Visible−Light-Mediated Nucleophilic Addition of an α-Aminoalkyl Radical to Isocyanate or Isothiocyanate

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General Information:

All reactions were carried out in glassware under a N_2 balloon. Chemicals without special descriptions were obtained from commercial sources, and were used without further purification. Column chromatography was generally performed on silica gel (300-400 mesh). Thin layer chromatography (TLC) was visualized using UV light. NMR spectra were recorded on Varian mercury 300 and Varian mercury 400 spectrometers. Chemical shifts are reported in parts per million (δ) relative to TMS (0.0 ppm) for ^{1}H-NMR data and $CDCl_3$ (77.16 ppm) for ^{13}C-NMR data. The abbreviations are used: s = singlet, d = doublet, t = triplet, q = quartet, dd = double doublet, m = multiplet, br.s = broad singlet, and br = broad signal. High resolution mass spectra were measured on Bruker-micrOTOF-Q II and Agilent LC-MS 1260/6130 (ESI) mass spectrometers. IR Spectra were recorded on a Thermo Fisher Nicolet 6700 FT-IR spectrometer. Melting points were determined using an Electrothermal IA 8103 melting point apparatus. The thermometer was not calibrated. In situ IR spectra were recorded on a Mettler Toledo ReactIR^{TM} iC 10 spectrometer using a SiComp sensor.

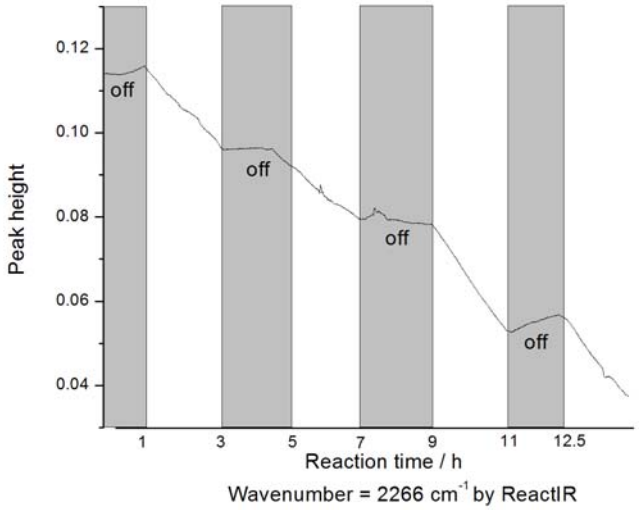
Experimental Procedures:

A 25 mL Schlenk tube was charged with *N*,*N*-dimethylaniline (3 mmol), phenyl isocyanate (0.3 mmol), FIrpic (2.1 mg, 0.003 mmol, 1 mol %), and CH_2Cl_2 (2 mL). After degassed with standard frozen-thaw procedure, the reaction mixture was placed at a distance of about 5 cm from a 14 W compact fluorescent lamp and stirred at room temperature. After 24 h, the reaction mixture was diluted with EtOAc (15 mL) and H_2O (15 mL). The layers were separated. The aqueous layer was extracted with EtOAc (2 x 15 mL). The combined organic layers were dried over $MgSO_4$. The crude materials were purified by silica gel flash chromatography (PE/EtOAc = 12:1~ 9:1) to give the desired products.

In situ IR Experiment:

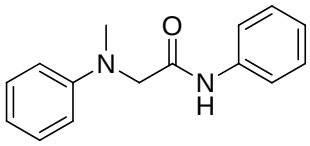
A reaction vessel equipped with a ReactIR^{TM} SiComp sensor was charged with *N*,*N*-dimethylaniline (6 mmol), phenyl isocyanate (0.6 mmol), FIrpic (4.2 mg, 0.006 mmol, 1 mol %), and CH_2Cl_2 (5 mL). After degassed with standard frozen-thaw procedure, the reaction mixture was placed at a distance of about 5 cm from a 14 W compact fluorescent lamp and stirred at room temperature. Light was turned on/off during the course of reaction. The reaction vessel was wrapped with aluminum foil during the "off" periods.

Reaction time (h)	0-1	1-3	3-5	5-7	7-9	9-11	11-12.5	12.5-14
Light	off	on	off	on	off	on	off	on



Characterizations:

2-(Methyl(phenyl)amino)-*N*-phenylacetamide (3a)：



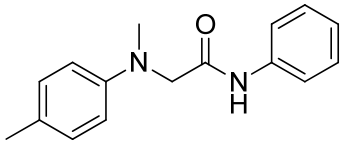
White solid. m.p. = 115- 116.2 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (s, 1H), 7.53 (2H), 7.34-7.30 (4H), 7.13 (1H), 6.91-6.85 (3H), 3.96 (s, 2H), 3.09 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.8, 149.6, 137.3, 129.6, 129.1, 124.7, 120.0, 119.5, 113.8, 60.1, 40.2.

IR: 3242, 3031, 2912, 1654, 1597, 1496, 1434, 1319, 1247, 1118, 860, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{16}N_2NaO^+$ ($[M+ Na]^+$) 263.1155, found 263.1146



2-(Methyl(*p*-tolyl)amino)-*N*-phenylacetamide (3b)：

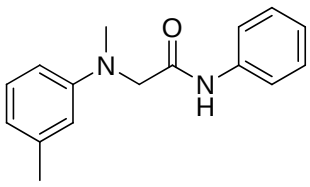
White solid. m.p. = 129.4- 131.5 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (s, 1H), 7.54 (2H), 7.33 (2H), 7.12 (3H), 6.77 (2H), 3.91 (s, 2H), 3.05 (s, 3H), 2.30 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.0, 147.5, 137.4, 130.1, 129.1, 129.0, 124.6, 120.0, 114.1, 60.5, 40.4, 20.4.

IR: 3333, 2912, 2855, 1659, 1597, 1506, 1438, 1314, 1242, 1204, 1118, 793, 745, 692, cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{19}N_2O^+$ ($[M+ H]^+$) 255.1492, found 255.1490.



2-(Methyl(*m*-tolyl)amino)-*N*-phenylacetamide (3c)：

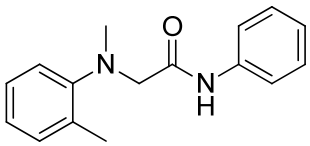
White solid. m.p. = 109.2- 110.9 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.52 (s, 1H), 7.57 (2H), 7.34 (2H), 7.22 (1H), 7.14 (1H), 6.75-6.67 (3H), 3.96 (s, 2H), 3.08 (s, 3H), 2.37 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.9, 149.6, 139.4, 137.3, 129.4, 129.0, 124.6, 120.3, 119.9, 114.5, 110.9, 60.1, 40.1, 21.9.

IR: 3232, 2917, 1659, 1507, 1529, 1486, 1438, 1319, 1238, 1051, 822, 755, 683 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{19}N_2O^+$ ([M+ H]$^+$) 255.1492, found 255.1487.



2-(Methyl(*o*-tolyl)amino)-*N*-phenylacetamide (3d)：

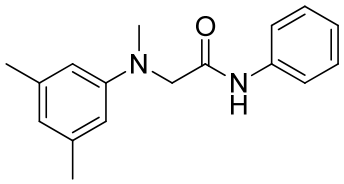
White solid. m.p. = 59.4- 60.8 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.33 (s, 1H), 7.76 (2H), 7.50 (2H), 7.37 (2H), 7.29-7.22 (3H), 3.82 (s, 2H), 2.91 (s, 3H), 2.59 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.3, 150.8, 137.5, 132.2, 131.5, 129.1, 127.2, 124.7, 124.4, 120.6, 119.4, 61.5, 43.5, 18.6.

IR: 3270, 3055, 2950, 2855, 1663, 1597, 1506, 1434, 1223, 1094, 932, 750, 683 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{19}N_2O^+$ ([M+ H]$^+$) 255.1492, found 255.1492.



2-((3,5-Dimethylphenyl)(methyl)amino)-*N*-phenylacetamide (3e)：

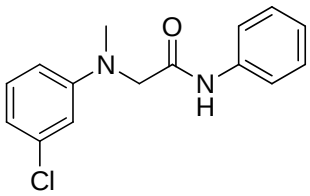
White solid. m.p. = 105.8- 107.2 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (s, 1H), 7.57 (2H), 7.35 (2H), 7.14 (1H), 6.59-6.49 (3H), 3.95 (s, 2H), 3.06 (s, 3H), 2.32 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.0, 149.8, 139.2, 137.3, 129.0, 124.6, 121.4, 119.9, 111.8, 60.2, 40.1, 21.8.

IR: 3227, 3051, 2912, 1659, 1591, 1525, 1496, 1438, 1314, 1233, 908, 760, 683 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{17}H_{21}N_2O^+$ ([M+ H]$^+$) 269.1648, found 269.1641.



2-((3-Chlorophenyl)(methyl)amino)-*N*-phenylacetamide (3f)：

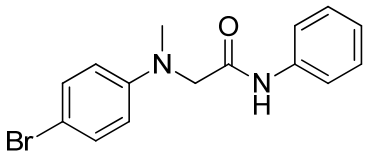
White solid. m.p. = 105.2- 107 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (s, 1H), 7.52 (2H), 7.32 (2H), 7.19 (1H), 7.13 (1H), 6.84 (1H), 6.80 (1H), 6.65 (1H), 3.94 (s, 2H), 3.07 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.2, 150.5, 137.1, 135.4, 130.6, 129.1, 124.8, 120.1, 119.2, 113.6, 111.7, 59.5, 40.1.

IR: 3246, 2917, 1659, 1591, 1529, 1491, 1367, 1209, 1199, 822, 755, 678 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{16}ClN_2O^+$ ($[M+ H]^+$) 275.0946, found 275.0951.



2-((4-Bromophenyl)(methyl)amino)-*N*-phenylacetamide (3g)：

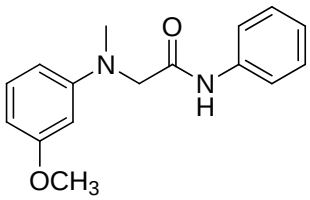
White solid. m.p. = 169.4- 171.3 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (s, 1H), 7.51 (2H), 7.36 (2H), 7.32 (2H), 7.13 (1H), 6.67 (2H), 3.91 (s, 2H), 3.06 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.3, 148.4, 137.1, 132.3, 129.1, 124.8, 120.1, 115.3, 111.6, 59.8, 40.3.

IR: 3266, 3142, 2917, 1663, 1548, 1496, 1438, 1310, 1252, 1190, 946, 802, 755, 683 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{16}BrN_2O^+$ ($[M+ H]^+$) 319.0441, found 319.0438.



2-((3-Methoxyphenyl)(methyl)amino)-*N*-phenylacetamide (3h)：

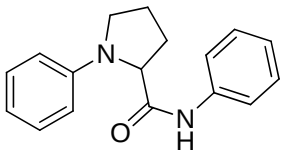
White solid. m.p. = 114.4- 115.8 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (s, 1H), 7.53 (2H), 7.32 (2H), 7.21 (1H), 7.12 (1H), 6.51 – 6.38 (3H), 3.95 (s, 2H), 3.80 (s, 3H), 3.07 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.7, 160.8, 150.9, 137.2, 130.3, 129.1, 124.6, 120.0, 106.6, 104.0, 100.4, 59.8, 55.3, 40.1.

IR: 3318, 2917, 1678, 1591, 1525, 1491, 1310, 1231, 1161, 1046, 826, 755, 678 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{19}N_2O_2^+$ ([M+ H]$^+$) 271.1441, found 271.1447.



***N*,1-Diphenylpyrrolidine-2-carboxamide (3i):**

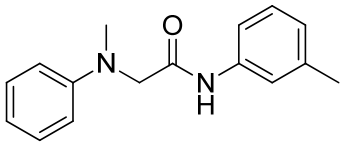
White solid. m.p. = 150.7- 152.8 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (s, 1H), 7.51 (2H), 7.33-7.28 (4H), 7.11 (1H), 6.87 (1H), 6.74 (2H), 4.10 (d, 1H), 3.78 (t, 1H), 3.37-3.20 (m, 1H), 2.50-2.24 (m, 2H), 2.09-2.01 (dd, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.3, 147.7, 137.3, 129.5, 129.0, 124.6, 120.0, 118.8, 113.5, 65.4, 50.1, 31.7, 24.4.

IR: 3314, 2979, 2855, 1659, 1597, 1496, 1434, 1329, 1176, 874, 745, 692 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{17}H_{19}N_2O^+$ ([M+ H]$^+$) 267.1492, found 267.1490.



2-(Methyl(phenyl)amino)-*N*-(*m*-tolyl)acetamide (3j):

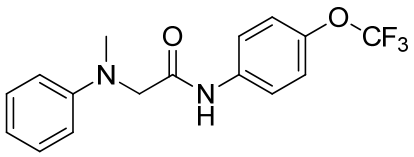
White solid. m.p. = 140.2- 142 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.43 (s, 1H), 7.38-7.30 (4H), 7.22 (1H), 6.95 (1H), 6.91 (1H), 6.84 (2H), 3.95 (s, 2H), 3.09 (s, 3H), 2.35 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 168.7, 149.5, 139.0, 137.2, 129.5, 128.9, 125.4, 120.6, 119.3, 117.0, 113.7, 60.1, 40.1, 21.5.

IR: 3242, 2917, 1659, 1591, 1506, 1444, 1367, 1247, 1118, 793, 750, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{19}N_2O^+$ ([M+ H]$^+$) 255.1492, found 255.1492.



2-(Methyl(phenyl)amino)-*N*-(4-(trifluoromethoxy)phenyl)acetamide (3k)：

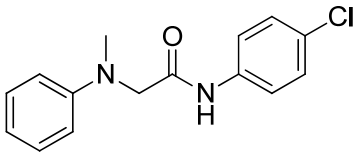
White solid. m.p. = 118.6- 119.6 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (s, 1H), 7.57 (2H), 7.32 (2H), 7.17 (2H), 6.92 (1H), 6.83 (2H), 3.96 (s, 2H), 3.08 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.0, 149.5, 145.5, 136.0, 129.7, 121.9, 121.2, 119.7, 113.9, 60.1, 40.3.

IR: 3227, 1659, 1587, 1496, 1223, 1089, 826, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{16}F_3N_2O_2^+$ ($[M+ H]^+$) 325.1158, found 325.1174.



***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)acetamide (3l)：**

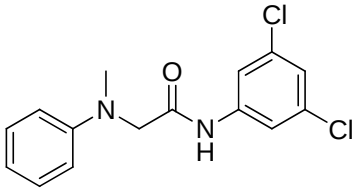
White solid. m.p. = 134.8- 136.1 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (s, 1H), 7.41 (2H), 7.26-7.15 (4H), 6.84 (1H), 6.75 (2H), 3.87 (s, 2H), 3.00 (s, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 168.9, 149.4, 135.9, 129.6, 129.0, 121.2, 119.5, 113.7, 59.9, 40.2 , 29.7.

IR: 3227, 1654, 1601, 1501, 1262, 1147, 851, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{16}ClN_2O^+$ ($[M+ H]^+$) 275.0946, found 275.0952.



***N*-(3,5-Dichlorophenyl)-2-(methyl(phenyl)amino)acetamide (3m)：**

White solid. m.p. = 188.4- 189.6 ºC.

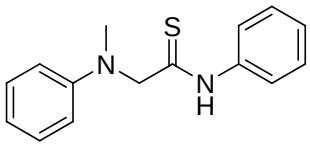
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (s, 1H), 7.51 (2H), 7.31 (2H), 7.10 (1H), 6.92 (1H),

6.81 (2H), 3.93 (s, 2H), 3.07 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.2, 149.4, 139.1, 135.4, 129.7, 124.6, 119.9, 118.2, 114.0, 60.2, 40.4.

IR: 3223, 2921, 2855, 1663, 1572, 1496, 1400, 1367, 1247, 1204, 1113, 845, 798, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{15}Cl_2N_2O^+$ ($[M+ H]^+$) 309.0556, found 309.0562.



2-(Methyl(phenyl)amino)-*N*-phenylethanethioamide (5a)：

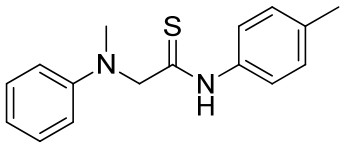
Yellow solid. m.p. = 134.8- 136.4 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.12 (s, 1H), 7.75 (2H), 7.37 (2H), 7.30 (2H), 7.23 (1H), 6.91 (1H), 6.80 (2H), 4.34 (s, 2H), 3.07 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 197.4, 149.3, 137.9, 129.6, 129.0, 127.0, 123.2, 119.9, 114.0, 69.4, 39.9.

IR: 3227, 2897, 1597, 1506, 1438, 1271, 1094, 989, 745, 683 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{17}N_2S^+$ ($[M+ H]^+$) 257.1107, found 257.1107.



2-(Methyl(phenyl)amino)-*N*-(*p*-tolyl)ethanethioamide (5b)：

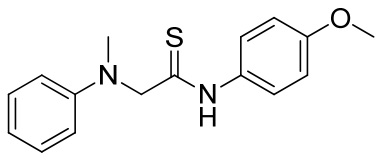
Yellow solid. m.p. = 123.8- 125.4 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.11 (s, 1H), 7.65 (2H), 7.34 (2H), 7.21 (2H), 6.95 (1H), 6.84 (2H), 4.37 (s, 2H), 3.10 (s, 3H), 2.37 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 197.1, 149.2, 136.9, 135.3, 129.5, 129.4, 123.1, 119.7, 113.8, 69.2, 39.8, 21.2.

