Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry.

Supporting Information

Brønsted Acid Mediated Intramolecular Cyclopropane Ring Expansion/[4+2]-Cycloaddition

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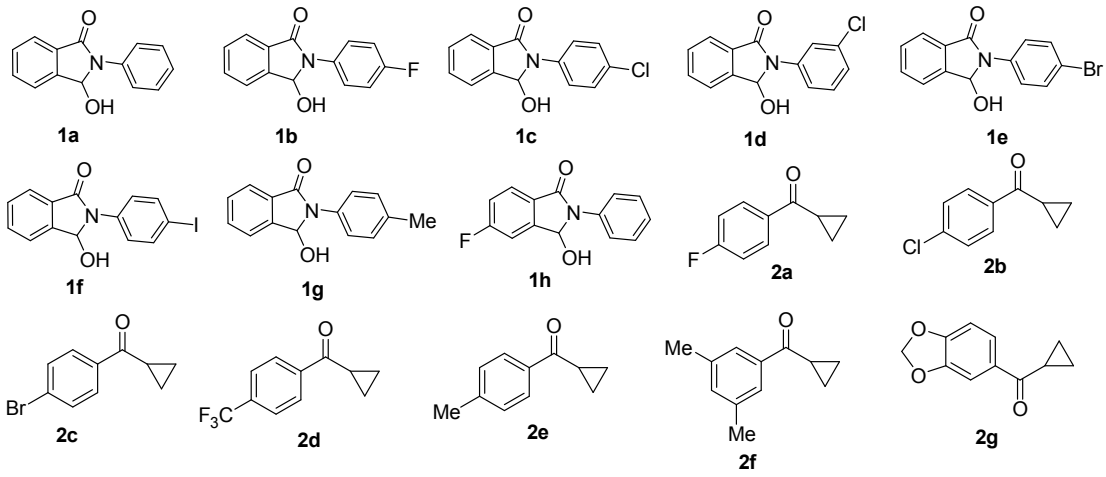
General Information

All reactions were carried out under an air atmosphere condition. Solvents and reagents were purchased from commercial source and used without further purification. Flash column chromatography was performed using silica gel (200-300 mesh). Analytical thin-layer chromatography was performed using glass plates pre-coated with 200-300 mesh silica gel impregnated with a fluorescent indicator (254 nm). NMR spectra were recorded in $CDCl_3$ on Bruker NMR-400 (400 MHz) and NMR-500 (500 MHz) with TMS as an internal reference. HRMS were performed on Agilent 6540 Q-TOF mass spectrometer (ESI).



Scheme S1. Substrates employed in the reaction

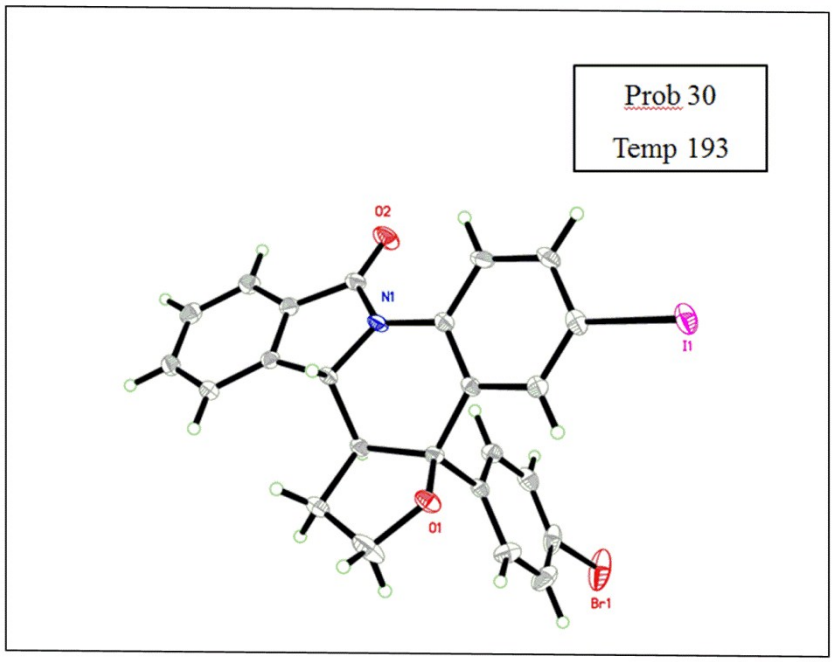
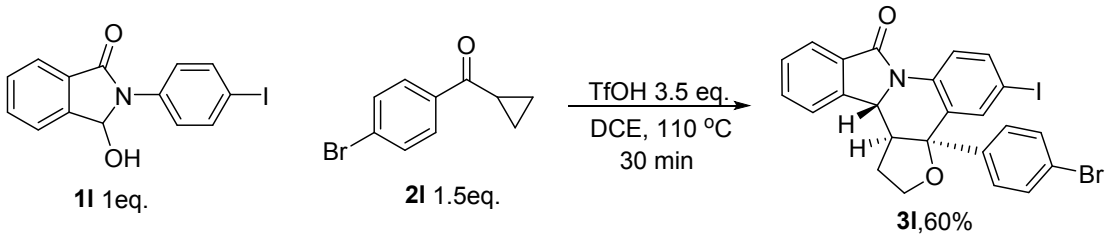


Figure S1. ORTEP drawing (30%) of the crystal structure **3m**

Crystallographic data **3m** (CCDC 1960679) has been deposited vat the Cambridge Crystallographic Database Centre and is available on request from the Director, CCDC, 12 Union

Road, Cambridge, CB2 1EZ, UK (http//www.ccdc.cam.ac.uk).

Table S1. Crystal data parameter for compound **3m**	
Formula unit	$C_{24}H_{17}BrINO_2$
Formula wt.	558.20
Crystal system	monoclinic
T [K]	210
a [Å]	13.4658 (4)
b [Å]	15.2404 (4)
c [Å]	10.0603 (3)
α [°]	90
β[°]	105.1680 (10)
γ [°]	90
Volume [Å3]	1992.69 (10)
Space group	P 21/c
Z	4
Reflns. Collected	9900
*R*1 [I>2σ(I)], *wR*2	0.0469, 0.1170
GOF	1.065
CCDC Reference NO.	1960679



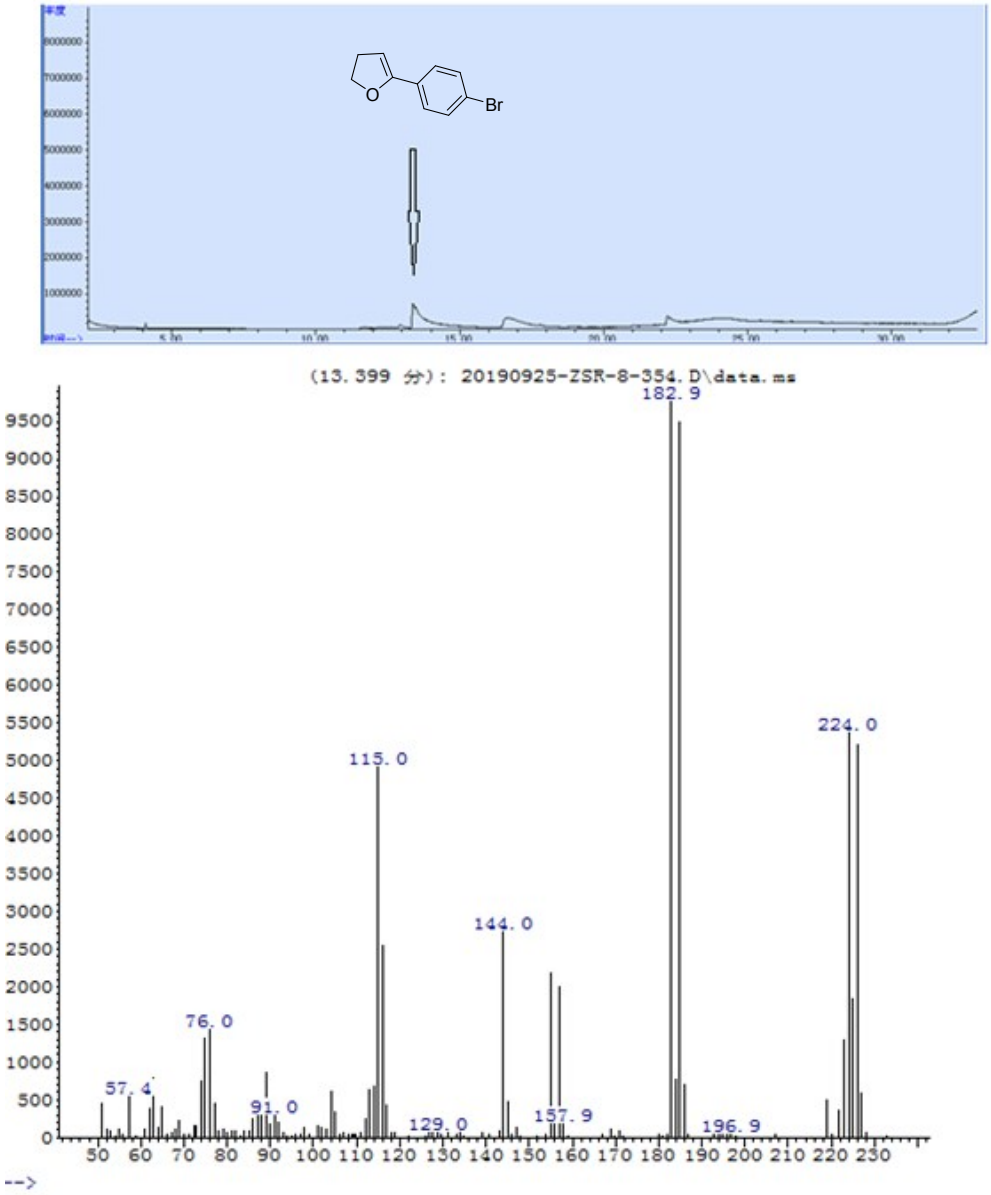


Figure S2. Detection of intermediate

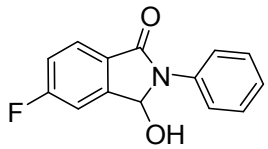
GC-MS:7890A/5975C

Column: HP-5MS 5% Phenyl Methyl Silox 325 °C: 30 m x 250 μm x 0.25 μm

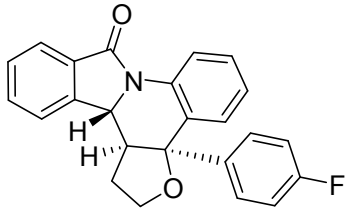
Detection method: Initial temperature 80°C keep 3 mins

Heating rate 10 °C /min Final temperature 280 °C keep 10 mins

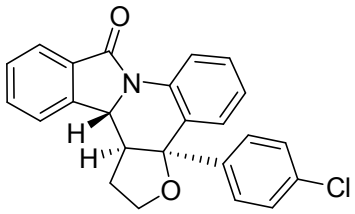
Split ratio 20:1



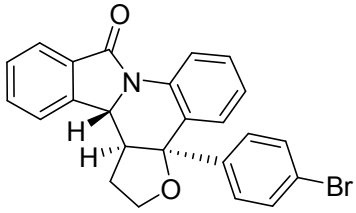
Compound (**1h**). white solid, m.p: 88-89 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61-7.48 (m, 3H), 7.34-7.27 (m, 3H), 7.25-7.21 (m, 1H), 6.99 (t, J = 8.1 Hz, 1H), 6.27-6.24 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.2 (d, J = 252.4 Hz), 165.8, 145.5, 136.8, 129.2, 126.0, 125.9 (d, J = 9.6 Hz), 125.6, 121.5, 120.4, 120.1, 117.6 (d, J = 23.4Hz), 110.9 (d, J = 24.1 Hz).



Compound **(3a**). white solid (75.7 mg, 68%). m.p: 83-85 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (d, J = 8.2 Hz, 1H), 8.04 (d, J = 6.9 Hz, 1H), 7.68-7.59 (m, 3H), 7.37-7.34 (m, 1H), 7.26-7.23 (m, 2H), 7.07-7.06 (m, 2H), 6.97 (t, J = 8.6 Hz, 2H), 4.67 (d, J = 11.6 Hz, 1H), 4.34-4.31 (m, 2H), 2.64-2.61 (m, 2H), 2.28-2.23 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 162.5 (d, J = 245.2 Hz), 143.0, 142.1, 135.9, 132.9, 132.4, 130.0, 128.8, 128.4 (d, J = 8.0 Hz), 125.0, 124.4, 121.6, 119.3, 115.2 (d, J = 21.0 Hz), 84.5, 66.3, 56.9, 50.3, 24.9. ^{19}F NMR (372 MHz, $CDCl_3$) δ -115.1. HRMS (ESI) calcd for $C_{24}H_{19}FNO_2$ ([M+H]$^+$): 372.1394 found 372.1398.

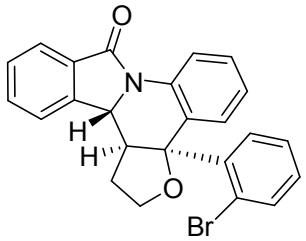


Compound **(3b**). white solid (80.1 mg, 69%). m.p: 176-178 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (d, J = 8.2 Hz, 1H), 8.04 (d, J = 6.8 Hz, 1H), 7.67-7.59 (m, 3H), 7.38-7.34 (m, 1H), 7.24-7.20 (m, 4H), 7.07-7.04 (m, 2H), 4.67 (d, J = 11.6 Hz, 1H), 4.35-4.30 (m, 2H), 2.63-2.58 (m, 2H), 2.26-2.20 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 144.3, 143.7,134.1, 132.9, 132.2, 130.4, 129.0, 128.7, 128.4, 127.0, 124.9, 124.8, 122.7, 120.5, 85.6, 65.6, 58.4, 51.1, 27.8. HRMS (ESI) calcd for $C_{24}H_{19}ClNO_2$ ([M+H]$^+$): 388.1099 found 388.1095.

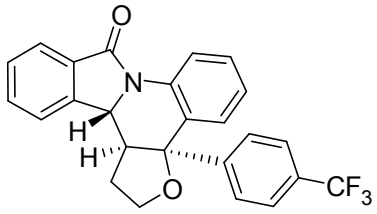


Compound **(3c**). white solid (86.8 mg, 67%). m.p: 223-225 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (d, J = 8.2 Hz, 1H), 8.04 (d, J = 6.7 Hz, 1H), 7.67-7.58 (m, 3H), 7.41-7.39 (m, 2H), 7.38-7.34 (m, 1H), 7.16-7.13 (m, 2H), 7.07-7.05 (m, 2H), 4.65 (d, J = 11.5 Hz, 1H), 4.34-4.30 (m, 2H), 2.62-2.57 (m, 2H), 2.27-2.22 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 144.8, 143.7, 134.1, 132.9, 132.3, 131.4, 130.4, 129.0, 128.7,

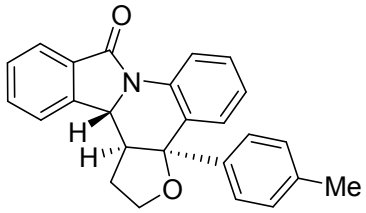
127.4, 124.9, 124.7, 122.7, 121.1, 120.5, 85.6, 65.6, 58.4, 51.1, 27.9. HRMS (ESI) calcd for $C_{24}H_{19}BrNO_2$ ($[M+H]^+$): 432.0594 found 432.0590.



