Supporting Information

Direct Access to Pyrrole Anhydrides via Oxidative Self-Coupling of Pyrrole Carboxaldehydes

Surabhi Panday, Tapas Maity, Pratibha Bhatti and Joydev K. Laha*

[a]*Department of Pharmaceutical Technology (Process Chemistry),*
National Institute of Pharmaceutical Education and Research,
S. A. S. Nagar, Punjab 160062,
India
E-mail: jlaha@niper.ac.in

Table of Contents

1. CRYSTAL STRUCTURE DATA OF 2n

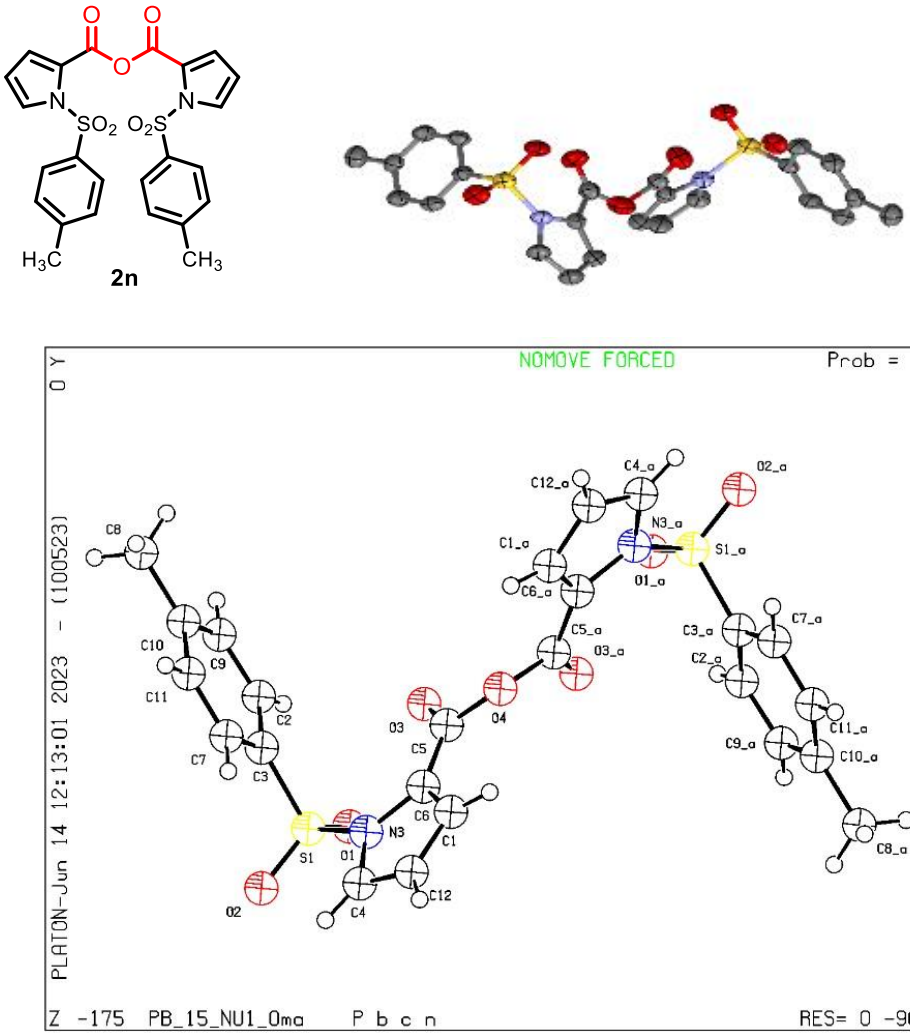


Figure 1. **Crystal** structure and **ORTEP** diagram of compound **2n**

Table 1 Crystal data and structure refinement for PB_15_NU1_0ma.

Ccdc no.	
Empirical formula	$C_{24}H_{20}N_2O_7S_2$
Formula weight	512.54
Temperature/K	298
Crystal system	orthorhombic
Space group	Pbcn
a/Å	15.700(2)
b/Å	11.2137(13)
c/Å	13.4533(13)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	2368.6(5)
Z	4
ρ_{calc}g/cm^3	1.437

μ/mm^{-1}	0.273
F(000)	1064.0
Crystal size/mm^3	0.21 × 0.126 × 0.061
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	4.464 to 51.39
Index ranges	-19 ≤ h ≤ 19, -13 ≤ k ≤ 13, -16 ≤ l ≤ 16
Reflections collected	36961
Independent reflections	2258 [R_{int} = 0.1737, R_{sigma} = 0.0580]
Data/restraints/parameters	2258/0/162
Goodness-of-fit on F^2	1.029
Final R indexes [I>=2σ (I)]	R_1 = 0.0418, wR_2 = 0.0996
Final R indexes [all data]	R_1 = 0.0988, wR_2 = 0.1246
Largest diff. peak/hole / e Å^{-3}	0.20/-0.22

Table 2 Fractional Atomic Coordinates (×10^4) and Equivalent Isotropic Displacement Parameters (Å^2×10^3) for PB_15_NU1_0ma. U_{eq} is defined as 1/3 of the trace of the orthogonalised U_{IJ} tensor.

Atom	*x*	*y*	*z*	U(eq)
S1	2889.5(5)	6211.2(6)	5347.6(5)	56.8(6)
O1	3369.1(13)	7279.3(16)	5428.9(13)	68.1(8)
O4	2400.4(13)	6008.3(19)	4474.2(13)	74.1(8)
O3	4120.6(14)	6369(2)	7199.6(15)	80.9(9)
N1	3572.3(13)	5047.7(19)	5374.1(13)	52.7(8)
O2	5000	4823(3)	7500	87.0(11)
C13	638.4(19)	5455(3)	8930(2)	83.0(11)
C2	1208.2(17)	5638(3)	8034.4(19)	62.3(10)
C3	1316.6(18)	4748(3)	7330(2)	65.2(10)
C4	1828.8(17)	4923(3)	6516(2)	60.9(9)
C5	2257.3(16)	5994(2)	6401.9(18)	50.3(9)
C6	4196.7(16)	4741(2)	6067.9(19)	53.6(8)
C7	4408.3(18)	5446(3)	6936(2)	61.7(9)
C8	2168.2(18)	6881(3)	7100(2)	62.9(9)
C9	1640.0(19)	6699(3)	7900(2)	67.7(10)
C10	4549.2(19)	3693(3)	5752(2)	70.2(10)
C11	4149(2)	3346(3)	4880(2)	79.7(11)
C12	3554(2)	4161(3)	4660(2)	65.9(10)

Table 3 Anisotropic Displacement Parameters (Å^2×10^3) for PB_15_NU1_0ma. The Anisotropic displacement factor exponent takes the form: -2π^2[h^{2}a*^{2}U_{11}+2hka*b*U_{12}+…].

Atom	U_{11}	U_{22}	U_{33}	U_{23}	U_{13}	U_{12}
S1	66.0(8)	56.9(7)	47.5(7)	-0.5(3)	-5.0(3)	3.7(4)
O1	84.6(15)	54.5(14)	65.2(13)	2.6(9)	2.9(10)	-6.1(11)
O4	82.8(15)	91.6(16)	47.8(13)	-1.7(10)	-18.2(9)	8.9(12)
O3	82.6(16)	93.1(17)	67.0(14)	-25.7(12)	-18.2(11)	20.6(14)

N1	57.6(15)	55.0(15)	45.6(12)	-11.1(11)	-1.2(10)	-0.2(11)
O2	96(2)	68(2)	97(2)	0	-48(2)	0
C13	66(2)	111(3)	72(2)	2.6(19)	6.8(16)	1(2)
C2	50.1(18)	80(2)	56.5(18)	0.4(17)	-4.9(14)	8.4(16)
C3	66(2)	59.3(19)	70.4(19)	4.6(16)	-2.6(16)	0.6(16)
C4	72(2)	52.0(18)	58.9(17)	-5.6(14)	-6.8(15)	8.2(15)
C5	53.4(17)	48.9(17)	48.5(16)	-1.9(12)	-7.8(12)	7.7(13)
C6	47.9(17)	57.0(18)	56.0(16)	-0.4(14)	-3.1(13)	-1.5(14)
C7	55.9(19)	71(2)	58.7(18)	4.6(16)	-10.8(14)	-1.5(17)
C8	71(2)	56.4(19)	61.5(18)	-11.6(14)	1.6(15)	-4.8(15)
C9	69(2)	72(2)	62(2)	-13.8(16)	0.0(16)	3.0(18)
C10	61.6(19)	60(2)	89(2)	-3.0(17)	-2.5(18)	4.1(16)
C11	80(2)	63(2)	97(3)	-26.5(18)	11(2)	-0.5(19)
C12	70(2)	71(2)	56.8(18)	-19.8(15)	2.8(14)	-3.1(18)

Table 4 Bond Lengths for PB_15_NU1_0ma.

Atom	Atom	Length/Å	Atom	Atom	Length/Å
S1	O1	1.4190(19)	C2	C3	1.387(4)
S1	O4	1.4220(19)	C2	C9	1.381(4)
S1	N1	1.689(2)	C3	C4	1.373(4)
S1	C5	1.748(3)	C4	C5	1.385(4)
O3	C7	1.184(3)	C5	C8	1.376(3)
N1	C6	1.396(3)	C6	C7	1.449(4)
N1	C12	1.382(3)	C6	C10	1.367(4)
O2	C7	1.387(3)	C8	C9	1.374(4)
O2	C7[1]	1.387(3)	C10	C11	1.387(4)
C13	C2	1.515(4)	C11	C12	1.340(4)

[1]1-X,+Y,3/2-Z

Table 5 Bond Angles for PB_15_NU1_0ma.

Atom	Atom	Atom	Angle/°	Atom	Atom	Atom	Angle/°
O1	S1	O4	119.03(12)	C4	C5	S1	119.1(2)
O1	S1	N1	108.27(11)	C8	C5	S1	120.7(2)
O1	S1	C5	110.89(12)	C8	C5	C4	120.1(3)
O4	S1	N1	103.69(11)	N1	C6	C7	124.5(2)
O4	S1	C5	109.97(13)	C10	C6	N1	106.7(2)
N1	S1	C5	103.61(11)	C10	C6	C7	128.8(3)
C6	N1	S1	130.52(17)	O3	C7	O2	122.1(3)
C12	N1	S1	121.8(2)	O3	C7	C6	129.1(3)
C12	N1	C6	107.6(2)	O2	C7	C6	108.7(3)
C7	O2	C7[1]	119.6(3)	C9	C8	C5	119.3(3)
C3	C2	C13	121.2(3)	C8	C9	C2	121.8(3)

C9	C2	C13	120.7(3)	C6	C10	C11	108.7(3)
C9	C2	C3	118.1(3)	C12	C11	C10	108.1(3)
C4	C3	C2	121.0(3)	C11	C12	N1	108.8(3)
C3	C4	C5	119.8(3)				

[1]1-X,+Y,3/2-Z

Table 6 Torsion Angles for PB_15_NU1_0ma.

A	B	C	D	Angle/°	A	B	C	D	Angle/°
S1	N1	C6	C7	-2.7(4)	C2	C3	C4	C5	1.2(4)
S1	N1	C6	C10	178.0(2)	C3	C2	C9	C8	-0.4(4)
S1	N1	C12	C11	-178.5(2)	C3	C4	C5	S1	-178.70(19)
S1	C5	C8	C9	177.4(2)	C3	C4	C5	C8	-0.2(4)
O1	S1	N1	C6	54.4(2)	C4	C5	C8	C9	-1.1(4)
O1	S1	N1	C12	-128.9(2)	C5	S1	N1	C6	-63.4(2)
O1	S1	C5	C4	-171.66(19)	C5	S1	N1	C12	113.3(2)
O1	S1	C5	C8	9.8(3)	C5	C8	C9	C2	1.4(4)
O4	S1	N1	C6	-178.3(2)	C6	N1	C12	C11	-1.2(3)
O4	S1	N1	C12	-1.5(2)	C6	C10	C11	C12	-0.3(4)
O4	S1	C5	C4	54.6(2)	C7[1]	O2	C7	O3	-34.0(2)
O4	S1	C5	C8	-123.9(2)	C7[1]	O2	C7	C6	149.6(2)
N1	S1	C5	C4	-55.7(2)	C7	C6	C10	C11	-179.7(3)
N1	S1	C5	C8	125.8(2)	C9	C2	C3	C4	-0.9(4)
N1	C6	C7	O3	-1.3(5)	C10	C6	C7	O3	177.8(3)
N1	C6	C7	O2	174.8(2)	C10	C6	C7	O2	-6.0(4)
N1	C6	C10	C11	-0.4(3)	C10	C11	C12	N1	0.9(4)
C13	C2	C3	C4	179.5(2)	C12	N1	C6	C7	-179.7(3)
C13	C2	C9	C8	179.2(3)	C12	N1	C6	C10	1.0(3)

[1]1-X,+Y,3/2-Z

Table 7 Hydrogen Atom Coordinates (Å×10⁴) and Isotropic Displacement Parameters (Å²×10³) for PB_15_NU1_0ma.

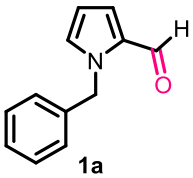
Atom	*x*	*y*	*z*	U(eq)
H13A	887.61	5835.02	9499.04	124
H13B	577.79	4616.42	9056.99	124
H13C	88.6	5795.8	8800.96	124
H3	1038.29	4022.14	7410.19	78
H4	1887.94	4323.72	6042.74	73
H8	2462.38	7595.74	7032.02	75
H9	1571.42	7306.17	8363.99	81
H10	4985.44	3281.18	6069.44	84
H11	4271.33	2665.45	4512.28	96
H12	3188.26	4135.11	4116.77	79

2. PROCEDURE FOR THE SAMPLE PREPARATION OF CRYSTAL (2n)

We opted for a solvent in which our compound (2n, 100 mg) readily dissolves, with popular choices being water, ethanol, or a solvent mixture. The compound (2n, 100 mg) was effectively dissolved in 2 mL of MeOH, ensuring thorough dissolution through a gradual addition process coupled with stirring. Controlled evaporation ensued, achieved by letting the solution stand at room temperature. Upon the formation of crystals, they were separated from the residual solution via filtration. A cleansing rinse with a cold solvent followed to eliminate impurities, and the crystals were subsequently dried completely. The Single Crystal X-ray diffraction (SC-XRD) was conducted using a Bruker D8 Venture instrument equipped with a photon counting detector, and APEX5 software was employed for chemical crystallography.

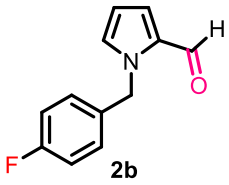
2. CHARACTERIZATION DATA OF SUBSTRATES

1-Benzyl-1H-Pyrrole-2-carbaldehyde (1a)[1]



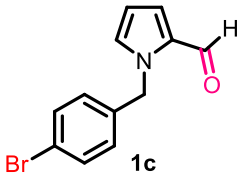
Brown oily liquid (185 mg, 99%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.56 (s, 1H), 7.31 (t, *J* = 7.2 Hz, 2H), 7.26 (dd, *J* = 6.4, 4.1 Hz, 1H), 7.15 (d, *J* = 7.5 Hz, 2H), 6.97 (d, *J* = 3.3 Hz, 2H), 6.27 (t, *J* = 3.1 Hz, 1H), 5.56 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 137.6, 131.5, 128.8, 127.8, 127.3, 124.9, 110.2, 52.0.

1-(4-Fluorobenzyl-1H-Pyrrole-2-carbaldehyde (1b)[1]



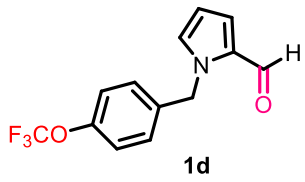
Yellow oily liquid (198 mg, 98%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.54 (s, 1H), 7.32 – 7.19 (m, 1H), 6.96 – 6.89 (m, 2H), 6.78 (d, *J* = 9.6 Hz, 1H), 6.31 – 6.27 (m, 1H), 5.54 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 164.0, 162.1, 140.31 (d, 3*J*C−F = 7.3 Hz), 131.55 (d, 2*J*C−F = 5.2 Hz), 130.31 (d, 3*J*C−F = 8.4 Hz), 125.1, 122.75 (d, 4*J*C−F = 3.1 Hz), 114.69 (d, 2*J*C−F = 21.2 Hz), 114.0 (d, 2*J*C−F = 22.1 Hz), 110.4, 51.5.

1-(4-Bromobenzyl-1H-Pyrrole-2-carbaldehyde (1c)[1]



White solid (254 mg, 97%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.52 (s, 1H), 7.41 (d, *J* = 8.0 Hz, 2H), 6.98 (dd, *J* = 18.3, 5.2 Hz, 4H), 6.27 (s, 1H), 5.49 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 131.9, 131.46, 129.0, 125.1, 121.7, 110.4, 51.4.

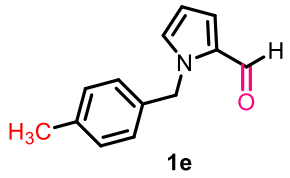
1-(4-Trifluoromethoxy)benzyl-1H-Pyrrole-2-carbaldehyde (1d)[1]



1d

Brown liquid (227 mg, 97%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.53 (s), 7.14 (q, *J* = 8.8 Hz), 7.02 – 6.92 (m), 6.31 – 6.24 (m), 5.54 (s). NMR (151 MHz,) δ 179.4, 148.5, 136.3, 131.3, 128.5, 125.0, 121.0, 110.3, 77.2, 77.0, 76.7, 51.1.

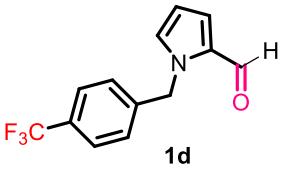
1-(4-(Methyl)benzyl)-1H-Pyrrole-2-carbaldehyde (1e)[1]



1e

Brown solid (195 mg, 98%); ^{1}H NMR (600 MHz, $CDCl_3$-d_6) δ 9.56 (s), 7.25 (s), 7.12 (d, *J* = 7.8 Hz), 7.07 (d, *J* = 7.4 Hz), 6.96 (d, *J* = 3.3 Hz), 6.26 (t, *J* = 2.8 Hz), 5.52 (s), 2.32 (s). NMR (151 MHz, $CDCl_3$-d_6) δ 179.61, 137.5, 134.6, 131.6, 131.4, 129.5, 127.5, 124.9, 110.1, 77.4, 77.2, 77.0, 51.8, 21.2.

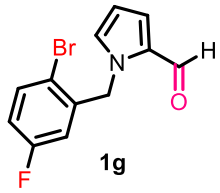
1-(4-Trifluoromethyl)benzyl-1H-Pyrrole-2-carbaldehyde (1f)[1]



1d

Yellow oily liquid (248 mg, 98%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.54 (s, 1H), 7.51 (d, *J* = 7.7 Hz, 1H), 7.41 (t, *J* = 7.8 Hz, 1H), 7.37 (s, 1H), 7.29 (d, *J* = 7.7 Hz, 1H), 6.99 (d, *J* = 3.6 Hz, 2H), 6.34 – 6.28 (m, 1H), 5.60 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 138.7, 131.5, 130.5, 129.3, 125.2, 124.6 (d, 4*J*C−F = 3.3 Hz), 123.8 (d, 4*J*C−F = 3.4 Hz), 110.6, 51.5.

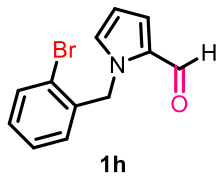
1-(2-Bromo-5-fluorobenzyl)-1H-Pyrrole-2-carbaldehyde (1g)[1]



1g

White solid (198 mg, 95%); ^{1}H NMR (600 MHz, $CDCl_3$-d_6) δ 7.49 (dd, *J* = 8.7, 5.2 Hz, 1H), 7.19 (dd, *J* = 4.1, 1.7 Hz, 1H), 7.05 – 6.98 (m, 1H), 6.84 (td, *J* = 8.3, 3.0 Hz, 1H), 6.30 (dd, *J* = 4.0, 2.6 Hz, 1H), 6.26 (dd, *J* = 9.3, 2.9 Hz, 1H), 5.57 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) NMR (151 MHz,) NMR (151 MHz,) δ 163.0, 161.3, 155.4, 139.2, 133.6, 131.4, 121.3, 120.7, 115.8 (d, *J* = 30.8 Hz), 114.4 (d, 2*J*C−F = 24.6 Hz), 109.7, 52.1.

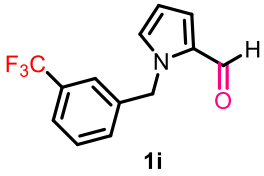
1-(2-Bromobenzyl)-1H-Pyrrole-2-carbaldehyde (1h)[1]



1h

Brown solid (256 mg, 97%); ^{1}H NMR (600 MHz, $CDCl_3$-d_6) ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.56 (d, *J* = 15.0 Hz, 1H), 7.67 (d, *J* = 7.7 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.34 (t, *J* = 7.5 Hz, 1H), 7.05 – 7.02 (m, 1H), 6.92 (s, 1H), 6.60 (d, *J* = 7.7 Hz, 1H), 6.35 – 6.29 (m, 1H), 5.80 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 136.7, 132.5, 131.8, 127.5, 127.3, 127.1, 126.1, 126.1, 126.0, 126.0, 125.9, 125.4, 124.8, 123.3, 110.6, 77.3, 77.1, 76.8, 48.5.

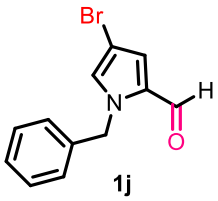
1-(3-(Trifluoromethyl)benzyl)-1H-Pyrrole-2-carbaldehyde (1i)[1]



1i

Yellow solid (248 mg, 98%); NMR (600 MHz, $CDCl_3$-d_6)δ 9.54 (s, 1H), 7.51 (d, *J* = 7.8 Hz, 1H), 7.41 (t, *J* = 7.7 Hz, 1H), 7.37 (s, 1H), 7.29 (d, *J* = 7.7 Hz, 1H), 6.99 (d, *J* = 3.9 Hz, 2H), 6.31 (s, 1H), 5.60 (s, 2H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.6, 138.8, 131.5 (d, 3*J*C−F = 9.6 Hz), 130.5, 129.3, 125.2, 124.6 (d, 4*J*C−F = 3.7 Hz), 123.8 (d, 4*J*C−F = 3.6 Hz), 110.6, 51.5.

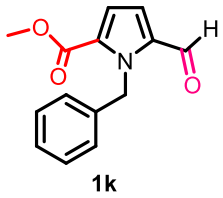
1-Benzyl-4-bromo-1H-Pyrrole-2-carbaldehyde (1j)[1]



1j

Pink solid (256 mg, 98%); NMR (600 MHz, $CDCl_3$-d_6) δ 9.49 (s, 1H), 7.34 – 7.31 (m), 7.30 – 7.28 (m), 7.16 (dd, *J* = 5.0, 3.3 Hz), 6.93 (d, *J* = 1.8 Hz), 6.93 – 6.91 (m), 5.51 (s). ^{13}C NMR (151 MHz, $CDCl_3$-d_6) δ 179.1, 136.6, 131.7, 130.5, 128.9, 128.2, 127.6, 125.4 97.4, 52.3.

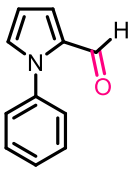
Methyl-1-benzyl-5-formyl-1H-Pyrrole-2-carbaldehyde (1k)[1]



1k

Orange oily liquid (238 mg, 98%); NMR (600 MHz, $CDCl_3$-d_6) δ 9.72 (s, 1H), 7.27 – 7.24 (m, 1H), 7.24 – 7.23 (m, 1H), 7.21 – 7.18 (m, 1H), 7.04 (d, *J* = 7.2 Hz, 2H), 7.01 (d, *J* = 4.3 Hz, 1H), 6.95 (d, *J* = 4.2 Hz, 1H), 6.11 (s, 2H), 3.82 (s, 3H). NMR (151 MHz, $CDCl_3$-d_6) δ 181.1, 161.1, 138.1, 135.3, 129.5, 128.5, 127.3, 126.5, 122.5, 117.6, 51.9, 49.3. HRMS (ESI) m/z calcd for $C_{14}H_{13}NO_3$, $[M+1]^+$ 244.0974, found $[M+H]^+$ 244.0976.

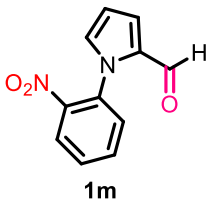
1-(Phenyl-1H-Pyrrole-2-carbaldehyde (1l)[2]



1m

Brown liquid (162 mg, 95%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.56 (s), 7.48 – 7.44 (m), 7.44 – 7.40 (m), 7.36 – 7.33 (m), 7.16 (dd, *J* = 4.0, 1.7 Hz), 7.07 (t, *J* = 2.1 Hz), 6.40 (dd, *J* = 4.0, 2.6 Hz).NMR (151 MHz, $CDCl_3$-d_6) δ 179.18, 138.91, 132.72, 131.19, 129.25, 128.39, 126.22, 122.14, 111.01, 77.42, 77.21, 77.00.

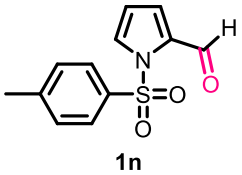
1-(2-nitrophenyl)-1H-Pyrrole-2carbaldehyde (1m)[3]



1m

Yellow solid (213 mg, 99%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.48 (s, 1H), 8.11 (d, *J* = 7.8 Hz, 1H), 7.69 (t, *J* = 7.5 Hz, 1H), 7.60 (t, *J* = 7.7 Hz, 1H), 7.40 (d, *J* = 7.8 Hz, 1H), 7.12 (d, *J* = 2.3 Hz, 1H), 7.00 (s, 1H), 6.51 – 6.44 (m, 1H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 178.8, 145.9, 133.7, 133.6, 132.7, 131.2, 129.8, 129.6, 125.3, 124.9, 111.7. HRMS (ESI) m/z calcd for $C_{11}H_8N_2O_3$, $[M+1]^+$ 217.0613, found $[M+H]^+$ 217.0610.

1-(Phenylsulfonyl)-1H-Pyrrole-2-carbaldehyde (1n)[4]



1n

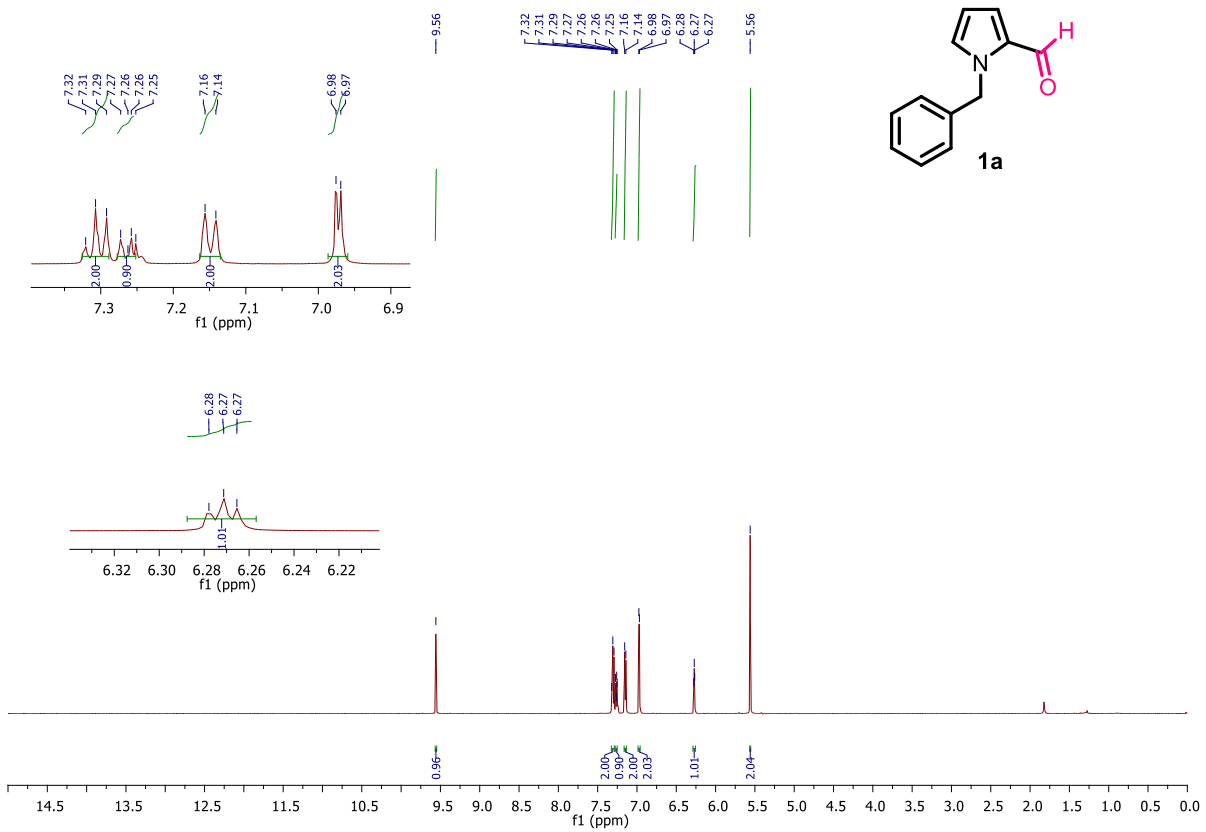
white solid (223 mg, 95%); ^{1}H NMR (500 MHz, $CDCl_3$-d_6) δ 9.96 (s, 1H), 7.79 (d, *J* = 7.8 Hz, 2H), 7.61 (s, 1H), 7.31 (d, *J* = 7.8 Hz, 2H), 7.15 (s, 1H), 6.39 (s, 1H), 2.41 (s, 4H). ^{13}C NMR (126 MHz, $CDCl_3$-d_6) δ 179.0, 146.0, 135.2, 133.5, 130.2, 129.5, 127.5, 124.5, 112.4, 21.7.

3. REFERENCES

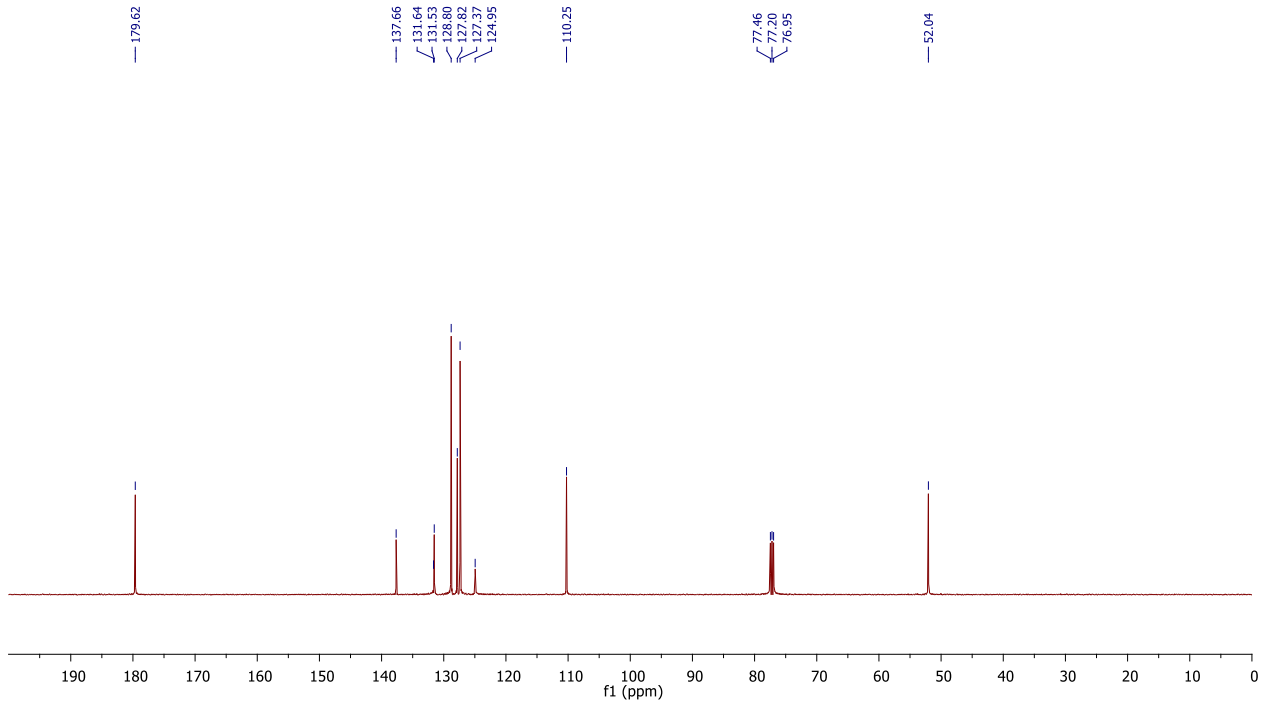
1. Z. Li, M. Luo, B. Cai, M. Huang, J. Jiang, L. Wang, L. Wu, *Eur. J. Med. Chem*.**,** 2018, **157**, 665-682.
2. L. Liua, F. Wua, Y. Liua, J. Xiea, B. Daia, Z. Zhou, *J. Chem. Res.*, 2014, **38**, 180-182.
3. J. Ni, Y. Jiang, Z. Qi, R. Yan, *Chem. Asian J.*, 2019, **14**, 2898−2902.
4. K. Wang and Z. Liu, *Synth. Commun.*, 2010, **40**, 144-150.

