Supporting Information

for

Eco-friendly Chemoselective N-Functionalization of Isatines mediated by Supported KF in 2-MeTHF

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Instrumentation and General Analytical Methods

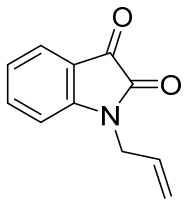
Melting points were determined on a Reichert–Kofler hot-stage microscope and are uncorrected. Mass spectra were obtained on a Shimadzu QP 1000 instrument (EI, 70 eV) and on a Bruker maXis 4G instrument (ESI-TOF, HRMS). IR spectra were recorded on a Perkin-Elmer FTIR 1605 spectrophotometer. ^{1}H, ^{13}C, ^{15}N and ^{19}F NMR spectra were recorded with a Bruker Avance III 400 spectrometer (400 MHz for ^{1}H, 100 MHz for ^{13}C, 40 MHz for ^{15}N, 376 MHz for ^{19}F) at 297 K using a "directly" detecting broadband observe (BBFO) probe. The center of the solvent signal was used as an internal standard which was related to TMS with δ 7.26 ppm (^{1}H in $CDCl_3$), δ 2.49 ppm (^{1}H in DMSO-d_6), δ 77.0 ppm (^{13}C in $CDCl_3$) and δ 39.5 ppm (^{13}C in DMSO-d_6). ^{15}N NMR spectra (gs-HMBC) were referenced against neat, external nitromethane, ^{19}F NMR spectra by absolute referencing via Ξ ratio. Spin-spin coupling constants (J) are given in Hz. In nearly all cases, full and unambiguous assignment of all resonances was performed by combined application of standard NMR techniques, such as APT, HSQC, HMBC, COSY and NOESY experiments.

2-MeTHF was distilled over Na / benzophenone. Chemicals were purchased from Sigma-Aldrich, Acros, Alfa Aesar and TCI Europe. Solutions were evaporated under reduced pressure with a rotary evaporator. TLC was carried out on aluminium sheets precoated with silica gel 60F254 (Macherey-Nagel, Merk); the spots were visualised under UV light (λ = 254 nm) and/or $KMnO_4$ (aq.) was used as revealing system.

General Procedure for the preparation of *N*-substituted isatins (General Procedure 1)

To a solution of the *N*-unsubstituted isatin derivative (2.0 mmol, 1.0 equiv) in 2-MeTHF was added KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) and, the reaction mixture was stirred for 5 min at rt. Then, the electrophilic agent (2.0 mmol, 1.0 equiv) was added dropwise and, the mixture refluxed for the appropriate time as reported in the manuscript. Subsequently, the reaction mixture was allowed to cool to rt and then, filtered, washed thoroughly with 2-MeTHF and the filtrate evaporated under vacuum. Analytical pure sample were recrystallyzed from CPME.

1-allyl-1*H*-indole-2,3-dione (2)



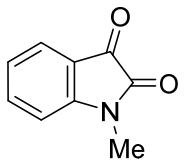
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 3-bromo-1-propene (0.242 g, 2.0 mmol, 1.0 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 2h), compound **2** was obtained in 95% yield (0.355 g) as a red solid; mp 71-72 °C (lit.,[1] 81-83°C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.59 (m, 1H, Indole H-4), 7.56 (m, 1H, Indole H-6), 7.11 (m, 1H, Indole H-5), 6.89 (d, *J* = 7.9 Hz, 1H, Indole H-7), 5.83 (m, 1H, C<u>H</u>=CH_2), 5.31 (m, 1H, CH=C<u>H</u>$_2$), 5.28 (m, 1H, CH=C<u>H</u>$_2$), 4.35 (s, 2H, NC<u>H</u>$_2$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.2 (Indole C-3), 157.8 (Indole C-2), 150.8 (Indole C-7a), 138.3 (Indole C-6), 130.3 (<u>C</u>H=CH_2), 125.3 (Indole C-4), 123.7 (Indole C-5), 118.6

(CH=$\underline{C}H_2$), 117.5 (Indole C-3a), 110.9 (Indole C-7), 42.4 (NCH_2). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -245.6 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_9NO_2H^+$ 188.0706 $[M+H]^+$; found 188.0709.

1-methyl-1*H*-indole-2,3-dione (3a)

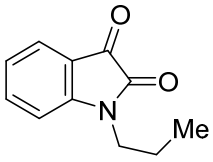


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), iodomethane (0.312 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 1h), compound **3a** was obtained in 94% yield (0.303 g) as a red solid; mp 131-133 °C (lit.,[2] 127-129°C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (m, 1H, Indole H-6), 7.57 (m, 1H, Indole H-4), 7.11 (m, 1H, Indole H-5), 6.89 (m, 1H, Indole H-7), 3.24 (s, 3H, NCH_3). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.3 (Indole C-3), 158.2 (Indole C-2), 151.4 (Indole C-7a), 138.4 (Indole C-6), 125.2 (Indole C-4), 123.8 (Indole C-5), 117.4 (Indole C-3a), 109.9 (Indole C-7), 26.2 (NCH_3). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -253.8 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_9H_7NO_2H^+$ 162.0550 $[M+H]^+$; found 162.0552.

1-propyl-1*H*-indole-2,3-dione (3b)



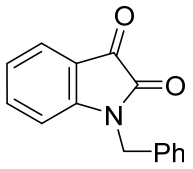
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 1-bromopropane (0.270 g, 2.2 mmol, 1.1 equiv) and KF-Celite

(1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 1h), compound **3b** was obtained in 92% yield (0.348 g) as a red solid; mp 71-72 °C (lit.,[3] 66-68 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.58 (m, 1H, Indole H-4), 7.57 (m, 1H, Indole H-6), 7.09 (m, 1H, Indole H-5), 6.89 (d, *J* = 8.3 Hz, 1H, Indole H-7), 3.68 (m, 2H, NCH_2), 1.73 (m, 2H, $C\underline{H}_2CH_3$), 0.98 (t, *J* = 7.4 Hz, 3H, $CH_2C\underline{H}_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.6 (Indole C-3), 158.1 (Indole C-2), 151.0 (Indole C-7a), 138.3 (Indole C-6), 125.4 (Indole C-4), 123.5 (Indole C-5), 117.5 (Indole C-3a), 110.1 (Indole C-7), 41.7 ($N\underline{C}H_2$), 20.6 ($\underline{C}H_2CH_3$), 11.3 ($CH_2\underline{C}H_3$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -242.2 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_{11}NO_2H^+$ 190.0862 $[M+H]^+$; found 190.0865.

1-benzyl-1*H*-indole-2,3-dione (3c)



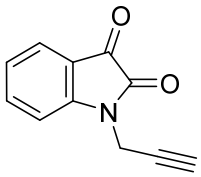
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), (bromomethyl)benzene (0.376 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 1h), compound **3c** was obtained in 95% yield (0.449 g) as an orange solid; mp 121-123 °C (lit.,[3] 122-123°C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.59 (m, 1H, Indole H-4), 7.48 (m, 1H, Indole H-6), 7.33 (m, 4H, Ph H-2,3,5,6), 7.29 (m, 1H, Ph H-4), 7.08 (m, 1H, Indole H-5), 6.78 (d, *J* = 8.0 Hz, 1H, Indole H-7), 4.92 (s, 2H, $C\underline{H}_2Ph$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.2 (Indole C-3), 158.2 (Indole C-2), 150.6 (Indole C-7a), 138.3 (Indole C-6), 134.4 (Ph C-1), 129.0 (Ph C-3,5), 128.1 (Ph C-4), 127.4 (Ph C-2,6), 125.3 (Indole C-4), 123.8

(Indole C-5), 117.6 (Indole C-3a), 111.0 (Indole C-7), 44.0 (<u>C</u>H_2Ph). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -242.2 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{15}H_{11}NO_2H^+$ 238.0862 $[M+H]^+$; found 238.0866.

1-(2-propyn-1-yl)-1*H*-indole-2,3-dione (3d)

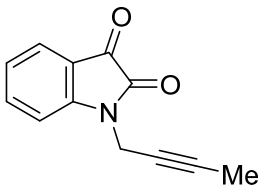


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 3-bromo-propyne (0.261 g, 2.2 mmol, 1.1 equiv) and KF (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 3h), compound **3d** was obtained in 95% yield (0.352 g) as an orange solid; mp 138-140°C (lit.,[4] 147-149°C).

^{1}H NMR (400 MHz, DMSO-d_6): δ 7.71 (m, 1H, Indole H-6), 7.58 (m, 1H, Indole H-4), 7.23 (m, 1H, Indole H-7), 7.17 (m, 1H, Indole H-5), 4.54 (d, ^4J = 2.5 Hz, 2H, NCH_2), 3.34 (t, ^4J = 2.5 Hz, 1H, C≡C<u>H</u>). **^{13}C NMR** (100 MHz, DMSO-d_6): δ 182.5 (Indole C-3), 157.3 (Indole C-2), 149.4 (Indole C-7a), 138.1 (Indole C-6), 124.5 (Indole C-4), 123.6 (Indole C-5), 117.6 (Indole C-3a), 111.2 (Indole C-7), 77.3 (<u>C</u>≡CH), 74.9 (C≡<u>C</u>H), 29.0 (NCH_2). **^{15}N NMR** (40 MHz, DMSO-d_6): δ -247.7 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_7NO_2H^+$ 186.0550 $[M+H]^+$; found 186.0553.

1-(2-butyn-1-yl)-1*H*-indole-2,3-dione (3e)

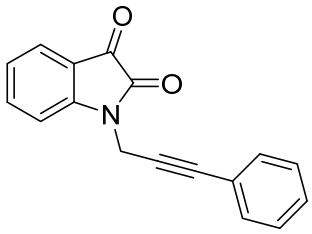


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 1-bromo-2-butyne (0.293 g, 2.2 mmol, 1.1 equiv) and KF (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 3h), compound **3e** was obtained in 95% yield (0.378 g) as an orange solid; mp 112-113 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.63 (m, 1H, Indole H-6), 7.62 (m, 1H, Indole H-4), 7.15 (m, 1H, Indole H-5), 7.11 (m, 1H, Indole H-7), 4.47 (q, ^{4}J = 2.4 Hz, 2H, NCH_2), 1.79 (t, ^{4}J = 2.5 Hz, 1H, ≡C-C$\underline{H}_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.0 (Indole C-3), 157.2 (Indole C-2), 150.0 (Indole C-7a), 138.3 (Indole C-6), 125.3 (Indole C-4), 123.9 (Indole C-5), 117.6 (Indole C-3a), 111.2 (Indole C-7), 81.1 ($\underline{C}$≡C-CH_3), 71.0 (C≡$\underline{C}$-CH_3), 29.9 (NCH_2), 3.4 (CH_3). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -246.2 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{12}H_9NO_2H^+$ 200.0706 $[M+H]^+$; found 200.0709.

1-(3-phenyl-2-propyn-1-yl)-1*H*-indole-2,3-dione (3f)



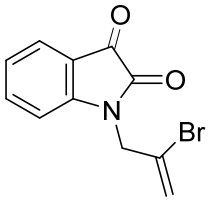
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), (3-chloro-1-propyn-1-yl)benzene (0.331 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12h), compound **3f** was obtained in 88% yield (0.460 g) as an orange solid; mp 131-133 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (m, 2H, Indole H-4,6), 7.40 (m, 2H, Ph H-2,6), 7.32 (m, 1H, Ph H-4), 7.30 (m, 2H, Ph H-3,5), 7.21 (m, 1H, Indole H-7), 7.17 (m, 1H, Indole H-5), 4.76 (s, 2H, NCH_2). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.8 (Indole C-3), 157.2 (Indole C-2), 149.9 (Indole C-7a), 138.4 (Indole C-6), 131.8 (Ph C-2,6), 128.9

(Ph C-4), 128.3 (Ph C-3,5), 125.4 (Indole C-4), 124.1 (Indole C-5), 121.8 (Ph C-1), 117.7 (Indole C-3a), 111.2 (Indole C-7), 84.8 (C≡CPh), 80.8 (C≡CPh), 30.3 ($N\underline{C}H_2$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -247.6 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{17}H_{11}NNaO_2$ 284.0682 $[M+Na]^+$; found 284.0686.

1-(2-bromo-2-propen-1-yl)-1*H*-indole-2,3-dione (3g)

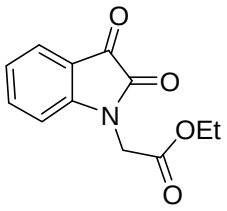


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 2,3dibromo-1-propene (0.506 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12 h), compound **3g** was obtained in 90% yield (0.477 g) as an orange solid; mp 58-60°C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.64 (m, 1H, Indole H-4), 7.60 (m, 1H, Indole H-6), 7.16 (m, 1H, Indole H-5), 6.93 (m, 1H, Indole H-7), 5.89 (dt, $^2J_{Hcis,Htrans}$ = 2.6 Hz, $^4J_{Htrans,CH2}$ = 1.5 Hz, 1H, $C\underline{H}_2$=CBr trans to Br), 5.70 (dt, $^2J_{Hcis,Htrans}$ = 2.6 Hz, $^4J_{Hcis,CH2}$ = 1.1 Hz, 1H, $C\underline{H}_2$=CBr cis to Br), 4.59 (dd, $^4J_{Htrans,CH2}$ = 1.5 Hz, $^4J_{Hcis,CH2}$ = 1.1 Hz, 2H, $NC\underline{H}_2$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.4 (Indole C-3), 157.7 (Indole C-2), 150.1 (Indole C-7a), 138.5 (Indole C-6), 125.5 (Indole C-4), 125.1 ($\underline{C}Br=CH_2$), 124.2 (Indole C-5), 119.4 ($CBr=\underline{C}H_2$), 117.5 (Indole C-3a), 110.9 (Indole C-7), 47.7 (NCH_2). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -246.4 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_8BrNO_2H^+$ 265.9811 $[M+H]^+$; found 265.9814.

ethyl (2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)acetate (3h)

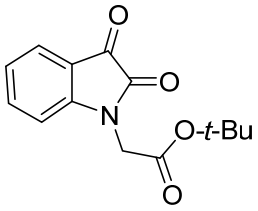


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), ethyl bromoacetate (0.367 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 4 h), compound **3h** was obtained in 93% yield (0.433 g) as an orange solid; mp 91-92 °C (lit.,[4] 105-110°C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.62 (m, 1H, Indole H-4), 7.58 (m, 1H, Indole H-6), 7.14 (m, 1H, Indole H-5), 6.78 (m, 1H, Indole H-7), 4.47 (s, 2H, NCH_2), 4.23 (q, J = 7.1 Hz, 2H, $C\underline{H}_2CH_3$), 1.27 (t, J = 7.1 Hz, 3H, $CH_2C\underline{H}_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.4 (Indole C-3), 166.7 (O=$\underline{C}$O), 158.0 (Indole C-2), 150.3 (Indole C-7a), 138.4 (Indole C-6), 125.5 (Indole C-4), 124.1 (Indole C-5), 117.6 (Indole C-3a), 110.1 (Indole C-7), 62.1 ($\underline{C}H_2CH_3$), 41.2 (NCH_2), 14.0 (CH_3). **^{15}N NMR** (40 MHz, $CDCl_3$): δ-251.5 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{12}H_{11}NO_4H^+$ 234.0761 $[M+H]^+$; found 234.0764.

2-methyl-2-propanyl (2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)acetate (3i)



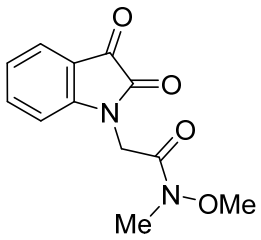
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 2-methyl-2-propanyl bromoacetate (0.429 g, 2.2 mmol, 1.1 equiv)

and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 6h), compound **3i** was obtained in 94% yield (0.496 g) as a yellow solid; mp 115-116 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.63 (m, 1H, Indole H-4), 7.58 (m, 1H, Indole H-6), 7.14 (m, 1H, Indole H-5), 6.77 (m, 1H, Indole H-7), 4.38 (s, 2H, NCH_2), 1.45 (s, 9H, $C(CH_3)_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.6 (Indole C-3), 165.7 (O=<u>C</u>O), 158.0 (Indole C-2), 150.5 (Indole C-7a), 138.3 (Indole C-6), 125.5 (Indole C-4), 124.0 (Indole C-5), 117.6 (Indole C-3a), 110.1 (Indole C-7), 83.4 ($\underline{C}(CH_3)_3$), 42.0 (NCH_2), 27.9 ($C(\underline{C}H_3)_3$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -250.5 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{14}H_{15}NO_4H^+$ 262.1074 $[M+H]^+$; found 262.1077.

2-(2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)-*N*-methoxy-*N*-methylacetamide (3j)



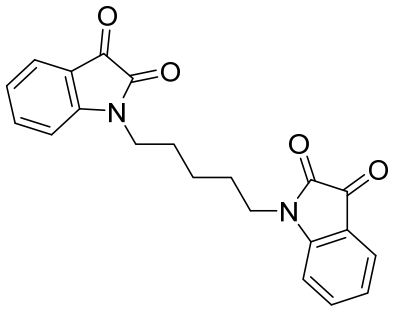
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 2-chloro-*N*-methoxy-*N*-methylacetamide (0.302 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 6h), compound **3j** was obtained in 89% yield (0.442 g) as a red solid; mp 130-131 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.60 (m, 1H, Indole H-4), 7.55 (m, 1H, Indole H-6), 7.11 (m, 1H, Indole H-5), 6.80 (m, 1H, Indole H-7), 4.66 (s, 2H, NCH_2), 3.82 (s, 3H, OCH_3), 3.22 (s, 3H, $NC\underline{H}_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 186.5 (O=<u>C</u>N), 182.8 (Indole C-3), 166.5 ($CH_2\underline{C}$=O), 158.4 (Indole C-2), 150.9 (Indole C-7a), 138.3 (Indole C-6), 125.3 (Indole C-4), 123.8 (Indole C-5), 117.6 (Indole C-3a), 110.5 (Indole C-7),

61.7 (OCH_3), 40.9 ($N\underline{C}H_2$), 32.4 ($N\underline{C}H_3$). **^{15}N NMR** (40 MHz, $CDCl_3$):δ -251.8 (Indole N-1), -195.3 (O=C$\underline{N}$).

HRMS (ESI), *m/z*: calcd. for $C_{12}H_{12}KN_2O_4$ 287.0432 $[M+K]^+$; found 287.0429.

1,1'-(1,5-pentanediyl)bis(1*H*-indole-2,3-dione) (3k)

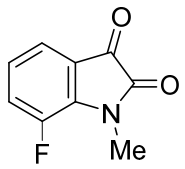


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 1,5-dibromopentane (0.506 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12h), compound **3l** was obtained in 86% yield (0.624 g) as an orange solid; mp 145-147 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.59 (m, 2H, Indole H-6,6′), 7.58 (d, ^3J = 7.5 Hz, 2H, Indole H-4,4′), 7.10 (m, 2H, Indole H-5,5′), 6.92 (d, ^3J = 8.2 Hz, 2H, Indole H-7,7′), 3.71 (t, ^3J = 7.2 Hz, 4H, NCH_2), 1.78 (m, 4H, $NCH_2C\underline{H}_2$), 1.46 (m, 2H, $NCH_2CH_2C\underline{H}_2$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.4 (Indole C-3,3′), 158.2 (Indole C-2, 2′), 150.7 (Indole C-7a, 7a′), 138.5 (Indole C-4,4′), 125.4 (Indole C-6,6′), 123.7 (Indole C-5,5′), 117.5 (Indole C-3a,3a′), 110.1 (Indole C-7,7′), 39.7 (NCH_2), 26.6 ($NCH_2\underline{C}H_2$), 23.8 ($NCH_2CH_2\underline{C}H_2$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -242.7 (2N, Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{21}H_{18}N_2NaO_4$ 385.1159 $[M+Na]^+$; found 385.1157.

7-fluoro-1-methyl-1*H*-indole-2,3-dione (3l)

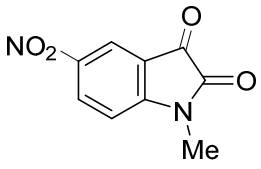


By following General Procedure 1, starting from 7-fluoro-1*H*-indole-2,3-dione (0.330 g, 2.0 mmol, 1.0 equiv), iodomethane (0.312 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 6h), compound **3l** was obtained in 89% yield (0.412 g) as a red solid; mp 120-122 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, J = 7.4 Hz, 1H, Indole H-4), 7.34 (m, 1H, Indole H-6), 7.07 (m, 1H, Indole H-5), 3.46 (d, $J_{H,F\ through\text{-}space}$ = 2.9 Hz, 3H, NCH_3). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.4 ($^{4}J_{C,F}$ = 3.7 Hz, Indole C-3), 157.9 (Indole C-2), 148.2 ($^{1}J_{C,F}$ = 248.0 Hz, Indole C-7), 137.5 (d, $^{2}J_{C,F}$ = 8.7 Hz, Indole C-7a), 126.4 (d, $^{2}J_{C,F}$ = 19.6 Hz, Indole C-6), 124.6 (d, $^{3}J_{C,F}$ = 5.8 Hz, Indole C-5), 121.2 (d, $^{4}J_{C,F}$ = 3.4 Hz, Indole C-4), 120.0 (d, $^{3}J_{C,F}$= 2.7 Hz, Indole C-3a), 29.1 (d, $J_{C,F}$ = 5.5 Hz, NCH_3). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -256.9 (Indole N-1). **^{19}F NMR** (376 MHz, $CDCl_3$): δ -134.0 (7-F).

HRMS (ESI), *m/z*: calcd. for $C_9H_6FNO_2H^+$ 180.0455 $[M+H]^+$; found 180.0457.

