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Supporting Information for

Diverse Catalytic Reactivity of a Dearomatized PN^{3}P*-Nickel Hydride Pincer Complex Towards CO_2 Reduction

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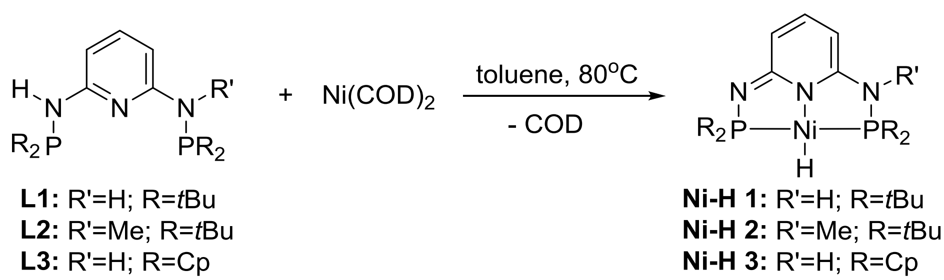
1. General information. All manipulation of air- and/or moisture-sensitive compounds were carried out under an atmosphere of purified argon in a Vacuum Atmospheres glovebox or using standard Schlenk techniques. All solvents were distilled under Ar from appropriate drying agents. Unless otherwise statement, commercial reagents were used as received without purification. NMR spectra were recorded on Bruker Advance 400, Bruker Avance-500, Bruker Avance-600, or Bruker Avance-700 NMR spectrometers in deuterated solvents. ^{1}H NMR chemical shifts were referenced to the residual hydrogen signals of the deuterated solvents (7.26 ppm, $CDCl_3$; 7.16 ppm, C_6D_6; 1.94 ppm, CD_3CN;), and the ^{13}C NMR chemical shifts were referenced to the ^{13}C signals of the deuterated solvents (77.2 ppm, $CDCl_3$; 128.1 ppm, C_6D_6; 67.4, 25.2 ppm, THF-d_8;). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, s = sextet, h = heptet, m = multiplet, br = broad), coupling constants (Hz) and integration. Gas chromatography was performed on Agilent 5975C GC inert XL EI/CI MSD with Triple-Axis MS Detector. The X-ray diffraction data were collected using Bruker-AXS KAPPA-APEXII CCD diffractometer (CuKα, λ= 1.54178 Å). Indexing was performed using APEX2 (Difference Vectors method). Data integration and reduction were performed using SaintPlus 6.01. Absorption correction was performed by multi-scan method implemented in SADABS. Space groups were determined using XPREP implemented in APEX2. Structures were solved using SHELXS-97 (direct methods) and refined using SHELXL-97 (fullmatrix least-squares on F2). Elemental analyses were conducted by Flash 2000-Thermo Scientific CHNO Analyzer.

2. Procedures for preparation of nickel pincer hydride complexes.



Synthesis of nickel pincer hydride complex 1, (PN^{3}P^{*tBu})NiH. To a suspension of 2,6-(tBu$_2$PNH)$_2$C$_6$H$_4$ (**L1**) (398 mg, 1.0 mmol) in toluene (8.0 mL) was added Ni(COD)$_2$ (275 mg, 1.0 mmol) under an argon atmosphere, and the mixture was stirred at 80 °C for 12 h, then cooled to room temperature. The solution was filtered and the solid was washed with pentane (3×3.0 mL), then dried under vacuum. The pale yellow solid (PN^{3}P^{*tBu})NiH (**1**) thus obtained (388 mg, 85%). Crystals of complex (PN^{3}P^{*tBu})NiH (**1**) suitable for X-ray diffraction were obtained by slow evaporation of its pentane solution. ^{1}H NMR (600 MHz, C_6D_6): 6.95 (t, J = 7.6 Hz, 1H), 6.70 (s, 1H), 5.21 (s, 1H), 4.02 (s, 1H), 1.51 (s, 9H), 1.48 (s, 9H), 1.04 (s, 9H), 1.02 (s, 9H), -15.87 (dd, J =58.2, 53.0 Hz, 1H). ^{13}C NMR (THF-d_8, 176 MHz): 173.3 (s), 161.1 (s), 138.2 (s), 104.3 (d, J = 21.9 Hz), 86.7 (br), 36.6 (s), 36.5 (s), 28.9 (s), 28.7 (s). ^{31}P NMR (243 MHz, C_6D_6): 129.1 (d, J = 226.1 Hz), 121.3 (d, J = 221.4 Hz). Elemental analysis (%) for $C_{21}H_{41}N_3NiP_2$: Calculated: C, 55.29; H, 9.06; N, 9.21. Found: C, 55.21; H, 8.96; N, 9.18.

Synthesis of nickel pincer hydride complex 2, (*Me*PN^{3}P^{*tBu})NiH. Following the procedure described for the synthesis of complex (PN^{3}P^{*tBu})NiH (**1**), reaction of **L2** (411 mg, 1.0 mmol) and

$Ni(COD)_2$ (275 mg, 1.0 mmol) gave (*Me*PN^{3}P*^{tBu})NiH (**2**) as a yellow solid (418 mg, 89% yield). Crystals of complex (*Me*PN^{3}P*^{tBu})NiH (**2**) suitable for X-ray diffraction were obtained by slow evaporation of its pentane solution. ^{1}H NMR (400 MHz, C_6D_6): 7.00 (t, *J* = 8.3 Hz, 1H), 6.78 (d, *J* = 8.4, 1H), 5.04 (d, *J* = 7.4 Hz, 1H), 2.55 (d, *J* = 3.5 Hz, 3H), 1.51 (s, 9H), 1.47 (s, 9H), 1.18 (s, 9H), 1.15 (s, 9H), -15.62 (dd, *J* = 60.5, 45.3 Hz, 1H). ^{13}C NMR (C_6D_6, 100 MHz): 173.6 (s), 159.7 (s), 138.7 (s), 106.0 (d, *J* = 21.5 Hz), 86.7 (s), 37.0 (s), 36.8 (s), 29.4 (d, *J* = 2.8 Hz), 28.6, 28.5. ^{31}P NMR (162 MHz, C_6D_6): 138.2 (dd, *J* = 222.6, 15.3 Hz), 130.2 (dd, *J* = 222.7, 23.8 Hz). Elemental analysis (%) for $C_{22}H_{43}N_3NiP_2$: Calculated: C, 56.19; H, 9.22; N, 8.94. Found: C, 56.26; H, 9.17; N, 8.91.

Synthesis of nickel pincer hydride complex 3, (PN^{3}P*^{Cp})NiH. Following the procedure described for the synthesis of complex (PN^{3}P*^{tBu})NiH (**1**), reaction of **L3** (446 mg, 1.0 mmol) and $Ni(COD)_2$ (275 mg, 1.0 mmol) gave (PN^{3}P*^{Cp})NiH (**3**) as a yellow solid (398 mg, 79% yield). ^{1}H NMR (600 MHz, CD_3CN): 7.26-7.14 (m, 1H), 6.91 (t, *J* = 7.9 Hz, 1H), 5.65 (d, *J* = 7.8 Hz, 2H), 1.90-1.84 (m, 10H), 1.70-1.54 (m, 26H), -16.44 (t, *J* =58.1, 1H). ^{13}C NMR (THF-d_8, 176 MHz): 138.5 (s), 129.5 (s), 129.1 (s), 128.8 (s), 125.9 (s), 39.0 (s), 38.8 (s), 30.0 (br), 29.4 (s), 27.3 (br), 27.1 (br). ^{31}P NMR (243 MHz, C_6D_6): 106.5 (d, *J* = 221.7 Hz), 98.7 (d, *J* = 223.5 Hz). Elemental analysis (%) for $C_{25}H_{41}N_3NiP_2$: Calculated: C, 59.55; H, 8.20; N, 8.33. Found: C, 59.47; H, 8.27; N, 8.26.

3. General procedures for hydrosilylation of CO_2 to methanol: The nickel pincer hydride complex **1,** (PN^{3}P*^{tBu})NiH (4.6 mg, 0.01 mmol), and DMF (2.0 mL) were added into a fresh vial. The vial was sealed, and CO_2 was introduced into the vial via a balloon. The reaction was stirred for 30 min at room temperature. Then, Ph_2SiH_2 (184 mg, 1 mmol) was injected via syringe into the vial. The reaction mixture was heated at 60°C in an oil bath for the specified reaction periods. The reaction was left to cool at room temperature, and 2 equivalents of NaOH/H_2O solution was added for the hydrolysis of the silylated methanol. It was stirred for 24 h at room temperature before an aliquot of isopropyl alcohol was added as an internal standard. An aliquot of 0.2 mL was removed from the sample and diluted with CH_2Cl_2 before the resulting mixture was subjected to GC analysis. A GC calibration curve was constructed with isopropanol and various concentrations of methanol to get the linearity of the CH_3OH/isopropanol signal.

4. Typical procedure for the catalytic methylation of amines to methylamines: To a stainless steel autoclave was added the nickel pincer hydride complex **Ni1**, (PN^{3}P*^{tBu})NiH (6.8 mg, 0.015 mmol), dibenzylamine **1a** (98.5 mg, 0.50 mmol), Ph_2SiH_2 (460 mg, 2.5 mmol) and 15.0 mL of CH_3CN. The resulting solution was purged with CO_2 and stirred under 2.7 atm of CO_2 at 120 °C for 24 hours. After reaction, the autoclave was cooled to room temperature, and then CO_2 was vented. The products were isolated by column chromatography on silica gel.

5. Typical procedure for the catalytic formylation of amines to formamides: To a stainless steel autoclave was added the nickel pincer hydride complex **Ni1**, (PN^{3}P*^{tBu})NiH (6.8 mg, 0.015 mmol), dibenzylamine **1a** (98.5 mg, 0.50 mmol), Ph_2SiH_2 (230 mg, 1.25 mmol) and 5.0 mL of CH_3CN. The resulting solution was purged with CO_2 and stirred under 8.2 atm of CO_2 at room temperature for 24 hours. After reaction, the autoclave was cooled to room temperature, and then CO_2 was vented. The products were isolated by column chromatography on silica gel.

6. Table S1. Solvent screening for hydrosilylation of CO_2 to methanol.

$$CO_2 + Ph_2SiH_2 \xrightarrow[\text{RT to 60 }^{o}\text{C}]{\textbf{Ni-H 1}\text{ 1.25\% (based on Si-H)}} \xrightarrow[\text{rt, 24 h}]{NaOH/H_2O} CH_3OH$$

Entry	Solvent	Time [h][b]	Yield [%][c]
1	THF	20	83
2	CH_3CN	28	87
3[d]	CH_2Cl_2	N/A	N/A
4[d]	Toluene	N/A	N/A

[a] Reaction conditions: CO_2 balloon, catalyst, 1.0 mmol of Ph_2SiH_2, 2.0 mL of solvent. [b] Time required for the full consumption of Ph_2SiH_2 monitored by GC/MS. [c] Yields of methanol determined by GC based on Si-H. [d] No methanol was observed.

7. Table S2. Hydrosilane screening for hydrosilylation of CO_2 to methanol.

$$CO_2 + \text{hydrosilane} \xrightarrow[\text{RT to 60 }^{o}\text{C}]{\textbf{Ni-H 1}\text{ 1.25\% (based on Si-H)}} \xrightarrow[\text{rt, 24 h}]{NaOH/H_2O} CH_3OH$$

Entry	Hydrosilane (mmol)	Time [h][b]	Yield [%][c]
1	$PhSiH_3$ (2/3)	24	90
2[d]	Et_3SiH (2)	N/A	N/A
3[d]	$(EtO)_3SiH$ (2)	N/A	N/A
4[d]	*i*-Pr_3SiH (2)	N/A	N/A

[a] Reaction conditions: CO_2 balloon, catalyst, 2.0 mL of DMF. [b] Time required for the full consumption of hydrosilane monitored by GC/MS. [c] Yields of methanol determined by GC based on Si-H. [d] No methanol was observed.

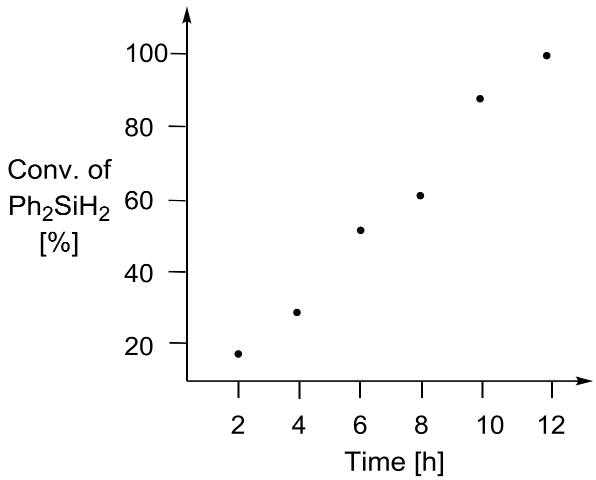
8. Table S3. Catalysts screening for hydrosilylation of CO_2 to methanol.

$$CO_2 + Ph_2SiH_2 \xrightarrow[\text{DMF, RT to 60 }^{o}\text{C}]{\text{[Ni-H] catalyst}} \xrightarrow[\text{rt, 24 h}]{NaOH/H_2O} CH_3OH$$

Entry	Catalyst	Catalyst loading [% Si-H]	Time [h][b]	Yield [%][c]	TON
1	**Ni1**	1.25	12	91	73
2	**Ni2**	1.25	12	41	33
3	**Ni3**	1.25	12	63	50

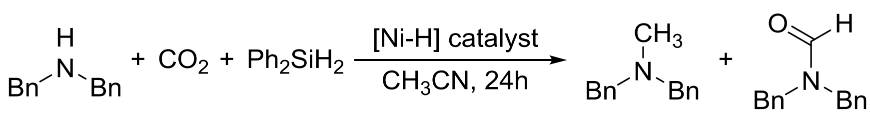
[a] CO_2 balloon, catalyst, 1.0 mmol of Ph_2SiH_2, 2.0 mL of DMF. [b] Time required for the full consumption of Ph_2SiH_2 monitored by GC/MS. [c] Yields of CH_3OH determined by GC based on Si-H.

9. Figure S1. Typical time profile.



Typical time profile.
Conditions: CO_2 balloon, **Ni1** (1.25%), 1.0 mmol of Ph_2SiH_2, 2.0 mL of DMF at 60 °C.

10. Table S4. Optimization of the reductive functionalization of dibenzylamine with CO_2 and Ph_2SiH_2 catalyzed by PN^3P*-Ni hydride complexes.[a]



1a **2a** **3a**

Entry	[Ni-H] catalyst	P_{CO_2} [atm]	T [°C]	Yield [%][b]	
				2a	**3a**
1	**Ni1**	2.7	100	85	11
2[c]	—	2.7	100	<1	7
3	**Ni1**	2.7	120	93	<5
4	**Ni1**	5.4	120	62	31
5	**Ni1**	5.4	80	41	53
6[d]	**Ni1**	5.4	80	<1	96
7[d]	**Ni1**	8.2	r.t.	<1	96
8	**Ni2**	2.7	120	81	16
9	**Ni3**	2.7	120	89	6
10[d]	**Ni2**	8.2	r.t.	11	85
11[d]	**Ni3**	8.2	r.t.	7	90

Condition: [a] [Ni-H] complex (0.015 mmol), **1a** (0.50 mmol), Ph_2SiH_2 (2.5 mmol), CH_3CN (15.0 mL), 24 h. [b] Determined by ^1H NMR spectroscopy of the crude reaction mixture using CH_2Br_2 as the internal standard. [c] Without catalyst. [d] 2.5 equiv. of Ph_2SiH_2, 5 mL of CH_3CN.

