Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

A Practical Approach for the Synthesis of Oxindole and Isatin Derivatives by Pd-Catalyzed Intramolecular Amination

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Supporting information

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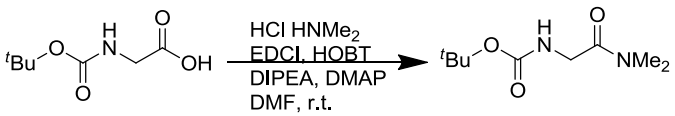
1. Reagents: Unless otherwise noted, all reagents were purchased from commercial suppliers and usedwithout further purification. Column chromatography purifications were performed using 300–400 mesh silica gel.

2. Instruments: NMR spectra were recorded on Varian Inova–400 MHz, Inova–300 MHz, Bruker DRX–400 or Bruker DRX–500 instruments and calibrated using residual solvent peaks as internal reference. Multiplicities are recorded as: s = singlet, d = doublet, q = quartet, brs = broad singlet, m = multiplet. HRMS analyses were carried out using a Bruker micrOTOF–Q instrument or a TOF–MS instrument.

3. Experimental section: Unless otherwide noted, all experiments were performed under air atmosphere. No reaction required anhydrous condition. All the glasswares used in the experiments were dried by vacuum oven.

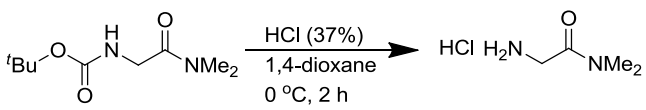
4. Preparation of glycine dimethylamide

4.1 Preparation of N-Boc-glycine dimethylamide



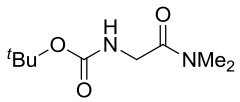
A mixture of N-Boc-Gly-OH (50 mmol, 1.0 equiv), dimethylamine (55 mmol, 1.1 equiv), EDCI (55 mmol, 1.1 equiv), HOBt (55 mmol, 1.1 equiv), DIPEA (150 mmol, 3.0 equiv) and DMAP (2.5 mmol, 5 mol%) in DMF (0.2 M) was stirred at room temperature overnight. Water was added and the mixture was extracted with DCM. The combined organic layers was washed with saturated ammonium chloride, sodium bicarbonate and brine, dried over anhydrous Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give N-Boc-glycine dimethylamide as a white solid in 87% yield.

4.2 Preparation of 2-Amino Acetyl dimethylamide hydrochloride

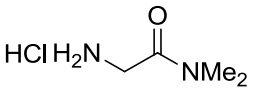


N-Boc-glycine dimethylamide (4.08 g, 20 mmol) was dissolved in 1,4-dioxane (32 mL) and Concentrated hydrochloric acid (16 mL) was added. The reaction mixture was stirring at ice bath over

2 h. The solvent was concentrated under vacuum to give 2-amino acetic dimethylamide, hydrochloride as a white solid in 95% yield. The crude product was used in the next step without any purification.



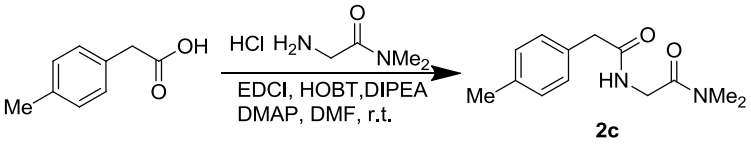
N-Boc-glycine dimethylamide was obtained as a while solid (8.91g, 87%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.51 (brs, 1H), 3.92 (d, *J* = 8.4 Hz, 2H), 2.96 (s, 3H), 2.94 (s, 3H), 1.43 (s, 9H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.5, 156.1, 79.7, 42.5, 36.0, 35.8, 28.6; HRMS Calcd for $C_9H_{18}N_2O_3$ [M+H$^+$]: 203.1396, Found: 203.1380.



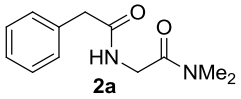
2-amino acetic dimethylamide, hydrochloride was obtained as a while solid (2.65 g, 95%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (brs, 3H), 4.13 (d, *J* = 4.4 Hz, 2H), 3.02 (s, 3H), 2.95 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.5, 40.9, 36.7, 36.1.

5. General procedures for the preparation of various phenylacetamide

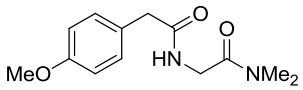
5.1 preparation of various carboxylic acid substrates



4- methyl phenylacetic acid (10 mmol, 1.0 equiv), amine (11 mmol, 1.1 equiv), EDCI (11 mmol, 1.1 equiv), HOBt (11 mmol, 1.1 equiv), DIPEA (30 mmol, 3.0 equiv) and DMAP (0.5 mmol, 5 mol%) in DMF (0.2 M) was stirred at room temperature overnight. Water was added and the mixture was extracted with DCM. The combined organic layers was washed with saturated ammonium chloride, sodium bicarbonate and brine, dried over anhydrous Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give **2c** as a white solid in 80% yield.

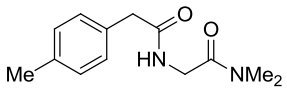


2a was obtained as a while solid (1.97g, 81%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 – 7.33 (m, 2H), 7.32 – 7.25 (m, 3H), 6.64 (brs, 1H), 4.02 (d, *J* = 3.6 Hz, 2H), 3.62 (s, 2H), 2.96 (s, 3H), 2.94 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.5, 167.3, 134.2, 128.9, 128.5, 126.9, 43.1, 40.9, 35.4, 35.0; HRMS Calcd for $C_{12}H_{16}N_2O_2$ [M+Na$^+$]: 243.1109, Found: 243.1114.



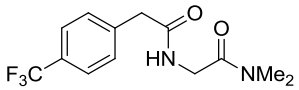
2b

2b was obtained as a while solid (2.03 g, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 (d, *J* = 7.6 Hz, 2H), 6.81 (d, *J* = 8.4 Hz, 2H), 6.66 (brs, 1H), 3.94 (d, *J* = 4.0 Hz, 2H), 3.71 (s, 3H), 3.48 (s, 2H), 2.88 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.3, 167.8, 158.7, 130.3, 126.7, 114.2, 55.1, 42.5, 41.3, 35.8, 35.4; HRMS Calcd for $C_{13}H_{18}N_2O_3$ [M+H$^+$]: 251.1396, Found: 251.1399.



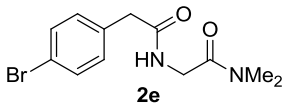
2c

2c was obtained as a while solid (1.88 g, 80%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 – 7.05 (m, 4H), 6.73 (brs, 1H), 3.92 (d, *J* = 4.0 Hz, 2H), 3.49 (s, 2H), 2.85 (s, 6H), 2.24 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.1, 167.78, 136.6, 131.6, 129.4, 129.1, 42.9, 41.2, 35.7, 35.3, 21.0; HRMS Calcd for $C_{13}H_{18}N_2O_2$ [M+H$^+$]: 235.1438, Found: 235.1447.



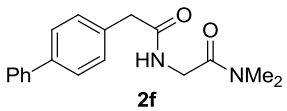
2d

2d was obtained as a while solid (1.82 g, 63%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.0 Hz, 2H), 7.41 (d, *J* =8.0 Hz, 2H), 6.74 (brs, 1H), 4.02 (d, *J* = 4.0 Hz, 2H), 3.65 (s, 2H), 2.96 (s, 3H), 2.95 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.0, 167.8, 139.0, 129.7, 127.4 (q, $J_{C\text{-}F}$= 225.7 Hz), 125.7 (q, $J_{C\text{-}F}$ = 3.4 Hz), 43.1, 41.5, 35.9, 35.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.53; HRMS Calcd for $C_{13}H_{15}F_3N_2O_2$ [M+H$^+$]: 289.1164, Found: 289.1163.



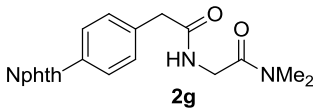
2e

2e was obtained as a while solid (2.36 g, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.4 Hz, 2H), 7.18 (d, *J* = 8.4 Hz, 2H), 6.63 (brs, 1H), 4.02 (d, *J* = 4.0 Hz, 2H), 3.56 (s, 2H), 2.97 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 167.8, 133.8, 132.0, 131.1, 121.4, 42.9, 41.5, 36.0, 35.7; HRMS Calcd for $C_{12}H_{15}BrN_2O_2$ [M+Na$^+$]: 321.0215, Found: 321.0205.



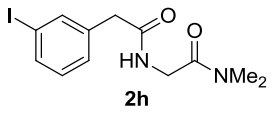
2f

2f was obtained as a while solid (2.22 g, 75%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.0 Hz, 4H), 7.44 – 7.41 (m, 2H), 7.39 – 7.30 (m, 3H), 6.66 (brs, 1H), 4.04 (d, *J* = 4.0 Hz, 2H), 3.65 (s, 2H), 2.96 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.4, 167.3, 140.2, 139.7, 133.2, 129.3, 128.3, 127.2, 126.8, 126.6, 42.7, 41.0, 35.4, 35.1; HRMS Calcd for $C_{18}H_{20}N_2O_2$ [M+H$^+$]: 297.1603, Found: 297.1624.



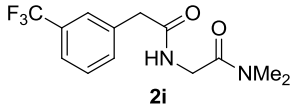
2g

2g was obtained as a while solid (2.71 g, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 – 7.91 (m, 2H), 7.81 – 7.79 (m, 2H), 7.48 – 7.42 (m, 4H), 6.67 (brs, 1H), 4.03 (d, *J* = 4.0 Hz, 2H), 3.65 (s, 2H), 2.97 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.5, 167.9, 167.4, 134.9, 134.6, 131.9, 131.0, 130.2, 127.0, 124.0, 43.4, 41.6, 36.1, 35.8; HRMS Calcd for $C_{20}H_{20}N_3O_4$ [M+H$^+$]: 366.1454, Found: 366.1462.



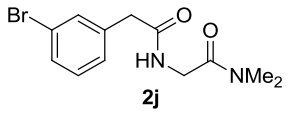
2h

2h was obtained as a while solid (2.25 g, 65%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (s, 1H), 7.60 (d, *J* = 8.0 Hz, 1H), 7.27 (d, *J* = 7.2 Hz, 1H), 7.09 – 7.05 (m, 1H), 6.66 (brs, 1H), 4.01 (d, *J* = 4.0 Hz, 2H), 3.53 (s, 2H), 3.02 (s, 3H), 3.01 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 167.9, 138.4, 137.2, 136.6, 130.7, 128.8, 94.9, 43.0, 41.7, 36.1, 35.8; HRMS Calcd for $C_{12}H_{15}IN_2O_2$ [M+H$^+$]: 347.0256, Found: 347.0250.



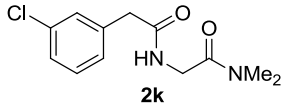
2i

2i was obtained as a while solid (1.96 g, 68%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (s, 1H), 7.52 – 7.45 (m, 2H), 7.45 – 7.37 (m, 1H), 6.91 (brs, 1H), 4.02 (d, *J* = 4.0 Hz, 2H), 3.63 (s, 2H), 2.93 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.0, 167.9, 136.2, 132.4, 130.2 (q, $J_{C\text{-}F}$ = 32.0 Hz), 128.6, 125.6 (q, $J_{C\text{-}F}$ = 3.3 Hz), 123.8 (q, $J_{C\text{-}F}$ = 270.7 Hz), 123.3 (q, $J_{C\text{-}F}$ = 3.0 Hz), 42.1, 41.0, 35.5, 35.0; ^{19}F NMR (376 MHz, $CDCl_3$) δ -112.61; HRMS Calcd for $C_{13}H_{15}F_3N_2O_2$ [M+H$^+$]: 289.1164, Found: 289.1160.



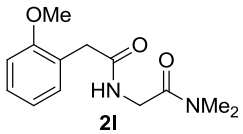
2j

2j was obtained as a while solid (2.36 g, 79%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 (s, 1H), 7.32 (d, *J* = 8.0 Hz, 1H), 7.19 – 7.11 (m, 2H), 6.93 (brs, 1H), 3.97 (d, *J* = 4.0 Hz, 2H), 3.51 (s, 2H), 2.89 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.2, 167.8, 137.2, 132.2, 130.2, 130.1, 127.9, 122.6, 42.7, 41.4, 35.9, 35.5; HRMS Calcd for $C_{12}H_{15}BrN_2O_2$ [M+H$^+$]: 299.0395, Found: 299.0384.



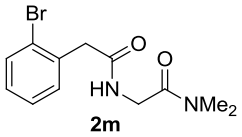
2k

2k was obtained as a while solid (2.01g, 79%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.29 (s, 1H), 7.25 (d, *J* = 6.8 Hz, 2H), 7.18 (d, *J* = 6.8 Hz, 1H), 6.80 (brs, 1H), 4.02 (d, *J* = 4.0 Hz, 2H), 3.57 (s, 2H), 2.95 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 167.9, 136.9, 134.7, 130.2, 129.6, 127.6, 127.6, 43.1, 41.6, 36.1, 35.7; HRMS Calcd for $C_{12}H_{15}ClN_2O_2$ [M+H$^+$]: 255.0900, Found: 255.0880.



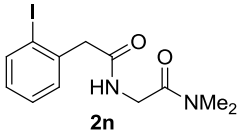
2l

2l was obtained as a while solid (2.10 g, 84%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 – 7.21 (m, 2H), 6.97 (brs, 1H), 6.95 – 6.86 (m, 2H), 3.97 (d, *J* = 4.0 Hz, 2H), 3.88 (s, 3H), 3.61 (s, 2H), 2.93 (s, 3H), 2.92 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.3, 167.9, 157.1, 131.1, 128.8, 123.5, 120.9, 110.6, 55.5, 41.5, 38.5, 35.9, 35.5; HRMS Calcd for $C_{13}H_{18}N_2O_3$ [M+H$^+$]: 251.1396, Found: 251.1393.



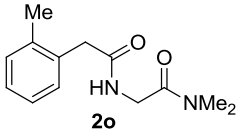
2m

2m was obtained as a while solid (2.43 g, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (d, *J* = 8.0 Hz, 1H), 7.09 (d, *J* = 7.6 Hz,1H), 7.05 – 7.01 (m, 1H), 6.90-6.86 (m, 1H), 6.38 (brs, 1H), 3.75 (d, *J* = 4.0 Hz, 2H), 3.49 (s, 2H), 2.67 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 167.7, 134.7, 133.1, 131.7, 129.2, 128.0, 125.0, 43.7, 41.5, 35.9, 35.6; HRMS Calcd for $C_{12}H_{15}BrN_2O_2$ [M+Na$^+$]: 321.0215.; Found: 321.0212.



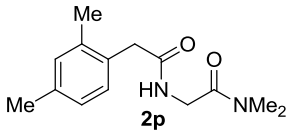
2n

2n was obtained as a while solid (2.32g, 67%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* =8.4 Hz,1H), 7.41 – 7.28 (m, 2H), 6.99 – 6.95 (m, 1H), 6.61 (brs, 1H), 4.02 (d, *J* =4.0 Hz, 2H), 3.77 (s, 2H), 2.95 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 167.8, 139.9, 138.2, 130.9, 129.3, 128.9, 101.3, 48.4, 41.6, 36.0, 35.6; HRMS Calcd for $C_{12}H_{15}N_2O_2$ [M+H$^+$]: 347.0256, Found: 347.0257.



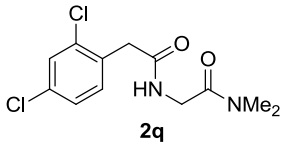
2o

2o was obtained as a while solid (1.92 g, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 (s, 4H), 6.46 (brs, 1H), 3.98 (d, *J* = 3.6 Hz, 2H), 3.61 (s, 2H), 2.92 (s, 3H), 2.91 (s, 3H), 2.30 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.9, 167.8, 137.1, 133.1, 130.8, 130.5, 127.9, 126.7, 41.6, 41.4, 35.9, 35.6, 19.6; HRMS Calcd for $C_{13}H_{18}N_2O_2$ [M+H$^+$]: 235.1438, Found: 235.1449.



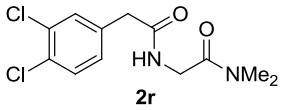
2p

2p was obtained as a while solid (1.64g, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 (d, *J* = 7.6 Hz, 1H), 7.09 – 7.00 (m, 2H), 6.50 (brs, 1H), 4.05 (d, *J* = 4.0 Hz, 2H), 3.64 (s, 2H), 3.00 (s, 3H), 2.99 (s, 3H), 2.35 (s, 3H), 2.32 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.7, 167.3, 131.1, 129.9, 126.8, 40.7, 35.4, 35.0, 20.6, 19.0; HRMS Calcd for $C_{14}H_{20}N_2O_2$ [M+H$^+$]: 249.1603, Found: 249.1609.



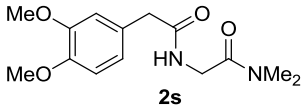
2q

2q was obtained as a while solid (2.02 g, 70%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (s, 1H), 7.27 (d, *J* = 8.4 Hz, 1H), 7.20 (d, *J* = 8.4 Hz, 1H), 6.80 (brs, 1H), 4.01 (d, *J* = 4.0 Hz, 2H), 3.68 (s, 2H), 2.94 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.1, 167.7, 135.1, 133.8, 132.3, 131.6, 129.4, 127.5, 41.5, 40.4, 35.9, 35.5; HRMS Calcd for $C_{12}H_{14}Cl_2N_2O_2$ [M+H$^+$]: 289.0511, Found: 289.0513.



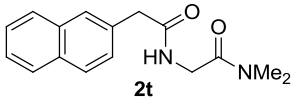
2r

2r was obtained as a while solid (1.96 g, 68%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.39 (m, 1H), 7.38 (s, 1 H), 7.14 (d, *J* = 8.4 Hz, 1H), 6.74 (brs, 1H), 4.02 (d, *J* = 4.0 Hz, 2H), 3.54 (s, 2H), 2.97 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 167.8, 135.0, 132.8, 131.5, 131.4, 130.8, 128.8, 42.5, 41.6, 36.0, 35.7; HRMS Calcd for $C_{12}H_{14}Cl_2N_2O_2$ [M+H$^+$]: 289.0511.; Found: 289.0510.



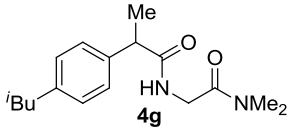
2s

2s was obtained as a while solid (1.77 g, 63%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.83 – 6.82 (m, 2H), 6.80 (s, 1H), 6.63 (s, 1H), 4.00 (d, *J* = 4.0 Hz, 2H), 3.87 (s, 3H), 3.85 (s, 3H), 3.54 (s, 2H), 2.95 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.3, 167.7, 149.0, 148.1, 127.1, 121.4, 112.3, 111.3, 55.8, 55.7, 42.9, 41.3, 35.8, 35.4; HRMS Calcd for $C_{14}H_{20}N_2O_4$ [M+H$^+$]: 281.1501, Found: 281.1504.



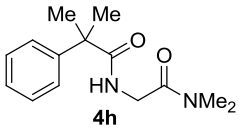
2t

2t was obtained as a while solid (1.95 g, 72%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.0 Hz, 1H), 7.81 (d, *J* = 8.0 Hz, 1H), 7.74 (s, 1H), 7.50 – 7.44 (m, 2H), 7.40 (d, *J* =4.4 Hz, 2H), 6.67 (brs, 1H), 4.01 (s, 2H), 3.88 (s, 2H), 2.78 (s, 3H), 2.76 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.9, 167.6, 133.9, 132.1, 131.1, 128.7, 128.2, 128.1, 126.5, 125.9, 125.6, 123.8, 41.3, 41.2 35.7, 35.3.; HRMS Calcd for $C_{16}H_{18}N_2O_2$ [M+H$^+$]: 271.1447, Found: 271.1450.



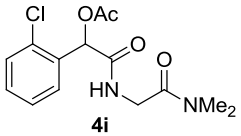
4g

4g was obtained as a while solid (2.56 g, 82%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.0 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 6.56 (brs, 1H), 4.06 – 3.90 (m, 2H), 3.62 – 3.57 (m, 1H), 2.94 (s, 3H), 2.93 (s, 3H), 2.43 (d, *J* = 7.2 Hz, 2H), 1.98 – 1.72 (m, 2H), 1.51 (d, *J* = 7.2 Hz, 3H), 0.88 (d, *J* = 6.8 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.5, 168.0, 140.7, 138.3, 129.6, 127.3, 46.6, 45.1, 41.5, 35.9, 35.6, 30.2, 22.5, 18.5; HRMS Calcd for $C_{17}H_{26}N_2O_2$ [M+Na$^+$]: 313.1892, Found: 313.1882.



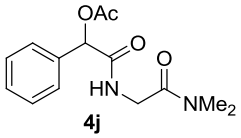
4h

4h was obtained as a while solid (2.11 g, 85%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (d, *J* = 7.2 Hz, 2H),7.40 – 7.36 (m, 2H), 7.31 – 7.27 (m, 1H), 6.45 (brs, 1H), 4.00 (d, *J* = 4.0 Hz, 2H), 2.97 (s, 3H), 2.96 (s, 3H), 1.64 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 177.3, 168.1, 144.9, 128.7, 127.1, 126.3, 46.9, 41.6, 35.9, 35.6, 27.0; HRMS Calcd for $C_{14}H_{20}N_2O_2$ [M+H$^+$]: 249.1603, Found: 249.1612.



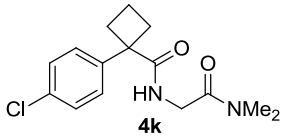
4i

4i was obtained as a while solid (1.94 g, 62%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.45 (m, 1H), 7.39 – 7.30 (m, 2H), 7.26 – 7.21 (m, 2H), 6.47 (brs, 1H), 4.08 – 3.94 (m, 2H), 2.95 (s, 3H), 2.92 (s, 3H), 2.16 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 167.5, 167.4, 133.8, 133.4, 130.3, 130.0, 129.5, 127.3, 72.3, 41.3, 35.9, 35.6, 20.9; HRMS Calcd for $C_{14}H_{17}ClN_2O_4$ [M+H$^+$]: 313.0955, Found: 313.0949.



4j

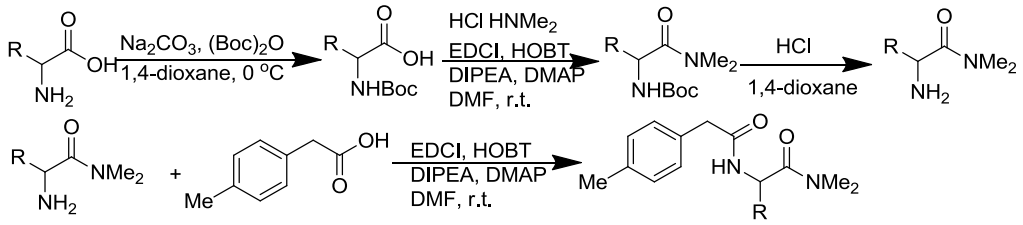
4j was obtained as a while solid (1.86 g, 67%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 (d, *J* = 7.2 Hz, 2H), 7.38 (s, 1H), 7.29 (d, *J* = 7.2 Hz, 3H), 6.07 (brs, 1H), 3.98 (d, *J* = 1.0 Hz, 2H), 2.92 (s, 3H), 2.88 (s, 3H), 2.14 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 168.3, 167.5, 135.5, 128.9, 128.7, 127.4, 75.4, 41.1, 35.8, 35.5, 20.9; HRMS Calcd for $C_{14}H_{18}N_2O_4$ [M+H$^+$]: 279.1345, Found: 279.1347.



4k

4k was obtained as a while solid (2.18 g, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 – 7.30 (m, 2H), 7.29 – 7.23 (m, 2H), 6.41 (brs, 1H), 3.94 (d, *J* = 4.0 Hz, 2H), 2.93 (s, 6H), 2.87 – 2.77 (m, 2H), 2.52 – 2.39 (m, 2H), 2.15 – 2.04 (m, 1H), 1.95 – 1.79 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 167.4, 142.4, 132.1, 128.3, 127.2, 52.0, 41.0, 35.3, 34.9, 31.8, 16.0; HRMS Calcd for $C_{15}H_{19}ClN_2O_2$ [M+H$^+$]: 295.1213, Found: 295.1202.

5.2 Preparation of various directing groups protected 4-Methylphenylacetic acid



5.2.1 N-Boc-amino acid

Amino acid (20 mmol, 1.0 equiv) and Na_2CO_3 (40 mmol, 2.0 equiv) were dissolved in 1,4-dioxane (60 mL). Then, di-tert-butyl-dicarbonate (30 mmol, 1.5 equiv) was added. The resultant solution was allowed to react at 0 ℃ for 2 h and at room temperature overnight. Then, 1 M HCl (15 mL) was added dropwise to adjust pH value of the solution to about 5 at 0 ℃. The solution was extracted with EtOAc (3 × 40 mL) and CH_2Cl_2 (3 × 40 mL), respectively. The organic phases were mixed and dried with anhydrous Na_2SO_4. The reaction afforded N-Boc-amino acid. Oil-like solid, yield 96%.

5.2.2 N-Boc-Amino dimethylamide

N-Boc-Amino acid (15 mmol, 1.0 equiv), amine (16.5 mmol, 1.1 equiv), EDCI (16.5 mmol, 1.1 equiv), HOBt (16.5 mmol, 1.1 equiv), DIPEA (30 mmol, 2.0 equiv), and DMAP (0.75 mmol, 5 mol%) in DMF (0.2 M) was stirred at room temperature overnight. Water was added and the mixture was extracted with DCM. The combined organic layers was washed with saturated ammonium chloride, sodium bicarbonate and brine, dried over anhydrous Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give N-Boc-Amino amide as a white solid in 85% yield.

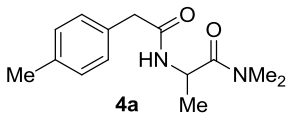
5.2.3 2-Amino Dimethylamide Hydrochloride

N-Boc-Amino amide (12 mmol, 1.0 equiv) was dissolved in 1,4-dioxane (19.2 mL) and Concentrated hydrochloric acid (9.6 mL) was added. The reaction mixture was Stirring at ice bath over 2 h. The solvent was concentrated under vacuum to give 2-amino amide hydrochloride as a white solid in 90% yield.

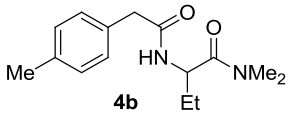
5.2.4 2-(4-MethylPhenylAcetAmido) Dimethylamide

4-Mephenylacetic acid (10 mmol, 1.0 equiv), 2-amino dimethylamide hydrochloride (11 mmol, 1.1 equiv), EDCI (11 mmol, 1.1 equiv), HOBt (11 mmol, 1.1 equiv), DIPEA (30 mmol, 3.0 equiv), and DMAP (0.5 mmol, 5 mol%) in DMF (0.2 M) was stirred at room temperature overnight. Water was added and the mixture was extracted with DCM. The combined organic layers was washed with saturated ammonium chloride, sodium bicarbonate and brine, dried over anhydrous Na_2SO_4, and

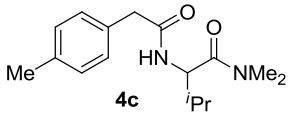
concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to various amide as a white solid in 78% yield.



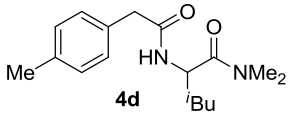
4a was obtained as a white solid (1.94 g, 78%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 – 7.07 (m, 4H), 6.80 (d, *J* =6.8 Hz, 1H), 4.87-4.80 (m, 1H), 3.47 (s, 2H), 2.99 (s, 3H), 2.88 (s, 3H), 2.28 (s, 3H), 1.23 (d, *J* =6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.3, 170.5, 136.7, 131.7, 129.5, 129.2, 45.2, 43.1, 36.9, 35.7, 21.1, 18.5; HRMS Calcd for $C_{14}H_{20}N_2O_2$ [M+H$^+$]: 249.1603, Found: 249.1600.



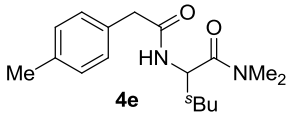
4b was obtained as a white solid (2.16 g, 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.13 – 7.07 (m, 4H), 6.75 (d, *J* =7.6 Hz, 1H), 4.87 – 4.82 (m, 1H), 3.48 (s, 2H), 3.01 (s, 3H), 2.88 (s, 3H), 2.27 (s, 3H), 1.75 – 1.67 (m, 1H), 1.55 – 1.43 (m, 1H), 0.79 (t, *J* =7.4 Hz, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.7, 170.9, 136.6, 131.9, 129.5, 129.1, 49.9, 43.1, 37.1, 35.6, 25.7, 21.0, 9.4; HRMS Calcd for $C_{15}H_{22}N_2O_2$ [M+Na$^+$]: 285.1579, Found: 285.1565.



4c was obtained as a white solid (2.07 g, 75%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.15 – 7.10 (m, 4H), 6.51 (d, *J* =8.4 Hz, 1H), 4.80 – 4.76 (m, 1H), 3.51 (s, 2H), 3.07 (s, 3H), 2.91 (s, 3H), 2.30 (s, 3H), 1.95 – 1.87 (m, 1H), 0.87 (d, *J* = 6.8 Hz, 3H), 0.77 (d, *J* = 6.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 171.2, 136.8, 131.9, 129.6, 129.3, 53.5, 43.3, 37.5, 35.7, 31.6, 21.2, 19.6, 17.6; HRMS Calcd for $C_{16}H_{24}N_2O_2$ [M+H$^+$]: 277.1916, Found: 277.1913.

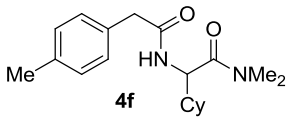


4d was obtained as a white solid (1.98 g, 68%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.14 – 7.08 (m, 4H), 6.70 (d, *J* = 8.4 Hz, 1H), 5.00 – 4.95 (m, 1H), 3.48 (s, 2H), 3.05 (s, 3H), 2.89 (s, 3H), 2.28 (s, 3H), 1.59 – 1.50 (m, 1H), 1.47 – 1.33 (m, 2H), 0.91 (d, *J* = 6.4 Hz, 3H), 0.84 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.6, 171.0, 136.7, 131.9, 129.5, 129.2, 47.3, 43.0, 42.3, 37.1, 35.8, 24.7, 23.4, 22.0, 21.1; HRMS Calcd for $C_{17}H_{26}N_2O_2$ [M+H$^+$]: 291.2073, Found: 291.2063.



4e was obtained as a white solid (1.94 g, 67%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.15 – 7.08 (m, 4H), 6.56 (d, *J* = 8.8 Hz, 1H), 4.82 – 4.78 (m, 1H), 3.50 (s, 2H), 3.08 (s, 3H), 2.90 (s, 3H), 2.29 (s, 3H), 1.74

– 1.63 (m, 1H), 1.44 – 1.34 (m, 1H), 1.04 – 0.92 (m, 1H), 0.84 (d, *J* = 6.8 Hz, 3H), 0.79 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.1, 171.2, 136.7, 131.9, 129.5, 129.2, 52.8, 43.1, 38.0, 37.6, 35.7, 24.3, 21.1, 15.6, 11.2; HRMS Calcd for $C_{17}H_{26}N_2O_2$ [M+H$^+$]: 291.2073, Found: 291.2063.

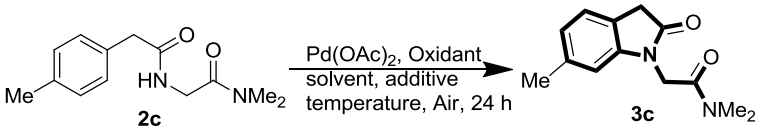


4f

4f was obtained as a white solid (2.02 g, 64%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22 – 7.06 (m, 4H), 6.37 (d, *J* = 9.2 Hz, 1H), 4.82-4.78 (m, 1H), 3.57 – 3.46 (m, 2H), 3.08 (s, 3H), 2.92 (s, 3H), 2.31 (s, 3H), 1.72 – 1.53 (m, 6H), 1.19 – 0.97 (m, 4H), 0.91 – 0.81 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 171.2, 136.8, 132.0, 129.6, 129.3, 53.1, 43.1, 41.3, 37.6, 35.7, 29.9, 28.2, 26.2, 26.1, 26.0, 21.1; HRMS Calcd for $C_{19}H_{28}N_2O_2$ [M+H$^+$]: 317.2229, Found: 317.2219.

6. Screening of reaction conditions of intramolecular δ-C(sp2)–H amination

Table 1. Screening of reaction conditions[a]

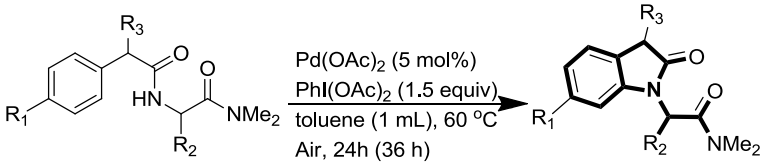


entry	oxidant	additive	temperature	solvent	yeild
1	$PhI(OAc)_2$	PivOH	80 °C	DCE	67%
2	$PhI(OAc)_2$	PivOH	80 °C	THF	22%
3	$PhI(OAc)_2$	PivOH	80 °C	HFIP	35%
4	$PhI(OAc)_2$	PivOH	80 °C	1,4-dioxiane	45%
5	$PhI(OAc)_2$	PivOH	80 °C	Ac2O	17%
6	$PhI(OAc)_2$	PivOH	80 °C	toluene	70%
7	$PhI(OAc)_2$	-	80 °C	toluene	83%
8	**$PhI(OAc)_2$**	**-**	**60 °C**	**toluene**	**91%**
9	$PhI(OAc)_2$	-	25 °C	toluene	53%
10[b]	$PhI(OAc)_2$	-	60 °C	toluene	-
11	$K_2S_2O_8$	-	60 °C	toluene	-
12	NFSI	-	60 °C	toluene	-
13	DTBP	-	60 °C	toluene	-
14	$NaIO_4$	-	60 °C	toluene	-

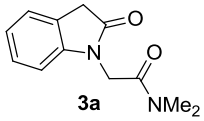
15	$Cu(OAc)_2$	-	60 °C	toluene	-

[a]Reaction conditions: **2c** (0.1 mmol), $Pd(OAc)_2$ (5 mol%), $PhI(OAc)_2$ (1.5 equiv), in solvent (0.5 mL),60 °C, 24 h. Yield was based on GC using tridecane as the internal standard. [b]No $Pd(OAc)_2$.

7. Palladium-catalyzed intramolecular γ-C(sp2)–H amination

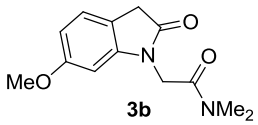


A mixture of acid derivatives (0.2 mmol, 1.0 equiv), $Pd(OAc)_2$ (2.2 mg, 0.05 equiv), $PhI(OAc)_2$ (96.6 mg, 1.5 equiv) and toluene (1 mL) in a 25 mL glass vial (under air atmosphere, sealed with PTFE cap) was heated at 60 °C for 24 hours (36 hours). The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give the cyclized product.



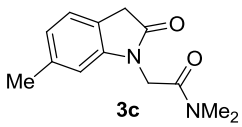
3a

3a was obtained as a while solid (37.5 mg, 86%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 – 7.21 (m, 2H), 7.04-7.00 (m, 1H), 6.80 (d, *J* = 7.6 Hz, 1H), 4.51 (s, 2H), 3.59 (s, 2H), 3.11 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.3, 166.2, 144.5, 128.0, 124.5, 124.3, 122.6, 109.0, 41.9, 36.7, 35.9, 35.7; HRMS Calcd for $C_{12}H_{14}N_2O_2$ [M+H$^+$]: 219.1134, Found: 219.1123.



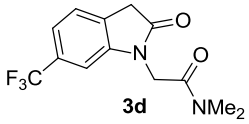
3b

3b was obtained as a white solid (45.3 mg, 91%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12 (d, *J* = 8.4 Hz, 1H), 6.53 (d, *J* = 8.0 Hz, 1H), 6.42 (s, 1H), 4.49 (s, 2H), 3.79 (s, 3H), 3.53 (s, 2H), 3.11 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 176.2, 166.2, 160.2, 145.8, 125.1, 116.3, 106.8, 97.2, 55.8, 42.1, 36.9, 36.1, 35.3; HRMS Calcd for $C_{13}H_{16}N_2O_3$ [M+H$^+$]: 249.1239, Found: 249.1242.

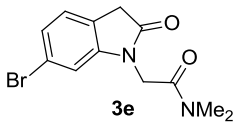


3c

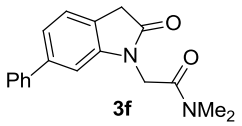
3c was obtained as a white solid (38.7 mg, 88%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (d, *J* = 7.6 Hz, 1H), 6.83 (d, *J* = 7.6 Hz, 1H), 6.63 (s, 1H), 4.50 (s, 2H), 3.55 (s, 2H), 3.12 (s, 3H), 2.98 (s, 3H), 2.34 (s, 3H).; ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.8, 166.4, 144.7, 138.2, 124.3, 123.4, 121.4, 109.9, 42.0, 36.9, 36.1, 35.6, 22.0; HRMS Calcd for $C_{13}H_{16}N_2O_2$ [M+H$^+$]: 233.1290, Found: 233.1297.



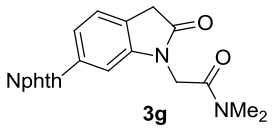
3d was obtained as a white solid (30.9 mg, 54%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 – 7.29 (dd, *J* = 17.60, 9.6 Hz, 2H), 6.96 (s, 1H), 4.53 (s, 2H), 3.64 (s, 2H), 3.14 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 165.5, 145.3, 130.6 (q, $J_{C\text{-}F}$ = 32.3 Hz), 128.4, 124.8, 124.2 (q, $J_{C\text{-}F}$ = 243.0 Hz), 119.8 (q, $J_{C\text{-}F}$ = 4.0 Hz), 105.7 (q, $J_{C\text{-}F}$ = 3.7 Hz), 41.8, 36.7, 36.1, 35.6; ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.22; HRMS Calcd for $C_{13}H_{13}F_3N_2O_2$ [M+H$^+$]: 287.1007, Found: 287.0998.



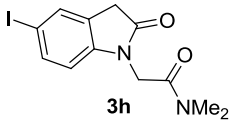
3e was obtained as a white solid (37.3 mg, 63%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (s, 1H), 7.36 (d, *J* = 8.4 Hz, 1H), 6.69 (d, *J* = 8.0 Hz, 1H), 4.50 (s, 2H), 3.60 (s, 2H), 3.11 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 165.9, 143.8, 131.0, 127.8, 126.4, 115.4, 110.6, 42.0, 36.8, 36.1, 35.7; HRMS Calcd for $C_{13}H_{13}BrN_2O_2$ [M+H$^+$]: 297.0239, Found: 297.0225.



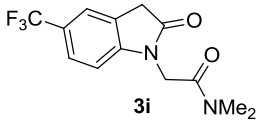
3f was obtained as a white solid (45.8 mg, 78%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 (d, *J* = 6.8 Hz, 2H), 7.44 – 7.41 (m, 2H), 7.35 (d, *J* = 7.6 Hz, 1H), 7.30 (d, *J* = 7.6 Hz, 1H), 7.25 (d, *J* = 8.0 Hz, 1H), 6.99 (s, 1H), 4.56 (s, 2H), 3.63 (s, 2H), 3.13 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.6, 166.1, 145.2, 141.7, 141.4, 128.9, 127.6, 127.5, 124.8, 123.5, 121.8, 108.0, 42.0, 36.8, 36.1, 35.6; HRMS Calcd for $C_{18}H_{18}N_2O_2$ [M+H$^+$]: 295.1447, Found: 295.1436.



3g was obtained as a white solid (52.9 mg, 73%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95-7.91 (m, 2H), 7.81-7.77 (m, 2H), 7.37 (d, *J* = 7.2 Hz, 1H), 7.13 (d, *J* = 7.2 Hz, 1H), 6.94 (s, 1H), 4.55 (s, 2H), 3.61 (s, 2H), 3.10 (s, 3H), 2.95 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.3, 167.4, 166.0, 145.4, 134.8, 134.7, 131.9, 131.7, 124.9, 124.3, 124.0, 120.9, 107.8, 42.2, 36.9, 36.1, 35.6, 29.9; HRMS Calcd for $C_{20}H_{17}N_3O_4$ [M+H$^+$]: 364.1219, Found: 364.1215.

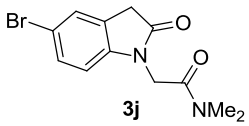


3h was obtained as a white solid (38.5 mg, 56%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (s, 2H), 6.59 (d, *J* = 8.0 Hz, 1H), 4.49 (s, 2H), 3.58 (s, 2H), 3.11 (s, 3H), 2.96 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 167.9, 138.4, 137.2, 136.6, 130.7, 128.8, 94.9, 43.0, 41.7, 36.1, 35.8; HRMS Calcd for $C_{12}H_{13}IN_2O_2$ [M+H$^+$]: 345.0022, Found: 345.0010.



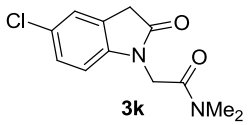
3i

3i was obtained as a white solid (33.1 mg, 58%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, *J* = 9.0 Hz, 1H), 7.50 (s, 1H), 6.86 (d, *J* = 8.0 Hz, 1H), 4.55 (s, 2H), 3.65 (s, 2H), 3.14 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.1, 165.7, 147.7, 135.6 (q, $J_{C\text{-}F}$ = 34.3 Hz), 125.9 (q, $J_{C\text{-}F}$ = 4.3 Hz), 123.2 (q, $J_{C\text{-}F}$ = 286.1 Hz),124.9, 121.7 (q, $J_{C\text{-}F}$ = 4.0 Hz), 108.9, 41.9, 36.8, 36.1, 35.6; HRMS Calcd for $C_{13}H_{13}F_3N_2O_2$ [M+H$^+$]: 287.1007, Found: 287.0999.



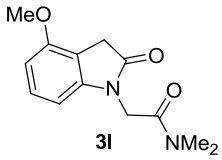
3j

3j was obtained as a white solid (36.7 mg, 62%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (s, 1H), 7.36 (d, *J* = 7.6 Hz, 1H), 6.69 (d, *J* = 8.4 Hz, 1H), 4.50 (s, 2H), 3.60 (s, 2H), 3.12 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 165.9, 143.8, 131.0, 127.8, 126.4, 115.4, 110.6, 42.0, 36.8, 36.1, 35.7; HRMS Calcd for $C_{12}H_{13}BrN_2O_2$ [M+H$^+$]: 297.0239, Found: 297.0229.



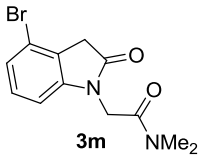
3k

3k was obtained as a white solid (35.2 mg, 70%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (s, 1H), 7.21 (d, *J* = 11.6 Hz, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 4.50 (s, 2H), 3.59 (s, 2H), 3.11 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 166.0, 143.3, 128.1, 126.0, 125.0, 110.1, 42.0, 36.8, 36.0, 35.7; HRMS Calcd for $C_{12}H_{13}ClN_2O_2$ [M+H$^+$]: 253.0666, Found: 253.0650.



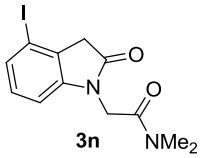
3l

3l was obtained as a white solid (42.1 mg, 85%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23-7.19 (m, 1H), 6.60 (d, *J* = 8.4 Hz, 1H), 6.49 (d, *J* = 4.0 Hz, 1H), 4.50 (s, 2H), 3.85 (s, 3H), 3.52 (s, 2H), 3.10 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.7, 166.4, 145.8, 129.4, 111.1, 105.8, 102.6, 55.7, 42.3, 36.9, 36.1, 33.6; HRMS Calcd for $C_{13}H_{16}N_2O_3$ [M+H$^+$]: 249.1239, Found: 249.1236.

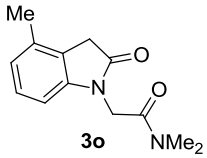


3m

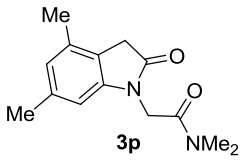
3m was obtained as a white solid (33.7 mg, 57%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18 (d, *J* = 7.2 Hz, 1H), 7.15-7.11 (m, 1H), 6.76 (d, *J* = 7.6 Hz, 1H), 4.52 (s, 2H), 3.57 (s, 2H), 3.13 (s, 3H), 2.99 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.0, 165.9, 145.5, 129.6, 125.6, 125.3, 119.2, 107.9, 42.1, 37.1, 36.8, 36.0; HRMS Calcd for $C_{12}H_{13}BrN_2O_2$ [M+H$^+$]: 297.0239, Found: 297.0223.



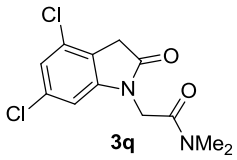
3n was obtained as a white solid (37.8 mg, 55%) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (d, *J* = 8.0 Hz, 1H), 6.99-6.95 (m, 1H), 6.77 (d, *J* = 7.6 Hz, 1H), 4.48 (s, 2H), 3.48 (s, 2H), 3.12 (s, 3H), 2.97 (s, 3H).; ^{13}C NMR (101 MHz, $CDCl_3$) δ 173.6, 165.9, 144.8, 131.6, 129.8, 108.8, 92.4, 42.2, 40.5, 36.9, 36.1; HRMS Calcd for $C_{12}H_{13}IN_2O_2$ [M+H$^+$]: 345.0022, Found: 345.0008.



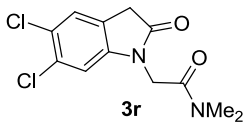
3o was obtained as a white solid (38.5 mg, 83%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.16-7.12 (m, 1H), 6.85 (d, *J* = 8.0 Hz, 1H), 6.64 (d, *J* = 7.6 Hz, 1H), 4.50 (s, 2H), 3.48 (s, 2H), 3.10 (s, 3H), 2.96 (s, 3H), 2.26 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.4, 166.3, 144.3, 134.2, 128.1, 124.0, 123.1, 106.6, 42.1, 36.8, 36.0, 34.8, 18.7; HRMS Calcd for $C_{13}H_{16}N_2O_2$ [M+H$^+$]: 233.1290, Found: 233.1277.



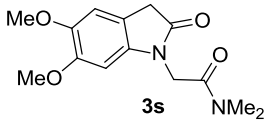
3p was obtained as a white solid (30.5 mg, 62%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.67 (s, 1H), 6.47 (s, 1H), 4.48 (s, 2H), 3.43 (s, 2H), 3.11 (s, 3H), 2.97 (s, 3H), 2.30 (s, 3H), 2.21 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.8, 166.4, 144.4, 138.1, 133.8, 124.7, 120.1, 107.4, 42.1, 36.8, 36.0, 34.6, 21.9, 18.6; HRMS Calcd for $C_{14}H_{18}N_2O_2$ [M+H$^+$]: 247.1447, Found: 247.1443.



3q was obtained as a white solid (26.9 mg, 47%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.03 (s, 1H), 6.68 (s, 1H), 4.47 (s, 2H), 3.56 (s, 2H), 3.12 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.3 , 165.4, 146.5, 134.7, 131.0, 122.6, 121.5, 108.4, 42.0, 36.8, 36.1, 35.0; HRMS Calcd for $C_{12}H_{12}Cl_2N_2O_2$ [M+H$^+$]: 287.0354, Found: 287.0350.

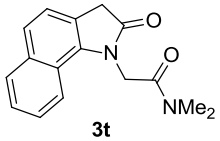


3r was obtained as a white solid (29.8 mg, 52%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31 (s, 1H), 6.86 (s, 1H), 4.48 (s, 2H), 3.57 (s, 2H), 3.12 (s, 3H), 2.98 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 165.5, 144.3, 132.0, 126.4, 124.3, 111.1, 41.9, 36.8, 36.1, 35.3; HRMS Calcd for $C_{12}H_{12}Cl_2N_2O_2$ [M+H$^+$]: 287.0354, Found: 287.0330.



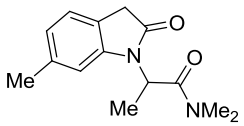
3s

3s was obtained as a white solid (28.4 mg, 51%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.87 (s, 1H), 6.57 (s, 1H), 4.50 (s, 2H), 3.89 (s, 3H), 3.84 (s, 3H), 3.54 (s, 2H), 3.12 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.7, 166.7, 149.7, 145.4, 138.5, 115.1, 109.9, 95.7, 57.2, 56.7, 42.6, 37.1, 36.1, 35.9; HRMS Calcd for $C_{14}H_{18}Cl_2N_2O_4$ [M+H$^+$]: 279.1345, Found: 279.1300.



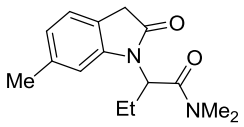
3t

3t was obtained as a white solid (25.8 mg, 48%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81-7.77 (m, 2H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.50-7.46 (m, 1H), 7.36-7.32 (m, 1H), 7.12 (d, *J* = 8.8 Hz, 1H), 4.59 (s, 2H), 3.84 (s, 2H), 3.13 (s, 3H), 2.97 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.9, 166.5, 142.1, 130.2, 129.8, 129.2, 129.0, 127.4, 124.1, 122.7, 117.7, 110.5, 42.0, 36.8, 36.0, 34.9; HRMS Calcd for $C_{16}H_{16}N_2O_2$ [M+H$^+$]: 269.1290, Found: 269.1262.



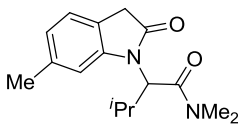
5a

5a was obtained as a white solid (35.6 mg, 72%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12 (d, *J* = 7.6 Hz, 1H), 7.01 (s, 1H), 6.85 (d, *J* = 7.2 Hz, 1H), 5.42 (q, *J* = 6.8 Hz, 1H), 3.51 (s, 2H), 2.94 (s, 3H), 2.90 (s, 3H), 2.34 (s, 3H), 1.51 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 169.4, 142.8, 138.6, 124.3, 123.4, 121.5, 111.9, 47.1, 37.2, 36.5, 35.2, 22.1, 14.9; HRMS Calcd for $C_{14}H_{18}N_2O_2$ [M+H$^+$]: 247.1447, Found: 247.1444.



5b

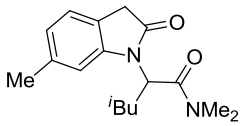
5b was obtained as a white solid (36.5 mg, 70%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (d, *J* = 7.6 Hz, 1H), 7.08 (s, 1H), 6.84 (d, *J* = 7.6 Hz, 1H), 5.23 – 5.19 (m, 1H), 3.60 – 3.46 (m, 2H), 2.95 (s, 3H), 2.93(s, 3H), 2.33 (s, 3H), 2.16 – 1.98 (m, 2H), 0.87 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.3, 169.0, 143.0, 138.5, 124.2, 123.3, 121.3, 112.3, 52.9, 37.2, 36.4, 35.1, 22.1, 22.0, 10.6; HRMS Calcd for $C_{15}H_{20}N_2O_2$ [M+H$^+$]: 261.1603, Found: 261.1599.



5c

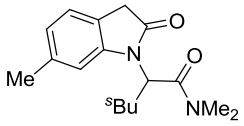
5c was obtained as a white solid (33.0 mg, 60%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (s, 1H), 7.10 (d, *J* = 7.6 Hz, 1H), 6.84 (d, *J* = 7.6 Hz, 1H), 4.94 (d, *J* = 10.8 Hz, 1H), 3.04 (s, 3H), 2.94 (s, 3H), 2.91 –

2.82 (m, 1H), 2.34 (s, 3H), 1.05 (d, J = 6.4 Hz, 3H), 0.75 (d, J = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.6, 168.4, 143.4, 138.4, 124.0, 123.3, 121.1, 113.2, 57.4, 37.5, 36.3, 35.1, 26.8, 22.2, 20.6, 18.4; HRMS Calcd for $C_{16}H_{22}N_2O_2$ [M+H$^+$]: 275.1760, Found: 275.1444.



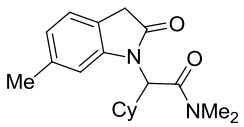
5d

5d was obtained as a white solid (31.8 mg, 55%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (d, J = 4.8 Hz, 1H), 7.10 (s, 1H), 6.84 (d, J = 7.6 Hz, 1H), 5.39 (t, J = 7.4 Hz, 1H), 3.51 (q, J = 16.9 Hz, 2H), 2.97 (s, 3H), 2.93 (s, 3H), 1.95 (t, J = 7.0 Hz, 2H), 1.49 – 1.41 (m, 1H), 0.98 (d, J = 6.8 Hz, 3H), 0.89 (d, J = 6.8 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 169.3, 143.1, 138.5, 124.2, 123.3, 121.4, 112.5, 49.7, 37.7, 37.3, 36.5, 35.2, 24.9, 23.4, 22.4, 22.1; HRMS Calcd for $C_{17}H_{24}N_2O_2$ [M+H$^+$]: 289.1916, Found: 289.1911.



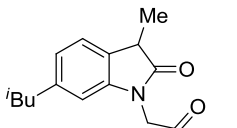
5e

5e was obtained as a white solid (31.2 mg, 54%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (s, 1H), 7.08 (d, J = 7.6 Hz, 1H), 6.83 (d, J = 7.6 Hz, 1H), 5.03 (d, J = 10.8 Hz, 1H), 3.59 – 3.43 (m, 2H), 3.06 (s, 3H), 2.93 (s, 3H), 2.70 – 2.61 (m, 1H), 2.34 (s, 3H), 1.21 – 1.14 (m, 1H), 1.03-0.92 (m, 1H), 0.98 (d, J = 6.4 Hz, 3H), 0.79 (t, J = 7.4 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.6, 168.5, 143.4, 138.3, 123.9, 123.3, 121.1, 113.3, 56.2, 37.6, 36.3, 35.1, 32.6, 24.4, 22.1, 16.5, 10.9; HRMS Calcd for $C_{17}H_{24}N_2O_2$ [M+H$^+$]: 289.1916, Found: 289.1905.



5f

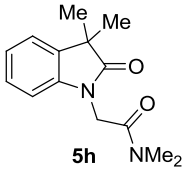
5f was obtained as a white solid (30.2 mg, 48%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 (s, 1H), 7.07 (d, J = 7.6 Hz, 1H), 6.81 (d, J = 7.6 Hz, 1H), 5.01 (d, J = 10.8 Hz, 1H), 3.57 – 3.41 (m, 2H), 3.01 (s, 3H), 2.90 (s, 3H), 2.57-2.49 (m, 1H), 2.33 (s, 3H), 1.91 (d, J = 12.0 Hz, 1H), 1.69 (d, J = 12.0 Hz, 1H), 1.61 (s, 2H), 1.34 – 1.24 (m, 2H), 1.11 (t, J = 9.4 Hz, 2H), 0.98 – 0.86 (m, 2H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 175.5, 168.2, 143.4, 138.3, 123.9, 123.2, 121.0, 113.0, 56.0, 37.4, 36.2, 35.5, 35.0, 31.1, 28.1, 26.4, 25.8, 25.7, 22.1; HRMS Calcd for $C_{19}H_{26}N_2O_2$ [M+H$^+$]:315.2073, Found: 315.2066.



5g

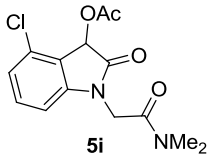
5g was obtained as a white solid (52.6 mg, 91%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12 (d, J = 7.6 Hz, 1H), 6.82 (d, J = 7.6 Hz, 1H), 6.62 (s, 1H), 4.55 – 4.43 (m, 2H), 3.10 (s, 3H), 2.96 (s, 3H), 2.45 (d, J =

7.2 Hz, 2H), 1.88 – 1.81 (m, 1H), 1.48 (d, *J* = 7.6 Hz, 3H), 0.89 (d, *J* = 6.8 Hz, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 179.3, 166.5, 143.3, 142.1, 127.9, 123.5, 123.2, 109.7, 45.9, 42.2, 40.4, 36.9, 36.0, 30.4, 22.6, 22.6, 15.8; HRMS Calcd for $C_{17}H_{24}N_2O_2$ [M+H$^+$]:289.1916.; Found: 289.1905.



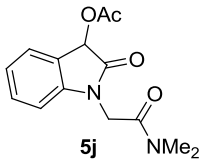
5h

5h was obtained as a white solid (45.4 mg, 92%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22 – 7.19 (m, 2H), 7.06-7.03 (m, 1H), 6.83 (d, *J* = 7.6 Hz, 1H), 4.51 (s, 2H), 3.09 (s, 3H), 2.96 (s, 3H), 1.41 (s, 6H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 181.6, 166.4, 142.1, 135.6, 127.9, 122.8, 122.4, 109.0, 44.3, 42.0, 36.8, 36.0, 24.7; HRMS Calcd for $C_{14}H_{18}N_2O_2$ [M+H$^+$]:247.1447, Found: 247.1434.



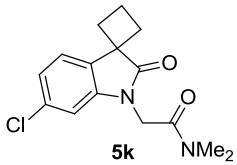
5i

5i was obtained as a white solid (52.2 mg, 84%) ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27-7.23 (m, 1H), 7.02 (d, *J* = 8.4 Hz, 1H), 6.76 (d, *J* = 8.0 Hz, 1H), 6.18 (s, 1H), 4.66 (d, *J* = 16.4 Hz, 1H), 4.34 (d, *J* = 16.4 Hz, 1H), 3.11 (s, 3H), 2.98 (s, 3H), 2.20 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 169.7, 165.7, 145.6, 131.7, 131.7, 121.6, 108.2, 69.0, 42.5, 36.9, 36.1, 20.5; HRMS Calcd for $C_{14}H_{15}ClN_2O_2$ [M+H$^+$]:311.0799, Found: 311.0790.



5j

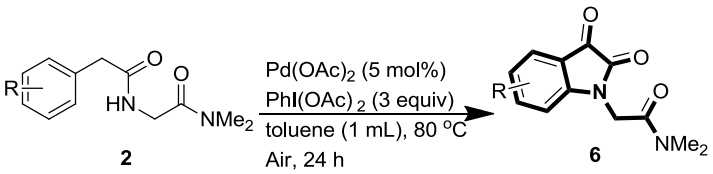
5j was obtained as a white solid (50.4 mg, 91%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 7.2 Hz, 1H), 7.32-7.28 (m, 1H), 7.07-7.03 (m, 1H), 6.84 (d, *J* = 7.6 Hz, 1H), 6.05 (s, 1H), 4.63 (d, *J* = 8.0 Hz, 1H), 4.39 (d, *J* = 8.0 Hz, 1H), 3.11 (s, 3H), 2.98 (s, 3H), 2.19 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.6, 170.5, 165.9, 144.0, 130.6, 125.8, 124.4, 123.5, 109.6, 70.0, 42.3, 36.9, 36.1, 21.0; HRMS Calcd for $C_{14}H_{16}N_2O_4$ [M+H$^+$]:277.1188, Found: 277.1182.



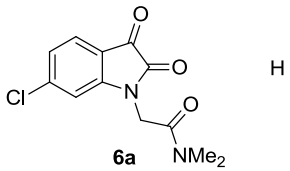
5k

5k was obtained as a white solid (53.9 mg, 92%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.38 (d, *J* = 8.0 Hz, 1H), 7.02 (d, *J* = 7.6 Hz, 1H), 6.73 (s, 1H), 4.43 (s, 2H), 3.08 (s, 3H), 2.94 (s, 3H), 2.68 – 2.58 (m, 2H), 2.38 – 2.27 (m, 3H), 2.26 – 2.13 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 180.4, 165.9, 143.6, 133.5, 132.5, 109.3, 47.9, 41.8, 36.7, 35.9, 31.6, 16.8; HRMS Calcd for $C_{14}H_{15}ClN_2O_2$ [M+H$^+$]: 293.1057, Found: 293.1047.

8. Synthesis of the isatin derivatives

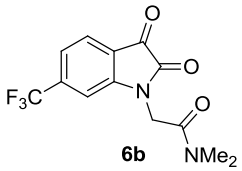


A mixture of acid derivatives (0.2 mmol, 1.0 equiv), $Pd(OAc)_2$ (0.01mmol, 5mol%), $PhI(OAc)_2$ (0.6 mmol, 3 equiv) and toluene (1 mL) in a 25 mL glass vial (under air atmosphere, sealed with PTFE cap) was heated at 80 ^oC for 24 hours. The reaction mixture was cooled to room temperature, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give the cyclized product.

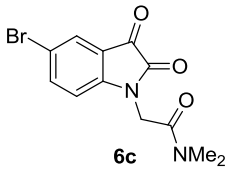


H

6a was obtained as a orange solid (48.1 mg, 82%). ^1H NMR (400 MHz, $CDCl_3$) δ 7.56 (d, J = 8.0 Hz, 1H), 7.10 (d, J = 8.4 Hz, 1H), 6.86 (s, 1H), 4.53 (s, 2H), 3.14 (s, 3H), 3.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 181.5, 164.9, 158.6, 152.4, 145.1, 126.6, 124.5, 116.3, 112.1, 41.9, 36.8, 36.2; HRMS Calcd for $C_{12}H_{11}ClN_2O_3$ [M+H^+]: 267.0536, Found: 267.0530.

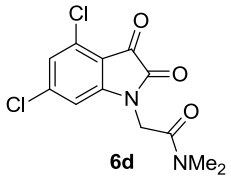


6b was obtained as a orange solid (40.3 mg, 67%). ^1H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, J = 7.6 Hz, 1H), 7.40 (d, J = 7.6 Hz, 1H), 7.05 (s, 1H), 4.58 (s, 2H), 3.16 (s, 3H), 3.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 182.3, 164.7, 157.9, 151.6, 139.2 (q, $J_{C\text{-}F}$ = 25.7 Hz), 125.9, 123.1 (q, $J_{C\text{-}F}$ = 234.0 Hz), 121.2 (q, $J_{C\text{-}F}$ = 1.3 Hz), 108.2 (q, $J_{C\text{-}F}$ = 4.0 Hz), 41.9, 36.8, 36.2; ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.64; HRMS Calcd for $C_{13}H_{11}F_3N_2O_3$ [M+H^+]: 301.0800, Found: 301.0806.



