

Continuous Synthesis of Pyridocarbazoles and Initial Photophysical and Bioprobe Characterization **

D. Tyler McQuade, Alexander G. O'Brien, Markus Dörr, Rajathees Rajaratnam, Ursula Eisold, Bopanna Monnanda, Tomoya Nobuta, Hans-Gerd Löhmansröben, Eric Meggers, Peter H. Seeberger*

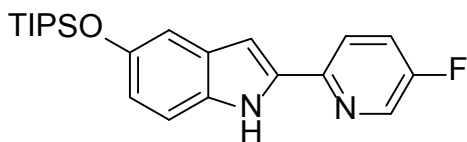
S1. General Procedure

Techniques:

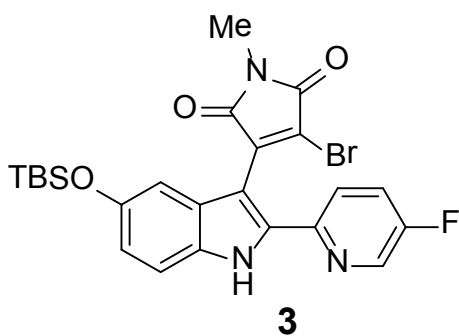
Reactions were carried out using heat gun-dried glassware and were conducted under nitrogen atmosphere. NMR spectra were recorded under standard conditions on a *Bruker Avance 300* spectrometer ($\nu = 300$ MHz for ^1H , $\nu = 75$ MHz for ^{13}C), *Bruker DRX-400* spectrometer ($\nu = 400$ MHz for ^1H , $\nu = 100$ MHz for ^{13}C) or *Bruker DRX-500* spectrometer ($\nu = 500$ MHz for ^1H , $\nu = 125$ MHz for ^{13}C). Spectra were calibrated to the residual solvent peaks. Infrared spectra of the solid products were recorded on a *Bruker Alpha-P* FT-IR-Interferometer or *Bruker Tensor 37* using *Opus 6.5* for data evaluation. Absorptions are noted in wave numbers ($\tilde{\nu}$). HR-ESI mass spectra were acquired with a LTQ-FT mass spectrometer (Thermo Fischer Scientific). The resolution was set to 100.000. HR-APCI mass spectra were acquired with a LTQ-FT mass spectrometer (Thermo Fischer Scientific). The resolution was set to 100.000. HR-EI mass spectra were acquired with a MAT95 double focusing sector field mass spectrometer (Finnigan). An internal standard (PFK) was used for mass calibration. Ion mass m/z are noted in u. Reagents and solvents were used as received from standard suppliers. Pyridylindoles were synthesized according to literature.^[1] Potassium *tert*-butyl 2-(difluoroboryl)-5-(triisopropylsilyloxy)-1*H*-indole-1-carboxylate fluoride was synthesized according to literature.^[2] Maleinimides were synthesized according to literature. Reaction progress were controlled by thin layer chromatography using plates purchased from *Merck* (Silica 60 F₂₅₄) and optical evaluation using a UV-lamp of 254 nm or 366 nm wavelength. Chromatographic separations were performed using Silica 60 (grit size 40-63 μm) purchased from *Merck*.

S2. General procedure for the synthesis of monobromides:

A solution of corresponding pyridylindole (1.0 eq), was dissolved in dry THF and stirred at -15 °C under nitrogen. Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (3.0 eq) was added to the solution over 30 min. A solution of corresponding maleinimide (1.1 eq) in dry THF was added to the yellow solution over 15 min. The dark purple solution was allowed to stir for another 30 min at -15 °C and then at RT overnight. The solution was poured into aq. 10% HCl, which was cooled to 0 °C, and extracted three times with EtOAc. The combined organic phases were washed with sat. aq. NaCl solution and dried over NaSO_4 . The solvent was evaporated and concentrated to dryness *in vacuo*. The crude material was subjected to silica gel chromatography with hexane-ethylacetate or dichloromethane. The combined product eluents were dried *in vacuo* to obtain the product as a solid. (Several signals in the ^1H -NMR and ^{13}C -NMR spectra are split due to the presence of two conformers and reported as multiple signals (e.g. 2x s for two split singletts). If mentioned case is true for certain signals in ^1H -NMR spectra, then relevant peaks of the minor conformer are given in brackets. Signals in ^{13}C -NMR spectra are only given for the main conformer.)

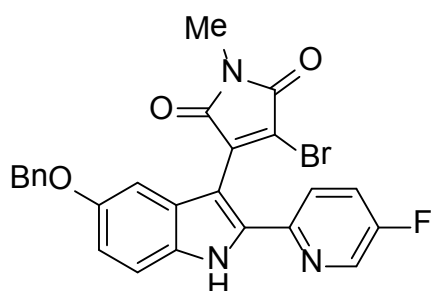


2-(5-fluoropyridin-2-yl)-5-(triisopropylsilyloxy)-1H-indole S1. Potassium *tert*-butyl 2-(difluoroboryl)-5-(triisopropylsilyloxy)-1H-indole-1-carboxylate fluoride (800 mg, 1.6 mmol, 1.0 eq) was dissolved in dimethoxyethane/water (14 mL, 3.5/1) and purged with nitrogen for 10 min. Tetrakis(triphenylphosphine)palladium (184 mg, 0.16 mmol, 0.1 eq) were added. The reaction mixture was purged for additional 10 min with nitrogen, followed by adding 2-bromo-5-fluoropyridine (262 mg, 1.5 mmol, 0.95 eq). The reaction mixture was refluxed for 18 h under nitrogen atmosphere. The orange solution was cooled to room temperature and diluted with water (15 mL). The Aqueous layer was extracted with ethylacetate (5 x 15 mL). The combined organic phases were washed with sat. aq. NaCl solution and dried over NaSO₄. The solvent was evaporated and concentrated to dryness *in vacuo*. The crude material was subjected to silica gel chromatography with hexane-ethylacetate (10:1). The resulting yellow oil was charged on silica gel and heated to 80 °C *in vacuo* for 18 h. The product was washed off with ethylacetate (300 mL) and concentrated to dryness *in vacuo*. Compound XX (177 mg, 4.6 mmol, 29% over two steps) was obtained as a brown oil. **¹H-NMR** (300 MHz, CDCl₃): δ = 9.32 (s, 1H), 8.40 (d, *J* = 2.8 Hz, 1H), 7.75 (dd, *J* = 8.8, 4.3 Hz, 1H), 7.44 (ddd, *J* = 8.7, 8.2, 2.9 Hz, 1H), 7.24 (d, *J* = 8.8 Hz, 1H), 7.09 (d, *J* = 2.3 Hz, 1H), 6.87–6.82 (m, 2H), 1.29–1.23 (m, 3H), 1.15 – 1.10 (m, 18H); **¹³C-NMR** (75 MHz, CDCl₃): δ = 158.58 (d_{C-F}, *J* = 255.5 Hz), 150.30, 147.00, 137.13 (d_{C-F}, *J* = 24.3 Hz), 136.41, 132.39, 129.85, 124.03 (d_{C-F}, *J* = 19.3 Hz), 120.72 (d_{C-F}, *J* = 4.4 Hz), 117.99, 111.77, 110.03, 100.19, 18.16, 12.85; **IR** 3460, 2943, 2866, 2327, 1624, 1548, 1459, 1449, 1386, 1288, 1226, 1153, 1118, 965, 881, 830, 785, 709, 680, 644, 586, 522, 504, 442; **HRMS** (ITMS ESI) *m/z* calculated for C₂₂H₃₀FN₂OSi⁺ 385.2111, found 385.2103.

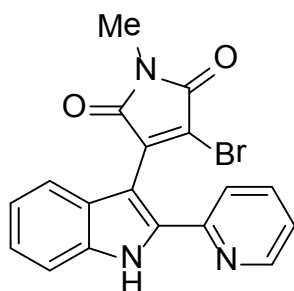


Compound 3. The synthesis was performed according to the general procedure using 5-(*tert*-butyldimethylsilyloxy)-2-(5-fluoropyridin-2-yl)-1H-indole (540 mg, 1.57 mmol, 1.0 eq) dissolved in dry THF (4.0 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (4.71 mL, 4.71 mmol, 3.0 eq), 3,4-dibromo-1-methyl-1H-pyrrole-2,5-dione (464 mg, 1.72 mmol, 1.1 eq) in dry THF (4.0 mL), aq. 10% HCl (35 mL). Aqueous layer was extracted with EtOAc (4 x 50 mL). Chromatography eluent: Hexane-Ethylacetate (3:1 to 2:1). Compound **3** (331 mg, 0.42 mmol, 27%) was obtained as a red solid. **¹H-NMR** (500 MHz, CDCl₃): δ = 9.74 (bs, 1H), 8.45 (s, 1H), 7.42–7.33 (m, 2H), 7.29 (d, *J* = 8.7 Hz, 1H), 6.91 (d, *J*

= 2.0 Hz, 1H), 6.85 (dd, $J = 8.7, 2.2$ Hz, 1H), 3.18 (3.17) (2x s, 3H), 1.01 (s, 9H), 0.21 (s, 6H); $^{13}\text{C-NMR}$ (125 MHz, CDCl_3): $\delta = 168.32, 166.17, 158.60$ ($d_{\text{C-F}}, J = 258.7$ Hz), 150.58, 145.77, 139.77, 137.77 ($d_{\text{C-F}}, J = 24.6$ Hz), 135.23, 131.58, 131.34, 128.31, 123.73 ($d_{\text{C-F}}, J = 16.2$ Hz), 123.20 ($d_{\text{C-F}}, J = 20.8$ Hz), 118.92, 112.35, 110.53, 110.41, 25.80, 25.07, 18.26, -4.38; IR 3396, 2957, 2930, 2892, 2856, 1774, 1638, 1576, 1440, 1382, 1273, 1212, 1113, 898, 853, 794, 777, 734, 569, 486 IR 3396, 2957, 2930, 2892, 2856, 2360, 2341, 1773, 1638, 1576, 1527, 1474, 1441, 1382, 1273, 1212, 1113, 978, 898, 853, 794, 777, 734, 569, 523, 486 HRMS (ITMS ESI) m/z calculated for $\text{C}_{24}\text{H}_{25}\text{BrFN}_3\text{NaO}_3\text{Si}^+$ 552.0725, found 552.0726.

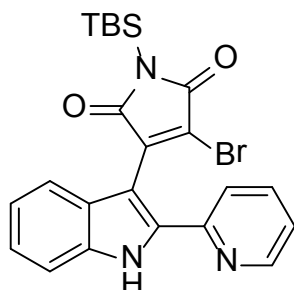


Compound S6. The synthesis was performed according to the general procedure using 5-(benzyloxy)-2-(5-fluoropyridin-2-yl)-1*H*-indole (150 mg, 0.47 mmol, 1.0 eq) dissolved in dry THF (1.5 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (1.41 mL, 1.41 mmol, 3.0 eq), 3,4-dibromo-1-methyl-1*H*-pyrrole-2,5-dione (140 mg, 0.52 mmol, 1.1 eq) in dry THF (1.0 mL), aq. 10% HCl (15 mL). Aqueous layer was extracted with EtOAc (3 x 30 mL). Chromatography eluent: Hexane-Ethylacetate (4:1). Compound **S6** (77 mg, 0.15 mmol, 32%) was obtained as a red solid. $^1\text{H-NMR}$ (500 MHz, $\text{CDCl}_3/\text{dms}\text{-}d_6$ (2.3/1)): $\delta = 8.46$ (8.45) (2x s, 1H), 8.05 (s, 1H), 7.82–7.76 (m, 1H), 7.65–7.57 (m, 1H), 7.45–7.40 (m, 2H), 7.40–7.39 (m, 1H), 7.36–7.29 (m, 2H), 7.30–7.25 (m, 1H), 6.98–6.95 (m, 1H), 6.93 (6.92) (2x d, $J = 9.0$, 1H), 5.04 (s, 2H), 3.02 (3.01) (2x s, 3H); $^{13}\text{C-NMR}$ (125 MHz, $\text{CDCl}_3/\text{dms}\text{-}d_6$ (2.3/1)): $\delta = 167.74, 165.74, 157.81$ ($d_{\text{C-F}}, J = 256.5$ Hz), 153.15, 146.31, 140.34, 137.03 ($d_{\text{C-F}}, J = 24.1$ Hz), 136.98, 131.51, 129.01, 127.99, 126.57, 123.37 ($d_{\text{C-F}}, J = 18.6$ Hz), 122.76 ($d_{\text{C-F}}, J = 4.4$ Hz), 120.69, 114.12, 112.91, 106.43, 103.38, 100.92, 99.89, 69.75, 24.32; IR 3098, 3024, 3006, 2923, 2854, 2607, 2410, 2362, 1772, 1612, 1509, 1434, 1403, 1378, 1302, 1260, 1198, 1114, 1025, 998, 955, 830, 761, 730, 678, 615, 567, 438 HRMS (ITMS ESI) m/z calculated for $\text{C}_{25}\text{H}_{17}\text{BrFN}_3\text{NaO}_3^+$ 528.0330, found 528.0331.

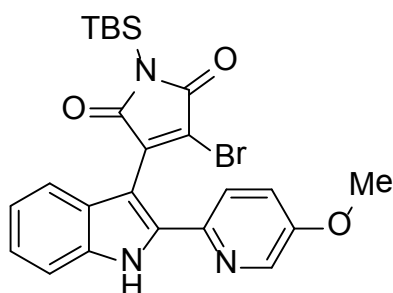


Compound S7. The synthesis was performed according to the general procedure using 2-(pyridin-2-yl)-1*H*-indole (200 mg, 1.03 mmol, 1.0 eq) dissolved in dry THF (2.0 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (3.09 mL, 3.09 mmol, 3.0 eq), 3,4-dibromo-1-methyl-1*H*-pyrrole-2,5-dione (304 mg, 1.13 mmol, 1.1 eq) in dry THF (2.0 mL), aq. 10% HCl (30 mL). Aqueous layer was extracted with EtOAc (3 x 30 mL). Chromatography eluent: Dichloromethane. Compound **S7** (147 mg, 0.38 mmol, 37%) was obtained as a red solid. $^1\text{H-NMR}$ (500 MHz, CDCl_3): $\delta = 10.02$ (bs, 1H), 8.69-8.61 (m, 1H), 7.73-7.65 (m, 1H), 7.55-7.50

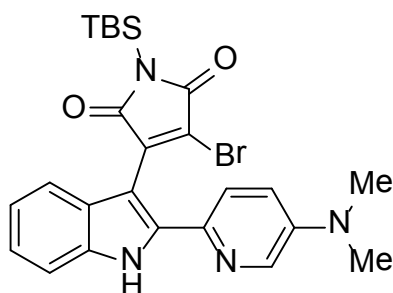
(m, 1H), 7.49-7.44 (m, 1H), 7.40-7.36 (m, 1H), 7.34-7.27 (m, 1H), 7.25-7.16 (m, 2H), 3.20 (3.19) (2x s, 3H); $^{13}\text{C-NMR}$ (125 MHz, CDCl_3); δ = 168.5, 166.3, 149.7, 140.0, 137.0, 136.8, 135.8, 135.4, 127.5, 124.4, 124.2, 123.1, 122.5, 121.4, 121.2, 112.0, 101.7, 25.2; **IR** 3406, 3059, 1767, 1700, 1634, 1588, 1480, 1426, 1377, 1338, 1290, 1260, 1213, 1159, 982, 879, 849, 827, 813, 789, 731, 696, 671, 627, 570, 513, 464, 421; **HRMS** (ITMS, APCI) m/z calculated for $\text{C}_{18}\text{H}_{13}\text{BrN}_3\text{O}_2^+$ 382.0186, found 382.0185.



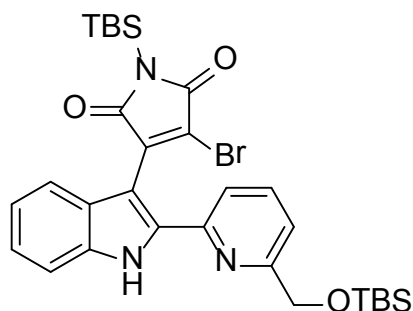
Compound S8. The compound was synthesized according to literature procedures.^[3]



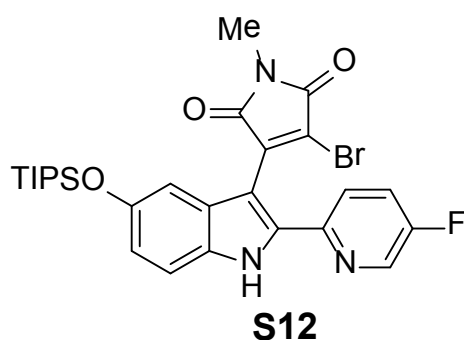
Compound S9. The compound was synthesized according to literature procedures.^[1]



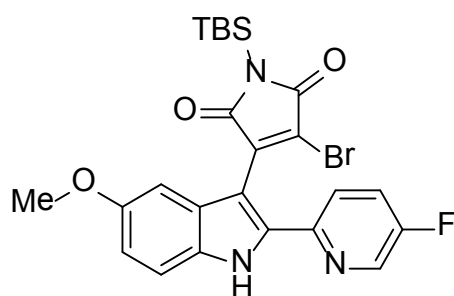
Compound S10. The compound was synthesized according to literature procedures.^[1]



Compound S11. The compound was synthesized according to literature procedures.^[1]

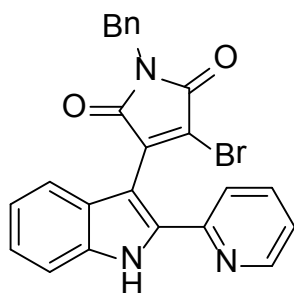


Compound S12. The synthesis was performed according to the general procedure using 2-(5-fluoropyridin-2-yl)-5-(triisopropylsilyloxy)-1*H*-indole (140 mg, 0.36 mmol, 1.0 eq) dissolved in dry THF (1 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (1.08 mL, 1.08 mmol, 3.0 eq), 3,4-dibromo-1-methyl-1*H*-pyrrole-2,5-dione (108 mg, 0.40 mmol, 1.1 eq) in dry THF (806 μ L), aq. 10% HCl (10 mL). Aqueous layer was extracted with EtOAc (3 x 30 mL). Chromatography eluent: Hexane-Ethylacetate (5:1). Compound **S12** (77 mg, 0.13 mmol, 37%) was obtained as a red solid. ¹H-NMR (500 MHz, CDCl₃): δ = 8.45 (s, 1H), 7.49–7.36 (m, 2H), 7.32 (d, J = 8.7 Hz, 1H), 6.96 (d, J = 1.8 Hz, 1H), 6.93 (dd, J = 8.7, 2.2 Hz, 1H), 3.18 (3.16) (2x s, 3H), 1.33–1.28 (m, 3H), 1.12 (d, J = 7.3 Hz, 18H); ¹³C-NMR (125 MHz, CDCl₃): δ = 168.41, 166.26, 158.67 (d_{C-F}, J = 258.9 Hz), 151.29, 145.64, 139.72, 137.27 (d_{C-F}, J = 22.9 Hz), 135.19, 131.47, 128.26, 127.96, 124.53, 123.70, 119.23, 112.57, 110.28, 110.16, 25.21, 18.16, 12.82; IR 3365, 3071, 2924, 2866, 2350, 2327, 1775.53, 1636, 1576, 1434, 1272, 1231, 1185, 1106, 1037, 897, 846, 807, 662 HRMS (ITMS ESI) m/z calculated for C₂₇H₃₁BrFN₃NaO₃Si⁺ 594,1194, found 594,1193.