11. Crystallographic data for nickel hydride PN^3P^*-pincer complexes 1, 2 and 3.

	(PN^3P^{*tBu})NiH **1**	$(MePN^3P^{*tBu})$NiH **2**	(PN^3P^{*Cp})NiH **3**
Formula	$C_{21}H_{41}N_3NiP_2$	$C_{22}H_{43}N_3NiP_2$	$C_{25}H_{41}N_3NiP_2$
Formula weight	456.20	470.22	504.26
Crystsyst	orthorhombic	orthorhombic	tetragonal
Space group	Pbca	Pna21	I 41/a
T[K]	293	100	120
a[Å]	11.1132(4)	21.7707(14)	20.386(4)
b[Å]	15.6569(6)	8.2148(5)	20.386(4)
c[Å]	28.2950(12)	14.0657(9)	24.639(5)
α[deg]	90	90	90
β[deg]	90	90	90
λ[deg]	90	90	90
V[Å3]	4923.3(3)	2515.5(3)	10240(4)
Z	8	4	16
Density[$gcm^{-3]}$	1.231	1.242	1.308
F(000)	1968	1016	4320
θ range (°)	3.1 to 28.8	4.1 to 65.0	2.674 to 33.980
Data collected (*hkl*)	$-14 \leq h \leq 14$ $-19 \leq k \leq 21$ $-37 \leq l \leq 37$	$-25 \leq h \leq 25$ $-8 \leq k \leq 9$ $-16 \leq l \leq 16$	$-31 \leq h \leq 31$ $-32 \leq k \leq 30$ $-36 \leq l \leq 38$
Reflns collected/unique	30459/5979	31183/4211	306993/10043
Data/restrains/para	5979/0/248	4211/0/271	10043/0/288
Goodness-of-fit on F^2	1.049	1.007	1.062
Final R_1, wR_2 [I>2σ(I)]	0.0391, 0.0982	0.0403, 0.0962	0.0224, 0.0592
R_1, wR_2 (all data)	0.0508, 0.1055	0.0430, 0.1106	0.0250, 0.0606
Δρmax, min/e Å-3	0.38, -0.28	1.01, -0.50	0.46, -0.36

12. Product characterization.

***N*-methyldibenzylamine**:[1] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=7.41-7.39 (m, 4H), 7.37-7.34 (m, 4H), 7.29-7.26 (m, 2H), 3.55 (s, 4H), 2.22 (s, 3H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=139.4, 129.0, 128.4, 127.1, 62.0, 42.4.

***N*,*N*-dimethyl-1-phenylmethanamine**:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.36-7.33 (m, 4H), 7.30-7.27 (m, 1H), 3.45 (s, 2H), 2.27 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=138.9, 129.1, 128.3, 127.1, 64.5, 45.4.

***N*-cyclohexyl-*N*-methylcyclohexanamine**:[3] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=2.44-2.39 (m, 2H), 2.16 (s, 3H), 1.70-1.69 (m, 8H), 1.54-1.51 (m, 2H), 1.20-1.12 (m, 8H), 1.04-0.97 (m, 2H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=59.4, 32.9, 30.5, 26.3, 26.2.

***N*-dodecyl-*N*-methyldodecan-1-amine**:[4] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=2.23-2.20 (m, 4H), 2.10 (s, 3H), 1.38-1.35 (m, 4H), 1.21-1.16 (m, 36H), 0.78 (t, J = 7.0 Hz, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=57.9, 42.2, 32.0, 29.8, 29.7, 29.7, 29.4, 27.7, 27.3, 22.7, 14.1.

1,2,2,6,6-pentamethylpiperidine:[5] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=2.19 (s, 3H), 1.50-1.46 (m, 2H), 1.41-1.40 (m, 4H), 1.00 (s, 12H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=53.8, 41.3, 28.6, 26.4, 18.0.

***N*,*N*-dimethylaniline**:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.31-7.28 (m, 2H), 6.81-6.77 (m, 3H), 3.00 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=150.8, 129.2, 116.8, 112.8, 40.8.

***N*-ethyl-*N*-methylaniline**:[6] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.30 (t, J = 7.9 Hz, 2H), 6.80-6.75 (m, 3H), 3.48-3.45 (m, 2H), 2.97 (s, 3H), 1.19 (t, J = 7.1 Hz, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=149.3, 129.3, 116.2, 112.6, 47.0, 37.6, 11.3.

4-methoxy-*N*,*N*-dimethylaniline:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=6.86 (d, J = 8.4 Hz, 2H), 6.77 (d, J = 8.8 Hz, 2H), 3.78 (s, 3H), 2.88 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=152.1, 145.9, 115.1, 114.8, 55.9, 42.0.

4-chloro-*N*,*N*-dimethylaniline:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.21-7.18 (m, 2H), 6.67-6.64 (m, 2H), 2.94 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=149.3, 128.9, 121.5, 113.8, 40.8.

4-bromo-*N*,*N*-dimethylaniline:[2] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=7.33-7.30 (m, 2H), 6.60-6.58 (m, 2H), 2.94-2.93 (m, 6H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=149.6, 131.8, 114.2, 108.6, 40.7.

4-methoxy-*N*-(4-methoxyphenyl)-*N*-methylaniline:[5] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.03 (d, J = 8.5 Hz, 4H), 7.03 (d, J = 8.7 Hz, 4H), 3.85 (s, 6H), 3.31 (s, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=154.3, 143.7, 121.5, 114.5, 55.5, 41.0.

4-methylmorpholine:[7] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=3.58-3.57 (m, 4H), 2.27 (br, 4H), 2.15 (s, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=66.9, 55.4, 46.4.

1-methyl-1,2,3,4-tetrahydroquinoline:[8] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=7.27-7.23 (m, 1H), 7.12 (d, J = 7.3 Hz, 1H), 6.80-6.76 (m, 2H), 3.37 (t, J = 5.7 Hz, 2H), 3.04 (s, 3H), 2.94 (t, J = 6.5 Hz, 2H), 2.17-2.12 (m, 2H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=146.8, 128.9, 127.1, 122.9, 116.3, 111.0, 51.3, 39.2, 27.9, 22.5.

1,2-dimethylindoline:[9] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.11-7.05 (m, 2H), 6.68 (t, *J* = 7.1 Hz, 1H), 6.47 (d, *J* = 7.9 Hz, 1H), 3.45-3.38 (m, 1H), 3.09 (q, *J* = 8.2 Hz, 1H), 2.73 (s, 3H), 2.64-2.59 (m, 1H), 1.34 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=153.7, 129.3, 127.5, 124.1, 117.9, 107.3, 63.0, 37.5, 33.9, 18.9.

1-(4-chlorophenyl)-*N,N*-dimethylmethanamine:[10] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.28 (d, *J* = 8.4 Hz, 2H), 7.23 (d, *J* = 8.5 Hz, 2H), 3.37 (s, 2H), 2.22 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=137.6, 132.8, 130.4, 128.5, 63.7, 45.4.

1-(4-methoxyphenyl)-*N,N*-dimethylmethanamine:[11] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.19 (d, *J* = 8.6 Hz, 2H), 6.83 (d, *J* = 8.7 Hz, 2H), 3.75 (s, 3H), 3.34 (s, 2H), 2.20 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=158.8, 130.7, 130.3, 113.6, 63.7, 55.1, 45.1.

***N,N*-dimethyl-1,1-diphenylmethanamine**:[12] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.51 (d, *J* = 7.3 Hz, 4H), 7.34 (t, *J* = 7.6 Hz, 4H), 7.24 (t, *J* = 7.3 Hz, 2H), 4.15 (s, 1H), 2.28 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=143.6, 128.6, 127.9, 127.0, 78.2, 44.9.

***N,N*,4-trimethylaniline**:[8] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.19-7.17 (m, 2H), 6.82-6.80 (m, 2H), 3.01 (s, 6H), 2.39 (s, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=149.0, 129.7, 126.1, 113.3, 41.1, 20.4.

***N,N*,2-trimethylaniline**:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.35-7.32 (m, 2H), 7.22-7.20 (m, 1H), 7.14-7.12 (m, 1H), 2.87 (s, 6H), 2.53 (s, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=152.8, 132.2, 131.2, 126.5, 122.7, 118.4, 44.3, 18.5.

2-methoxy-*N,N*-dimethylaniline:[3] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.00-6.86 (m, 4H), 3.89 (s, 3H), 2.79 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=152.6, 142.6, 122.6, 120.9, 118.3, 111.1, 55.4, 43.5.

4-fluoro-*N,N*-dimethylaniline:[2] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.11-7.08 (m, 2H), 6.80-6.78 (m, 2H), 2.99 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=155.6 (d, *J* = 234.6 Hz), 147.6, 115.3 (d, *J* = 22.3 Hz), 113.8 (d, *J* = 7.6 Hz), 41.0.

***N,N*,3,5-tetramethylaniline**:[13] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=6.58-6.57 (m, 3H), 3.08 (s, 6H), 2.47 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=151.0, 138.6, 118.9, 110.9, 40.8, 21.9.

***N,N,2,6*-tetramethylaniline**:[14] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.24-7.22 (m, 2H), 7.19-7.17 (m, 1H), 3.07 (s, 6H), 2.55 (s, 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=149.8, 137.2, 128.9, 124.9, 42.6, 19.3.

2,6-diisopropyl-*N,N*-dimethylaniline:[14] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.57-7.55 (m, 1H), 7.51-7.50 (m, 2H), 3.81-3.77 (m, 2H), 3.27 (s, 6H), 1.65 (d, *J* = 7.3 Hz, 12H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=149.3, 147.5, 126.5, 124.2, 44.4, 28.4, 24.6.

***N,N*,2,4,6-pentamethylaniline**:[15] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.05 (s, 2H), 3.04 (s, 6H), 2.51 (s, 6H), 2.48 (s, 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=147.2, 137.1, 134.3, 129.6, 42.7, 20.8, 19.1.

ethyl 4-(dimethylamino)benzoate:[16] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.91 (d, *J* = 6.8 Hz, 2H), 6.62 (d, *J* = 6.8 Hz, 2H), 4.31 (q, *J* = 7.1 Hz, 2H), 3.00 (s, 6H), 1.36 (t, *J* = 7.2 Hz, 3H). ^{13}C NMR ($CDCl_3$, 176 MHz): δ=167.1, 153.2, 131.2, 117.2, 110.7, 60.1, 40.1, 14.5.

***N,N*-dibenzylformamide**:[17] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.44 (s, 1H), 7.41-7.31 (m, 6H), 7.23-7.19 (m, 4H), 4.43 (s, 2H), 4.27 (s, 2H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=162.9, 136.0, 135.7, 129.0, 128.7, 128.5, 128.2, 127.7, 127.7, 50.2, 44.6.

***N,N*-didodecylformamide**: ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.00 (s, 1H), 3.24 (t, *J* = 7.4 Hz, 2H), 3.15 (t, *J* = 7.1 Hz, 2H), 1.51-1.48 (m, 4H), 1.25-1.23 (m, 36H), 0.85 (t, *J* = 6.6 Hz, 6H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=162.7, 47.5, 42.2, 32.0, 29.7, 29.4, 29.3, 28.7, 27.4, 27.0, 26.5, 22.8, 14.2. Elemental analysis (%) for $C_{25}H_{51}NO$: Calculated: C, 78.67; H, 13.47; N, 3.67. Found: C, 78.71; H, 13.51; N, 3.65.
morpholine-4-carbaldehyde:[18] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=7.69 (s, 1H), 3.32 (t, *J* = 5.3 Hz, 2H), 3.28 (d, *J* = 4.9 Hz, 2H), 3.17 (d, *J* = 5.5 Hz, 2H), 3.06 (d, *J* = 5.1 Hz, 2H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=160.2, 66.5, 65.6, 45.0, 39.7.

3,4-dihydroisoquinoline-2(1H)-carbaldehyde:[19] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.00, 7.96 (s, total 1H), 7.00-6.95 (m, total 2H), 6.92-6.87 (m, total 2H), 4.43, 4.27 (s, total 2H), 3.53, 3.38 (t, *J* = 6.2 Hz, and t, *J* = 5.9 Hz, total 2H), 2.64, 2.60 (t, *J* = 5.9 Hz, and t, *J* = 6.2 Hz, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=160.9, 160.5, 133.8, 133.1, 131.9, 131.2, 128.5, 128.3, 126.3, 125.9, 125.3, 46.5, 42.4, 41.5, 37.2, 29.0, 27.3.

3,4-dihydroquinoline-1(2H)-carbaldehyde:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.36, 8.02, 7.93 (s, d, *J* = 8.2 Hz, and s, total 1H), 6.81-6.63 (m, total 4H), 3.36, 3.22 (t, *J* = 5.9 Hz, and t, *J* = 5.7 Hz, total 2H), 2.45, 2.36 (t, *J* = 6.7 Hz, and t, *J* = 6.4 Hz, total 2H), 1.59-1.43 (m, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=160.6, 159.8, 136.3, 135.6, 128.6, 128.3, 127.5, 126.5, 126.0, 125.0, 123.2, 123.1, 121.1, 115.8, 45.0, 39.1, 26.1, 21.9, 21.2.

2-methylindoline-1-carbaldehyde:[21] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.80, 8.42, 8.02 (s, s, and d, *J* = 8.1 Hz, total 1H), 7.15-6.96 (m, total 4H), 4.66-4.61, 4.39-4.34, 4.06-4.02 (m, total 1H), 3.34-3.24, 2.67-2.51 (m, total 2H), 1.32, 1.27 (d, *J* = 6.4 Hz, and d, *J* = 6.4 Hz, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=158.5, 156.5, 139.5, 139.3, 129.5, 126.4, 126.3, 125.1, 124.0, 123.2, 123.0, 115.3, 108.6, 53.5, 51.9, 35.0, 34.6, 22.1, 19.2.

indoline-1-carbaldehyde:[22] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.62, 8.20, 7.82 (s, s, and d, *J* = 7.9 Hz, total 1H), 6.97-6.78 (m, total 4H), 3.76, 3.70 (t, *J* = 8.4 Hz, and t, *J* = 8.3 Hz, total 2H), 2.85, 2.80 (t, *J* = 8.1 Hz, and t, *J* = 8.6 Hz, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=158.8, 156.9, 140.6, 140.4, 131.6, 131.2, 126.8, 126.7, 125.3, 124.2, 123.7, 123.4, 115.7, 108.8, 46.2, 43.9, 27.0, 26.4.

***N*-methyl-*N*-phenylformamide**:[23] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.46 (s, 1H), 7.40 (t, *J* = 7.7 Hz, 2H), 7.26 (t, *J* = 7.8 Hz, 1H), 7.17-7.15 (m, 2H), 3.31 (s, 3H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=162.0, 141.9, 129.4, 126.1, 122.0, 31.7.

***N*-ethyl-*N*-phenylformamide**:[18] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.10, 8.07 (s, total 1H), 7.13-7.05 (m, total 2H), 7.00-6.94 (m, total 1H), 6.90-6.86 (m, total 2H), 3.58, 3.44 (q, *J* = 7.2 Hz, and q, *J* = 7.2 Hz, total 2H), 0.89-0.85 (m, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=161.3, 161.1, 140.2, 137.9, 128.9, 128.4, 126.0, 125.2, 123.3, 43.9, 39.2, 14.3, 12.4.

***N*-(4-methoxyphenyl)-*N*-methylformamide**:[24] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.34 (s, 1H), 7.10-7.09 (m, 2H), 6.93-6.91 (m, 2H), 3.82 (s, 3H), 3.27 (s, 3H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=162.4, 158.2, 135.1, 124.5, 114.7, 55.5, 32.6.

***N*-(4-chlorophenyl)-*N*-methylformamide**: ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.42, 8.32 (s, total 1H), 7.38-7.31 (m, 2H), 7.10-7.07 (m, 2H), 3.32, 3.27 (s, total 3H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=162.0, 161.8, 140.5, 138.5, 131.5, 130.9, 129.5, 128.8, 124.3, 123.2, 36.4, 31.7.

***N*-benzyl-*N*-phenylformamide**:[17] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.52, 8.49 (s, total 1H), 7.27-7.21 (m, total 6H), 7.17-7.13 (m, total 2H), 7.05-7.04 (m, total 2H), 4.97, 4.73 (s, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=162.3, 161.9, 140.6, 138.7, 136.4, 129.2, 128.6, 128.4, 128.2, 127.5, 127.4, 127.0, 126.9, 126.4, 126.2, 124.9, 123.4, 53.3, 48.2.

***N*-benzylformamide**:[19] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.05, 7.96, 7.94 (s, total 1H), 7.34-7.17, 6.71 (m and br, total 6H), 4.32, 4.24 (d, J = 6.2 Hz and d, J = 6.4 Hz, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.9, 161.5, 137.7, 137.6, 128.7, 128.5, 127.7, 127.4, 127.3, 126.8, 45.5, 41.8.

***N*-(4-chlorobenzyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.19, 8.09 (s, and d, J = 11.9 Hz, total 1H), 7.30-7.24, 7.17-7.14 (m, total 4H), 6.24, 6.17 (br, total 1H), 4.38, 4.34 (d, J = 6.1 Hz, and d, J = 6.4 Hz, total 2H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.9, 161.4, 136.3, 136.2, 133.8, 133.4, 129.1, 128.9, 128.4, 45.1, 41.1.

