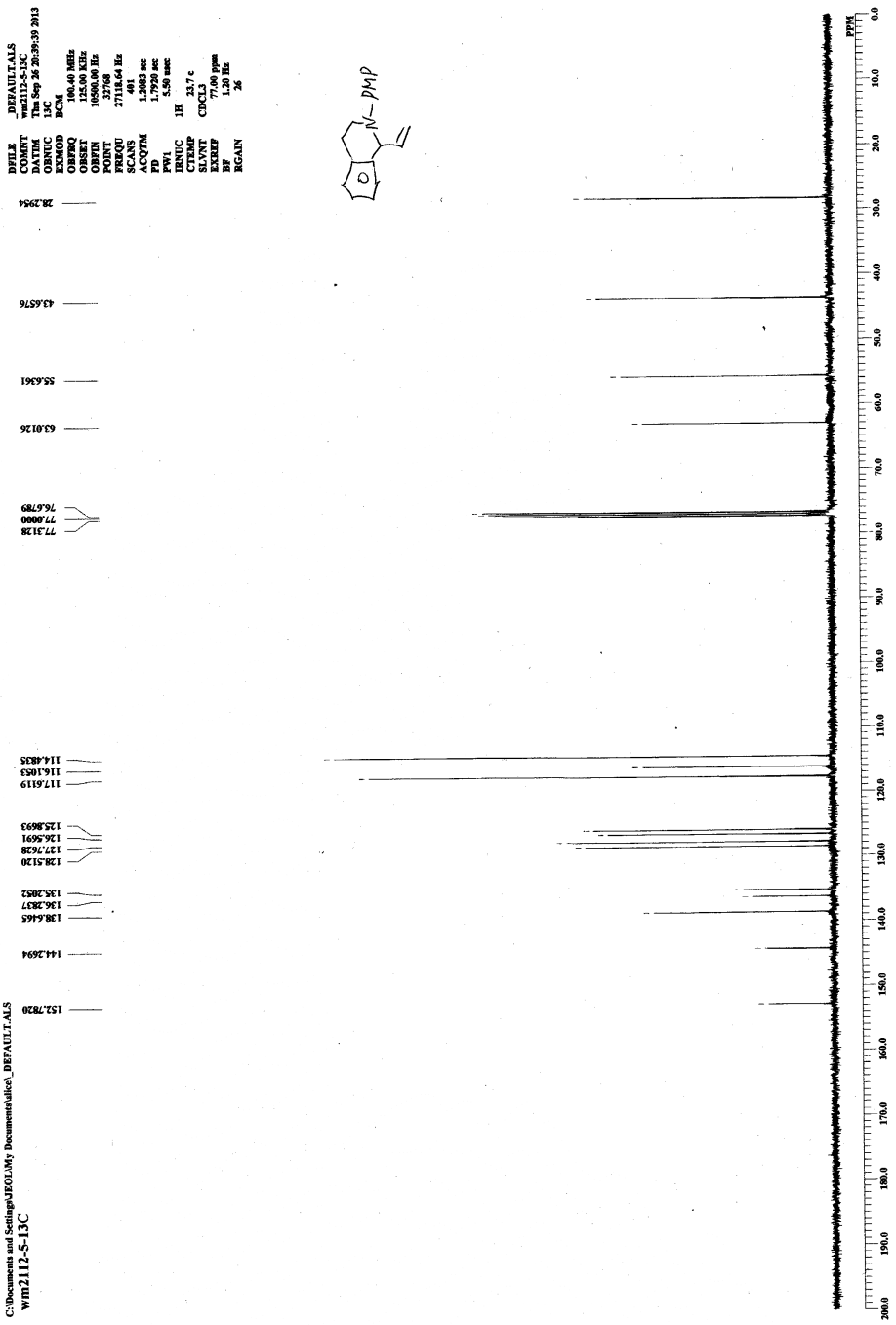
1-Allyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (17)



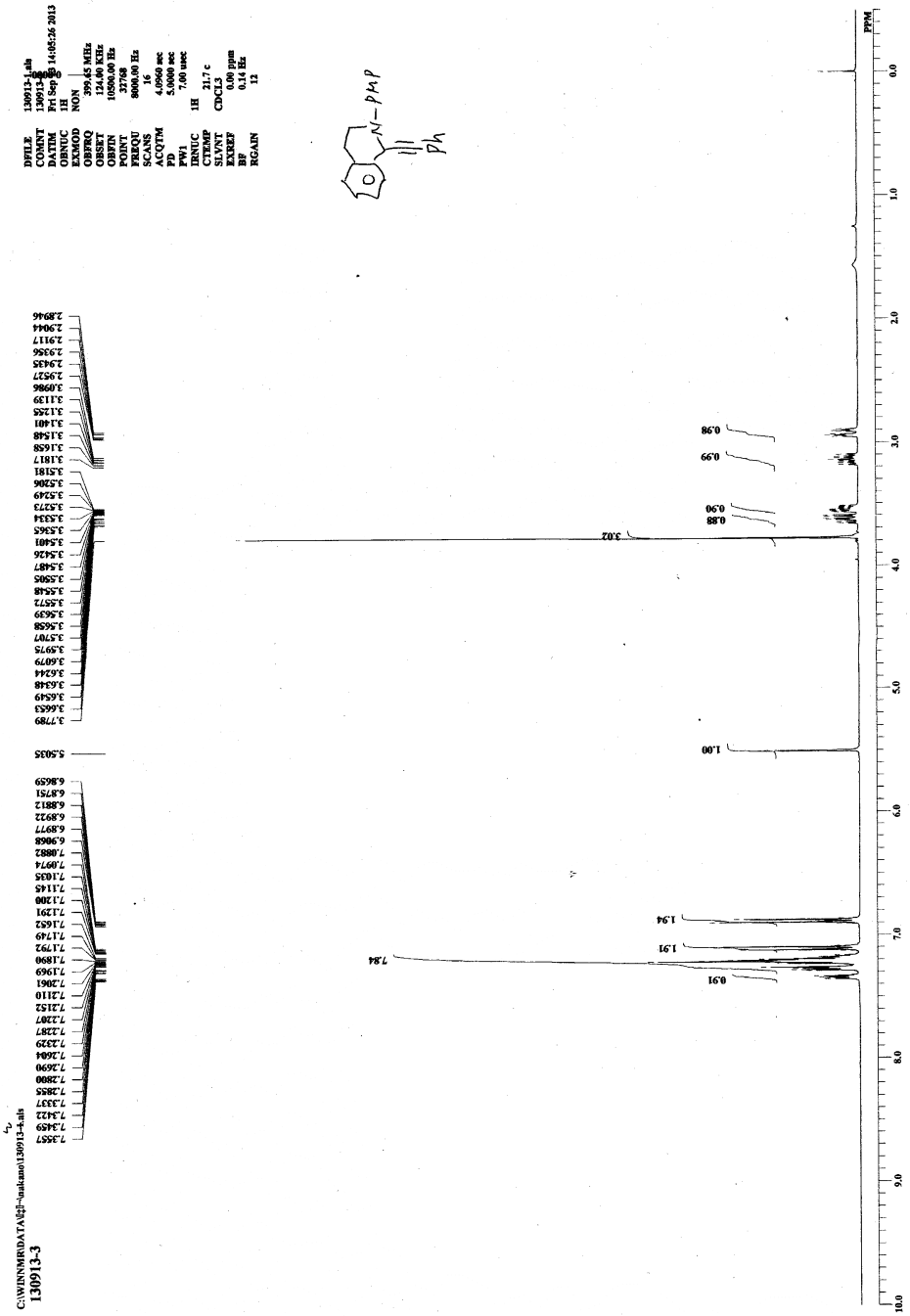

C:\WINNMR\DATA\山中~\nakano\130925-5-13C.als
130925-5-13C
152.5433
144.4258
138.2842
136.0779
134.8594
128.7178
127.1347
126.3468
125.6141
117.2826
116.5993
114.6317
77.3211
77.0000
76.6872
60.1230
55.6855
42.7602
40.6279
27.6769
DFILE 130925-5-13C.als
COMNT 130925-5-13C
DATIM Thu Sep 26 09:42:13 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 212
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 23.0 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 26
N-PMP
PPM
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0

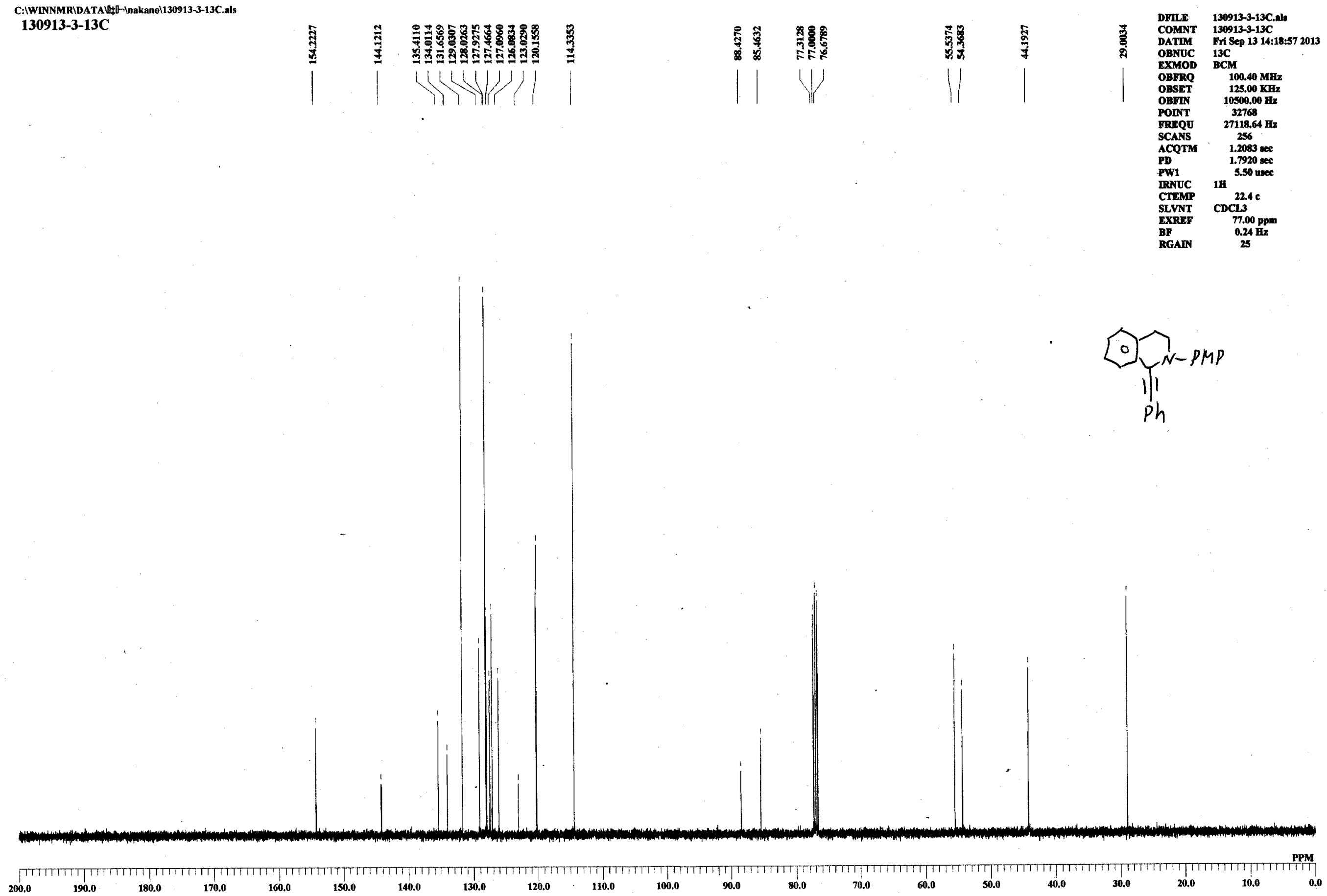
1-Vinyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (18)



