Electronic Supplementary Information

Unactivated alkylsulfinic acids as an alkyl radical source for the synthesis of 3,3-dialkylindolin-2-ones via an electron donor-acceptor complex

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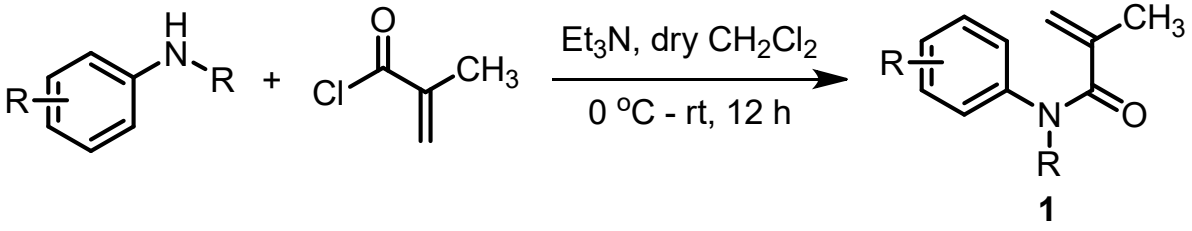
General Information

Unless otherwise noted, all reagents were obtained from commercial suppliers and used without further purification. Alkylsulfinic acids were purchased from Aldrich or prepared by the methods described below. 2-Isocyano-1,1'-biphenyl (**IBP**) was obtained from HFC. All the reactions were carried out under N_2 gas atmosphere using oven-dried glassware. All solvents were distilled prior to use and stored over 3 Å/4 Å molecular sieves.[1] The progress of the optimization reactions were monitored by gas chromatography. The progress of the substrate scope was monitored by analytical thin layer chromatography (TLC) and visualization was accomplished by irradiation with short wave UV light at 254 nm and by staining in phosphomolybdic acid. Products were purified by column chromatography on 100-200 mesh silica gels. All products were characterized by a Bruker Avance 300 MHz spectrometer. Chemical shifts are expressed as δ-value in parts per million (ppm) and were calibrated using the residual protonated solvent as an internal standard. The peak patterns are indicated as follows: s, singlet; bs, (broad singlet); d, doublet; t, triplet; dd, (doublet of doublets); dt, (double of triplets); m, multiplet and so on. The coupling constants, J, are reported in Hertz (Hz). A custom-made photoreactor setup was used for the photocatalytic reactions (see below). The vial is placed inside the fitted well in which irradiation takes place with LED light at the desired wavelength (415 nm wavelength) at a distance of 0.5 cm. Reaction temperature is easily controlled using a recirculating system with water.

Experimental Section

*General procedures for the preparation of N-arylacrylamides (**1**)*



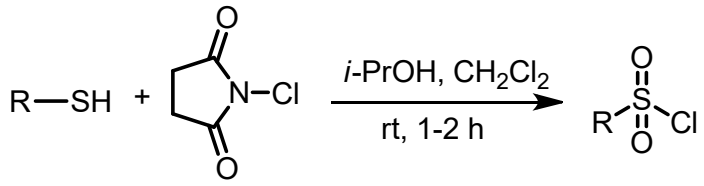
1

A round flask equipped with a magnetic stirring bar was charged with N-alkyl substituted aniline (1.0 equiv.), trimethylamine (2.0 equiv.), and dichloromethane. Afterwards, methacryloyl chloride (1.5 equiv.) in dichloromethane was slowly added into the reaction mixture at 0 °C

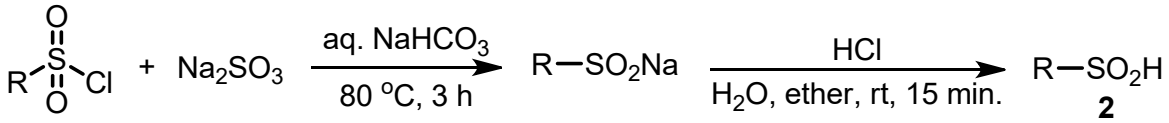
under nitrogen atmosphere. Then, the reaction mixture was stirred and was allowed to warm up to room temperature for overnight. Subsequently, water was added into the mixture, the organic phase was collected, and the aqueous layer was extracted with dichloromethane. The combined organic phase was washed with saturated brine solution and dried over Na_2SO_4, filtered, and concentrated under reduced pressure. Resultant residue was purified by column chromatography on silica gel using 0-10% ethyl acetate in hexane to provide the desired N-arylacrylamides (**1**).

*General procedure for the preparation of alkylsulfinic acids (**2**)*

step - 1



step - 2



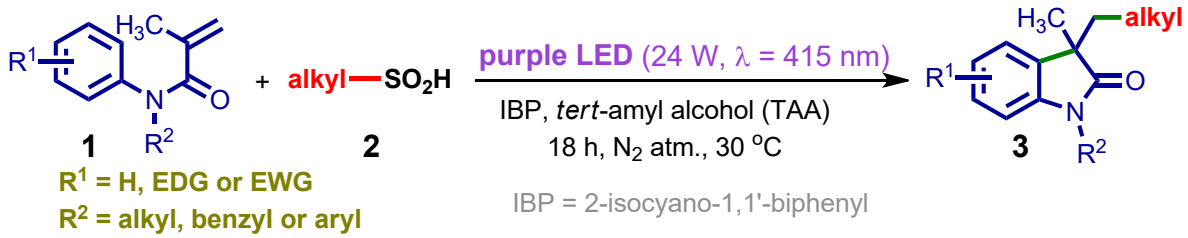
Alkylsulfinic acids were synthesized in two steps as described below.

Step-1: A round flask equipped with a magnetic stirring bar was charged with required alkylthiol (1.0 equiv.) and isopropanol (2.0 equiv.) in dichloromethane. To this stirred solution, N-chlorosuccinimide (3.5 equiv.) was added portion-wise at 0 °C. Afterwards, the reaction mixture was stirred and was allowed to warm up to room temperature over the period of 1-2 h. Subsequently, the mixture was diluted with saturated $NaHCO_3$, and extracted with ethyl acetate. The combined organic extracts were dried over Na_2SO_4, filtered, and concentrated under reduced pressure to afford the crude material. Resultant residue was purified by a filtration on silica gel column chromatography using 0-10% ethyl acetate in hexane to provide the pure alkylsulfinyl chloride.

Step-2: A round flask equipped with a magnetic stirring bar was charged with as synthesized alkylsulfinyl chloride (1.0 equiv.), sodium sulfite (2.0 equiv.), sodium bicarbonate (2.0 equiv.) and water. Then, the reaction mixture was stirred at 80 °C for 3 h. Later, water was removed

under reduced pressure. The remaining solid was extracted with ethanol and recrystallized to get the required sodium sulfinate (white to light-yellow powder and hygroscopic). It was then dissolved in minimum amount of water, followed by *t*-butyl methyl ether and concentrated aqueous hydrochloric acid (15 mmol) was added. Resultant mixture was stirred for 15 minutes, transferred to a separator funnel, and the aqueous layer was removed. The organic layer was concentrated under reduced pressure. The white solid obtained was recrystallized using ether-hexane mixture and dried under vacuum to give alkylsulfinic acids.

*General procedure for the synthesis of 3,3-dialkylindolin-2-ones (**3**)*

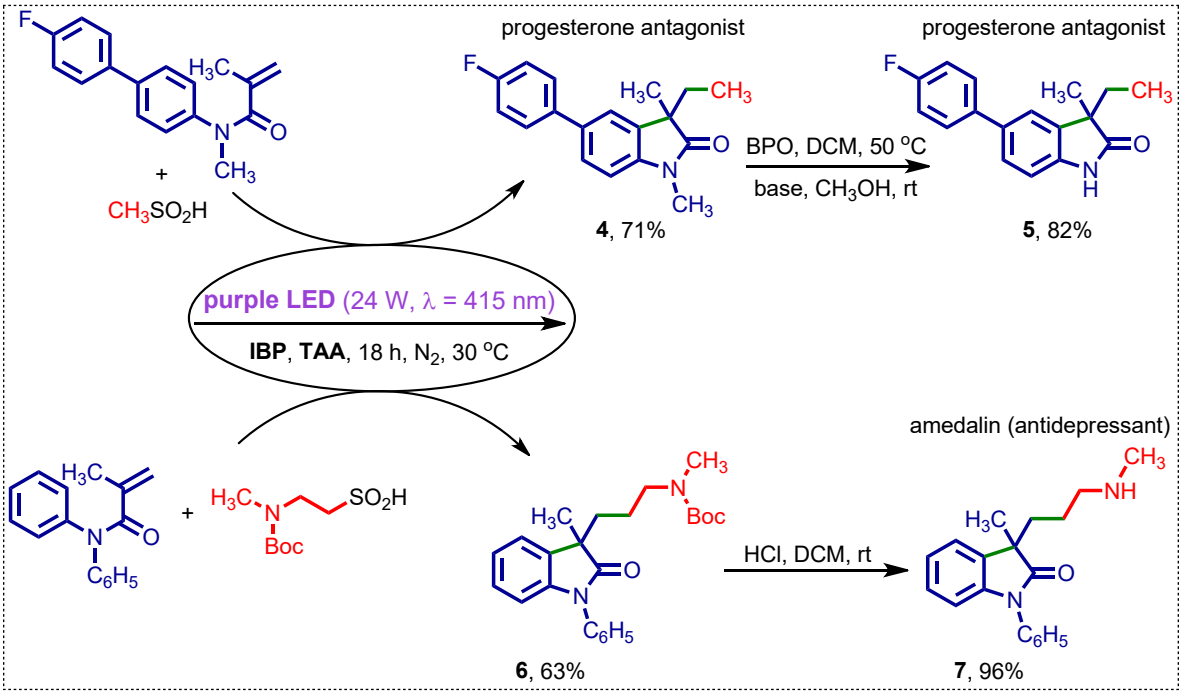


An oven-dried glass vial equipped with a magnetic stir bar was evacuated and backfilled with nitrogen gas was added N-arylacrylamides (**1**, 1.0 mmol, 1.0 equiv.), alkylsulfinic acids (**2**, 1.2 mmol, 1.2 equiv.), **IBP** (54 mg, 30 mol%), and **TAA** (2.0 mL). Resultant pale-yellow reaction mixture was stirred few minutes to dissolve well and then with stirring irradiated through the plane bottom side of the vial using 24 W purple LEDs (λ = 415 nm) at a distance of 0.5 cm under nitrogen gas atmosphere at 30 °C. The progress of reaction was monitored by TLC. After reaction completion (18 h, as indicated by disappearance of precursor in TLC), the volatiles were completely removed by vacuum evaporation. Subsequently, aqueous $NaHCO_3$ solution (2 mL) was added, sonicated and product was extracted with ethyl acetate, dried over anhydrous Na_2SO_4, filtered and concentrated. The resulting crude mixture was purified by column chromatography on silica gel using 5-20% ethyl acetate in hexane to provide the desired 3,3-dialkylindolin-2-one **3**.

The large-scale reaction was carried out using **1a** (1.75 g, 10.0 mmol), **2a** (1.8 g, 12.0 mmol), **IBP** (537 mg, 30 mol%), and deaerated **TAA** (20 mL). After 18 h, the volatiles were completely removed by vacuum evaporation. Subsequently, aqueous $NaHCO_3$ solution was added, sonicated and product was extracted with ethyl acetate, dried over anhydrous Na_2SO_4, filtered and concentrated. The resulting crude mixture was purified by column chromatography on silica gel

using 5-10% ethyl acetate in hexane to provide the desired 1,3-dimethyl-3-((tetrahydro-2H-pyran-4-yl)methyl)indolin-2-one (**3a**, 1.95 g, 75% yield).

Synthesis of bioactive compounds 4-7



Synthesis of 4: An oven-dried glass vial equipped with a magnetic stir bar was evacuated and backfilled with nitrogen gas was added N-(4'-fluoro-[1,1'-biphenyl]-4-yl)-N-methylmethacrylamide (1.0 mmol, 1.0 equiv.), methylsulfinic acid (1.2 mmol, 1.2 equiv.), IBP (54 mg, 30 mol%), and TAA (2.0 mL). Resultant pale-yellow reaction mixture was stirred few minutes to dissolve well and then with stirring irradiated through the plane bottom side of the vial using 24 W purple LEDs (λ = 415 nm) at a distance of 0.5 cm under nitrogen gas atmosphere at 30 °C. After reaction completion (18 h, as indicated by disappearance of precursor in TLC), the volatiles were completely removed by vacuum evaporation. Subsequently, aqueous $NaHCO_3$ solution (2 mL) was added, sonicated and product was extracted with ethyl acetate, dried over anhydrous Na_2SO_4, filtered and concentrated. The resulting crude mixture was purified by column chromatography on silica gel using 5-10% ethyl acetate in hexane to provide the desired 3-ethyl-5-(4-fluorophenyl)-1,3-dimethylindolin-2-one (**4**) in 71% yield.

Synthesis of 5 (demethylation): A solution of **4** (0.5 mmol) and benzoyl peroxide (1.0 mmol) in dry DCE (2 mL) was heated slowly to 80 °C. After stirring for 24 h, the reaction mixture was cooled to rt and the solvent was evaporated. The residue was dissolved in MeOH (3 mL), NaOH (80 mg) was added and then the reaction mixture was stirred for 12 h at room temperature. Afterwards, the slurry was poured into saturated aqueous brine solution and extracted with ethyl acetate. The combined organic layers were dried by anhydrous Na_2SO_4 and concentrated. The residue was dissolved in a methanolic ammonia solution and stirred for 12 h at room temperature. After reaction, the mixture was extracted by ethyl acetate and dried by anhydrous Na_2SO_4 and concentrated, purified by column chromatography on silica gel using 5-40% ethyl acetate in hexane to provide the desired product **5** (82%) as a white solid.

Synthesis of 6: An oven-dried glass vial equipped with a magnetic stir bar was evacuated and backfilled with nitrogen gas was added N,N-diphenylmethacrylamide (1.0 mmol, 1.0 equiv.), 2-((*t*-butoxycarbonyl)(methyl)amino)ethanesulfinic acid (1.2 mmol, 1.2 equiv.), IBP (54 mg, 30 mol%), and TAA (3.0 mL). Resultant pale-yellow reaction mixture was stirred few minutes to dissolve well and then with stirring irradiated through the plane bottom side of the vial using 24 W purple LEDs (λ = 415 nm) at a distance of 0.5 cm under nitrogen gas atmosphere at 30 °C. After reaction completion (18 h, as indicated by disappearance of precursor in TLC), the volatiles were completely removed by vacuum evaporation. Subsequently, water was added, sonicated and product was extracted with ethyl acetate, dried over anhydrous Na_2SO_4, filtered and concentrated. The resulting crude mixture was purified by column chromatography on silica gel using 5-30% ethyl acetate in hexane to provide the desired *t*-butyl methyl(3-(3-methyl-2-oxo-1-phenylindolin-3-yl)propyl)carbamate (**6**) in 63% yield.

Synthesis of 7 (deprotection): A solution of **6** (0.5 mmol) in dry DCM (5 mL) was cooled to 0±5 °C and then added HCl. Resultant reaction mixture was stirred for 12 h. the volatiles were completely removed by vacuum evaporation. Subsequently, aqueous $NaHCO_3$ solution was added till neutralization, sonicated and product was extracted with ethyl acetate, dried over anhydrous Na_2SO_4, filtered and concentrated. The resulting crude mixture was purified by column chromatography on silica gel using 10-50% ethyl acetate in hexane to provide the desired **4** in 96% yield.

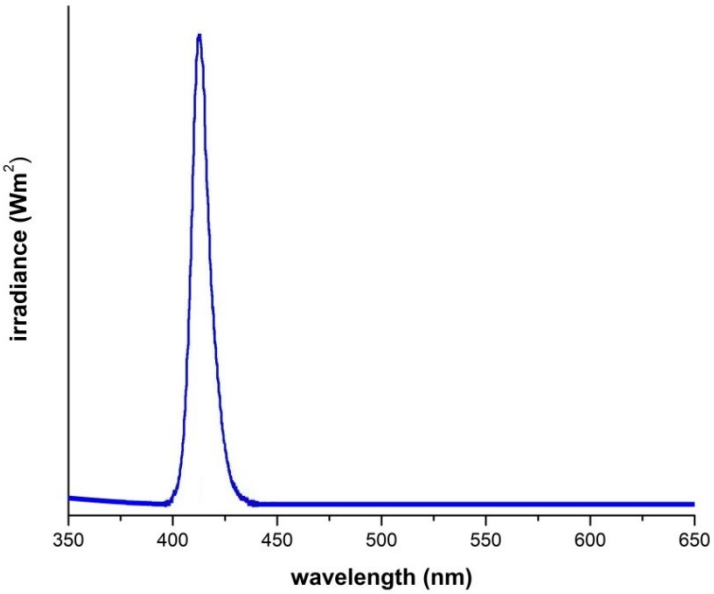


Figure S1. Emission spectra of light source

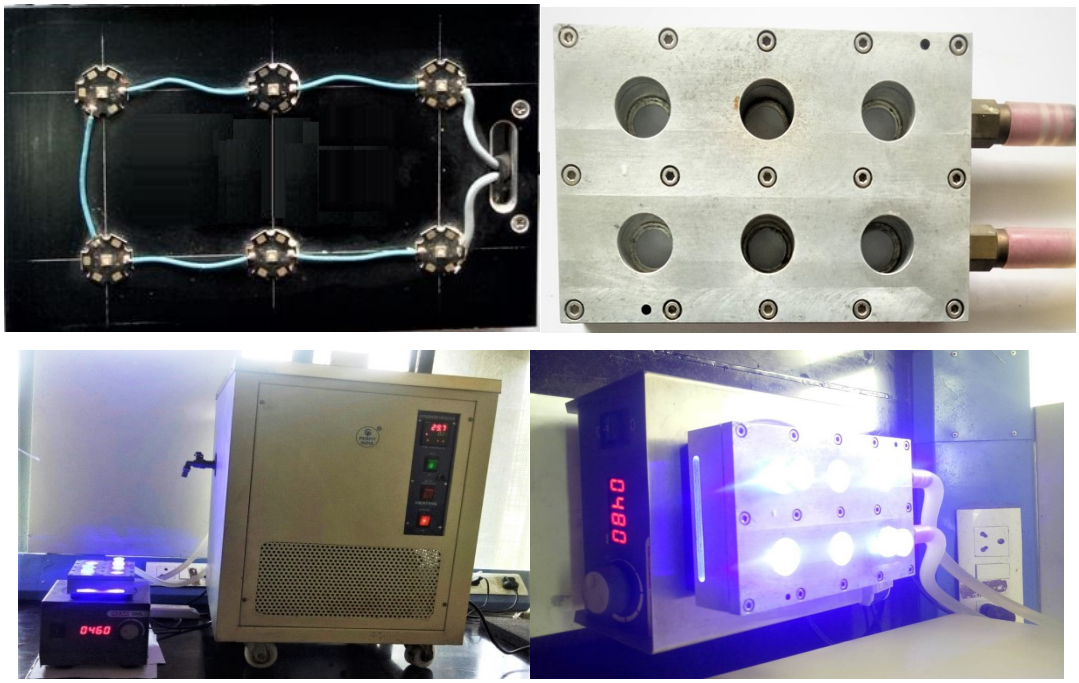
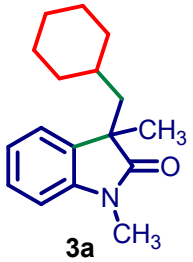


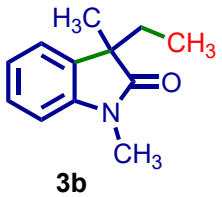
Figure S2. A few photographs of parts of a custom build photochemical reactor setup used to perform reactions described in this work. LEDs with a solid support (top, left), holding cum cooling unit (top, right), a picture of complete photochemical reactor setup under running conditions with turn-on blue LEDs with the cooling machine for maintaining uniform temperature (below, left) and a cross section of the setup (below, right).

