Electronic Supplementary Material (ESI) for Chemical Science.

Ruthenium-Catalysed Decarboxylative Unsymmetric Dual *ortho-/meta-* C-H Bond Functionalization of Arenecarboxylic Acids

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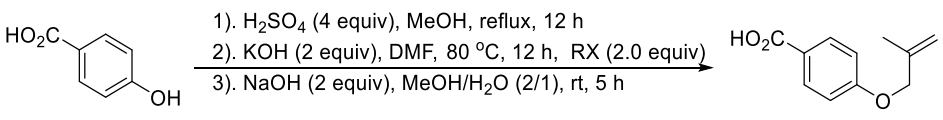
1. General information

Unless otherwise noted, all reactions were set up in oven-dried 4 mL vials sealed with PTFE lining caps under argon atmosphere using glovebox or standard Schlenk techniques. Commercially available chemicals were obtained from Energy Chemical, Aladdin, Adamas, Leyan, Meryer, Bidepharm, Acros Organics, Aldrich Chemical Co., Alfa Aesar and TCI and used as received unless otherwise stated. Anhydrous solvents were purchased from Energy Chemical and Adamas-beta® or processed using JCMEYER Solvent Drying System and used without any further purification. Reactions were monitored by thin layer chromatography (TLC) using analytic glass-silica gel plates. And the visualization of compounds was assisted with irradiation of UV light at 254 nm or staining using phosphomolybdic acid. Flash column chromatography was carried out on silica gel (300-400 mesh) eluting with petroleum ether/ethyl acetate. Gas chromatography (GC) analysis was performed on an Agilent 7890B system with FID detectors and HP-5 capillary column using nitrogen as carrier gas. Gas chromatography-mass analysis (GC-MS) analysis was performed on an Agilent 7890B GC system with an Agilent 5977B Mass Selective Detector (EI) and HP-5 capillary column using helium as carrier gas. High-resolution mass spectra (HRMS) were obtained with a Thermo Orbitrap Elite ESI-FTMS, and the corresponding molecular ion, such as $[M+H]^+$ were given in m/z units. Nuclear magnetic resonance spectra, including ^{1}H-NMR, ^{13}C-NMR, and ^{19}F-NMR spectra, were obtained on Bruker 600 MHz or JNM-ECZ 400 spectrometers. The spectra are calibrated to the residual ^{1}H and ^{13}C signals of the solvents. The ^{1}H-NMR chemical shifts were recorded relative to chloroform-*d* or DMSO-d_6 as the internal reference (chloroform-*d*: δ = 7.26 ppm, DMSO-d_6: δ = 2.50 ppm, 3.30 ppm), and the ^{1}H-NMR data were reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quadruplet, m = multiplet and br = broad), coupling constants (*J values* in Hz) and integration. The ^{13}C NMR chemical shifts were recorded using chloroform-*d* as the internal reference (chloroform-*d*: δ = 77.00 ppm, DMSO-d_6: δ = 39.52 ppm).

2. Synthesis of substrates

Procedure A[1]

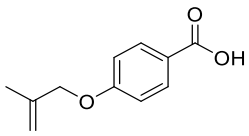


Step 1: To a mixture of substituted *p*-hydroxy benzoic acid (1 equiv) in methanol (0.1 M) was added concentrated sulfuric acid (4 equiv) and the reaction mixture was refluxed for 12 hours, cooled to room temperature and poured into 10% aqueous solution of sodium bicarbonate. The product was extracted using ethyl acetate, and the extract was washed with brine, dried over anhydrous sodium sulfate. The solvent was removed under reduced pressure and the residue was used in next step without further purification.

Step 2: To the solution of the obtained methyl 4-hydroxybenzoate (1.0 equiv) in N,N-dimethylformaldehyde (0.1 M) was added potassium hydroxide (4 equiv), allyl halide (1.5 equiv) under vigorous stirring. The resulted mixture was stirred for 10 hours at 80℃. After completion, the reaction mixture was filtered and diluted with ethyl acetate, and washed with water and brine. The organic layer was dried over anhydrous sodium sulfate, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel (petroleum ether/ethyl acetate, v/v, 10/1) to afford the desired product.

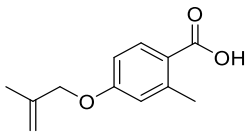
Step 3: The obtained product was dissolved in methanol/water (v/v, 2:1), and sodium hydroxide (2 equiv) was added. After stirring for about 5 hours at room temperature, the solvent was then evaporated and the resulted residue was redissolved in water. The aqueous solution was acidified slowly using diluted hydrochloric acid. After stirring for 30 minutes, the crystalline precipitate was filtered, washed with water and dried in vacuo to give corresponding product.

4-((2-methylallyl)oxy)benzoic acid



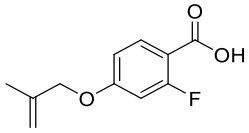
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.09 – 8.03 (m, 2H), 6.99 – 6.94 (m, 2H), 5.10 (s, 1H), 5.02 (s, 1H), 4.51 (s, 2H), 1.84 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.0, 163.4, 140.2, 132.5, 121.9, 114.6, 113.4, 72.0, 19.5. HRMS (ESI) Calcd for $C_{11}H_{12}O_3$ $[M+H]^+$: 193.0859, found 193.0863.The spectra data are consistent with the reported values[2].

2-methyl-4-((2-methylallyl)oxy)benzoic acid



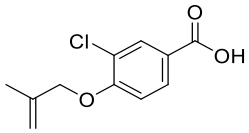
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.09 – 8.05 (m, 1H), 6.80 – 6.77 (m, 2H), 5.10 (s, 1H), 5.01 (s, 1H), 4.48 (s, 2H), 2.65 (s, 3H), 1.84 (s, 3H).^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.1, 162.4, 144.4, 140.4, 134.2, 120.8, 118.1, 113.3, 111.9, 71.8, 22.9, 19.5. HRMS (ESI) Calcd for $C_{12}H_{14}O_3$ $[M+H]^+$: 207.1015, found 207.1017.

2-fluoro-4-((2-methylallyl)oxy)benzoic acid



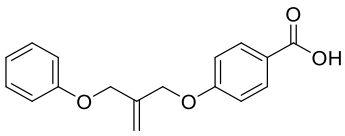
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.98 (t, *J* = 8.7 Hz, 1H), 6.77 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.68 (dd, *J* = 12.7, 2.3 Hz, 1H), 5.09 (s, 1H), 5.03 (s, 1H), 4.49 (s, 2H), 1.83 (s, 3H).^{13}C NMR (151 MHz, Chloroform-*d*) δ 169.7 (d, *J* = 3.6 Hz), 164.7 (d, *J* = 11.7 Hz), 164.3 (d, *J* = 262.0 Hz), 139.7, 134.2 (d, *J* = 1.9 Hz), 113.8, 111.1 (d, *J* = 2.7 Hz), 110.0 (d, *J* = 9.1 Hz), 103.3 (d, *J* = 25.7 Hz), 72.4, 19.4. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -104.70 (dd, *J* = 12.6, 8.7 Hz). HRMS (ESI) Calcd for $C_{11}H_{11}FO_3$ $[M+H]^+$: 211.0765, found 211.0769.

3-chloro-4-((2-methylallyl)oxy)benzoic acid



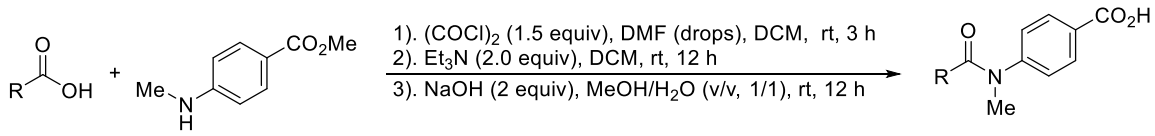
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (d, *J* = 2.0 Hz, 1H), 7.98 (dd, *J* = 8.6, 2.0 Hz, 1H), 6.96 (d, *J* = 8.7 Hz, 1H), 5.16 (s, 1H), 5.07 – 5.04 (m, 1H), 4.59 (s, 2H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 171.0, 158.7, 139.6, 132.5, 130.6, 123.3, 122.5, 113.7, 112.7, 72.7, 19.4. HRMS (ESI) Calcd for $C_{11}H_{11}ClO_3$ $[M+H]^+$: 227.0469, found 227.0472.

4-((2-(phenoxymethyl)allyl)oxy)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 8.8 Hz, 2H), 7.33 – 7.27 (m, 2H), 7.02 – 6.91 (m, 5H), 5.45 (d, *J* = 12.7 Hz, 2H), 4.73 (s, 2H), 4.66 (s, 2H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 171.9, 163.1, 158.6, 139.9, 132.5, 129.7, 122.1, 121.3, 116.5, 114.9, 114.7, 68.8, 68.6. HRMS (ESI) Calcd for $C_{11}H_{11}ClO_3$ $[M+H]^+$: 285.1121, found 285.1125.

Procedure B[3]

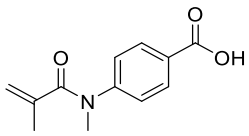


Step 1: To a suspension of carboxylic acid (1.2 equiv) in dichloromethane (0.3 M) was added a catalytic amount of N,N-dimethylformaldehyde (drops). At ambient temperature, oxalylchloride (1.5 equiv) was added dropwise over a period of 0.5 hours, forming a homogenous solution. The resulting solution was kept stirring at room temperature for 3 hours. Then, the solvent was removed under reduced pressure.

Step 2: The residue was dissolved in anhydrous dichloromethane and slowly added dropwise to a solution of the aniline derivative (1.0 equiv) and triethylamine (2.5 equiv) solution in dichloromethane (0.25 M). The reaction mixture was kept stirring at ambient temperature and monitored by TLC. Upon completion, the mixture was extracted with dichloromethane (50 mL*3) and the combined organic phase was washed with ammonium chloride aqueous solution (80 mL) and brine (80 mL). The resulted solution was dried over anhydrous sodium sulfate, then the solvent was removed under reduced pressure, and the residue was purified by flash column chromatography on silica gel (ethyl acetate/petroleum ether) afforded the amide product.

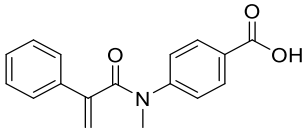
Step 3: To a suspension of the product from last step (1.0 equiv) in mixed solvents of methanol/water (v/v, 1/1, 0.1 M) was added NaOH (2.0 equiv) at ambient temperature. The resulting solution was kept stirring at room temperature for 4~12 hours until complete consumption. Then, dilute hydrochloric acid was added to adjust the pH to 3~4. The precipitated solid was filtered and washed with water twice (If no precipitation of solids, the volatiles was removed at reduced pressure and cooled at 0℃ to obtain the solid precipitate.). The solid was then dried at 80℃ under reduced pressure for 3 hours to get the acid product.

4-(N-methylmethacrylamido)benzoic acid



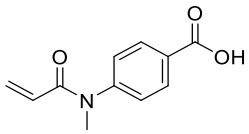
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.6 Hz, 2H), 7.25 (d, *J* = 8.6 Hz, 2H), 5.12 (s, 1H), 5.02 (s, 1H), 3.41 (s, 3H), 1.83 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.1, 170.7, 149.7, 140.8, 131.5, 127.5, 126.1, 120.6, 37.6, 20.3. HRMS (ESI) Calcd for $C_{12}H_{13}NO_3$ $[M+H]^+$: 220.0968, found 220.0965.

4-(N-methyl-2-phenylacrylamido)benzoic acid



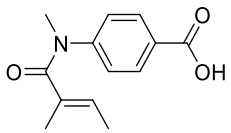
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.92 (d, *J* = 8.2 Hz, 2H), 7.26 – 7.17 (m, 5H), 7.11 (d, *J* = 6.7 Hz, 2H), 5.57 (s, 1H), 5.45 (s, 1H), 3.43 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 170.8, 170.6, 148.6, 145.6, 136.5, 131.1, 128.7, 128.4, 127.5, 126.5, 126.3, 118.6, 37.5. HRMS (ESI) Calcd for $C_{17}H_{15}NO_3$ $[M+H]^+$: 282.1124, found 282.1124.

4-(N-methylacrylamido)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.17 (d, *J* = 8.2 Hz, 2H), 7.30 (d, *J* = 8.2 Hz, 2H), 6.43 (d, *J* = 16.6 Hz, 1H), 6.12 (dd, *J* = 16.6, 10.4 Hz, 1H), 5.61 (d, *J* = 10.4 Hz, 1H), 3.42 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 170.6, 166.0, 148.2, 131.7, 128.7, 128.5, 128.4, 127.1, 37.5. HRMS (ESI) Calcd for $C_{11}H_{11}NO_3$ $[M+H]^+$: 206.0811, found 206.0813.

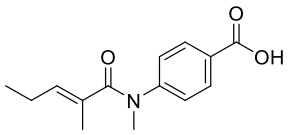
(E)-4-(N,2-dimethylbut-2-enamido)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.5 Hz, 2H), 7.21 (d, *J* = 8.5 Hz, 2H), 5.80

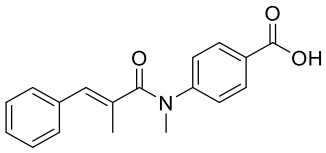
– 5.74 (m, 1H), 3.40 (s, 3H), 1.63 (s, 3H), 1.51 (d, *J* = 6.9 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.5, 170.9, 150.1, 132.4, 132.1, 131.4, 127.0, 125.9, 37.7, 14.1, 13.6. HRMS (ESI) Calcd for $C_{13}H_{15}NO_3$ $[M+H]^+$: 234.1124, found 234.1119.

(E)-4-(N,2-dimethylpent-2-enamido)benzoic acid



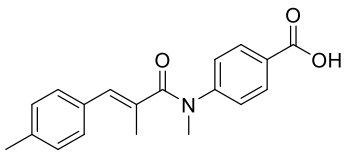
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 8.5 Hz, 2H), 7.21 (d, *J* = 8.5 Hz, 2H), 5.62 – 5.56 (m, 1H), 3.40 (s, 3H), 1.89 (q, *J* = 7.5 Hz, 2H), 1.66 (s, 3H), 0.73 (t, *J* = 7.5 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.6, 170.9, 150.3, 138.9, 131.3, 130.6, 127.0, 126.0, 37.6, 21.2, 14.2, 12.8. HRMS (ESI) Calcd for $C_{14}H_{17}NO_3$ $[M+H]^+$: 248.1281, found 248.1274.

(E)-4-(N,2-dimethyl-3-phenylacrylamido)benzoic acid



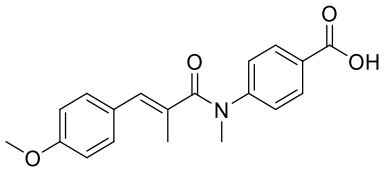
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.5 Hz, 2H), 7.29 (dd, *J* = 14.7, 8.1 Hz, 4H), 7.22 (t, *J* = 7.4 Hz, 1H), 7.07 (d, *J* = 7.5 Hz, 2H), 6.65 (s, 1H), 3.47 (s, 3H), 1.90 (d, *J* = 1.2 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.5, 170.8, 149.9, 135.8, 134.9, 133.1, 131.5, 129.0, 128.4, 127.8, 127.2, 126.0, 37.7, 16.3. HRMS (ESI) Calcd for $C_{18}H_{17}NO_3$ $[M+H]^+$: 296.1281, found 296.1275.

(E)-4-(N,2-dimethyl-3-(p-tolyl)acrylamido)benzoic acid



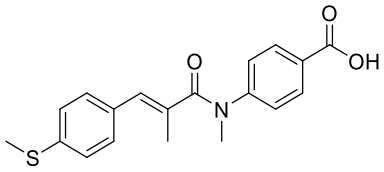
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.5 Hz, 2H), 7.29 (d, *J* = 8.5 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 6.98 (d, *J* = 8.0 Hz, 2H), 6.62 (s, 1H), 3.47 (s, 3H), 2.31 (s, 3H), 1.89 (d, *J* = 1.2 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.6, 170.6, 150.0, 137.8, 135.0, 133.0, 132.2, 131.5, 129.1, 129.0, 127.1, 125.9, 37.7, 21.4, 16.4. HRMS (ESI) Calcd for $C_{19}H_{19}NO_3$ $[M+H]^+$: 310.1437, found 310.1434.

(E)-4-(3-(4-methoxyphenyl)-N,2-dimethylacrylamido)benzoic acid



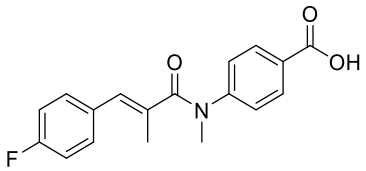
White solid. ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.97 (s, 1H), 7.91 (d, J = 8.3 Hz, 2H), 7.39 (d, J = 8.3 Hz, 2H), 7.07 (d, J = 8.5 Hz, 2H), 6.88 (d, J = 8.5 Hz, 2H), 6.43 (s, 1H), 3.73 (s, 3H), 3.34 (s, 3H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 172.4, 166.7, 158.7, 148.9, 132.8, 130.8, 130.2, 130.2, 128.1, 128.0, 125.9, 113.9, 55.1, 37.0, 16.0. HRMS (ESI) Calcd for $C_{19}H_{19}NO_4$ [M+H]$^+$: 326.1386, found 326.1385.

(E)-4-(N,2-dimethyl-3-(4-(methylthio)phenyl)acrylamido)benzoic acid



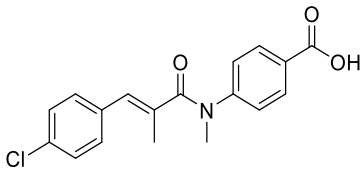
White solid. ^{1}H NMR (600 MHz, Chloroform-d) δ 8.09 (d, J = 8.4 Hz, 2H), 7.28 (d, J = 8.5 Hz, 2H), 7.15 (d, J = 8.4 Hz, 2H), 7.01 (d, J = 8.4 Hz, 2H), 6.60 (s, 1H), 3.46 (s, 3H), 2.45 (s, 3H), 1.91 – 1.86 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-d) δ 173.5, 170.8, 149.9, 138.6, 134.5, 132.5, 132.5, 131.5, 129.5, 127.2, 126.1, 125.9, 37.8, 16.5, 15.6. HRMS (ESI) Calcd for $C_{19}H_{19}NO_3S$ [M+H]$^+$: 342.1158, found 342.1155.

(E)-4-(3-(4-fluorophenyl)-N,2-dimethylacrylamido)benzoic acid



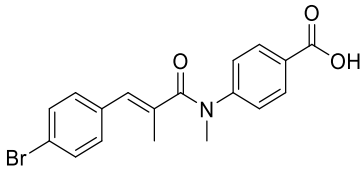
White solid. ^{1}H NMR (600 MHz, Chloroform-d) δ 8.10 (d, J = 8.4 Hz, 2H), 7.29 (d, J = 8.4 Hz, 2H), 7.04 (dd, J = 8.4, 5.6 Hz, 2H), 6.97 (t, J = 8.6 Hz, 2H), 6.61 (s, 1H), 3.47 (s, 3H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-d) δ 173.3, 170.68, 162.19 (d, J = 248.2 Hz), 149.9, 133.8, 133.0, 131.9 (d, J = 3.3 Hz), 131.5, 130.7 (d, J = 8.1 Hz), 127.27, 125.97, 115.47 (d, J = 21.6 Hz), 37.75, 16.29. ^{19}F NMR (565 MHz, Chloroform-d) δ -113.35– 13.44 (m). HRMS (ESI) Calcd for $C_{18}H_{16}FNO_3$ [M+H]$^+$: 314.1187, found 314.1180.

(E)-4-(3-(4-chlorophenyl)-N,2-dimethylacrylamido)benzoic acid



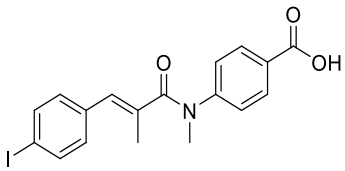
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.5 Hz, 2H), 7.29 (d, *J* = 8.5 Hz, 2H), 7.26–7.22 (m, 2H), 6.99 (d, *J* = 8.2 Hz, 2H), 6.58 (s, 1H), 3.47 (s, 3H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.1, 170.82, 170.77, 149.7, 134.2, 133.7, 133.6, 131.5, 130.3, 128.7, 127.4, 126.0, 37.7, 16.4. HRMS (ESI) Calcd for $C_{18}H_{16}ClNO_3$ [M+H]$^+$: 330.0891, found 330.0896.

(E)-4-(3-(4-bromophenyl)-N,2-dimethylacrylamido)benzoic acid



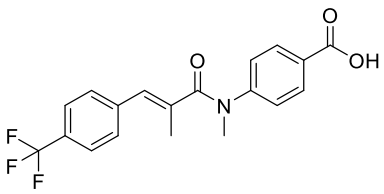
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.10 (d, *J* = 8.5 Hz, 2H), 7.40 (d, *J* = 8.4 Hz, 2H), 7.28 (d, *J* = 8.5 Hz, 2H), 6.92 (d, *J* = 8.4 Hz, 2H), 6.56 (s, 1H), 3.46 (s, 3H), 1.86 (d, *J* = 1.2 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.14, 170.8, 149.7, 134.6, 133.8, 133.6, 131.8, 131.6, 131.5, 131.4, 130.5, 127.5, 126.0, 121.9, 37.7, 16.4. HRMS (ESI) Calcd for $C_{18}H_{16}BrNO_3$ [M+H]$^+$: 374.0386, found 374.0390.

(E)-4-(3-(4-iodophenyl)-N,2-dimethylacrylamido)benzoic acid



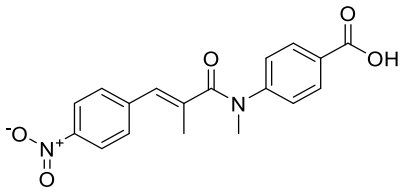
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.09 (d, *J* = 8.5 Hz, 2H), 7.60 (d, *J* = 8.3 Hz, 2H), 7.28 (d, *J* = 8.5 Hz, 2H), 6.79 (d, *J* = 8.3 Hz, 2H), 6.53 (s, 1H), 3.46 (s, 3H), 1.88 – 1.85 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.1, 170.8, 149.7, 137.6, 135.2, 133.9, 133.7, 131.5, 130.7, 127.5, 126.0, 93.6, 37.7, 16.4. HRMS (ESI) Calcd for $C_{18}H_{16}INO_3$ [M+H]$^+$: 422.0247, found 422.0249.

(E)-4-(N,2-dimethyl-3-(4-(trifluoromethyl)phenyl)acrylamido)benzoic acid



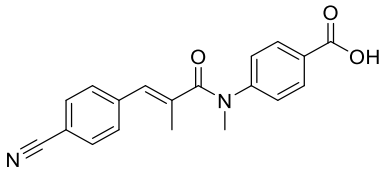
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 – 8.09 (m, 2H), 7.53 (d, *J* = 8.3 Hz, 2H), 7.33 – 7.28 (m, 2H), 7.15 (d, *J* = 8.3 Hz, 2H), 6.62 (s, 1H), 3.48 (s, 3H), 1.90 (d, *J* = 1.5 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.8, 170.7, 149.6, 139.3, 135.3, 133.1, 131.6, 129.7 (q, *J* = 32.4 Hz), 129.1, 127.5, 126.0, 125.4 (q, *J* = 3.8 Hz), 124.08 (q, *J* = 272.0 Hz), δ 124.08 (q, *J* = 272.0 Hz), 37.7, 16.4. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -62.70. HRMS (ESI) Calcd for $C_{19}H_{16}F_3NO_3$ $[M+H]^+$: 364.1155, found 364.1150.

(E)-4-(N,2-dimethyl-3-(4-nitrophenyl)acrylamido)benzoic acid



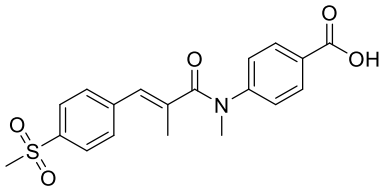
Yellow solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 – 8.10 (m, 4H), 7.31 (d, *J* = 8.6 Hz, 2H), 7.19 (d, *J* = 8.8 Hz, 2H), 6.63 (s, 1H), 3.48 (s, 3H), 1.91 (d, *J* = 1.4 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.4, 170.7, 149.4, 147.0, 142.3, 136.9, 132.2, 131.6, 129.6, 127.8, 126.1, 123.8, 37.7, 16.6. HRMS (ESI) Calcd for $C_{18}H_{16}N_2O_5$ $[M+H]^+$: 341.1132, found 341.1132.

(E)-4-(3-(4-cyanophenyl)-N,2-dimethylacrylamido)benzoic acid



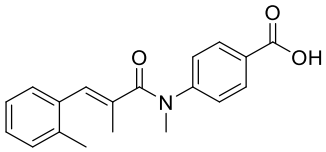
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.11 (d, *J* = 8.5 Hz, 2H), 7.57 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 8.5 Hz, 2H), 7.14 (d, *J* = 8.2 Hz, 2H), 6.60 (s, 1H), 3.47 (s, 3H), 1.89 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.4, 170.6, 149.4, 140.4, 136.3, 132.6, 132.2, 131.6, 129.5, 127.6, 126.0, 118.7, 111.3, 37.7, 16.5. HRMS (ESI) Calcd for $C_{19}H_{16}N_2O_3$ $[M+H]^+$: 321.1233, found 321.1230.

(E)-4-(N,2-dimethyl-3-(4-(methylsulfonyl)phenyl)acrylamido)benzoic acid



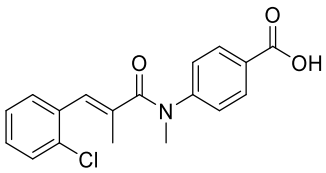
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.11 (d, *J* = 8.4 Hz, 2H), 7.85 (d, *J* = 8.3 Hz, 2H), 7.30 (d, *J* = 8.5 Hz, 2H), 7.22 (d, *J* = 8.4 Hz, 2H), 6.61 (s, 1H), 3.47 (s, 3H), 3.03 (s, 3H), 1.92 – 1.89 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.3, 170.3, 149.3, 141.2, 139.3, 136.4, 132.3, 131.5, 129.5, 127.53, 127.45, 125.9, 44.5, 37.6, 16.4. HRMS (ESI) Calcd for $C_{19}H_{16}NO_5S$ $[M+H]^+$: 374.1056, found 374.1057.

(E)-4-(N,2-dimethyl-3-(o-tolyl)acrylamido)benzoic acid



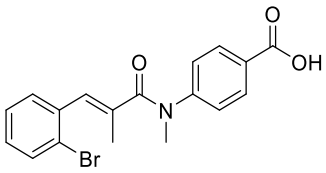
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.12 (d, *J* = 8.5 Hz, 2H), 7.30 (d, *J* = 8.5 Hz, 2H), 7.15 – 7.05 (m, 3H), 6.93 (d, *J* = 7.0 Hz, 1H), 6.56 (s, 1H), 3.48 (s, 3H), 1.85 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.4, 170.7, 150.2, 136.6, 134.8, 133.8, 133.5, 131.6, 130.0, 128.6, 127.8, 127.4, 126.1, 125.6, 37.7, 19.4, 16.0. HRMS (ESI) Calcd for $C_{19}H_{16}NO_5S$ $[M+H]^+$: 310.1437, found 310.1434.

(E)-4-(3-(2-chlorophenyl)-N,2-dimethylacrylamido)benzoic acid



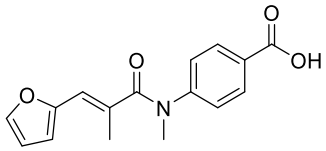
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.11 (d, *J* = 8.5 Hz, 2H), 7.30 (dd, *J* = 22.9, 7.7 Hz, 3H), 7.20 – 7.13 (m, 2H), 7.08 (dd, *J* = 6.8, 2.3 Hz, 1H), 6.61 (s, 1H), 3.48 (s, 3H), 1.85 (d, *J* = 1.3 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.9, 170.9, 149.6, 134.9, 134.1, 133.8, 131.6, 131.4, 130.2, 129.5, 129.0, 127.6, 126.5, 126.1, 37.8, 16.0. HRMS (ESI) Calcd for $C_{18}H_{16}ClNO_3$ $[M+H]^+$: 330.0891, found 330.0892.

(E)-4-(3-(2-bromophenyl)-N,2-dimethylacrylamido)benzoic acid



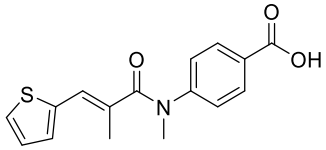
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.11 (d, *J* = 8.5 Hz, 2H), 7.48 (d, *J* = 7.8 Hz, 1H), 7.34 (d, *J* = 8.5 Hz, 2H), 7.23 (t, *J* = 7.4 Hz, 1H), 7.08 (t, *J* = 7.7 Hz, 2H), 6.59 (s, 1H), 3.49 (s, 3H), 1.84 (d, *J* = 1.3 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.8, 170.9, 149.5, 136.0, 134.7, 133.4, 132.7, 131.7, 130.3, 129.2, 127.5, 127.1, 126.1, 123.9, 37.8, 15.9. HRMS (ESI) Calcd for $C_{18}H_{16}BrNO_3$ $[M+H]^+$: 374.0386, found 374.0387.

(E)-4-(3-(furan-2-yl)-N,2-dimethylacrylamido)benzoic acid



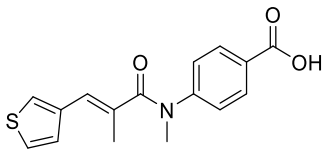
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (d, *J* = 8.5 Hz, 2H), 7.40 (s, 1H), 7.25 (s, 1H), 6.61 (s, 1H), 6.39 (t, *J* = 2.7 Hz, 1H), 6.32 (d, *J* = 3.4 Hz, 1H), 3.45 (s, 3H), 1.90 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.2, 170.7, 151.8, 149.7, 143.2, 131.6, 130.1, 127.2, 125.7, 123.7, 112.7, 111.8, 38.0, 16.8. HRMS (ESI) Calcd for $C_{16}H_{15}NO_4$ $[M+H]^+$: 286.1073, found 286.1066.

(E)-4-(N,2-dimethyl-3-(thiophen-2-yl)acrylamido)benzoic acid



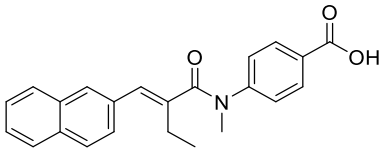
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.08 (d, *J* = 8.5 Hz, 2H), 7.28 (d, *J* = 8.6 Hz, 2H), 7.26 – 7.24 (m, 1H), 7.13 (d, *J* = 2.1 Hz, 1H), 7.00 – 6.96 (m, 1H), 6.74 (s, 1H), 3.46 (s, 3H), 1.89 – 1.86 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 173.46, 170.4, 149.9, 137.2, 131.7, 131.5, 129.6, 128.6, 127.0, 125.9, 125.6, 125.4, 37.9, 16.9. HRMS (ESI) Calcd for $C_{16}H_{15}NO_3S$ $[M+H]^+$: 302.0845, found 302.0842.

(E)-4-(N,2-dimethyl-3-(thiophen-3-yl)acrylamido)benzoic acid



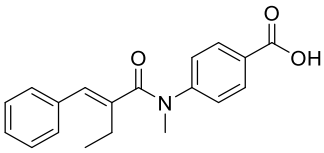
White solid. ^{1}H NMR (600 MHz, DMSO-d_6) δ 12.99 (s, 1H), 7.90 (d, J = 8.4 Hz, 2H), 7.62 (d, J = 4.8 Hz, 1H), 7.37 (d, J = 8.5 Hz, 2H), 7.09 (d, J = 3.3 Hz, 1H), 7.07 (t, J = 3.9 Hz, 1H), 6.83 (s, 1H), 3.33 (s, 3H), 1.89 – 1.83 (m, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 171.8, 166.7, 148.6, 138.4, 130.3, 130.0, 129.9, 128.4, 128.2, 127.5, 127.1, 125.9, 37.2, 16.6. HRMS (ESI) Calcd for $C_{16}H_{15}NO_3S$ [M+H]$^+$: 302.0845, found 302.0834.

(E)-4-(N-methyl-2-(naphthalen-2-ylmethylene)butanamido)benzoic acid



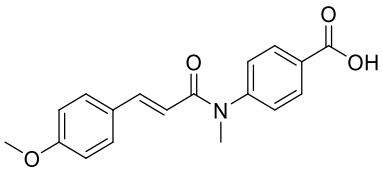
White solid. ^{1}H NMR (600 MHz, DMSO-d_6) δ 7.96 (d, J = 8.3 Hz, 2H), 7.84 (t, J = 7.2 Hz, 3H), 7.61 (s, 1H), 7.48 (dd, J = 6.2, 3.2 Hz, 2H), 7.44 (d, J = 8.4 Hz, 2H), 7.21 – 7.17 (m, 1H), 6.65 (s, 1H), 3.38 (s, 3H), 2.34 (q, J = 7.4 Hz, 2H), 1.08 (t, J = 7.5 Hz, 3H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 1701.0, 167.5, 147.8, 139.3, 133.1, 132.7, 132.3, 132.1, 130.2, 128.0, 127.9, 127.5, 127.3, 126.6, 126.4, 126.2, 37.3, 22.1, 12.56. HRMS (ESI) Calcd for $C_{23}H_{21}NO_3$ [M+H]$^+$: 360.1594, found 360.1591.

(E)-4-(2-benzylidene-N-methylbutanamido)benzoic acid



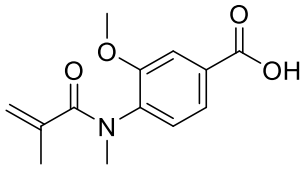
White solid. ^{1}H NMR (600 MHz, Chloroform-d) δ 8.11 (d, J = 8.3 Hz, 2H), 7.35 (d, J = 8.3 Hz, 2H), 7.28 (t, J = 7.4 Hz, 2H), 7.22 (t, J = 7.3 Hz, 1H), 7.03 (d, J = 7.5 Hz, 2H), 6.59 (d, J = 5.0 Hz, 1H), 3.49 (s, 3H), 2.31 (q, J = 7.5 Hz, 2H), 1.10 (t, J = 7.5 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-d) δ 172.5, 170.9, 149.6, 139.3, 135.8, 134.3, 131.4, 128.7, 128.4, 127.7, 127.5, 126.3, 37.9, 22.4, 13.0. HRMS (ESI) Calcd for $C_{19}H_{19}NO_3$ [M+H]$^+$: 310.1437, found 310.1431.

(E)-4-(3-(4-methoxyphenyl)-N-methylacrylamido)benzoic acid



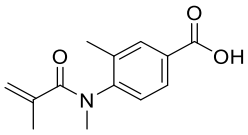
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.20 (d, *J* = 8.4 Hz, 2H), 7.72 (d, *J* = 15.4 Hz, 1H), 7.37 (d, *J* = 8.4 Hz, 2H), 7.31 (d, *J* = 8.7 Hz, 2H), 6.83 (d, *J* = 8.7 Hz, 2H), 6.28 (d, *J* = 15.4 Hz, 1H), 3.80 (s, 3H), 3.48 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 170.6, 166.7, 161.2, 148.7, 142.7, 131.7, 129.7, 128.3, 127.8, 127.1, 115.9, 114.3, 55.5, 37.5. HRMS (ESI) Calcd for $C_{18}H_{17}NO_4$ $[M+H]^+$: 312.1230, found 312.122.

3-methoxy-4-(N-methylmethacrylamido)benzoic acid



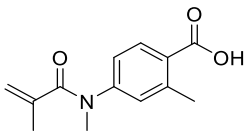
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.74 – 7.69 (m, 1H), 7.63 (s, 1H), 7.20 (d, *J* = 7.9 Hz, 1H), 4.94 (d, *J* = 23.1 Hz, 2H), 3.90 (s, 3H), 3.26 (s, 3H), 1.82 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.8, 170.7, 154.5, 140.2, 138.6, 129.7, 128.5, 123.3, 118.5, 113.2, 55.8, 36.7, 19.9. HRMS (ESI) Calcd for $C_{13}H_{15}NO_4$ $[M+H]^+$: 250.1073, found 250.1070.

3-methyl-4-(N-methylmethacrylamido)benzoic acid



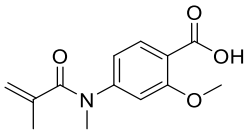
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.01 (s, 1H), 7.92 (d, *J* = 7.7 Hz, 1H), 7.15 (d, *J* = 7.8 Hz, 1H), 5.00 (s, 1H), 4.94 (s, 1H), 3.25 (s, 3H), 2.33 (s, 3H), 1.77 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.2, 170.9, 148.2, 140.1, 135.4, 133.5, 129.1, 129.0, 128.5, 119.7, 36.8, 20.3, 17.9. HRMS (ESI) Calcd for $C_{13}H_{15}NO_3$ $[M+H]^+$: 234.1124, found 234.1117.

2-methyl-4-(N-methylmethacrylamido)benzoic acid



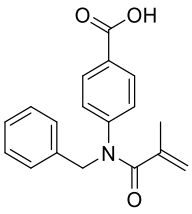
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 – 8.02 (m, 1H), 7.07 – 7.03 (m, 2H), 5.12 – 5.09 (m, 1H), 5.03 (s, 1H), 3.38 (s, 3H), 2.65 (s, 3H), 1.83 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.1, 171.8, 148.6, 143.1, 140.4, 132.9, 129.2, 126.6, 123.5, 120.3, 37.6, 22.4, 20.3. HRMS (ESI) Calcd for $C_{13}H_{15}NO_3$ [M+H]$^+$: 234.1124, found 234.1118.

2-methoxy-4-(N-methylmethacrylamido)benzoic acid



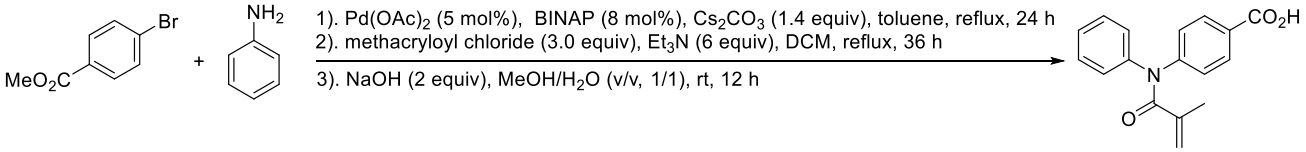
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (dd, *J* = 8.3, 3.4 Hz, 1H), 6.93 (d, *J* = 8.4 Hz, 1H), 6.87 (d, *J* = 1.8 Hz, 1H), 5.16 (s, 1H), 5.08 (s, 1H), 4.05 (s, 3H), 3.40 (s, 3H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 171.9, 165.1, 158.7, 150.6, 140.5, 134.7, 120.3, 119.1, 115.8, 109.7, 56.9, 37.6, 20.2. HRMS (ESI) Calcd for $C_{13}H_{15}NO_4$ [M+H]$^+$: 250.1073, found 250.1071.

4-(N-benzylmethacrylamido)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.02 (d, *J* = 8.5 Hz, 2H), 7.31 – 7.27 (m, 3H), 7.23 (d, *J* = 6.8 Hz, 2H), 7.11 (d, *J* = 8.5 Hz, 2H), 5.13 (s, 1H), 5.07 (s, 1H), 5.05 (s, 2H), 1.85 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 171.9, 170.7, 148.4, 140.4, 137.1, 131.3, 128.8, 128.3, 127.72, 127.68, 127.0, 120.7, 53.1, 20.4. HRMS (ESI) Calcd for $C_{18}H_{17}NO_3$ [M+H]$^+$: 296.1281, found 296.1276.

Procedure C[4]

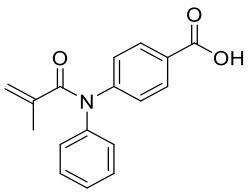


Step 1: To a solution of aryl bromide (1 equiv, **mmol, mg) in toluene (0.1 M) was added aniline (1.2 equiv), cesium carboxylate (1.4 equiv), BINAP (0.08 equiv), and $Pd(OAc)_2$ (0.05 equiv) at room temperature. The reaction mixture was allowed stirring at 120 °C for 24 h. The reaction was monitored by TLC. After completion, the mixture was cooled to room temperature, diluted with ethyl acetate, washed with 2M aqueous HCl, brine, and dried over anhydrous sodium sulfate. The solution was concentrated, loaded on silica gel, and purified by silica gel chromatography (petroleum ether/ethyl acetate~5/1) to yield a secondary amine intermediate as a pale-yellow solid (2.32 g, 82% yield).

Step 2: To a solution of the above obtained secondary amine (1 equiv) in dichloromethane (0.1 M) was added triethylamine (6.0 equiv) and methacryloyl chloride (3 equiv). The reaction mixture was stirred and refluxed for about 36 hours. Then, the reaction mixture was cooled to room temperature, diluted with dichloromethane, washed with water and diluted hydrochloric acid. The organic layer was dried over anhydrous sodium sulfate and concentrated. Then the residue was purified by silica gel chromatography (petroleum ether/ethyl acetate~3/1) to yield an amide intermediate (white solid, 492 mg. 55% yield).

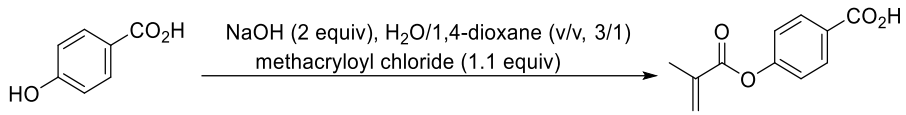
Step 3: To a suspension of the obtained product from last step (1.0 equiv) in mixed solvent of methanol/water (v/v, 1/1, 0.1 M) was added sodium hydroxide (2.0 equiv) at ambient temperature. The resulting solution was kept stirring at room temperature for 4~12 hours until the complete consumption. Then, dilute hydrochloric acid was added to adjust the pH to 3~4. The precipitated solid was filtered and washed with water twice. The solid was then dried at 80℃ under vacuum for 3 hours to get the acid product **1an** as white solid (245 mg, 83%).

4-(N-phenylmethacrylamido)benzoic acid



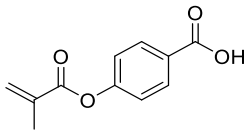
White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.06 (d, *J* = 8.6 Hz, 2H), 7.38 (t, *J* = 7.8 Hz, 2H), 7.29 (t, *J* = 7.4 Hz, 1H), 7.25 (d, *J* = 8.6 Hz, 2H), 7.16 (d, *J* = 7.9 Hz, 2H), 5.27 (s, 1H), 5.23 (s, 1H), 1.86 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.1, 170.9, 148.5, 143.0, 141.0, 131.2, 129.6, 127.8, 127.4, 126.7, 126.4, 122.0, 19.9. HRMS (ESI) Calcd for $C_{17}H_{15}NO_3$ $[M+H]^+$: 282.1124, found 282.1121.

Procedure D



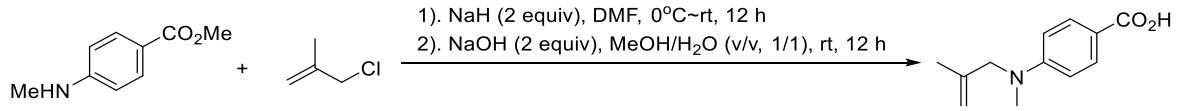
First, an alkaline solution of sodium hydroxide (60 mmol, 2 equiv, 2.40 g,) in 50 mL of deionized water was prepared, wherein 4-hydroxybenzoic acid (30 mmol, 1 equiv, 4.15 g) was added. To the resulted solution, a solution of methacryloyl chloride (33 mmol, 1.1 equiv, 3.46 g) in 20 mL of anhydrous dioxane was added dropwise under vigorous stirring within 30 min. Then, the reaction mixture was stirred at room temperature for 5 hours. Next, the solution was acidified with hydrochloric acid (10%), whereupon a white solid precipitated, which was filtered off, washed with hydrochloric acid (10%, 50 mL) and warm deionized water (3x50 mL) and finally recrystallized from ethanol to yield the desired product **1h** (4.21 g, 68%) as a white solid.

4-(methacryloyloxy)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.17 (d, *J* = 8.7 Hz, 2H), 7.26 (d, *J* = 8.7 Hz, 2H), 6.38 (s, 1H), 5.81 (s, 1H), 2.08 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 171.49, 165.36, 155.49, 135.65, 132.02, 128.14, 126.86, 121.97, 18.48. HRMS (ESI) Calcd for $C_{11}H_{10}O_4$ $[M+H]^+$: 207.0651, found 207.0653.The spectra data are consistent with the reported values[5].

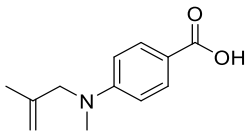
Procedure E[6]



Methyl 4-(methylamino)benzoate (3 mmol, 1 equiv) was dissolved in a round bottom flask containing N,N-dimethylformaldehyde. Sodium hydride (6 mmol, 2 equiv) was added at 0 ºC in batches. The mixture was allowed stirring for 20 minutes and then 3-chloro-2-methylprop-1-ene (4.5 mmol, 1.5 equiv) dissolved in 5 mL of dichloromethane was added dropwise. The reaction mixture was kept stirring for 12 hours at room temperature. After completion, the reaction mixture was quenched with aqueous sodium bicarbonate solution (30 mL). The reaction mixture was extracted with diethyl ether (30 mL×3) and dried over anhydrous magnesium sulfate. After concentration, the residue was purified by column chromatography (petroleum ether/ethyl acetate ~ 20:1) to give the ester product (480 mg, 73%) as a colorless oil.

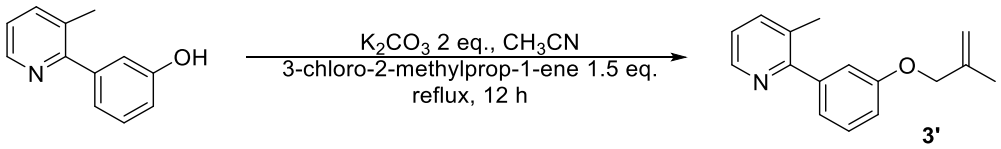
To a suspension of the obtained ester (1.0 equiv) in mixed methanol/water (v/v, 1/1, 0.1 M) was added sodium hydroxide (2.0 equiv) at ambient temperature. The resulting solution was kept stirring at room temperature for 12 hours. Then, dilute hydrochloric acid was added to adjust the pH to 3~4. The precipitated solid was filtered and washed with water twice. The solid was then dried at 80℃ under vacuum for 3 hours to get the desired product as a white solid (390 mg, 88%).

4-(methyl(2-methylallyl)amino)benzoic acid



White solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 9.0 Hz, 2H), 6.63 (d, *J* = 9.0 Hz, 2H), 4.87 (s, 1H), 4.73 (s, 1H), 3.89 (s, 2H), 3.05 (s, 3H), 1.73 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 172.6, 153.3, 140.1, 132.2, 116.2, 111.1, 110.8, 58.3, 38.7, 20.1. HRMS (ESI) Calcd for $C_{12}H_{15}NO_2$ $[M+H]^+$: 206.1175, found 206.1172.

Procedure F



3'

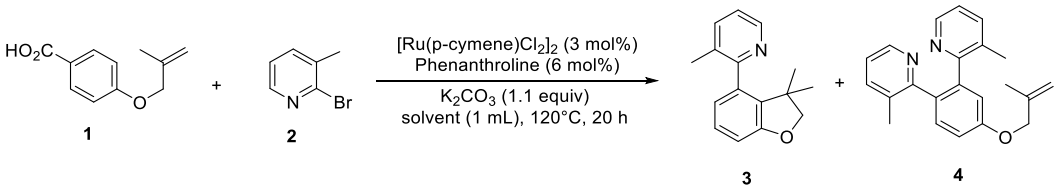
To a suspension of 3-(3-methylpyridin-2-yl)phenol (1 mmol, 1.0 equiv) in acetonitrile (0.3 M) was added 3-chloro-2-methylprop-1-ene (1.5 mmol) and K_2CO_3 (2.0 mmol). The resulting solution was heated to reflux at 75℃ for 12 hours until the full consumption of material monitored by TLC. Then the reaction mixture was cooled to room temperature and filtered through silica gel washed with EA. The combined organic phase was concentrated under reduced pressure and purification of the crude residue by flash column chromatography on silica gel (petroleum ether/ethyl acetate, v/v, 5/1) afforded the desired **3'** (yellow oil, 20.0 mg, 82% yield). ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.55 – 8.50 (m, 1H), 7.59 (ddd, *J* = 7.7, 1.6, 0.7 Hz, 1H), 7.42 – 7.32 (m, 1H), 7.19 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.10 – 7.08 (m, 1H), 7.08 – 7.06 (m, 1H), 6.96 (ddd, *J* = 8.3, 2.6, 0.9 Hz, 1H), 5.16 – 5.06 (m, 1H), 4.98 (s, 1H), 4.48 (s, 2H), 2.35 (s, 3H), 1.86 – 1.81 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 158.7, 158.5, 146.9, 141.8, 141.0, 138.8, 131.1, 129.3, 122.3, 121.6, 115.3, 114.8, 112.8, 71.9, 20.2, 19.6. HRMS (ESI) Calcd for $C_{20}H_{17}NO_2$ $[M+H]^+$: 240.1382, found 240.1374.

3. Evaluation of reaction parameters

General procedure: in an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added carboxylic acid (**1**), 2-bromopyridine (**2**), ruthenium catalyst precursor, ligand, base, additive, solvent and 10 μL of *n*-dodecane as an internal standard. The reaction vail was sealed with a PTFE lining cap, heated at given temperature and stirred for indicated time. Then, the reaction mixture was cooled to room temperature, diluted with ethyl acetate and filtered through celite. The resulting solution was analyzed by gas chromatography and yield was calibrated with a standard line.

3.1 Evaluation of solvents[a]

Table S1: the solvent effects

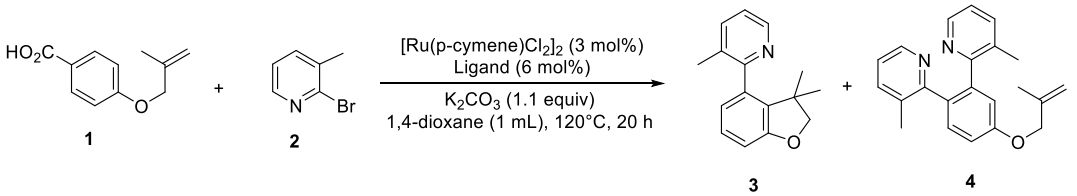


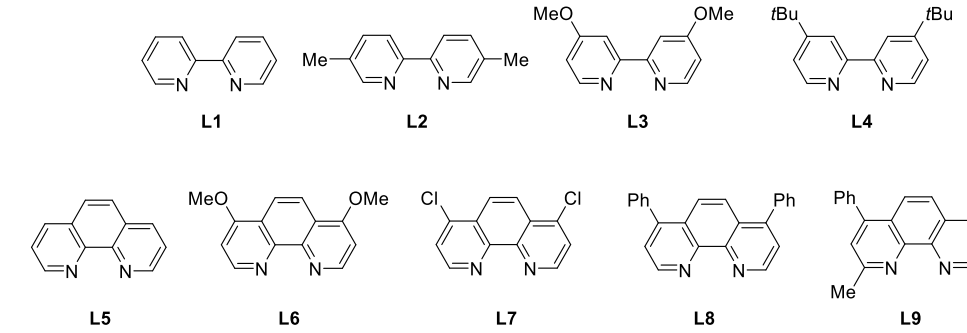
entry	*Solvent*	**3** *(%)*	**4** *(%)*
1	1,4-dioxane	58	23
2	toluene	9	13
3	NMP	47	22
4[b]	DMF	20	21

[a] reaction conditions: **1** (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), K_2CO_3 (0.22 mmol, 1.1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 3 mol%) and phenanthroline (0.012 mmol, 6 mol%) was dissolved in 1mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard. [b] 10% of uncyclized 2-aryl pyridine product was detected.

3.2 Evaluation of ligands[a]

Table S2: the ligand effects



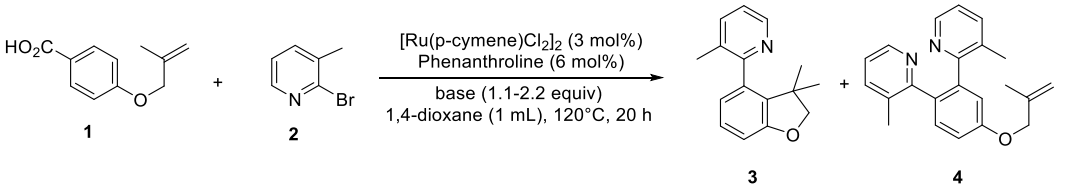


entry	*ligand*	***3*** *(%)*	***4*** *(%)*
1	**L1**	27	17
2	**L2**	44	23
3	**L3**	trace	21
4	**L4**	trace	24
5	**L5**	55	23
6	**L6**	ND	20
7	**L7**	trace	6
8	**L8**	54	trace
9	**L9**	ND	ND

[a] reaction conditions: **1** (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), K_2CO_3 (0.22 mmol, 1.1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 3 mol%) and ligand (0.012 mmol, 6 mol%) was dissolved in 1mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard. ND: not detected.

3.3 Evaluation of bases[a]

Table S3: the bases effects



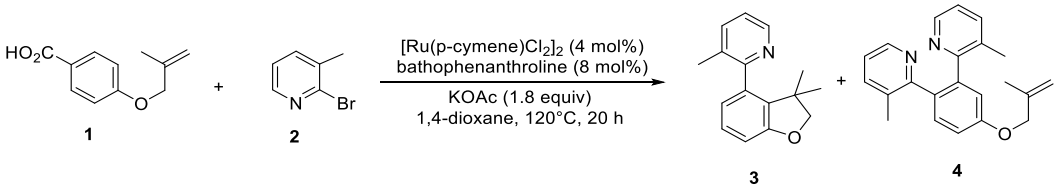
entry	*base*		***3*** *(%)*	***4*** *(%)*
1	K_2CO_3	(1.1 equiv)	58	23
2	KOH	(1.1 equiv)	45	21
3	K_3PO_4	(1.1 equiv)	30	27
4	Cs_2CO_3	(1.1 equiv)	ND	ND
5	NaOAc	(2.2 equiv)	19	6
6	$NaHCO_3$	(2.2 equiv)	31	23

7	$KHCO_3$	(2.2 equiv)	37	30
8	KOAc	(2.2 equiv)	57	18
9	KOAc	(1.8 equiv)	58	13
10	KOAc	(1.5 equiv)	57	22
11[b]	KOAc	(1.8 equiv)	62	18
12[c]	KOAc	(1.8 equiv)	64	14
13[c,d]	KOAc	(1.8 equiv)	67	13

[a] reaction conditions: **1** (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), base (0.22-0.44 mmol, 1.1-2.2 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 3 mol%) and phenanthroline (0.012 mmol, 6 mol%) was dissolved in 1mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with ** as internal standard. [b] with [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 3 mol%) and bathophenanthroline (0.012 mmol, 6 mol%); [c] with [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 4 mol%) and bathophenanthroline (0.016 mmol, 8 mol%); [d] in 2 mL of dioxane. ND:not detected.

3.4 Evaluation of concentration[a]

Table S4: the effects of concentration

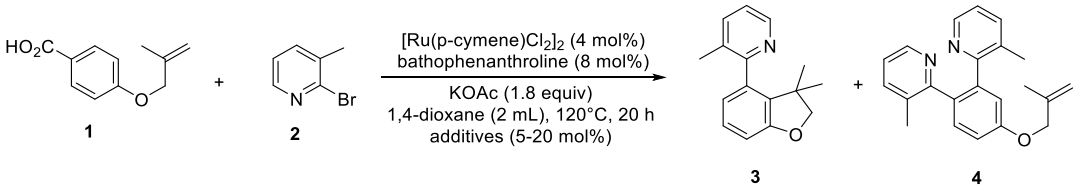


entry	*1,4-dioxane*	***3*** *(%)*	***4*** *(%)*
1	0.5 mL	55	19
2	1.0 mL	64	14
3	1.5 mL	65	14
4	2.0 mL	67	13
5	3.0 mL	43	5

[a] reaction conditions: **1** (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), KOAc (0.36 mmol, 1.8 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%) and phenanthroline (0.016 mmol, 8 mol%) was dissolved in 1mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard.

3.5 Evaluations of additives[a]

Table S5: the influence of additives

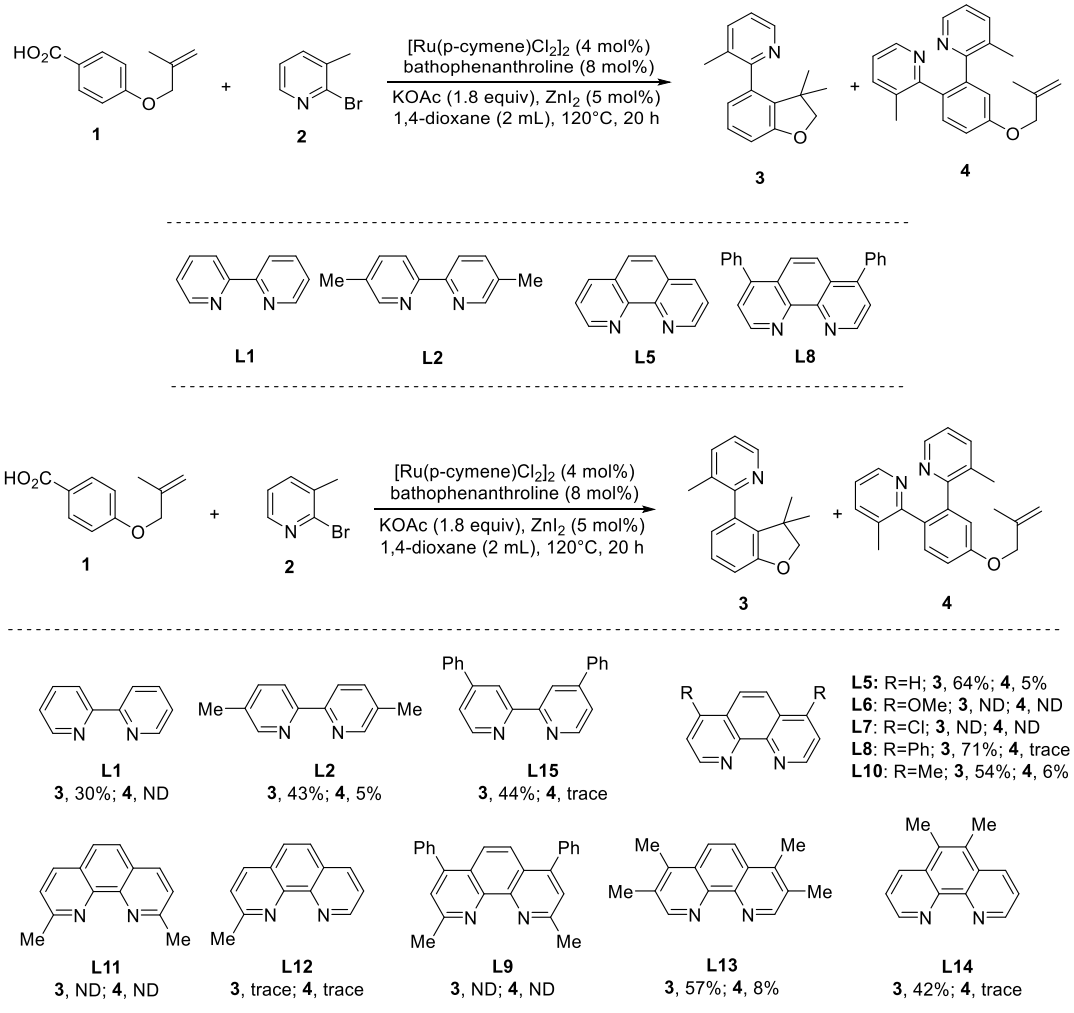


entry		*additive*	***3*** *(%)*	*4 (%)*
1	none	none	67	13
2	ZnI_2	20 mol%	65	trace
3	ZnI_2	10 mol%	69	trace
4	ZnI_2	5 mol%	71	trace
5[b]	ZnI_2	20 mol%	67	trace
6	PivOH	20 mol%	61	8
7	$MesCO_2H$	20 mol%	57	7

[a] reaction conditions: **1** (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), KOAc (0.36 mmol, 1.8 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%) and phenanthroline (0.016 mmol, 8 mol%) was dissolved in 2 mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard; ND:not detected. [b] reaction for 48 hours.

3.6 Control experiments[a]

Table S6: control experiments



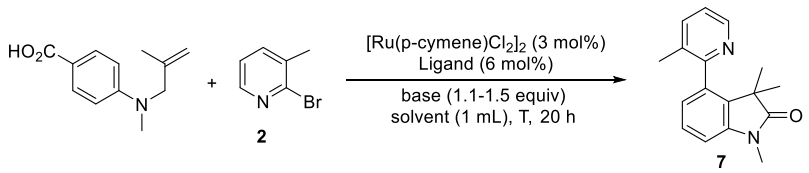
entry	*deviations*	***3*** *(%)*	*4 (%)*

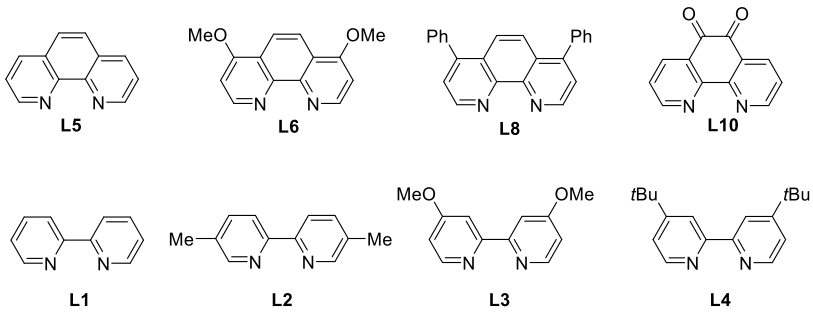
1	none	71(73)	trace
2	without [Ru(*p*-cymene)Cl_2]$_2$	N.D.	N.D.
3	without KOAc	N.D.	N.D.
4	without ligand	8	N.D.
5	without ZnI_2	67	13
6	at 100℃	63	trace
7	**L1** instead of **L8**	30	N.D.
8	**L2** instead of **L8**	43	5
9	**L15** instead of **L8**	44	trace
10	**L5** instead of **L8**	64	5
11	**L6** instead of **L8**	ND	ND
12	**L7** instead of **L8**	ND	ND
13	**L10** instead of **L8**	54	6
14	**L11** instead of **L8**	ND	ND
15	**L12** instead of **L8**	trace	trace
16	**L9** instead of **L8**	ND	ND
17	**L13** instead of **L8**	57	8
18	**L14** instead of **L8**	42	trace
19	toluene as solvent	65	ND
20	NMP as solvent	57	ND

[a] reaction conditions: **1a** (0.2 mmol, 1.0 equiv), **2a** (0.2 mmol, 1.0 equiv), KOAc (0.36 mmol, 1.8 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%) and ZnI (0.01 mmol, 5 mol%) were dissolved in 2 mL of 1,4-dioxane and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard.ND: not detected.

3.7 Evaluation of reaction conditions with 4-(methyl(2-methylallyl)amino)benzoic acid and **2**[a]

Table S7: the solvent, base, ligand, and temperature effects





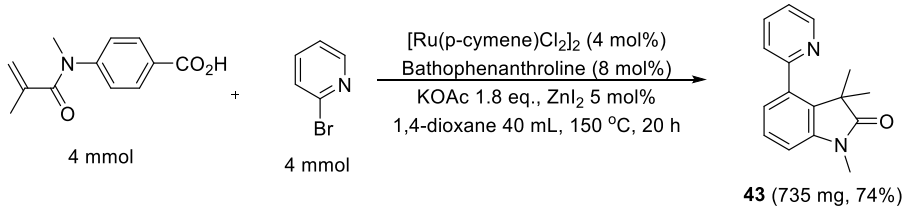
entry	*ligand*	*base*	*Solvent*	*temperature*	*addtives*	*7*

	mol%		equiv		1 mL	℃	10 mol%	%
1	L8	6	K_2CO_3	1.1	1,4-dioxane	120	--	90
2	L8	6	K_2CO_3	1.1	toluene	120	--	72
3	L8	6	K_2CO_3	1.1	NMP	120	--	45
4	L8	6	K_2CO_3	1.1	DMF	120	--	26
5	L8	6	K_2CO_3	1.5	1,4-dioxane	120	--	93
6	L8	6	K_2CO_3	1.5	1,4-dioxane	100	--	92
7	L8	6	KOAc	1.5	1,4-dioxane	100	--	90
8	L8	6	KOH	1.5	1,4-dioxane	100	--	83
9	L5	6	K_2CO_3	1.5	1,4-dioxane	100	--	48
10	L6	6	K_2CO_3	1.5	1,4-dioxane	100	--	13
11	L10	6	K_2CO_3	1.5	1,4-dioxane	100	--	0
12	L1	6	K_2CO_3	1.5	1,4-dioxane	100	--	90
13	L2	6	K_2CO_3	1.5	1,4-dioxane	100	--	68
14	L3	6	K_2CO_3	1.5	1,4-dioxane	100	--	5
15	L4	6	K_2CO_3	1.5	1,4-dioxane	100	--	68
16	L1	6	KOAc	1.5	1,4-dioxane	100	--	90
17	L8	6	KOAc	1.5	1,4-dioxane	80	--	87
18	L8	6	K_2CO_3	1.5	1,4-dioxane	80	--	15
19	L1	6	KOAc	1.5	1,4-dioxane	80	--	84
20	L1	6	K_2CO_3	1.5	1,4-dioxane	80	--	20
21	L8	6	KOAc	1.5	1,4-dioxane	80	ZnI_2	82
22[b]	L1	6	KOAc	1.5	1,4-dioxane	100	--	0
23	--	--	KOAc	1.5	1,4-dioxane	100	--	0
24	L5	6	--	--	1,4-dioxane	100	--	0

[a] reaction conditions: 4-(methyl(2-methylallyl)amino)benzoic acid (0.2 mmol, 1.0 equiv), **2** (0.2 mmol, 1.0 equiv), base (1.1-1.5 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.006mmol, 3 mol%) and ligand (0.012 mmol, 6 mol%) was dissolved in 1mL of solvent and heated up at 120 ℃ for 20 hours. GC yield with dodecane as internal standard. [b] without [Ru(*p*-cymene)Cl_2]$_2$.

4. Scaleup reaction and derivatization

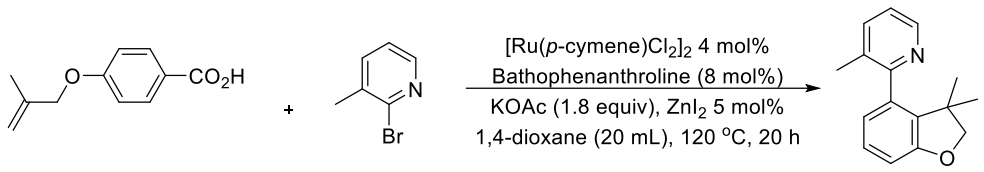
4.1 Scaleup reaction with 4-(methyl(2-methylallyl)amino)benzoic acid and 2-bromopyridine



43 (735 mg, 74%)

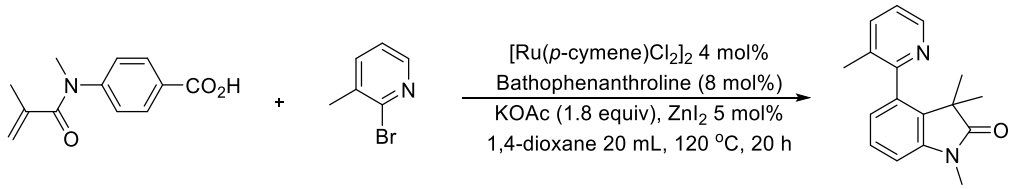
In an argon-filled glove box, to an oven-dried 150 mL tube equipped with a magnetic stir bar was added 4-(N-methylmethacrylamido)benzoic acid (4 mmol, 880 mg), 2-bromopyridine (4 mmol, 628 mg), [Ru(*p*-

cymene)Cl_2]$_2$ (0.16 mmol, 98 mg), bathophenanthroline (0.32 mmol, 108 mg), KOAc (7.2 mmol, 700 mg), ZnI_2 (0.2 mmol, 64 mg) and 1,4-dioxane (40 mL). The reaction vail was sealed with a PTFE lining cap, transferred outside of glovebox, heated up to 150℃ and stirred for 20 hours. Then, the reaction mixture was cooled to room temperature, diluted with ethyl acetate and filtered through celite, concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel using petroleum ether/ethyl acetate (v/v, 10/1~5/1) to give the desired product **43** as a pale brown solid (735 mg, 74%).



2.0 mmol 2.0 mmol **3** (305 mg, 64% yield)

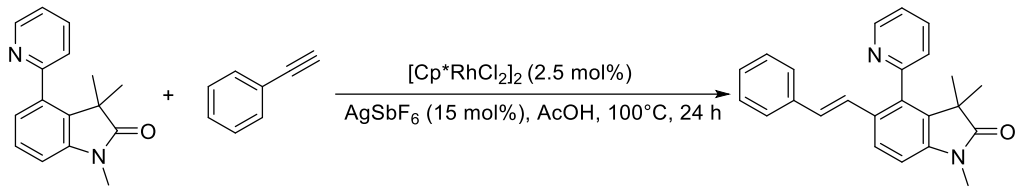
In an argon-filled glove box, to an oven-dried 75 mL tube equipped with a magnetic stir bar was added4-((2-methylallyl)oxy)benzoic acid, 2-bromo-3-methyl-pyridine (2 mmol, 344 mg), [Ru(*p*-cymene)Cl_2]$_2$ (0.08 mmol, 49 mg), bathophenanthroline (0.16 mmol, 54 mg), KOAc (3.6 mmol, 350 mg), ZnI_2 (0.1 mmol, 32 mg) and 1,4-dioxane (20 mL). The reaction vail was sealed with a PTFE lining cap, transferred outside of glovebox, heated up to 120℃ and stirred for 20 hours. Then, the reaction mixture was cooled to room temperature, diluted with ethyl acetate and filtered through celite, concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel using petroleum ether/ethyl acetate (v/v, 10/1~5/1) to give the desired product **3** as a pale brown oil (305 mg, 64% yield).



2.0 mmol 2.0 mmol **7** (510 mg, 96% yield)

In an argon-filled glove box, to an oven-dried 75 mL tube equipped with a magnetic stir bar was added 4-(N-methylmethacrylamido)benzoic acid (2 mmol), 2-bromo-3-methyl-pyridine (2 mmol, 344 mg), [Ru(*p*-cymene)Cl_2]$_2$ (0.08 mmol, 49 mg), bathophenanthroline (0.16 mmol, 54 mg), KOAc (3.6 mmol, 350 mg), ZnI_2 (0.1 mmol, 32 mg) and 1,4-dioxane (20 mL). The reaction vail was sealed with a PTFE lining cap, transferred outside of glovebox, heated up to 120℃ and stirred for 20 hours. Then, the reaction mixture was cooled to room temperature, diluted with ethyl acetate and filtered through celite, concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel using petroleum ether/ethyl acetate (v/v, 10/1~5/1) to give the desired product **7** as a pale brown solid (510 mg, 96% yield).

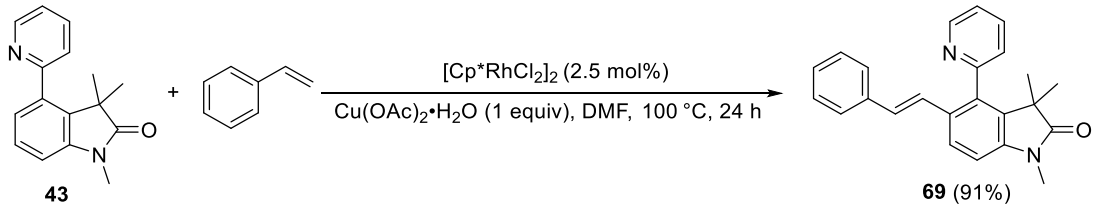
4.2 Rhodium-catalyzed hydroarylation with 4 and phenylacetylene[7]



43 **69** (77%)

An oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged sequentially with $[Cp^*RhCl_2]_2$ (1.6 mg, 0.0025 mmol), $AgSbF_6$ (10.3 mg, 0.03 mmol), **43** (0.1 mmol), HOAc (1 mL), and phenylacetylene (0.15 mmol, 1.5 equiv) under argon. The mixture was then stirred at room temperature for 12 hours. Then, the mixture was diluted with ethyl acetate (10 mL) and filtered through a short pad of silica gel. The filtrate was adsorbed on silica gel and concentrated by rotary evaporation and purified by flash chromatography (petroleum ether/ethyl acetate, v/v, 5/1) to yield **69** as a white solid (27.1 mg, 77%).

4.3 Rhodium-catalyzed alkenylation with **43** and styrene[8]



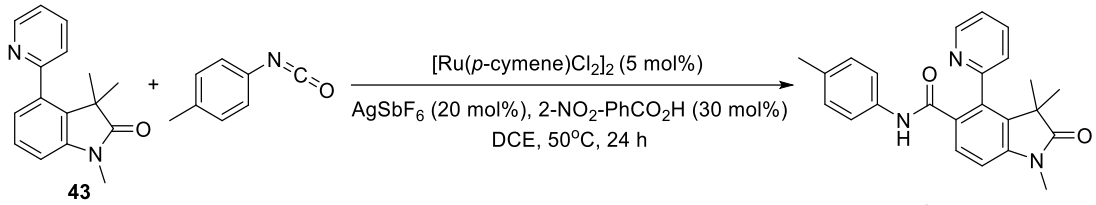
43 **69** (91%)

To an oven-dried 4 mL vail were added pyrazole (0.1 mmol, 1 equiv), styrene (0.15 mmol, 1.5 equiv), $[(Cp^*RhCl_2)_2]$ (0.0025 mmol, 1.6 mg, 2.5 mol%), $Cu(OAc)_2 \cdot H_2O$ (0.1 mmol, 20 mg), and N,N-dimethylformaldehyde (1 mL). The resulting mixture was stirred under argon at 60℃ for 24 hours. Then the reaction mixture was cooled to room temperature and extracted with diethyl ether (20 mL). The organic layer was washed with water (10 mL*3) and dried over anhydrous sodium sulfate. Product **69** (white solid, 32.2 mg, 91% yield) was isolated by column chromatography on silica gel, using petroleum ether/ethyl acetate (v/v, 5/1) as eluant.

(E)-1,3,3-trimethyl-4-(pyridin-2-yl)-5-styrylindolin-2-one (**69**): ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.78 (d, *J* = 4.3 Hz, 1H), 7.77 (td, *J* = 7.7, 1.8 Hz, 1H), 7.70 (d, *J* = 8.2 Hz, 1H), 7.37 (ddd, *J* = 7.5, 4.9, 0.9 Hz, 1H), 7.30 (d, *J* = 7.7 Hz, 1H), 7.26 – 7.19 (m, 4H), 7.19 – 7.13 (m, 1H), 6.95 (d, *J* = 8.2 Hz, 1H), 6.85 (d, *J* = 16.1 Hz, 1H), 6.59 (d, *J* = 16.1 Hz, 1H), 3.27 (s, 3H), 1.14 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.7, 157.0, 149.4,

142.5, 137.7, 137.2, 136.0, 133.0, 131.4, 128.7, 128.6, 127.4, 126.5, 126.4, 126.2, 125.3, 122.8, 108.5, 45.7, 26.5, 24.2. HRMS (ESI) Calcd for $C_{24}H_{22}N_2O$ $[M+H]^+$: 355.1804, found 355.1795.

4.4 Ruthenium-catalyzed amidation with 4 and aryl isocyanate[9]

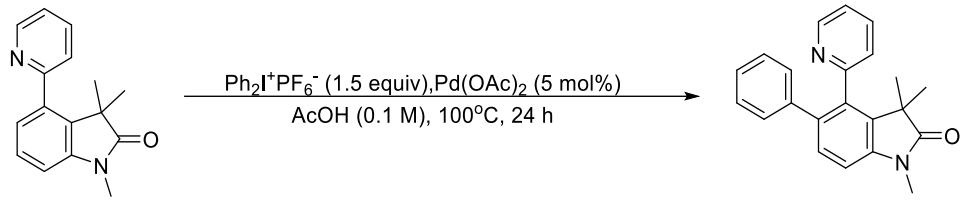


43 **70** (78%)

To a dry 4 mL vail were added $[RuCl_2(p\text{-cymene})]_2$ (3.1 mg, 0.005 mmol, 5 mol%), $AgSbF_6$ (6.9 mg, 0.02 mmol, 20 mol%), o-nitrobenzoic acid (5.0 mg, 0.03 mmol, 30 mol%), **43** (0.1 mmol, 1 equiv), 4-MePhCNO (0.18 mmol, 1.8 equiv) and 1,2-dichloroethane (1 mL). Then the reaction mixture was stirred at 50℃ for 24 hours. After reaction, the reaction mixture was cooled to room temperature, concentrated under reduced pressure and purified by column chromatography on silica gel, using petroleum ether/ethyl acetate (v/v, 1/1) as eluant to yield **70** as a white solid (30.0 mg, 78%).

1,3,3-trimethyl-2-oxo-4-(pyridin-2-yl)-N-(p-tolyl)indoline-5-carboxamide (**70**): ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.74 (d, *J* = 4.6 Hz, 1H), 7.79 (d, *J* = 8.1 Hz, 1H), 7.77 – 7.69 (m, 1H), 7.55 (s, 1H), 7.37 (d, *J* = 7.7 Hz, 1H), 7.34 (dd, *J* = 7.4, 5.1 Hz, 1H), 7.11 (d, *J* = 8.2 Hz, 2H), 7.00 (dd, *J* = 8.2, 2.4 Hz, 3H), 3.27 (s, 3H), 2.24 (s, 3H), 1.11 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.5, 166.4, 156.7, 148.8, 145.0, 137.1, 135.4, 134.0, 133.2, 131.3, 129.4, 129.4, 126.1, 123.6, 119.7, 108.5, 45.6, 26.6, 24.1, 20.9. HRMS (ESI) Calcd for $C_{24}H_{23}N_2O_3$ $[M+H]^+$: 386.186, found 386.1854.

4.5 Palladium-catalyzed arylation of 4 with diphenyliodonium hexafluorophosphate[10]



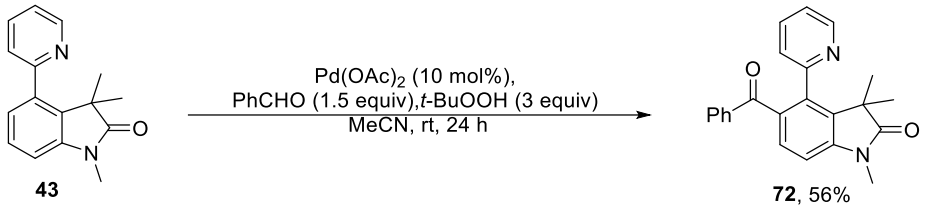
43 **71** (78%)

Substrate **43** (0.1 mmol, 1 equiv), $[Ph_2I]PF_6$ (0.15 mmol, 1.5 equiv) and $Pd(OAc)_2$ (0.005 mmol, 5 mol%) were combined in acetic acid (1 mL) in a 4 mL vial. The vial was sealed with a PTFE lining cap, and the reaction mixture was stirred at 100°C for 12 hours. After reaction, the reaction mixture was filtered through a plug of celite and concentrated under reduced pressure. The residue was dissolved in dichloromethane and extracted

with saturated aqueous sodium bicarbonate (10 mL*2) and brine (30 mL). The organic layer was dried over anhydrous magnesium sulfate, filtered, and concentrated to afford an orange oil, which was further purified by chromatography on silica gel with petroleum ether/ethyl acetate (v/v, 3/1) as eluant to yield **71** as a colorless oil (25.0 mg, 78% yield).

1,3,3-trimethyl-5-phenyl-4-(pyridin-2-yl)indolin-2-one (**71**): ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.64 (d, *J* = 4.3 Hz, 1H), 7.44 (td, *J* = 7.7, 1.7 Hz, 1H), 7.37 (d, *J* = 8.0 Hz, 1H), 7.17 – 7.06 (m, 6H), 6.98 (d, *J* = 8.0 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 3.29 (s, 3H), 1.18 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.9, 157.7, 148.5, 142.5, 141.0, 137.3, 136.5, 135.5, 133.4, 130.0, 129.5, 127.8, 126.4, 126.3, 122.2, 108.1, 46.0, 26.6, 24.2. HRMS (ESI) Calcd for $C_{22}H_{20}N_2O$ $[M+H]^+$: 329.1648, found 329.1636.

4.6 Palladium-catalyzed benzylation of 4 with 2-oxo-2-phenylacetic acid[11]

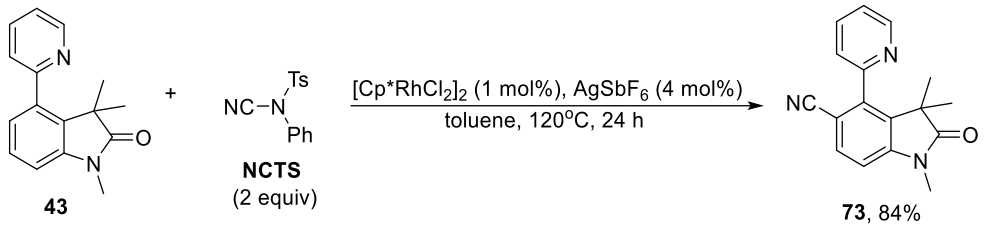


43 **72**, 56%

In an argon-filled glovebox, to an oven-dried 4 mL vial was added **43** (0.1 mmol, 25.2 mg, 1.0 equiv), benzaldehyde (0.15 mmol, 47.7 mg, 1.5 equiv), tert-butyl hydroperoxide (0.3 mmol, 3.0 equiv) and palladium acetate (0.01 mmol, 2.3 mg, 0.1 equiv) and anhydrous acetonitrile (1.0 mL). Then the vessel was sealed with PTFE lining cap and the reaction mixture was stirred for 24 hours at room temperature. After that the reaction mixture was poured into water (20 mL) and extracted with ethyl acetate (20 mL). The organic layer was washed with water (10 mL) and brine (10 mL), dried over anhydrous Na_2SO_4 and the solvent was evaporated under reduced pressure. The crude product was purified by column chromatography using ethyl acetate/hexane as eluent to afford the desired product **72** as a colorless oil (56%, 20.0 mg).

5-benzoyl-1,3,3-trimethyl-4-(pyridin-2-yl)indolin-2-one (**72**): ^{1}H NMR (600 MHz, Chloroform-d) δ 8.53 (d, J = 4.8 Hz, 1H), 7.68 (d, J = 7.5 Hz, 2H), 7.59 (td, J = 7.7, 1.6 Hz, 1H), 7.51 (d, J = 8.1 Hz, 1H), 7.46 (t, J = 7.4 Hz, 1H), 7.34 (t, J = 7.7 Hz, 2H), 7.28 (d, J = 7.8 Hz, 1H), 7.16 (dd, J = 7.5, 4.9 Hz, 1H), 6.95 (d, J = 8.1 Hz, 1H), 3.30 (s, 3H), 1.19 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-d) δ 197.0, 181.9, 156.4, 148.7, 145.5, 138.6, 138.3, 135.4, 133.8, 133.8, 132.6, 130.5, 130.2, 128.1, 125.8, 122.5, 106.9, 45.7, 26.6, 24.2.

4.7 Rhodium-catalyzed cyanation of **43** with NCTS[12]

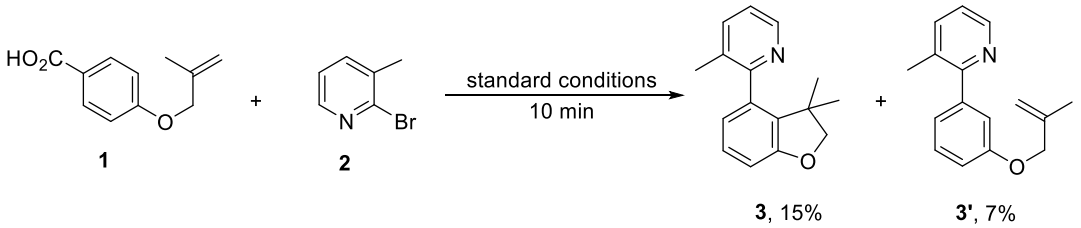


In an argon-filled glovebox, to an oven-dried 4 mL vial equipped with a magnetic stir bar were added **43** (0.1 mmol. 25.2 mg, 1 equiv), NCTS (0.2 mmol, 54.5 mg, 2 equiv), $[Cp^*RhCl_2]_2$ (1 mol %), $AgSbF_4$ (4 mol%) and toluene (1 mL). The vial was sealed with a PTFE lining cap and transferred outside of glovebox. Then the reaction mixture was stirred for 24 hours at 120℃. After reaction, the reaction mixture was cooled to room temperature and the solvent was removed under reduced pressure. The resulted residue was purified by flash column chromatography (EtOAc/petroleum ether, v/v, 1/2) on silica gel to give product **73** as a colorless oil (84%, 23.2 mg).

1,3,3-trimethyl-2-oxo-4-(pyridin-2-yl)indoline-5-carbonitrile (**73**): ^{1}H NMR (600 MHz, Chloroform-d) δ 8.76 (d, J = 4.3 Hz, 1H), 7.85 (td, J = 7.7, 1.6 Hz, 1H), 7.70 (d, J = 8.2 Hz, 1H), 7.42 (dd, J = 7.7, 4.6 Hz, 2H), 6.97 (d, J = 8.2 Hz, 1H), 3.27 (s, 3H), 1.18 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-d) δ 181.4, 154.6, 149.6, 147.01, 141.1, 136.6, 134.0, 133.8, 125.1, 123.8, 118.2, 108.2, 106.8, 45.5, 26.7, 23.9.

5. Mechanistic investigations

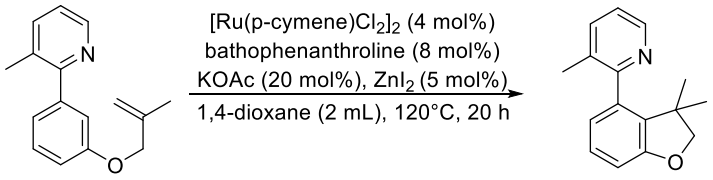
5.1 Capture of intermediate



In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added carboxylic acid (**1**, 0.2 mmol, 1 equiv), 2-bromo-3-methylpyridine (**2**, 0.2 mmol, 1 equiv), $[Ru(p\text{-cymene})Cl_2]_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%), ZnI (0.01 mmol, 5 mol%), 10 μL of dedocane and 2 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and

heated up to 120 ℃. After stiring for 10 minutes, the reaction was removed from heating and cooled to room temperature. The reaction mixture was diluted with ethyl acetate, filtered through celite and analyzed by gas chromotography, and the yields were calibrated with standard lines.

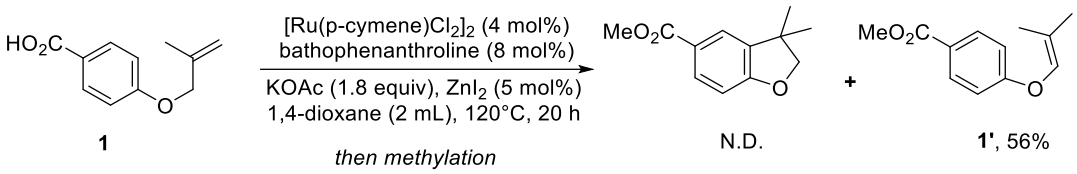
5.2 Intermediate cyclization with **3'**



3' **3**, 100%

In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added **3'** (0.2 mmol, 1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%), ZnI (0.01 mmol, 5 mol%), 10 μL of dedocane and 2 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and heated up to 120 ℃. After stiring for 20 hours, the reaction was removed from heating and cooled to room temperature. The reaction mixture was diluted with ethyl acetate, filtered through celite and analyzed by gas chromotography, and the yields were calibrated with standard lines.

5.3 Cyclization with **1**



1 N.D. **1'**, 56%

In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added **1** (0.2 mmol, 1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%), ZnI (0.01 mmol, 5 mol%), 10 μL of dedocane and 2 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and heated up to 120 ℃. After stiring for 20 hours, the reaction was cooled to room temperature, dilute with ethyl acetate and analyzed by GC. Then, the solvent was removed under reduced pressure. To the residue was added potassium carboxylate (2 equiv), 3 mL of acetonitrile, and methyl iodide (3 equiv). The vial was sealed and heated up to 65 ℃. After stirring for 2 hours, the reaction mixture was cooled to room temperature, the volatiles were removed under reduced pressure, and the residue was purified by flash

column chromotography with petrolum ether and ethyl acetate. Compound **1'** was obained as a colorless oil (23.0 mg, 56%),[12] and product from intramolecular cyclization was not detected.

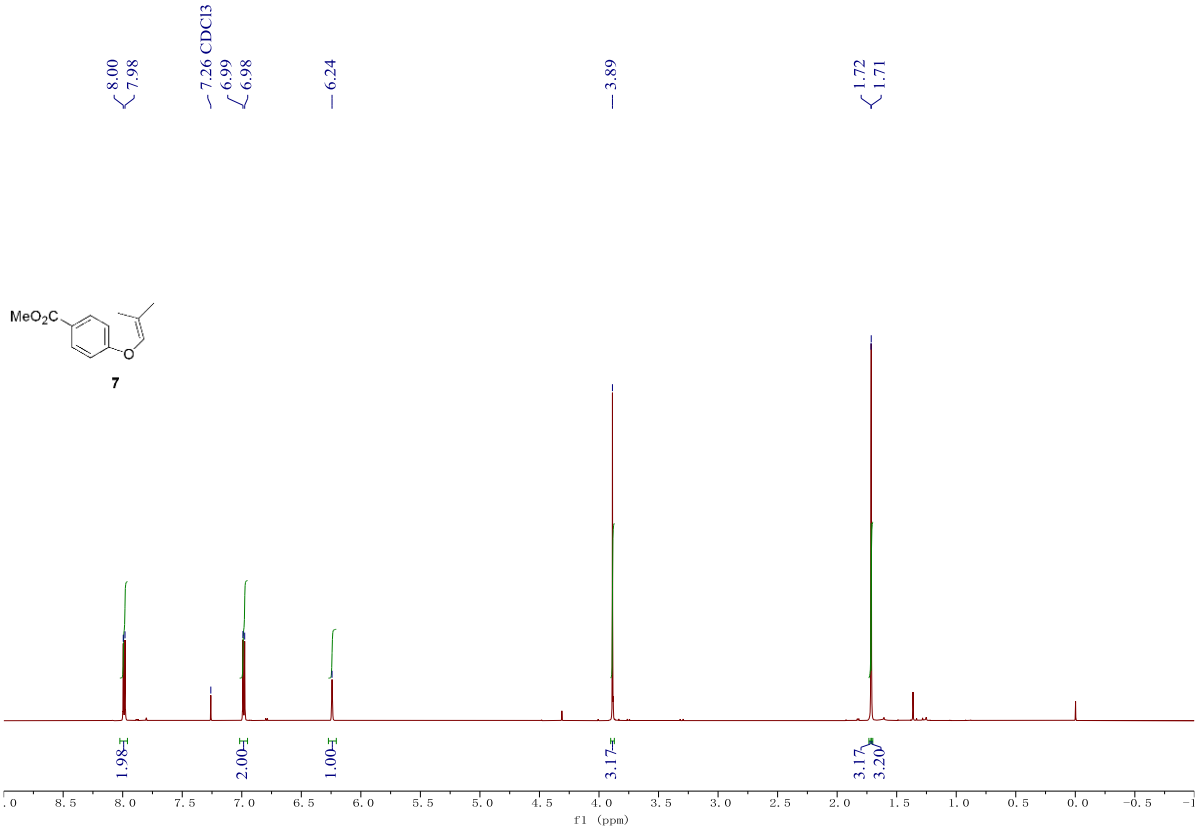
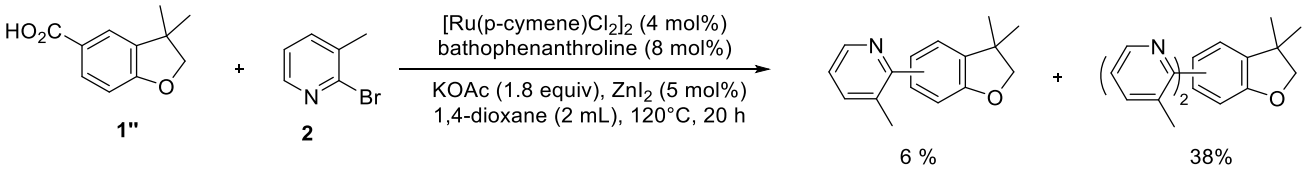


Figure S1: H-NMR of the compound **1a'**

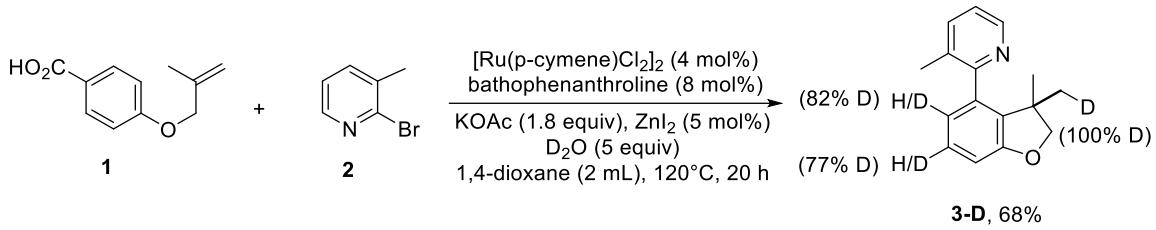
5.4 Decarboxylative 2-pyridination with **1',**



In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added **1''** (0.2 mmol, 1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%), ZnI (0.01 mmol, 5 mol%), 10 μL of dedocane and 2 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and heated up to 120 ℃. After stiring for 20 hours, the reaction was cooled to room temperature, dilute with ethyl acetate and analyzed by GC and GCMS. A mixture of the decarboxylative 2-pyridination products were observed. Then the mixture was purified using preparative thin-layer chromatography to yield a mixture of mono-2-pyridination products **3** (colorless oil, 3.3 mg, 6%), and a mixture

of bis-2-pyridination products **4** (reddish brown oil, 25.1 mg, 38%).

5.5 Deuterium scrambling experiments



In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added **1** (0.2 mmol, 1 equiv), **2** (0.2 mmol), [Ru(*p*-cymene)Cl_2]$_2$ (0.008mmol, 4 mol%), bathophenanthroline (0.016 mmol, 8 mol%), KOAc (0.36 mmol, 1.8 equiv), ZnI_2 (0.01 mmol, 5 mol%), D_2O (1 mmol, 5 equiv) and 2 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and heated up to 120 ℃. After stiring for 20 hours, the reaction was cooled to room temperature, the solvent was removed under reduced pressure, and the residue was purified by flash column chromatography on silica gel using petrolum ether/ethyl acetate (v/v, 10/1) to give the desired product **3-D** (32.6 mg, pale yellow oil, 68%), which was analyzed by ^{1}H-NMR.

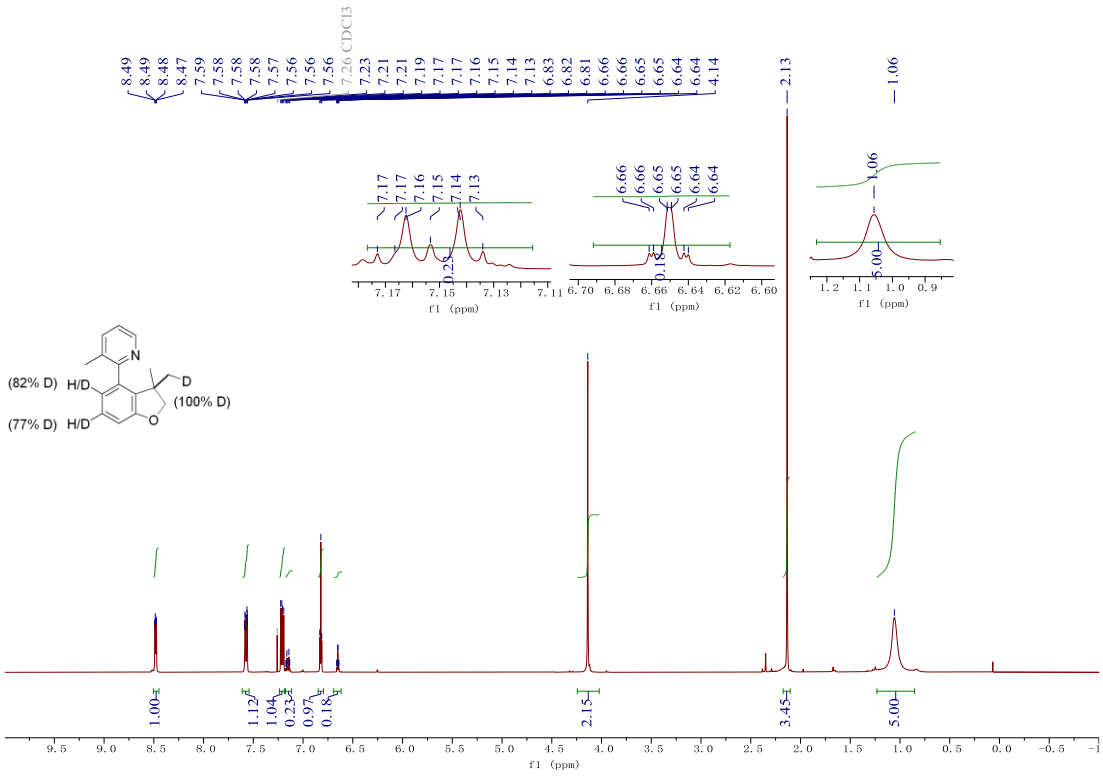
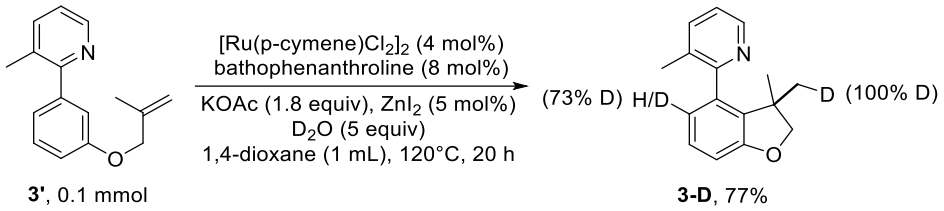


Figure S2: ^{1}H-NMR of **3-D** isolated from deuterium scrambling study



In an argon-filled glove box, to an oven-dried 4 mL vial equipped with a magnetic stir bar was added **3'** (0.1 mmol, 1 equiv), [Ru(*p*-cymene)Cl_2]$_2$ (0.004mmol, 4 mol%), bathophenanthroline (0.008 mmol, 8 mol%), KOAc (0.18 mmol, 1.8 equiv), ZnI_2 (0.005 mmol, 5 mol%), D_2O (0.5 mmol, 5 equiv) and 1 mL of 1,4-dioxane. The vial was sealed with a PTFE linning cap, transferred outside of glovebox, and heated up to 120 ℃. After stiring for 20 hours, the reaction was cooled to room temperature, the solvent was removed under reduced pressure, and the residue was purified by flash column chromatography on silica gel using petrolum ether/ethyl acetate (v/v, 10/1) to give the recovered **3-D'** (18.1 mg, pale yellow oil, 77%), which was annalyzed by ^{1}H-NMR.

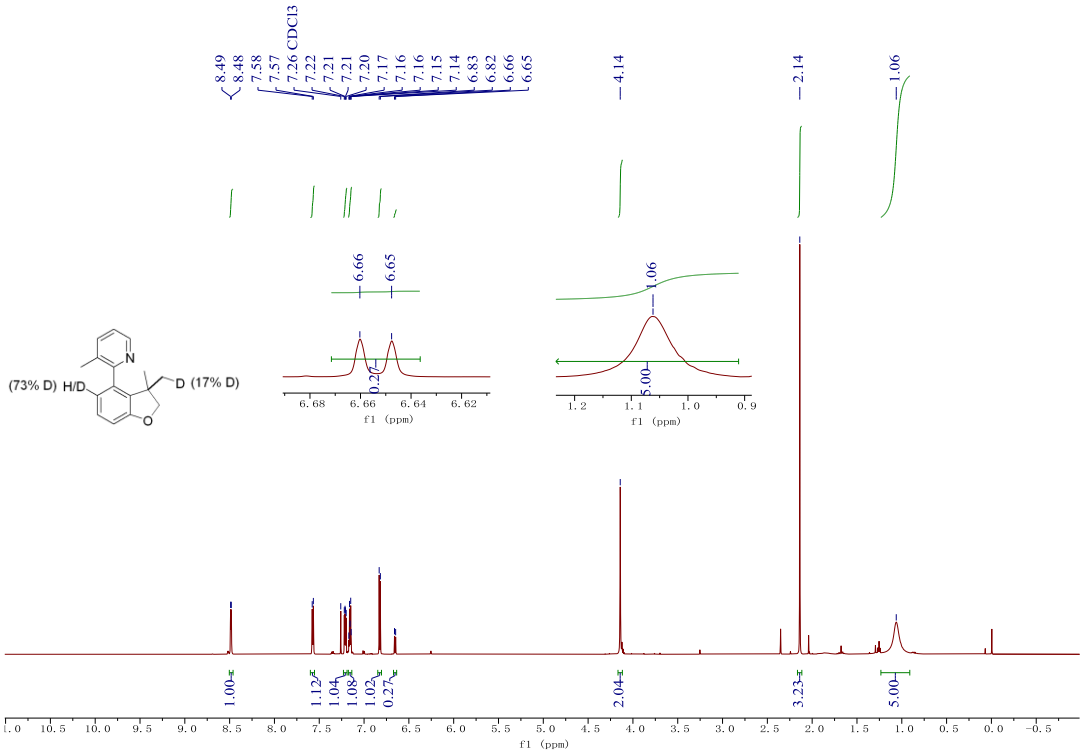
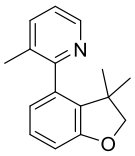


Figure S3: ^{1}H-NMR of **3a-D** isolated from cyclization of **3a'** in the presence of D_2O

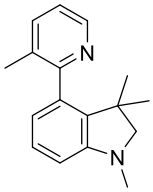
6. Substrate Scopes

2-(3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**3**)



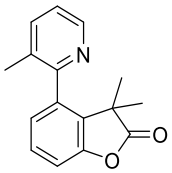
Colorless oil, 35.0 mg, 73% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.50 – 8.45 (m, 1H), 7.57 (ddd, *J* = 7.7, 1.6, 0.7 Hz, 1H), 7.21 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.18 – 7.12 (m, 1H), 6.82 (dd, *J* = 8.0, 0.9 Hz, 1H), 6.65 (dd, *J* = 7.5, 0.9 Hz, 1H), 4.14 (s, 2H), 2.13 (s, 3H), 1.06 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 160.0, 158.2, 146.1, 137.7, 137.6, 132.9, 131.9, 128.1, 122.7, 121.5, 109.6, 84.8, 43.0, 25.9, 19.7. HRMS (ESI) Calcd for $C_{16}H_{17}NO$ $[M+H]^+$: 240.1382, found 240.1375.