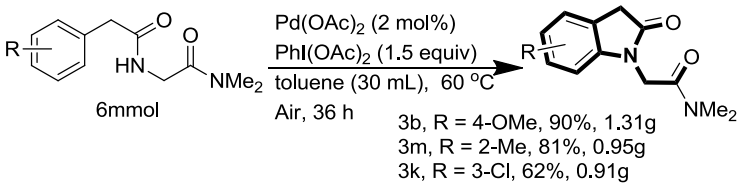
6c was obtained as a orange solid (49.7 mg, 80%). ^1H NMR (400 MHz, $CDCl_3$) δ 7.72 (s, 1H), 7.67 (d, J = 8.4 Hz, 1H), 6.79 (d, J = 8.4 Hz, 1H), 4.54 (s, 2H), 3.13 (s, 3H), 2.99 (s, 3H); ^{13}C NMR (101 MHz,

$CDCl_3$) δ 181.9, 165., 157.9, 150.1, 140.8, 128.3, 119.0, 117.0, 113.1, 41.9, 36.9, 36.1; HRMS 0 for $C_{12}H_{11}BrN_2O_3$ [M+H^+]: 311.0031, Found: 311.0021.



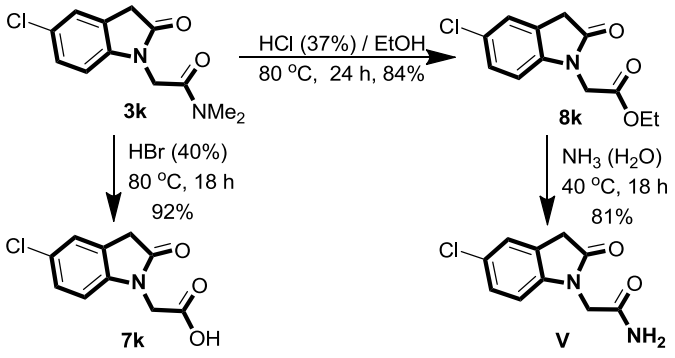
6d was obtained as a orange solid (36.1 mg, 60%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.08 (s, 1H), 6.76 (s, 1H), 4.53 (s, 2H), 3.14 (s, 3H), 3.00 (s, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 178.6, 164.6, 157.8, 153.0, 144.9, 134.8, 125.5, 113.6, 110.5, 42.0, 36.8, 36.2; HRMS Calcd for $C_{12}H_{10}Cl_2N_2O_3$ [M+H^+]: 301.0147, Found: 301.0141.

9. Gram scale of intramolecular γ-C(sp2)–H amination reaction



To a 50 mL sealed tube (under air atmosphere, sealed with PTFE cap) equipped with a magnetic stir bar was sequentially added phenylacetamide (6 mmol, 1.0 equiv), $Pd(OAc)_2$ (0.12 mmol, 2 mol%), $PhI(OAc)_2$ (9 mmol, 1.5 equiv), toluene (30 mL). The reaction was stirred for 48 h at 60 °C and cooled down to room temperature. The crude reaction mixture was diluted with EtOAc (30 mL) and filtered through a short pad of Celite. The sealed tube and Celite pad were washed with an additional 20 mL of EtOAc. The filtrate was concentrated *in vacuo*, and the resulting residue was purified by column chromatography on silica gel using EtOAc/PE as the eluent.

10. The transformation of directing group



10.1 2-(5-Chloro-2-oxo-2,3-dihydroindol-1-yl)acetic acid 7k

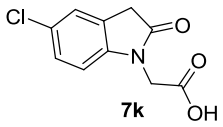
A mixture of the cyclized product **3k** (0.2 mmol, 1.0 equiv) and hydrobromide acid (1 mL) in a 25 mL glass vial (under air atmosphere, sealed with PTFE cap) was heated at 80 ^{o}C for 18 hours. The reaction mixture was cooled to room temperature. Water was added and the mixture was extracted with EtOAc. The combined organic layer was washed with water and brine, dried over Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give the product **7k** as a white solid in 92% yield.

10.2 2-(5-Chloro-2-oxo-2,3-dihydroindol-1-yl)acetic ether 8k

A mixture of the cyclized product **3k** (1 mmol, 1.0 equiv), hydrochloric acid (2.5 mL) and EtOH (2.5 mL) in a 25 mL glass vial (under air atmosphere, sealed with PTFE cap) was heated at 80 ^{o}C for 24 hours. The reaction mixture was cooled to room temperature. Water was added and the mixture was extracted with EtOAc. The combined organic layer was washed with water and brine, dried over Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give the product **8k** as a white solid in 84% yield.

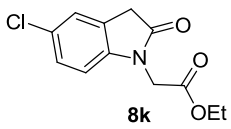
10.3 2-(5-Chloro-2-oxo-2,3-dihydroindol-1-yl)acetamide V

A mixture of the product **8k** (0.2 mmol, 1.0equiv) and aqueous ammonia 28% w/w (1 mL) in a 25 mL glass vial (under air atmosphere, sealed with PTFE cap). After stirring at 40 ^{o}C for 18 hours, Water was added and the mixture was extracted with EtOAc. The combined organic layer was washed with water and brine, dried over Na_2SO_4, and concentrated in vacuo. The resulting residue was purified by column chromatography on silica gel to give the product **V** as a white solid in 81% yield.



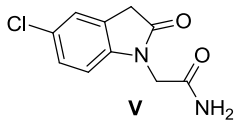
7k

7k was obtained as a white solid (41.4 mg, 92%). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.28 (s, 1H), 7.24 (d, J = 6.8 Hz, 1H), 6.76 (d, J = 6.8 Hz, 1H), 4.09 (s, 2H), 3.57 (s, 2H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 173.9, 144.1, 127.1, 126.7, 125.4, 124.1, 110.2, 69.8, 43.3, 35.2; HRMS Calcd for $C_{10}H_8ClNO_3$ [M+H^{+}]: 225.0193, Found: 225.0180.



8k

8k was obtained as a white solid (212.5 mg, 84%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (d, *J* = 7.2 Hz, 1H), 7.23 (s, 1H), 6.63 (d, *J* = 8.0 Hz, 1H), 4.44 (s, 2H), 4.22 (q, *J* = 7.2 Hz, 2H), 3.59 (s, 2H), 1.27 (t, *J* = 7.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 167.6, 142.6, 128.3, 128.1, 126.0, 125.3, 109.3, 62.1, 41.6, 35.6, 14.3; HRMS Calcd for $C_{12}H_{12}ClNO_3$ [M+H$^+$]: 253.0506, Found: 253.0516.



V

V was obtained as a white solid (36.3 mg, 81%). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.60 (s, 1H), 7.33 (s, 2H), 7.29 (d, *J* = 6.0 Hz, 1H) 7.23 (s, 1H), 6.85 (d, *J* = 8.0 Hz, 1H), 4.24 (s, 2H), 3.60 (s, 2H); ^{13}C NMR (101 MHz, DMSO-d_6) δ 174.1, 168.3, 143.5, 127.1, 126.9, 125.8, 124.3, 109.8, 42.1, 35.2; HRMS Calcd for $C_{10}H_9ClN_2O_2$ [M+H$^+$]: 224.0353, Found: 224.0350.

11. References

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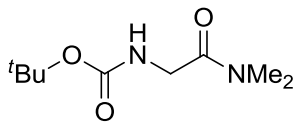
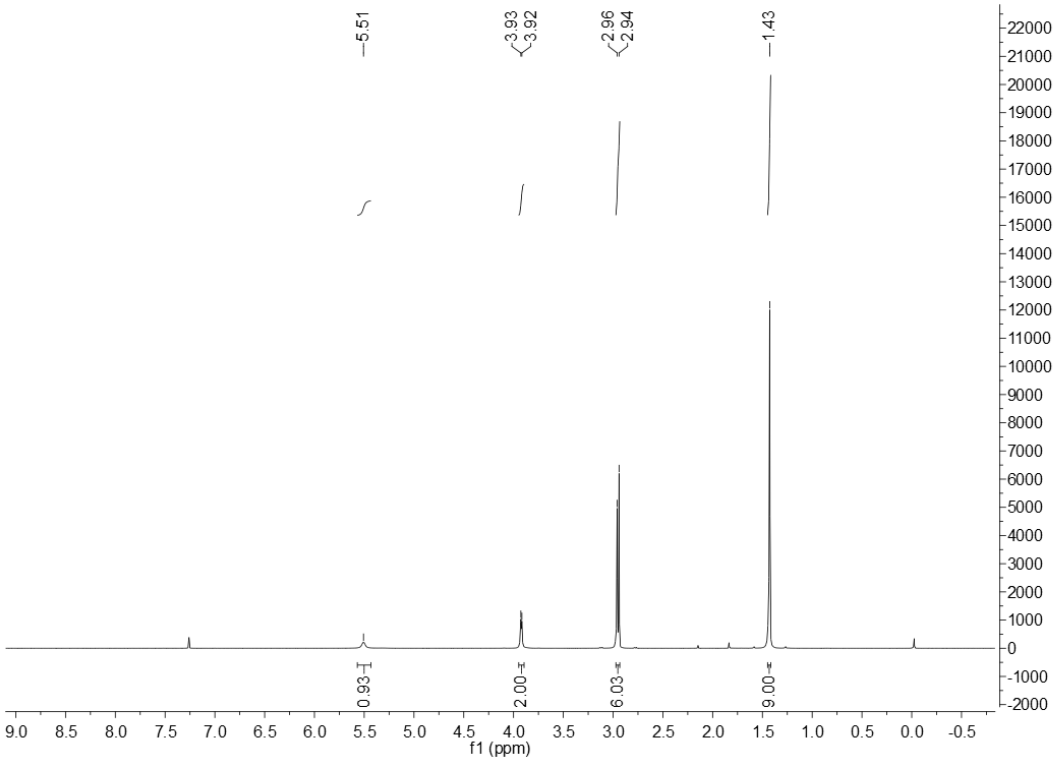
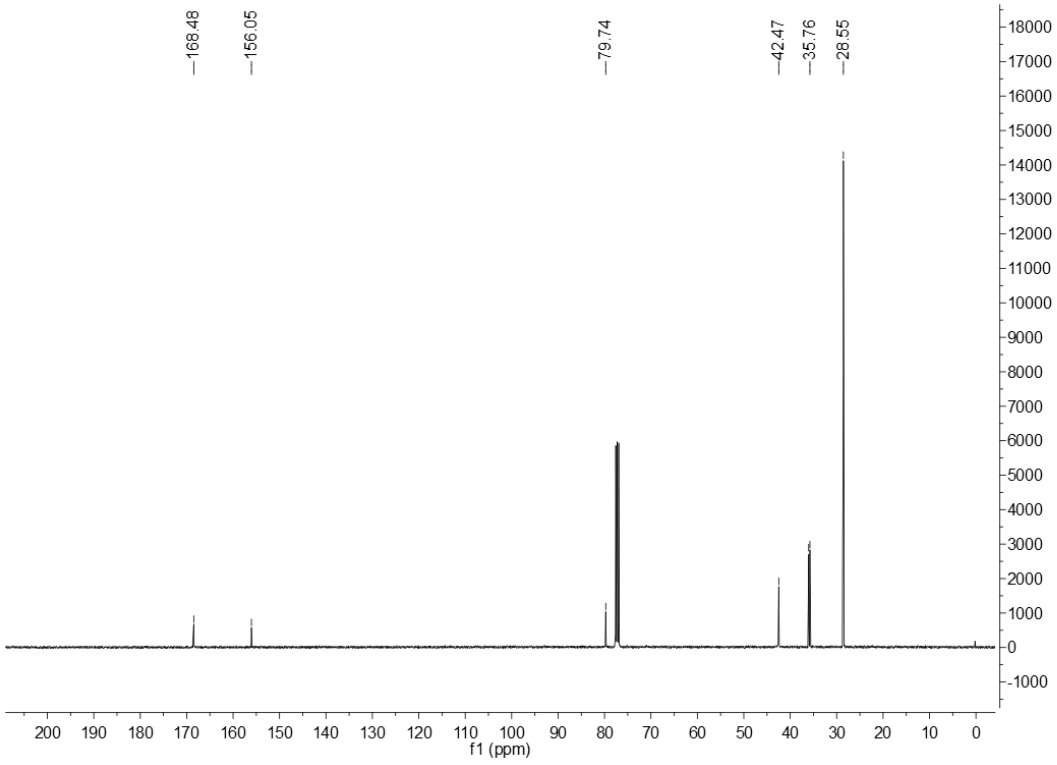
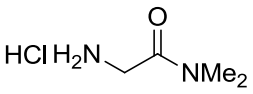
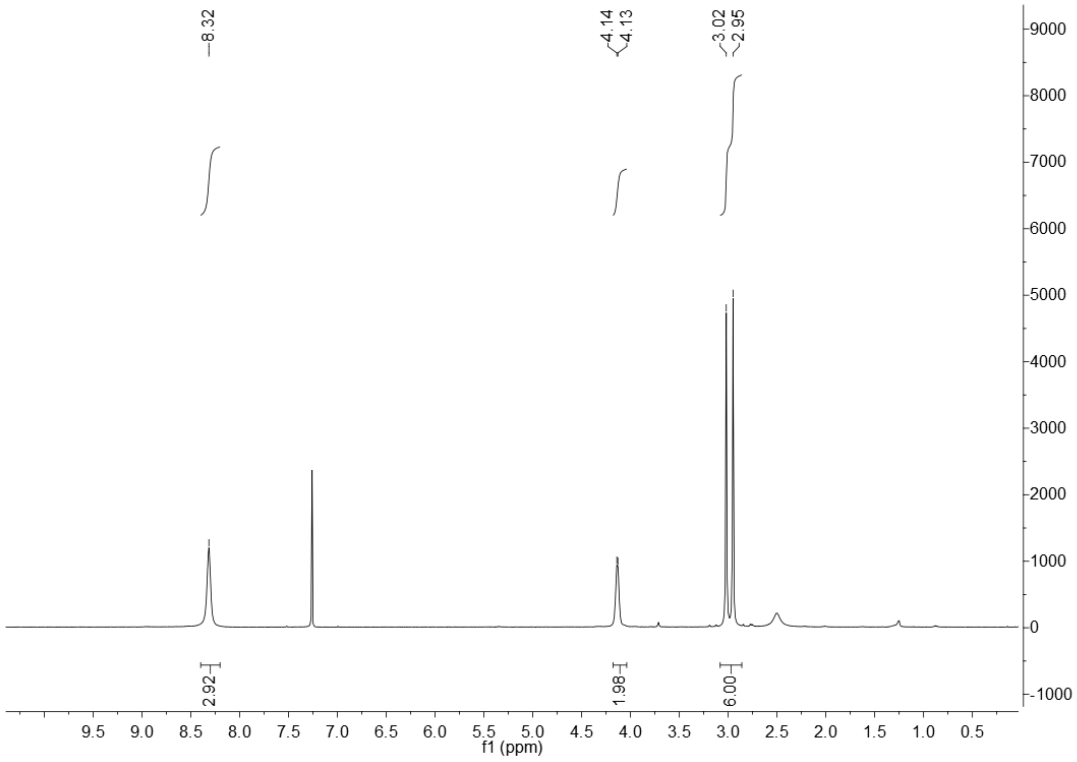
NMR spectra

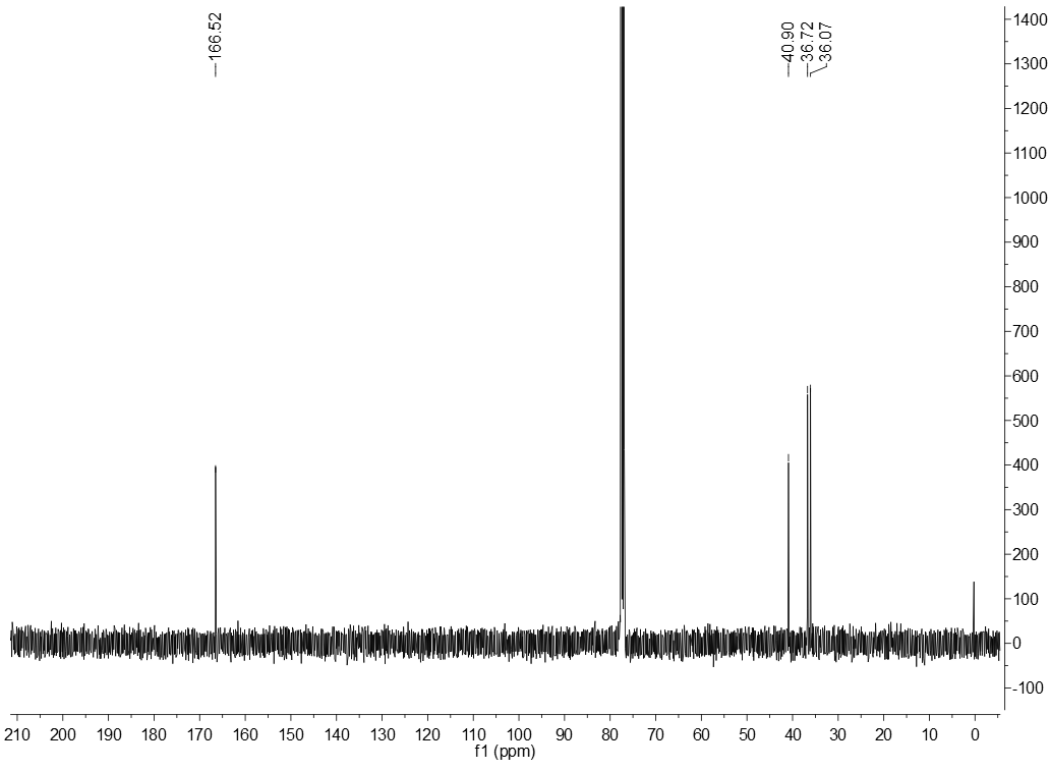


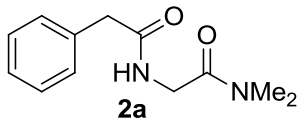

5.51
3.93
3.92
2.96
2.94
1.43
0.93
2.00
6.03
9.00
f1 (ppm)


168.48
156.05
79.74
42.47
35.76
28.55
f1 (ppm)

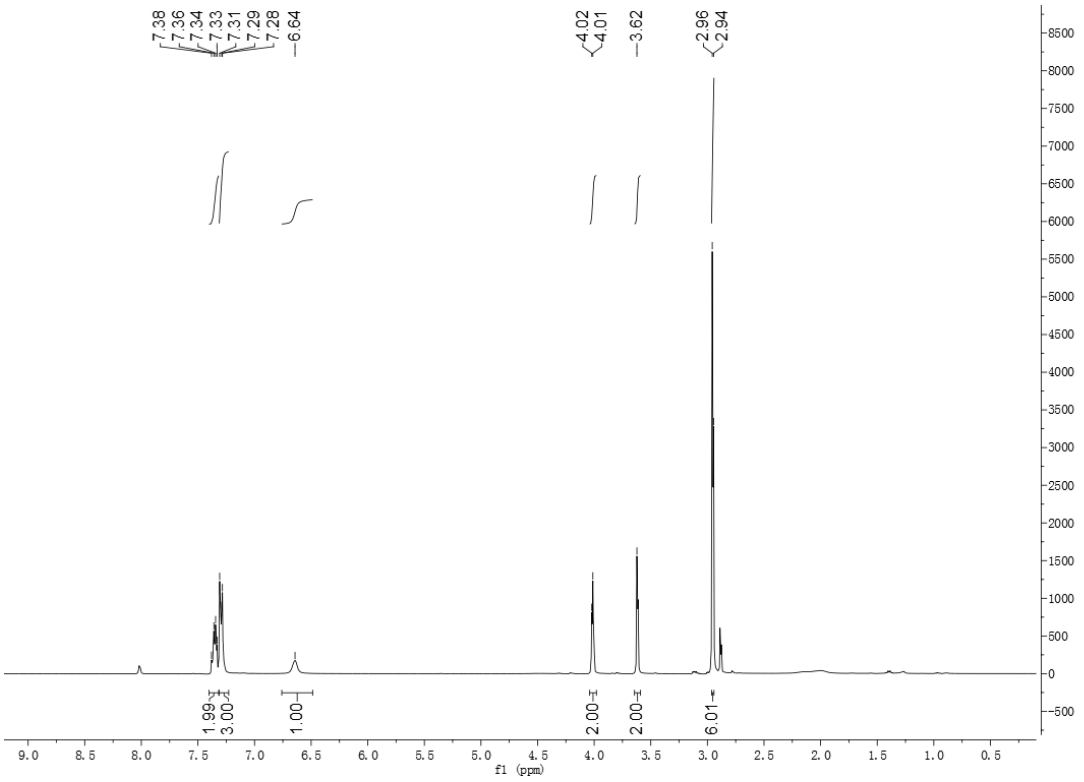

HCl
H2N
O
NMe2

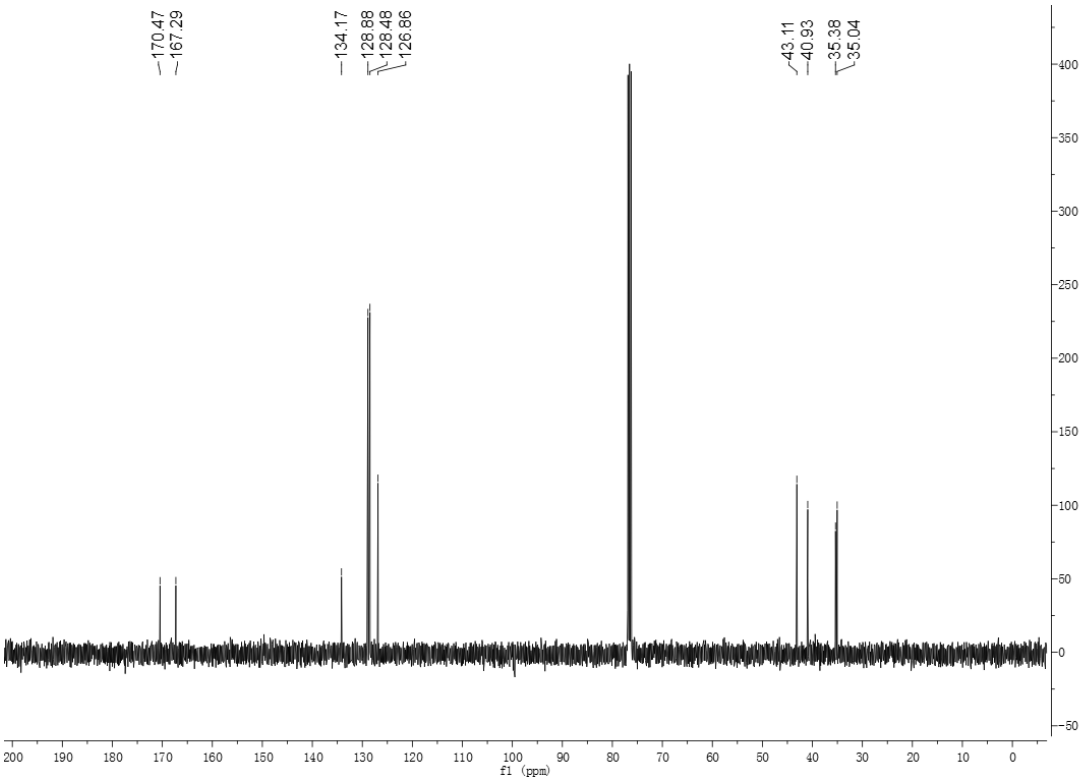

8.32
4.14
4.13
3.02
2.95
2.92
1.98
6.00
f1 (ppm)

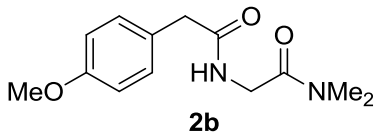

166.52
40.90
36.72
36.07
f1 (ppm)


O
O
HN
NMe2

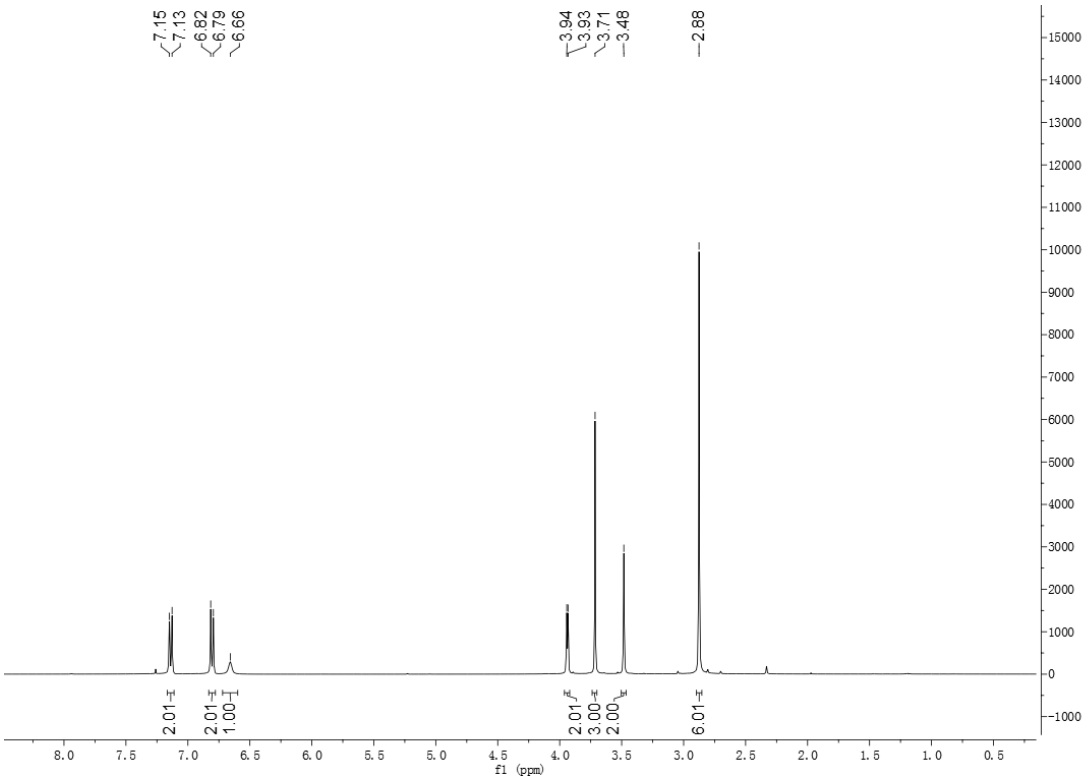
2a

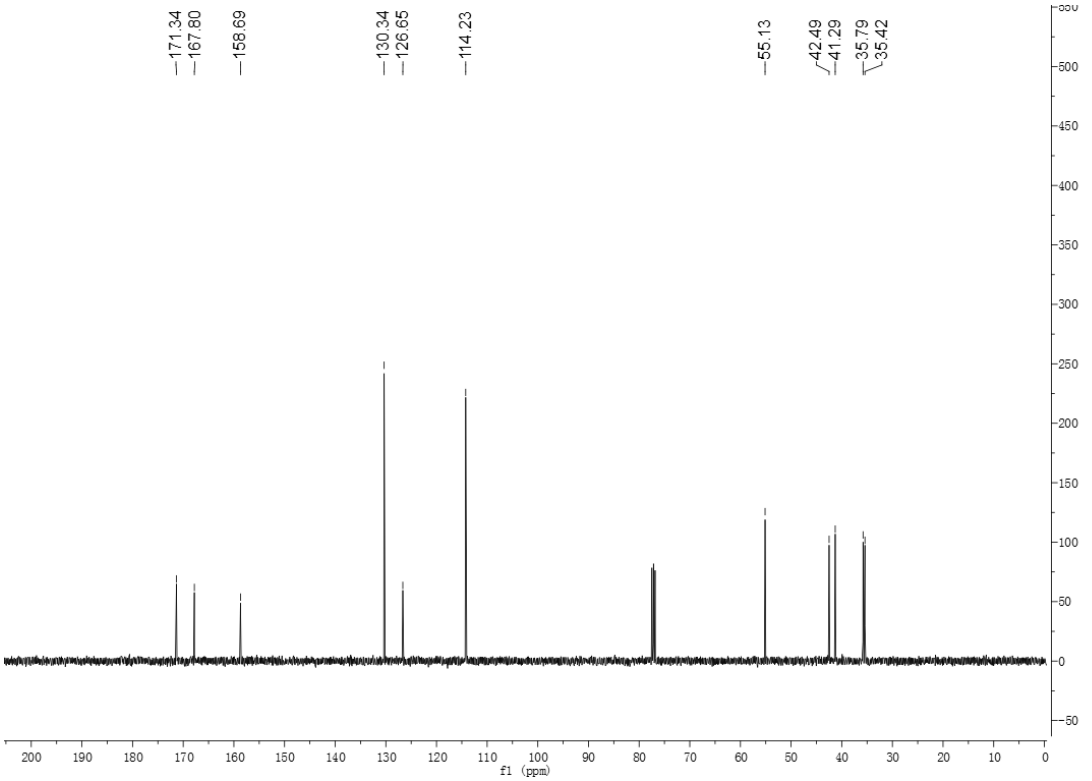

7.38
7.36
7.34
7.33
7.31
7.29
7.28
6.64
4.02
4.01
3.62
2.96
2.94
1.99
3.00
1.00
2.00
2.00
6.01
f1 (ppm)

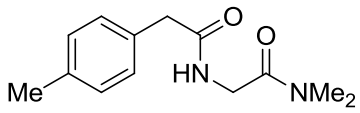

170.47
167.29
134.17
128.88
128.48
126.86
43.11
40.93
35.38
35.04
f1 (ppm)


O
O
HN
MeO
NMe2

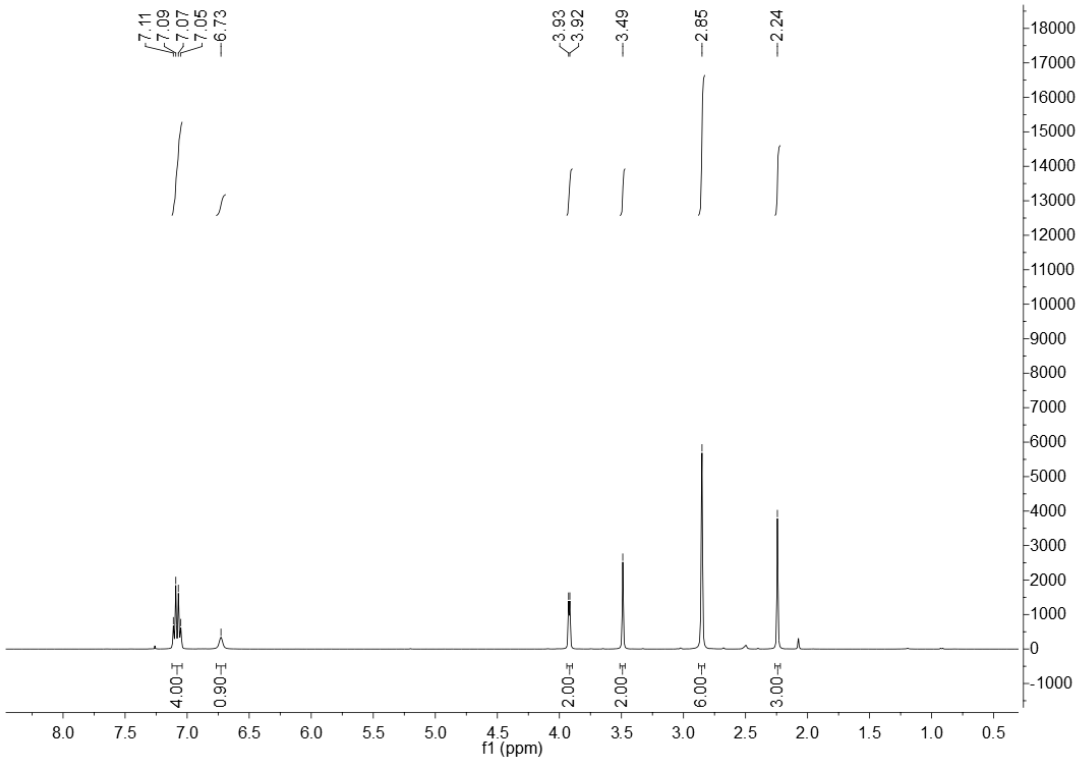
2b

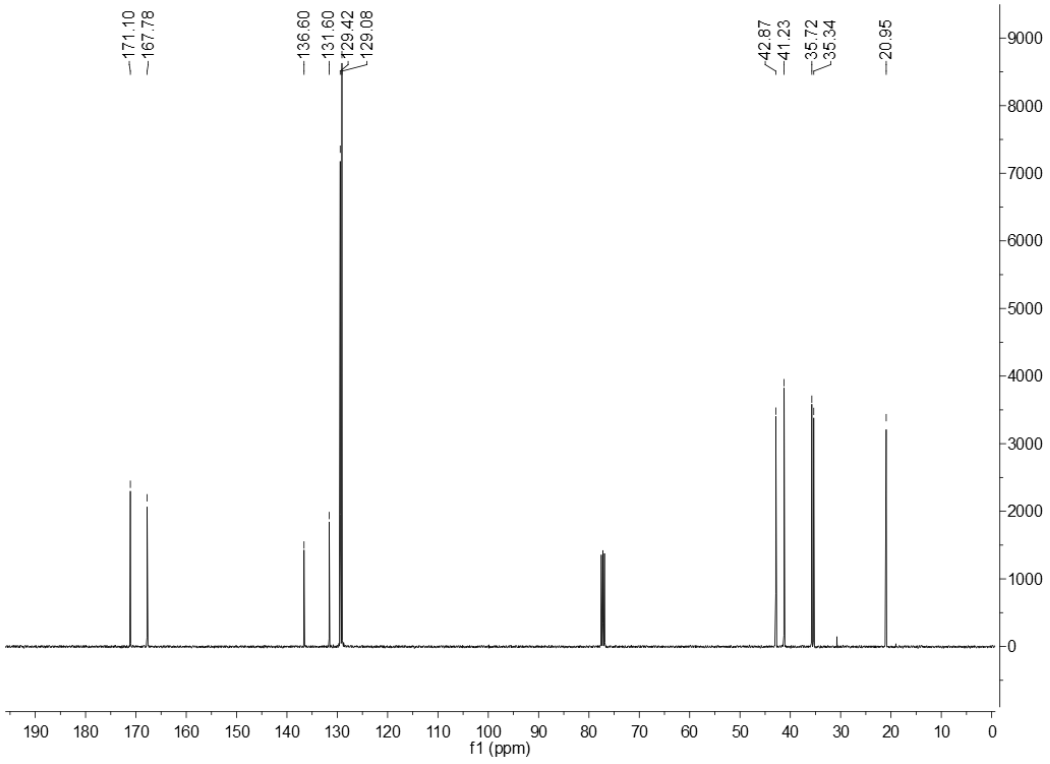

7.15
7.13
6.82
6.79
6.66
3.94
3.93
3.71
3.48
2.88
2.01
2.01
1.00
2.01
3.00
2.00
6.01
f1 (ppm)

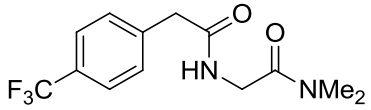

171.34
167.80
158.69
130.34
126.65
114.23
55.13
42.49
41.29
35.79
35.42
f1 (ppm)


O
O
HN
Me
NMe2

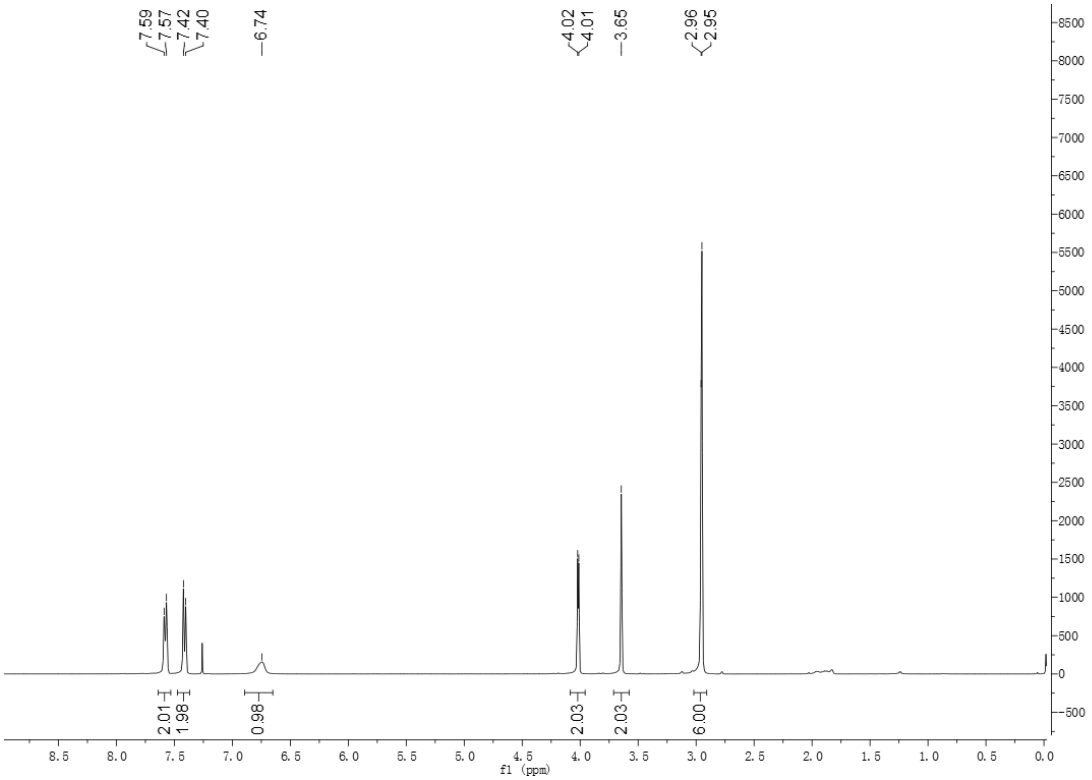
2c

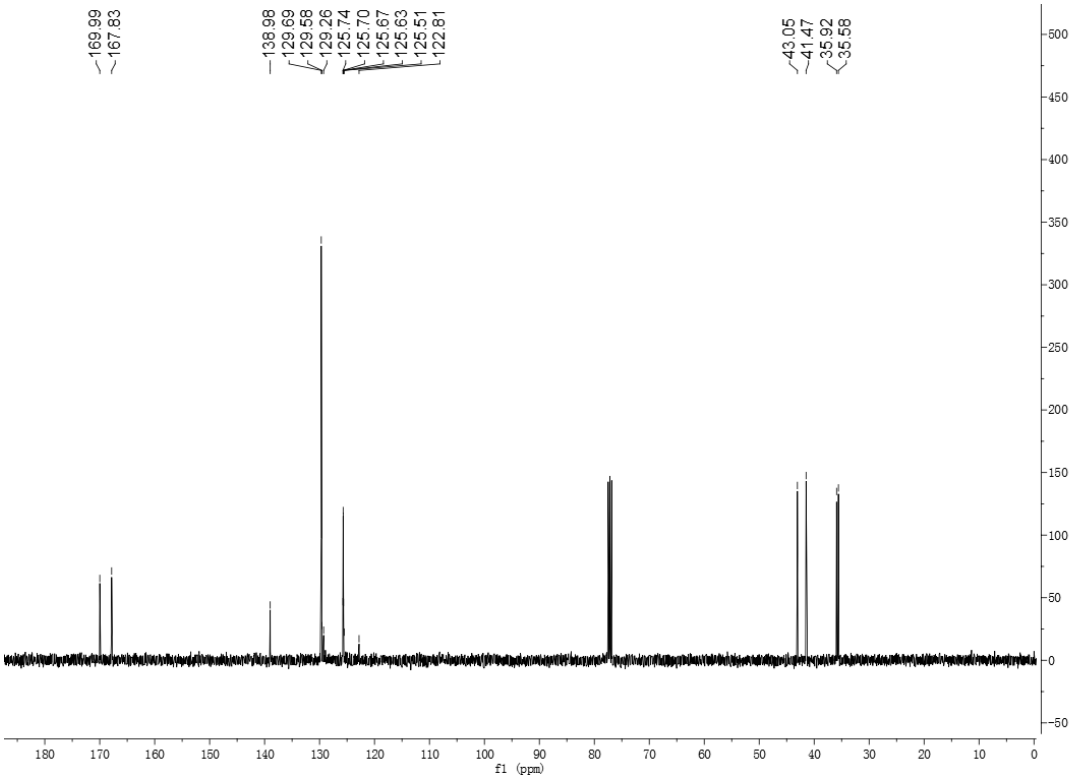

7.11
7.09
7.07
7.05
6.73
3.93
3.92
3.49
2.85
2.24
4.00
0.90
2.00
2.00
6.00
3.00
f1 (ppm)

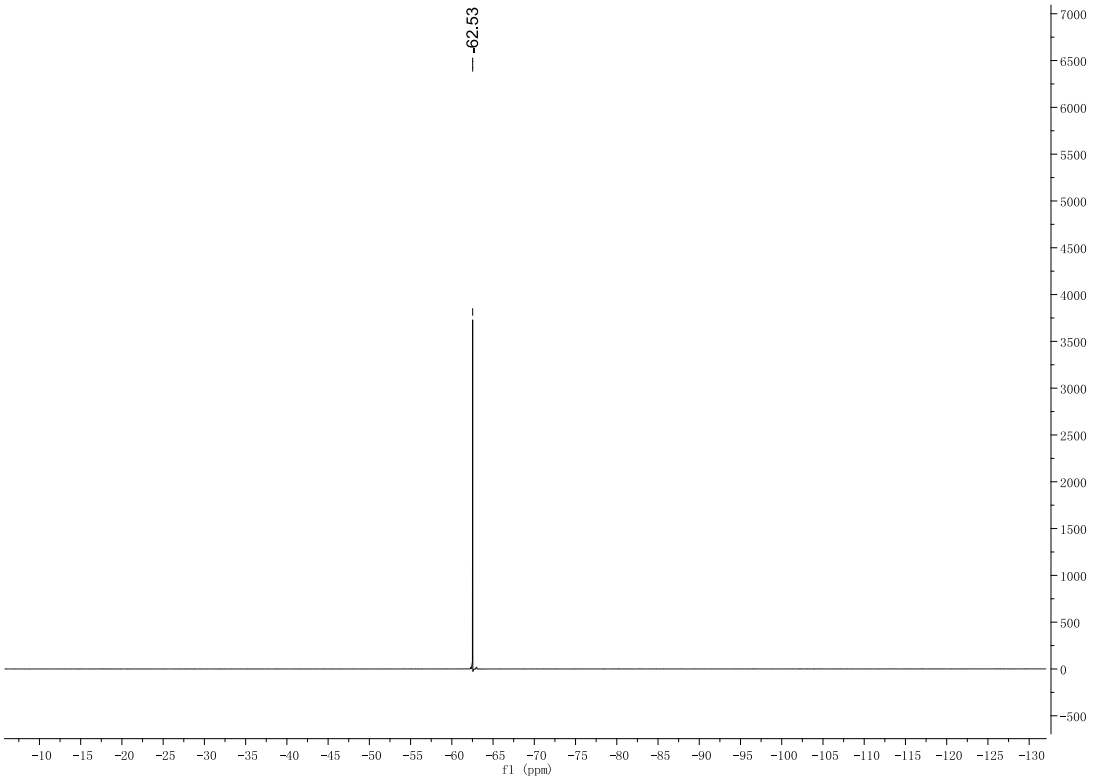

171.10
167.78
136.60
131.60
129.42
129.08
42.87
41.23
35.72
35.34
20.95
f1 (ppm)

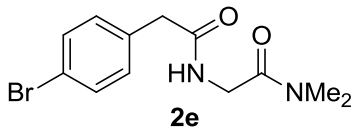

O
O
HN
F3C
NMe2

2d

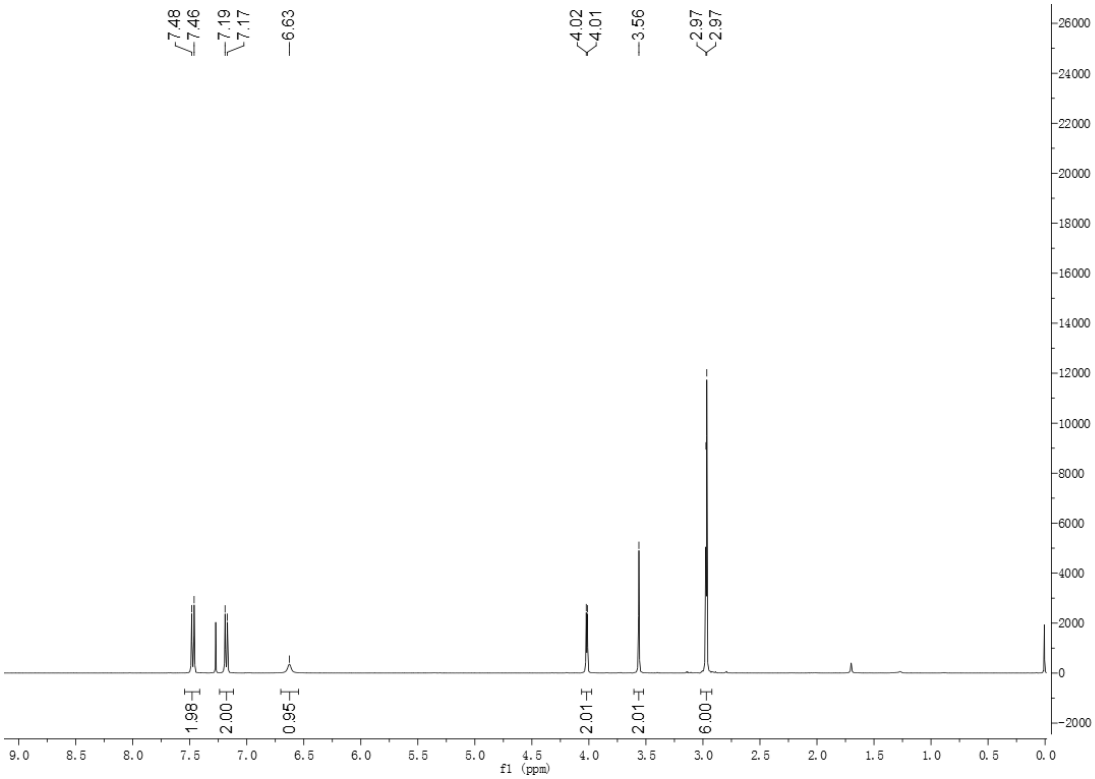

7.59
7.57
7.42
7.40
6.74
4.02
4.01
3.65
2.96
2.95
2.01
1.98
0.98
2.03
2.03
6.00
f1 (ppm)

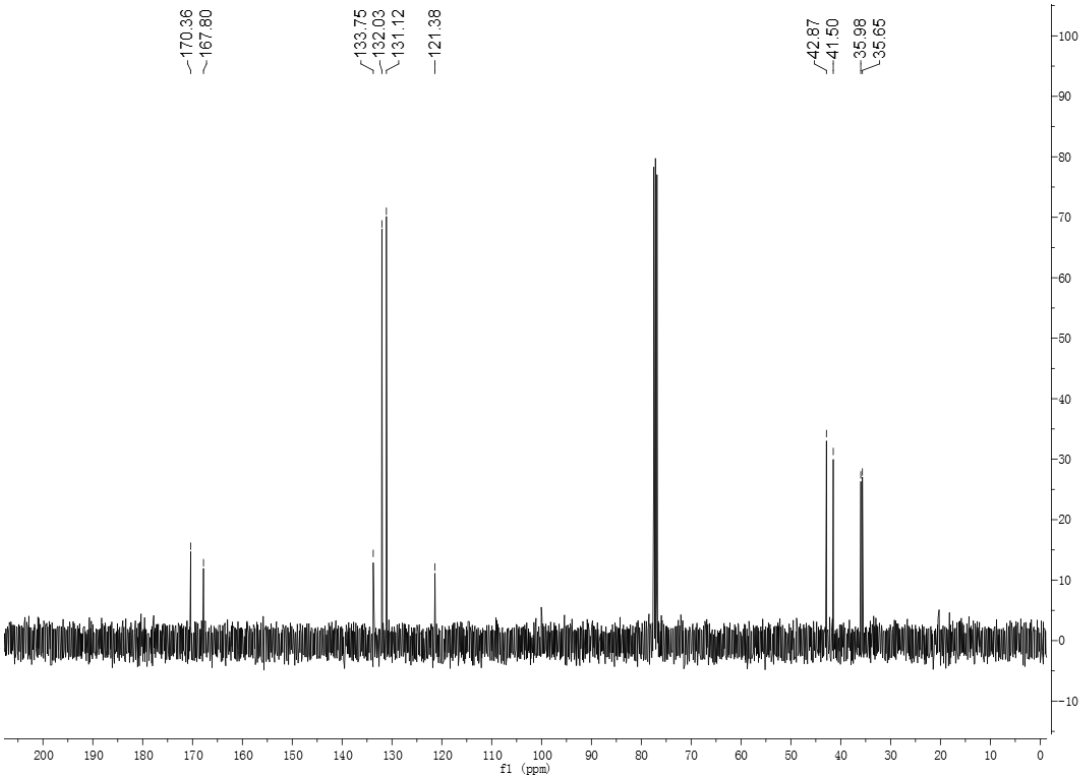

169.99
167.83
138.98
129.69
129.58
129.26
125.74
125.70
125.67
125.63
125.51
122.81
43.05
41.47
35.92
35.58
f1 (ppm)

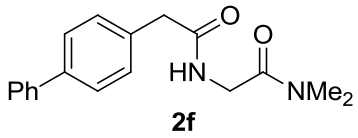

-62.53
f1 (ppm)


O
O
HN
Br
NMe2

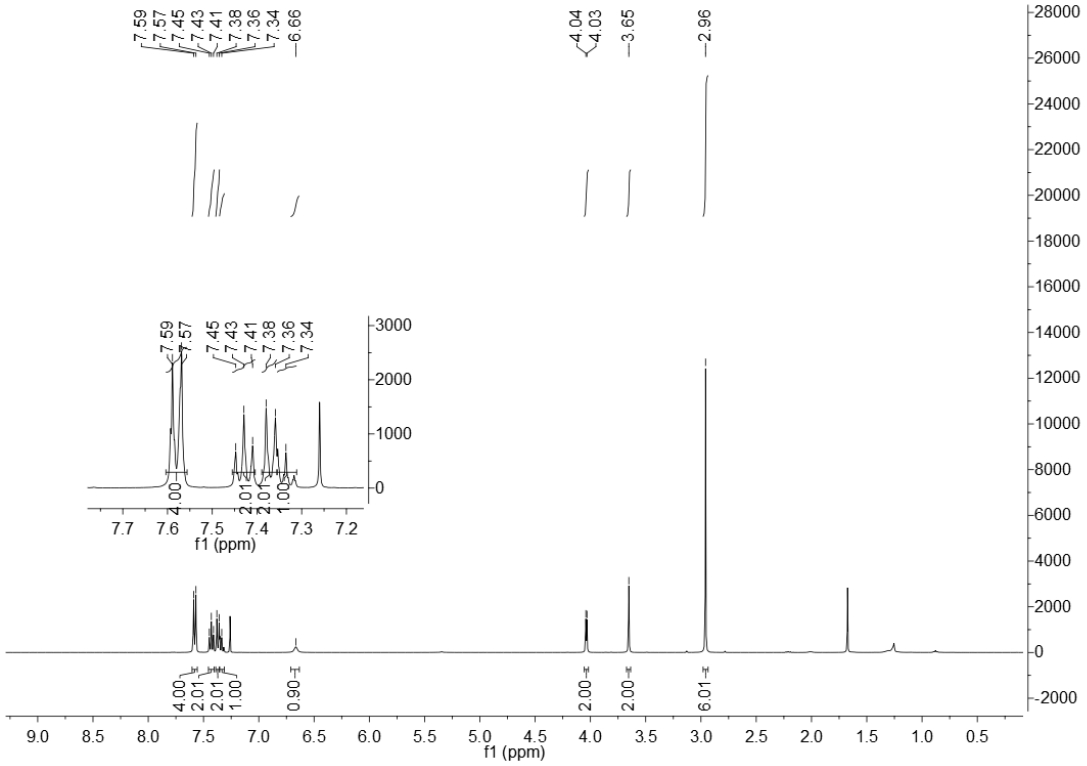
2e

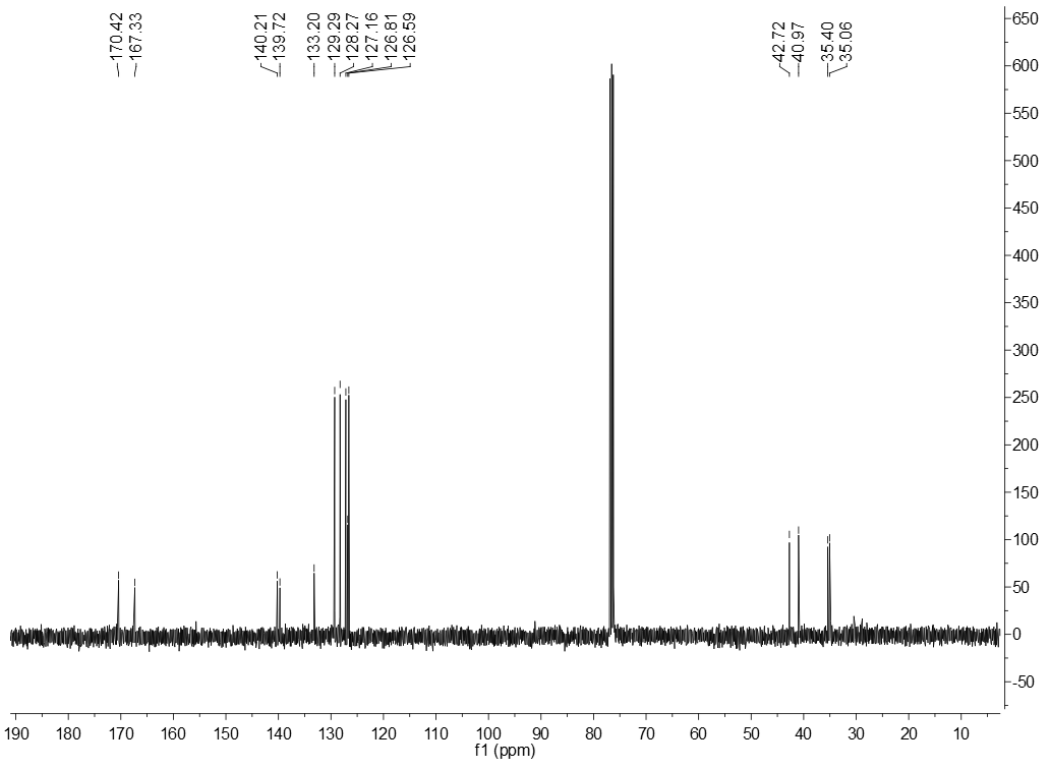

7.48
7.46
7.19
7.17
6.63
4.02
4.01
3.56
2.97
2.97
1.98
2.00
0.95
2.01
2.01
6.00
f1 (ppm)

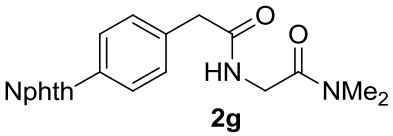

170.36
167.80
133.75
132.03
131.12
121.38
42.87
41.50
35.98
35.65
f1 (ppm)


O
O
HN
Ph
NMe2

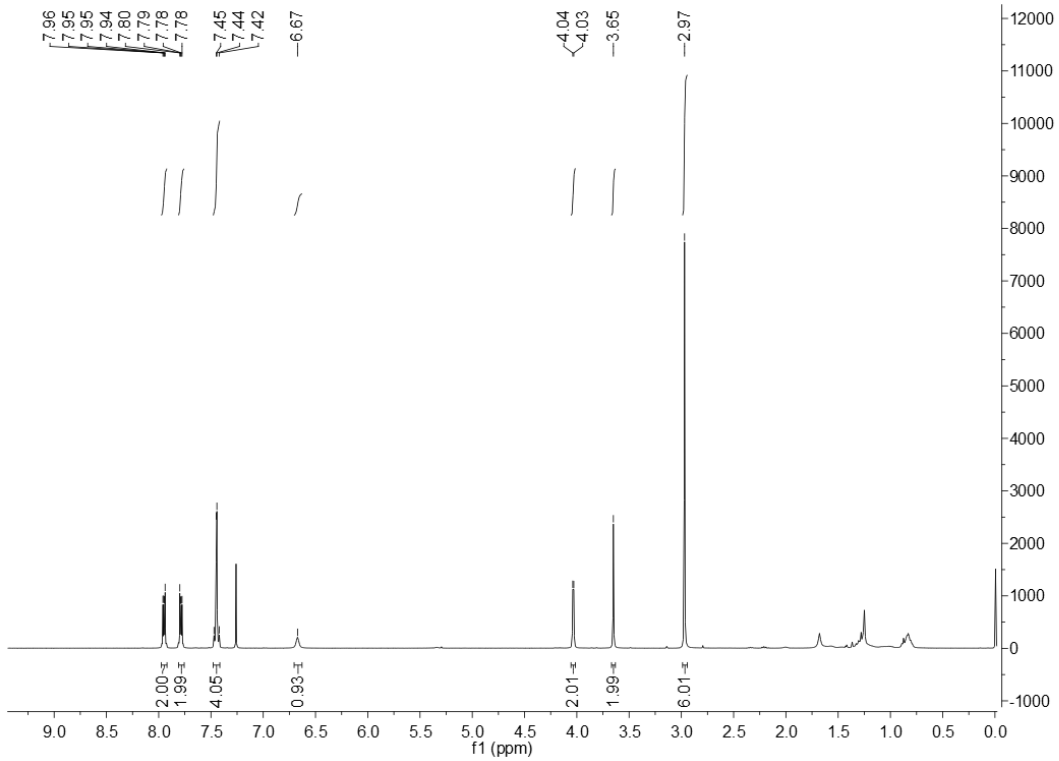
2f

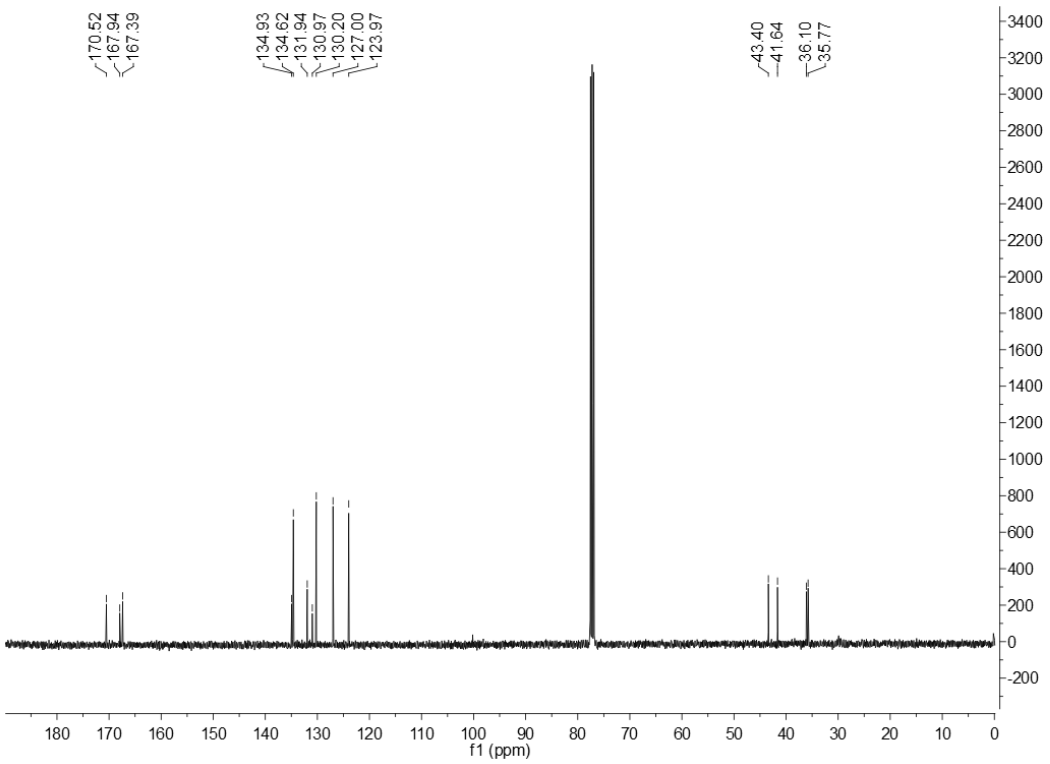

7.59
7.57
7.45
7.43
7.41
7.38
7.36
7.34
6.66
4.04
4.03
3.65
2.96
4.00
2.01
2.01
1.00
0.90
2.00
2.00
6.01
f1 (ppm)

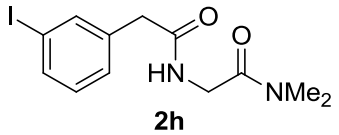

170.42
167.33
140.21
139.72
133.20
129.29
128.27
127.16
126.81
126.59
42.72
40.97
35.40
35.06
f1 (ppm)