Experimental characterization data for products



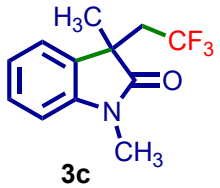
3a

3-(Cyclohexylmethyl)-1,3-dimethylindolin-2-one (3a):[2] Synthesized by following a general procedure. Pale-yellowish green oil (218 mg, 84% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.35. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.26 (t, J=7.6 Hz, 1H), 7.16 (d, J=7.4 Hz, 1H), 7.07 (t, J=7.4 Hz, 1H), 6.84 (d, J=7.6 Hz, 1H), 3.25 (s, 3H), 1.92 (dd, J=14, 7 Hz, 1H), 1.74 (dd, J=14, 5 Hz, 1H), 1.52-1.45 (m, 3H), 1.35-1.20 (m, 5H), 1.01-0.73 (m, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.3, 143.2, 134.6, 127.6, 122.8, 122.5, 108.1, 48.0, 45.6, 34.9, 34.6, 33.6, 26.33, 26.27, 26.23, 26.16. Spectra data are consistent with those reported in the literature.[2]



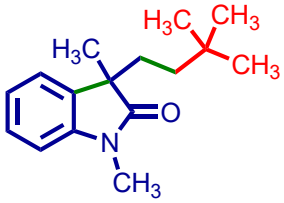
3b

3-Ethyl-1,3-dimethylindolin-2-one (3b):[2] Synthesized by following a general procedure. Pale-yellow oil (120 mg, 62% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.39. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.31-7.24 (m, 1H), 7.18-7.16 (m, 1H), 7.09-7.04 (m, 1H), 6.85 (d, J=7.4 Hz, 1H), 3.23 (s, 3H), 2.01-1.87 (m, 1H), 1.83-1.70 (m, 1H), 1.36 (s, 3H), 0.59 (t, J = 7.6 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.7, 143.5, 133.9, 127.5, 122.4, 122.3, 107.8, 48.9, 31.4, 26.1, 23.3, 8.81. Spectra data are consistent with those reported in the literature.[2]



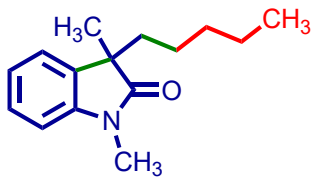
3c

1,3-Dimethyl-3-(2,2,2-trifluoroethyl)indolin-2-one (3c):[3] Synthesized by following a general procedure. Colorless oil (160 mg, 65% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.38. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.35 (td, J=7.6, 1.0 Hz, 1H), 7.30-7.26 (m, 1H), 7.11 (td, J=7.6, 1.0 Hz, 1H), 6.90 (d, J=7.6 Hz, 1H), 3.26 (s, 3H), 2.86-2.82 (m, 1H), 2.69-2.65 (m, 1H), 1.43 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 178.6, 142.9, 131.0, 128.5, 125.2 (q, J=274.2 Hz), 123.6, 122.7, 108.5, 44.4 (d, J=1.8 Hz), 40.7 (q, J=28.0 Hz), 26.4, 25.0. Spectra data are consistent with those reported in the literature.[3]



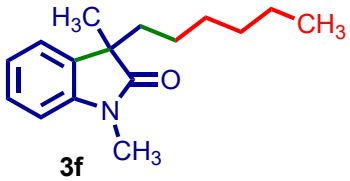
3d

3-(3,3-Dimethylbutyl)-1,3-dimethylindolin-2-one (3d):[4] Synthesized by following a general procedure. Pale-yellow oil (113 mg, 46% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.26 (t, J=7.2 Hz, 1H), 7.14 (d, J=7.2 Hz, 1H), 7.06 (t, J=7.4 Hz, 1H), 6.85 (d, J=7.4 Hz, 1H), 3.22 (s, 3H), 1.88-1.83 (m, 1H), 1.72-1.67 (m, 1H), 1.36 (s, 3H), 0.92-0.86 (m, 1H), 0.77 (s, 9H), 0.69-0.63 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.0, 143.5, 134.4, 127.7, 122.6, 122.5, 108.0, 48.4, 37.9, 33.5, 30.0, 29.3, 26.3, 24.2. Spectra data are consistent with those reported in the literature.[4]



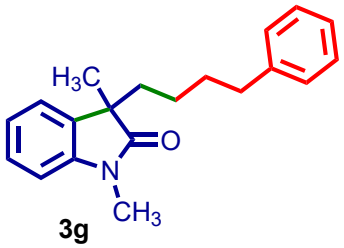
3e

1,3-Dimethyl-3-pentylindolin-2-one (3e):[2] Synthesized by following a general procedure. Pale-yellow oil (119 mg, 51% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.25 (t, J=6.8 Hz, 1H), 7.16 (d, J=6.8 Hz, 1H) 7.07 (t, J=7.8 Hz, 1H), 6.84 (d, J=7.8 Hz, 1H), 3.22 (s, 3H), 1.90-1.85 (m, 1H), 1.75-1.68 (m, 1H), 1.34 (s, 3H), 1.19-1.11 (m, 5H), 1.01-0.96 (m, 1H), 0.78 (t, J=7.2 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.1, 143.5, 134.5, 127.7, 122.6, 122.5, 108.0, 48.6, 38.6, 32.3, 26.3, 24.2, 23.9, 22.5, 14.1. Spectra data are consistent with those reported in the literature.[2]



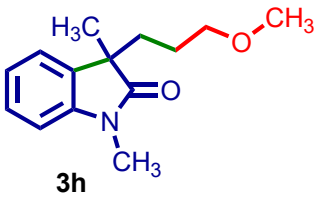
3f

3-Hexyl-1,3-dimethylindolin-2-one (3f):[4] Synthesized by following a general procedure. Pale-yellow oil (145 mg, 59% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27 (t, J=7.8 Hz, 1H), 7.16 (d, J=7.4 Hz, 1H), 7.07 (t, J=7.4 Hz, 1H), 6.84 (d, J=7.8 Hz, 1H), 3.21 (s, 3H), 1.90-1.86 (m, 1H), 1.73-1.68 (m, 1H), 1.35 (s, 3H), 1.22-1.07 (m, 6H), 0.99-0.94 (m, 1H), 0.76 (t, J=7.2 Hz, 4H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.0, 143.5, 134.5, 127.7, 122.6, 122.5, 108.0, 48.6, 38.7, 31.7, 29.5, 26.2, 24.5, 23.9, 22.7, 14.1. Spectra data are consistent with those reported in the literature.[4]



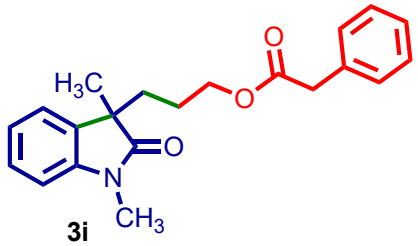
3g

1,3-Dimethyl-3-(4-phenylbutyl)indolin-2-one (3g):[4] Synthesized by following a general procedure. Pale-yellowish green oil (201 mg, 68% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.35. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.30-7.27 (m, 1H), 7.23 (t, J=7.4 Hz, 2H), 7.16-7.12 (m, 2H), 7.09-7.04 (m, 3H), 6.84 (d, J=7.4 Hz, 1H), 3.21 (s, 3H), 2.45 (t, J=7.8 Hz, 2H), 1.97-1.92 (m, 1H), 1.79-1.74 (m, 1H), 1.51-1.42 (m, 2H), 1.35 (s, 3H), 1.10-1.02 (m, 1H), 0.96-0.89 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.0, 143.5, 142.6, 134.3, 128.4, 128.3, 127.8, 125.7, 122.63, 122.58, 108.0, 48.6, 38.4, 35.8, 31.8, 26.3, 24.4, 23.9. Spectra data are consistent with those reported in the literature.[4]



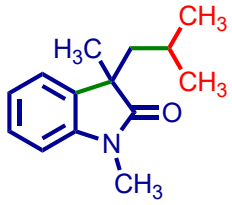
3h

3-(3-Methoxypropyl)-1,3-dimethylindolin-2-one (3h):[5] Synthesized by following a general procedure. Pale-yellow oil (140 mg, 60% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27-7.22 (m, 1H), 7.19 (d, J=7.2 Hz, 1H), 7.04 (t, J=7.4 Hz, 1H), 6.84 (d, J=7.4 Hz, 1H), 3.22 (s, 3H), 3.20 (s, 3H), 1.96-1.90 (m, 2H), 1.84-1.78 (m, 2H), 1.37 (s, 3H), 1.28-1.23 (m, 1H), 1.17-1.11 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.7, 143.4, 134.1, 127.9, 122.7, 108.1, 72.5, 58.5, 48.3, 35.1, 26.3, 24.8, 23.8. Spectra data are consistent with those reported in the literature.[5]



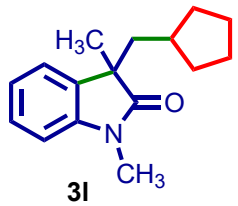
3i

3-(1,3-Dimethyl-2-oxoindolin-3-yl)propyl 2-phenylacetate (3i): Synthesized by following a general procedure. Yellow oil (213 mg, 63% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.31-7.27 (m, 2H), 7.26-7.20 (m, 4H), 7.15-7.13 (m, 1H), 7.09-7.07 (m, 1H), 6.85 (d, J=7.8 Hz, 1H), 3.95 (t, J=6.2 Hz, 2H), 3.54 (s, 2H), 3.21 (s, 3H), 1.88 (td, J=12.6, 4.4 Hz, 1H), 1.73 (td, J=12.6, 4.4 Hz, 1H), 1.53-1.42 (m, 2H), 1.34 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.7, 171.7, 143.4, 134.2, 134.1, 129.3, 128.6, 127.9, 127.1, 122.64, 122.57, 108.1, 64.5, 48.4, 41.5, 38.1, 28.7, 26.3, 23.9.



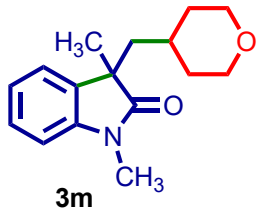
3j

3-Isobutyl-1,3-dimethylindolin-2-one (3j):[2] Synthesized by following a general procedure. Pale-yellow solid (173 mg, 79% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.37. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27 (t, J=7.8 Hz, 1H), 7.16 (d, J=7.2 Hz, 1H), 7.07 (t, J=7.2 Hz, 1H), 6.85 (d, J=7.8 Hz, 1H), 3.24 (s, 3H), 1.93 (dd, J=13.6, 6.2 Hz, 1H), 1.76 (dd, J=13.6, 6.2 Hz, 1H), 1.32 (s, 3H), 1.29-1.22 (m, 1H), 0.62 (dd, J=18.4, 6.2 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.2, 143.4, 134.4, 127.7, 122.9, 122.5, 108.1, 48.2, 46.9, 26.32, 26.27, 25.7, 24.2, 23.0. Spectra data are consistent with those reported in the literature.[2]



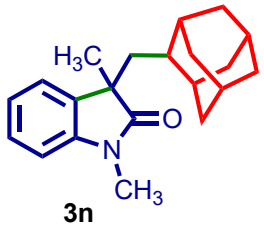
3l

3-(Cyclopentylmethyl)-1,3-dimethylindolin-2-one (3l):[2] Synthesized by following a general procedure. Yellow oil (189 mg, 77% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27 (t, J=7.2 Hz, 1H), 7.16 (d, J=7.2 Hz, 1H), 7.04 (t, J=7.4 Hz, 1H), 6.85 (d, J=7.4 Hz, 1H), 3.21 (s, 3H), 2.05 (dd, J=13.6, 6.2 Hz, 1H), 1.89 (dd, J=13.6, 6.2 Hz, 1H), 1.49-1.35 (m, 4H), 1.33-1.22 (m, 7H), 1.04-0.97 (m, 1H), 0.86-0.76 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.2, 143.4, 134.6, 127.7, 123.0, 122.4, 107.9, 48.6, 44.6, 37.4, 33.9, 32.8, 26.3, 25.4, 25.1, 25.0. Spectra data are consistent with those reported in the literature.[2]



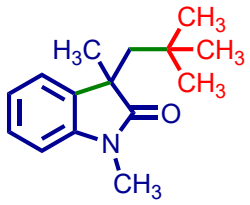
3m

1,3-Dimethyl-3-((tetrahydro-2H-pyran-4-yl)methyl)indolin-2-one (3m):[5] Synthesized by following a general procedure. Yellow oil (209 mg, 81% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.31. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.25 (t, J=8.2 Hz, 1H), 7.15 (d, J=7.4 Hz, 1H), 7.06 (t, J=7.4 Hz, 1H), 6.83 (d, J=8.2 Hz, 1H), 3.81-3.72 (m, 2H), 3.21 (s, 3H), 3.13-3.05 (m, 2H), 1.99 (dd, J=13.8, 5.6 Hz, 1H), 1.77 (dd, J=13.8, 5.6 Hz, 1H), 1.33-0.98 (m, 8H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.9, 143.1, 134.2, 127.9, 122.8, 122.6, 108.2, 67.8, 67.76, 47.8, 45.0, 34.1, 33.5, 32.3, 26.4, 26.2. Spectra data are consistent with those reported in the literature.[5]



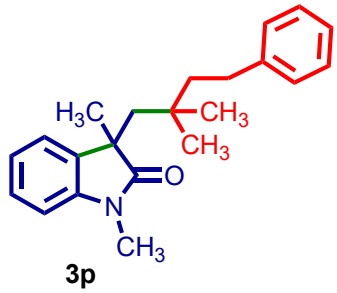
3n

3-((1R,2S,5S)-Adamantan-2-ylmethyl)-1,3-dimethylindolin-2-one (3n):[5] Synthesized by following a general procedure. Pale-yellow oil (264 mg, 85% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.25 (t, J=7.4 Hz, 1H), 7.16 (d, J=7.4 Hz, 1H), 7.02 (t, J=7.4 Hz, 1H), 6.82 (d, J=7.4 Hz, 1H), 3.21 (s, 3H), 2.12 (dd, J=13.8, 5.6 Hz, 1H), 1.89-1.84 (m, 2H), 1.80 (d, J=11.6 Hz, 1H), 1.68-1.56 (m, 6H), 1.49-1.34 (m, 8H), 1.26 (s, 1H), 1.12 (s, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.1, 143.4, 134.4, 127.7, 122.7, 122.4, 108.0, 48.5, 41.8, 41.2, 39.15, 39.13, 38.2, 33.4, 32.8, 31.9, 31.8, 27.8, 27.76, 26.3, 25.2. Spectra data are consistent with those reported in the literature.[5]



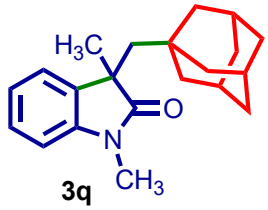
3o

1,3-Dimethyl-3-neopentylindolin-2-one (3o):[2] Synthesized by following a general procedure. Pale-yellow oil (186 mg, 80% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.37. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.26 (t, J=7.8 Hz, 1H), 7.18 (d, J=7.4 Hz, 1H), 7.01 (t, J=7.4 Hz, 1H), 6.85 (d, J=7.8 Hz, 1H), 3.21 (s, 3H), 2.15 (d, J=14.0 Hz, 1H), 1.87 (d, J=14.0 Hz, 1H), 1.29 (s, 3H), 0.61 (s, 9H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.1, 143.0, 134.3, 127.6, 124.0, 122.1, 108.1, 50.9, 47.5, 31.9, 30.9, 28.4, 26.3. Spectra data are consistent with those reported in the literature.[2]



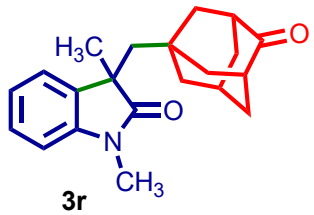
3p

3-(2,2-Dimethyl-4-phenylbutyl)-1,3-dimethylindolin-2-one (3p):[5] Synthesized by following a general procedure. Pale-yellow oil (278 mg, 86% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.35. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.29-7.22 (m, 4H), 7.16 (t, J=7.4 Hz, 1H), 7.10 (d, J=7.4 Hz, 2H), 7.06-7.02 (m, 1H), 6.86 (d, J=7.8 Hz, 1H), 3.19 (s, 3H), 2.58-2.47 (m, 2H), 2.27 (d, J=14.0 Hz, 1H), 1.95 (d, J=14.0 Hz, 1H), 1.34-1.18 (m, 6H), 0.67 (s, 3H), 0.61 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.1, 143.2, 142.9, 134.3, 128.33, 128.27, 127.7, 125.5, 123.9, 122.1, 108.2, 48.7, 47.3, 46.1, 34.5, 30.5, 28.5, 28.4, 27.7, 26.3. Spectra data are consistent with those reported in the literature.[5]



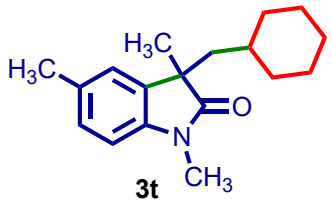
3q

3-((1s,3s)-Adamantan-1-ylmethyl)-1,3-dimethylindolin-2-one (3q):[5] Synthesized by following a general procedure. Pale-yellow oil (270 mg, 87% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.36. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.27 (t, J=7.8 Hz, 1H), 7.18 (d, J=7.4 Hz, 1H), 7.03 (t, J=7.4 Hz, 1H), 6.83 (d, J=7.8 Hz, 1H), 3.23 (s, 3H), 2.00 (d, J=13.6 Hz, 1H), 1.74-1.72 (m, 4H), 1.51 (d, J=11.2 Hz, 3H), 1.38 (d, J=11.2 Hz, 3H), 1.27 (s, 3H), 1.18 (q, J=11.4 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.3, 142.7, 134.8, 127.6, 123.7, 122.1, 108.1, 52.2, 46.8, 43.4, 36.8, 34.0, 28.72, 28.67, 26.4. Spectra data are consistent with those reported in the literature.[5]



