Supporting information for

Convenient Synthesis of Substituted Tetrahydrofuran via Lewis Base Catalyzed [3+2] Domino Reactions

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Contents

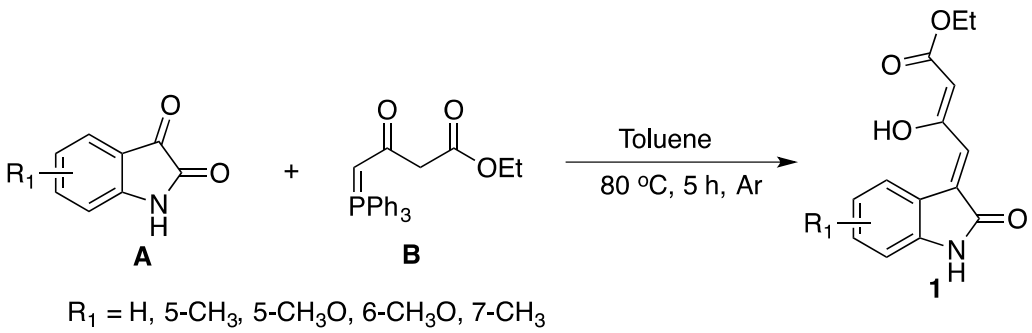
1. General Information

TLC monitored all reactions with silica gel-coated plates. Flash column chromatography was performed using 200-300 mesh silica gel. ^{1}H- and ^{13}C-NMR spectra were recorded at ambient temperature on Bruker 400 instruments using tetramethylsilane as an external standard. HRMS were obtained on Waters Xevo Q-TOF MS with ESI resource. Melting points were measured on a RY-I apparatus and are reported uncorrected. All the solvents were purified by standard methods.

2. Materials

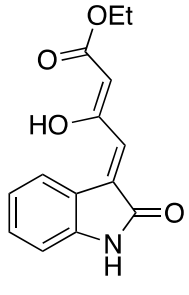
Unless otherwise noted, all commercially available compounds were used without further purification, substrate **1f, 1g, 1h** were prepared according to known literature procedures.[1]

3. General procedure for the synthesis of 1



R_1 = H, 5-CH_3, 5-CH_3O, 6-CH_3O, 7-CH_3

To a dried and argon-filled two neck round bottole was added isatin derivatives **A** (3 mmol) and ylide **B** (4.5 mmol) in toluene 10 ml, the mixture was stirred at 80 °C and monitored by TLC until completion of the reaction. After purification by column chromatography on silica gel (Ethyl acetate/petroleum = 1: 2) the desired product **1** was obtained as a solid.



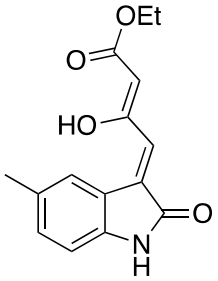
1a

Ethyl-(*Z*)-3-hydroxy-4-((*E*)-2-oxoindolin-3-ylidene)but-2-enoate (1a)

Orange solid; Yield 20%, m.p. 114-115 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.38 (d, *J* = 2.0 Hz, 1H), 8.60 (s, 1H), 8.40 (d, *J* = 8.0 Hz, 1H), 7.26 (td, *J* = 7.8, 1.2 Hz, 1H), 7.02

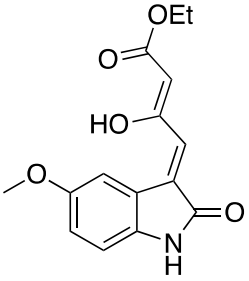
(td, *J* = 7.6, 0.8 Hz, 1H), 6.87 (d, *J* = 1.6 Hz, 1H), 6.85 (s, 1H), 5.53 (s, 1H), 4.29 (q, *J* = 7.2 Hz, 2H), 1.34 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100MHz, $CDCl_3$) δ = 172.39, 167.49, 142.82, 133.63, 131.37, 129.01, 127.42, 122.64, 121.02, 110.05, 99.08, 60.87, 50.75, 14.17 ppm; ESI-HRMS: calcd. for ‘ $C_{14}H_{13}NO_4$+H 260.0923, found 260.0934.

Ethyl-(*Z*)-3-hydroxy-4-((*E*)-5-methyl-2-oxoindolin-3-ylidene)but-2-enoate (1b)



1b

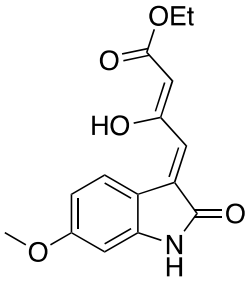
Reddish orange solid; Yield 22%, m.p. 135-136 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.40 (d, *J* = 2.0 Hz, 1H), 8.37 (d, *J* = 7.2 Hz, 1H), 8.21 (s, 1H), 7.07 (d, *J* = 8.0 Hz, 1H), 6.83 (d, *J* = 2.0 Hz, 1H), 6.74 (d, *J* = 8.0 Hz, 1H), 5.52 (s, 1H), 4.29 (q, *J* = 7.0 Hz, 2H), 2.33 (s, 3H), 1.35 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.45, 167.60, 140.49, 134.16, 132.55, 131.86, 129.50, 127.04, 121.00, 109.70, 98.87, 60.85, 50.76, 21.24, 14.18 ppm; ESI-HRMS: calcd. for $C_{15}H_{15}NO_4$+H 274.1079, found 274.1085.



1c

Ethyl-(*Z*)-3-hydroxy-4-((*E*)-5-methoxy-2-oxoindolin-3-ylidene)but-2-enoate (1c)

Red dark solid; Yield 16%, m.p. 136-137 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.42 (d, *J* = 2.0 Hz, 1H), 8.23 (d, *J* = 2.4 Hz, 1H), 8.07 (d, *J* = 2.8 Hz, 1H), 6.85 (d, *J* = 2.4 Hz, 1H), 6.83 (d, *J* = 2.4 Hz, 1H), 6.75 (d, *J* = 8.8 Hz, 1H), 5.53 (s, 1H), 4.29 (q, *J* = 7.2 Hz, 2H), 3.80 (s, 3H), 1.34 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.42, 167.41, 155.52, 136.62, 127.56, 121.76, 120.27, 117.29, 114.74, 110.32, 99.28, 60.92, 55.81, 50.71, 14.17 ppm; ESI-HRMS: calcd. for $C_{15}H_{15}NO_5$+H 290.1028, found 290.1029.



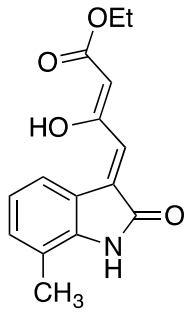
1d

Ethyl-(*Z*)-3-hydroxy-4-((*E*)-6-methoxy-2-oxoindolin-3-ylidene)but-2-enoate (1d)

Orange solid; Yield 28%, m.p. 147-148 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.40 (d, *J* = 2.0 Hz, 1H), 8.33 (d, *J* = 8.8 Hz, 1H), 8.04 (d, *J* = 8.8 Hz, 1H), 6.71 (d, *J* =

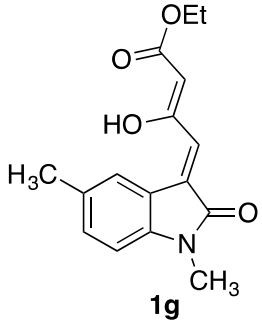
2.0 Hz, 1H), 6.52 – 6.53 (m, 1H), 6.40 (d, *J* = 2.4 Hz, 1H), 5.48 (s, 1H), 4.27 (q, *J* = 7.0 Hz, 2H), 3.84 (s, 3H), 1.34 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.56, 168.08, 162.60, 144.48, 131.75, 130.61, 124.19, 114.21, 107.64, 97.96, 96.78, 60.74, 55.57, 50.77, 14.20 ppm; ESI-HRMS: calcd. for $C_{15}H_{15}NO_5$+H 290.1028, found 290.1030.

Ethyl-(*Z*)-3-hydroxy-4-((*E*)-7-methyl-2-oxoindolin-3-ylidene)but-2-enoate (1e)



1e

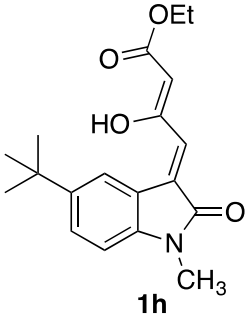
Orange solid; Yield 18%, m.p. 145-146 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 12.36 (q, *J* = 2.0 Hz, 1H), 9.13 (s, 1H), 8.24 (d, *J* = 8.0 Hz, 1H), 7.09 (d, *J* = 7.6 Hz, 1H), 6.94 (t, *J* = 7.6 Hz, 1H), 6.85 (d, *J* = 2.0 Hz, 1H), 5.53 (s, 1H), 4.28 (q, *J* = 7.0 Hz, 2H), 2.28 (s, 3H), 1.34 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.40, 170.32, 167.62, 141.65, 132.70, 127.28, 126.43, 122.43, 120.59, 119.13, 98.94, 60.82, 50.80, 16.29, 14.18 ppm.



1g

Ethyl-(*Z*)-4-((*E*)-1,5-dimethyl-2-oxoindolin-3-ylidene)-3-hydroxybut-2-enoate (1g)

Red solid; Yield 25%, m.p. 110-111 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.40 (d, *J* = 2.0 Hz, 1H), 8.23 (s, 1H), 7.12 (d, *J* = 8.0 Hz, 1H), 6.87 (d, *J* = 2.0 Hz, 1H), 6.67 (d, *J* = 8.0 Hz,1H), 5.51 (s, 1H), 4.28 (q, *J* = 7. 2 Hz, 2H), 3.21 (s, 3H), 2.34 (s, 3H), 1.34 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.49, 167.75, 143.28, 133.85, 132.33, 131.60, 129.31, 126.81, 120.46, 107.69, 98.67, 60.79, 50.79, 26.24, 21.21, 14.17 ppm; ESI-HRMS: calcd. for $C_{16}H_{17}NO_4$+H 288.1236, found 288.1231.



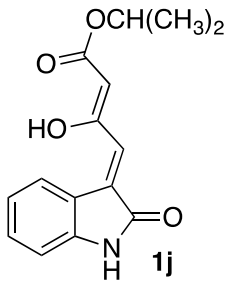
1h

Ethyl-(*Z*)-4-((*E*)-5-(*tert*-butyl)-1-methyl-2-oxoindolin-3-ylidene)-3-hydroxybut-2-enoate (1h)

Reddish orange solid; Yield 30%, m.p. 140-141 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 12.45 (d, *J* = 2.0 Hz, 1H), 8.54 (d, *J* = 1.6 Hz, 1H), 7.36 (dd, *J* = 8.2, 1.8 Hz, 1H),

6.88 (d, *J* = 2.0 Hz, 1H), 6.72 (d, *J* = 8.4 Hz, 1H), 5.54 (s, 1H), 4.29 (q, *J* = 7.2 Hz, 2H), 3.23 (s, 3H), 1.35 (s, 3H), 1.33 (s, 9H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.56, 168.40, 167.84, 145.58, 143.16, 132.60, 128.04, 126.63, 126.09, 120.20, 107.41, 98.76, 60.81, 34.63, 31.45, 31.45, 31.45, 26.24, 14.17 ppm .

isopropyl (*Z*)-3-hydroxy-4-((*E*)-2-oxoindolin-3-ylidene)but-2-enoate (1j)



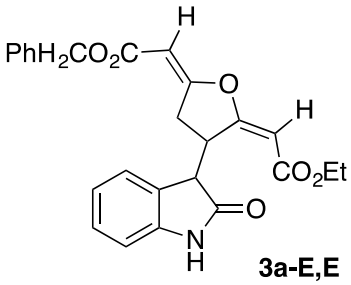
1j

Yellow solid, m.p. 118-119 °C, 36%, ^{1}H NMR (400 MHz, $CDCl_3$) δ = 12.47 (s, 1H), 8.62 (s, 1H), 8.42 (d, *J* = 7.2 Hz, 1H), 7.27 (t, *J* = 7.6 Hz, 1H), 7.30 (t, *J* = 8.0 Hz, 1H), 6.86 (d, *J* = 7.6 Hz, 1H), 6.85 (s, 1H), 5.51 (s, 1H), 5.10-5.20 (m, 1H), 1.33 (d, *J* = 6.0 Hz, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 172.00, 169.93, 167.34, 142.69, 138.59, 132.14, 131.32, 129.01, 127.57, 122.65, 110.00, 99.60, 68.57, 21.84 ppm; ESI-HRMS: calcd. for $C_{15}H_{15}NO_4$+H 274.1079, found 274.1070.

4. General procedure for the [3+2] annulation reaction:

Allenoates (1.2 mmol) was added to a solution of methyleneoxindoles (**1**) (1 mmol) and catalyst DABCO (0.2 mmol) in CH_2Cl_2 (2 mL). The stirring was maintained at room temperature until completion of the reaction (the reaction was monitored by TLC plate). The residue was purified by a flash column chromatography to yield **3** as a colorless solid.

Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl) dihydrofuran-2(3*H*)-ylidene)acetate (3a-E,E)

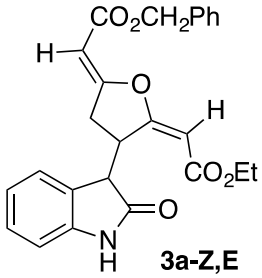


3a-E,E

White solid; m.p. 177-178 °C; Yield 15%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.80 (s, 1H), 7.40 (d, *J* = 7.6 Hz, 1H), 7.27 – 7.36 (m, 5H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.08 (t, *J* = 7.6 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.83 (s, 1H), 5.65 (s, 1H), 5.10 (d, *J* = 12.4 Hz, 1H), 4.99 (d, *J* = 12.4 Hz, 1H), 4.33 (d, *J* = 10.4 Hz, 1H), 4.28 (d, *J* = 2.8 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 2.99

(ddd, *J* = 19.6, 10.2, 2.4 Hz, 1H), 2.82 (d, *J* = 19.6Hz, 1H), 1.29 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.73, 173.31, 171.27, 167.16, 167.08, 141.37, 136.08, 128.69, 128.48, 128.05, 128.01, 127.04, 124.31, 122.94, 109.84, 99.94, 96.01, 94.40, 65.72, 60.20, 47.89, 39.83, 30.68, 14.33 ppm; ESI-HRMS: calcd. for $C_{25}H_{23}NO_6$+H 434.1604, found 434.1609.

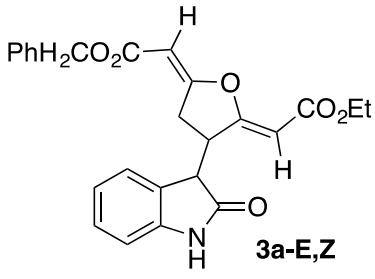
Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3a-Z,E)



3a-Z,E

White solid; m.p. 162-163 °C; Yield 30%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.42 (s, 1H), 7.21 – 7.43 (m, 5H), 7.18 (t, *J* =7.8 Hz, 1H), 7.07 (d, *J* = 7.2 Hz, 1H), 6.92 (t, *J* = 7.4 Hz, 1H), 6.83 (d, *J* = 8.0 Hz, 1H), 5.84 (s, 1H), 5.36 (s, 1H), 5.05 (d, *J* = 12.4 Hz, 1H), 4.97 (d, *J* = 12.4 Hz, 1H), 4.53 (d, *J* = 10.0 Hz, 1H), 4.34 (s, 1H), 4.19 – 4.31 (m, 2H), 3.04 (dd, *J* = 19.2, 9.8 Hz, 1H), 2.73 (d, *J* = 19.2 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.88, 172.89, 170.84, 166.43, 166.31, 141.99, 136.09, 128.96, 128.48, 128.08, 127.96, 124.47, 124.40, 122.58, 109.96, 96.72, 94.30, 65.60, 60.54, 47.21, 40.17, 30.39, 14.30 ppm; ESI-HRMS: calcd. for $C_{25}H_{23}NO_6$+H 434.1604, found 434.1588.

Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3a-E,Z)

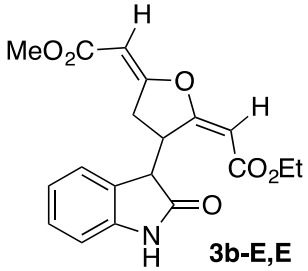


3a-E,Z

White solid; m.p. 162-163 °C; Yield 45%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.42 (s, 1H), 7.21-7.43 (m, 5H), 7.18 (t, *J* = 7.8 Hz, 1H), 7.07 (d, *J* = 7.2 Hz, 1H), 6.92 (t, *J* = 7.4 Hz, 1H), 6.83 (d, *J* = 8.0 Hz, 1H), 5.84 (s, 1H), 5.36 (s, 1H), 5.05 (d, *J* = 12.4 Hz, 1H), 4.97 (d, *J* = 12.4 Hz, 1H), 4.53 (d, *J* = 10.0 Hz, 1H), 4.34 (s, 1H), 4.19 – 4.31 (m, 2H), 3.04 (dd, *J* = 19.2, 9.8 Hz, 1H), 2.73 (d, *J* = 19.2 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.88, 172.89, 170.84, 166.43, 166.31, 141.99, 136.09, 128.96, 128.48, 128.08, 127.96,

124.47, 124.40, 122.58, 109.96, 96.72, 94.30, 65.60, 60.54, 47.21, 40.17, 30.39, 14.30 ppm; ESI-HRMS: calcd. for $C_{25}H_{23}NO_6$+H 434.1604, found 434.1588.

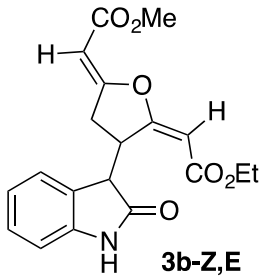
Ethyl-(*E*)-2-((*E*)-5-(2-methoxy-2-oxoethylidene)-3-(2-oxoindolin-3-yl) dihydrofuran-2(3*H*)-ylidene)acetate (3b-E,E)



3b-E,E

White solid; m.p. 205-206 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.48 (s, 1H), 7.41 (d, *J* = 7.6 Hz, 1H), 7.24 (t, *J* = 8.0 Hz, 1H), 7.09 (t, *J* = 7.4 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.61 (t, *J* = 1.6 Hz, 1H), 4.34 (d, *J* = 10.4 Hz, 1H), 4.28 (d, *J* = 3.2 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 3.63 (s, 3H), 2.99 (ddd, *J* = 20.0, 10.2, 2.4 Hz, 1H), 2.83 (d, *J* = 19.6 Hz, 1H), 1.30 (t, *J* = 7.2 Hz, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.53, 173.37, 170.98, 167.77, 167.18, 141.31, 128.71, 127.08, 124.37, 122.98, 109.77, 95.95, 94.30, 60.20, 51.08, 47.91, 39.84, 30.58, 14.35 ppm; ESI-HRMS: calcd. for $C_{19}H_{19}NO_6$+Na 380.1110, found 380.1104.

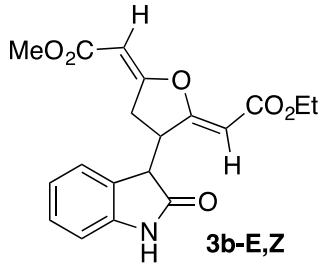
Ethyl-(*E*)-2-((*Z*)-5-(2-methoxy-2-oxoethylidene)-3-(2-oxoindolin-3-yl) dihydrofuran-2(3*H*)-ylidene)acetate (3b-*Z*,E)



3b-Z,E

White solid; m.p. 207-208 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.20 (t, *J* = 7.6 Hz, 1H), 7.08 (d, *J* = 7.6 Hz, 1H), 6.93 (t, *J* = 7.6 Hz, 1H), 6.86 (d, *J* = 8.0 Hz, 1H), 5.84 (s, 1H), 5.33 (s, 1H), 4.53 (d, *J* = 10.0 Hz, 1H), 4.36 (d, *J* = 3.2 Hz, 1H), 4.33 – 4.18 (m, 2H), 3.56 (s, 3H), 3.05 (ddd, *J* = 19.6, 10.0, 2.4 Hz, 1H), 2.70 (d, *J* = 19.2 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.79, 172.96, 170.61, 167.12, 166.33, 141.94, 128.97, 124.45, 124.42, 122.60, 109.96, 96.66, 94.12, 60.55, 51.09, 47.18, 40.06, 30.29, 14.30 ppm; ESI-HRMS: calcd. for $C_{19}H_{19}NO_6$+Na 380.1110, found 380.1097.

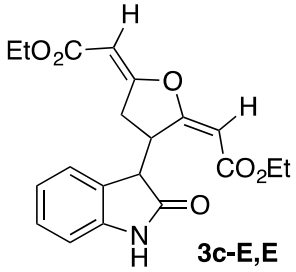
Ethyl-(*Z*)-2-((*E*)-5-(2-methoxy-2-oxoethylidene)-3-(2-oxoindolin-3-yl) dihydrofuran-2(3*H*)-ylidene)acetate (3b-E,*Z*)



3b-E,Z

White solid; m.p. 140-141 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.81 (br, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 7.6 Hz, 1H), 6.97 (t, *J* = 7.6 Hz, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 5.63 (s, 1H), 5.37 (s, 1H), 4.23 (q, *J* = 6.8 Hz, 2H), 3.89-3.93 (m, 1H), 3.78 (d, *J* = 2.8 Hz, 1H), 3.59 (s, 3H), 3.25 (ddd, *J* = 18.9, 10.1, 1.3 Hz, 1H), 2.49 (ddd, *J* = 19.1, 6.3, 1.8 Hz, 1H), 1.31 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 171.09, 167.74, 167.41, 164.16, 141.70, 129.39, 124.85, 124.08, 123.12, 110.14, 95.40, 93.92, 60.26, 51.17, 48.02, 41.44, 28.57, 14.27 ppm; ESI-HRMS: calcd. for $C_{19}H_{19}NO_6$+H 358.1291, found 358.1287.

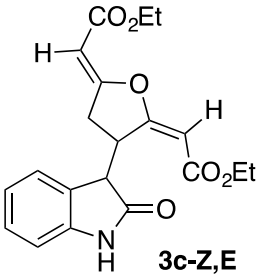
Diethyl-2,2'-(3-(2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene) (2*E*,2'*E*)-diacetate (3c-E,E)



3c-E,E

White solid; m.p. 165-166 °C; Yield 10%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.64 (s, 1H), 7.40 (d, *J* = 7.2 Hz, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.08 (t, *J* = 7.6 Hz, 1H), 6.84 (d, *J* = 7.6 Hz, 1H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.59 (t, *J* = 1.8 Hz, 1H), 4.33 (d, *J* = 9.6 Hz, 1H), 4.28 (d, *J* = 3.6 Hz, 1H), 4.19 (q, *J* = 7.0 Hz, 2H), 4.01-4.13 (m, 2H), 2.98 (ddd, *J* = 20.0, 10.4, 2.5 Hz, 1H), 2.79-2.85 (m, 1H), 1.30 (t, *J* = 7.2 Hz, 3H), 1.20 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.38, 170.75, 169.41, 167.36, 167.21, 141.30, 128.69, 127.09, 124.36, 122.96, 109.75, 95.86, 94.69, 60.18, 59.81, 47.87, 39.88, 30.52, 14.34, 14.24 ppm; ESI-HRMS: calcd. for $C_{20}H_{21}NO_6$+H 372.1447, found 372.1451.

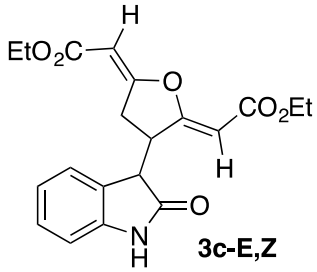
Diethyl-2,2'-(3-(2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene) (2*Z*,2'*E*)-diacetate (3c-Z,E)



3c-Z,E

white solid; m.p. 182-183 °C; Yield 21%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.30 (s, 1H), 7.20 (t, *J* = 7.6 Hz, 1H), 7.08 (d, *J* = 7.2 Hz, 1H), 6.93 (t, *J* = 7.4 Hz, 1H), 6.86 (d, *J* = 7.6 Hz, 1H), 5.83 (s, 1H), 5.31 (s, 1H), 4.52 (d, *J* = 10.0 Hz, 1H), 4.35 (s, 1H), 4.20 – 4.29 (m, 2H), 3.97 – 4.05 (m, 2H), 3.03 (dd, *J* = 19.2, 10.0 Hz, 1H), 2.70 (d, *J* = 19.6 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H), 1.16 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.91, 172.78, 170.36, 166.70, 166.35, 141.94, 128.95, 124.48, 124.45, 122.60, 109.93, 96.56, 94.57, 60.53, 59.80, 47.20, 40.12, 30.24, 14.31, 14.20 ppm; ESI-HRMS: calcd. for $C_{20}H_{21}NO_6$+H 372.1447, found 372.1441.

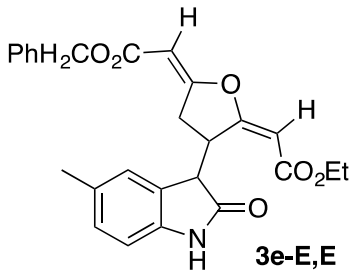
Diethyl-2,2'-(3-(2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene) (2*Z*,2'*E*)-diacetate (3c-E,Z)



3c-E,Z

White solid; m.p. 109-110 °C; Yield 31%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.32 (s, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.20 (d, *J* = 7.6 Hz, 1H), 6.80 (t, *J* = 7.6 Hz, 1H), 6.88 (d, *J* = 8.0 Hz, 1H), 5.61 (t, *J* = 2.0 Hz, 1H), 5.36 (d, *J* = 1.2 Hz, 1H), 4.23 (q, *J* = 7.2 Hz, 2H), 4.02-4.09 (m, 2H), 3.89-3.93 (m, 1H), 3.78 (d, *J* = 3.2Hz, 1H), 3.25 (ddd, *J* = 18.9, 10.1, 1.9 Hz, 1H), 2.50 (ddd, *J* = 18.9, 6.4, 2.1 Hz, 1H), 1.32 (t, *J* = 7.2 Hz, 3H), 1.20 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.50, 170.88, 167.78, 167.01, 164.21, 141.81, 129.35, 124.83, 124.11, 123.07, 110.19, 95.79, 93.81, 60.25, 59.94, 48.05, 41.47, 28.50, 14.26, 14.20ppm; ESI-HRMS: calcd. for $C_{20}H_{21}NO_6$+H 372.1447, found 372.1440.

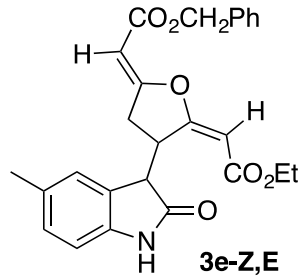
Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3e-E,E)



3e-E,E

White solid; m.p. 168-169 °C; Yield 15%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.59 (s, 1H), 7.39 – 7.27 (m, 5H), 7.21 (s, 1H), 7.03 (d, *J* = 7.6Hz, 1H), 6.73 (d, *J* = 7.6 Hz, 1H), 5.82 (d, *J* = 1.6 Hz, 1H), 5.65 (t, *J* = 1.8 Hz, 1H), 5.11 (d, *J* = 12.4 Hz, 1H), 5.00 (d, *J* =12.4 Hz, 1H), 4.31 (d, *J* = 9.6 Hz, 1H), 4.25 (d, *J* = 3.2 Hz, 1H), 4.20 (q, *J* = 7.1 Hz, 2H), 2.98 (ddd, *J* = 20.0, 10.4, 2.4 Hz, 1H), 2.88 – 2.78 (m, 1H), 2.34 (s, 3H), 1.30 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.75, 173.47, 171.34, 167.23, 167.08, 138.90, 136.11, 132.51, 128.97, 128.46, 128.02, 127.09, 125.00, 109.53, 95.90, 94.37, 65.70, 60.18, 47.89, 39.88, 30.66, 21.03, 14.33 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1780.

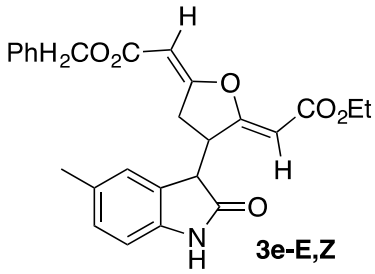
Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3e-Z,E)



3e-Z,E

White solid; m.p. 178-179 °C; Yield 16%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.24 (s, 1H), 7.18 – 7.41 (m, 5H), 6.97 (d, *J* = 8.0 Hz, 1H), 6.87 (s, 1H), 6.70 (d, *J* = 7.6 Hz, 1H), 5.84 (d, *J* = 1.2 Hz, 1H), 5.37 (s, 1H), 5.05 (d, *J* = 12.4 Hz, 1H), 4.98 (d, *J* = 12.4 Hz, 1H), 4.50 (d, *J* = 9.6 Hz, 1H), 4.29 (d, *J* = 4.4 Hz, 1H), 4.21 – 4.28 (m, 2H), 3.02 (ddd, *J* = 19.2, 10.0, 2.4 Hz, 1H), 2.71 (d, *J* = 19.2 Hz, 1H), 2.24 (s, 3H), 1.33 (t, *J* = 7.2 Hz, 4H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.99, 173.03, 171.06, 166.42, 166.31, 139.53, 136.09, 132.02, 129.20, 128.48, 128.08, 127.97, 125.12, 124.44, 109.65, 96.66, 94.15, 65.54, 60.53, 47.26, 40.17, 30.42, 21.07, 14.31 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1752.

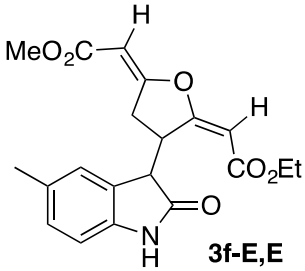
Benzyl-(*E*)-2-((*Z*)-5-(2-ethoxy-2-oxoethylidene)-4-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3e-E,Z)



3e-E,Z

White solid; m.p. 187-188 °C; Yield 31%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.36 (s, 1H), 7.28-7.36 (m, 5H), 7.02 (d, *J* = 8.0 Hz, 1H), 6.98 (s, 1H), 6.75 (d, *J* = 8.0 Hz, 1H), 5.69 (t, *J* = 1.8 Hz, 1H), 5.34 (d, *J* = 1.2 Hz, 1H), 5.08 (d, *J* = 12.4 Hz, 1H), 5.04 (d, *J* = 12.4 Hz, 1H), 4.20-4.28 (m, 2H), 3.86-3.90 (m, 1H), 3.73 (d, *J* = 2.8 Hz, 1H), 3.26 (ddd, *J* = 18.8, 10.1, 1.7 Hz, 1H), 2.53 (ddd, *J* = 18.9, 6.7, 2.0 Hz, 1H), 2.26 (s, 3H), 1.32 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.60, 171.52, 167.73, 166.77, 164.19, 139.35, 136.07, 132.61, 129.68, 128.47, 128.06, 127.94, 125.39, 124.17, 109.94, 95.43, 93.82, 65.72, 60.23, 47.92, 41.49, 28.69, 21.13, 14.26ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1780.

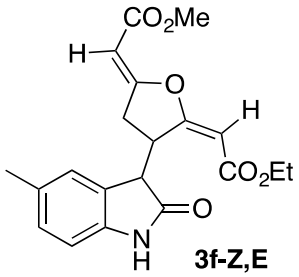
Ethyl-(*E*)-2-((*E*)-5-(2-methoxy-2-oxoethylidene)-3-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3f-E,E)



3f-E,E

White solid; m.p. 184-185 °C; Yield 12%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.62 (s, 1H), 7.22 (s, 1H), 7.03 (d, *J* = 7.6 Hz, 1H), 6.73 (d, *J* = 7.6 Hz, 1H), 5.82 (s, 1H), 5.60 (s, 1H), 4.32 (d, *J* = 10.4 Hz, 1H), 4.24 (d, *J* = 2.8 Hz, 1H), 4.20 (q, *J* = 7.2 Hz, 2H), 3.62 (s, 3H), 2.98 (ddd, *J* = 19.6, 10.4, 2.4 Hz, 1H), 2.81 (d, *J* = 19.6 Hz, 1H), 2.34 (s, 3H), 1.30 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.67, 173.50, 171.04, 167.74, 167.25, 138.91, 132.54, 128.99, 127.15, 125.04, 109.50, 95.86, 94.29, 60.17, 51.03, 39.92, 30.58, 21.04, 14.34 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 372.1447, found 372.1447.

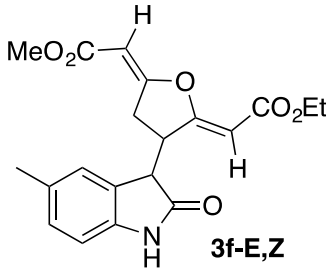
Ethyl-(*E*)-2-((*Z*)-3-(5-methyl-2-oxoindolin-3-yl)-5-(2-(methylperoxy)-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3f-*Z*,E)



3f-Z,E

White solid; m.p. 168-169 °C; Yield 24%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.98 (s, 1H), 6.99 (d, *J* = 7.6 Hz, 1H), 6.87 (s, 1H), 6.74 (d, *J* = 8.0 Hz, 1H), 5.84 (d, *J* = 1.2 Hz, 1H), 5.34 (s, 1H), 4.51 (d, *J* = 10.0 Hz, 1H), 4.31 (d, *J* = 3.2 Hz, 1H), 4.29 – 4.20 (m, 2H), 3.57 (s, 3H), 3.04 (ddd, *J* = 19.2, 10.0, 2.4 Hz, 1H), 2.68 (d, *J* = 19.2 Hz, 1H), 2.25 (s, 3H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.68, 173.03, 170.80, 167.13, 166.30, 139.44, 132.09, 129.21, 125.17, 124.53, 109.56, 96.68, 94.01, 60.52, 51.07, 47.21, 40.12, 30.35, 21.06, 14.32ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 372.1447, found 372.1441.

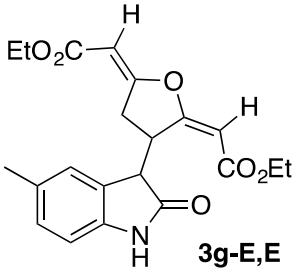
Ethyl-(*Z*)-2-((*E*)-5-(2-methoxy-2-oxoethylidene)-3-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3f-E,*Z*)



3f-E,Z

White solid; m.p. 165-166 °C; Yield 37%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.54 (s, 1H), 7.03 (d, *J* = 7.6 Hz, 1H), 6.97 (s, 1H), 6.78 (d, *J* = 8.0 Hz, 1H), 5.65 (s, 1H), 5.35 (d, *J* = 1.2 Hz, 1H), 4.21-4.27 (m, 2H), 3.87-3.91 (m, 1H), 3.74 (d, *J* = 2.8 Hz, 1H), 3.26 (ddd, *J* = 18.8, 10.1, 1.6 Hz, 1H), 2.49 (ddd, *J* = 18.9, 6.9, 2.0 Hz, 1H), 2.26 (s, 3H), 1.32 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.68, 171.18, 167.80, 167.40, 164.19, 139.40, 132.62, 129.69, 125.37, 124.23, 109.98, 95.38, 93.76, 60.21, 51.15, 47.95, 41.47, 28.59, 21.12, 14.26 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 372.1447, found 372.1445.

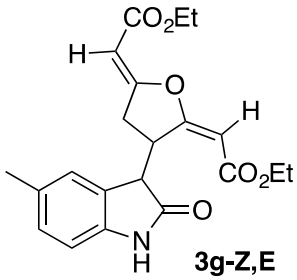
Diethyl-2,2'-(3-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*E*,2'*E*)-diacetate (3g-E,E)



3g-E,E

White solid; m.p. 176-177 °C; Yield 26%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.57 (br, 1H), 7.22 (s, 1H), 7.03 (d, *J* = 8.0 Hz, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 5.82 (s, 1H), 5.59 (s, 1H), 4.31 (d, *J* = 9.6 Hz, 1H), 4.24 (d, *J* = 2.8 Hz, 1H), 4.20 (q, *J* = 7.1 Hz, 2H), 4.15 – 4.01 (m, 2H), 2.97 (ddd, *J* = 20.0, 10.4, 2.4 Hz, 1H), 2.81 (d, *J* = 20.0 Hz, 1H), 2.34 (s, 3H), 1.30 (t, *J* = 7.0 Hz, 3H), 1.20 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.72, 173.55, 170.81, 167.32, 167.27, 138.91, 132.51, 128.96, 127.15, 125.01, 109.49, 95.76, 94.67, 60.16, 59.77, 47.92, 39.94, 30.51, 21.03, 14.34, 14.23 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 408.1423, found 408.1412.

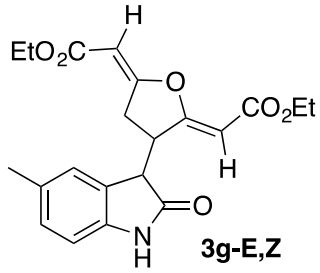
Diethyl-2,2'-(3-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3g-Z,E)



3g-Z,E

White solid; m.p. 198-199 °C; Yield 26%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.35 (s, 1H), 6.99 (d, *J* = 8.0 Hz, 1H), 6.87 (s, 1H), 6.75 (d, *J* = 8.0 Hz, 1H), 5.84 (s, 1H), 5.32 (s, 1H), 4.50 (d, *J* = 9.6 Hz, 1H), 4.30 (d, *J* = 2.8 Hz, 1H), 4.28 – 4.20 (m, 2H), 4.07 – 3.97 (m, 2H), 3.02 (ddd, *J* = 19.6, 10.0, 2.4 Hz, 1H), 2.69 (d, *J* = 19.6 Hz, 1H), 2.25 (s, 3H), 1.33 (t, *J* = 7.2 Hz, 3H), 1.17 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100MHz, $CDCl_3$) δ = 176.97, 173.11, 170.56, 166.69, 166.34, 139.47, 132.02, 129.17, 125.14, 124.50, 109.62, 96.51, 94.45, 60.51, 59.80, 47.26, 40.12, 30.27, 21.07, 14.32, 14.20 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 408.1423, found 408.1404.

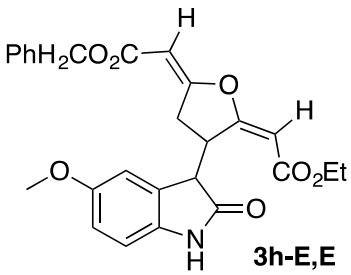
Diethyl-2,2'-(3-(5-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3g-E,Z)



3g-E,Z

White solid; m.p. 142-143 °C; Yield 27%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.34 (s, 1H), 7.04 (d, *J* = 7.6 Hz, 1H), 6.98 (s, 1H), 6.77 (d, *J* = 8.0 Hz, 1H), 5.64 (s, 1H), 5.34 (s, 1H), 4.21-4.27 (m, 2H), 4.04-4.10 (m, 2H), 3.87-3.91 (m, 1H), 3.74 (d, *J* = 2.8 Hz, 1H), 3.26 (dd, *J* = 18.8, 10.1 Hz, 1H), 2.49 (ddd, *J* = 18.8, 6.9, 1.9 Hz, 1H), 2.26 (s, 3H), 1.32 (t, *J* = 6.8 Hz, 3H), 1.20 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.86, 171.02, 167.91, 167.07, 164.32, 139.48, 132.62, 129.70, 125.41, 124.27, 110.05, 95.83, 93.66, 60.27, 60.00, 47.94, 41.54, 28.55, 21.18, 14.30, 14.24 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 408.1423, found 408.1413.

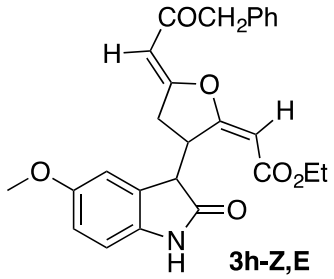
Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(5-methoxy-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3h-E,E)



3h-E,E

White solid; m.p. 152-153 °C; Yield 9%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.52 (s, 1H), 7.28 – 7.37(m, 5H), 7.00 (s, 1H), 6.78 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.75 (d, *J* = 8.8 Hz, 1H), 5.83 (d, *J* = 0.8 Hz, 1H), 5.65 (s, 1H), 5.11 (d, *J* = 12.4 Hz, 1H), 5.01 (d, *J* = 12.4 Hz, 1H), 4.28-4.31 (m, 2H), 4.19 (q, *J* = 7.0 Hz, 2H), 3.81 (s, 3H), 2.99 (ddd, *J* = 19.6, 10.0, 2.4 Hz, 1H), 2.83 (d, *J* = 20.0 Hz, 1H), 1.30 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.49, 173.23, 171.25, 167.19, 167.07, 156.26, 136.17, 134.76, 128.48, 128.41, 128.05, 128.02, 113.67, 111.23, 110.23, 96.06, 94.45, 65.71, 60.18, 55.91, 48.26, 40.01, 30.68, 14.34 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1705.

