



Supporting Information

for

A novel methodology for the efficient synthesis of 3-monohalooxindoles by acidolysis of 3-phosphate-substituted oxindoles with haloid acids

Li Liu, Yue Li, Tiao Huang, Dulin Kong and Mingshu Wu

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Experimental details as well as compound characterization and spectral data of the products

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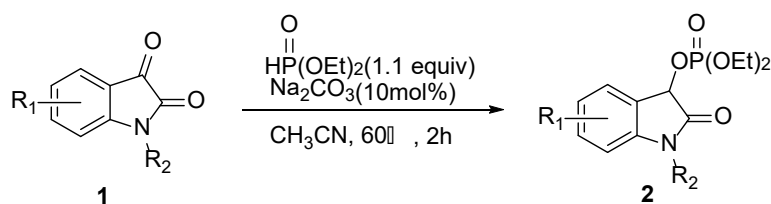
References

I Experimental section

General methods

The reactions were monitored by thin-layer chromatography (TLC) using silica gel GF254. All compounds were fully characterized by spectroscopic data. The NMR spectra were recorded on a Bruker Avance III (^1H : 400 MHz, ^{13}C : 100 MHz, ^{19}F NMR: 377 MHz, ^{31}P : 162 MHz), chemical shifts (δ) are expressed in ppm, and J values are given in Hz. CDCl_3 and $\text{DMSO}-d_6$ were used as solvents. High-resolution mass spectra were recorded on LCMS-IT-TOF. All chemicals and solvents were used as received without further purification unless otherwise stated. Column chromatography was performed on silica gel (200–300 mesh).

General procedure for preparation of oxindole derivatives 2

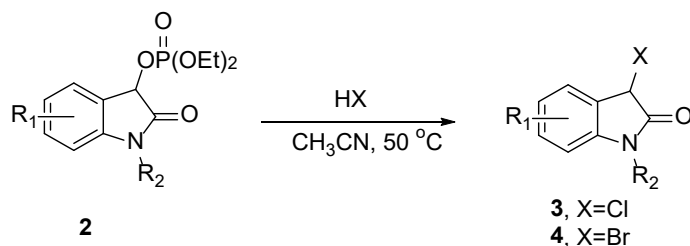


All 3-phosphate-substituted oxindoles were prepared according to a procedure described in the literature [1-3].

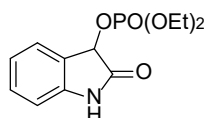
A 100-mL round-bottom flask was charged with an isatin **1** (10 mmol), Na_2CO_3 (1 mmol), diethyl phosphite (11 mmol), and CH_3CN (20 mL). The reaction mixture was stirred at 60°C in a preheated oil bath until completion of the reaction (4 h). After

completion of the reaction, the residue was purified by column chromatography to provide **2**.

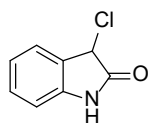
General procedure for preparation of compounds **3** and **4**



To a 10-mL screw-cap glass vial equipped with a magnetic stirrer was added CH₃CN (3mL), a diethyl (2-oxoindolin-3-yl)phosphate **2** (0.5 mmol), concentrated hydrochloric acid (0.64 mL, 36%, 7.5 mmol) or concentrated hydrobromic acid (1.10 mL, 40%, 7.5 mmol). Then, the reaction mixture was stirred at 50 °C for 6 h until completion of the reaction. The solvent was evaporated under vacuum and the residue mixture was directly purified by flash column chromatography on silica gel to obtain a product **3** or **4**.

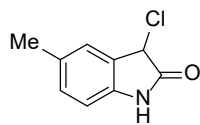


Diethyl (2-oxoindolin-3-yl) phosphate (2a): Brown oil (95%). ¹H NMR (400 MHz, Chloroform-*d*) δ 9.44 (s, 1H), 7.41 (d, *J* = 7.5 Hz, 1H), 7.23 – 7.12 (m, 1H), 6.95 (td, *J* = 7.6, 1.0 Hz, 1H), 6.82 (d, *J* = 7.8 Hz, 1H), 5.49 (d, *J*_{P-H} = 12.9 Hz, 1H), 4.23 – 4.07 (m, 4H), 1.27 (m, *J* = 12.0, 7.1, 1.2 Hz, 6H). ¹³C NMR (100 MHz, Chloroform-*d*) δ 173.13 (d, *J* = 6.5 Hz), 141.02, 129.61, 125.00, 123.52 (d, *J* = 2.9 Hz), 121.82, 109.76, 71.91 (d, *J* = 5.9 Hz), 63.72 (d, *J* = 6.2 Hz), 63.48 (d, *J* = 6.0 Hz), 15.00 (d, *J* = 7.1 Hz, 2C). ³¹P NMR (162 MHz, Chloroform-*d*) δ -1.25(s).

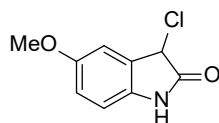


3-Chloroindolin-2-one (3a) [4]: Brown solid; mp: 165- 166 °C (92%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.77 (s, 1H), 7.35 (d, *J* = 7.4 Hz, 1H), 7.28 (t, *J* = 7.7 Hz, 1H), 7.02 (s, 1H), 6.88 (d, *J* = 7.8 Hz, 1H), 5.55 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.21, 142.43, 130.32, 126.51, 125.64, 122.32, 110.18, 52.25. HRMS

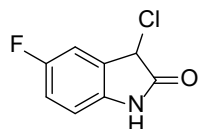
(ESI): m/z calcd for C₈H₆ClNO [M-H]⁻: 166.0065; found: 166.0056.



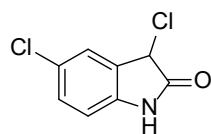
3-Chloro-5-methylindolin-2-one (3b) [5]: solid; mp: 96- 97 °C (81%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.66 (s, 1H), 7.16 (s, 1H), 7.08 (d, *J* = 7.9 Hz, 1H), 6.76 (d, *J* = 7.9 Hz, 1H), 5.50 (s, 1H), 2.25 (d, *J* = 2.0 Hz, 3H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.2, 139.9, 131.4, 130.5, 126.5, 126.2, 109.9, 52.4, 20.5. HRMS (ESI): m/z calcd for C₉H₈ClNO [M-H]⁻: 180.0222; found: 180.0215.



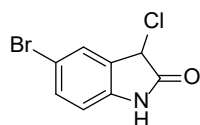
3-Chloro-5-methoxyindolin-2-one (3c): solid; mp: 106-107 °C (81%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.58 (s, 1H), 6.98 (d, *J* = 2.5 Hz, 1H), 6.86 (dd, *J* = 8.5, 2.6 Hz, 1H), 6.79 (d, *J* = 8.5 Hz, 1H), 5.52 (s, 1H), 3.72 (s, 3H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.0, 155.2, 135.6, 127.6, 115.4, 112.1, 110.7, 55.6, 52.6. HRMS (ESI): m/z calcd for C₉H₈ClNO₂ [M-H]⁻: 196.0171; found: 196.0172.



3-Chloro-5-fluoroindolin-2-one (3d): solid; mp: 183- 184 °C (51%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.79 (s, 1H), 7.28 (d, *J* = 8.1 Hz, 1H), 7.14 (t, *J* = 9.1 Hz, 1H), 6.87 (dd, *J* = 8.6, 4.4 Hz, 1H), 5.58 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.1, 158.1 (d, *J*_{F-C} = 237.9 Hz), 138.6 (d, *J* = 2.0 Hz), 128.1 (d, *J* = 8.9 Hz), 116.7 (d, *J* = 23.3 Hz), 113.3 (d, *J* = 25.2 Hz), 111.1 (d, *J* = 8.1 Hz), 52.1 (d, *J* = 1.8 Hz). ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -120.90. HRMS (ESI): m/z calcd for C₈H₅ClFNO [M-H]⁻: 183.9971; found: 183.9964.

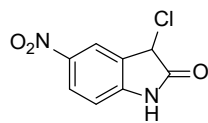


3,5-Dichloroindolin-2-one (3e) [5]: solid; mp: 200- 201 °C (75%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.90 (s, 1H), 7.42 (d, *J* = 2.2 Hz, 1H), 7.34 (dd, *J* = 8.3, 2.2 Hz, 1H), 6.89 (s, 1H), 5.58 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.9, 141.3, 130.1, 128.5, 126.2, 125.7, 111.7, 51.7. HRMS (ESI): m/z calcd for C₈H₅Cl₂NO [M-H]⁻: 199.9675; found: 199.9667.

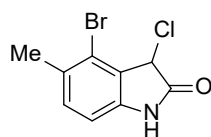


5-Bromo-3-chloroindolin-2-one (3f) [6]: solid; mp: 189-190 °C (58%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.91 (s, 1H), 7.54 (d, *J* = 2.1 Hz, 1H), 7.47 (dd, *J* = 8.3, 2.1 Hz, 1H), 6.84 (d, *J* = 8.3 Hz, 1H), 5.58 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.7, 141.7, 133.0, 128.9, 128.4, 113.7, 112.1, 51.6. HRMS (ESI): m/z

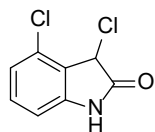
calcd for C₈H₅BrClNO [M-H]⁻: 243.9170; found: 243.9158.



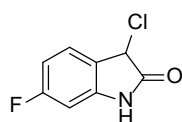
3-Chloro-5-nitroindolin-2-one (3g): solid; mp: 178-179°C (69%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.46 (s, 1H), 8.32 – 7.86 (m, 2H), 7.21 – 6.83 (m, 1H), 5.67 (d, *J* = 3.3 Hz, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.49, 148.75, 142.50, 127.54 (d, *J* = 3.5 Hz), 127.28 (d, *J* = 3.5 Hz), 121.23, 110.48 (d, *J* = 2.4 Hz), 51.08. **HRMS (ESI):** *m/z* calcd for C₈H₅ClN₂O₃ [M-H]⁻: 210.9916; found: 210.9909.



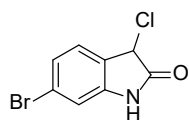
4-Bromo-3-chloro-5-methylindolin-2-one (3h): solid; mp: 181-182 °C (82%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.88 (s, 1H), 7.25 (d, *J* = 7.9 Hz, 1H), 6.78 (d, *J* = 7.9 Hz, 1H), 5.40 (s, 1H), 2.27 (s, 3H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.0, 141.9, 132.3, 130.9, 126.0, 122.4, 109.3, 53.5, 21.4. **HRMS (ESI):** *m/z* calcd for C₉H₇BrClNO [M-H]⁻: 257.9327; found: 257.9333.



3,4-Dichloroindolin-2-one (3i): solid; mp: 168-169°C (96%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.00 (s, 1H), 7.33 (s, 0H), 7.06 (d, *J* = 8.2 Hz, 1H), 6.85 (d, *J* = 7.8 Hz, 1H), 5.57 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.2, 144.3, 132.2, 131.0, 123.6, 122.4, 109.1, 51.4. **HRMS (ESI):** *m/z* calcd for C₈H₅Cl₂NO [M-H]⁻: 199.9675; found: 199.9668.

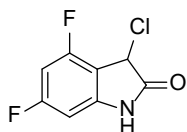


3-Chloro-6-fluoroindolin-2-one (3j) [5]: solid; mp: 165- 166 °C (55%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.92 (s, 1H), 7.38 (t, *J* = 4.3 Hz, 1H), 6.82 (dd, *J* = 8.2, 2.3 Hz, 1H), 6.70 (d, *J* = 9.1 Hz, 1H), 5.52 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.5, 163.3 (d, *J*_{F-C} = 245.1 Hz), 144.2 (d, *J* = 12.6 Hz), 127.4 (d, *J* = 10.3 Hz), 122.5 (d, *J* = 2.9 Hz), 108.6 (d, *J* = 22.7 Hz), 98.5 (d, *J* = 27.4 Hz), 51.6. ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -109.39. **HRMS (ESI):** *m/z* calcd for C₈H₅ClFNO [M - H]⁻: 183.9971; found: 199.9961.

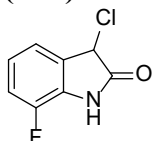


6-Bromo-3-chloroindolin-2-one (3k): solid; mp: 185- 186 °C (51%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.92 (s, 1H), 7.32 (d, *J* = 8.0 Hz, 1H), 7.23 (d, *J* = 1.7 Hz, 1H), 7.03 (d, *J* = 1.8 Hz, 1H), 5.56 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.0, 144.0, 127.4, 125.8, 125.0, 122.9, 113.0, 51.6. **HRMS (ESI):** *m/z* calcd for

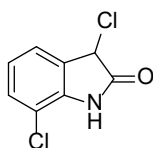
C₈H₅BrClNO [M-H]⁻: 243.9170; found: 243.9161.



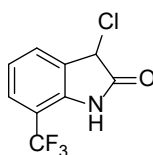
3-Chloro-4,6-difluoroindolin-2-one (3l): Yellow solid; mp: 179- 180 °C (80%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.19 (s, 1H), 6.87 (t, *J* = 10.0 Hz, 1H), 6.63 (d, *J* = 8.7 Hz, 1H), 5.69 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.7, 164.1 (dd, *J*_{F-C} = 247.5, 13.3 Hz), 158.7 (dd, *J*_{F-C} = 251.3, 15.2 Hz), 145.5 (dd, *J* = 15.1, 10.3 Hz), 108.7 (d, *J* = 16.3 Hz), 97.6 (m), 95.4 (d, *J* = 27.3 Hz), 48.9. ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -105.22 (d, *J* = 8.9 Hz), -112.69 (d, *J* = 8.9 Hz). HRMS (ESI): *m/z* calcd for C₈H₄ClF₂NO [M-H]⁻: 201.9877; found: 201.9866.



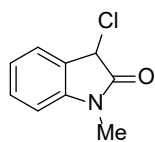
3-Chloro-7-fluoroindolin-2-one (3m) [7]: solid; mp: 165- 166 °C (72%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.31 (s, 1H), 7.25 – 7.17 (m, 2H), 7.04 (td, *J* = 8.2, 4.7 Hz, 1H), 5.64 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.0, 146.3 (d, *J*_{F-C} = 243.3 Hz), 129.6 (d, *J* = 13.0 Hz), 129.3 (d, *J* = 3.8 Hz), 123.2 (d, *J* = 6.0 Hz), 121.7 (d, *J* = 3.3 Hz), 117.3 (d, *J* = 17.1 Hz), 51.9 (d, *J* = 3.3 Hz). ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -132.21. HRMS (ESI): *m/z* calcd for C₈H₅ClFNO [M-H]⁻: 183.9971; found: 183.9971.



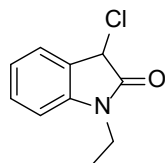
3,7-Dichloroindolin-2-one (3n): solid; mp: 172- 173 °C (72%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.22 (s, 1H), 7.54 – 7.25 (m, 2H), 7.05 (t, *J* = 7.8 Hz, 1H), 5.67 (s, 1H). ¹³C NMR (100MHz, DMSO-*d*₆) δ 173.1, 140.1, 130.2, 128.3, 124.3, 123.6, 114.3, 52.3. HRMS (ESI): *m/z* calcd for C₈H₅Cl₂NO [M-H]⁻: 199.9675; found: 199.9667.



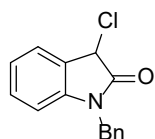
3-Chloro-7-(trifluoromethyl)indolin-2-one (3o) [7]: solid; mp: 121- 122 °C (55%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.27 (s, 1H), 7.67 (d, *J* = 7.5 Hz, 1H), 7.59 (d, *J* = 8.1 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 5.67 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.6, 139.7 (d, *J* = 2.4 Hz), 129.7, 128.5, 126.6 (d, *J* = 4.5 Hz), 123.3 (d, *J*_{F-C} = 271.8 Hz), 122.5, 111.3 (d, *J* = 33.1 Hz), 50.7. ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -60.31. HRMS (ESI): *m/z* calcd for C₉H₅ClF₃NO [M-H]⁻: 233.9939; found: 233.9930.



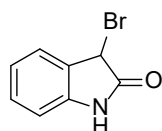
3-Chloro-1-methylindolin-2-one (3p) [8]: Yellow solid; mp: 152- 153 °C (88%). ^1H NMR (400 MHz, DMSO- d_6) δ 7.46 – 7.35 (m, 2H), 7.11 (t, J = 7.6 Hz, 1H), 7.05 (dd, J = 7.9, 2.2 Hz, 1H), 5.65 (s, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, DMSO- d_6) δ 173.2, 139.9, 131.4, 130.5, 126.5, 126.1, 109.9, 52.4, 20.5. **HRMS (ESI)**: m/z calcd for $\text{C}_9\text{H}_8\text{ClNO}$ $[\text{M}-\text{H}]^-$: 180.0222; found: 180.0210.



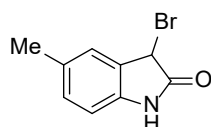
3-Chloro-1-ethylindolin-2-one (3q) [9]: Brown solid; mp: 69-70 °C (73%). ^1H NMR (400 MHz, DMSO- d_6) δ 7.48 – 7.35 (m, 2H), 7.12 (d, J = 7.8 Hz, 2H), 5.66 (s, 1H), 3.71 (d, J = 7.1 Hz, 2H), 1.15 (s, 3H). ^{13}C NMR (100 MHz, DMSO- d_6) δ 171.1, 142.7, 130.4, 125.8, 125.5, 122.8, 109.3, 51.7, 34.5, 12.3. **HRMS (ESI)**: m/z calcd for $\text{C}_{10}\text{H}_{10}\text{ClNO}$ $[\text{M}-\text{H}]^-$: 194.0378; found: 194.0380.



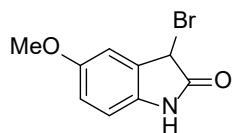
1-Benzyl-3-chloroindolin-2-one (3r) [8]: solid; mp: 139-140 °C (75%). ^1H NMR (400 MHz, DMSO- d_6) δ 7.45 (d, J = 7.4 Hz, 1H), 7.36 – 7.26 (m, 6H), 7.10 (td, J = 7.6, 1.0 Hz, 1H), 6.98 (d, J = 7.9 Hz, 1H), 5.82 (s, 1H), 4.93 (d, J = 1.6 Hz, 2H). ^{13}C NMR (100 MHz, DMSO- d_6) δ 171.8, 142.7, 135.8, 130.3, 128.7 (2C), 127.6, 127.2 (2C), 125.8, 125.5, 123.1, 109.8, 51.6, 42.9. **HRMS (ESI)**: m/z calcd for $\text{C}_{15}\text{H}_{12}\text{ClNO}$ $[\text{M}+\text{H}]^+$: 258.0680; found: 258.0669.



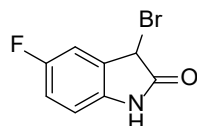
3-Bromoindolin-2-one (4a) [10]: Brown solid; mp: 68-69 °C (73%). ^1H NMR (400 MHz, DMSO- d_6) δ 10.76 (s, 1H), 7.33 (d, J = 7.5 Hz, 1H), 7.26 (m, J = 7.7, 1.0 Hz, 1H), 7.01 (m, J = 7.5, 1.0 Hz, 1H), 6.85 (dd, J = 7.8, 0.9 Hz, 1H), 5.70 (s, 1H). ^{13}C NMR (100 MHz, DMSO- d_6) δ 173.5, 142.4, 130.2, 127.0, 126.0, 122.3, 110.1, 40.5. **HRMS (ESI)**: m/z calcd for $\text{C}_8\text{H}_6\text{BrNO}$ $[\text{M}-\text{H}]^-$: 209.9560; found: 209.9554.



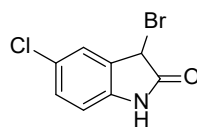
3-Bromo-5-methylindolin-2-one (4b) [11]: Brown solid; mp: 166-167 °C (76%). ^1H NMR (400 MHz, DMSO- d_6) δ 10.65 (s, 1H), 7.12 (s, 1H), 7.04 (dd, J = 7.9, 1.8 Hz, 1H), 6.74 (d, J = 7.9 Hz, 1H), 5.63 (s, 1H), 2.23 (s, 3H). ^{13}C NMR (100 MHz, DMSO- d_6) δ 173.5, 139.9, 131.3, 130.5, 127.0, 126.5, 109.9, 40.7, 20.5. **HRMS (ESI)**: m/z calcd for $\text{C}_9\text{H}_8\text{BrNO}$ $[\text{M}-\text{H}]^-$: 223.9717; found: 223.9712.



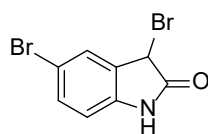
3-Bromo-5-methoxyindolin-2-one (4c): Yellow solid; mp: 166-167 °C (75%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.59 (s, 1H), 6.95 (d, *J* = 2.6 Hz, 1H), 6.83 (d, *J* = 2.6 Hz, 1H), 6.77 (d, *J* = 8.5 Hz, 1H), 5.65 (s, 1H), 3.71 (s, 3H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.5, 155.2, 135.6, 128.1, 115.4, 112.3, 110.7, 55.6, 40.9. HRMS (ESI): *m/z* calcd for C₉H₈BrNO₂ [M-H]⁻: 239.9666; found: 239.9654.



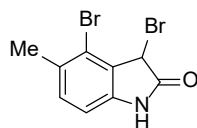
3-Bromo-5-fluoroindolin-2-one (4d): Brown solid; mp: 167-168 °C (55%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.79 (s, 1H), 7.30 – 7.20 (m, 1H), 7.11 (d, *J* = 2.8 Hz, 1H), 6.86 (dd, *J* = 8.5, 4.4 Hz, 1H), 5.70 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.55, 158.07 (d, *J*_{F-C} = 237.7 Hz), 138.60 (d, *J* = 2.2 Hz), 128.65 (d, *J* = 9.1 Hz), 116.64 (d, *J* = 23.4 Hz), 113.53 (d, *J* = 25.2 Hz), 111.10 (d, *J* = 8.1 Hz), 40.00 (d, *J* = 1.9 Hz). ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -121.02. HRMS (ESI): *m/z* calcd for C₈H₅BrFNO [M-H]⁻: 227.9466; found: 227.9462.



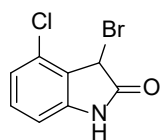
3-Bromo-5-chloroindolin-2-one (4e) [11]: Brown solid; mp: 122-123 °C (58%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.89 (s, 1H), 7.39 (d, *J* = 2.2 Hz, 1H), 7.34 – 7.26 (m, 1H), 6.87 (d, *J* = 8.3 Hz, 1H), 5.70 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.34, 141.31, 130.04, 129.11, 126.20, 125.95, 111.74, 39.65. HRMS (ESI): *m/z* calcd for C₈H₅BrClNO [M-H]⁻: 243.9170; found: 243.9182.



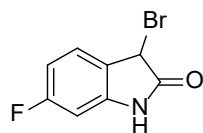
3,5-Dibromoindolin-2-one (4f): Brown solid; mp: 138-139 °C (53%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.90 (s, 1H), 7.50 (s, 1H), 7.44 (dd, *J* = 8.3, 2.1 Hz, 1H), 6.82 (d, *J* = 8.3 Hz, 1H), 5.70 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.8, 141.7, 133.0, 128.9, 128.4, 113.8, 112.2, 51.6. HRMS (ESI): *m/z* calcd for C₈H₅Br₂NO [M-H]⁻: 289.8645; found: 289.8646.



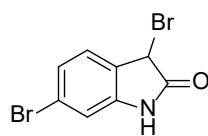
3,4-Dibromo-5-methylindolin-2-one (4g): Brown solid; mp: 207-208 °C (72%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.87 (s, 1H), 7.24 (d, *J* = 7.9 Hz, 1H), 6.78 (d, *J* = 7.8 Hz, 1H), 5.49 (s, 1H), 2.27 (s, 3H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.6, 141.8, 132.2, 130.7, 126.4, 122.5, 109.2, 41.9, 21.5. HRMS (ESI): *m/z* calcd for C₉H₇Br₂NO [M-H]⁻: 303.8801; found: 303.8788.



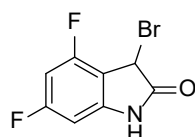
3-Bromo-4-chloroindolin-2-one (4h): Brown solid; mp: 168- 169 °C (66%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.99 (s, 1H), 7.29 (d, *J* = 8.0 Hz, 1H), 7.04 (dd, *J* = 8.3, 0.8 Hz, 1H), 6.85 (d, *J* = 7.8 Hz, 1H), 5.65 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 172.77, 144.21, 132.01, 131.02, 124.14, 122.34, 109.09, 39.24. **HRMS (ESI):** *m/z* calcd for C₈H₅BrClNO [M-H]⁻: 243.9170; found: 243.9169.



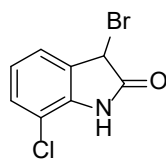
3-Bromo-6-fluoroindolin-2-one (4i): Brown solid; mp: 147- 148 °C (71%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.91 (s, 1H), 7.35 (dd, *J* = 8.4, 5.5 Hz, 1H), 6.80 (d, *J* = 2.1 Hz, 1H), 6.68 (dd, *J* = 9.1, 2.5 Hz, 1H), 5.66 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 174.0, 163.1 (d, *J*_{F-C} = 245.1 Hz), 144.1 (d, *J* = 12.7 Hz), 127.7 (d, *J* = 10.3 Hz), 123.0 (d, *J* = 2.9 Hz), 108.6 (d, *J* = 22.8 Hz), 98.4 (d, *J* = 27.4 Hz), 39.7. ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -109.40. **HRMS (ESI):** *m/z* calcd for C₈H₅BrFNO [M-H]⁻: 227.9466; found: 227.9461.



3,6-Dibromoindolin-2-one (4j): Brown solid; mp: 163- 164 °C (63%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 10.92 (s, 1H), 7.27 (d, *J* = 8.0 Hz, 1H), 7.18 (dd, *J* = 8.0, 1.8 Hz, 1H), 7.02 (d, *J* = 1.8 Hz, 1H), 5.67 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.45, 143.94, 127.72, 126.43, 124.97, 122.78, 113.06, 39.58. **HRMS (ESI):** *m/z* calcd for C₈H₅Br₂NO [M+H]⁺: 290.8717; found: 290.8730.

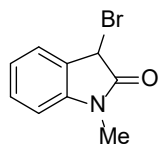


3-Bromo-4,6-difluoroindolin-2-one (4k): Yellow solid; mp: 156- 157 °C (78%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.18 (s, 1H), 6.85 (t, *J* = 10.0 Hz, 1H), 6.62 (d, *J* = 8.7 Hz, 1H), 5.77 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.3, 164.1 (dd, *J* = 247.7, 13.3 Hz), 158.6 (dd, *J* = 251.7, 15.1 Hz), 145.4 (dd, *J* = 15.0, 10.3 Hz), 109.3 (d, *J* = 19.4 Hz), 97.5 (m), 95.4 (d, *J* = 27.5 Hz), 36.0. ¹⁹F NMR (377 MHz, DMSO-*d*₆) δ -105.36 (d, *J* = 9.0 Hz), -111.67 (d, *J* = 9.0 Hz). **HRMS (ESI):** *m/z* calcd for C₈H₄BrF₂NO [M + Na]⁺: 269.9337; found: 269.9349.

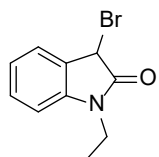


3-Bromo-7-chloroindolin-2-one (4l): Brown solid; mp: 166- 167 °C (58%). ¹H NMR (400 MHz, DMSO-*d*₆) δ 11.20 (s, 1H), 7.30 (t, *J* = 7.7 Hz, 2H), 7.02 (t, *J* = 7.8 Hz, 1H), 5.78 (s, 1H). ¹³C NMR (100 MHz, DMSO-*d*₆) δ 173.94, 140.48, 130.41, 129.28, 125.07, 123.98, 114.65, 40.69. **HRMS (ESI):** *m/z* calcd for

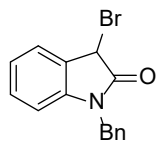
$\text{C}_8\text{H}_5\text{BrClNO}$ $[\text{M}-\text{H}]^-$: 243.9170; found: 243.9168.



3-Bromo-1-methylindolin-2-one (4m) [8]: Brown solid; mp: 107- 108 °C (78%). ^1H NMR (400 MHz, $\text{DMSO}-d_6$) δ 7.43 – 7.31 (m, 2H), 7.09 (td, J = 7.6, 1.0 Hz, 1H), 7.03 (d, J = 7.8 Hz, 1H), 5.79 (s, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $\text{DMSO}-d_6$) δ 171.85, 143.68, 130.24, 126.17, 125.66, 122.90, 109.25, 39.60, 26.44. **HRMS (ESI)**: m/z calcd for $\text{C}_9\text{H}_5\text{BrNO}$ $[\text{M}+\text{H}]^+$: 225.9862; found: 225.9858.

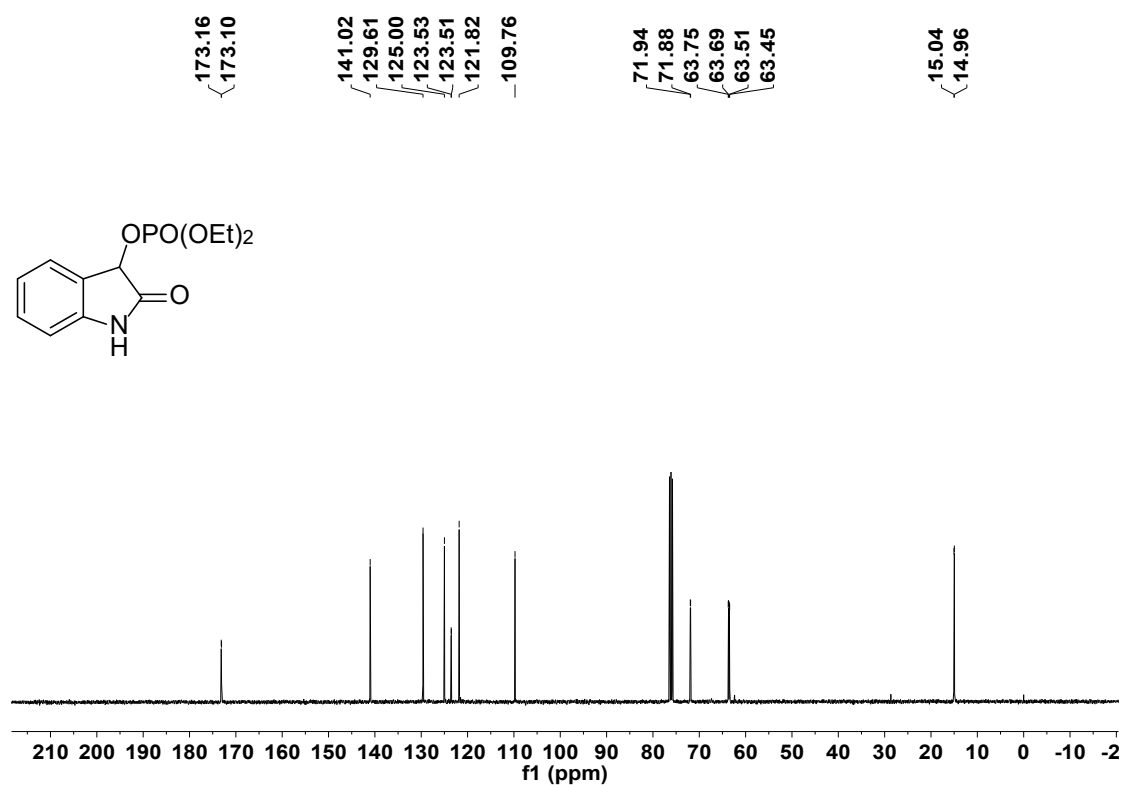
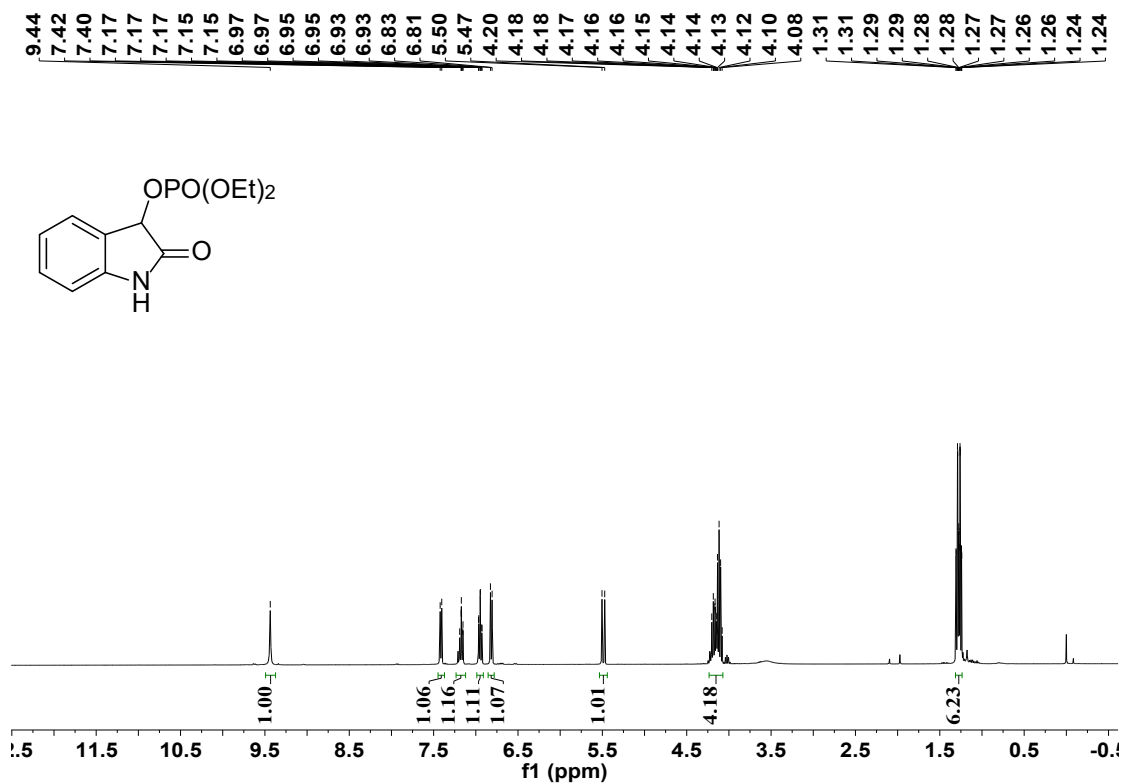


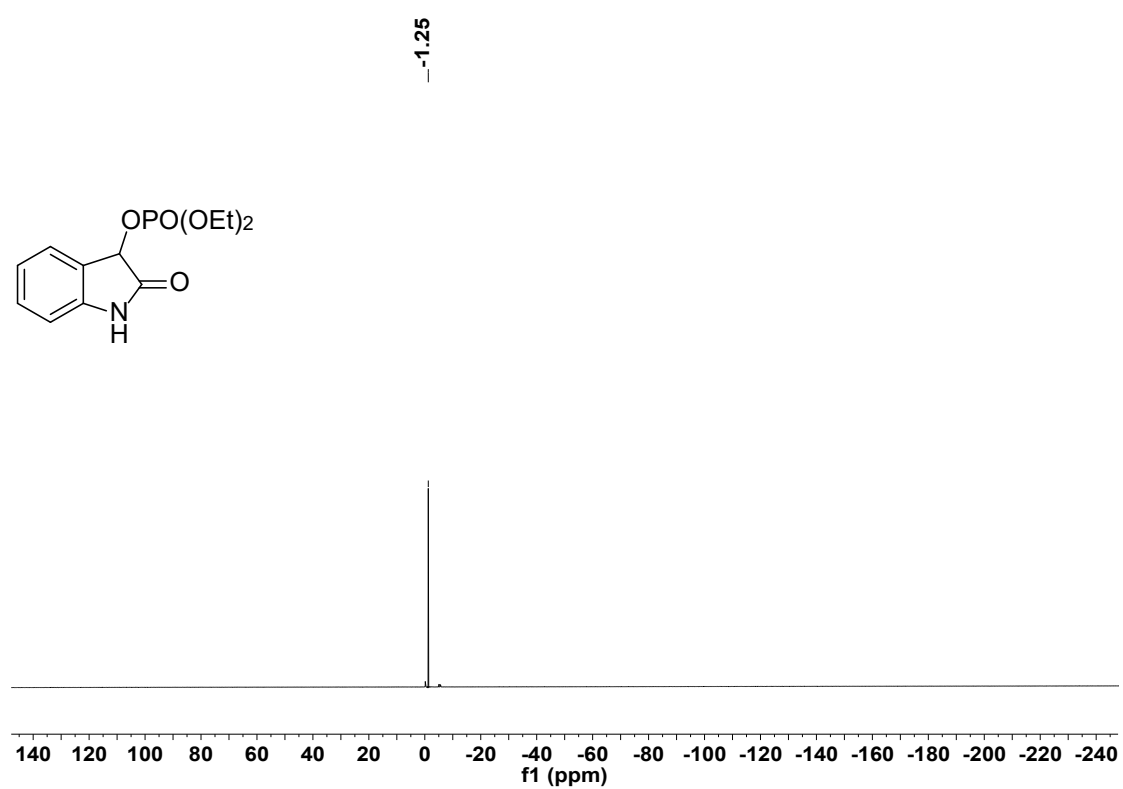
3-Bromo-1-ethylindolin-2-one (4n) [8]: Brown solid; mp: 112-113 °C (60%). ^1H NMR (400 MHz, $\text{DMSO}-d_6$) δ 7.39 – 7.31 (m, 2H), 7.07 (t, J = 7.5 Hz, 2H), 5.77 (s, 1H), 3.69 (q, J = 7.2 Hz, 2H), 1.13 (t, J = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $\text{DMSO}-d_6$) δ 171.51, 142.64, 130.25, 126.33, 125.91, 122.75, 109.26, 39.74, 34.59, 12.29. **HRMS (ESI)**: m/z calcd for $\text{C}_{10}\text{H}_{10}\text{BrNO}$ $[\text{M}+\text{H}]^+$: 240.0019; found: 240.0007.