1-methyl-5-nitro-1*H*-indole-2,3-dione (3m)

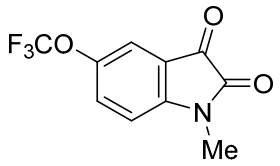


By following General Procedure 1, starting from 5-nitro-1*H*-indole-2,3-dione (0.384 g, 2.0 mmol, 1.0 equiv), iodomethane (0.312 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 6h), compound **3m** was obtained in 88% yield (0.362 g) as a brown solid; mp 132-134 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ 8.53 (dd, $^{3}J_{\text{IndoleH6,IndoleH7}}$ = 8.8 Hz, $^{4}J_{\text{IndoleH6,IndoleH4}}$ = 2.4 Hz, 1H, Indole H-6), 8.22 (d, $^{4}J_{\text{IndoleH4,IndoleH6}}$ = 2.4 Hz, 1H, Indole H-4), 7.35 (d, $^{3}J_{\text{IndoleH7,IndoleH6}}$ = 8.8 Hz, 1H, Indole H-7), 3.21 (s, 3H, NCH_3). **^{13}C NMR** (100 MHz, DMSO-d_6): δ 181.2 (Indole C-3), 158.9 (Indole C-2), 155.6 (Indole C-7a), 142.0 (Indole C-5), 133.0 (Indole C-6), 118.9 (Indole C-4), 117.8 (Indole C-3a), 110.9 (Indole C-7), 26.5 (NCH_3). **^{15}N NMR** (40 MHz, DMSO-d_6): δ -248.2 (Indole N-1), -8.1 (NO_2).

HRMS (ESI), *m/z*: calcd. for $C_9H_6N_2O_4H^+$ 207.0400 $[M+H]^+$; found 207.0403.

1-methyl-5-(trifluoromethoxy)-1*H*-indole-2,3-dione (3n)[5]

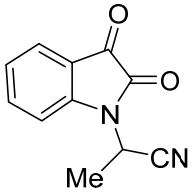


By following General Procedure 1, starting from 5-(trifluoromethoxy)-1*H*-indole-2,3-dione (0.462 g, 2.0 mmol, 1.0 equiv), iodomethane (0.312 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 6h), compound **3n** was obtained in 85% yield (0.417 g) as an orange solid; mp 47-49 °C.

^{1}H NMR (400 MHz, DMSO-d_6): δ 7.69 (dd, $^{3}J_{\text{IndoleH6,IndoleH7}}$ = 8.6 Hz, $^{4}J_{\text{IndoleH6,IndoleH4}}$ = 1.7 Hz, 1H, Indole H-6), 7.56 (d, $^{4}J_{\text{IndoleH4,IndoleH6}}$ = 1.7 Hz, 1H, Indole H-4), 7.24 (d, $^{3}J_{\text{IndoleH7,IndoleH6}}$ = 8.6 Hz, 1H, Indole H-7), 3.14 (s, 3H, NCH_3). **^{13}C NMR** (100 MHz, DMSO-d_6): δ 182.3 (Indole C-3), 158.3 (Indole C-2), 150.1 (Indole C-7a), 143.8 (q, $^{3}J_{C,F}$ = 2.1 Hz, Indole C-5), 130.6 (Indole C-6), 119.8 (q, $^{1}J_{C,F}$ = 256.4 Hz, OCF_3), 118.4 (Indole C-3a), 117.5 (Indole C-4), 111.9 (Indole C-7), 26.2 (NCH_3). **^{15}N NMR** (40 MHz, DMSO-d_6): δ -253.0 (Indole N-1). **^{19}F NMR** (376 MHz, $CDCl_3$): δ -57.6 (CF_3).

HRMS (ESI), *m/z*: calcd. for $C_{10}H_6F_3NO_3H^+$ 246.0372 $[M+H]^+$; found 246.0375.

2-(2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)propanenitrile (3o)

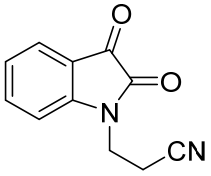


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 2-bromopropanenitrile (0.294 g, 2.2 mmol, 1.1 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 24 h), compound **3p** was obtained in 43% yield (0.172 g) as a yellow solid; mp 125-127 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.71 (m, 1H, Indole H-4), 7.28 (m, 1H, Indole H-7), 7.70 (m, 1H, Indole H-6), 7.25 (m, 1H, Indole H-5), 5.58 (q, ^{3}J = 7.3 Hz, 1H, C<u>H</u>CN), 1.80 (d, ^{3}J = 7.3 Hz, 3H, CH_3). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 181.0 (Indole C-3), 156.5 (Indole C-2), 147.1 (Indole C-7a), 138.7 (Indole C-6), 126.2 (Indole C-4), 124.8 (Indole C-5), 117.9 (Indole C-3a), 116.0 (C≡N), 111.4 (Indole C-7), 36.8 (<u>C</u>HCN), 17.3 (CH_3). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -245.8 (Indole N-1), -117.9 (-C≡<u>N</u>).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_8N_2NaO_2$ 223.0478 $[M+Na]^+$; found 223.0476.

3-(2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)propanenitrile (4a)

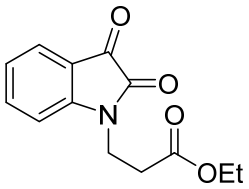


By following General Procedure1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), acrylonitrile (0.127 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 12h), compound **4a** was obtained in 71% yield (284 g) as a brown solid. mp 115-117 °C (lit.,[6] 133° C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.65 (m, 2H, Indole H-4,6), 7.18 (m, 1H, Indole H-5), 7.04 (m, 1H, Indole H-7), 4.05 (t, ^{3}J = 6.8 Hz, 2H, $NC\underline{H}_2$), 2.82 (t, ^{3}J = 6.8 Hz, 2H, $C\underline{H}_2CN$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 182.1 (Indole C-3), 158.2 (Indole C-2), 149.6 (Indole C-7a), 138.7 (Indole C-6), 126.0 (Indole C-4), 124.5 (Indole C-5), 117.7 (Indole C-3a), 116.9 ($\underline{C}\equiv N$), 109.9 (Indole C-7), 36.3 ($N\underline{C}H_2$), 16.6 ($\underline{C}H_2CN$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -247.6 (Indole N-1), -129.7 (-$C\equiv\underline{N}$).

HRMS (ESI), *m/z*: calcd. for $C_{11}H_8N_2NaO_2$ 223.0478 $[M+Na]^+$; found 223.0481.

ethyl 3-(2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl (4b)

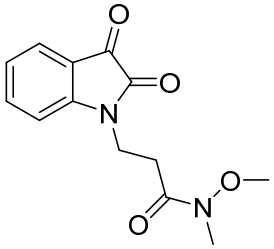


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), ethyl acrylate (0.240 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12 h), compound **4b** was obtained in 86% yield (0.425 g) as a light brown solid. mp 48-51 °C.

^{1}H NMR (400M Hz, $CDCl_3$): δ 7.59 (m, 1H, Indole H-6), 7.58 (m, 1H, Indole H-4), 7.11 (m, 1H, Indole H-5), 7.02 (m, 1H, Indole H-7), 4.11 (q, ^{3}J = 7.1 Hz, 2H, OCH_2), 4.01 (t, ^{3}J = 7.0 Hz, 2H, NCH_2), 2.74 (t, ^{3}J = 7.0 Hz, 2H, $NCH_2C\underline{H}_2$), 1.21 (t, ^{3}J = 7.1 Hz, 3H, $CH_2C\underline{H}_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.1 (Indole C-3), 170.8 ($O\underline{C}$=O), 158.3 (Indole C-2), 150.5 (Indole C-7a), 138.4 (Indole C-6), 125.5 (Indole C-4), 123.8 (Indole C-5), 117.6 (Indole C-3a), 110.4 (Indole C-7), 61.1 (OCH_2), 36.2 (NCH_2), 32.2 ($NCH_2\underline{C}H_2$), 14.0 ($CH_2\underline{C}H_3$). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -245.2 (Indole N-1).

HRMS (ESI), *m/z*: calcd. for $C_{13}H_{14}NO_4H^+$ 248.0917 $[M+H]^+$; found 248.0914.

3-(2,3-dioxo-2,3-dihydro-1*H*-indol-1-yl)-*N*-methoxy-*N*-methylpropanamide (4c)

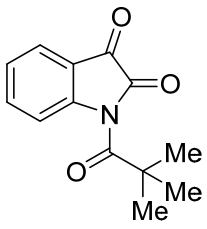


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), N-methoxy-N-methylacrylamide (0.276 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12h), compound **4c** was obtained in 83% yield (0.435 g) as an orange solid. mp 85-87 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.59 (m, 1H, Indole H-6), 7.58 (m, 1H, Indole H-4), 7.10 (m, 2H, Indole H-5,7), 4.04 (t, ^{3}J = 6.8 Hz, 2H, NCH_2), 3.65 (s, 3H, OCH_3), 3.11 (s, 3H, NCH_3), 2.89 (t, ^{3}J = 6.8 Hz, 2H, CH_2C=O). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 183.3 (Indole C-3), 171.4 ($CH_2\underline{C}$=O), 158.6 (Indole C-2), 150.8 (Indole C-7a), 138.4 (Indole C-6), 125.3 (Indole C-4), 123.6 (Indole C-5), 117.6 (Indole C-3a), 110.5 (Indole C-7), 61.4 (OCH_3), 36.3 (NCH_2), 32.1 (NCH_3), 30.0 ($\underline{C}H_2C$=O). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -244.5 (Indole N-1), -193.1 (NCH_3).

HRMS (ESI), *m/z*: calcd. for $C_{13}H_{14}N_2NaO_4$ 285.0846 $[M+Na]^+$; found 285.0851.

1-(2,2-dimethylpropanoyl)-1*H*-indole-2,3-dione (5a)

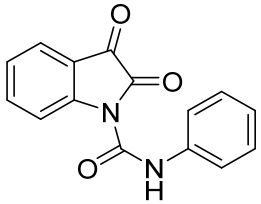


By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), 2,2-dimethylpropanoyl chloride (0.289 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 12h), compound **5a** was obtained in 88% yield (0.407 g) as a yellow solid; mp 78-80°C

^{1}H NMR (400MHz, $CDCl_3$): δ 7.81 (m, 1H, Indole H-7), 7.74 (m, 1H, Indole H-4), 7.66 (m, 1H, Indole H-6), 7.28 (m, 1H, Indole H-5), 1.44 (s, 9H, $C(CH_3)_3$). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 180.5 (Indole C-3), 180.3 (O=$\underline{C}C(CH_3)_3$), 156.5 (Indole C-2), 149.8 (Indole C-7a), 138.6 (Indole C-6), 125.5 (Indole C-5), 125.3 (Indole C-4), 119.5 (Indole C-3a), 117.2 (Indole C-7), 43.2 ($\underline{C}(CH_3)_3$), 26.5 ($C(\underline{C}H_3)_3$).

HRMS (ESI), *m/z*: calcd. for $C_{13}H_{13}NO_3H^+$ 232.0968 $[M+H]^+$; found 232.0971.

2,3-dioxo-*N*-phenyl-1-indolinecarboxamide (5b)



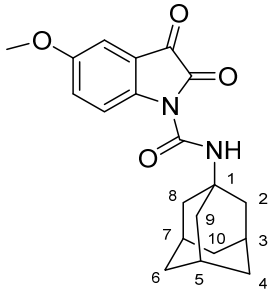
By following General Procedure 1, starting from 1*H*-indole-2,3-dione (0.294 g, 2.0 mmol, 1.0 equiv), phenyl isocyanate (0.286 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g, 50% w/w) in 2-MeTHF (reaction time 12 h), compound **5b** was obtained in 92% yield (0.490 g) as a yellow solid. mp 175-177°C (lit.,[7] 168 °C).

^{1}H NMR (400 MHz, $CDCl_3$): δ 10.09 (s, 1H, NH), 8.48 (m, 1H, Indole H-7) 7.77 (m, 1H, Indole H-4), 7.73 (m, 1H, Indole H-6), 7.58 (m, 2H, Ph H-2,6), 7.39 (m, 2H, Ph H-3,5), 7.32 (m, 1H, Indole H-5), 7.19 (m, 1H, Ph H-4). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 180.0 (Indole C-3), 159.3 (Indole C-2), 148.6 (Indole C-7a), 148.0 (O=$\underline{C}$NH), 139.2 (Indole C-6), 136.4 (Ph C-1), 129.2 (Ph C-3,5), 126.0 (Indole C-5), 125.5 (Indole C-4),

125.1 (Ph C-4), 118.5 (Indole C-3a), 118.2 (Indole C-7), 120.7 (Ph C-2,6). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -267.3 (O=C<u>N</u>H), Indole N-1 not found *via* HMBC.

HRMS (ESI), *m/z*: calcd. for $C_{15}H_{10}N_2O_3H^+$ 267.0764 $[M+H]^+$; found 267.0767.

***N*-(adamantan-1-yl)-5-methoxy-2,3-dioxo-1-indolinecarboxamide (5c)**



By following General Procedure 1, starting from 5-methoxy-1*H*-indole-2,3-dione (0.354 g, 2.0 mmol, 1.0 equiv), 1-Adamantyl isocyanate (0.425 g, 2.4 mmol, 1.2 equiv) and KF-Celite (1.5 equiv, 3.0 mmol, 0.349 g , 50% w/w) in 2-MeTHF (reaction time 12 h), compound **5c** was obtained in 92% yield (0.652 g) as a brown solid. mp 163-165 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.28 (m, 1H, Indole H-7), 7.94 (s, 1H, NH), 7.18 (m, 1H, Indole H-6), 7.16 (m, 1H, Indole H-4), 3.82 (s, 3H, OCH_3), 2.13 (m, 3H, Adam H-3,5,7), 2.09 (m, 6H, Adam H-2,8,9), 1.72 (m, 6H, Adam H-4,6,10). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 181.0 (Indole C-3), 159.3 (Indole C-2), 157.2 (Indole C-5), 148.8 (O=<u>C</u>NH), 143.4 (Indole C-7a), 125.7 (Indole C-6), 119.3 (Indole C-7), 118.9 (Indole C-3a), 108.1 (Indole C-4), 55.8 (OCH_3), 52.4 (Adam C-1), 41.6 (Adam C-2,8,9), 36.2 (Adam C-4,6,10), 29.4 (Adam C-3,5,7). **^{15}N NMR** (40 MHz, $CDCl_3$): δ -260.2 (O=C<u>N</u>H), Indole N-1 not found *via* HMBC.

HRMS (ESI), *m/z*: calcd. for $C_{20}H_{22}N_2NaO_4$ 377.1472 $[M+Na]^+$; found 377.1468.

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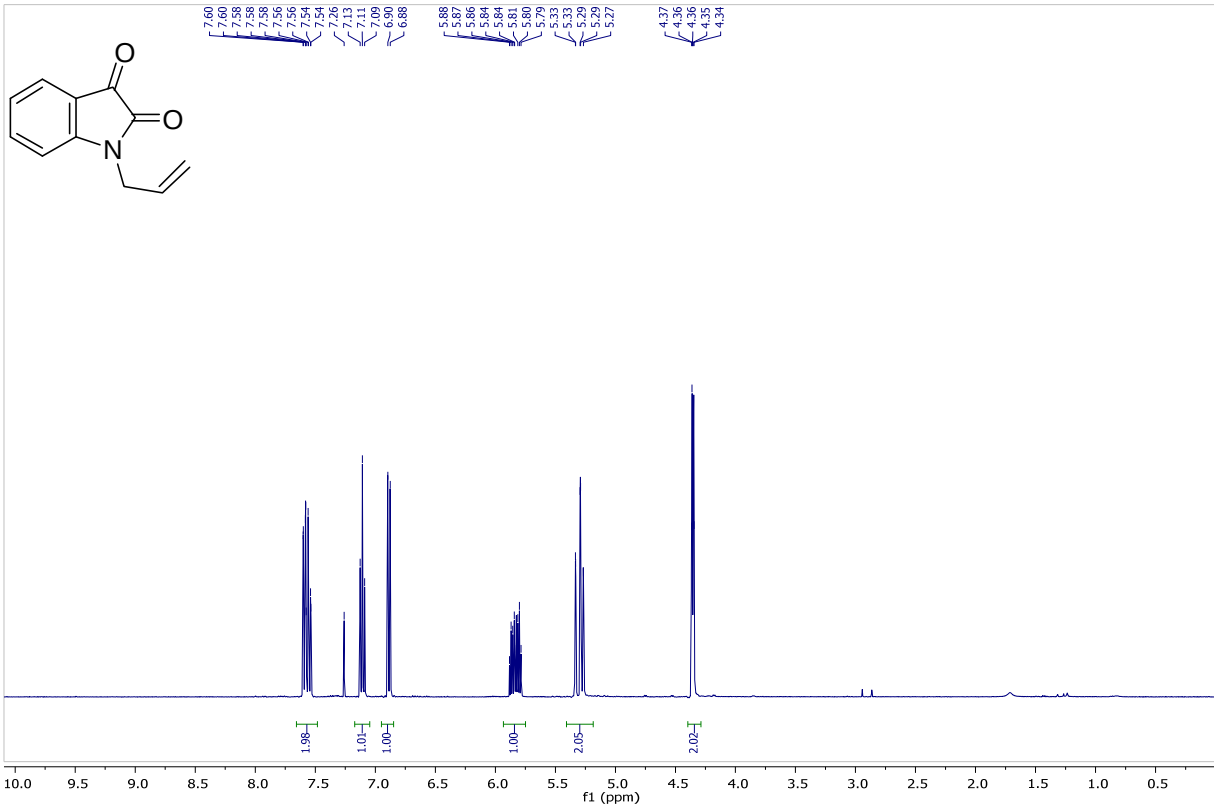
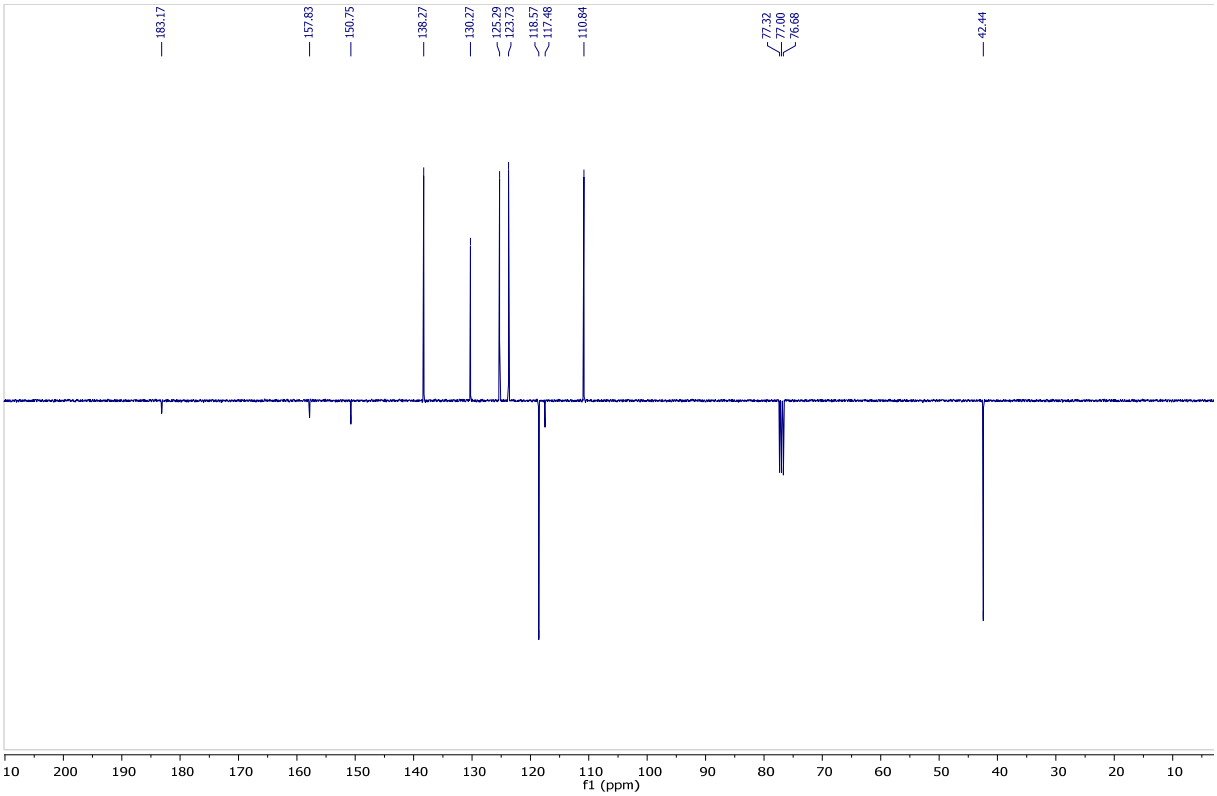
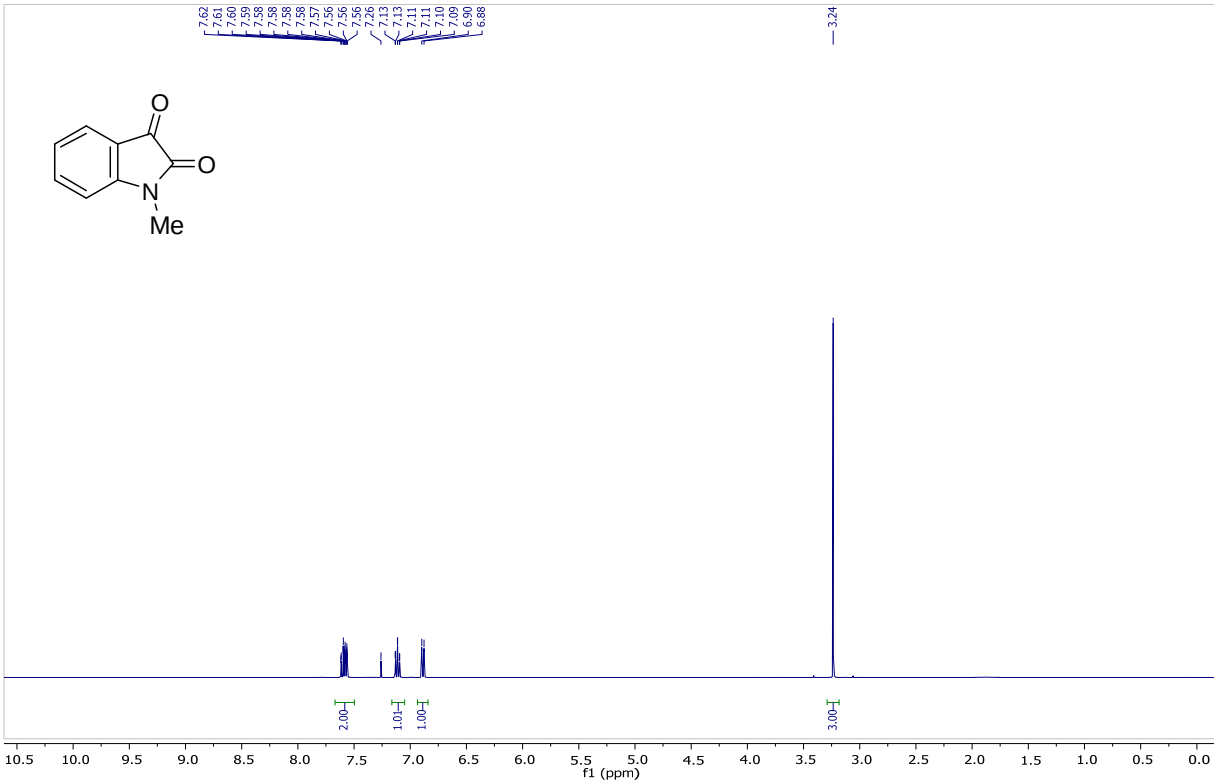
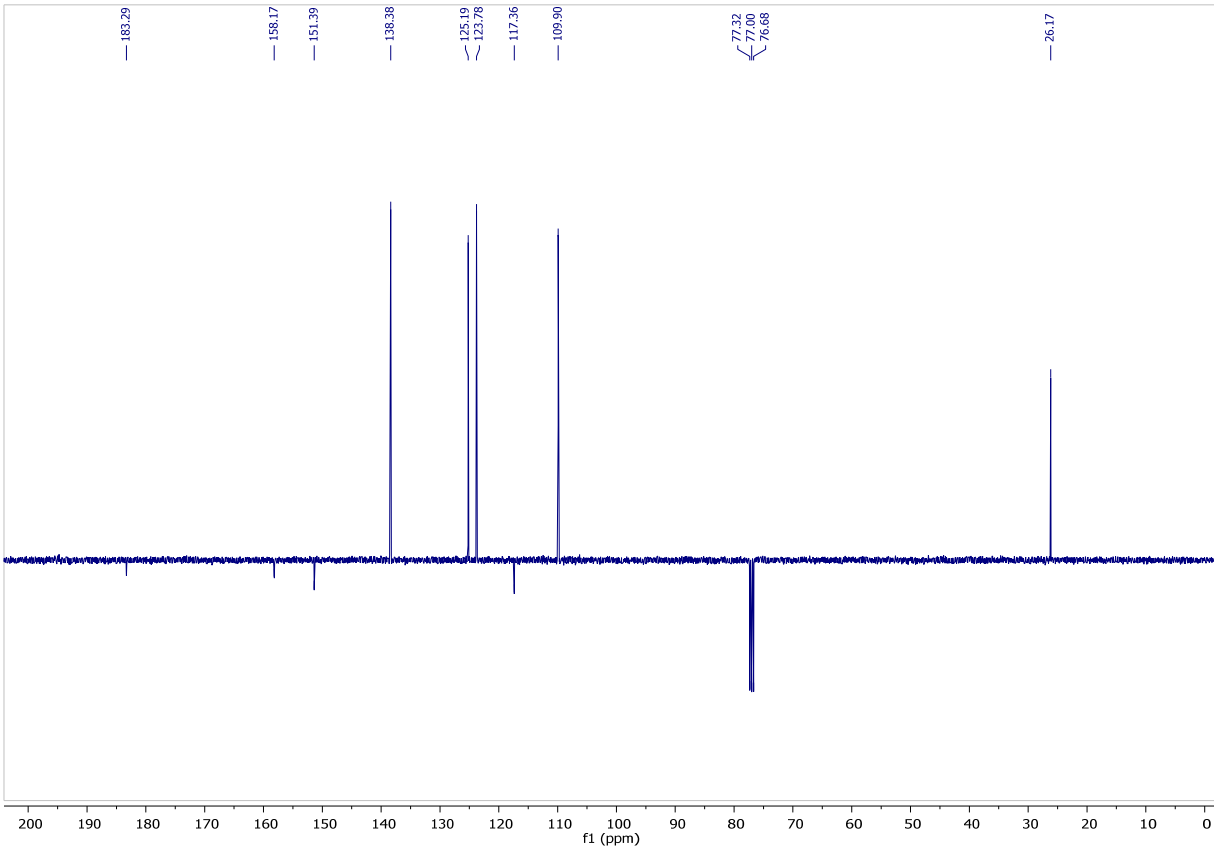
(2)