Nphth
HN
O
O
NMe2

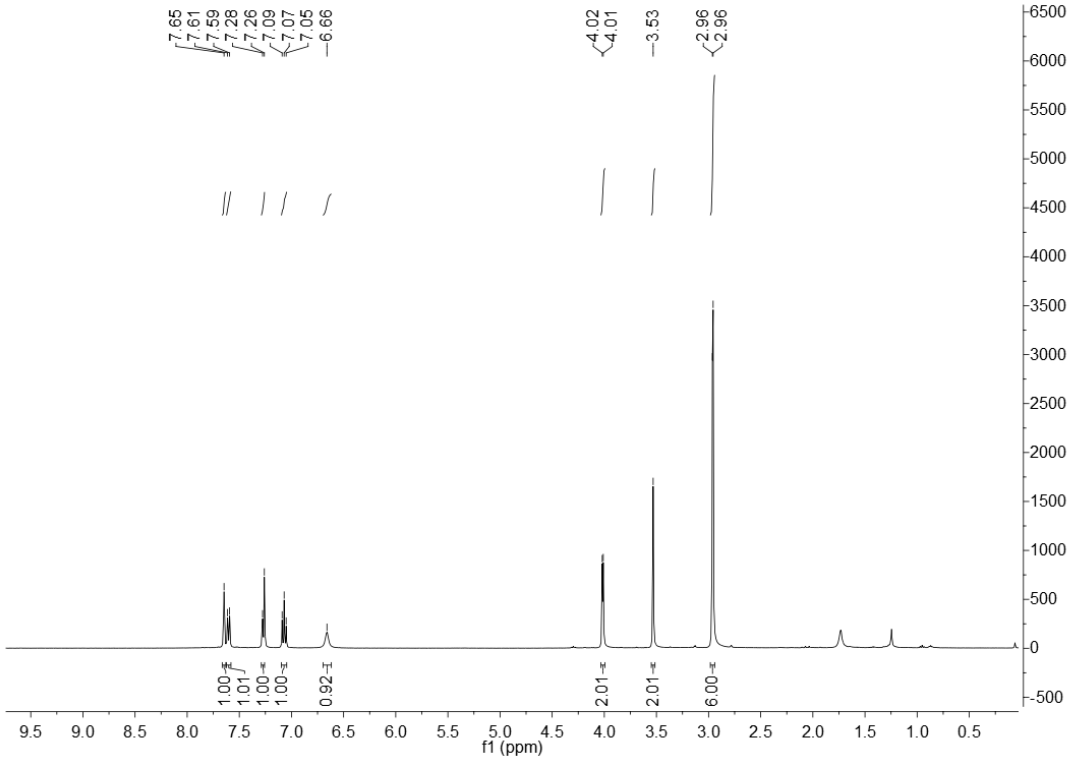
2g

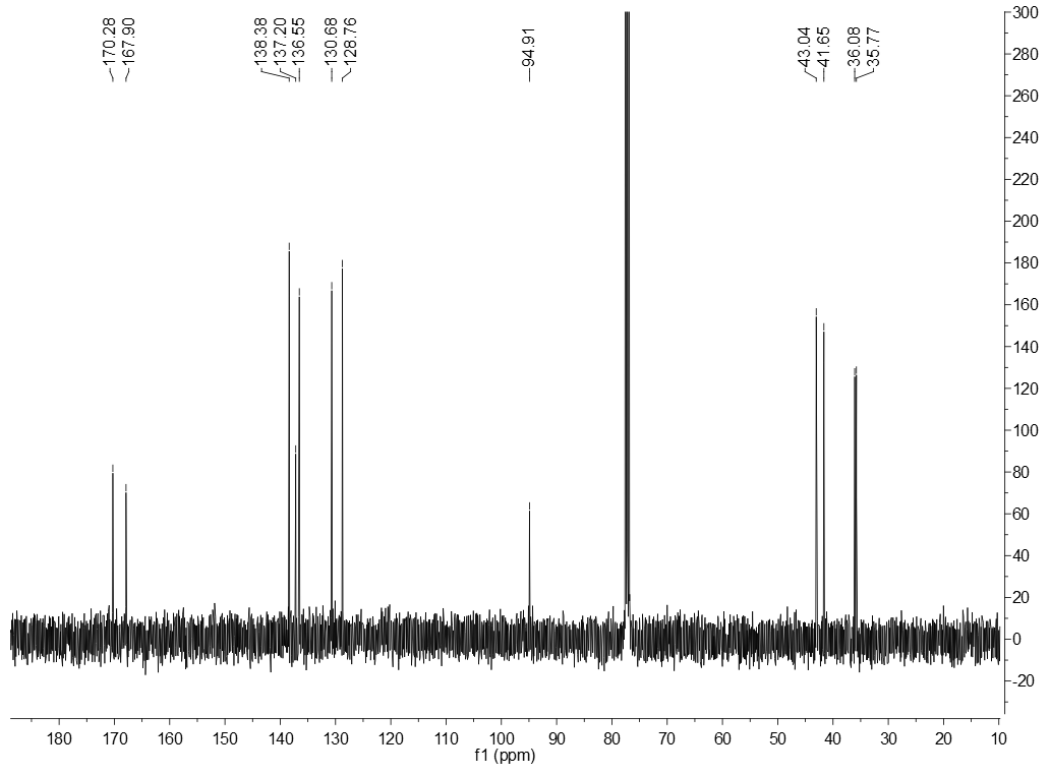

7.96
7.95
7.95
7.94
7.80
7.79
7.78
7.78
7.45
7.44
7.42
6.67
4.04
4.03
3.65
2.97
2.00
1.99
4.05
0.93
2.01
1.99
6.01
f1 (ppm)


170.52
167.94
167.39
134.93
134.62
131.94
130.97
130.20
127.00
123.97
43.40
41.64
36.10
35.77
f1 (ppm)


I
O
HN
O
NMe2

2h


7.65
7.61
7.59
7.28
7.26
7.09
7.07
7.05
6.66
4.02
4.01
3.53
2.96
2.96
1.00
1.01
1.00
1.00
0.92
2.01
2.01
6.00
f1 (ppm)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138.38
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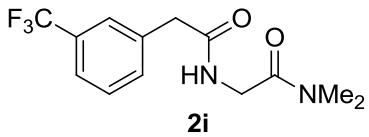
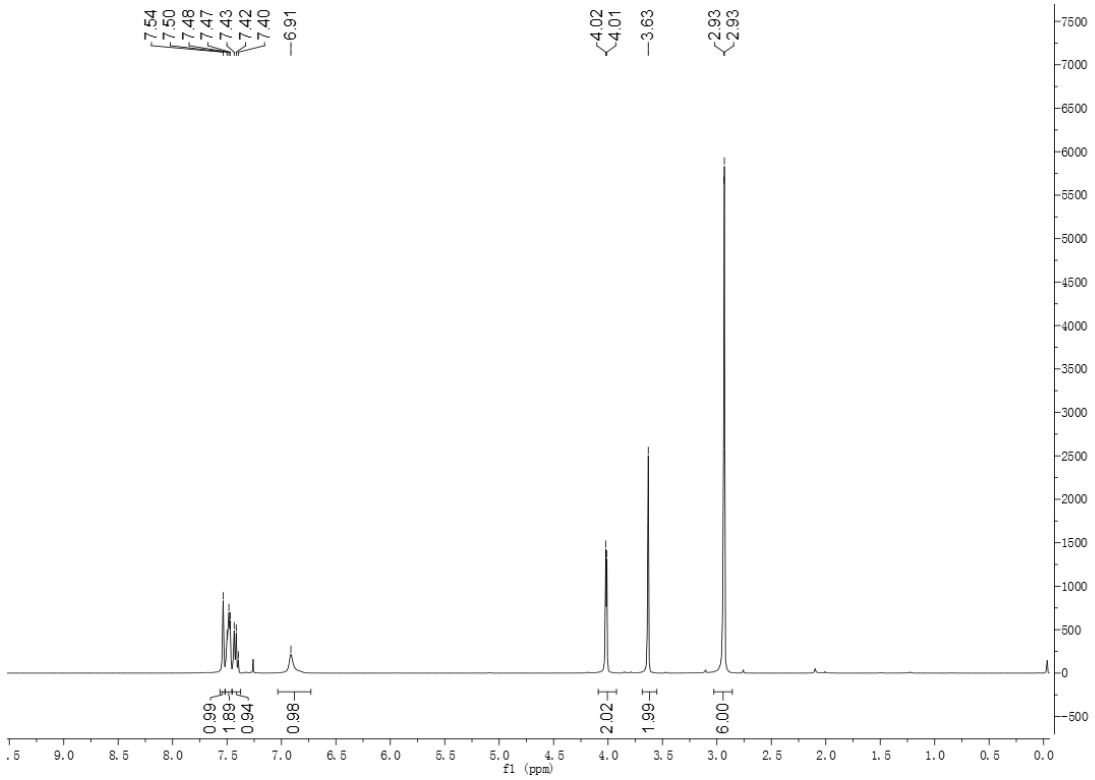
136.55
130.68
128.76
94.91
43.04
41.65
36.08
35.77
f1 (ppm)


F3C
O
HN
O
NMe2

2i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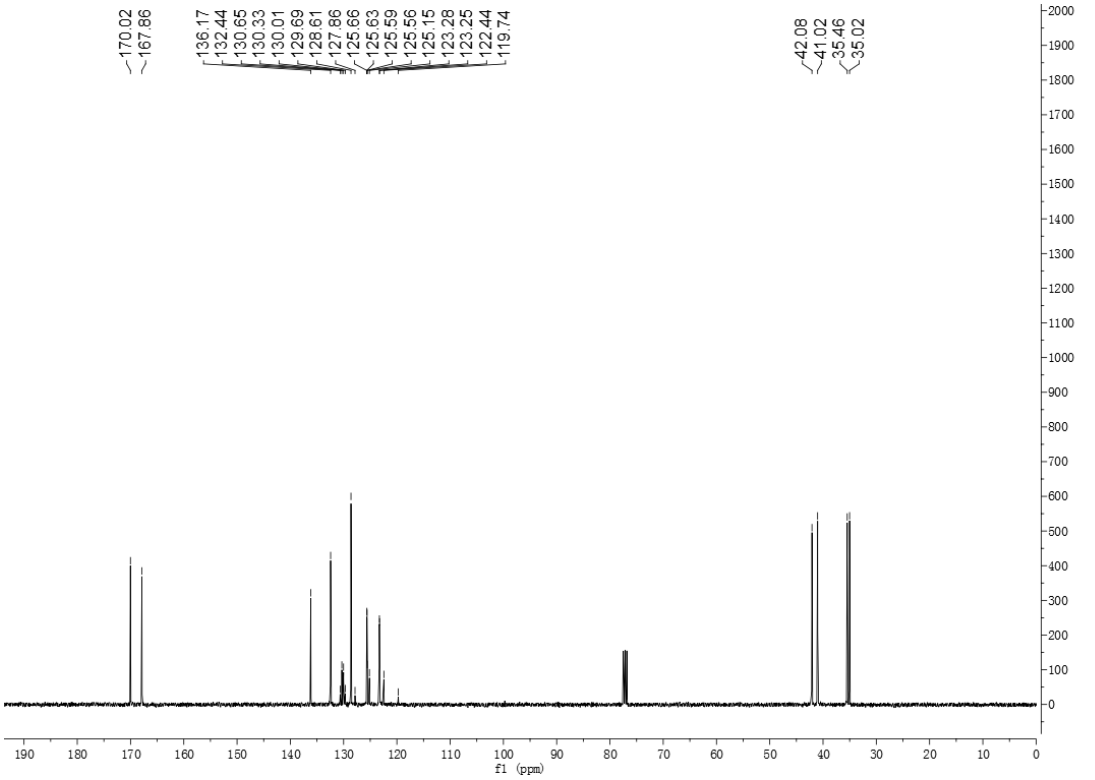
7.50
7.48
7.47
7.43
7.42
7.40
6.91
4.02
4.01
3.63
2.93
2.93
0.99
1.89
0.94
0.98
2.02
1.99
6.00
f1 (ppm)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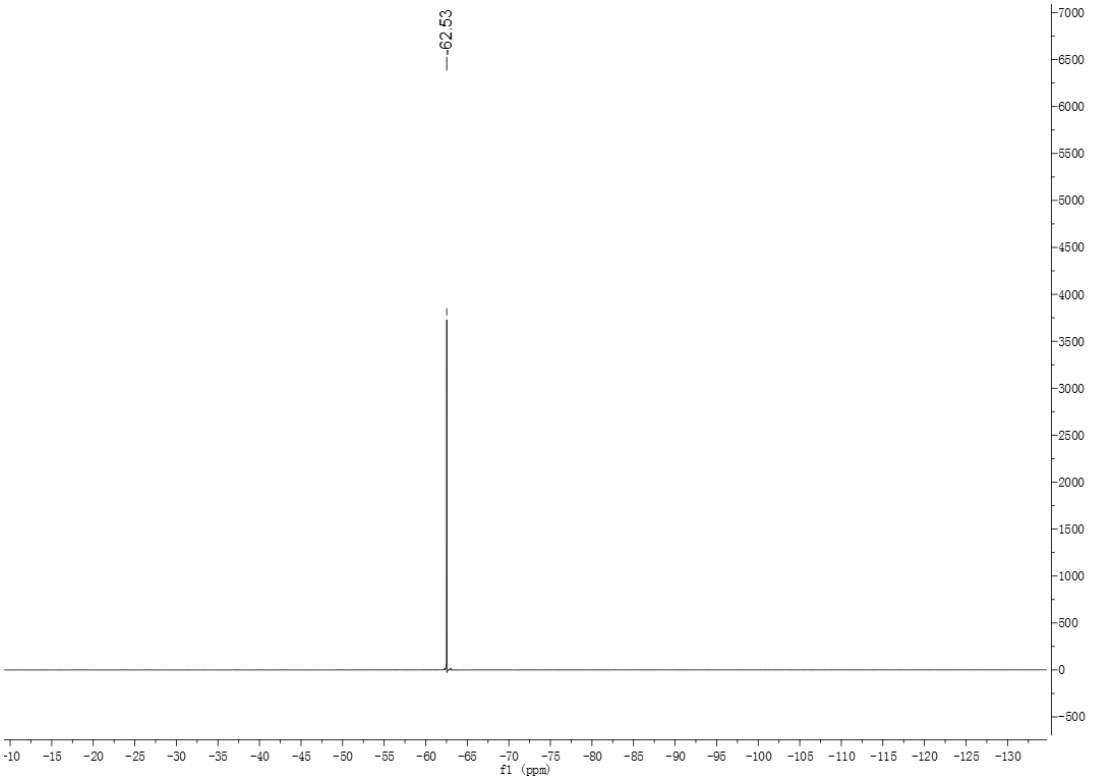
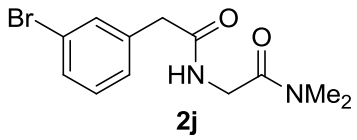
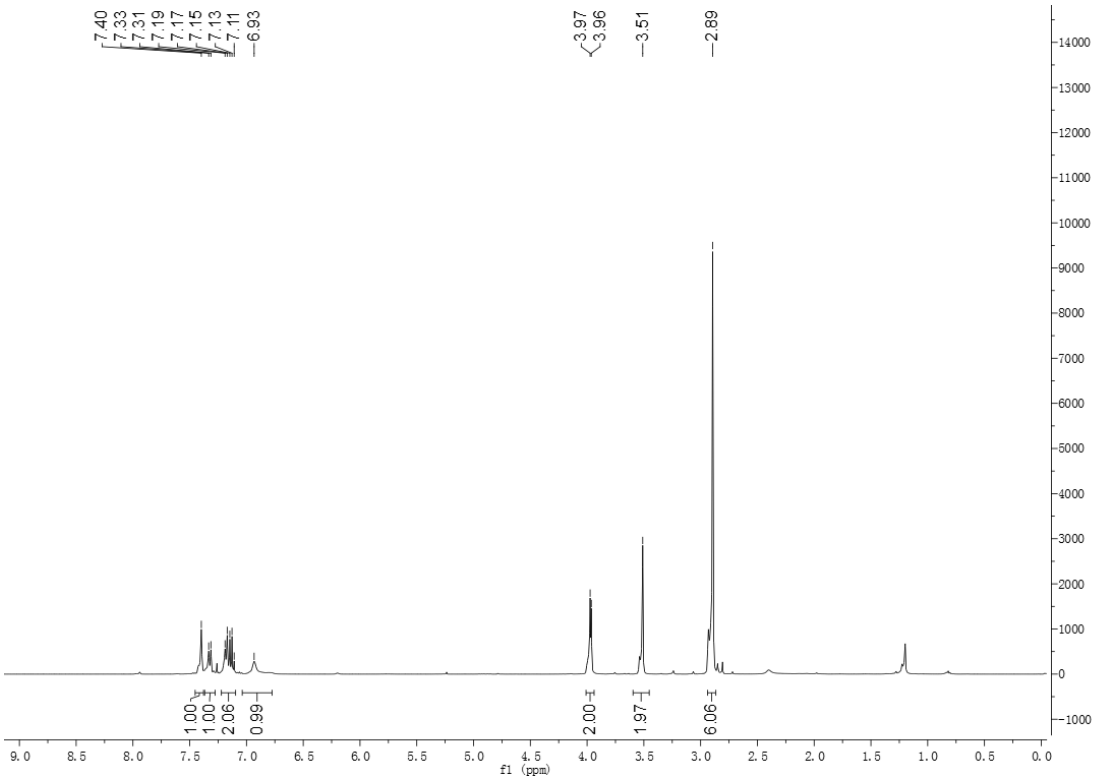
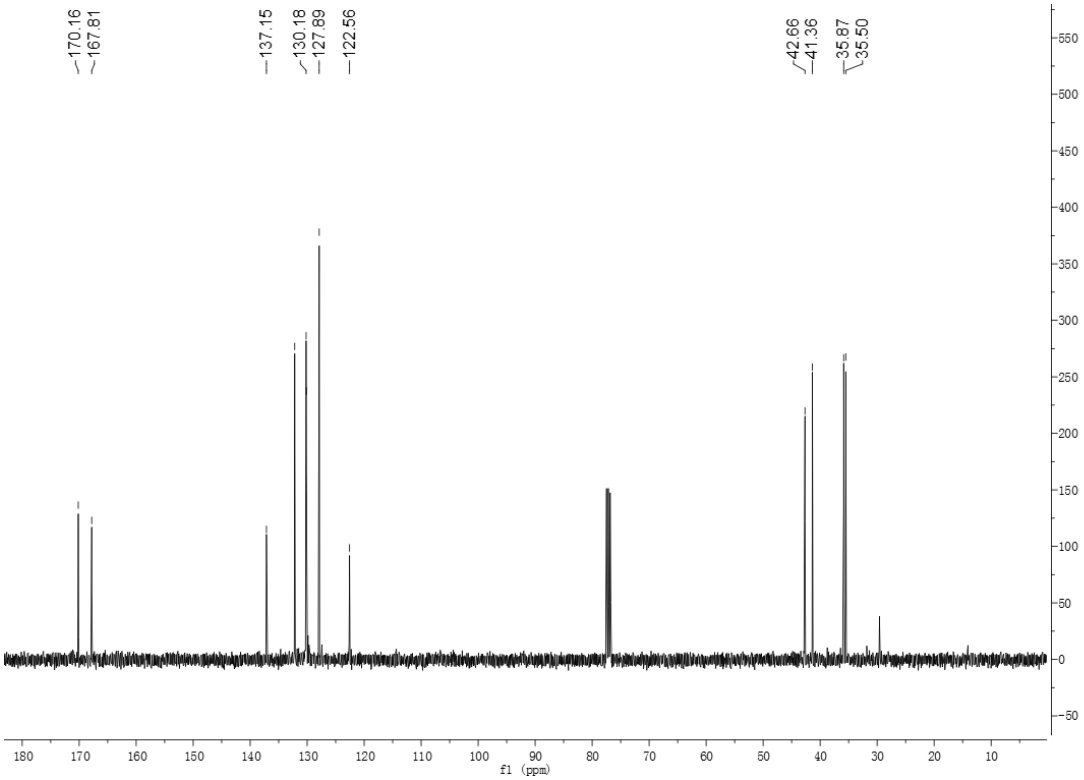
167.86
136.17
132.44
130.65
130.33
130.01
129.69
128.61
127.86
125.66
125.63
125.59
125.56
125.15
123.28
123.25
122.44
119.74
42.08
41.02
35.46
35.02
f1 (ppm)


-62.53
f1 (ppm)


Br
O
HN
O
NMe2

2j


7.40
7.33
7.31
7.19
7.17
7.15
7.13
7.11
6.93
3.97
3.96
3.51
2.89
1.00
1.00
2.06
0.99
2.00
1.97
6.06
f1 (ppm)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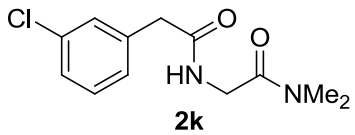
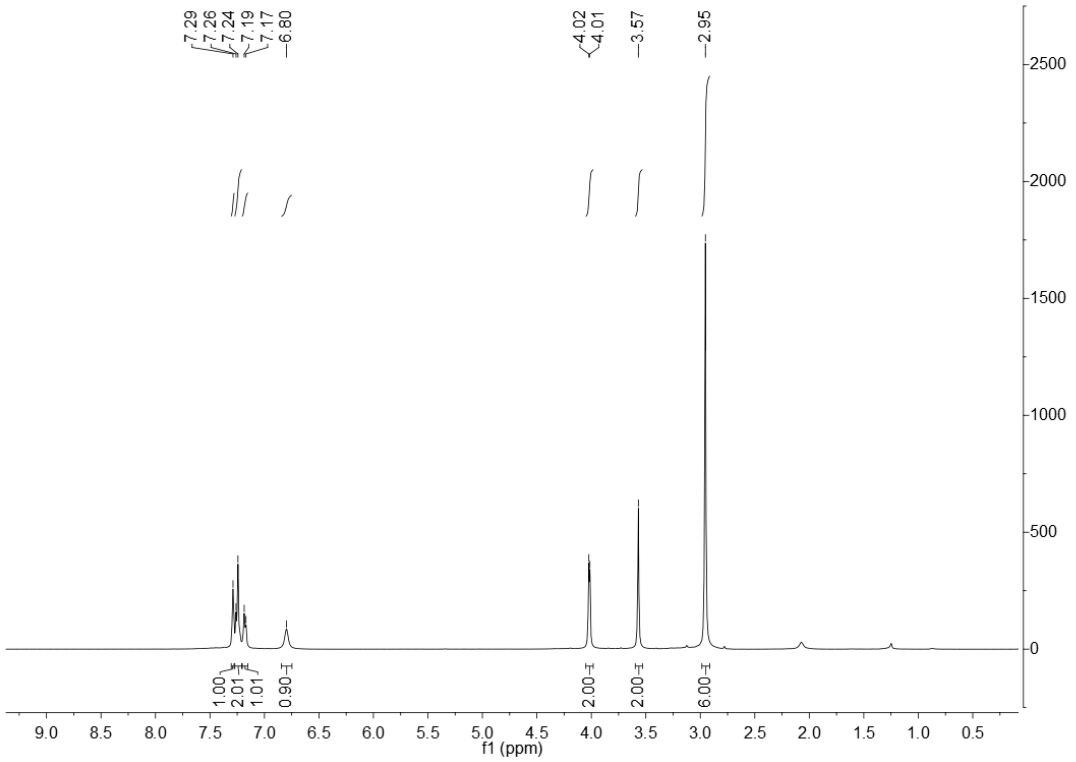
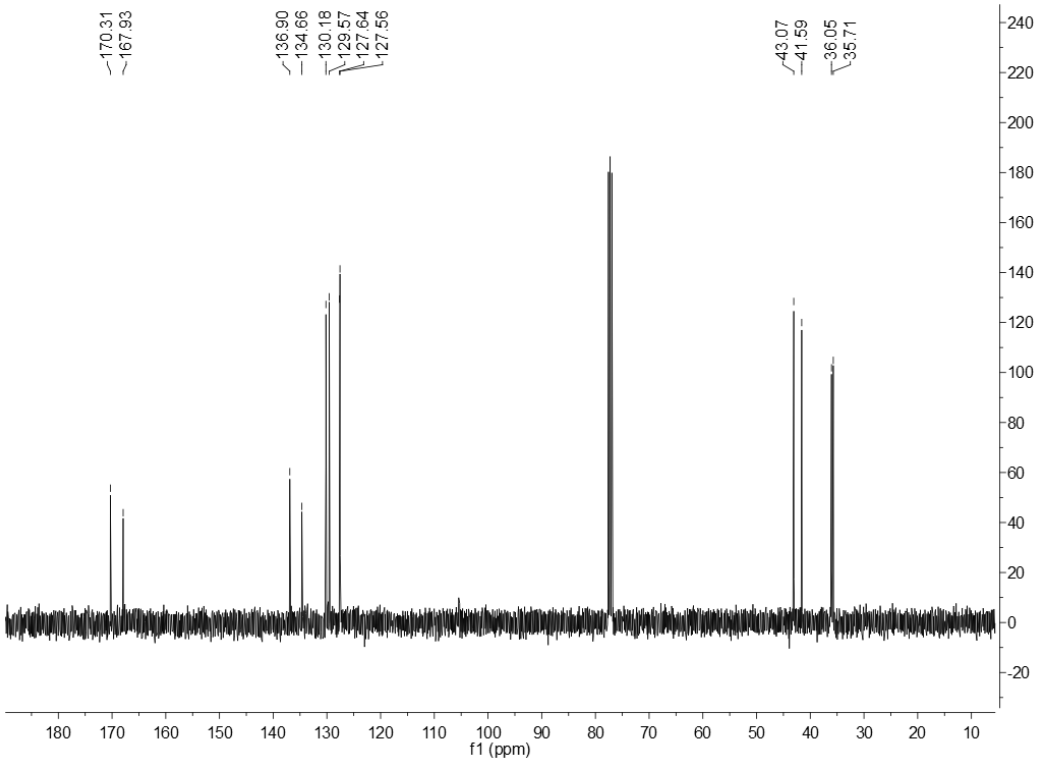
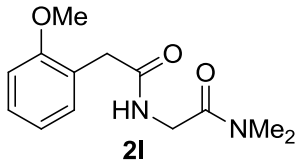
130.18
127.89
122.56
42.66
41.36
35.87
35.50
f1 (ppm)


Cl
O
O
HN
NMe2

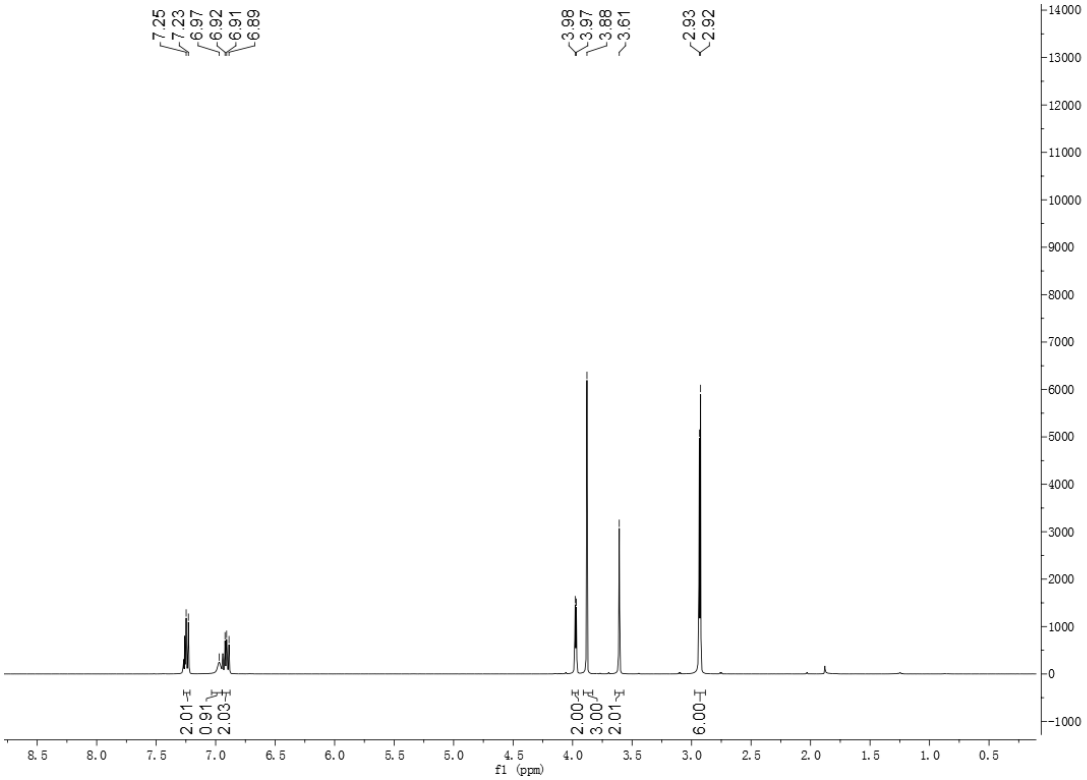
2k

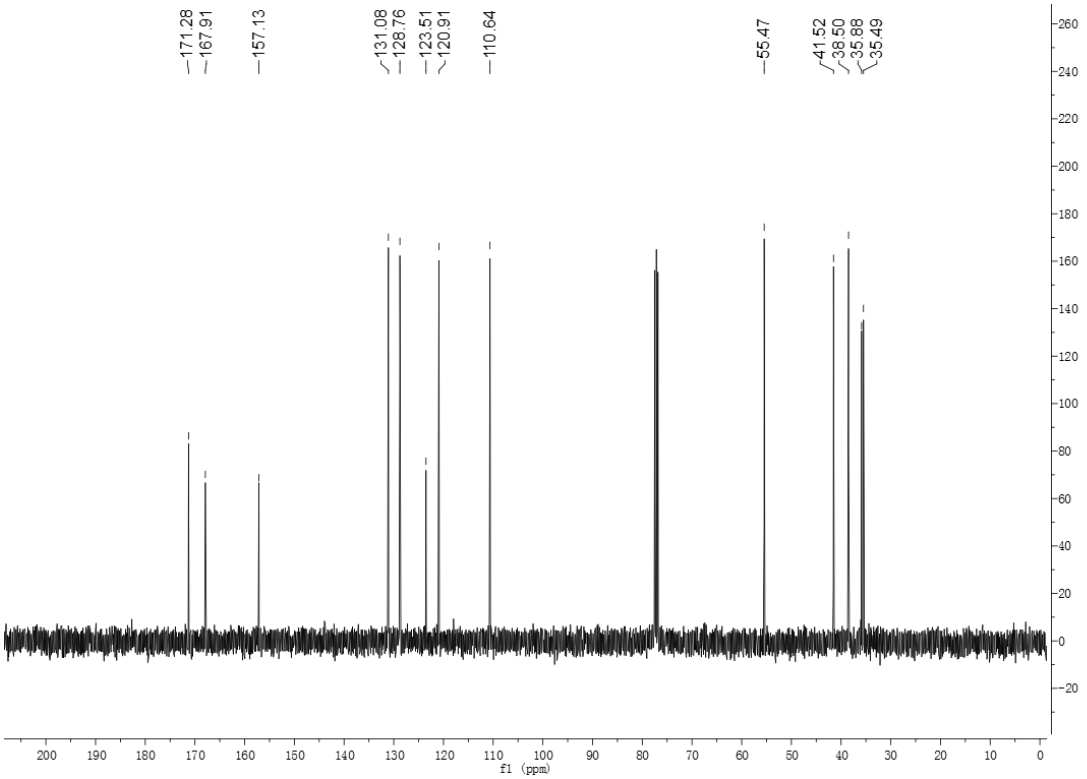

7.29
7.26
7.24
7.19
7.17
6.80
4.02
4.01
3.57
2.95
1.00
2.01
1.01
0.90
2.00
2.00
6.00
f1 (ppm)

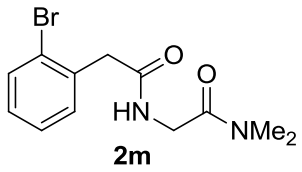

170.31
167.93
136.90
134.66
130.18
129.57
127.64
127.56
43.07
41.59
36.05
35.71
f1 (ppm)


OMe
O
HN
O
NMe2

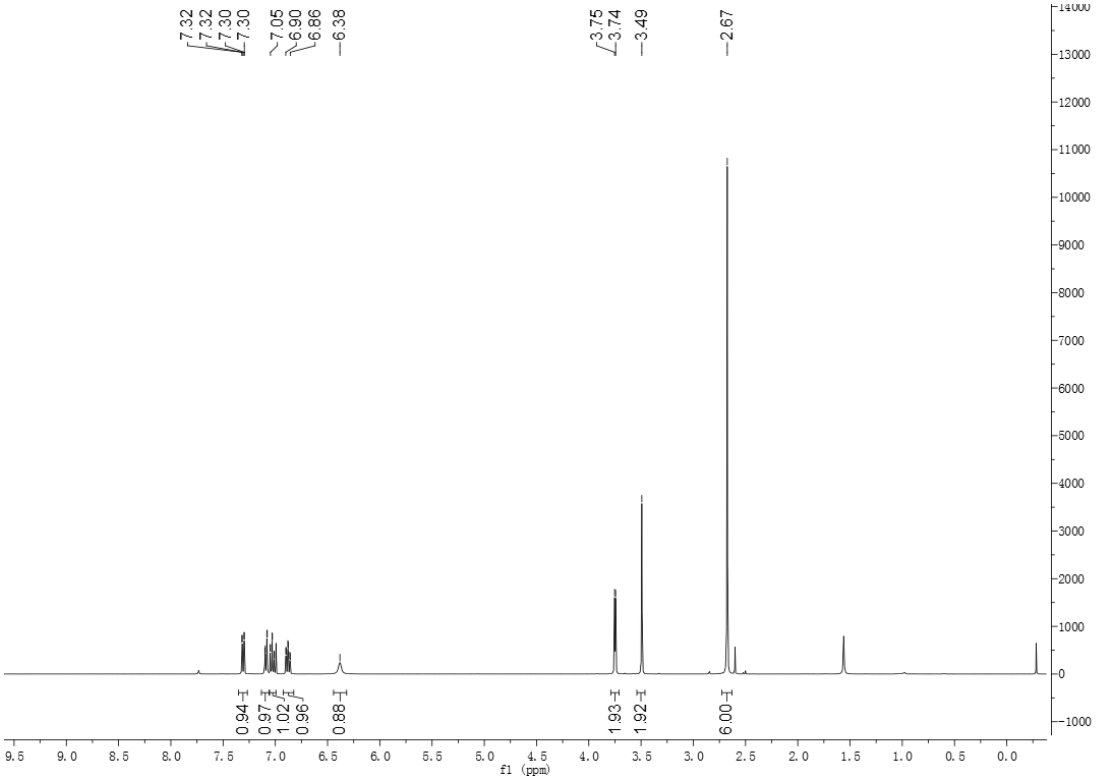
2l

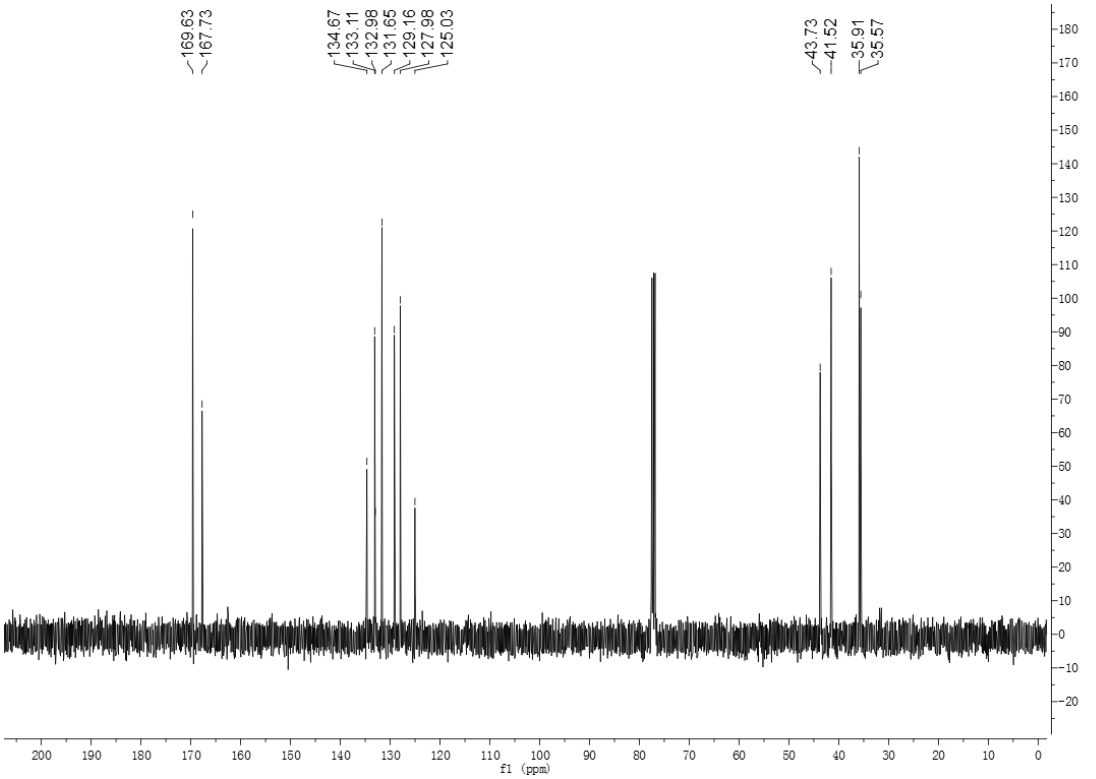

7.25
7.23
6.97
6.92
6.91
6.89
3.98
3.97
3.88
3.61
2.93
2.92
2.01
0.91
2.03
2.00
3.00
2.01
6.00
f1 (ppm)

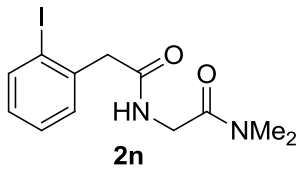

171.28
167.91
157.13
131.08
128.76
123.51
120.91
110.64
55.47
41.52
38.50
35.88
35.49
f1 (ppm)


Br
O
HN
O
NMe2

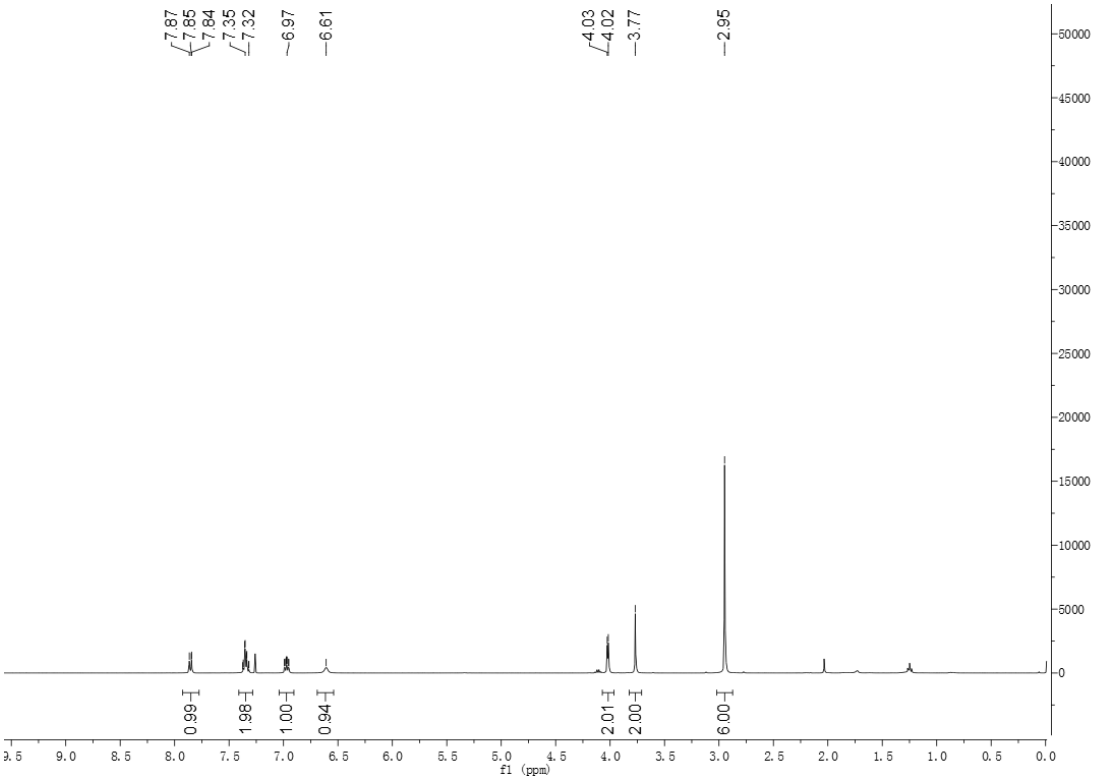
2m

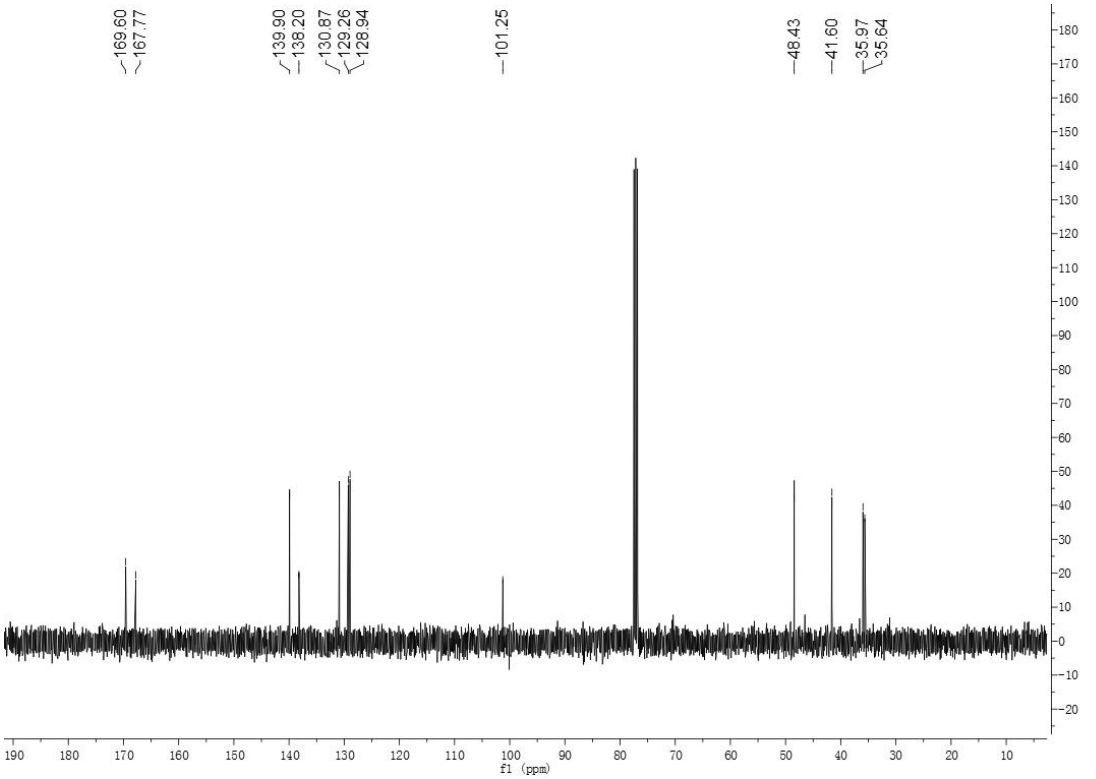

7.32
7.32
7.30
7.30
7.05
6.90
6.86
6.38
3.75
3.74
3.49
2.67
0.94
0.97
1.02
0.96
0.88
1.93
1.92
6.00
f1 (ppm)

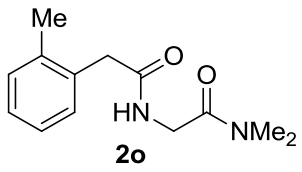

169.63
167.73
134.67
133.11
132.98
131.65
129.16
127.98
125.03
43.73
41.52
35.91
35.57
f1 (ppm)


I
O
HN
O
NMe2

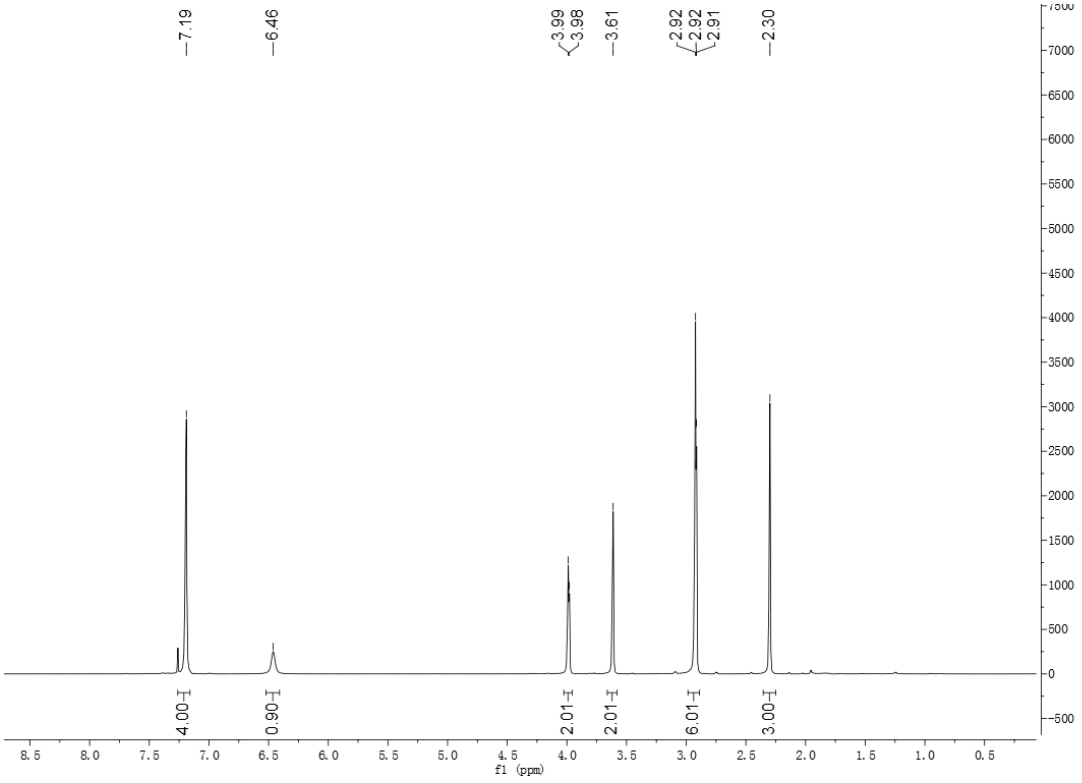
2n

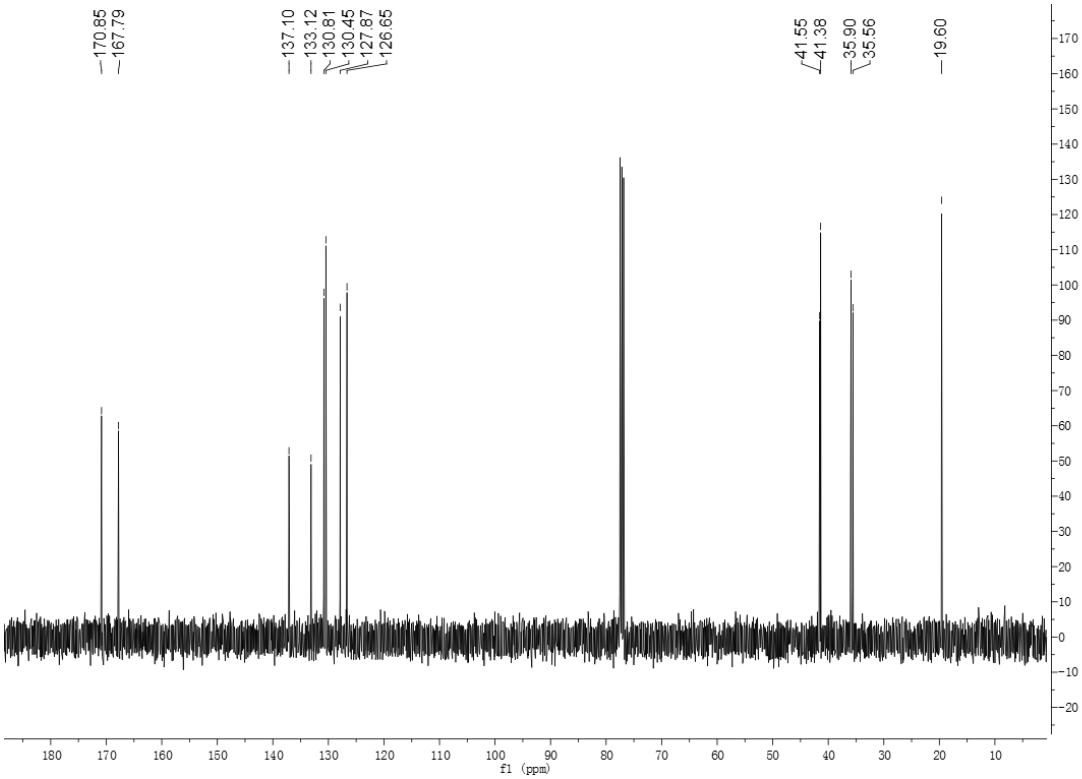

7.87
7.85
7.84
7.35
7.32
6.97
6.61
4.03
4.02
3.77
2.95
0.99
1.98
1.00
0.94
2.01
2.00
6.00
f1 (ppm)

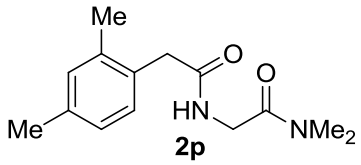

169.60
167.77
139.90
138.20
130.87
129.26
128.94
101.25
48.43
41.60
35.97
35.64
f1 (ppm)


Me
O
HN
O
NMe2

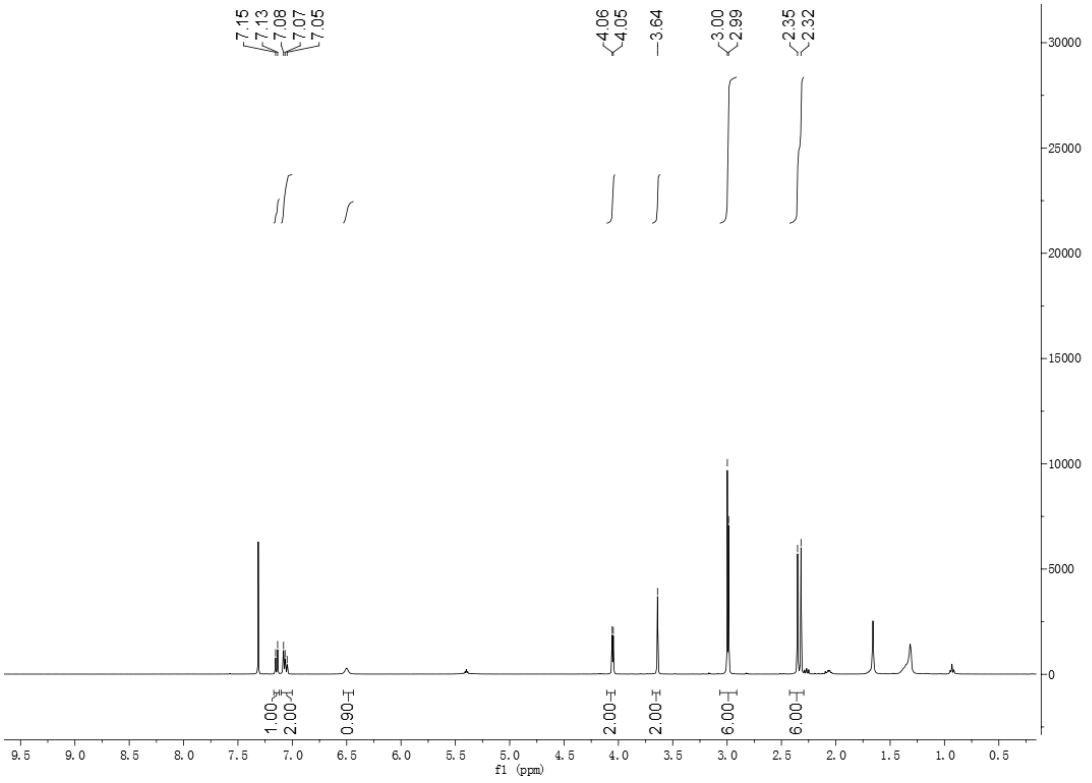
2o

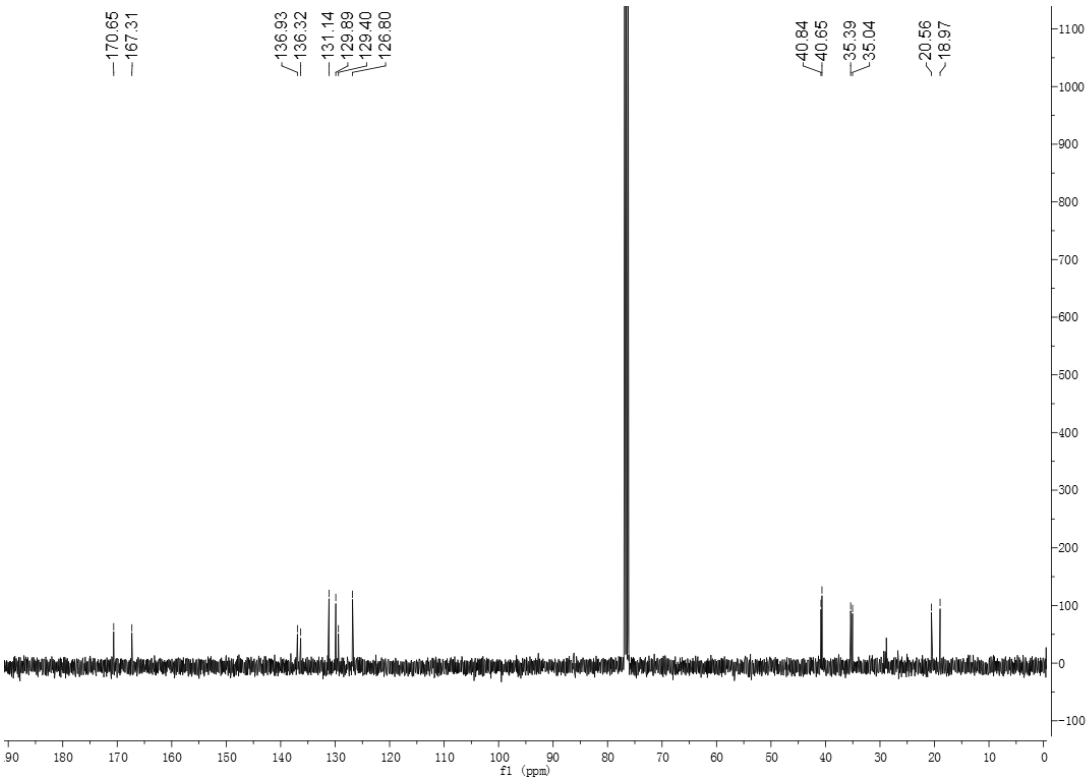

7.19
6.46
3.99
3.98
3.61
2.92
2.92
2.91
2.30
4.00
0.90
2.01
2.01
6.01
3.00
f1 (ppm)

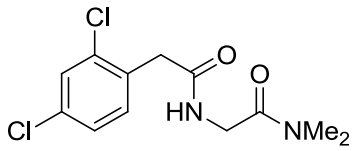

170.85
167.79
137.10
133.12
130.81
130.45
127.87
126.65
41.55
41.38
35.90
35.56
19.60
f1 (ppm)


Me
O
O
HN
Me
NMe2

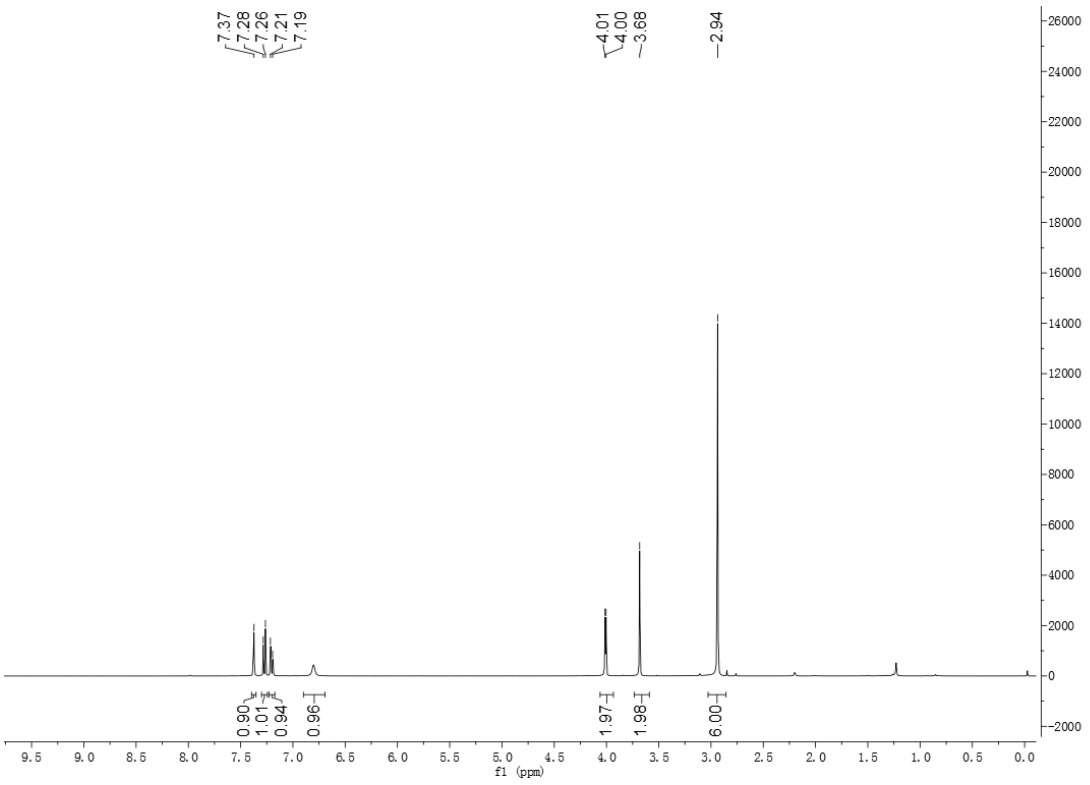
2p

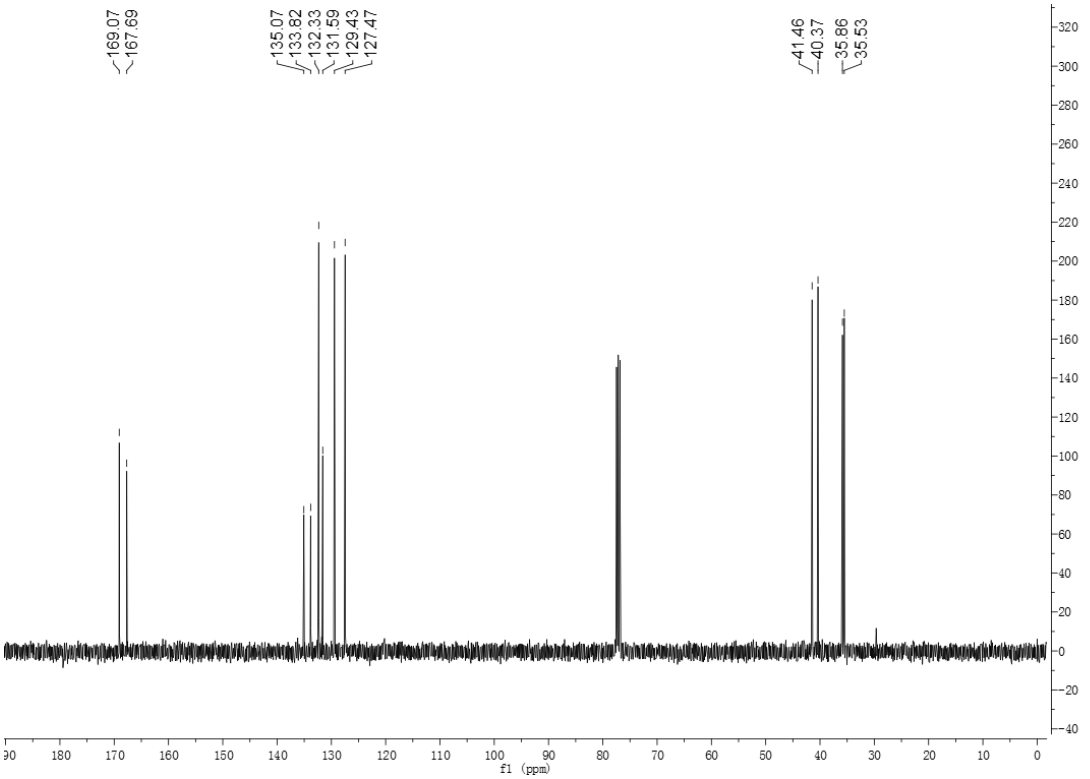

7.15
7.13
7.08
7.07
7.05
4.06
4.05
3.64
3.00
2.99
2.35
2.32
1.00
2.00
0.90
2.00
2.00
6.00
6.00
f1 (ppm)

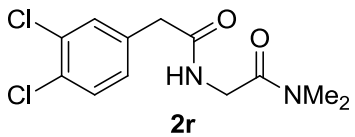

170.65
167.31
136.93
136.32
131.14
129.89
129.40
126.80
40.84
40.65
35.39
35.04
20.56
18.97
f1 (ppm)