***N*-(4-methoxybenzyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.01, 7.92 (s, and d, J = 12.0 Hz, total 1H), 7.11-7.04 (m, 2H), 6.80-6.74 (m, 2H), 4.22, 4.16 (d, J = 5.6 Hz, and d, J = 6.3 Hz, total 2H), 3.70, 3.67 (s, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.8, 161.3, 159.0, 158.7, 129.8, 129.6, 128.8, 128.2, 114.0, 113.8, 55.1, 55.1, 45.0, 41.2.

***N*-(2-methoxybenzyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.93, 7.87 (s, and d, J = 11.9 Hz, total 1H), 7.45, 6.84-6.82 (br and m, total 1H), 7.14-6.99 (m, total 2H), 6.78-6.67 (m, total 2H), 4.25, 4.09 (d, J = 6.2 Hz, and d, J = 6.4 Hz, total 2H), 3.61, 3.60 (s, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.8, 161.2, 156.7, 156.6, 128.7, 128.2, 128.1, 128.1, 125.6, 125.3, 120.0, 119.9, 109.9, 109.7, 54.6, 41.0, 36.8.

***N*-cyclohexylformamide**:[22] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=7.87-7.83 (m, 1H), 7.08, 6.86 (br, total 1H), 3.59-3.53, 3.06-3.05 (m, total 1H), 1.67-1.64 (m, 2H), 1.51-1.48 (m, 2H), 1.40-1.37 (m, 1H), 1.14-1.07, 0.98-0.91 (m, 5H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=163.6, 160.5, 51.8, 46.8, 34.2, 32.5, 25.1, 25.0, 24.7, 24.5.

***N*-(1-phenylethyl)formamide**:[19] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.07, 8.06, 8.04, 8.02 (s, total 1H), 7.31-7.22 (m, total 4H), 7.13, 7.02 (br, total 1H), 5.15-5.10, 4.64-4.59 (m, total 1H), 1.51, 1.45 (d, J = 6.9 Hz and d, J = 6.9 Hz, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.5, 163.3, 160.7, 142.9, 142.8, 128.8, 128.6, 127.6, 127.3, 126.0, 125.7, 51.9, 47.5, 23.4, 21.8.

***N*-benzhydrylformamide**:[19] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.07, 8.05 (s, total 1H), 7.32-7.21 (m, total 10H), 6.26, 5.70 (d, J = 8.2 Hz, and d, J = 8.6 Hz, total 1H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.6, 160.6, 141.1, 140.9, 128.9, 128.7, 128.0, 127.5, 127.4, 127.3, 60.0, 55.6.

***N*-*p*-tolylformamide**:[17] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.90, 8.88, 8.01 (s, total 1H), 8.64, 8.62, 8.31, 8.31 (s, total 1H), 7.44-7.42, 7.15-7.10, 7.00-6.99 (m, total 4H), 2.33, 2.30 (s, total 3H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=163.3, 159.5, 135.2, 134.5, 134.3, 130.3, 129.6, 120.2, 119.1, 21.0, 20.9.

***N-o*-tolylformamide**:[25] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=9.19, 8.51 (d, J = 10.8 Hz, and br, total 1H), 8.47, 8.27 (d, J = 11.2 Hz, and d, J = 2.1 Hz, total 1H), 7.72, 7.19-7.04 (d, J = 7.9 Hz and m, total 4H), 2.29, 2.20 (s, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=164.1, 160.2, 135.1, 134.6, 131.0, 130.4, 130.2, 129.8, 126.8, 126.3, 125.9, 125.4, 123.5, 121.0, 17.6, 17.5.

***N*-(4-methoxyphenyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=9.03, 8.63 (d, J = 11.7 Hz and br, total 1H), 8.48, 8.21 (d, J = 11.5 Hz, and d, J = 2.0 Hz, total 1H), 7.41, 6.99 (d, J = 9.0 Hz, and d, J = 8.9 Hz, total 2H), 6.82, 6.78 (d, J = 8.9 Hz, and d, J = 9.1 Hz, total 2H), 3.74, 3.71 (s, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=163.5, 159.7, 157.4, 156.5, 130.2, 129.8, 121.9, 121.3, 114.8, 114.1, 55.5, 55.4.

***N*-(4-(tert-butyl)phenyl)formamide**:[19] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=9.54, 9.06 (d, J = 11.5 Hz, and s, total 1H), 8.72, 8.35 (d, J = 11.3 Hz, and s, total 1H), 7.56 (d, J = 8.7 Hz, 1H), 7.38-7.34 (m, 2H), 7.09 (d, J = 8.5 Hz, 1H), 1.34, 1.32 (s, total 9H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=163.4, 160.0, 147.5, 134.3, 126.4, 125.7, 120.1, 118.6, 34.3, 31.3.

***N*-(2-methoxyphenyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.73, 8.45 (d, J = 11.6 Hz and br, total 1H), 8.36, 7.78 (br, total 1H), 7.20-7.18, 7.12-7.05, 6.97-6.88 (m, total 4H), 3.88, 3.86 (s, total 3H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=161.6, 158.9, 148.9, 147.9, 126.9, 126.4, 125.4, 124.4, 120.6, 116.8, 111.4, 110.2, 55.9.

***N*-(4-bromophenyl)formamide**:[26] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.66, 8.36 (br, total 1H), 7.44-7.41 (m, 4H), 6.99-6.97 (m, 1H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=162.7, 159.3, 136.1, 136.0, 132.9, 132.2, 121.7, 120.5, 118.4, 117.6.

***N*-(3,5-dimethylphenyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=9.58, 9.01 (d, J = 11.3 Hz, and s, total 1H), 8.73, 8.34 (d, J = 11.3 Hz, and d, J = 2.1 Hz, total 1H), 7.26, 6.80, 6.76, 6.75 (br, total 3H), 2.29, 2.27 (s, total 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=163.2, 159.9, 139.2, 138.4, 136.9, 136.7, 126.6, 126.2, 117.9, 116.2, 21.0. 21.0.

***N*-(2,6-dimethylphenyl)formamide**:[27] ^{1}H NMR ($CDCl_3$, 600 MHz): δ=8.34, 8.08 (br, and d, J = 11.9 Hz, total 1H), 7.38, 7.15-7.06 (br and m, total 4H), 2.30, 2.23 (s, total 6H). ^{13}C NMR ($CDCl_3$, 151 MHz): δ=165.2, 159.7, 135.4, 133.3, 132.6, 128.9, 128.4, 127.8, 18.9, 18.7.

***N*-(2,6-diisopropylphenyl)formamide**:[20] ^{1}H NMR ($CDCl_3$, 500 MHz): δ=8.30, 8.22 (d, J = 1.6 Hz, and d, J = 11.7 Hz, total 1H), 8.02, 7.59 (d, J = 12.0 Hz, and br, total 1H), 7.35-7.29, 7.22-7.18 (m, total 3H), 3.27-3.19, 3.13-3.05 (m, total 2H), 1.22, 1.18 (d, J = 6.9 Hz, and d, J = 6.7 Hz, total 12H). ^{13}C NMR ($CDCl_3$, 126 MHz): δ=166.0, 161.1, 146.8, 146.2, 130.3, 128.9, 123.8, 123.6, 28.8, 28.5, 23.7, 23.7.

ethyl 4-formamidobenzoate:[28] ^{1}H NMR ($CDCl_3$, 700 MHz): δ=8.93-8.91, 8.86-8.84 (m, total 1H), 8.42, 8.10 (s, total 1H), 8.03-8.02, 8.01-7.99 (m, total 2H), 7.64-7.63 (m, total 1H), 7.15-7.14 (m, 1H), 4.38-4.33 (m, total 2H), 1.39-1.37 (m, total 3H). ^{13}C NMR ($CDCl_3$, 176 MHz): δ=166.3, 166.1, 162.4, 159.5, 141.2, 141.1, 131.6, 131.0, 127.0, 126.5, 119.2, 117.3, 61.3, 61.2, 14.5.

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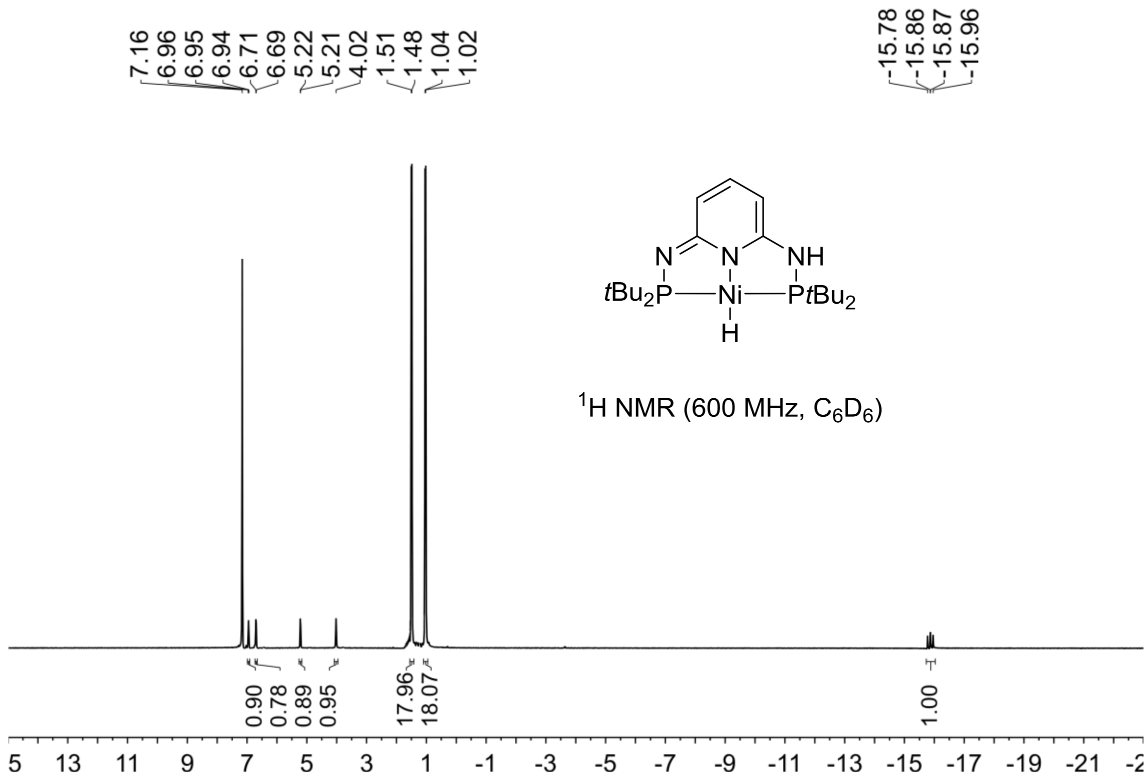
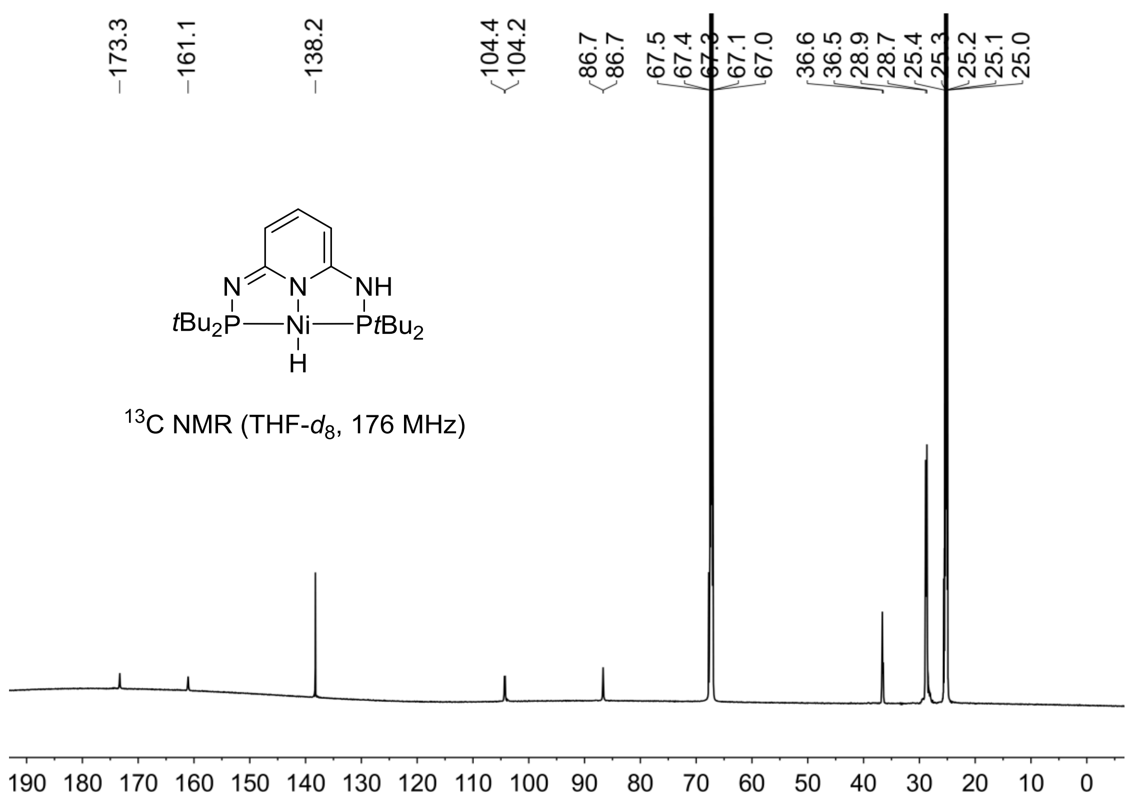
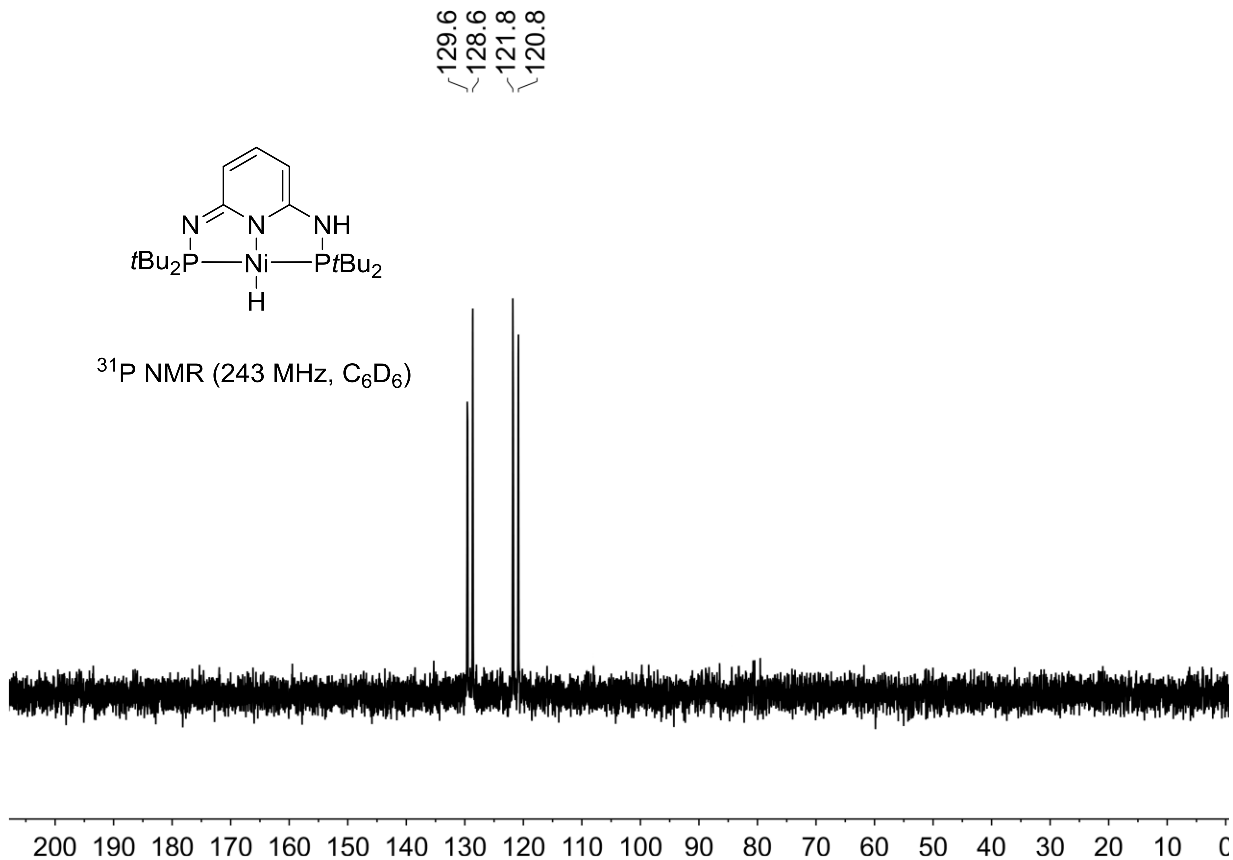
14. NMR spectra.