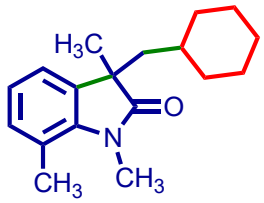
3r

1,3-Dimethyl-3-(((1S,3S)-4-oxoadamantan-1-yl)methyl)indolin-2-one (3r):[5] Synthesized by following a general procedure. Pale-yellow wax (272 mg, 84% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.33. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.25 (t, J=7.8 Hz, 1H), 7.15 (d, J=7.4 Hz, 1H), 7.02 (t, J=7.4 Hz, 1H), 6.83 (d, J=7.8 Hz, 1H), 3.21 (s, 3H), 2.29 (s, 2H), 2.11 (d, J=14.0 Hz, 1H), 1.90 (s, 1H), 1.82-1.67 (m, 5H), 1.50-1.37 (m, 6H), 1.26 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 218.0, 180.7, 142.6, 133.9, 128.0, 123.4, 122.4, 108.5, 49.7, 46.7, 46.5, 46.3, 44.7, 43.7, 42.2, 38.53, 38.49, 33.9, 28.7, 27.8, 26.4. Spectra data are consistent with those reported in the literature.[5]



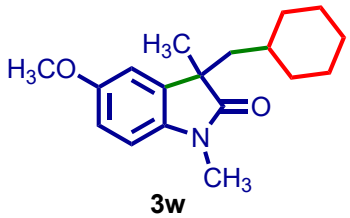
3t

3-(Cyclohexylmethyl)-1,3,5-trimethylindolin-2-one (3t):[6] Synthesized by following a general procedure. Pale-yellow wax (215 mg, 79% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.05 (d, J=7.8 Hz, 1H), 6.96 (s, 1H), 6.72 (d, J=7.8 Hz, 1H), 3.19 (s, 3H), 2.34 (s, 3H), 1.91 (dd, J=13.6, 6.4 Hz 1H), 1.69 (dd, J=13.6 Hz, 6.4 Hz 1H), 1.52-1.47 (m, 3H), 1.35-1.33 (m, 1H), 1.29 (s, 3H), 1.23-1.20 (m, 1H), 1.02-0.91 (m, 4H), 0.84-0.70 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.3, 140.9, 134.6, 131.9, 127.9, 123.7, 107.8, 48.0, 45.6, 34.8, 34.6, 33.6, 26.4, 26.38, 26.27, 26.16, 21.4. Spectra data are consistent with those reported in the literature.[6]



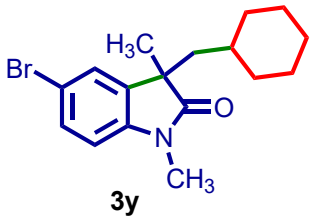
3v

3-(Cyclohexylmethyl)-1,3,7-trimethylindolin-2-one (3v):[6] Synthesized by following a general procedure. Yellow oil (153 mg, 56% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.99-6.92 (m, 3H), 3.48 (s, 3H), 2.59 (3H), 1.91 (dd, J=13.8, 6.6 Hz, 1H), 1.68 (dd, J=13.8, 6.6 Hz 1H), 1.54-1.46 (m, 3H), 1.37-1.33 (m, 1H), 1.28 (s, 3H), 1.22-1.20 (m, 1H), 1.00-0.68 (m, 6H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 182.1, 141.0, 135.2, 131.4, 122.4, 120.8, 119.6, 47.3, 45.8, 34.8, 34.6, 33.7, 29.7, 26.8, 26.3, 26.2, 19.3. Spectra data are consistent with those reported in the literature.[6]



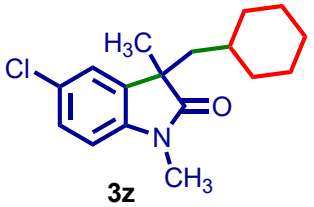
3w

3-(Cyclohexylmethyl)-5-methoxy-1,3-dimethylindolin-2-one (3w):[6] Synthesized by following a general procedure. Yellow oil (205 mg, 71% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.32. ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.79–6.72 (m, 3H), 3.81 (s, 3H), 3.19 (s, 3H), 1.92 (dd, J=13.8, 6.6 Hz, 1H), 1.68 (dd, J=13.8, 6.6 Hz, 1H), 1.53-1.46 (m, 3H), 1.36-1.20 (m, 5H), 1.03-0.94 (m, 4H), 0.87-0.74 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.9, 155.9, 136.7, 135.9, 111.4, 110.5, 108.1, 55.8, 48.4, 45.4, 34.7, 34.4, 33.5, 26.3, 26.2, 26.1, 26.0. Spectra data are consistent with those reported in the literature.[6]



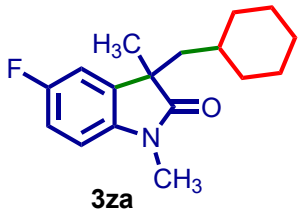
3y

5-Bromo-3-(cyclohexylmethyl)-1,3-dimethylindolin-2-one (3y):[6] Synthesized by following a general procedure. Yellow wax (246 mg, 73% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 (d, J = 8.2, 1H), 7.25 (s, 1H), 6.71 (d, J = 8.2 Hz, 1H), 3.21 (s, 3H), 1.94 (dd, J=13.6, 6.8 Hz, 1H), 1.71 (dd, J=13.6, 6.8 Hz, 1H), 1.52-1.46 (m, 3H), 1.32-1.21 (m, 5H), 1.06-0.88 (m, 4H), 0.85-0.69 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.4, 142.2, 136.6, 130.4, 125.9, 115.1, 109.4, 48.1, 45.3, 34.7, 34.4, 33.4, 33.3, 26.6, 26.3, 26.1, 26.0, 25.9. Spectra data are consistent with those reported in the literature.[6]



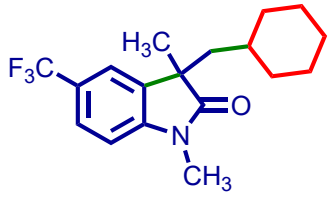
3z

5-Chloro-3-(cyclohexylmethyl)-1,3-dimethylindolin-2-one (3z):[6] Synthesized by following a general procedure. Yellow oil (240 mg, 82% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.29-7.21 (m, 1H), 7.13 (s, 1H), 6.77 (d, J=7.8 Hz, 1H), 3.19 (s, 3H), 1.93 (dd, J=12.6, 6.4 Hz, 1H), 1.70 (dd, J=12.6, 6.4 Hz, 1H), 1.52-1.47 (m, 3H), 1.33-1.19 (m, 5H), 1.02-0.81 (m, 4H), 0.80-0.67 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.5, 141.7, 136.2, 127.7, 127.5, 123.2, 108.8, 48.1, 45.3, 34.7, 34.4, 33.4, 26.3, 26.2, 26.0, 25.9. Spectra data are consistent with those reported in the literature.[6]



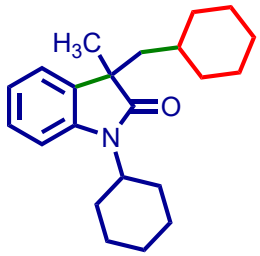
3za

3-(Cyclohexylmethyl)-5-fluoro-1,3-dimethylindolin-2-one (3za):[5] Synthesized by following a general procedure. Yellow oil (191 mg, 69% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.35. ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.98-6.93 (m, 1H), 6.91 (dd, J=7.8, 3.6 Hz, 1H), 6.76 (dd, J=7.8, 3.6 Hz, 1H), 3.20 (s, 3H), 1.93 (dd, J=13.6, 4.8 Hz, 1H), 1.71 (dd, J=13.6, 4.8 Hz, 1H), 1.53-1.45 (m, 3H), 1.35-1.18 (m, 5H), 1.02-0.92 (m, 4H), 0.91-0.74 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.9, 159.5(d, J=238.6 Hz), 139.2, 136.3 (d, J=7.2 Hz), 113.9 (d, J=22.8 Hz), 111.1 (d, 24.0 Hz), 108.5 (d, 7.8 Hz), 48.5, 45.5, 34.9, 34.5, 33.6, 26.5, 26.3, 26.23, 26.19. Spectra data are consistent with those reported in the literature.[5]



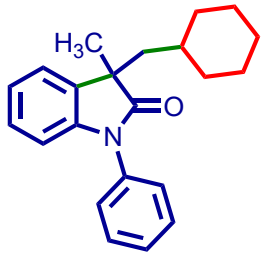
3zb

3-(Cyclohexylmethyl)-1,3-dimethyl-5-(trifluoromethyl)indolin-2-one (3zb):[3] Synthesized by following a general procedure. Yellow oil (190 mg, 58% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.34. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.57-7.54 (m, 1H), 7.39 (d, J=1.8 Hz, 1H), 6.92 (d, J=7.8 Hz, 1H), 3.25 (s, 3H), 1.97 (dd, J=14.2, 5.4 Hz, 1H), 1.76 (dd, J=14.2, 5.4 Hz, 1H), 1.50-1.46 (m, 3H), 1.34-1.16 (m, 5H), 1.03-0.91 (m, 4H), 0.87-0.70 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.0, 146.0, 135.0, 128.5, 125.8, 125.3 (q, J=4.0 Hz), 124.5 (q, J=30.8 Hz), 124.3 (q, J=268.6 Hz), 119.7 (q, J=3.6 Hz), 107.8, 47.8, 45.2, 34.7, 34.3, 33.5, 26.4, 26.0, 25.9. Spectra data are consistent with those reported in the literature.[3]



3zc

1-Cyclohexyl-3-(cyclohexylmethyl)-3-methylindolin-2-one (3zc):[5] Synthesized by following a general procedure. Pale-yellow oil (270 mg, 83% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.31. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.21-7.19 (m, 1H), 7.16-7.12 (m, 1H), 7.07-7.01 (m, 2H), 4.23-4.19 (m, 1H), 2.17-2.12 (m, 2H), 1.93-1.89 (m, 3H), 1.76-1.65 (m, 4H), 1.52-1.41 (m, 5H), 1.34-1.31 (m, 1H), 1.27 (s, 3H), 1.15-1.11 (m, 1H), 1.00-0.78 (m, 5H), 0.73-0.51 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 181.0, 142.3, 135.1, 127.3, 123.0, 121.8, 110.1, 51.9, 47.5, 45.8, 35.0, 34.5, 33.9, 29.2, 29.1, 26.4, 26.3, 26.2, 25.6. Spectra data are consistent with those reported in the literature.[5]



3zd

3-(Cyclohexylmethyl)-3-methyl-1-phenylindolin-2-one (3zd):[6] Synthesized by following a general procedure. Yellow solid (246 mg, 77% yield). R_f (ethyl acetate:n-hexane, 1:5): 0.32. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.50-7.47 (m, 2H), 7.41-7.37 (m, 3H), 7.23-7.17 (m, 2H), 7.10-7.07 (m, 1H), 6.82 (d, J=7.8 Hz, 1H), 2.03 (dd, J=13.8, 6.6 Hz, 1H), 1.83 (dd, J=13.8, 6.6 Hz, 1H), 1.56-1.51 (m, 4H), 1.45 (s, 3H), 1.16-1.13 (m, 1H), 1.00-0.81 (m, 4H), 0.79-0.72 (m, 1H), 0.70-0.62 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$) δ 180.6, 143.2, 134.3, 129.7, 128.0, 127.6, 126.6, 123.2, 123.0, 109.4, 48.1, 46.0, 35.1, 34.6, 33.7, 26.6, 26.3, 26.2. Spectra data are consistent with those reported in the literature.[6]

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Copies of NMR spectra of products

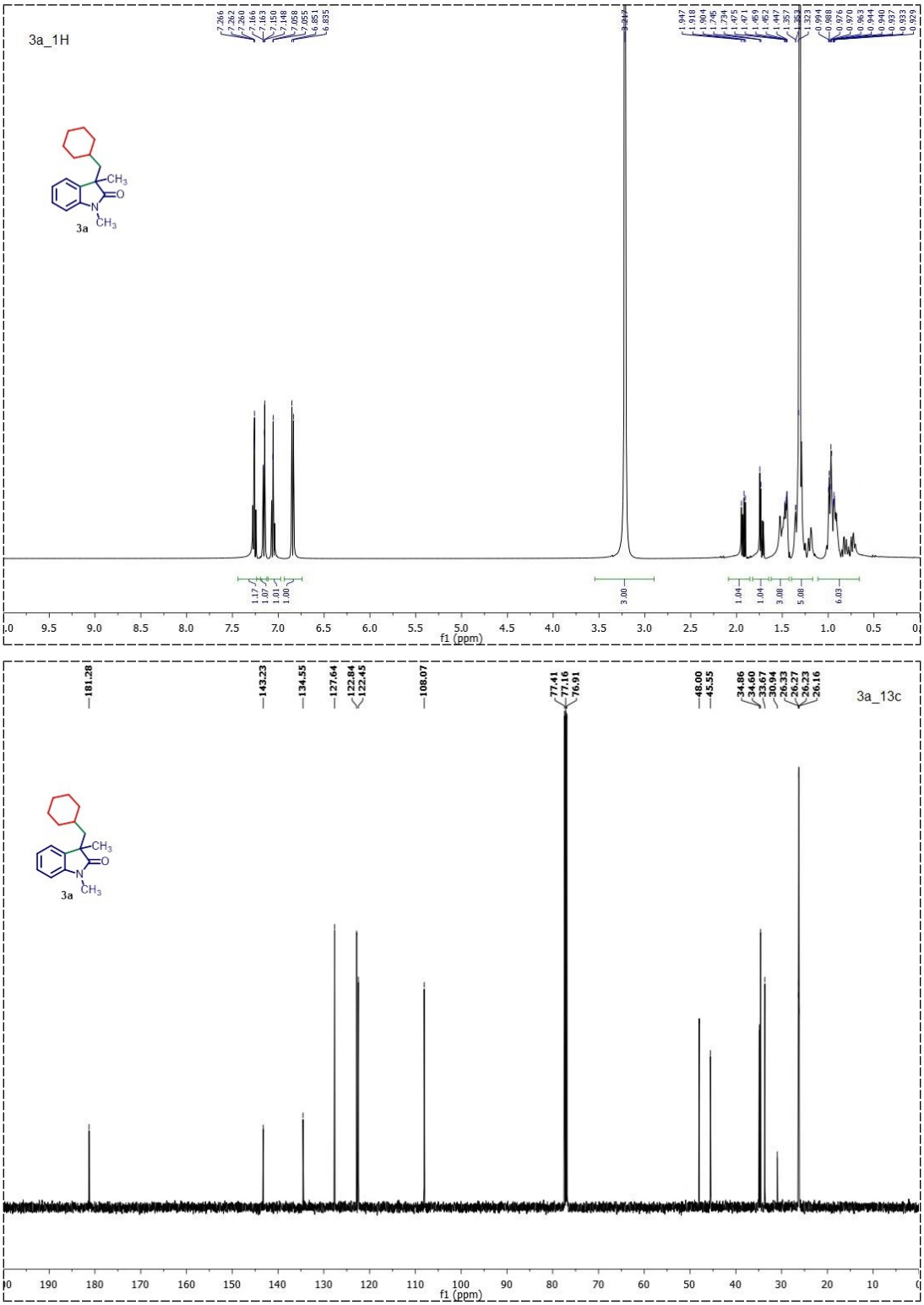

Figure S3. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3a** in $CDCl_3$.

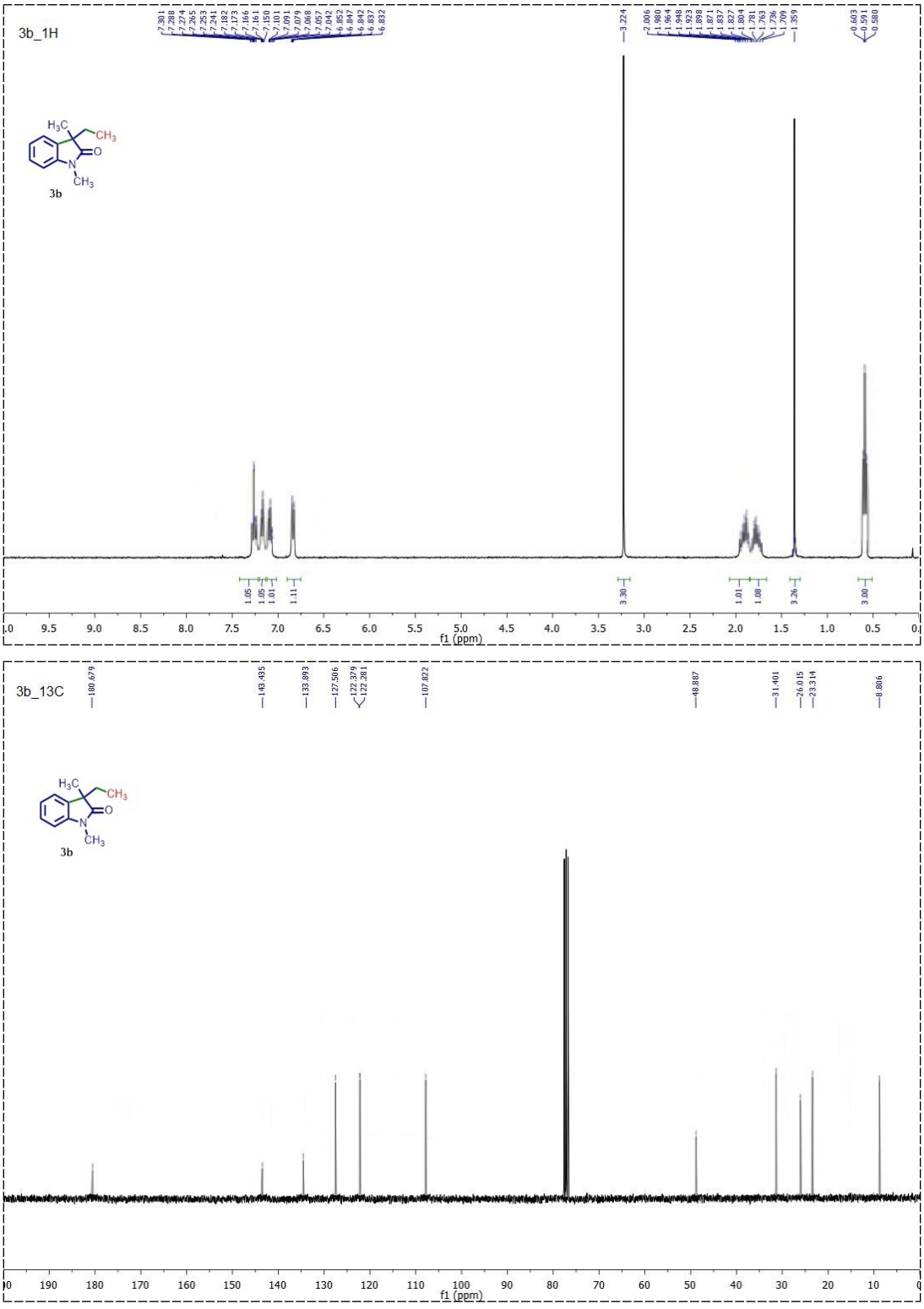

Figure S4. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3b** in $CDCl_3$.