Cl
O
O
HN
Cl
NMe2

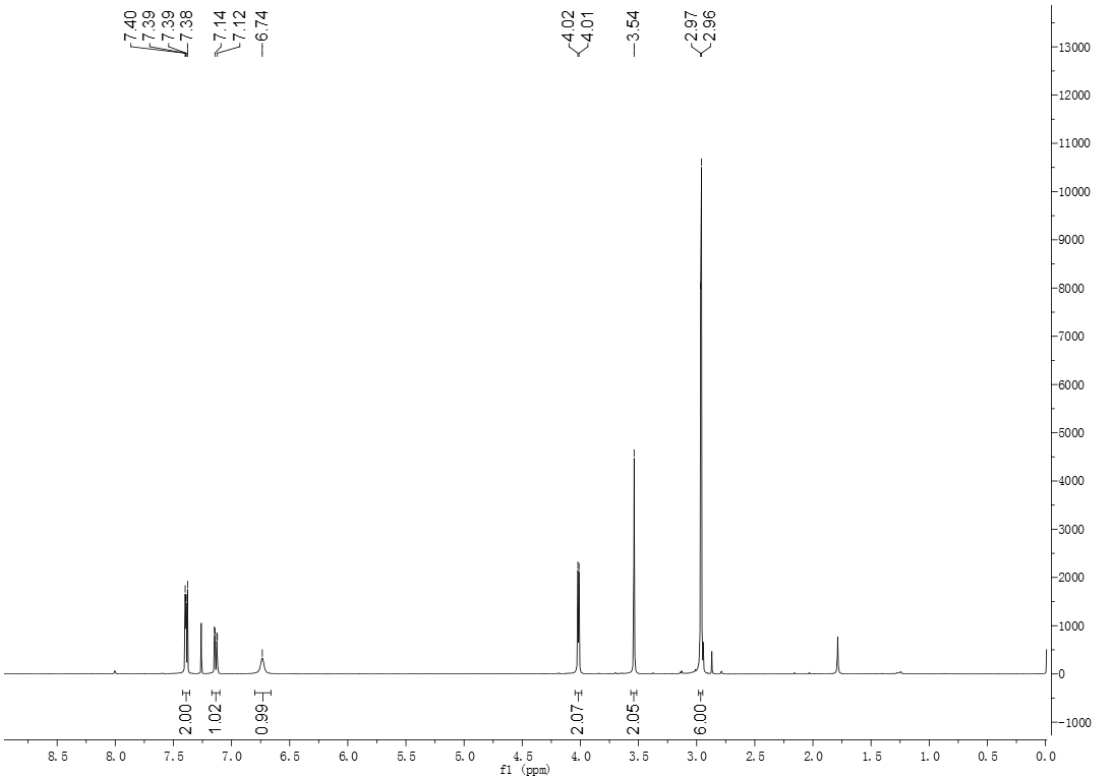
2q

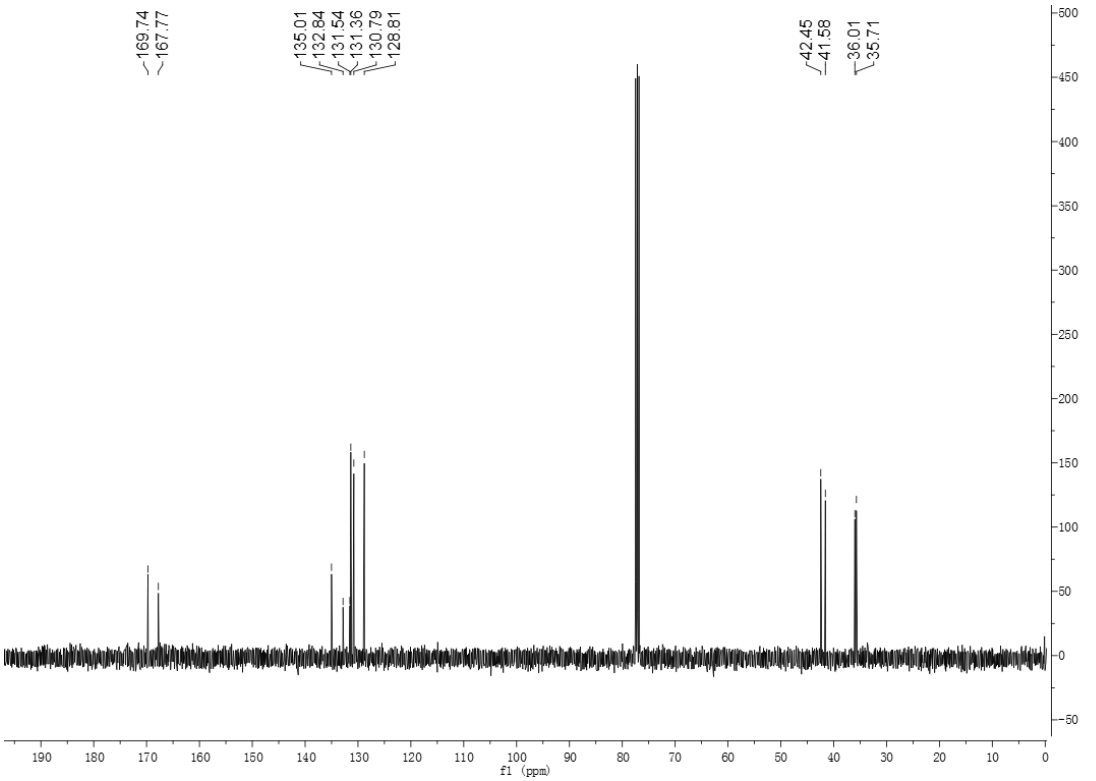

7.37
7.28
7.26
7.21
7.19
4.01
4.00
3.68
2.94
0.90
1.01
0.94
0.96
1.97
1.98
6.00
f1 (ppm)

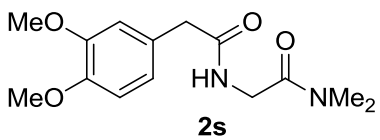

169.07
167.69
135.07
133.82
132.33
131.59
129.43
127.47
41.46
40.37
35.86
35.53
f1 (ppm)


Cl
Cl
O
HN
O
NMe2

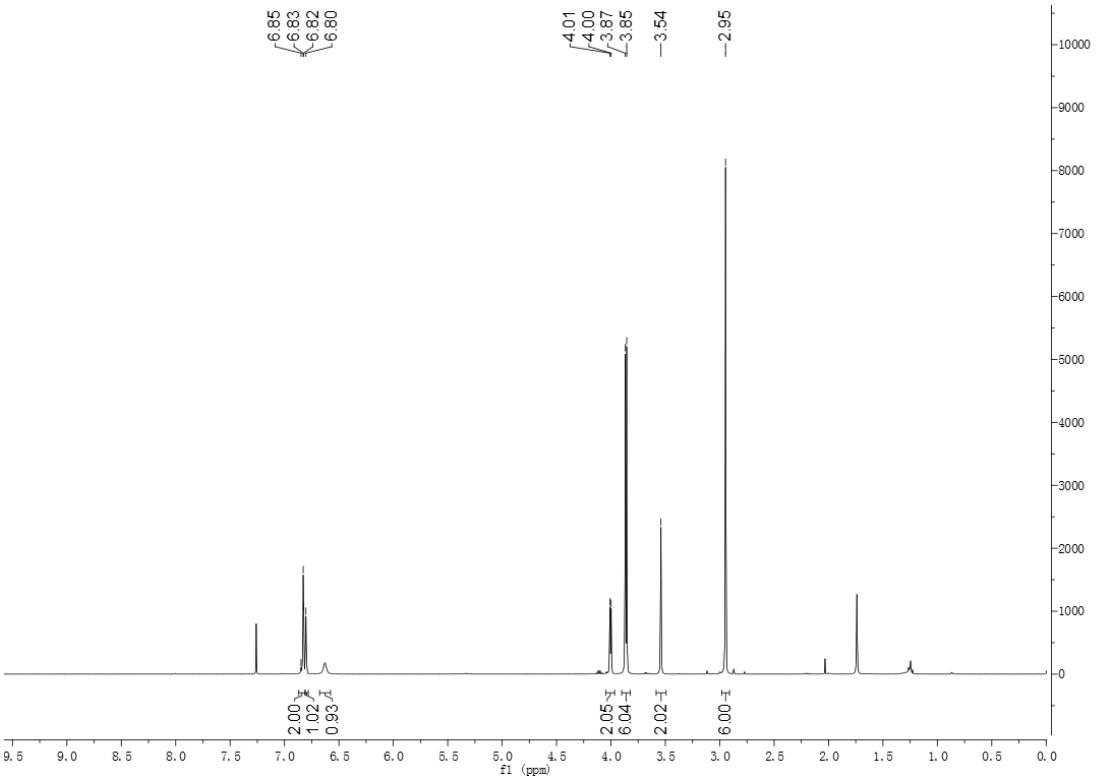
2r

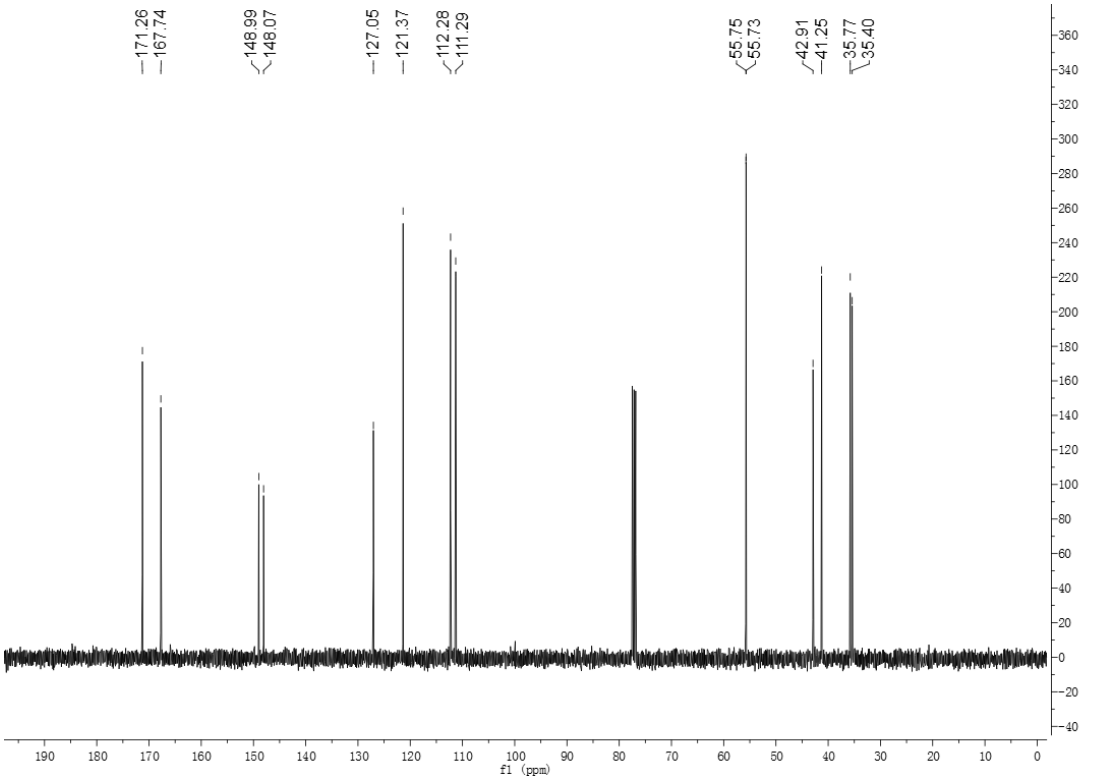

7.40
7.39
7.39
7.38
7.14
7.12
6.74
4.02
4.01
3.54
2.97
2.96
2.00
1.02
0.99
2.07
2.05
6.00
f1 (ppm)

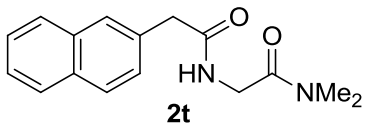

169.74
167.77
135.01
132.84
131.54
131.36
130.79
128.81
42.45
41.58
36.01
35.71
f1 (ppm)


MeO
MeO
O
HN
O
NMe2

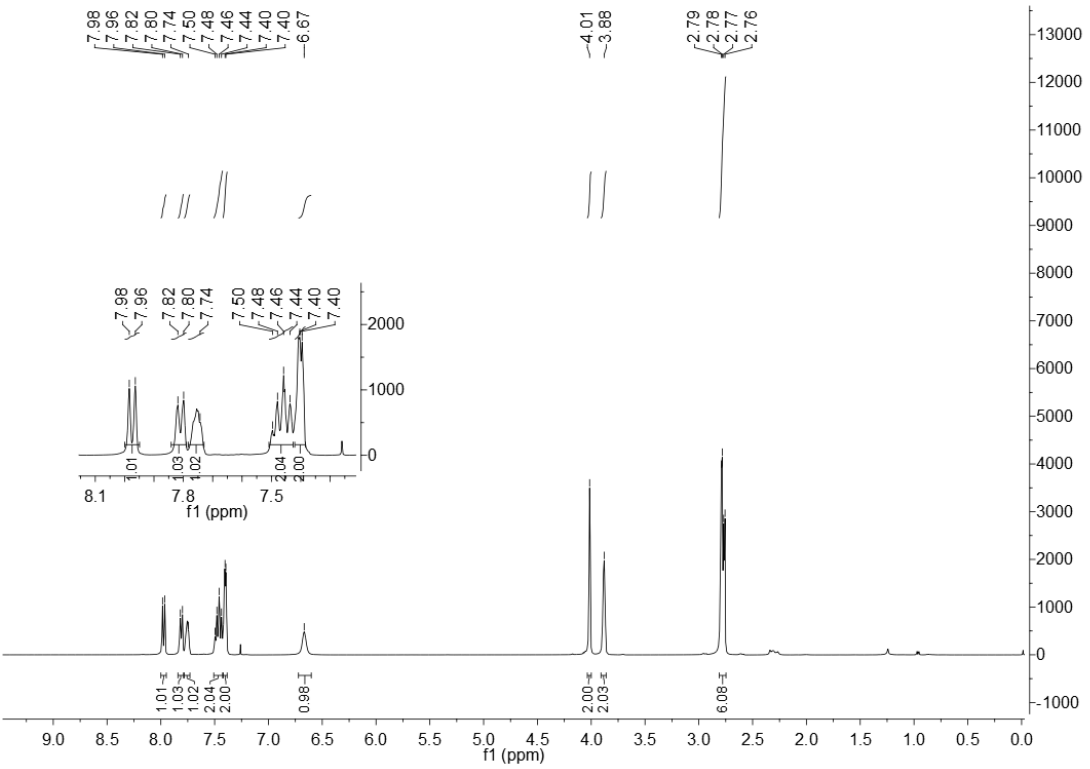
2s

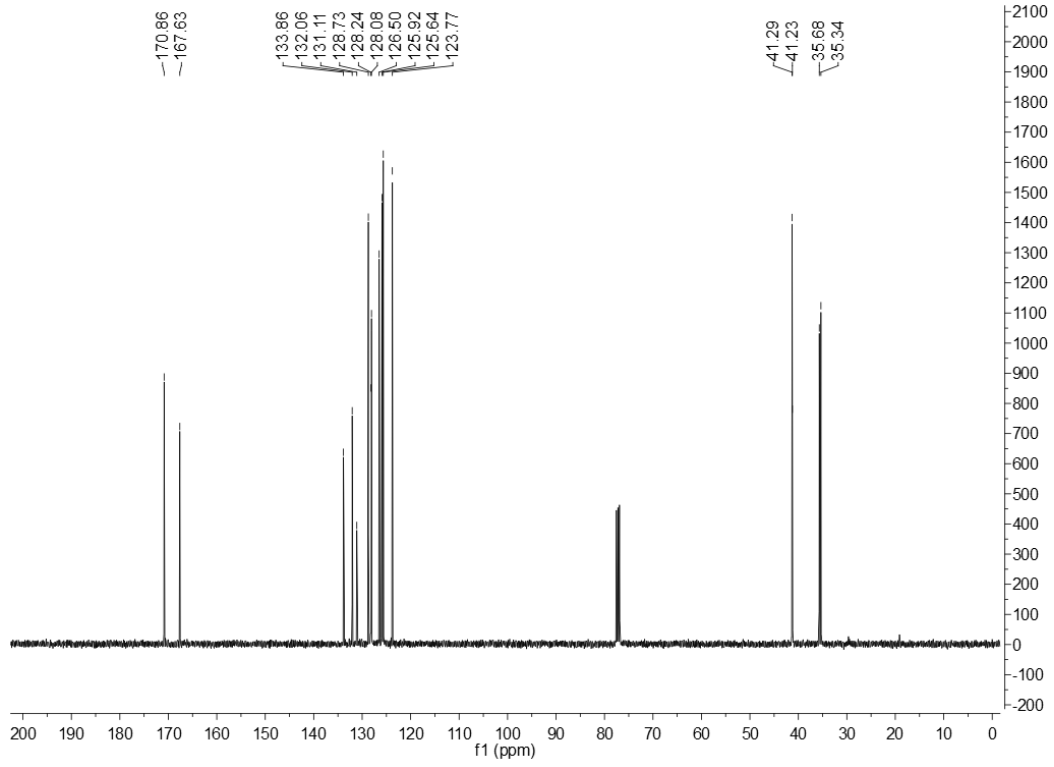

6.85
6.83
6.82
6.80
4.01
4.00
3.87
3.85
3.54
2.95
2.00
1.02
0.93
2.05
6.04
2.02
6.00
f1 (ppm)

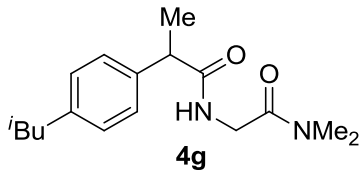

171.26
167.74
148.99
148.07
127.05
121.37
112.28
111.29
55.75
55.73
42.91
41.25
35.77
35.40
f1 (ppm)


O
O
HN
NMe2

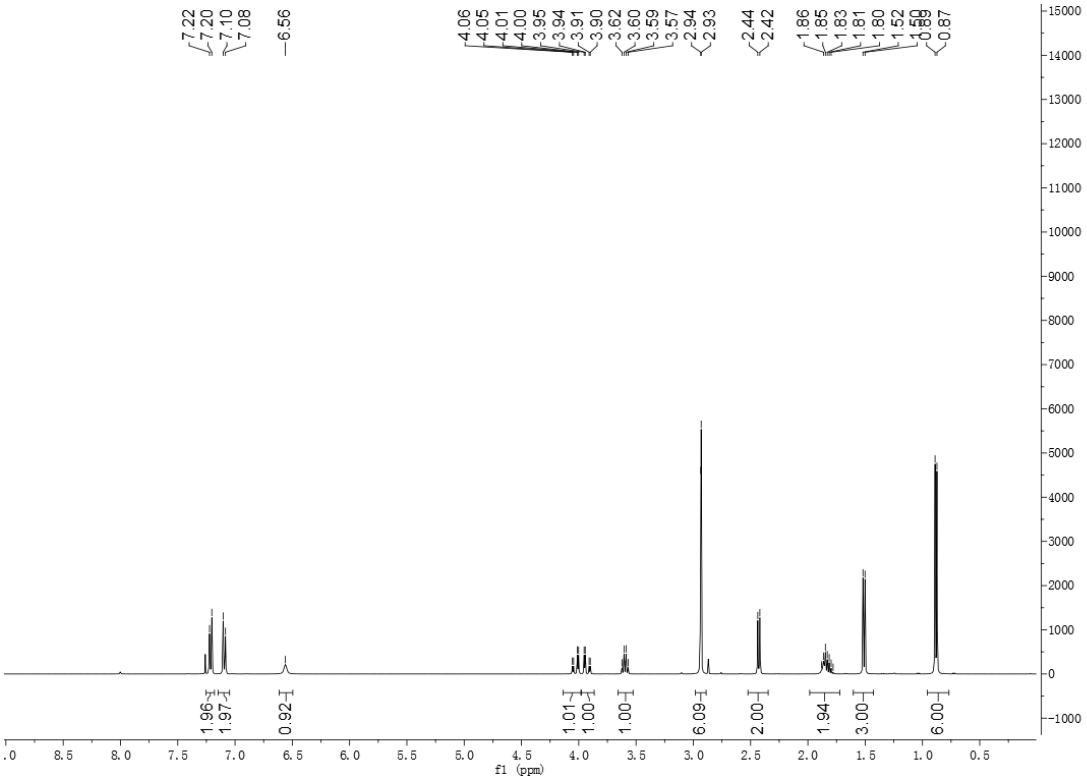
2t

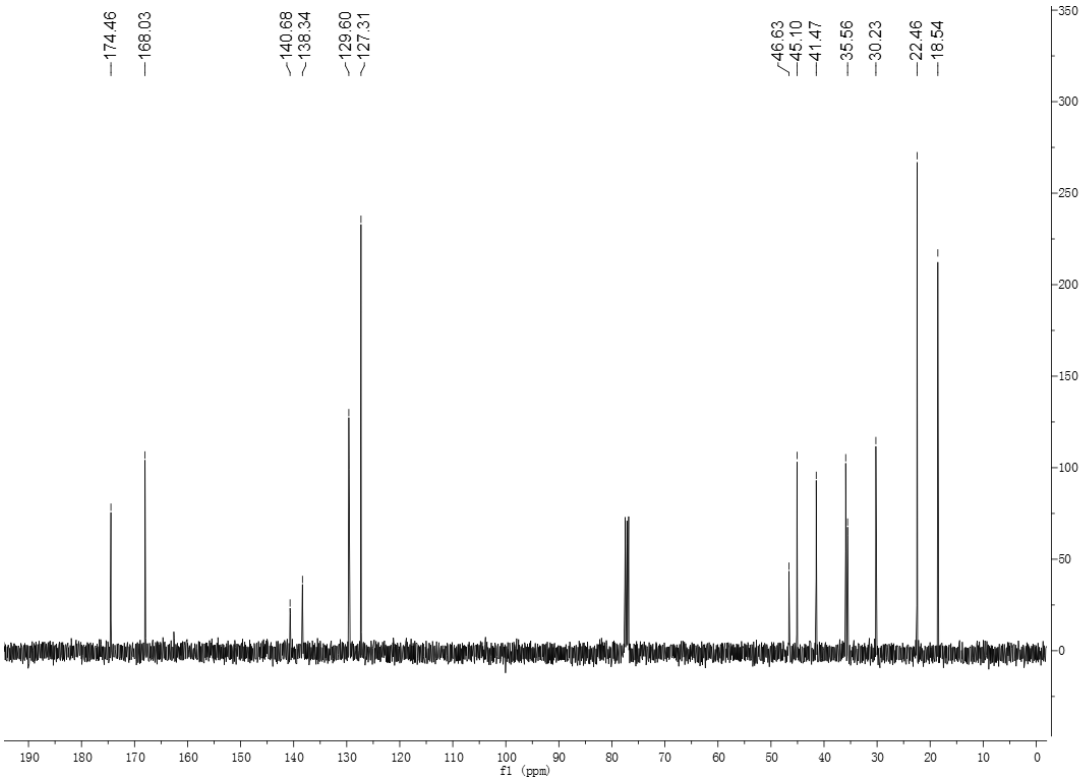

7.98
7.96
7.82
7.80
7.74
7.50
7.48
7.46
7.44
7.40
7.40
6.67
4.01
3.88
2.79
2.78
2.77
2.76
1.01
1.03
1.02
2.04
2.00
0.98
2.00
2.03
6.08
f1 (ppm)

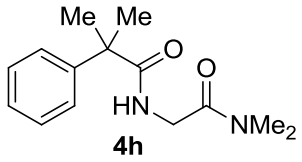

170.86
167.63
133.86
132.06
131.11
128.73
128.24
128.08
126.50
125.92
125.64
123.77
41.29
41.23
35.68
35.34
f1 (ppm)


Me
O
O
HN
NMe2
iBu

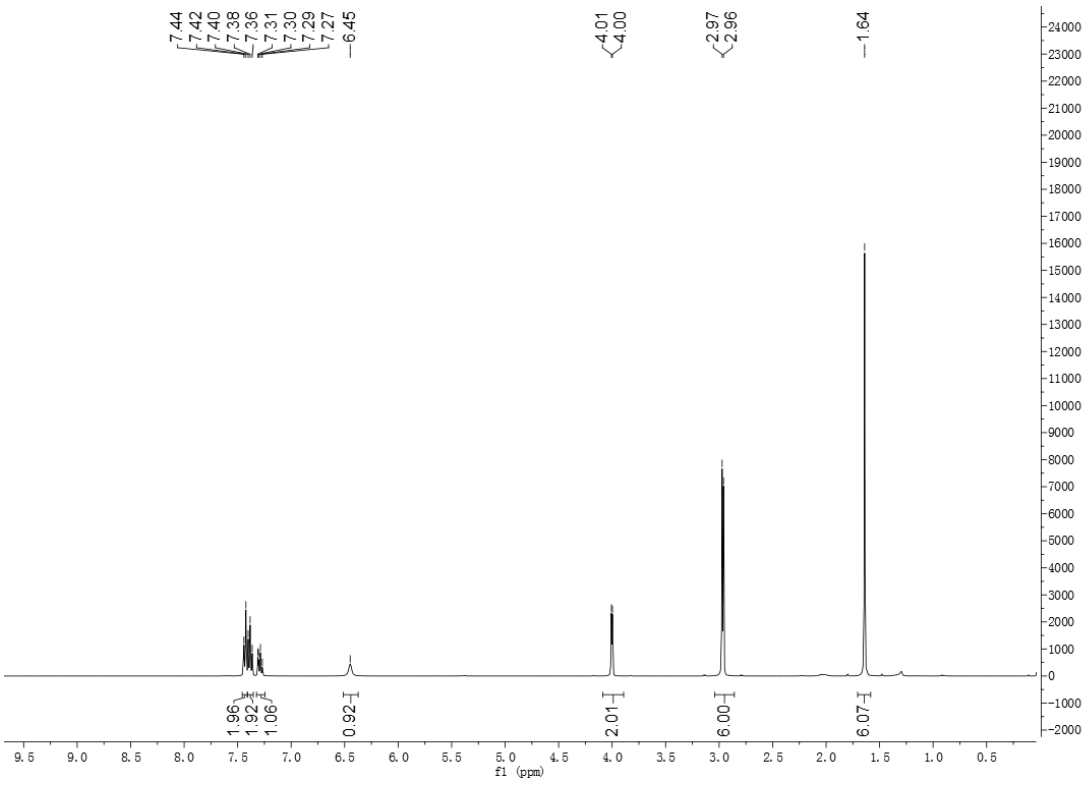
4g

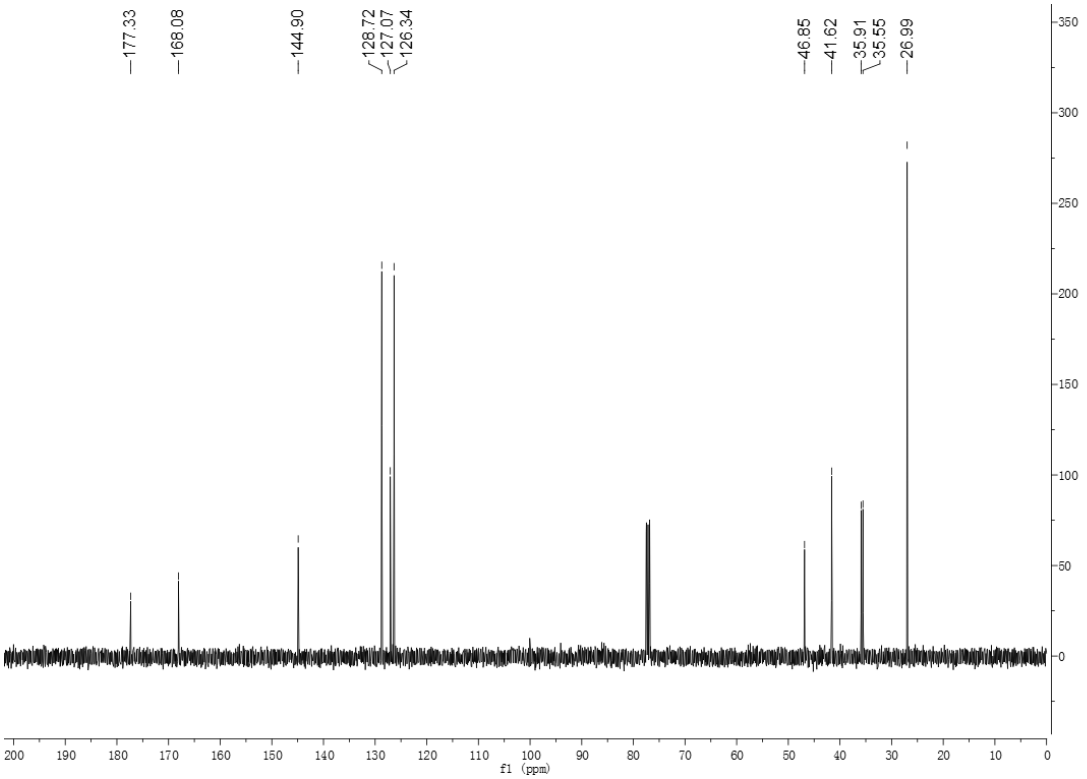

7.22
7.20
7.10
7.08
6.56
4.06
4.05
4.01
4.00
3.95
3.94
3.91
3.90
3.62
3.60
3.59
3.57
2.94
2.93
2.44
2.42
1.86
1.85
1.83
1.81
1.80
1.52
0.89
0.87
1.96
1.97
0.92
1.01
1.00
1.00
6.09
2.00
1.94
3.00
6.00
f1 (ppm)

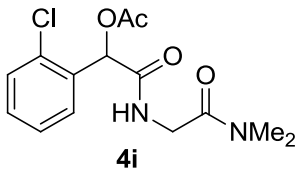

174.46
168.03
140.68
138.34
129.60
127.31
46.63
45.10
41.47
35.56
30.23
22.46
18.54
f1 (ppm)


Me
Me
O
O
HN
NMe2

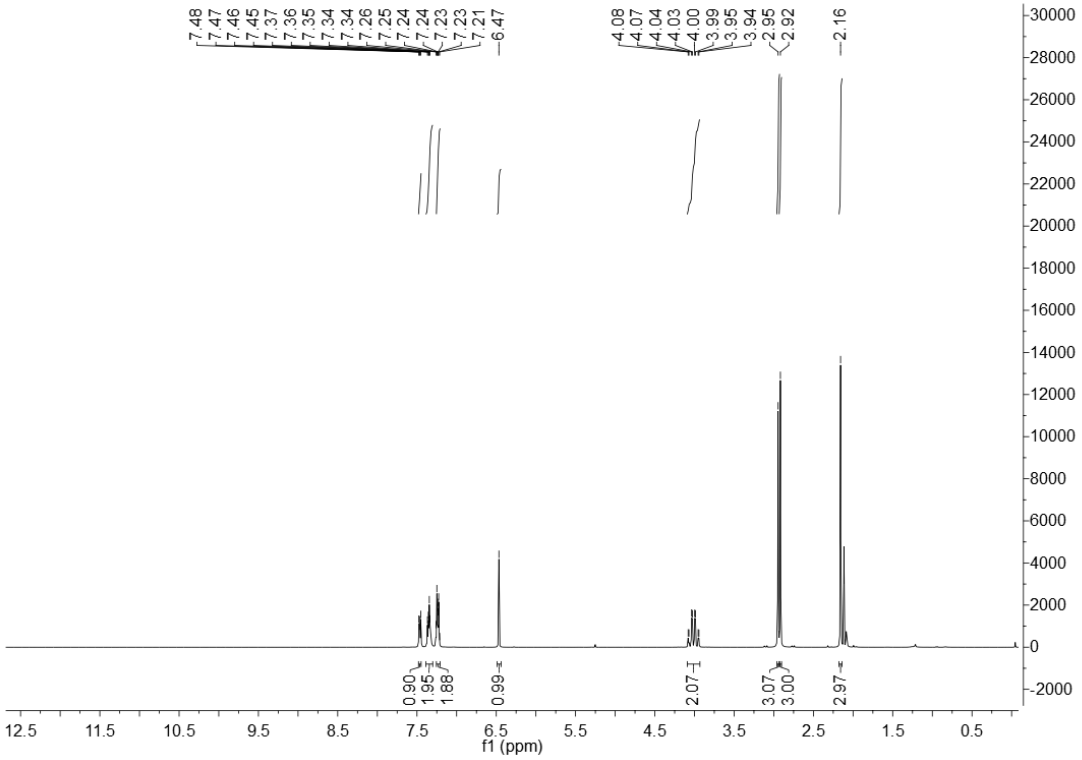
4h


7.44
7.42
7.40
7.38
7.36
7.31
7.30
7.29
7.27
6.45
4.01
4.00
2.97
2.96
1.64
1.96
1.92
1.06
0.92
2.01
6.00
6.07
f1 (ppm)


177.33
168.08
144.90
128.72
127.07
126.34
46.85
41.62
35.91
35.55
26.99
f1 (ppm)


Cl
OAc
O
O
HN
NMe2

4i


7.48
7.47
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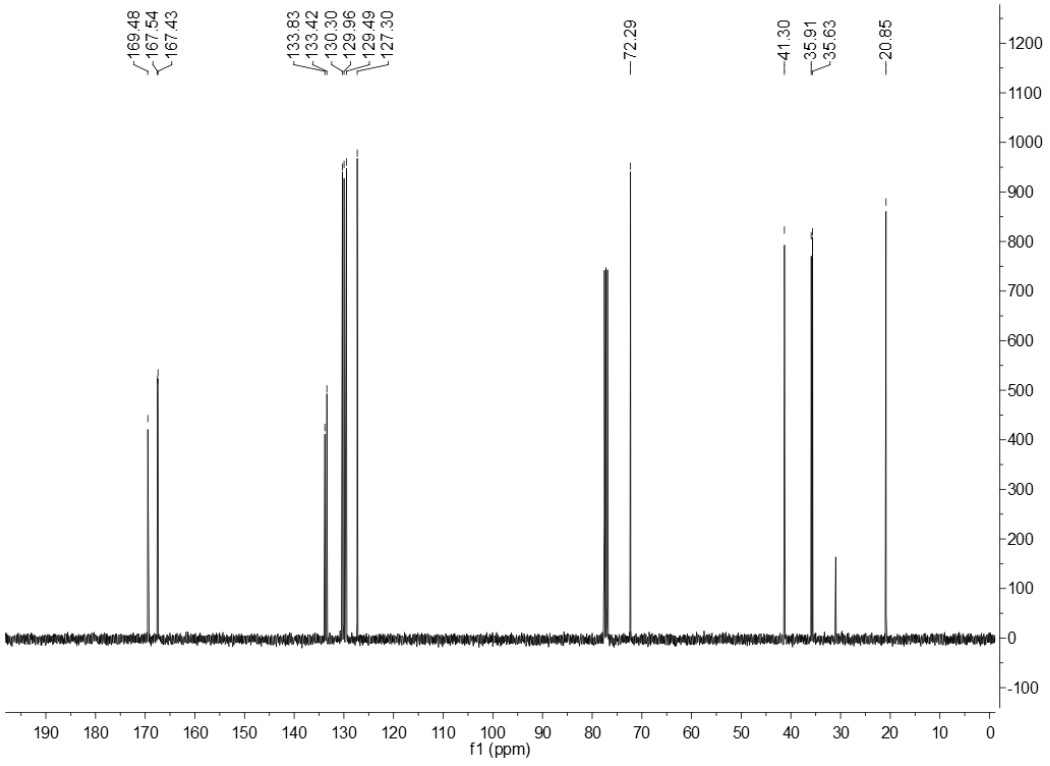
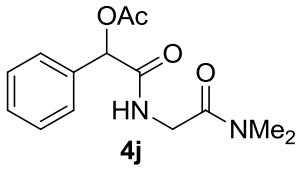
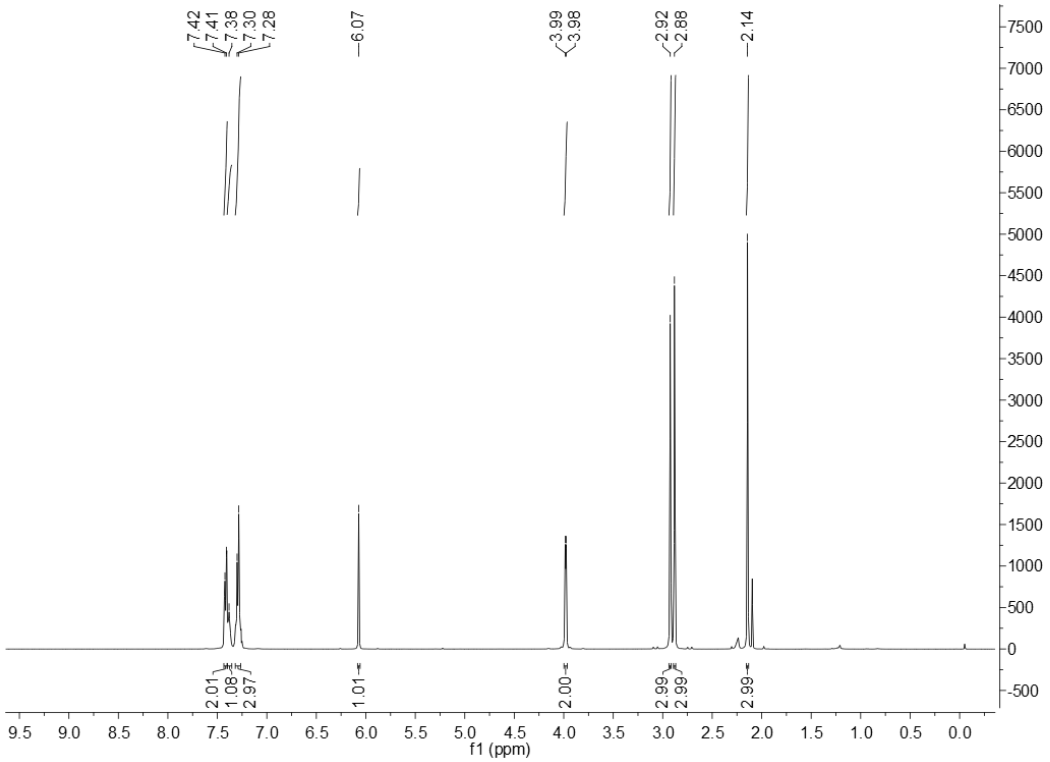
7.45
7.37
7.36
7.35
7.34
7.34
7.26
7.25
7.24
7.24
7.23
7.23
7.21
6.47
4.08
4.07
4.04
4.03
4.00
3.99
3.95
3.94
2.95
2.92
2.16
0.90
1.95
1.88
0.99
2.07
3.07
3.00
2.97
f1 (ppm)


169.48
167.54
167.43
133.83
133.42
130.30
129.96
129.49
127.30
72.29
41.30
35.91
35.63
20.85
f1 (ppm)


OAc
O
O
HN
NMe2

4j


7.42
7.41
7.38
7.30
7.28
6.07
3.99
3.98
2.92
2.88
2.14
2.01
1.08
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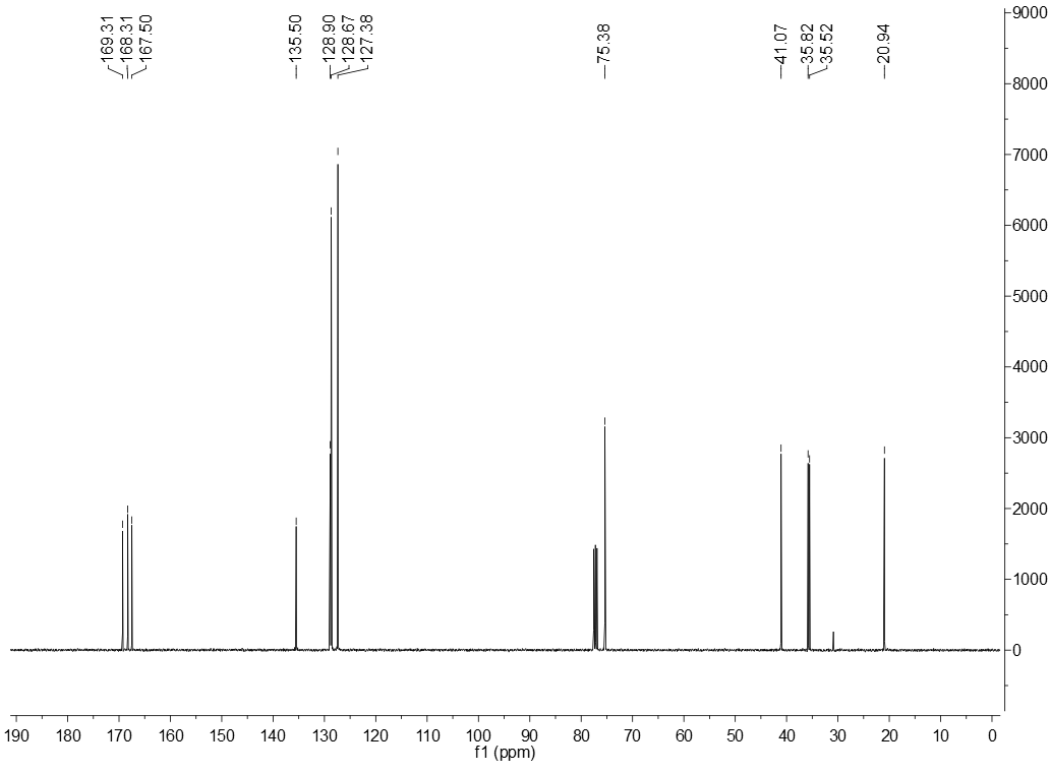
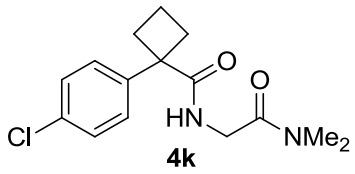
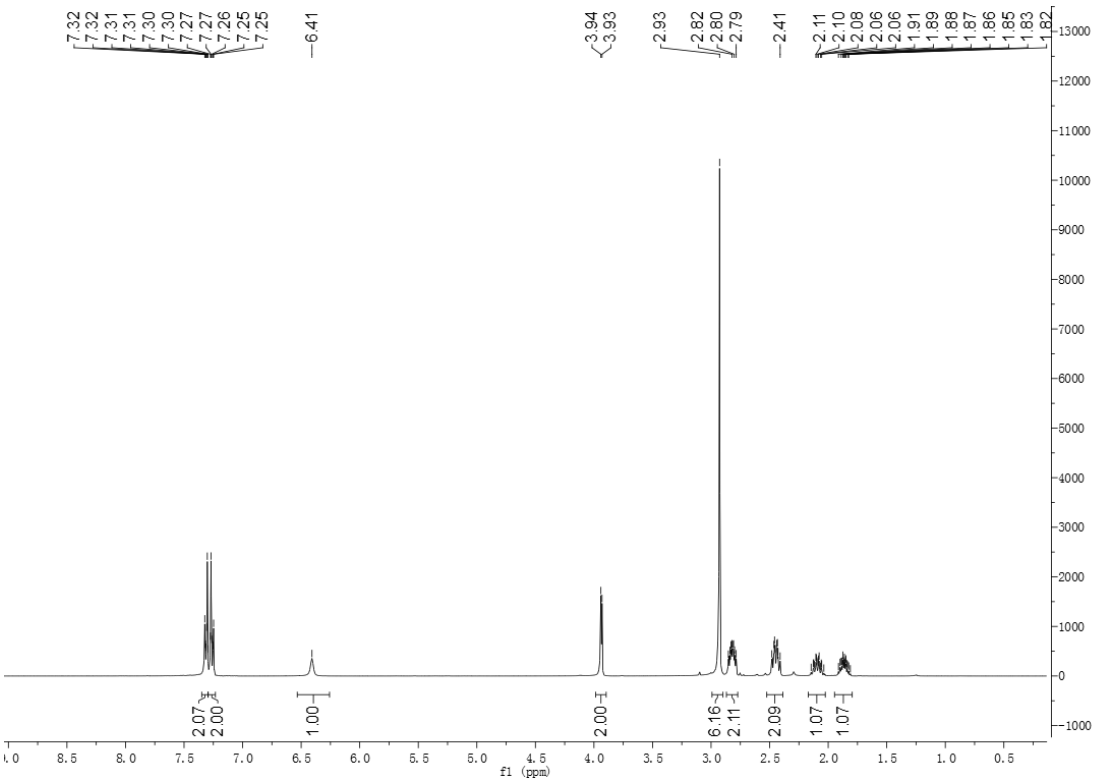
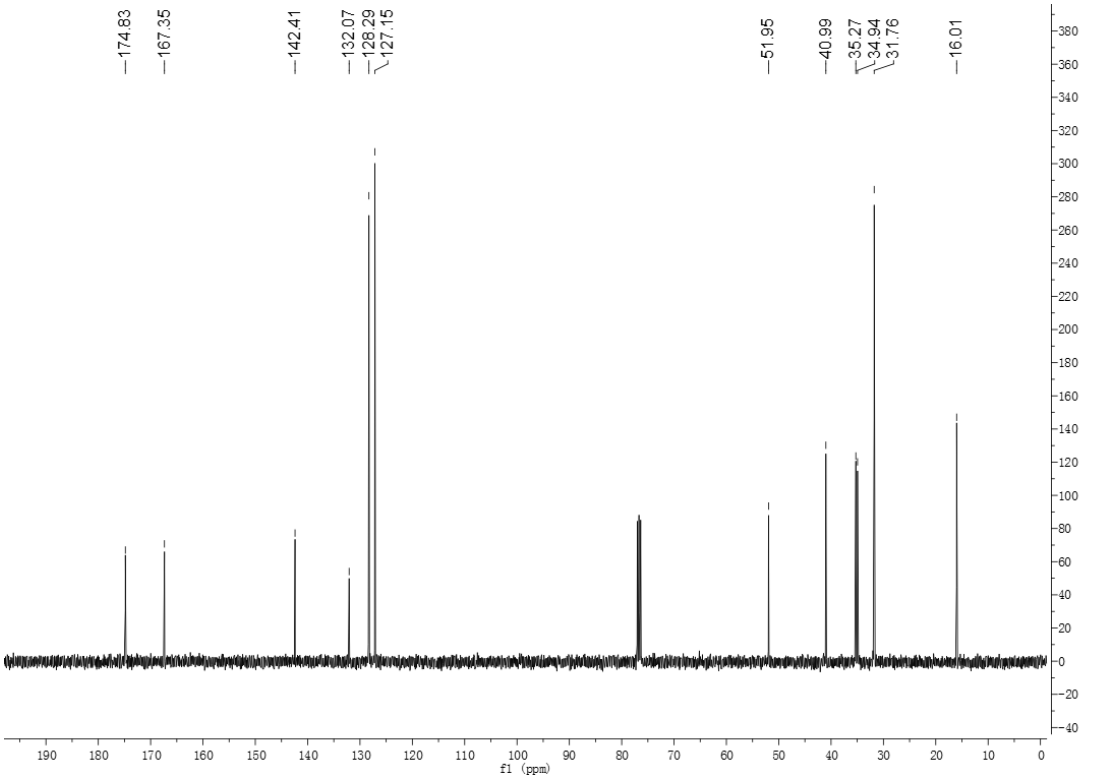
1.01
2.00
2.99
2.99
2.99
f1 (ppm)

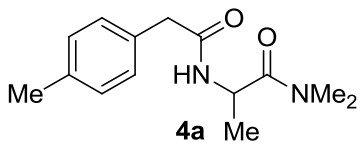

169.31
168.31
167.50
135.50
128.90
128.67
127.38
75.38
41.07
35.82
35.52
20.94
f1 (ppm)


O
O
HN
Cl
NMe2

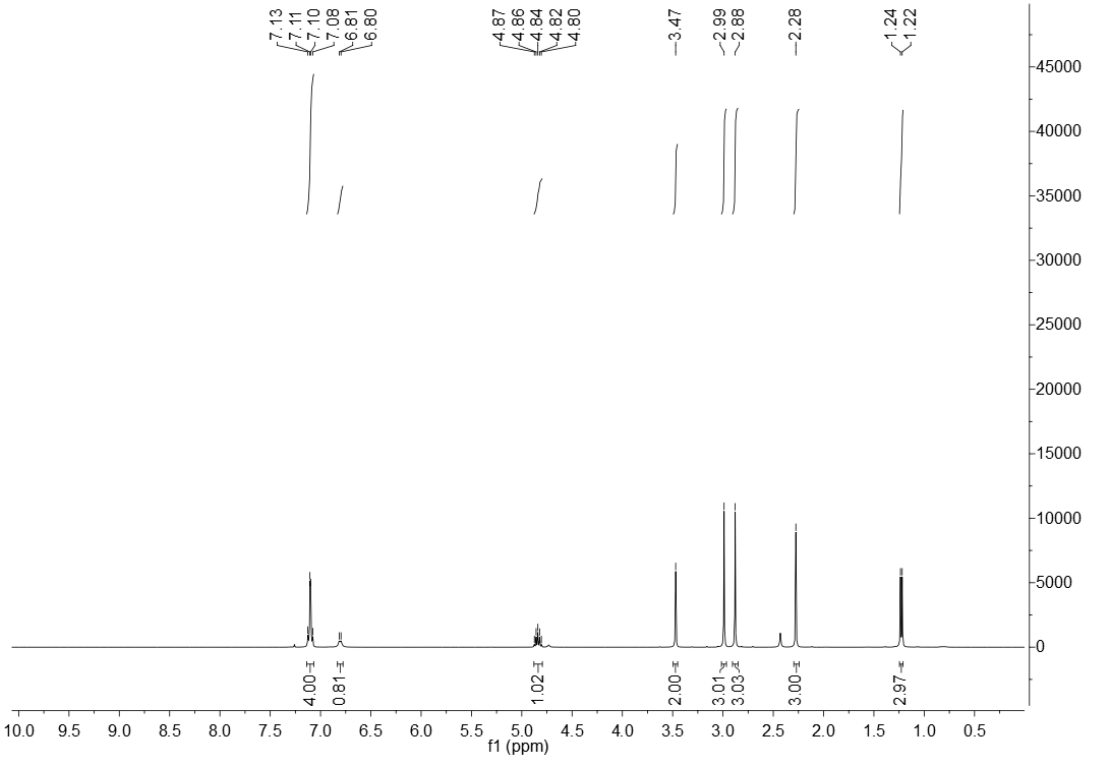
4k

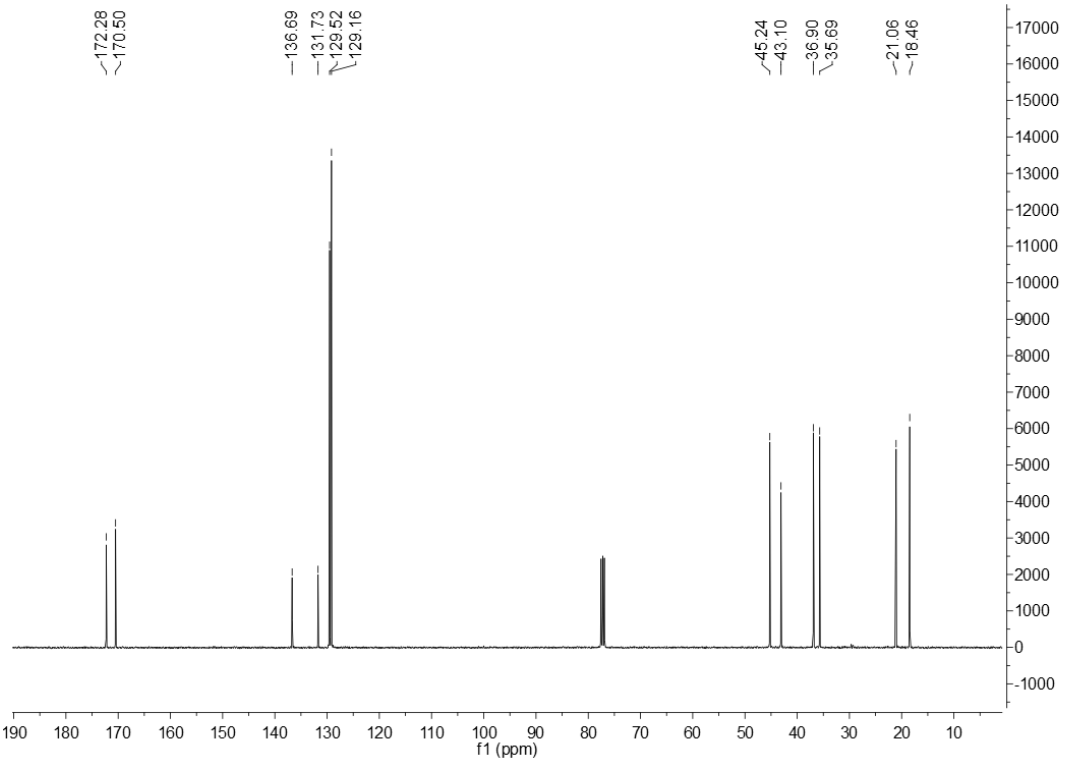

7.32
7.32
7.31
7.31
7.30
7.30
7.27
7.27
7.26
7.25
7.25
6.41
3.94
3.93
2.93
2.82
2.80
2.79
2.41
2.11
2.10
2.08
2.06
2.06
1.91
1.89
1.88
1.87
1.86
1.85
1.83
1.82
2.07
2.00
1.00
2.00
6.16
2.11
2.09
1.07
1.07
f1 (ppm)

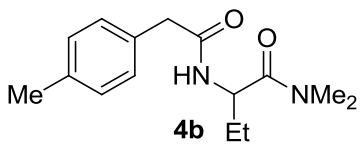

174.83
167.35
142.41
132.07
128.29
127.15
51.95
40.99
35.27
34.94
31.76
16.01
f1 (ppm)


O
O
HN
Me
NMe2
Me

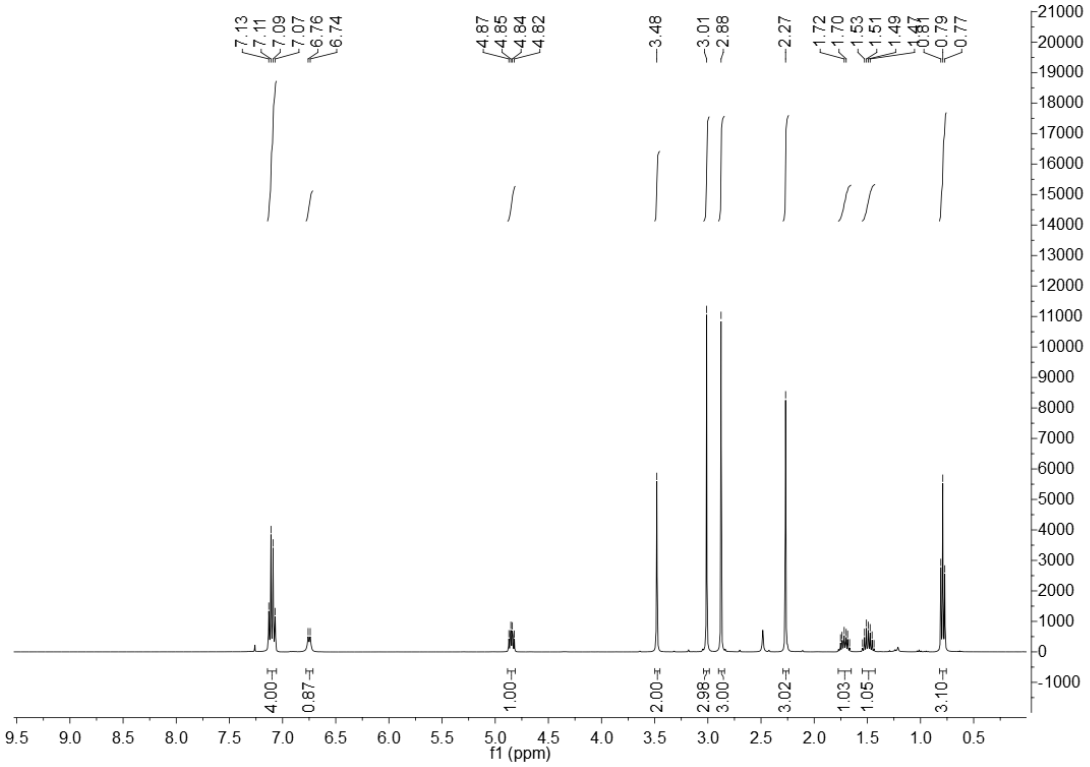
4a


7.13
7.11
7.10
7.08
6.81
6.80
4.87
4.86
4.84
4.82
4.80
3.47
2.99
2.88
2.28
1.24
1.22
4.00
0.81
1.02
2.00
3.01
3.03
3.00
2.97
f1 (ppm)


172.28
170.50
136.69
131.73
129.52
129.16
45.24
43.10
36.90
35.69
21.06
18.46
f1 (ppm)


O
O
HN
Me
NMe2
Et

4b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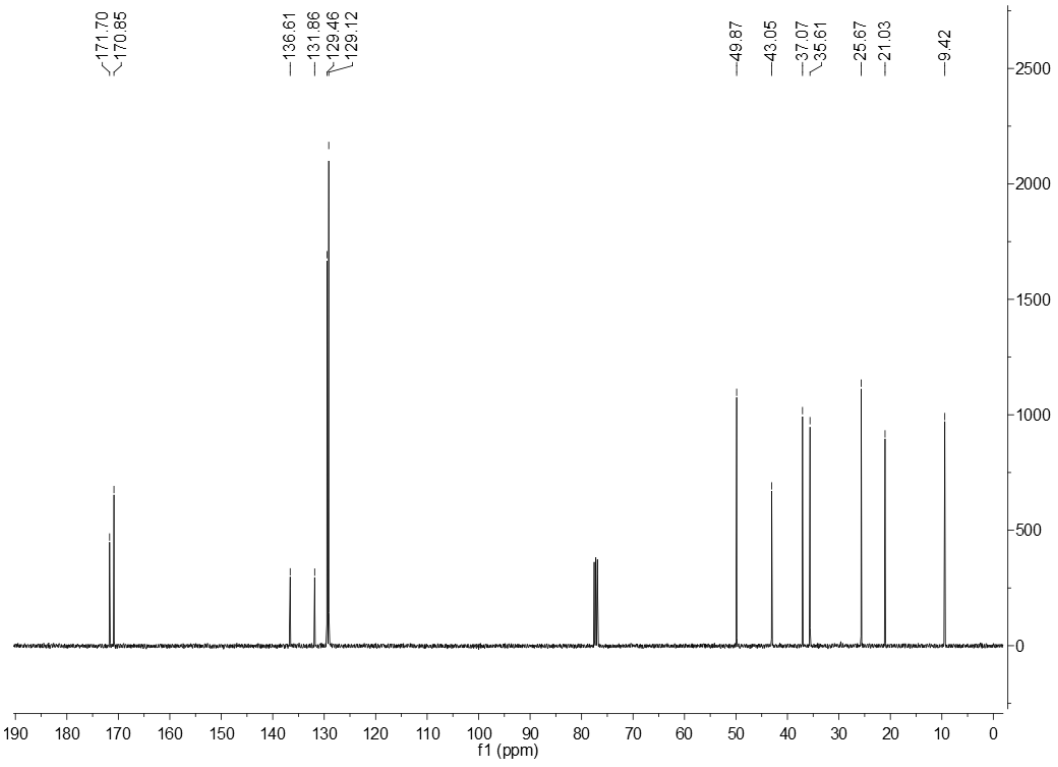
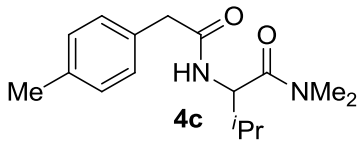
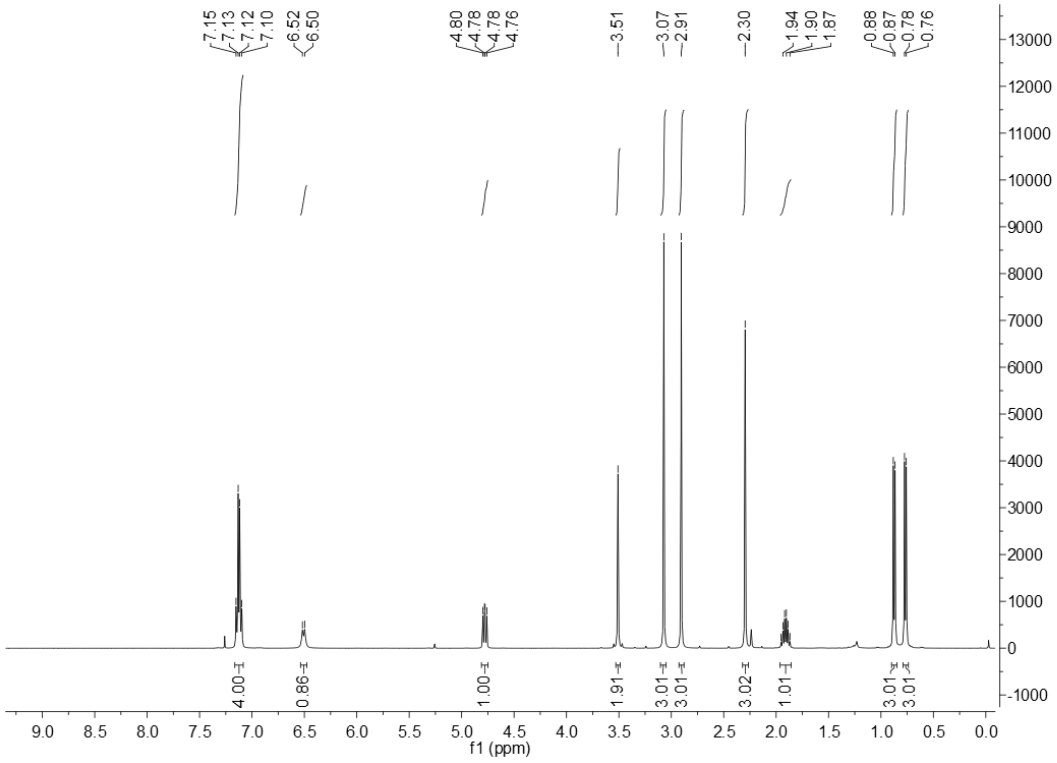
7.11
7.09
7.07
6.76
6.74
4.87
4.85
4.84
4.82
3.48
3.01
2.88
2.27
1.72
1.70
1.53
1.51
1.49
0.81
0.79
0.77
4.00
0.87
1.00
2.00
2.98
3.00
3.02
1.03
1.05
3.10
f1 (ppm)


171.70
170.85
136.61
131.86
129.46
129.12
49.87
43.05
37.07
35.61
25.67
21.03
9.42
f1 (ppm)