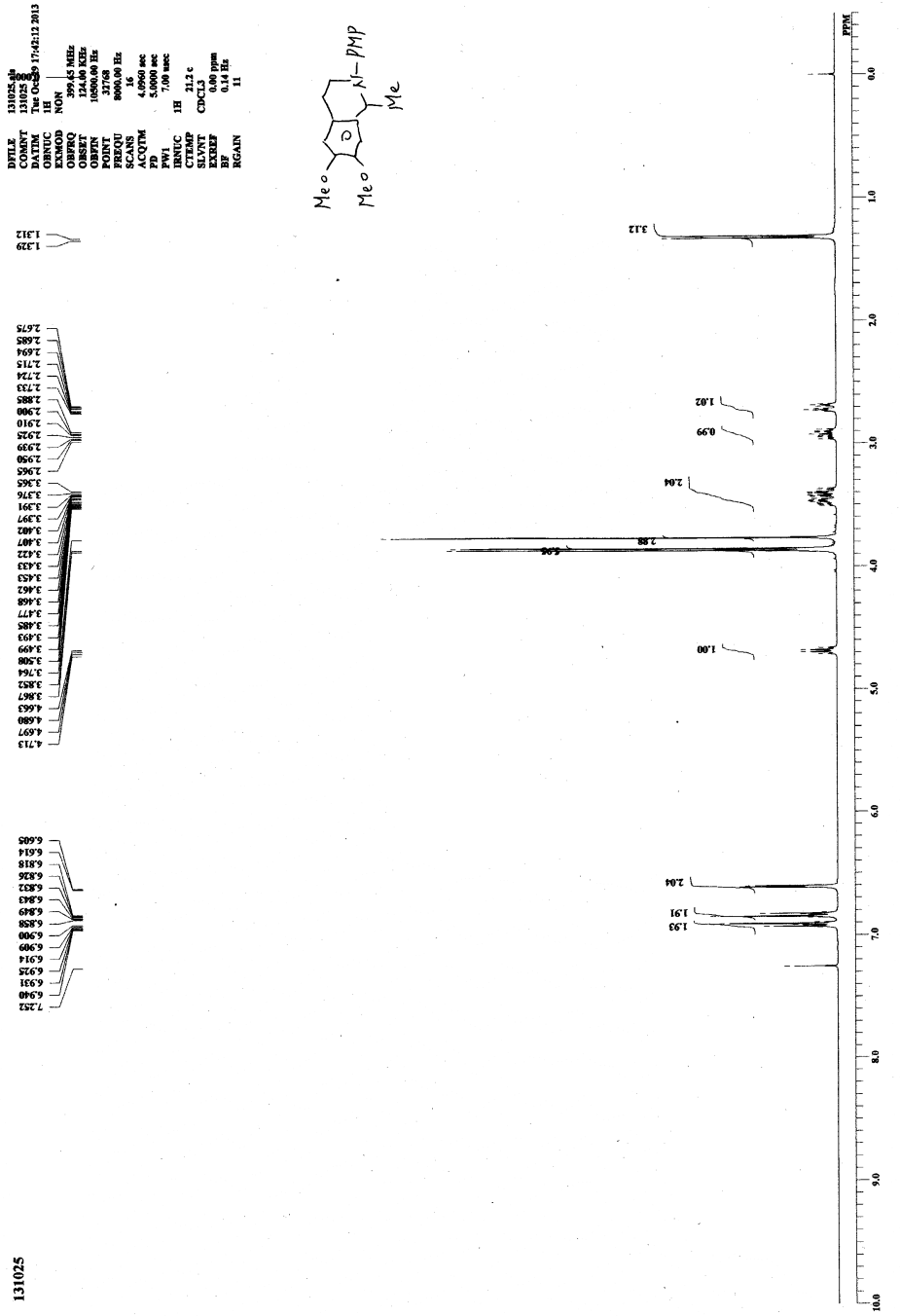

C:\Documents and Settings\JEOL\My Documents\alice_DEFAULT.ALS
wm2112-5-13C
DFILE _DEFAULT.ALS
COMNT wm2112-5-13C
DATIM Thu Sep 26 20:39:39 2013
OBNUC 13C
EXMOD BCM
OBSFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 401
ACQTM 1.2083 sec
PD 1.7500 sec
PW1 5.50 usec
IRNUC 1H 23.7 c
CTEMP
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.20 Hz
RGAIN 26
28.2954
43.6576
55.6361
63.0126
76.6789
77.0000
77.3128
114.4835
116.1053
117.6119
125.8693
126.5691
127.7628
128.5120
135.2052
136.2837
138.6465
144.2694
152.7820
N- PMP
PPM
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

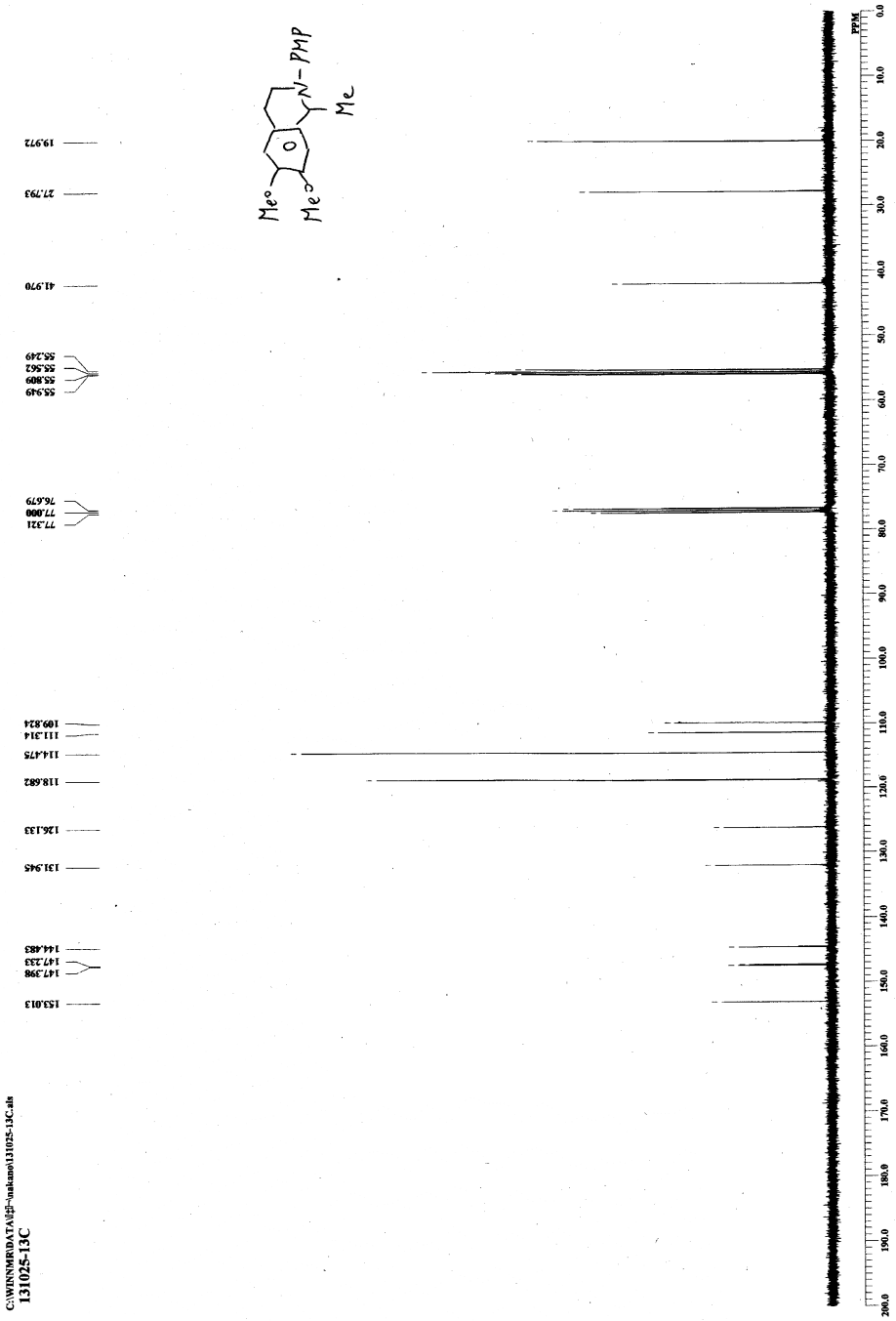
1-Phenylethynyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (19)



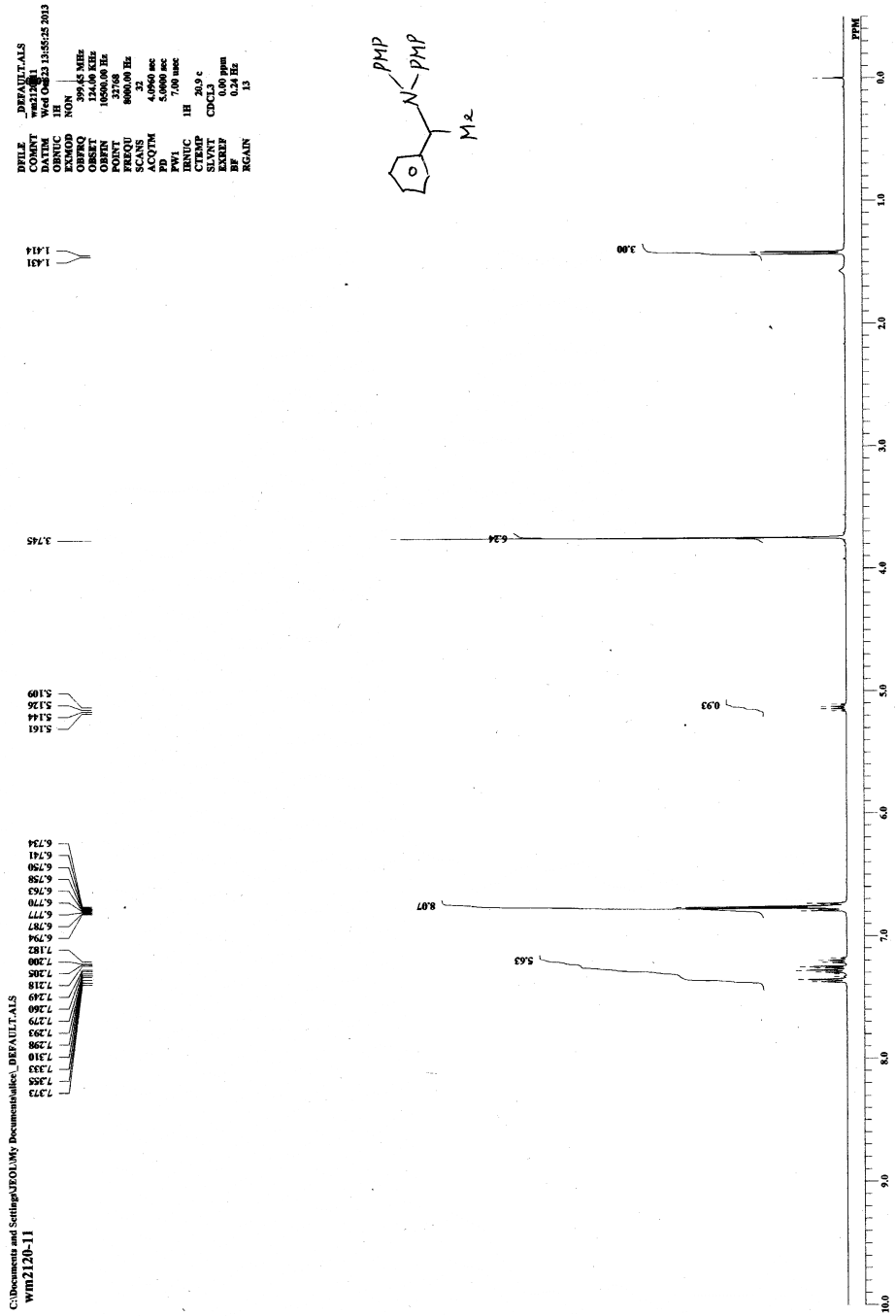

C:\WINNMR\DATA\山田\nakano\130913-3-13C.als
130913-3-13C
154.2227
144.1212
135.4110
134.0114
131.6569
129.0307
128.0263
127.9275
127.4664
127.0960
126.0834
123.0290
120.1558
114.3353
88.4270
85.4632
77.3128
77.0000
76.6789
55.5374
54.3683
44.1927
29.0034
DFILE 130913-3-13C.als
COMNT 130913-3-13C
DATIM Fri Sep 13 14:18:57 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 256
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.24 Hz
RGAIN 25
N–PMP
Ph
PPM
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