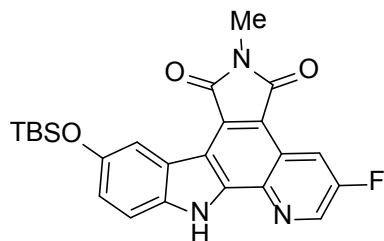


Compound S13. The synthesis was performed according to the general procedure using 2-(5-fluoropyridin-2-yl)-5-methoxy-1*H*-indole (3.25 g, 13.4 mmol, 1.0 eq) dissolved in dry THF

(40.0 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (40.2 mL, 40.2 mmol, 3.0 eq), 3,4-dibromo-1-(*tert*-butyldimethylsilyl)-1*H*-pyrrole-2,5-dione (5.43 g, 14.74 mmol, 1.1 eq) in dry THF (30.0 mL), aq. 10% HCl (400 mL). Aqueous layer was extracted with EtOAc (3 x 150 mL). Chromatography eluent: Hexane-Ethylacetate (8:1 to 6:1). Compound **S13** (3.016 g, 5.7 mmol, 43%) was obtained as an orange solid. $^1\text{H-NMR}$ (500 MHz, CDCl_3): δ = 9.70 (bs, 1H), 8.44 (s, 1H), 7.34–7.27 (m, 3H), 6.94 (dd, J = 8.8, 2.4 Hz, 1H), 6.90 (d, J = 2.3 Hz, 1H), 3.85 (s, 3H), 1.01 (s, 9H), 0.49 (s, 6H); $^{13}\text{C-NMR}$ (125 MHz, CDCl_3): δ = 173.44, 170.91, 158.65 ($d_{\text{C-F}}$, J = 258.3 Hz), 155.28, 146.00, 141.52, 137.89 ($d_{\text{C-F}}$, J = 24.3 Hz), 135.99, 131.00, 127.77, 125.82, 123.43 ($d_{\text{C-F}}$, J = 18.5 Hz), 123.16, 115.13, 112.82, 102.59, 101.54, 55.67, 26.43, 19.04, -4.26; **IR**: 3289, 2953, 2928, 2851, 2360, 2341, 2050, 1762, 1699, 1638, 1480, 1461, 1313, 1194, 1085, 1058, 912, 810, 795, 728, 678, 490, 456, 443, 406 **HRMS** (ITMS, ESI) m/z calculated for $\text{C}_{24}\text{H}_{26}\text{BrFN}_3\text{O}_3\text{Si}^+$ 530.0905, found 530.0906.

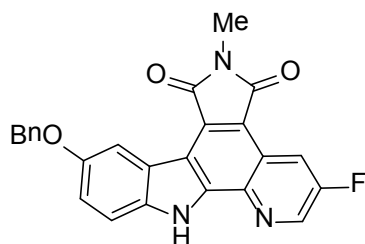


Compound S14. The synthesis was performed according to the general procedure using 2-(pyridin-2-yl)-1*H*-indole (2.25 g, 11.6 mmol, 1.0 eq) dissolved in dry THF (28 mL), Lithium bis(trimethylsilyl)amide (1 M solution in hexanes) (34.7 mL, 34.7 mmol, 3.0 eq), 1-benzyl-3,4-dibromo-1*H*-pyrrole-2,5-dione (4.39 g, 12.7 mmol, 1.1 eq) in dry THF (30 mL), aq. 10% HCl (85 mL). Aqueous layer was extracted with EtOAc (3x60 mL). Chromatography eluent: Hexane-Ethylacetate (3:1). Compound XX (1.90 g, 4.14 mmol, 36%) was obtained as a red solid. $^1\text{H NMR}$ (300 MHz, CDCl_3): δ = 9.93 (bs, 1H), 8.59-8.54 (m, 1H), 7.57-7.49 (m, 2H), 7.47-7.24 (m, 8H), 7.23-7.16 (m, 2H), 4.82 (s, 2H); $^{13}\text{C-NMR}$ (75 MHz, CDCl_3): δ = 168.1, 165.8, 149.6, 149.4, 140.1, 136.9, 136.6, 136.4, 135.9, 128.9, 128.9, 128.2, 127.2, 124.3, 123.7, 123.0, 122.6, 121.4, 112.0, 101.8, 42.8; **IR** 3301, 3030, 1773, 1701, 1640, 1587, 1479, 1428, 1393, 1337, 1287, 1261, 1207, 1153, 1101, 1069, 961, 929, 816, 789, 731, 698, 636, 592, 569, 497, 431; **HRMS** (ITMS, APCI) m/z calculated for $\text{C}_{24}\text{H}_{17}\text{BrN}_3\text{O}_2^+$ 458.0499, found 458.0498.

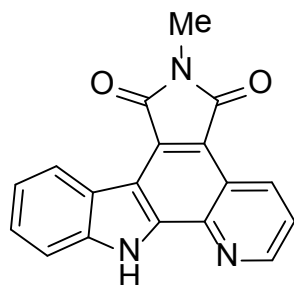


Compound 4. Compound 3 (33 mgs, 0,062 mmol) was dissolved in 33mL of toluene to provide a light yellow solution. The solution was filtered through a 0.45 micro PTFE syringe filter and the solution was primed into a Vapourtec R2C+ system. The solution was pumped through the 5mL photoreactor at 333uL/min (15min res time). The desired material was collected and concentrated to yield a dark orange solid. The material was then chromatographed over silica gel using a 3.5 Hex, 1.5 2% Et3N/EtOAc solvent system (R_f – 0.21). The fraction containing product were concentrated to yield 25mgs (89% yield) of an

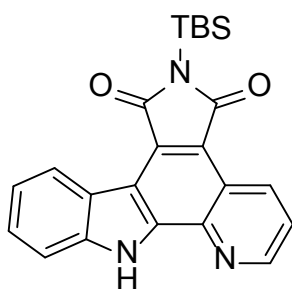
orange solid. $^1\text{H-NMR}$ (400 MHz, pyridine) δ 9.44 – 9.35 (m, 1H), 9.30 (d, $J = 2.9$ Hz, 1H), 8.23 (d, $J = 8.7$ Hz, 1H), 7.77 (dd, $J = 8.7, 2.5$ Hz, 1H), 3.53 (s, 3H), 1.45 (s, 9H), 0.8 (s, 6H). $^{13}\text{C-NMR}$ (101 MHz, cdCl_3) δ 169.77, 168.73, 159.04, 156.47, 151.01, 141.51, 141.23, 140.54, 134.66, 134.47, 129.48, 122.62, 122.14, 122.07, 121.58, 117.20, 117.01, 114.97, 114.44, 111.91, 29.69, 25.48, 17.96, -4.32. IR 3327, 2928, 2857, 1755, 1694, 1565, 1528, 1472, 1442, 1417, 1378, 1333, 1281, 1250, 1224, 1170, 962, 899, 840, 807, 781, 743 HRMS (ITMS, ESI) m/z calculated for $\text{C}_{24}\text{H}_{25}\text{FN}_3\text{O}_3\text{Si}^+$ 450.1649 found 450.1665



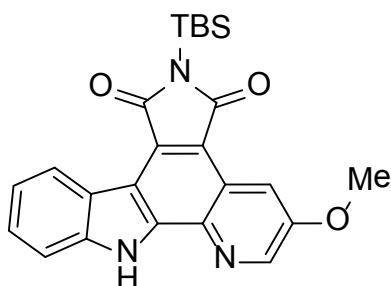
Compound 6. The starting solid (62mgs, 0,122 mmol) was dissolved in 62mL of toluene to provide a light yellow solution that was free of particulate. The solution was pushed through the 5000uL reactor at 333uL/min using the Vapourtec system. The reaction proceeded over 3 hours. As the initial product emerged from the microreactor, a red solid was observed. The material began to clog the back pressure regulator and pyridine was added to the solution in an attempt to reduce/eliminate or make the solid more free flowing. The pyridine addition made the solid more free flowing, but the solid did not dissolve. The collected suspension was centrifuged to collect the solid that was then dissolved in ethyl acetate. The EtOAc solution was pre-absorbed onto loading media and then applied to a silica gel column and eluted with 3.5 Hex, 1.5 2% Et3N, EtOAc. The product spot (fractions 5-20) was concentrated yielding a bright orange solid (54mgs; >95% yield). $^1\text{H NMR}$ (400 MHz, DMSO) δ 10.04 (br s, 1H), 9.05 (m, 1H), 8.88 (d, 1H), 8.70 (d, 1H), 7.58 (m, 3H), 7.43 (m, 2H), 7.34 (m, 2H), 5.30 (s, 2H), 3.32 (s, 3H). $^{13}\text{C NMR}$ (101 MHz, DMSO). δ 168.88, 168.15, 157.84, 156.14, 153.41, 141.07, 140.89, 139.99, 137.19, 135.07, 134.35, 128.60, 128.44, 127.85, 121.08, 117.28, 113.63, 113.14, 106.80, 69.71, 23.53 IR 3318, 1685, 1526, 1444, 1377, 1299, 1226, 742, 697 HRMS (ITMS, ESI) m/z calculated for $\text{C}_{25}\text{H}_{16}\text{FN}_3\text{NaO}_3$ 448.1073, found 448.1088.



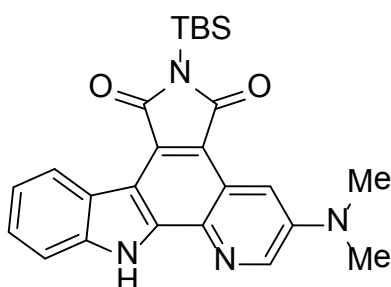
Compound 7. Material was prepared using the general method and the spectral data matched the literature.^[4]



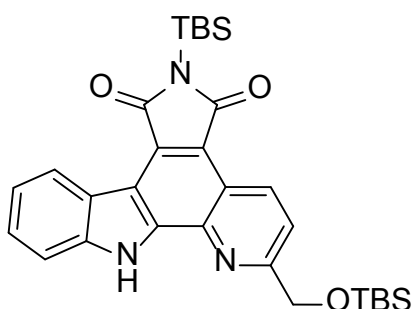
Compound 8. Material was prepared using the general method and the spectral data matched the literature.^[4]



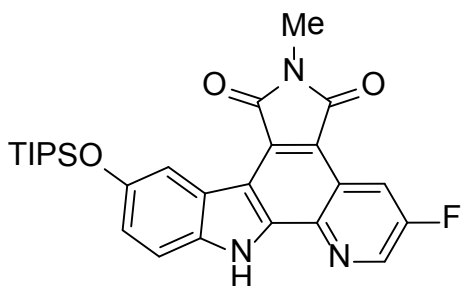
Compound 9. Material was prepared using the general method and the spectral data matched the literature.^[1]



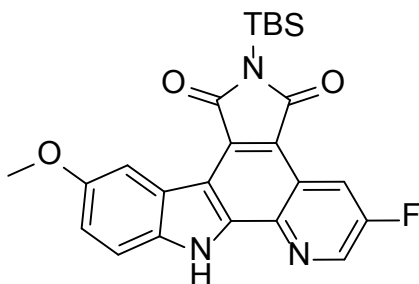
Compound 10. Material was prepared using the general method and the spectral data matched the literature.^[1]



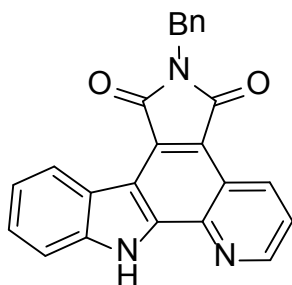
Compound 11. Material was prepared using the general method.^[1] **¹H NMR** (600 MHz, cdcl₃) δ 10.01 (s, 1H), 9.38 (d, J = 8.7 Hz, 1H), 9.03 (d, J = 7.9 Hz, 1H), 7.86 (d, J = 8.7 Hz, 1H), 7.54 (m, 1H), 7.40 (m, 1H), 1.08 (s, 6H), 1.00 (s, 6H), 0.65 (s, 4H), 0.17 (s, 4H). **¹³C NMR** (151 MHz, cdcl₃) δ 175.59, 174.48, 162.80, 139.79, 139.41, 137.58, 134.68, 129.99, 127.35, 125.59, 122.46, 121.73, 121.03, 120.82, 120.52, 115.21, 111.41, 77.37, 77.16, 76.95, 66.82, 26.65, 26.08, 19.29, 18.58, -3.79, -5.08. **HRMS** (ITMS, ESI) m/z calculated for C₃₀H₄₀N₃Si₂O₃+ 546.2608, found 546.2629.



Compound 12. Material was prepared using the general method $^1\text{H NMR}$ (400 MHz, cdCl_3) δ 9.83(bs, 1H), 9.02 (dd, 1H), 8.86 (s, 1H), 8.59 (s, 1H), 7.51 (d, 1H), 7.22 (d, 1H), 3.30 (s, 3H), 1.41 (septet, 3H), 1.19 (d, 18H) $^{13}\text{C NMR}$ (101 MHz, cdCl_3) δ 170.27, 169.03, 159.01, 157.30, 151.91, 141.70, 141.51, 140.90, 137.28, 135.01, 134.76, 130.13, 123.12, 122.59, 122.54, 121.97, 117.82, 117.80, 117.77, 117.74, 117.69, 115.57, 114.75, 112.23, 112.18, 24.36, 18.44, 13.09. **IR** 3317, 2925, 2867, 1753, 1690, 1629, 1609, 1563, 1527, 1497, 1472, 1443, 1417, 1372, 1333, 1295, 1280, 1250, 1225, 1170, 1128, 1057, 1033, 1015, 997, 958, 887, 836, 806, 780 **LRMS** (ESI) m/z calculated for $\text{C}_{27}\text{H}_{31}\text{FN}_3\text{O}_3\text{Si}^+$ 492.21, found 492.19. **HRMS** (ITMS, ESI) m/z calculated for $\text{C}_{27}\text{H}_{31}\text{FN}_3\text{O}_3\text{Si}^+$ 492.2119, found 492.2126.



Compound 13. Material was prepared using the general method $^1\text{H NMR}$ (400 MHz, cdCl_3) δ 9.78 (br s, 1H), 9.02 (m, 1H), 8.82 (m, 1H), 8.55 (m, 1H), 7.51 (m, 1H), 7.20 (m, 1H), 4.01 (s, 3H), 1.05 (s, 9H), 0.64 (s, 6H). $^{13}\text{C-NMR}$ (101 MHz, CDCl_3): 175.13, 173.71, 159.06, 156.50, 155.42, 141.32, 141.05, 140.35, 135.19, 134.07, 131.59, 122.72, 122.12, 122.05, 119.62, 117.74, 117.55, 117.40, 114.59, 112.06, 107.12, 56.08, 26.45, 19.07, 3.75. **IR** 2930, 2859, 1750, 1689, 1633, 1562, 1529, 1476, 1438, 1417, 1404, 1368, 1335, 1306, 1255, 1215, 1180, 1151, 1062, 1044, 1005, 939, 897, 846, 827, 811, 758, 699, 683, 663 **HRMS** (ITMS, ESI) m/z calculated for $\text{C}_{24}\text{H}_{25}\text{FN}_3\text{O}_3\text{Si}^+$ 450.1649, found 450.1668.