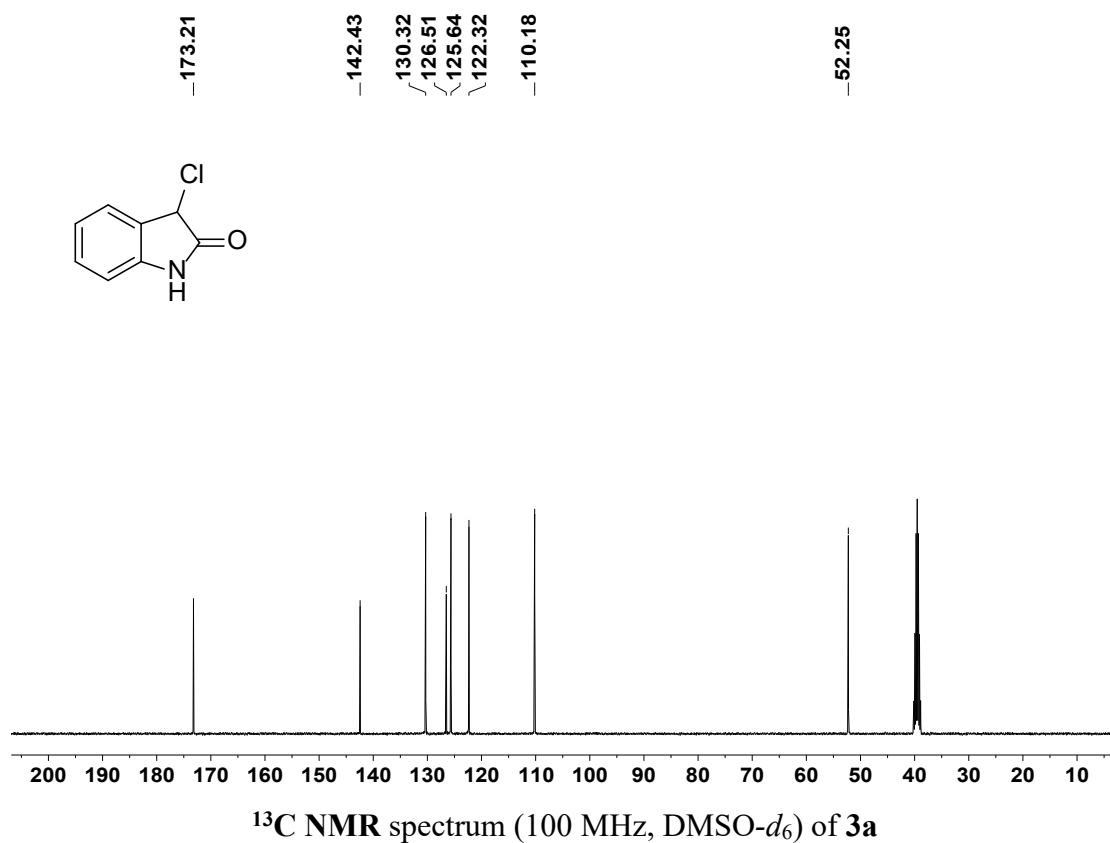
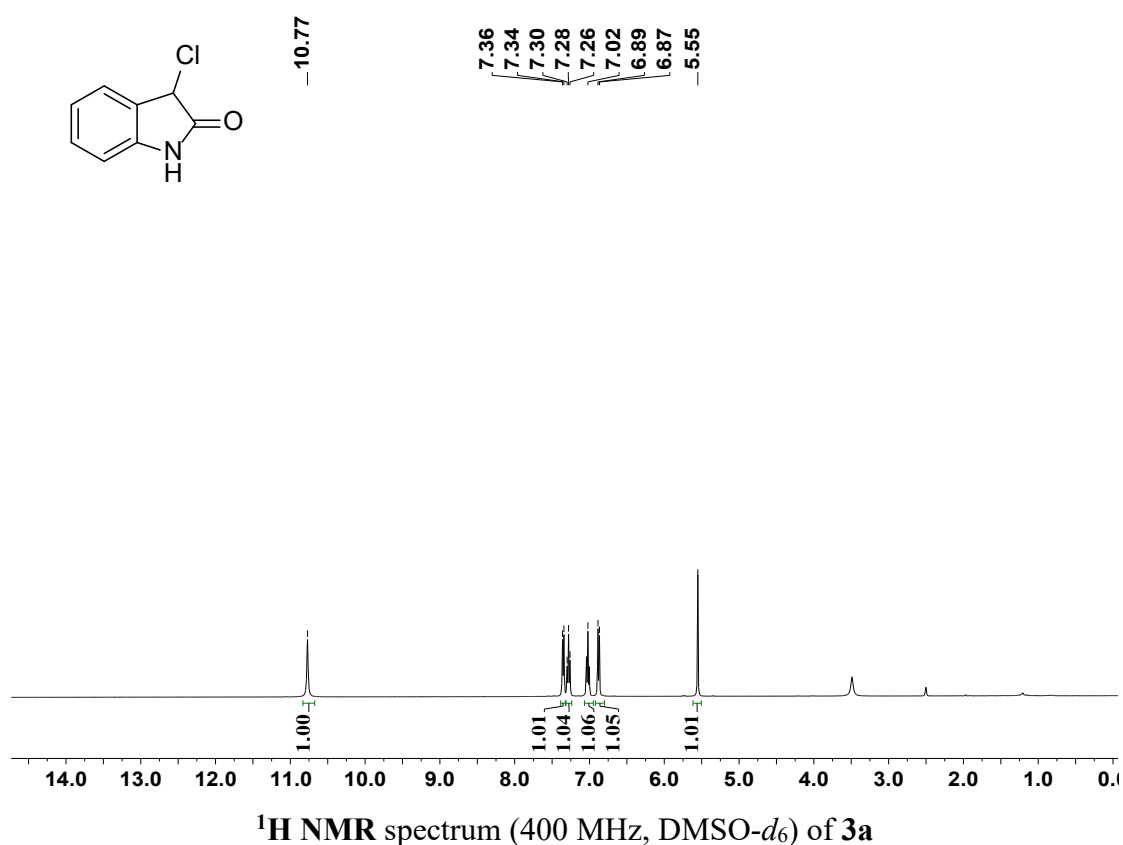


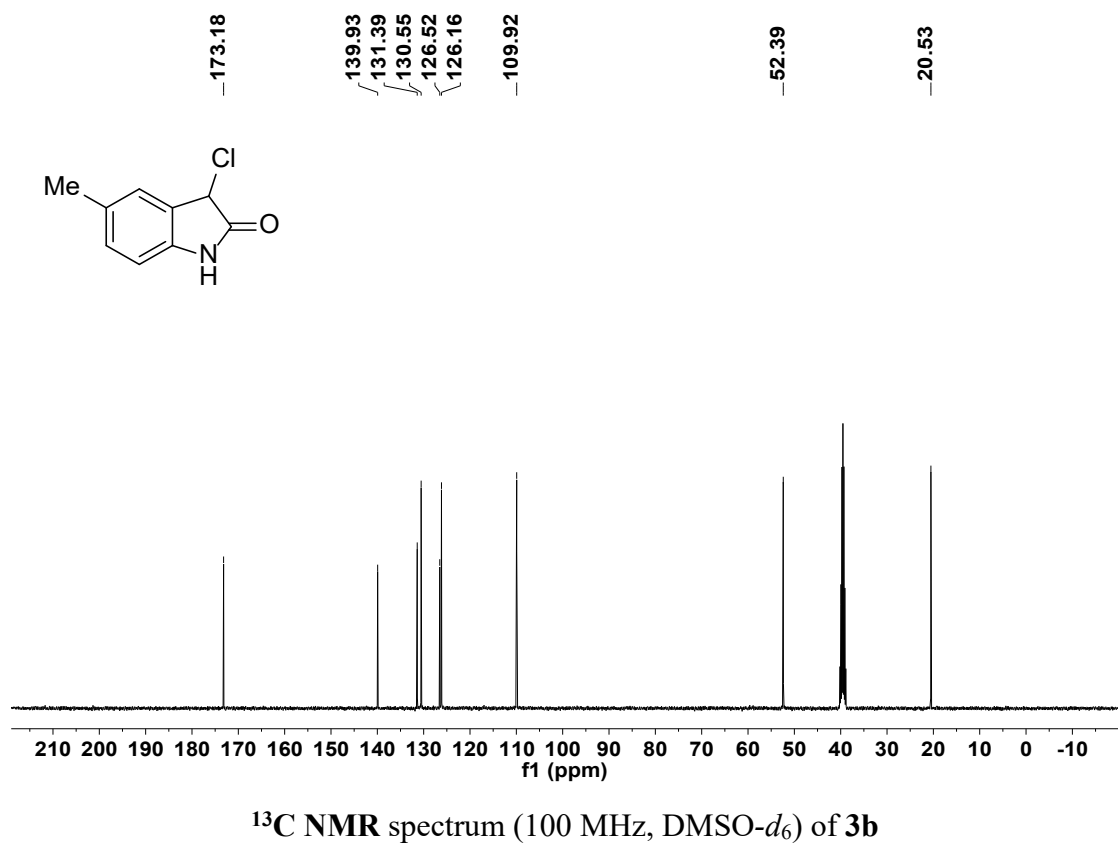
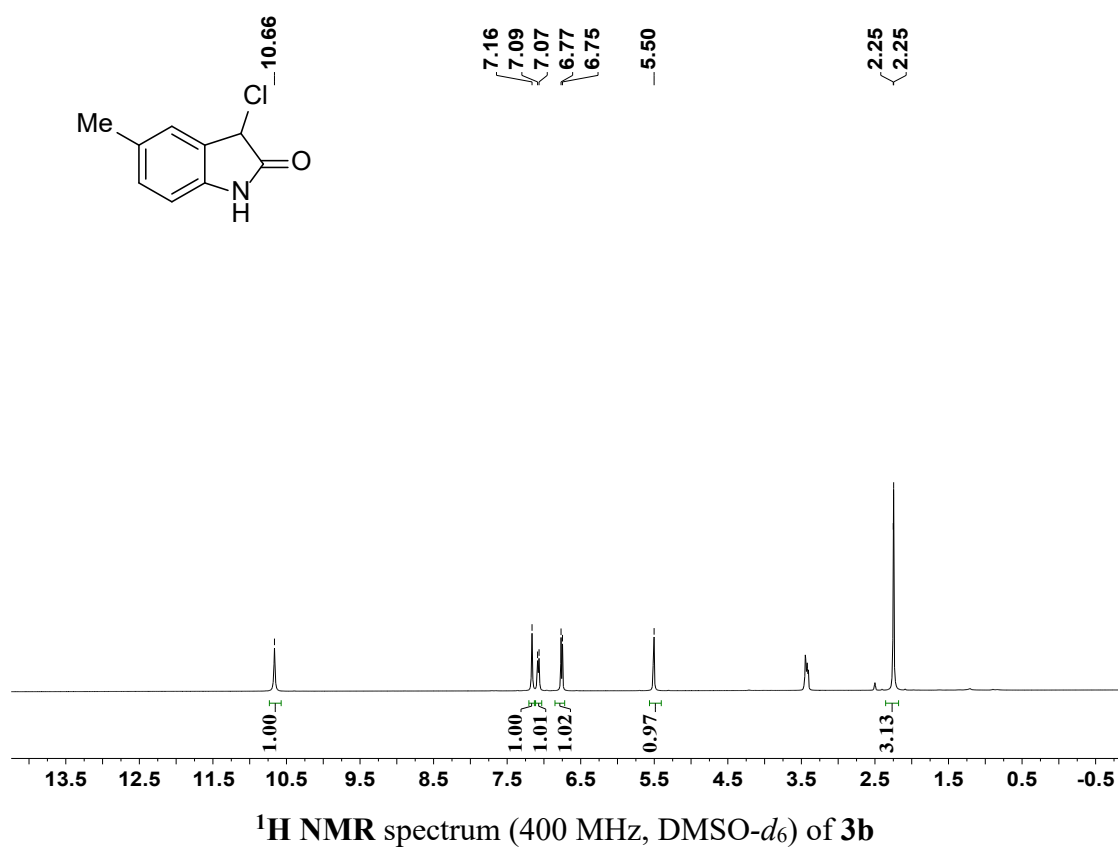
1-Benzyl-3-bromoindolin-2-one (4o) [8]: Brown solid; mp: 127-128 °C (62%). ^1H NMR (400 MHz, $\text{DMSO}-d_6$) δ 7.42 (d, J = 7.4 Hz, 1H), 7.34 (d, J = 5.2 Hz, 4H), 7.31 – 7.23 (m, 1H), 7.08 (dd, J = 7.6, 1.0 Hz, 1H), 6.95 (d, J = 7.9 Hz, 1H), 5.93 (s, 1H), 4.92 (d, J = 9.1 Hz, 2H). ^{13}C NMR (100 MHz, $\text{DMSO}-d_6$) δ 172.23, 142.65, 135.87, 130.14, 128.71, 127.56, 127.16, 126.29, 125.93, 123.06, 109.81, 42.92, 39.57. **HRMS (ESI)**: m/z calcd for $\text{C}_{15}\text{H}_{12}\text{BrNO}$ $[\text{M}+\text{H}]^+$: 302.0175; found: 302.0164.

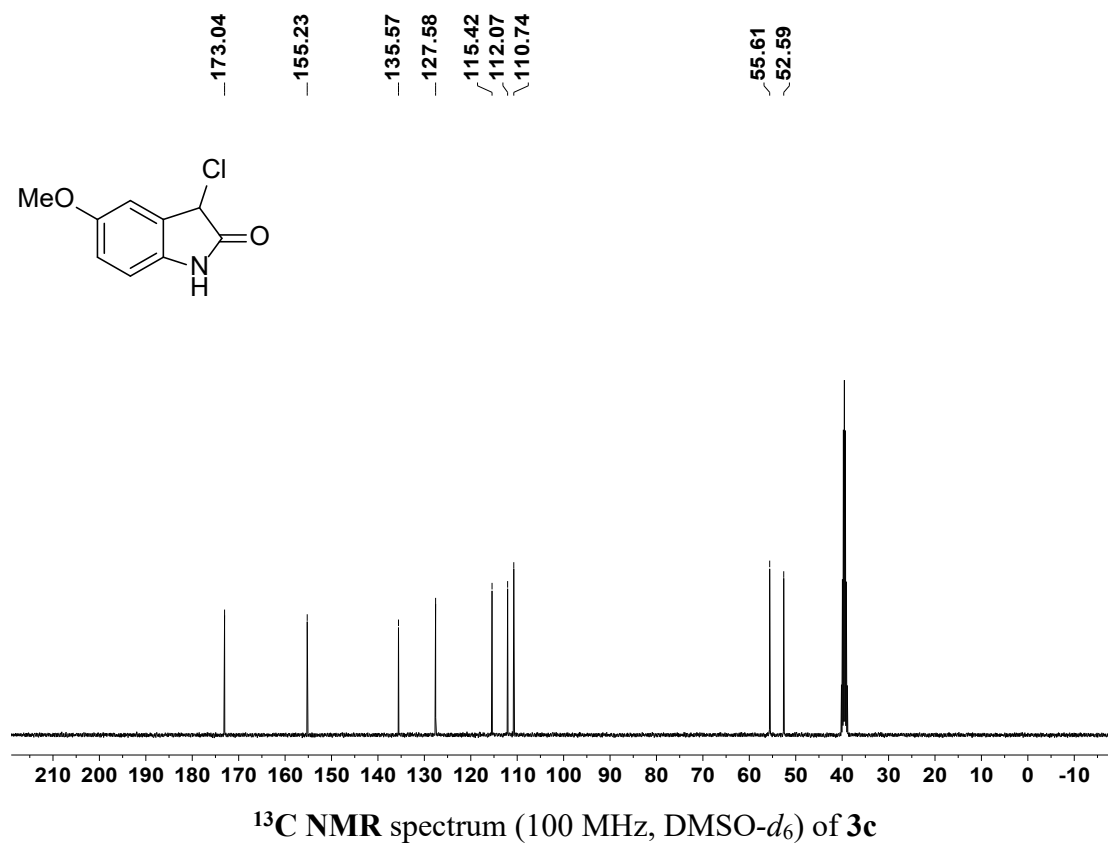
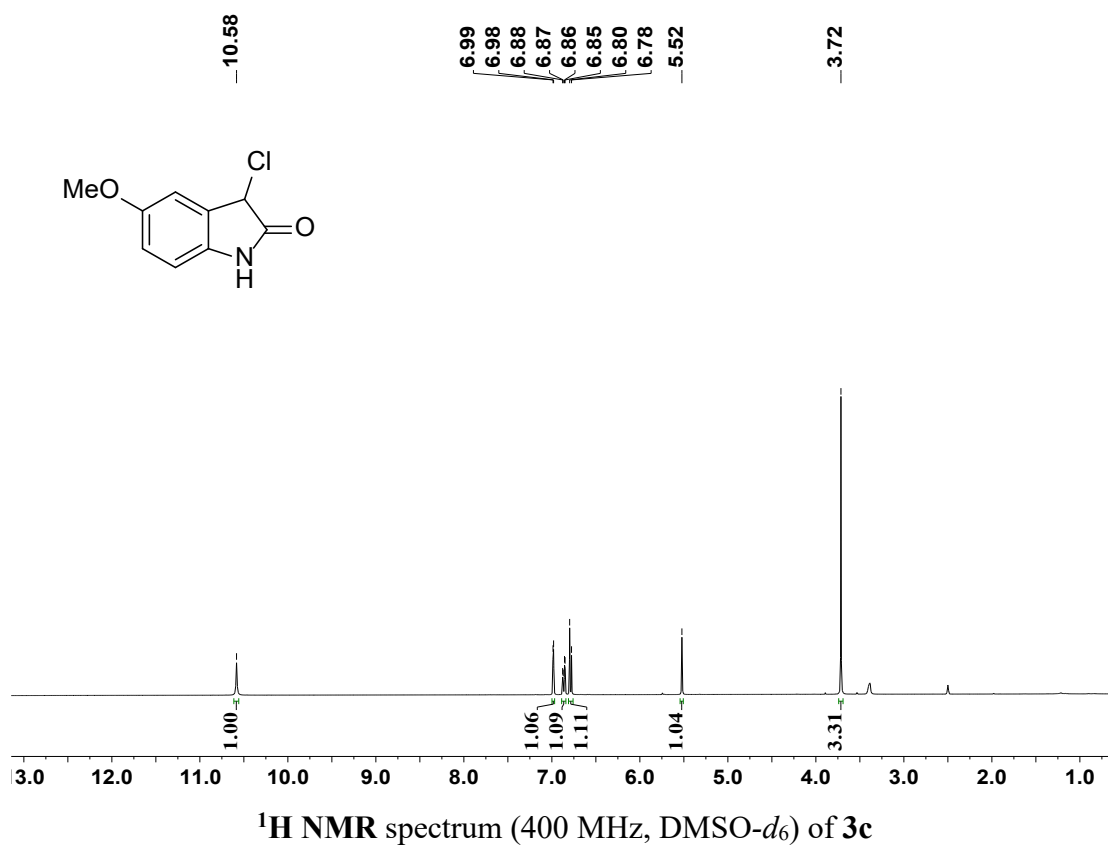
II Spectra of compounds 2–4

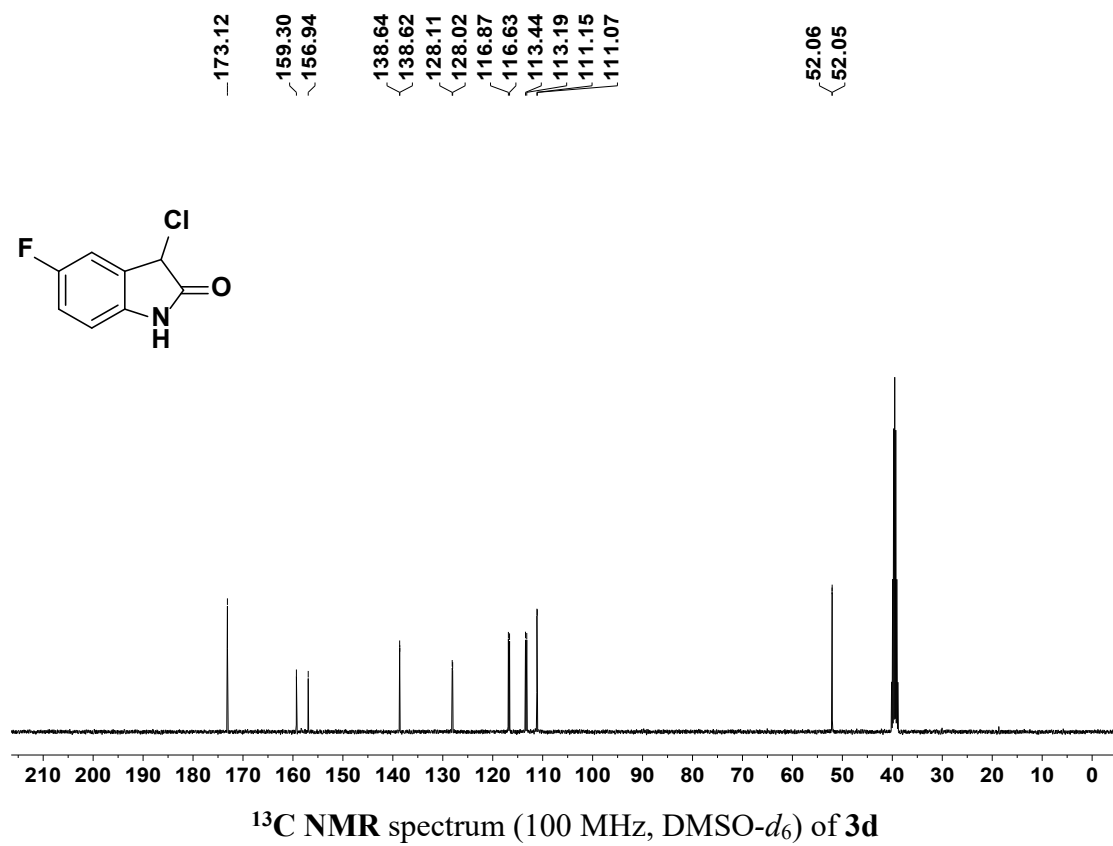
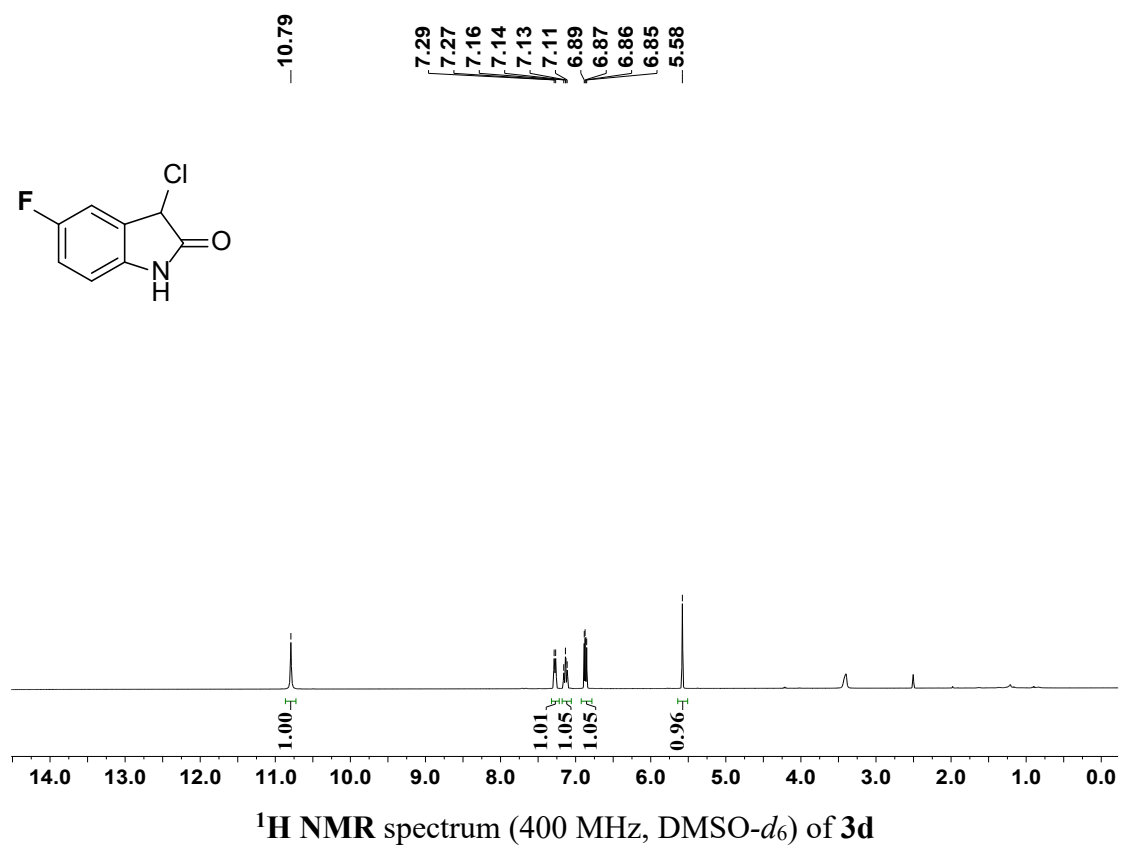


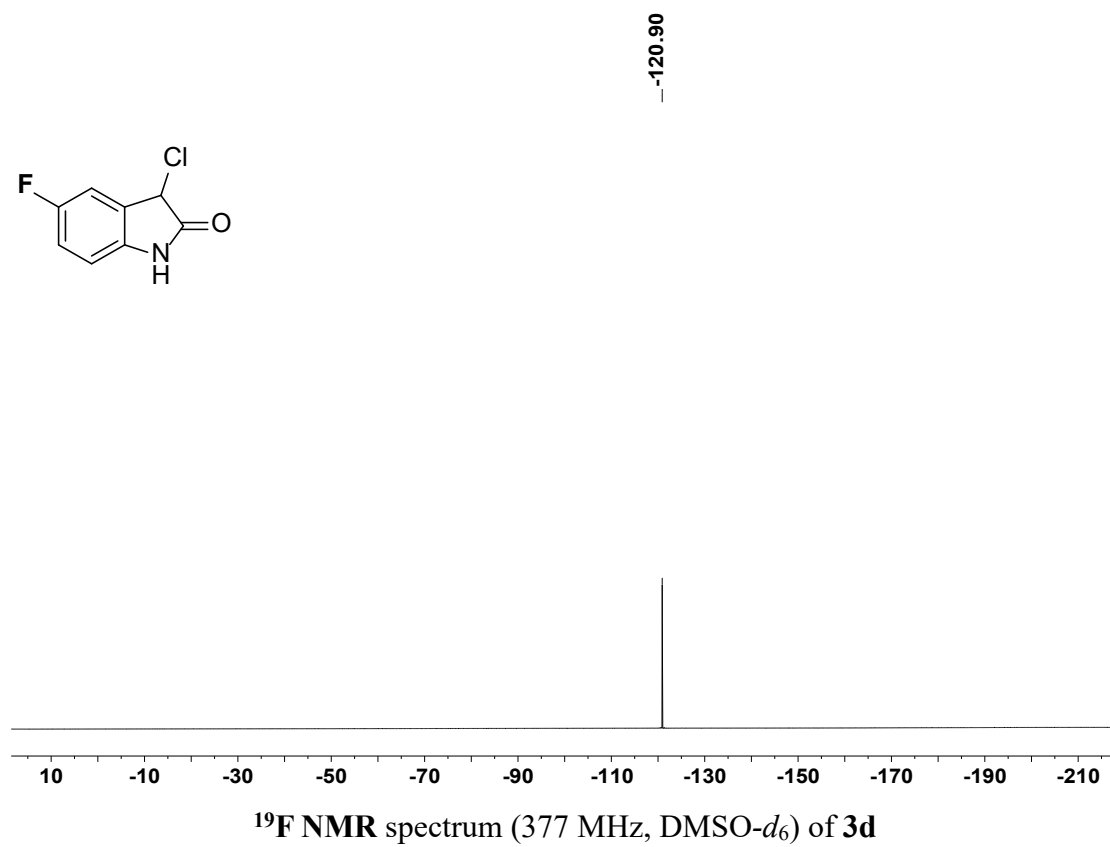


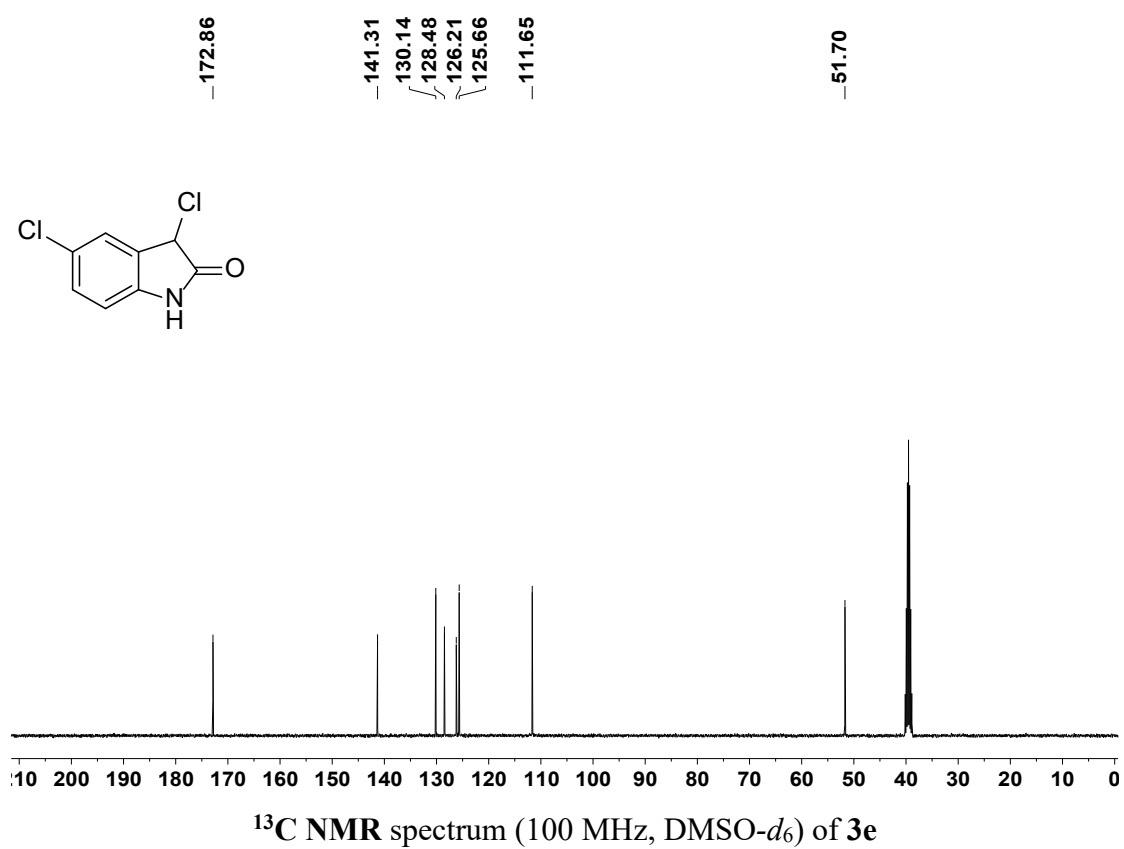
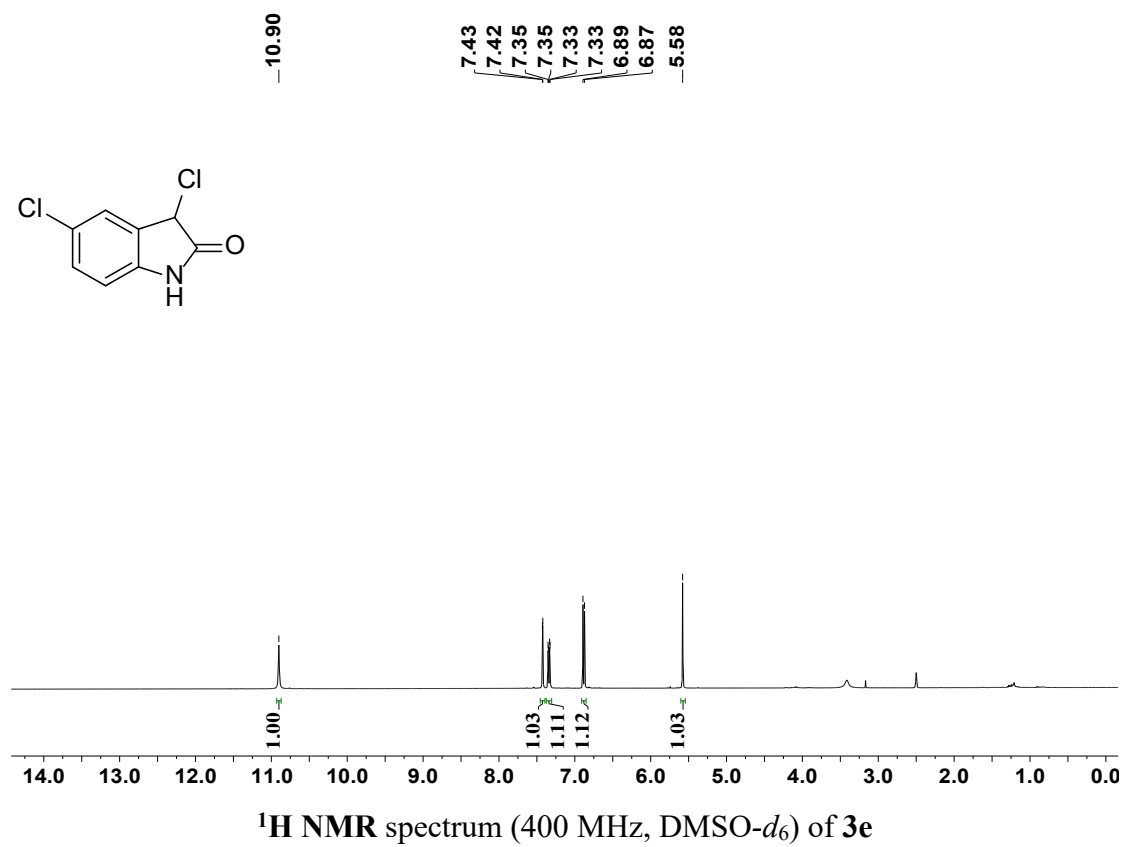