IR: 3204, 1597, 1501, 1381, 1276, 1113, 1085, 812, 750, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{17}N_2S^-$ ($[M- H]^-$) 269.1118, found 269.1110.



***N*-(4-Methoxyphenyl)-2-(methyl(phenyl)amino)ethanethioamide (5c):**

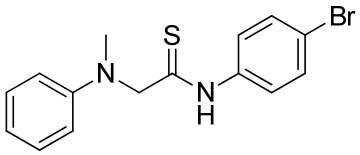
Yellow solid. m.p. = 94.8- 96.4 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.04 (s, 1H), 7.63 (2H), 7.31 (2H), 6.92 (3H), 6.81 (2H), 4.36 (s, 2H), 3.80 (s, 3H), 3.09 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 197.0, 158.2, 149.3, 131.0, 129.6, 124.9, 119.8, 114.1, 113.9, 69.1, 55.6, 39.9.

IR: 3232, 3208, 2921, 2855, 1597, 1501, 1391, 1242, 1108, 1027, 826, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{16}H_{18}N_2OSNa^+$ ($[M+Na]^+$) 309.1032, found 309.1037.



***N*-(4-Bromophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5d):**

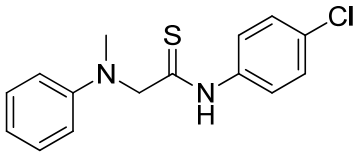
Yellow solid. m.p. = 121.7- 123.6 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.14 (s, 1H), 7.69 (2H), 7.49 (2H), 7.33 (2H), 6.95 (1H), 6.82 (2H), 4.34 (s, 2H), 3.09 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ197.8, 149.3, 136.9, 131.9, 129.6, 124.7, 120.0, 119.9, 114.0, 69.5, 40.0.

IR: 3213, 2902, 1597, 1515, 1491, 1386, 1271, 1085, 822, 745, 688 cm^{-1}.

HRMS (ESI) m/z calculated for $C_{15}H_{14}N_2BrS^-$ ($[M- H]^-$) 333.0066, found 333.0050.



***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5e):**

Yellow solid. m.p. = 139.8- 141 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 10.15 (s, 1H), 7.74 (2H), 7.33 (4H), 6.94 (1H), 6.82 (2H), 4.35 (s, 2H), 3.09 (s, 3H).

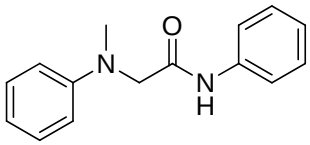
^{13}C NMR (100 MHz, $CDCl_3$) δ 197.8, 149.2, 136.4, 132.1, 129.6, 129.0, 124.5, 120.1, 114.0, 69.5, 40.0.

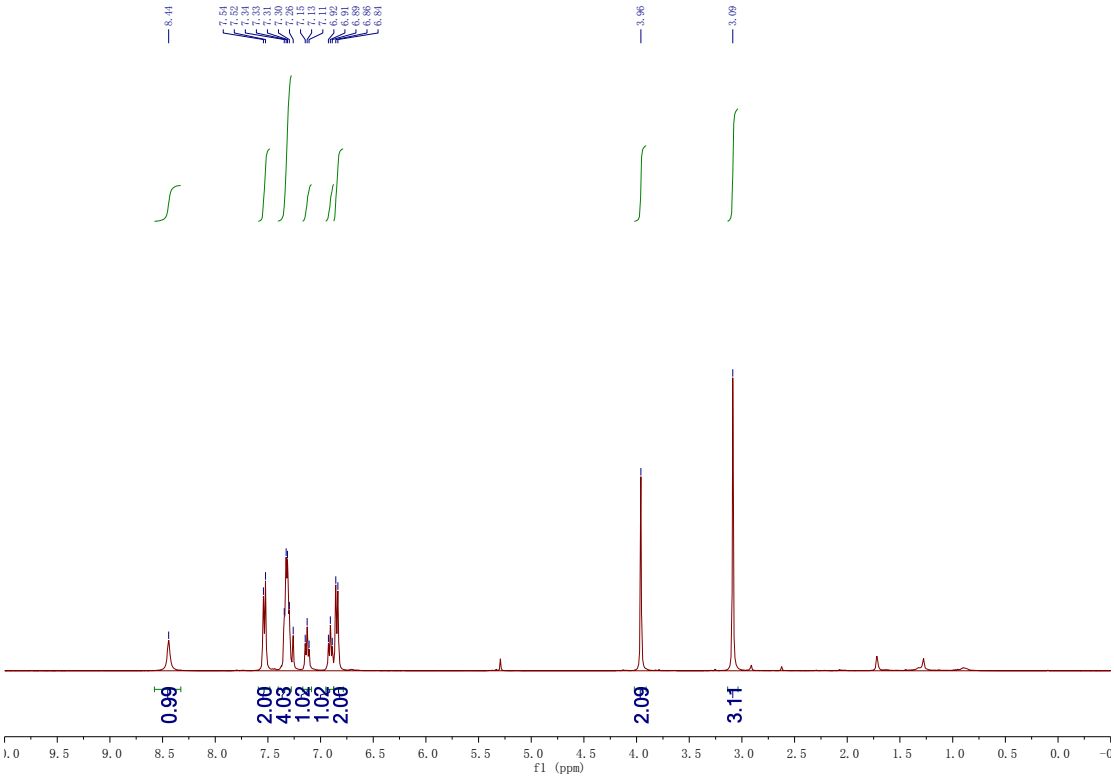
IR: 3232, 2893, 1597, 1496, 1386, 1271, 822, 745, 683 cm^{-1}.

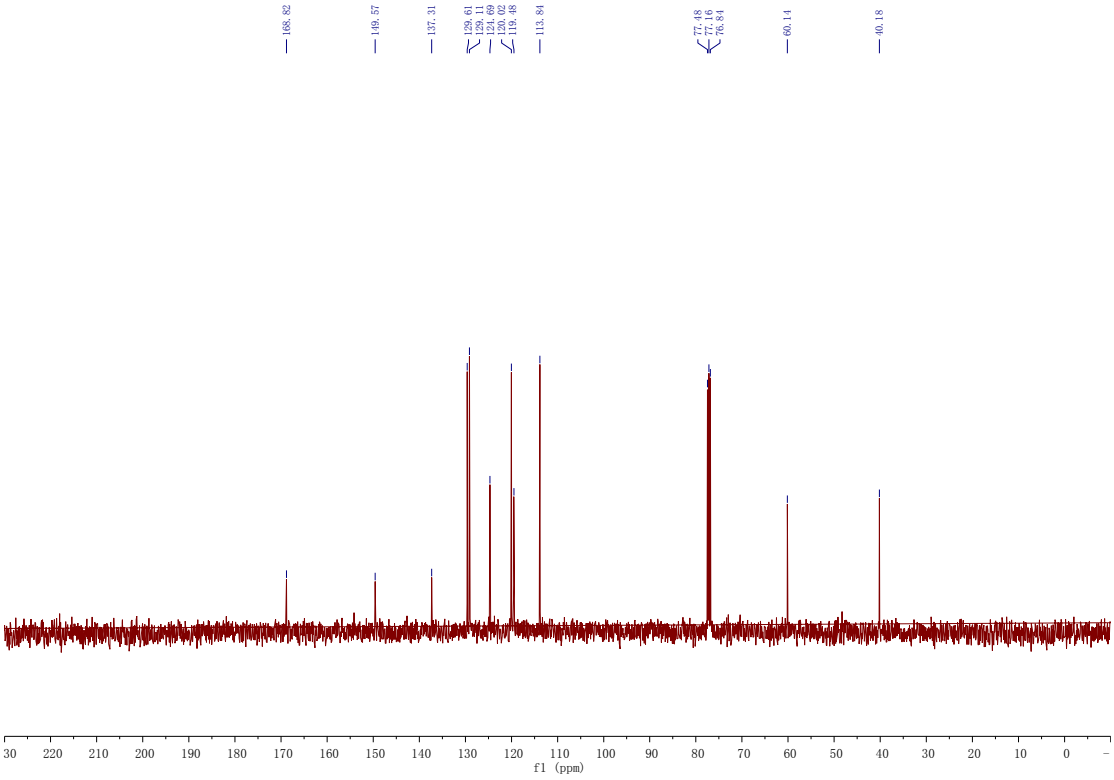
HRMS (ESI) m/z calculated for $C_{15}H_{14}ClN_2S^-$ ($[M-H]^-$) 289.0571, found 289.0565.

NMR Spectra:

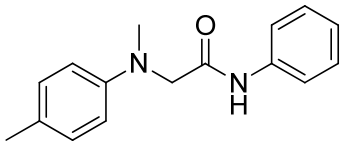
2-(Methyl(phenyl)amino)-*N*-phenylacetamide (3a):

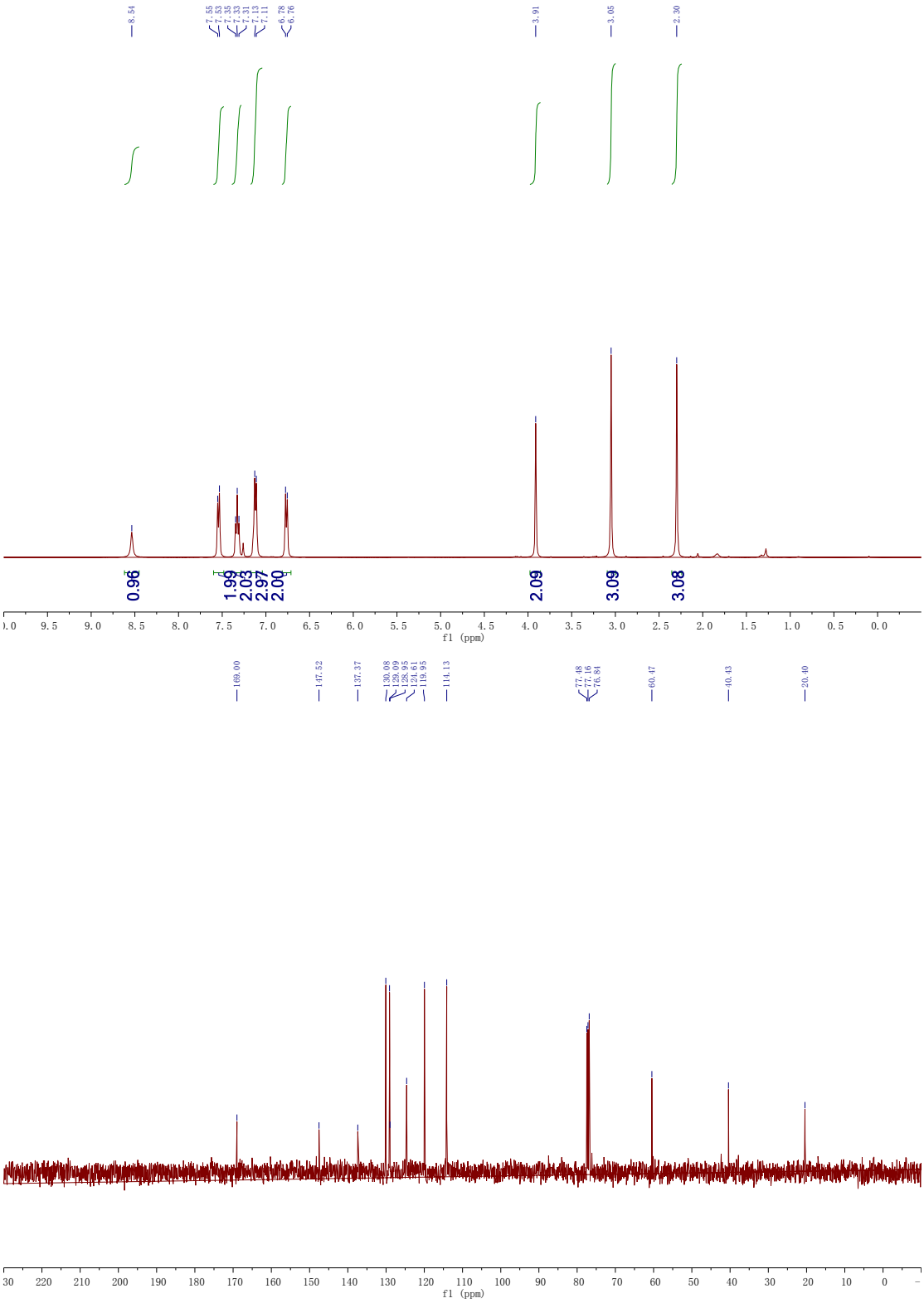




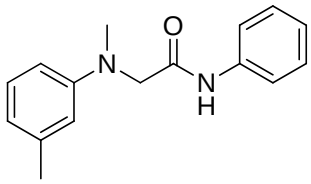


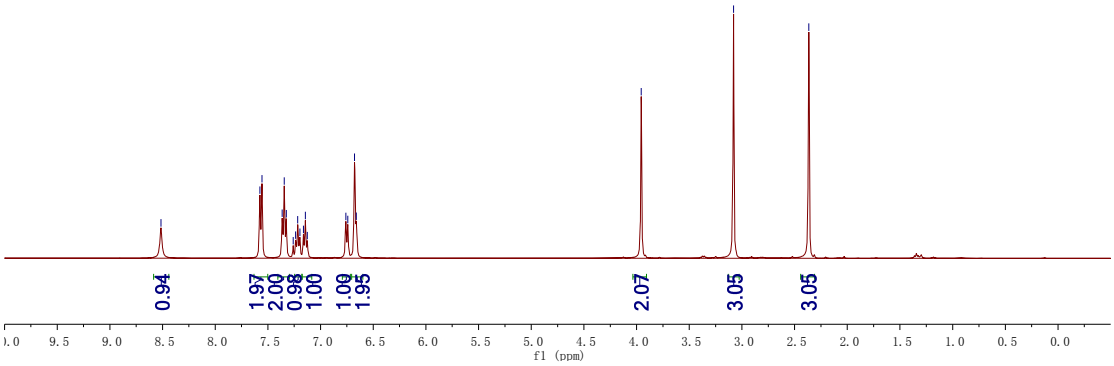
2-(Methyl(*p*-tolyl)amino)-*N*-phenylacetamide (3b):

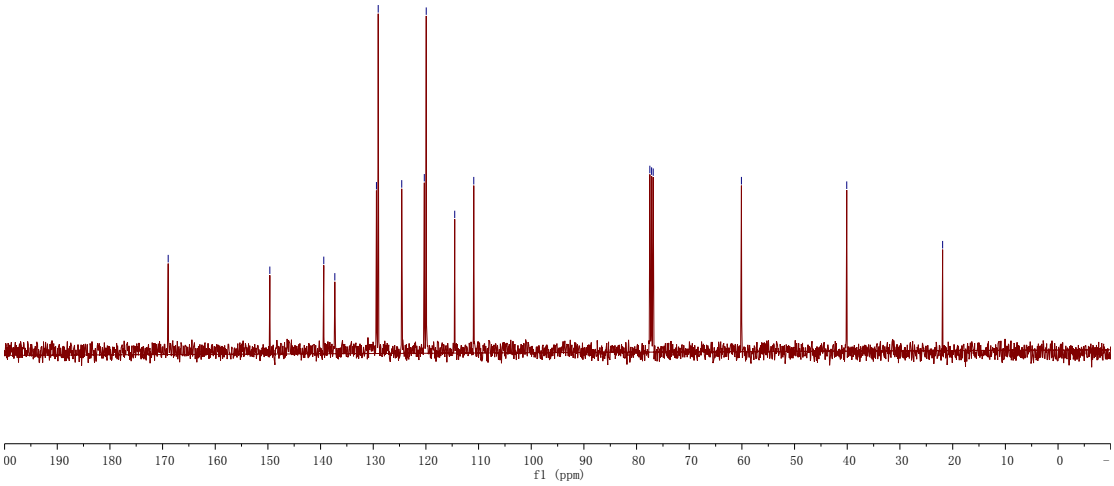




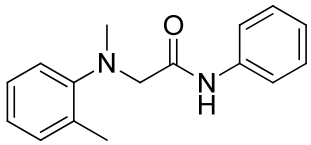
2-(Methyl(*m*-tolyl)amino)-*N*-phenylacetamide (3c):