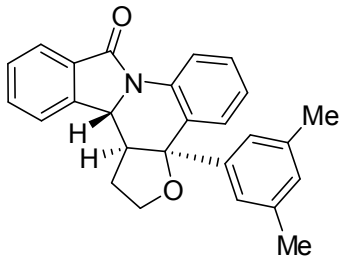
Compound **(3d)**. white solid (85.3 mg, 66%). m.p: 236-238 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (d, J = 8.1 Hz, 1H), 8.05 (d, J = 6.7 Hz, 1H), 7.96-7.94 (m, 1H), 7.69-7.66 (m, 1H), 7.62-7.59 (m, 2H), 7.44-7.39 (m, 3H), 7.06 (t, J = 7.2 Hz, 1H), 6.95-6.93 (m, 1H), 4.71 (d, J = 11.6 Hz, 1H), 4.40-4.38 (m, 2H), 3.13 (dd, J = 11.6, 6.6 Hz, 1H), 2.56-2.55 (m, 1H), 2.19-2.13 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 143.9, 143.5, 135.8, 135.0, 133.0, 132.1, 129.3, 129.1, 128.9, 128.5, 128.1, 126.9, 124.9, 124.6, 122.7, 121.2, 120.5, 86.5, 65.4, 57.9, 46.8, 27.9. HRMS (ESI) calcd for $C_{24}H_{19}BrNO_2$ ($[M+H]^+$): 432.0594 found 432.0588.



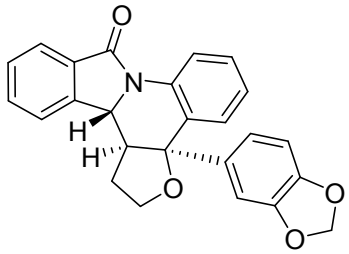
Compound **(3e)**. white solid (78.3 mg, 62%). m.p: 133-135 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 (d, J = 8.4 Hz, 1H), 8.06-8.04 (m, 1H), 7.67-7.61 (m, 3H), 7.55-7.53 (m, 2H), 7.44-7.37 (m, 3H), 7.07-7.04 (m, 2H), 4.67 (d, J = 11.5 Hz, 1H), 4.37-4.34 (m, 2H), 2.66-2.57 (m, 2H), 2.27-2.23 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 149.9, 143.6, 134.2, 132.9, 130.5, 130.3, 129.1, 128.6, 126.0, 125.3, 124.9, 122.7, 120.5, 85.7, 65.7, 58.4, 51.2, 27.9. ^{19}F NMR (372 MHz, $CDCl_3$) δ -62.5. HRMS (ESI) calcd for $C_{25}H_{19}F_3NO_2$ ($[M+H]^+$): 422.1362 found 422.1358.



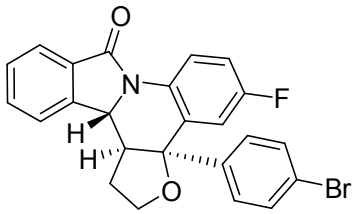
Compound **(3f)**. white solid (82.6 mg, 75%). m.p: 169-170 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, J = 8.2 Hz, 1H), 8.02 (d, J = 6.9 Hz, 1H), 7.68-7.63 (m, 1H), 7.62-7.56 (m, 2H), 7.36-7.32 (m, 1H), 7.17-7.15 (m, 2H), 7.10-7.05 (m, 4H), 4.67 (d, J = 11.5 Hz, 1H), 4.33 (dd, J = 9.3, 5.3 Hz, 2H), 2.62 (dd, J = 11.6, 6.8 Hz, 1H), 2.57-2.51 (m, 1H), 2.30 (s, 3H), 2.29-2.21 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 143.9, 142.6, 136.7, 134.0, 133.1, 132.1, 128.9, 128.4, 125.8, 125.5, 124.8, 124.6, 122.1, 120.4, 85.8, 65.4, 58.6, 51.0, 27.9, 20.9. HRMS (ESI) calcd for $C_{25}H_{22}NO_2$ ($[M+H]^+$): 368.1645 found 368.1639.



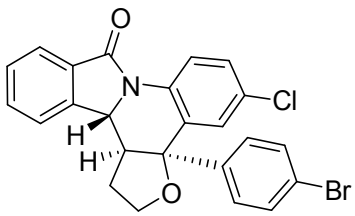
Compound (**3g**). white solid (70.8 mg, 62%). m.p: 230-232 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, J = 7.6 Hz, 1H), 8.06-8.04 (m, 1H), 7.69-7.67 (m, 1H), 7.64-7.57 (m, 2H), 7.37-7.32 (m, 1H), 7.12-7.04 (m, 2H), 6.88 (s, 2H), 6.85 (s, 2H), 4.67 (d, J = 11.6 Hz, 1H), 4.33 (dd, J = 9.5, 5.5 Hz, 2H), 2.66 (dd, J = 11.6, 6.8 Hz, 1H), 2.57-2.51 (m, 2H), 2.26 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 145.3, 143.9, 137.7, 134.0, 133.1, 132.1, 130.6, 128.9, 128.7, 128.4, 124.9, 124.7, 123.4, 122.7, 120.3, 85.9, 65.3, 58.5, 50.8, 27.8, 21.4. HRMS (ESI) calcd for $C_{26}H_{24}NO_2$ ([M+H]$^+$): 382.1802 found 382.1808.



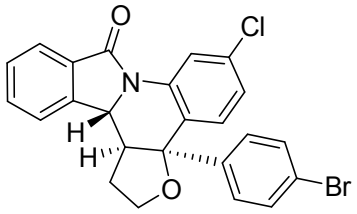
Compound (**3h**). white solid (69.0 mg, 58%). m.p: 173-175 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36 (d, J = 8.2 Hz, 1H), 8.04 (d, J = 6.8 Hz, 1H), 7.68-7.57 (m, 3H), 7.37-7.34 (m, 1H), 7.15-7.06 (m, 2H), 6.78-6.70 (m, 3H), 5.92 (s, 2H), 4.65 (d, J = 11.6 Hz, 1H), 4.33 (dd, J = 9.5, 5.3 Hz, 2H), 2.63-2.52 (m, 2H), 2.31-2.21 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 147.7, 146.5, 139.2, 132.2, 130.8, 130.4, 128.9, 128.5, 124.8, 124.7, 122.7, 120.4, 118.8, 107.9, 106.4, 101.1, 85.8, 65.6, 101.1, 85.8, 65.5, 58.6, 51.1, 29.7. HRMS (ESI) calcd for $C_{25}H_{20}NO_4$ ([M+H]$^+$): 398.1387 found 398.1382.



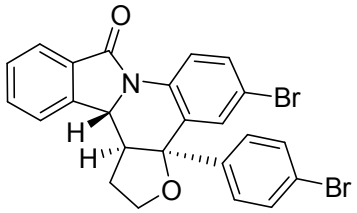
Compound **(3i**). white solid (78.1 mg, 58%). m.p: 227-228 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35 (dd, J = 9.1, 5.2 Hz, 1H), 8.03 (d, J = 6.7 Hz, 1H), 7.66-7.61 (m, 3H), 7.44-7.41 (m, 2H), 7.15-7.13 (m, 2H), 7.09-7.04 (m, 1H), 6.74 (dd, J = 9.1, 2.9 Hz, 1H), 4.62 (d, J = 11.6 Hz, 1H), 4.33-4.29 (m, 2H), 2.62-2.54 (m, 2H), 2.30-2.25 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.4, 159.4 (d, J = 249.8 Hz), 144.2, 143.5, 132.7, 132.4, 131.6, 130.2, 129.1, 127.3, 124.8, 122.6, 122.2 (d, J = 7.8 Hz), 121.4, 116.7 (d, J = 23.1 Hz), 116.1 (d, J = 22.5 Hz), 85.5, 65.6, 58.5, 50.9, 27.9. ^{19}F NMR (372 MHz, $CDCl_3$) δ -116.4. HRMS (ESI) calcd for $C_{24}H_{18}BrFNO_2$ ([M+H]$^+$): 450.0499 found 450.0493.



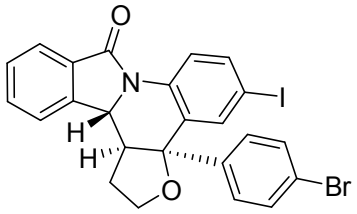
Compound **(3j)**. white solid (96.3 mg, 69%). m.p: 232-234 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 (d, J = 8.8 Hz, 1H), 8.03 (d, J = 8.8 Hz, 1H), 7.65-7.61 (m, 3H), 7.43 (d, J = 8.5 Hz, 2H), 7.30 (dd, J = 8.8, 2.4 Hz, 1H), 7.14-7.12 (m, 2H), 7.01 (d, J = 2.4 Hz, 1H), 4.63 (d, J = 11.5 Hz, 1H), 4.34-4.30 (m, 2H), 2.61-2.53 (m, 2H), 2.27-2.22 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 144.0, 143.5, 132.7, 132.5, 132.1, 131.6, 130.3, 130.1, 129.2, 129.0, 127.3, 124.8, 122.7, 121.4, 85.4, 65.7, 58.4, 50.9, 29.7, 27.9. HRMS (ESI) calcd for $C_{24}H_{18}BrClNO_2$ ([M+H]$^+$): 466.0204 found 466.0205.



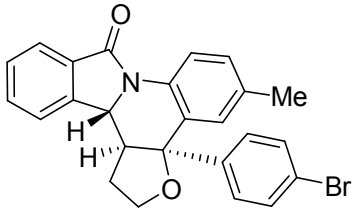
Compound **(3k)**. white solid (92.0 mg, 66%). m.p: 184-185 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (s, 1H), 8.11 (d, J = 7.2 Hz, 1H), 7.73-7.67 (m, 3H), 7.50-7.48 (m, 2H), 7.20 (d, J = 6.8 Hz, 2H), 7.11-7.02 (m, 2H), 4.72 (d, J = 11.5Hz, 1H), 4.41-4.37 (m, 2H), 2.67-2.63 (m, 2H), 2.36-2.30 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.5, 144.3, 143.5, 135.0, 134.5, 132.6, 131.7, 131.5, 129.2, 128.8, 127.3, 125.1, 124.9, 122.7, 121.3, 120.4, 85.4, 65.6, 58.3, 50.7, 29.7, 27.7. HRMS (ESI) calcd for $C_{24}H_{18}BrClNO_2$ ([M+H]$^+$): 466.0204 found 466.0198.



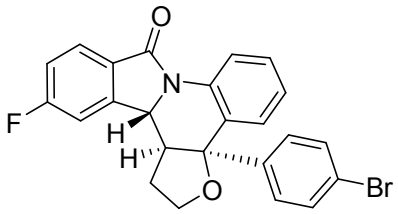
Compound (**3l**) [1]. White solid (97.5 mg, 64%). m.p: 264-266 °C (lit. mp 263-266 °C). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 8.8 Hz, 1H), 8.03 (d, J = 7.2 Hz, 1H), 7.65−7.60 (m, 3H), 7.48−7.42 (m, 3H), 7.17−7.12 (m, 3H), 4.62 (d, J = 11.6 Hz, 1H), 4.34−4.30 (m, 2H), 2.61−2.54 (m, 2H), 2.29−2.19 (m, 1H). ^{13}C{1H} NMR (125 MHz, $CDCl_3$) δ 165.5, 144.0, 143.5, 133.2, 131.8, 131.6, 129.1, 127.3, 124.9, 122.7, 122.1, 121.4, 117.8, 85.3, 65.7, 58.3, 50.9, 27.9.



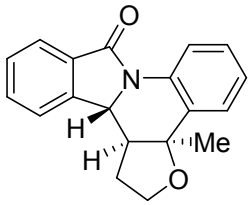
Compound **(3m)**. white solid (96.7 mg, 58%). m.p: 295-297 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, J = 8.7 Hz, 1H), 8.02 (d, J = 7.0 Hz, 1H), 7.67-7.59 (m, 4H), 7.43 (d, J = 8.6 Hz, 2H), 7.36-7.35 (m, 1H), 7.12 (d, J = 8.5 Hz, 2H), 4.62 (d, J = 8.8 Hz, 1H), 4.33-4.29 (m, 2H), 2.60-2.51 (m, 2H), 2.27-2.21 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.5, 144.1, 143.5, 139.1, 137.7, 133.9, 132.7, 132.6, 131.6, 129.2, 127.3, 124.9, 122.7, 122.4, 121.4, 88.7, 85.2, 65.7, 58.2, 51.0, 27.8. HRMS (ESI) calcd for $C_{24}H_{18}BrINO_2$ ([M+H]$^+$): 557.9560 found 557.9564.



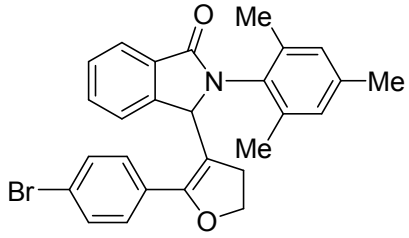
Compound **(3n)**. white solid (92.1 mg, 69%). m.p: 220-222 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 (d, J = 8.4 Hz, 1H), 8.03-8.01 (m, 1H), 7.66-7.55 (m, 3H), 7.42-7.40 (m, 2H), 7.18-7.13 (m, 3H), 6.85-6.84 (m, 1H), 4.62 (d, J = 11.5 Hz, 1H), 4.33-4.30 (m, 2H), 2.59-2.55 (m, 2H), 2.29-2.23 (m, 1H), 2.22 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.3, 144.9, 143.7, 134.6, 133.1, 132.1, 131.7, 131.4, 130.5, 130.2, 129.6, 128.9, 127.4, 124.7, 122.6, 120.9, 120.4, 85.7, 65.6, 58.5, 51.2, 27.9, 21.0. HRMS (ESI) calcd for $C_{25}H_{20}BrNO_2$ ([M+H]$^+$): 446.0750 found 446.0746.



Compound **(3o**). white solid (74.2 mg, 55%). m.p: 227-229 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 (d, J = 8.1 Hz, 1H), 8.01 (dd, J = 9.1, 5.1 Hz, 1H), 7.42-7.40 (m, 2H), 7.38-7.28 (m, 3H), 7.16-7.14 (m, 2H), 7.09-7.03 (m, 2H), 4.64 (d, J = 11.5 Hz, 1H), 4.33-4.29 (m, 2H), 2.61 (dd, J = 11.5, 6.6 Hz, 1H), 2.49-2.43 (m, 1H), 2.28-2.23 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4 (d, J = 251.2 Hz), 164.5, 146.0, 144.6, 133.9, 131.5, 130.5, 130.2, 128.9, 128.8, 127.4, 126.9 (d, J = 9.7 Hz), 125.1, 121.2, 120.3, 116.9 (d, J = 23.2 Hz), 110.4 (d, J = 24.6 Hz), 85.6, 65.5, 58.1, 50.8, 29.7, 27.8. ^{19}F NMR (372 MHz, $CDCl_3$) δ -116.5. HRMS (ESI) calcd for $C_{24}H_{18}BrFNO_2$ ([M+H]$^+$): 450.0499 found 450.0493.