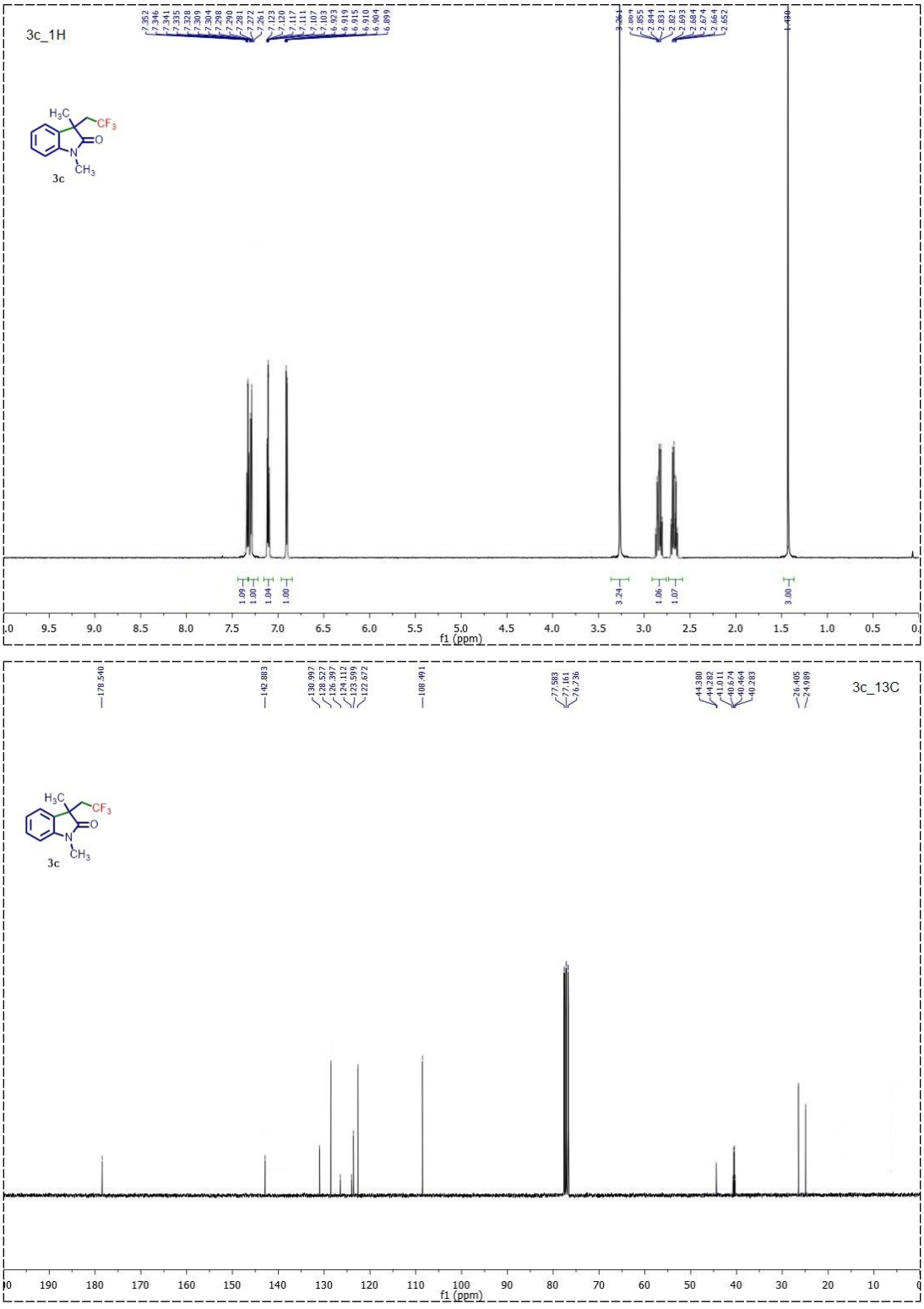

Figure S5. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3c** in $CDCl_3$.

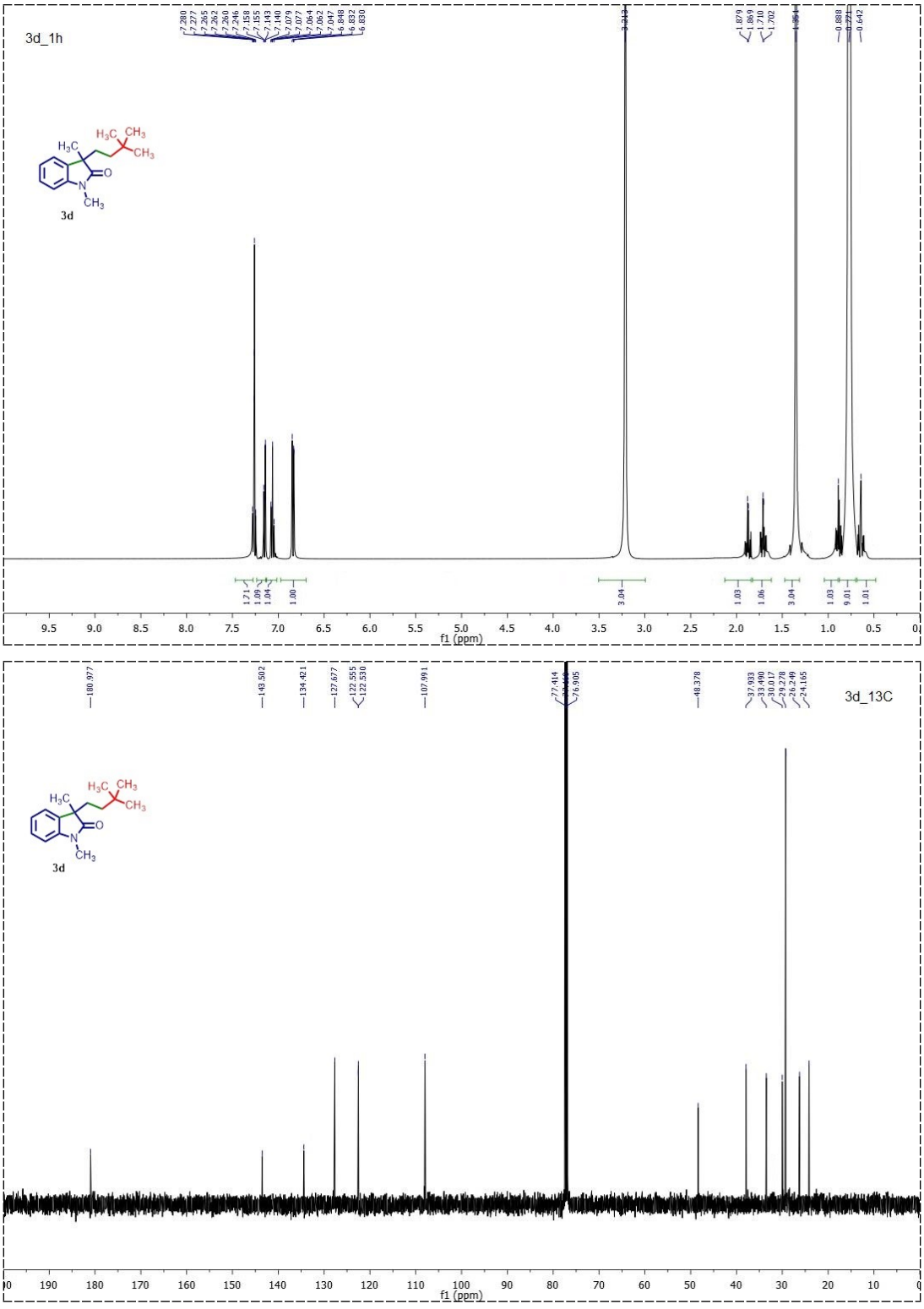

Figure S6. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3d** in $CDCl_3$.

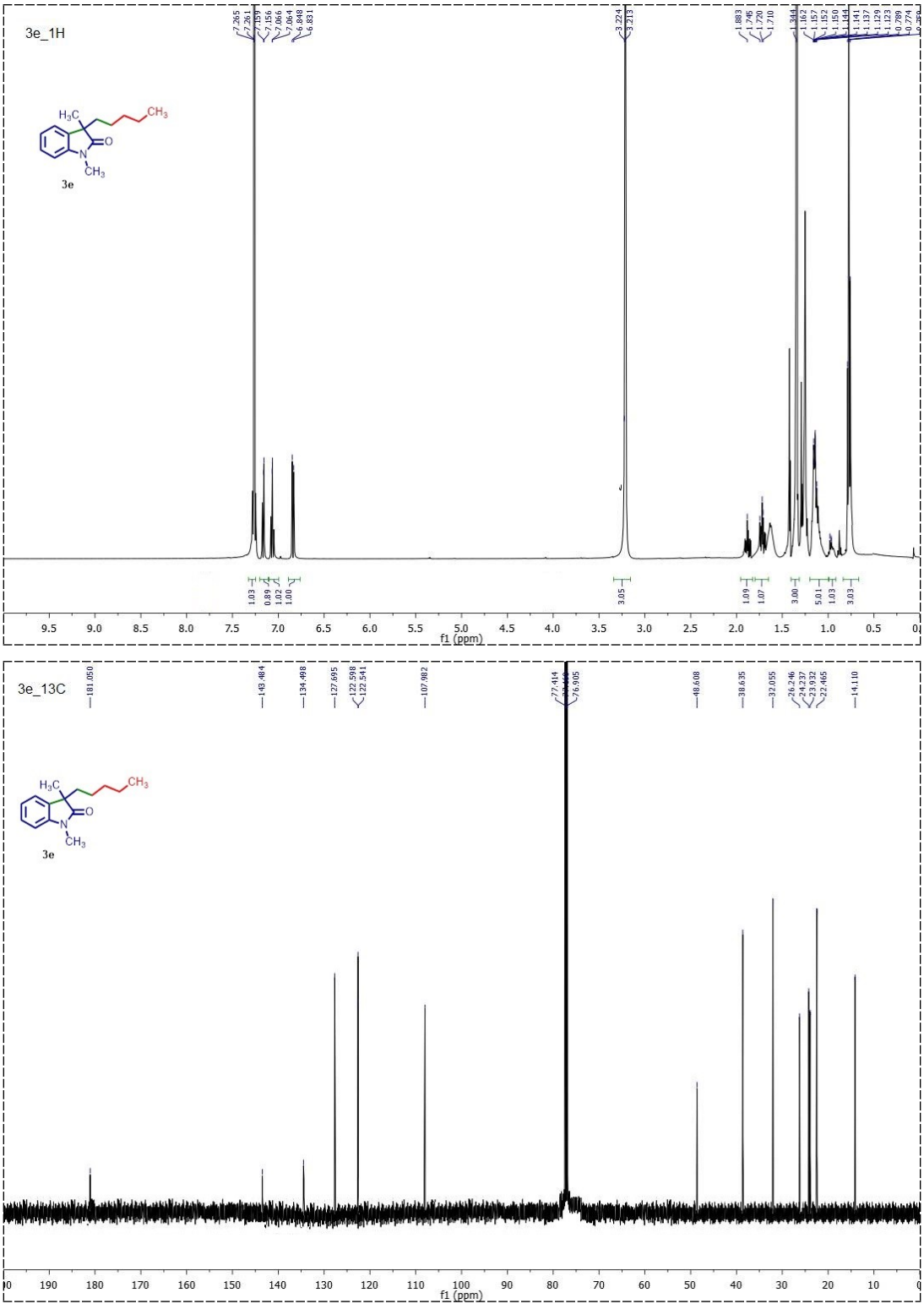

Figure S7. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3e** in $CDCl_3$.

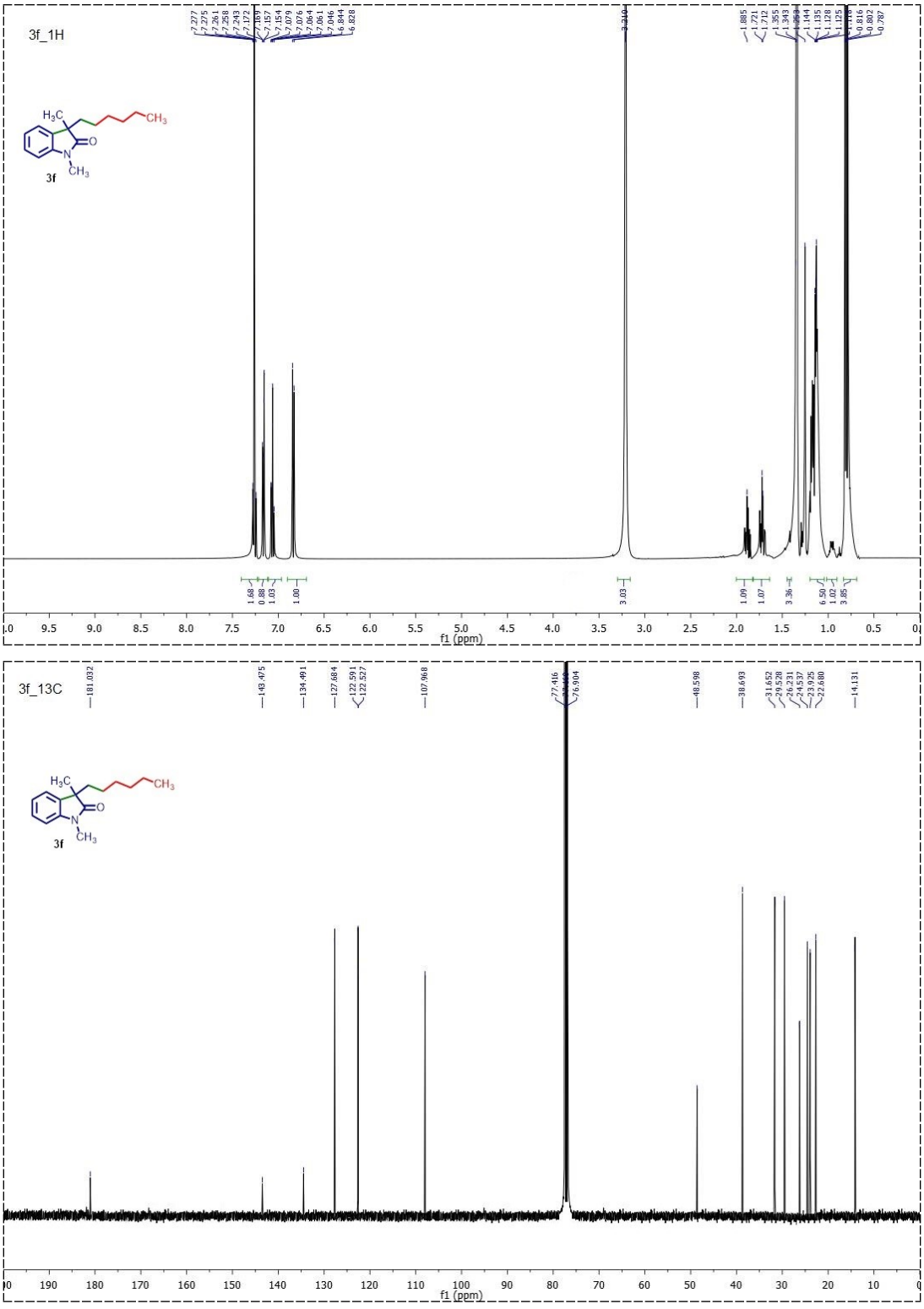

Figure S8. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3f** in $CDCl_3$.

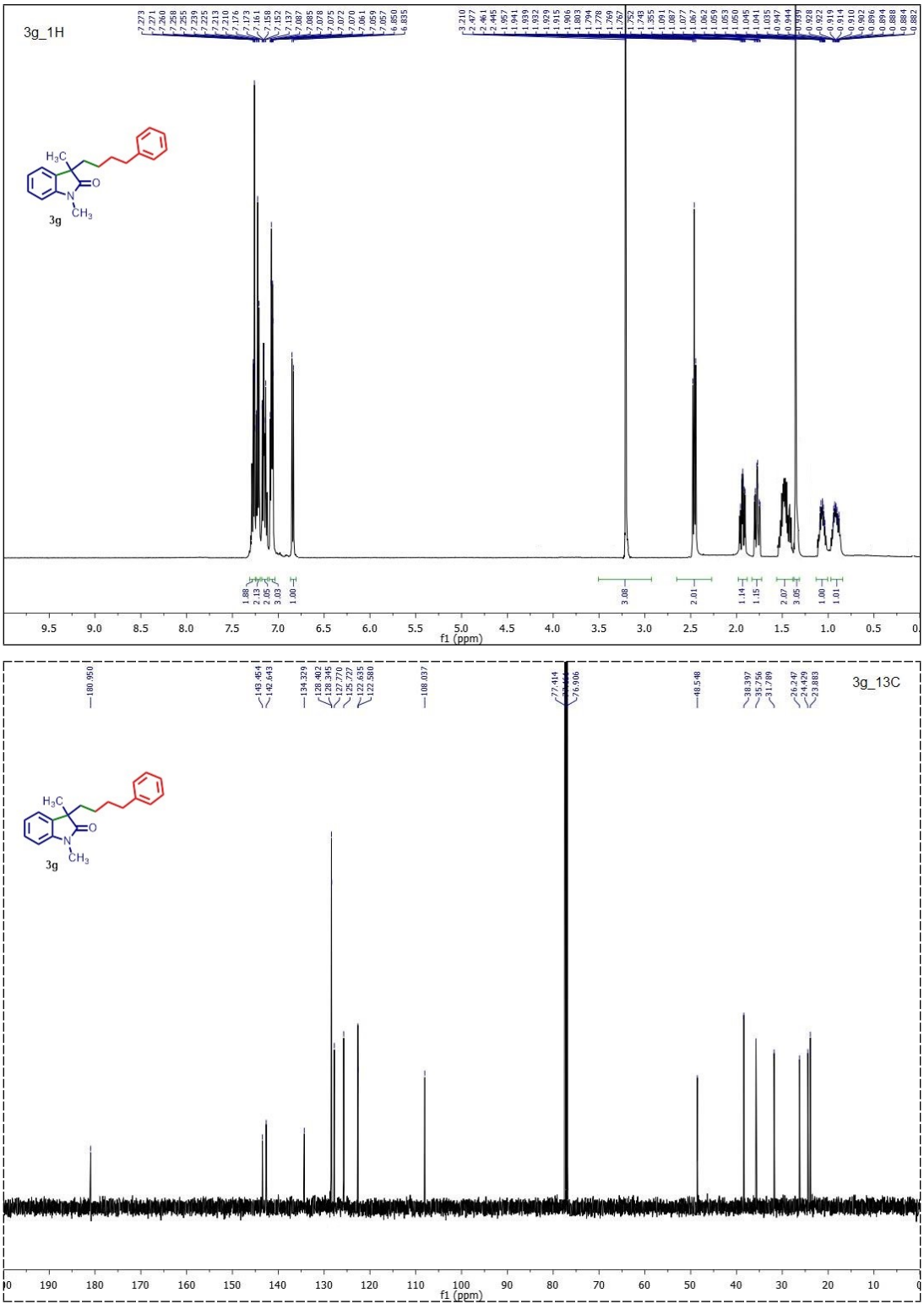

Figure S9. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3g** in $CDCl_3$.