O
O
HN
Me
NMe2
4c
iPr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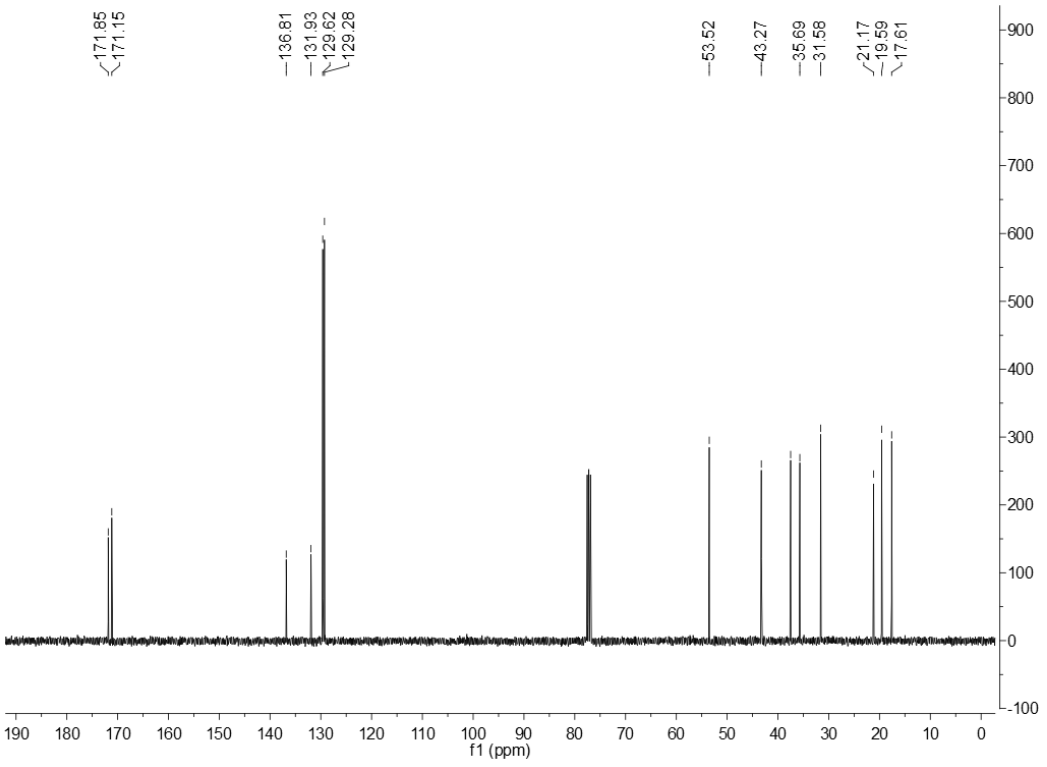
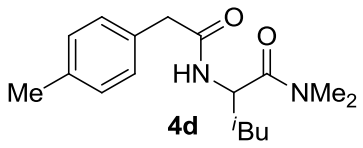
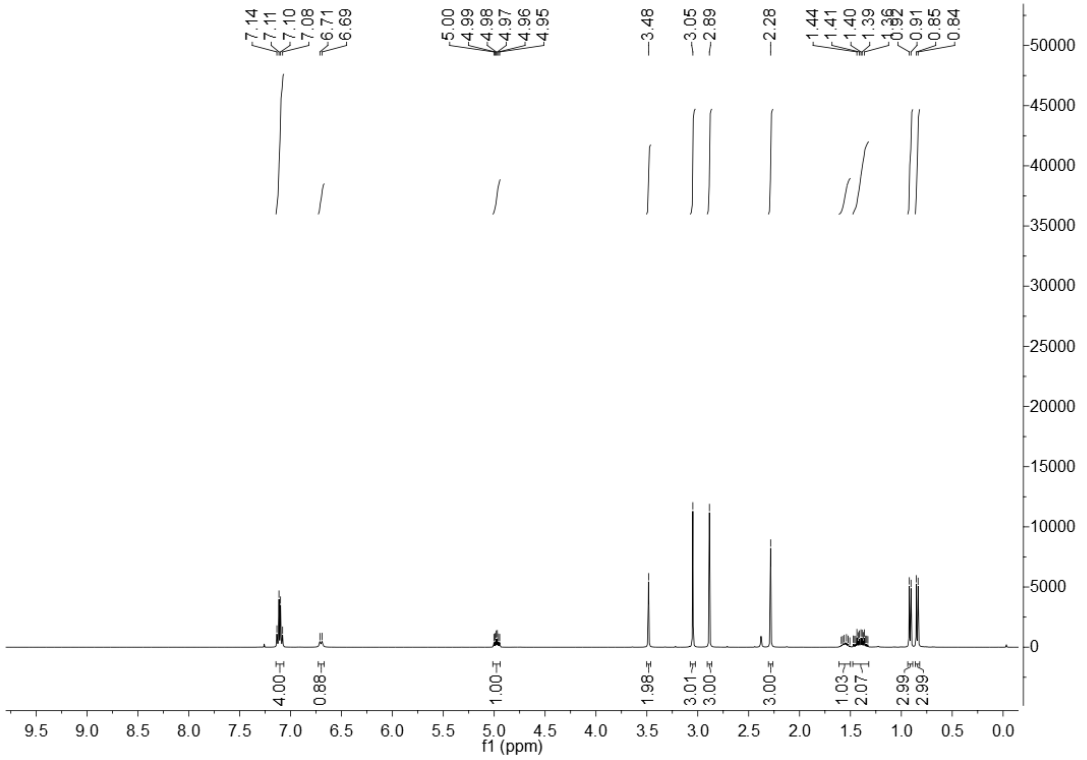
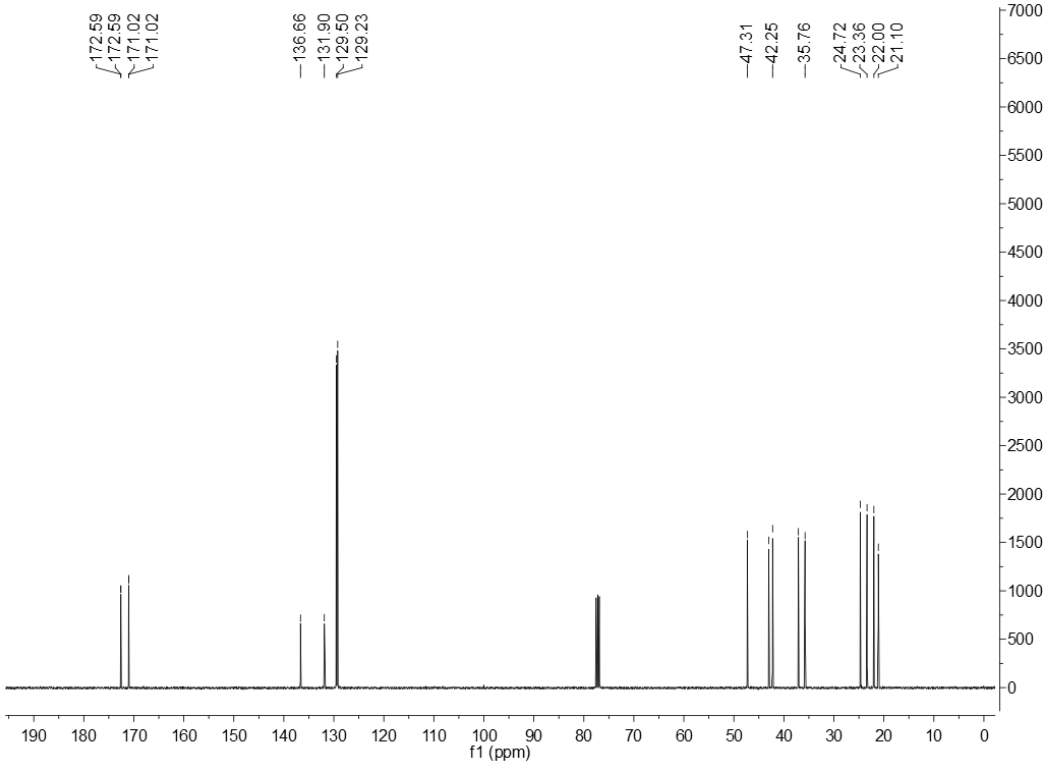
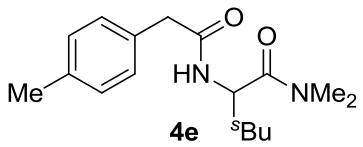
7.13
7.12
7.10
6.52
6.50
4.80
4.78
4.78
4.76
3.51
3.07
2.91
2.30
1.94
1.90
1.87
0.88
0.87
0.78
0.76
4.00
0.86
1.00
1.91
3.01
3.01
3.02
1.01
3.01
3.01
f1 (ppm)


171.85
171.15
136.81
131.93
129.62
129.28
53.52
43.27
35.69
31.58
21.17
19.59
17.61
f1 (ppm)

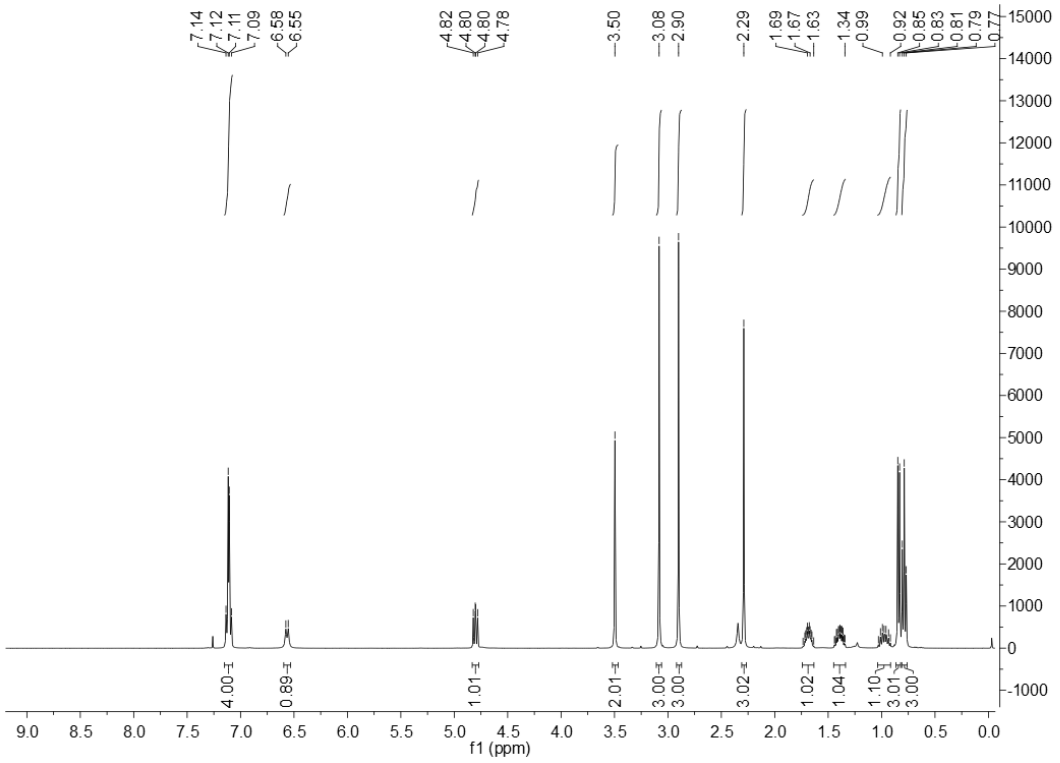

O
O
HN
NMe2
Me
4d
iBu

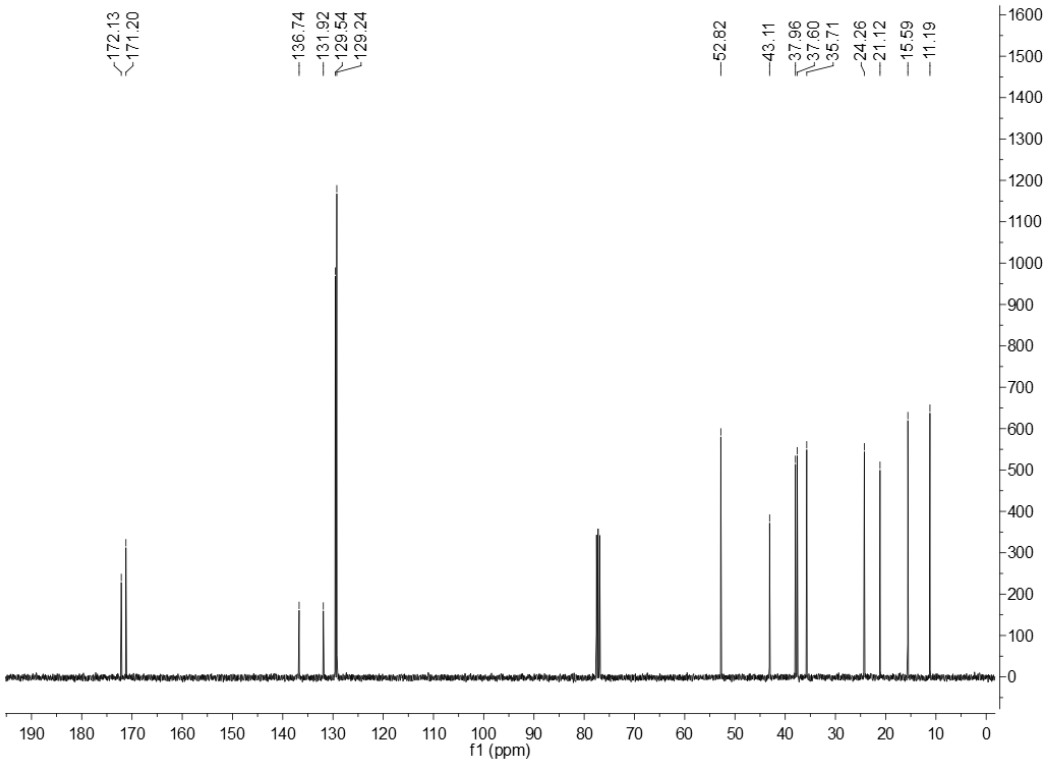

7.14
7.11
7.10
7.08
6.71
6.69
5.00
4.99
4.98
4.97
4.96
4.95
3.48
3.05
2.89
2.28
1.44
1.41
1.40
1.39
0.91
0.85
0.84
4.00
0.88
1.00
1.98
3.01
3.00
3.00
1.03
2.07
2.99
2.99
f1 (ppm)

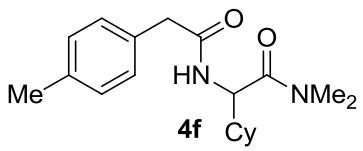

172.59
172.59
171.02
171.02
136.66
131.90
129.50
129.23
47.31
42.25
35.76
24.72
23.36
22.00
21.10
f1 (ppm)


O
O
HN
NMe2
Me
sBu

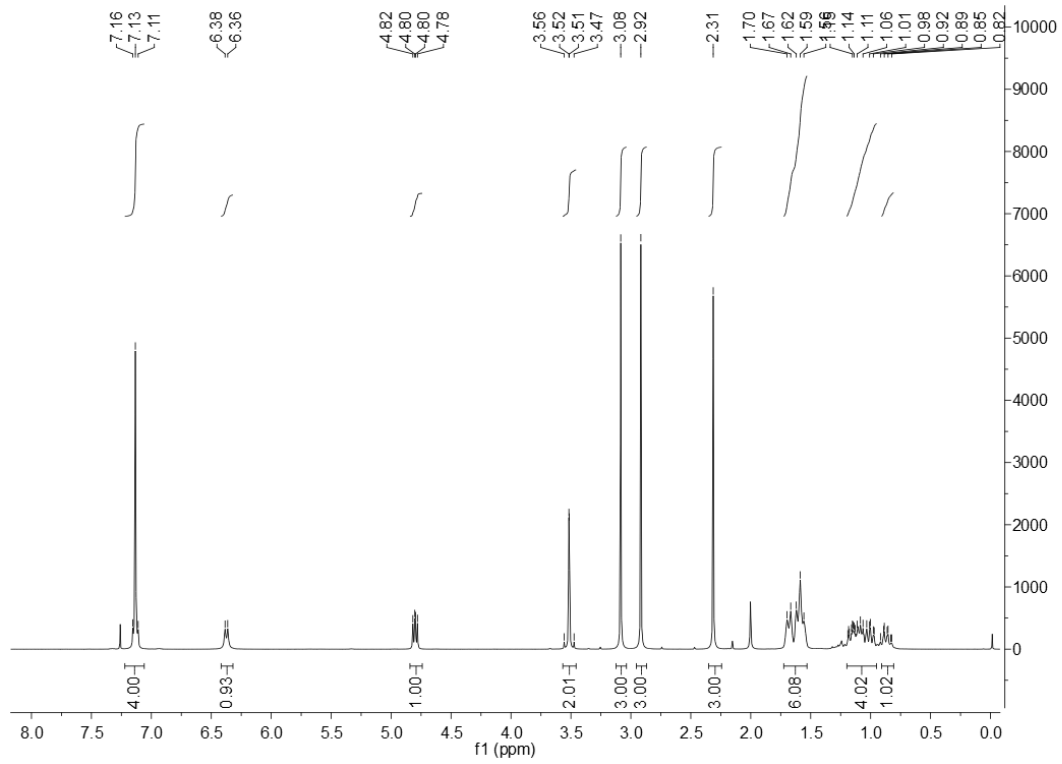
4e

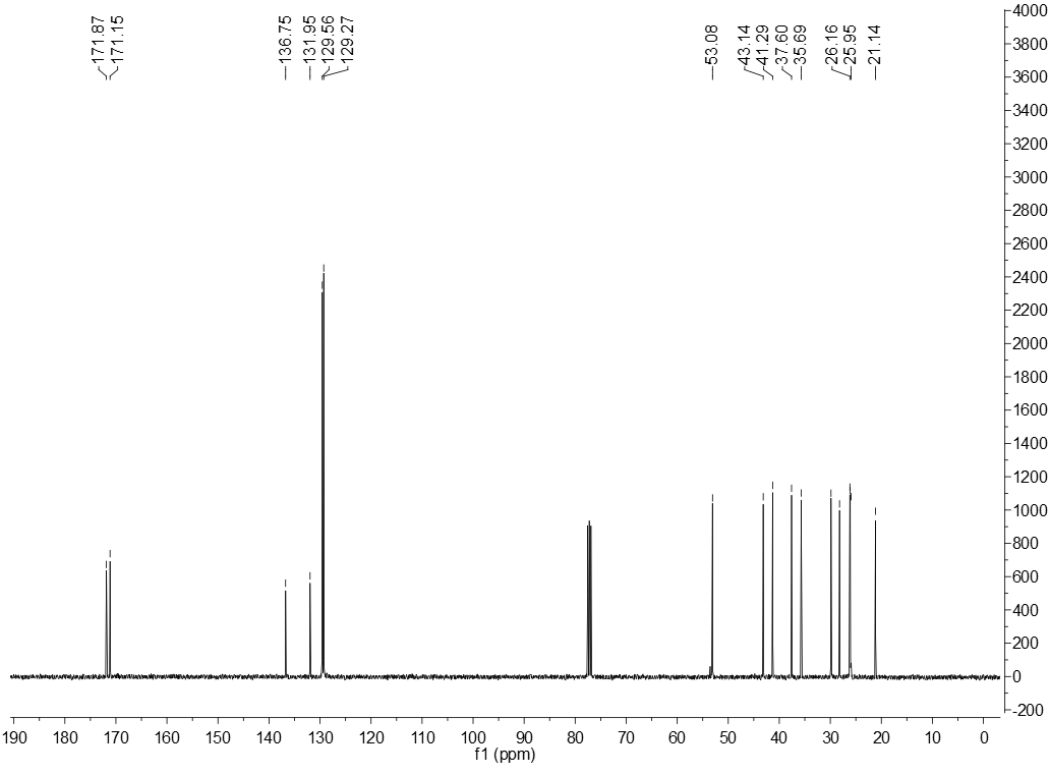

7.14
7.12
7.11
7.09
6.58
6.55
4.82
4.80
4.80
4.78
3.50
3.08
2.90
2.29
1.69
1.67
1.63
1.34
0.99
0.92
0.85
0.83
0.81
0.79
0.77
4.00
0.89
1.01
2.01
3.00
3.00
3.02
1.02
1.04
1.10
3.01
3.00
f1 (ppm)

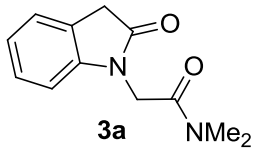

172.13
171.20
136.74
131.92
129.54
129.24
52.82
43.11
37.96
37.60
35.71
24.26
21.12
15.59
11.19
f1 (ppm)


O
O
HN
NMe2
Me
Cy

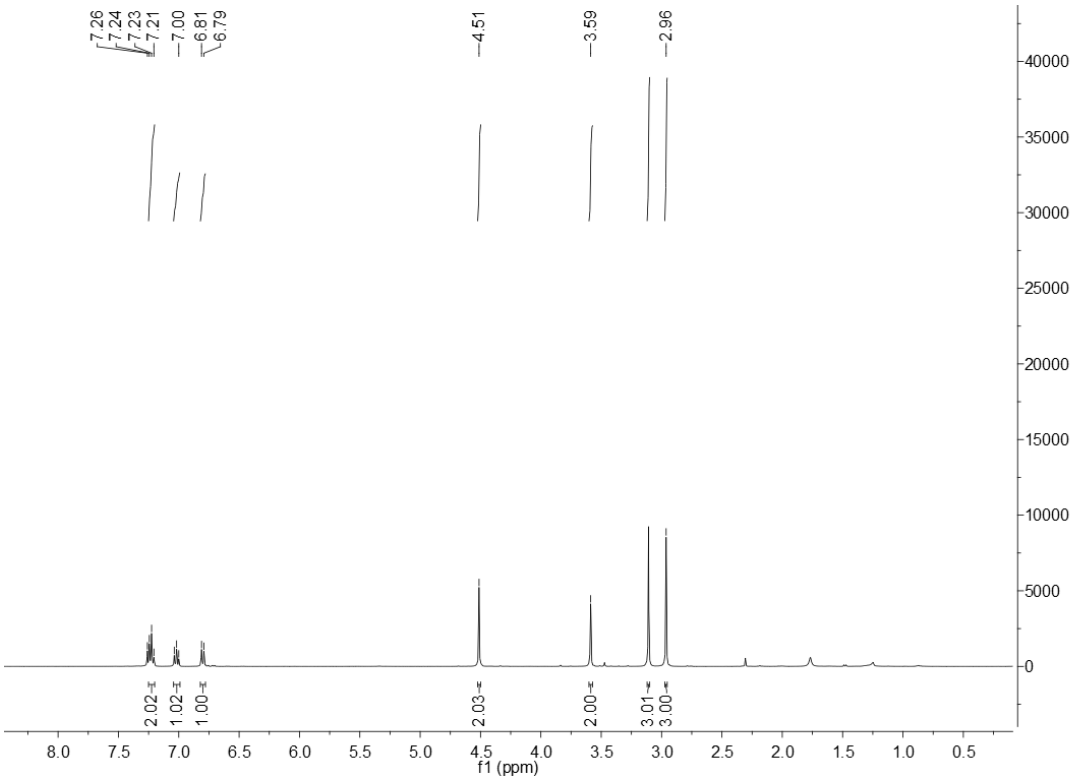
4f

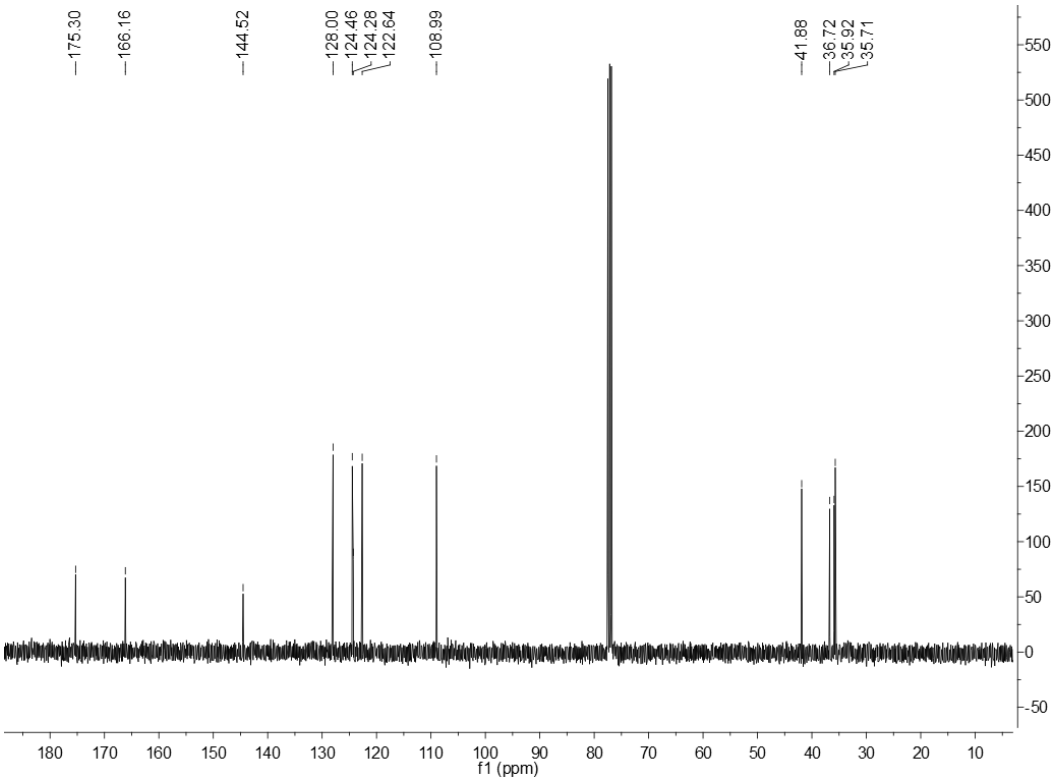

7.16
7.13
7.11
6.38
6.36
4.82
4.80
4.80
4.78
3.56
3.52
3.51
3.47
3.08
2.92
2.31
1.70
1.67
1.62
1.59
1.14
1.11
1.06
1.01
0.98
0.92
0.89
0.85
0.82
4.00
0.93
1.00
2.01
3.00
3.00
3.00
6.08
4.02
1.02
f1 (ppm)

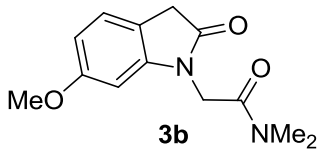

171.87
171.15
136.75
131.95
129.56
129.27
53.08
43.14
41.29
37.60
35.69
26.16
25.95
21.14
f1 (ppm)


O
N
O
NMe2

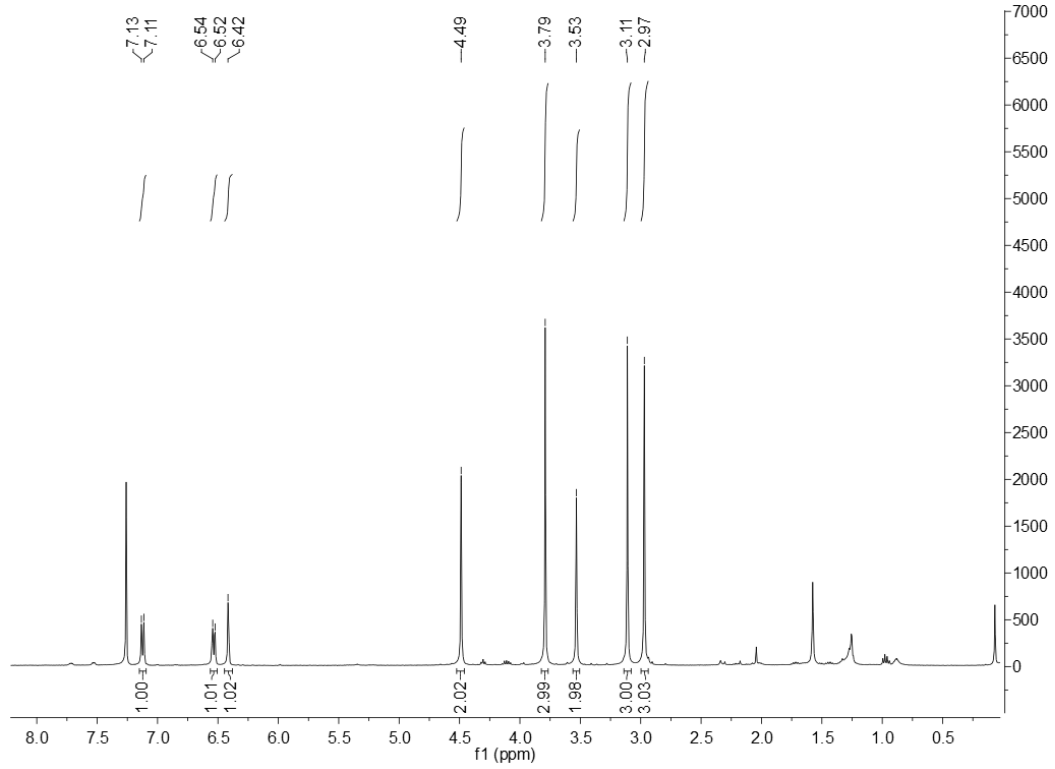
3a

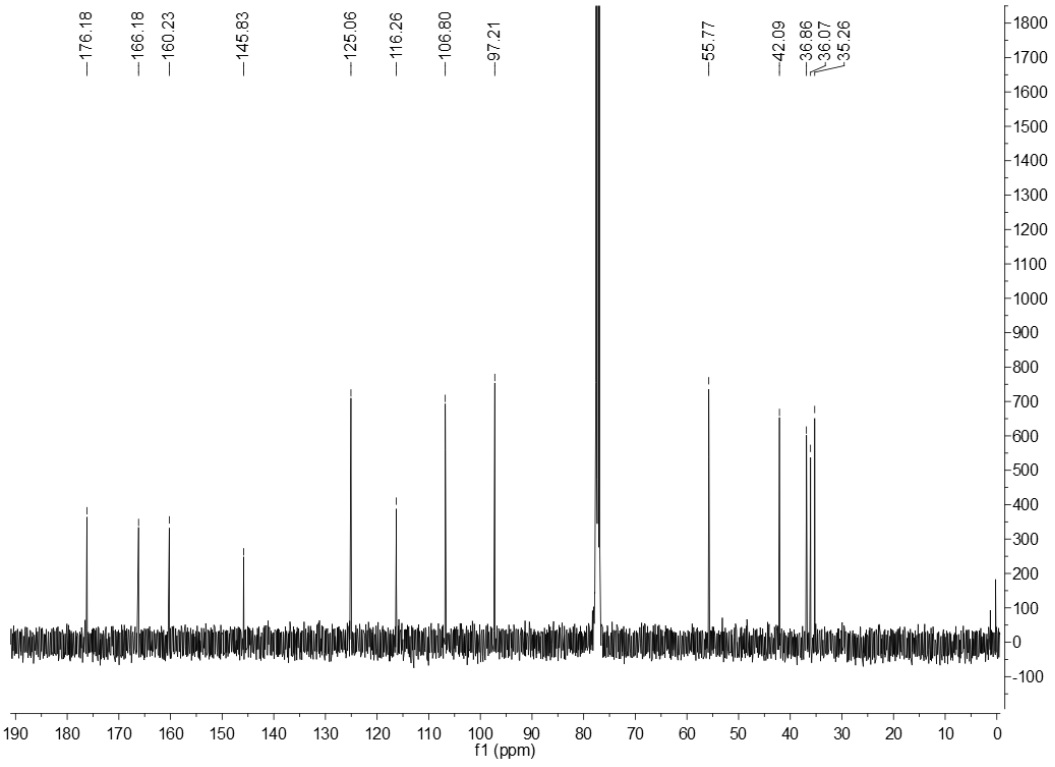

7.26
7.24
7.23
7.21
7.00
6.81
6.79
4.51
3.59
2.96
2.02
1.02
1.00
2.03
2.00
3.01
3.00
f1 (ppm)

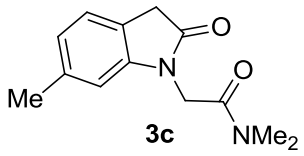

175.30
166.16
144.52
128.00
124.46
124.28
122.64
108.99
41.88
36.72
35.92
35.71
f1 (ppm)


MeO
O
N
O
NMe2

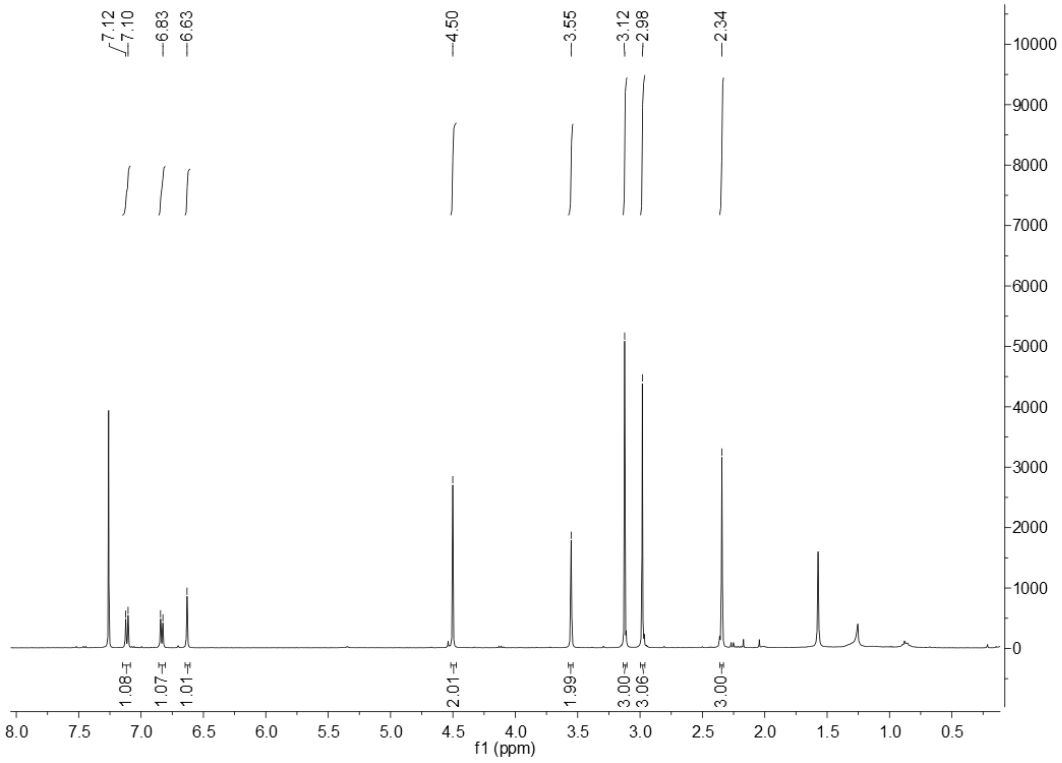
3b

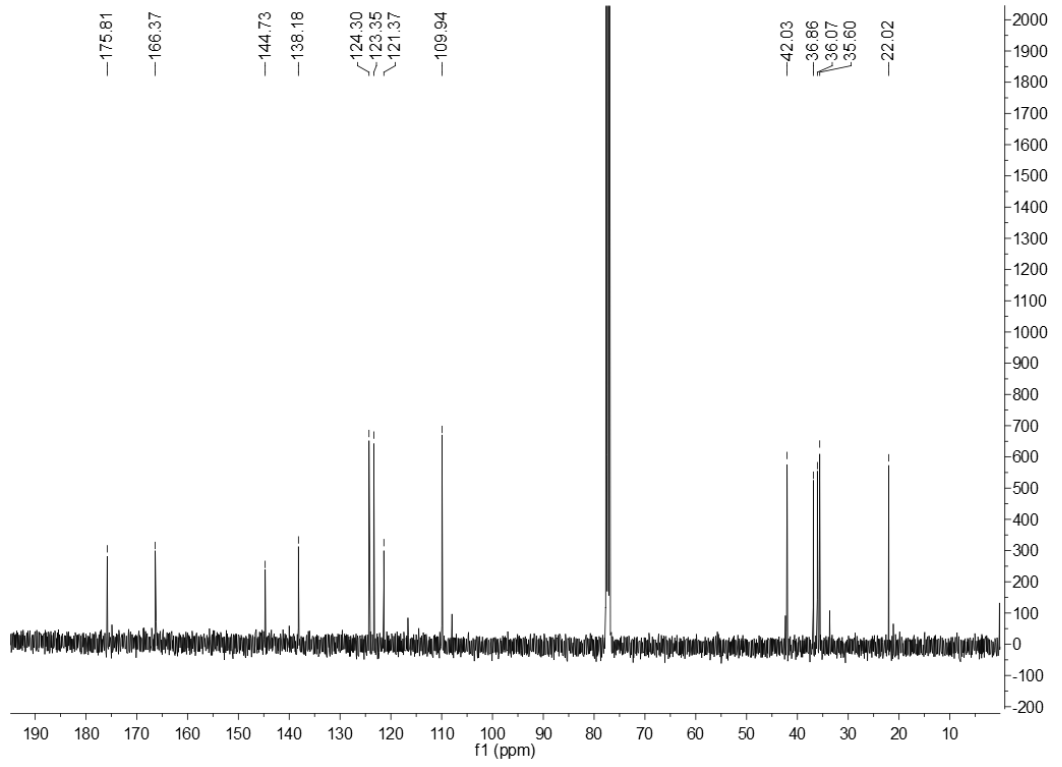

7.13
7.11
6.54
6.52
6.42
4.49
3.79
3.53
3.11
2.97
1.00
1.01
1.02
2.02
2.99
1.98
3.00
3.03
f1 (ppm)

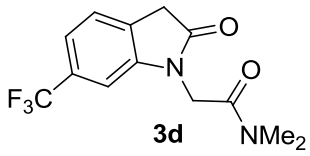

176.18
166.18
160.23
145.83
125.06
116.26
106.80
97.21
55.77
42.09
36.86
36.07
35.26
f1 (ppm)


O
N
O
Me
NMe2

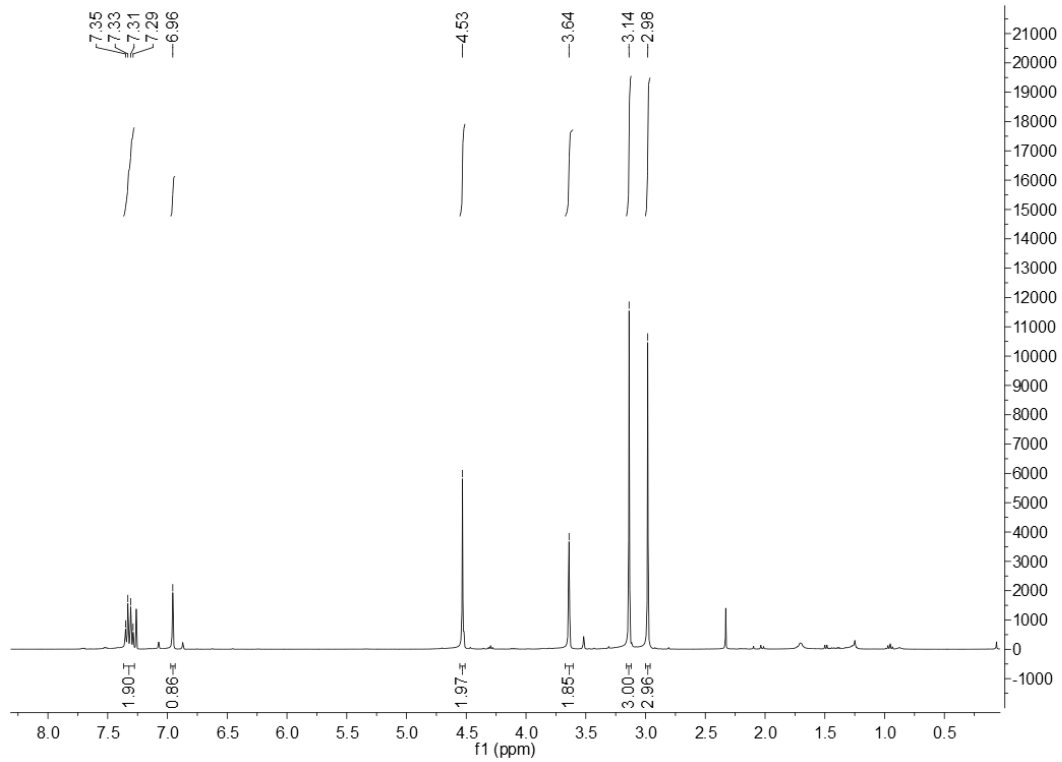
3c

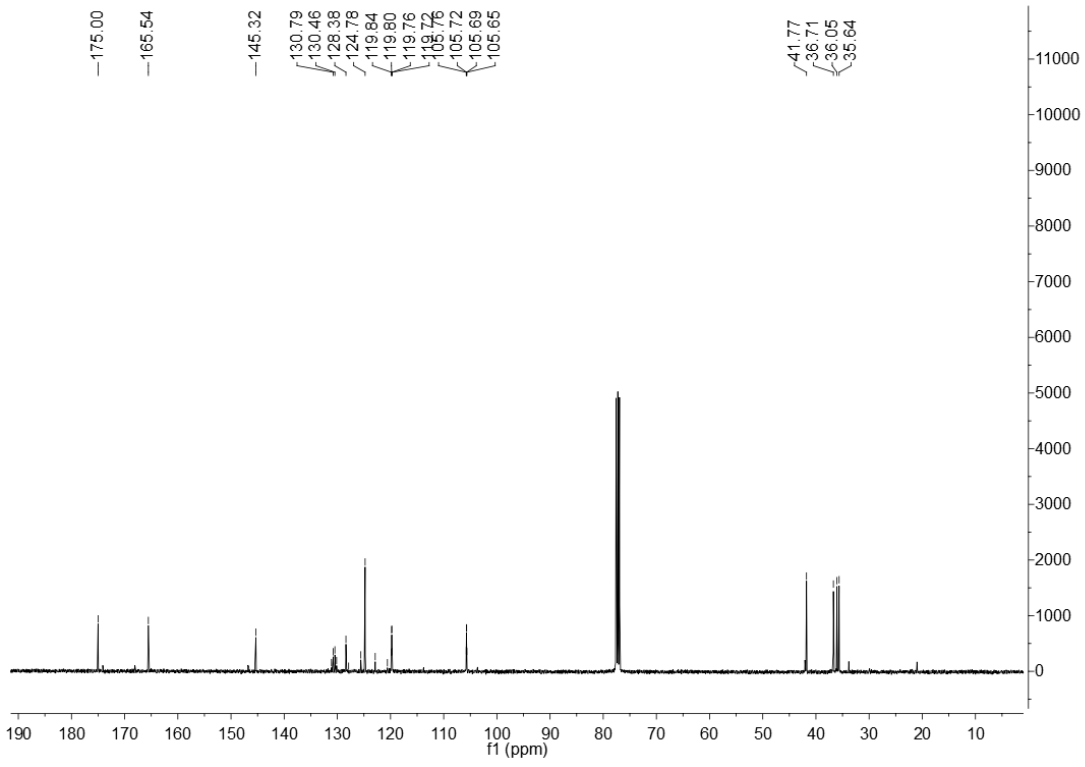

7.12
7.10
6.83
6.63
4.50
3.55
3.12
2.98
2.34
1.08
1.07
1.01
2.01
1.99
3.00
3.06
3.00
f1 (ppm)


175.81
166.37
144.73
138.18
124.30
123.35
121.37
109.94
42.03
36.86
36.07
35.60
22.02
f1 (ppm)


O
N
O
F3C
NMe2

3d


7.35
7.33
7.31
7.29
6.96
4.53
3.64
3.14
2.98
1.90
0.86
1.97
1.85
3.00
2.96
f1 (ppm)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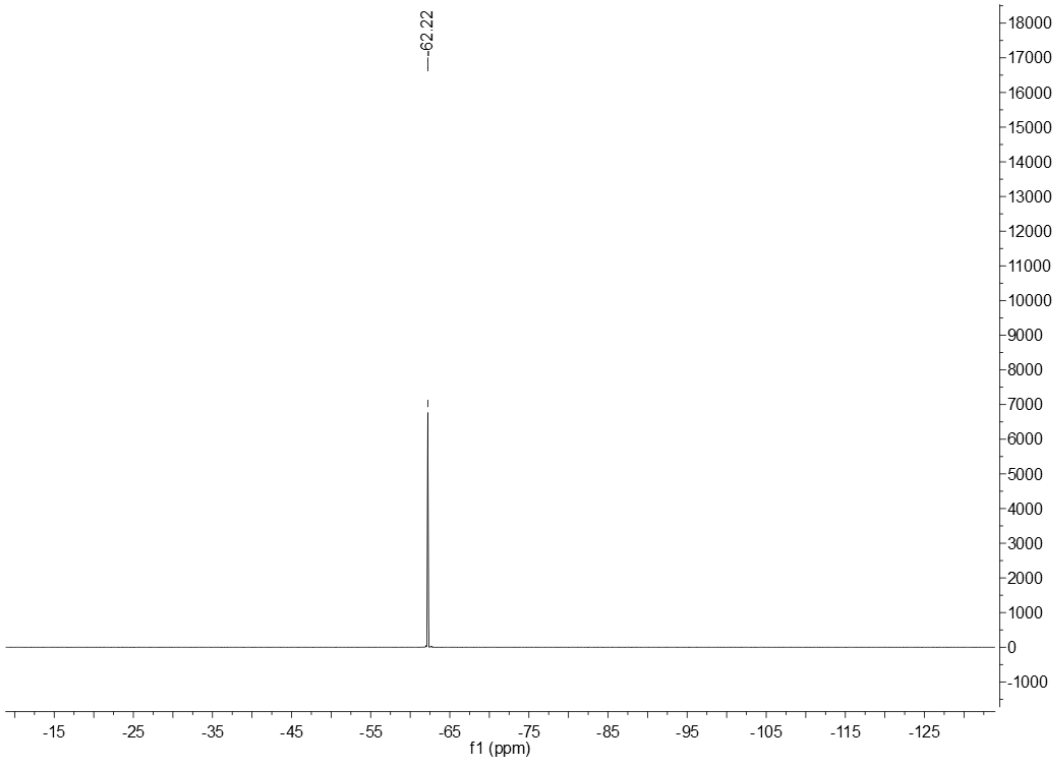
145.32
130.79
130.46
128.38
124.78
119.84
119.80
119.76
119.72
105.76
105.72
105.69
105.65
41.77
36.71
36.05
35.64
f1 (ppm)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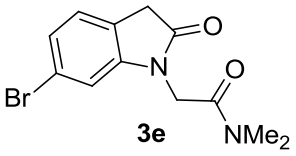
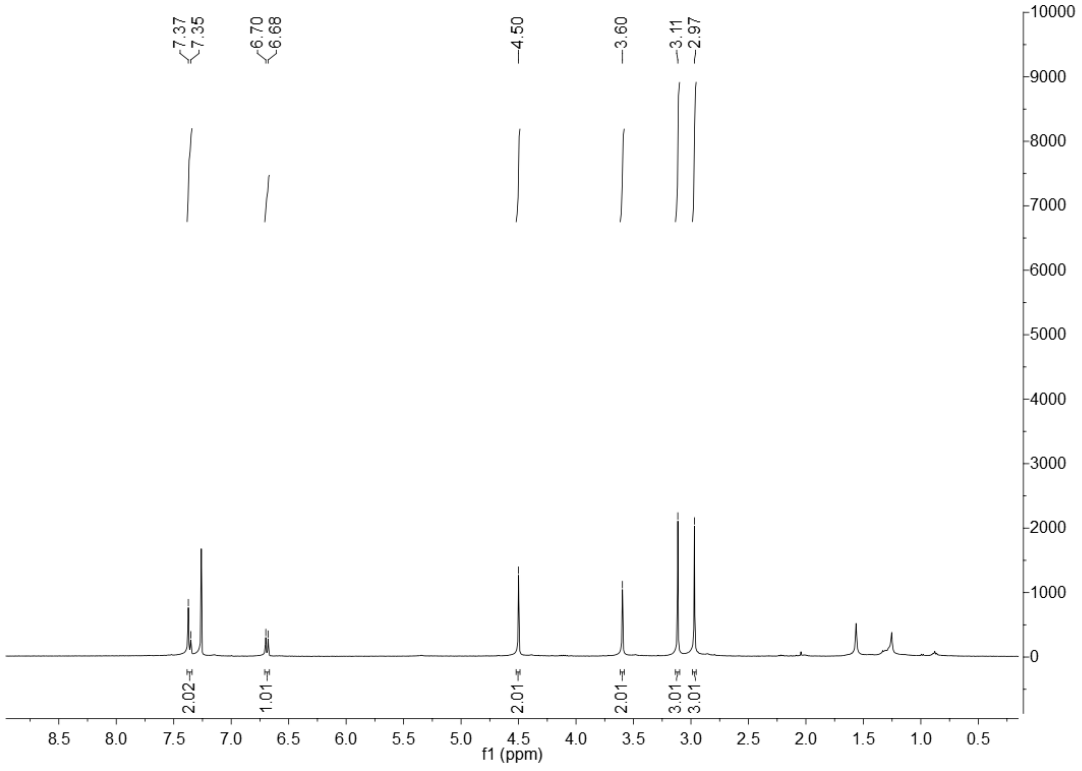
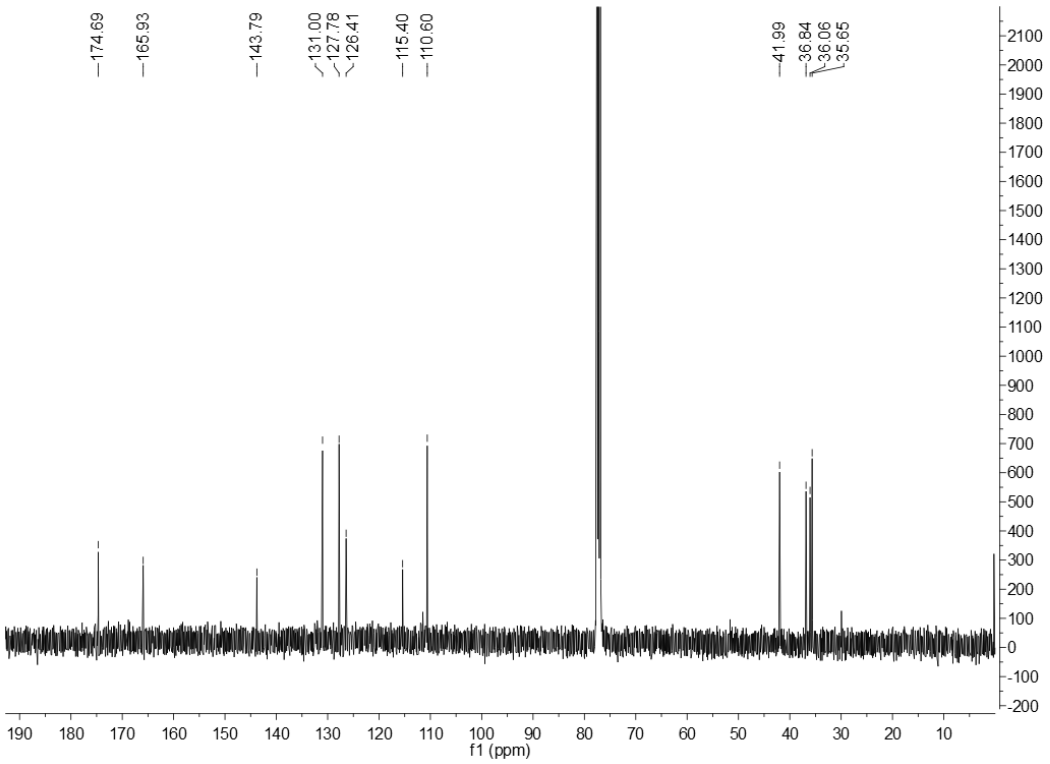
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-15
-25
-35
-45
-55
-65
-75
-85
-95
-105
-115
-125
f1 (ppm)


O
N
O
Br
NMe2

3e


7.37
7.35
6.70
6.68
4.50
3.60
3.11
2.97
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2.02
1.01
2.01
2.01
3.01
3.01
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


174.69
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143.79
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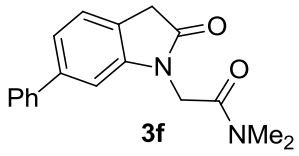
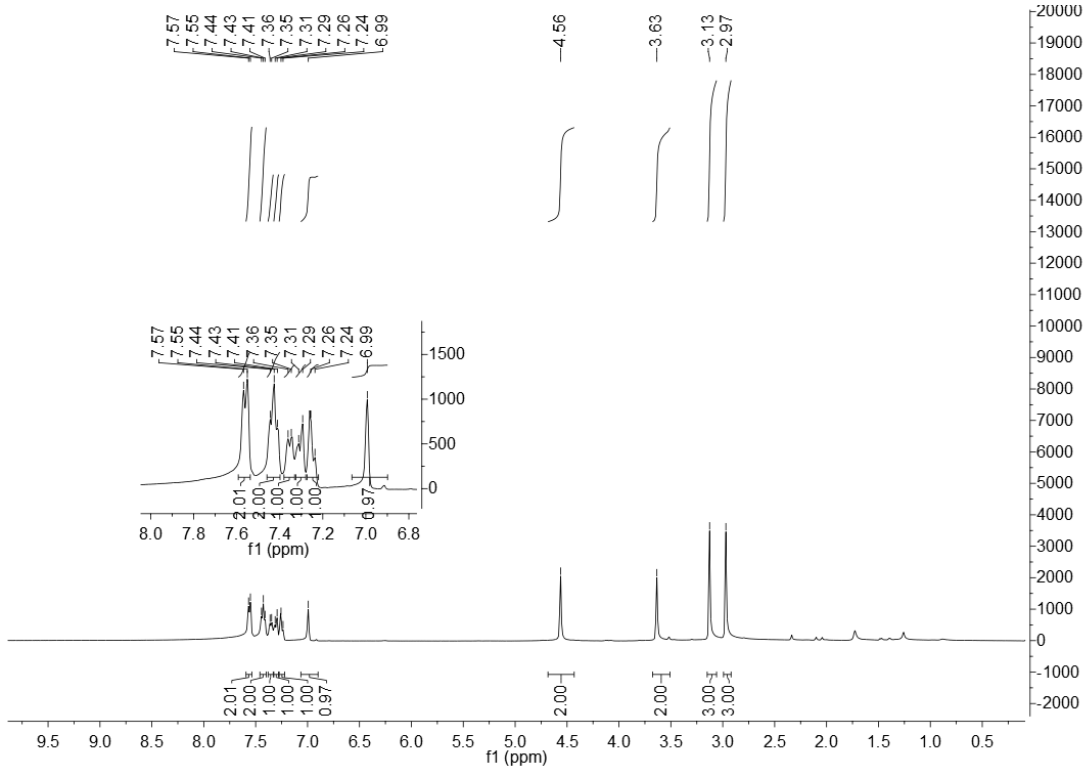
127.78
126.41
115.40
110.60
41.99
36.84
36.06
35.65
f1 (ppm)


O
N
O
Ph
NMe2

3f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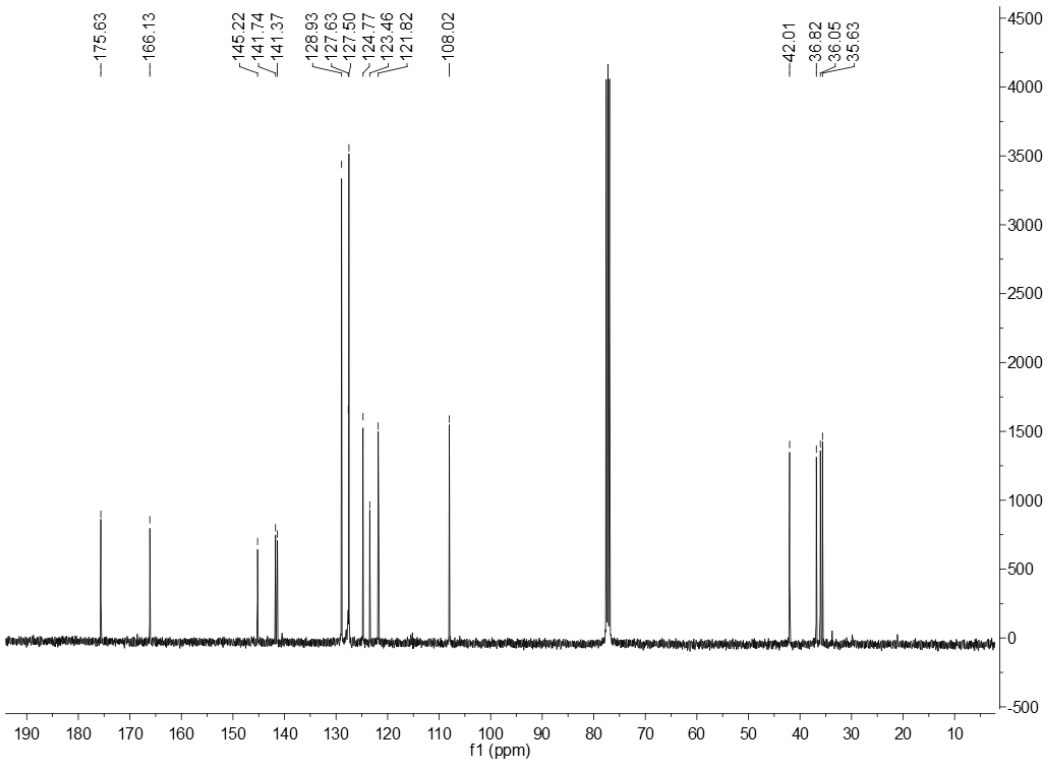
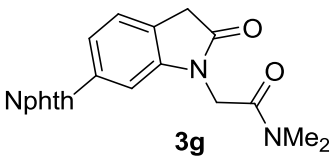
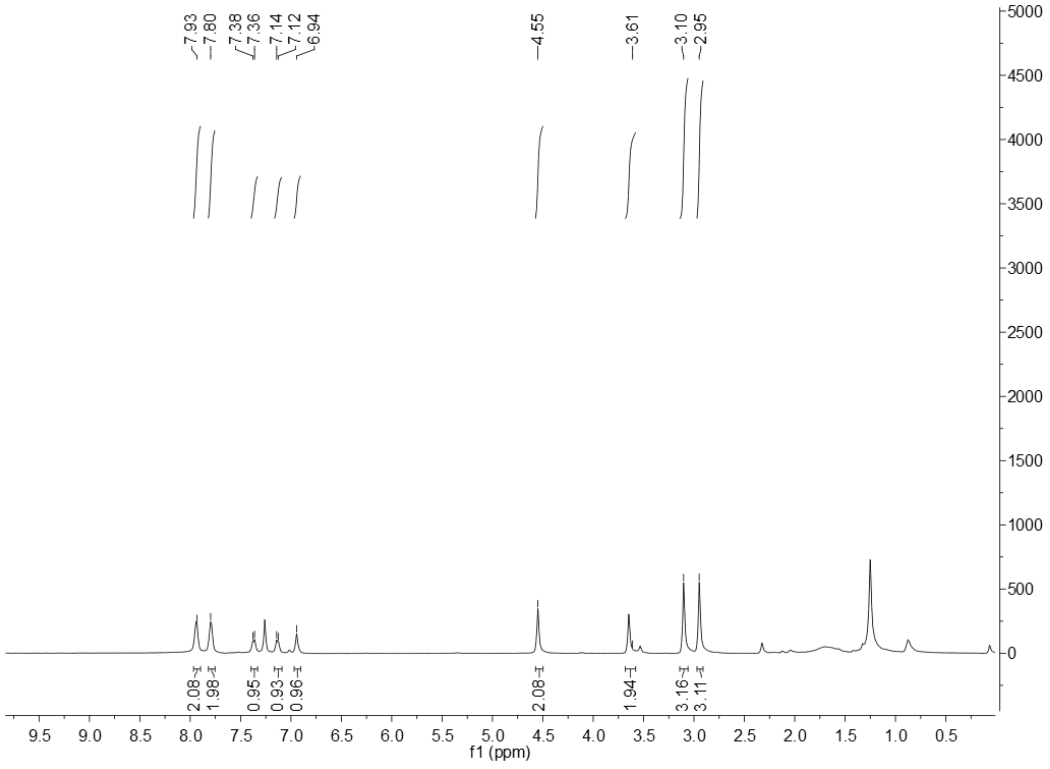
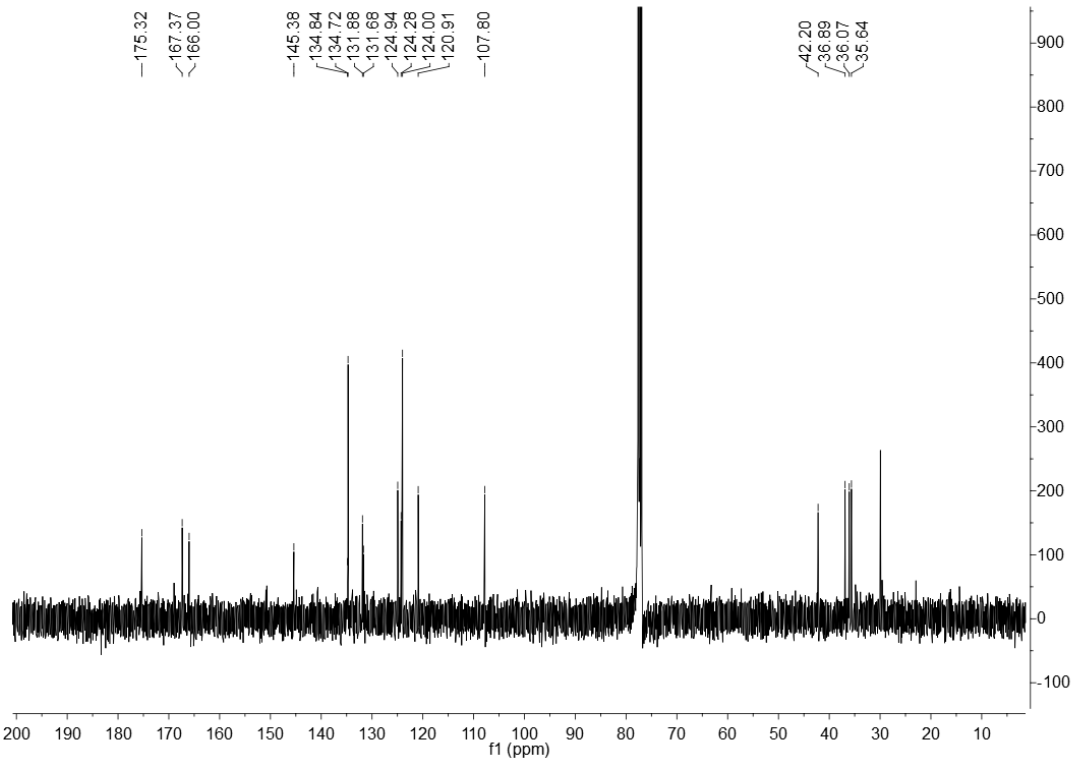
7.55
7.44
7.43
7.41
7.36
7.35
7.31
7.29
7.26
7.24
6.99
4.56
3.63
3.13
2.97
2.01
2.00
1.00
1.00
1.00
0.97
2.00
2.00
3.00
3.00
f1 (ppm)