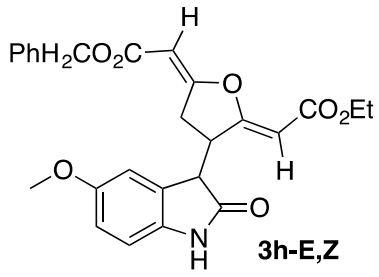
Ethyl-(*E*)-2-((*Z*)-3-(5-methyl-2-oxoindolin-3-yl)-5-(2-oxo-3-phenylpropylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3h-Z,E)



3h-Z,E

White solid; m.p. 150-151 °C; Yield 27%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.45 (s, 1H), 7.21 – 7.39 (m, 5H), 6.74 (d, *J* = 8.8 Hz, 1H), 6.72 (d, *J* = 2.4 Hz, 1H), 6.68 (s, 1H), 5.84 (d, *J* = 1.2 Hz, 1H), 5.40 (s, 1H), 5.06 (d, *J* = 12.4 Hz, 1H), 4.99 (d, *J* = 12.4 Hz, 1H), 4.51 (d, *J* =10.0 Hz, 1H), 4.32 (d, *J* = 3.2 Hz, 1H), 4.20 – 4.30 (m, 2H), 3.71 (s, 3H), 3.05 (ddd, *J* = 19.6, 10.0, 2.6 Hz, 1H), 2.73 (d, *J* = 19.2 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.86, 172.86, 170.89, 166.41, 166.28, 155.75, 136.13, 135.50, 128.49, 128.09, 128.00, 125.77, 113.76, 111.66, 110.32, 96.76, 94.36, 65.62, 60.54, 55.87, 47.64, 40.15, 30.41, 14.30 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1710.

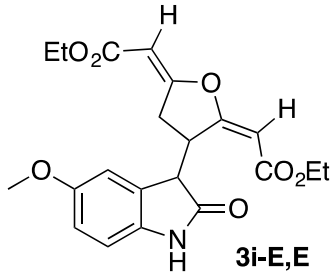
Benzyl-(*E*)-2-((*Z*)-5-(2-ethoxy-2-oxoethylidene)-4-(5-methoxy-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3h-E,Z)



3h-E,Z

White solid; m.p. 121-122 °C; Yield 36%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.30-7.38 (m, 5H), 6.82 (s, 1H), 6.75-6.79 (m, 2H), 5.70 (t, *J* = 2.0 Hz, 1H), 5.35 (d, *J* = 1.6 Hz, 1H), 5.10 (d, *J* = 12.4 Hz, 1H), 5.06 (d, *J* = 12.4 Hz, 1H), 4.24 (qd, *J* = 7.1, 1.5 Hz, 1H), 3.89-3.93 (m, 1H), 3.76 (d, *J* = 3.2 Hz, 1H), 3.74 (s, 3H), 3.28 (ddd, *J* = 18.9, 10.1, 1.8 Hz, 1H), 2.57 (ddd, *J* = 18.9, 6.5, 2.1 Hz, 1H), 1.33 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 171.48, 167.48, 166.83, 164.12, 155.97, 136.10, 128.53, 128.12, 128.00, 125.49, 113.87, 111.97, 110.70, 95.47, 94.03, 65.78, 60.30, 55.78, 48.38, 41.48, 28.79, 14.29 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1705.

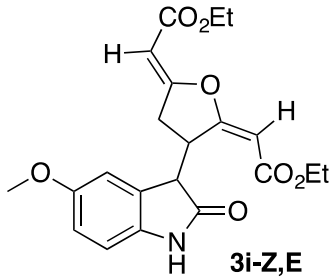
Diethyl-2,2'-(3-(5-methoxy-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*E*,2'*E*)-diacetate (3i-E,E)



3i-E,E

Yield 24%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.36 (s, 1H), 7.01 (s, 1H), 6.78 (dd, *J* = 8.4, 2.4Hz, 1H), 6.75 (d, *J* = 8.4 Hz, 1H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.59 (s, 1H), 4.27-4.32 (m, 2H), 4.19 (q, *J* = 7.2 Hz, 2H), 4.08 (m, 2H), 3.81 (s, 3H), 2.98 (ddd, *J* = 19.2, 10.0, 2.4 Hz, 1H), 2.83 (d, *J* = 20.0 Hz, 1H), 1.30 (t, *J* = 7.0 Hz, 3H), 1.21 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100MHz, $CDCl_3$) δ = 176.44, 173.32, 170.72, 167.34, 167.24, 156.21, 134.68, 128.41, 113.59, 111.21, 110.19, 95.88, 94.71, 60.17, 59.80, 55.90, 48.23, 40.01, 30.49, 14.35, 14.25 ppm；ESI-HRMS: calcd. for $C_{21}H_{23}NO_7$+H 402.1553, found 402.1548.

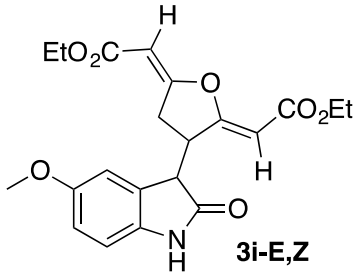
Diethyl-2,2'-(3-(5-methoxy-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3i-Z,E)



3i-Z,E

Yield 24%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.25 (s, 1H), 6.77 (d, *J* = 8.4 Hz, 1H), 6.74 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.69 (s, 1H), 5.84 (d, *J* = 1.2 Hz, 1H), 5.35 (s, 1H), 4.51 (d, *J* = 10.0 Hz, 1H), 4.33 (d, *J* = 3.2 Hz, 1H), 4.20 – 4.30 (m, 2H), 3.98 – 4.08 (m, 2H), 3.73 (s, 3H), 3.05 (ddd, *J* = 19.6, 10.0, 2.6 Hz, 1H), 2.71 (d, *J* = 19.2 Hz, 1H), 1.33 (t, *J* = 7.2 Hz, 3H), 1.17 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.88, 172.97, 170.42, 166.62, 166.33, 155.70, 135.46, 125.75, 113.73, 111.54, 110.32, 96.57, 94.62, 60.53, 59.82, 55.86, 47.63, 40.07, 30.25, 14.31, 14.21ppm；ESI-HRMS: calcd. for $C_{21}H_{23}NO_7$+H 402.1553, found 402.1554.

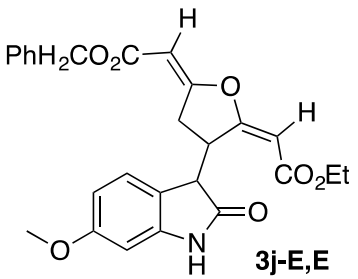
Diethyl-2,2'-(3-(5-methoxy-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3i-E,Z)



3i-E,Z

White solid; m.p. 99.0-100 °C; Yield 24%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.16 (s, 1H), 6.81 (d, *J* = 2.4 Hz, 1H), 6.79 (d, *J* = 2.4 Hz, 1H), 6.76 (s, 1H), 5.63 (t, *J* = 2.0 Hz, 1H), 5.33 (d, *J* = 1.6 Hz, 1H), 4.22 (qd, *J* = 7.1, 1.8 Hz, 2H), 4.04 - 4.10 (m, 2H), 3.87-3.92 (m, 1H), 3.75 (d, *J* = 3.2 Hz, 1H), 3.73 (s, 3H), 3.26 (ddd, *J* = 18.9, 10.1, 1.9 Hz, 1H), 2.53 (ddd, *J* = 18.9, 6.6, 2.1 Hz, 1H), 1.31 (t, *J* = 6.8 Hz, 3H), 1.21 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.37, 170.86, 167.54, 167.02, 164.11, 155.91, 135.13, 125.48, 113.77, 111.94, 110.58, 95.79, 93.78, 60.24, 59.96, 55.74, 48.26, 41.45, 28.55, 14.26, 14.21ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_7$+H 402.1553, found 402.1541.

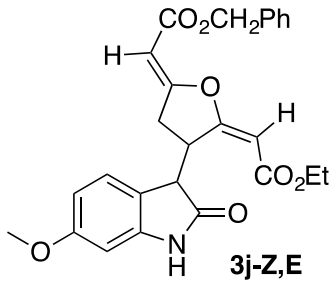
Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(6-methoxy-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3j-E,E)



3j-E,E

White solid; m.p. 178-179 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.38 (s, 1H), 7.27 – 7.36 (m, 6H), 6.59 (dd, *J* = 8.0, 2.2 Hz, 1H), 6.42 (d, *J* = 2.4 Hz, 1H), 5.81 (d, *J* = 1.2 Hz, 1H), 5.65 (t, *J* = 1.8 Hz, 1H), 5.12 (d, *J* = 12.4 Hz, 1H), 5.02 (d, *J* = 12.4 Hz, 1H), 4.25 – 4.32 (m, 1H), 4.14 – 4.23 (m, 3H), 3.81 (s, 3H), 2.97 (ddd, *J* = 20.0, 10.0, 2.4 Hz, 1H), 2.83 (dt, *J* = 20.0, 1.8 Hz, 1H), 1.30 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.17, 173.30, 171.35, 167.19, 167.13, 160.42, 142.46, 136.15, 128.51, 128.06, 125.06, 118.87, 107.62, 97.27, 96.03, 94.43, 65.75, 60.21, 55.56, 47.39, 40.12, 30.65, 14.36 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1703.

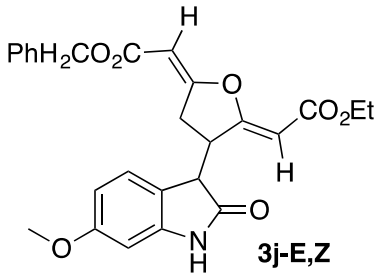
Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(6-methoxy-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3j-Z,E)



3j-Z,E

White solid; m.p. 198-199 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.29 (s, 1H), 7.22 – 7.38 (m, 5H), 6.95 (d, *J* = 8.2 Hz, 1H), 6.40 – 6.47 (m, 2H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.38 (t, *J* = 2.0 Hz, 1H), 5.07 (d, *J* = 12.4 Hz, 1H), 4.99 (d, *J* = 12.4 Hz, 1H), 4.45– 4.54 (m, 1H), 4.17 – 4.33 (m, 3H), 3.76 (s, 3H), 3.03 (ddd, *J* = 19.6, 10.0, 2.4 Hz, 1H), 2.73 (dt, *J* = 19.2, 1.6 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.06, 170.95, 166.52, 166.34, 160.56, 143.20, 128.51, 128.09, 127.94, 125.16, 116.02, 107.42, 97.24, 96.57, 94.22, 65.64, 60.52, 55.44, 46.75, 40.25, 30.36, 14.30ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1706.

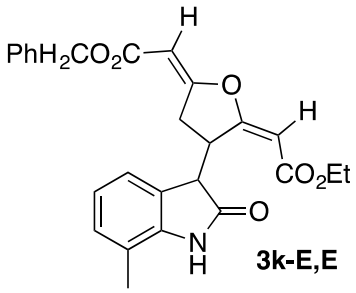
Benzyl-(*E*)-2-((*Z*)-5-(2-ethoxy-2-oxoethylidene)-4-(6-methoxy-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3j-E,Z)



3j-E,Z

White solid; m.p. 155-156 °C; Yield 34%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.31 (s, 1H), 7.27 – 7.38 (m, 5H), 7.07 (d, *J* = 8.3 Hz, 1H), 6.48 (dd, *J* = 8.3, 2.3 Hz, 1H), 6.45 (d, *J* = 2.2 Hz, 1H), 5.68 (t, *J* = 2.0 Hz, 1H), 5.36 (d, *J* = 1.5 Hz, 1H), 5.09 (d, *J* = 12.5 Hz, 1H), 5.04 (d, *J* = 12.5 Hz, 1H), 4.27 – 4.19 (m, 2H), 3.90 – 3.83 (m, 1H), 3.76 (s, 3H), 3.72 (d, *J* = 3.1 Hz, 1H), 3.23 (ddd, *J* = 18.9, 10.1, 1.9 Hz, 1H), 2.51 (ddd, *J* = 18.9, 6.3, 2.1 Hz, 1H), 1.32 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.33, 171.61, 167.91, 166.87, 164.25, 160.84, 143.15, 136.10, 128.53, 128.11, 127.95, 125.57, 115.75, 107.68, 97.69, 95.42, 93.94, 65.79, 60.31, 55.50, 47.73, 41.64, 28.60, 14.30 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_7$+H 464.1709, found 464.1707.

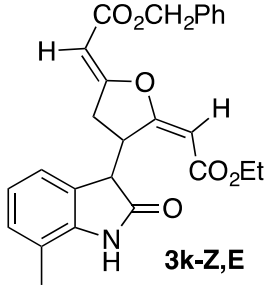
Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(7-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3k-E,E)



3k-E,E

White solid; m.p. 140-141 °C; Yield 12%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.83 (s, 1H), 7.26 – 7.36 (m, 5H), 7.23 (d, *J* = 7.2 Hz, 1H), 7.06 (d, *J* = 7.6 Hz, 1H), 7.00 (t, *J* = 7.6 Hz, 1H), 5.82 (d, *J* = 0.8 Hz, 1H), 5.64 (s, 1H), 5.10 (d, *J* = 12.4 Hz, 1H), 5.01 (d, *J* = 12.4 Hz, 1H), 4.28 – 4.36 (m, 2H), 4.19 (q, *J* = 7.2 Hz, 2H), 3.00 (ddd, *J* = 20.0, 10.2, 2.4 Hz, 1H), 2.80 (dt, *J* = 20.0, 1.8 Hz, 1H), 2.22 (s, 3H), 1.29 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.95, 173.45, 171.42, 167.14, 167.10, 140.12, 136.12, 130.04, 128.48, 128.05, 127.97, 126.62, 122.89, 121.67, 118.97, 95.96, 94.31, 65.72, 60.18, 48.35, 39.80, 30.76, 16.35, 14.33 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1766.

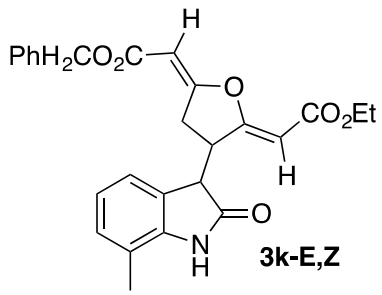
Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(7-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3k-Z,E)



3k-Z,E

White solid; m.p. 161-162 °C; Yield 25%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 9.10 (s, 1H), 7.21 – 7.36 (m, 5H), 7.01 (d, *J* = 7.6 Hz, 1H), 6.92 (d, *J* = 7.2 Hz, 1H), 6.84 (t, *J* = 7.6 Hz, 1H), 5.84 (d, *J* = 1.2 Hz, 1H), 5.39 (t, *J* = 1.8 Hz, 1H), 5.05 (d, *J* = 12.4 Hz, 1H), 4.99 (d, *J* = 12.4 Hz, 1H), 4.49 – 4.57 (m, 1H), 4.37 (d, *J* = 3.6 Hz, 1H), 4.20 – 4.30 (m, 2H), 3.07 (ddd, *J* = 19.2, 10.0, 2.6 Hz, 1H), 2.72 (dt, *J* = 19.6, 1.8 Hz, 1H), 2.25 (s, 3H), 1.34 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.65, 173.05, 171.01, 166.50, 166.34, 140.99, 136.07, 130.24, 128.46, 128.04, 127.86, 123.99, 122.48, 121.65, 119.44, 96.69, 94.19, 65.59, 60.52, 47.69, 39.99, 30.43, 16.53, 14.26 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1764.

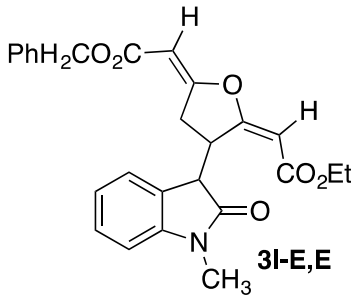
Benzyl-(*E*)-2-((*Z*)-5-(2-ethoxy-2-oxoethylidene)-4-(7-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3k-E,Z)



3k-E,Z

White solid; m.p. 77-78 °C; Yield 37%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.69 (s, 1H), 7.28-7.35 (m, 5H), 7.06 (d, *J* = 7.6 Hz, 1H), 7.03 (d, *J* = 7.6 Hz, 1H), 6.90 (t, *J* = 7.6 Hz, 1H), 5.69 (t, *J* = 2.0 Hz, 1H), 5.36 (d, *J* = 1.5 Hz, 1H), 5.08 (d, *J* = 12.5 Hz, 1H), 5.04 (d, *J* = 12.5 Hz, 1H), 4.23 (q, *J* = 7.0 Hz, 2H), 3.96 – 3.88 (m, 1H), 3.79 (d, *J* = 3.1 Hz, 1H), 3.27 (ddd, *J* = 18.9, 10.1, 1.8 Hz, 1H), 2.25 (s, 3H), 1.31 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 177.04, 171.54, 167.69, 166.85, 164.16, 140.63, 136.07, 130.68, 128.48, 128.06, 127.91, 123.69, 123.03, 122.12, 119.60, 95.40, 93.93, 65.73, 60.24, 48.34, 41.39, 28.67, 16.47, 14.26 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1754.

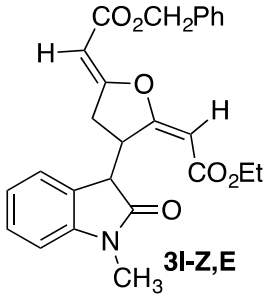
Benzyl-(*E*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3l-E,E)



3l-E,E

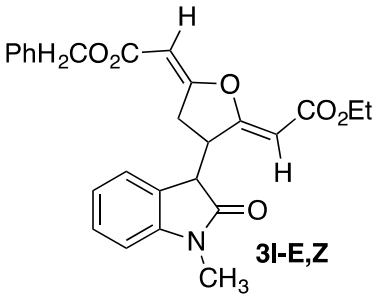
White solid; m.p. 131-132 °C; Yield 30%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.41 (d, *J* = 7.6 Hz, 1H), 7.27 – 7.36 (m, 6H), 7.10 (td, *J* = 7.6, 0.8 Hz, 1H), 6.81 (d, *J* = 7.6 Hz, 1H), 5.83 (d, *J* = 1.2 Hz, 1H), 5.65 (t, *J* = 2.0 Hz, 1H), 5.10 (d, *J* = 12.4 Hz, 1H), 5.03 (d, *J* = 12.4 Hz, 1H),4.30 – 4.38 (m, 1H), 4.26 (d, *J* = 3.6 Hz, 1H), 4.18 (q, *J* = 7.2 Hz, 2H), 3.10 (s, 3H), 2.94 (ddd, *J* = 19.6, 10.4, 2.4 Hz, 1H), 2.68 (dt, *J* = 19.6, 2.0 Hz, 1H), 1.29 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.86, 173.59, 171.36, 167.25, 167.08, 142.10, 136.18, 132.53, 128.89, 128.47, 128.03, 128.00, 126.41, 124.71, 108.02, 95.91, 94.34, 65.63, 60.13, 47.54, 39.89, 30.59, 26.07, 21.03, 14.33 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 448.1760, found 448.1773.

Benzyl-(*Z*)-2-((*E*)-5-(2-ethoxy-2-oxoethylidene)-4-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3l-Z,E)



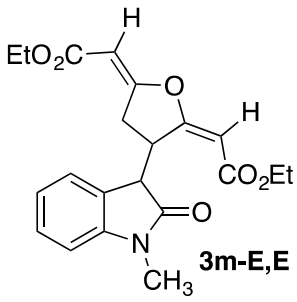
White solid; m.p. 99-100 °C; Yield 30%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.33 – 7.37 (m, 1H), 7.27 (m, 5H), 7.09 (d, *J* = 7.6 Hz, 1H), 6.95 (t, *J* = 7.4 Hz, 1H), 6.75 (d, *J* = 7.6 Hz, 1H), 5.83 (d, *J* = 0.8 Hz, 1H), 5.36 (s, 1H), 5.04 (d, *J* = 12.4 Hz, 1H), 4.95 (d, *J* = 12.4 Hz, 1H), 4.53 (d, *J* = 10.0 Hz, 1H), 4.30 (d, *J* = 3.2 Hz, 1H), 4.18 – 4.28 (m, 2H), 3.19 (s, 3H), 2.98 (ddd, *J* = 19.2, 10.0, 2.6 Hz, 1H), 2.54 (d, *J* = 19.6 Hz, 1H), 1.33 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$) δ = 174.80, 172.91, 170.91, 166.47, 166.23, 144.91, 136.05, 128.96, 128.49, 128.08, 127.93, 124.11, 123.82, 122.60, 108.23, 96.81, 94.21, 65.59, 60.55, 46.81, 40.16, 30.38, 26.35, 14.29 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 448.1760, found 448.1744.

Benzyl-(*E*)-2-((*Z*)-5-(2-ethoxy-2-oxoethylidene)-4-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3l-E,Z)



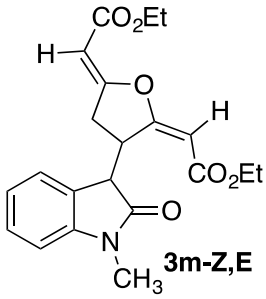
Yield 30%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.27-7.37 (m, 6H), 7.20 (d, *J* = 7.6 Hz, 1H), 7.00 (t, *J* = 7.6 Hz, 1H), 6.82 (d, *J* = 7.6 Hz, 1H), 5.67 (t, *J* = 2.0 Hz, 1H), 5.36 (d, *J* = 1.6 Hz, 1H), 5.07 (d, *J* = 12.8 Hz, 1H), 5.02 (d, *J* = 12.8 Hz, 1H), 4.23 (q, *J* = 7.2 Hz, 2H), 3.91-3.95 (m, 1H), 3.73 (d, *J* = 2.8 Hz, 1H), 3.21 (s, 3H), 3.15-3.20 (m, 1H), 2.37 (ddd, *J* = 19.2, 6.4, 2.0 Hz, 1H), 1.32 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.47, 171.46, 167.84, 166.78, 164.13, 144.71, 136.01, 129.36, 128.48, 128.06, 127.92, 124.46, 123.43, 123.08, 108.55, 95.43, 93.90, 65.72, 60.23, 47.63, 41.44, 28.55, 26.46, 14.26ppm;ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 448.1760, found 448.1775.

Diethyl-2,2'-(3-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*E*,2'*E*)-diacetate (3m-E,E)



White solid; m.p. 130-131 °C; Yield 19%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.42 (d, *J* = 7.2 Hz, 1H), 7.31 (t, *J* = 7.8 Hz, 1H), 7.10 (t, *J* = 7.6 Hz, 1H), 6.82 (d, *J* = 7.6 Hz, 1H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.59 (t, *J* = 2.0 Hz 1H), 4.33 (d, *J* = 9.6 Hz, 1H), 4.27 (d, *J* = 3.2 Hz, 1H), 4.18 (q, *J* = 7.2 Hz, 2H), 4.02 – 4.12 (m, 2H), 3.14 (s, 3H), 2.94 (ddd, *J* = 20.0, 10.4, 2.4 Hz, 1H), 2.68 (m, 1H), 1.29 (t, *J* = 7.2 Hz, 3H), 1.21 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.99, 173.52, 170.78, 167.34, 167.23, 144.49, 128.70, 126.46, 123.91, 122.93, 108.29, 95.87, 94.64, 60.13, 59.75, 47.58, 39.86, 30.47, 26.11, 14.35, 14.26 ppm；ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 386.1604, found 386.1602.

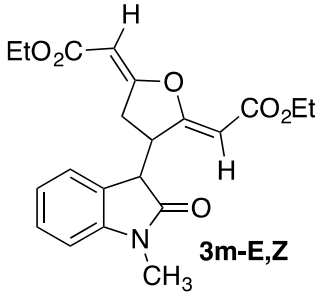
Diethyl-2,2'-(3-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3m-Z,E)



White solid; m.p. 140-141 °C; Yield 19%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.26 (t, *J* = 7.8 Hz, 1H), 7.09 (d, *J* = 7.2 Hz, 1H), 6.95 (td, *J* = 7.6, 0.4 Hz, 1H), 6.79 (d, *J* = 8.0 Hz, 1H), 5.82 (d, *J* = 1.2 Hz, 1H), 5.30 (t, *J* = 1.8 Hz, 1H), 4.56 – 4.51 (m, 1H), 4.32 (d, *J* = 3.6 Hz, 1H), 4.19 – 4.29 (m, 2 H), 3.92 – 4.08 (m, 2H), 3.23 (s, 3H), 2.98 (ddd, *J* = 19.2, 10.0, 2.6 Hz, 1H), 2.48 – 2.57 (dt, *J* = 19.6, 1.8 Hz, 1H), 1.33 (t, *J* = 7.0 Hz, 2H), 1.15 (t, *J* = 7.2 Hz, 2H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.85, 173.00, 170.41, 166.67, 166.26, 144.92, 128.93, 124.10, 123.87, 122.59, 108.20, 96.63, 94.47, 60.51, 59.72, 46.81, 40.10, 30.22, 26.38, 14.28, 14.18 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 386.1604, found 386.1629.

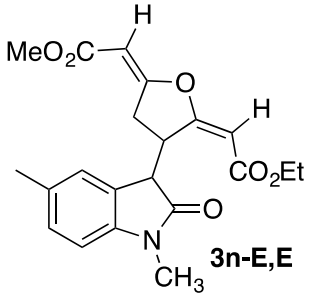
Diethyl-2,2'-(3-(1-methyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3m-E,Z)

White solid; m.p. 142-143 °C; Yield 37%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.30 (t, *J* = 8.0 Hz, 1H), 7.20 (d, *J* = 7.6 Hz, 1H), 7.00 (t, *J* = 7.2 Hz,



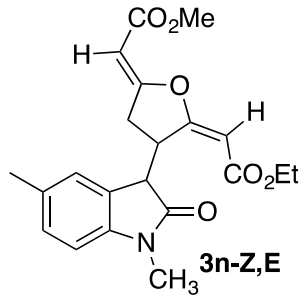
1H), 6.83 (t, *J* = 7.6 Hz, 1H), 5.61 (t, *J* = 2.0 Hz, 1H), 5.35 (d, *J* = 1.6 Hz, 1H), 4.20-4.25 (m, 2H), 4.01-4.08 (m, 2H), 3.90-3.95 (m, 1H), 3.74 (d, *J* = 3.2 Hz, 1H), 3.22 (s, 3H), 3.17 (ddd, *J* = 18.8, 12.0, 2.0 Hz, 1H), 2.35 (ddd, *J* = 18.9, 6.6, 2.2 Hz, 1H), 1.31 (t, *J* = 7.2 Hz, 3H), 1.19 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.56, 170.97, 167.99, 167.03, 164.22, 144.78, 129.38, 124.51, 123.54, 123.11, 108.58, 95.77, 93.76, 60.24, 59.93, 47.66, 41.49, 28.43, 26.51, 14.30, 14.23 ppm; ESI-HRMS: calcd. for C21H23NO6+H 386.1604, found 386.1636.

Ethyl-(*E*)-2-((*E*)-3-(1,5-dimethyl-2-oxoindolin-3-yl)-5-(2-methoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3n-E,E)



White solid; m.p. 159-160 °C; Yield 13%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.24 (s, 1H), 7.03 – 7.17 (m, 1H), 6.71 (d, *J* = 7.6 Hz, 1H), 5.82 (d, *J* = 2.0 Hz, 1H), 5.60 (t, *J* = 2.0 Hz, 1H), 4.26 – 4.39 (m, 1H), 4.23 (d, *J* = 3.2 Hz, 1H), 4.19 (q, *J* = 7.0 Hz, 2H), 3.62 (s, 3H), 3.11 (s, 3H), 2.94 (ddd, *J* = 20.0, 10.4, 2.6 Hz, 1H), 2.67 (dt, *J* = 19.6,2.0 Hz, 1H), 2.35 (s, 3H), 1.29 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.89, 173.68, 171.10, 167.76, 167.26, 142.10, 132.54, 128.89, 126.41, 124.71, 108.02, 95.82, 94.16, 60.13, 51.02, 47.60, 39.82, 30.49, 26.00, 21.04, 14.33ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+Na 386.1604, found 408.1442.

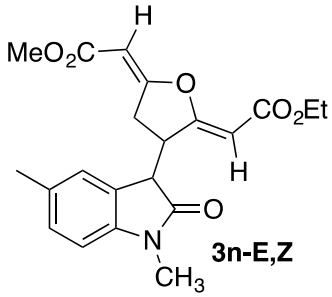
Ethyl-(*E*)-2-((*Z*)-3-(1,5-dimethyl-2-oxoindolin-3-yl)-5-(2-methoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3n-Z,E)



White solid; m.p. 151-152 °C; Yield 13%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.05 (dt, *J* = 7.6,0.8 Hz, 1H), 6.89 (s, 1H), 6.68 (d, *J* = 8.0 Hz, 1H), 5.83 (d, *J* = 1.2 Hz, 1H), 5.33 (t, *J* = 2.0 Hz, 1H), 4.52 (m, 1H), 4.17 – 4.33 (m, 3H), 3.56 (s, 3H), 3.21 (s, 3H), 2.99 (ddd, *J* = 19.2, 10.2, 2.4 Hz, 1H), 2.51 (dt, *J* = 19.2,2.0 Hz, 1H), 2.26 (s, 3H), 1.33 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C

NMR (100 MHz, $CDCl_3$) δ = 174.75, 173.09, 170.90, 167.13, 166.22, 142.55, 132.08, 129.09, 124.85, 123.88, 107.92, 96.72, 93.85, 60.51, 51.02, 46.86, 40.05, 30.30, 26.41, 21.05, 14.29 ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 386.1604, found 386.1631.

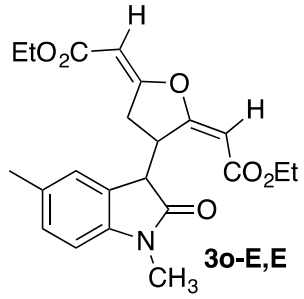
Ethyl-(*Z*)-2-((*E*)-3-(1,5-dimethyl-2-oxoindolin-3-yl)-5-(2-methoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3n-E,Z)



3n-E,Z

White solid; m.p. 124-125 °C; Yield 25%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.10 (d, *J* = 8.0 Hz, 1H), 6.99 (s, 1H), 6.72 (d, *J* = 8.0 Hz, 1H), 5.65 (t, *J* = 2.0 Hz, 1H), 5.34 (d, *J* = 1.6 Hz, 1H), 4.24 (qd, *J* = 7.1, 2.5 Hz, 2H), 3.89-3.95 (m, 1H), 3.71 (d, *J* = 2.8 Hz, 1H), 3.61 (s, 3H), 3.21 (s, 3H), 3.20 (ddd, *J* = 18.6, 10.2, 1.9 Hz, 3H), 2.36 (ddd, *J* = 18.9, 7.0, 2.2 Hz, 1H). 2.27 (s, 3H), 1.32 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.50, 171.29, 168.05, 167.46, 164.23, 142.42, 132.70, 129.63, 125.19, 123.59, 108.35, 95.37, 93.68, 60.23, 51.19, 47.51, 41.49, 28.48, 26.53, 21.15, 14.30ppm; ESI-HRMS: calcd. for $C_{21}H_{23}NO_6$+H 386.1604, found 386.1628.

Diethyl-2,2'-(3-(1,5-dimethyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*E*,2'*E*)-diacetate (3o-E,E)

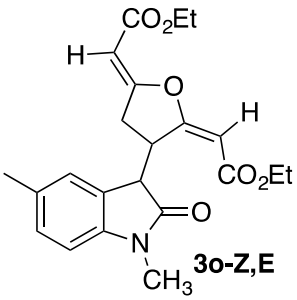


3o-E,E

White solid; m.p. 140-141 °C; Yield 25%; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.23 (s, 1H), 7.09 (d, *J* = 7.6 Hz, 1H), 6.70 (d, *J* = 8.0 Hz, 1H), 5.81 (d, *J* = 1.2 Hz, 1H), 5.58 (s, 1H), 4.31 (d, *J* = 9.6 Hz, 1H), 4.23 (d, *J* = 3.2 Hz, 1H), 4.18 (q, *J* = 7.2 Hz, 2H), 4.01 – 4.12 (m, 2H), 3.11 (s, 3H), 2.93 (ddd, *J* = 19.6, 10.2, 2.4 Hz, 1H), 2.67 (d, *J* = 20.0 Hz, 1H), 2.35 (s, 3H), 1.29 (t, *J* = 7.2 Hz, 3H), 1.21 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.91, 173.69, 170.84, 167.33, 167.29, 142.08, 132.52, 128.87, 126.38, 124.63, 108.00, 95.73, 94.58, 60.11, 59.66, 47.56, 39.87, 30.43,

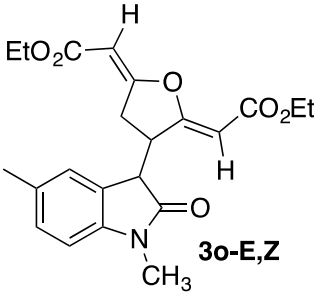
26.11, 21.03, 14.33, 14.25 ppm; ESI-HRMS: calcd. for $C_{22}H_{25}NO_6$+H 400.1760, found 400.1769.

Diethyl-2,2'-(3-(1,5-dimethyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3o-Z,E)



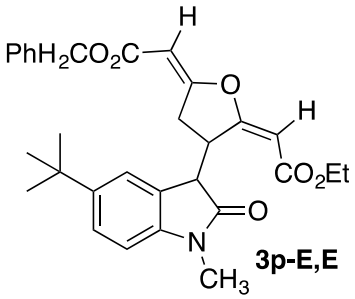
White solid; m.p. 151-152 °C; Yield 25%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.05 (d, *J* = 8.0 Hz, 1H), 6.89 (s, 1H), 6.68 (d, *J* = 8.0 Hz, 1H), 5.83 (d, *J* = 1.6 Hz, 1H), 5.31 (t, *J* = 2.0 Hz, 1H), 4.45 – 4.57 (m, 1H), 4.16 – 4.33 (m, 3H), 3.91 – 4.10 (m, 2H), 3.21 (s, 3H), 2.97 (ddd, *J* = 19.6, 10.2, 2.6 Hz, 1H), 2.51 (dt, *J* = 19.6, 1.8 Hz, 1H), 2.26 (s, 3H), 1.33 (t, *J* = 7.0 Hz, 3H), 1.16 (t, *J* = 7.0 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.81, 173.13, 170.63, 166.69, 166.28, 142.56, 132.10, 129.09, 124.92, 123.91, 107.90, 96.63, 94.37, 60.52, 59.74, 46.88, 40.14, 30.28, 26.41, 21.06, 14.30, 14.21 ppm; ESI-HRMS: calcd. for $C_{22}H_{25}NO_6$+H 400.1760, found 400.1774.

Diethyl-2,2'-(3-(1,5-dimethyl-2-oxoindolin-3-yl)dihydrofuran-2,5-diylidene)(2*Z*,2'*E*)-diacetate (3o-E,Z)



White solid; m.p. 123-124 °C; Yield 26%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.10 (d, *J* = 6.8 Hz, 1H), 7.00 (s, 1H), 6.72 (d, *J* = 7.6 Hz, 1H), 5.64 (t, *J* = 2.0 Hz, 1H), 5.34 (d, *J* = 1.6 Hz, 1H), 4.24 (qd, *J* = 7.1, 2.5 Hz, 2H), 4.03-4.09 (m, 2H), 3.88-3.94 (m, 1H), 3.71 (d, *J* = 3.2 Hz, 1H), 3.21 (s, 3H), 3.20 (ddd, *J* = 18.6, 10.1, 1.9 Hz, 3H), 2.36 (ddd, *J* = 18.8, 7.0, 2.2 Hz, 1H), 2.28 (s, 3H), 1.32 (t, *J* = 7.2 Hz, 3H), 1.20 (t, *J* = 6.8 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.50, 171.02, 168.02, 167.03, 164.24, 142.38, 132.66, 129.58, 125.20, 124.80, 123.57, 108.29, 95.76, 93.55, 60.19, 59.92, 47.44, 41.52, 28.40, 26.49, 21.13, 14.27, 14.20 ppm; ESI-HRMS: calcd. for $C_{22}H_{25}NO_6$+H 400.1760, found 400.1768.

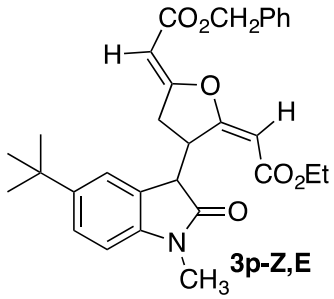
Benzyl-(*E*)-2-((*E*)-4-(5-(*tert*-butyl)-1-methyl-2-oxoindolin-3-yl)-5-(2-ethoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3p-E,E)



3p-E,E

White solid; m.p. 109-110 °C; Yield 17%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.40 (s, 1H), 7.27 – 7.35 (m, 6H), 6.73 (d, *J* = 8.0 Hz, 1H), 5.83 (d, *J* = 1.6 Hz, 1H), 5.65 (t, *J* = 2.0 Hz, 1H), 5.10 (d, *J* = 12.4 Hz, 1H), 5.04 (d, *J* = 12.8 Hz, 1H), 4.30 – 4.38 (m, 1H),4.25 (d, *J* = 3.6 Hz, 1H), 4.19 (q, *J* = 7.2 Hz, 2H), 3.08 (s, 3H), 2.94 (ddd, *J* = 20.0, 10.4, 2.4 Hz, 1H), 2.69 (dt, *J* = 19.6, 2.0 Hz, 1H), 1.34 (s, 9H), 1.30 (t, *J* = 7.2 Hz, 3H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 175.04, 173.39, 171.39, 167.20, 167.17, 146.23, 142.07, 136.15, 128.48, 128.05, 128.00, 126.03, 125.36, 120.95, 107.77, 96.11, 94.29, 65.67, 60.14, 47.60, 39.93, 34.61, 31.61, 30.64, 26.08, 14.34 ppm; ESI-HRMS: calcd. for $C_{30}H_{33}NO_6$+H 504.2386, found 504.2382.

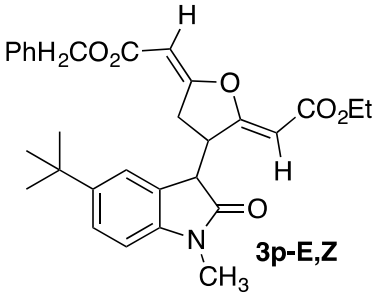
Benzyl-(*Z*)-2-((*E*)-4-(5-(*tert*-butyl)-1-methyl-2-oxoindolin-3-yl)-5-(2-ethoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3p-Z,E)



3p-Z,E

Yield 36%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.28 – 7.38 (m, 5H), 7.24 (d, *J* = 1.6 Hz, 1H), 7.11 (s, 1H), 6.65 (d, *J* = 8.0 Hz, 1H), 5.85 (s, 1H), 5.31 (s, 1H), 4.99 (s, 2H), 4.53 (d, *J* = 9.2 Hz, 1H), 4.22 – 4.33 (m, 2H), 4.20 (d, *J* = 3.2 Hz, 1H), 3.17 (s, 3H), 2.90 (ddd, *J* = 19.2, 9.8, 2.4 Hz, 1H), 2.54 (d, *J* = 19.2 Hz, 1H), 1.24 (s,12H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 173.91, 172.22, 169.96, 165.32, 165.23, 144.59, 141.40, 135.13, 127.45, 127.03, 126.86, 124.27, 122.41, 120.49, 106.57, 95.72, 93.18, 64.46, 59.58, 46.25, 39.36, 33.35, 30.35, 29.36, 28.68, 25.35, 13.30 ppm; ESI-HRMS: calcd. for $C_{30}H_{33}NO_6$+H 504.2386, found 504.2384.

Benzyl-(*E*)-2-((*Z*)-4-(5-(*tert*-butyl)-1-methyl-2-oxoindolin-3-yl)-5-(2-ethoxy-2-oxoethylidene)dihydrofuran-2(3*H*)-ylidene)acetate (3p-E,Z)

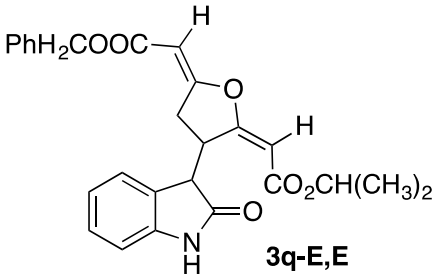


3p-E,Z

Yield 36%; ^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.23-7.34 (m, 7H), 6.71 (d, J = 8.0 Hz, 1H),

5.58 (t, J = 2.0 Hz, 1H), 5.38 (d, J = 1.2 Hz, 1H), 5.03 (s, 2H), 4.24 (qd, *J* = 7.1, 1.6 Hz, 1H), 3.88-3.93 (m, 1H), 3.68 (d, J = 3.2 Hz, 1H), 3.18 (s, 3H), 3.07 (ddd, *J* = 19.0, 10.1, 2.2 Hz, 1H), 2.43 (ddd, *J* = 19.0, 4.9, 1.9 Hz, 1H), 1.32 (t, J = 7.2 Hz, 3H), 1.24 (s, 9H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 174.57, 171.66, 167.92, 166.67, 164.14, 146.23, 142.23, 136.12, 128.47, 128.05, 127.88, 125.75, 123.07, 121.68, 107.92, 95.11, 94.30, 65.61, 60.21, 48.67, 41.60, 34.43, 31.32, 28.86, 26.44, 14.30 ppm; ESI-HRMS: calcd. for $C_{30}H_{33}NO_6$+H 504.2386, found 504.2388.