4. ^{1}H and ^{13}C Spectra

1a ^{1}H NMR ($CDCl_3$)



^{13}C{1H} NMR ($CDCl_3$)



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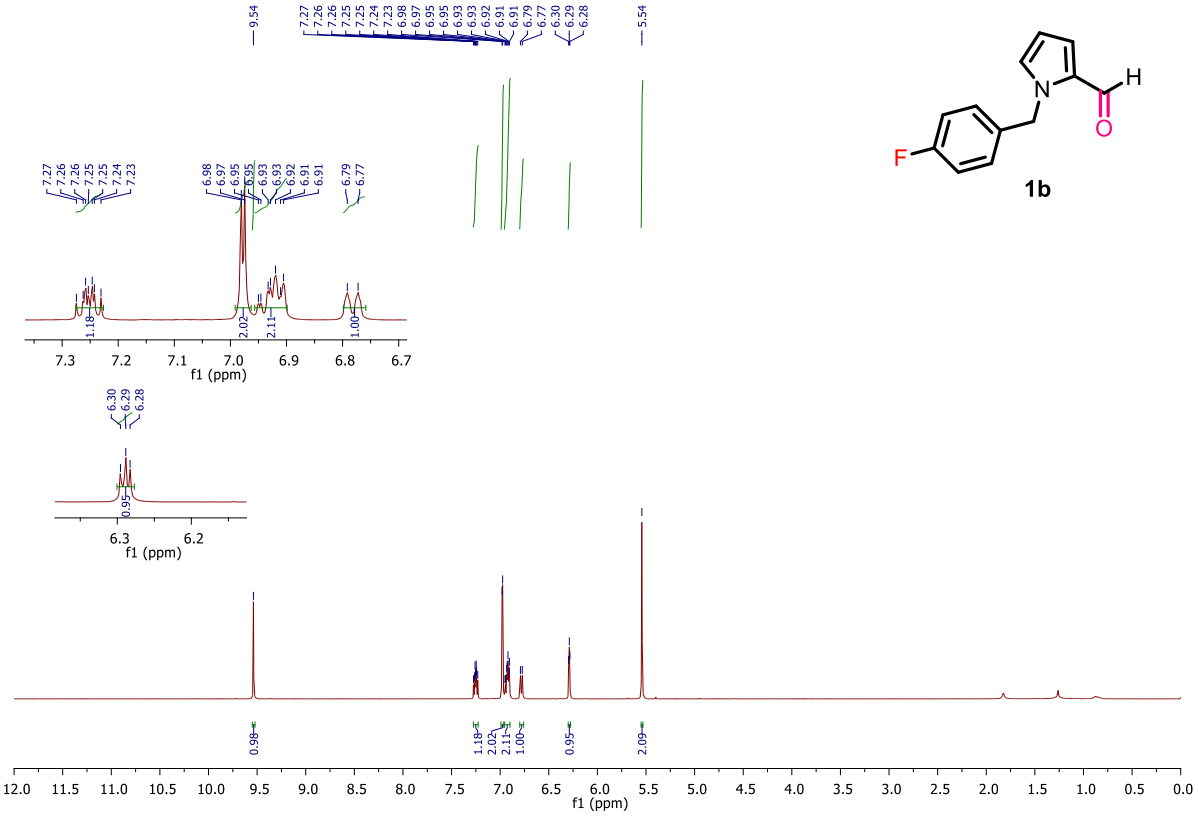
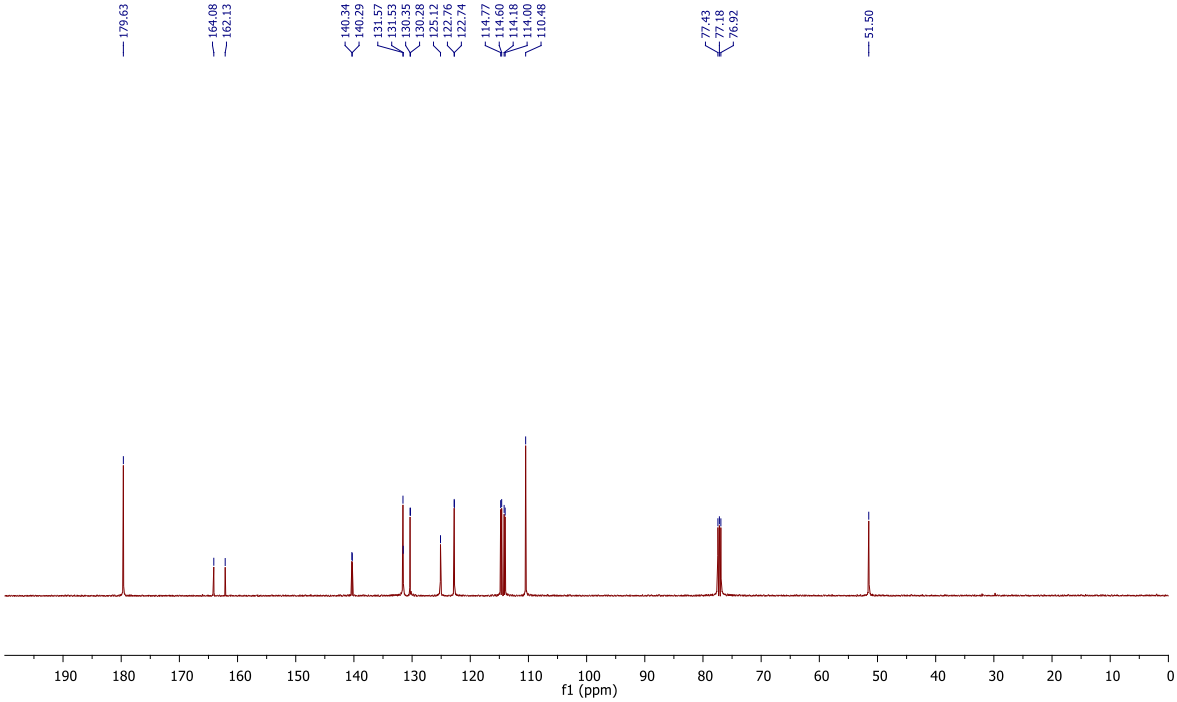
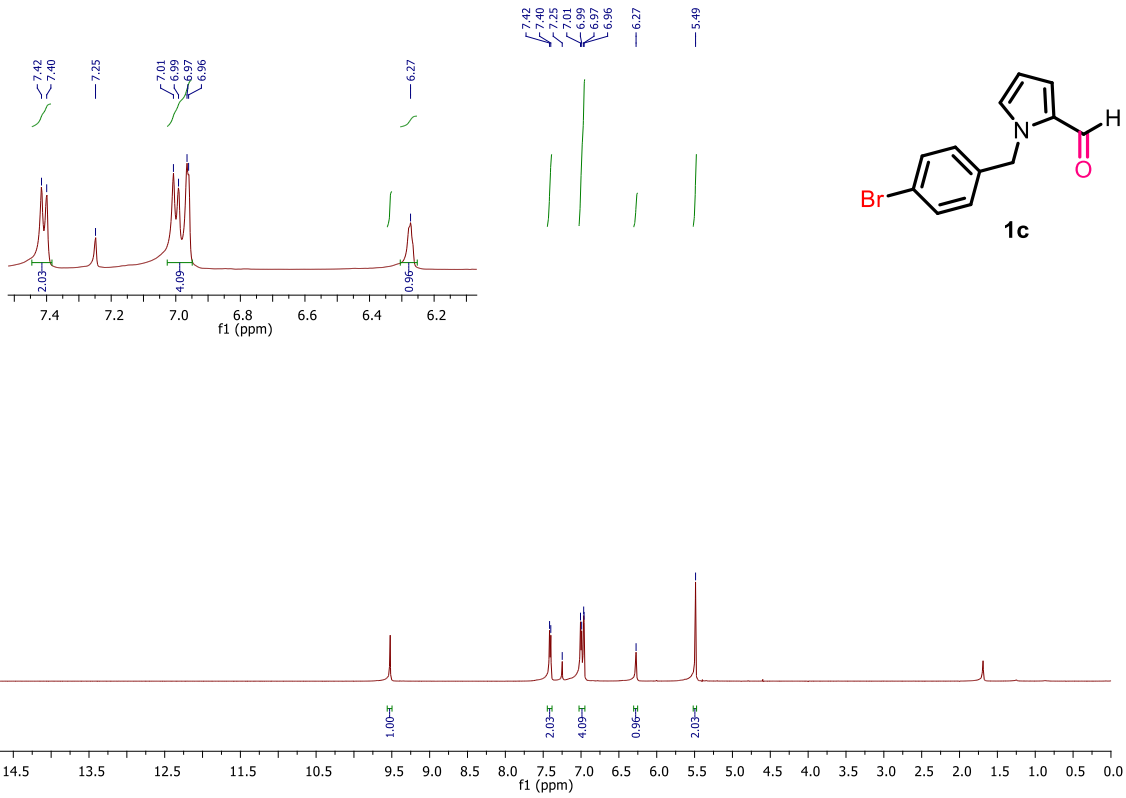


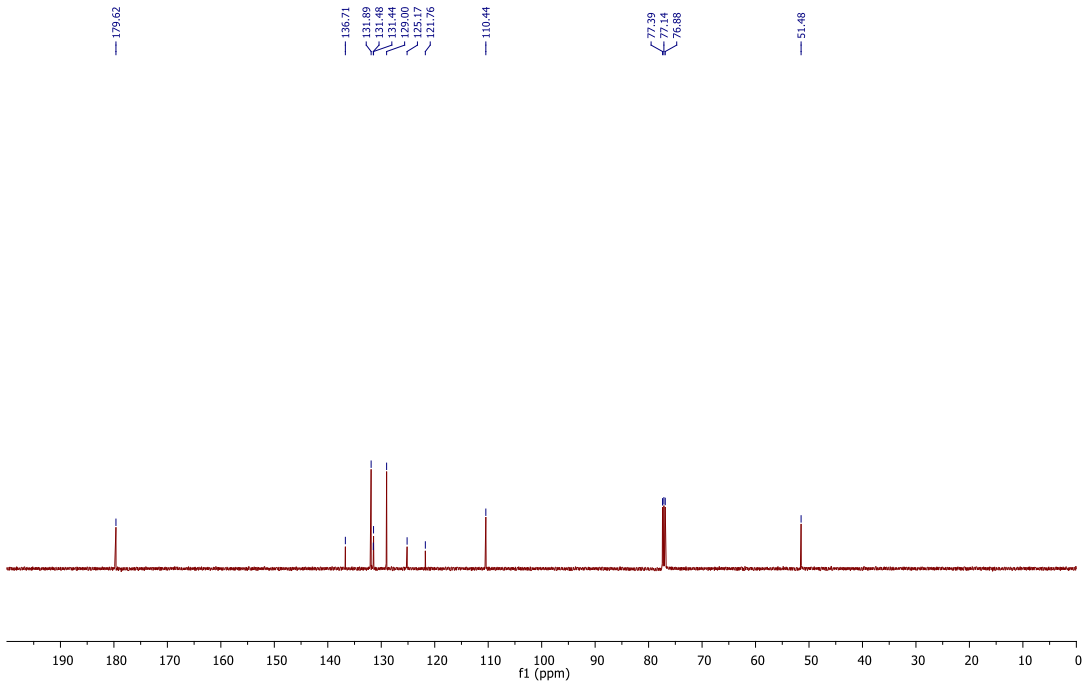
^{13}C{1H} NMR ($CDCl_3$)



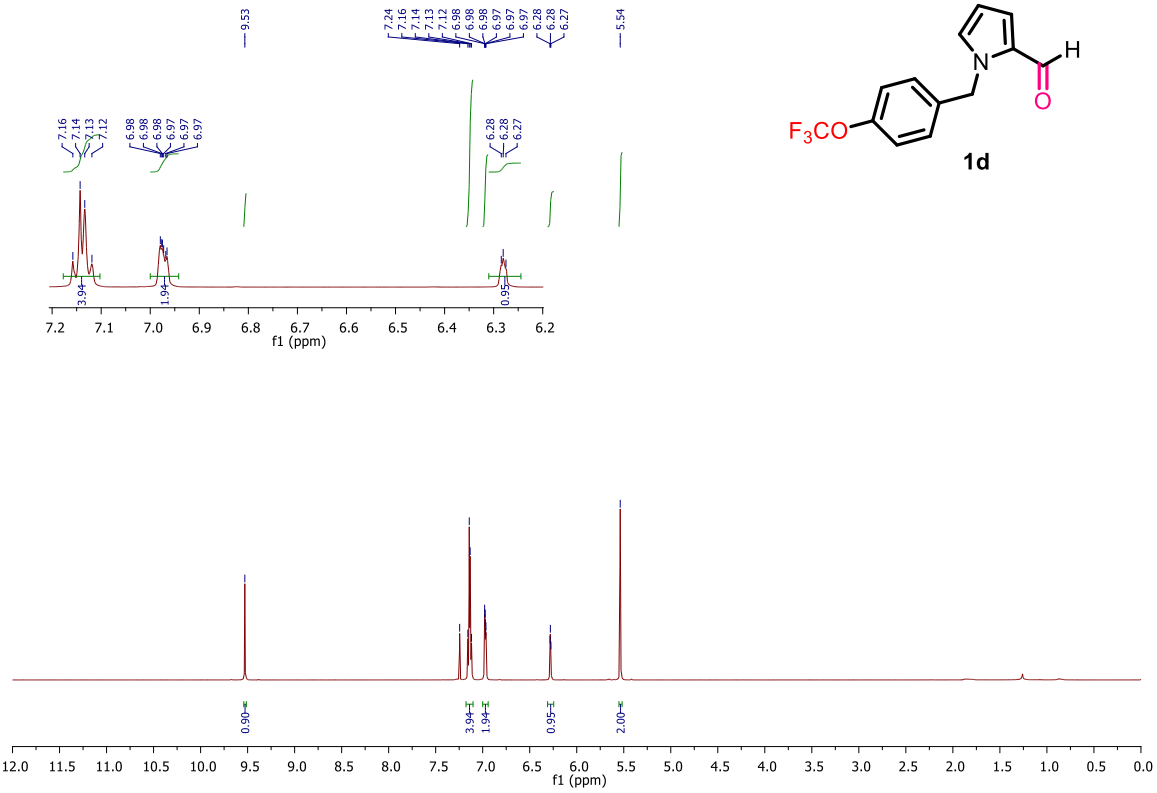
1c ^{1}H NMR ($CDCl_3$)



^{13}C{1H} NMR ($CDCl_3$)

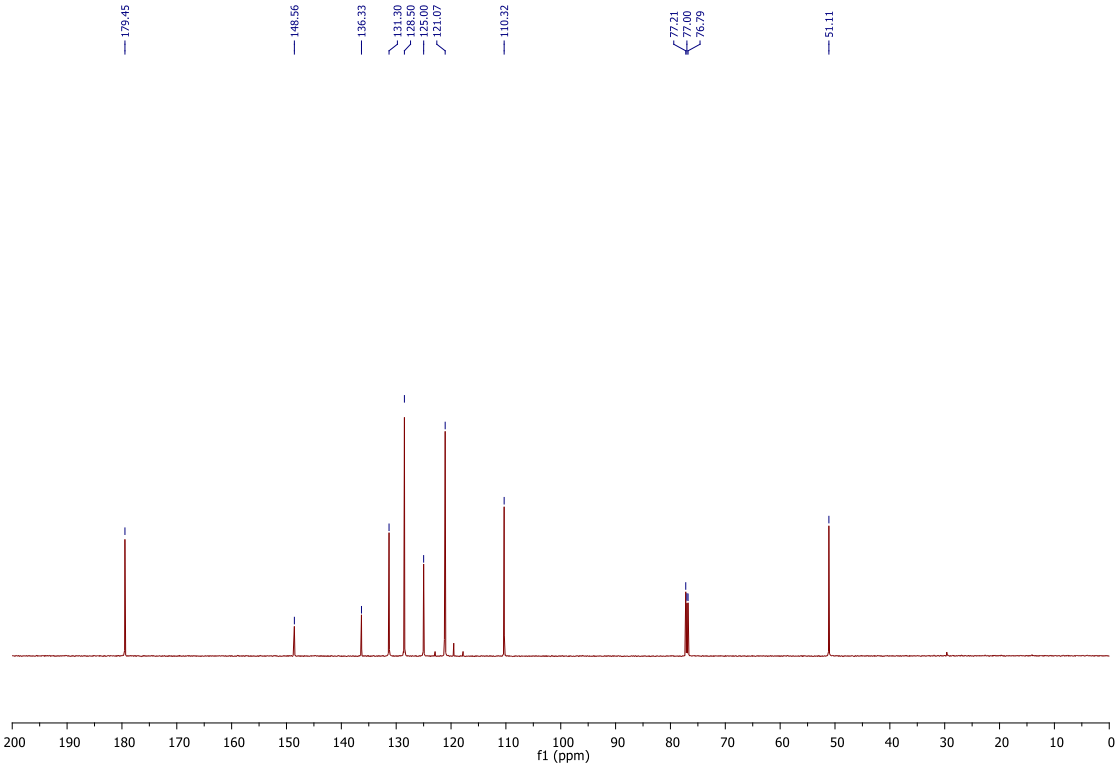


1d ^{1}H NMR ($CDCl_3$)

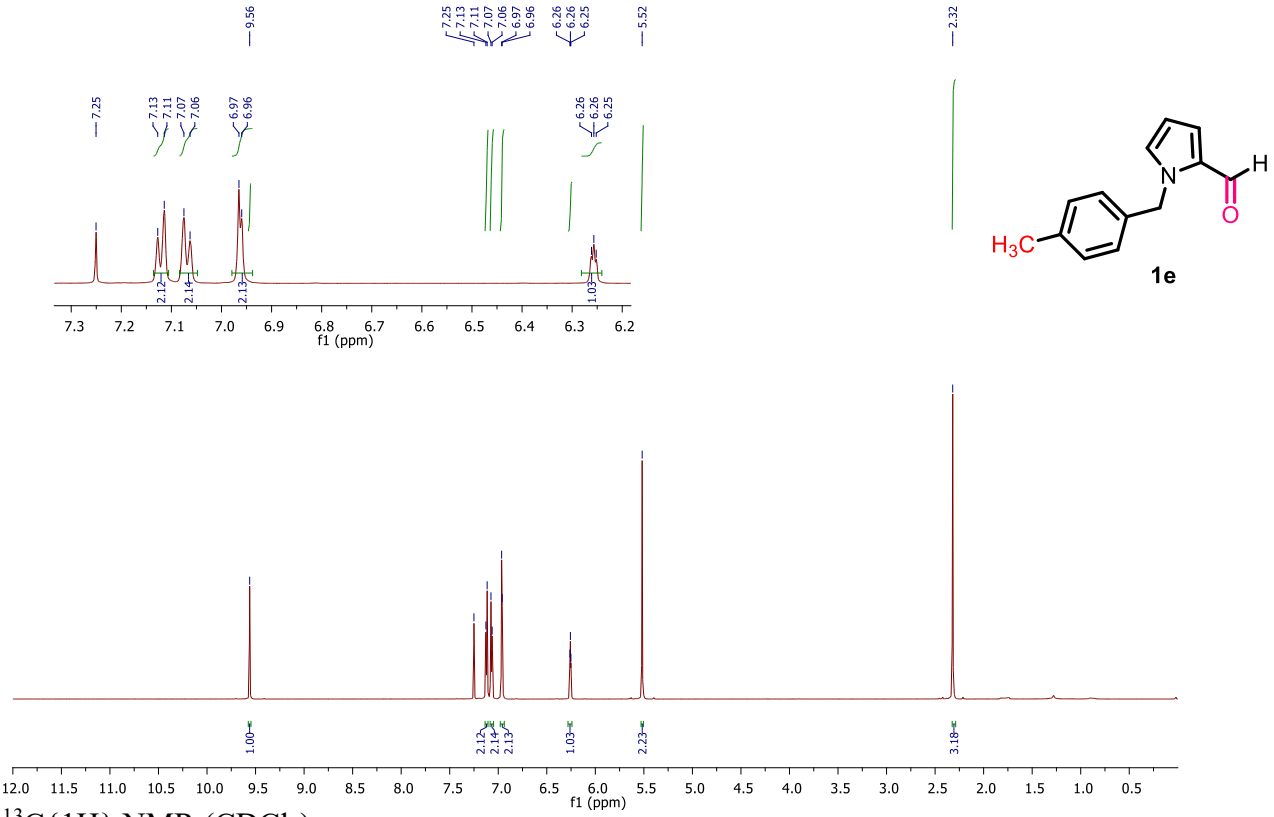


1d

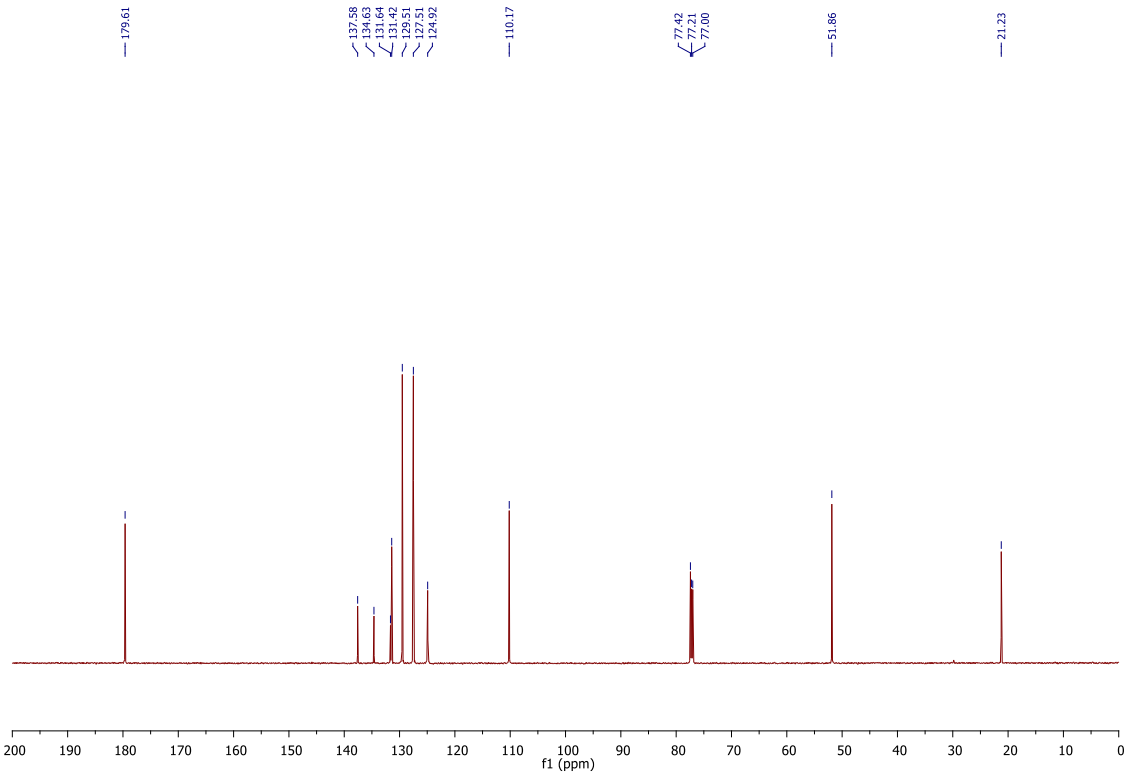
^{13}C{1H} NMR ($CDCl_3$)



1e ^{1}H NMR ($CDCl_3$)



^{13}C{1H} NMR ($CDCl_3$)



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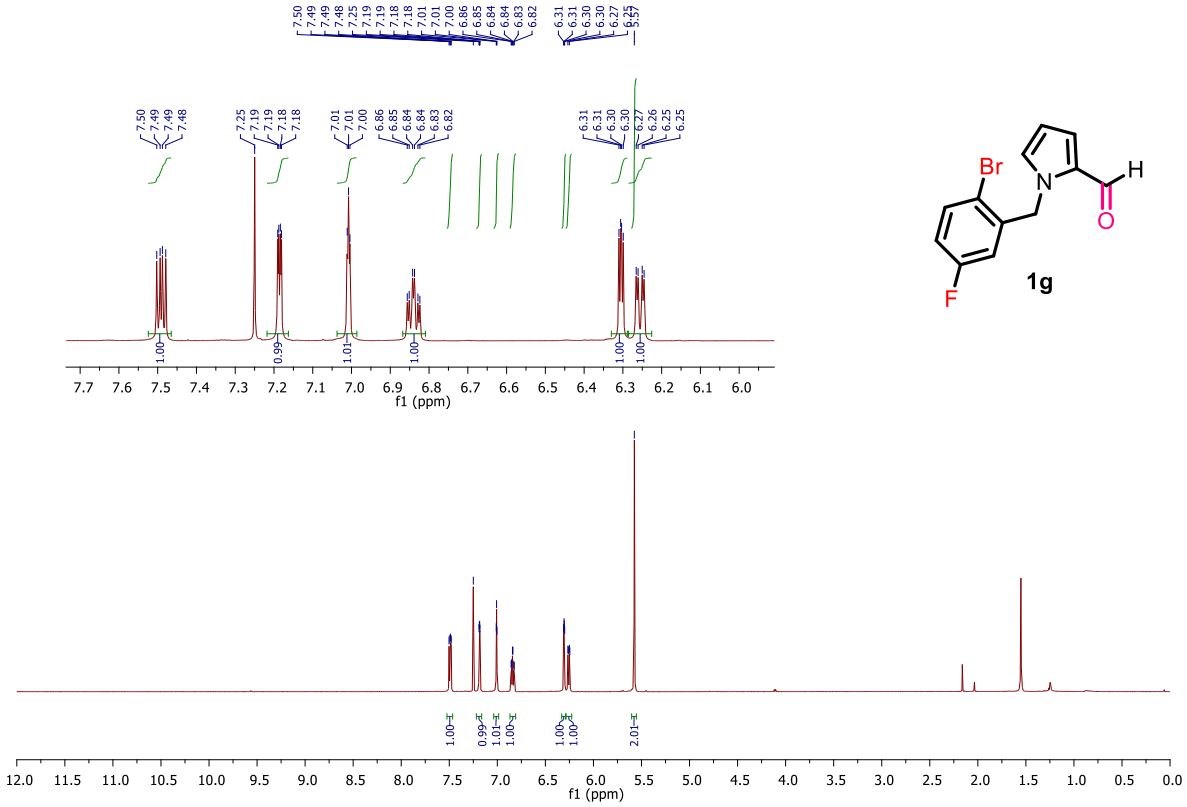
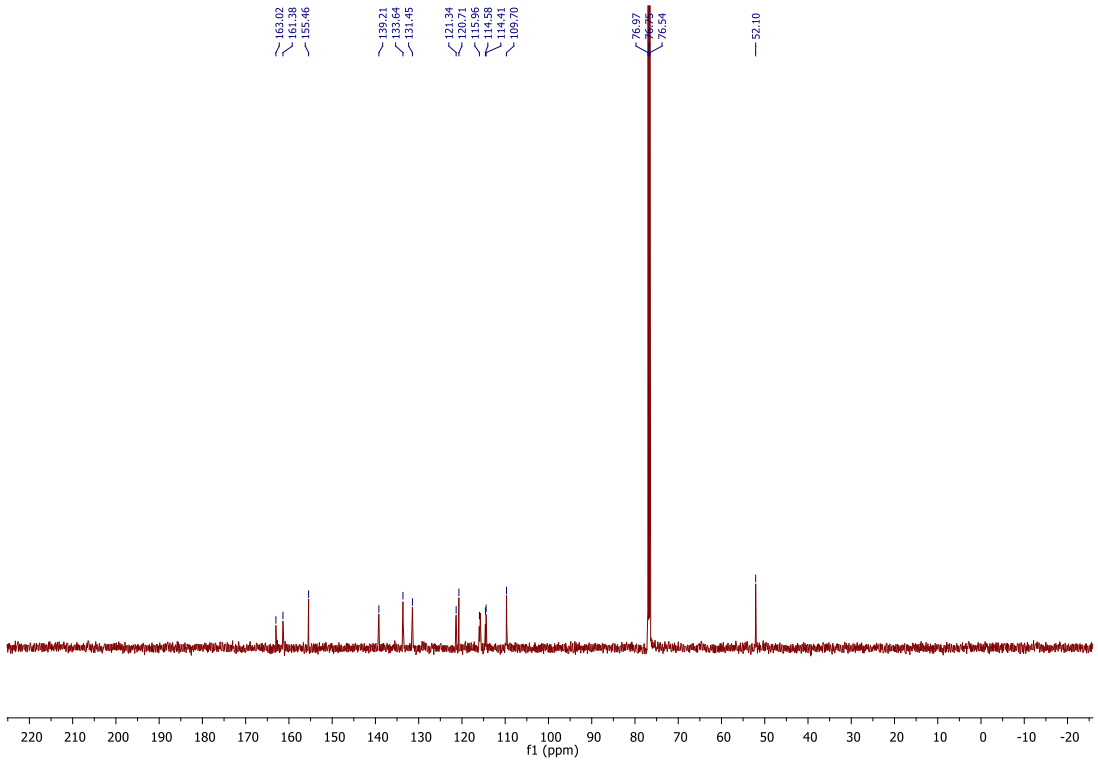
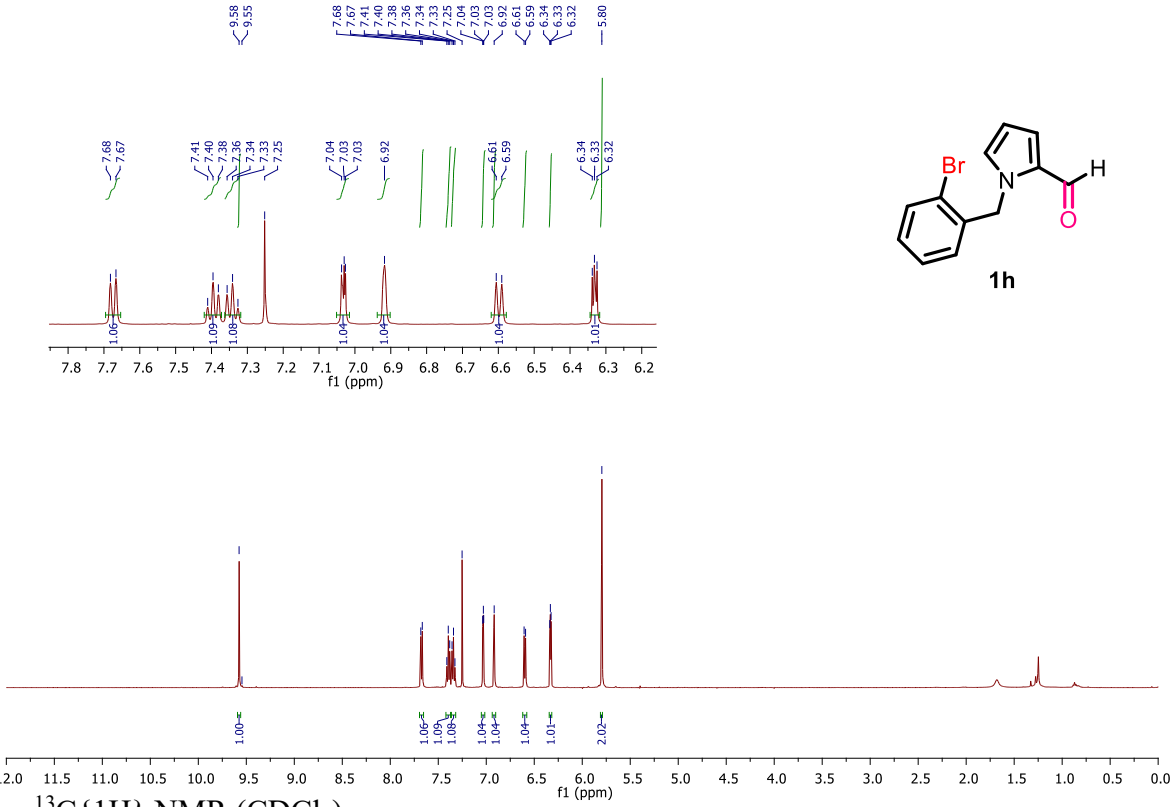


^{13}C{1H} NMR ($CDCl_3$)

