Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

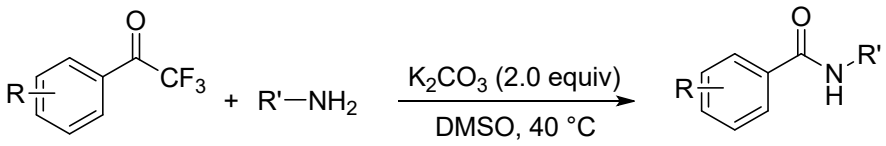
K_2CO_3-promoted synthesis of amides from 1-aryl-2,2,2-trifluoroethanones and amines under mild conditions

Table of contents

1. General information

Unless otherwise noted, all of the reagents were purchased from commercial suppliers and used without purification. Purification of products was conducted by flash chromatography on silica gel (200-300 mesh). Nuclear magnetic resonance (NMR) spectra were measured on a Bruker Avance III 400 (400 MHz). The ^{1}H NMR (400 MHz) chemical shifts were obtained relative to $CDCl_3$ as the internal reference ($CDCl_3$: δ 7.26 ppm). The ^{13}C NMR (101 MHz) chemical shifts were given using $CDCl_3$ as the internal standard ($CDCl_3$: δ 77.16 ppm). The ^{1}H NMR (400 MHz) chemical shifts were obtained relative to DMSO-d6 as the internal reference (DMSO-d6: δ 2.50 ppm). The ^{13}C NMR (101 MHz) chemical shifts were given using DMSO-d6 as the internal standard (DMSO-d6: δ 39.9 ppm).Chemical shifts are reported in ppm using tetramethylsilane as internal standard (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, m = multiplet). Compounds described in the literature were characterized by the comparison of ^{1}H and/or ^{13}C NMR spectra to the previously reported data. HRMS data were obtained on a VG ZAB-HS mass spectrometer, Brucker Apex IV FTMS spectrometer.

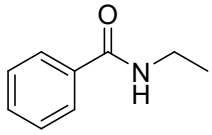
2. General procedure for the reaction



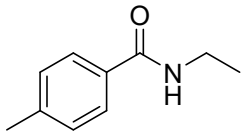
1 **2** **3**

1-Aryl-2,2,2-trifluoroethanones **1** (0.2 mmol, 1.0 equiv.), amines **2** (0.24 mmol, 1.2 equiv.) and K_2CO_3 (0.4 mmol, 2.0 equiv.) were mixed with DMSO (2 mL) at 40 °C in an oil bath under air for 4 h. After completion of reaction as indicated by TLC, the reaction was cooled to room temperature, the reaction mixture was diluted with water (10 mL) and extracted three times with EtOAc (10 mL). The solvent was removed under vacuum and the residue was purified by silica gel chromatography, using a mixture of petroleum ether/ethyl acetate to give the desired product **3**.

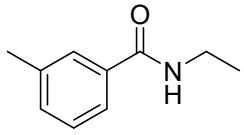
3. Characterization data



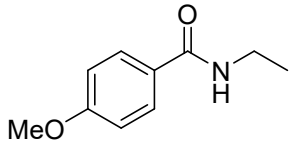
***N*-ethylbenzamide (3a).**[1] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3a** (93%, 27.8 mg), white solid, mp 69-70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.8 Hz, 2H), 7.47 (t, *J* = 6.9 Hz, 1H), 7.43 – 7.35 (m, 2H), 6.37 (s, 1H), 3.52 – 3.42 (m, 2H), 1.23 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.6, 134.9, 131.4, 128.6, 127.0, 35.0, 15.0.



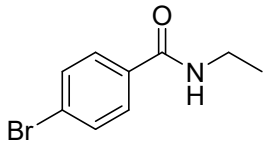
***N*-ethyl-4-methylbenzamide (3b).**[1] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3b** (70%, 22.8 mg), white solid, mp 91-93 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.2 Hz, 2H), 7.18 (d, *J* = 7.9 Hz, 2H), 6.38 (s, 1H), 3.50 – 3.41 (m, 2H), 2.36 (s, 3H), 1.21 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.5, 141.7, 132.0, 129.2, 126.9, 34.9, 21.5, 15.0.



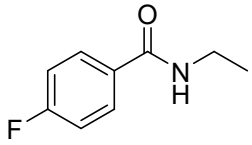
***N*-ethyl-3-methylbenzamide (3c).**[2] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3c** (91%, 29.8 mg), white oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (s, 1H), 7.54 – 7.48 (m, 1H), 7.26 – 7.20 (m, 2H), 6.54 (s, 1H), 3.46 – 3.39 (m, 2H), 2.32 (s, 3H), 1.19 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.8, 138.3, 134.8, 132.0, 128.4, 127.7, 123.9, 34.9, 21.3, 14.9.



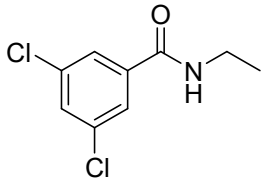
4-Methoxy-*N*-ethylbenzamide (3d).[1] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3d** (91%, 32.6 mg), white solid, mp 69-70 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.8 Hz, 2H), 6.84 (d, *J* = 8.8 Hz, 2H), 6.55 (s, 1H), 3.79 (s, 3H), 3.47 – 3.37 (m, 2H), 1.18 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.1, 161.9, 128.7, 127.1, 113.6, 55.4, 34.9, 15.0.



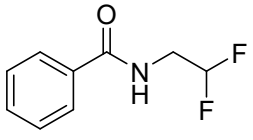
4-Bromo-*N*-ethylbenzamide (3e).[3] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3e** (77%, 35.1 mg), white solid, mp 107-109 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.6 Hz, 2H), 7.48 (d, *J* = 8.6 Hz, 2H), 6.66 (s, 1H), 3.47 – 3.37 (m, 2H), 1.19 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.7, 133.6, 131.7, 128.6, 126.0, 35.1, 14.8.



4-Fluoro-*N*-ethylbenzamide (3f).[3] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3f** (87%, 29.1 mg), white solid, mp 74-75 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.70 (m, 2H), 7.01 (t, *J* = 8.2 Hz, 2H), 6.63 (s, 1H), 3.46 – 3.37 (m, 2H), 1.18 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.6, 164.6 (d, *J* = 251.3 Hz), 131.0 (d, *J* = 3.1 Hz), 129.3 (d, *J* = 8.9 Hz), 115.5 (d, *J* = 21.9 Hz), 35.1, 14.9. ^{19}F NMR (376 MHz, $CDCl_3$) δ -108.76 (m).

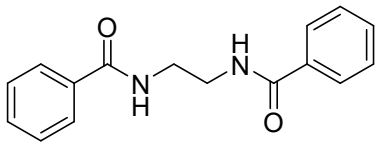


3,5-Dichloro-*N*-ethylbenzamide (3g). Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3g** (66%, 40.6 mg), white solid, mp 107-108 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.58 (m, 2H), 7.43 – 7.37 (m, 1H), 6.97 (s, 1H), 3.47 – 3.40 (m, 2H), 1.21 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.2, 137.7, 135.3, 131.1, 125.7, 35.3, 14.7. HRMS (ESI) m/z: calcd for $C_9H_{10}NOCl_2$ $[M+H]^+$: 218.0134; found: 218.0142.

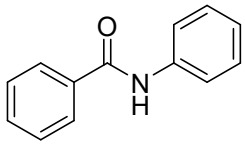


***N*-(2,2-difluoroethyl)benzamide (3h).**[4] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3h** (93%, 34.4 mg), white solid, mp 73-75 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.7 Hz, 2H), 7.51 (t, *J* = 7.1 Hz, 1H), 7.45 – 7.36 (m, 2H), 6.95 (s, 1H), 5.93 (tt, *J* = 56.8, 4.3 Hz, 1H), 3.88 – 3.69 (m,

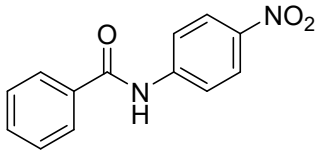
2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.3, 133.5, 132.1, 128.7, 127.2, 113.8 (t, *J* = 241.4 Hz), 42.3 (t, *J* = 26.7 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -122.72 (dt, *J* = 56.0, 14.7 Hz).



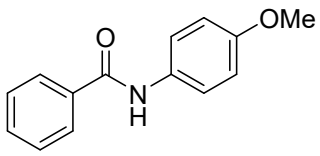
***N*,*N*'-dibenzoyl-1,2-ethylenediamine (3i).**[5] Purification by column chromatography (petroleum ether/ethyl acetate, 1:1 v/v) afforded **3i** (52%, 27.9 mg), white solid, mp 240-242 ℃. ^{1}H NMR (400 MHz, DMSO) δ 8.61 (s, 2H), 7.85 (d, *J* = 7.2 Hz, 4H), 7.56 – 7.49 (m, 2H), 7.49 – 7.41 (m, 4H), 3.50 – 3.41 (m, 4H). ^{13}C NMR (101 MHz, DMSO) δ 166.6, 134.6, 131.1, 128.3, 127.2, 39.2.



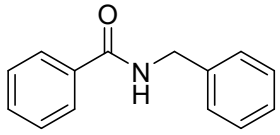
***N*-phenylbenzamide (3j).**[6] Purification by column chromatography (petroleum ether/ethyl acetate, 10:1 v/v) afforded **3j** (55%, 21.8 mg), white solid, mp 150-151 ℃. ^{1}H NMR (400 MHz, DMSO) δ 10.29 (s, 1H), 7.98 (d, *J* = 7.2 Hz, 2H), 7.82 (d, *J* = 7.8 Hz, 2H), 7.62 – 7.57 (m, 1H), 7.56 – 7.48 (m, 2H), 7.36 (t, *J* = 7.6 Hz, 2H), 7.11 (t, *J* = 7.2 Hz, 1H). ^{13}C NMR (101 MHz, DMSO) δ 165.6, 139.2, 135.0, 131.6, 128.6, 128.4, 127.7, 123.7, 120.4.



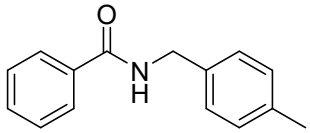
***N*-(4-nitrophenyl)-benzamide (3k).**[6] Purification by column chromatography (petroleum ether/ethyl acetate, 10:1 v/v) afforded **3k** (40%, 19.2 mg), yellow solid, mp 190-192 ℃. ^{1}H NMR (400 MHz, DMSO) δ 10.79 (s, 1H), 8.25 (d, *J* = 9.3 Hz, 2H), 8.05 (d, *J* = 9.3 Hz, 2H), 7.96 (d, *J* = 7.1 Hz, 2H), 7.62 (t, *J* = 7.3 Hz, 1H), 7.58 – 7.50 (m, 2H). ^{13}C NMR (101 MHz, DMSO) δ 166.3, 145.5, 142.5, 134.2, 132.2, 128.5, 127.9, 124.8, 119.9.



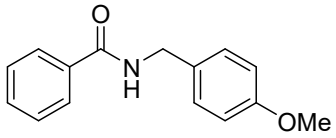
***N*-(4-methoxyphenyl)-benzamide (3l).**[7] Purification by column chromatography (petroleum ether/ethyl acetate, 5:1 v/v) afforded **3l** (46%, 20.9 mg), white solid, mp 151-152 ℃. ^{1}H NMR (400 MHz, DMSO) δ 10.17 (s, 1H), 7.96 (d, *J* = 7.0 Hz, 2H), 7.70 (d, *J* = 9.0 Hz, 2H), 7.60 – 7.49 (m, 3H), 6.93 (d, *J* = 9.0 Hz, 2H), 3.74 (s, 3H).^{13}C NMR (101 MHz, DMSO) δ 165.2, 155.6, 135.1, 132.3, 131.4, 128.4, 127.6, 122.0, 113.8, 55.2.



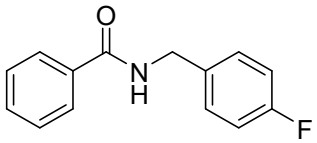
***N*-benzoylbenzylamine (3m).**[3] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3m** (94%, 39.7 mg), white solid, mp 103-104 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, *J* = 7.7 Hz, 2H), 7.46 (t, *J* = 7.1 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 2H), 7.30 (s, 5H), 6.92 (s, 1H), 4.57 (d, *J* = 5.6 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.6 , 138.3, 134.4, 131.5, 128.6, 127.8, 127.5, 127.1, 44.0.



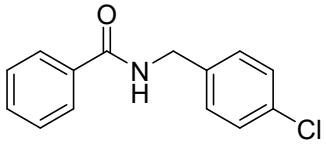
***N*-[(4-methylphenyl)methyl]benzamide (3n).**[8] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3n** (96%, 43.2 mg), white solid, mp 130-132 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.6 Hz, 2H), 7.47 (t, *J* = 7.2 Hz, 1H), 7.42 – 7.34 (m, 2H), 7.22 (d, *J* = 7.6 Hz, 2H), 7.14 (d, *J* = 7.7 Hz, 2H), 6.84 (s, 1H), 4.55 (d, *J* = 5.4 Hz, 2H), 2.34 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.5, 137.2, 135.3, 134.5, 131.5, 129.4, 128.5, 127.9, 127.1, 43.8, 21.2.



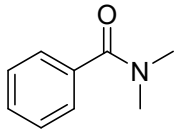
***N*-(4-methoxybenzyl)benzamide (3o).**[9] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3o** (95%, 45.8 mg), white solid, mp 97-98 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.7 Hz, 2H), 7.44 (t, *J* = 6.8 Hz, 1H), 7.40 – 7.31 (m, 2H), 7.22 (d, *J* = 8.4 Hz, 2H), 6.97 – 6.76 (m, 3H), 4.50 (d, *J* = 3.8 Hz, 2H), 3.75 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.4, 159.0, 134.4, 131.4, 130.4, 129.2, 128.5, 127.1, 114.1, 55.3, 43.5.



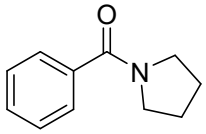
N-**[(4-fluorophenyl)methyl]benzamide (3p).**[10] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3p** (95%, 43.5 mg), white solid, mp 116-117 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.7 Hz, 2H), 7.45 (t, *J* = 7.3 Hz, 1H), 7.39 – 7.30 (m, 2H), 7.26 – 7.18 (m, 2H), 7.13 (s, 1H), 7.01 – 7.87 (m, 2H), 4.49 (d, *J* = 5.6 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.7, 163.3, 160.9, 134.2, 131.6, 129.4, 128.6, 127.1, 115.6, 115.4, 43.2. ^{19}F NMR (376 MHz, $CDCl_3$) δ -115.18.



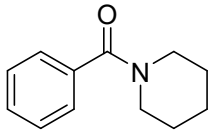
***N*-[(4-chlorophenyl)methyl]benzamide (3q).**[8] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3q** (92%, 45.2 mg), white solid, mp 139-141 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (d, *J* = 7.5 Hz, 2H), 7.48 (t, *J* = 7.3 Hz, 1H), 7.43 – 7.36 (m, 2H), 7.31 – 7.19 (m, 4H), 6.71 (s, 1H), 4.55 (d, *J* = 5.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.6, 136.9, 134.2, 133.4, 131.8, 129.3, 128.9, 128.7, 127.1, 43.4.



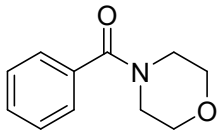
***N*,*N*-dimethylbenzamide (3r).**[7] Purification by column chromatography (petroleum ether/ethyl acetate, 2:1 v/v) afforded **3r** (51%, 15.2 mg), white solid, mp 42-43 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (s, 5H), 3.09 (s, 3H), 2.95 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 136.4, 129.6, 128.4, 127.1, 39.7, 35.4.



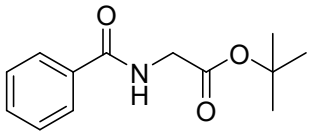
Phenyl(pyrrolidin-1-yl)methanone (3s).[11] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3s** (90%, 31.5 mg), white solid, mp 101-102 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 – 7.41 (m, 2H), 7.39 – 7.27 (m, 3H), 3.64 – 3.54 (m, 2H), 3.39 – 3.31 (m, 2H), 1.94 – 1.85 (m, 2H), 1.84 – 1.76 (d, *J* = 5.9 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 137.2, 129.7, 128.2, 127.0, 49.6, 46.2, 26.4, 24.4.



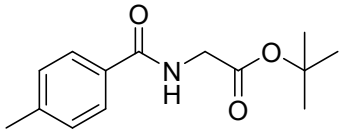
Phenyl(piperidin-1-yl)methanone (3y).[11] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3y** (81%, 30.7 mg), yellow oil. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.27 (m, 5H), 3.76 – 3.59 (m, 2H), 3.38 – 3.23 (m, 2H), 1.68 – 1.57 (m, 4H), 1.52 – 1.42 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 136.5, 129.3, 128.4, 126.8, 48.8, 43.1, 26.6, 25.7, 24.6.



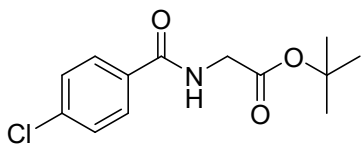
Morpholino(phenyl)methanone (3u).[11] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3u** (81%, 30.7 mg), white solid, mp 74-75 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.30 (m, 5H), 3.79 – 3.38 (m, 8H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.4, 135.3, 129.9, 128.6, 127.1, 66.9, 48.2, 42.6.



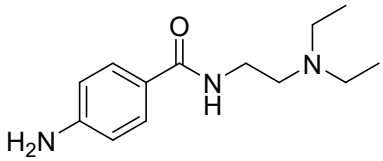
Hippuric acid tert-butyl ester (3v).[12] Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3v** (71%, 33.4 mg), yellow solid, mp 110-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (d, J = 8.0 Hz, 2H), 7.47 (t, J = 6.8 Hz, 1H), 7.43 – 7.35 (m, 2H), 6.77 (s, 1H), 4.10 (d, J = 4.7 Hz, 2H), 1.47 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 167.3, 133.8, 131.7, 128.5, 127.0, 82.5, 42.5, 28.0.



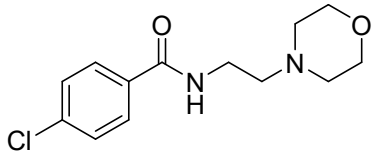
***N*-(4-methylbenzoyl)glycine 1,1-dimethylethyl ester (3w).** Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3w** (51%, 25.5 mg), yellow solid, mp 111-112 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, J = 7.4 Hz, 2H), 7.19 (d, J = 7.6 Hz, 2H), 6.73 (s, 1H), 4.09 (d, J = 4.7 Hz, 2H), 2.35 (s, 3H), 1.47 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 167.3, 142.2, 131.1, 129.3, 127.1, 82.5, 42.5, 28.1, 21.5. HRMS (ESI) m/z: calcd for $C_{14}H_{19}NNaO_3$ $[M+Na]^+$: 272.1257; found: 272.1274.



***N*-(4-chlorobenzoyl)glycine 1,1-dimethylethyl ester (3x).** Purification by column chromatography (petroleum ether/ethyl acetate, 3:1 v/v) afforded **3x** (81%, 43.7 mg), yellow solid,mp 112-113 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.5 Hz, 2H), 7.35 (d, *J* = 8.5 Hz, 2H), 6.87 (s, 1H), 4.09 (d, *J* = 4.9 Hz, 2H), 1.47 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 166.3, 138.0, 132.2, 128.9, 128.6, 82.7, 42.6, 28.1. HRMS (ESI) m/z: calcd for $C_{13}H_{16}NNaO_3Cl$ $[M+Na]^+$: 292.0711; found: 292.0728.



Procainamide (4).[13] Purification by column chromatography (dichloromethane /methanol, 10:1 v/v) afforded **4** (72%, 33.9 mg), white solid, mp 45-46 ℃. ^{1}H NMR (400 MHz, DMSO) δ 8.49 (s, 1H), 7.63 (d, *J* = 8.1 Hz, 2H), 6.53 (d, *J* = 8.1 Hz, 2H), 5.69 (s, 2H), 3.59 – 3.52 (m, 2H), 3.15 – 2.99 (m, 6H), 1.19 (t, *J* = 6.9 Hz, 6H). ^{13}C NMR (101 MHz, DMSO) δ 166.6, 151.9, 128.9, 120.7, 112.6, 50.9, 46.9, 35.5, 10.0 .



Moclobemide (5).[14] Purification by column chromatography (dichloromethane /methanol, 5:1 v/v) afforded **5** (89%, 47.8 mg), white solid, mp 135-136 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 (d, *J* = 8.3 Hz, 2H), 7.34 (d, *J* = 8.3 Hz, 2H), 6.88 (s, 1H), 3.73 – 3.61 (m, 4H), 3.52 – 3.43 (m, 2H), 2.54 (t, *J* = 5.8 Hz, 2H), 2.44 (s, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.4, 137.6, 133.0, 128.8, 128.4, 67.0, 56.9, 53.4, 36.2.