Compound 14. $^1\text{H NMR}$ (400 MHz, CDCl_3); δ = 10.13 (s, 1H), 9.25-9.18 (m, 1H), 8.92-8.62 (m, 1H), 8.86-8.83 (m, 1H), 7.55-7.42 (m, 5H), 7.35-7.18 (m, 4H), 4.86 (s, 2H); $^{13}\text{C-NMR}$ (100 MHz, CDCl_3); δ = 169.7, 168.8, 150.5, 139.9, 139.6, 137.6, 137.0, 134.2, 128.9, 128.8, 128.4, 128.0, 127.8, 125.4, 123.0, 122.1, 122.0, 121.9, 118.4, 115.7, 111.7, 41.7; **IR** 3416, 3063, 3033, 2920, 2850, 1752, 1696, 1593, 1553, 1523, 1497, 1456, 1429, 1384, 1334, 1292, 1235, 1137, 1104, 1065, 1017, 911, 821, 798, 744, 700, 627, 586, 534, 501, 429 **HRMS**

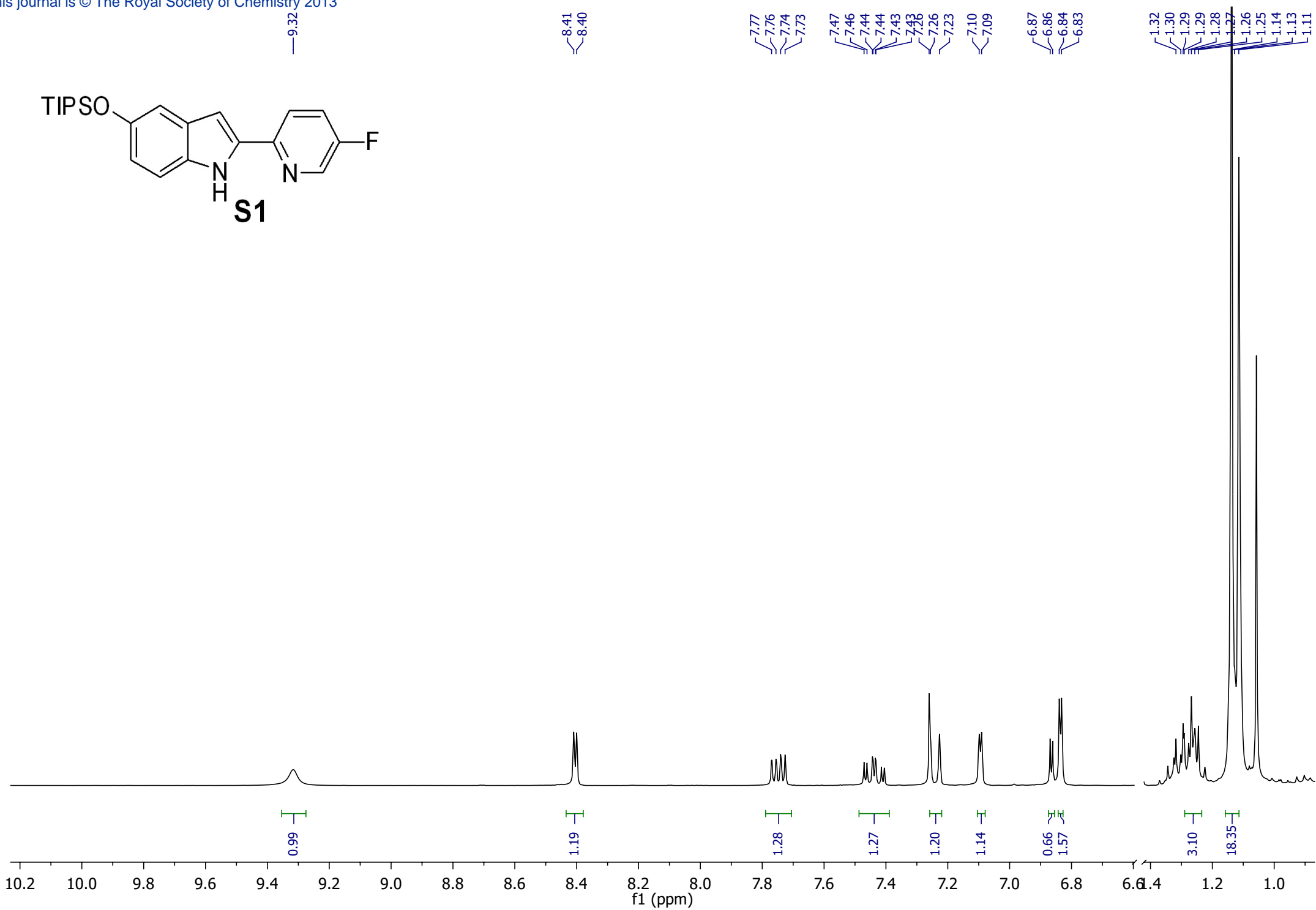
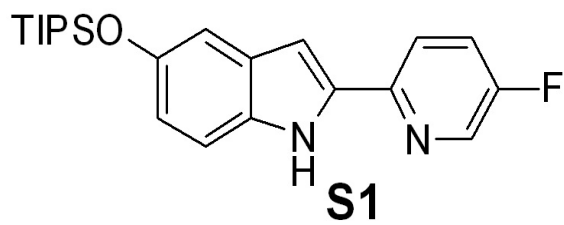
(ESI) m/z calculated for C₂₄H₁₆N₃O₂ 378.1243 found 378.1247 C₂₄H₁₅N₃NaO₂⁺ 400.1056, found 400.1044.

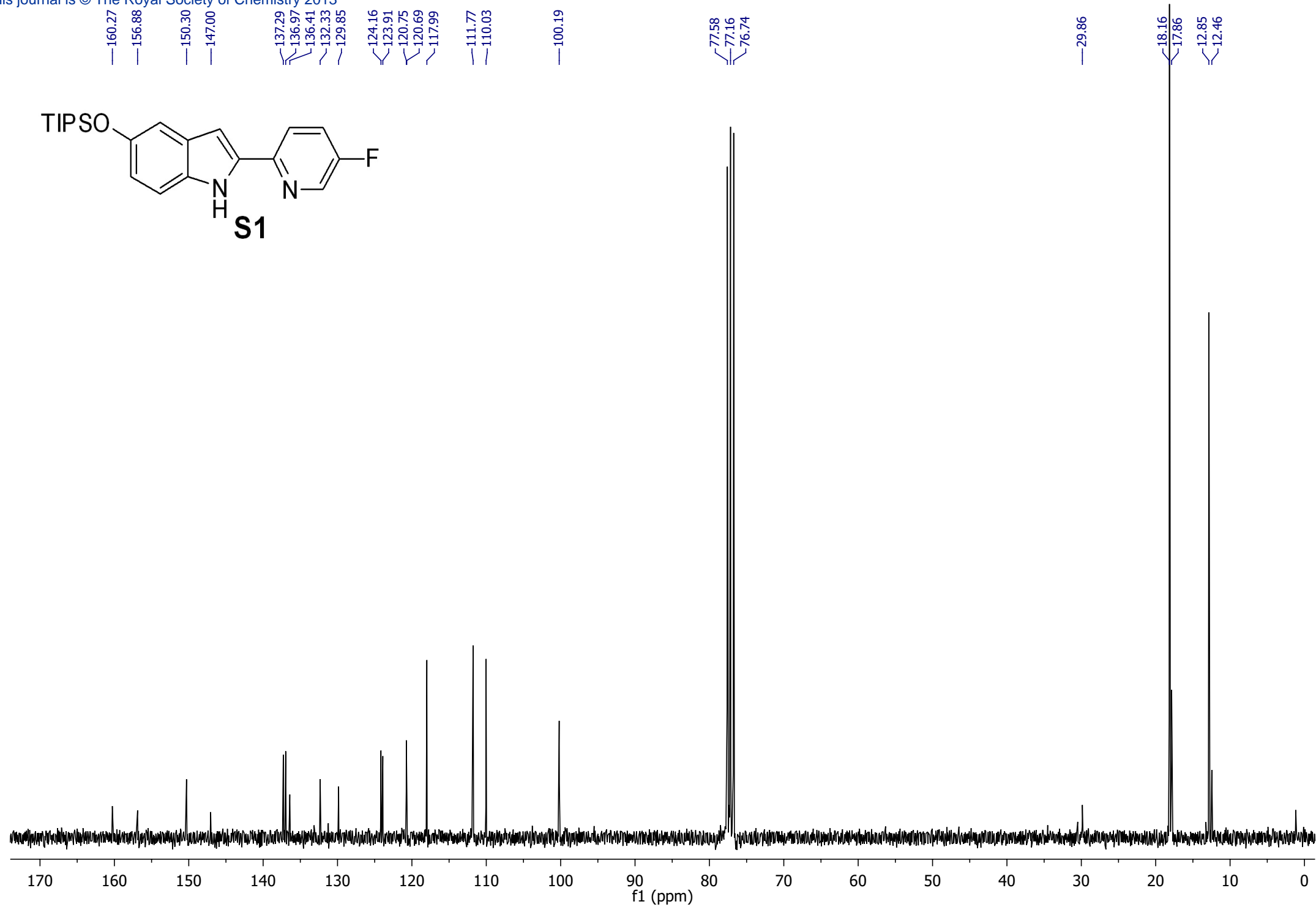
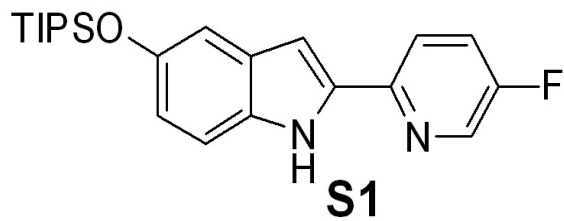
S3 Absorption and Fluorescence Spectroscopy

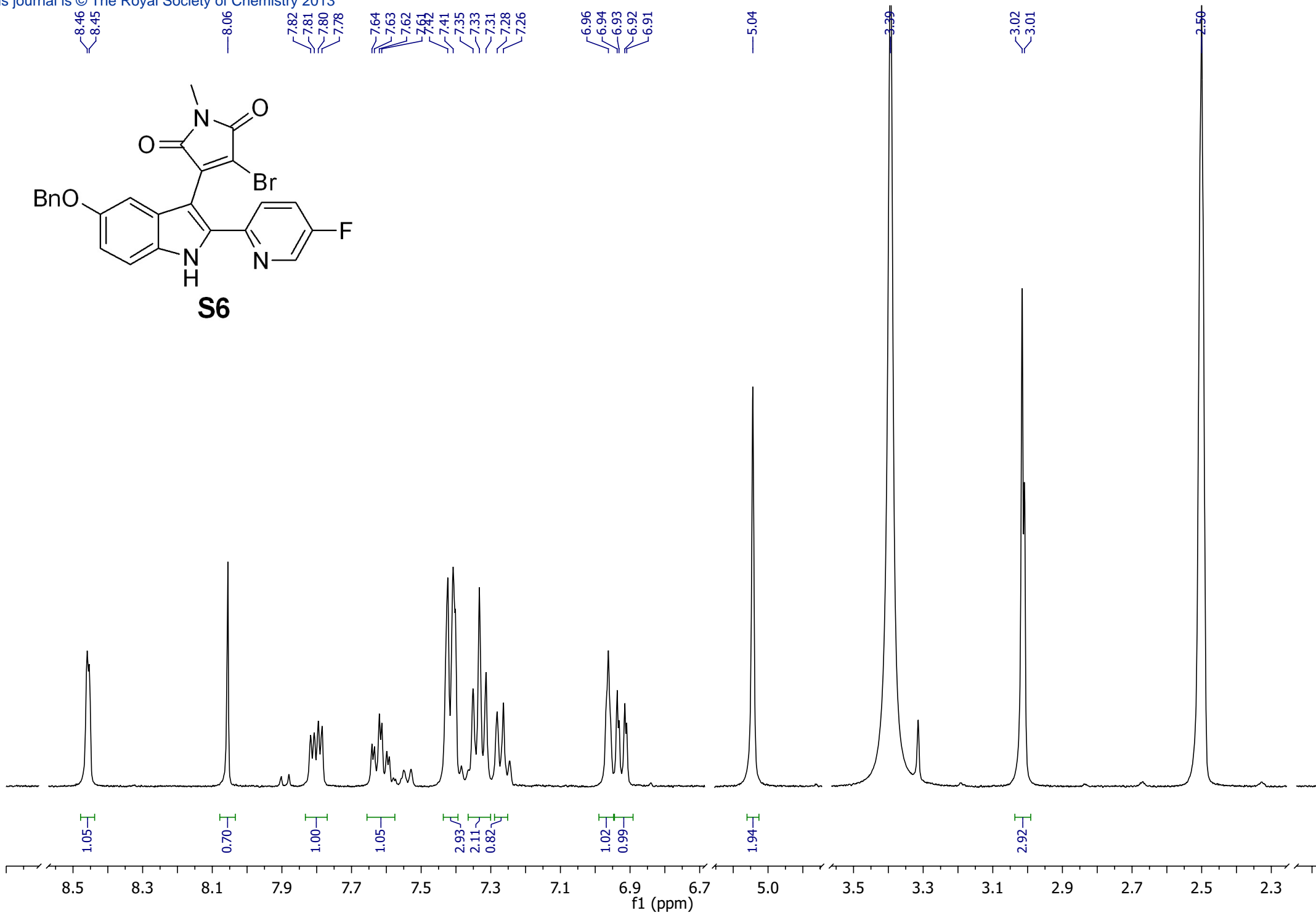
The samples were prepared in chloroform of analytical grade (0.1 mM). The absorption spectra were measured in the spectral range of 270 nm < λ < 580 nm using a Lambda 750 UV/Vis spectrometer (Perkin-Elmer). The steady-state fluorescence measurements were performed using a Fluoromax 4 spectrofluorometer (Horiba Jobin Yvon) operated in single-photon-counting mode. The samples were excited at $\lambda_{\text{ex}} = 366$ nm, respectively. The emission spectra were recorded in the spectral range of 425 nm < $\lambda_{\text{em}} < 620$ nm. The fluorescence decays were also measured using the Fluoromax 4 spectrofluorometer and operated in the time-correlated single-photon-counting mode (TCSPC). A NanoLED-370 at $\lambda_{\text{ex}} = 371$ nm (pulse width = 1.1 ns) operated at a repetition rate of 1 MHz was used and the emission was detected at $\lambda_{\text{em}} = 480$ nm. The data were fitted monoexponential using the software package provided by Horiba Jobin Yvon (DAS6).

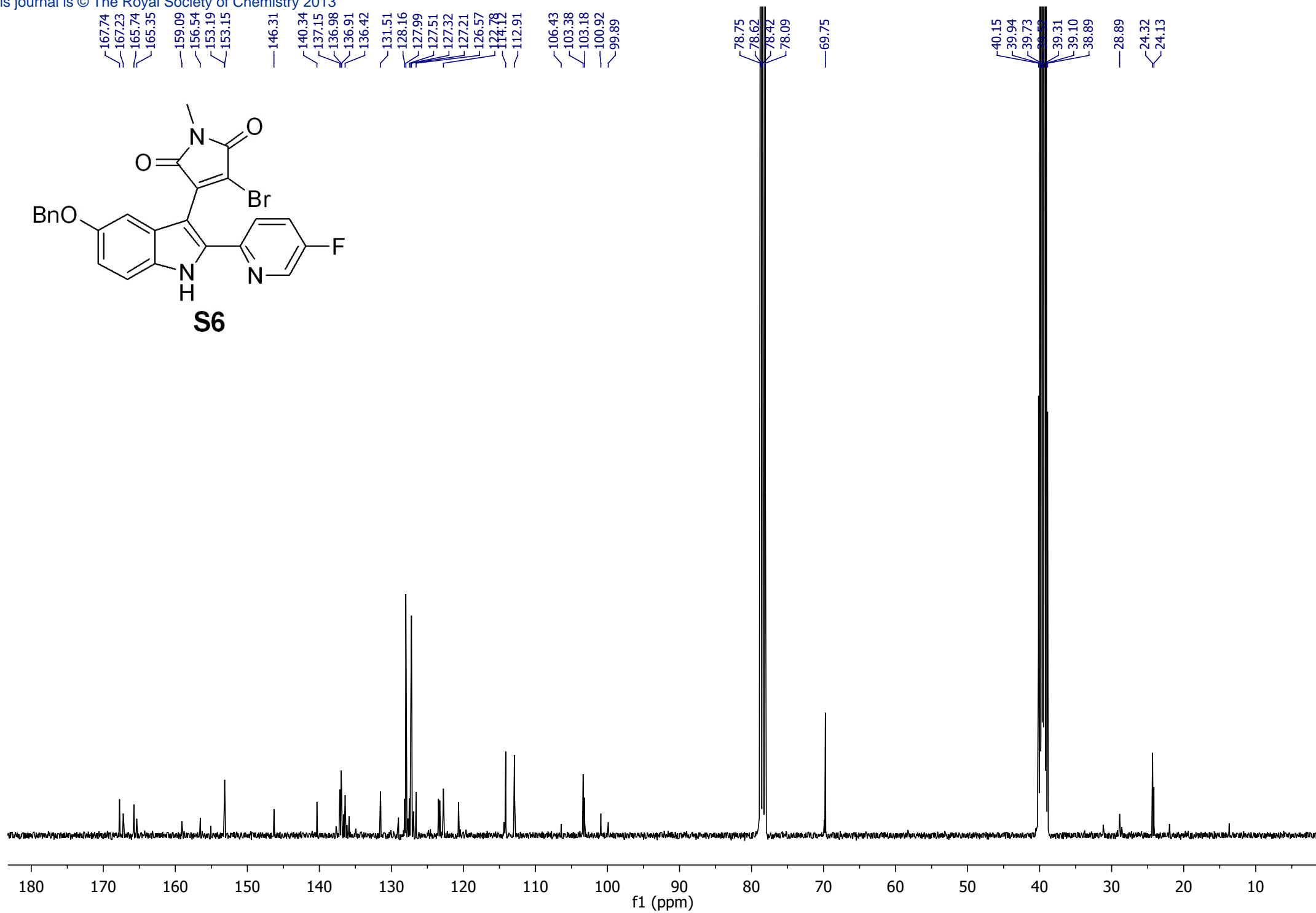
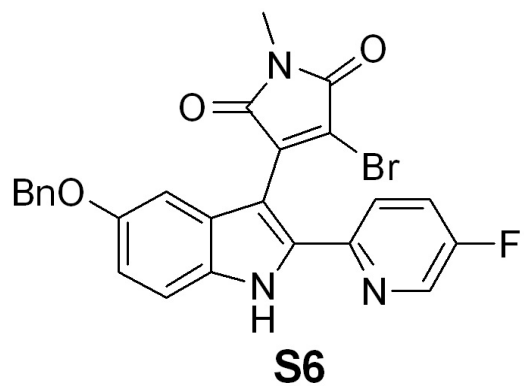
S4 References