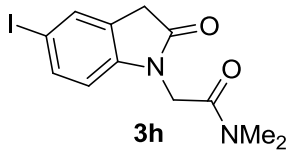

175.63
166.13
145.22
141.74
141.37
128.93
127.63
127.50
124.77
123.46
121.82
108.02
42.01
36.82
36.05
35.63
f1 (ppm)


O
N
O
Nphth
NMe2

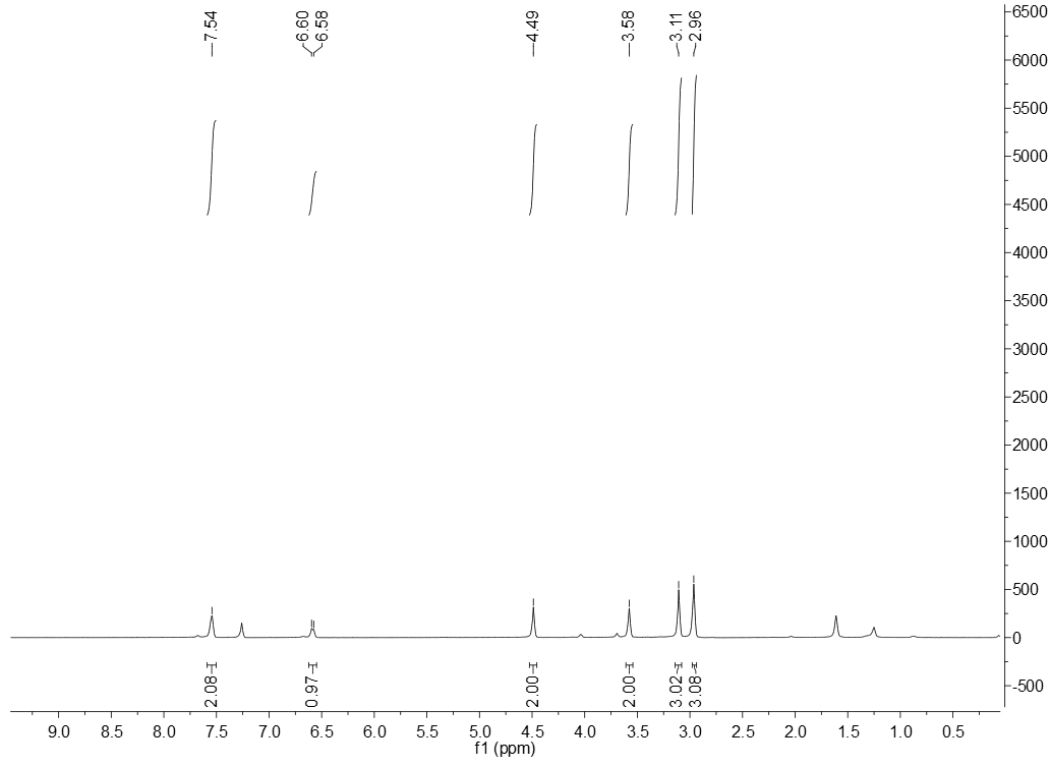
3g

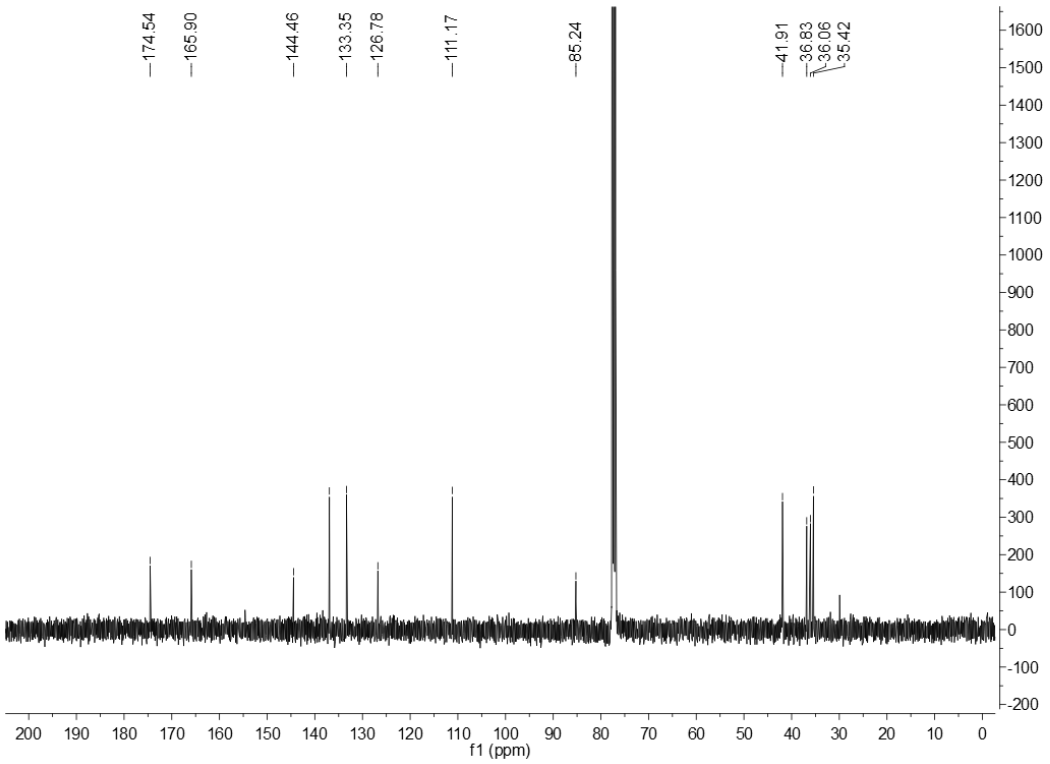

7.93
7.80
7.38
7.36
7.14
7.12
6.94
4.55
3.61
3.10
2.95
2.08
1.98
0.95
0.93
0.96
2.08
1.94
3.16
3.11
f1 (ppm)

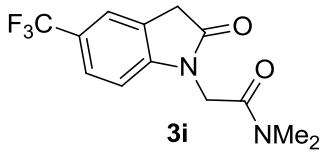

175.32
167.37
166.00
145.38
134.84
134.72
131.88
131.68
124.94
124.28
124.00
120.91
107.80
42.20
36.89
36.07
35.64
f1 (ppm)


I
O
N
O
NMe2

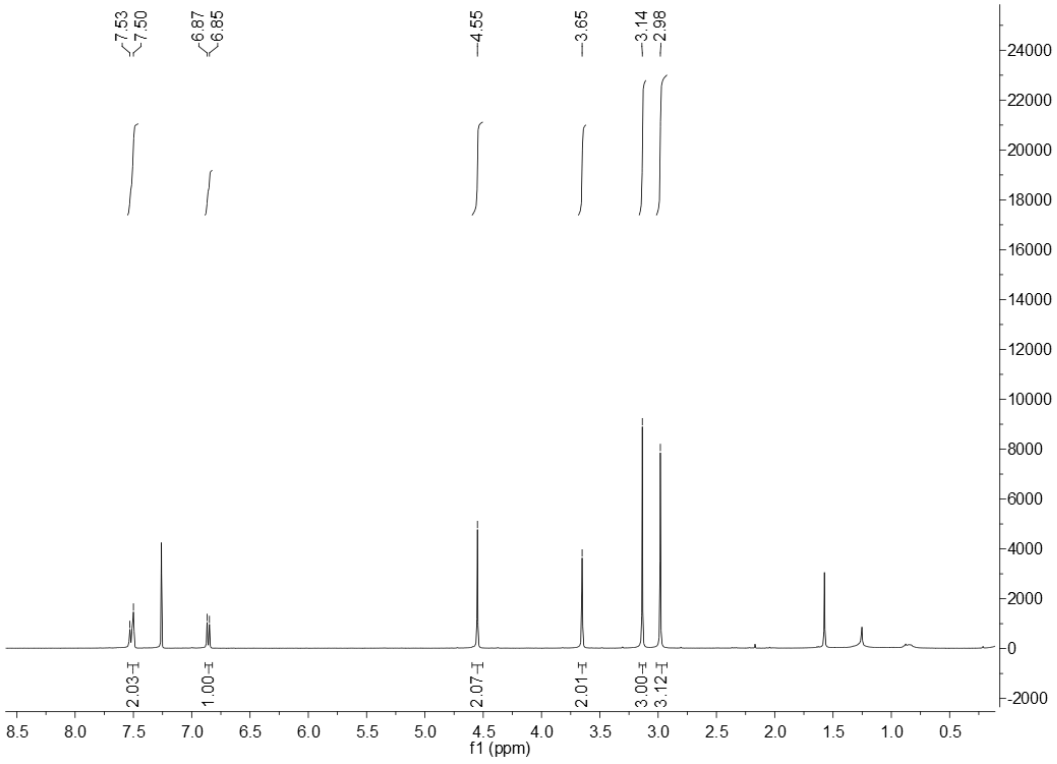
3h

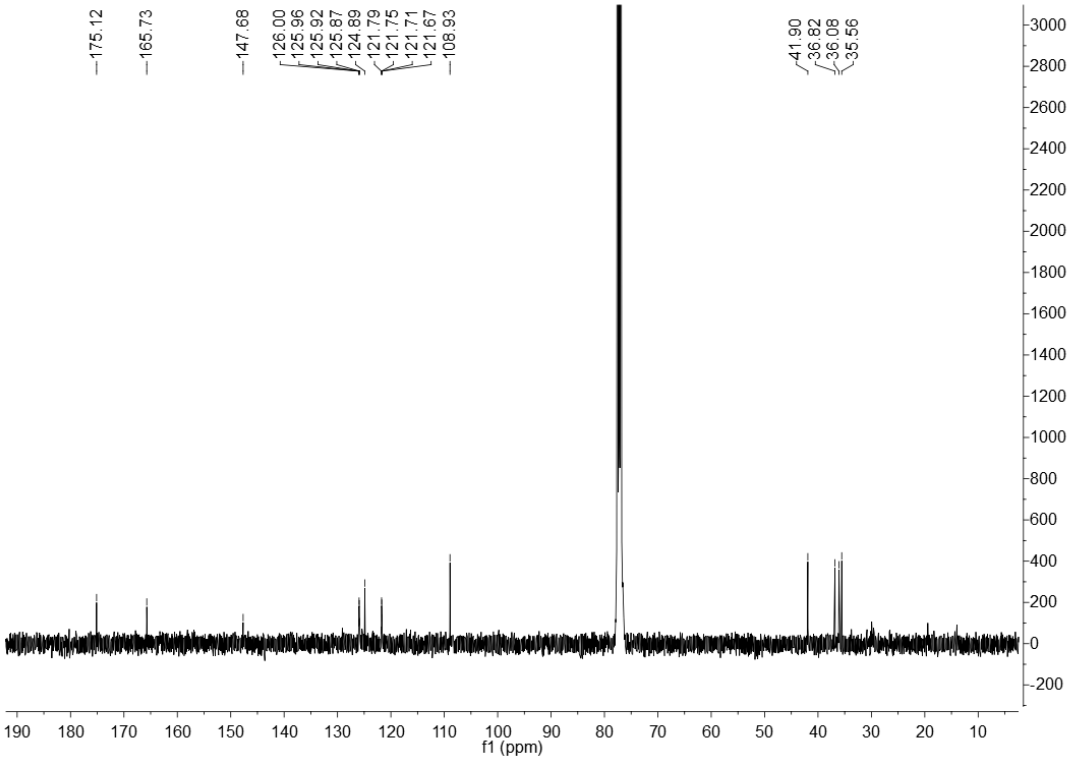

7.54
6.60
6.58
4.49
3.58
3.11
2.96
2.08
0.97
2.00
2.00
3.02
3.08
f1 (ppm)

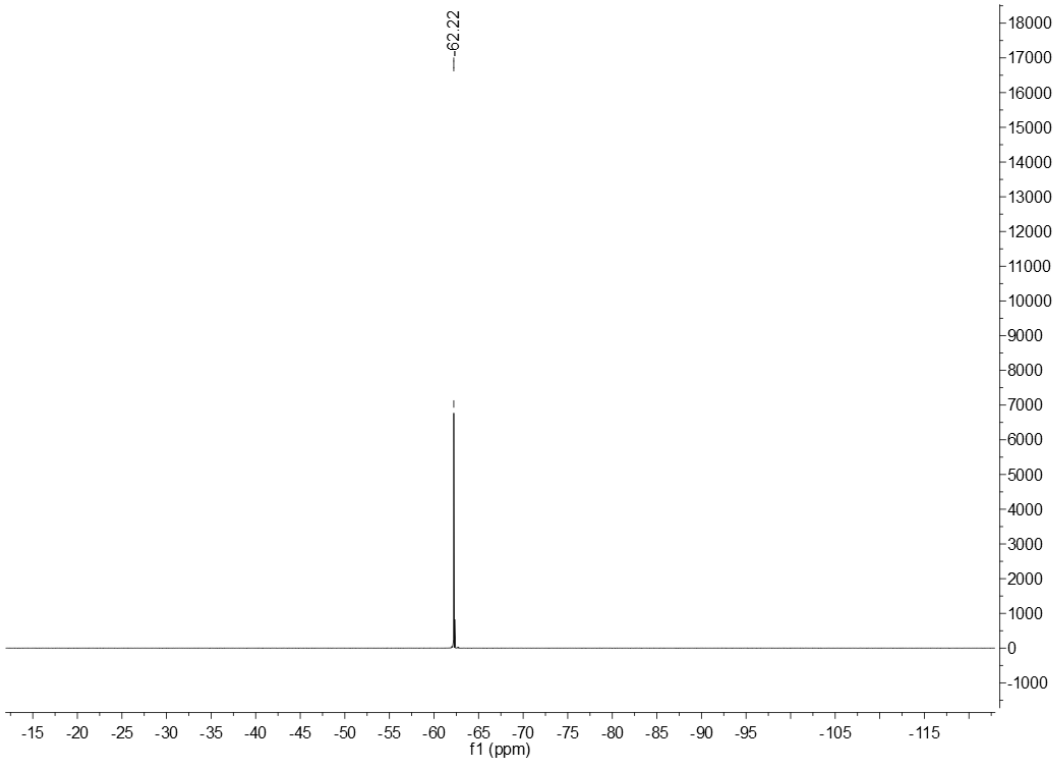

174.54
165.90
144.46
133.35
126.78
111.17
85.24
41.91
36.83
36.06
35.42
f1 (ppm)

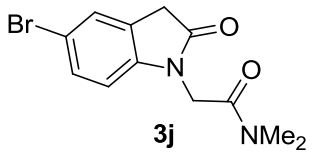

F3C
O
N
O
NMe2

3i

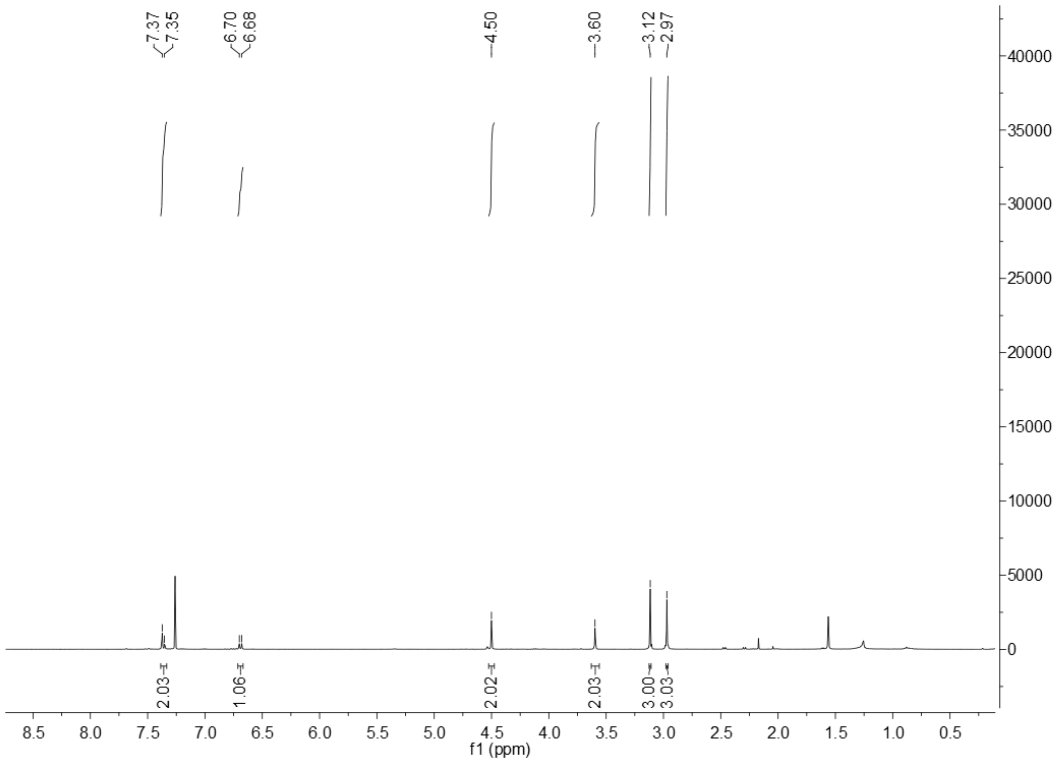

7.53
7.50
6.87
6.85
4.55
3.65
3.14
2.98
2.03
1.00
2.07
2.01
3.00
3.12
f1 (ppm)

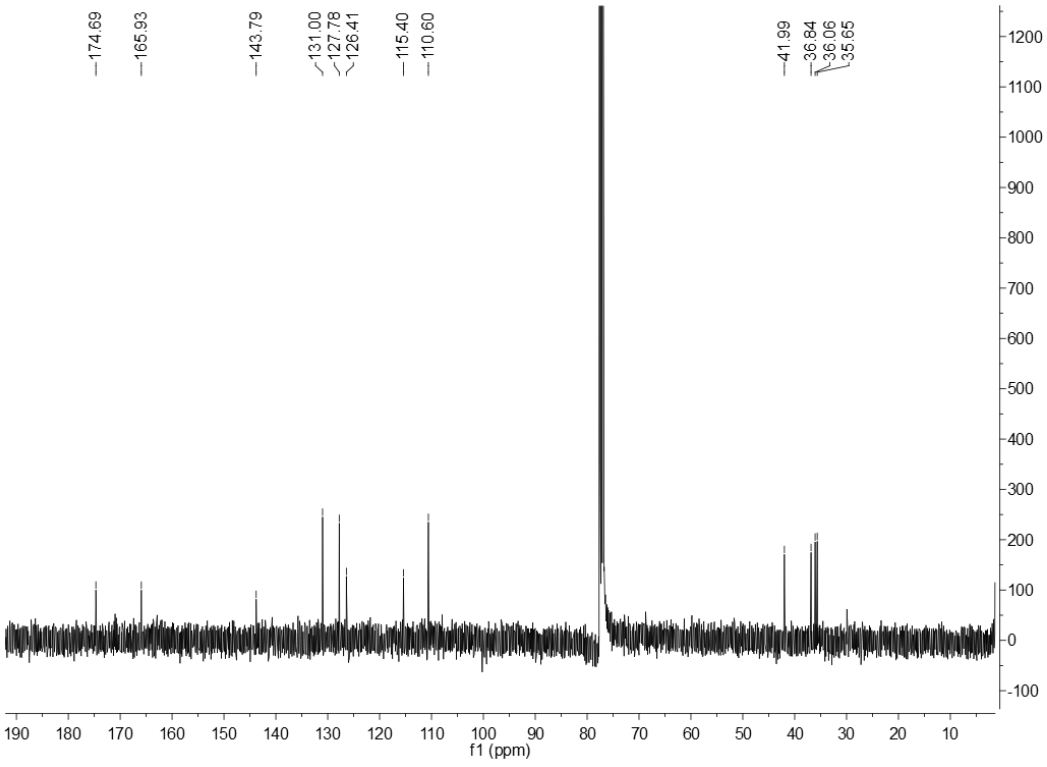

175.12
165.73
147.68
126.00
125.96
125.92
125.87
124.89
121.79
121.75
121.71
121.67
108.93
41.90
36.82
36.08
35.56
f1 (ppm)

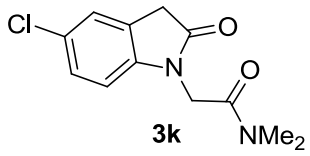

-62.22
f1 (ppm)


Br
O
N
O
NMe2

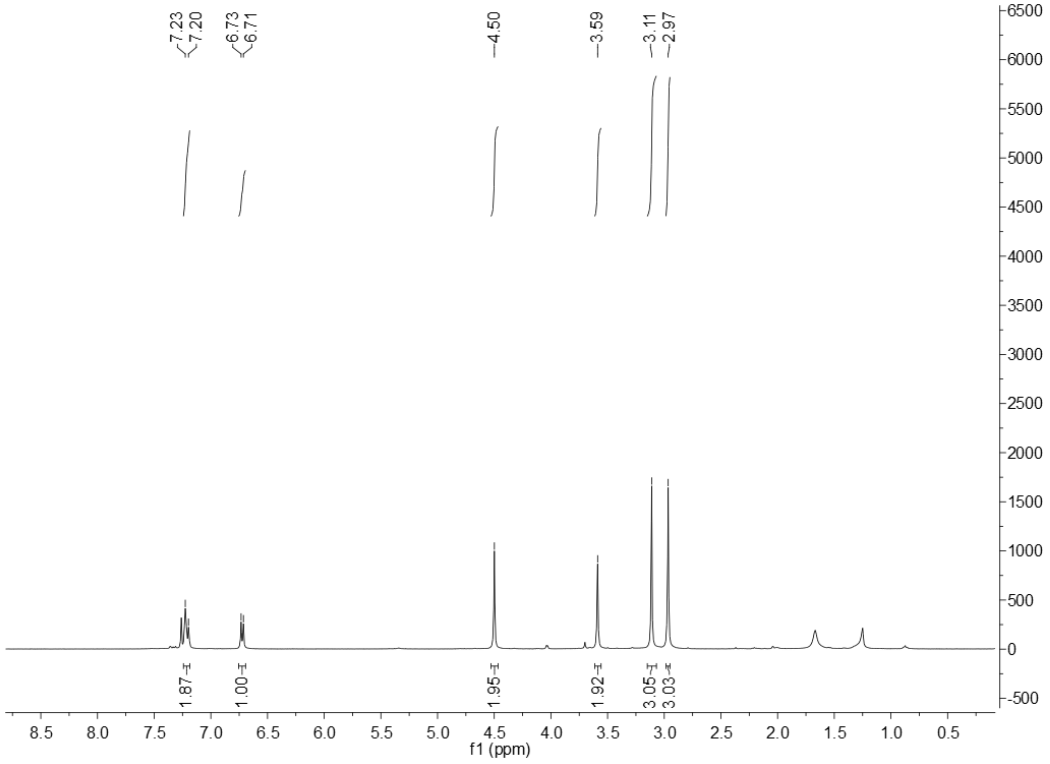
3j

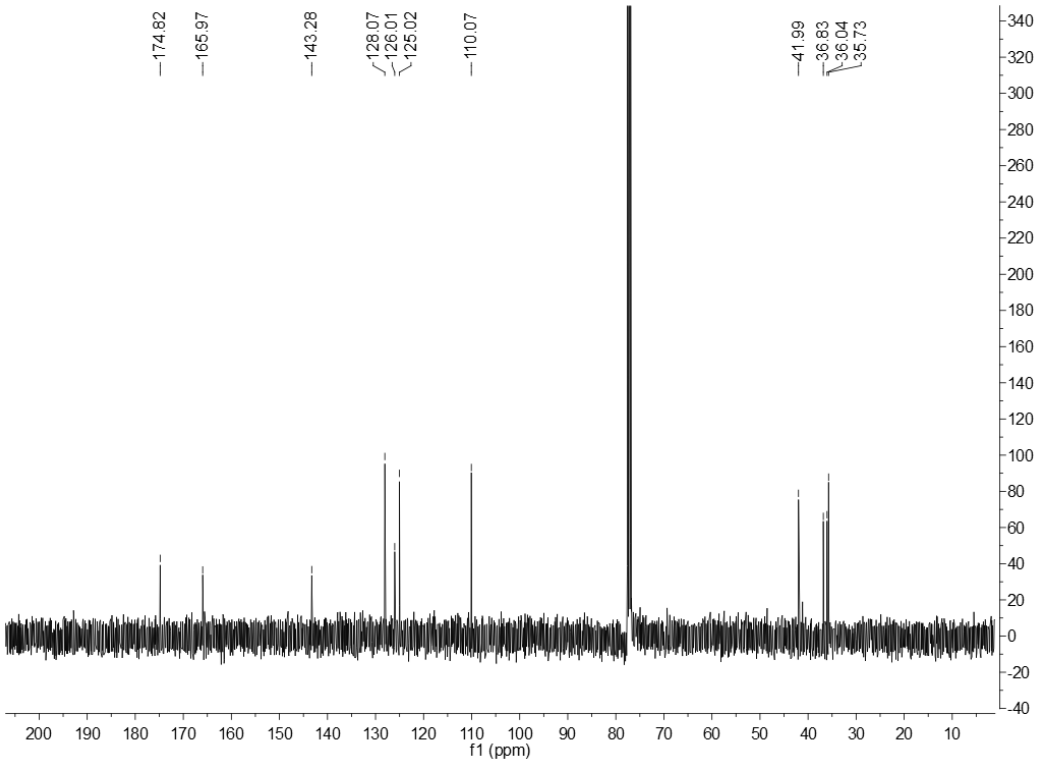

7.37
7.35
6.70
6.68
4.50
3.60
3.12
2.97
2.03
1.06
2.02
2.03
3.00
3.03
f1 (ppm)

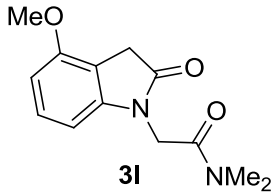

174.69
165.93
143.79
131.00
127.78
126.41
115.40
110.60
41.99
36.84
36.06
35.65
f1 (ppm)


Cl
O
N
O
NMe2

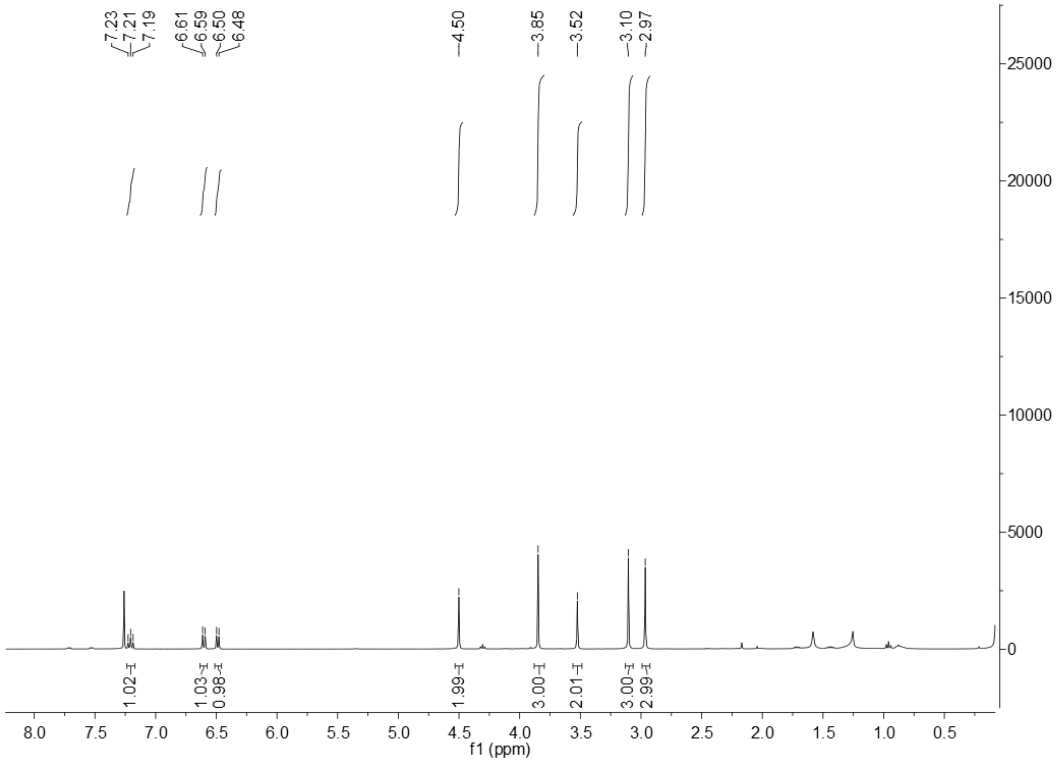
3k

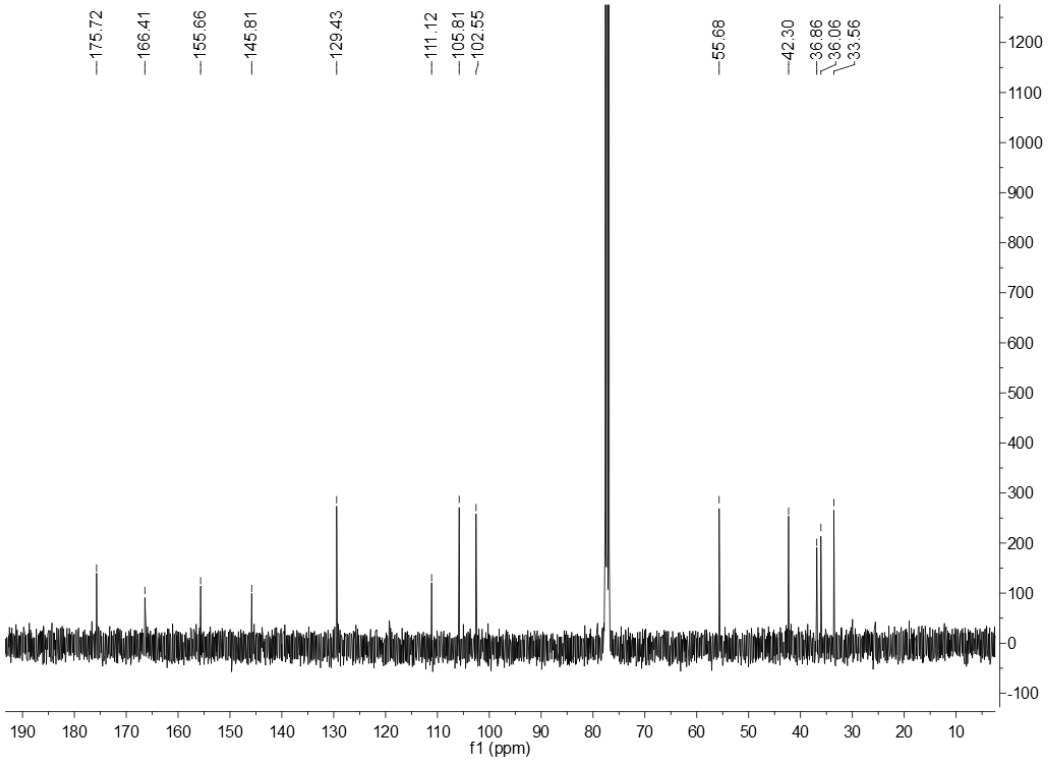

7.23
7.20
6.73
6.71
4.50
3.59
3.11
2.97
1.87
1.00
1.95
1.92
3.05
3.03
f1 (ppm)

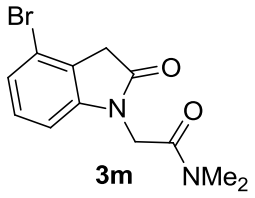

174.82
165.97
143.28
128.07
126.01
125.02
110.07
41.99
36.83
36.04
35.73
f1 (ppm)


MeO
O
N
O
NMe2

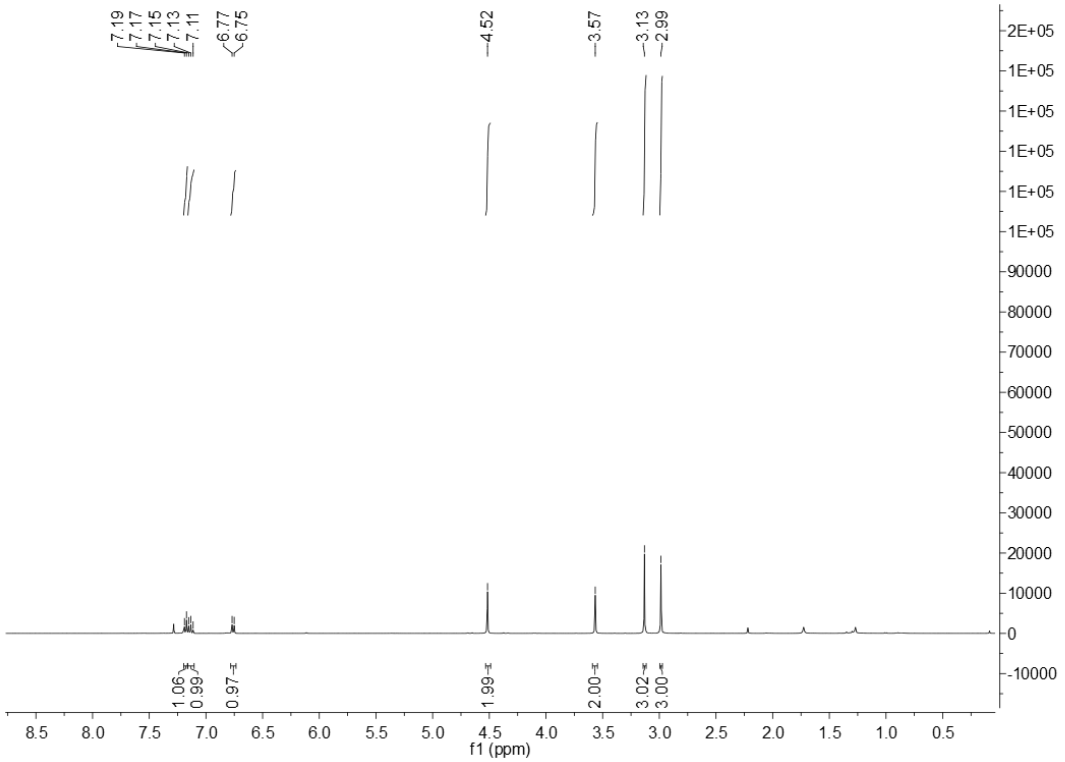
3l

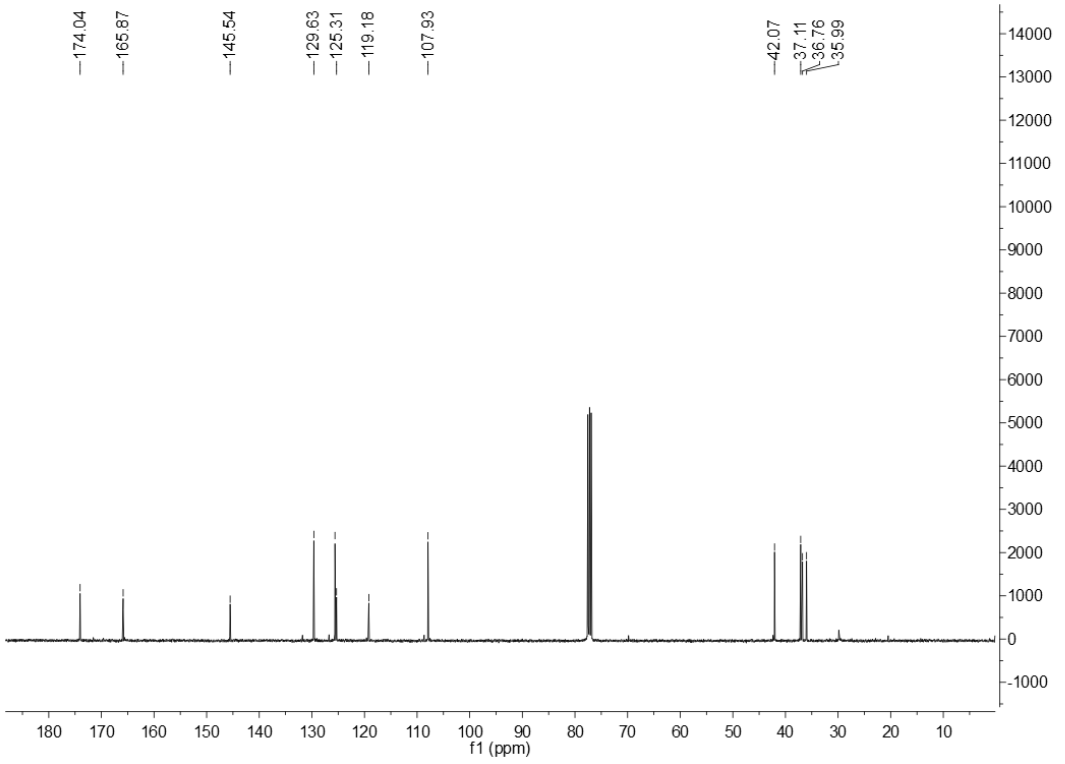

7.23
7.21
7.19
6.61
6.59
6.50
6.48
4.50
3.85
3.52
3.10
2.97
1.02
1.03
0.98
1.99
3.00
2.01
3.00
2.99
f1 (ppm)

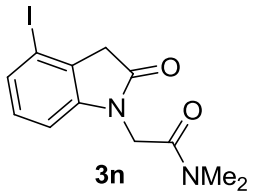

175.72
166.41
155.66
145.81
129.43
111.12
105.81
102.55
55.68
42.30
36.86
36.06
33.56
f1 (ppm)


Br
O
N
O
NMe2

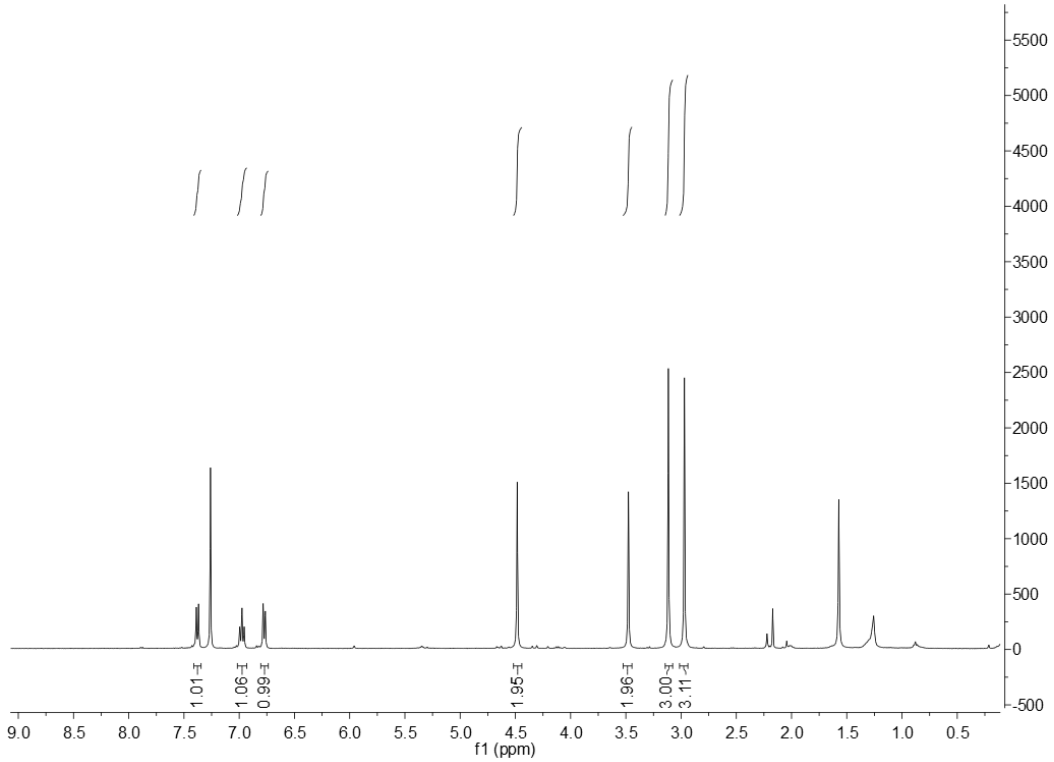
3m

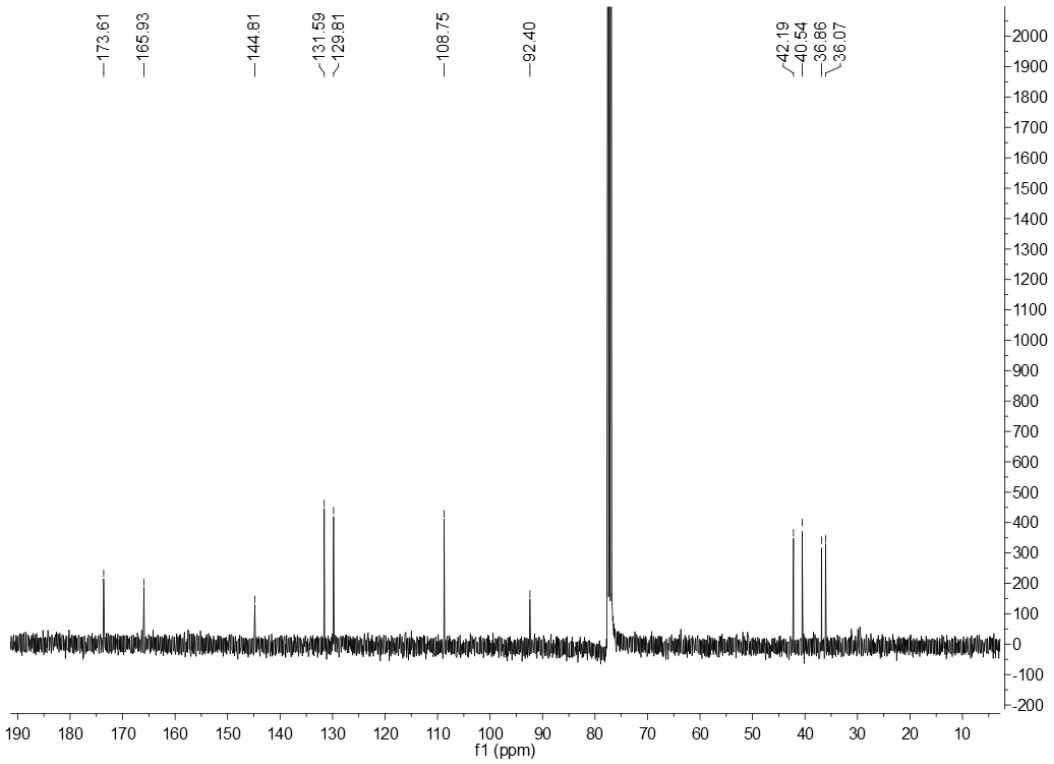

7.19
7.17
7.15
7.13
7.11
6.77
6.75
4.52
3.57
3.13
2.99
1.06
0.99
0.97
1.99
2.00
3.02
3.00
f1 (ppm)

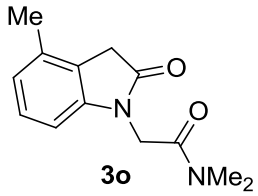

174.04
165.87
145.54
129.63
125.31
119.18
107.93
42.07
37.11
36.76
35.99
f1 (ppm)


I
O
N
O
NMe2

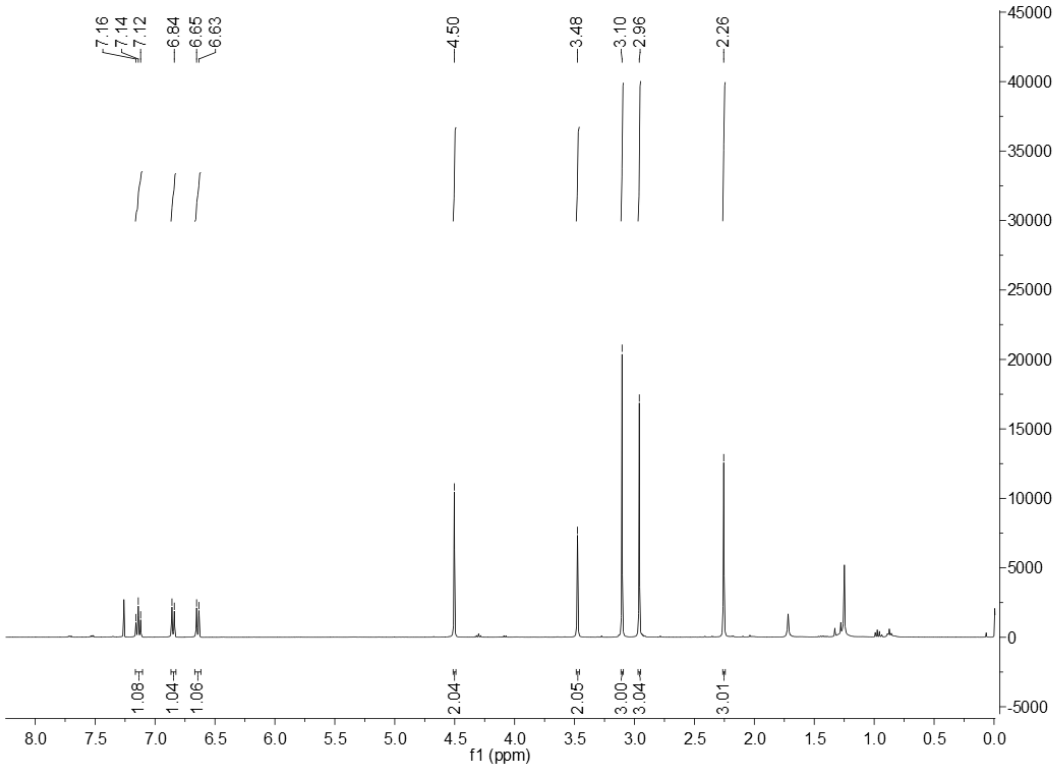
3n

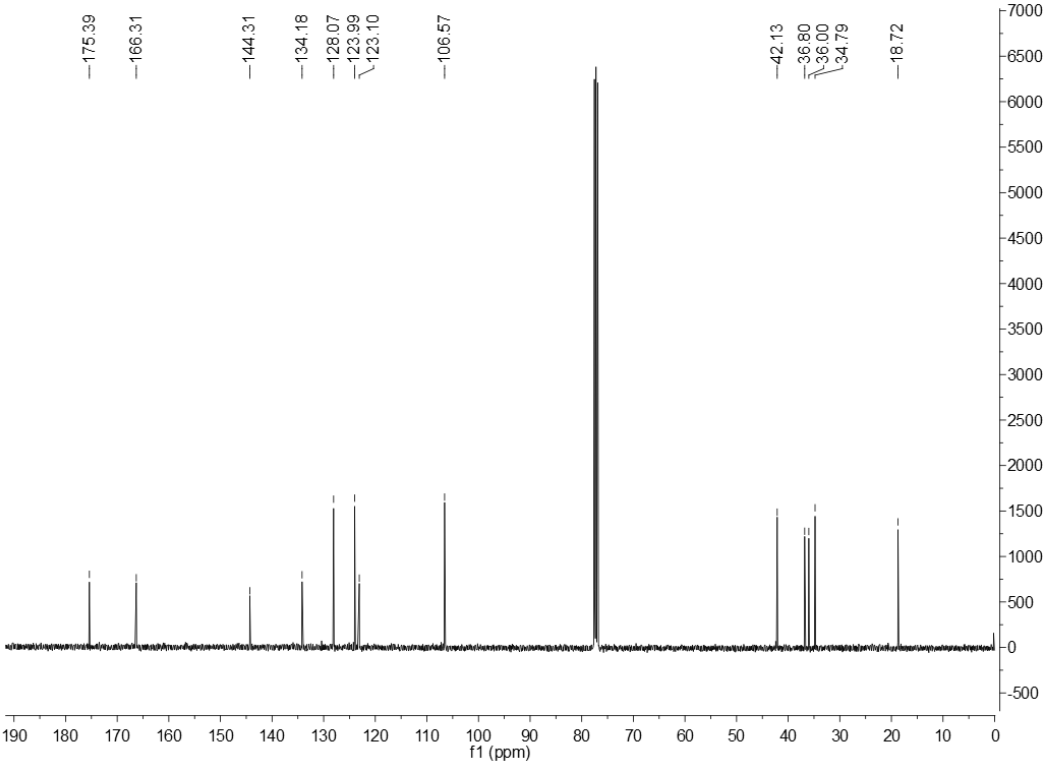

1.01
1.06
0.99
1.95
1.96
3.00
3.11
f1 (ppm)

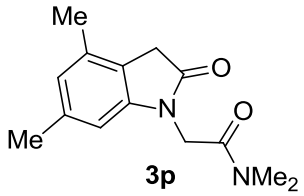

173.61
165.93
144.81
131.59
129.81
108.75
92.40
42.19
40.54
36.86
36.07
f1 (ppm)

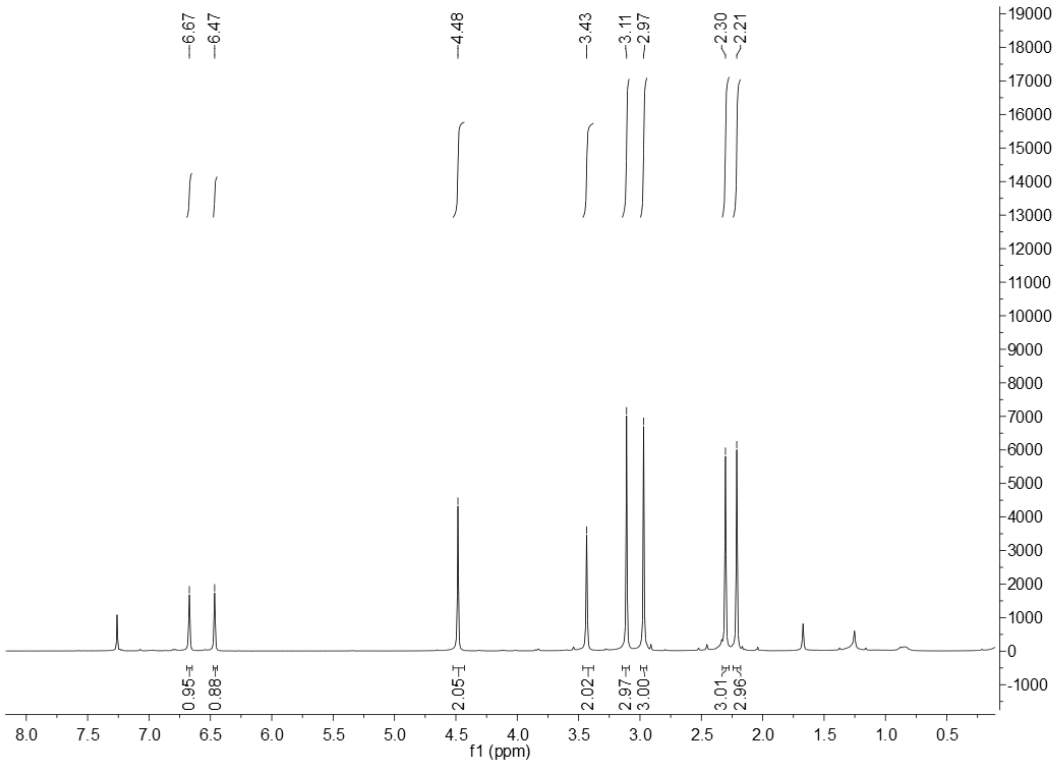

Me
O
N
O
NMe2

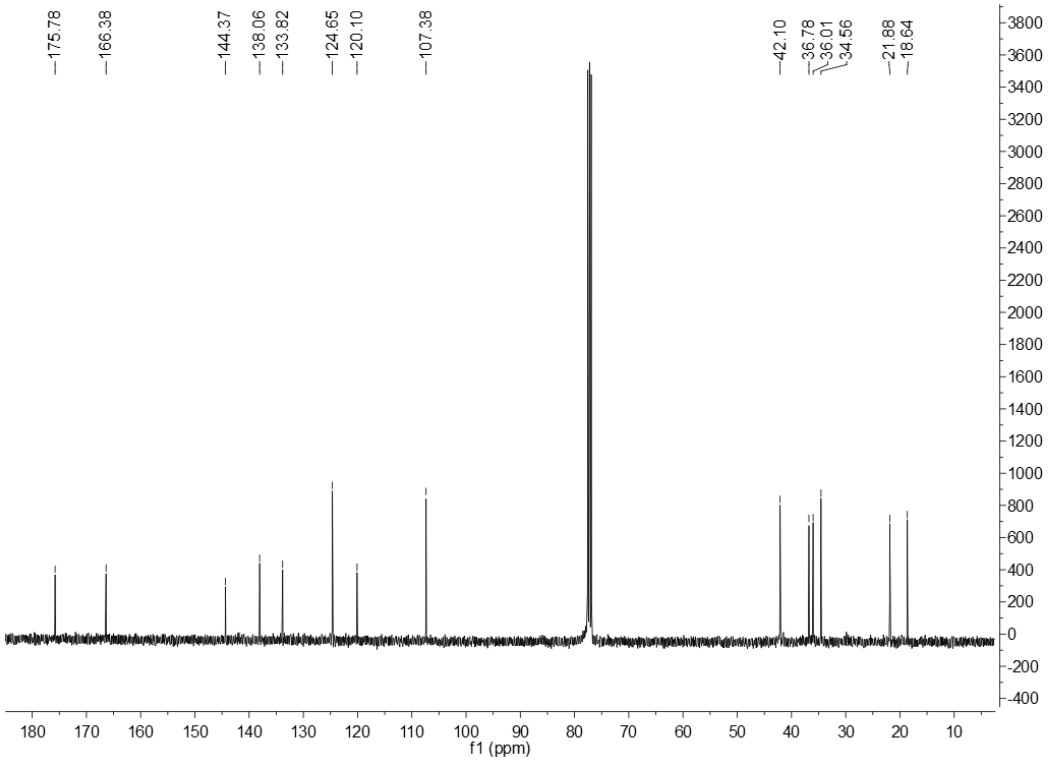
3o

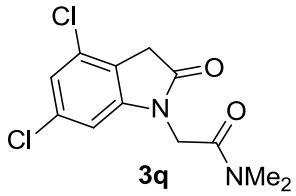

7.16
7.14
7.12
6.84
6.65
6.63
4.50
3.48
3.10
2.96
2.26
1.08
1.04
1.06
2.04
2.05
3.00
3.04
3.01
f1 (ppm)


175.39
166.31
144.31
134.18
128.07
123.99
123.10
106.57
42.13
36.80
36.00
34.79
18.72
f1 (ppm)

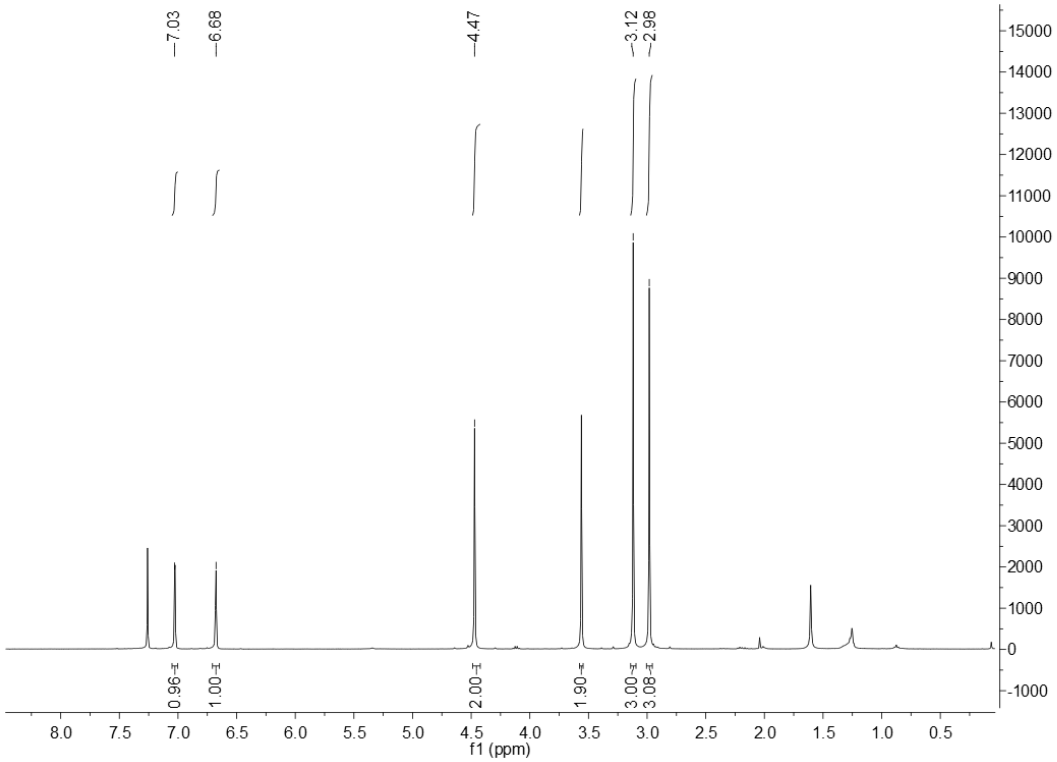

Me
O
N
O
Me
3p
NMe2

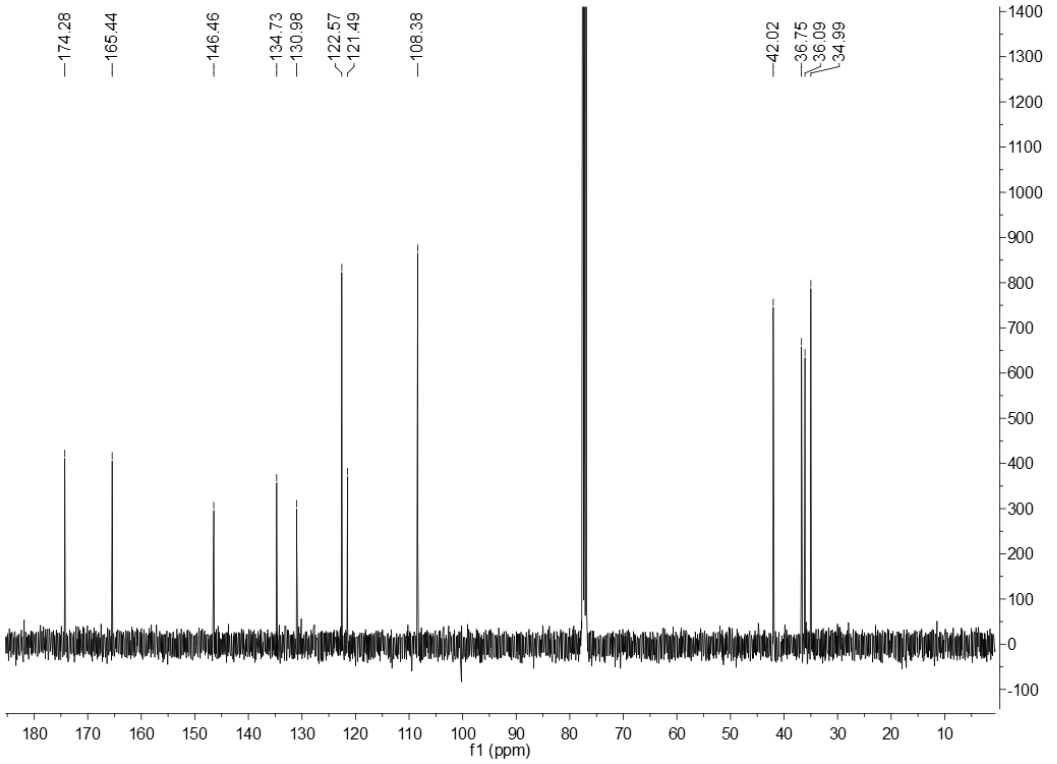

6.67
6.47
4.48
3.43
3.11
2.97
2.30
2.21
0.95
0.88
2.05
2.02
2.97
3.00
3.01
2.96
f1 (ppm)

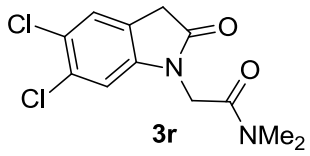

175.78
166.38
144.37
138.06
133.82
124.65
120.10
107.38
42.10
36.78
36.01
34.56
21.88
18.64
f1 (ppm)


