Supporting Information

Phosphine-Mediated Reaction of 3-Methyl Allenoate and Isatins: A Protocol for the Synthesis of Spirofuran Oxindoles

Anu Jose,[a] Jayakrishnan A. J.,[a] Seetha Lakshmi K. C., [a] Sunil Varughese,[a] and Vijay Nair*[a]

[a] Chemical Science and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Trivandrum 695 019, India

E-mail: vijaynair_2001@yahoo.com

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1. General

Melting points were recorded on a Büchi melting point apparatus and are uncorrected. NMR spectra were recorded at 500 (^{1}H) and 126 (^{13}C) MHz on Bruker Avance DPX-500S MHz NMR spectrometer. Chemical shifts (δ) are reported relative to TMS (^{1}H) and $CDCl_3$ (^{13}C) as the internal standards. Coupling constant (*J*) is reported in Hertz (Hz). Mass spectra were recorded under HRMS (ESI) using Thermo Scientific Exactive Orbitrap mass spectrometer. IR spectra were recorded on a Bruker Alpha-T FT-IR spectrophotometer. Allenoates were prepared using known literature procedures.[1] Isatins were purchased from Sigma-Aldrich and the *N*-protection was carried out using known procedures.[2] Gravity column chromatography was performed using silica gel and mixtures of petroleum ether-ethyl acetate were used for elution.

2. General experimental procedure for the synthesis of spiro tetrahydrofuran oxindole derivatives

A solution of the isatin (0.5 mmol) and the allenoate (0.75 mmol) in dry THF (5 ml) was taken in a round bottom flask under argon atmosphere. To this solution triphenylphosphine (0.75 mmol) was added and stirred for 30 min. The crude product after

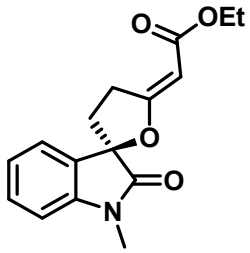
[1] Lang, R. W.; Hansen, H.-J. *Org. Synth. Coll. Vol*. **1990**, *7*, 232; 1984, 62, 202.

[2] Shmidt, M. S.; Reverdito, A. M.; Kremenchuzky, L.; Perillo, I. A.; Blanco, M. M. *Molecules* **2008**, *13*, 831

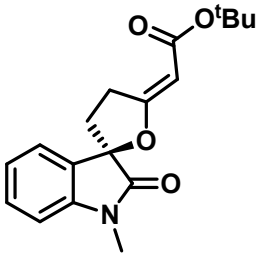
removal of the solvent was purified by column chromatography using 100-200 silica gel and 85:15 hexane: ethyl acetate as the eluent afforded spirotetrahydrofuran oxindole derivative.

3. Characterization data for compounds

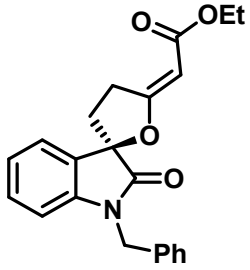
(*E*)-Ethyl 2-(1'-methyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (8)

	Yield: 126 mg (88%), pale yellow oil. **IR** (film) ν_{max}: 1721, 1701, 1643, 1614, 1112, 1054 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.36 (t, *J* = 7.5 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.41 (s, 1H), 4.14 (q, *J* = 7.0 Hz, 2H), 3.56 – 3.52 (m, 2H), 3.18 (d, *J* = 1.5 Hz, 3H), 2.52 – 2.47 (m, 1H), 2.33 – 2.27 (m, 1H), 1.27 (t, *J* = 7.0 Hz, 3H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 175.0, 174.1, 167.8, 143.9, 130.8, 126.9, 123.9, 123.3, 108.6, 91.7, 85.5, 59.3, 33.0, 30.3, 26.2, 14.5 ppm. **HRMS (ESI-MS)** calcd for $C_{16}H_{17}NO_4Na^+$310.10553; Found: 310.10452.

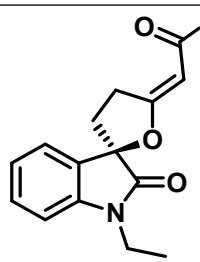
(*E*)-*Tert*-butyl 2-(1'-methyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4H)-ylidene)acetate (9)

	Yield: 129 mg (82%), pale yellow oil. **IR** (film) ν_{max}: 1726, 1698, 1644, 1615, 1109, 1057 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.36 (t, *J* = 7.5 Hz, 1H), 7.28 (d, *J* = 7.5 Hz, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.83 (d, *J* = 8.0 Hz, 1H), 5.35 (s, 1H), 3.53 – 3.49 (m, 2H),3.19 (s, 3H), 2.52 – 2.46 (m, 1H), 2.32 – 2.25 (m, 1H), 1.48 (s, 9H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 174.3, 173.9, 167.3, 143.9, 130.8, 127.1, 123.9, 123.3, 108.6, 93.5, 85.1, 79.1, 33.15, 30.0, 28.4, 26.2 ppm. **HRMS (ESI-MS)** calcd for $C_{18}H_{21}NO_4Na^+$338.13683; Found: 338.13568.

(*E*)-Ethyl 2-(1'-benzyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (10)

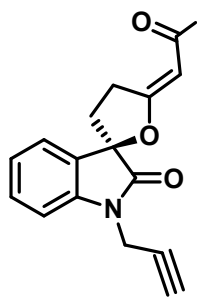
	Yield: 131 mg (72%), pale yellow oil. **IR** (film) ν_{max}: 1718 (broad), 1647, 1614, 1113, 1053 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.31 – 7.20 (m, 7H), 7.03 (t, *J* = 7.5 Hz, 1H), 6.70 (d, *J* = 8.0 Hz, 1H), 5.45 (s, 1H), 4.84 (q, *J* = 16.0 Hz, 2H), 4.15 (q, *J* = 7.0 Hz, 2H), 3.58 (t, *J* = 7.5 Hz, 2H), 2.58 – 2.53 (m, 1H), 2.36 – 2.30 (m, 1H), 1.27 (t, *J* = 7.0 Hz, 3H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 175.0, 174.4, 167.8, 143.1, 135.1, 130.7, 128.9, 127.8, 127.2, 127.0, 124.1, 123.4, 109.7, 91.9, 85.5, 59.3, 43.8, 33.4, 30.3, 14.5ppm. **HRMS (ESI-MS)** calcd for $C_{22}H_{21}NO_4Na^+$386.13683; Found: 386.13594.

(*E*)-Ethyl 2-(1'-ethyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (11)



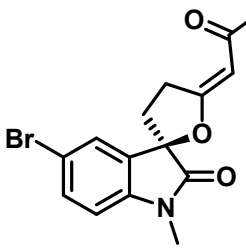
Yield: 117 mg (78%), pale yellow oil.
IR (film) ν_{max}: 1722 (broad), 1648, 1615, 1117, 1059 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.34 (t, *J* = 7.5 Hz, 1H), 7.29 (d, *J* = 7.5 Hz, 1H), 7.07 (t, *J* = 7.5 Hz, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 5.42 (s, 1H), 4.15 (q, *J* = 7.0 Hz, 2H), 3.73 (q, *J* = 7.0 Hz, 2H), 3.56 – 3.53 (m, 2H), 2.53 – 2.48 (m, 1H), 2.32 – 2.26 (m, 1H), 1.30 – 1.25 (m, 6H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$): δ 175.0, 173.8, 167.8, 143.0, 130.7, 127.2, 124.2, 123.1, 108.7, 91.7, 85.4, 59.2, 34.8, 33.1, 30.3, 14.5, 12.5 ppm.
HRMS (ESI-MS) calcd for $C_{17}H_{19}NO_4Na^+$324.12118; Found: 324.11960.

(*E*)-Ethyl 2-(2'-oxo-1'-(prop-2-ynyl)-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (12)



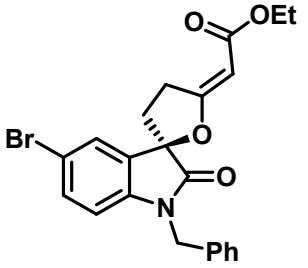
Yield: 106 mg (68%), colourless oil.
IR (film) ν_{max}: 1719 (broad), 1648, 1614, 1112, 1055 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.38 (t, *J* = 8.0 Hz, 1H), 7.30 (d, *J* = 7.5 Hz, 1H), 7.12 (t, *J* = 7.5 Hz, 1H), 7.06 (d, *J* = 8.0 Hz, 1H), 5.35 (s, 1H), 4.55 (dd, J_1 = 17.5 Hz, J_2 = 1.5 Hz, 1H), 4.36 (dd, J_1 = 18.0 Hz, J_2 = 2.0 Hz, 1H), 3.52 – 3.49 (m, 2H), 2.54 – 2.49 (m, 1H), 2.33 – 2.23 (m, 2H), 1.48 (s, 9H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$): δ 173.7, 173.4, 167.2, 142.0, 130.7, 127.1, 124.0, 123.7, 109.7, 93.7, 85.1, 79.1, 76.3, 72.9, 33.4, 29.9, 29.3, 28.4 ppm.

(*E*)-Ethyl 2-(5'-bromo-1'-methyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (13)



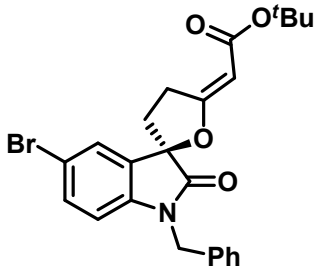
Yield: 99 mg (54%), pale yellow oil.
IR (film) ν_{max}: 1729, 1705, 1650, 1612, 1118, 1059 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.48 (d, *J* = 8.5 Hz, 1H), 7.40 (s, 1H), 6.71 (t, *J* = 8.0 Hz, 1H), 5.41 (s, 1H), 4.15 (q, *J* = 7.0 Hz, 2H), 3.55 – 3.52 (m, 2H), 3.18 (s, 3H), 2.53 – 2.48 (m, 1H), 2.32 – 2.26 (m, 1H), 1.29 (t, *J* = 7.5 Hz, 3H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$) δ 174.4, 173.6, 167.6, 142.9, 133.5, 129.1, 127.3, 115.9, 109.9, 92.2, 84.9, 59.4, 33.2, 30.1, 26.3, 14.5 ppm.
HRMS (ESI-MS) calcd for $C_{16}H_{16}BrNO_4Na^+$ 388.01604; Found: 388.01486.

(*E*)-Ethyl 2-(1'-benzyl-5'-bromo-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (14)



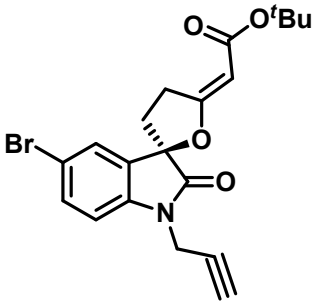
Yield: 157 mg (71%), colourless solid (mp 132-133 ^{o}C).
IR (film) ν_{max}: 1734 (broad), 1651, 1265, 1118 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.31 – 7.20 (m, 7H), 7.03 (t, *J* = 7.5 Hz, 1H), 6.70 (d, *J* = 8.0 Hz, 1H), 5.45 (s, 1H), 4.89 – 4.81 (m, 2H), 4.15 (q, *J* = 7.0 Hz, 2H), 3.59 – 3.56 (m, 2H), 2.58 – 2.53 (m, 1H), 2.36 – 2.30 (m, 1H), 1.27 (t, *J* = 7.0 Hz, 3H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$):δ 174.4, 173.9, 167.7, 142.0, 134.6, 133.5, 129.0, 128.0, 127.4, 127.2, 116.1, 111.2, 92.3, 85.1, 59.5, 43.9, 33.5, 30.1, 14.5 ppm.
HRMS (ESI-MS) calcd for $C_{22}H_{20}BrNO_4Na^+$464.04734; Found: 464.04697.

(*E*)-*Tert*-butyl 2-(1'-benzyl-5'-bromo-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (15)



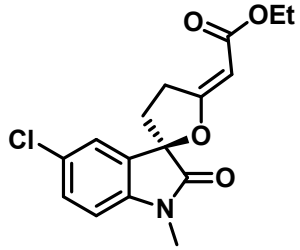
Yield: 122 mg (52%), pale yellow solid (m p 40-42^{o}C).
IR (film) ν_{max}: 1734 (broad), 1651, 1265, 1114 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.40 (d, *J* = 7.0 Hz, 1H), 7.36 – 7.31 (m, 3H), 7.29 – 7.27 (m, 1H), 7.25 – 7.23 (m, 2H), 6.57 (d, *J* = 8.5 Hz, 1H), 5.39 (t, *J* = 1.5 Hz, 1H), 4.88 – 4.80 (m, 2H), 3.56 – 3.52 (m, 2H), 2.59 – 2.54 (m, 1H), 2.35 – 2.29 (m, 1H), 1.49 (s, 9H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$): δ 174.1, 173.4, 167.2, 142.0, 134.6, 133.4, 129.3 129.0, 128.0, 127.4, 127.2, 116.1, 111.1, 94.1, 84.8, 79.3, 43.9, 33.6, 29.9, 28.4ppm.
HRMS (ESI-MS) calcd for $C_{24}H_{24}BrNO_4Na^+$ 492.07864; Found: 492.07806

(*E*)-*Tert*-butyl 2-(5'-bromo-2'-oxo-1'-(prop-2-ynyl)-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (16)

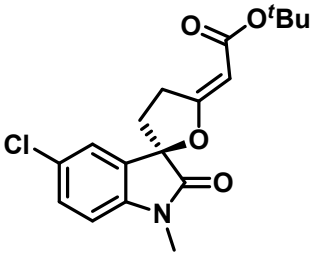


Yield: 127 mg (61%), yellow solid (m p 55-57^{o}C).
IR (film) ν_{max}: 1737, 1702, 1649, 1265, 1114 cm^{-1}.
^{1}H NMR (500 MHz, $CDCl_3$): δ 7.51 (dd, J_1 = 8.5 Hz, J_2 = 2.0 Hz, 1H), 7.43 (d, *J* = 2.0 Hz, 1H), 6.96 (d, *J* = 8.0 Hz, 1H), 5.36 (t, *J* = 1.5 Hz, 1H), 4.54 (dd, J_1 = 17.5 Hz, J_2 = 2.5 Hz, 1H), 4.36 (dd, J_1 = 18.0 Hz, J_2 = 2.5 Hz, 1H), 3.52 – 3.48 (m, 2H), 2.55 – 2.50 (m, 1H), 2.32 – 2.25 (m, 1H), 1.49 (s, 9H) ppm.
^{13}C NMR (126 MHz, $CDCl_3$): δ 173.2, 173.0, 167.1, 141.0, 133.5, 129.1, 127.4, 116.4, 111.3, 94.1, 84.7, 79.4, 75.85, 73.28, 33.5, 29.8, 29.5, 28.4ppm.
HRMS (ESI-MS) calcd for $C_{20}H_{20}BrNO_4Na^+$440.04734; Found: 440.04630.