7.60
7.60
7.58
7.58
7.58
7.56
7.56
7.54
7.54
7.26
7.13
7.11
7.09
6.90
6.88
5.88
5.87
5.86
5.84
5.84
5.81
5.80
5.79
5.33
5.33
5.29
5.29
5.27
4.37
4.36
4.36
4.35
4.34
O
O
N
1.98
1.01
1.00
1.00
2.05
2.02
10.0 9.5 9.0 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)

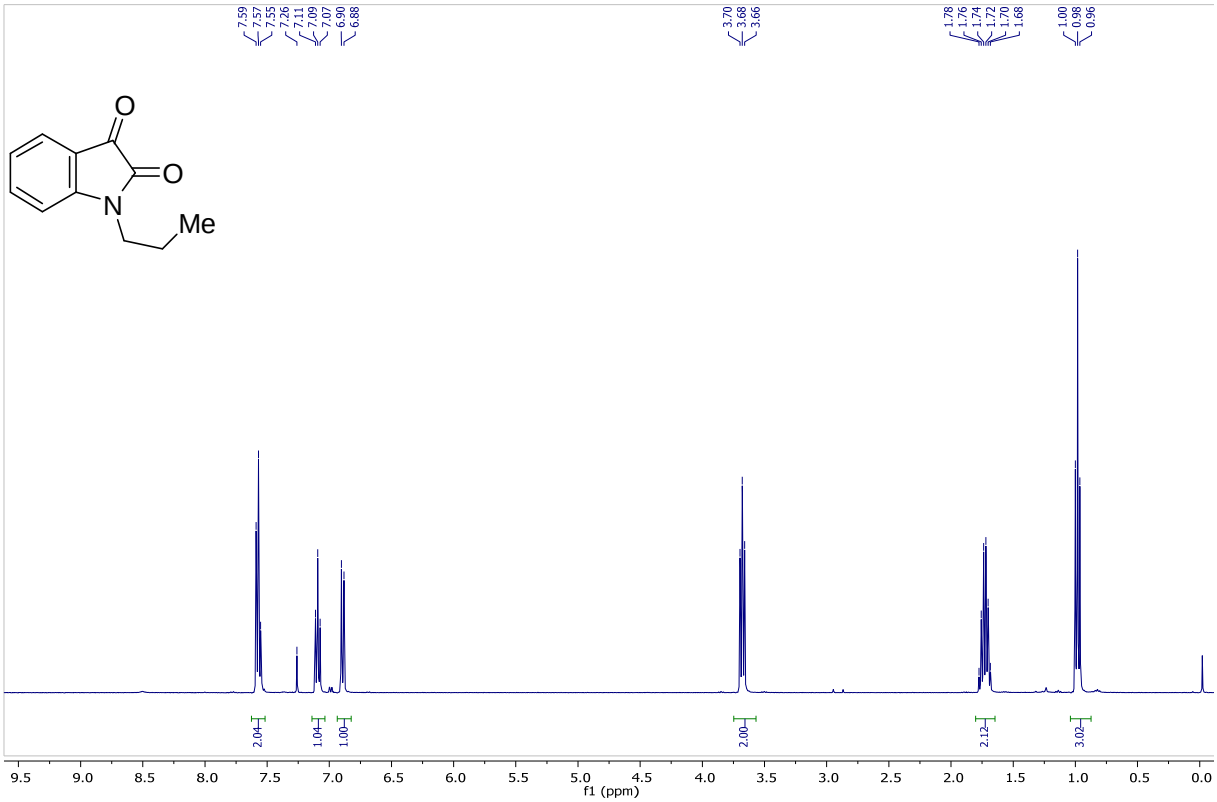

183.17
157.83
150.75
138.27
130.27
125.29
123.73
118.57
117.48
110.84
77.32
77.00
76.68
42.44
10 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

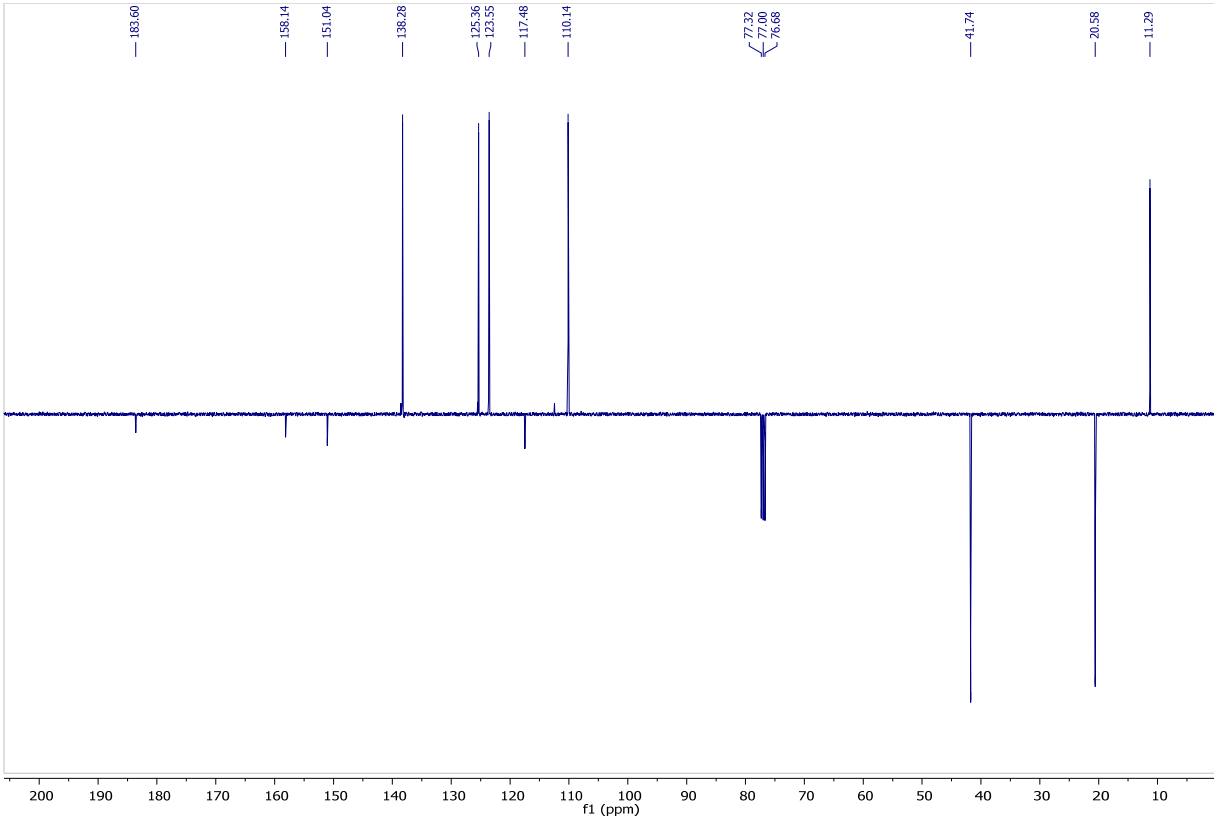
(3a)


7.62
7.61
7.60
7.59
7.58
7.58
7.58
7.58
7.57
7.56
7.56
7.56
7.26
7.13
7.11
7.11
7.10
7.09
6.90
6.88
3.24
O
O
N
Me
2.00
1.01
1.00
3.00
10.5 10.0 9.5 9.0 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 0.0
f1 (ppm)

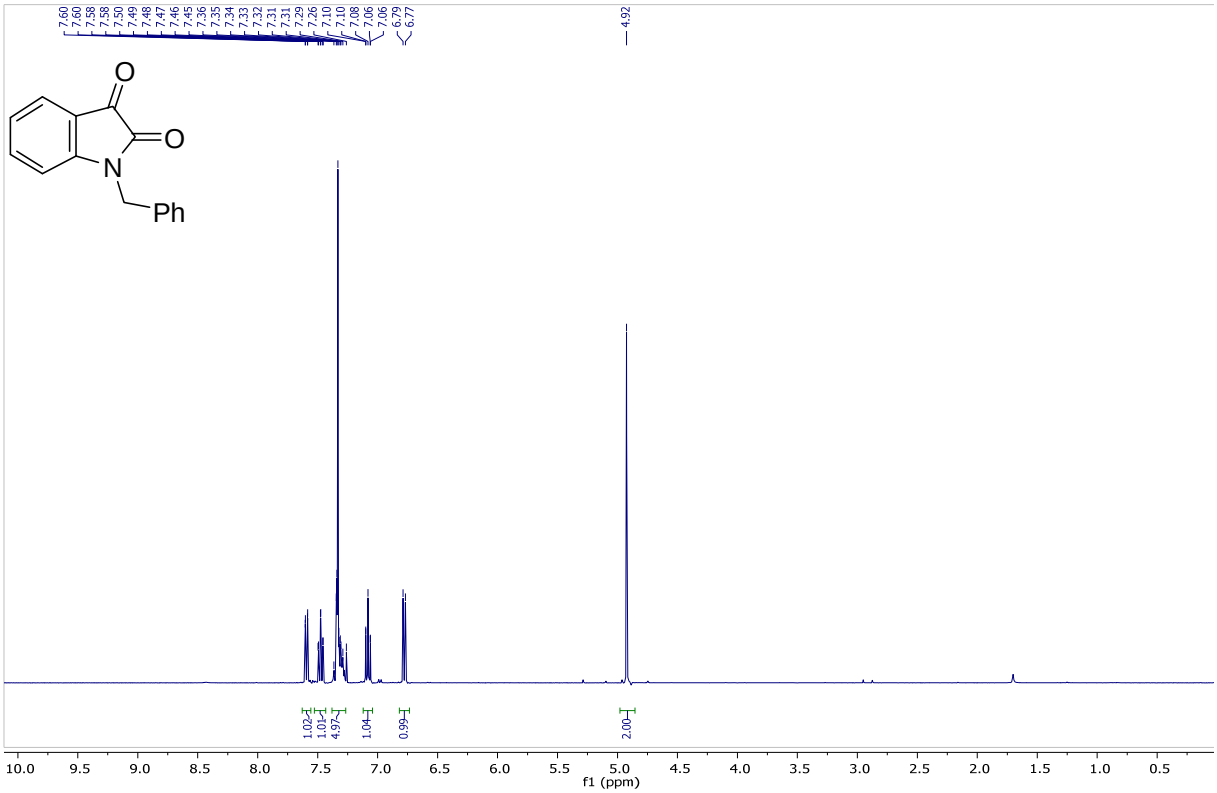

183.29
158.17
151.39
138.38
125.19
123.78
117.36
109.90
77.32
77.00
76.68
26.17
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

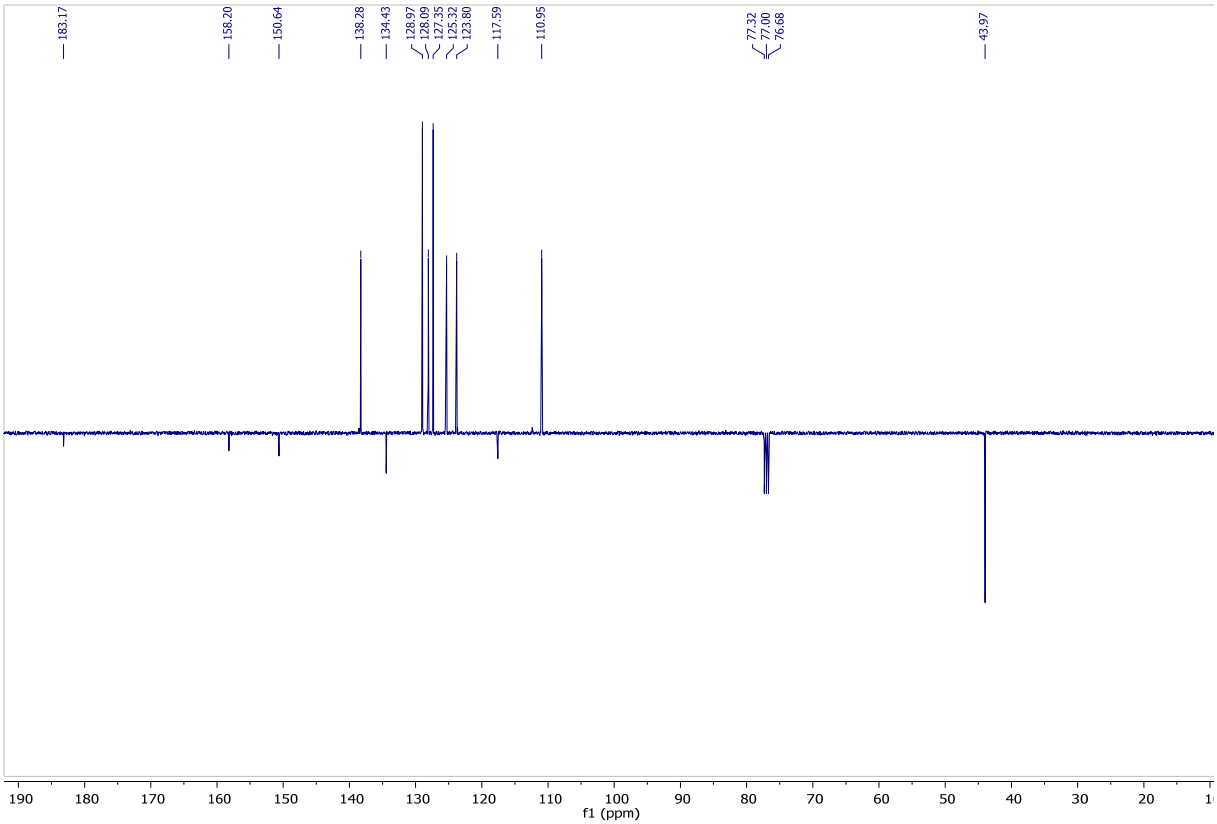
(3b)


7.59
7.57
7.55
7.26
7.11
7.09
7.07
6.90
6.88
3.70
3.68
3.66
1.78
1.76
1.74
1.72
1.70
1.68
1.00
0.98
0.96
O
O
N
Me
2.04
1.04
1.00
2.00
2.12
3.02
f1 (ppm)

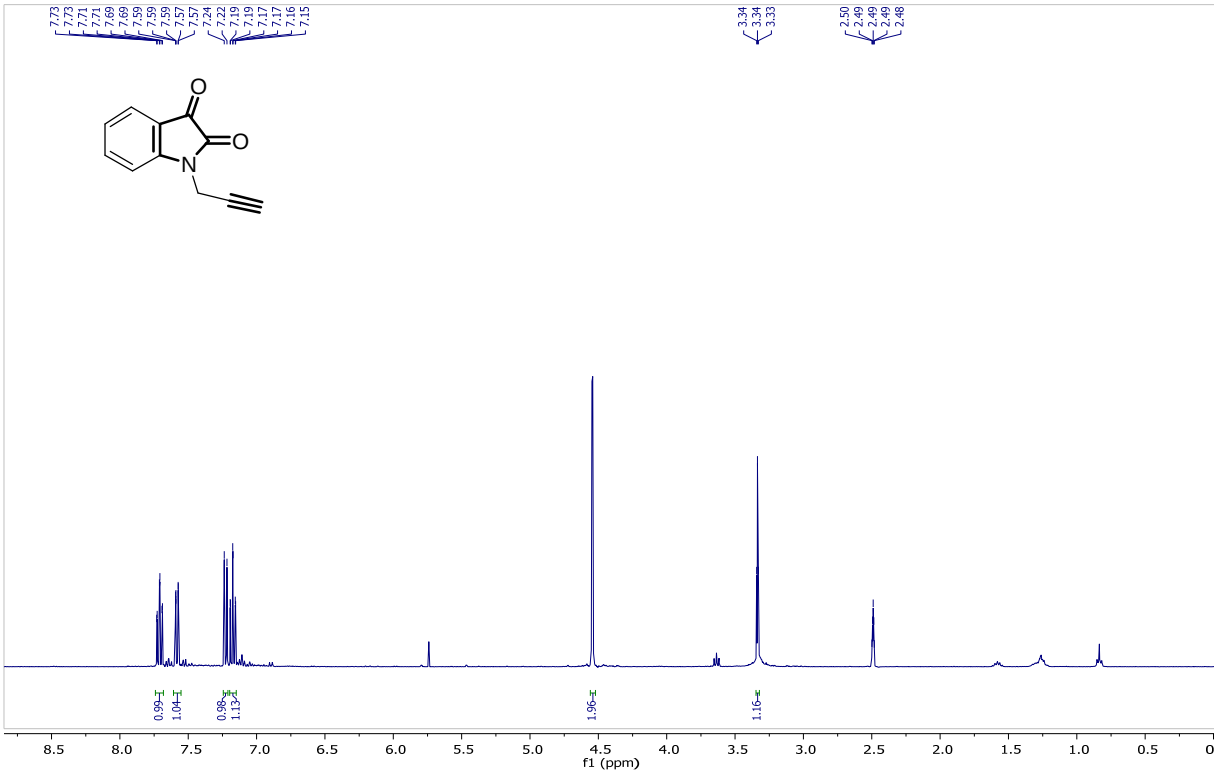

183.60
158.14
151.04
138.28
125.36
123.55
117.48
110.14
77.32
77.00
76.68
41.74
20.58
11.29
f1 (ppm)