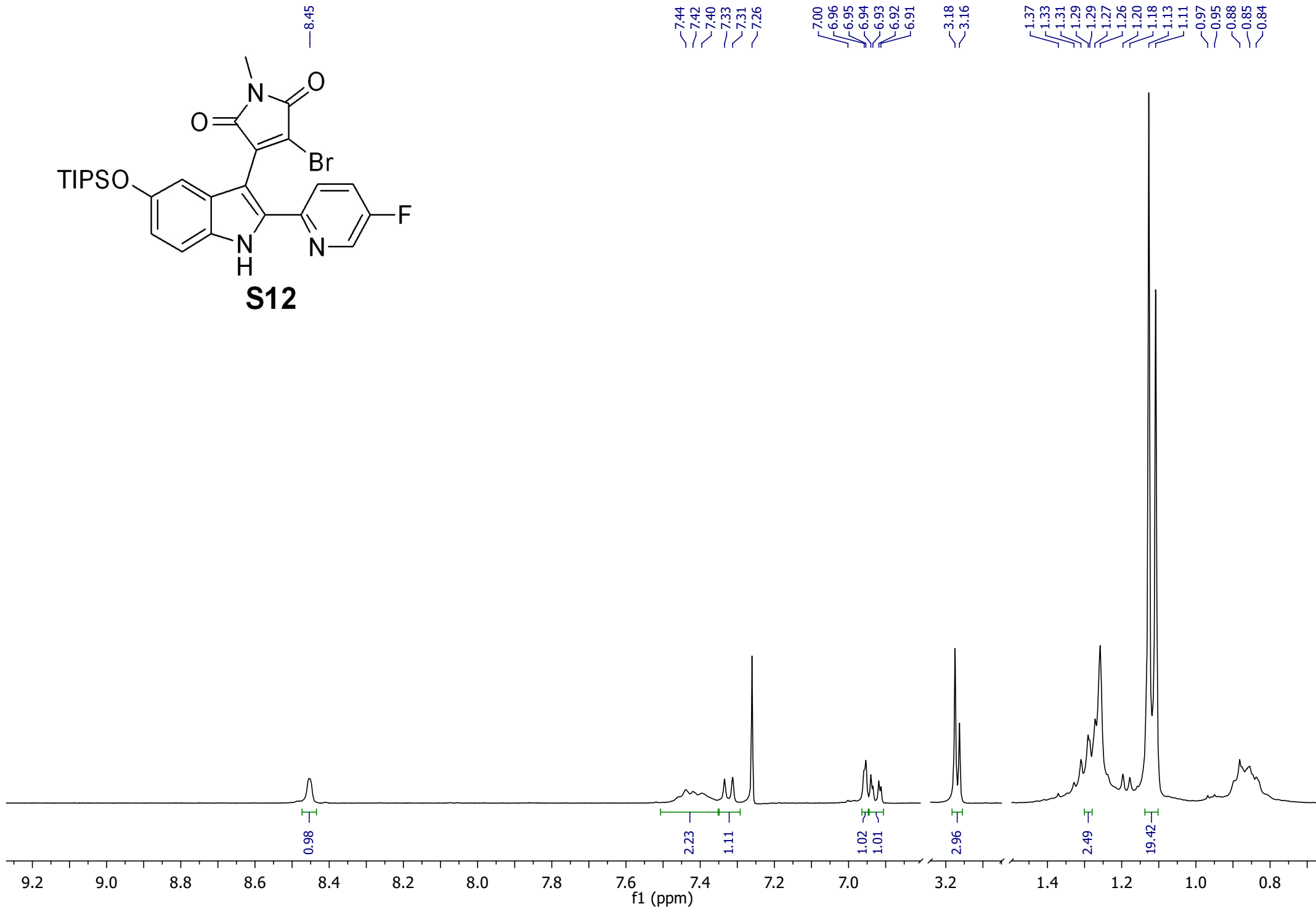
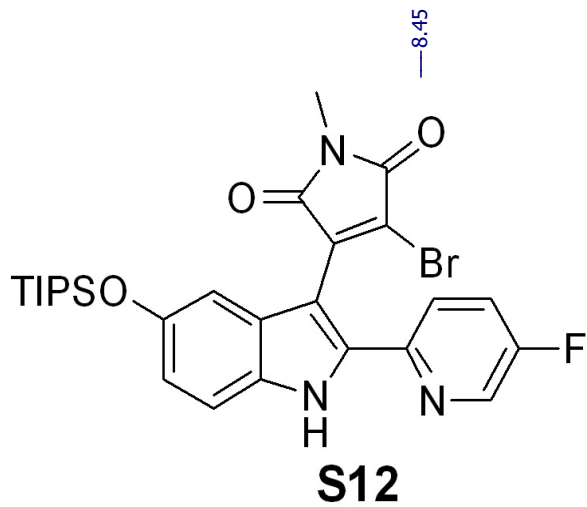
- [S1] N. Pagano, J. Maksimoska, H. Bregman, D. S. Williams, R. D. Webster, F. Xue, E. Meggers, *Org. Biomol. Chem.* **2007**, 5, 1218–1227.
- [S2] N. Pagano, E. Y. Wong, T. Breiding, H. Liu, A. Wilbuer, H. Bregman, Q. Shen, S. L. Diamond, and E. Meggers, *J. Org. Chem.* **2009**, 74, 8997–9009.
- [S3] H. Bregman, D. S. Williams, E. Meggers, *Synthesis* **2005**, 9, 1521–1527.
- [S4] H. Bregman, D. S. Williams, G. E. Atilla, P. J. Carroll, E. Meggers, *J. Am. Chem. Soc.* **2004**, 126, 13591–13595.

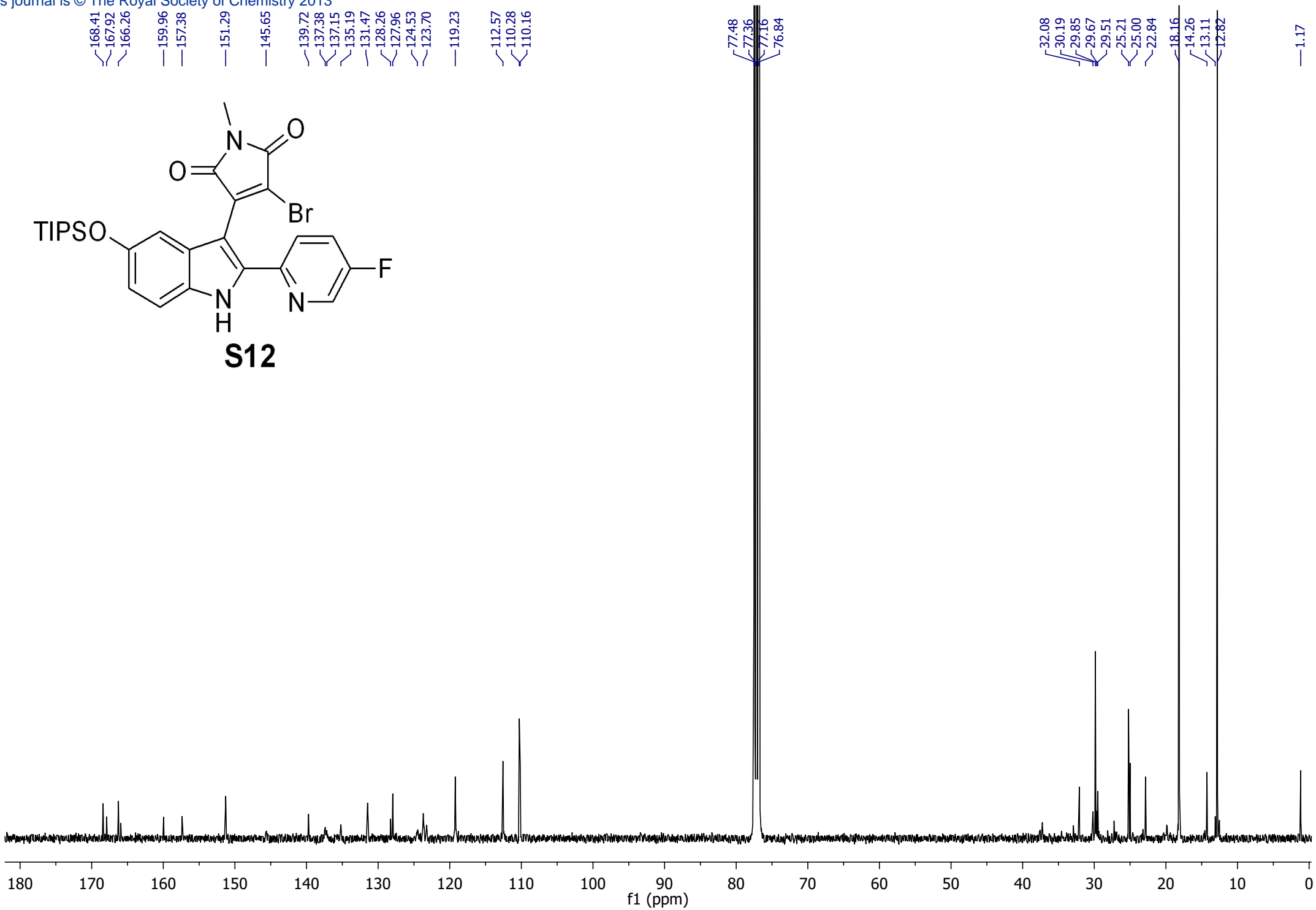
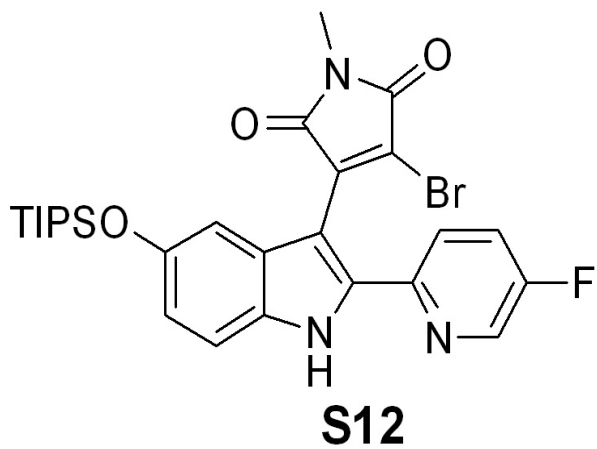


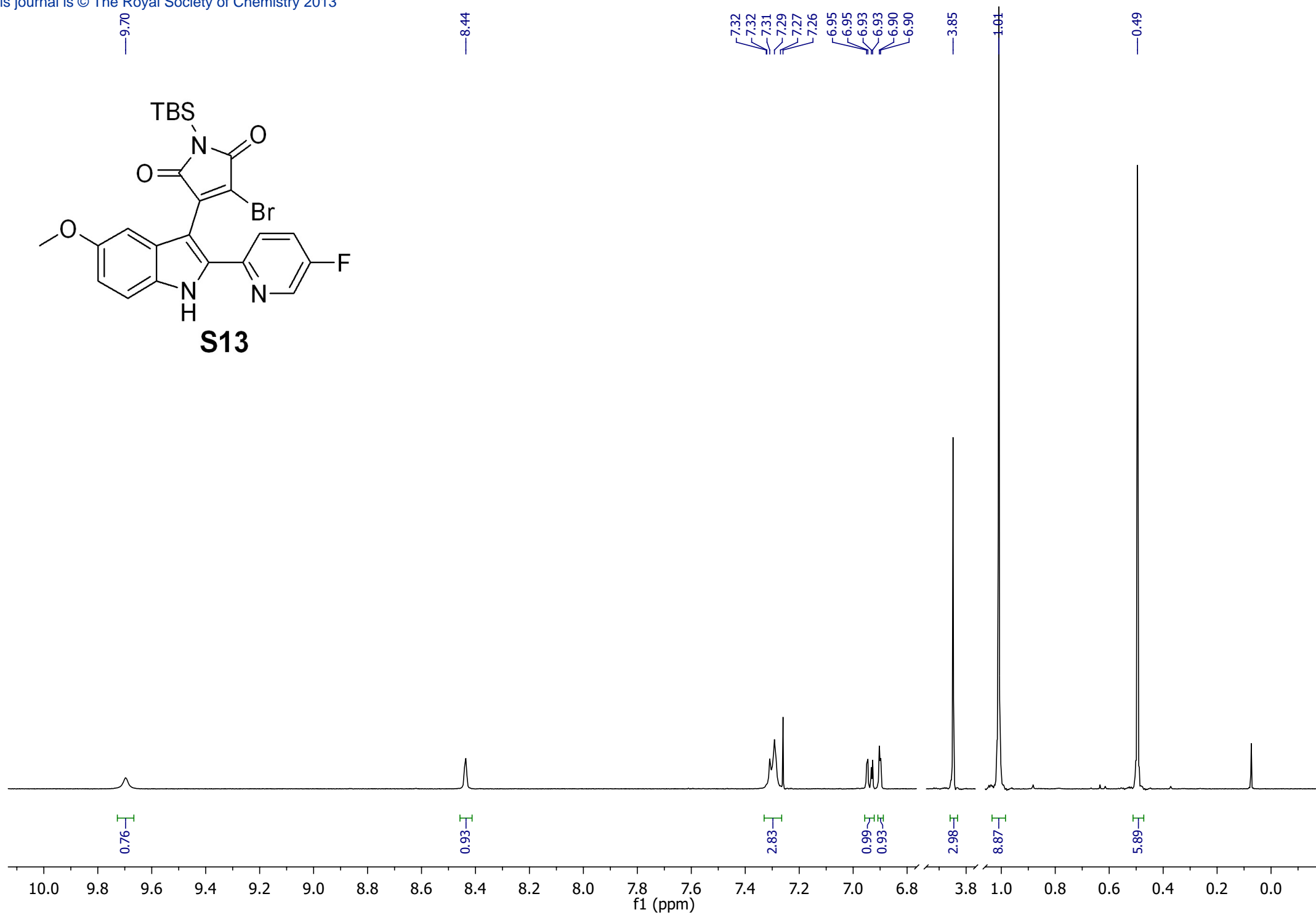
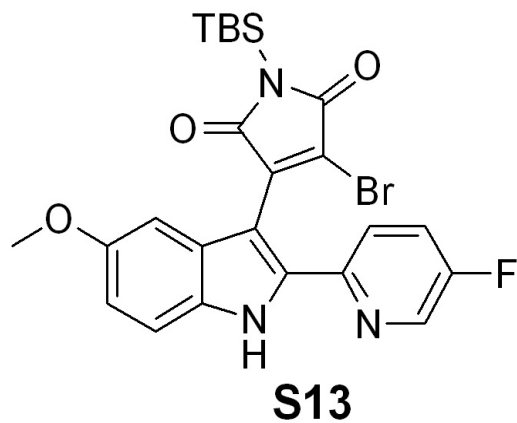


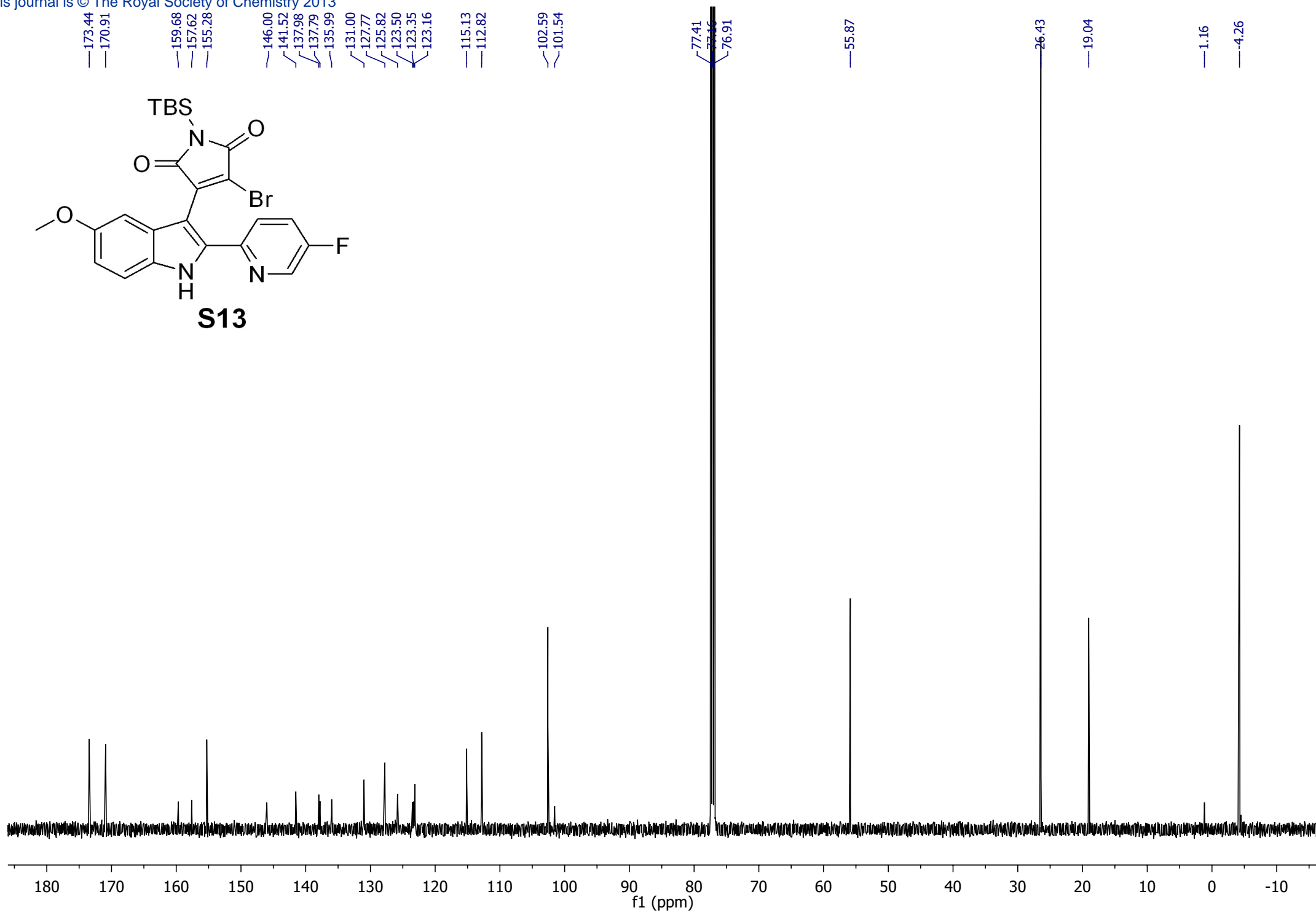
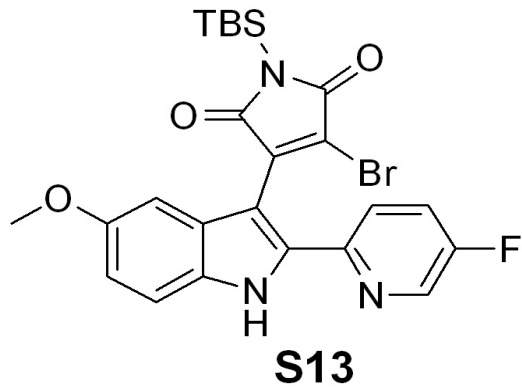