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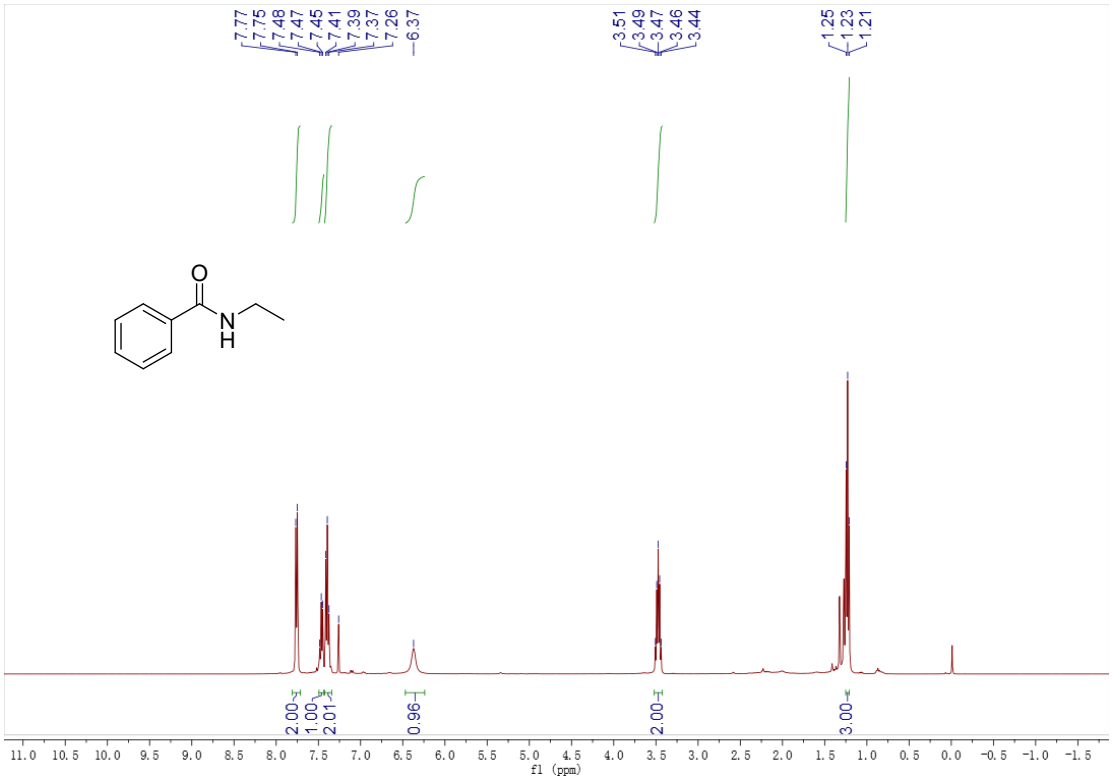
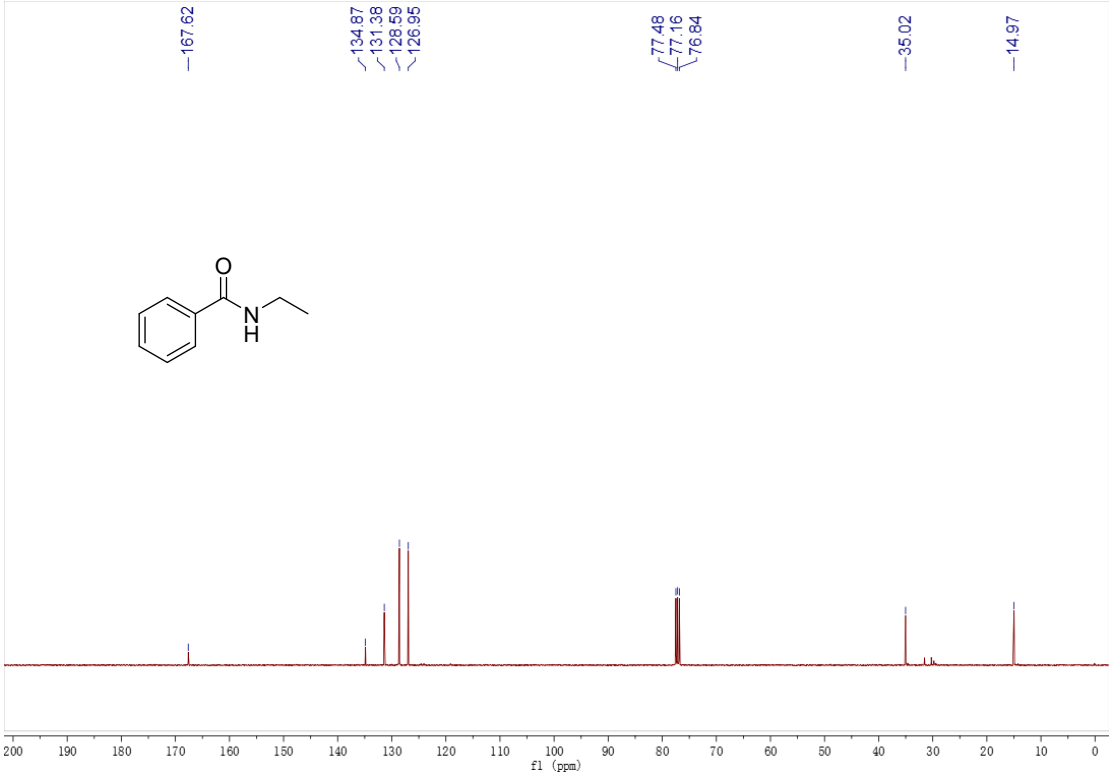
4. The ^{1}H and ^{13}C NMR Spectra of Compounds

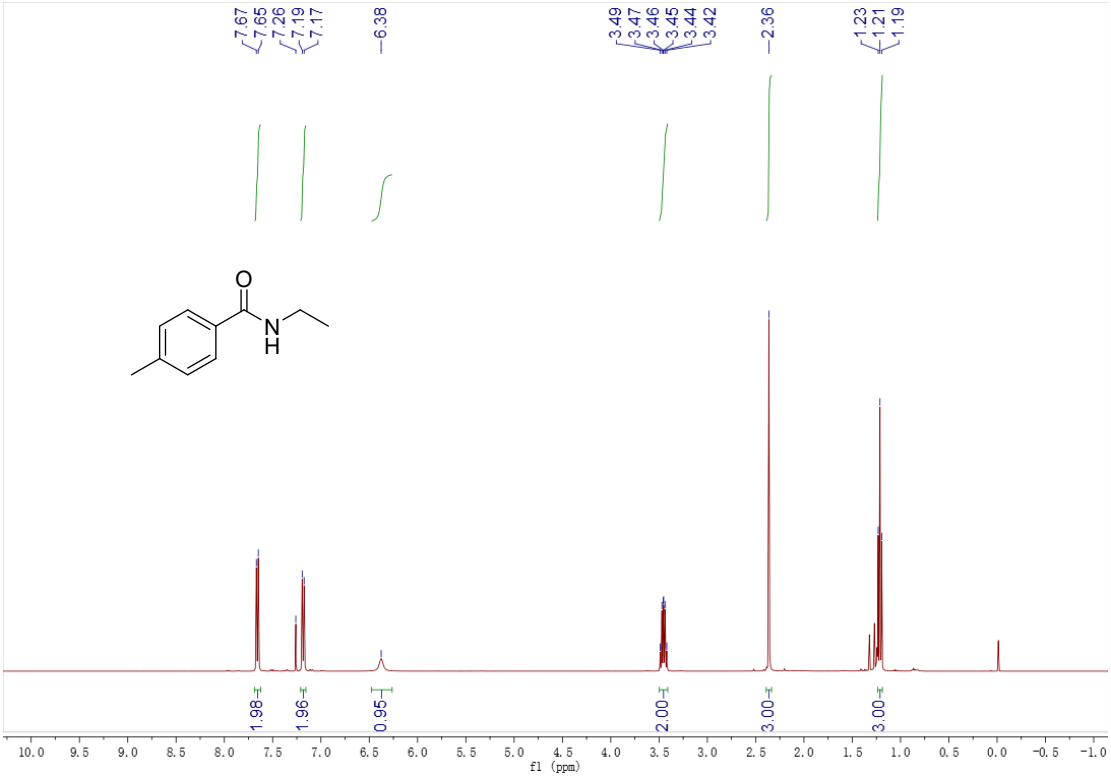
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3a**



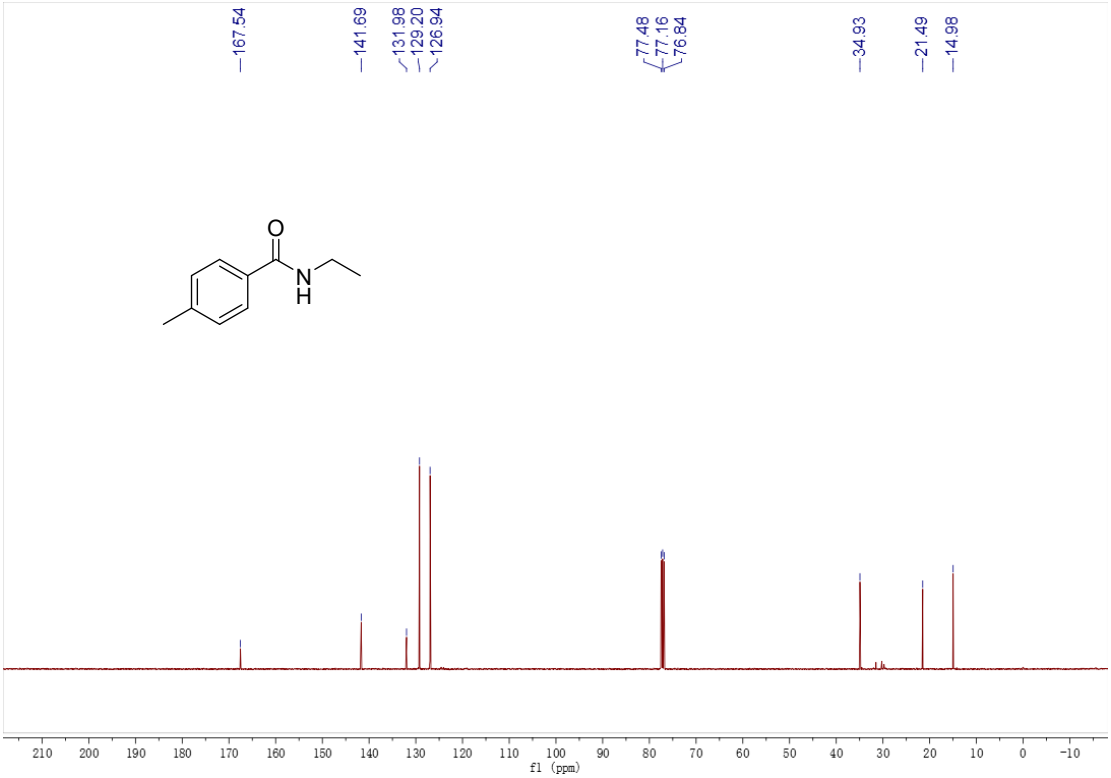
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3a**



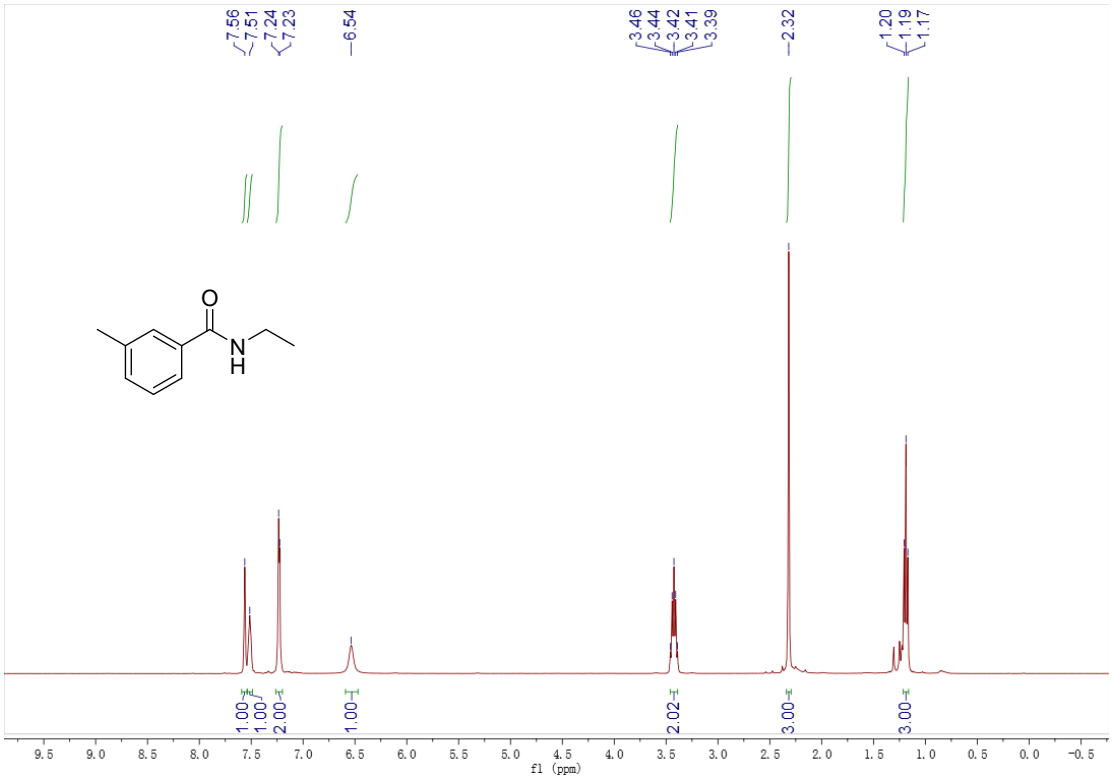
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3b**



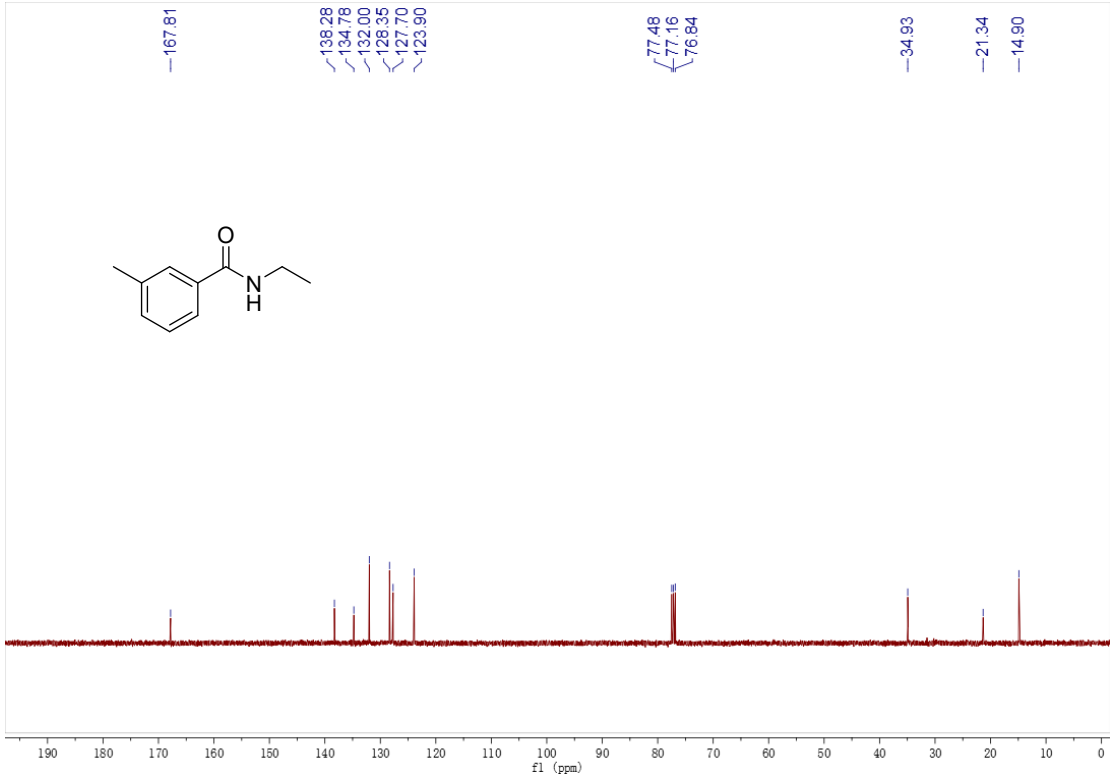
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3b**



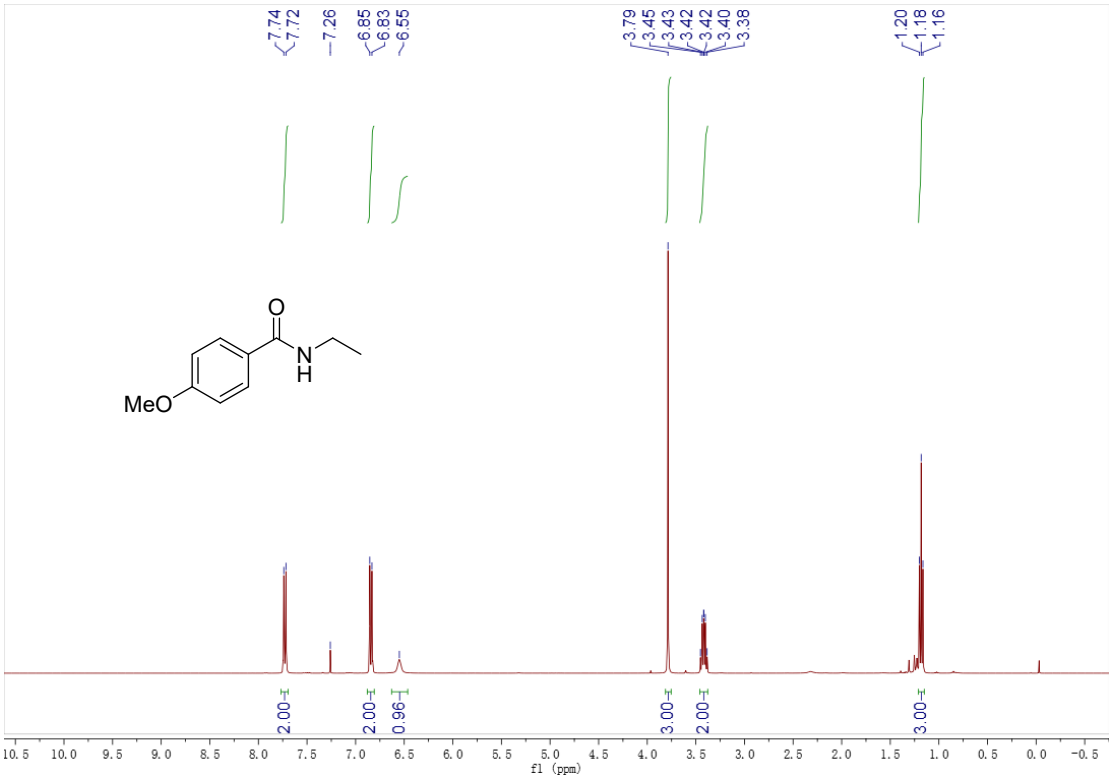
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3c**



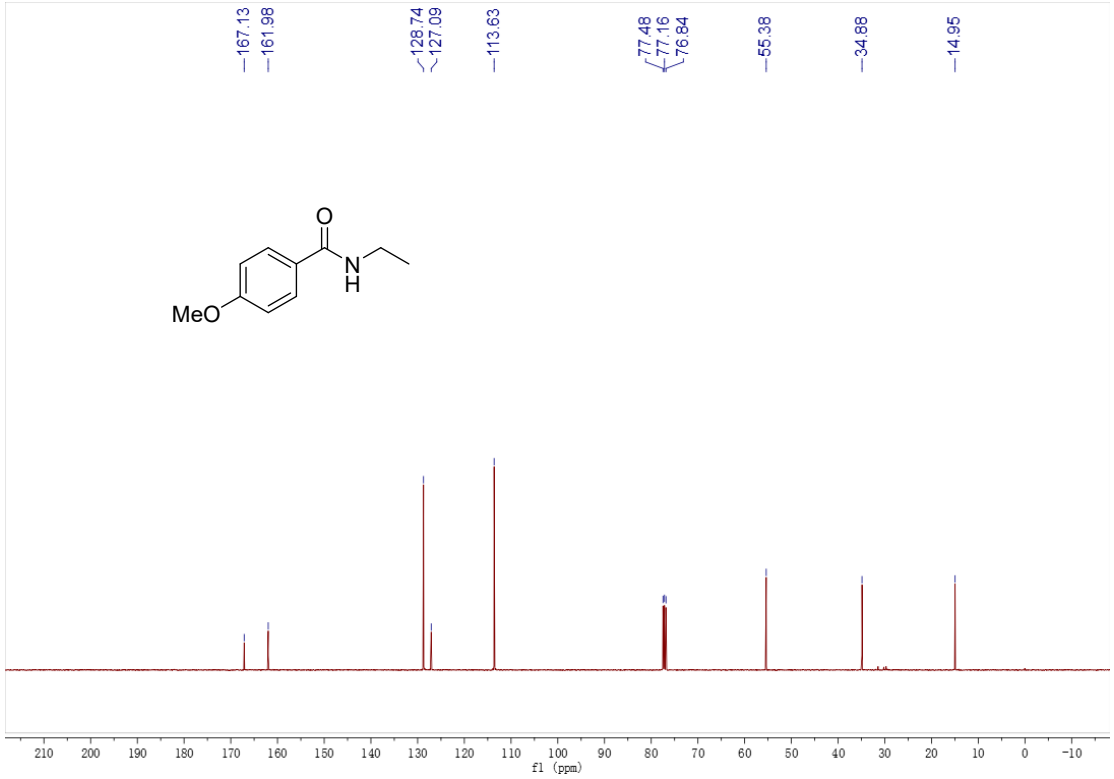
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3c**