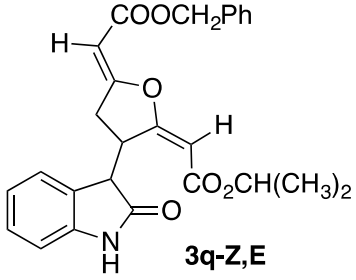
benzyl (*E*)-2-((*E*)-5-(2-isopropoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3q-E,E)



3q-E,E

^{1}H NMR (400 MHz, $CDCl_3$) δ = 7.51 (s, 1H), 7.41 (d, *J* = 7.6 Hz, 1H), 7.23 – 7.36 (m, 6H), 7.08 (td, *J* = 7.6, 1.2 Hz, 1H), 6.84 (d, *J* =8.0 Hz, 1H), 5.79 (d, *J* = 1.2 Hz, 1H), 5.65 (t, *J* = 1.9 Hz, 1H), 4.99 – 5.14 (m, 3H), 4.31 – 4.36 (m, 1H), 4.30 (d, *J* = 3.2 Hz, 1H), 2.98 (qd, *J* =19.8, 10.2 Hz, 2.6 Hz, 1H), 2.82 (dt, *J* = 19.6, 1.8 Hz, 1H), 1.26 (d, *J* = 6.0 Hz, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.53, 172.96, 171.31, 167.14, 166.64, 141.29, 136.11, 128.69, 128.49, 128.06, 128.02, 127.08, 124.39, 122.96, 109.74, 96.56, 94.32, 76.68, 67.47, 65.71, 47.88, 39.81, 30.71, 22.01, 21.99 ppm. ESI-HRMS: calcd. for C26H25NO6+H 448.1760, found 448.1751.

benzyl (*Z*)-2-((*E*)-5-(2-isopropoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3q-Z,E)

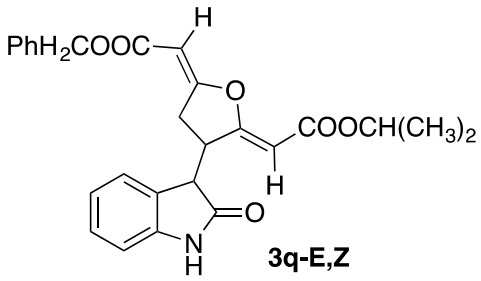


3q-Z,E

^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.47 (s, 1H), 7.18 – 7.38 (m, 6H), 7.10 (d, *J* = 7.2 Hz, 1H), 6.94 (t, *J* = 8.0 Hz, 1H), 6.85 (d, *J* = 7.6 Hz, 1H), 5.83 (s, 1H), 5.38 (s, 1H), 5.16 (m, 1H), 4.96 –5.10 (q, *J* =12.4 Hz, 2H), 4.54 (d, *J* = 10.0 Hz, 1H), 4.35 (s, 1H), 3.05 (dd, *J* = 19.6, 10.0 Hz, 1H), 2.74 (d, *J* = 19.6 Hz, 1H), 1.33 (d, *J* = 6.2 Hz, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ: 195.94, 176.91, 172.56, 170.88, 166.46, 165.79, 141.99,

136.08, 128.95, 128.47, 128.06, 127.94, 124.49, 124.40, 122.57, 109.96, 97.27, 94.20, 68.00, 65.58, 47.32, 40.15, 30.41, 21.96, 21.96 ppm. ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1758.

benzyl (*E*)-2-((*Z*)-5-(2-isopropoxy-2-oxoethylidene)-4-(2-oxoindolin-3-yl)dihydrofuran-2(3*H*)-ylidene)acetate (3q-E,Z)

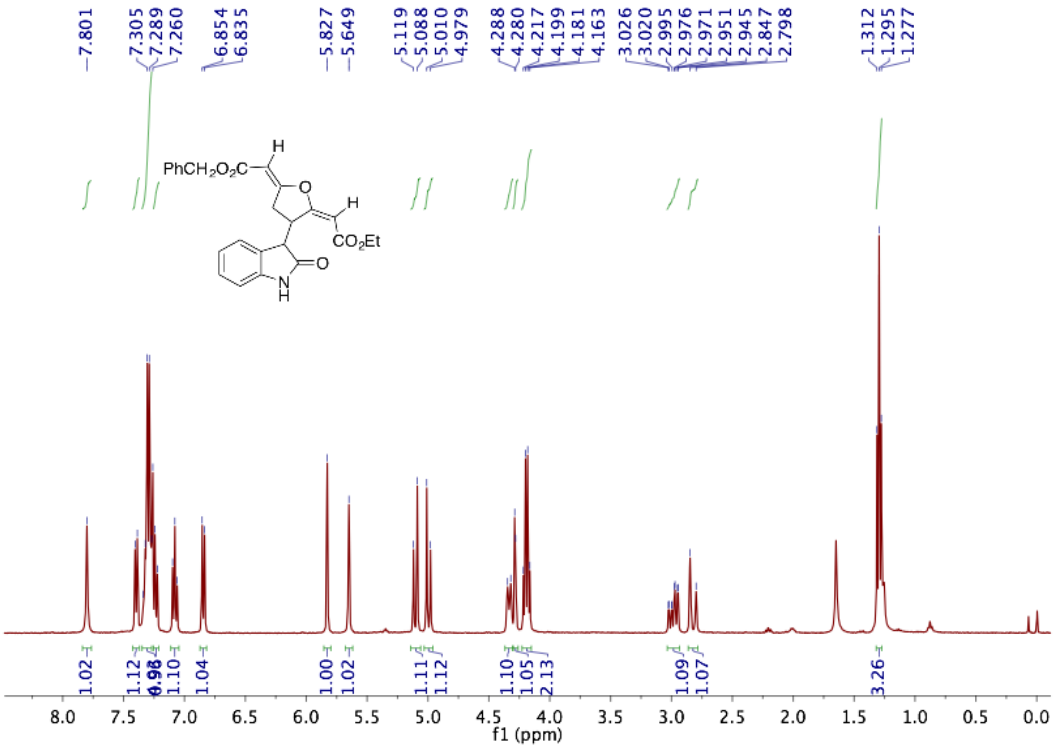


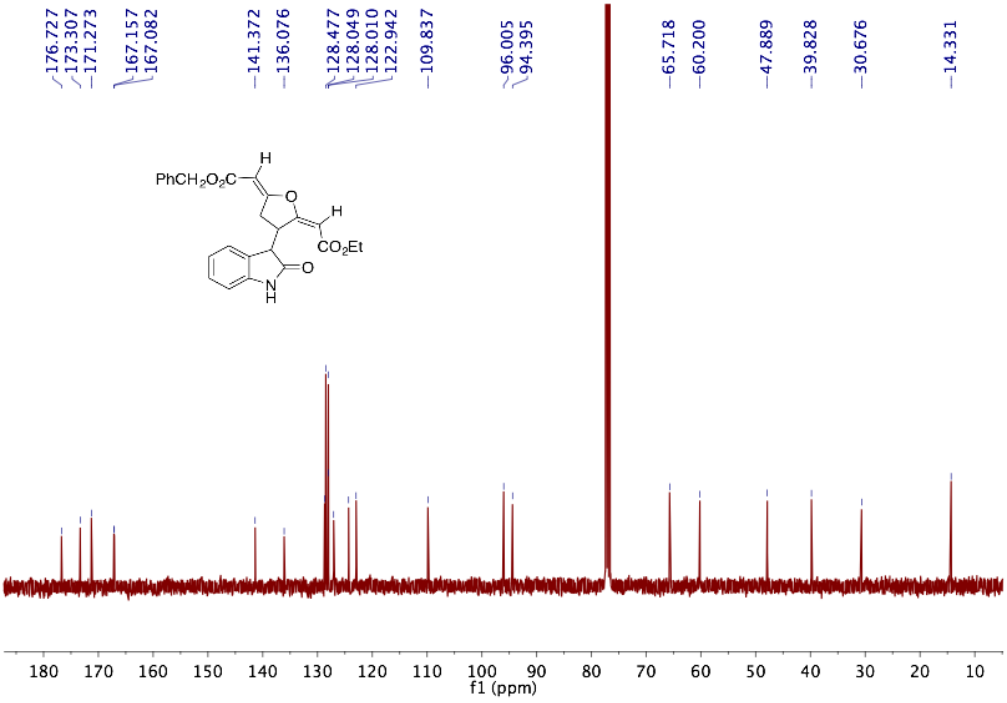
3q-E,Z

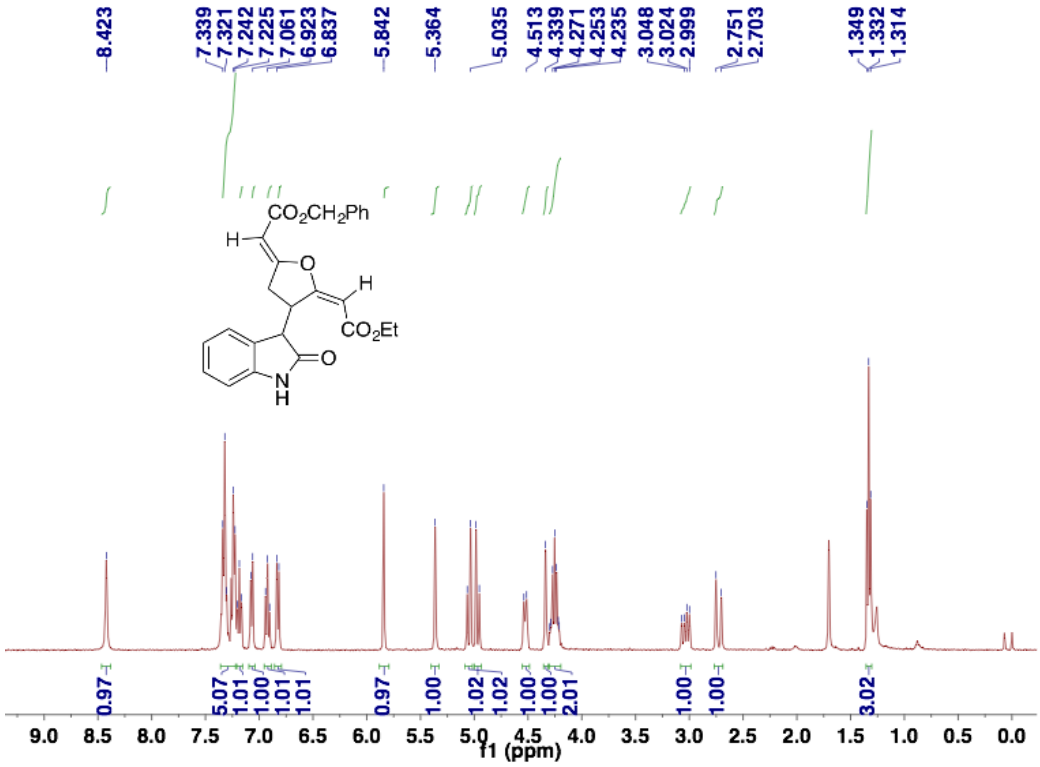
^{1}H NMR (400 MHz, $CDCl_3$) δ = 8.44 (s, 1H), 7.17-7.36 (m, 7H), 6.98 (t, *J* = 7.6 Hz, 1H), 6.86 (d, *J* = 7.6 Hz, 1H), 5.66 (t, *J* = 2.0 Hz, 1H), 5.35 (d, *J* = 1.6 Hz, 1H), 5.16-5.17 (m, 1H), 5.00-5.10 (m, 2H), 3.87-3.92 (m, 1H), 3.76 (d, *J* = 3.2 Hz, 1H), 3.23 (ddd, *J* = 18.9, 10.1, 2.1 Hz, 1H), 2.50 (ddd, *J* = 18.9, 6.3, 2.2 Hz, 1H), 1.30 (dd, *J* = 6.0, 3.6 Hz, 6H) ppm; ^{13}C NMR (100 MHz, $CDCl_3$) δ = 176.50, 171.46, 167.45, 166.77, 163.68, 141.80, 136.05, 129.34, 128.54, 128.47, 128.06, 127.97, 127.92, 124.81, 124.05, 123.05, 110.20, 95.36, 94.47, 67.63, 65.71, 48.11, 41.43, 28.65, 21.93 ppm; ESI-HRMS: calcd. for $C_{26}H_{25}NO_6$+H 448.1760, found 448.1755.

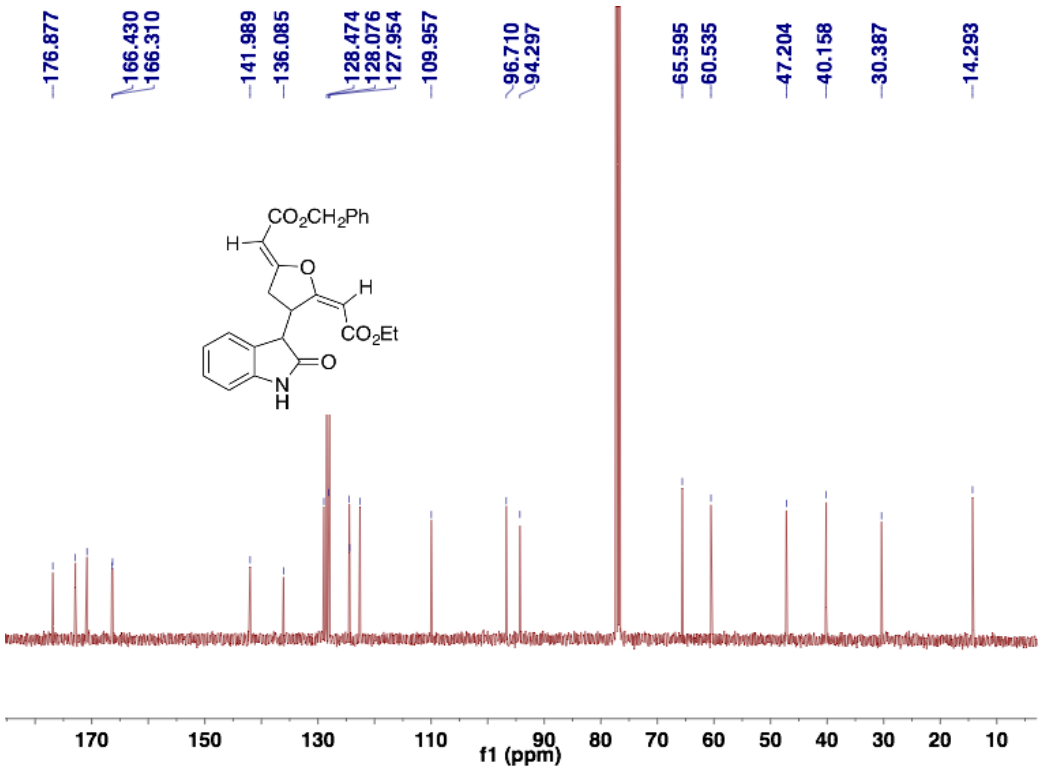
J. Kun, Z.-J. Jia, X. Yin, L. Wu, Y.-C. Chen, *Org. Lett.* **2010**, *12*, 2766-2769.

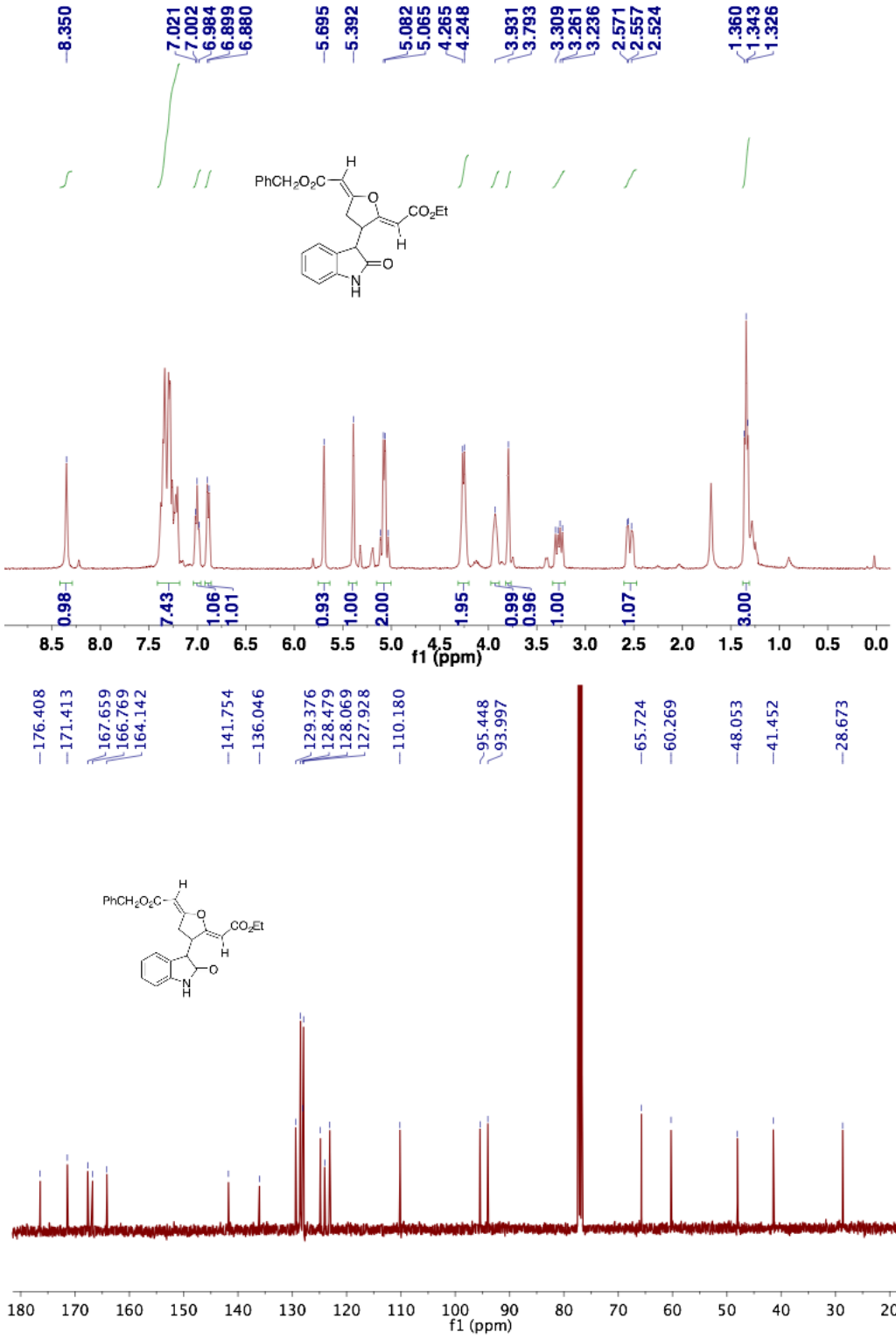
5. Representative spectra of 3.

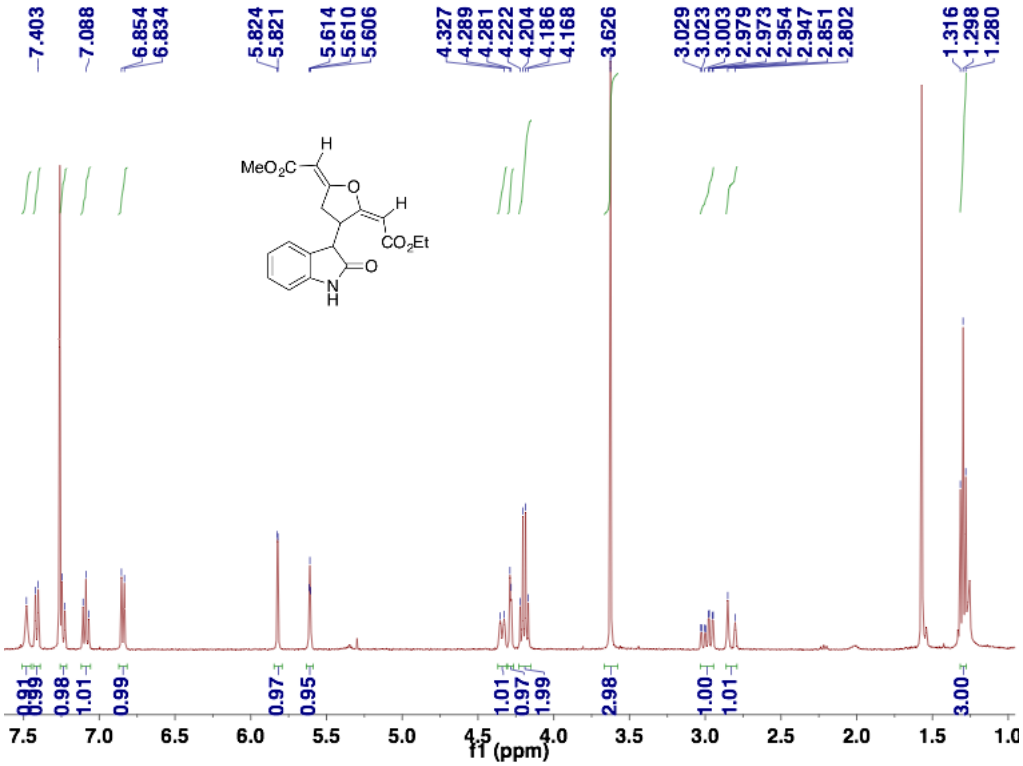

7.801
7.305
7.289
7.260
6.854
6.835
5.827
5.649
5.119
5.088
5.010
4.979
4.288
4.280
4.217
4.199
4.181
4.163
3.026
3.020
2.995
2.976
2.971
2.951
2.945
2.847
2.798
1.312
1.295
1.277
PhCH2O2C
H
O
H
CO2Et
O
N
H
1.02
1.12
1.10
1.04
1.00
1.02
1.11
1.12
1.10
1.05
2.13
1.09
1.07
3.26
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

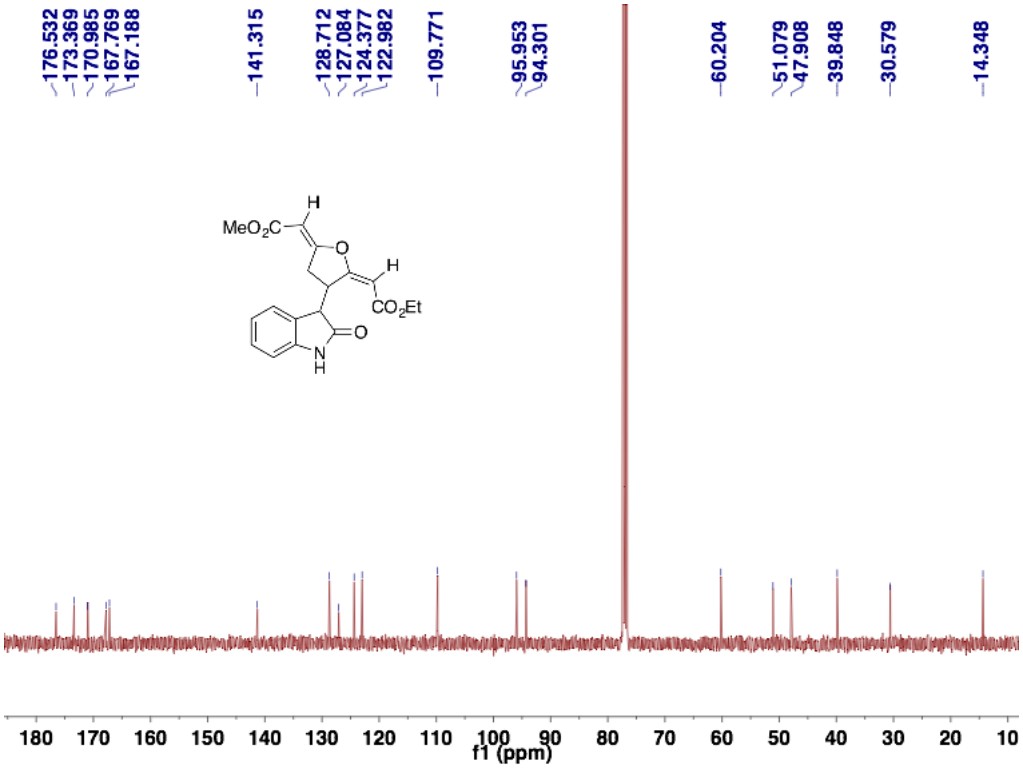

176.727
173.307
171.273
167.157
167.082
141.372
136.076
128.477
128.049
128.010
122.942
109.837
96.005
94.395
65.718
60.200
47.889
39.828
30.676
14.331
PhCH2O2C
H
O
H
CO2Et
O
N
H
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

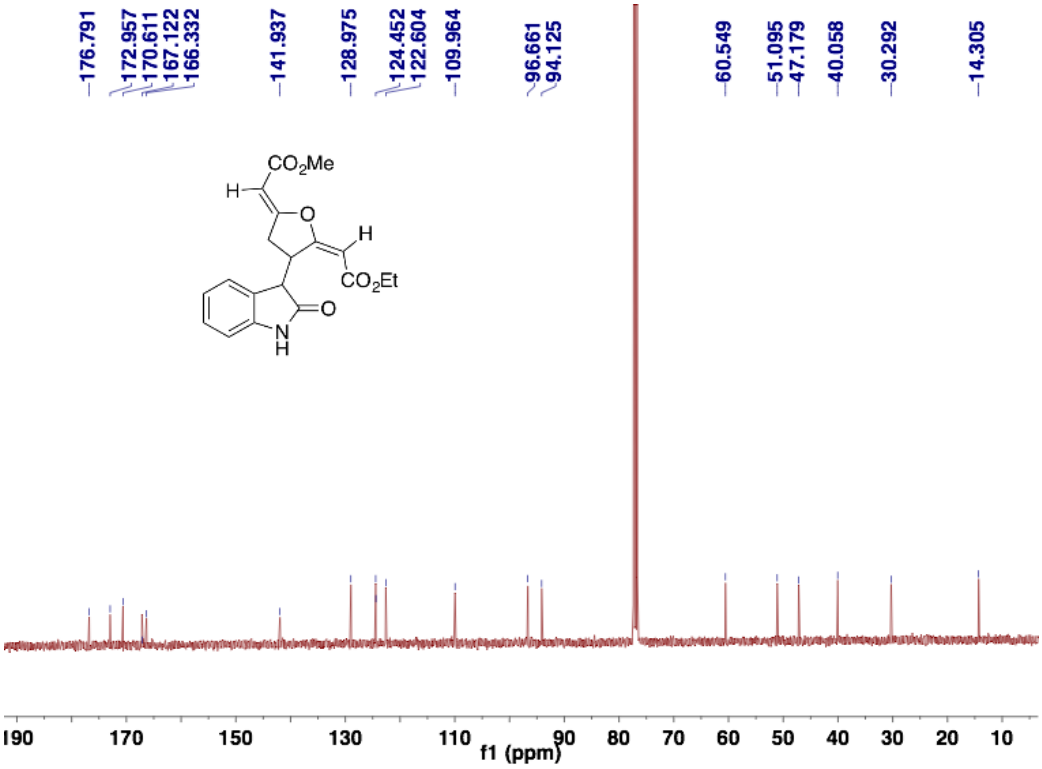

8.423
7.339
7.321
7.242
7.225
7.061
6.923
6.837
5.842
5.364
5.035
4.513
4.339
4.271
4.253
4.235
3.048
3.024
2.999
2.751
2.703
1.349
1.332
1.314
CO2CH2Ph
H
O
H
CO2Et
O
N
H
0.97
5.07
1.01
1.00
1.01
1.01
0.97
1.00
1.02
1.02
1.00
1.00
2.01
1.00
1.00
3.02
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

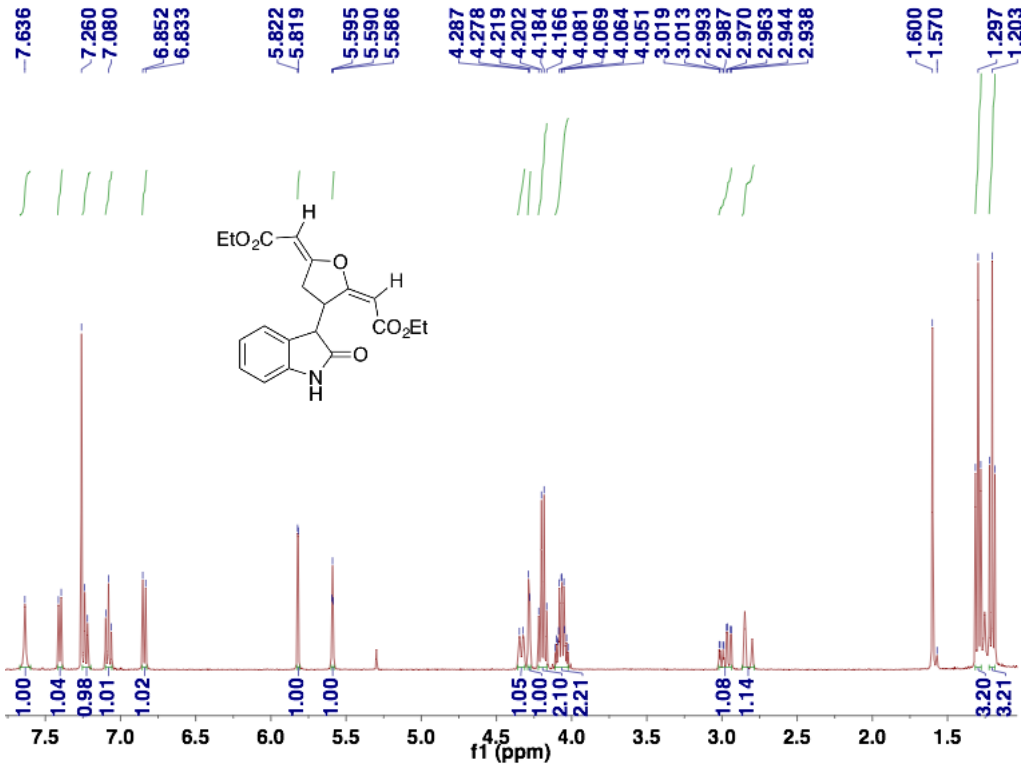

176.877
166.430
166.310
141.989
136.085
128.474
128.076
127.954
109.957
96.710
94.297
65.595
60.535
47.204
40.158
30.387
14.293
CO2CH2Ph
H
O
H
CO2Et
O
N
H
170 150 130 110 90 80 70 60 50 40 30 20 10
f1 (ppm)

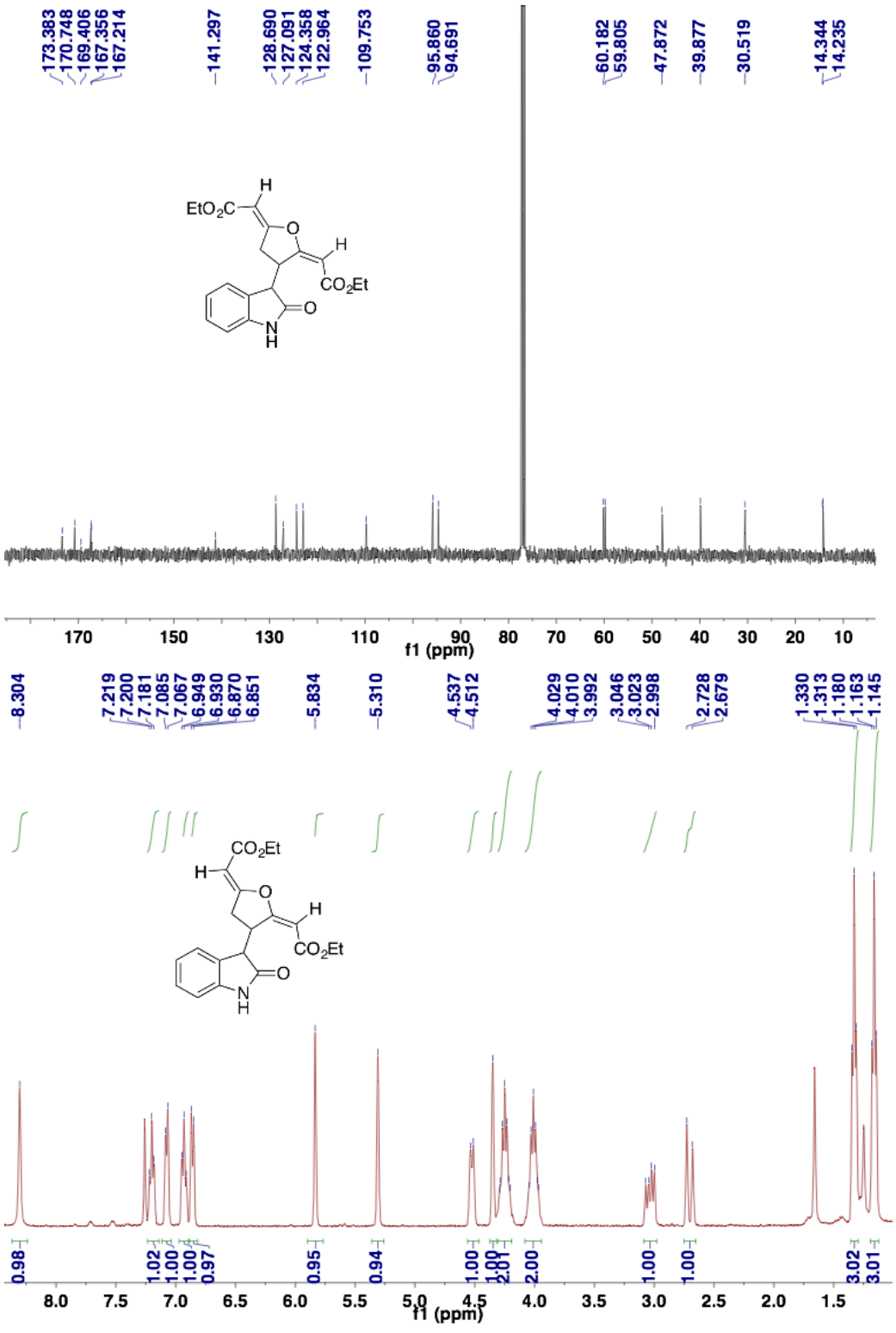

8.350
7.021
7.002
6.984
6.899
6.880
5.695
5.392
5.082
5.065
4.265
4.248
3.931
3.793
3.309
3.261
3.236
2.571
2.557
2.524
1.360
1.343
1.326
PhCH2O2C
CO2Et
0.98
7.43
1.06
1.01
0.93
1.00
2.00
1.95
0.99
0.96
1.00
1.07
3.00
f1 (ppm)
176.408
171.413
167.659
166.769
164.142
141.754
136.046
129.376
128.479
128.069
127.928
110.180
95.448
93.997
65.724
60.269
48.053
41.452
28.673
14.257
f1 (ppm)

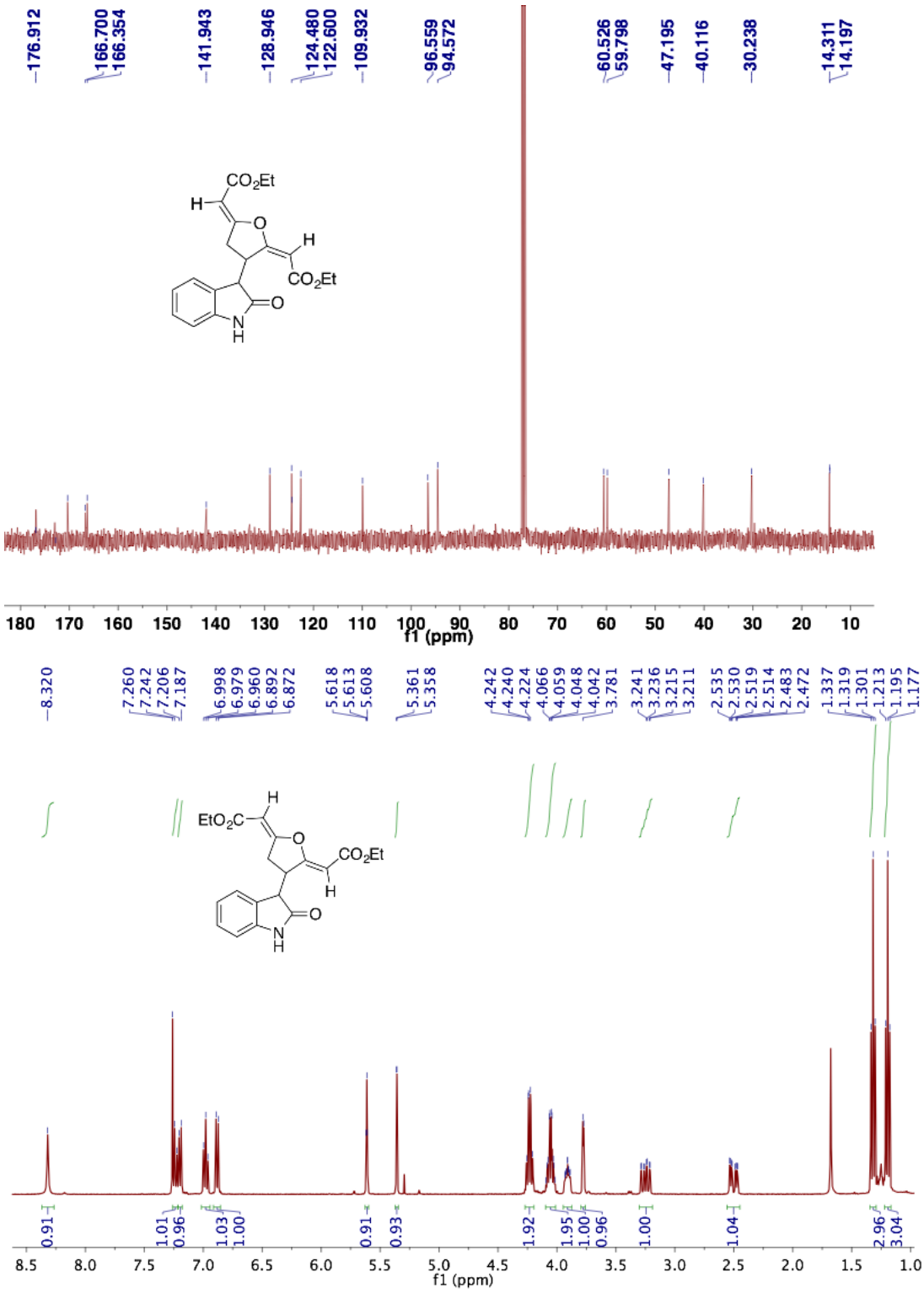

7.403
7.088
6.854
6.834
5.824
5.821
5.614
5.610
5.606
4.327
4.289
4.281
4.222
4.204
4.186
4.168
3.626
3.029
3.023
3.003
2.979
2.973
2.954
2.947
2.851
2.802
1.316
1.298
1.280
MeO2C
CO2Et
f1 (ppm)

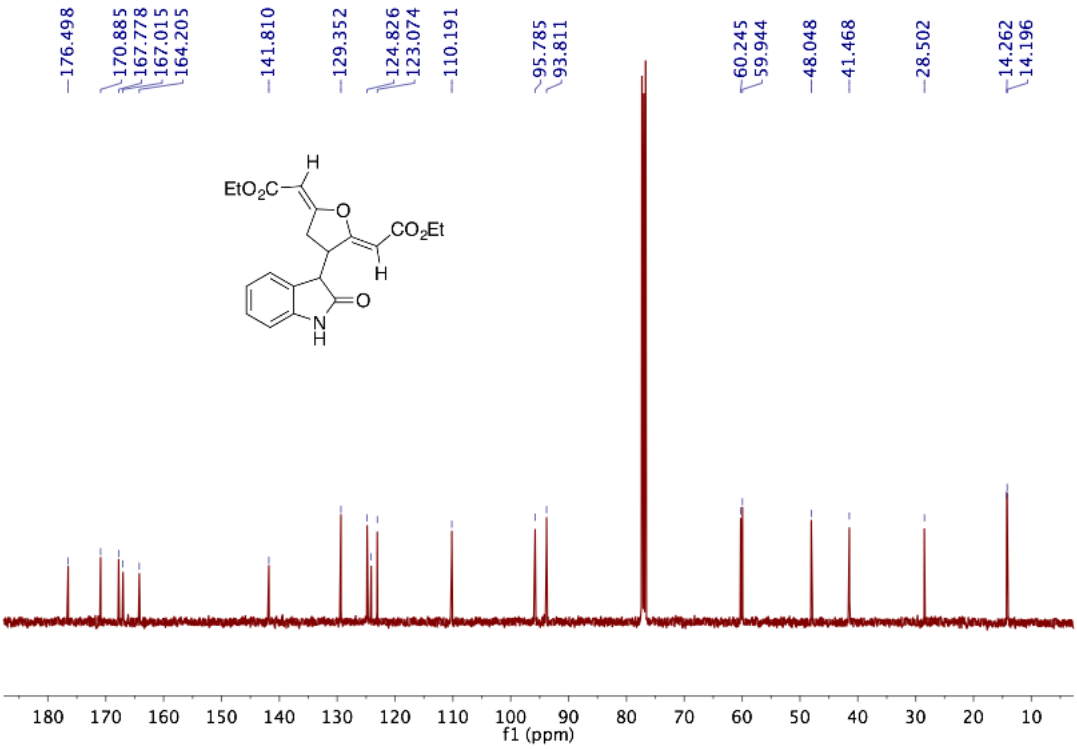

176.532
173.369
170.985
167.769
167.188
141.315
128.712
127.084
124.377
122.982
109.771
95.953
94.301
60.204
51.079
47.908
39.848
30.579
14.348
MeO2C
CO2Et
f1 (ppm)