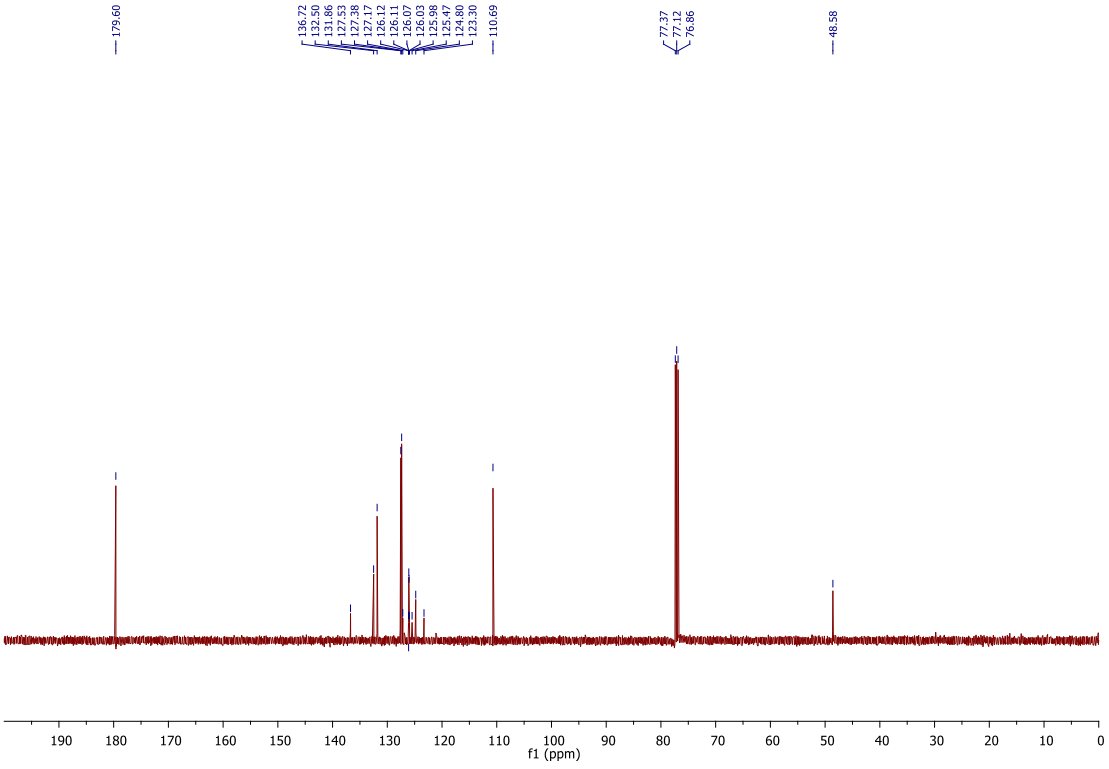


1h ^{1}H NMR ($CDCl_3$)

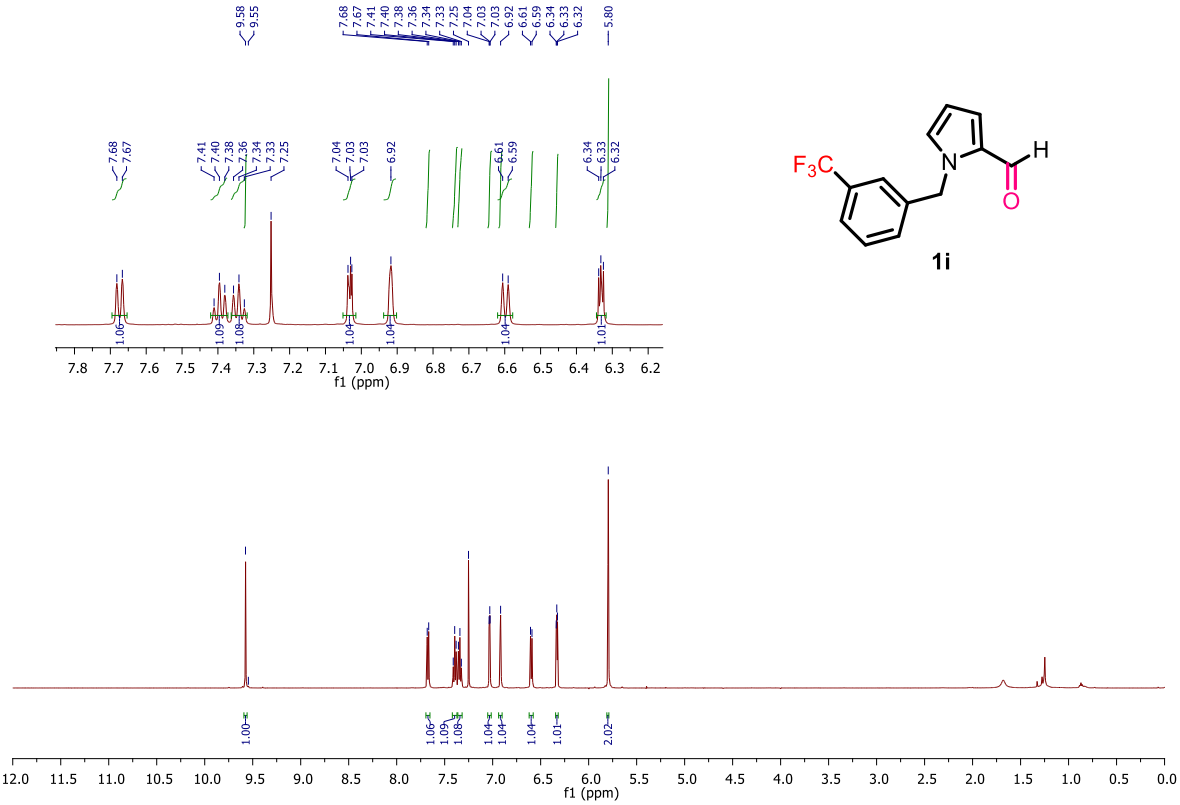


1h

^{13}C{1H} NMR ($CDCl_3$)

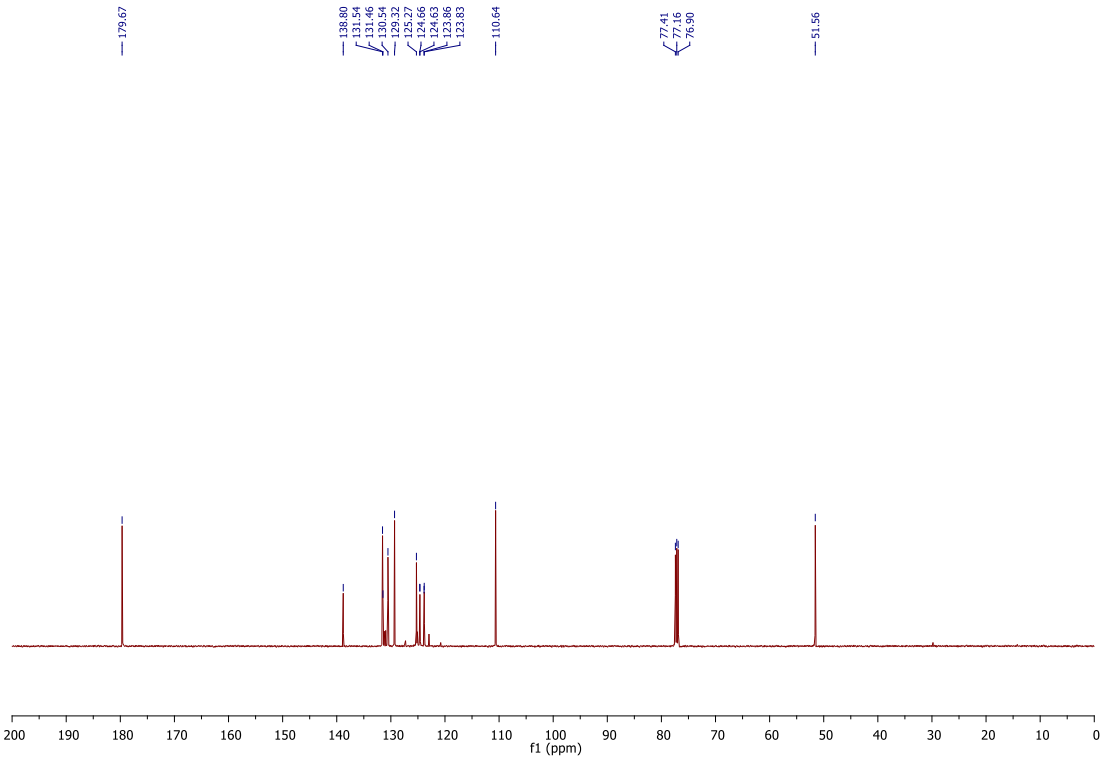


1i ^{1}H NMR ($CDCl_3$)

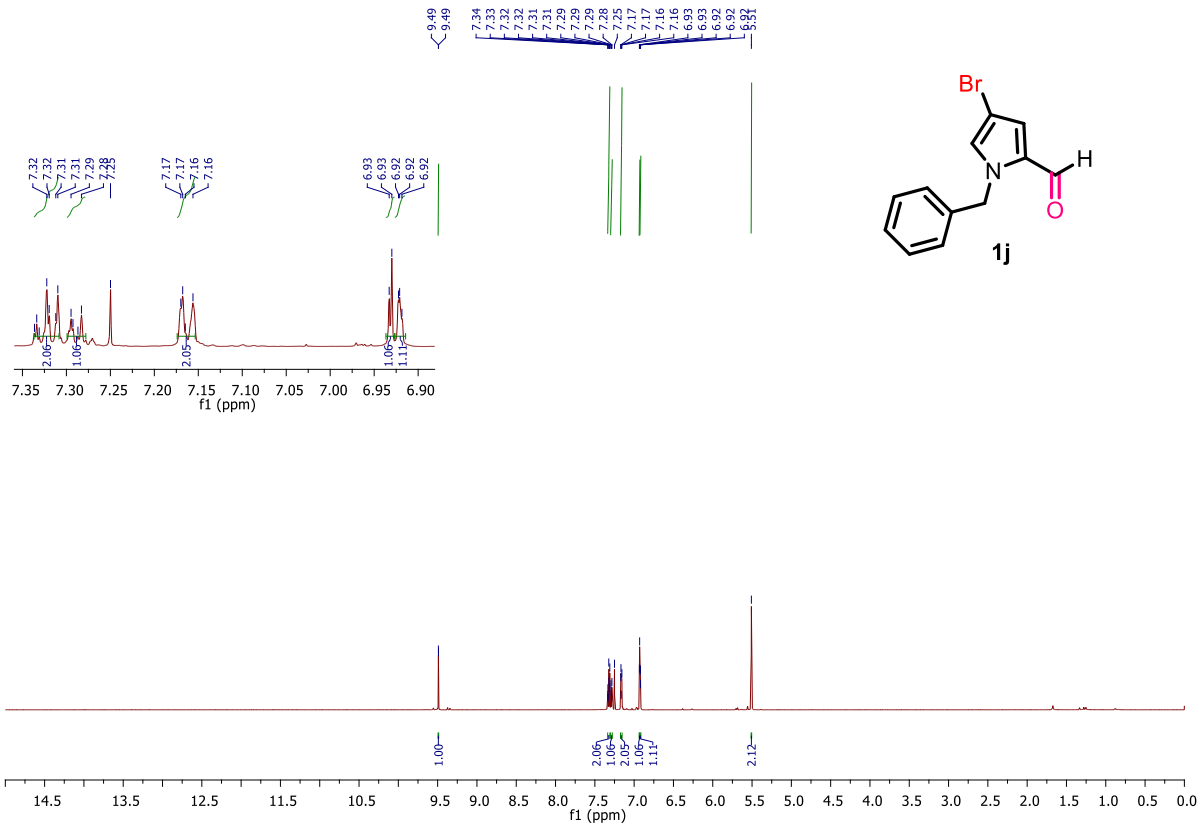


1i

^{13}C{1H} NMR ($CDCl_3$)



1j ^{1}H NMR ($CDCl_3$)



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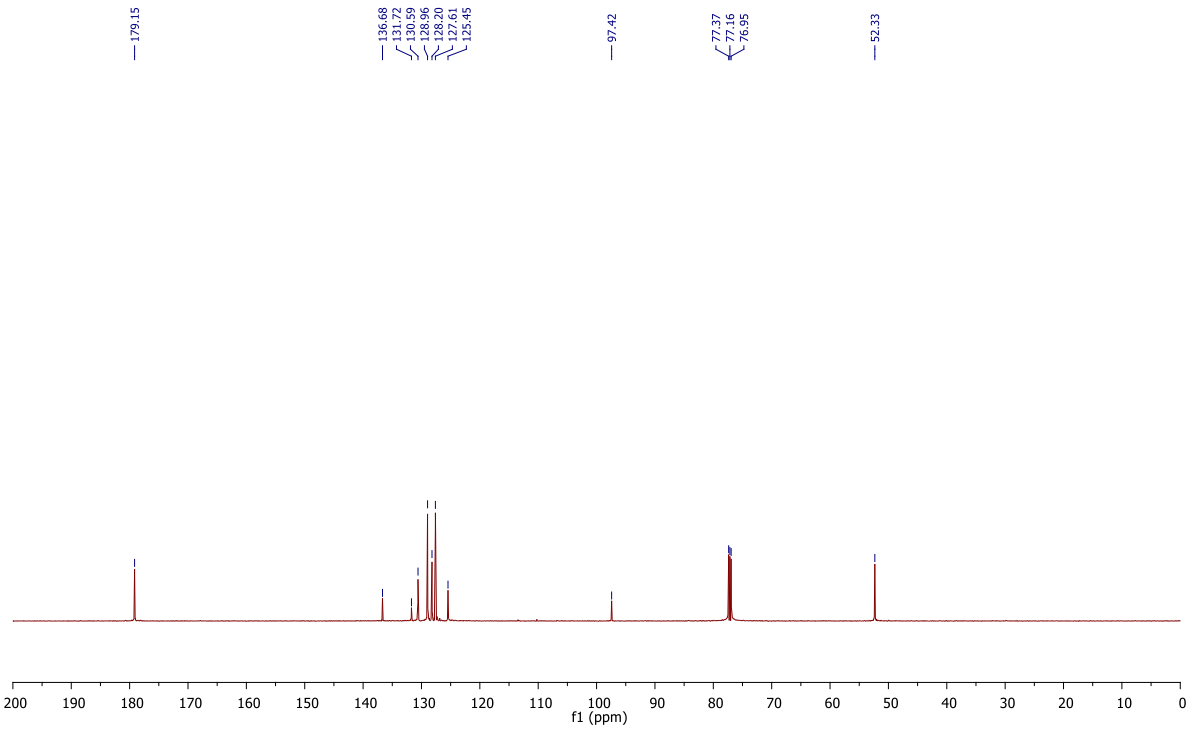
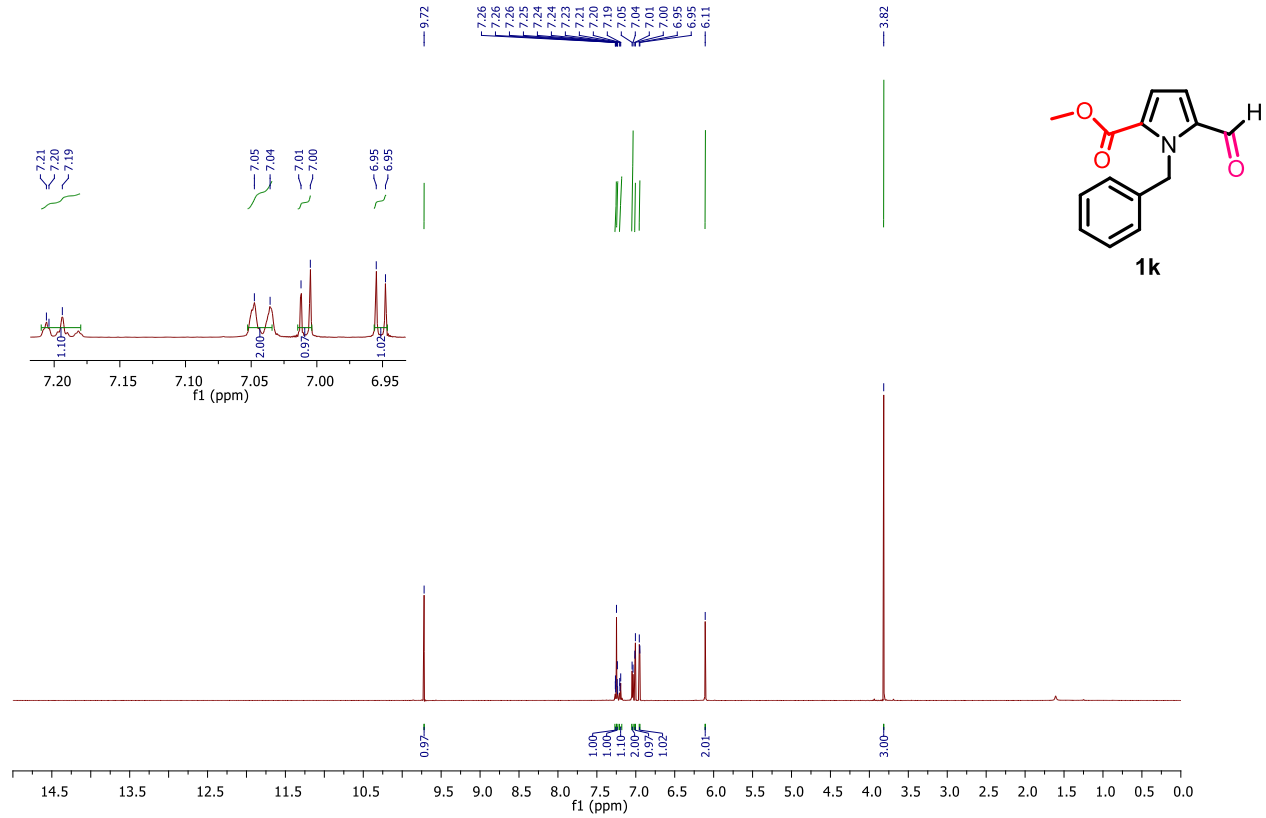
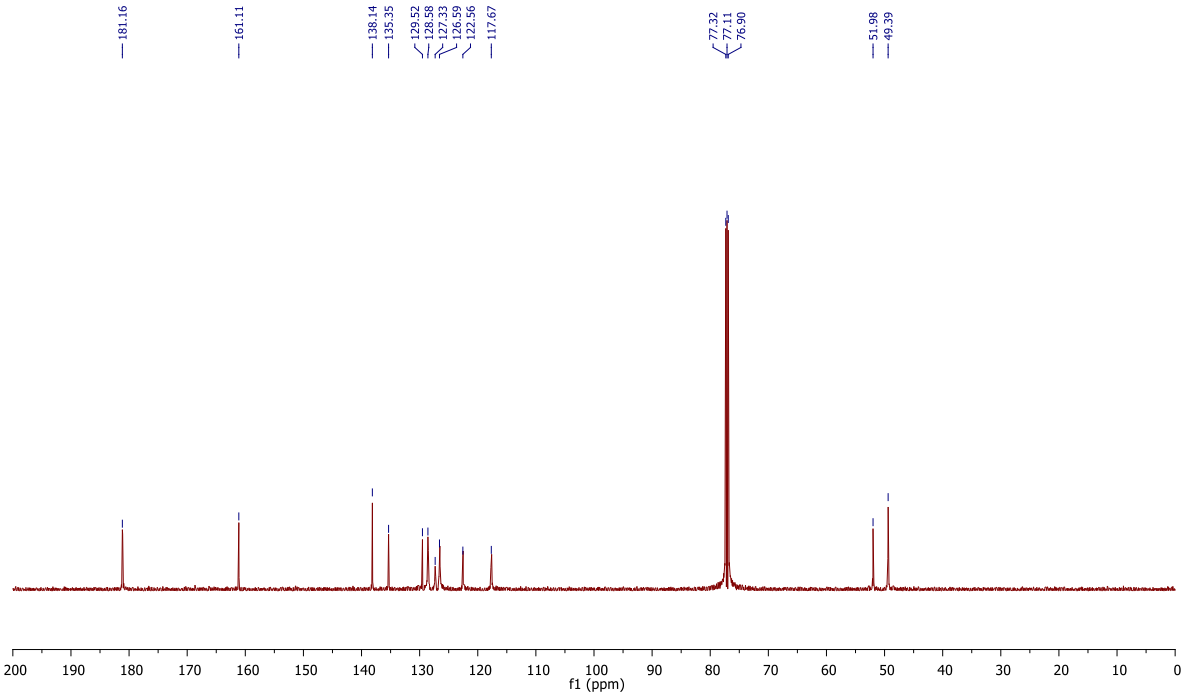


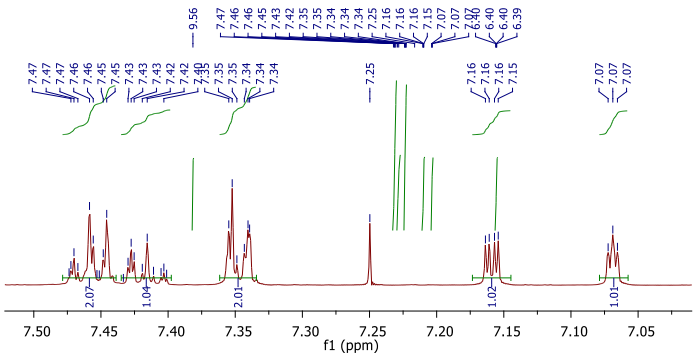
1k ^{1}H NMR ($CDCl_3$)

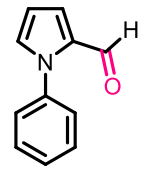


^{13}C{1H} NMR ($CDCl_3$)



1l ^{1}H NMR ($CDCl_3$)





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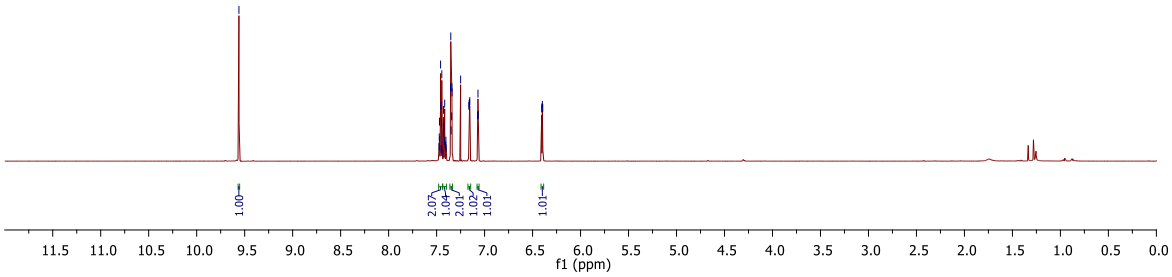

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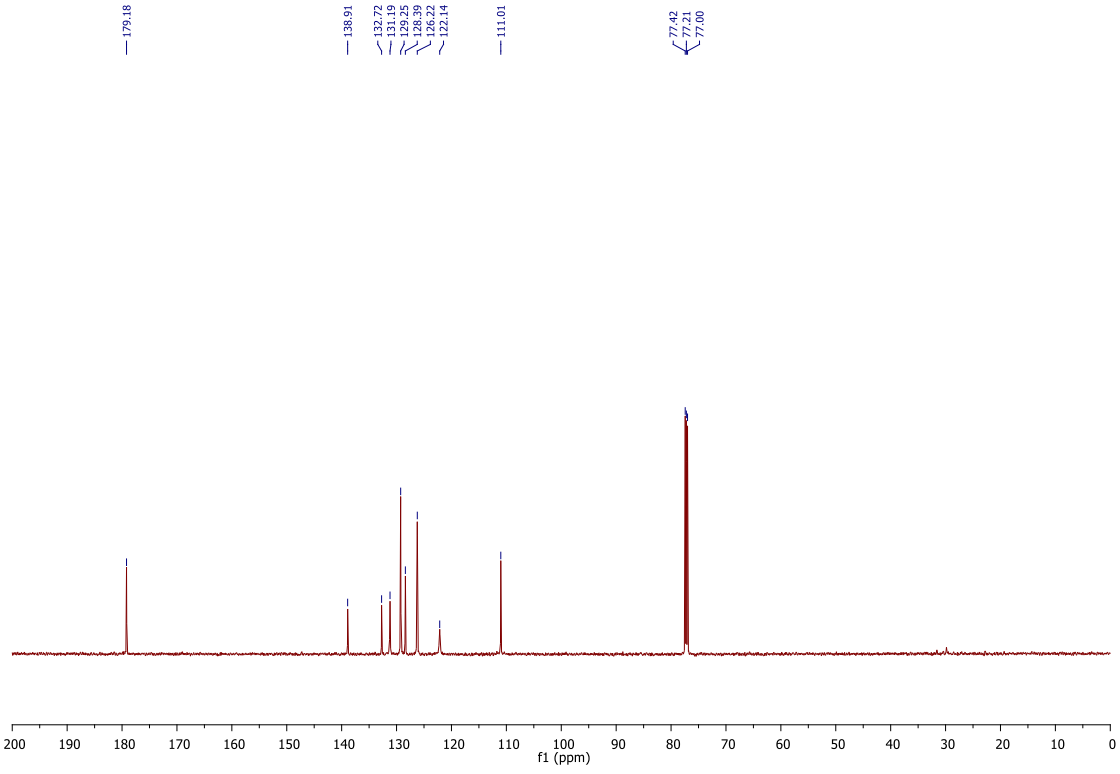
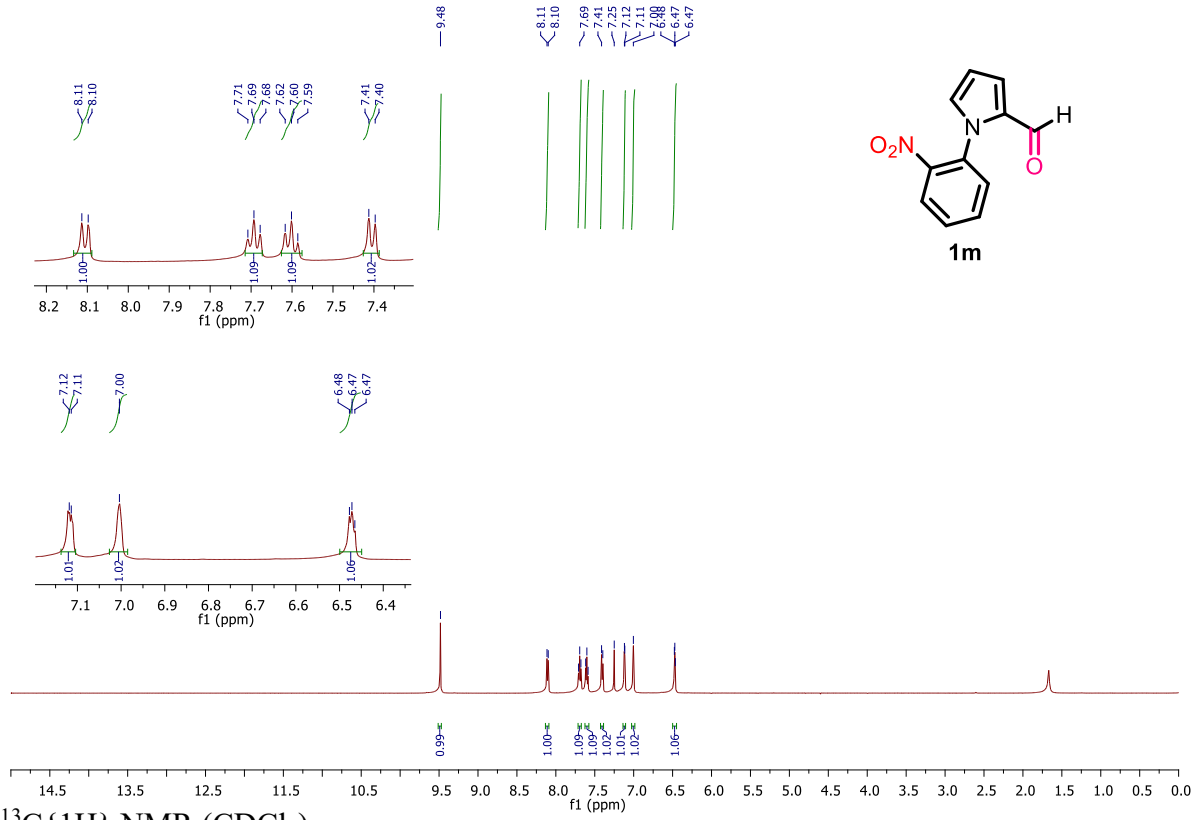
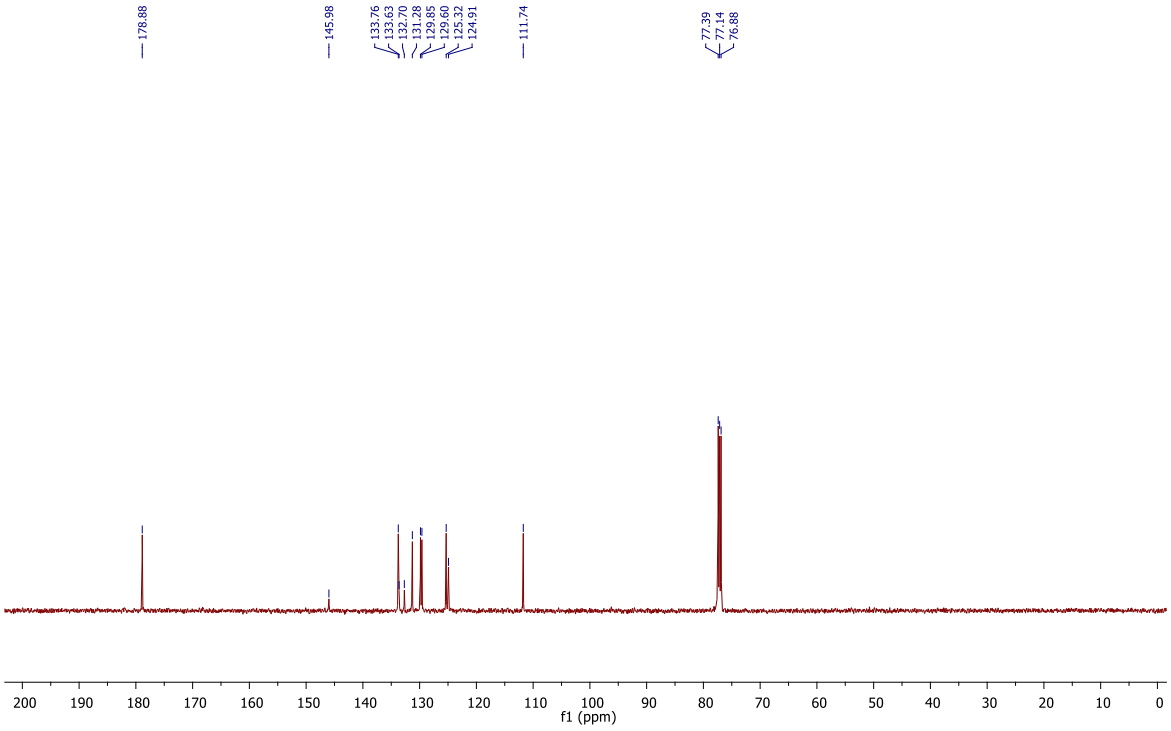


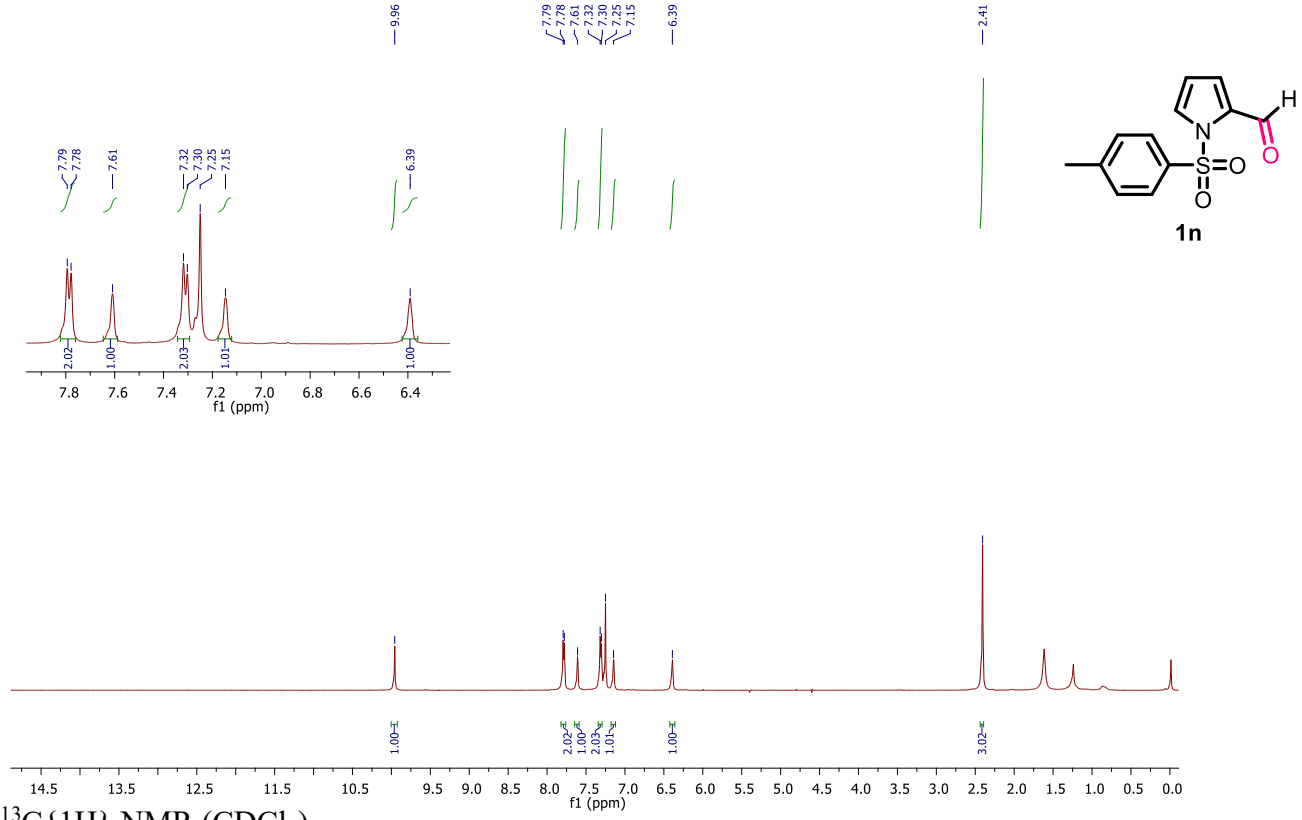
1m ^{1}H NMR ($CDCl_3$)