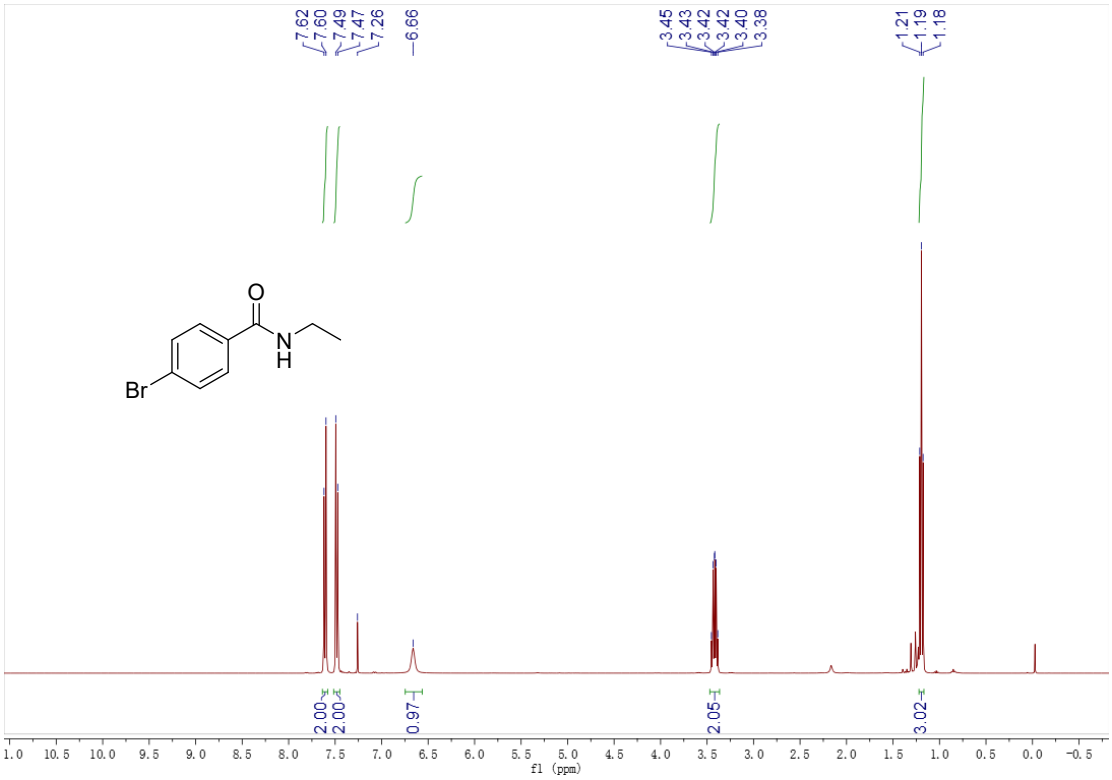
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3d**



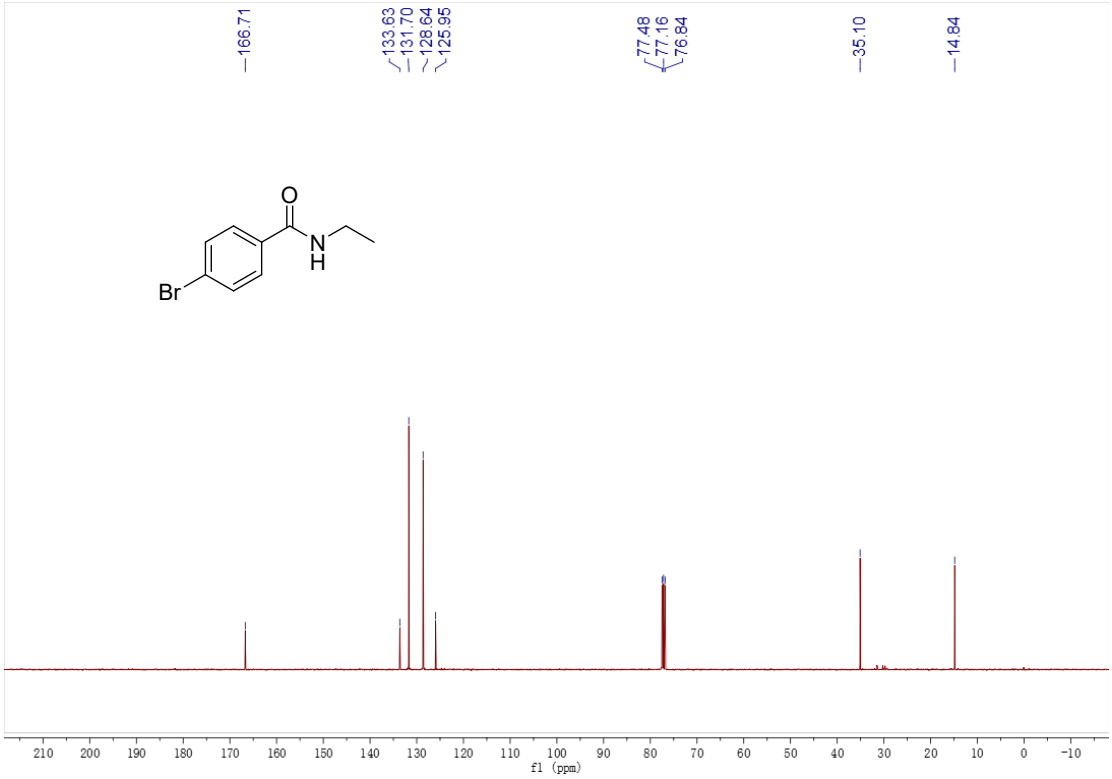
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3d**



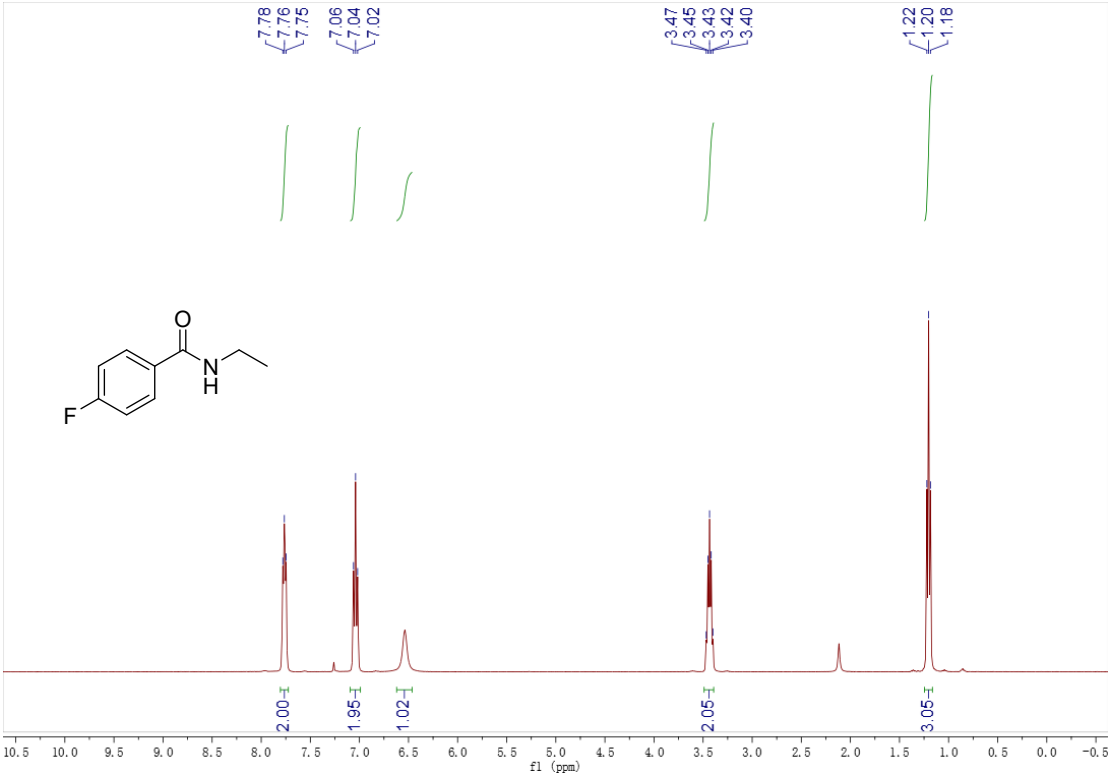
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3e**



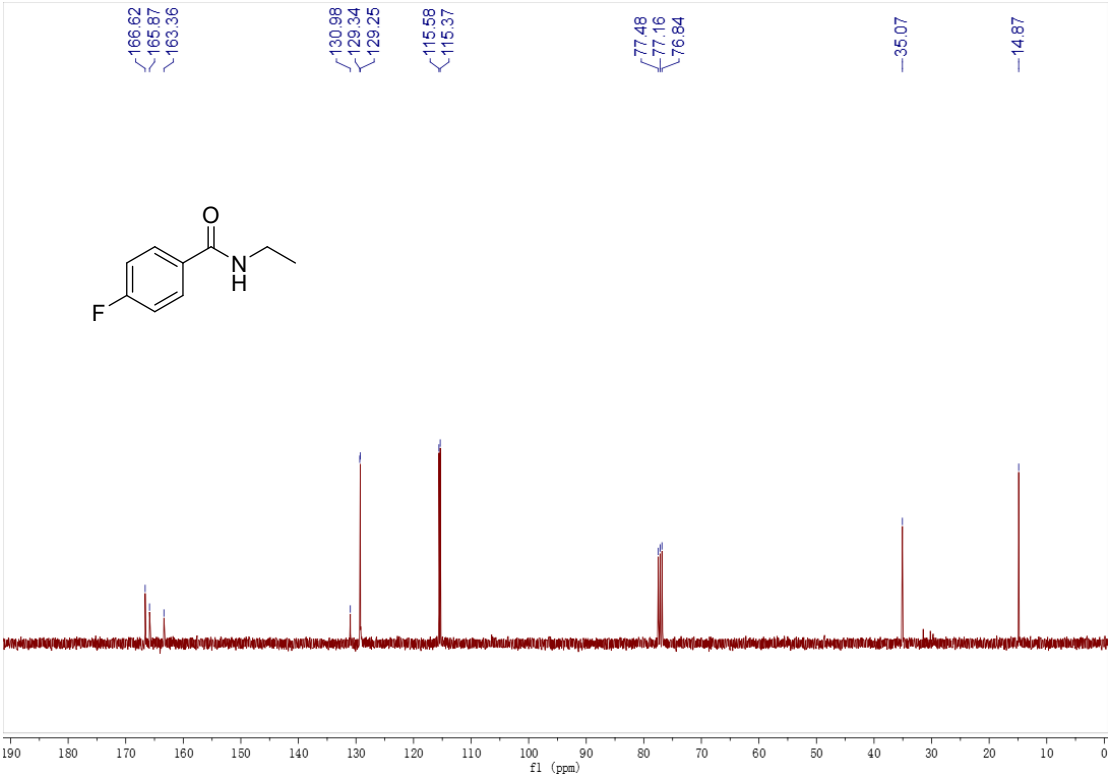
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3e**



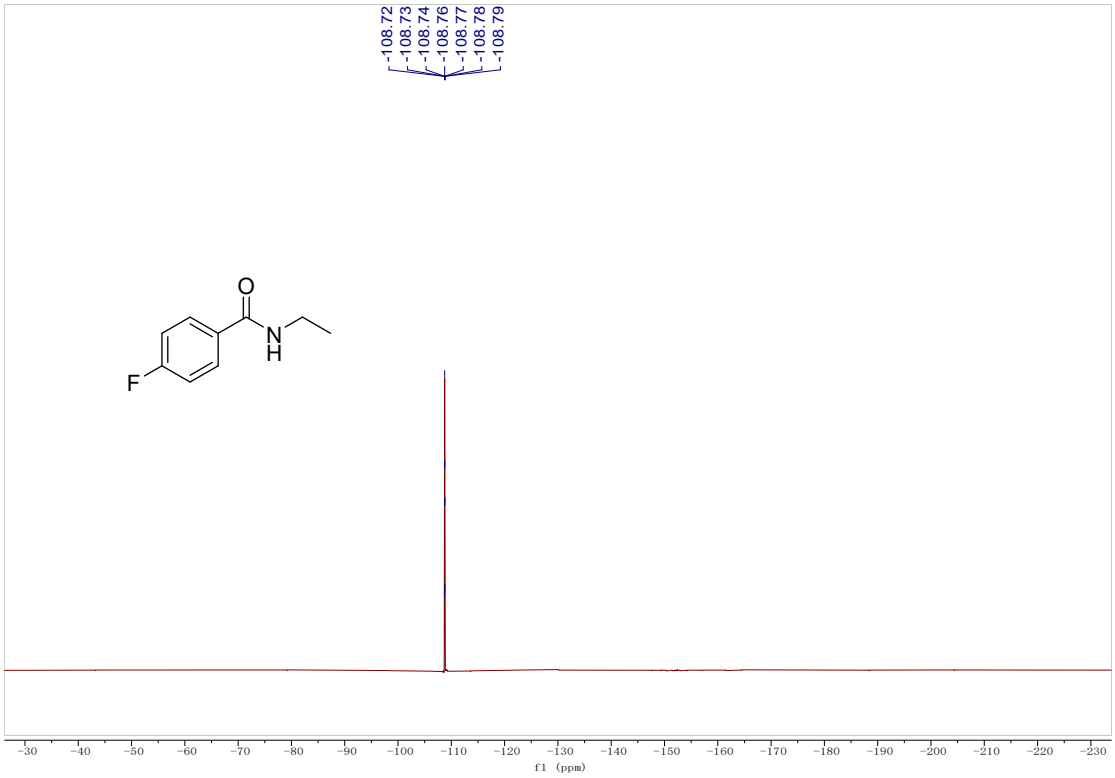
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3f**



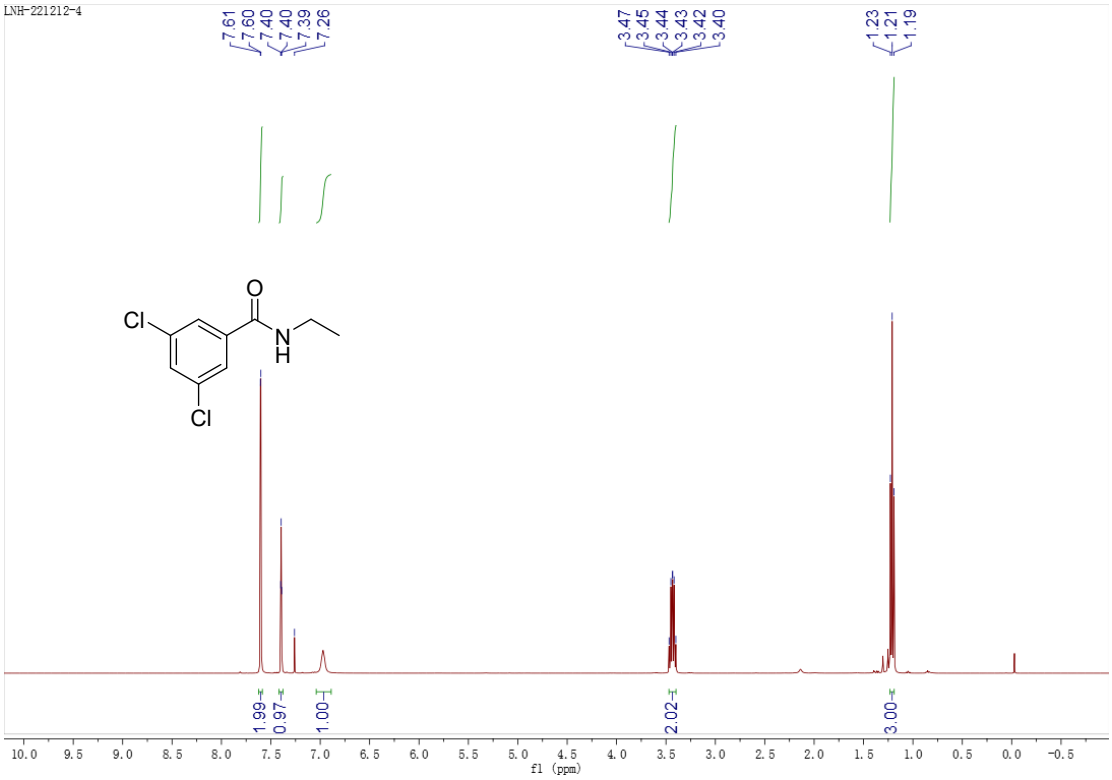
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3f**



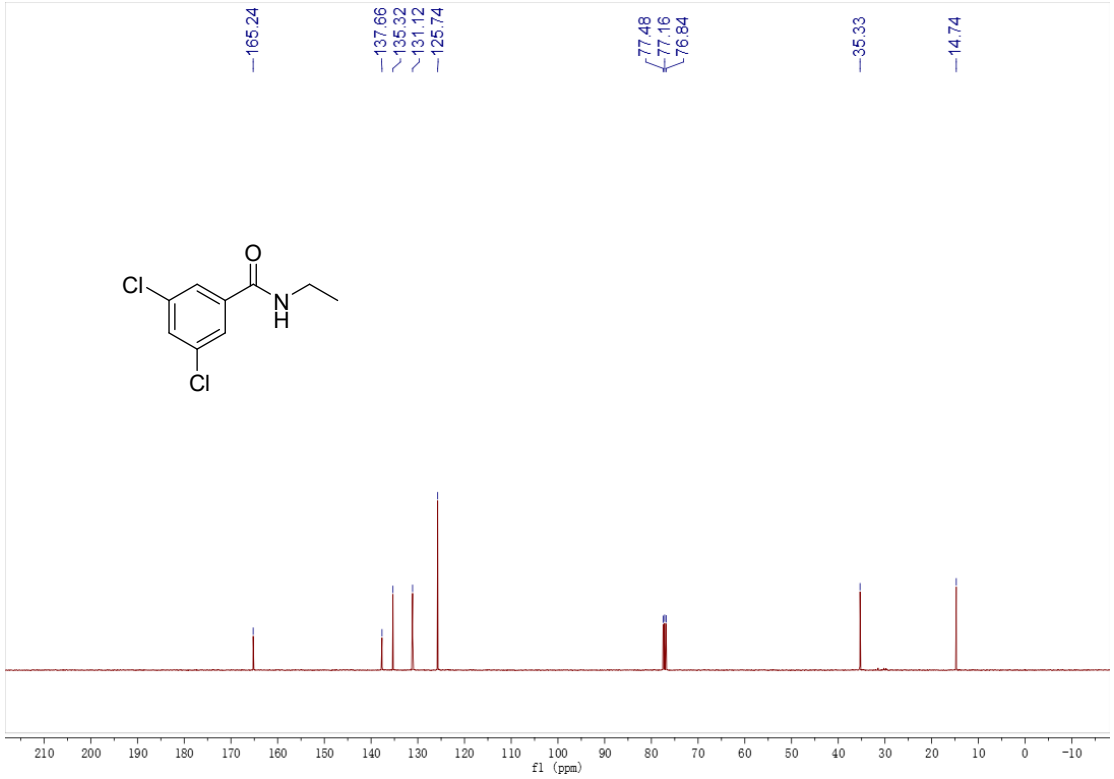
^{19}F NMR spectrum (376 MHz, $CDCl_3$) of compound **3f**