1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indoline (**5**)



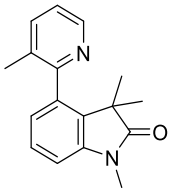
White solid, 30.2 mg, 60% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.52 – 8.40 (m, 1H), 7.58 – 7.52 (m, 1H), 7.19 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.12 (t, *J* = 7.7 Hz, 1H), 6.52 (d, *J* = 7.9 Hz, 1H), 6.45 (dd, *J* = 7.6, 0.7 Hz, 1H), 3.18 – 2.83 (m, 2H), 2.77 (s, 3H), 2.14 (s, 3H), 1.44 – 1.08 (m, 3H), 0.96 – 0.58 (m, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 159.2, 153.0, 145.8, 137.7, 136.6, 135.1, 132.0, 127.5, 122.4, 118.9, 107.3, 71.2, 41.4, 36.3, 27.7, 25.1, 19.7. HRMS (ESI) Calcd for $C_{17}H_{20}N_2$ $[M+H]^+$: 253.1699, found 253.1693.

3,3-dimethyl-4-(3-methylpyridin-2-yl)benzofuran-2(3H)-one (**6**)



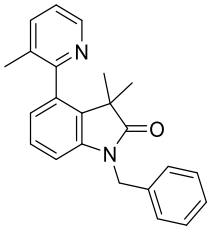
Colorless oil, 37.5 mg, 73% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.53 – 8.47 (m, 1H), 7.68 – 7.58 (m, 1H), 7.33 (t, *J* = 7.9 Hz, 1H), 7.27 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.16 (dd, *J* = 8.1, 1.0 Hz, 1H), 6.96 (dd, *J* = 7.7, 1.0 Hz, 1H), 2.10 (s, 3H), 1.27 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.3, 156.4, 152.8, 146.3, 138.3, 137.9, 132.1, 130.6, 128.5, 125.0, 123.3, 110.6, 44.0, 24.5, 19.6. HRMS (ESI) Calcd for $C_{16}H_{15}NO_2$ $[M+H]^+$: 254.1176, found 254.1175.

1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**7**)



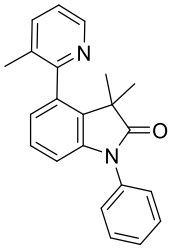
Light brown solid, 44.8 mg, 84% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.51 – 8.47 (m, 1H), 7.58 (ddd, *J* = 7.7, 1.6, 0.7 Hz, 1H), 7.30 (t, *J* = 7.8 Hz, 1H), 7.24 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.88 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.83 (dd, *J* = 7.8, 1.0 Hz, 1H), 3.24 (s, 3H), 2.07 (s, 3H), 1.12 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.6, 157.6, 146.2, 143.4, 137.9, 137.5, 132.3, 132.0, 127.7, 123.4, 123.0, 107.8, 45.3, 26.5, 23.5, 19.6. HRMS (ESI) Calcd for $C_{17}H_{18}N_2O$ $[M+H]^+$: 267.1491, found 267.1488.

1-benzyl-3,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**8**)



Light brown solid, 61.0 mg, 89% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 – 8.45 (m, 1H), 7.65 – 7.58 (m, 1H), 7.36 – 7.26 (m, 6H), 7.20 (t, *J* = 7.8 Hz, 1H), 6.82 (dd, *J* = 7.7, 0.9 Hz, 1H), 6.77 (dd, *J* = 7.9, 0.9 Hz, 1H), 4.98 (s, 2H), 2.11 (s, 3H), 1.24 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.7, 157.6, 146.1, 142.4, 137.9, 137.6, 136.0, 132.2, 132.0, 128.8, 127.60, 127.59, 127.1, 123.4, 123.0, 108.9, 45.4, 43.6, 19.6. HRMS (ESI) Calcd for $C_{23}H_{22}N_2O$ $[M+H]^+$: 343.1804, found 343.1799.

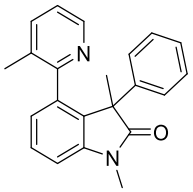
3,3-dimethyl-4-(3-methylpyridin-2-yl)-1-phenylindolin-2-one (**9**)



Light brown oil, 63.2 mg, 96% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.56 – 8.51 (m, 1H), 7.62 (ddd, *J* = 7.7, 1.5, 0.7 Hz, 1H), 7.56 – 7.50 (m, 2H), 7.47 – 7.38 (m, 3H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.23 (t,

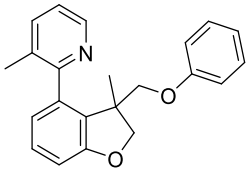
J = 7.8 Hz, 1H), 6.87 (ddd, *J* = 7.9, 4.9, 1.0 Hz, 2H), 2.15 (s, 3H), 1.39 – 1.11 (m, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.0, 157.7, 146.3, 143.4, 138.0, 137.9, 134.7, 132.1, 132.1, 129.7, 128.1, 127.6, 126.9, 123.9, 123.1, 109.2, 45.5, 23.9, 19.7. HRMS (ESI) Calcd for $C_{22}H_{20}N_2O$ $[M+H]^+$: 329.1648, found 329.1645.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-phenylindolin-2-one (**10**)



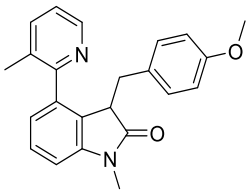
Dark brown solid, 52.6 mg, 80% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.38 (d, *J* = 4.0 Hz, 1H), 7.34 (t, *J* = 7.8 Hz, 1H), 7.19 (d, *J* = 7.1 Hz, 1H), 7.09 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.08 – 7.05 (m, 1H), 7.02 – 6.96 (m, 3H), 6.81 (dd, *J* = 7.7, 0.8 Hz, 1H), 6.68 – 6.63 (m, 2H), 3.36 (s, 3H), 1.76 (s, 3H), 1.33 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.8, 156.7, 145.6, 143.5, 139.5, 137.8, 137.4, 133.4, 132.6, 128.1, 128.0, 126.9, 126.4, 123.7, 122.8, 108.0, 53.3, 26.8, 21.8, 18.4. HRMS (ESI) Calcd for $C_{22}H_{20}N_2O$ $[M+H]^+$: 329.1648, found 329.1641.

3-methyl-2-(3-methyl-3-(phenoxymethyl)-2,3-dihydrobenzofuran-4-yl)pyridine (**11**)



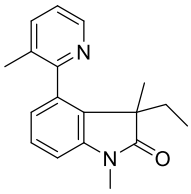
light yellow oil, 45.5 mg, 70% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.51 – 8.46 (m, 1H), 7.54 (d, *J* = 7.5 Hz, 1H), 7.25 – 7.19 (m, 4H), 6.94 – 6.87 (m, 2H), 6.83 – 6.74 (m, 2H), 6.72 (dd, *J* = 7.6, 0.9 Hz, 1H), 4.72 (d, *J* = 8.7 Hz, 1H), 4.16 (d, *J* = 8.7 Hz, 1H), 4.08 – 3.68 (m, 2H), 2.13 (s, 3H), 1.12 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 160.9, 158.9, 157.9, 146.2, 138.3, 138.0, 132.1, 129.4, 129.0, 128.9, 122.9, 121.6, 120.7, 114.4, 109.9, 80.3, 71.6, 47.5, 20.9, 19.6. HRMS (ESI) Calcd for $C_{22}H_{21}NO_2$ $[M+H]^+$: 332.1645, found 332.1639.

3-(4-methoxybenzyl)-1-methyl-4-(3-methylpyridin-2-yl)indolin-2-one (**12**)



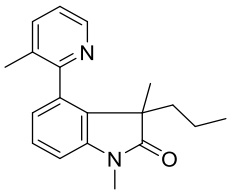
Light brown solid, 51.0 mg, 78% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.60 – 8.55 (m, 1H), 7.65 (ddd, *J* = 7.7, 1.6, 0.7 Hz, 1H), 7.30 – 7.24 (m, 2H), 7.02 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.74 – 6.69 (m, 2H), 6.67 (d, *J* = 7.5 Hz, 1H), 6.59 – 6.53 (m, 2H), 4.02 (t, *J* = 4.9 Hz, 1H), 3.67 (s, 3H), 3.07 (s, 3H), 3.01 (dd, *J* = 13.9, 4.4 Hz, 1H), 2.34 (dd, *J* = 13.9, 5.5 Hz, 1H), 2.29 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 177.5, 158.0, 157.1, 147.2, 145.1, 138.8, 136.9, 131.4, 130.2, 129.0, 127.9, 126.9, 123.3, 122.9, 113.2, 107.6, 55.2, 47.1, 33.9, 26.2, 19.6. HRMS (ESI) Calcd for $C_{23}H_{22}N_2O_2$ $[M+H]^+$: 359.1754, found 359.1749.

3-ethyl-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**13**)



Light brown oil, 52.0 mg, 93% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.47 (d, *J* = 3.9 Hz, 1H), 7.58 (d, *J* = 7.2 Hz, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 7.23 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.92 – 6.80 (m, 2H), 3.24 (s, 3H), 2.09 (s, 3H), 1.65 (dq, *J* = 14.6, 7.3 Hz, 1H), 1.36 (s, 1H), 1.11 (s, 3H), 0.51 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.8, 157.5, 146.1, 144.3, 137.9, 137.5, 131.9, 130.4, 127.6, 123.5, 122.9, 107.5, 50.5, 30.8, 26.3, 23.0, 19.4, 9.3. HRMS (ESI) Calcd for $C_{18}H_{16}N_2OS$ $[M+H]^+$: 309.1056, found 309.1052.

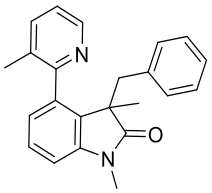
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-propylindolin-2-one (**14**)



Light brown oil, 56.0 mg, 95% yield ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.49 – 8.40 (m, 1H), 7.57 (d, *J* = 7.7 Hz, 1H), 7.30 – 7.26 (m, 1H), 7.21 (ddd, *J* = 7.5, 4.8, 2.8 Hz, 1H), 6.84 (dddd, *J* = 16.6, 7.7, 2.5, 0.9 Hz, 2H), 3.21 (d, *J* = 2.8 Hz, 3H), 2.07 (d, *J* = 2.5 Hz, 3H), 1.70 – 1.48 (m, 1H), 1.28 – 1.16 (m, 1H), 1.12 (s, 3H), 0.94 – 0.79 (m, 2H), 0.68 (q, *J* = 5.1 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.0, 157.4,

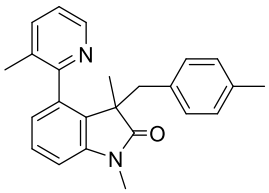
146.1, 144.1, 137.9, 137.3, 131.8, 130.7, 127.5, 123.4, 122.9, 107.5, 49.9, 39.8, 26.2, 23.6, 19.3, 18.1, 14.1. HRMS (ESI) Calcd for $C_{19}H_{22}N_2O$ $[M+H]^+$: 295.1804, found 295.1802.

3-benzyl-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**15**)



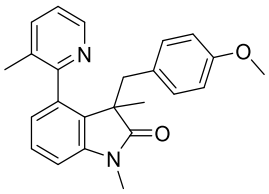
White solid, 63.0 mg, 85% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 (dd, *J* = 4.8, 1.1 Hz, 1H), 7.62 (ddd, *J* = 7.8, 1.6, 0.7 Hz, 1H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.23 (t, *J* = 7.8 Hz, 1H), 7.18 – 7.09 (m, 2H), 7.04 – 6.97 (m, 3H), 6.87 (dd, *J* = 7.8, 1.0 Hz, 1H), 6.57 – 6.52 (m, 1H), 3.27 (d, *J* = 12.4 Hz, 1H), 2.88 (s, 3H), 2.86 (d, *J* = 12.5 Hz, 1H), 2.09 (s, 3H), 1.10 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.9, 158.0, 146.3, 143.9, 138.0, 137.4, 137.0, 132.2, 129.9, 129.7, 127.7, 127.3, 126.3, 123.3, 123.0, 107.2, 51.5, 44.4, 25.9, 19.7. HRMS (ESI) Calcd for $C_{23}H_{22}N_2O$ $[M+H]^+$: 373.1546, found 373.1543.

1,3-dimethyl-3-(4-methylbenzyl)-4-(3-methylpyridin-2-yl)indolin-2-one (**16**)



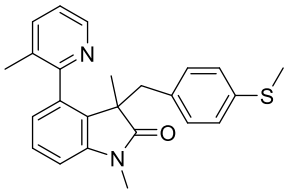
White solid, 59.2 mg, 85% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 3.8 Hz, 1H), 7.61 (d, *J* = 7.6 Hz, 1H), 7.27 (dd, *J* = 7.6, 4.7 Hz, 1H), 7.23 (t, *J* = 7.8 Hz, 1H), 7.00 (d, *J* = 7.5 Hz, 2H), 6.86 (d, *J* = 7.6 Hz, 1H), 6.81 (d, *J* = 7.8 Hz, 2H), 6.57 (d, *J* = 7.7 Hz, 1H), 3.21 (d, *J* = 12.5 Hz, 1H), 2.83 (d, *J* = 12.6 Hz, 1H), 2.18 (s, 3H), 2.09 (s, 3H), 1.10 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.0, 158.0, 146.3, 144.0, 138.0, 137.4, 135.6, 133.8, 132.2, 130.1, 129.5, 128.0, 127.6, 123.3, 123.0, 107.2, 51.4, 43.9, 25.9, 21.2, 20.8, 19.7. HRMS (ESI) Calcd for $C_{24}H_{24}N_2O$ $[M+H]^+$: 357.1961, found 357.1965.

3-(4-methoxybenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**17**)



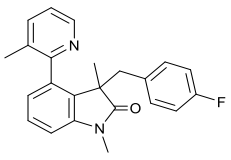
Colorless oil, 55.2 mg, 74% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 3.8 Hz, 1H), 7.61 (d, *J* = 7.2 Hz, 1H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.23 (t, *J* = 7.8 Hz, 1H), 7.08 (d, *J* = 8.3 Hz, 2H), 6.86 (d, *J* = 7.3 Hz, 1H), 6.62 – 6.52 (m, 3H), 3.68 (s, 3H), 3.19 (d, *J* = 12.6 Hz, 1H), 2.91 (s, 3H), 2.80 (d, *J* = 12.7 Hz, 1H), 2.09 (s, 3H), 1.07 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.0, 158.0, 146.3, 143.9, 138.0, 137.4, 132.2, 130.7, 130.0, 129.2, 127.7, 123.3, 123.0, 112.7, 107.3, 55.2, 51.6, 43.5, 26.0, 20.5, 19.7. HRMS (ESI) Calcd for $C_{24}H_{24}N_2O_2$ $[M+H]^+$: 373.1910, found 373.1909.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-(methylthio)benzyl)indolin-2-one (**18**)



White solid, 44.0 mg, 57% yield, ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 – 8.54 (m, 1H), 7.62 – 7.58 (m, 1H), 7.27 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 7.09 (d, *J* = 8.1 Hz, 2H), 6.91 (dd, *J* = 8.5, 1.9 Hz, 2H), 6.87 – 6.83 (m, 1H), 6.57 (d, *J* = 7.7 Hz, 1H), 3.22 (d, *J* = 12.5 Hz, 1H), 2.90 (s, 3H), 2.81 (d, *J* = 12.6 Hz, 1H), 2.35 (s, 3H), 2.08 (s, 3H), 1.08 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.8, 157.9, 146.2, 143.9, 138.0, 137.3, 135.7, 134.1, 132.2, 130.2, 129.7, 127.7, 125.8, 123.3, 123.0, 107.3, 51.4, 43.7, 25.9, 20.6, 19.6, 16.1. HRMS (ESI) Calcd for $C_{24}H_{24}N_2OS$ $[M+H]^+$: 389.1682, found 389.1676.

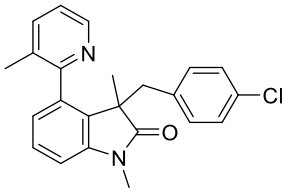
3-(4-fluorobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**19**)



White solid, 61.2 mg, 85% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 – 8.54 (m, 1H), 7.63 – 7.59 (m, 1H), 7.27 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 7.16 (dd, *J* = 8.4, 5.8 Hz, 2H), 6.86 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.73 – 6.65 (m, 2H), 6.57 – 6.53 (m, 1H), 3.27 (d, *J* = 12.5 Hz, 1H), 2.89 (s, 3H), 2.82

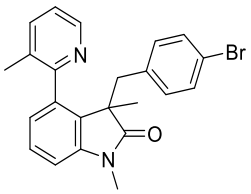
(d, *J* = 12.5 Hz, 1H), 2.08 (s, 3H), 1.06 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.7, 161.7 (d, *J* = 243.6 Hz), 157.9, 146.2, 143.8, 138.0, 137.4, 132.68, 132.66, 132.2, 131.2 (d, *J* = 7.7 Hz), 129.6, 127.8, 123.2(d, *J* = 44.5 Hz), 113.9 (d, *J* = 20.8 Hz), 107.3, 51.45, 51.45, 43.5, 25.9, 20.2, 19.6. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -116.98 – -117.07 (m). HRMS (ESI) Calcd for $C_{23}H_{21}FN_2O$ $[M+H]^+$: 361.1710, found 361.1705.

3-(4-chlorobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**20**)



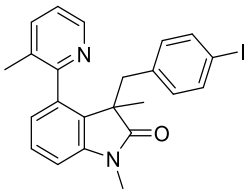
White solid, 69.0 mg, 92% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.56 (d, *J* = 4.0 Hz, 1H), 7.61 (d, *J* = 7.6 Hz, 1H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.24 (d, *J* = 7.8 Hz, 1H), 7.13 (d, *J* = 8.2 Hz, 2H), 6.97 (d, *J* = 8.3 Hz, 2H), 6.86 (d, *J* = 7.7 Hz, 1H), 6.57 (d, *J* = 7.7 Hz, 1H), 3.27 (d, *J* = 12.4 Hz, 1H), 2.91 (s, 3H), 2.81 (d, *J* = 12.5 Hz, 1H), 2.08 (s, 3H), 1.06 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.6, 157.8, 146.1, 143.7, 137.9, 137.3, 135.4, 132.12, 132.01, 131.0, 129.4, 127.8, 127.3, 123.3, 123.0, 107.3, 51.3, 43.5, 25.8, 20.3, 19.5. HRMS (ESI) Calcd for $C_{23}H_{21}ClN_2O$ $[M+H]^+$: 377.1415, found 377.1411.

3-(4-bromobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**21**)



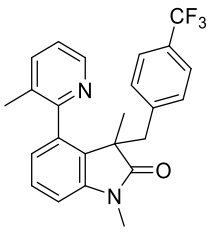
Colorless solid, 68.2 mg, 81% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.60 – 8.52 (m, 1H), 7.66 – 7.56 (m, 1H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.24 (t, *J* = 7.8 Hz, 1H), 7.12 (d, *J* = 8.4 Hz, 2H), 7.07 (d, *J* = 8.3 Hz, 2H), 6.86 (dd, *J* = 7.7, 0.7 Hz, 1H), 6.58 (d, *J* = 7.7 Hz, 1H), 3.25 (d, *J* = 12.4 Hz, 1H), 2.91 (s, 3H), 2.80 (d, *J* = 12.5 Hz, 1H), 2.09 (s, 3H), 1.06 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.7, 157.9, 146.2, 143.8, 138.1, 137.4, 136.0, 132.2, 131.5, 130.3, 129.4, 127.9, 123.4, 123.1, 120.4, 107.4, 51.3, 43.6, 26.0, 20.4, 19.6. HRMS (ESI) Calcd for $C_{23}H_{21}BrN_2O$ $[M+H]^+$: 421.0910, found 421.0911.

3-(4-iodobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**22**)



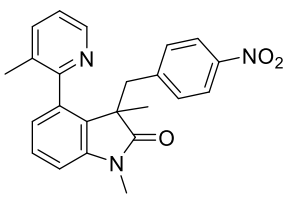
White solid, 87.2 mg, 93% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.59 – 8.52 (m, 1H), 7.65 – 7.57 (m, 1H), 7.35 – 7.31 (m, 2H), 7.28 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.24 (t, *J* = 7.8 Hz, 1H), 6.94 (d, *J* = 8.2 Hz, 2H), 6.86 (dd, *J* = 7.8, 0.8 Hz, 1H), 6.62 – 6.57 (m, 1H), 3.23 (d, *J* = 12.4 Hz, 1H), 2.92 (s, 3H), 2.79 (d, *J* = 12.5 Hz, 1H), 2.08 (s, 3H), 1.06 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.6, 157.9, 146.3, 143.8, 138.1, 137.4, 136.7, 136.4, 132.2, 131.9, 129.4, 127.9, 123.4, 123.1, 107.5, 92.1, 51.3, 43.7, 26.0, 20.5, 19.7. HRMS (ESI) Calcd for $C_{23}H_{21}IN_2O$ [M+H]$^+$: 469.0771, found 469.0766.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-(trifluoromethyl)benzyl)indolin-2-one (**23**)



White solid, 68.1 mg, 83% yield ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.59 – 8.53 (m, 1H), 7.61 (d, *J* = 7.1 Hz, 1H), 7.32 – 7.26 (m, 1H), 7.27 – 7.21 (m, 2H), 7.13 (d, *J* = 8.3 Hz, 2H), 6.97 (d, *J* = 8.4 Hz, 2H), 6.86 (d, *J* = 7.8 Hz, 1H), 6.57 (d, *J* = 7.8 Hz, 1H), 3.27 (d, *J* = 12.5 Hz, 1H), 2.91 (s, 3H), 2.82 (d, *J* = 12.5 Hz, 1H), 2.09 (s, 3H), 1.06 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.5, 157.9, 146.3, 143.7, 141.2, 138.1, 137.5, 132.3, 130.1, 129.3, 128.5 (q, *J* = 32.0 Hz), 128.0, 124.5 (q, *J* = 271.9 Hz), 124.1 (q, *J* = 3.7 Hz), 123.5, 123.1, 107.4, 51.3, 44.0, 25.9, 20.5, 19.6. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -62.33. HRMS (ESI) Calcd for $C_{24}H_{21}F_3N_2O$ [M+H]$^+$: 411.1678, found 411.1667.

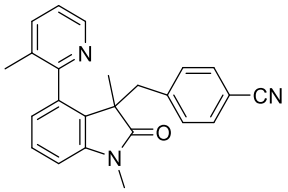
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-nitrobenzyl)indolin-2-one (**24**)



Colorless solid, 64.7 mg, 84% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.56 (d, *J* = 4.3 Hz, 1H), 7.85

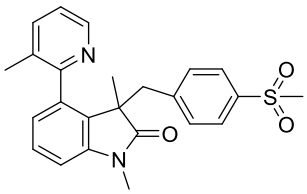
(d, *J* = 8.6 Hz, 2H), 7.63 (d, *J* = 7.7 Hz, 1H), 7.42 (d, *J* = 8.6 Hz, 2H), 7.29 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.23 (t, *J* = 7.8 Hz, 1H), 6.87 (d, *J* = 7.8 Hz, 1H), 6.55 (d, *J* = 7.8 Hz, 1H), 3.45 (d, *J* = 12.2 Hz, 1H), 2.94 (d, *J* = 12.1 Hz, 1H), 2.89 (s, 3H), 2.09 (s, 3H), 1.07 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.2, 157.6, 146.6, 146.2, 145.1, 143.5, 138.2, 137.4, 132.3, 130.7, 128. 8, 128.1, 123.7, 123.2, 122.4, 107.5, 51.3, 43.9, 25.9, 20.3, 19.6. HRMS (ESI) Calcd for $C_{23}H_{21}N_3O_3$ $[M+H]^+$: 388.1655, found 388.1655.

4-((1,3-dimethyl-4-(3-methylpyridin-2-yl)-2-oxoindolin-3-yl)methyl)benzonitrile (**25**)



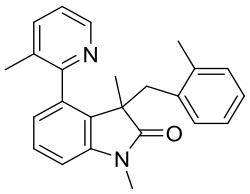
White solid, 64.0 mg, 87% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.55 (d, *J* = 3.8 Hz, 1H), 7.62 (d, *J* = 7.6 Hz, 1H), 7.34 (d, *J* = 8.2 Hz, 2H), 7.28 (dd, *J* = 7.8, 4.8 Hz, 3H), 7.23 (t, *J* = 7.8 Hz, 1H), 6.86 (d, *J* = 7.7 Hz, 1H), 6.55 (d, *J* = 7.7 Hz, 1H), 3.39 (d, *J* = 12.2 Hz, 1H), 2.90 – 2.85 (m, 4H), 2.08 (s, 3H), 1.05 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.2, 157.7, 146.2, 143.6, 142.8, 138.1, 137.4, 132.2, 131.0, 130.5, 128.9, 128.1, 123.6, 123.2, 119.4, 110.0, 107.4, 51.3, 44.2, 25.9, 20.2, 19.5. HRMS (ESI) Calcd for $C_{24}H_{21}N_3O$ $[M+H]^+$: 368.1757, found 368.1752.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-(methylsulfonyl)benzyl)indolin-2-one (**26**)



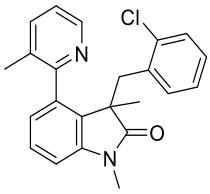
Colorless oil, 63.0 mg. 75% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 (d, *J* = 4.0 Hz, 1H), 7.65 (d, *J* = 7.6 Hz, 1H), 7.58 (d, *J* = 8.4 Hz, 2H), 7.43 (d, *J* = 8.2 Hz, 2H), 7.31 (dd, *J* = 7.6, 4.8 Hz, 1H), 7.24 (t, *J* = 7.8 Hz, 1H), 6.89 – 6.85 (m, 1H), 6.56 (d, *J* = 7.7 Hz, 1H), 3.41 (d, *J* = 12.3 Hz, 1H), 2.95 – 2.90 (m, 4H), 2.88 (s, 3H), 2.09 (s, 3H), 1.08 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.1, 157.5, 146.0, 143.7, 143.5, 138.3, 138.2, 137.1, 132.4, 130.7, 128.9, 128.1, 126.2, 123.6, 123.2, 107.5, 51.1, 44.5, 43.9, 25.9, 20.4, 19.5. HRMS (ESI) Calcd for $C_{24}H_{24}N_2O_3S$ $[M+H]^+$: 421.1580, found 421.1574.

1,3-dimethyl-3-(2-methylbenzyl)-4-(3-methylpyridin-2-yl)indolin-2-one (**27**)



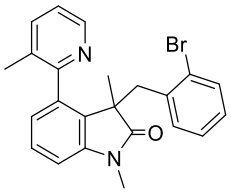
White solid, 50.0 mg, 70% yield, ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.56 – 8.49 (m, 1H), 7.55 (d, *J* = 7.6 Hz, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 7.25 (dd, *J* = 7.8, 4.9 Hz, 1H), 6.97 (d, *J* = 7.4 Hz, 1H), 6.93 (t, *J* = 7.9 Hz, 1H), 6.89 – 6.85 (m, 1H), 6.79 – 6.72 (m, 2H), 6.72 – 6.65 (m, 1H), 3.16 – 2.90 (m, 5H), 2.10 (s, 3H), 1.87 (s, 3H), 1.26 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.3, 157.9, 146.2, 144.1, 138.0, 137.3, 137.0, 135.6, 132.4, 130.9, 129.8, 128.8, 127.7, 126.1, 125.0, 123.5, 122.9, 107.5, 50.2, 39.2, 26.1, 22.9, 19.9, 19.2. HRMS (ESI) Calcd for $C_{24}H_{24}N_2O$ $[M+H]^+$: 357.1961, found 357.1953.

3-(2-chlorobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**28**)



Light brown solid, 63.7 mg, 85% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.55 – 8.48 (m, 1H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 7.25 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.23 – 7.18 (m, 1H), 6.99 (td, *J* = 7.9, 1.5 Hz, 1H), 6.90 – 6.85 (m, 2H), 6.81 (d, *J* = 7.7 Hz, 2H), 3.30 (d, *J* = 14.6 Hz, 1H), 3.13 (s, 3H), 2.93 (d, *J* = 11.7 Hz, 1H), 1.86 (s, 4H), 1.29 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.6, 157.5, 146.2, 143.9, 138.2, 137.4, 134.9, 134.6, 132.2, 130.6, 130.4, 129.1, 127.9, 127.5, 125.9, 123.5, 123.0, 107.6, 49.3, 38.8, 26.3, 22.8, 19.2. HRMS (ESI) Calcd for $C_{23}H_{21}ClN_2O$ $[M+H]^+$: 377.1415, found 421.377.1411.

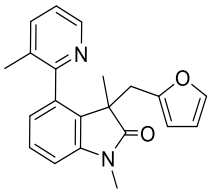
3-(2-bromobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**29**)



Colorless solid, 68.2 mg, 81% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 – 8.46 (m, 1H), 7.55 (d, *J* = 7.6 Hz, 1H), 7.40 (dd, *J* = 7.4, 1.8 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 7.25 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.95 – 6.88 (m, 2H), 6.85 (d, *J* = 7.8 Hz, 1H), 6.83 (d, *J* = 7.8 Hz, 1H), 6.71 (s, 1H), 3.27 (d, *J* = 14.8 Hz, 1H),

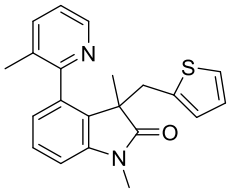
3.16 (s, 3H), 3.09 – 2.79 (m, 1H), 1.80 (s, 3H), 1.33 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.5, 157.4, 146.2, 143.8, 138.3, 137.4, 136.6, 132.5, 132.1, 130.5, 129.9, 127.9, 127.7, 126.6, 125.5, 123.6, 123.0, 107.7, 49.3, 41.3, 26.4, 23.7, 19.0. HRMS (ESI) Calcd for $C_{23}H_{21}BrN_2O$ $[M+H]^+$: 421.0910, found 421.0909.

3-(furan-2-ylmethyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**30**)



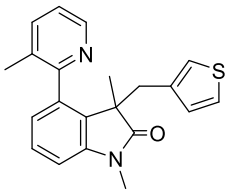
White solid, 59.1 mg, 89% yield ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 – 8.51 (m, 1H), 7.65 – 7.58 (m, 1H), 7.31 – 7.25 (m, 2H), 7.07 (dd, *J* = 1.7, 0.6 Hz, 1H), 6.87 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.80 – 6.75 (m, 1H), 6.04 (dd, *J* = 3.1, 1.8 Hz, 1H), 5.75 (s, 1H), 3.15 (s, 3H), 3.02 (d, *J* = 14.7 Hz, 1H), 2.97 – 2.81 (m, 1H), 2.05 (s, 3H), 1.27 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.1, 157.5, 151.8, 146.2, 144.1, 140.8, 138.2, 137.5, 132.3, 130.2, 127.7, 123.6, 123.0, 109.9, 107.5, 106.7, 49.7, 36.0, 26.4, 22.7, 19.6. HRMS (ESI) Calcd for $C_{21}H_{20}N_2O_2$ $[M+H]^+$: 333.1597, found 333.1593.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(thiophen-2-ylmethyl)indolin-2-one (**31**)



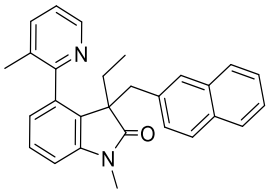
White solid, 62.0 mg, 89% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 – 8.53 (m, 1H), 7.63 – 7.58 (m, 1H), 7.29 – 7.22 (m, 2H), 6.99 – 6.96 (m, 1H), 6.92 (dd, *J* = 4.9, 3.0 Hz, 1H), 6.88 – 6.80 (m, 2H), 6.64 – 6.60 (m, 1H), 3.17 (d, *J* = 12.9 Hz, 1H), 2.97 (s, 3H), 2.94 (d, *J* = 13.0 Hz, 1H), 2.09 (s, 3H), 1.10 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 180.1, 157.9, 146.3, 144.0, 137.9, 137.5, 137.2, 132.1, 130.1, 129.1, 127.7, 123.5, 123.3, 123.0, 122.7, 107.2, 51.1, 38.9, 26.0, 20.8, 19.6. HRMS (ESI) Calcd for $C_{21}H_{20}N_2OS$ $[M+H]^+$: 349.1369, found 349.1358.

1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(thiophen-3-ylmethyl)indolin-2-one (**32**)



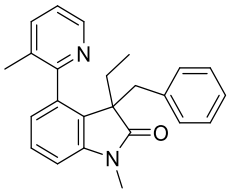
White solid, 50.1 mg, 72% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 (d, *J* = 3.8 Hz, 1H), 7.60 (d, *J* = 7.6 Hz, 1H), 7.29 – 7.26 (m, 1H), 7.25 (dd, *J* = 4.8, 3.0 Hz, 1H), 6.91 – 6.86 (m, 2H), 6.72 – 6.64 (m, 3H), 3.33 (d, *J* = 13.8 Hz, 1H), 3.14 (d, *J* = 13.9 Hz, 1H), 3.01 (s, 3H), 2.09 (s, 3H), 1.14 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.8, 157.7, 146.3, 144.5, 138.7, 138.1, 137.7, 132.1, 129.9, 127.9, 126.6, 125.9, 123.8, 123.6, 123.0, 107.4, 51.3, 38.9, 26.2, 21.4, 19.7. HRMS (ESI) Calcd for $C_{21}H_{20}N_2OS$ $[M+H]^+$: 349.1369, found 349.1368.

3-ethyl-1-methyl-4-(3-methylpyridin-2-yl)-3-(naphthalen-2-ylmethyl)indolin-2-one (**33**)



White solid, 74.7 mg, 92% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.63 (d, *J* = 4.1 Hz, 1H), 7.67 (dd, *J* = 6.0, 3.3 Hz, 2H), 7.63 (dd, *J* = 6.0, 3.4 Hz, 1H), 7.55 (s, 1H), 7.46 (d, *J* = 8.4 Hz, 1H), 7.38 – 7.28 (m, 4H), 7.19 (t, *J* = 7.8 Hz, 1H), 6.93 (d, *J* = 7.7 Hz, 1H), 6.45 (d, *J* = 7.7 Hz, 1H), 3.70 (s, 1H), 3.06 (d, *J* = 12.5 Hz, 1H), 2.82 (s, 3H), 2.15 (s, 3H), 1.88 (dq, *J* = 14.7, 7.4 Hz, 1H), 1.33 (s, 1H), 0.53 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.2, 157.5, 146.0, 145.0, 138.6, 137.0, 134.9, 133.1, 132.2, 128.5, 128.4, 128.2, 127.9, 127.5, 127.4, 126.4, 125.3, 125.0, 123.8, 123.0, 107.3, 57.6, 44.4, 28.4, 25.8, 19.6, 9.7. HRMS (ESI) Calcd for $C_{28}H_{26}N_2O$ $[M+H]^+$: 407.2117, found 407.2110.

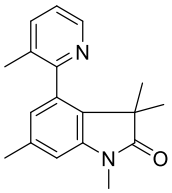
3-benzyl-3-ethyl-1-methyl-4-(3-methylpyridin-2-yl)indolin-2-one (**34**)



White solid, 57.0 mg, 80% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 – 8.54 (m, 1H), 7.64 – 7.60 (m, 1H), 7.26 (dd, *J* = 7.6, 4.8 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 7.17 – 7.13 (m, 2H), 7.05 – 6.95 (m, 3H), 6.90 (dd, *J* = 7.8, 0.8 Hz, 1H), 6.53 (d, *J* = 7.7 Hz, 1H), 3.57 (d, *J* = 12.0 Hz, 1H), 2.89 (s, 3H), 2.87 (s, 1H),

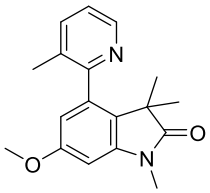
2.16 (s, 3H), 1.81 (dt, *J* = 14.8, 7.4 Hz, 1H), 1.27 – 1.21 (m, 1H), 0.50 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 179.2, 157.7, 146.1, 145.0, 138.3, 137.3, 137.1, 131.9, 129.7, 128.4, 127.4, 127.2, 126.1, 123.8, 122.8, 107.0, 57.6, 44.3, 28.1, 25.8, 19.6, 9.7. HRMS (ESI) Calcd for $C_{24}H_{24}N_2O$ $[M+H]^+$: 357.1961 found 357.1955.

1,3,3,6-tetramethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**35**)



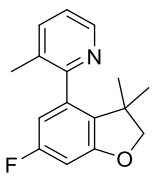
Light brown solid, 50.0 mg, 89% solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.47 (d, *J* = 4.0 Hz, 1H), 7.56 (d, *J* = 7.7 Hz, 1H), 7.22 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.70 (s, 1H), 6.64 (s, 1H), 3.22 (s, 3H), 2.37 (s, 3H), 2.08 (s, 3H), 1.09 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.9, 157.8, 146.1, 143.39, 137.8, 137.7, 137.3, 131.9, 129.3, 123.7, 122.9, 108.7, 45.0, 26.4, 23.6, 21.7, 19.6. HRMS (ESI) Calcd for $C_{18}H_{20}N_2O$ $[M+H]^+$: 281.1648, found 281.1645.

6-methoxy-1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**36**)



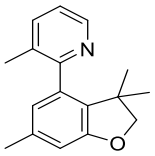
48.6 mg, dark brown solid, 82% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.51 – 8.45 (m, 1H), 7.58 (d, *J* = 7.7 Hz, 1H), 7.24 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.46 (d, *J* = 2.3 Hz, 1H), 6.33 (d, *J* = 2.3 Hz, 1H), 3.79 (s, 3H), 3.21 (s, 3H), 2.10 (s, 3H), 1.08 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.2, 159.5, 157.5, 146.2, 144.7, 138.1, 137.9, 131.9, 124.5, 123.1, 106.8, 96.0, 55.7, 44.8, 26.5, 23.7, 19.5. HRMS (ESI) Calcd for $C_{18}H_{20}N_2O_2$ $[M+H]^+$: 297.1598, found 297.1591.

2-(6-fluoro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**37**)



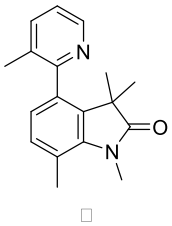
White yellow oil, 44.4 mg, 86% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.52 – 8.45 (m, 1H), 7.63 – 7.55 (m, 1H), 7.23 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.54 (dd, *J* = 9.3, 2.3 Hz, 1H), 6.38 (dd, *J* = 9.5, 2.3 Hz, 1H), 4.18 (s, 2H), 2.15 (s, 3H), 1.04 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 162.7 (d, *J* = 244.1 Hz),161.3 (d, *J* = 13.4 Hz), 157.05 (d, *J* = 2.1 Hz), 146.2, 138.1 (d, *J* = 9.8 Hz), 137.9, 131.9, 128.8 (d, *J* = 2.7 Hz), 123.0, 108.1(d, *J* = 22.7 Hz), 98.0 (d, *J* = 25.9 Hz), 85.9, 42.5, 26.3, 195.^{13}C NMR (151 MHz, Chloroform-*d*) δ 162.7 (d, *J* = 244.1 Hz), 161.3(d, *J* = 13.4 Hz), 157.1 (d, *J* = 2.1 Hz), 146.2, 138.1 (d, *J* = 9.8 Hz), 137.9, 131.8, 128.8 (d, *J* = 2.7 Hz), 123.0, 108.1 (d, *J* = 22.7 Hz), 98.0 (d, *J* = 25.9 Hz), 85.9, 42.5, 26.3, 19.5. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -114.52 (t, *J* = 9.4 Hz). HRMS (ESI) Calcd for $C_{16}H_{16}FNO$ $[M+H]^+$: 258.1288, found 258.1288.

2-methyl-2-(3,3,7-trimethyl-2,3-dihydrobenzofuran-4-yl)pyridine (**38**)



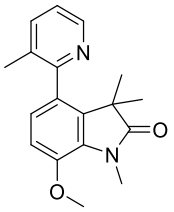
Pale yellow solid, 44.0 mg, 87% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.49 – 8.43 (m, 1H), 7.58 – 7.53 (m, 1H), 7.19 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.68 – 6.61 (m, 1H), 6.51 – 6.44 (m, 1H), 4.12 (s, 2H), 2.29 (s, 3H), 2.14 (s, 3H), 1.04 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 160.2, 158.3, 146.0, 138.2, 137.7, 137.1, 131.8, 130.0, 122.6, 122.0, 110.3, 85.0, 42.7, 26.7, 21.5, 19.6. HRMS (ESI) Calcd for $C_{17}H_{19}NO$ $[M+H]^+$: 254.1539, found 254.1532.

1,3,3,7-tetramethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**39**)



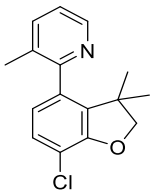
Light brown oil, 55.2 mg, 98% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.50 – 8.45 (m, 1H), 7.59 – 7.53 (m, 1H), 7.22 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.06 – 7.00 (m, 1H), 6.69 (d, *J* = 7.8 Hz, 1H), 3.53 (s, 3H), 2.62 (s, 3H), 2.06 (s, 3H), 1.09 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.4, 157.9, 146.1, 141.0, 137.8, 135.5, 132.8, 132.2, 131.4, 123.3, 122.9, 119.3, 44.6, 29.9, 23.7, 19.7, 19.5. HRMS (ESI) Calcd for $C_{18}H_{20}N_2O$ $[M+H]^+$: 281.1648, found 281.1643.

7-methoxy-1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**40**)



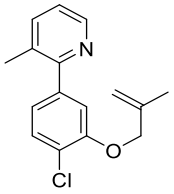
Light brown solid, 51.0 mg, 86% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.49 (dd, *J* = 4.9, 1.7 Hz, 1H), 7.57 (dd, *J* = 7.9, 1.8 Hz, 1H), 7.22 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.89 (d, *J* = 8.5 Hz, 1H), 6.77 (d, *J* = 8.4 Hz, 1H), 3.89 (s, 3H), 3.52 (s, 3H), 2.07 (s, 3H), 1.11 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.8, 157.8, 146.1, 145.1, 137.8, 133.9, 132.4, 131.0, 130.5, 123.7, 122.8, 111.5, 56.1, 45.4, 29.8, 23.6, 19.7. HRMS (ESI) Calcd for $C_{18}H_{20}N_2O_2$ $[M+H]^+$: 297.1598, found 297.1591.

2-(7-chloro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**41**)



Colorless oil, 22.1 mg, 40% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.48 (d, *J* = 4.4 Hz, 1H), 7.59 (d, *J* = 7.7 Hz, 1H), 7.23 (dd, *J* = 7.7, 4.8 Hz, 1H), 7.18 (d, *J* = 8.1 Hz, 1H), 6.61 (d, *J* = 8.1 Hz, 1H), 4.25 (s, 2H), 2.12 (s, 3H), 1.07 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 157.1, 155.7, 146.2, 138.0, 136.1, 134.7, 132.0, 128.4, 123.0, 122.6, 115.1, 85.1, 44.1, 26.4, 19.6. HRMS (ESI) Calcd for $C_{16}H_{16}ClNO$ $[M+H]^+$: 274.0993, found 274.0989.

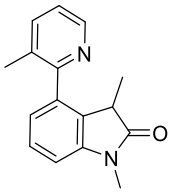
2-(7-chloro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**41'**)



Colorless oil, 13.0 mg, 24% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 – 8.49 (m, 1H), 7.61 (ddd, *J* = 7.7, 1.5, 0.7 Hz, 1H), 7.30 – 7.23 (m, 2H), 6.97 (dd, *J* = 8.3, 1.4 Hz, 1H), 6.91 (dd, *J* = 7.6, 1.4 Hz, 1H), 5.20 – 5.12 (m, 1H), 5.01 (dt, *J* = 2.5, 1.2 Hz, 1H), 4.55 (d, *J* = 3.4 Hz, 2H), 2.16 (s, 4H), 1.90 – 1.81 (m,

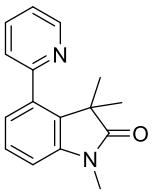
3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 157.1, 154.5, 146.6, 140.8, 140.4, 138.1, 132.4, 127.5, 123.0, 122.3, 122.0, 113.2, 113.1, 72.8, 19.5, 18.9. HRMS (ESI) Calcd for $C_{16}H_{16}ClNO$ $[M+H]^+$: 274.0993, found 274.0999.

1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**42**)



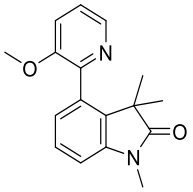
Light brown oil, 18.8 mg, 37% yield.^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 – 8.45 (m, 1H), 7.66 – 7.56 (m, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 7.23 (dd, *J* = 7.7, 4.8 Hz, 1H), 6.99 (d, *J* = 7.8 Hz, 1H), 6.85 (d, *J* = 7.8 Hz, 1H), 3.62 (q, *J* = 7.6 Hz, 1H), 3.23 (s, 3H), 2.22 (s, 3H), 0.90 (d, *J* = 7.6 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 178.9, 157.2, 147.0, 144.6, 138.4, 137.1, 131.4, 129.1, 127.8, 123.1, 122.8, 107.7, 40.4, 26.4, 19.4, 14.3. HRMS (ESI) Calcd for $C_{16}H_{16}N_2O$ $[M+H]^+$: 253.1335, found 253.1329.

1,3,3-trimethyl-4-(pyridin-2-yl)indolin-2-one (**43**)



Light yellow solid, 35.5 mg, 71% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.70 – 8.66 (m, 1H), 7.75 (td, *J* = 7.7, 1.8 Hz, 1H), 7.37 (d, *J* = 7.8 Hz, 1H), 7.35 – 7.28 (m, 2H), 7.03 – 6.99 (m, 1H), 6.91 (d, *J* = 7.8 Hz, 1H), 3.25 (s, 3H), 1.28 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.0, 158.9, 148.8, 143.3, 138.6, 136.4, 133.0, 127.7, 124.4, 124.1, 122.5, 108.2, 45.8, 26.5, 24.2. HRMS (ESI) Calcd for $C_{16}H_{16}N_2O$ $[M+H]^+$: 253.1335, found 253.1332.

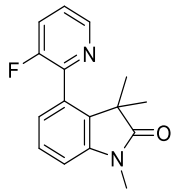
4-(3-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**44**)



Light brown solid, 47.9 mg, 85% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.28 – 8.25 (m, 1H), 7.34 –

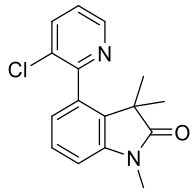
7.29 (m, 2H), 7.27 (dd, *J* = 8.4, 1.0 Hz, 1H), 6.92 (d, *J* = 7.7 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 3.73 (s, 3H), 3.23 (s, 3H), 1.13 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.7, 153.7, 148.3, 143.1, 140.4, 135.1, 133.0, 127.4, 124.0, 123.9, 117.9, 108.0, 55.3, 45.4, 26.4, 23.6. HRMS (ESI) Calcd for $C_{17}H_{18}N_2O_2$ $[M+H]^+$: 283.1441, found 283.1437.

4-(3-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**45**)



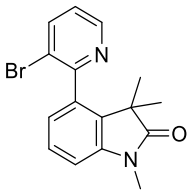
White solid, 41.2 mg, 76% solid. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.44 (dt, *J* = 4.6, 1.4 Hz, 1H), 7.47 – 7.41 (m, 1H), 7.34 – 7.25 (m, 2H), 6.89 (dd, *J* = 20.9, 7.8 Hz, 2H), 3.18 (s, 3H), 1.13 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.5, 157.1 (d, *J* = 257.4 Hz), 147.0 (d, *J* = 15.3 Hz), 144.7 (d, *J* = 5.4 Hz), 143.4, 133.6, 132.2 (d, *J* = 3.3 Hz), 127.6, 124.6 (d, *J* = 3.5 Hz), 124.0 (d, *J* = 2.0 Hz), 123.6 (d, *J* = 19.8 Hz), 108.7, 45.4, 26.5, 23.9. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -119.94 (dd, *J* = 8.9, 3.5 Hz). HRMS (ESI) Calcd for $C_{16}H_{15}FN_2O$ $[M+H]^+$: 271.1241, found 271.1240.

4-(3-chloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**46**)



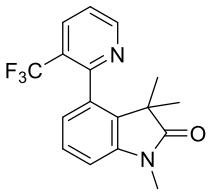
White solid, 45.0 mg, 79% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.52 (dd, *J* = 4.7, 1.5 Hz, 1H), 7.75 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.31 – 7.23 (m, 2H), 6.87 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.85 (dd, *J* = 7.8, 0.9 Hz, 1H), 3.19 (s, 3H), 1.10 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.5, 156.3, 146.8, 143.3, 137.4, 135.5, 132.6, 131.8, 127.6, 124.2, 123.5, 108.4, 45.3, 26.5, 23.7. HRMS (ESI) Calcd for $C_{16}H_{15}ClN_2O$ $[M+H]^+$: 287.0946, found 287.0939.

4-(3-bromopyridin-2-yl)-1,3,3-trimethylindolin-2-one (**47**)



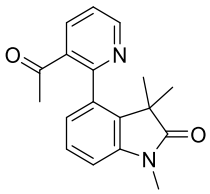
White solid, 50.0 mg, 50.0 mg, 76% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.61 (dd, *J* = 4.7, 1.2 Hz, 1H), 7.99 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 7.23 (dd, *J* = 8.1, 4.7 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 3.25 (s, 3H), 1.16 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 157.8, 147.3, 143.2, 140.6, 137.0, 132.3, 127.5, 124.3, 123.6, 121.8, 108.4, 45.3, 26.5, 23.7. HRMS (ESI) Calcd for $C_{16}H_{15}BrN_2O$ $[M+H]^+$: 331.0440, found 331.0437.

1,3,3-trimethyl-4-(3-(trifluoromethyl)pyridin-2-yl)indolin-2-one (**48**)



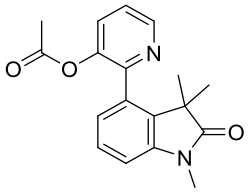
White solid, 51.0 mg, 80% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.85 (d, *J* = 4.7 Hz, 1H), 8.11 (dd, *J* = 8.0, 1.3 Hz, 1H), 7.51 (dd, *J* = 8.0, 4.9 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 6.98 – 6.94 (m, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 3.26 (s, 3H), 1.36 (s, 3H), 0.91 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 156.5, 151.3, 143.1, 135.4, 134.8 (q, *J* = 4.7 Hz), 132.5, 127.1, 126.0 (q, *J* = 31.6 Hz), 123.6, 123.3 (q, *J* = 273.6 Hz), 122.8, 108.7, 45.6, 26.5, 21.8. ^{19}F NMR (565 MHz, $CDCl_3$) δ -58.176. HRMS (ESI) Calcd for $C_{17}H_{15}F_3N_2O$ $[M+H]^+$: 321.1209, found 321.1208.

4-(3-acetylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**49**)



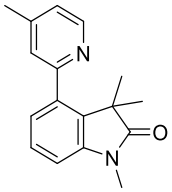
White solid, 37.0 mg, 63% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.77 (dd, *J* = 4.8, 1.7 Hz, 1H), 8.03 (dd, *J* = 7.9, 1.7 Hz, 1H), 7.44 (dd, *J* = 7.9, 4.8 Hz, 1H), 7.30 (t, *J* = 7.8 Hz, 1H), 6.95 (d, *J* = 7.8 Hz, 1H), 6.82 – 6.77 (m, 1H), 3.26 (s, 3H), 2.05 (s, 3H), 1.26 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 201.0, 181.6, 156.6, 150.5, 143.6, 137.0, 136.9, 136.0, 132.5, 127.9, 124.3, 122.9, 108.8, 45.7, 30.0, 26.6, 24.2. HRMS (ESI) Calcd for $C_{18}H_{18}N_2O_2$ $[M+H]^+$: 295.1441, found 295.1437.

2-(1,3,3-trimethyl-2-oxoindolin-4-yl)pyridin-3-yl acetate (**50**)



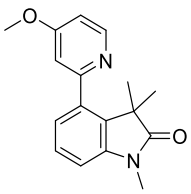
White solid, 31.0 mg, 50% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.57 (dd, *J* = 4.7, 1.4 Hz, 1H), 7.53 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.40 (dd, *J* = 8.2, 4.7 Hz, 1H), 7.27 (t, *J* = 7.8 Hz, 1H), 6.91 – 6.85 (m, 2H), 3.24 (s, 3H), 1.98 (s, 3H), 1.18 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.7, 168.9, 151.7, 146.4, 145.5, 143.3, 133.7, 133.3, 131.0, 127.3, 123.9, 123.5, 108.5, 45.5, 26.5, 23.9, 20.7. HRMS (ESI) Calcd for $C_{18}H_{18}N_2O_3$ $[M+H]^+$: 311.1390, found 311.1382.

1,3,3-trimethyl-4-(4-methylpyridin-2-yl)indolin-2-one (**51**)



Colorless oil, 42.0 mg, 79% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.52 (d, *J* = 5.0 Hz, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 7.20 – 7.16 (m, 1H), 7.14 – 7.10 (m, 1H), 6.99 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.89 (dd, *J* = 7.8, 0.8 Hz, 1H), 3.24 (s, 3H), 2.40 (s, 3H), 1.28 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.0, 158.7, 148.5, 147.4, 143.3, 138.7, 133.0, 127.6, 125.3, 124.1, 123.5, 108.1, 45.8, 26.5, 24.2, 21.2. HRMS (ESI) Calcd for $C_{17}H_{18}N_2O$ $[M+H]^+$: 267.1491, found 267.1486.

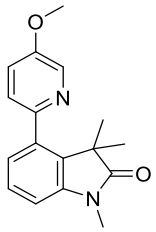
4-(4-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**52**)



Colorless oil, 45.2 mg, 80% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.47 (d, *J* = 5.7 Hz, 1H), 7.30 (t, *J* = 7.8 Hz, 1H), 6.99 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.91 – 6.88 (m, 1H), 6.86 (d, *J* = 2.3 Hz, 1H), 6.82 (dd, *J* = 5.8, 2.5 Hz, 1H), 3.86 (s, 3H), 3.23 (s, 3H), 1.29 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.0, 165.7, 160.3, 150.0, 143.2, 138.6, 132.8, 127.6, 123.9, 110.6, 108.6, 108.1, 55.3, 45.8, 26.5, 24.2. HRMS (ESI)

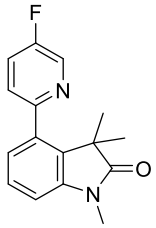
Calcd for $C_{17}H_{18}N_2O_2$ [M+H]$^+$: 283.1441, found 283.1438.

4-(5-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**53**)



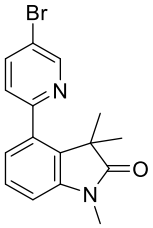
White solid, 34.0 mg, 60% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.36 (d, *J* = 2.6 Hz, 1H), 7.33 – 7.28 (m, 2H), 7.27 – 7.23 (m, 1H), 6.99 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.88 (dd, *J* = 7.8, 0.9 Hz, 1H), 3.91 (s, 3H), 3.23 (s, 3H), 1.29 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.0, 154.8, 151.1, 143.3, 138.2, 136.0, 133.1, 127.6, 124.6, 124.3, 120.9, 107.9, 55.7, 45.8, 26.5, 24.1. HRMS (ESI) Calcd for $C_{17}H_{18}N_2O_2$ [M+H]$^+$: 283.1441, found 283.1437.

4-(5-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**54**)



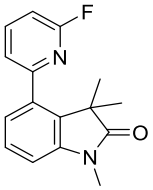
White solid, 38.2 mg, 71% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 (d, *J* = 2.9 Hz, 1H), 7.48 (td, *J* = 8.4, 2.9 Hz, 1H), 7.39 (dd, *J* = 8.6, 4.3 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 6.99 (d, *J* = 7.8 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 3.24 (s, 3H), 1.28 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.8, 158.8 (d, *J* = 257.2 Hz), 155.0 (d, *J* = 4.3 Hz), 143.5, 137.4, 136.9 (d, *J* = 23.2 Hz), 133.2, 127.8, 125.3 (d, *J* = 4.2 Hz), 124.1, 123.3 (d, *J* = 18.3 Hz), 108.3, 45.8, 26.5, 24.1. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -128.55 (dd, *J* = 8.1, 4.4 Hz). HRMS (ESI) Calcd for $C_{16}H_{15}FN_2O$ [M+H]$^+$: 271.1241, found 271.1239.

4-(5-bromopyridin-2-yl)-1,3,3-trimethylindolin-2-one (**55**)



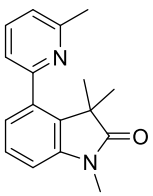
White solid, 40.0 mg, 61% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.75 (d, *J* = 2.3 Hz, 1H), 7.89 (dd, *J* = 8.3, 2.4 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 7.30 (d, *J* = 8.3 Hz, 1H), 6.99 (d, *J* = 7.8 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 3.25 (s, 3H), 1.30 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.82, 157.3, 149.8, 143.6, 139.1, 137.2, 133.1, 127.9, 125.6, 123.9, 119.9, 108.5, 45.8, 26.6, 24.2. HRMS (ESI) Calcd for $C_{16}H_{15}BrN_2O$ $[M+H]^+$: 331.0440, found 331.0434.

4-(6-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**56**)



Light brown solid, 40.3 mg, 75% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.54 (d, *J* = 2.9 Hz, 1H), 7.48 (td, *J* = 8.4, 2.9 Hz, 1H), 7.39 (dd, *J* = 8.6, 4.3 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 6.98 (d, *J* = 7.8 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 3.24 (s, 3H), 1.28 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.8, 158.8 (d, *J* = 257.1 Hz), 155.0 (d, *J* = 4.3 Hz), 143.5, 137.4, 136.9 (d, *J* = 23.1 Hz), 133.2, 127.8, 125.3 (d, *J* = 4.1 Hz), 124.1, 123.3 (d, *J* = 18.4 Hz), 108.3, 45.8, 26.5, 24.1. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -128.55 (dd, *J* = 8.1, 4.5 Hz).HRMS (ESI) Calcd for $C_{16}H_{15}FN_2O$ $[M+H]^+$: 271.1241, found 271.1234.

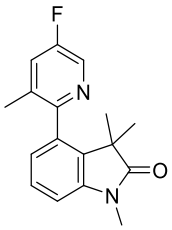
1,3,3-trimethyl-4-(6-methylpyridin-2-yl)indolin-2-one (**57**)



Light brown oil, 43.3 mg, 81% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.64 (t, *J* = 7.7 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 7.17 (dd, *J* = 7.7, 4.0 Hz, 2H), 7.01 (dd, *J* = 7.8, 0.9 Hz, 1H), 6.92 – 6.87 (m, 1H), 3.24 (s, 3H), 2.61 (s, 3H), 1.30 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.1, 158.2, 157.6, 143.4, 138.9, 136.6, 133.0, 127.7, 124.1, 121.9, 121.2, 108.1, 45.9, 26.5, 24.6, 24.2. HRMS (ESI) Calcd for $C_{17}H_{18}N_2O$

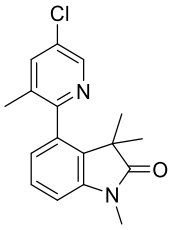
[M+H]$^+$: 267.1491, found 267.1488.

4-(5-fluoro-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**58**)



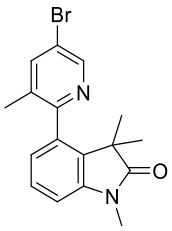
Light brown solid, 47.9 mg, 84% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.34 (d, *J* = 2.1 Hz, 1H), 7.38 – 7.27 (m, 2H), 6.88 (d, *J* = 7.8 Hz, 1H), 6.79 (d, *J* = 7.7 Hz, 1H), 3.23 (s, 3H), 2.08 (s, 3H), 1.10 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 158.9 (d, *J* = 257.1 Hz), 153.8, 143.4, 136.6, 134.2 (d, *J* = 22.7 Hz), 134.0 (d, *J* = 3.9 Hz), 132.5, 127.7, 124.4 (d, *J* = 17.7 Hz), 123.4, 108.0, 45.2, 26.4, 23.5, 19.7. ^{19}F NMR (565 MHz, Chloroform-*d*) δ -128.80 (d, *J* = 9.0 Hz). HRMS (ESI) Calcd for $C_{17}H_{17}FN_2O$ [M+H]$^+$: 285.1398, found 285.1390.

4-(5-chloro-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**59**)



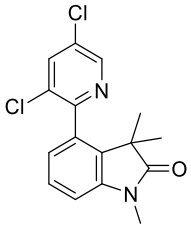
Light brown solid, 52.2 mg, 87% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.46 (d, *J* = 2.0 Hz, 1H), 7.60 (d, *J* = 1.8 Hz, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 6.79 (d, *J* = 7.7 Hz, 1H), 3.24 (s, 3H), 2.07 (s, 3H), 1.12 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 155.9, 145.0, 143.5, 137.4, 136.3, 133.6, 132.4, 131.1, 127.8, 123.2, 108.1, 45.3, 26.5, 23.6, 19.5. HRMS (ESI) Calcd for $C_{17}H_{17}ClN_2O$ [M+H]$^+$: 301.1102, found 301.1094.

4-(5-bromo-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**60**)



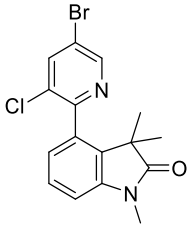
White solid, 60.6 mg, 87% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.58 – 8.52 (m, 1H), 7.80 – 7.71 (m, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 6.89 (d, *J* = 7.8 Hz, 1H), 6.79 (d, *J* = 7.7 Hz, 1H), 3.24 (s, 3H), 2.06 (s, 3H), 1.13 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 156.2, 147.1, 143.5, 140.2, 136.3, 134.1, 132.3, 127.8, 123.2, 119.9, 108.1, 45.3, 26.5, 23.6, 19.5. HRMS (ESI) Calcd for $C_{17}H_{17}BrN_2O$ $[M+H]^+$: 345.0597, found 345.0599.

4-(3,5-dichloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**61**)



Light brown solid, 36.4 mg, 57% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.55 (d, *J* = 2.0 Hz, 1H), 7.85 (d, *J* = 2.0 Hz, 1H), 7.34 (t, *J* = 7.8 Hz, 1H), 6.94 (d, *J* = 7.8 Hz, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 3.25 (s, 3H), 1.17 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.3, 154.5, 145.8, 143.4, 136.9, 134.4, 132.8, 132.0, 131.6, 127.7, 123.5, 108.7, 45.3, 26.5, 23.7. HRMS (ESI) Calcd for $C_{16}H_{14}Cl_2N_2O$ $[M+H]^+$: 321.0556, found 321.0556.

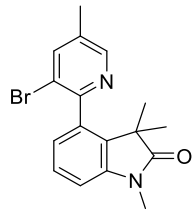
4-(5-bromo-3-chloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**62**)



Colorless solid, 38.0 mg, 53% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.65 (d, *J* = 2.0 Hz, 1H), 8.00 (d, *J* = 2.0 Hz, 1H), 7.34 (t, *J* = 7.8 Hz, 1H), 6.96 – 6.92 (m, 1H), 6.88 (d, *J* = 7.3 Hz, 1H), 3.25 (s, 3H), 1.17 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.3, 154.9, 148.0, 143.4, 139.6, 134.4, 132.8, 132.2, 127.7, 123.4, 119.9, 108.7, 45.3, 26.6, 23.8. HRMS (ESI) Calcd for $C_{16}H_{14}BrClN_2O$ $[M+H]^+$: 365.0050, found

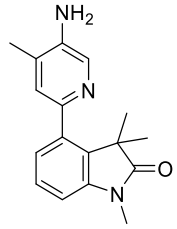
365.0050.

4-(3-bromo-5-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**63**)



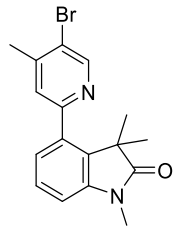
White solid, 60.0 mg, 87% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.43 (s, 1H), 7.81 (s, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 6.90 (d, *J* = 7.8 Hz, 1H), 6.87 (d, *J* = 7.8 Hz, 1H), 3.24 (s, 3H), 2.40 (s, 3H), 1.17 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.5, 154.7, 147.8, 143.2, 140.9, 136.9, 134.5, 132.5, 127.5, 123.9, 121.3, 108.2, 45.3, 26.5, 23.6, 17.9. HRMS (ESI) Calcd for $C_{17}H_{17}BrN_2O$ $[M+H]^+$: 345.0597, found 345.0590.

4-(5-amino-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**64**)



Light brown solid, 31.5 mg, 56% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (s, 1H), 7.27 (t, *J* = 7.8 Hz, 1H), 7.04 (s, 1H), 6.97 (dd, *J* = 7.8, 0.8 Hz, 1H), 6.85 (dd, *J* = 7.8, 0.7 Hz, 1H), 3.76 (s, 2H), 3.23 (s, 3H), 2.20 (s, 3H), 1.30 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.2, 149.0, 143.2, 140.4, 138.8, 135.5, 133.1, 130.6, 127.4, 125.6, 124.4, 107.5, 45.9, 26.5, 24.1, 17.0. HRMS (ESI) Calcd for $C_{17}H_{19}N_3O$ $[M+H]^+$: 282.1601, found 282.1595.

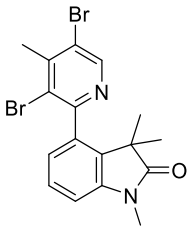
4-(5-bromo-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**65**)



Colorless oil, 57.3 mg, 83% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.69 (s, 1H), 7.32 (t, *J* = 7.8 Hz,

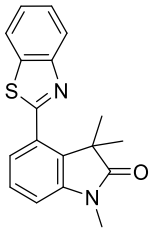
1H), 7.26 (s, 1H), 7.01 – 6.96 (m, 1H), 6.93 – 6.88 (m, 1H), 3.24 (s, 3H), 2.44 (s, 3H), 1.30 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.9, 157.6, 150.2, 147.2, 143.5, 137.3, 133.1, 127.7, 126.5, 124.0, 122.6, 108.4, 45.8, 26.5, 24.2, 22.5. HRMS (ESI) Calcd for $C_{17}H_{17}BrN_2O$ $[M+H]^+$: 345.0597, found 345.0599.

4-(3,5-dibromo-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**66**)



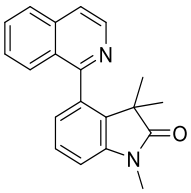
Light brown solid, 64.0 mg, 76% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.64 (s, 1H), 7.33 (t, *J* = 7.8 Hz, 1H), 6.92 (d, *J* = 7.8 Hz, 1H), 6.86 (d, *J* = 7.8 Hz, 1H), 3.25 (s, 3H), 2.66 (s, 3H), 1.27 (s, 3H), 1.07 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.4, 156.9, 148.6, 147.7, 143.3, 137.1, 132.0, 127.6, 124.8, 123.5, 122.6, 108.4, 45.3, 26.5, 25.4, 24.2, 22.1. HRMS (ESI) Calcd for $C_{17}H_{16}Br_2N_2O$ $[M+H]^+$: 422.9702, found 422.9700.

4-(benzo[d]thiazol-2-yl)-1,3,3-trimethylindolin-2-one (**67**)



White solid, 26.6 mg, 43% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.14 – 8.10 (m, 1H), 7.96 – 7.92 (m, 1H), 7.53 (ddd, *J* = 8.3, 7.3, 1.2 Hz, 1H), 7.46 – 7.41 (m, 2H), 7.39 (t, *J* = 7.7 Hz, 1H), 6.99 (dd, *J* = 7.6, 1.1 Hz, 1H), 3.28 (s, 3H), 1.60 (s, 6H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 182.0, 166.3, 153.9, 144.3, 135.6, 133.8, 130.9, 128.1, 126.5, 125.7, 124.8, 123.7, 121.5, 110.0, 46.5, 26.6, 23.0. HRMS (ESI) Calcd for $C_{18}H_{16}N_2OS$ $[M+H]^+$: 309.1056, found 309.1052.

4-(isoquinolin-1-yl)-1,3,3-trimethylindolin-2-one (**68**)



White solid, 22.3 mg, 37% yield. ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.61 (d, *J* = 5.7 Hz, 1H), 7.89 (d, *J* = 8.2 Hz, 1H), 7.72 (d, *J* = 5.7 Hz, 1H), 7.68 (t, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 8.4 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 1H), 7.38 (t, *J* = 7.8 Hz, 1H), 6.99 (dd, *J* = 7.8, 4.1 Hz, 2H), 3.29 (s, 3H), 1.36 (s, 3H), 0.69 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 181.7, 159.3, 143.4, 141.7, 136.4, 136.3, 133.5, 130.4, 128.1, 127.7, 127.4, 127.3, 127.0, 124.4, 120.7, 108.2, 45.6, 26.6, 25.6, 22.6. HRMS (ESI) Calcd for $C_{20}H_{18}N_2O$ $[M+H]^+$: 303.1491, found 303.1485.

7. References

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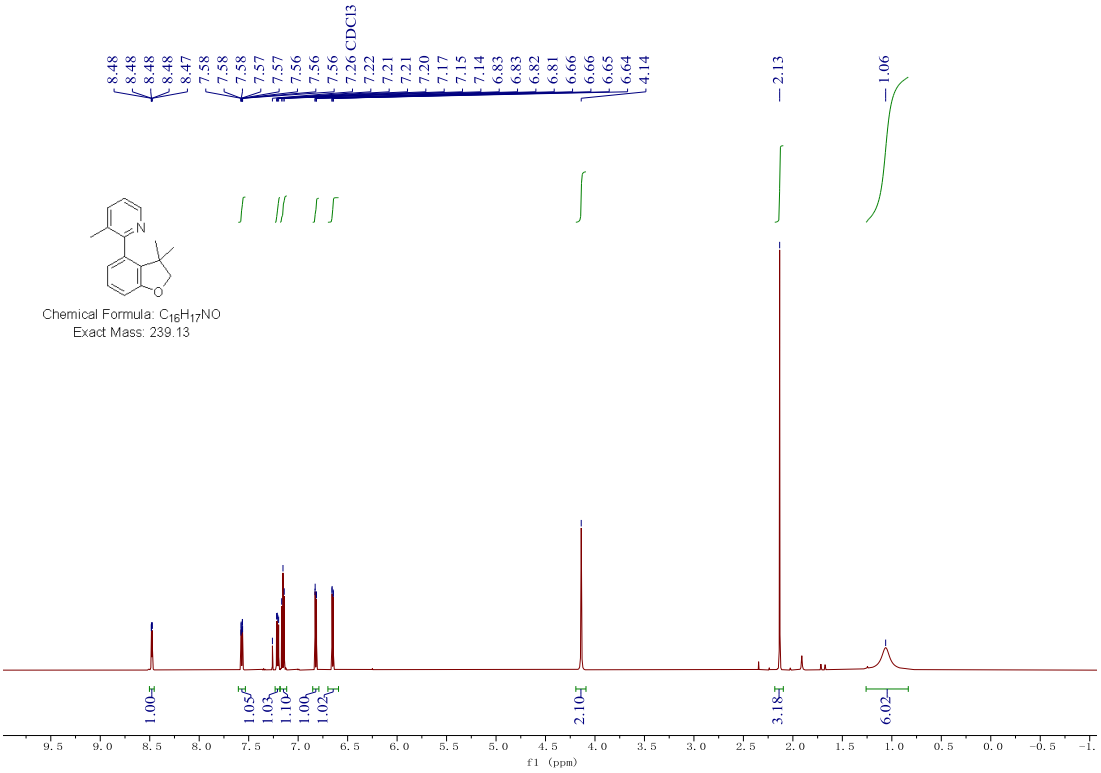
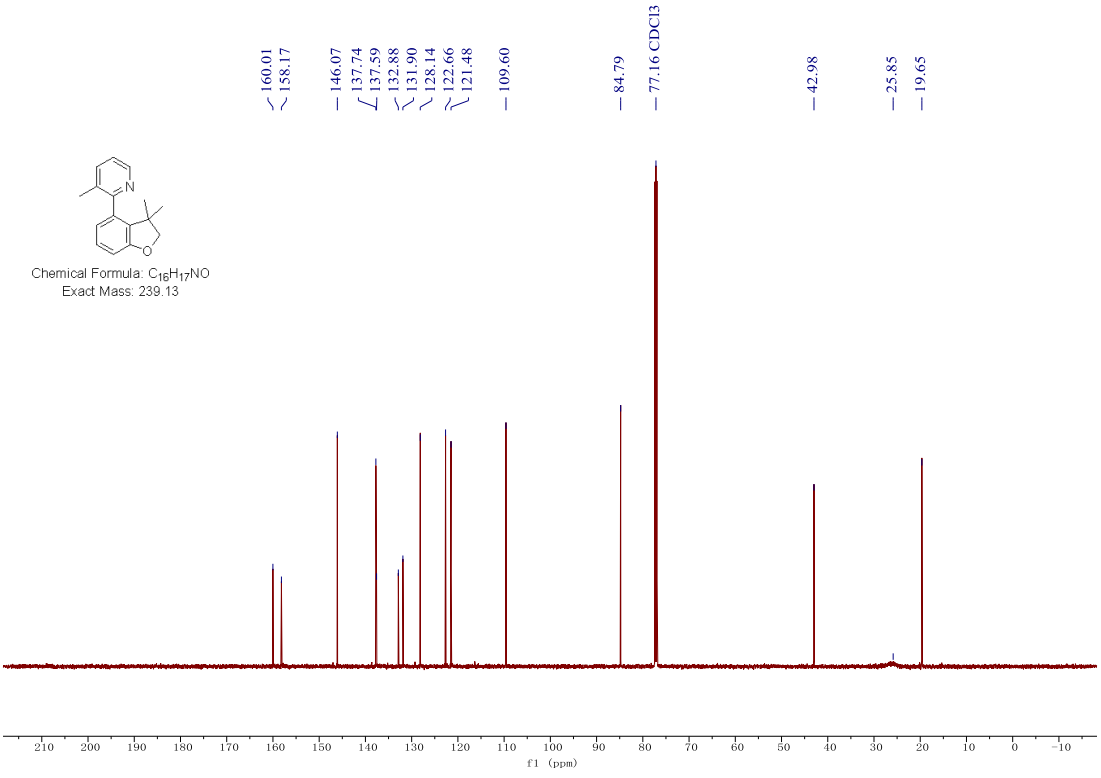
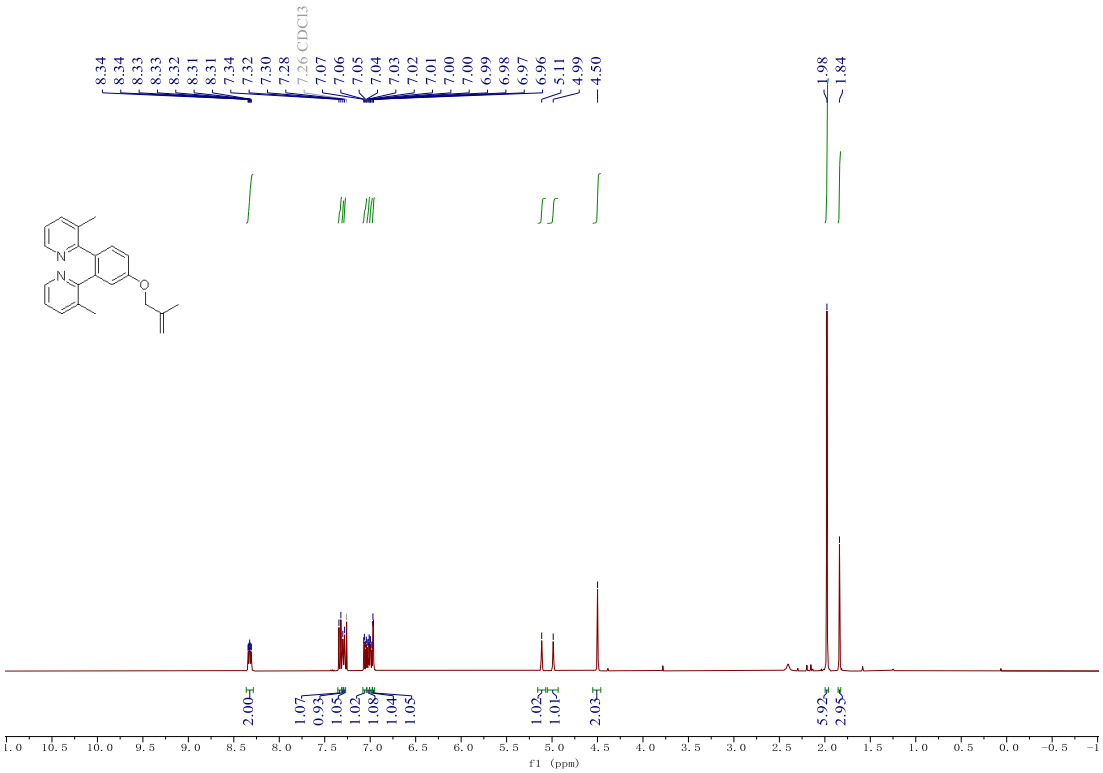
8. Spectra

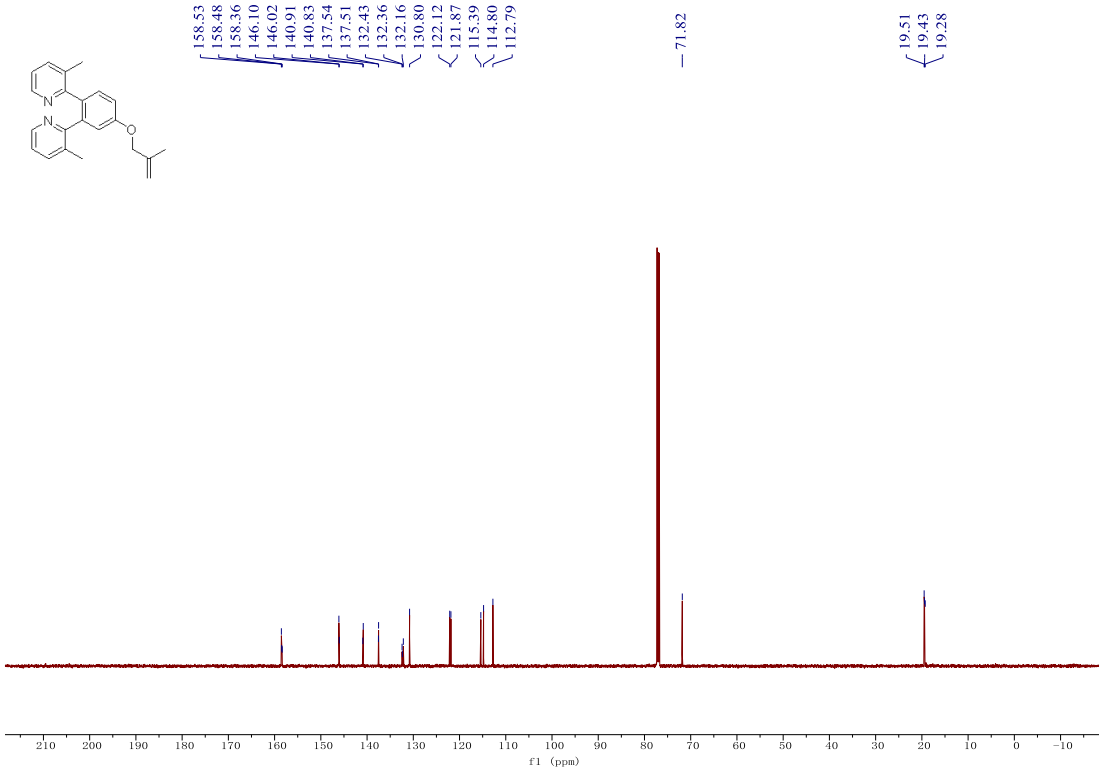
2-(3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine **3**



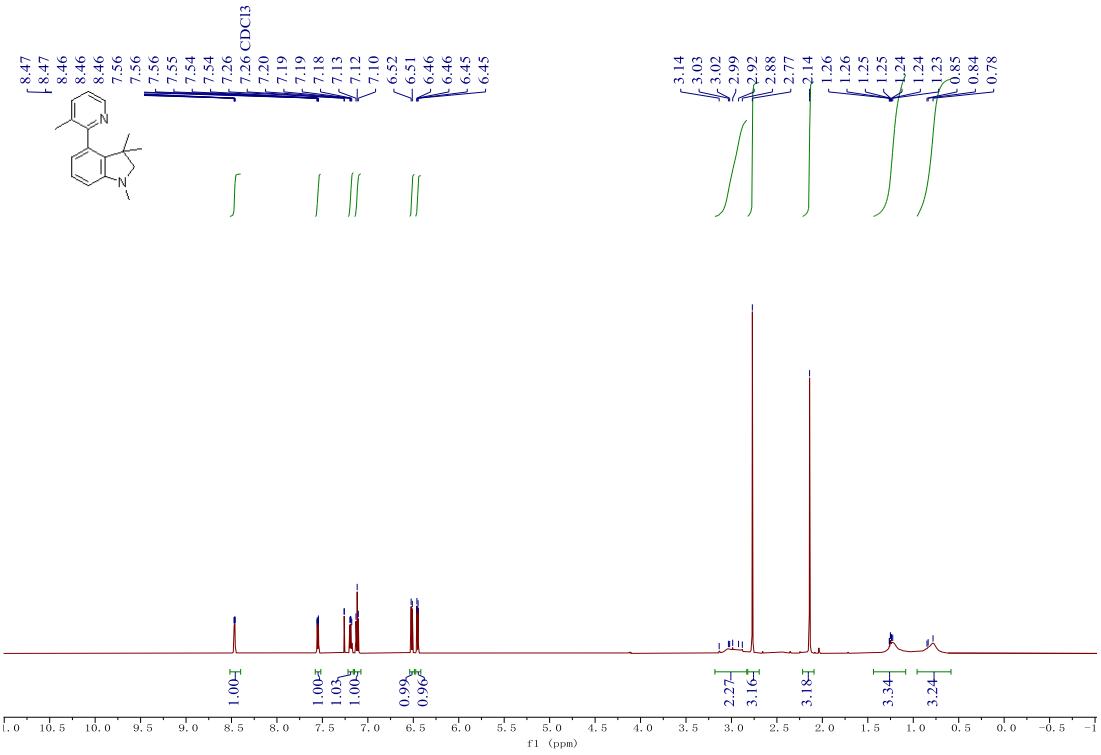


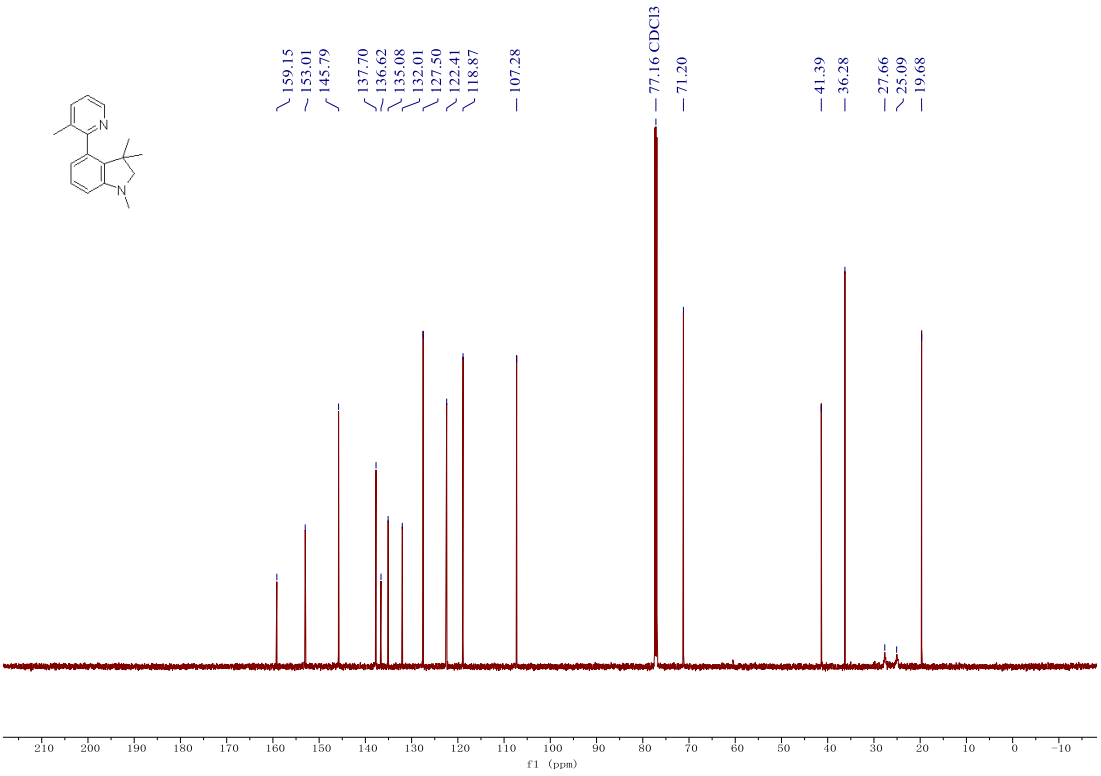
2,2'-(4-((2-methylallyl)oxy)-1,2-phenylene)bis(3-methylpyridine) (**4**)



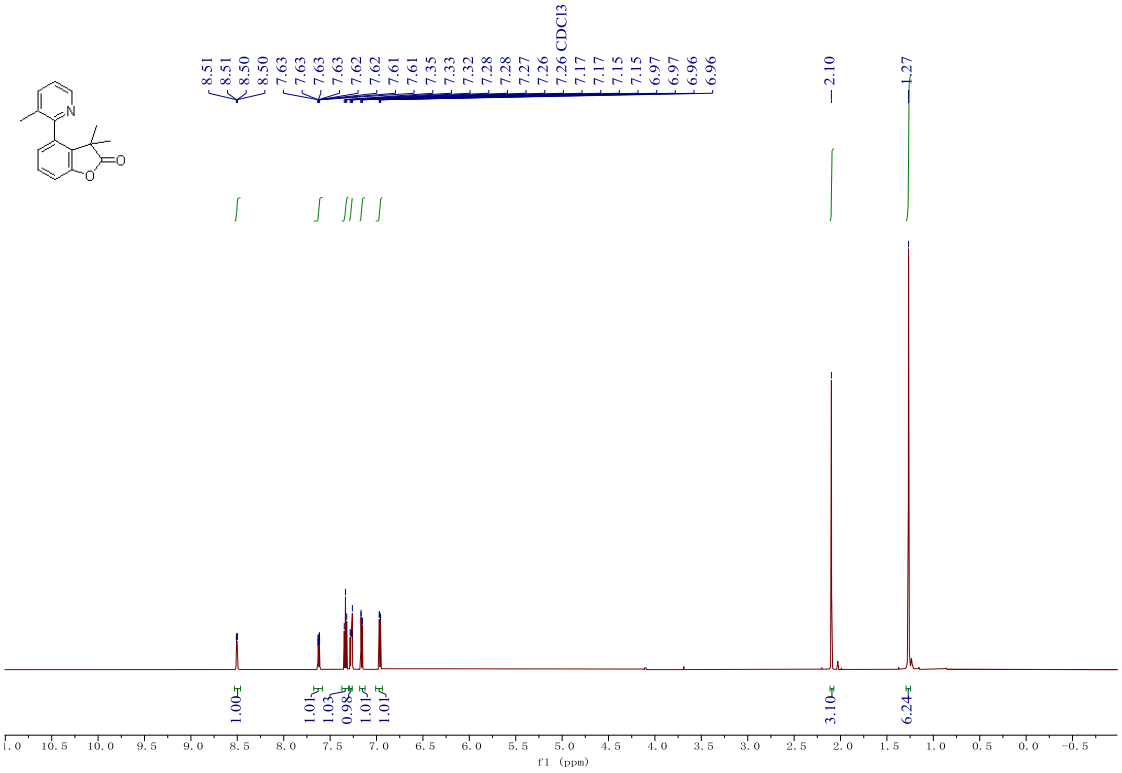


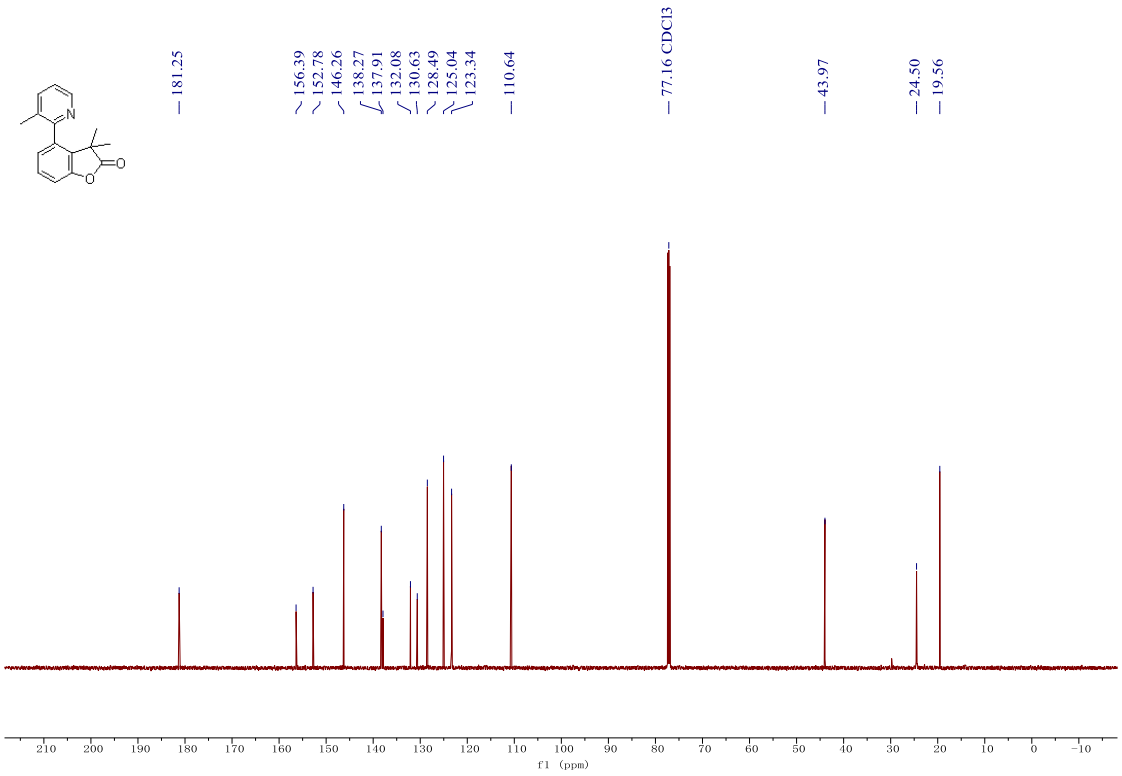
1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indoline (**5**)



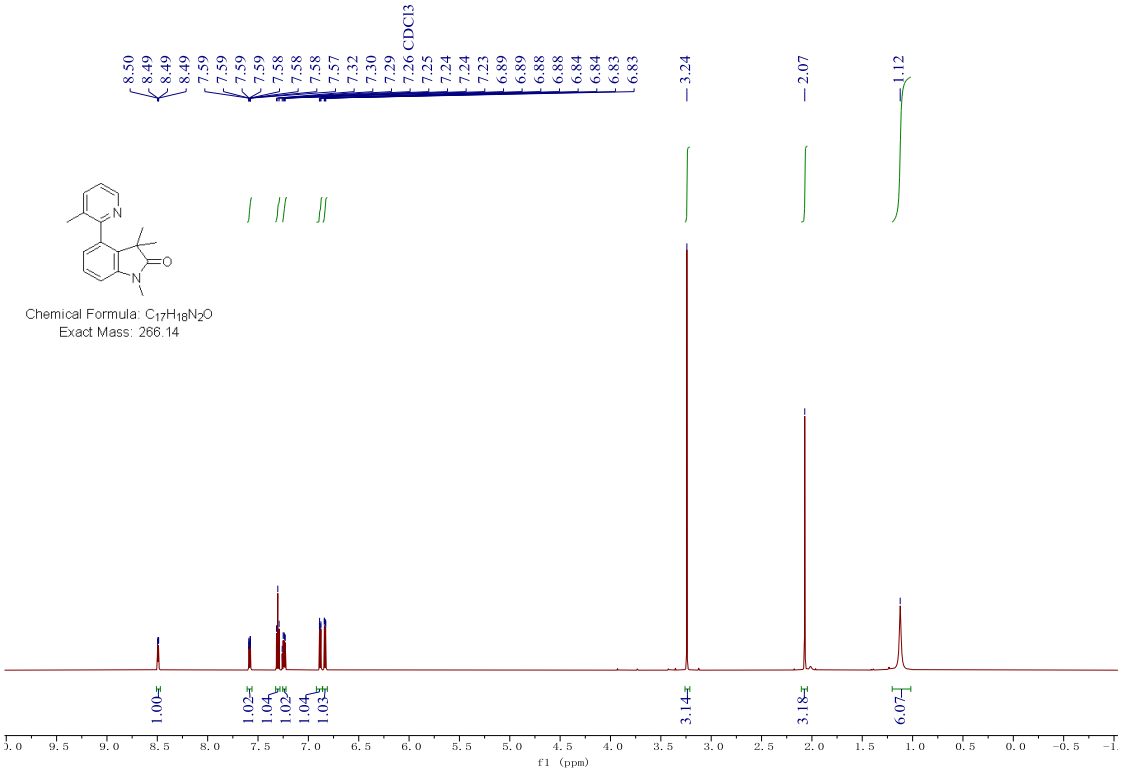


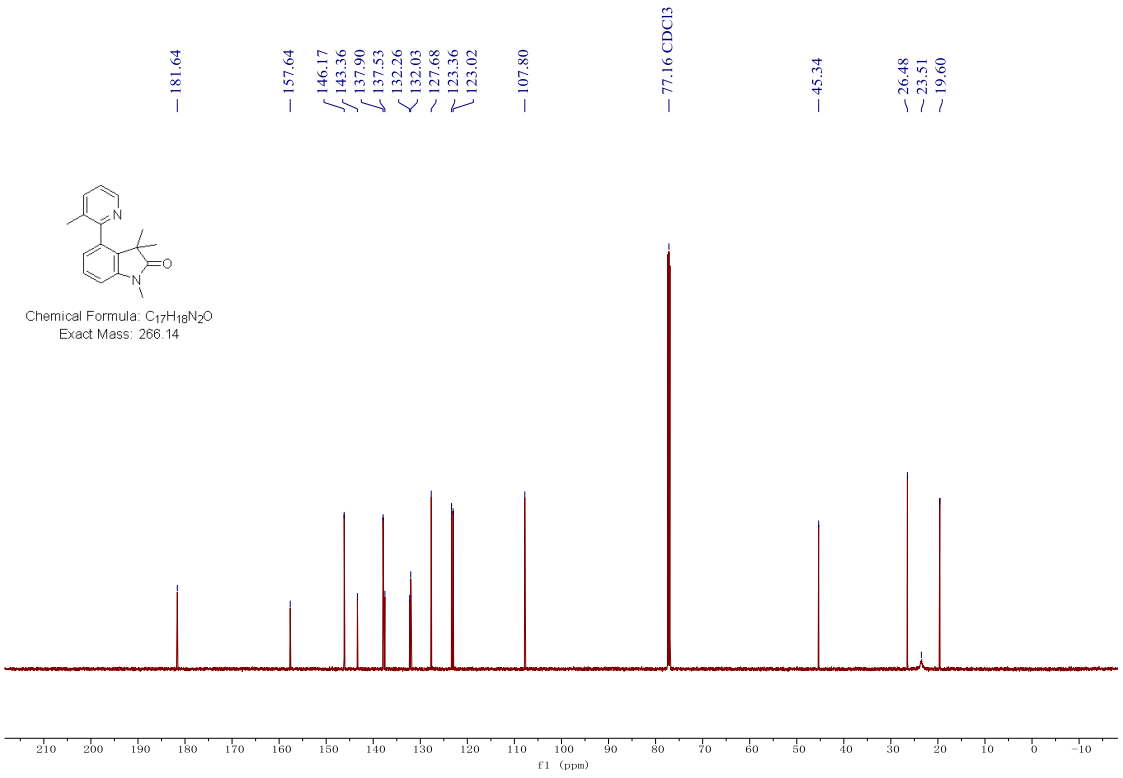
3,3-dimethyl-4-(3-methylpyridin-2-yl)benzofuran-2(3H)-one (**6**)



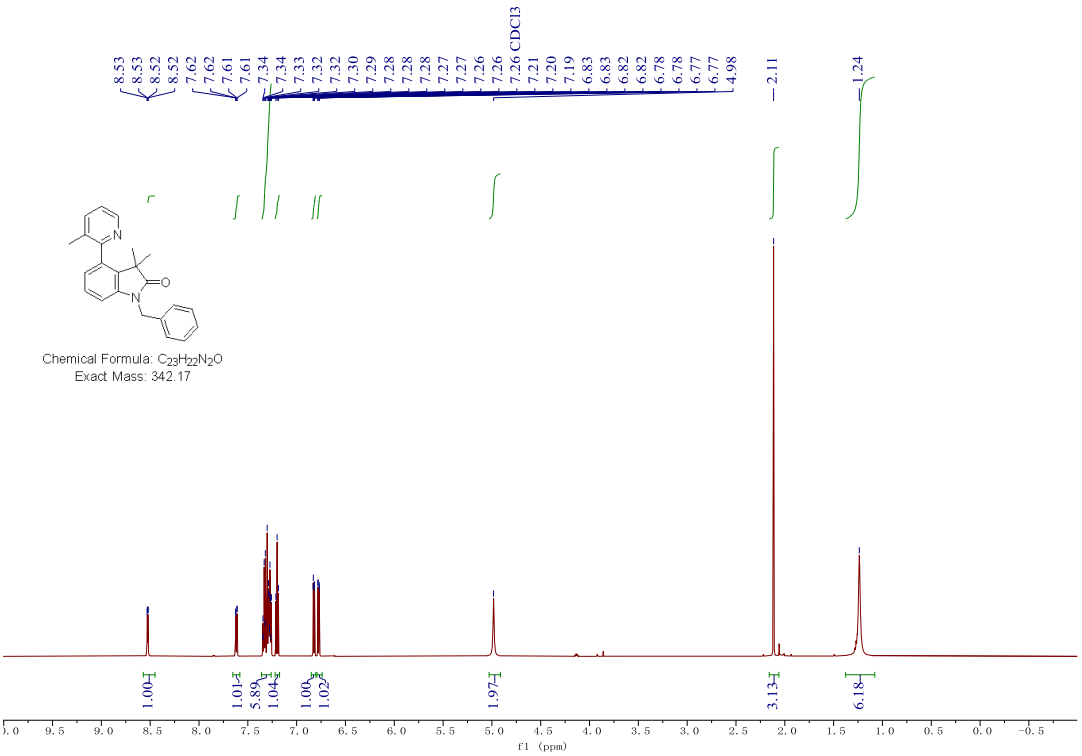


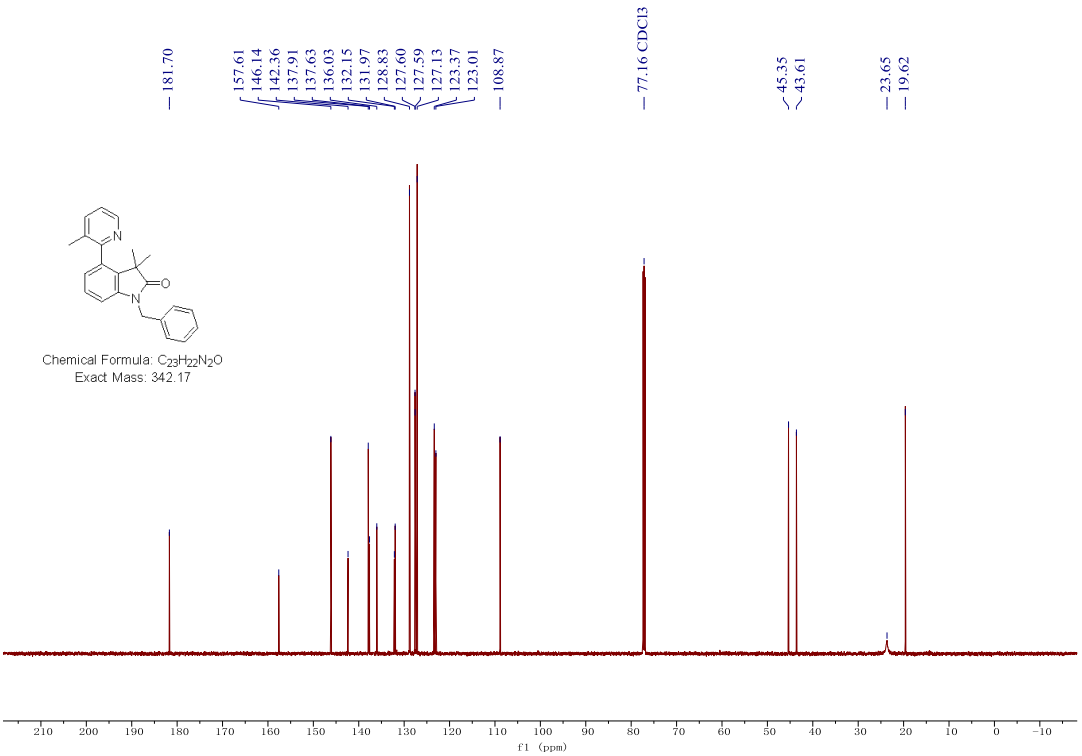
1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**7**)