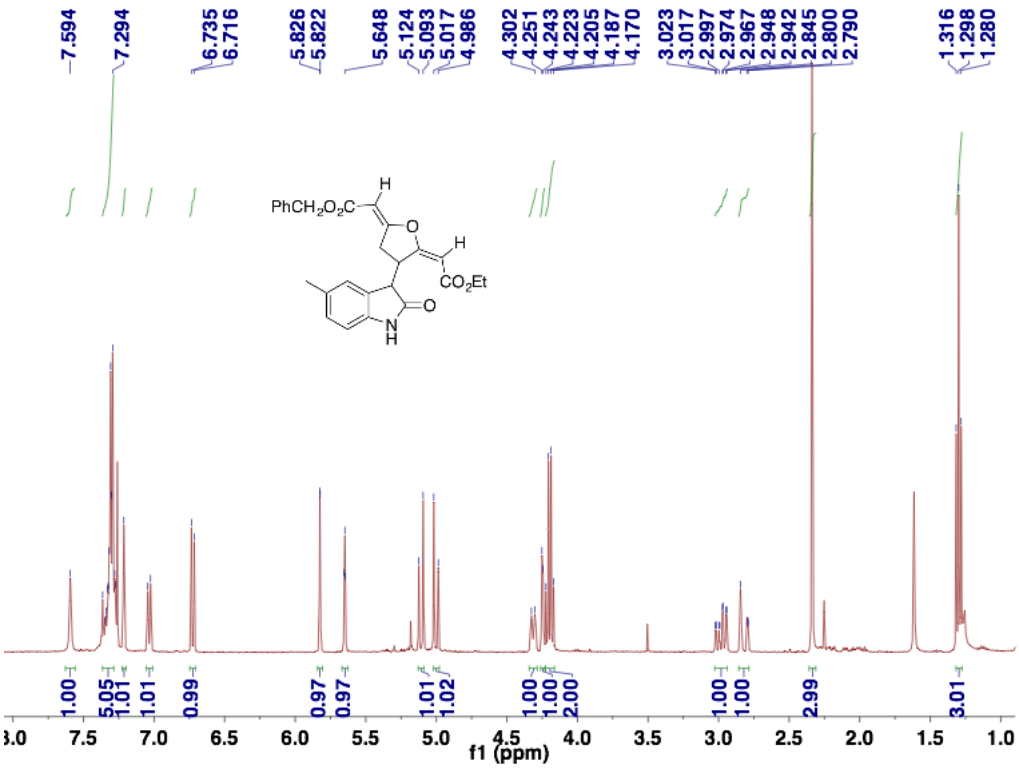

176.791
172.957
170.611
167.122
166.332
141.937
128.975
124.452
122.604
109.964
96.661
94.125
60.549
51.095
47.179
40.058
30.292
14.305
CO2Me
H
O
H
CO2Et
O
N
H
f1 (ppm)

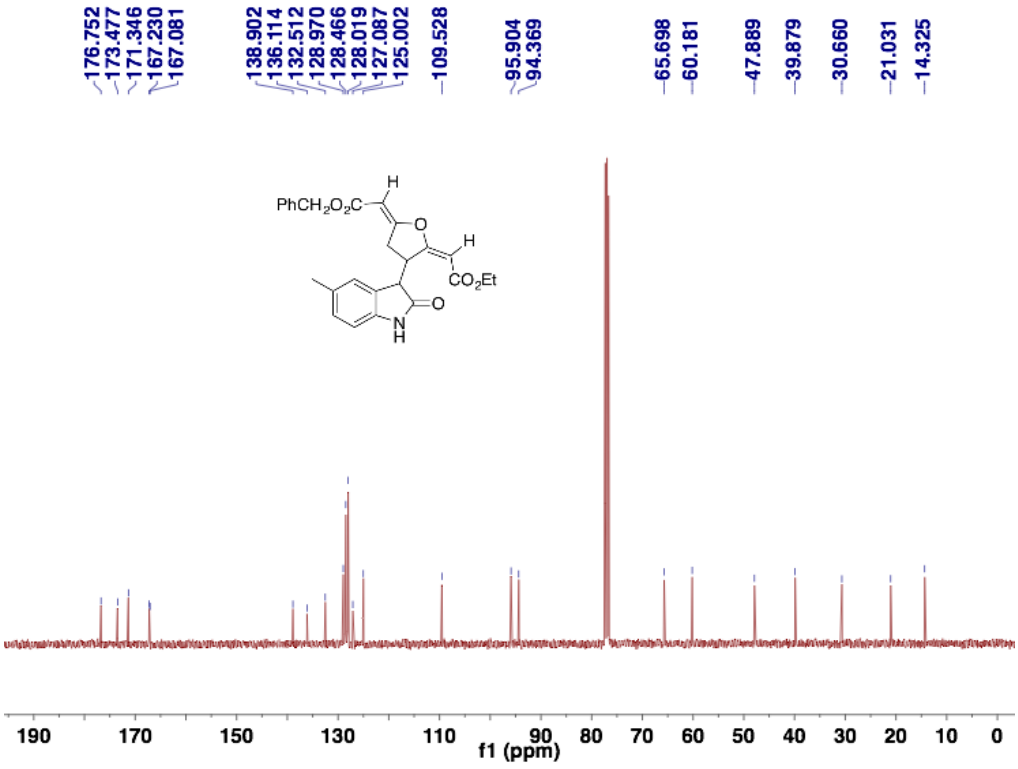

7.636
7.260
7.080
6.852
6.833
5.822
5.819
5.595
5.590
5.586
4.287
4.278
4.219
4.202
4.184
4.166
4.081
4.069
4.064
4.051
3.019
3.013
2.993
2.987
2.970
2.963
2.944
2.938
1.600
1.570
1.297
1.203
EtO2C
H
O
H
CO2Et
O
N
H
1.00
1.04
0.98
1.01
1.02
1.00
1.00
1.05
1.00
2.10
2.21
1.08
1.14
3.20
3.21
f1 (ppm)

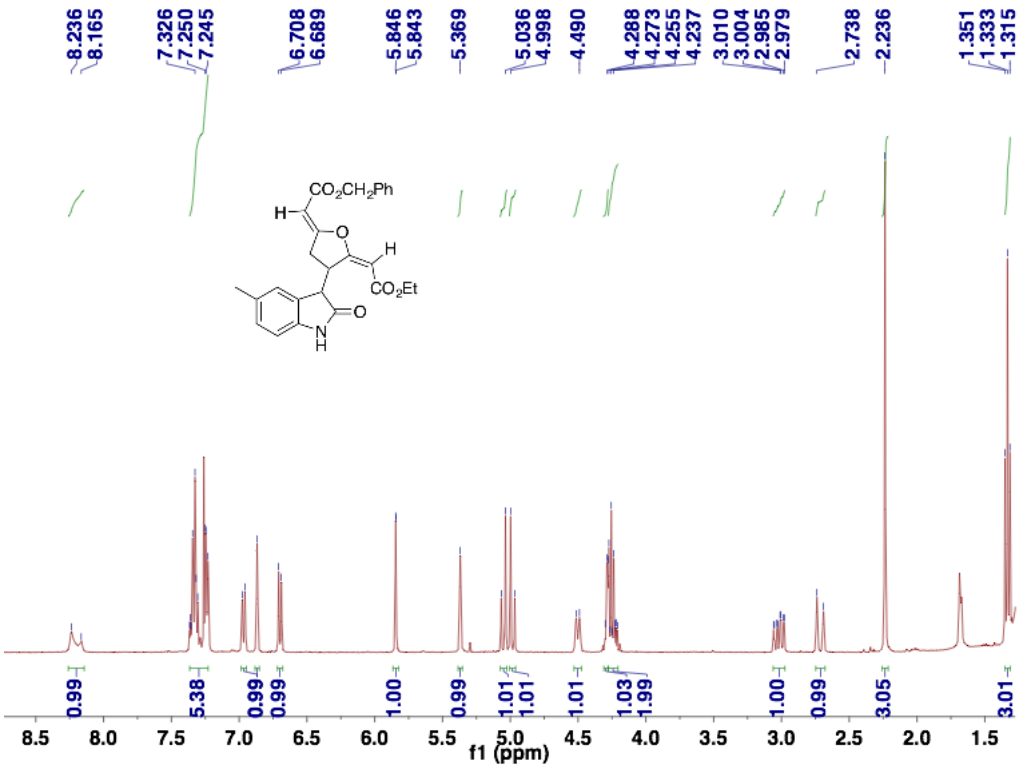

173.383
170.748
169.406
167.356
167.214
141.297
128.690
127.091
124.358
122.964
109.753
95.860
94.691
60.182
59.805
47.872
39.877
30.519
14.344
14.235
EtO2C
CO2Et
f1 (ppm)
8.304
7.219
7.200
7.181
7.085
7.067
6.949
6.930
6.870
6.851
5.834
5.310
4.537
4.512
4.029
4.010
3.992
3.046
3.023
2.998
2.728
2.679
1.330
1.313
1.180
1.163
1.145
0.98
1.02
1.00
1.00
0.97
0.95
0.94
1.00
1.01
2.01
2.00
1.00
1.00
3.02
3.01
f1 (ppm)


176.912
166.700
166.354
141.943
128.946
124.480
122.600
109.932
96.559
94.572
60.526
59.798
47.195
40.116
30.238
14.311
14.197
CO2Et
H
O
H
CO2Et
O
N
H
f1 (ppm)
8.320
7.260
7.242
7.206
7.187
6.998
6.979
6.960
6.892
6.872
5.618
5.613
5.608
5.361
5.358
4.242
4.240
4.224
4.066
4.059
4.048
4.042
3.781
3.241
3.236
3.215
3.211
2.535
2.530
2.519
2.514
2.483
2.472
1.337
1.319
1.301
1.213
1.195
1.177
EtO2C
H
O
CO2Et
H
O
N
H
0.91
1.01
0.96
1.03
1.00
0.91
0.93
1.92
1.95
1.00
0.96
1.00
1.04
2.96
3.04
f1 (ppm)


176.498
170.885
167.778
167.015
164.205
141.810
129.352
124.826
123.074
110.191
95.785
93.811
60.245
59.944
48.048
41.468
28.502
14.262
14.196
EtO2C
CO2Et
f1 (ppm)


7.594
7.294
6.735
6.716
5.826
5.822
5.648
5.124
5.093
5.017
4.986
4.302
4.251
4.243
4.223
4.205
4.187
4.170
3.023
3.017
2.997
2.974
2.967
2.948
2.942
2.845
2.800
2.790
1.316
1.298
1.280
PhCH2O2C
CO2Et
1.00
5.05
1.01
1.01
0.99
0.97
0.97
1.01
1.02
1.00
1.00
2.00
1.00
1.00
2.99
3.01
f1 (ppm)