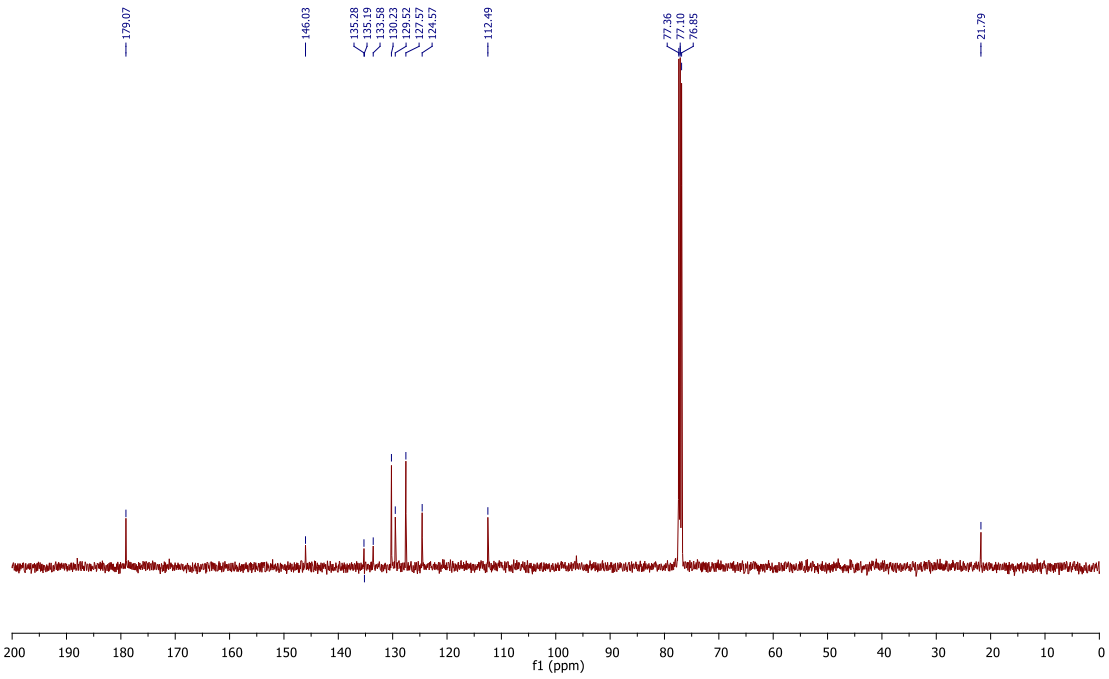
^{13}C{1H} NMR ($CDCl_3$)



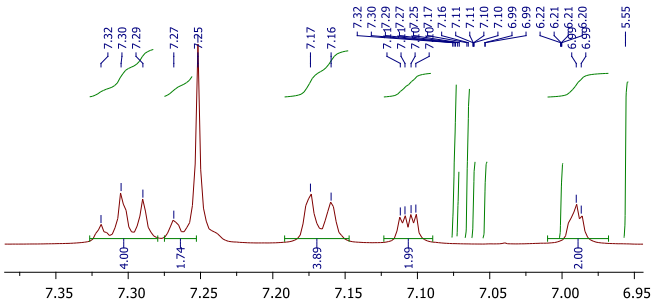
1n ^{1}H NMR ($CDCl_3$)

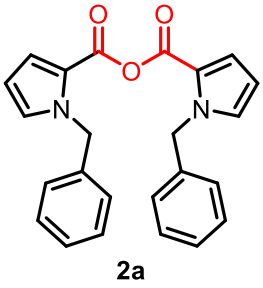


^{13}C{1H} NMR ($CDCl_3$)

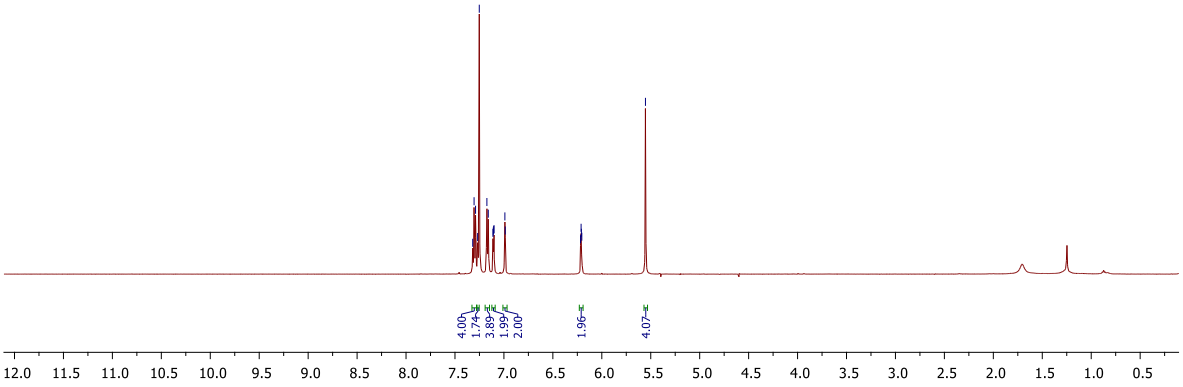


2a ^{1}H NMR ($CDCl_3$)

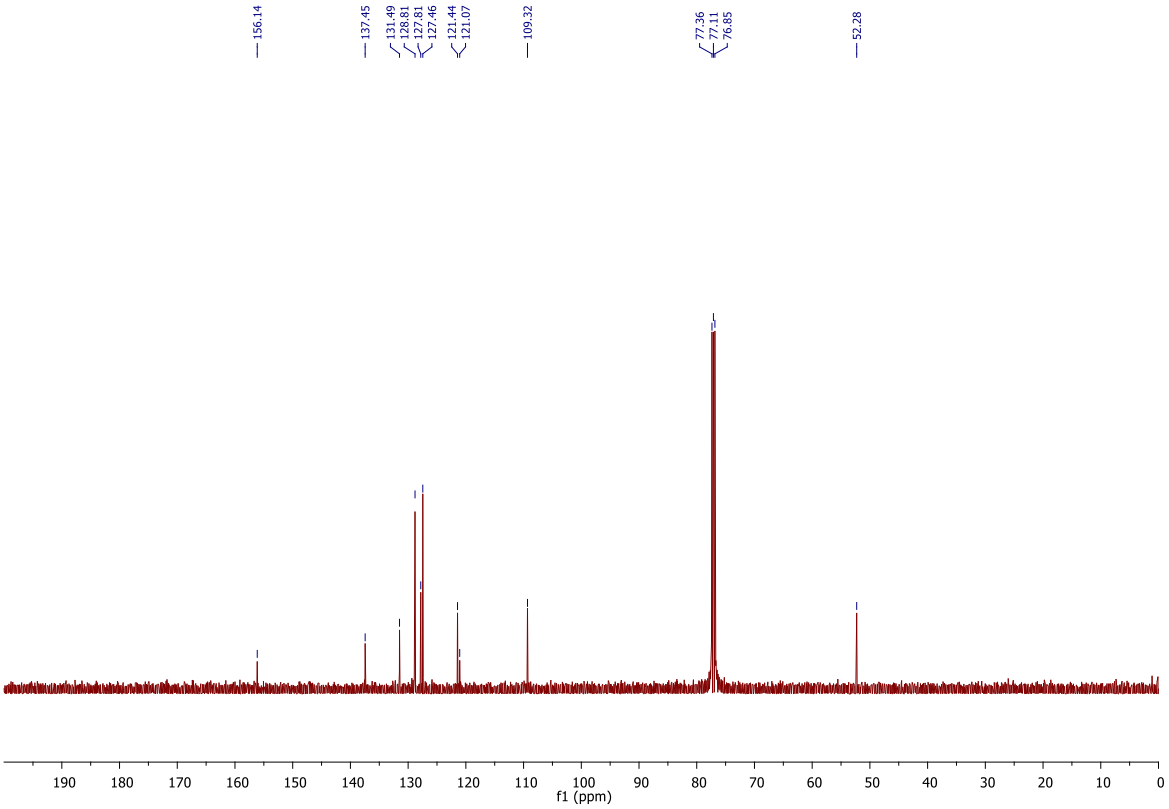




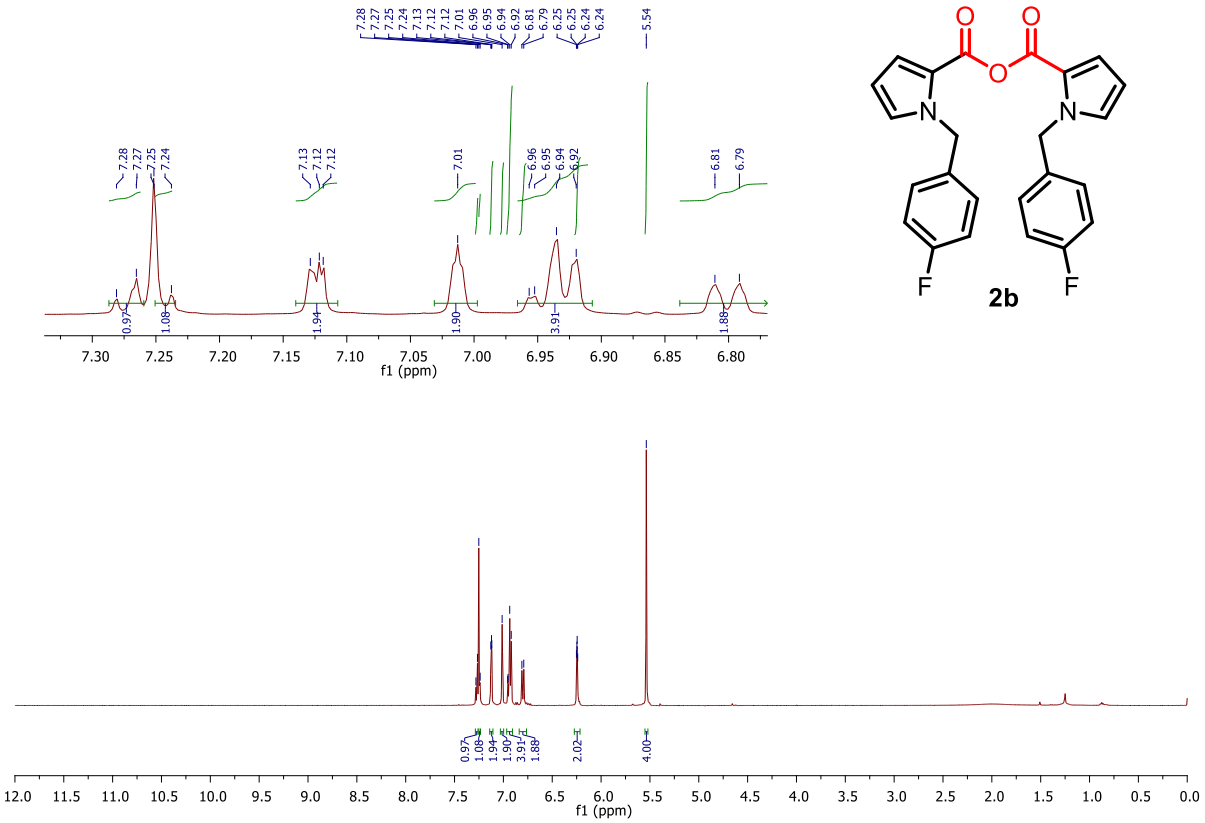
2a



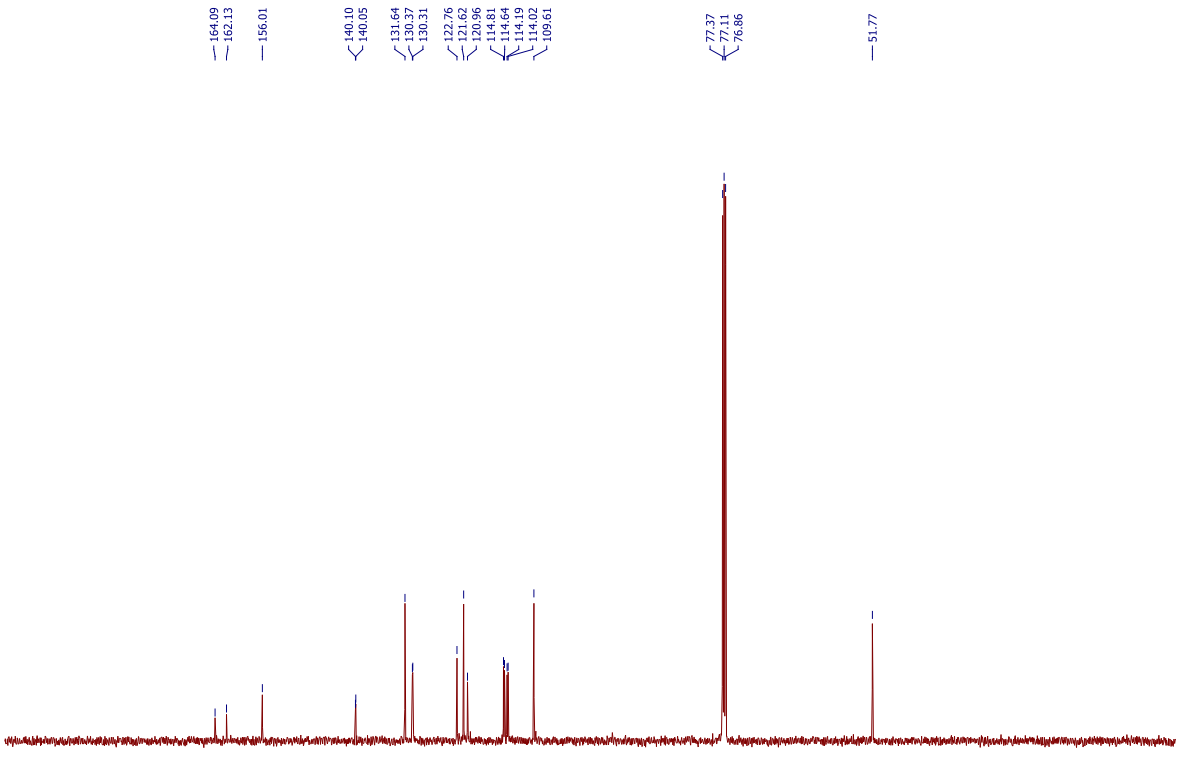
^{13}C{1H} NMR ($CDCl_3$)



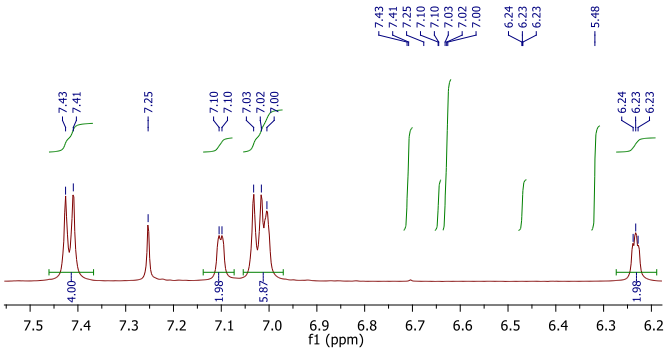
2b ^{1}H NMR ($CDCl_3$)

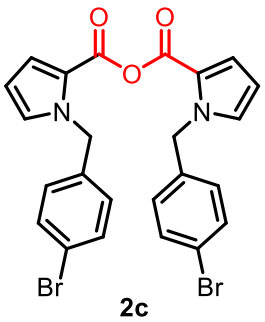


^{13}C{1H} NMR ($CDCl_3$)

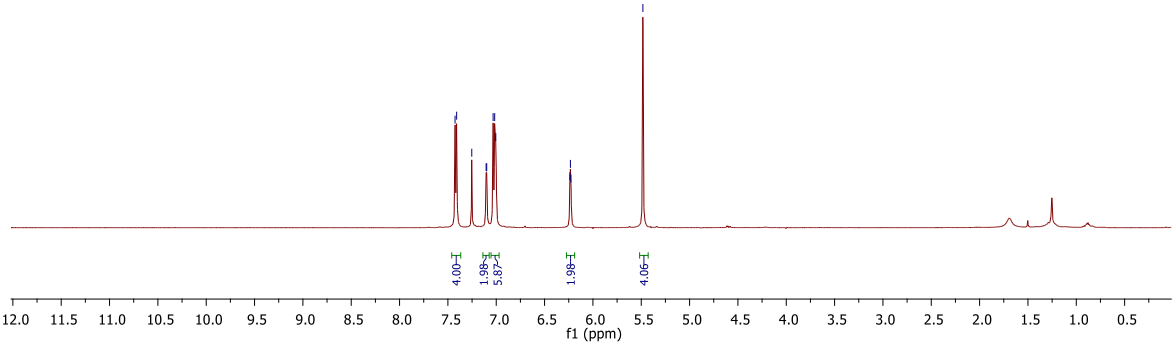


2c ^{1}H NMR ($CDCl_3$)





2c



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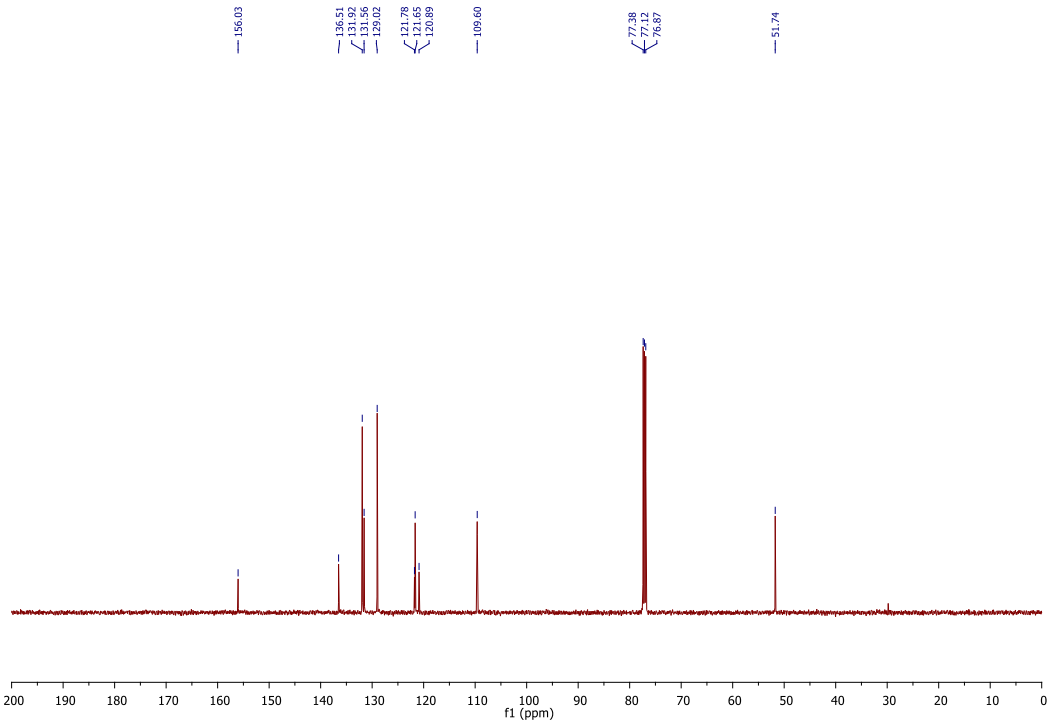
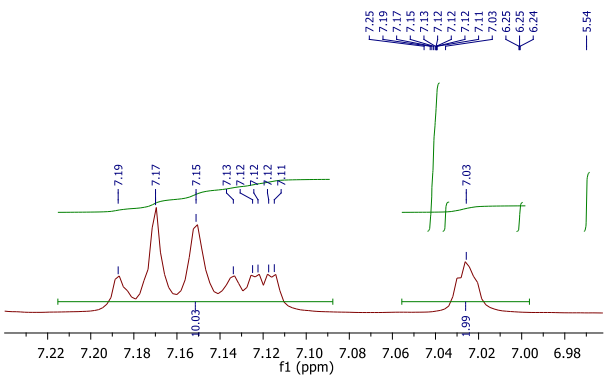
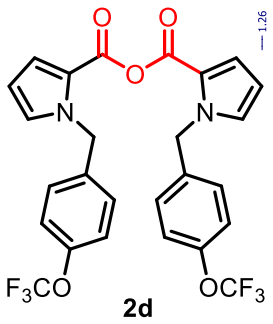
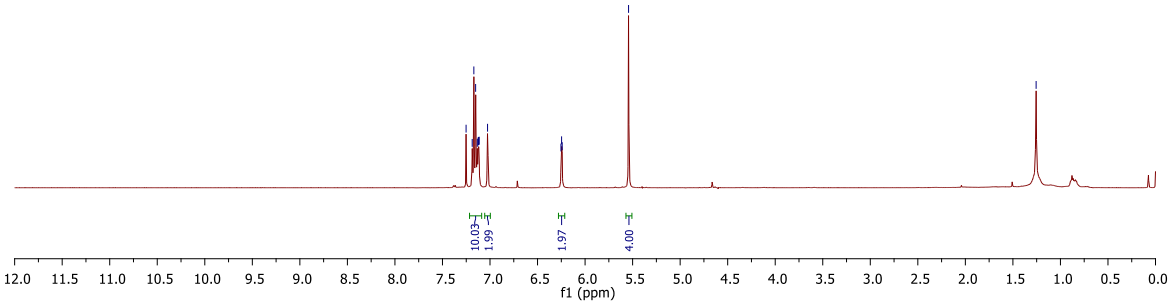


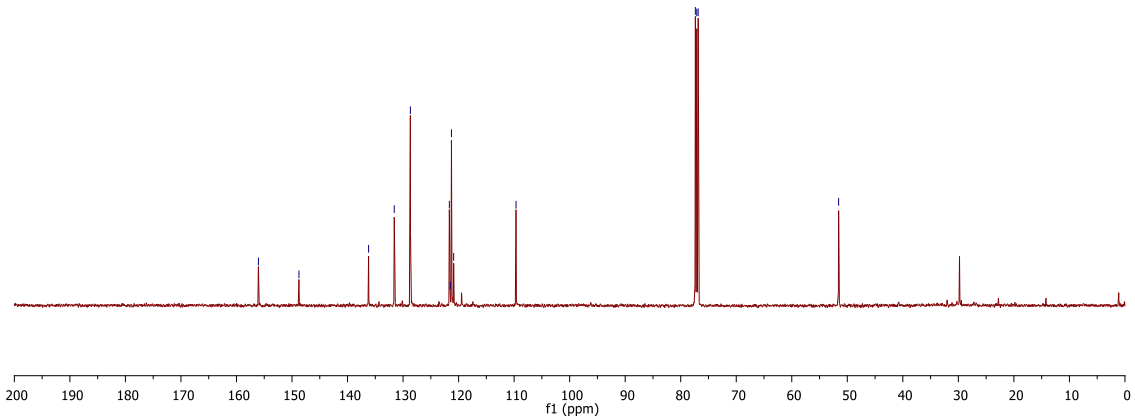
2d ^{1}H NMR ($CDCl_3$)



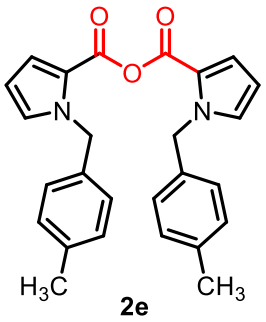


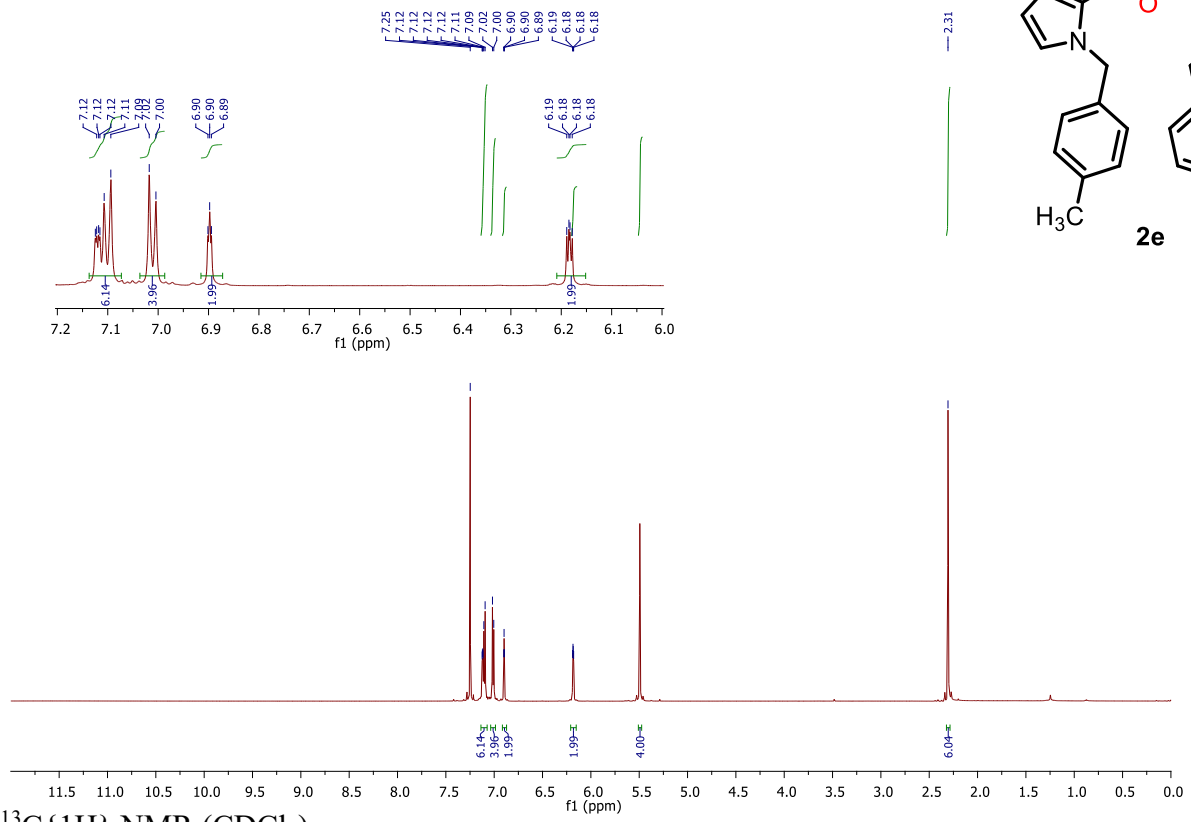


^{13}C{1H} NMR ($CDCl_3$)

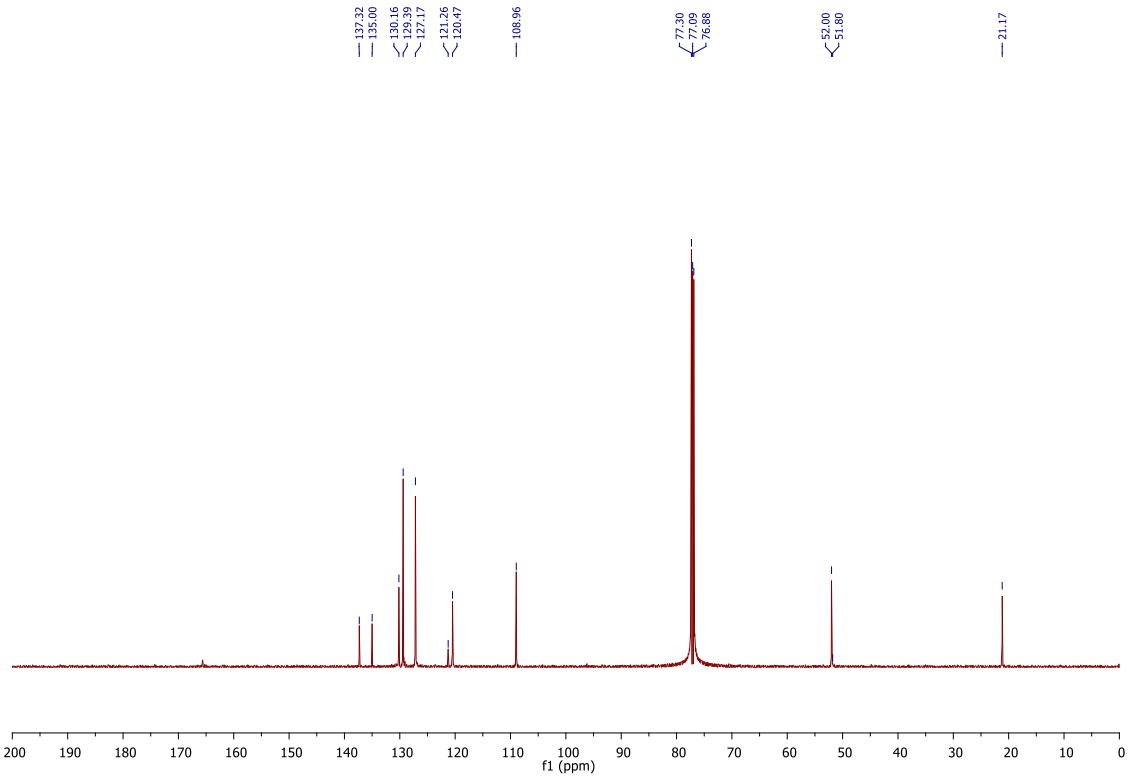


2e ^{1}H NMR ($CDCl_3$)

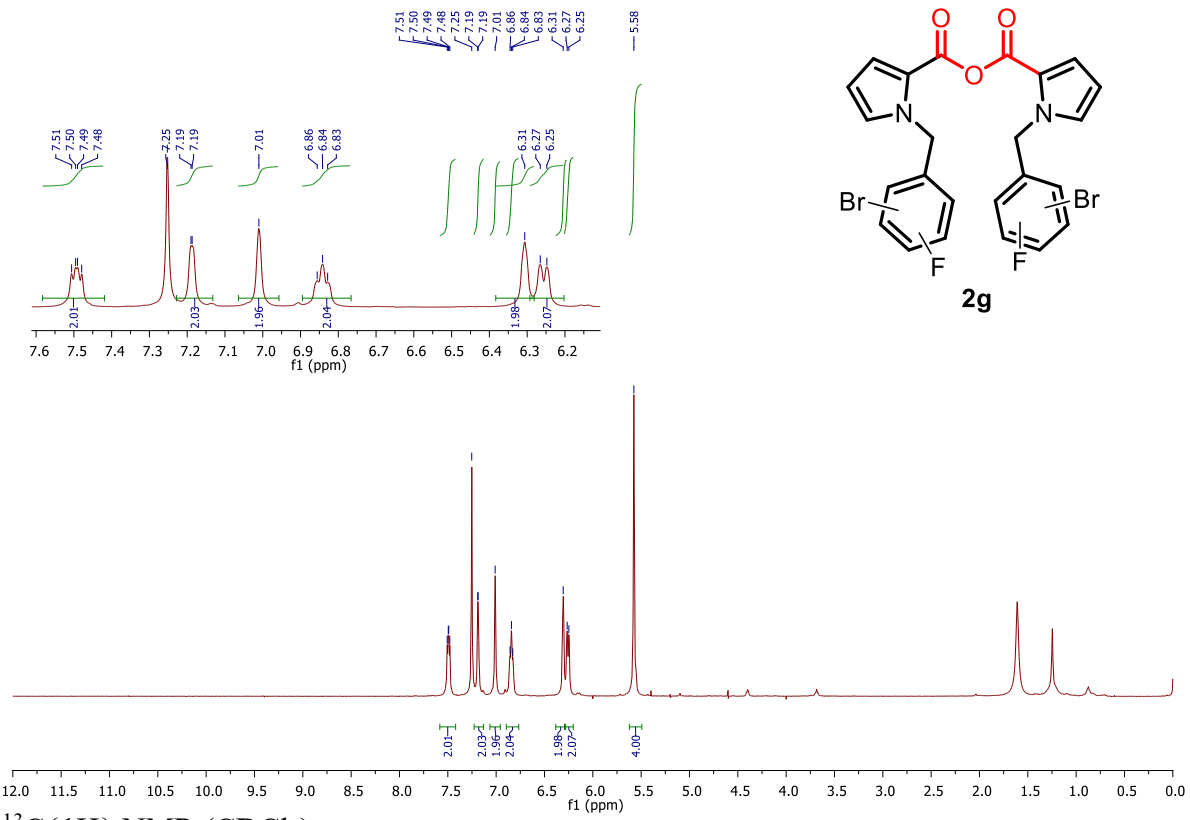




^{13}C{1H} NMR ($CDCl_3$)