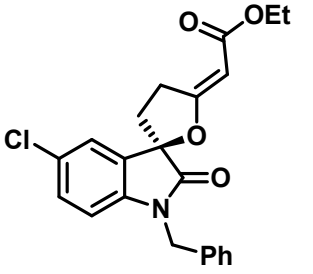
(*E*)-Ethyl 2-(5'-chloro-1'-methyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (17)

	Yield: 122 mg (76%), colourless oil. **IR** (film) ν_{max}: 1726, 1701, 1646, 1613, 1113, 1056 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.34 (d, *J* = 8.5 Hz, 1H), 7.28 (s, 1H), 6.77 (t, *J* = 8.0 Hz, 1H), 5.42 (s, 1H), 4.16 (q, *J* = 8.0 Hz, 2H), 3.55 – 3.52 (m, 2H), 3.18 (s, 3H), 2.54 – 2.49 (m, 1H), 2.33 – 2.26 (m, 1H), 1.28 (t, *J* = 7.0 Hz, 3H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 174.5, 173.8, 167.7, 142.4, 130.7, 128.8, 128.6, 124.6, 109.6, 92.2, 85.1, 59.4, 33.2, 30.1, 26.4, 14.5ppm. **HRMS (ESI-MS)** calcd for $C_{16}H_{16}ClNO_4Na^+$344.06656; Found: 344.06512.

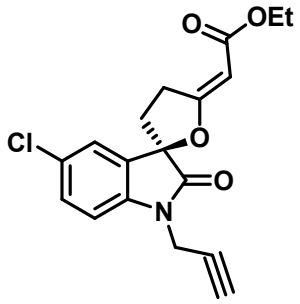
(*E*)-*Tert*-butyl 2-(5'-chloro-1'-methyl-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene)acetate (18)

	Yield: 126 mg (72%), colourless oil. **IR** (film) ν_{max}: 1728, 1702, 1648, 1613, 1110, 1059 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.33 (dd, J_1 = 8.5 Hz, J_2 = 2.0 Hz, 1H), 7.26 (s, 1H), 6.76 (d, *J* = 8.5 Hz, 1H), 5.34 (s, 1H), 3.52 – 3.48 (m, 2H),3.18 (s, 3H), 2.52 – 2.47 (m, 1H), 2.30 – 2.24 (m, 1H), 1.48 (s, 9H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 173.9, 173.4, 167.1, 142.4, 130.5, 129.0, 128.8, 124.6, 109.5, 93.9, 84.7, 79.2, 33.3, 29.8, 28.4, 26.3ppm. **HRMS (ESI-MS)** calcd for $C_{18}H_{20}ClNO_4Na^+$372.09786; Found: 372.09601.

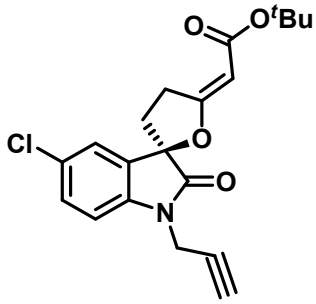
(*E*)-Ethyl 2-(1'-benzyl-5'-chloro-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (19)

	Yield: 151 mg (76%), yellow solid (m p123-125 ^oC). **IR** (film) ν_{max}: 1732, 1708, 1650, 1264, 1117 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.33 – 7.31 (m, 2H), 7.29 – 7.28 (m, 2H), 7.21 (dd, J_1 = 8.5 Hz, J_2 = 2.5 Hz, 1H), 6.62 (d, *J* = 8.5 Hz, 1H), 5.47(t, *J* = 2.0 Hz, 1H),4.89 – 4.81 (m, 2H), 4.17 (dq, J_1 = 7.0 Hz, J_2 = 2.0 Hz, 1H), 3.60 – 3.56 (m, 2H),2.61 – 2.56 (m, 1H), 2.37 – 2.31 (m, 1H), 1.29 (t, *J* = 7.0 Hz, 3H)ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 174.5, 174.0, 167.7, 141.5, 134.7, 130.6, 129.0, 128.90, 128.7, 128.0, 127.2, 124.7, 110.7, 92.3, 85.1, 59.4, 43.9, 33.5, 30.1, 14.5 ppm. **HRMS (ESI-MS)** calcd for $C_{22}H_{20}ClNO_4Na^+$420.09786;Found: 420.09720.

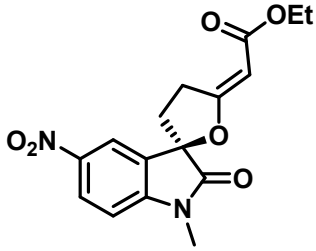
(*E*)-Ethyl 2-(5'-chloro-2'-oxo-1'-(prop-2-ynyl)-3H-spiro[furan-2,3'-indoline]-5(4H)-ylidene)acetate (20)

	Yield: 61 mg (35%), colourless oil. **IR** (film) ν_{max}: 1731, 1703, 1649, 1262, 1115 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.37 (dd, J_1 = 8.3 Hz, J_2 = 2.5 Hz, 1H),7.31 (d, J = 2.0 Hz, 1H), 7.01 (d, J = 8.5 Hz, 1H), 5.44 (t, J = 1.5 Hz, 1H), 4.54 (dd, J_1 = 18.0 Hz, J_2 = 2.5 Hz, 1H),4.37 (dd, J_1 = 17.5 Hz, J_2 = 2.5 Hz, 1H), 4.16 (dq, J_1 = 7.0 Hz, J_2 = 1.0 Hz, 2H), 3.56 – 3.52 (m, 2H),2.57 – 2.52 (m, 1H),2.34 – 2.27 (m, 2H), 1.29 (t, J = 7.0 Hz, 3H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 174.3, 172.9, 167.7, 140.5, 130.7, 129.3, 128.5, 124.7, 110.8, 92.4, 85.0, 75.9, 73.3, 59.5, 33.4, 30.00, 29.5, 14.5 ppm. **HRMS (ESI-MS)** calcd for $C_{18}H_{16}ClNO_4Na^+$ 368.06656; Found: 368.06601.

(*E*)-*Tert*-butyl 2-(5'-chloro-2'-oxo-1'-(prop-2-ynyl)-3H-spiro[furan-2,3'-indoline]-5(4H)-ylidene)acetate (21)

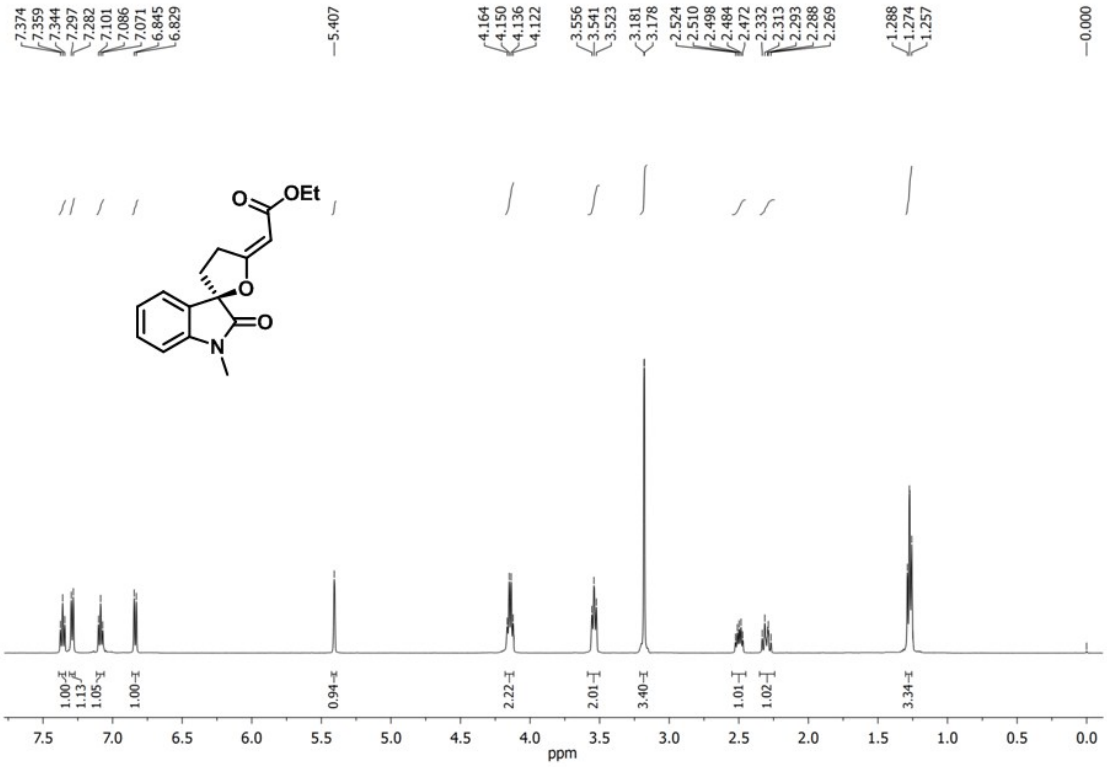
	Yield: 60 mg (32%), colourless oil. **IR** (film) ν_{max}: 1732, 1699, 1649, 1255, 1111 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 7.36 (dd, J_1 = 8.5 Hz, J_2 = 2.0 Hz, 1H),7.29 (d, J = 2.0 Hz, 1H), 7.01 (d, J = 8.5 Hz, 1H), 5.36 (t, J = 1.5 Hz, 1H), 4.54 (dd, J_1 = 17.5 Hz, J_2 = 2.5 Hz, 1H),4.36 (dd, J_1 = 17.5 Hz, J_2 = 2.5 Hz, 1H), 3.52 – 3.48 (m, 2H),2.55 – 2.50 (m, 1H),2.32 – 2.25 (m, 2H), 1.49 (s, 1H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ173.2, 173.0, 167.1, 140.4, 130.6, 129.3, 128.8, 124.6, 110.8, 94.1, 84.7, 79.3, 75.9, 73.3, 33.5, 29.7, 29.5, 28.4. **HRMS (ESI-MS)** calcd for $C_{20}H_{20}ClNO_4Na^+$ 396.09786; Found: 396.09694.

(*E*)-Ethyl 2-(1'-methyl-5'-nitro-2'-oxo-3*H*-spiro[furan-2,3'-indoline]-5(4*H*)-ylidene) acetate (22)

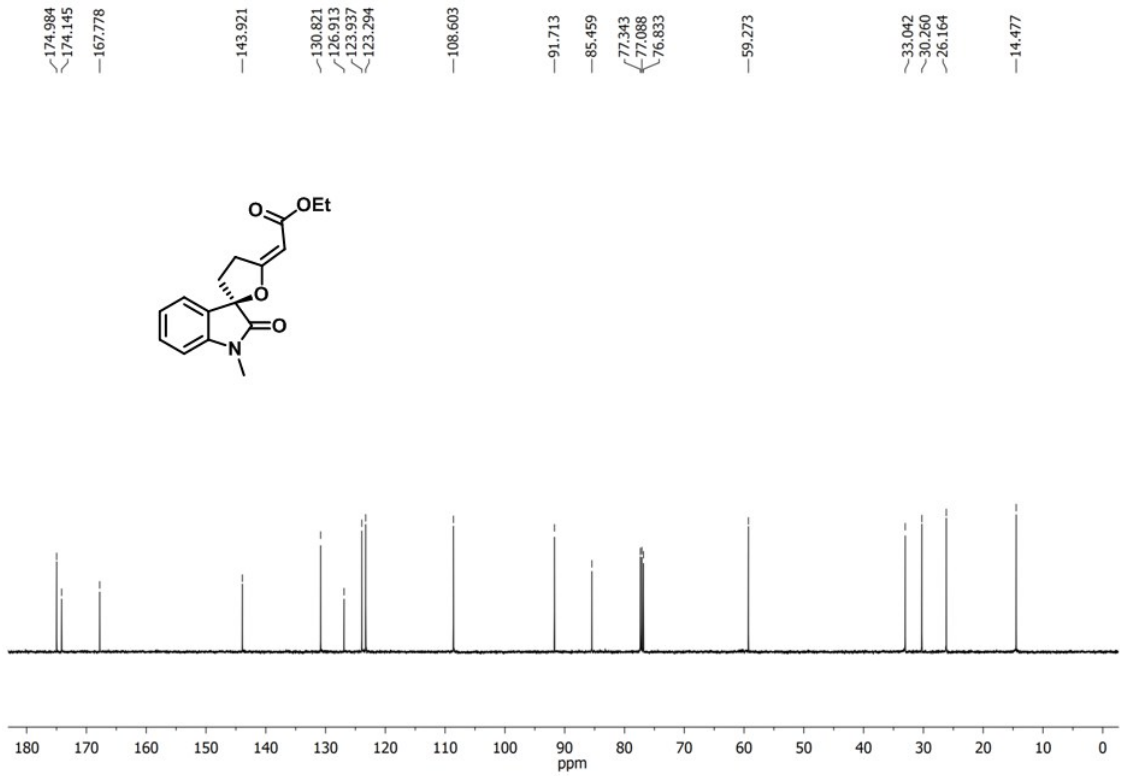
	Yield: 80 mg (48%), colourless oil. **IR** (film) ν_{max}: 1740, 1707, 1656, 1618, 1115, 1064 cm^{-1}. **^{1}H NMR** (500 MHz, $CDCl_3$): δ 8.34 (dd, J_1 = 8.5 Hz, J_2 = 1.5 Hz, 1H), 8.19 (d, J = 1.0 Hz, 1H), 6.95 (d, J = 9.0 Hz, 1H), 5.43 (s, 1H), 4.16 (q, J = 7.0 Hz, 2H), 3.62 – 3.51 (m, 2H),3.28 (s, 3H), 2.58 – 2.52 (m, 1H), 2.41 – 2.35 (m, 1H), 1.29 (t, J = 7.0 Hz, 3H) ppm. **^{13}C NMR** (126 MHz, $CDCl_3$): δ 174.3, 173.8, 167.4, 149.3, 144.0, 127.9, 127.7, 120.1, 108.2, 92.7, 84.2, 59.5, 33.2, 29.9, 26.7, 14.5 ppm. **HRMS (ESI-MS)** calcd for $C_{16}H_{16}N_2O_6Na^+$355.09061; Found: 355.08923.