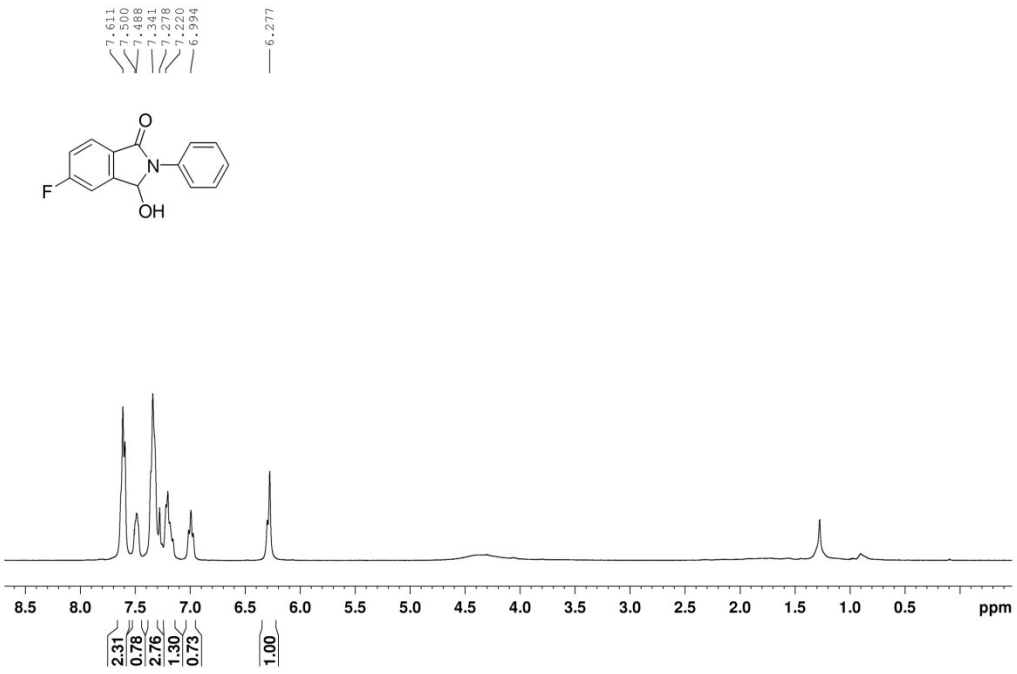
Compound **(3p).** white solid (45.4 mg, 52%). Mp: 149-152 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (dd, J = 8.3, 1.5 Hz, 1H), 7.97-7.95 (m, 1H), 7.66 -7.63 (m, 1H), 7.58-7.51 (m, 3H), 7.36 (dt, J = 8.4, 2.0 Hz, 1H), 7.20 (dt, J = 7.5, 1.2 Hz, 1H), 5.05 (d, J = 3.0 Hz, 1H), 3.82-3.74 (m, 1H), 3.49-3.38 (m, 1H), 2.82 (dt, J = 9.5, 3.0 Hz, 1H), 1.81 (s, 3H), 1.58-1.51 (m, 1H), 1.20-1.14 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 166.7, 143.3, 134.7, 133.0, 132.4, 130.5, 128.8, 128.4, 127.8, 124.9, 124.4, 121.6, 119.5, 80.2, 65.1, 58.0, 47.0, 28.8, 24.3.



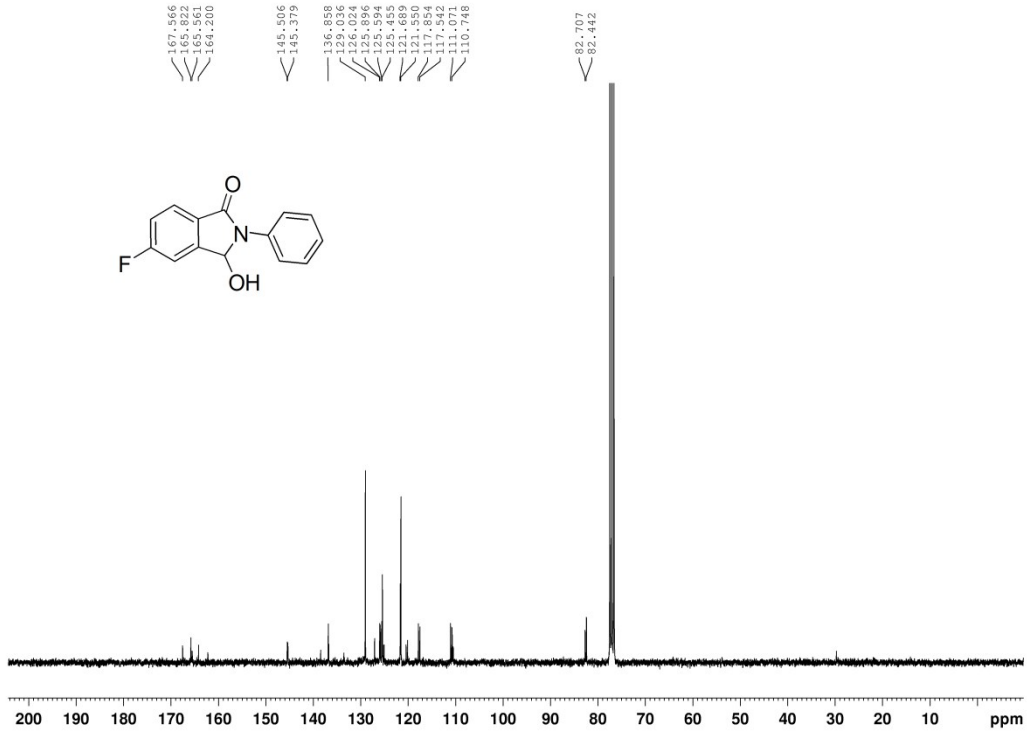
Compound (**5**). White solid (69.5 mg, 49%). m.p: 172-174 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, J = 7.5 Hz, 1H), 7.61 (t, J = 7.2 Hz, 1H), 7.53 (t, J = 7.4 Hz, 1H), 7.37-7.32 (m, 3H), 6.98 (s, 1H), 6.91 (s, 1H), 6.78 (d, J = 8.4 Hz, 2H), 5.56 (s, 1H), 4.48-4.41 (m, 1H), 4.31-4.29 (m, 1H), 2.51-2.47 (m, 1H), 2.42-2.38 (m, 1H), 2.33 (s, 3H), 2.29 (s, 3H), 1.91 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.2, 156.7, 144.5, 138.4, 137.9, 136.3, 132.2, 131.9, 131.3, 129.6, 129.3, 128.6, 124.4, 123.2, 123.0, 105.0, 69.0, 59.9, 21.0, 18.5, 17.9. HRMS (ESI) calcd for $C_{27}H_{25}BrNO_2$ ([M+H]$^+$): 474.1063 found 474.1065.

REFERENCES

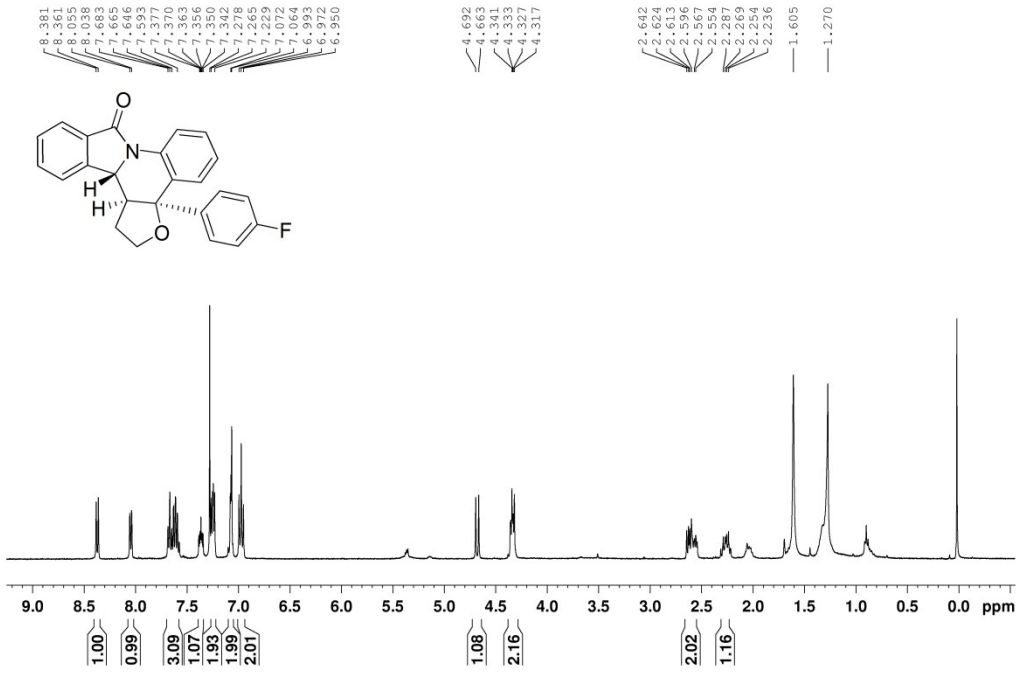
[1] J. Li, S. Bai, Y. Li, Z.-B. Wang, X. Hu, L. Liu. *J. Org. Chem.* 2018, **83,** 8780.