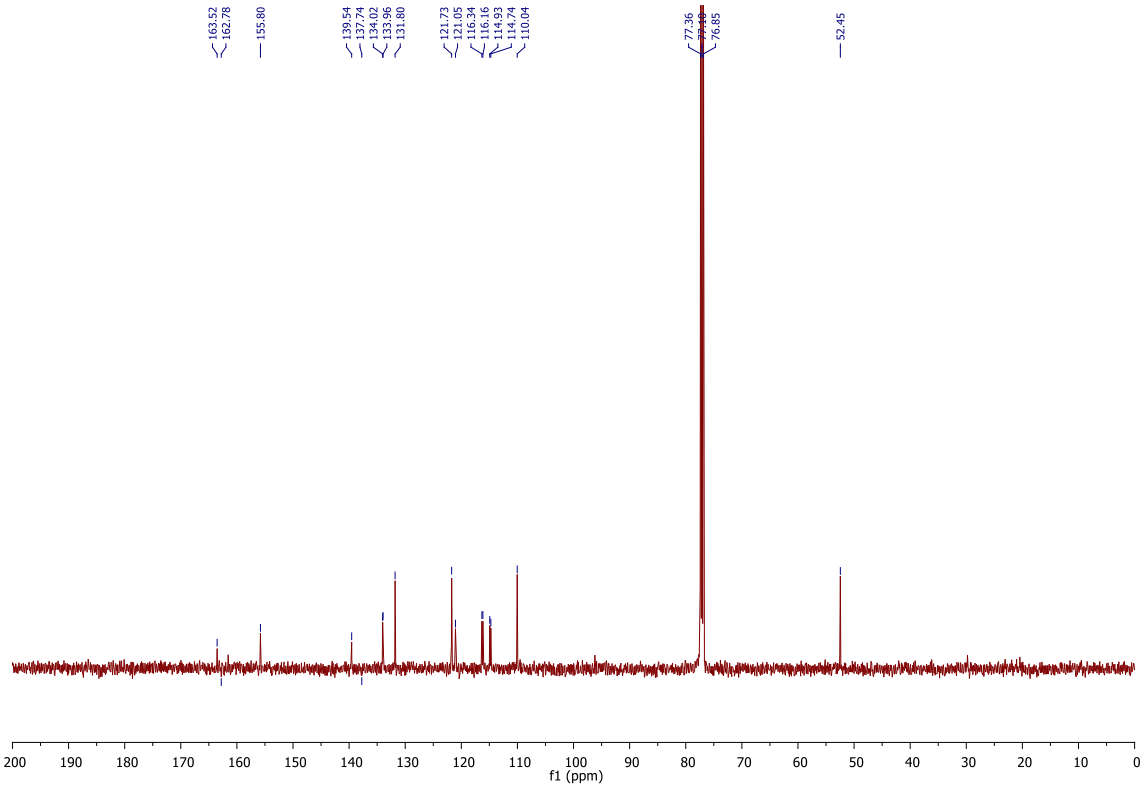


2g ^{1}H NMR ($CDCl_3$)

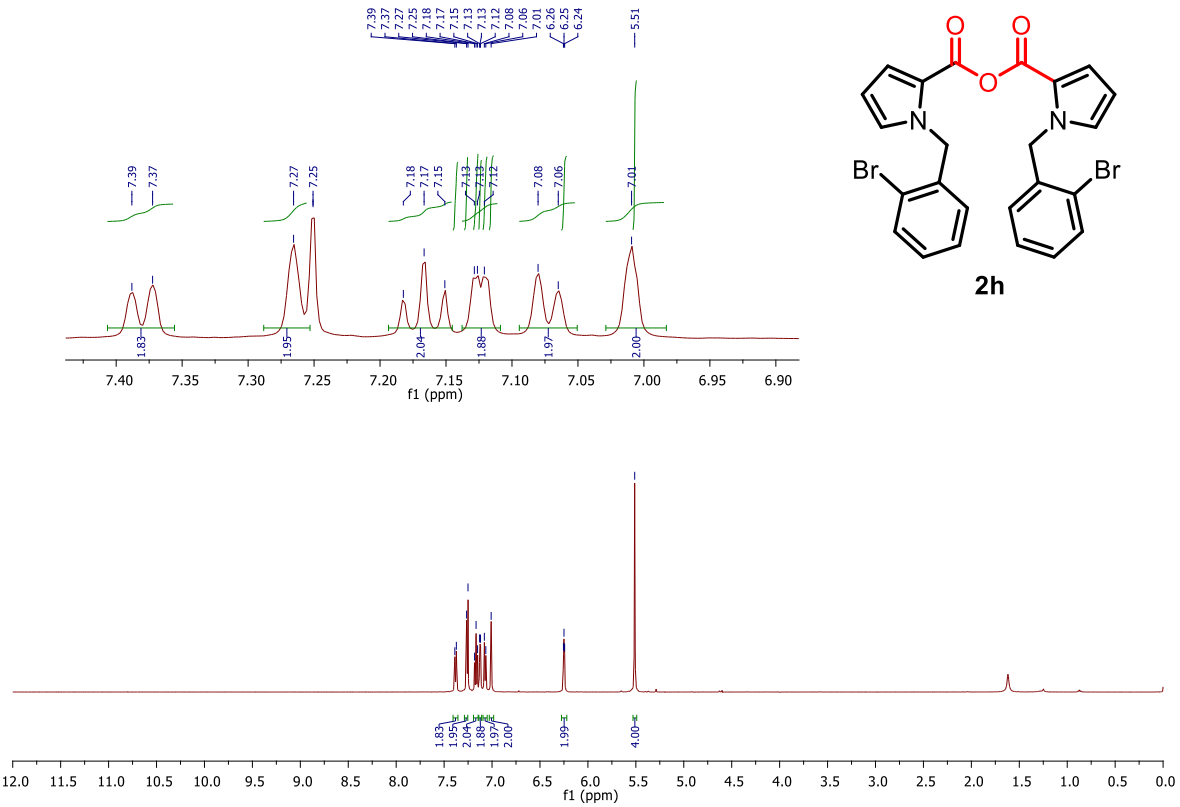


2g

^{13}C{1H} NMR ($CDCl_3$)

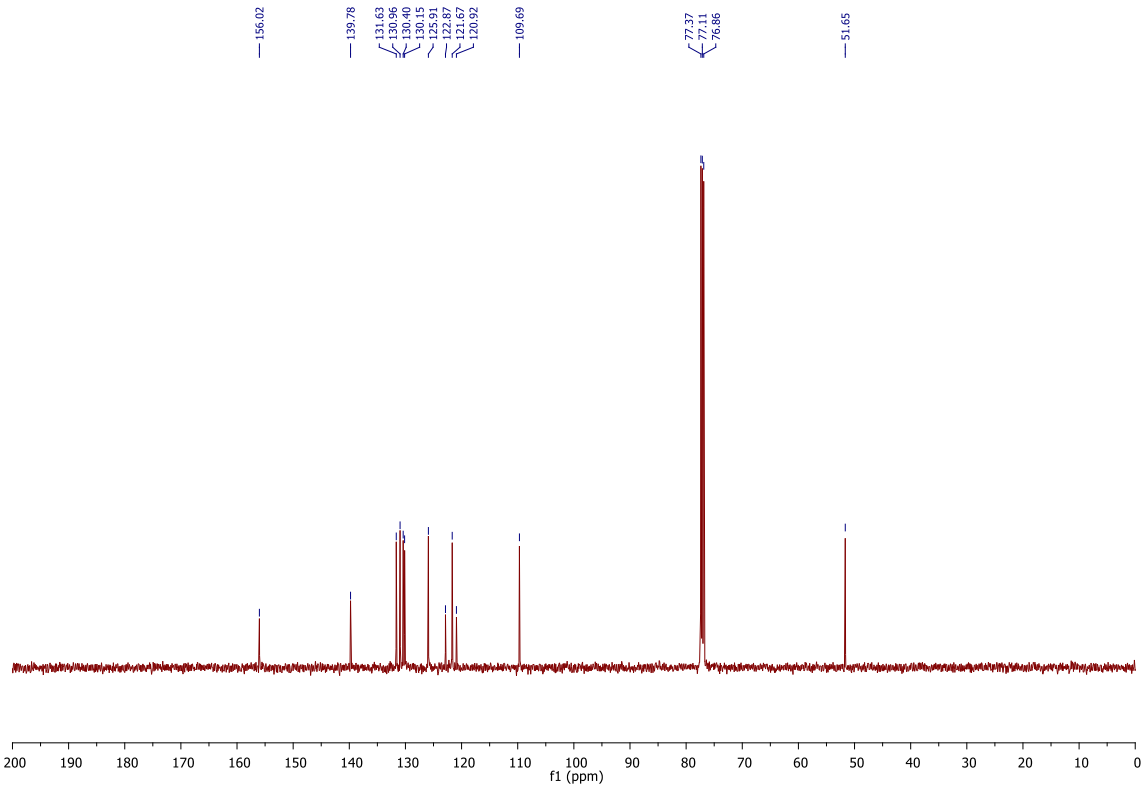


2h ^{1}H NMR ($CDCl_3$)

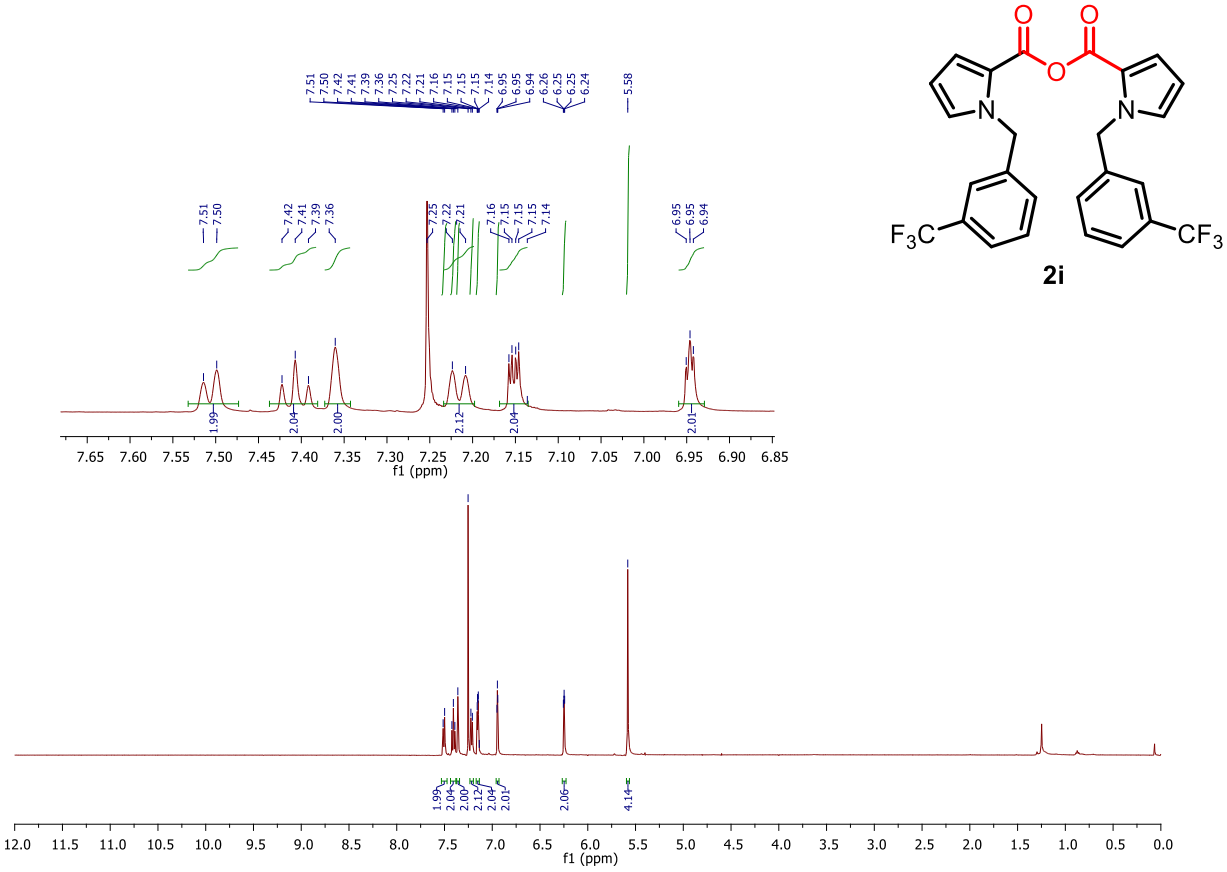


2h

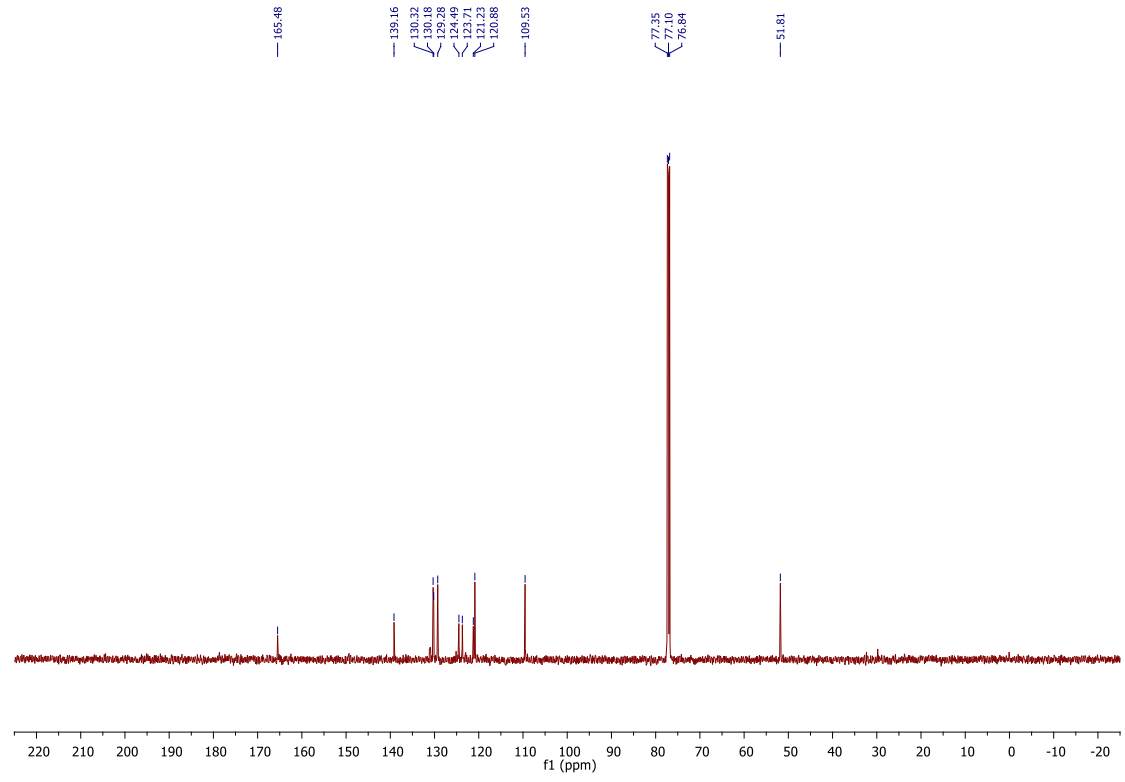
^{13}C{1H} NMR ($CDCl_3$)



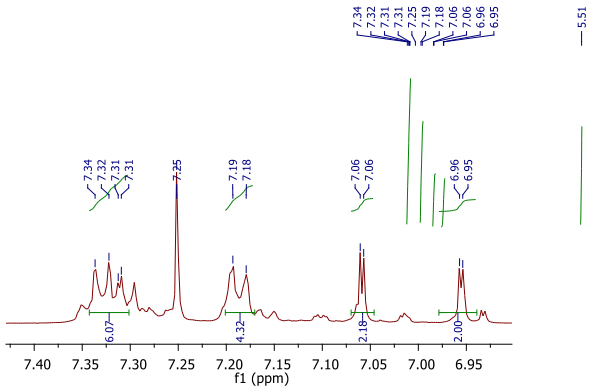
2i ^{1}H NMR ($CDCl_3$)

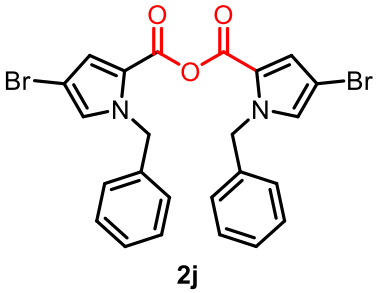


^{13}C{1H} NMR ($CDCl_3$)

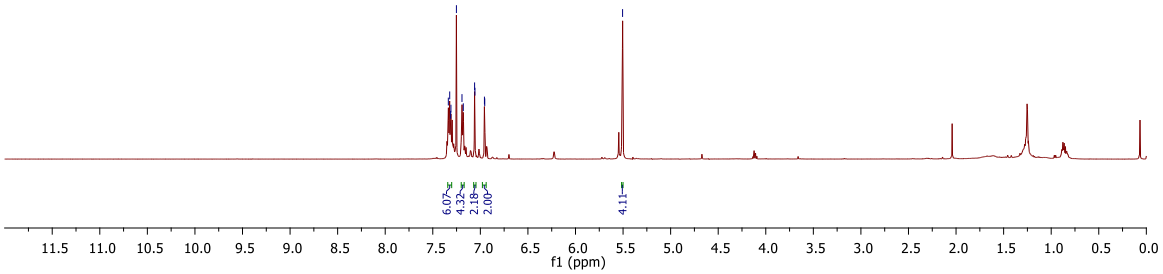


2j ^{1}H NMR ($CDCl_3$)

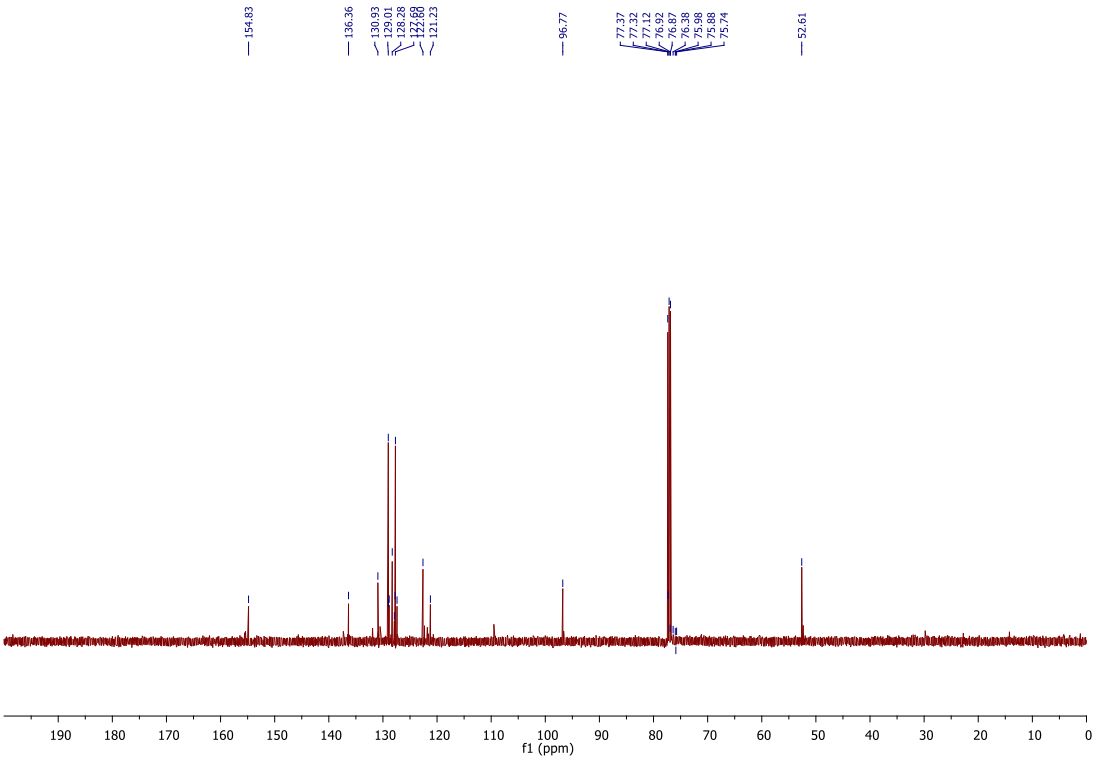




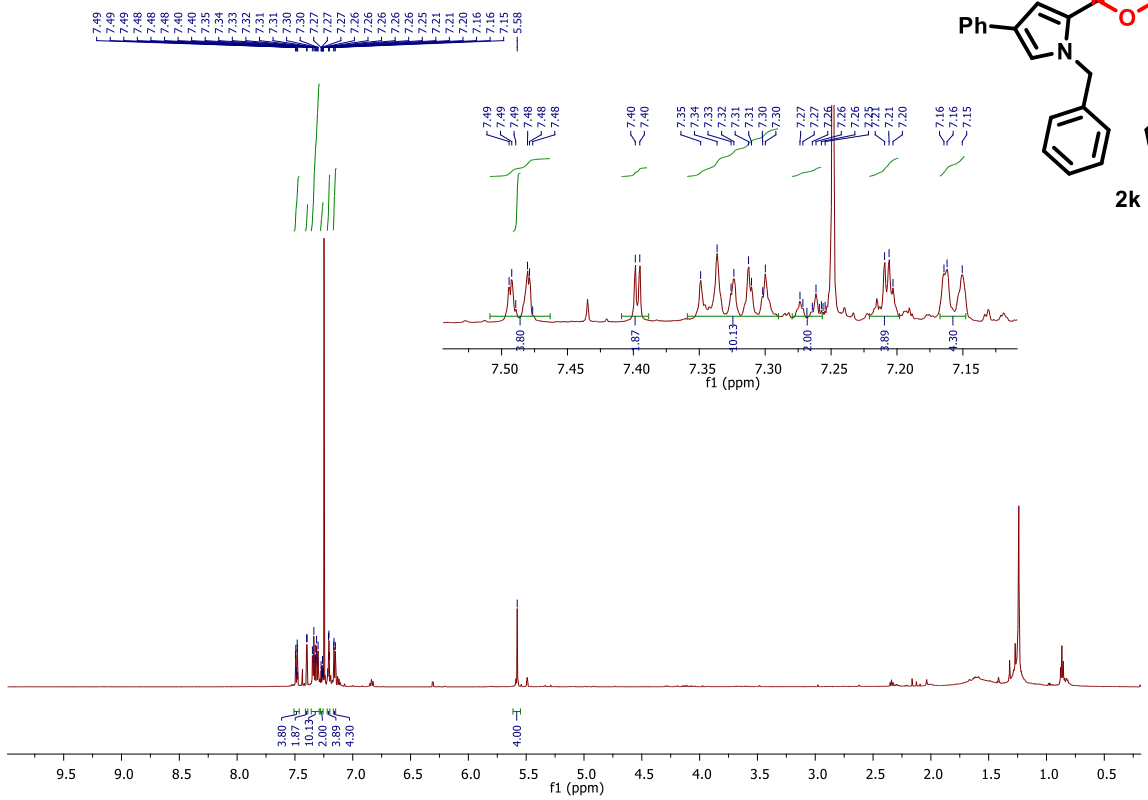
2j



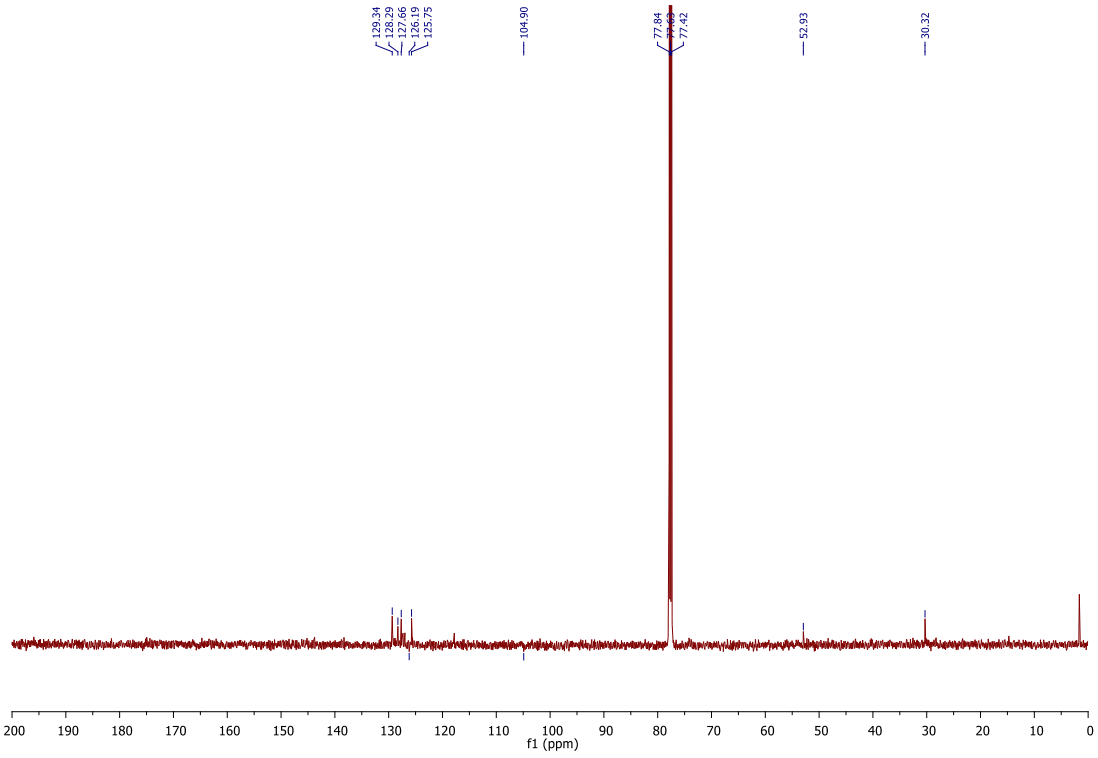
^{13}C{1H} NMR ($CDCl_3$)



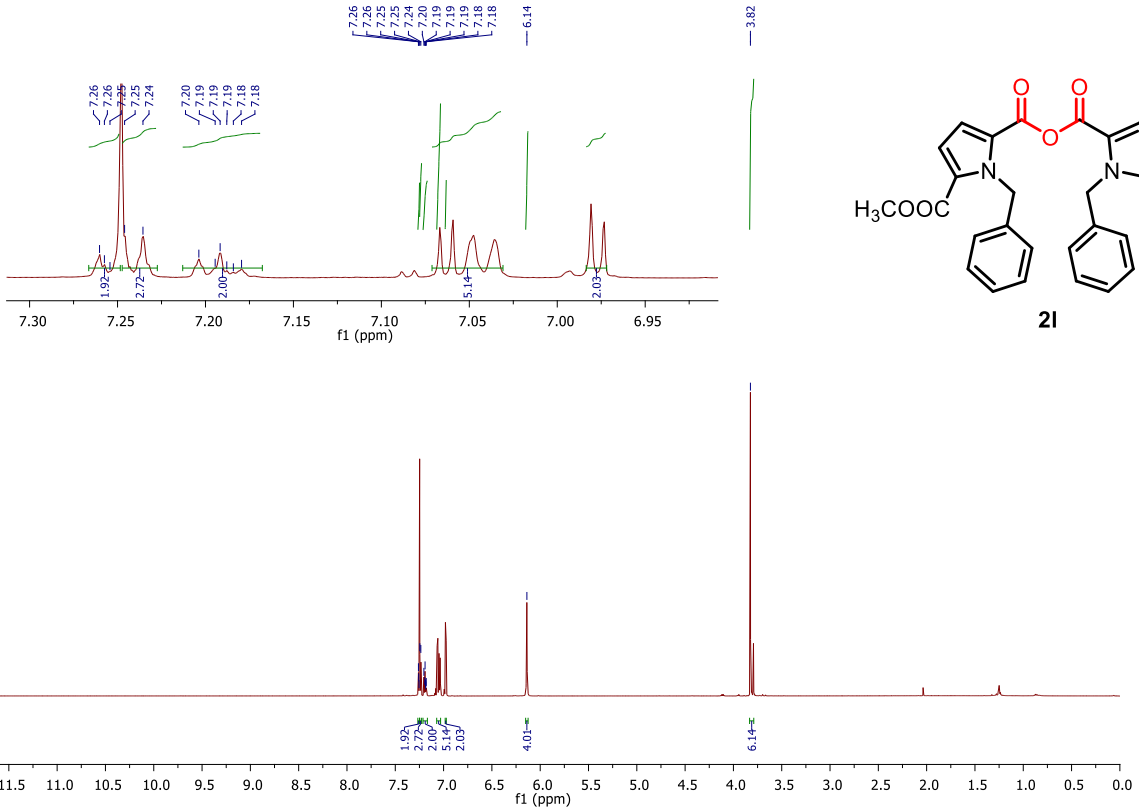
2k ^{1}H NMR ($CDCl_3$)



^{13}C{1H} NMR ($CDCl_3$)

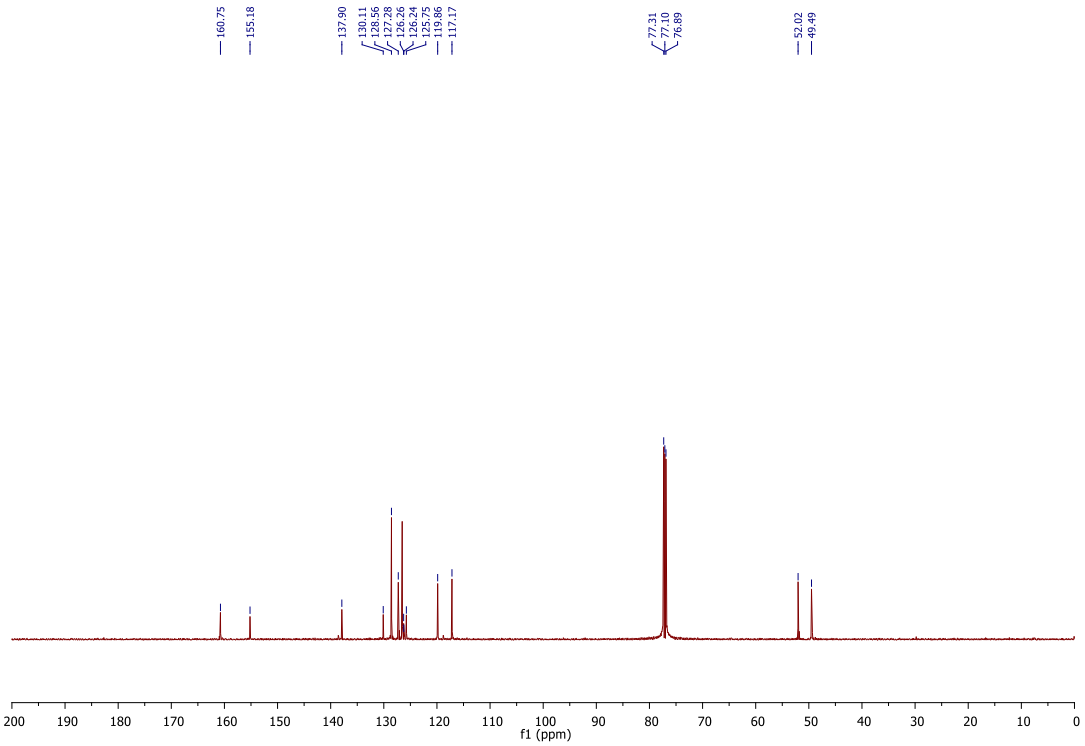


2l ^{1}H NMR ($CDCl_3$)

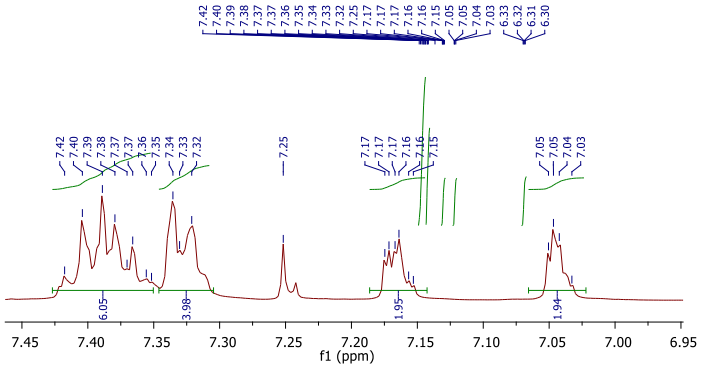


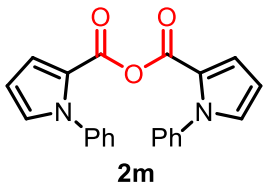
2l

^{13}C{1H} NMR ($CDCl_3$)