4. ^{1}H and ^{13}C NMR spectra of compounds

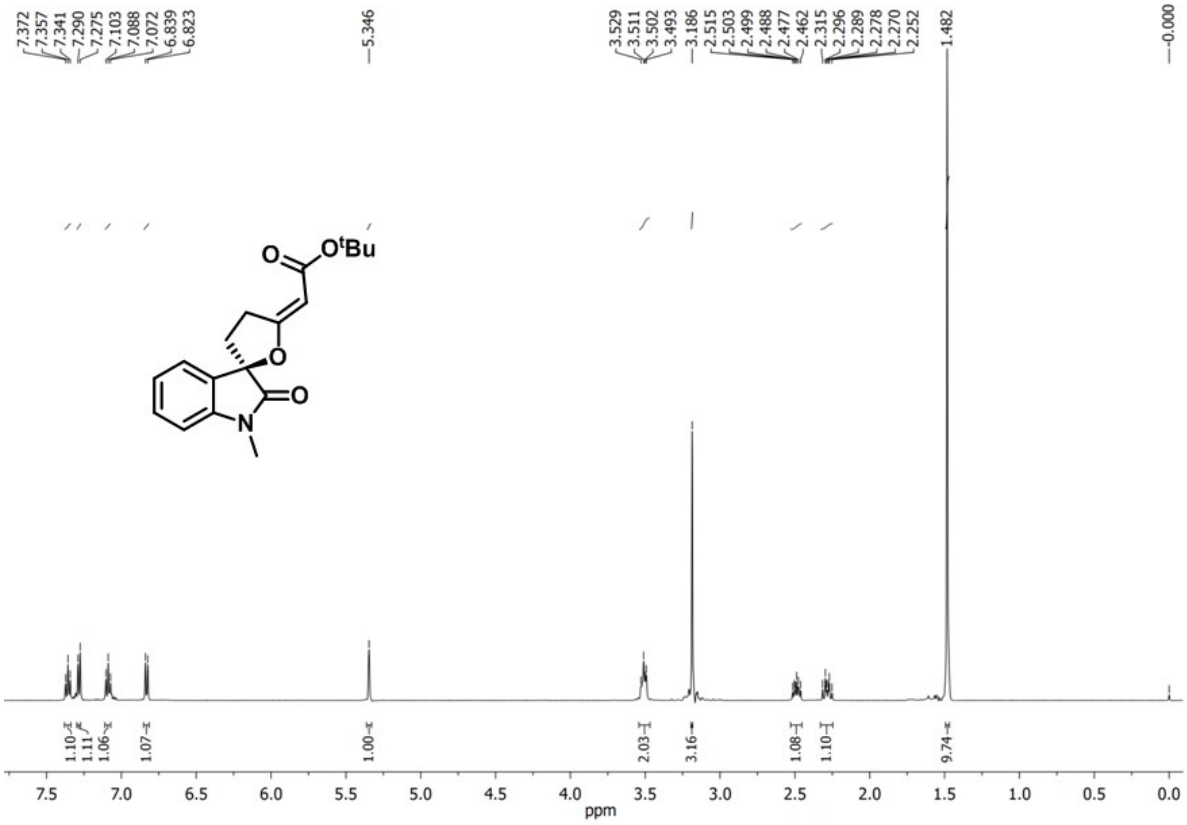
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 8



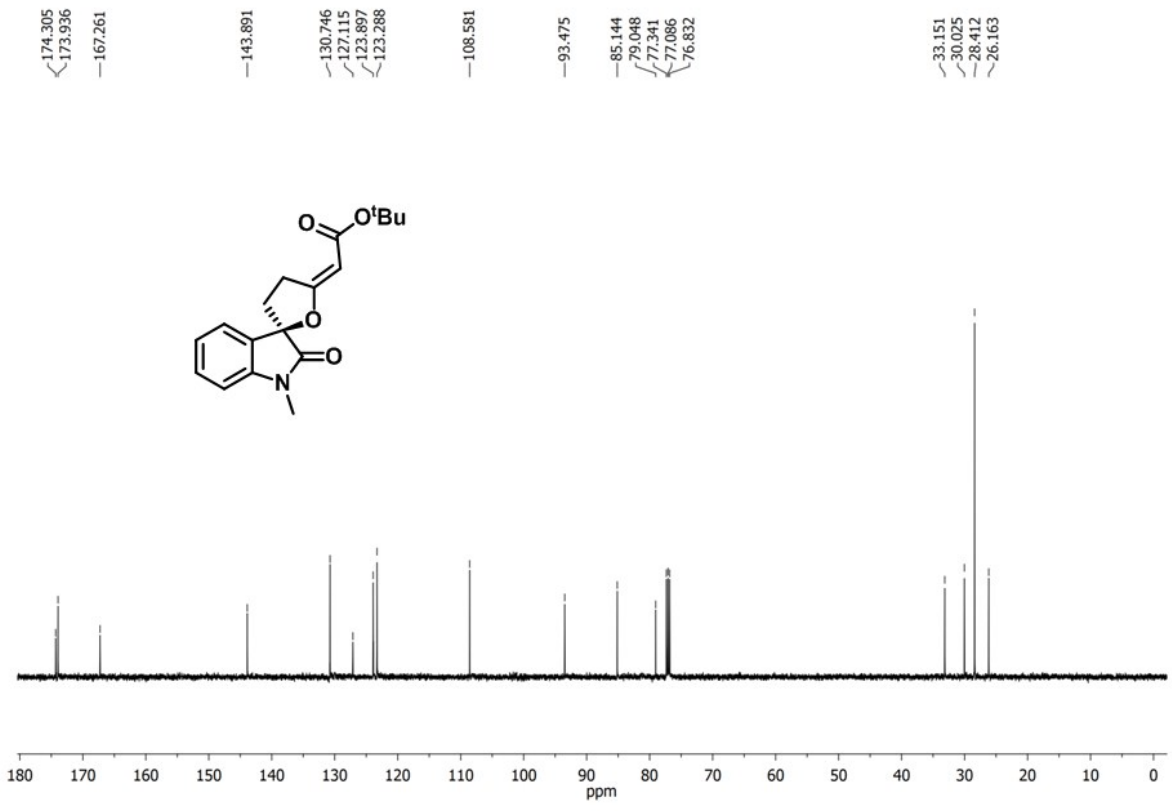
^{13}C NMR (126 MHz) of Compound 8



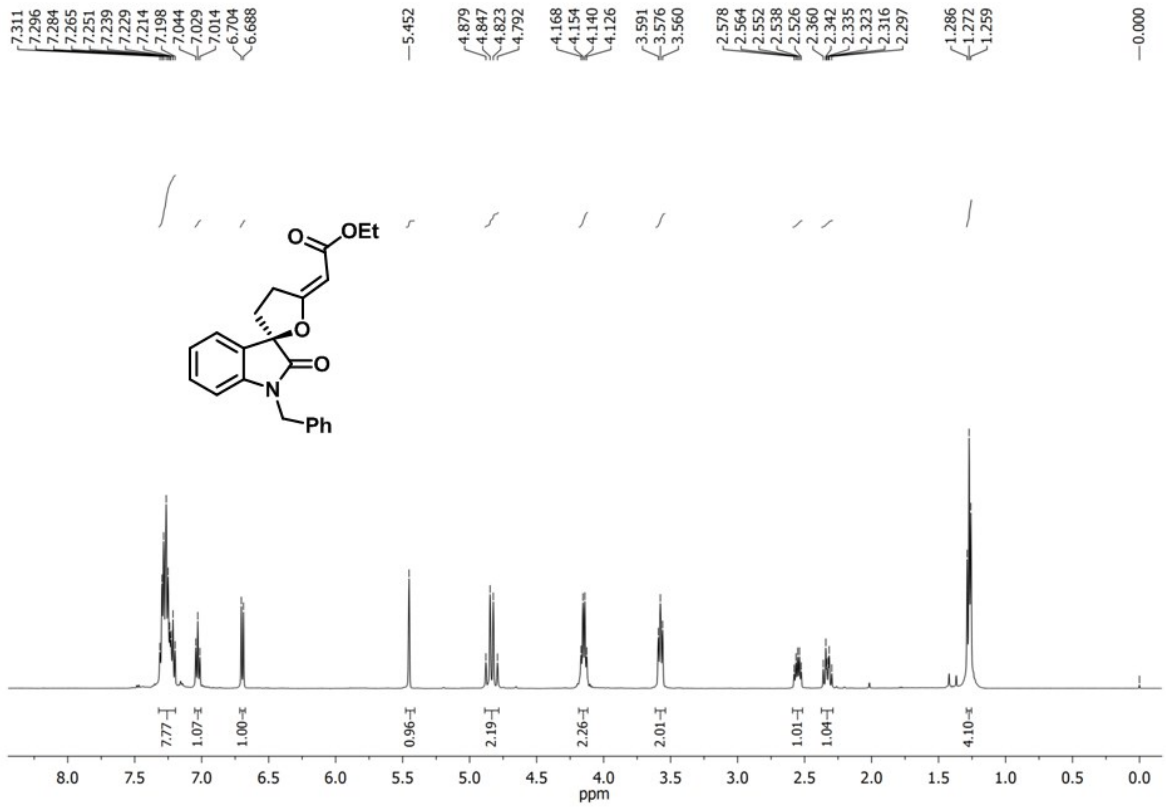
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 9



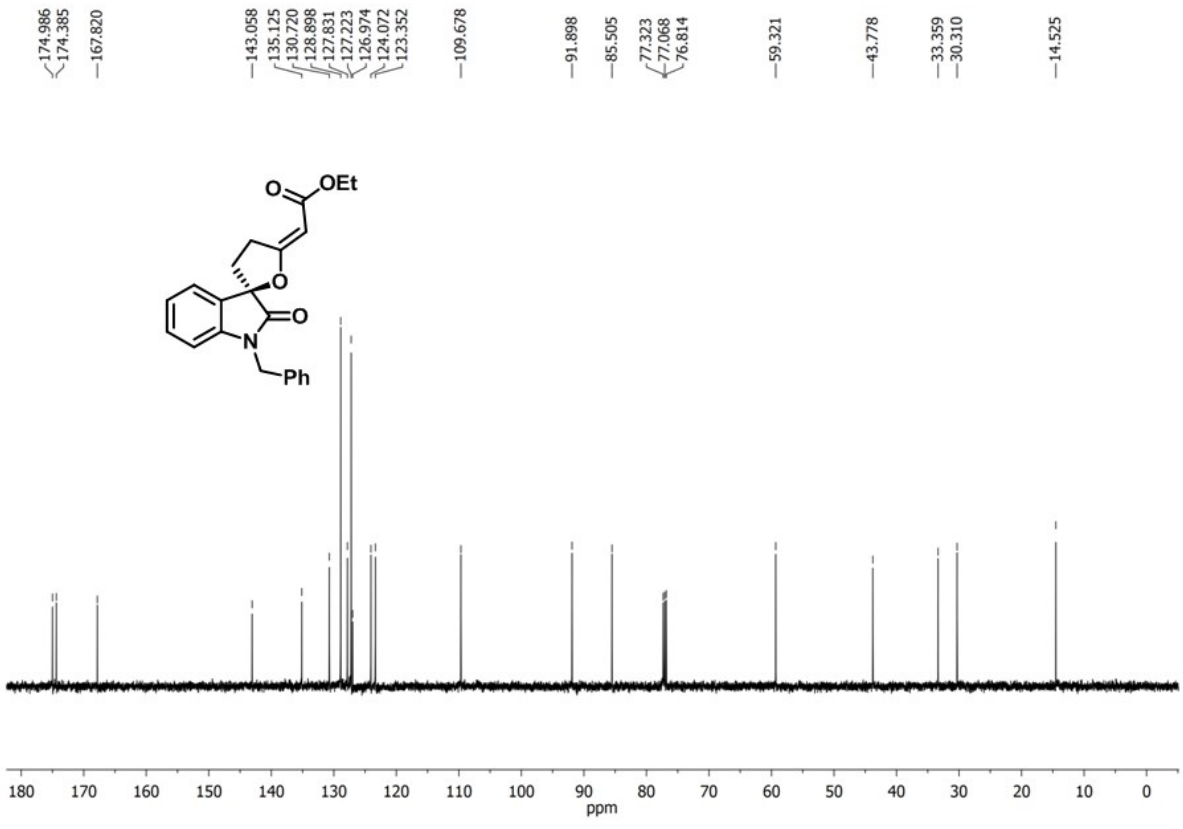
^{13}C NMR (126 MHz) of Compound 9



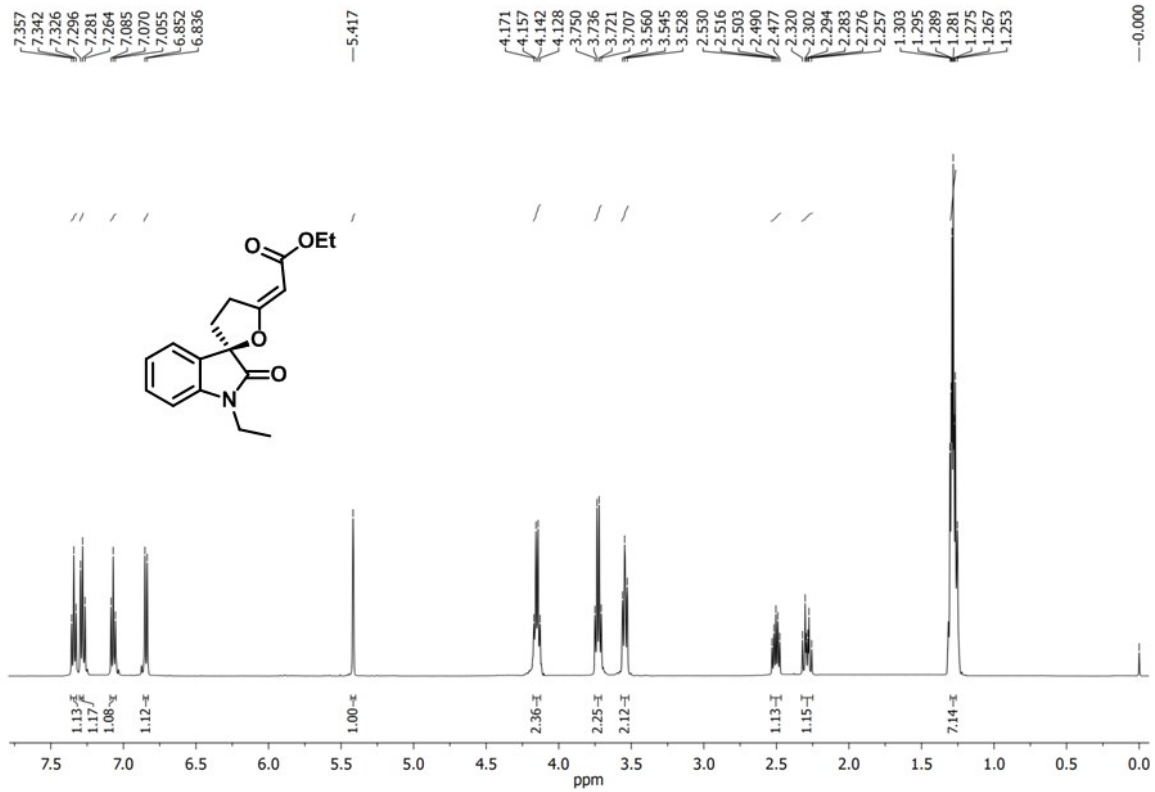
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 10