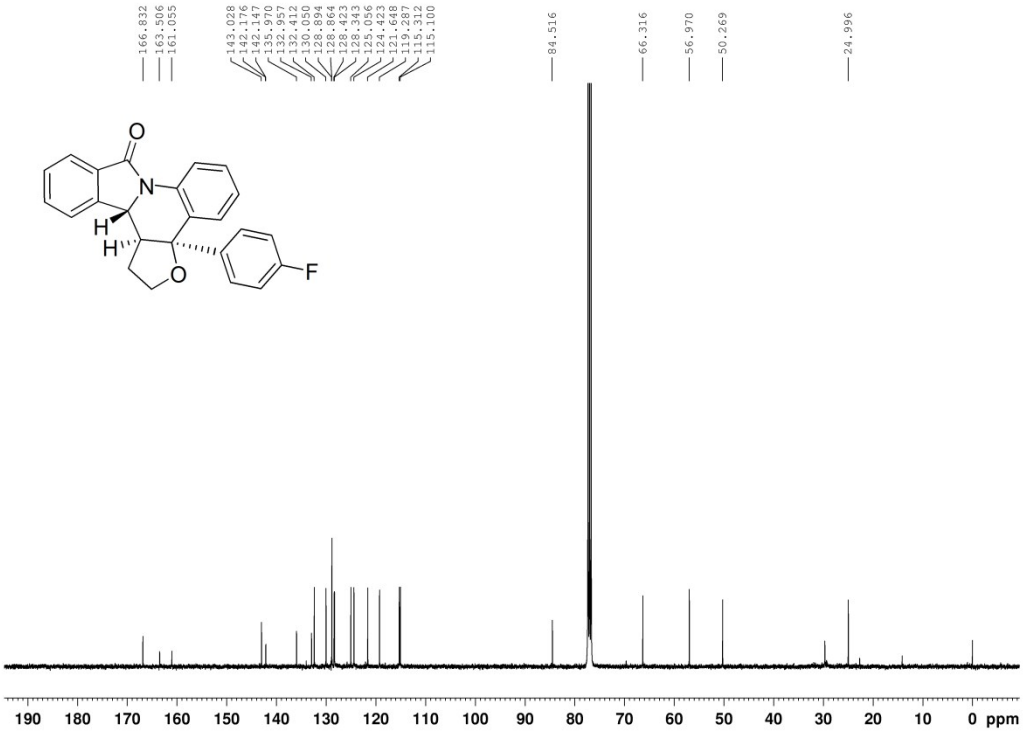
^{1}H NMR of **1h** in $CDCl_3$



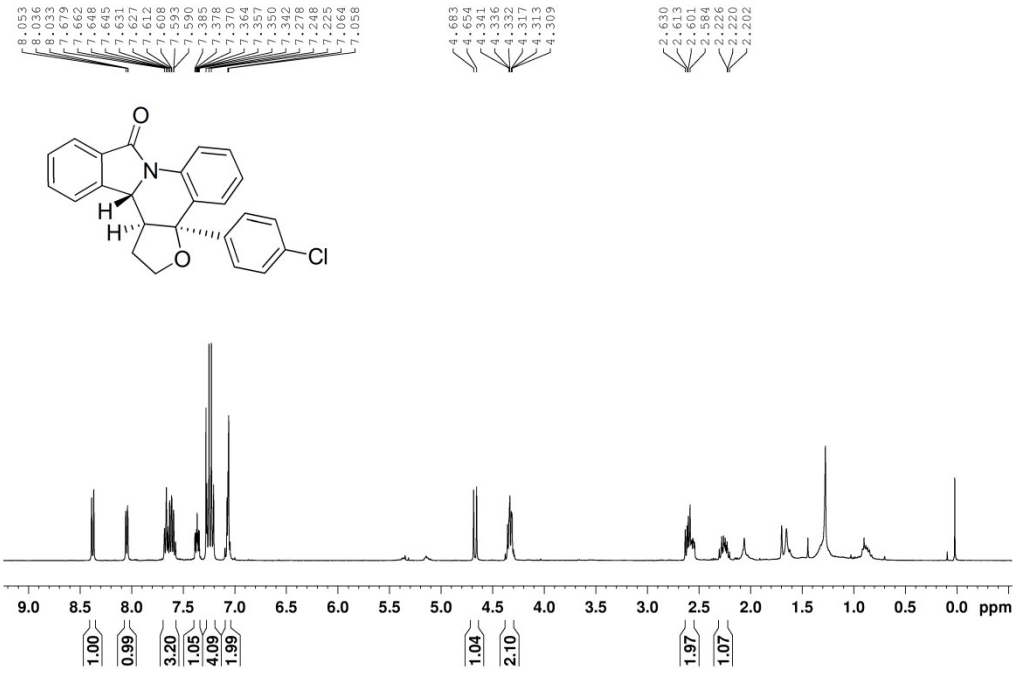
^{13}C NMR of **1h** in $CDCl_3$



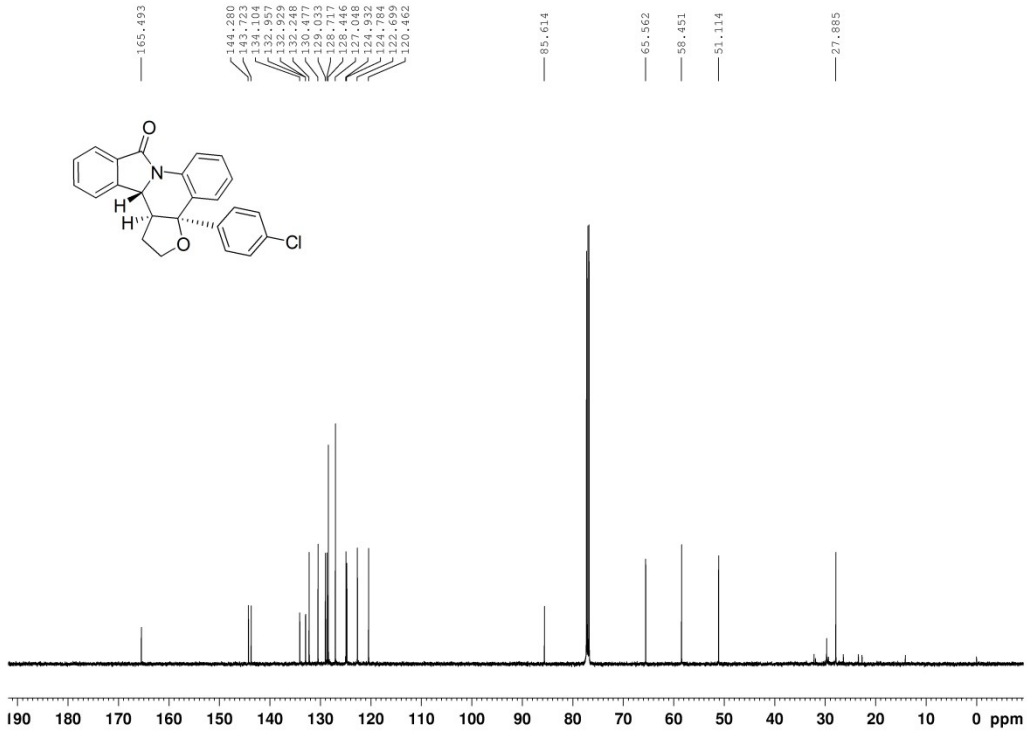
^{1}H NMR of **3a** in $CDCl_3$



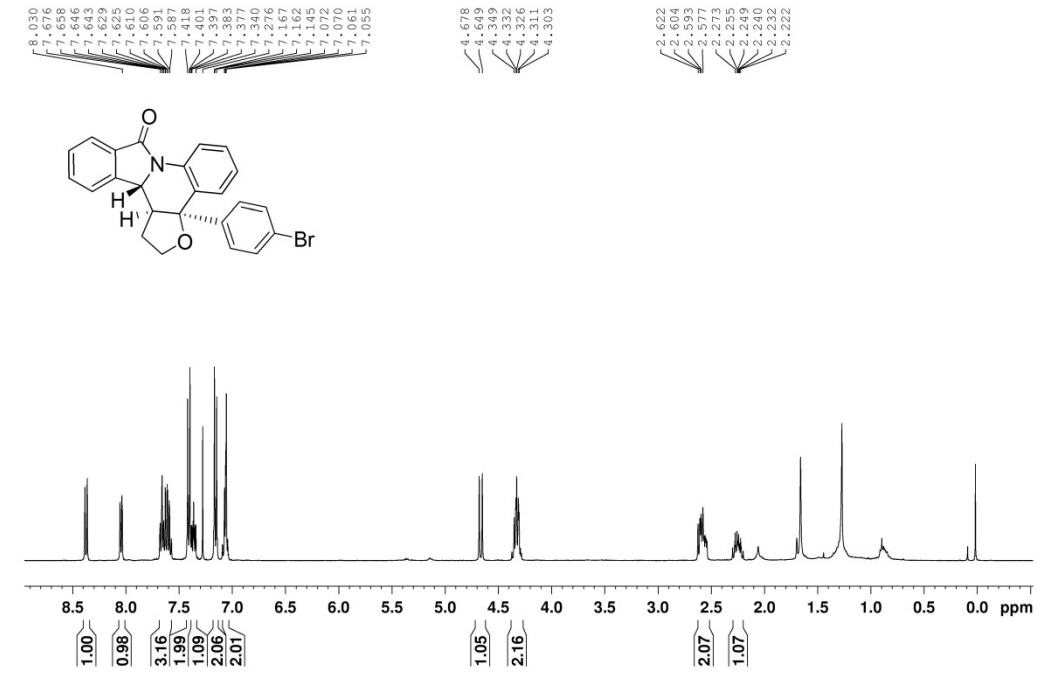
^{13}C NMR of **3a** in $CDCl_3$



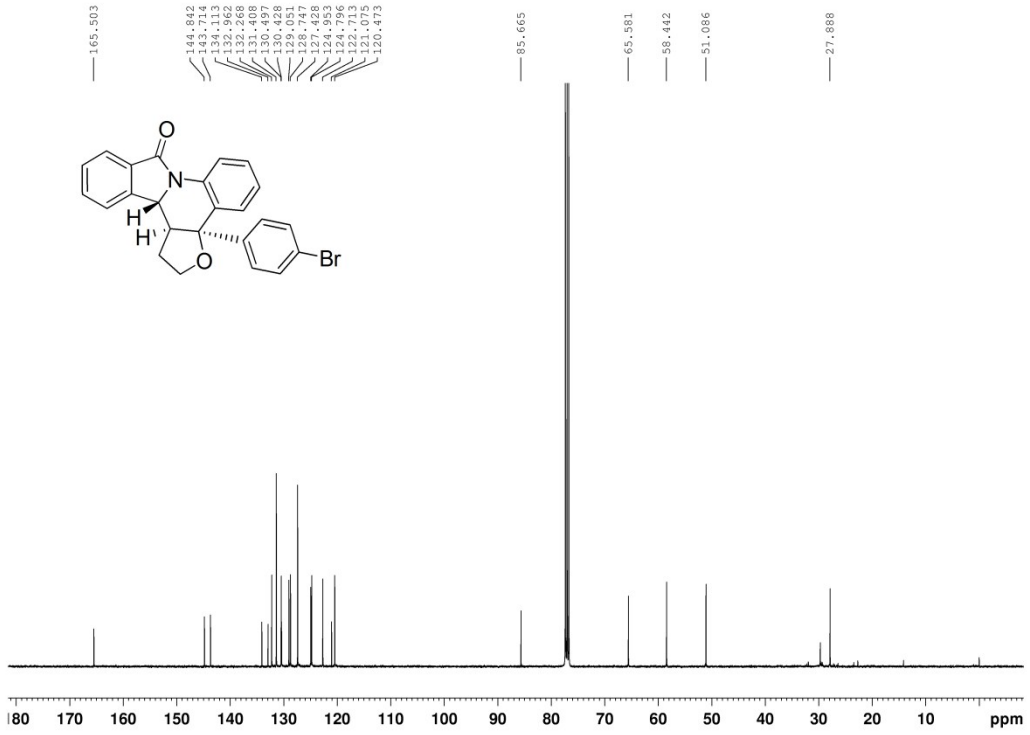
^{1}H NMR of **3b** in $CDCl_3$



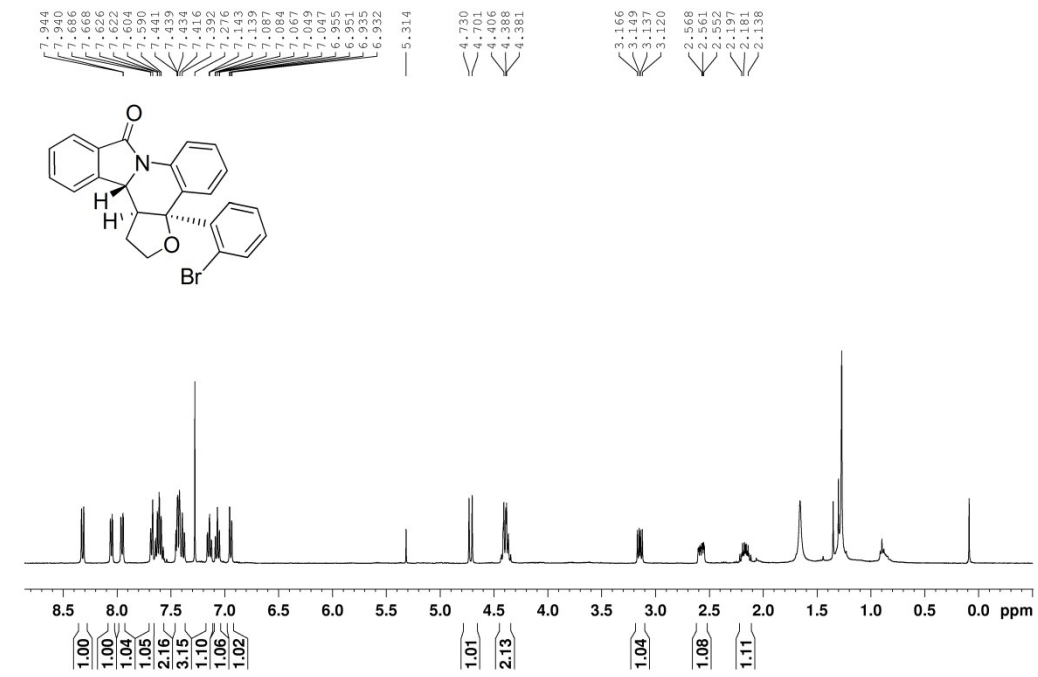
^{13}C NMR of **3b** in $CDCl_3$



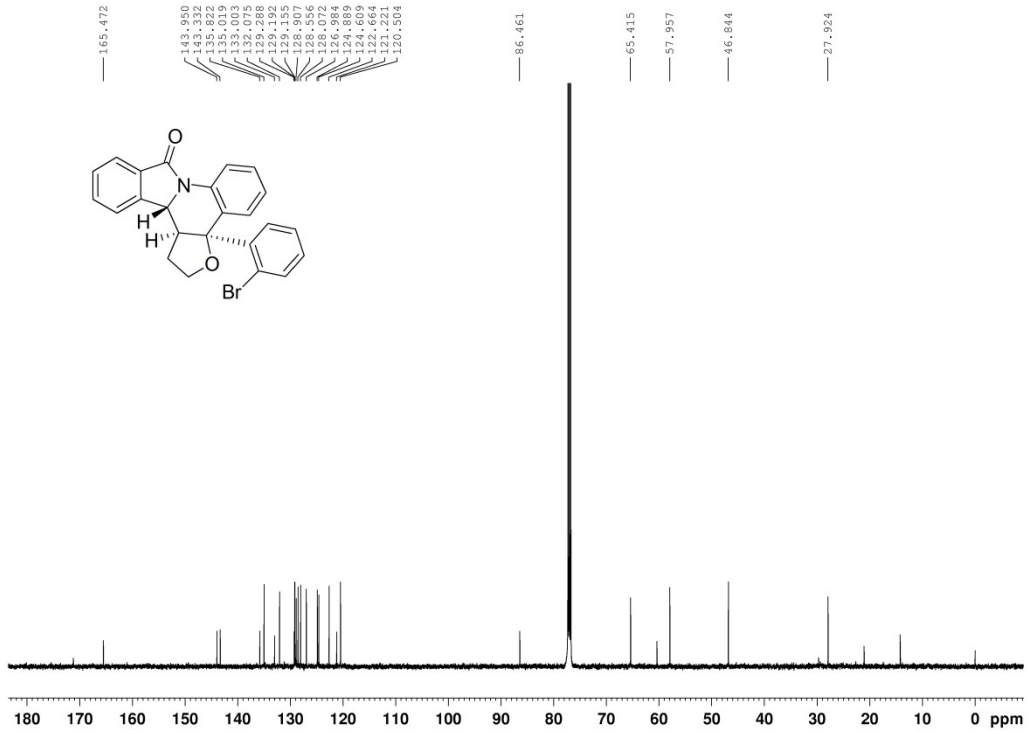
^{1}H NMR of **3c** in $CDCl_3$



^{13}C NMR of **3c** in $CDCl_3$



^{1}H NMR of **3d** in $CDCl_3$



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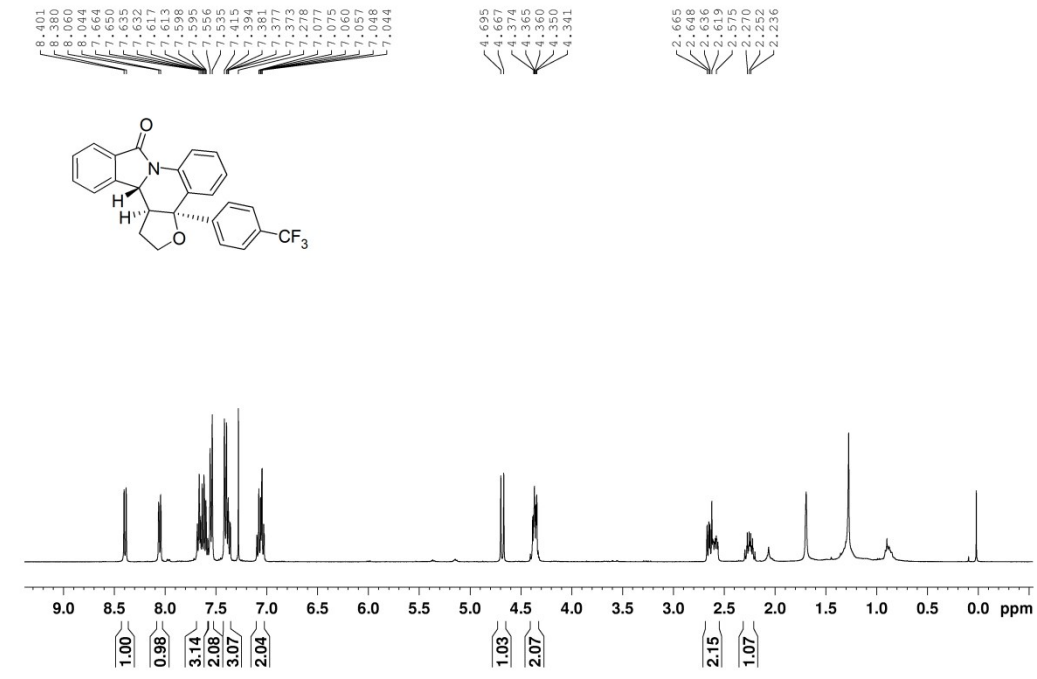
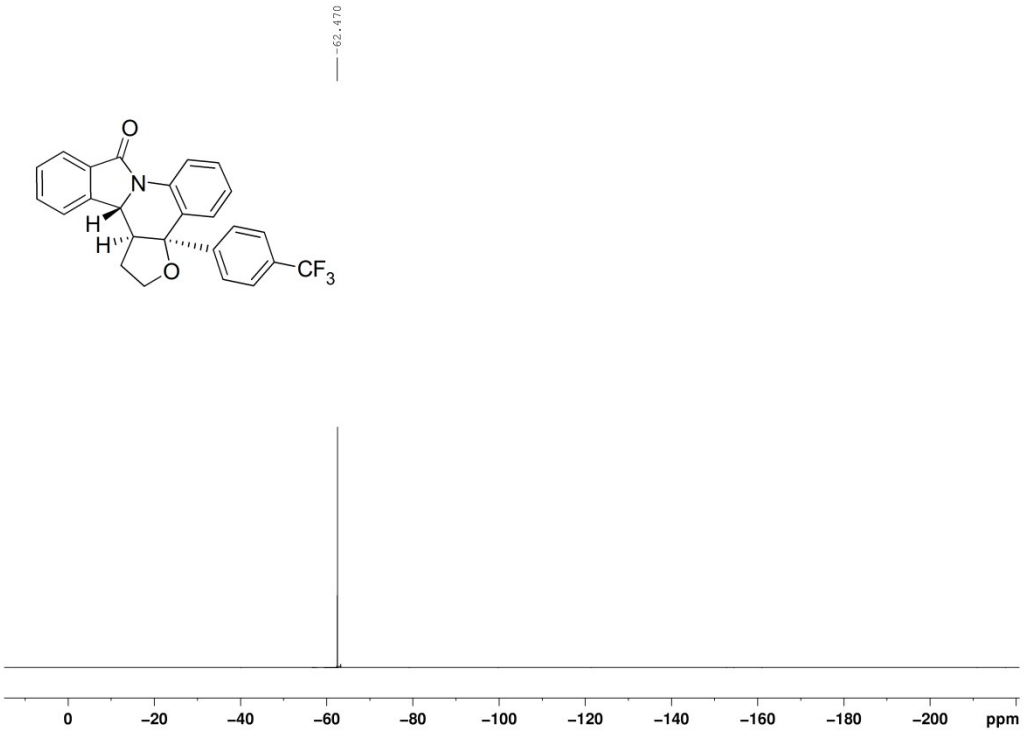
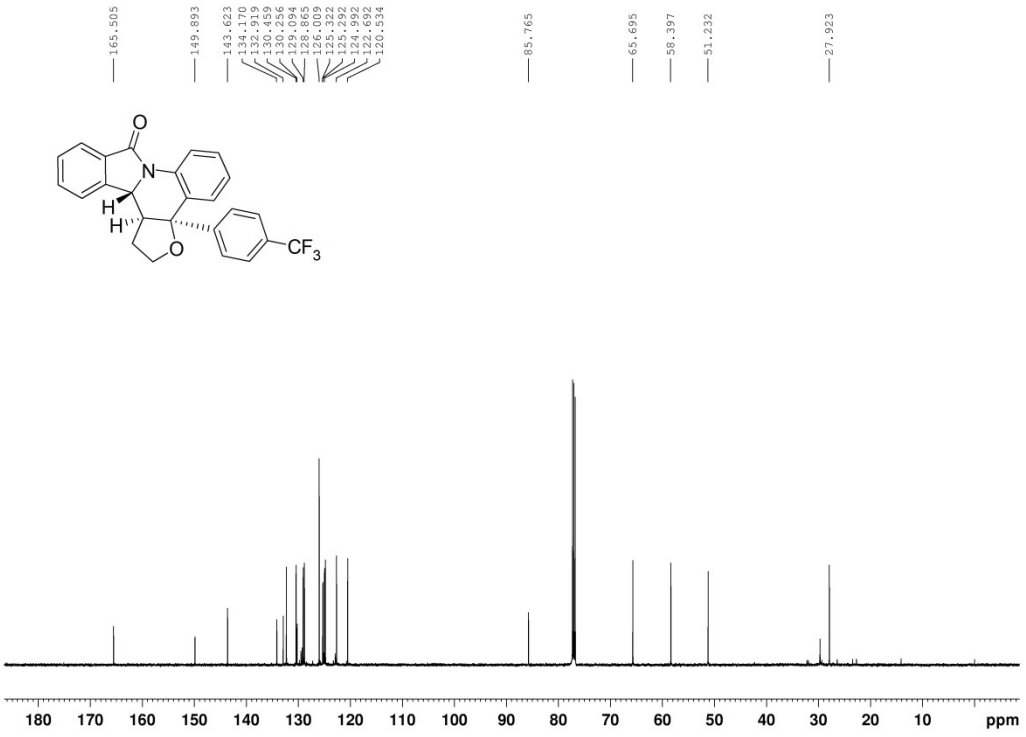