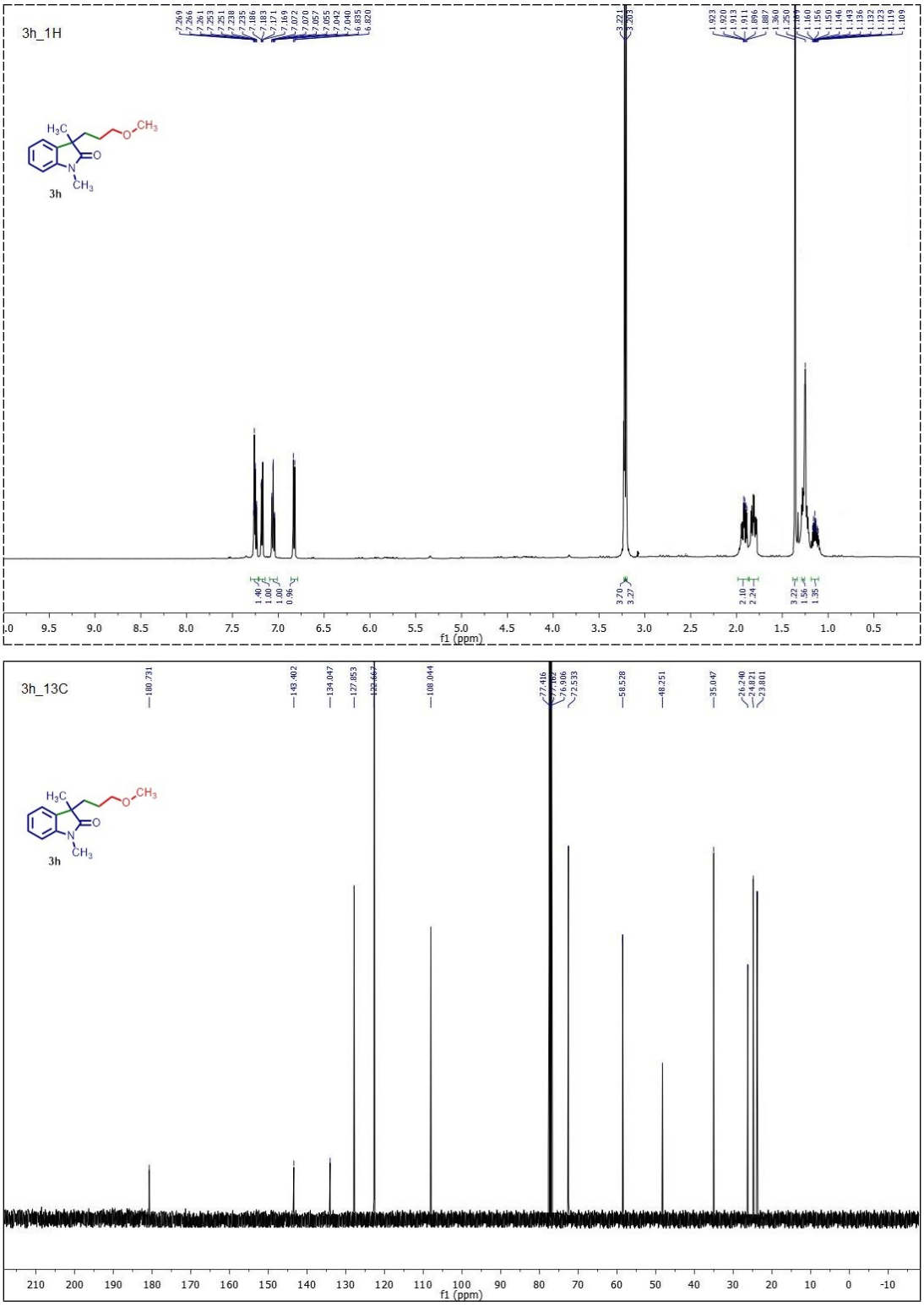

Figure S10. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3h** in $CDCl_3$.

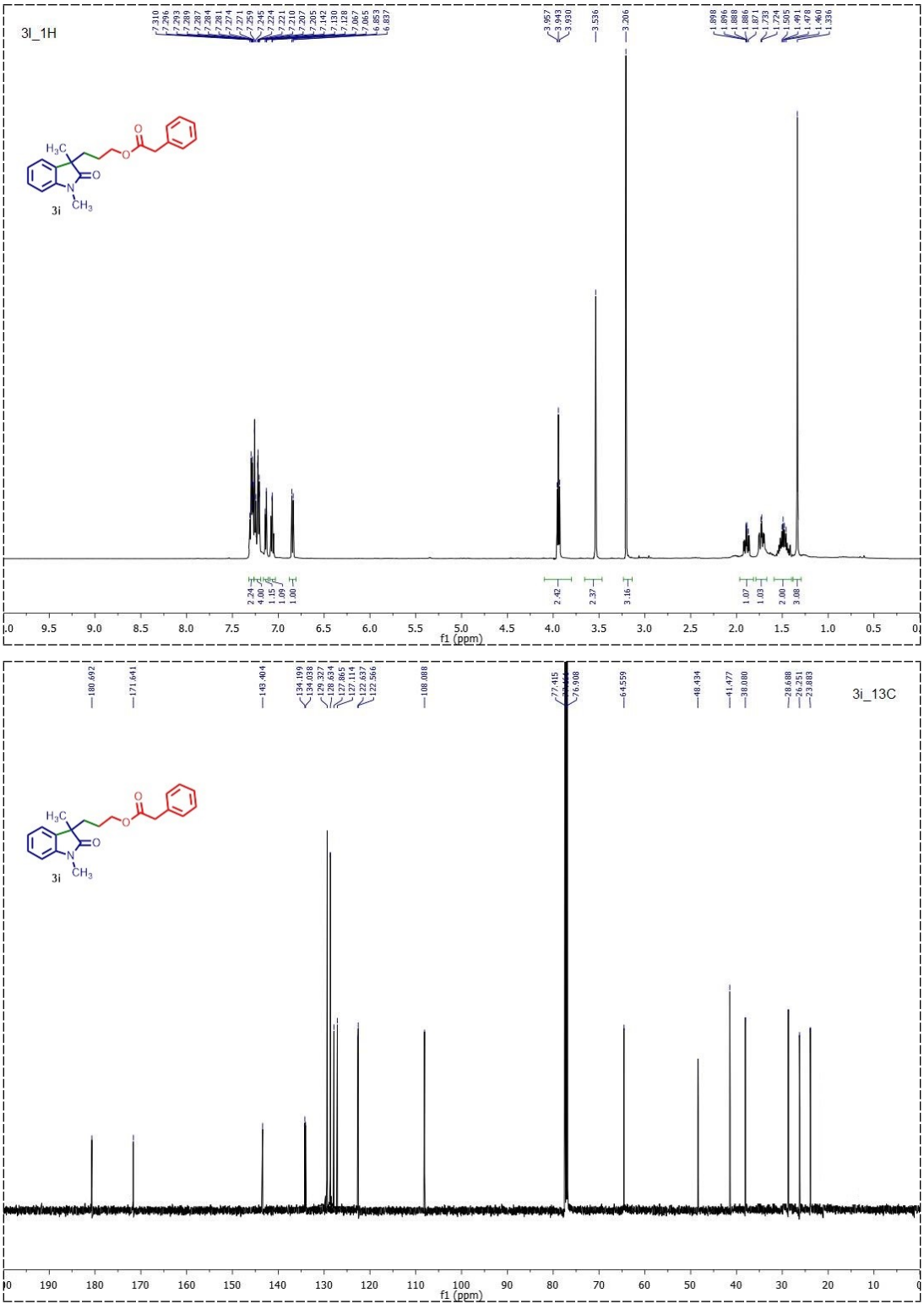

Figure S11. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3i** in $CDCl_3$.

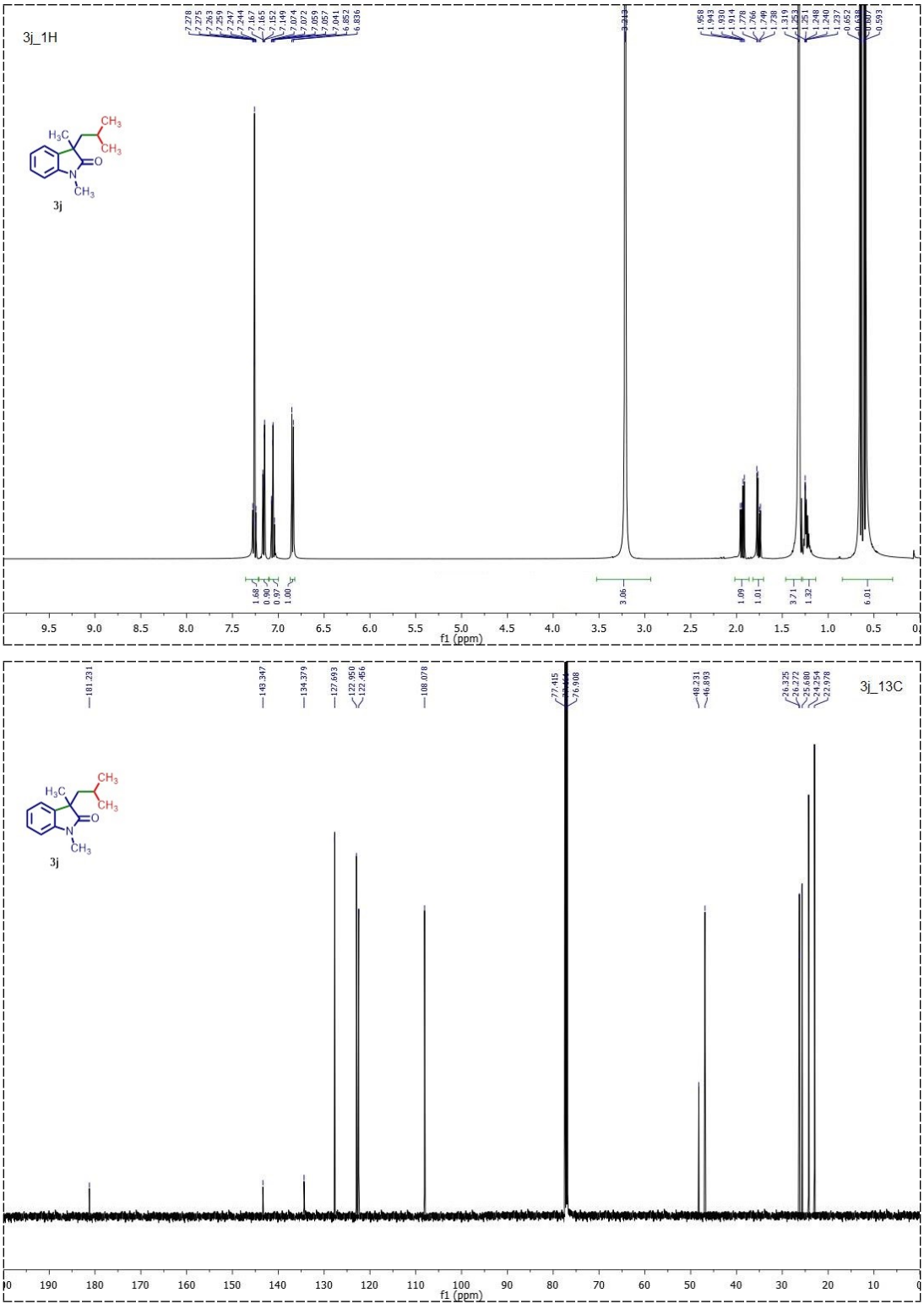

Figure S12. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3j** in $CDCl_3$.

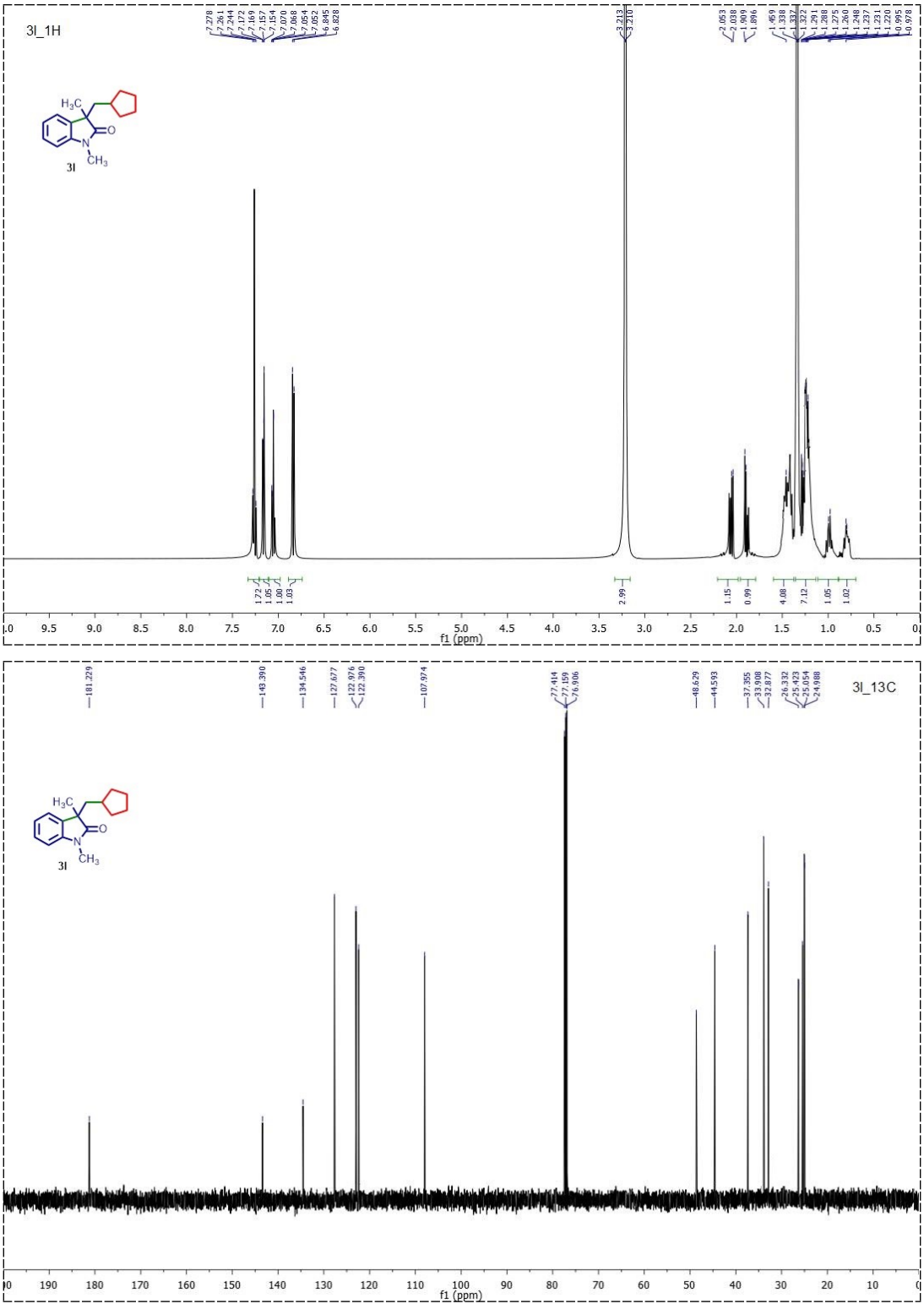

Figure S13. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3l** in $CDCl_3$.