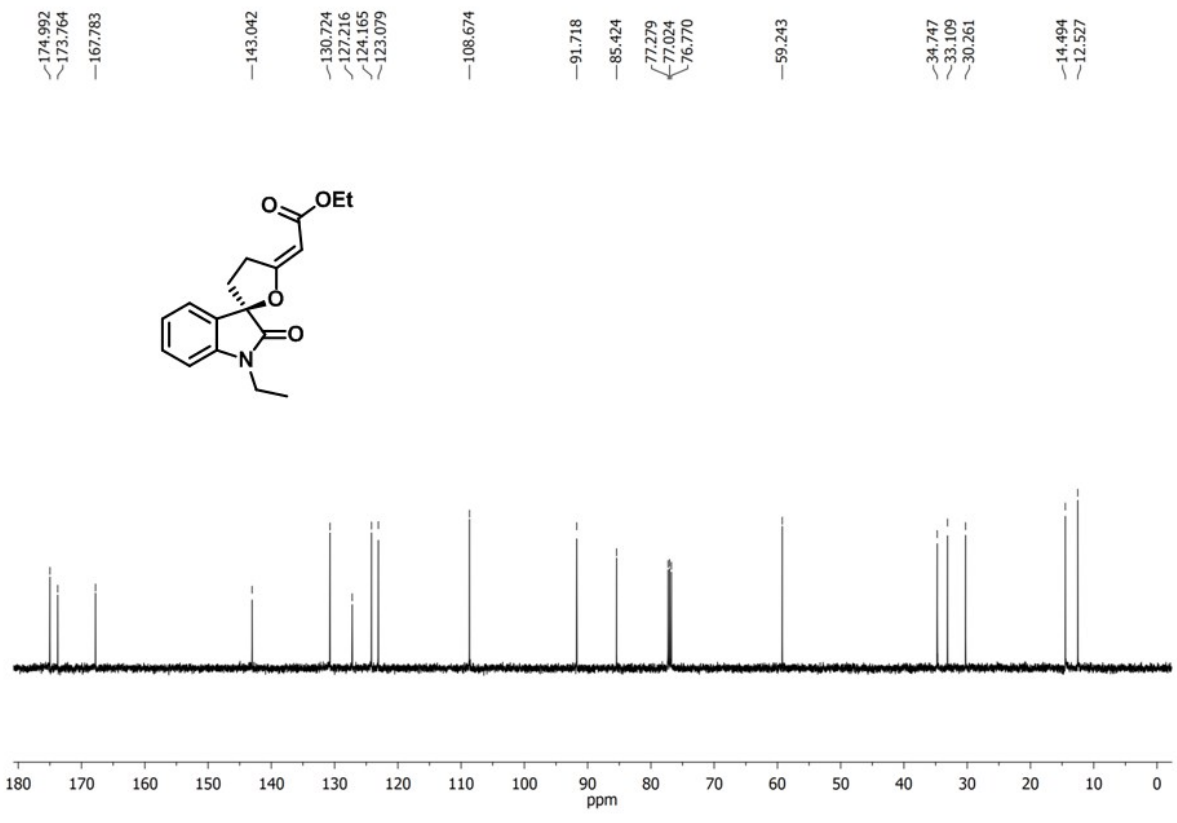
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 10



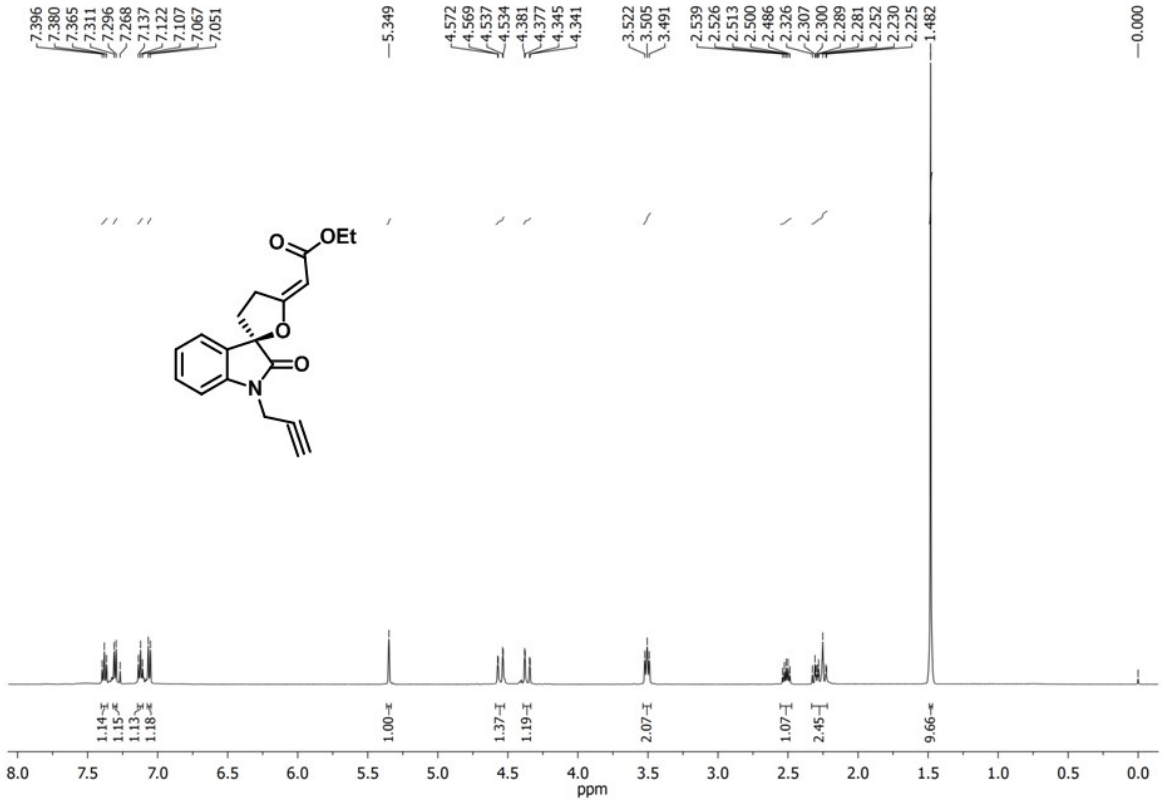
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 11



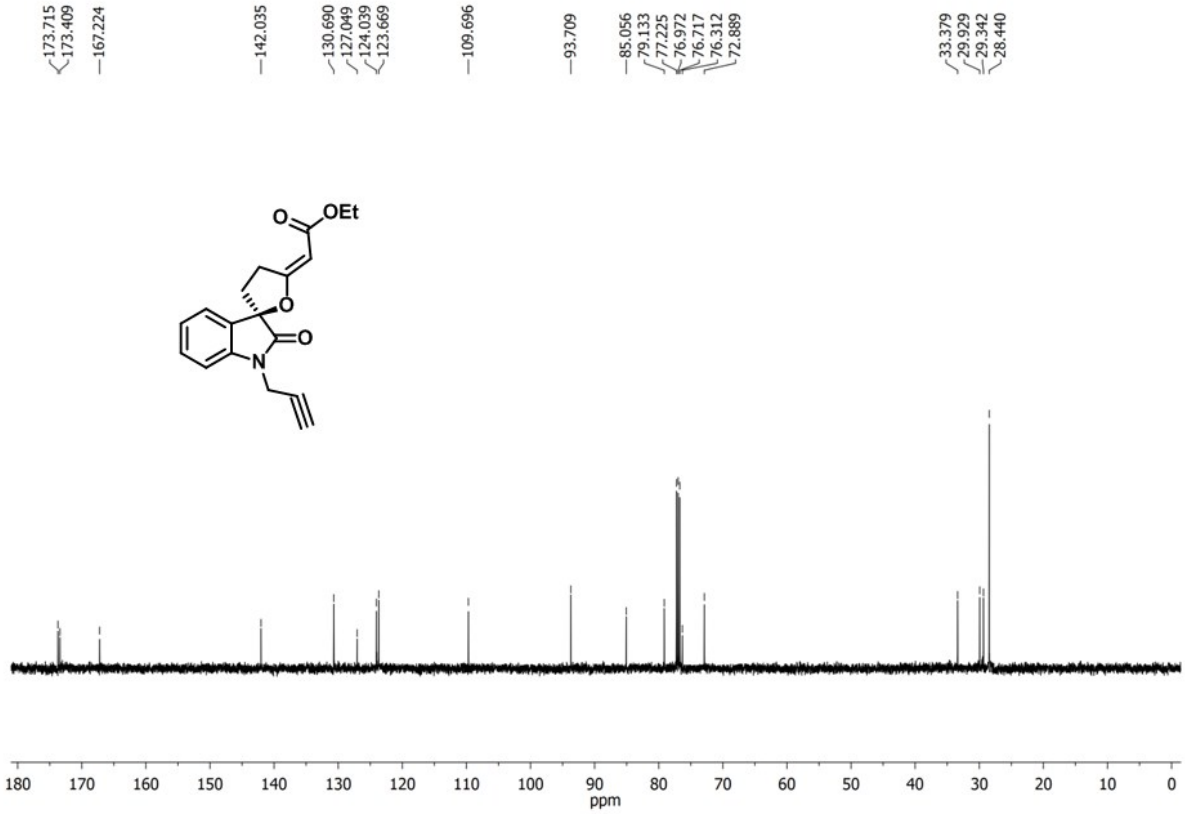
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 11



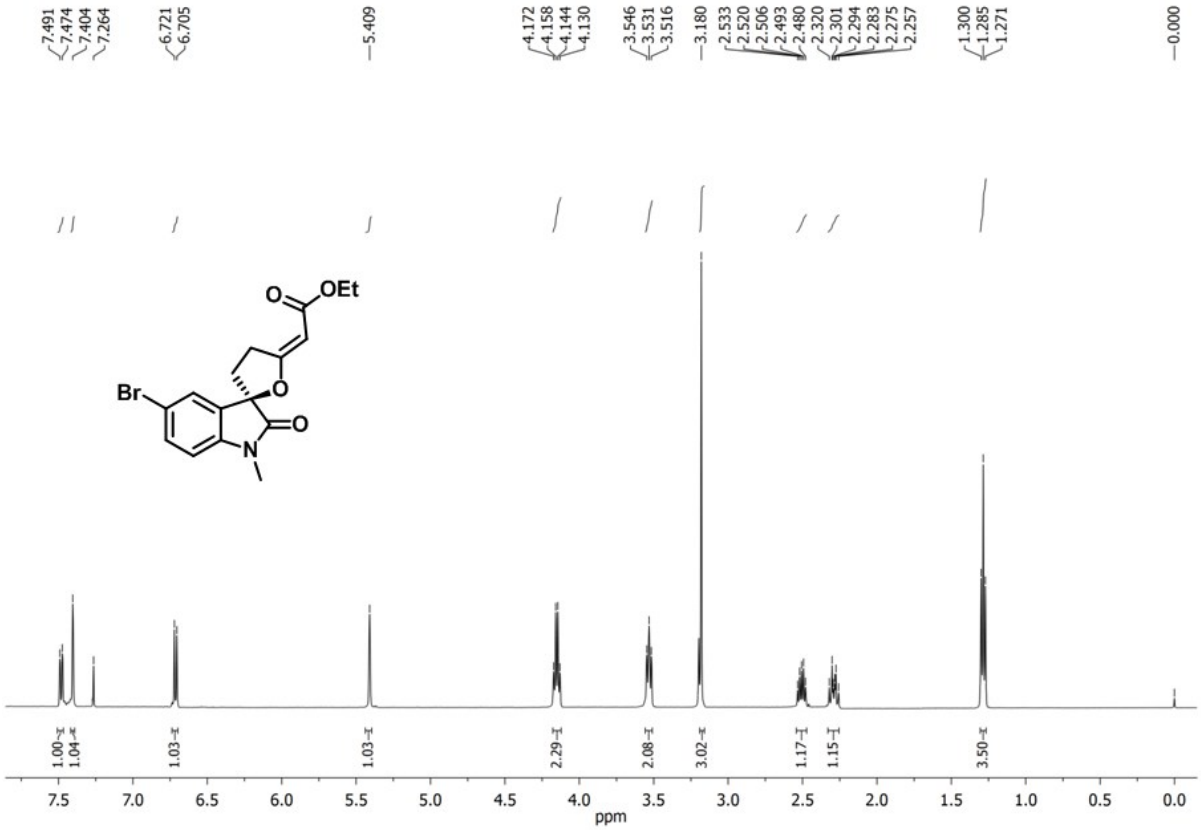
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 12