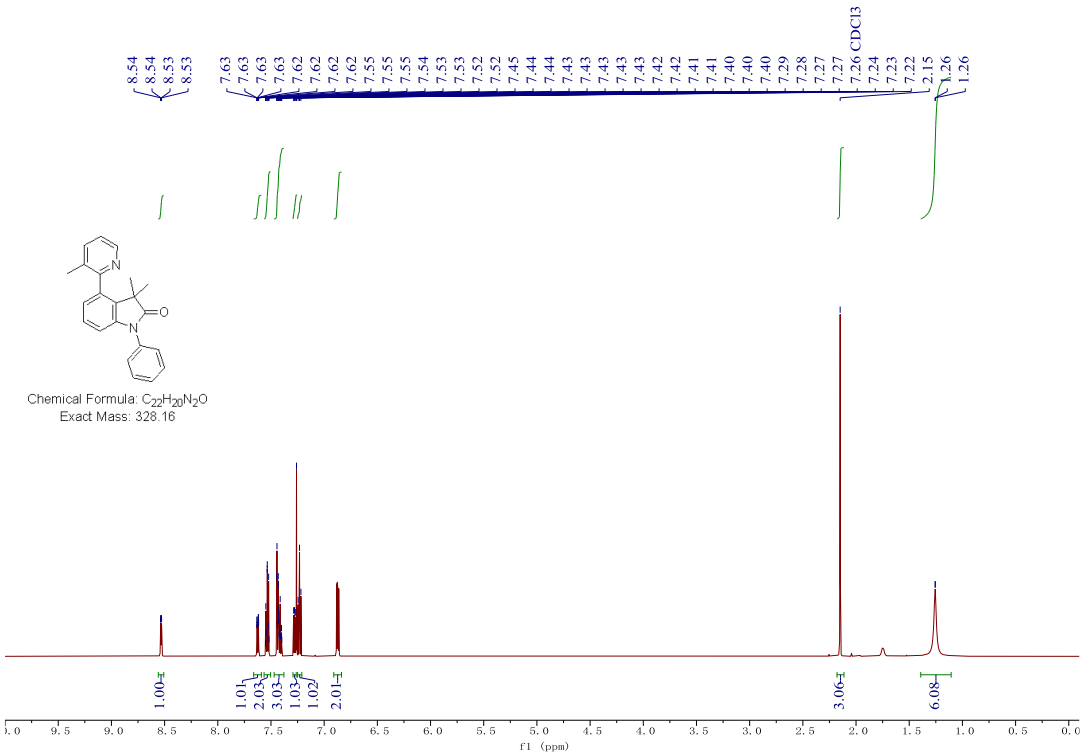


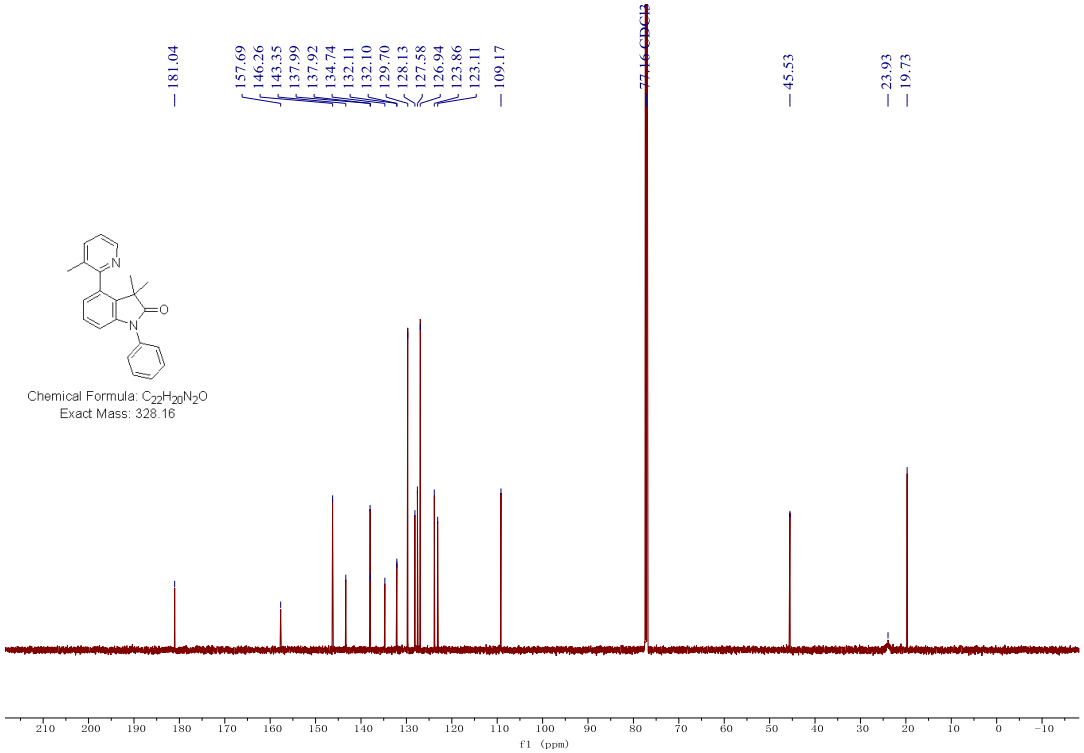
1-benzyl-3,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**8**)



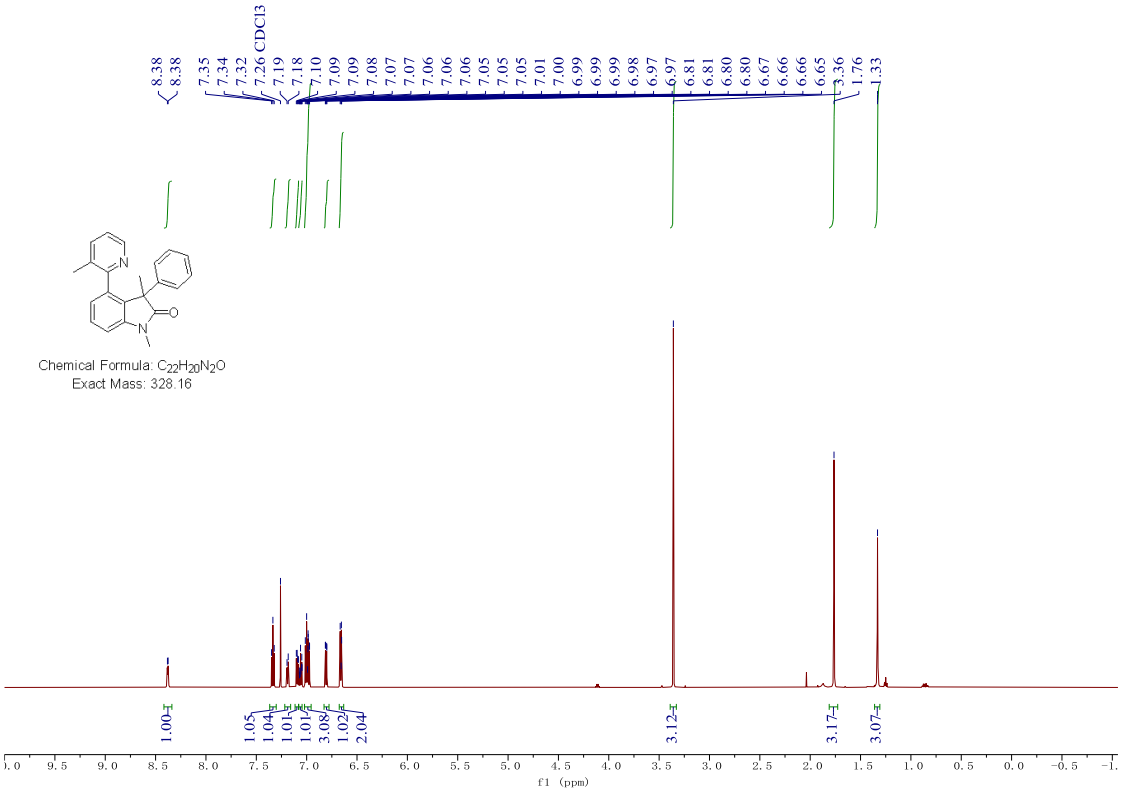


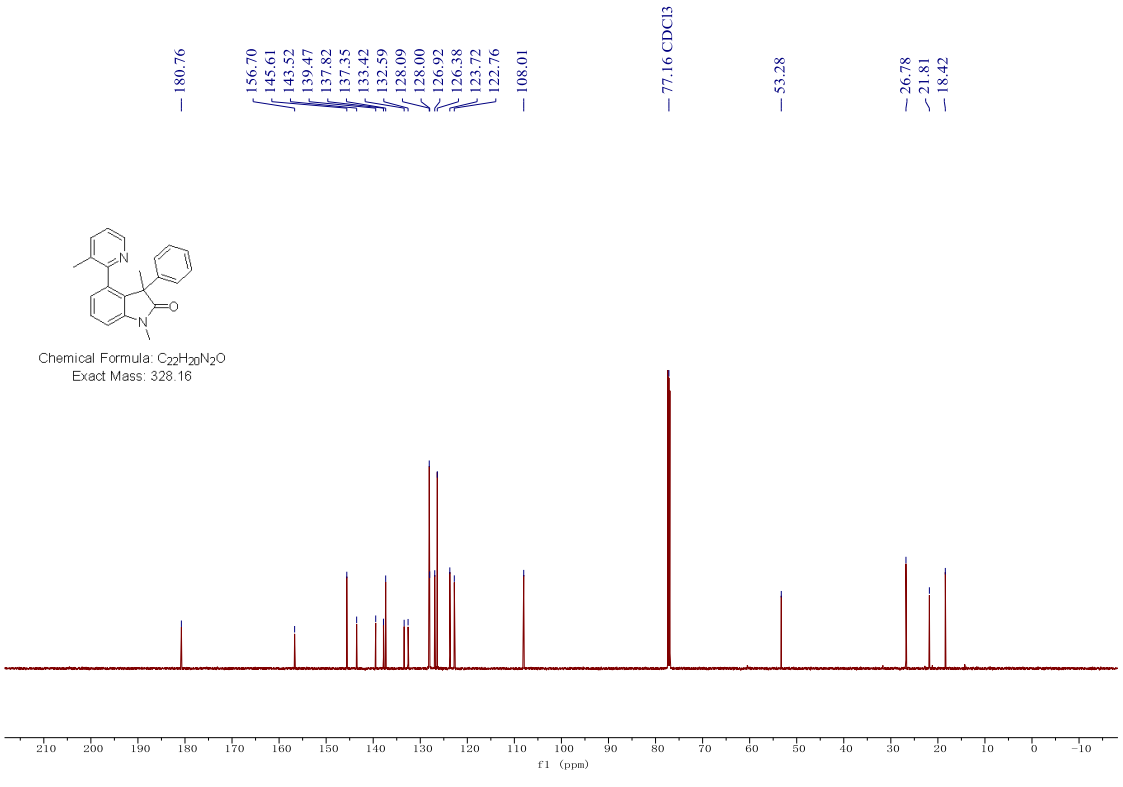
3,3-dimethyl-4-(3-methylpyridin-2-yl)-1-phenylindolin-2-one (**9**)



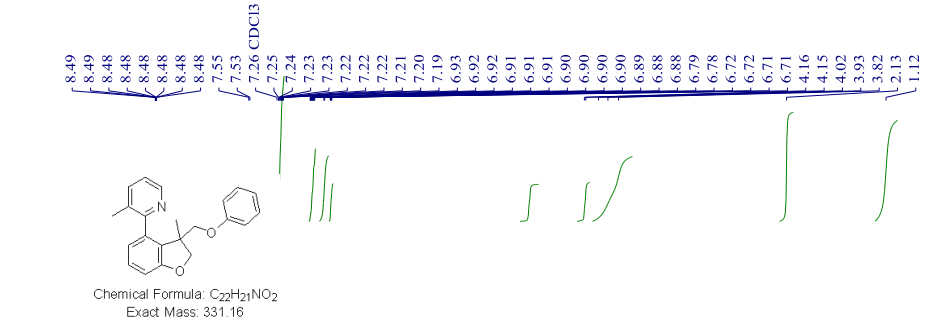


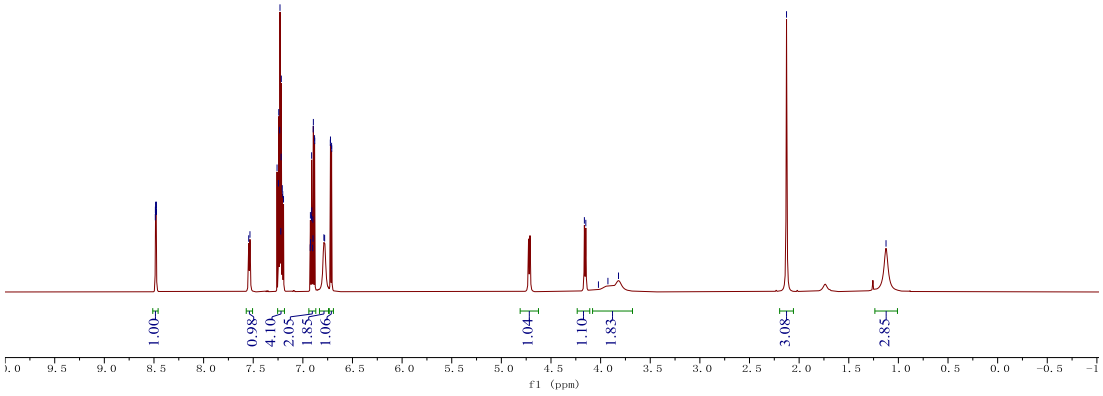
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-phenylindolin-2-one (**10**)

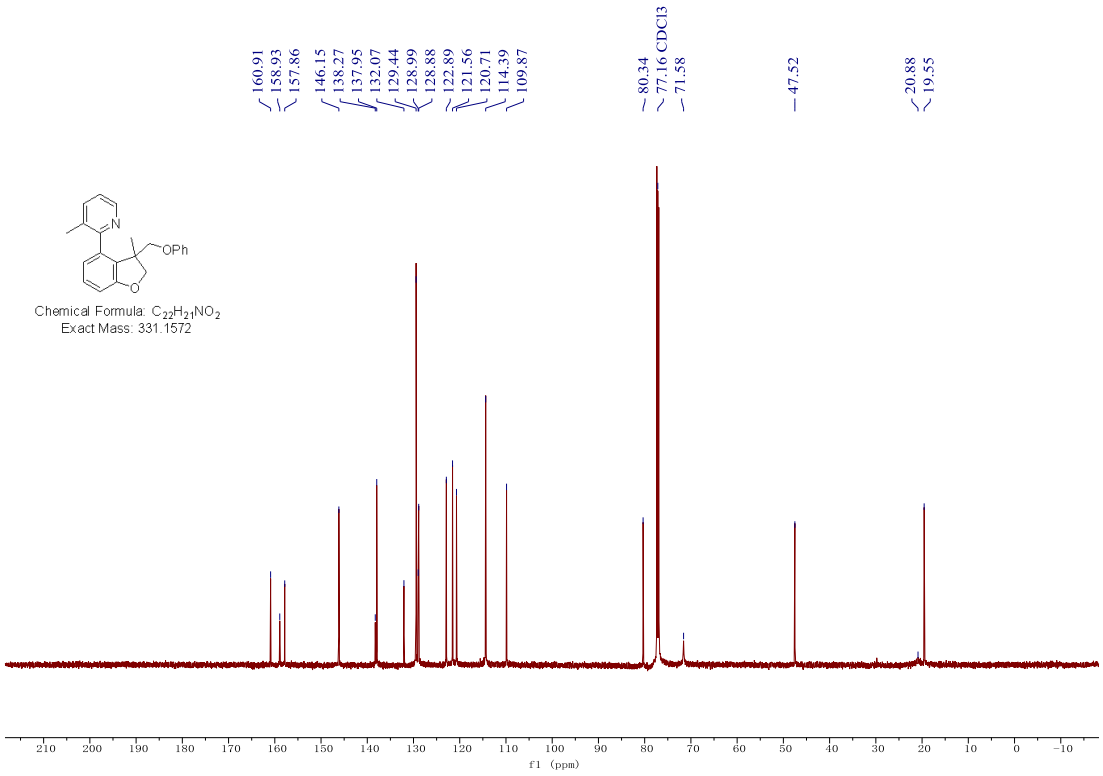




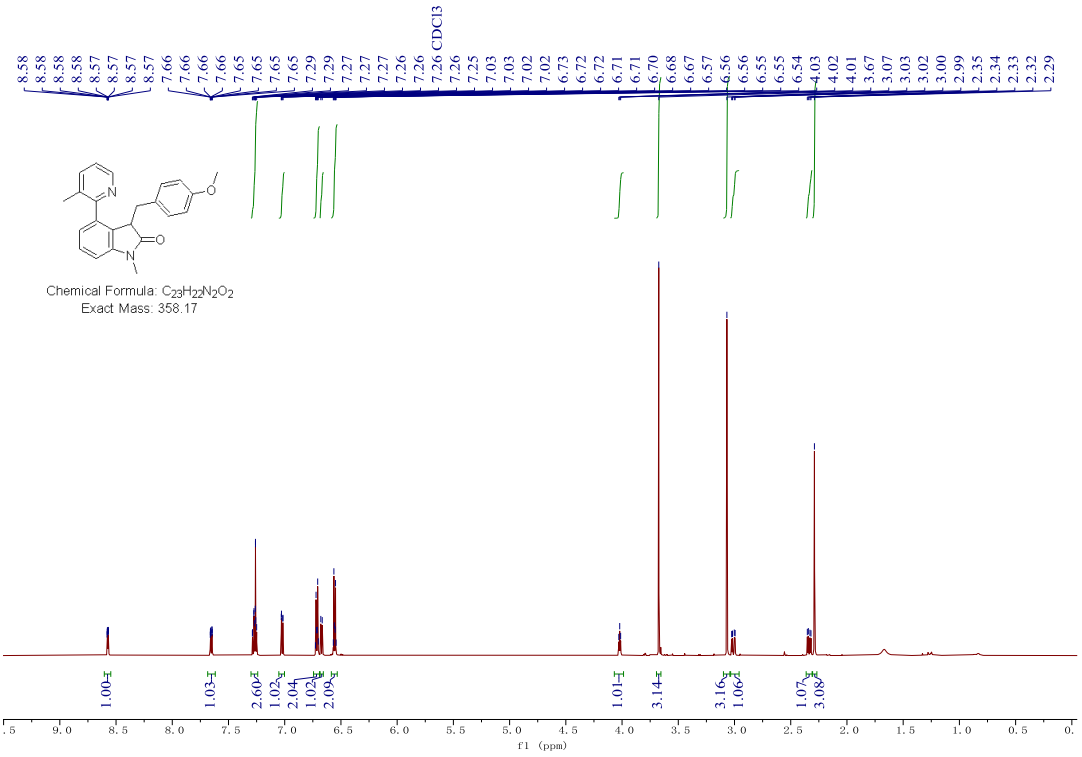
3-methyl-2-(3-methyl-3-(phenoxymethyl)-2,3-dihydrobenzofuran-4-yl)pyridine (**11**)

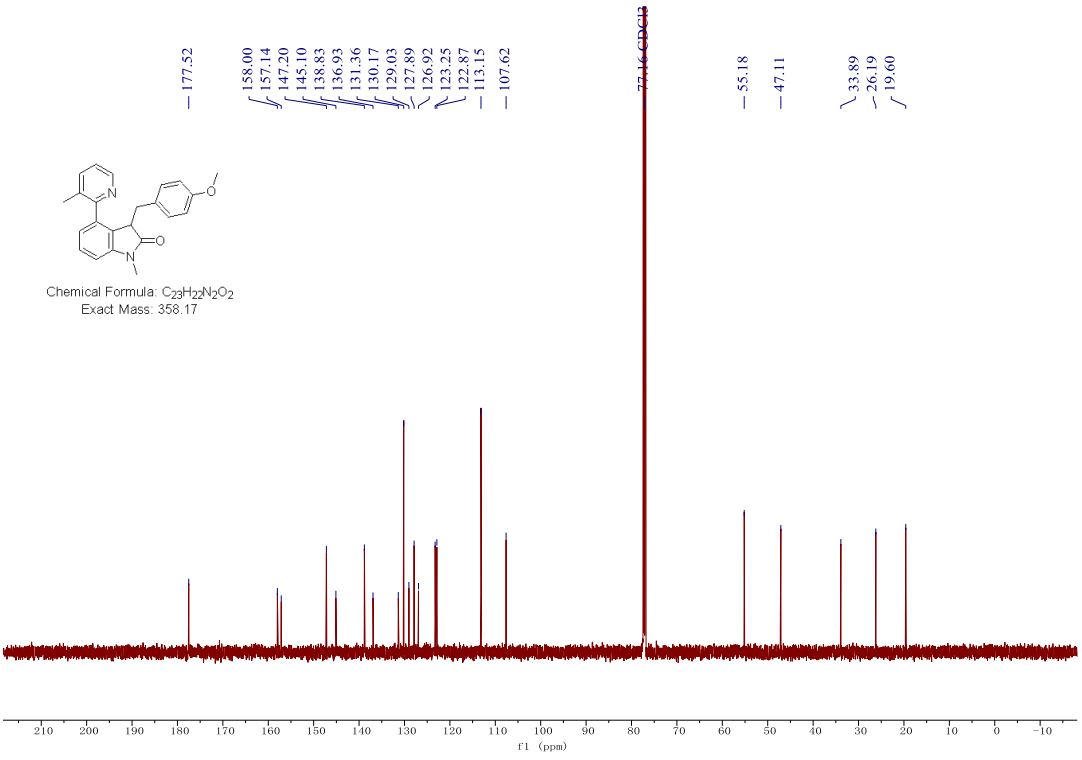




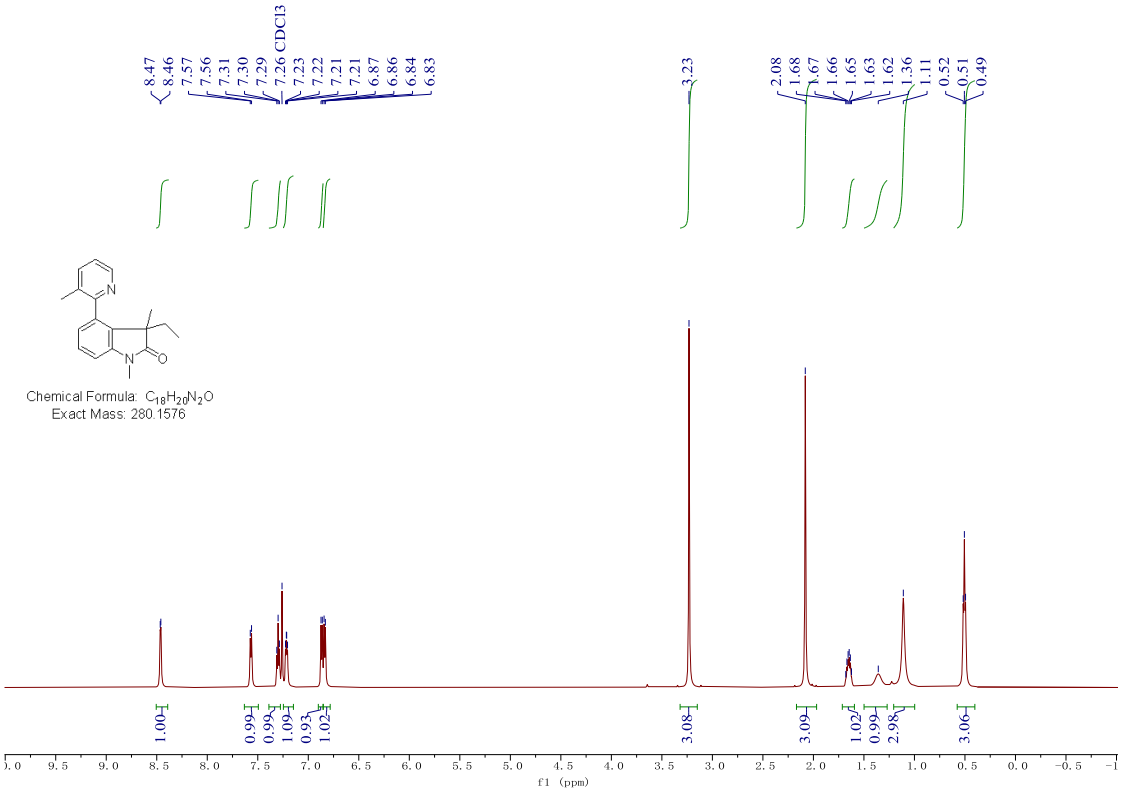


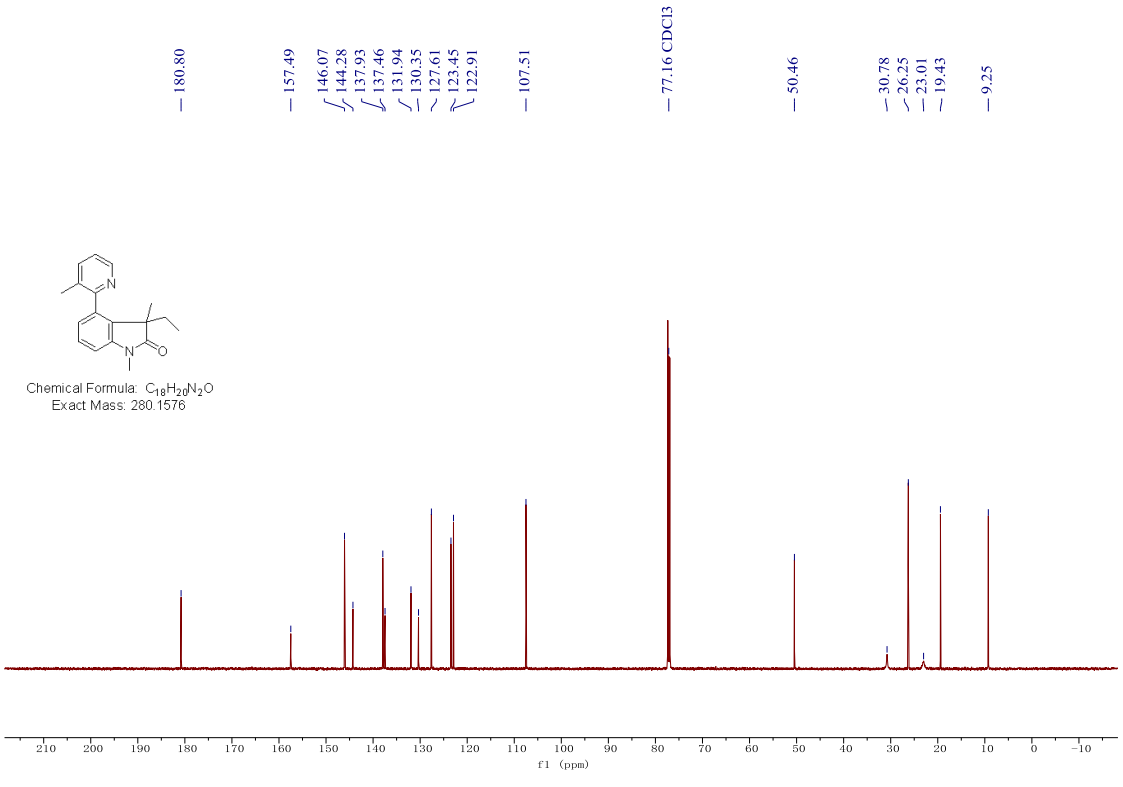
3-(4-methoxybenzyl)-1-methyl-4-(3-methylpyridin-2-yl)indolin-2-one (**12**)



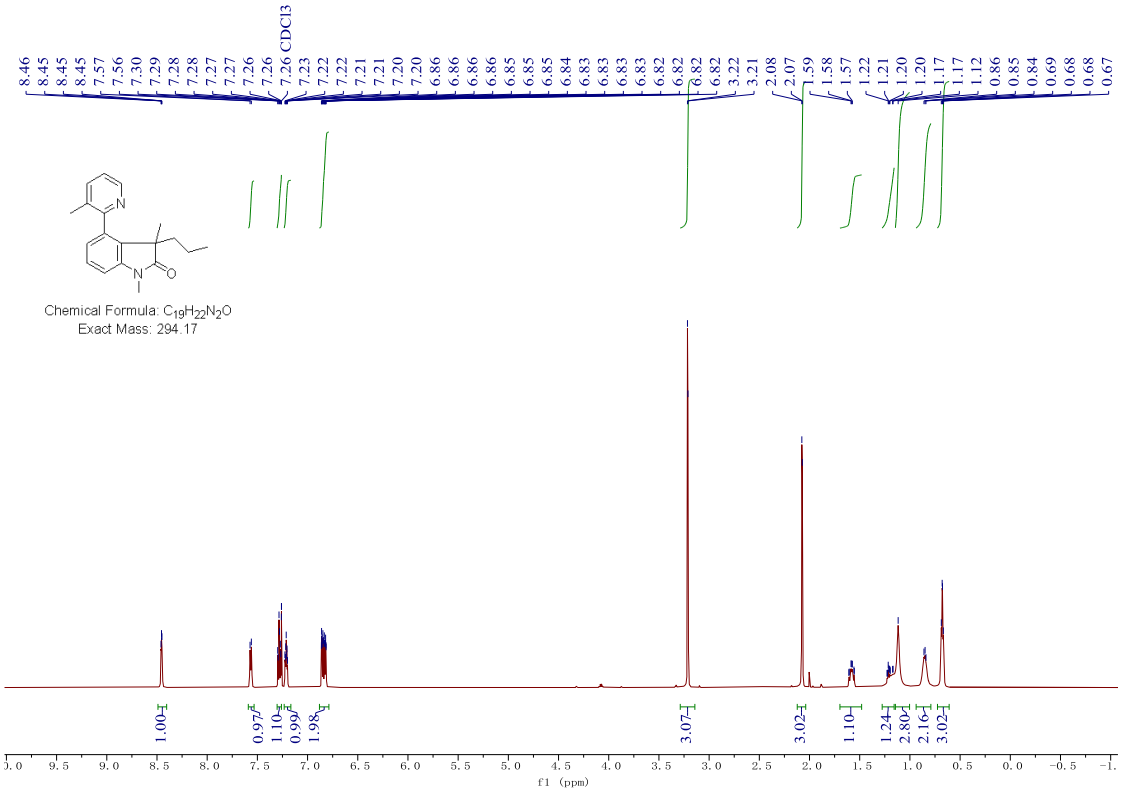


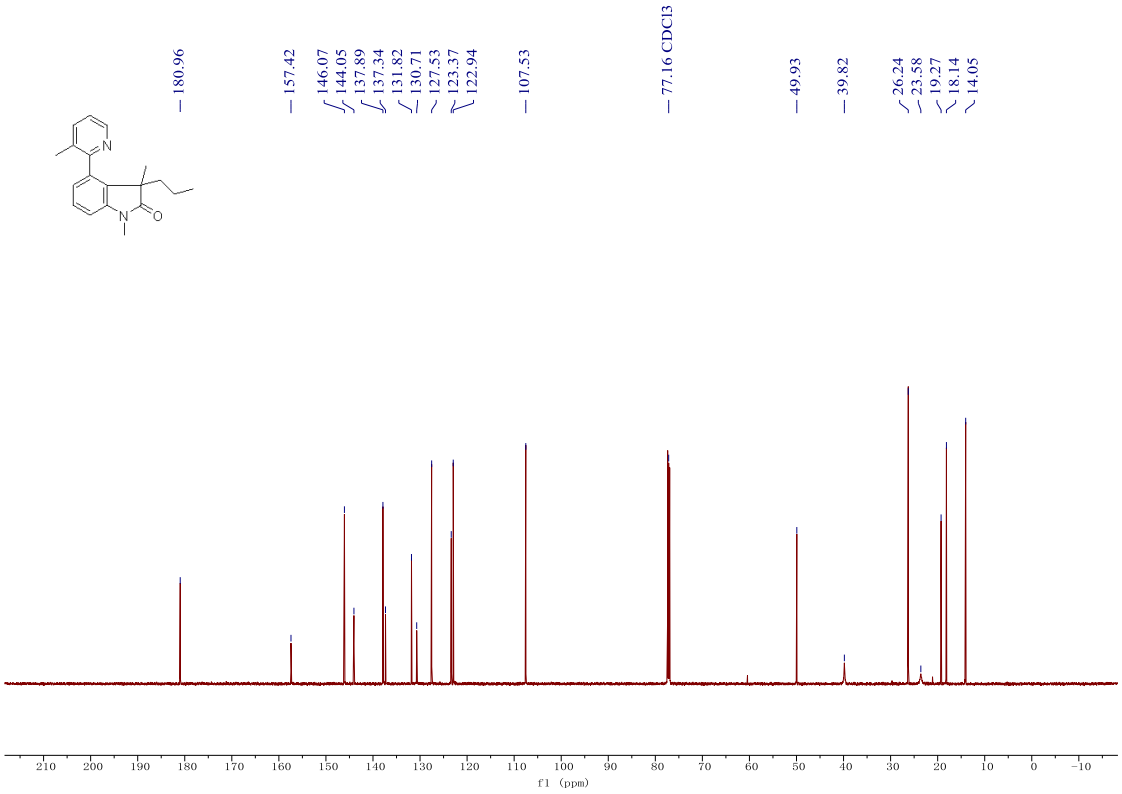
3-ethyl-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**13**)



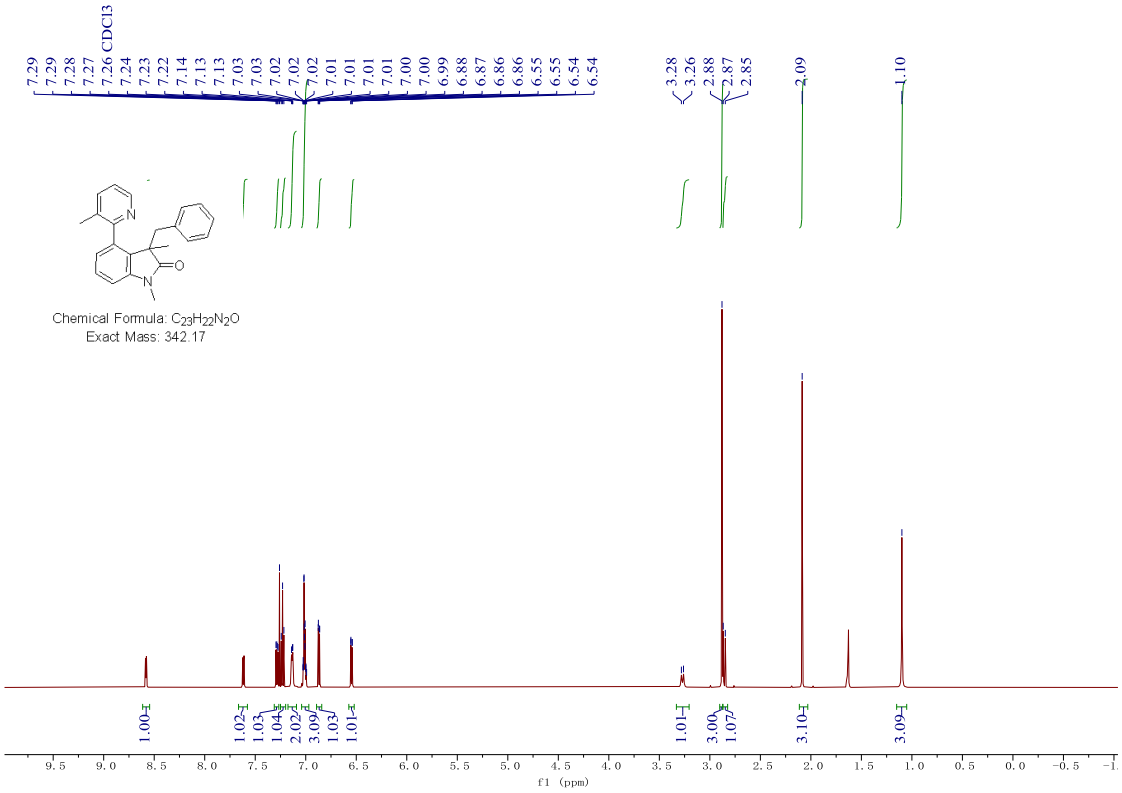


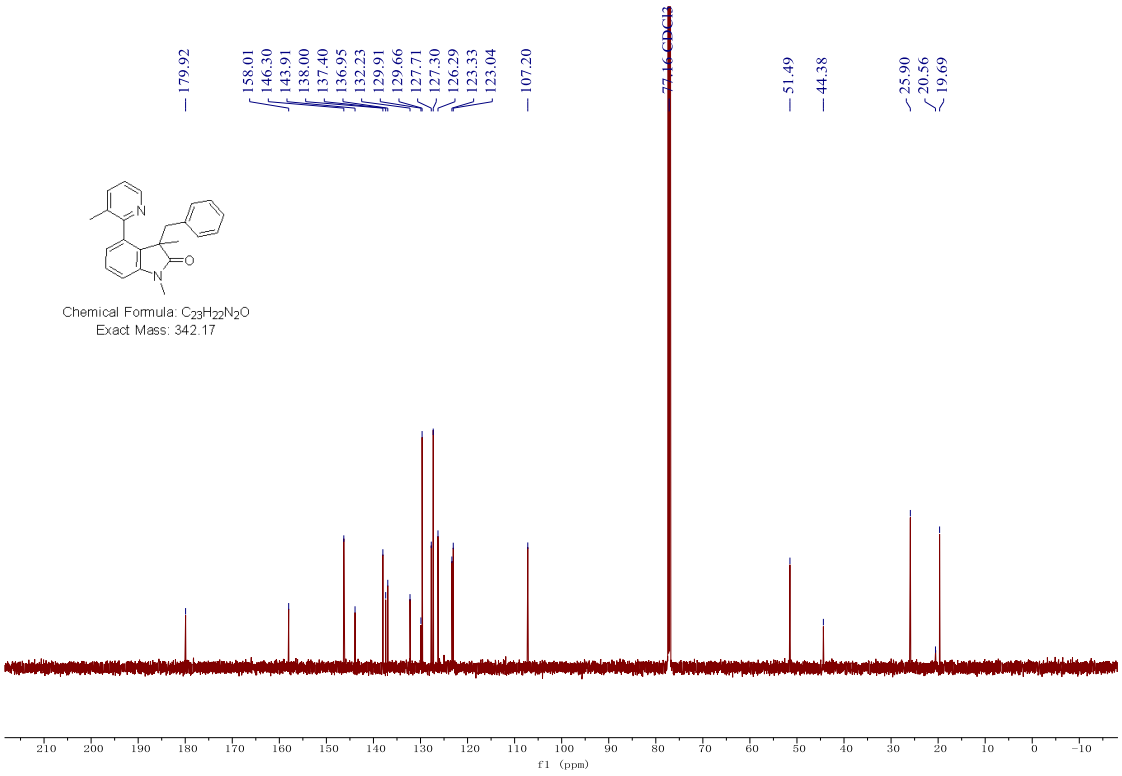
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-propylindolin-2-one (**14**)



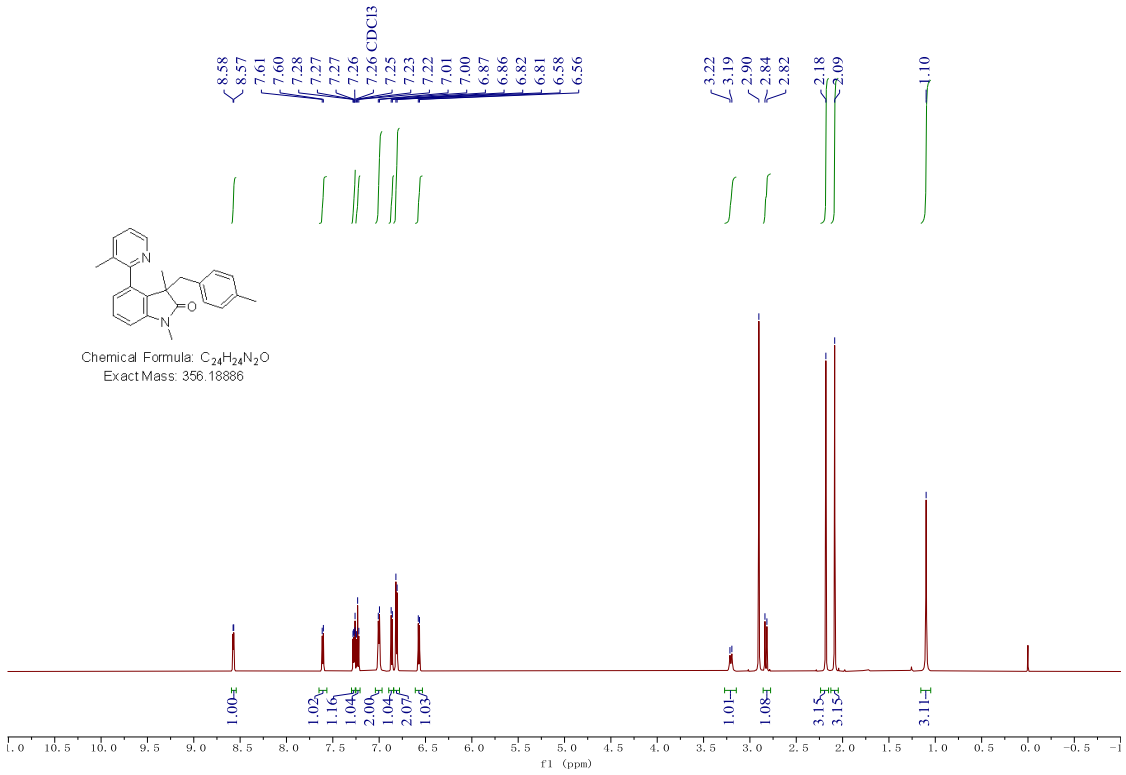


3-benzyl-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**15**)

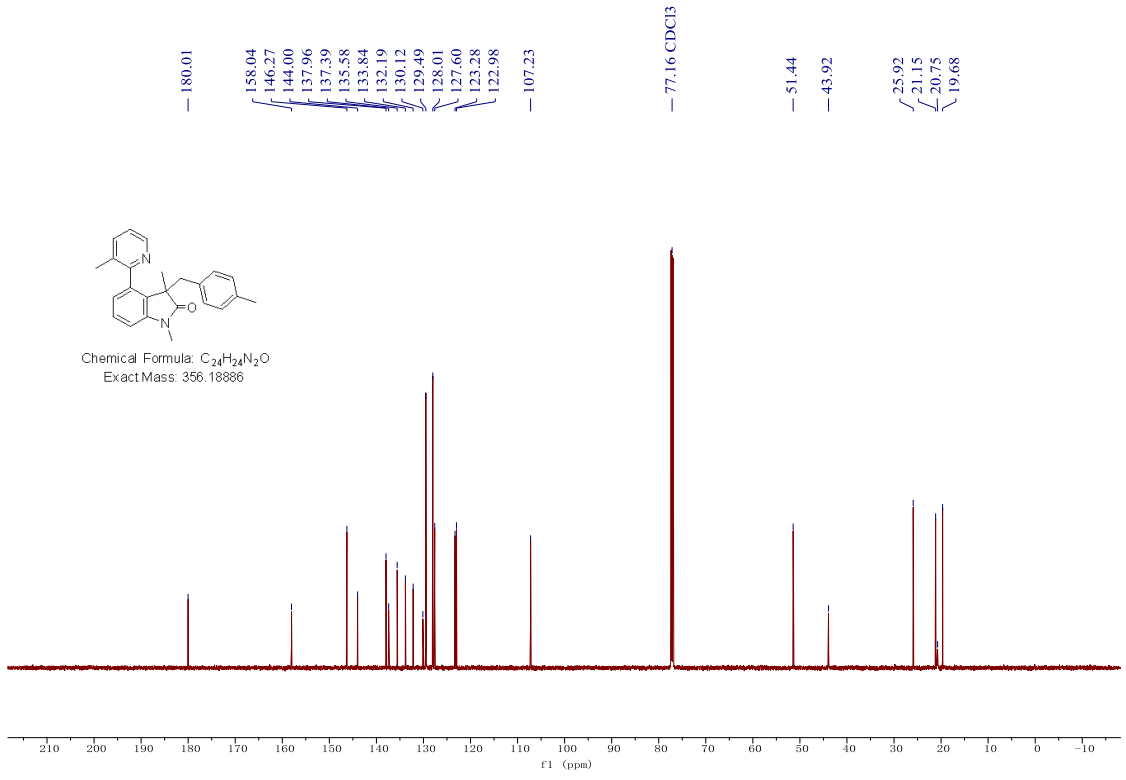




1,3-dimethyl-3-(4-methylbenzyl)-4-(3-methylpyridin-2-yl)indolin-2-one (**16**)

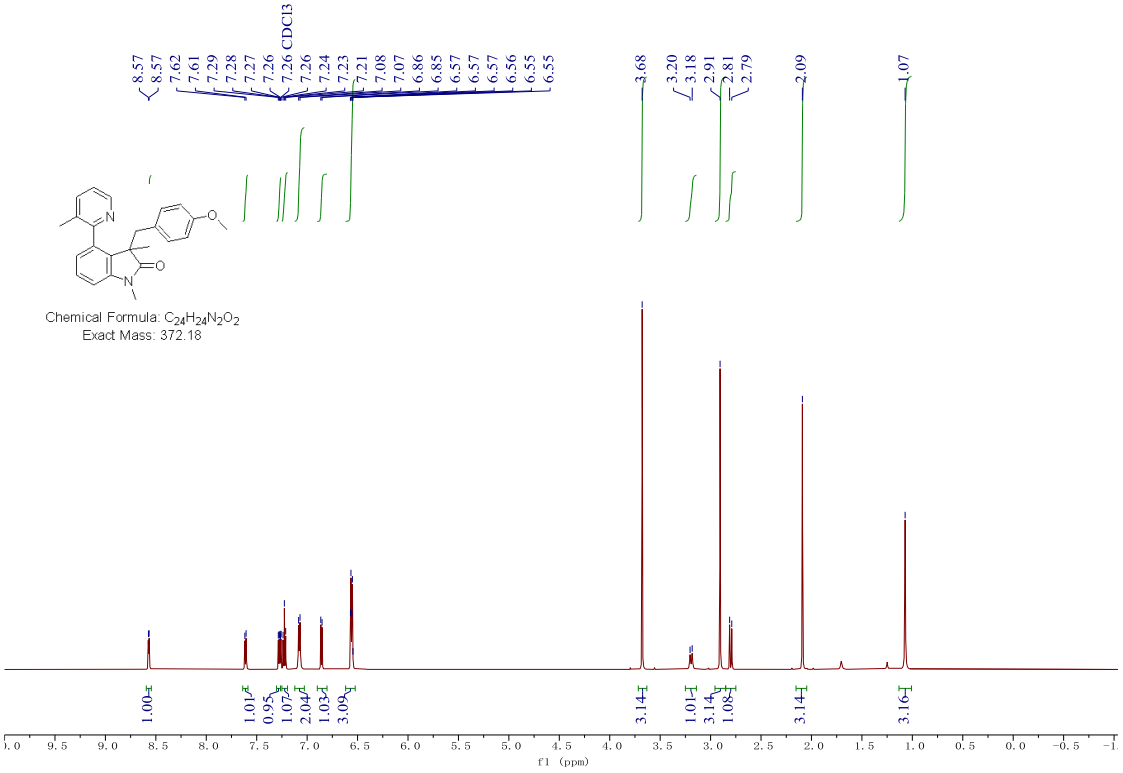


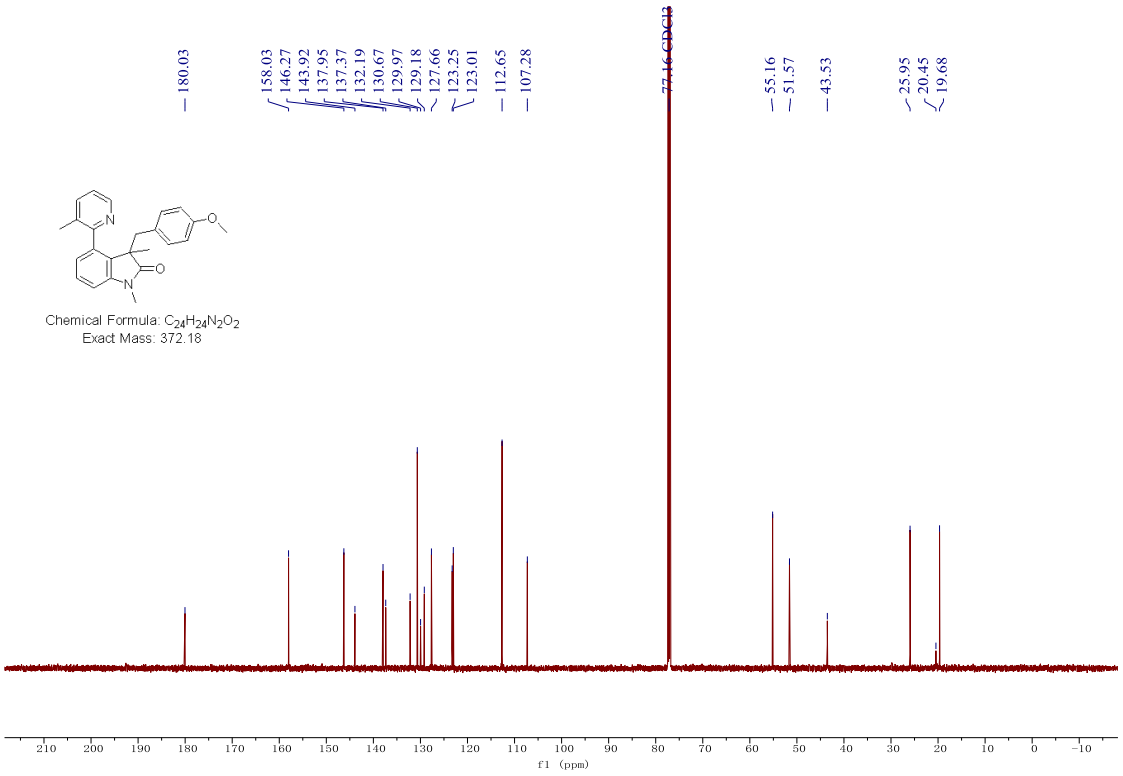
Chemical Formula: $C_{24}H_{24}N_2O$
Exact Mass: 356.18886



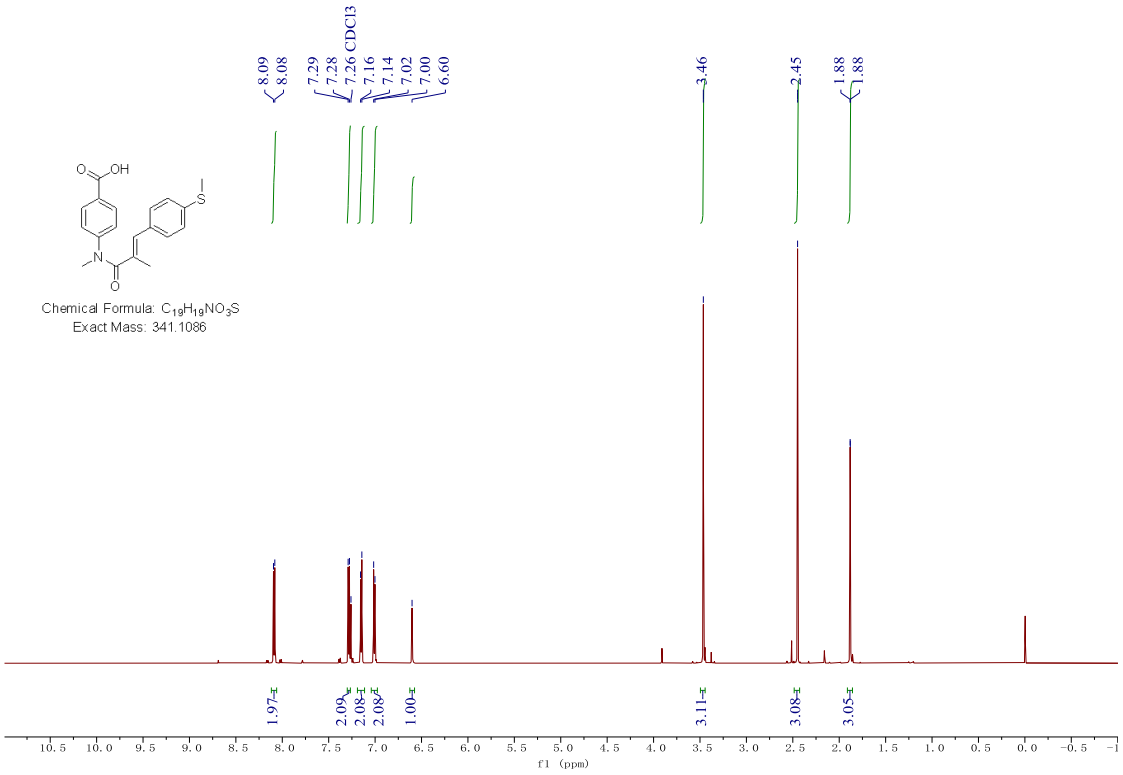
Chemical Formula: $C_{24}H_{24}N_2O$
Exact Mass: 356.18886

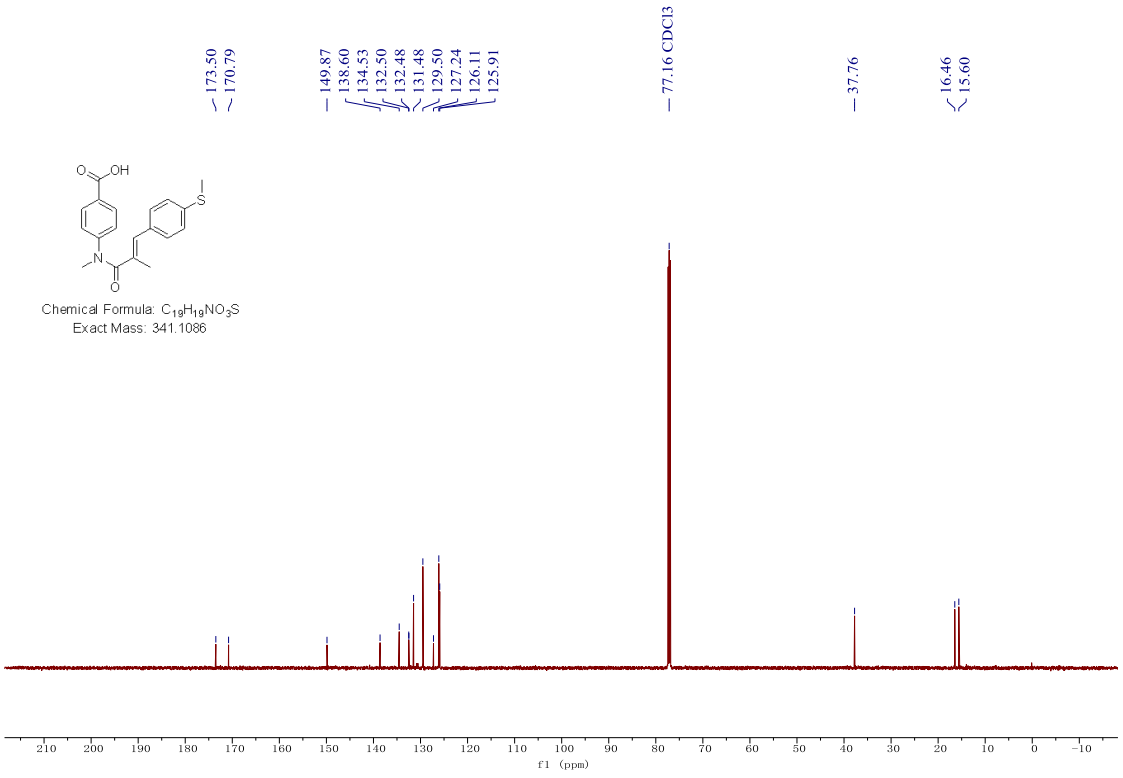
3-(4-methoxybenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**17**)



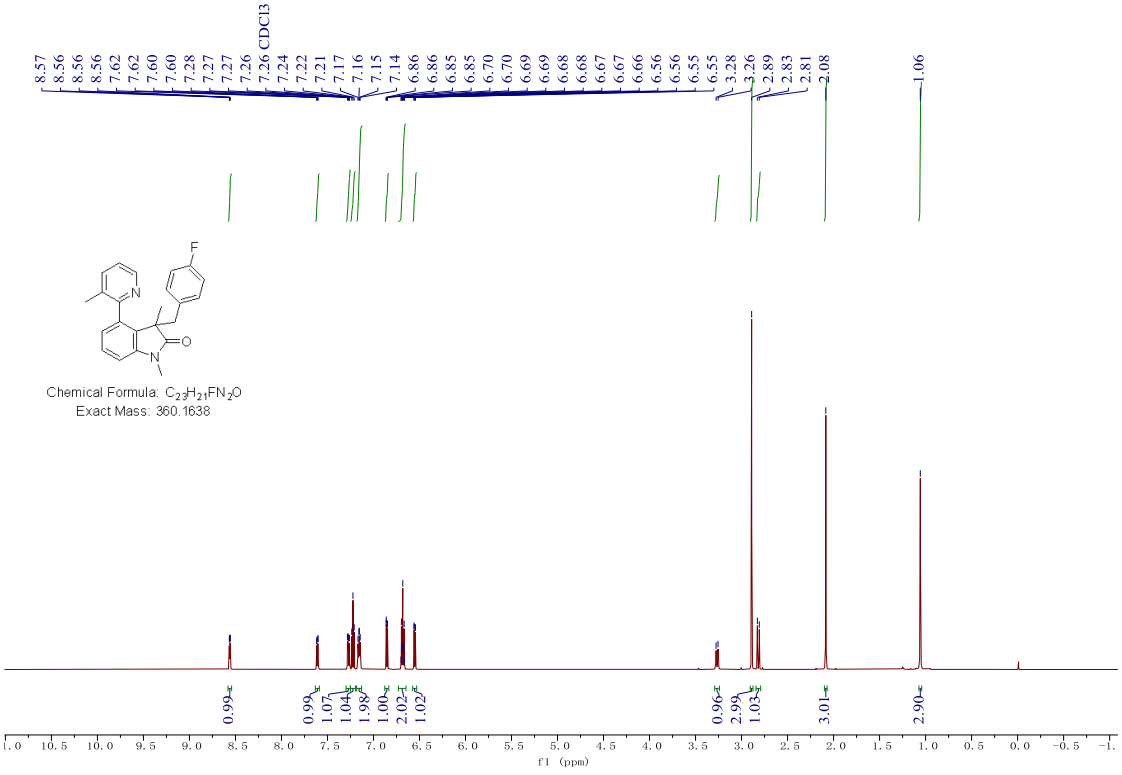


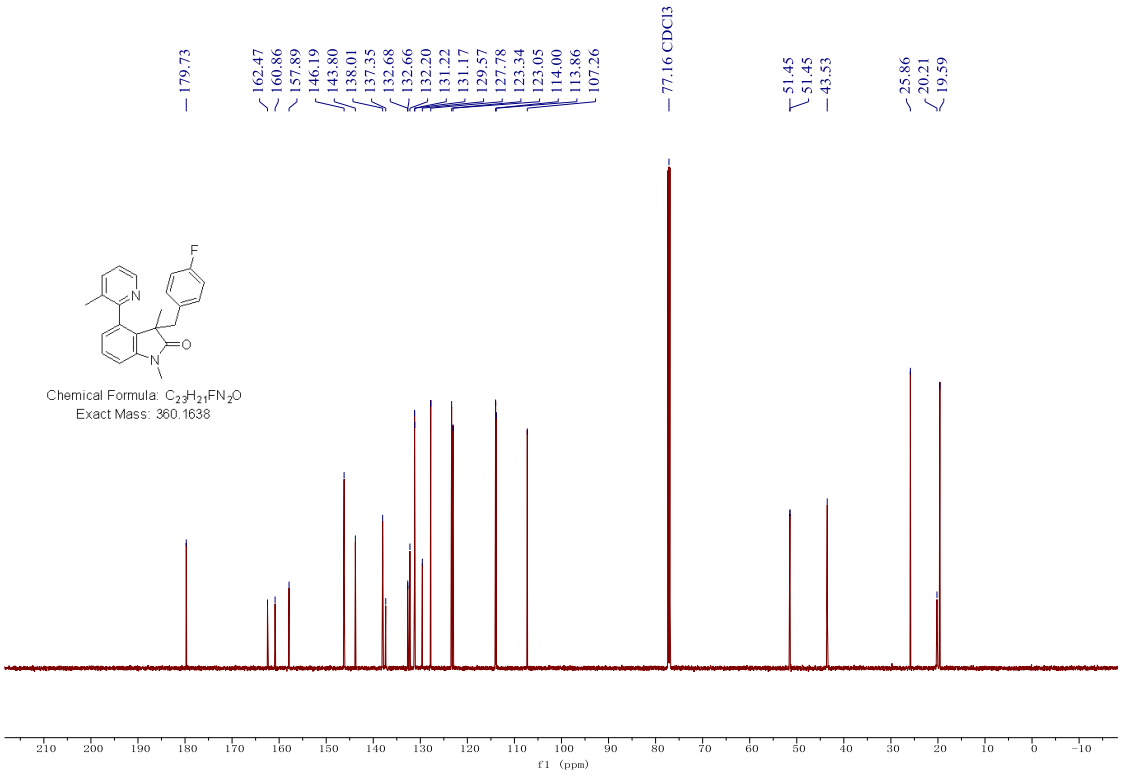
(E)-4-(N,2-dimethyl-3-(4-(methylthio)phenyl)acrylamido)benzoic acid (**18**)

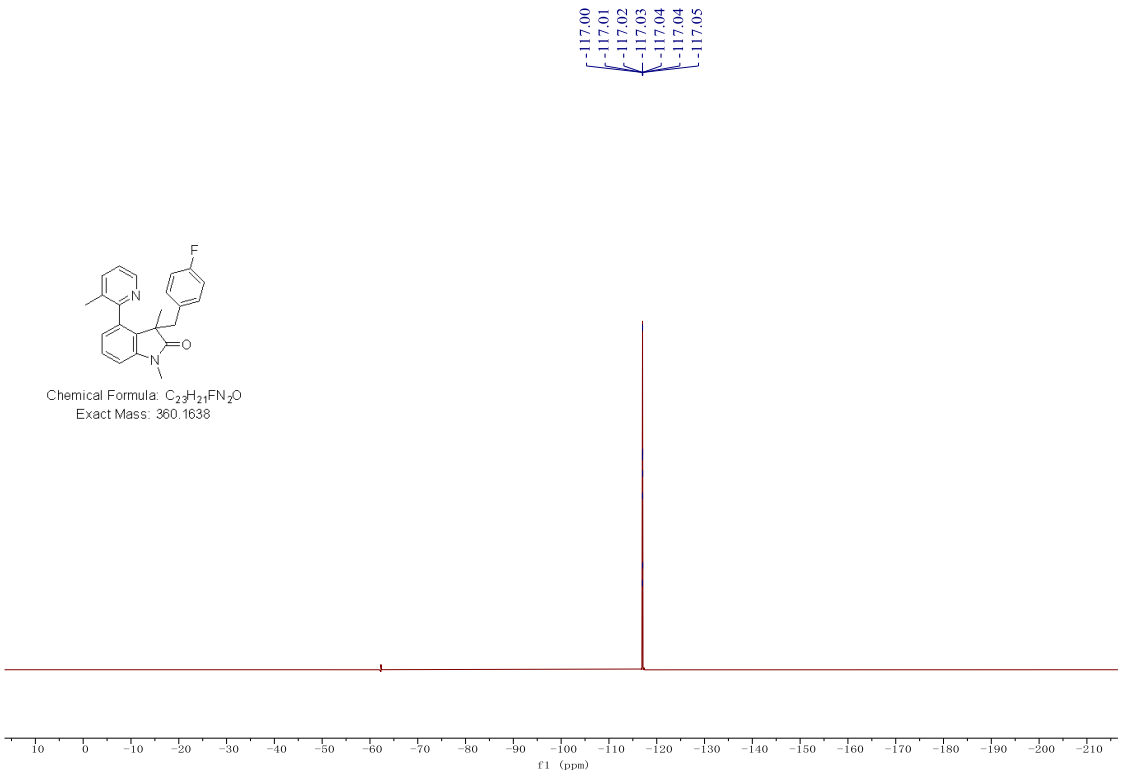




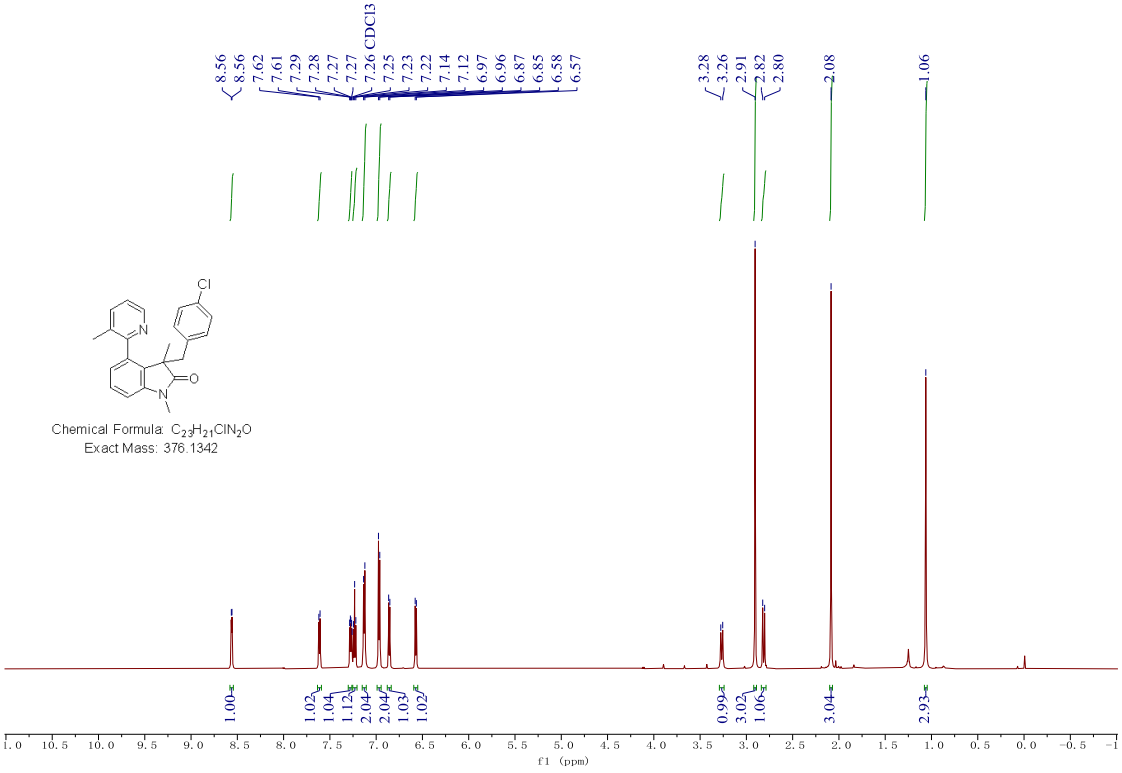
(E)-4-(3-(4-fluorophenyl)-N,2-dimethylacrylamido)benzoic acid (**19**)

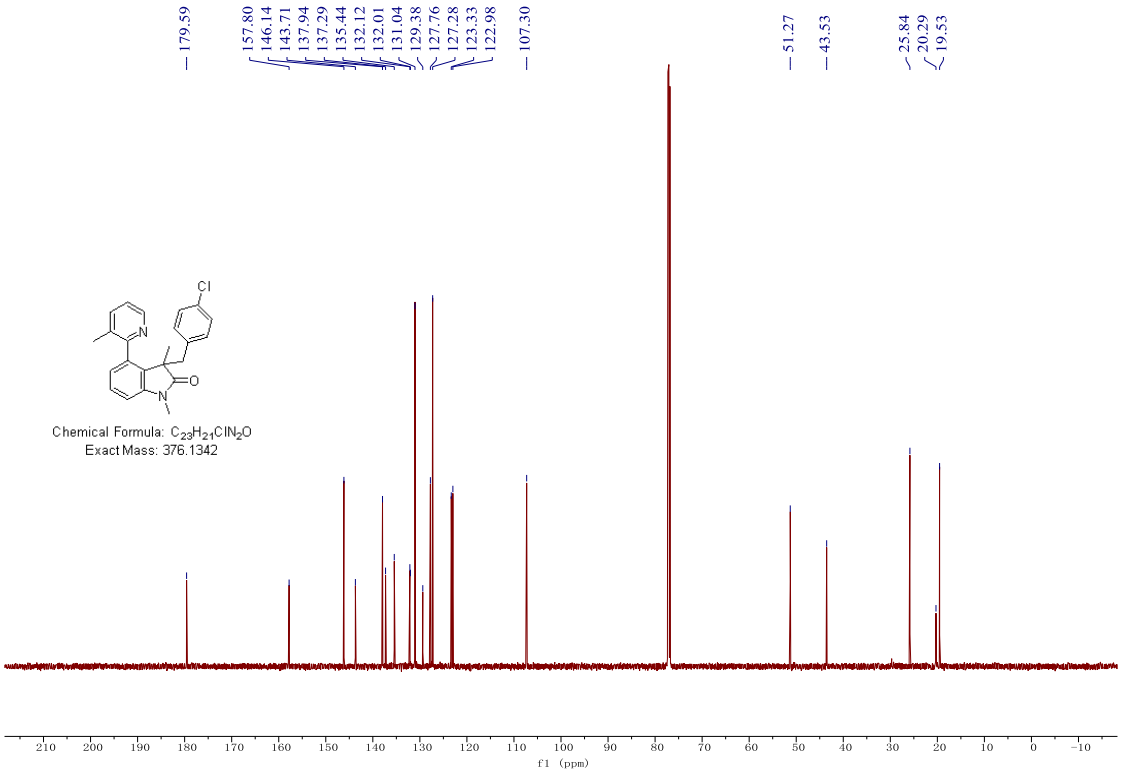




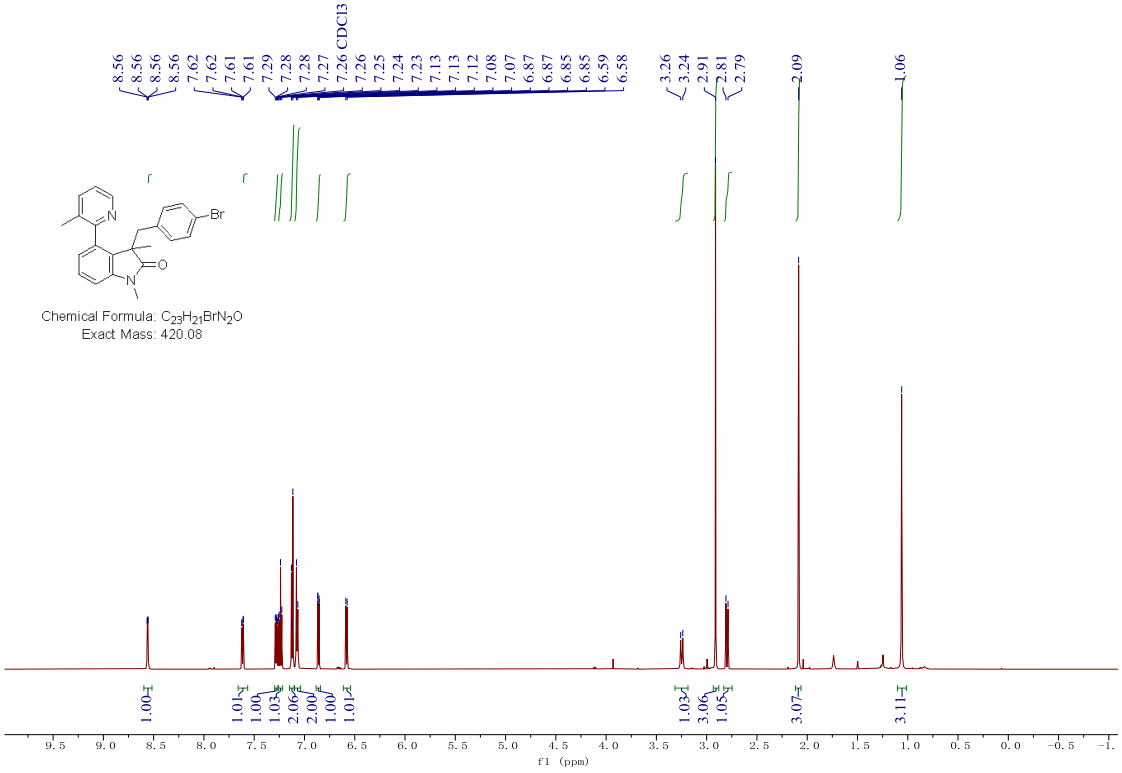


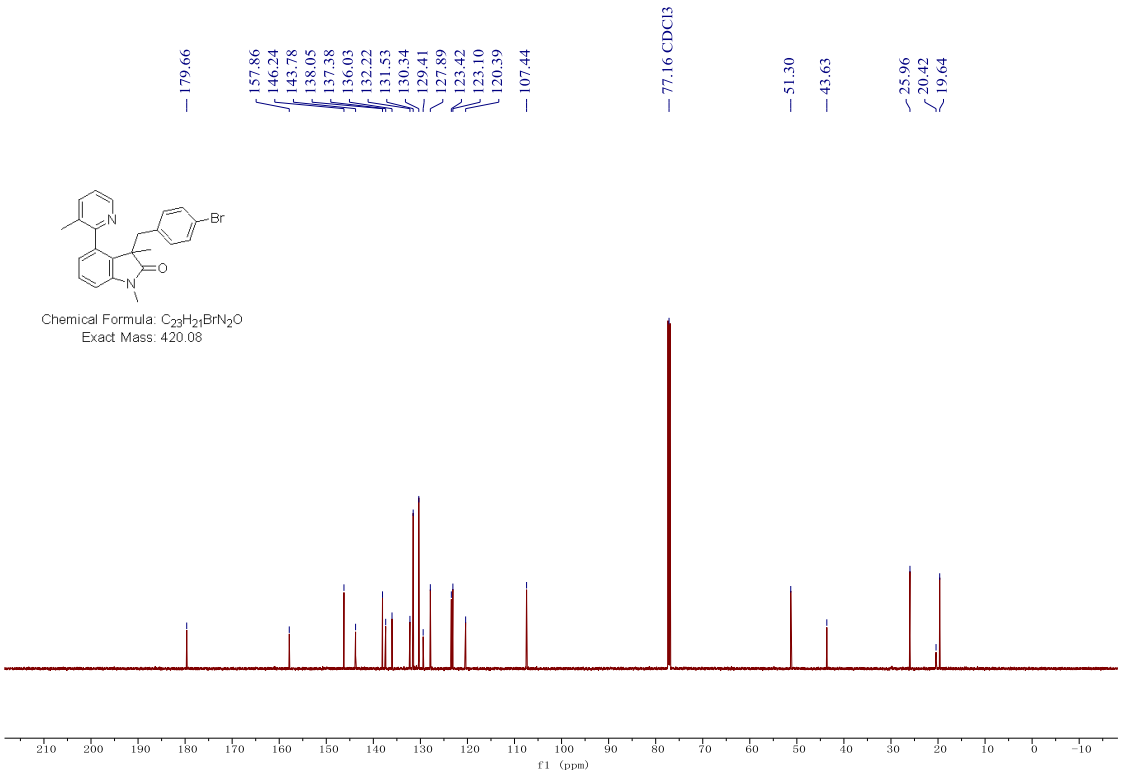
3-(4-chlorobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**20**)



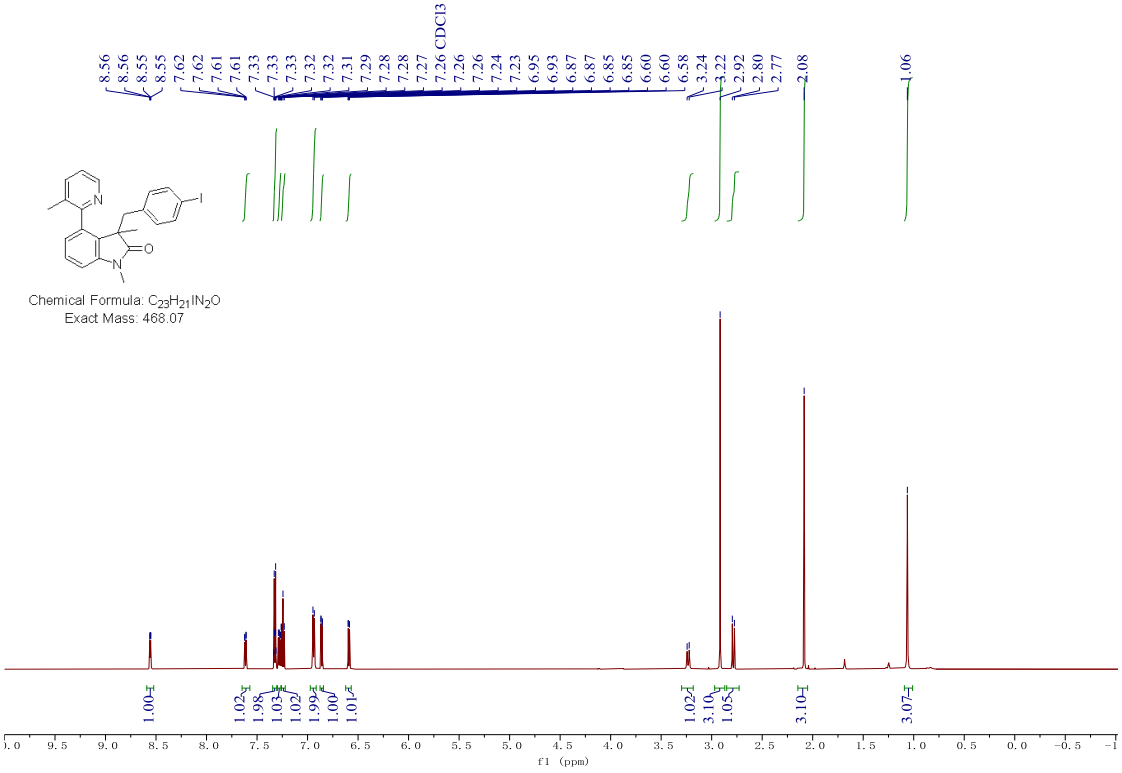


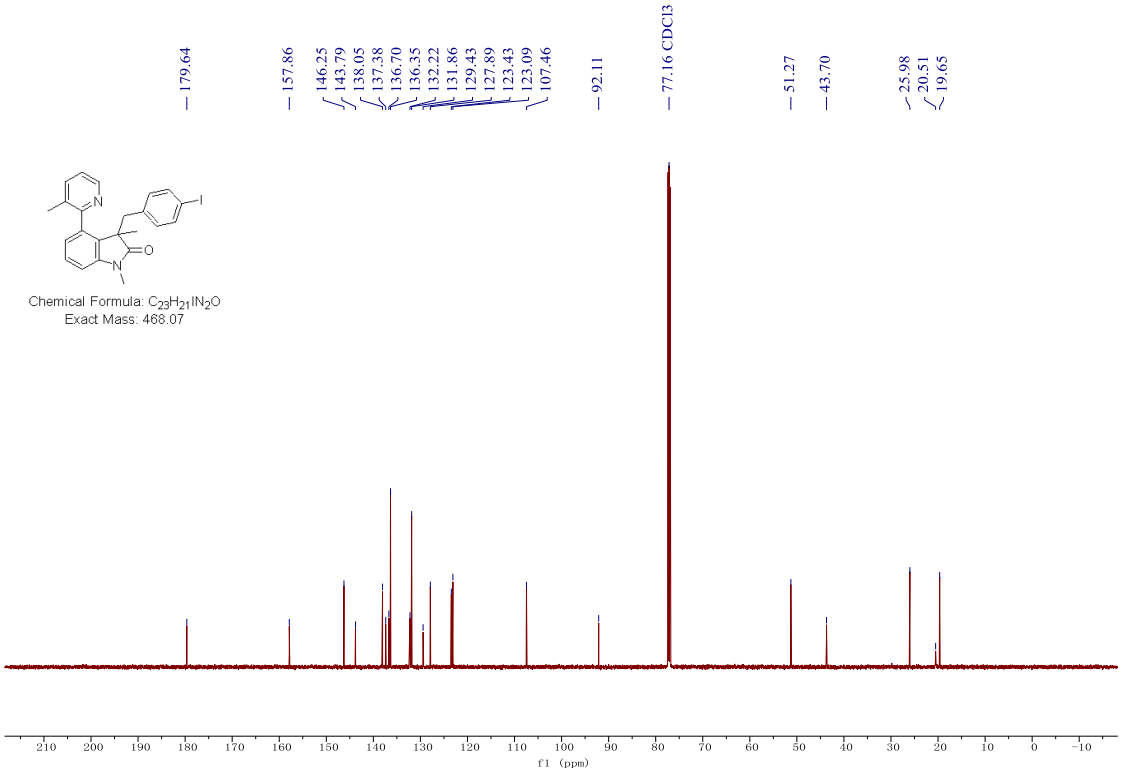
3-(4-bromobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**21**)



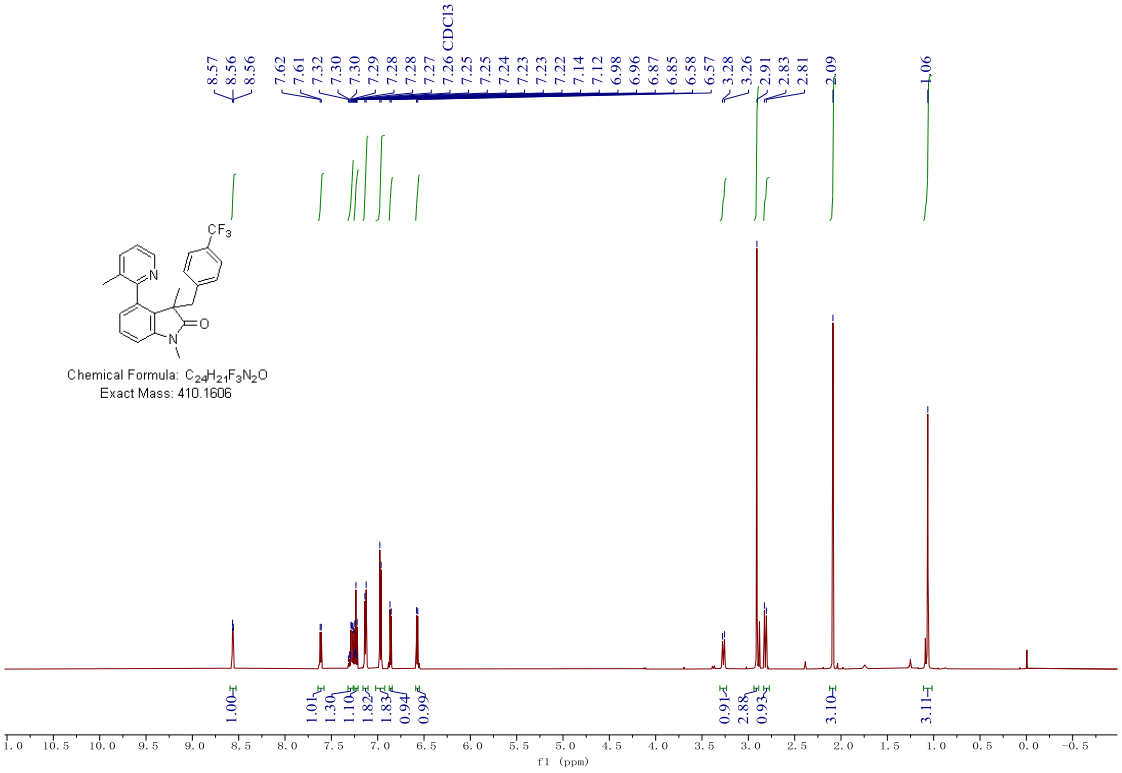


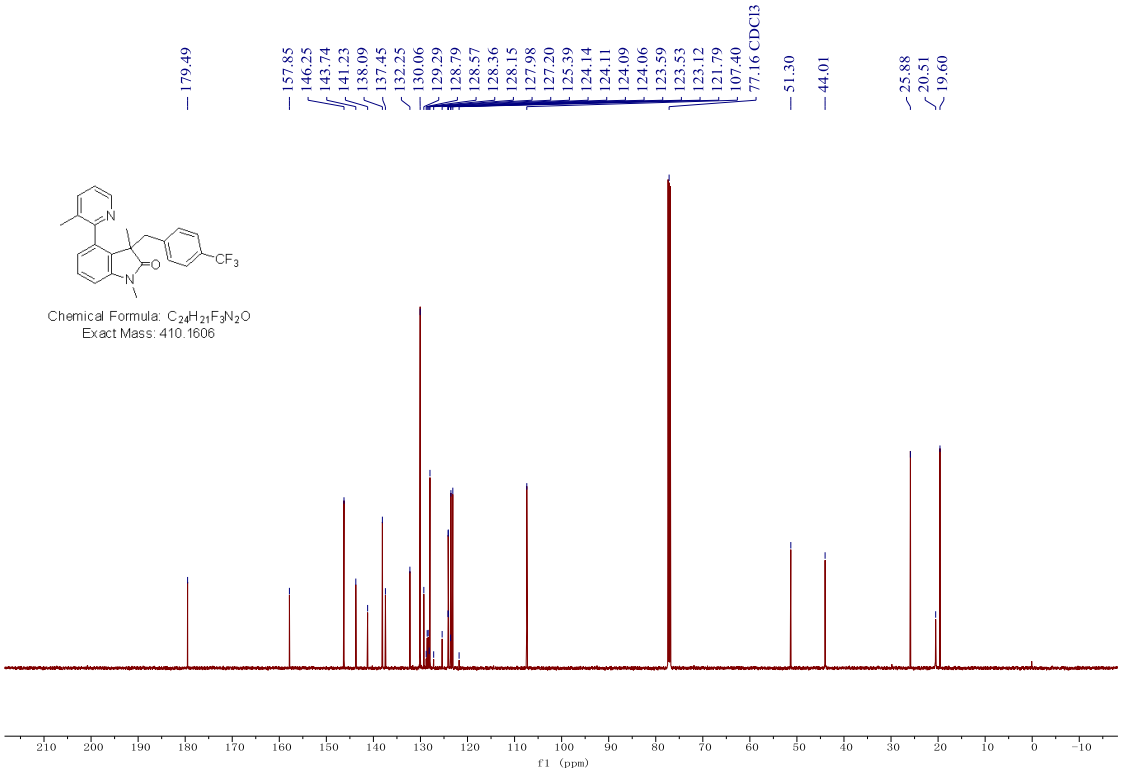
3-(4-iodobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**22**)





1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-(trifluoromethyl)benzyl)indolin-2-one (**23**)

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138.09
137.45
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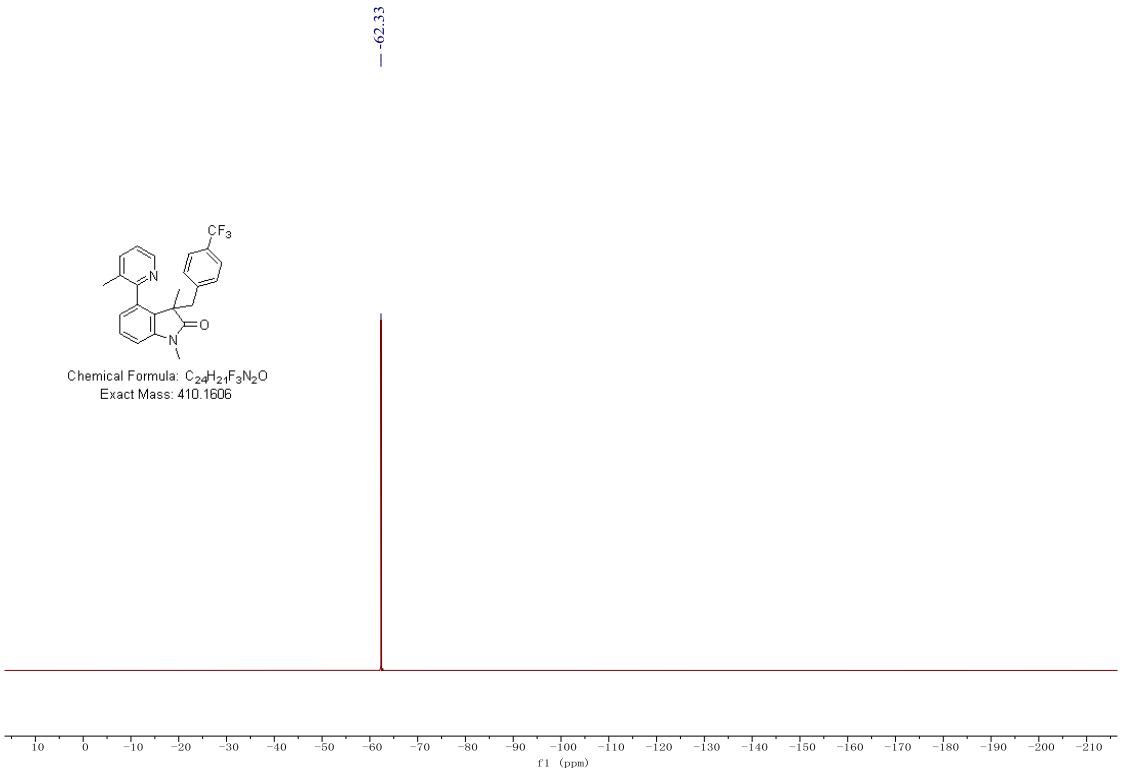
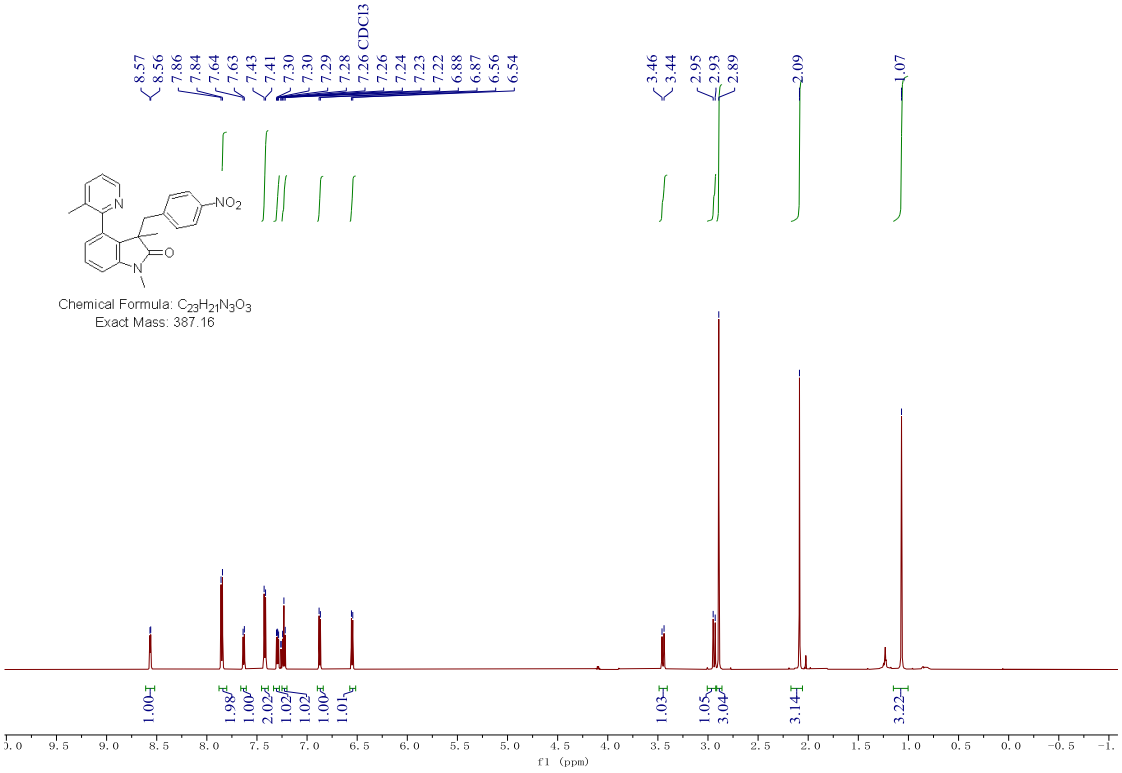
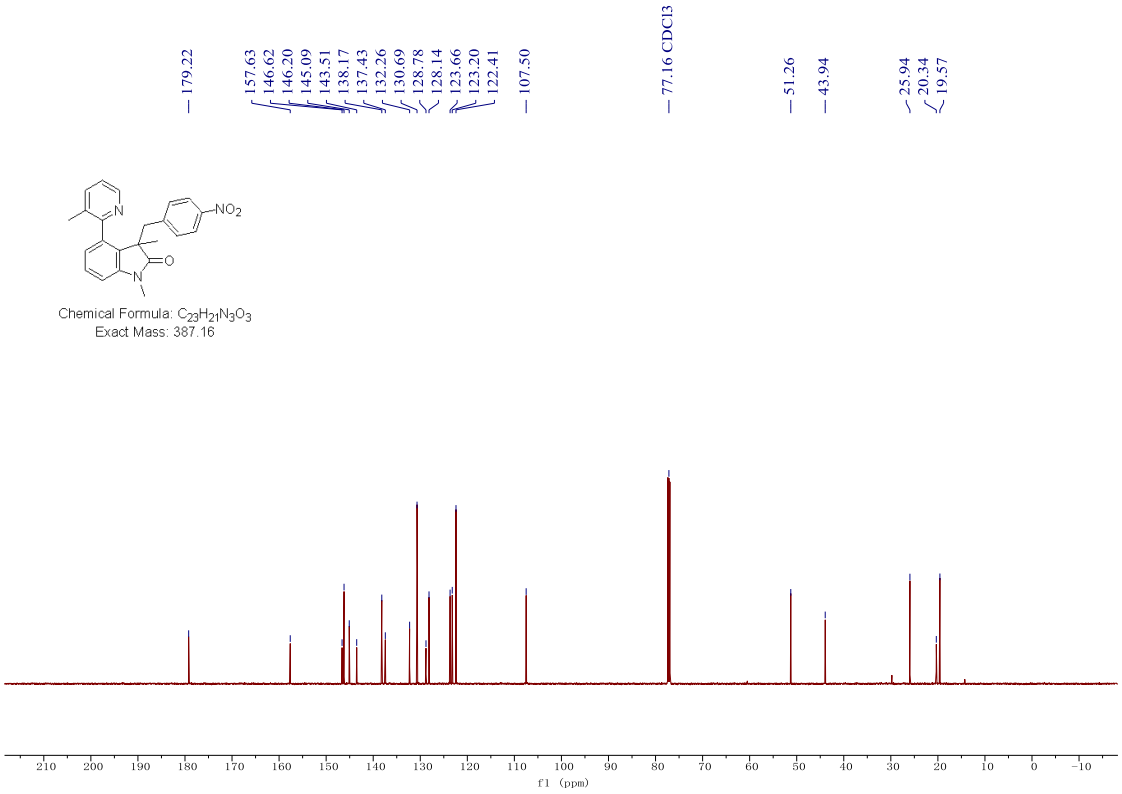
130.06
129.29
128.79
128.57
128.36
128.15
127.98
127.20
125.39
124.14
124.11
124.09
124.06
123.59
123.53
123.12
121.79
107.40
77.16 CDCl3
51.30
44.01
25.88
20.51
19.60
Chemical Formula: C24H21F3N2O
Exact Mass: 410.1606
f1 (ppm)

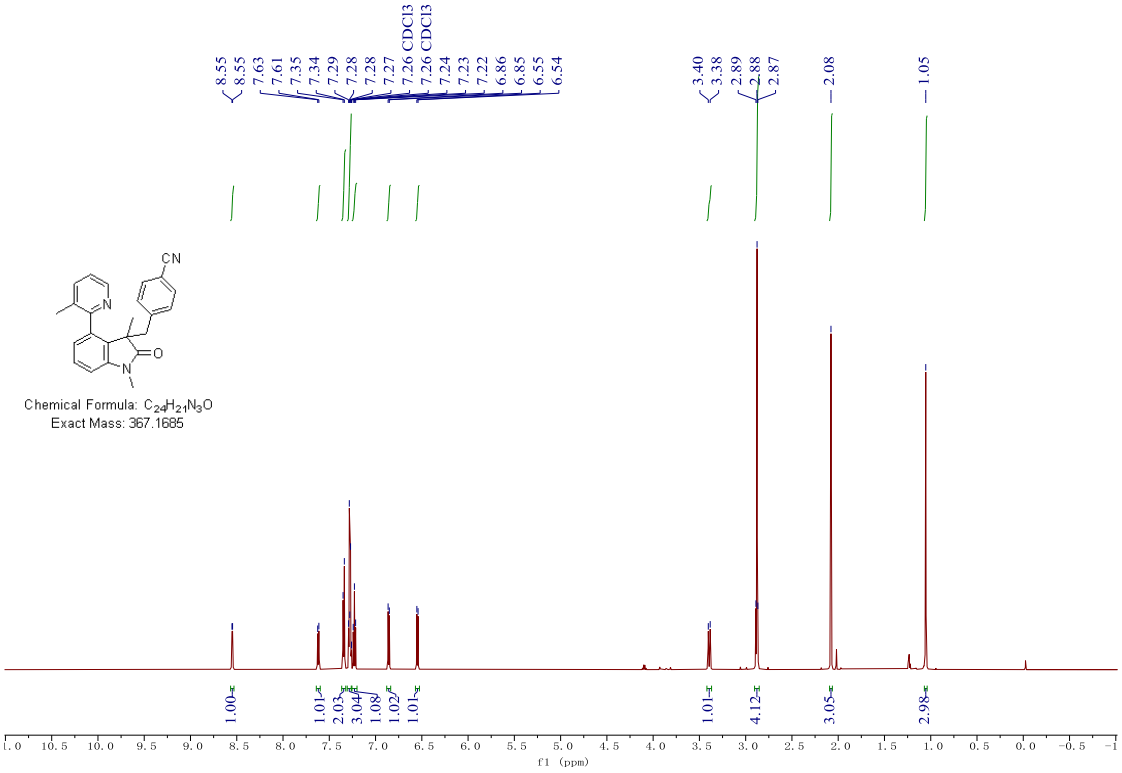

-62.33
Chemical Formula: C24H21F3N2O
Exact Mass: 410.1606
f1 (ppm)

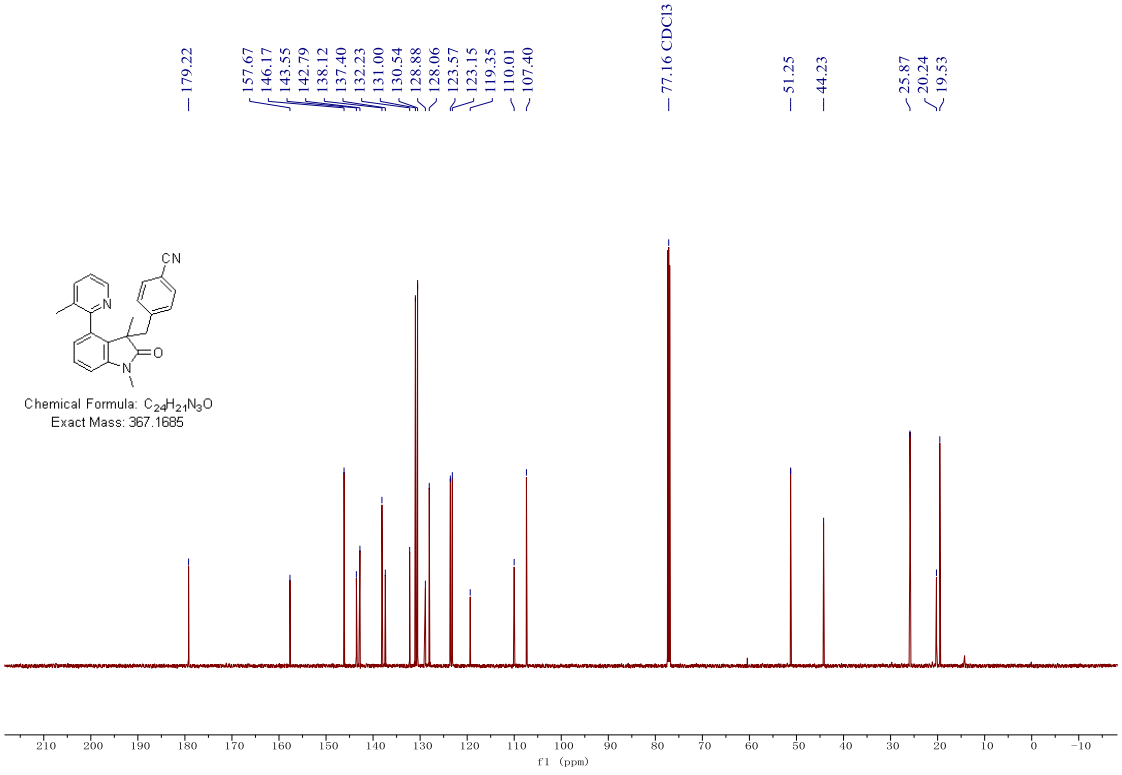
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-nitrobenzyl)indolin-2-one (**24**)