129.6
128.6
121.8
120.8
N
N
NH
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Ni
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31P NMR (243 MHz, C6D6)
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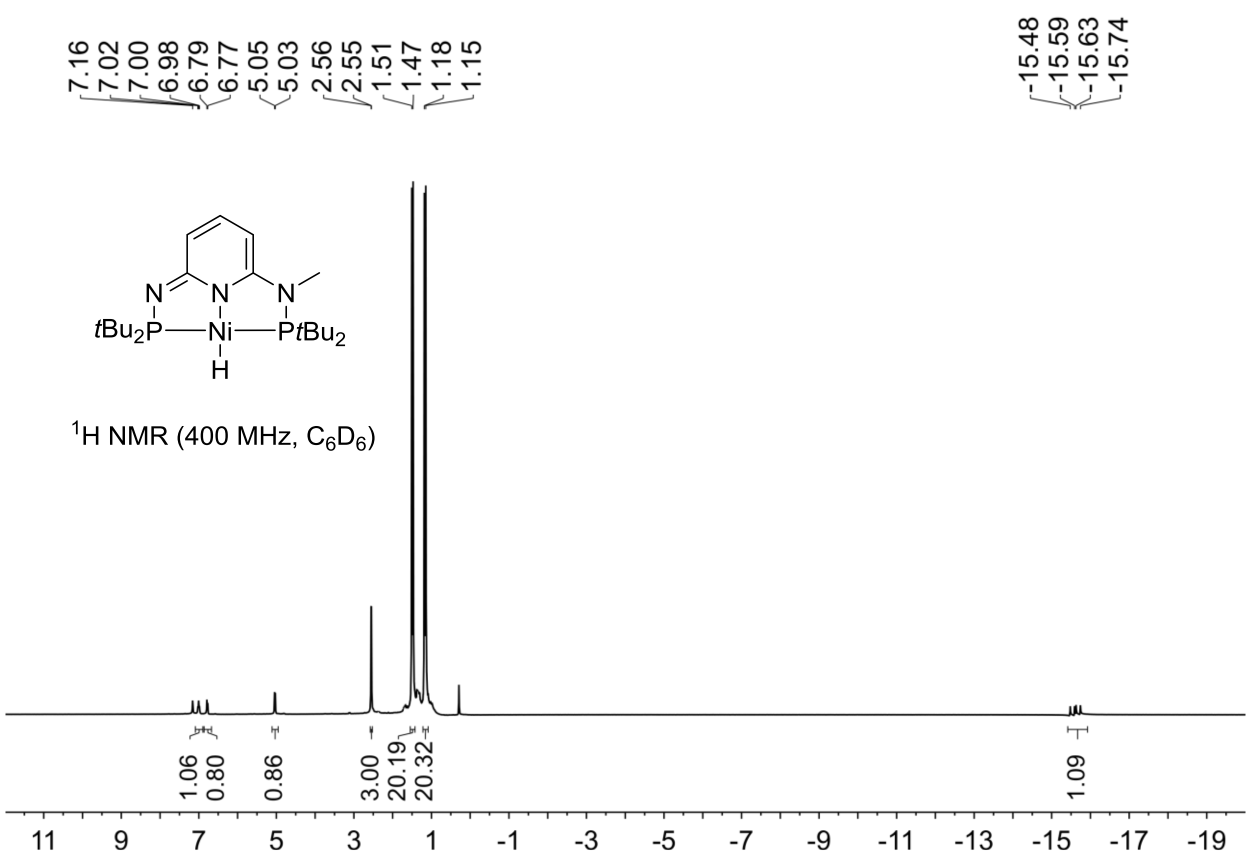
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6.98
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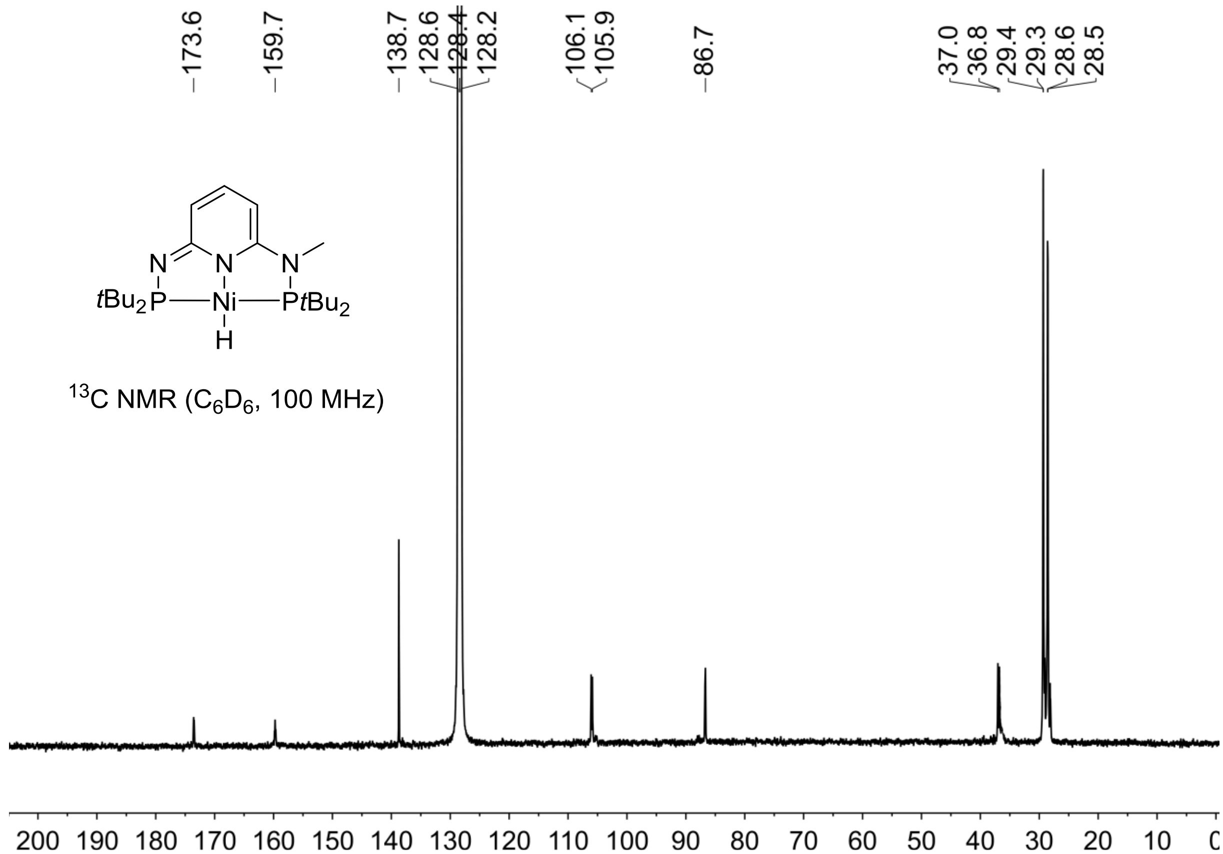
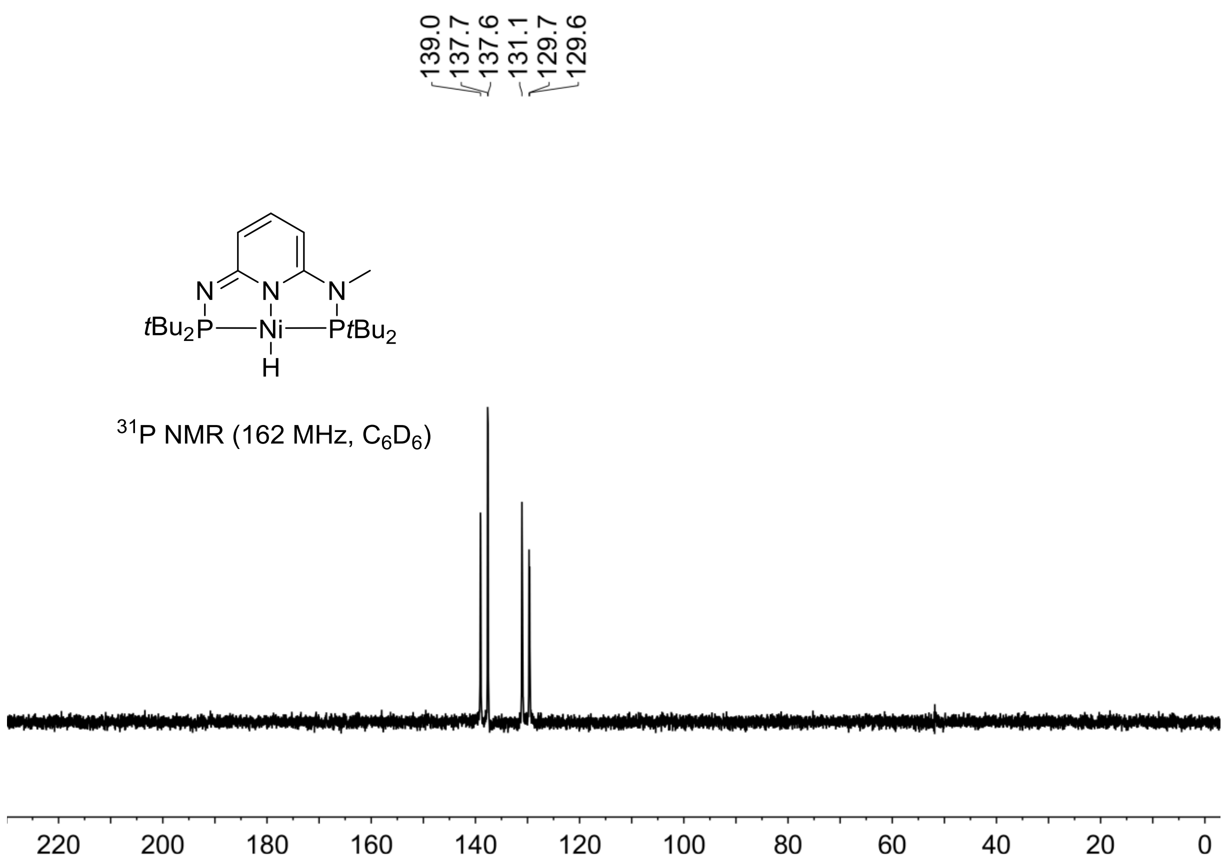
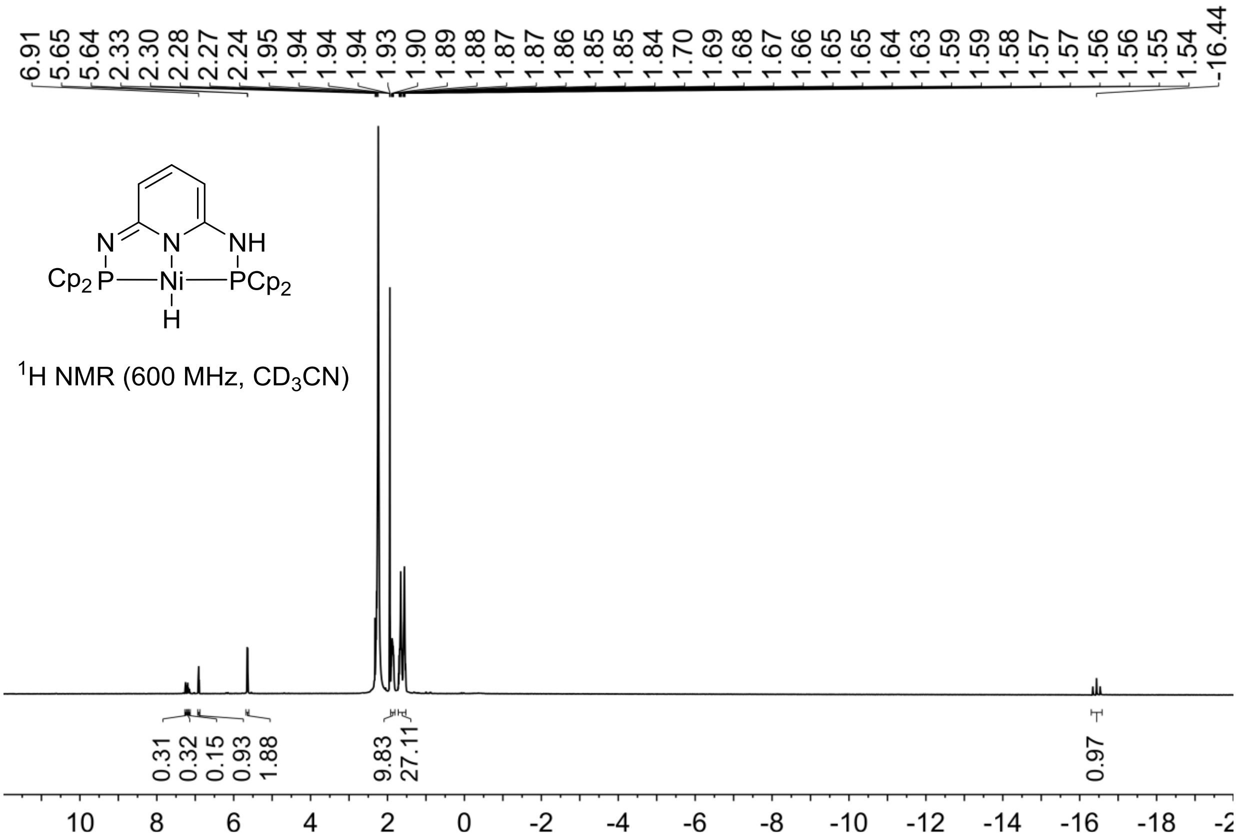
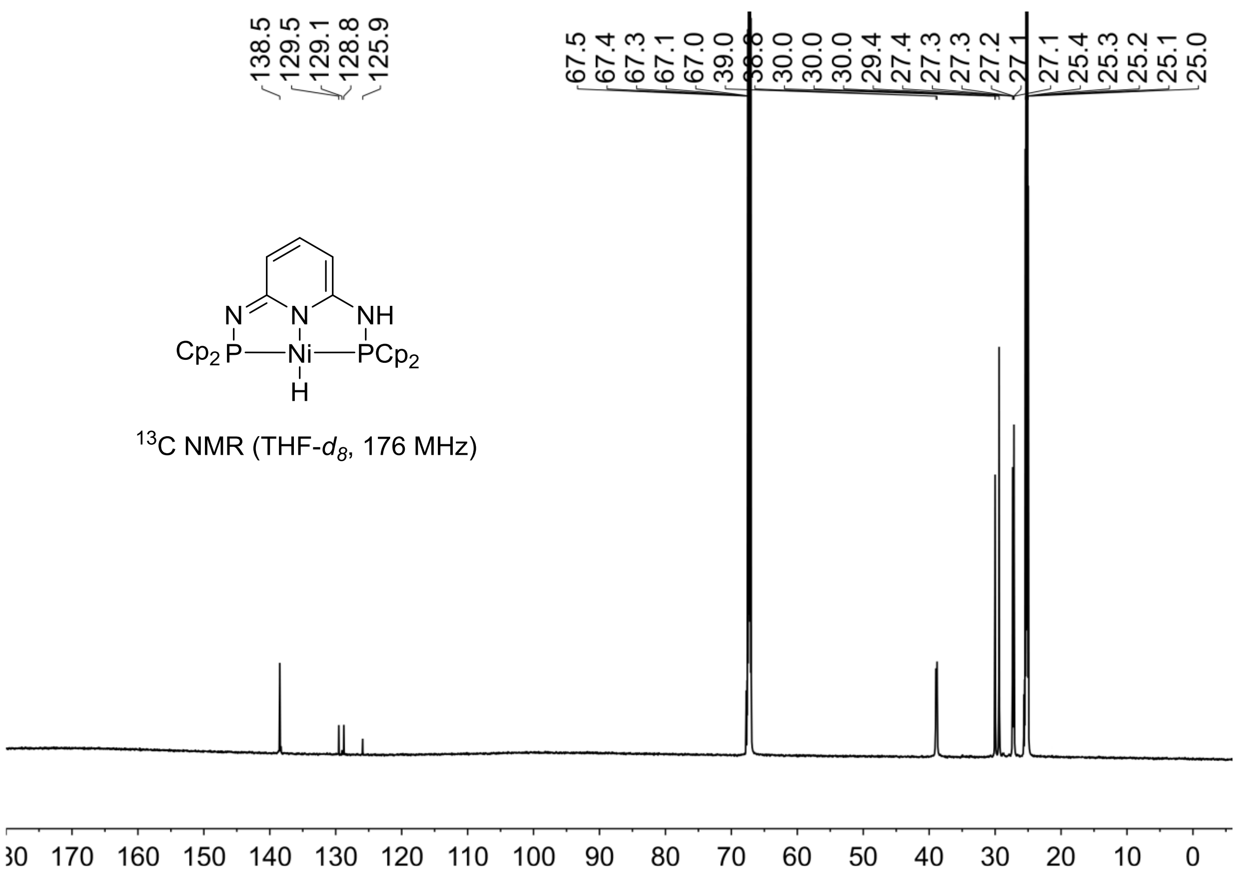
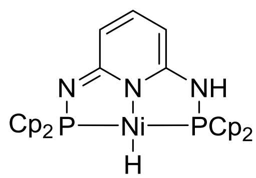
2.55
1.51
1.47
1.18
1.15
-15.48
-15.59
-15.63
-15.74
N
N
N
tBu2P
Ni
PtBu2
H
1H NMR (400 MHz, C6D6)
1.06
0.80
0.86
3.00
20.19
20.32
1.09
11 9 7 5 3 1 -1 -3 -5 -7 -9 -11 -13 -15 -17 -19