176.752
173.477
171.346
167.230
167.081
138.902
136.114
132.512
128.970
128.466
128.019
127.087
125.002
109.528
95.904
94.369
65.698
60.181
47.889
39.879
30.660
21.031
14.325
PhCH2O2C
H
O
H
CO2Et
O
N
H
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.236
8.165
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7.250
7.245
6.708
6.689
5.846
5.843
5.369
5.036
4.998
4.490
4.288
4.273
4.255
4.237
3.010
3.004
2.985
2.979
2.738
2.236
1.351
1.333
1.315
CO2CH2Ph
H
O
H
CO2Et
O
N
H
0.99
5.38
0.99
0.99
1.00
0.99
1.01
1.01
1.01
1.03
1.99
1.00
0.99
3.05
3.01
8.5
8.0
7.5
7.0
6.5
6.0
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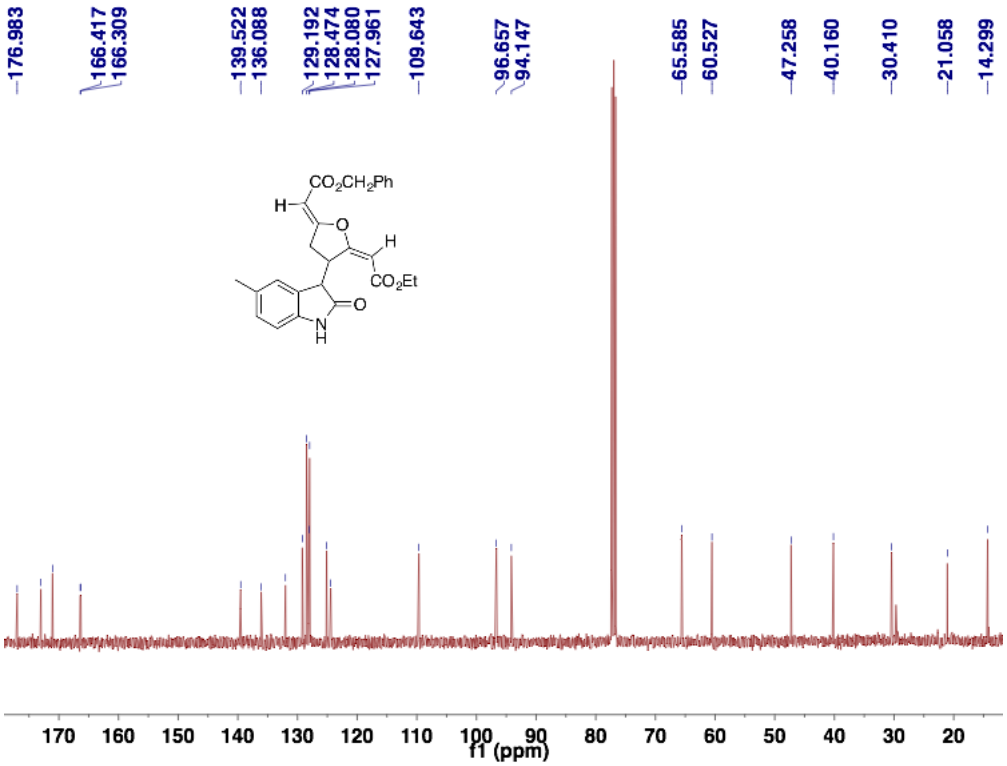
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f1 (ppm)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94.147
65.585
60.527
47.258
40.160
30.410
21.058
14.299
CO2CH2Ph
H
O
H
CO2Et
O
N
H
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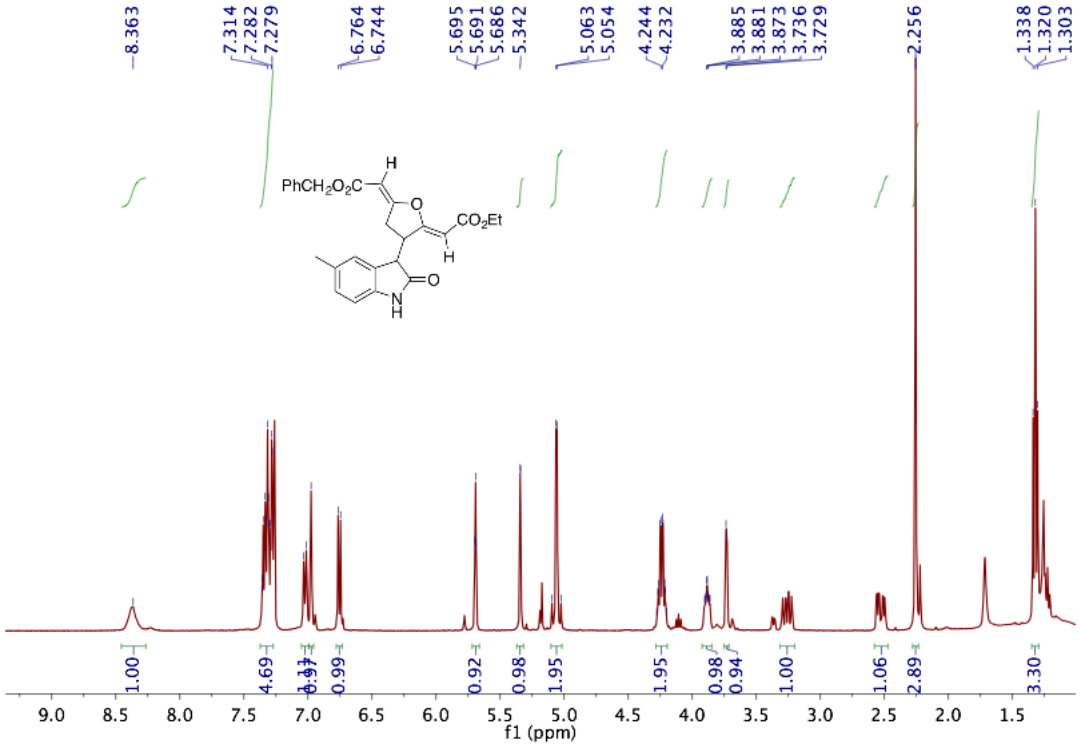
f1 (ppm)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7.282
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5.691
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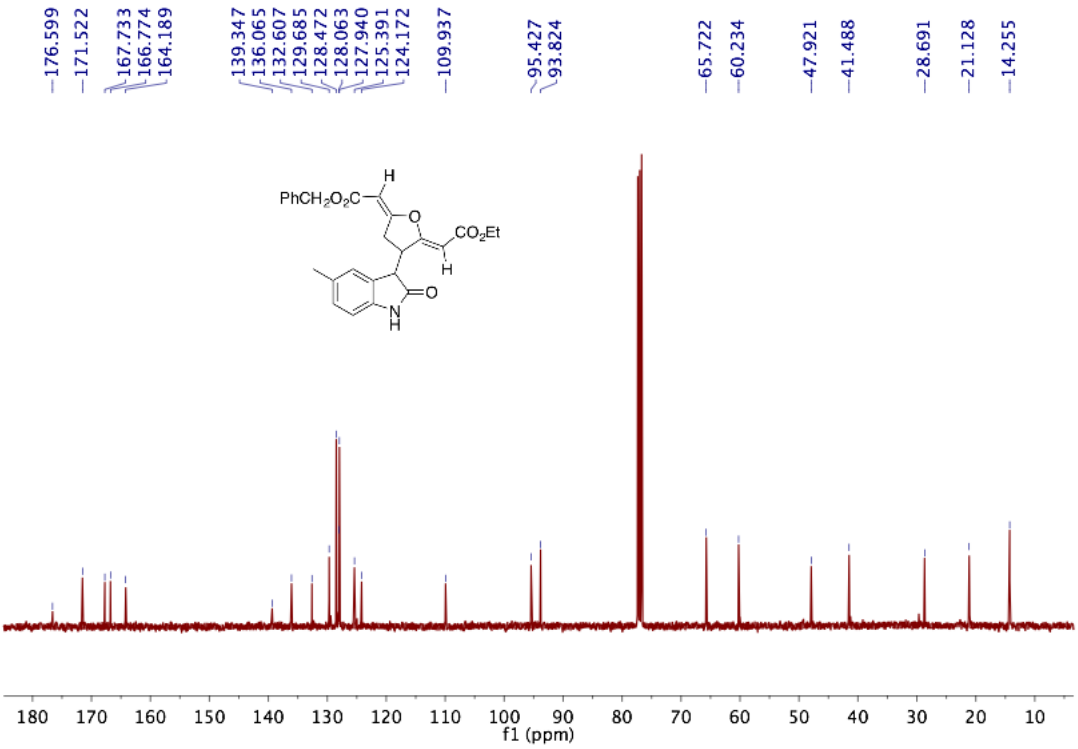
5.063
5.054
4.244
4.232
3.885
3.881
3.873
3.736
3.729
2.256
1.338
1.320
1.303
PhCH2O2C
H
O
CO2Et
H
O
N
H
1.00
4.69
0.99
0.92
0.98
1.95
1.95
0.98
0.94
1.00
1.06
2.89
3.30
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
f1 (ppm)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128.063
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125.391
124.172
109.937
95.427
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28.691
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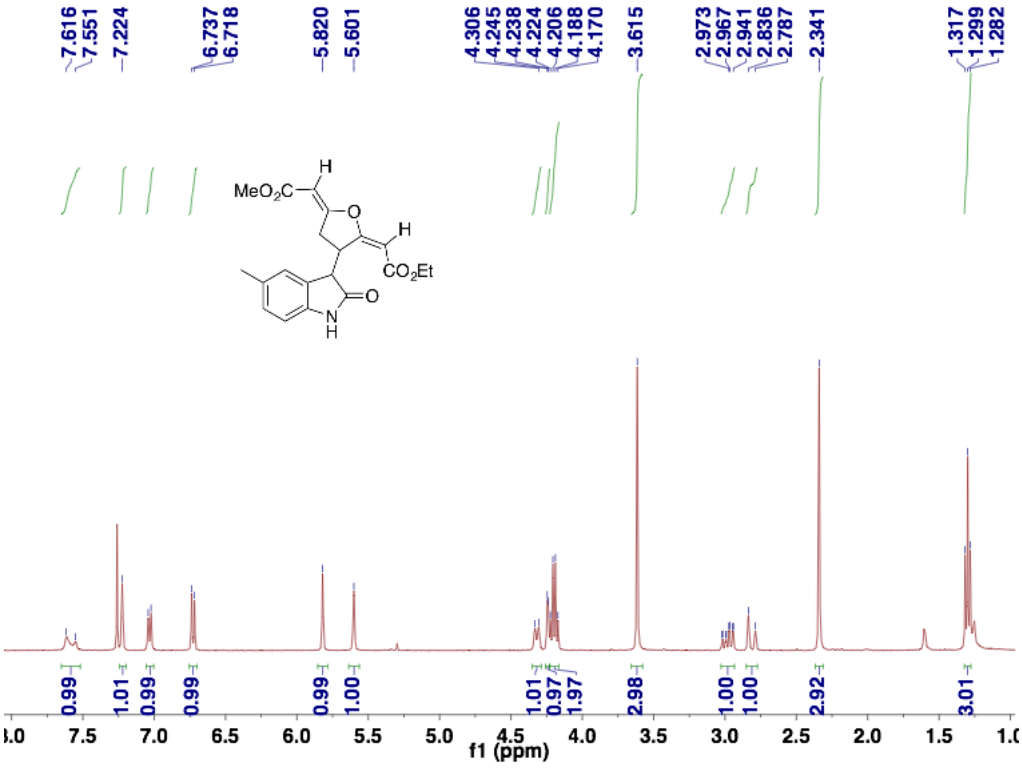
14.255
PhCH2O2C
CO2Et
f1 (ppm)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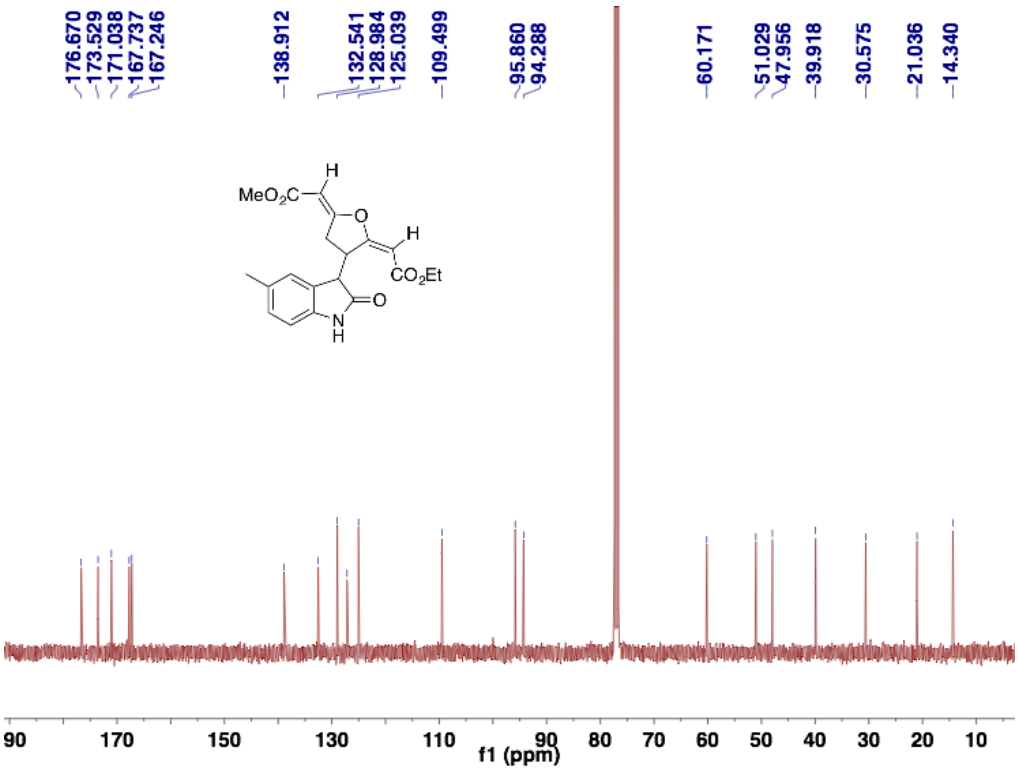
6.718
5.820
5.601
4.306
4.245
4.238
4.224
4.206
4.188
4.170
3.615
2.973
2.967
2.941
2.836
2.787
2.341
1.317
1.299
1.282
MeO2C
CO2Et
0.99
1.01
0.99
0.99
0.99
1.00
1.01
0.97
1.97
2.98
1.00
1.00
2.92
3.01
f1 (ppm)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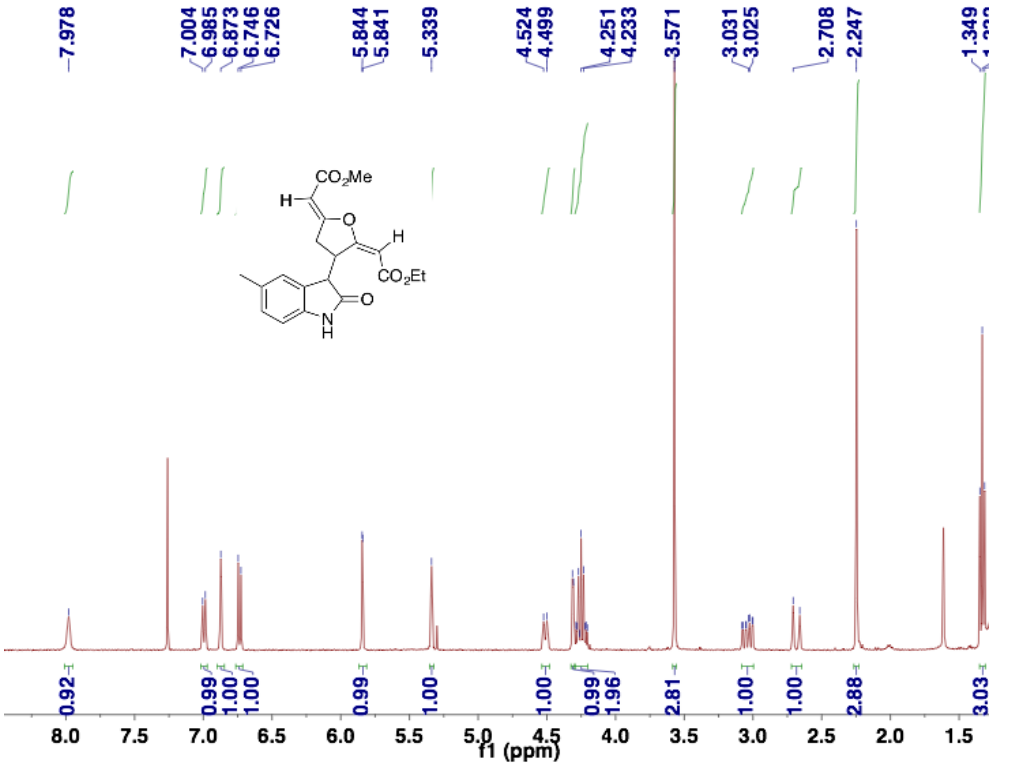
95.860
94.288
60.171
51.029
47.956
39.918
30.575
21.036
14.340
MeO2C
H
O
H
CO2Et
O
N
H
90
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)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4.251
4.233
3.571
3.031
3.025
2.708
2.247
1.349
CO2Me
H
O
H
CO2Et
O
N
H
0.92
0.99
1.00
1.00
0.99
1.00
1.00
0.99
1.96
2.81
1.00
1.00
2.88
3.03
8.0
7.5
7.0
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5.0
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2.5
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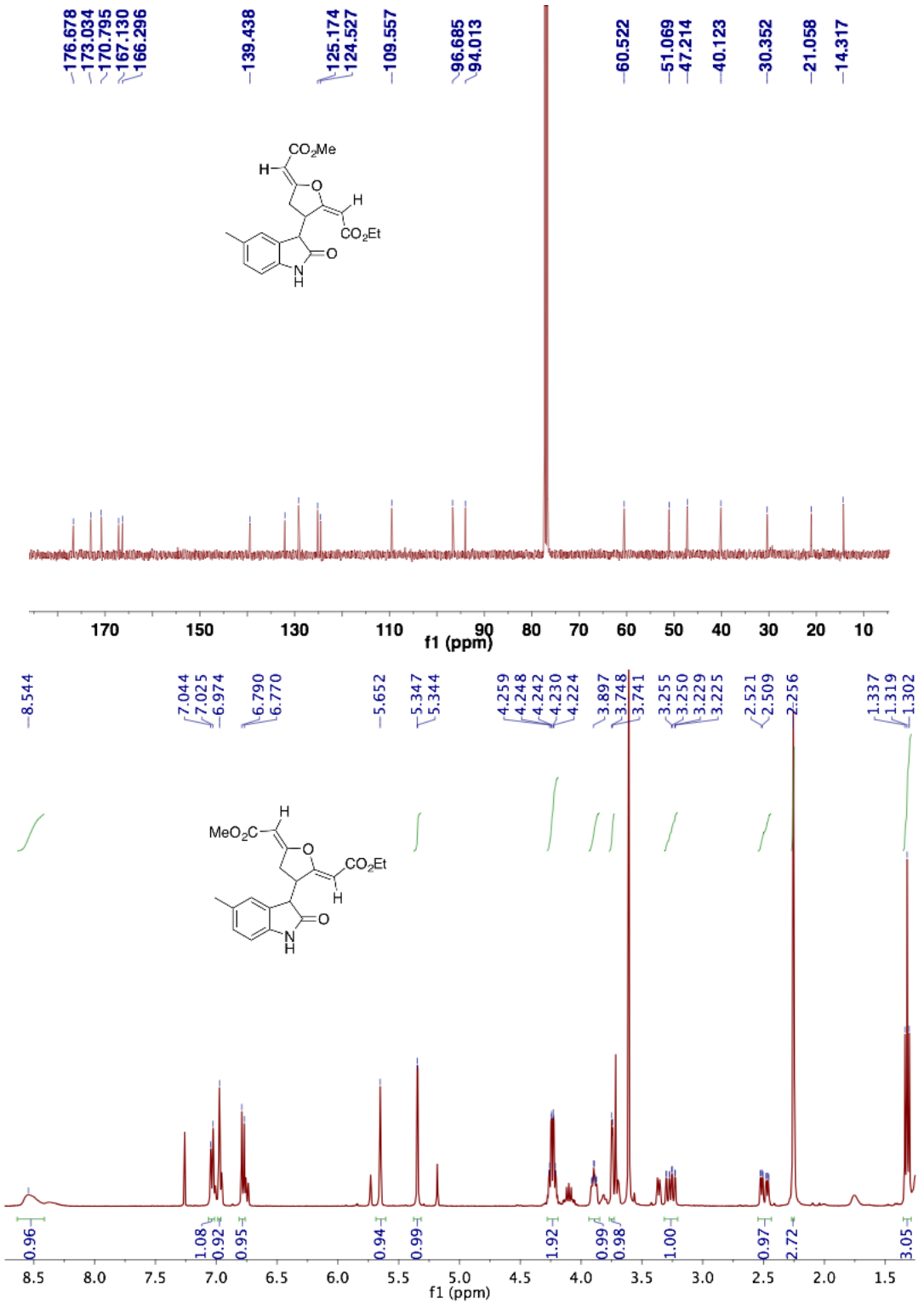
1.5
f1 (ppm)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139.438
125.174
124.527
109.557
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94.013
60.522
51.069
47.214
40.123
30.352
21.058
14.317
CO2Me
H
O
H
CO2Et
O
N
H
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)
8.544
7.044
7.025
6.974
6.790
6.770
5.652
5.347
5.344
4.259
4.248
4.242
4.230
4.224
3.897
3.748
3.741
3.255
3.250
3.229
3.225
2.521
2.509
2.256
1.337
1.319
1.302
MeO2C
H
O
CO2Et
H
O
N
H
0.96
1.08
0.92
0.95
0.94
0.99
1.92
0.99
0.98
1.00
0.97
2.72
3.05
8.5
8.0
7.5
7.0
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5.0
4.5
4.0
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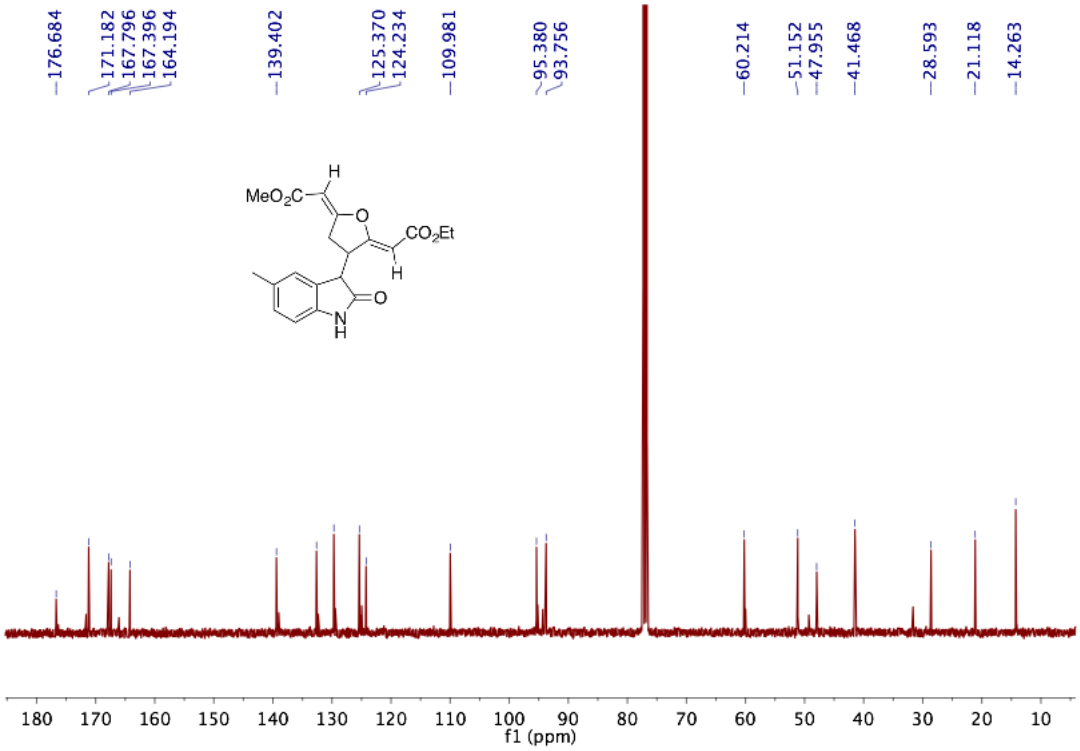
3.0
2.5
2.0
1.5
f1 (ppm)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47.955
41.468
28.593
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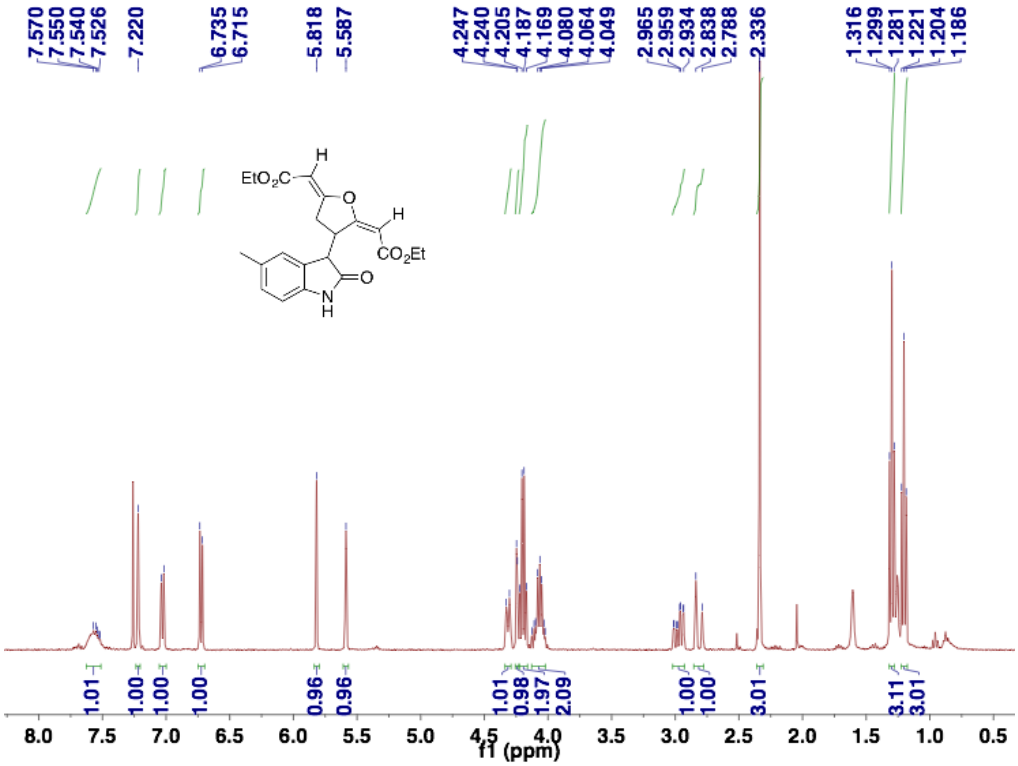
14.263
MeO2C
CO2Et
f1 (ppm)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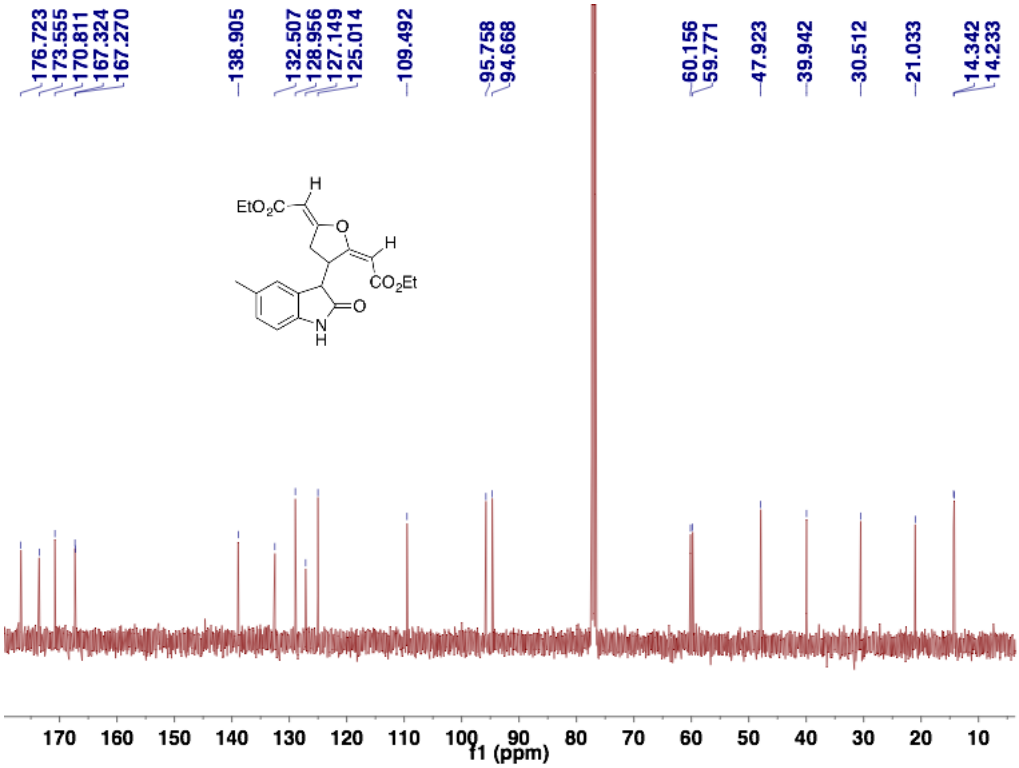
7.550
7.540
7.526
7.220
6.735
6.715
5.818
5.587
4.247
4.240
4.205
4.187
4.169
4.080
4.064
4.049
2.965
2.959
2.934
2.838
2.788
2.336
1.316
1.299
1.281
1.221
1.204
1.186
EtO2C
CO2Et
1.01
1.00
1.00
1.00
0.96
0.96
1.01
0.98
1.97
2.09
1.00
1.00
3.01
3.11
3.01
f1 (ppm)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94.668
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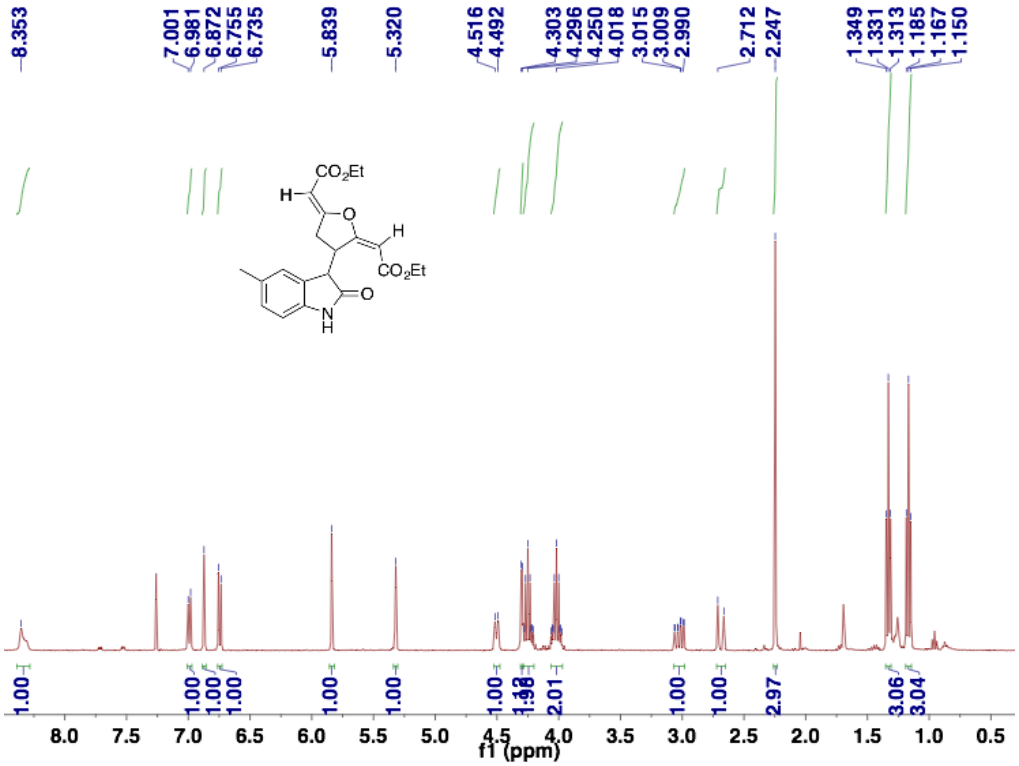
39.942
30.512
21.033
14.342
14.233
EtO2C
CO2Et
f1 (ppm)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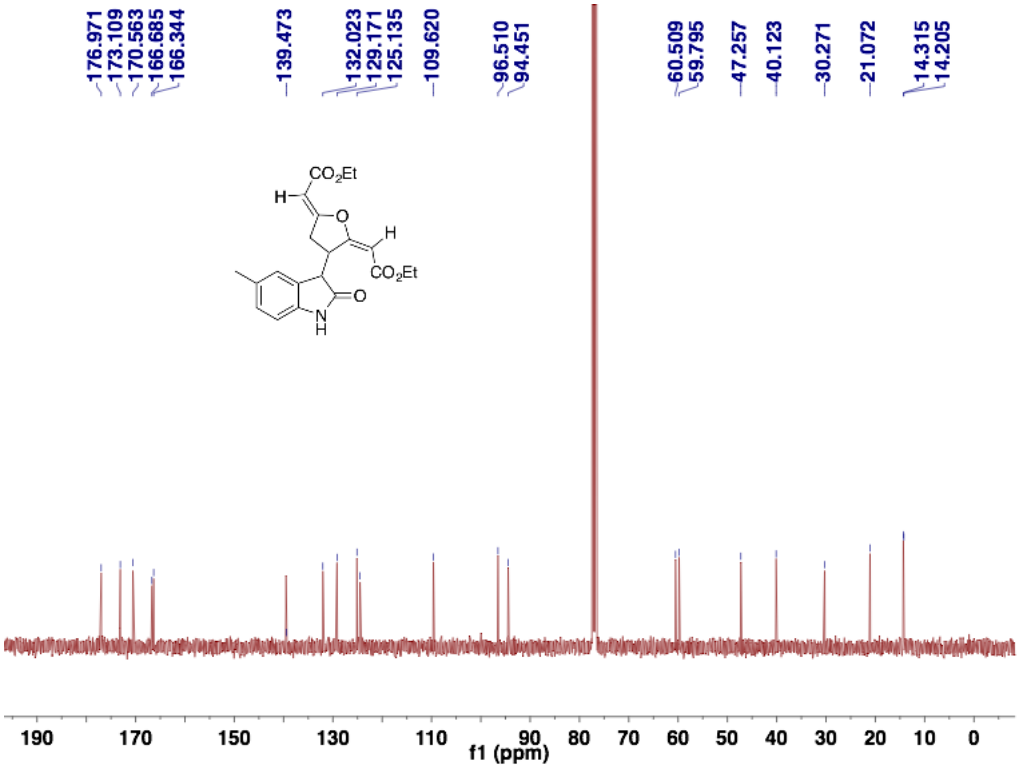
5.320
4.516
4.492
4.303
4.296
4.250
4.018
3.015
3.009
2.990
2.712
2.247
1.349
1.331
1.313
1.185
1.167
1.150
CO2Et
CO2Et
f1 (ppm)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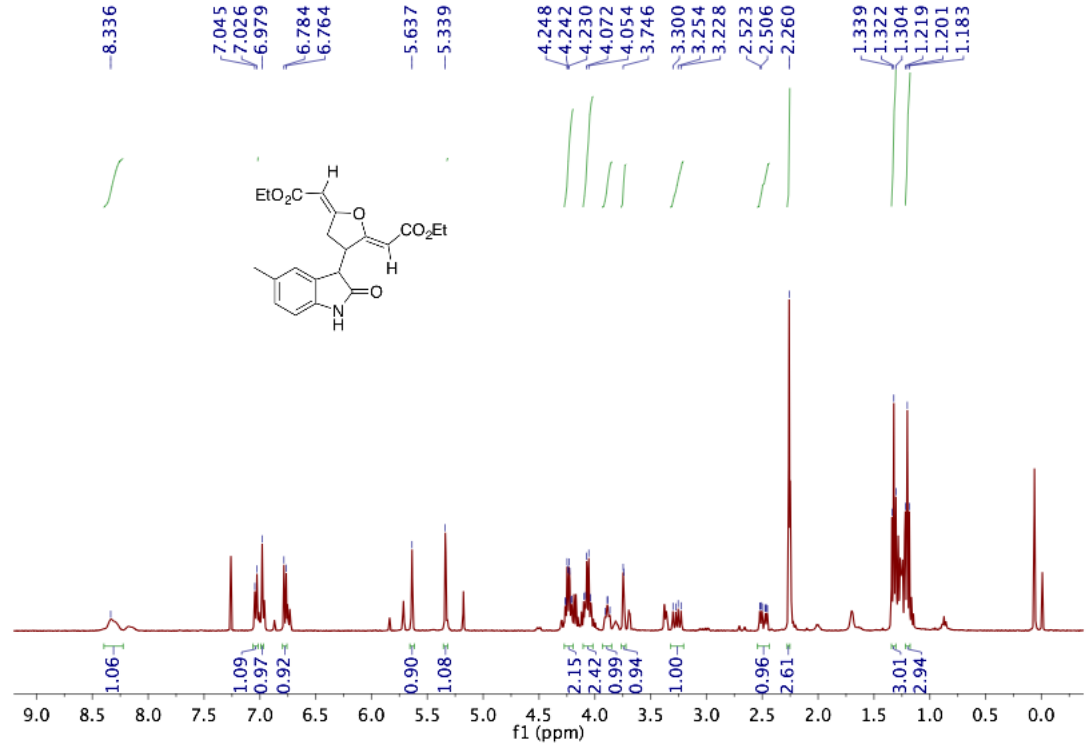
129.171
125.135
109.620
96.510
94.451
60.509
59.795
47.257
40.123
30.271
21.072
14.315
14.205
CO2Et
H
O
H
CO2Et
O
N
H
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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6.784
6.764
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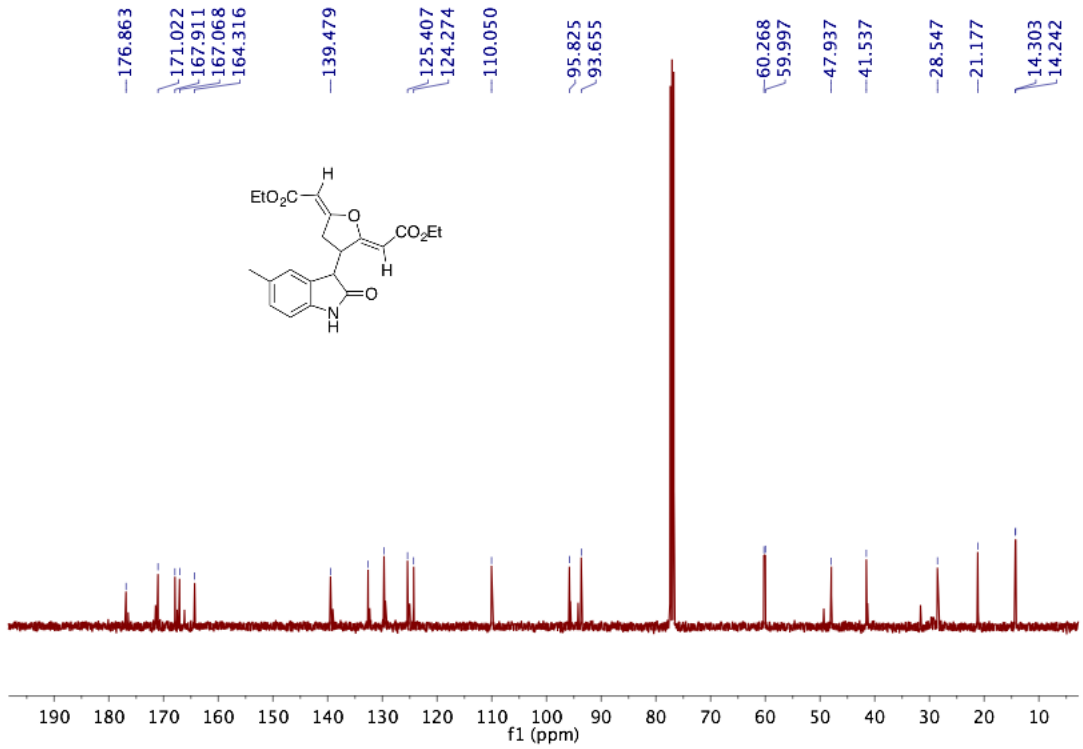
5.339
4.248
4.242
4.230
4.072
4.054
3.746
3.300
3.254
3.228
2.523
2.506
2.260
1.339
1.322
1.304
1.219
1.201
1.183
EtO2C
H
O
CO2Et
H
O
N
H
1.06
1.09
0.97
0.92
0.90
1.08
2.15
2.42
0.99
0.94
1.00
0.96
2.61
3.01
2.94
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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41.537
28.547
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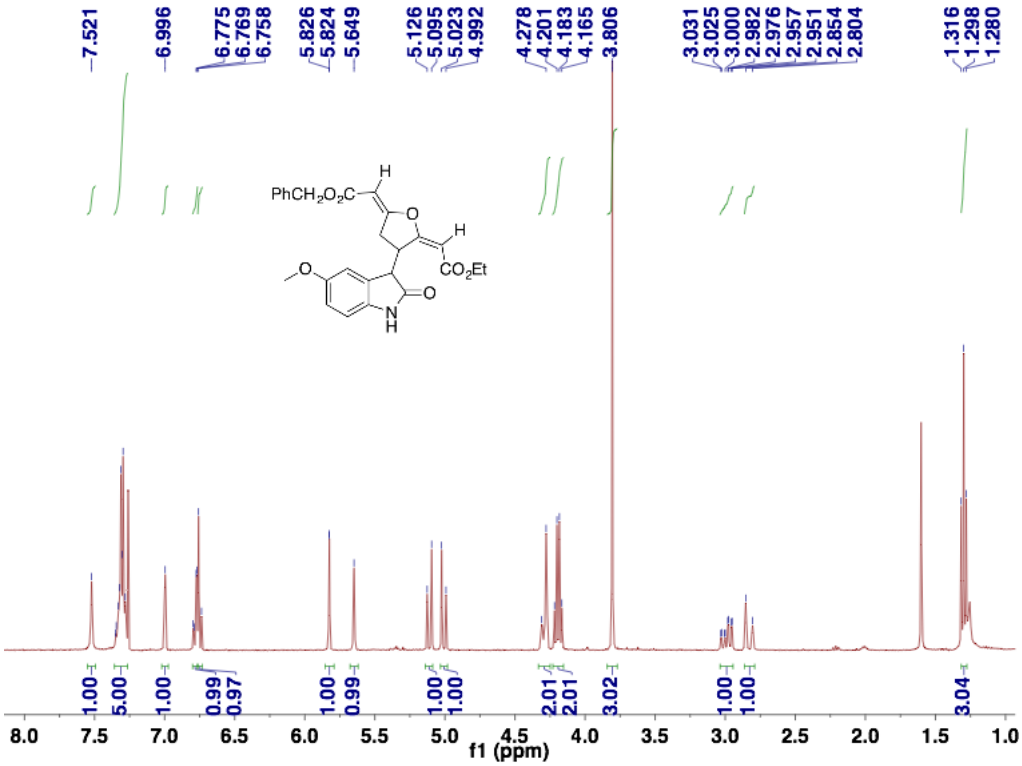
14.242
EtO2C
CO2Et
f1 (ppm)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5.095
5.023
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4.278
4.201
4.183
4.165
3.806
3.031
3.025
3.000
2.982
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2.957
2.951
2.854
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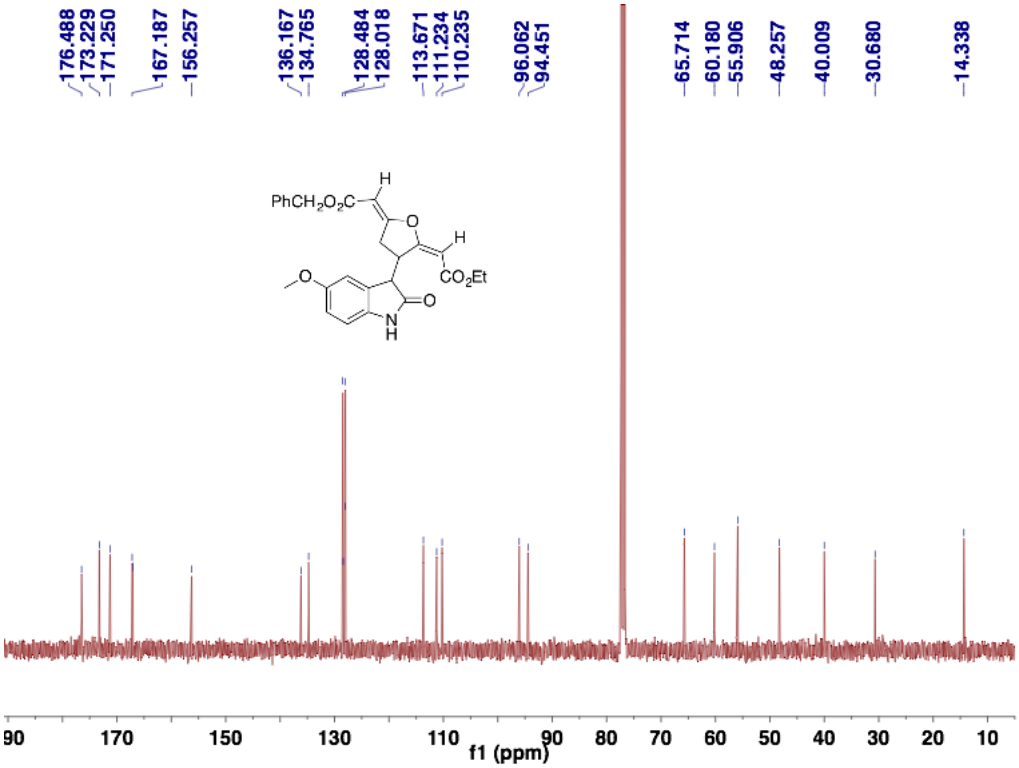
1.316
1.298
1.280
PhCH2O2C
CO2Et
f1 (ppm)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110.235
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94.451
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60.180
55.906
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14.338
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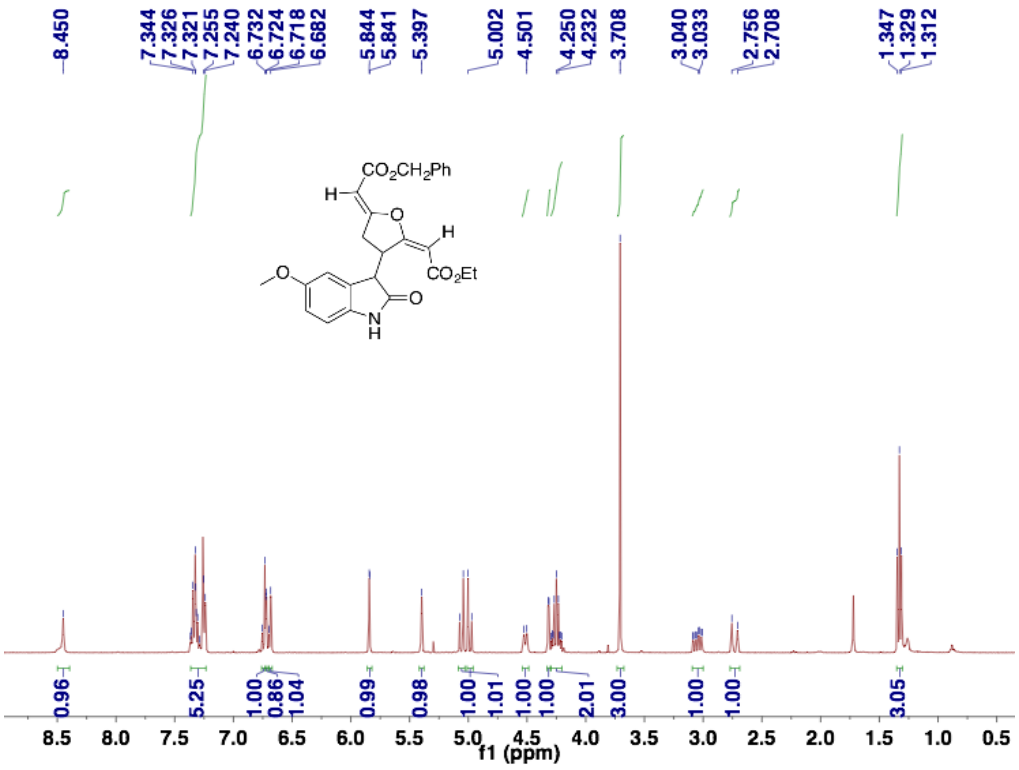
O
H
CO2Et
O
O
N
H
f1 (ppm)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5.841
5.397
5.002
4.501
4.250
4.232
3.708
3.040
3.033
2.756
2.708
1.347
1.329
1.312
CO2CH2Ph
H
O
H
CO2Et
O
O
N
H
0.96
5.25
1.00
0.86
1.04
0.99
0.98
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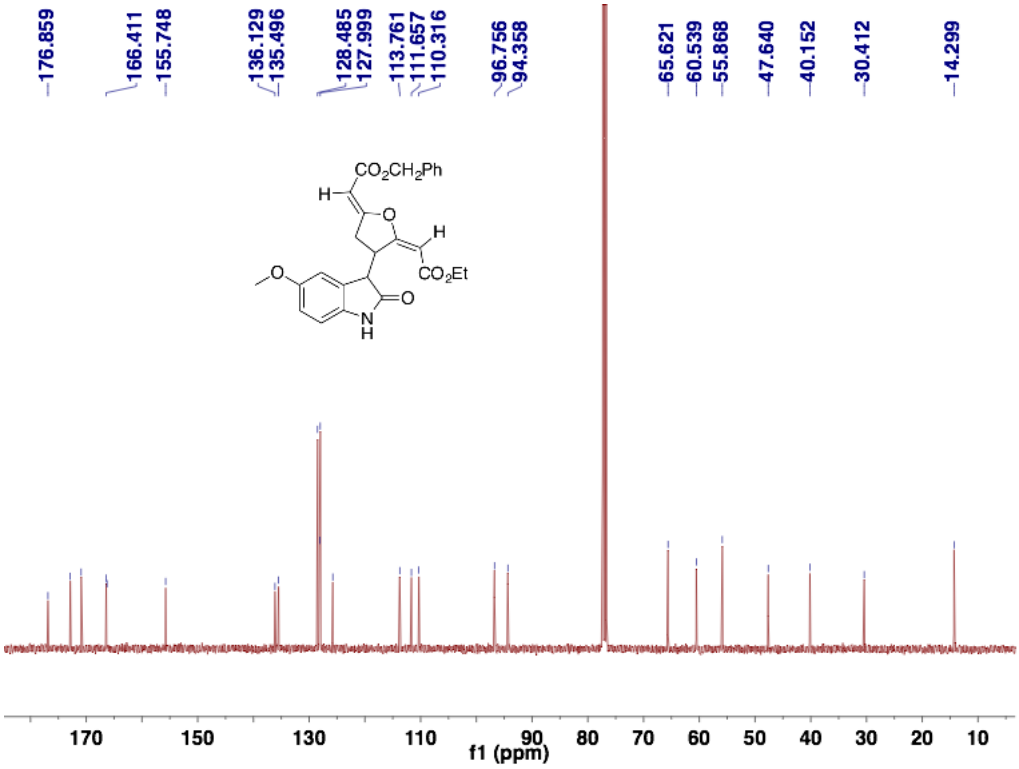
1.01
1.00
1.00
2.01
3.00
1.00
1.00
3.05
f1 (ppm)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65.621
60.539
55.868
47.640
40.152
30.412
14.299
CO2CH2Ph
H
O
H
CO2Et
O
O
N
H
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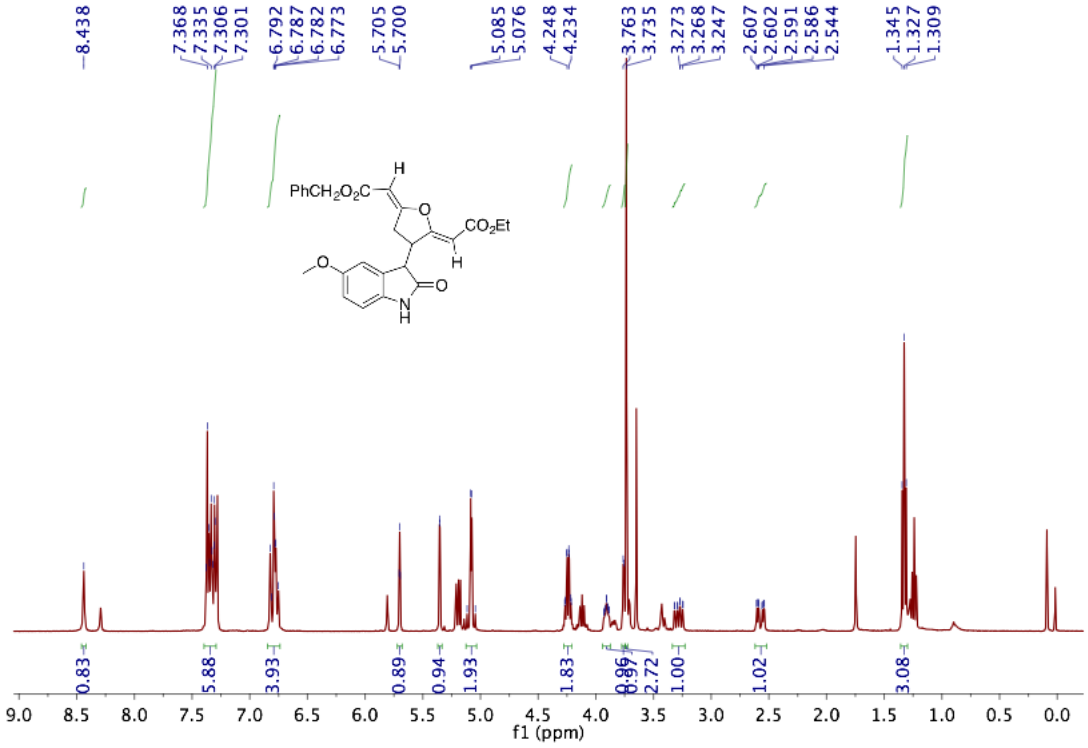
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)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5.085
5.076
4.248
4.234
3.763
3.735
3.273
3.268
3.247
2.607
2.602
2.591
2.586
2.544
1.345
1.327
1.309
PhCH2O2C
H
O
CO2Et
H
O
N
H
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3.93
0.89
0.94
1.93
1.83
0.96
0.97
2.72
1.00
1.02
3.08
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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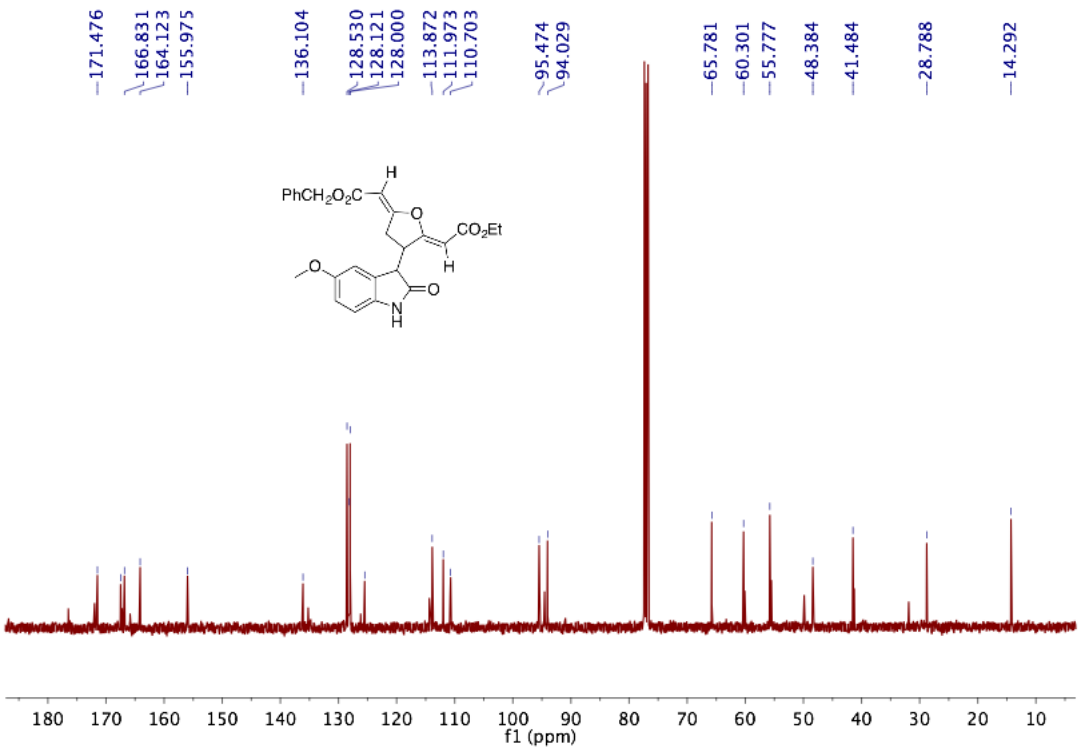
f1 (ppm)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128.000
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110.703
95.474
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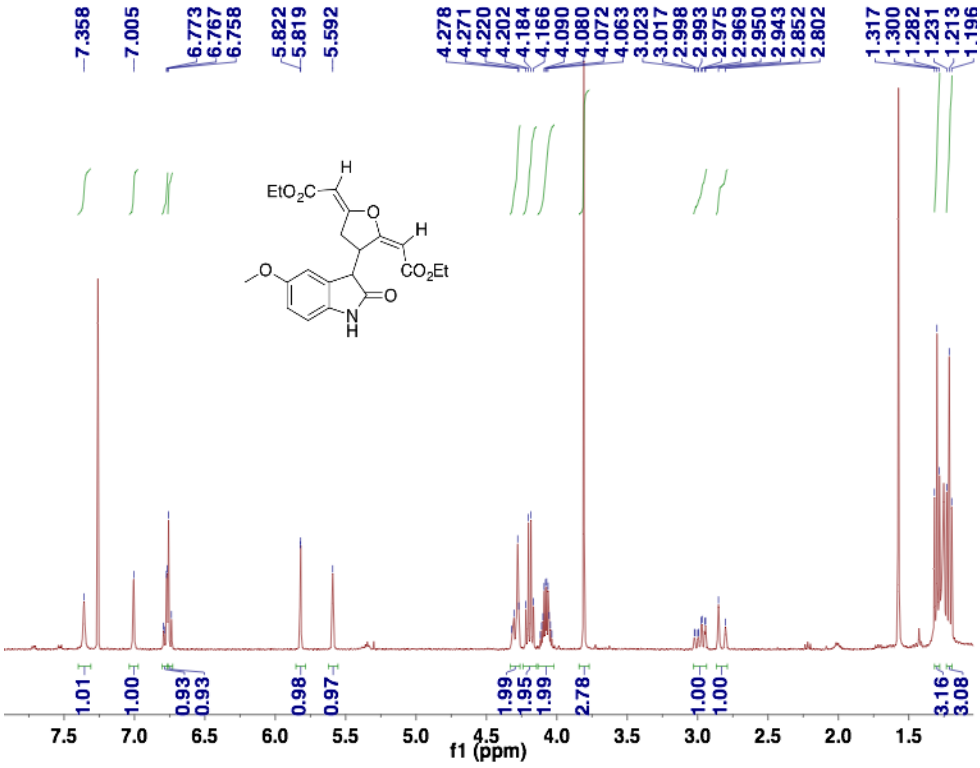
65.781
60.301
55.777
48.384
41.484
28.788
14.292
PhCH2O2C
CO2Et
f1 (ppm)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4.184
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4.090
4.080
4.072
4.063
3.023
3.017
2.998
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2.975
2.969
2.950
2.943
2.852
2.802
1.317
1.300
1.282
1.231
1.213
1.196
EtO2C
CO2Et
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1.00
0.93
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0.98
0.97
1.99
1.95
1.99
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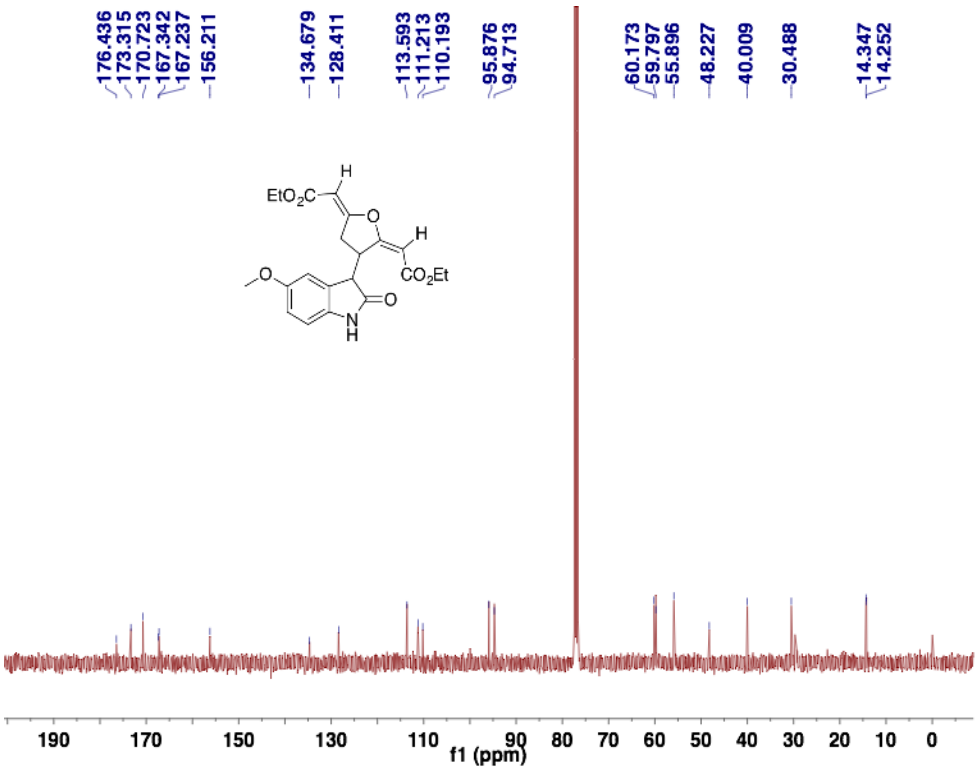
1.00
1.00
3.16
3.08
f1 (ppm)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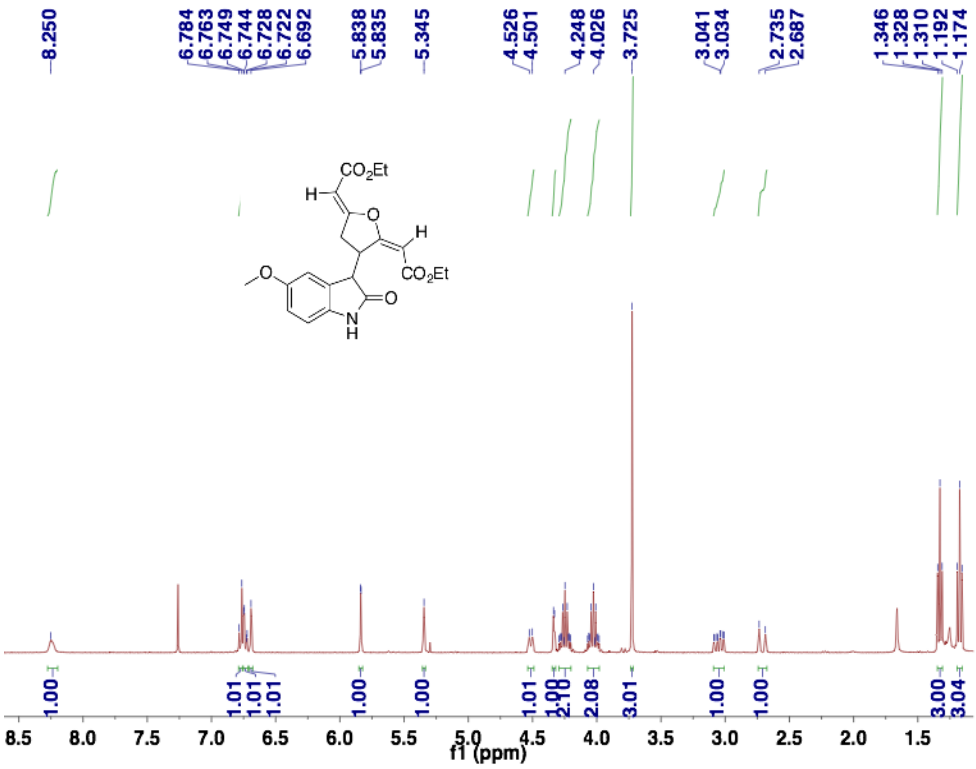
128.411
113.593
111.213
110.193
95.876
94.713
60.173
59.797
55.896
48.227
40.009
30.488
14.347
14.252
EtO2C
H
O
H
CO2Et
O
N
H
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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5.345
4.526
4.501
4.248
4.026
3.725
3.041
3.034
2.735
2.687
1.346
1.328
1.310
1.192
1.174
CO2Et
H
O
H
CO2Et
O
N
H
1.00
1.01
1.01
1.01
1.00
1.00
1.01
1.00
1.00
2.08
3.01
1.00
1.00
3.00
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8.0
7.5
7.0
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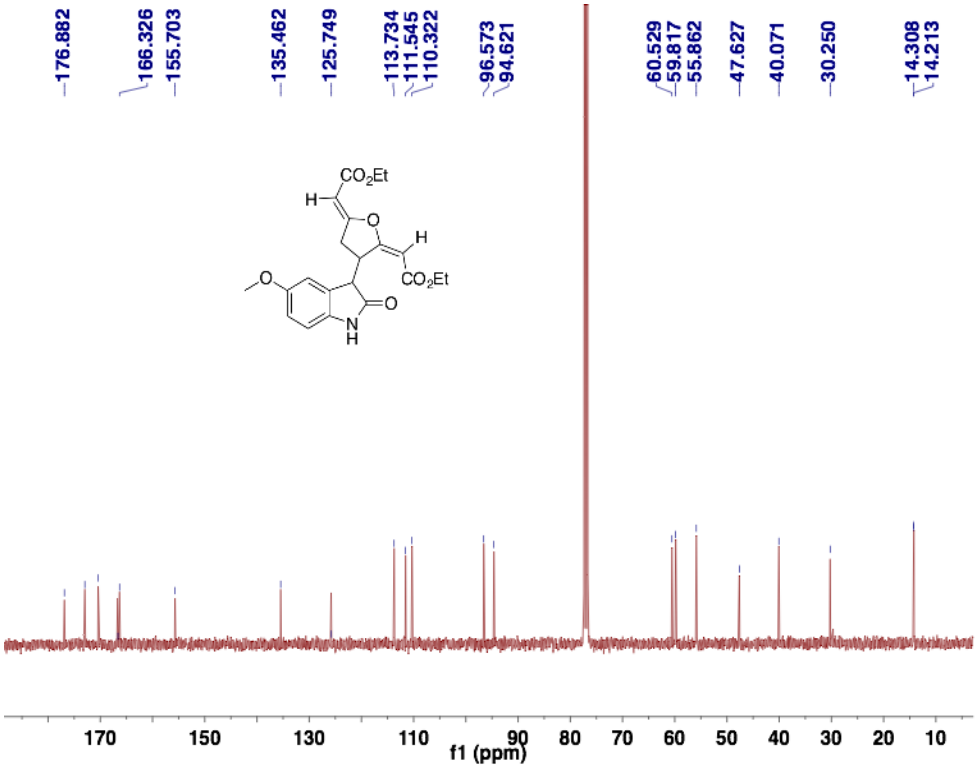
f1 (ppm)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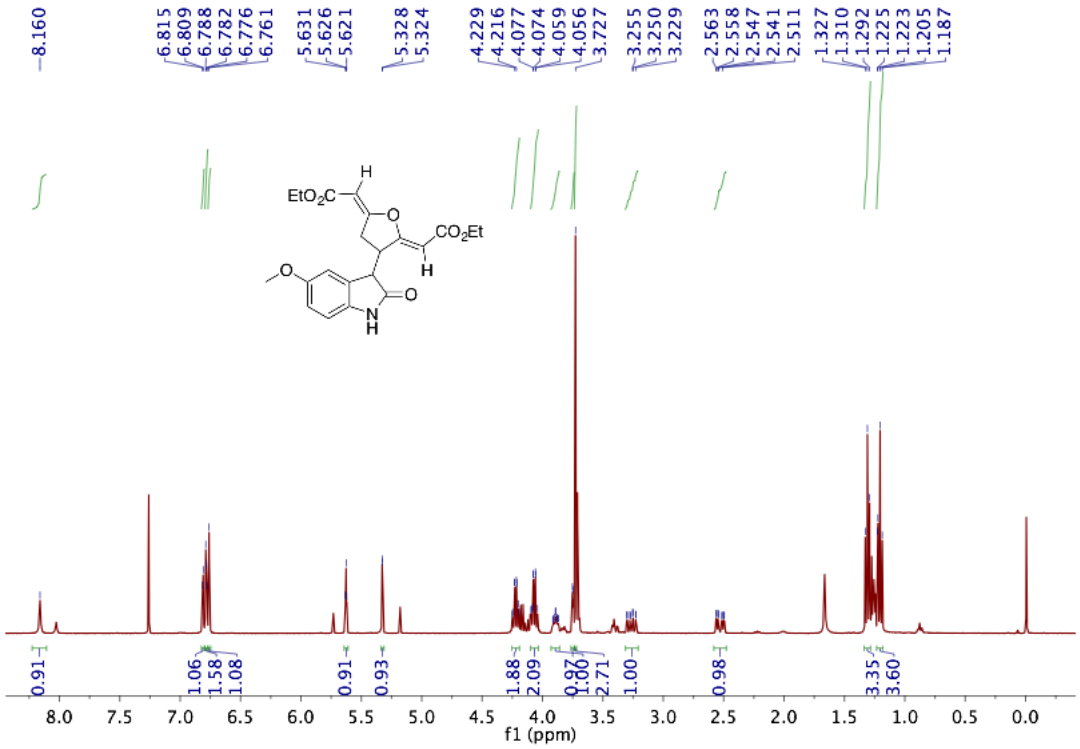
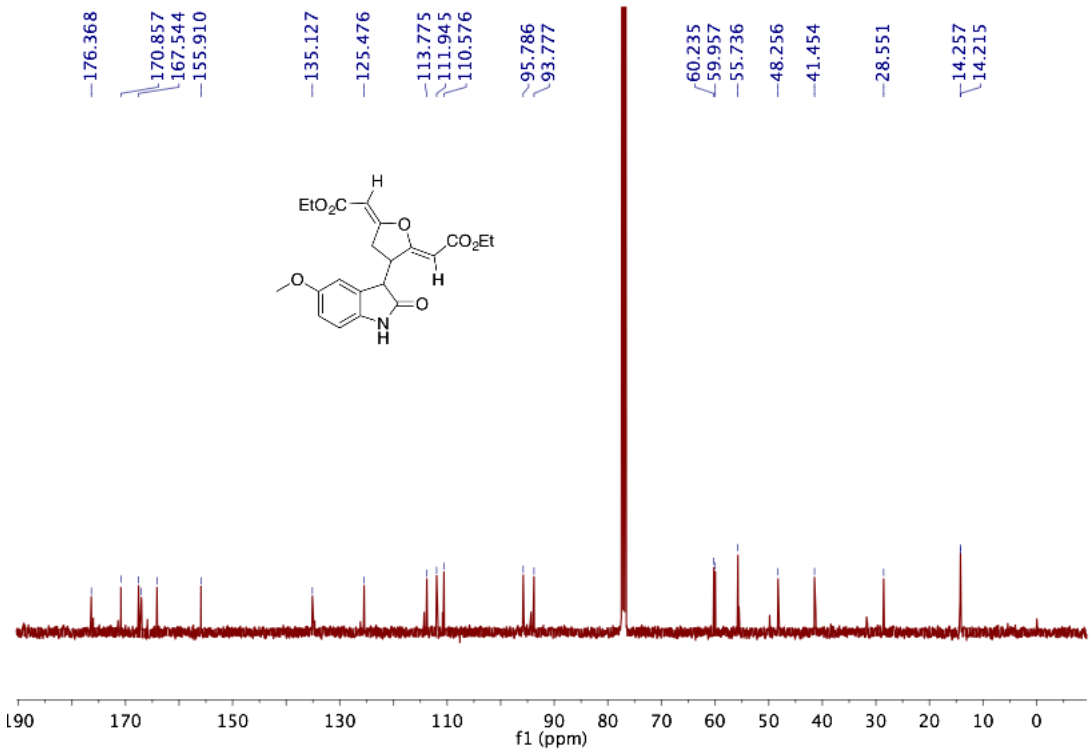
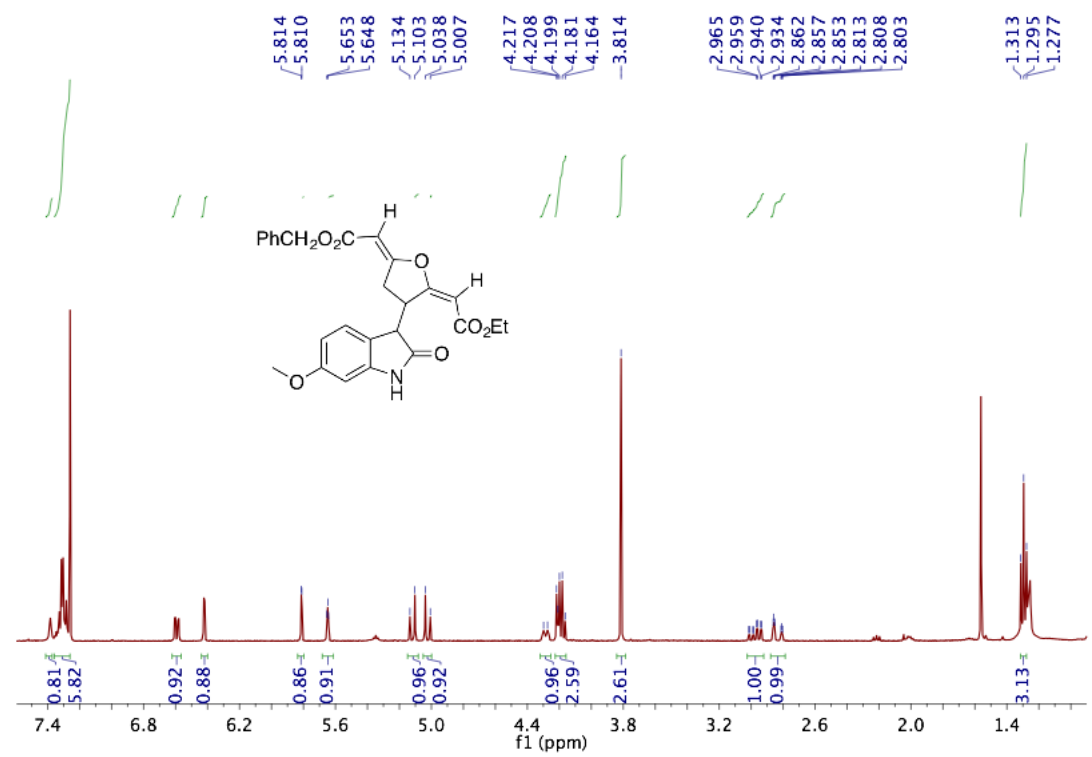
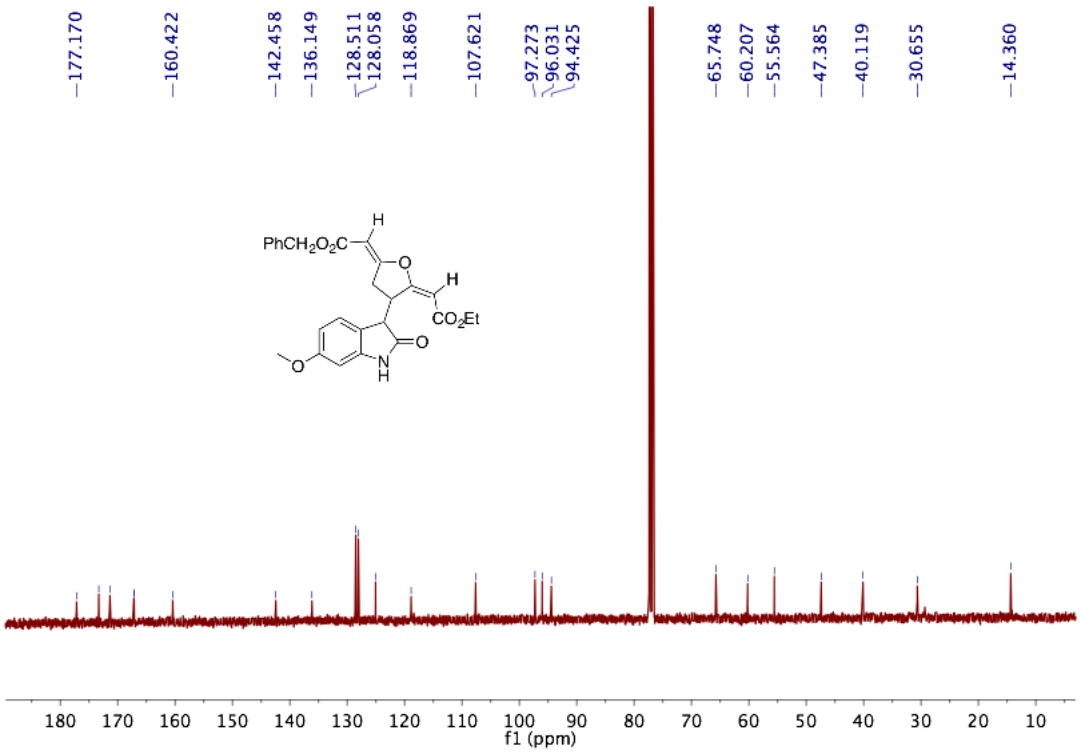
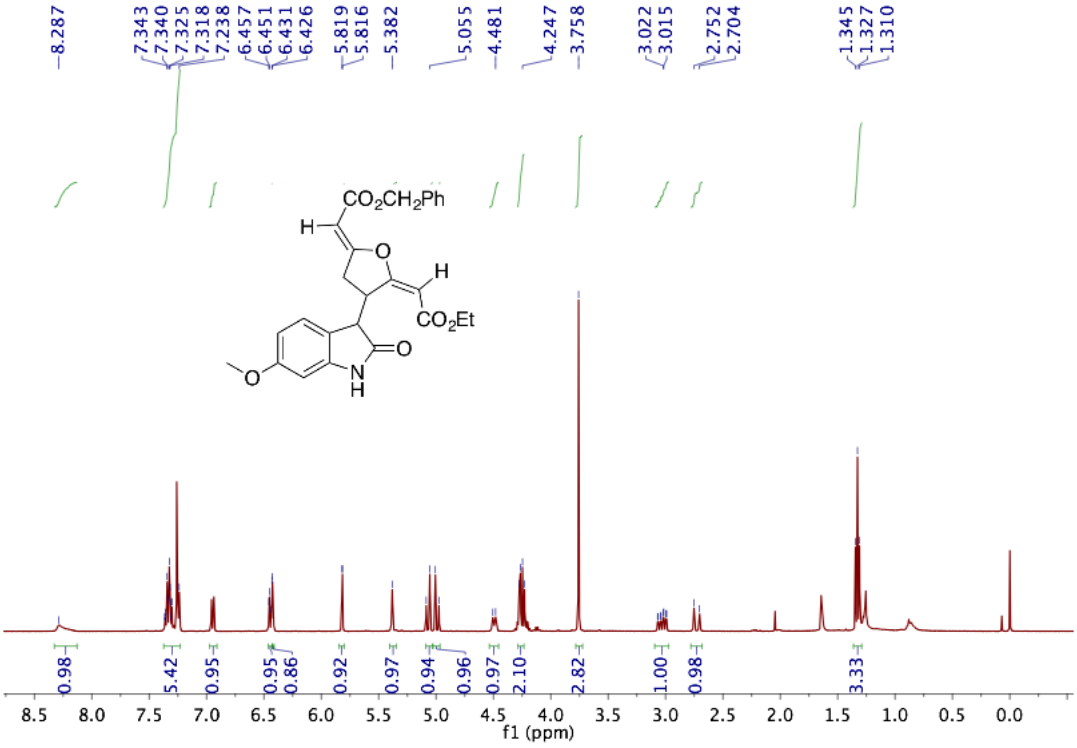
155.703
135.462
125.749
113.734
111.545
110.322
96.573
94.621
60.529
59.817
55.862
47.627
40.071
30.250
14.308
14.213
CO2Et
H
O
H
CO2Et
O
O
N
H
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)