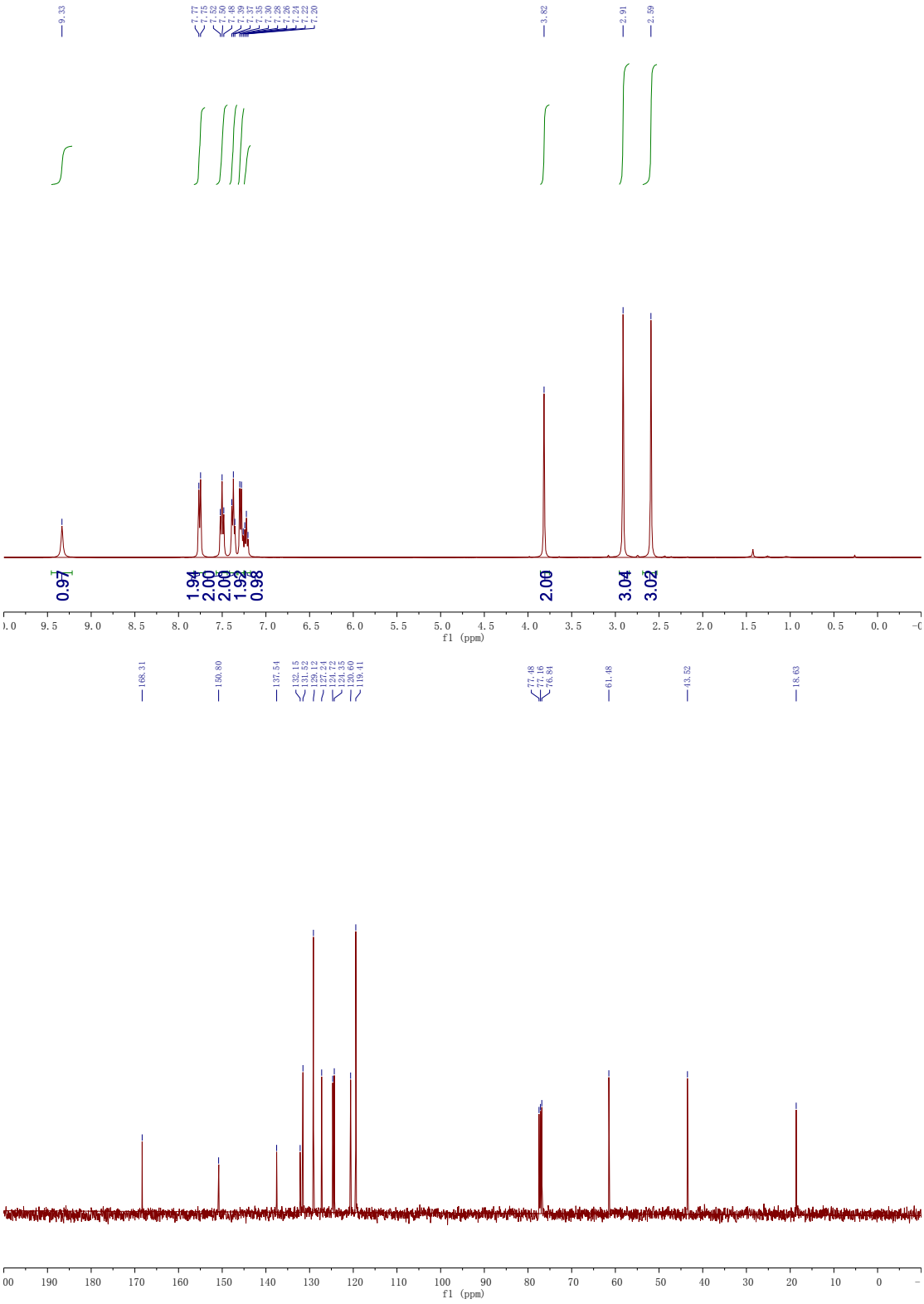




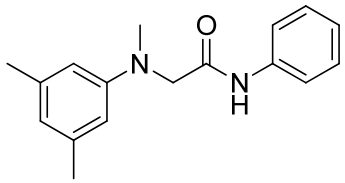


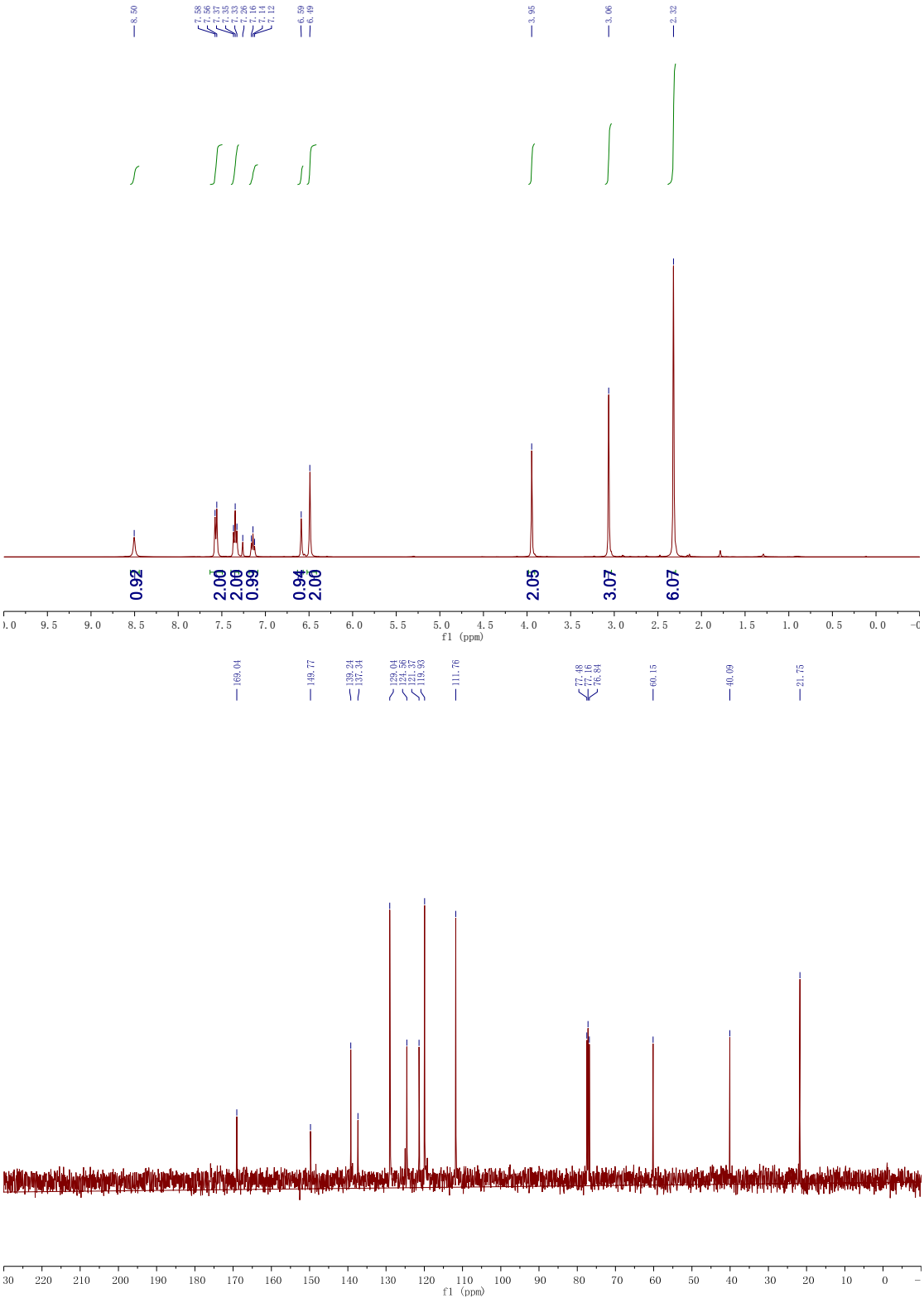
2-(Methyl(*o*-tolyl)amino)-*N*-phenylacetamide (3d):



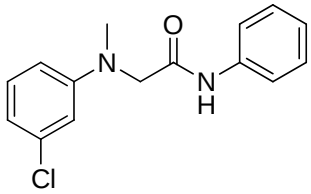


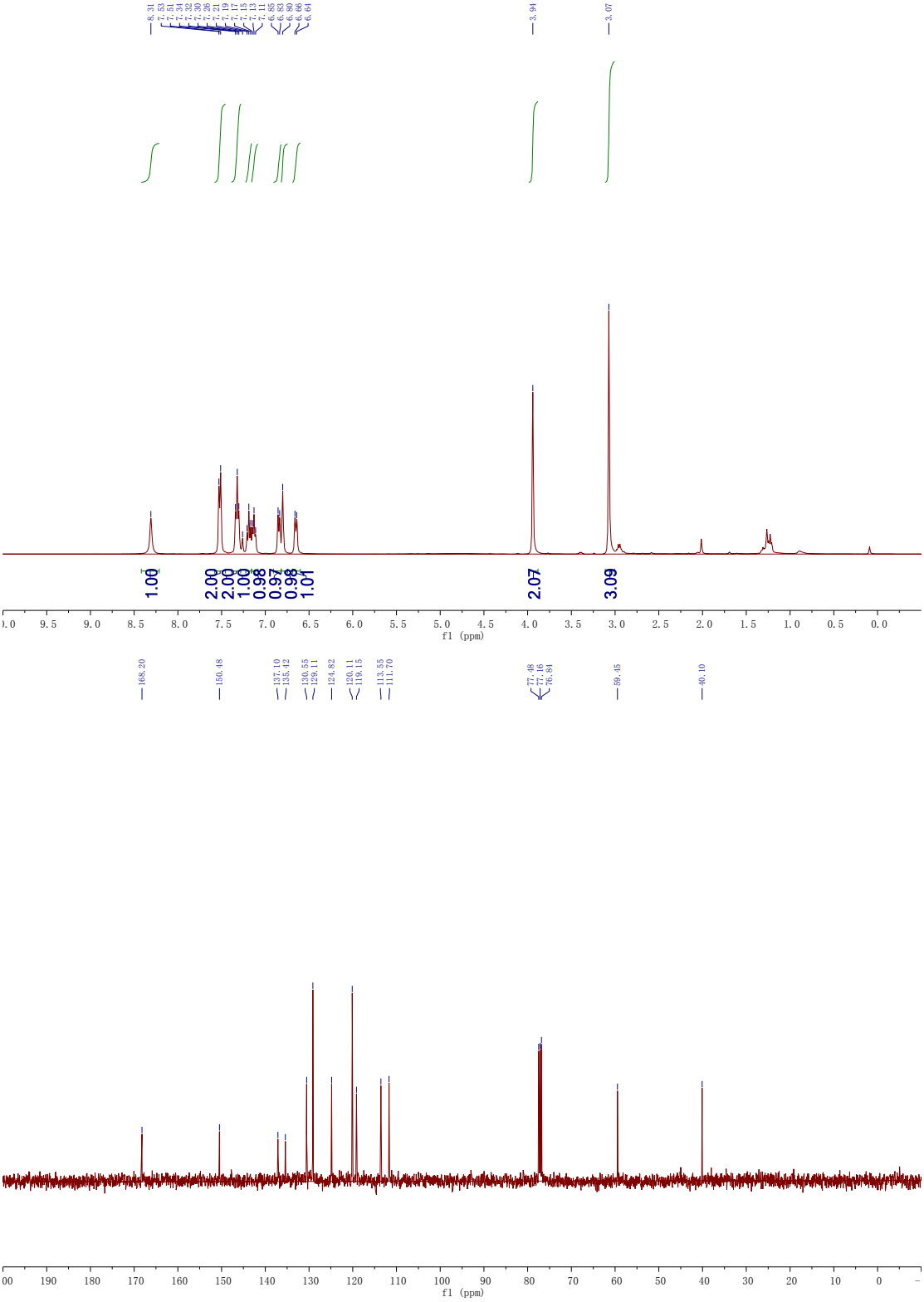
2-((3,5-Dimethylphenyl)(methyl)amino)-*N*-phenylacetamide (3e):



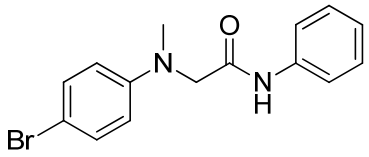


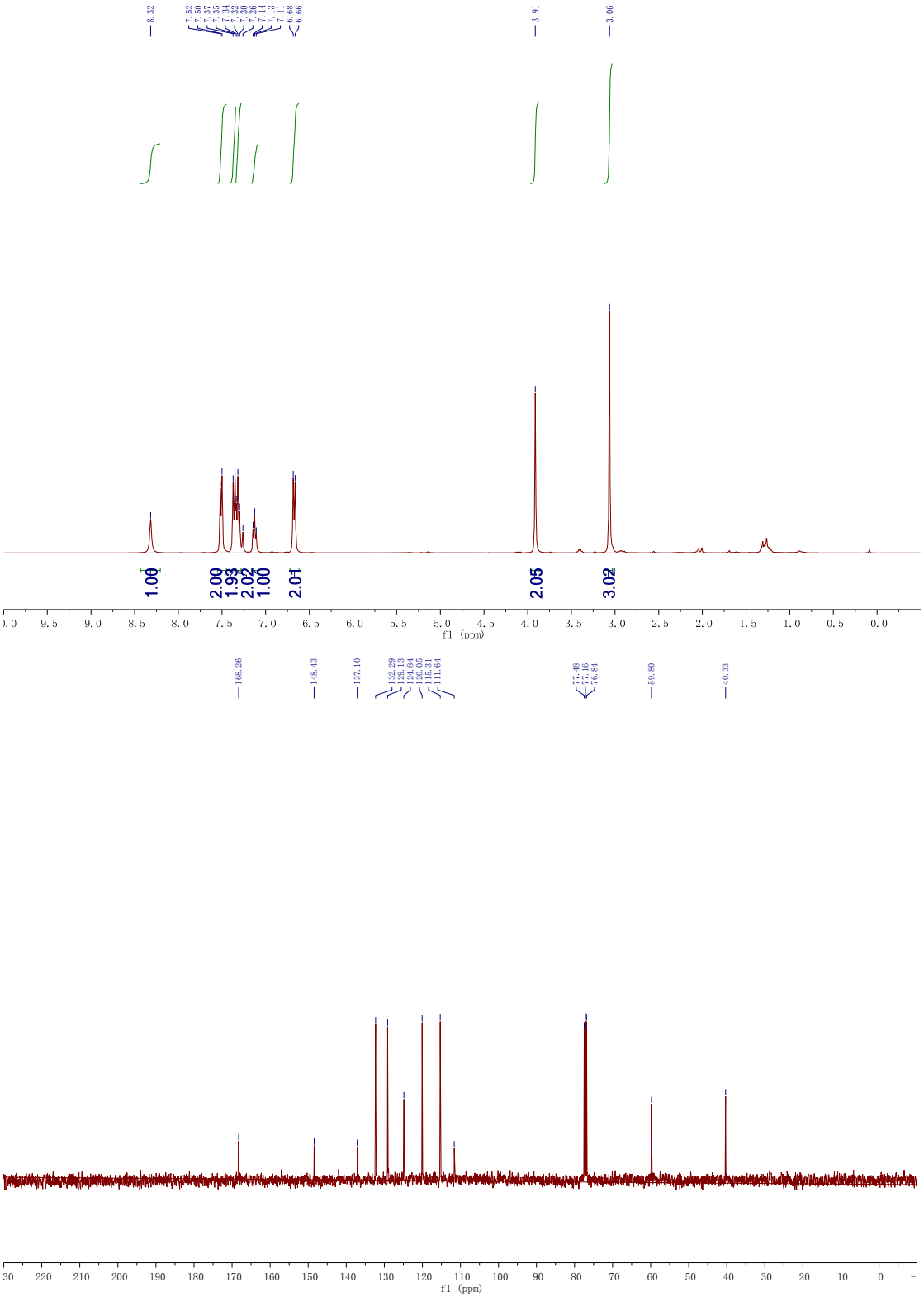
2-((3-Chlorophenyl)(methyl)amino)-*N*-phenylacetamide (3f):



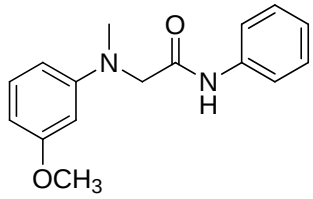


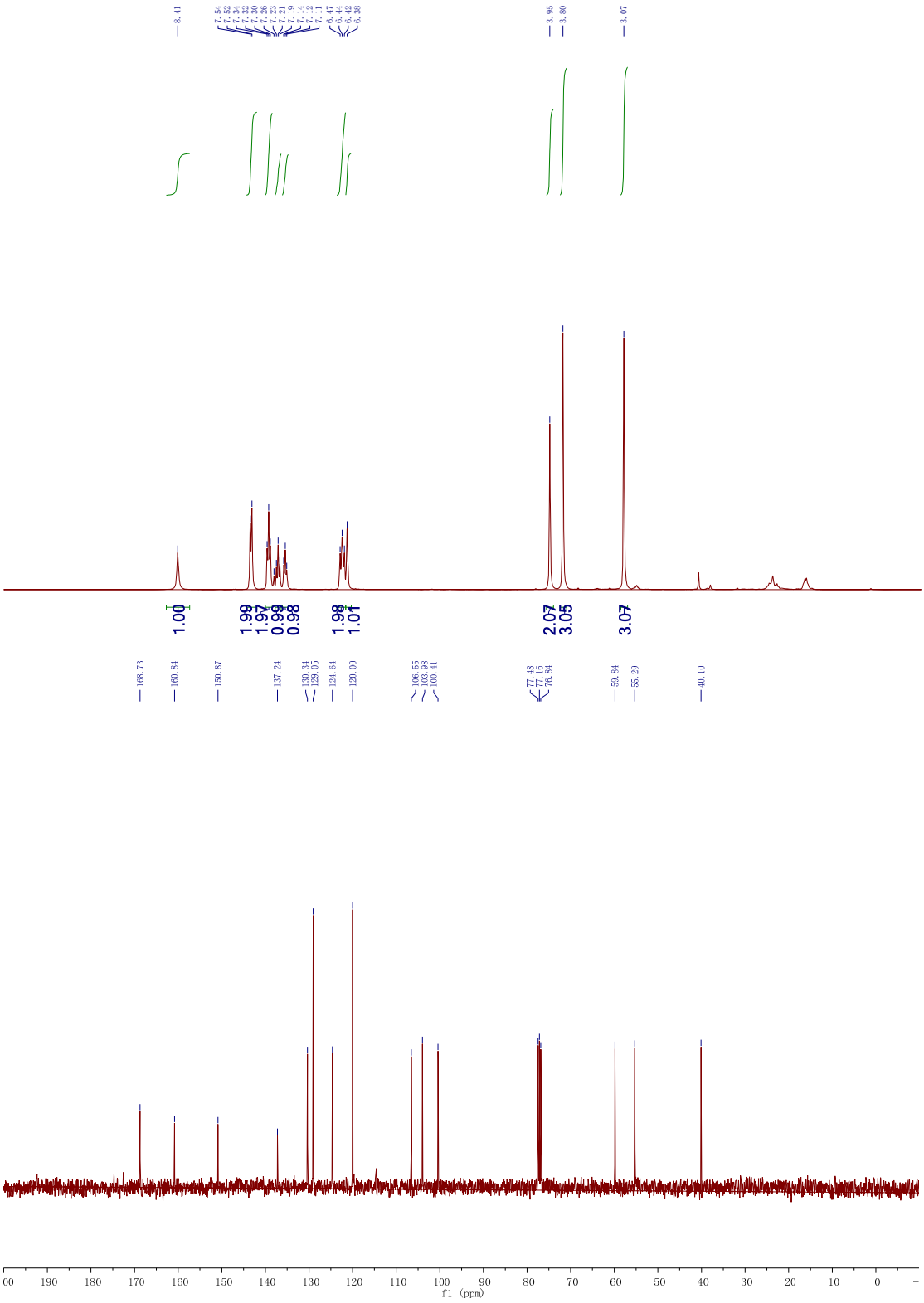
2-((4-Bromophenyl)(methyl)amino)-*N*-phenylacetamide (3g):