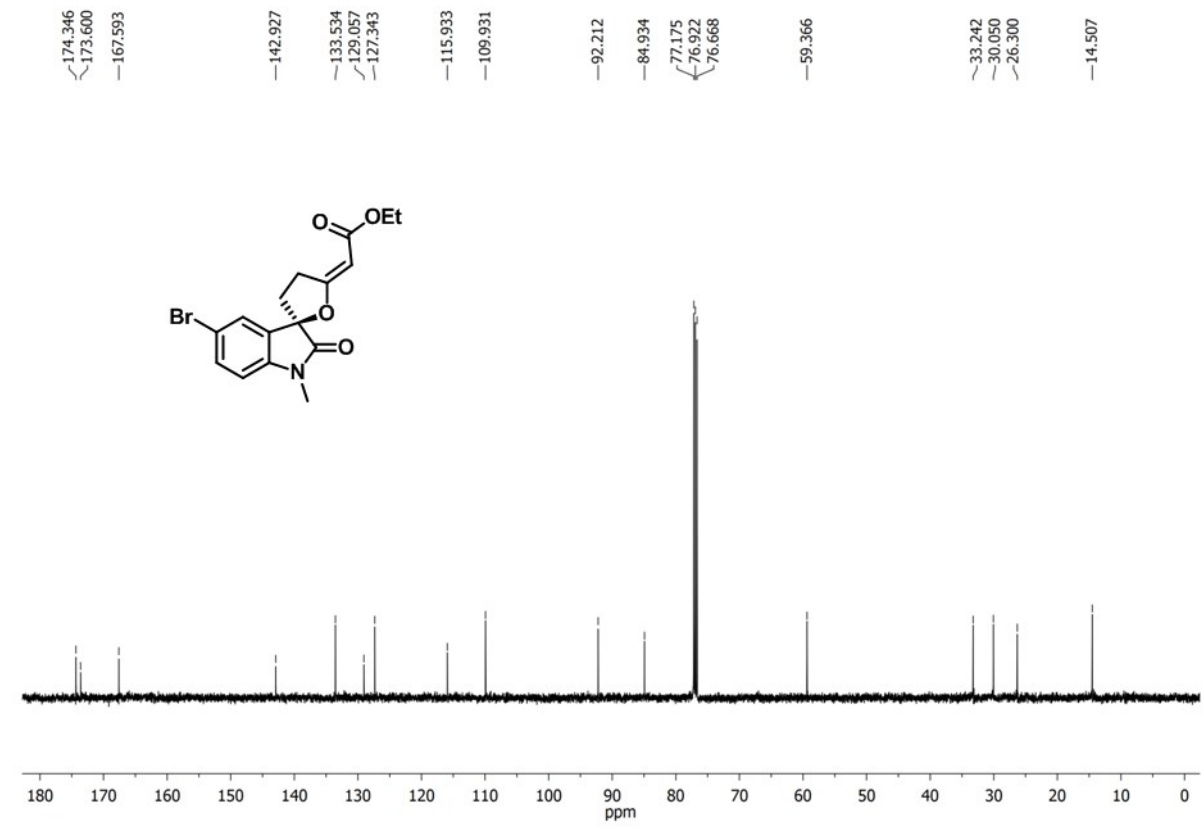
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 12



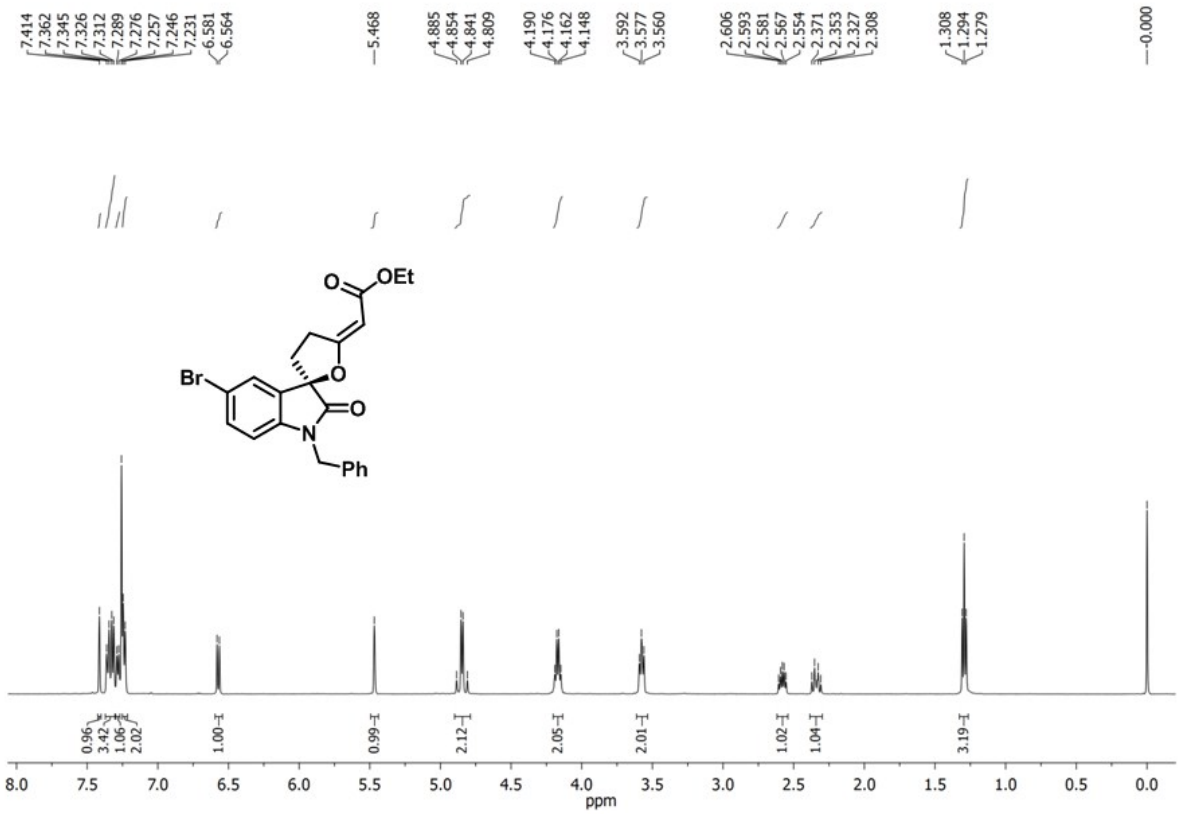
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 13



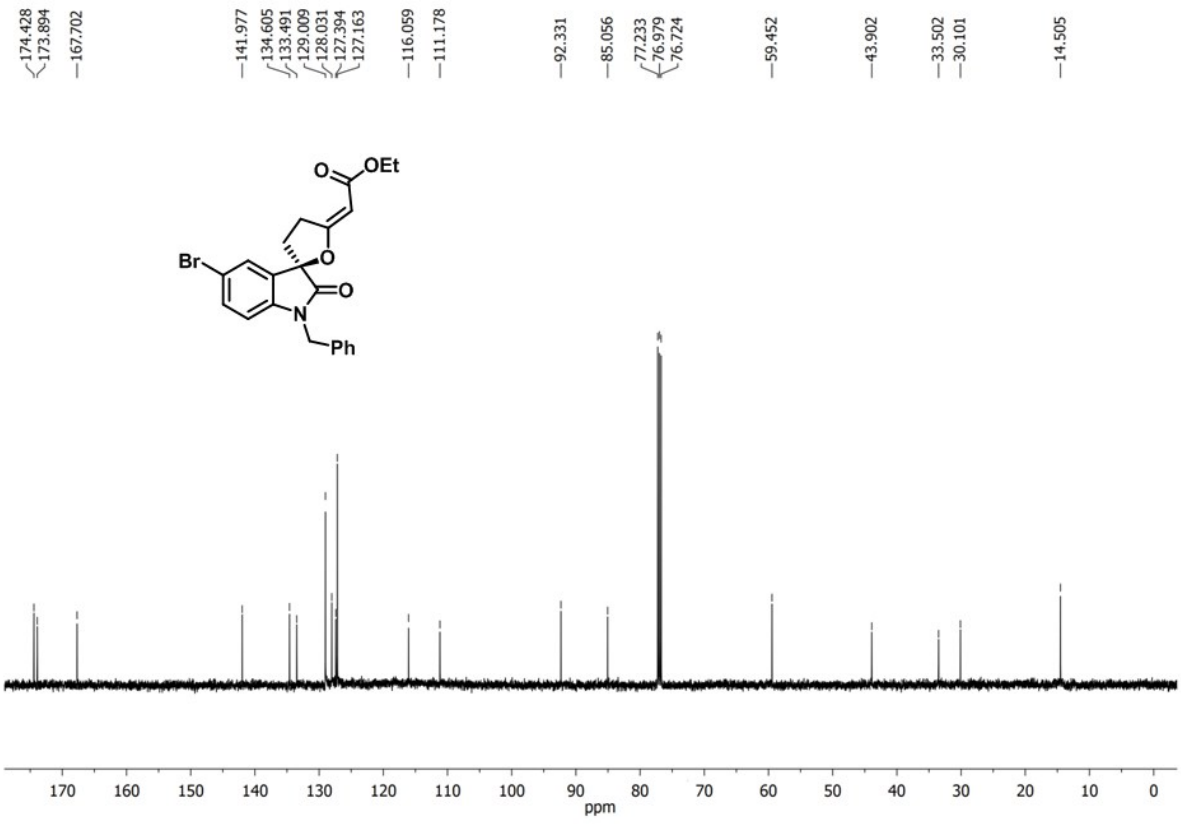
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 13



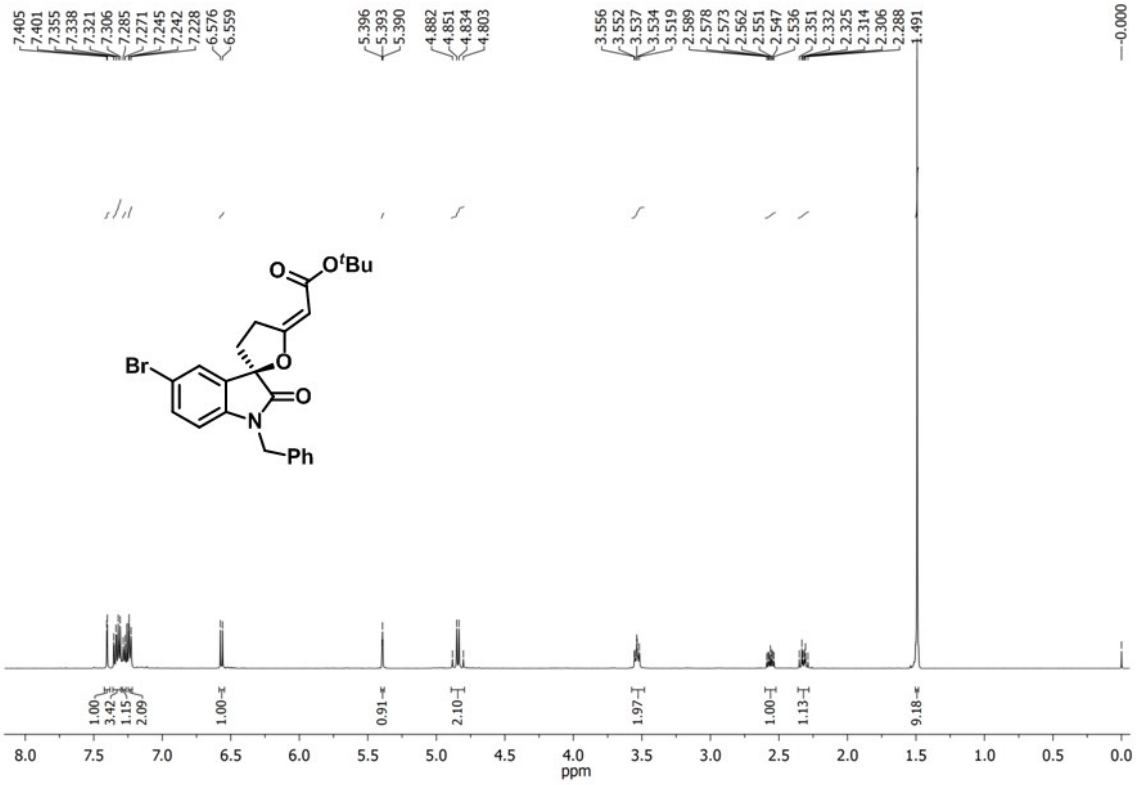
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 14



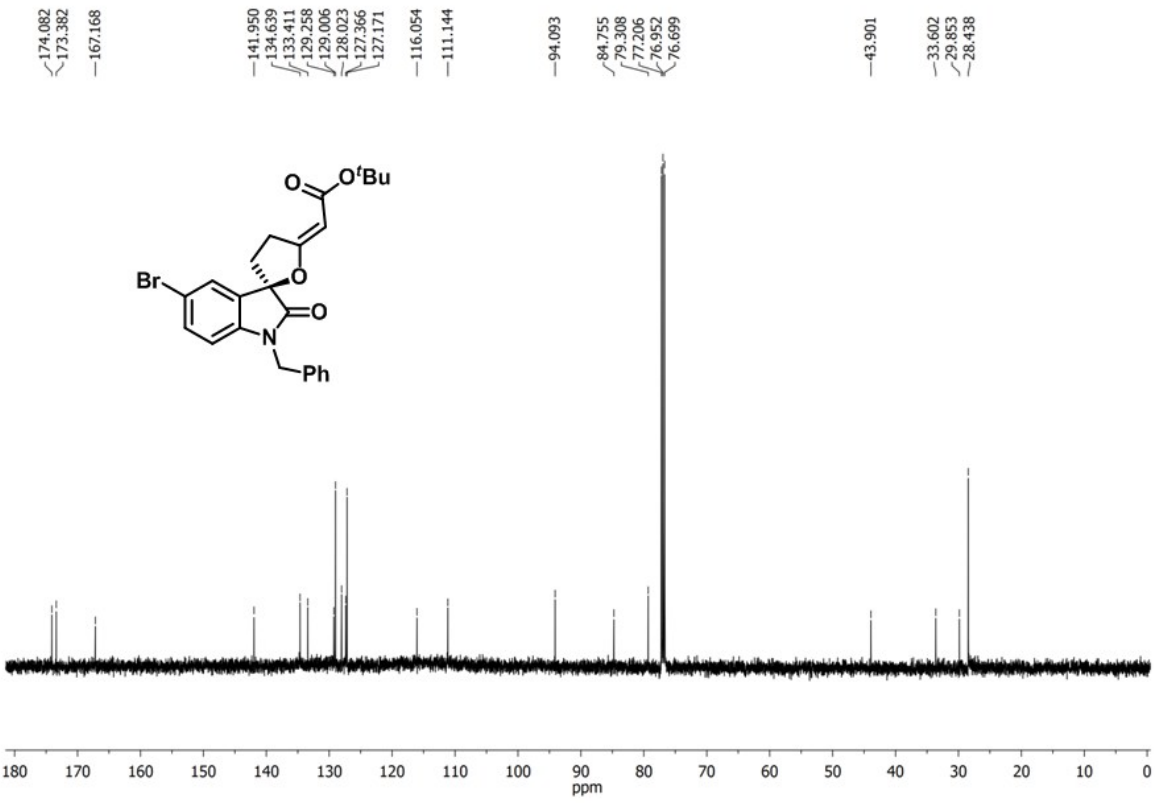
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 14