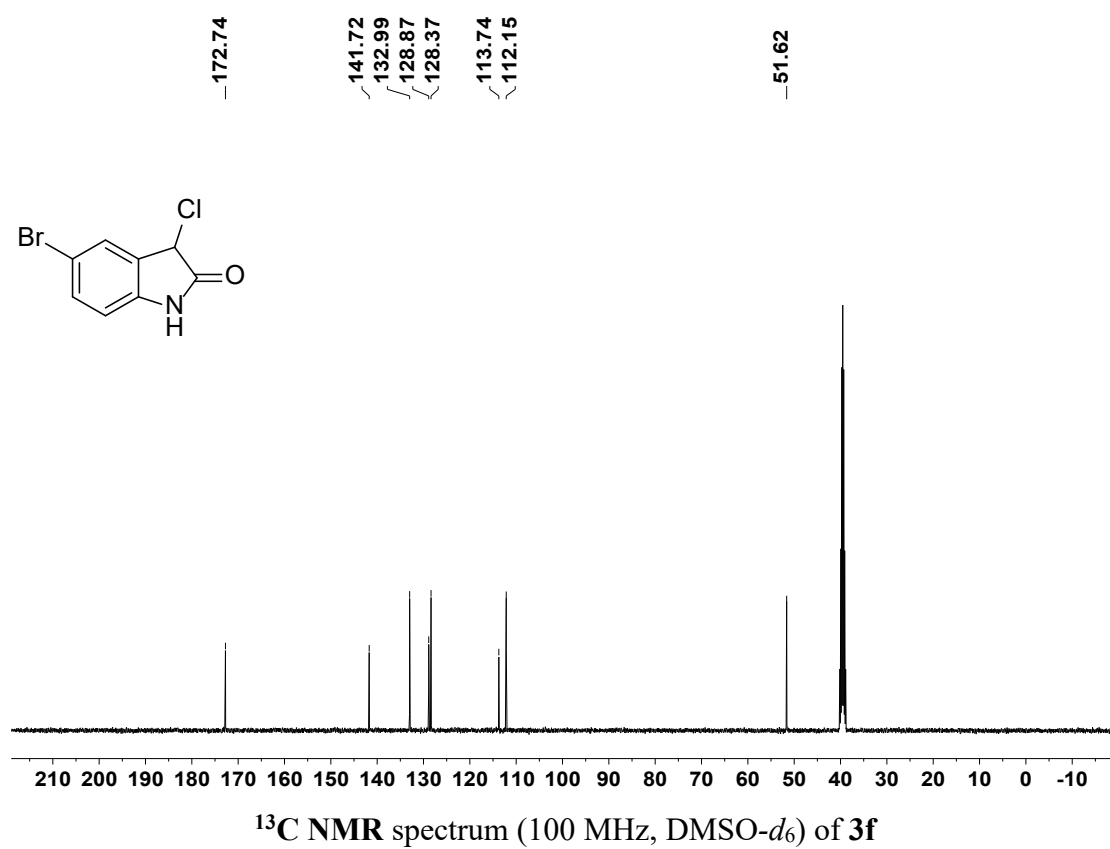
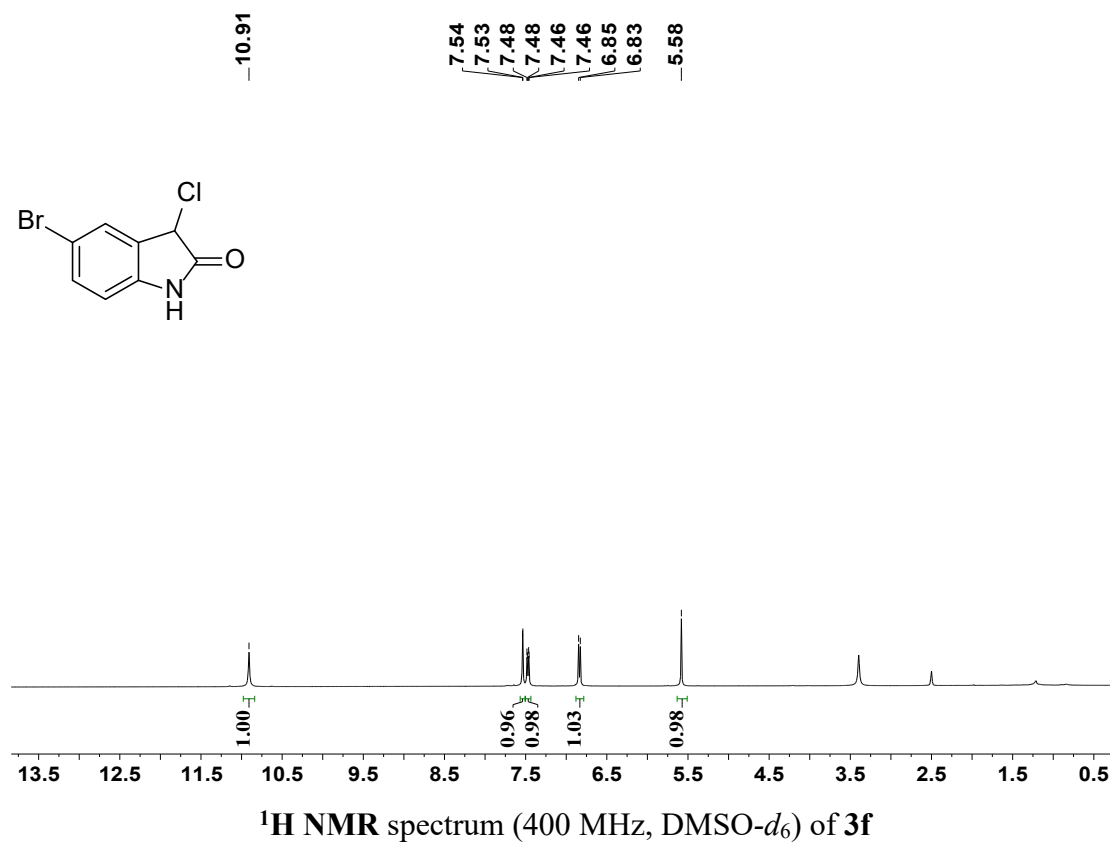


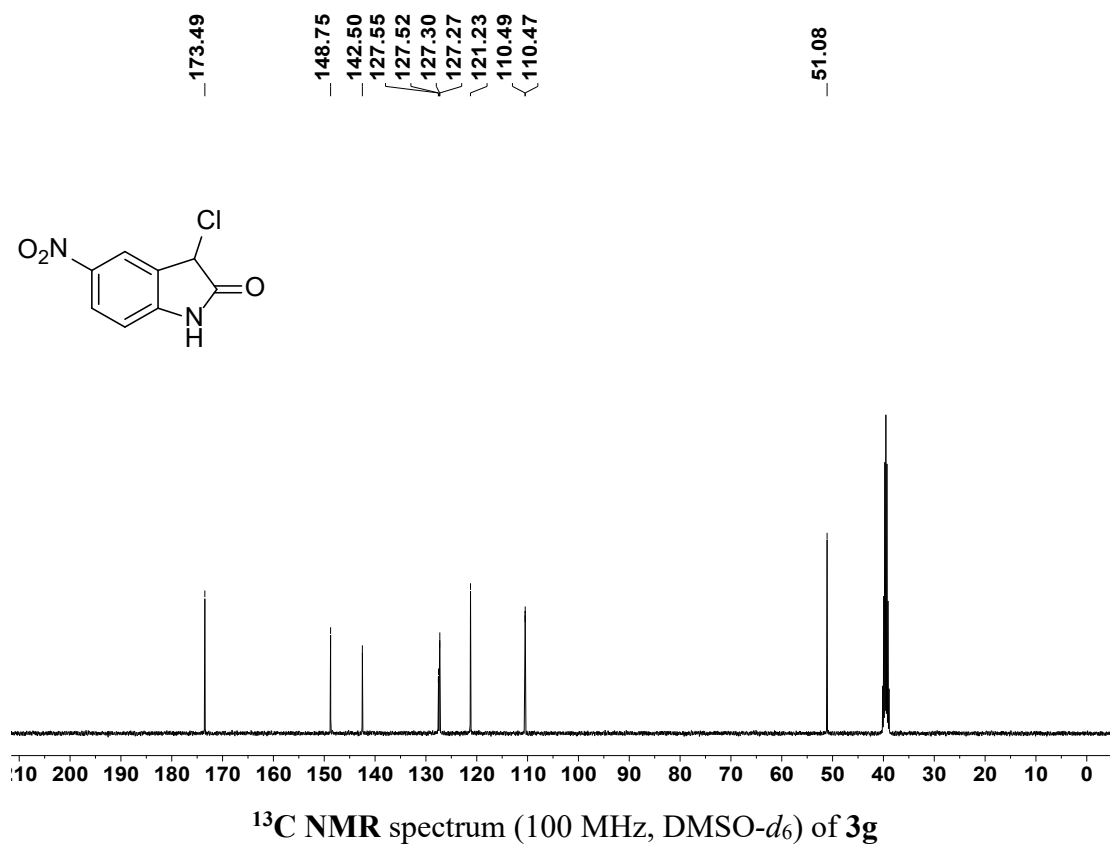
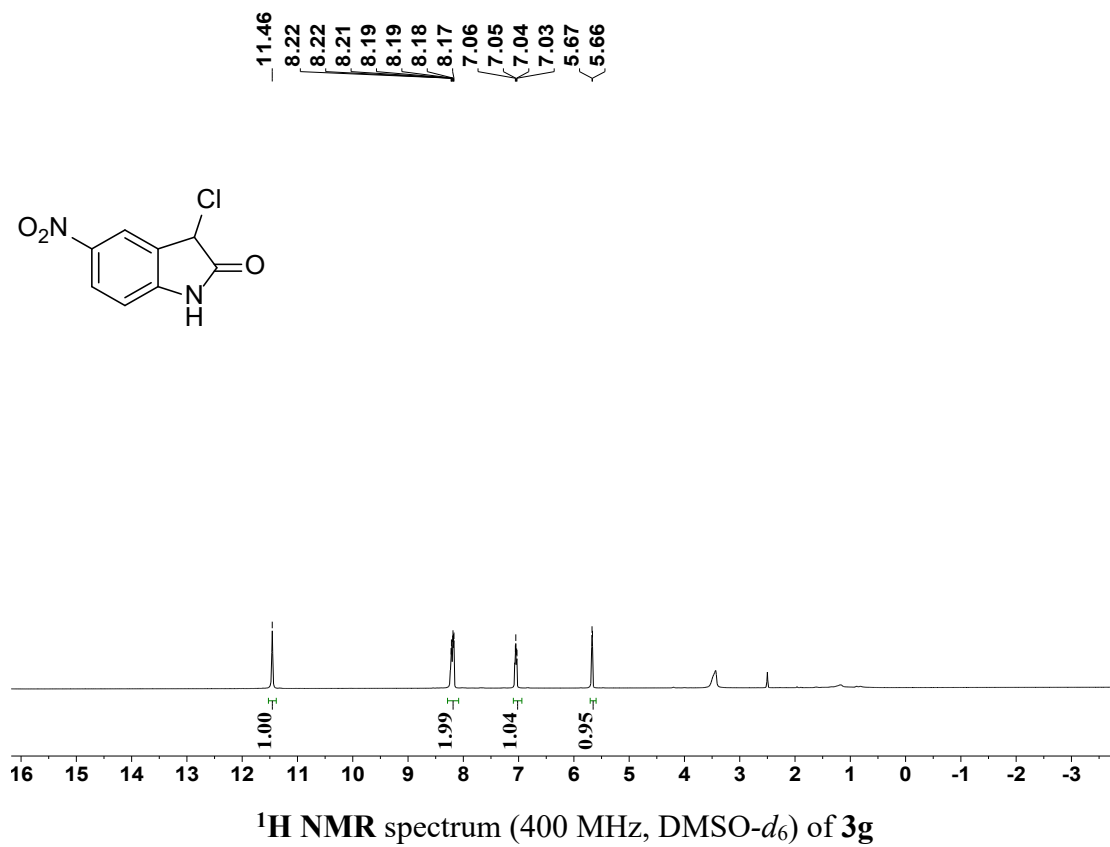


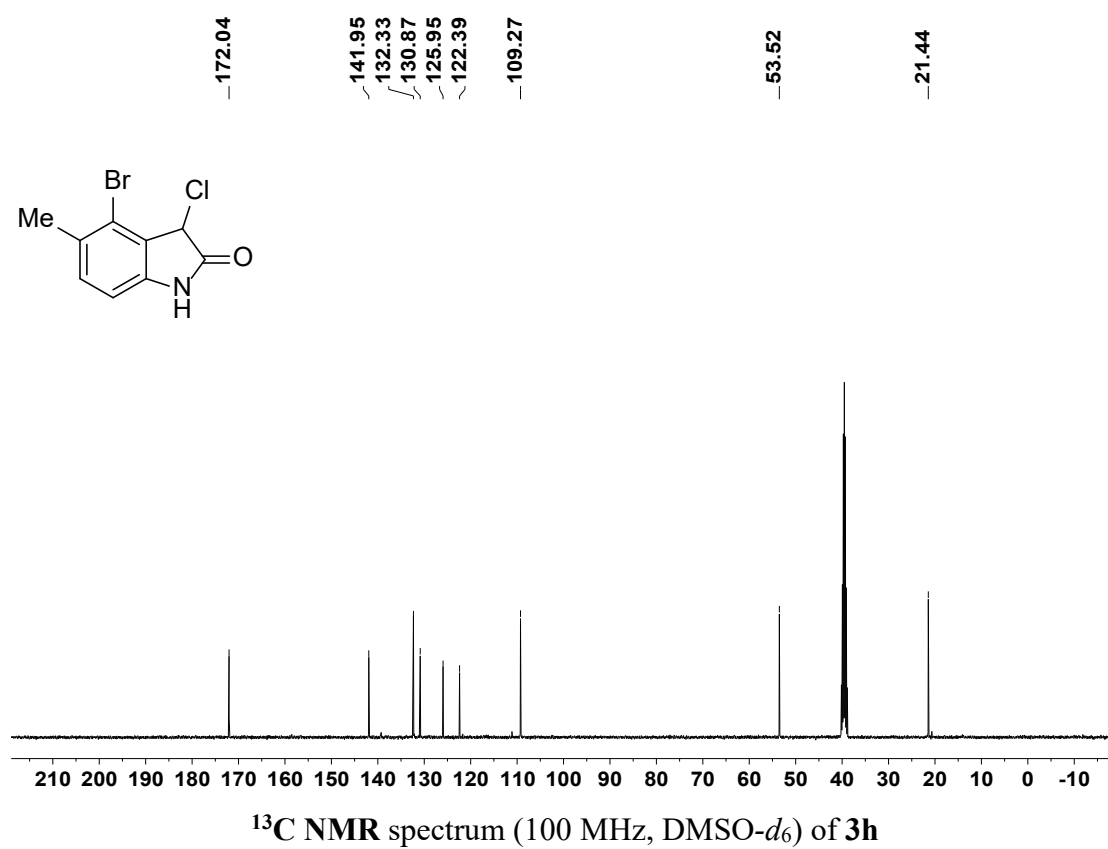
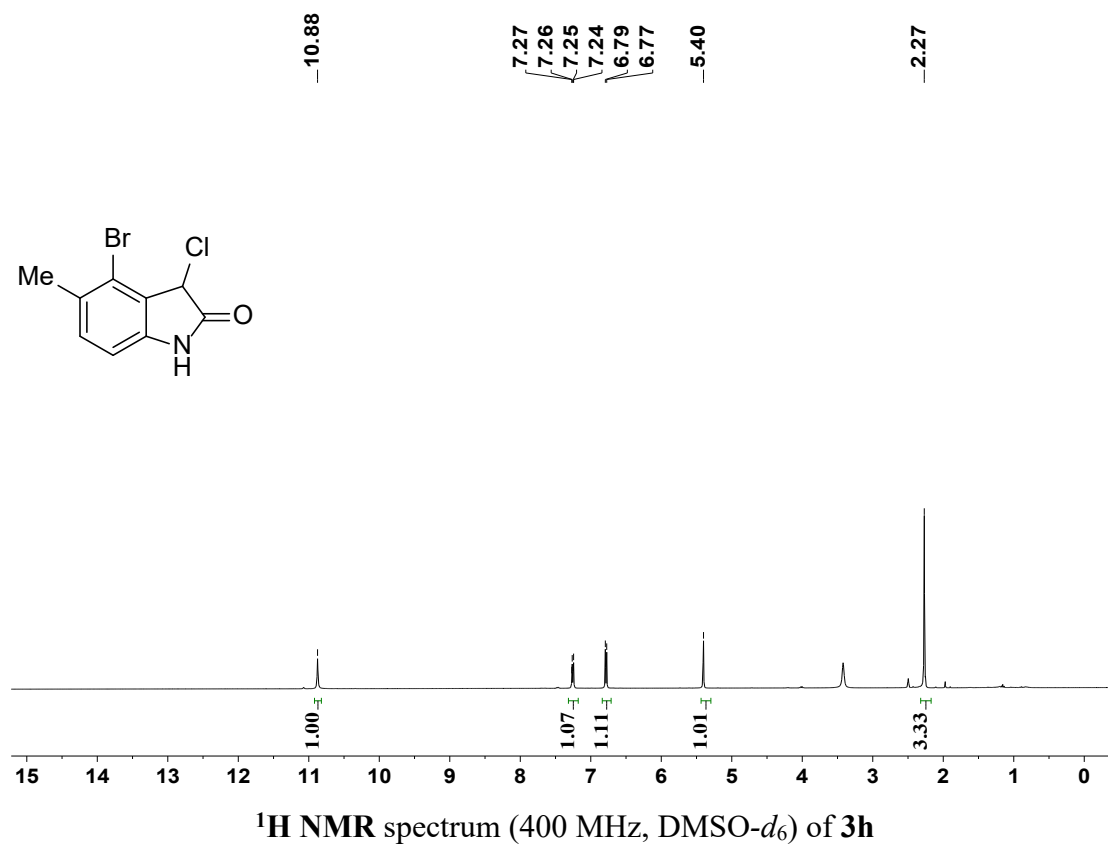


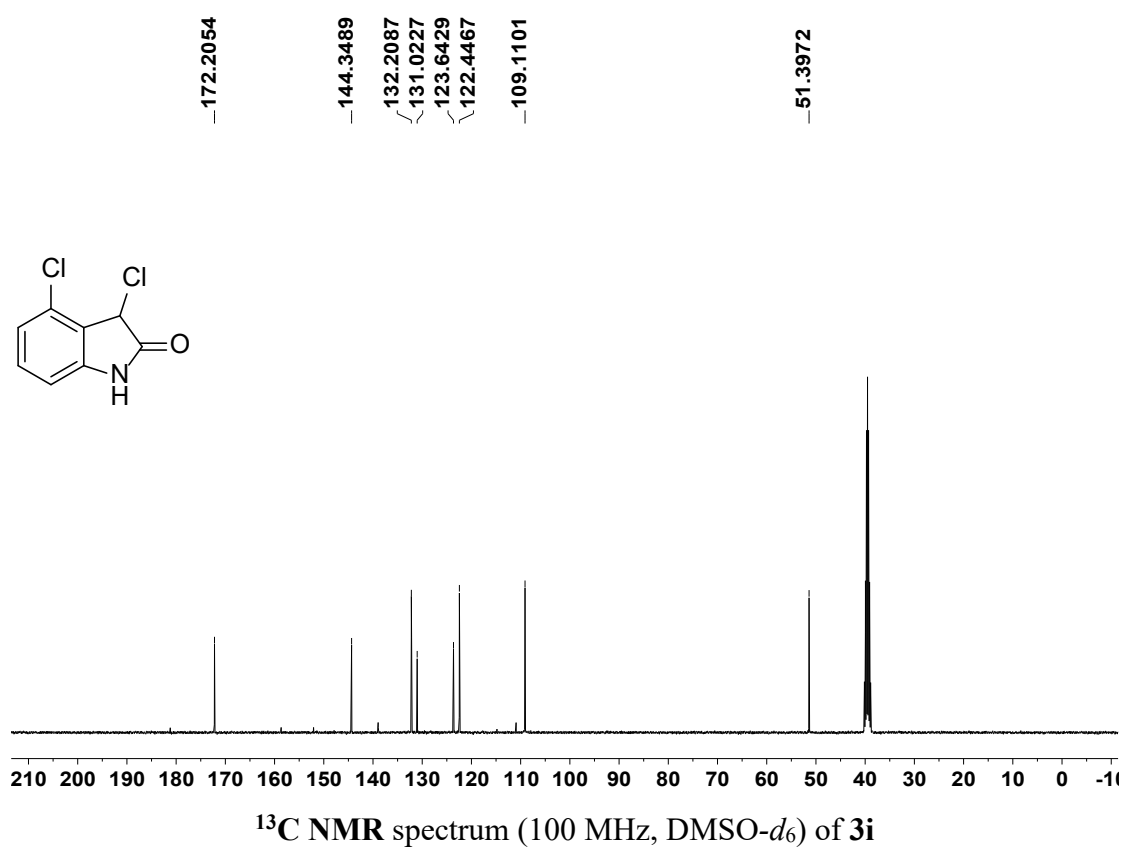
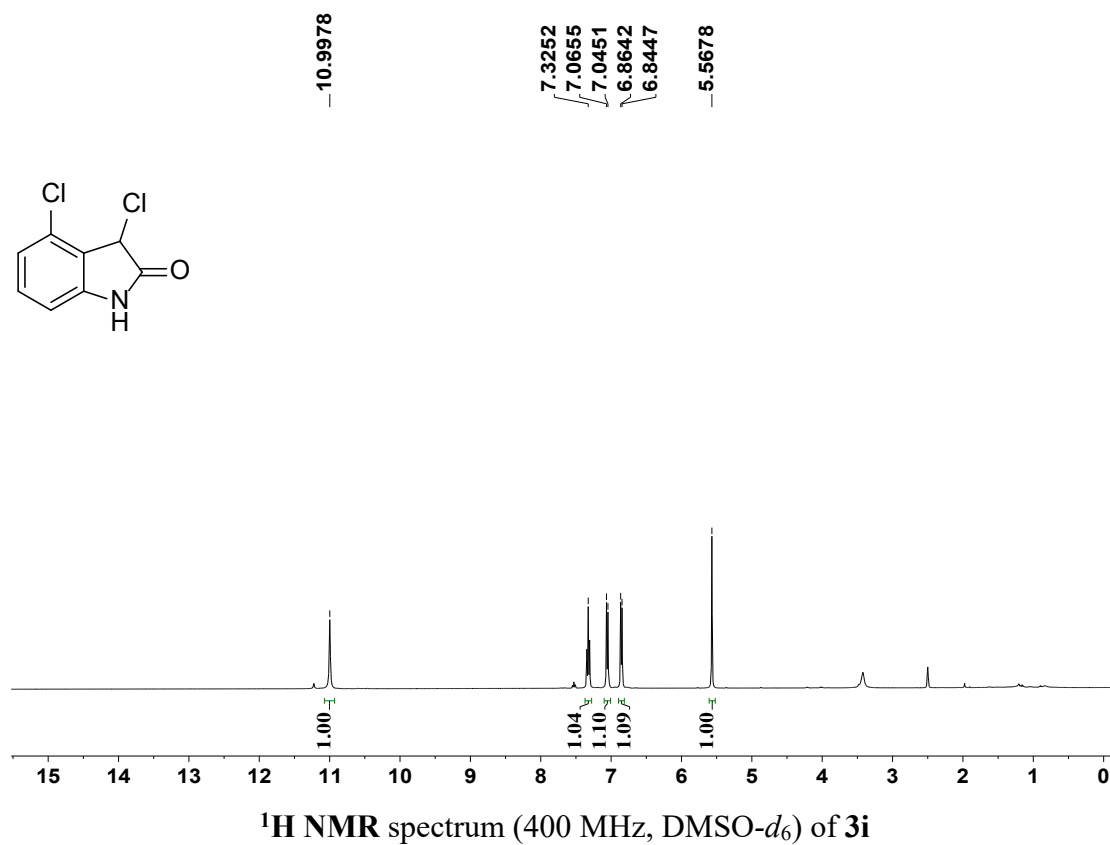


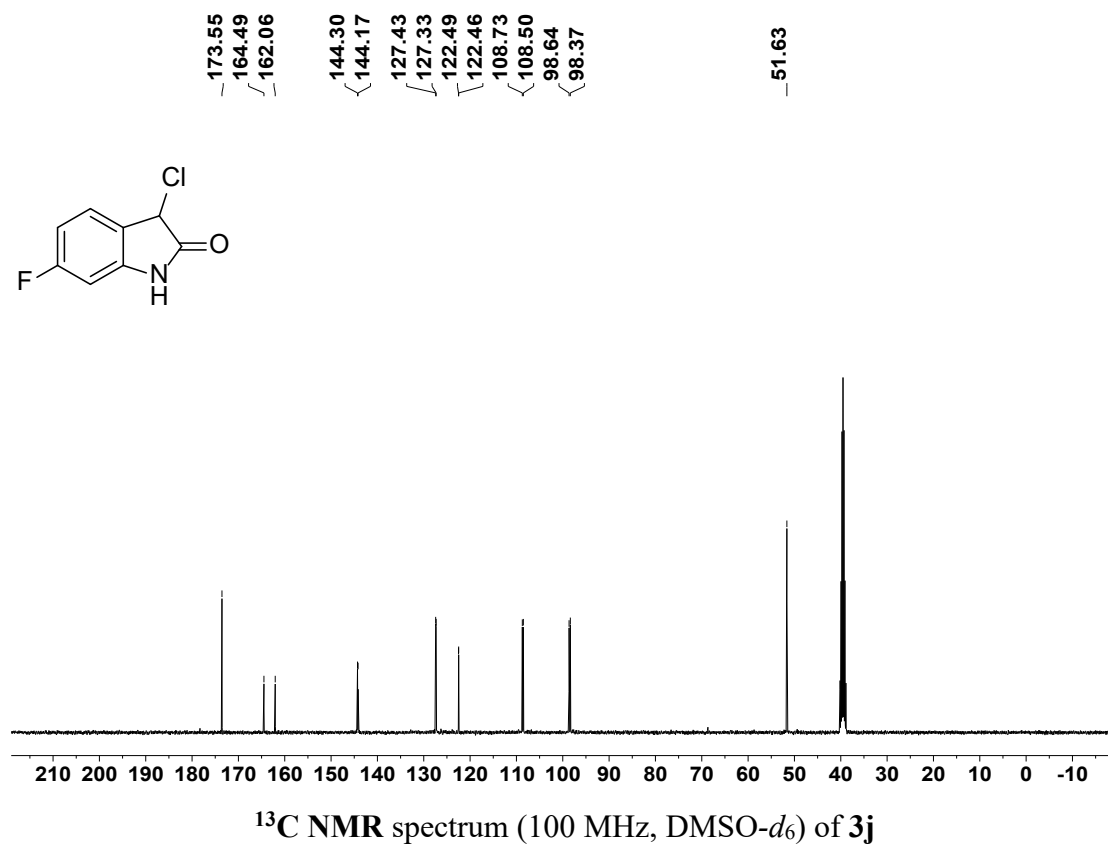
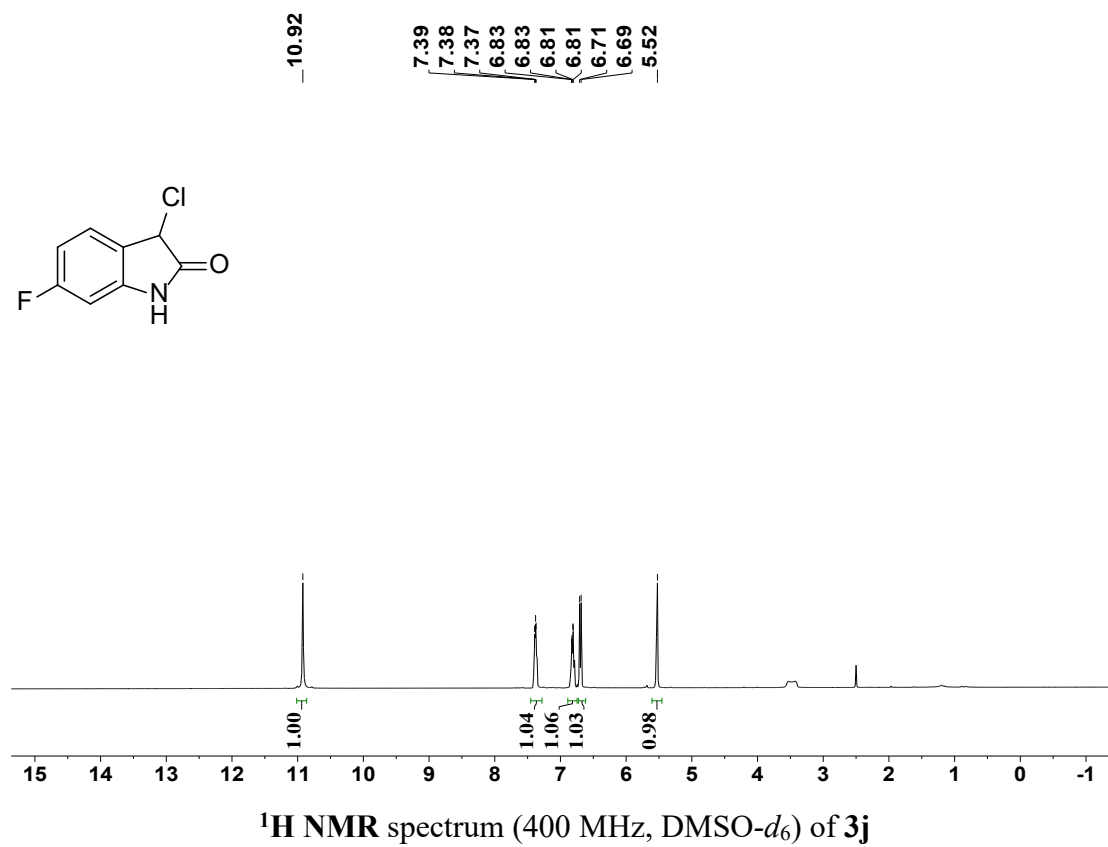


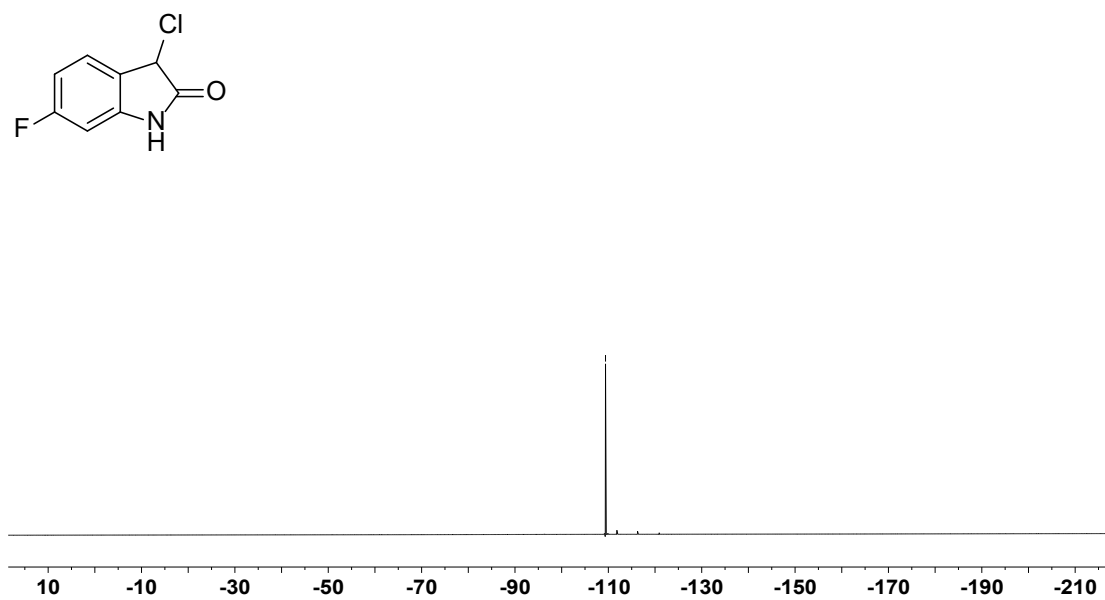




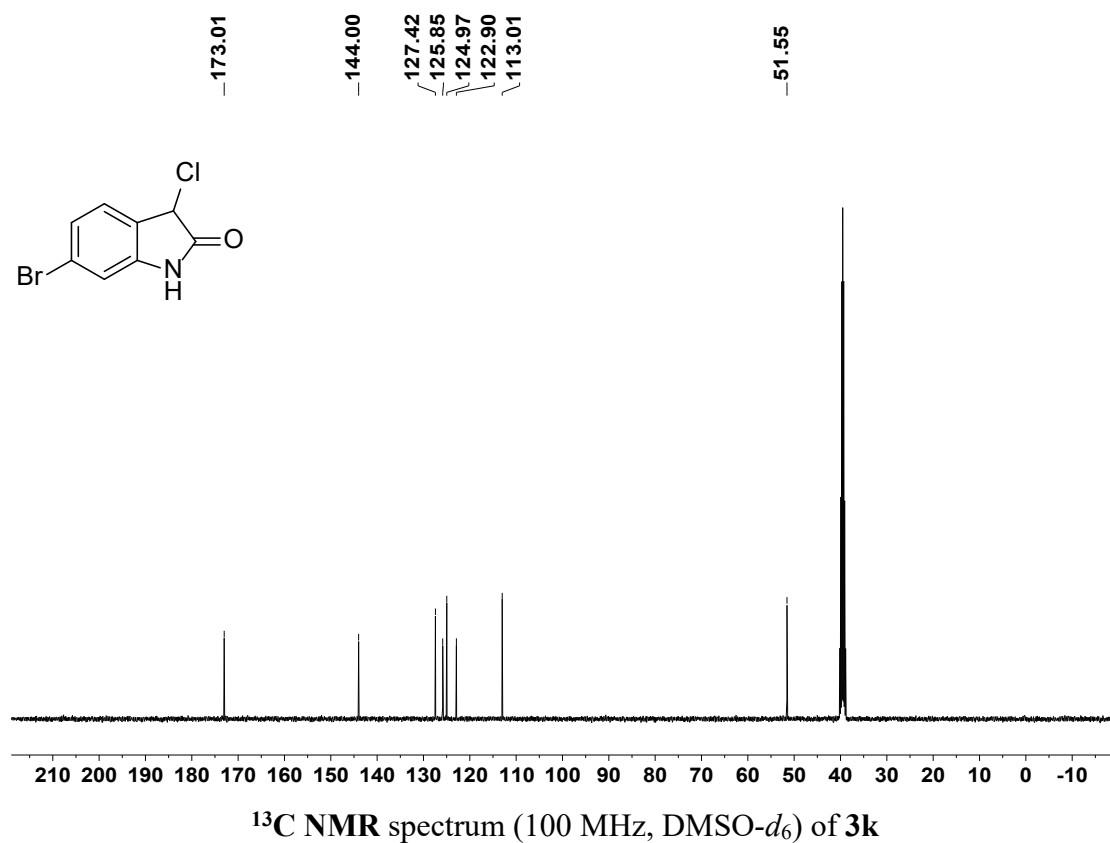
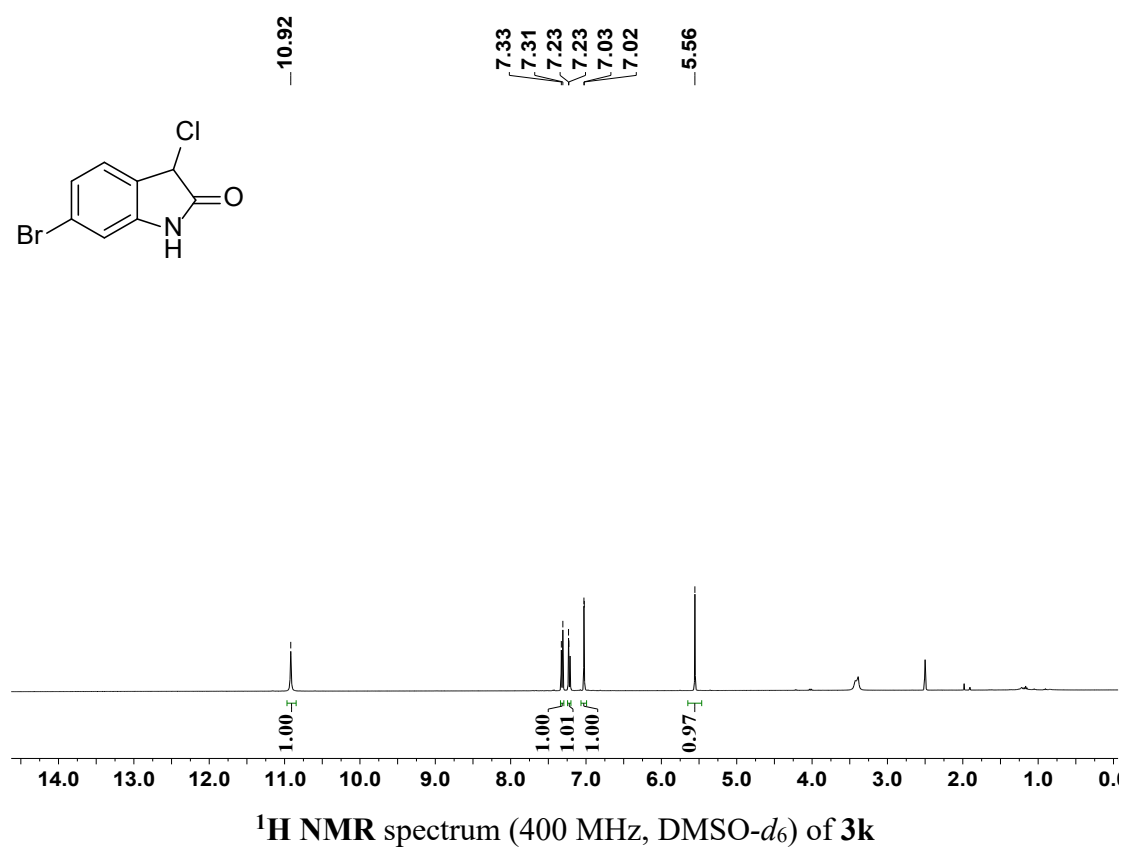