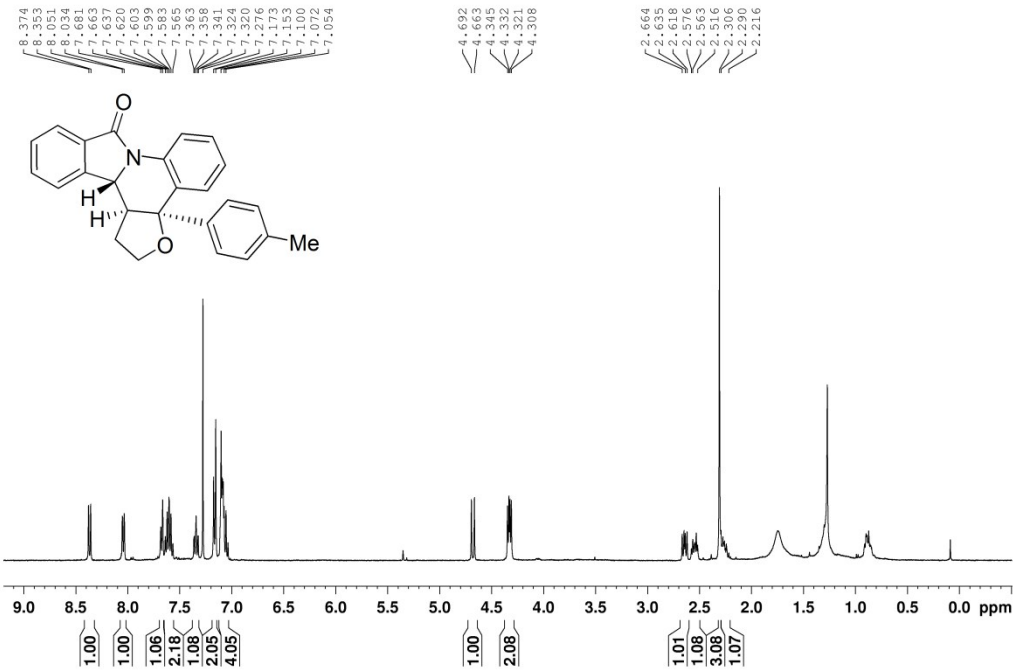
^{1}H NMR of **3e** in $CDCl_3$



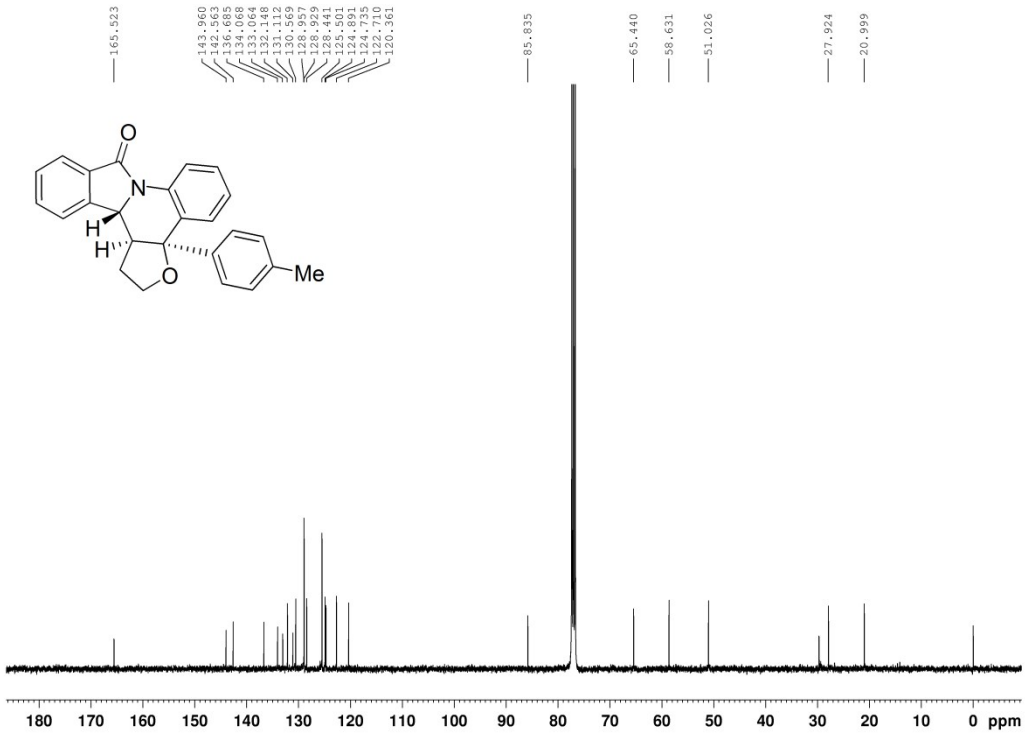
^{19}F NMR of **3e** in $CDCl_3$



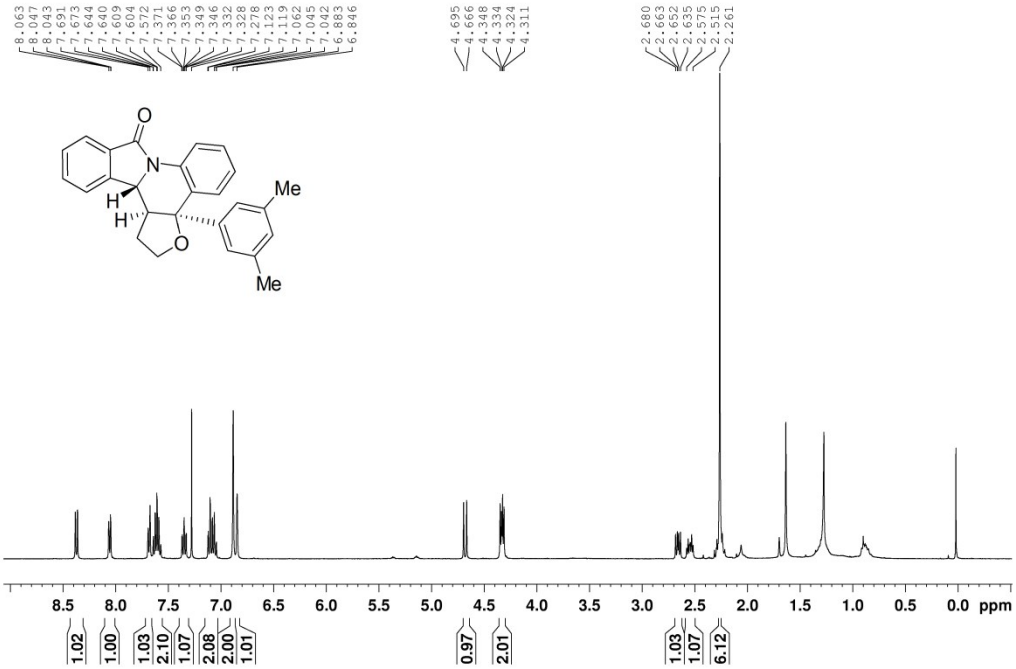
^{13}C NMR of **3e** in $CDCl_3$



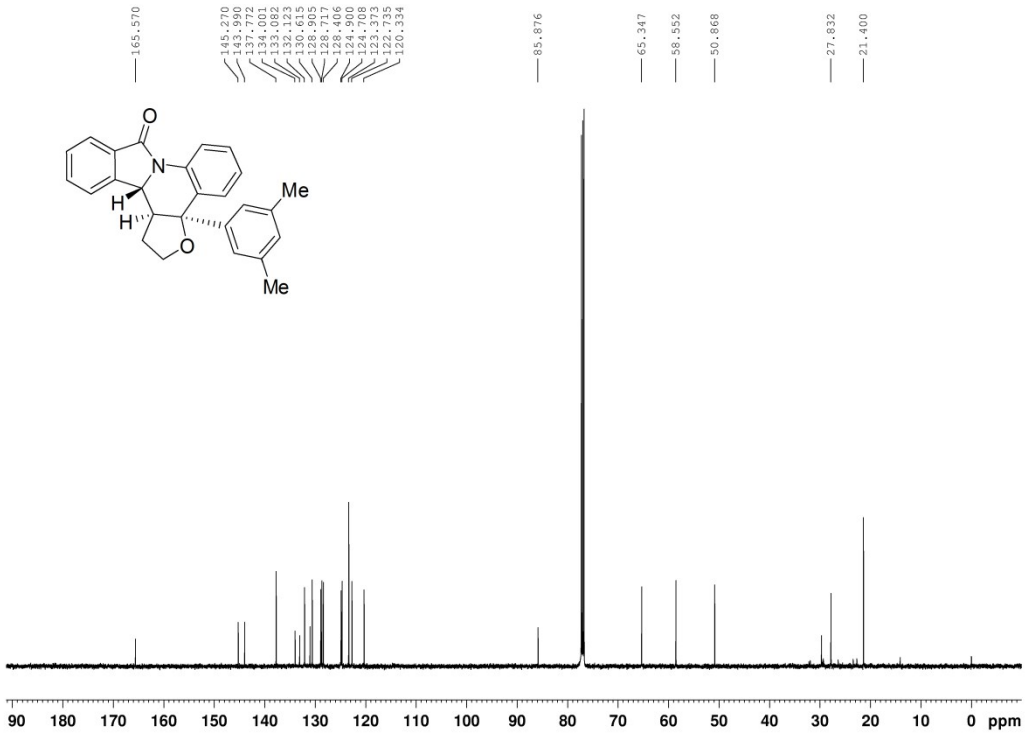
^{1}H NMR of **3f** in $CDCl_3$



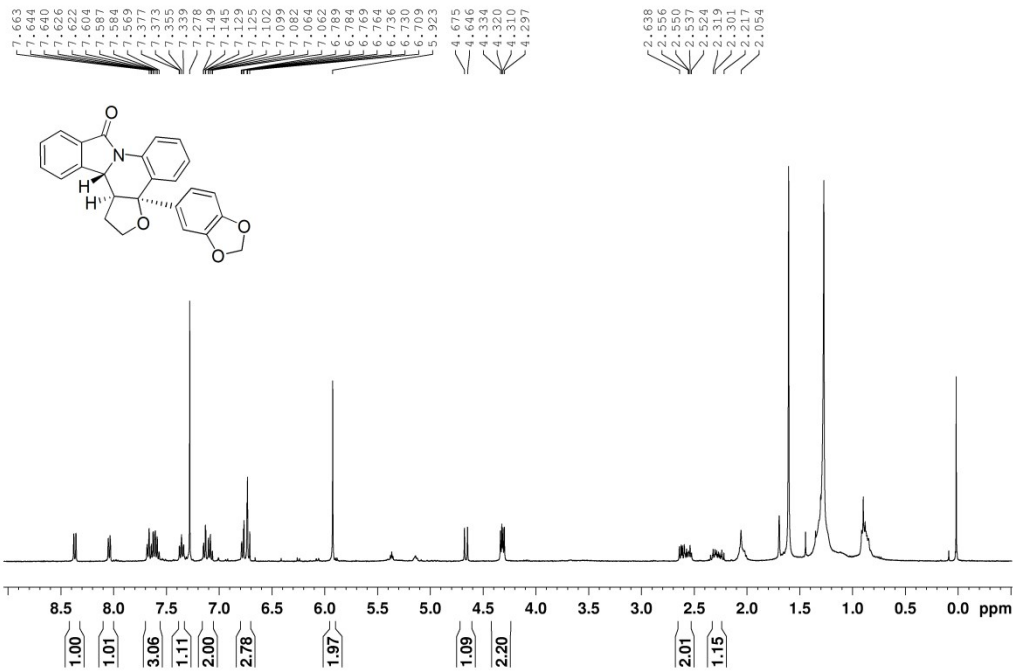
^{13}C NMR of **3f** in $CDCl_3$



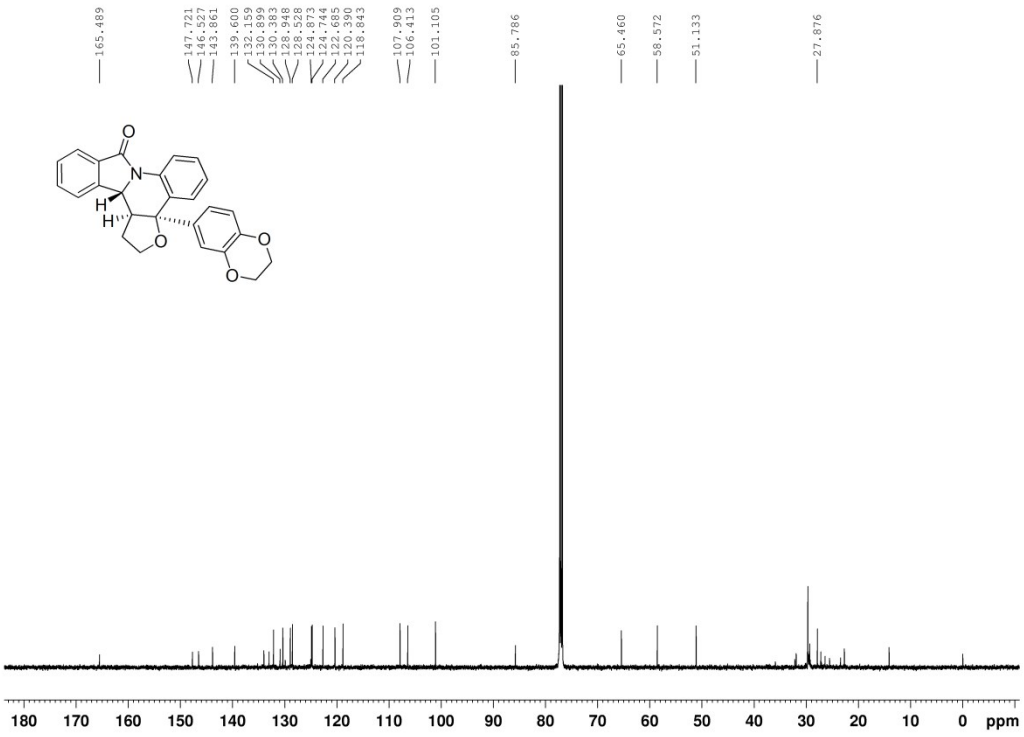
^{1}H NMR of **3g** in $CDCl_3$