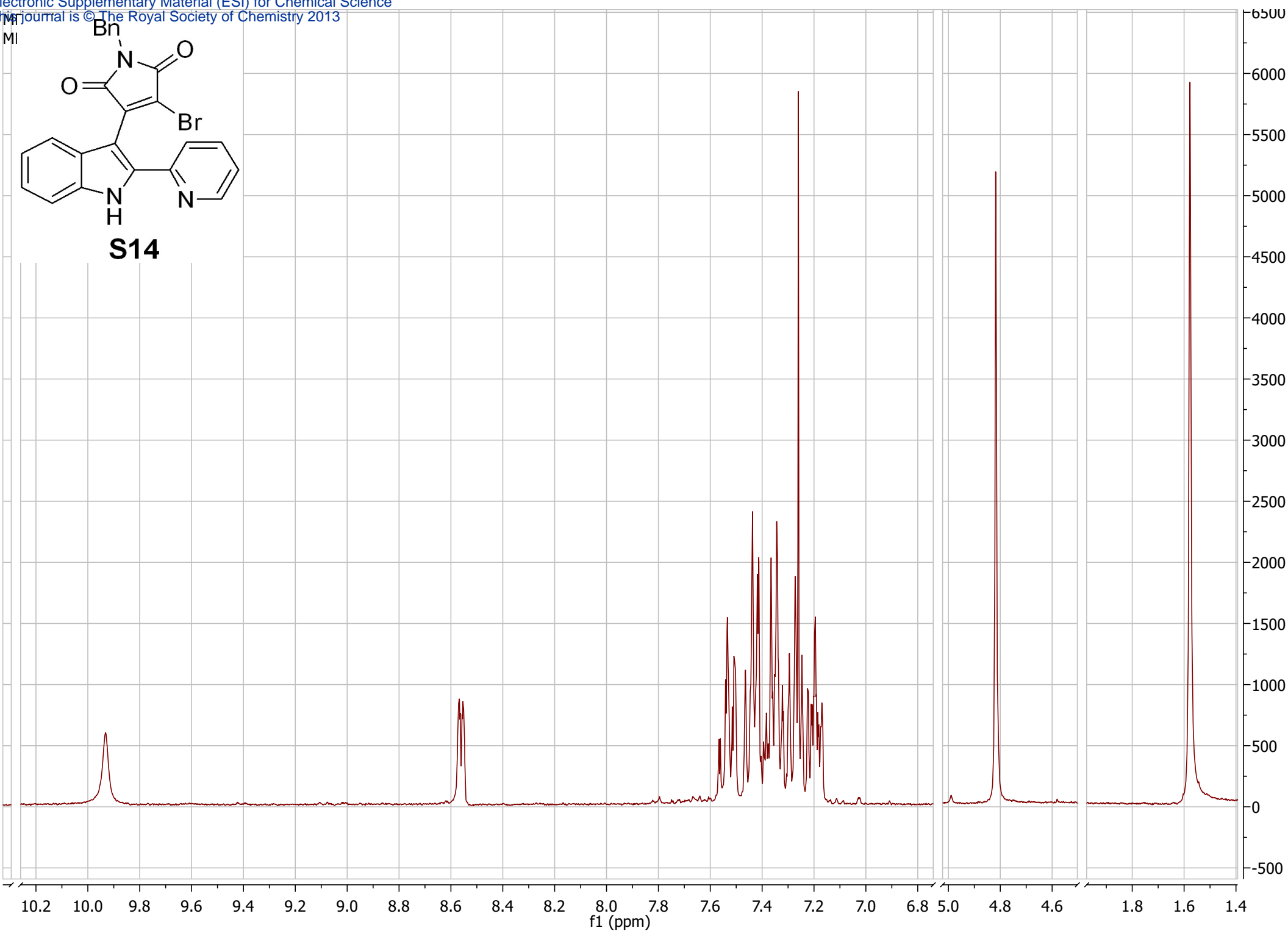
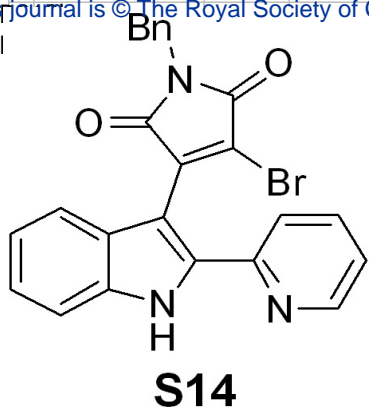


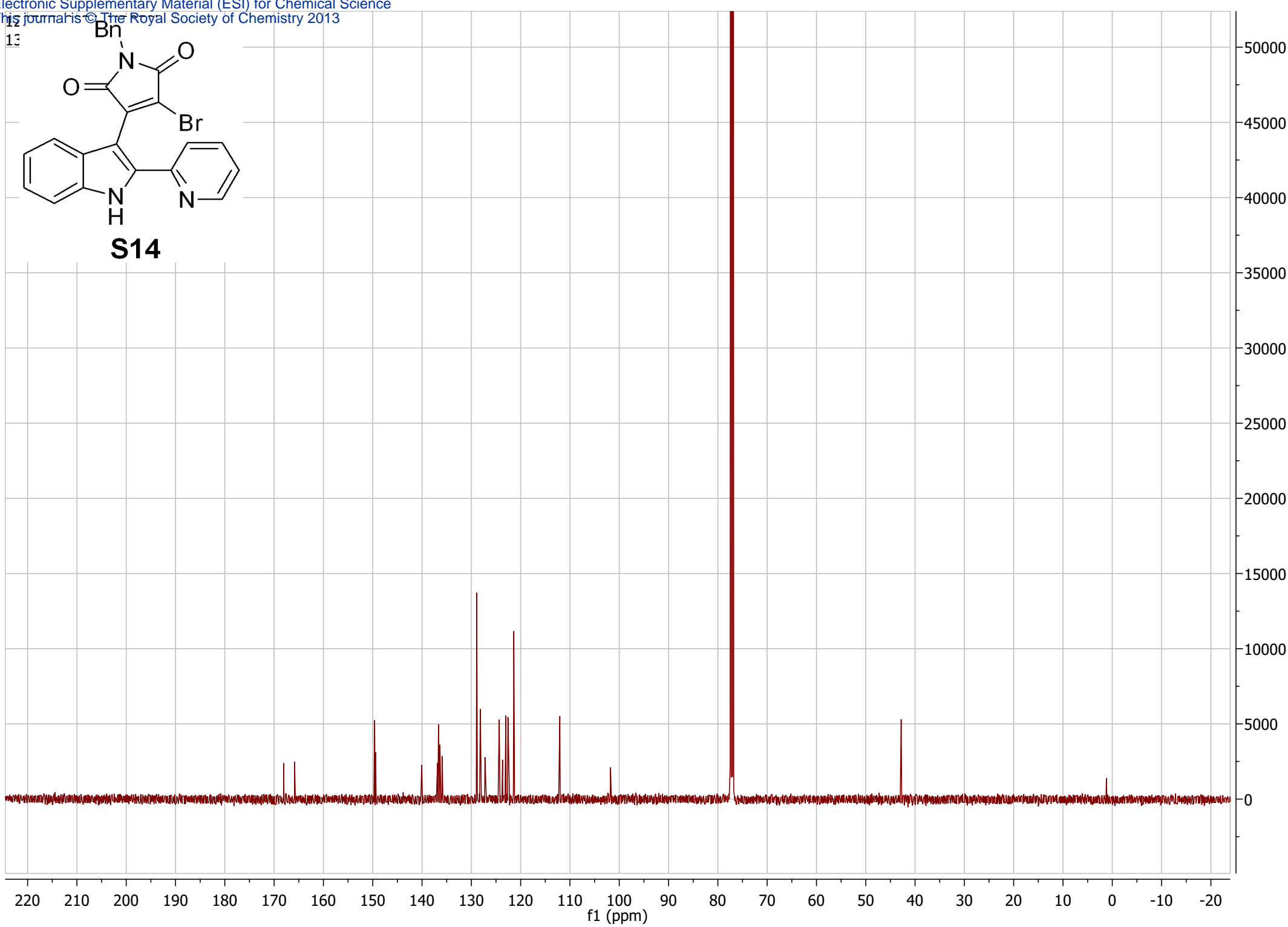


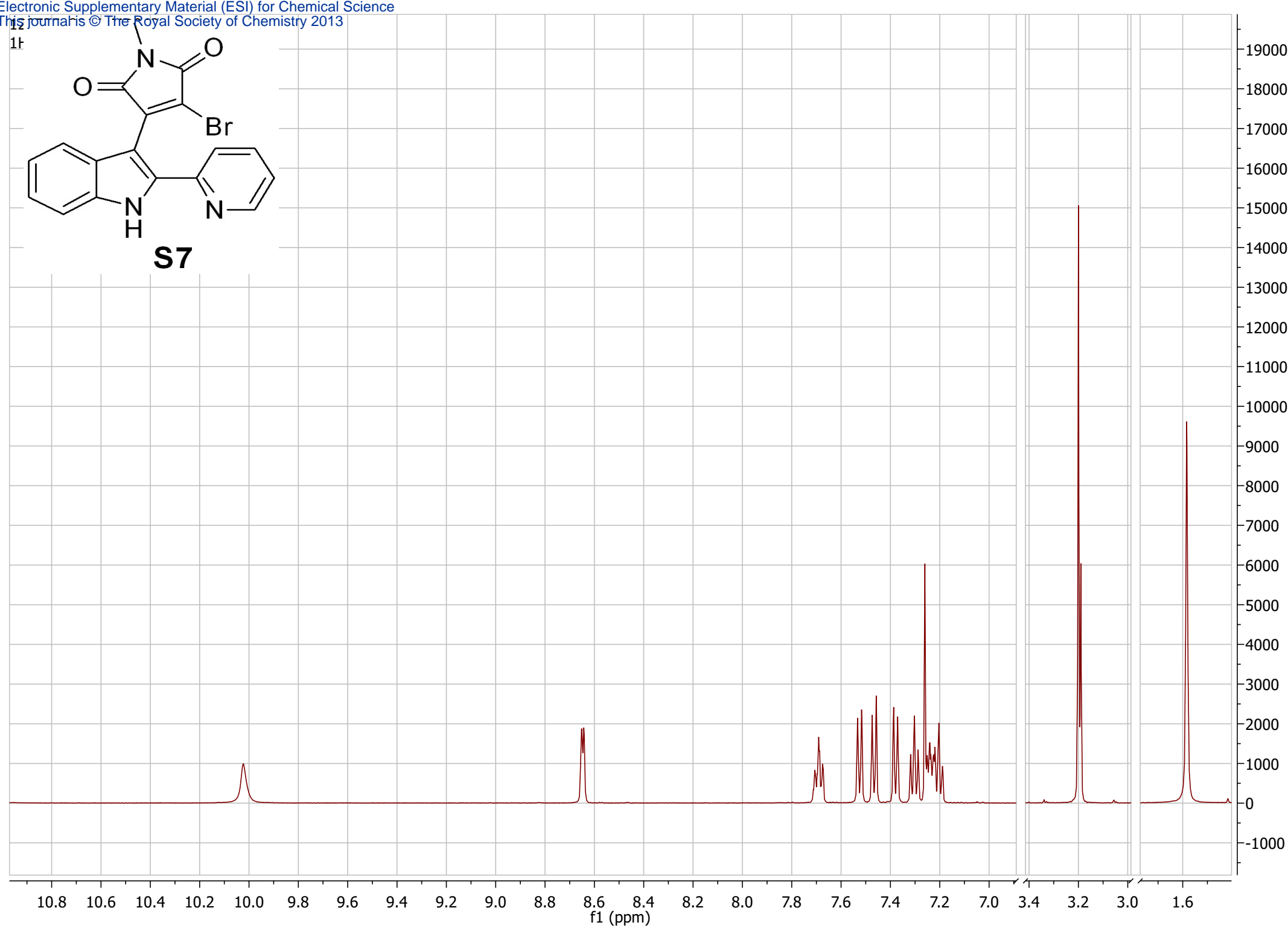


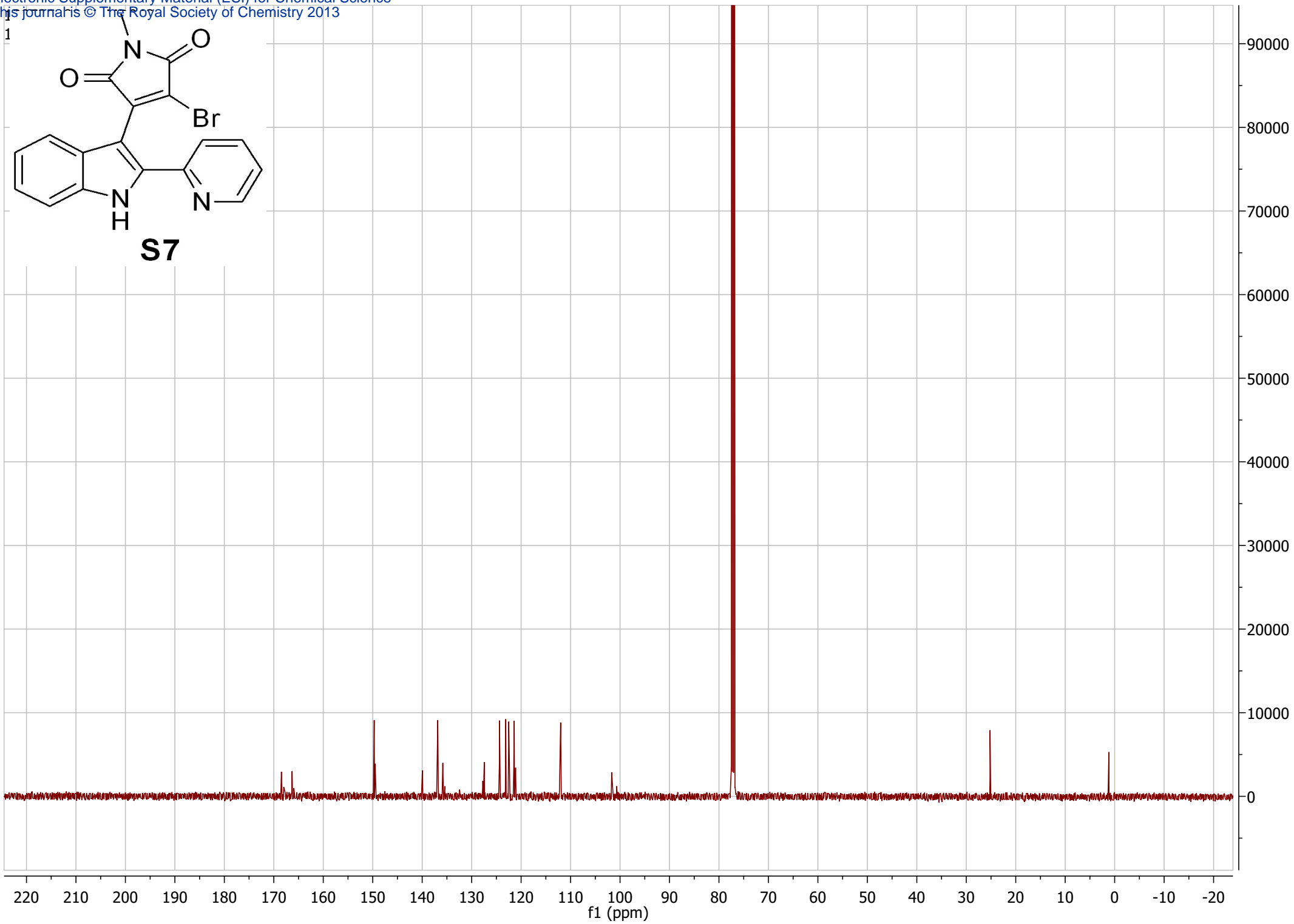
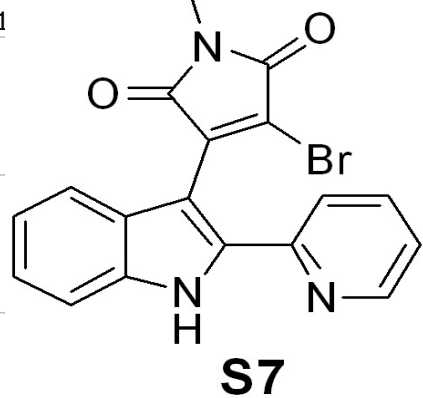