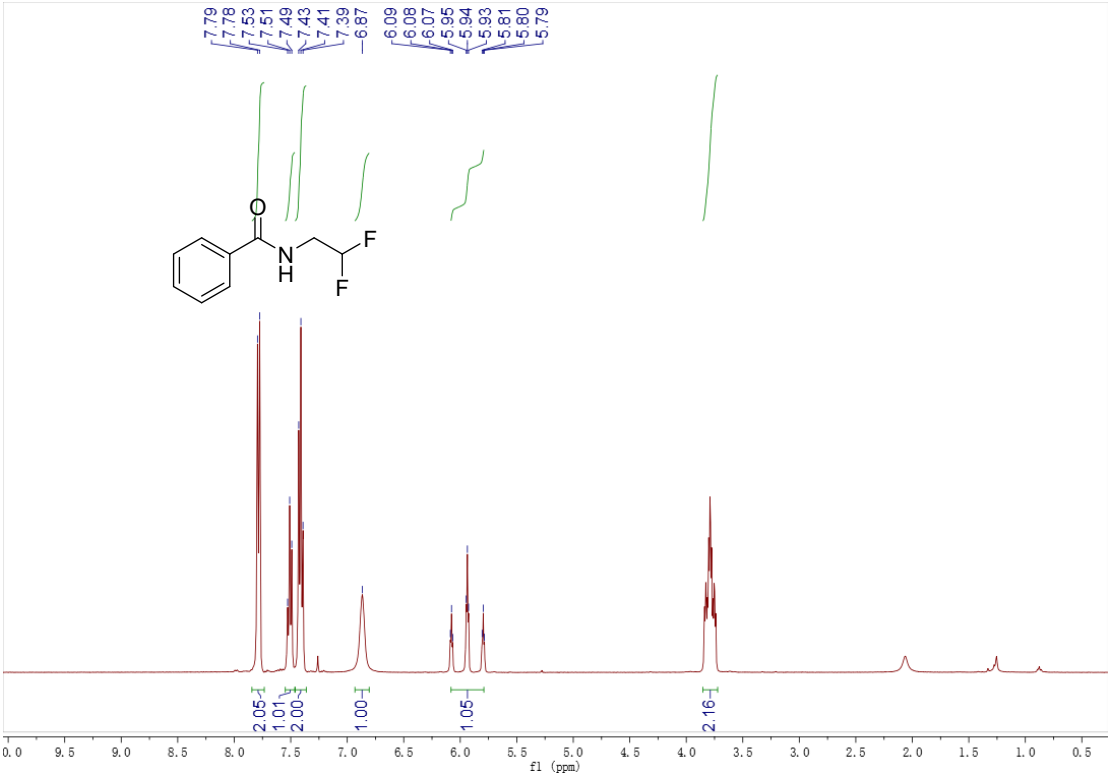
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3g**



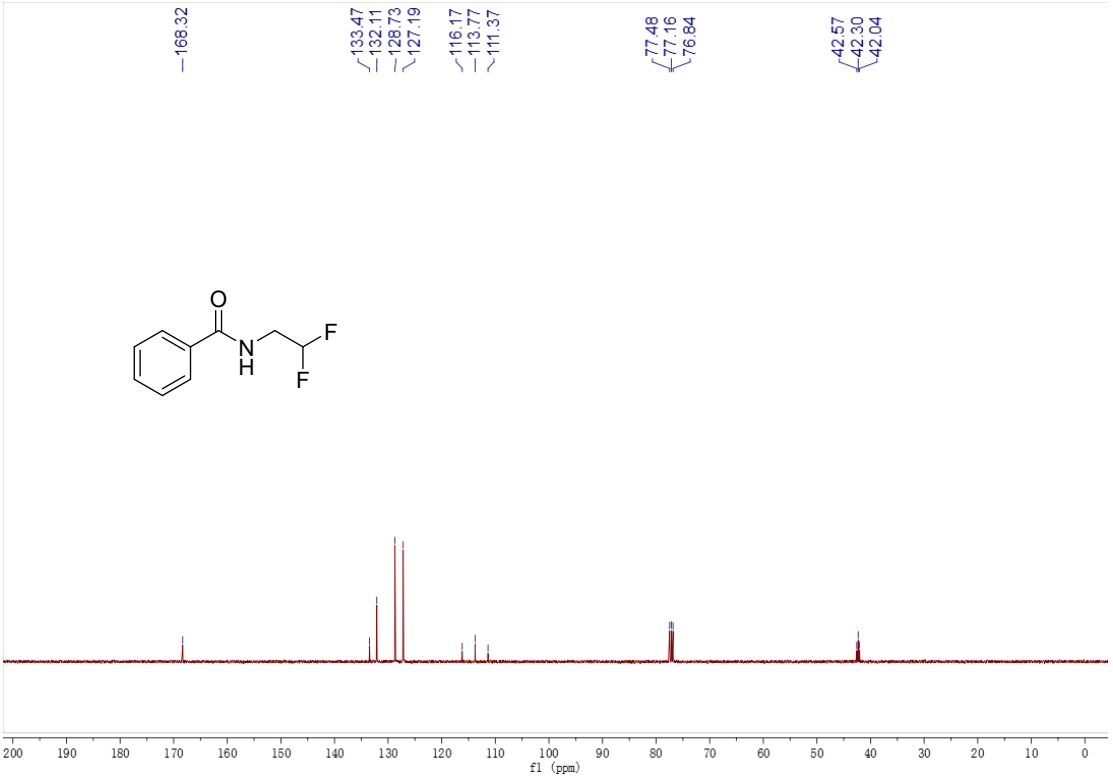
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3g**



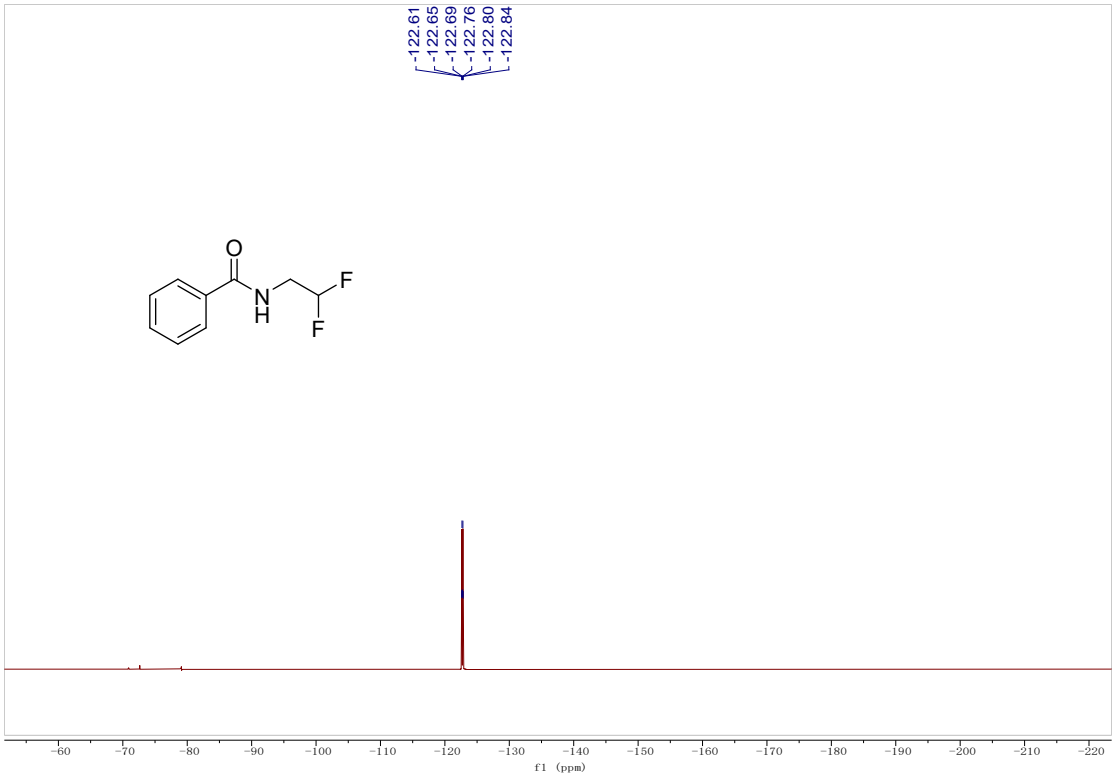
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3h**



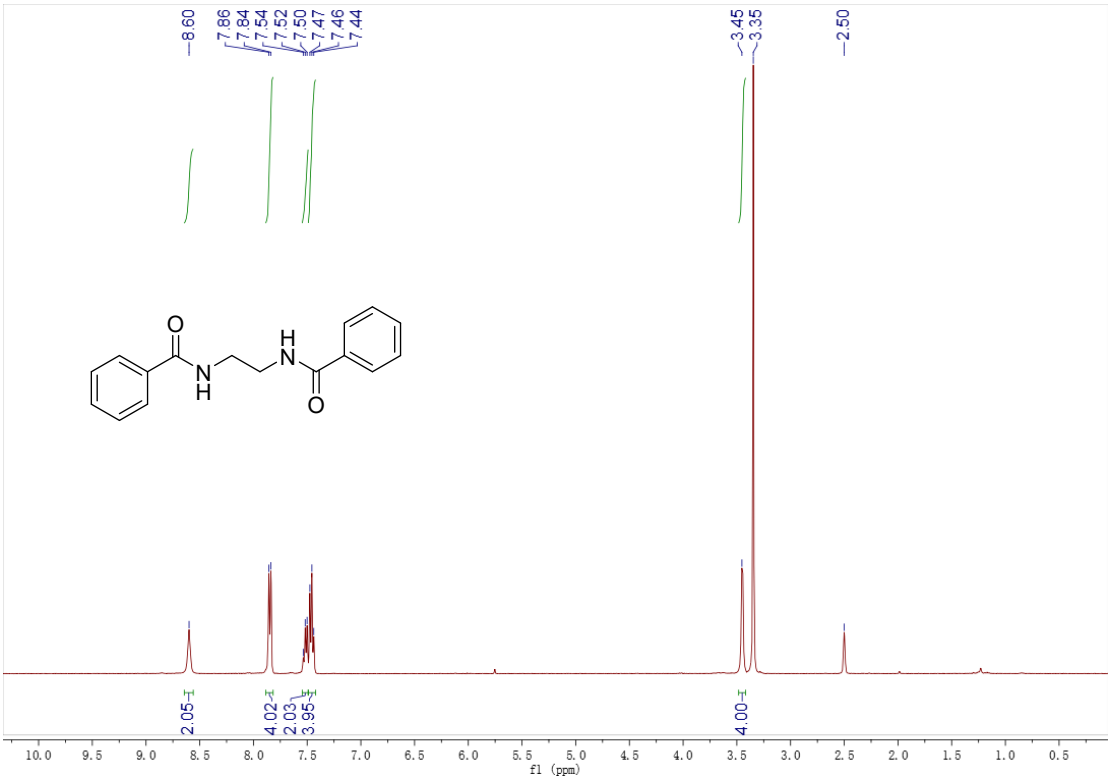
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3h**



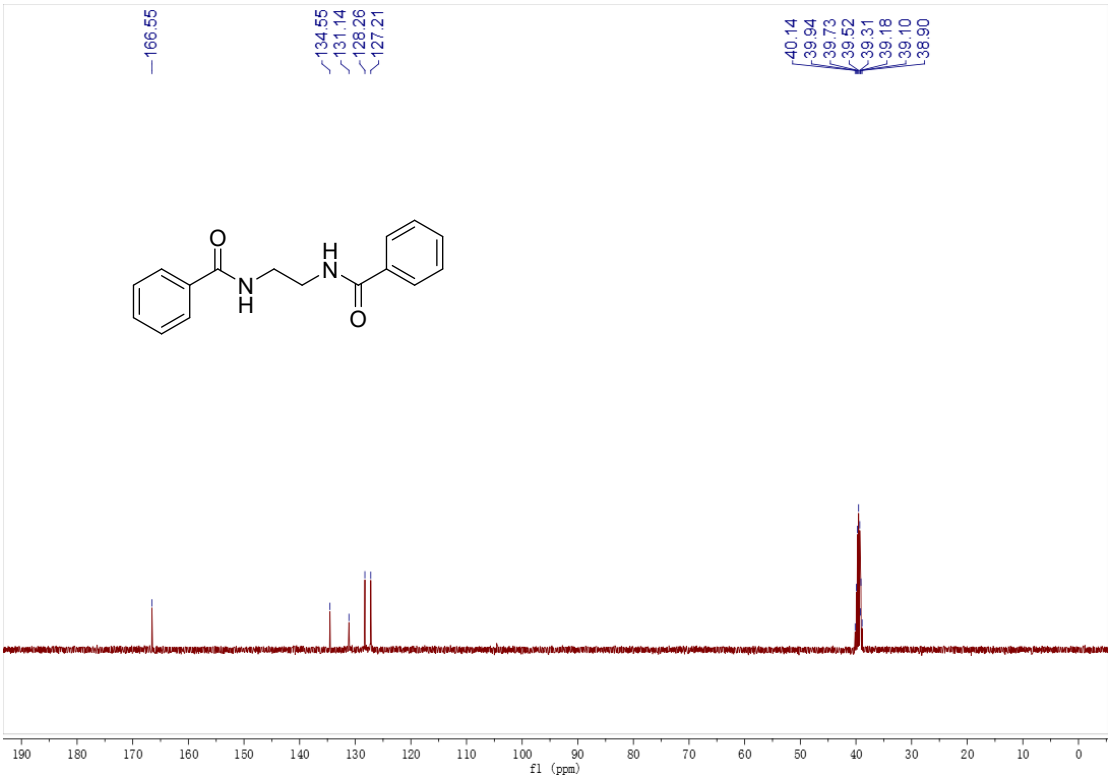
^{19}F NMR spectrum (376 MHz, $CDCl_3$) of compound **3h**



^{1}H NMR spectrum (400 MHz, DMSO-d6) of compound **3i**



^{13}C NMR spectrum (101 MHz, DMSO-d6) of compound **3i**



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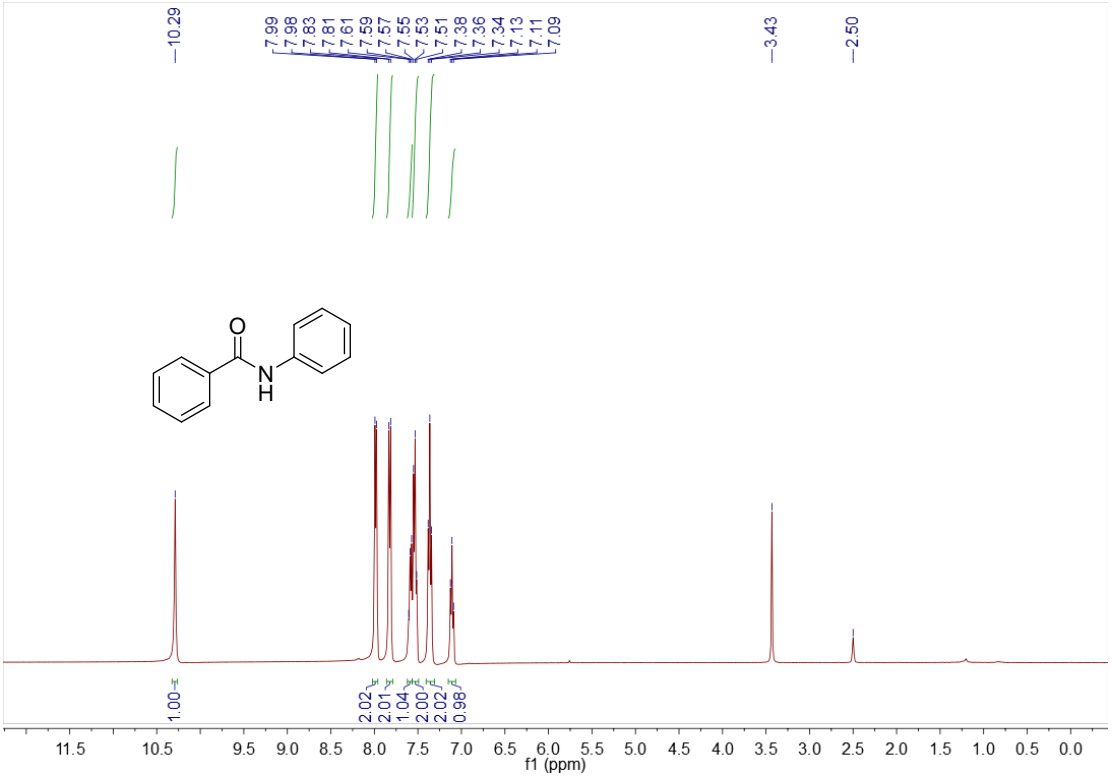
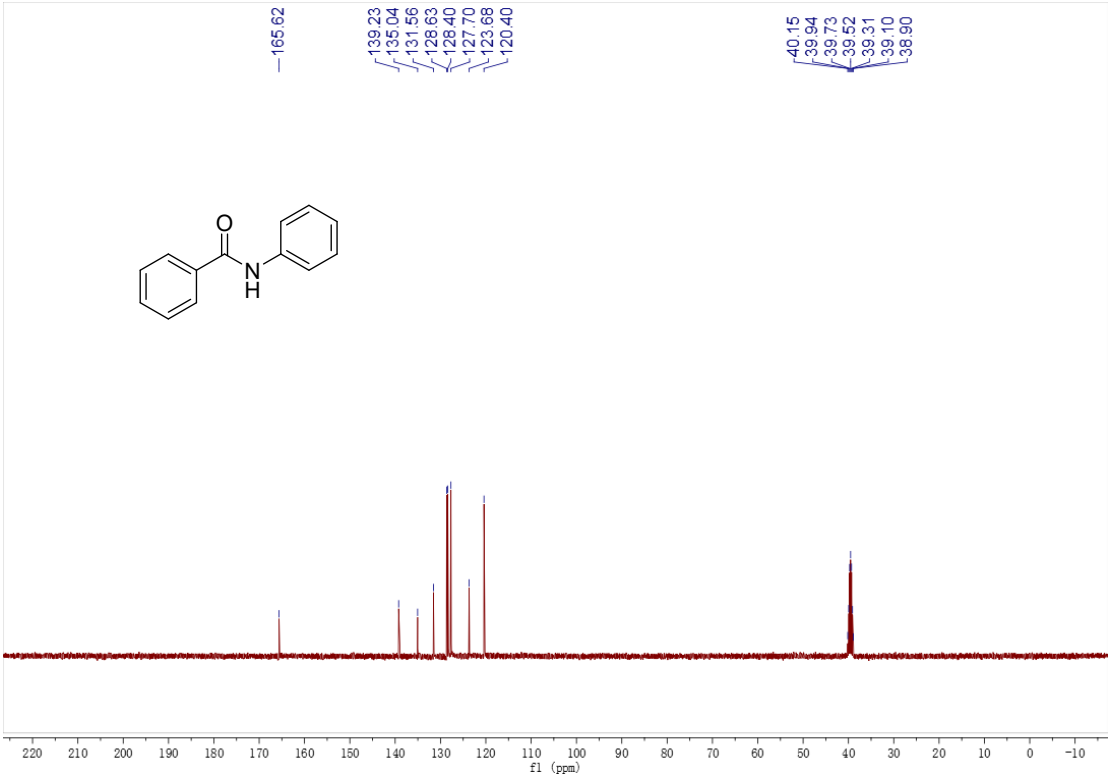
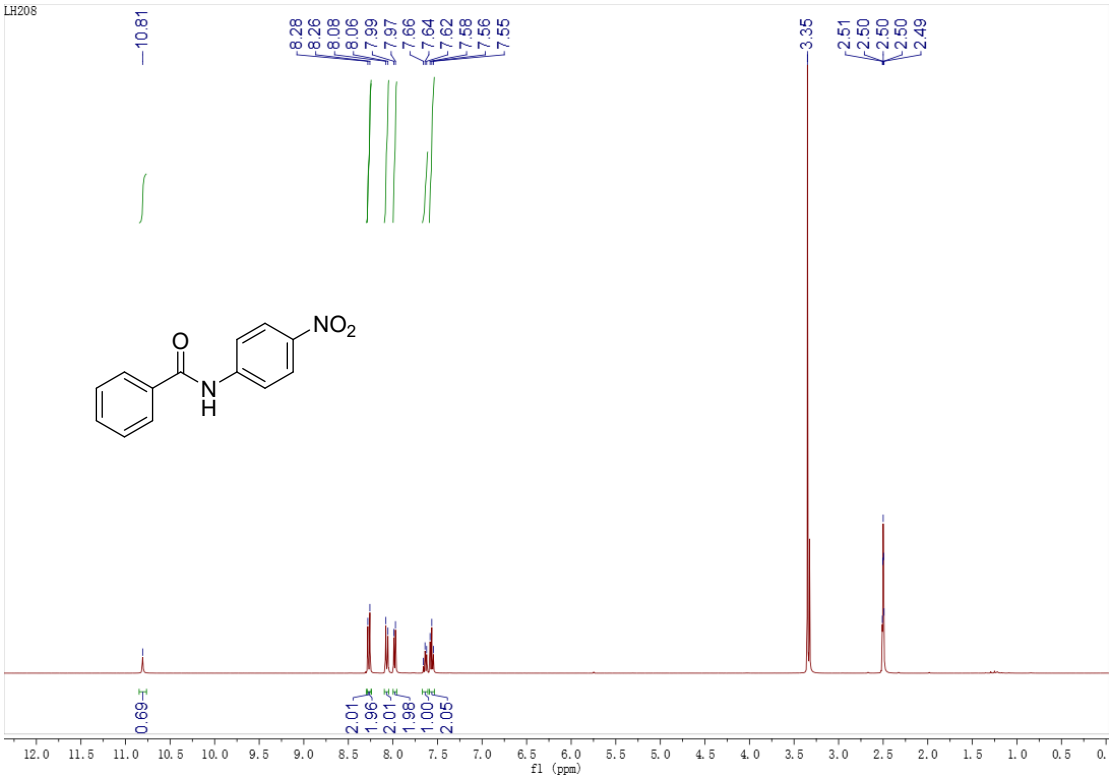