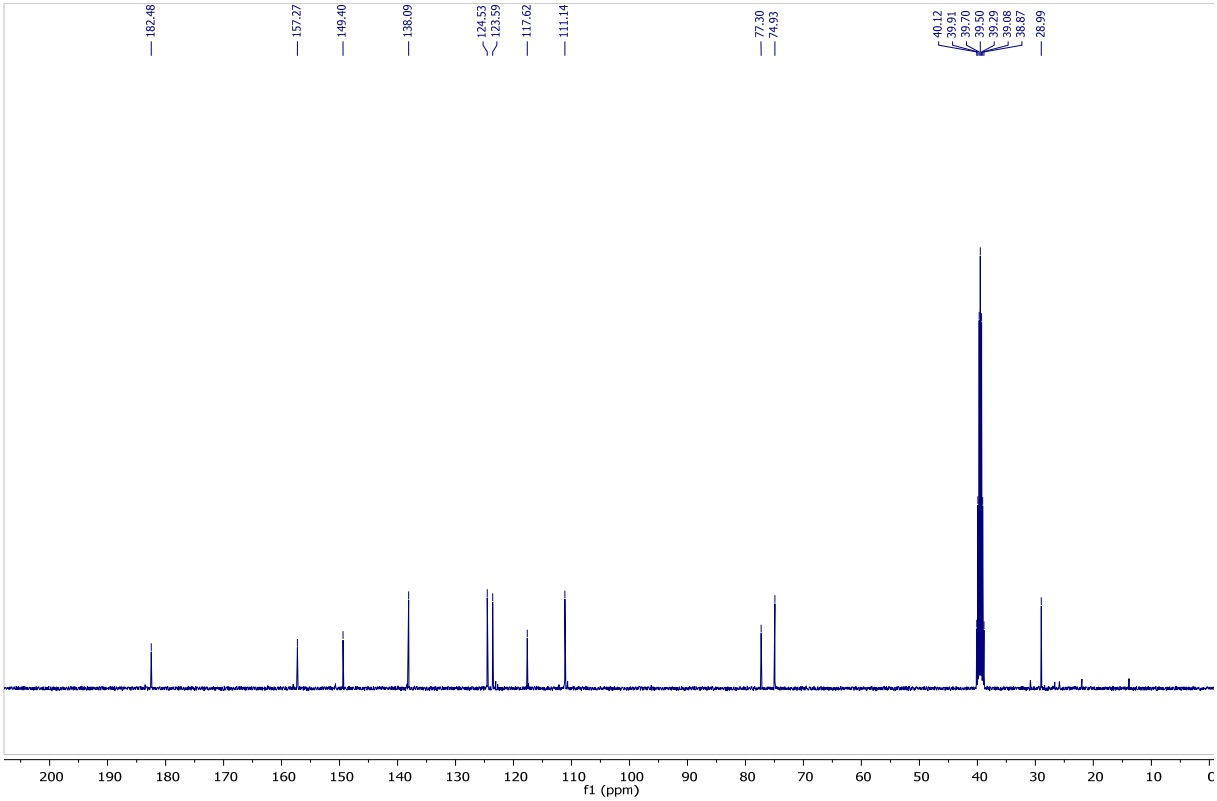
(3c)


7.60
7.60
7.58
7.58
7.50
7.49
7.48
7.47
7.46
7.45
7.36
7.35
7.34
7.33
7.32
7.31
7.31
7.29
7.26
7.10
7.10
7.08
7.06
7.06
6.79
6.77
4.92
O
O
N
Ph
1.02
1.01
4.97
1.04
0.99
2.00
10.0
9.5
9.0
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)

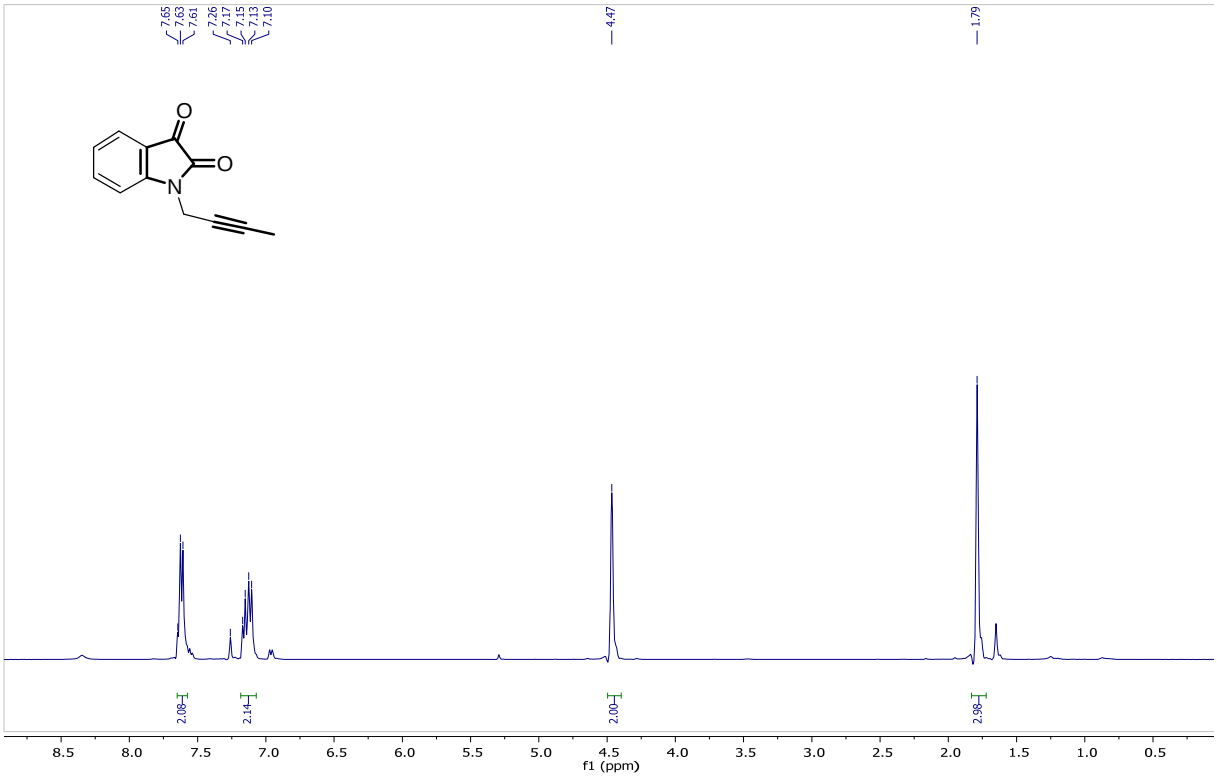

183.17
158.20
150.64
138.28
134.43
128.97
128.09
127.35
125.32
123.80
117.59
110.95
77.32
77.00
76.68
43.97
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

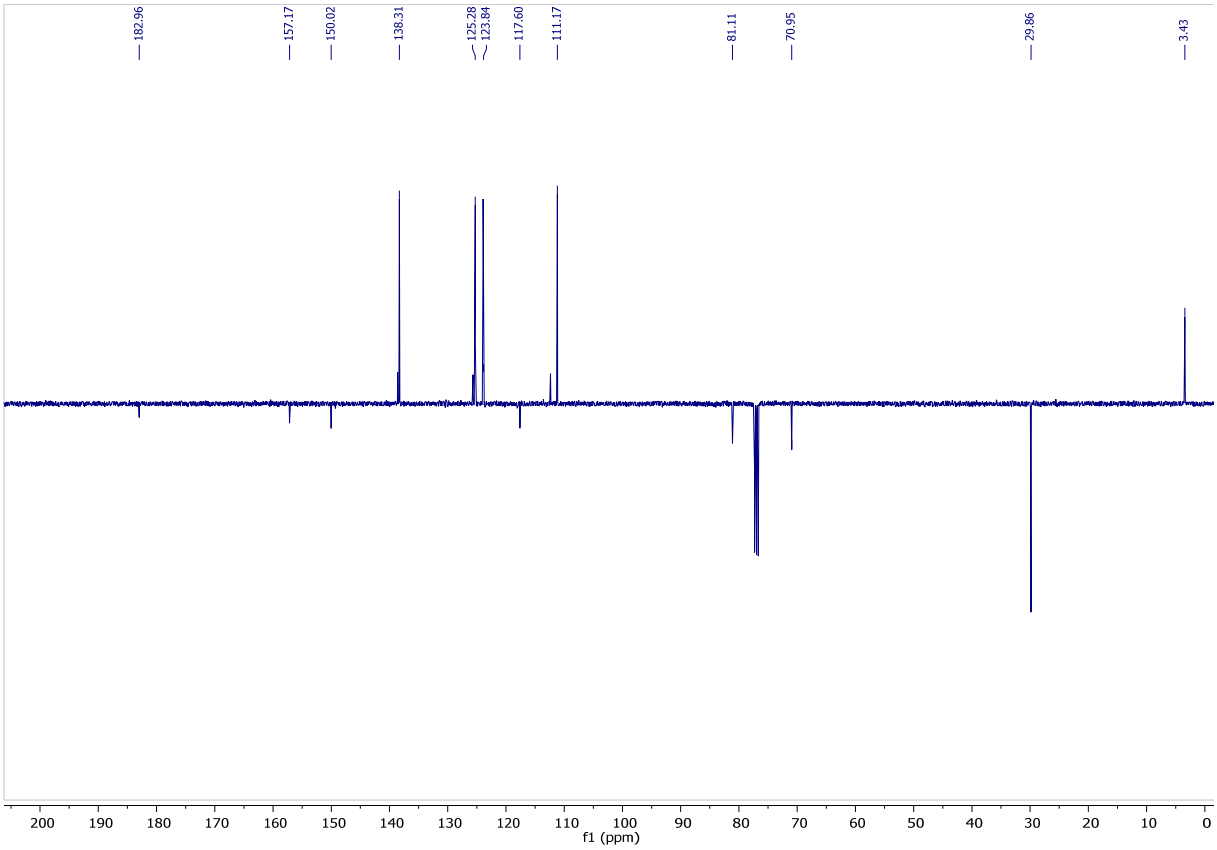
(3d)


7.73
7.73
7.71
7.71
7.69
7.69
7.59
7.59
7.59
7.57
7.57
7.24
7.22
7.19
7.19
7.17
7.17
7.16
7.15
3.34
3.34
3.33
2.50
2.49
2.49
2.49
2.48
O
O
N
0.99
1.04
0.98
1.13
1.96
1.16
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
0
f1 (ppm)

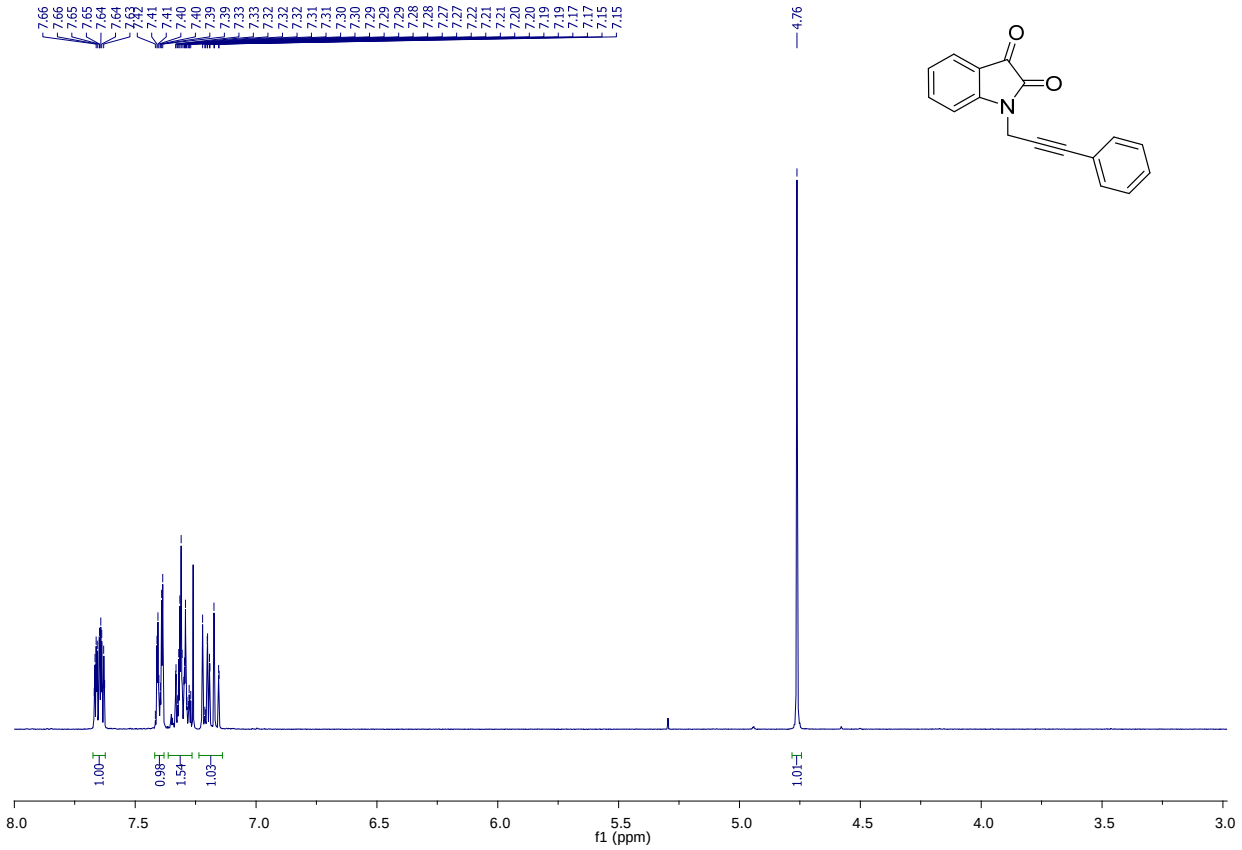

182.48
157.27
149.40
138.09
124.53
123.59
117.62
111.14
77.30
74.93
40.12
39.91
39.70
39.50
39.29
39.08
36.87
28.99
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

(3e)


7.65
7.63
7.61
7.26
7.17
7.15
7.13
7.10
4.47
1.79
O
O
N
2.08
2.14
2.00
2.98
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)


182.96
157.17
150.02
138.31
125.28
123.84
117.60
111.17
81.11
70.95
29.86
3.43
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(3f)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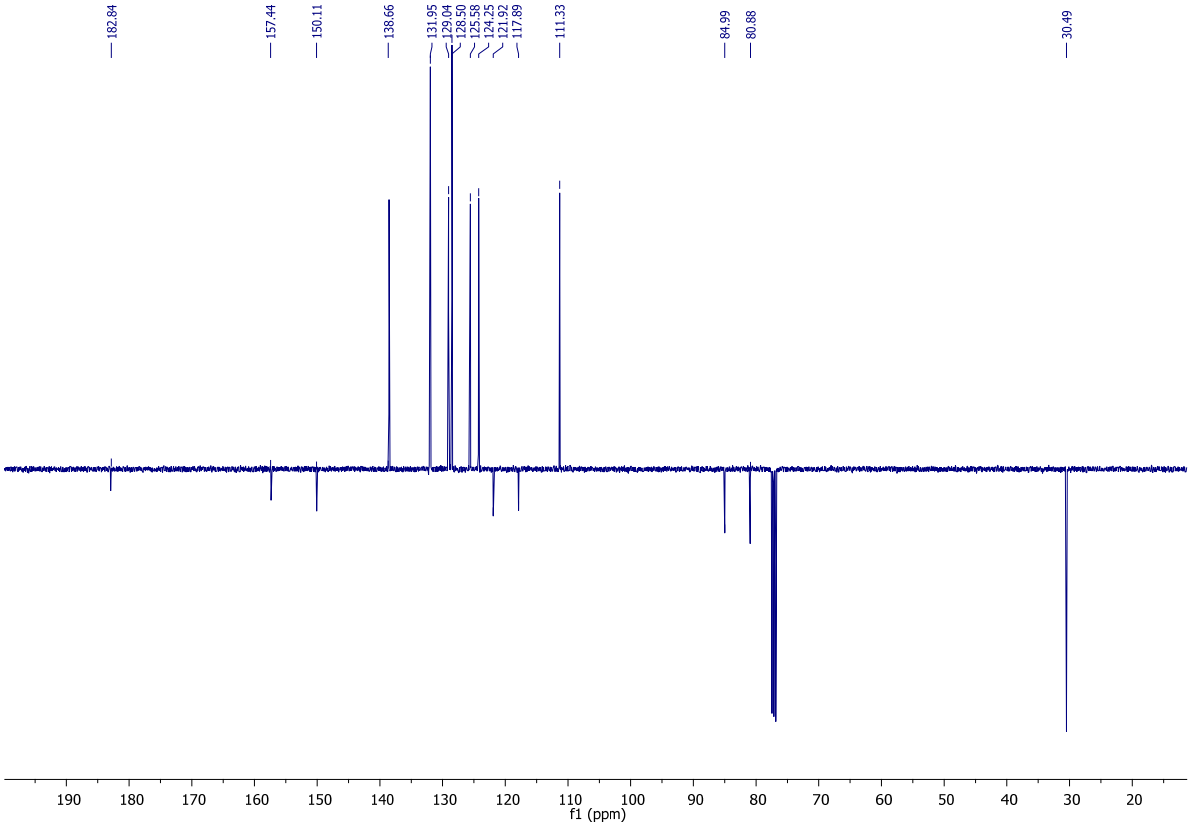
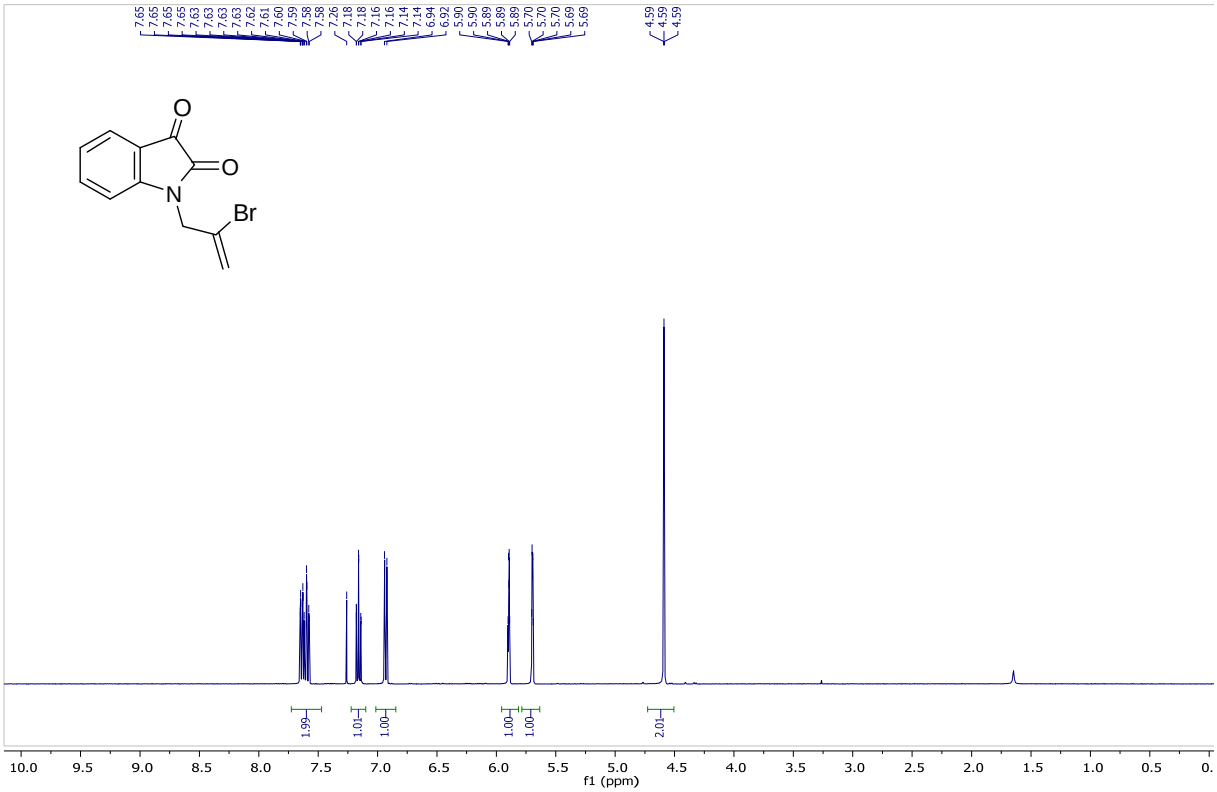
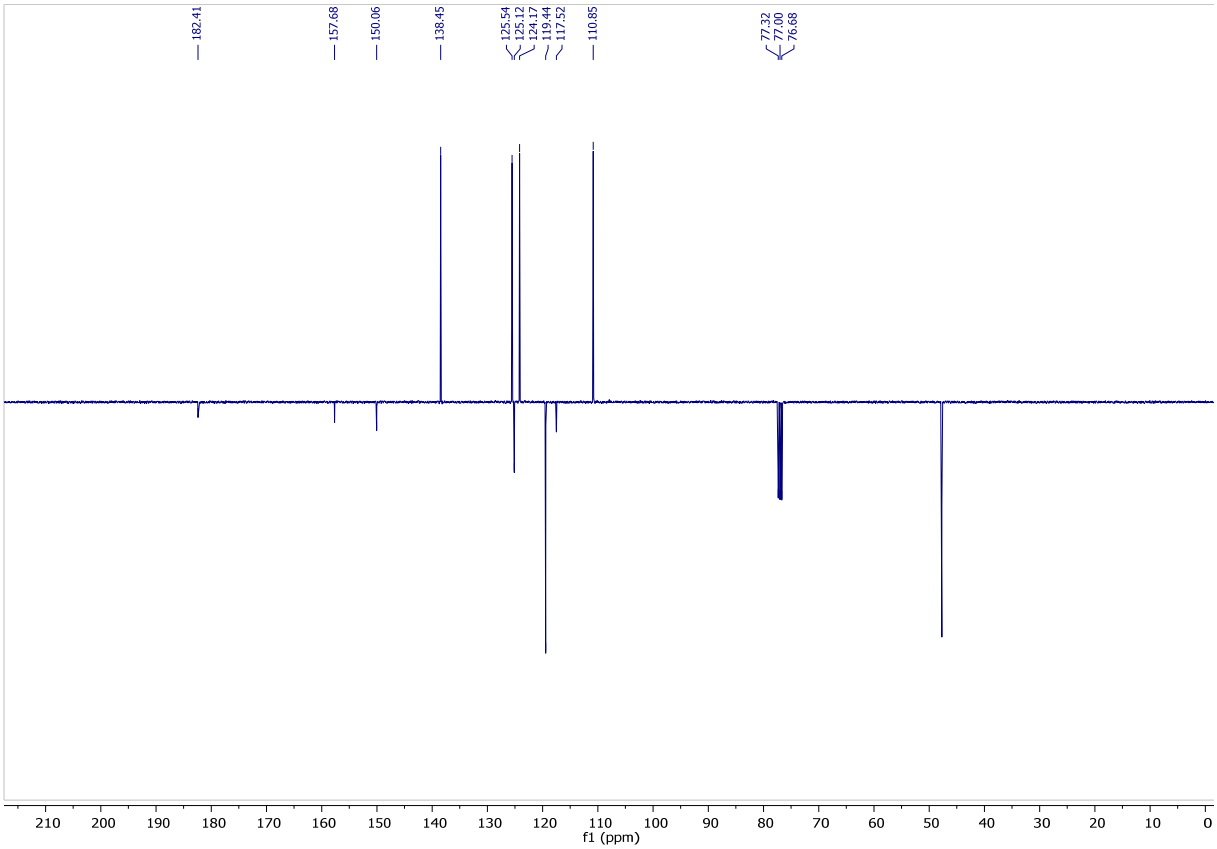
7.65
7.65
7.64
7.64
7.63
7.42
7.41
7.40
7.40
7.39
7.39
7.33
7.32
7.32
7.32
7.31
7.31
7.30
7.30
7.29
7.29
7.29
7.28
7.28
7.27
7.27
7.22
7.21
7.21
7.20
7.20
7.19
7.19
7.17
7.17
7.15
7.15
4.76
O
O
N
1.00
0.98
1.54
1.03
1.01
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
f1 (ppm)