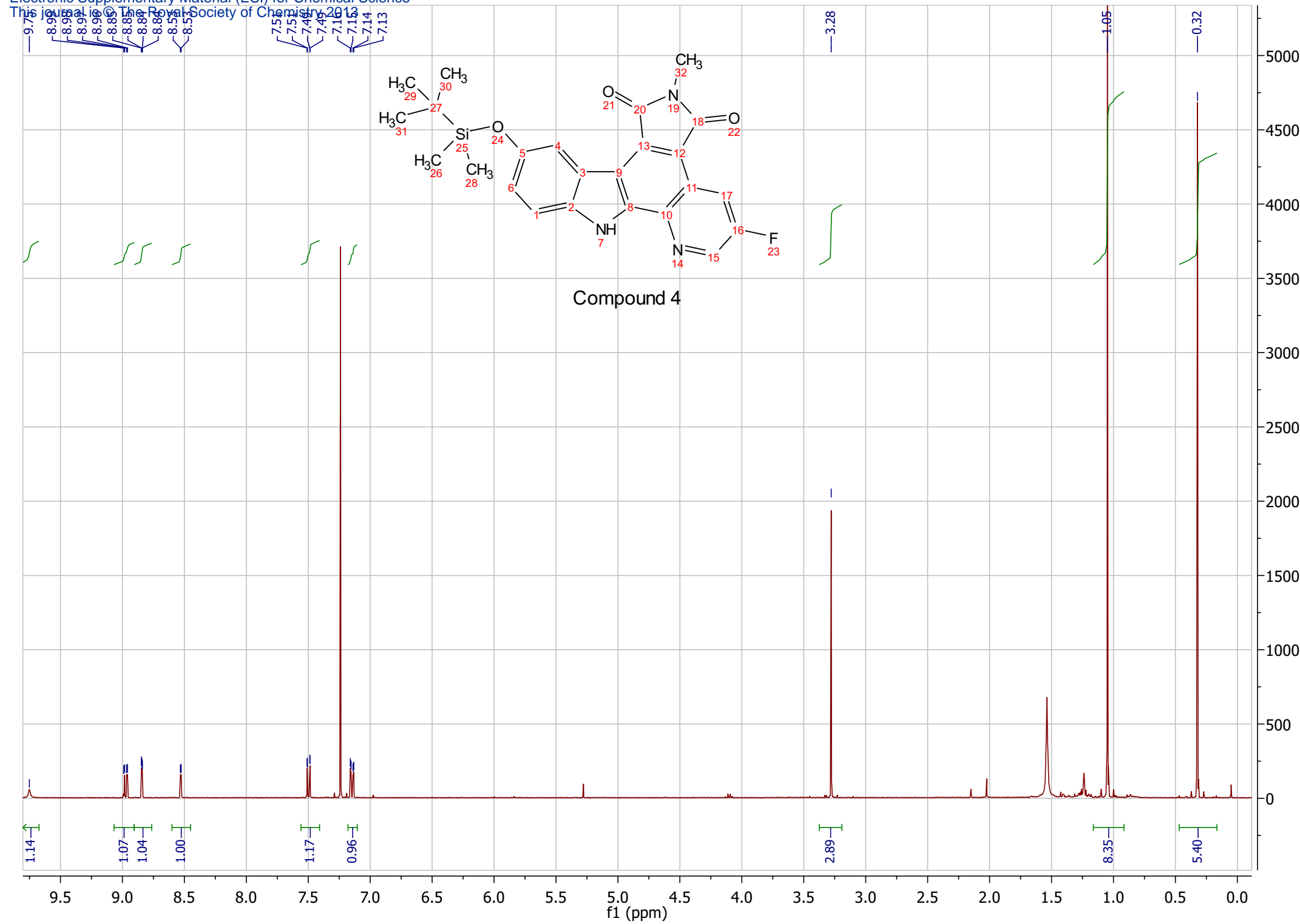


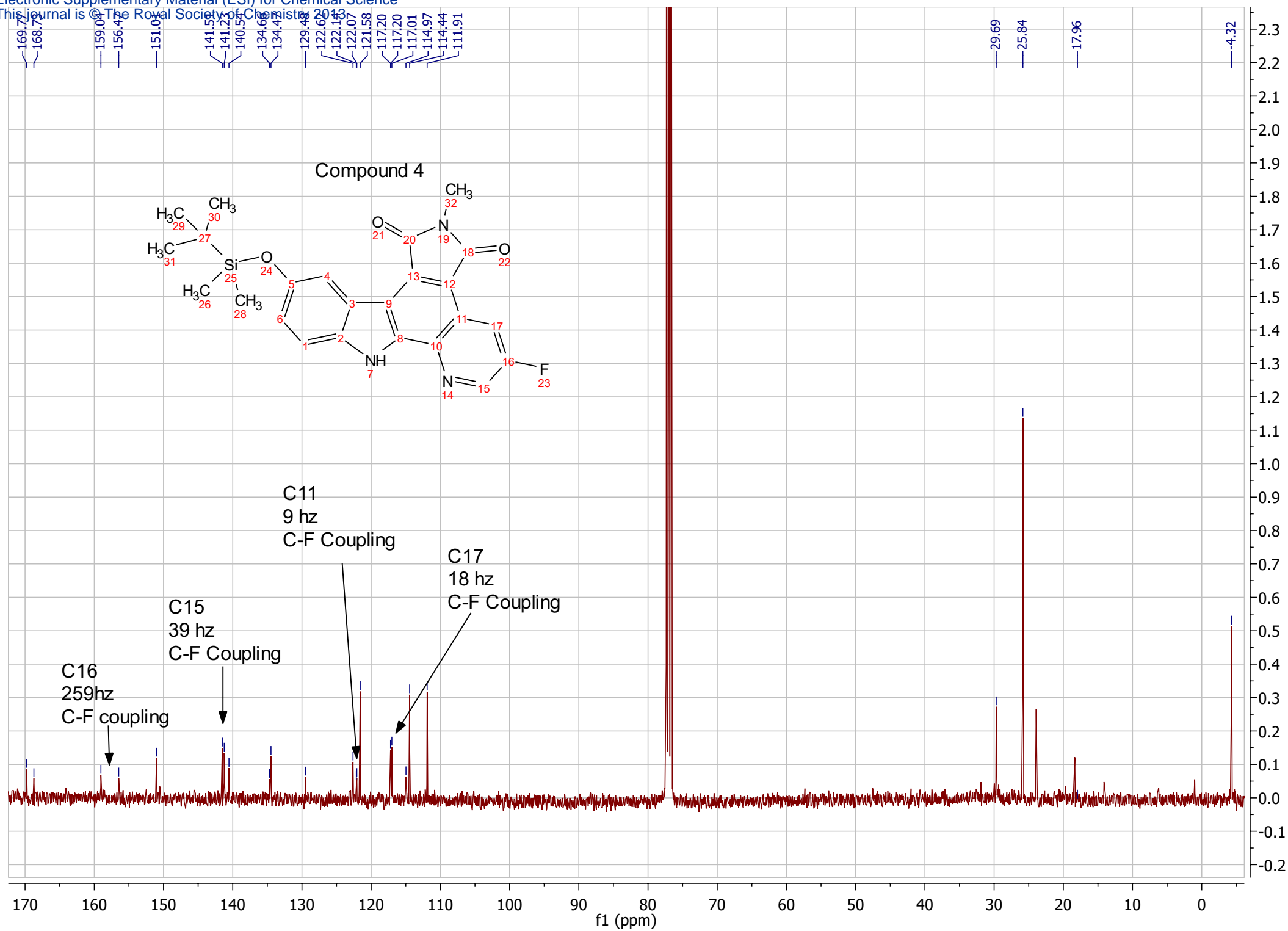


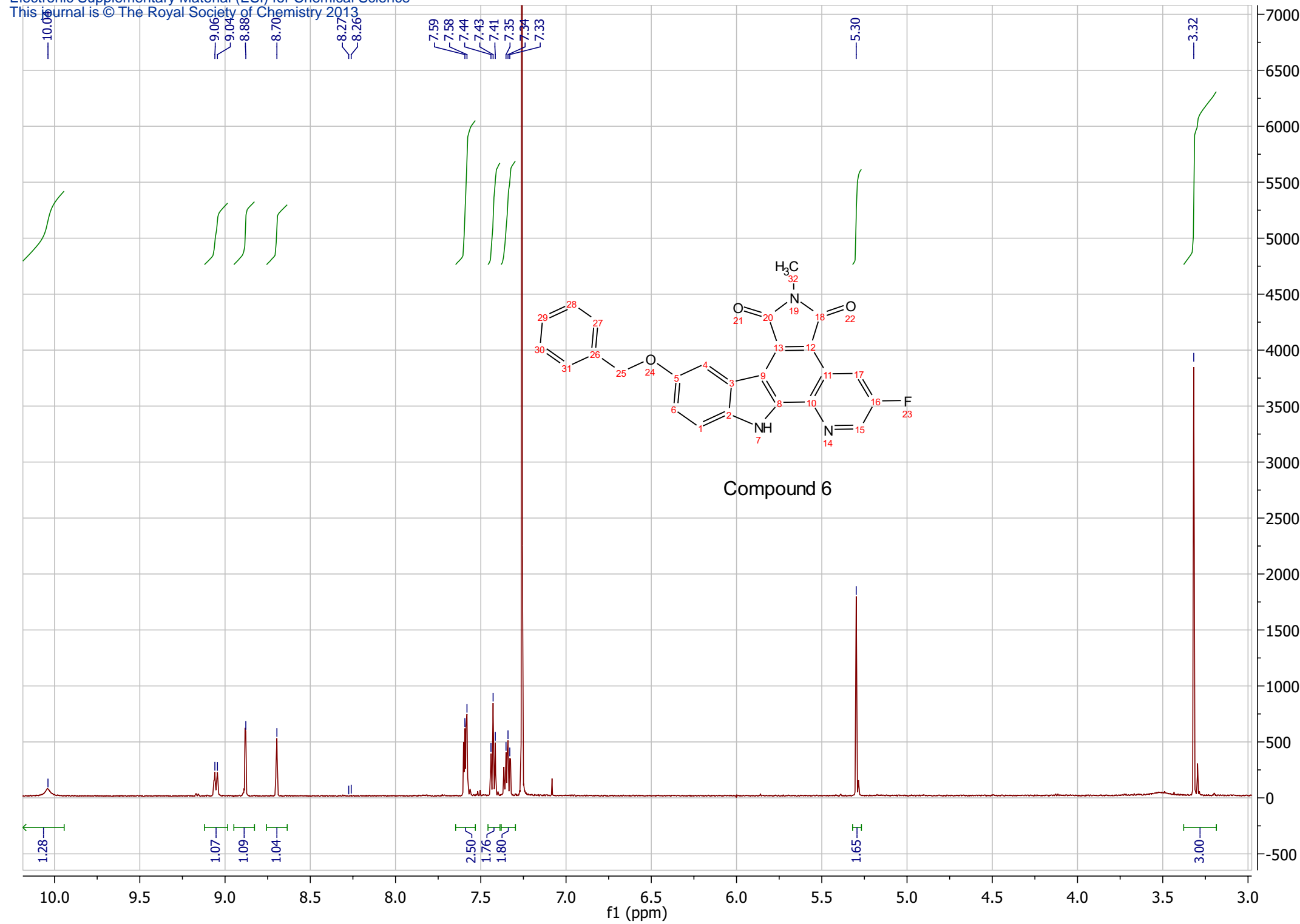


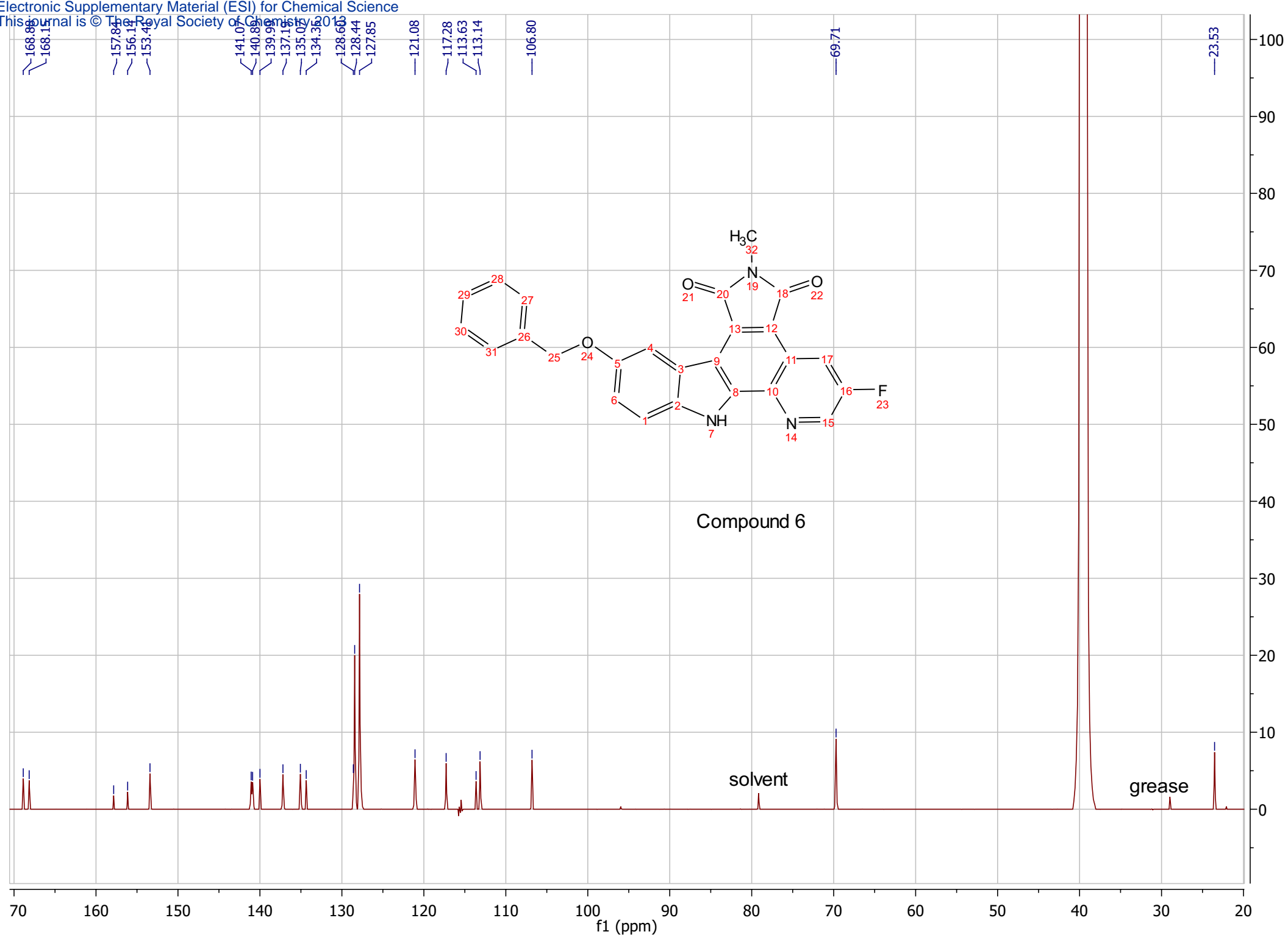


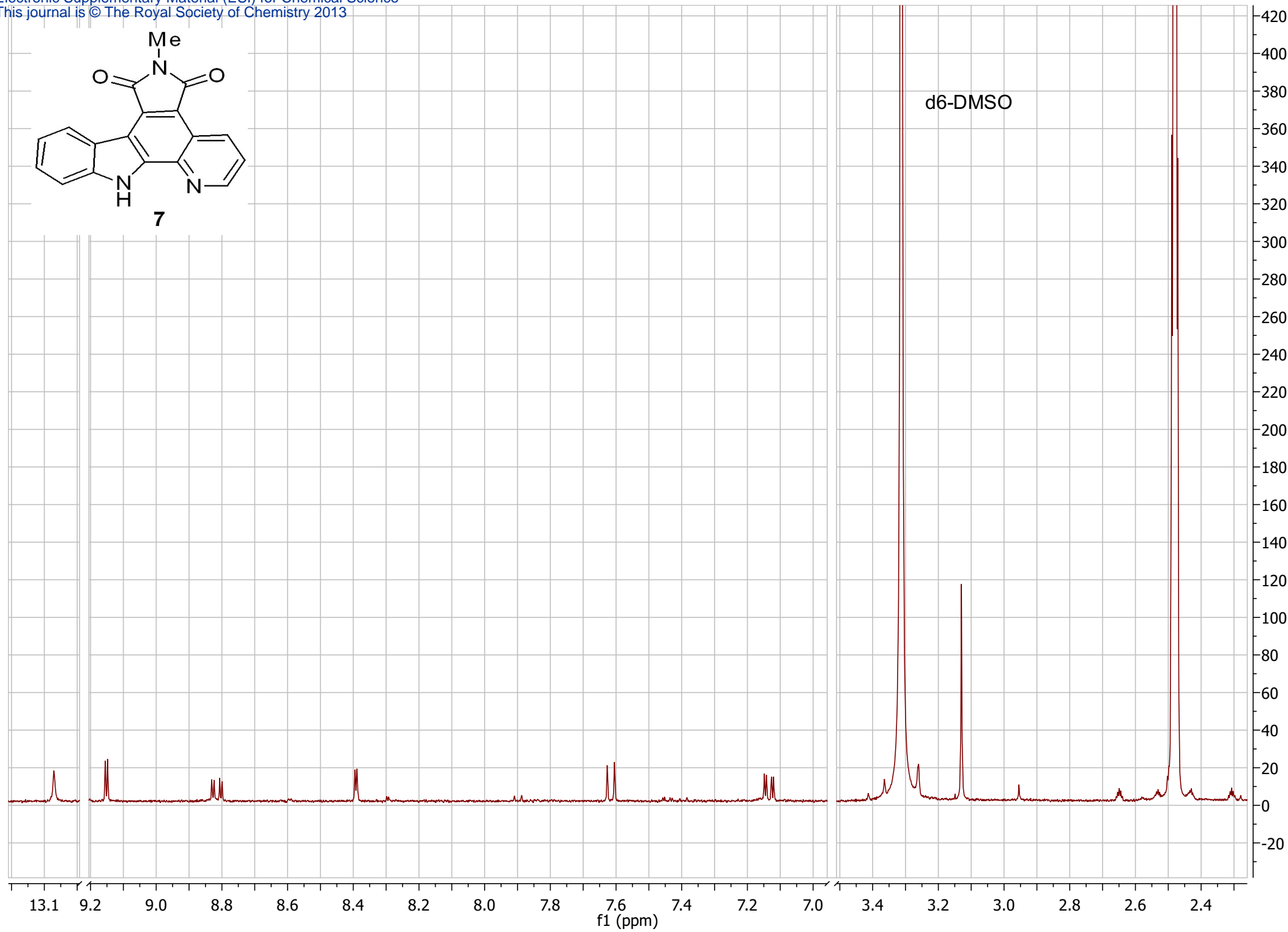
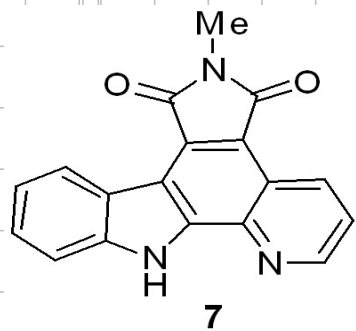