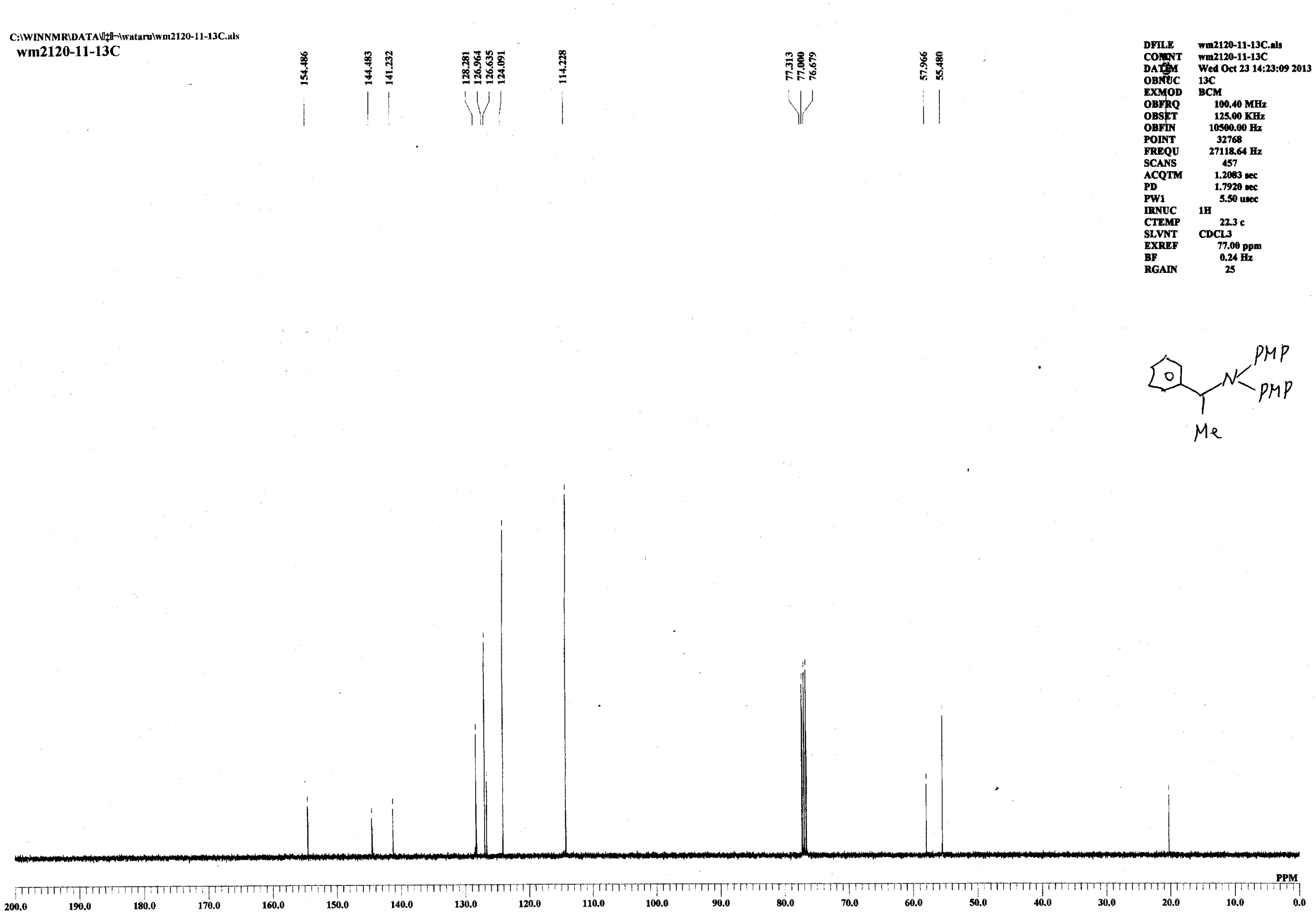
1-Methyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydro-6,7-dimethoxyisoquinoline (20)



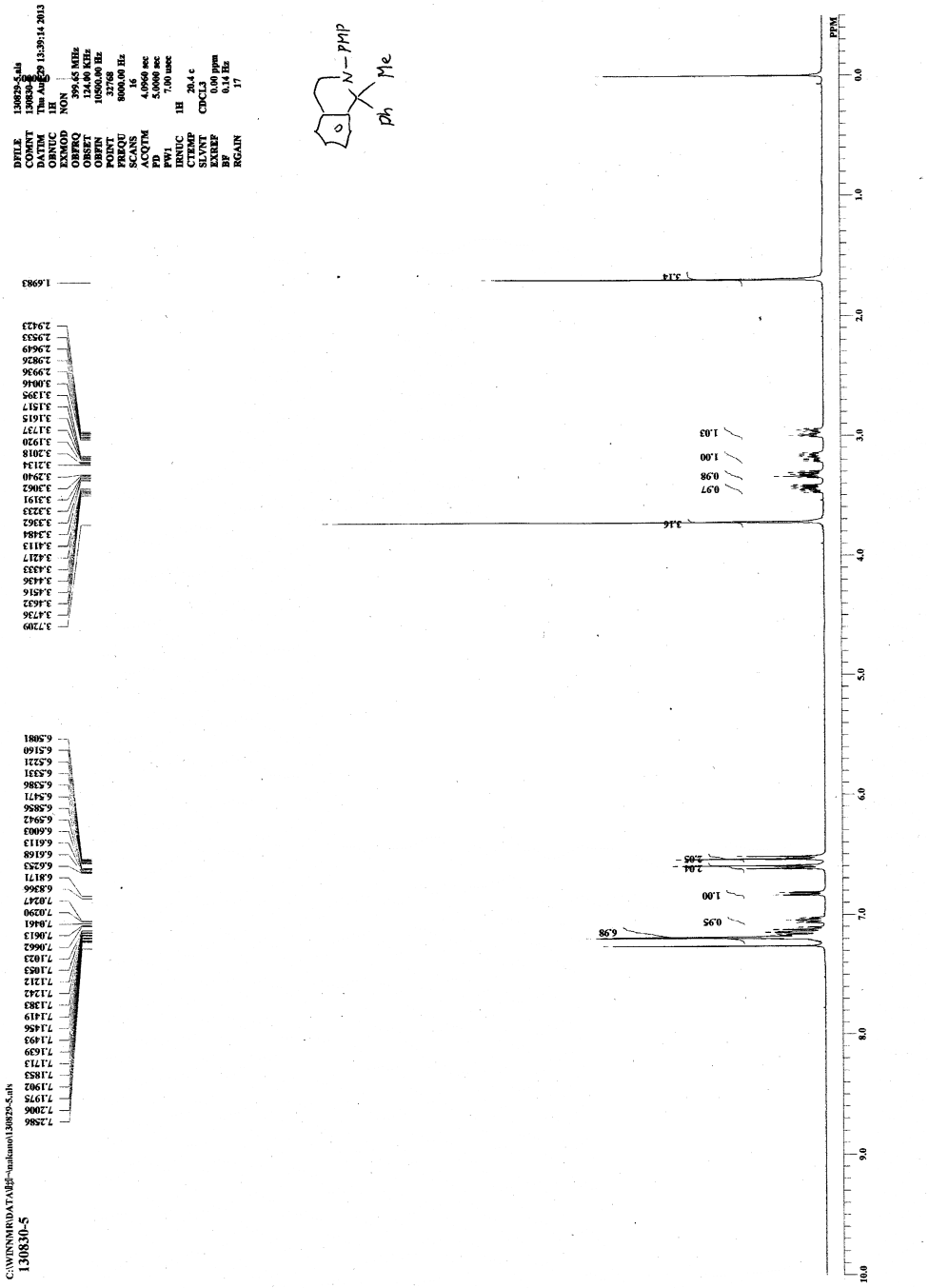

C:\WINNMR\DATA\データ\nakano\131025-13C.als
131025-13C
153.013
147.398
147.233
144.483
131.945
126.133
118.682
114.475
111.314
109.824
77.321
77.000
76.679
55.949
55.862
55.809
55.749
41.970
27.793
19.972
N-PMP
Me
Me
Me
PPM
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0

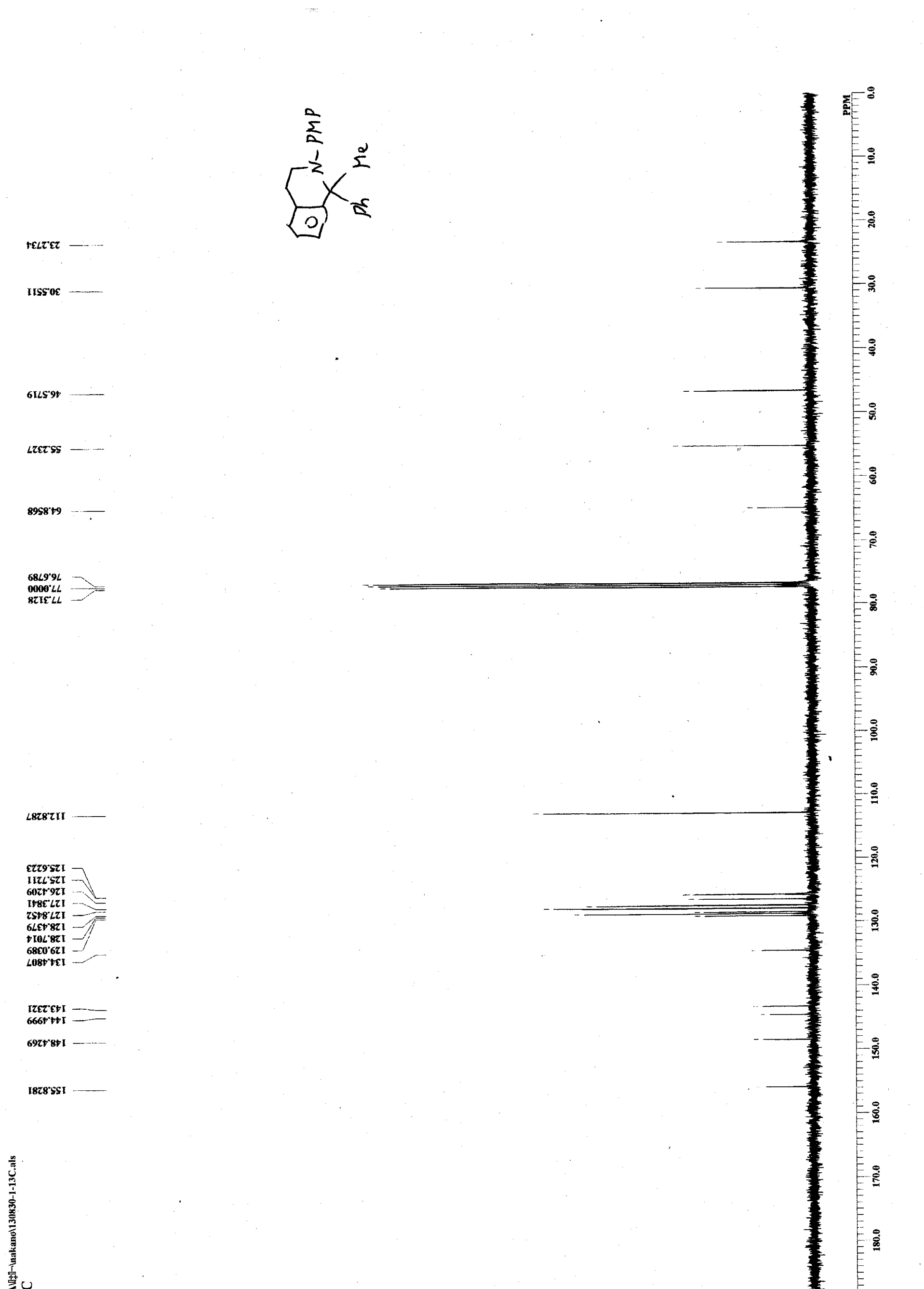
N,N-Di-(4-Methoxyphenyl)-1-phenylethylamine (21)