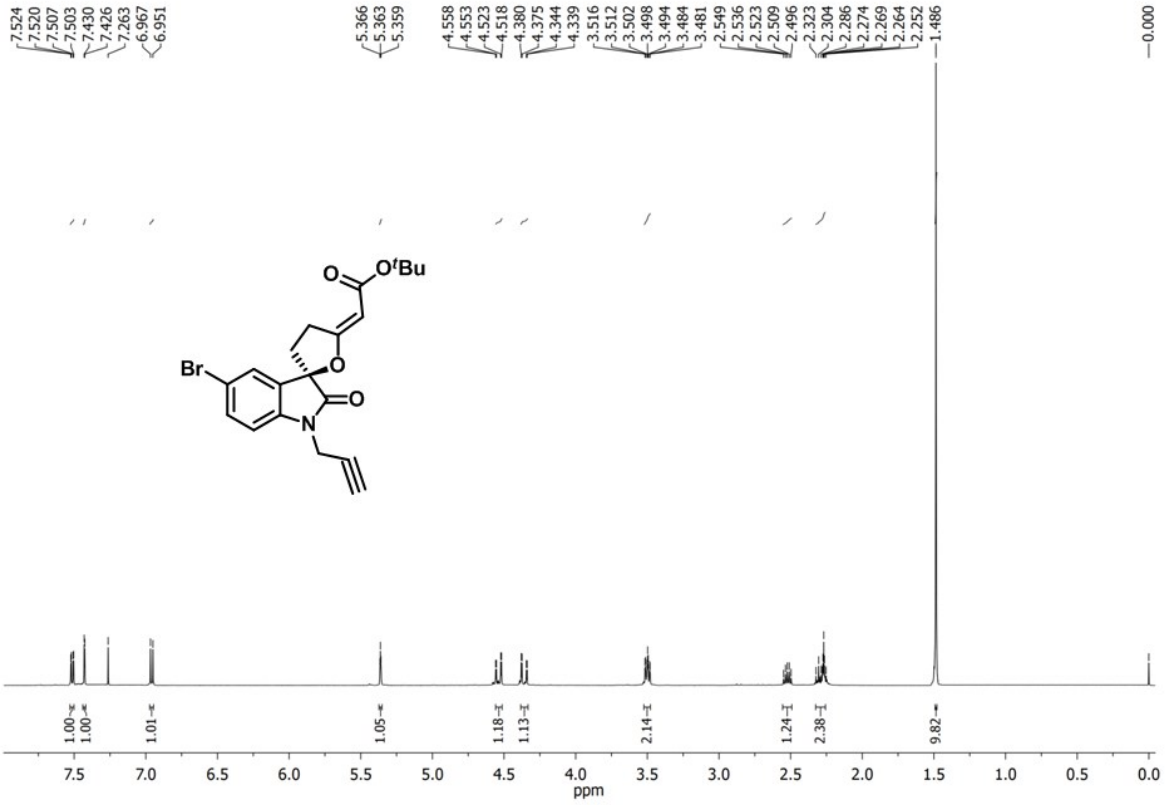
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 15



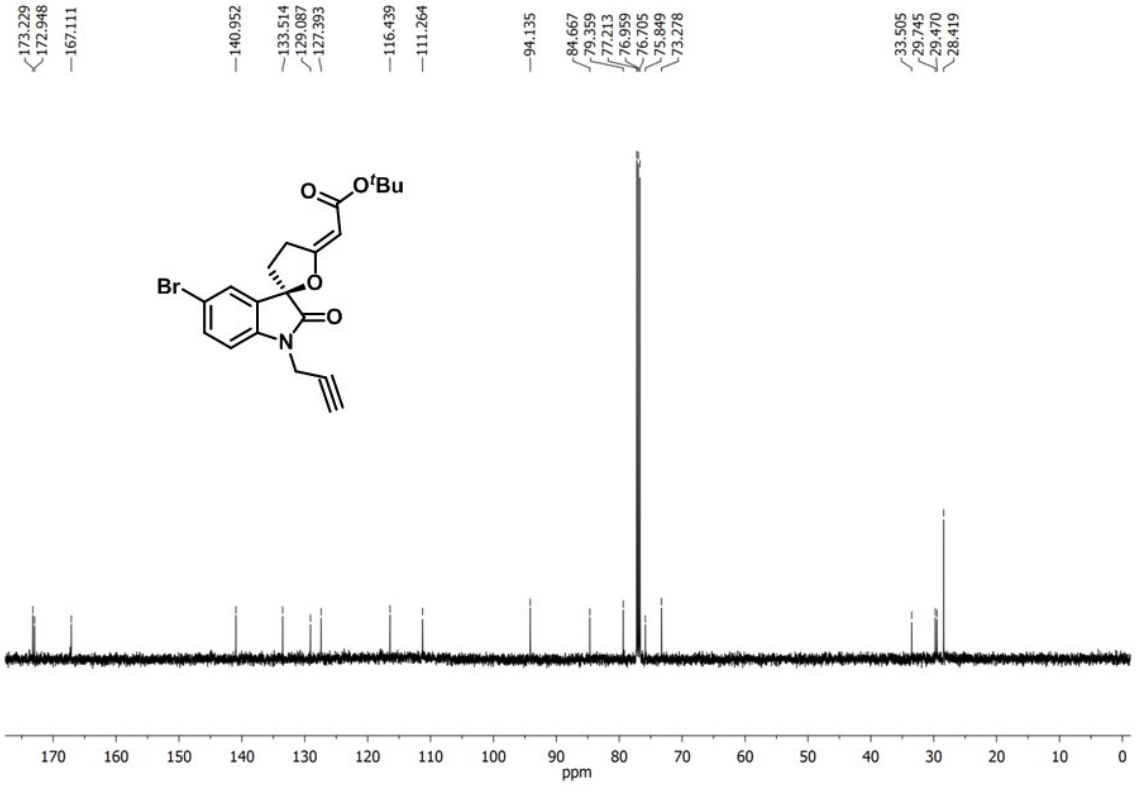
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 15



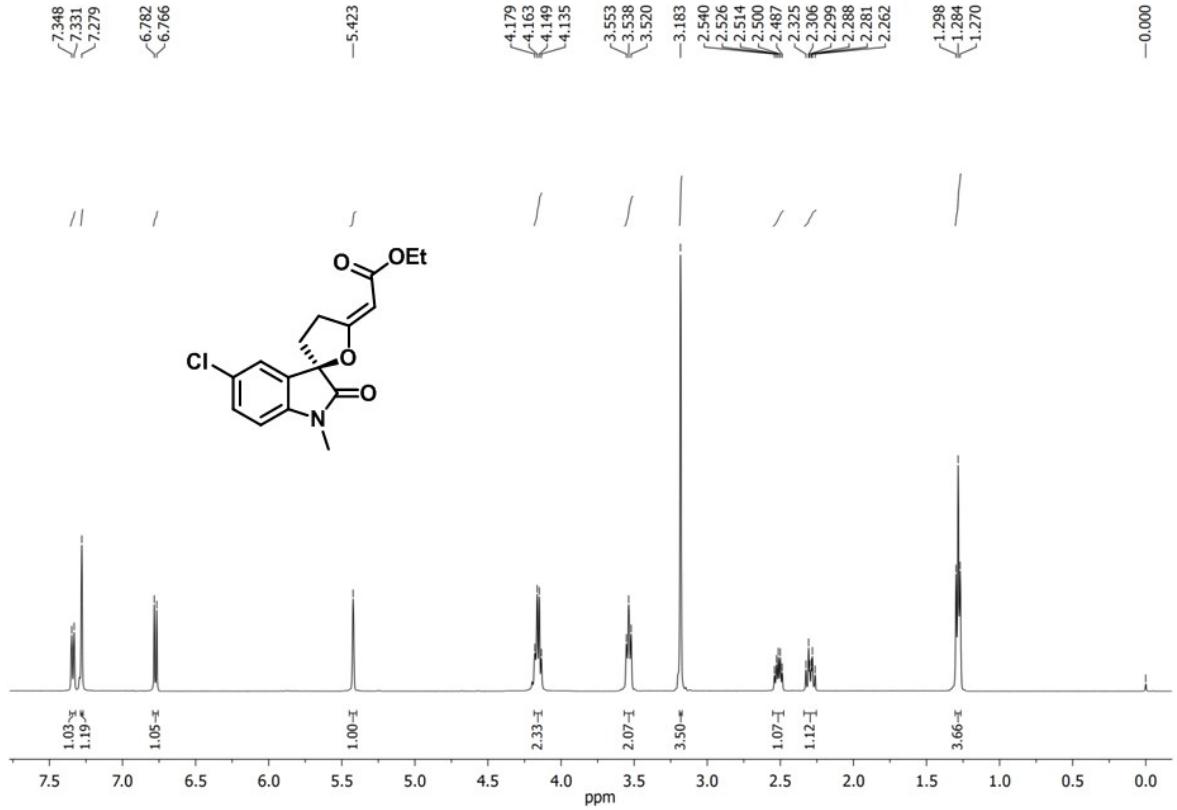
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 16



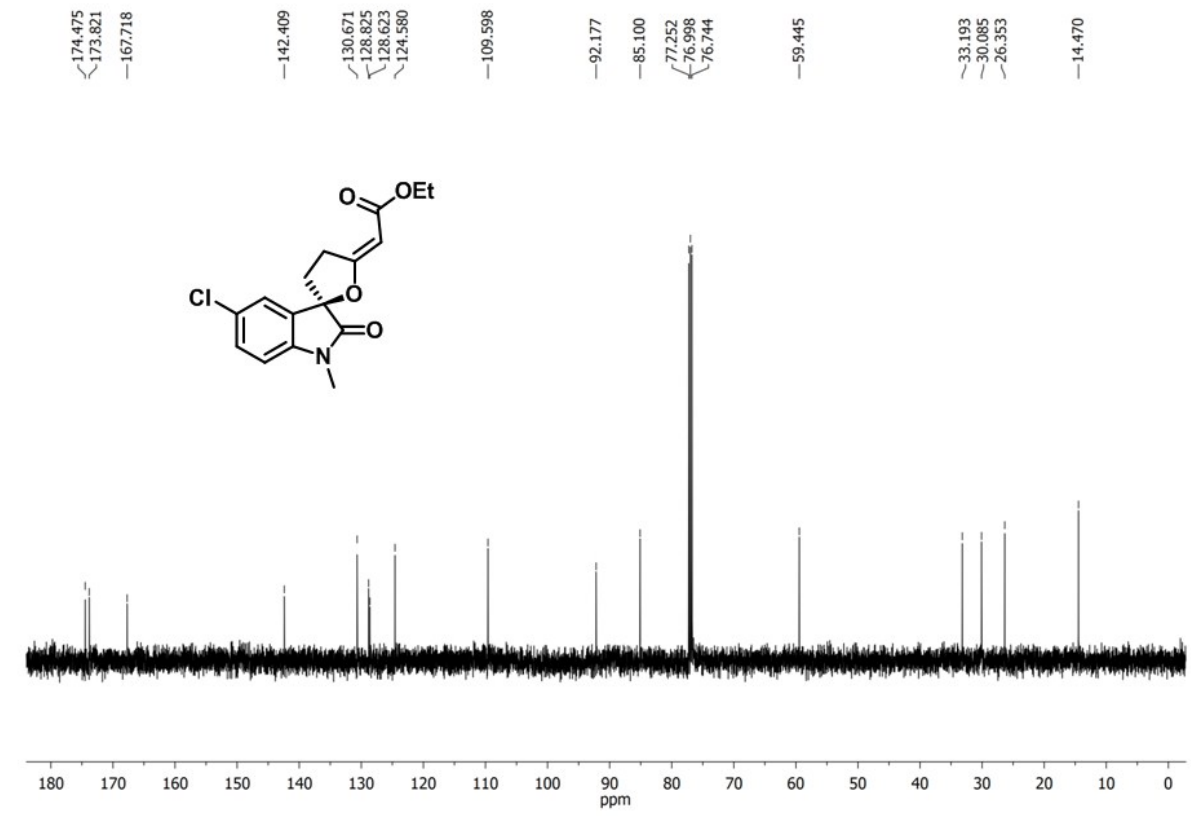
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 16



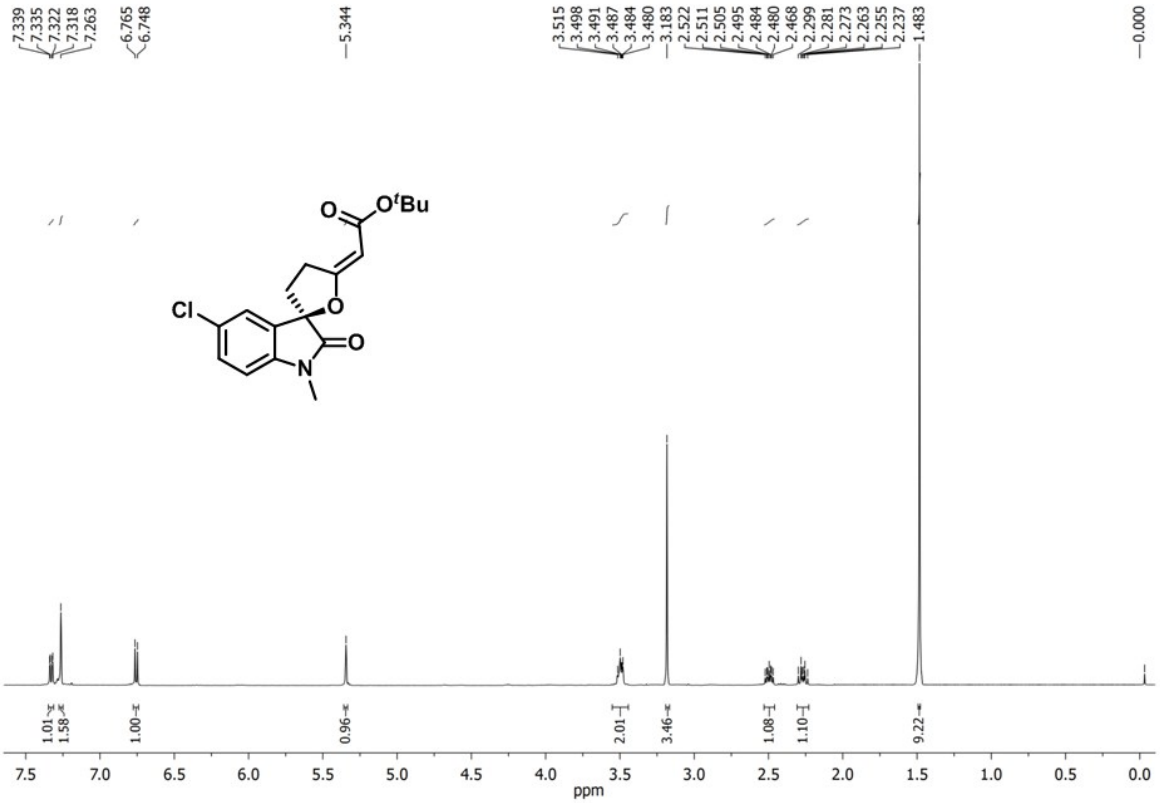
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 17