^{13}C NMR spectrum (101 MHz, DMSO-d6) of compound **3j**



^{1}H NMR spectrum (400 MHz, DMSO-d6) of compound **3k**



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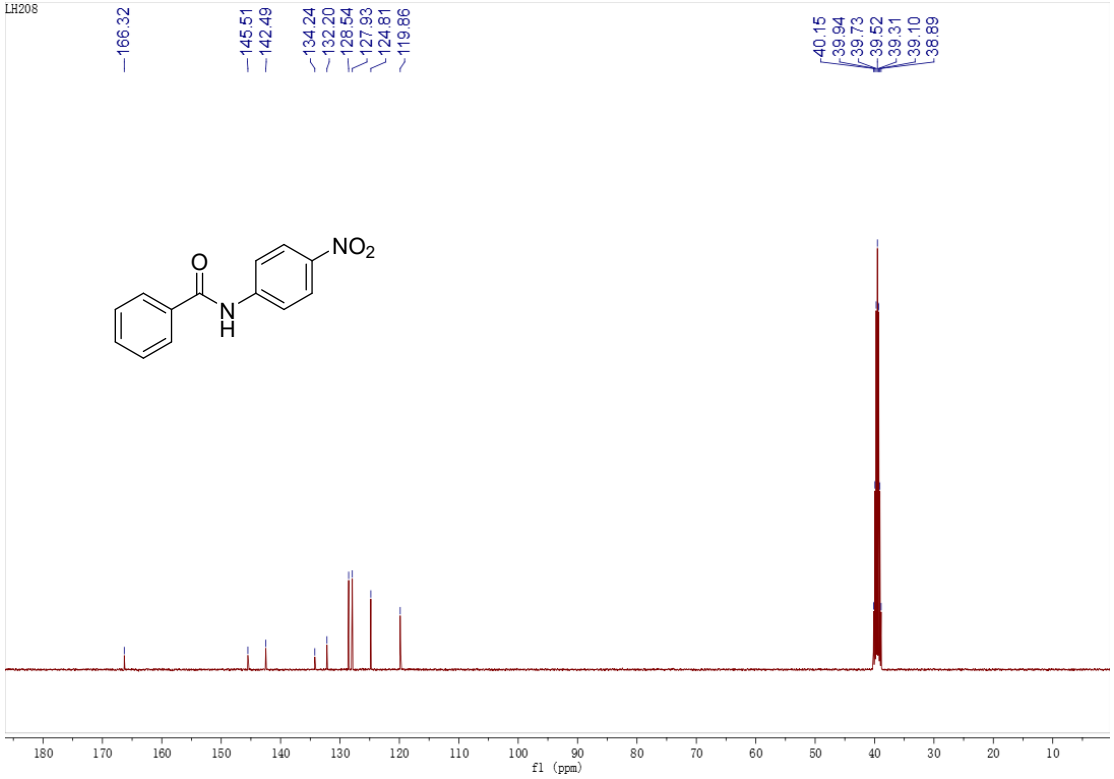
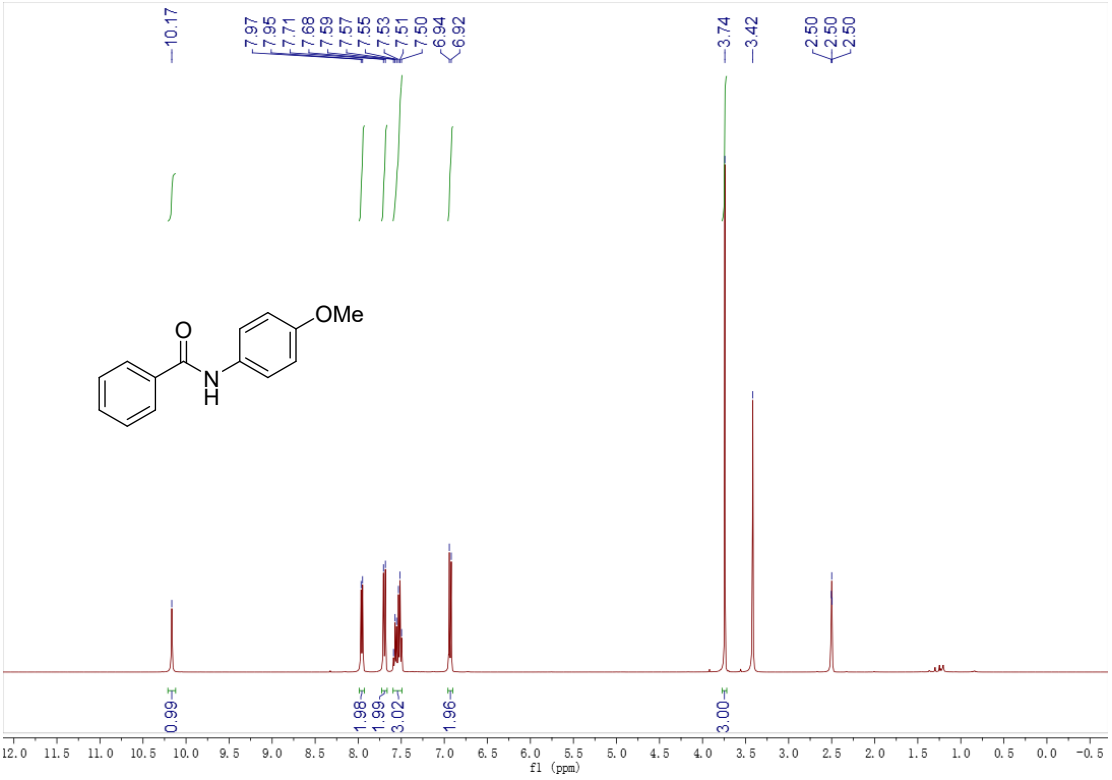
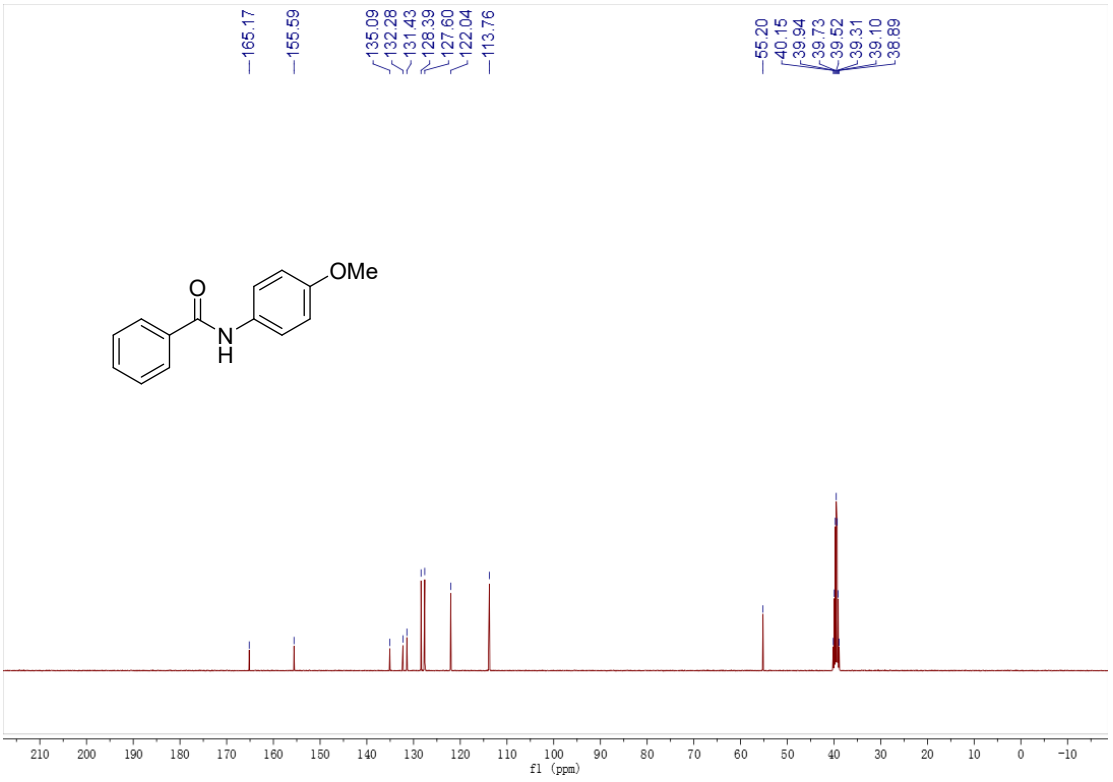


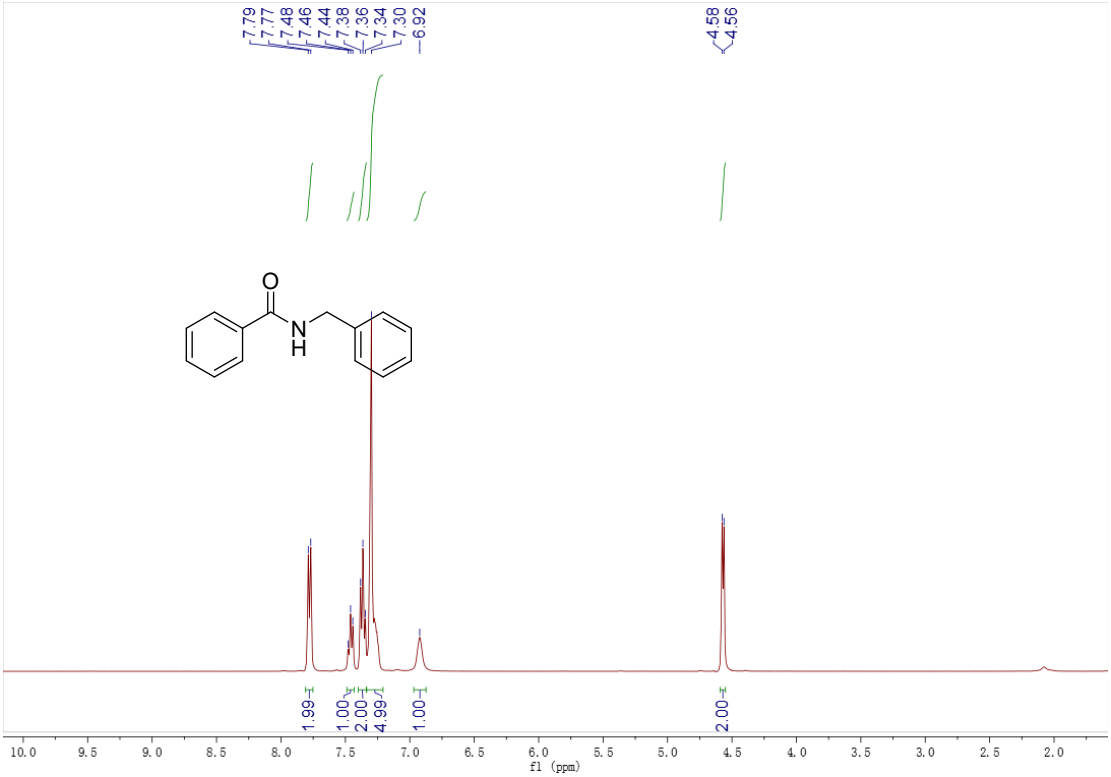
^{1}H NMR spectrum (400 MHz, DMSO-d6) of compound **3l**



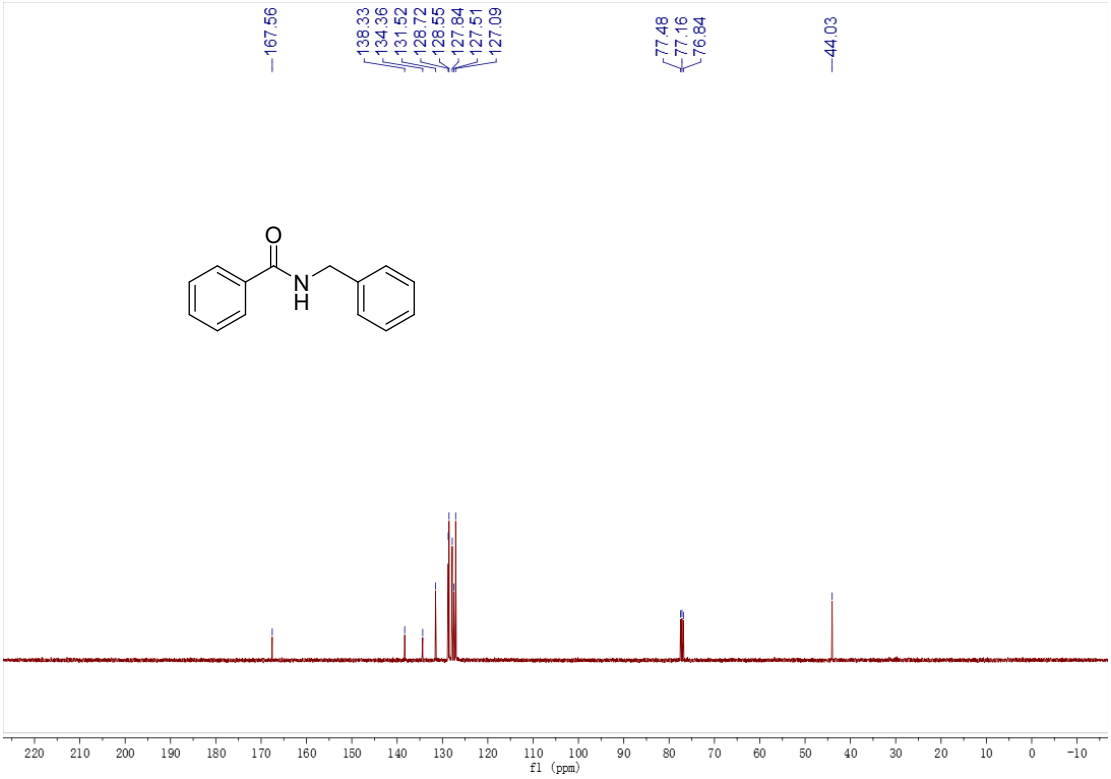
^{13}C NMR spectrum (101 MHz, DMSO-d6) of compound **3l**



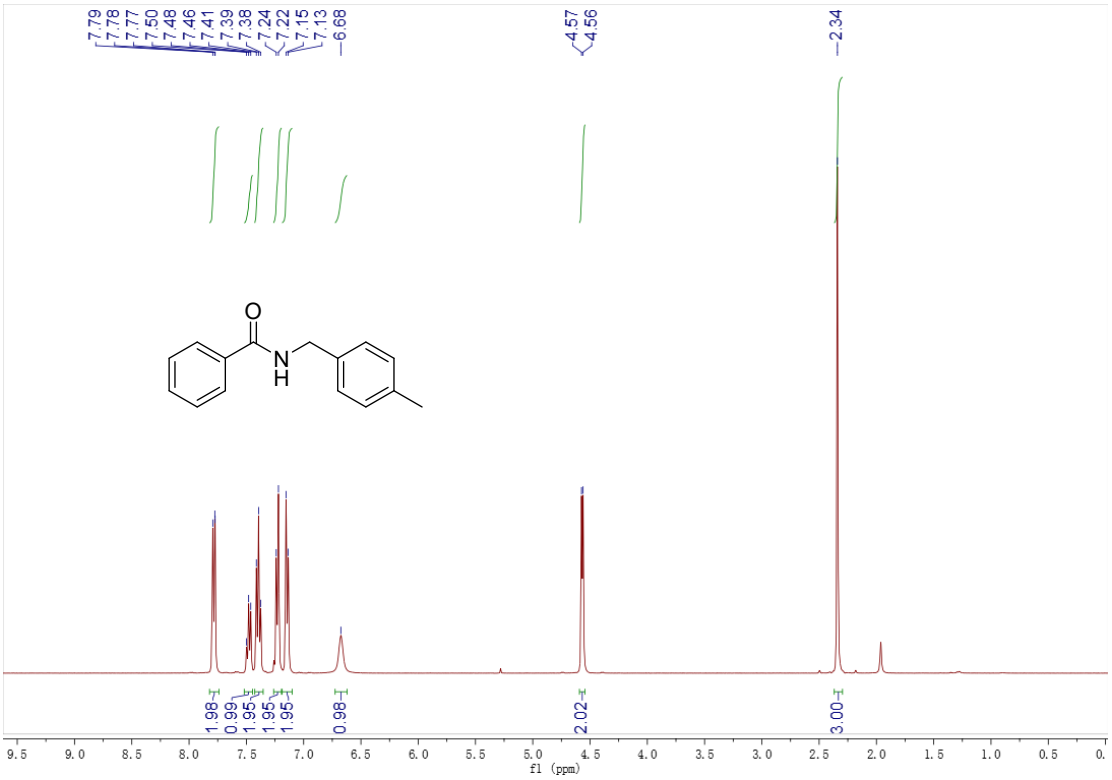
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3m**



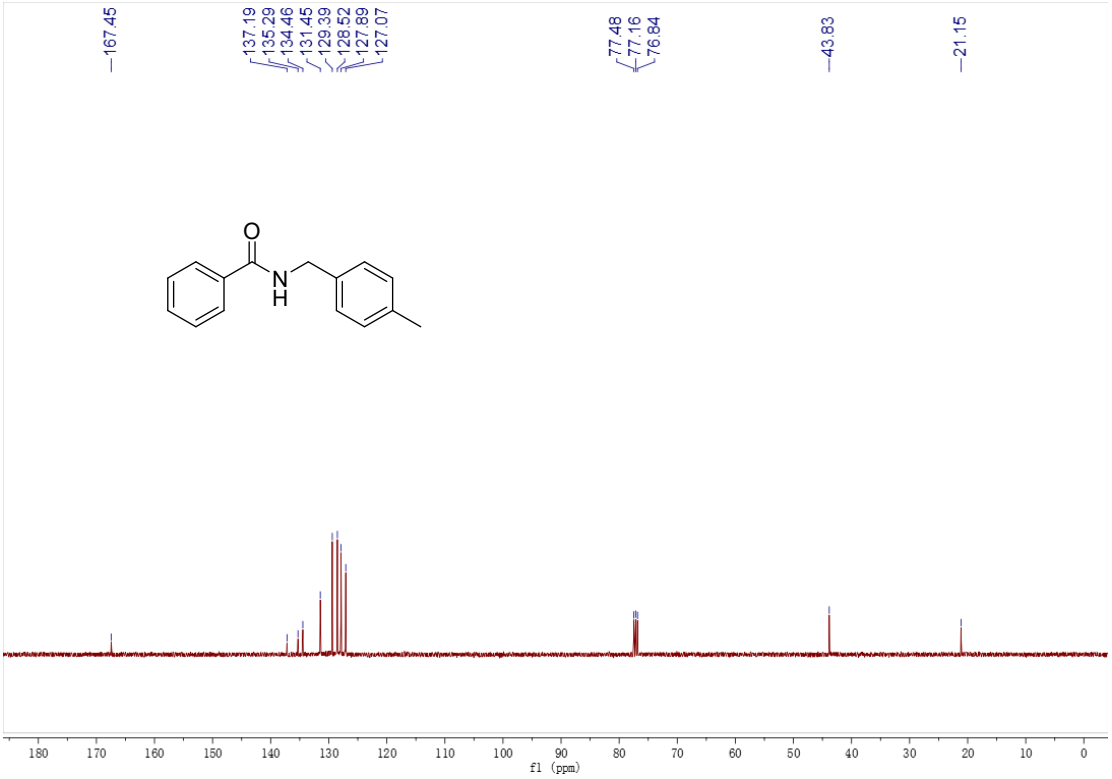
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3m**