Cl
O
N
O
Cl
NMe2

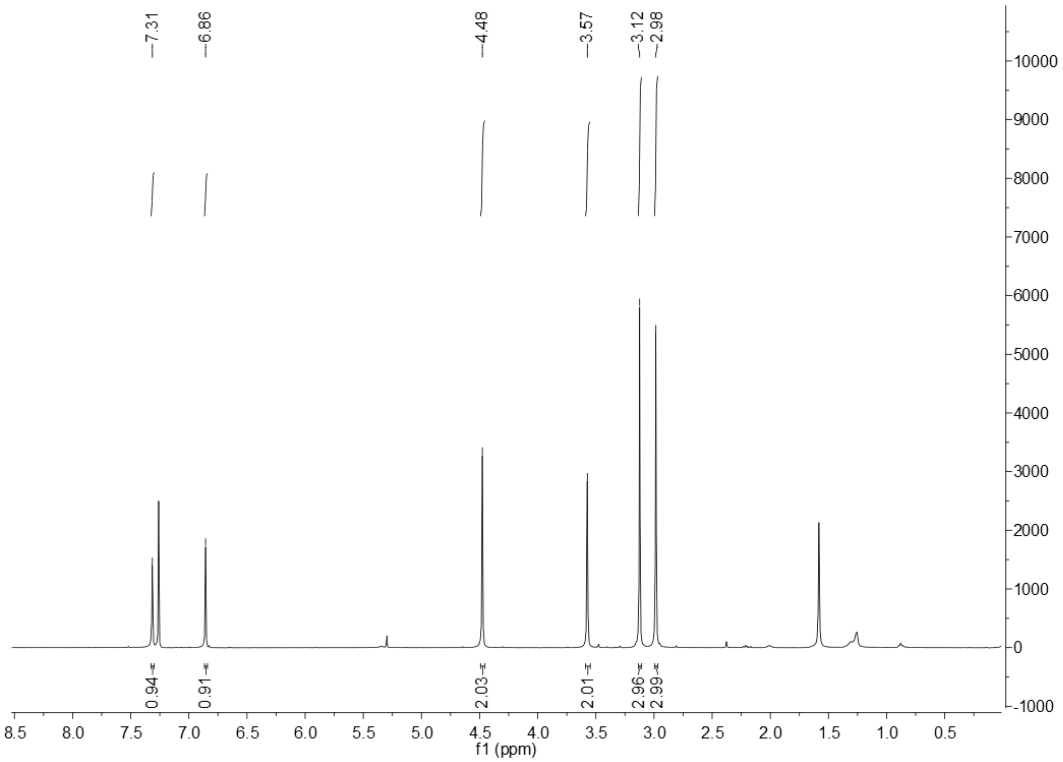
3q

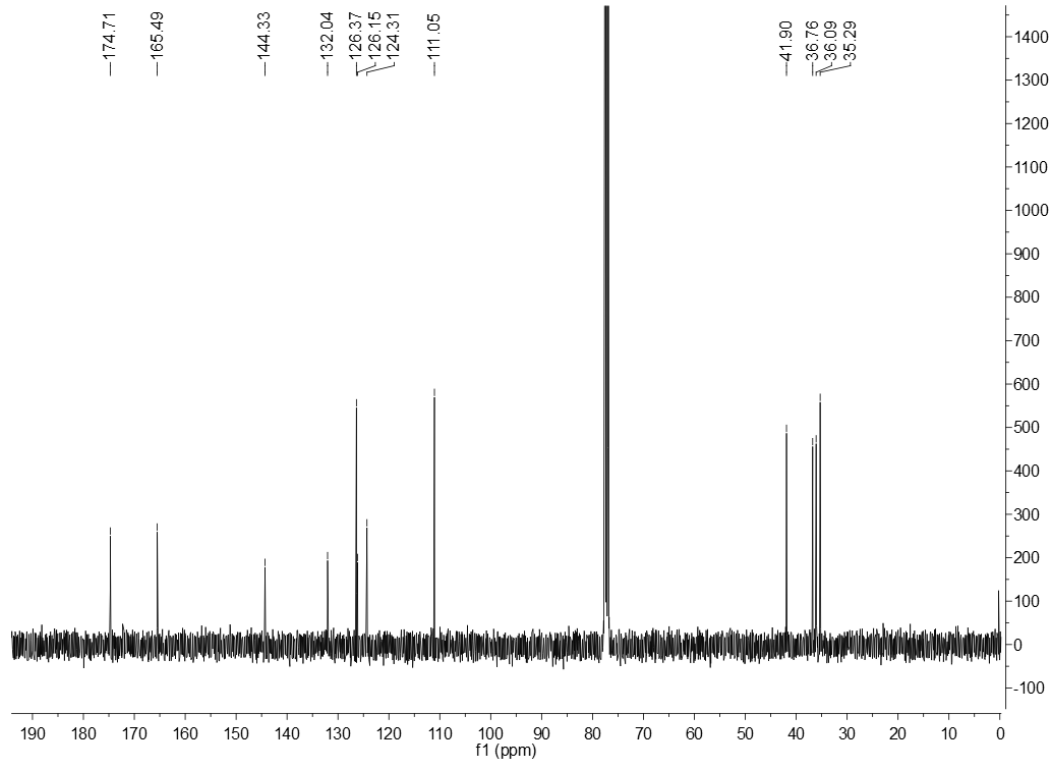

7.03
6.68
4.47
3.12
2.98
0.96
1.00
2.00
1.90
3.00
3.08
f1 (ppm)

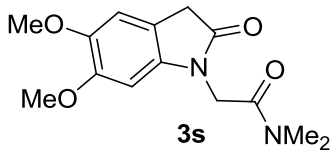

174.28
165.44
146.46
134.73
130.98
122.57
121.49
108.38
42.02
36.75
36.09
34.99
f1 (ppm)


Cl
Cl
O
N
O
NMe2

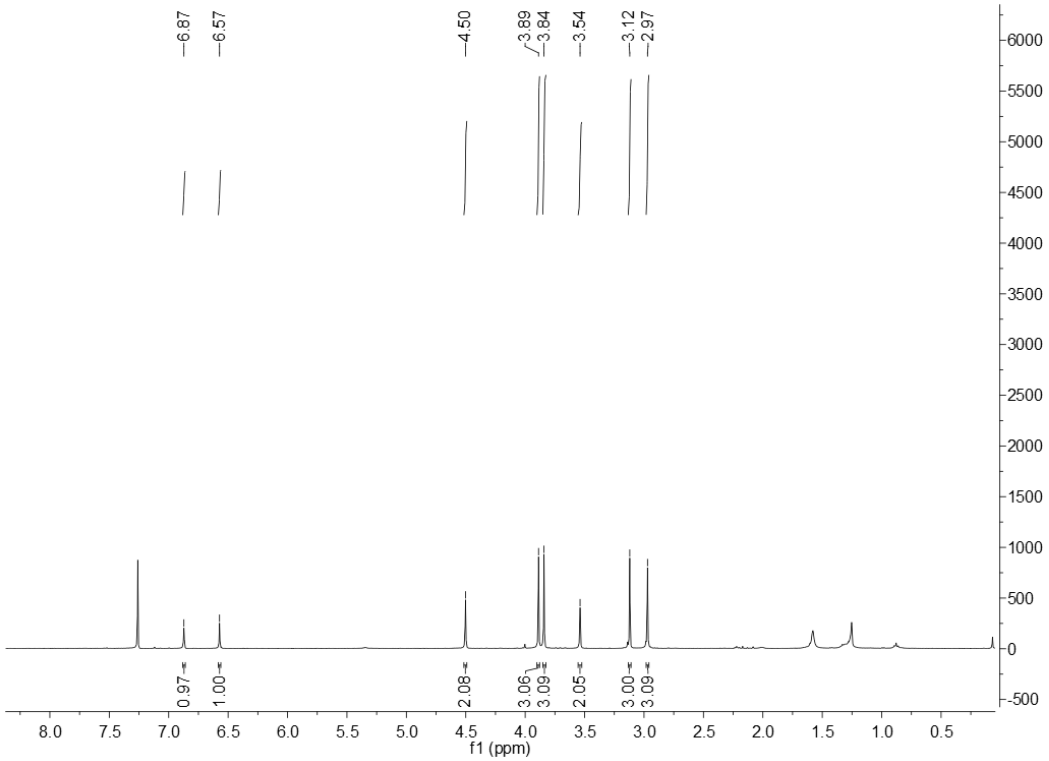
3r

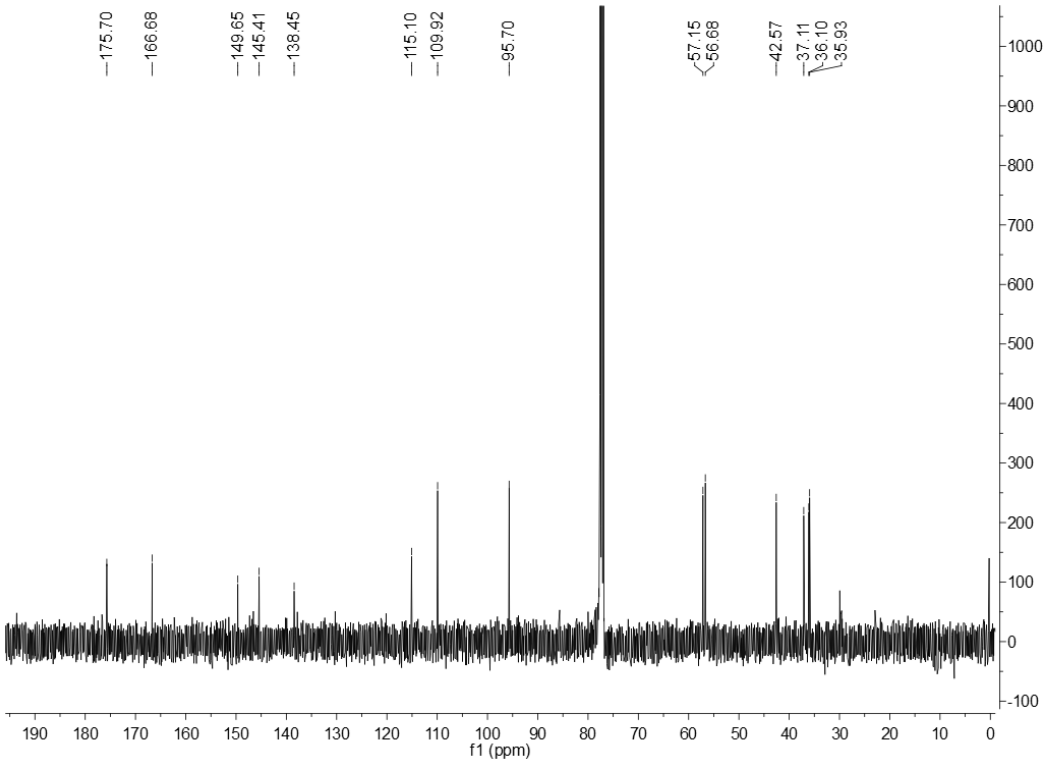

7.31
6.86
4.48
3.57
3.12
2.98
0.94
0.91
2.03
2.01
2.96
2.99
f1 (ppm)

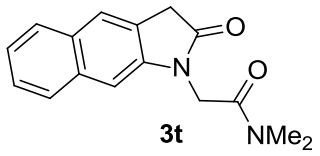

174.71
165.49
144.33
132.04
126.37
126.15
124.31
111.05
41.90
36.76
36.09
35.29
f1 (ppm)


MeO
MeO
O
N
O
NMe2

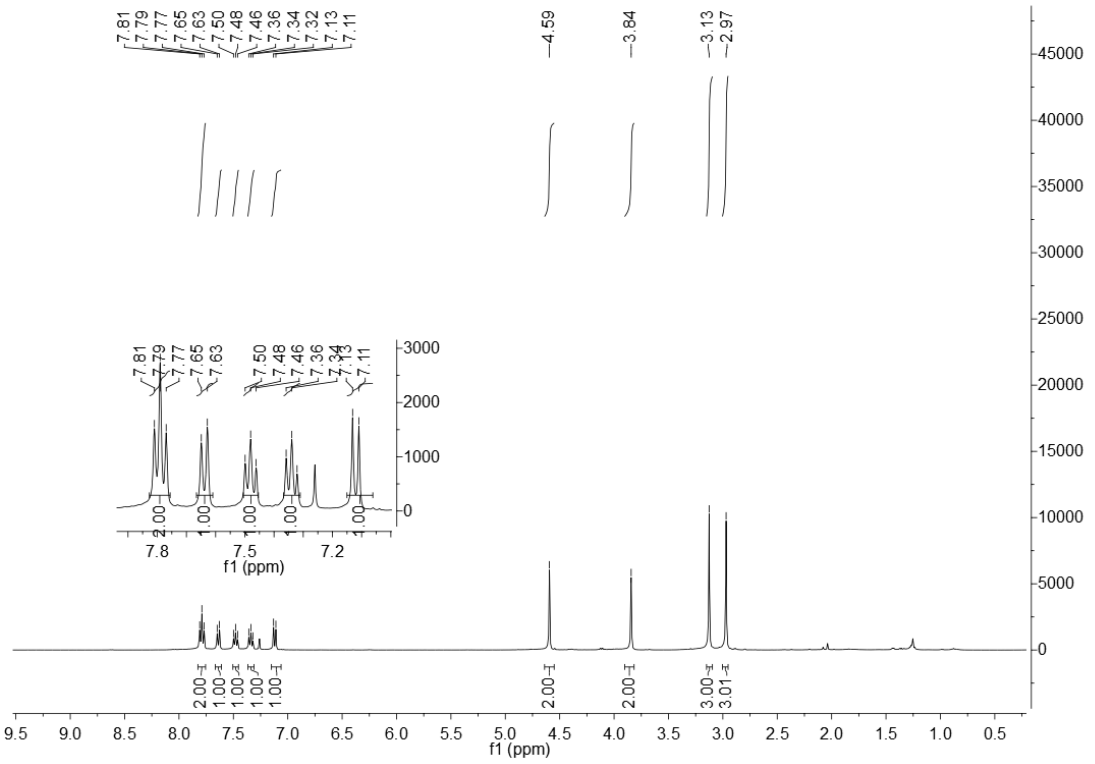
3s

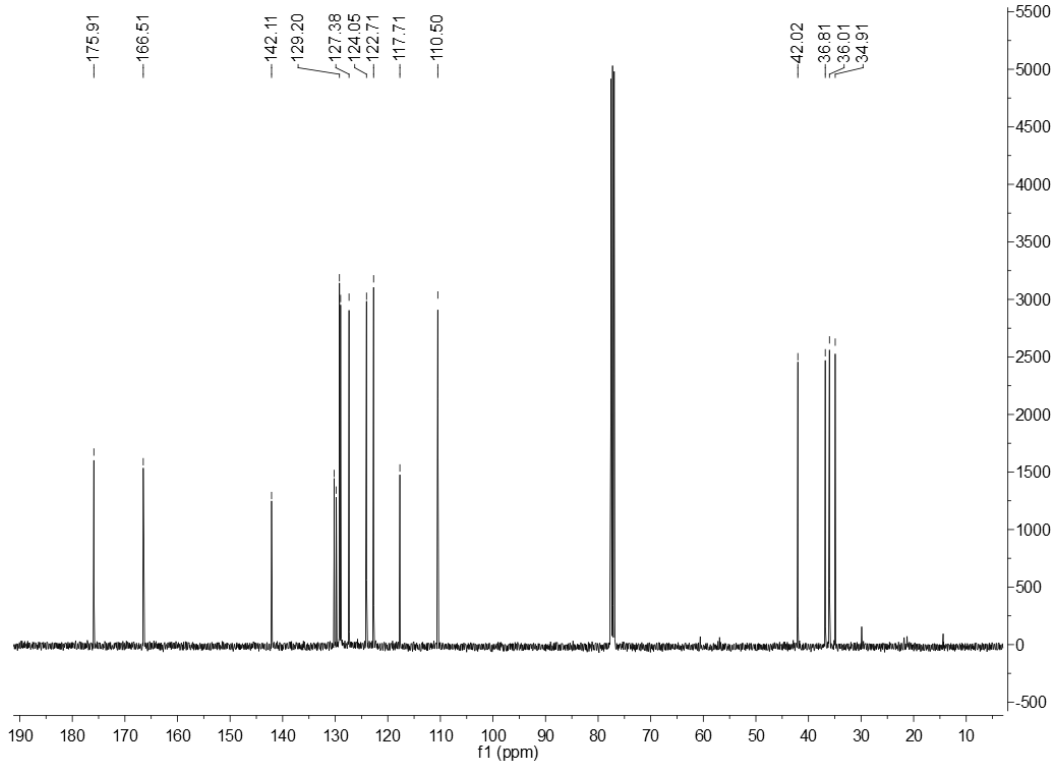

6.87
6.57
4.50
3.89
3.84
3.54
3.12
2.97
0.97
1.00
2.08
3.06
3.09
2.05
3.00
3.09
f1 (ppm)

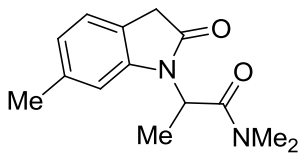

175.70
166.68
149.65
145.41
138.45
115.10
109.92
95.70
57.15
56.68
42.57
37.11
36.10
35.93
f1 (ppm)


O
N
O
NMe2

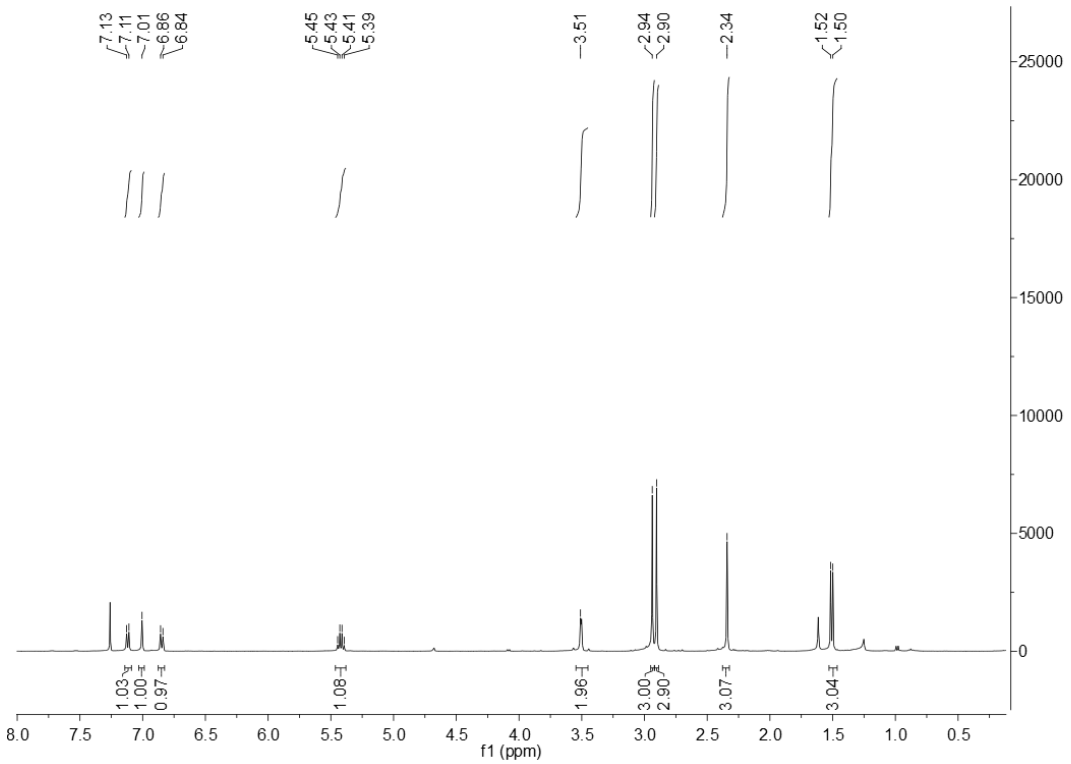
3t

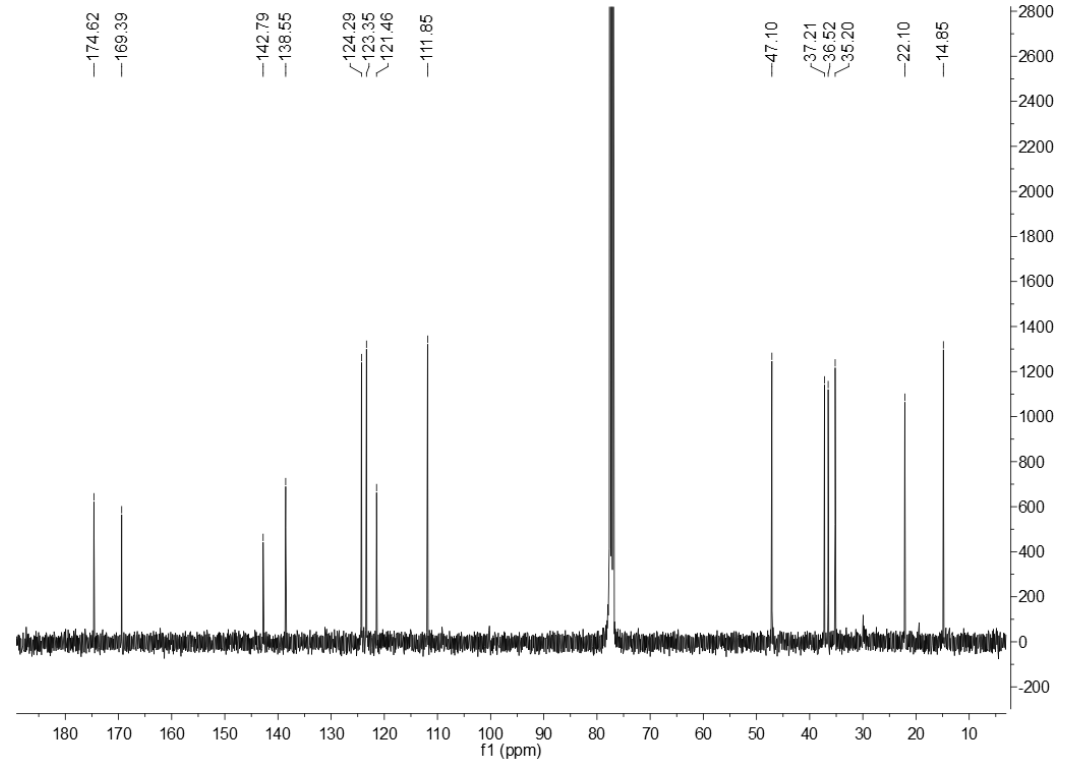

7.81
7.79
7.77
7.65
7.63
7.50
7.48
7.46
7.36
7.34
7.32
7.13
7.11
4.59
3.84
3.13
2.97
f1 (ppm)

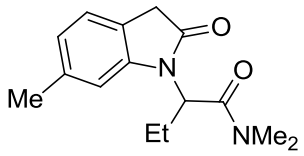

175.91
166.51
142.11
129.20
127.38
124.05
122.71
117.71
110.50
42.02
36.81
36.01
34.91
f1 (ppm)


O
N
O
Me
Me
NMe2

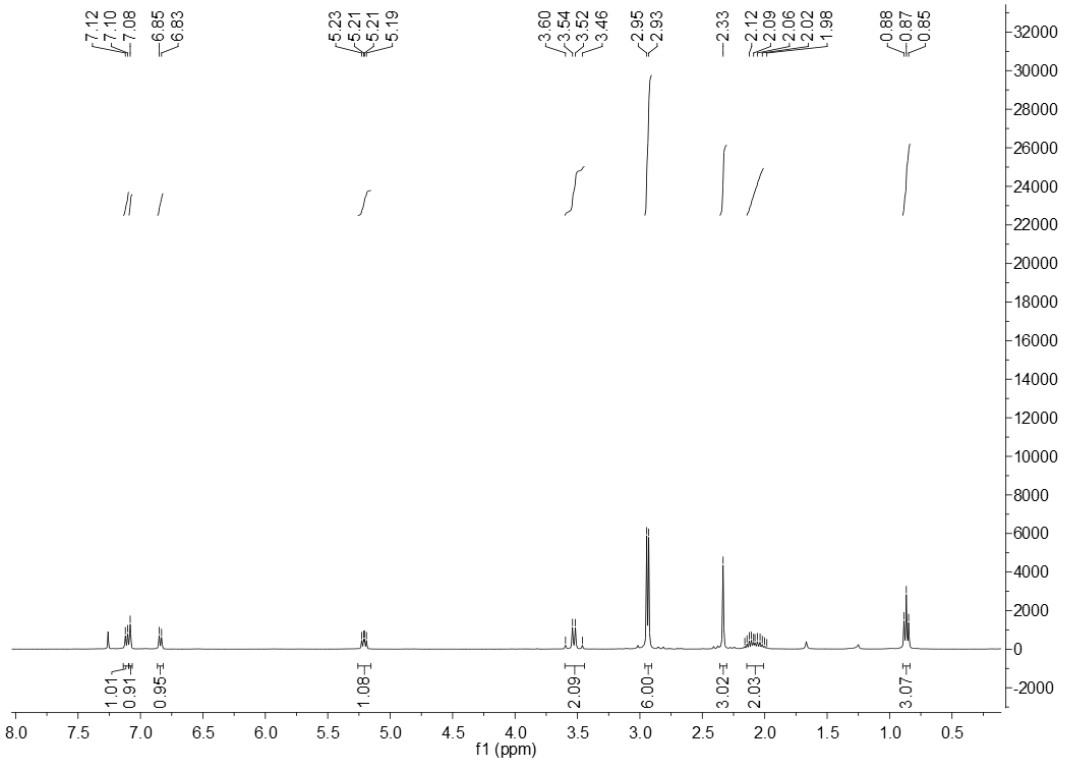
5a


7.13
7.11
7.01
6.86
6.84
5.45
5.43
5.41
5.39
3.51
2.94
2.90
2.34
1.52
1.50
1.03
1.00
0.97
1.08
1.96
3.00
2.90
3.07
3.04
f1 (ppm)


174.62
169.39
142.79
138.55
124.29
123.35
121.46
111.85
47.10
37.21
36.52
35.20
22.10
14.85
f1 (ppm)


O
N
O
Me
Et
NMe2

5b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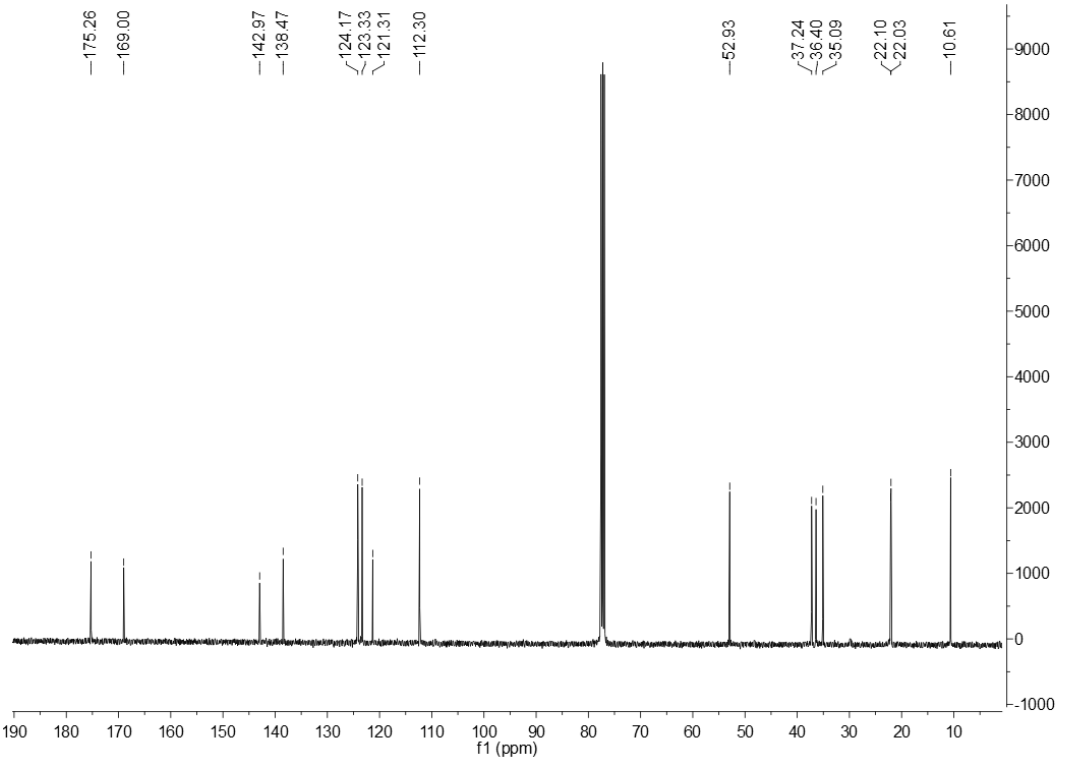
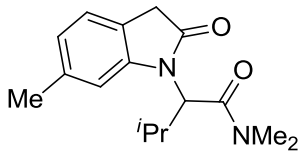
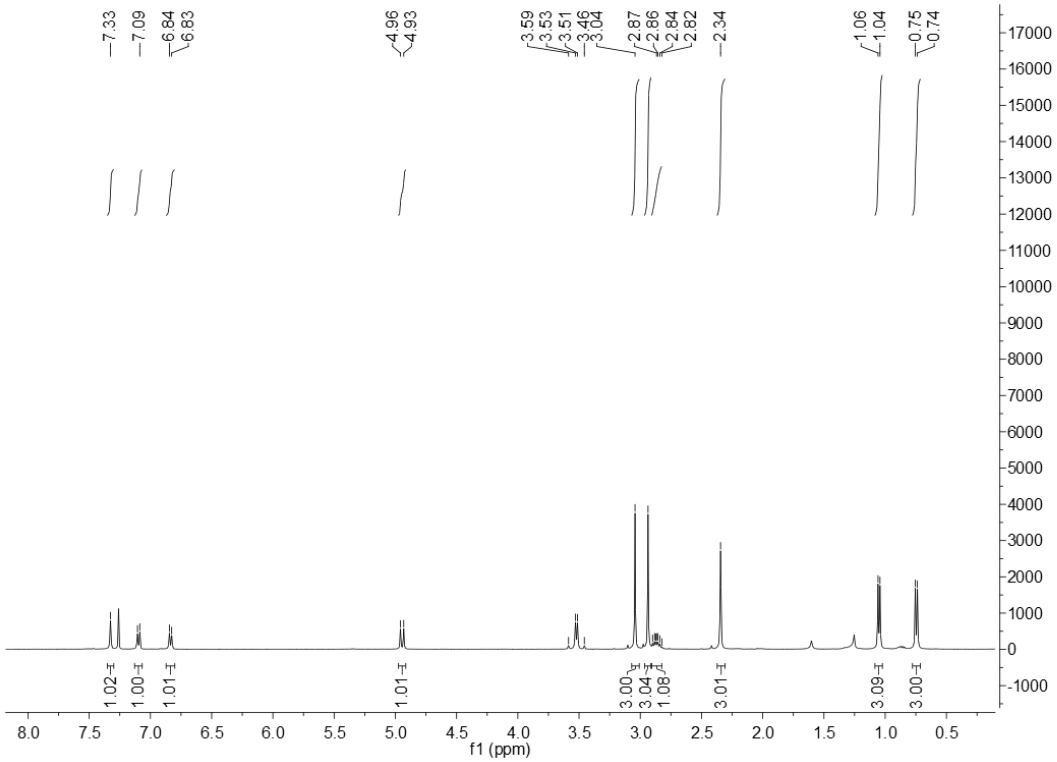
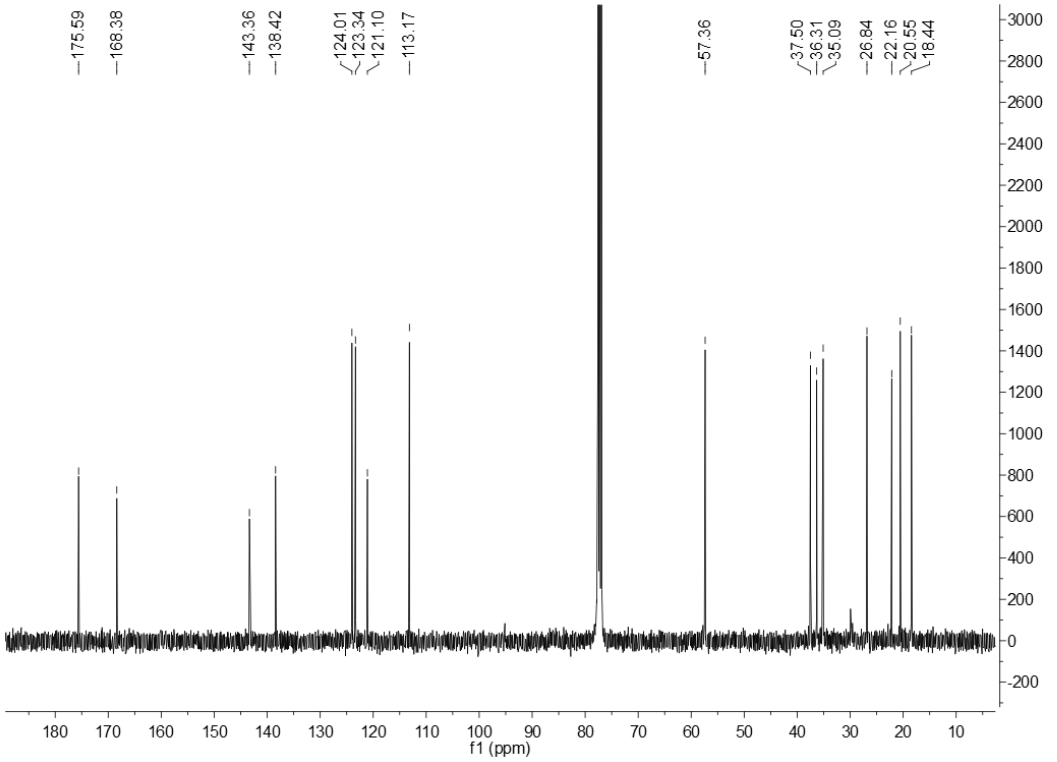
7.10
7.08
6.85
6.83
5.23
5.21
5.21
5.19
3.60
3.54
3.52
3.46
2.95
2.93
2.33
2.12
2.09
2.06
2.02
1.98
0.88
0.87
0.85
1.01
0.91
0.95
1.08
2.09
6.00
3.02
2.03
3.07
f1 (ppm)

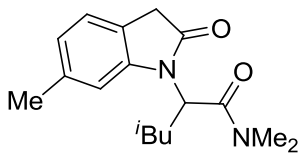

175.26
169.00
142.97
138.47
124.17
123.33
121.31
112.30
52.93
37.24
36.40
35.09
22.10
22.03
10.61
f1 (ppm)


O
N
O
Me
iPr
NMe2

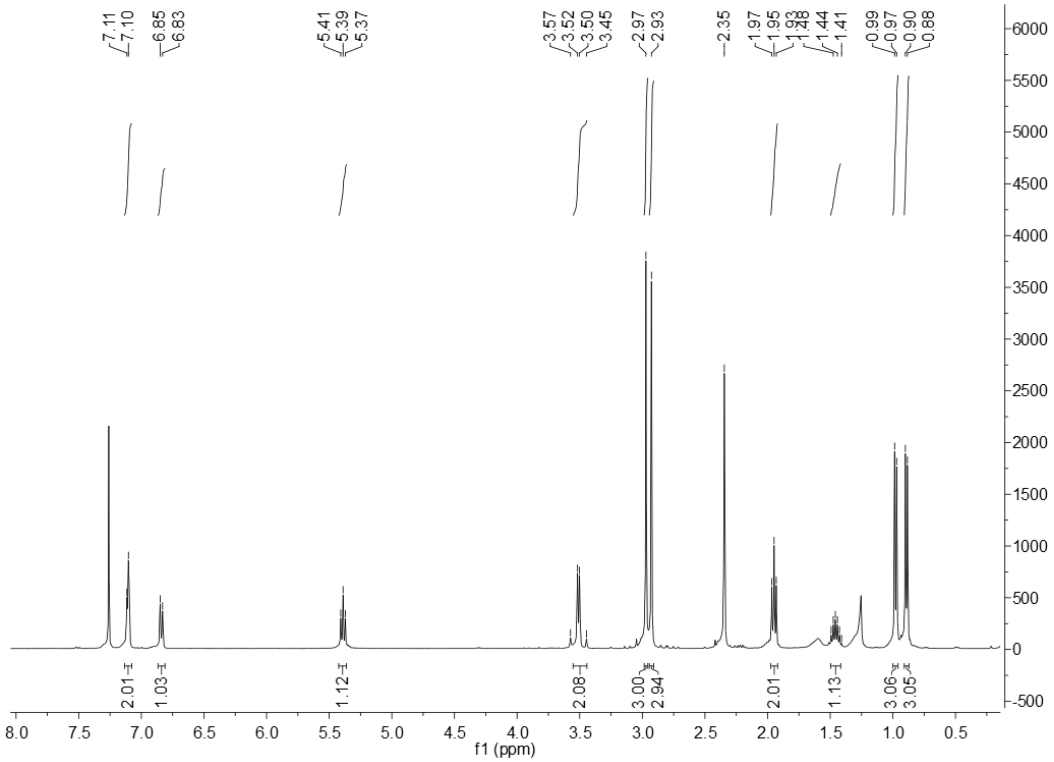
5c

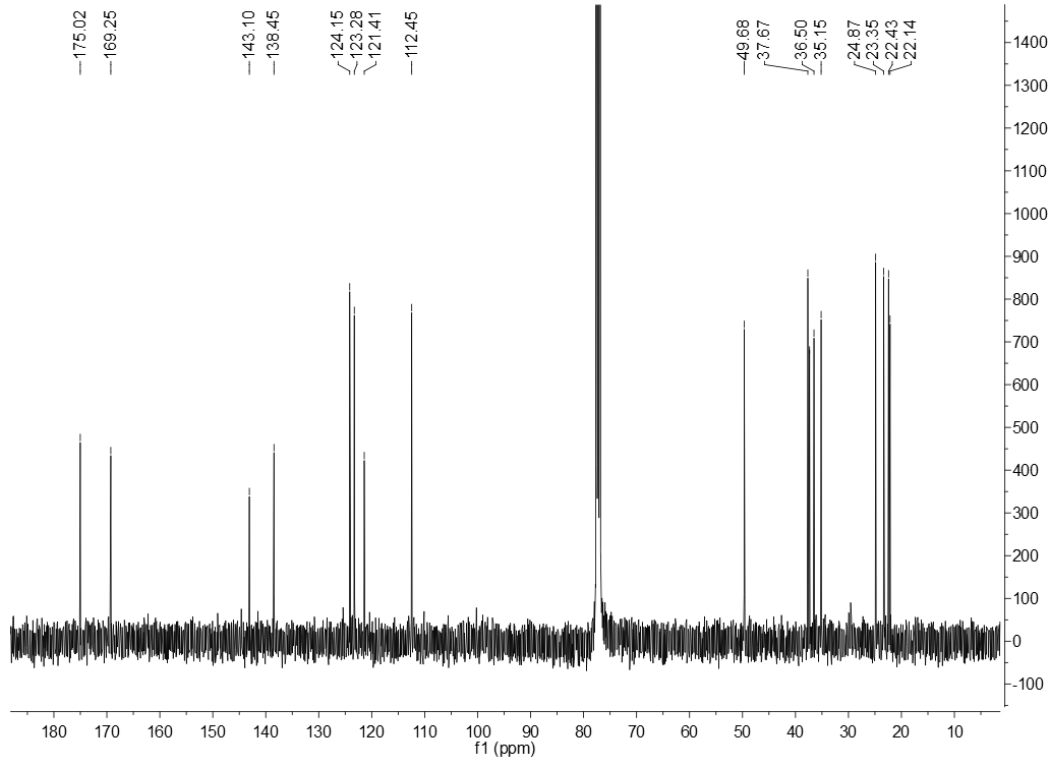

7.33
7.09
6.84
6.83
4.96
4.93
3.59
3.53
3.51
3.46
3.04
2.87
2.86
2.84
2.82
2.34
1.06
1.04
0.75
0.74
1.02
1.00
1.01
1.01
3.00
3.04
1.08
3.01
3.09
3.00
f1 (ppm)

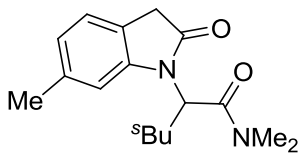

175.59
168.38
143.36
138.42
124.01
123.34
121.10
113.17
57.36
37.50
36.31
35.09
26.84
22.16
20.55
18.44
f1 (ppm)


O
N
O
Me
iBu
NMe2

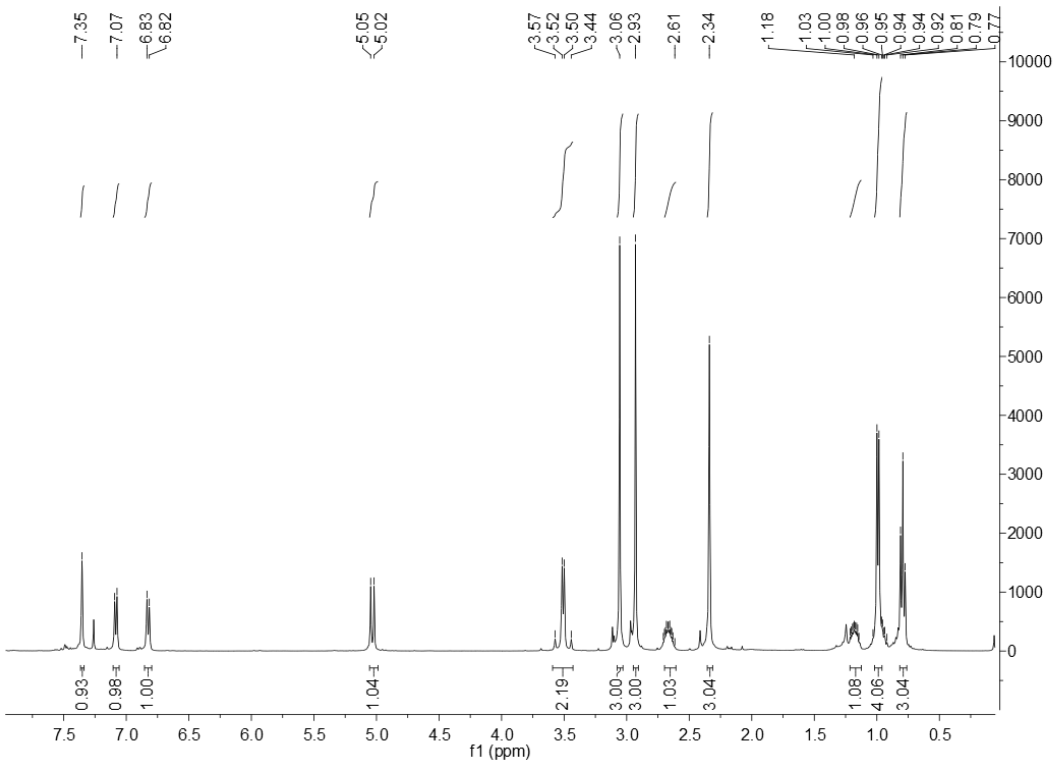
5d

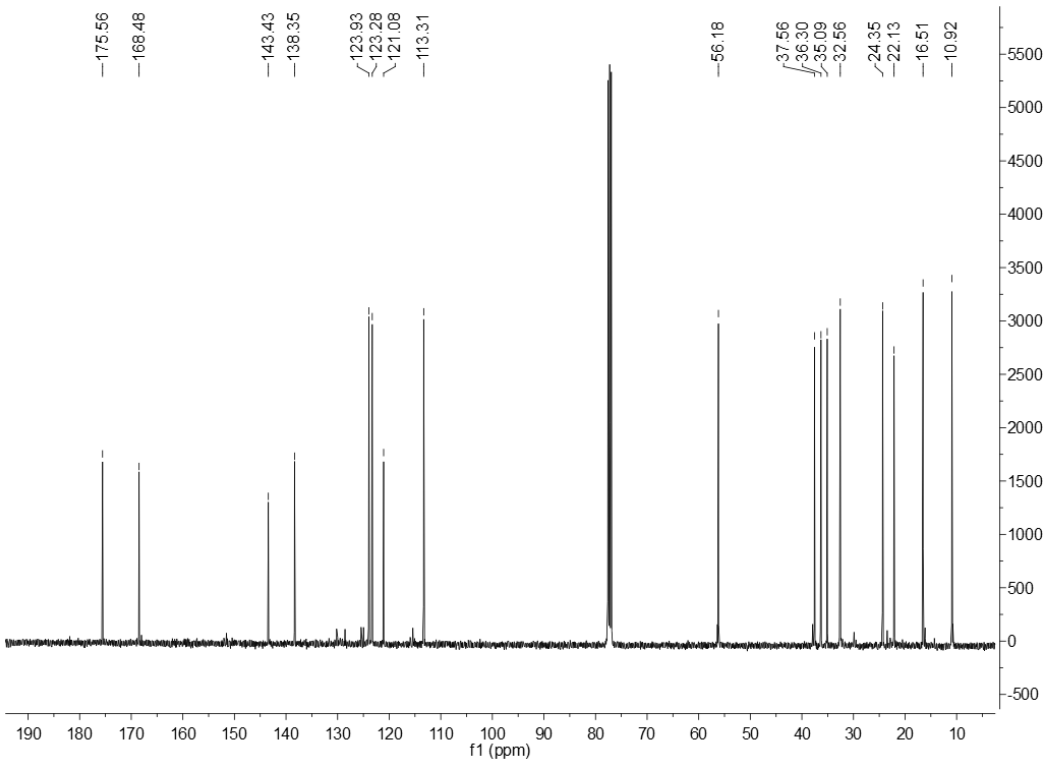

7.11
7.10
6.85
6.83
5.41
5.39
5.37
3.57
3.52
3.50
3.45
2.97
2.93
2.35
1.97
1.95
1.93
1.48
1.44
1.41
0.99
0.97
0.90
0.88
2.01
1.03
1.12
2.08
3.00
2.94
2.01
1.13
3.06
3.05
f1 (ppm)

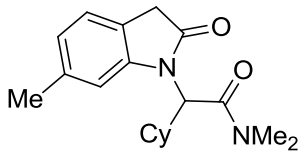

175.02
169.25
143.10
138.45
124.15
123.28
121.41
112.45
49.68
37.67
36.50
35.15
24.87
23.35
22.43
22.14
f1 (ppm)


O
N
O
Me
sBu
NMe2

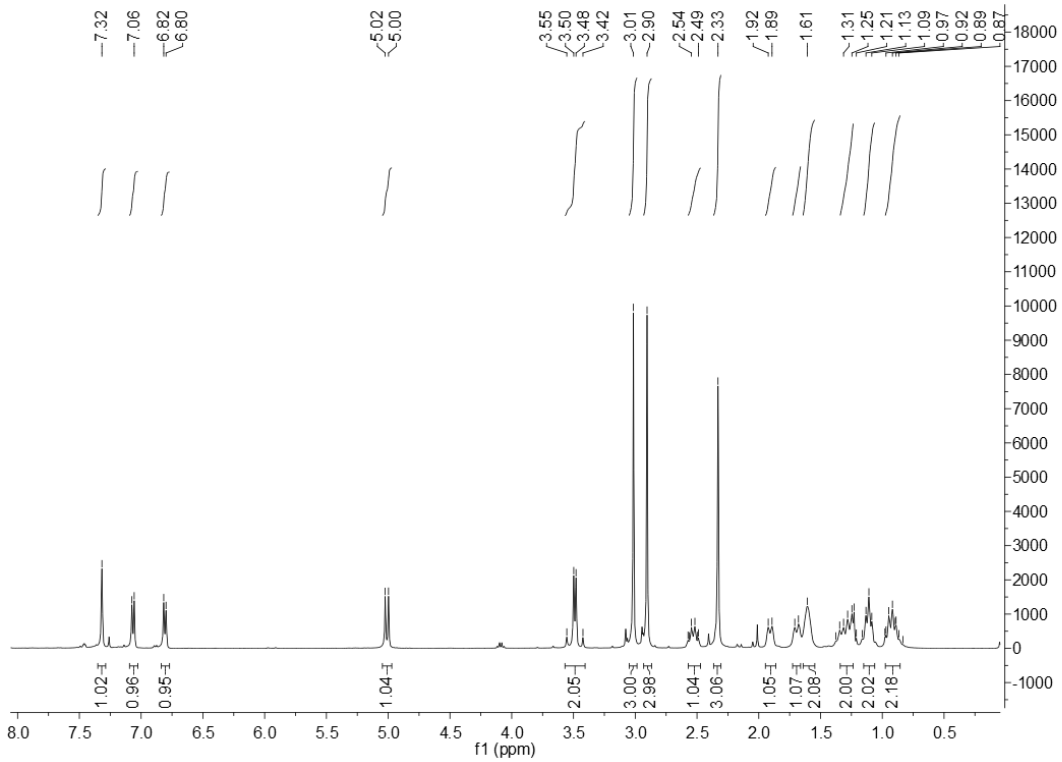
5e

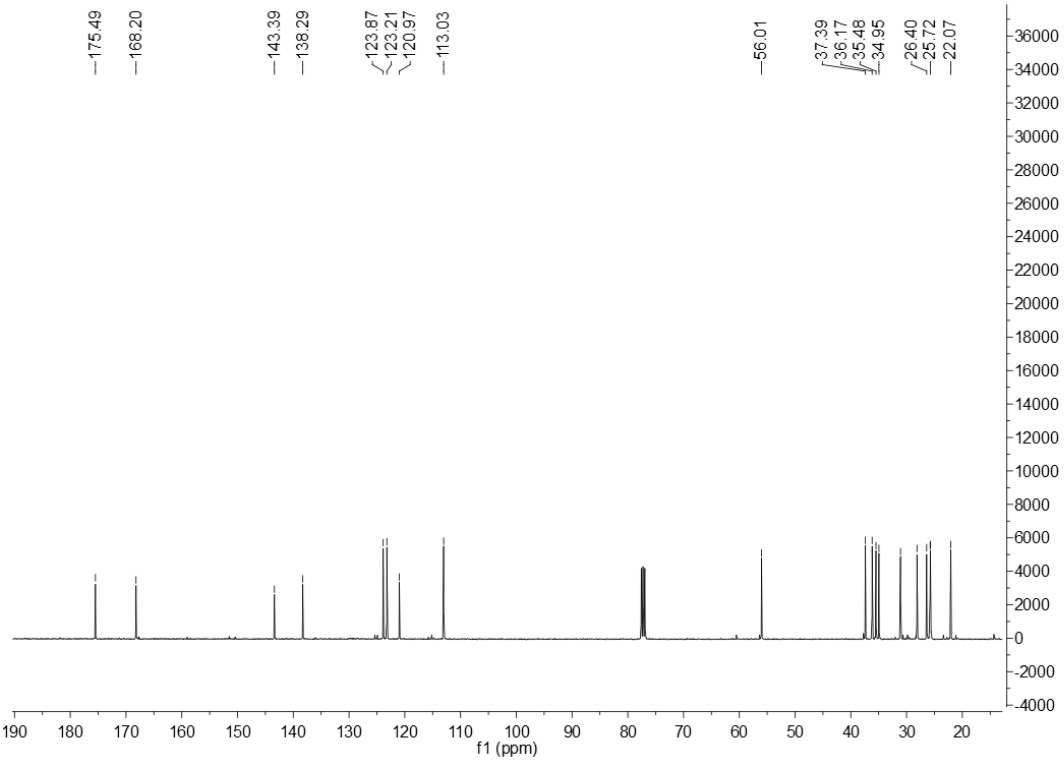

7.35
7.07
6.83
6.82
5.05
5.02
3.57
3.52
3.50
3.44
3.06
2.93
2.61
2.34
1.18
1.03
1.00
0.98
0.96
0.95
0.94
0.94
0.92
0.81
0.79
0.77
0.93
0.98
1.00
1.04
2.19
3.00
3.00
1.03
3.04
1.08
4.06
3.04
f1 (ppm)

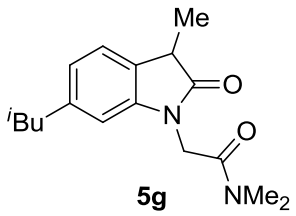

175.56
168.48
143.43
138.35
123.93
123.28
121.08
113.31
56.18
37.56
36.30
35.09
32.56
24.35
22.13
16.51
10.92
f1 (ppm)


O
N
O
Me
Cy
NMe2

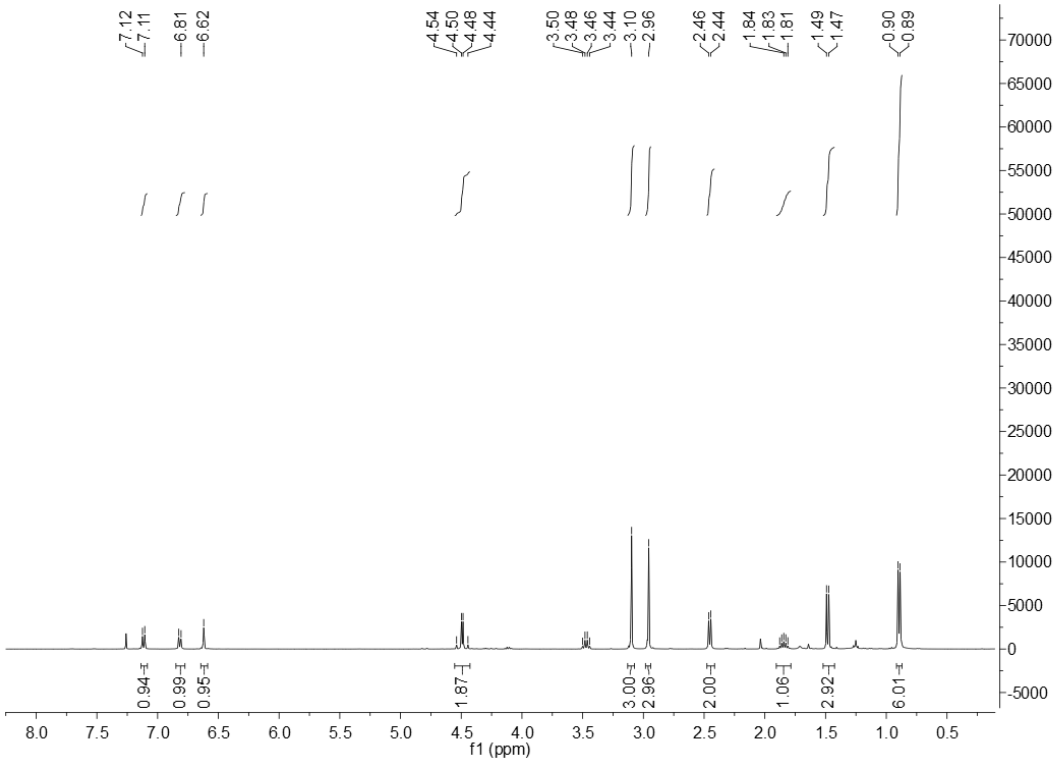
5f

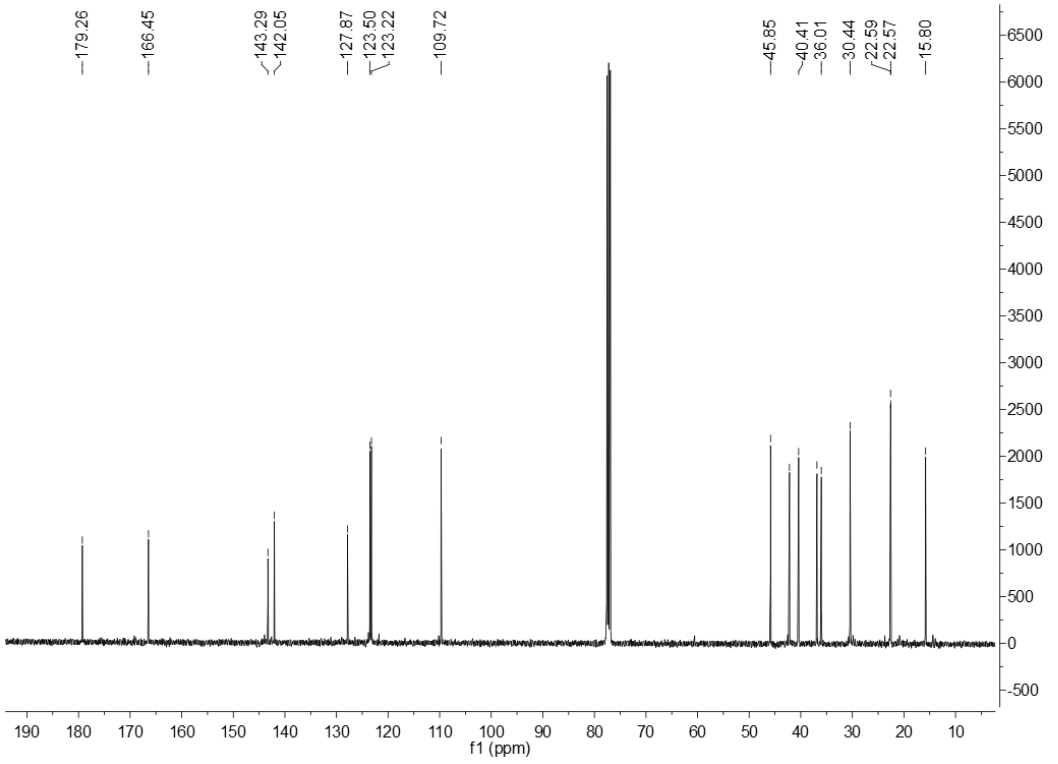

7.32
7.06
6.82
6.80
5.02
5.00
3.55
3.50
3.48
3.42
3.01
2.90
2.54
2.49
2.33
1.92
1.89
1.61
1.31
1.25
1.21
1.13
1.09
0.97
0.92
0.89
0.87
1.02
0.96
0.95
1.04
2.05
3.00
2.98
1.04
3.06
1.05
1.07
2.08
2.00
2.02
2.18
f1 (ppm)

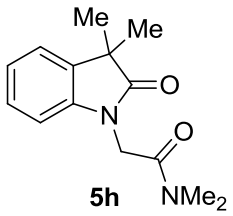

175.49
168.20
143.39
138.29
123.87
123.21
120.97
113.03
56.01
37.39
36.17
35.48
34.95
26.40
25.72
22.07
f1 (ppm)


Me
O
N
O
iBu
NMe2

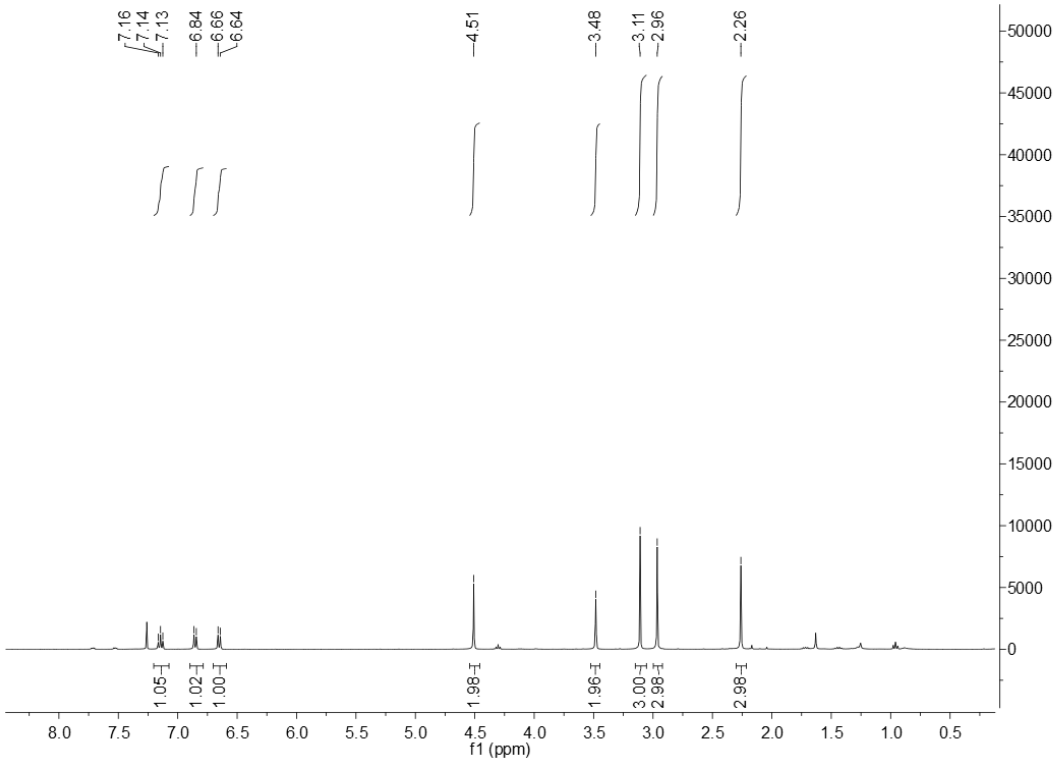
5g

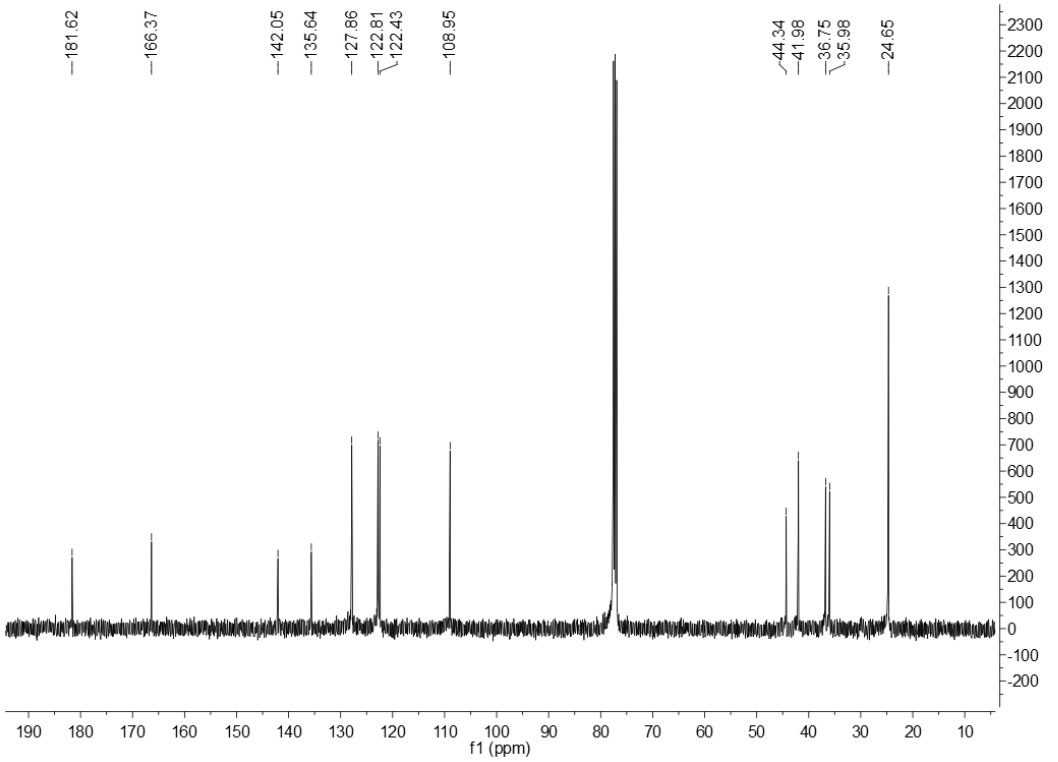

7.12
7.11
6.81
6.62
4.54
4.50
4.48
4.44
3.50
3.48
3.46
3.44
3.10
2.96
2.46
2.44
1.84
1.83
1.81
1.49
1.47
0.90
0.89
0.94
0.99
0.95
1.87
3.00
2.96
2.00
1.06
2.92
6.01
f1 (ppm)