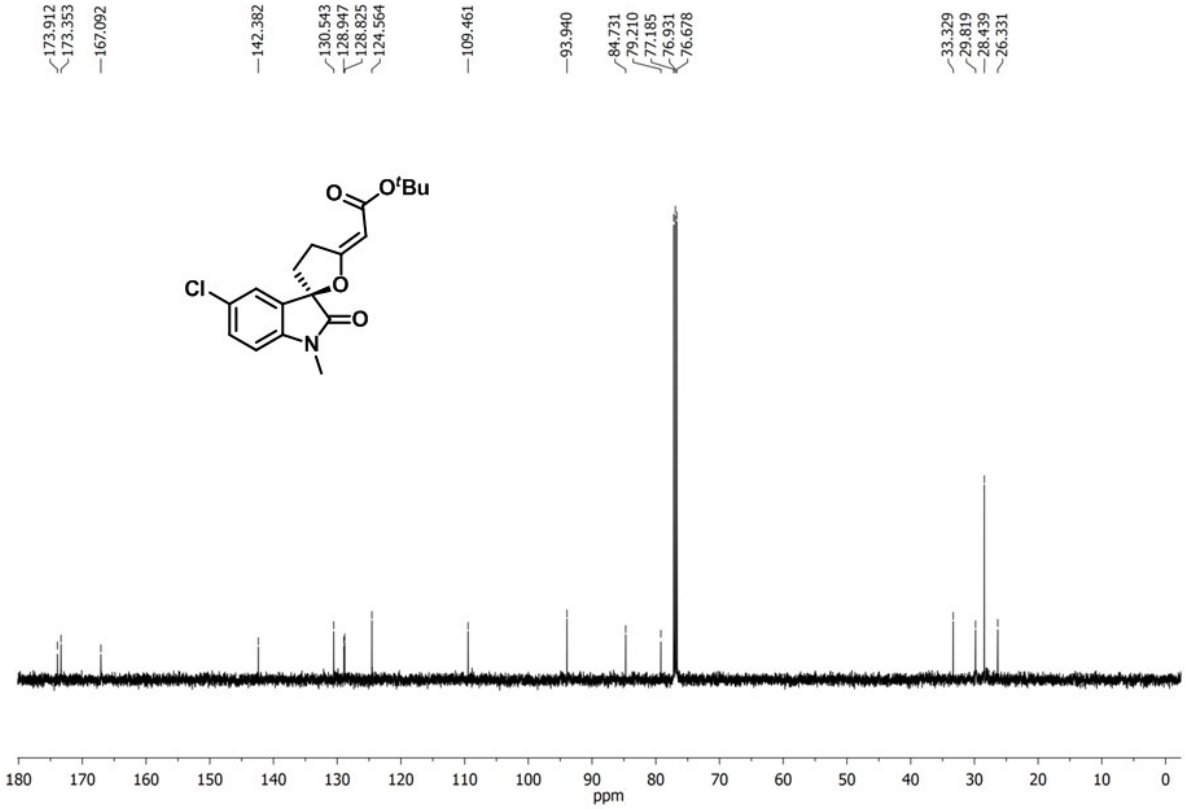
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 17



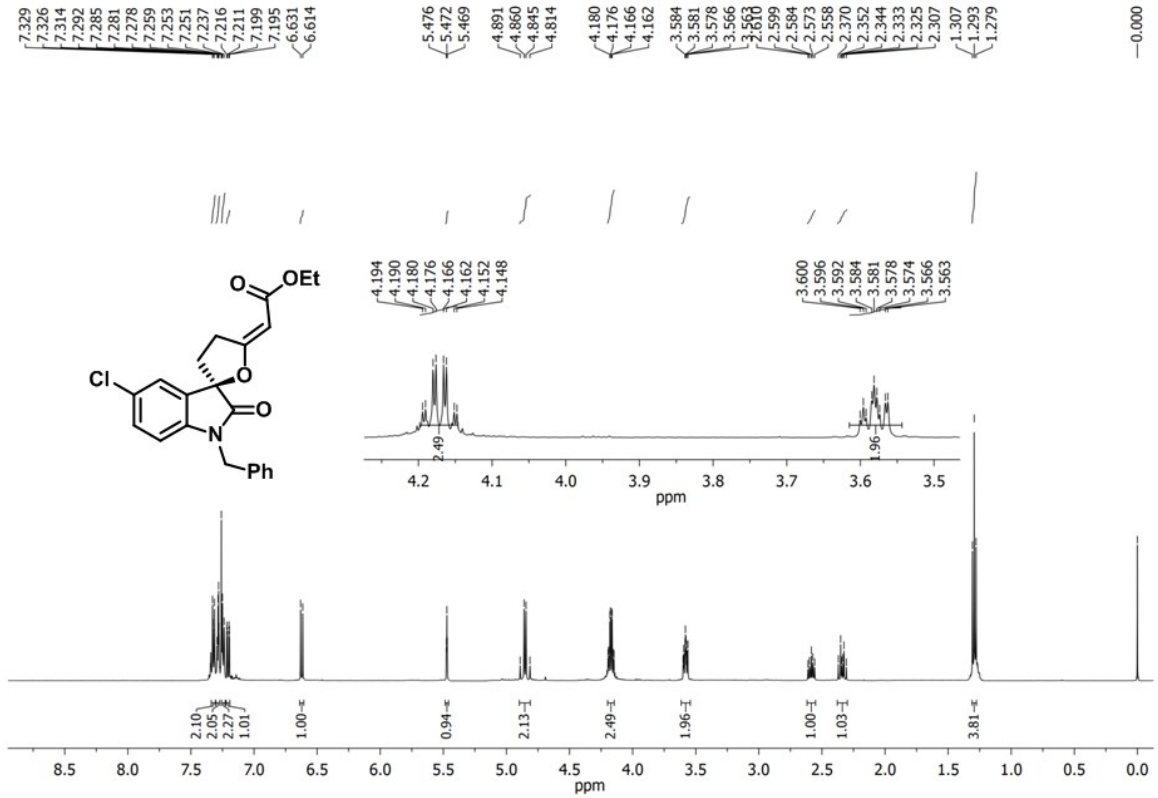
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 18



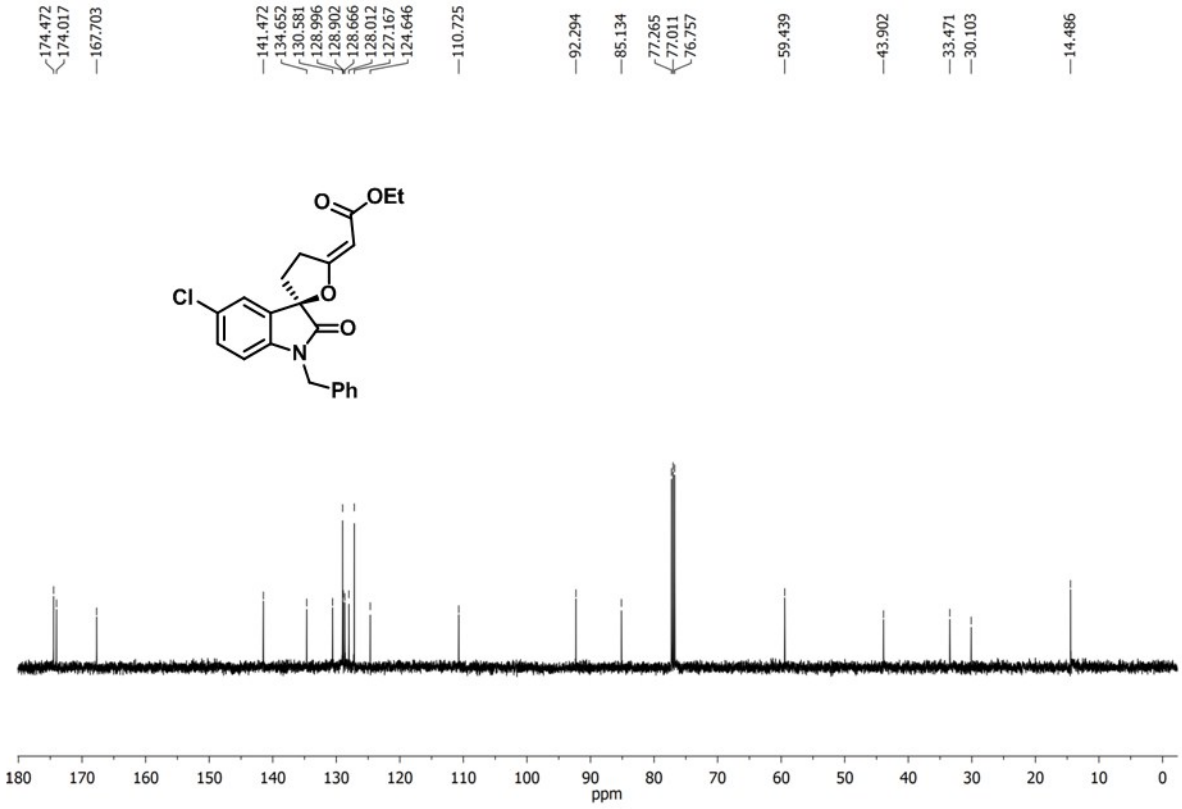
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 18



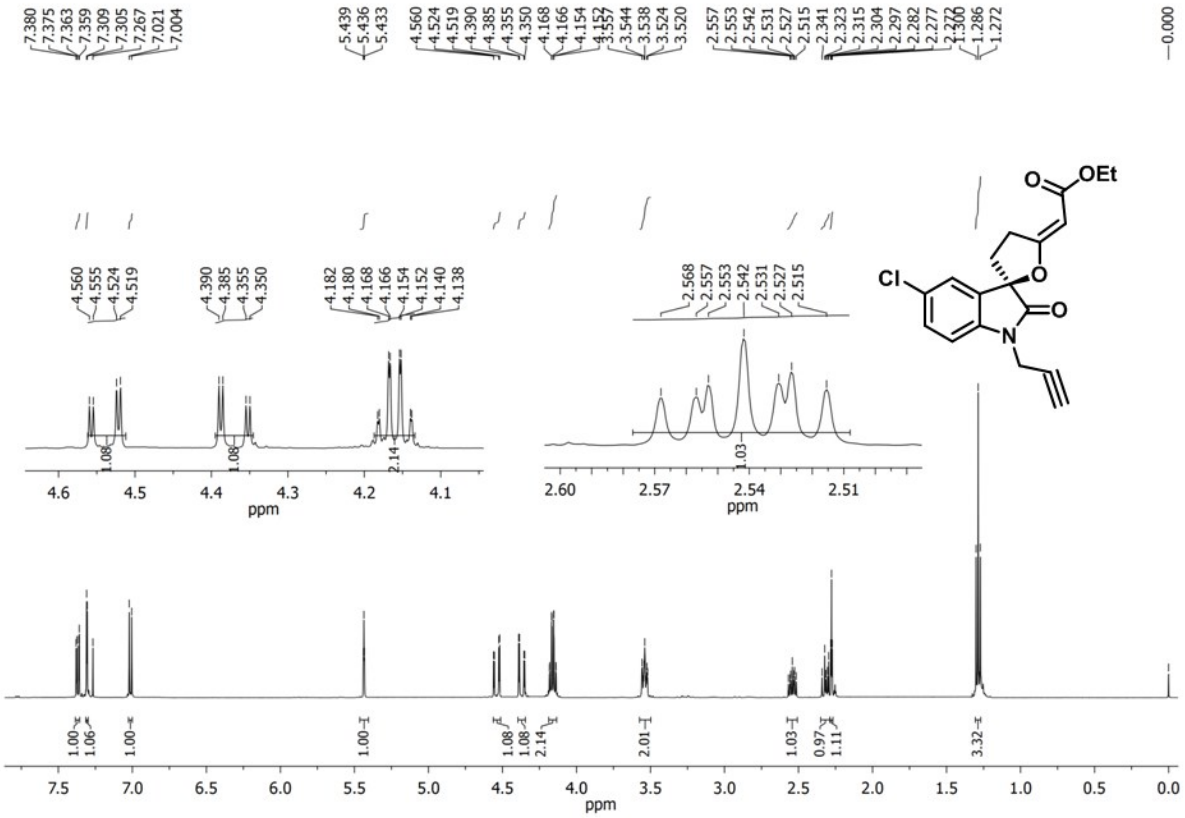
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 19



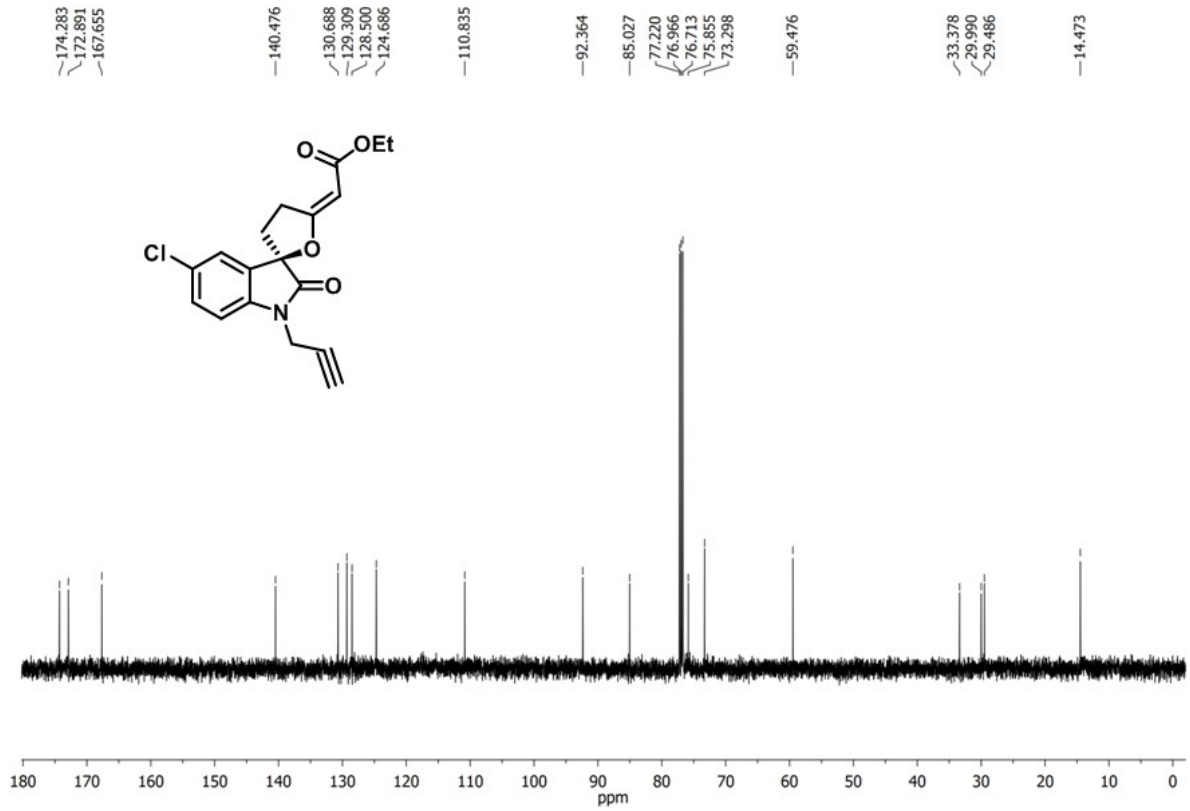
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 19