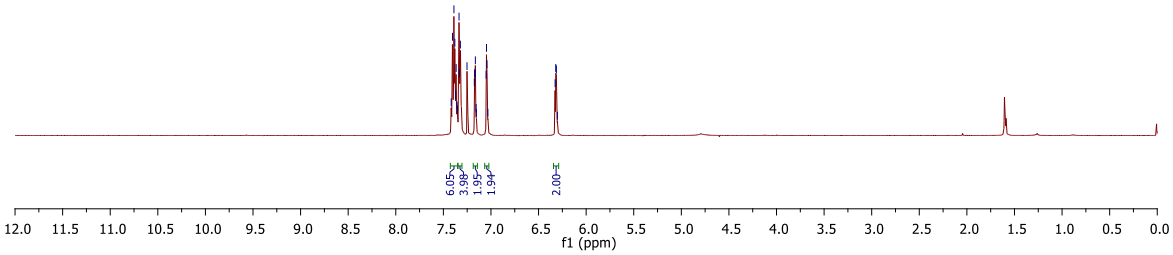


2m ^{1}H NMR ($CDCl_3$)

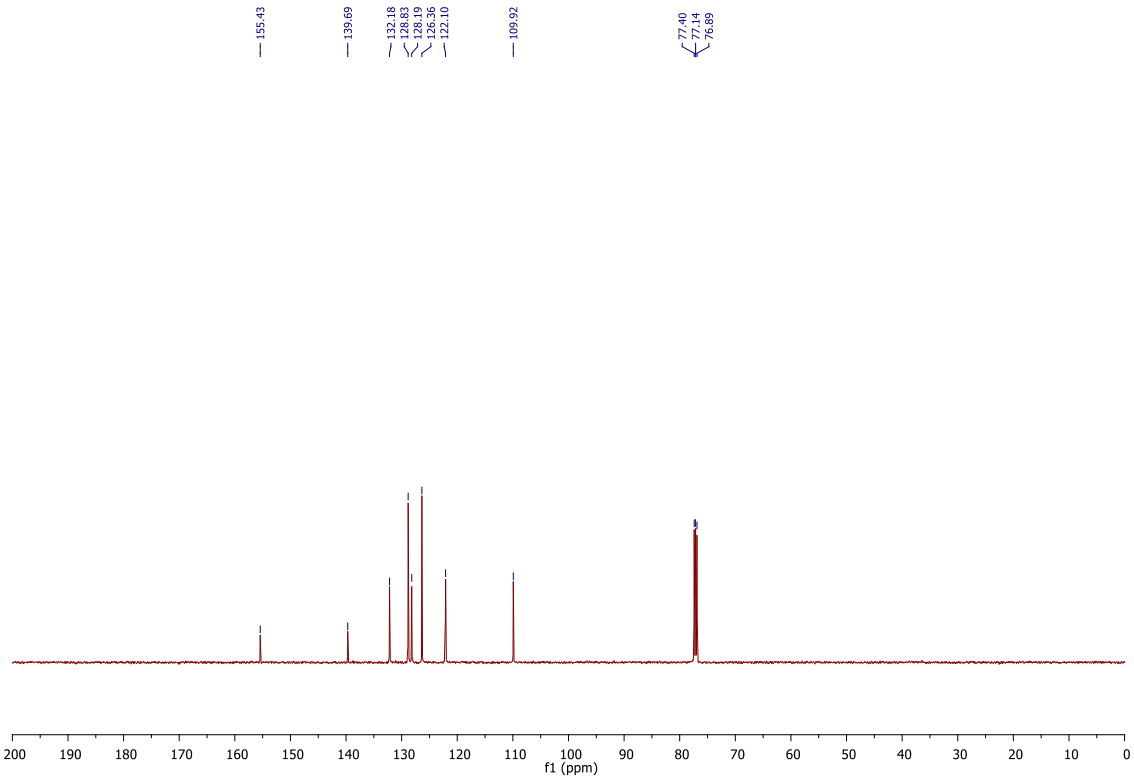




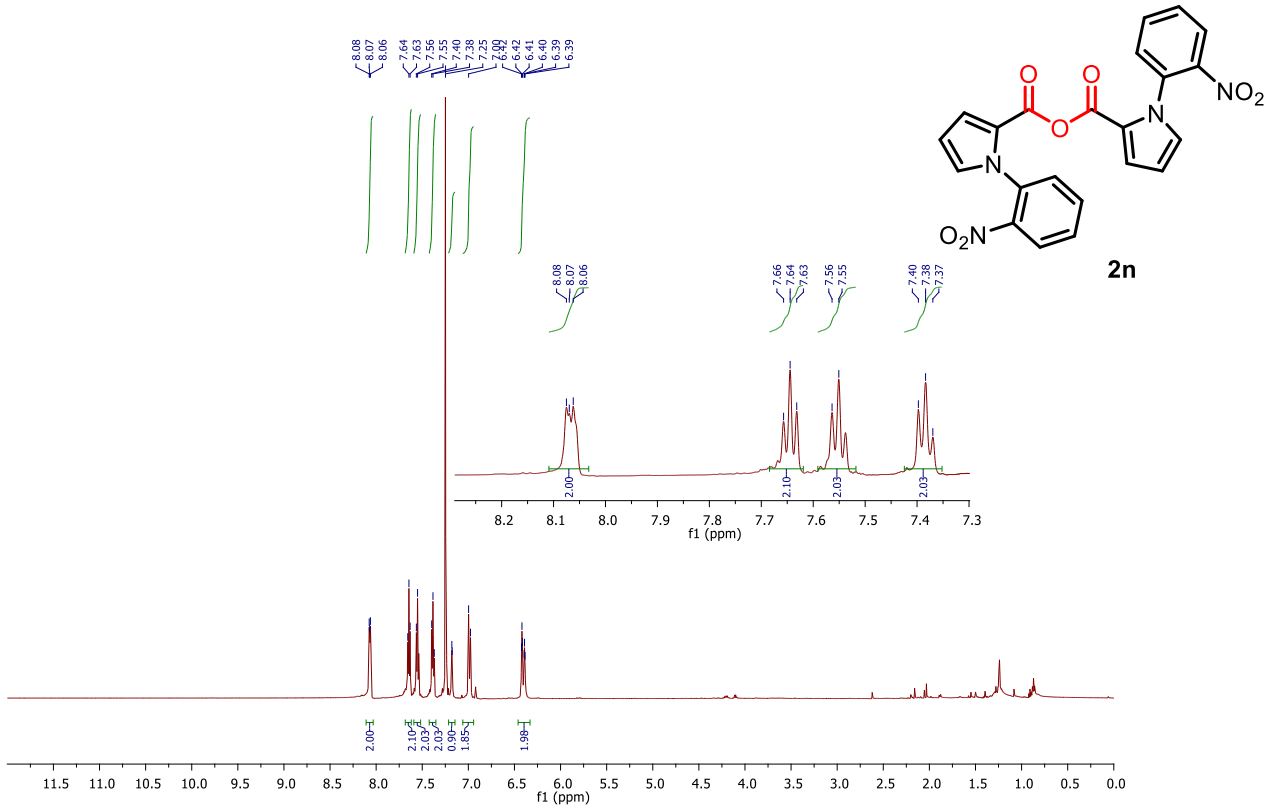
2m



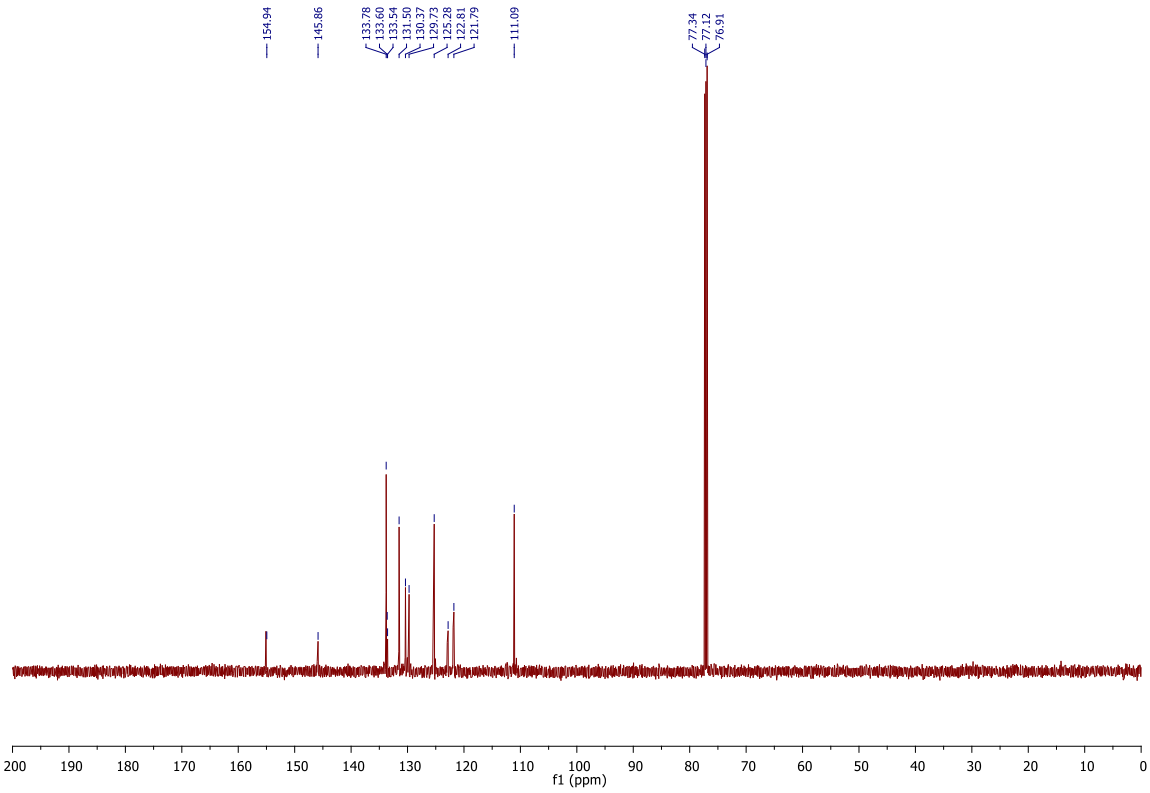
^{13}C{1H} NMR ($CDCl_3$)



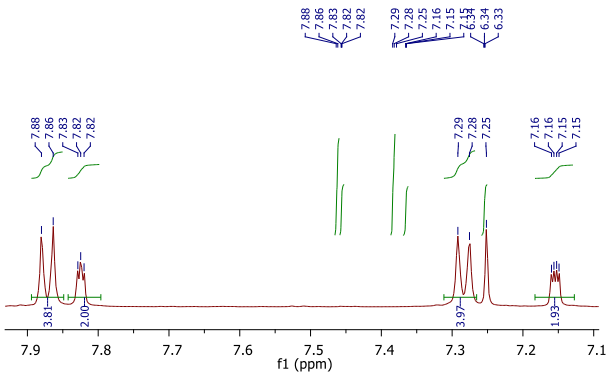
2n ^{1}H NMR ($CDCl_3$)

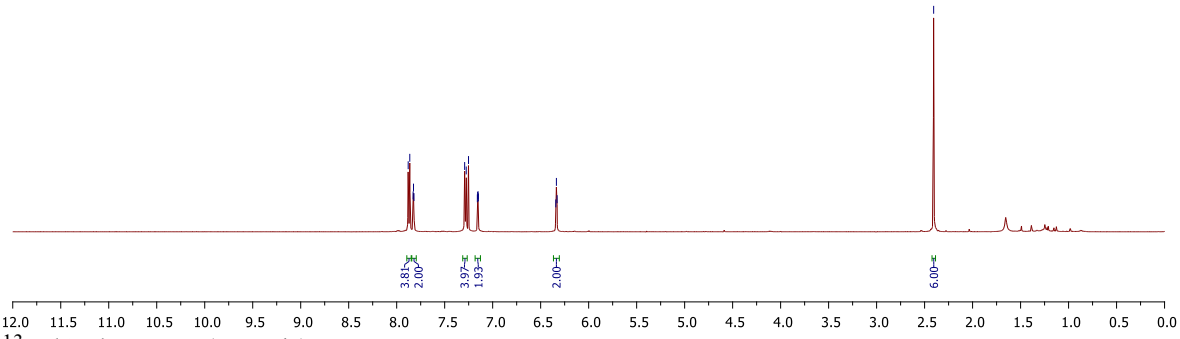


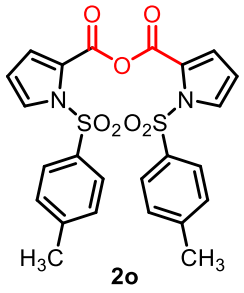
^{13}C{1H} NMR ($CDCl_3$)



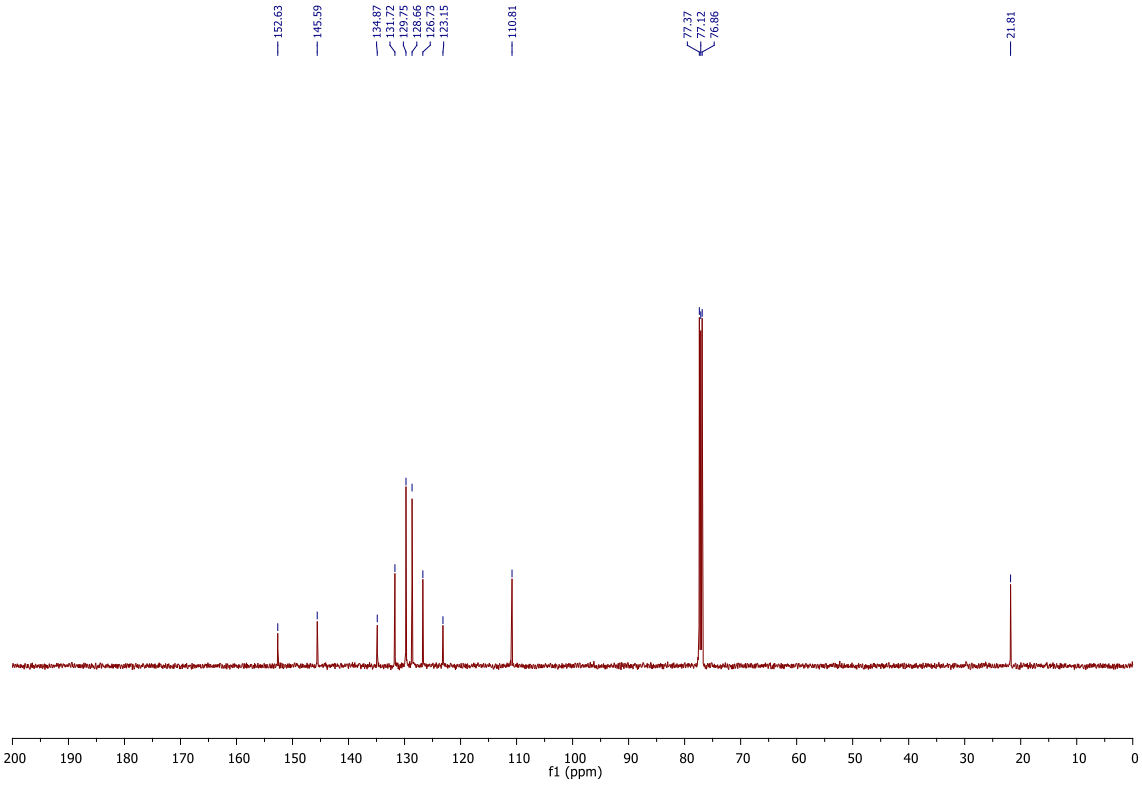
2o ^{1}H NMR ($CDCl_3$)



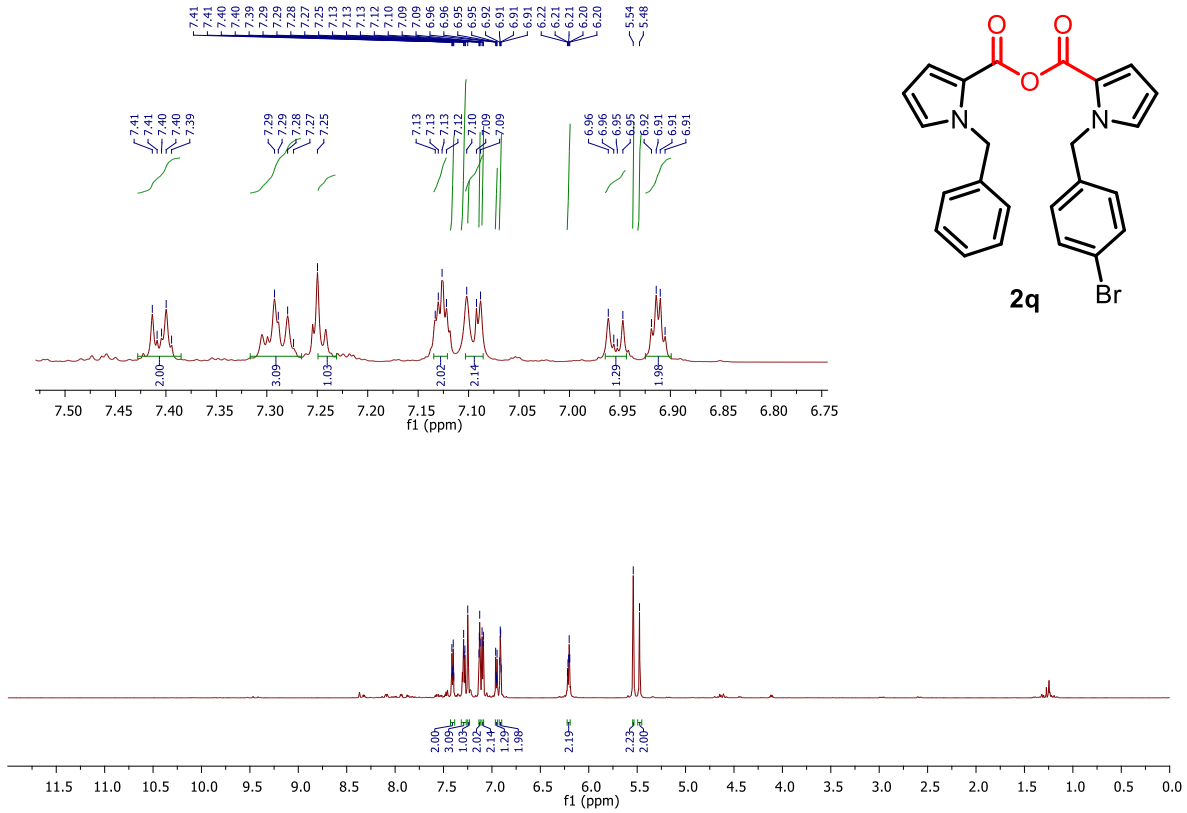




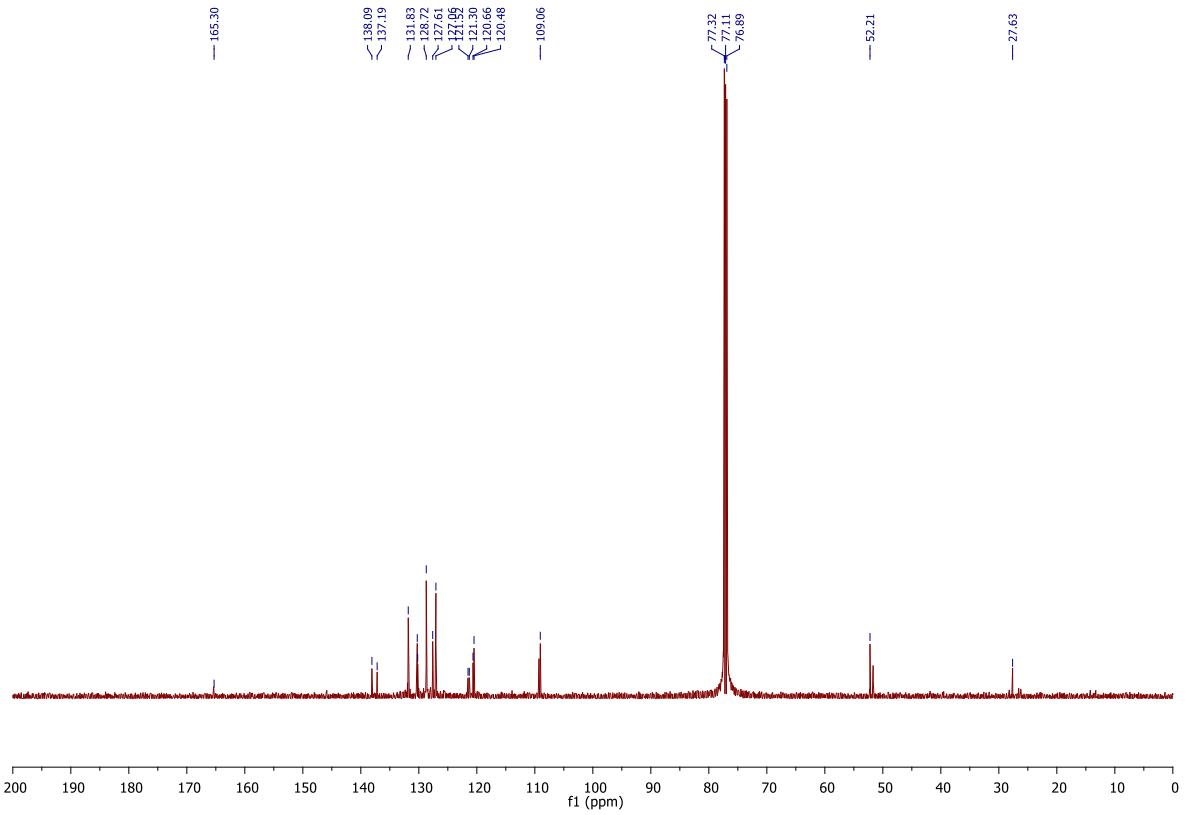
^{13}C{1H} NMR ($CDCl_3$)



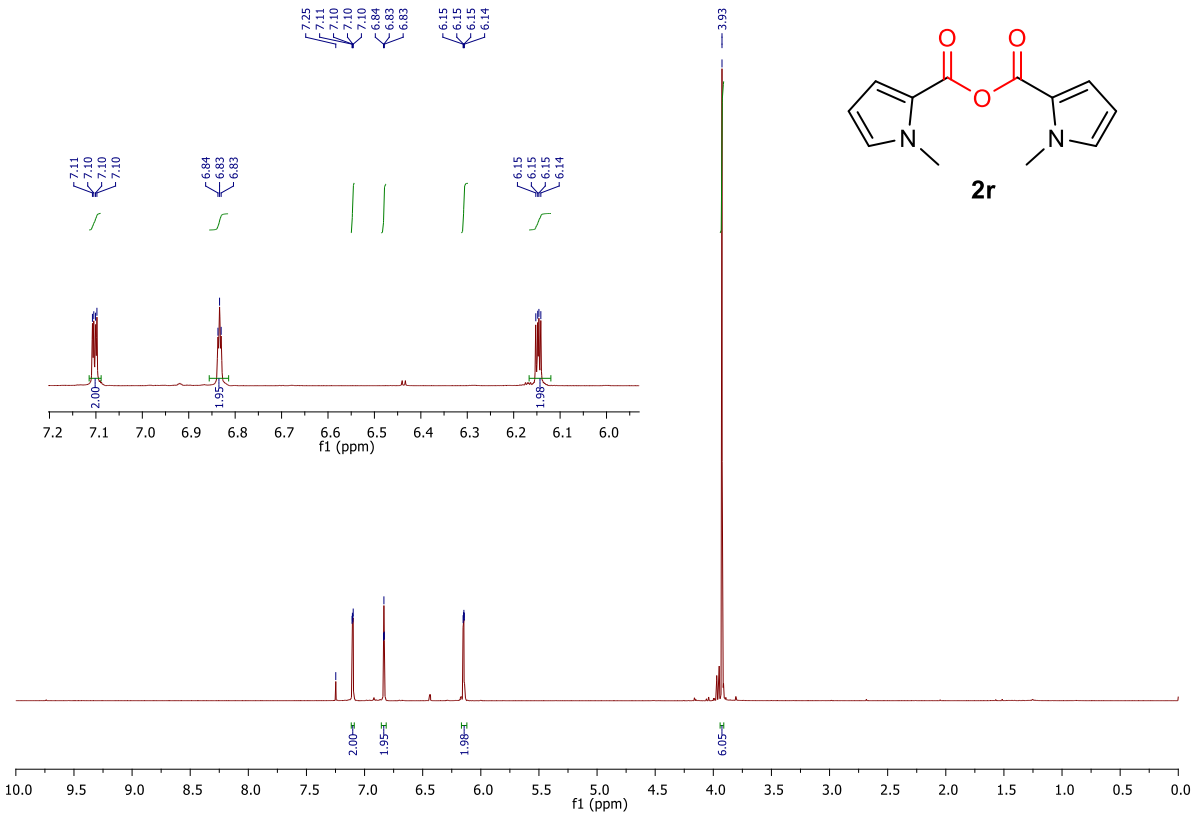
2q ^{1}H NMR ($CDCl_3$)



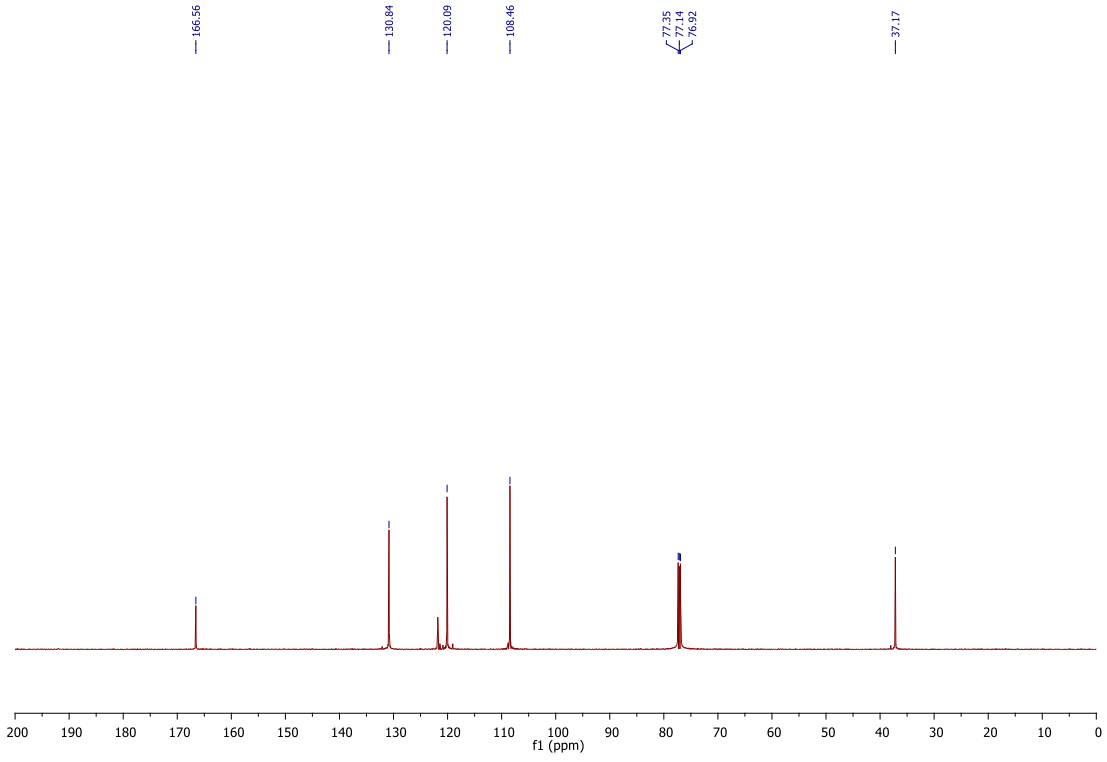
^{13}C{1H} NMR ($CDCl_3$)



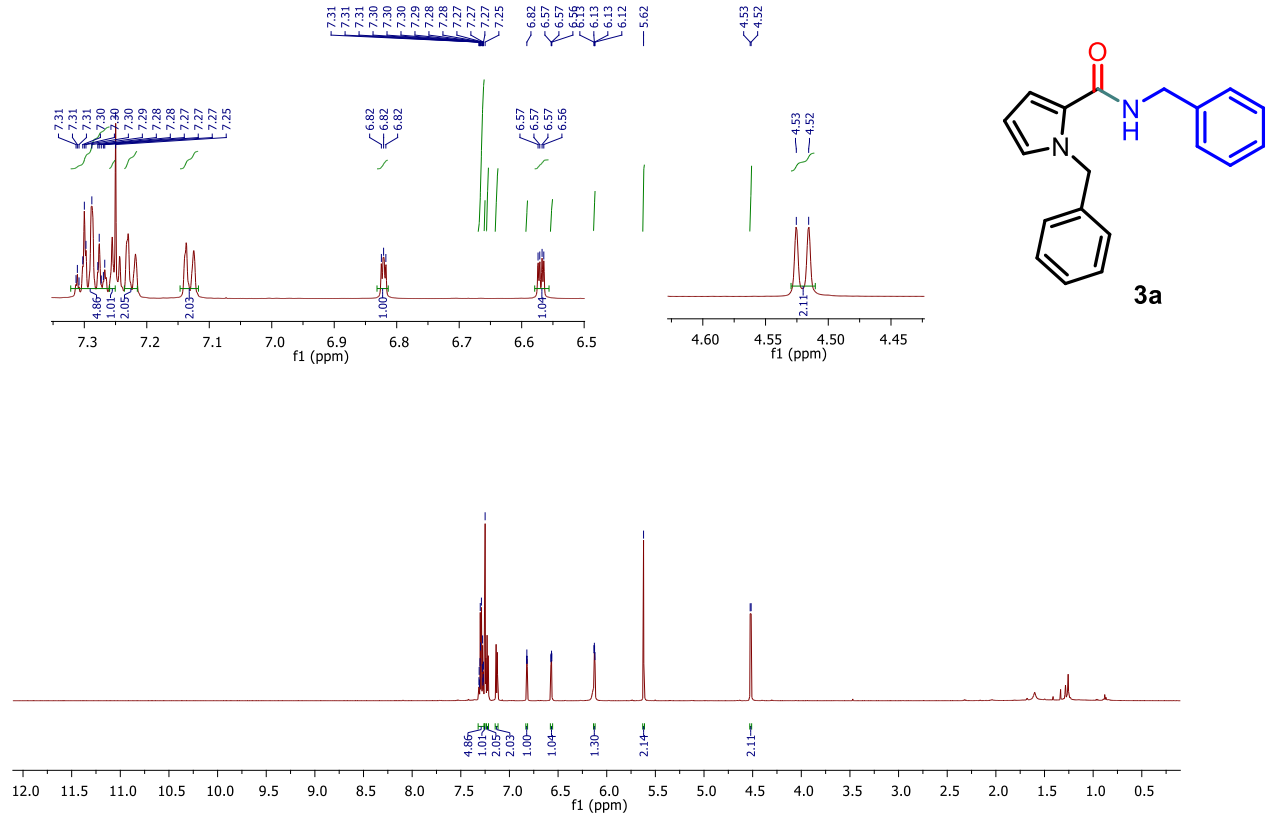
2r ^{1}H NMR ($CDCl_3$)



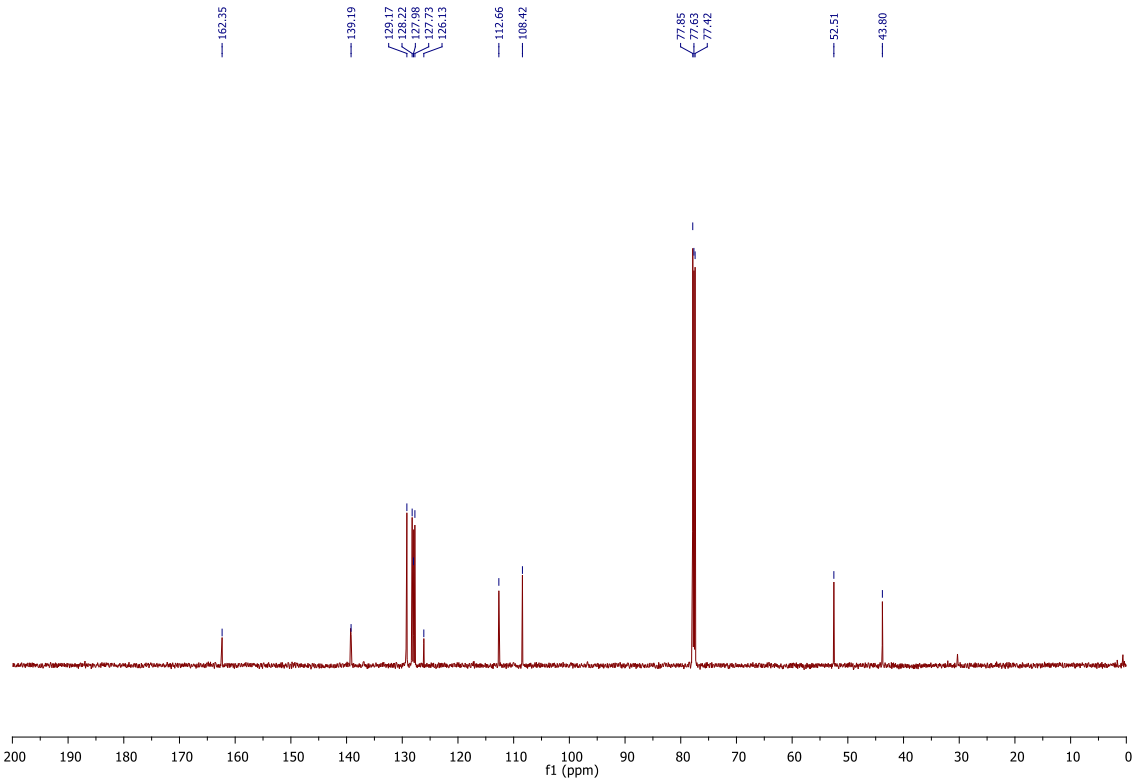
^{13}C{1H} NMR ($CDCl_3$)