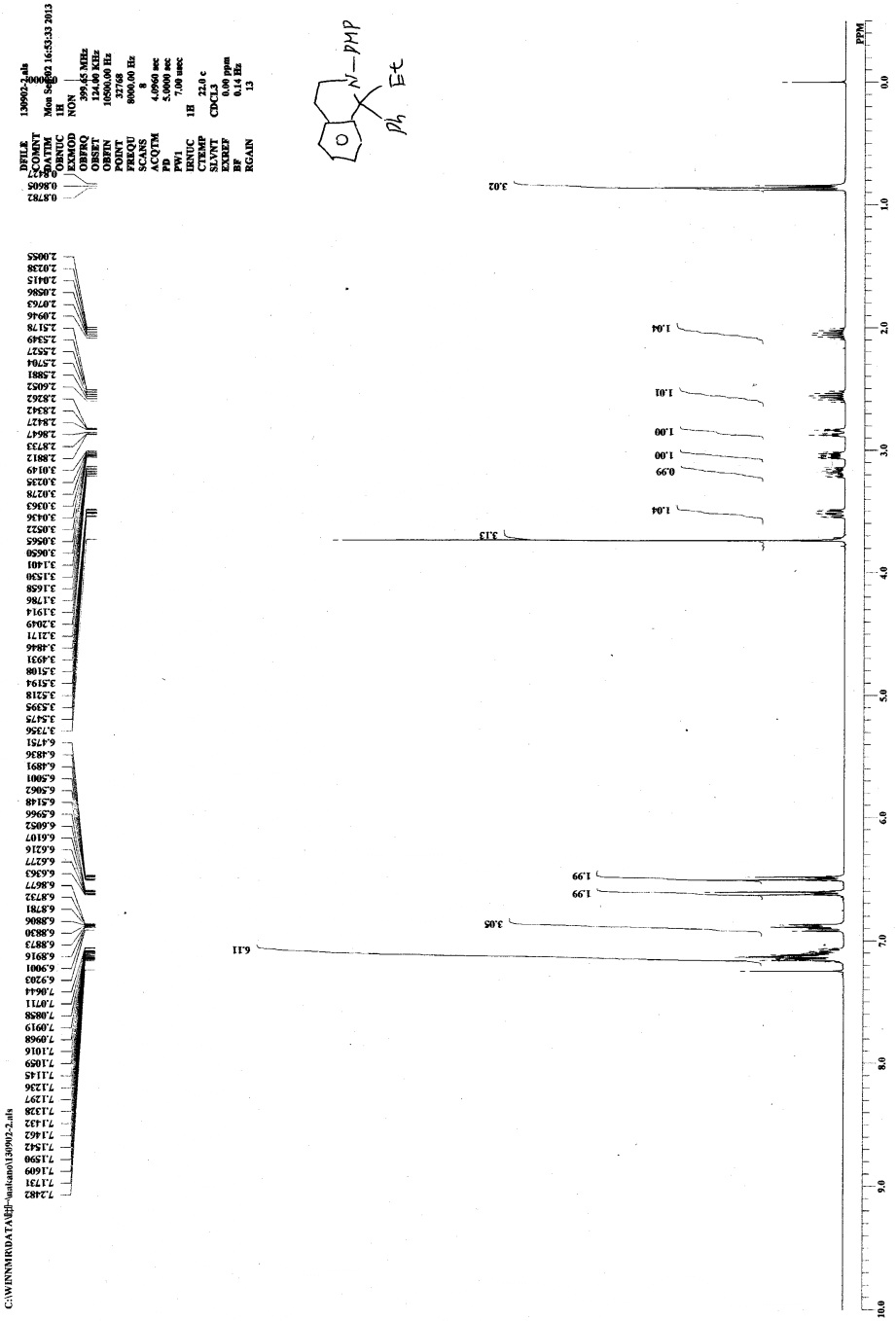

C:\WINNMR\DATA\…\wataru\wm2120-11-13C.als
wm2120-11-13C
154.486
144.483
141.232
128.281
126.964
126.635
124.091
114.228
77.313
77.000
76.679
57.966
55.480
DFILE wm2120-11-13C.als
COMNT wm2120-11-13C
DATIM Wed Oct 23 14:23:09 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 457
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.3 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.24 Hz
RGAIN 25
PMP
PMP
Me
PPM
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

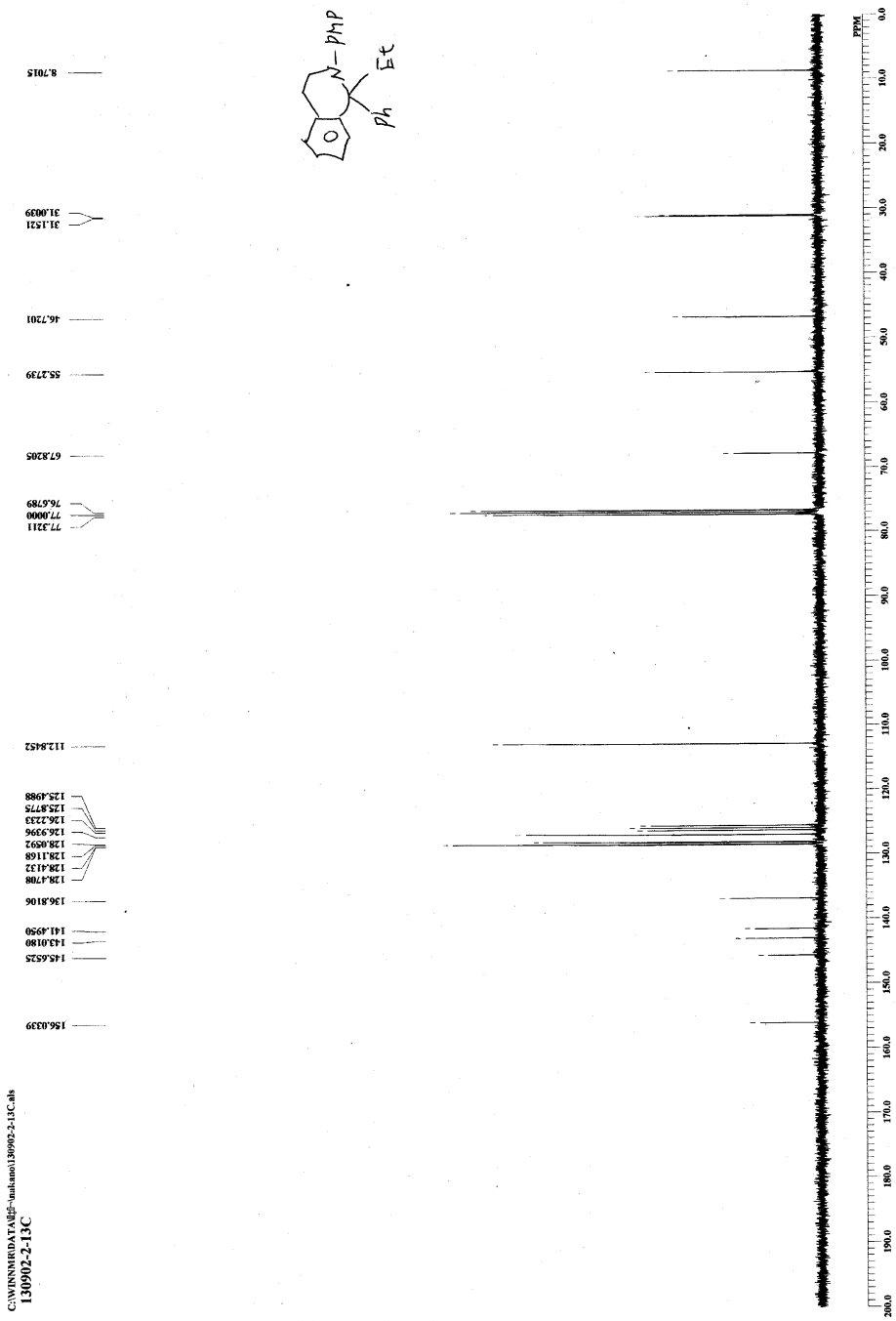
1-Methyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (22)



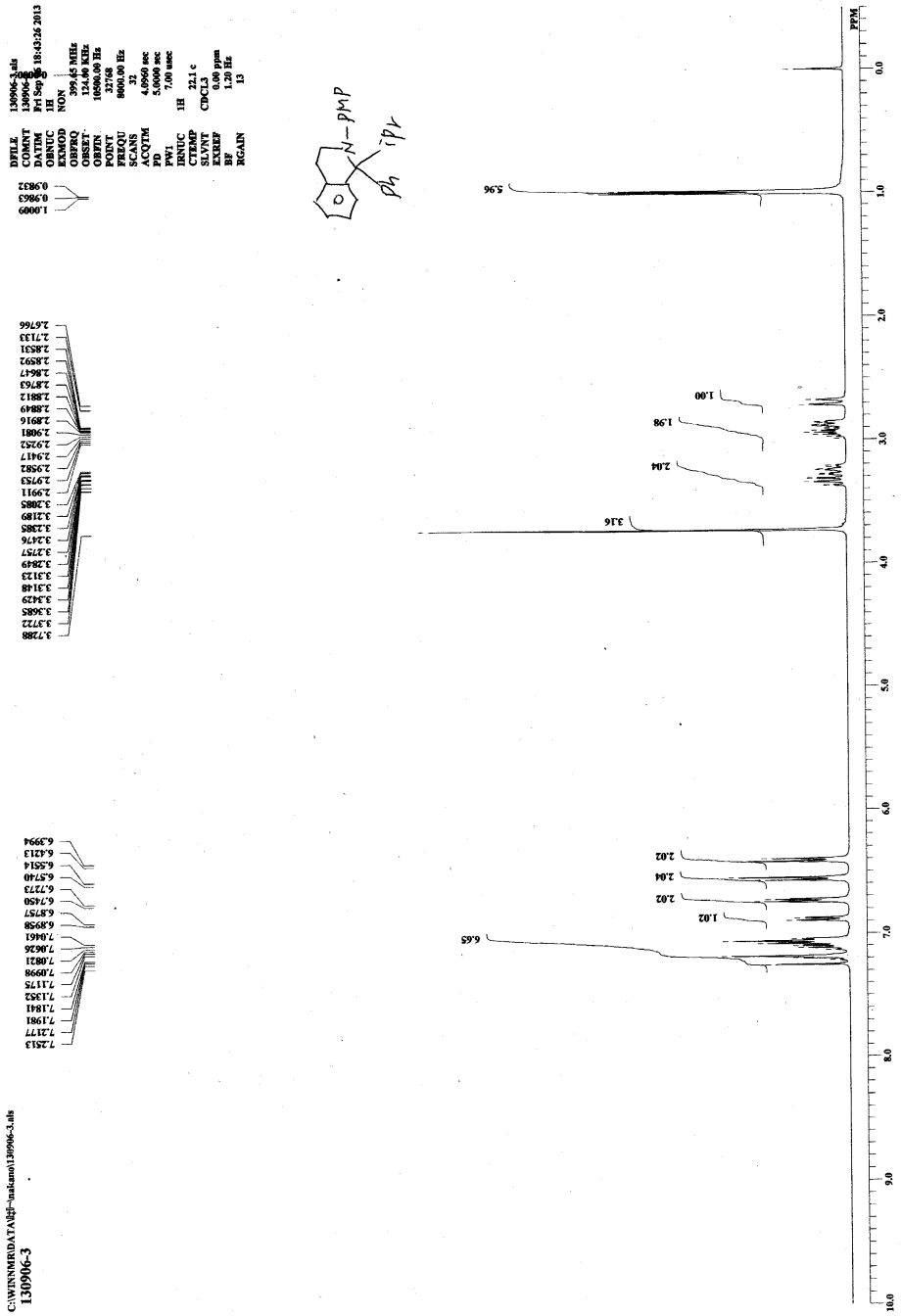

N-PMP
Me
Ph
23.7734
30.5511
46.5719
55.3327
64.8568
76.6789
77.0000
77.3128
112.8287
125.6223
125.7211
126.4209
127.3841
127.8452
128.4379
128.7014
129.0389
134.4807
143.3321
144.4999
148.4269
155.8281
130830-1-13C
PPM