8.160
6.815
6.809
6.788
6.782
6.776
6.761
5.631
5.626
5.621
5.328
5.324
4.229
4.216
4.077
4.074
4.059
4.056
3.727
3.255
3.250
3.229
2.563
2.558
2.547
2.541
2.511
1.327
1.310
1.292
1.225
1.223
1.205
1.187
EtO2C
H
O
CO2Et
H
O
N
H
0.91
1.06
1.58
1.08
0.91
0.93
1.88
2.09
0.87
1.00
2.71
1.00
0.98
3.35
3.60
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)


176.368
170.857
167.544
155.910
135.127
125.476
113.775
111.945
110.576
95.786
93.777
60.235
59.957
55.736
48.256
41.454
28.551
14.257
14.215
EtO2C
CO2Et
f1 (ppm)


5.814
5.810
5.653
5.648
5.134
5.103
5.038
5.007
4.217
4.208
4.199
4.181
4.164
3.814
2.965
2.959
2.940
2.934
2.862
2.857
2.853
2.813
2.808
2.803
1.313
1.295
1.277
PhCH2O2C
CO2Et
0.81
5.82
0.92
0.88
0.86
0.91
0.96
0.92
0.96
2.59
2.61
1.00
0.99
3.13
f1 (ppm)


177.170
160.422
142.458
136.149
128.511
128.058
118.869
107.621
97.273
96.031
94.425
65.748
60.207
55.564
47.385
40.119
30.655
14.360
PhCH2O2C
CO2Et
f1 (ppm)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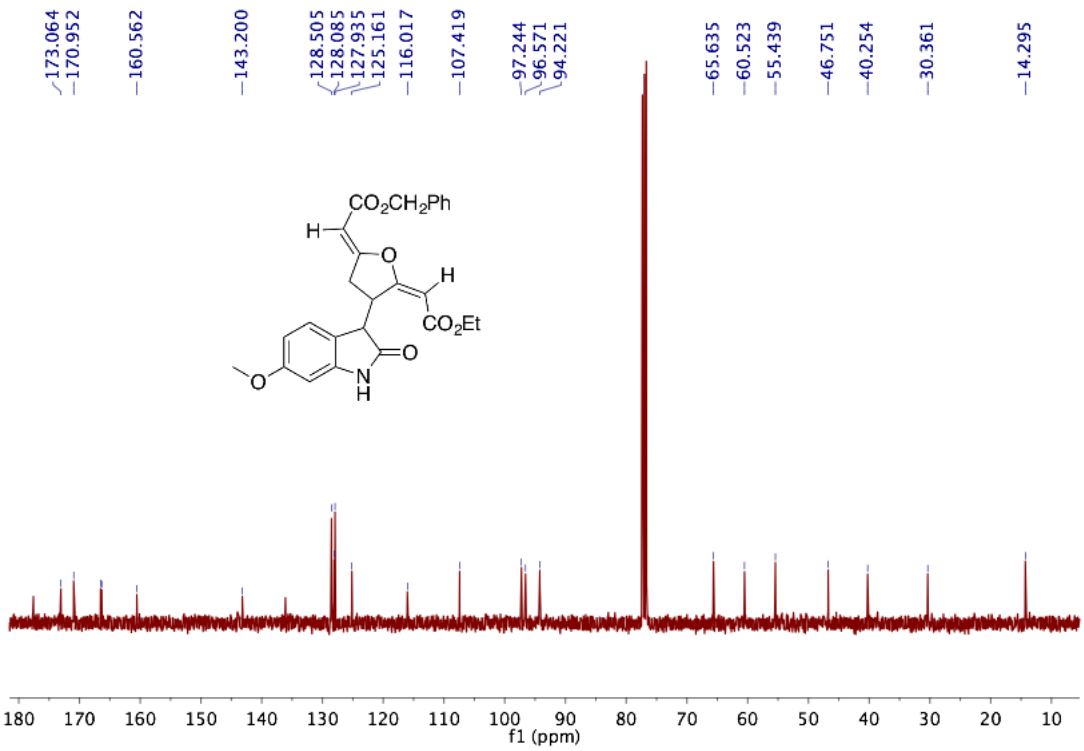
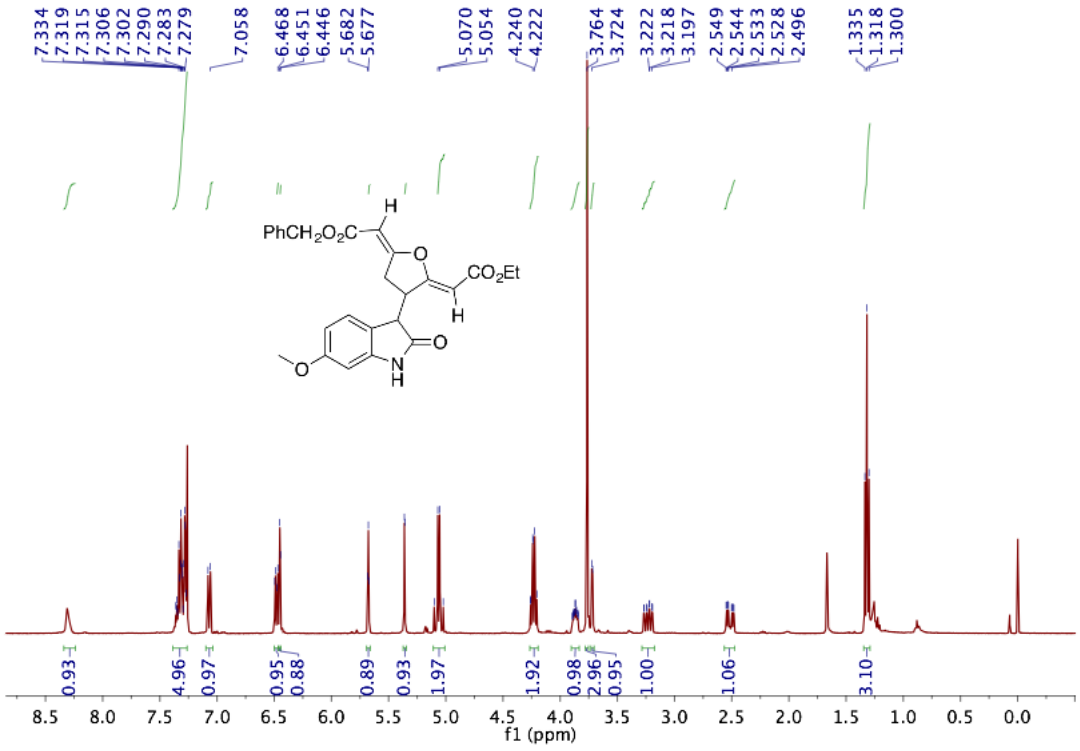
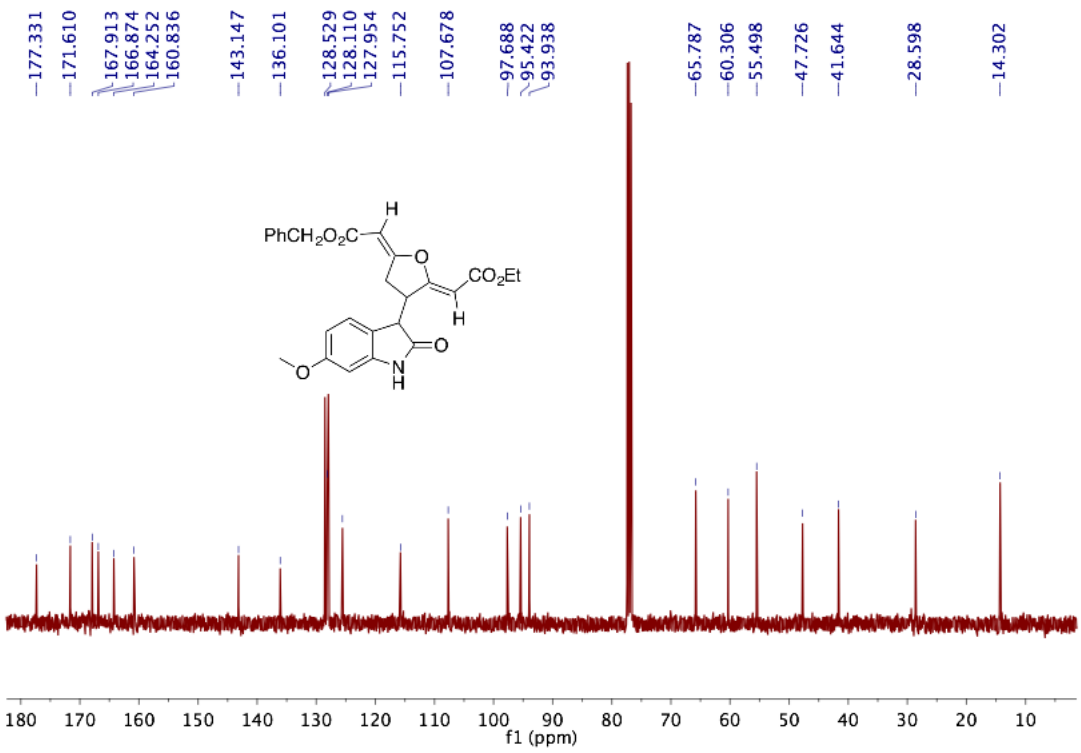
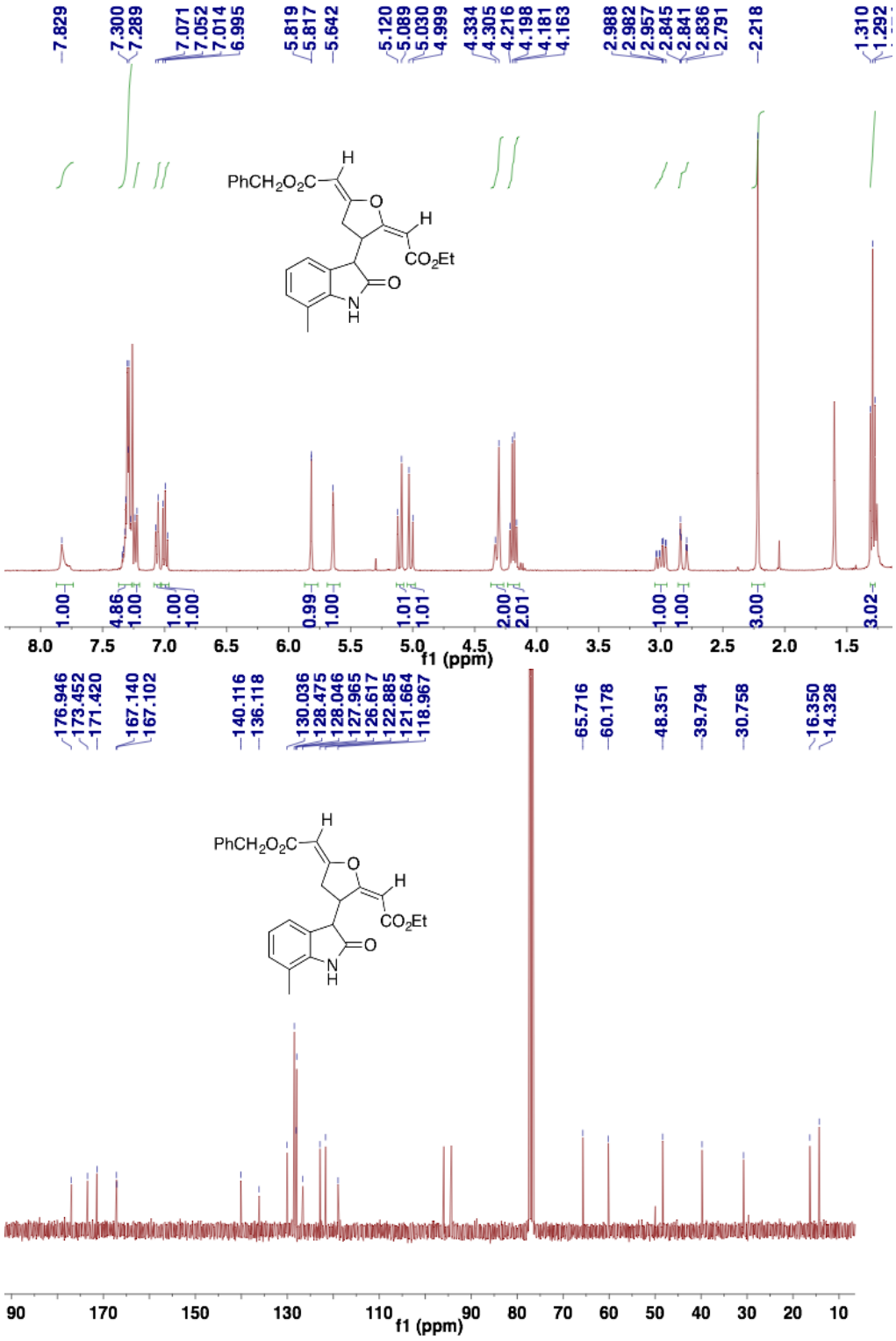
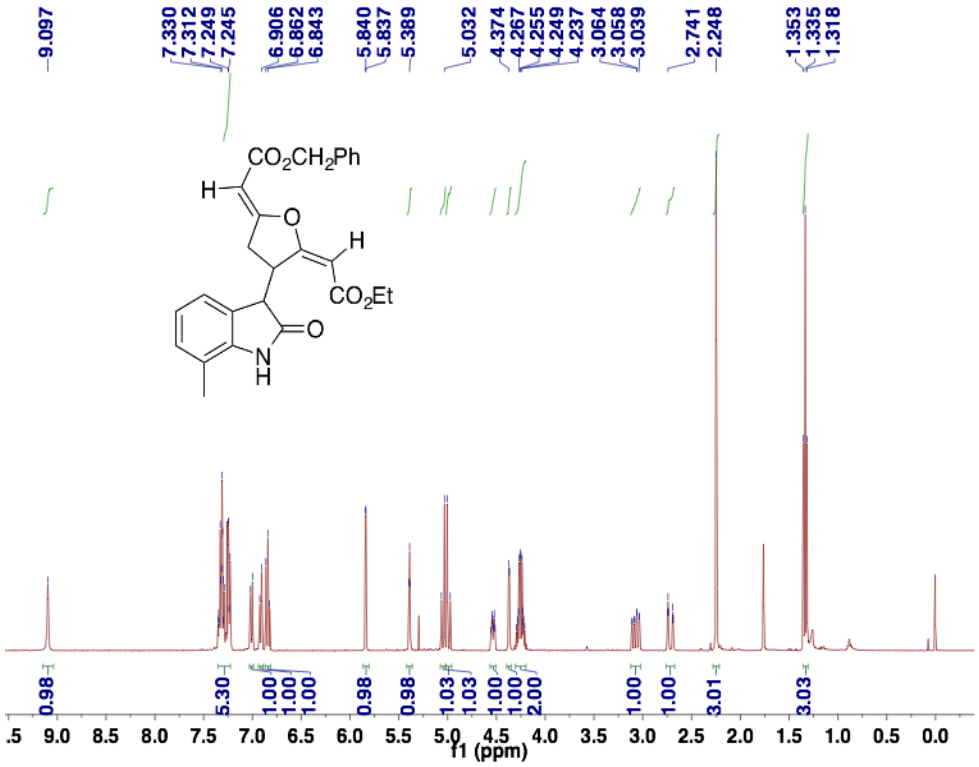
7.343
7.340
7.325
7.318
7.238
6.457
6.451
6.431
6.426
5.819
5.816
5.382
5.055
4.481
4.247
3.758
3.022
3.015
2.752
2.704
1.345
1.327
1.310
CO2CH2Ph
CO2Et
0.98
5.42
0.95
0.95
0.86
0.92
0.97
0.94
0.96
0.97
2.10
2.82
1.00
0.98
3.33
f1 (ppm)

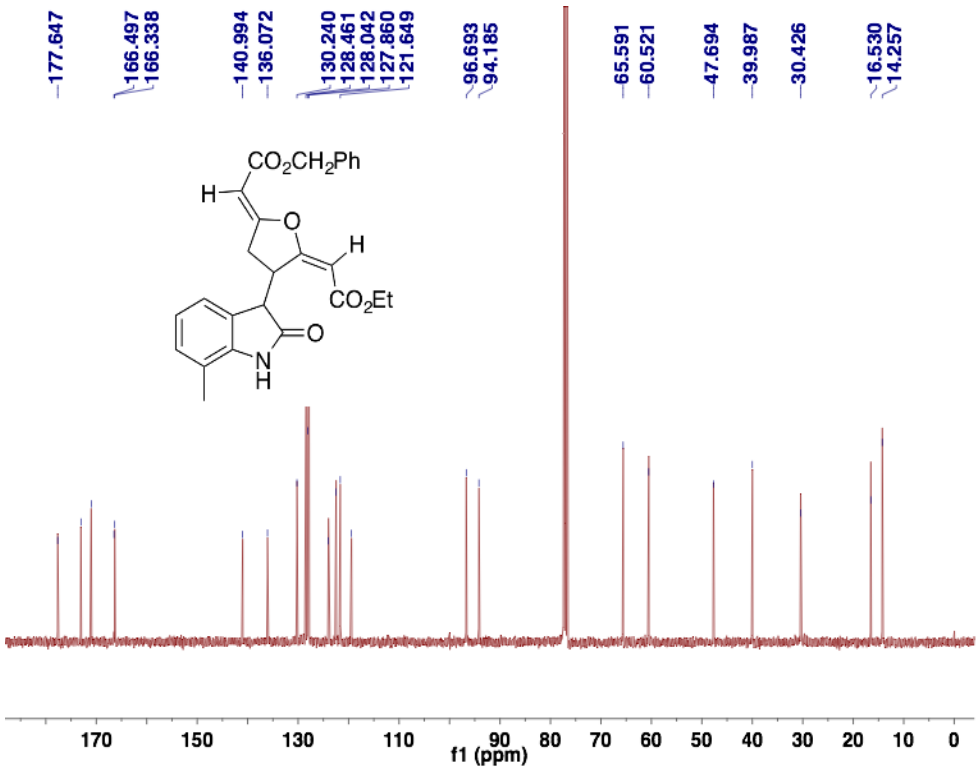

173.064
170.952
160.562
143.200
128.505
128.085
127.935
125.161
116.017
107.419
97.244
96.571
94.221
65.635
60.523
55.439
46.751
40.254
30.361
14.295
CO2CH2Ph
H
O
H
CO2Et
O
N
H
O
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

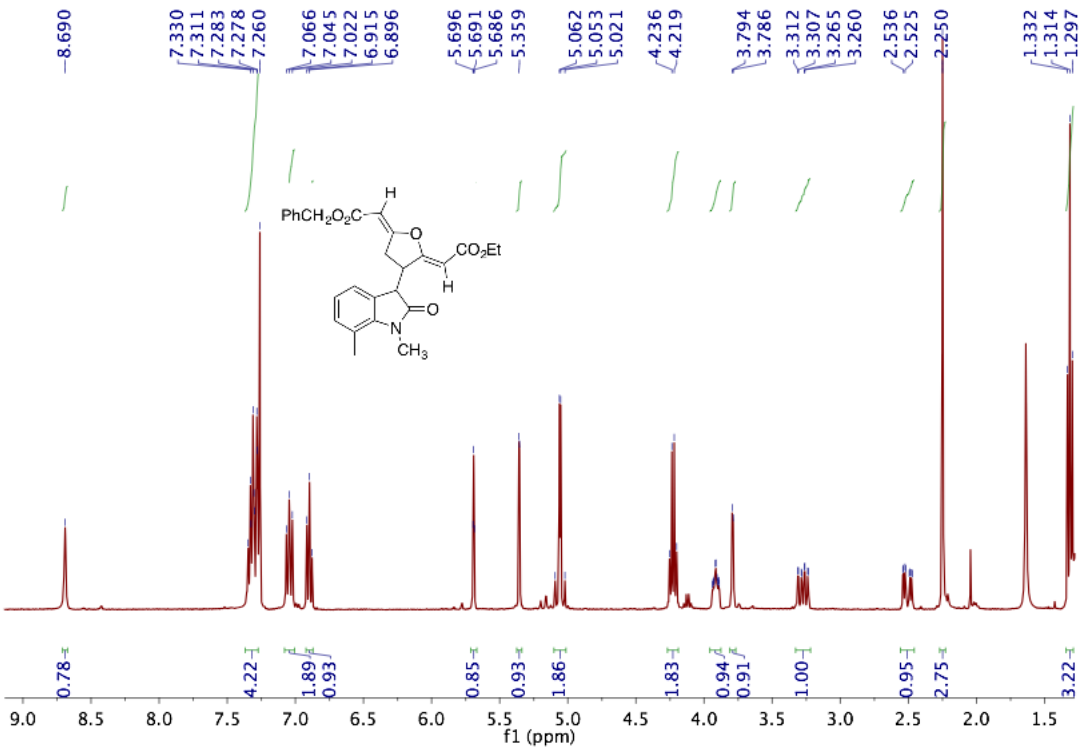

7.334
7.319
7.315
7.306
7.302
7.290
7.283
7.279
7.058
6.468
6.451
6.446
5.682
5.677
5.070
5.054
4.240
4.222
3.764
3.724
3.222
3.218
3.197
2.549
2.544
2.533
2.528
2.496
1.335
1.318
1.300
PhCH2O2C
H
O
CO2Et
H
O
N
H
O
0.93
4.96
0.97
0.95
0.88
0.89
0.93
1.97
1.92
0.98
2.96
0.95
1.00
1.06
3.10
8.5 8.0 7.5 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)

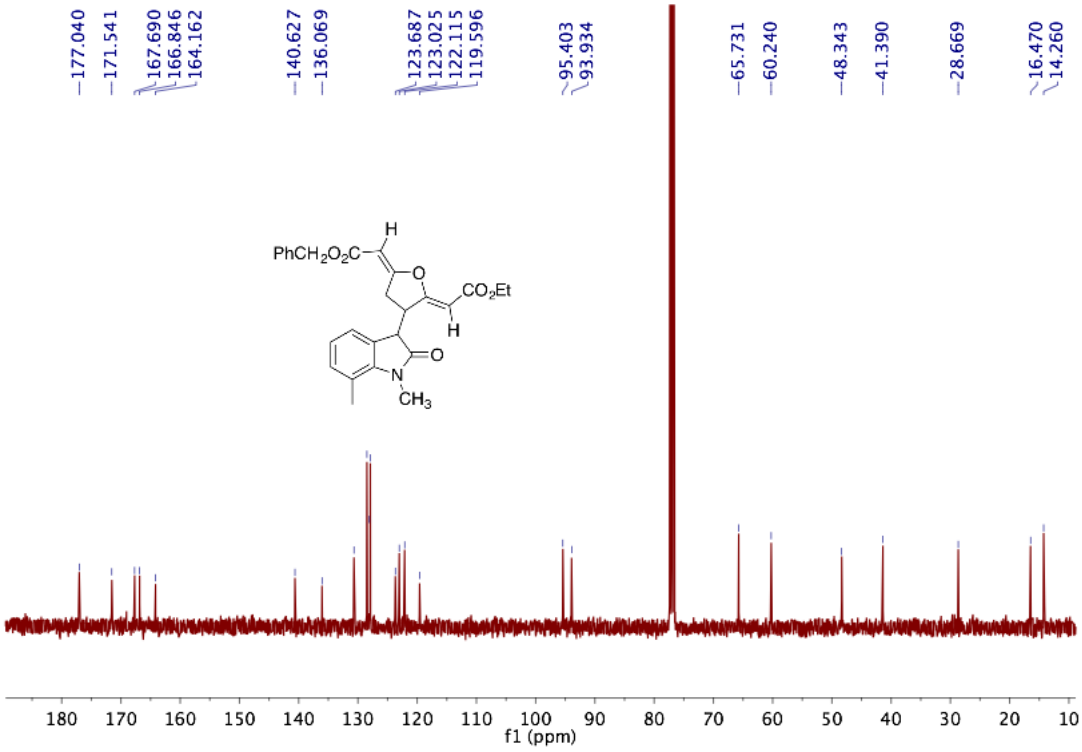

177.331
171.610
167.913
166.874
164.252
160.836
143.147
136.101
128.529
128.110
127.954
115.752
107.678
97.688
95.422
93.938
65.787
60.306
55.498
47.726
41.644
28.598
14.302
PhCH2O2C
H
O
CO2Et
H
O
N
H
O
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

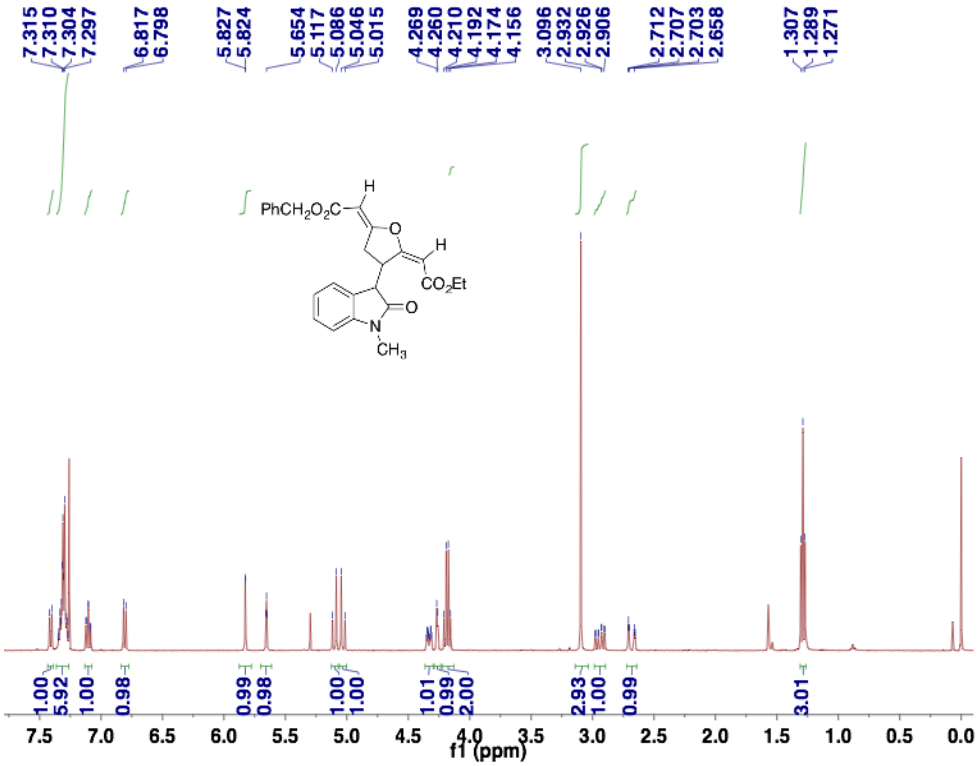

7.829
7.300
7.289
7.071
7.052
7.014
6.995
5.819
5.817
5.642
5.120
5.089
5.030
4.999
4.334
4.305
4.216
4.198
4.181
4.163
2.988
2.982
2.957
2.845
2.841
2.836
2.791
2.218
1.310
1.292
PhCH2O2C
H
O
H
CO2Et
O
N
H
1.00
4.86
1.00
1.00
1.00
0.99
1.00
1.01
1.01
2.00
2.01
1.00
1.00
3.00
3.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f1 (ppm)
176.946
173.452
171.420
167.140
167.102
140.116
136.118
130.036
128.475
128.046
127.965
126.617
122.885
121.664
118.967
65.716
60.178
48.351
39.794
30.758
16.350
14.328
PhCH2O2C
H
O
H
CO2Et
O
N
H
90
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)

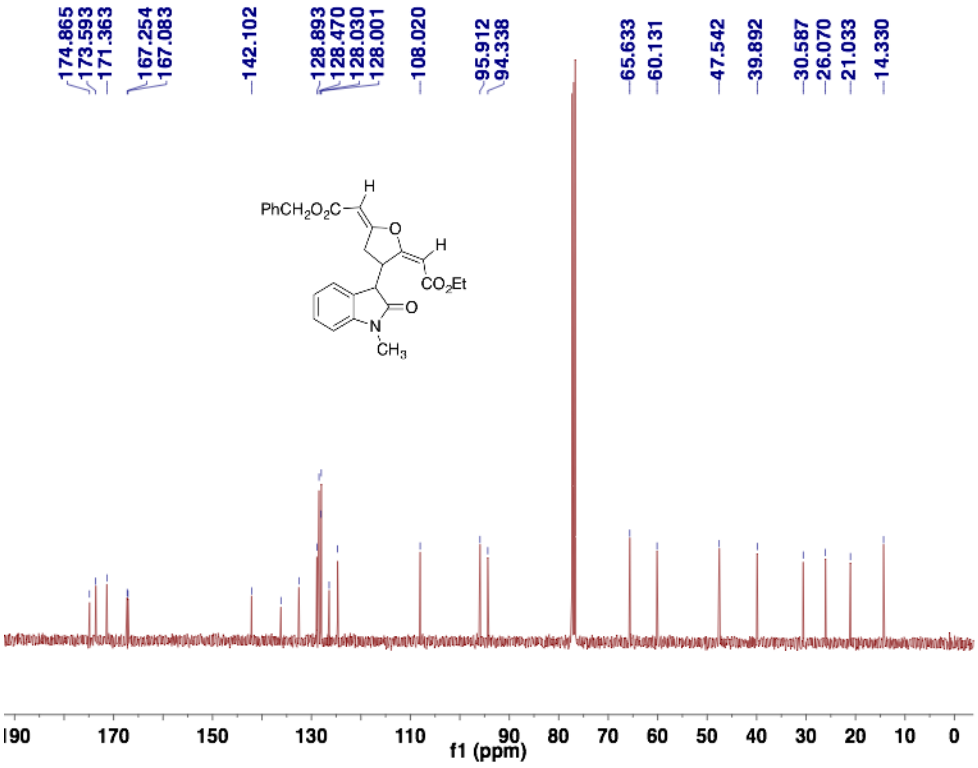

9.097
7.330
7.312
7.249
7.245
6.906
6.862
6.843
5.840
5.837
5.389
5.032
4.374
4.267
4.255
4.249
4.237
3.064
3.058
3.039
2.741
2.248
1.353
1.335
1.318
CO2CH2Ph
H
O
H
CO2Et
O
N
H
0.98
5.30
1.00
1.00
1.00
0.98
0.98
1.03
1.03
1.00
1.00
2.00
1.00
1.00
3.01
3.03
f1 (ppm)


177.647
166.497
166.338
140.994
136.072
130.240
128.461
128.042
127.860
121.649
96.693
94.185
65.591
60.521
47.694
39.987
30.426
16.530
14.257
CO2CH2Ph
H
O
H
CO2Et
O
N
H
f1 (ppm)


8.690
7.330
7.311
7.283
7.278
7.260
7.066
7.045
7.022
6.915
6.896
5.696
5.691
5.686
5.359
5.062
5.053
5.021
4.236
4.219
3.794
3.786
3.312
3.307
3.265
3.260
2.536
2.525
2.250
1.332
1.314
1.297
PhCH2O2C
CO2Et
N
CH3
0.78
4.22
1.89
0.93
0.85
0.93
1.86
1.83
0.94
0.91
1.00
0.95
2.75
3.22
f1 (ppm)


177.040
171.541
167.690
166.846
164.162
140.627
136.069
123.687
123.025
122.115
119.596
95.403
93.934
65.731
60.240
48.343
41.390
28.669
16.470
14.260
PhCH2O2C
CO2Et
N
CH3
f1 (ppm)