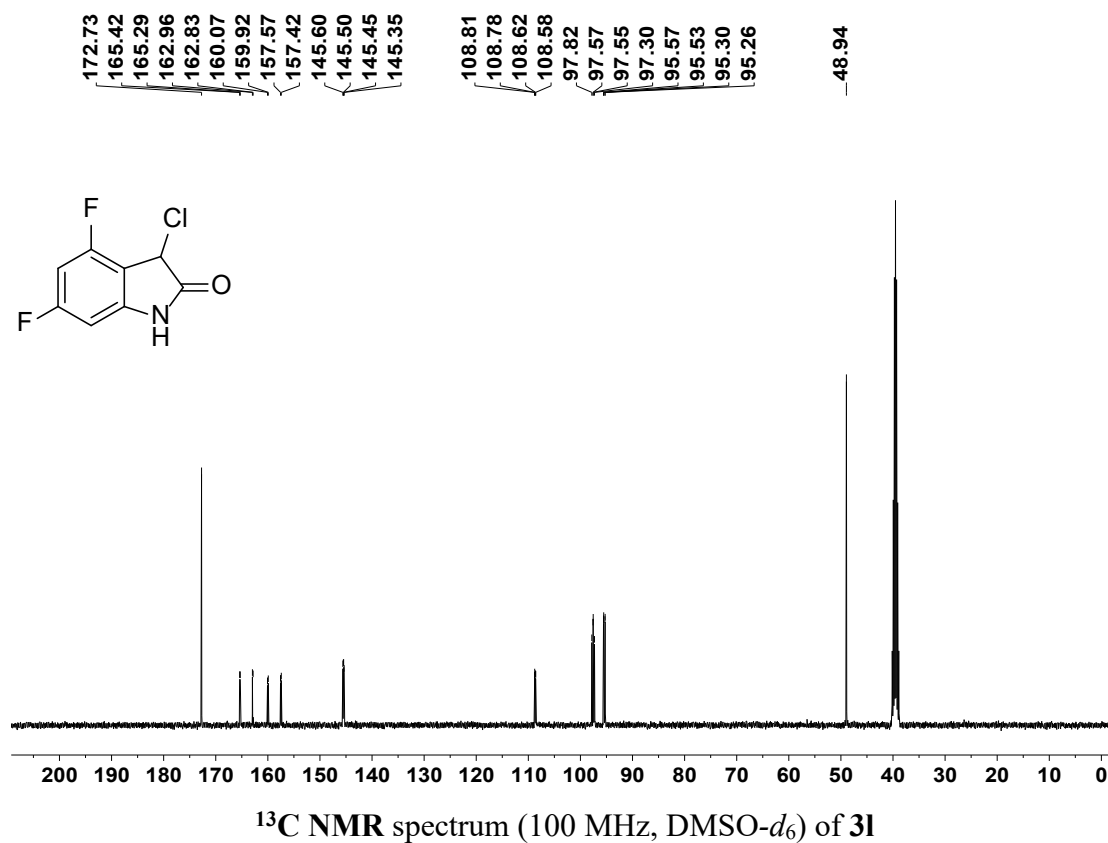
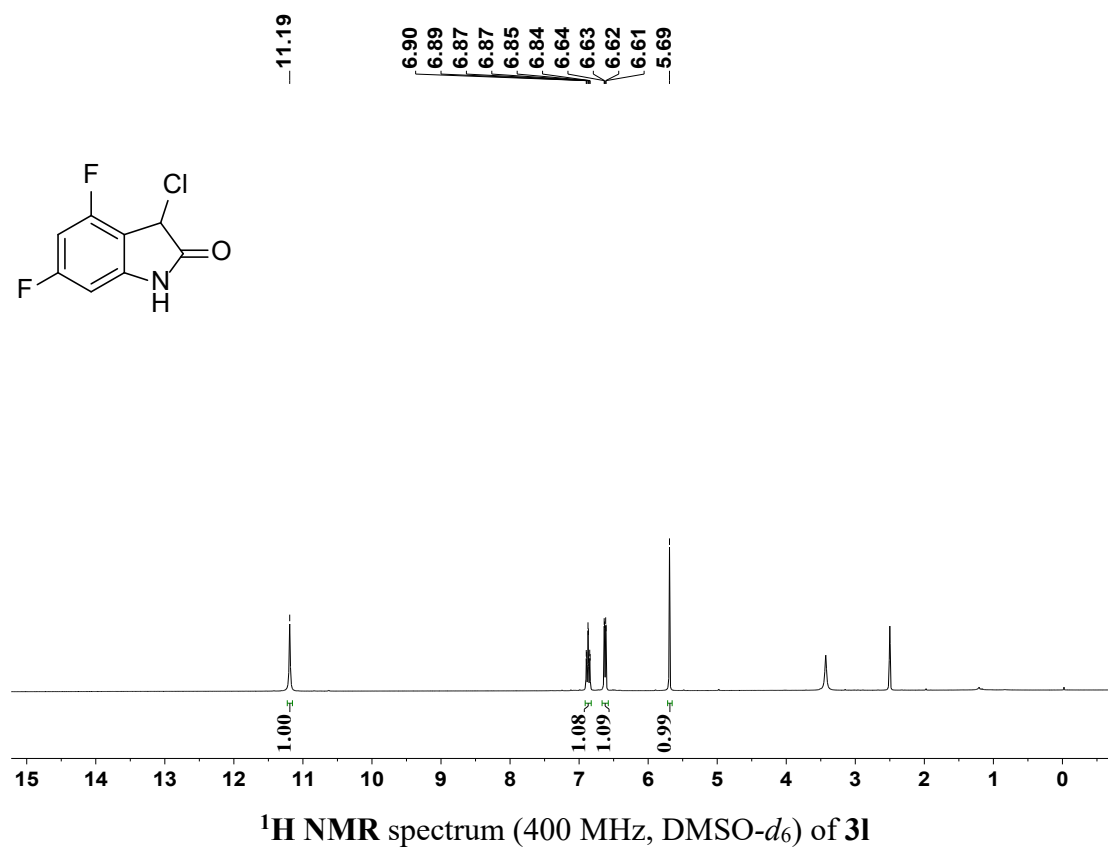


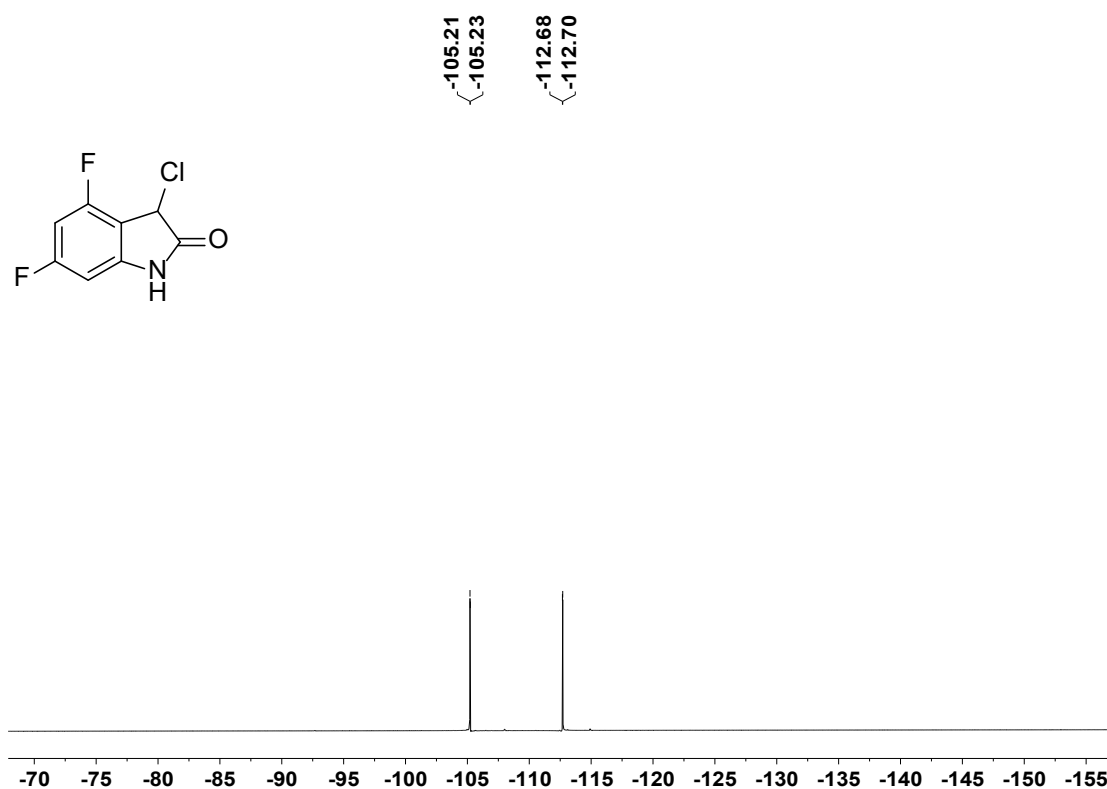


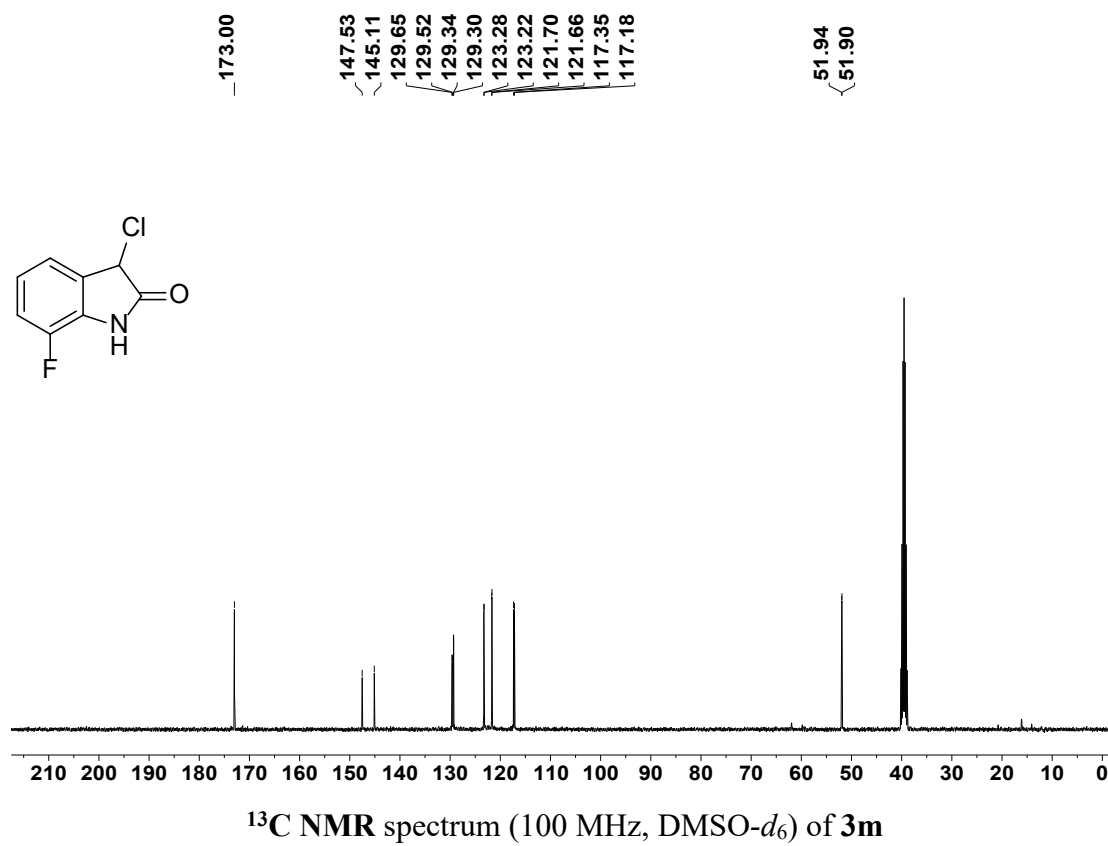
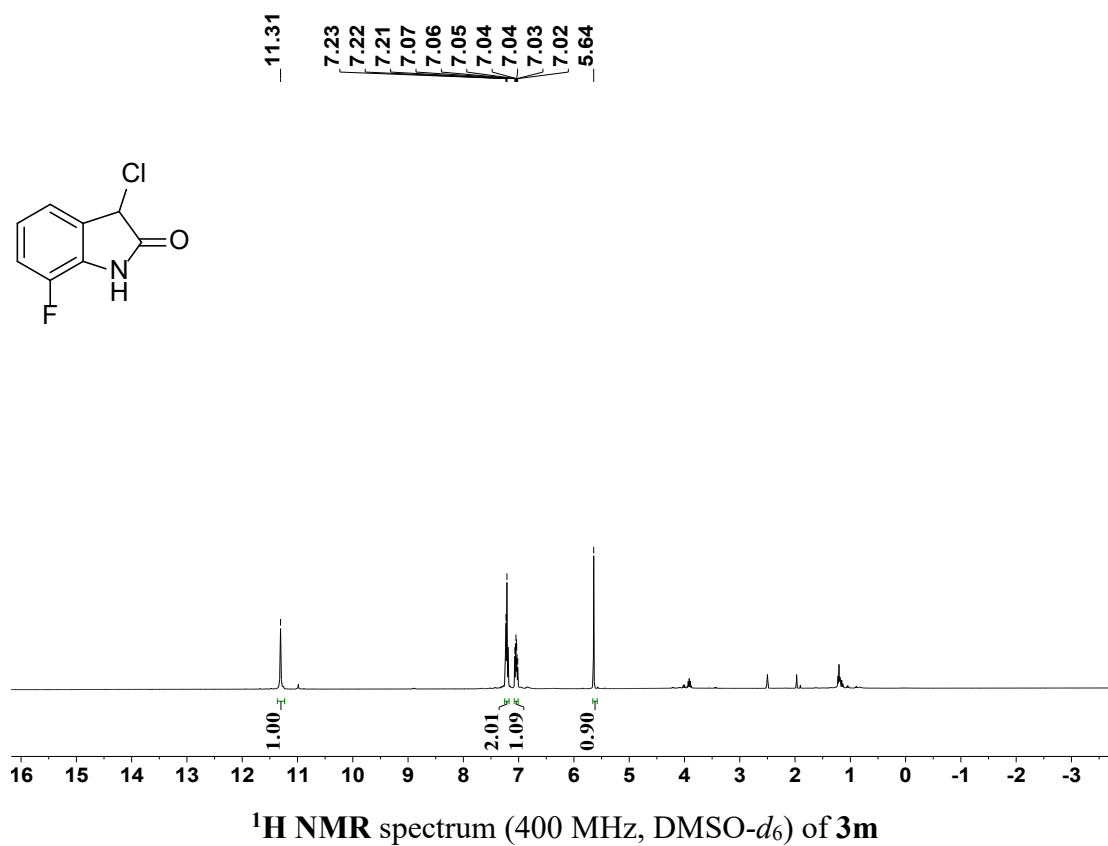


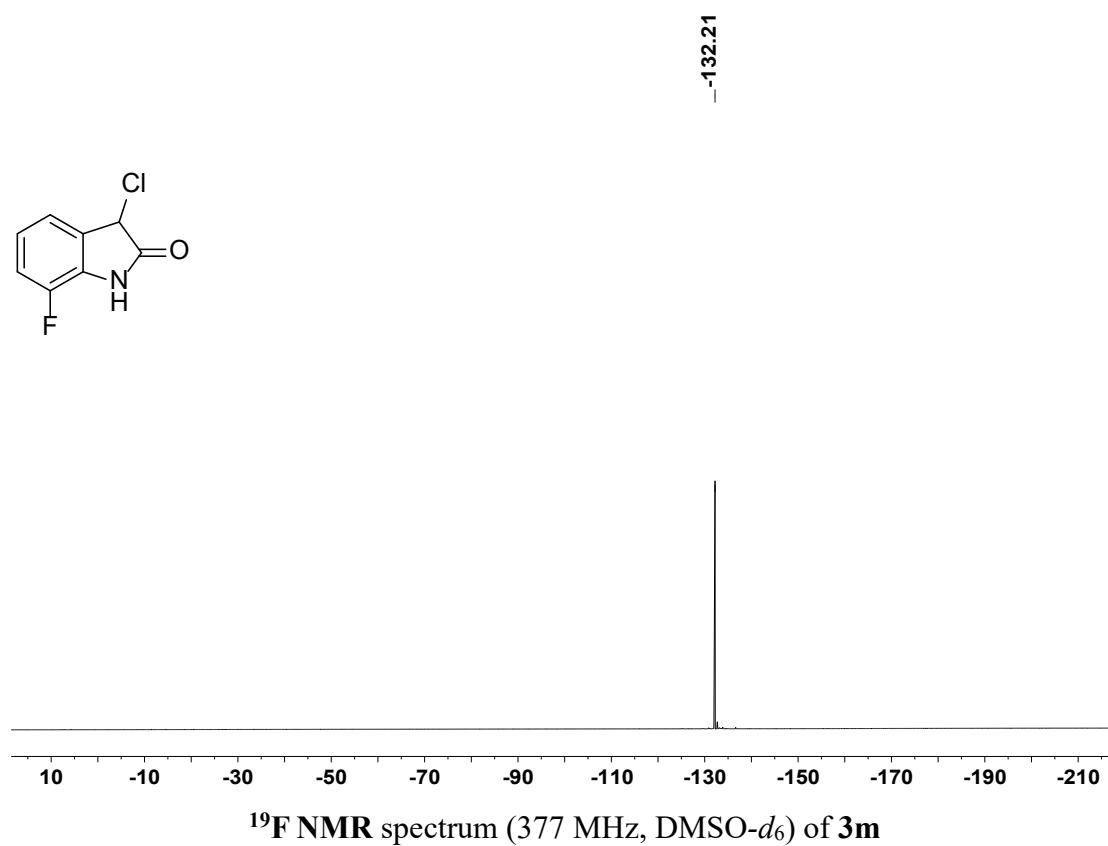
^{19}F NMR spectrum (377 MHz, $\text{DMSO-}d_6$) of **3j**

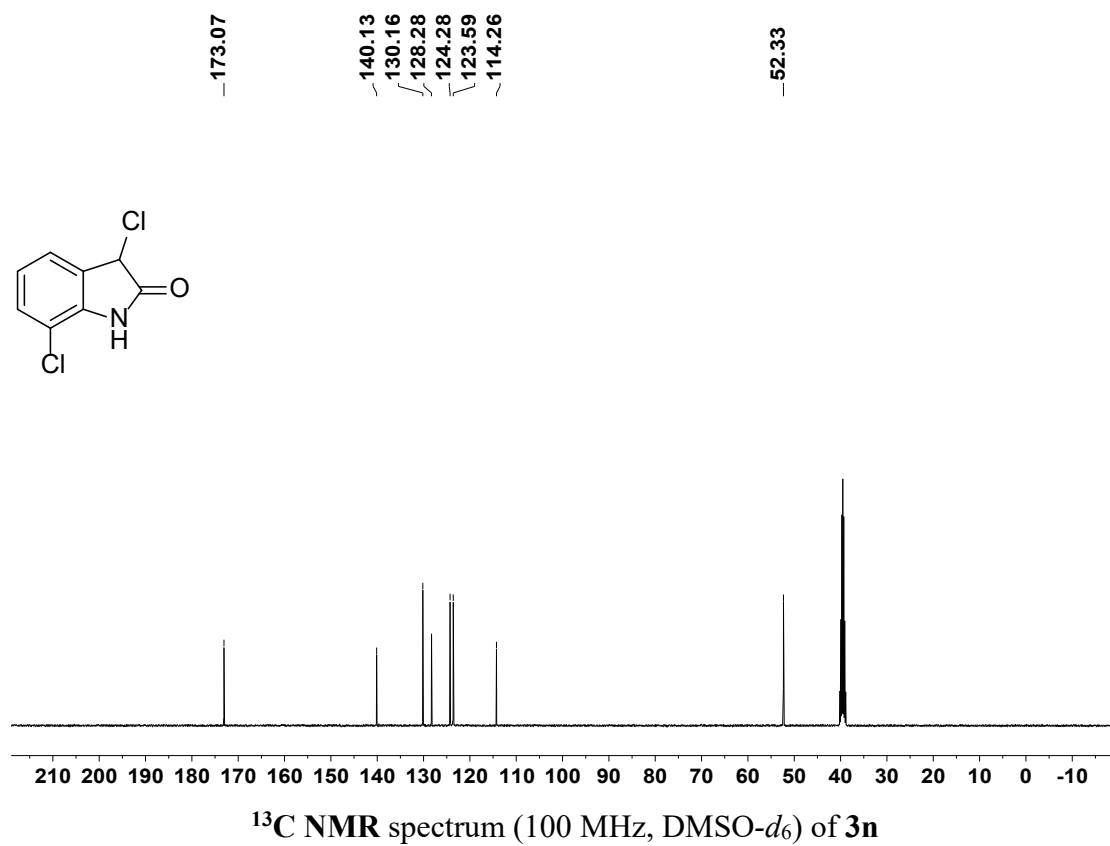
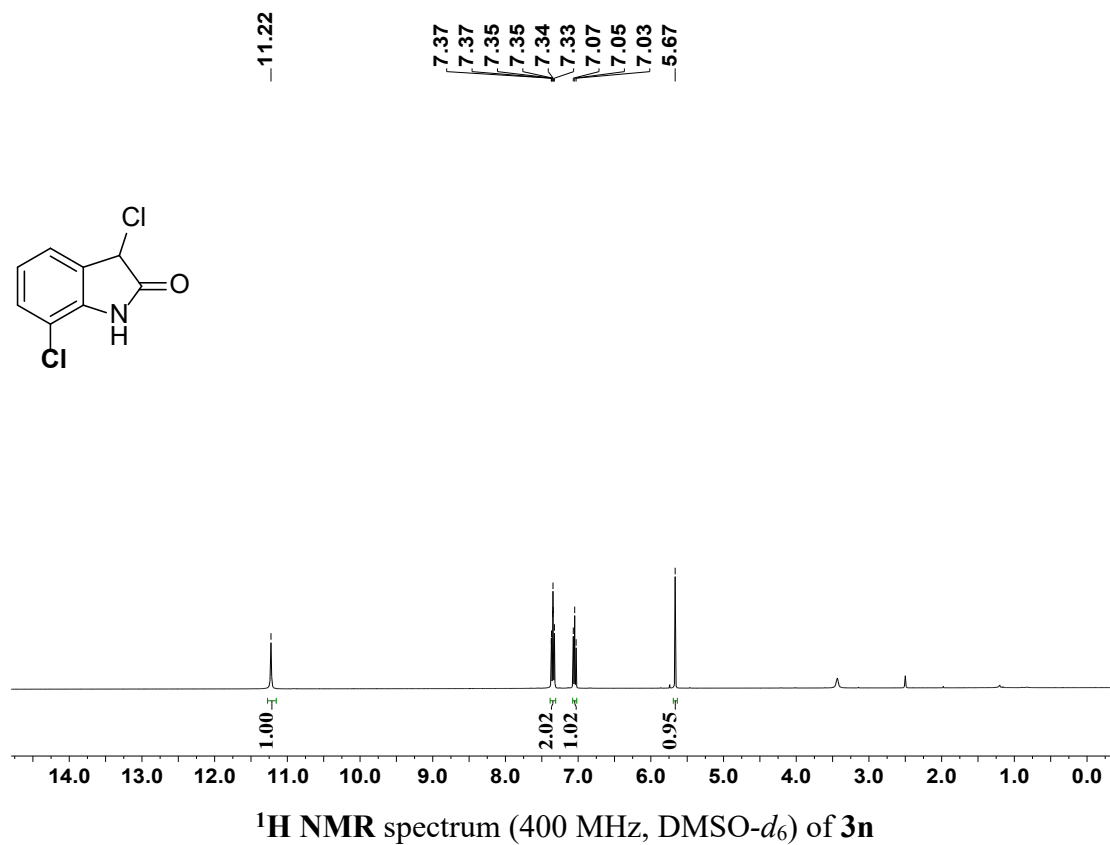