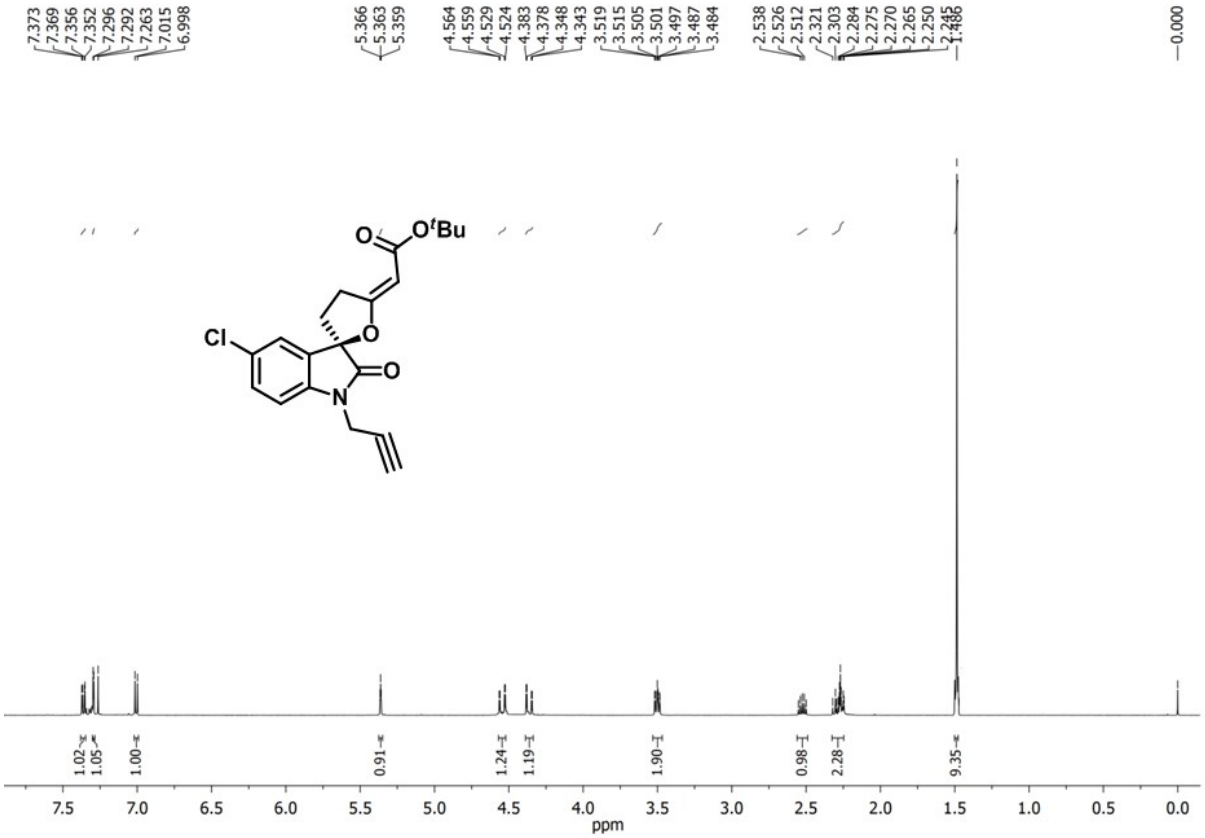
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 20



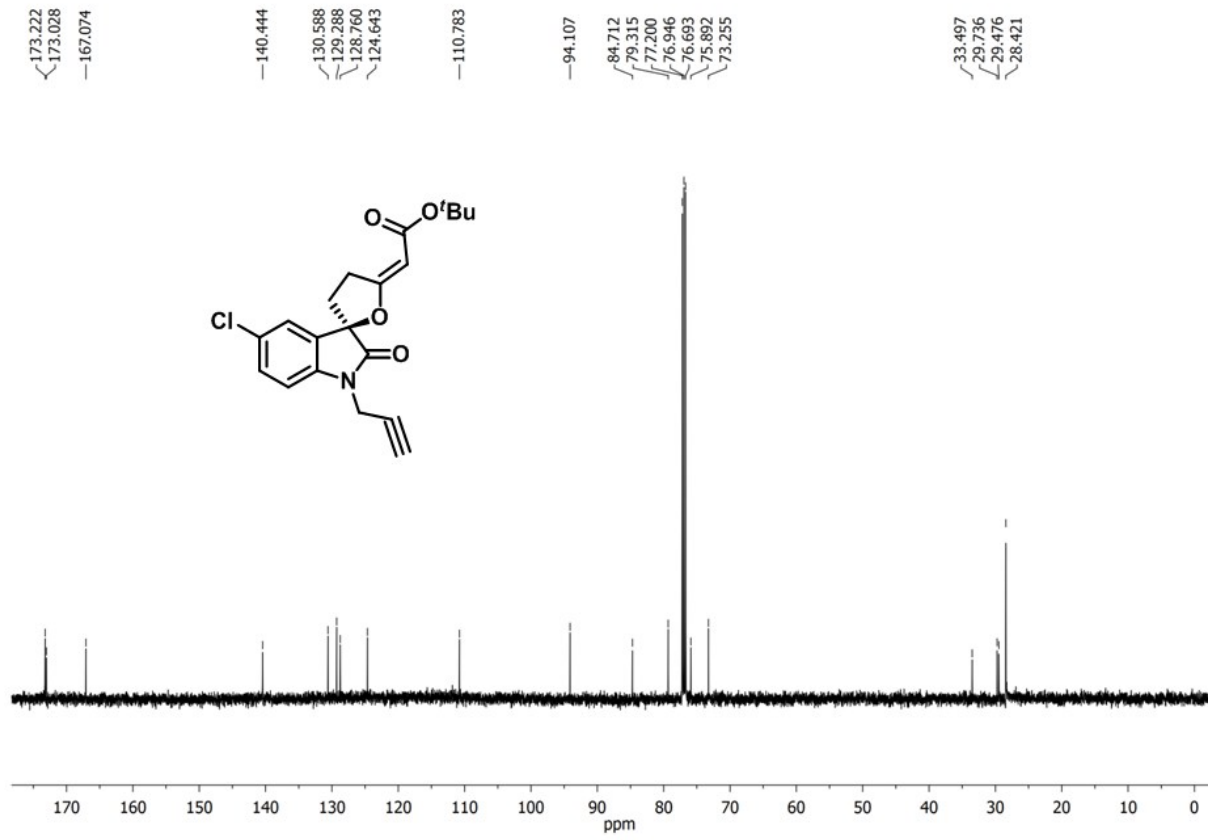
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 20



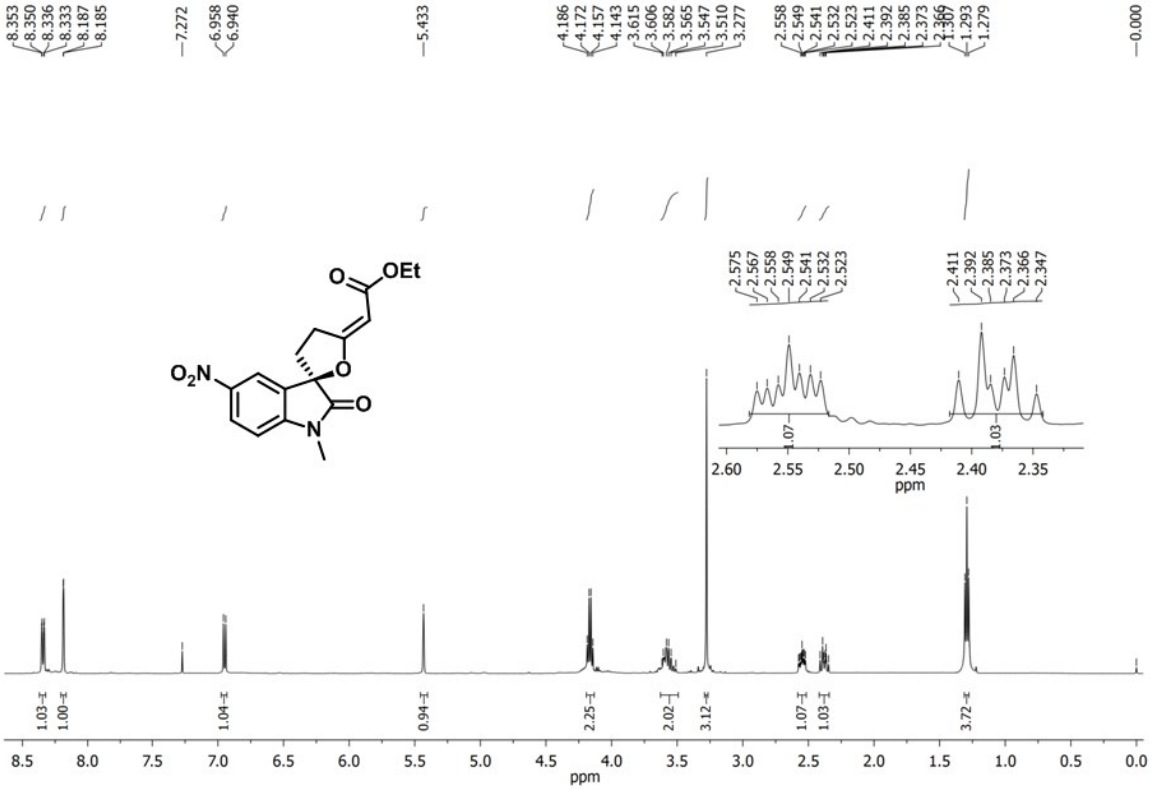
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 21



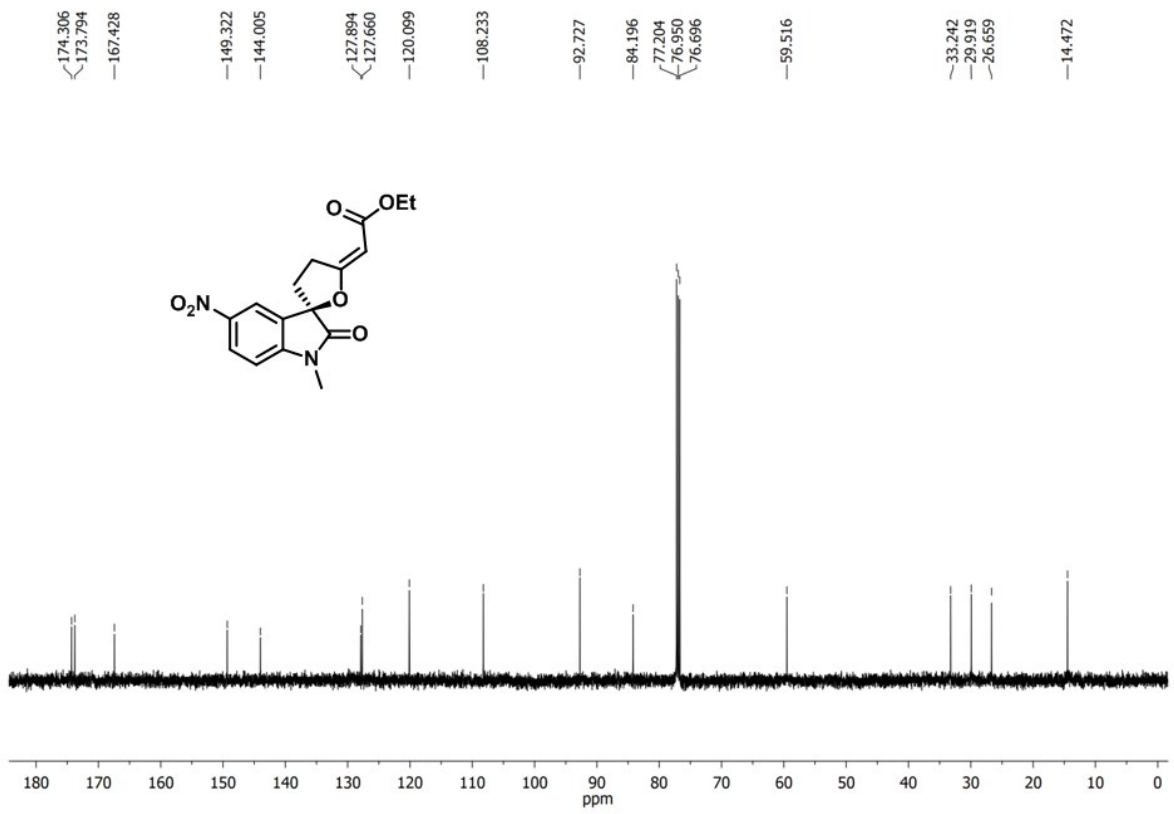
^{13}C NMR (126 MHz, $CDCl_3$) of Compound 21



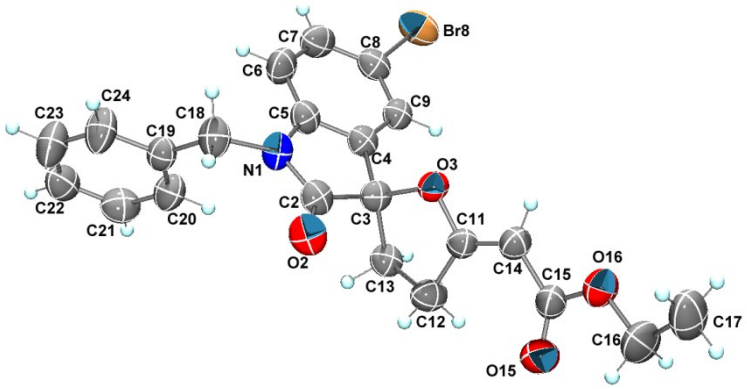
^{1}H NMR (500 MHz, $CDCl_3$) of Compound 22



^{13}C NMR (126 MHz, $CDCl_3$) of Compound 22



5. ORTEP of compound 14



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