173.6
159.7
138.7
128.6
128.4
128.2
106.1
105.9
86.7
37.0
36.8
29.4
29.3
28.6
28.5
N
N
N
tBu2P
Ni
PtBu2
H
13C NMR (C6D6, 100 MHz)
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

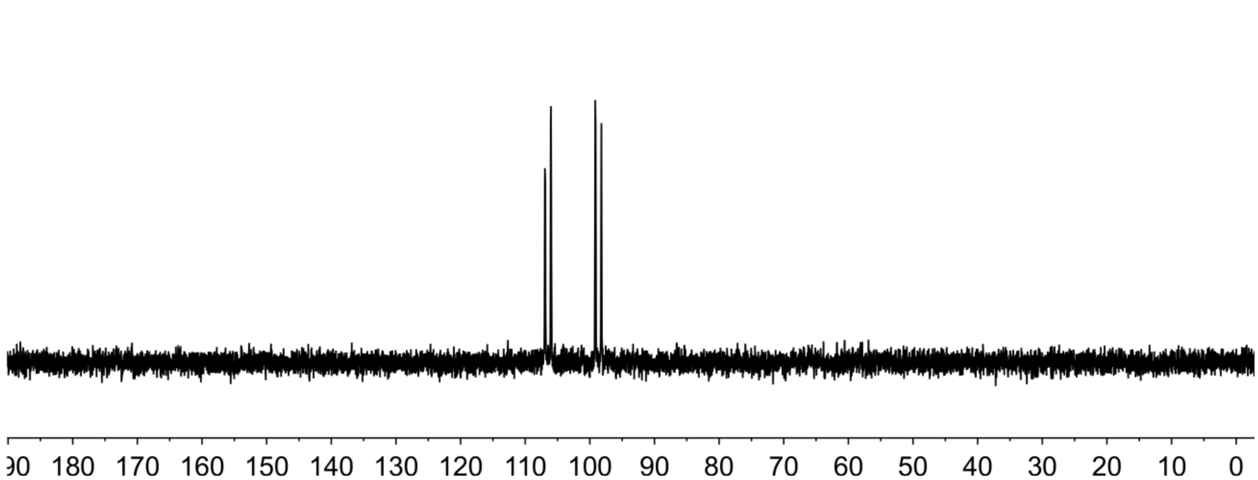

139.0
137.7
137.6
131.1
129.7
129.6
N
N
N
tBu2P
Ni
PtBu2
H
31P NMR (162 MHz, C6D6)
220 200 180 160 140 120 100 80 60 40 20 0

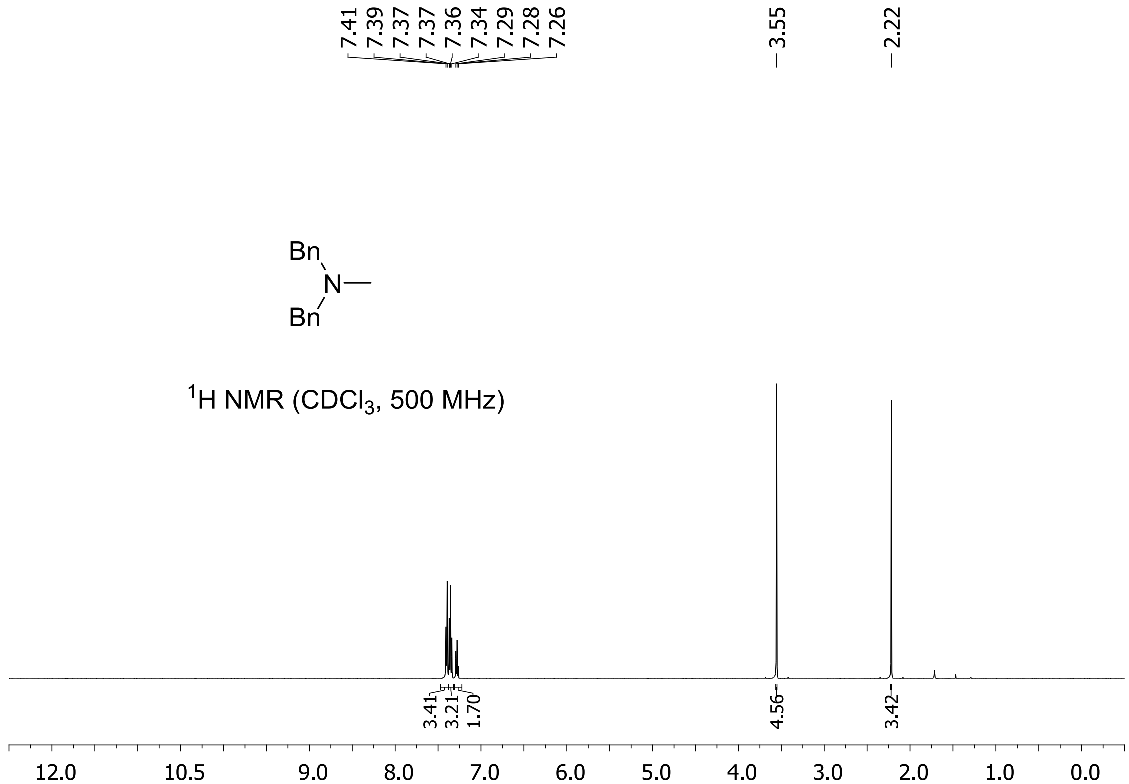

6.91
5.65
5.64
2.33
2.30
2.28
2.27
2.24
1.95
1.94
1.94
1.94
1.93
1.90
1.89
1.88
1.87
1.87
1.86
1.85
1.85
1.84
1.70
1.69
1.68
1.67
1.66
1.65
1.65
1.64
1.63
1.59
1.59
1.58
1.57
1.57
1.56
1.56
1.55
1.54
-16.44
N
N
NH
Cp2P
Ni
PCp2
H
1H NMR (600 MHz, CD3CN)
0.31
0.32
0.15
0.93
1.88
9.83
27.11
0.97
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18

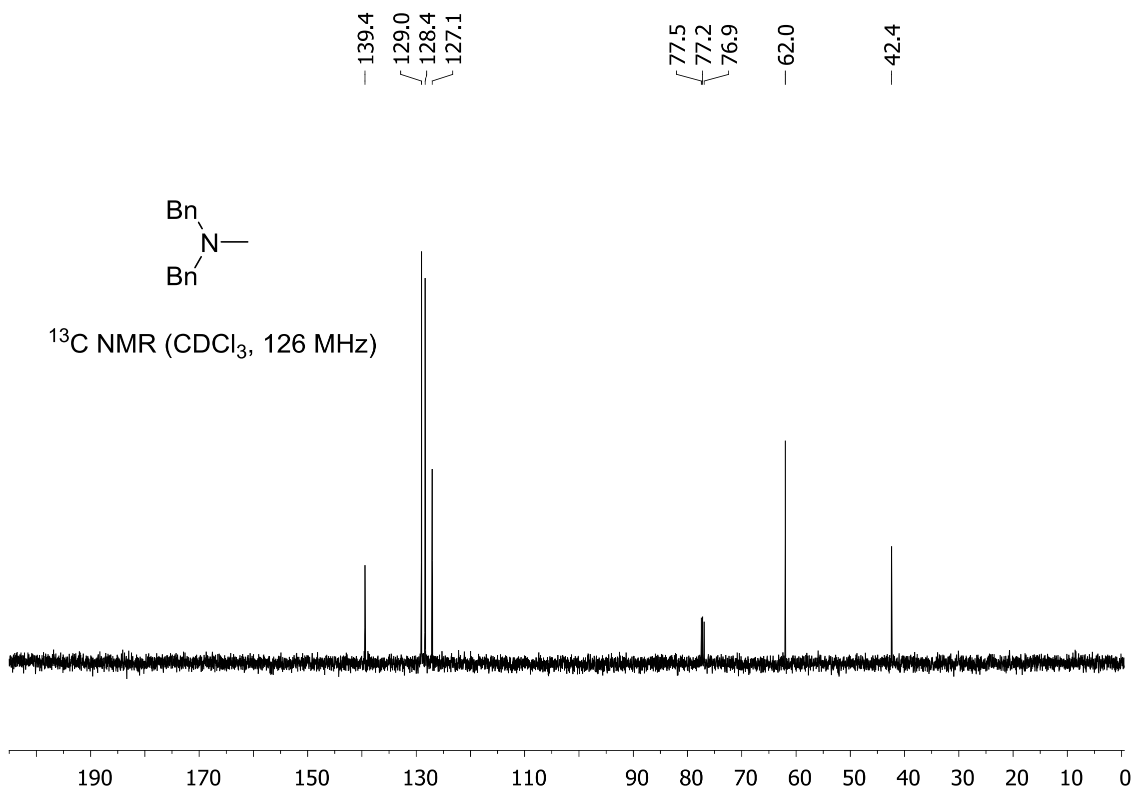

138.5
129.5
129.1
128.8
125.9
67.5
67.4
67.3
67.1
67.0
39.0
30.0
30.0
30.0
29.4
27.4
27.3
27.3
27.2
27.1
25.4
25.3
25.2
25.1
25.0
N
N
NH
Cp2P
Ni
PCp2
H
13C NMR (THF-d8, 176 MHz)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

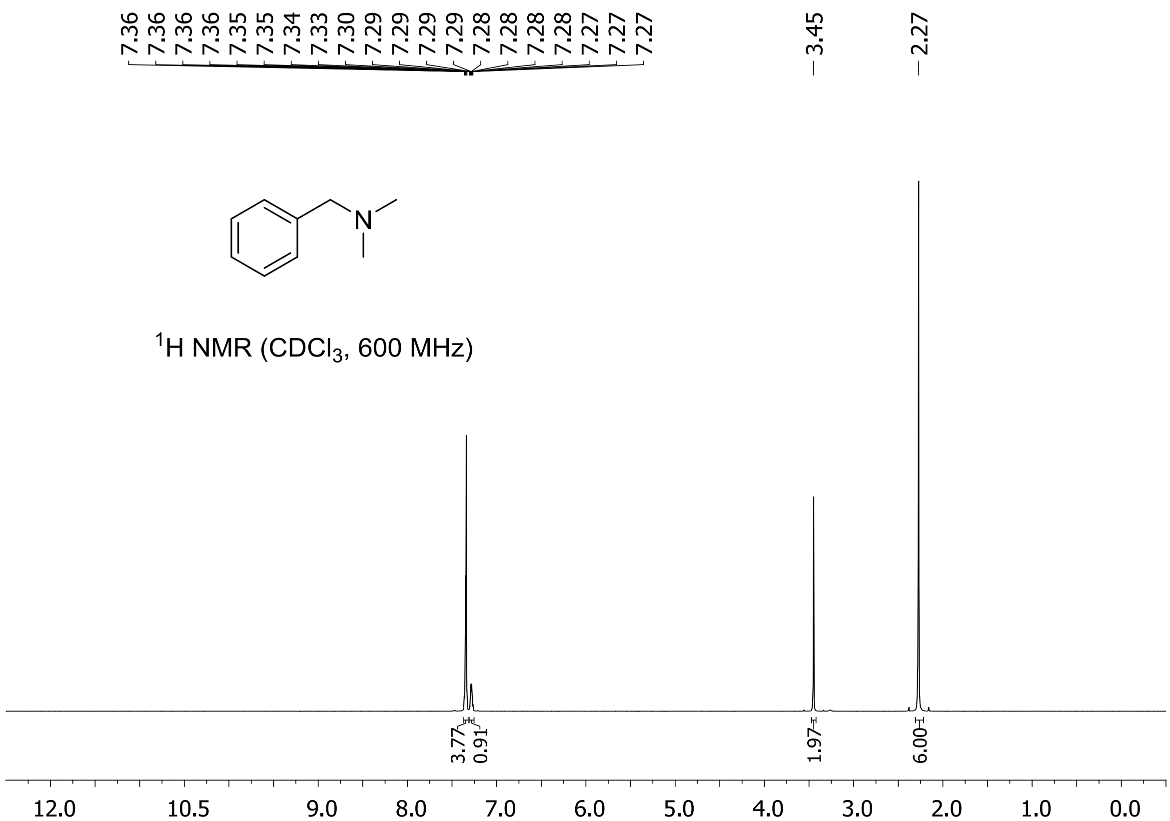


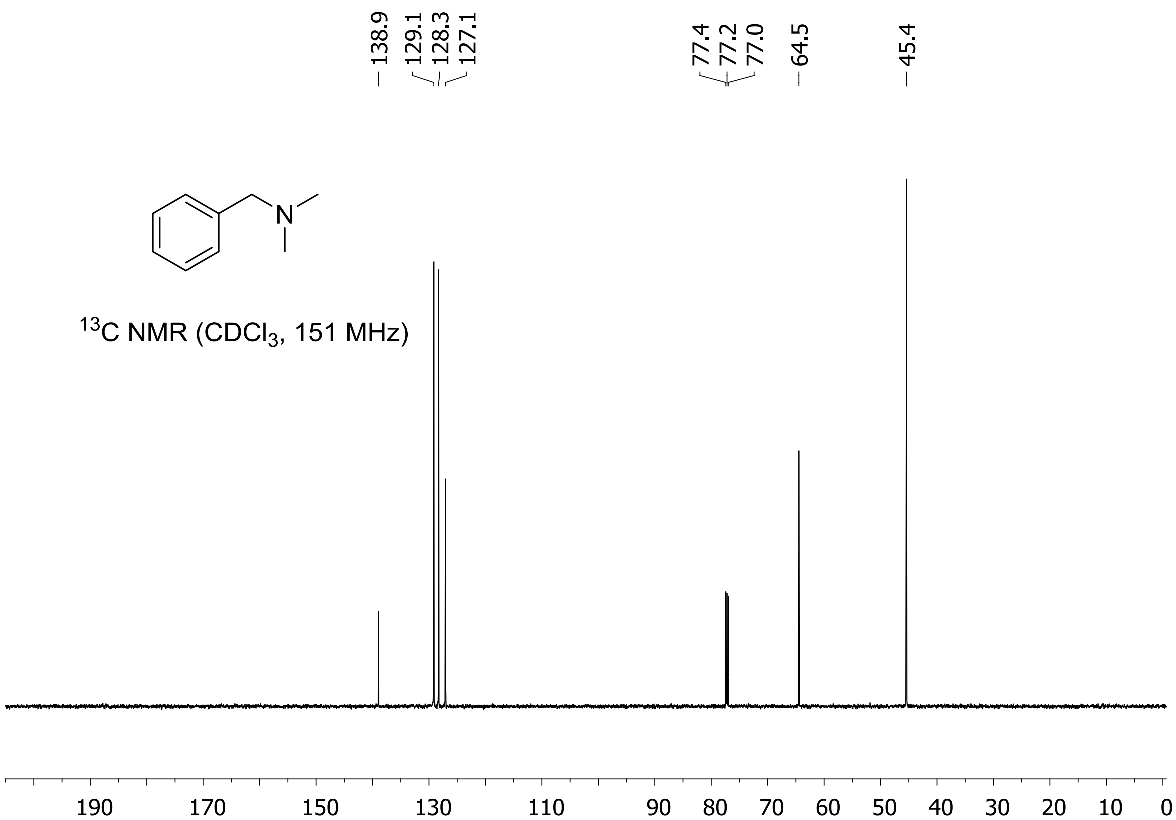
^{31}P NMR (243 MHz, C_6D_6)