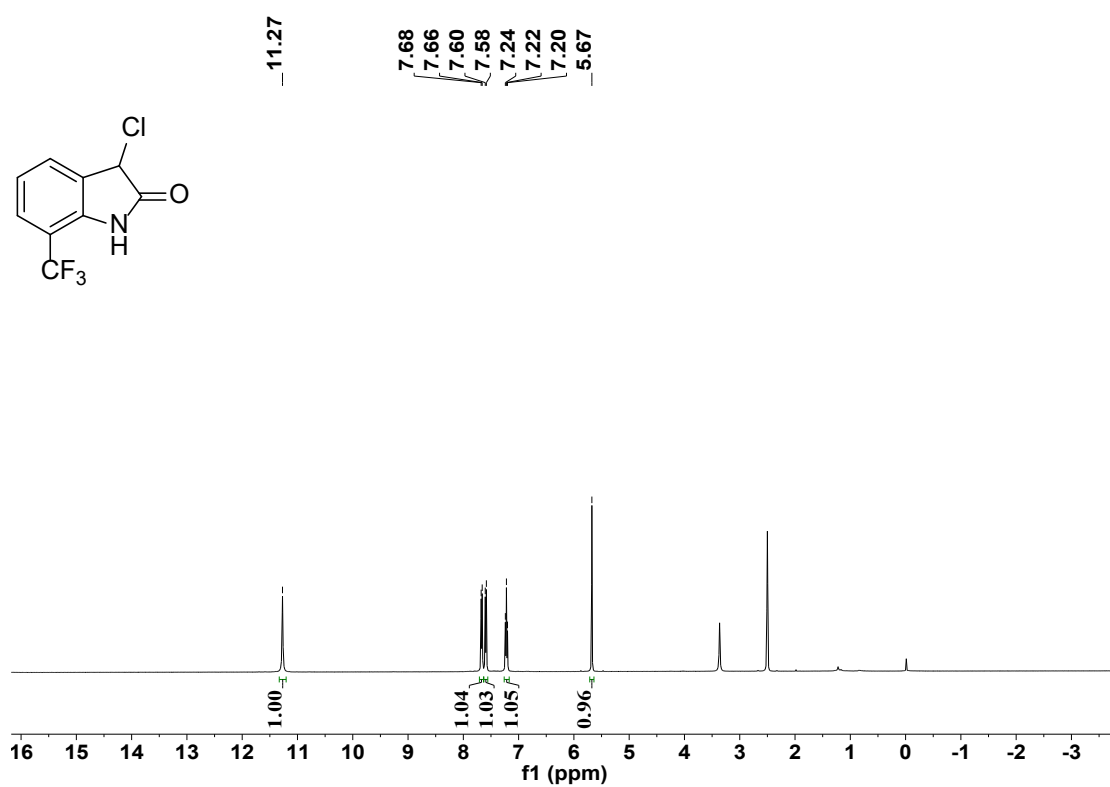




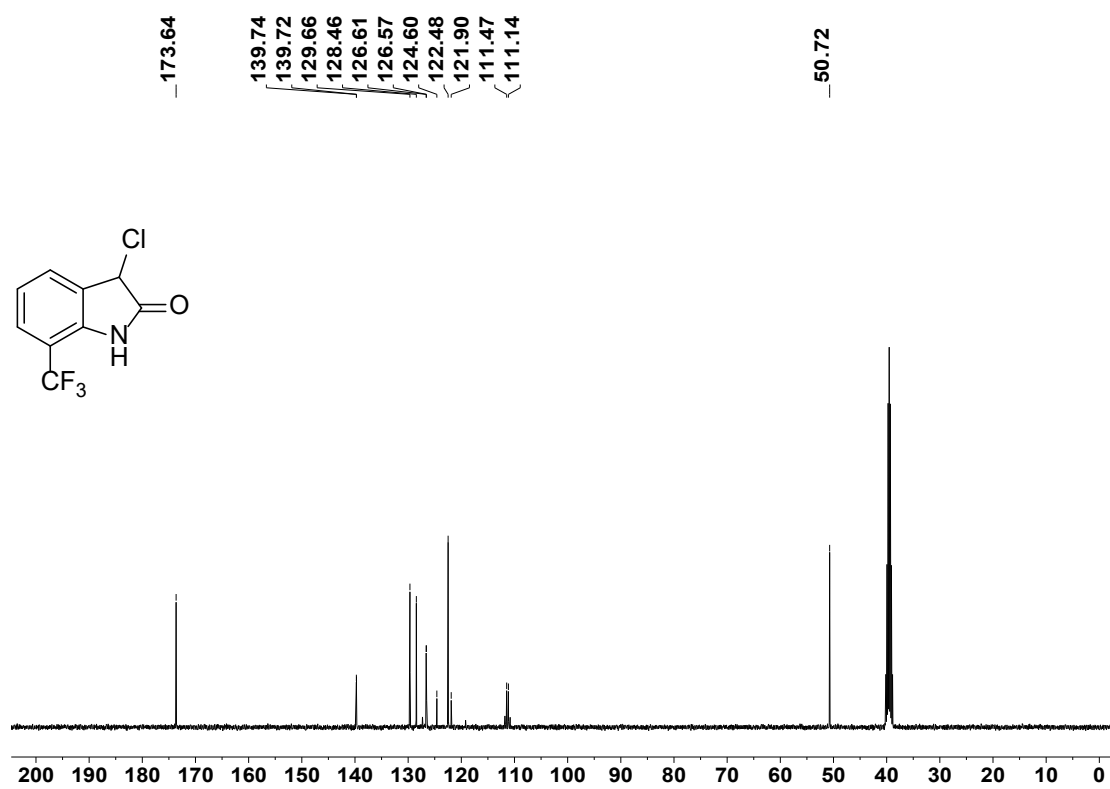




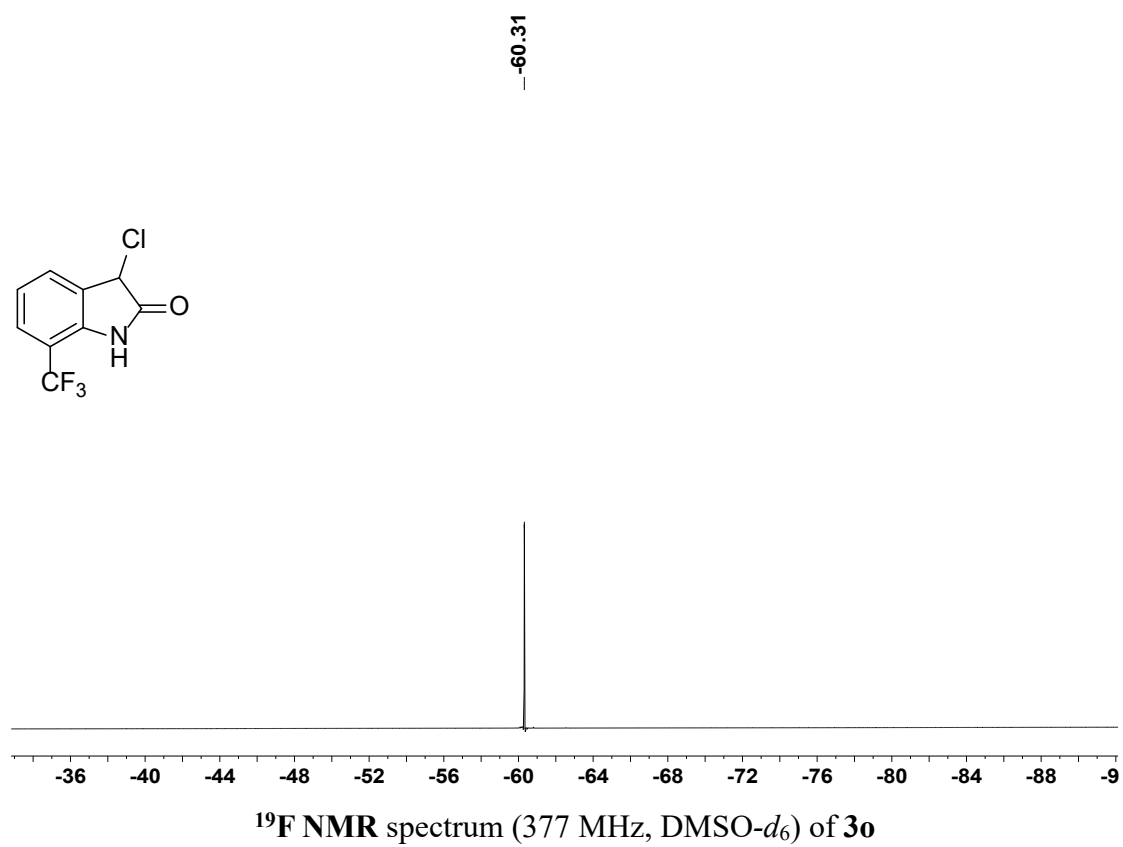


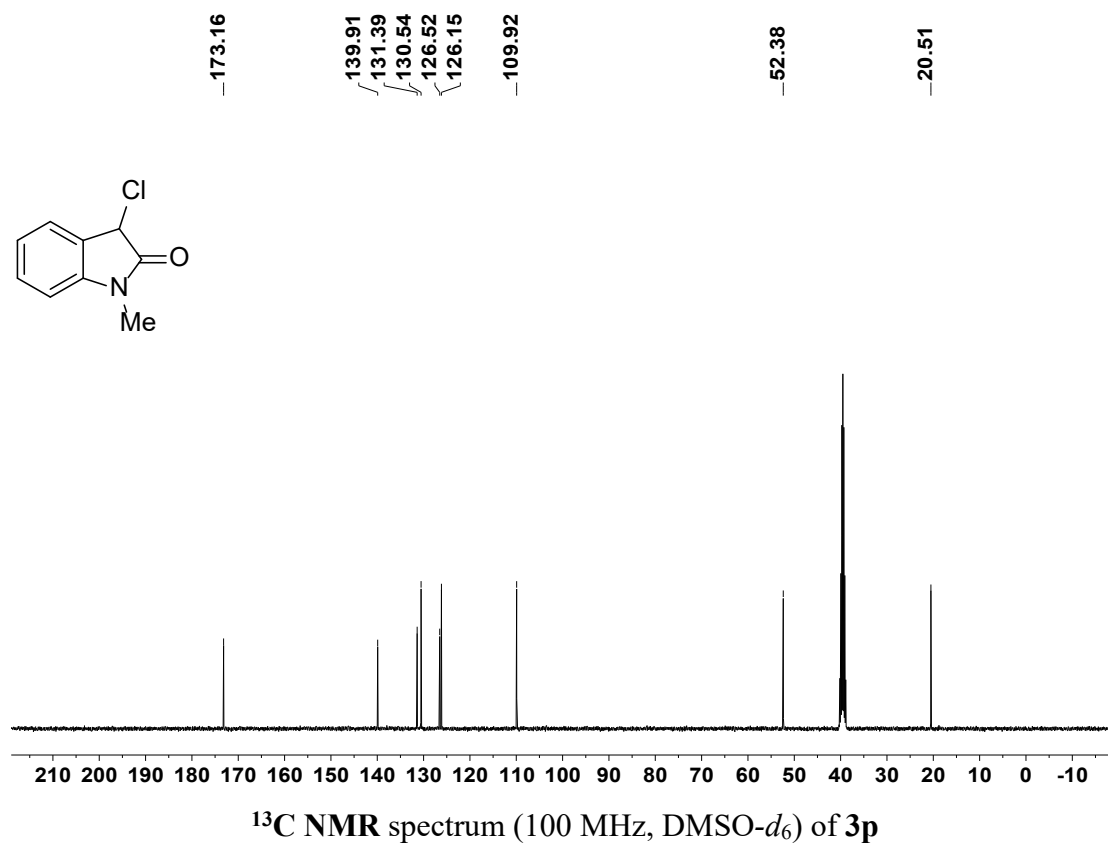
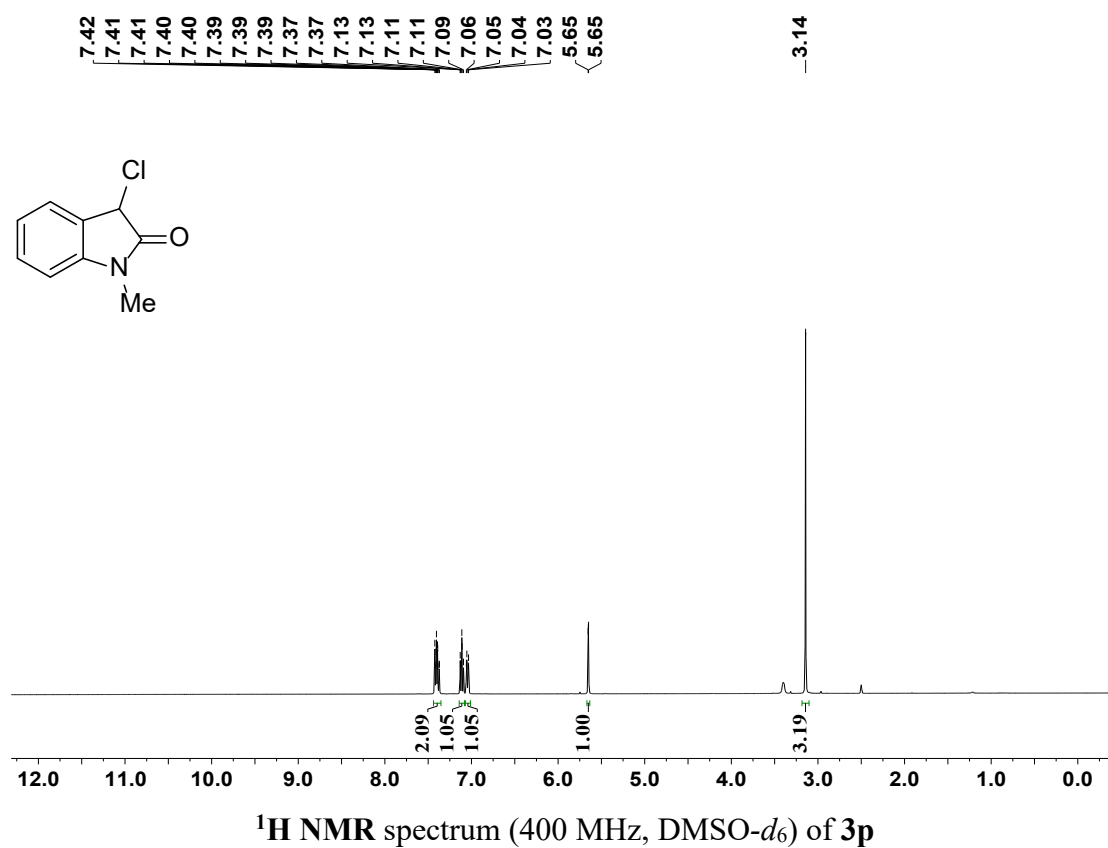


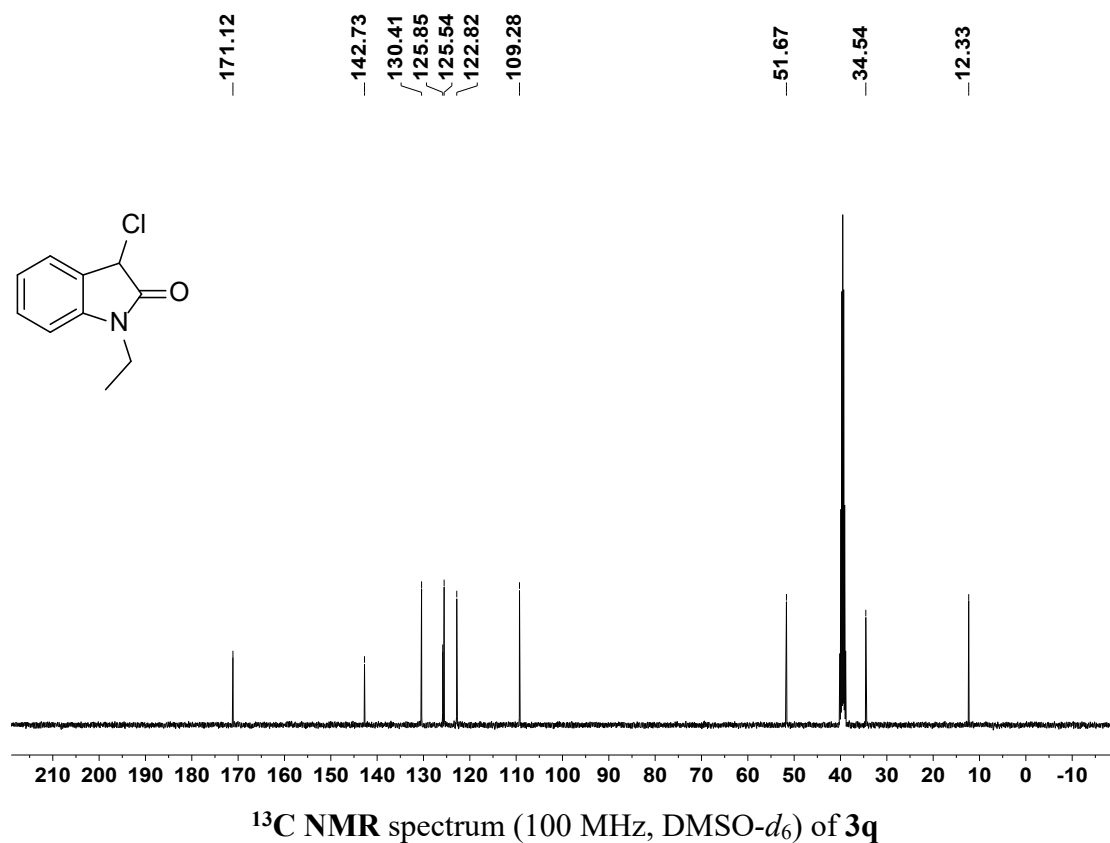
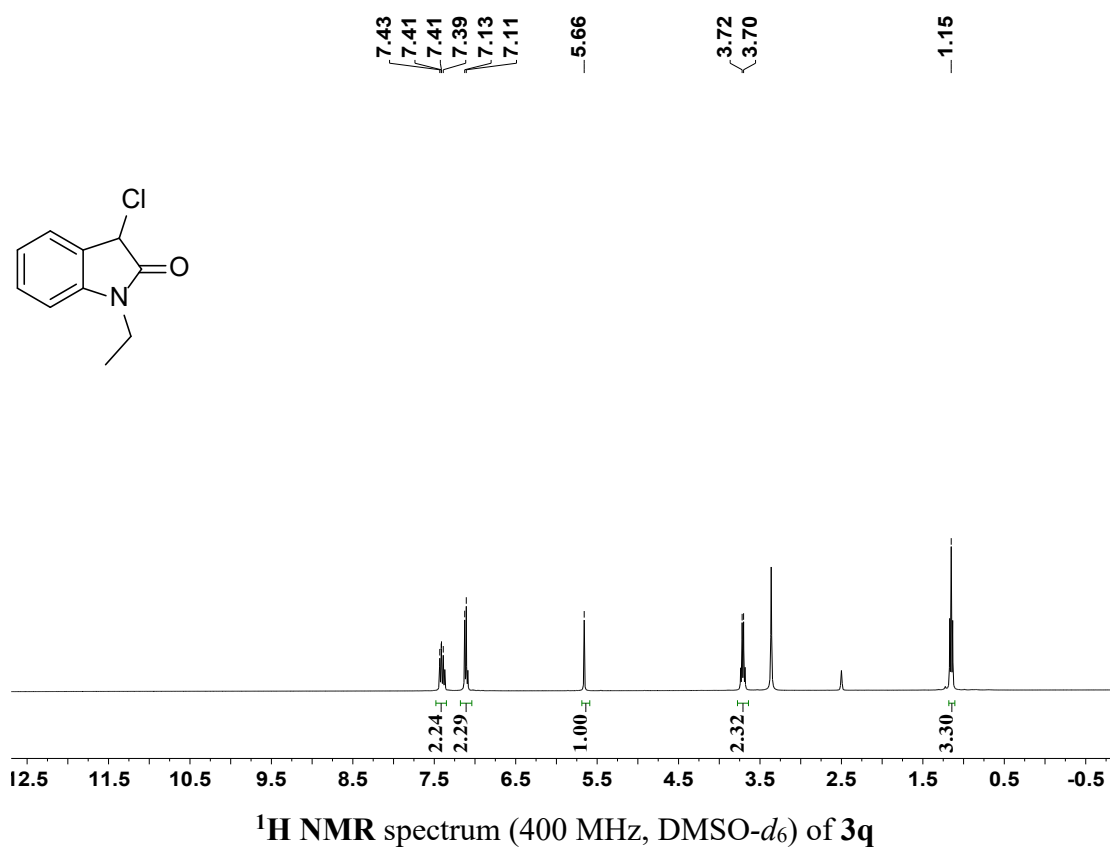
^1H NMR spectrum (400 MHz, $\text{DMSO}-d_6$) of **3o**

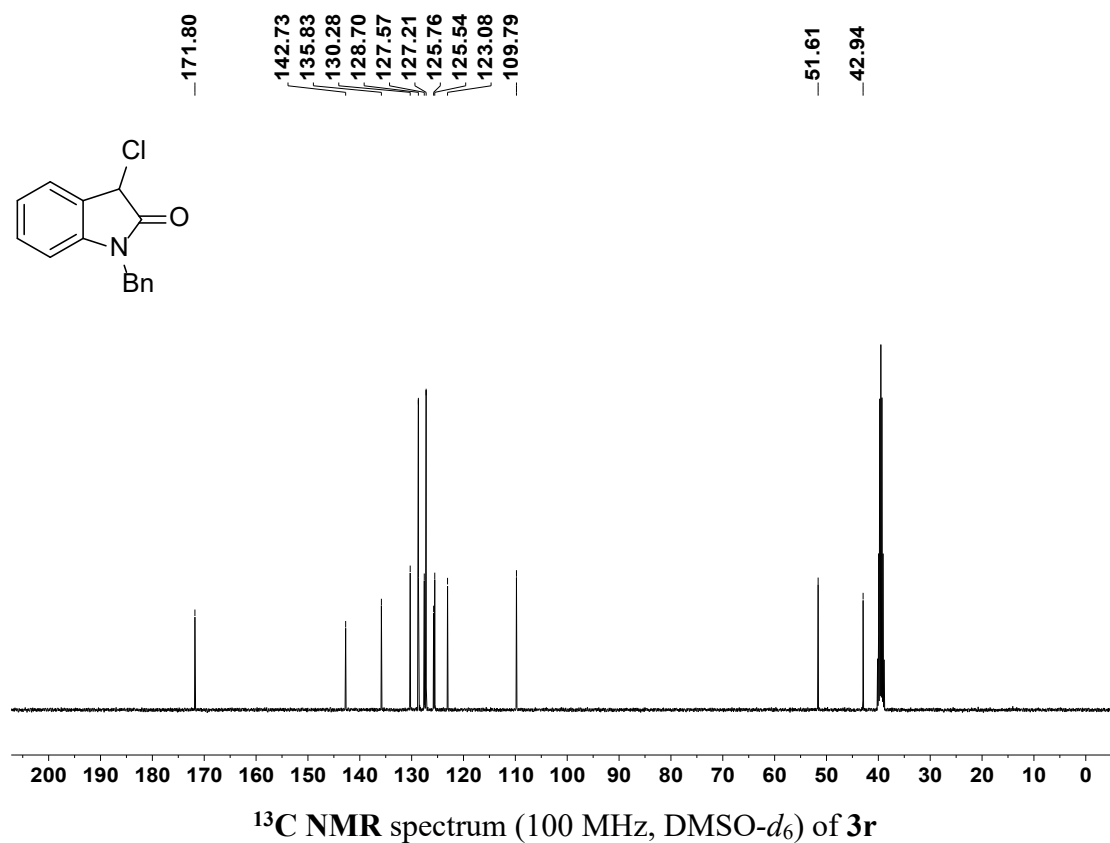
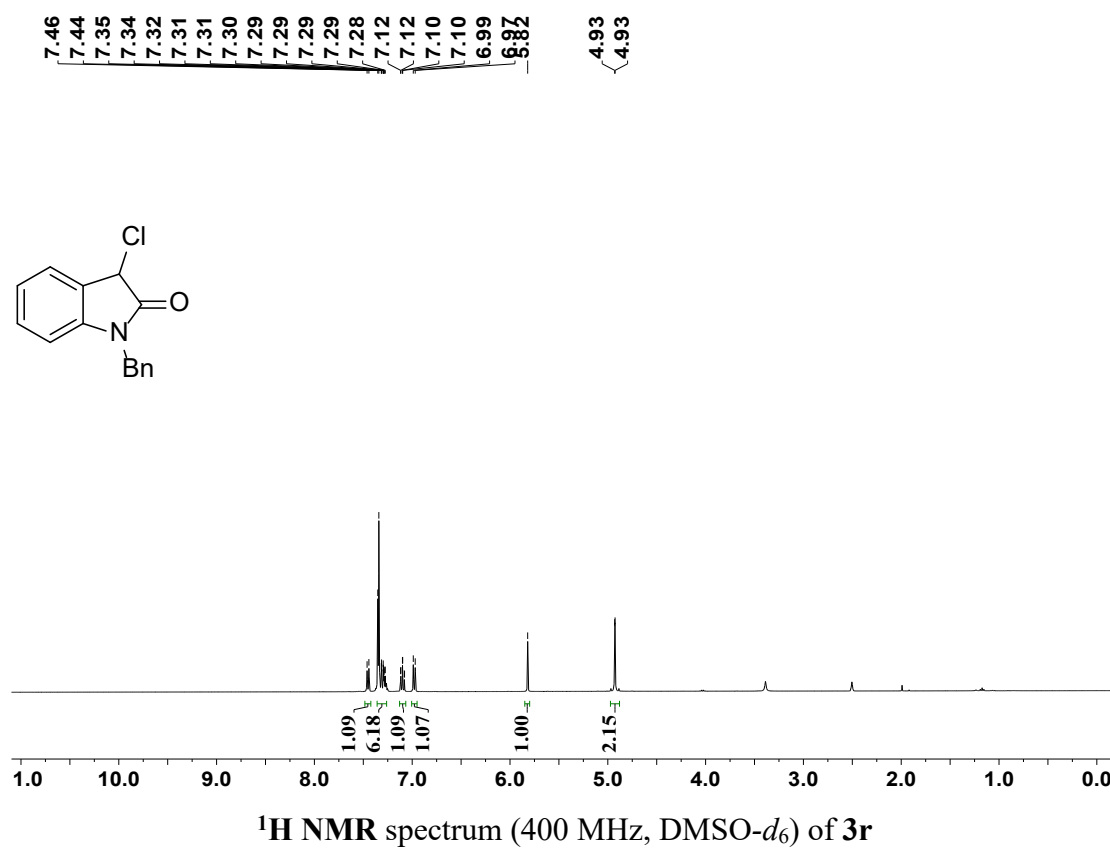


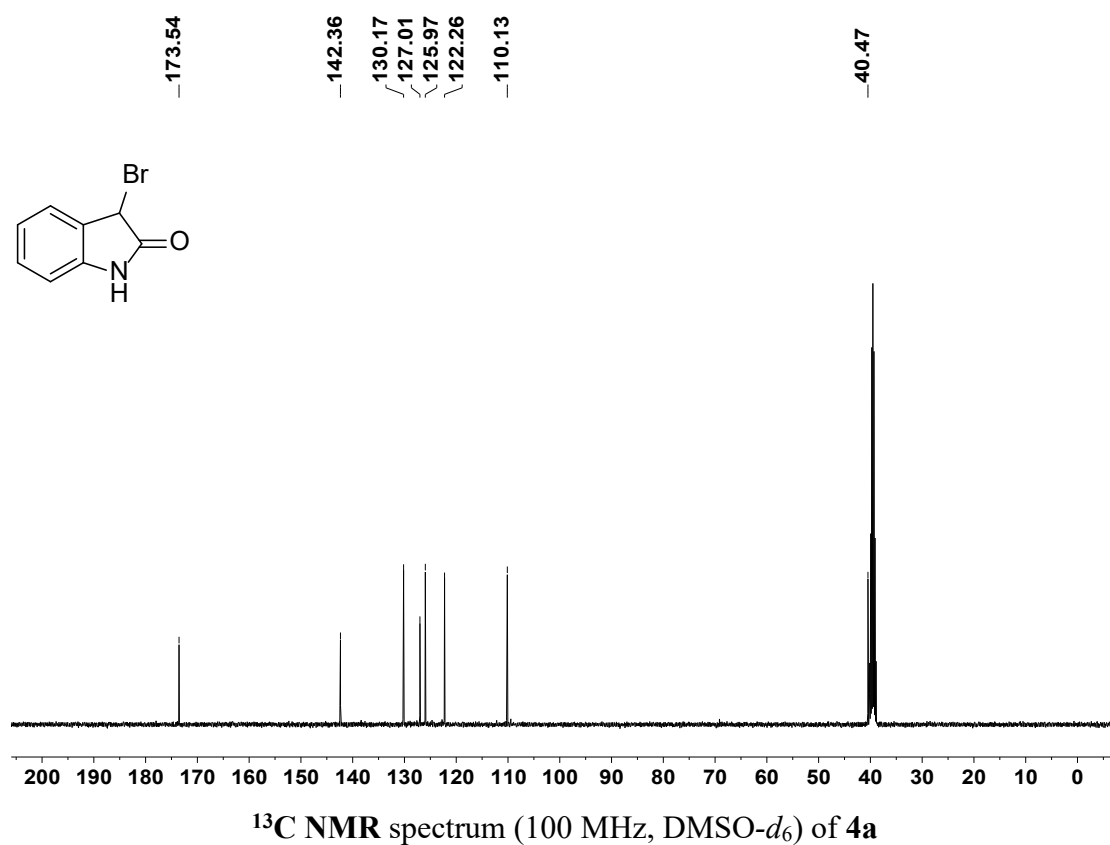
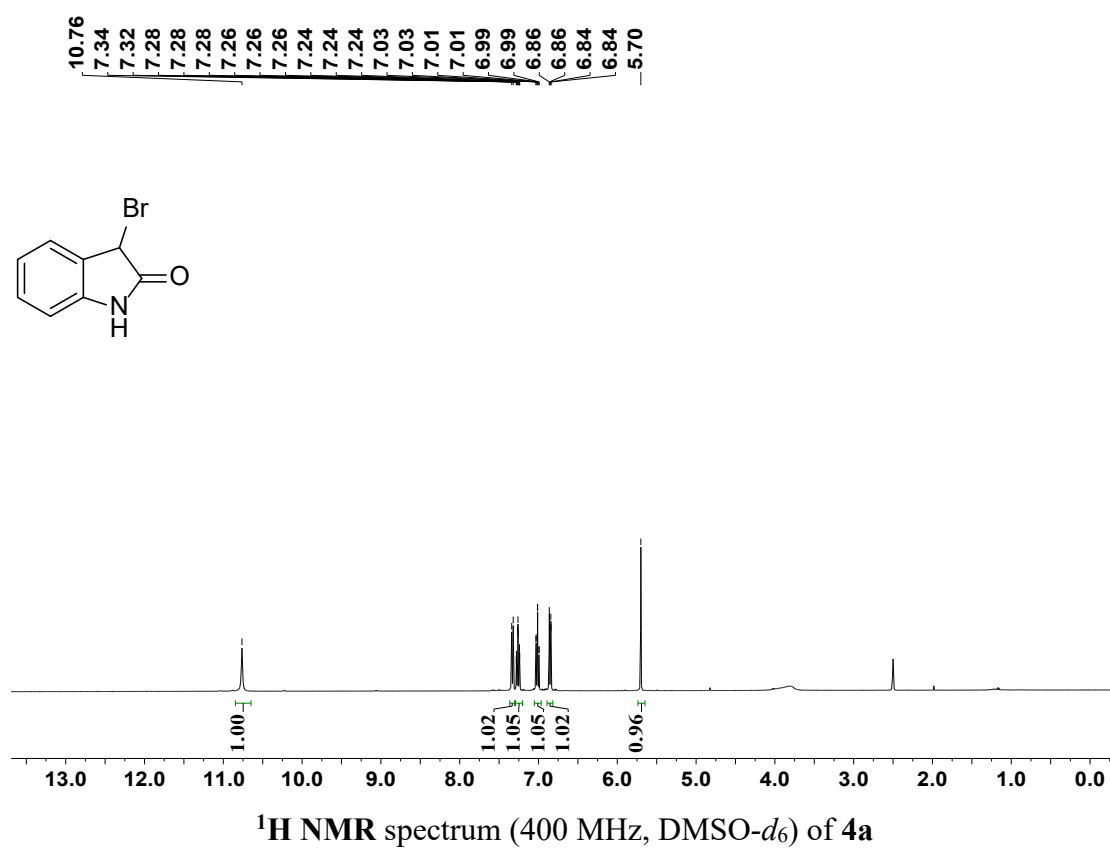
^{13}C NMR spectrum (100 MHz, $\text{DMSO}-d_6$) of **3o**

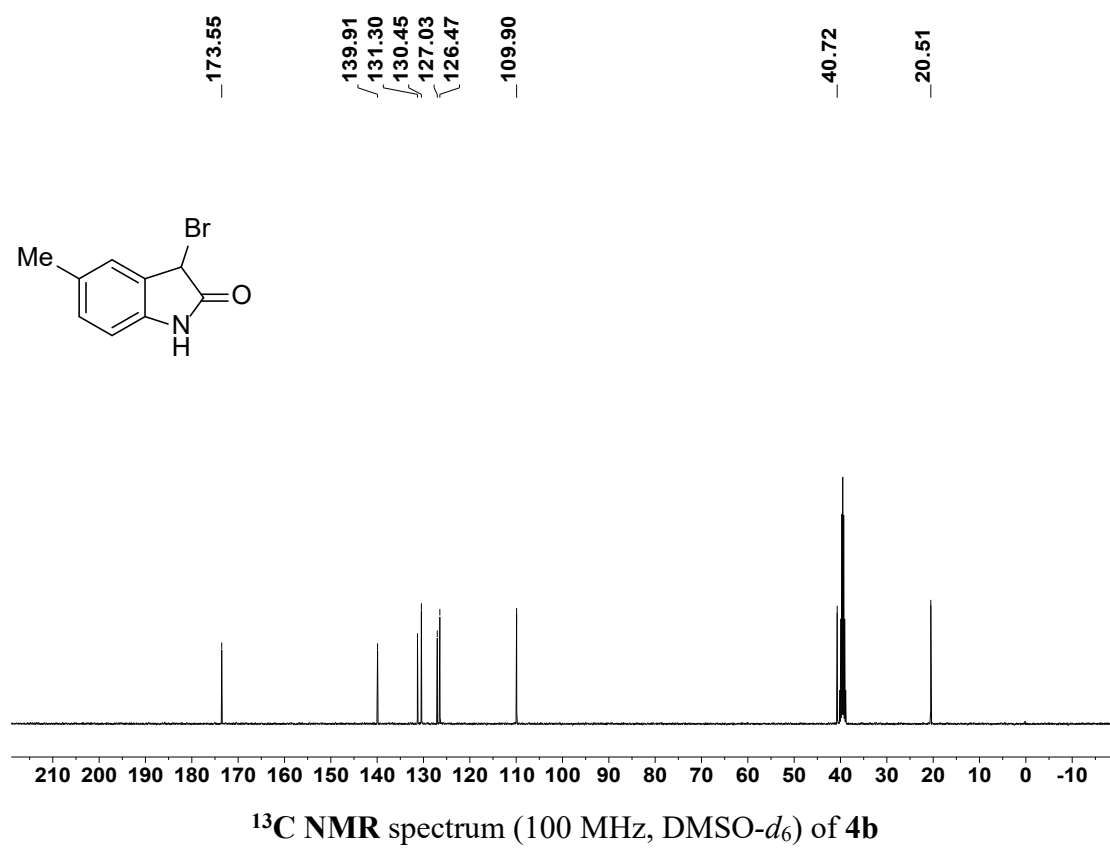
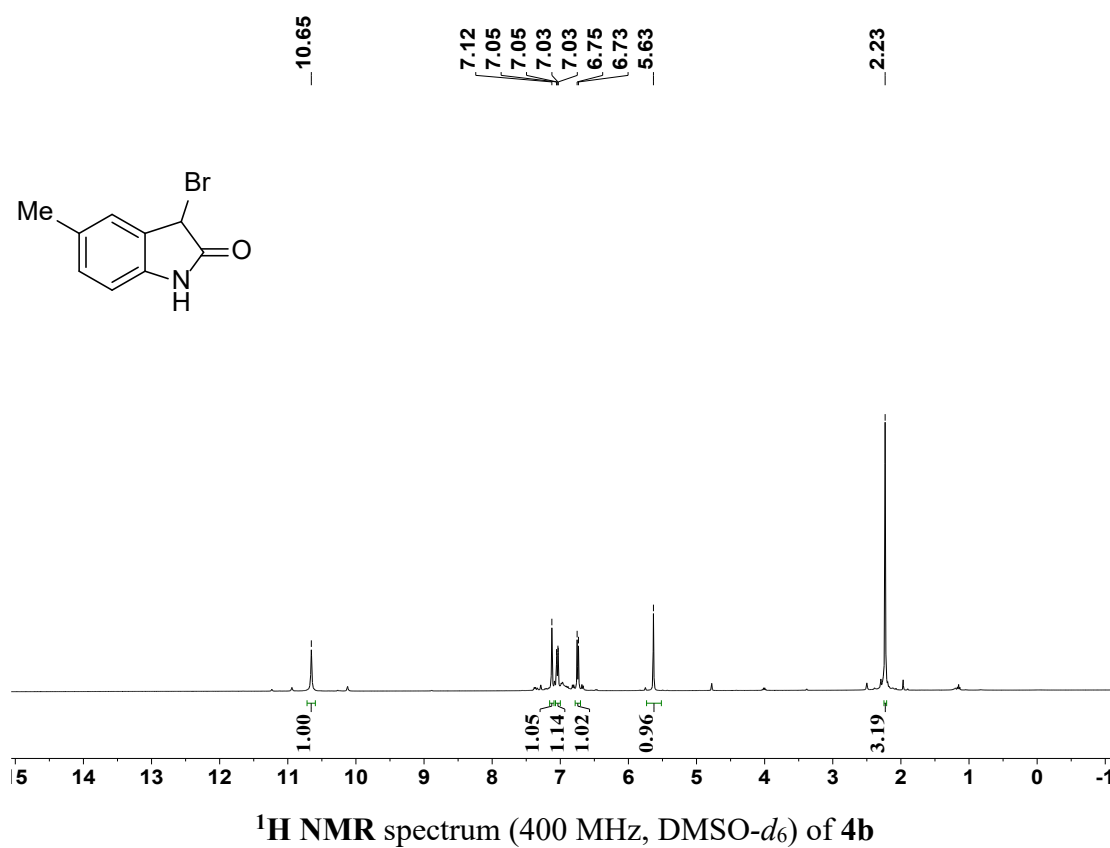


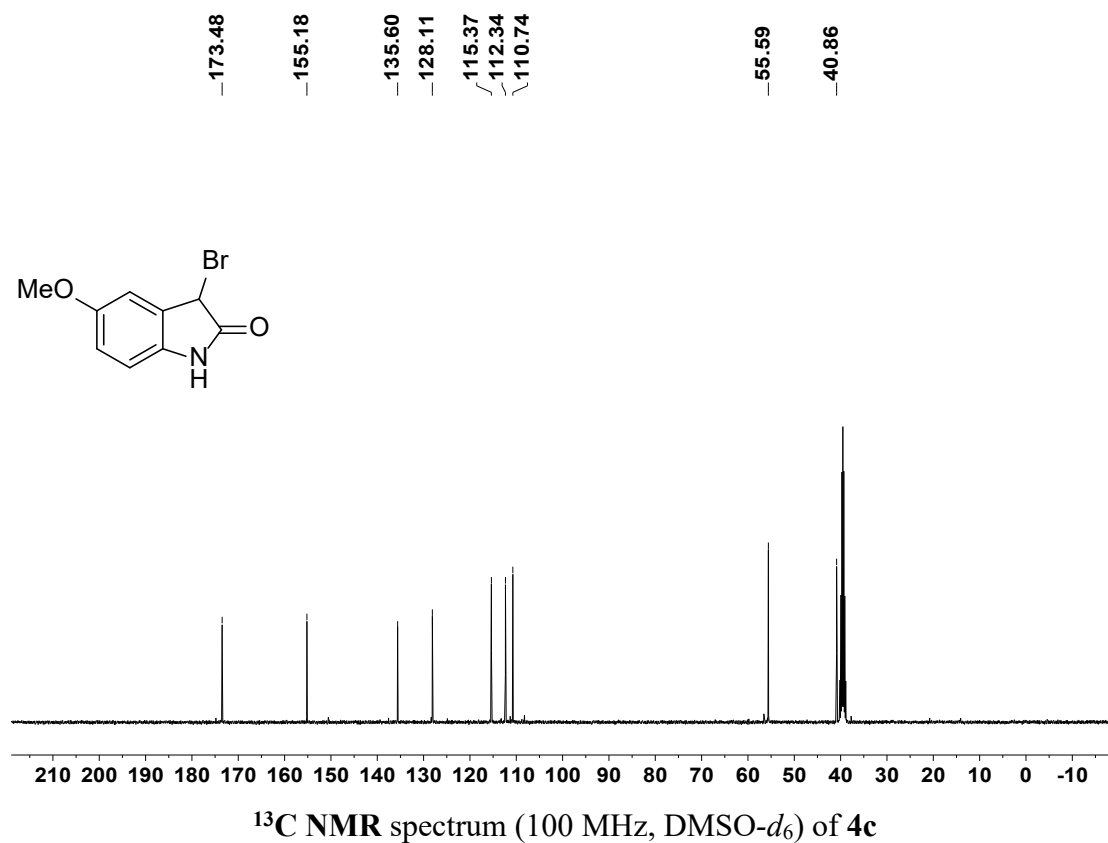
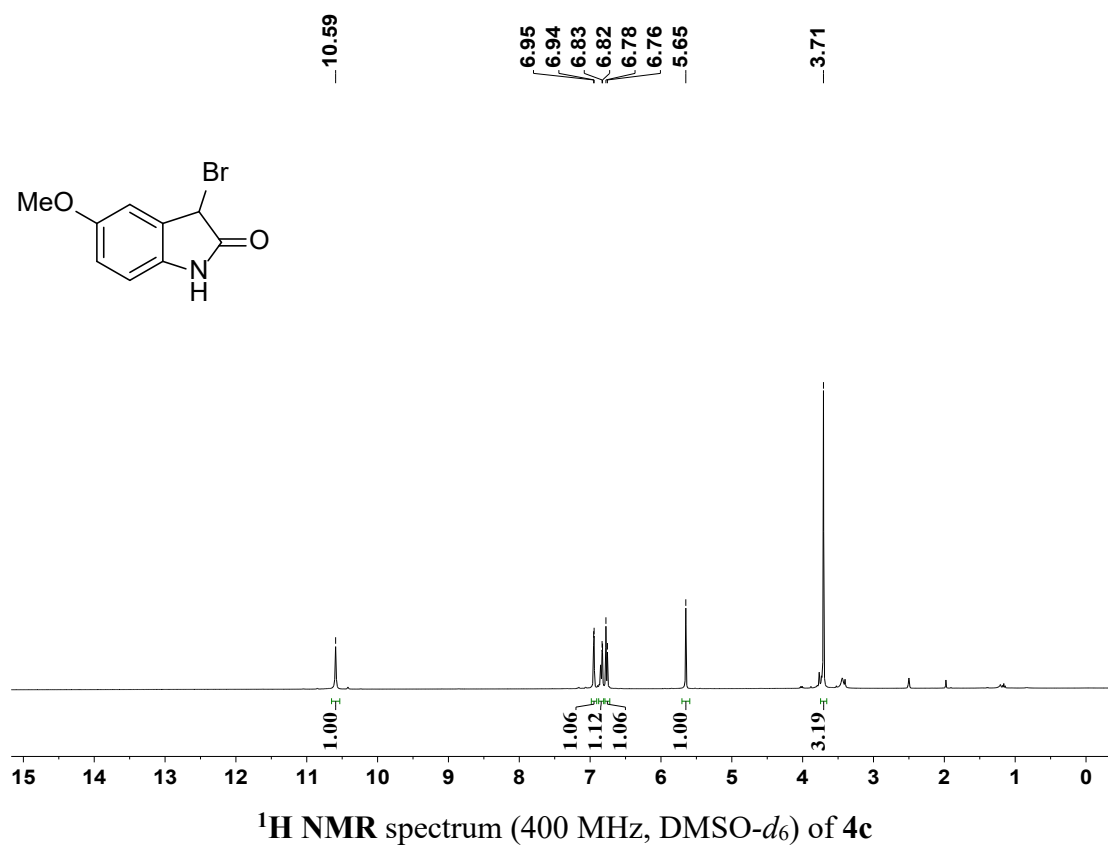