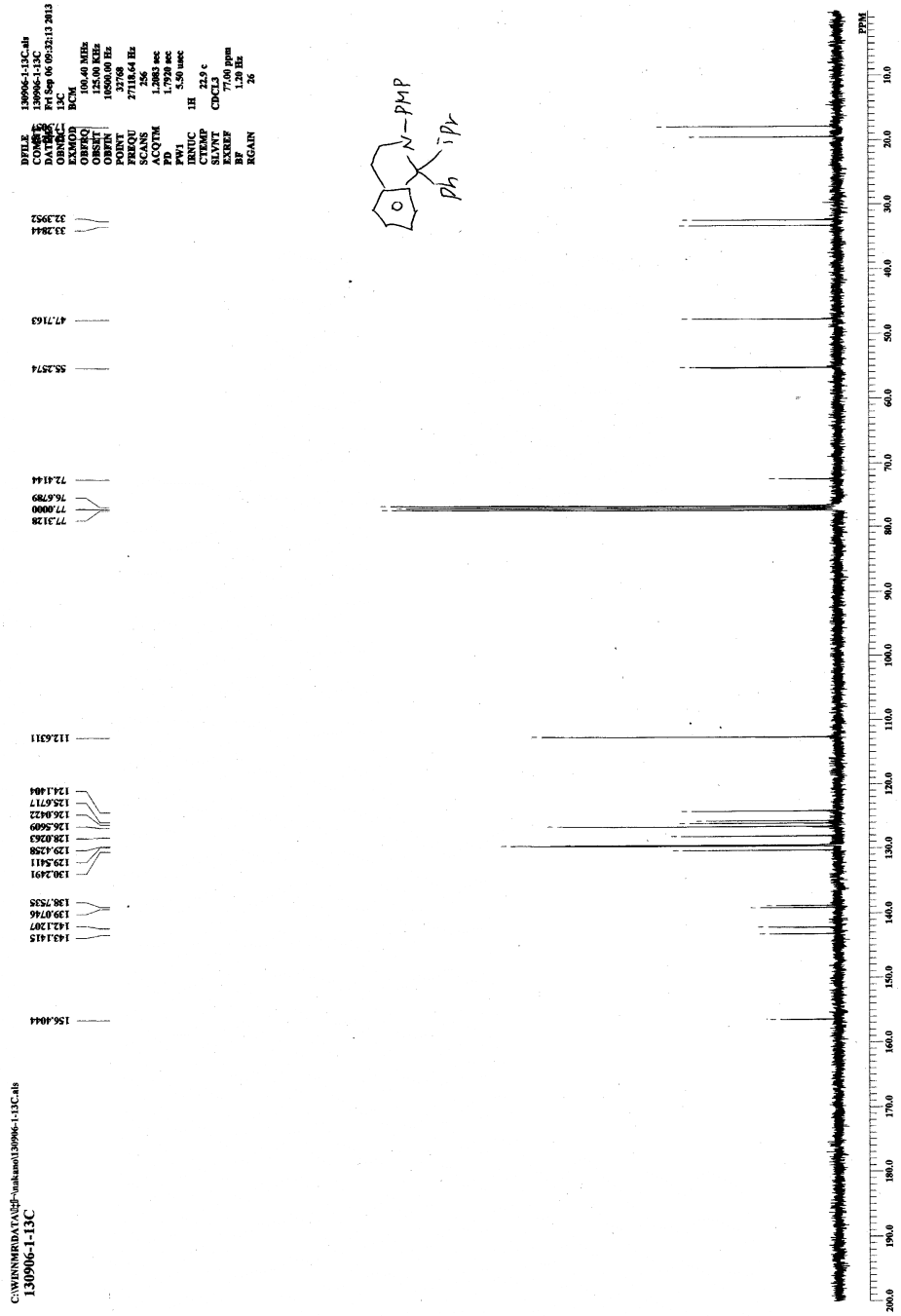
1-Ethyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (23)



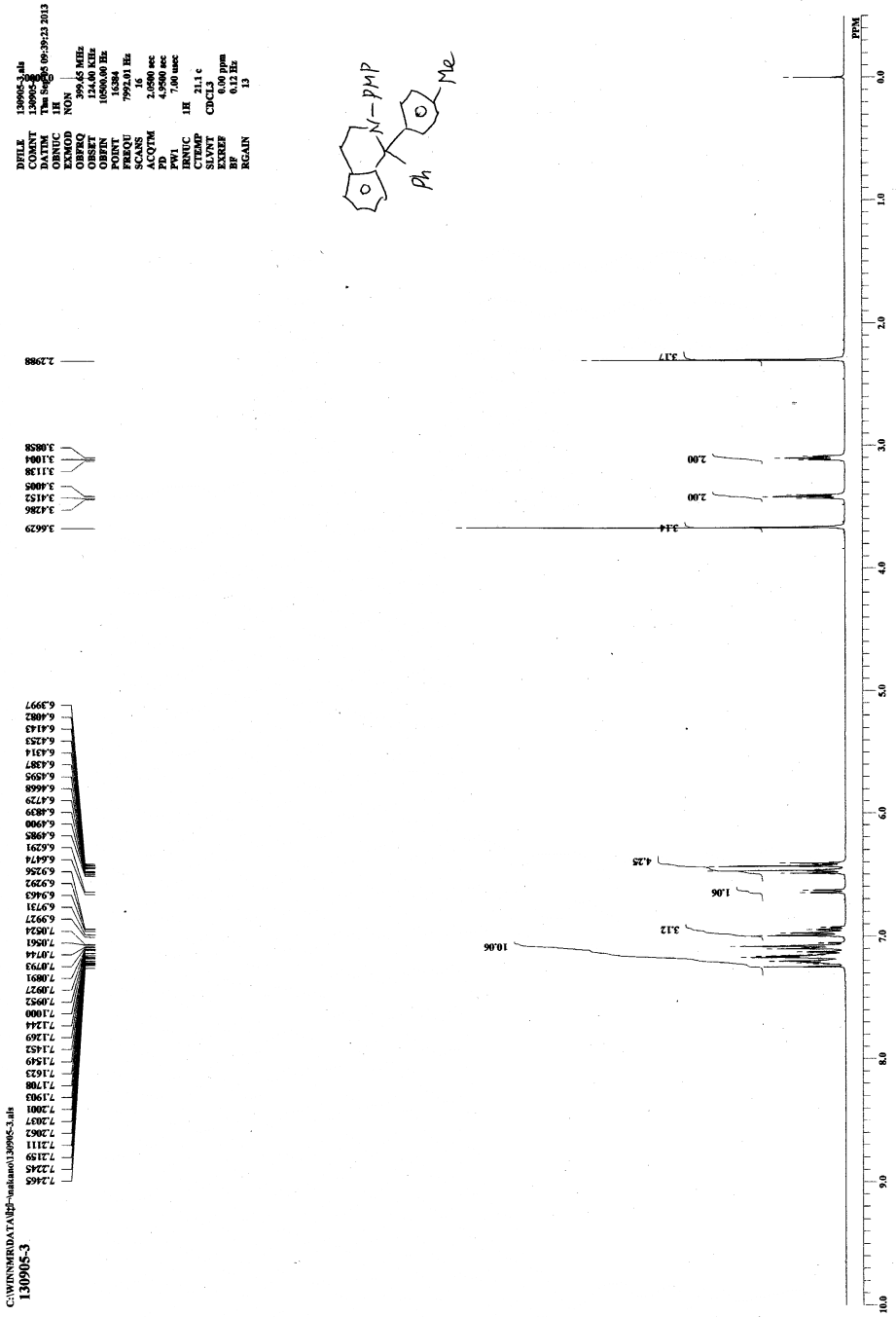

C:\WINNMR\DATA\鈴木-inukano\130902-2-13C.als
130902-2-13C
8.7015
31.0039
31.1521
46.7201
55.2739
67.8205
76.6789
77.0000
77.3211
112.8452
125.4988
125.8775
126.2233
126.9396
128.0892
128.1168
128.4132
128.4708
136.8106
141.4950
143.0180
145.6525
156.0339
PPM
Ph
Et
N-PMP
O

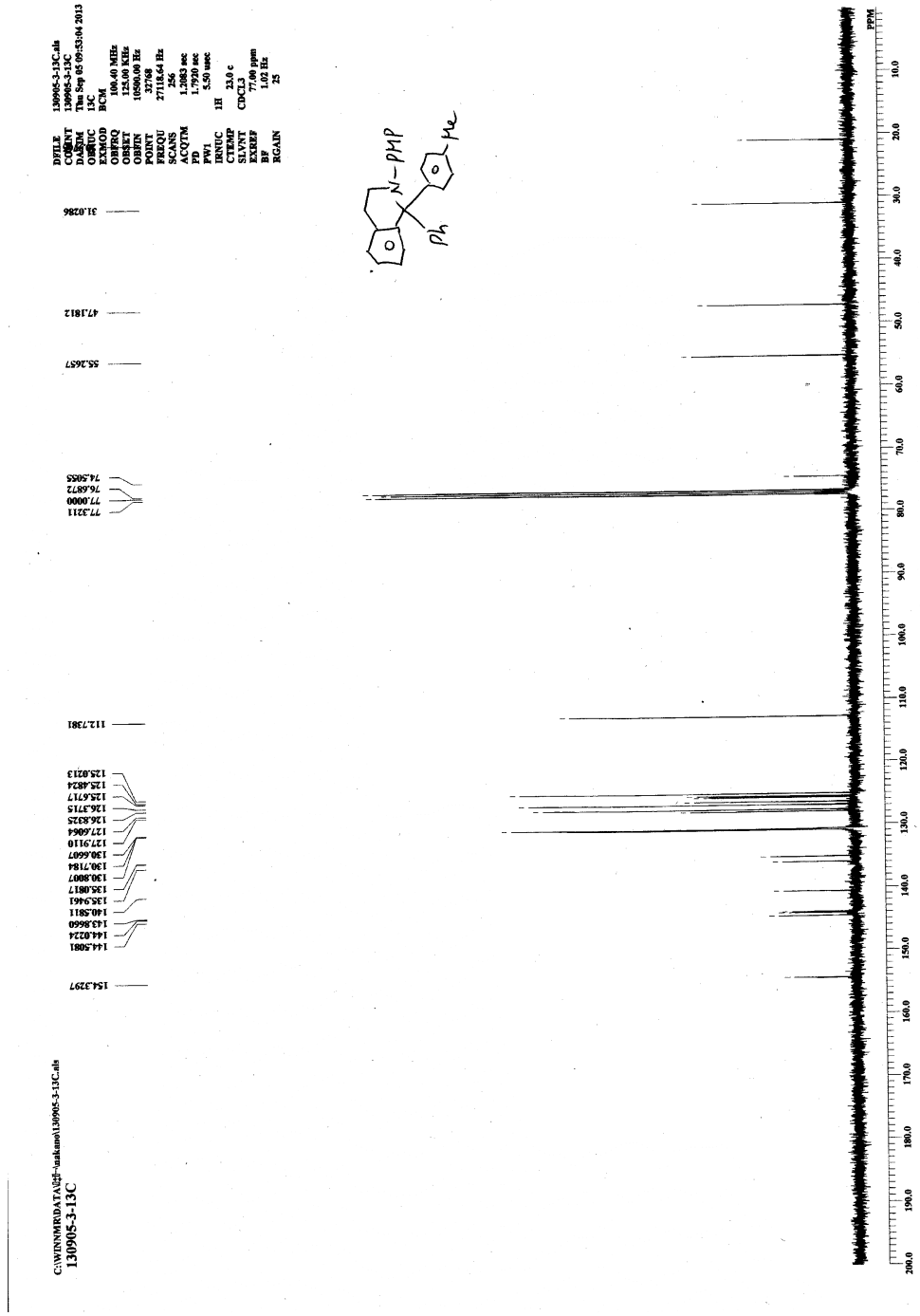
1-Isopropyl-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (24)