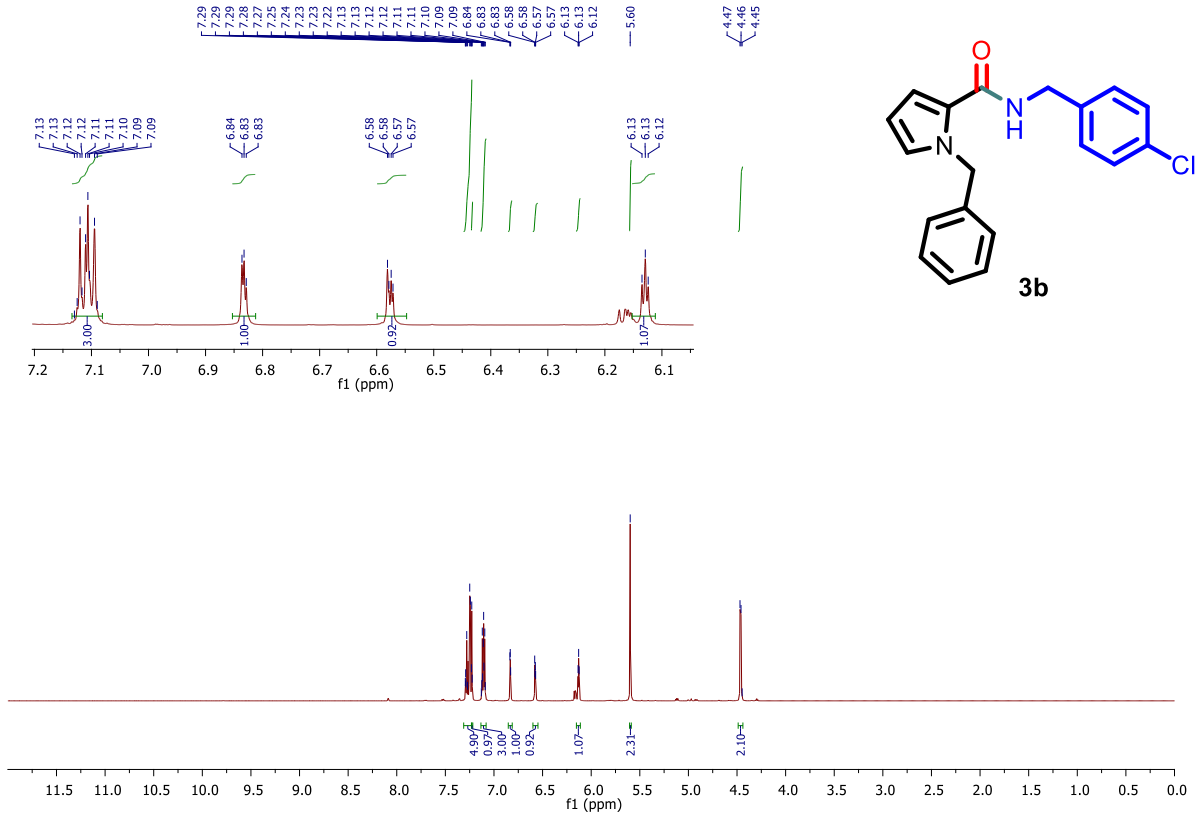
3a ^{1}H NMR ($CDCl_3$)



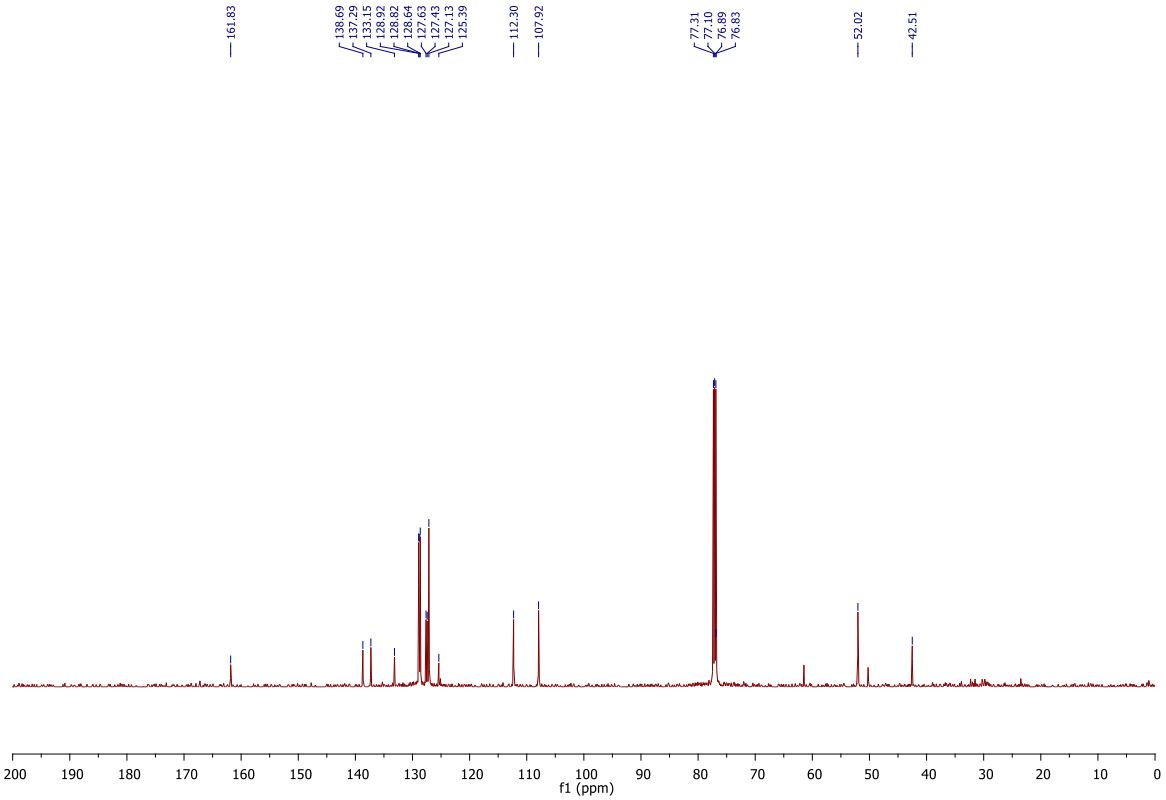
^{13}C{1H} NMR ($CDCl_3$)



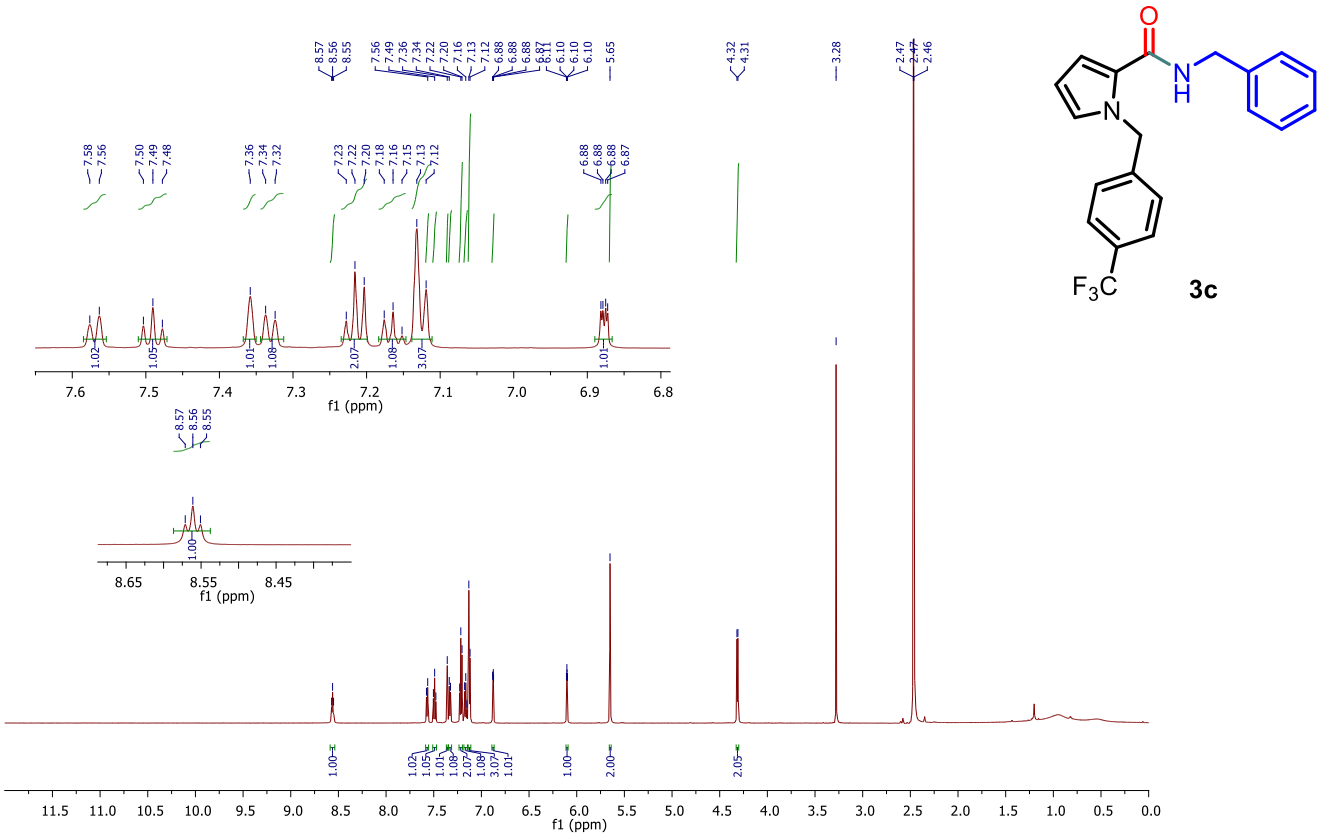
3b ^{1}H NMR ($CDCl_3$)



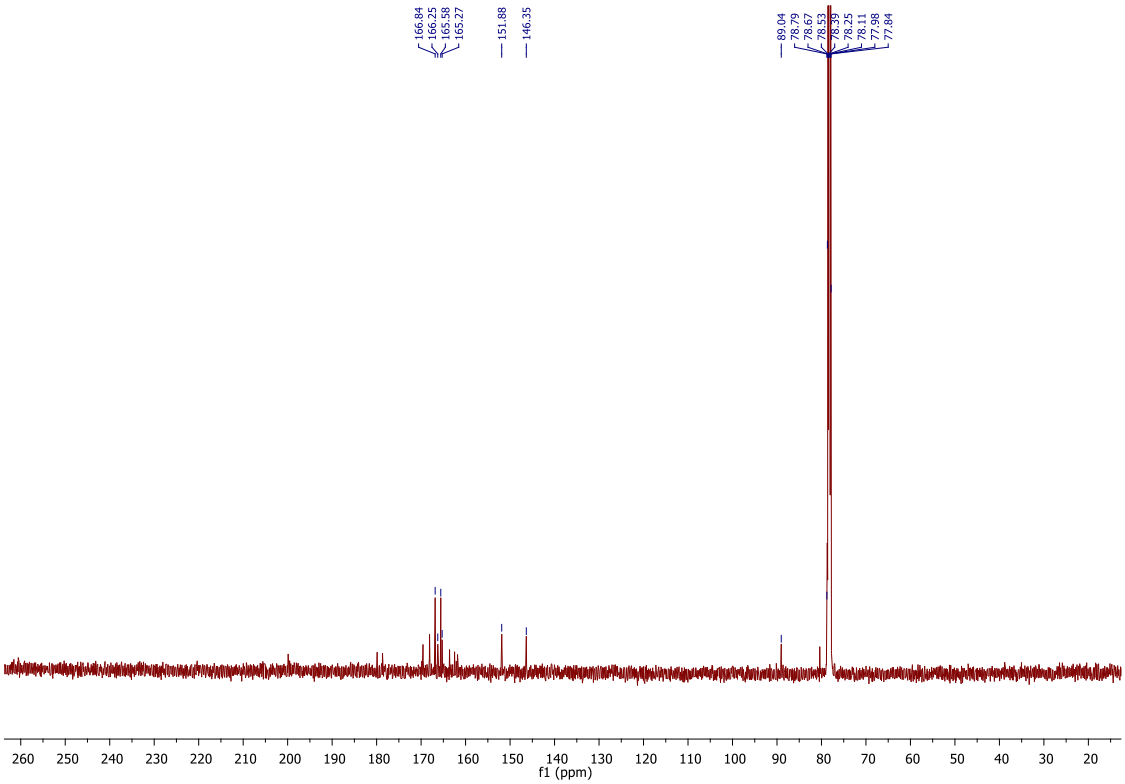
^{13}C{1H} NMR ($CDCl_3$)



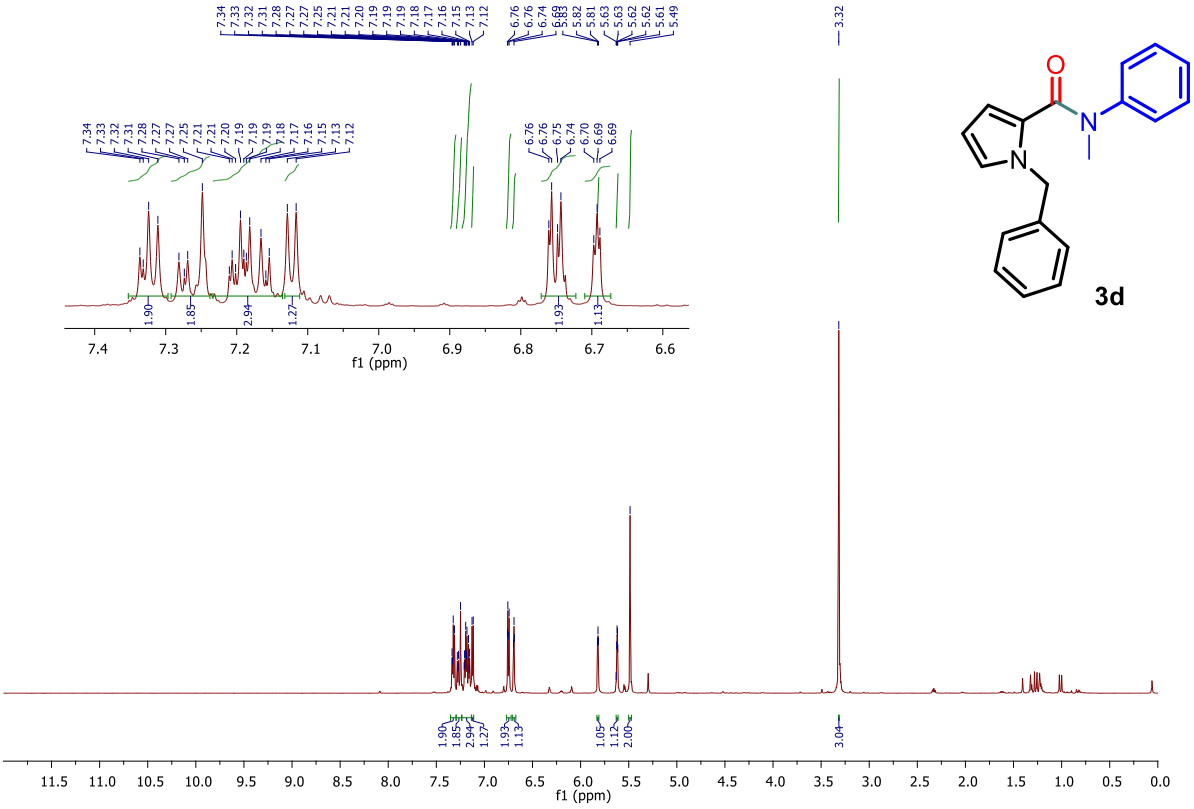
3c ^{1}H NMR (DMSO-d_6)



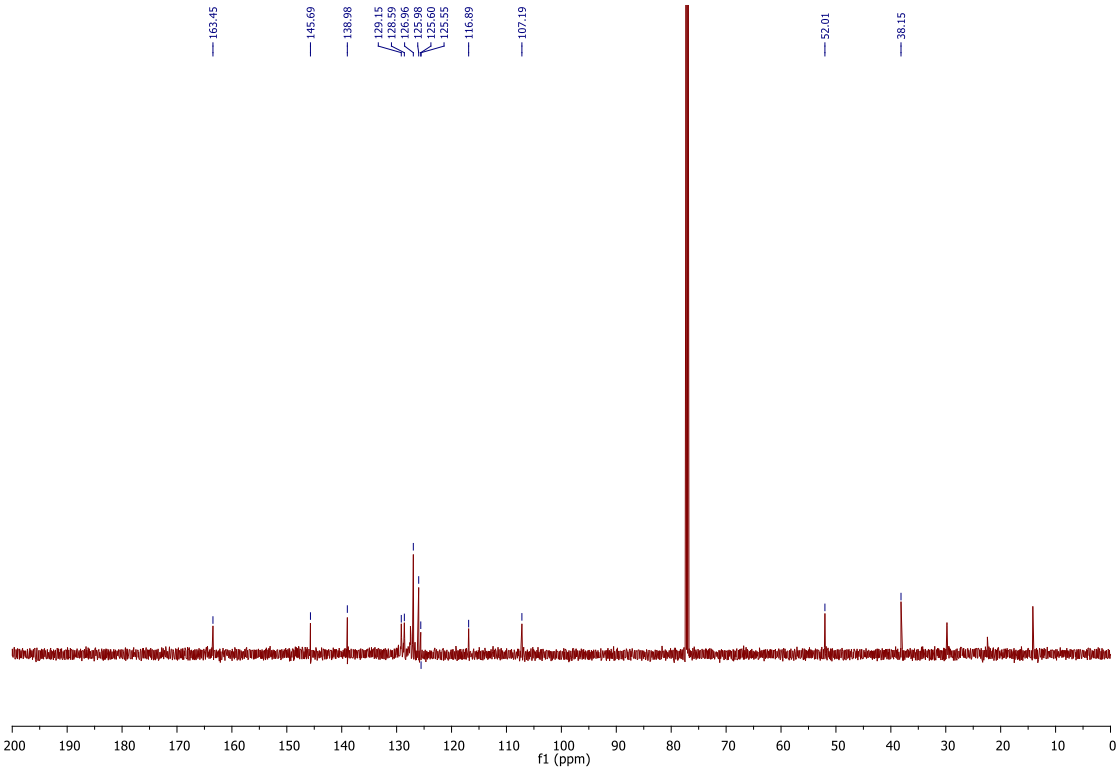
^{13}C{1H} NMR (DMSO-d_6)



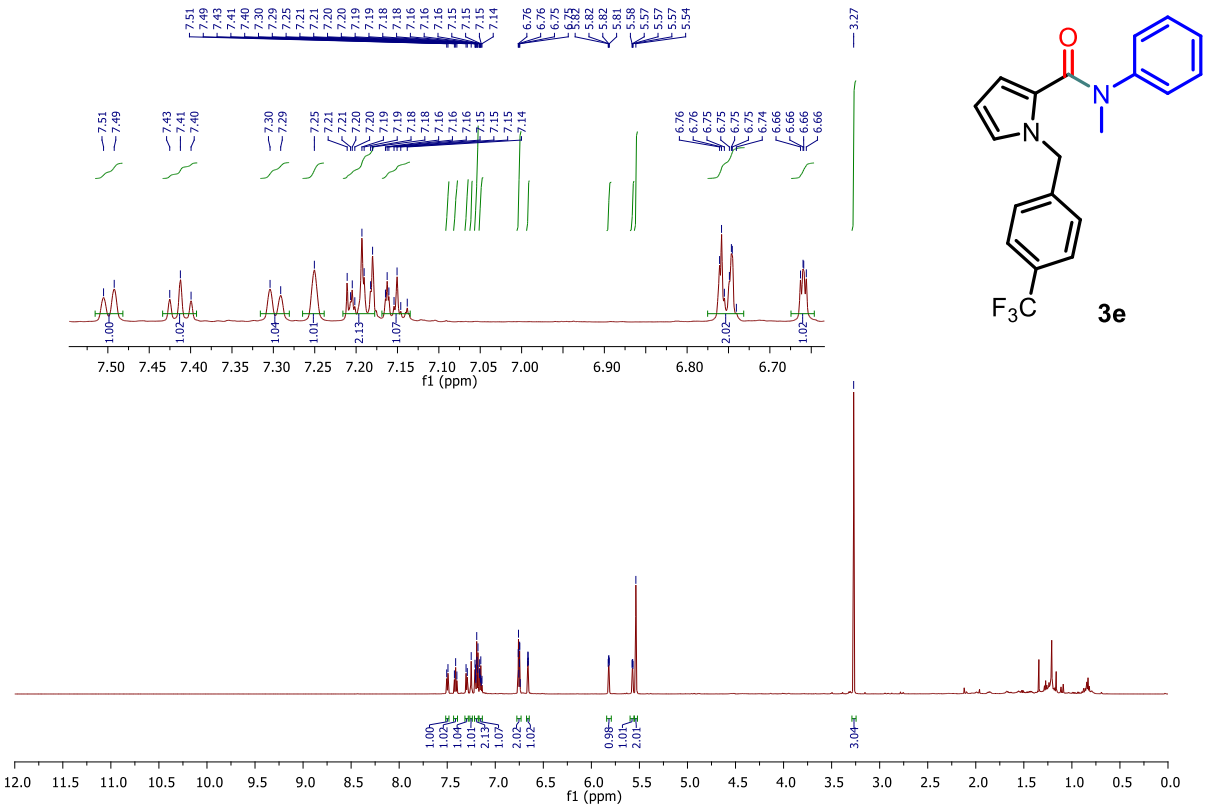
3d ^{1}H NMR ($CDCl_3$)



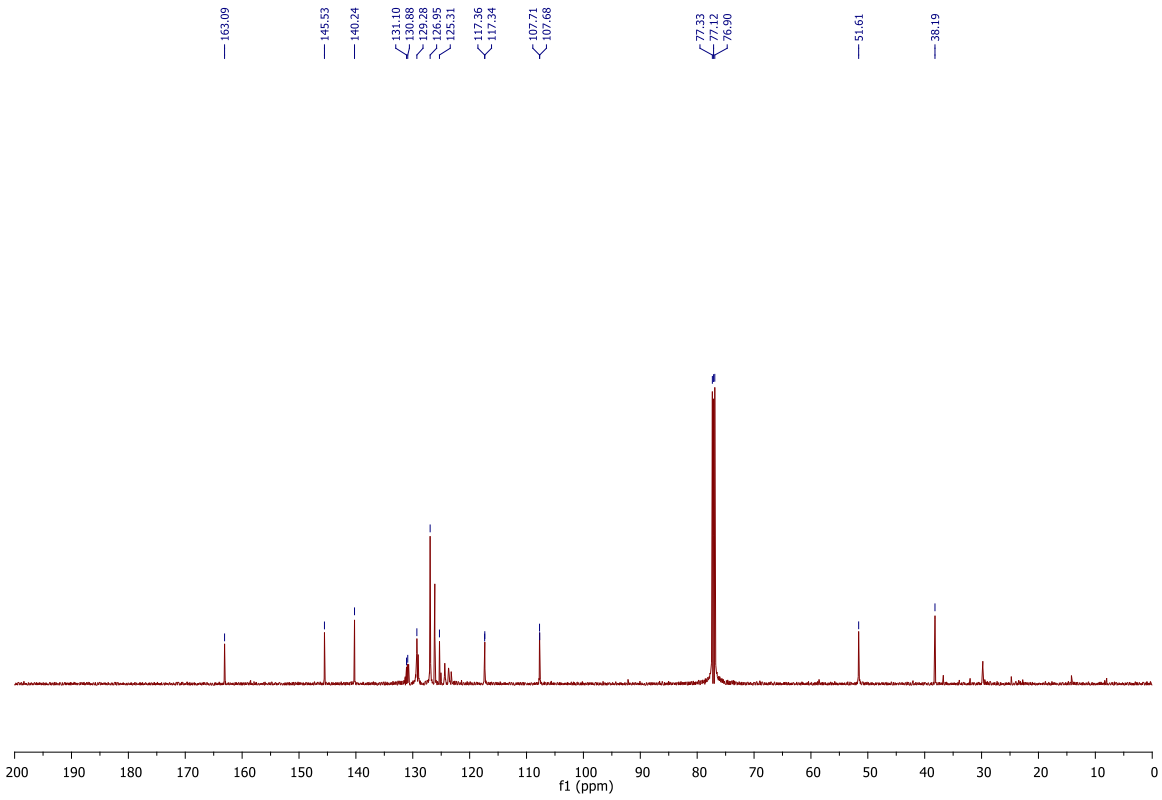
^{13}C{1H} NMR ($CDCl_3$)



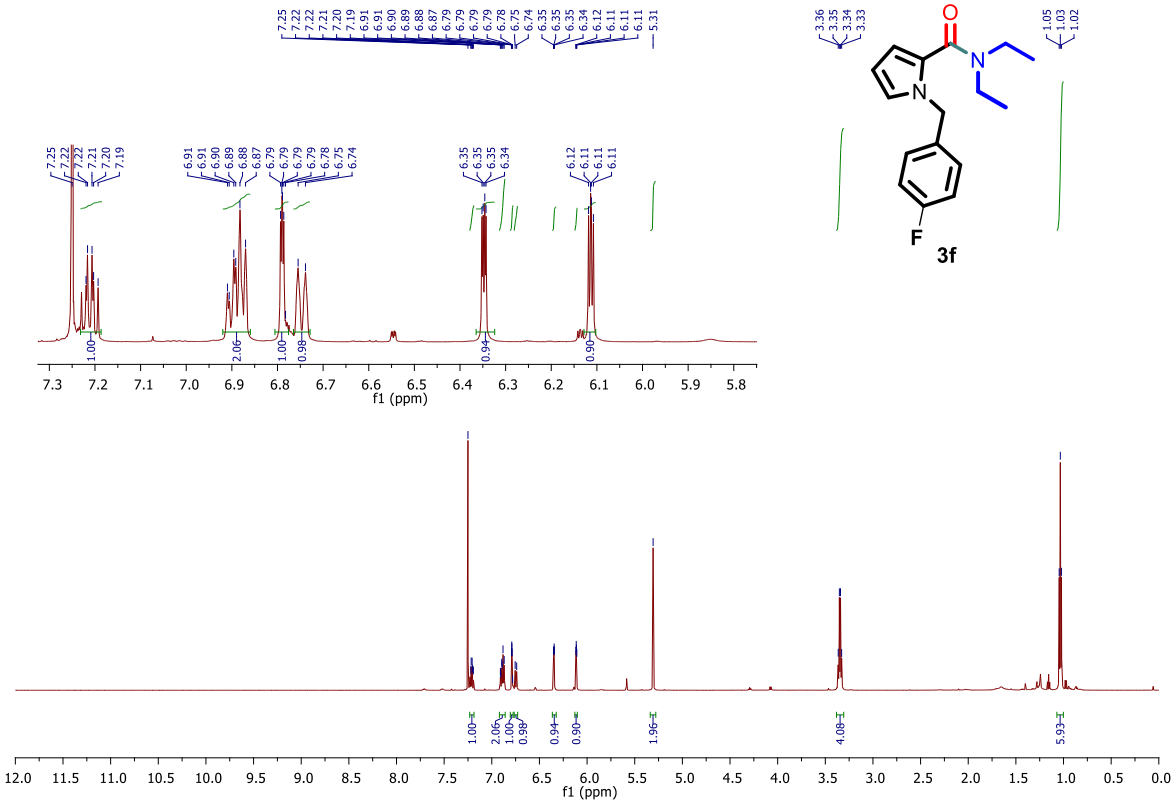
3e ^{1}H NMR ($CDCl_3$)



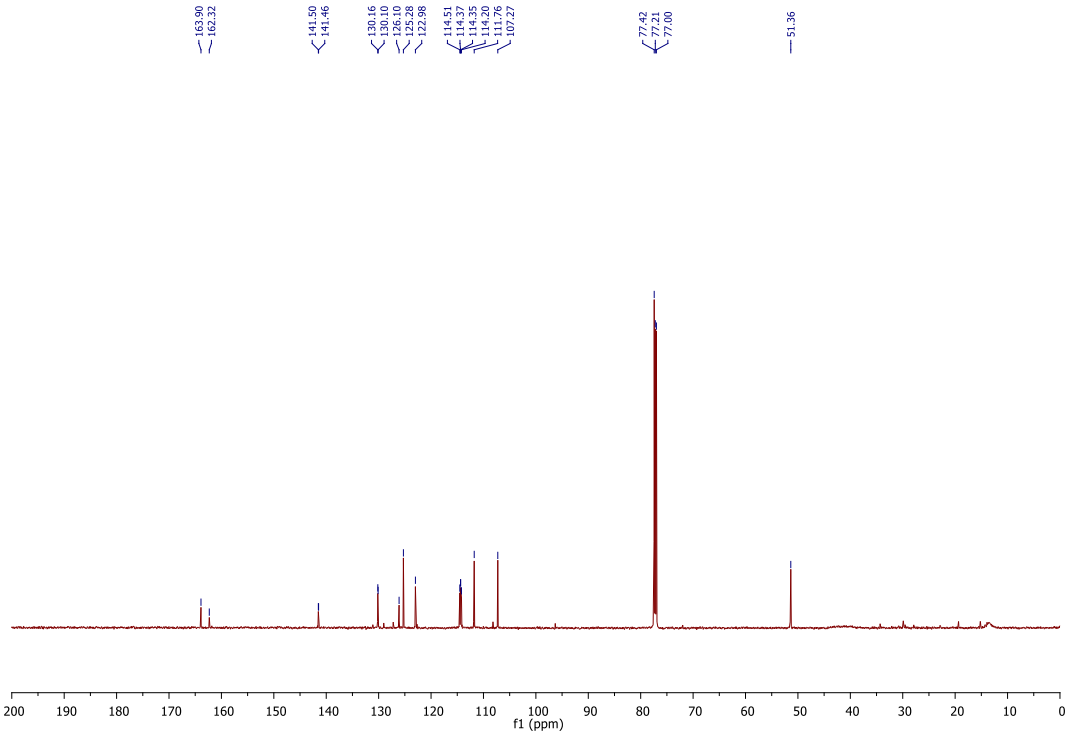
^{13}C{1H} NMR ($CDCl_3$)