7.315
7.310
7.304
7.297
6.817
6.798
5.827
5.824
5.654
5.117
5.086
5.046
5.015
4.269
4.260
4.210
4.192
4.174
4.156
3.096
2.932
2.926
2.906
2.712
2.707
2.703
2.658
1.307
1.289
1.271
PhCH2O2C
H
O
H
CO2Et
O
N
CH3
1.00
5.92
1.00
0.98
0.99
0.98
1.00
1.00
1.01
0.99
2.00
2.93
1.00
0.99
3.01
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)


174.865
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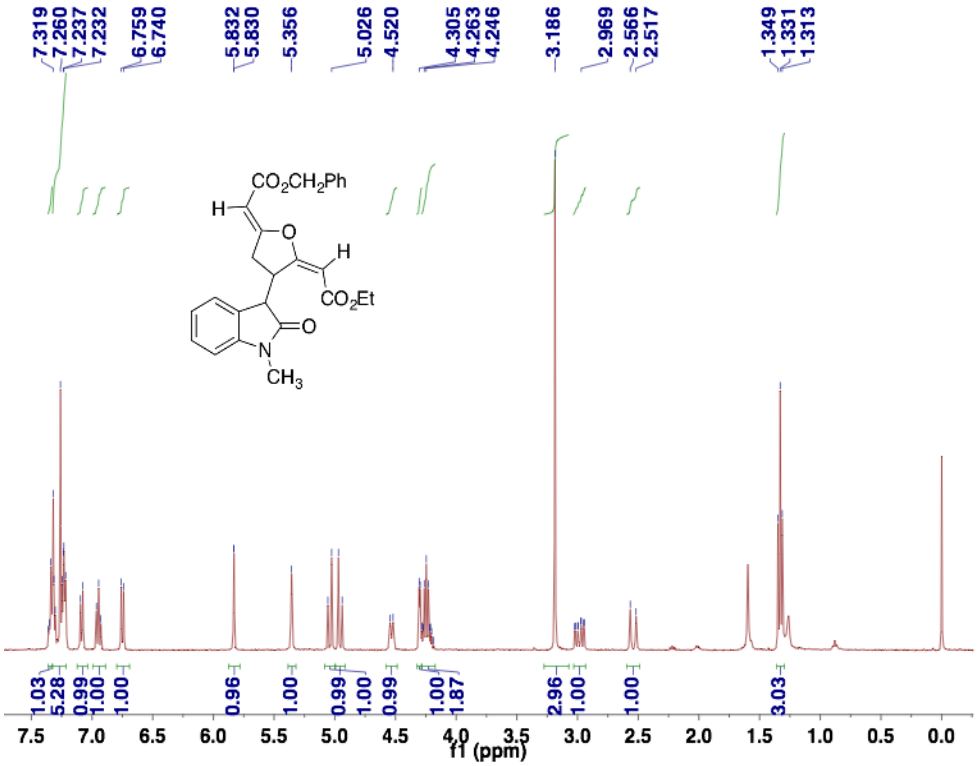
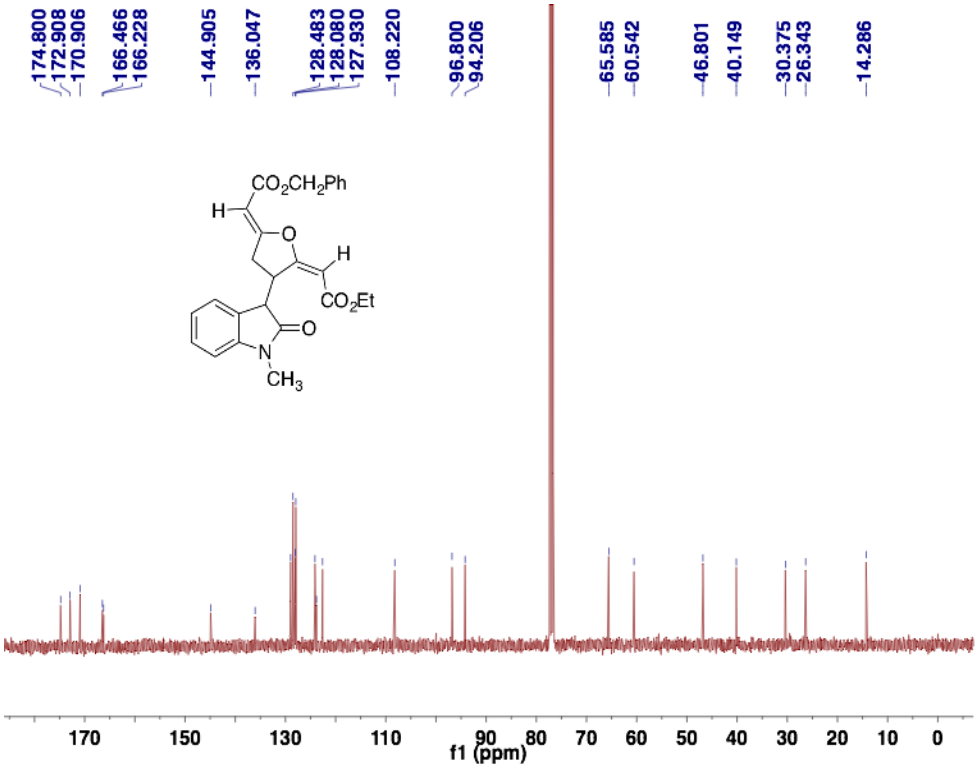
171.363
167.254
167.083
142.102
128.893
128.470
128.030
128.001
108.020
95.912
94.338
65.633
60.131
47.542
39.892
30.587
26.070
21.033
14.330
PhCH2O2C
H
O
H
CO2Et
O
N
CH3
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.319
7.260
7.237
7.232
6.759
6.740
5.832
5.830
5.356
5.026
4.520
4.305
4.263
4.246
3.186
2.969
2.566
2.517
1.349
1.331
1.313
CO2CH2Ph
H
O
H
CO2Et
O
N
CH3
1.03
5.28
0.99
1.00
1.00
0.96
1.00
0.99
1.00
0.99
1.00
1.87
2.96
1.00
1.00
3.03
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)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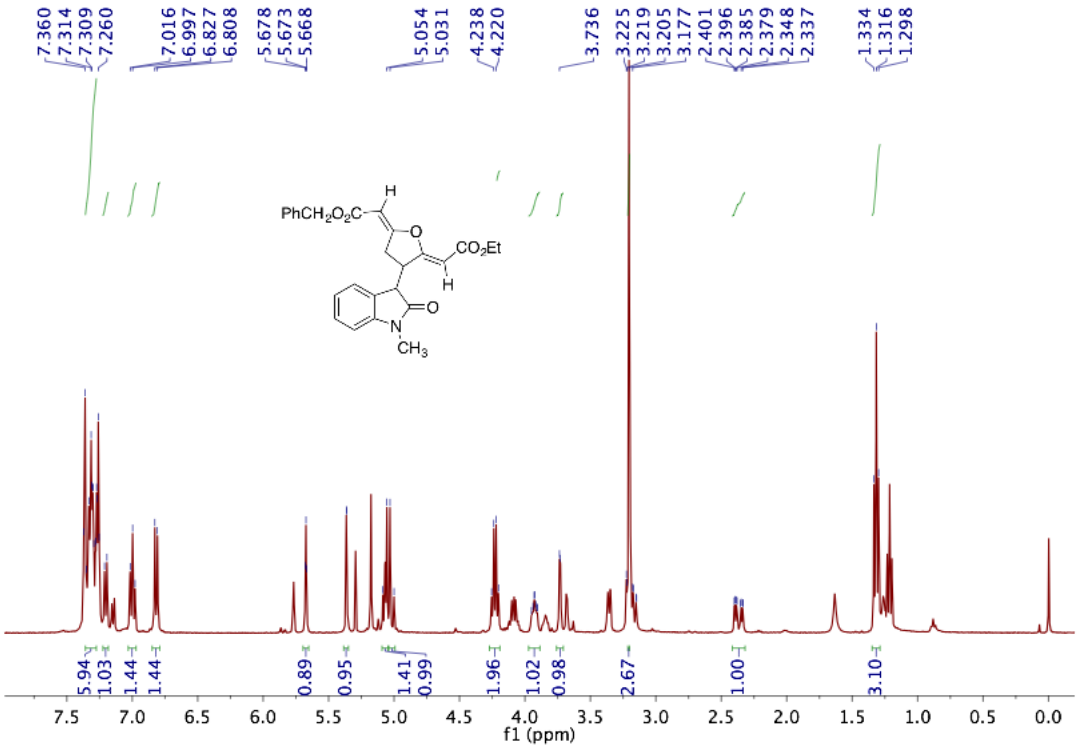
172.908
170.906
166.466
166.228
144.905
136.047
128.483
128.080
127.930
108.220
96.800
94.206
65.585
60.542
46.801
40.149
30.375
26.343
14.286
CO2CH2Ph
H
O
H
CO2Et
O
N
CH3
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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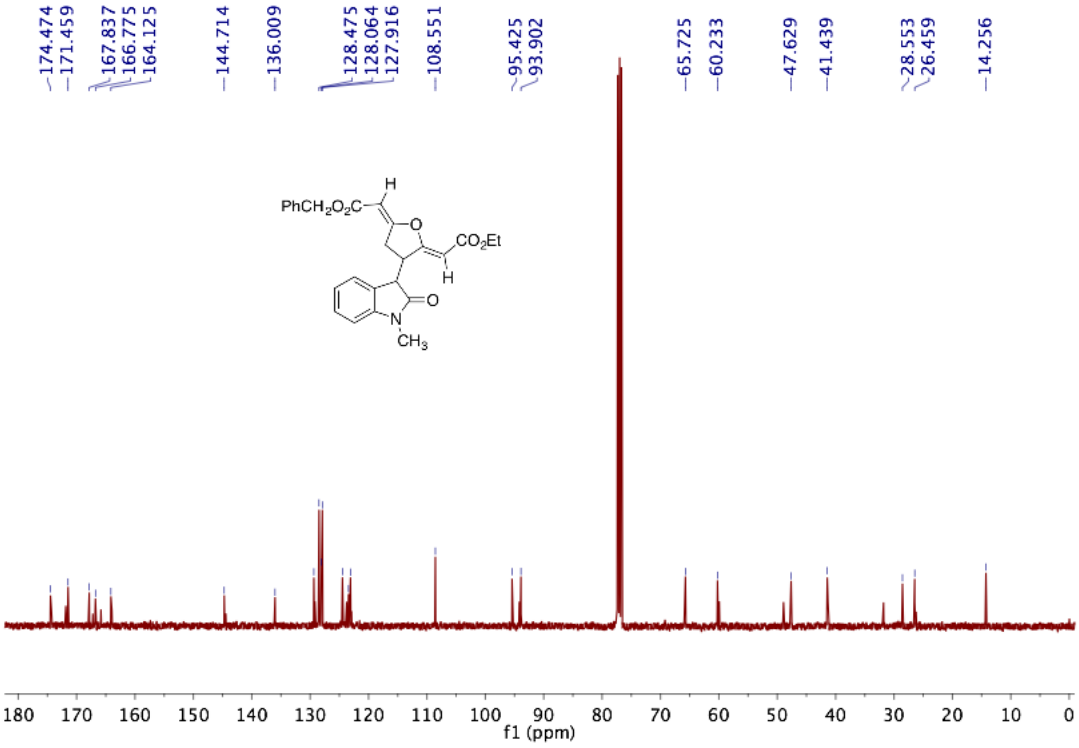
6.827
6.808
5.678
5.673
5.668
5.054
5.031
4.238
4.220
3.736
3.225
3.219
3.205
3.177
2.401
2.396
2.385
2.379
2.348
2.337
1.334
1.316
1.298
PhCH2O2C
CO2Et
H
O
N
CH3
5.94
1.03
1.44
1.44
0.89
0.95
1.41
0.99
1.96
1.02
0.98
2.67
1.00
3.10
f1 (ppm)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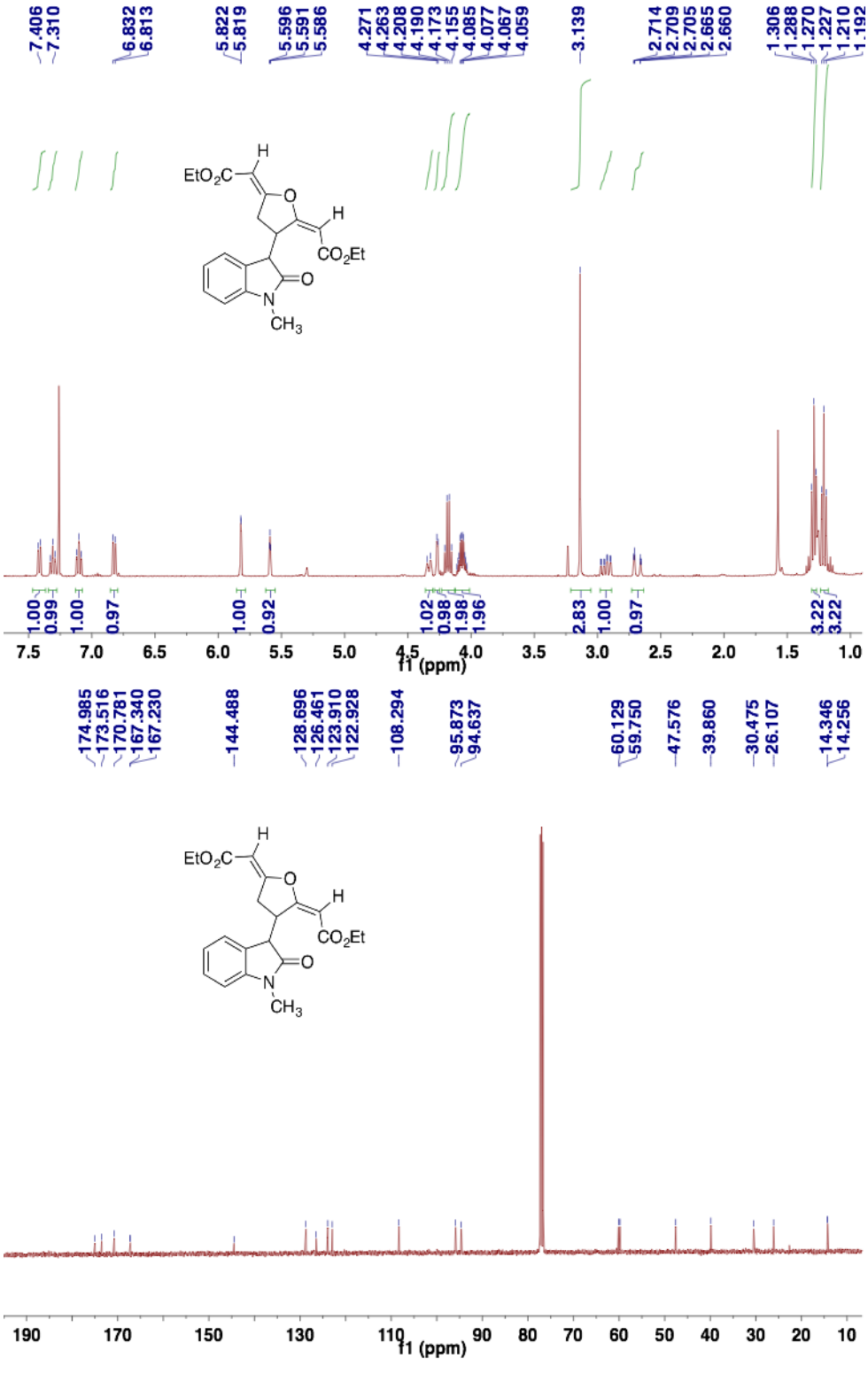
167.837
166.775
164.125
144.714
136.009
128.475
128.064
127.916
108.551
95.425
93.902
65.725
60.233
47.629
41.439
28.553
26.459
14.256
PhCH2O2C
CO2Et
H
O
N
CH3
f1 (ppm)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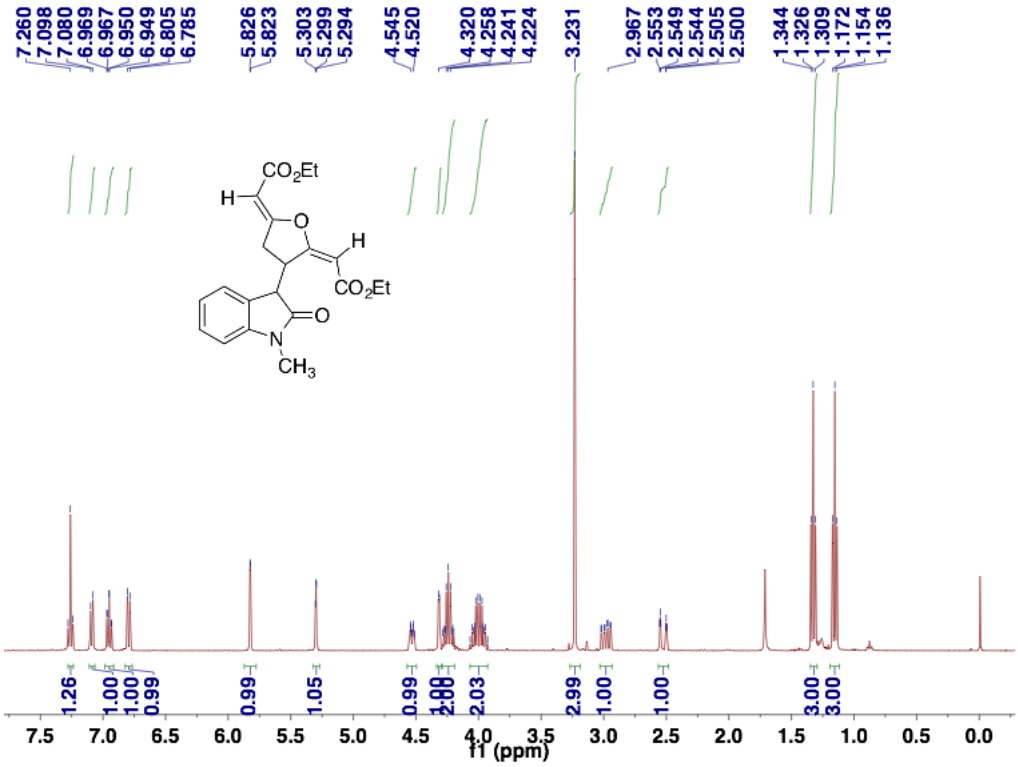
7.310
6.832
6.813
5.822
5.819
5.596
5.591
5.586
4.271
4.263
4.208
4.190
4.173
4.155
4.085
4.077
4.067
4.059
3.139
2.714
2.709
2.705
2.665
2.660
1.306
1.288
1.270
1.227
1.210
1.192
EtO2C
CO2Et
CH3
1.00
0.99
1.00
0.97
1.00
0.92
1.02
0.98
1.98
1.96
2.83
1.00
0.97
3.22
3.22
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f1 (ppm)
174.985
173.516
170.781
167.340
167.230
144.488
128.696
126.461
123.910
122.928
108.294
95.873
94.637
60.129
59.750
47.576
39.860
30.475
26.107
14.346
14.256
190
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)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7.080
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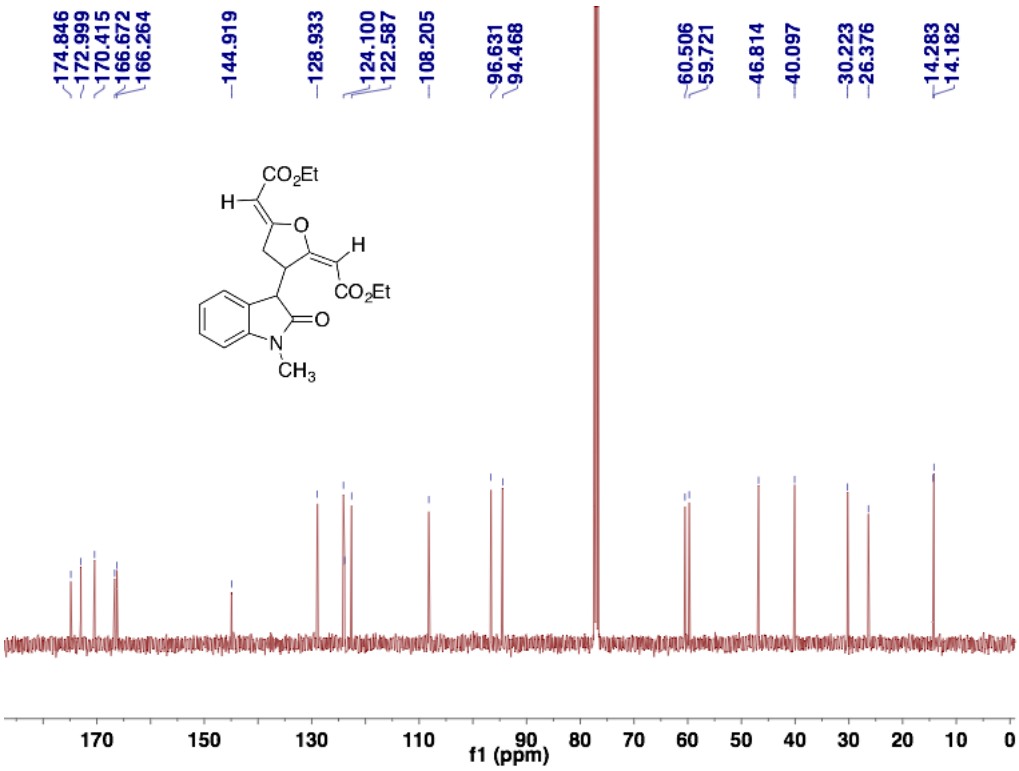
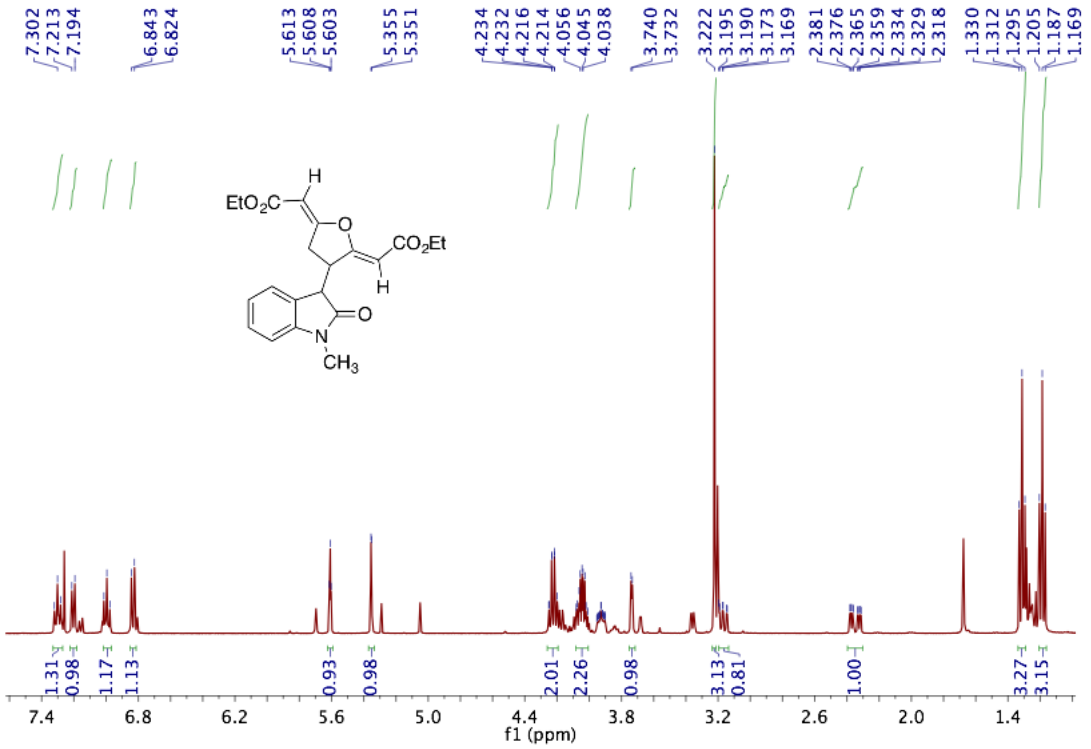
6.967
6.950
6.949
6.805
6.785
5.826
5.823
5.303
5.299
5.294
4.545
4.520
4.320
4.258
4.241
4.224
3.231
2.967
2.553
2.549
2.544
2.505
2.500
1.344
1.326
1.309
1.172
1.154
1.136
CO2Et
H
O
H
CO2Et
O
N
CH3
1.26
1.00
1.00
0.99
0.99
1.05
0.99
1.00
2.00
2.03
2.99
1.00
1.00
3.00
3.00
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


174.846
172.999
170.415
166.672
166.264
144.919
128.933
124.100
122.587
108.205
96.631
94.468
60.506
59.721
46.814
40.097
30.223
26.376
14.283
14.182
CO2Et
H
O
H
CO2Et
O
N
CH3
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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7.213
7.194
6.843
6.824
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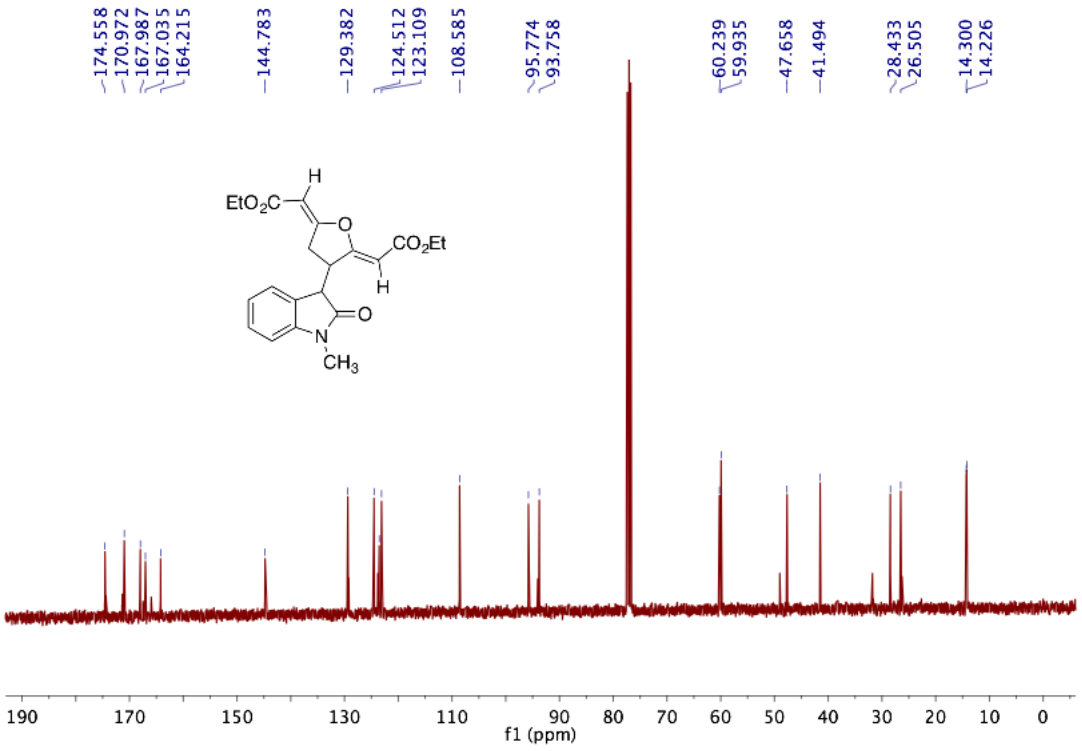
5.608
5.603
5.355
5.351
4.234
4.232
4.216
4.214
4.056
4.045
4.038
3.740
3.732
3.222
3.195
3.190
3.173
3.169
2.381
2.376
2.365
2.359
2.334
2.329
2.318
1.330
1.312
1.295
1.205
1.187
1.169
EtO2C
CO2Et
N
CH3
1.31
0.98
1.17
1.13
0.93
0.98
2.01
2.26
0.98
3.13
0.81
1.00
3.27
3.15
f1 (ppm)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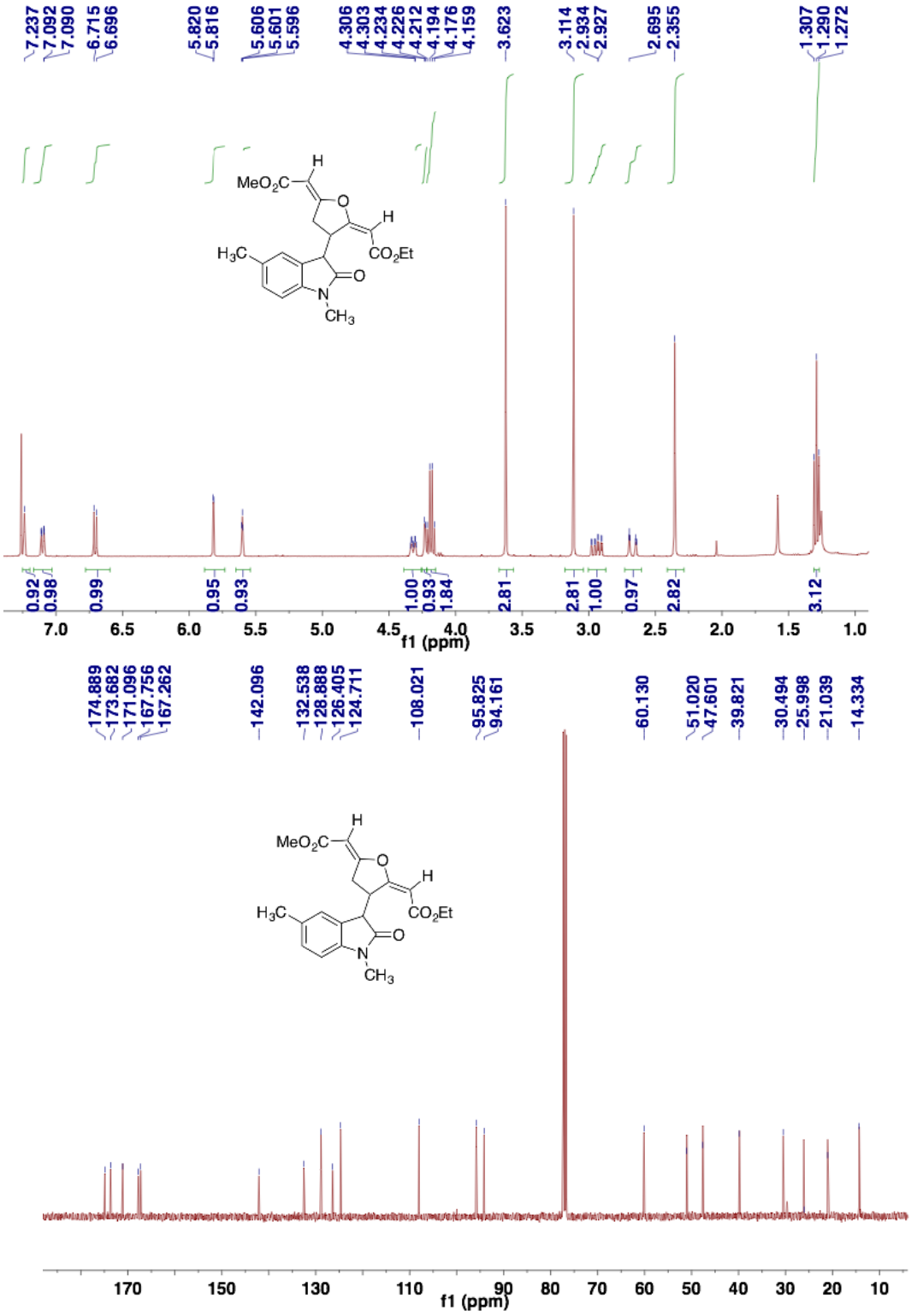
170.972
167.987
167.035
164.215
144.783
129.382
124.512
123.109
108.585
95.774
93.758
60.239
59.935
47.658
41.494
28.433
26.505
14.300
14.226
EtO2C
CO2Et
N
CH3
f1 (ppm)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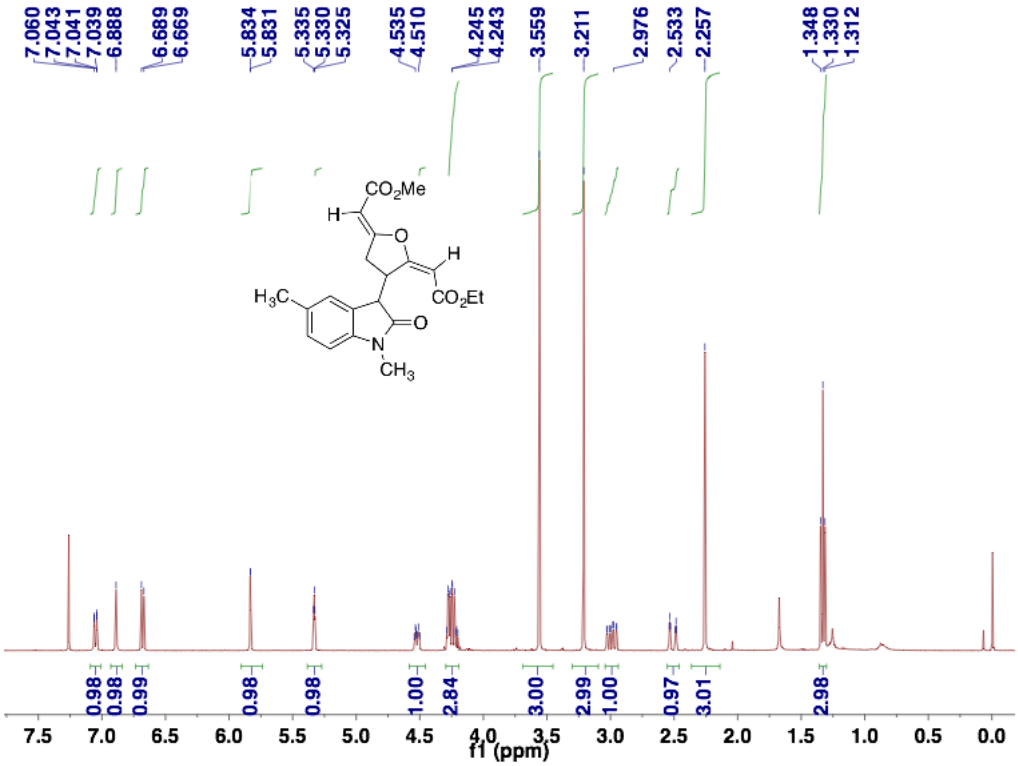
7.092
7.090
6.715
6.696
5.820
5.816
5.606
5.601
5.596
4.306
4.303
4.234
4.226
4.212
4.194
4.176
4.159
3.623
3.114
2.934
2.927
2.695
2.355
1.307
1.290
1.272
MeO2C
H
O
H
CO2Et
H3C
O
N
CH3
0.92
0.98
0.99
0.95
0.93
1.00
0.93
1.84
2.81
2.81
1.00
0.97
2.82
3.12
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
f1 (ppm)
174.889
173.682
171.096
167.756
167.262
142.096
132.538
128.888
126.405
124.711
108.021
95.825
94.161
60.130
51.020
47.601
39.821
30.494
25.998
21.039
14.334
MeO2C
H
O
H
CO2Et
H3C
O
N
CH3
170
150
130
110
90
80
70
60
50
40
30
20
10
f1 (ppm)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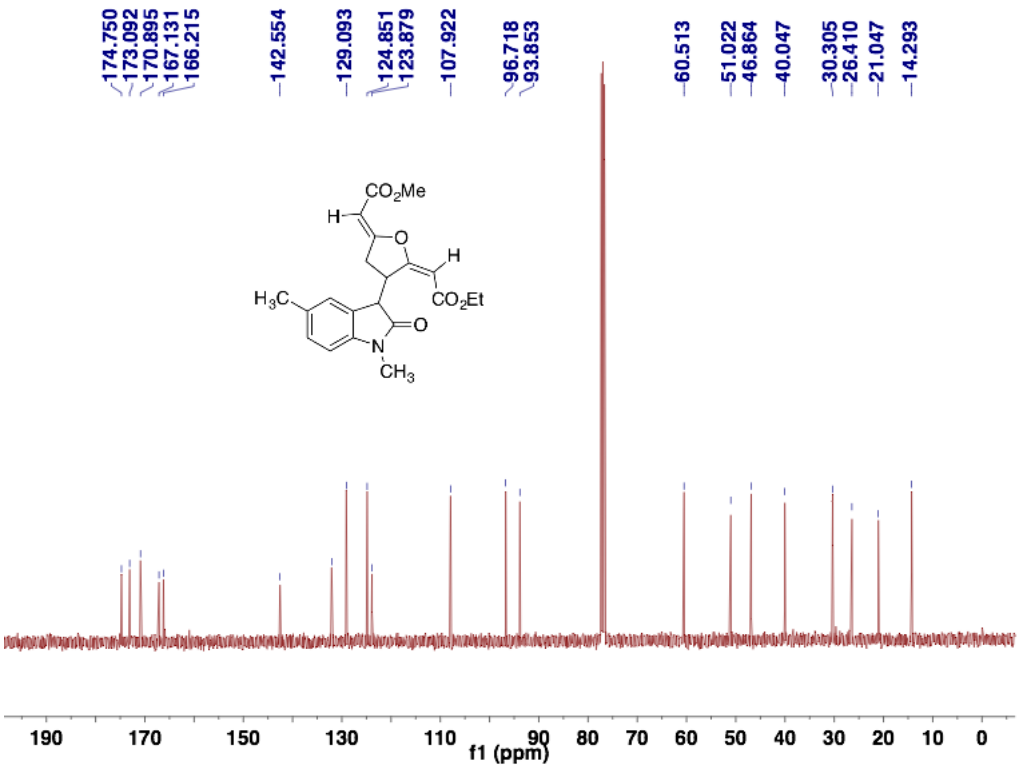
7.043
7.041
7.039
6.888
6.689
6.669
5.834
5.831
5.335
5.330
5.325
4.535
4.510
4.245
4.243
3.559
3.211
2.976
2.533
2.257
1.348
1.330
1.312
CO2Me
H
O
H
H3C
CO2Et
O
N
CH3
0.98
0.98
0.99
0.98
0.98
1.00
2.84
3.00
2.99
1.00
0.97
3.01
2.98
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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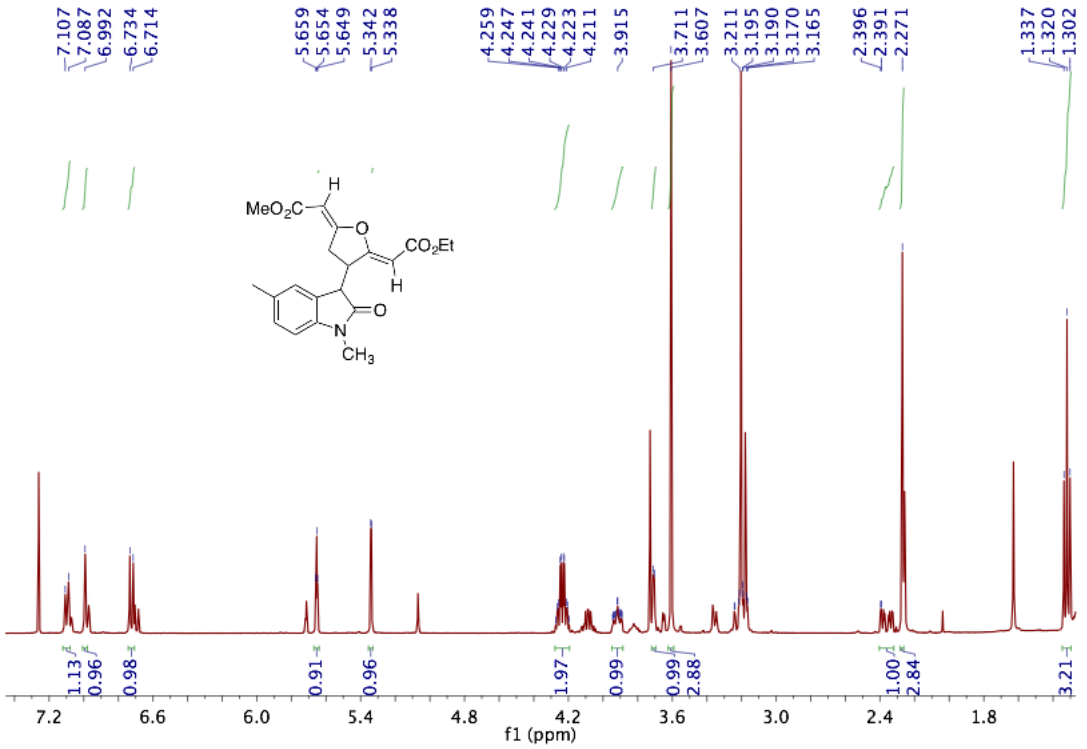
173.092
170.895
167.131
166.215
142.554
129.093
124.851
123.879
107.922
96.718
93.853
60.513
51.022
46.864
40.047
30.305
26.410
21.047
14.293
CO2Me
H
O
H
H3C
CO2Et
O
N
CH3
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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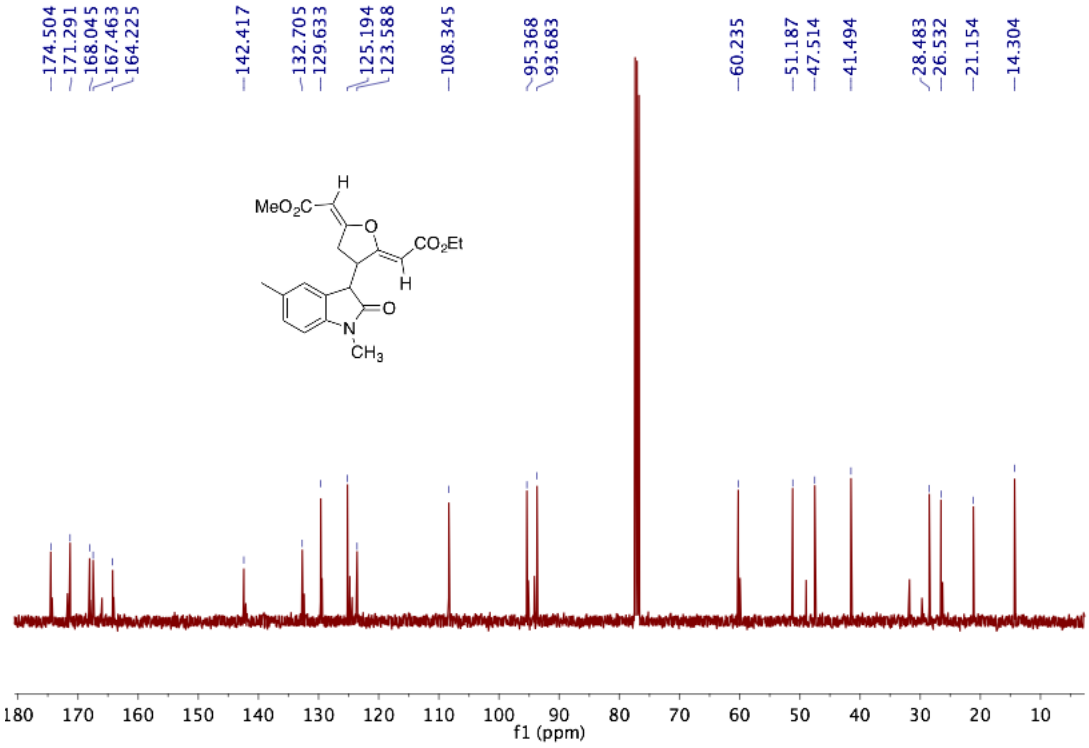
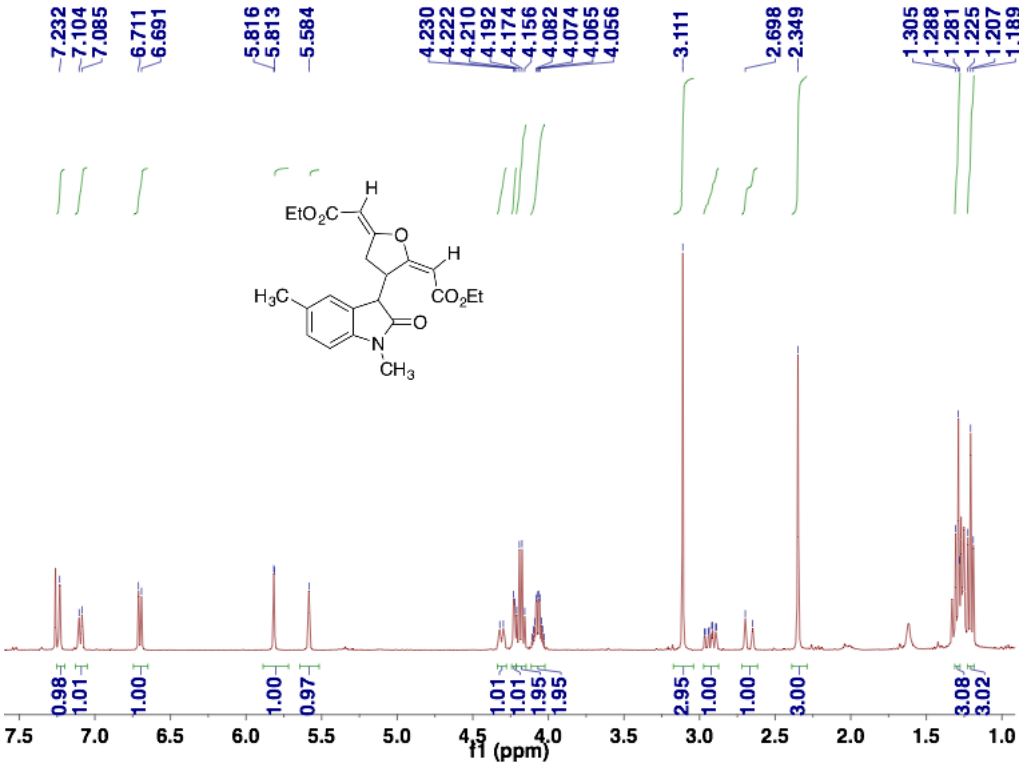
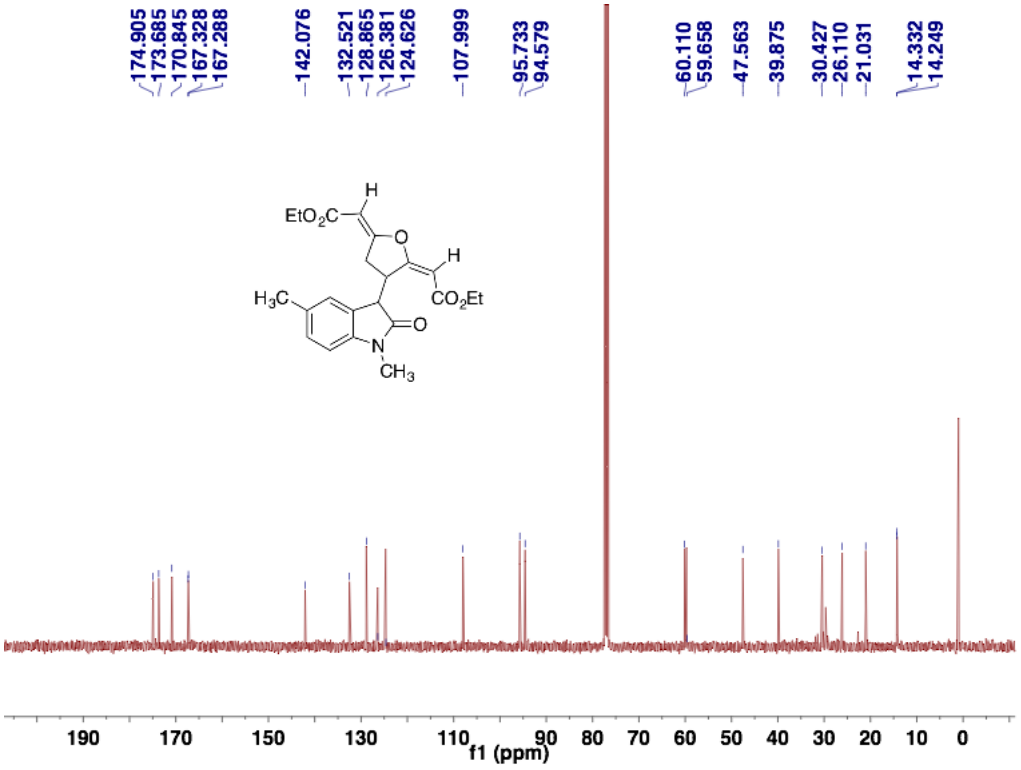
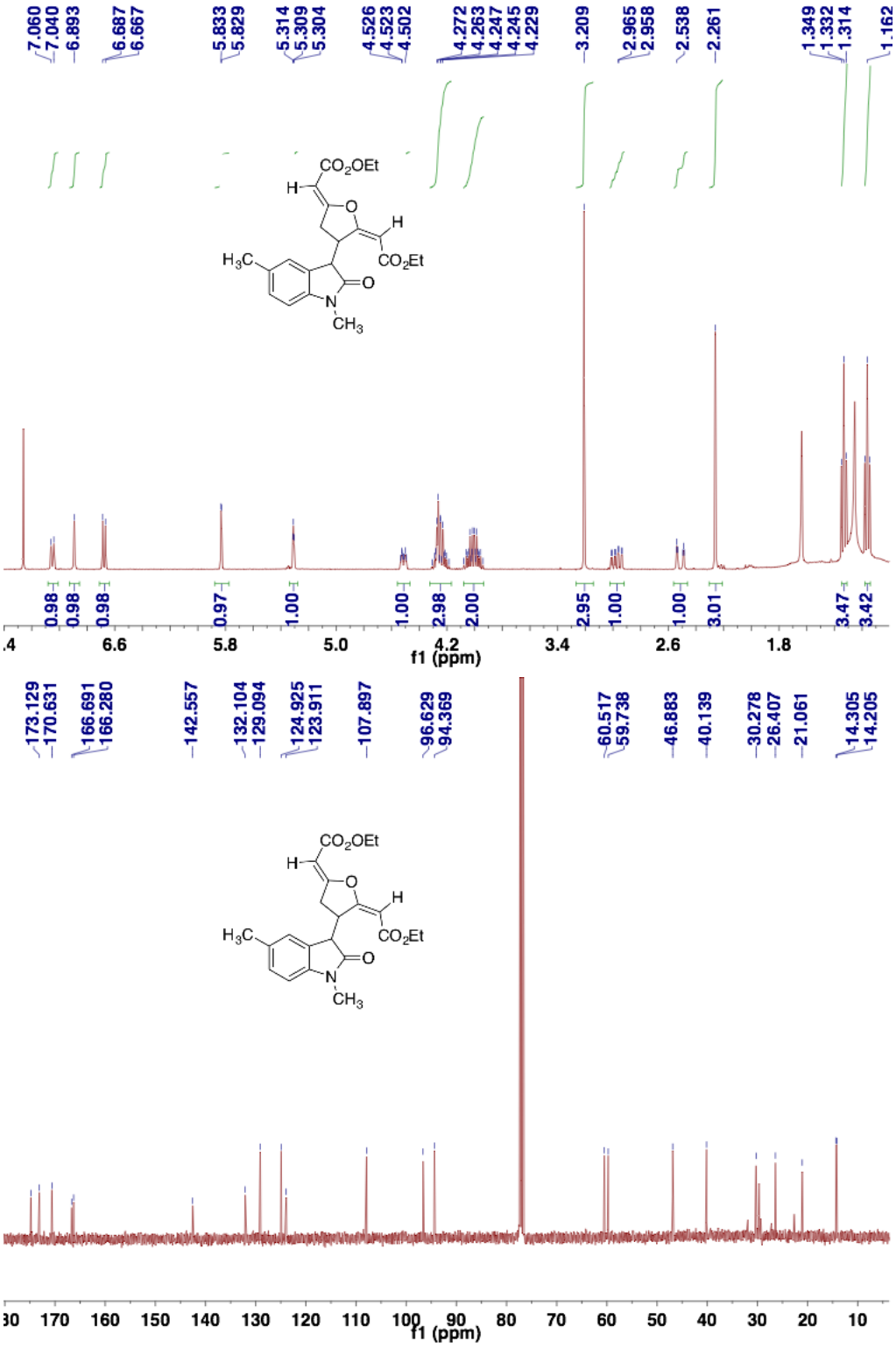
7.087
6.992
6.734
6.714
5.659
5.654
5.649
5.342
5.338
4.259
4.247
4.241
4.229
4.223
4.211
3.915
3.711
3.607
3.211
3.195
3.190
3.170
3.165
2.396
2.391
2.271
1.337
1.320
1.302
MeO2C
CO2Et
H
O
N
CH3
1.13
0.96
0.98
0.91
0.96
1.97
0.99
0.99
2.88
1.00
2.84
3.21
7.2
6.6
6.0
5.4
4.8
4.2
3.6
3.0
2.4
1.8
f1 (ppm)