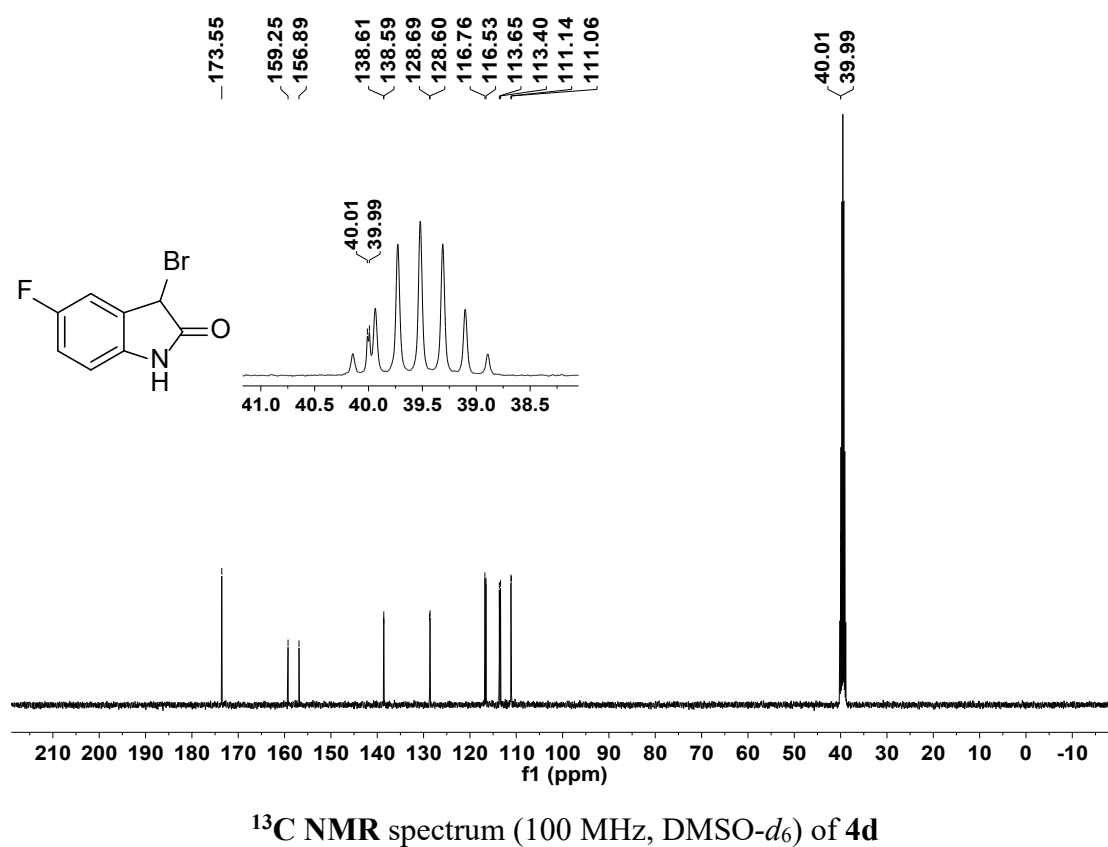
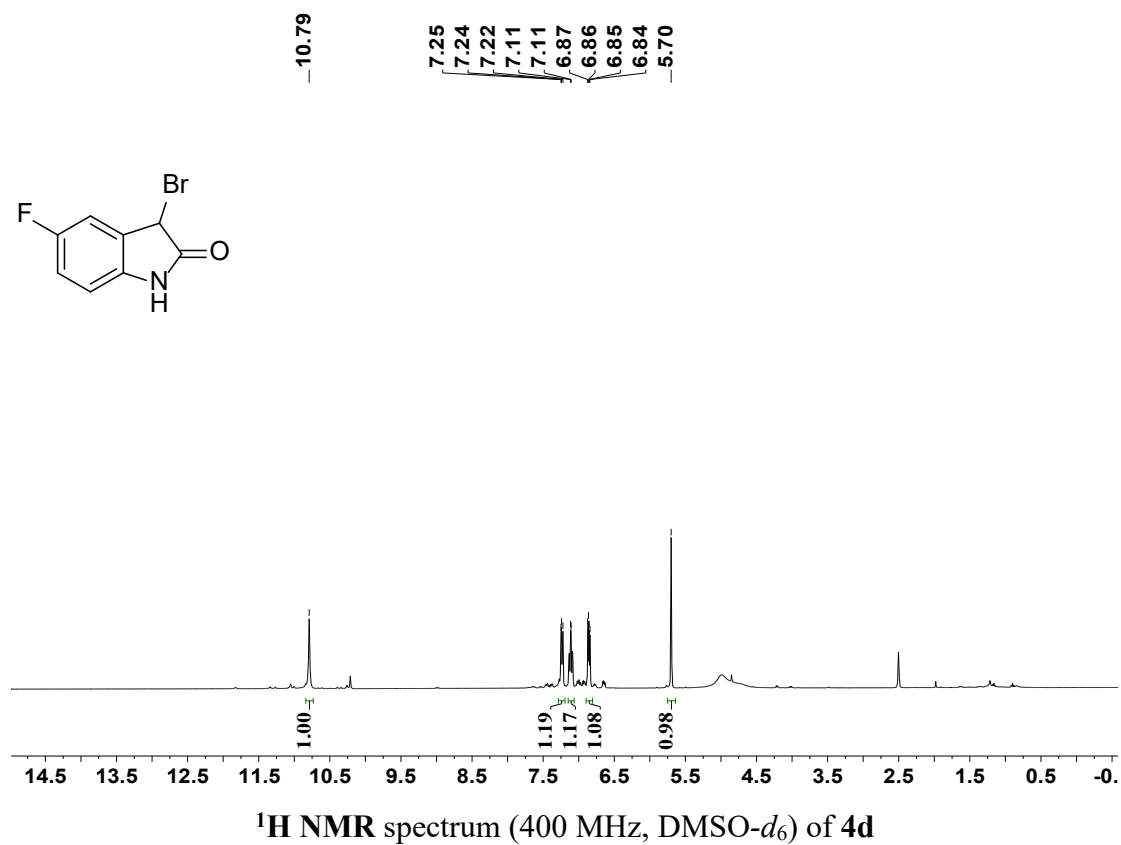


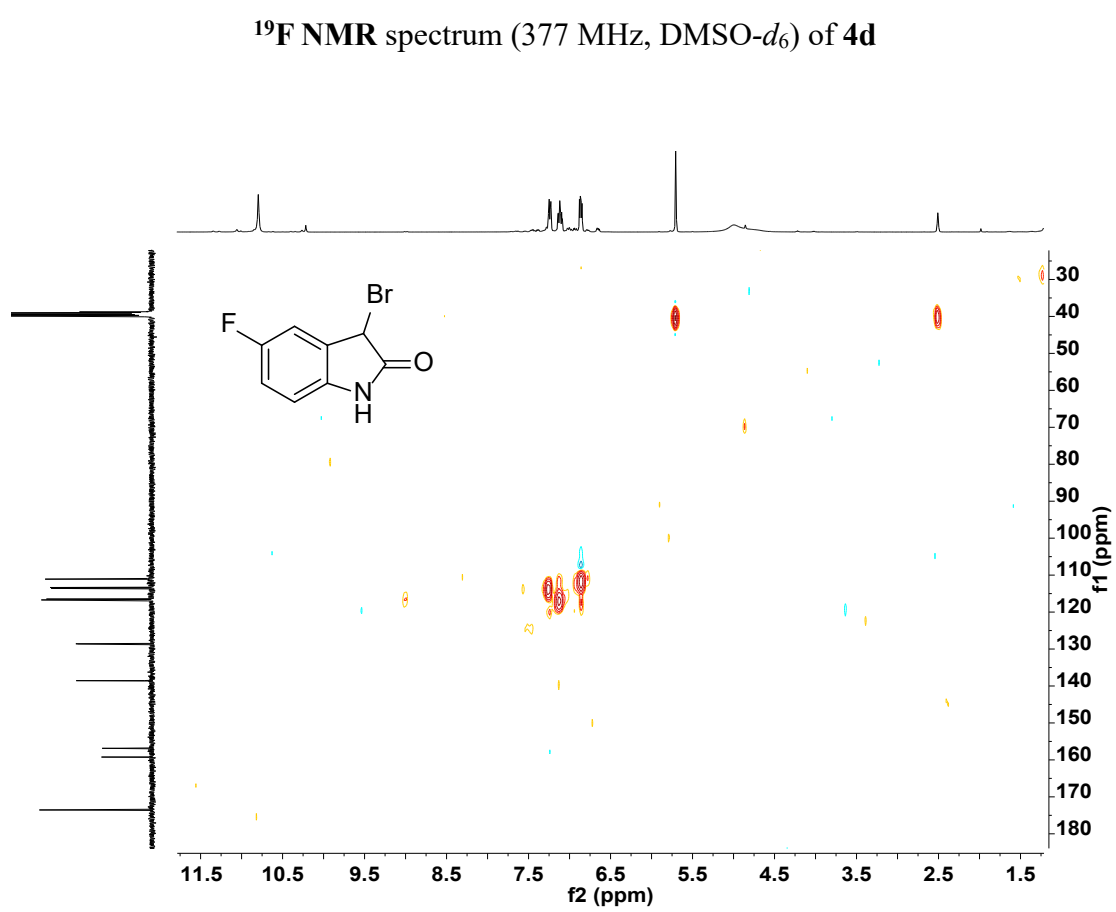
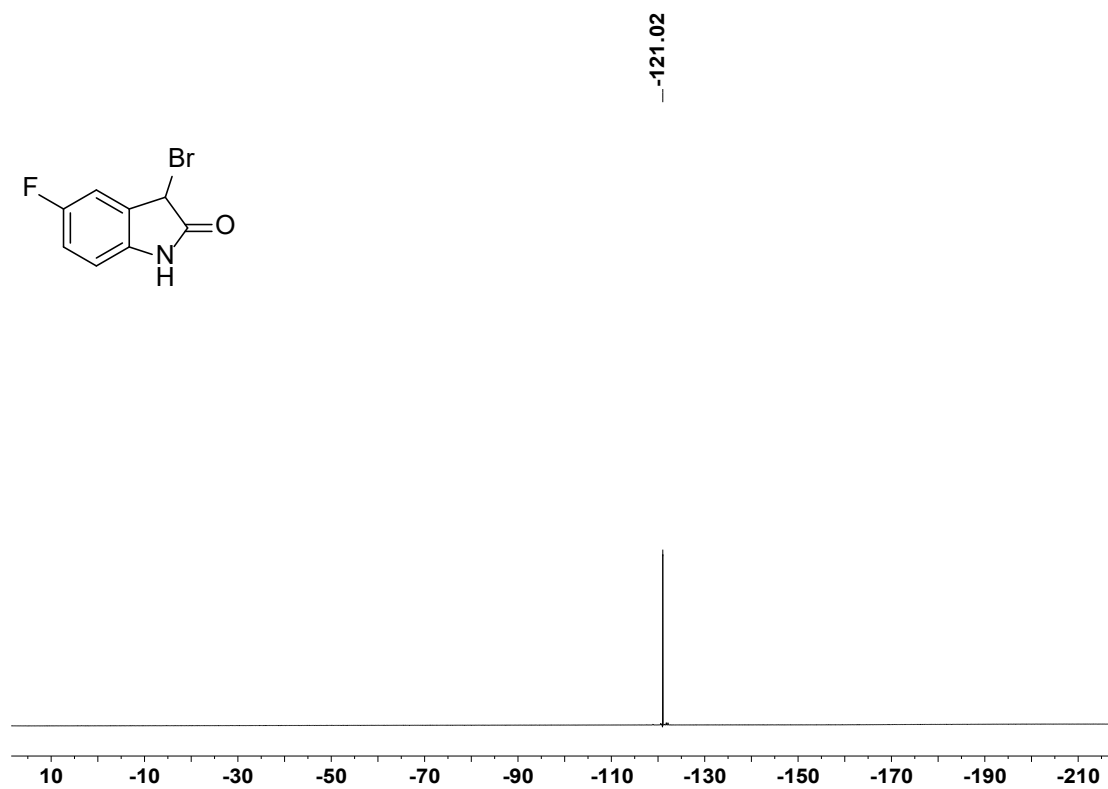




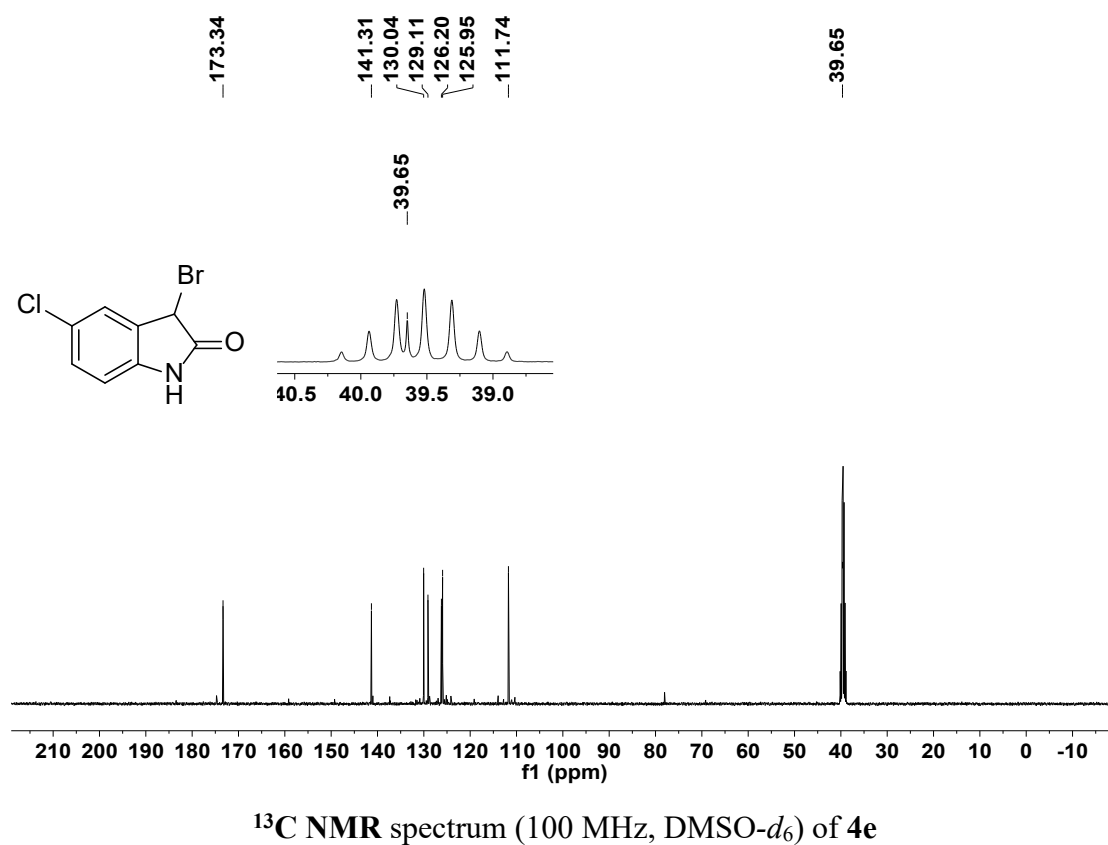
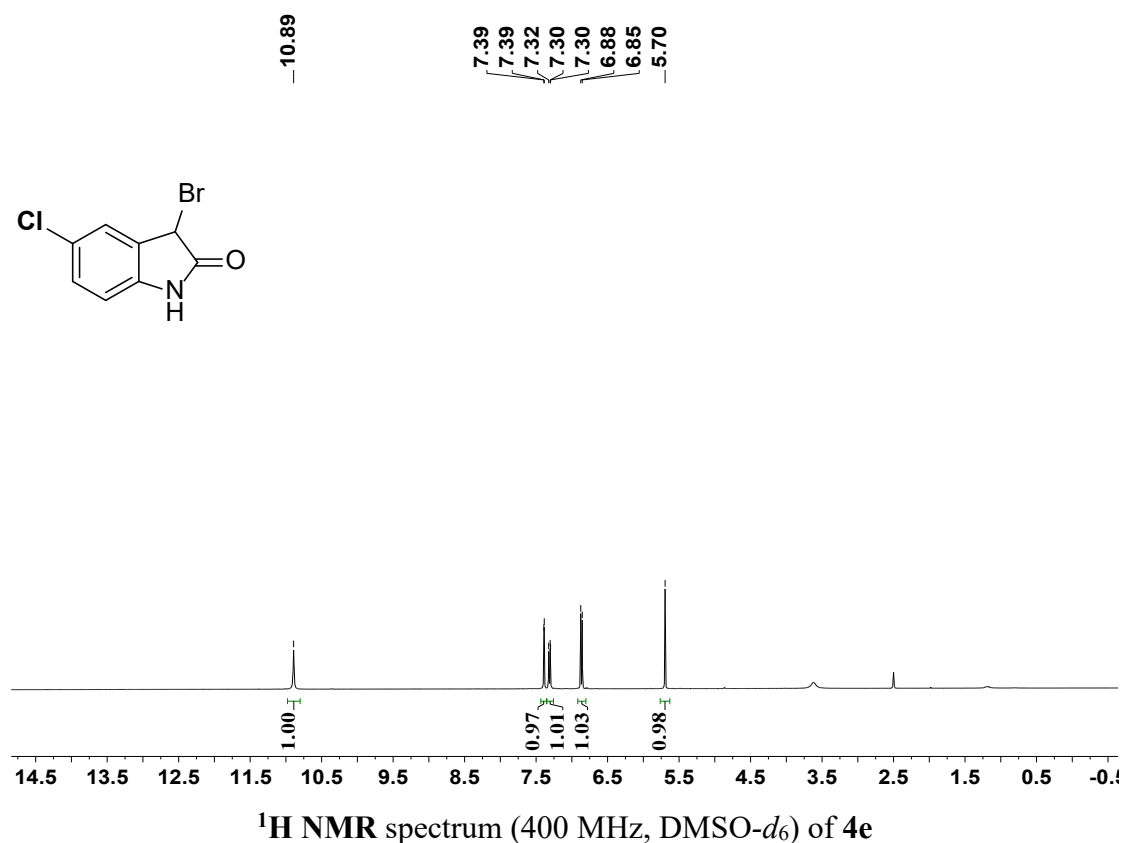


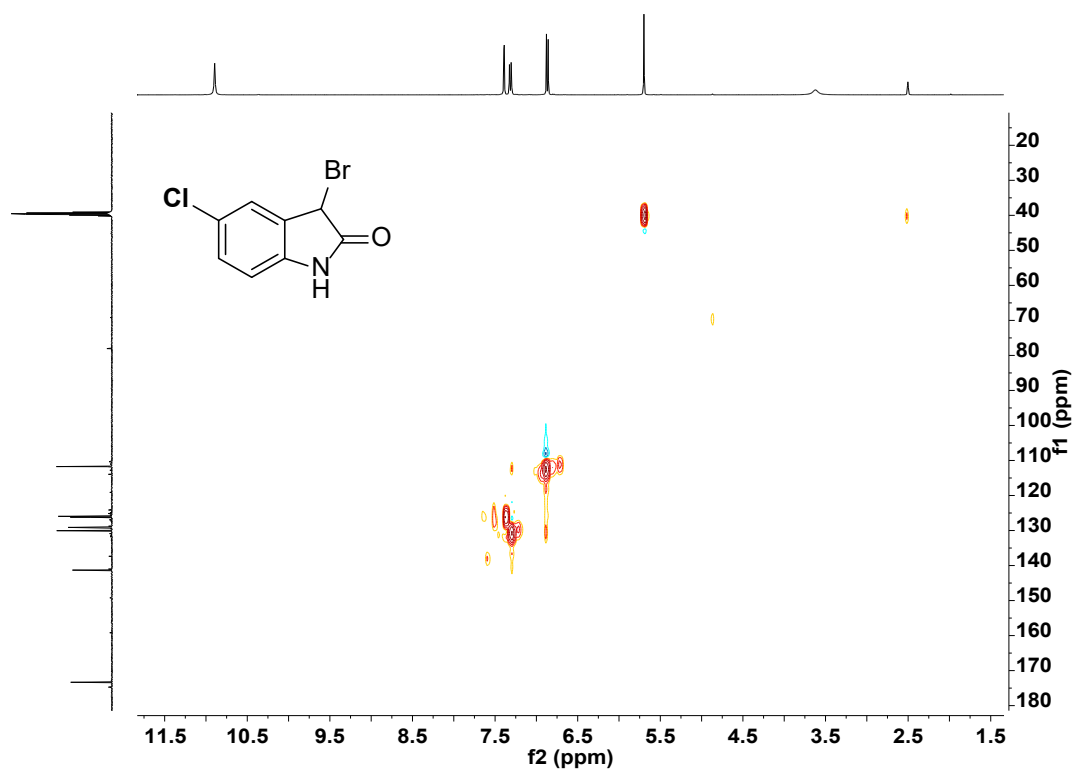




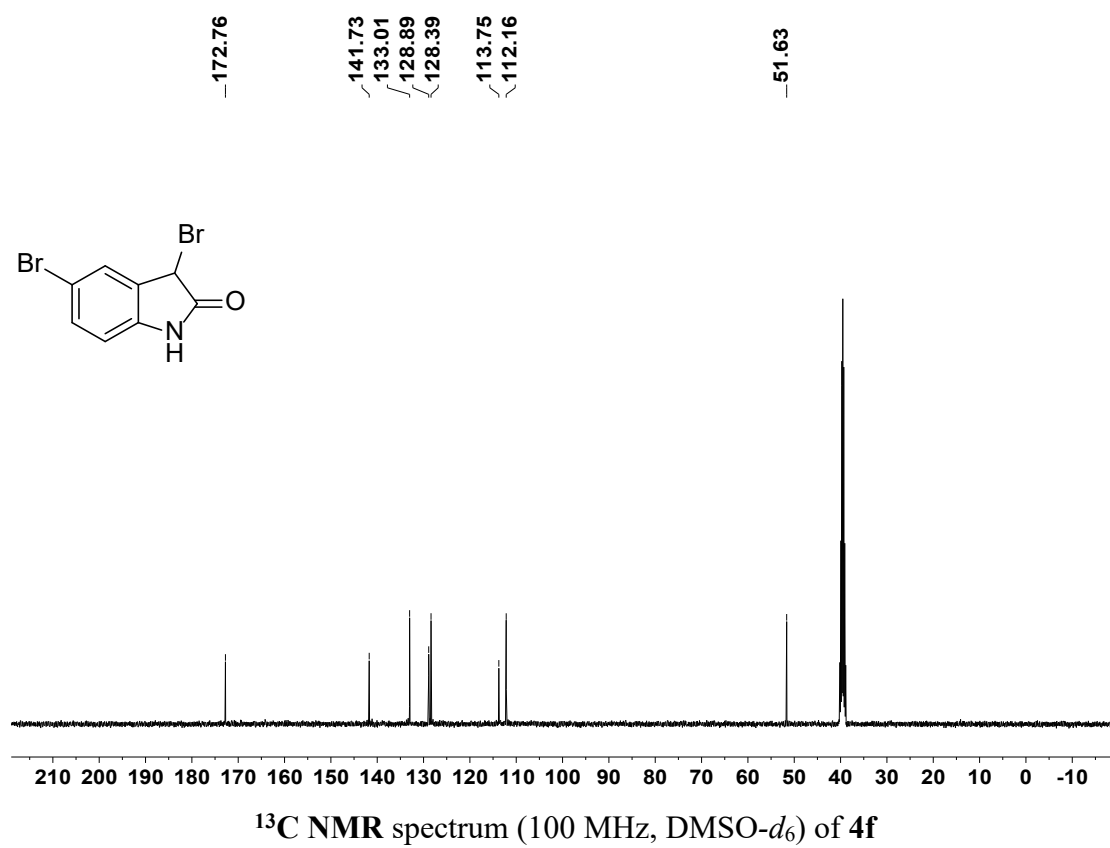
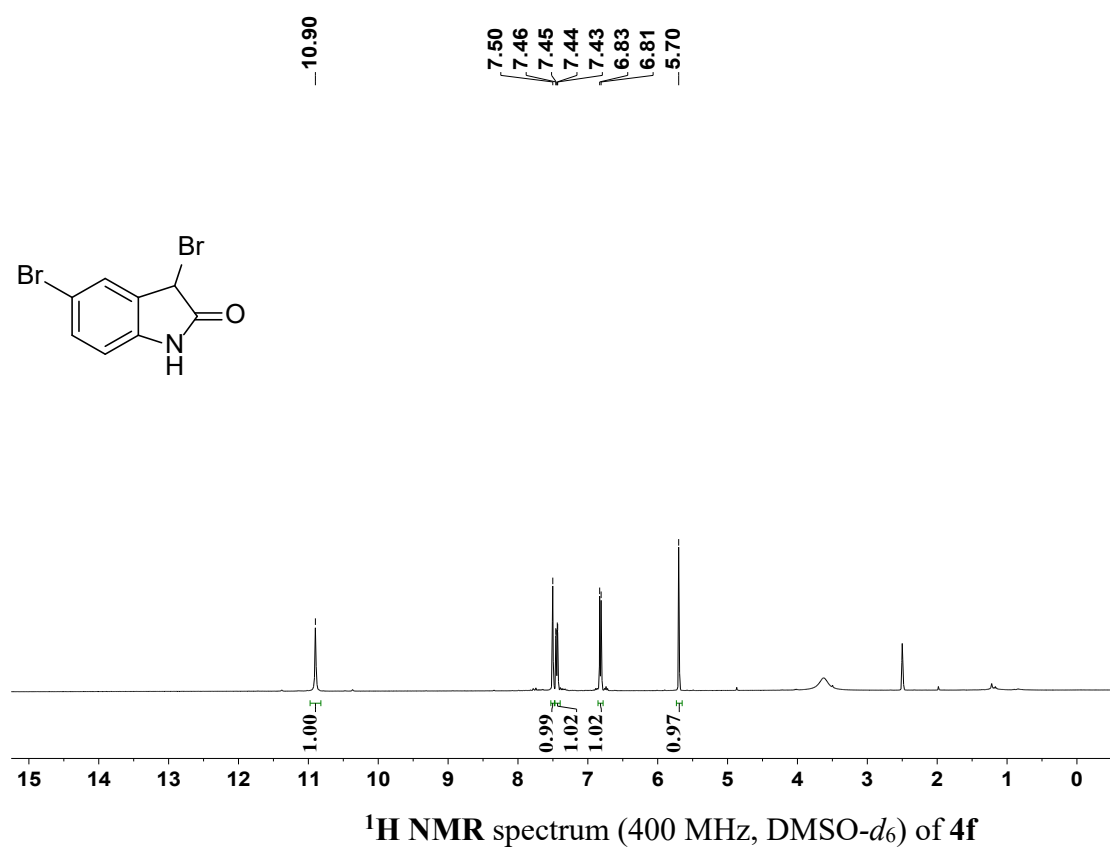


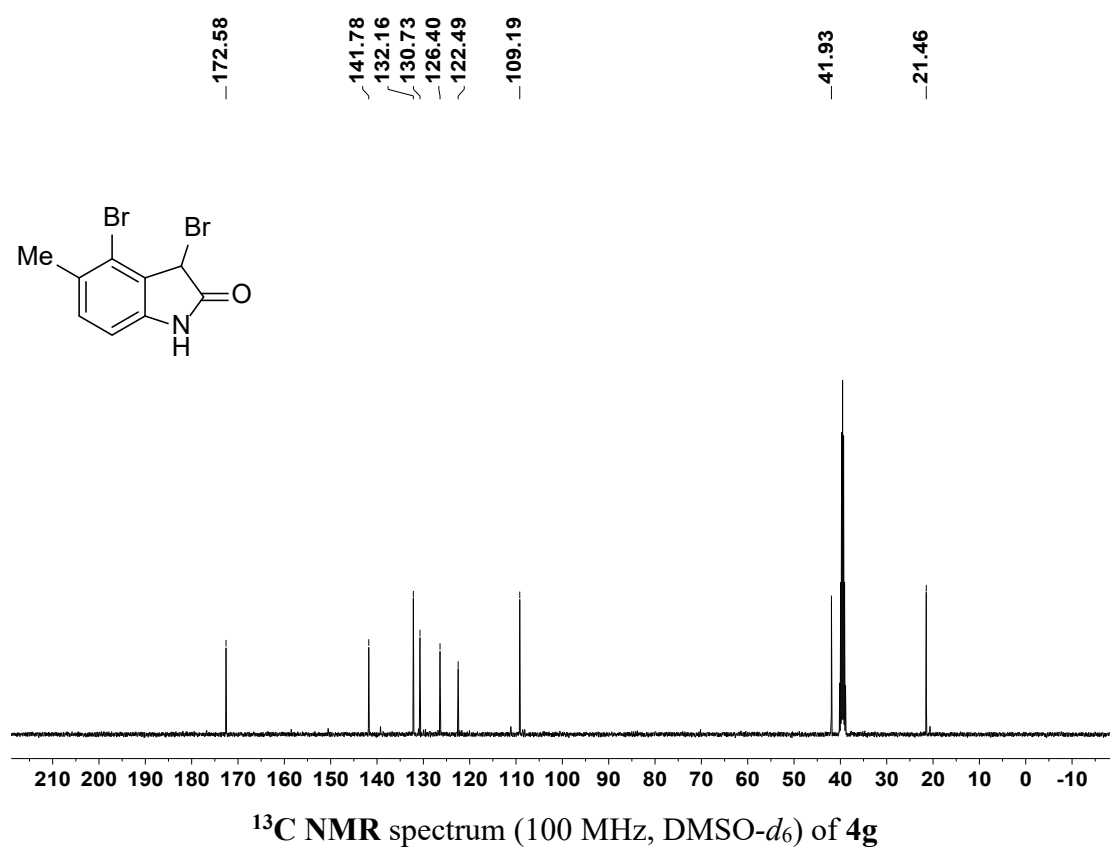
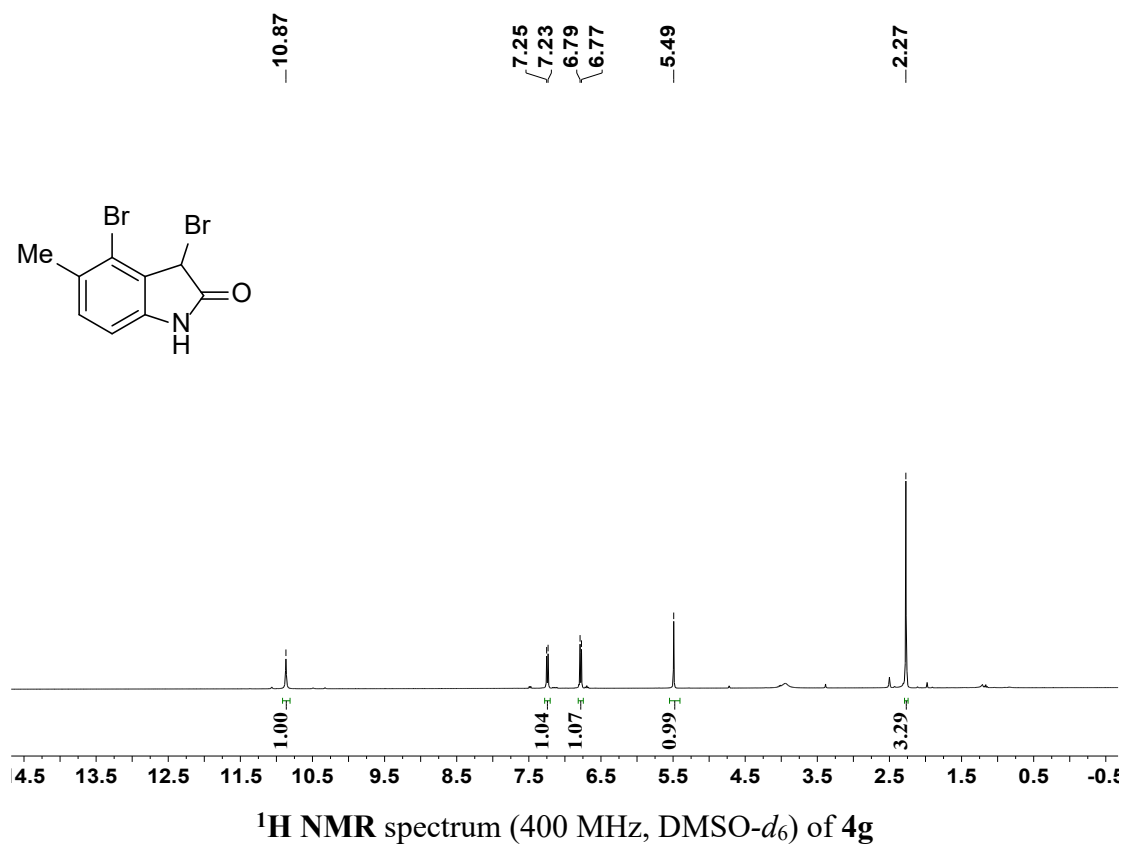
HSQC spectrum of **4d**