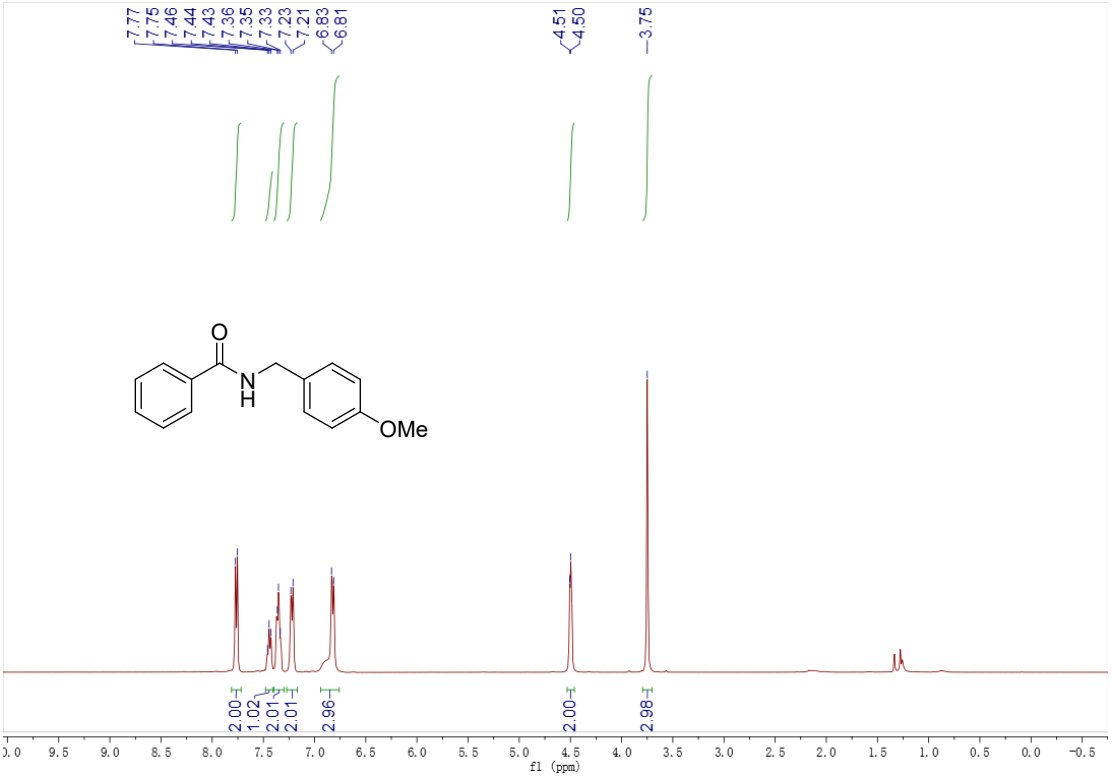
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3n**



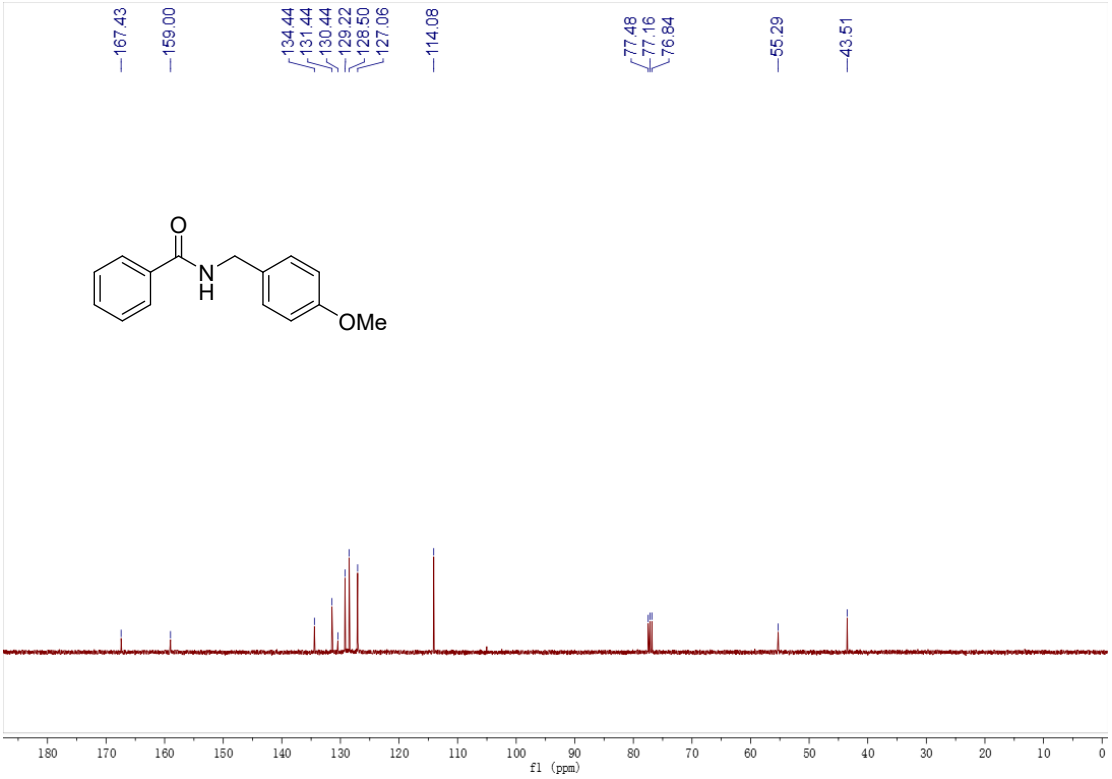
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3n**



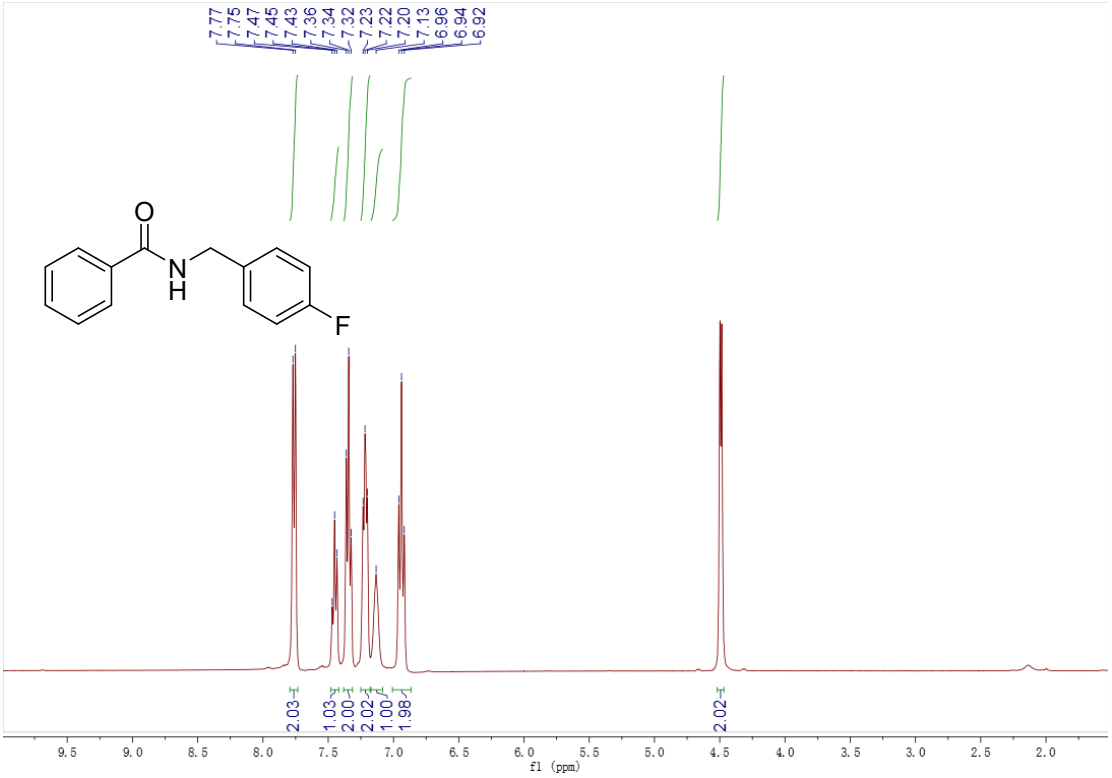
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3o**



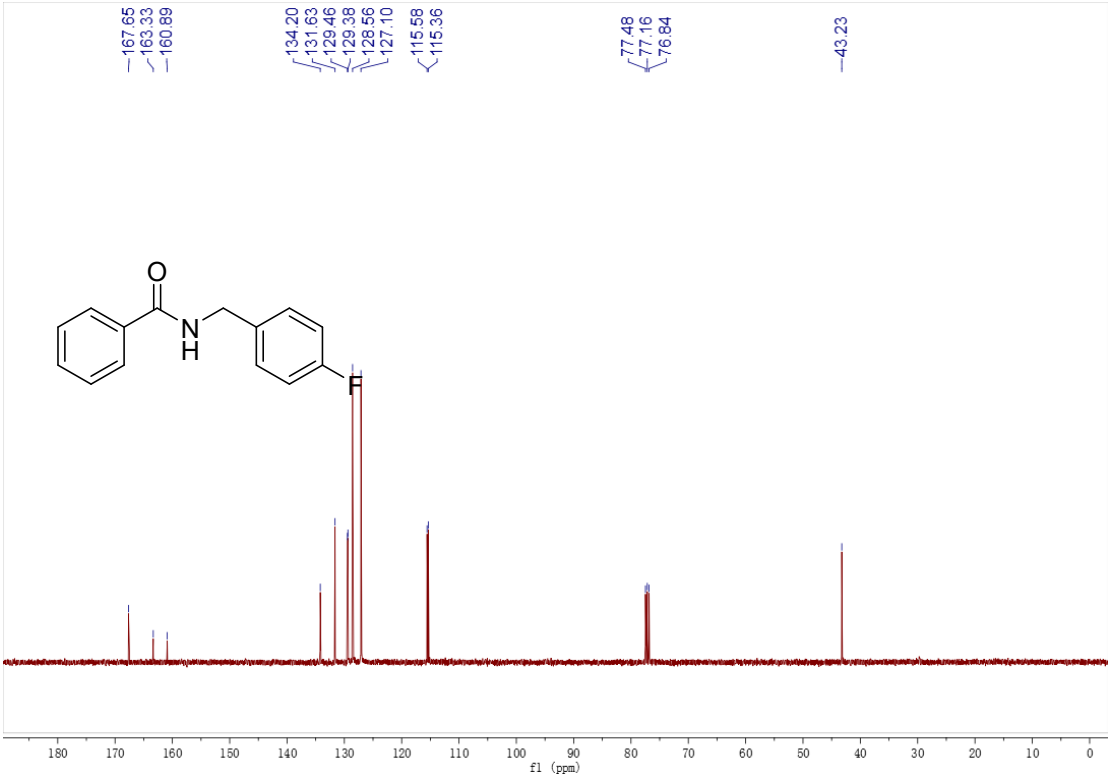
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3o**



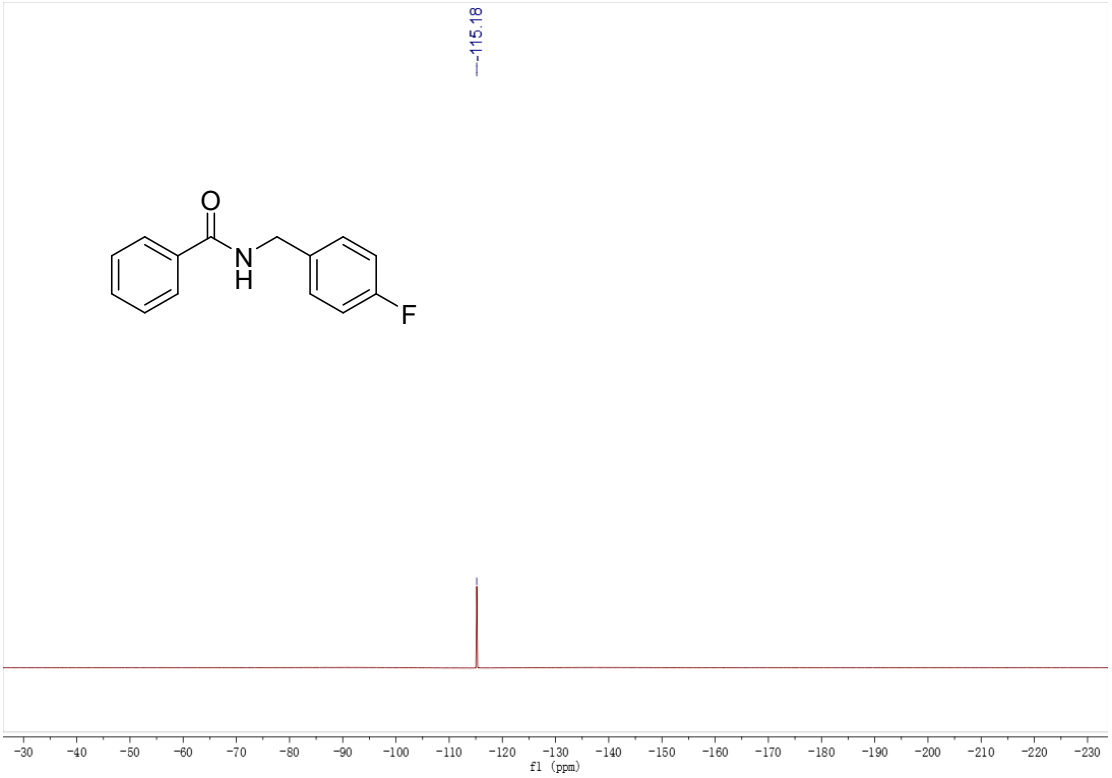
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3p**



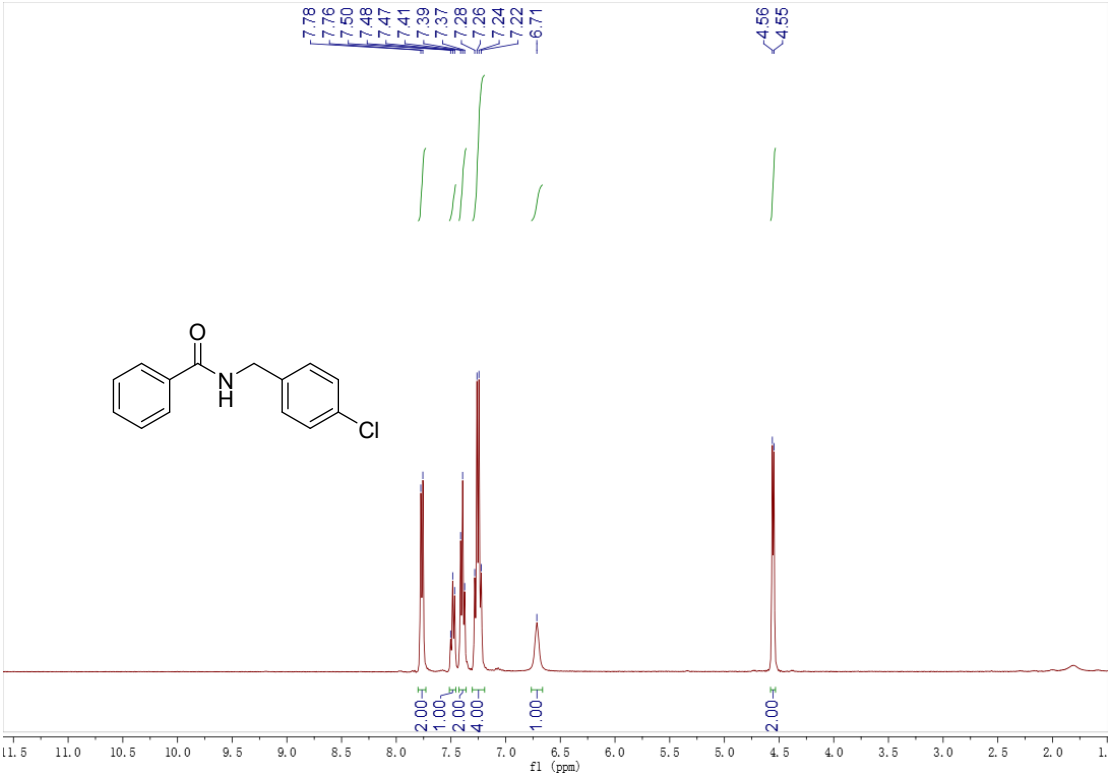
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3p**



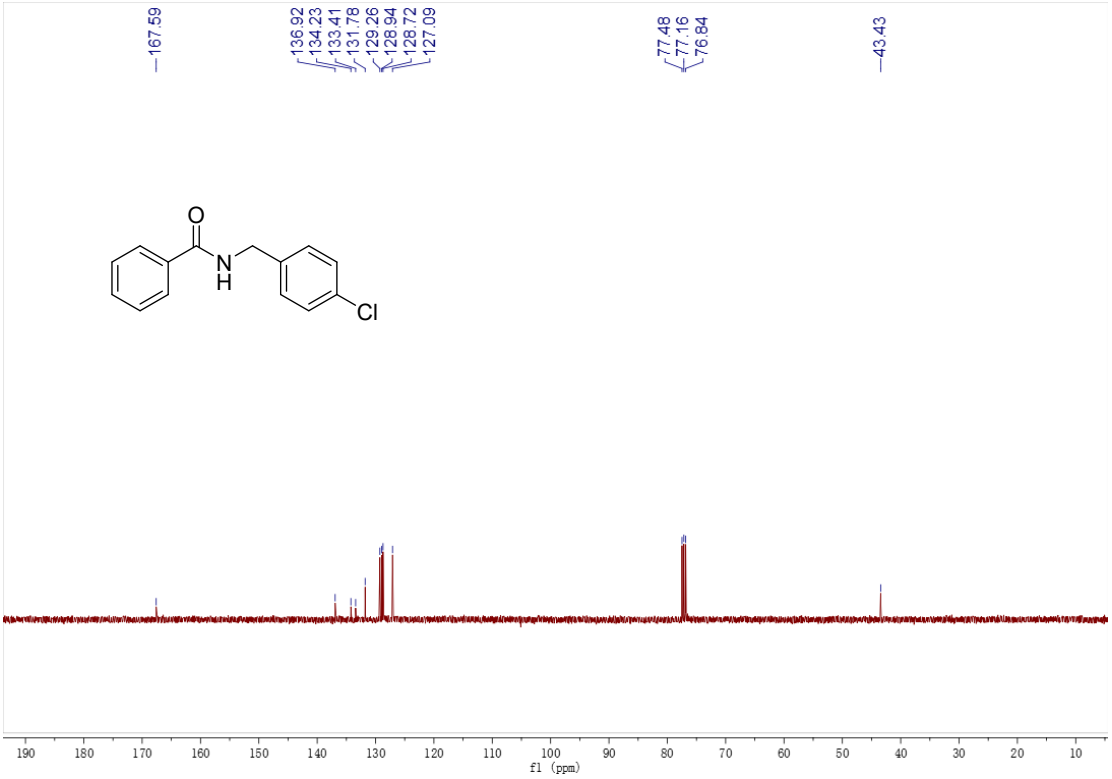
^{19}F NMR spectrum (376 MHz, $CDCl_3$) of compound **3p**



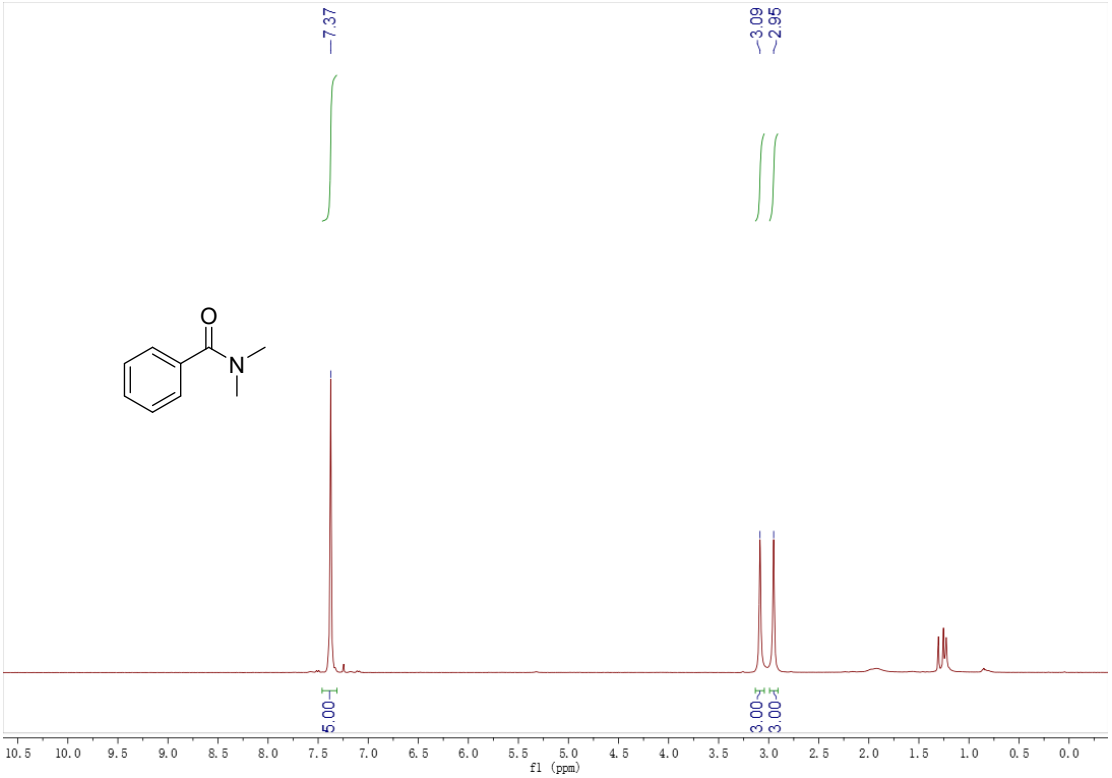
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3q**