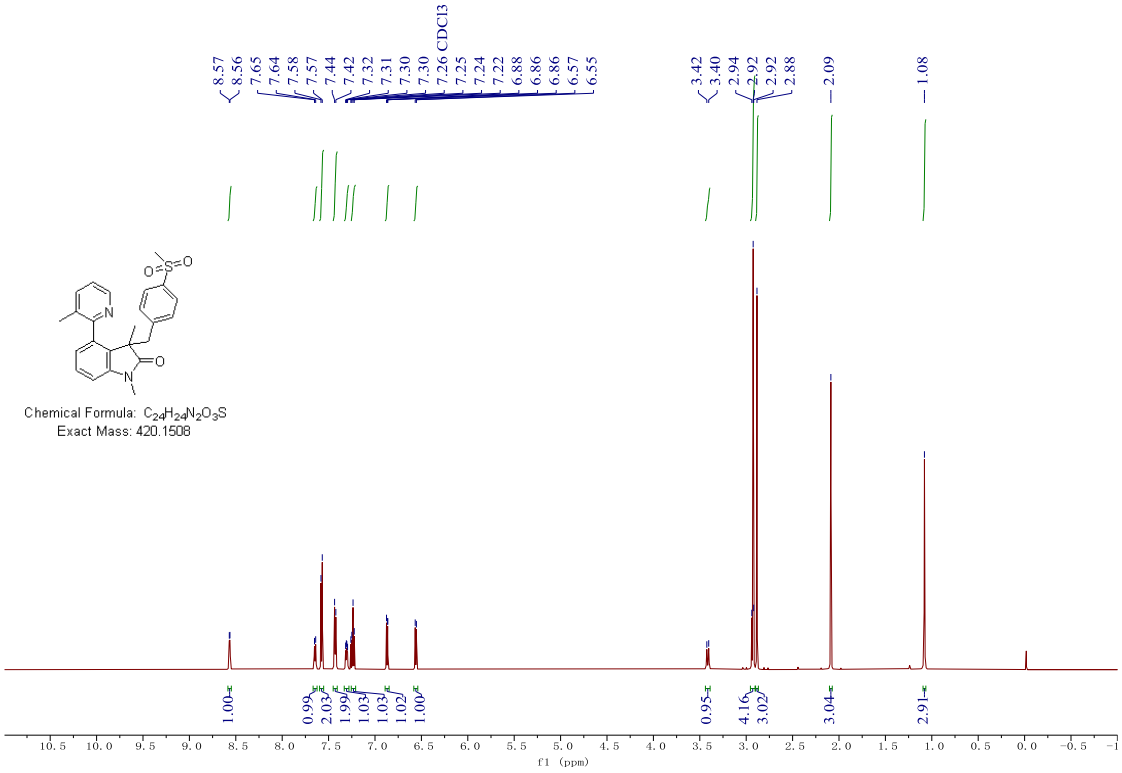


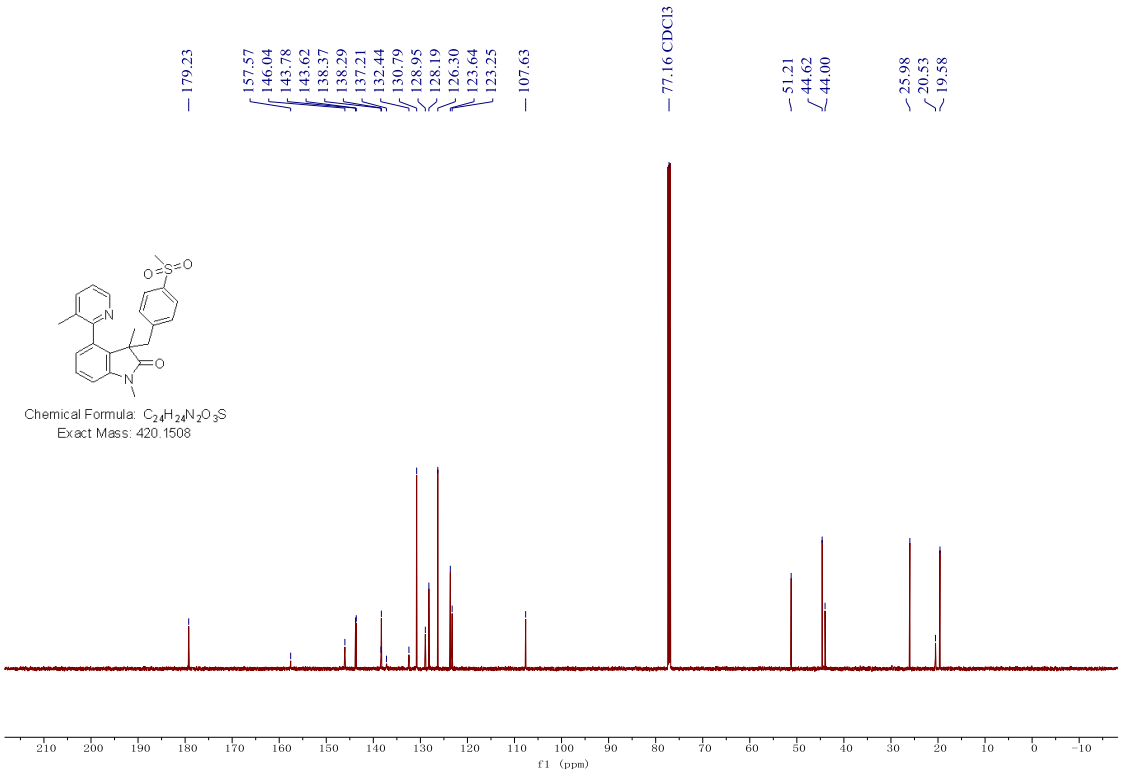
4-((1,3-dimethyl-4-(3-methylpyridin-2-yl)-2-oxoindolin-3-yl)methyl)benzonitrile (**25**)



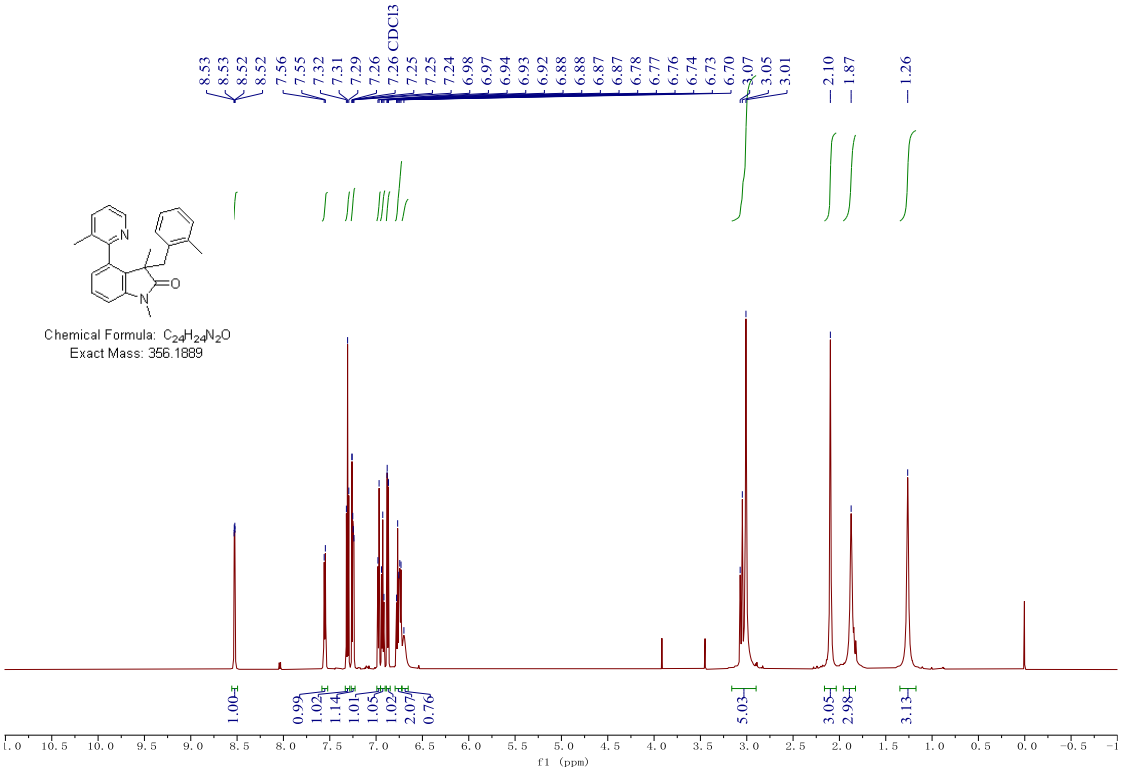


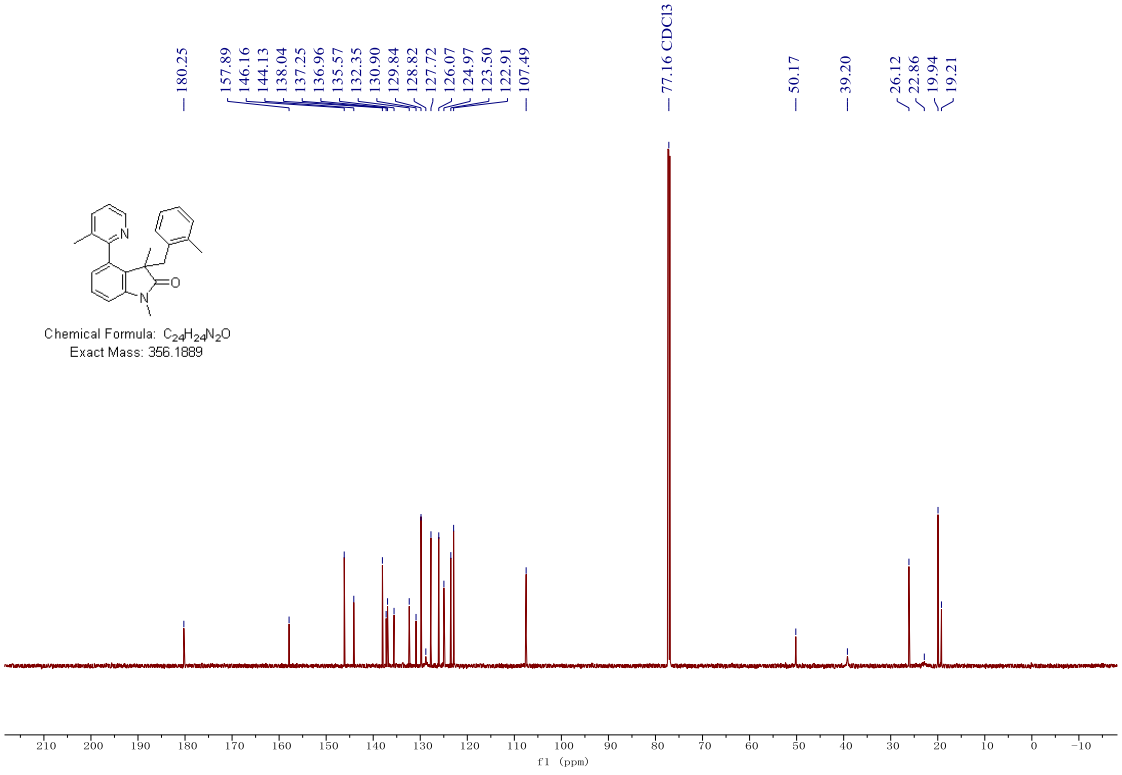
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(4-(methylsulfonyl)benzyl)indolin-2-one (**26**)



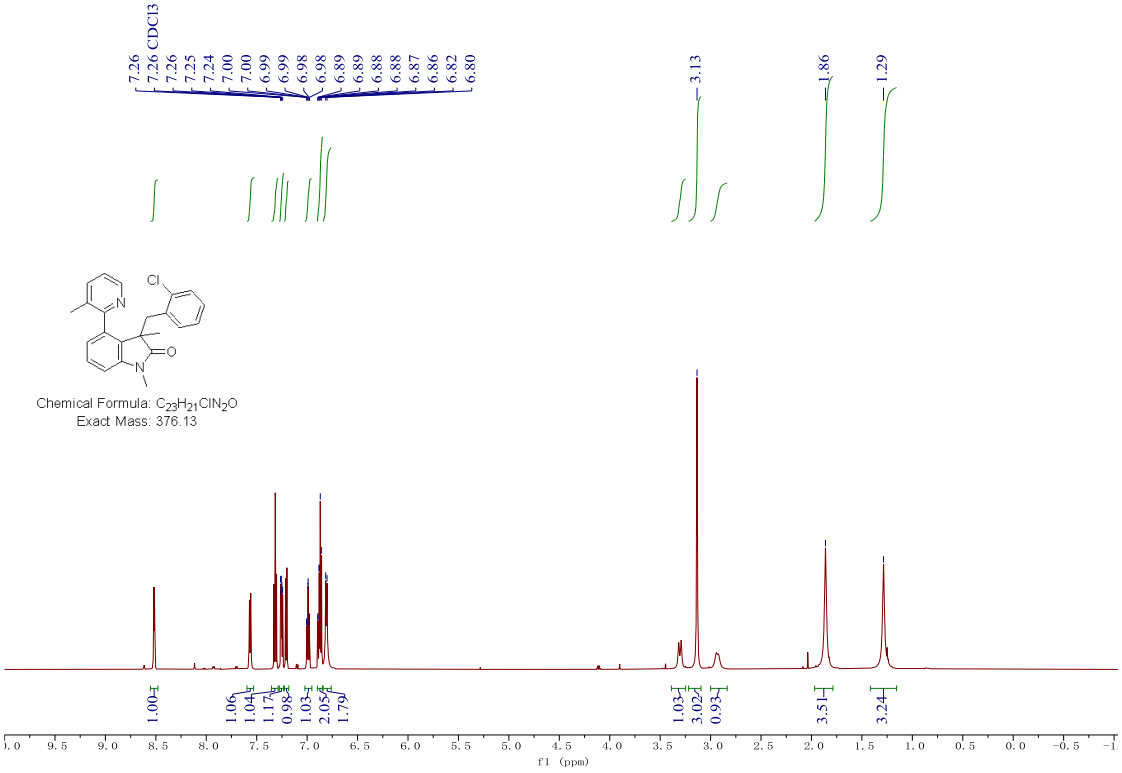


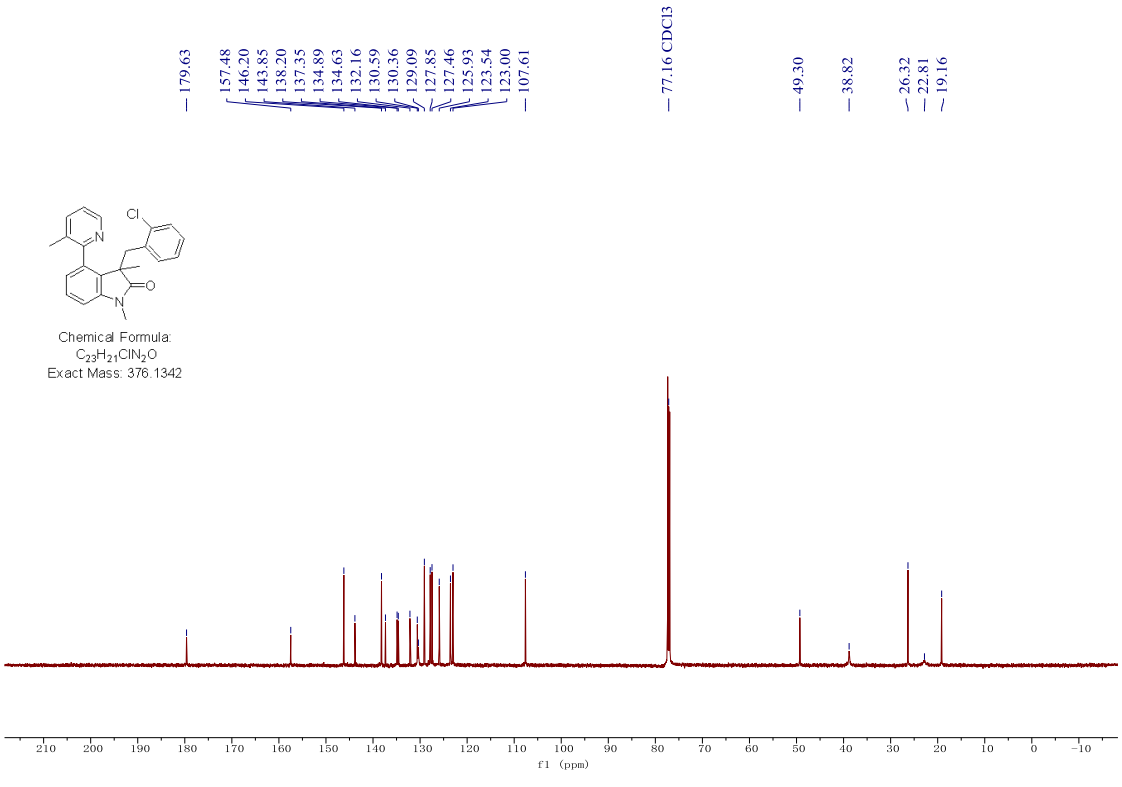
1,3-dimethyl-3-(2-methylbenzyl)-4-(3-methylpyridin-2-yl)indolin-2-one (**27**)



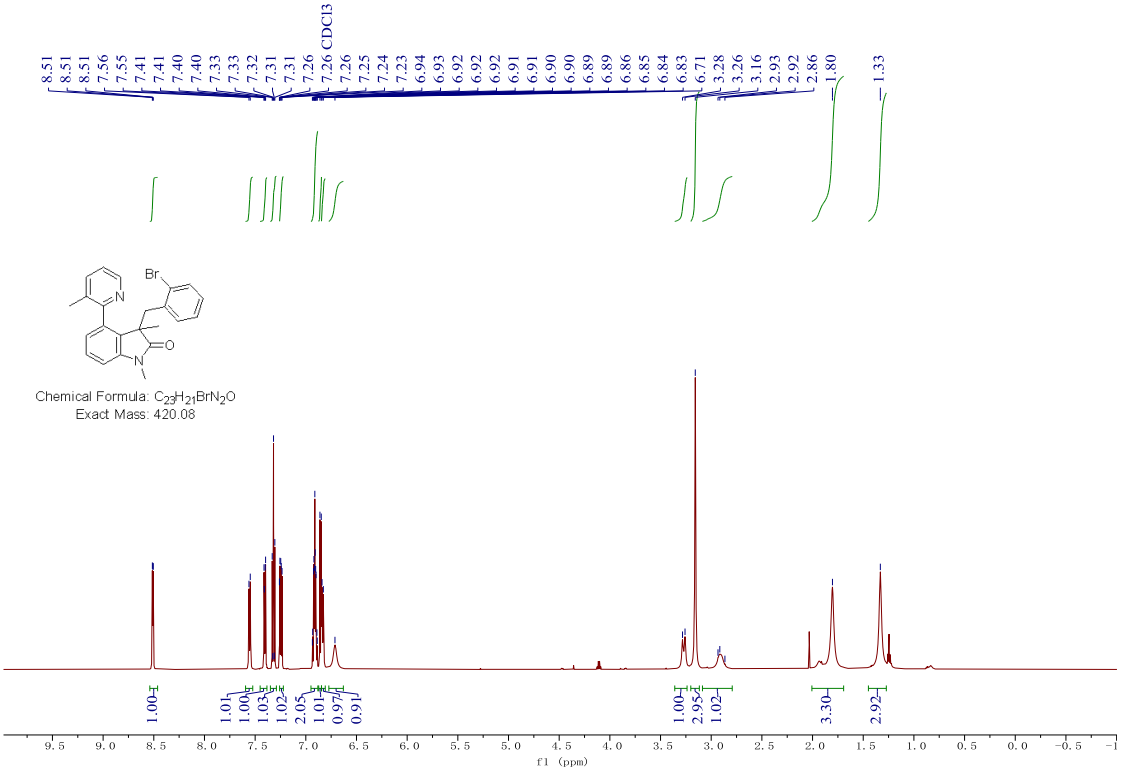


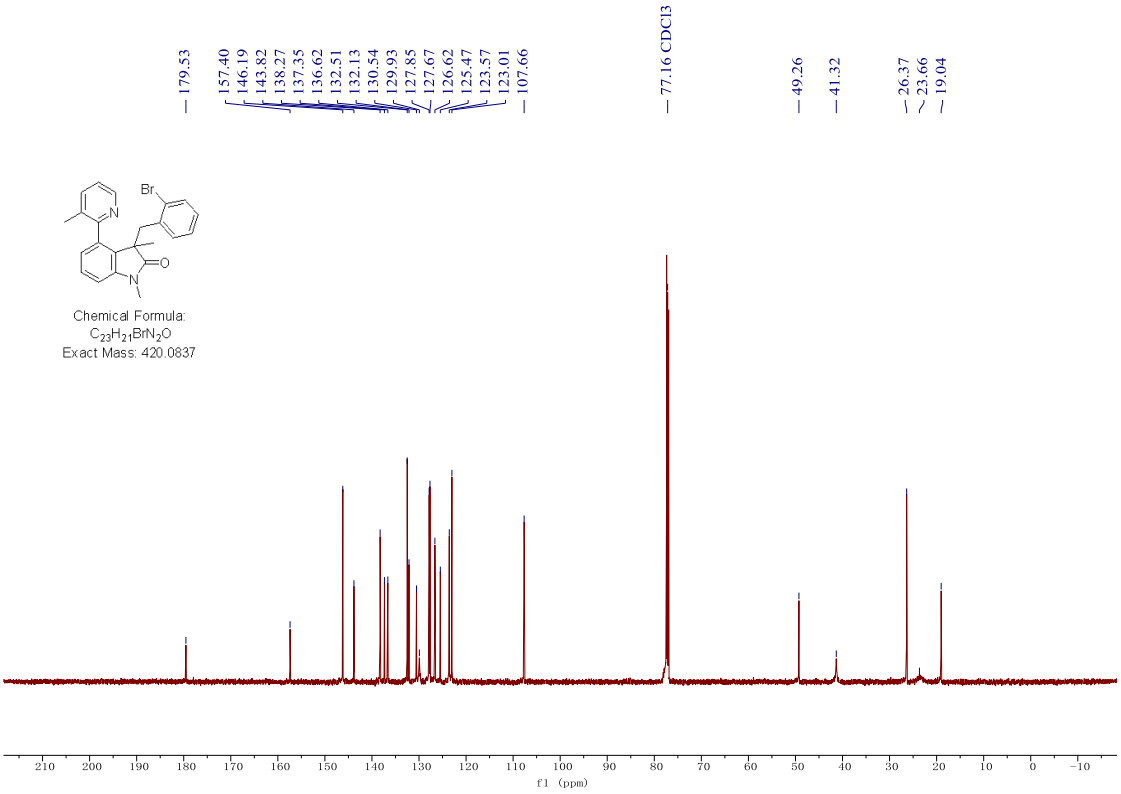
3-(2-chlorobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**28**)



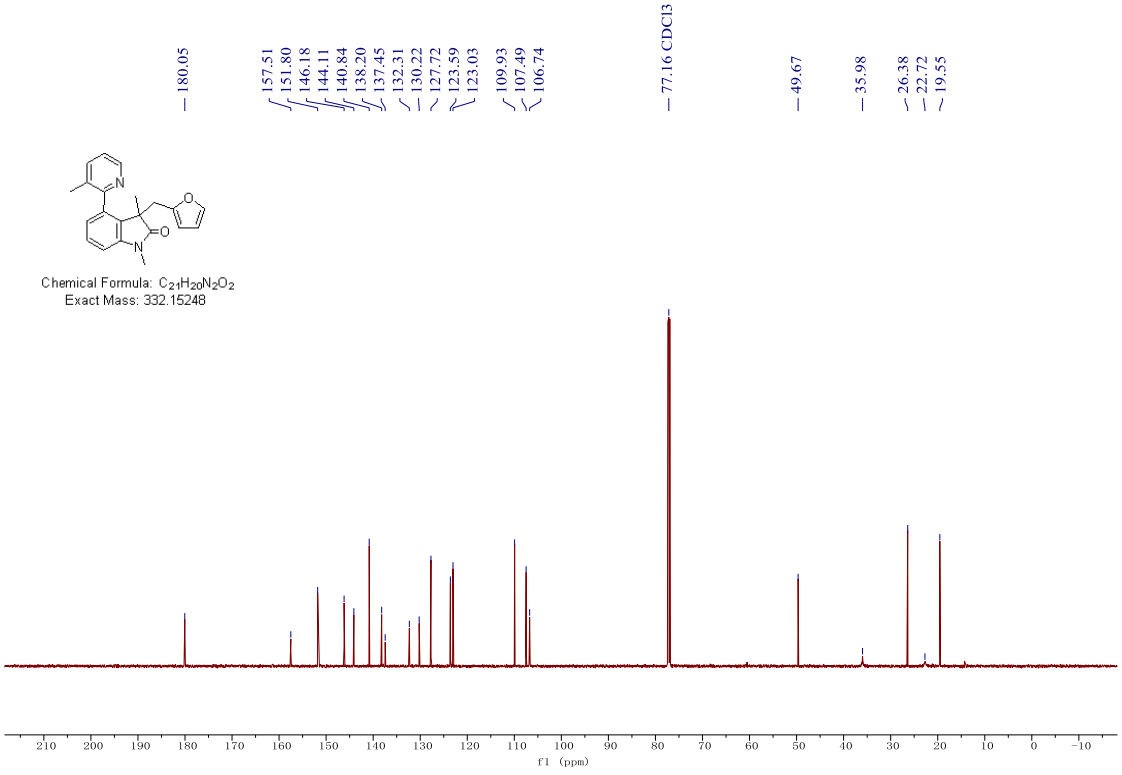


3-(2-bromobenzyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**29**)

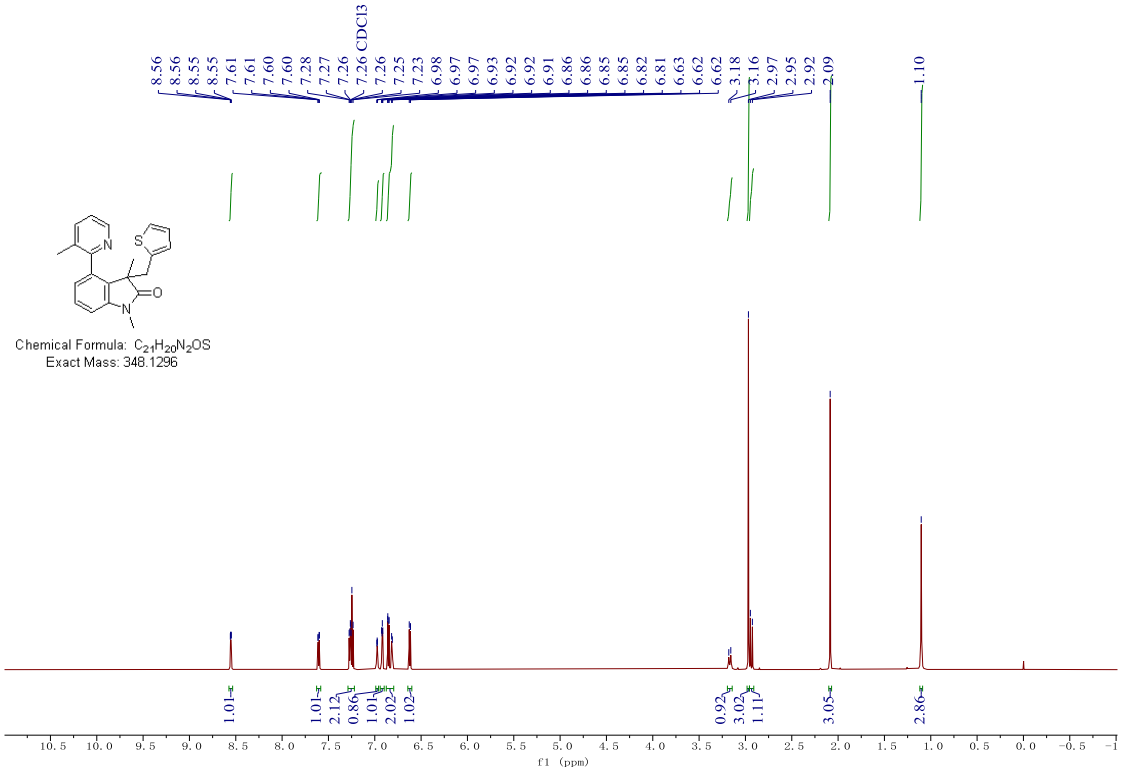


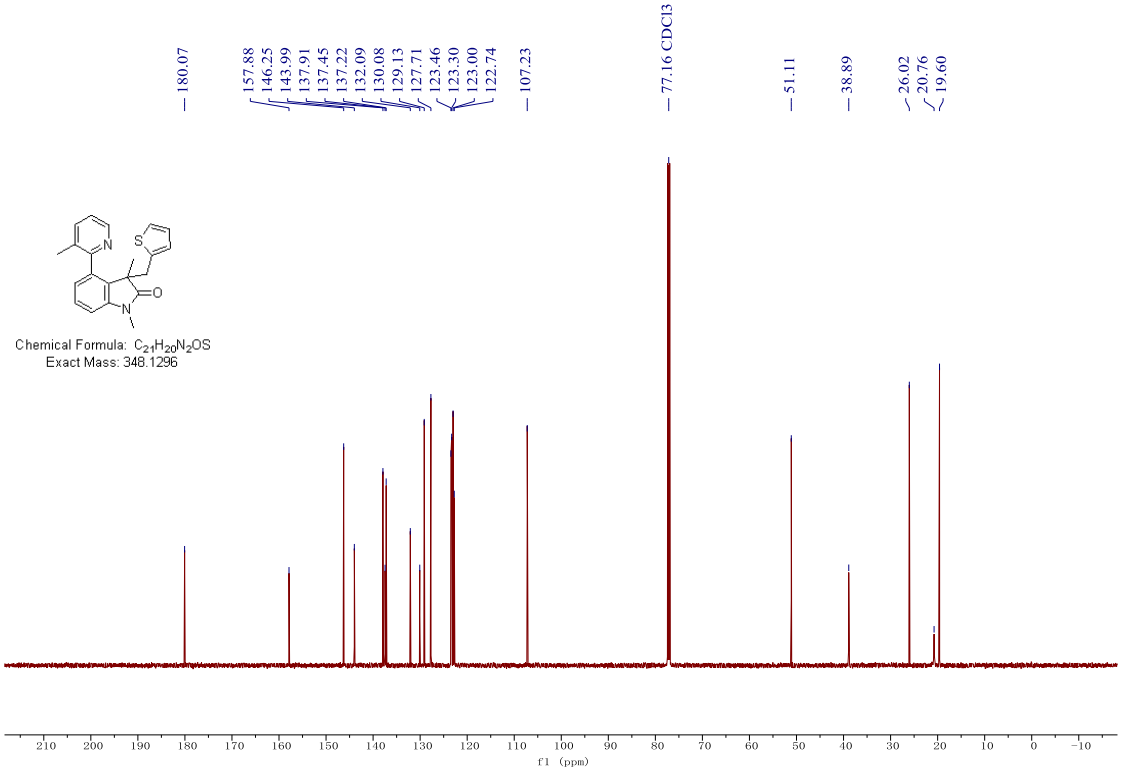


3-(furan-2-ylmethyl)-1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**30**)

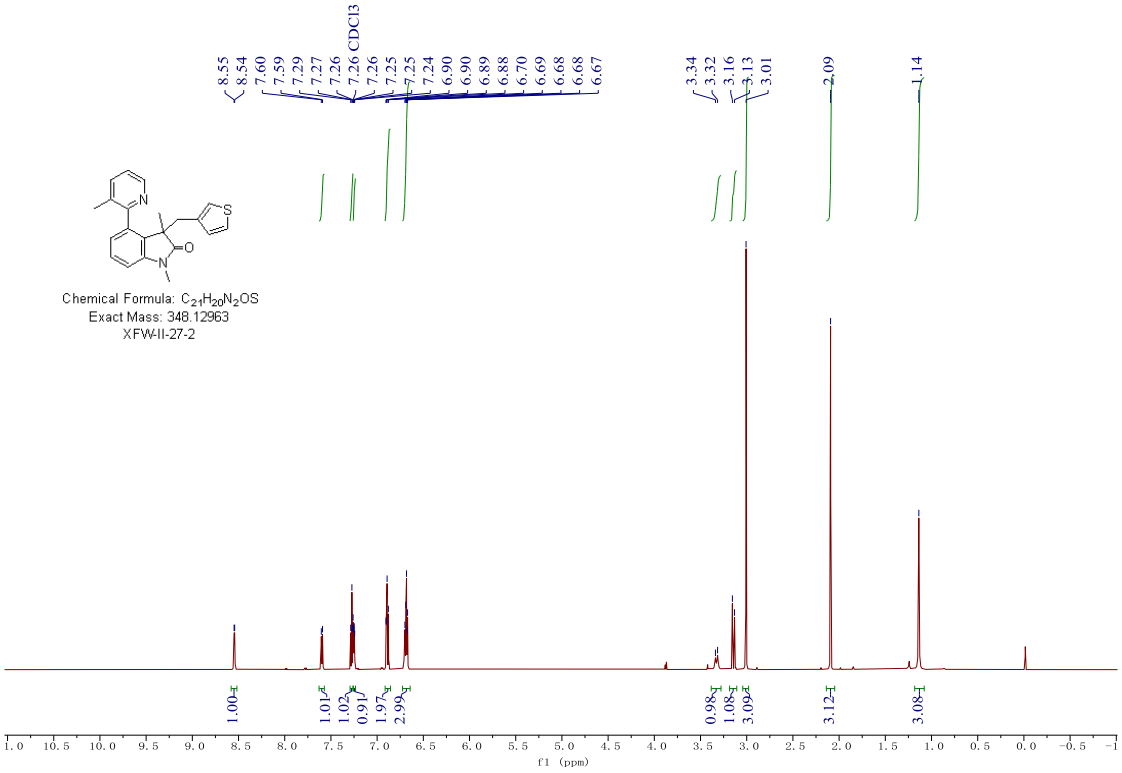


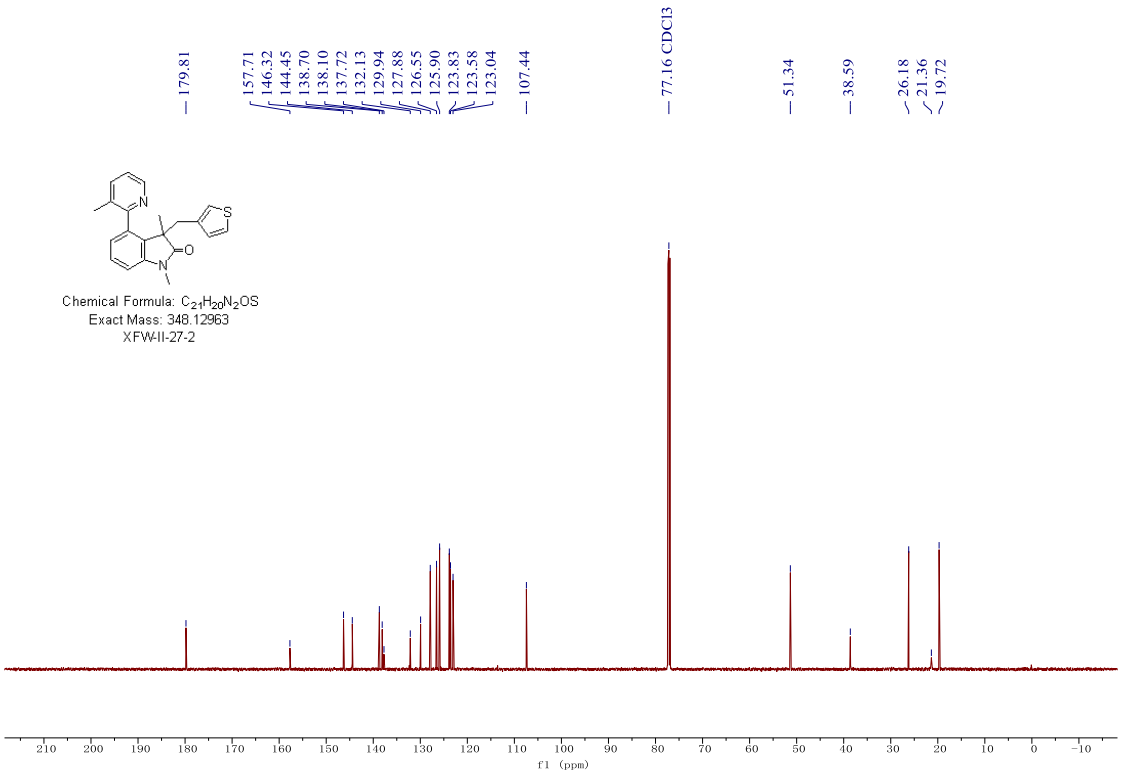
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(thiophen-2-ylmethyl)indolin-2-one (**31**)



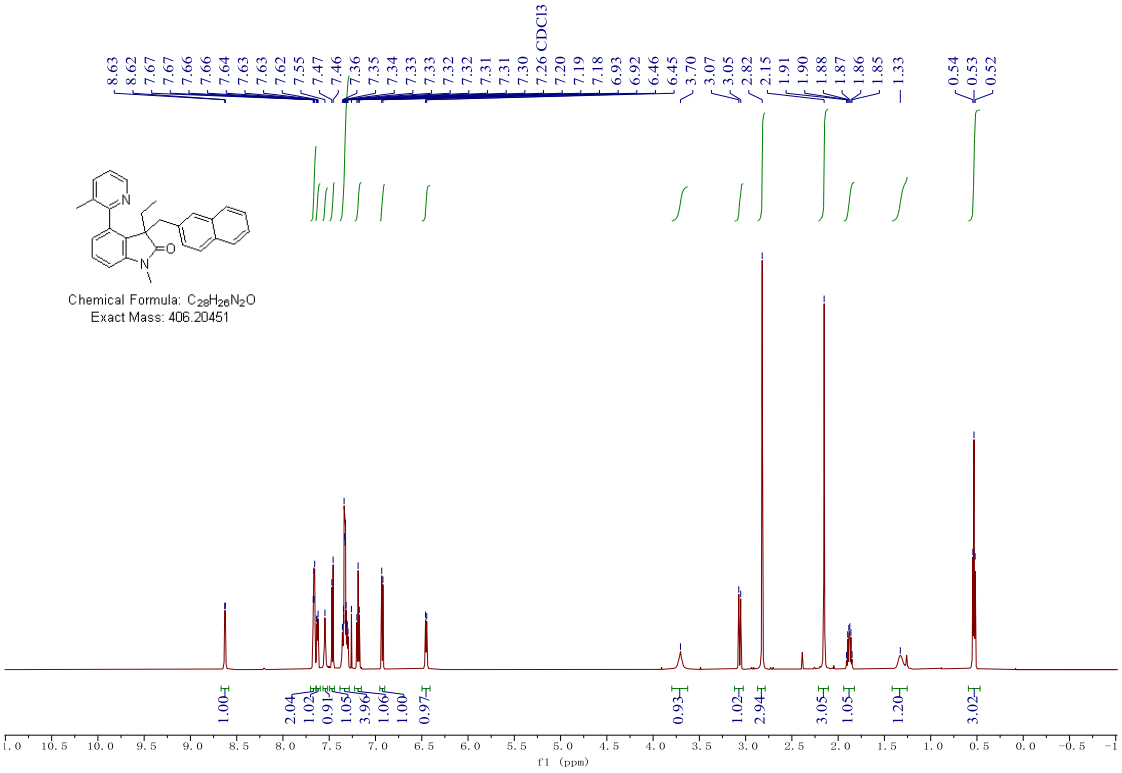


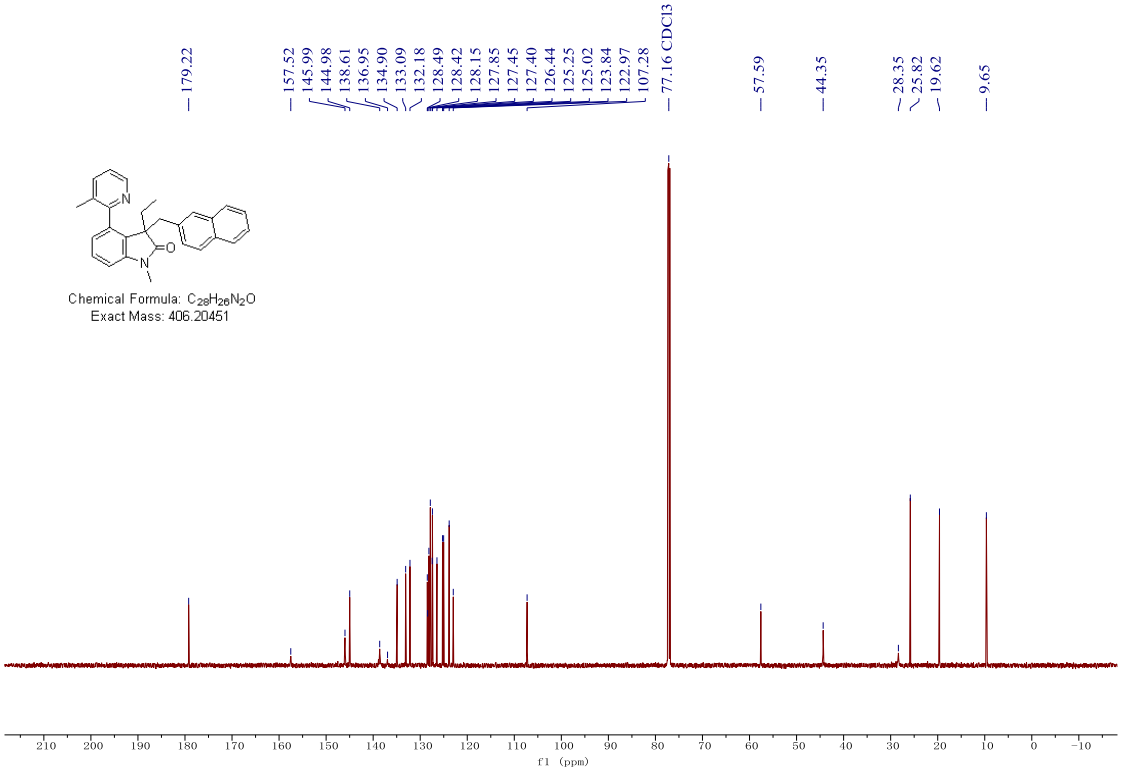
1,3-dimethyl-4-(3-methylpyridin-2-yl)-3-(thiophen-3-ylmethyl)indolin-2-one (**32**)



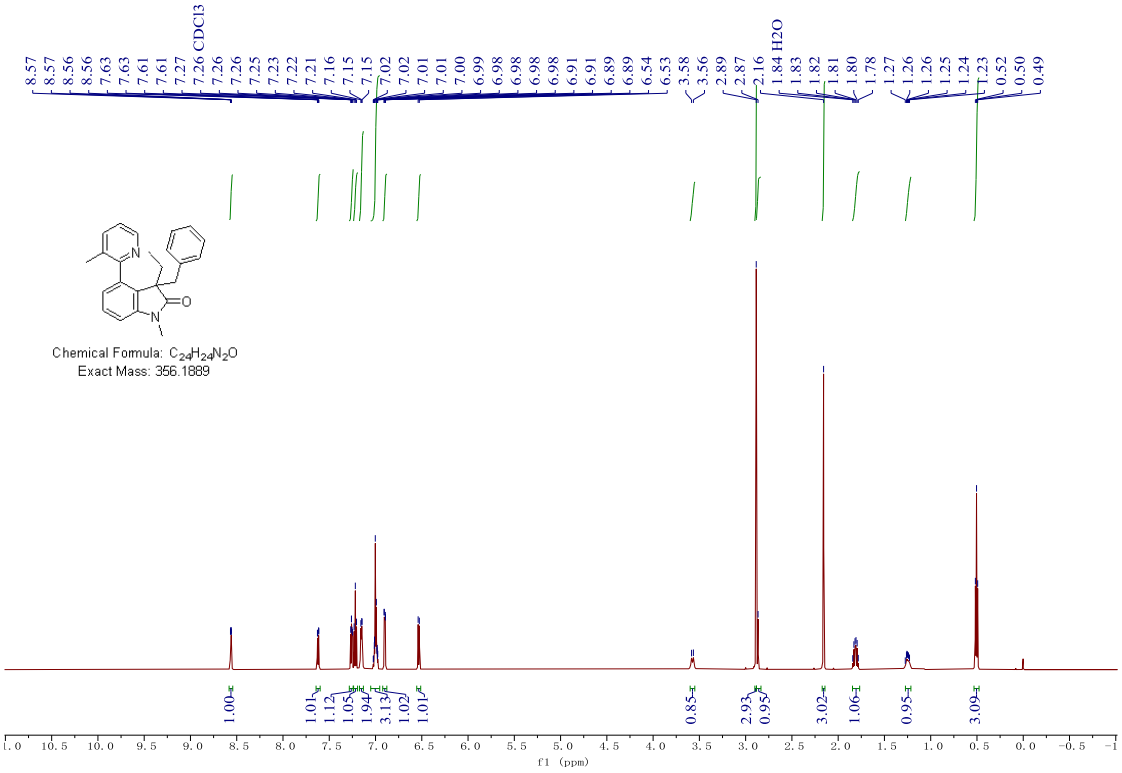


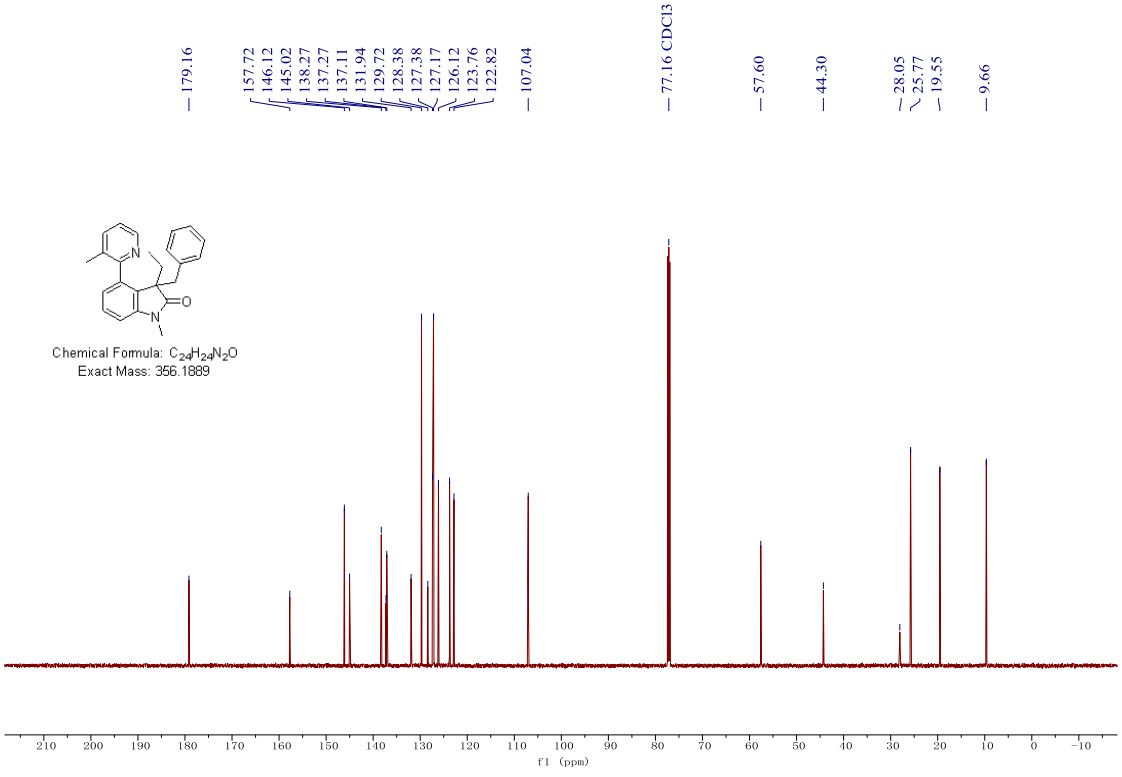
3-ethyl-1-methyl-4-(3-methylpyridin-2-yl)-3-(naphthalen-2-ylmethyl)indolin-2-one (**33**)



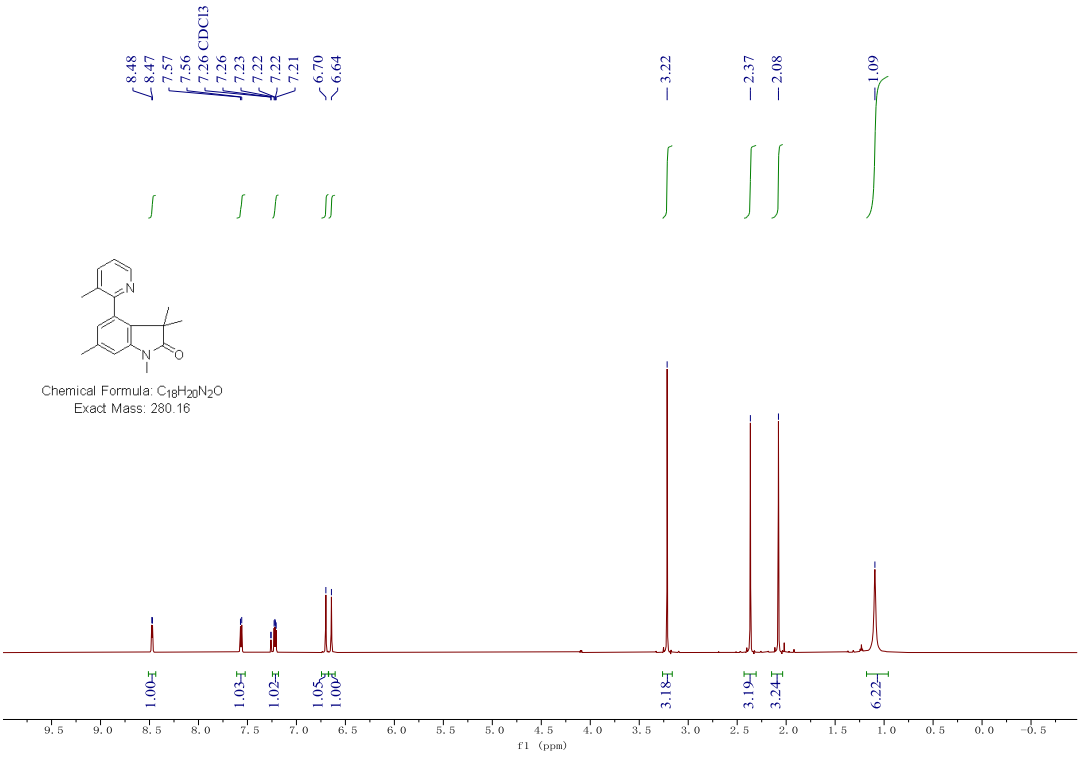


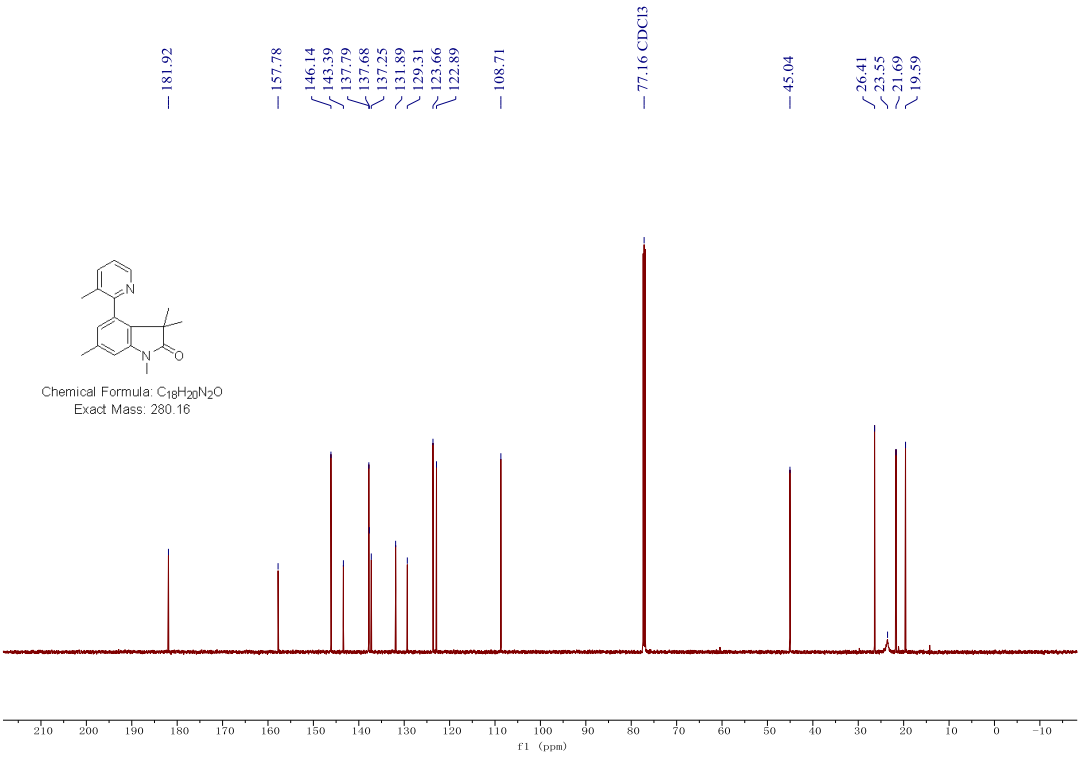
3-benzyl-3-ethyl-1-methyl-4-(3-methylpyridin-2-yl)indolin-2-one (**34**)



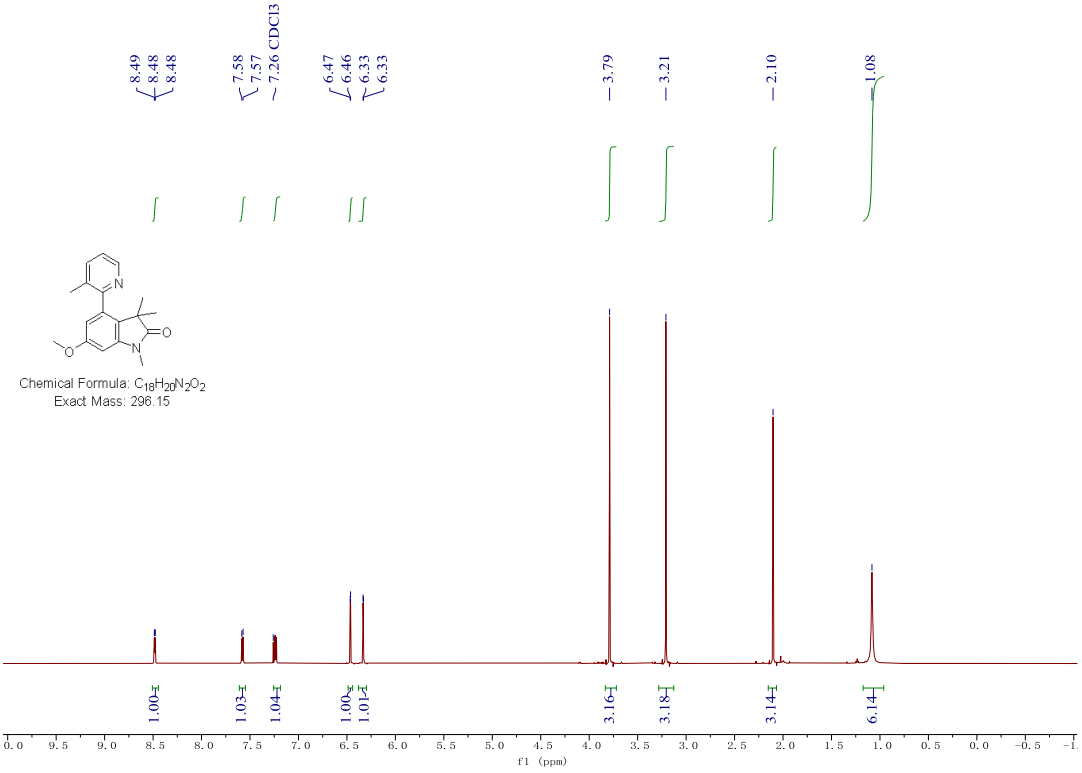


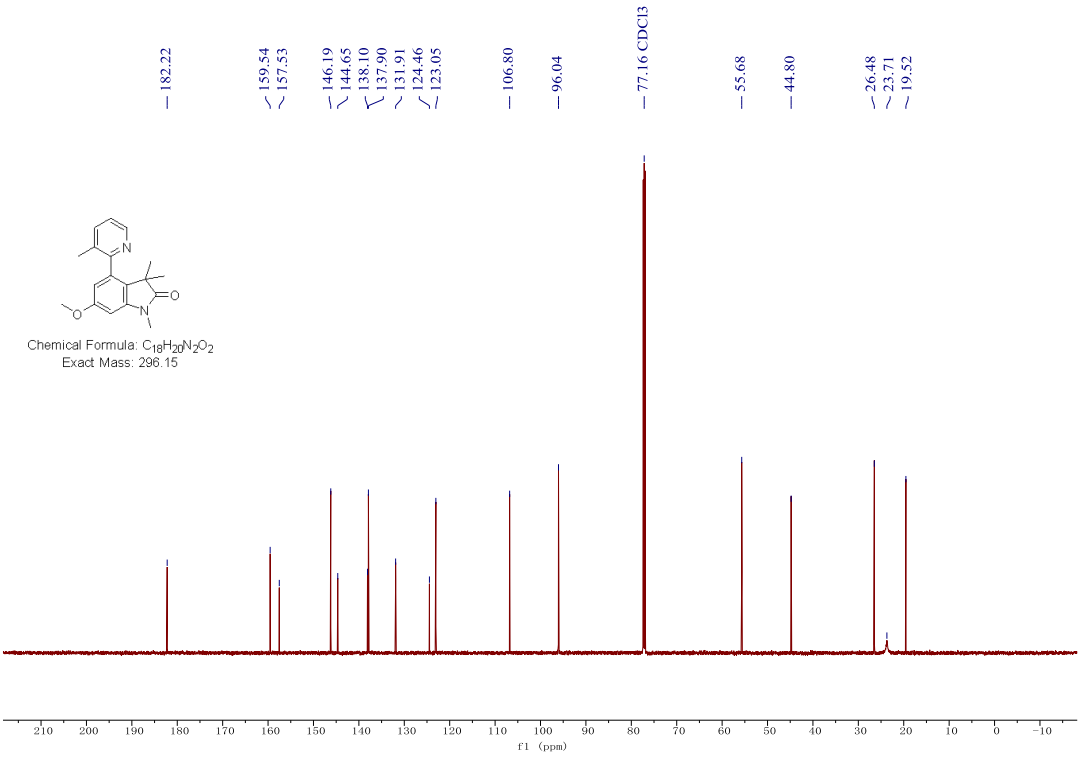
1,3,3,6-tetramethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**35**)



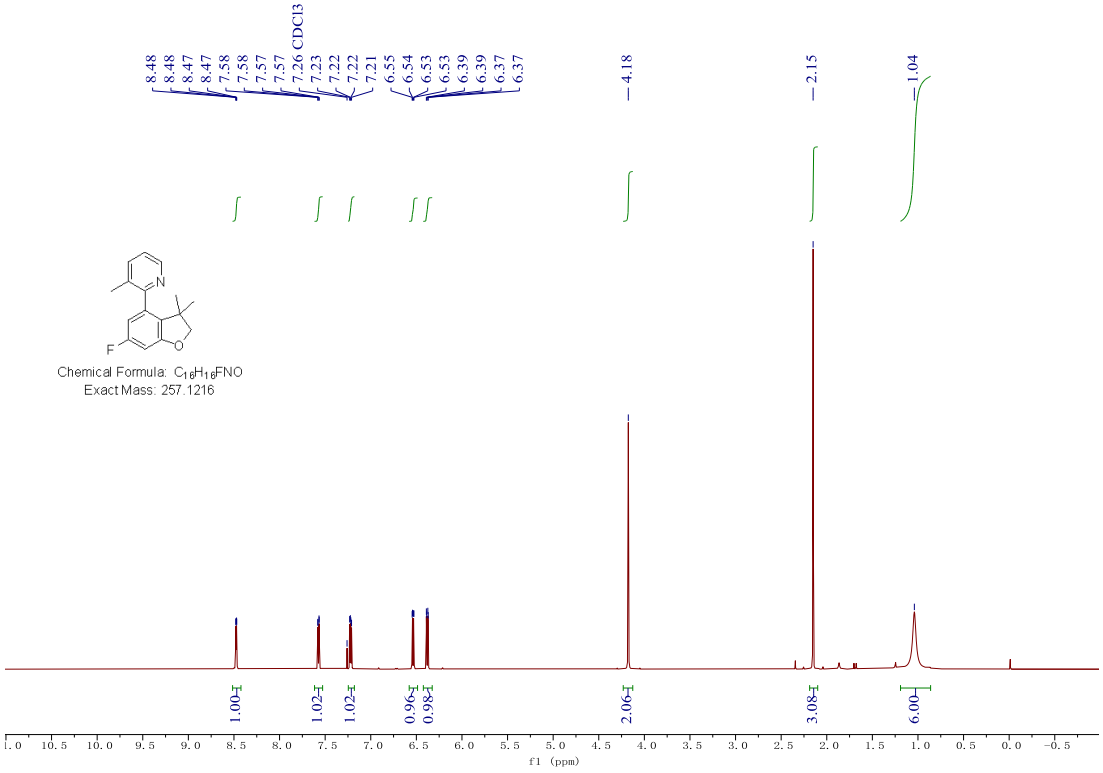


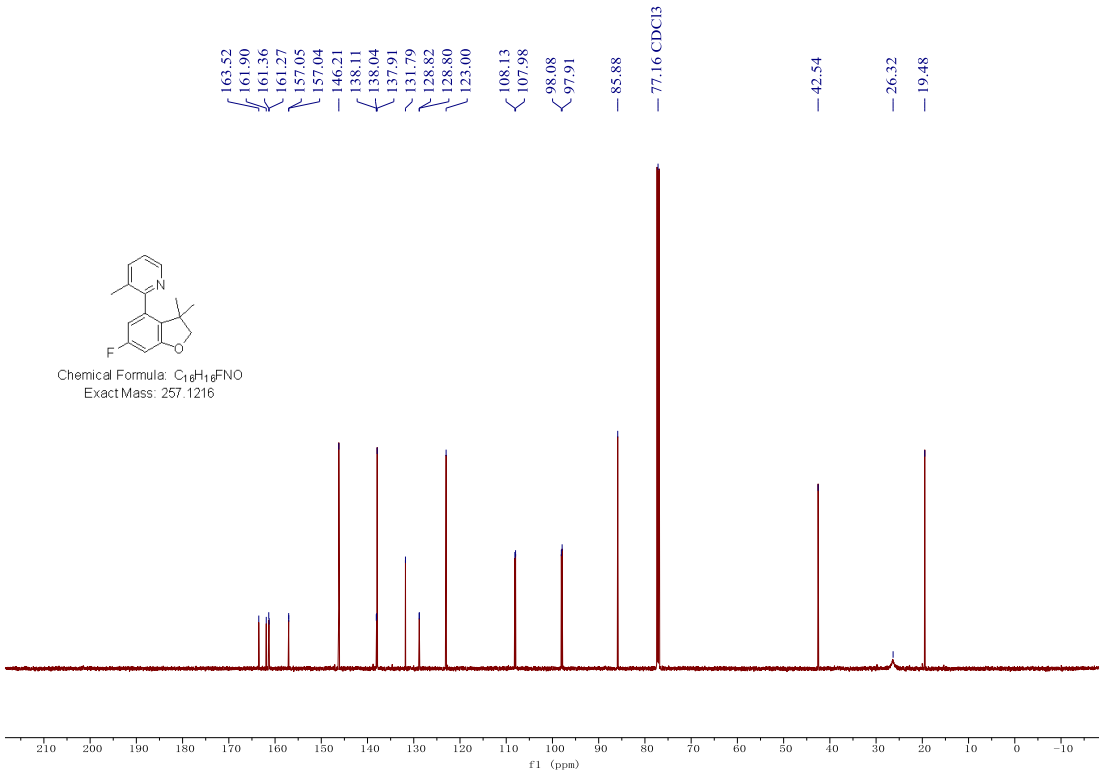
6-methoxy-1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**36**)

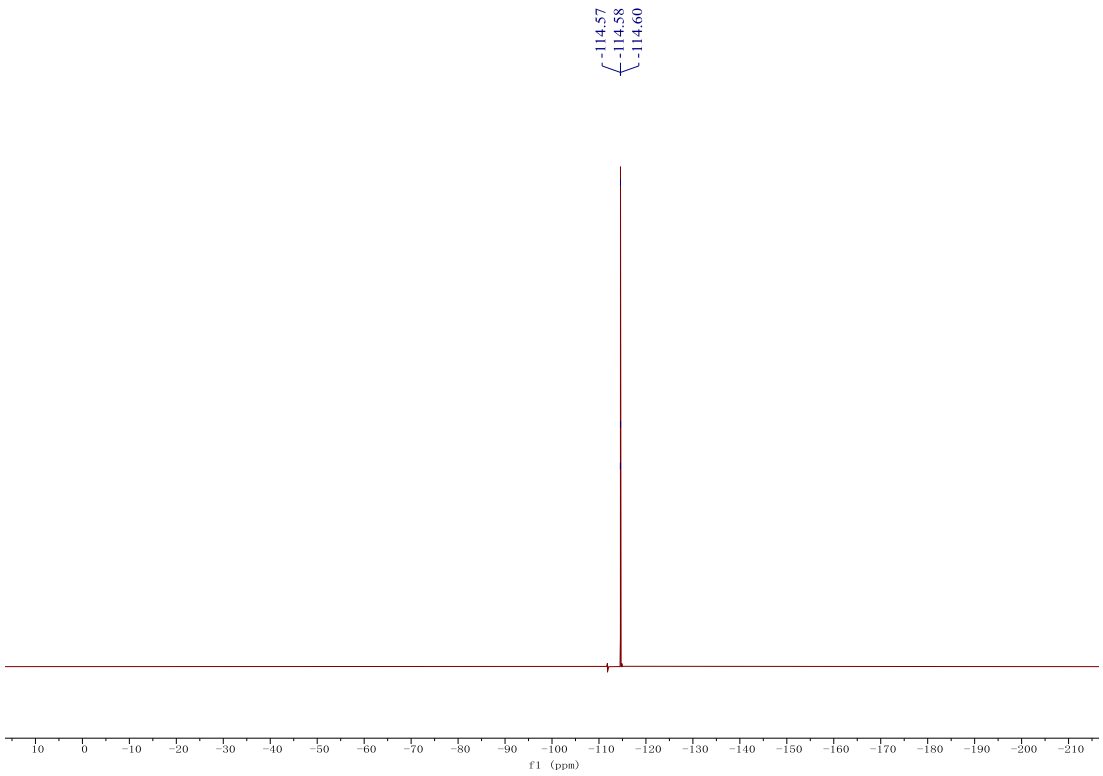




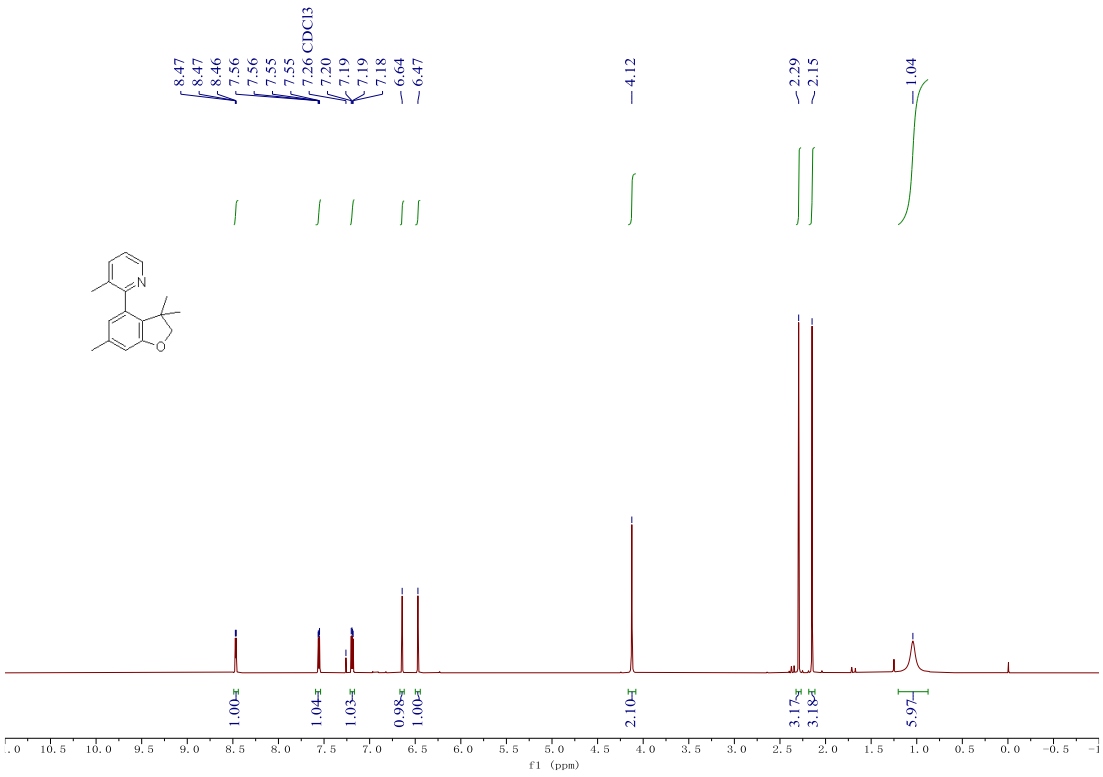
2-(6-fluoro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine **37**

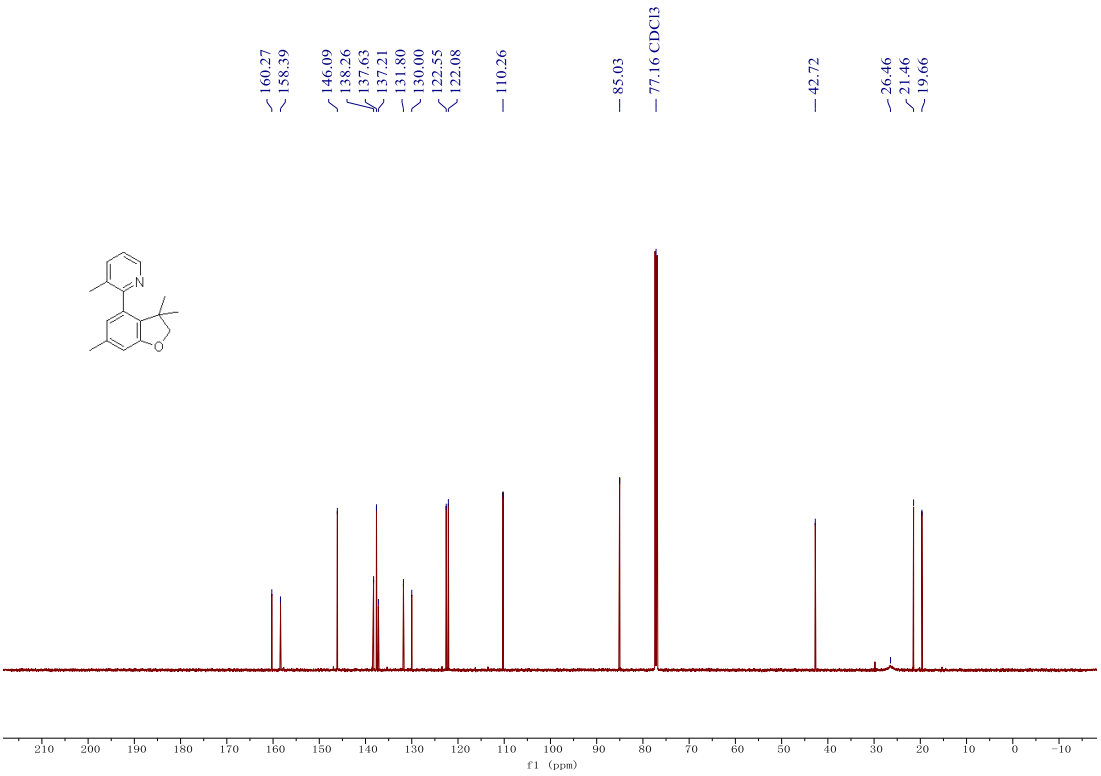




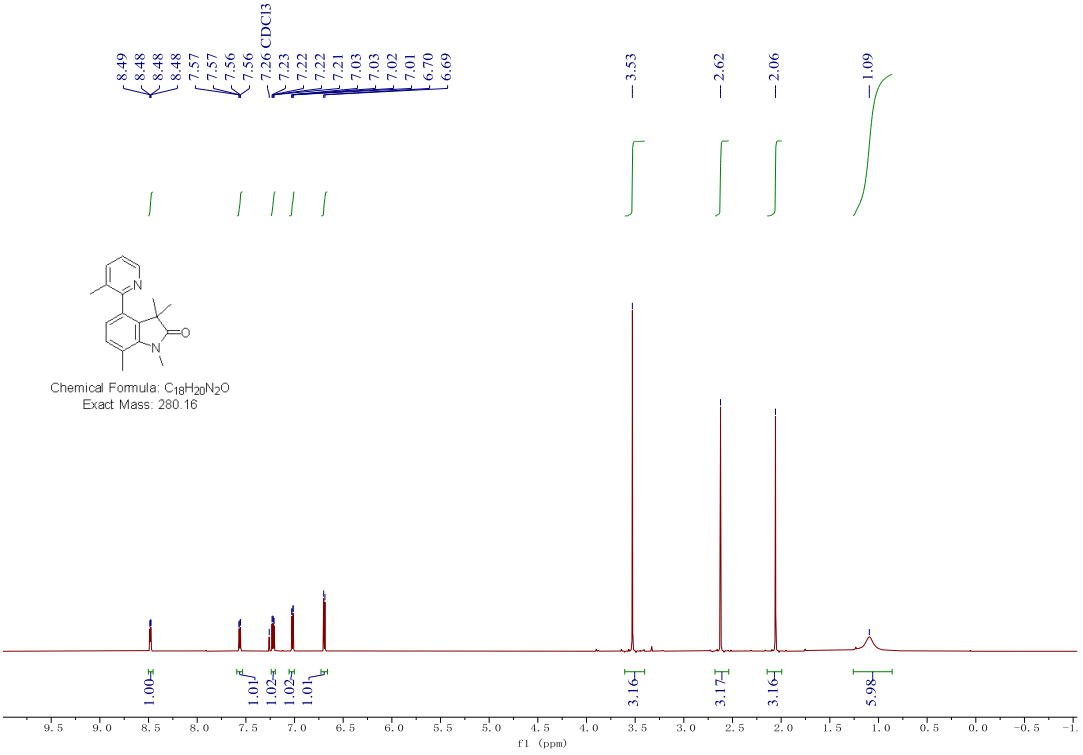


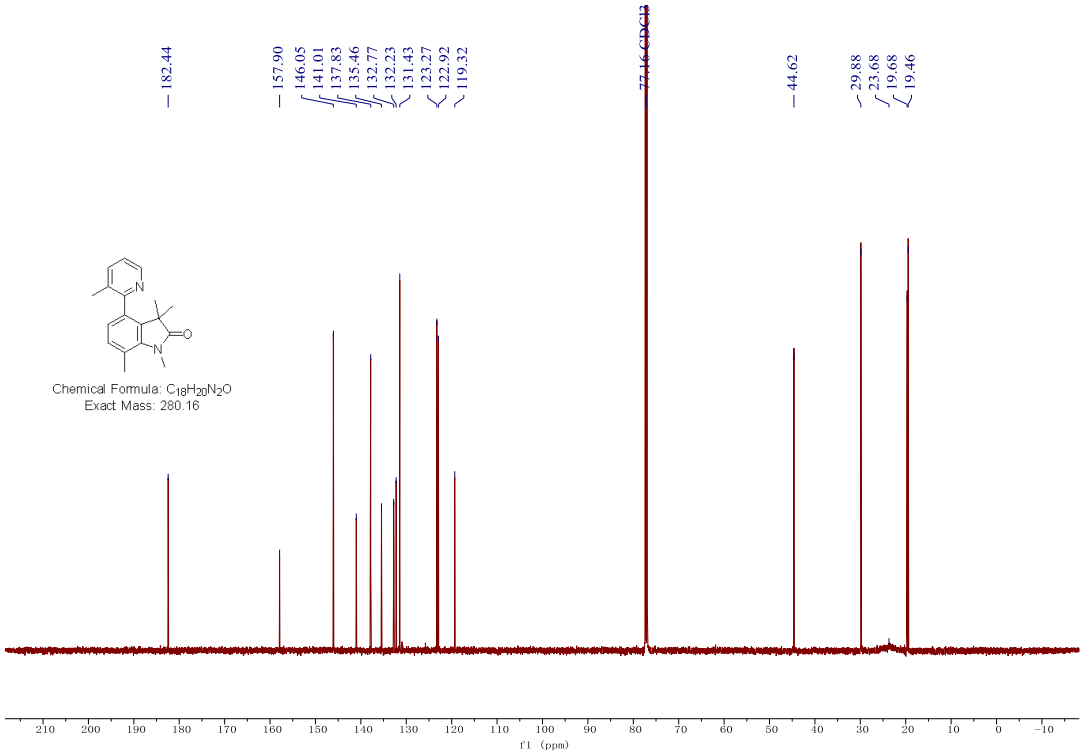
2-methyl-2-(3,3,7-trimethyl-2,3-dihydrobenzofuran-4-yl)pyridine **38**



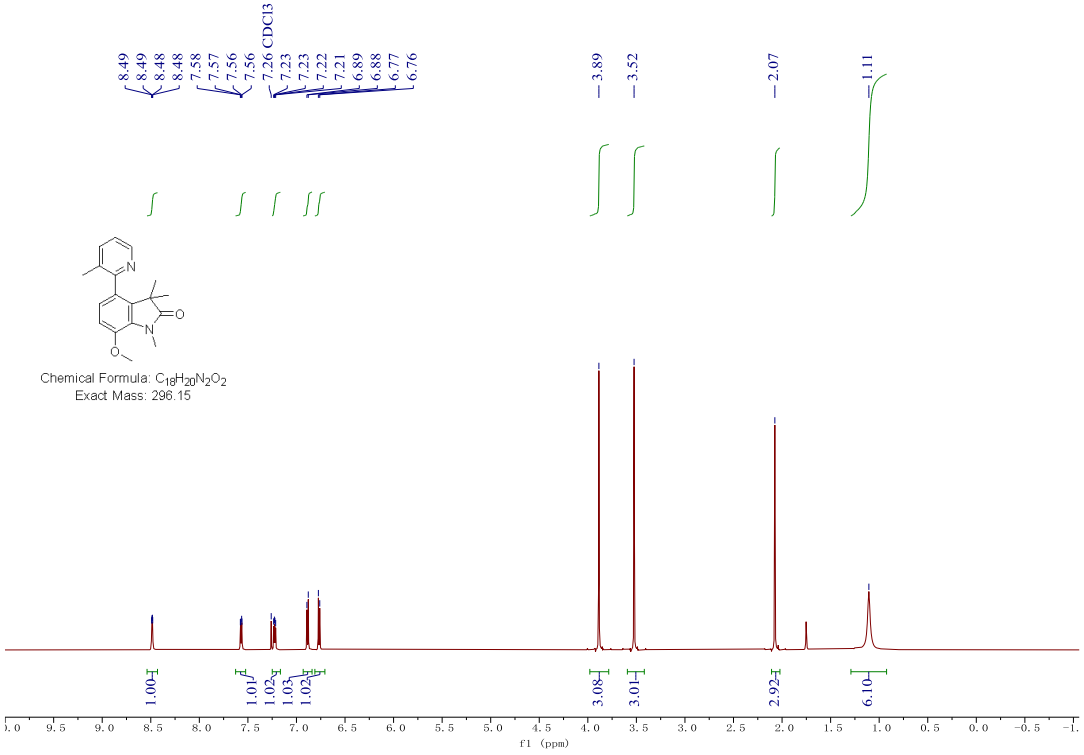


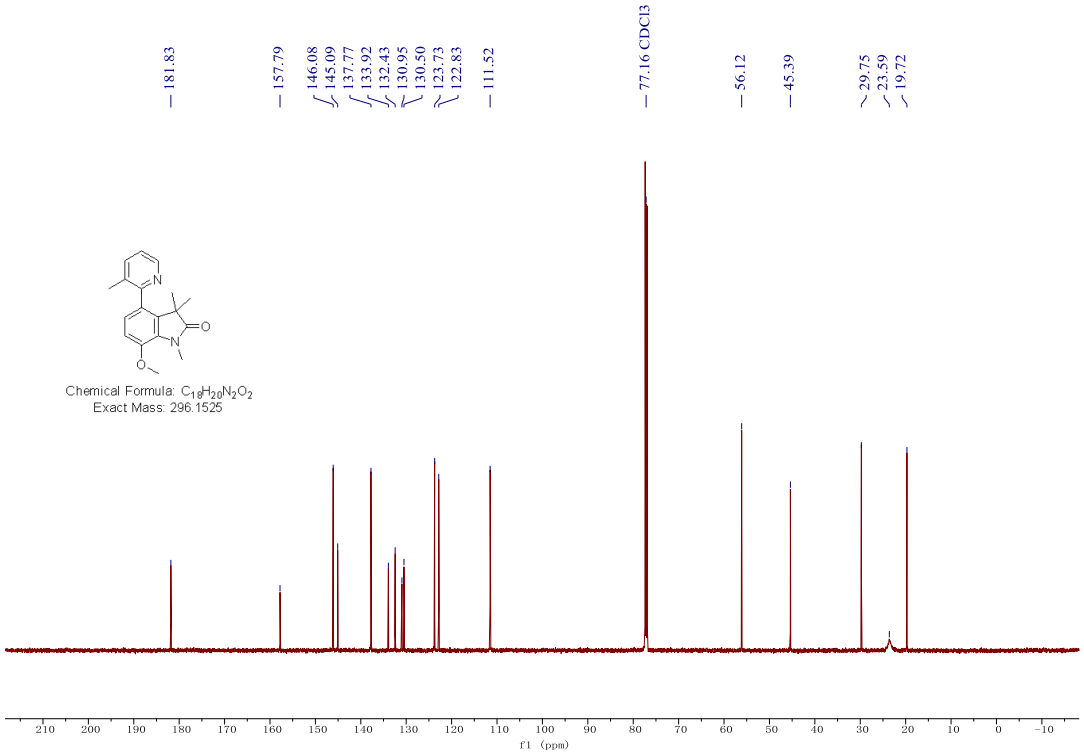
1,3,3,7-tetramethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**39**)



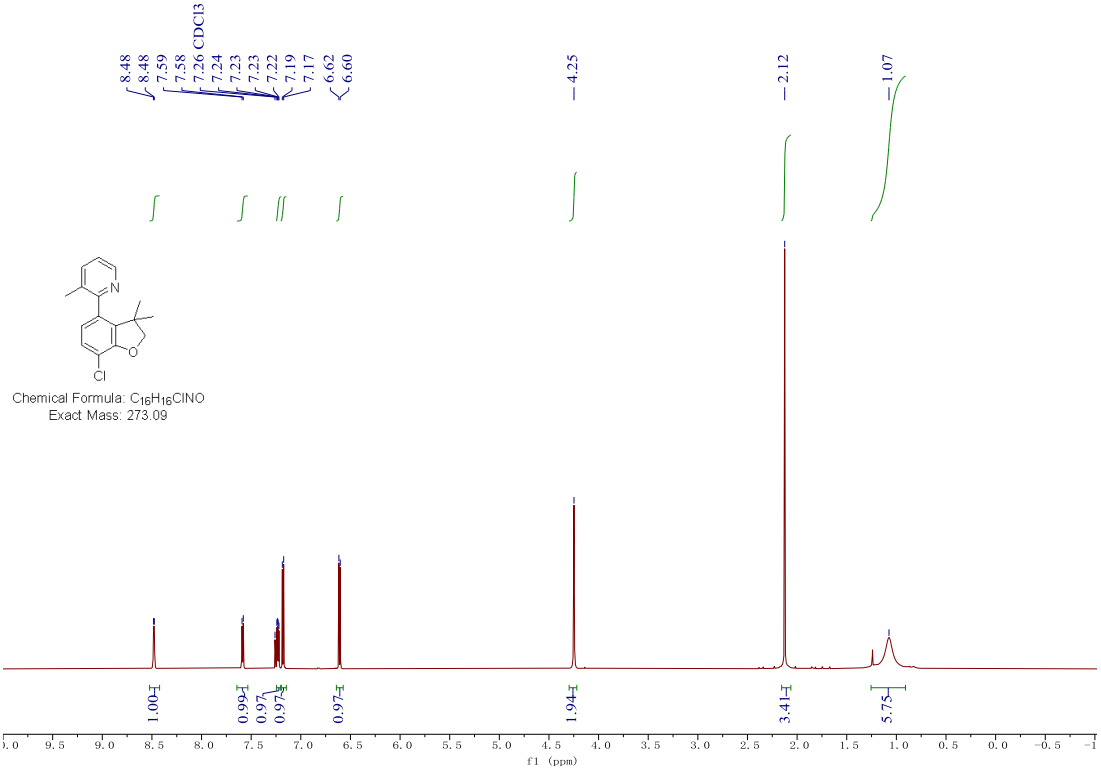


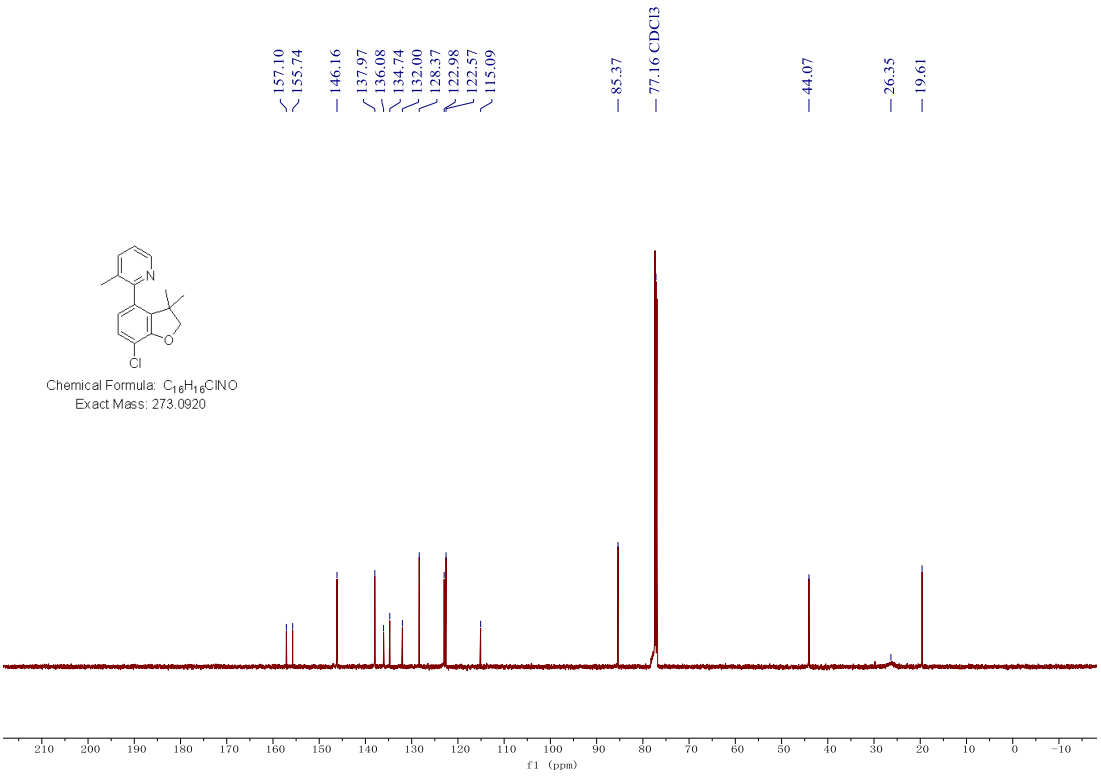
7-methoxy-1,3,3-trimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**40**)



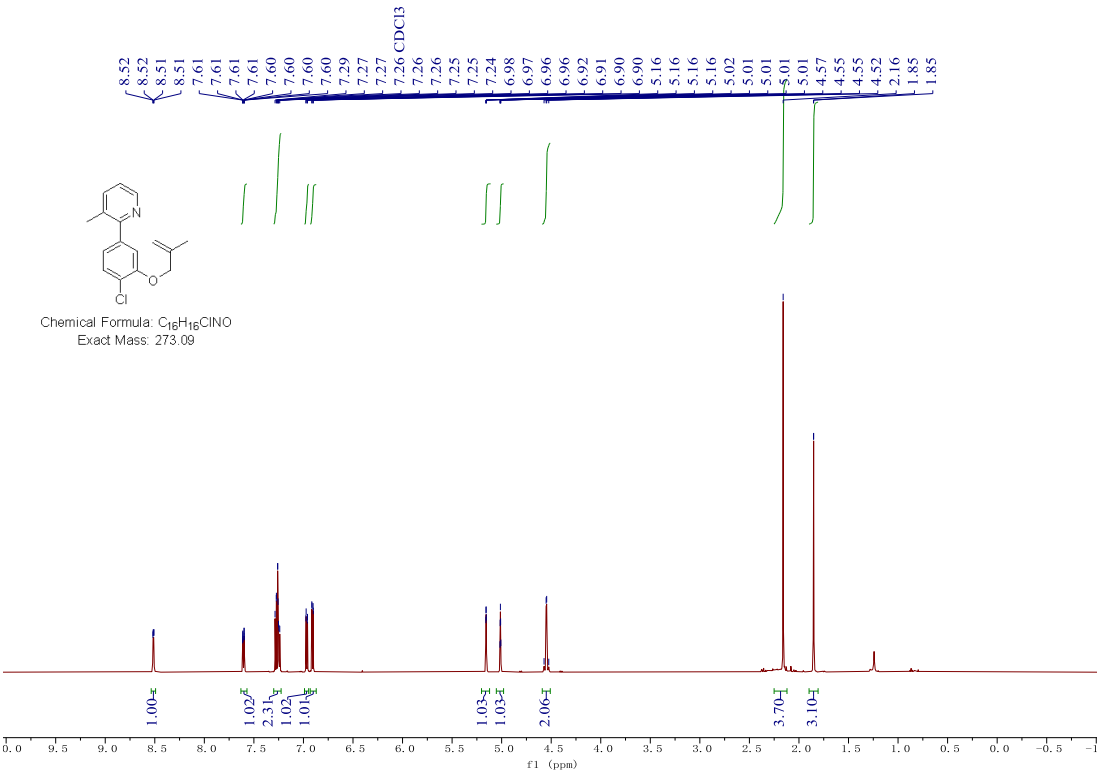


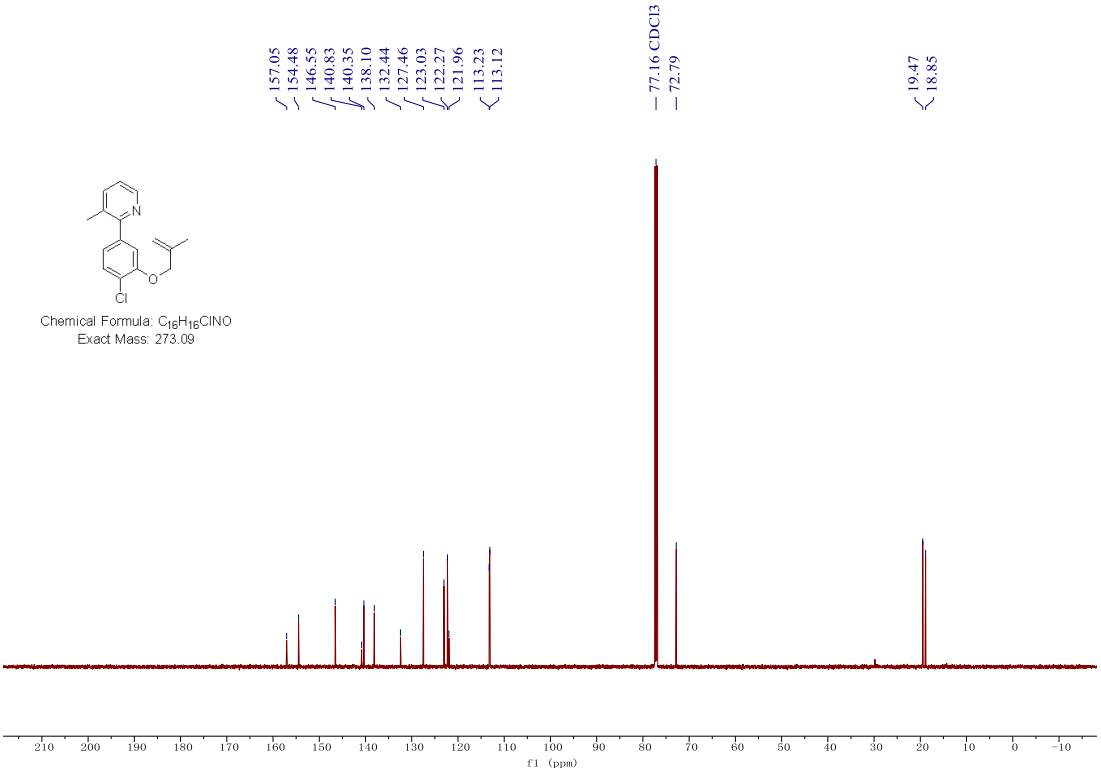
2-(7-chloro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**41**)



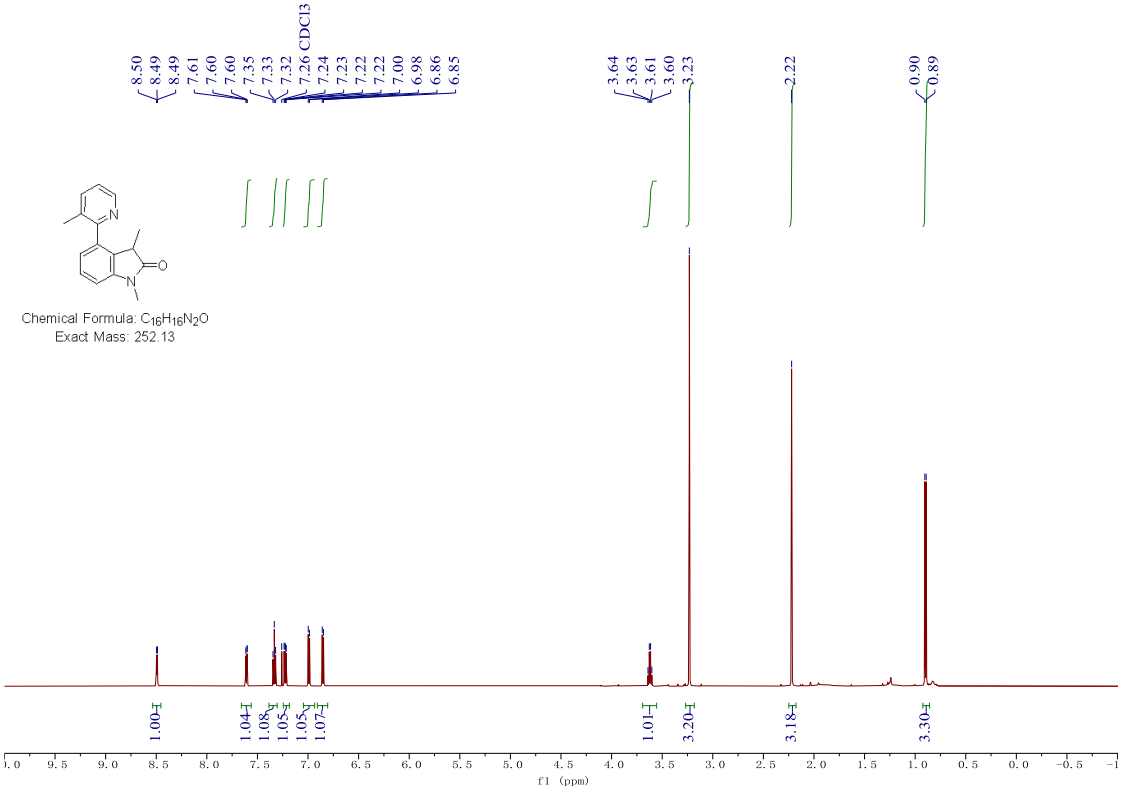


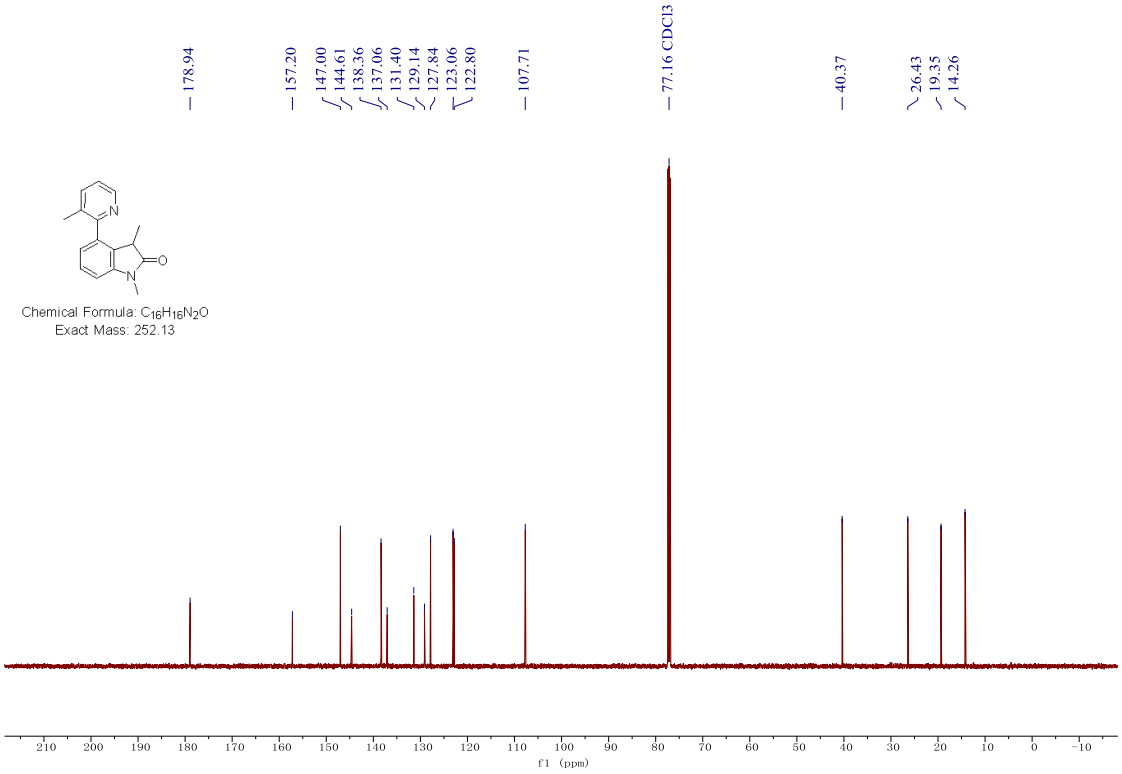
2-(7-chloro-3,3-dimethyl-2,3-dihydrobenzofuran-4-yl)-3-methylpyridine (**41'**)



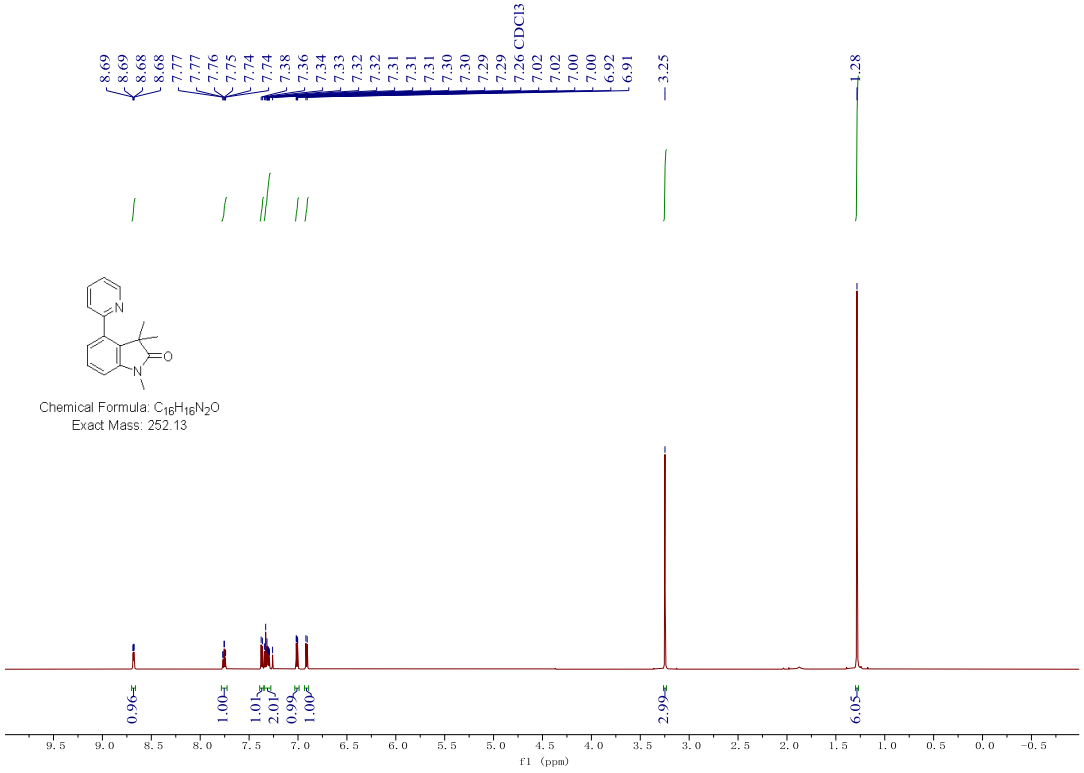


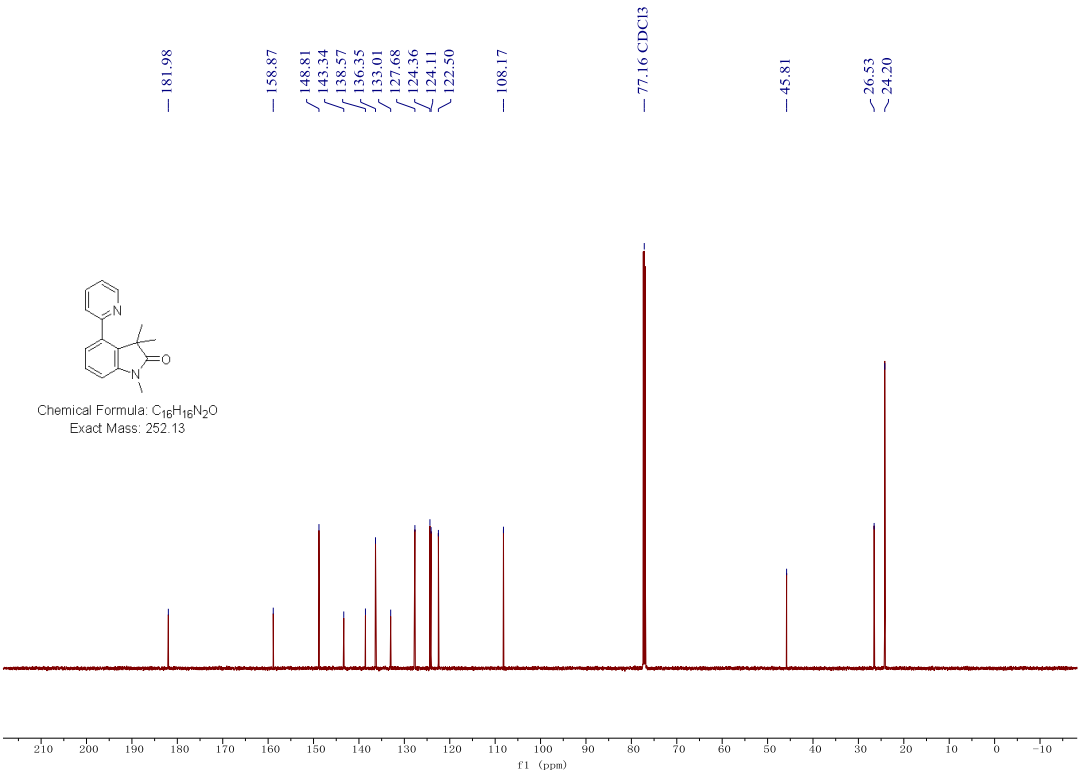
1,3-dimethyl-4-(3-methylpyridin-2-yl)indolin-2-one (**42**)