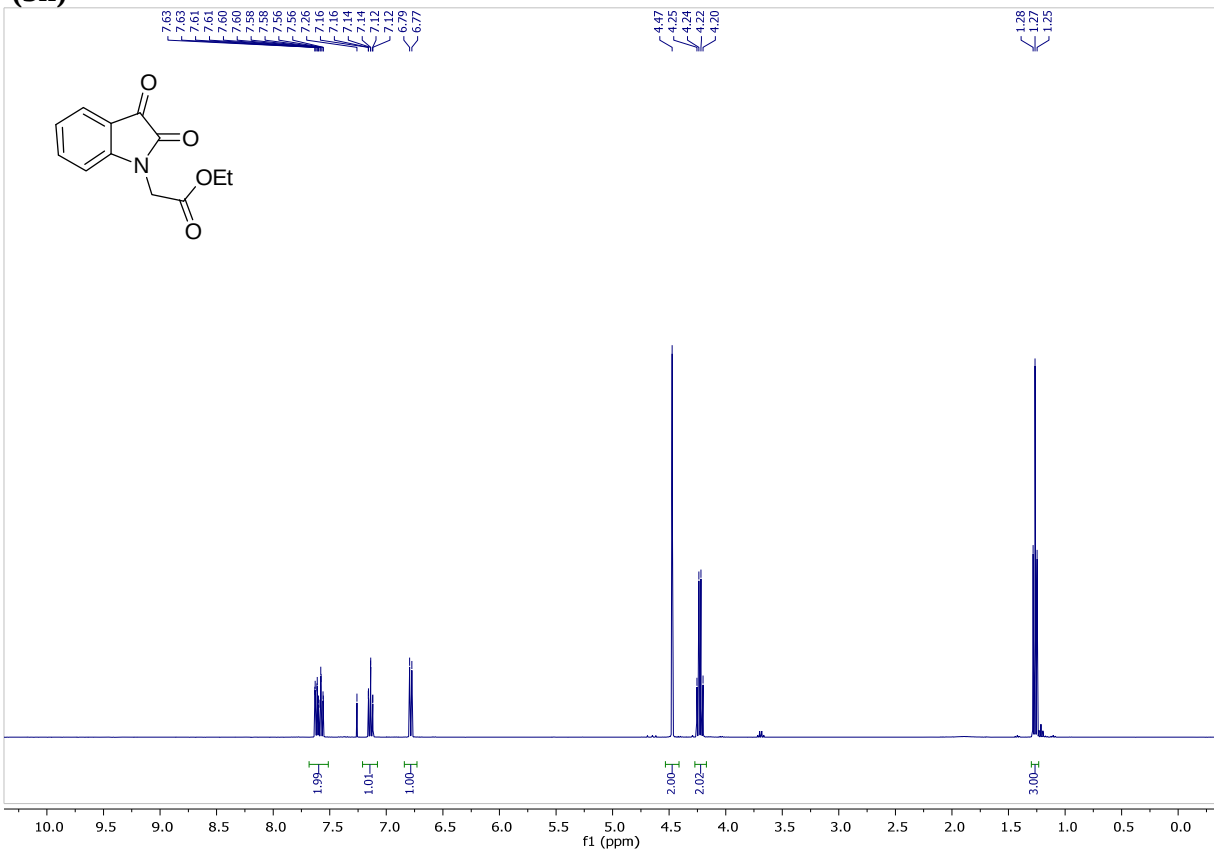

182.84
157.44
150.11
138.66
131.95
129.04
128.50
125.58
124.25
121.92
117.89
111.33
84.99
80.88
30.49
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

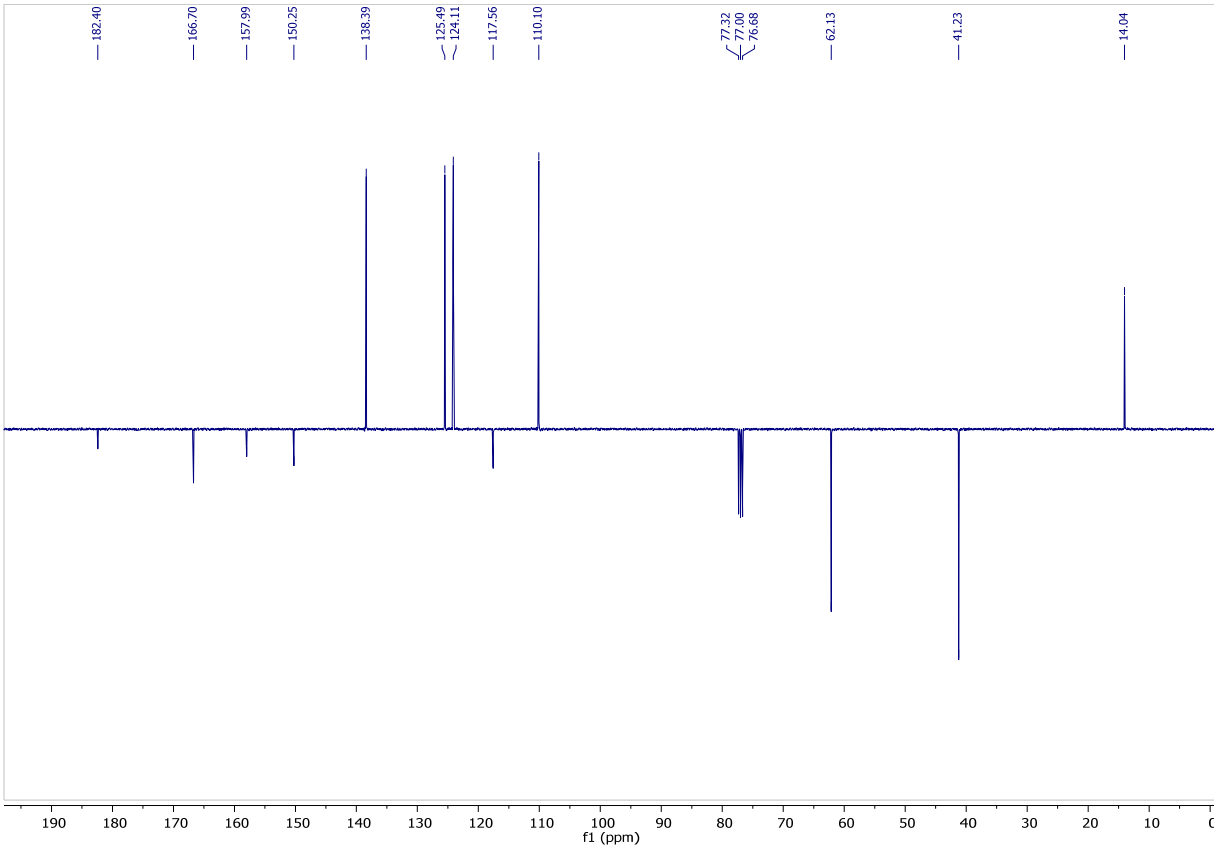
(3g)


7.65
7.65
7.65
7.65
7.63
7.63
7.63
7.63
7.62
7.61
7.60
7.59
7.58
7.58
7.26
7.18
7.18
7.16
7.16
7.14
7.14
6.94
6.92
5.90
5.90
5.89
5.89
5.89
5.70
5.70
5.70
5.69
5.69
4.59
4.59
4.59
O
O
N
Br
1.99
1.01
1.00
1.00
1.00
2.01
10.0
9.5
9.0
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)

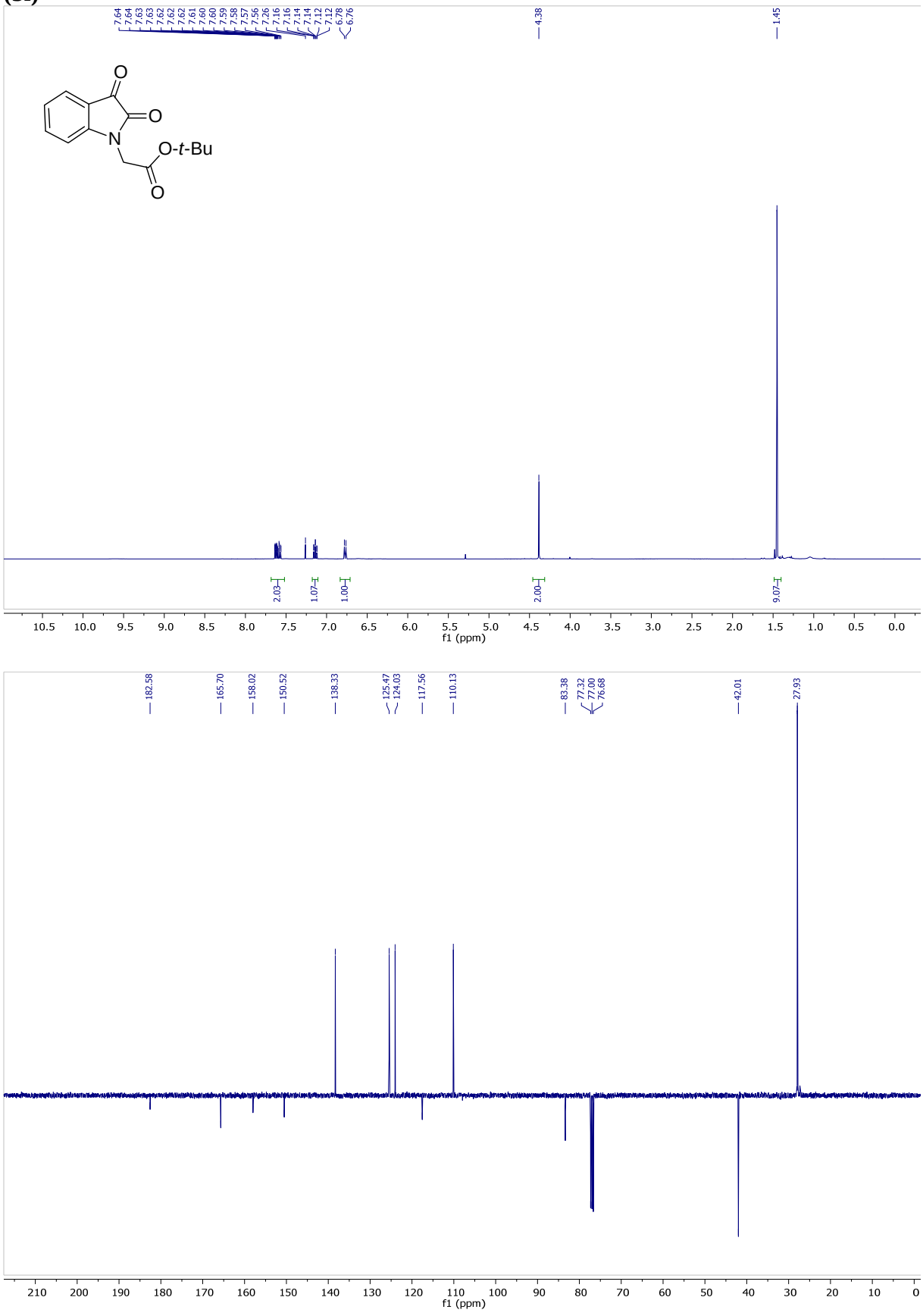

182.41
157.68
150.06
138.45
125.54
125.12
124.17
119.44
117.52
110.85
77.32
77.00
76.68
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(3h)


7.63
7.63
7.61
7.61
7.60
7.60
7.58
7.58
7.56
7.56
7.26
7.16
7.16
7.14
7.14
7.12
7.12
6.79
6.77
4.47
4.25
4.24
4.22
4.20
1.28
1.27
1.25
O
O
N
OEt
O
1.99
1.01
1.00
2.00
2.02
3.00
10.0
9.5
9.0
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
0.0
f1 (ppm)


182.40
166.70
157.99
150.25
138.39
125.49
124.11
117.56
110.10
77.32
77.00
76.68
62.13
41.23
14.04
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

(3i)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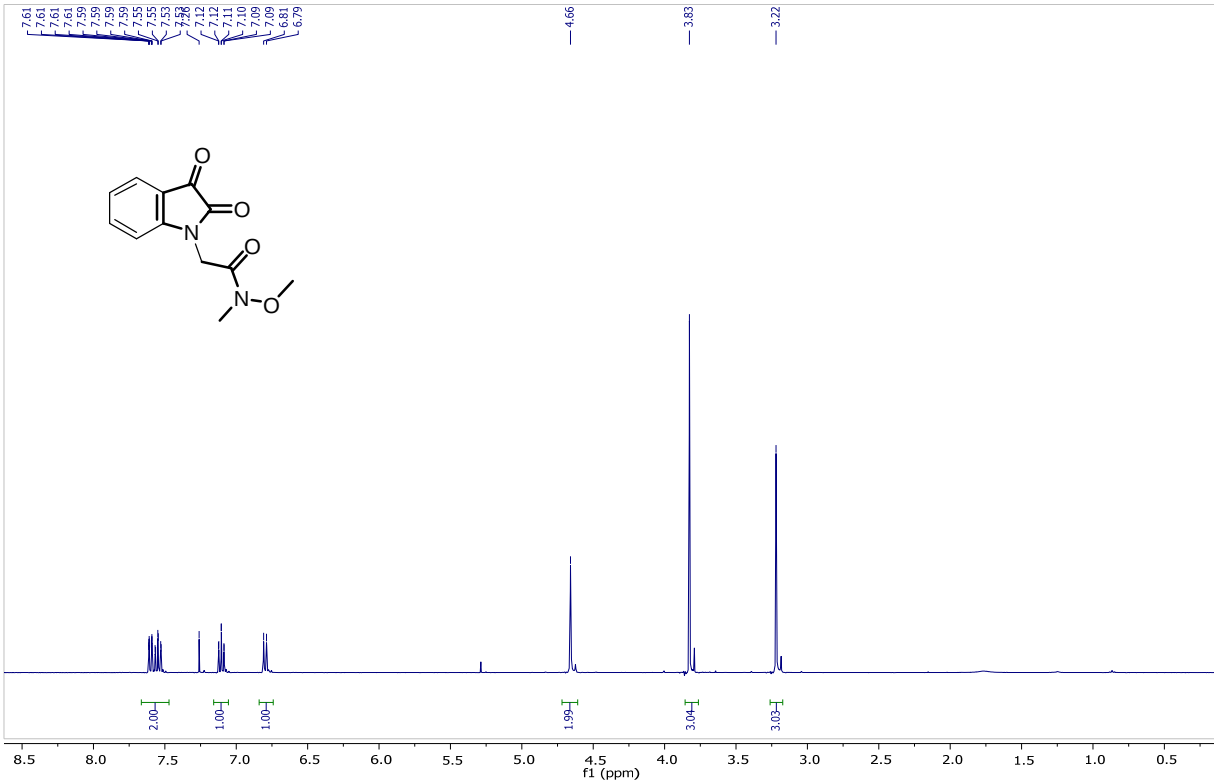
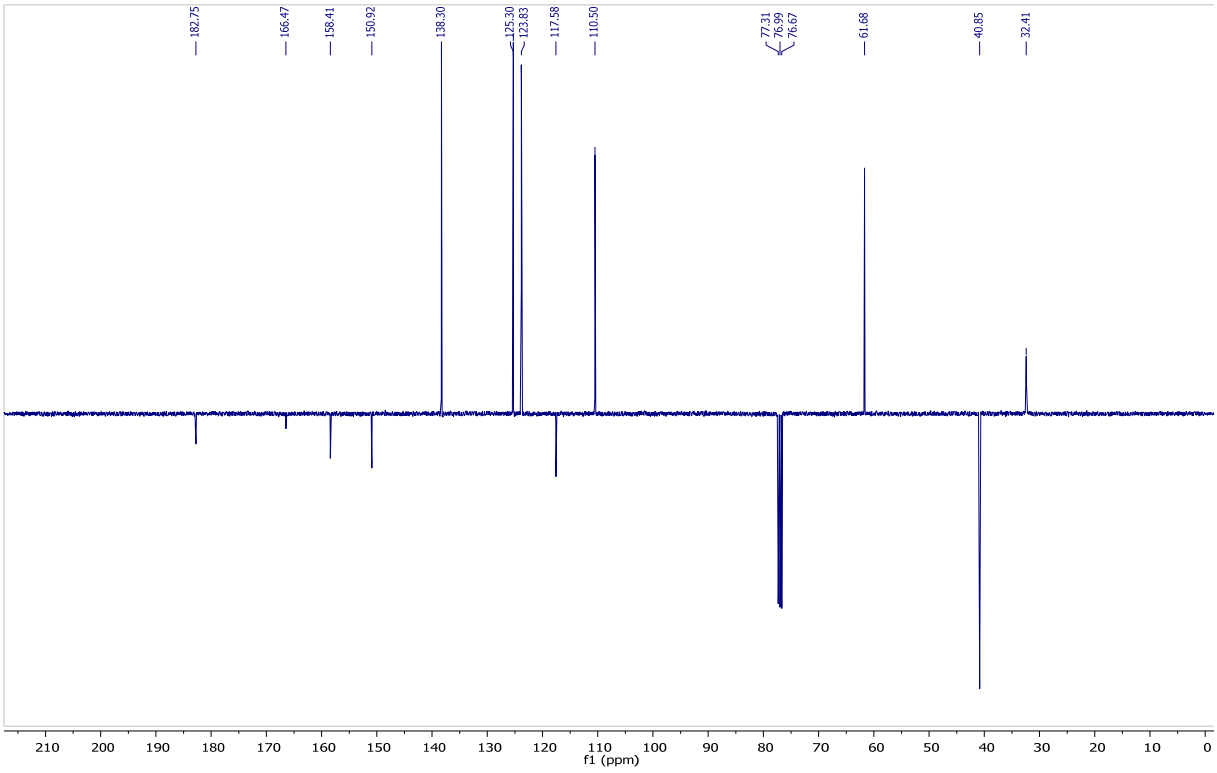
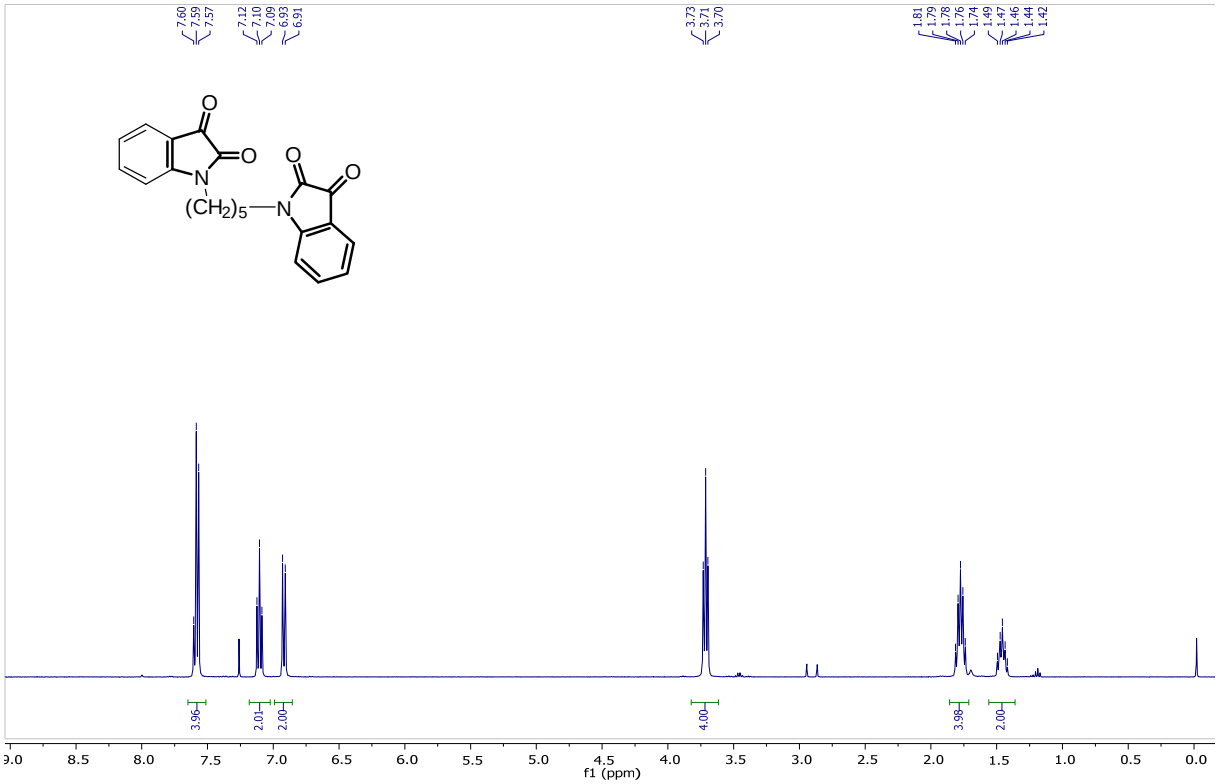
7.64
7.63
7.63
7.62
7.62
7.62
7.61
7.60
7.60
7.59
7.58
7.57
7.56
7.26
7.16
7.16
7.14
7.14
7.12
7.12
6.78
6.76
4.38
1.45
O
O
N
O-t-Bu
O
2.03
1.07
1.00
2.00
9.07
f1 (ppm)
182.58
165.70
158.02
150.52
138.33
125.47
124.03
117.56
110.13
83.38
77.32
77.00
76.68
42.01
27.93
f1 (ppm)