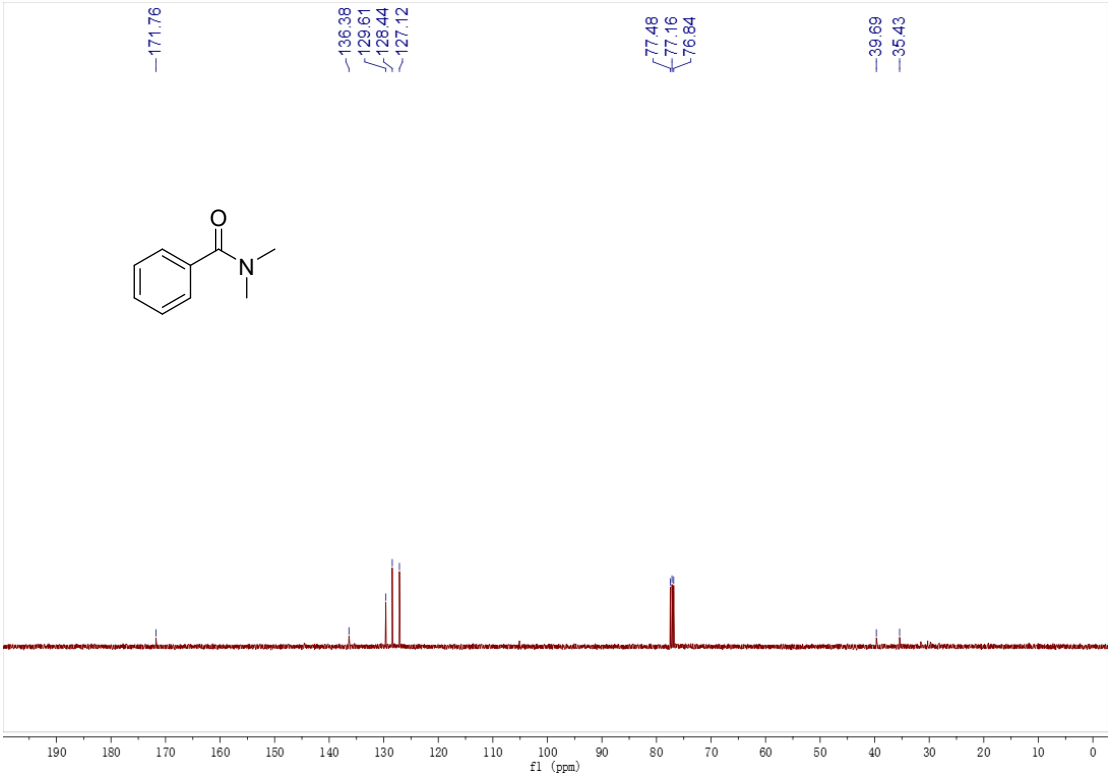
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3q**



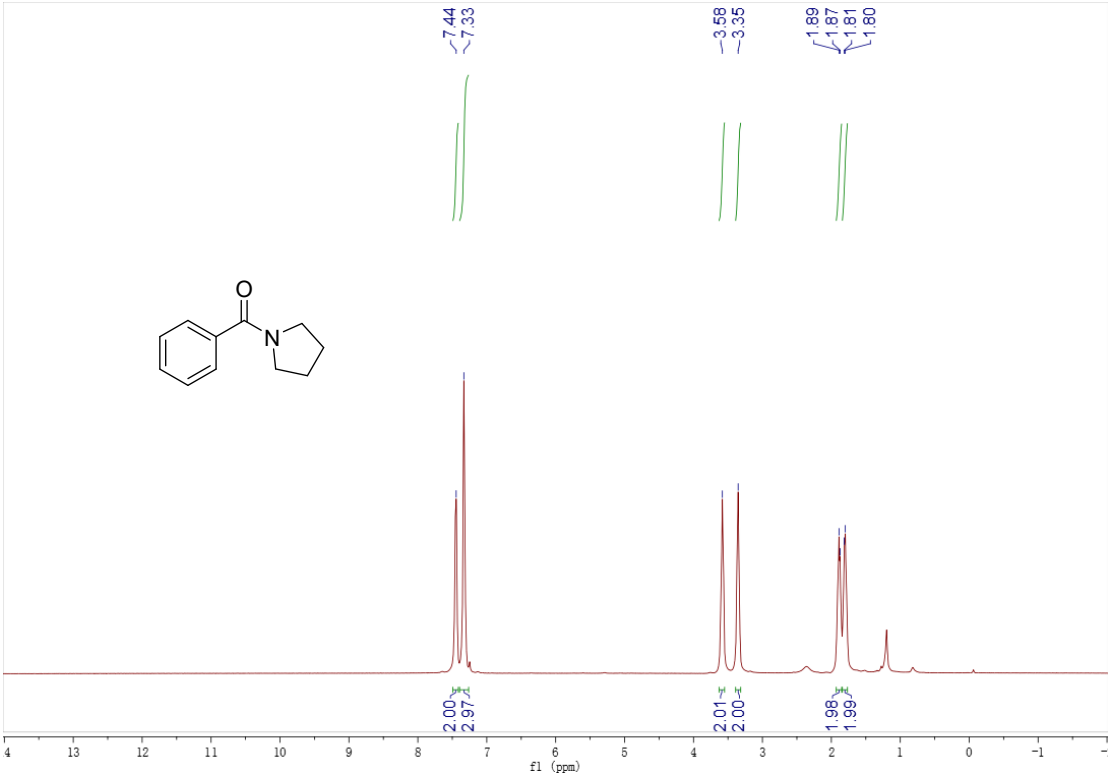
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3r**



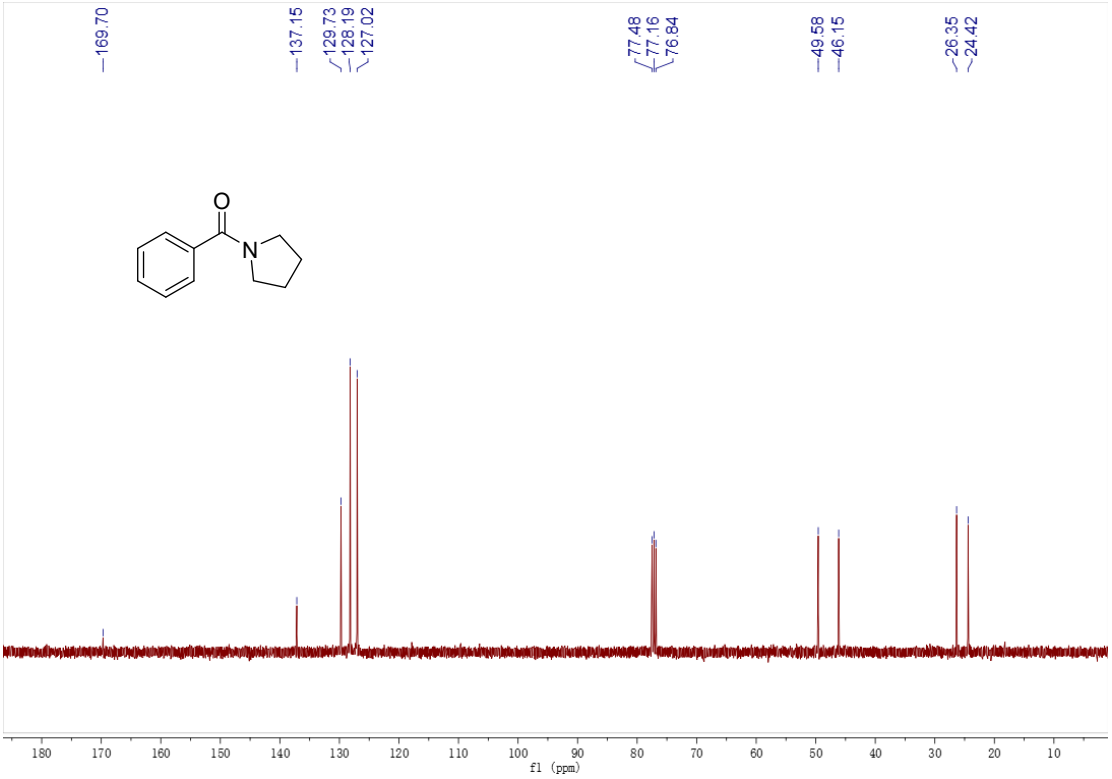
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3r**



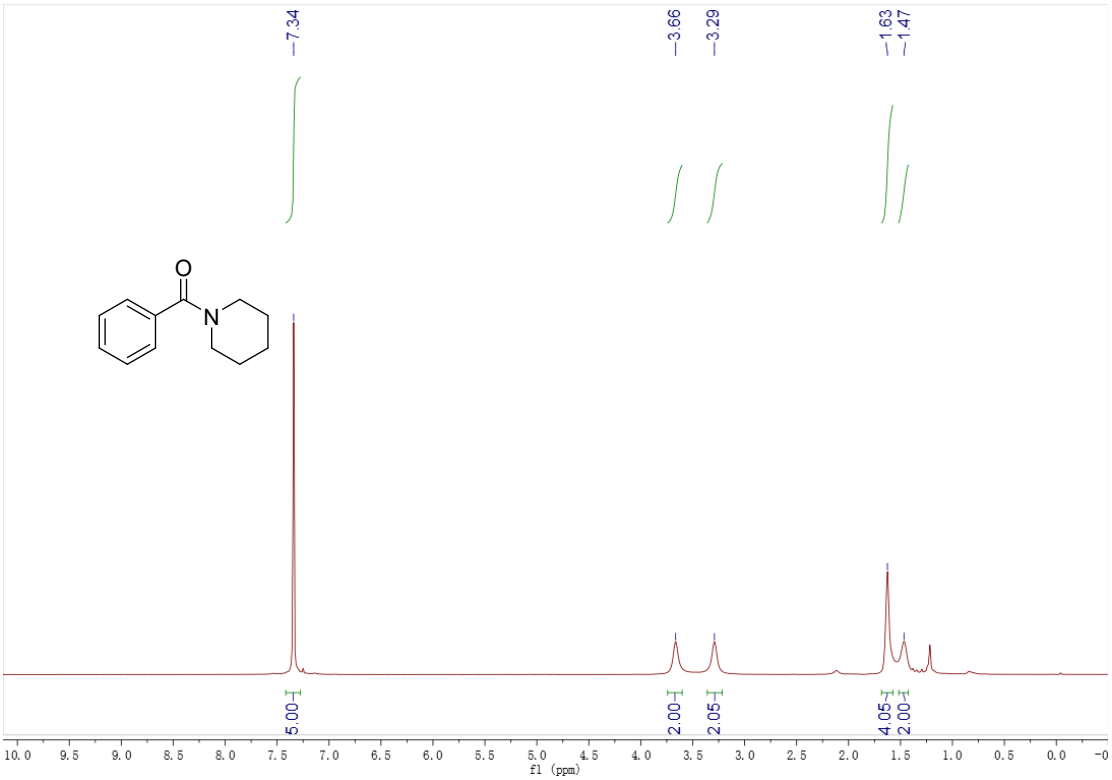
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3s**



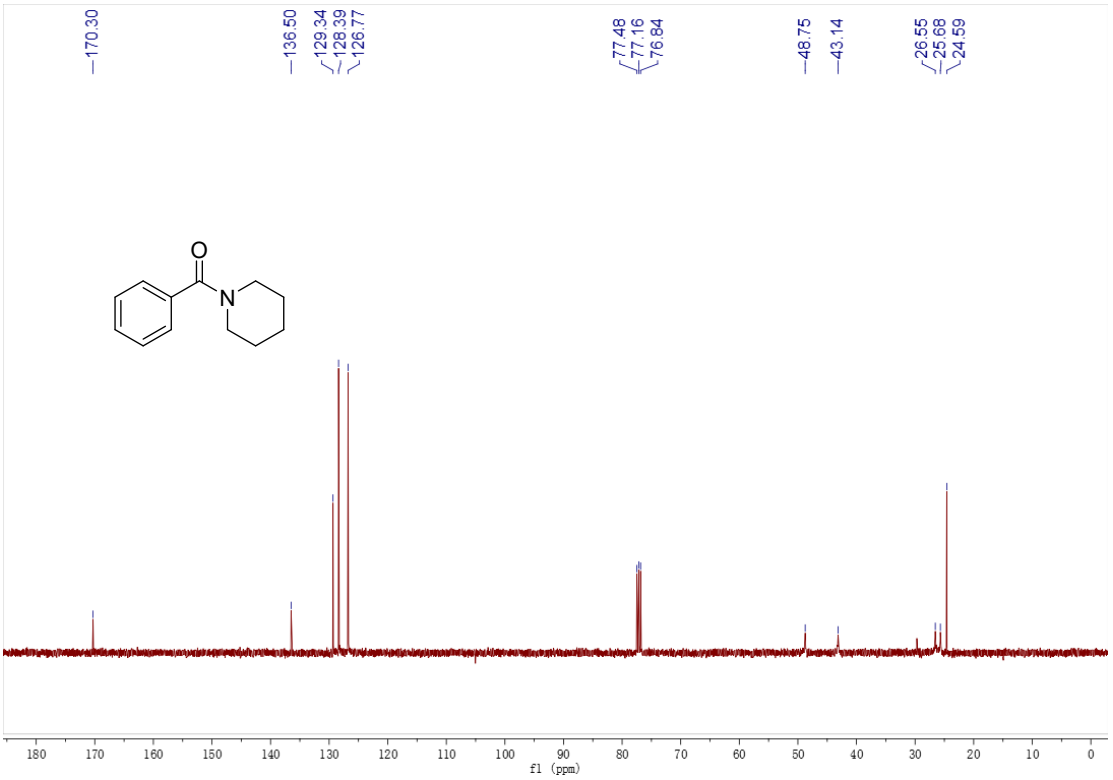
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3s**



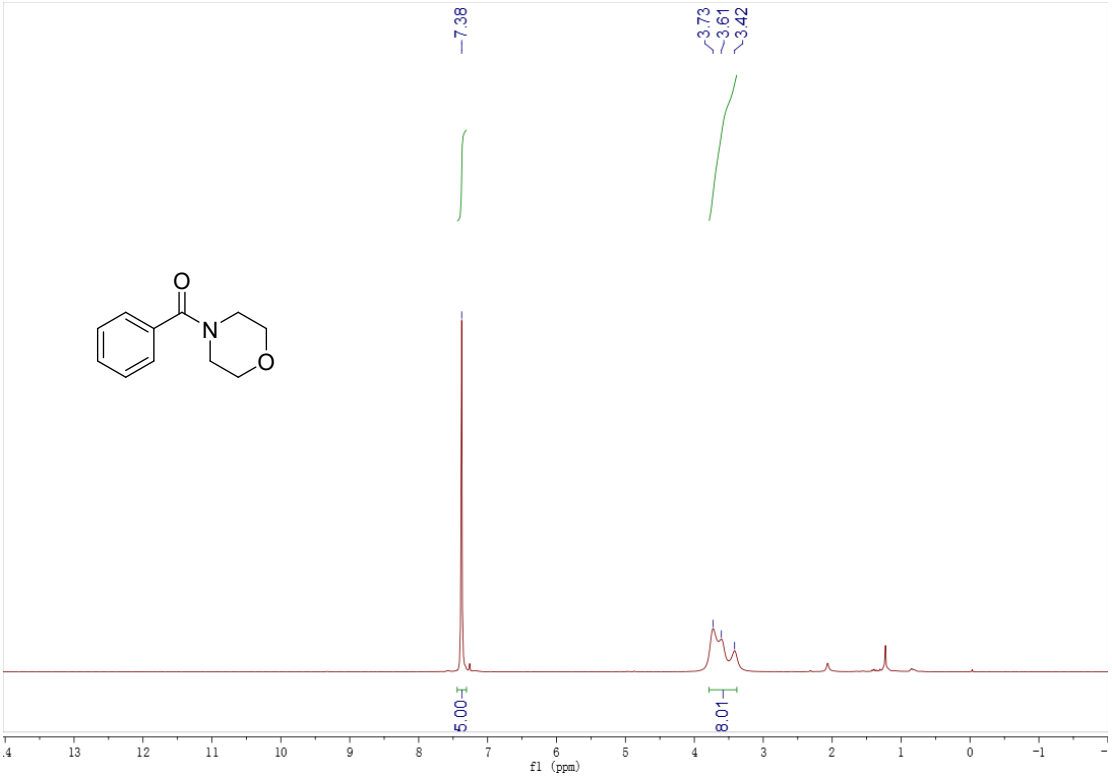
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3t**



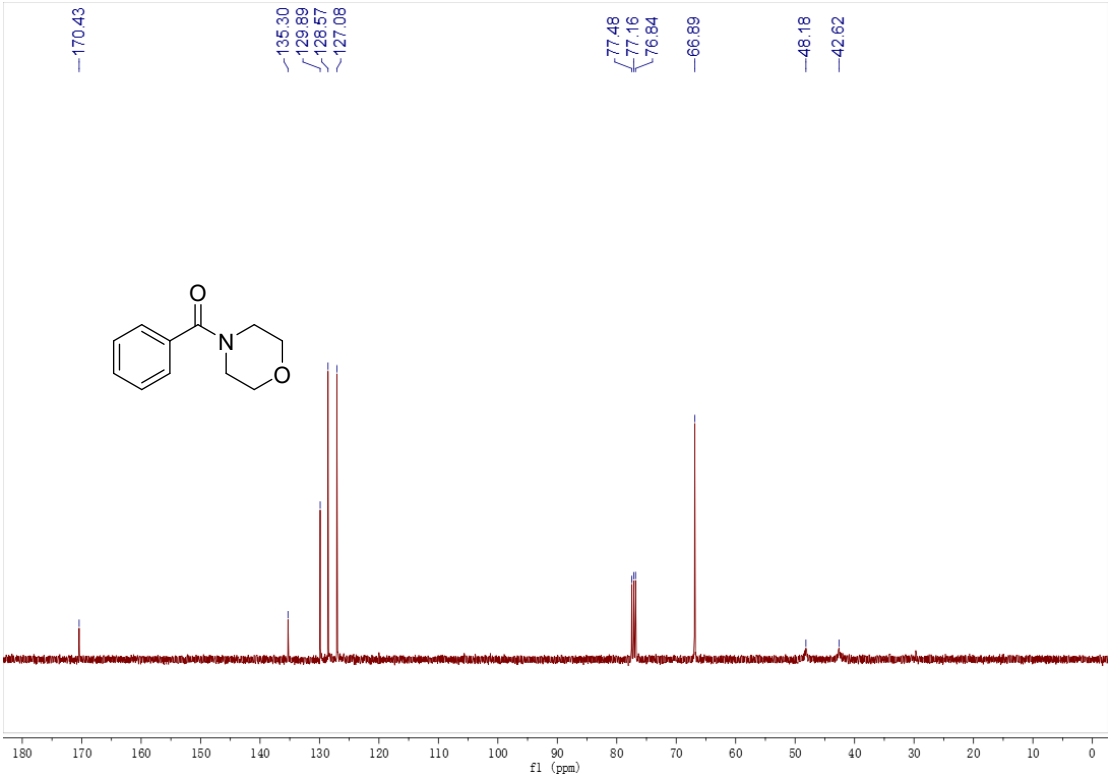
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3t**



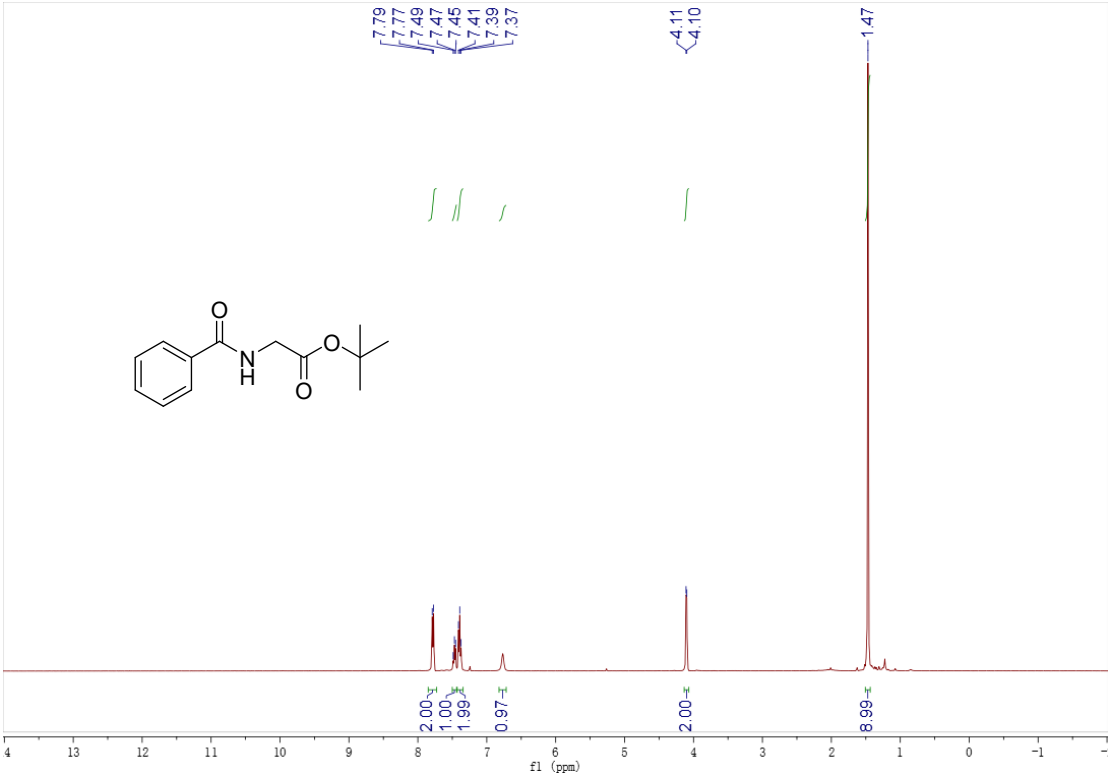
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3u**