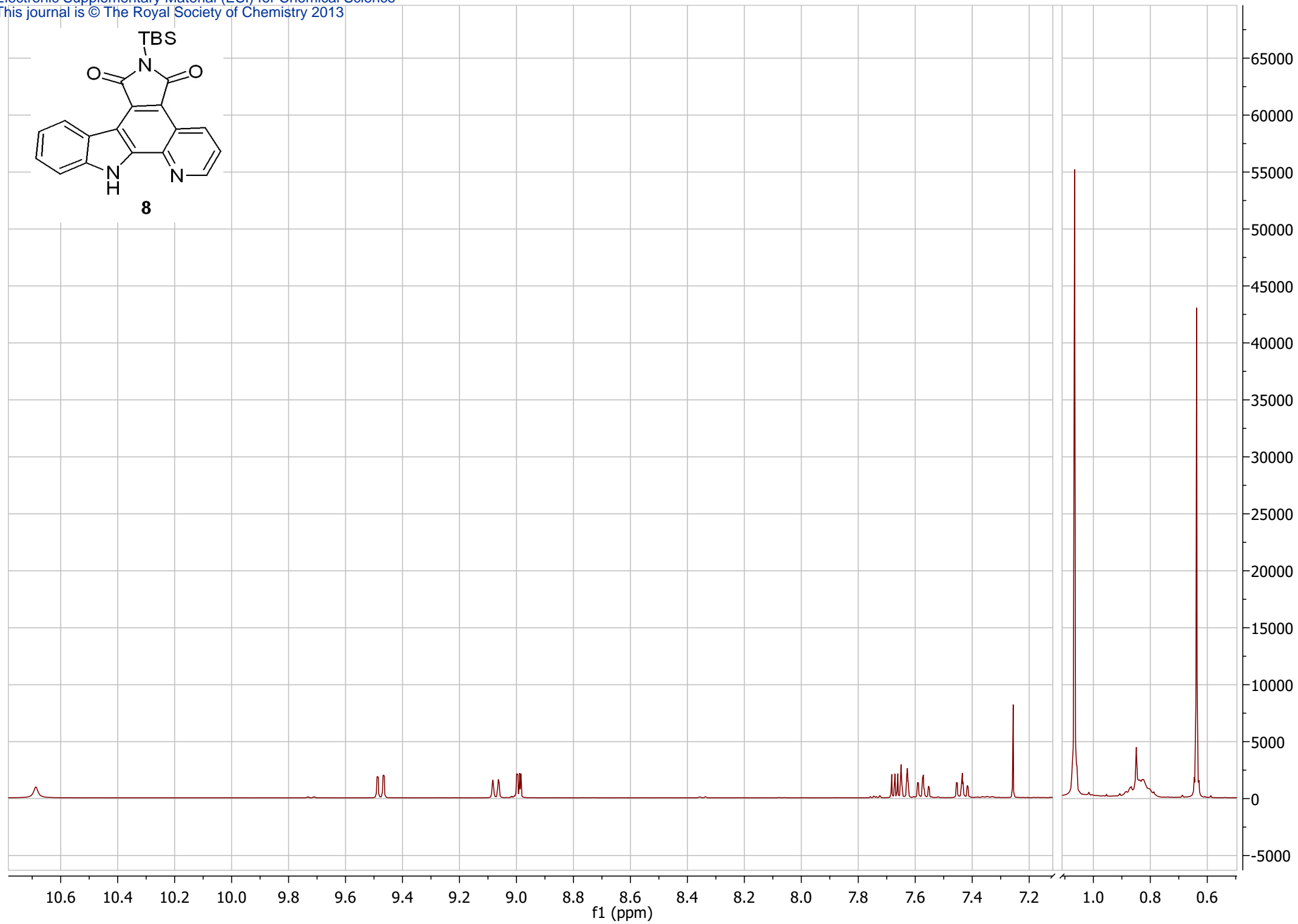
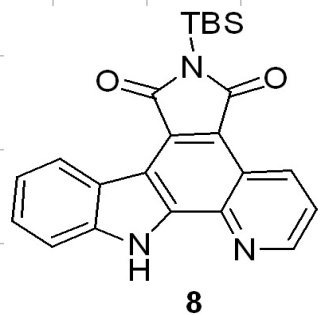


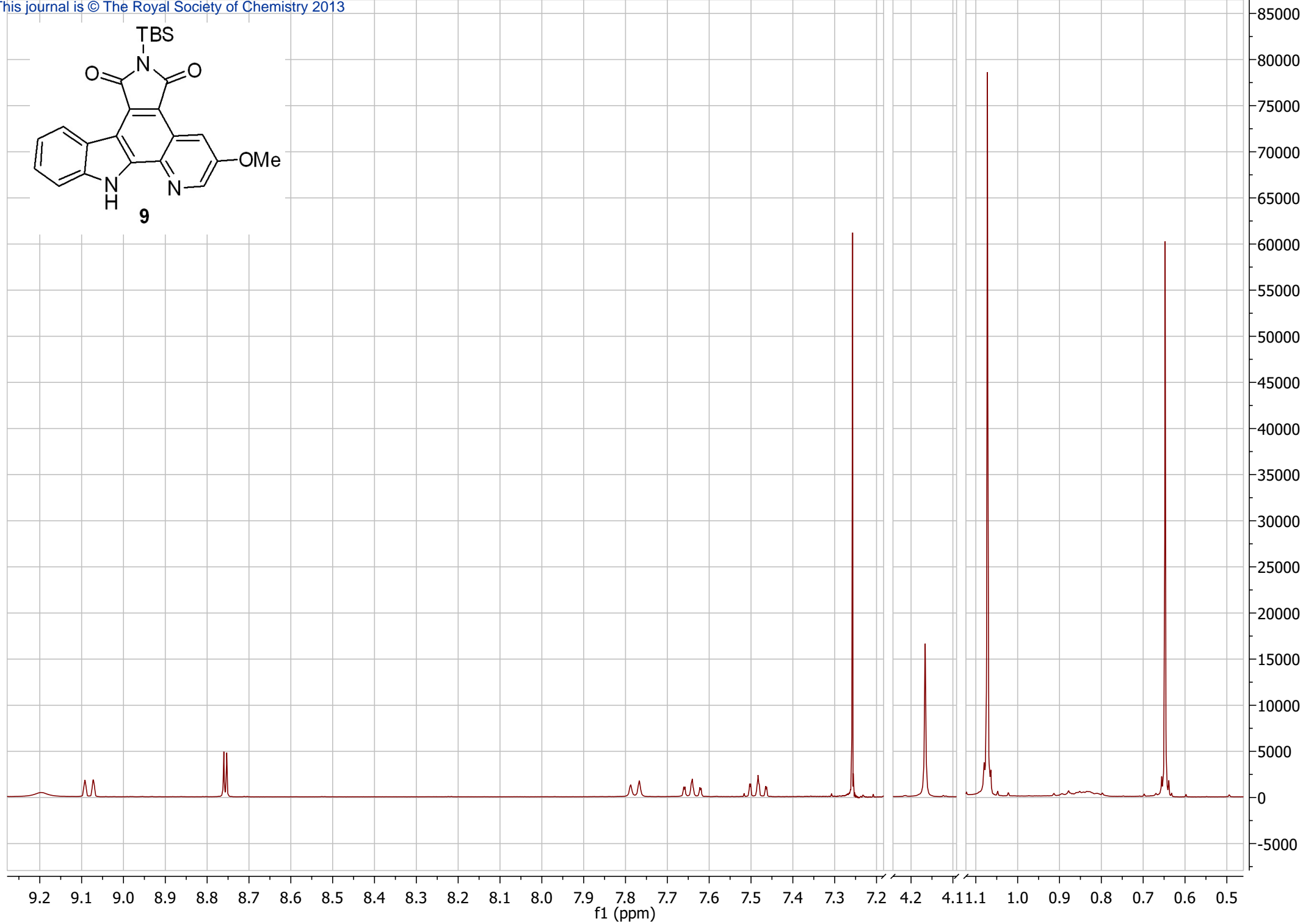
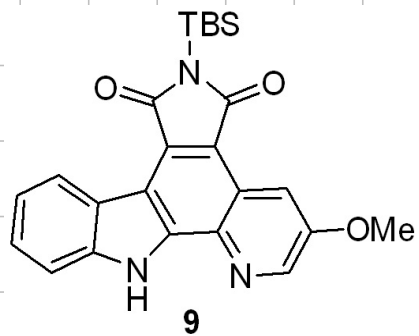


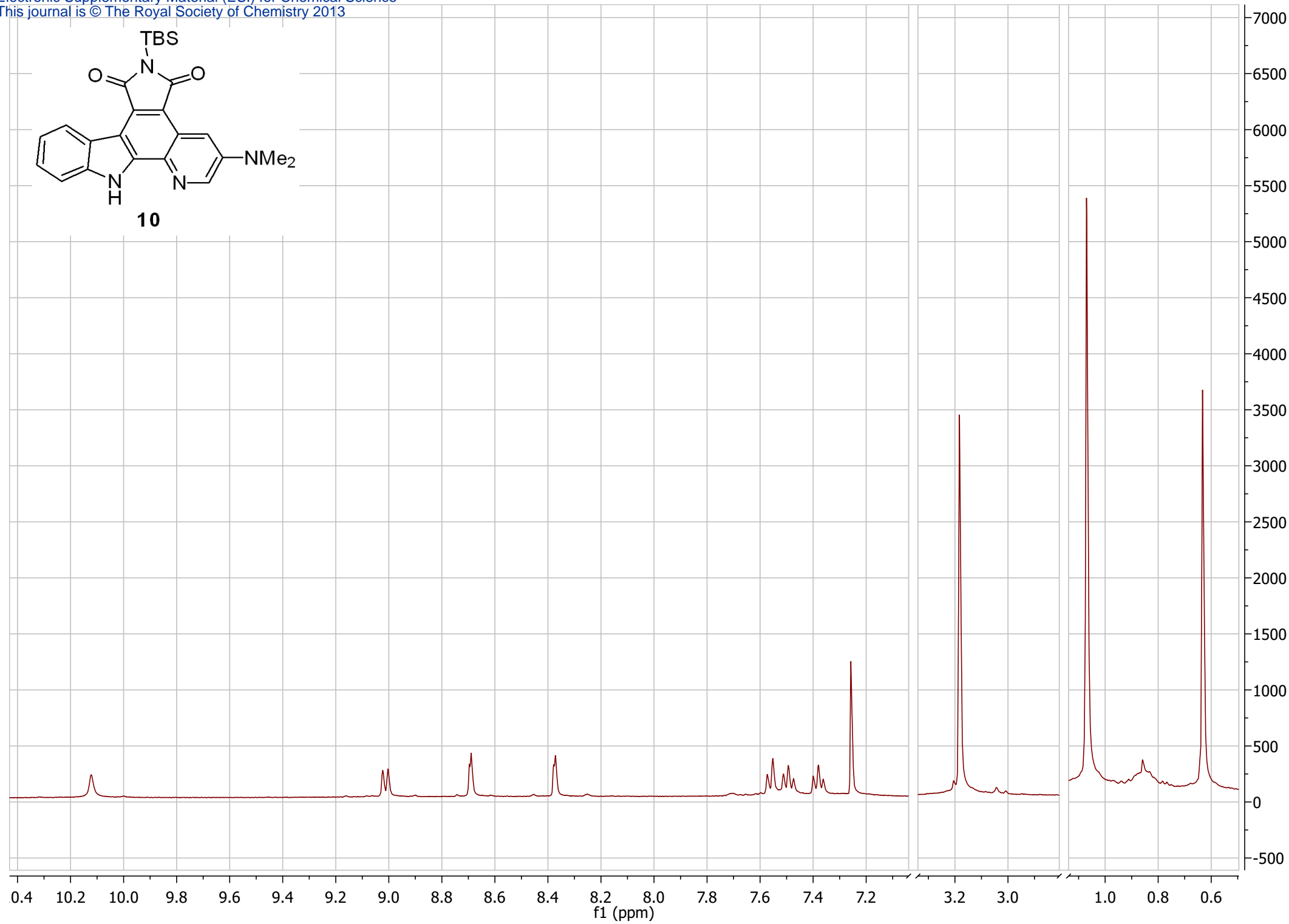
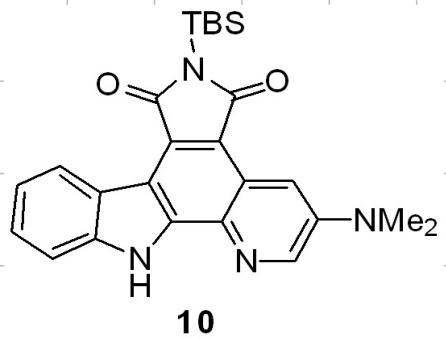