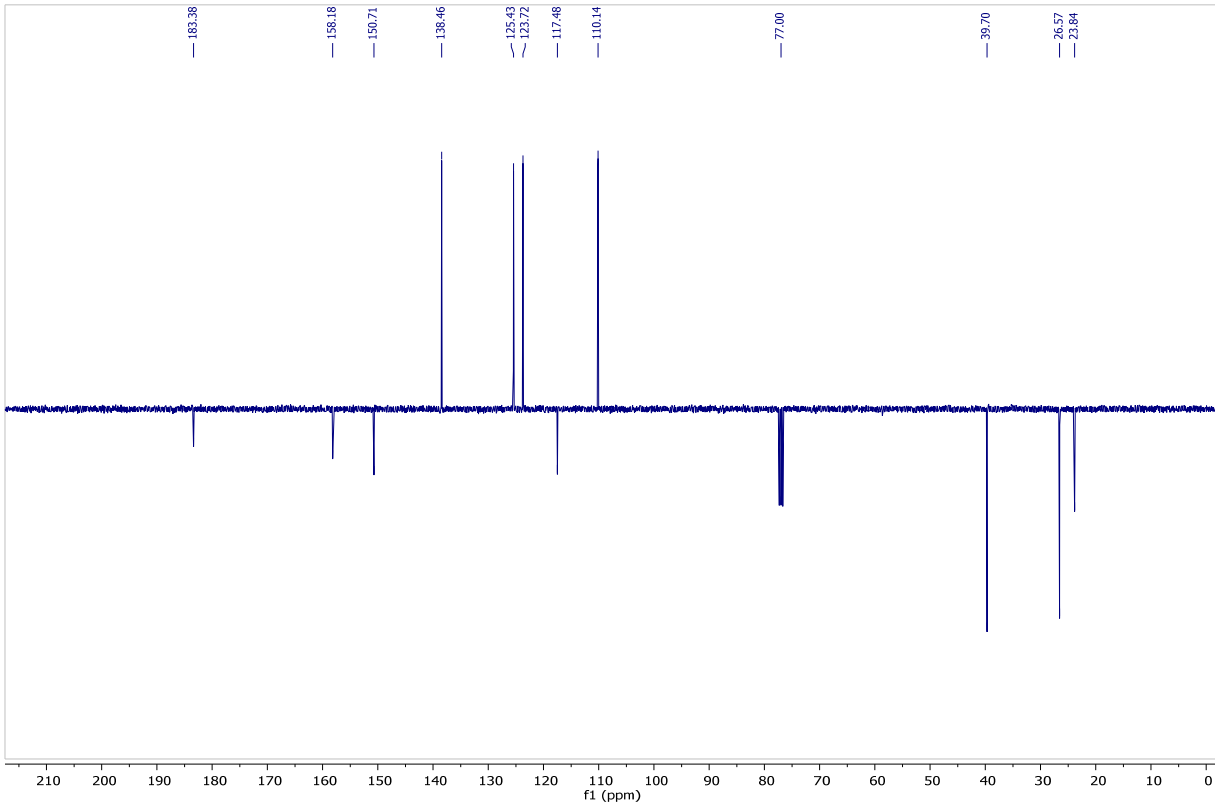
(3j)


7.61
7.61
7.61
7.61
7.59
7.59
7.59
7.59
7.55
7.55
7.53
7.28
7.12
7.12
7.11
7.10
7.09
7.09
6.81
6.79
4.66
3.83
3.22
O
O
N
O
N
O
2.00
1.00
1.00
1.99
3.04
3.03
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)

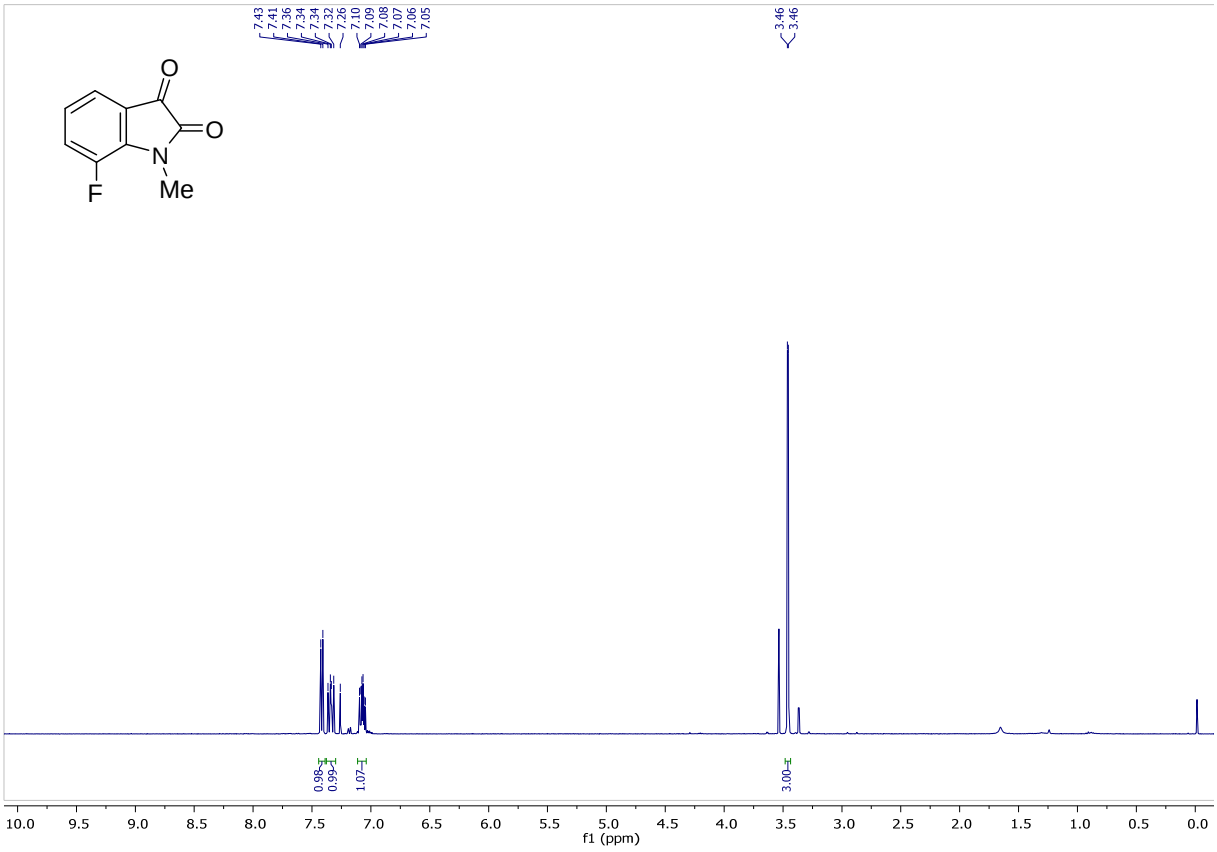

182.75
166.47
158.41
150.92
138.30
125.30
123.83
117.58
110.50
77.31
76.99
76.67
61.68
40.85
32.41
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

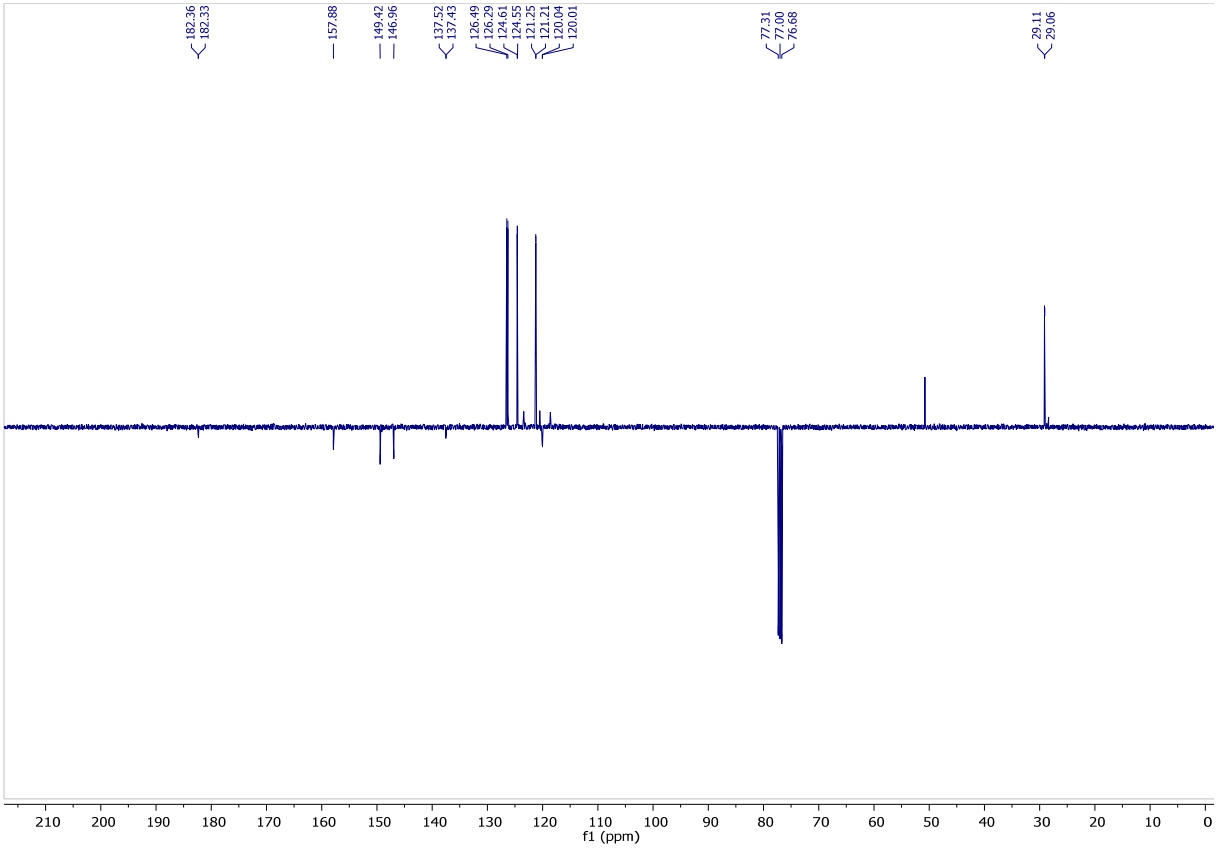
(3k)


7.60
7.59
7.57
7.12
7.10
7.09
6.93
6.91
3.73
3.71
3.70
1.81
1.79
1.78
1.76
1.74
1.49
1.47
1.46
1.44
1.42
O
O
N
(CH2)5
N
O
O
3.96
2.01
2.00
4.00
3.98
2.00
f1 (ppm)

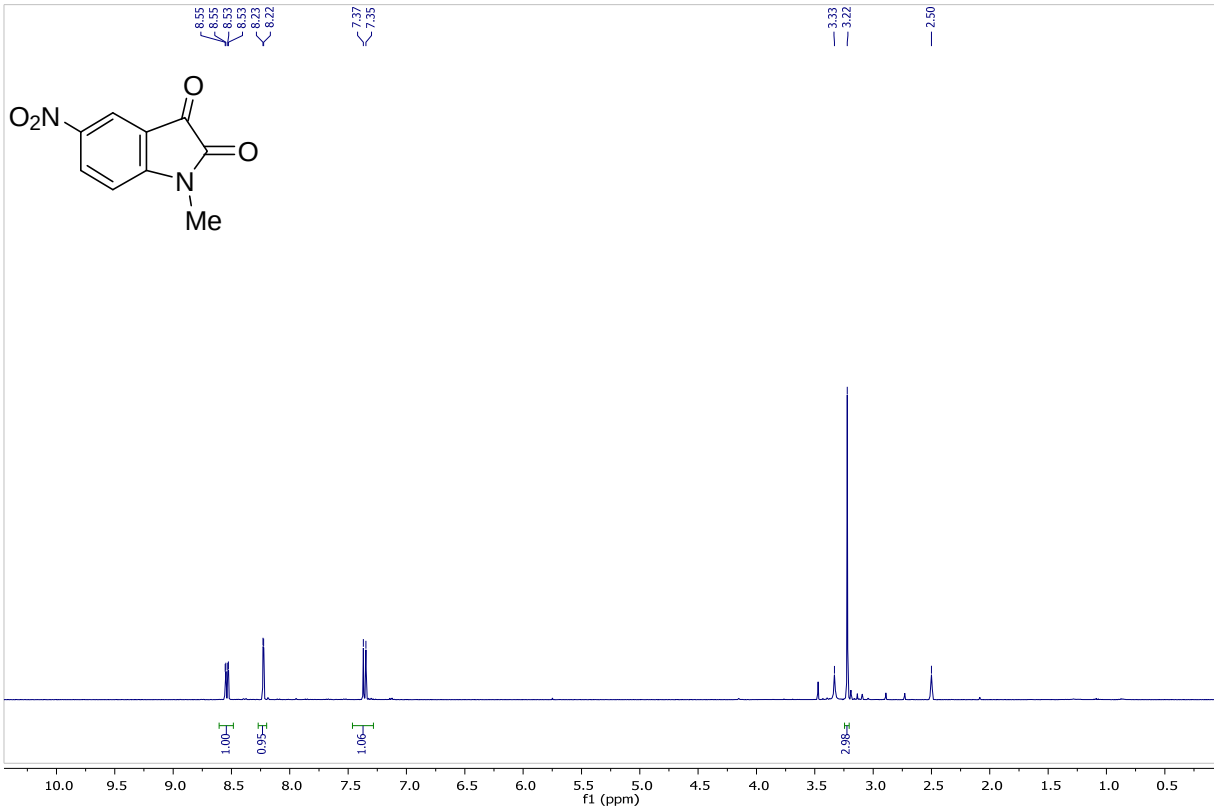

183.38
158.18
150.71
138.46
125.43
123.72
117.48
110.14
77.00
39.70
26.57
23.84
f1 (ppm)

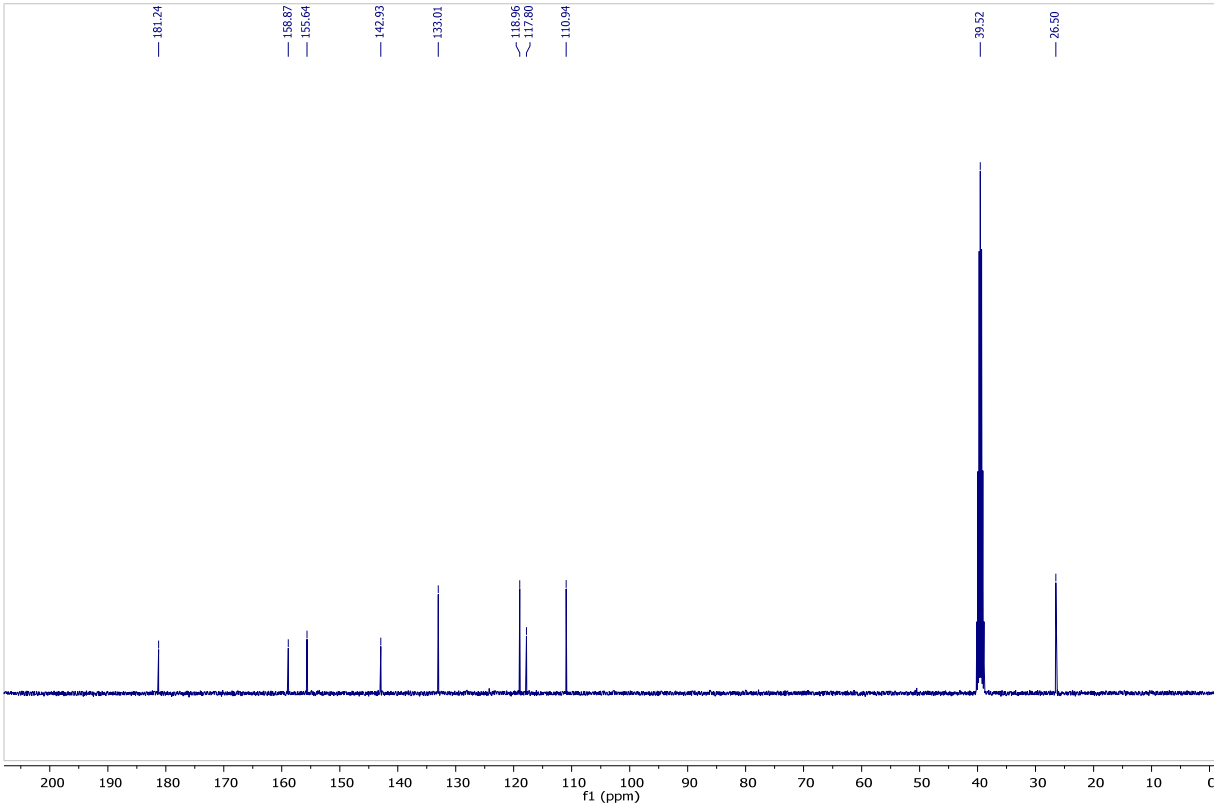
(3l)


7.43
7.41
7.36
7.34
7.34
7.32
7.26
7.10
7.09
7.08
7.07
7.06
7.05
3.46
3.46
O
O
N
Me
F
0.98
0.99
1.07
3.00
10.0 9.5 9.0 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 0.0
f1 (ppm)

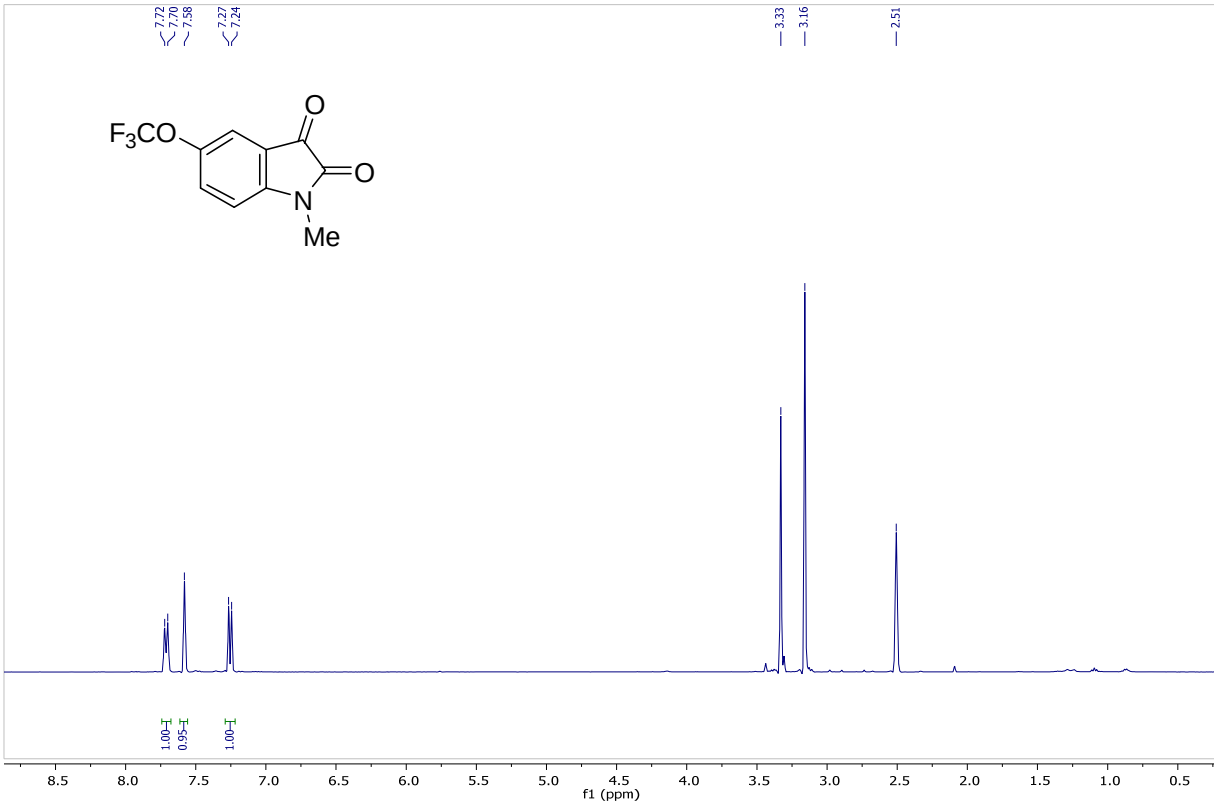

182.36
182.33
157.88
149.42
146.96
137.52
137.43
126.49
126.29
124.61
124.55
121.25
121.21
120.04
120.01
77.31
77.00
76.68
29.11
29.06
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