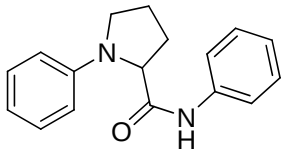


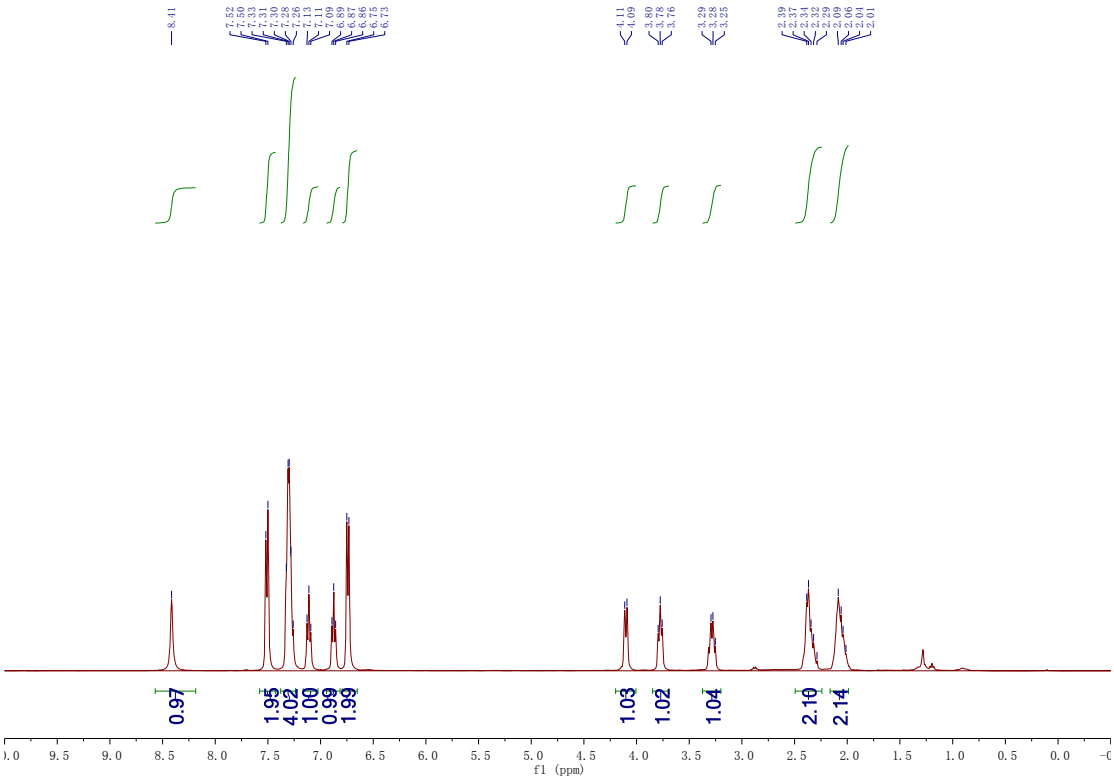
2-((3-Methoxyphenyl)(methyl)amino)-*N*-phenylacetamide (3h):

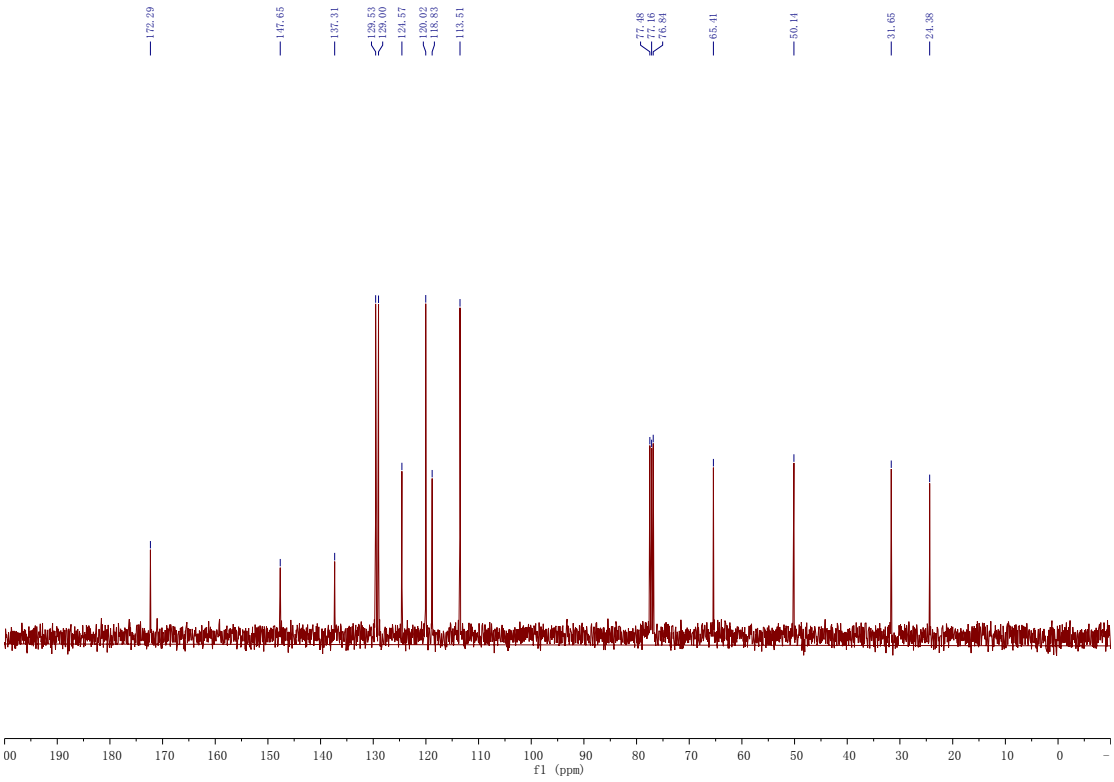




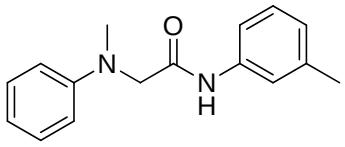
N,1-Diphenylpyrrolidine-2-carboxamide (3i):

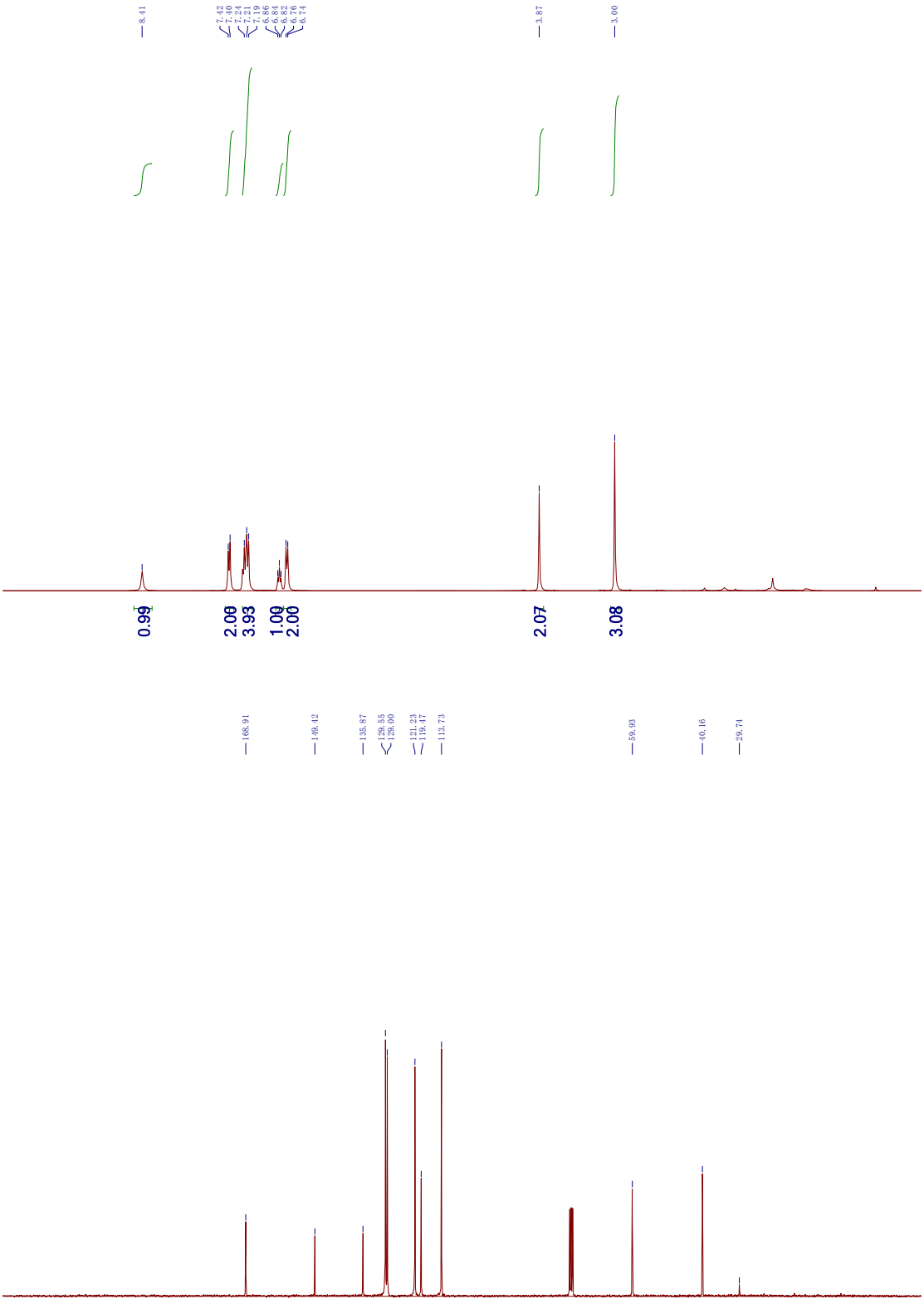




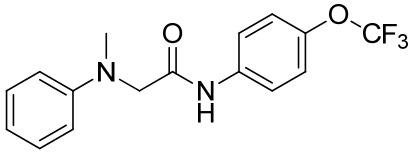


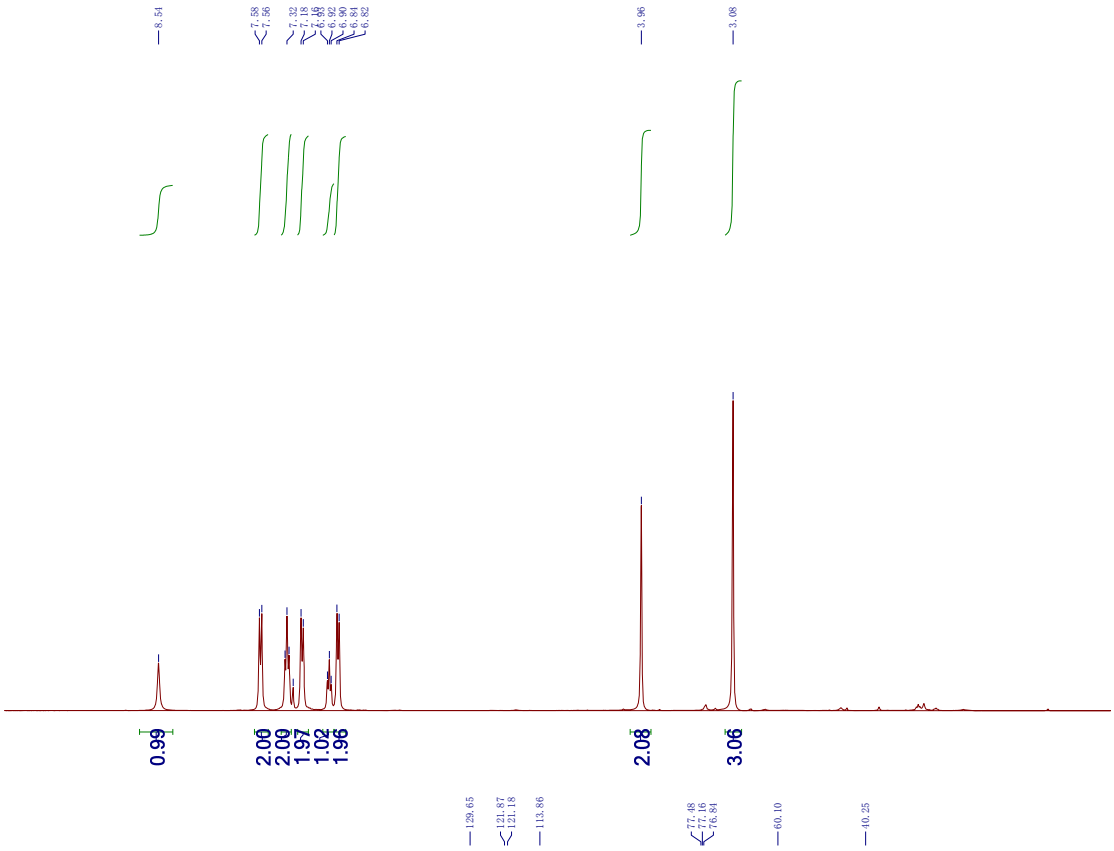
2-(Methyl(phenyl)amino)-*N*-(*m*-tolyl)acetamide (3j)：

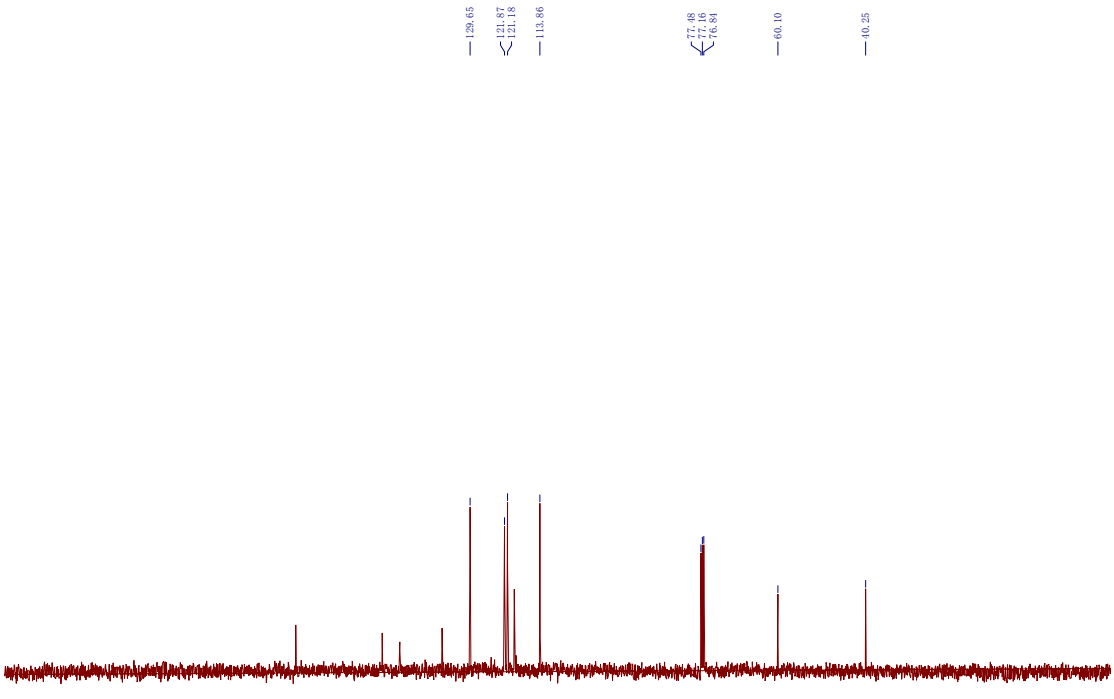




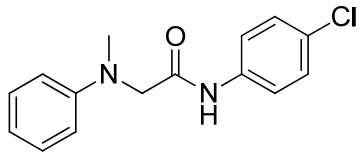
2-(Methyl(phenyl)amino)-*N*-(4-(trifluoromethoxy)phenyl)acetamide (3k)：