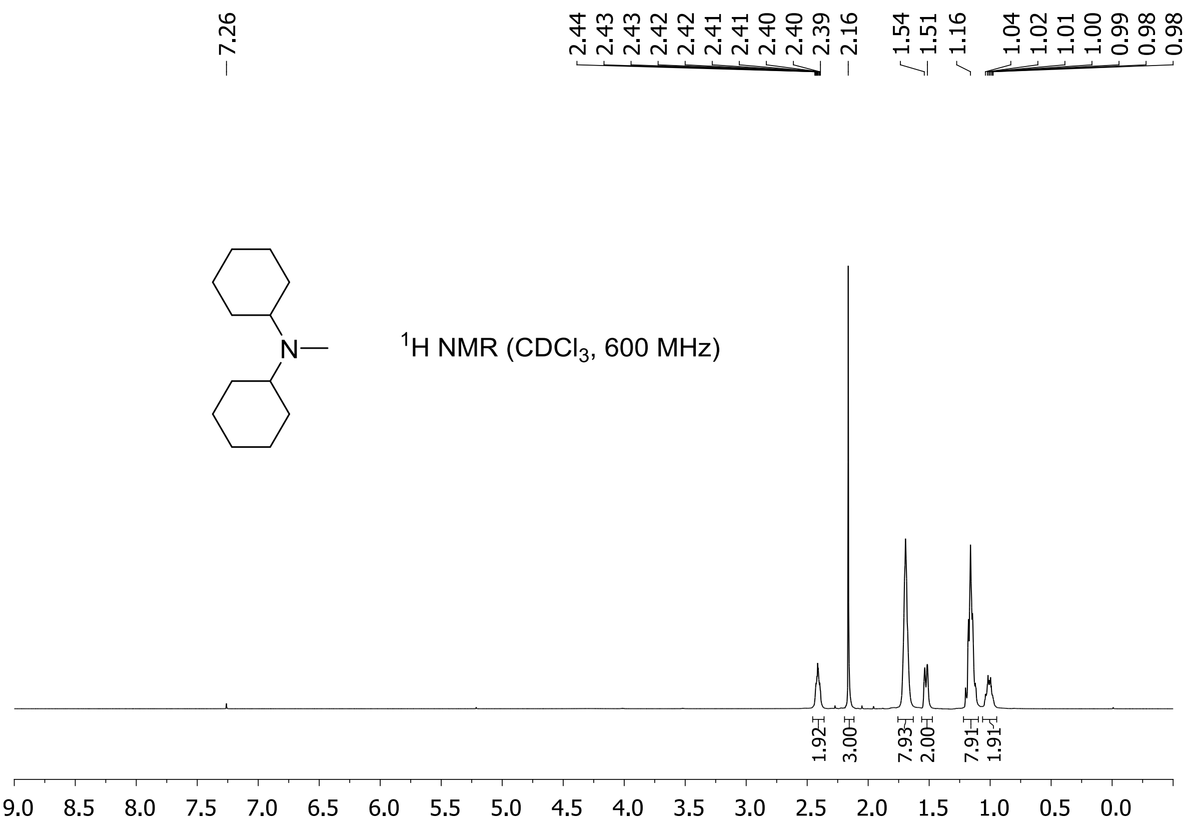



7.41 7.39 7.37 7.37 7.36 7.34 7.29 7.28 7.26
3.55
2.22
Bn
N
Bn
^{1}H NMR (CDCl$_3$, 500 MHz)
3.41 3.21 1.70
4.56
3.42
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

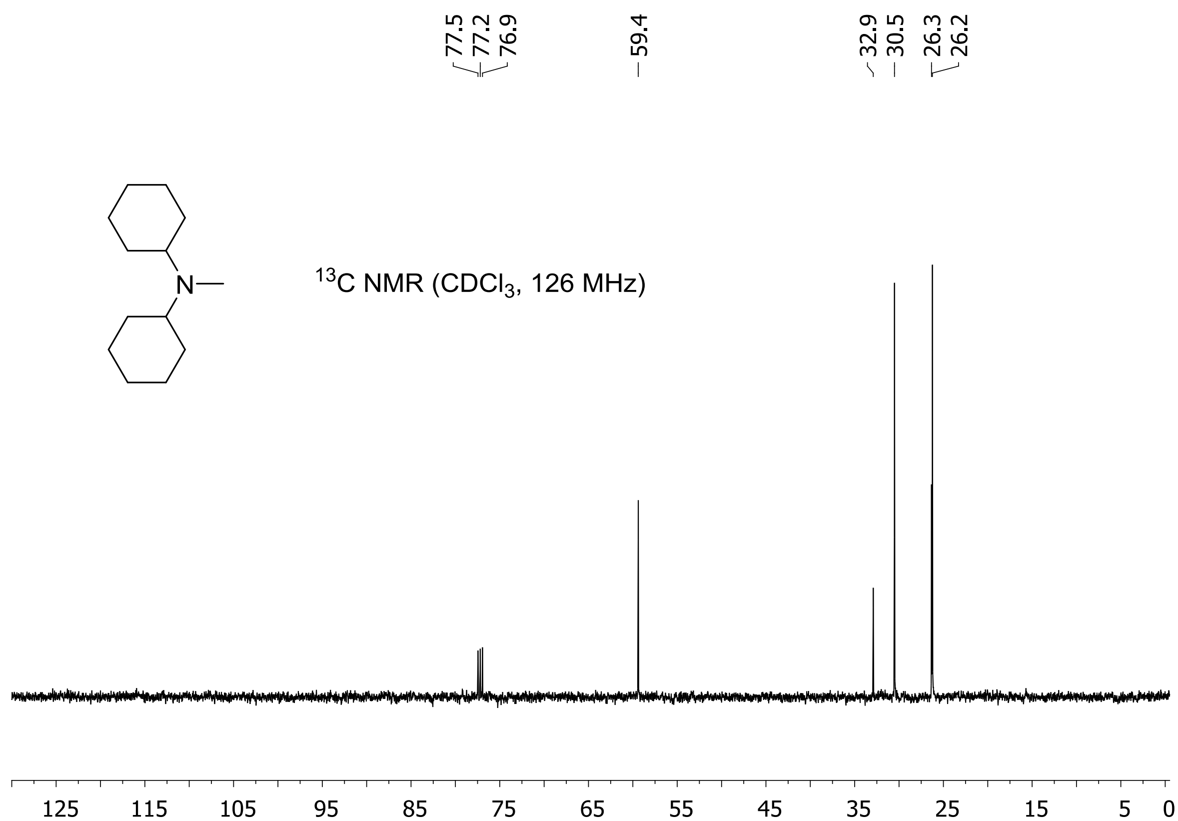

139.4
129.0 128.4 127.1
77.5 77.2 76.9
62.0
42.4
Bn
N
Bn
^{13}C NMR (CDCl$_3$, 126 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0


7.36
7.36
7.36
7.36
7.35
7.35
7.34
7.33
7.30
7.29
7.29
7.29
7.29
7.28
7.28
7.28
7.28
7.27
7.27
7.27
3.45
2.27
N
^{1}H NMR (CDCl$_3$, 600 MHz)
3.77
0.91
1.97
6.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

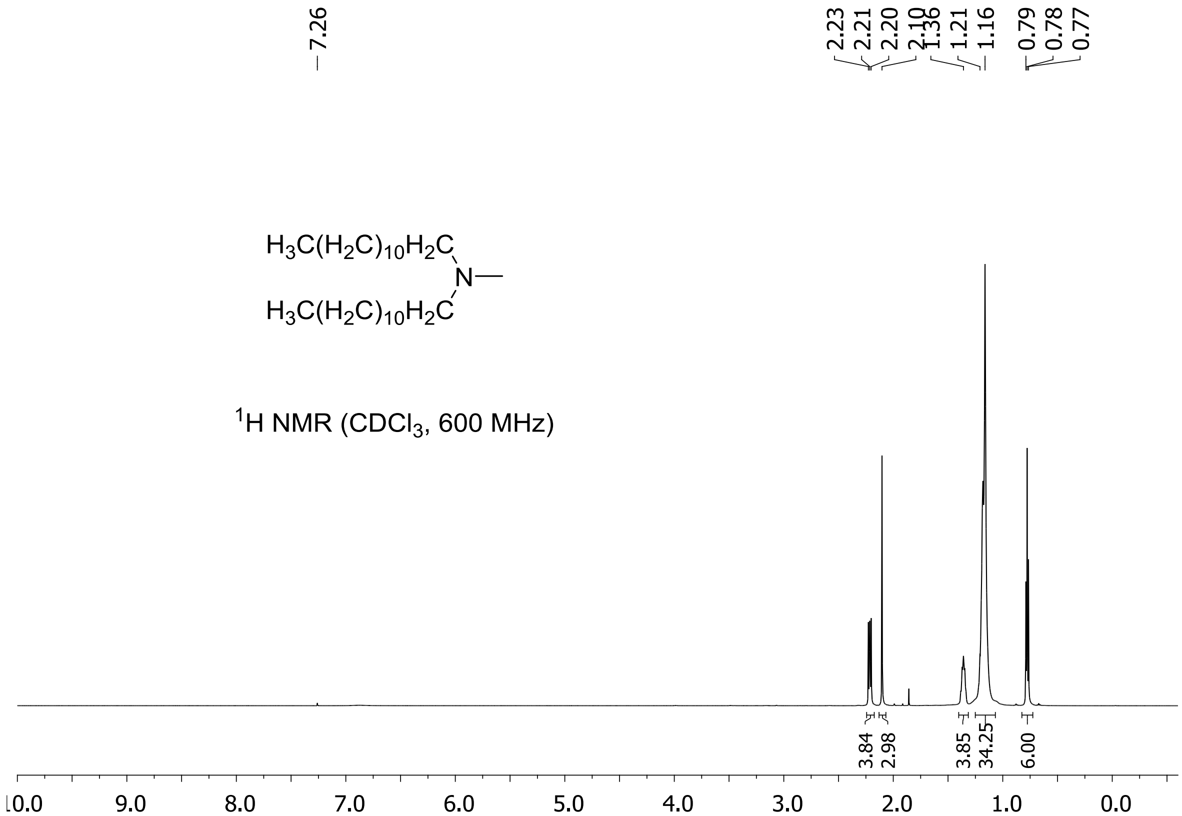

138.9
129.1
128.3
127.1
77.4
77.2
77.0
64.5
45.4
N
^{13}C NMR (CDCl$_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0



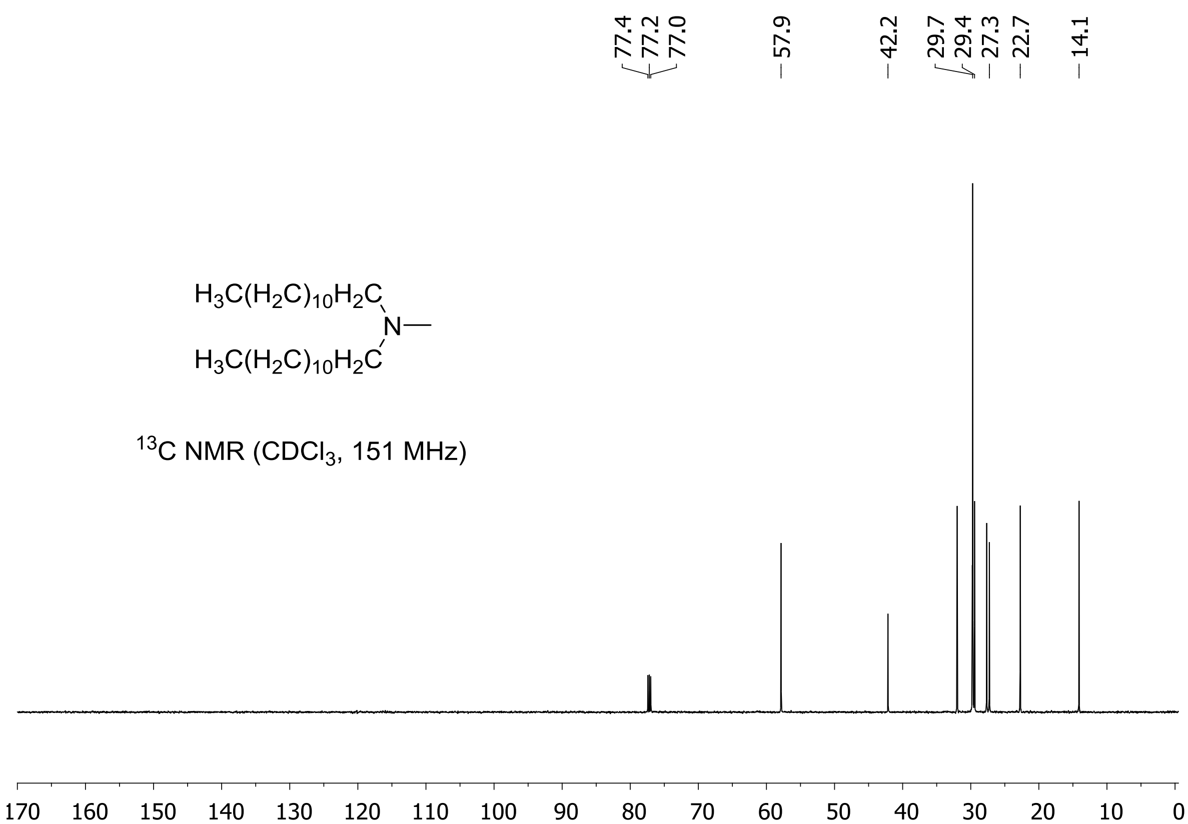
7.26
2.44 2.43 2.43 2.42 2.42 2.41 2.41 2.40 2.40 2.39
2.16
1.54 1.51
1.16
1.04 1.02 1.01 1.00 0.99 0.98 0.98
N
1H NMR (CDCl3, 600 MHz)
1.92 3.00 7.93 2.00 7.91 1.91
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0



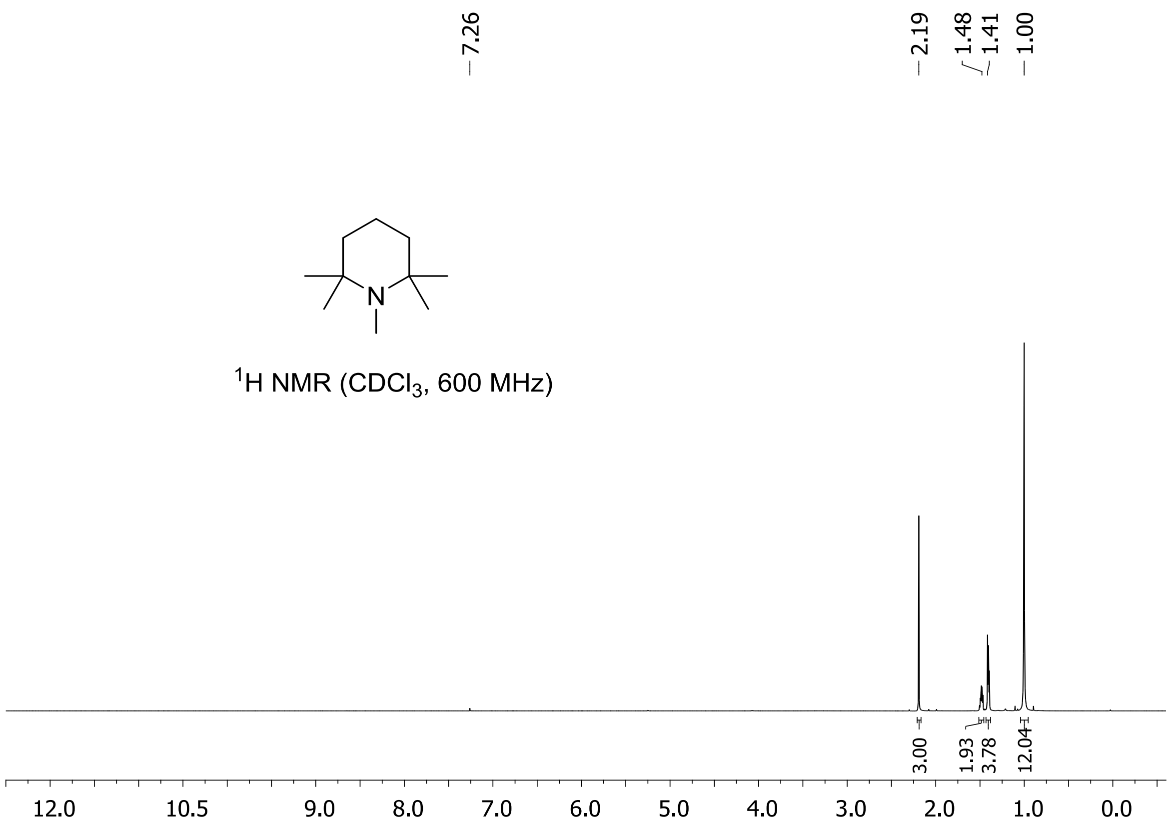
77.5 77.2 76.9
59.4
32.9 30.5 26.3 26.2
N
13C NMR (CDCl3, 126 MHz)
125 115 105 95 85 75 65 55 45 35 25 15 5 0