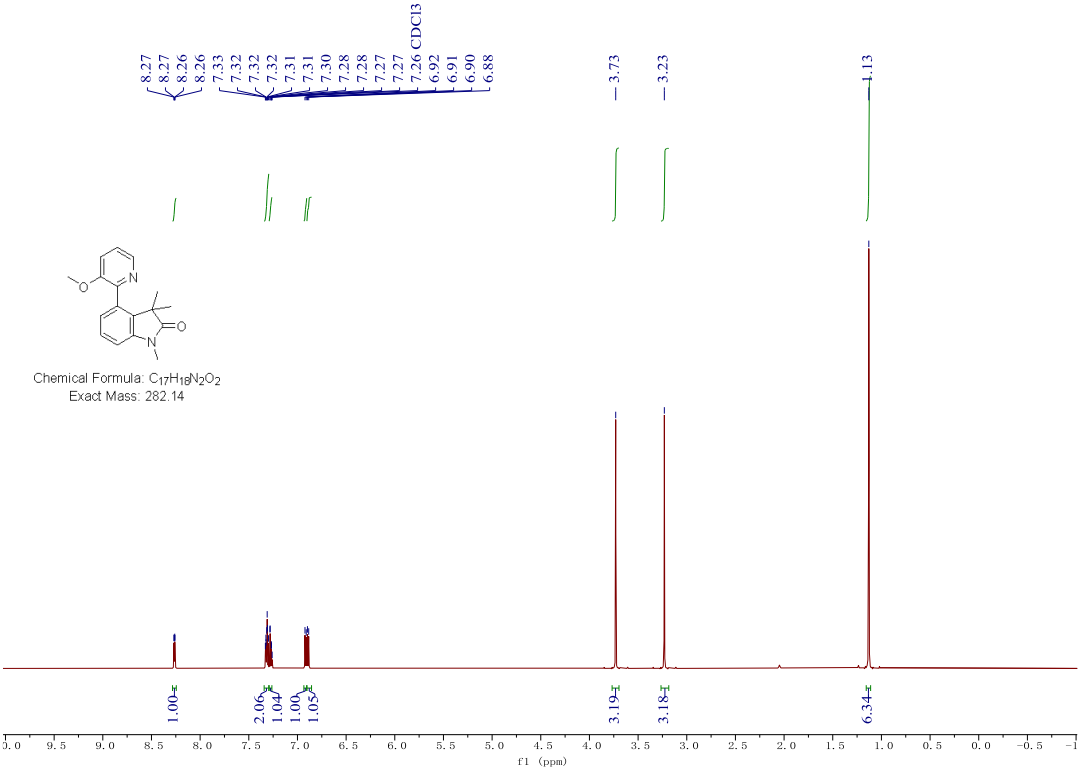


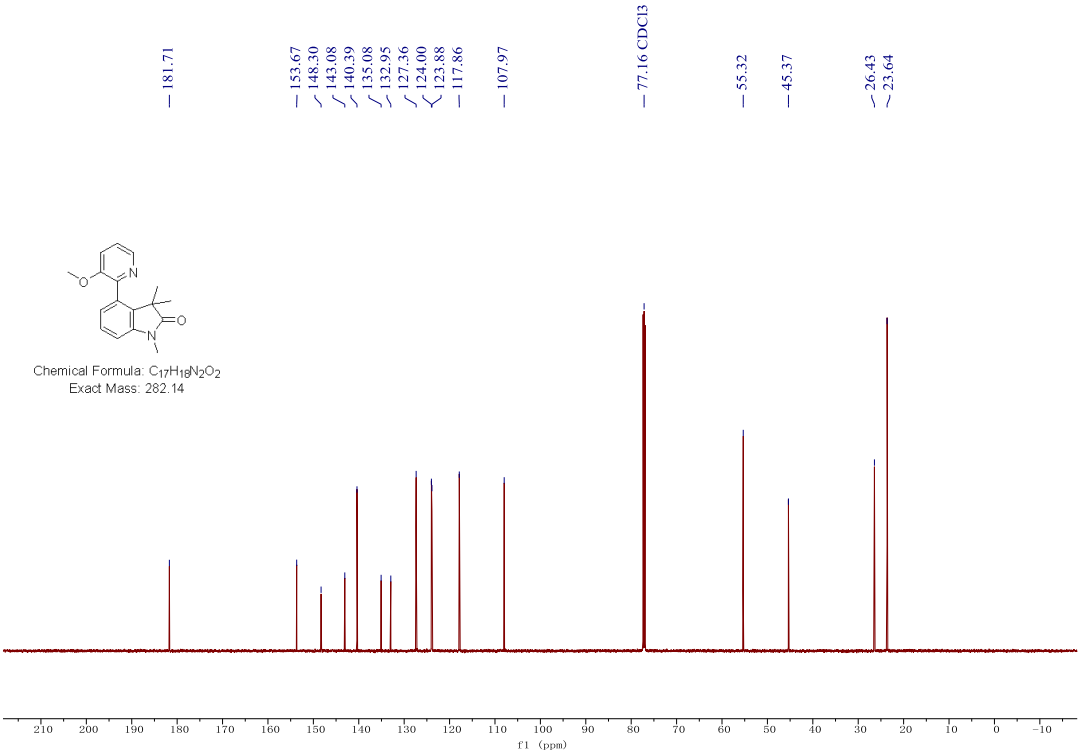
1,3,3-trimethyl-4-(pyridin-2-yl)indolin-2-one (**43**)



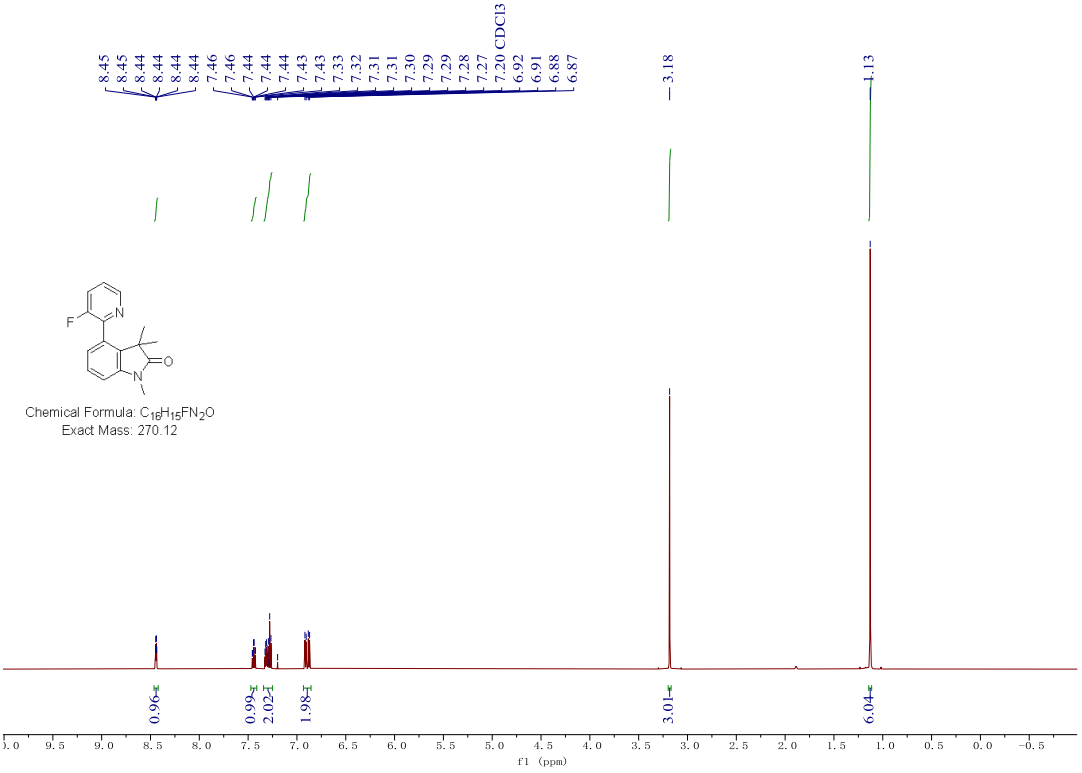


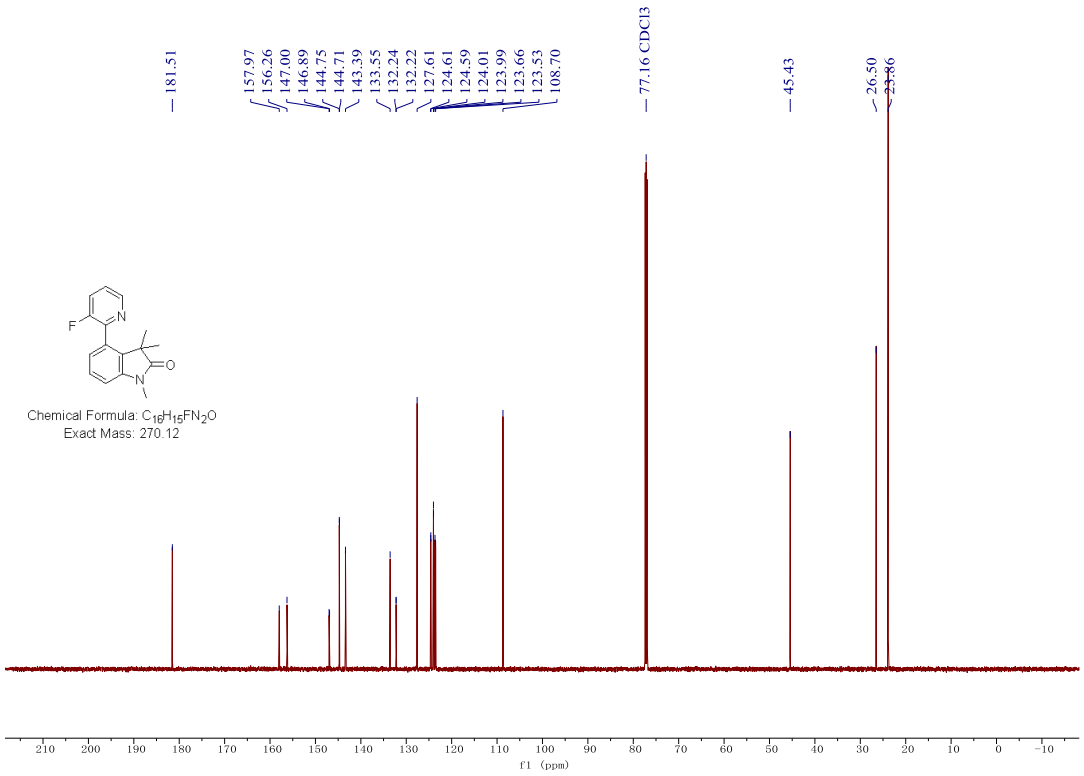
4-(3-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**44**)





4-(3-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**45**)

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F
N
O
N
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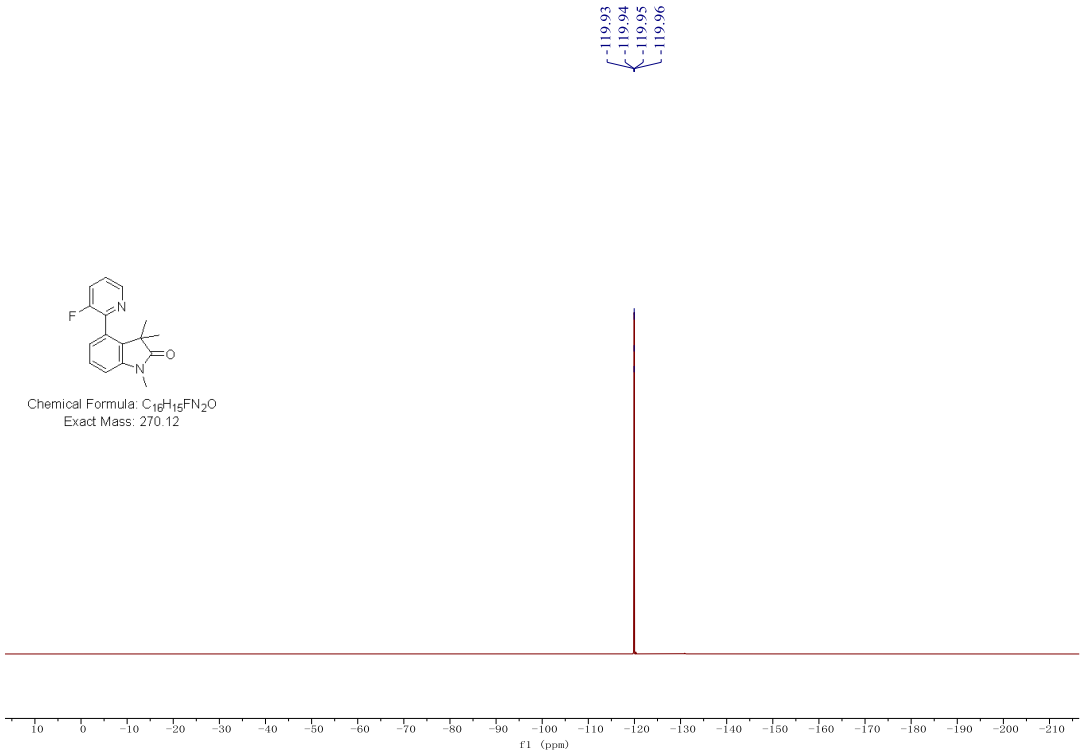
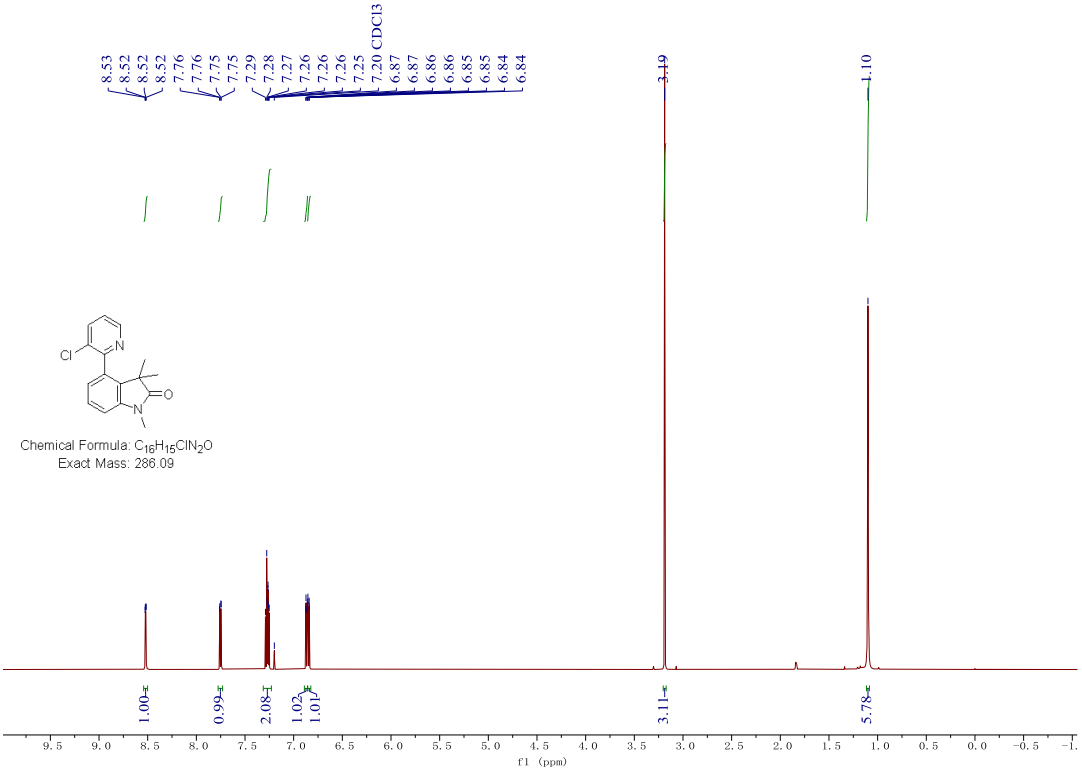
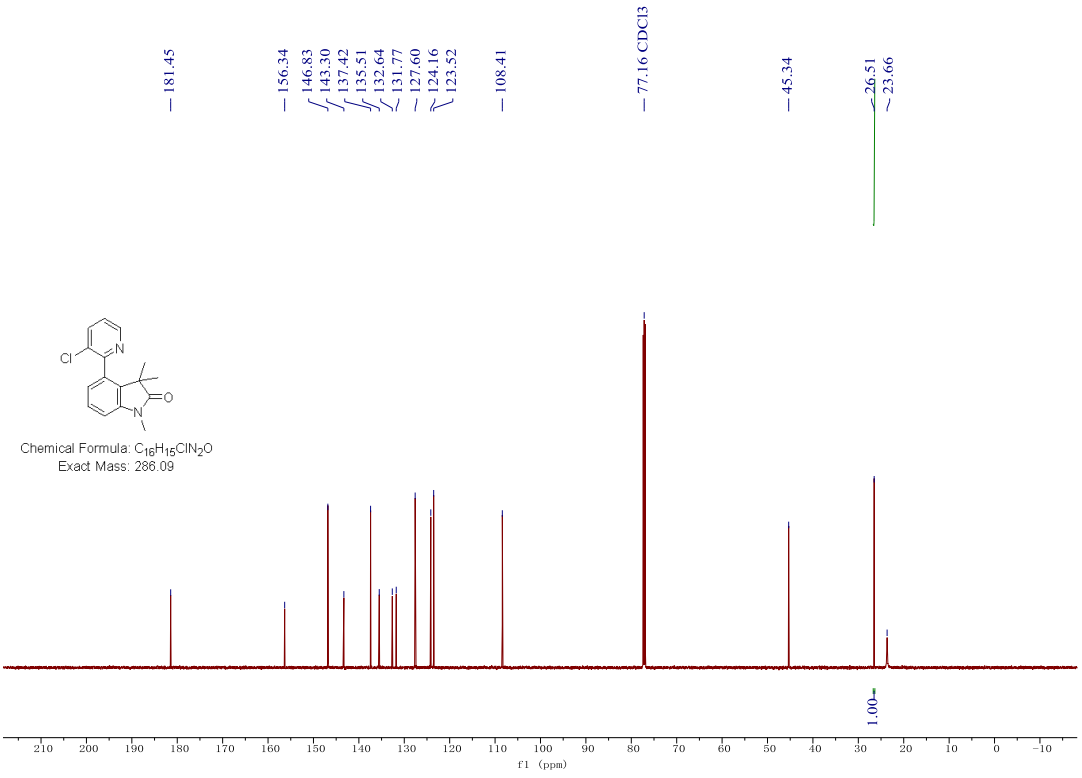
Exact Mass: 270.12
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

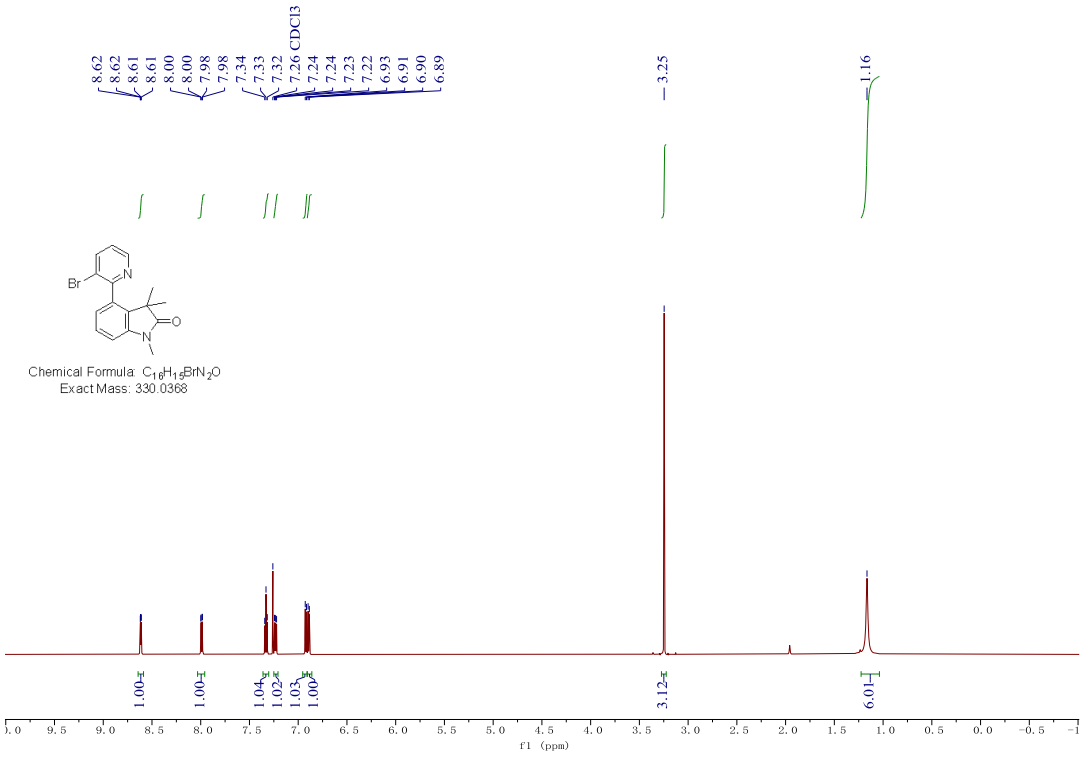

-119.93
-119.94
-119.95
-119.96
F
N
O
N
Chemical Formula: C16H15FN2O
Exact Mass: 270.12
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

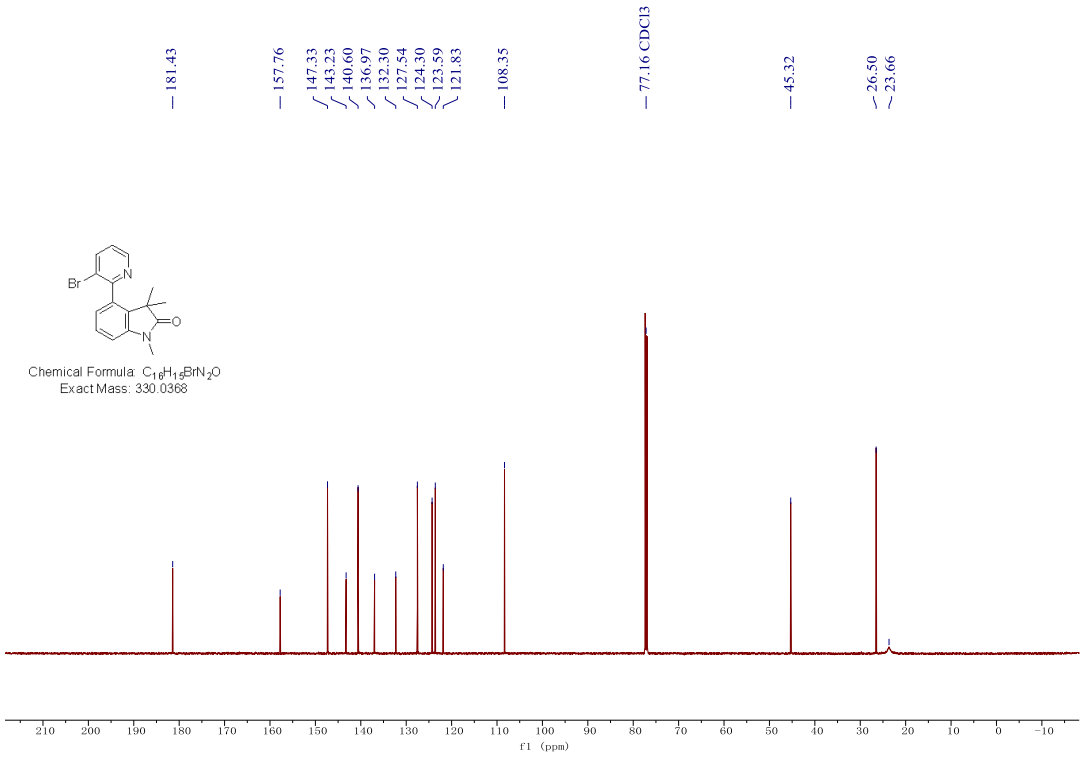
4-(3-chloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**46**)



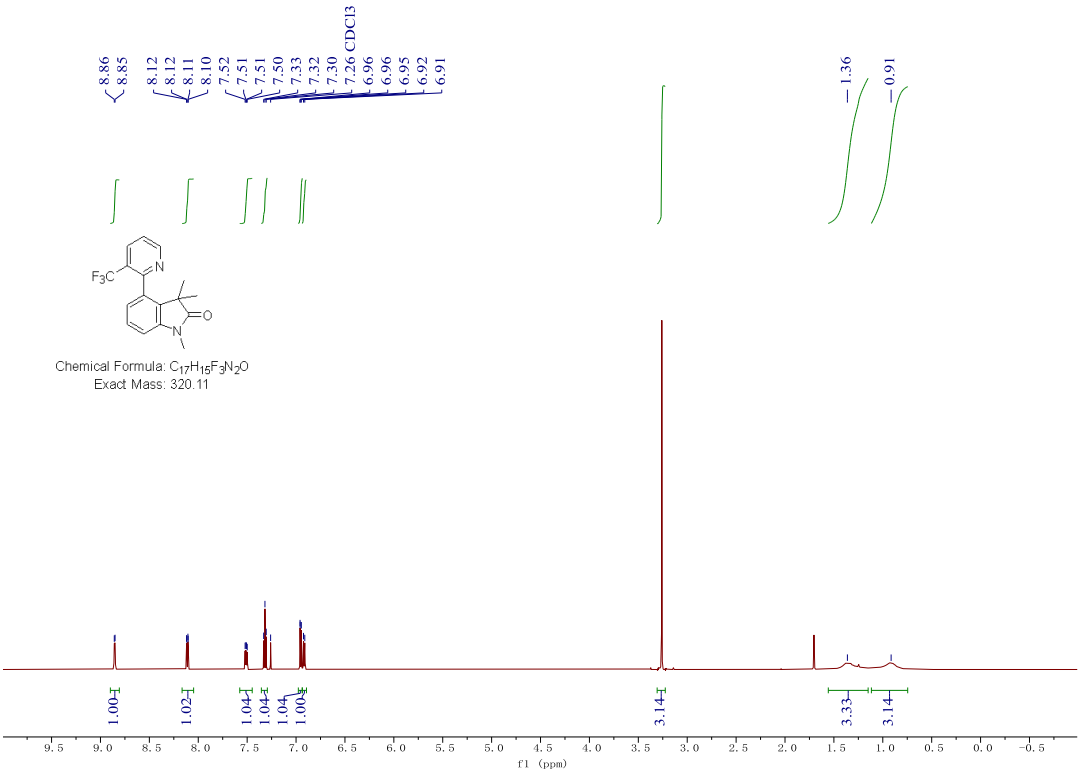


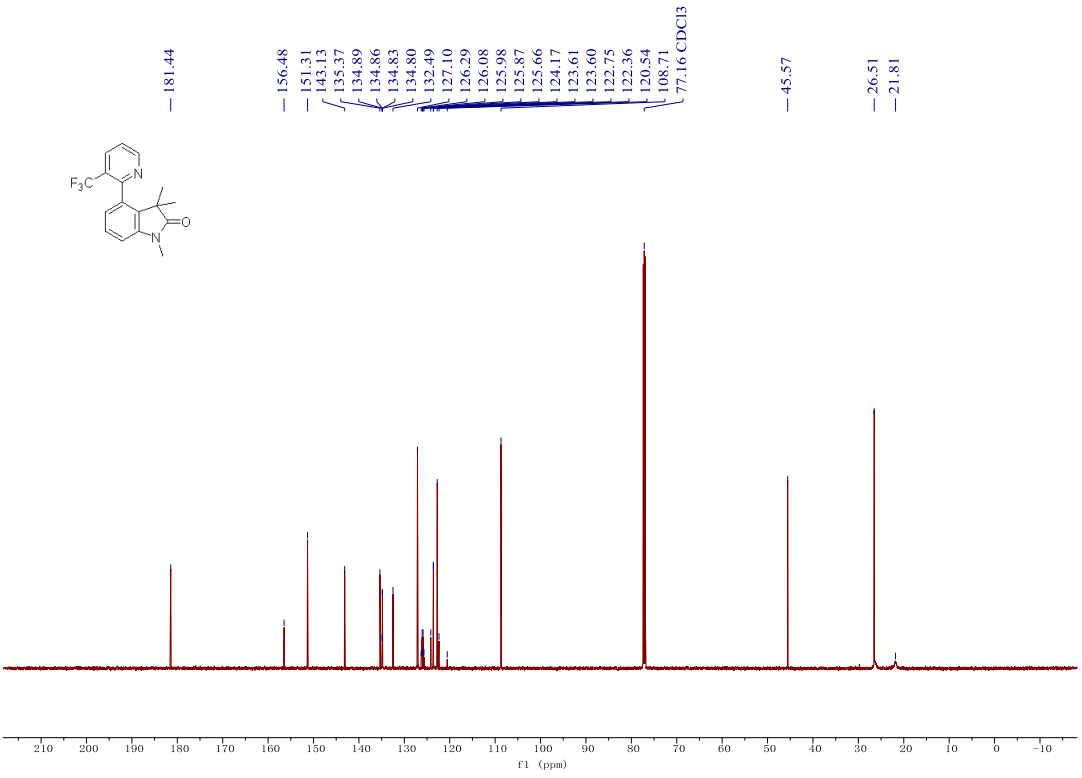
4-(3-bromopyridin-2-yl)-1,3,3-trimethylindolin-2-one (**47**)

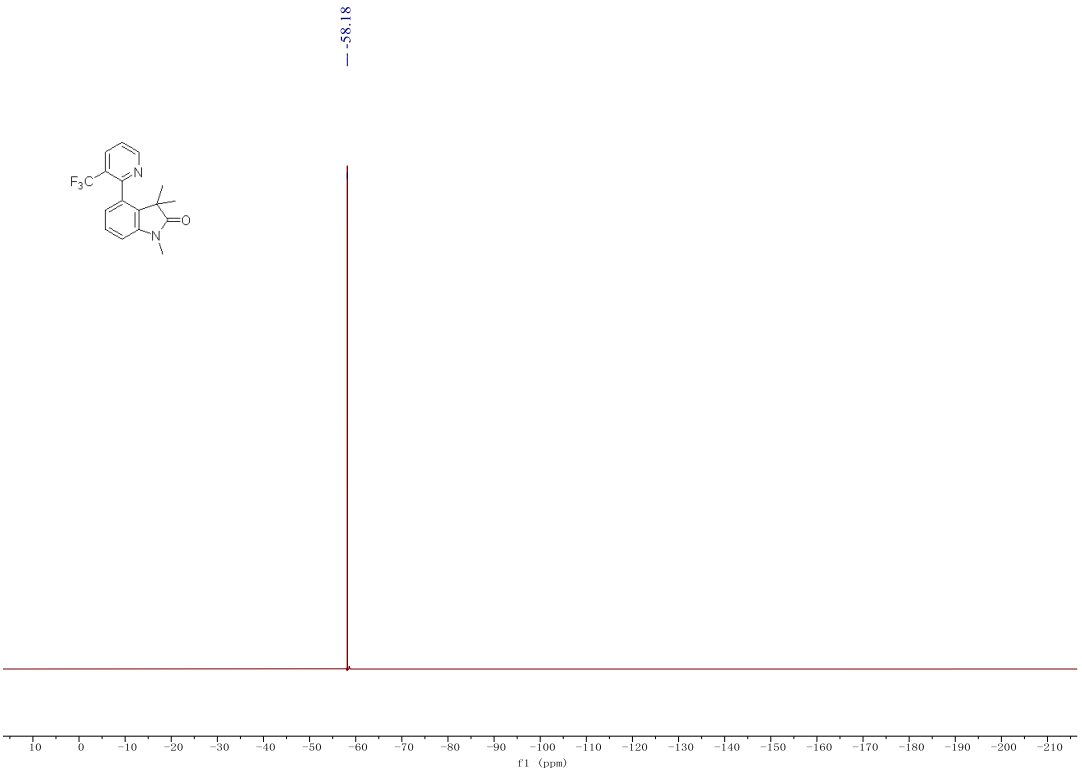




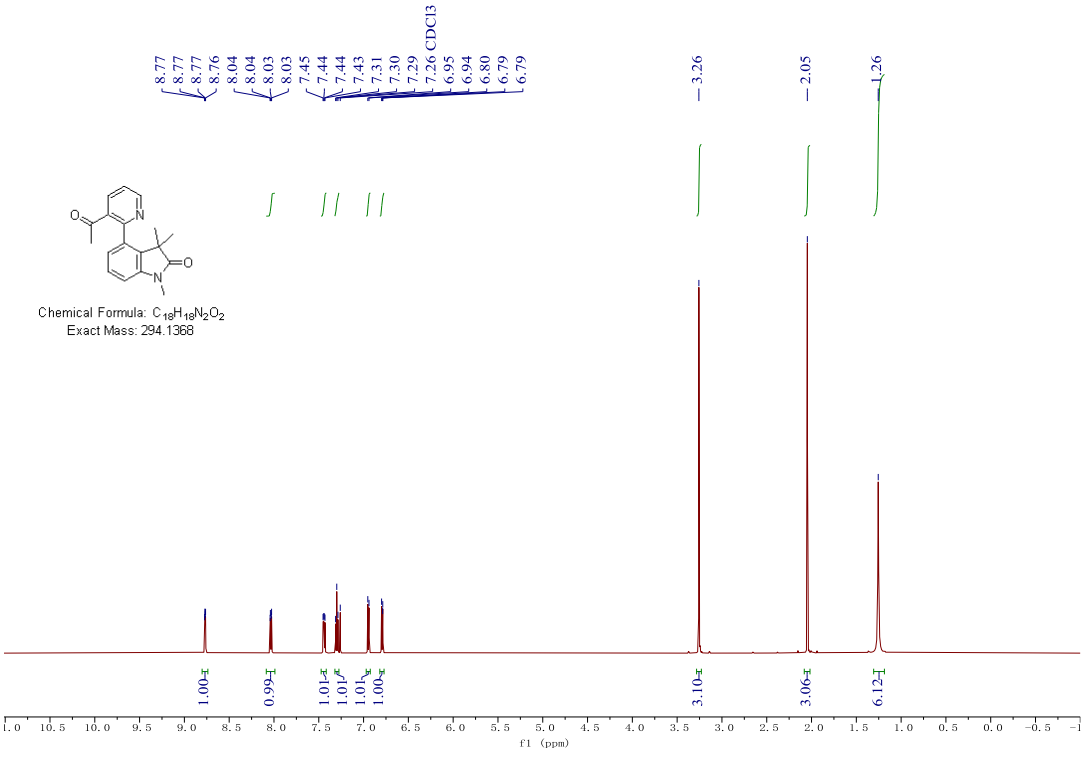
1,3,3-trimethyl-4-(3-(trifluoromethyl)pyridin-2-yl)indolin-2-one (**48**)

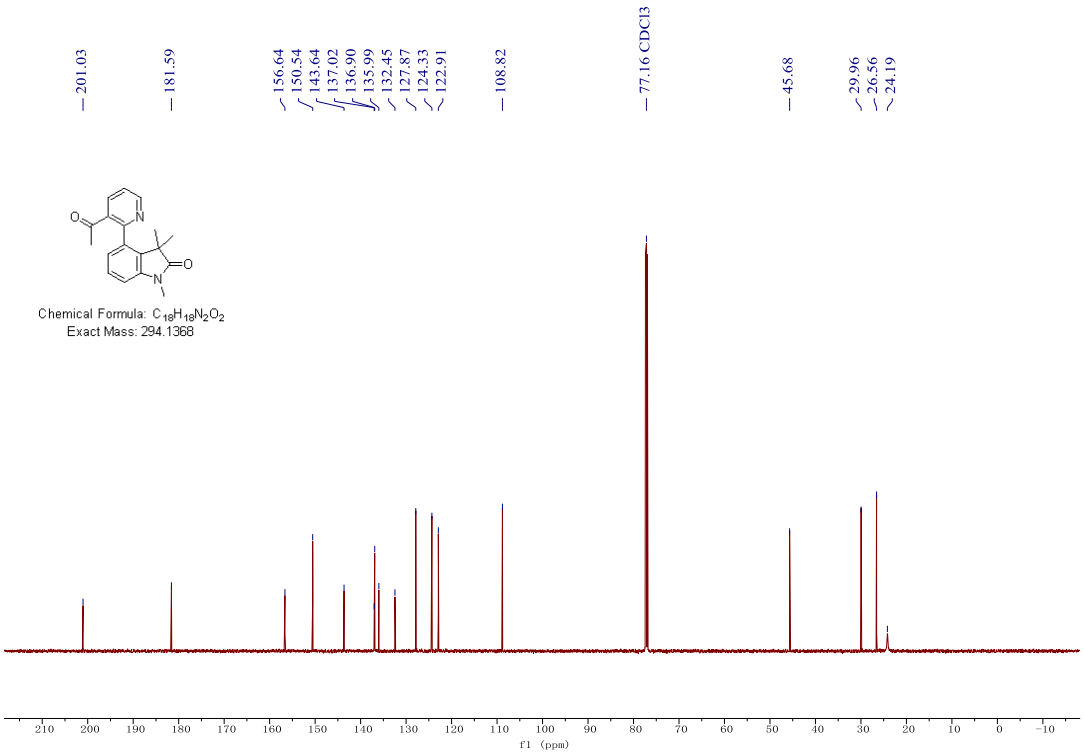




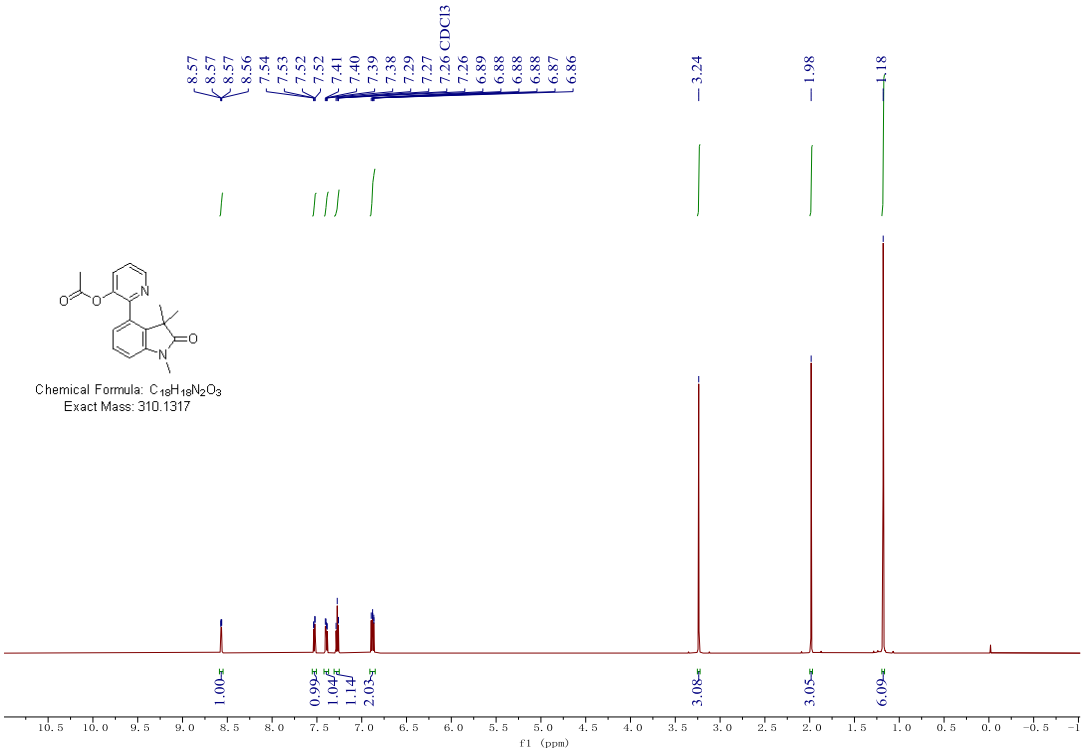


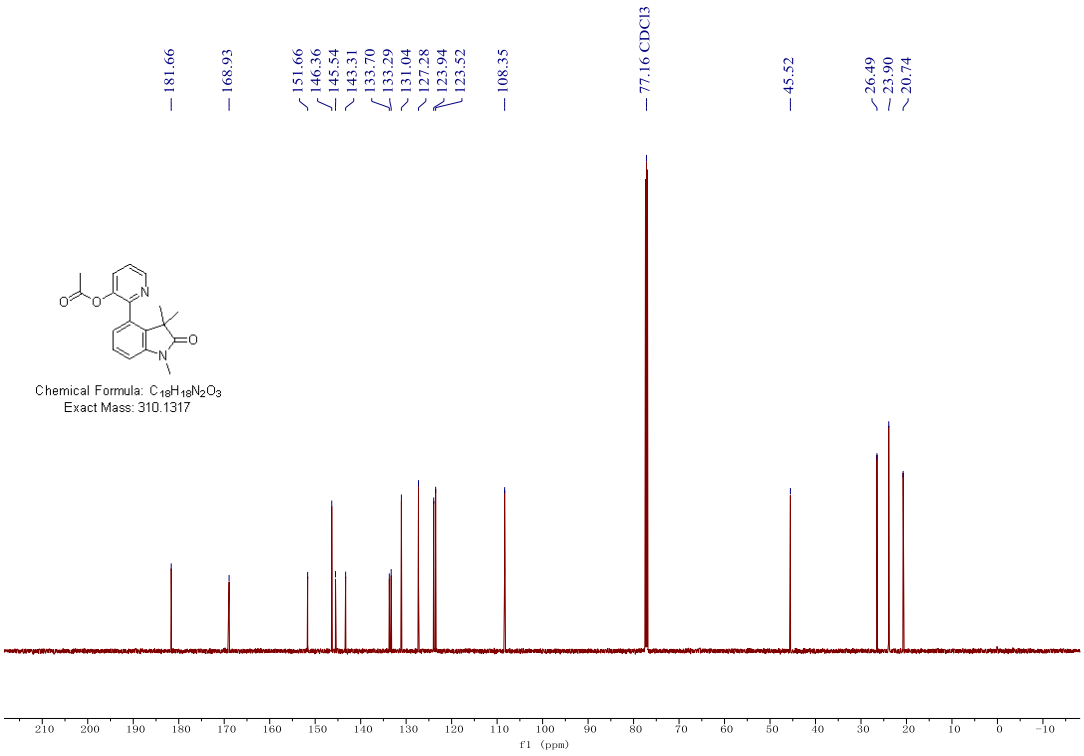
4-(3-acetylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**49**)



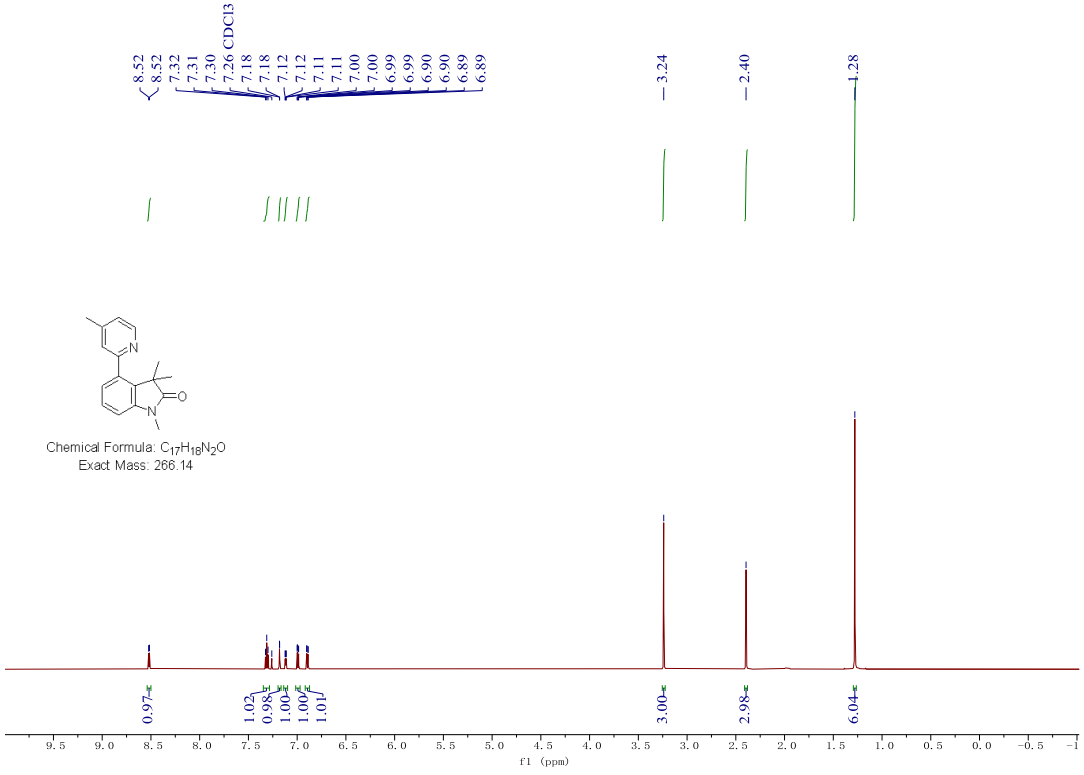


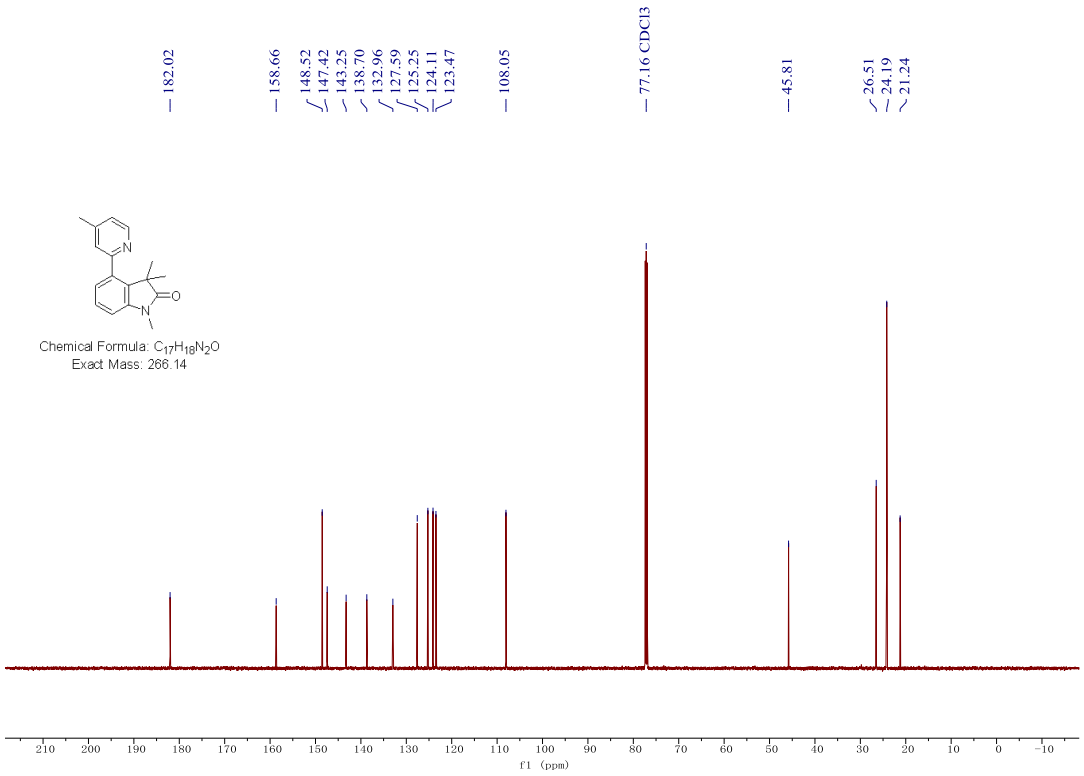
2-(1,3,3-trimethyl-2-oxoindolin-4-yl)pyridin-3-yl acetate (**50**)



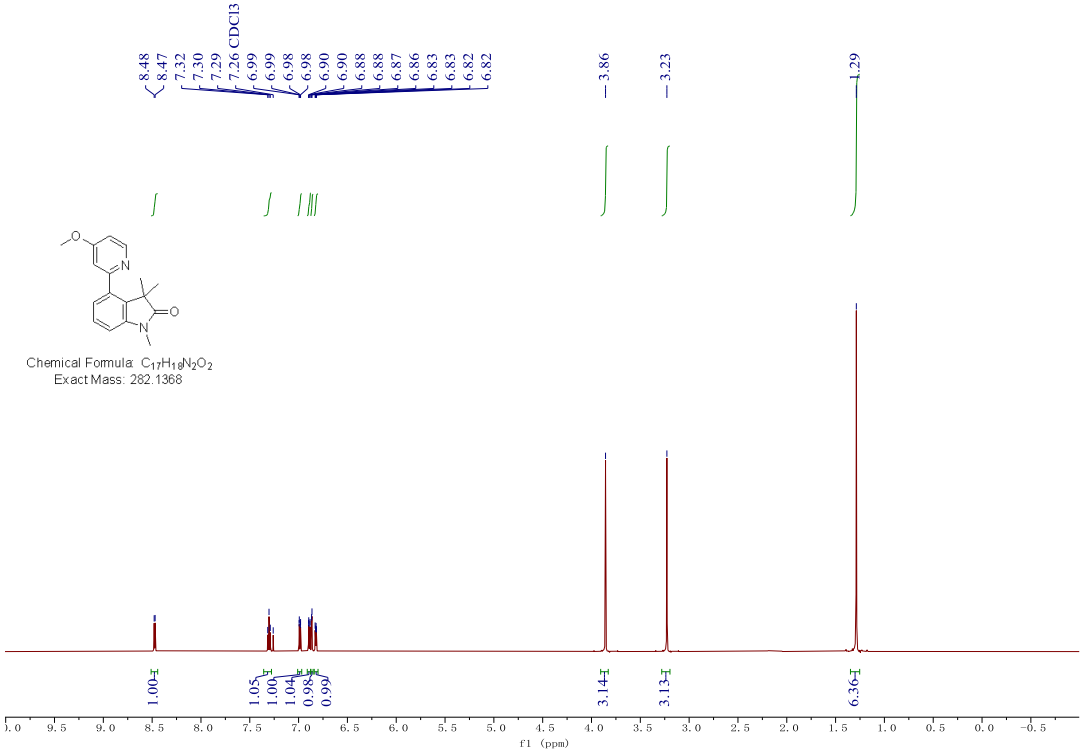


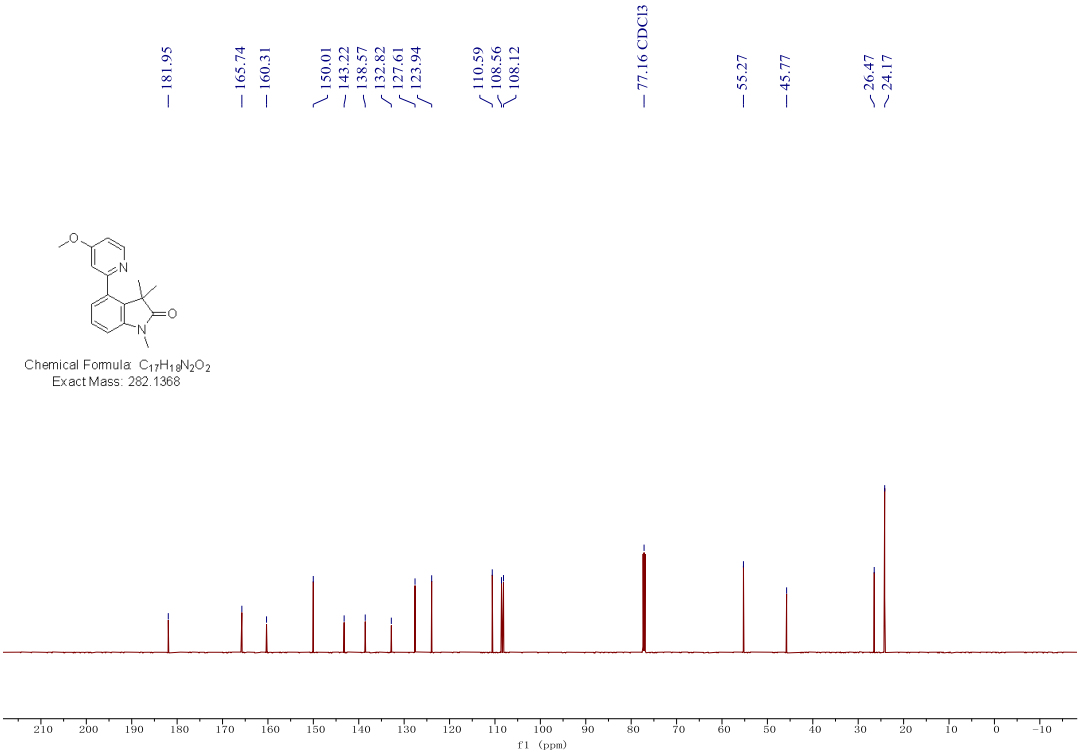
1,3,3-trimethyl-4-(4-methylpyridin-2-yl)indolin-2-one (**51**)



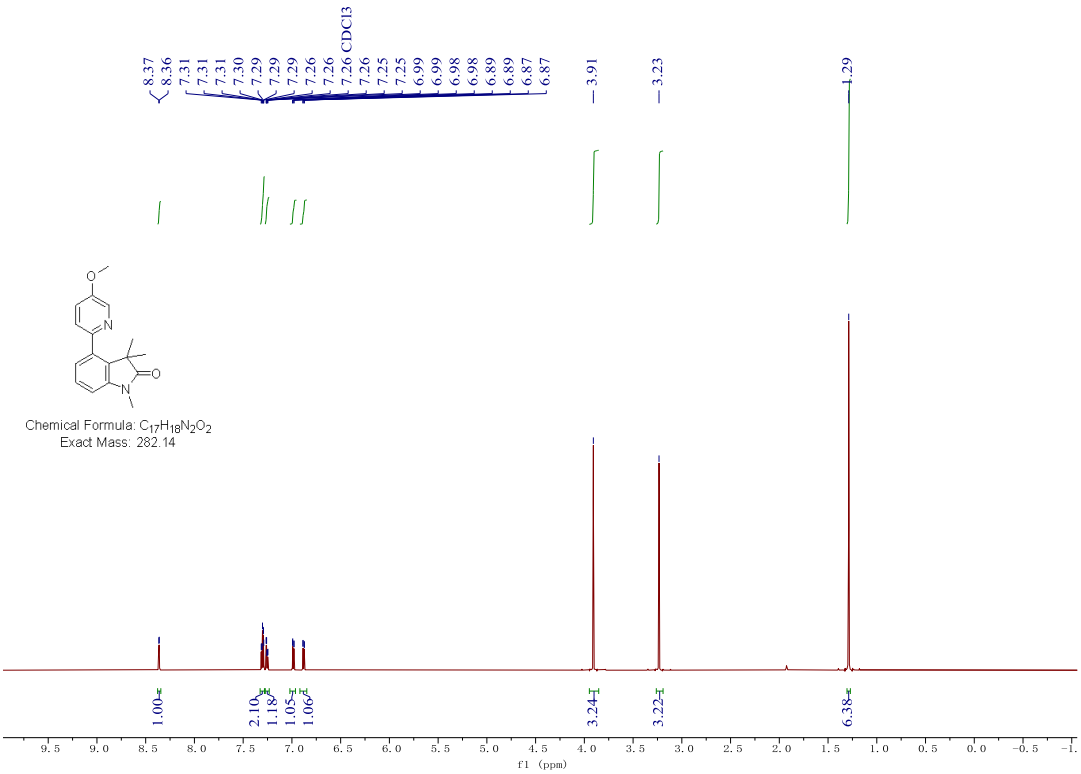


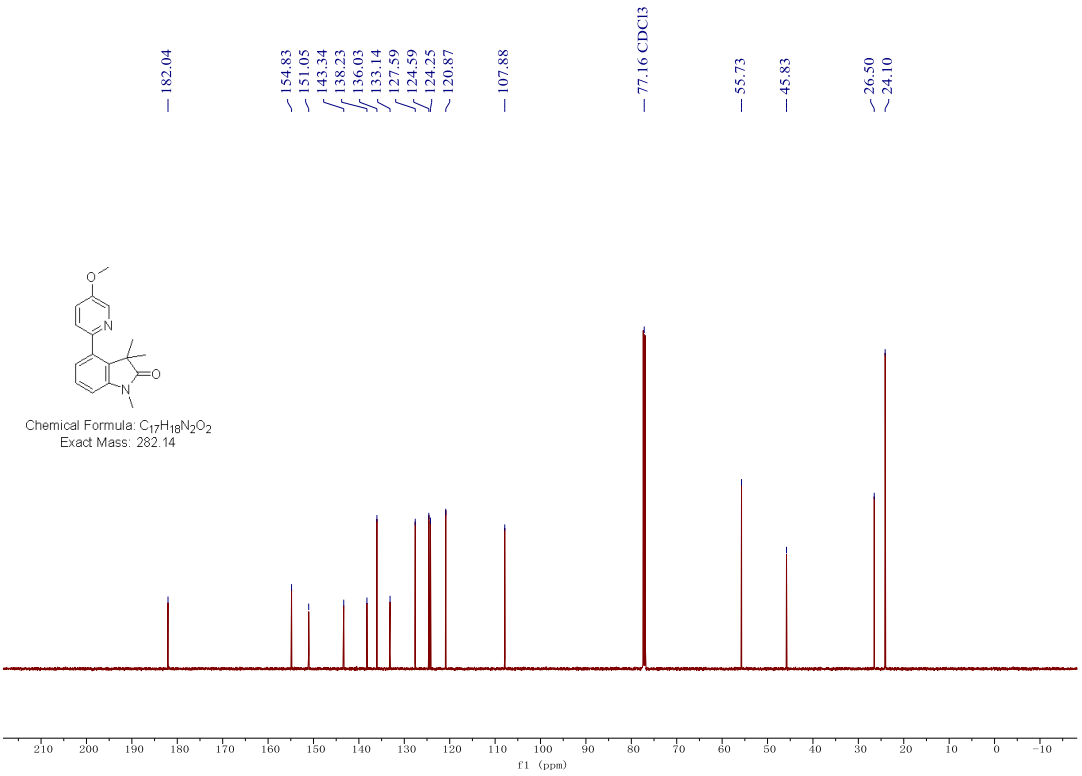
4-(4-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**52**)



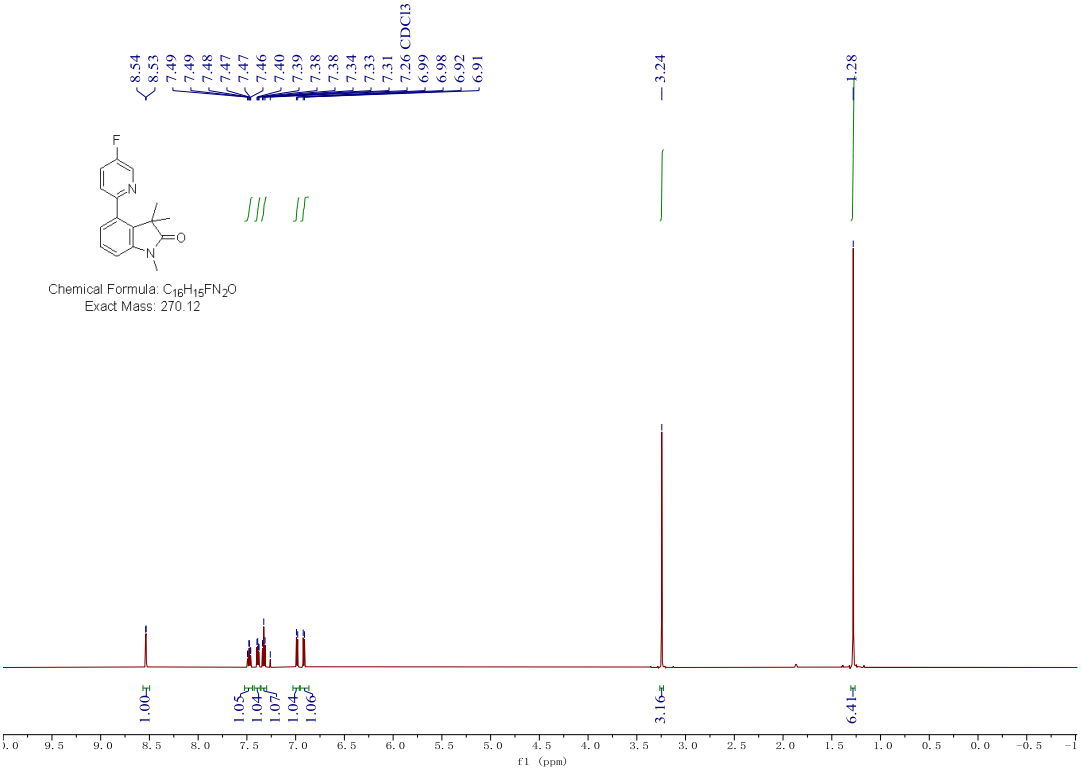


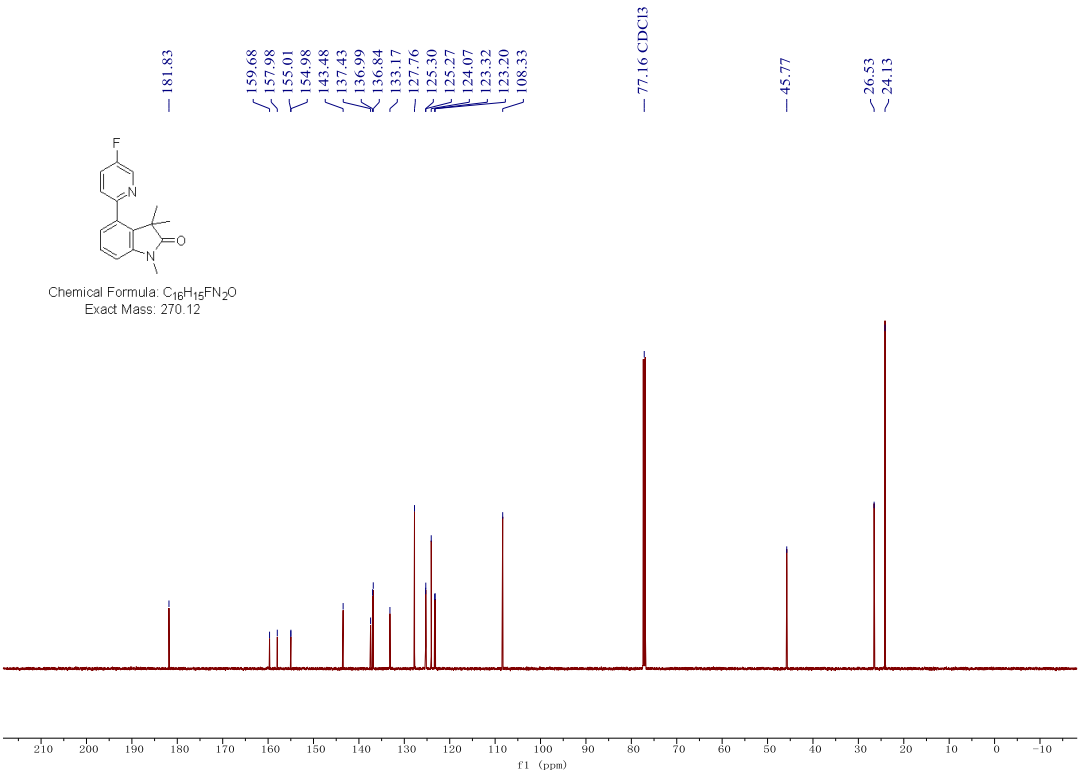
4-(5-methoxypyridin-2-yl)-1,3,3-trimethylindolin-2-one (**53**)

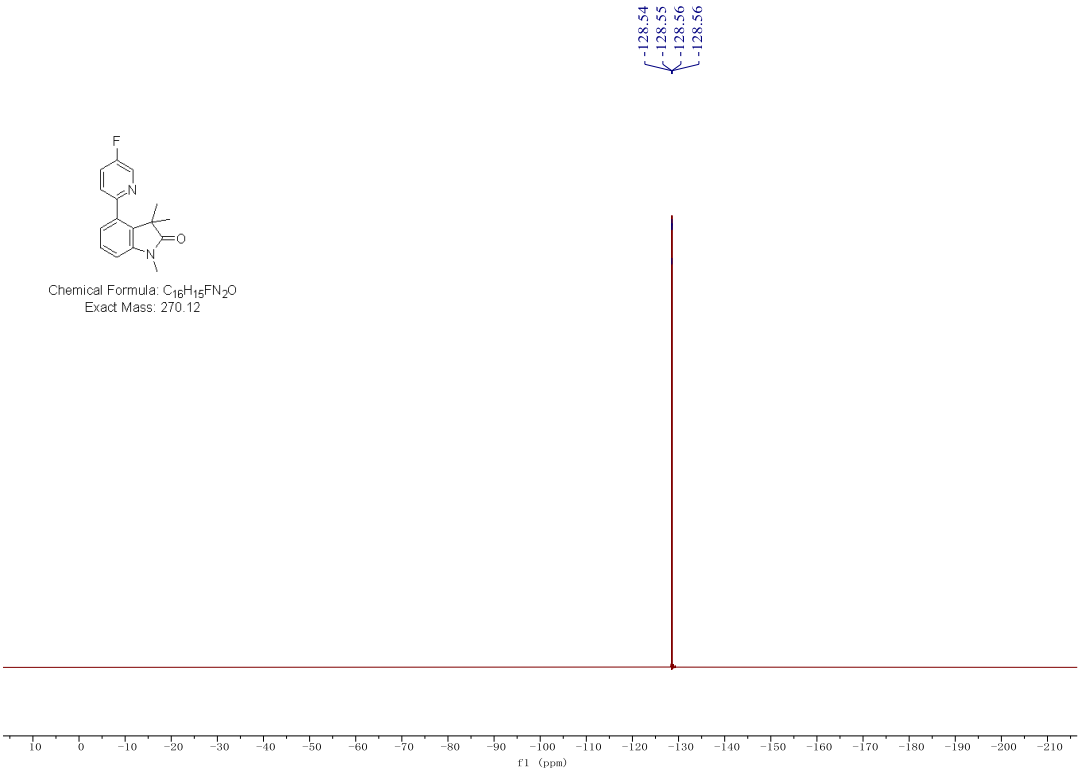




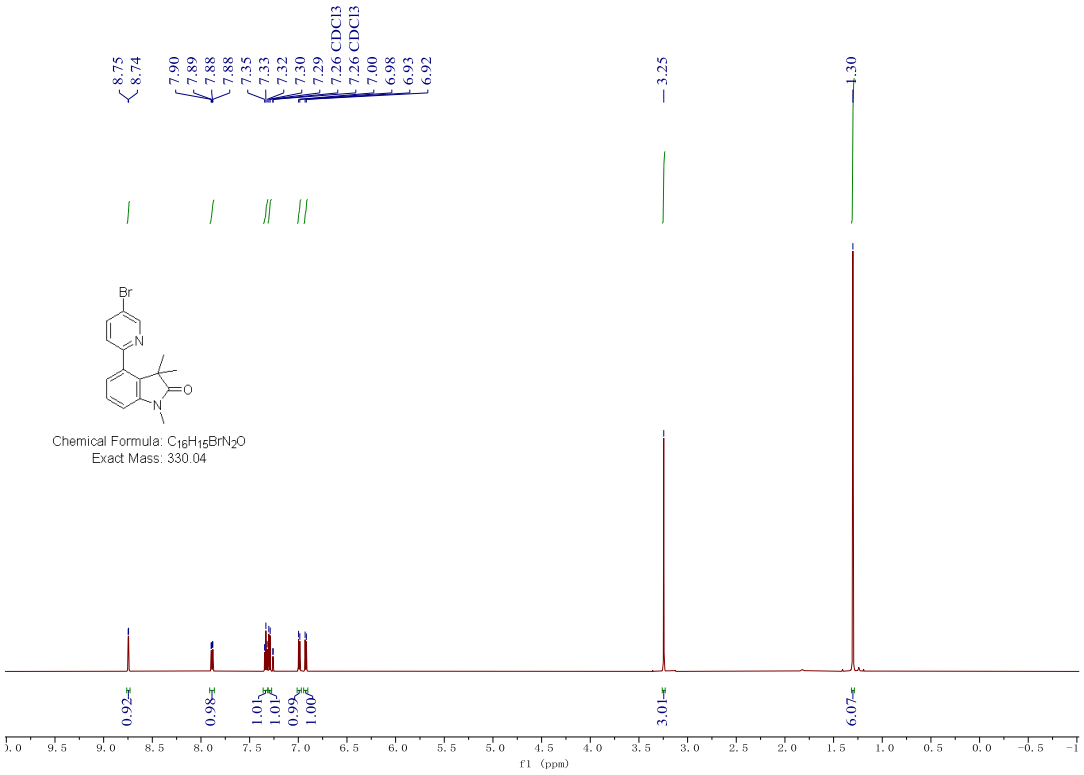
4-(5-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**54**)

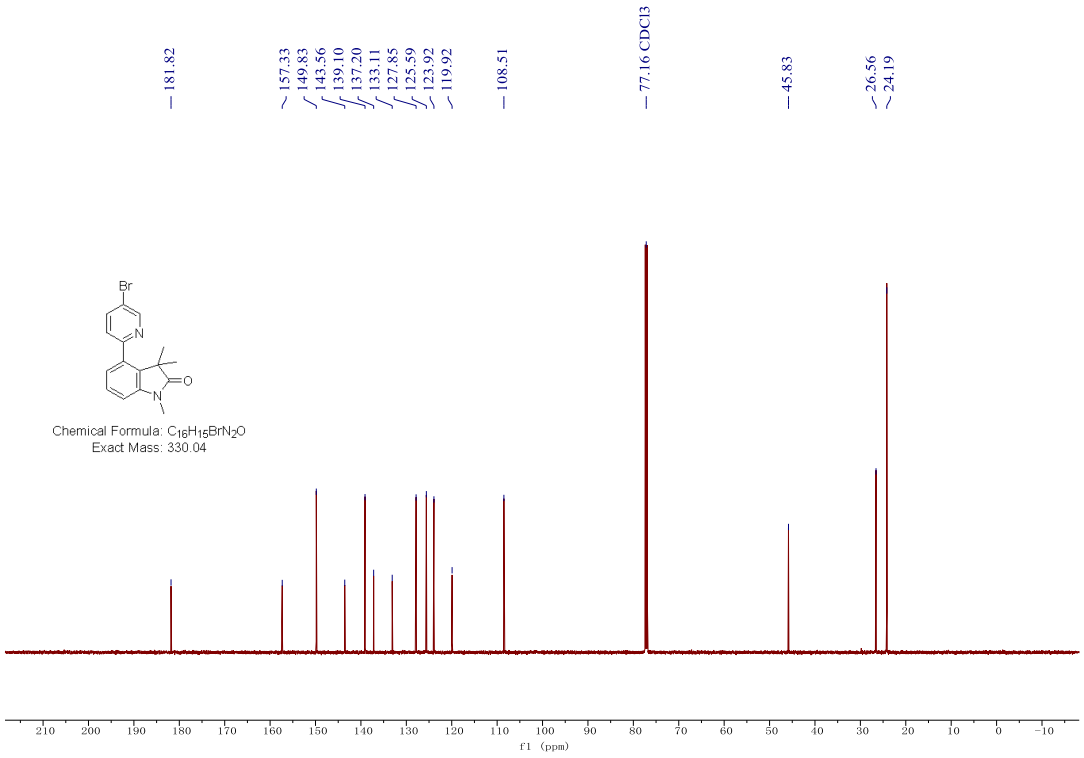



181.83
159.68
157.98
155.01
154.98
143.48
137.43
136.99
136.84
133.17
127.76
125.30
125.27
124.07
123.32
123.20
108.33
77.16 CDCl3
45.77
26.53
24.13
F
N
O
N
Chemical Formula: C16H15FN2O
Exact Mass: 270.12
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

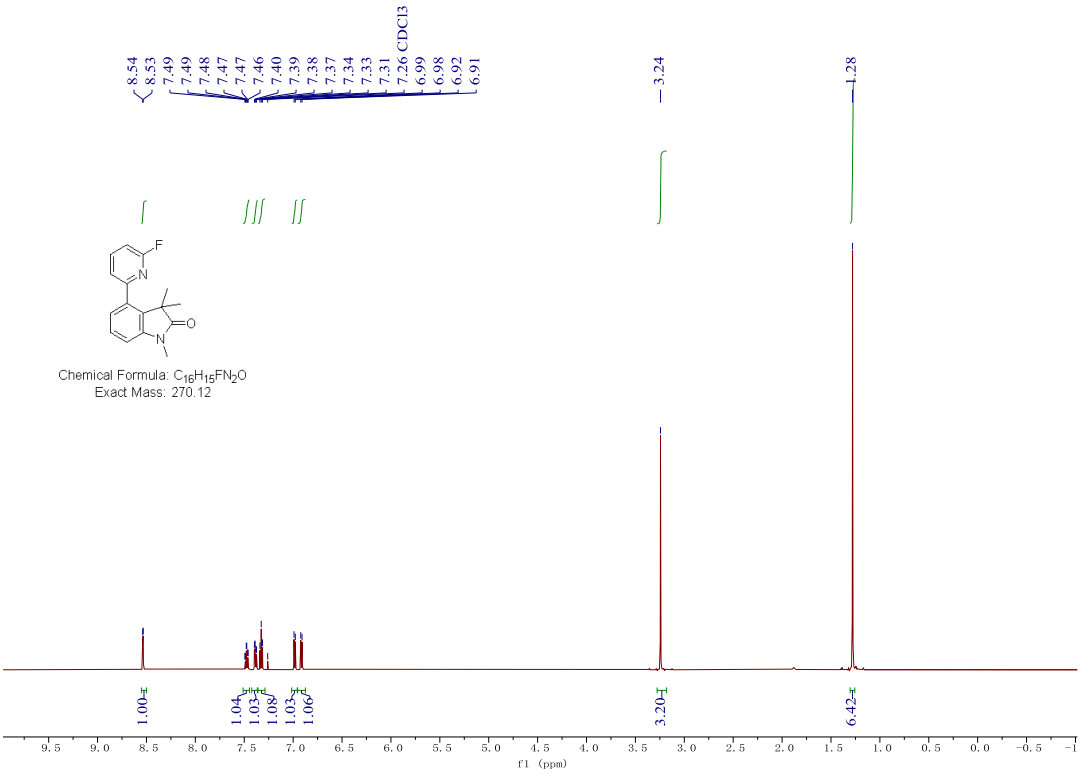

-128.54
-128.55
-128.56
-128.56
F
N
O
N
Chemical Formula: C16H15FN2O
Exact Mass: 270.12
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

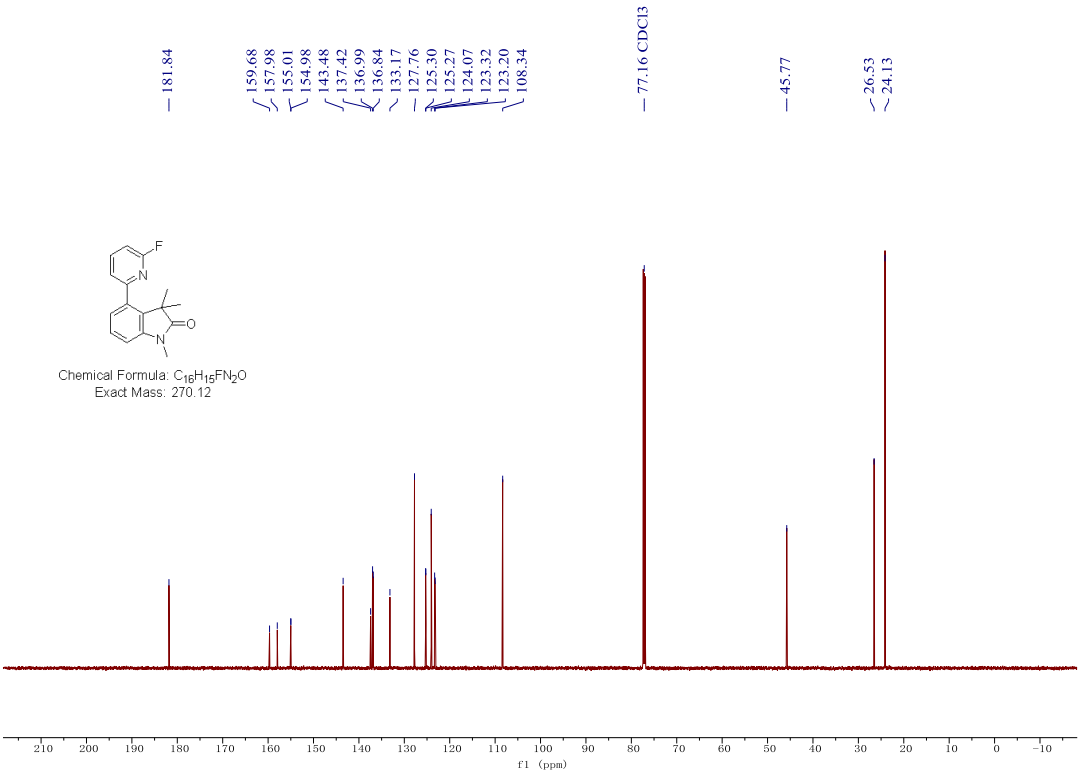
4-(5-bromopyridin-2-yl)-1,3,3-trimethylindolin-2-one (**55**)

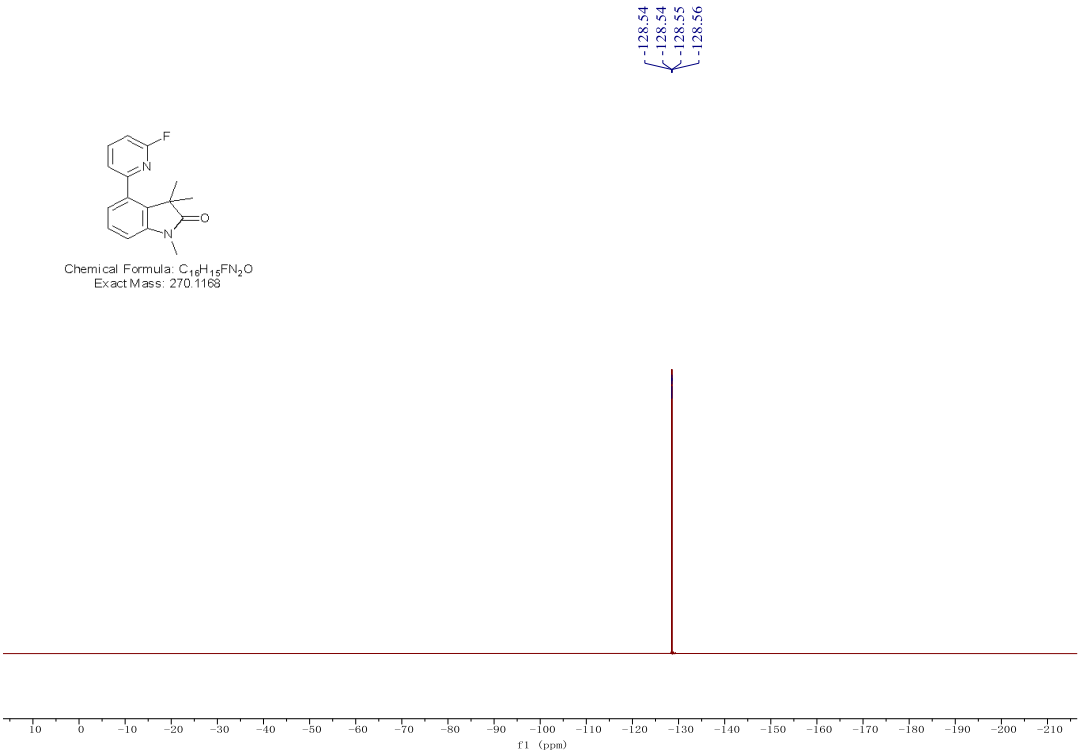




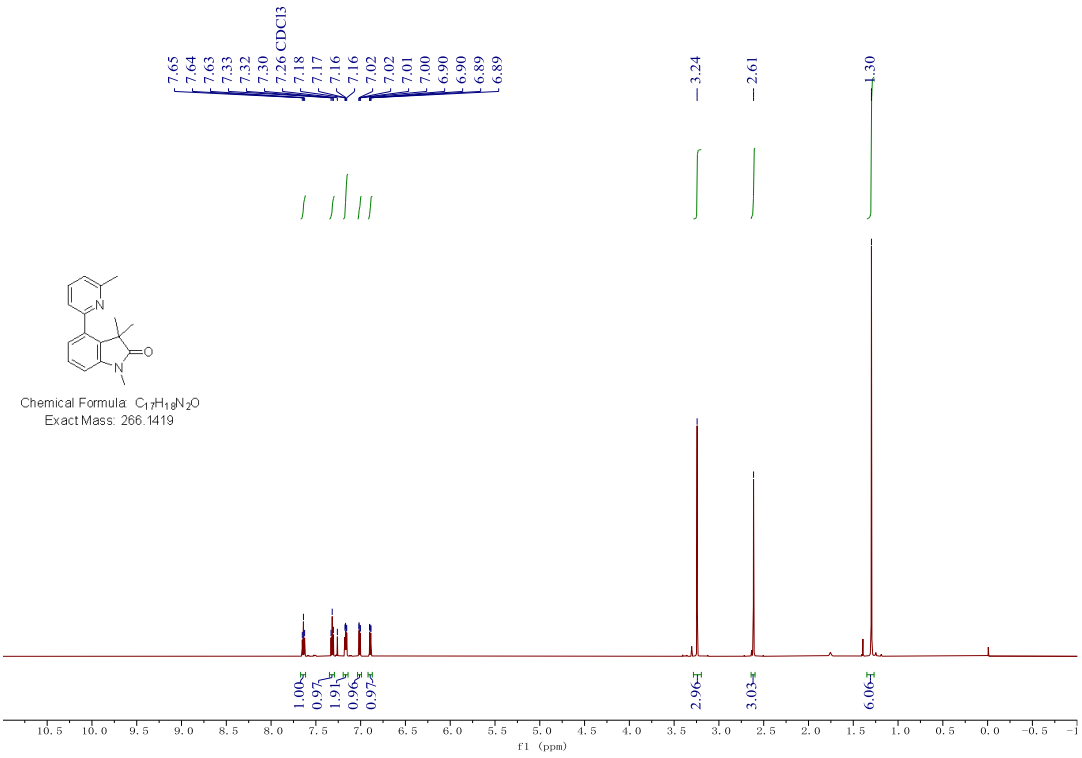
4-(6-fluoropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**56**)

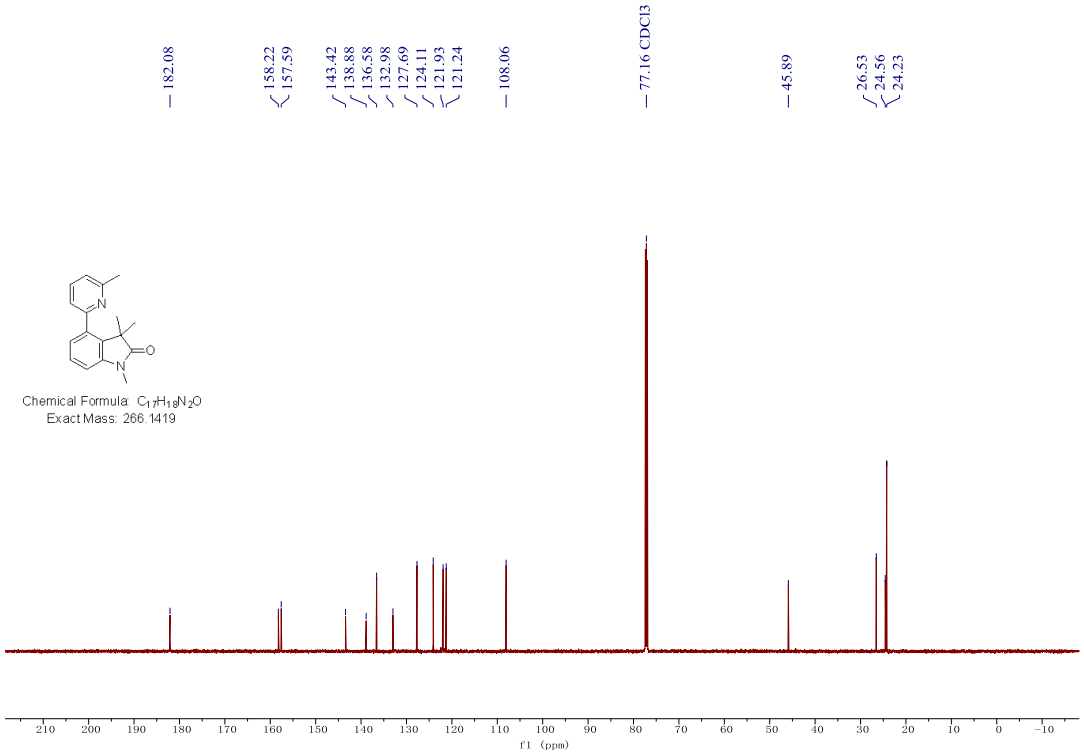




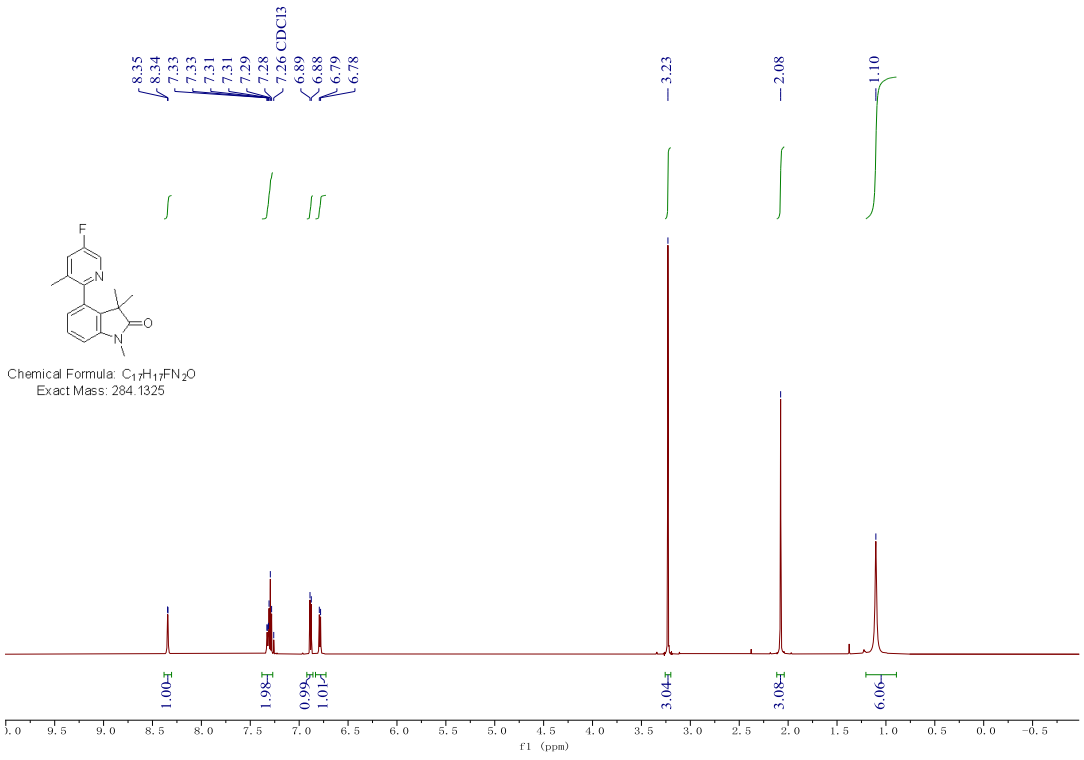


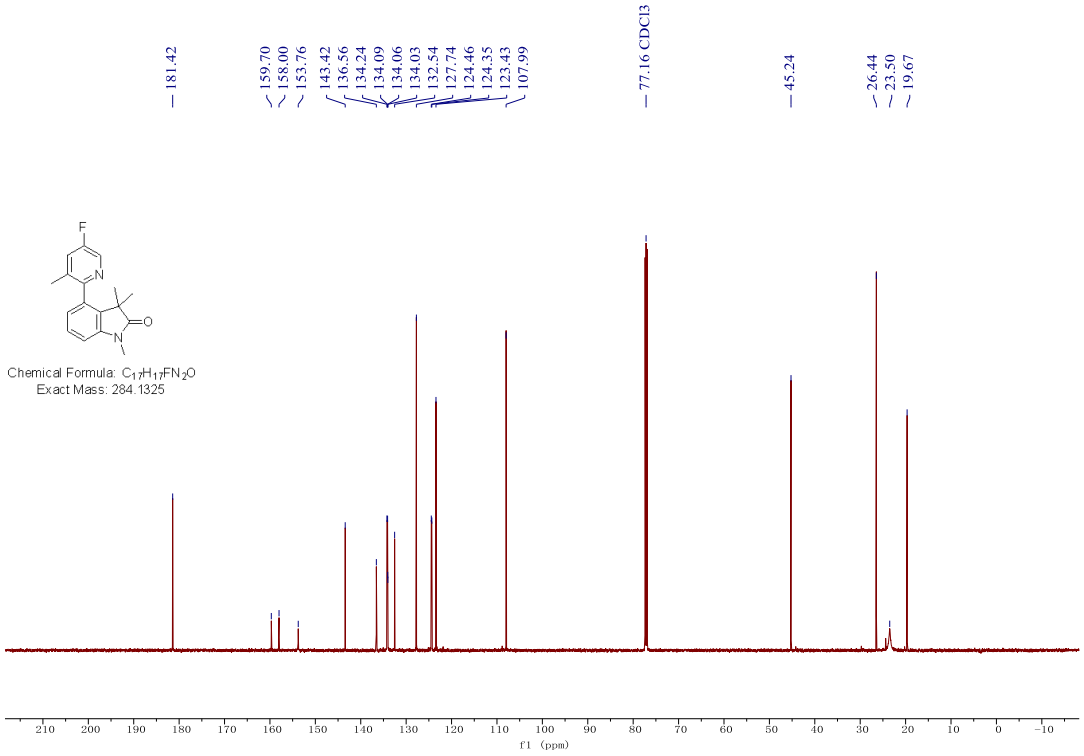
1,3,3-trimethyl-4-(6-methylpyridin-2-yl)indolin-2-one (**57**)

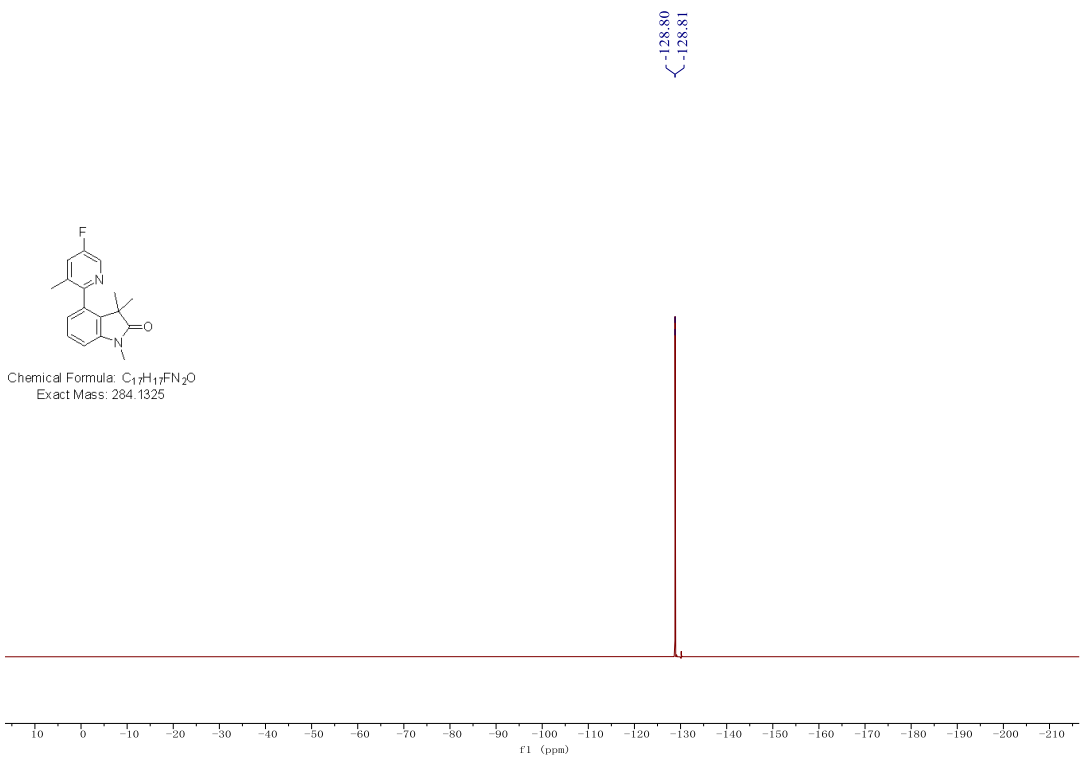




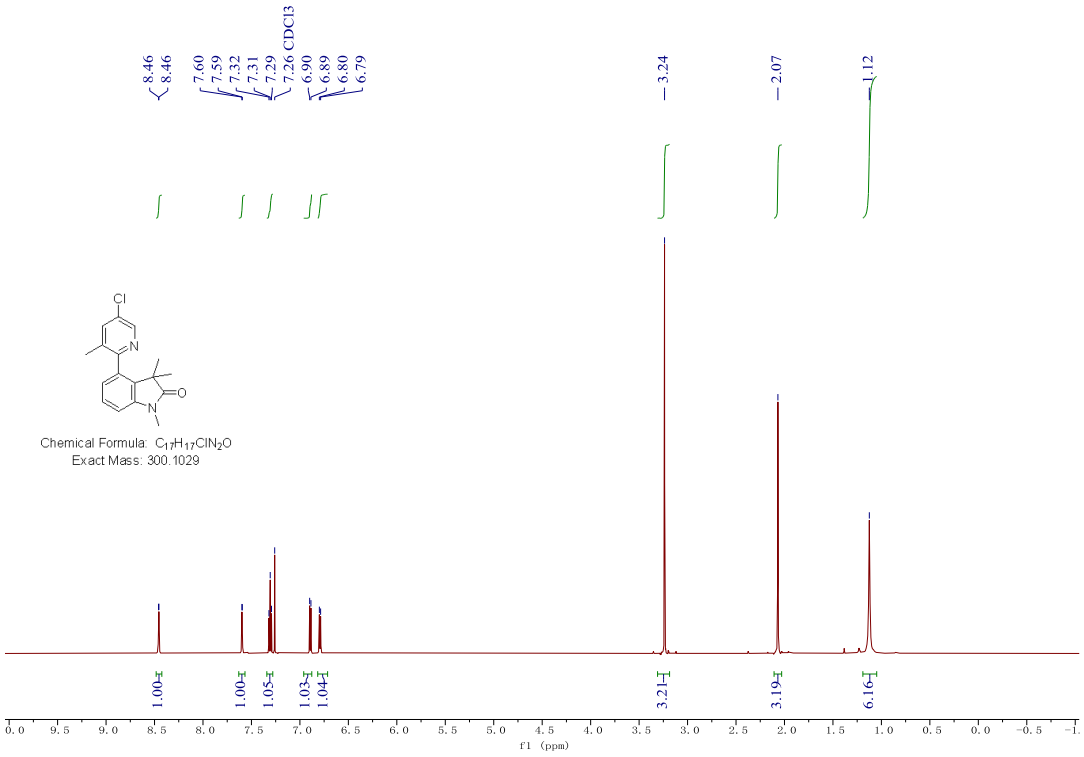
4-(5-fluoro-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**58**)

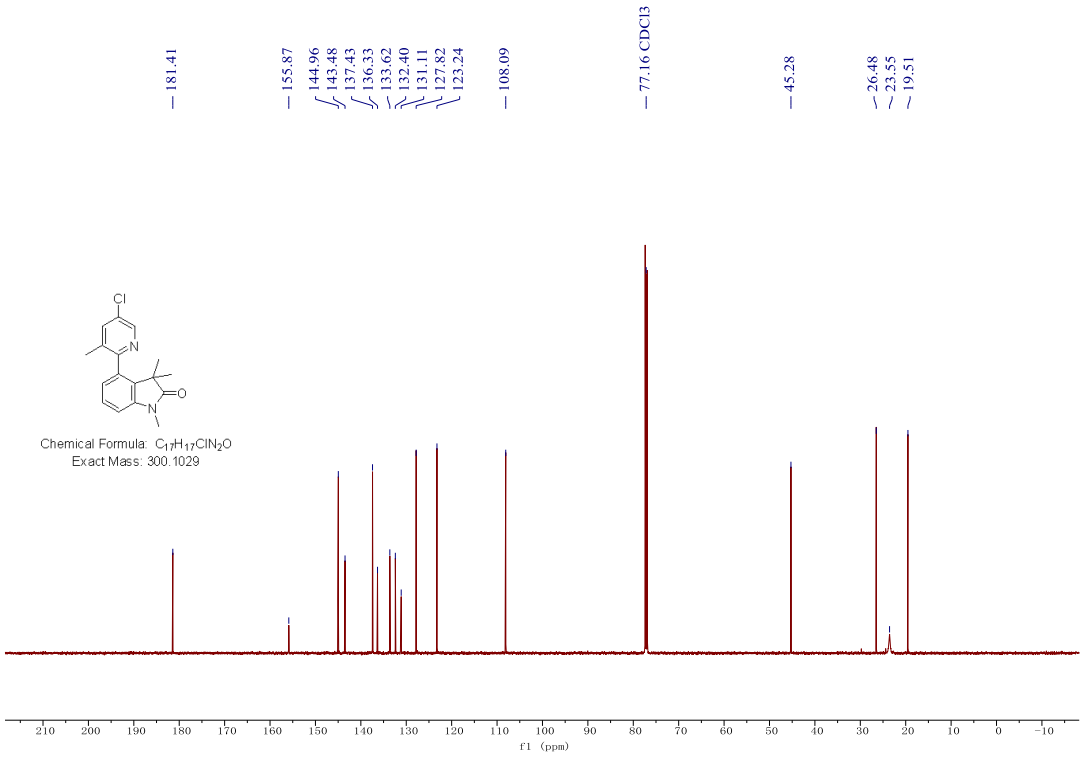



181.42
159.70
158.00
153.76
143.42
136.56
134.24
134.09
134.06
134.03
132.54
127.74
124.46
124.35
123.43
107.99
77.16 CDCl3
45.24
26.44
23.50
19.67
F
N
O
N
Chemical Formula: C17H17FN2O
Exact Mass: 284.1325
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

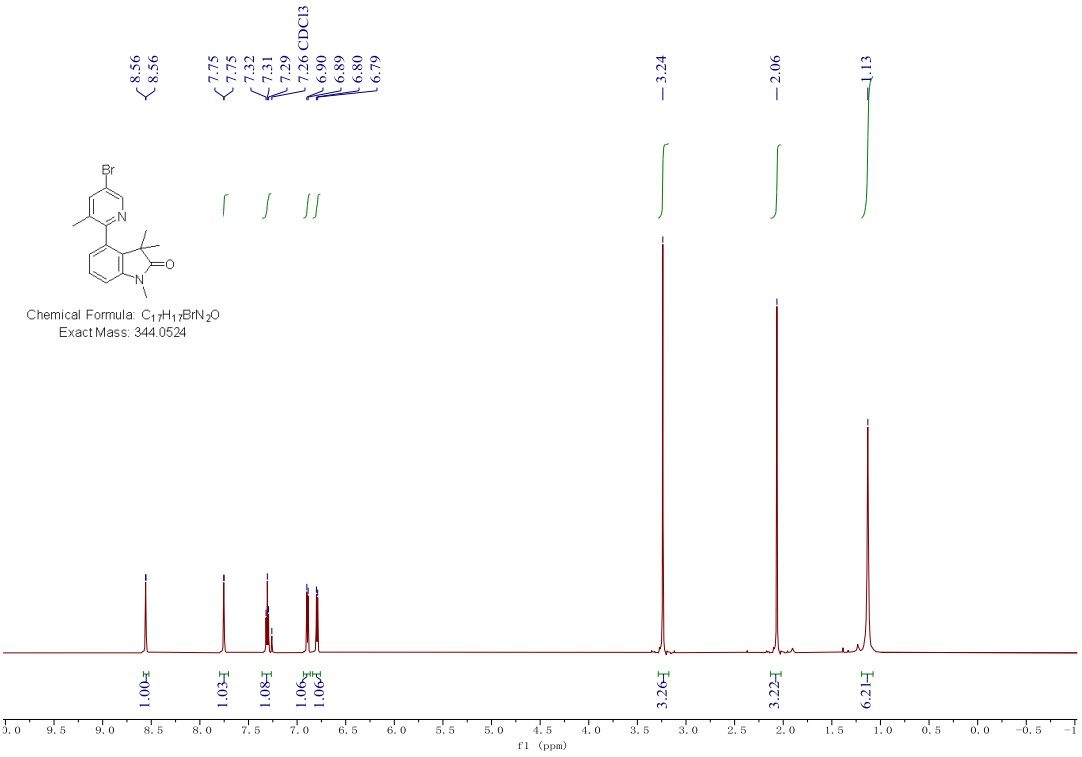

-128.80
-128.81
F
N
O
N
Chemical Formula: C17H17FN2O
Exact Mass: 284.1325
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