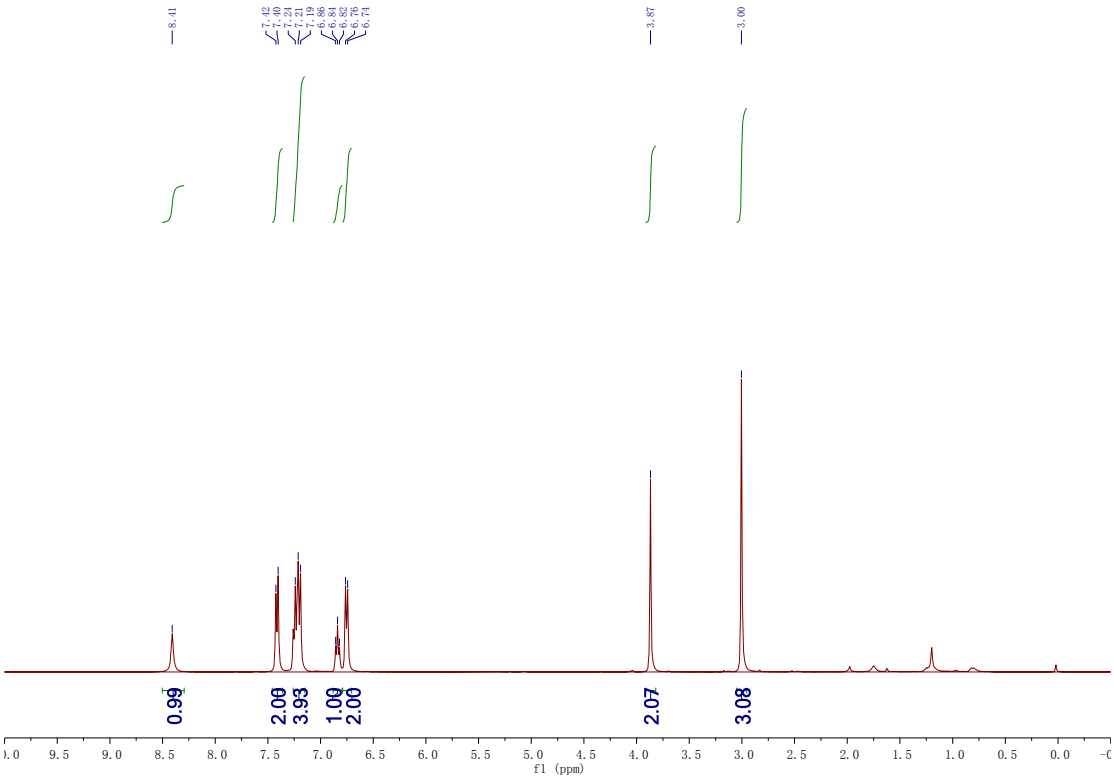


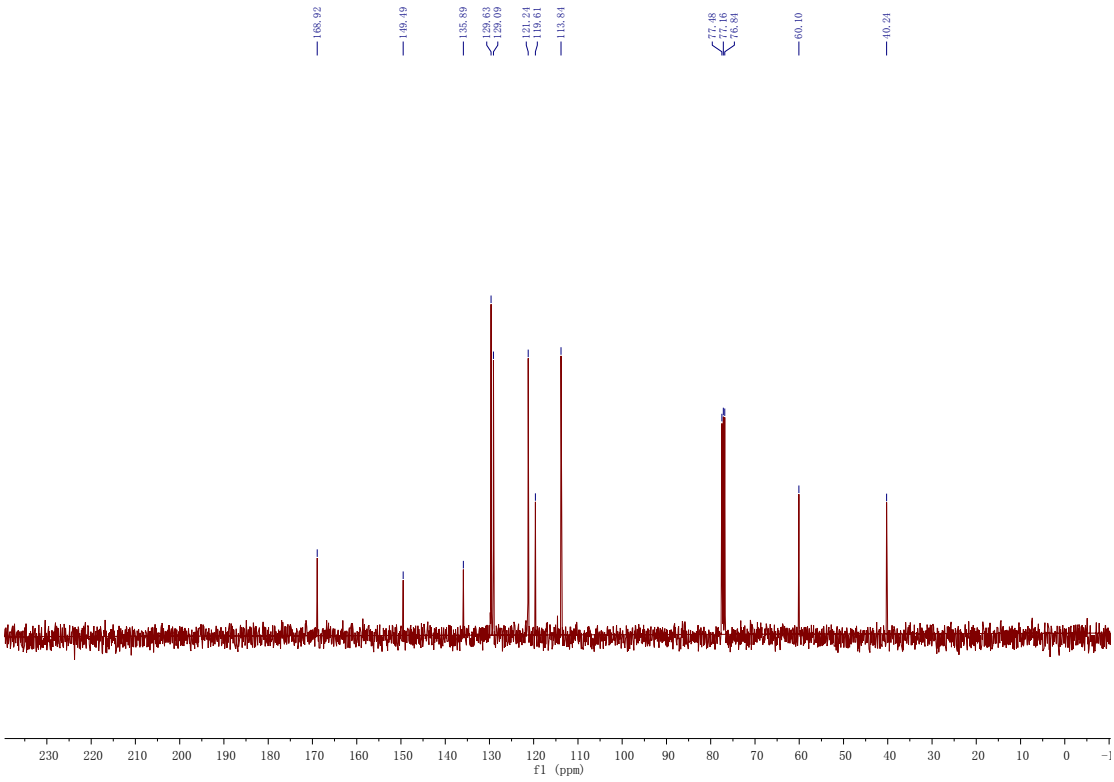




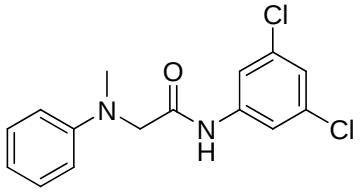
***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)acetamide (3l):**

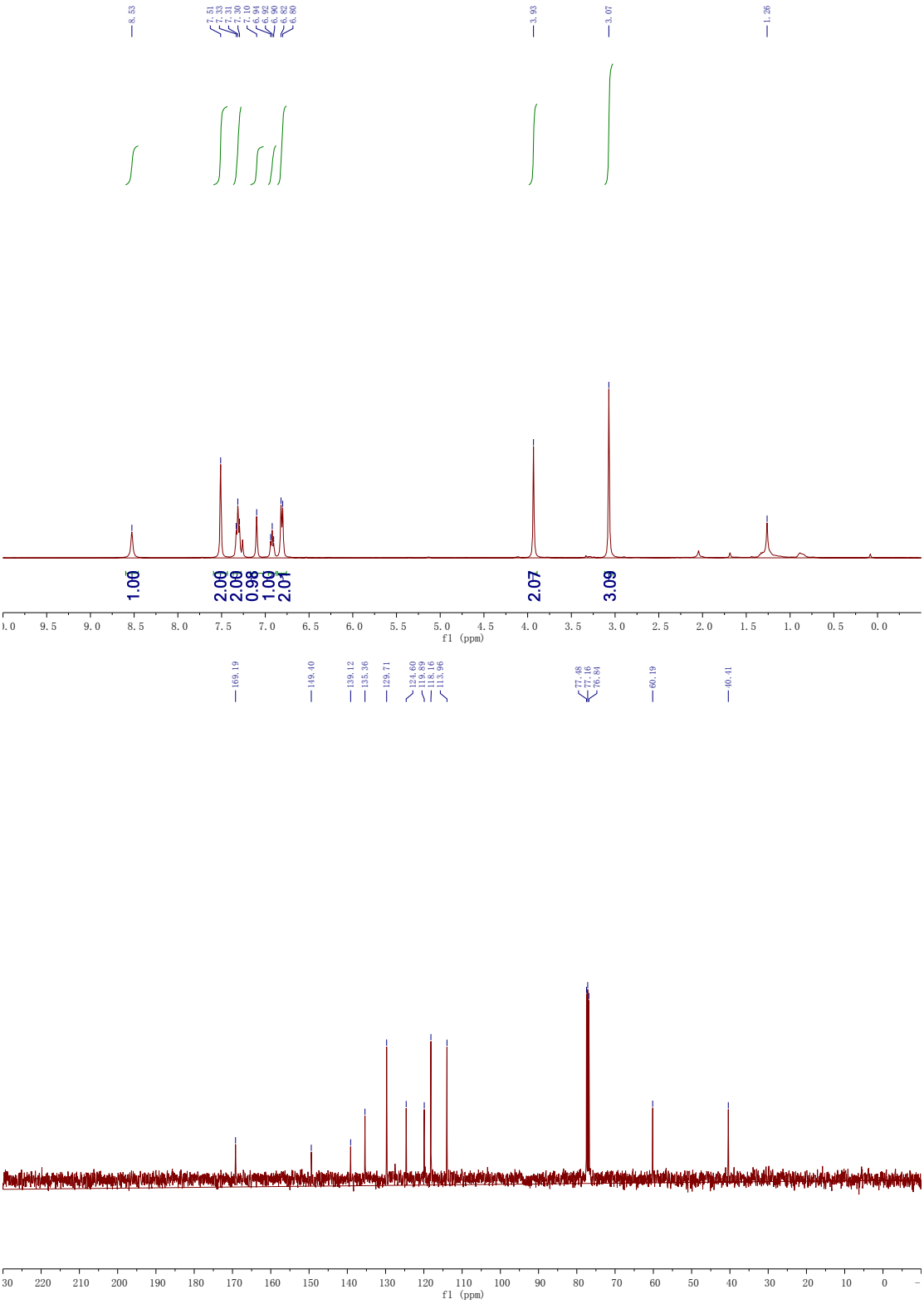




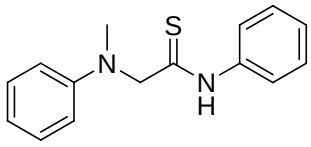


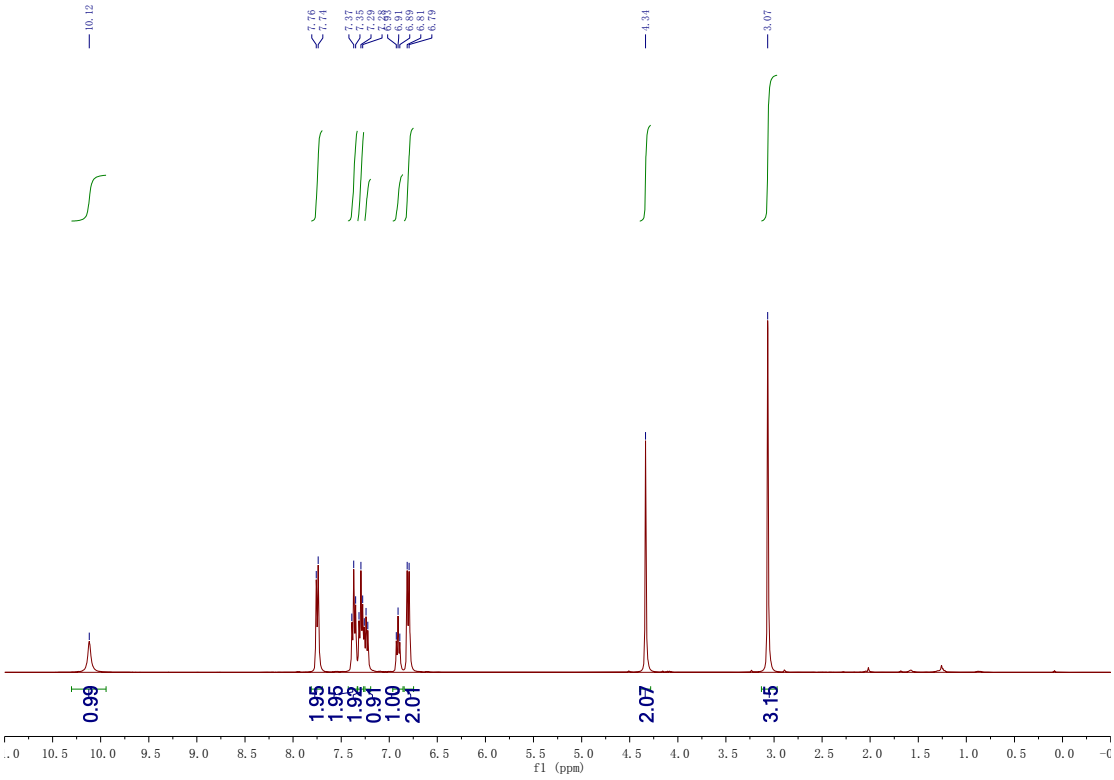
***N*-(3,5-Dichlorophenyl)-2-(methyl(phenyl)amino)acetamide (3m):**

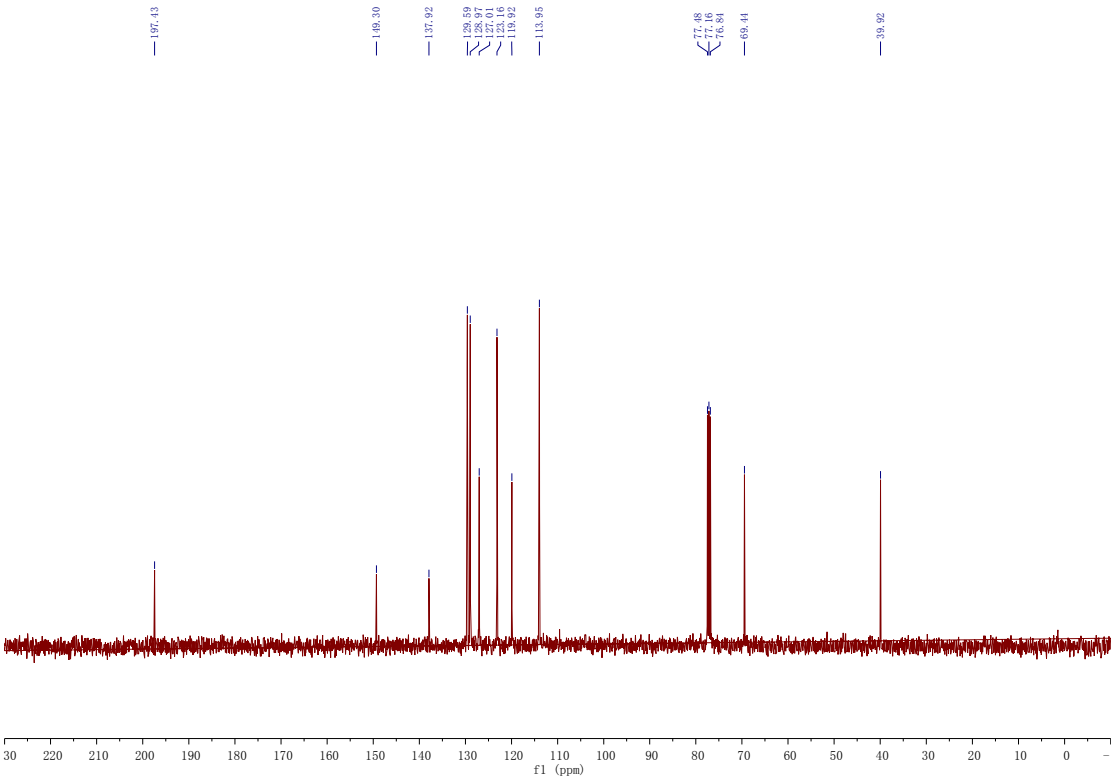




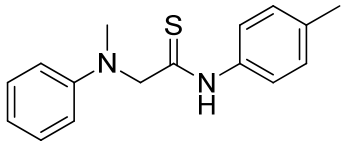
2-(Methyl(phenyl)amino)-*N*-phenylethanethioamide (5a):