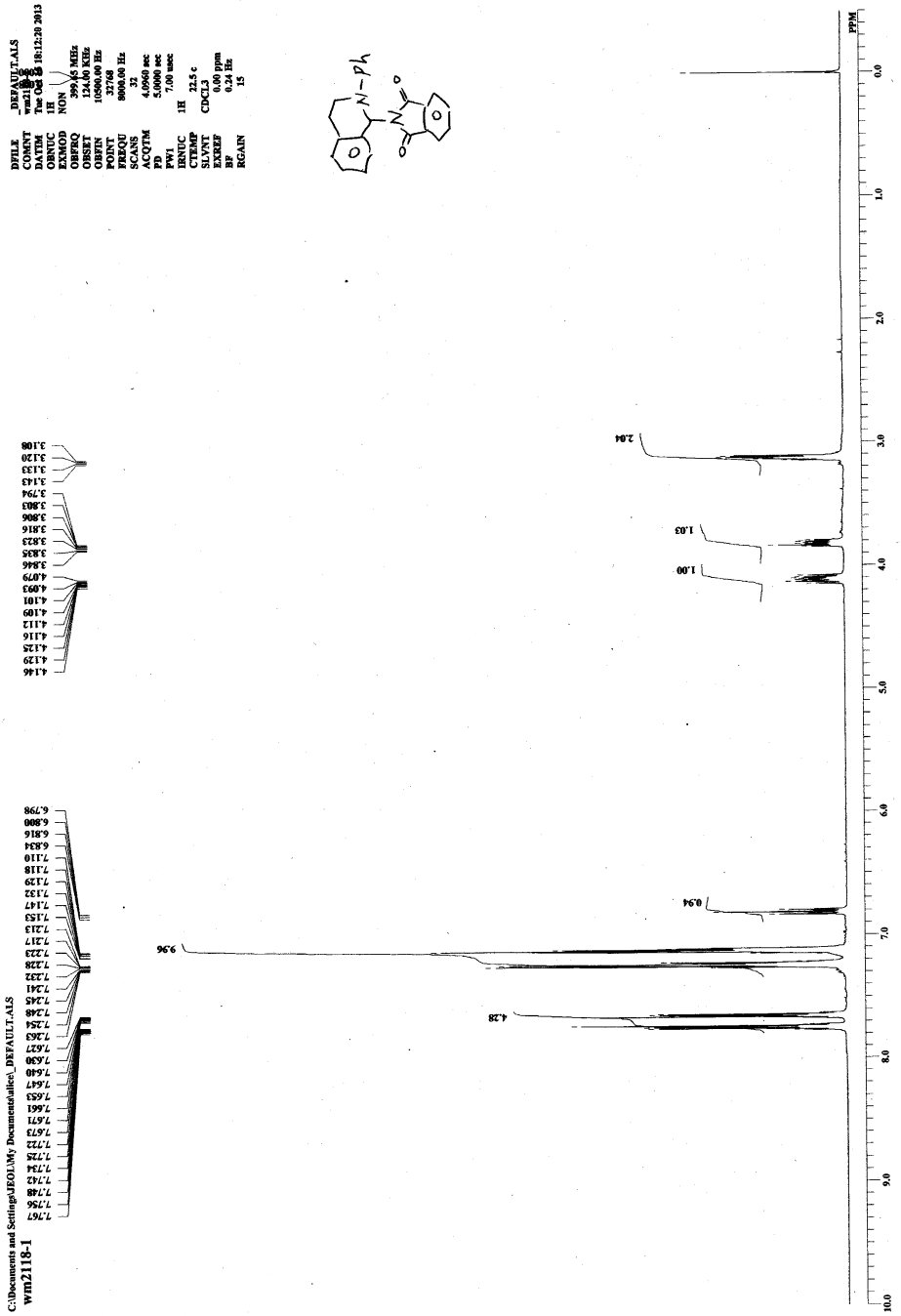

C:\WINNMRDATA\tf-nakano\130906-1-13C.als
130906-1-13C
DFILE 130906-1-13C.als
CDATE 130906-1-13C
DATIM Fri Sep 06 09:52:13 2013
OBSET 100.40 MHz
OBFRQ 125.00 KHz
OBSET 10500.00 Hz
OBFIN
POINT 32768
FREQU 27118.64 Hz
SCANS 256
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.9 c
SLVNT CDCl3
EXREF 77.00 ppm
RF 1.20 Hz
RGAIN 76
32.3952
33.2844
47.7163
55.2574
72.4144
76.6789
77.0000
77.3128
112.6311
124.1404
125.6717
126.0422
126.5609
128.0263
129.4258
129.5411
130.2491
136.7535
139.0746
142.1207
143.1415
156.4044
PPM

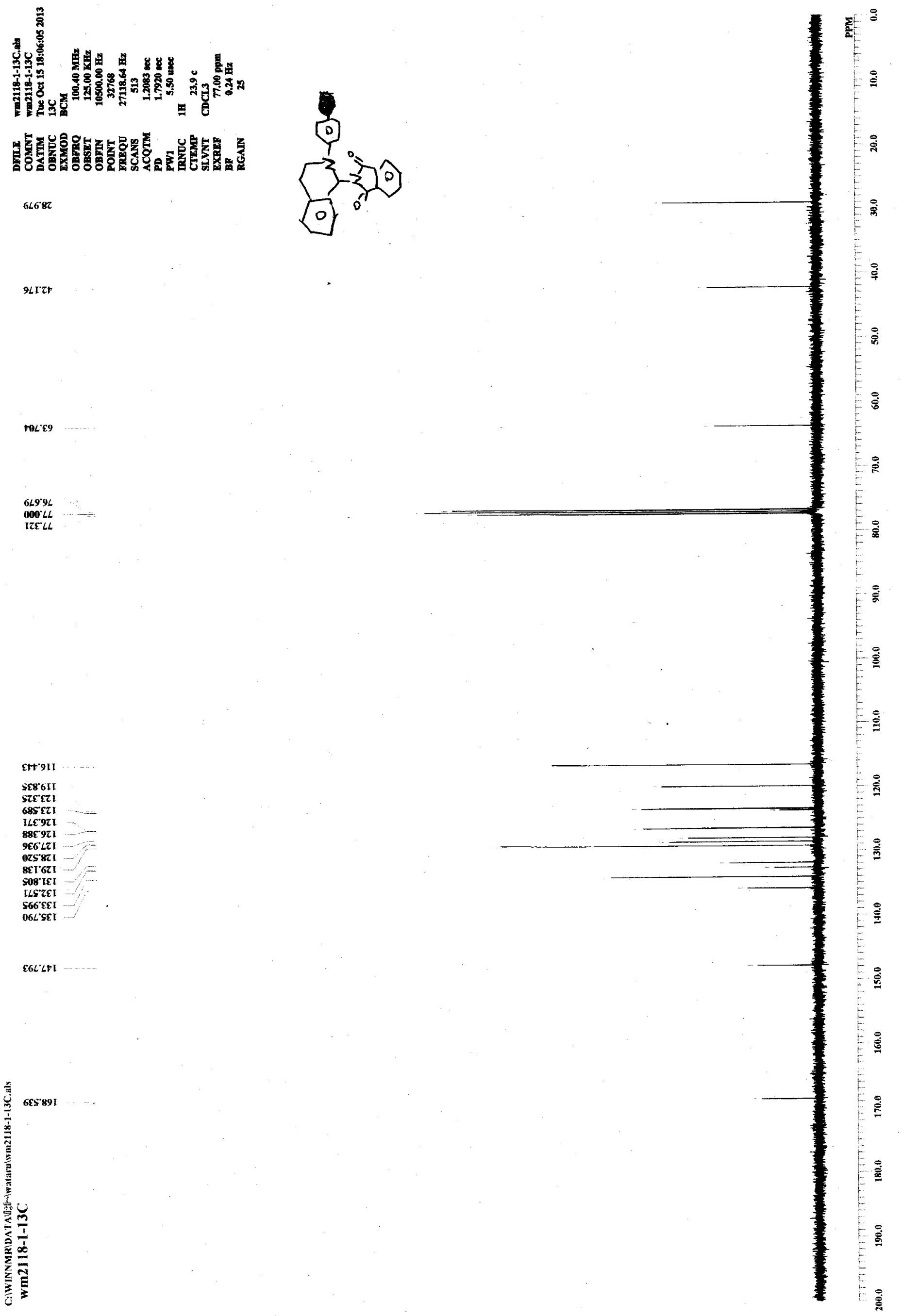
1-(4-Tolyl)-1-phenyl-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (25)




DFILE 130905-3-13C.als
COMENT 130905-3-13C
DATIM Thu Sep 05 09:53:04 2013
OBNUC 13C
EXMOD RCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 256
ACQTM 1.2058 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H 23.0 c
CTEMP
SLVNT CDCl3
EXREF 77.00 ppm
BF 1.02 Hz
RGAIN 25
31.0286
47.1812
55.3657
74.5055
76.8872
77.0000
77.3211
112.7381
125.0213
125.4824
125.5717
126.3715
126.8325
127.6064
127.9110
130.6607
130.7184
130.8007
135.0817
135.5961
140.5811
143.8660
144.0224
144.5081
154.3297
N-PMP
Ph
Me
PPM
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
C:\WINNMR\DATA\[illegible]\nakano\130905-3-13C.als
130905-3-13C

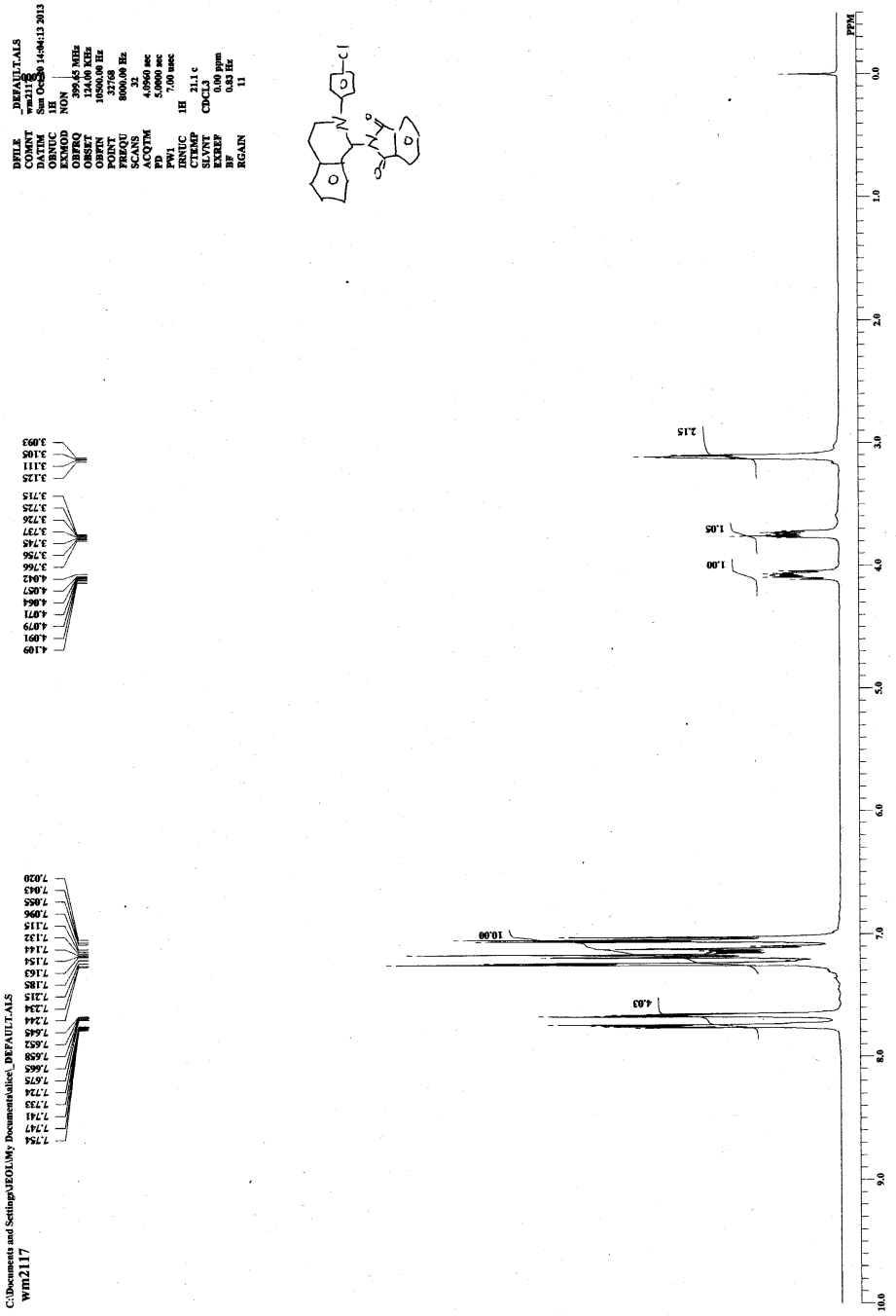
1-(Indene-1,3-dionyl)-2-phenyl-1,2,3,4-tetrahydroisoquinoline (26)