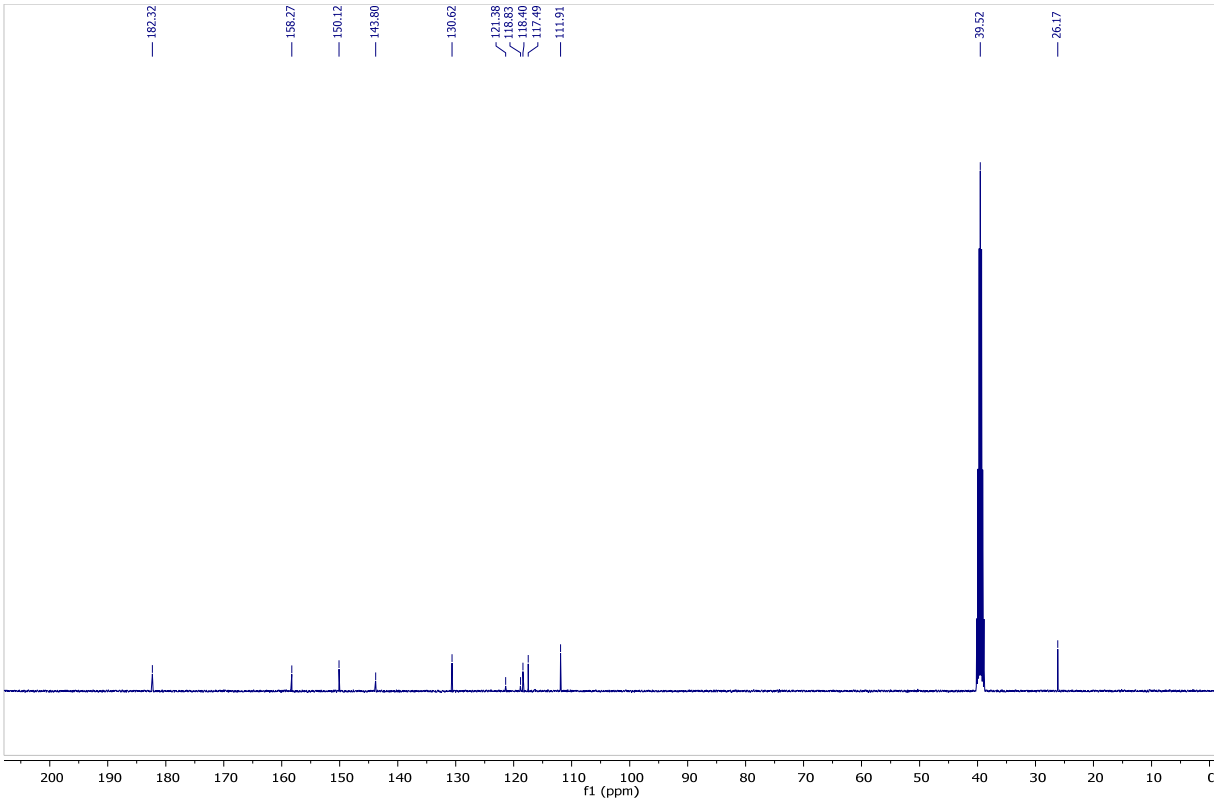
(3m)


8.55
8.55
8.53
8.53
8.23
8.22
7.37
7.35
3.33
3.22
2.50
O
O2N
O
N
Me
1.00
0.95
1.06
2.98
f1 (ppm)

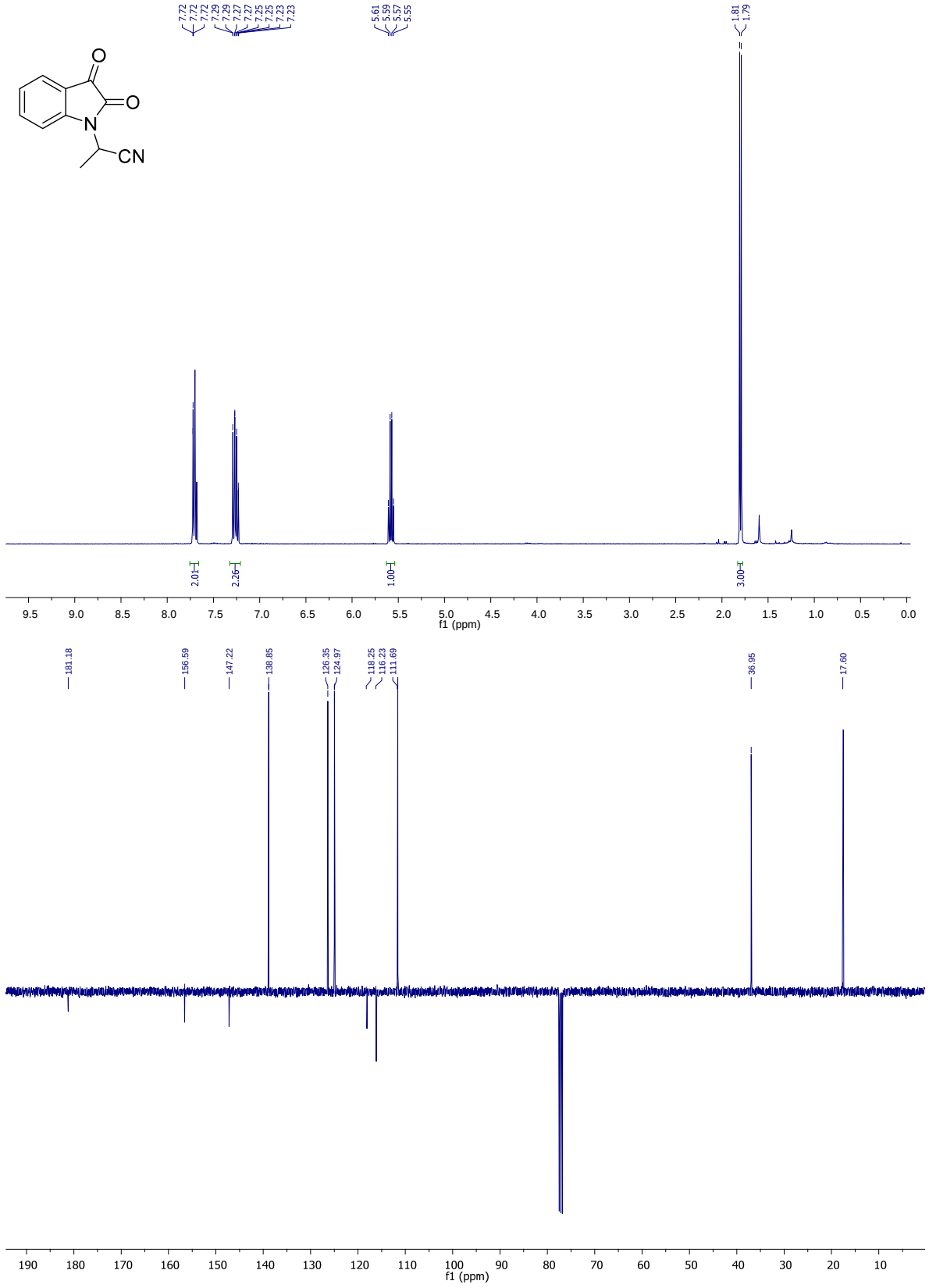

181.24
158.87
155.64
142.93
133.01
118.96
117.80
110.94
39.52
26.50
f1 (ppm)

(3n)

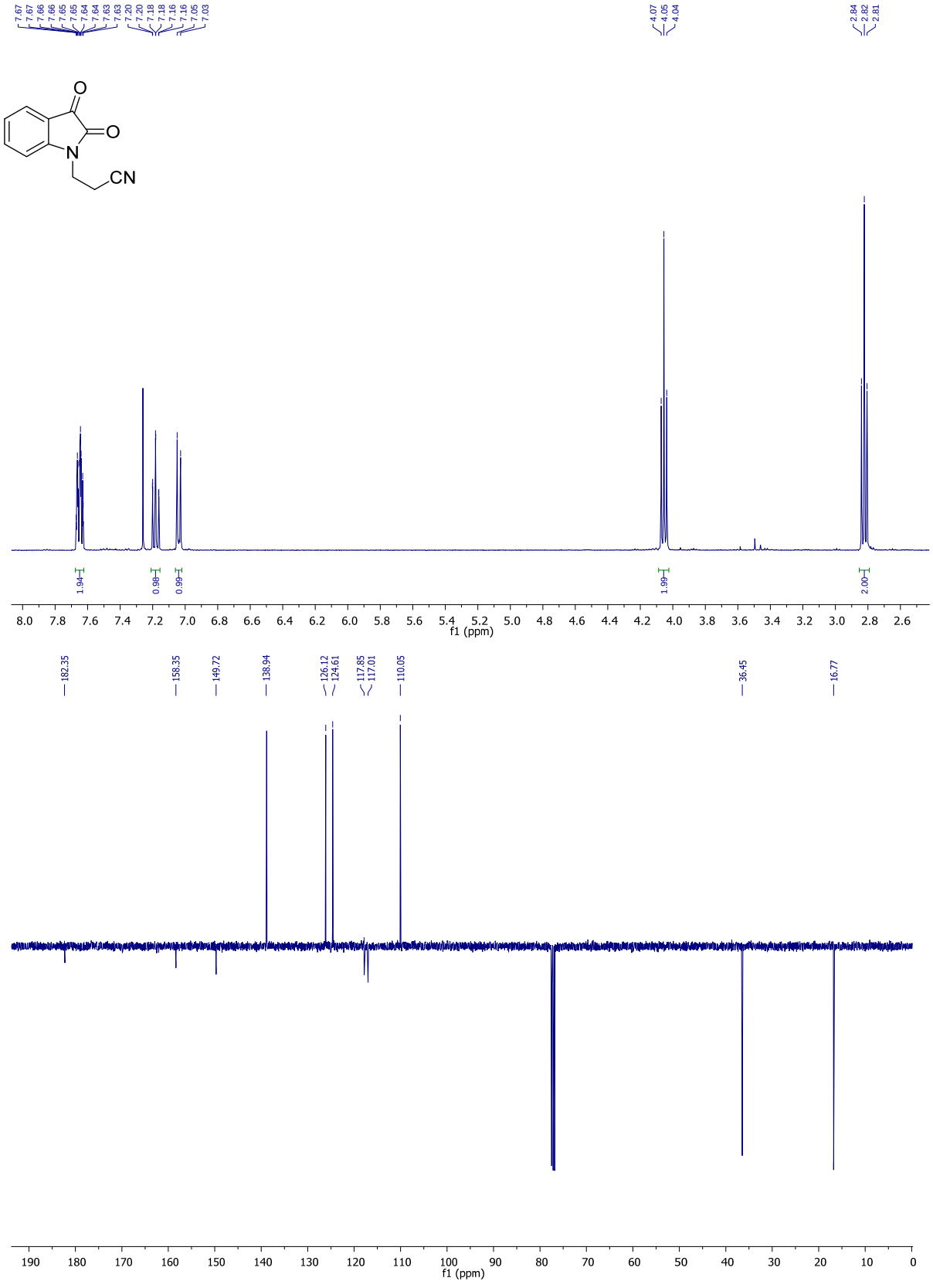

7.72
7.70
7.58
7.27
7.24
3.33
3.16
2.51
F3CO
O
O
N
Me
1.00
0.95
1.00
f1 (ppm)


182.32
158.27
150.12
143.80
130.62
121.38
118.83
118.40
117.49
111.91
39.52
26.17
f1 (ppm)

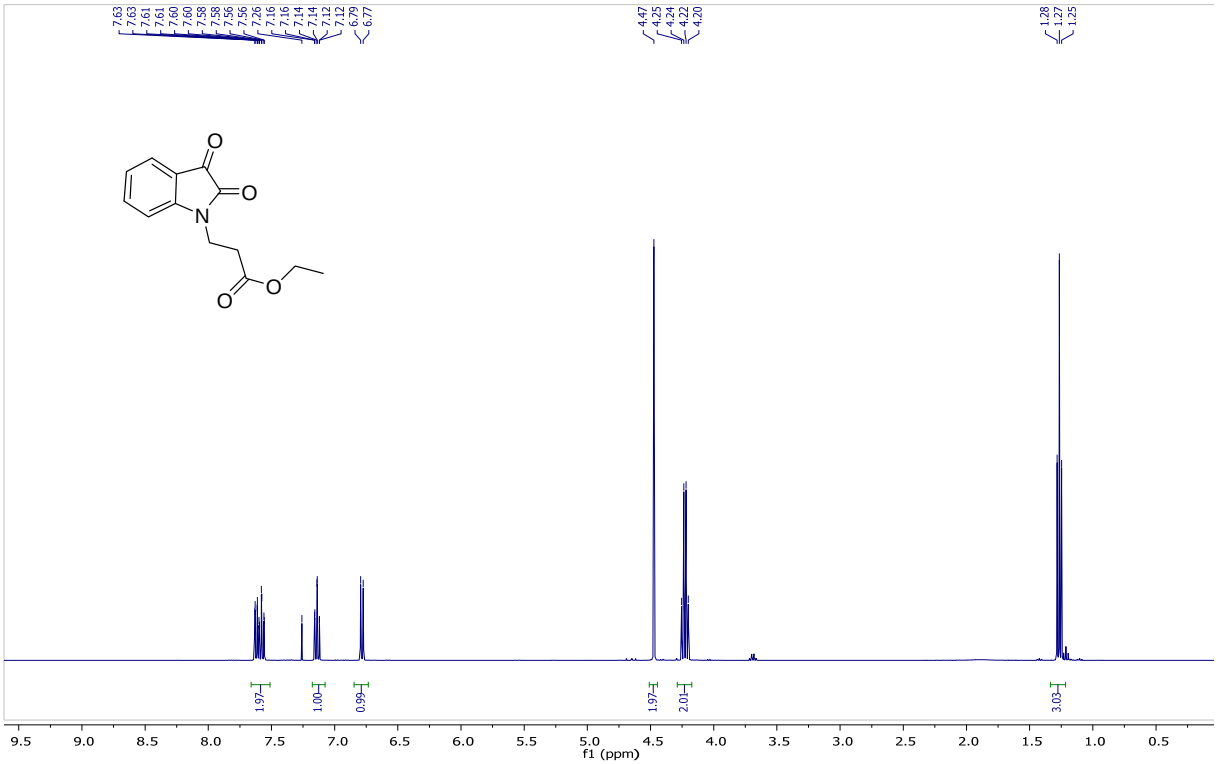
(3o)

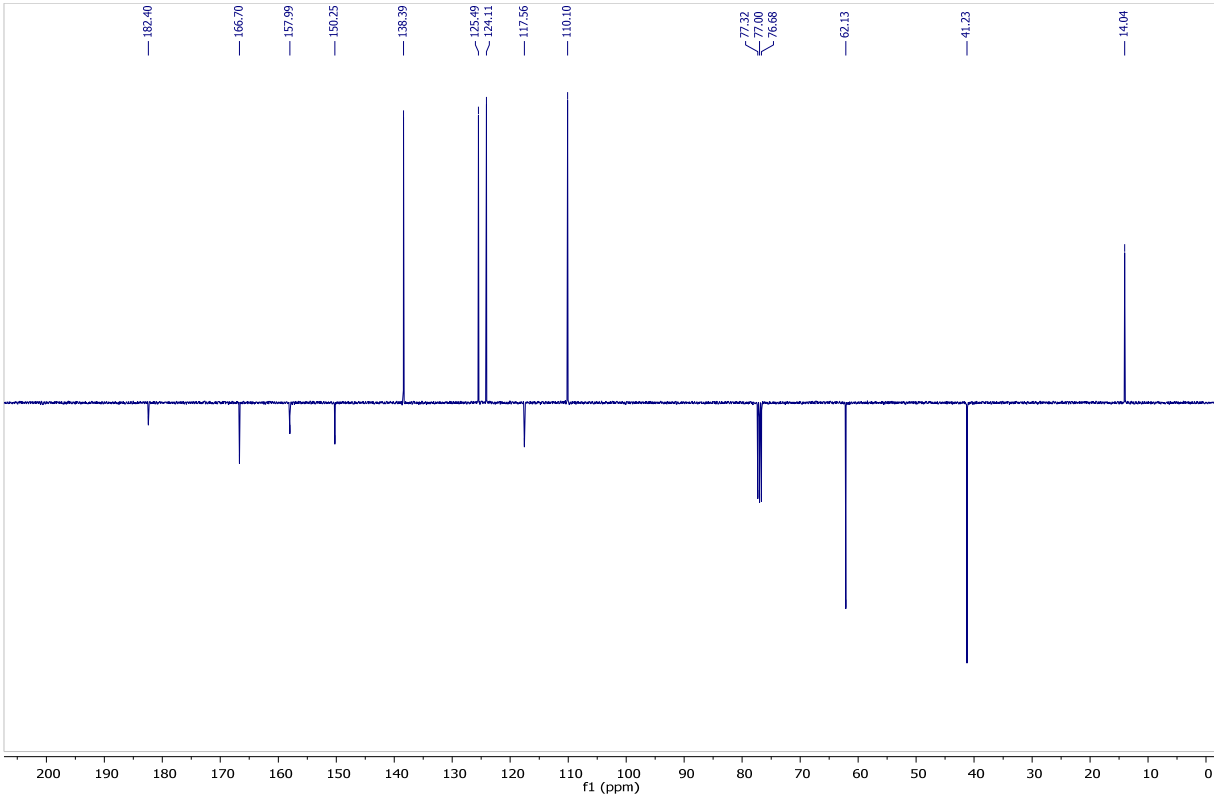

7.72
7.72
7.72
7.29
7.29
7.27
7.27
7.25
7.25
7.23
7.23
5.61
5.59
5.57
5.55
1.81
1.79
O
O
N
CN
2.01
2.26
1.00
3.00
f1 (ppm)
181.18
156.59
147.22
138.85
126.35
124.97
118.25
116.23
111.69
36.95
17.60
f1 (ppm)

(4a)

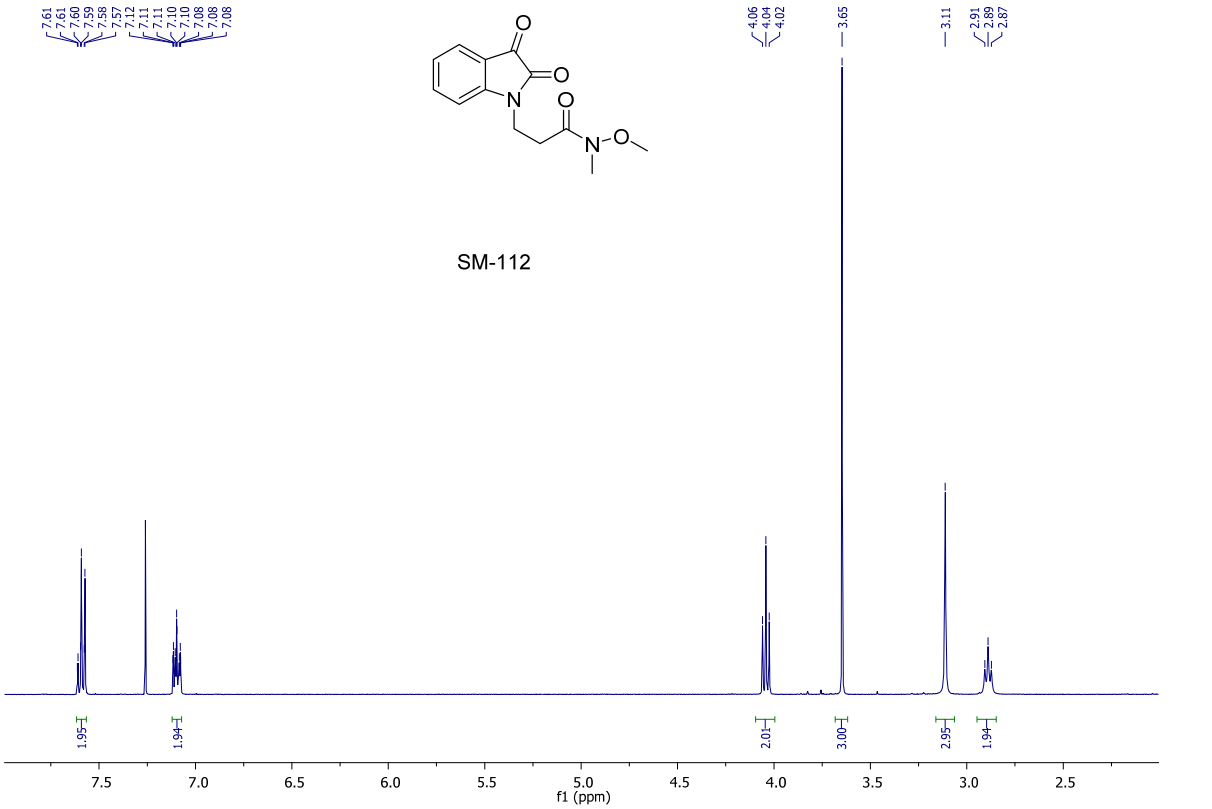

7.67
7.67
7.66
7.66
7.65
7.65
7.64
7.64
7.63
7.63
7.20
7.20
7.18
7.18
7.16
7.16
7.05
7.03
4.07
4.05
4.04
2.84
2.82
2.81
O
O
N
CN
1.94
0.98
0.99
1.99
2.00
f1 (ppm)
182.35
158.35
149.72
138.94
126.12
124.61
117.85
117.01
110.05
36.45
16.77
f1 (ppm)