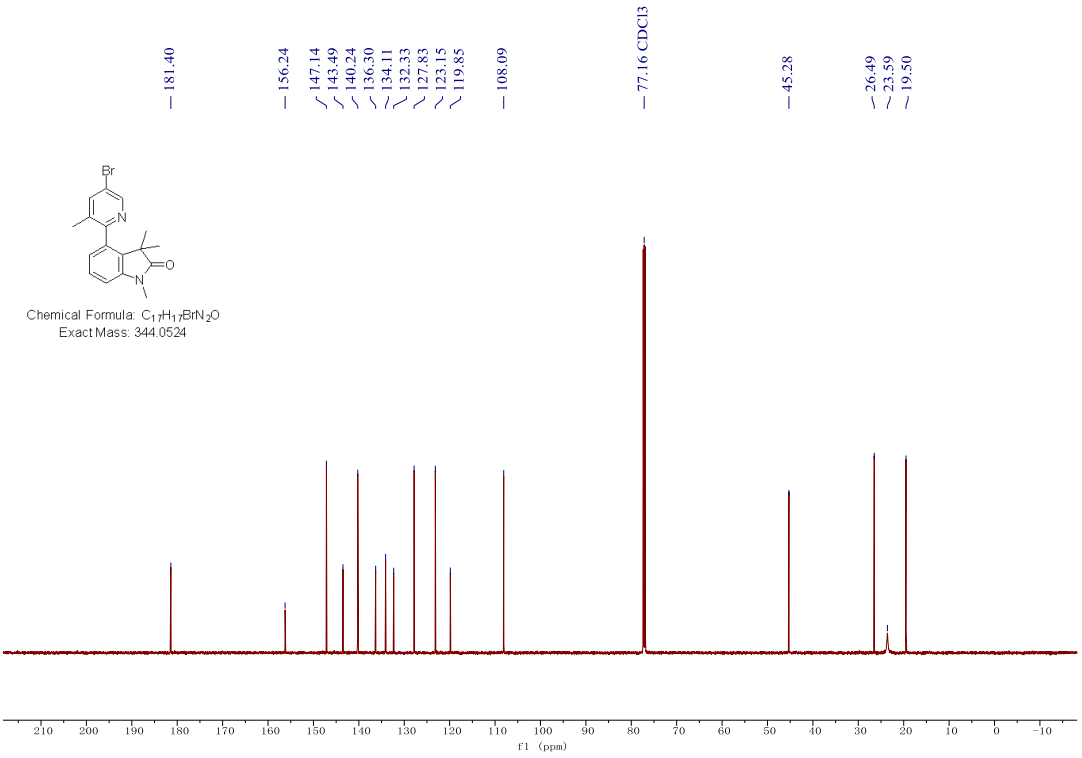
4-(5-chloro-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**59**)



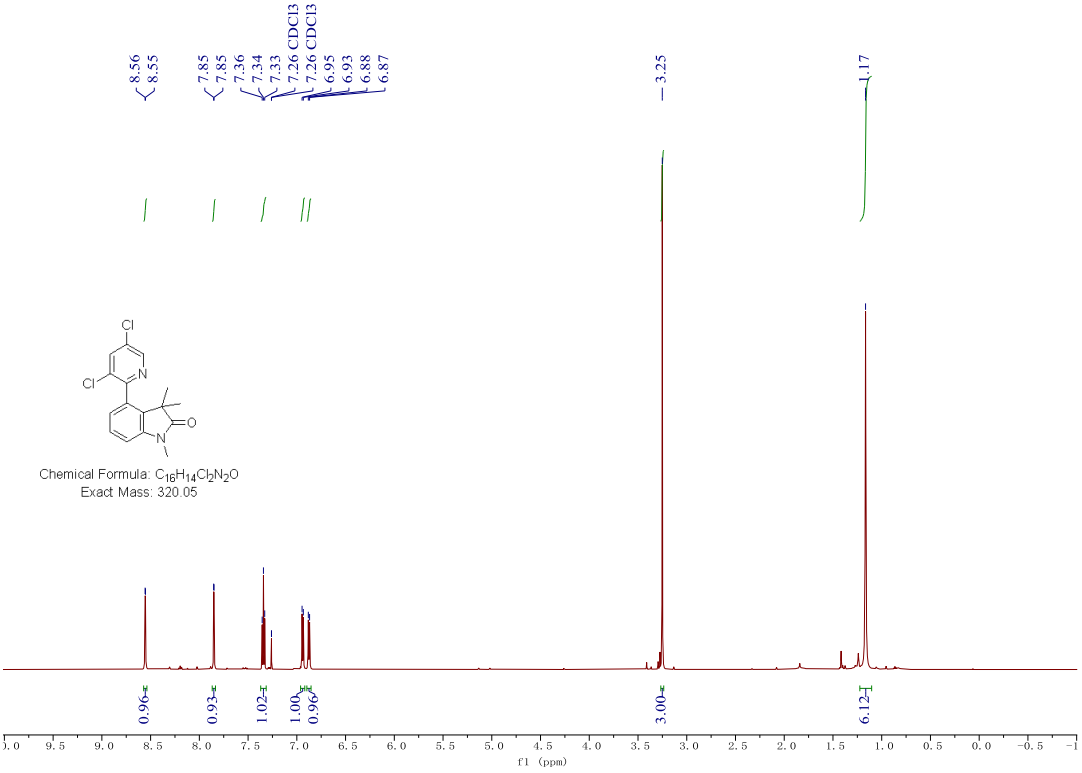


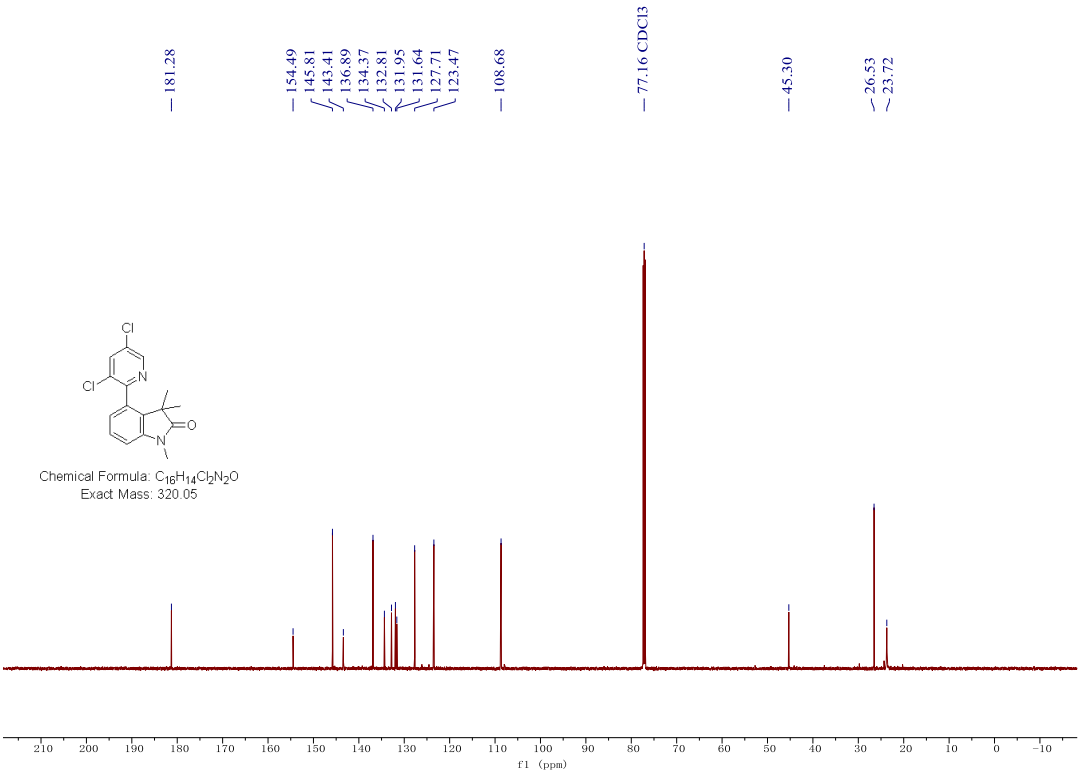
4-(5-bromo-3-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**60**)



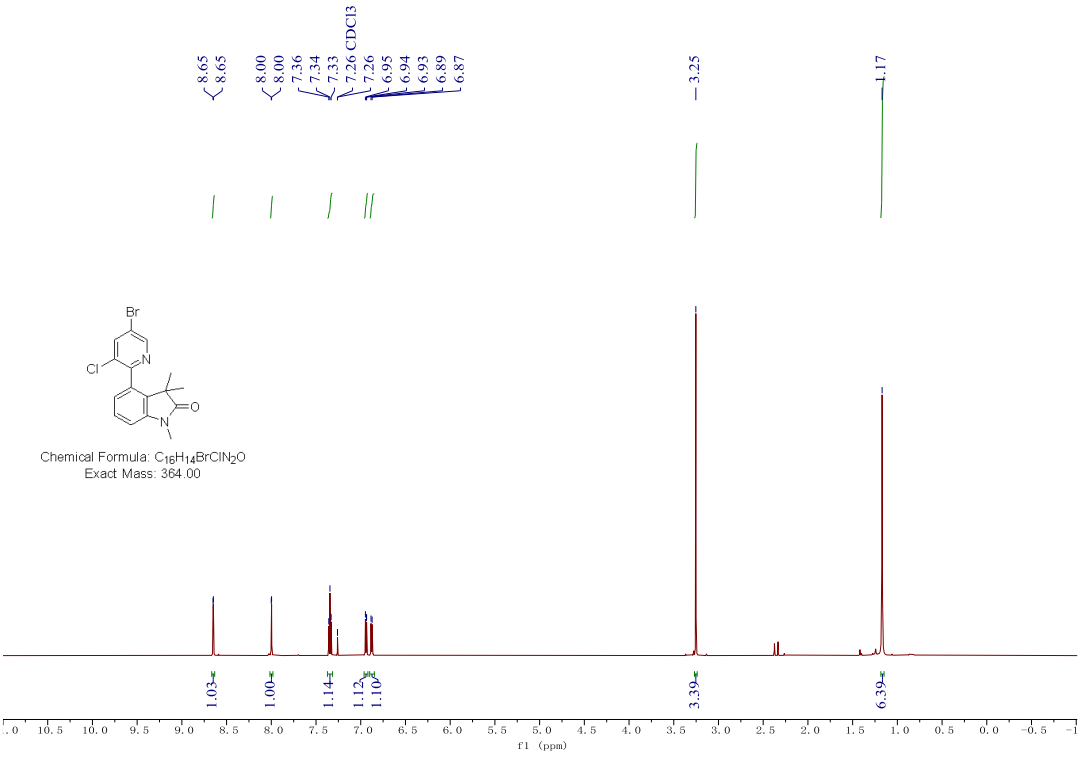


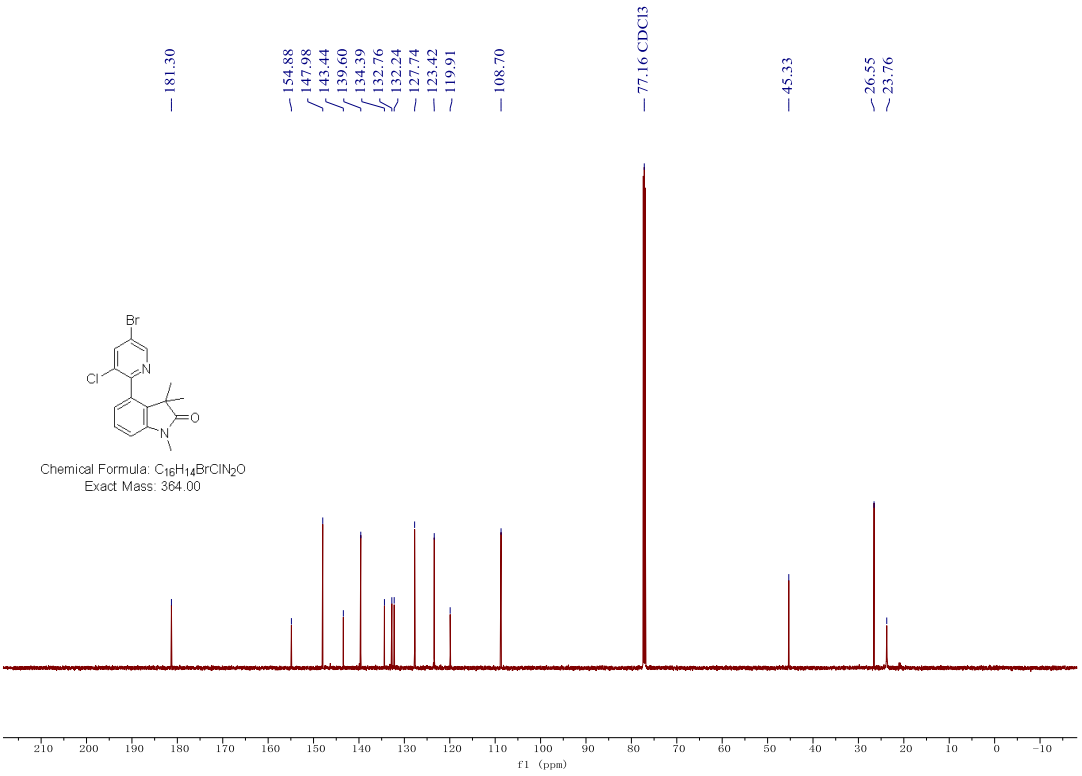
4-(3,5-dichloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**61**)



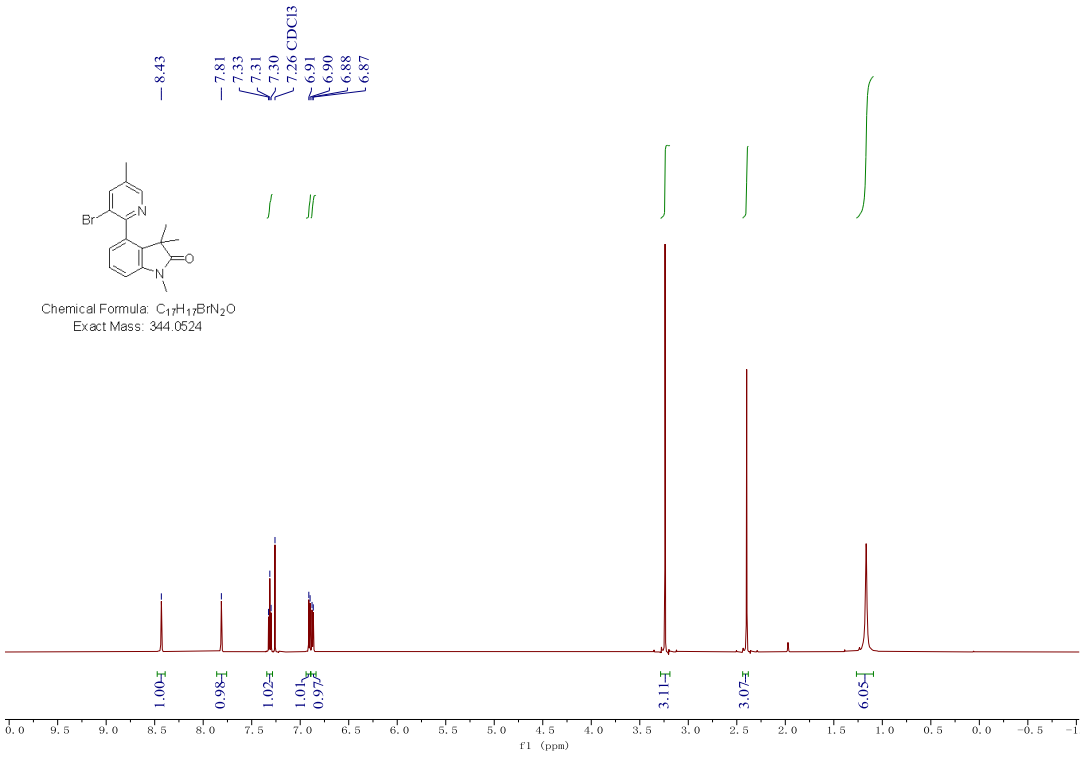


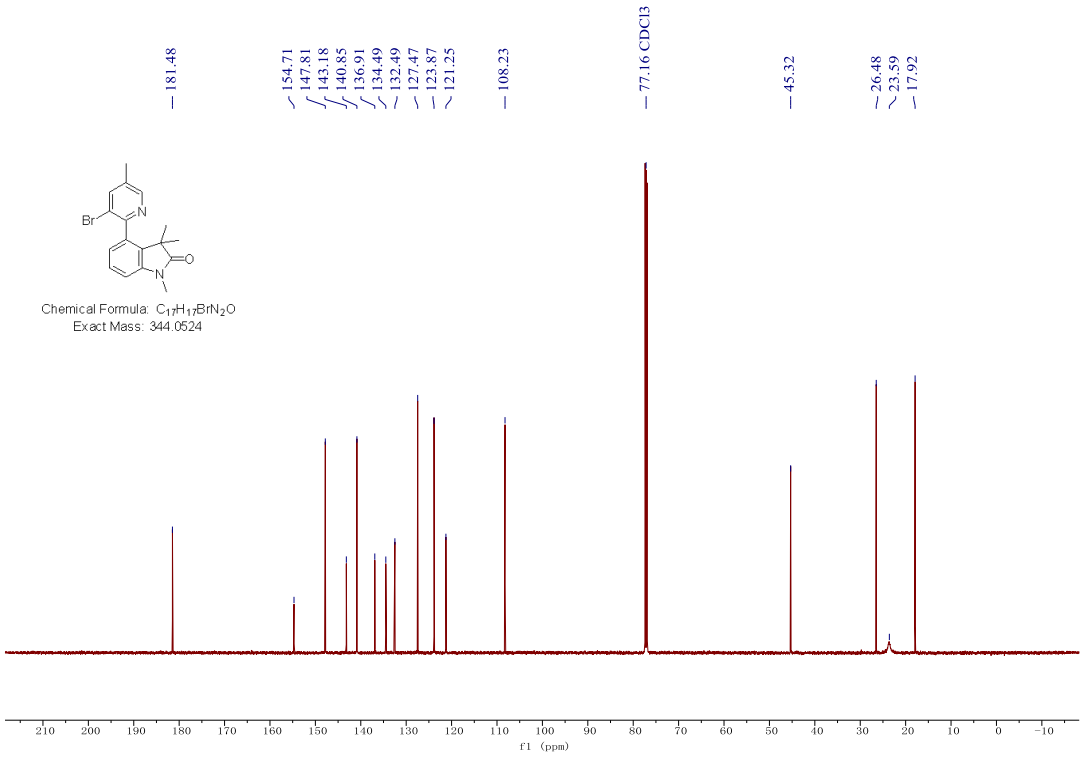
4-(5-bromo-3-chloropyridin-2-yl)-1,3,3-trimethylindolin-2-one (**62**)



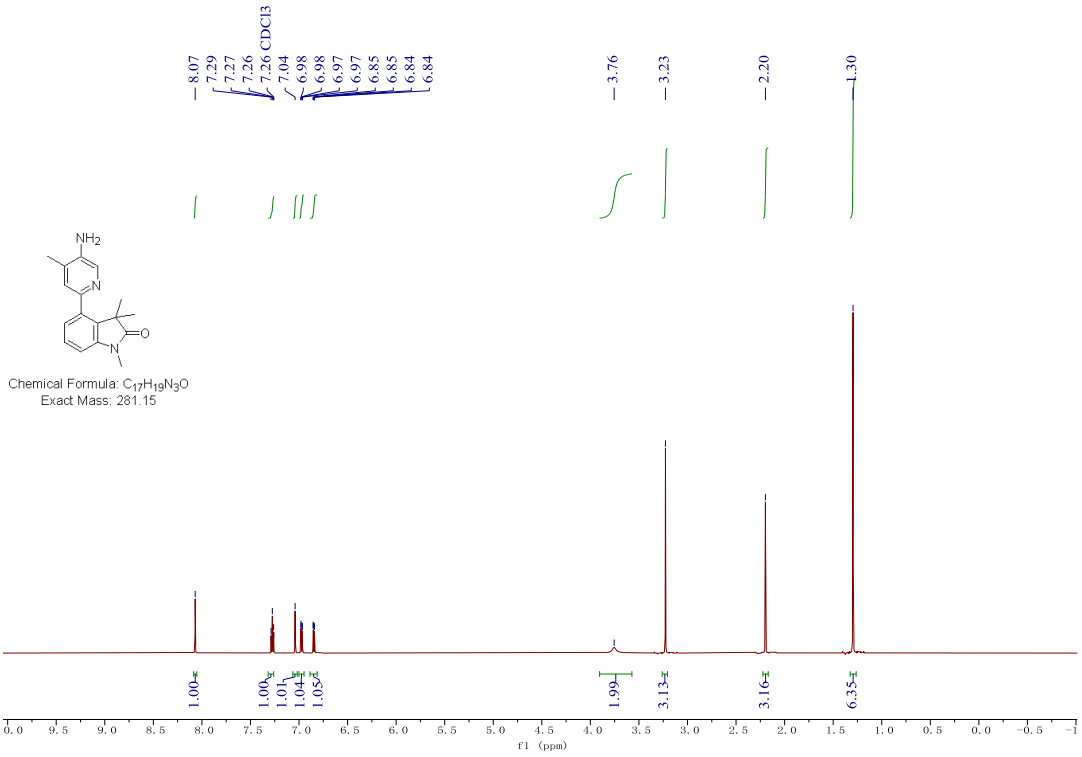


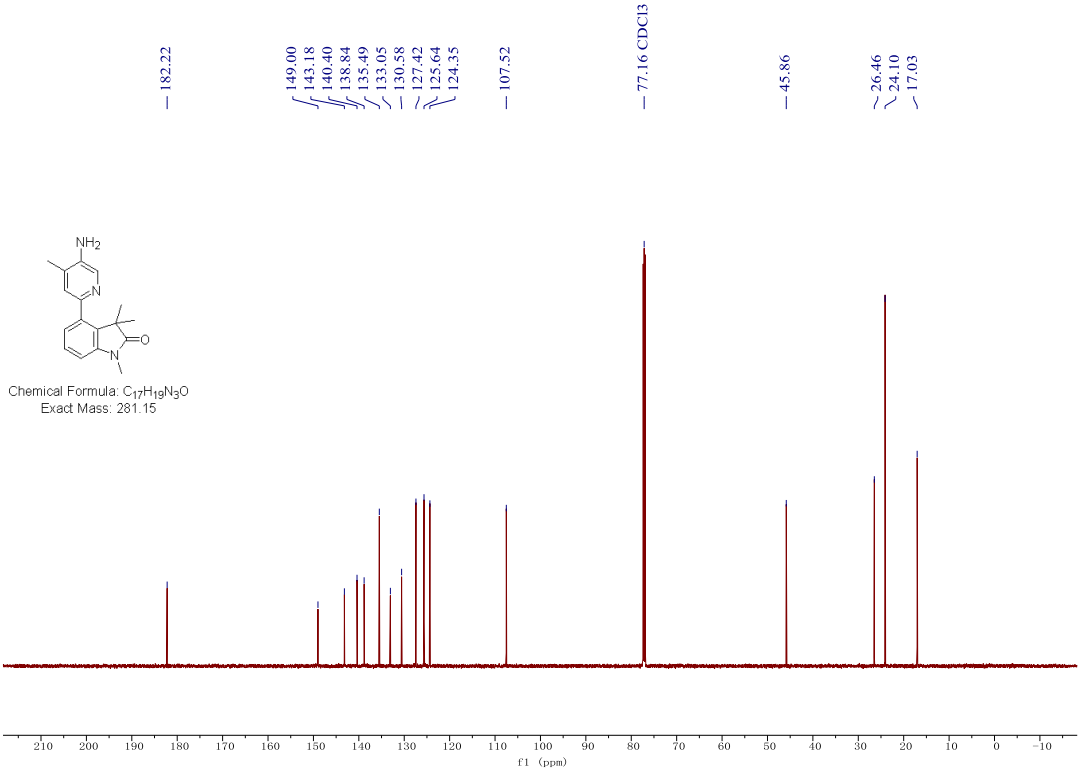
4-(3-bromo-5-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**63**)



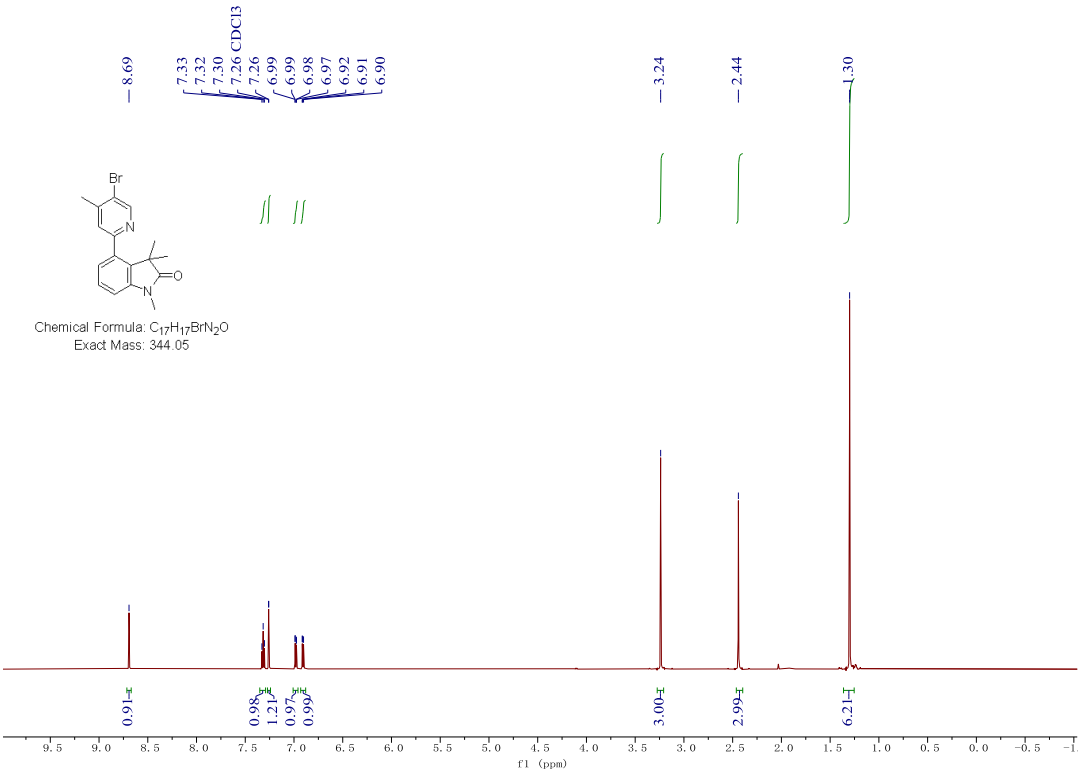


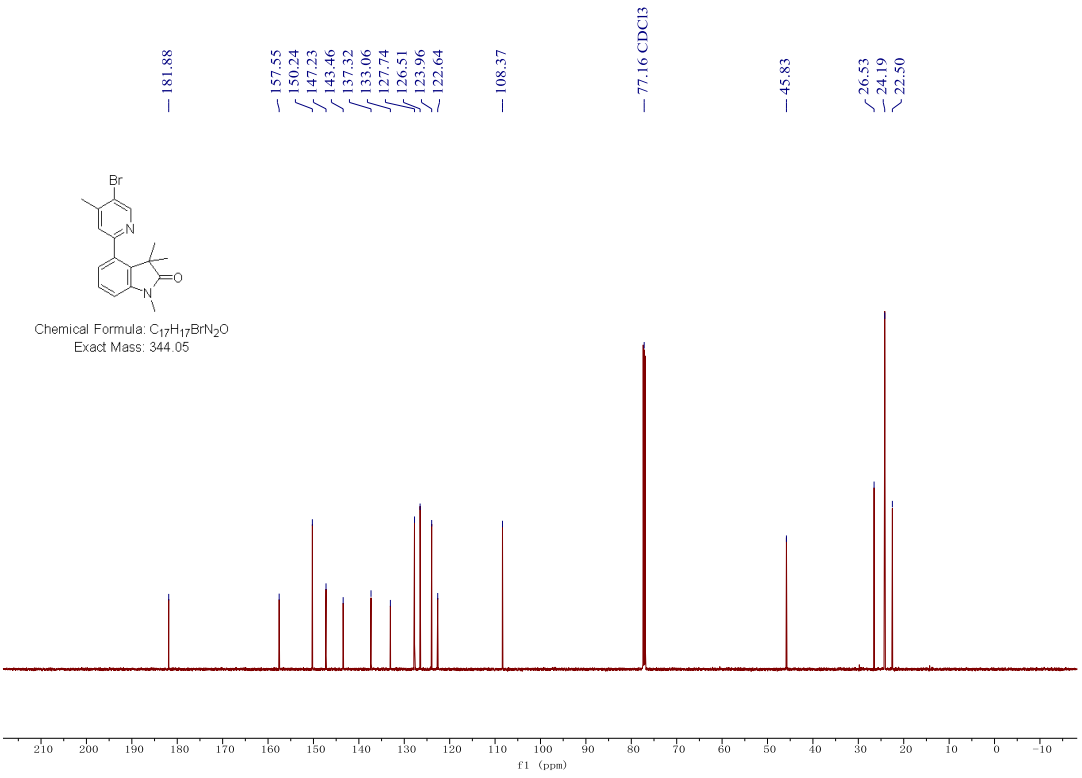
4-(5-amino-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**64**)



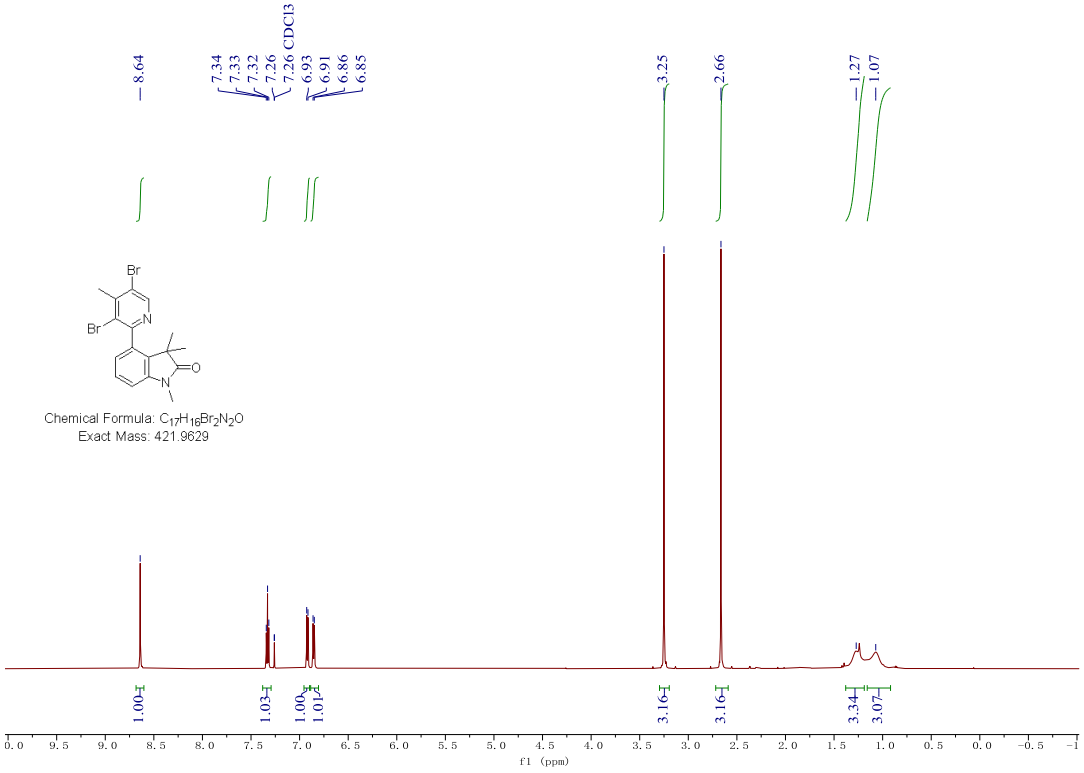


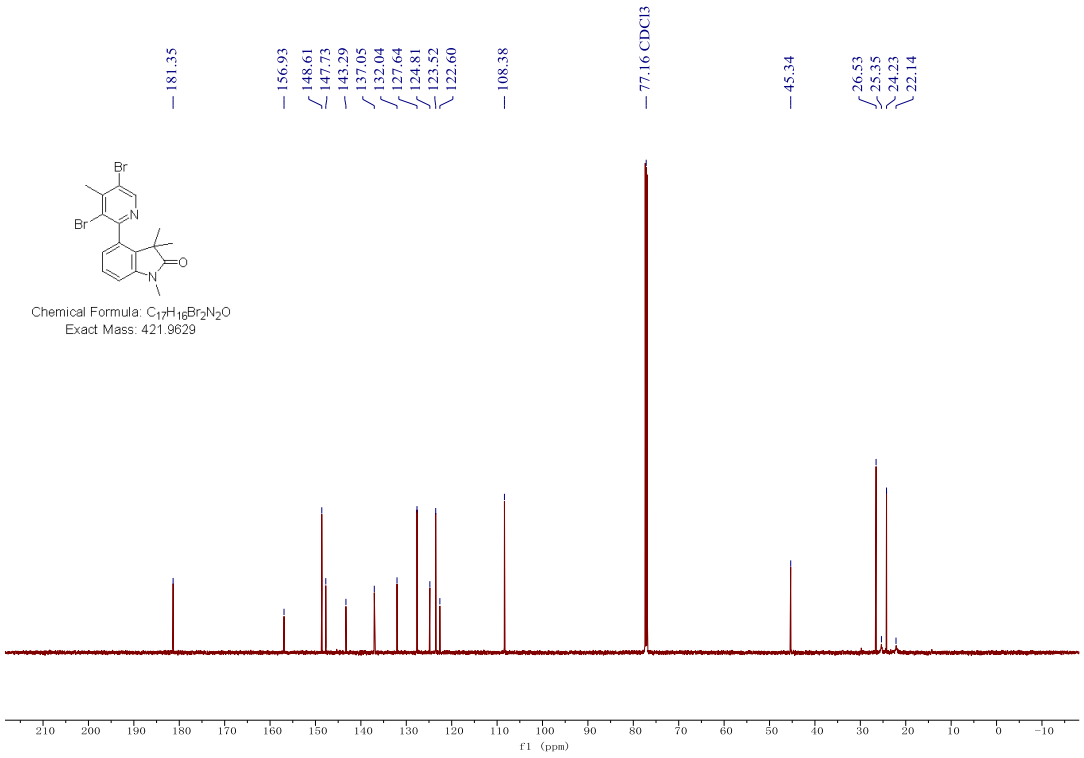
4-(5-bromo-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**65**)



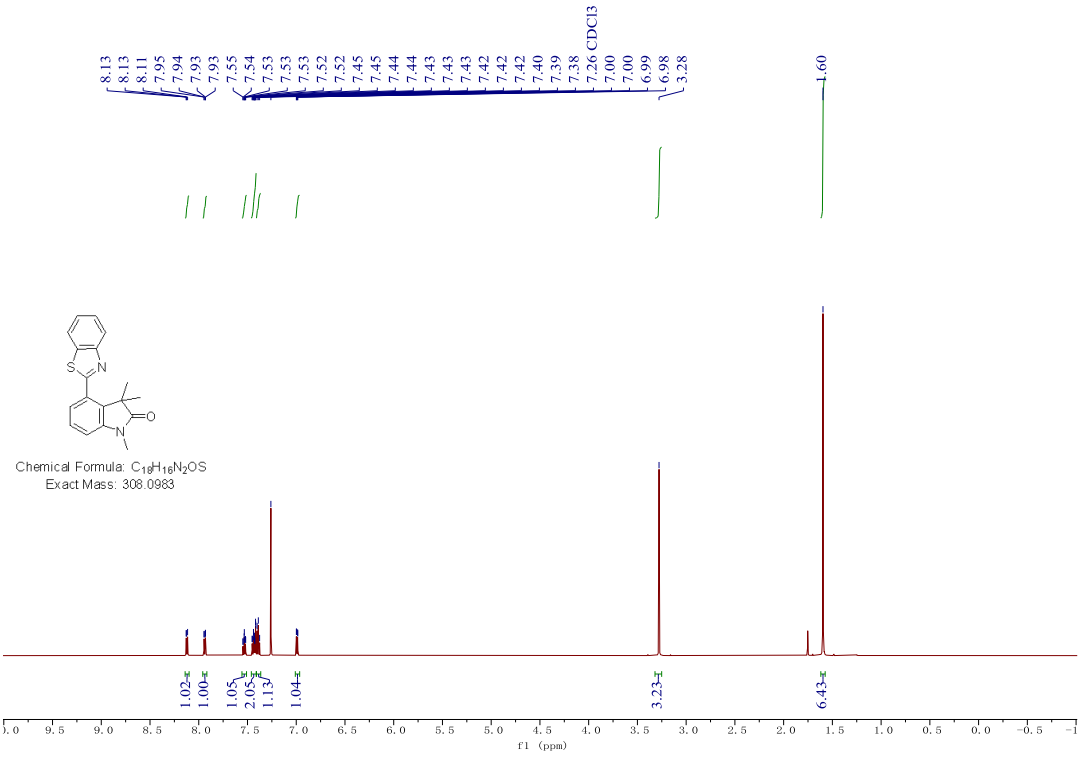


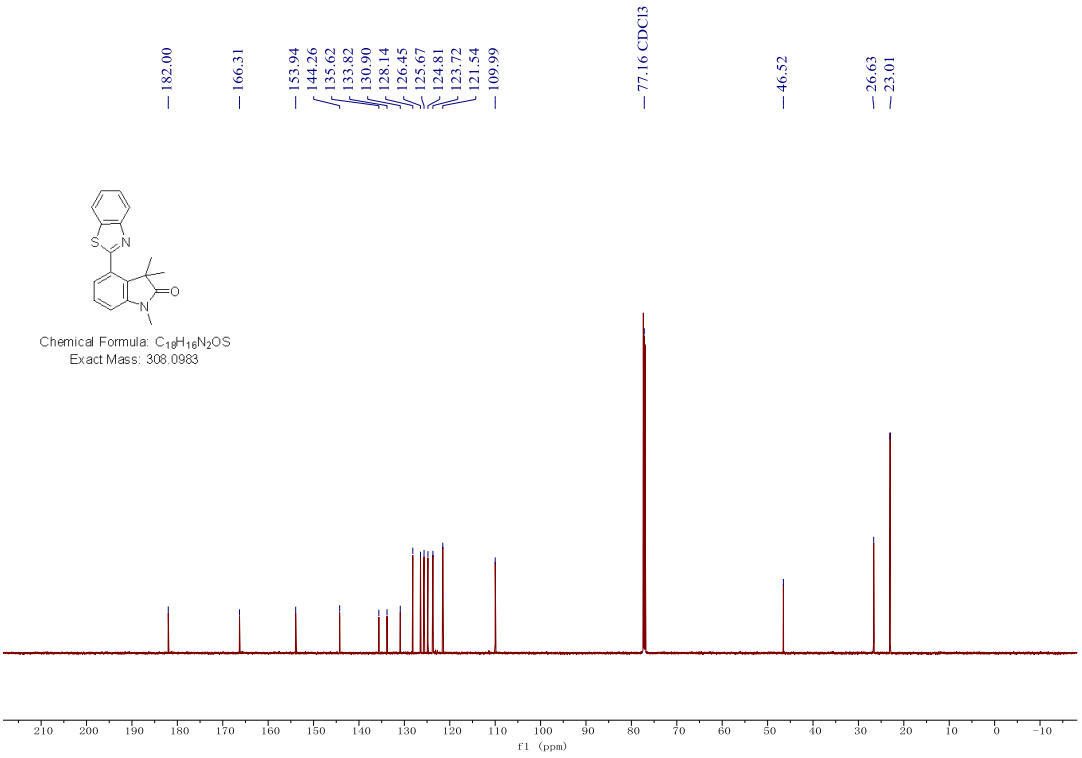
4-(3,5-dibromo-4-methylpyridin-2-yl)-1,3,3-trimethylindolin-2-one (**66**)



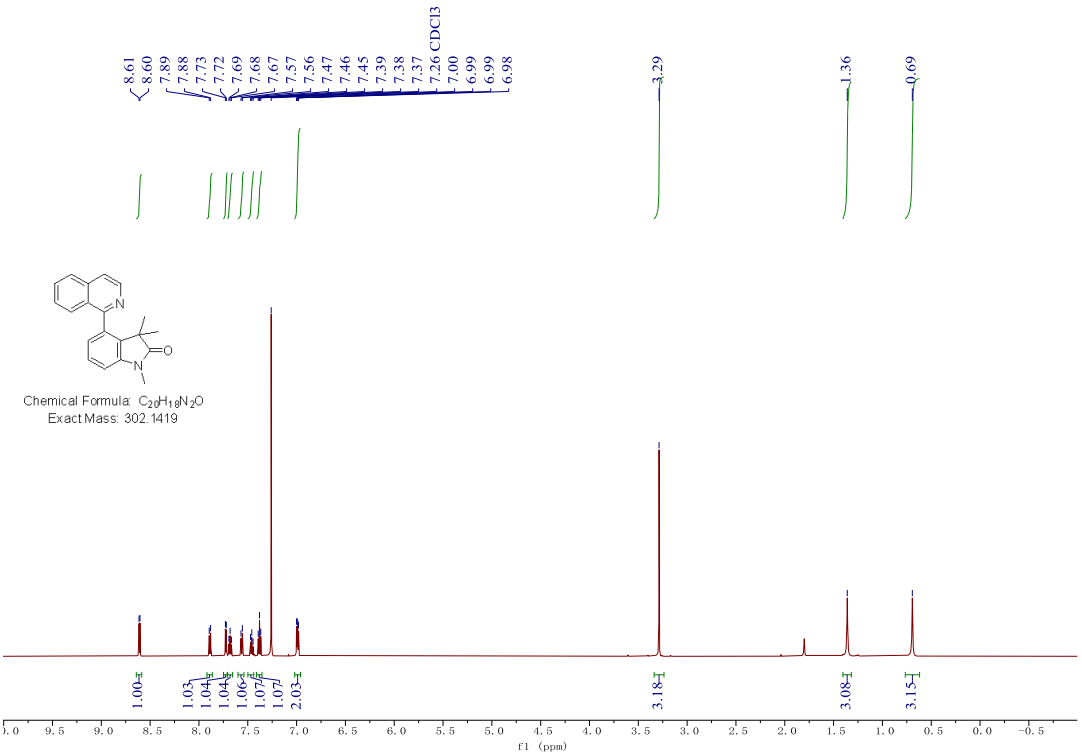


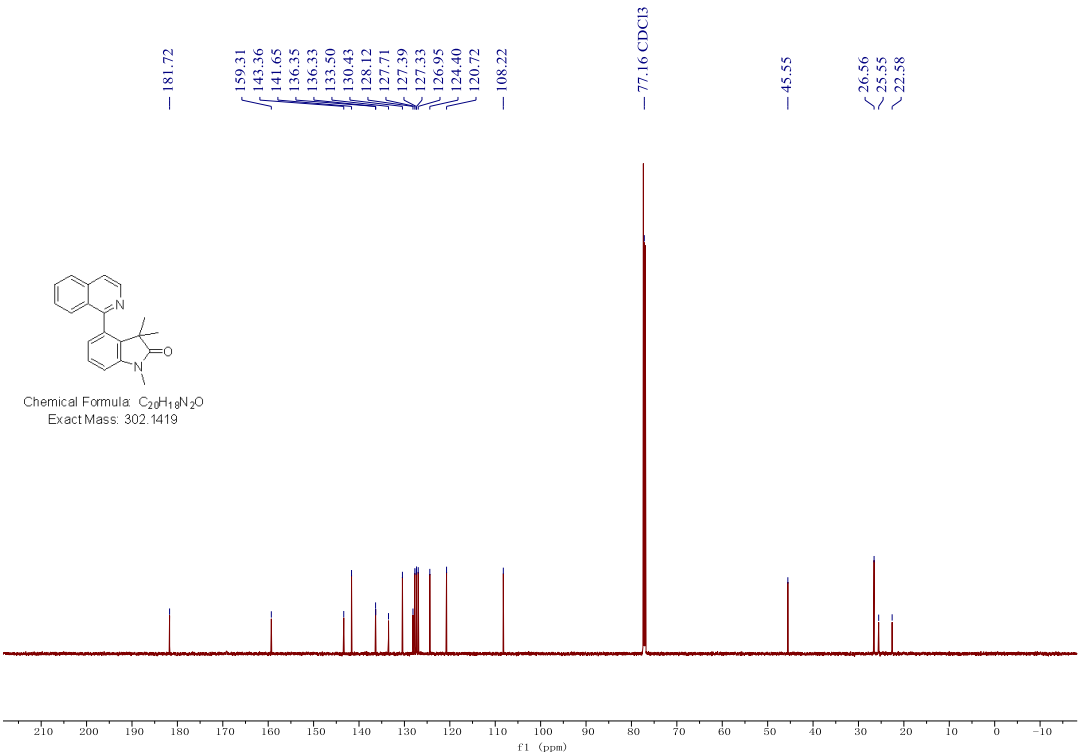
4-(benzo[d]thiazol-2-yl)-1,3,3-trimethylindolin-2-one (**67**)



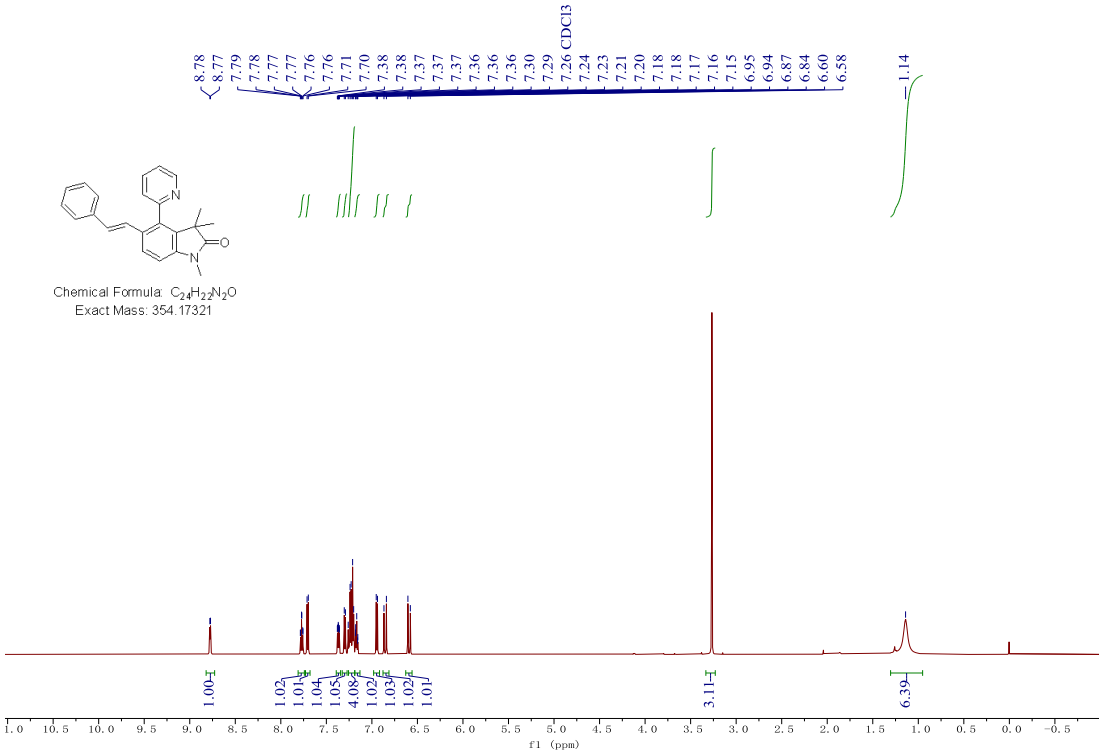


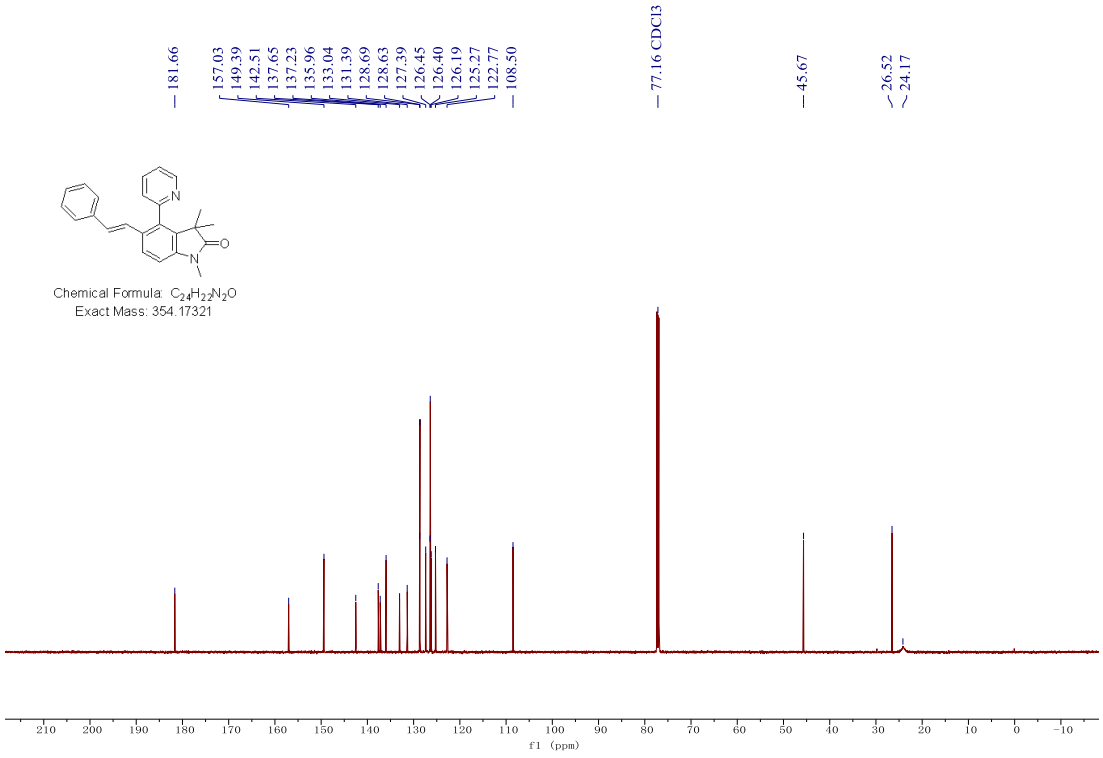
4-(isoquinolin-1-yl)-1,3,3-trimethylindolin-2-one (**68**)



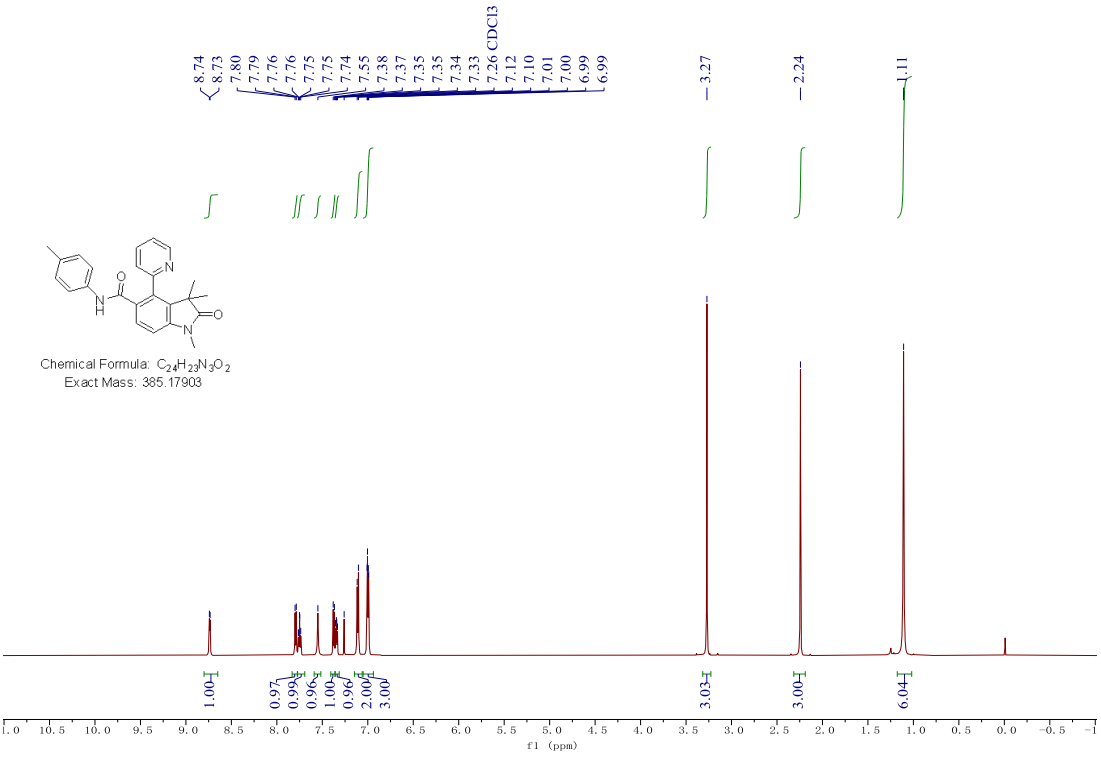


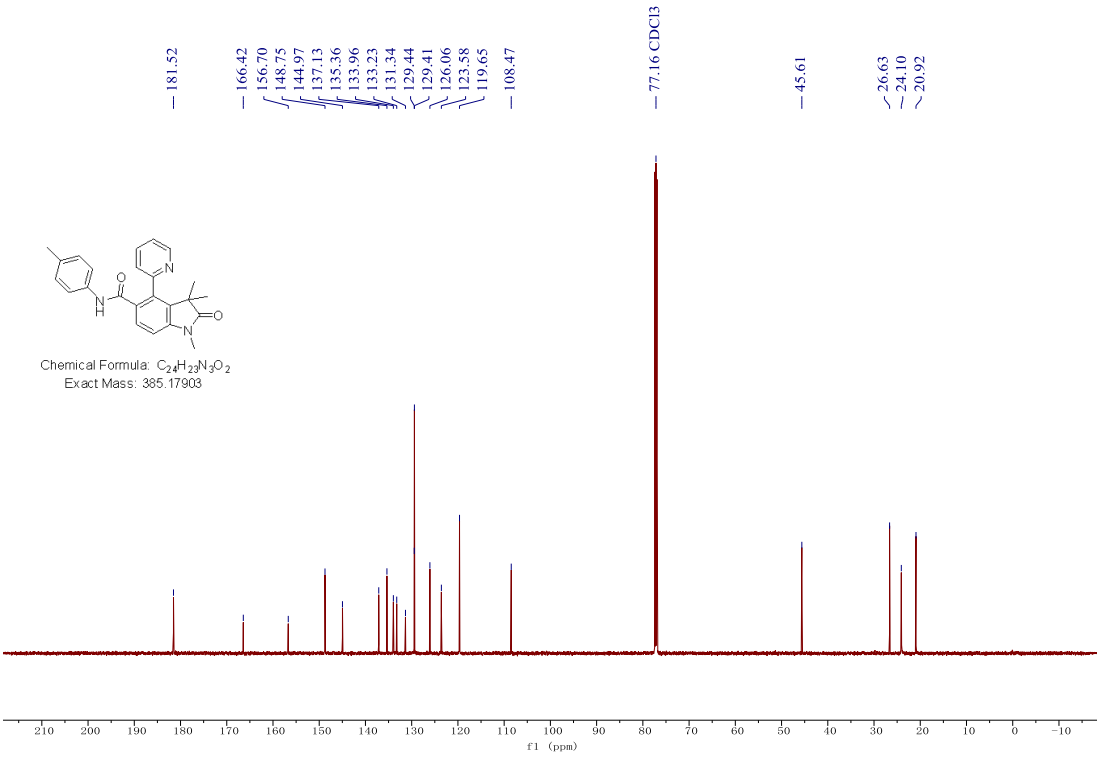
(E)-1,3,3-trimethyl-4-(pyridin-2-yl)-5-styrylindolin-2-one (**69**)



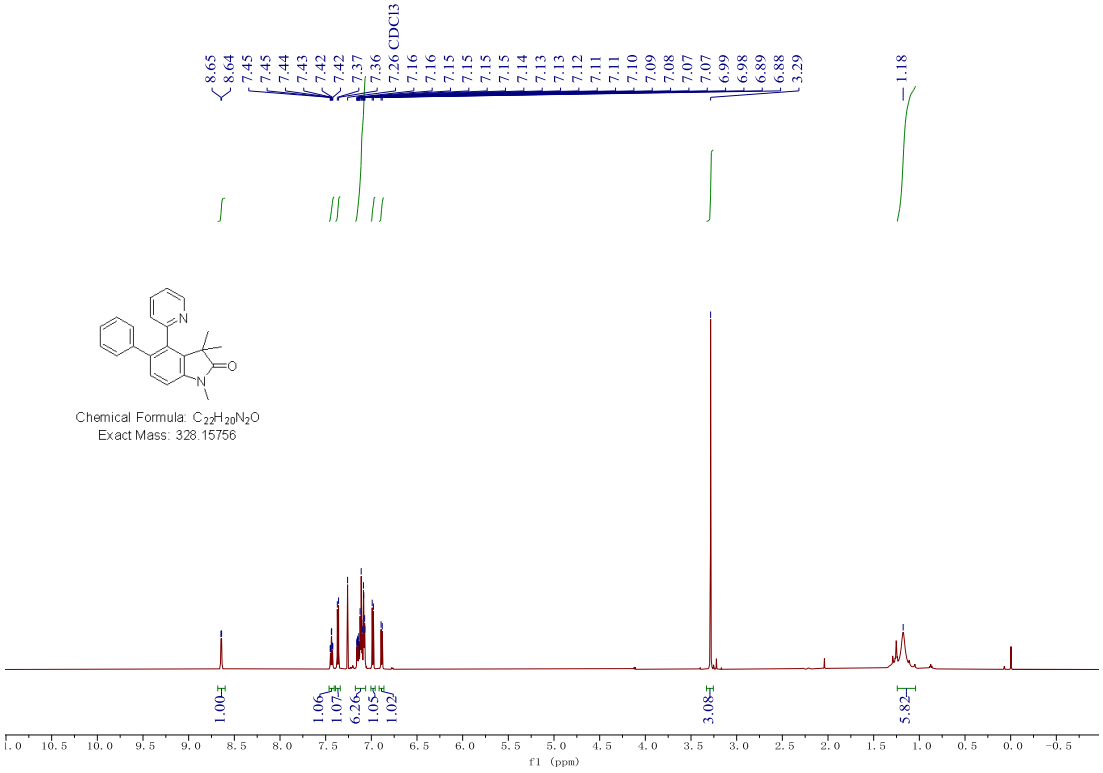


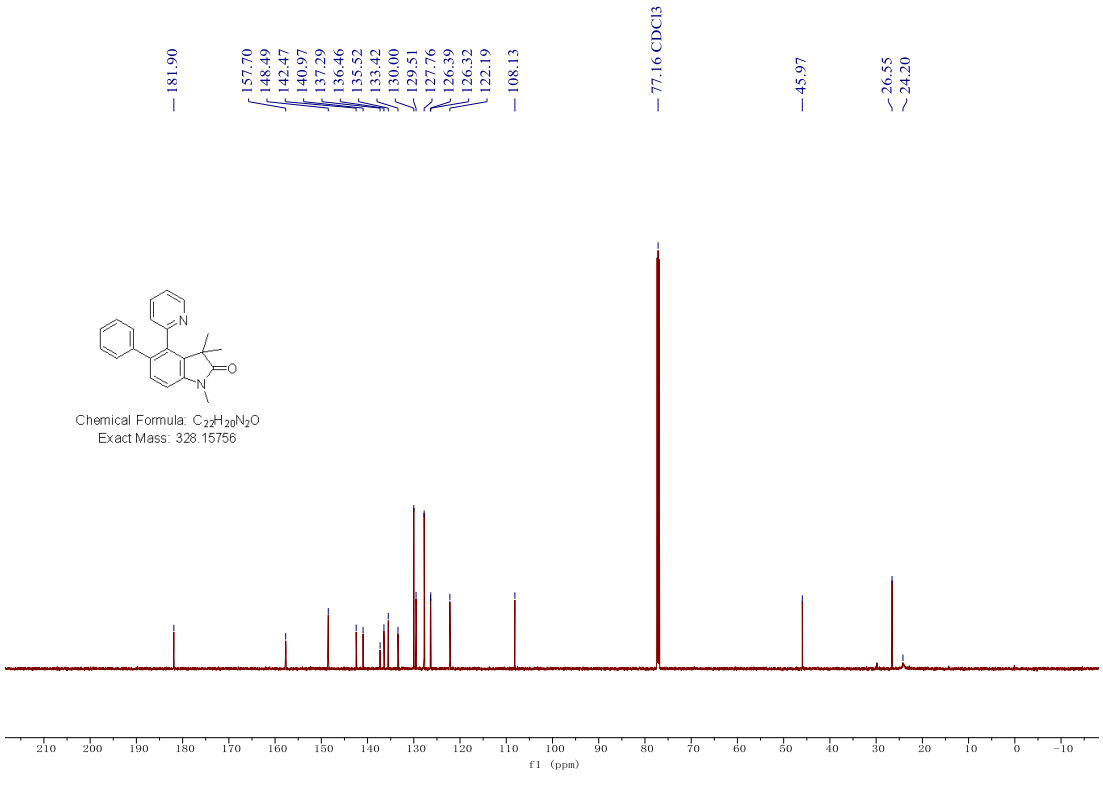
1,3,3-trimethyl-2-oxo-4-(pyridin-2-yl)-N-(p-tolyl)indoline-5-carboxamide (**70**)



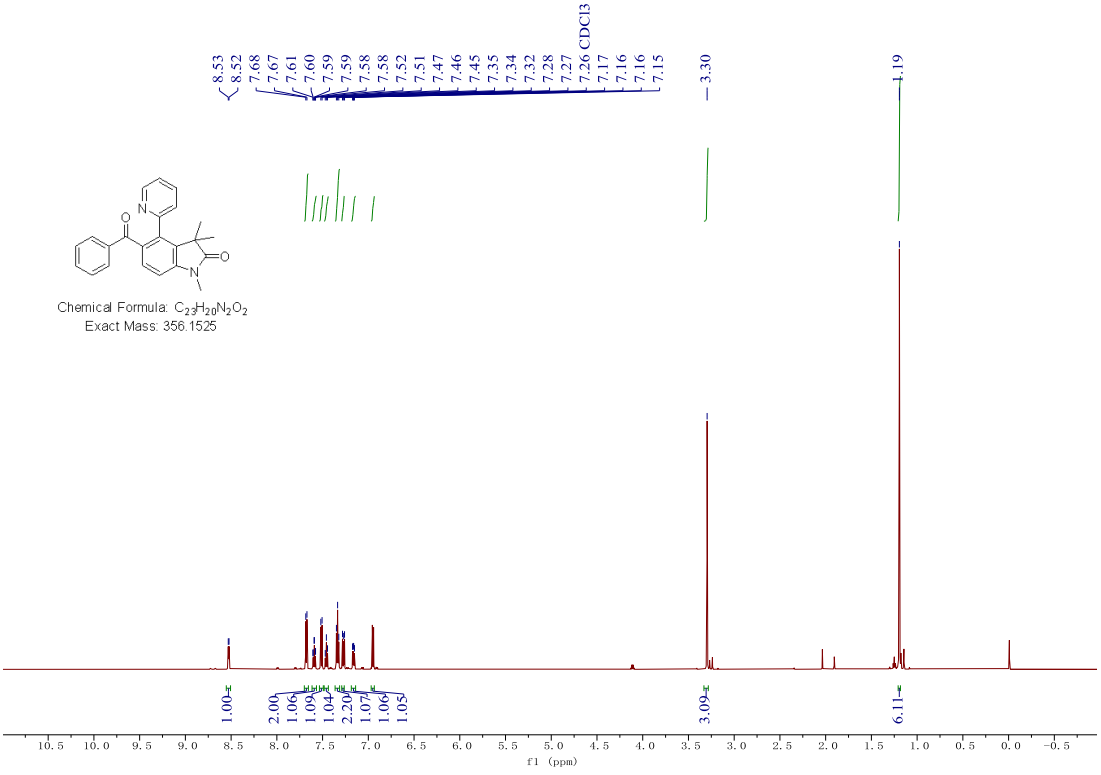


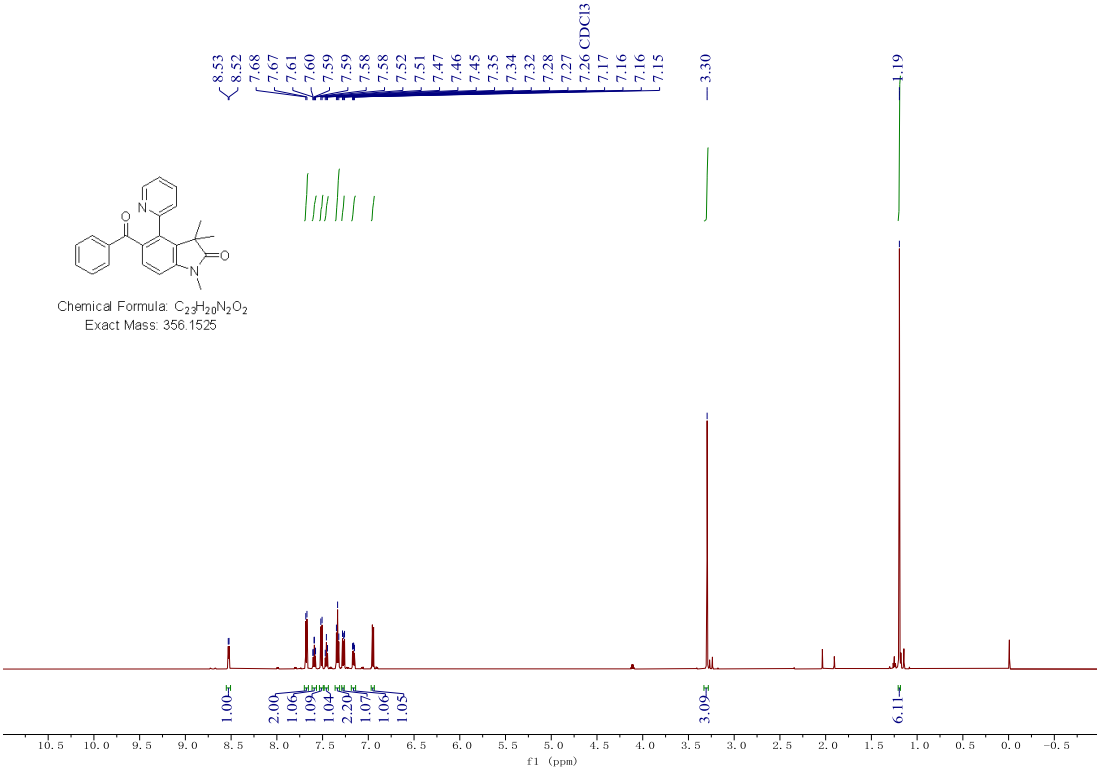
1,3,3-trimethyl-5-phenyl-4-(pyridin-2-yl)indolin-2-one (**71**)



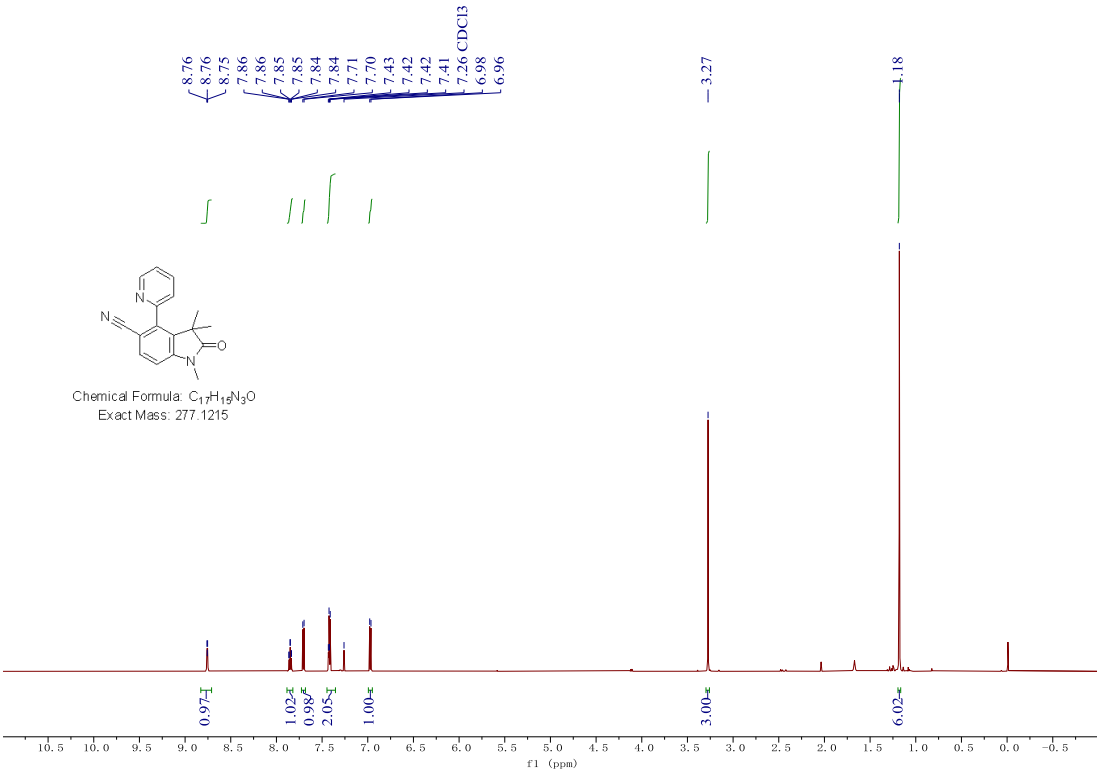


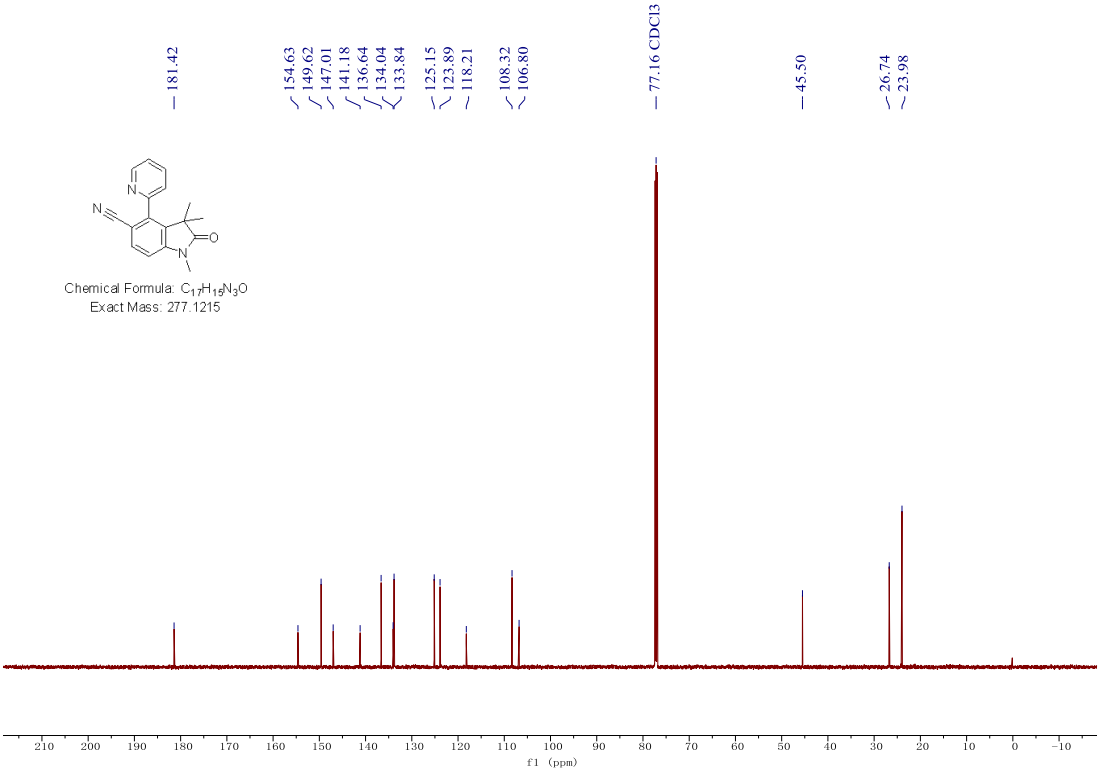
5-benzoyl-1,3,3-trimethyl-4-(pyridin-2-yl)indolin-2-one (**72**)



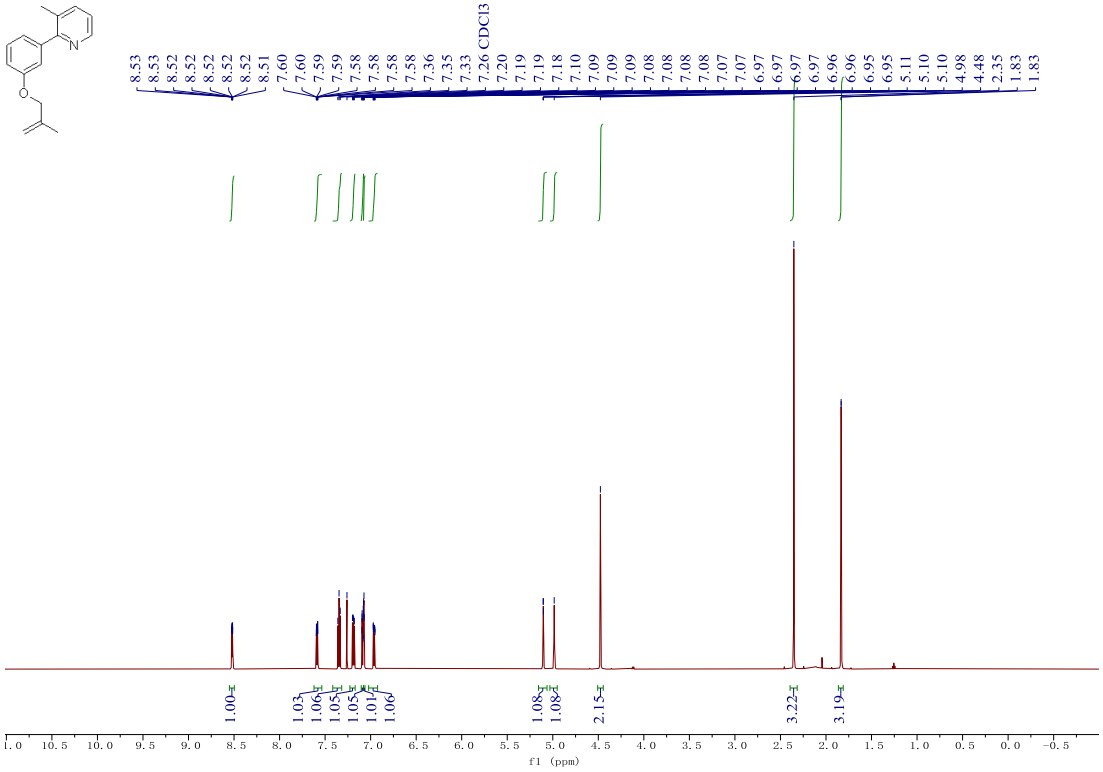


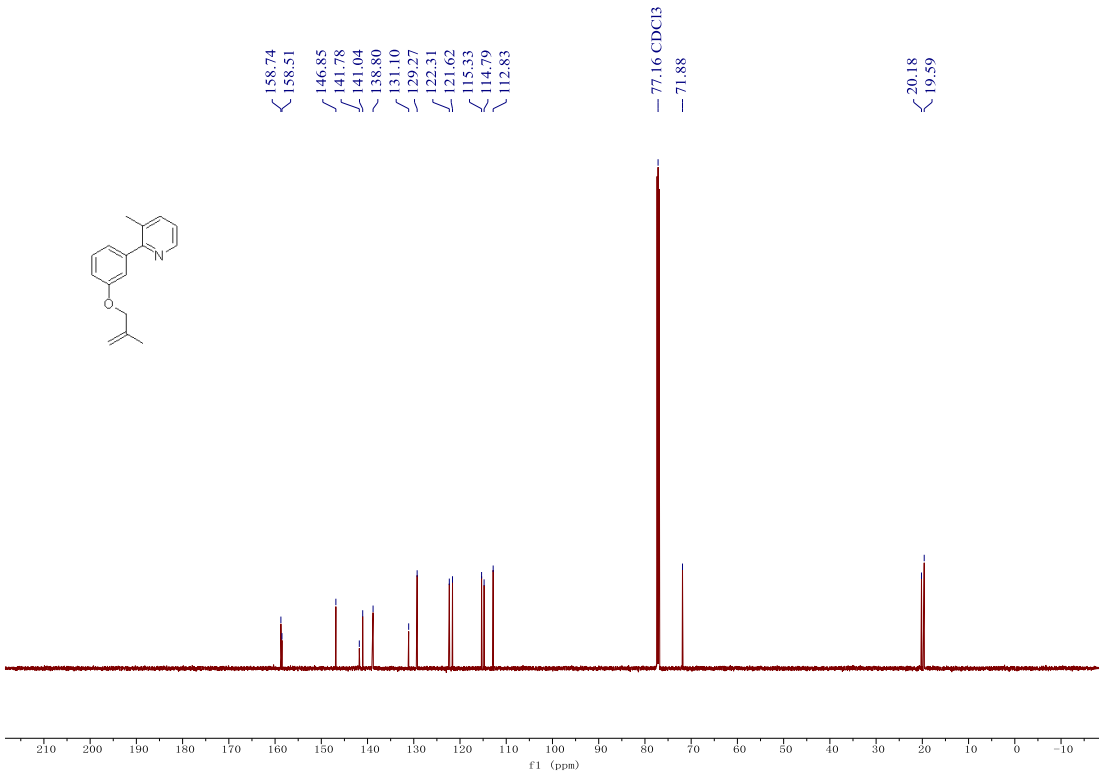
1,3,3-trimethyl-2-oxo-4-(pyridin-2-yl)indoline-5-carbonitrile (**73**)



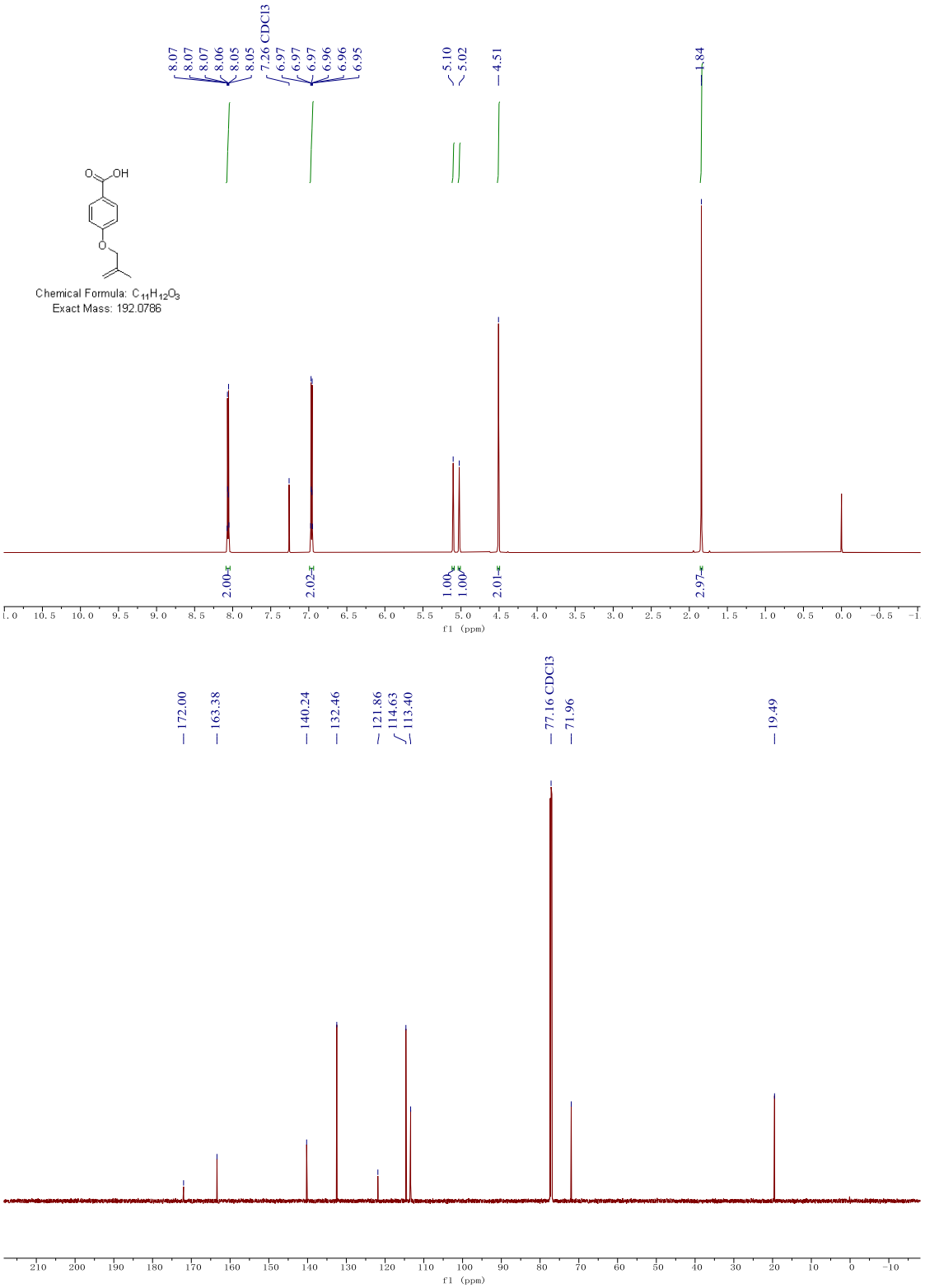


3-methyl-2-(3-((2-methylallyl)oxy)phenyl)pyridine (**3'**)

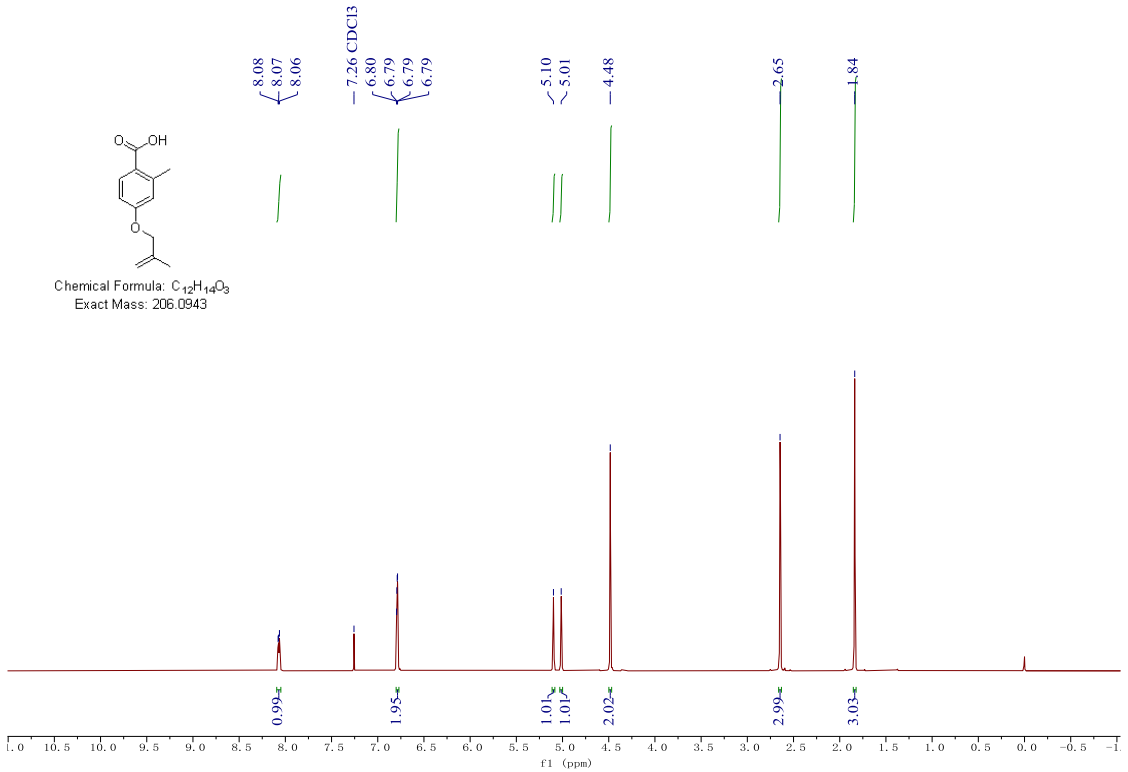


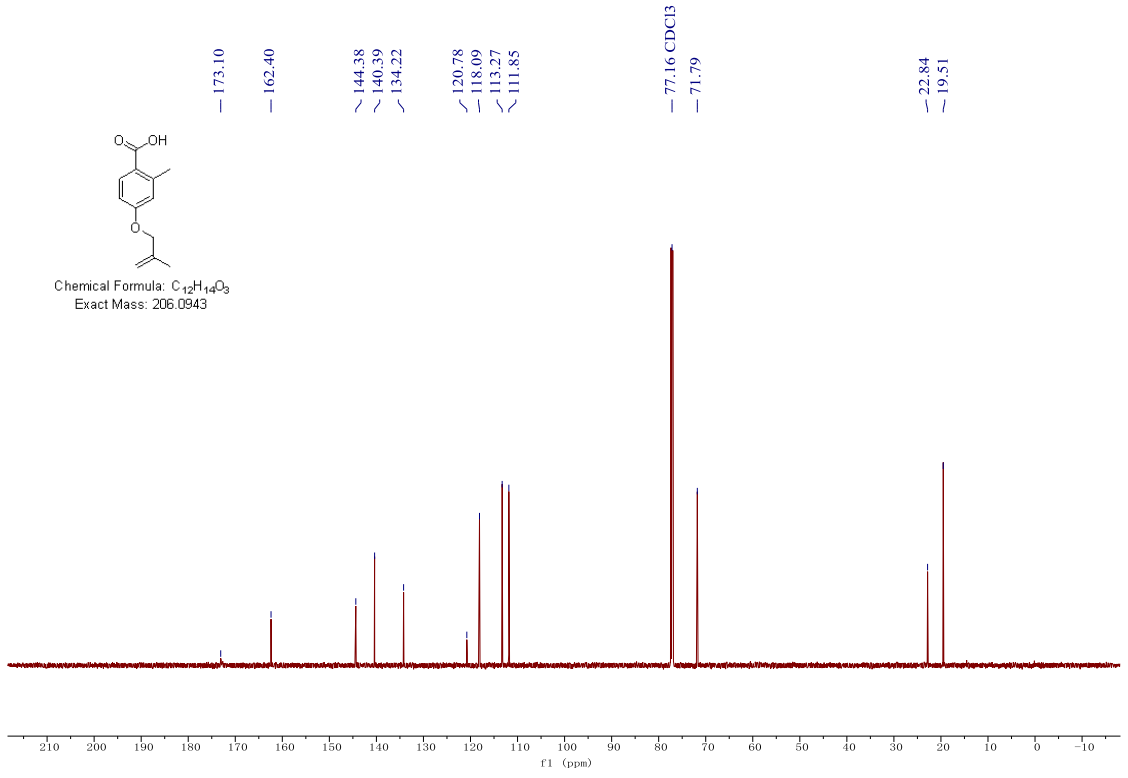


4-((2-methylallyl)oxy)benzoic acid

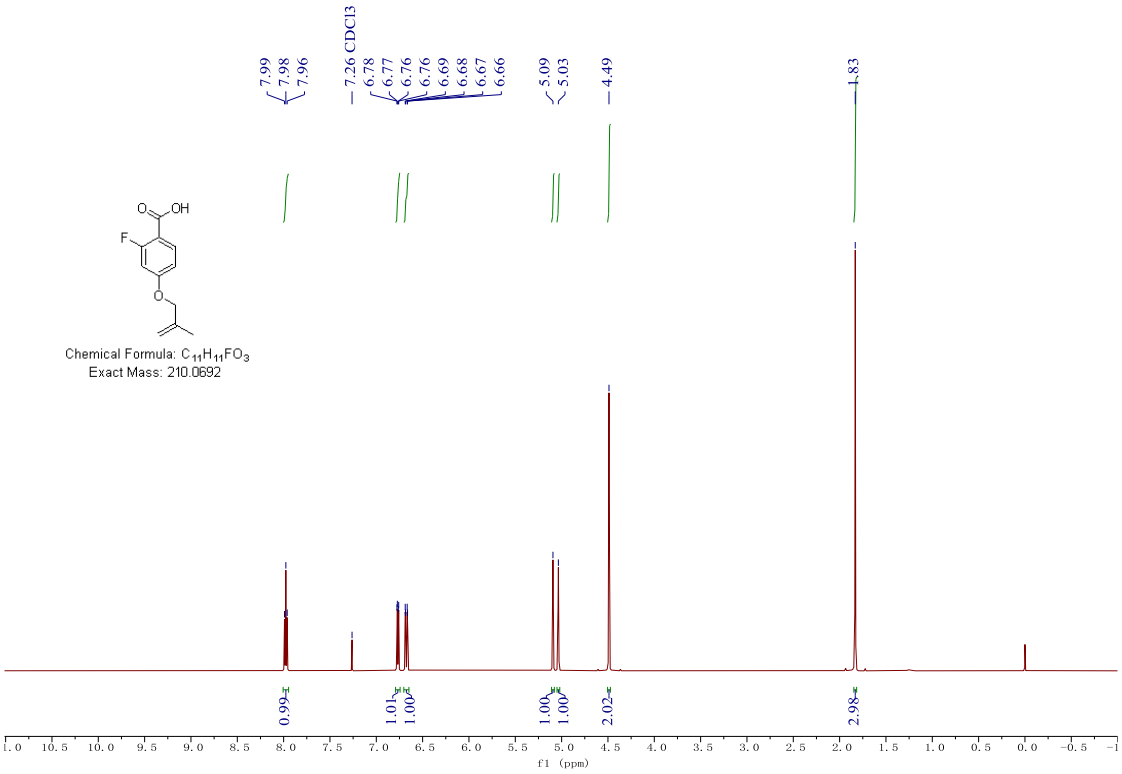


2-methyl-4-((2-methylallyl)oxy)benzoic acid





2-fluoro-4-((2-methylallyl)oxy)benzoic acid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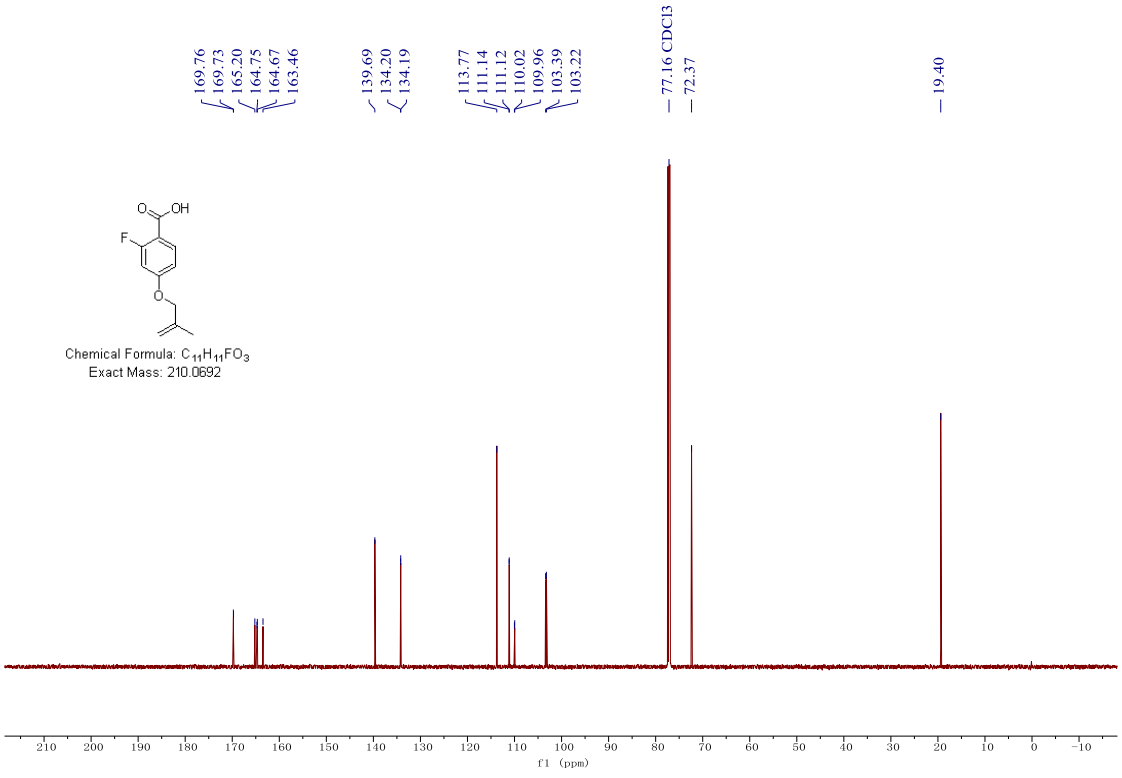
7.98
7.96
7.26 CDCl3
6.78
6.77
6.76
6.76
6.69
6.68
6.67
6.66
5.09
5.03
4.49
1.83
O
OH
F
O
Chemical Formula: C11H11FO3
Exact Mass: 210.0692
0.99
1.01
1.00
1.00
1.00
2.02
2.98
f1 (ppm)


169.76
169.73
165.20
164.75
164.67
163.46
139.69
134.20
134.19
113.77
111.14
111.12
110.02
109.96
103.39
103.22
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O
OH
F
O
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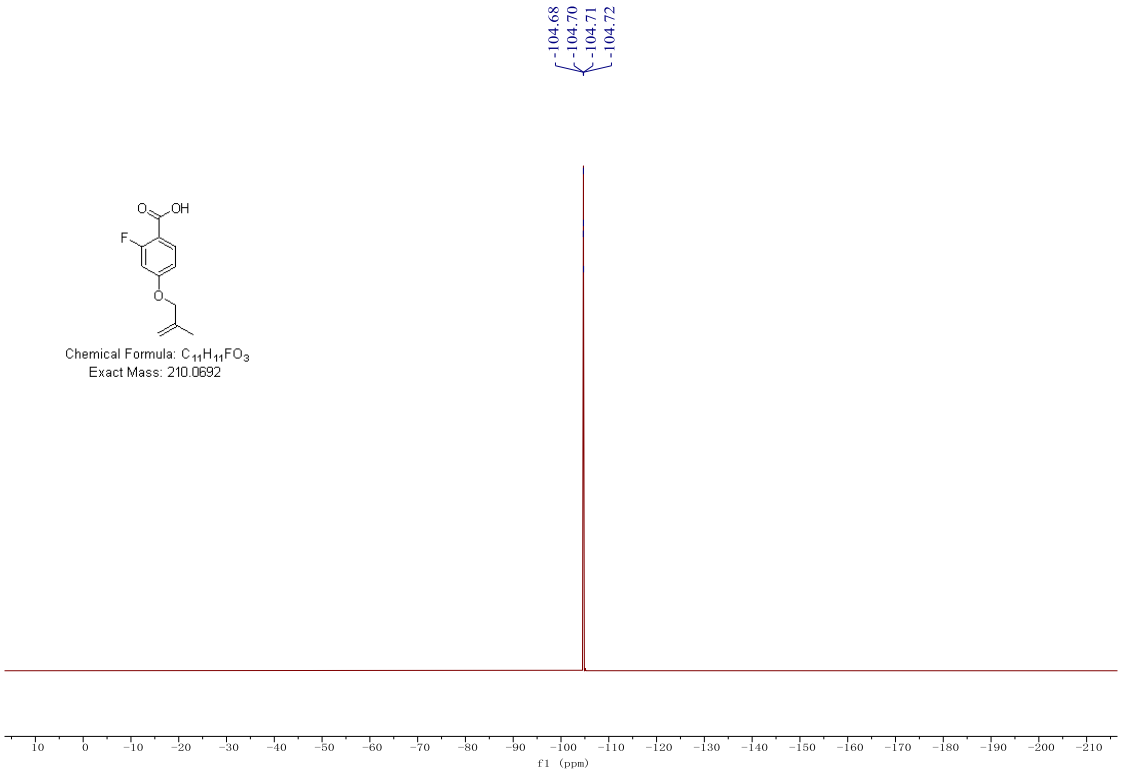
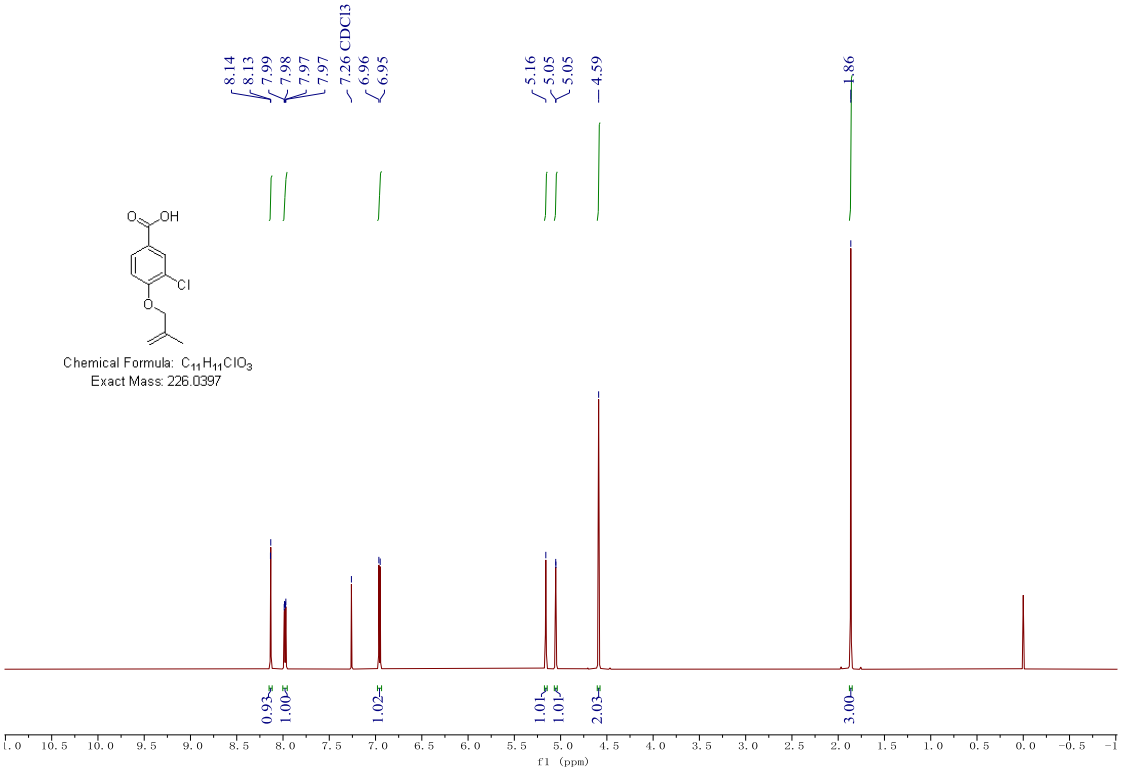
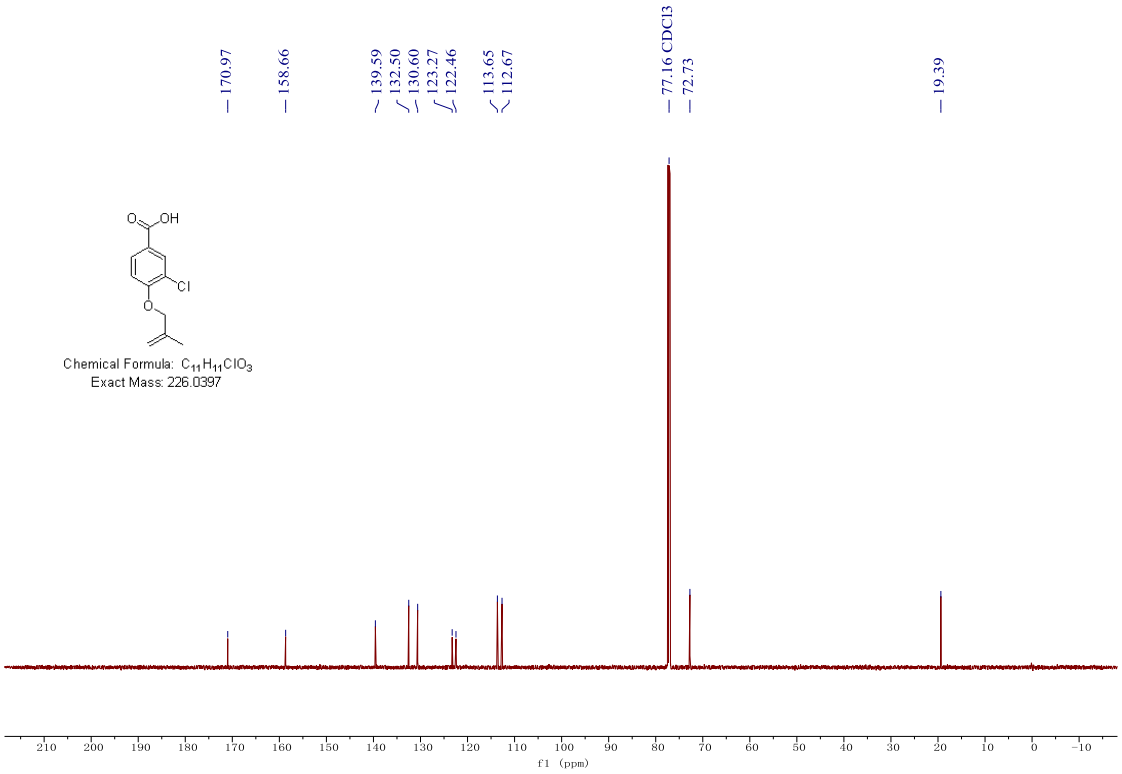
Exact Mass: 210.0692
f1 (ppm)