174.504
171.291
168.045
167.463
164.225
142.417
132.705
129.633
125.194
123.588
108.345
95.368
93.683
60.235
51.187
47.514
41.494
28.483
26.532
21.154
14.304
MeO2C
CO2Et
H
O
N
CH3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


7.232
7.104
7.085
6.711
6.691
5.816
5.813
5.584
4.230
4.222
4.210
4.192
4.174
4.156
4.082
4.074
4.065
4.056
3.111
2.698
2.349
1.305
1.288
1.281
1.225
1.207
1.189
EtO2C
H
O
H
CO2Et
H3C
O
N
CH3
0.98
1.01
1.00
1.00
0.97
1.01
1.01
1.95
1.95
2.95
1.00
1.00
3.00
3.08
3.02
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
f1 (ppm)


174.905
173.685
170.845
167.328
167.288
142.076
132.521
128.865
126.381
124.626
107.999
95.733
94.579
60.110
59.658
47.563
39.875
30.427
26.110
21.031
14.332
14.249
EtO2C
H
O
H
CO2Et
H3C
O
N
CH3
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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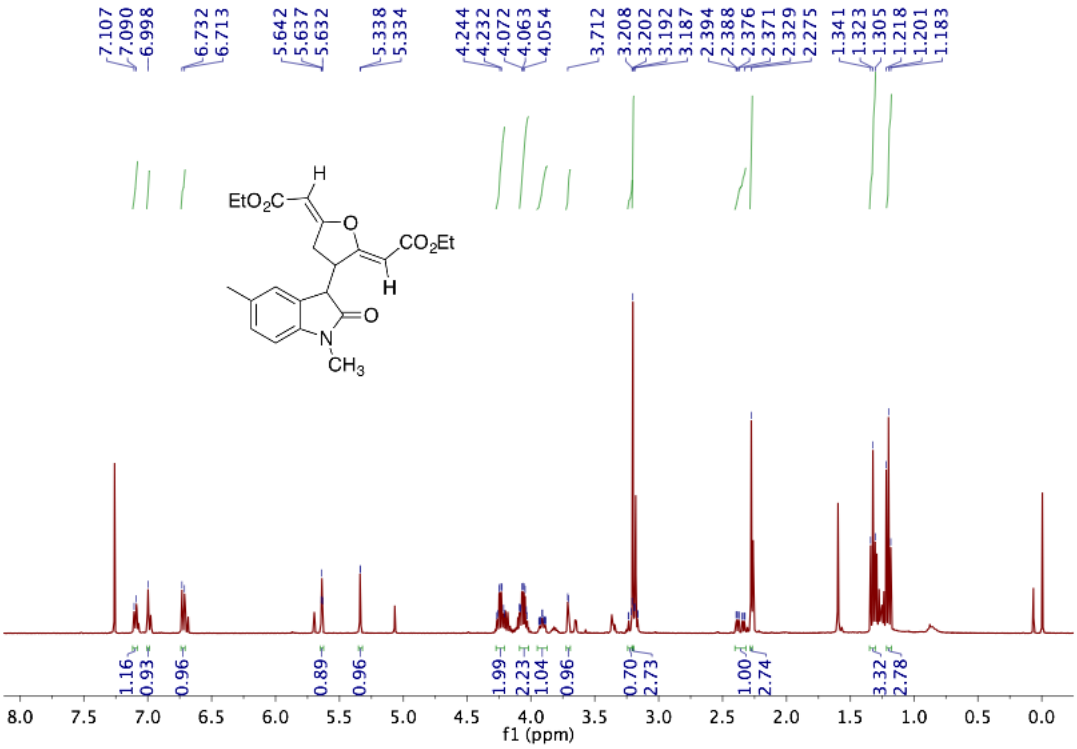
7.040
6.893
6.687
6.667
5.833
5.829
5.314
5.309
5.304
4.526
4.523
4.502
4.272
4.263
4.247
4.245
4.229
3.209
2.965
2.958
2.538
2.261
1.349
1.332
1.314
1.162
CO2OEt
H
O
H
CO2Et
H3C
O
N
CH3
0.98
0.98
0.98
0.97
1.00
1.00
2.98
2.00
2.95
1.00
1.00
3.01
3.47
3.42
6.6
5.8
5.0
4.2
3.4
2.6
1.8
f1 (ppm)
173.129
170.631
166.691
166.280
142.557
132.104
129.094
124.925
123.911
107.897
96.629
94.369
60.517
59.738
46.883
40.139
30.278
26.407
21.061
14.305
14.205
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)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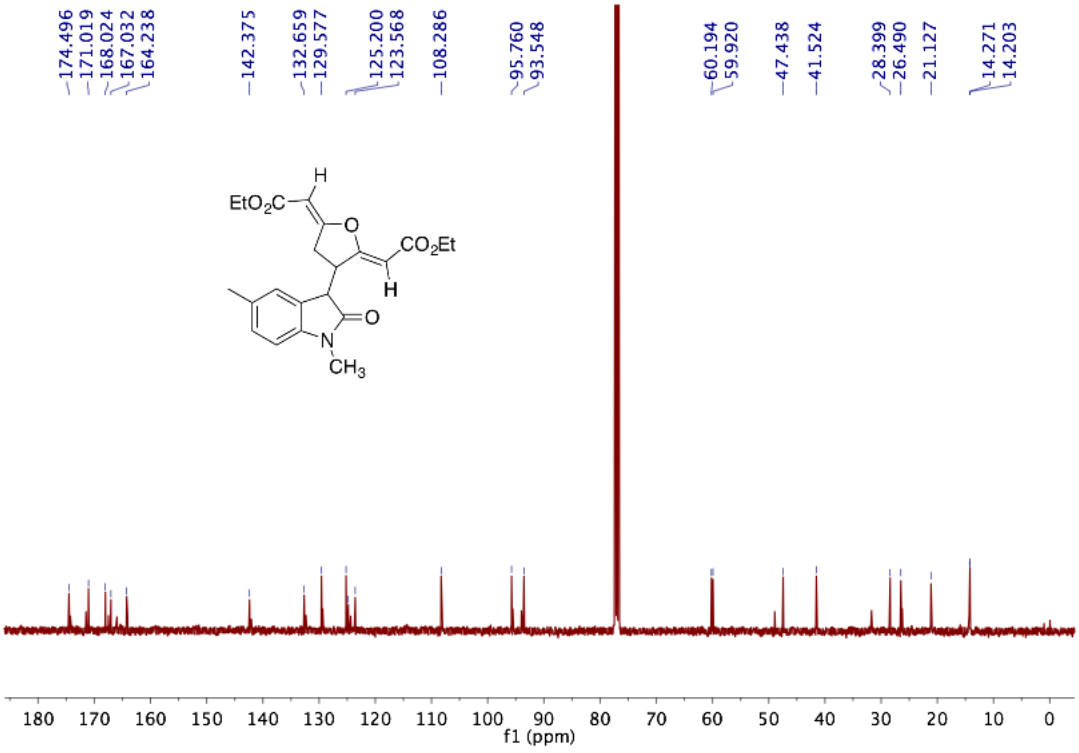
7.090
6.998
6.732
6.713
5.642
5.637
5.632
5.338
5.334
4.244
4.232
4.072
4.063
4.054
3.712
3.208
3.202
3.192
3.187
2.394
2.388
2.376
2.371
2.329
2.275
1.341
1.323
1.305
1.218
1.201
1.183
EtO2C
H
O
CO2Et
H
O
N
CH3
1.16
0.93
0.96
0.89
0.96
1.99
2.23
1.04
0.96
0.70
2.73
1.00
2.74
3.32
2.78
8.0
7.5
7.0
6.5
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)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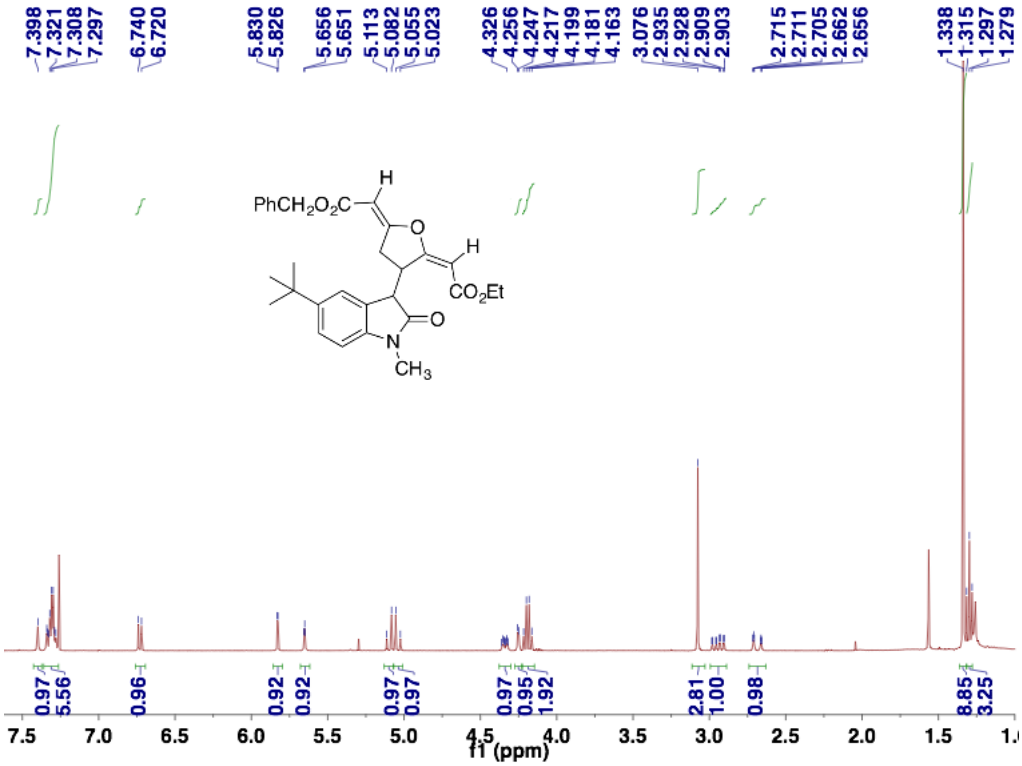
171.019
168.024
167.032
164.238
142.375
132.659
129.577
125.200
123.568
108.286
95.760
93.548
60.194
59.920
47.438
41.524
28.399
26.490
21.127
14.271
14.203
EtO2C
H
O
CO2Et
H
O
N
CH3
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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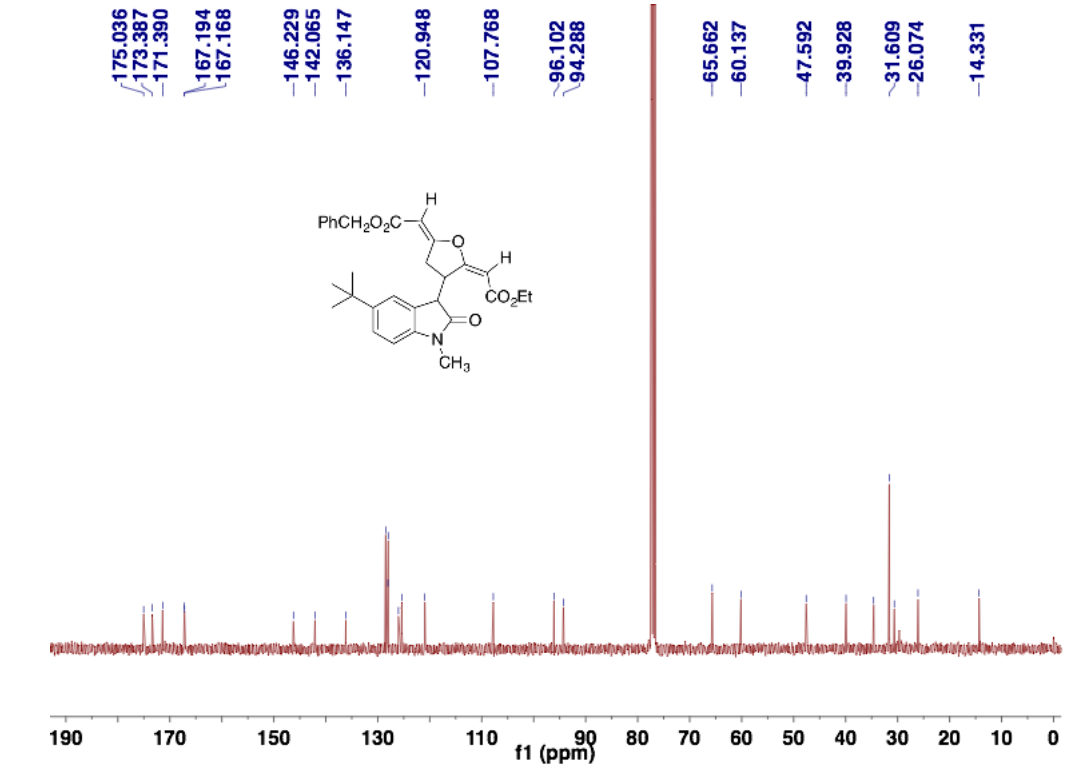
7.321
7.308
7.297
6.740
6.720
5.830
5.826
5.656
5.651
5.113
5.082
5.055
5.023
4.326
4.256
4.247
4.217
4.199
4.181
4.163
3.076
2.935
2.928
2.909
2.903
2.715
2.711
2.705
2.662
2.656
1.338
1.315
1.297
1.279
PhCH2O2C
H
O
H
CO2Et
O
N
CH3
0.97
5.56
0.96
0.92
0.92
0.97
0.97
0.97
0.95
1.92
2.81
1.00
0.98
8.85
3.25
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)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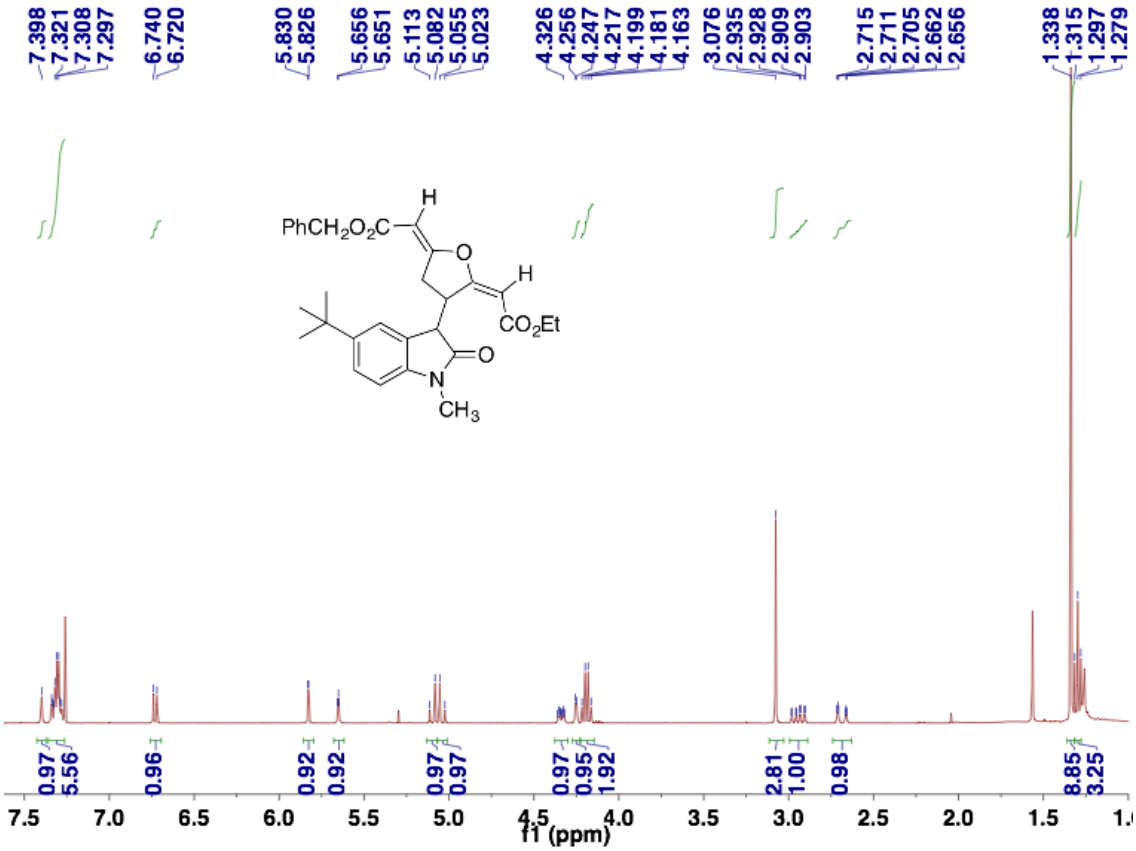
167.194
167.168
146.229
142.065
136.147
120.948
107.768
96.102
94.288
65.662
60.137
47.592
39.928
31.609
26.074
14.331
PhCH2O2C
H
O
H
CO2Et
O
N
CH3
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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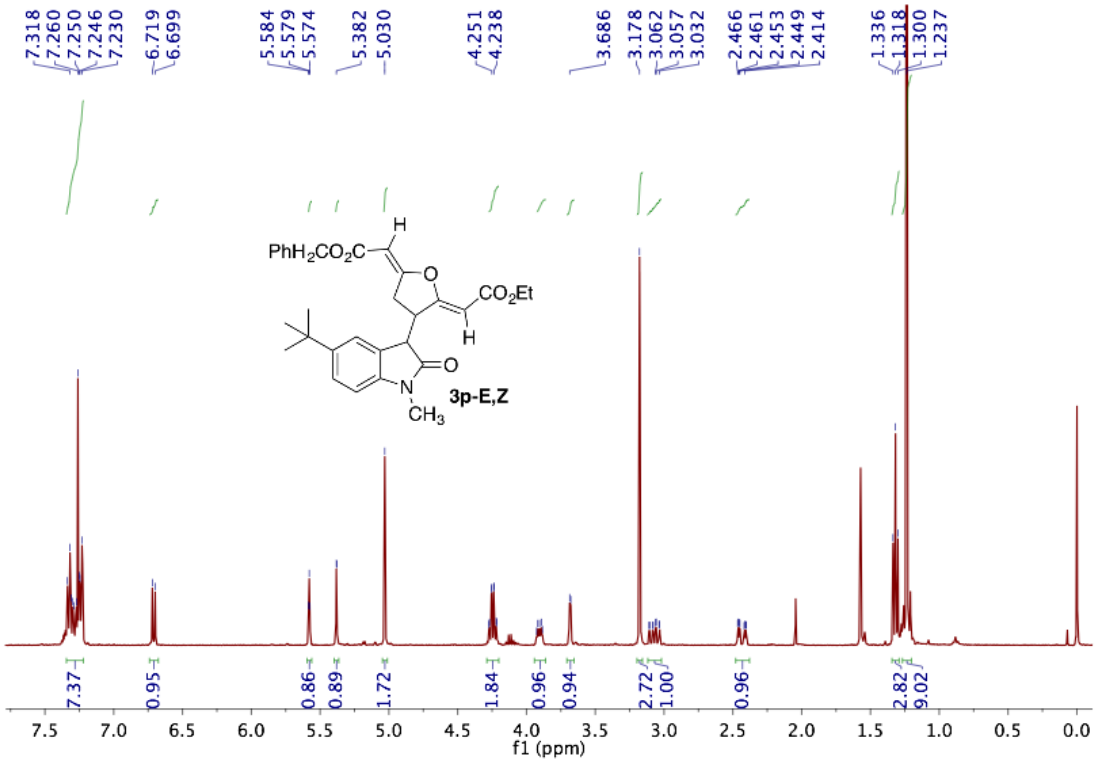
7.321
7.308
7.297
6.740
6.720
5.830
5.826
5.656
5.651
5.113
5.082
5.055
5.023
4.326
4.256
4.247
4.217
4.199
4.181
4.163
3.076
2.935
2.928
2.909
2.903
2.715
2.711
2.705
2.662
2.656
1.338
1.315
1.297
1.279
PhCH2O2C
H
O
H
CO2Et
O
N
CH3
0.97
5.56
0.96
0.92
0.92
0.97
0.97
0.97
0.95
1.92
2.81
1.00
0.98
8.85
3.25
f1 (ppm)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7.250
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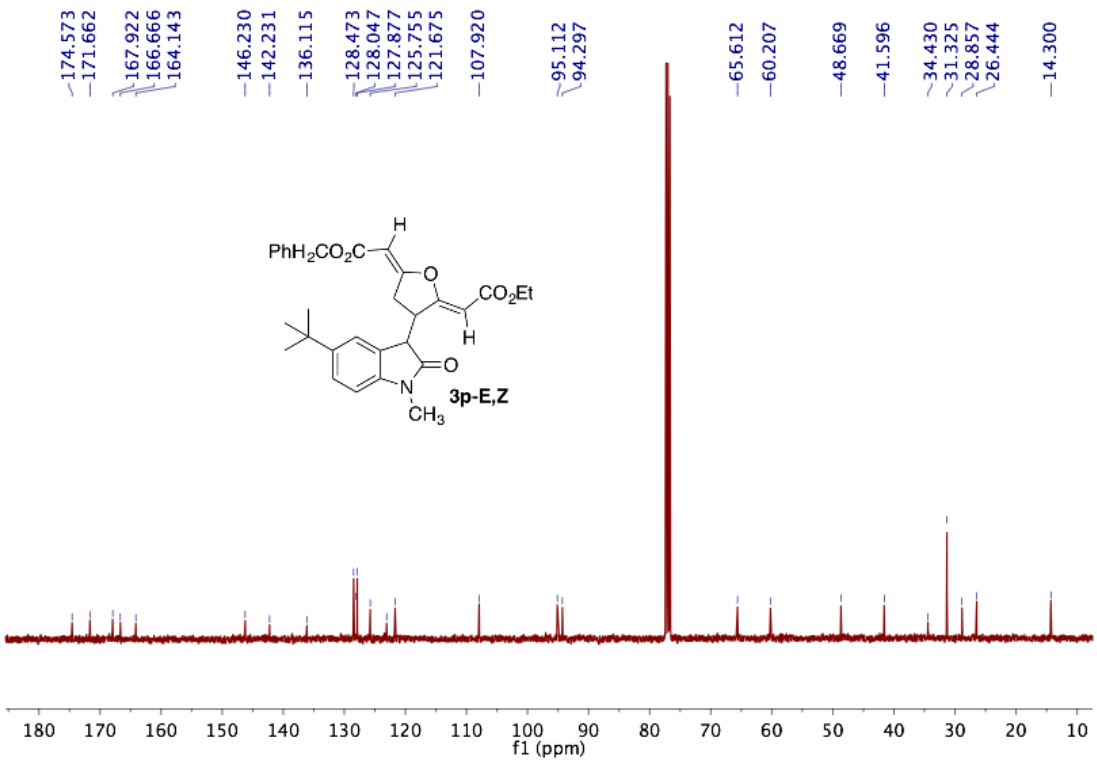
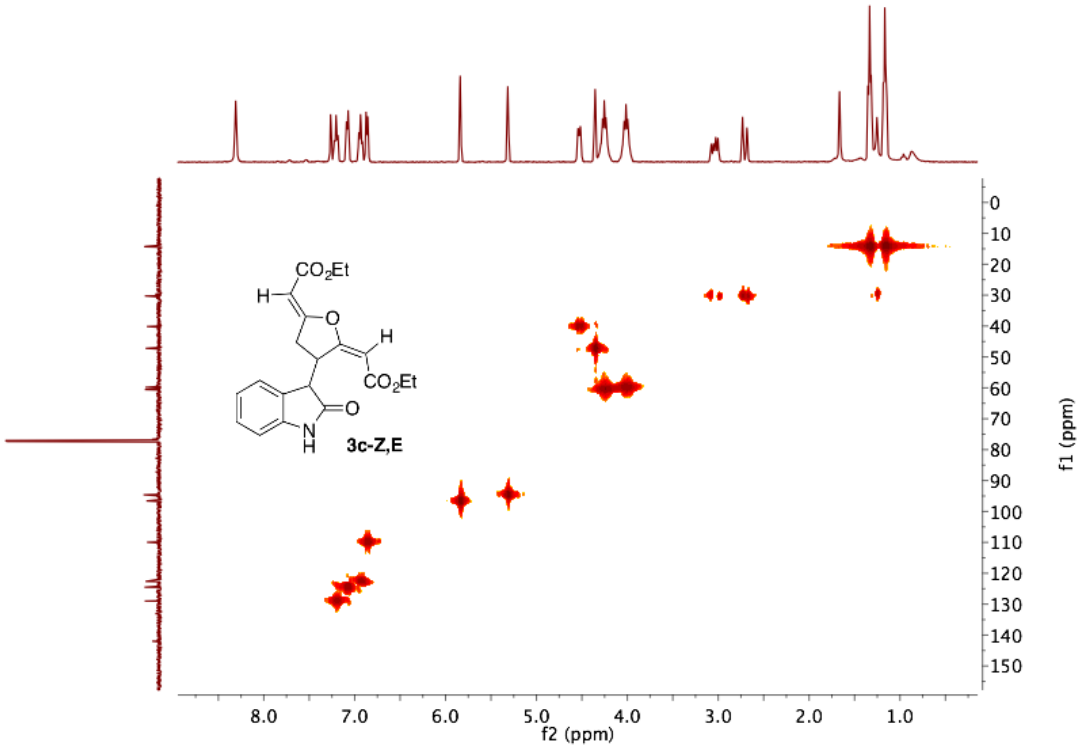
7.230
6.719
6.699
5.584
5.579
5.574
5.382
5.030
4.251
4.238
3.686
3.178
3.062
3.057
3.032
2.466
2.461
2.453
2.449
2.414
1.336
1.318
1.300
1.237
PhH2CO2C
H
O
CO2Et
H
O
N
CH3
3p-E,Z
7.37
0.95
0.86
0.89
1.72
1.84
0.96
0.94
2.72
1.00
0.96
2.82
9.02
f1 (ppm)

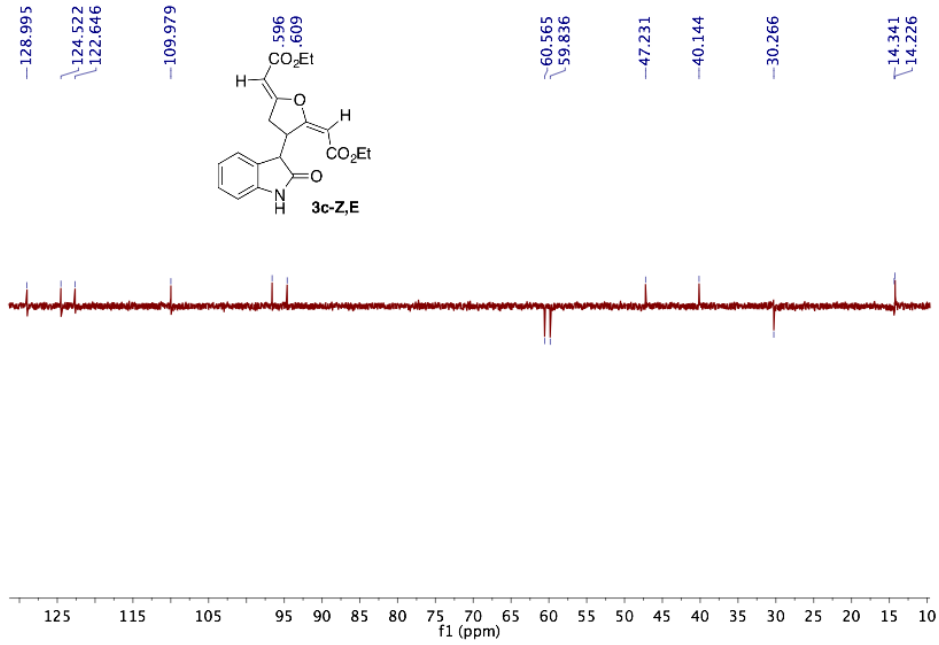


6. 2D NMR

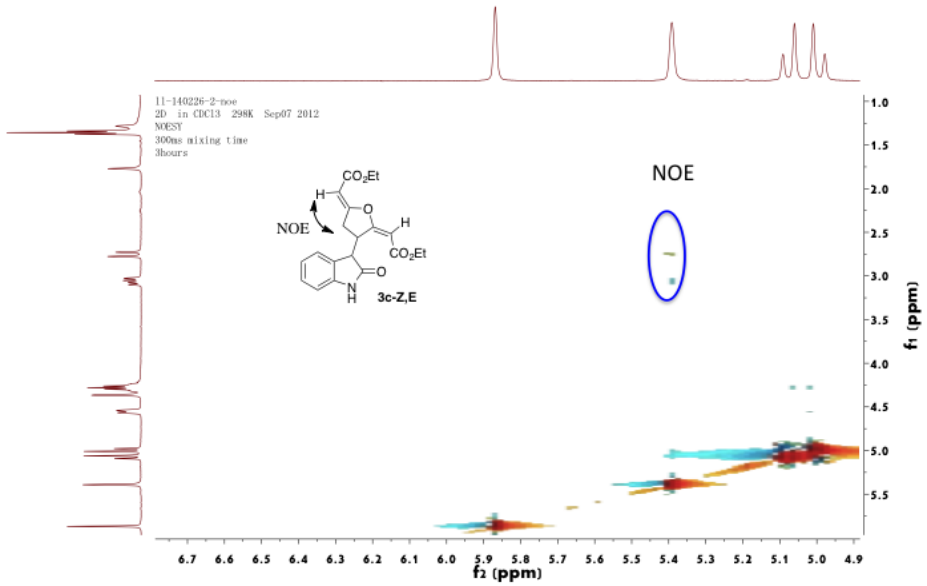
HMQC-3cZ,E



Dept-135



NOESY-3c-Z,E



7. X-Ray crystal structure of 3l-E,E