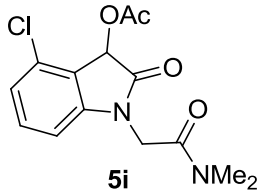

179.26
166.45
143.29
142.05
127.87
123.50
123.22
109.72
45.85
40.41
36.01
30.44
22.59
22.57
15.80
f1 (ppm)


Me
Me
O
N
O
NMe2

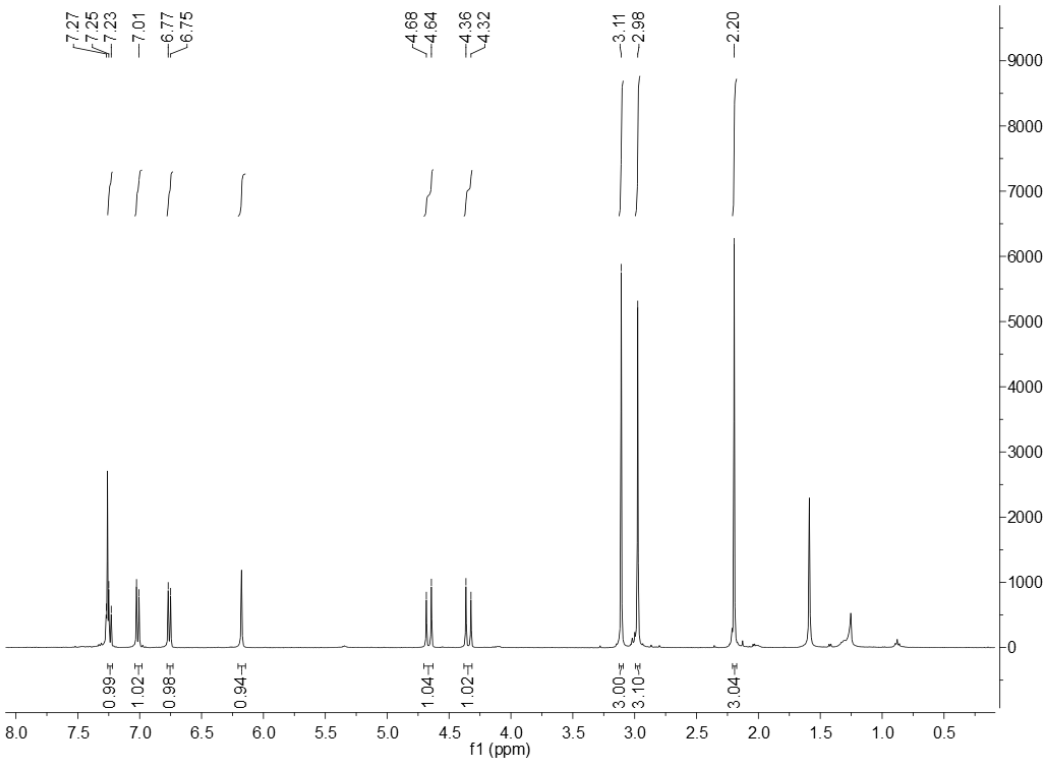
5h

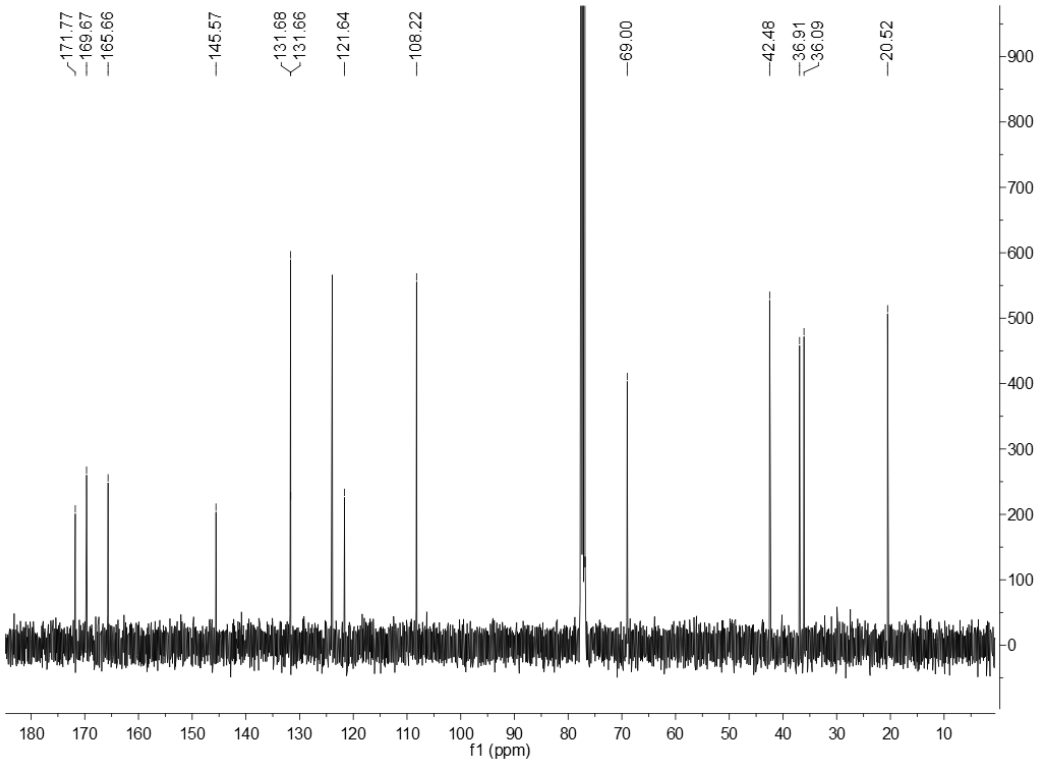

7.16
7.14
7.13
6.84
6.66
6.64
4.51
3.48
3.11
2.96
2.26
1.05
1.02
1.00
1.98
1.96
3.00
2.98
2.98
f1 (ppm)

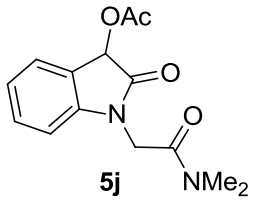

181.62
166.37
142.05
135.64
127.86
122.81
122.43
108.95
44.34
41.98
36.75
35.98
24.65
f1 (ppm)


Cl
OAc
O
N
O
NMe2

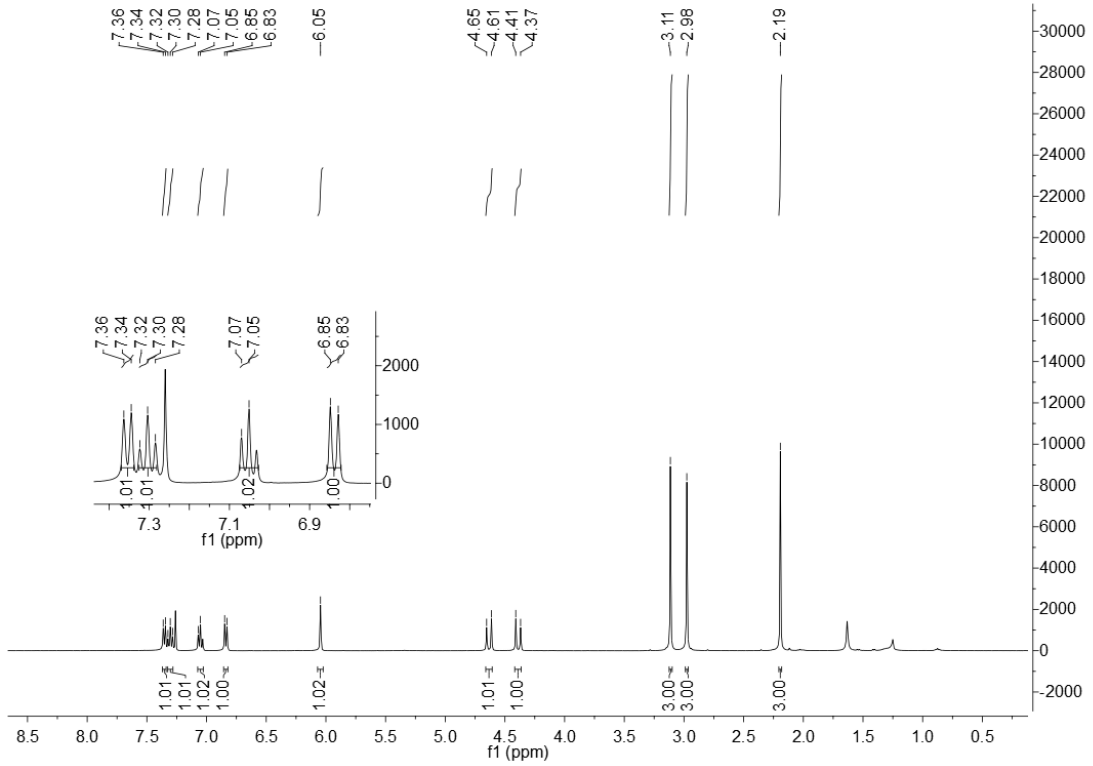
5i

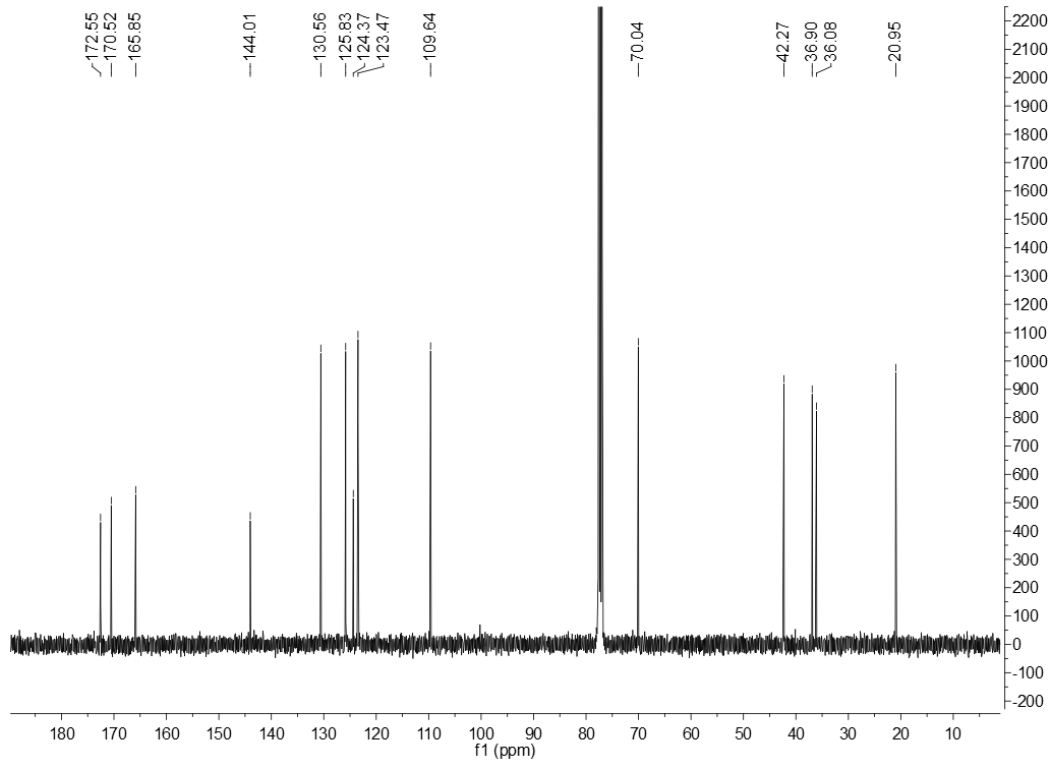

7.27
7.25
7.23
7.01
6.77
6.75
4.68
4.64
4.36
4.32
3.11
2.98
2.20
0.99
1.02
0.98
0.94
1.04
1.02
3.00
3.10
3.04
f1 (ppm)

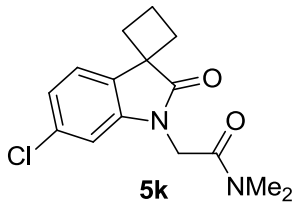

171.77
169.67
165.66
145.57
131.68
131.66
121.64
108.22
69.00
42.48
36.91
36.09
20.52
f1 (ppm)


OAc
O
N
O
NMe2

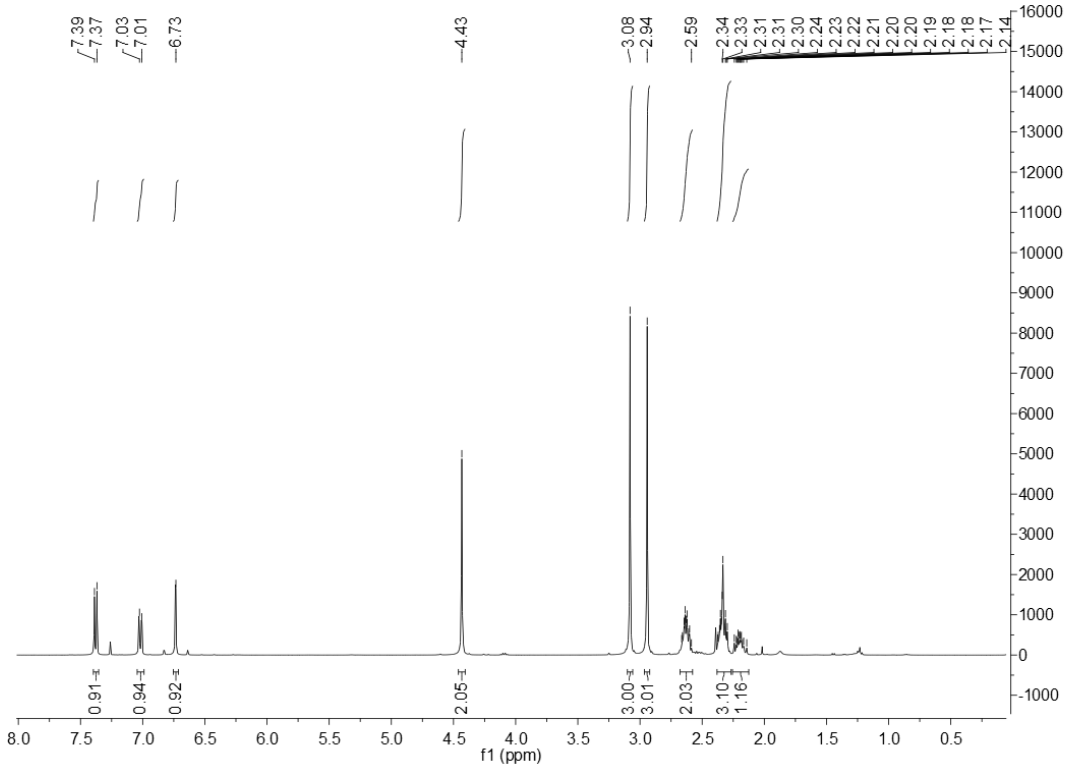
5j

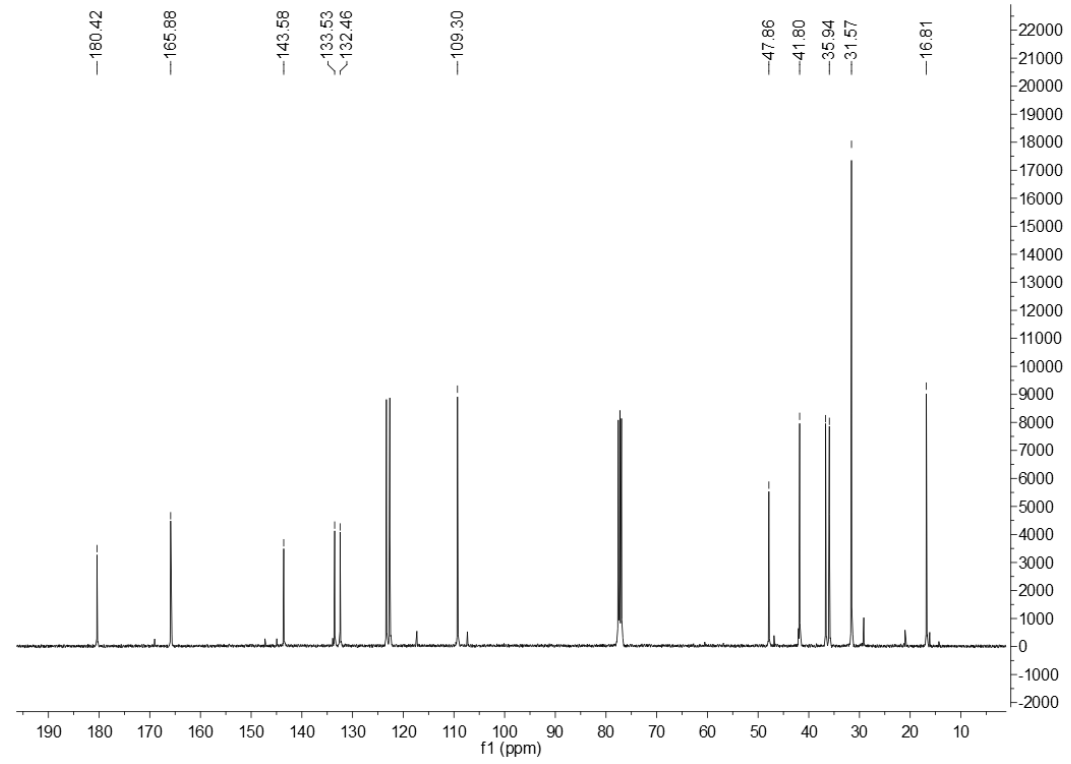

7.36
7.34
7.32
7.30
7.28
7.07
7.05
6.85
6.83
6.05
4.65
4.61
4.41
4.37
3.11
2.98
2.19
f1 (ppm)

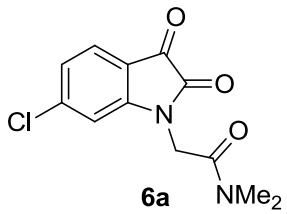

172.55
170.52
165.85
144.01
130.56
125.83
124.37
123.47
109.64
70.04
42.27
36.90
36.08
20.95
f1 (ppm)


O
N
O
Cl
NMe2

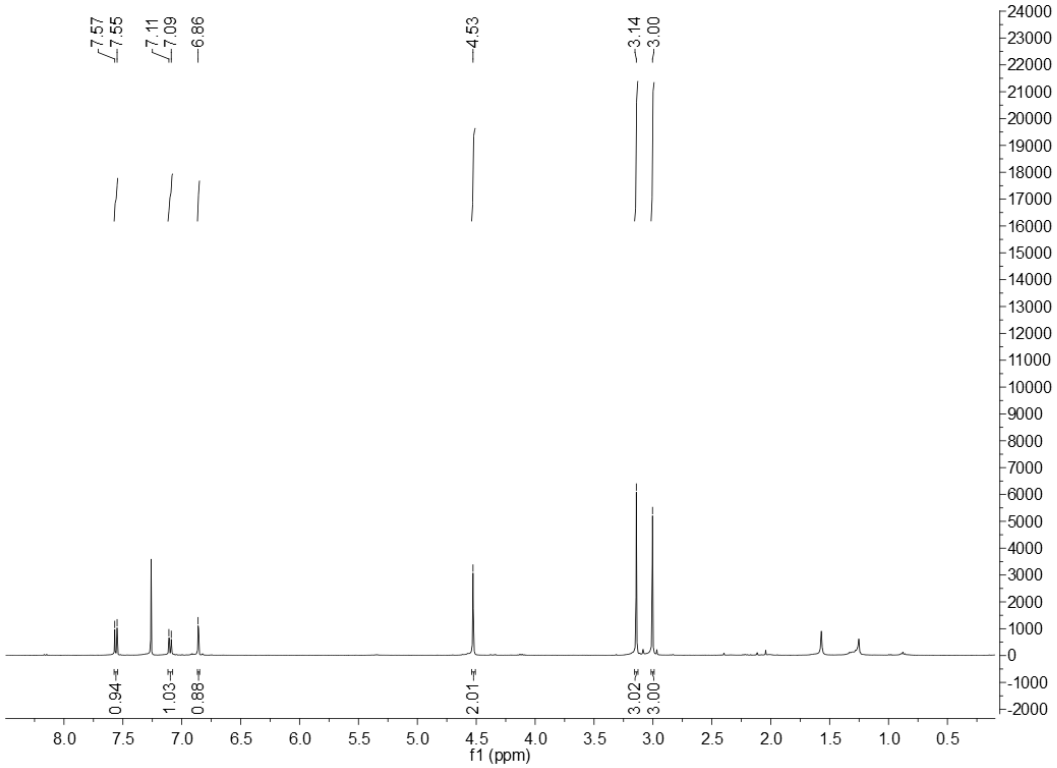
5k

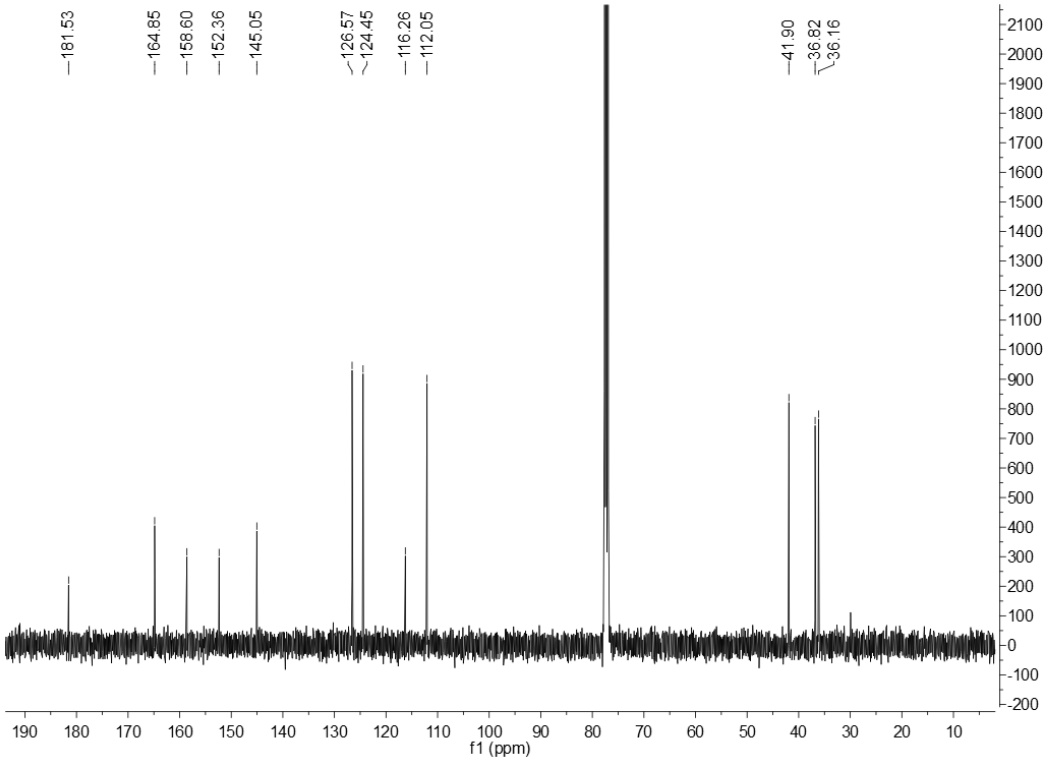

7.39
7.37
7.03
7.01
6.73
4.43
3.08
2.94
2.59
2.34
2.33
2.31
2.31
2.30
2.24
2.23
2.22
2.21
2.20
2.20
2.19
2.18
2.18
2.17
2.14
0.91
0.94
0.92
2.05
3.00
3.01
2.03
3.10
1.16
f1 (ppm)

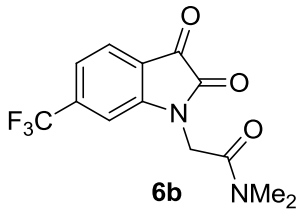

180.42
165.88
143.58
133.53
132.46
109.30
47.86
41.80
35.94
31.57
16.81
f1 (ppm)


O
O
Cl
N
O
NMe2

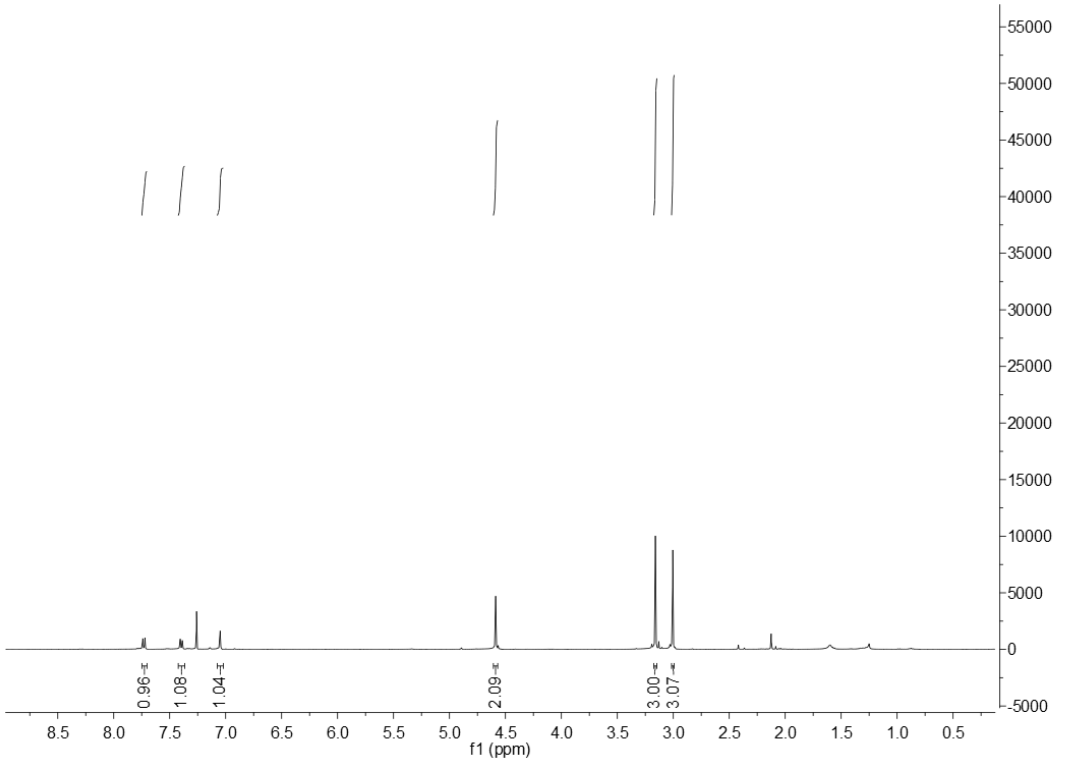
6a

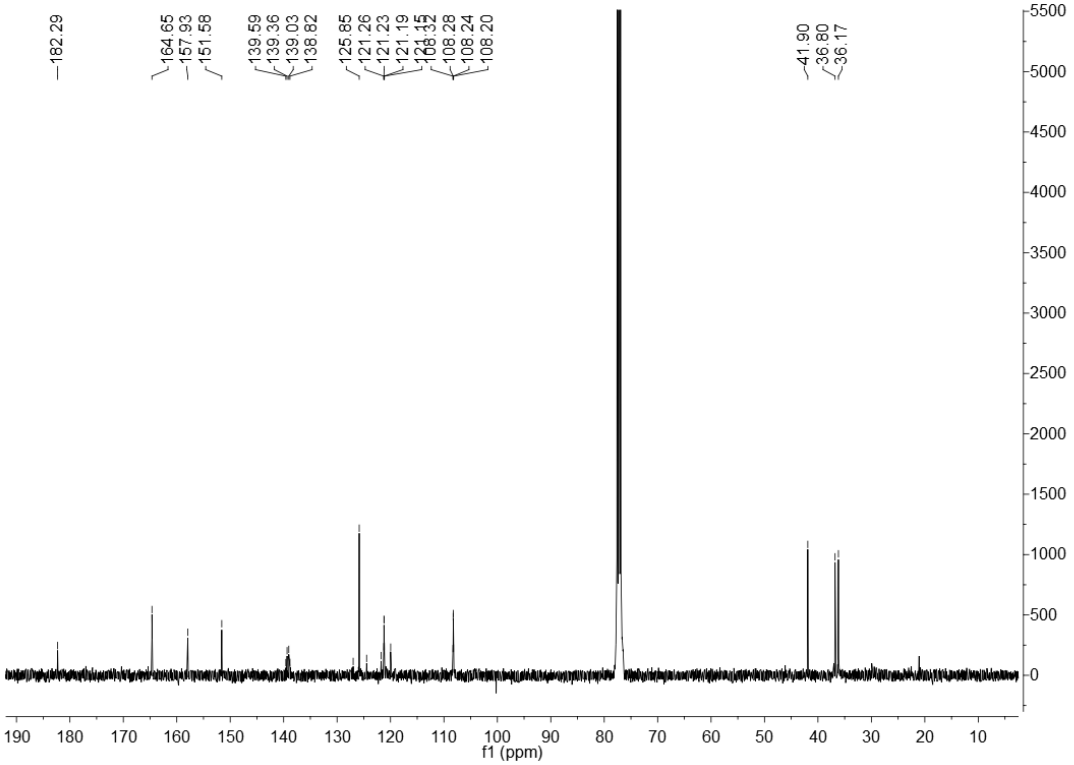

7.57
7.55
7.11
7.09
6.86
4.53
3.14
3.00
0.94
1.03
0.88
2.01
3.02
3.00
f1 (ppm)

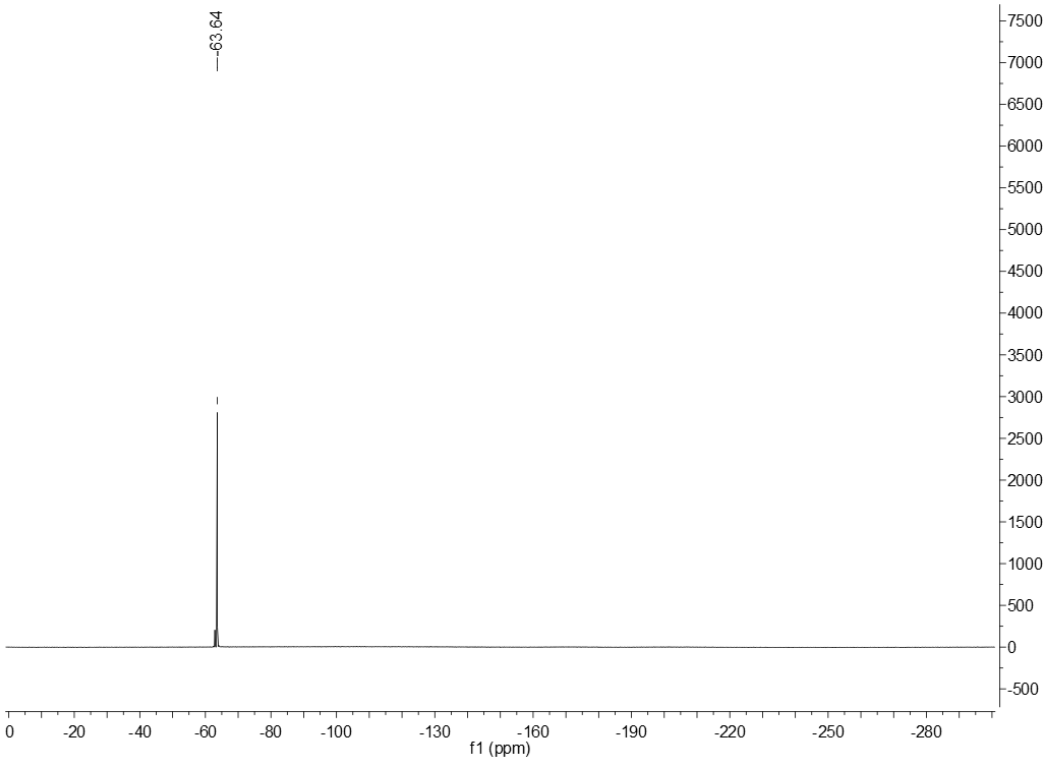

181.53
164.85
158.60
152.36
145.05
126.57
124.45
116.26
112.05
41.90
36.82
36.16
f1 (ppm)

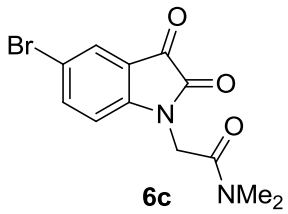

O
O
N
O
F3C
NMe2

6b

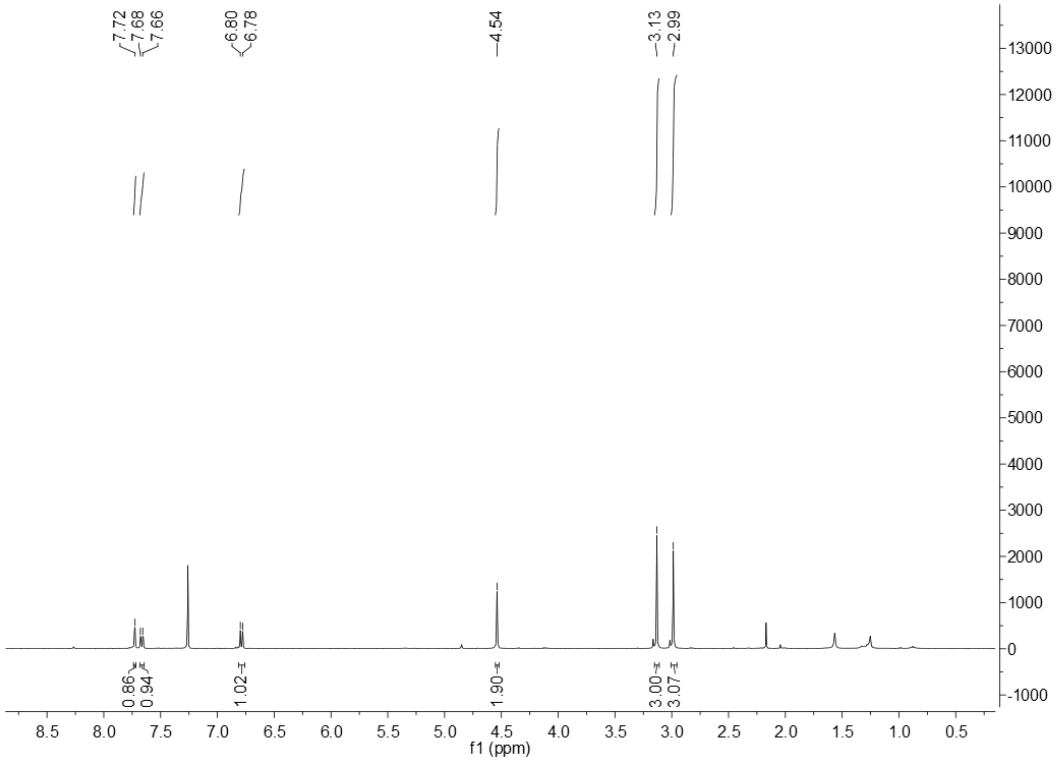

0.96
1.08
1.04
2.09
3.00
3.07
f1 (ppm)

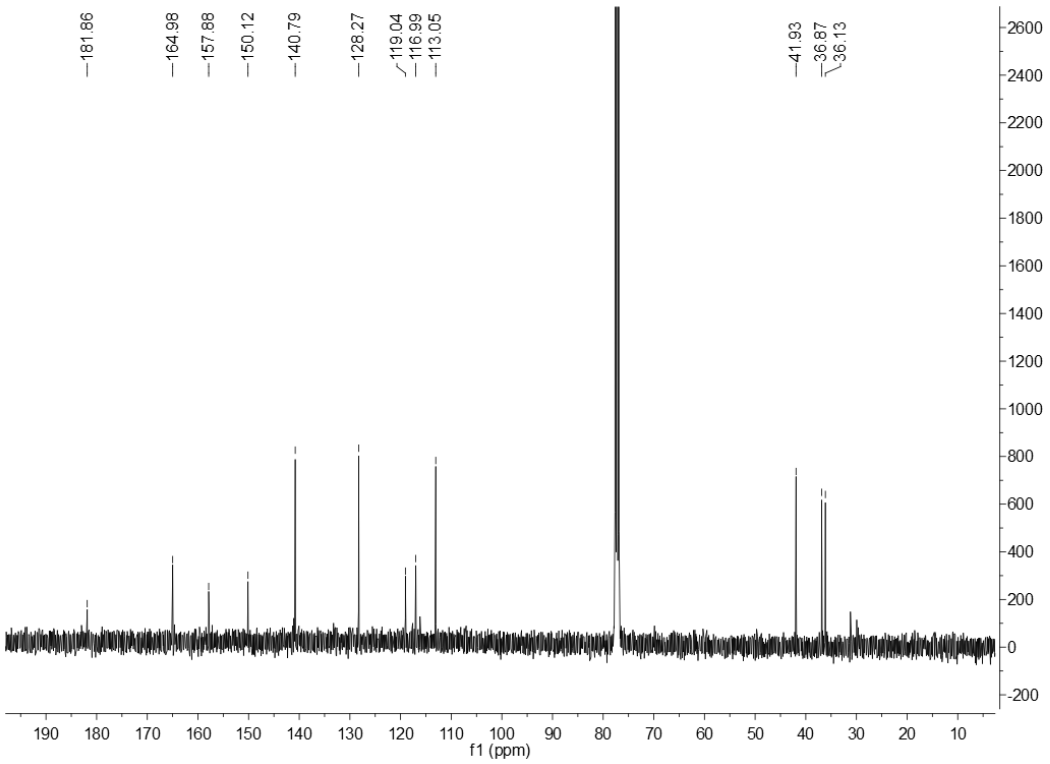

182.29
164.65
157.93
151.58
139.59
139.36
139.03
138.82
125.85
121.26
121.23
121.19
108.28
108.24
108.20
41.90
36.80
36.17
f1 (ppm)

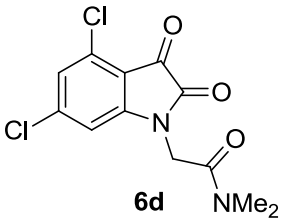

-63.64
f1 (ppm)


Br
O
O
N
O
NMe2

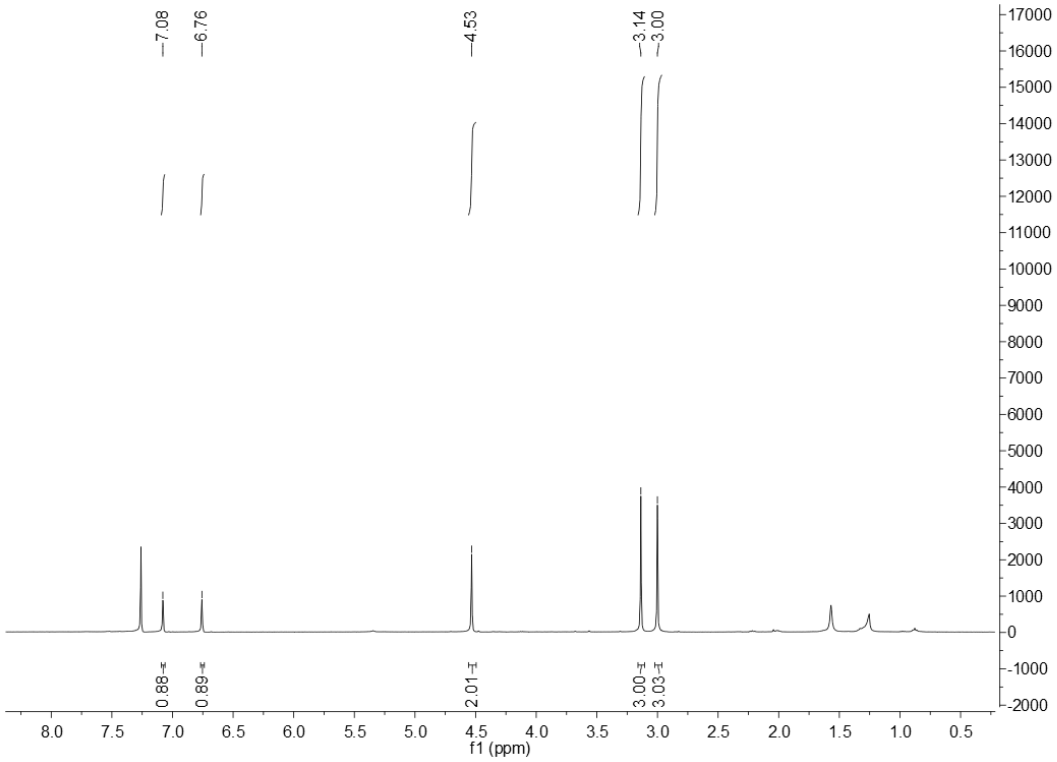
6c

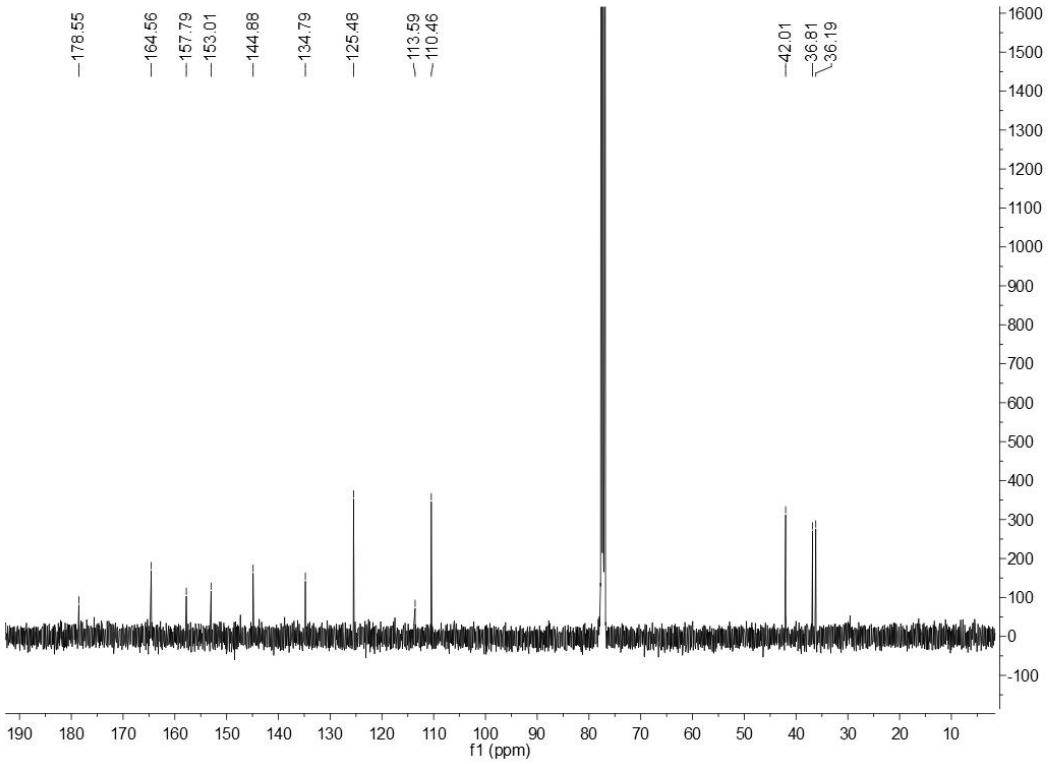

7.72
7.68
7.66
6.80
6.78
4.54
3.13
2.99
0.86
0.94
1.02
1.90
3.00
3.07
f1 (ppm)

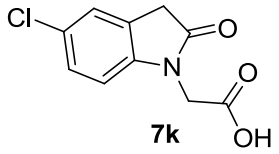

181.86
164.98
157.88
150.12
140.79
128.27
119.04
116.99
113.05
41.93
36.87
36.13
f1 (ppm)


Cl
O
O
Cl
N
O
NMe2

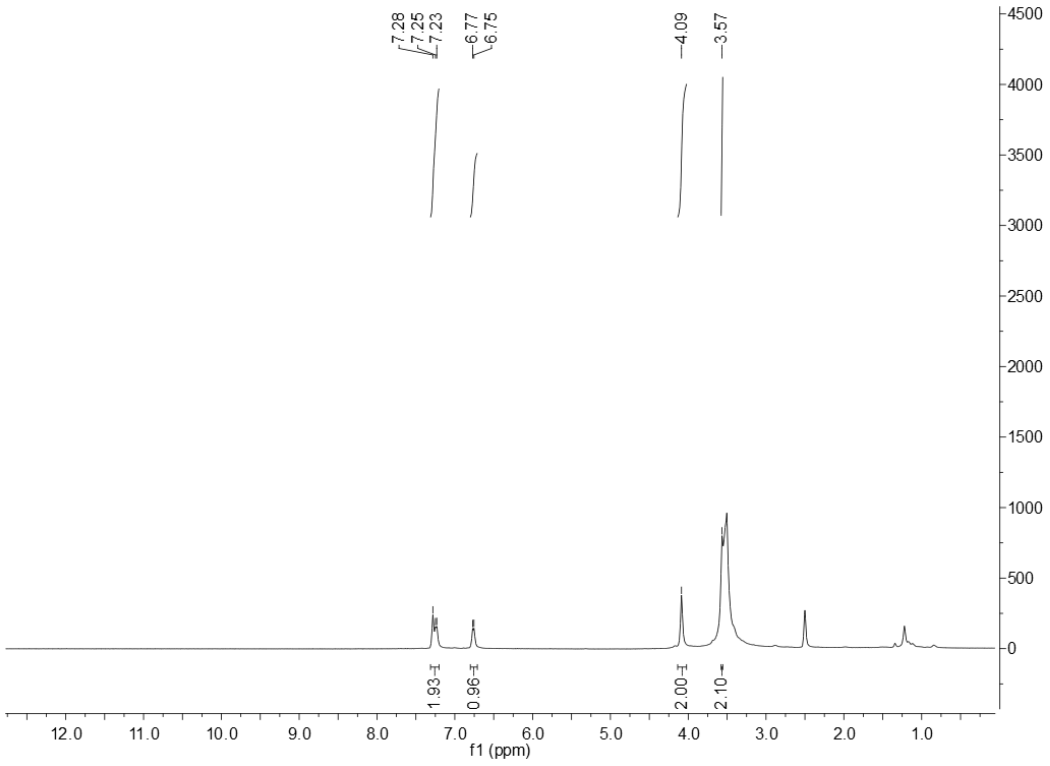
6d

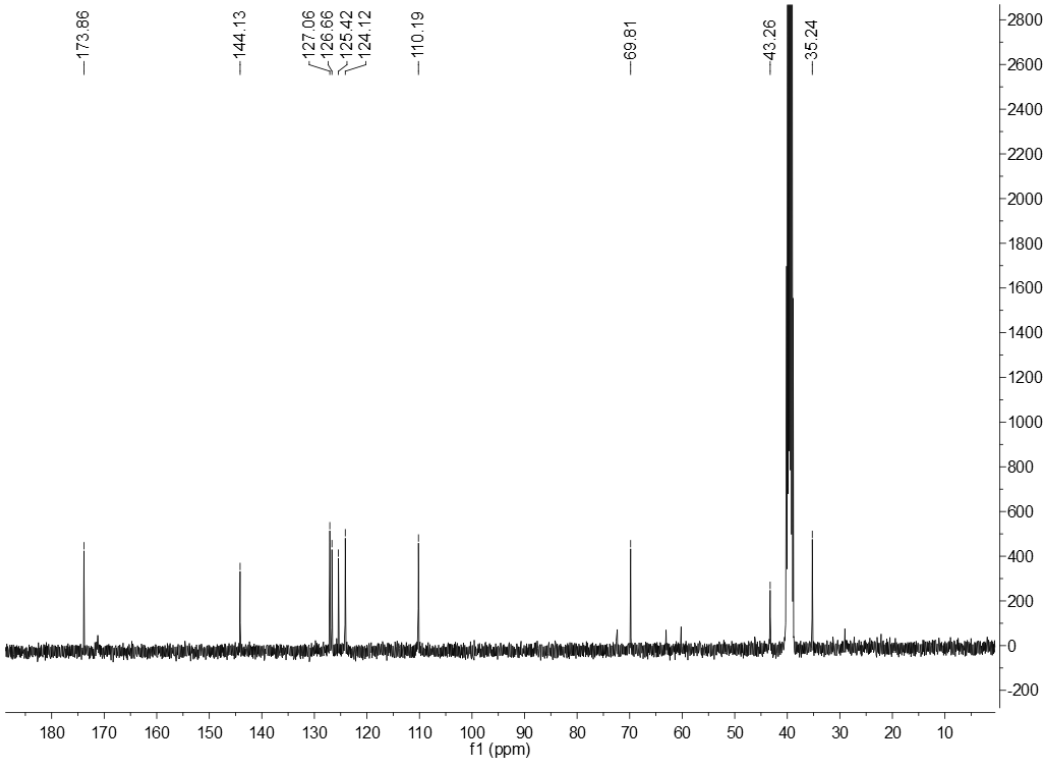

7.08
6.76
4.53
3.14
3.00
0.88
0.89
2.01
3.00
3.03
f1 (ppm)

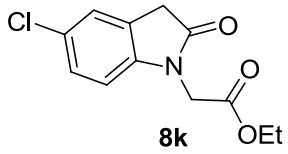

178.55
164.56
157.79
153.01
144.88
134.79
125.48
113.59
110.46
42.01
36.81
36.19
f1 (ppm)


Cl
O
N
O
OH

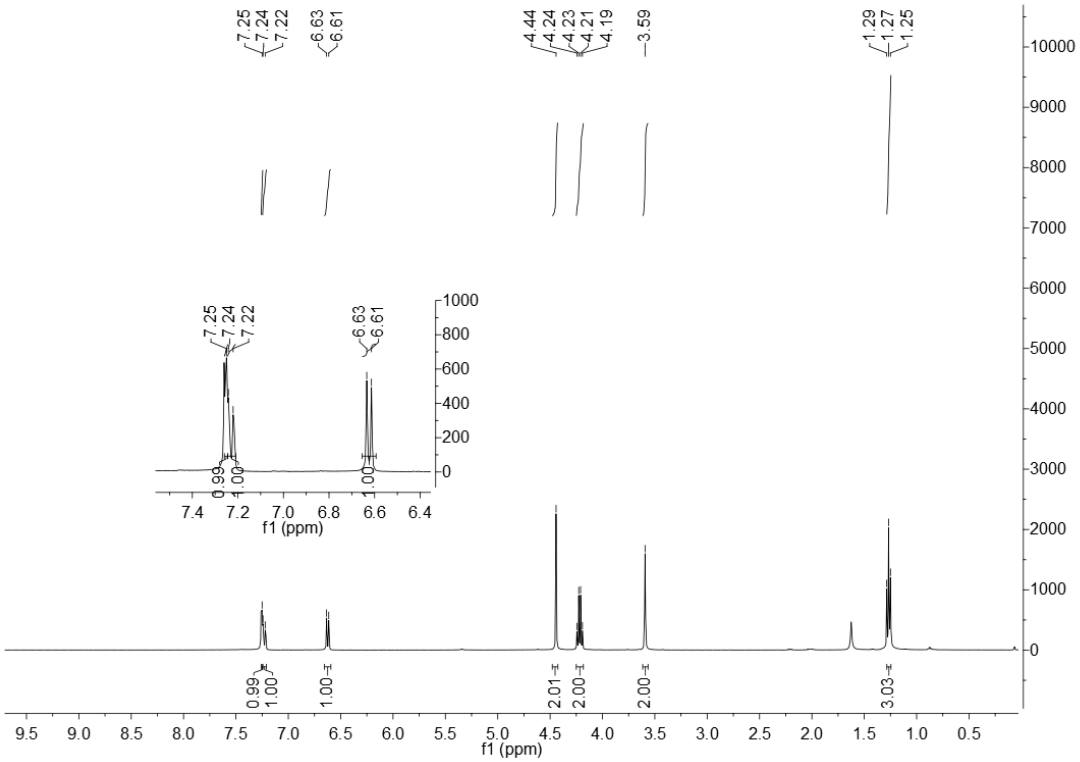
7k

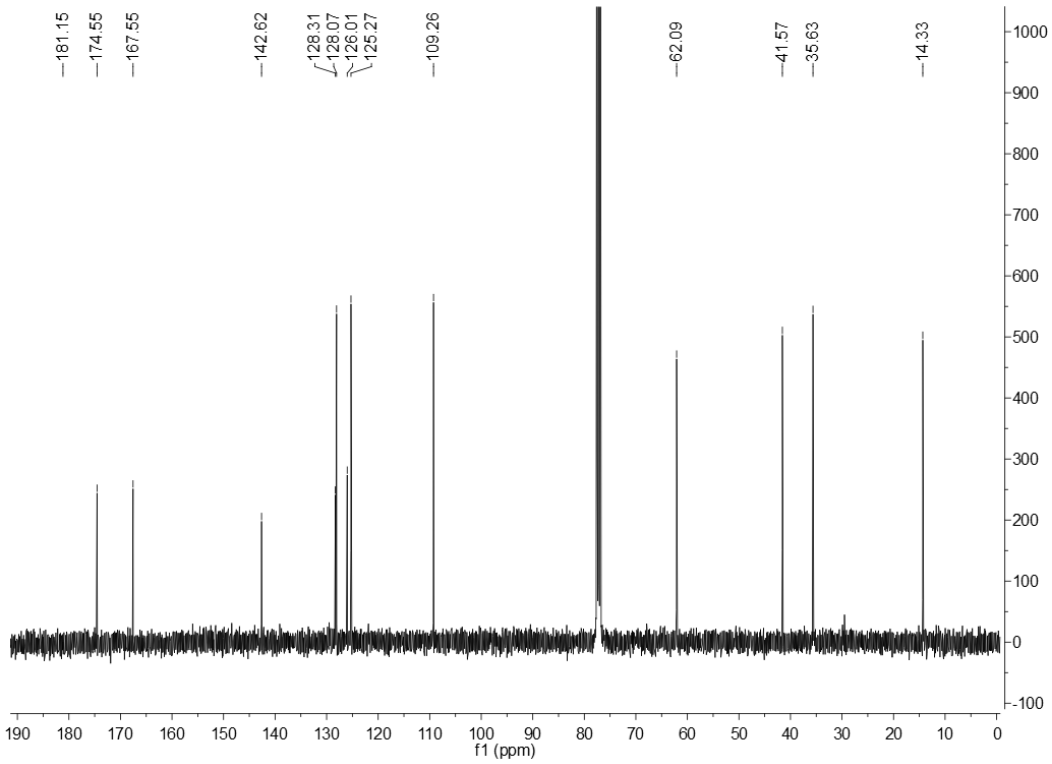

7.28
7.25
7.23
6.77
6.75
4.09
3.57
1.93
0.96
2.00
2.10
f1 (ppm)

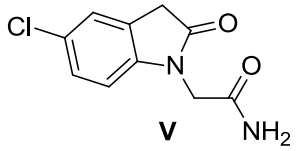

173.86
144.13
127.06
126.66
125.42
124.12
110.19
69.81
43.26
35.24
f1 (ppm)


Cl
O
N
O
OEt

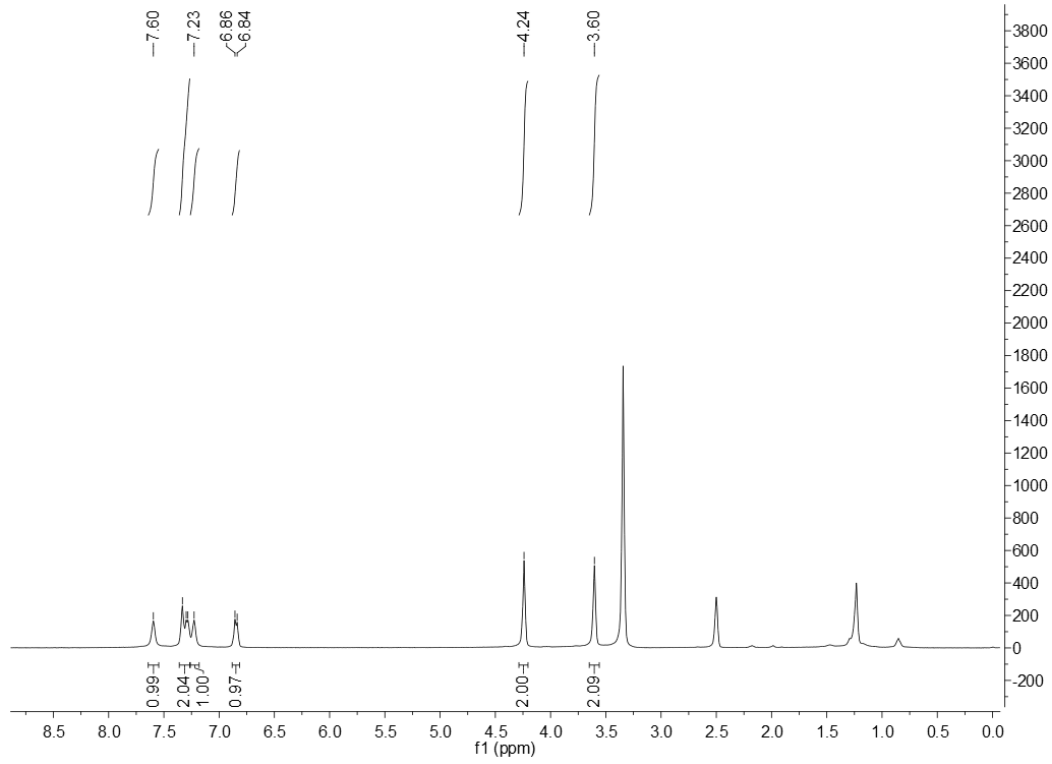
8k

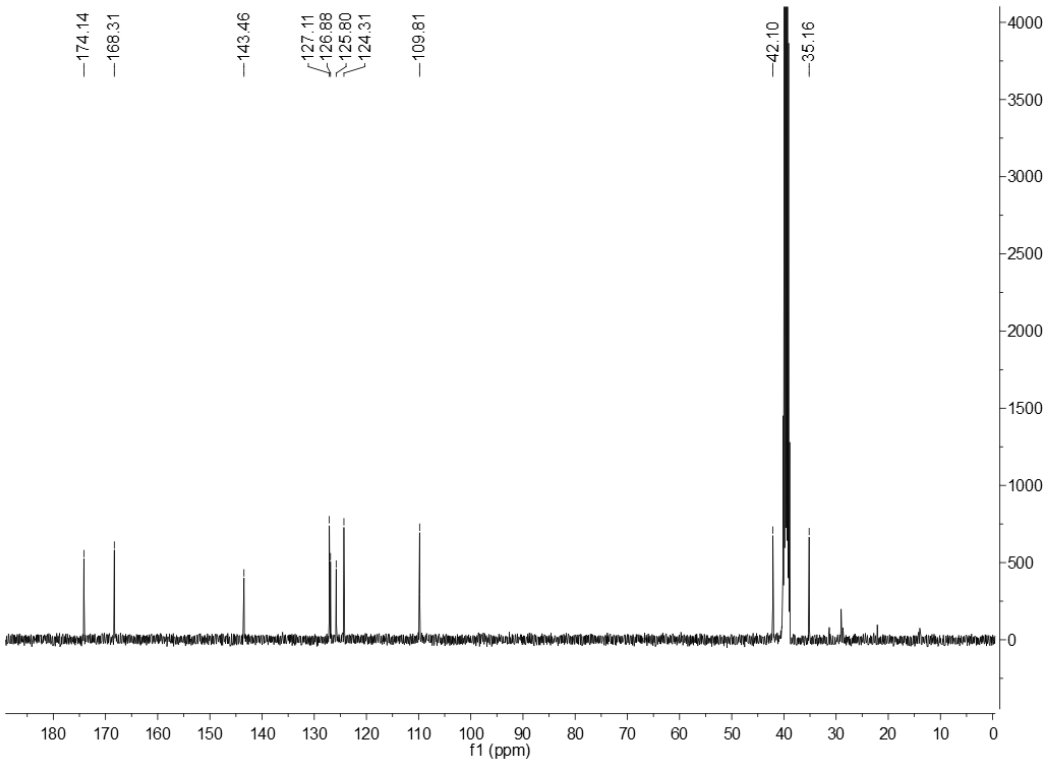

7.25
7.24
7.22
6.63
6.61
4.44
4.24
4.23
4.21
4.19
3.59
1.29
1.27
1.25
0.99
1.00
1.00
2.01
2.00
2.00
3.03
f1 (ppm)


181.15
174.55
167.55
142.62
128.31
128.07
126.01
125.27
109.26
62.09
41.57
35.63
14.33
f1 (ppm)


Cl
O
N
O
NH2

V


7.60
7.23
6.86
6.84
4.24
3.60
0.99
2.04
1.00
0.97
2.00
2.09
f1 (ppm)


174.14
168.31
143.46
127.11
126.88
125.80
124.31
109.81
42.10
35.16
4000
3500
3000
2500
2000
1500
1000
500
0
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)