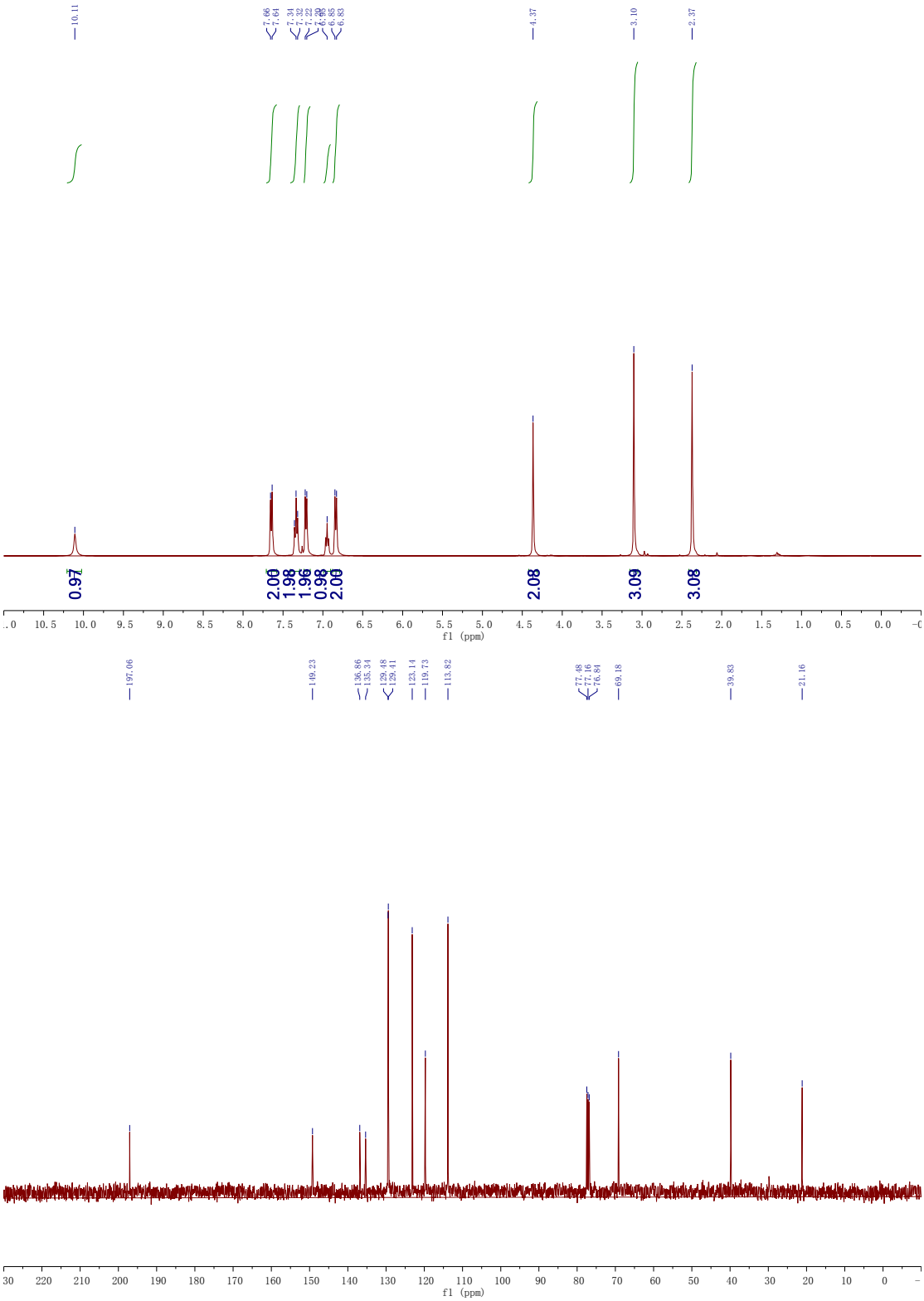




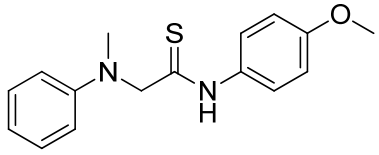


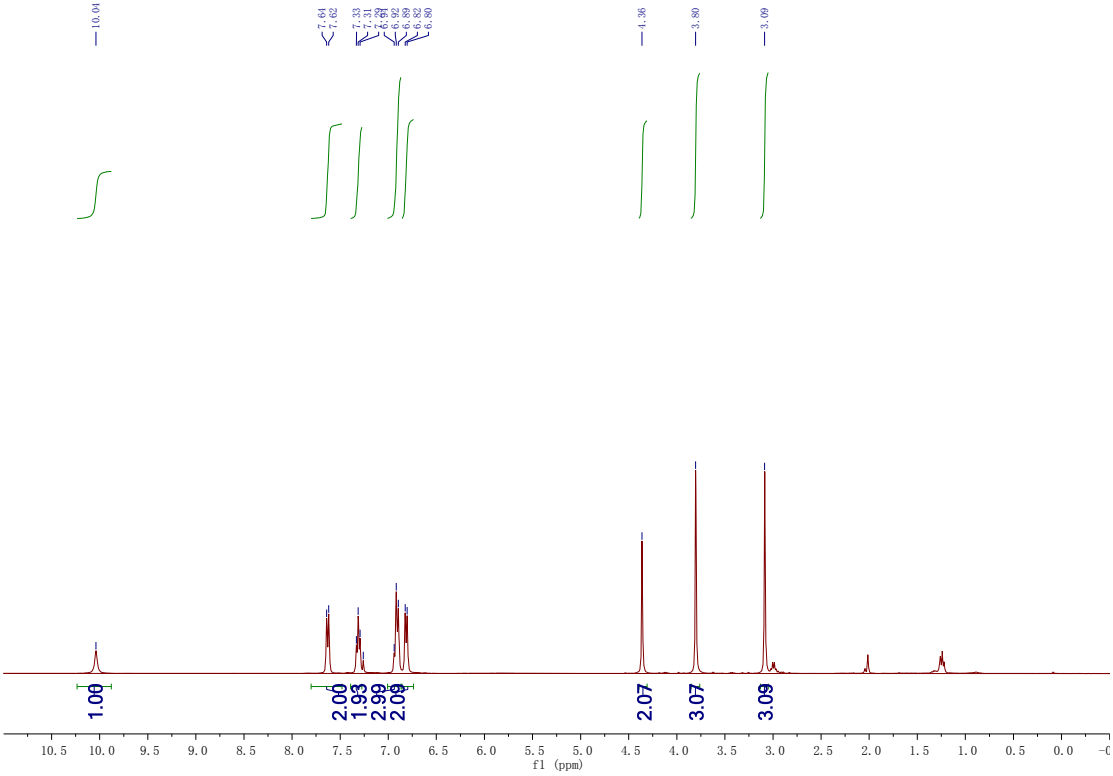
2-(Methyl(phenyl)amino)-*N*-(*p*-tolyl)ethanethioamide (5b):

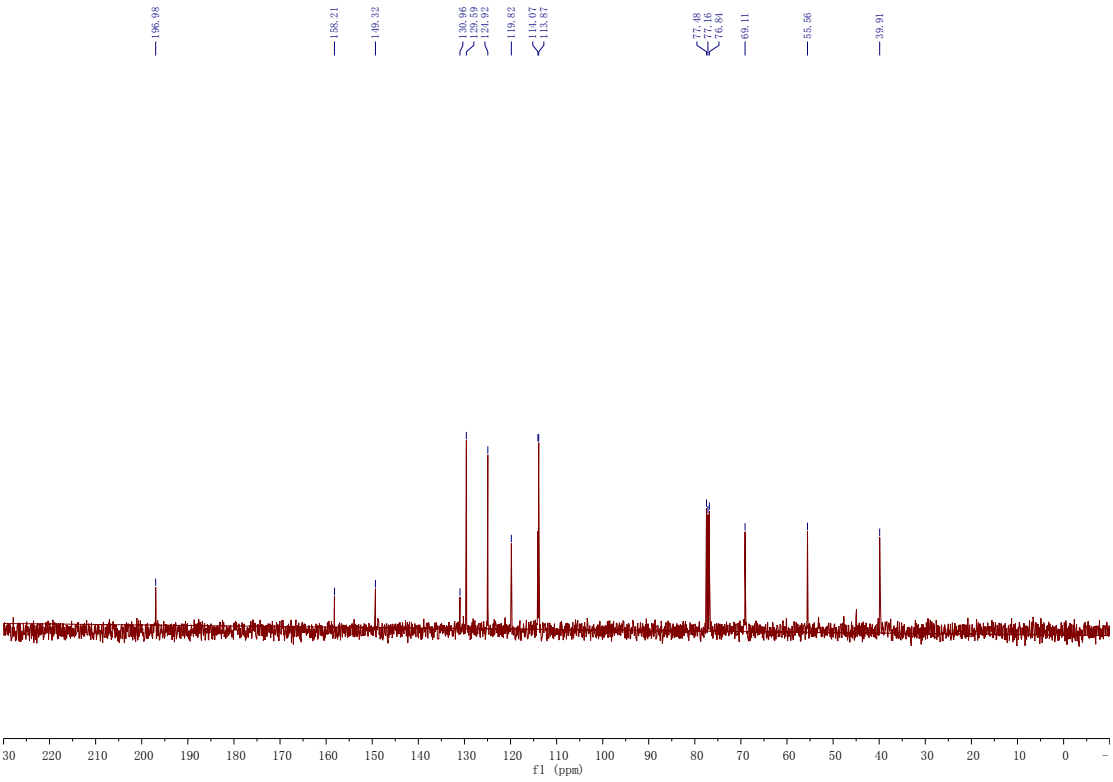




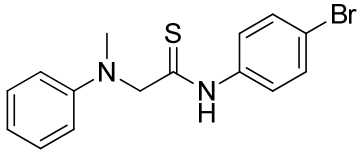
***N*-(4-Methoxyphenyl)-2-(methyl(phenyl)amino)ethanethioamide (5c):**

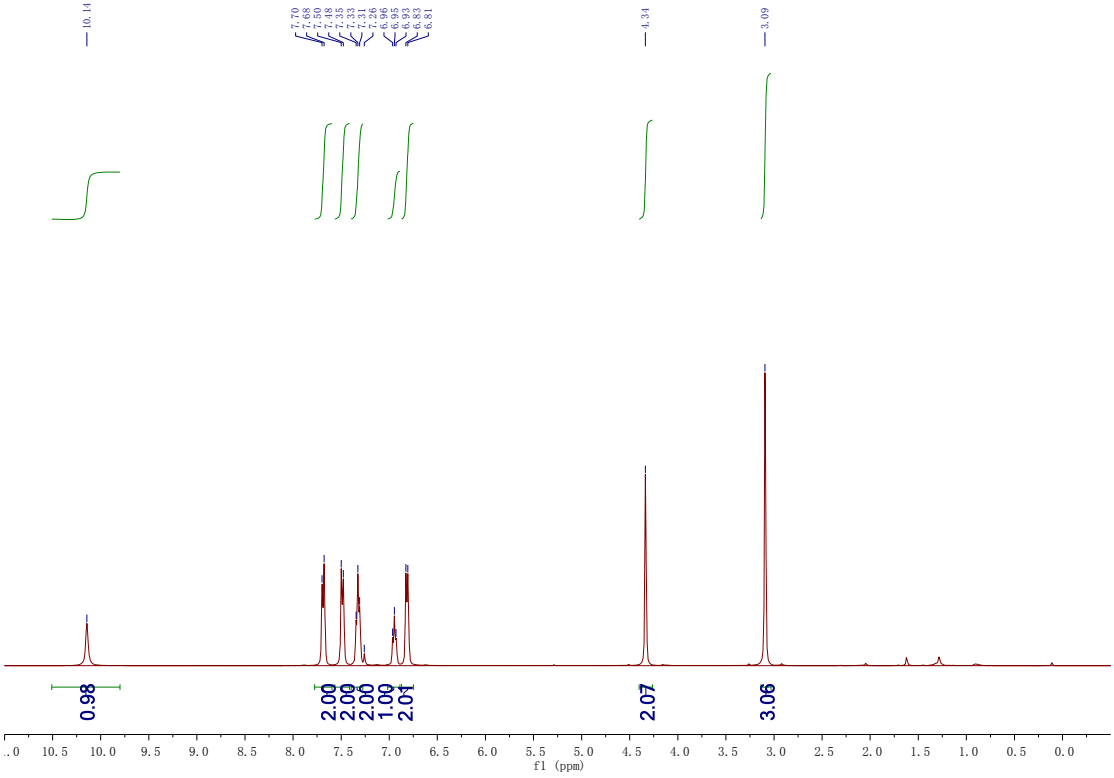


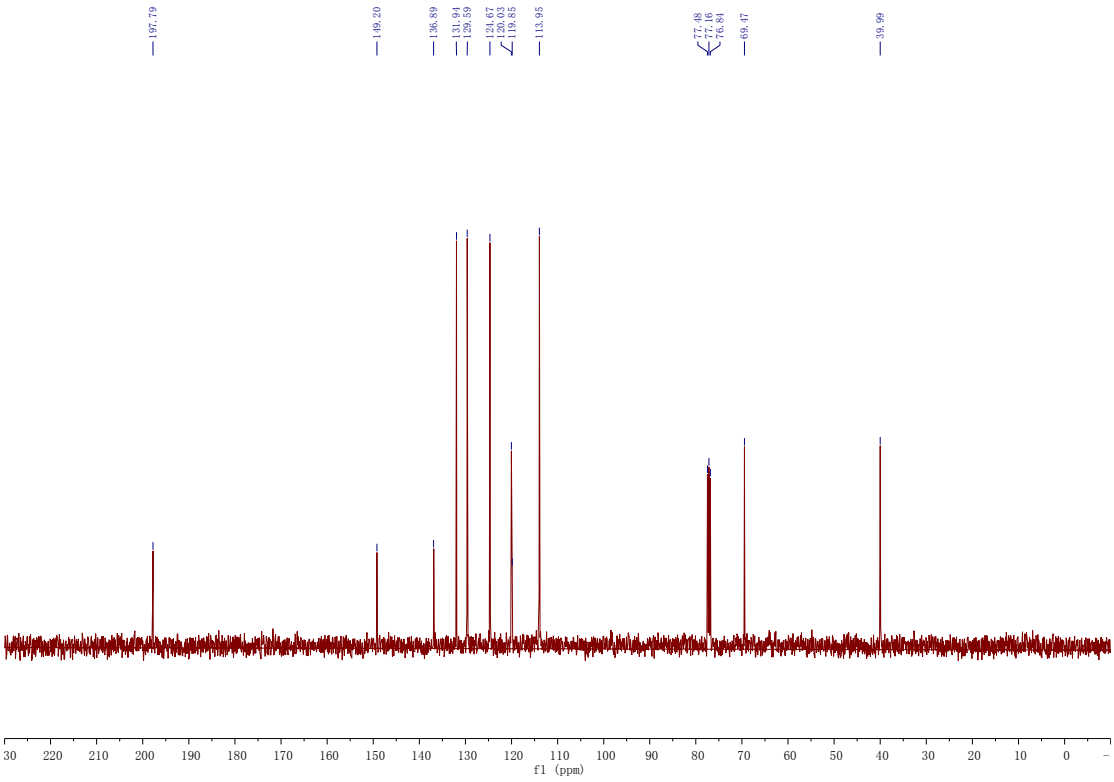




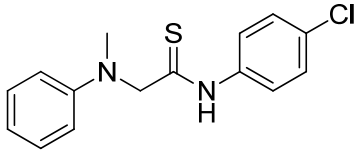
_N_-(4-Bromophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5d):