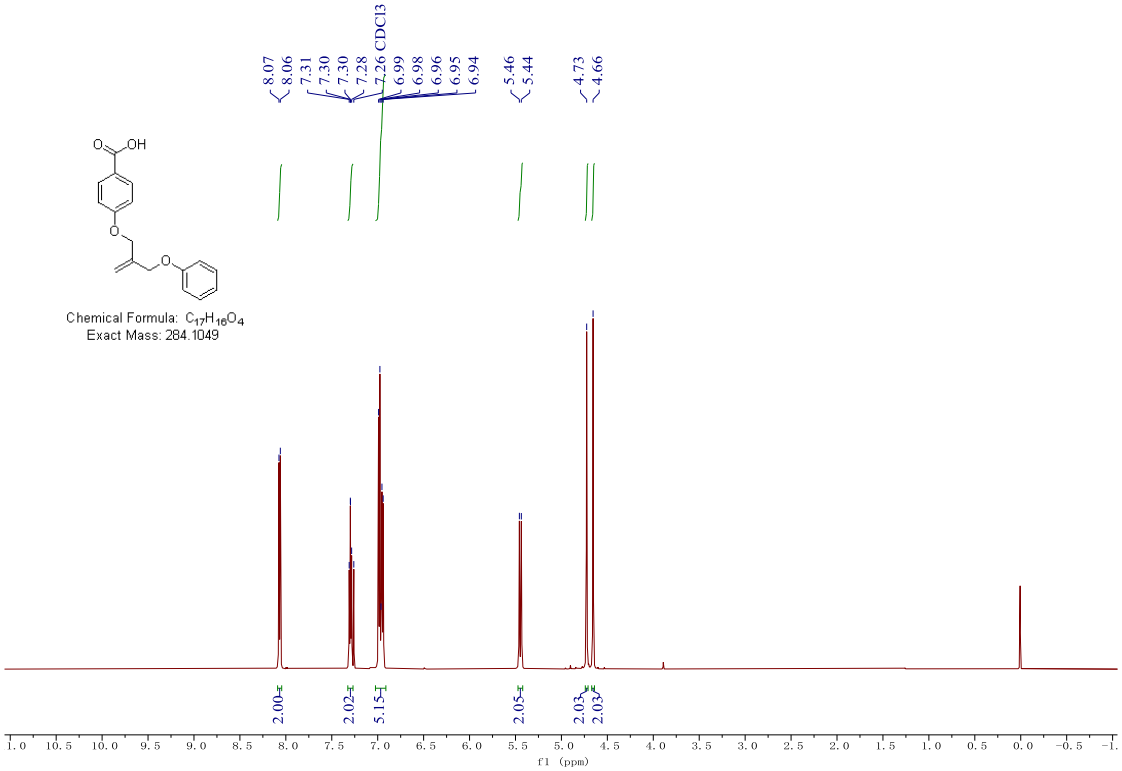


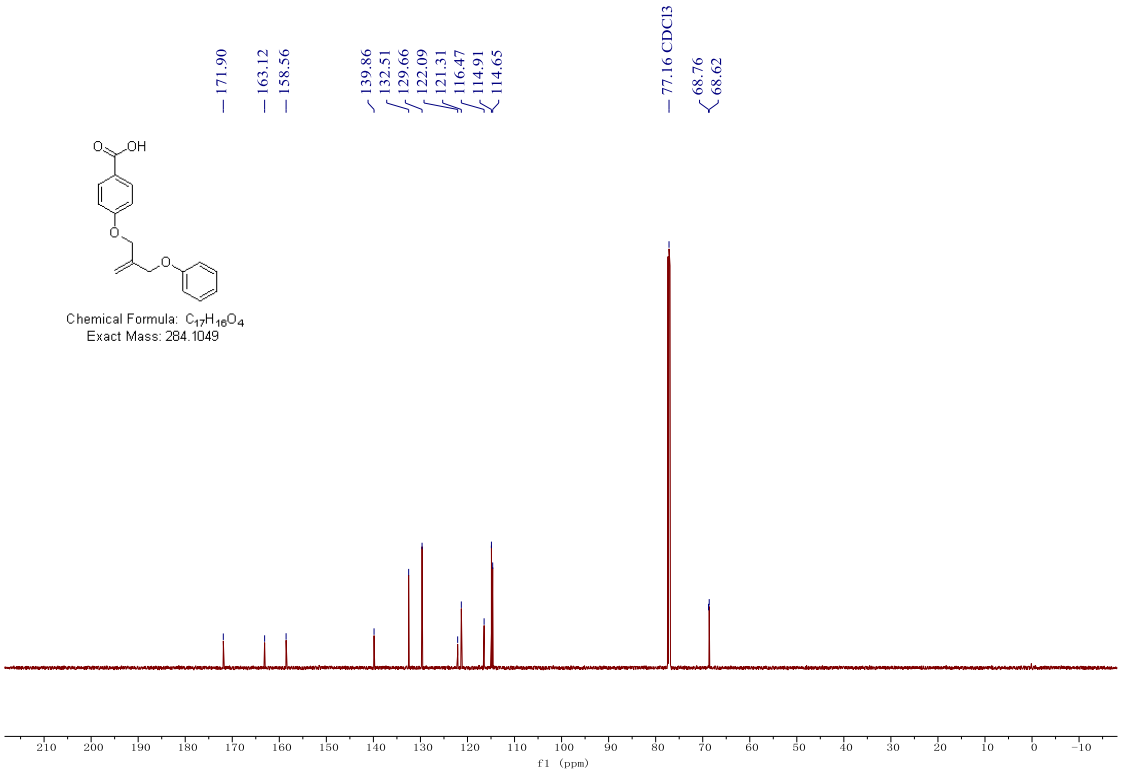
3-chloro-4-((2-methylallyl)oxy)benzoic acid



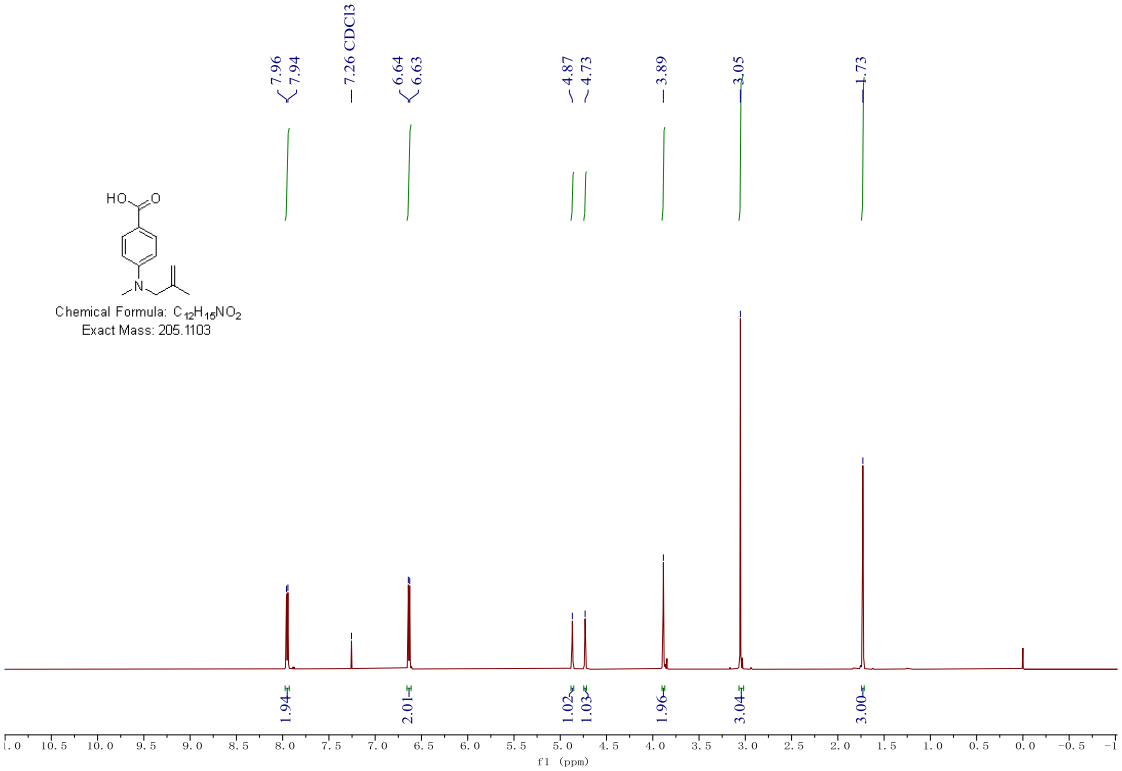


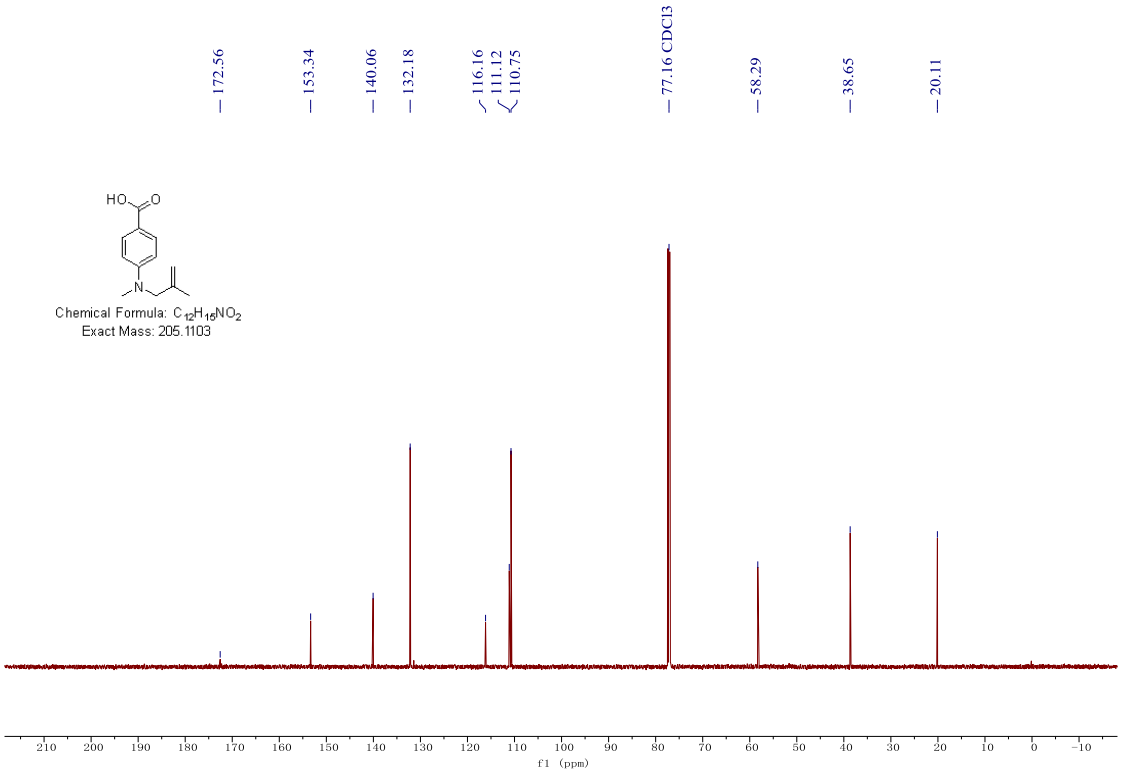
4-((2-(phenoxymethyl)allyl)oxy)benzoic acid



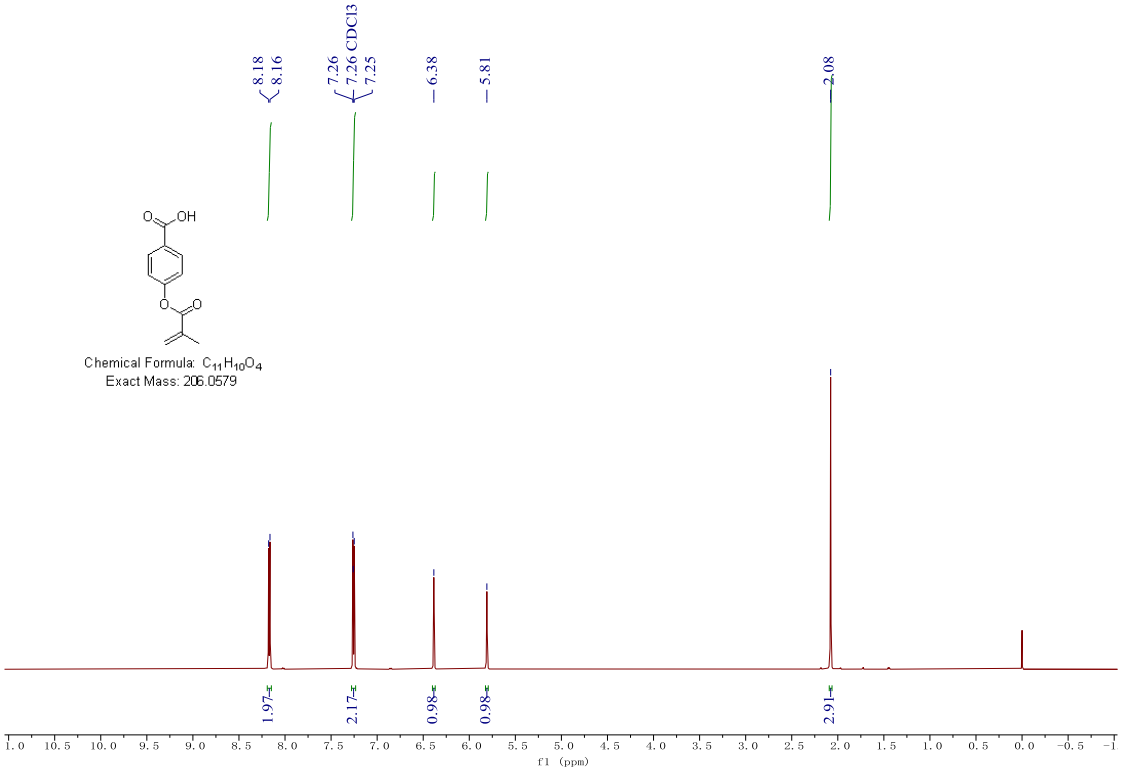


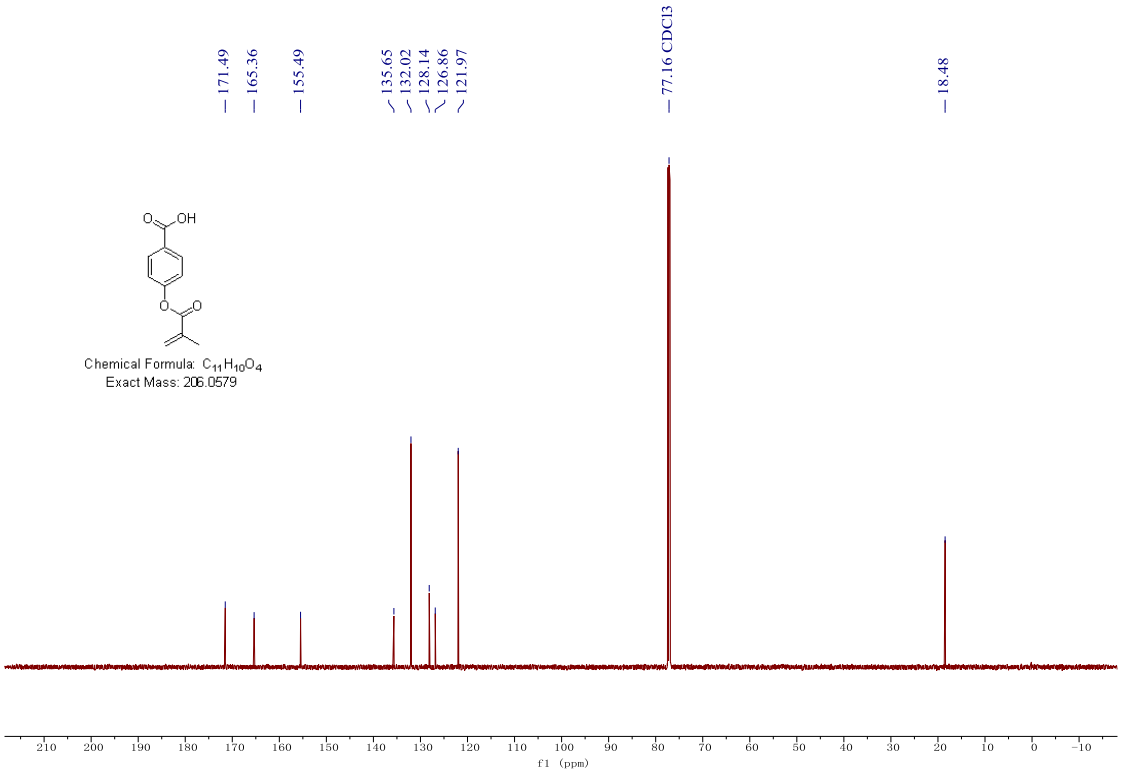
4-(methyl(2-methylallyl)amino)benzoic acid



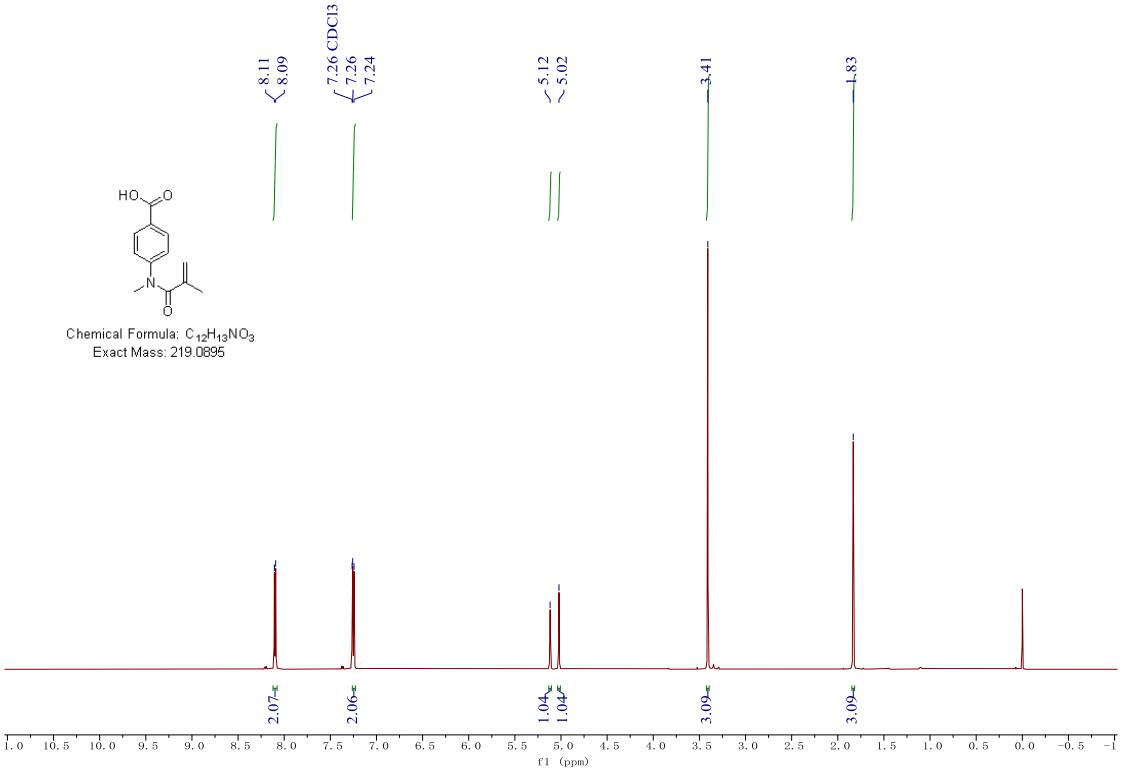


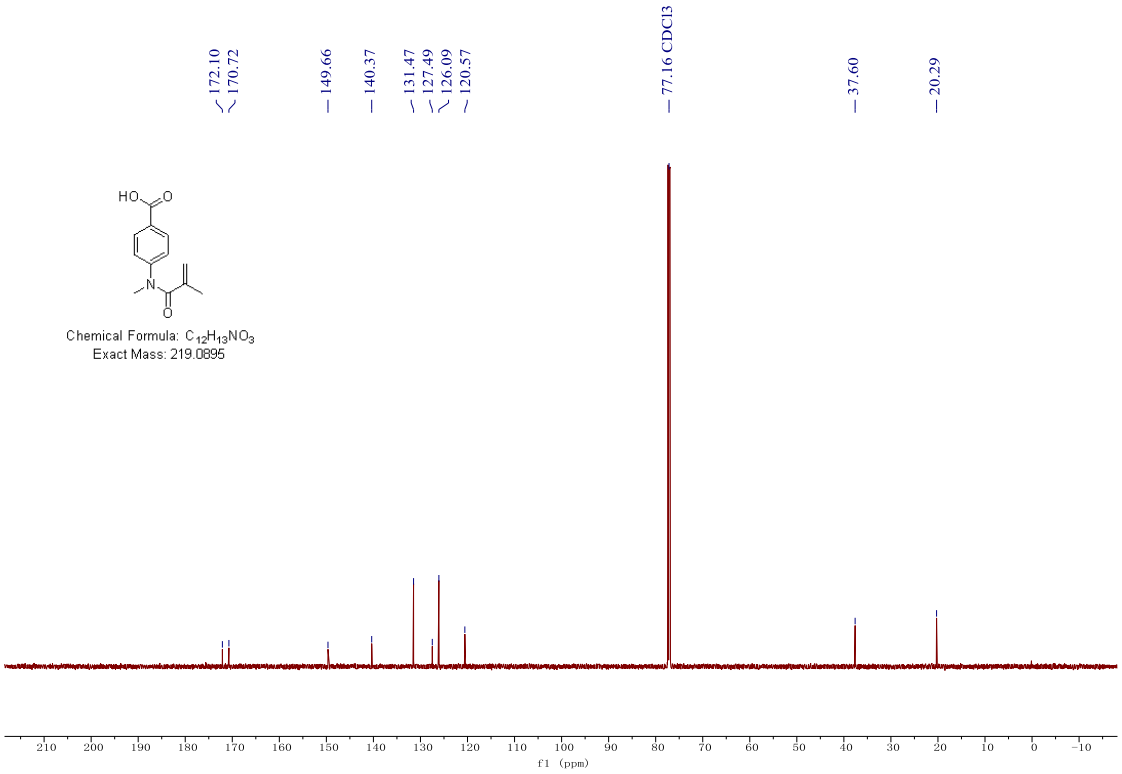
4-(methacryloyloxy)benzoic acid



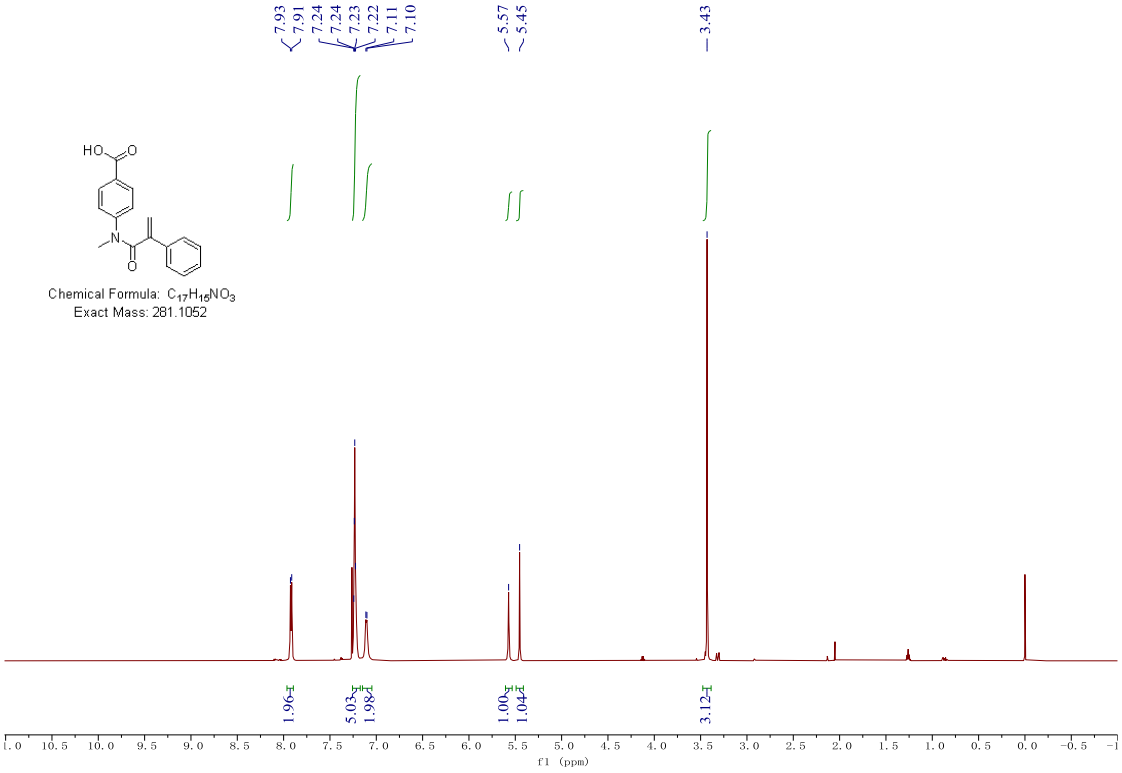


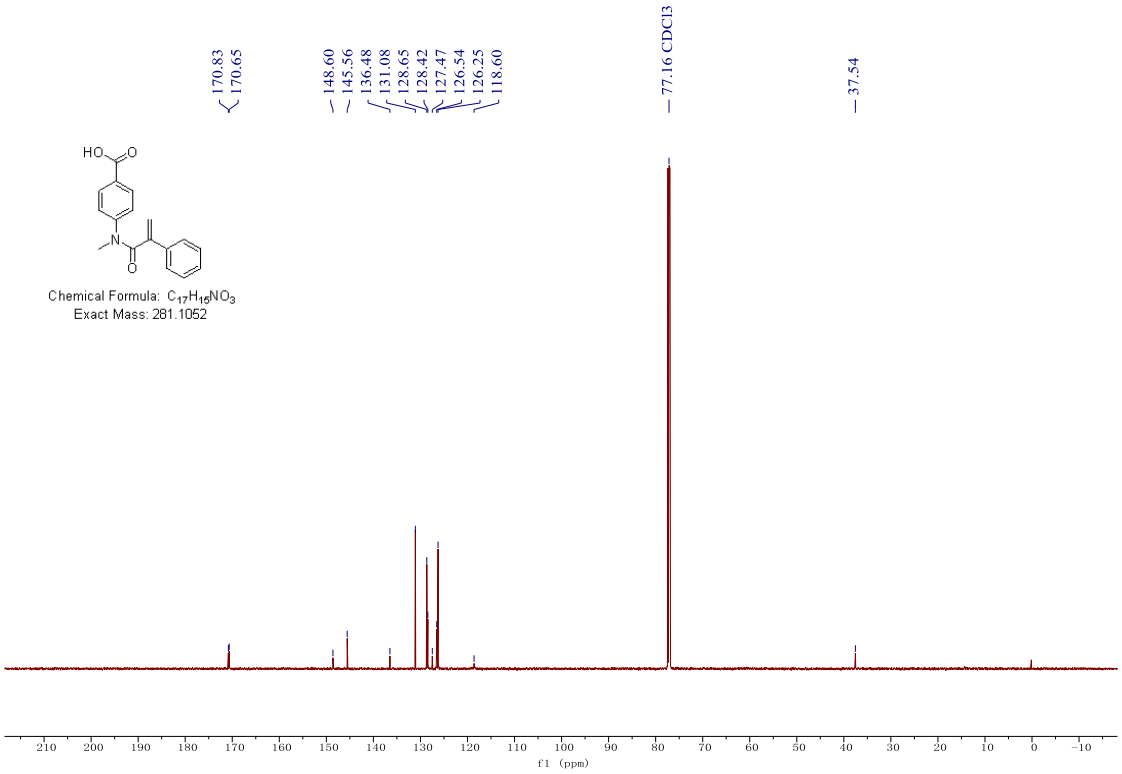
4-(N-methylmethacrylamido)benzoic acid



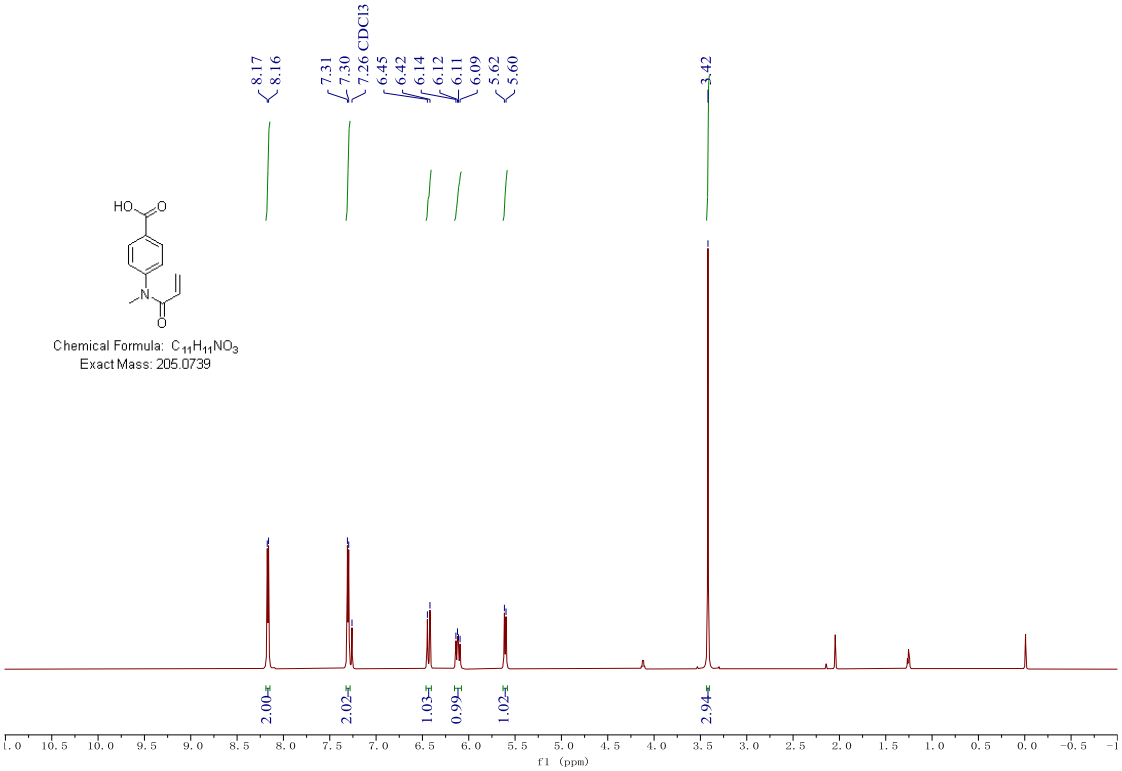


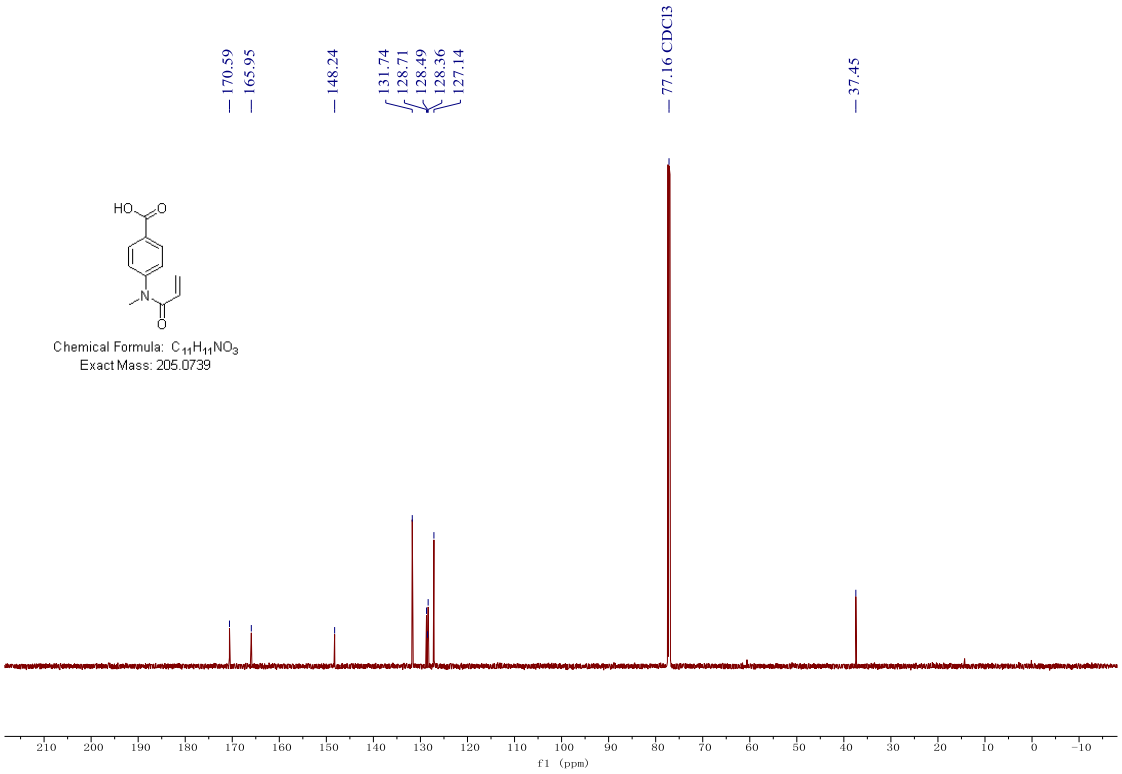
4-(N-methyl-2-phenylacrylamido)benzoic acid



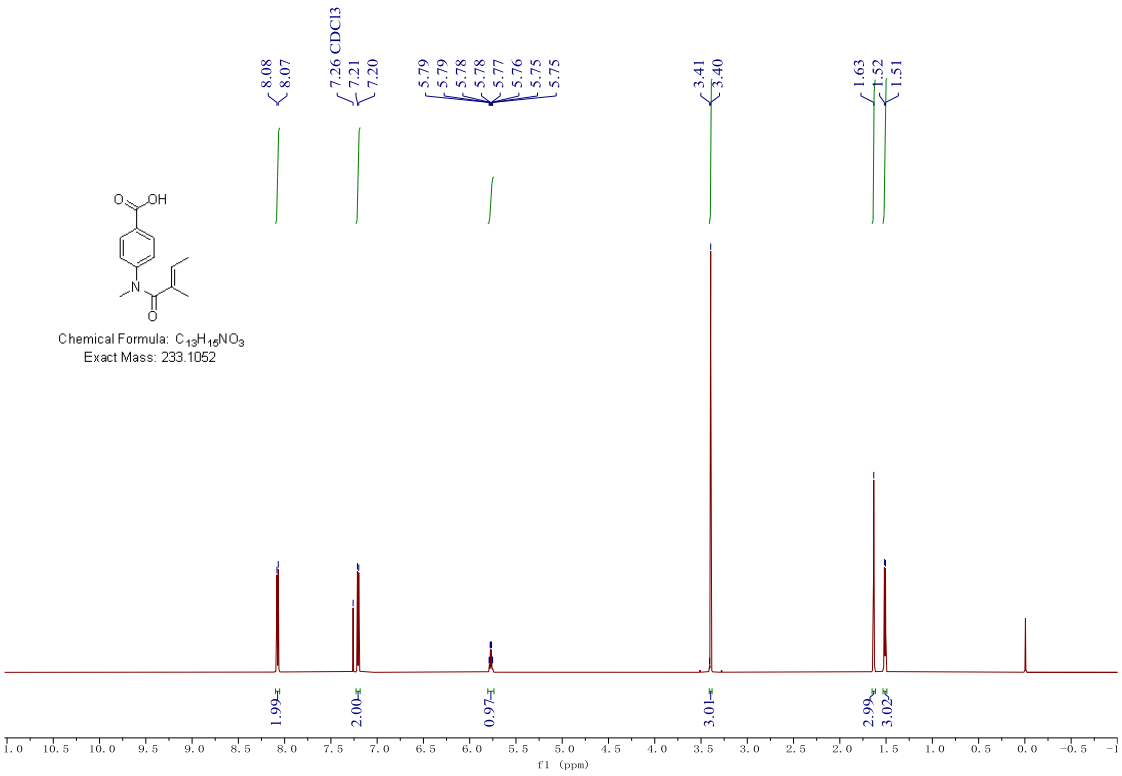


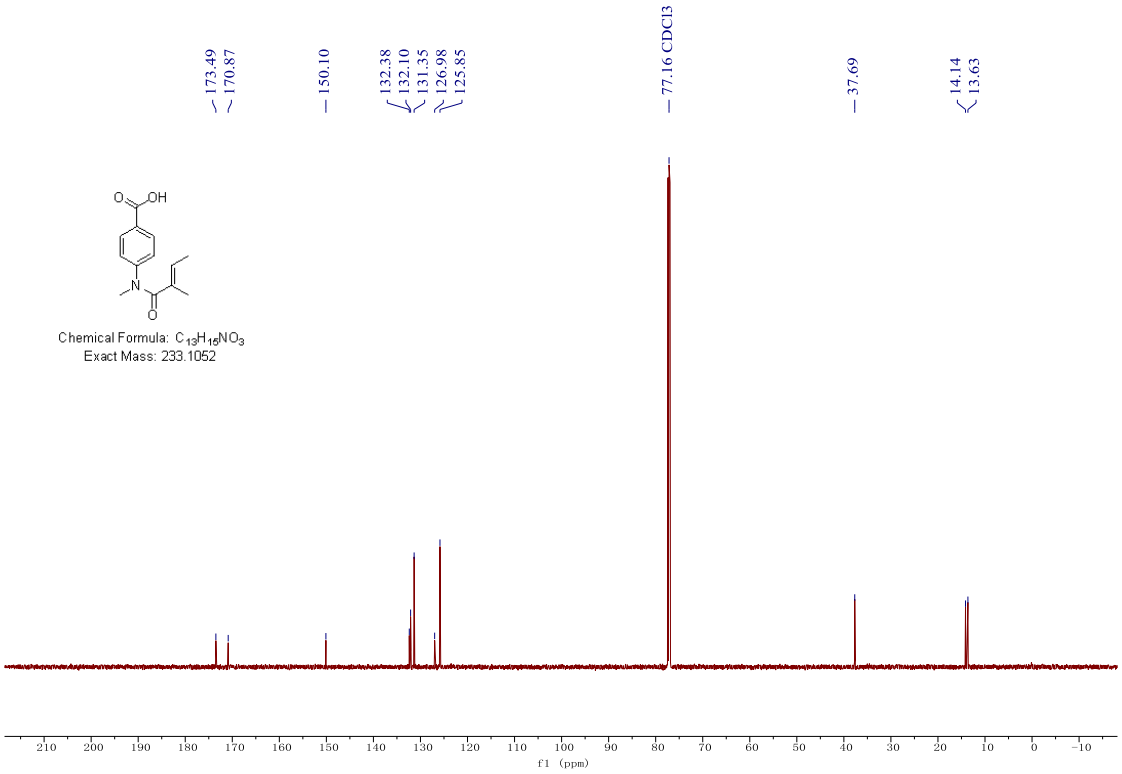
4-(N-methylacrylamido)benzoic acid



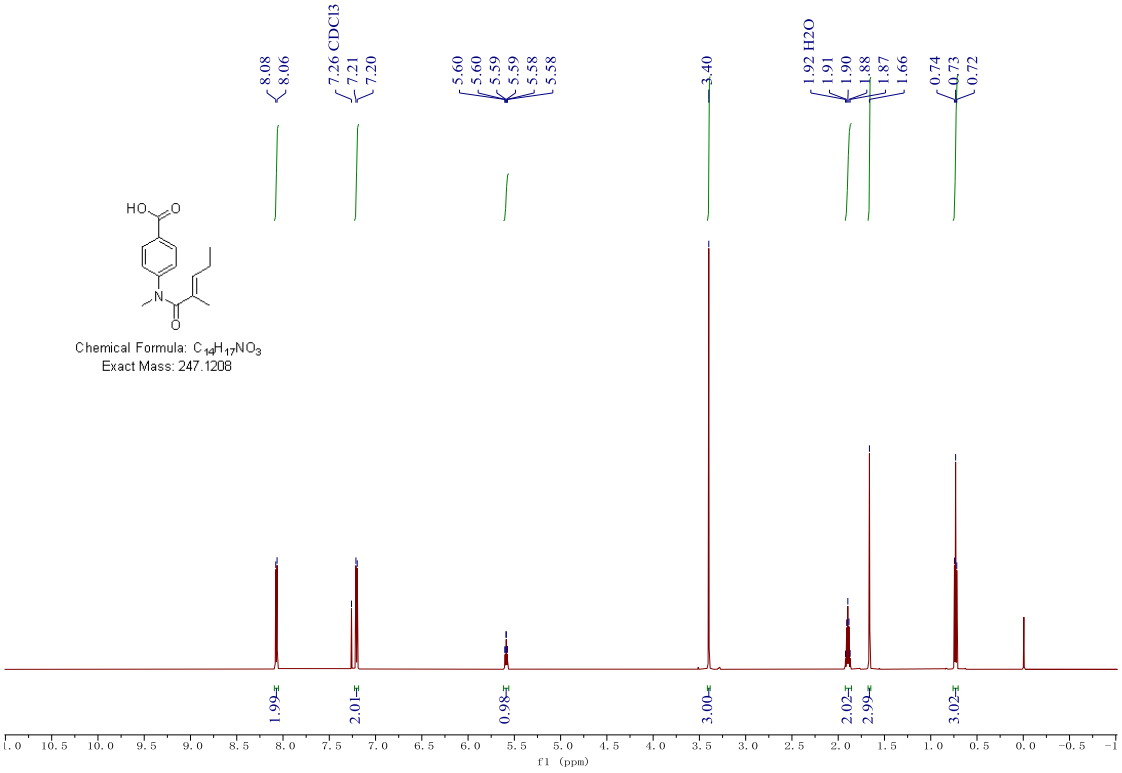


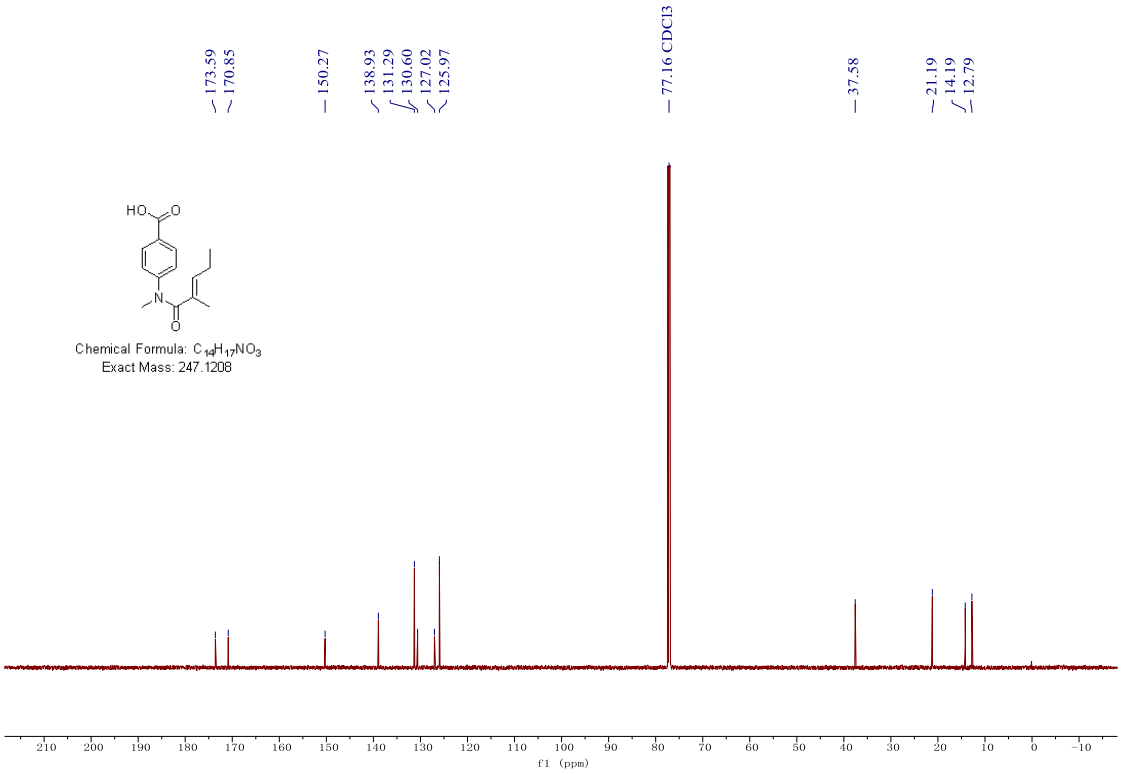
(E)-4-(N,2-dimethylbut-2-enamido)benzoic acid



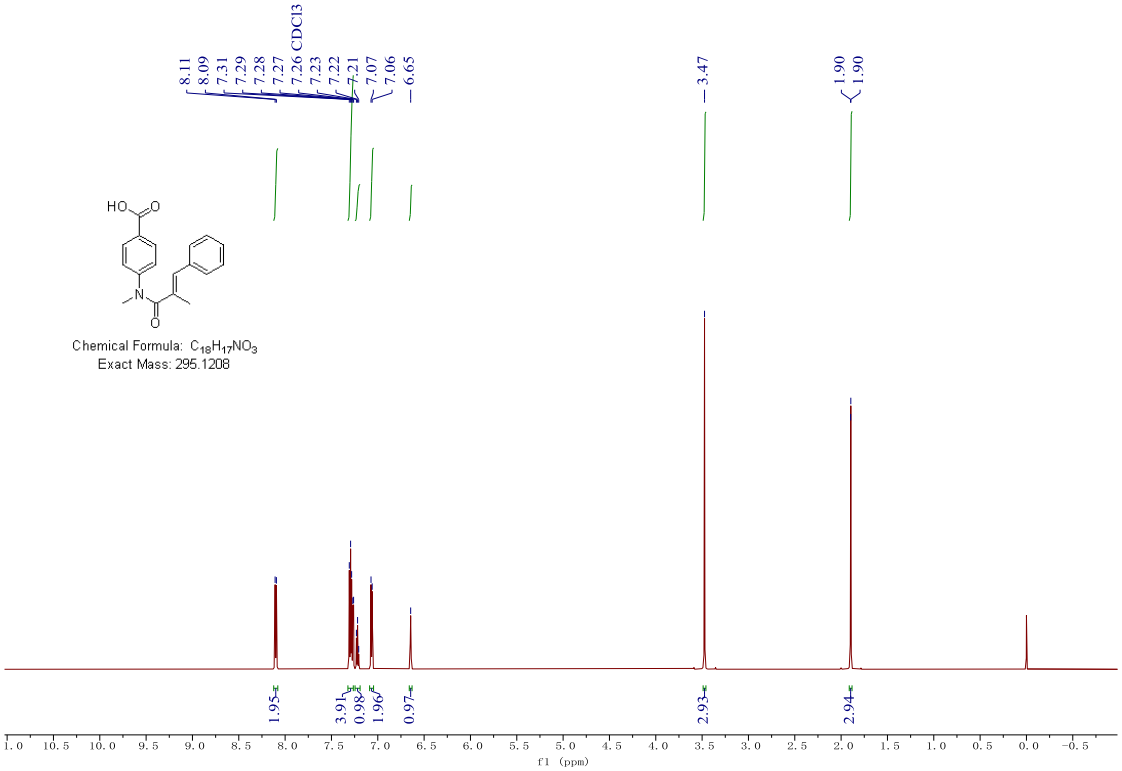


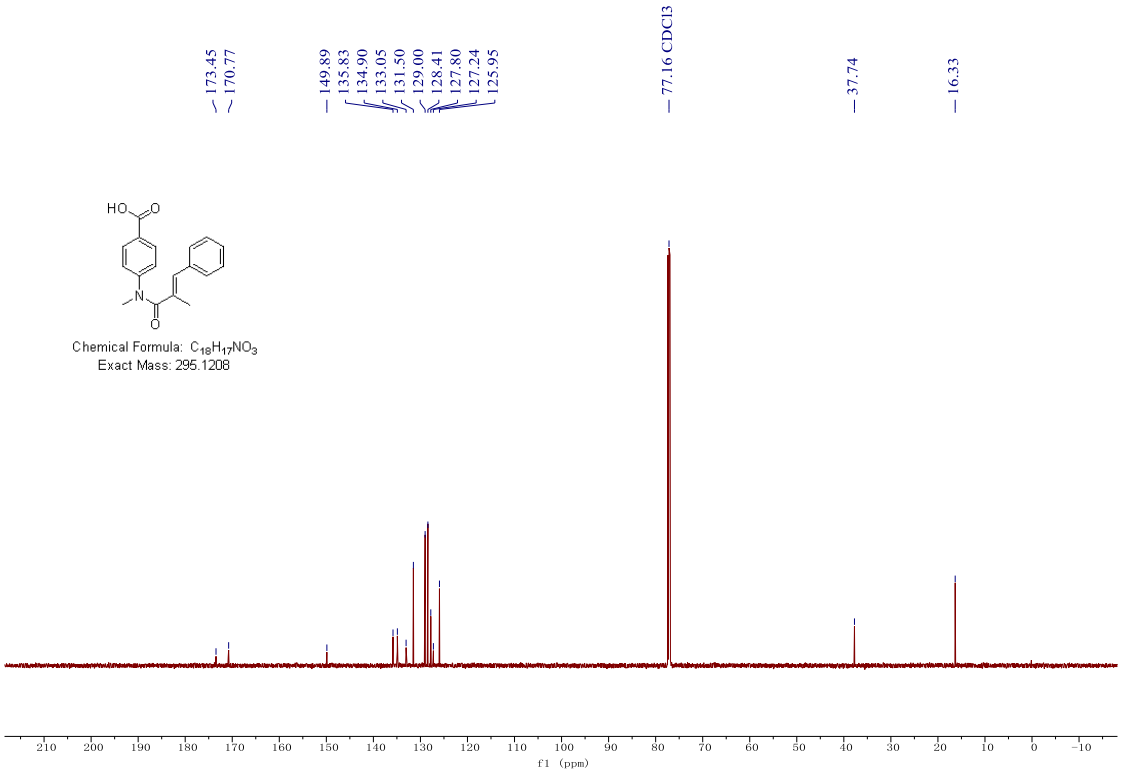
(E)-4-(N,2-dimethylpent-2-enamido)benzoic acid



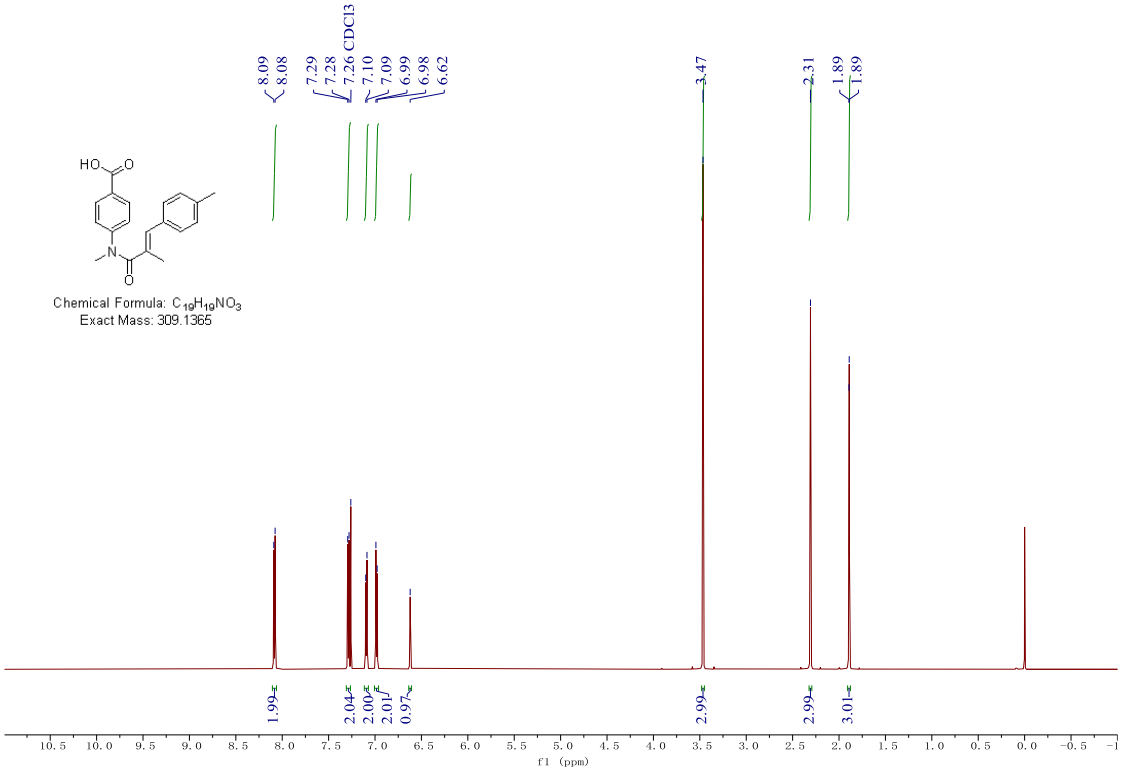


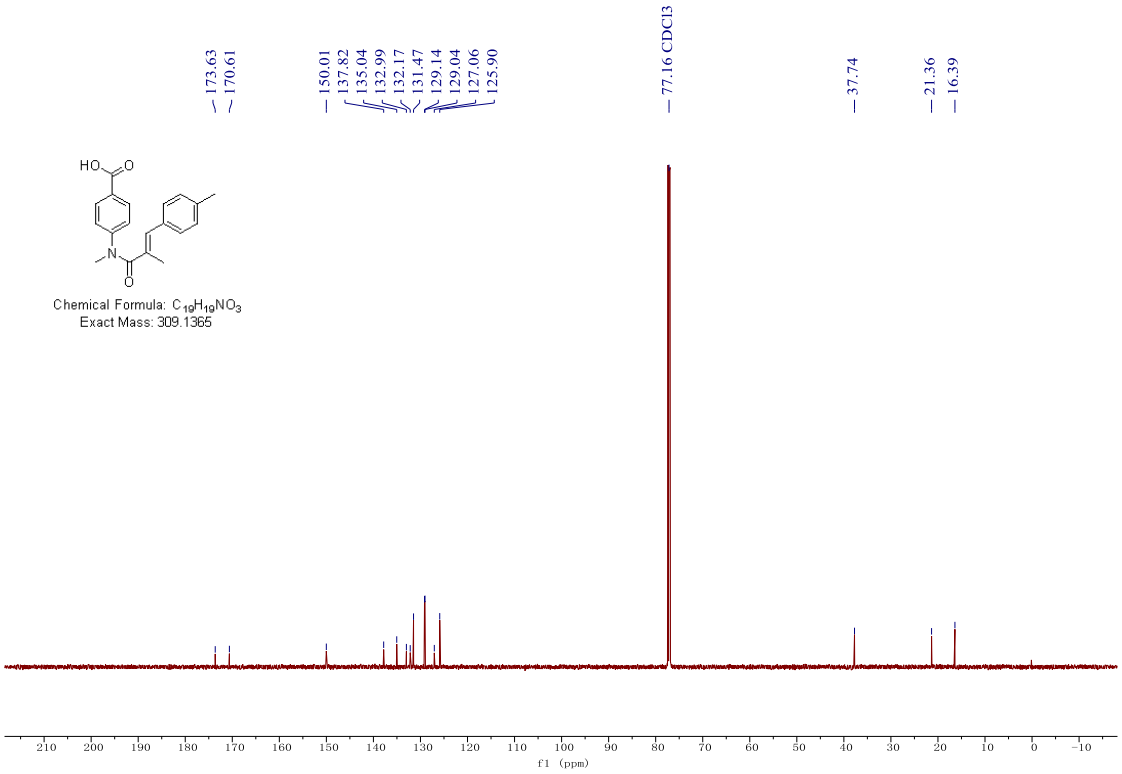
(E)-4-(N,2-dimethyl-3-phenylacrylamido)benzoic acid



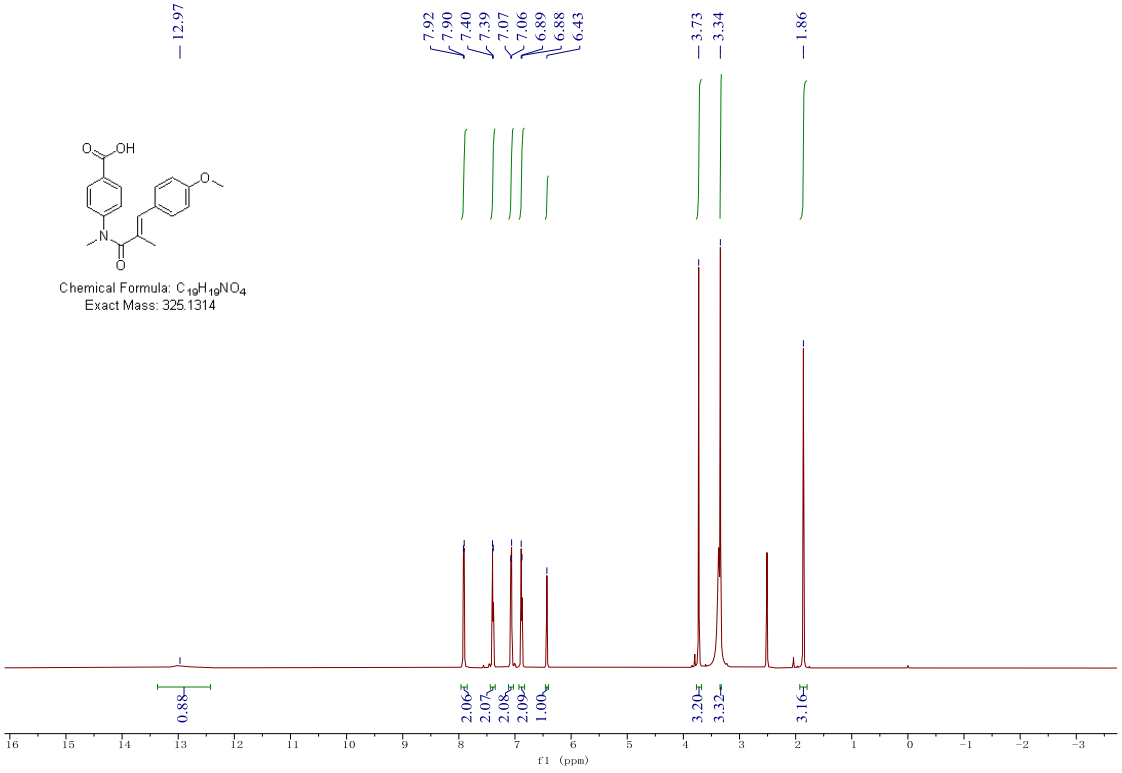


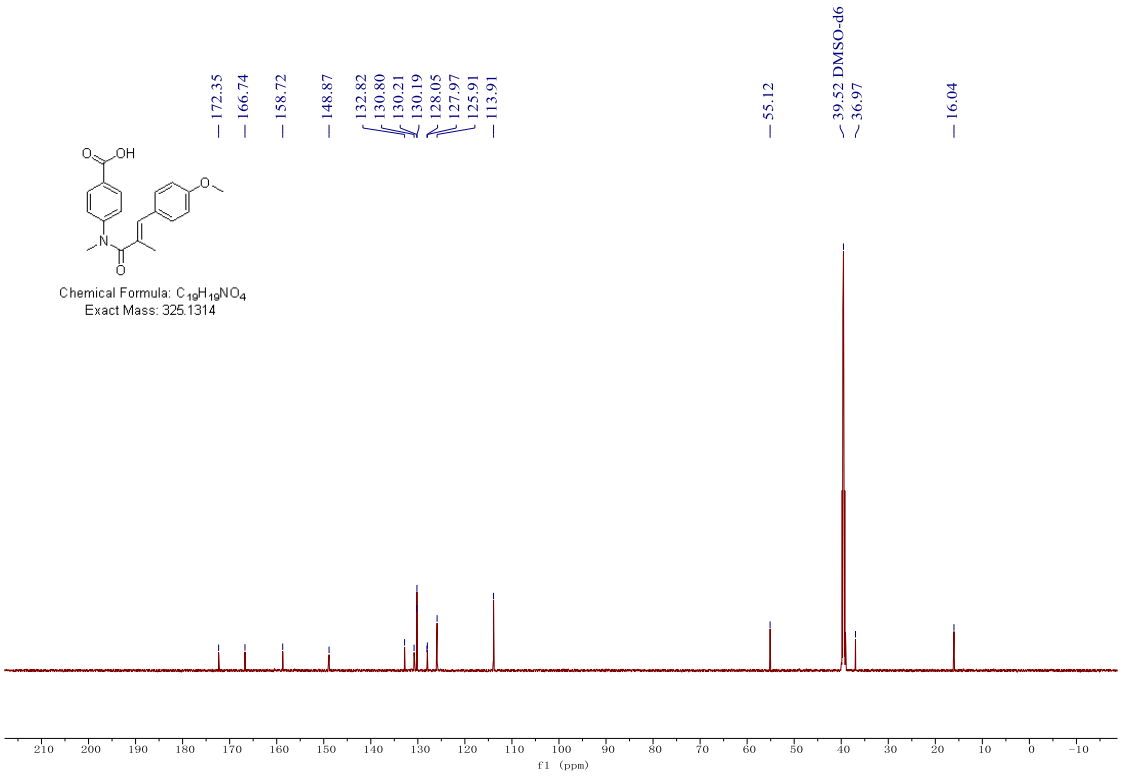
(E)-4-(N,2-dimethyl-3-(p-tolyl)acrylamido)benzoic acid



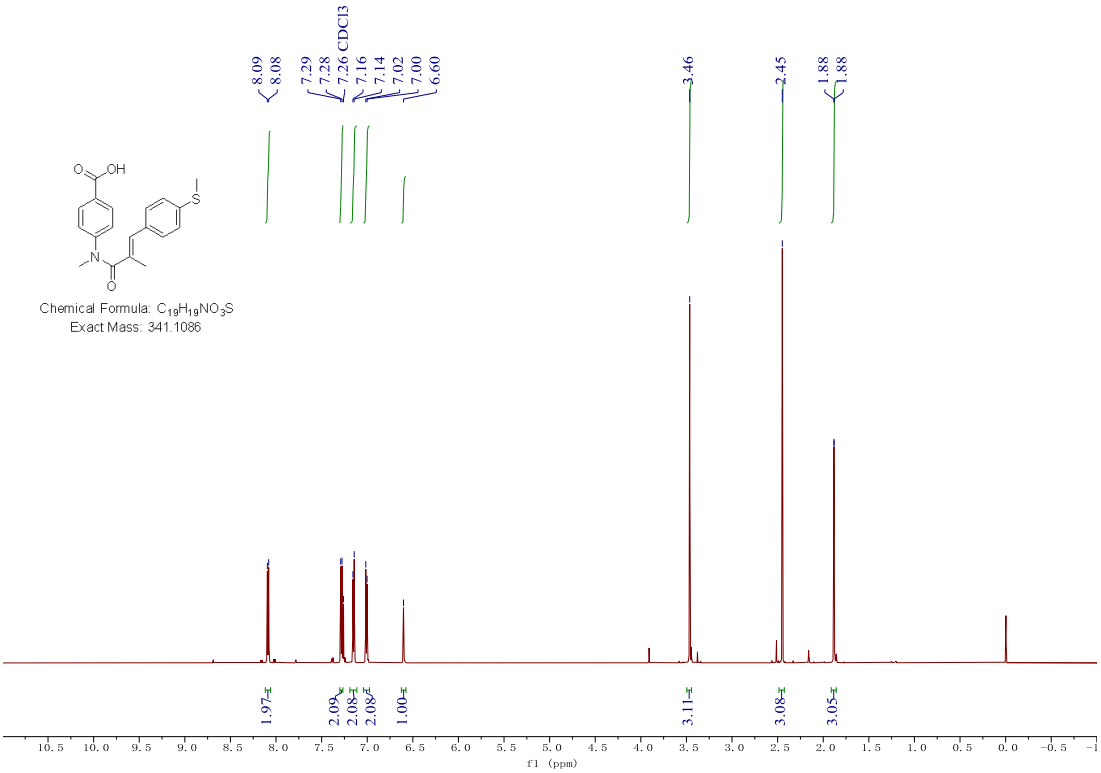


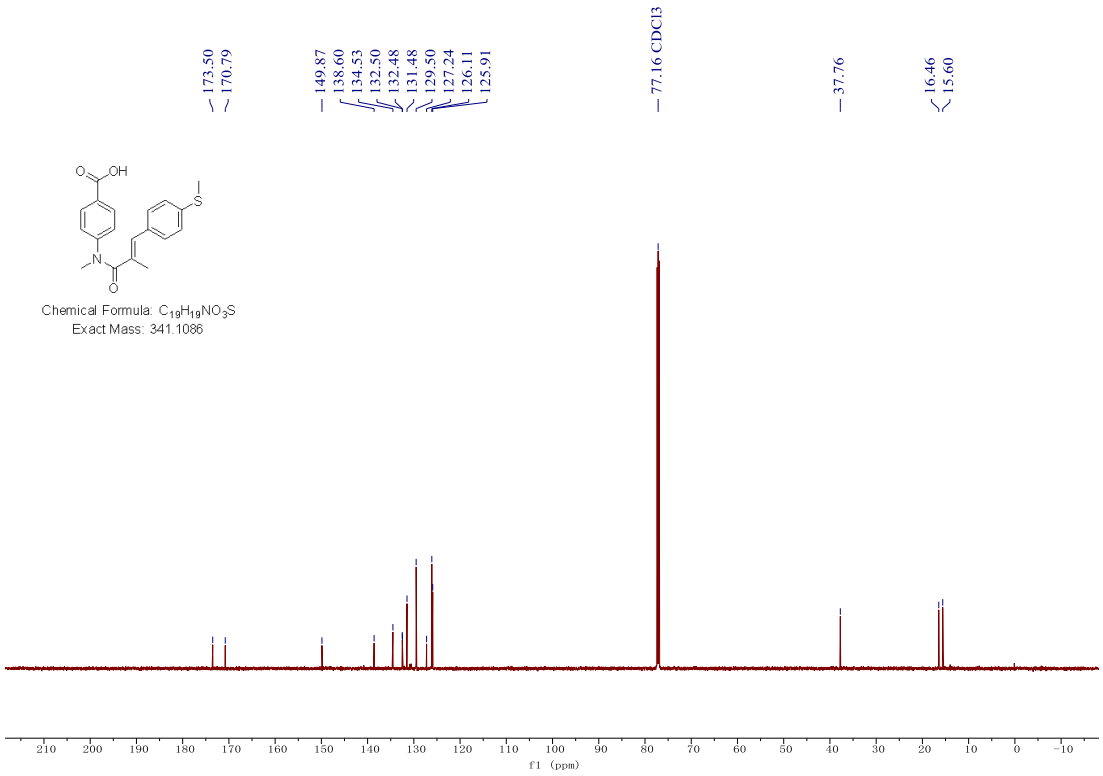
(E)-4-(3-(4-methoxyphenyl)-N,2-dimethylacrylamido)benzoic acid



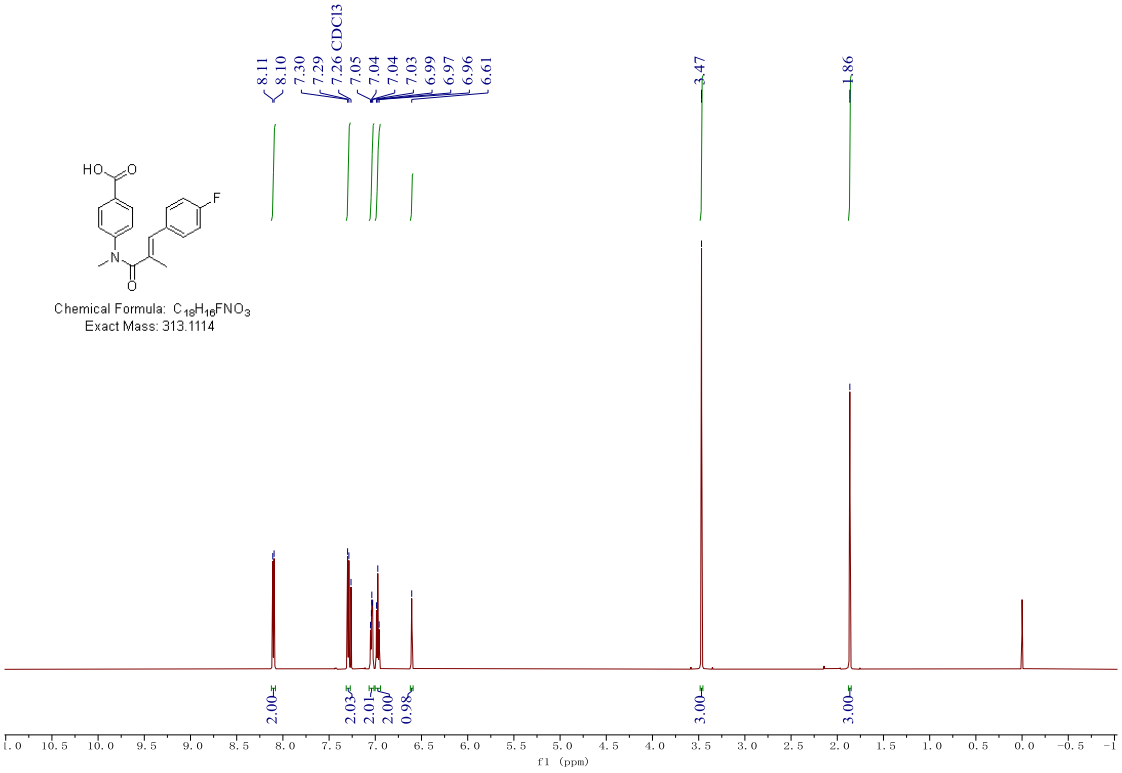


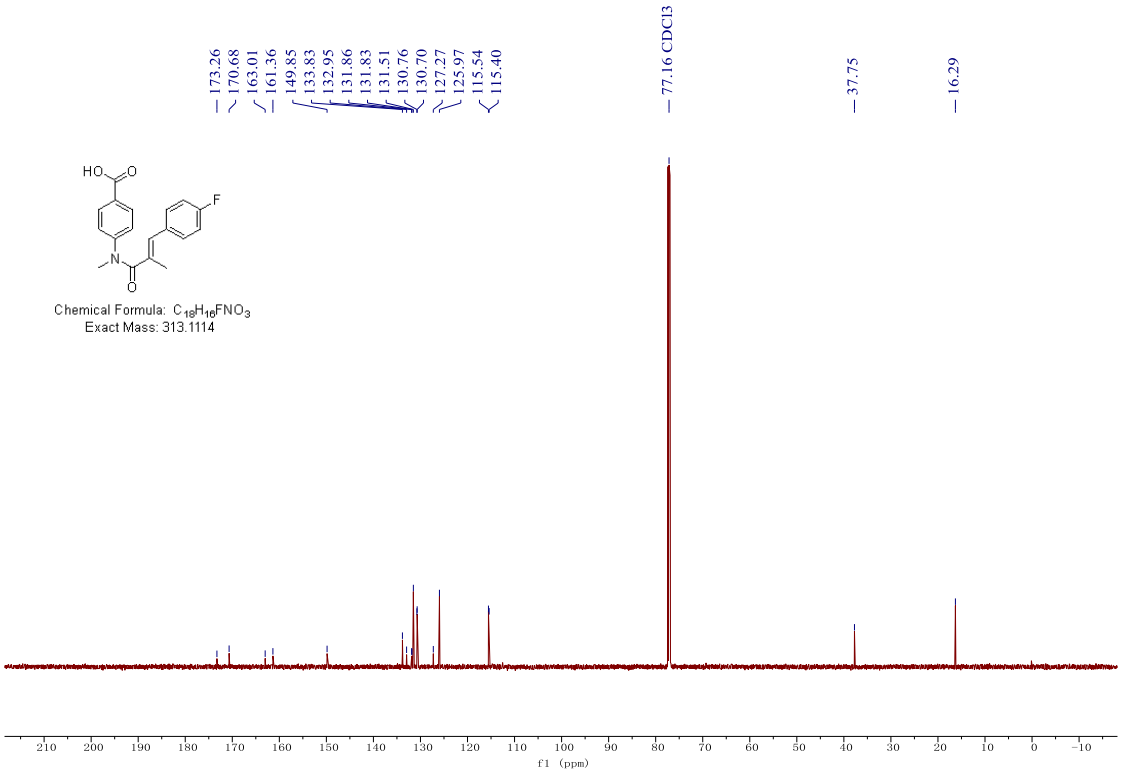
(E)-4-(N,2-dimethyl-3-(4-(methylthio)phenyl)acrylamido)benzoic acid

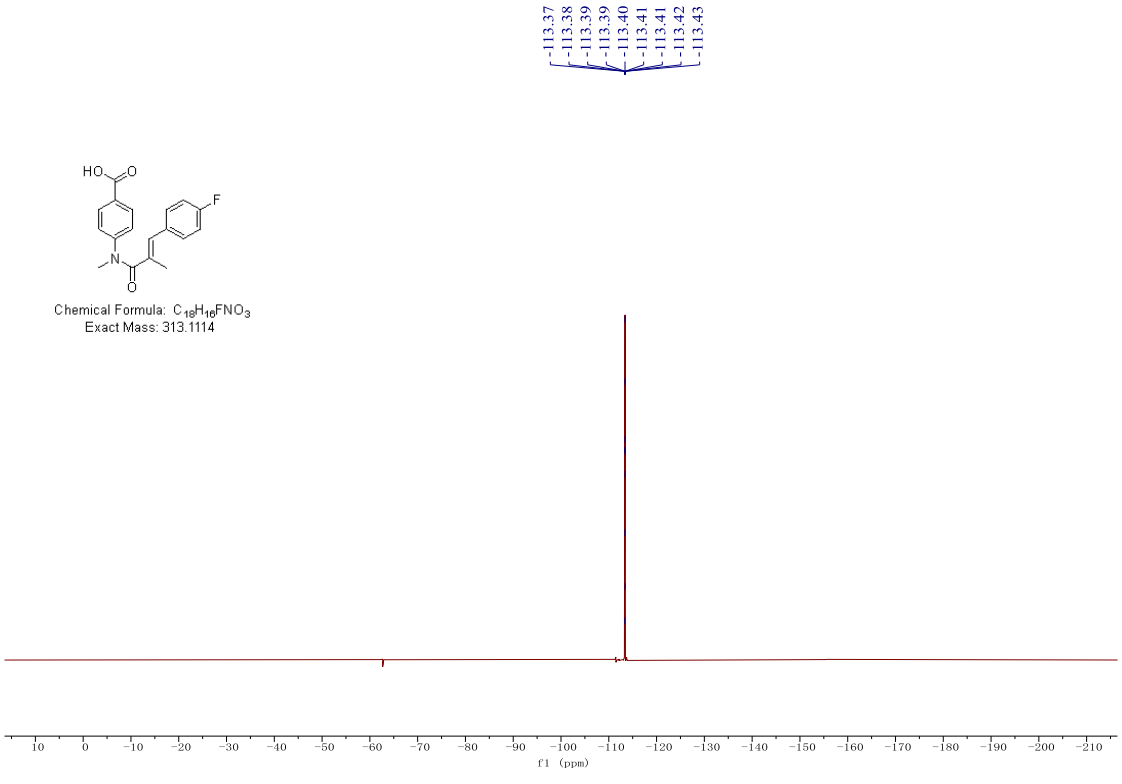




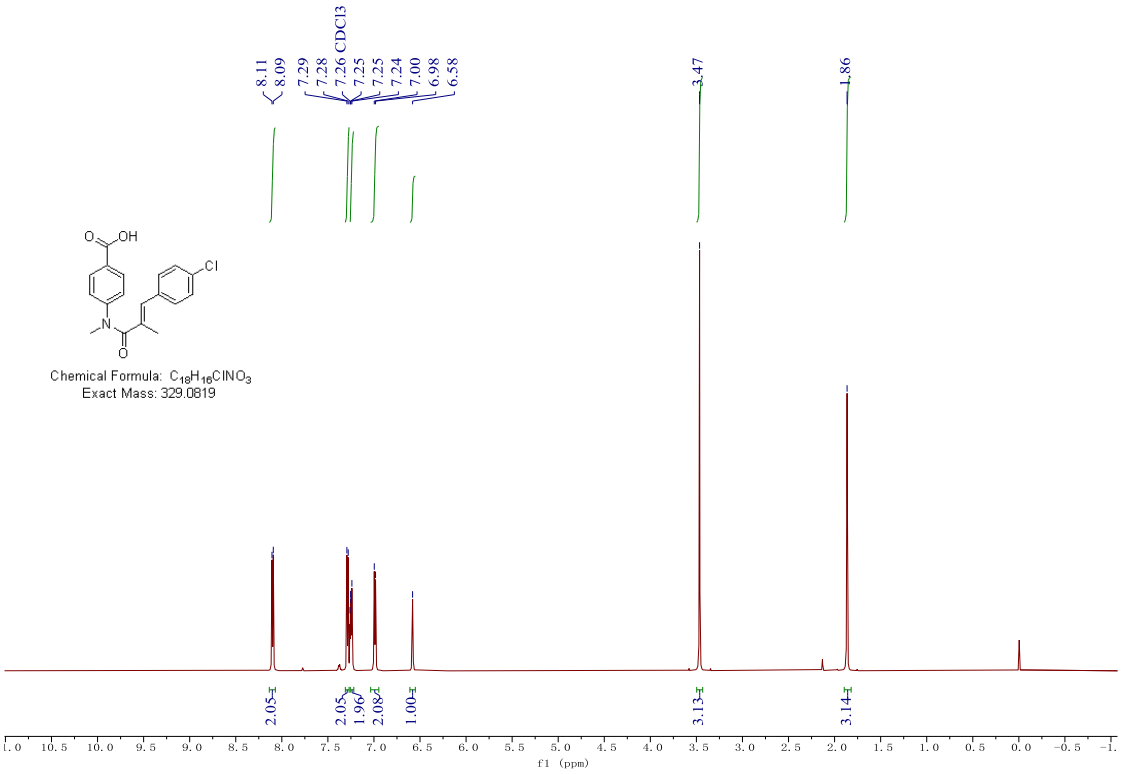
(E)-4-(3-(4-fluorophenyl)-N,2-dimethylacrylamido)benzoic acid

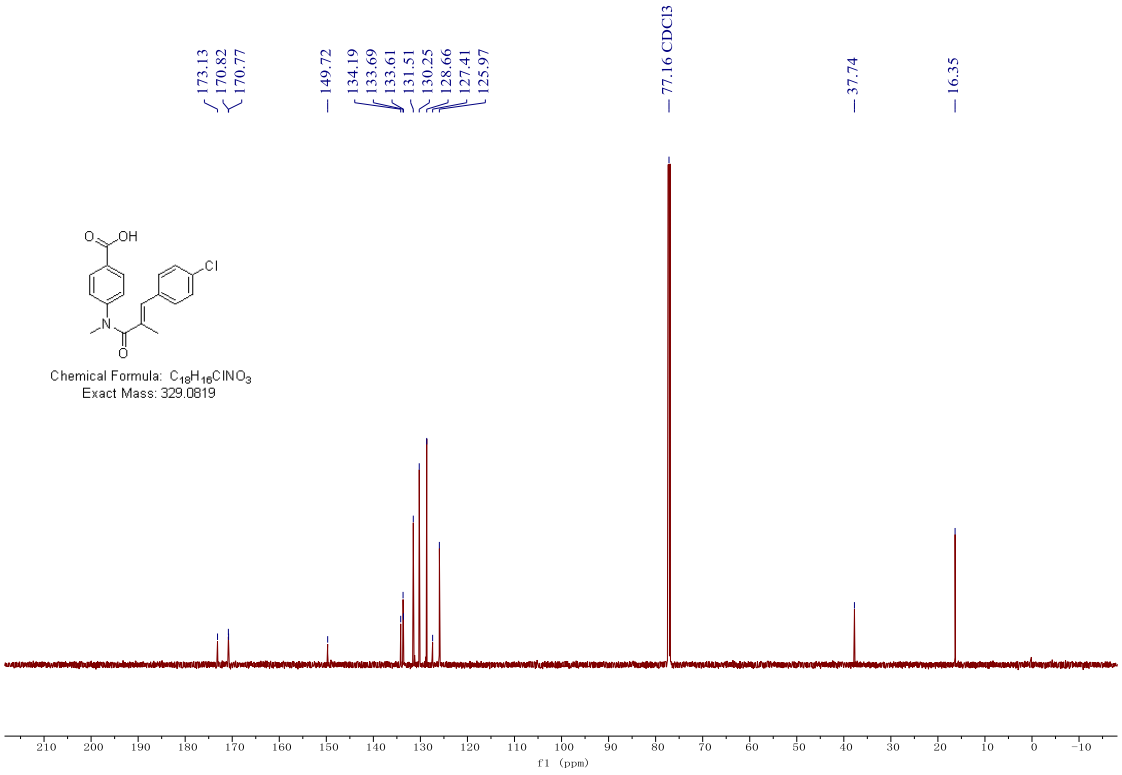




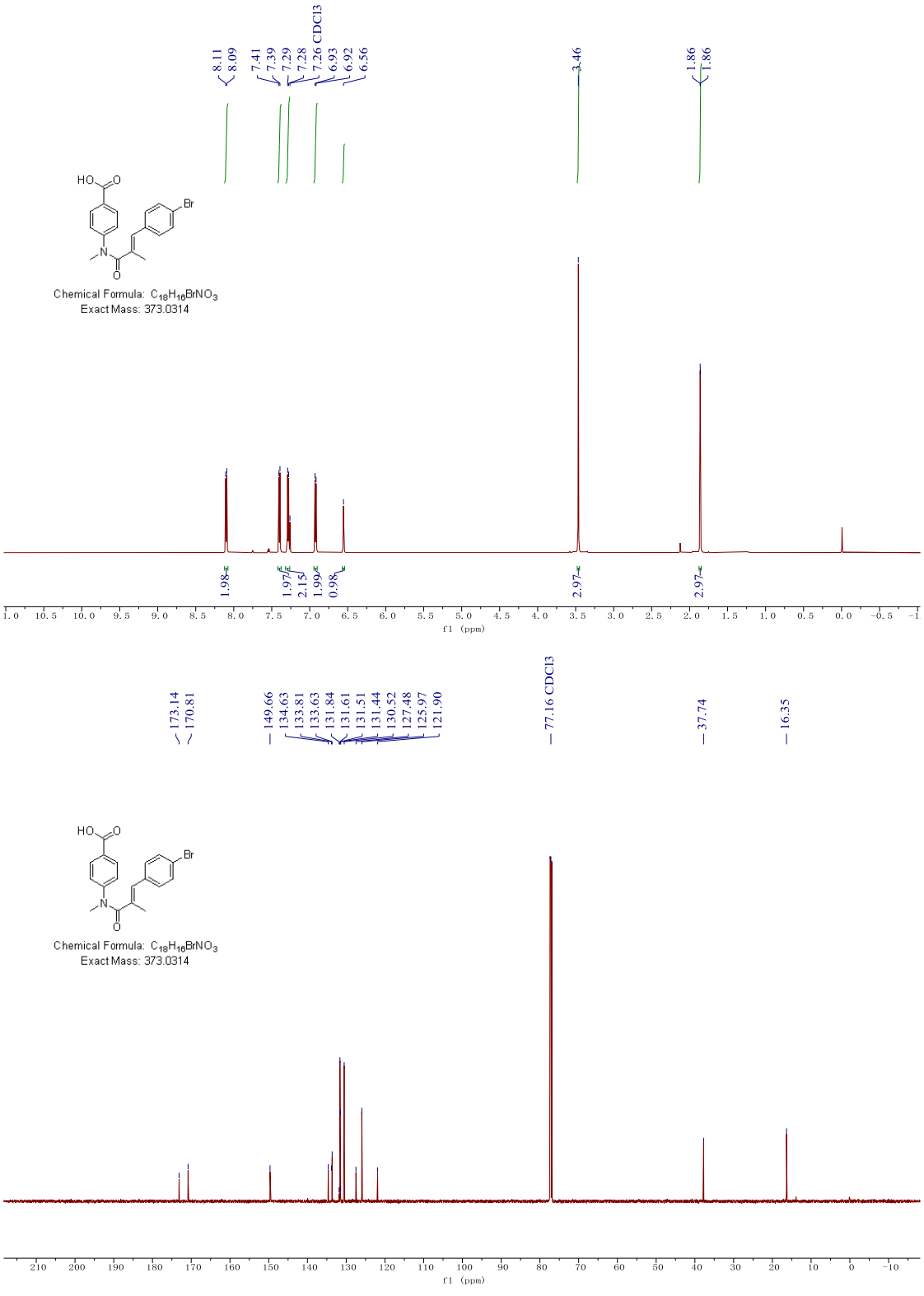


(E)-4-(3-(4-chlorophenyl)-N,2-dimethylacrylamido)benzoic acid

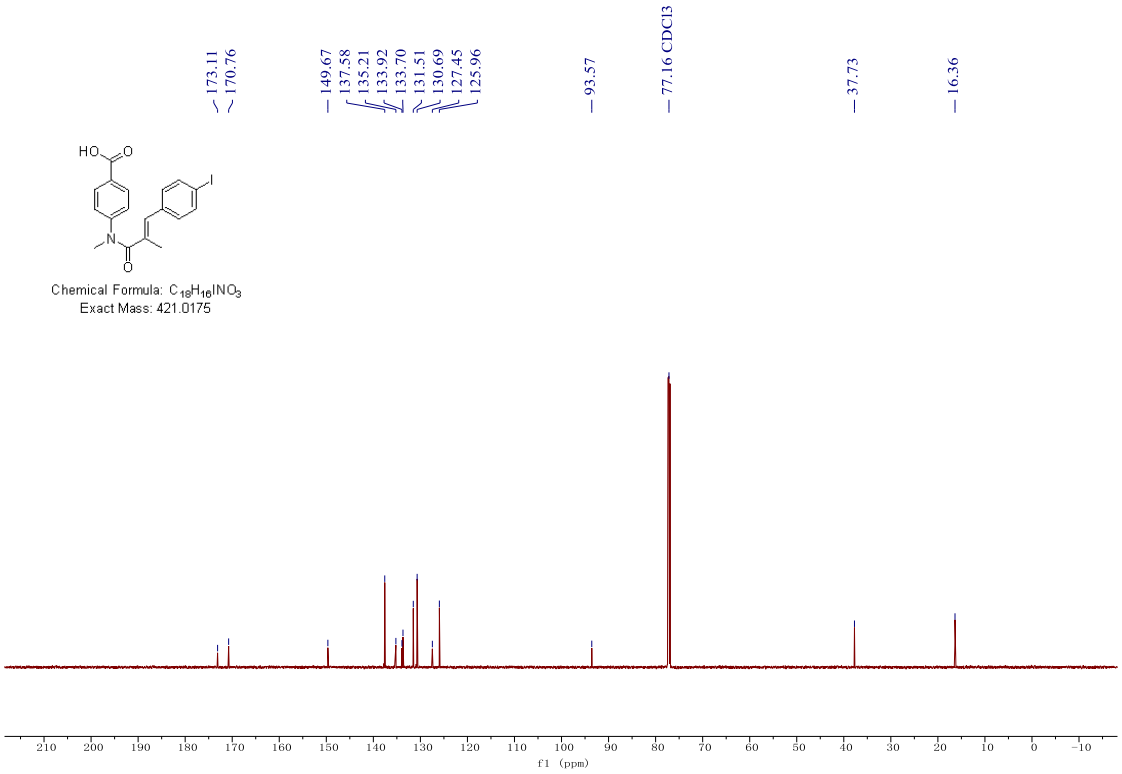


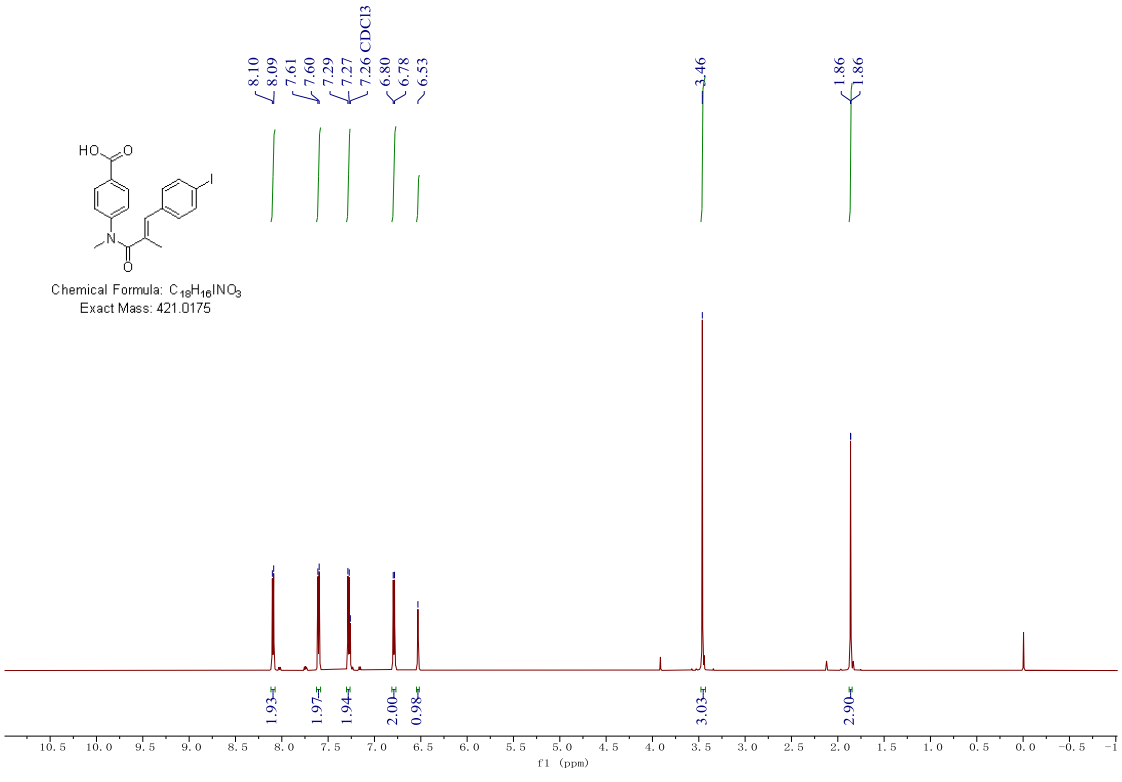


(E)-4-(3-(4-bromophenyl)-N,2-dimethylacrylamido)benzoic acid

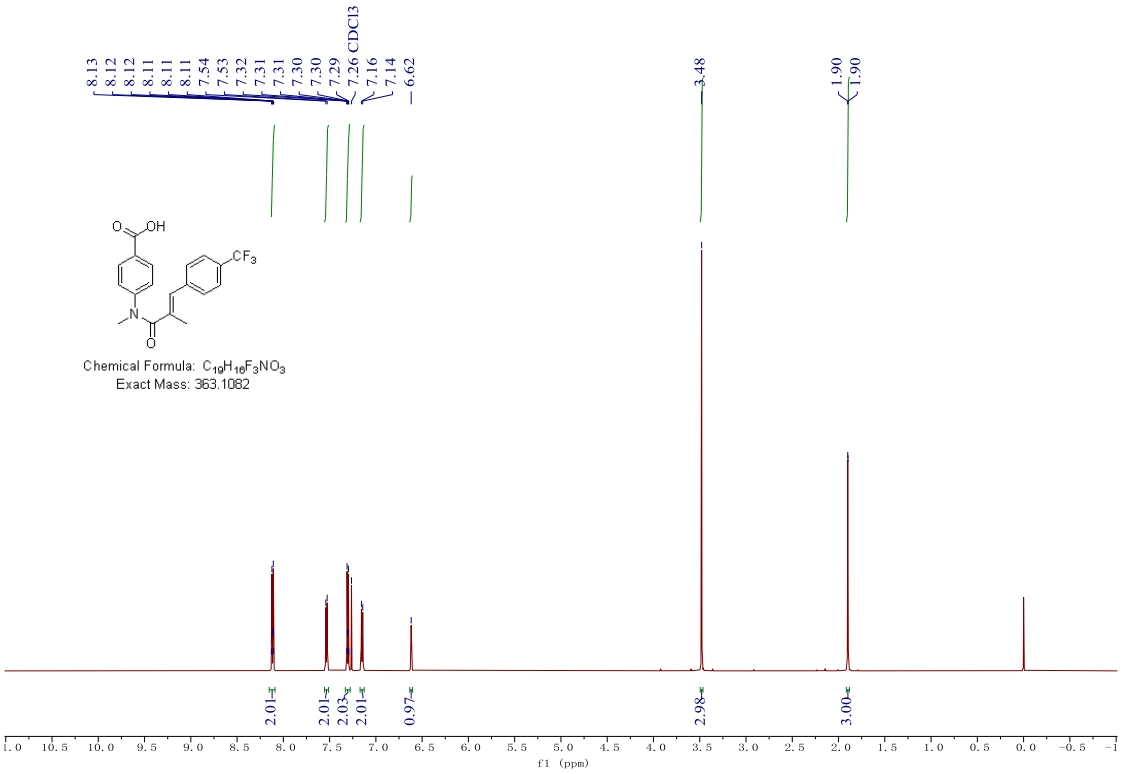


(E)-4-(3-(4-iodophenyl)-N,2-dimethylacrylamido)benzoic acid





(E)-4-(N,2-dimethyl-3-(4-(trifluoromethyl)phenyl)acrylamido)benzoic acid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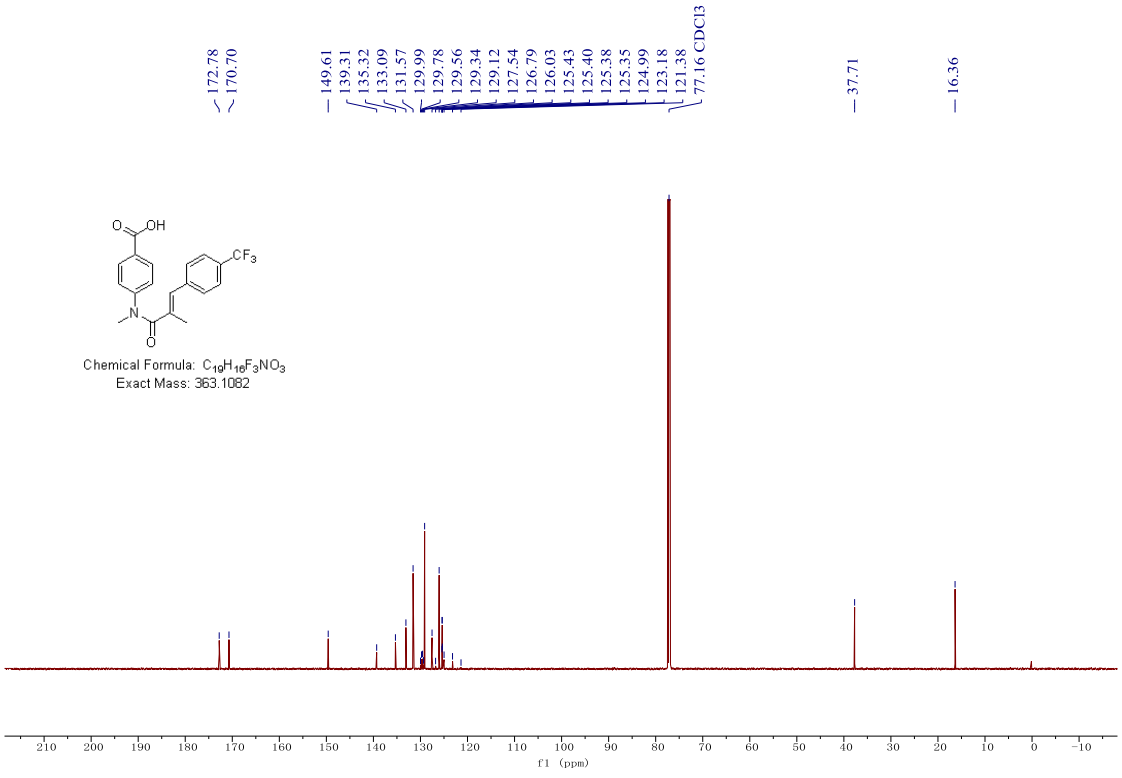
8.12
8.12
8.11
8.11
8.11
7.54
7.53
7.32
7.31
7.31
7.30
7.30
7.29
7.26 CDCl3
7.16
7.14
6.62
3.48
1.90
1.90
O
OH
CF3
N
O
Chemical Formula: C19H16F3NO3
Exact Mass: 363.1082
2.01
2.01
2.03
2.01
0.97
2.98
3.00
f1 (ppm)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126.79
126.03
125.43
125.40
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125.35
124.99
123.18
121.38
77.16 CDCl3
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N
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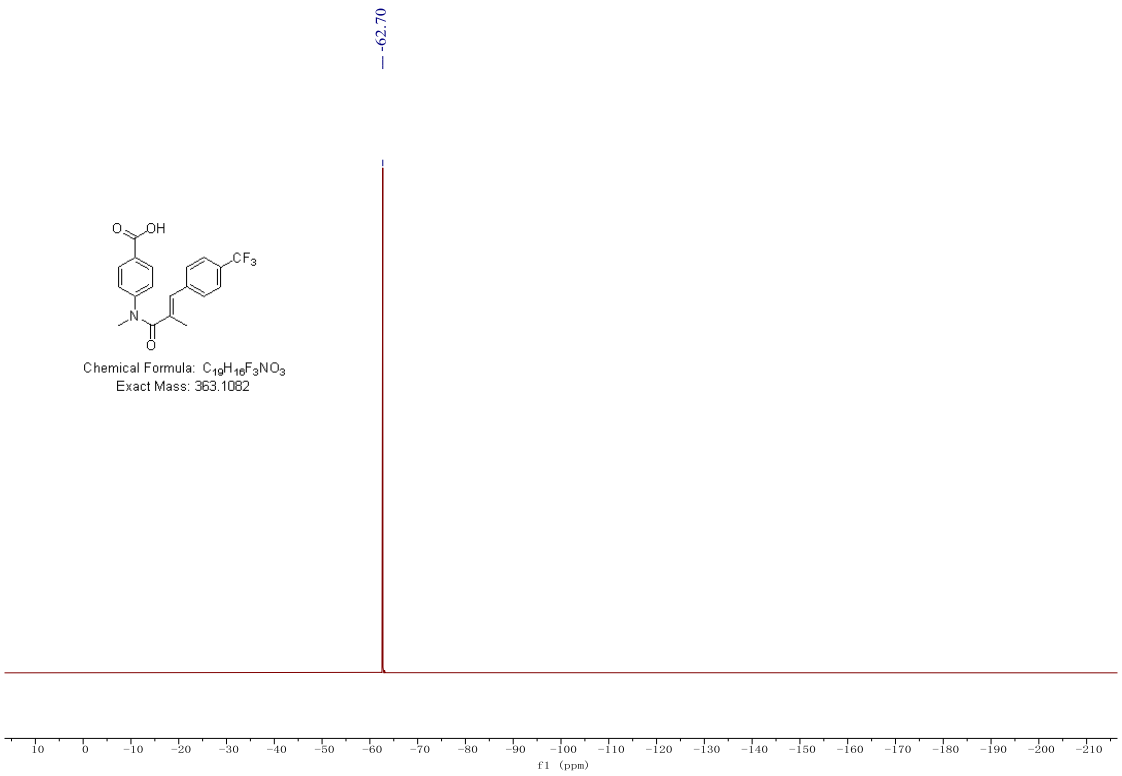
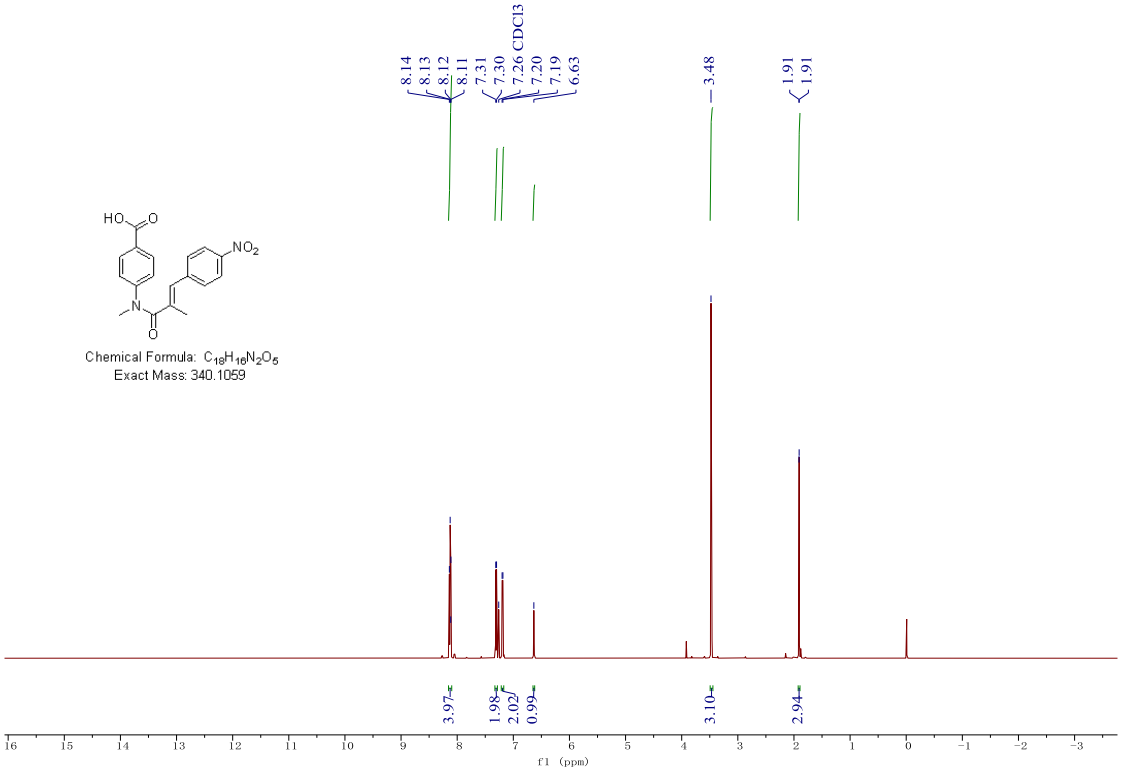
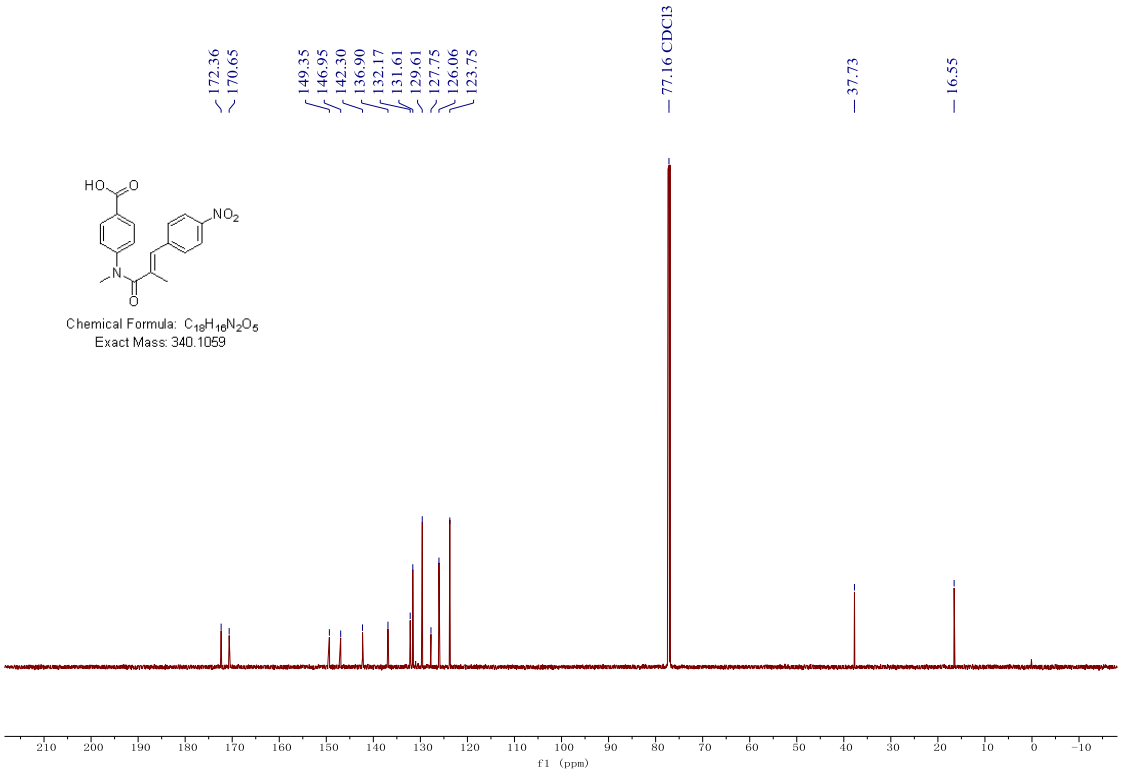
Chemical Formula: C19H16F3NO3
Exact Mass: 363.1082
f1 (ppm)