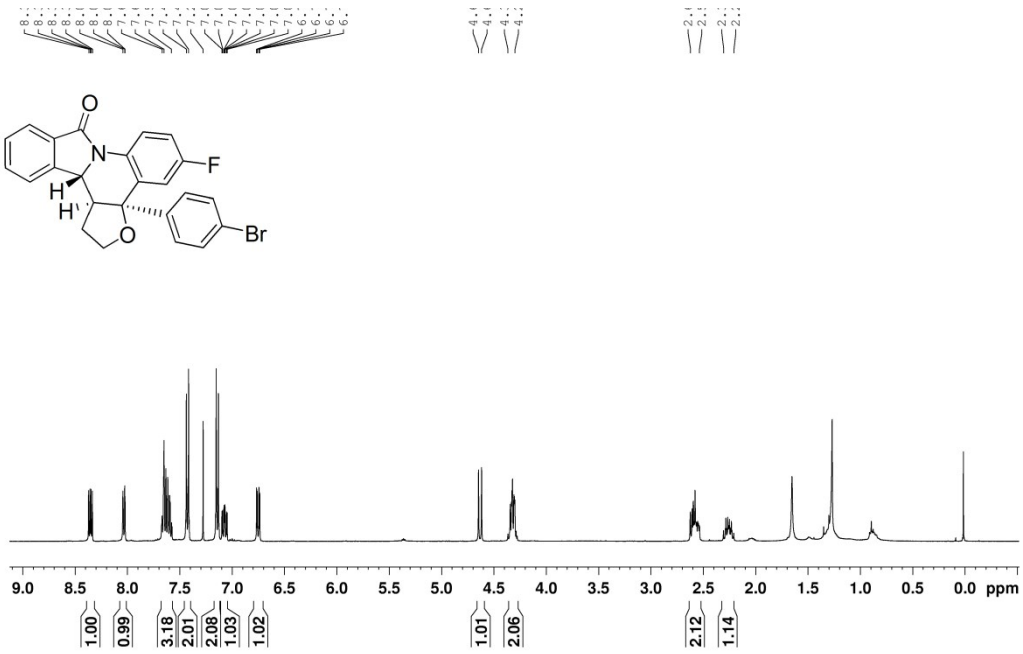
^{13}C NMR of **3g** in $CDCl_3$



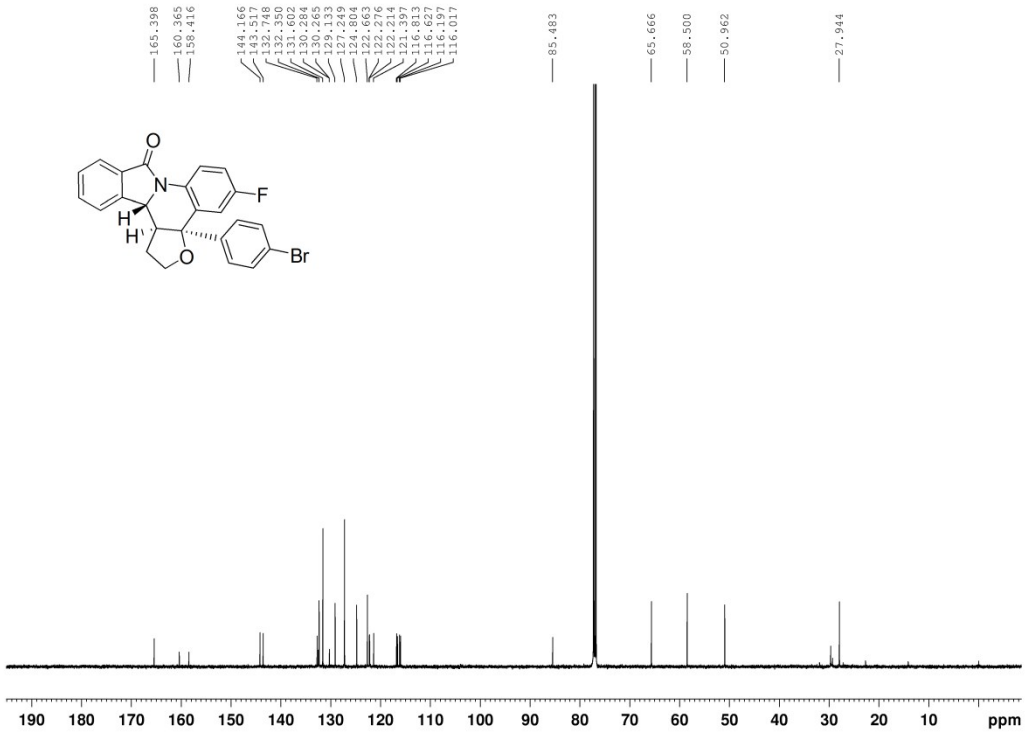
^{1}H NMR of **3h** in $CDCl_3$



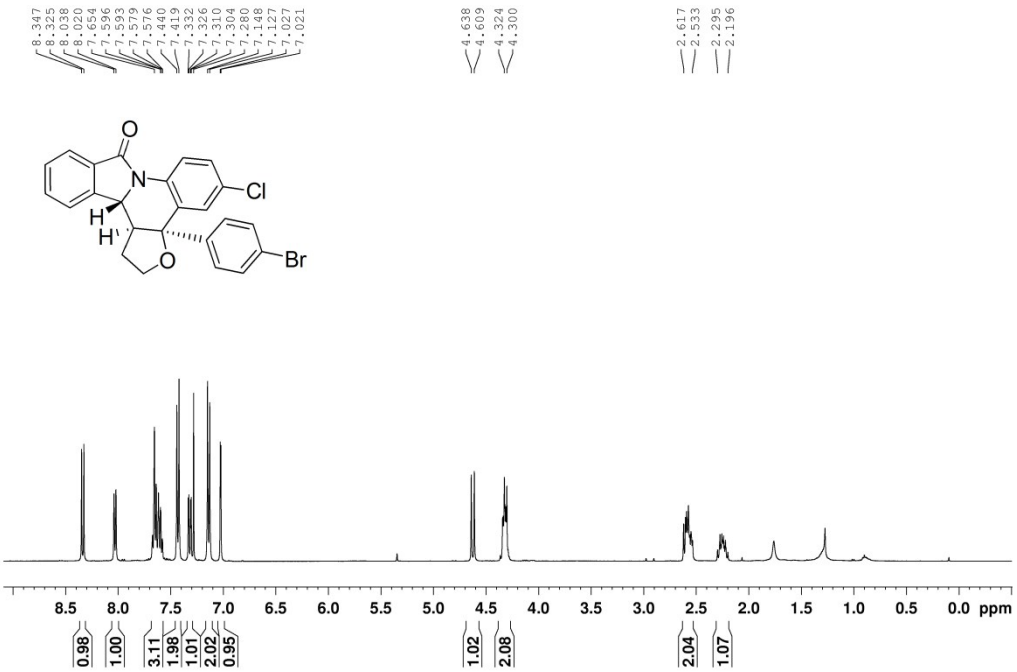
^{13}C NMR of **3h** in $CDCl_3$



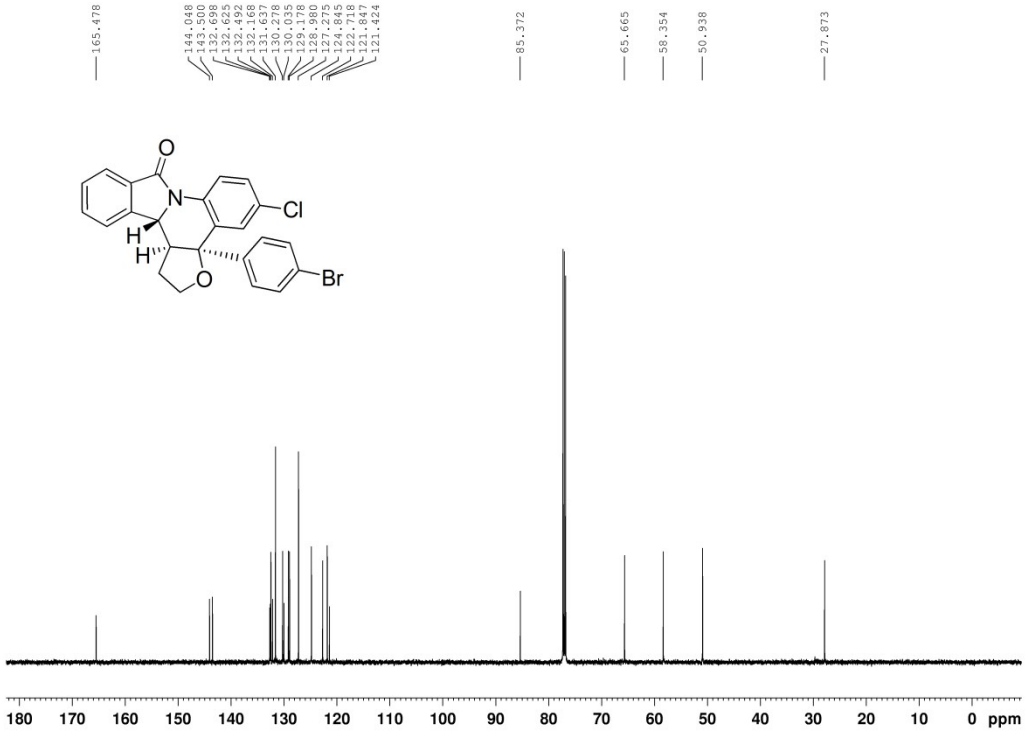
^{1}H NMR of **3i** in $CDCl_3$



^{13}C NMR of **3i** in $CDCl_3$



^{1}H NMR of **3j** in $CDCl_3$



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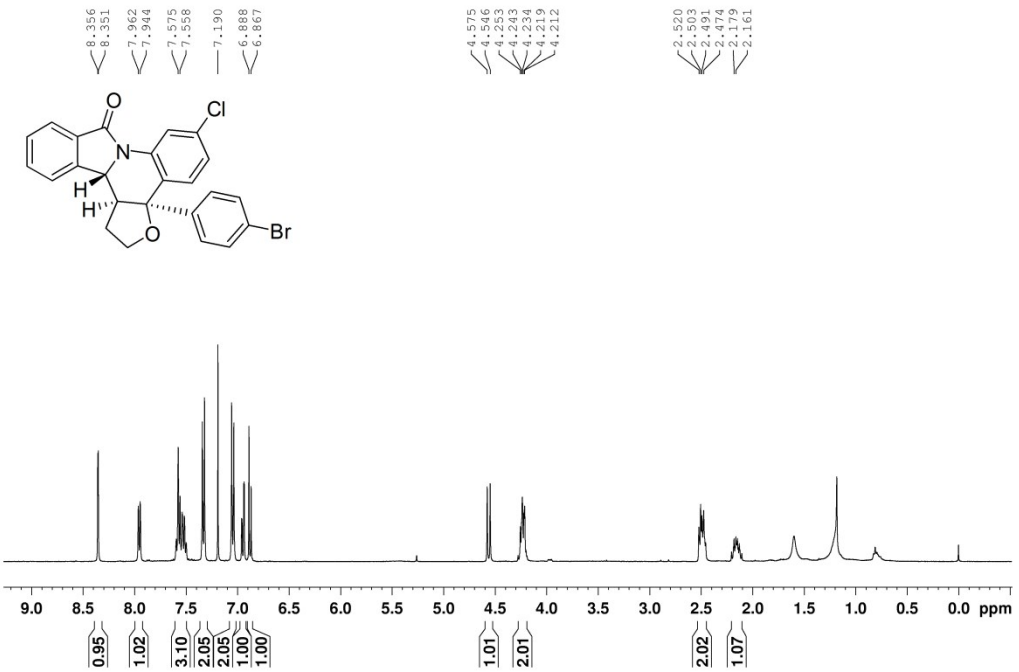