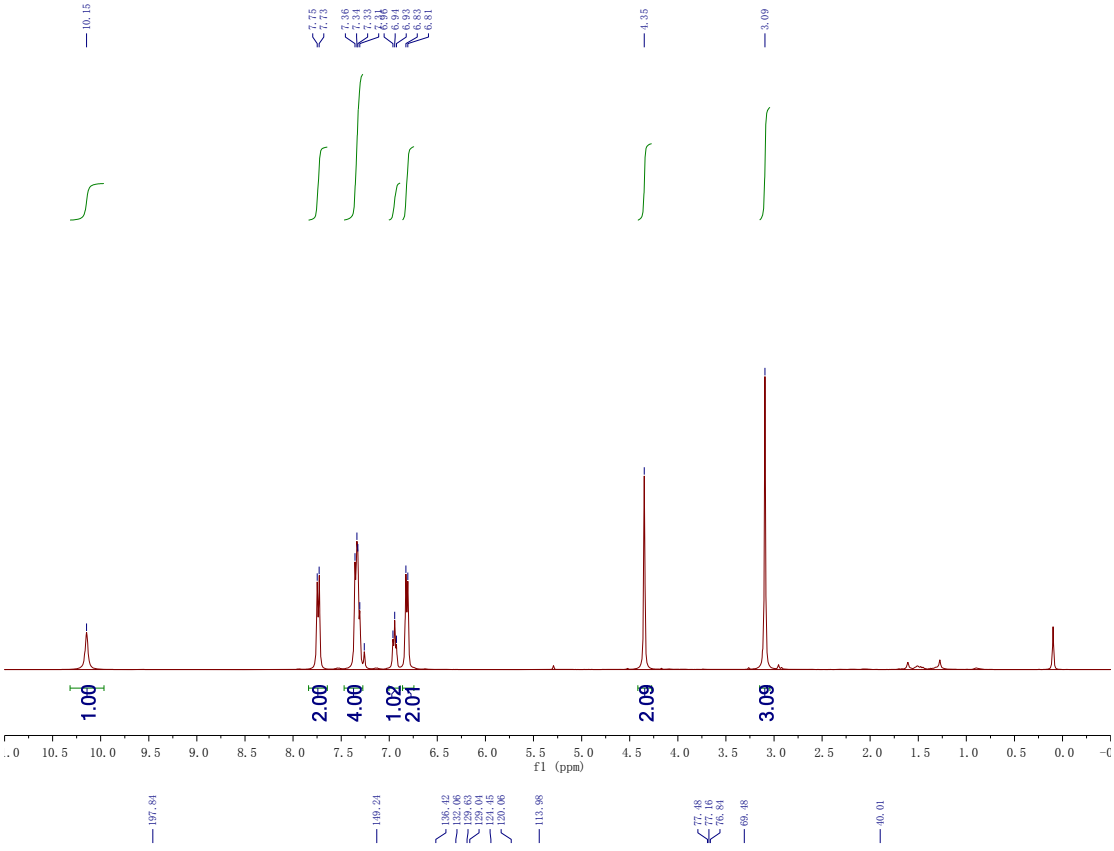


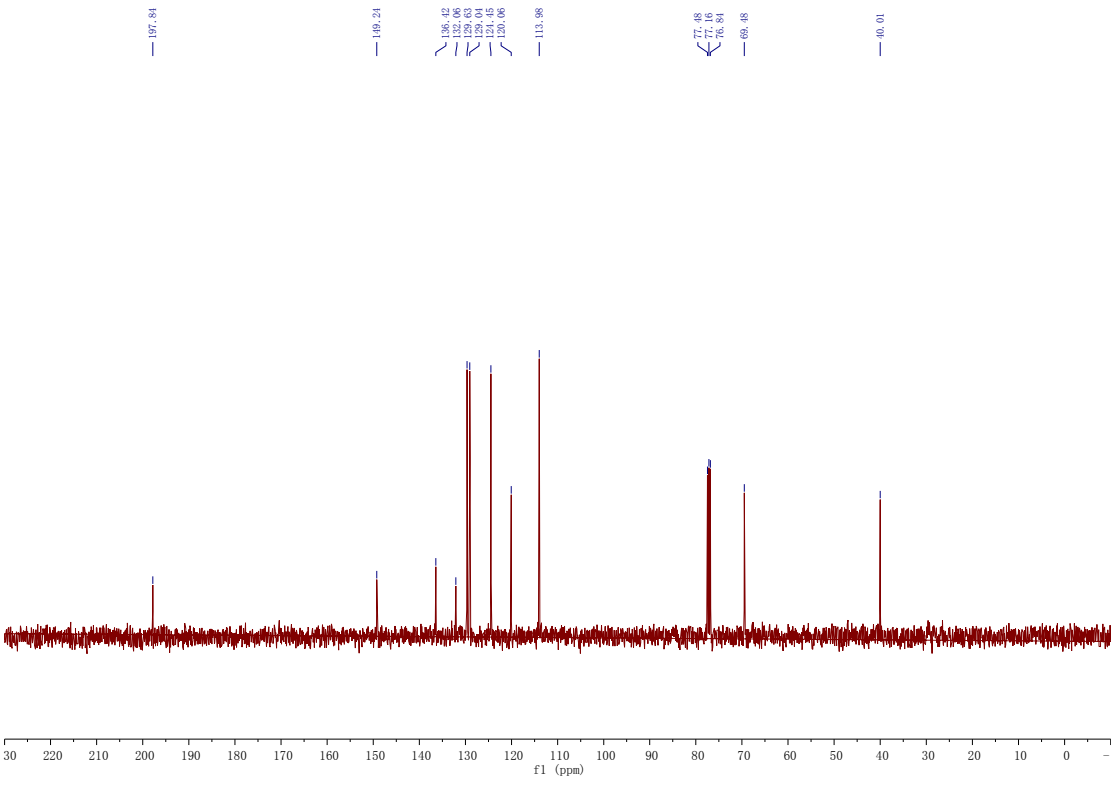




***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5e):**

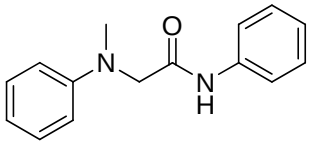


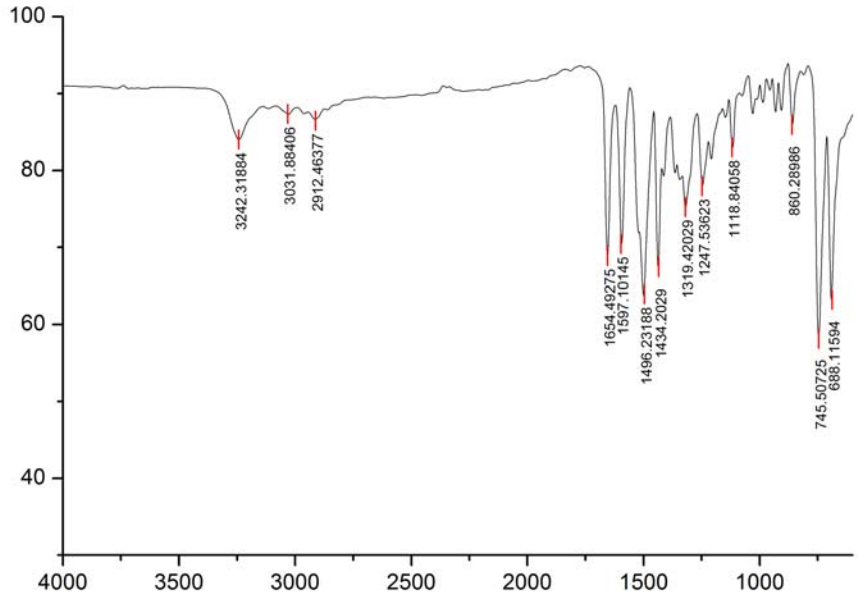




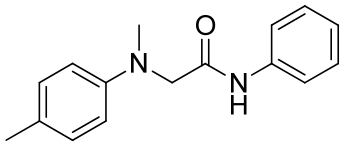
IR Spectra:

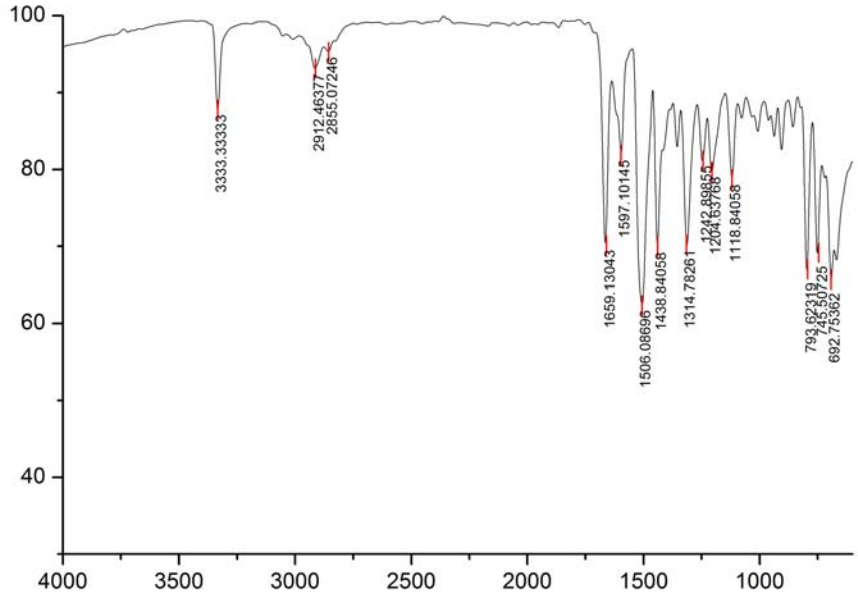
2-(Methyl(phenyl)amino)-*N*-phenylacetamide (3a):



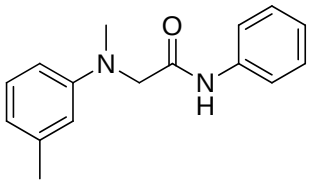


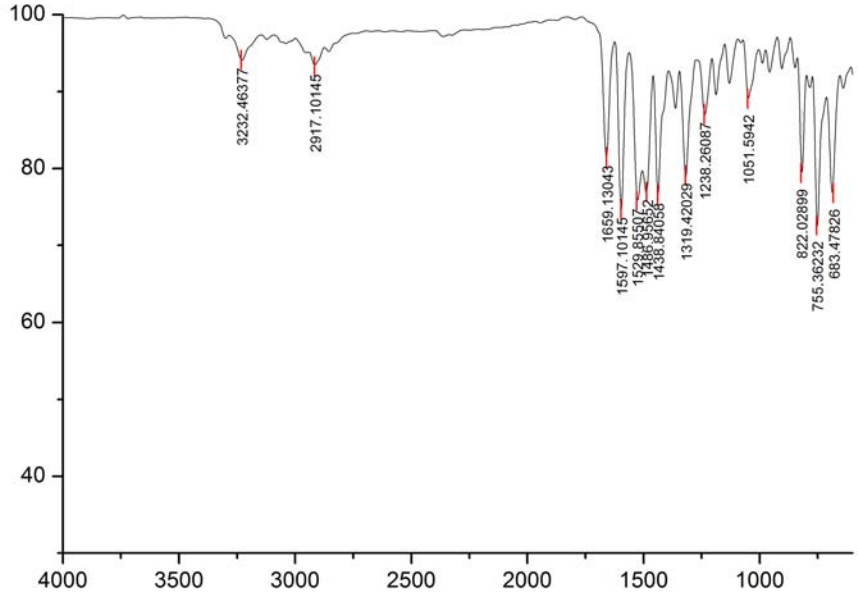
2-(Methyl(*p*-tolyl)amino)-*N*-phenylacetamide (3b):



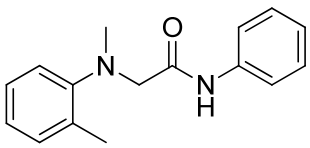


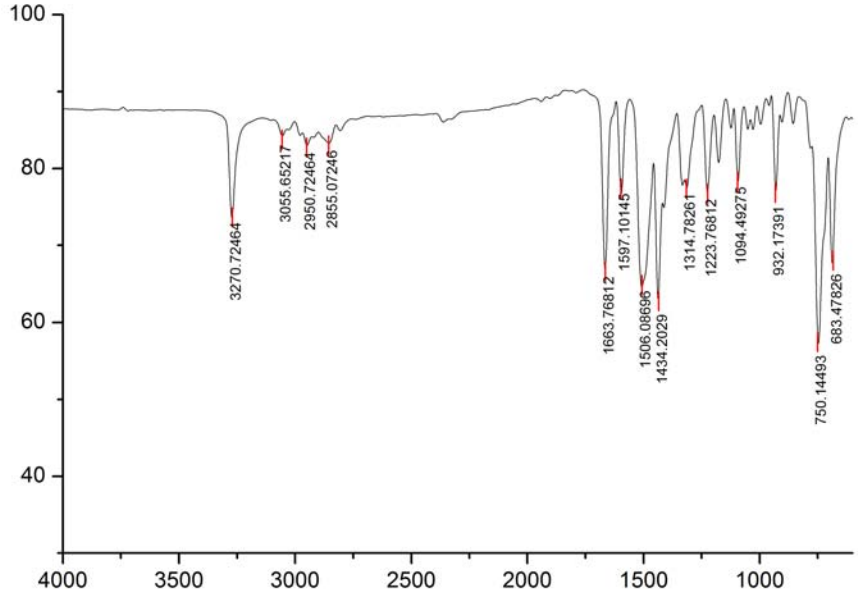
2-(Methyl(*m*-tolyl)amino)-*N*-phenylacetamide (3c):



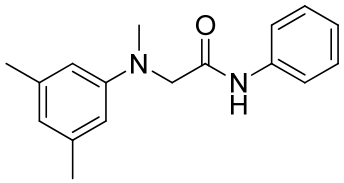


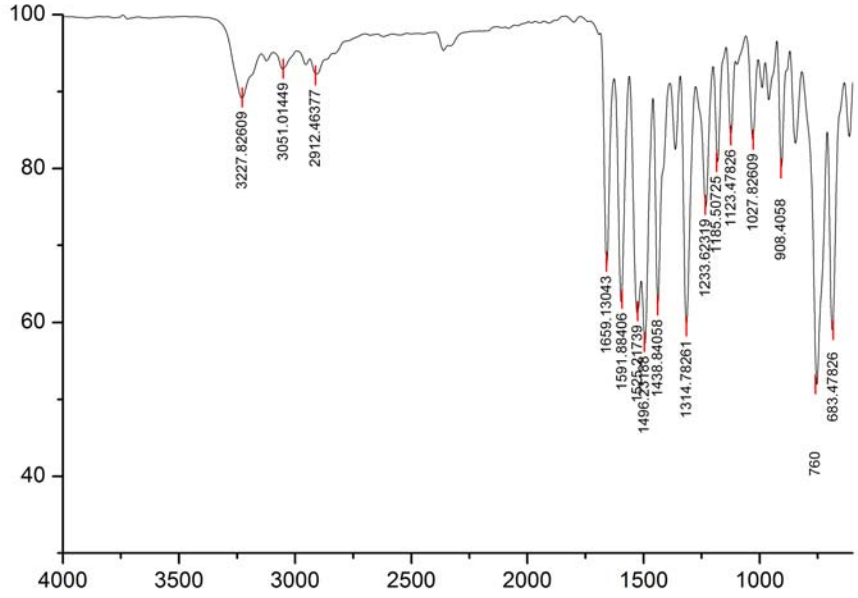
2-(Methyl(*o*-tolyl)amino)-*N*-phenylacetamide (3d):



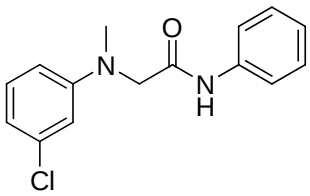


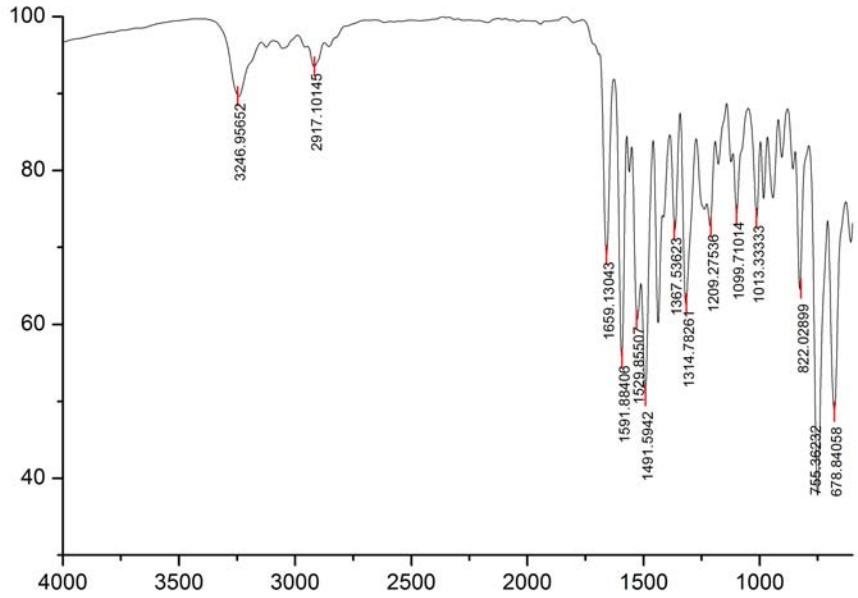
2-((3,5-Dimethylphenyl)(methyl)amino)-*N*-phenylacetamide (3e):



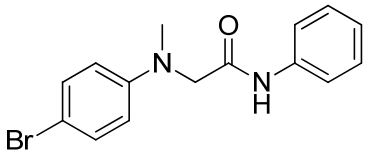


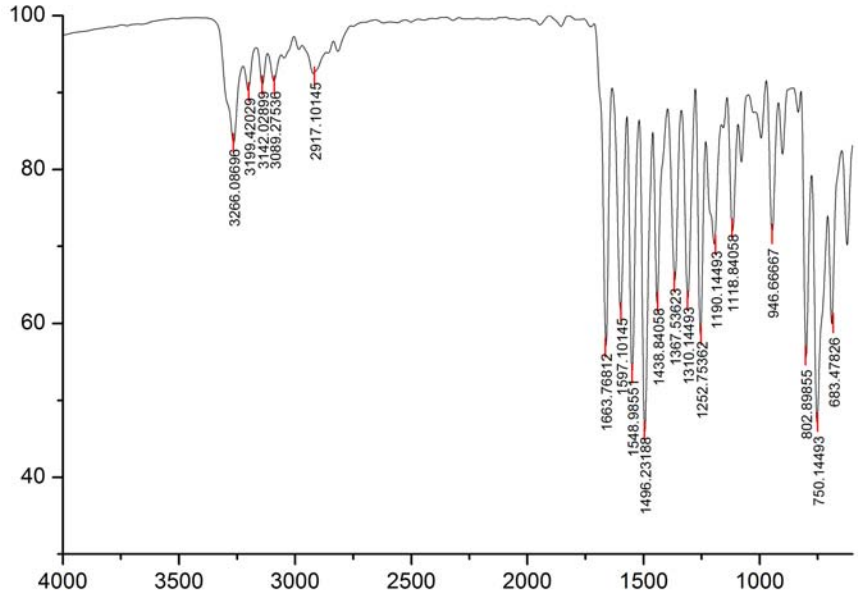
2-((3-Chlorophenyl)(methyl)amino)-*N*-phenylacetamide (3f):



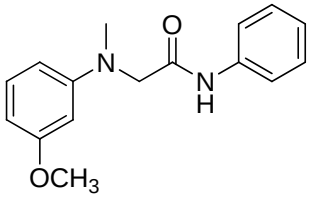


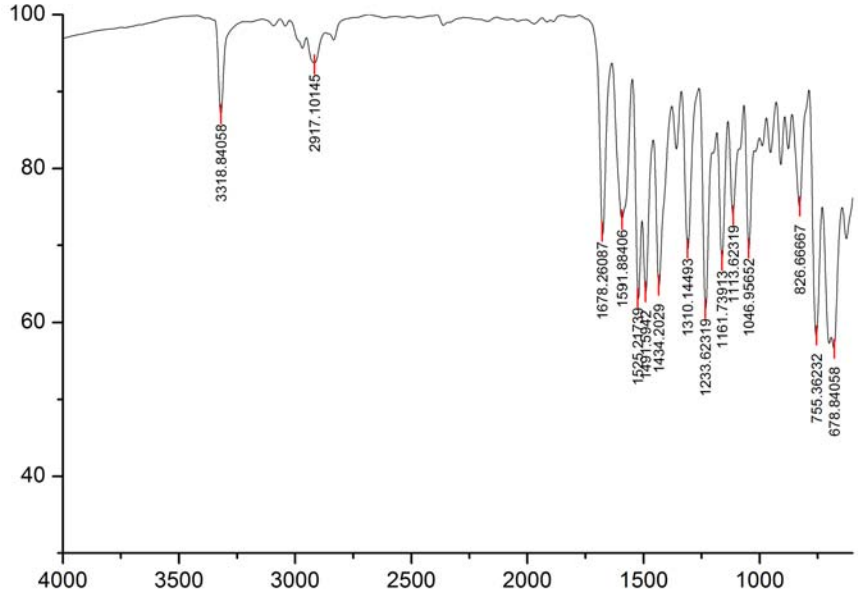
2-((4-Bromophenyl)(methyl)amino)-*N*-phenylacetamide (3g):