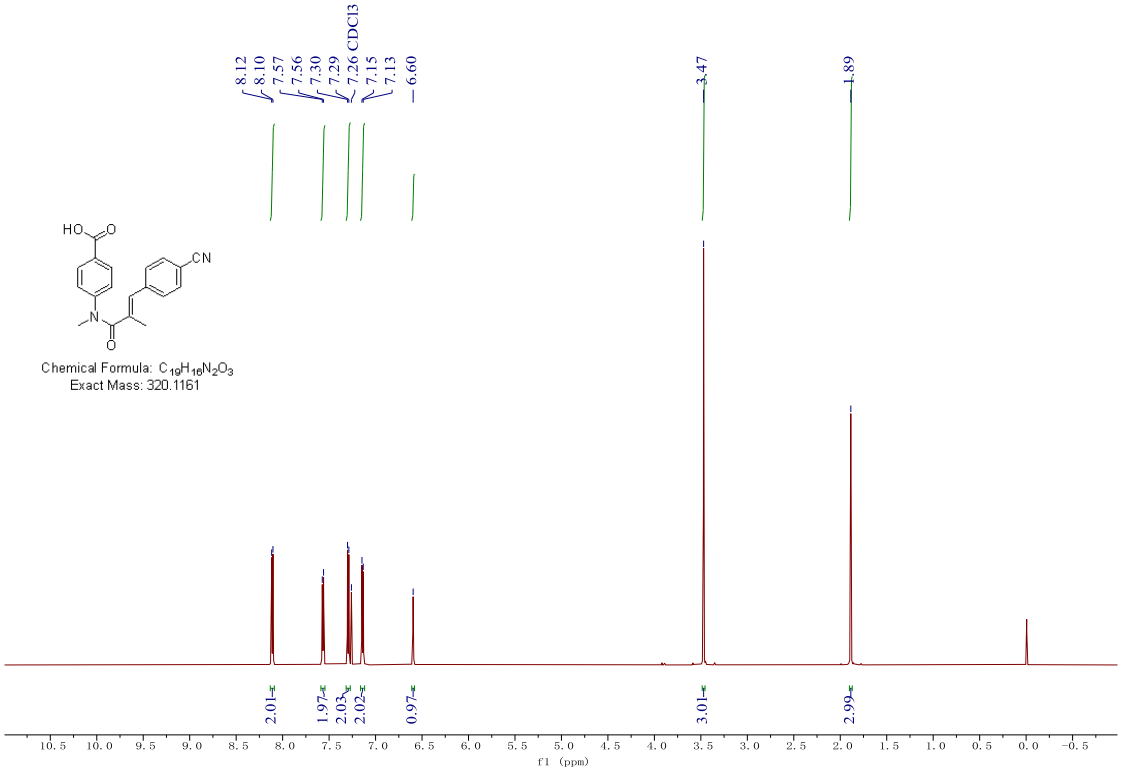


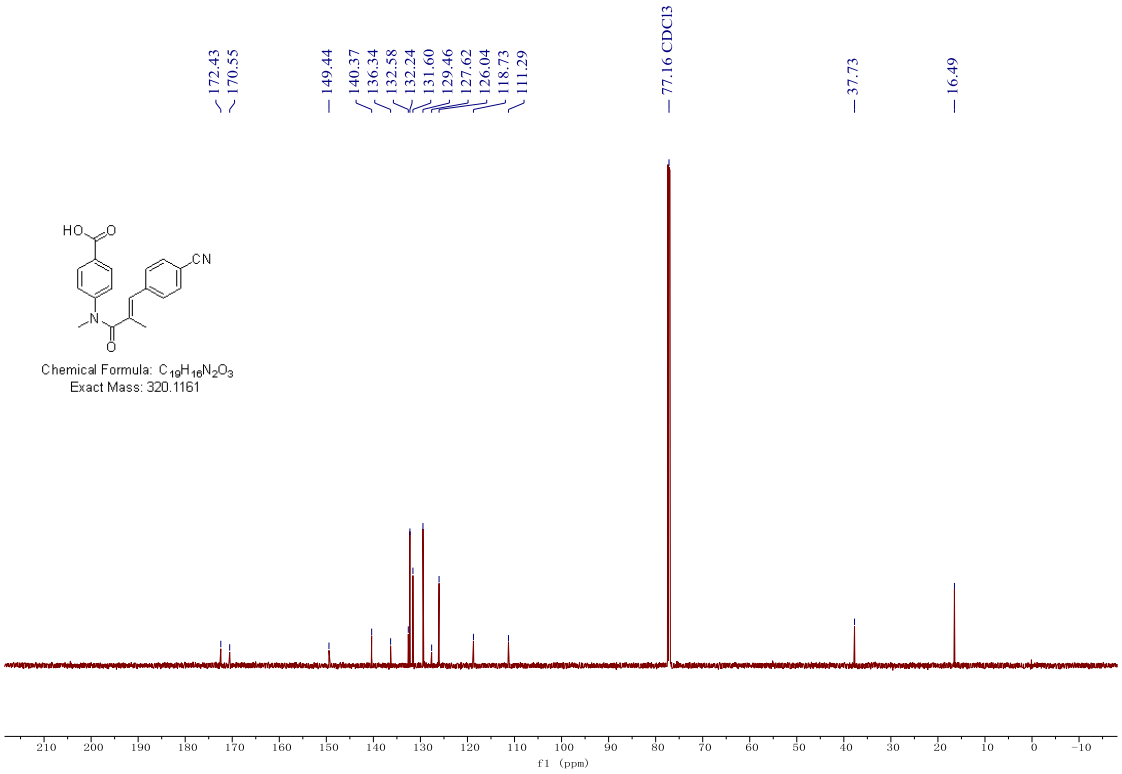
(E)-4-(N,2-dimethyl-3-(4-nitrophenyl)acrylamido)benzoic acid



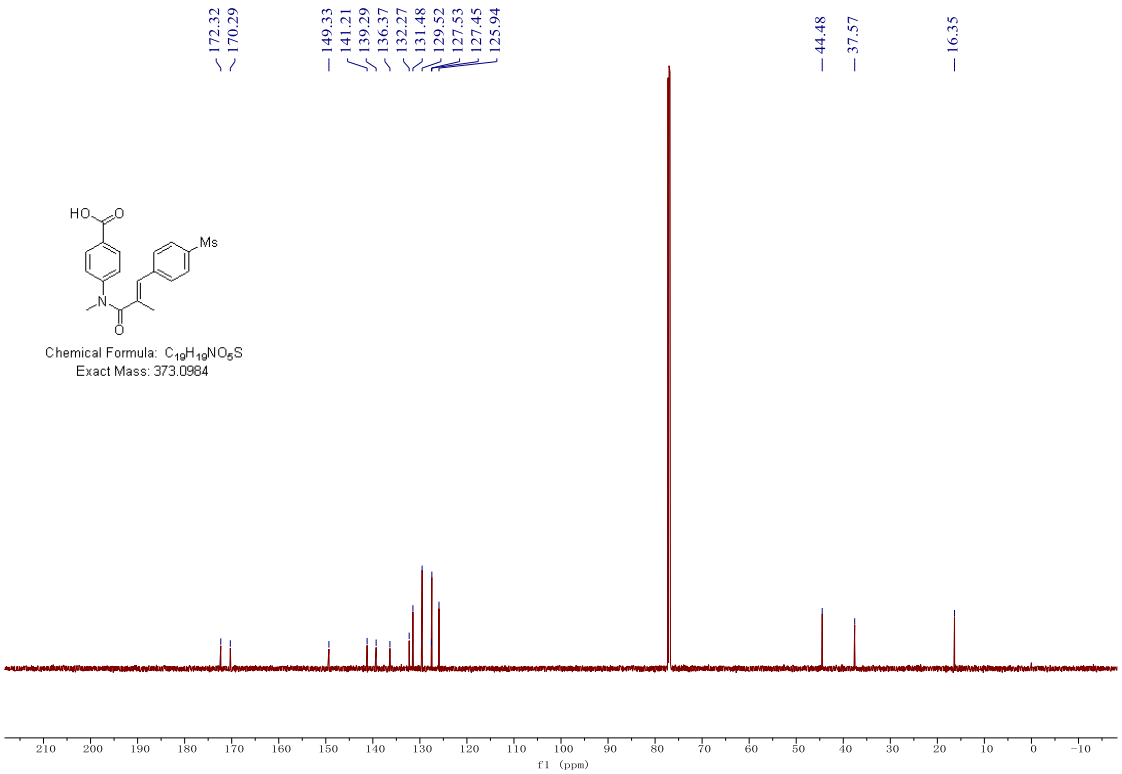


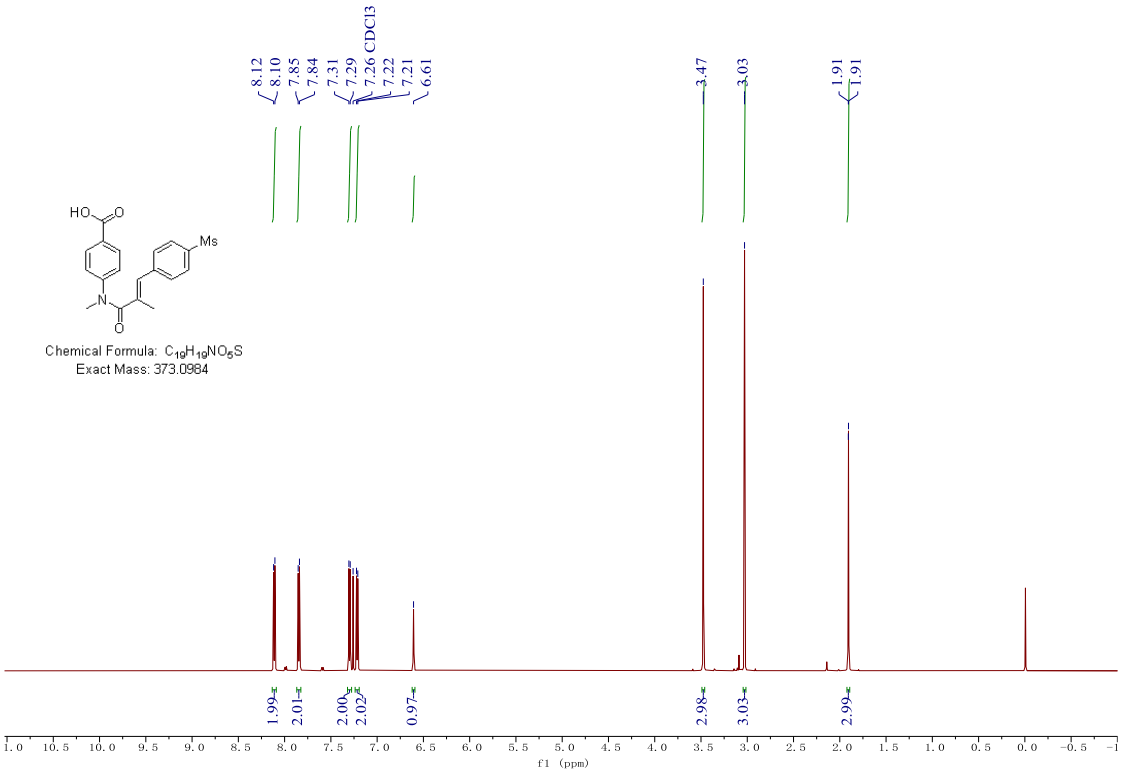
(E)-4-(3-(4-cyanophenyl)-N,2-dimethylacrylamido)benzoic acid



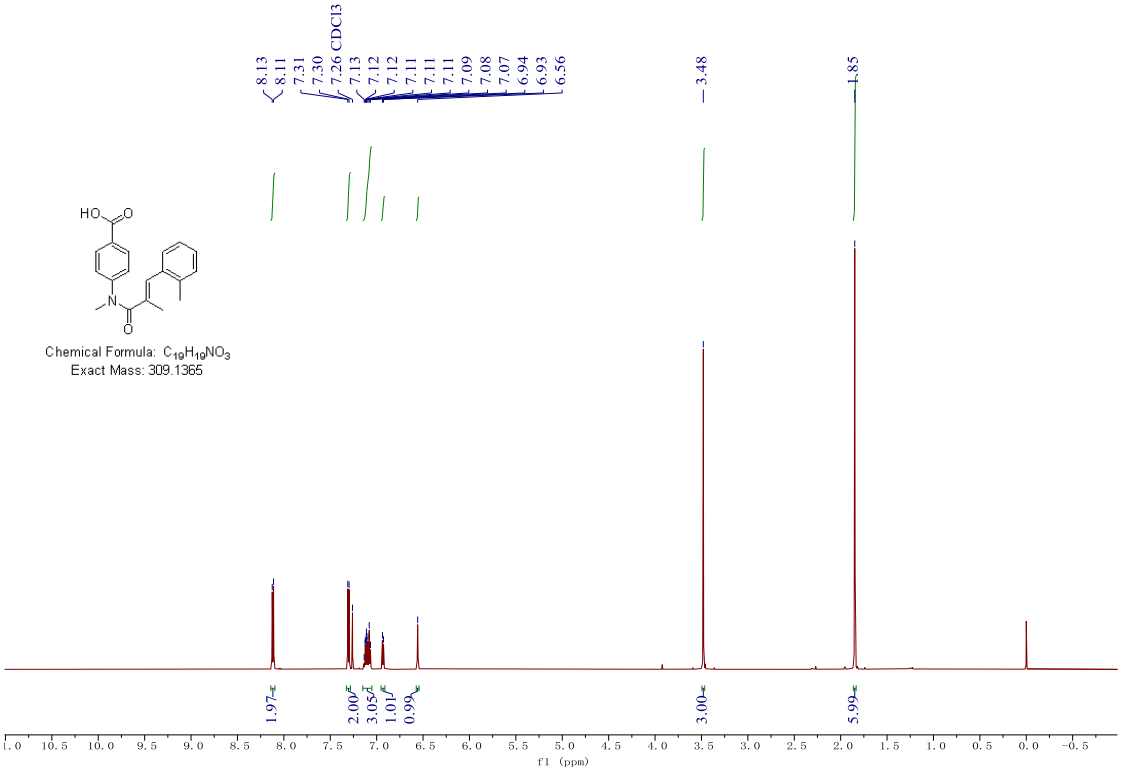


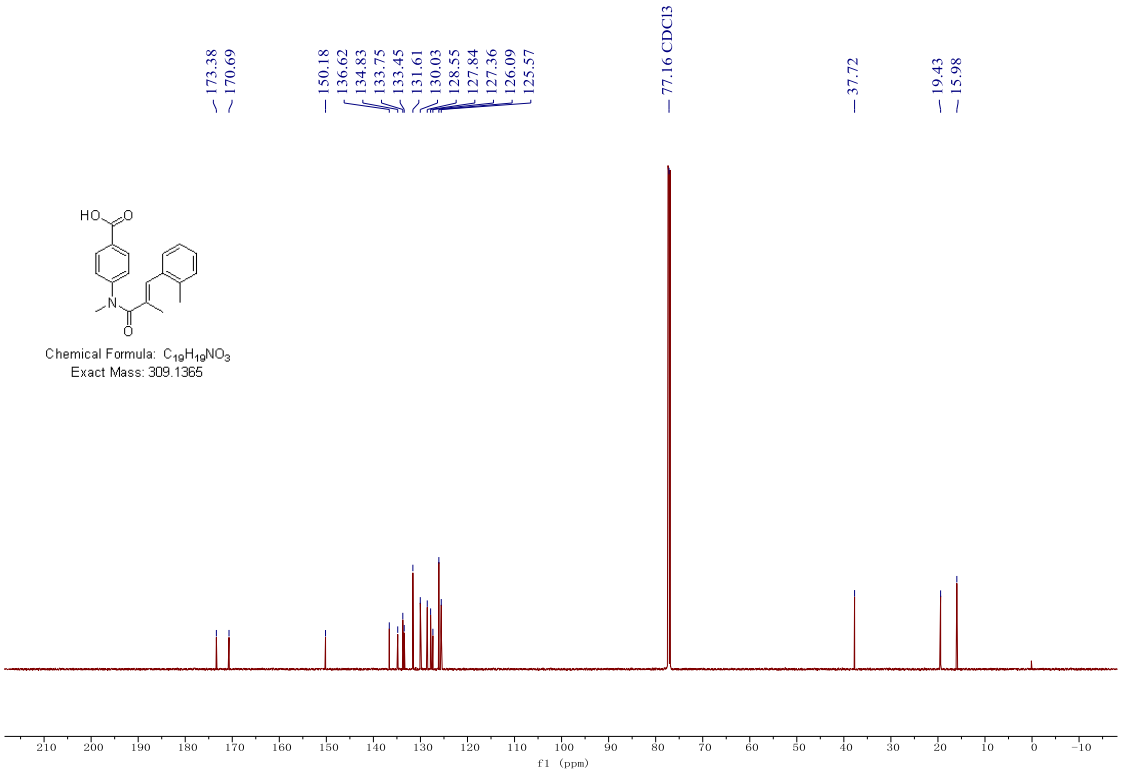
(E)-4-(N,2-dimethyl-3-(4-(methylsulfonyl)phenyl)acrylamido)benzoic acid



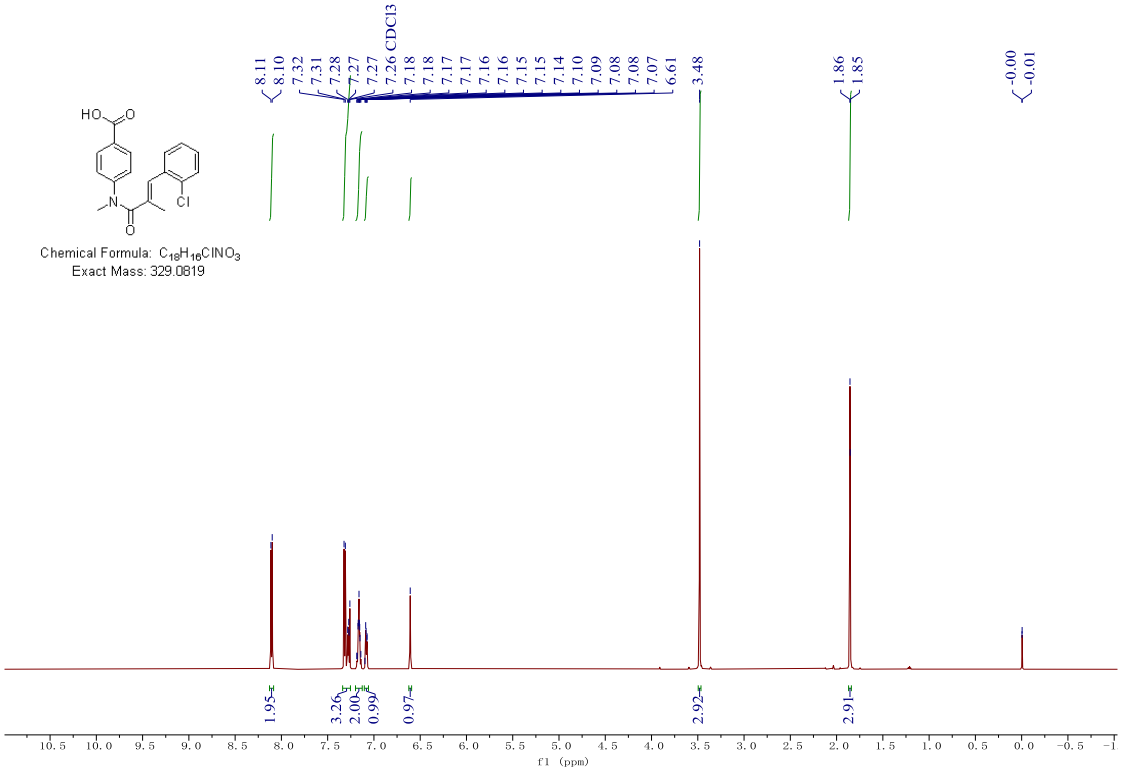


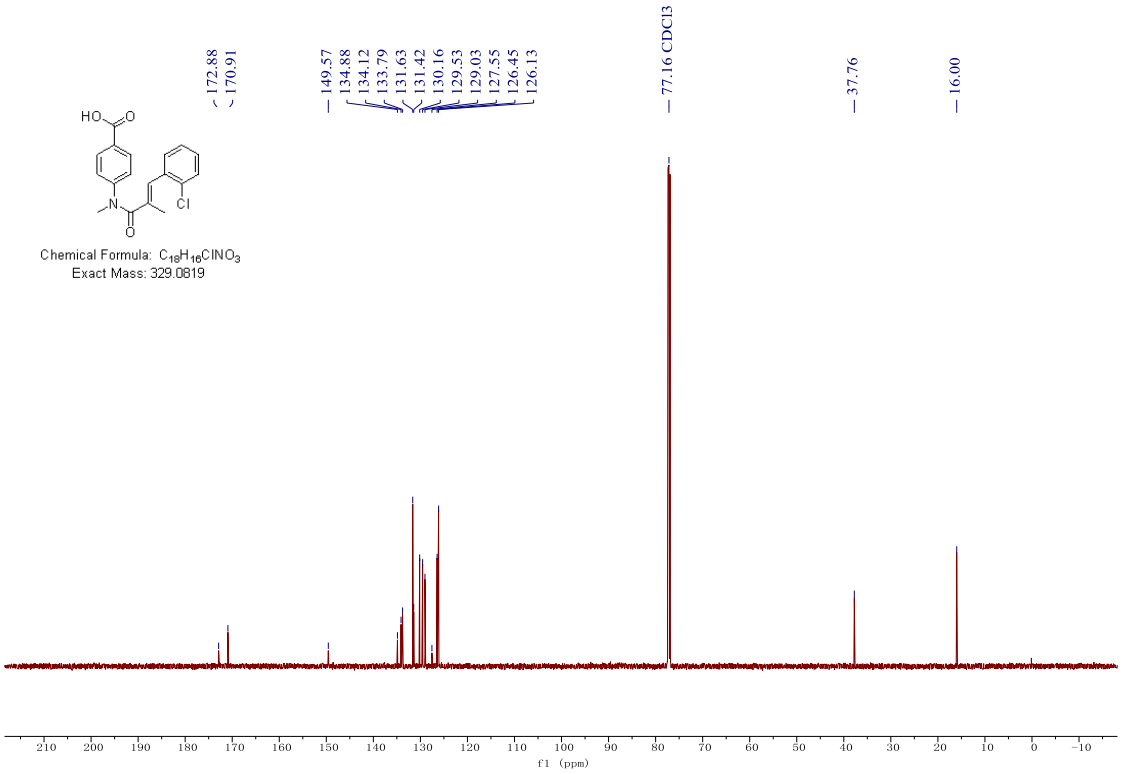
(E)-4-(N,2-dimethyl-3-(o-tolyl)acrylamido)benzoic acid



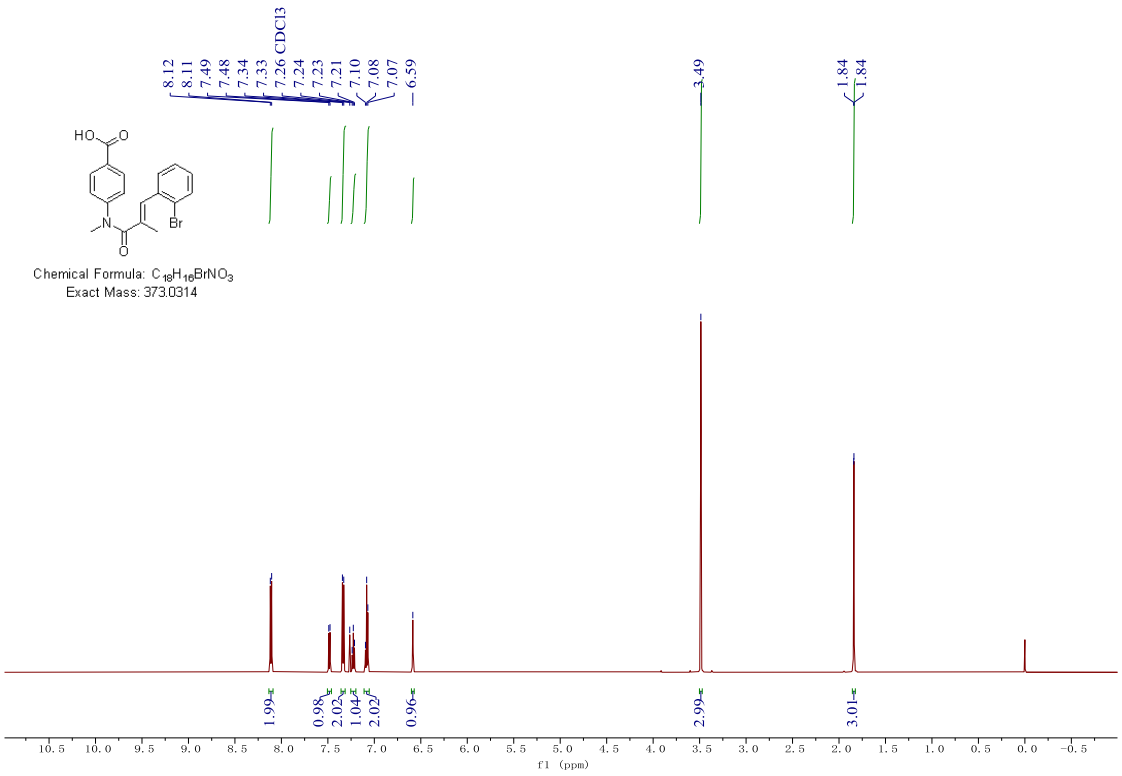


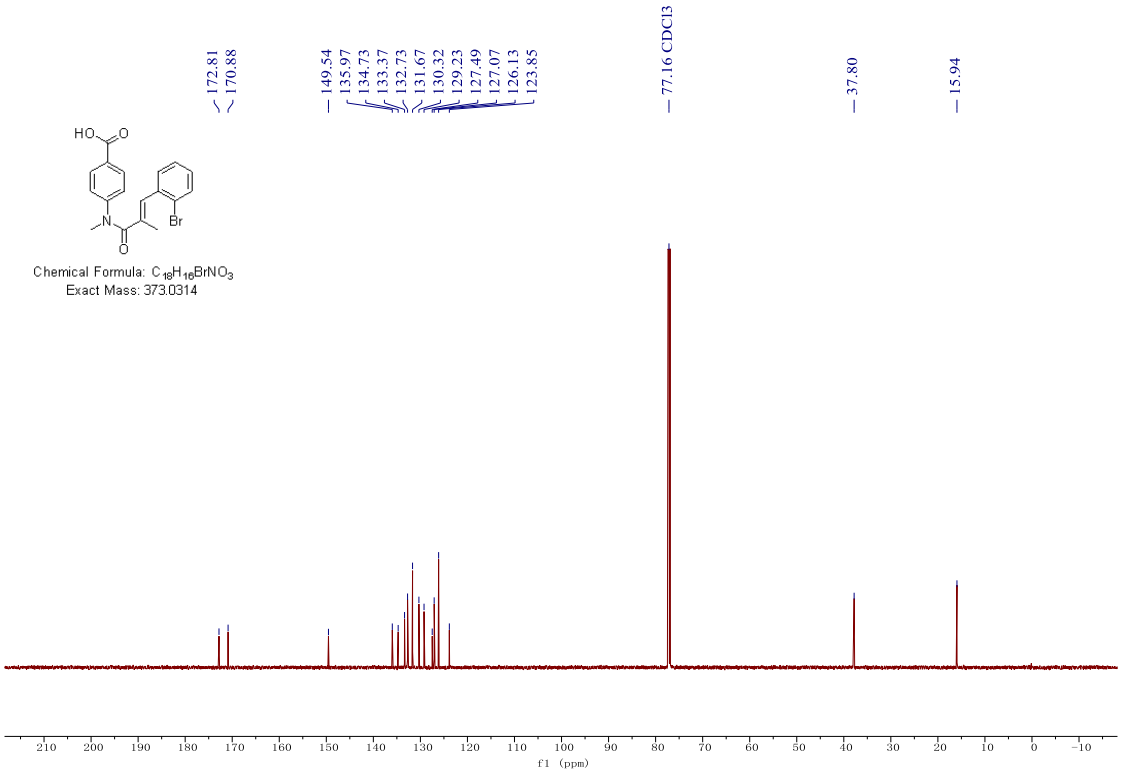
(E)-4-(3-(2-chlorophenyl)-N,2-dimethylacrylamido)benzoic acid



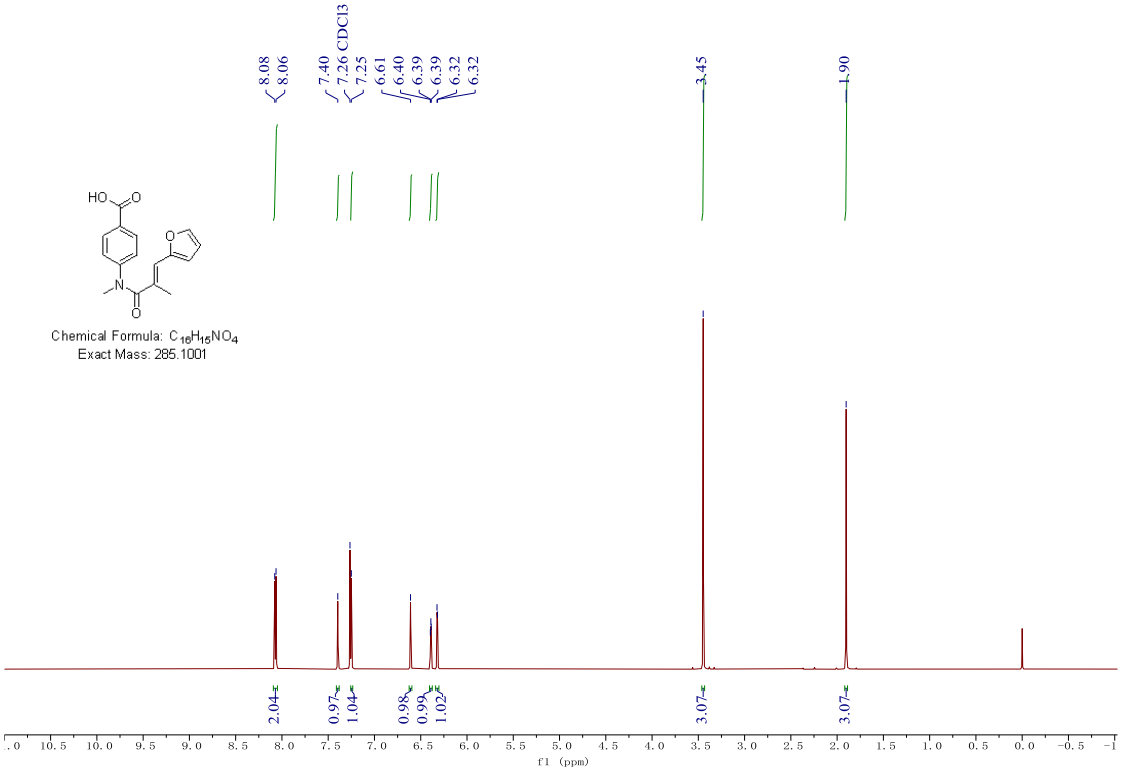


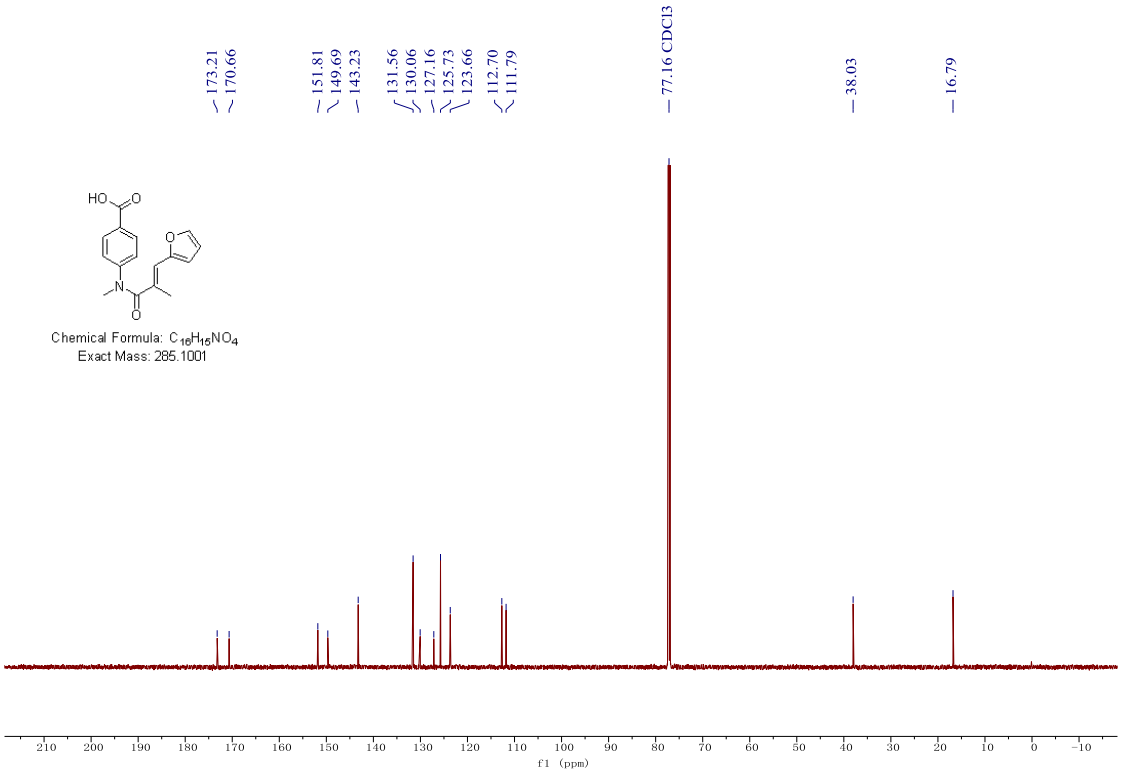
(E)-4-(3-(2-bromophenyl)-N,2-dimethylacrylamido)benzoic acid



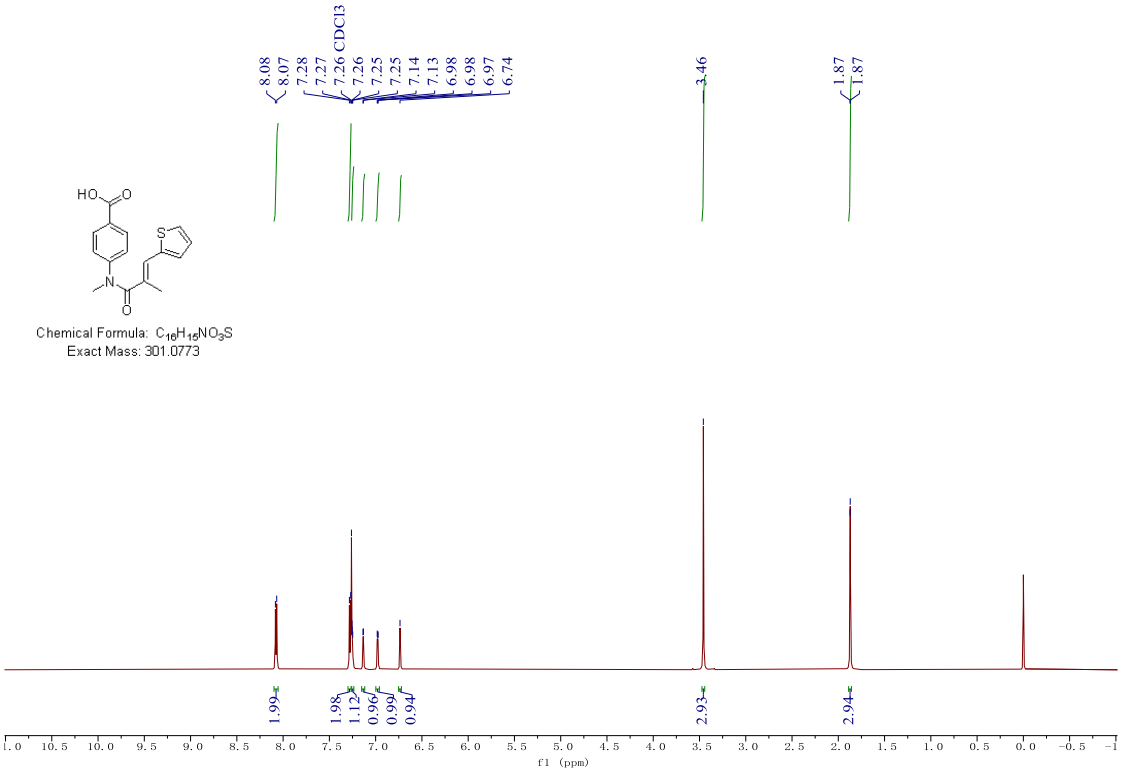


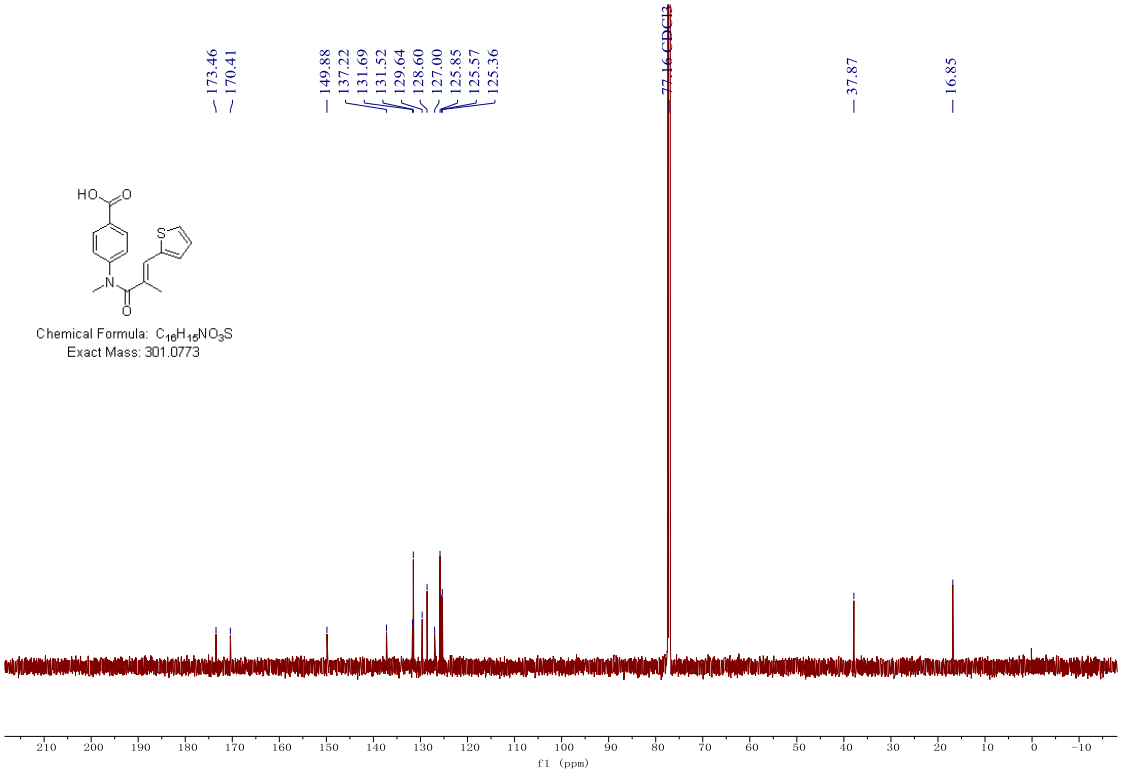
(E)-4-(3-(furan-2-yl)-N,2-dimethylacrylamido)benzoic acid



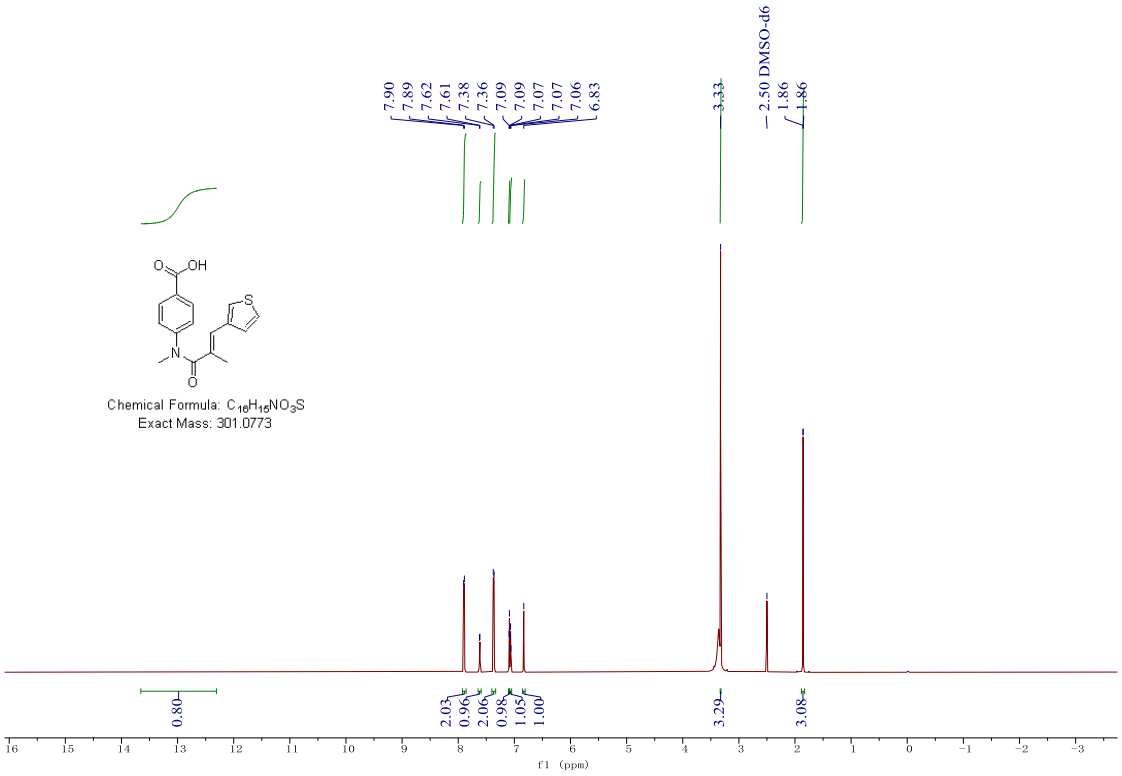


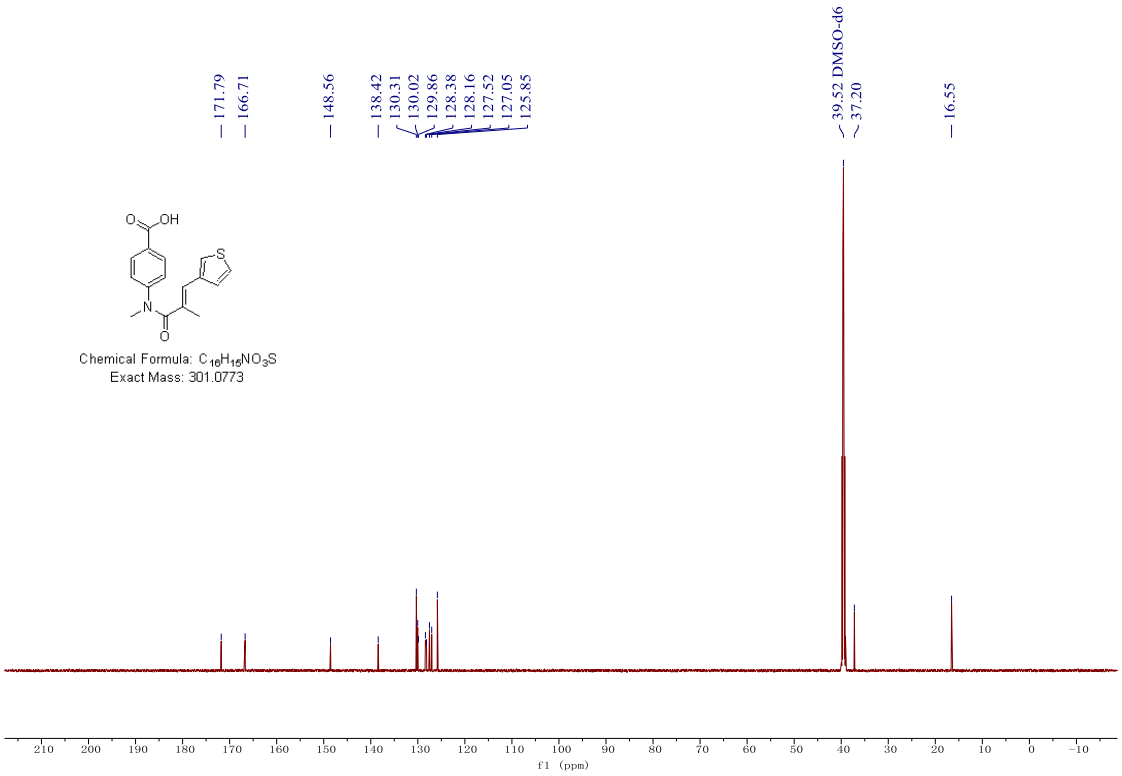
(E)-4-(N,2-dimethyl-3-(thiophen-2-yl)acrylamido)benzoic acid



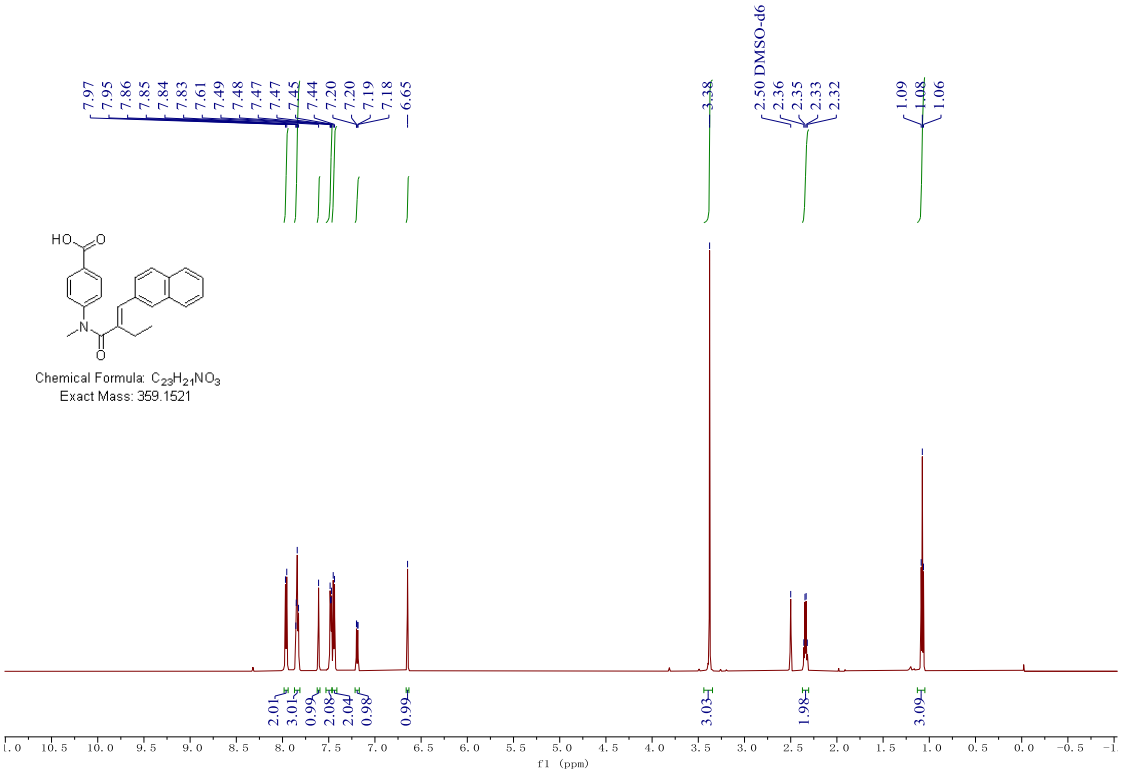


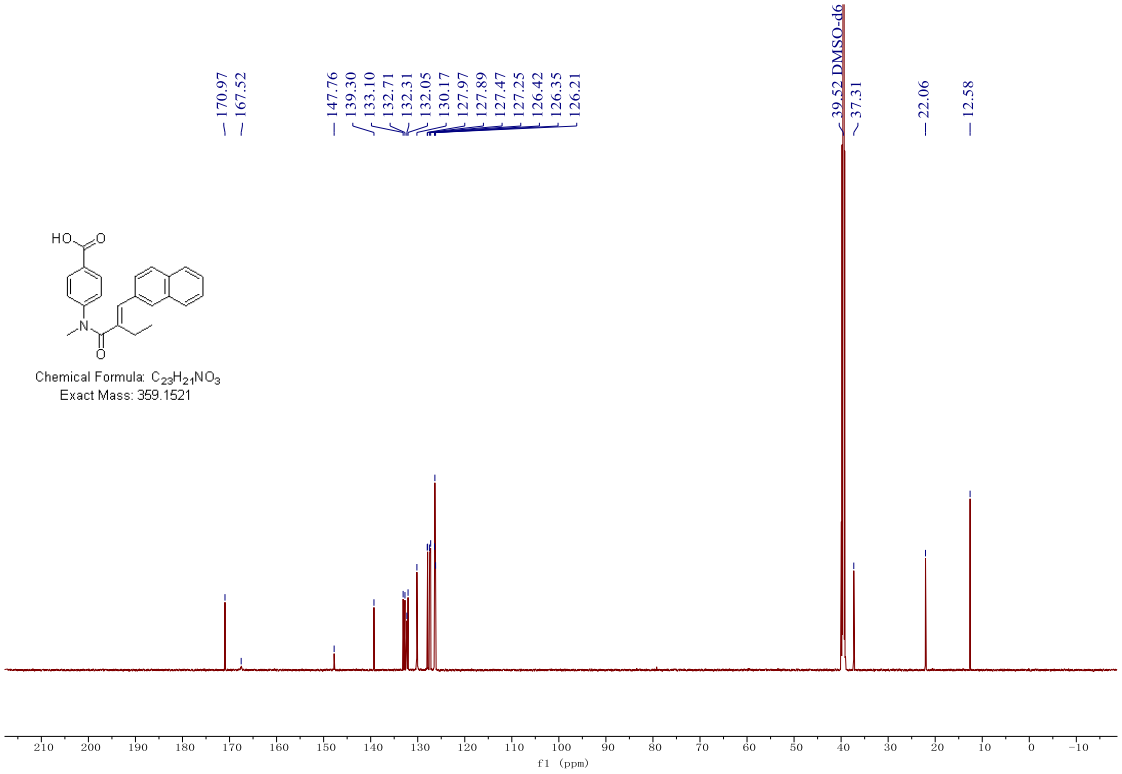
(E)-4-(N,2-dimethyl-3-(thiophen-3-yl)acrylamido)benzoic acid



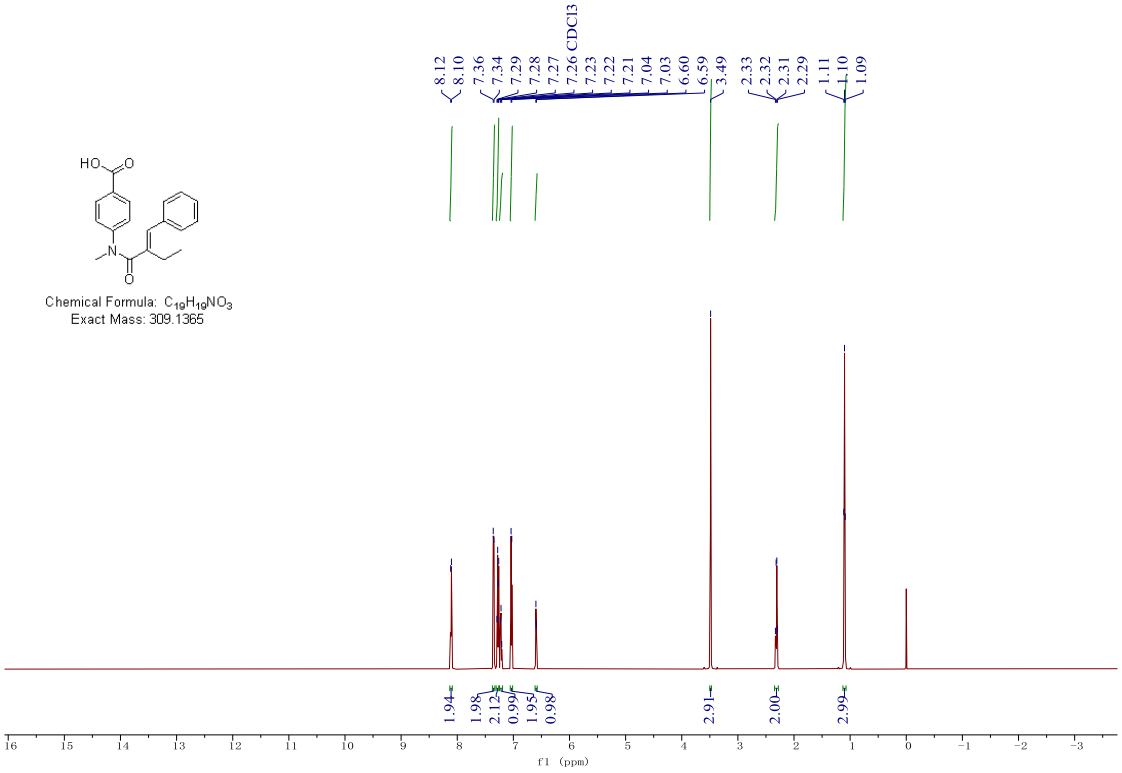


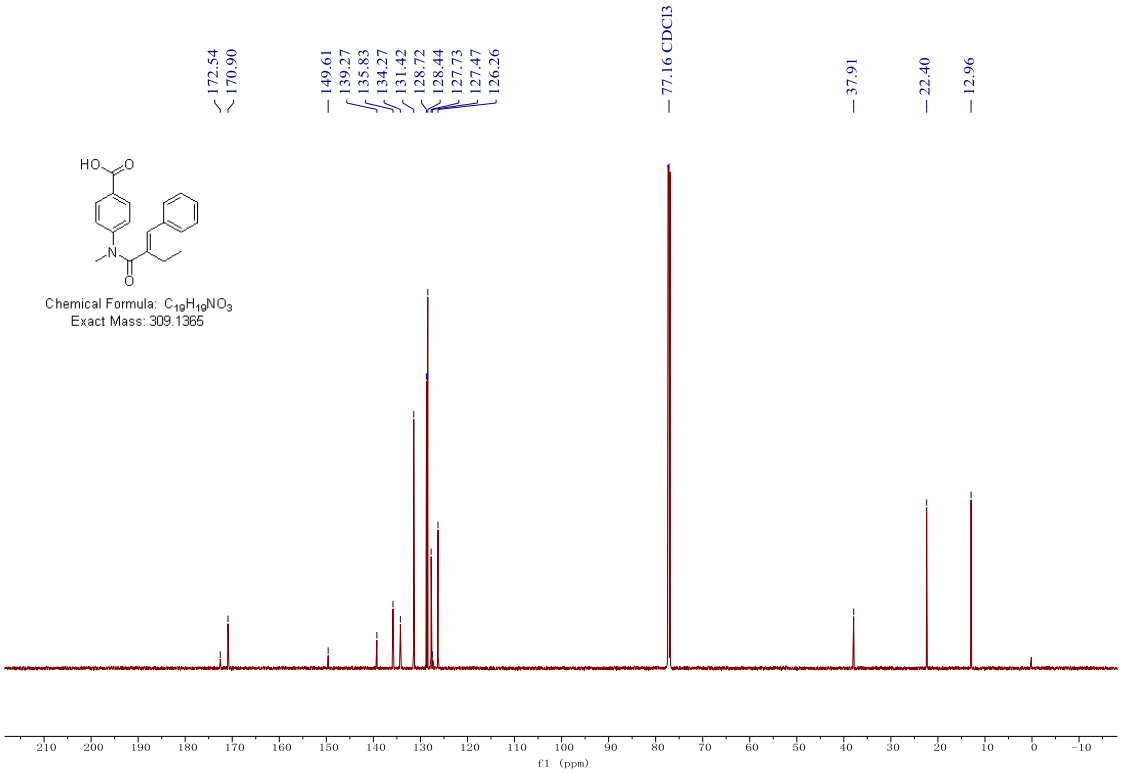
(E)-4-(N-methyl-2-(naphthalen-2-ylmethylene)butanamido)benzoic acid



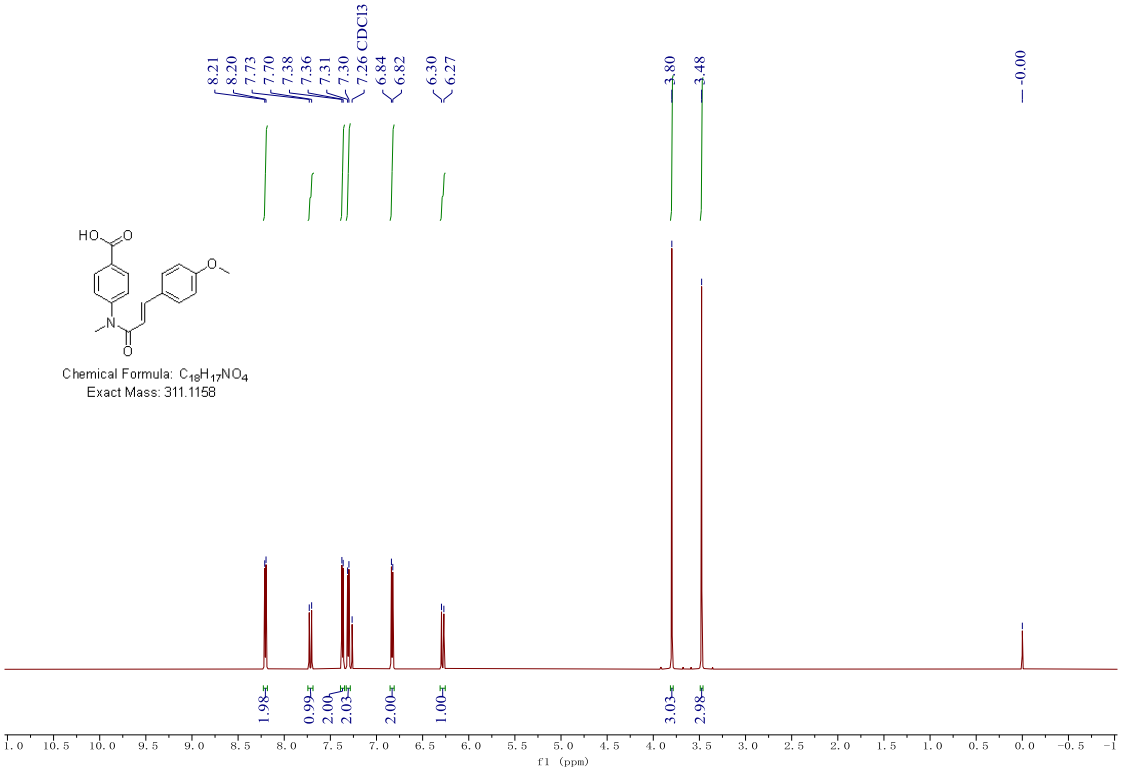


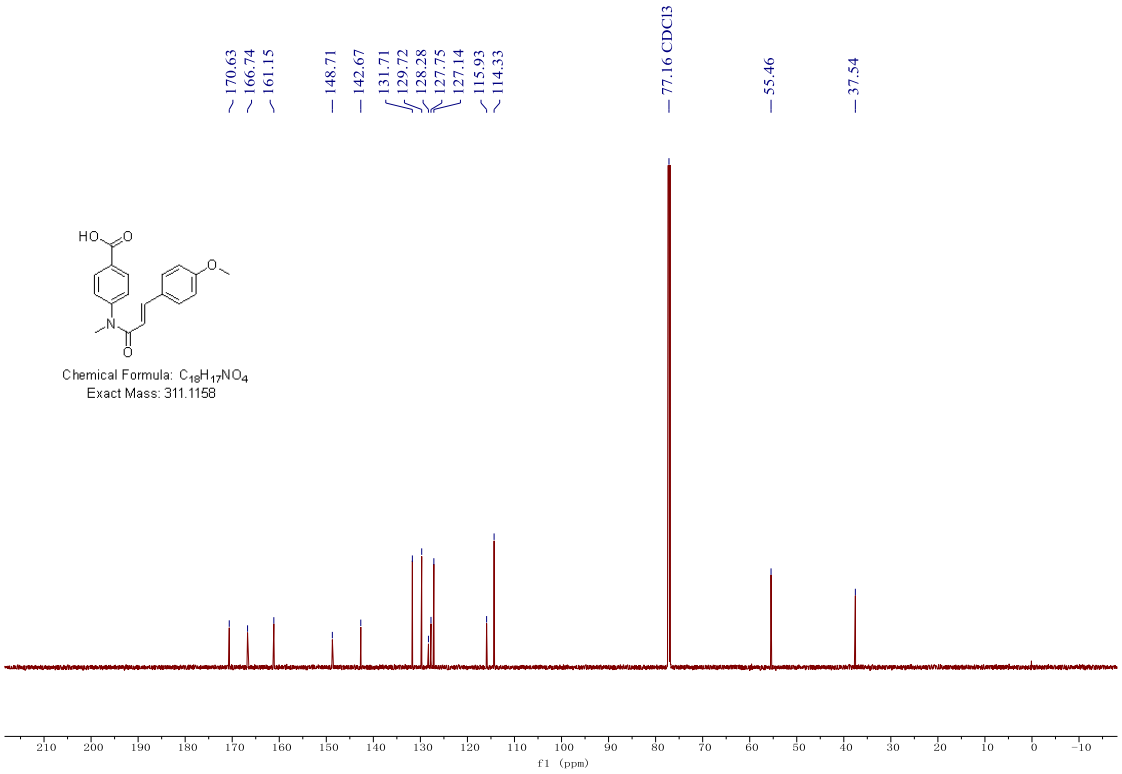
(E)-4-(2-benzylidene-N-methylbutanamido)benzoic acid



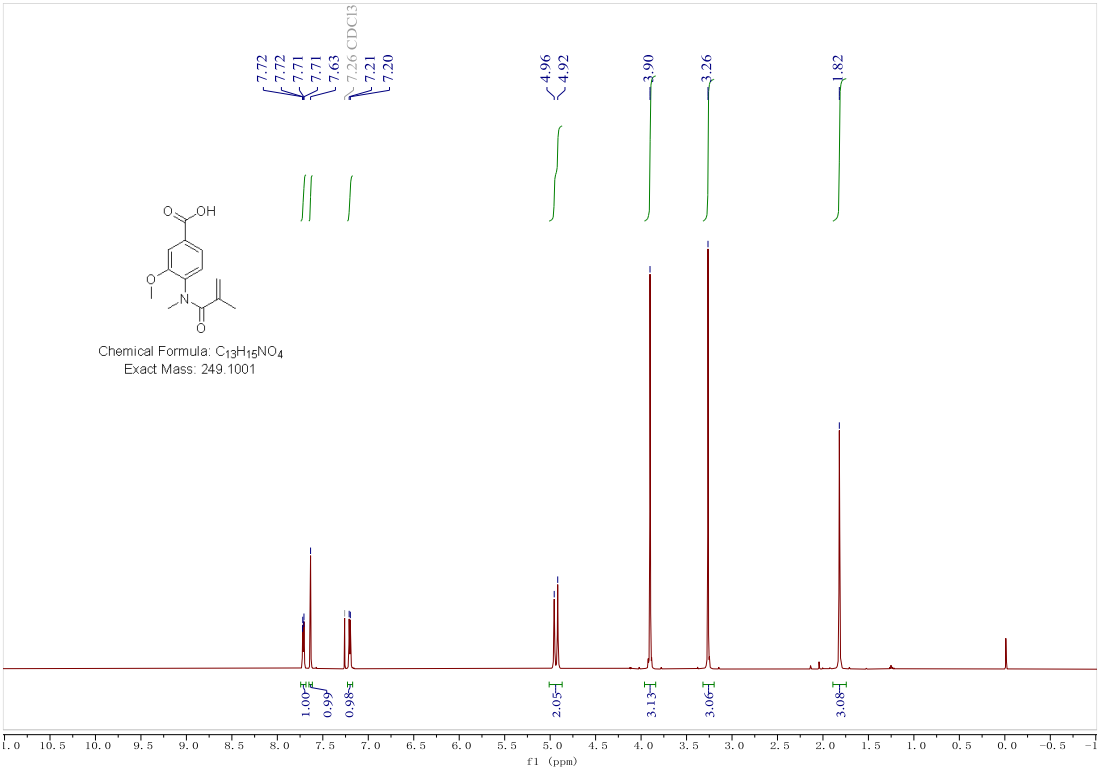


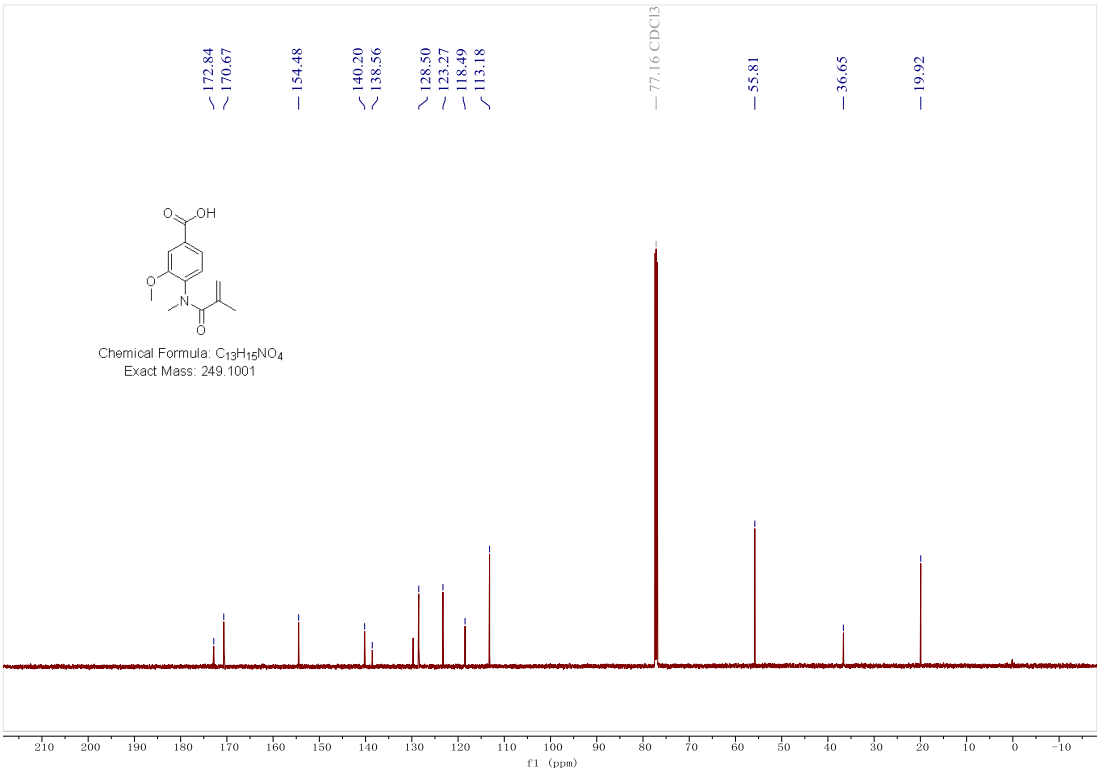
(E)-4-(3-(4-methoxyphenyl)-N-methylacrylamido)benzoic acid



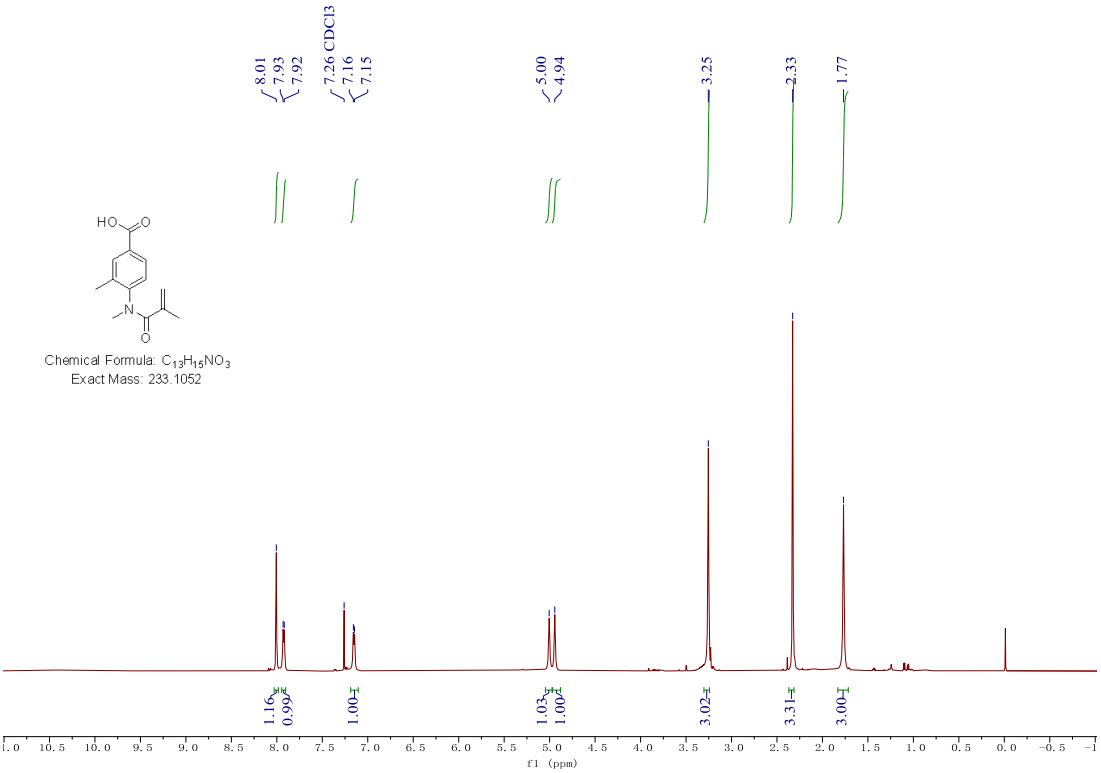


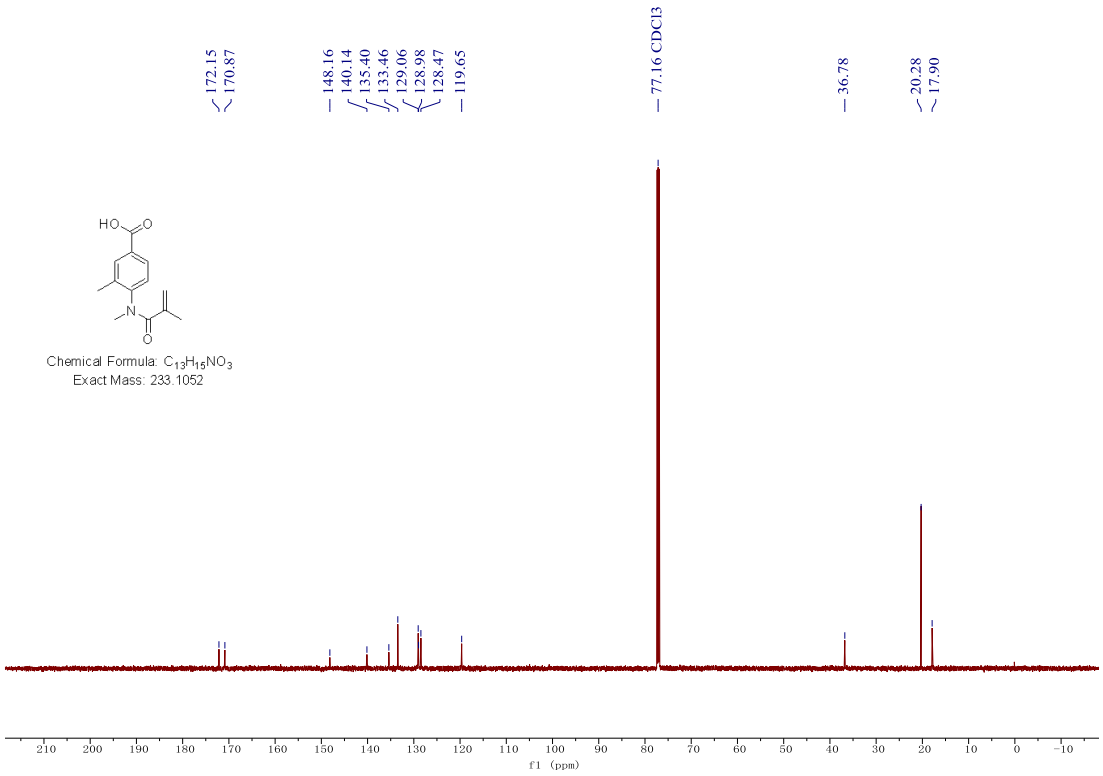
3-methoxy-4-(N-methylmethacrylamido)benzoic acid



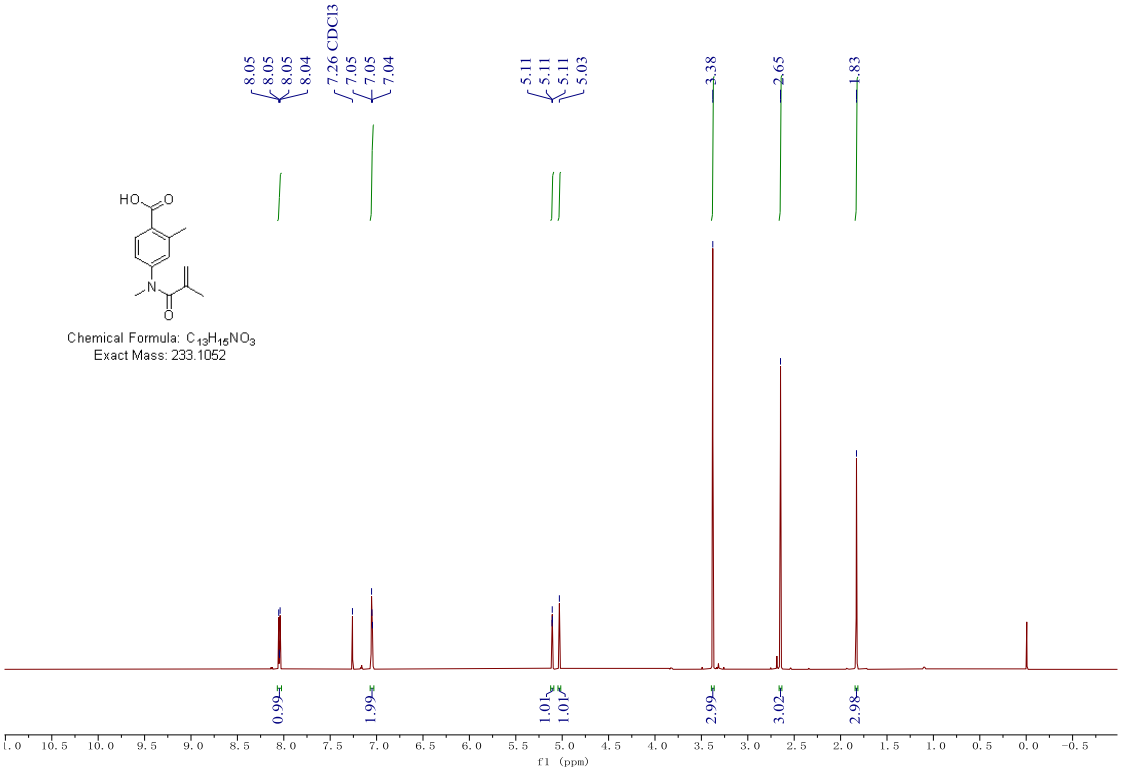


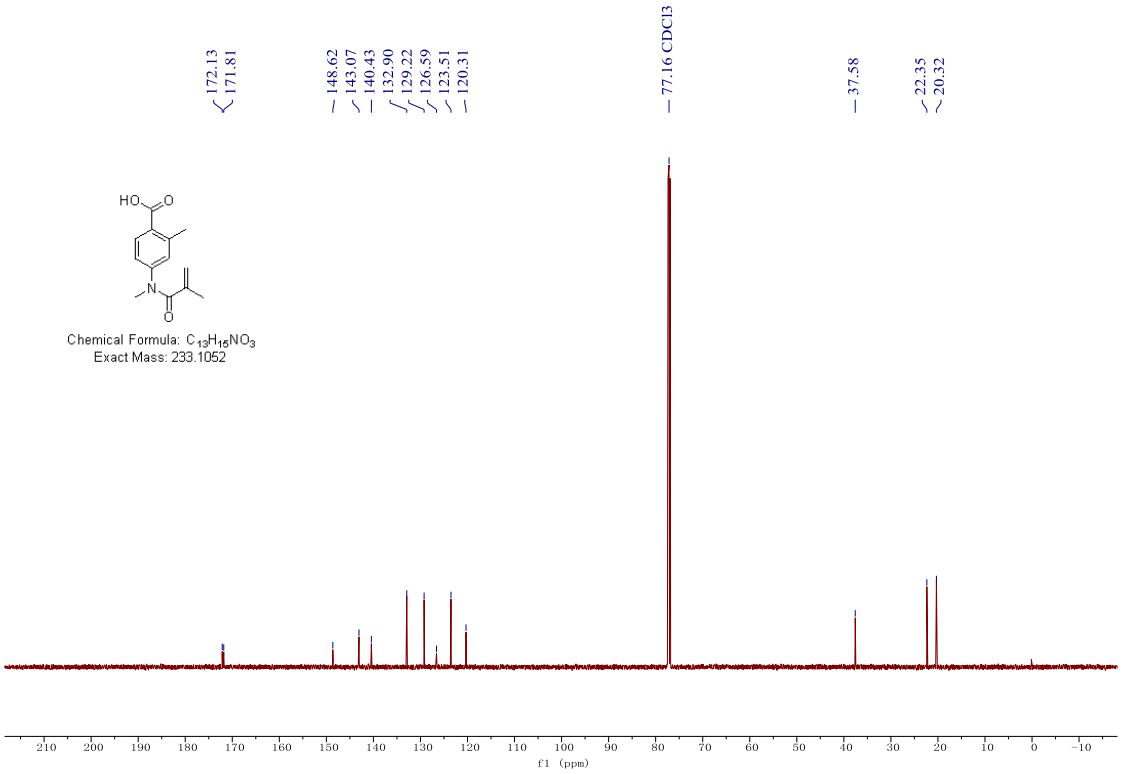
3-methyl-4-(N-methylmethacrylamido)benzoic acid



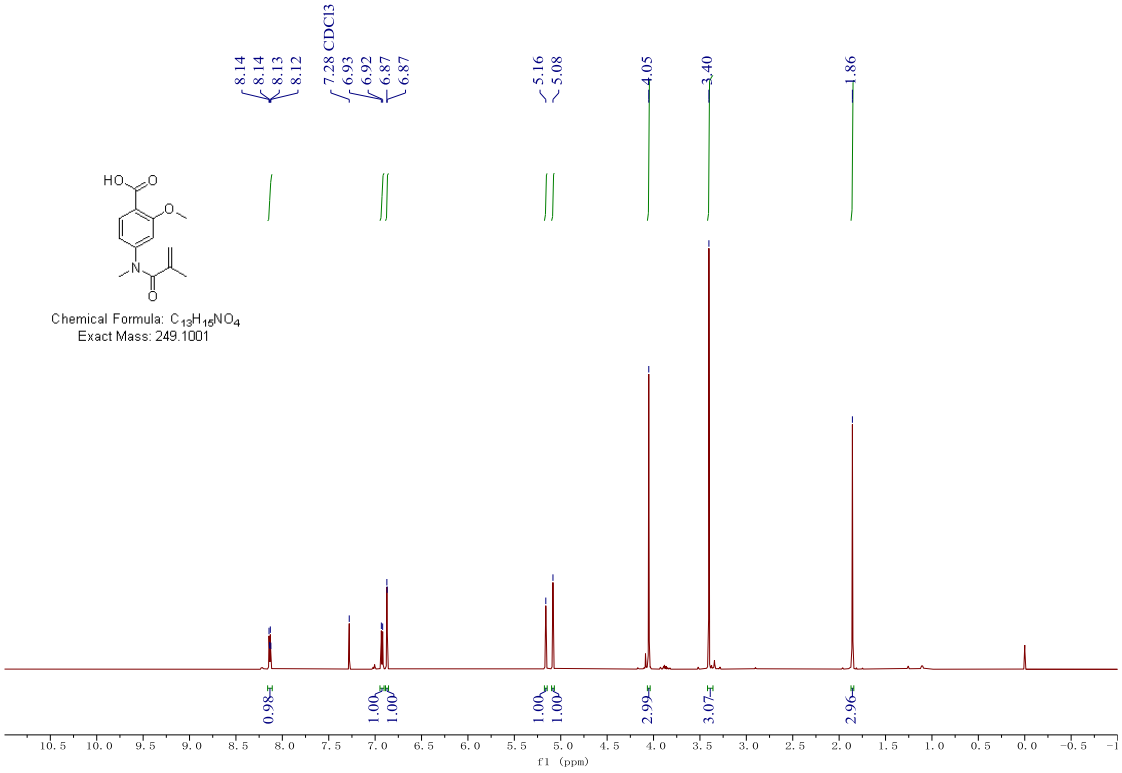


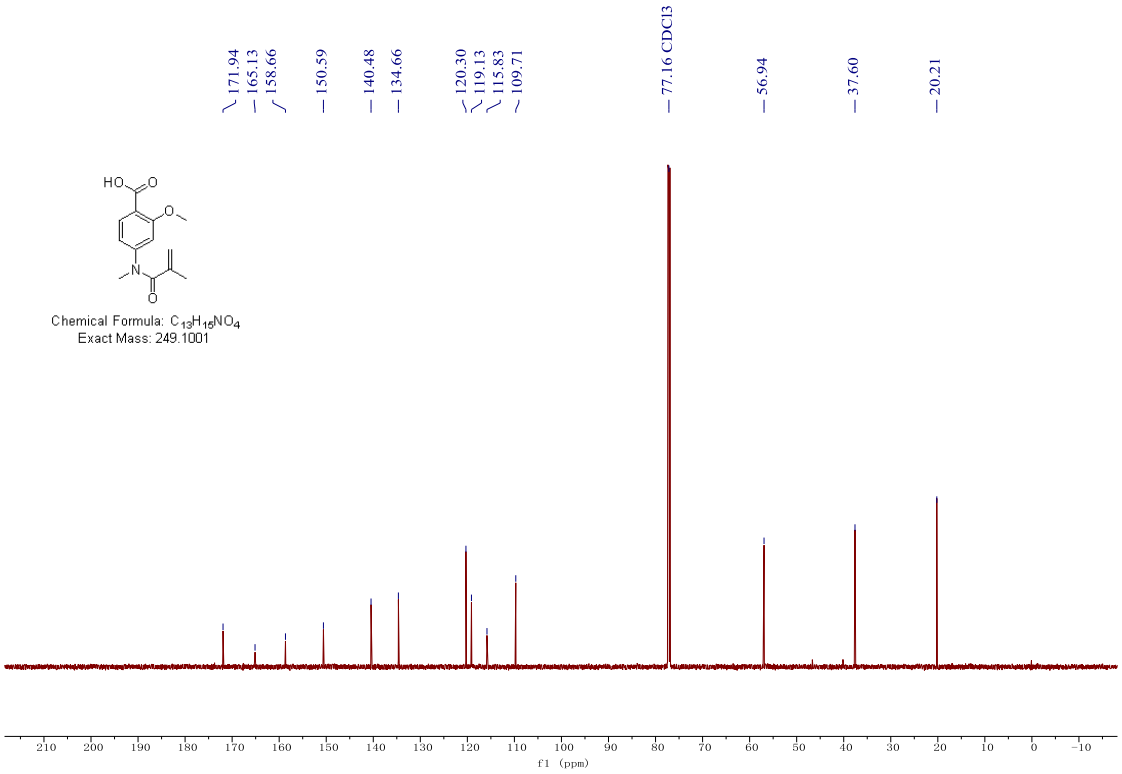
2-methyl-4-(N-methylmethacrylamido)benzoic acid



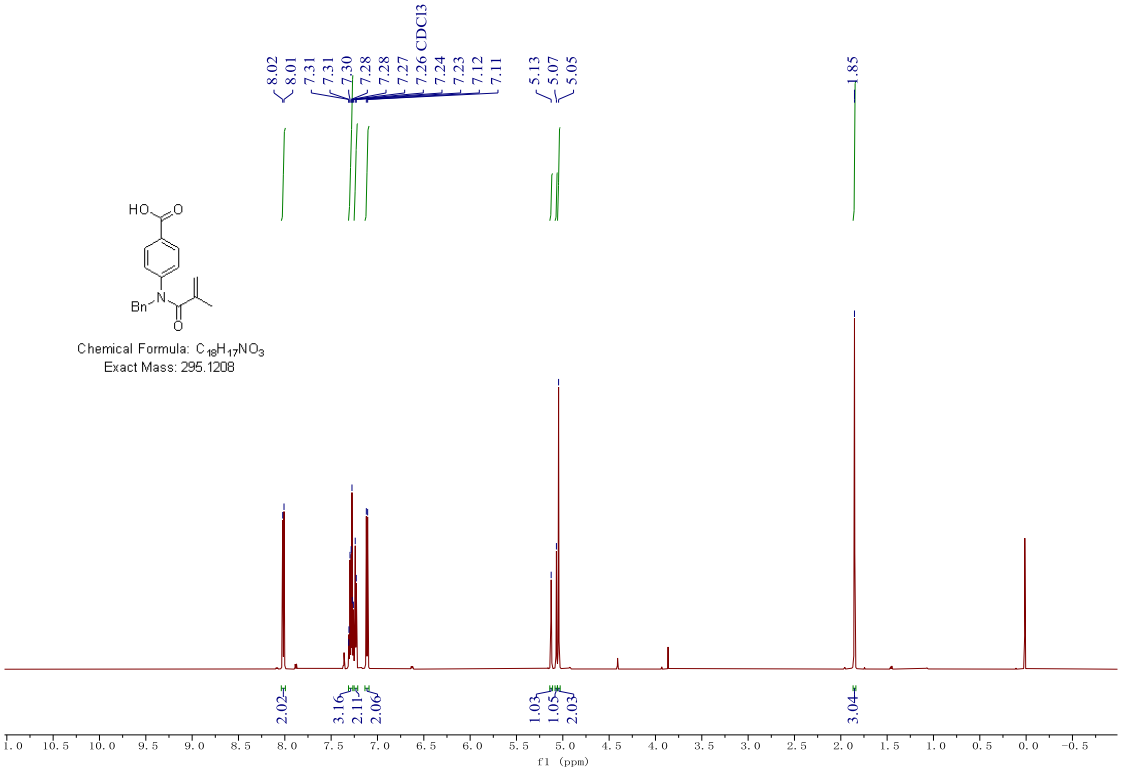


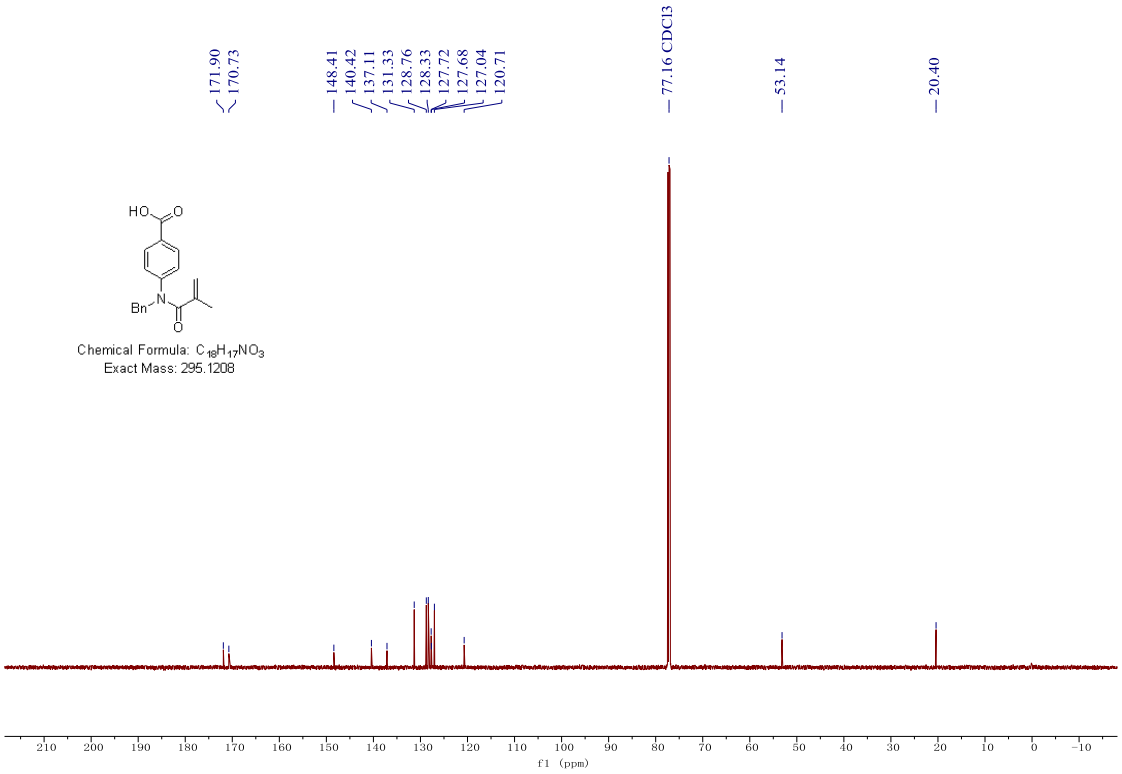
2-methoxy-4-(N-methylmethacrylamido)benzoic acid



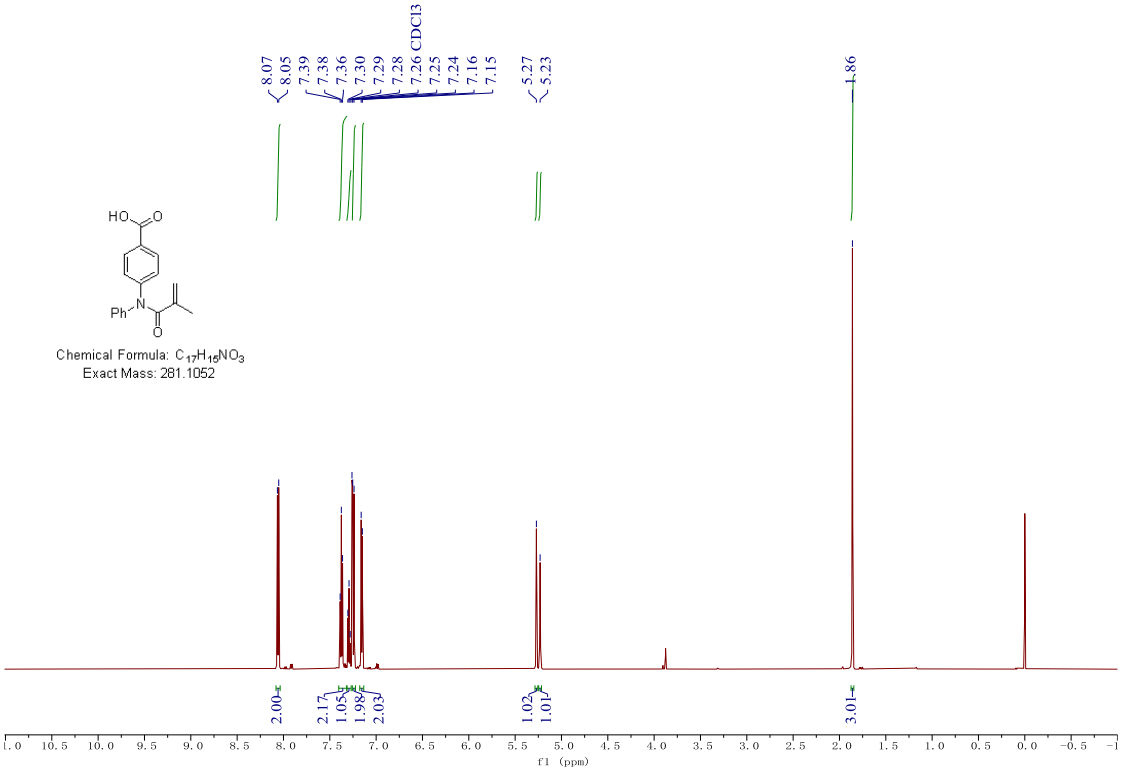


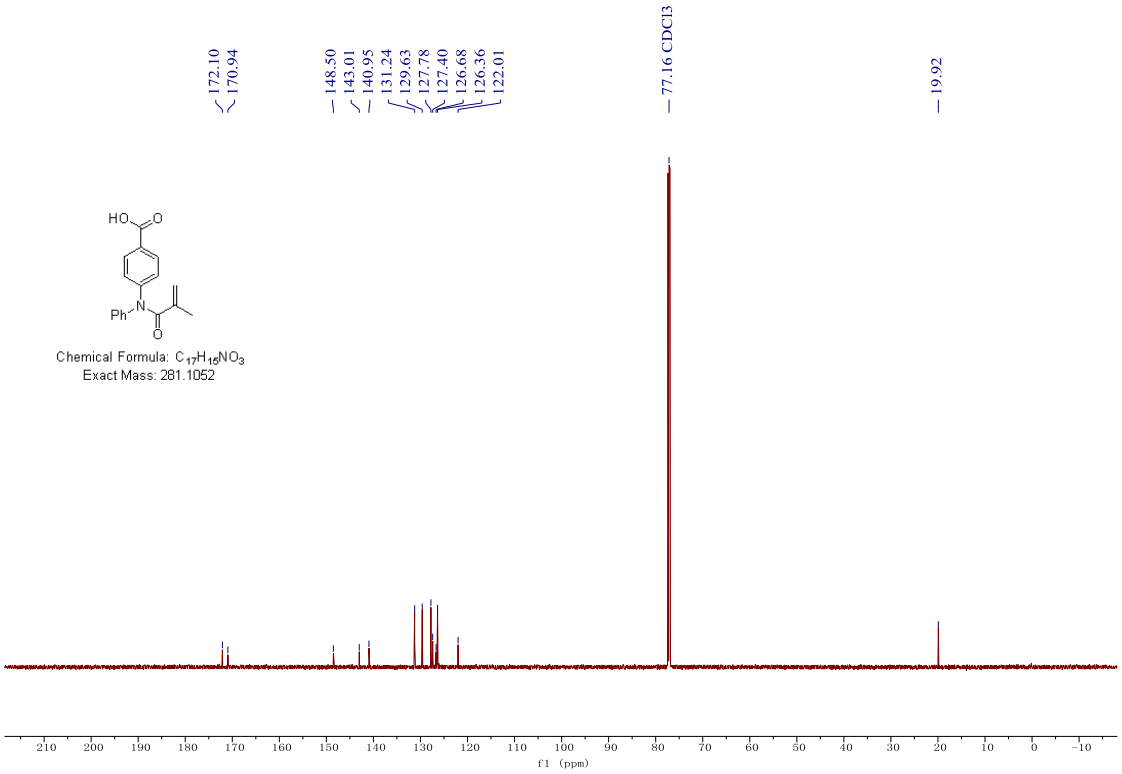
4-(N-benzylmethacrylamido)benzoic acid



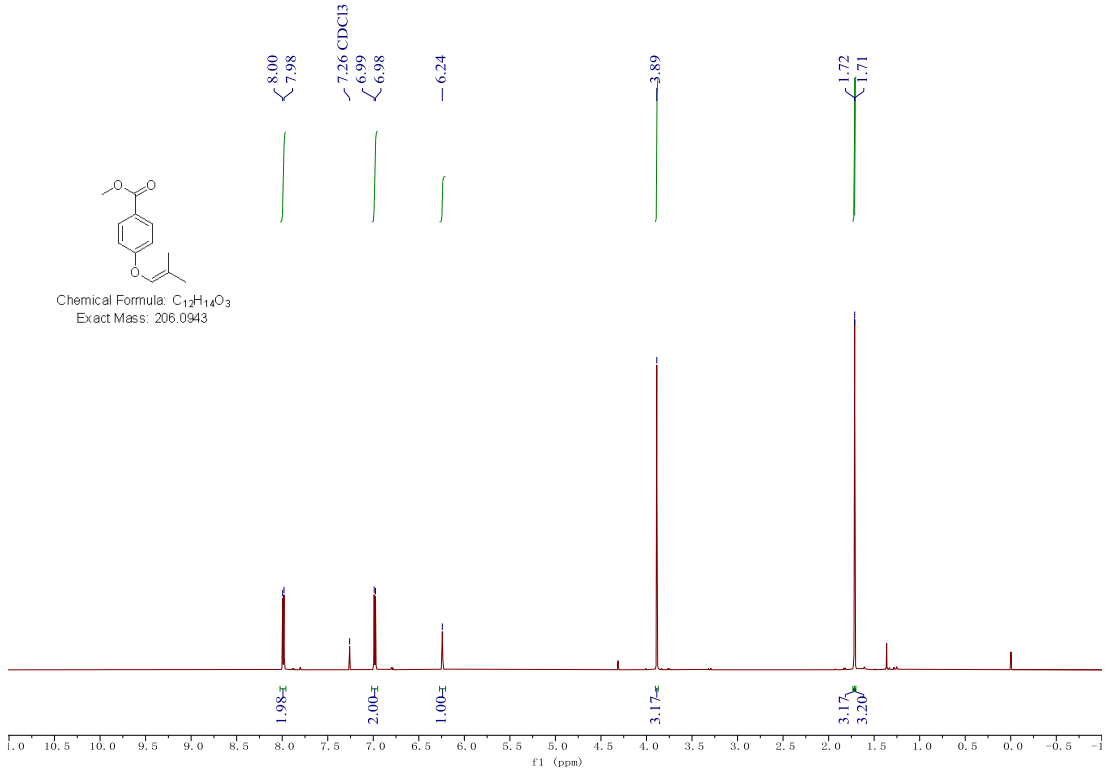


4-(N-phenylmethacrylamido)benzoic acid





methyl 4-((2-methylprop-1-en-1-yl)oxy)benzoate (**1'**):



methyl 4-((2-methylallyl)oxy)benzoate