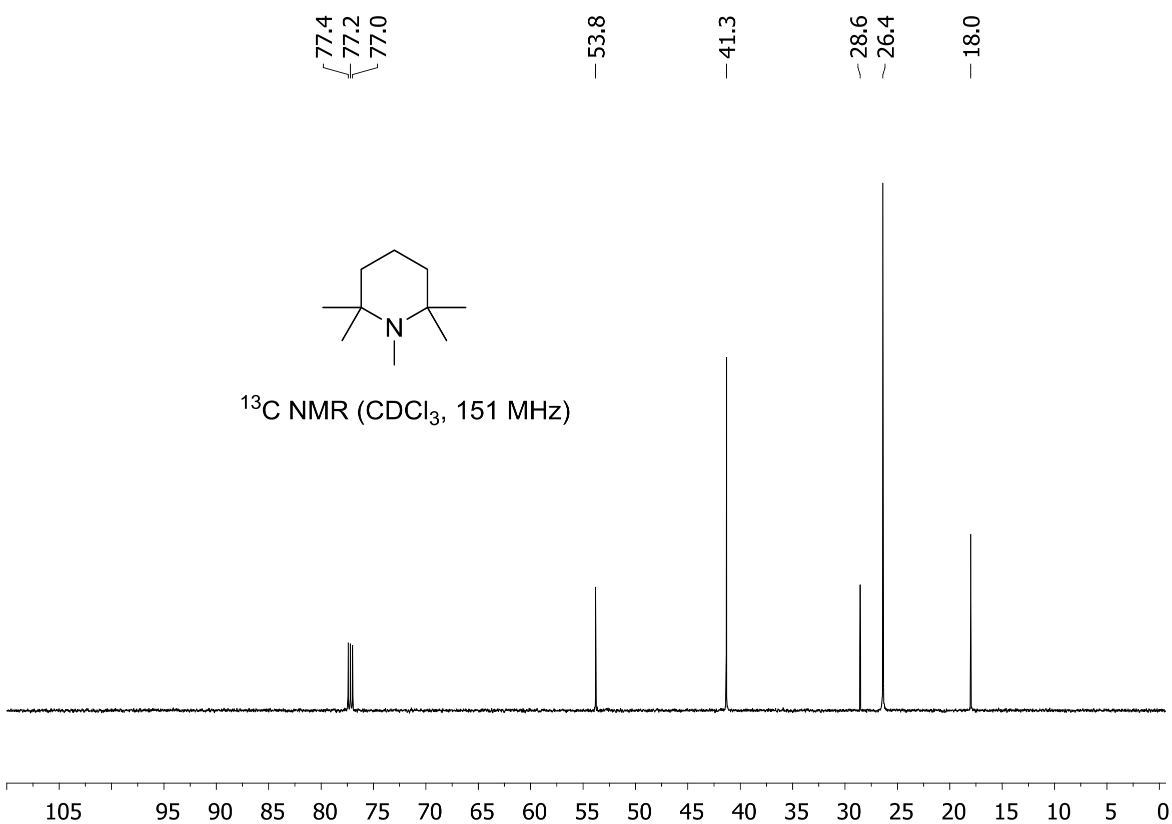


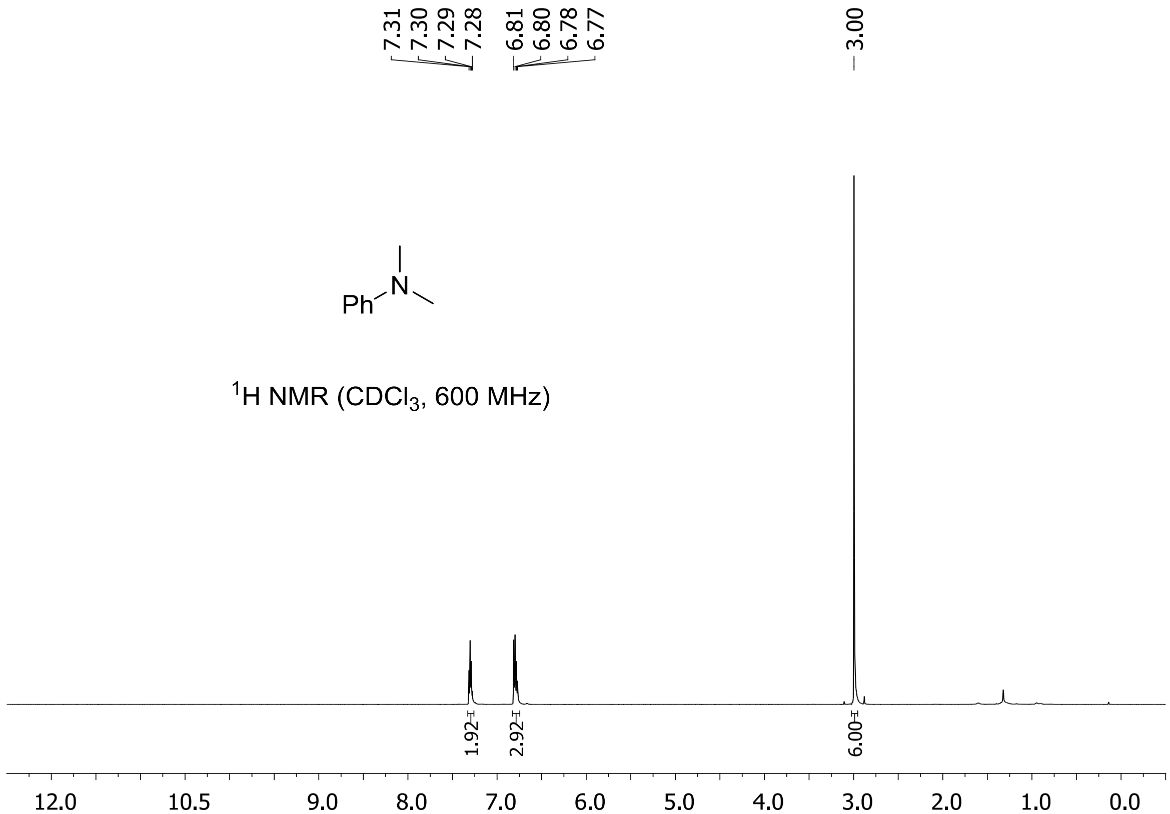
7.26
2.23
2.21
2.20
2.10
1.36
1.21
1.16
0.79
0.78
0.77
$H_3C(H_2C)_{10}H_2C$
N
$H_3C(H_2C)_{10}H_2C$
^{1}H NMR ($CDCl_3$, 600 MHz)
3.84
2.98
3.85
34.25
6.00
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

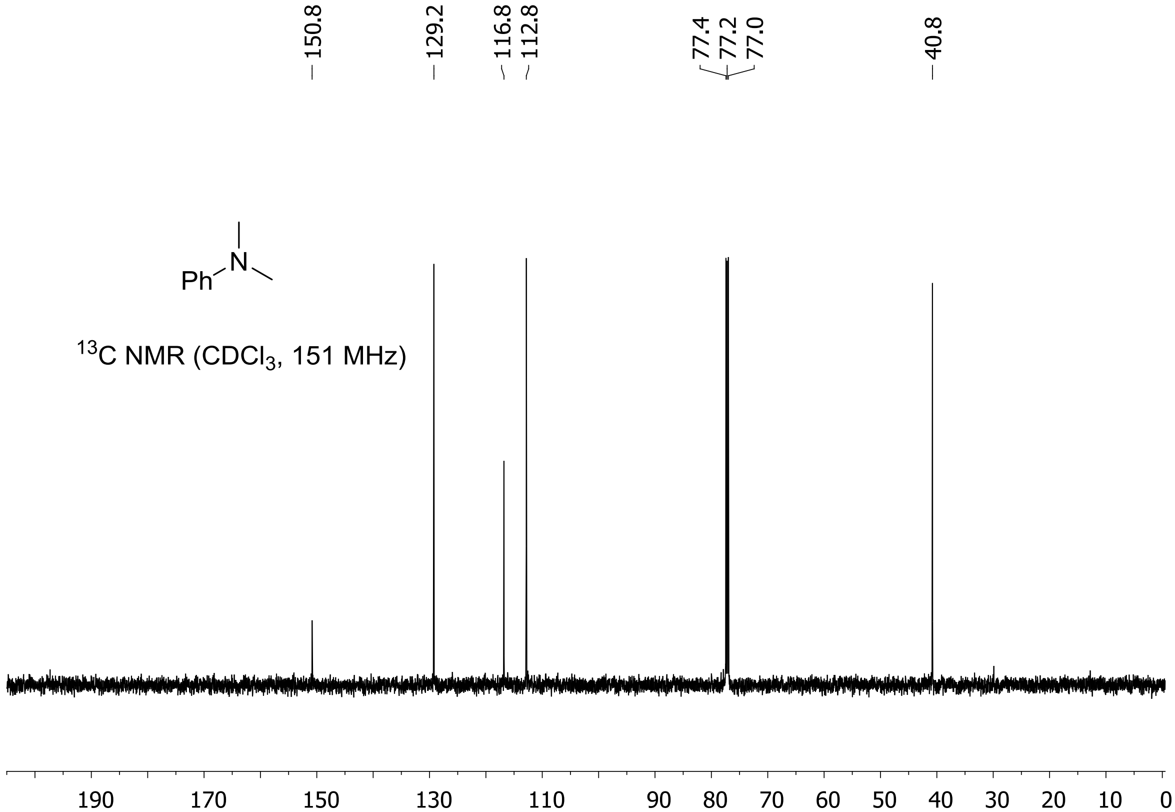


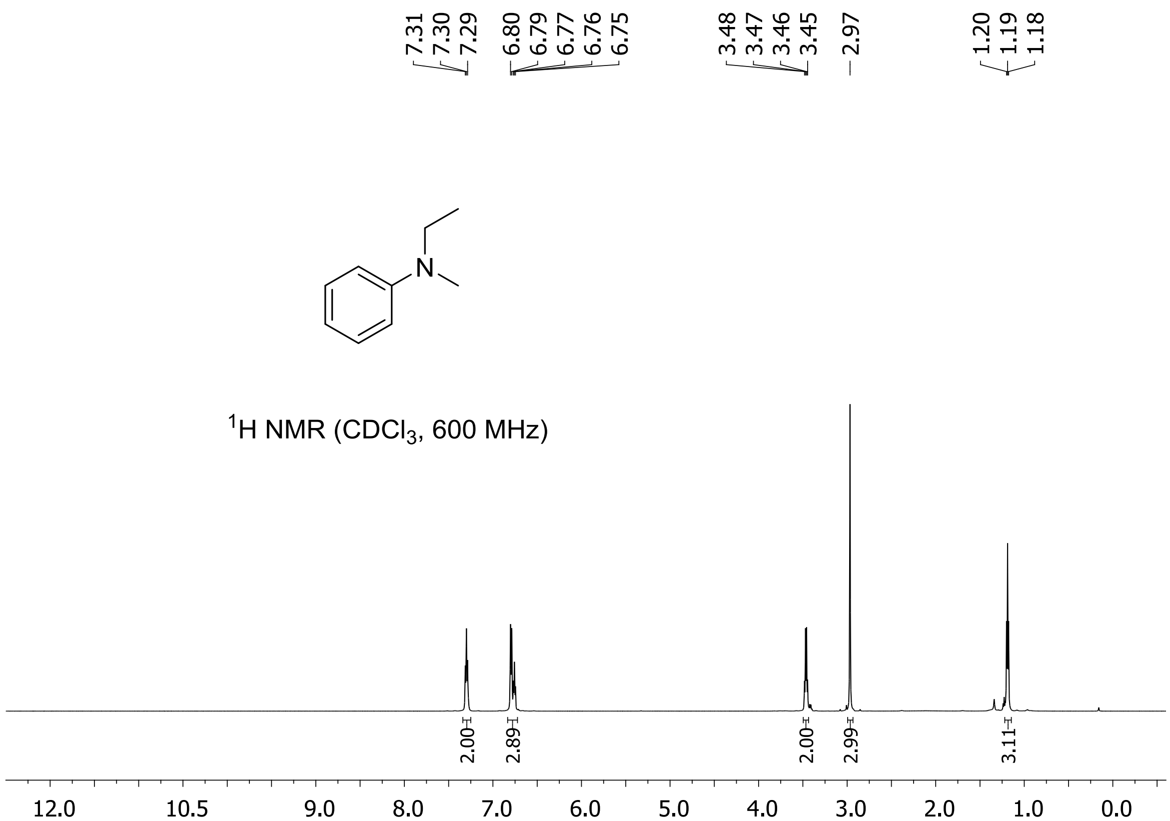
77.4
77.2
77.0
57.9
42.2
29.7
29.4
27.3
22.7
14.1
$H_3C(H_2C)_{10}H_2C$
N
$H_3C(H_2C)_{10}H_2C$
^{13}C NMR ($CDCl_3$, 151 MHz)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

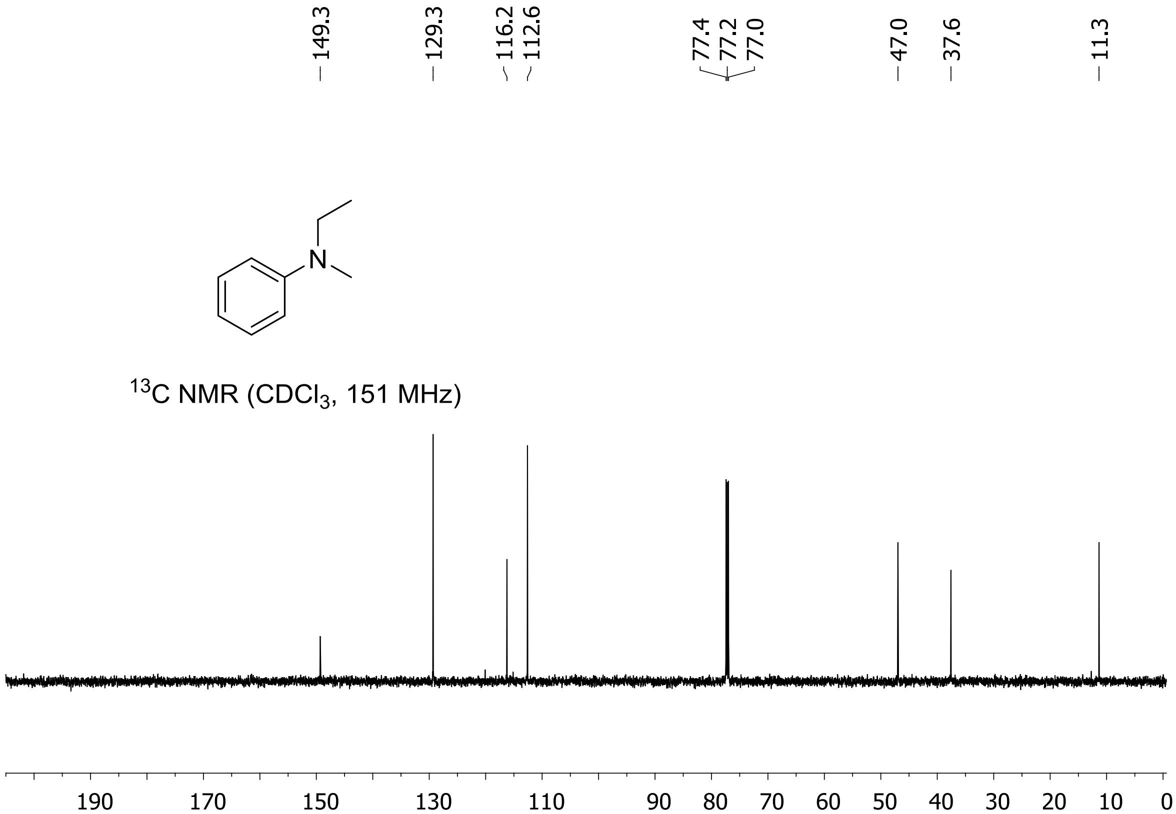

7.26
2.19
1.48
1.41
1.00
N
1H NMR (CDCl3, 600 MHz)
3.00
1.93
3.78
12.04
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