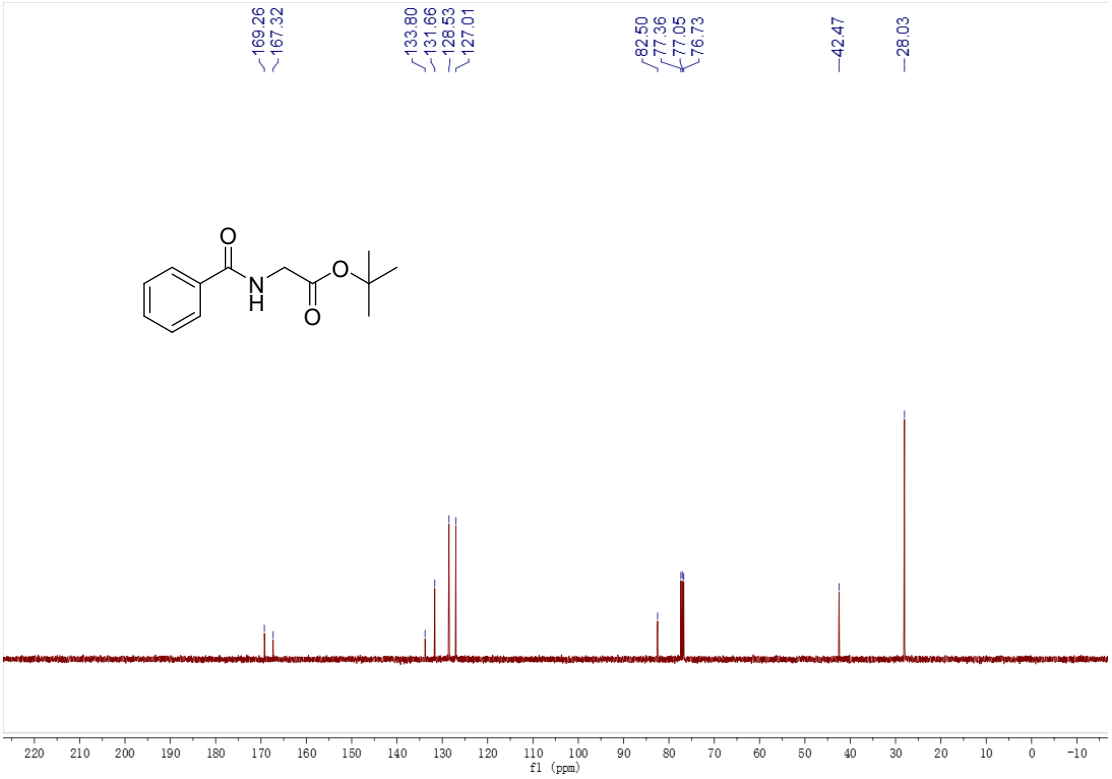
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3u**



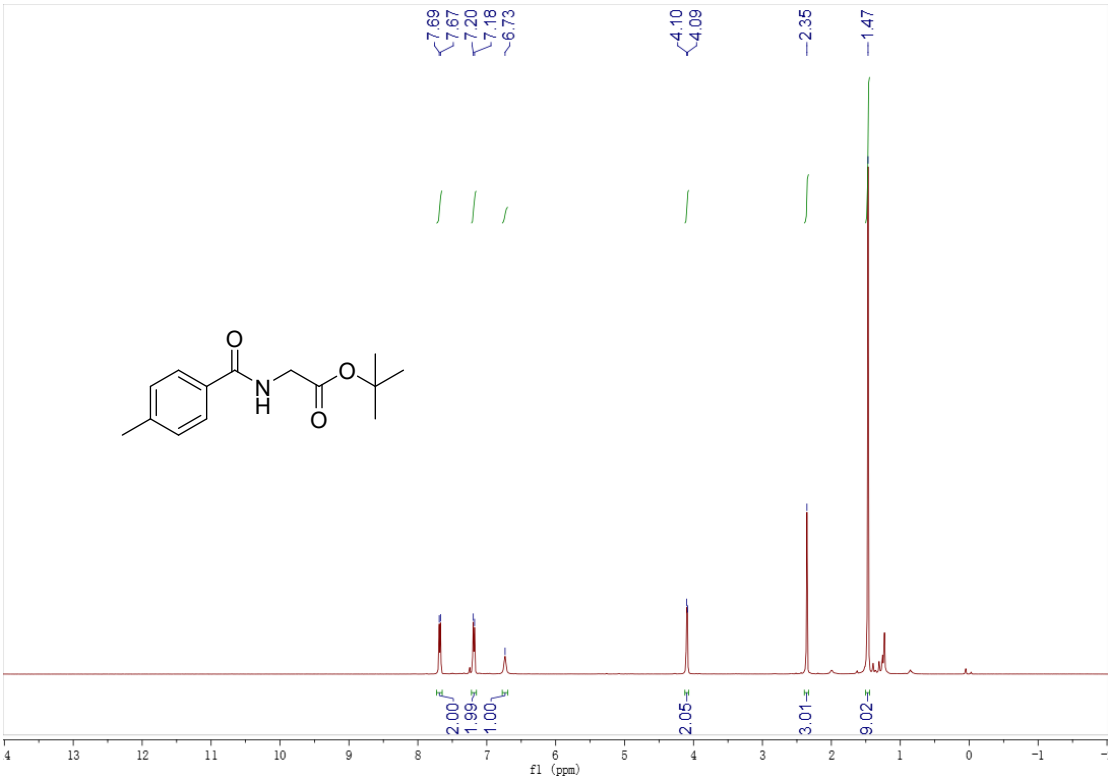
^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3v**



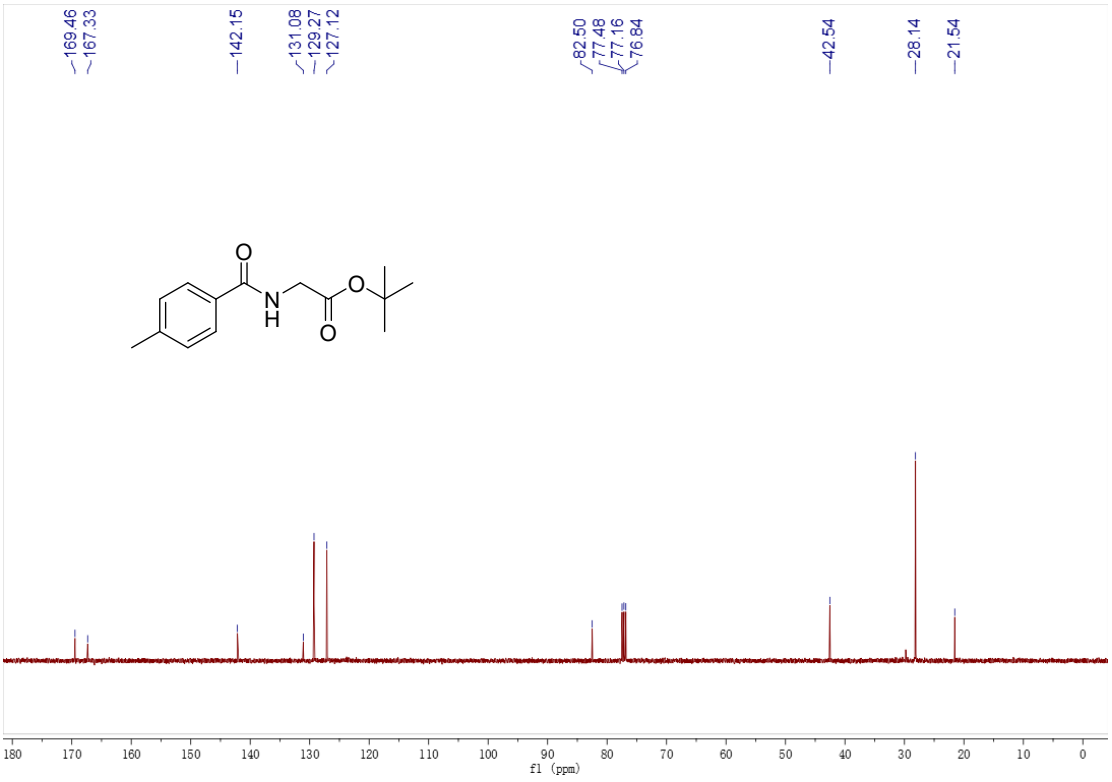
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3v**



^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3w**

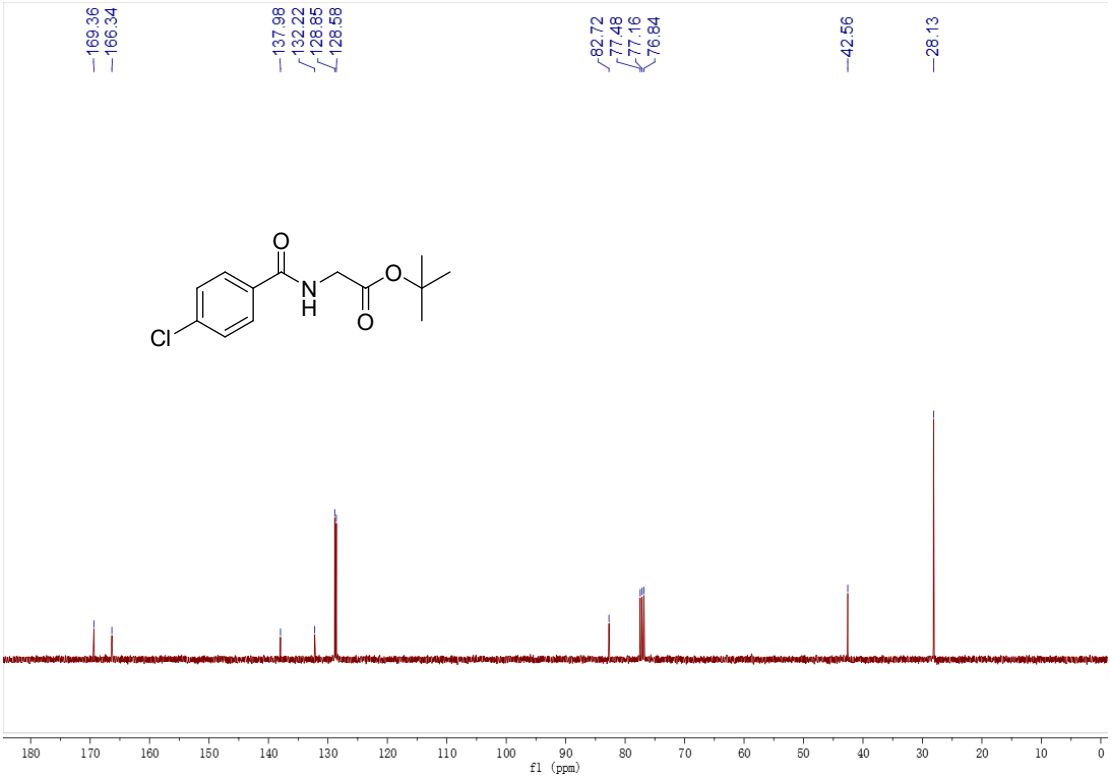


^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3w**

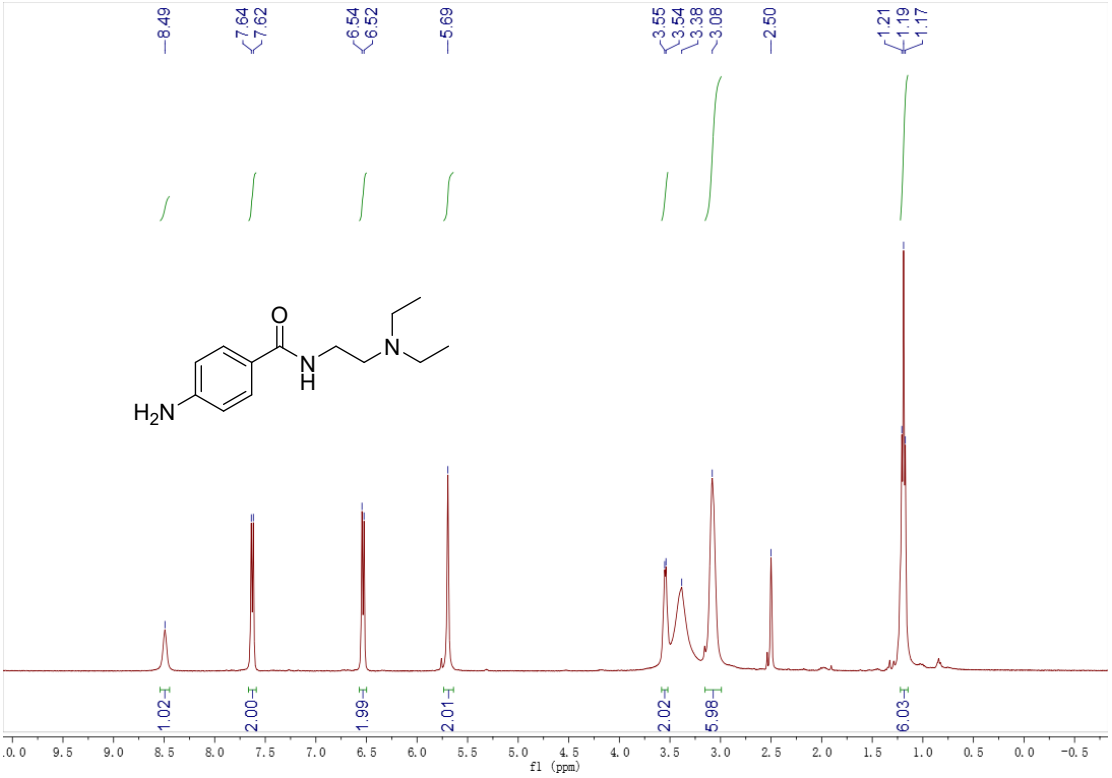


^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **3x**

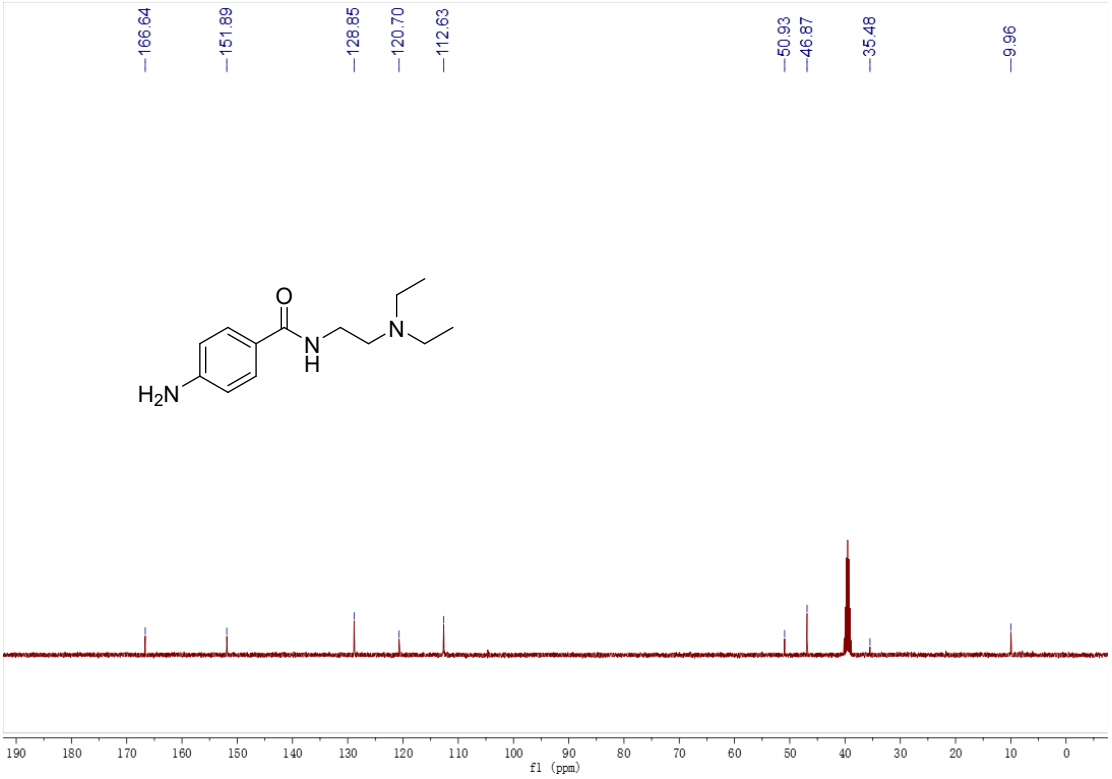
^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **3x**



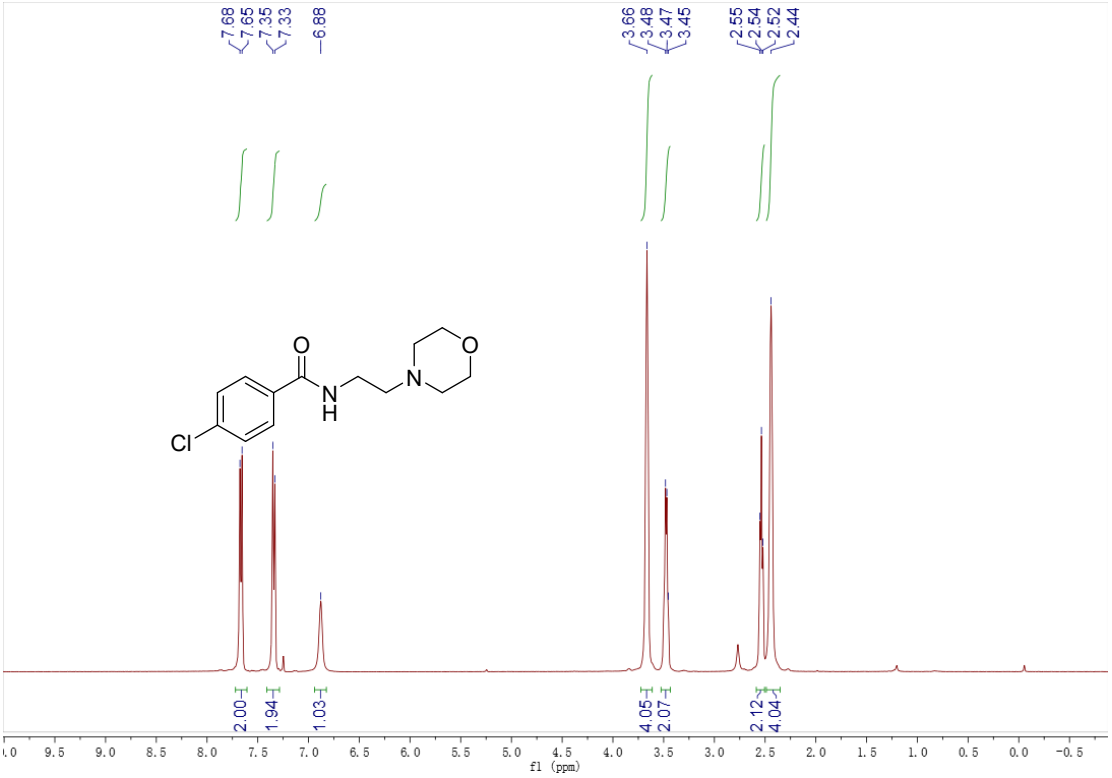
^{1}H NMR spectrum (400 MHz, DMSO-d6) of compound **4**



^{13}C NMR spectrum (101 MHz, DMSO-d6) of compound **4**



^{1}H NMR spectrum (400 MHz, $CDCl_3$) of compound **5**



^{13}C NMR spectrum (101 MHz, $CDCl_3$) of compound **5**