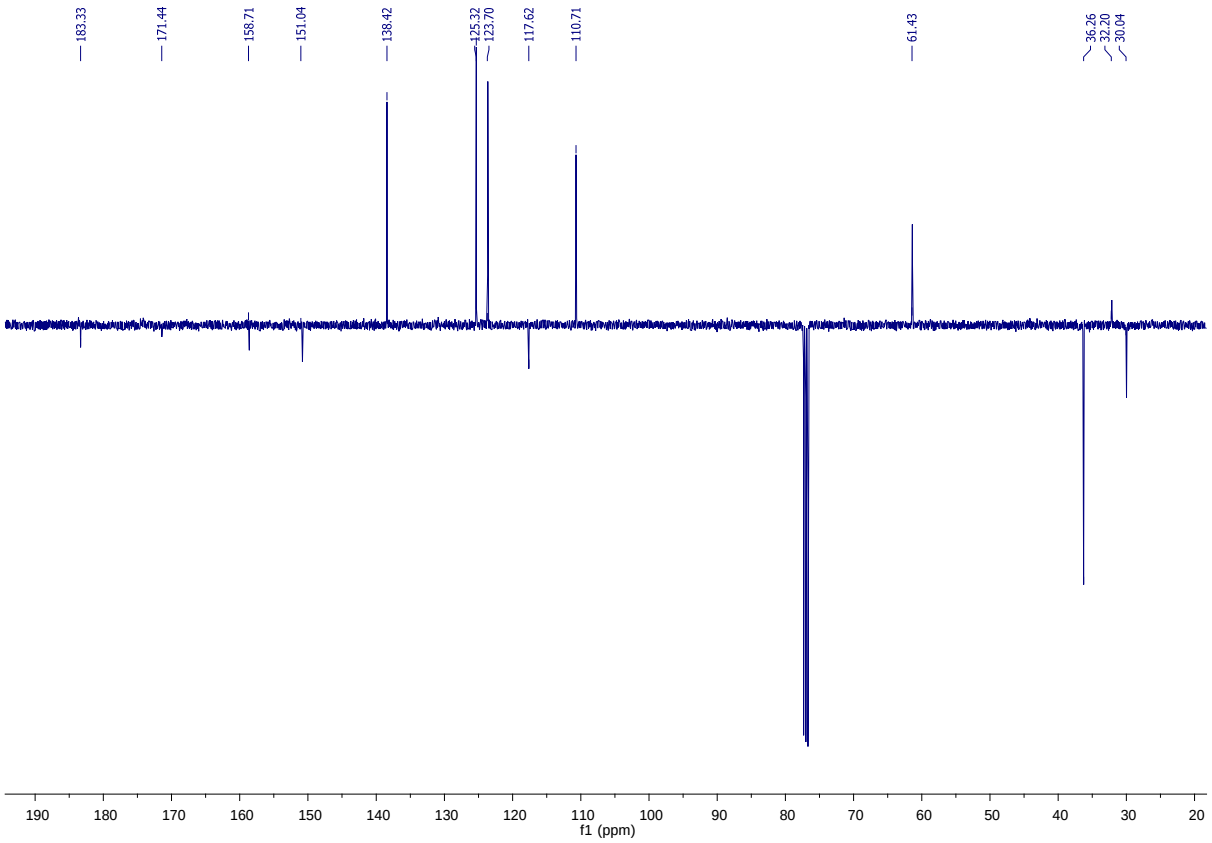
(4b)


7.63
7.63
7.61
7.61
7.60
7.60
7.58
7.58
7.56
7.56
7.26
7.16
7.14
7.14
7.12
7.12
6.79
6.77
4.47
4.25
4.24
4.22
4.20
1.28
1.27
1.25
O
O
N
O
O
1.97
1.00
0.99
1.97
2.01
3.03
f1 (ppm)

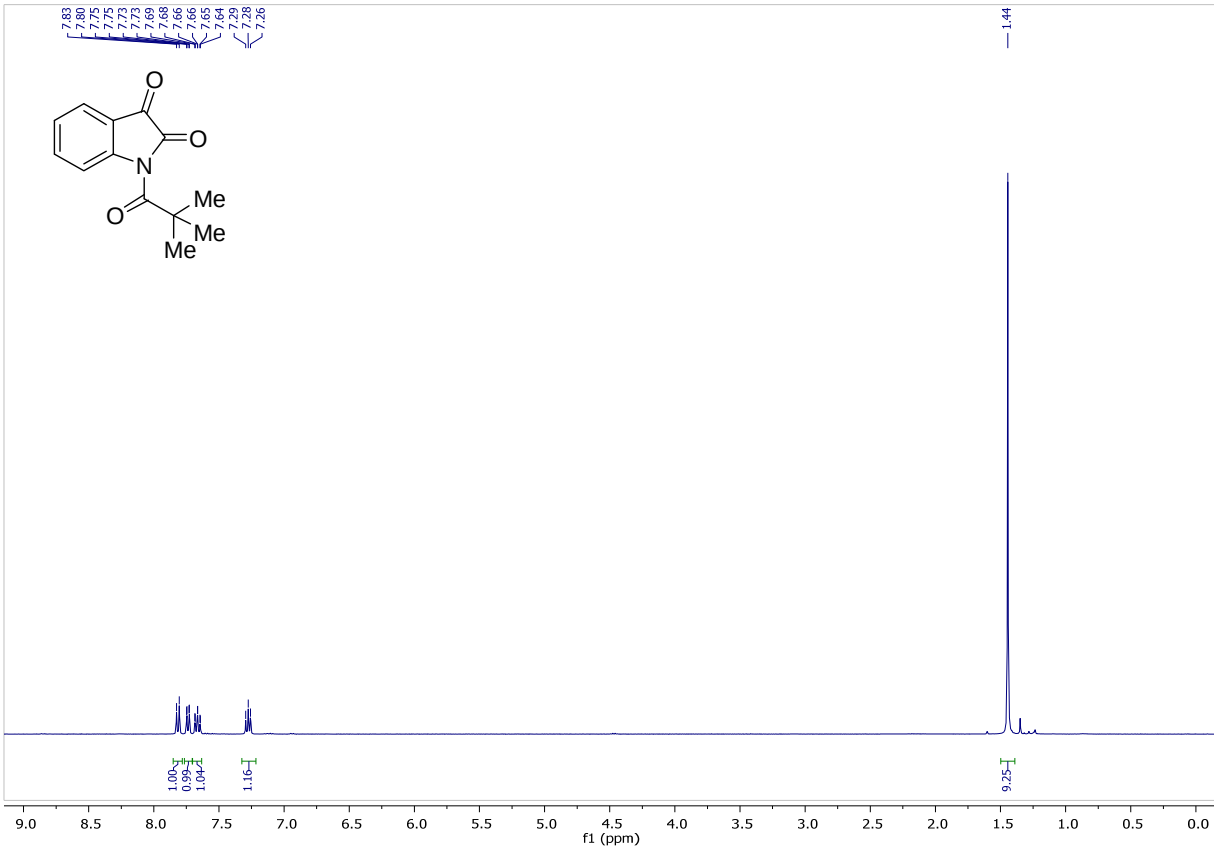

182.40
166.70
157.99
150.25
138.39
125.49
124.11
117.56
110.10
77.32
77.00
76.68
62.13
41.23
14.04
f1 (ppm)

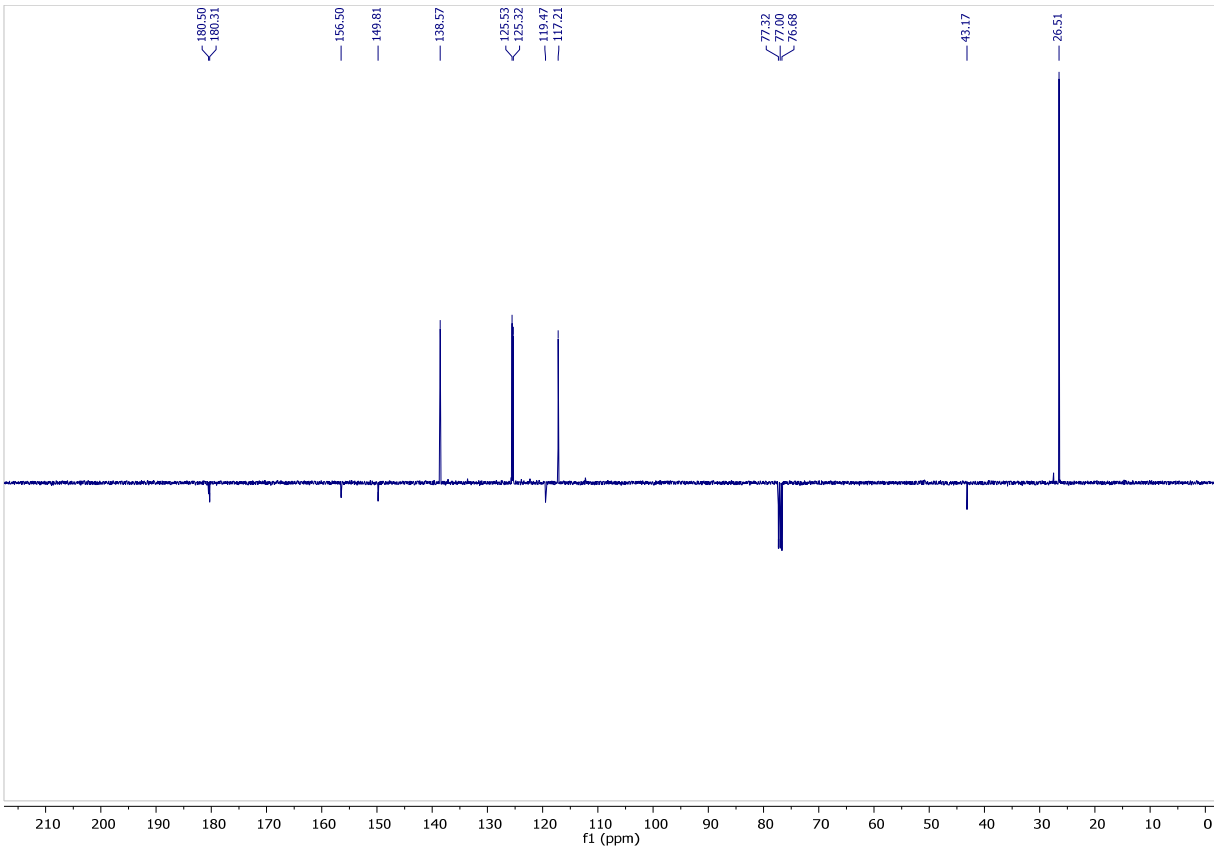
(4c)


7.61
7.61
7.60
7.59
7.58
7.57
7.12
7.11
7.11
7.10
7.08
7.08
7.08
4.06
4.04
4.02
3.65
3.11
2.91
2.89
2.87
O
O
N
O
N
O
SM-112
1.95
1.94
2.01
3.00
2.95
1.94
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
f1 (ppm)

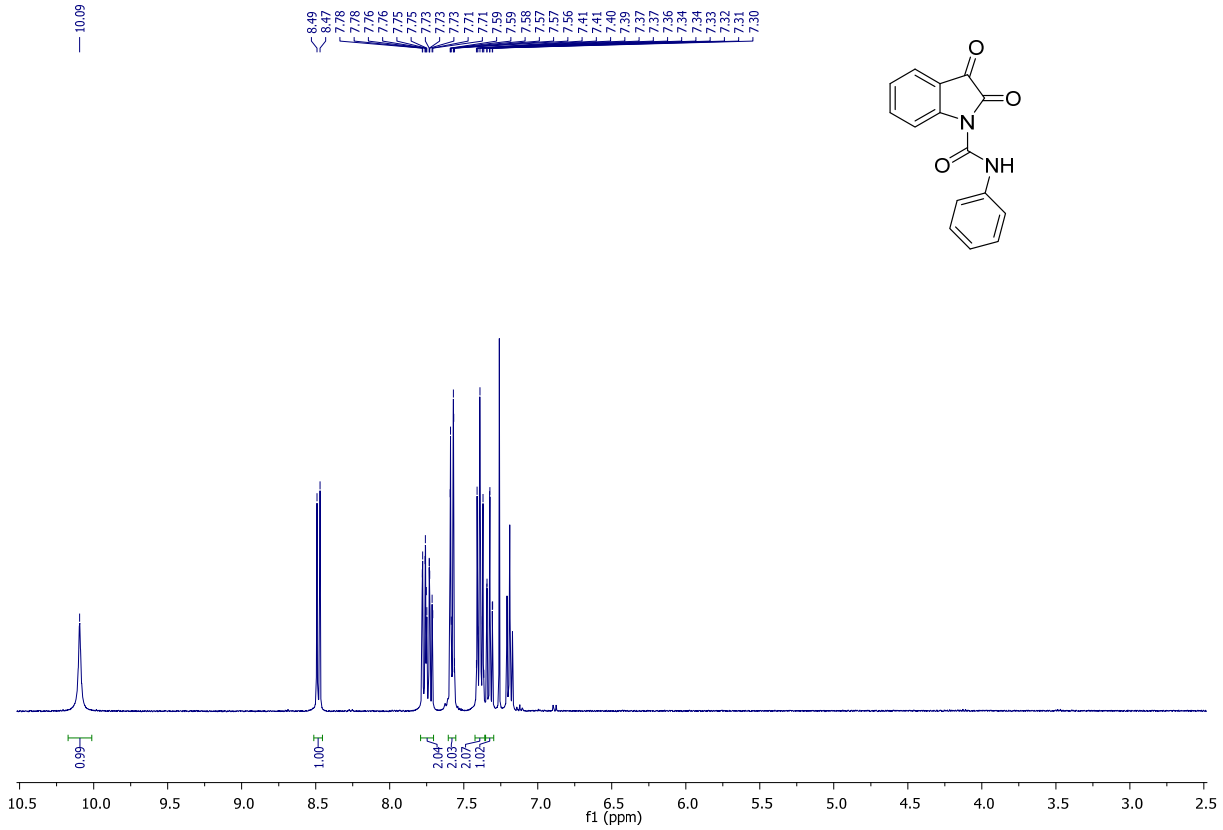

183.33
171.44
158.71
151.04
138.42
125.32
123.70
117.62
110.71
61.43
36.26
32.20
30.04
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

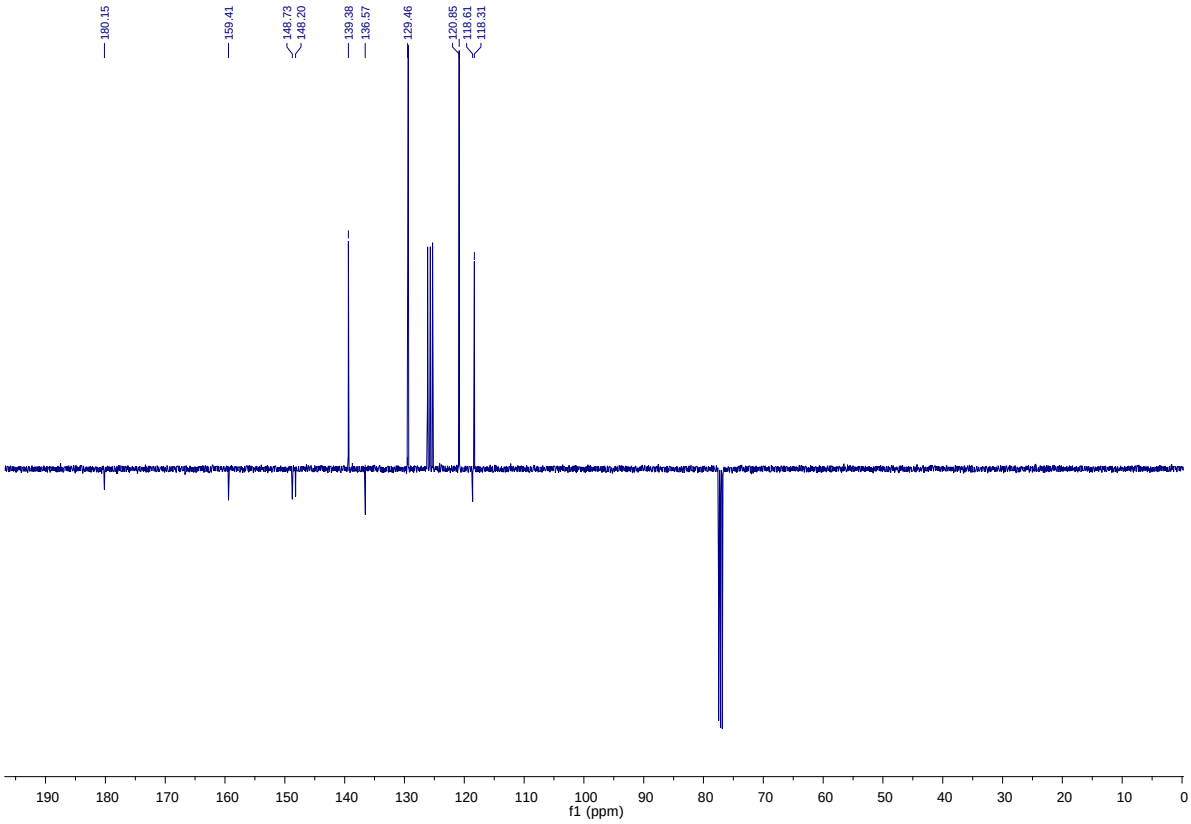
(5a)


7.83
7.80
7.75
7.75
7.73
7.73
7.69
7.68
7.66
7.66
7.65
7.64
7.29
7.28
7.26
1.44
O
O
N
O
Me
Me
Me
1.00
0.99
1.04
1.16
9.25
9.0
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
0.0
f1 (ppm)

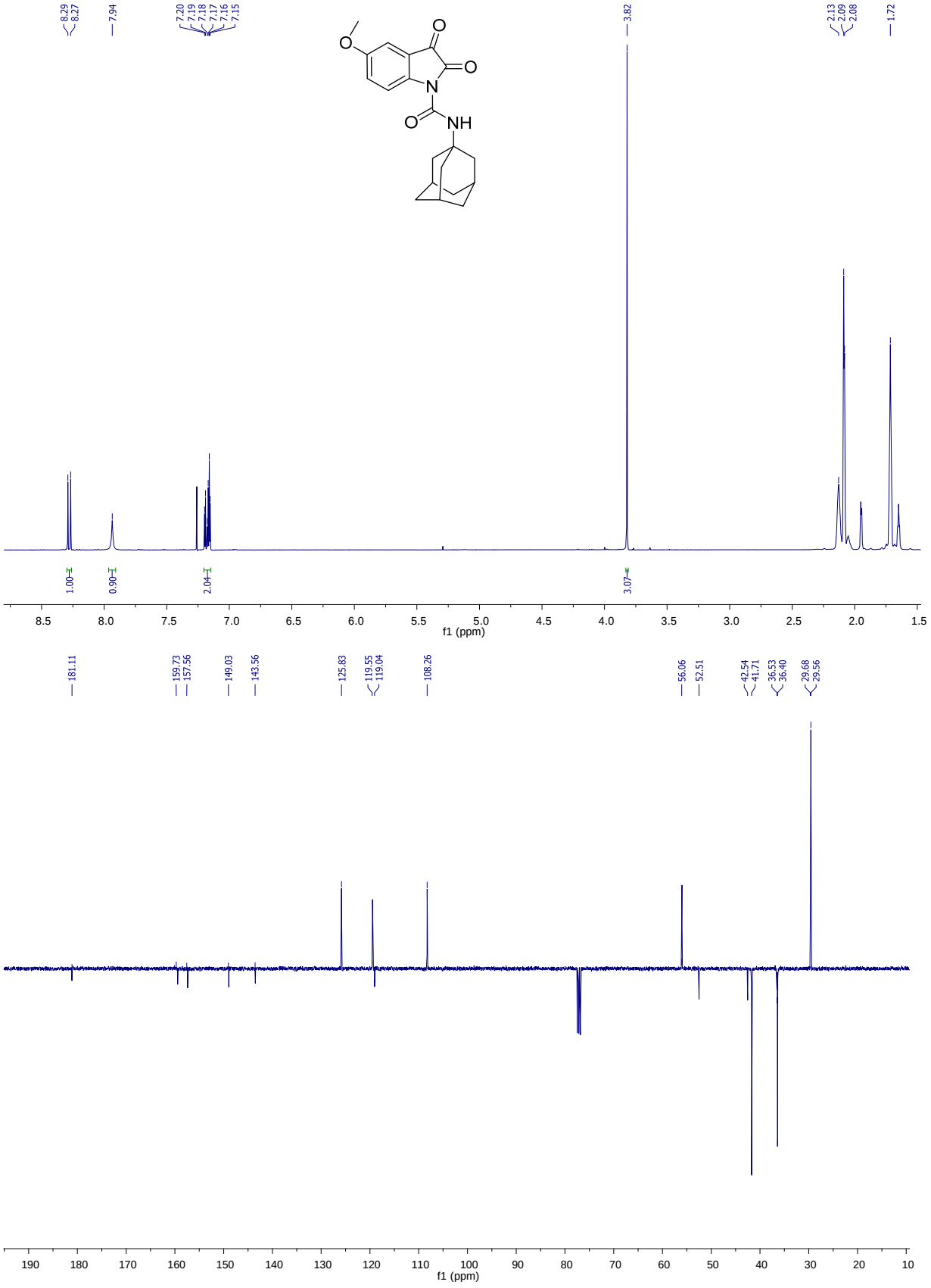

180.50
180.31
156.50
149.81
138.57
125.53
125.32
119.47
117.21
77.32
77.00
76.68
43.17
26.51
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(5b)


10.09
8.49
8.47
7.78
7.76
7.75
7.73
7.71
7.59
7.58
7.57
7.56
7.41
7.40
7.39
7.37
7.36
7.34
7.33
7.32
7.31
7.30
O
O
N
O
NH
0.99
1.00
2.04
2.03
2.07
1.02
10.5
10.0
9.5
9.0
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
f1 (ppm)


180.15
159.41
148.73
148.20
139.38
136.57
129.46
120.85
118.61
118.31
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

(5c)


8.29
8.27
7.94
7.20
7.19
7.18
7.17
7.16
7.15
3.82
2.13
2.09
2.08
1.72
O
O
O
N
O
NH
1.00
0.90
2.04
3.07
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
f1 (ppm)
181.11
159.73
157.56
149.03
143.56
125.83
119.55
119.04
108.26
56.06
52.51
42.54
41.71
36.53
36.40
29.68
29.56
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)