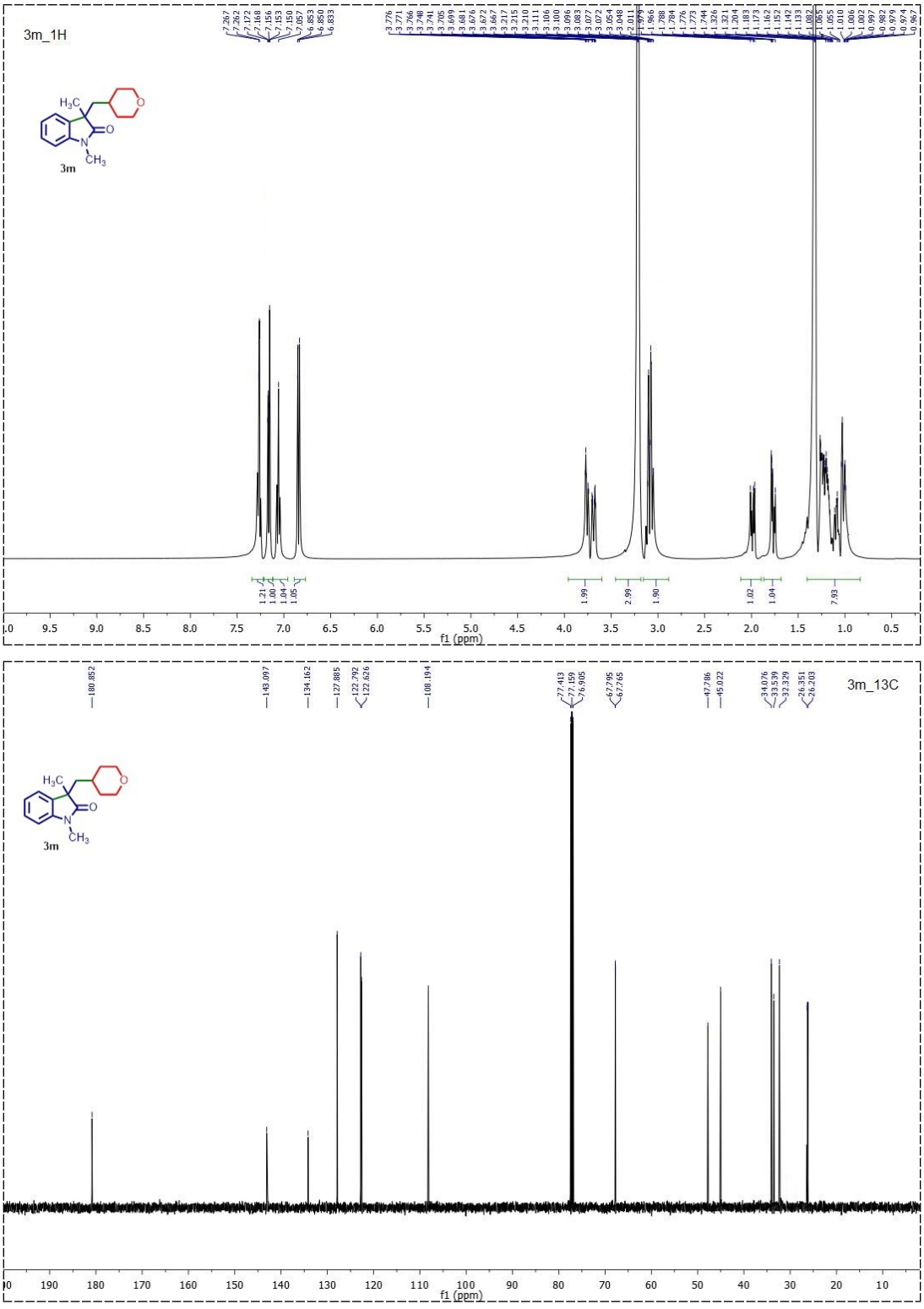

Figure S14. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3m** in $CDCl_3$.

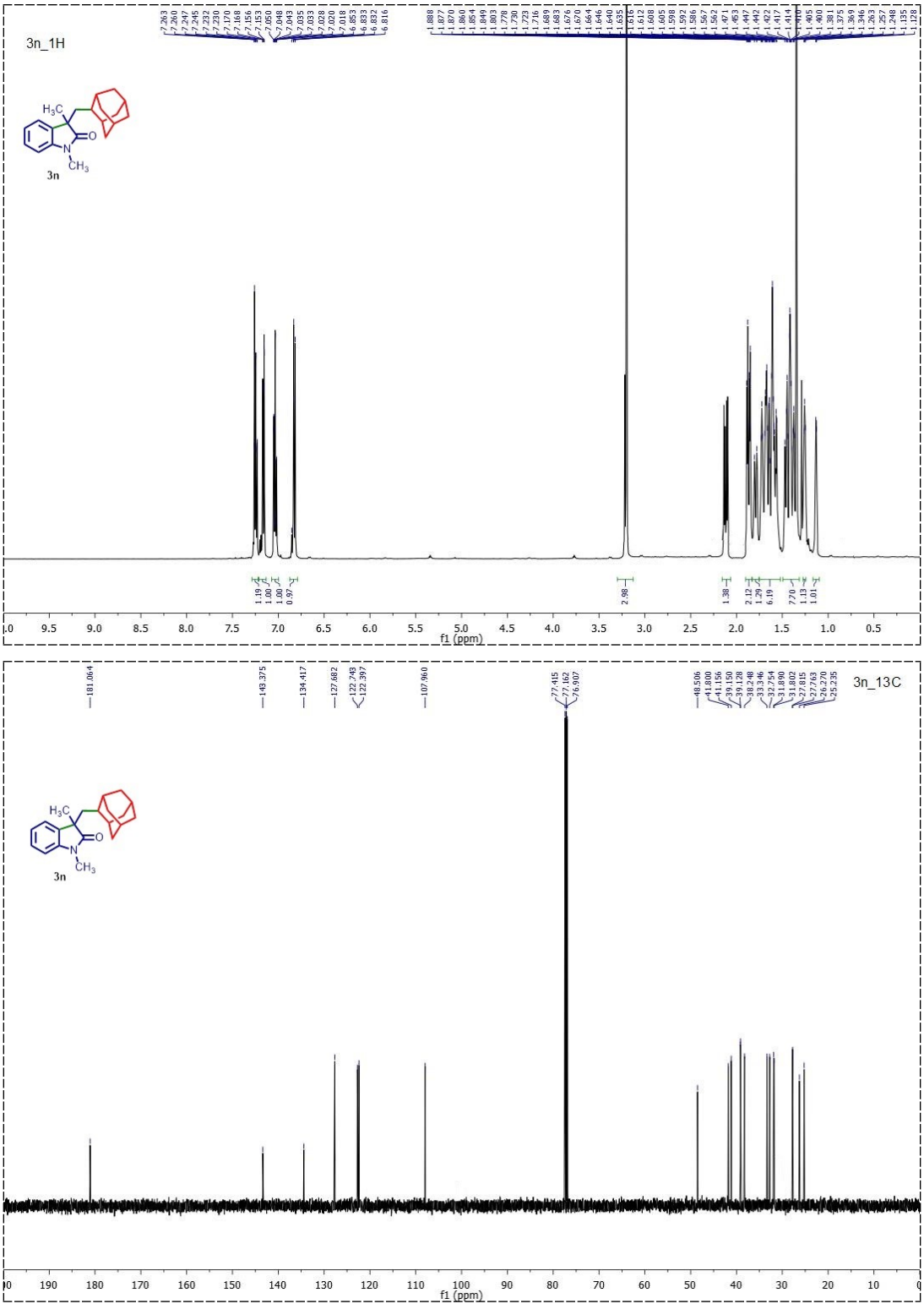

Figure S15. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3n** in $CDCl_3$.

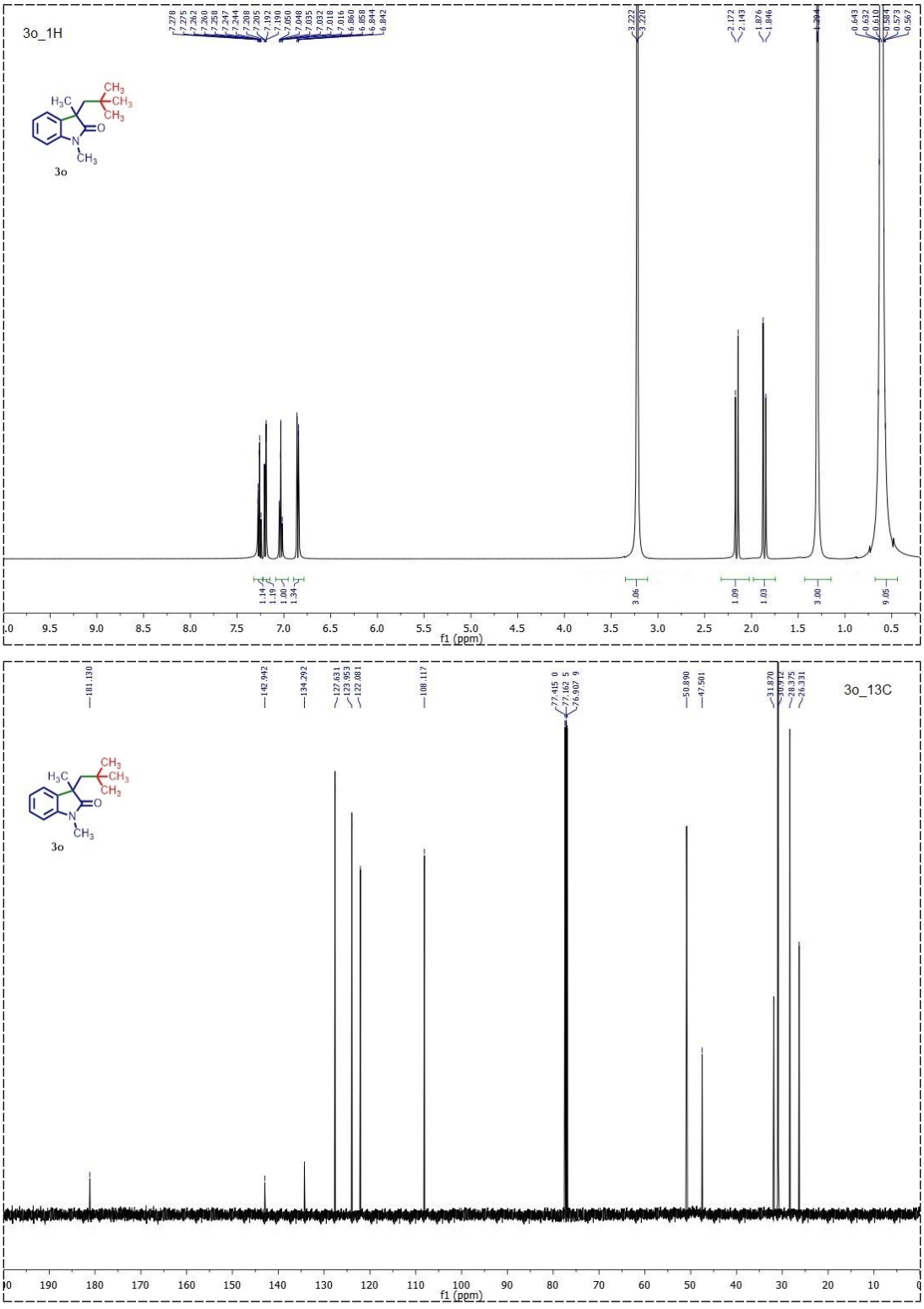

Figure S16. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3o** in $CDCl_3$.

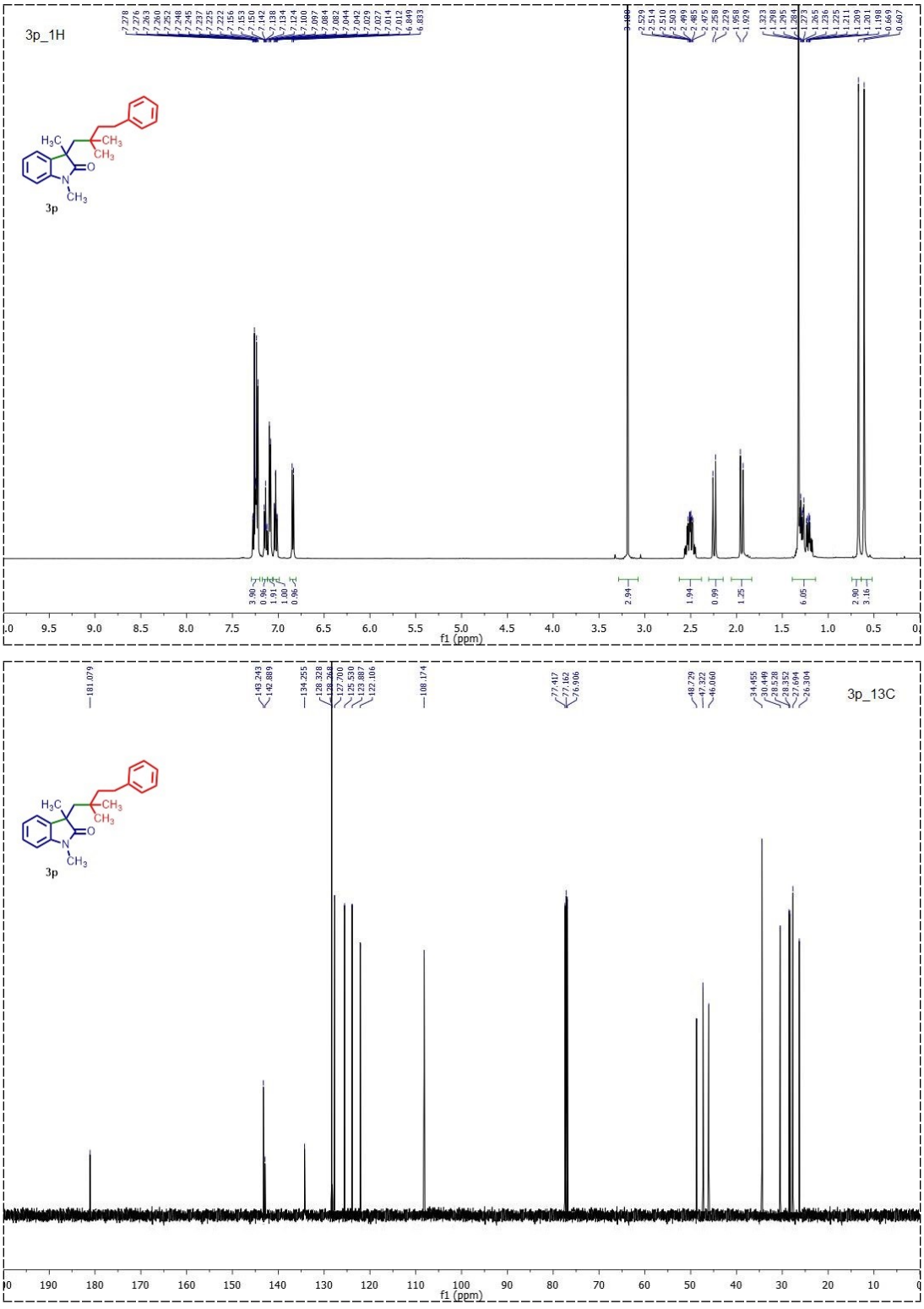

Figure S17. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3p** in $CDCl_3$.

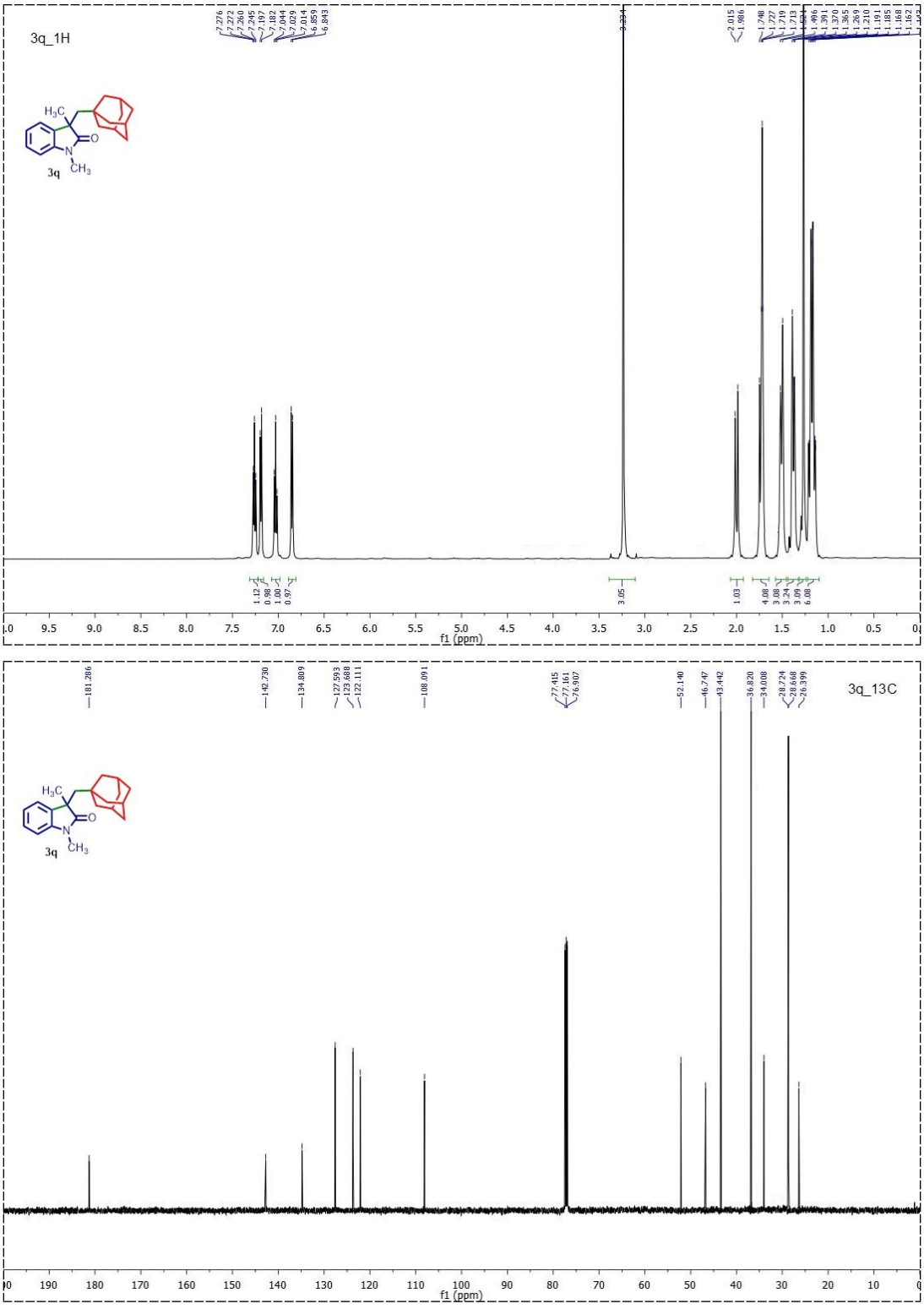

Figure S18. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3q** in $CDCl_3$.