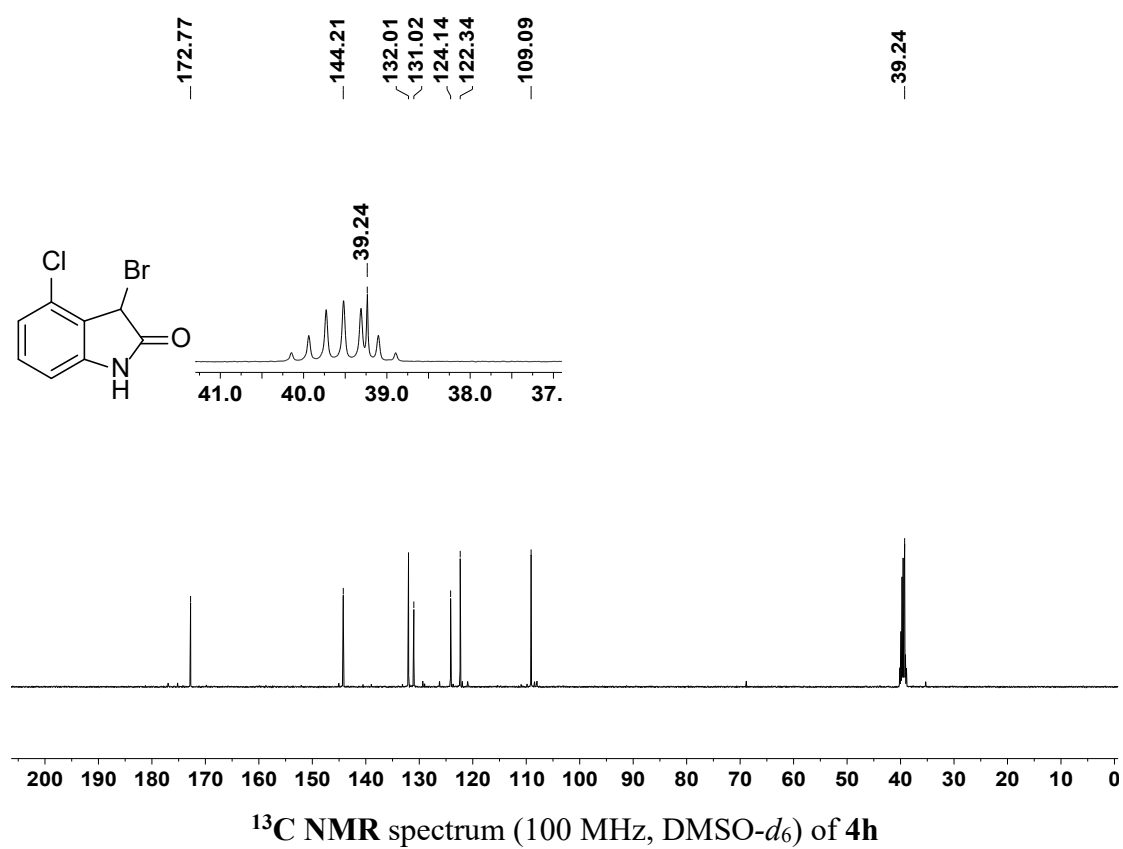
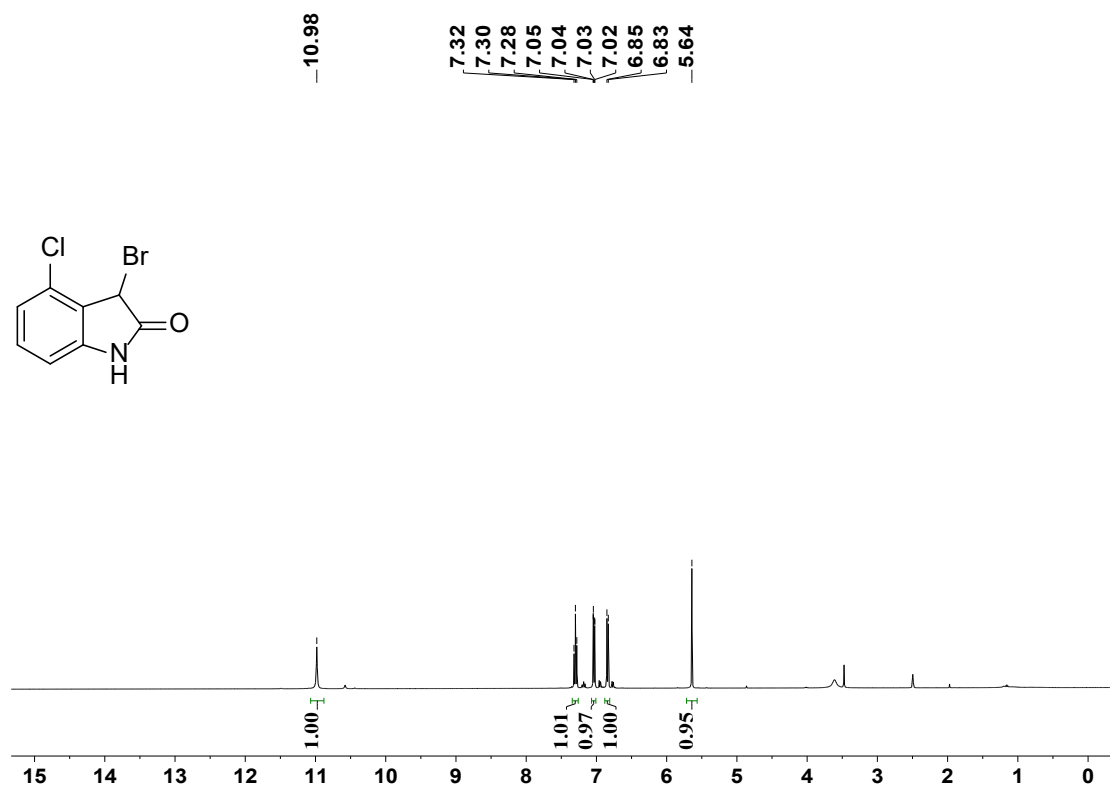


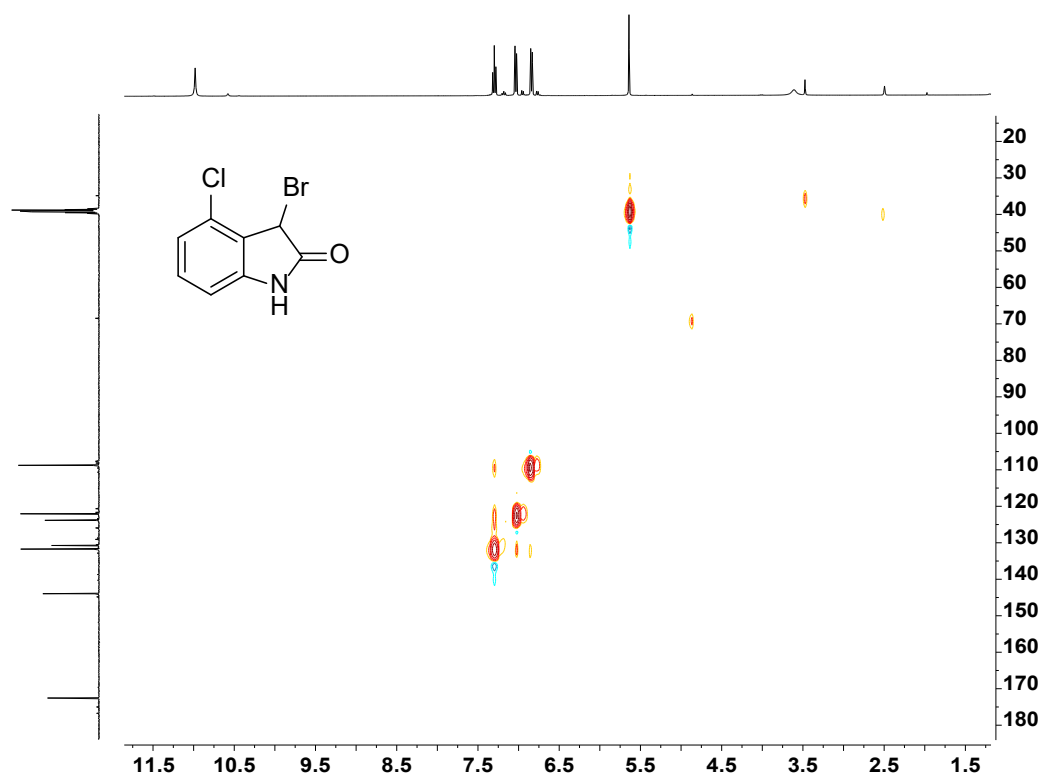


HSQC spectrum of 4e

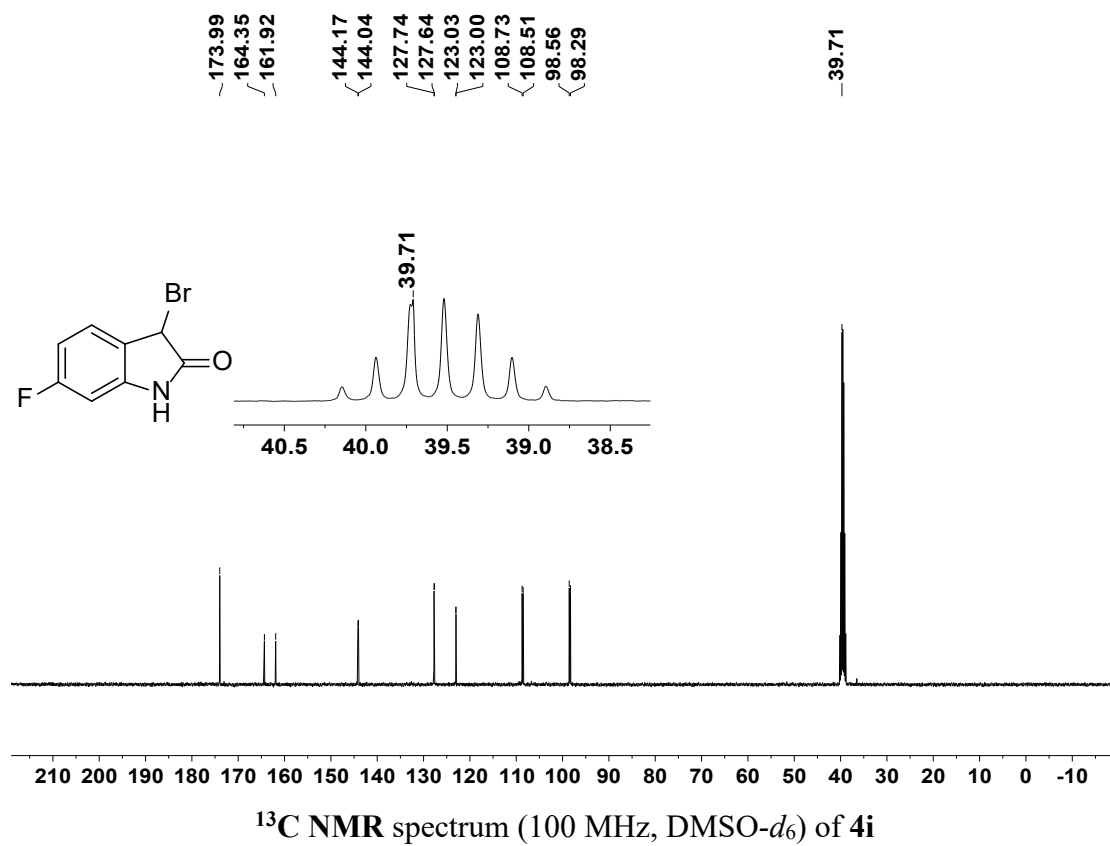
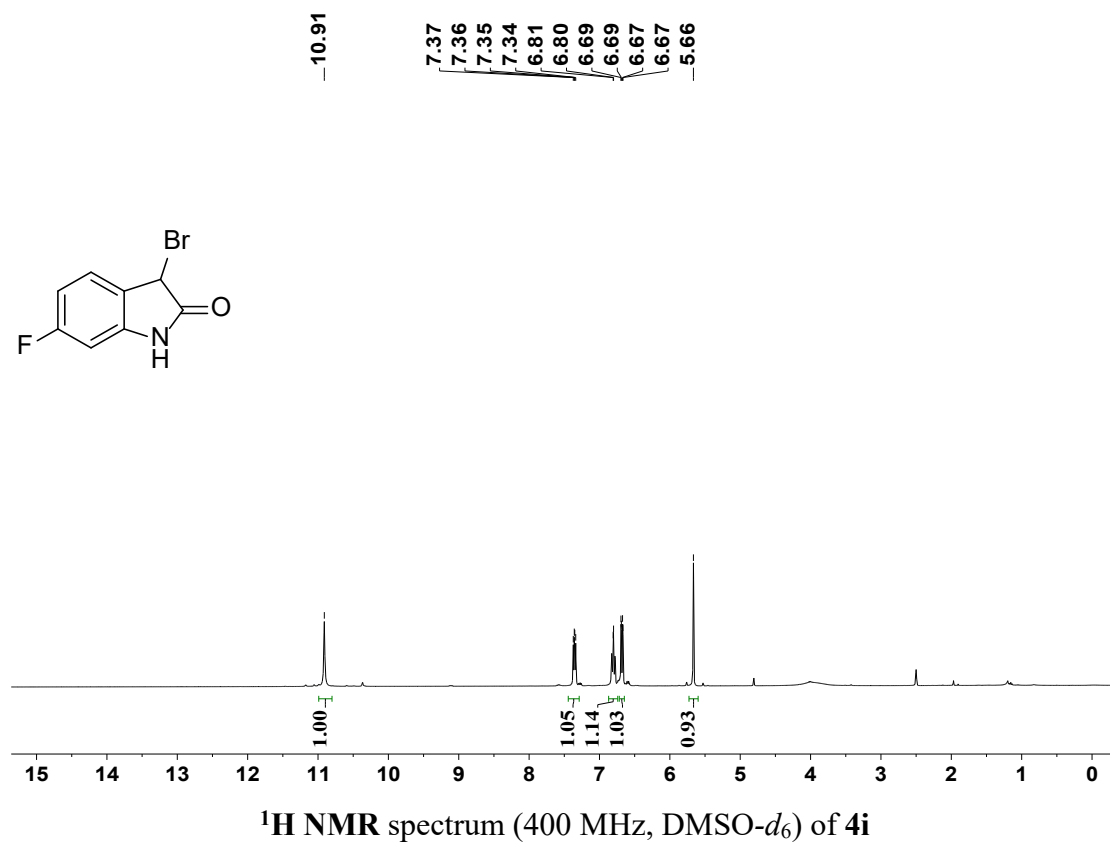


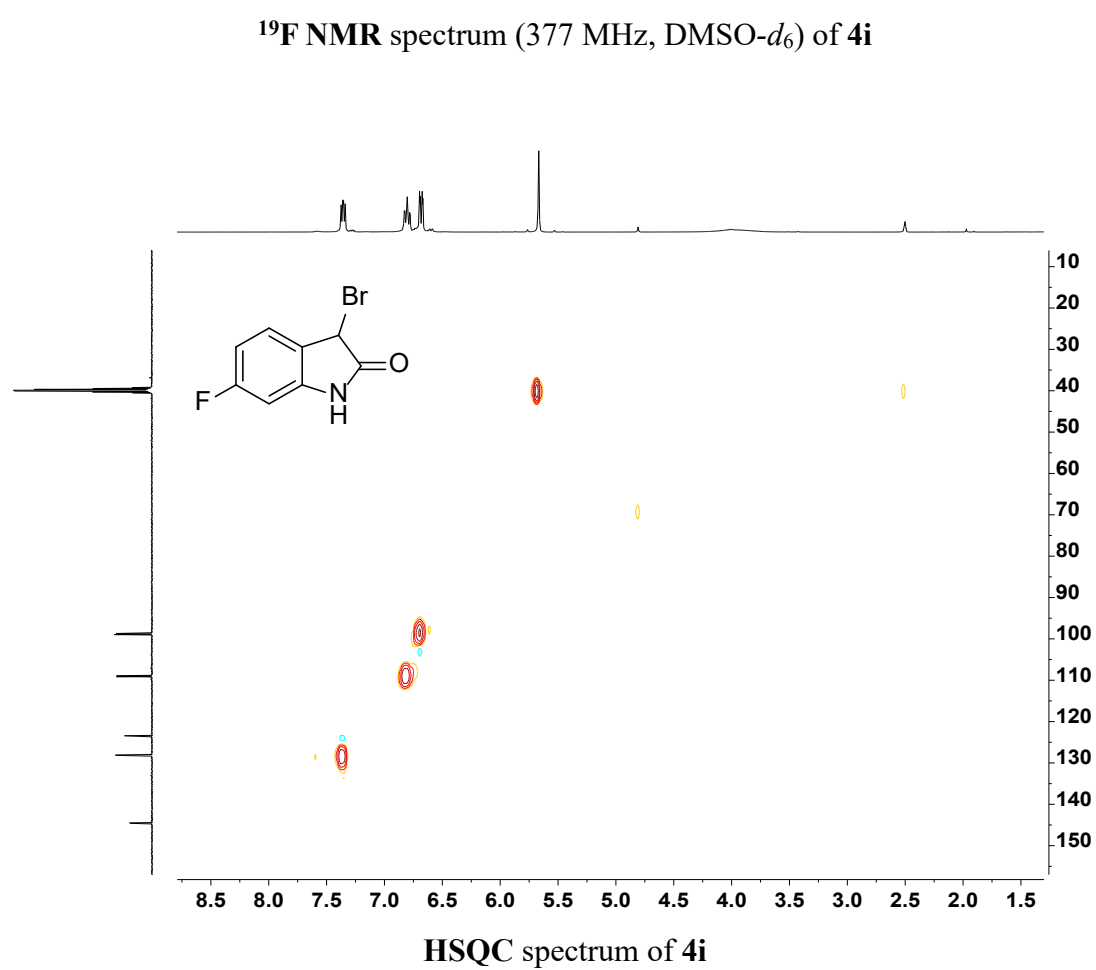
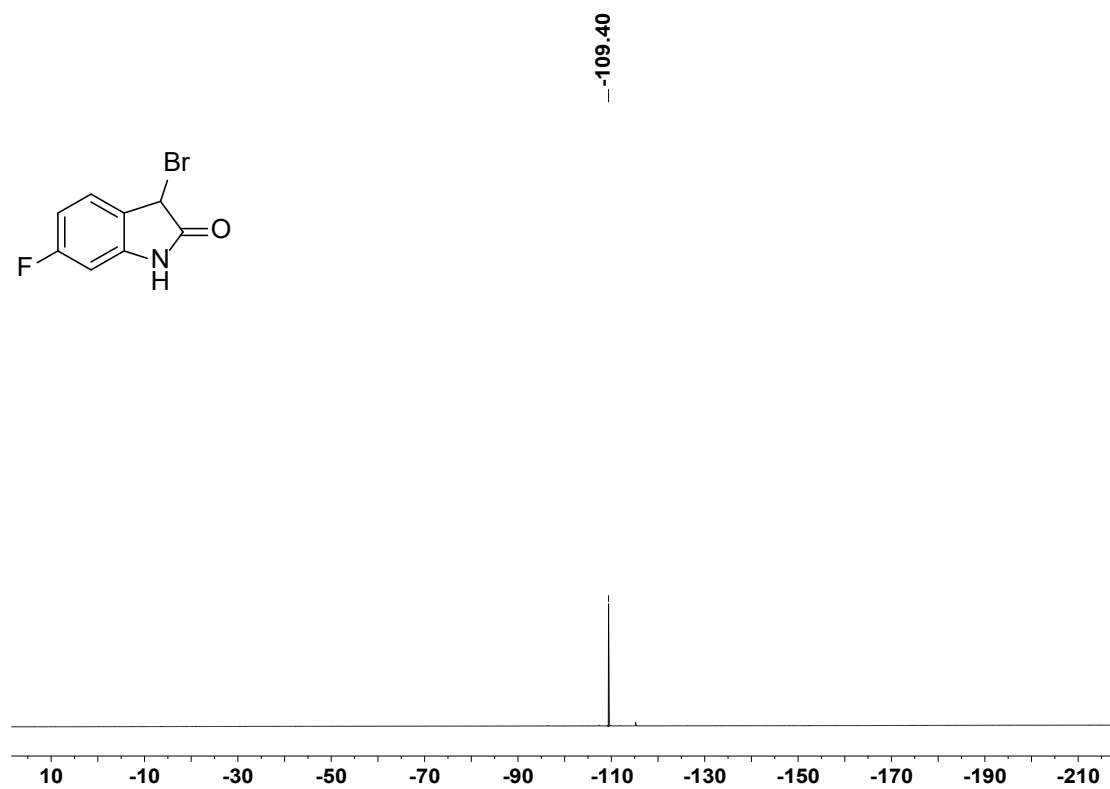


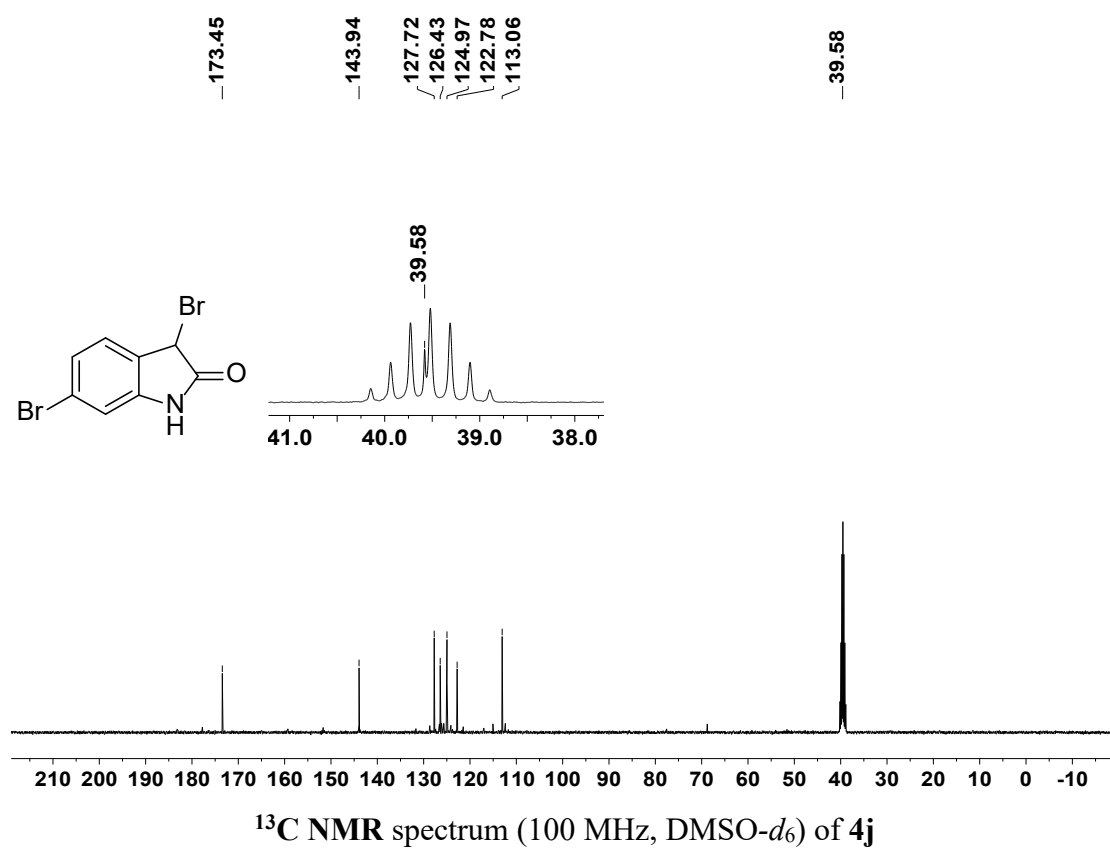
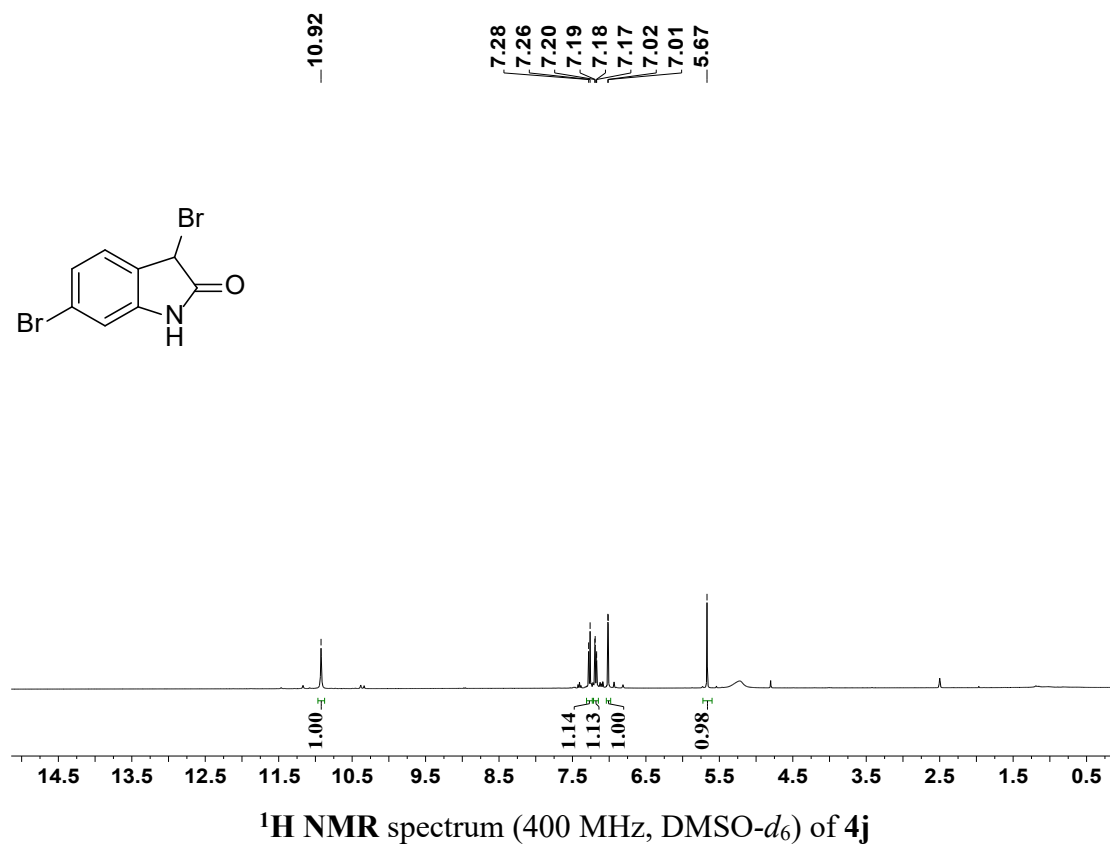


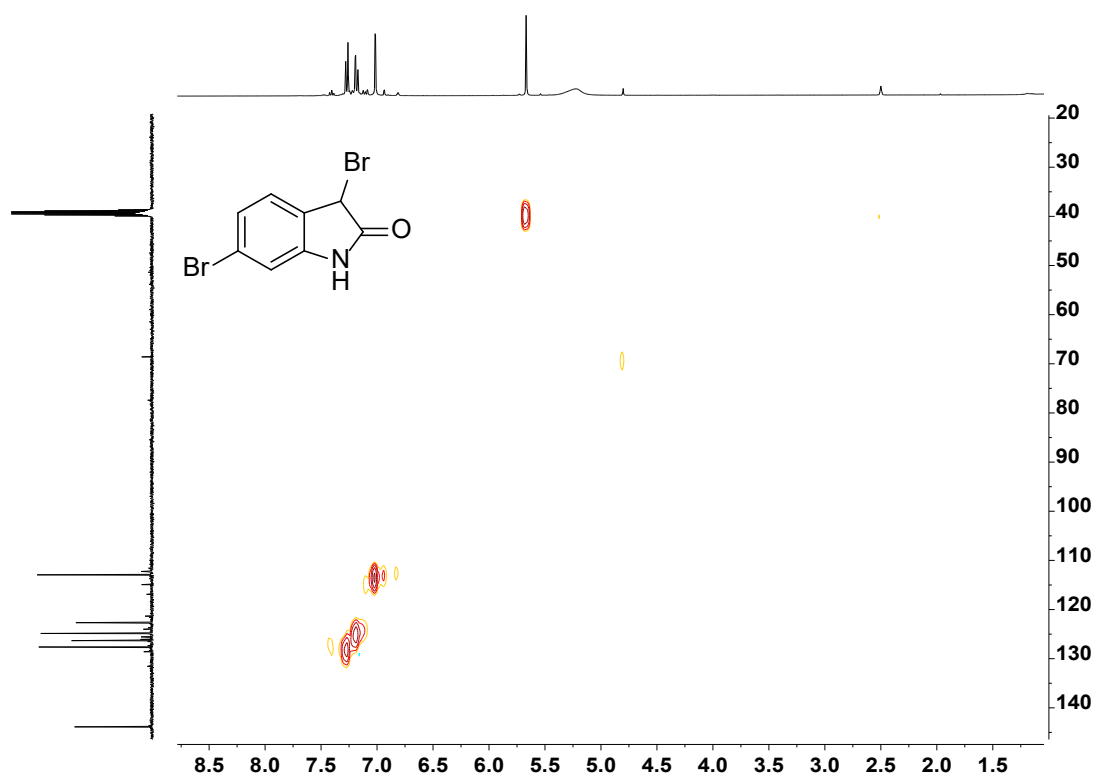


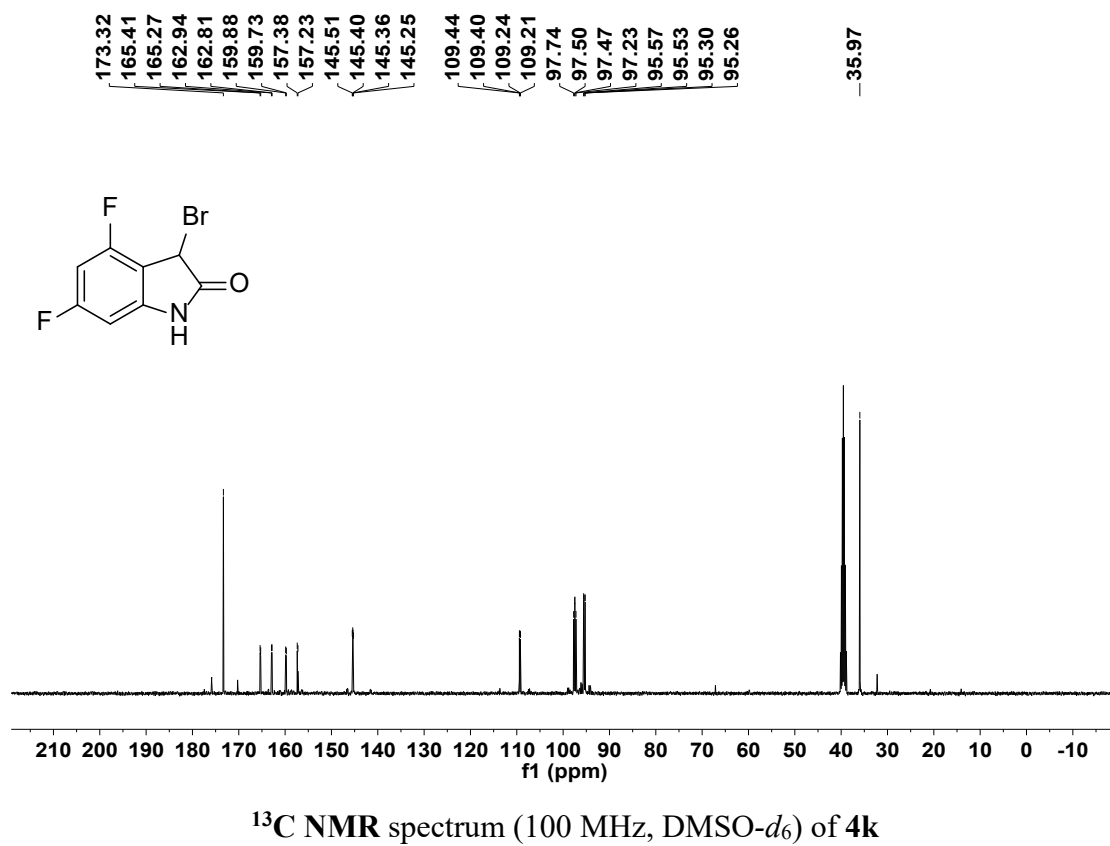
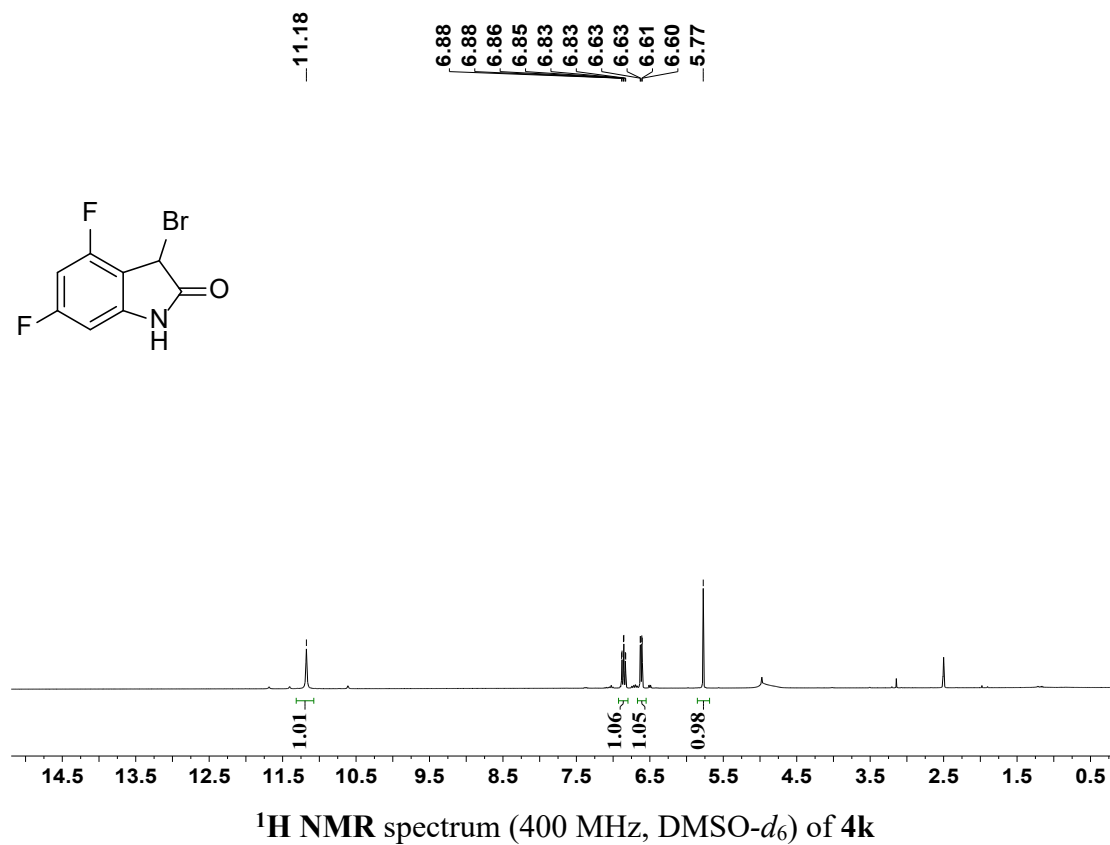
HSQC spectrum of 4i