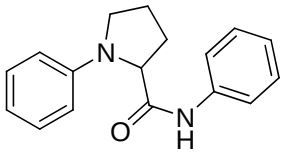


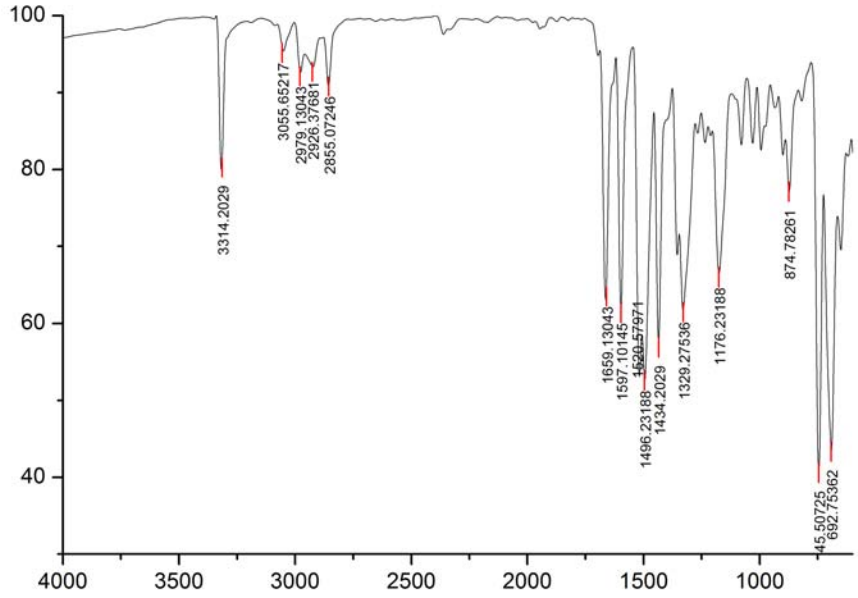
2-((3-Methoxyphenyl)(methyl)amino)-*N*-phenylacetamide (3h):



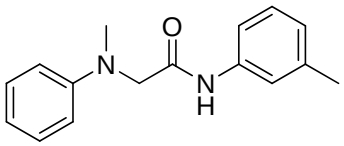


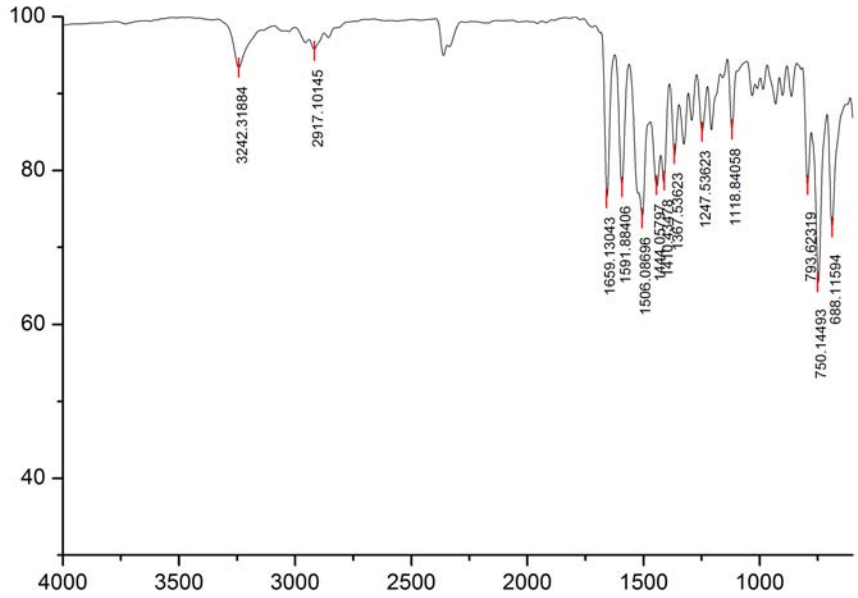
***N*,1-Diphenylpyrrolidine-2-carboxamide (3i):**



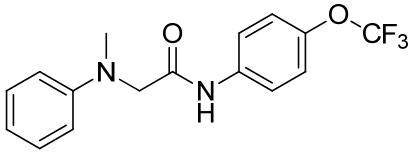


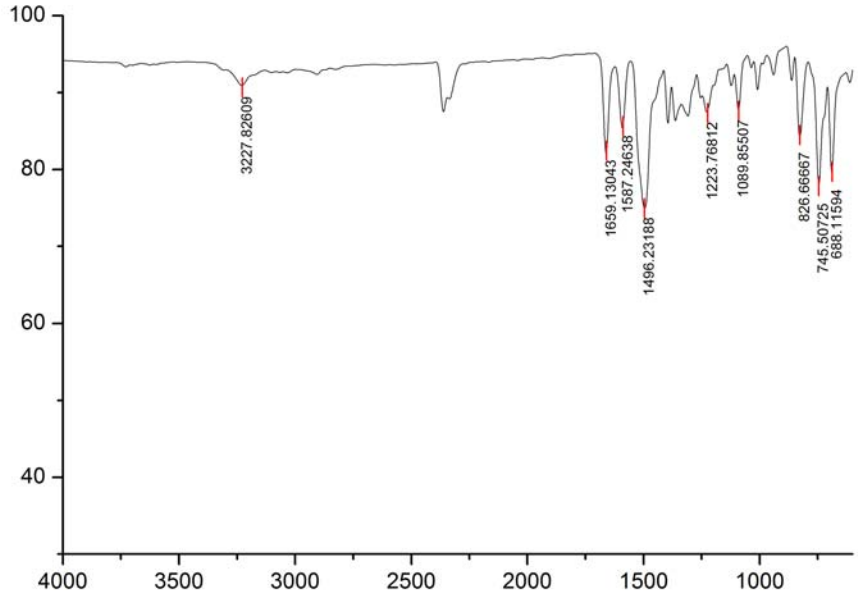
2-(Methyl(phenyl)amino)-*N*-(*m*-tolyl)acetamide (3j):



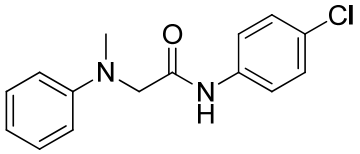


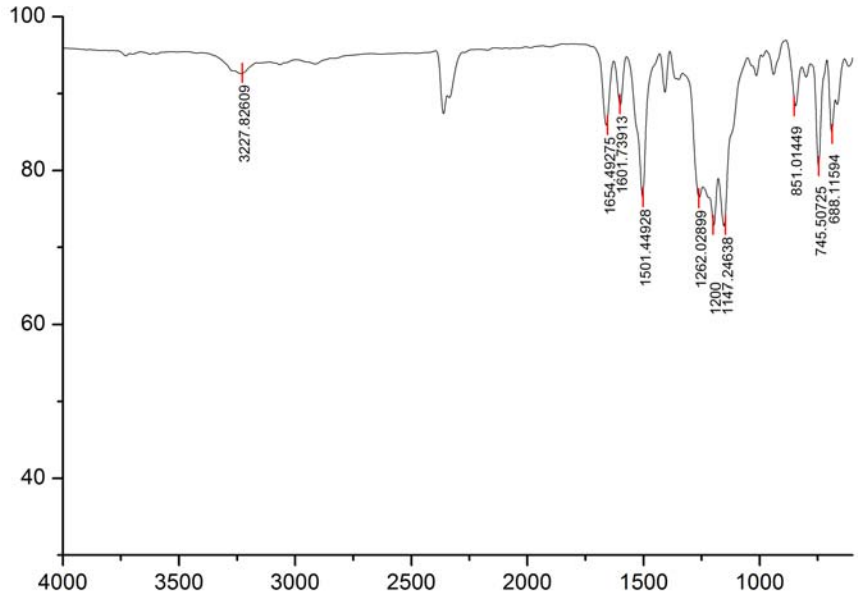
2-(Methyl(phenyl)amino)-*N*-(4-(trifluoromethoxy)phenyl)acetamide (3k)：



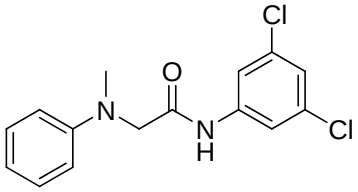


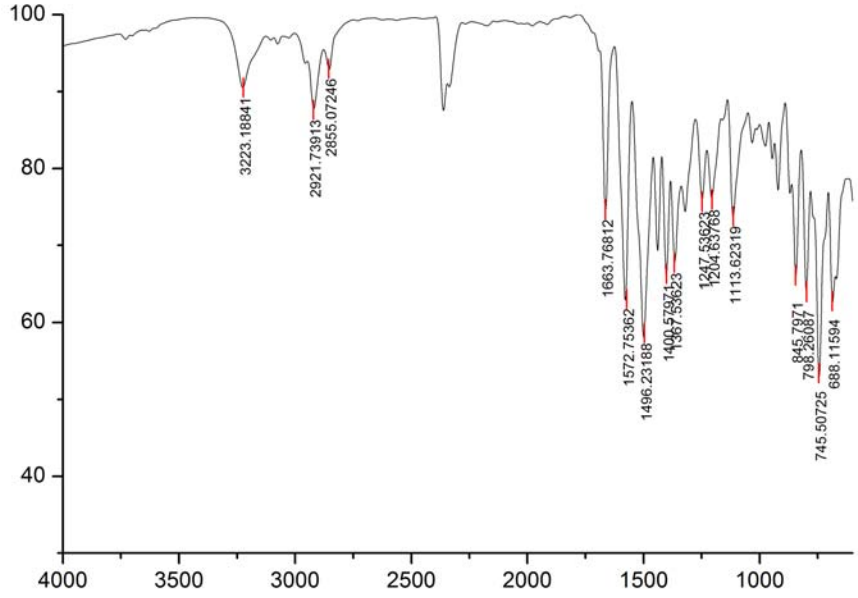
***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)acetamide (3l):**



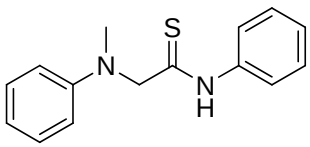


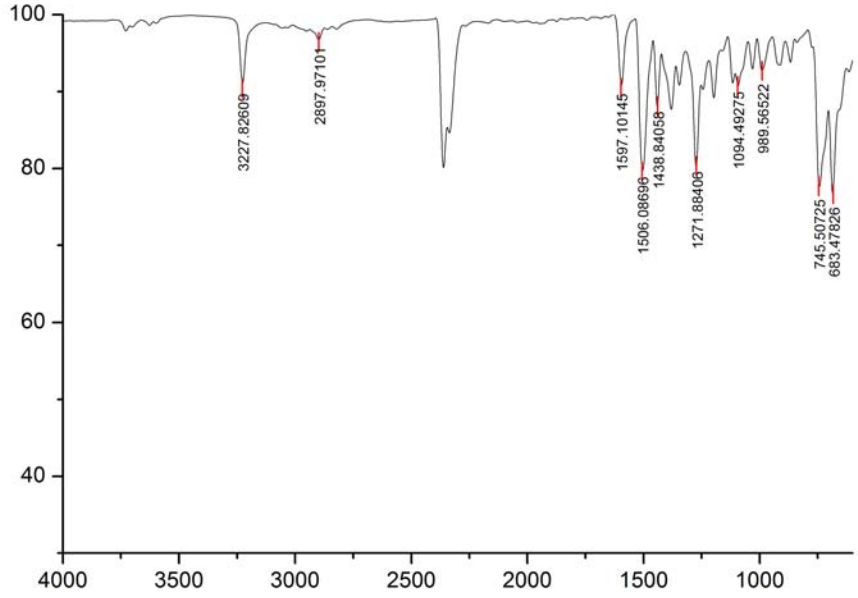
***N*-(3,5-Dichlorophenyl)-2-(methyl(phenyl)amino)acetamide (3m):**



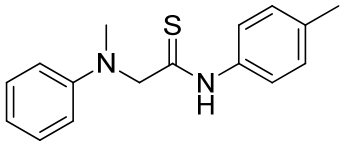


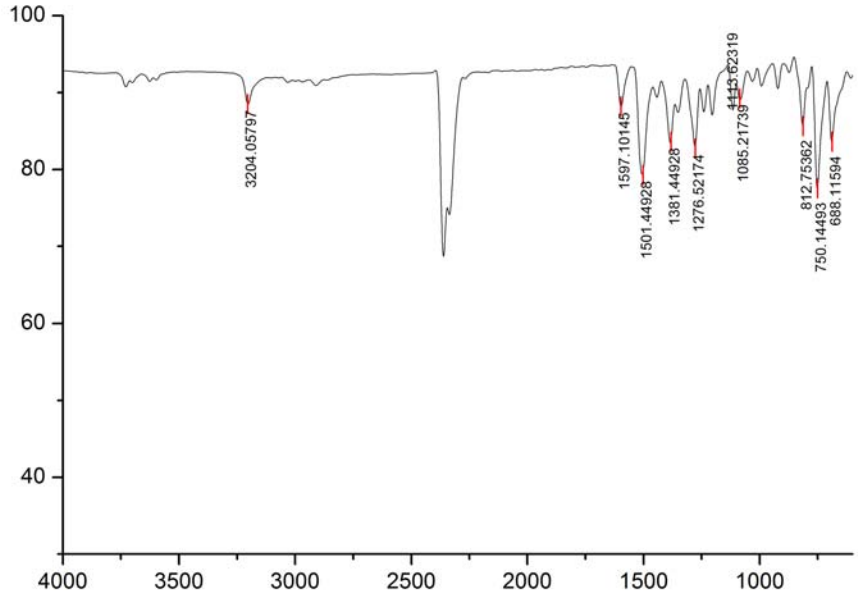
2-(Methyl(phenyl)amino)-*N*-phenylethanethioamide (5a):



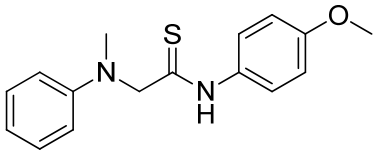


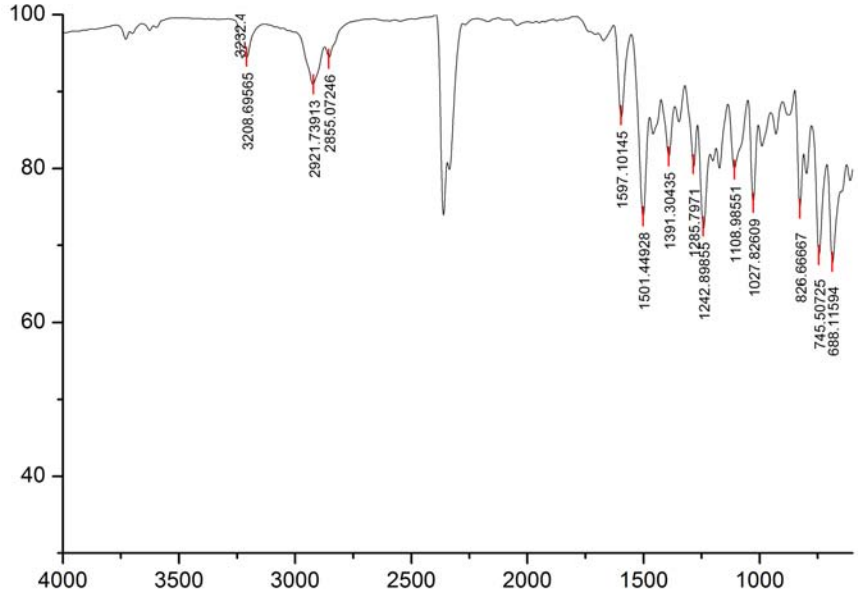
2-(Methyl(phenyl)amino)-*N*-(*p*-tolyl)ethanethioamide (5b):



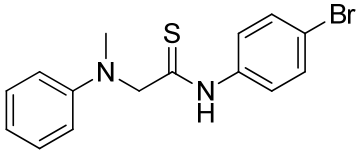


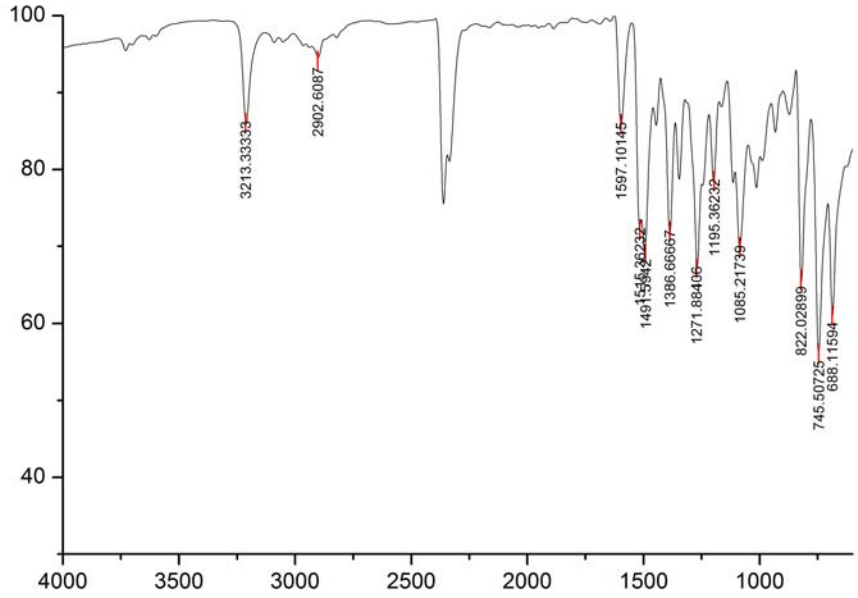
***N*-(4-Methoxyphenyl)-2-(methyl(phenyl)amino)ethanethioamide (5c):**





***N*-(4-Bromophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5d):**





***N*-(4-Chlorophenyl)-2-(methyl(phenyl)amino)ethanethioamide (5e):**