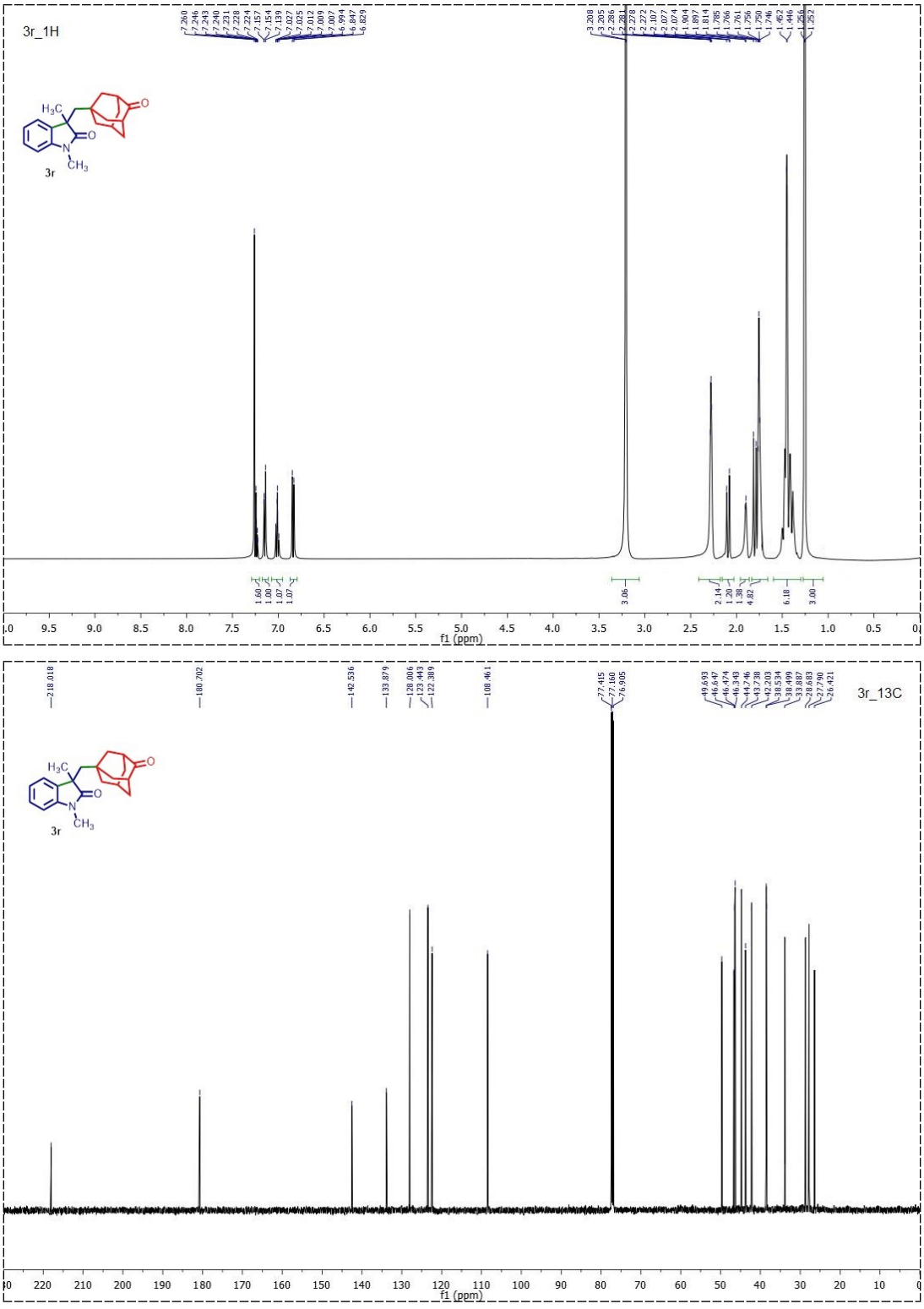

Figure S19. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3r** in $CDCl_3$.

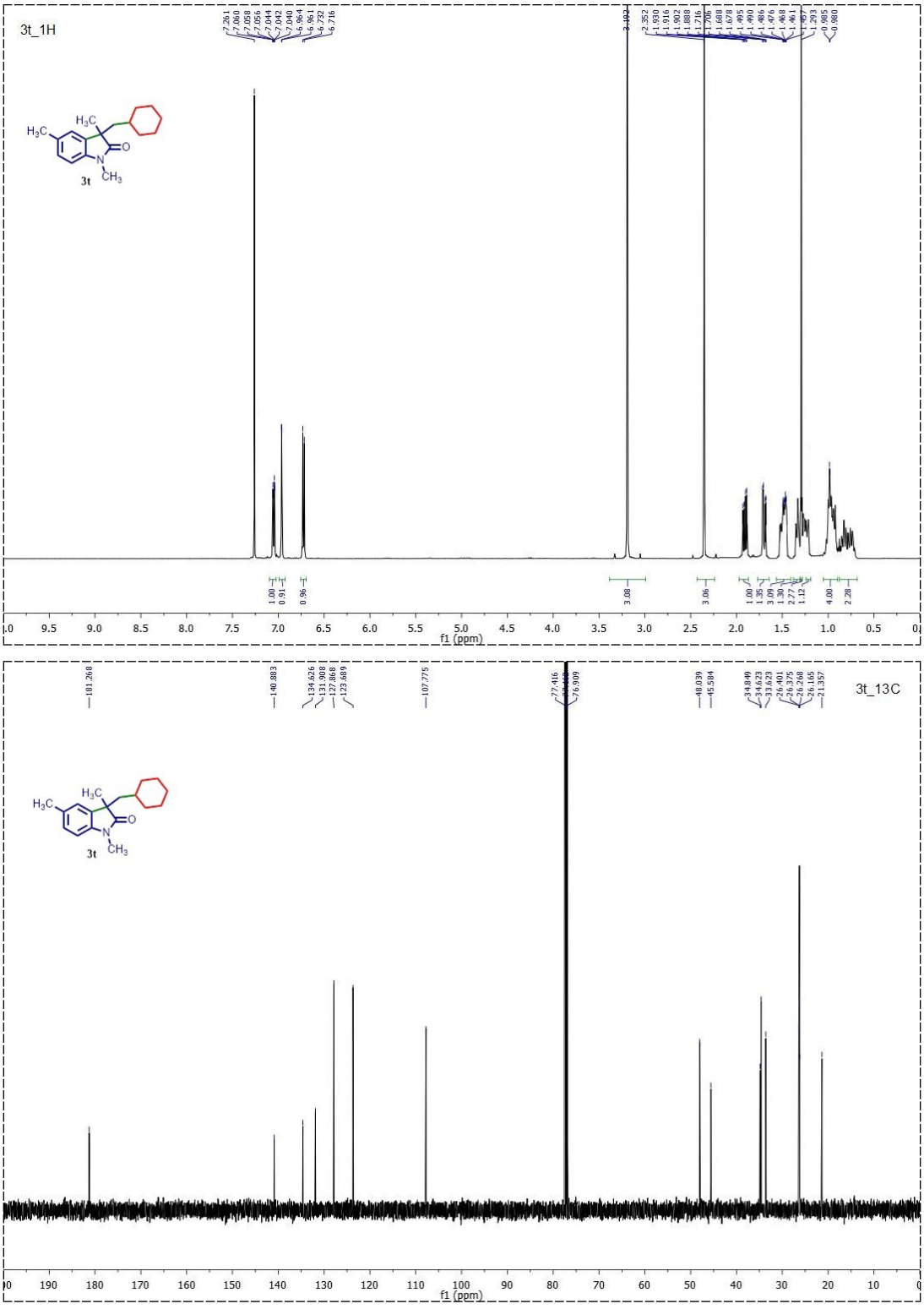

Figure S20. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3t** in $CDCl_3$.

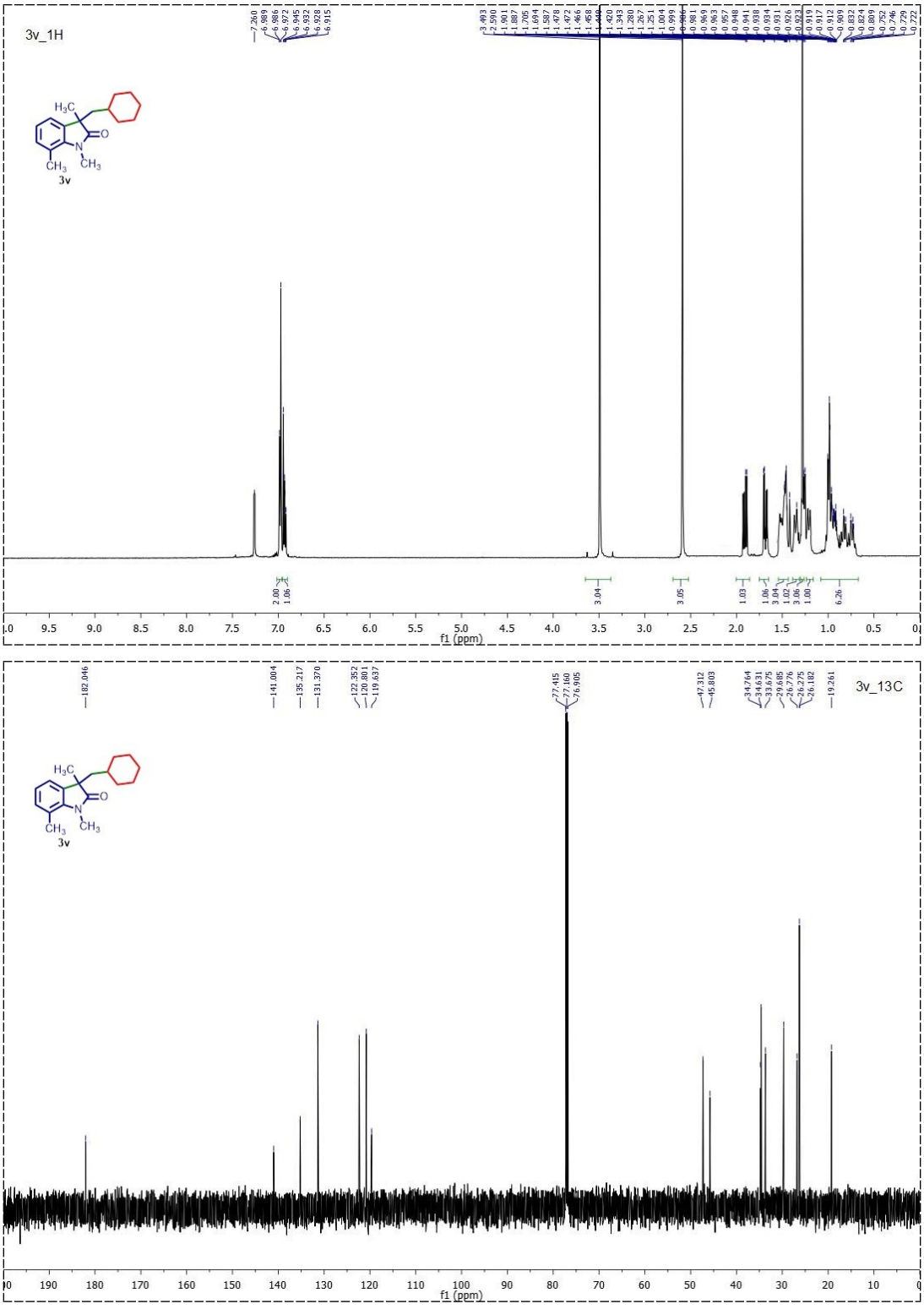

Figure S21. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3v** in $CDCl_3$.

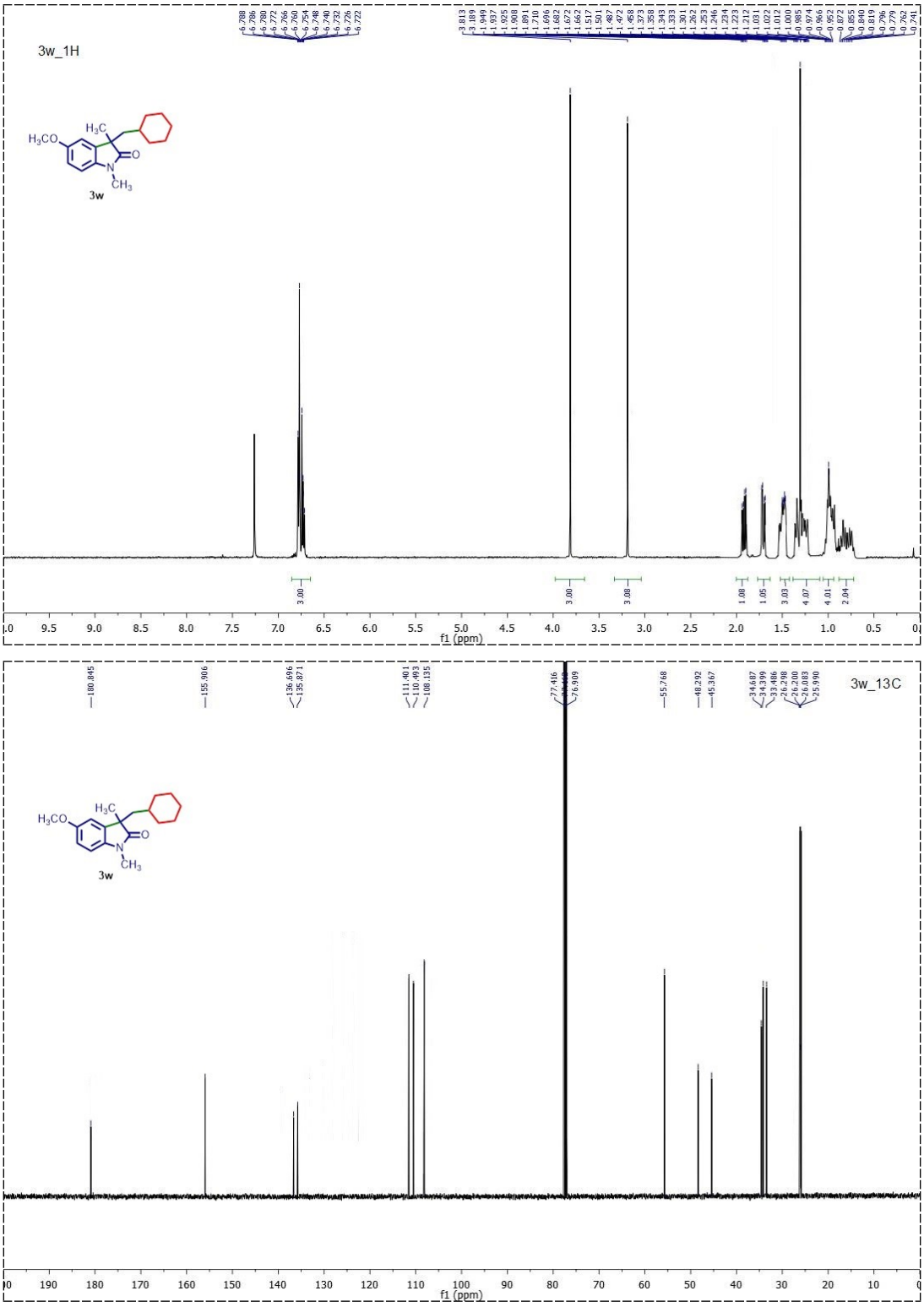

Figure S22. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3w** in $CDCl_3$.

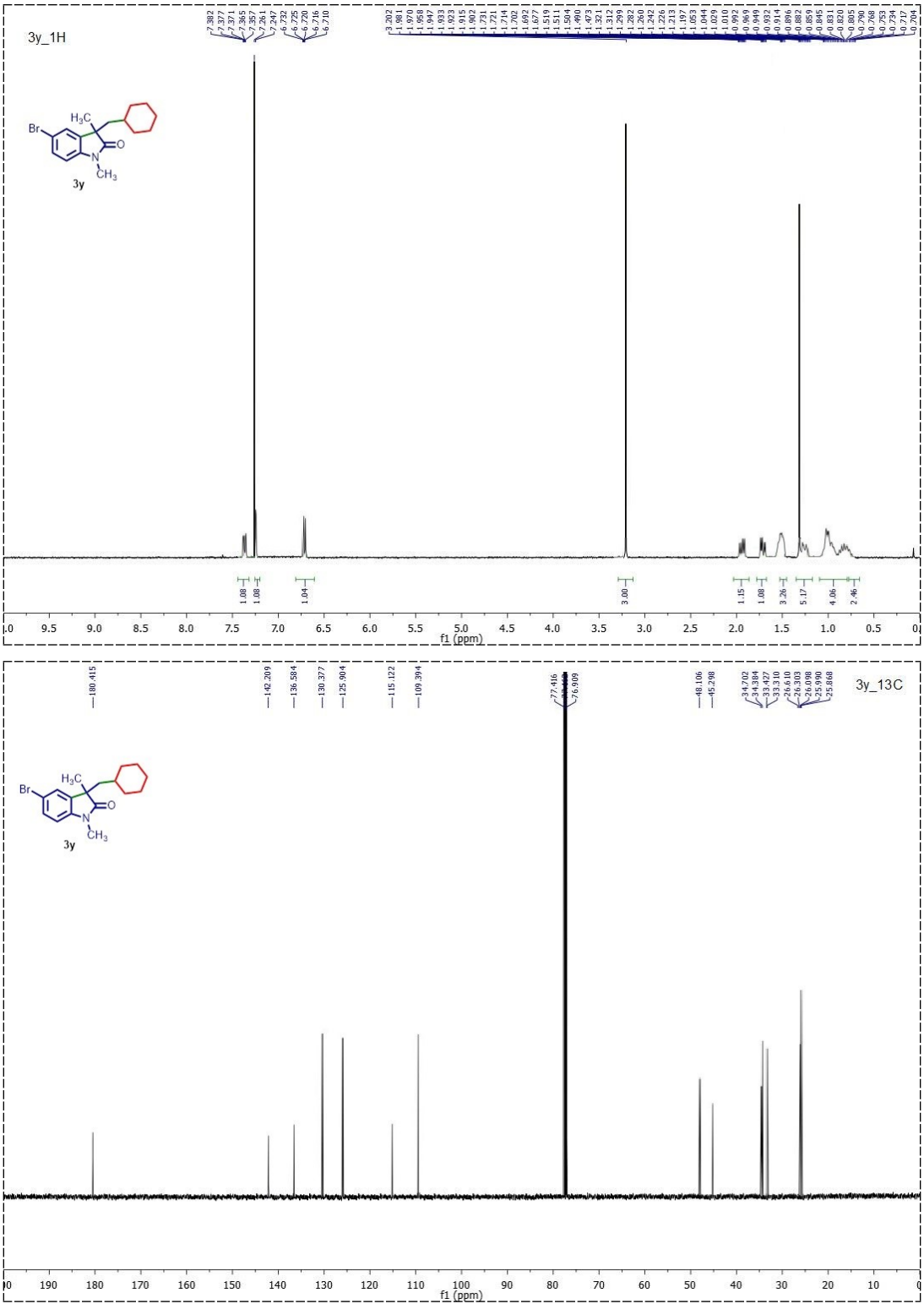

Figure S23. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3y** in $CDCl_3$.