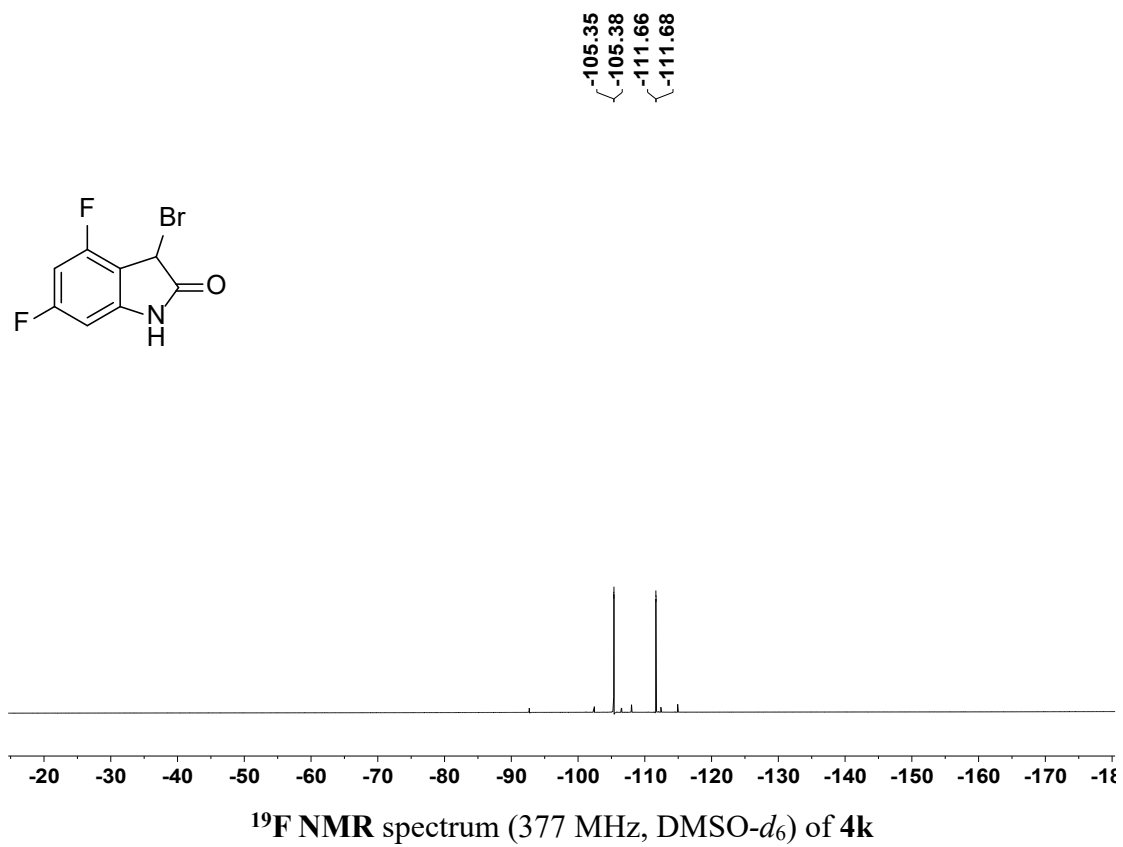


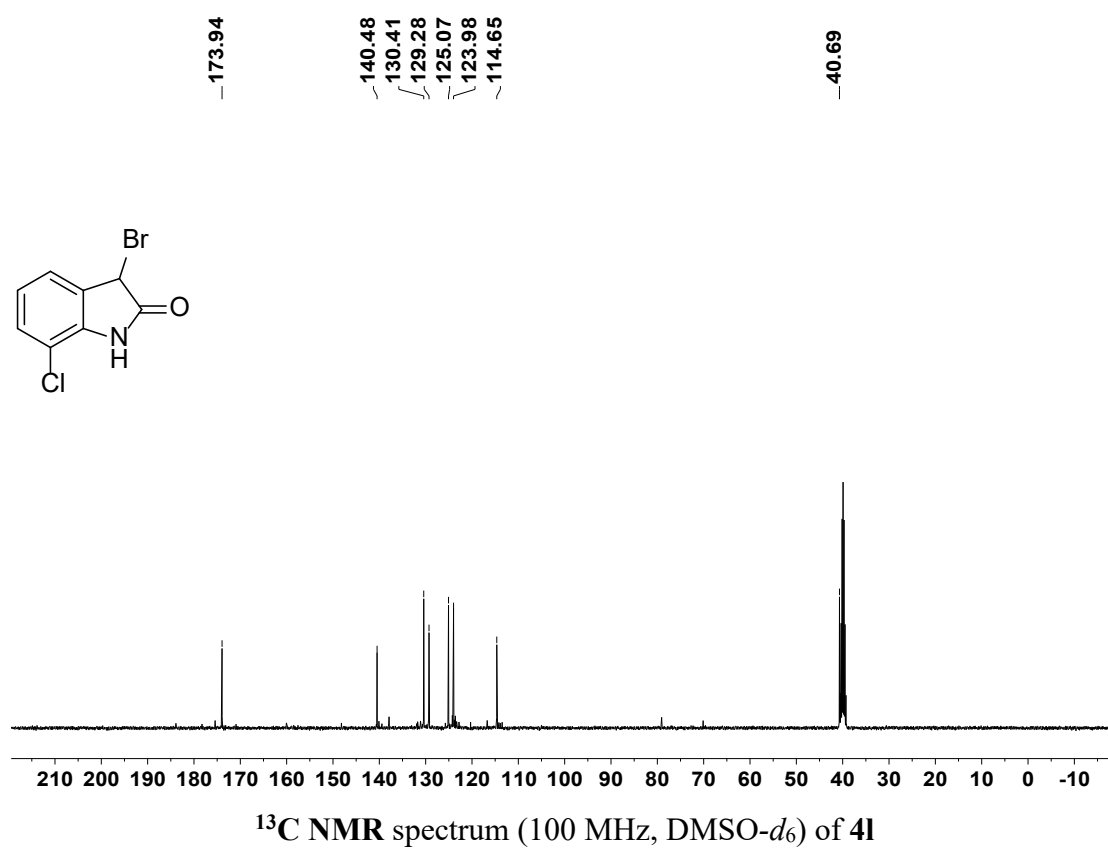
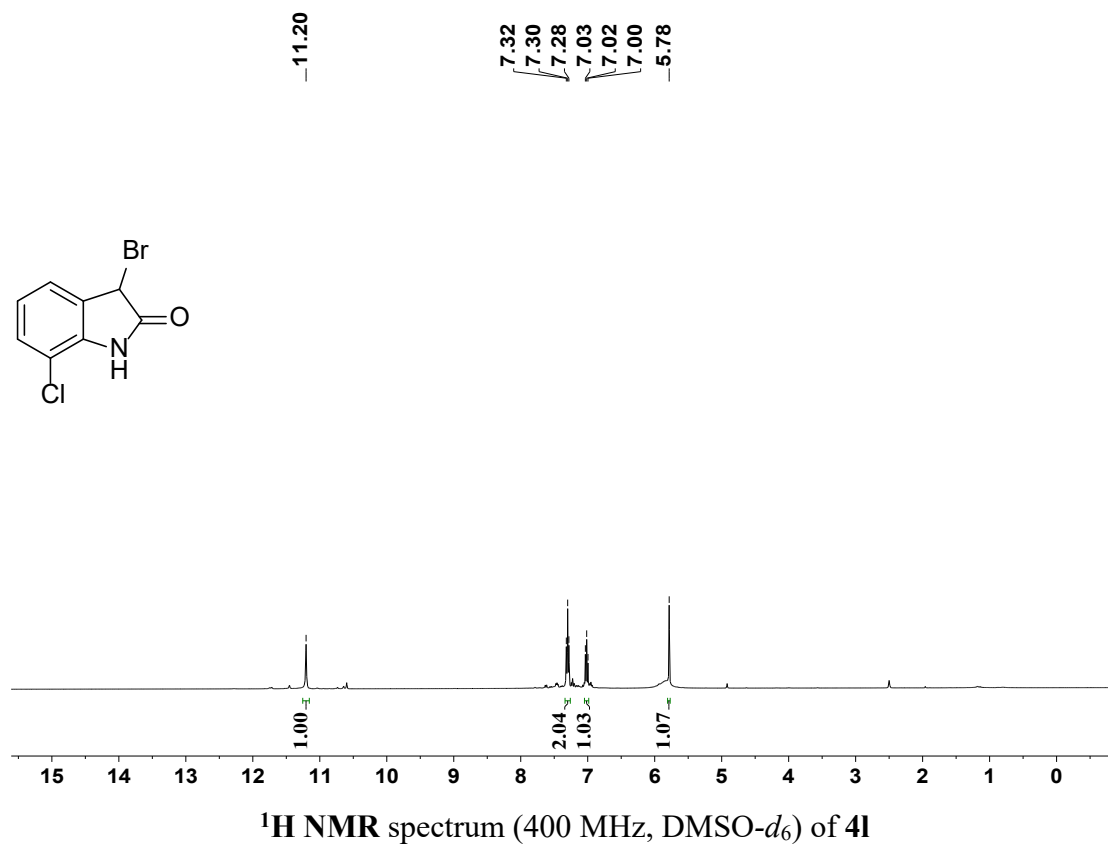


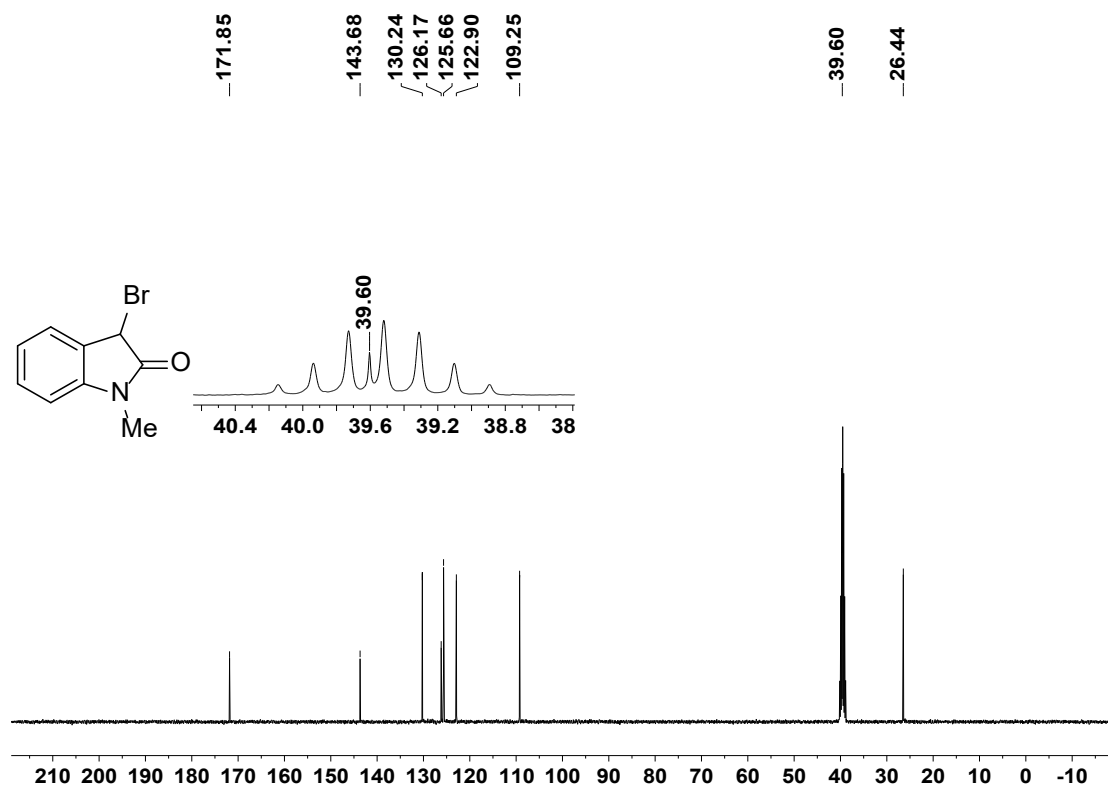
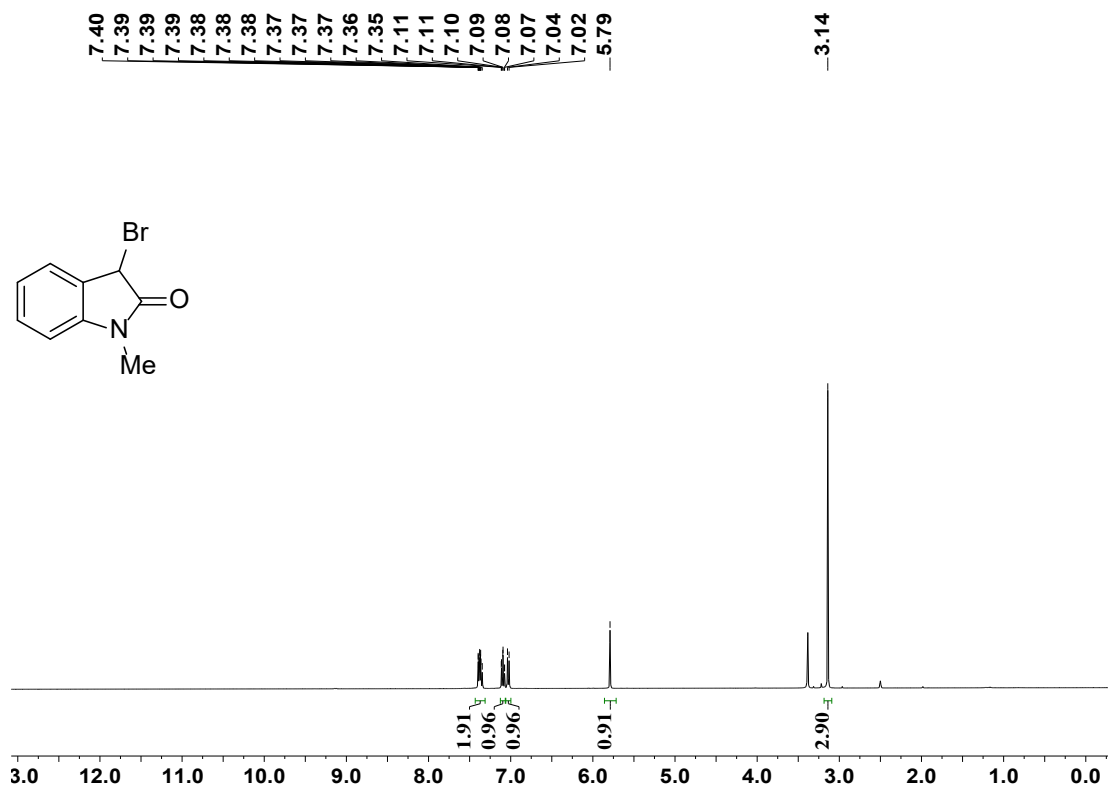


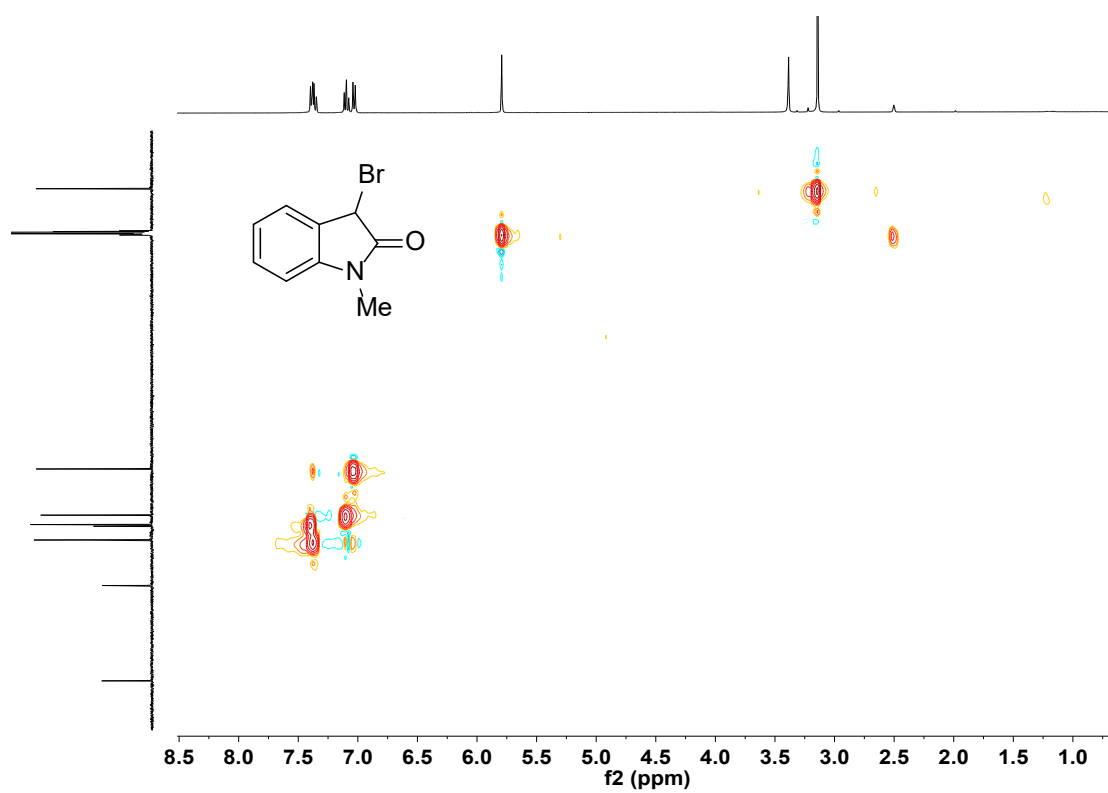




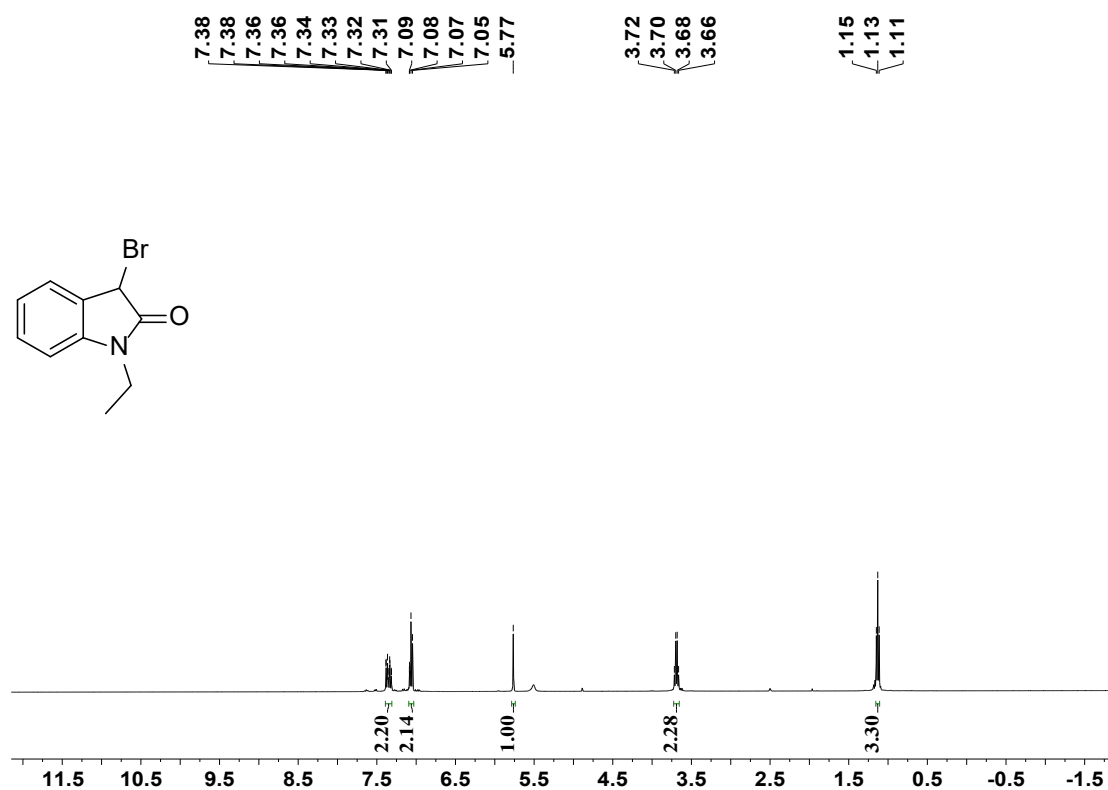




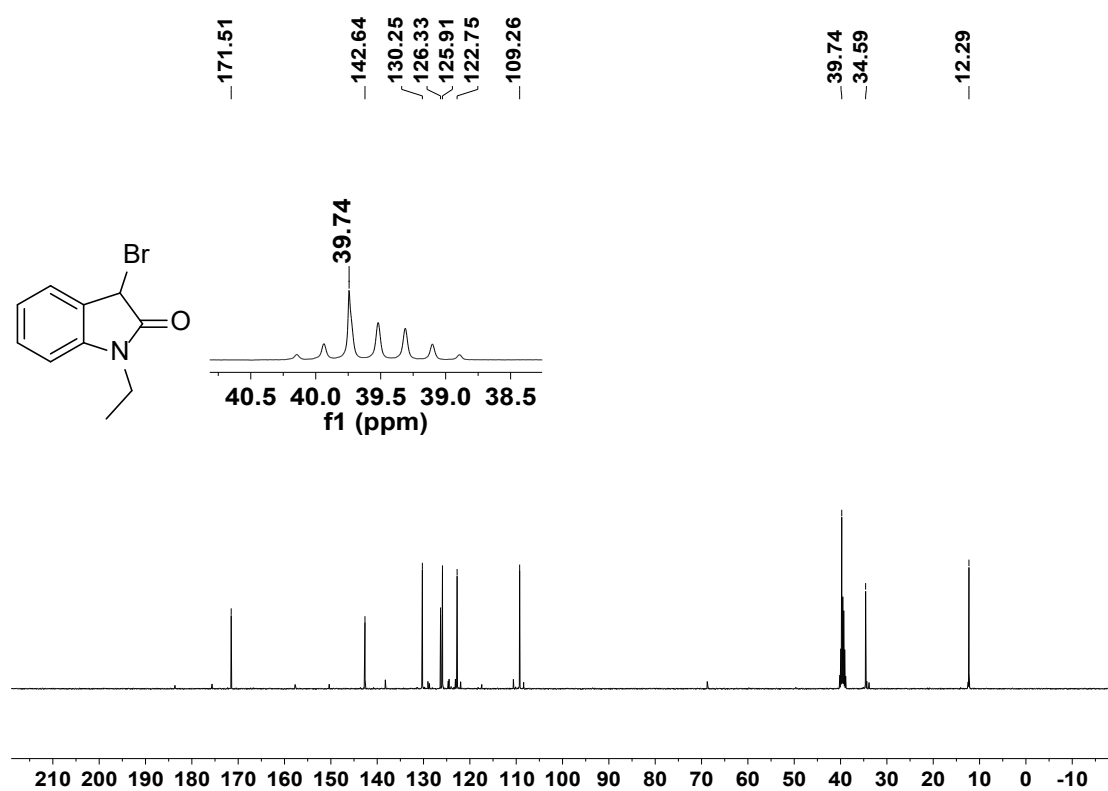




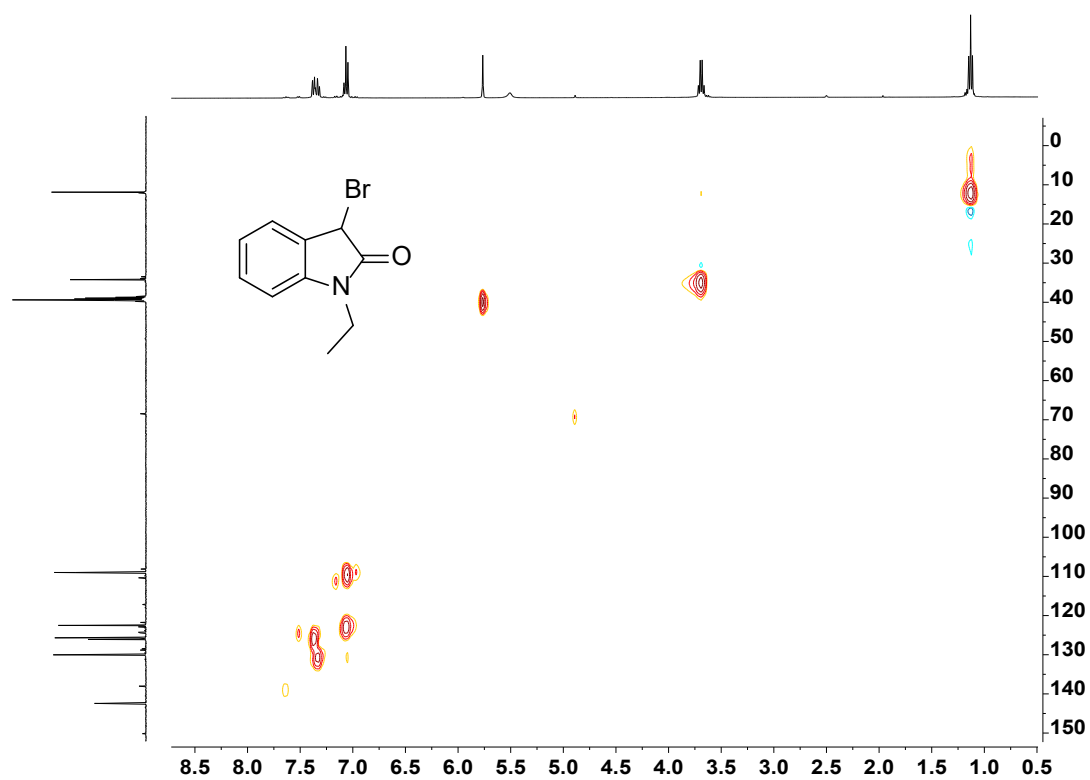
HSQC spectrum of 4m



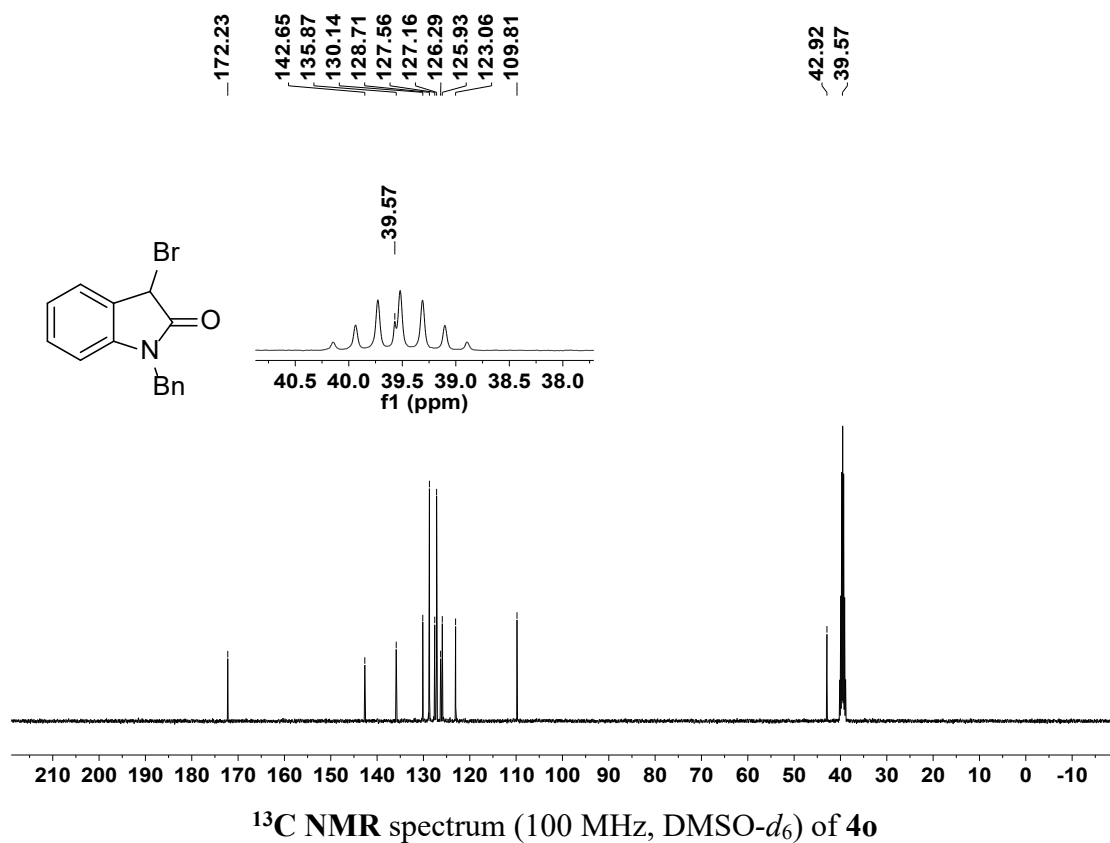
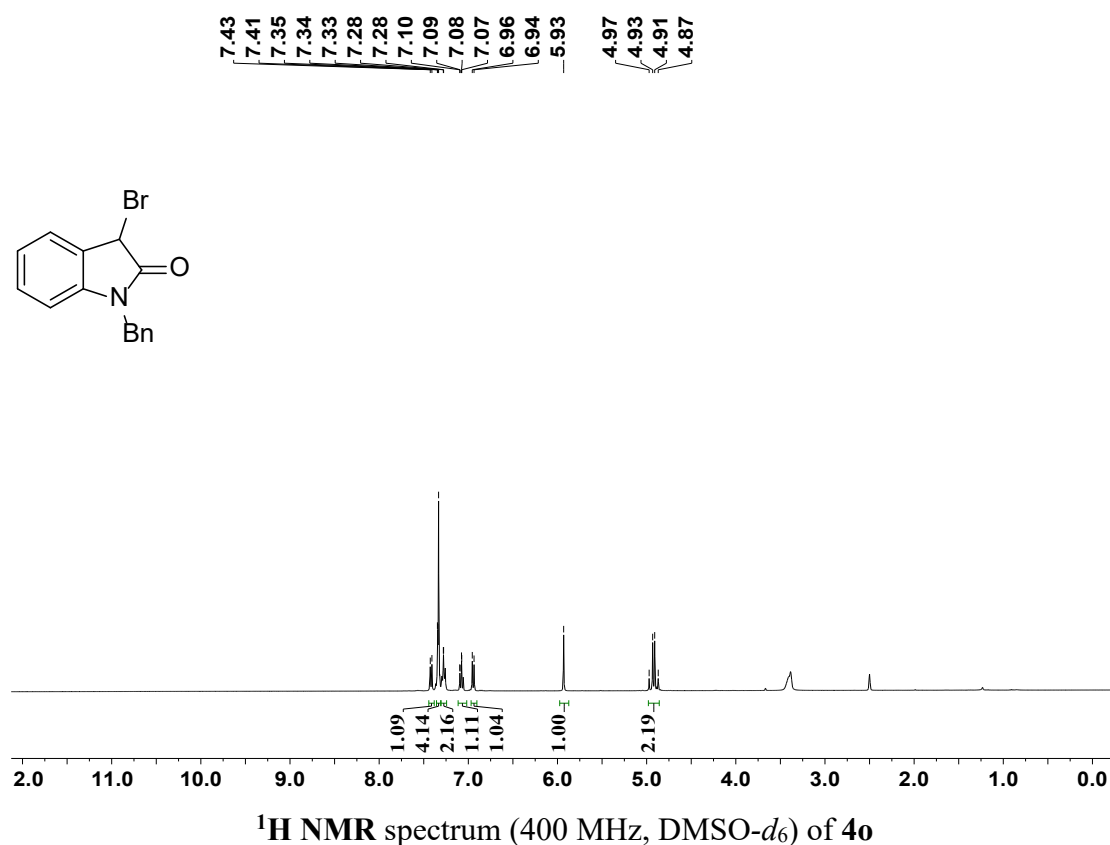
¹H NMR spectrum (400 MHz, DMSO-*d*₆) of 4n

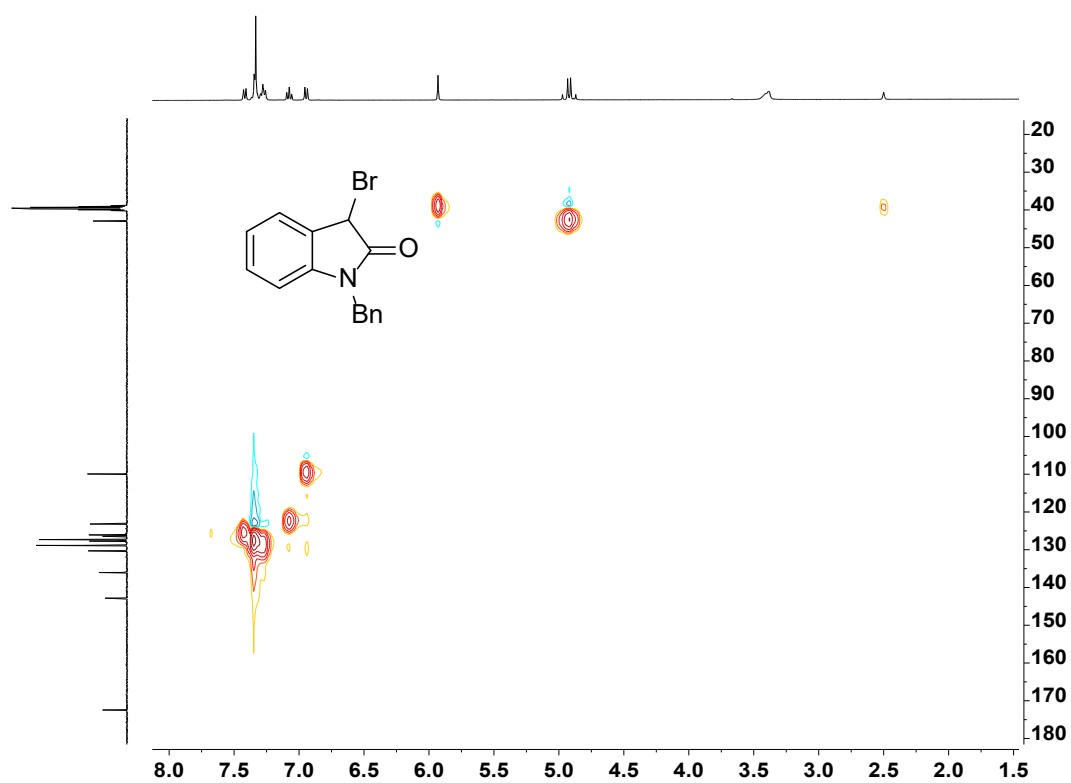


¹³C NMR spectrum (100 MHz, DMSO-*d*₆) of 4n



HSQC spectrum of **4n**





HSQC spectrum of **4o**

References

- 1 Hayashi, M.; Nakamura, S. *Angew. Chem. Int. Ed. Engl.* **2011**, *50* (10), 2249–2252. doi: 10.1002/anie.201007568
- 2 El Kaïm, L.; Gaultier, L.; Grimaud, L.; Dos Santos, A. *Synlett* **2005**, *2005* (15), 2335–2336. doi: 10.1055/s-2005-872670
- 3 Terada, M.; Kondoh, A.; Takei, A. *Synlett* **2016**, *27* (12), 1848–1853. doi: 10.1055/s-0035-1561859
- 4 Pu, X.; Li, Q.; Lu, Z.; Yang, X. *Eur. J. Org. Chem.* **2016**, *2016* (36), 5937–5940. doi: <https://doi.org/10.1002/ejoc.201601226>
- 5 CésardaSilva, R.; Chatterjee, I.; Escudero-Adán, E.; WeberPaixão, M.; Melchiorre, P. *Asian J. Org. Chem.* **2014**, *3* (4), 466–469. doi: <https://doi.org/10.1002/ajoc.201400014>
- 6 Noole, A.; Järving, I.; Werner, F.; Lopp, M.; Malkov, A.; Kanger, T. *Org. Lett.* **2012**, *14* (18), 4922–4925. doi: 10.1021/ol302245b
- 7 Wang, C.-S.; Li, T.-Z.; Cheng, Y.-C.; Zhou, J.; Mei, G.-J.; Shi, F. *J. Org. Chem.* **2019**, *84* (6), 3214–3222. doi: 10.1021/acs.joc.8b03004
- 8 Wang, X.; Dong, K.; Yan, B.; Zhang, C.; Qiu, L.; Xu, X. *RSC Advances* **2016**, *6* (74), 70221–70225. doi: 10.1039/C6RA16868J
- 9 Lakshmi Reddy, V.; Prathima, P. S.; Rao, V. J.; Bikshapathi, R. *New J. Chem.* **2018**, *42* (24), 20152–20155. doi: 10.1039/C8NJ04855J
- 10 Kajita, H.; Togni, A. *ChemistrySelect* **2017**, *2* (3), 1117–1121. doi: <https://doi.org/10.1002/slct.201700024>
- 11 Marek, L.; Kolman, L.; Váňa, J.; Svoboda, J.; Hanusek, J. *Beilstein Journal of Organic Chemistry* **2021**, *17*, 527–539. doi: 10.3762/bjoc.17.47