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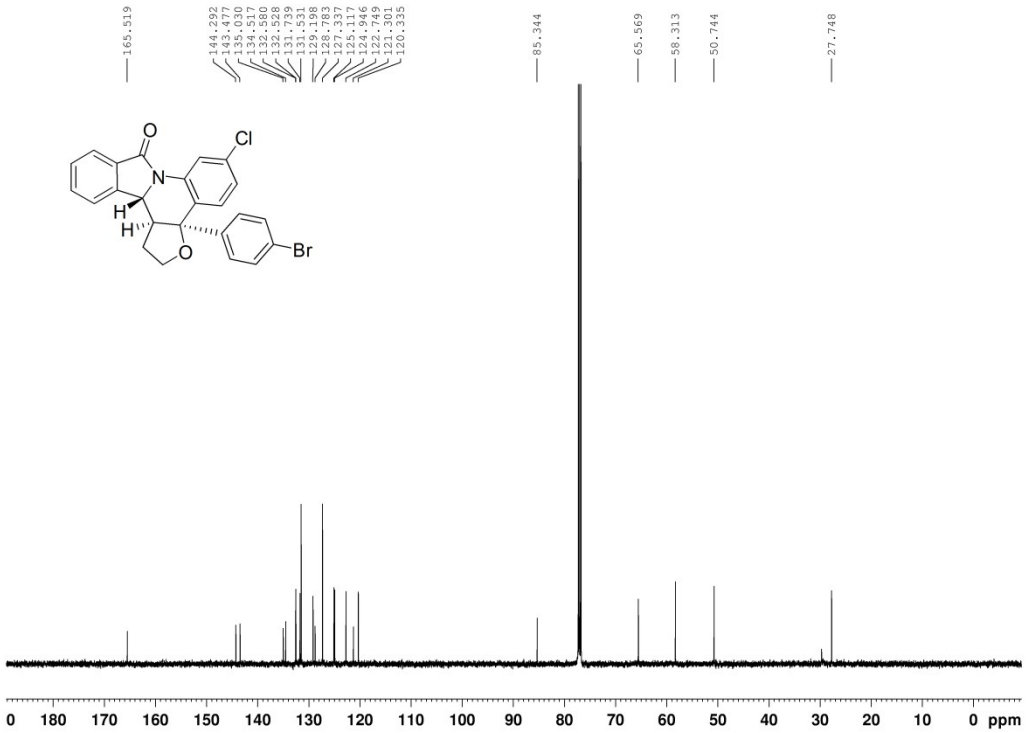

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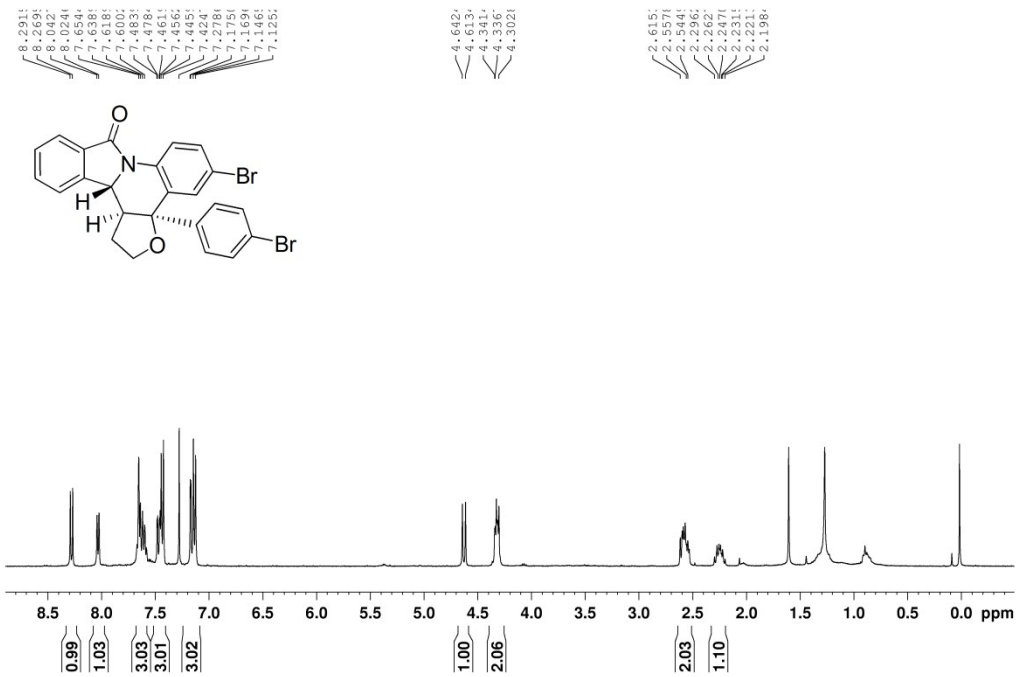

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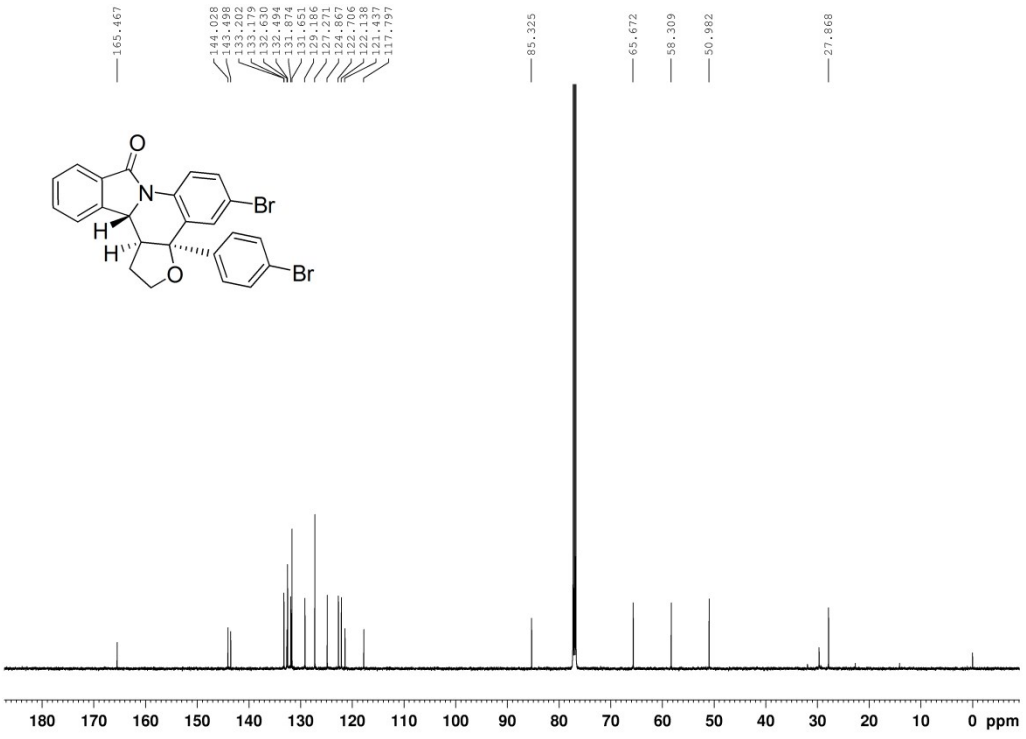

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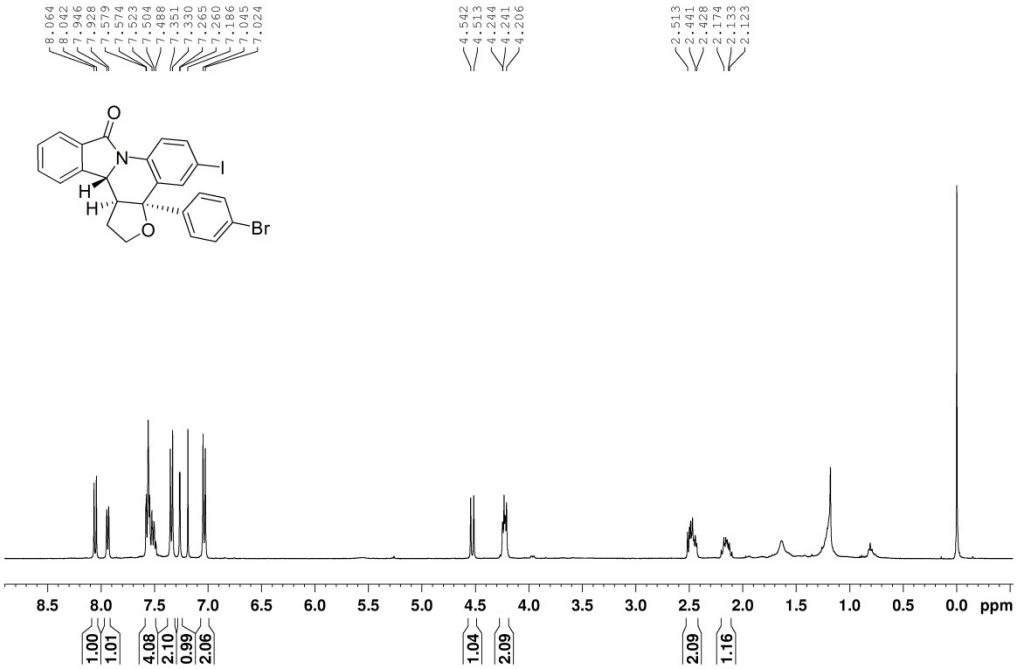

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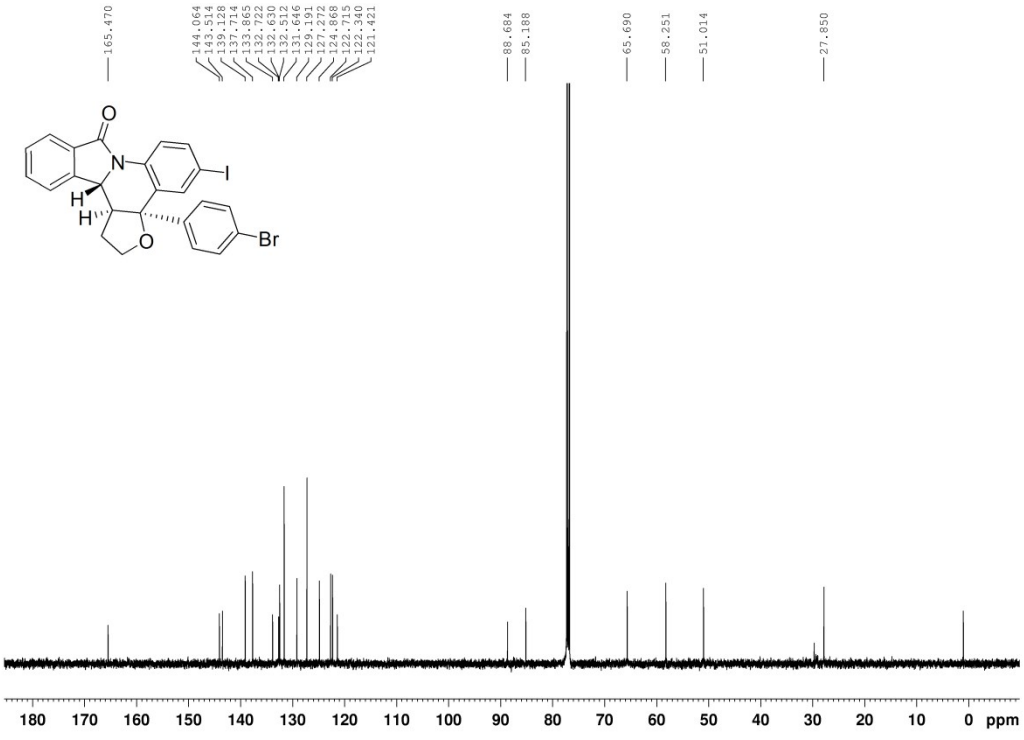

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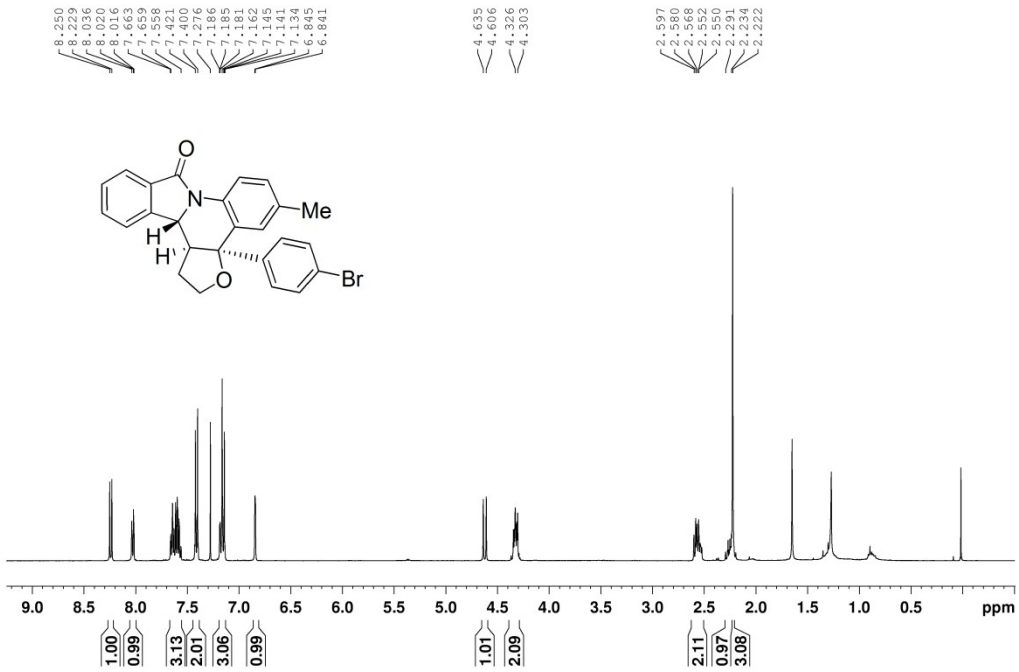

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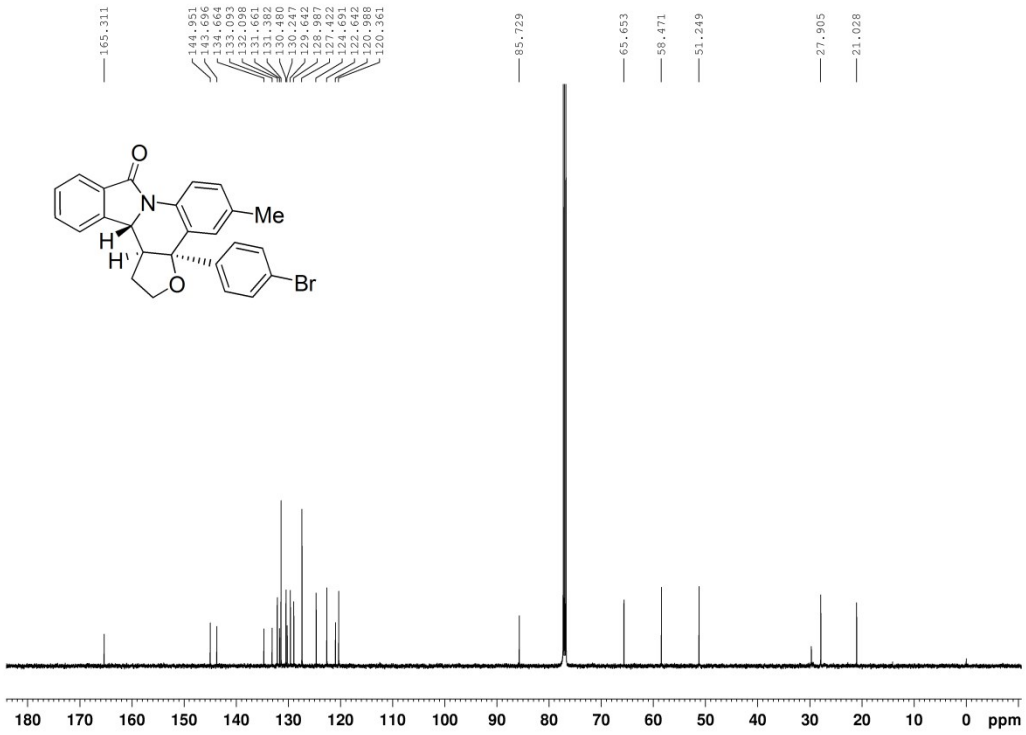