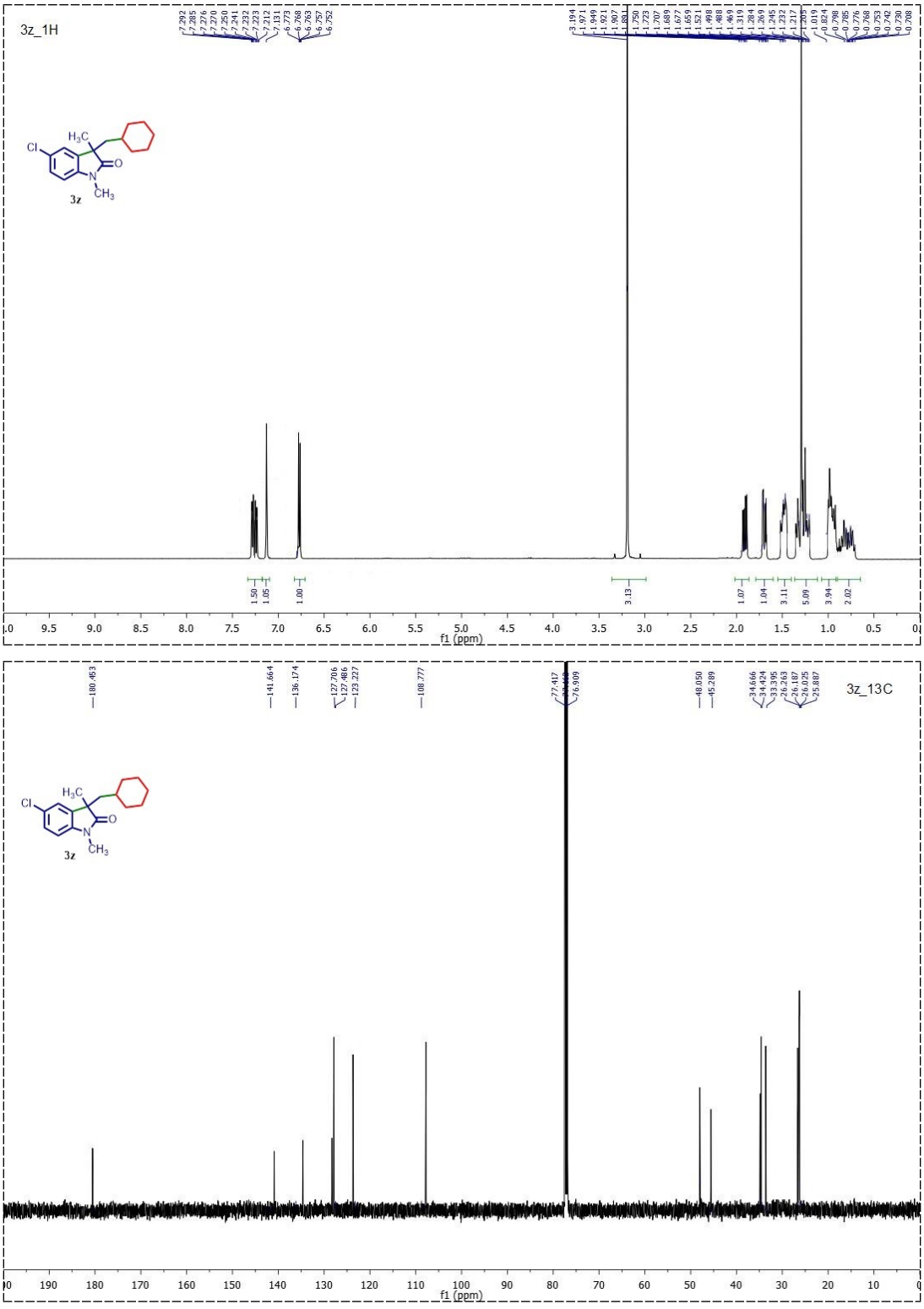

Figure S24. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3z** in $CDCl_3$.

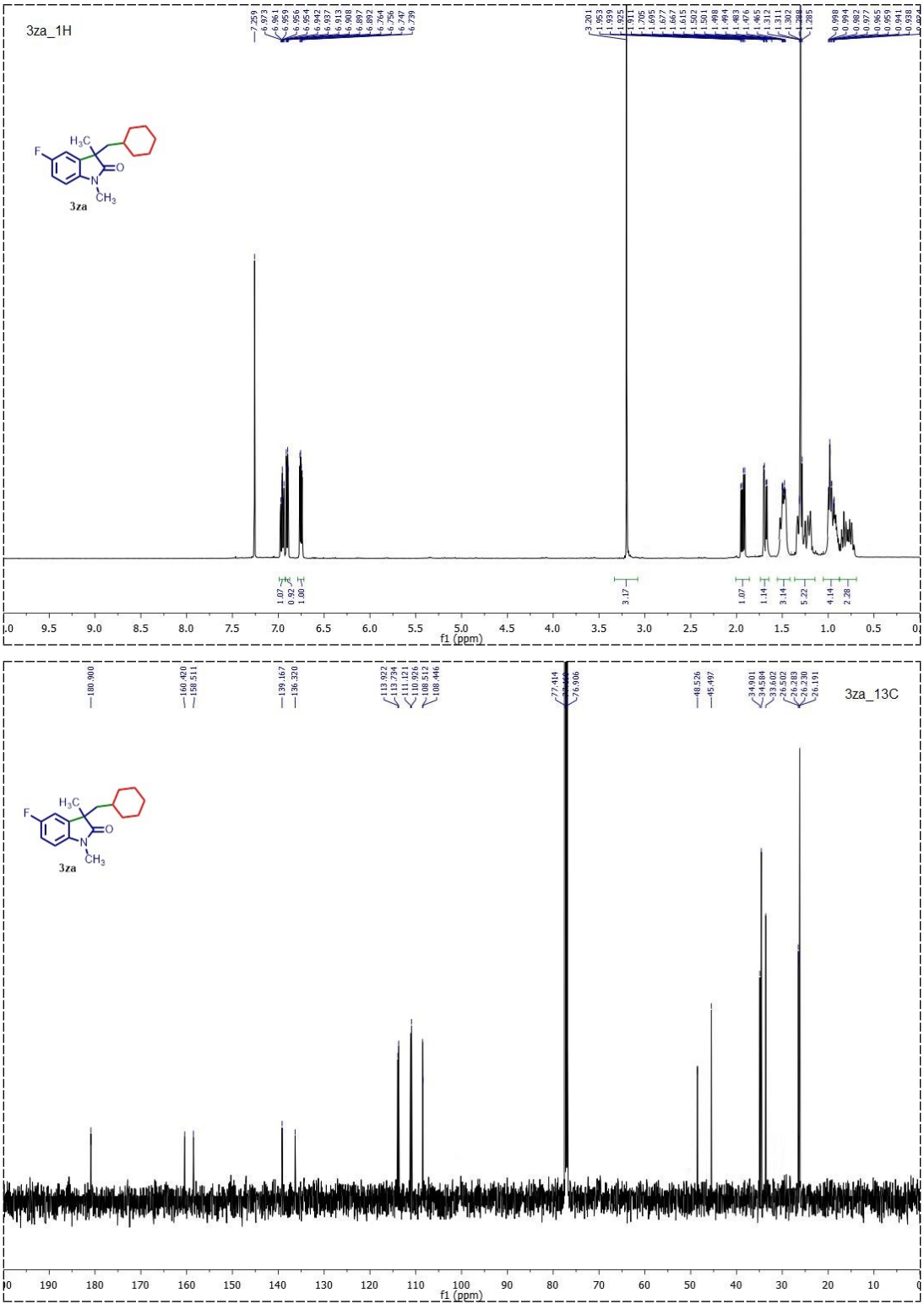

Figure S25. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3za** in $CDCl_3$.

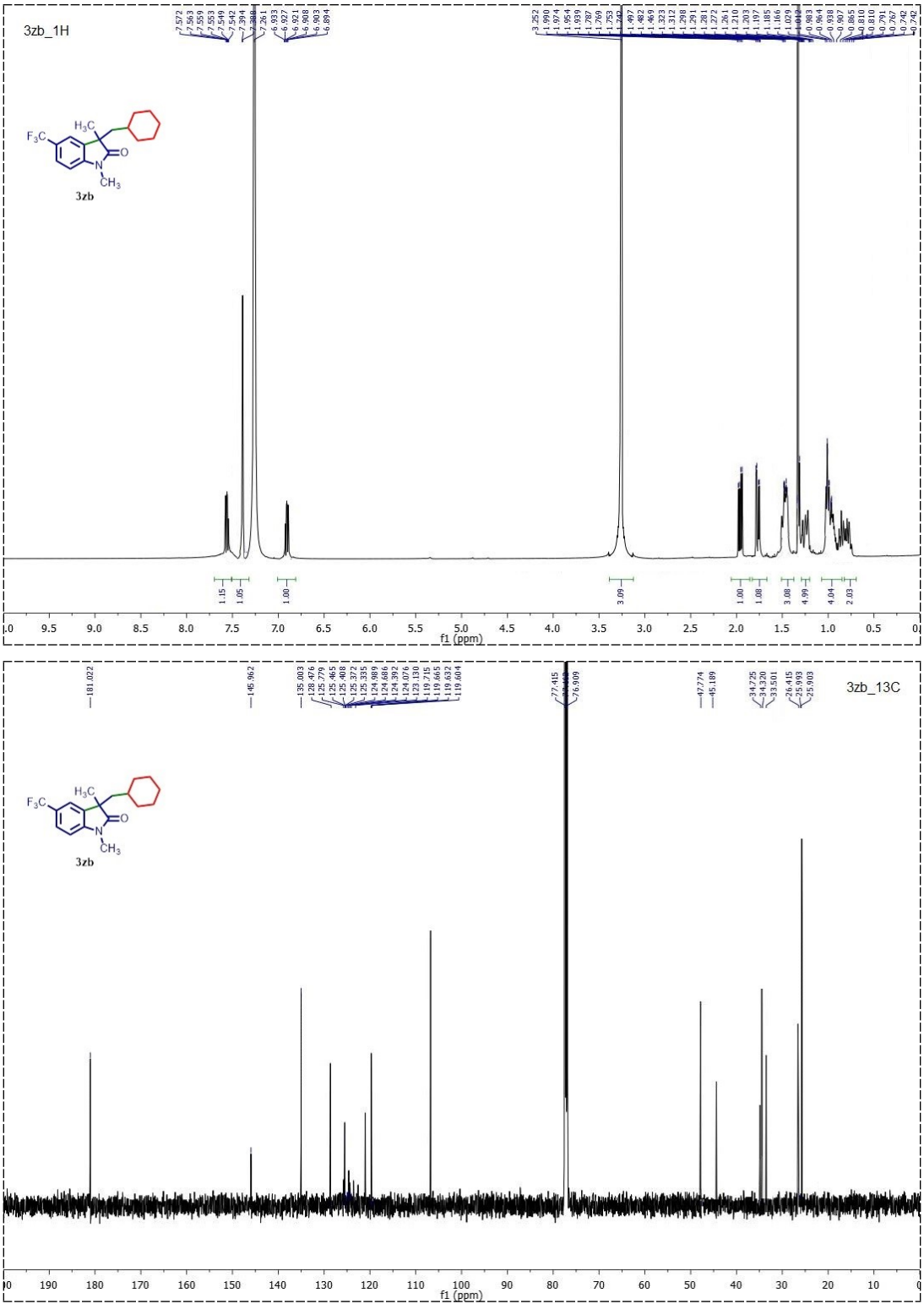

Figure S26. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3zb** in $CDCl_3$.

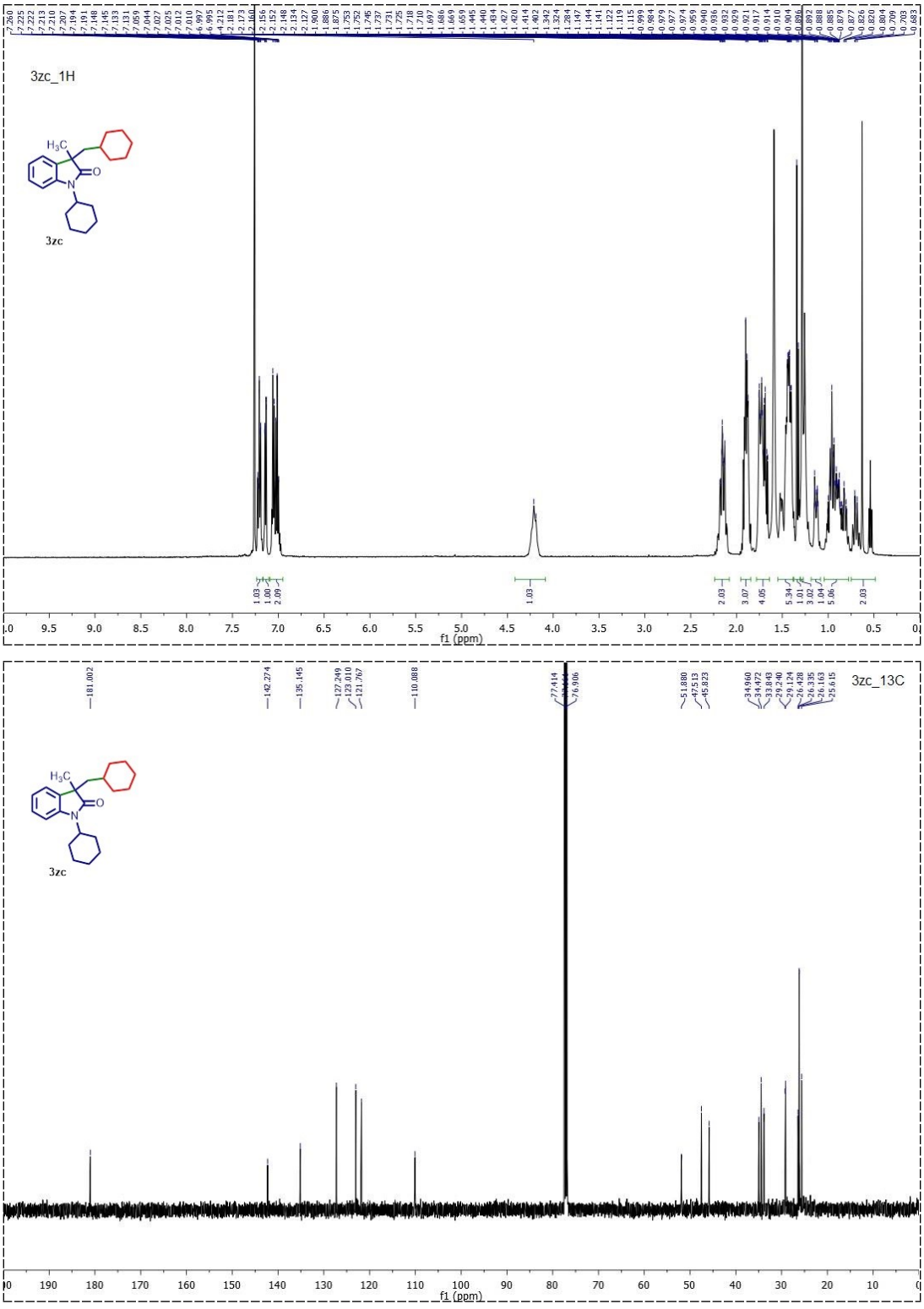

Figure S27. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3zc** in $CDCl_3$.

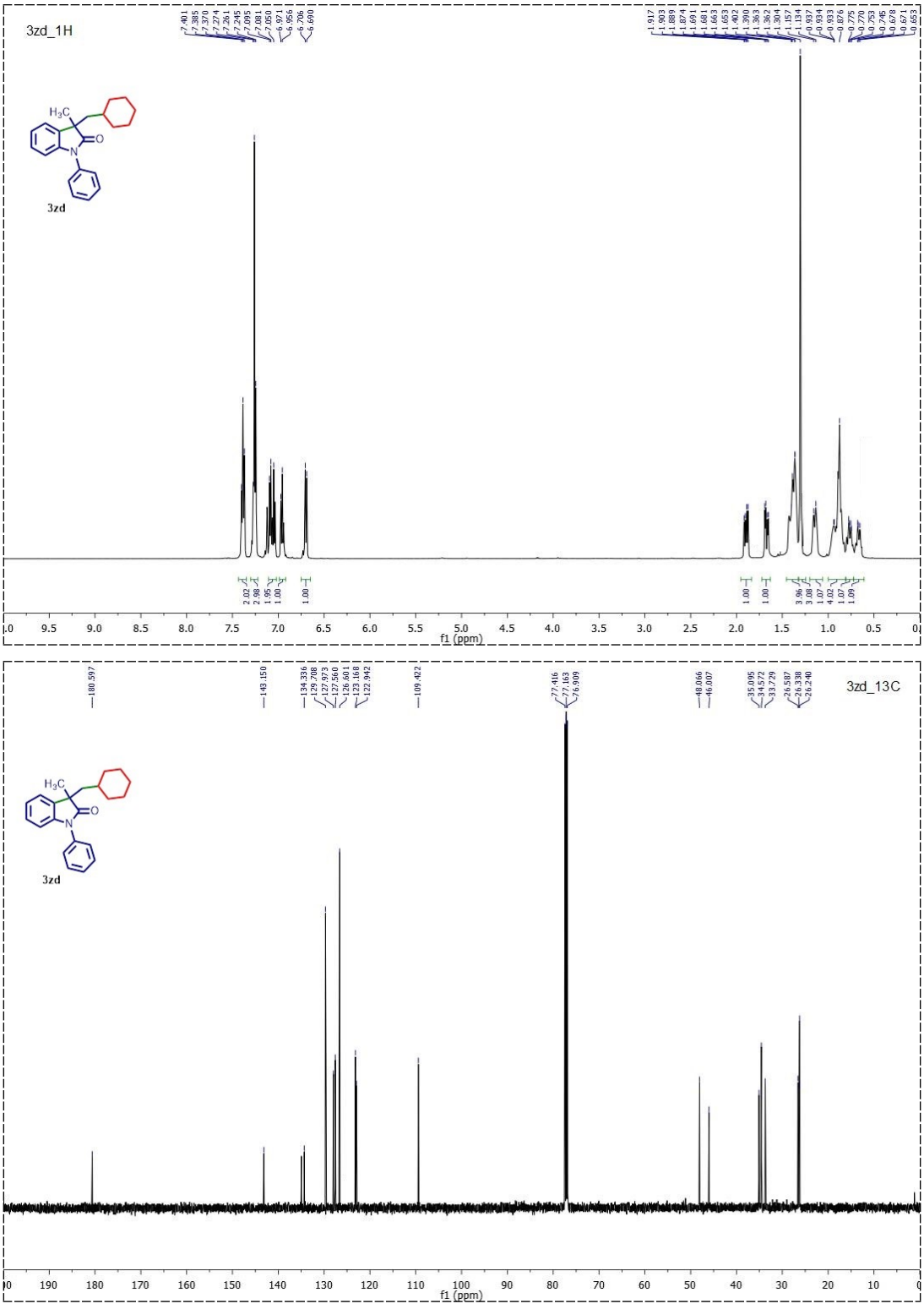

Figure S28. ^{1}H (top) and ^{13}C (bottom) NMR spectra of compound **3zd** in $CDCl_3$.