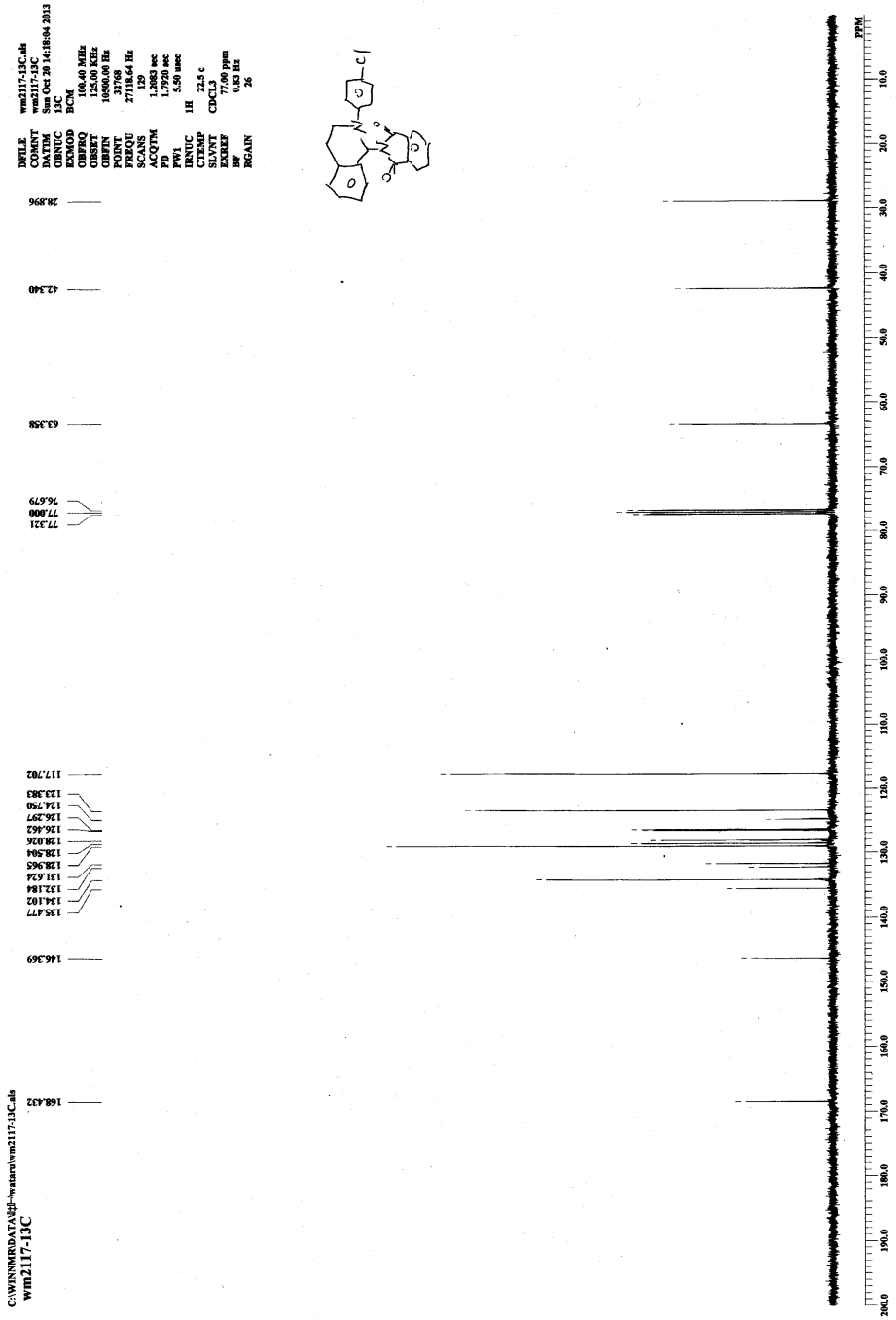




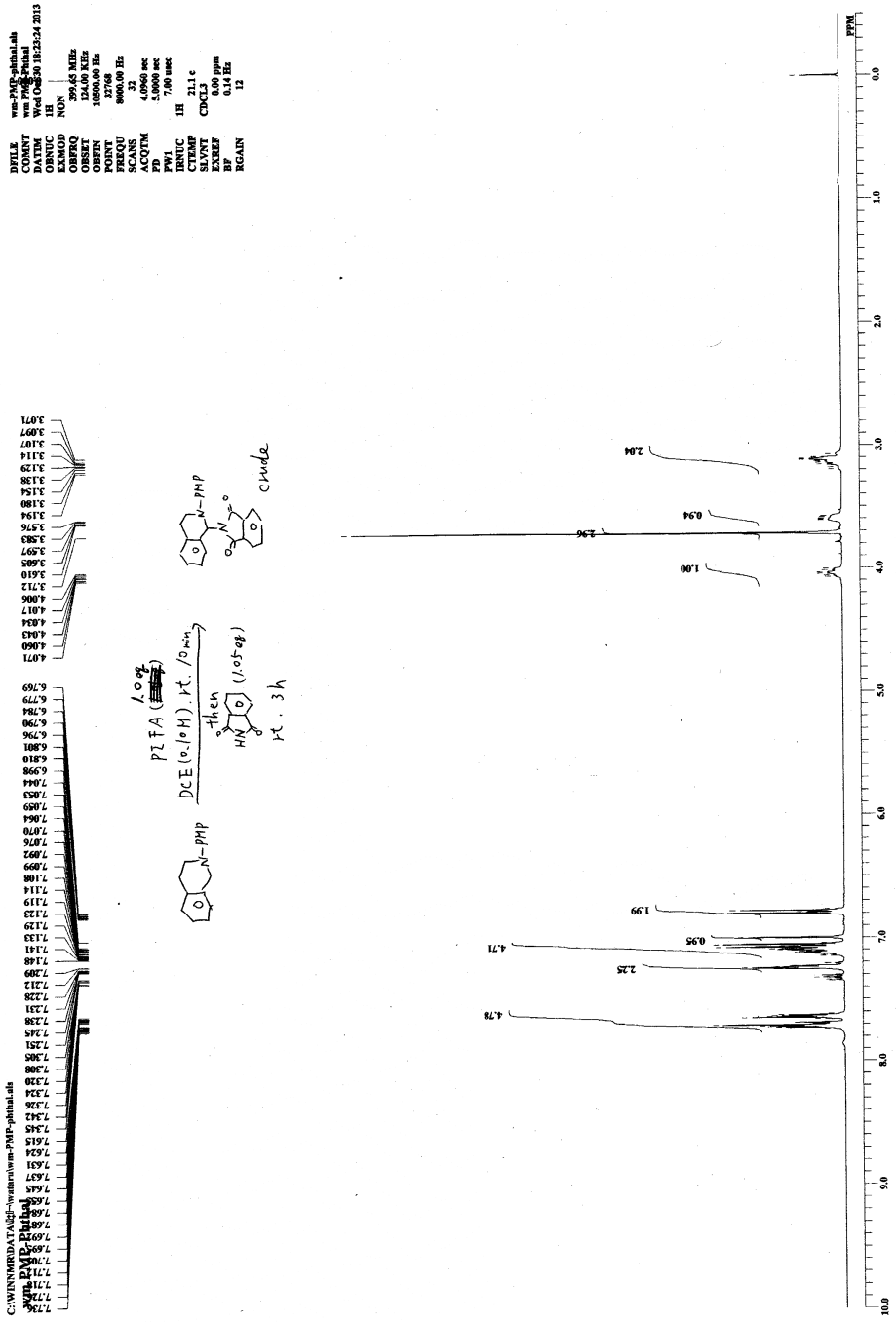
C:\WINNMR\DATA\...\wataru\wm2118-1-13C.als
wm2118-1-13C
DFILE wm2118-1-13C.als
COMNT wm2118-1-13C
DATIM Tue Oct 15 18:06:05 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 513
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 23.9 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.24 Hz
RGAIN 25
28.979
42.176
63.704
76.679
77.000
77.321
116.443
119.835
123.325
123.589
126.371
126.388
127.936
128.520
129.138
131.805
132.571
133.995
135.790
147.793
168.539
PPM

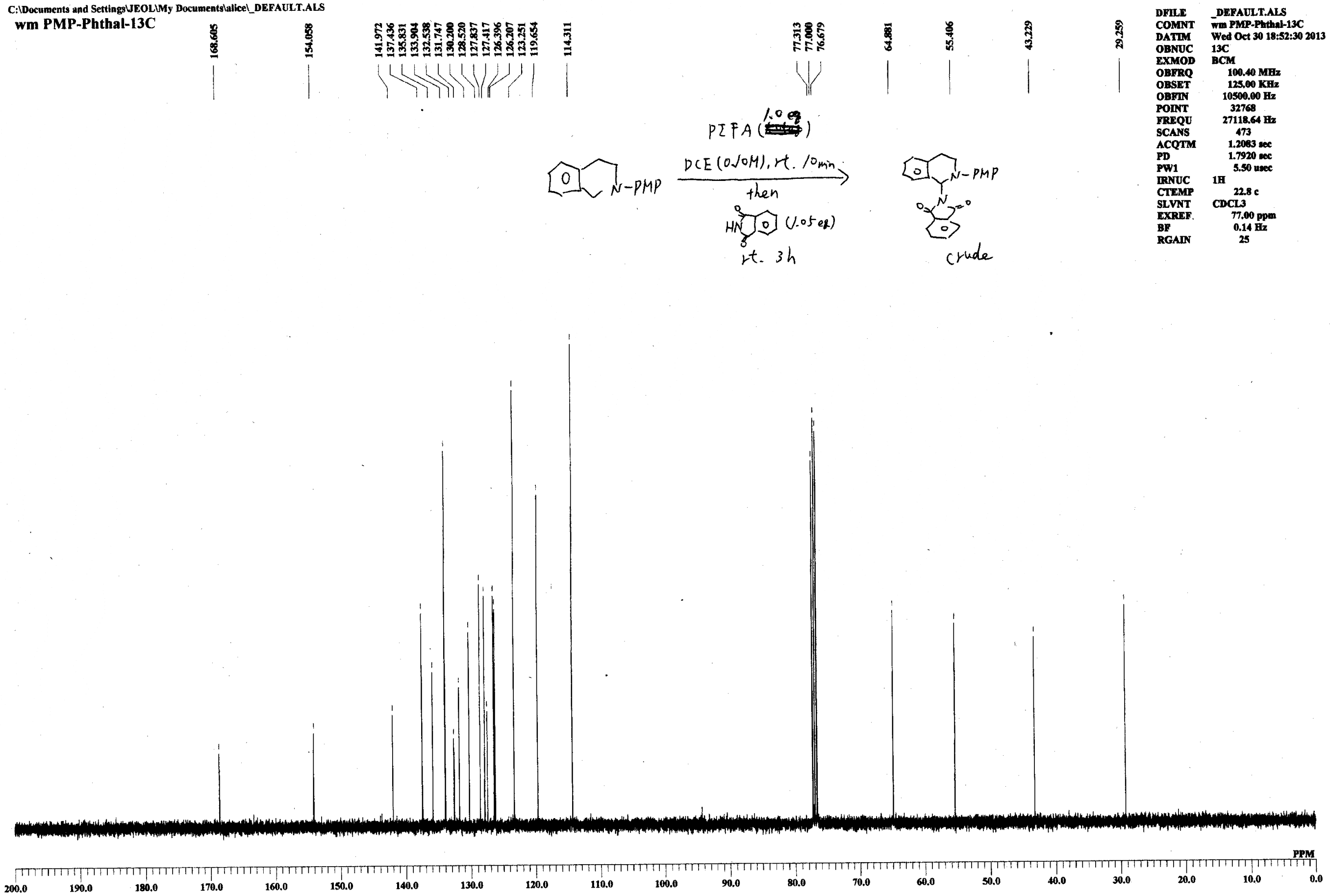
1-(Indene-1,3-dionyl)-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (27)