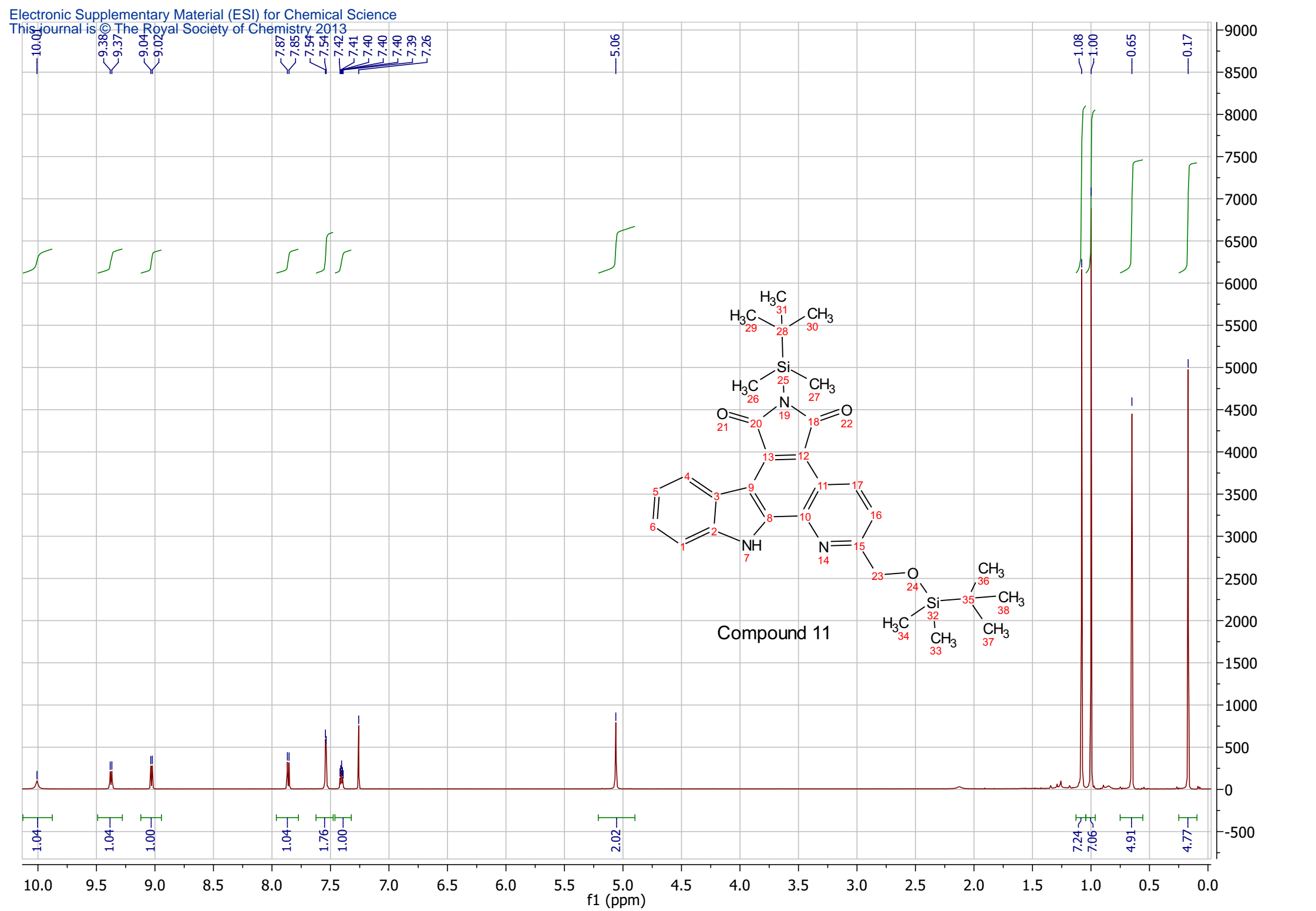


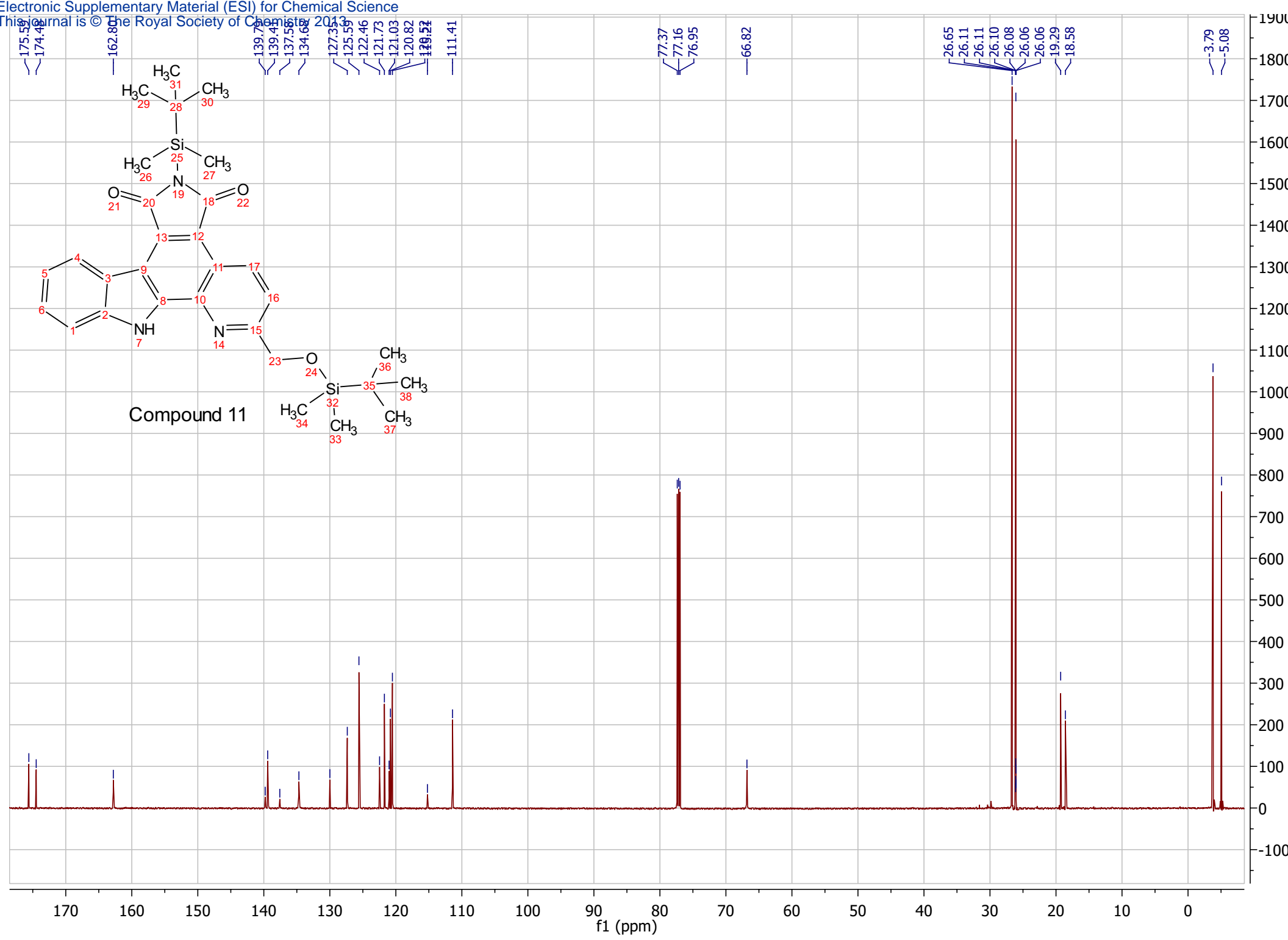




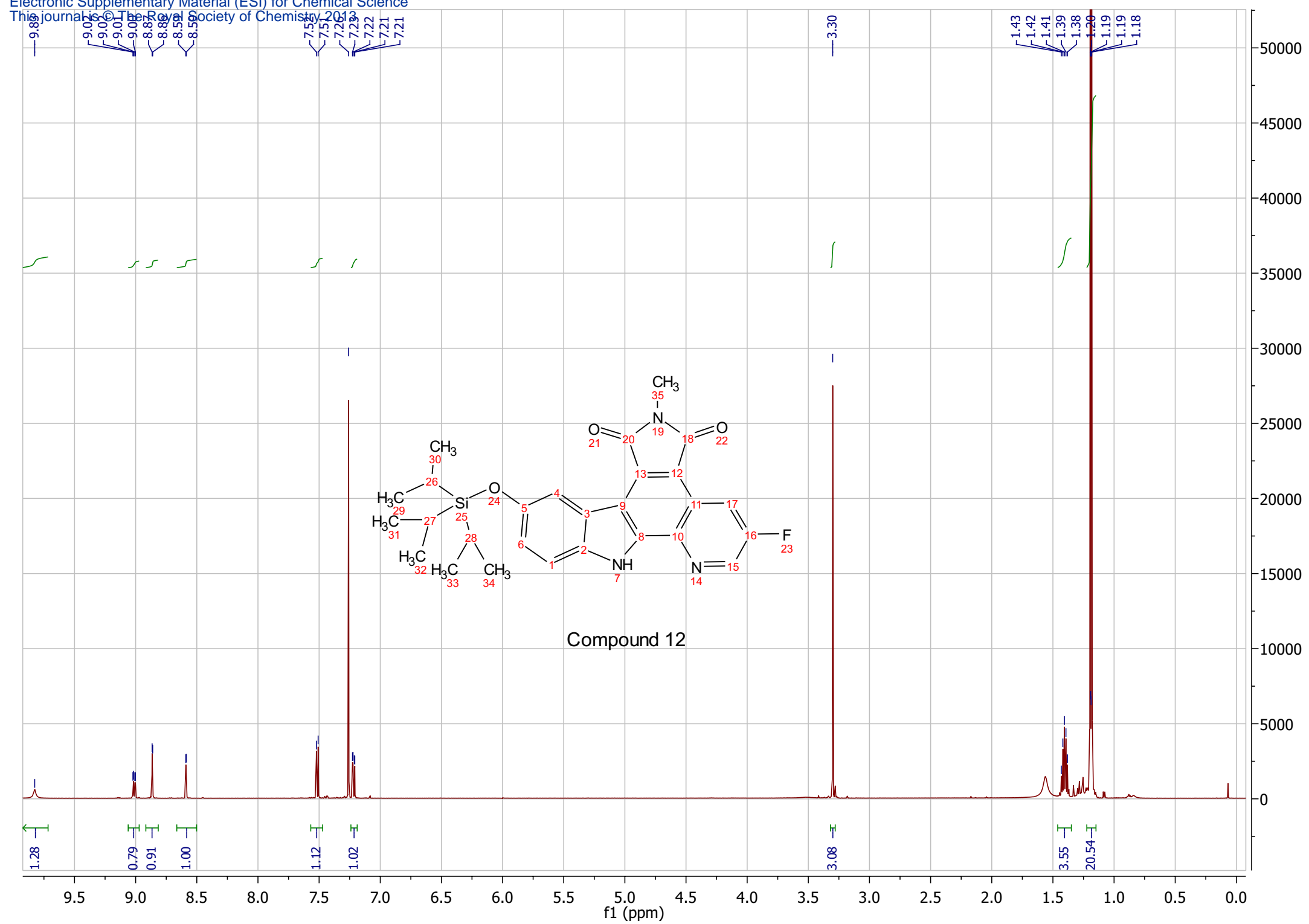


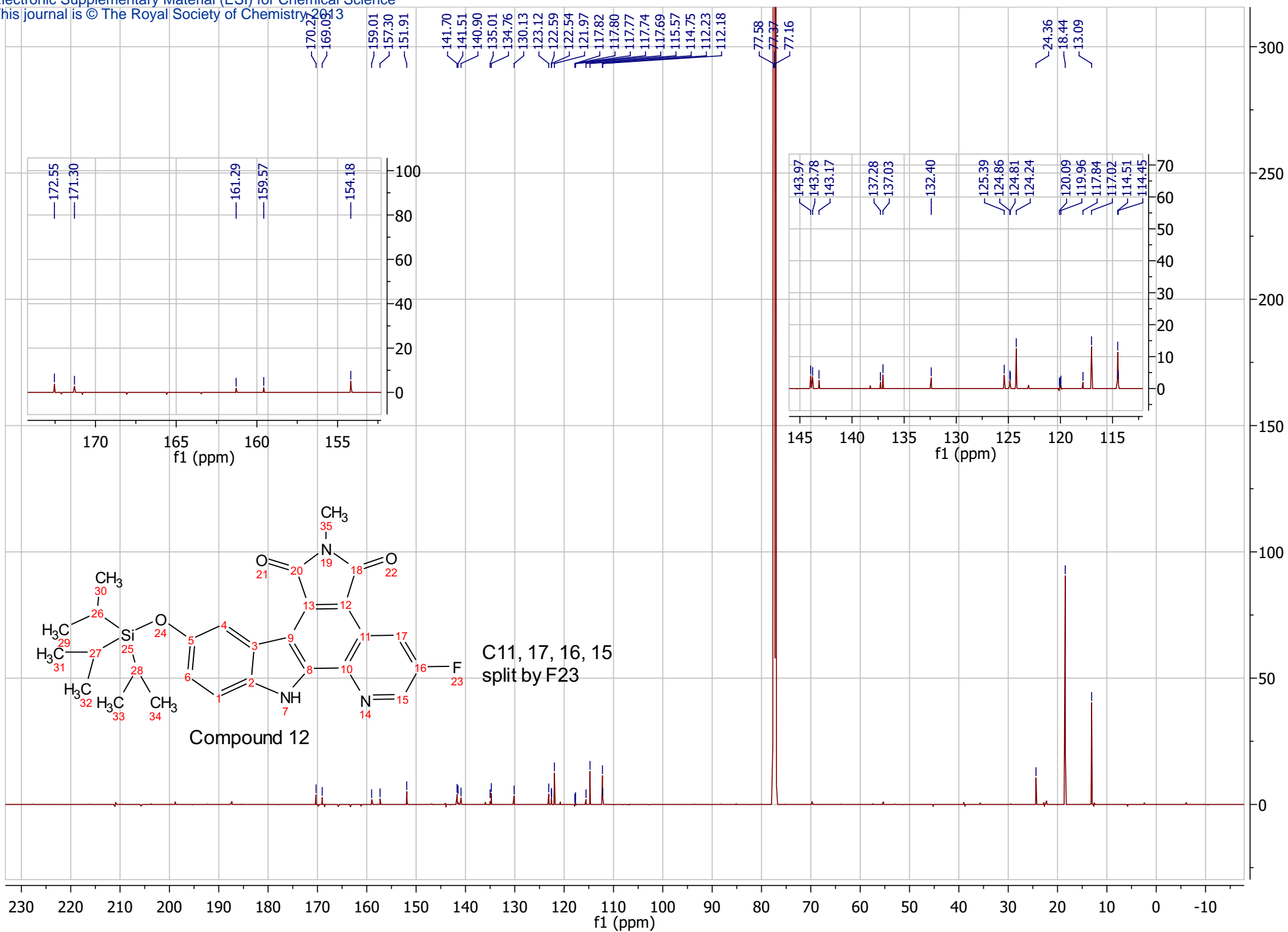


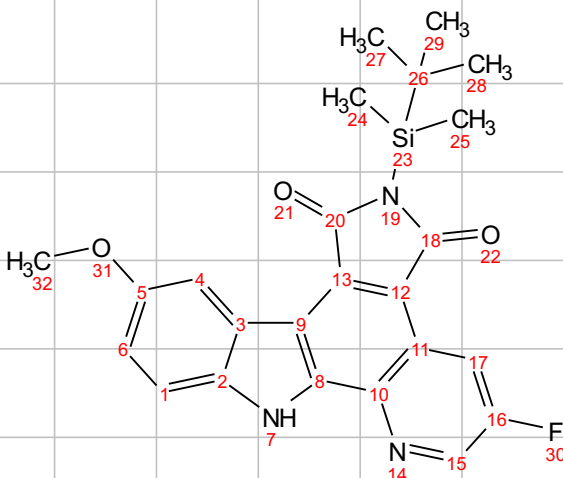
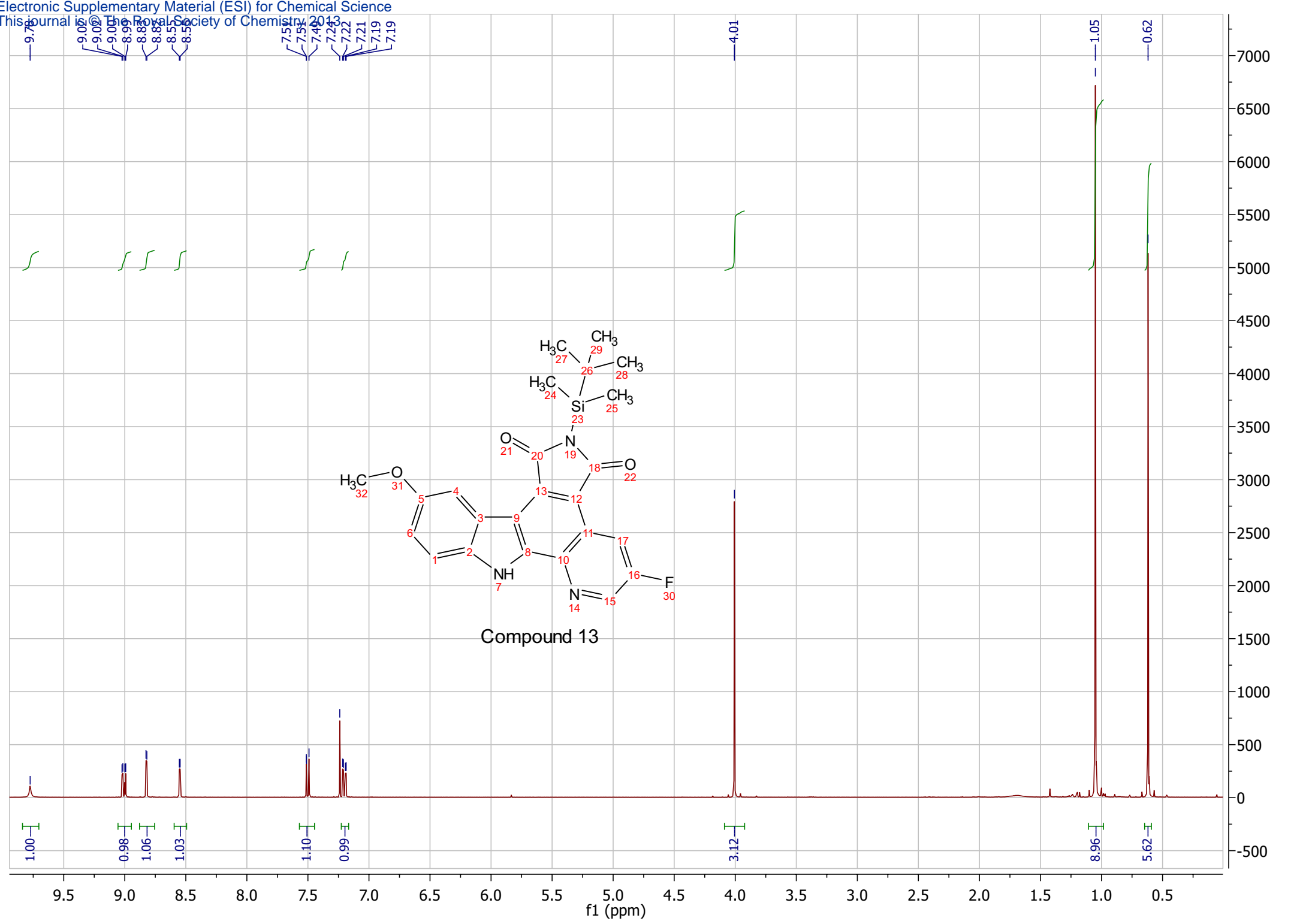




Compound 11







Compound 13