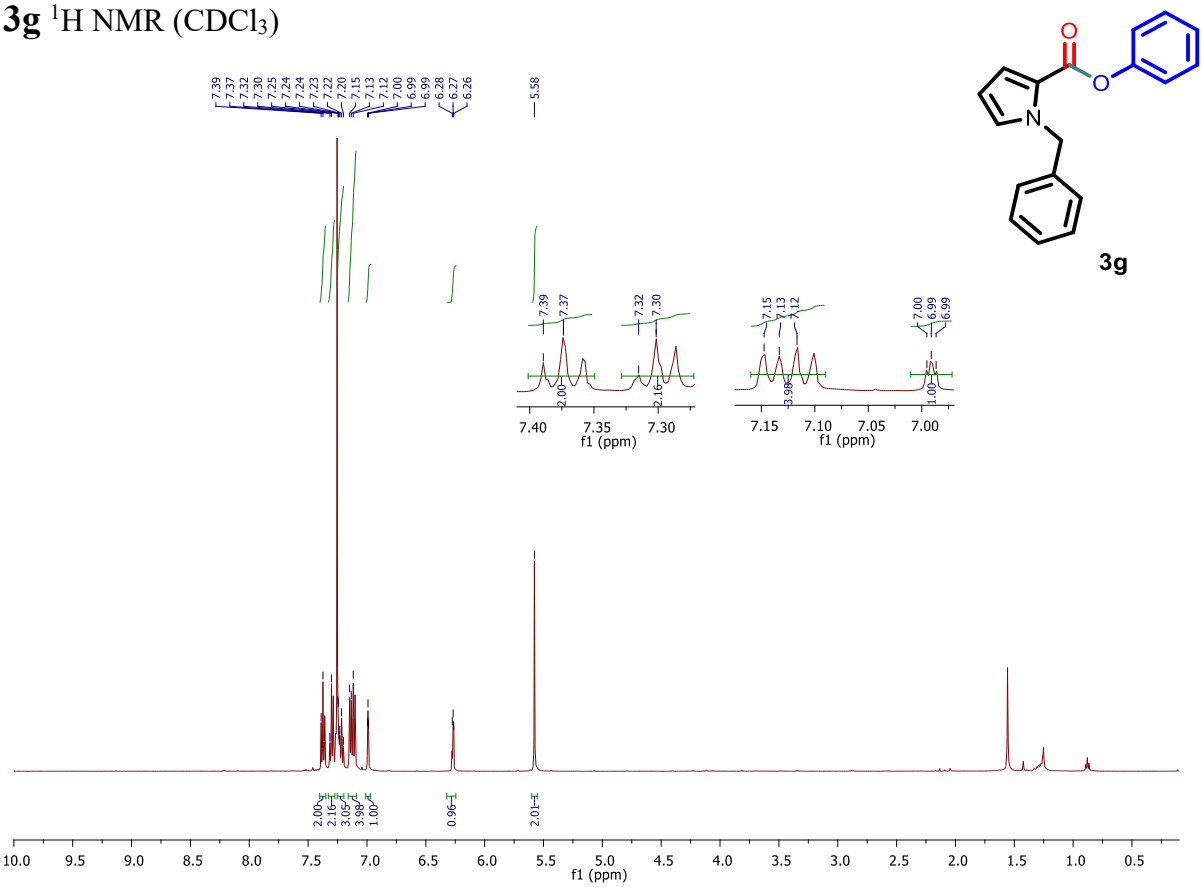
3f ^{1}H NMR ($CDCl_3$)



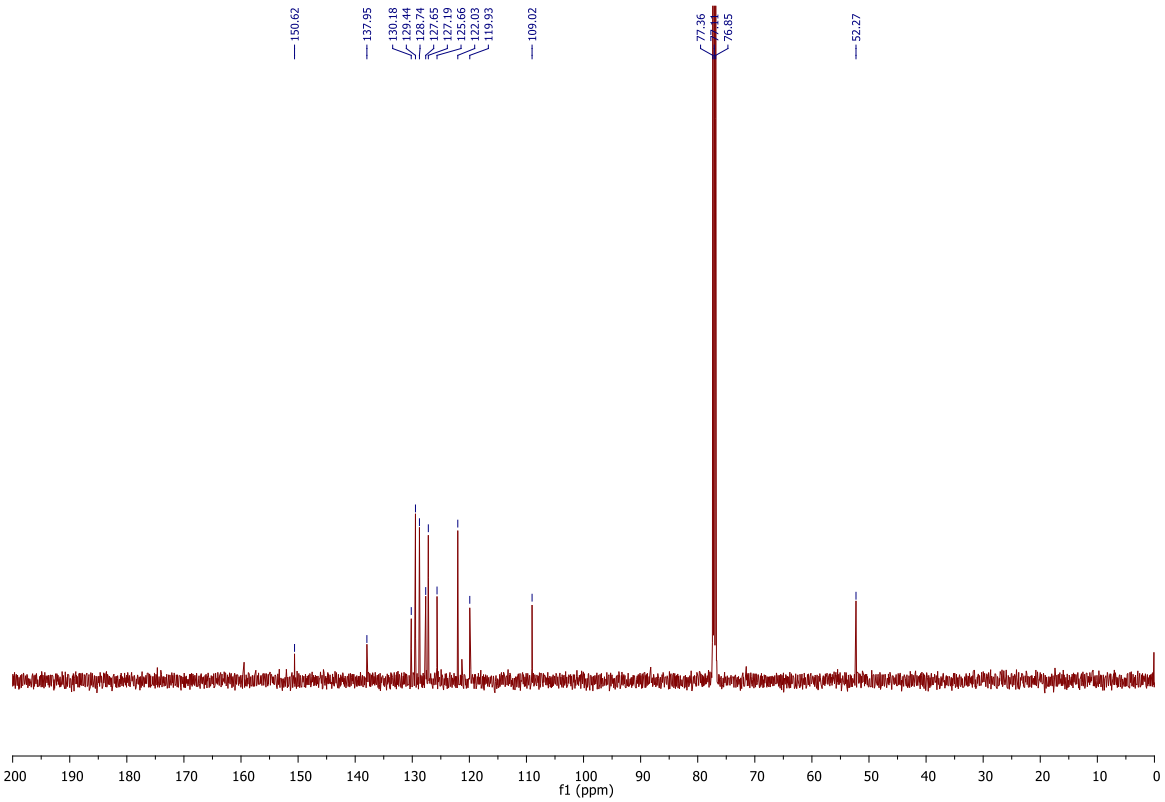
^{13}C{1H} NMR ($CDCl_3$)



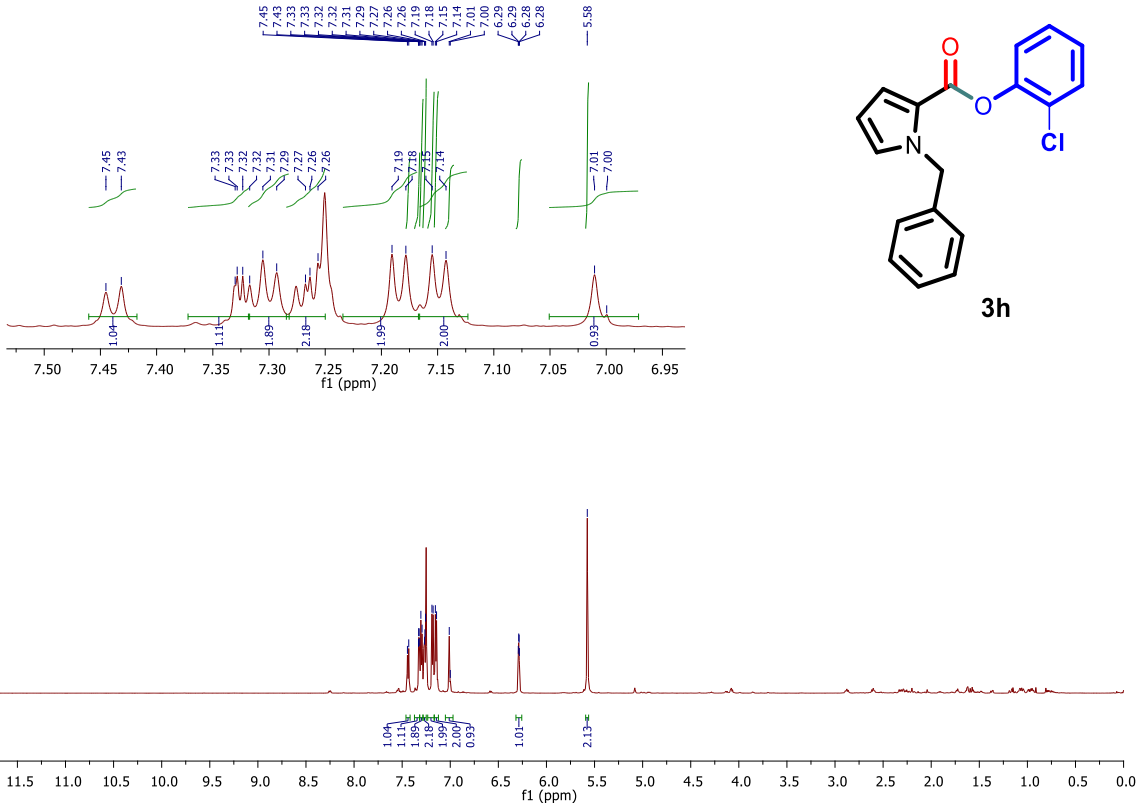
3g ^{1}H NMR ($CDCl_3$)



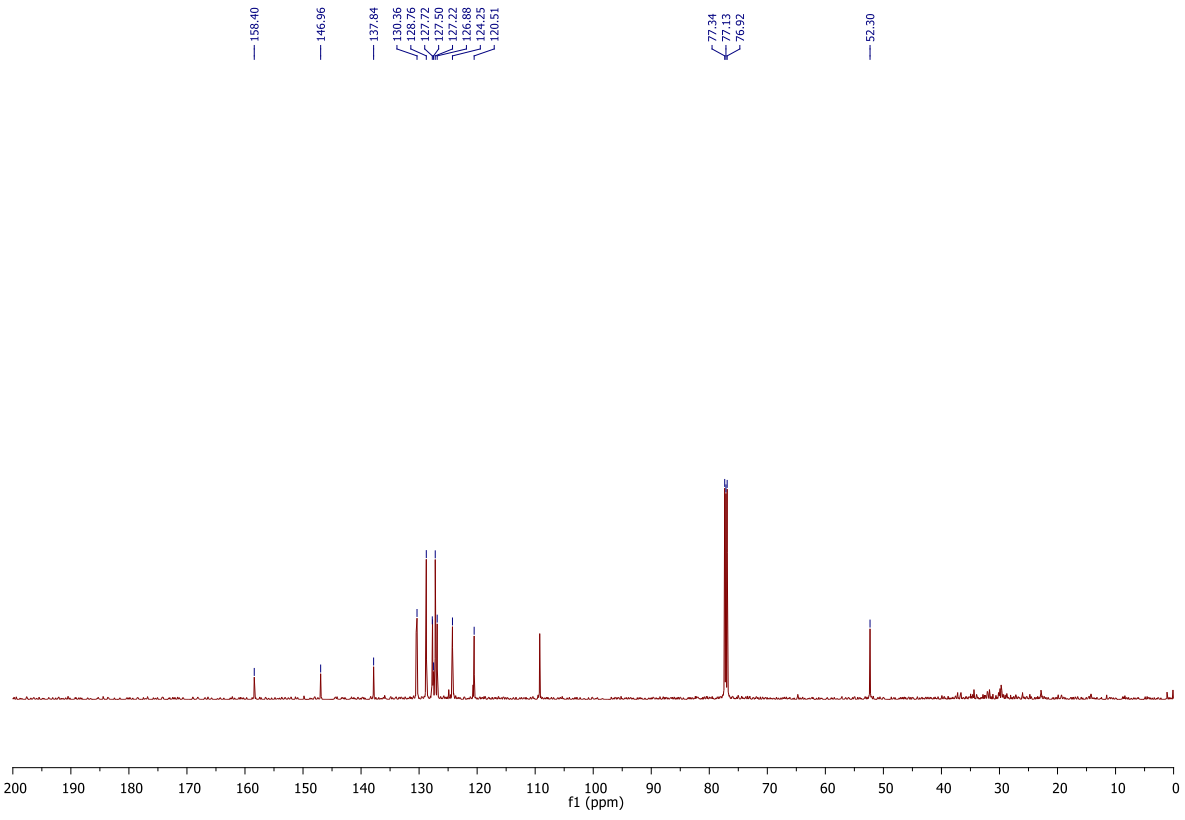
^{13}C{1H} NMR ($CDCl_3$)



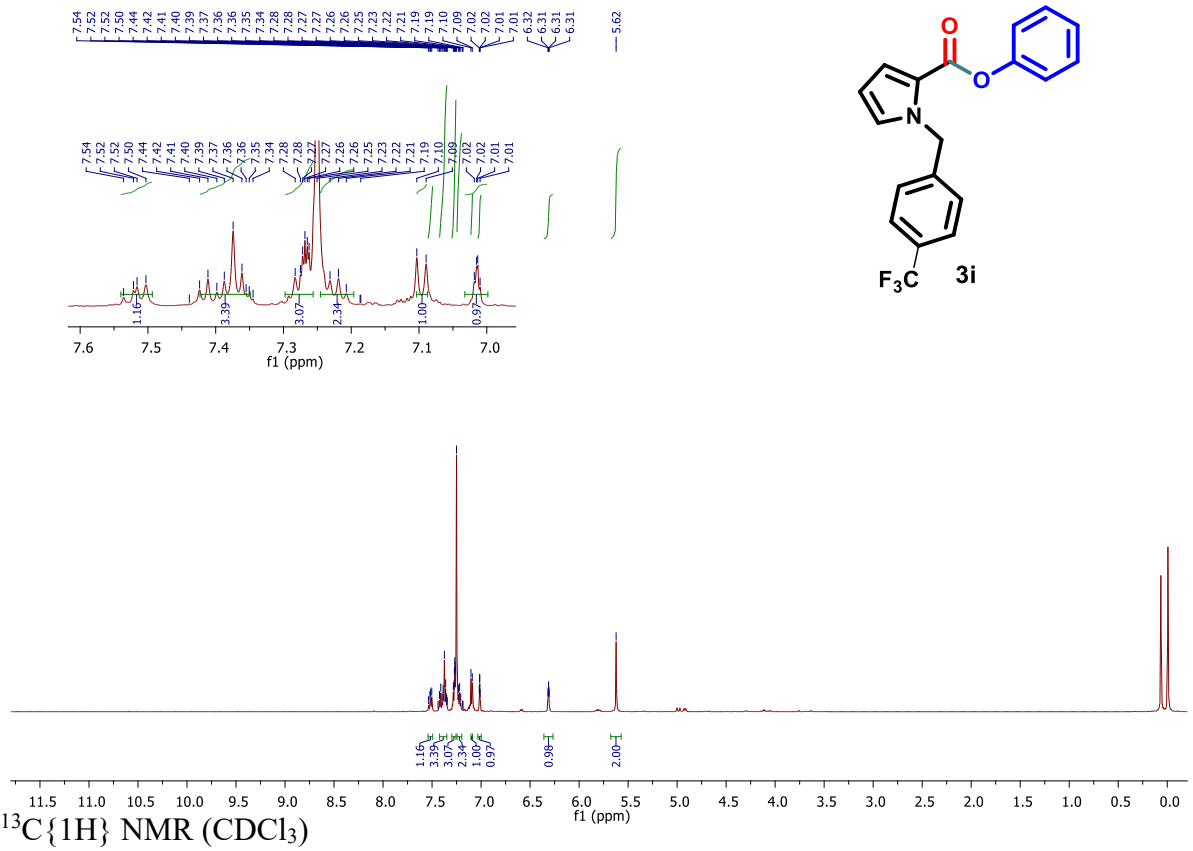
3h ^{1}H NMR ($CDCl_3$)



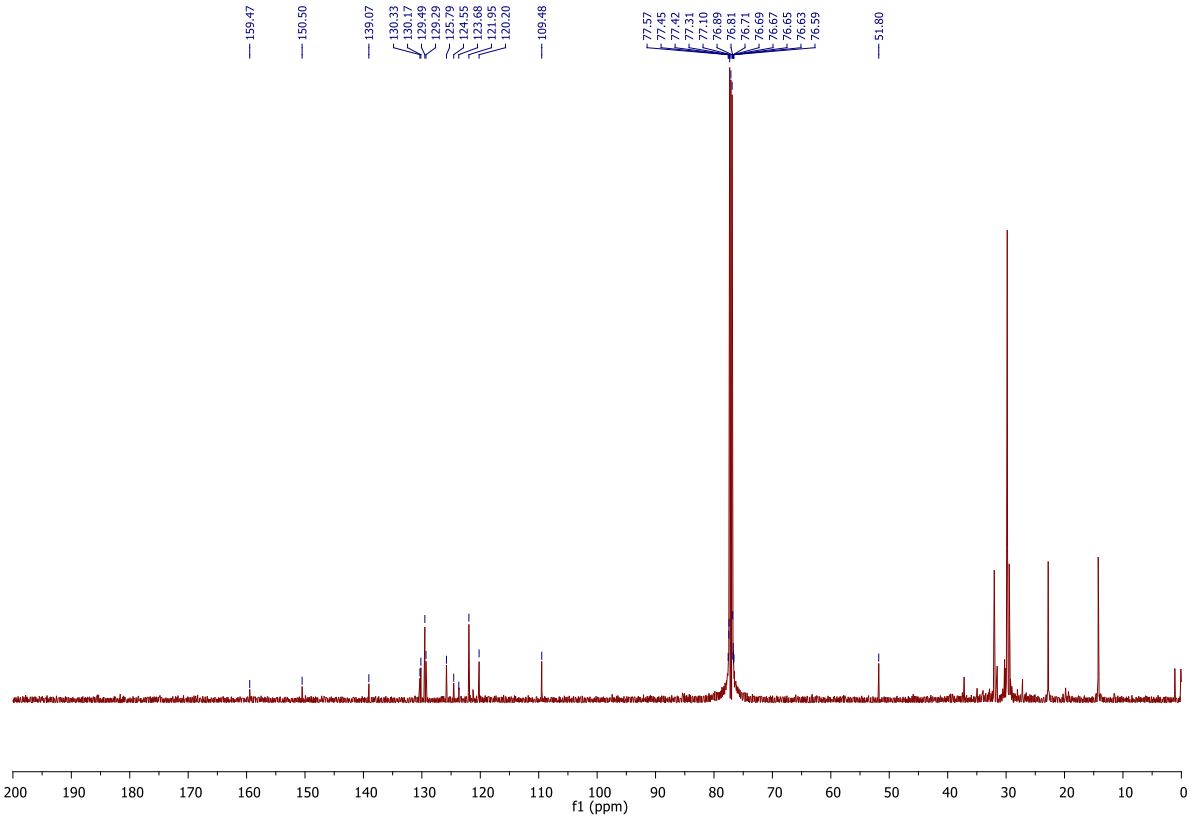
^{13}C{1H} NMR ($CDCl_3$)



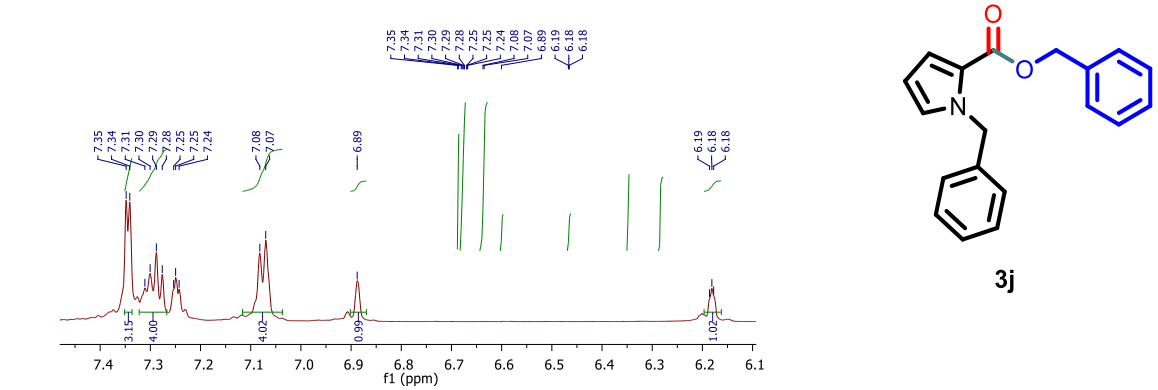
3i ^{1}H NMR ($CDCl_3$)



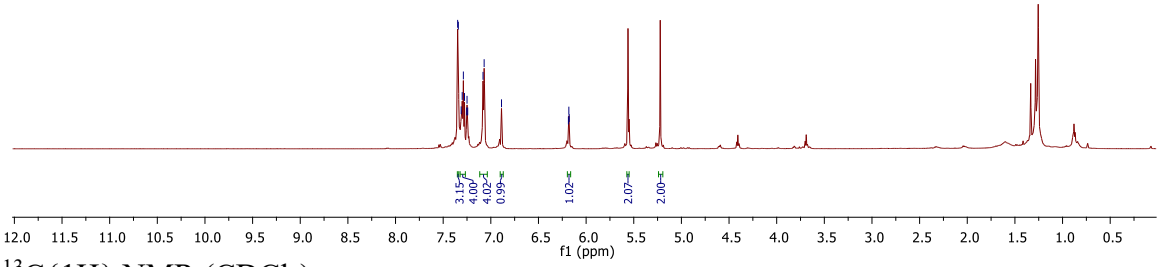
^{13}C{1H} NMR ($CDCl_3$)



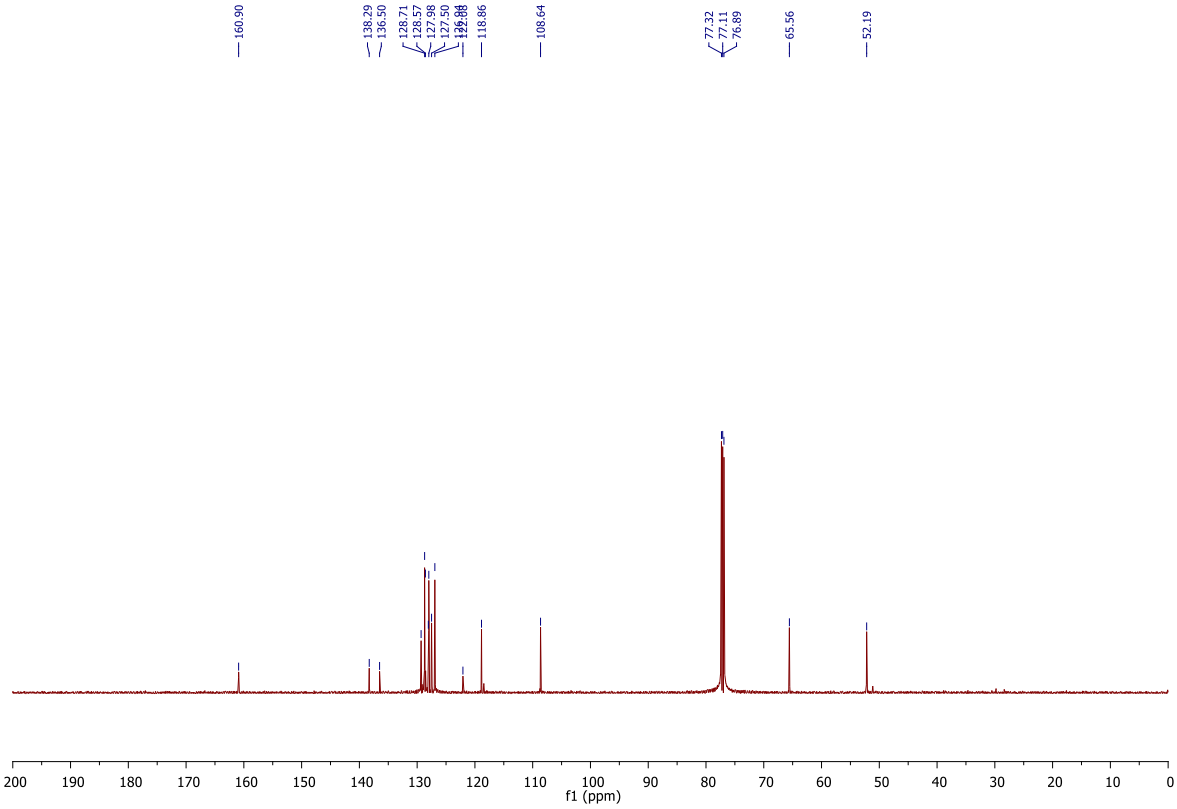
3j ^{1}H NMR ($CDCl_3$)



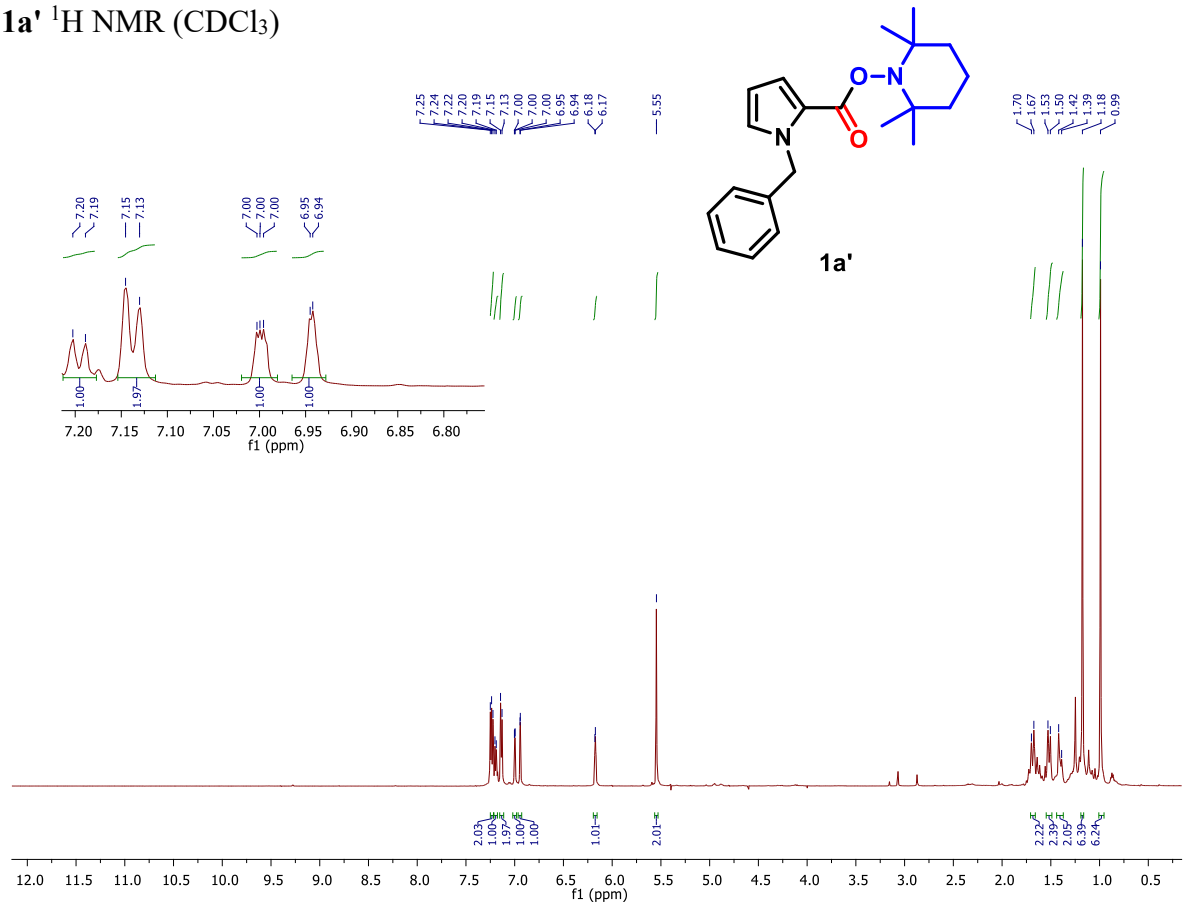
3j



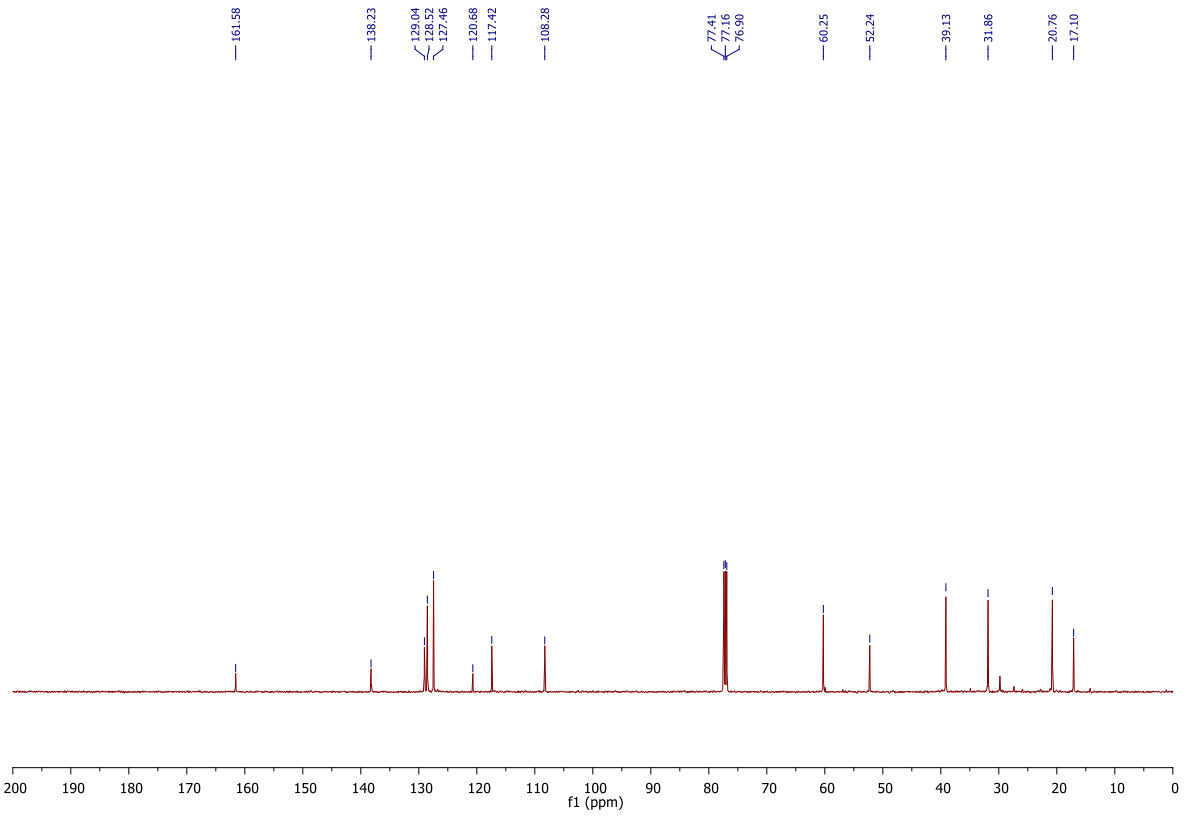
^{13}C{1H} NMR ($CDCl_3$)



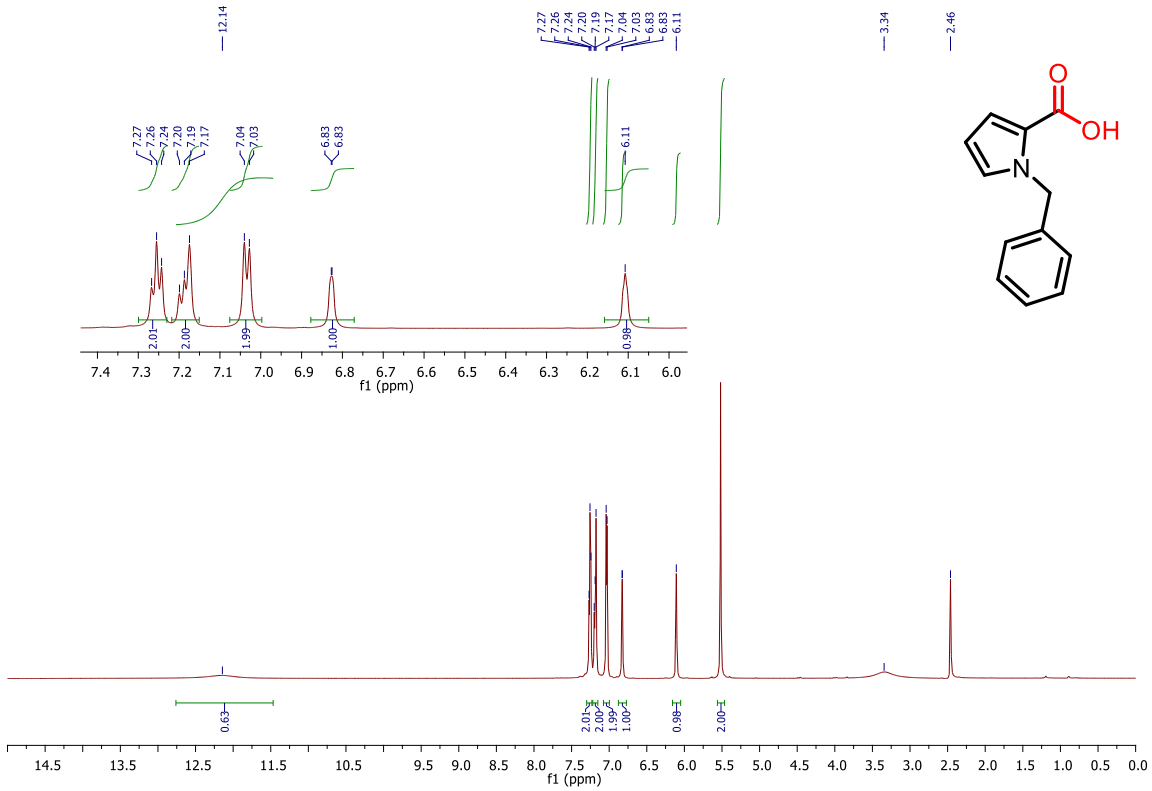
1a' ^{1}H NMR ($CDCl_3$)



$^{13}C\{1H\}$ NMR ($CDCl_3$)



^{1}H NMR (DMSO-d$_6$)



^{13}C{1H} NMR (DMSO-d$_6$)