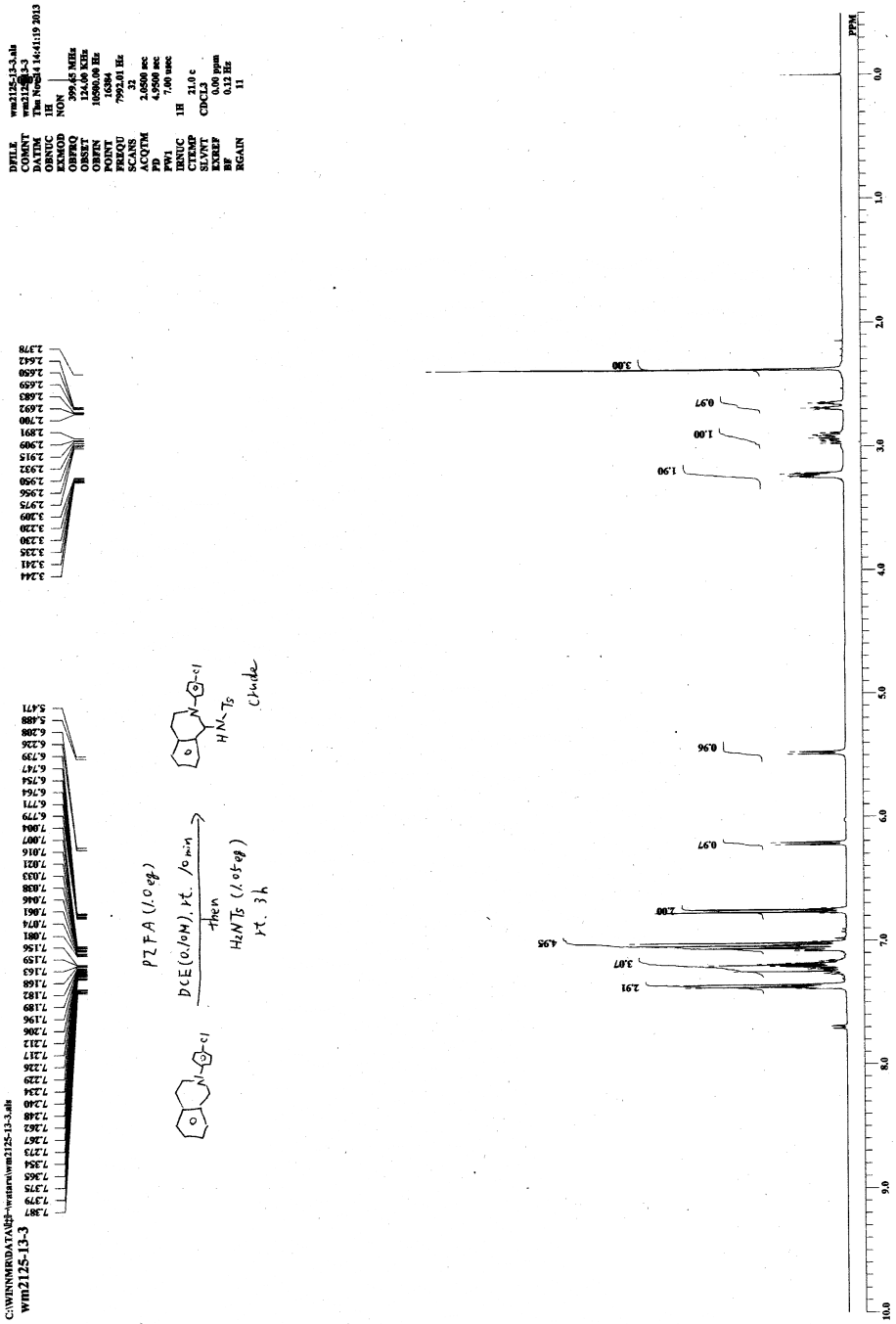

C:\WINNMR\DATA\djh~\nataro\wm2117-13C.als
wm2117-13C
DFILE wm2117-13C.als
COMNT wm2117-13C
DATIM Sun Oct 20 14:18:04 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 MHz
OBFIN 16500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 129
ACQTM 1.2083 sec
FD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.5 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.83 Hz
RGAIN 26
28.896
42.340
63.358
76.679
77.000
77.321
117.702
123.383
124.750
126.297
126.462
128.026
128.504
128.965
131.624
132.184
134.102
135.477
146.369
168.432
PPM

1-(Indene-1,3-dionyl)-2-(4-methoxyphenyl)-1,2,3,4-tetrahydroisoquinoline (28)



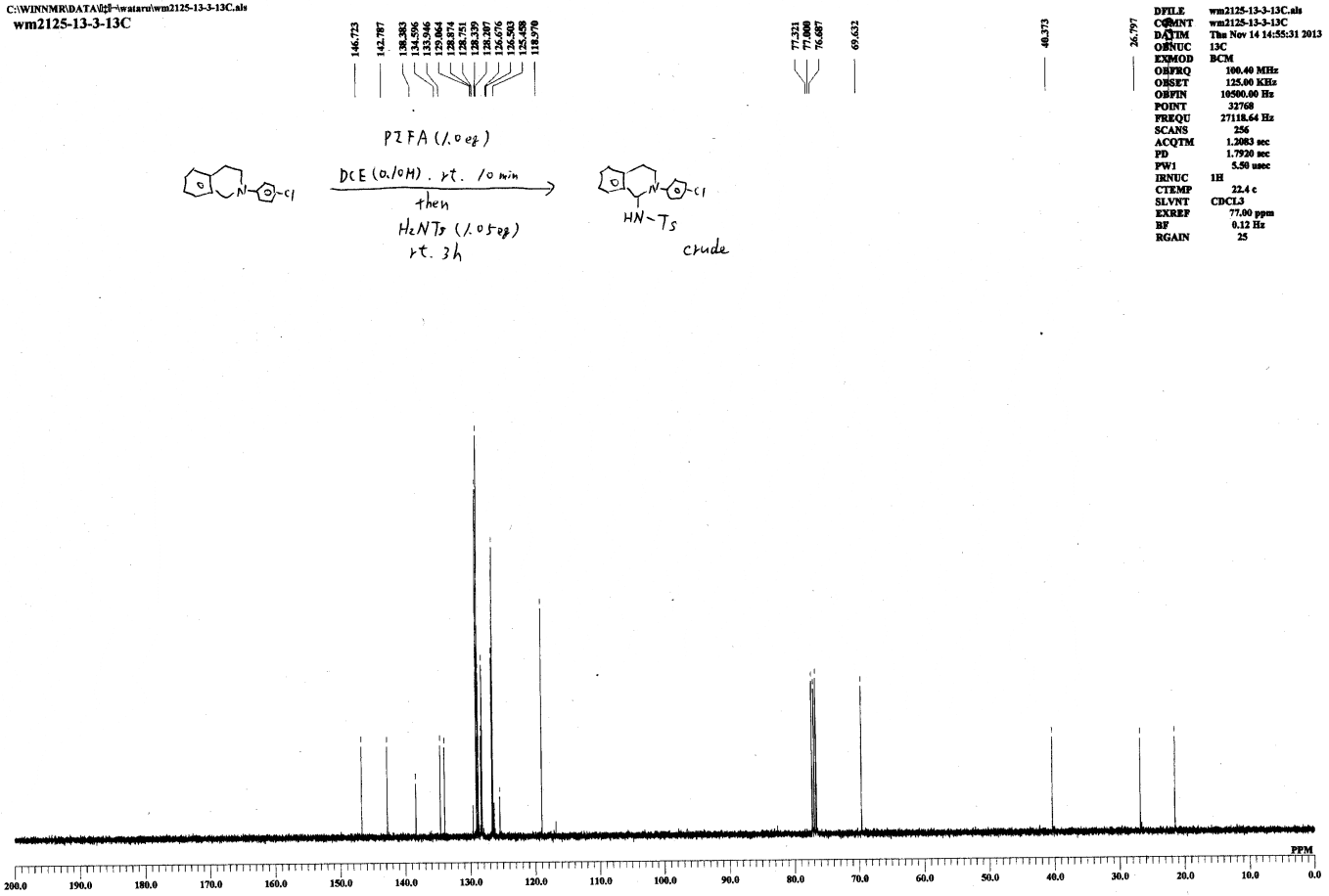

C:\Documents and Settings\JEOL\My Documents\alice_DEFAULT.ALS
wm PMP-Phthal-13C
168.605
154.058
141.972
137.436
135.831
133.904
132.538
131.747
130.200
128.520
127.837
127.417
126.396
126.207
123.251
119.654
114.311
77.313
77.000
76.679
64.881
55.406
43.229
29.259
DFILE _DEFAULT.ALS
COMNT wm PMP-Phthal-13C
DATIM Wed Oct 30 18:52:30 2013
OBNUC 13C
EXMOD BCM
OBFRQ 100.40 MHz
OBSET 125.00 KHz
OBFIN 10500.00 Hz
POINT 32768
FREQU 27118.64 Hz
SCANS 473
ACQTM 1.2083 sec
PD 1.7920 sec
PW1 5.50 usec
IRNUC 1H
CTEMP 22.8 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 0.14 Hz
RGAIN 25
N-PMP
PIFA (1.0 eq)
DCE (0.10M), rt. 10min
then
HN
(1.05 eq)
rt. 3h
N-PMP
crude
PPM
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0

1-(*N*-*p*-Tosyl)-2-(4-chlorophenyl)-1,2,3,4-tetrahydroisoquinoline (29)



C:\WINNMR\DATA\data\wataru\wm2125-13-3-13C.als

wm2125-13-3-13C



DFILE	wm2125-13-3-13C.als
COMNT	wm2125-13-3-13C
DATIM	Thu Nov 14 14:55:31 2013
OBNUC	13C
EXMOD	BCM
OBFRQ	100.40 MHz
OBSET	125.00 KHz
OBFIN	10500.00 Hz
POINT	32768
FREQU	27118.64 Hz
SCANS	256
ACQTM	1.2083 sec
PD	1.7920 sec
PW1	5.50 usec
IRNUC	1H
CTEMP	22.4 c
SLVNT	CDCL3
EXREF	77.00 ppm
BF	0.12 Hz
RGAIN	25