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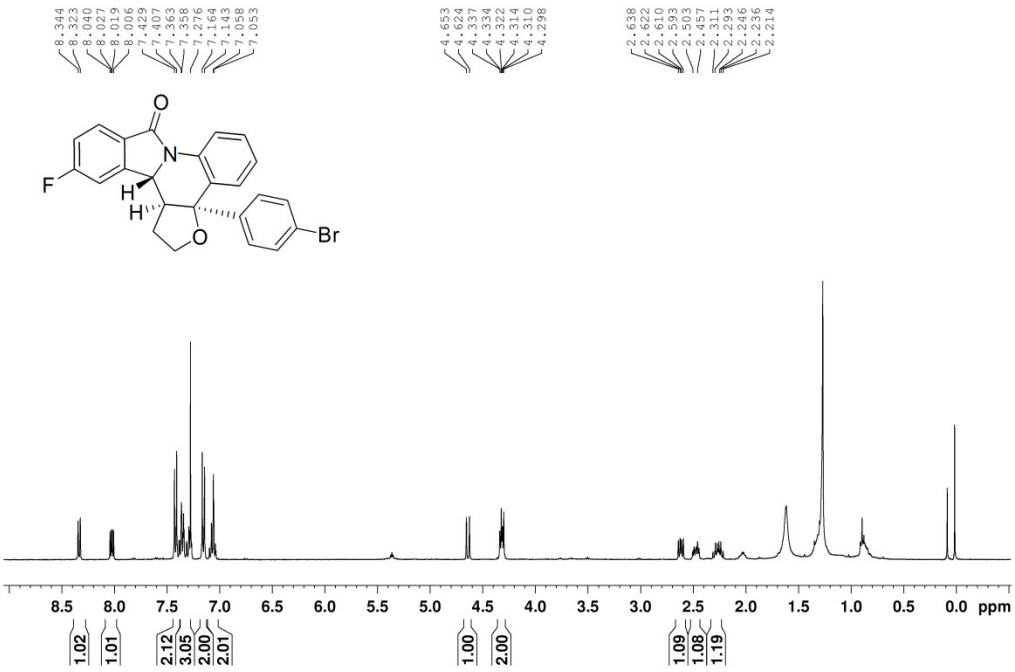

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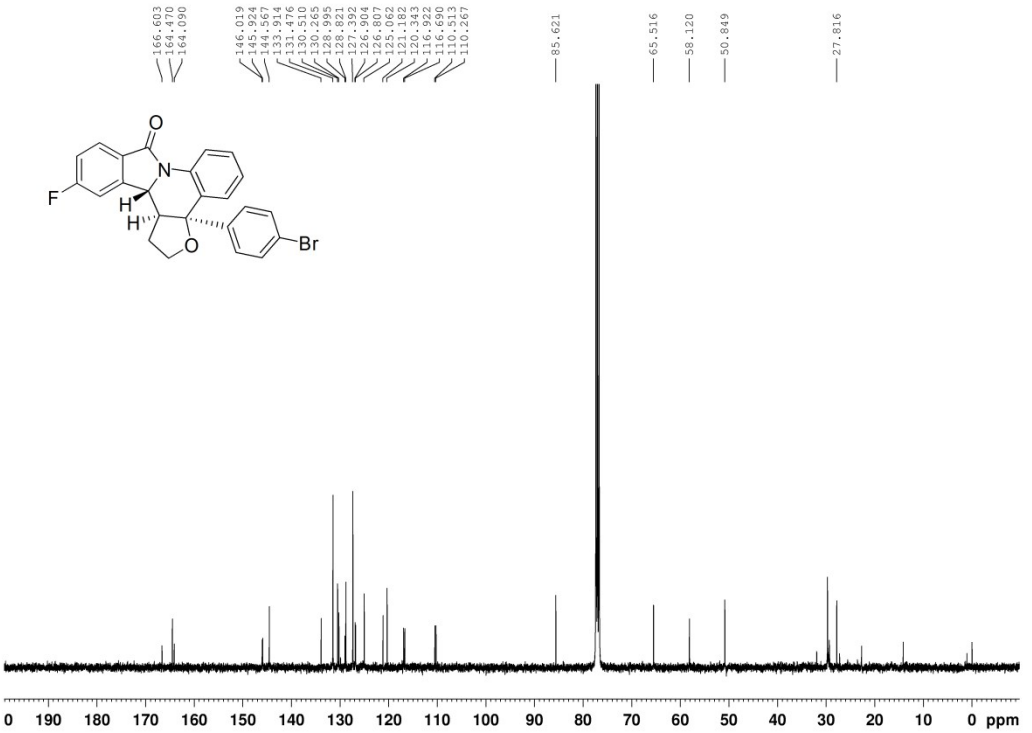

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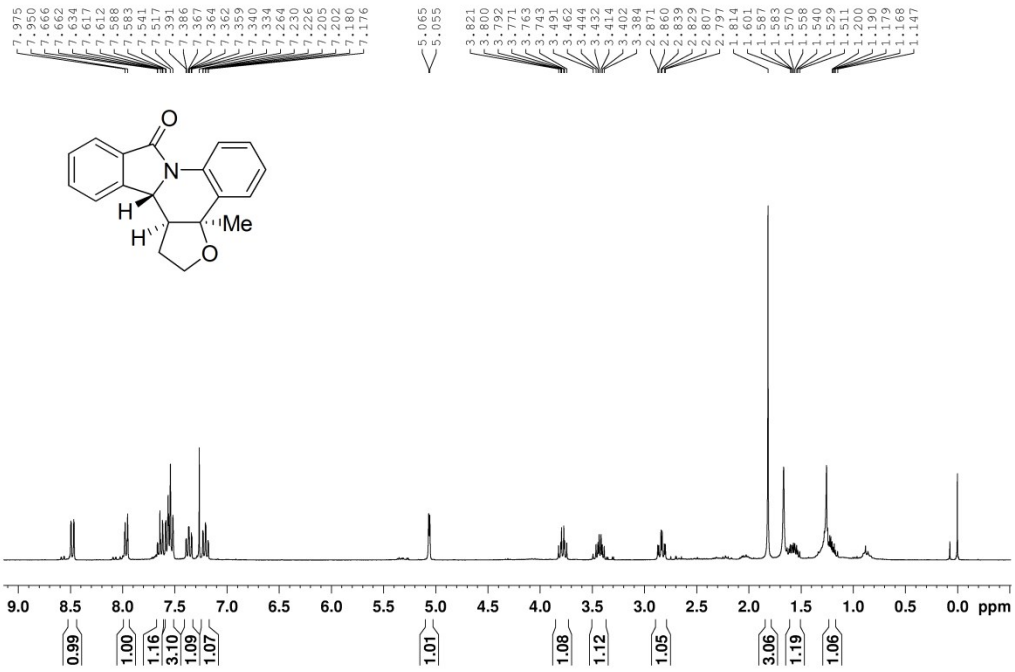

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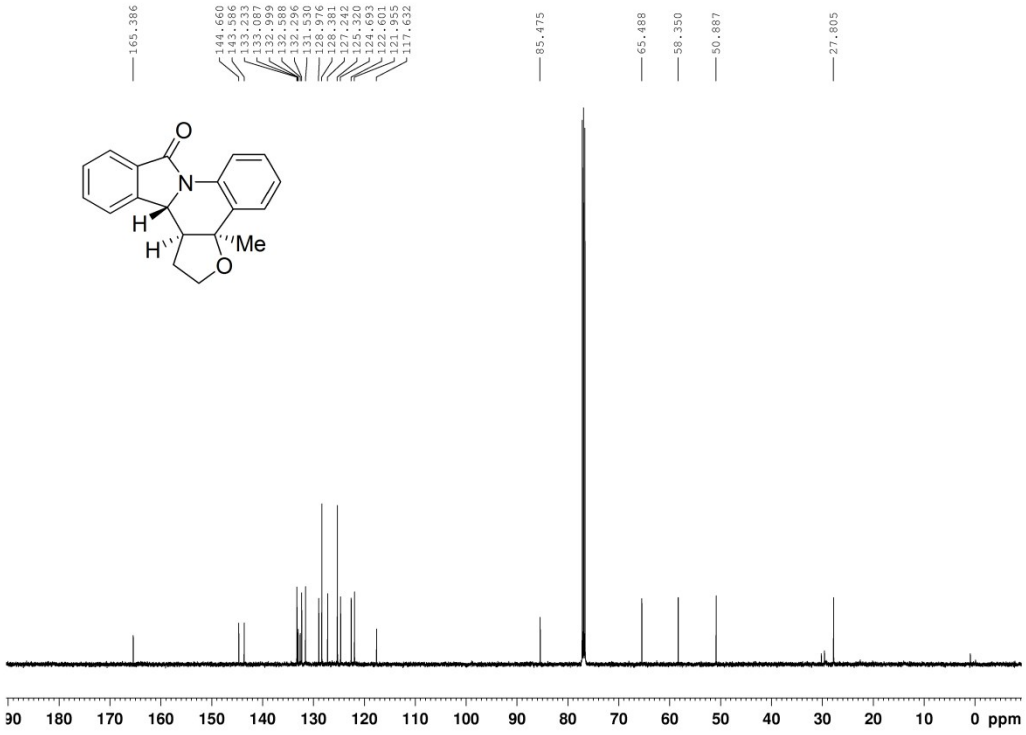

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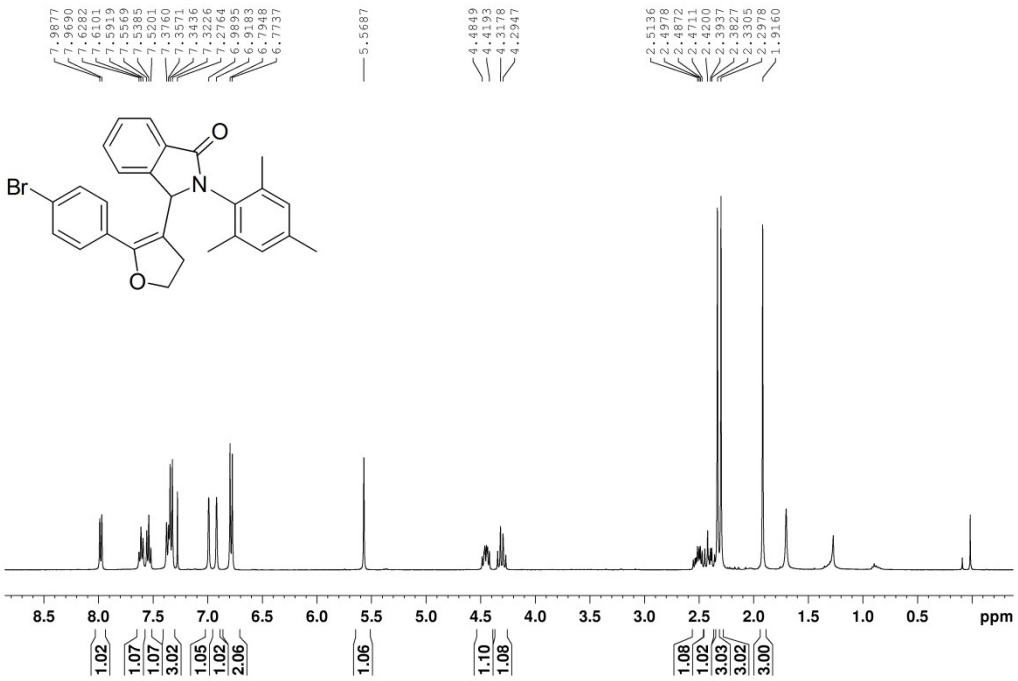
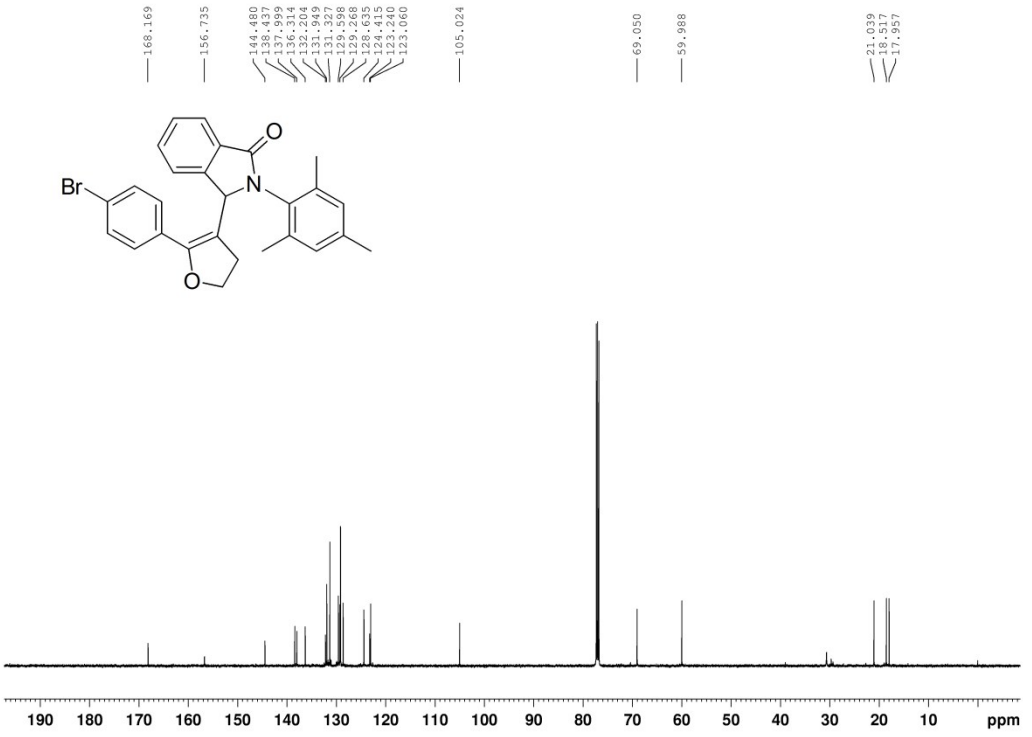


^{1}H NMR of **5** in $CDCl_3$



^{13}C NMR of **5** in $CDCl_3$