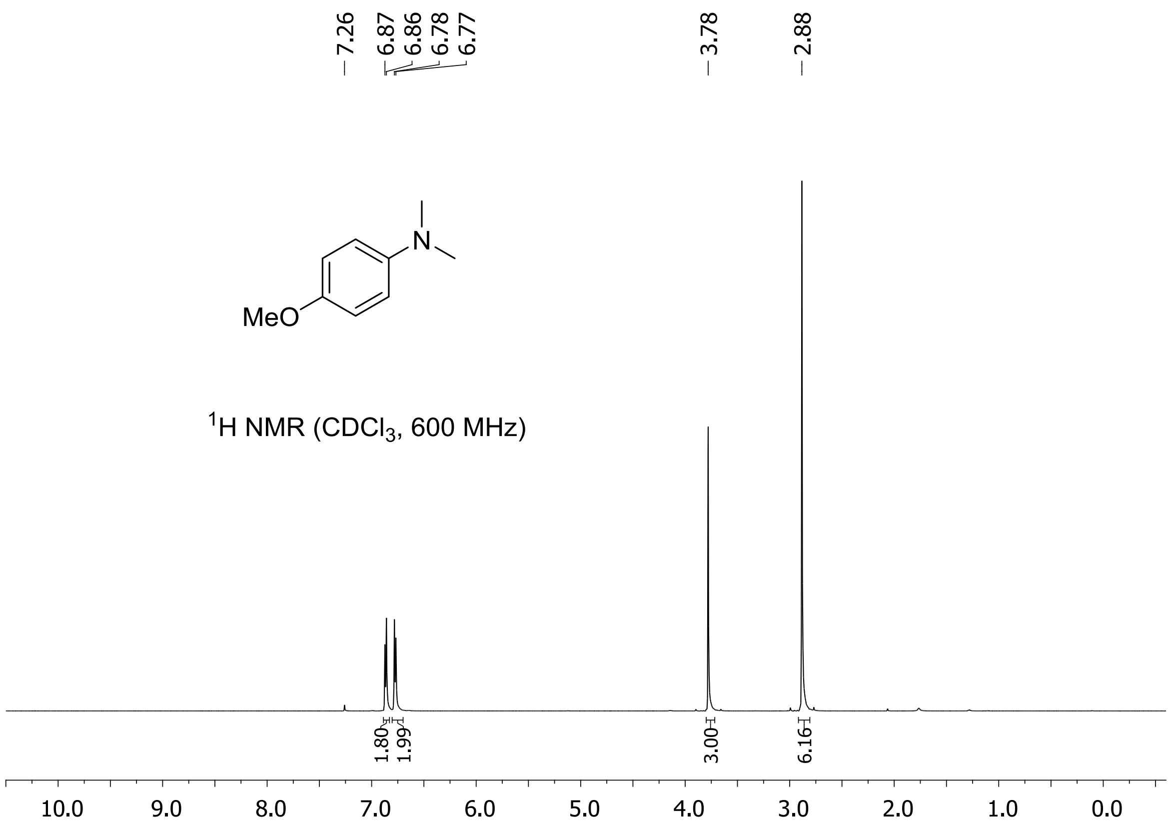

77.4
77.2
77.0
53.8
41.3
28.6
26.4
18.0
N
13C NMR (CDCl3, 151 MHz)
105
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

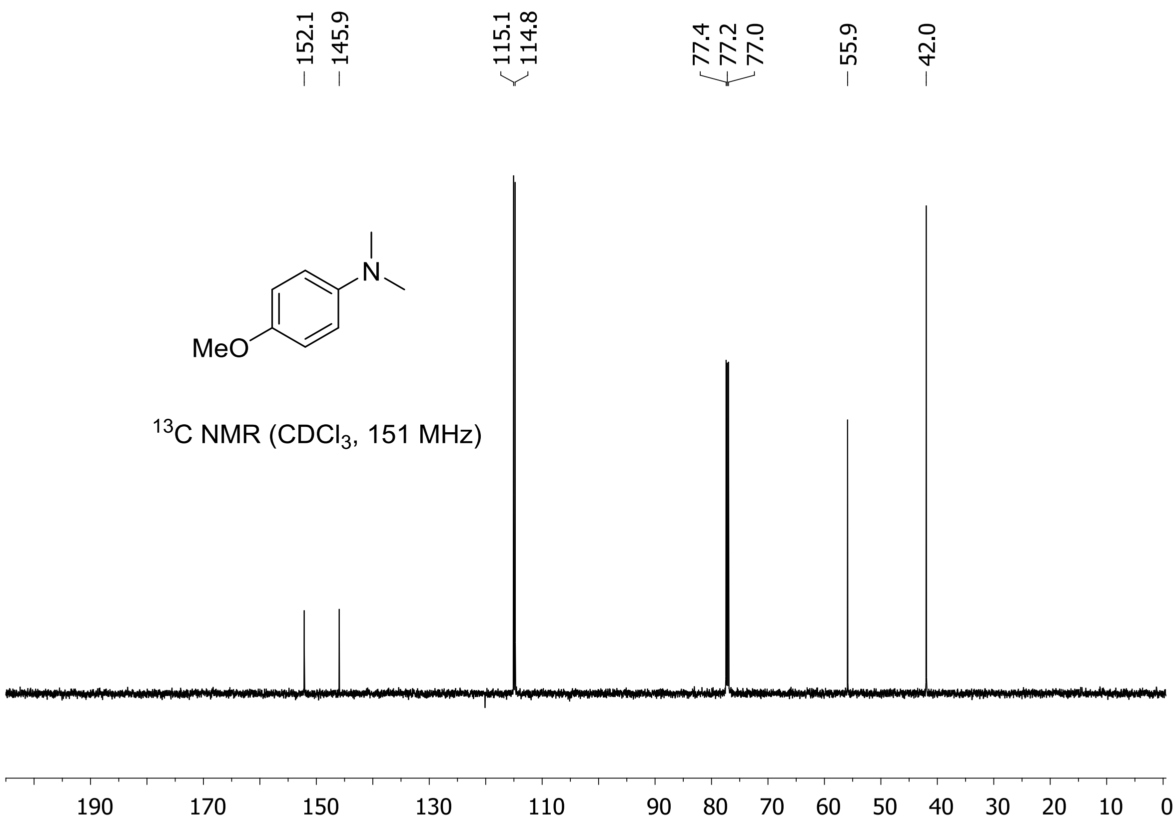

7.31
7.30
7.29
7.28
6.81
6.80
6.78
6.77
3.00
Ph
N
1H NMR (CDCl3, 600 MHz)
1.92
2.92
6.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

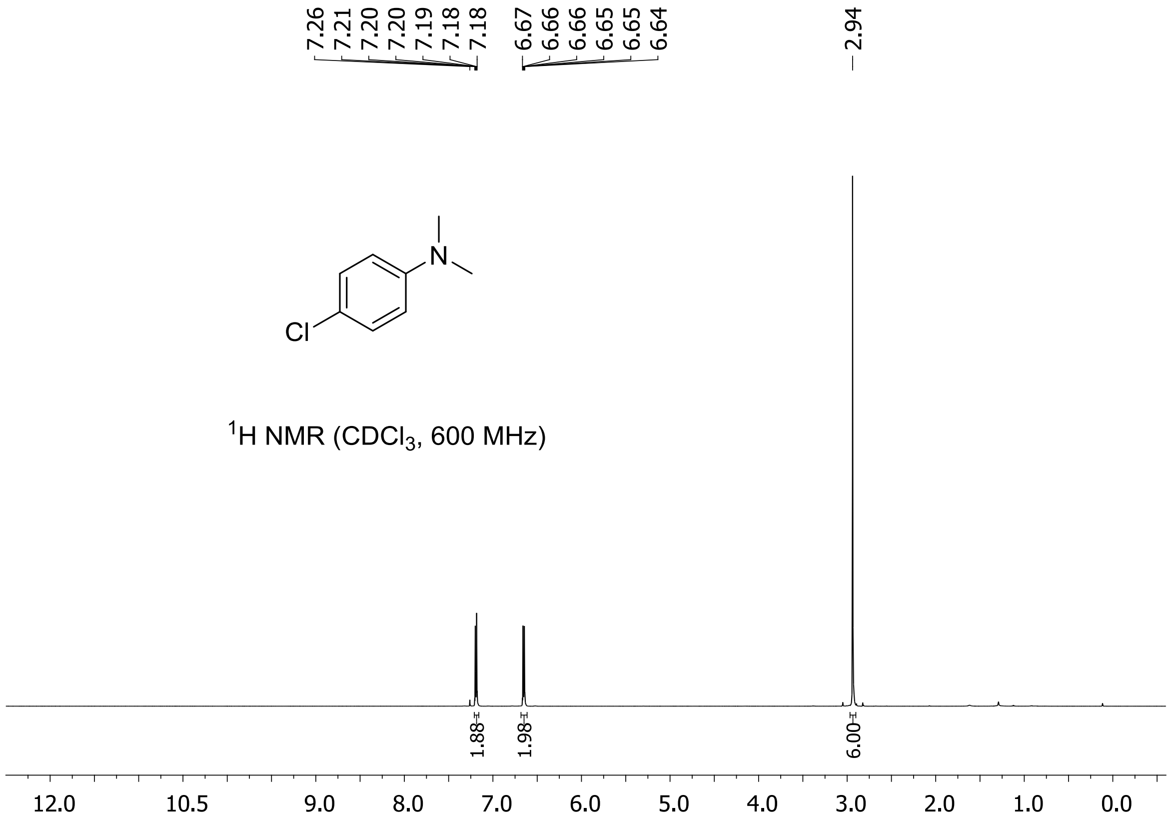

150.8
129.2
116.8
112.8
77.4
77.2
77.0
40.8
Ph
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

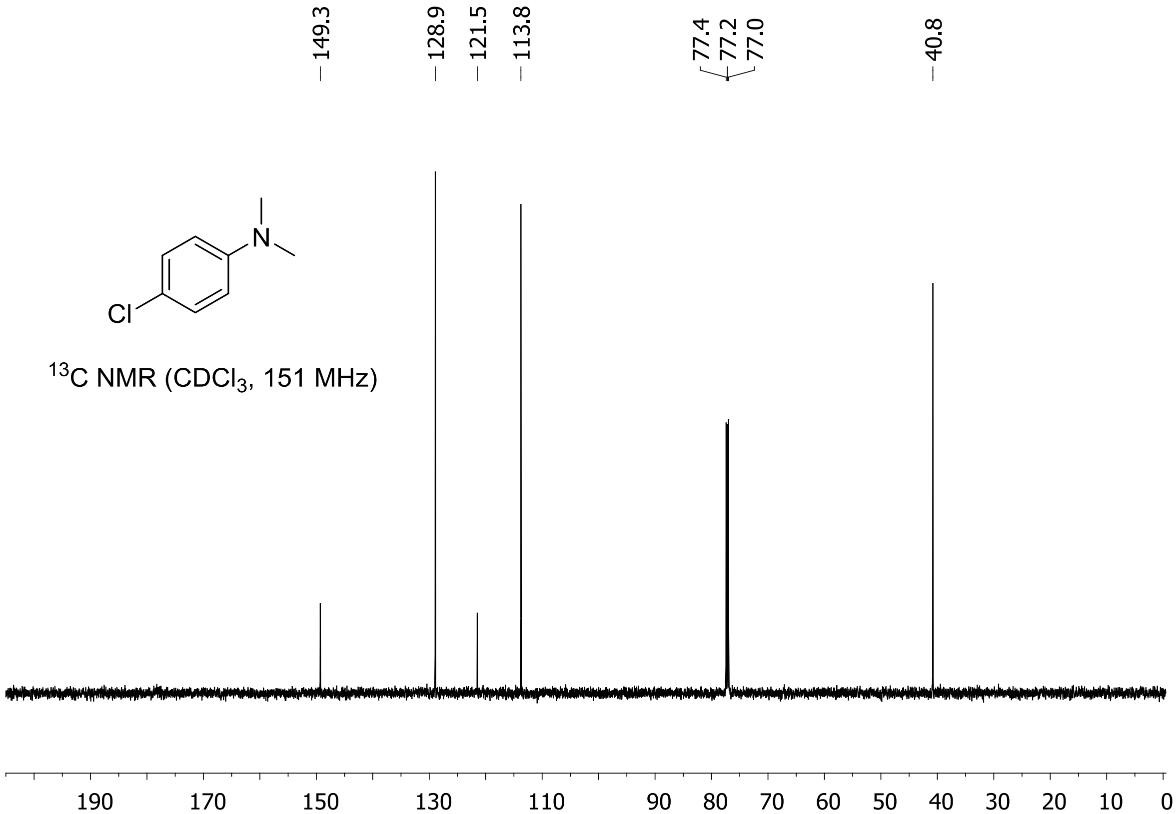

7.31
7.30
7.29
6.80
6.79
6.77
6.76
6.75
3.48
3.47
3.46
3.45
2.97
1.20
1.19
1.18
N
1H NMR (CDCl3, 600 MHz)
2.00
2.89
2.00
2.99
3.11
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

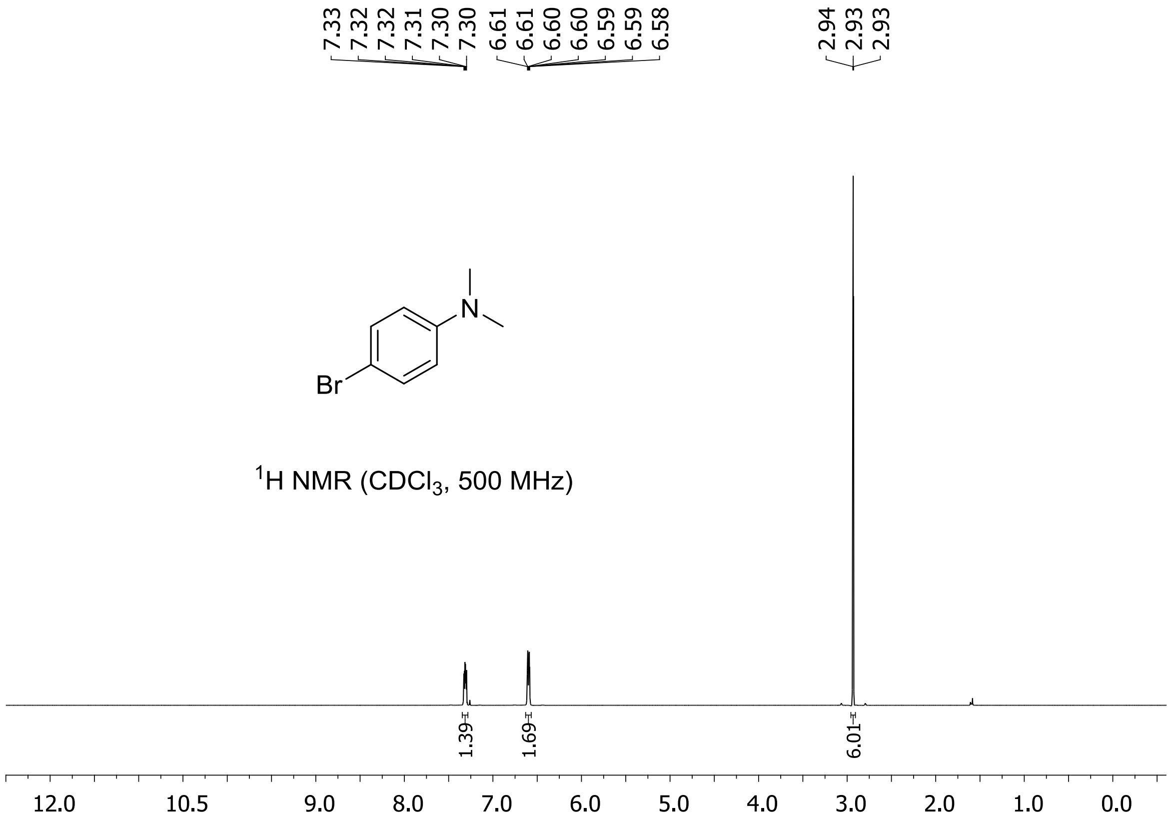

149.3
129.3
116.2
112.6
77.4
77.2
77.0
47.0
37.6
11.3
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

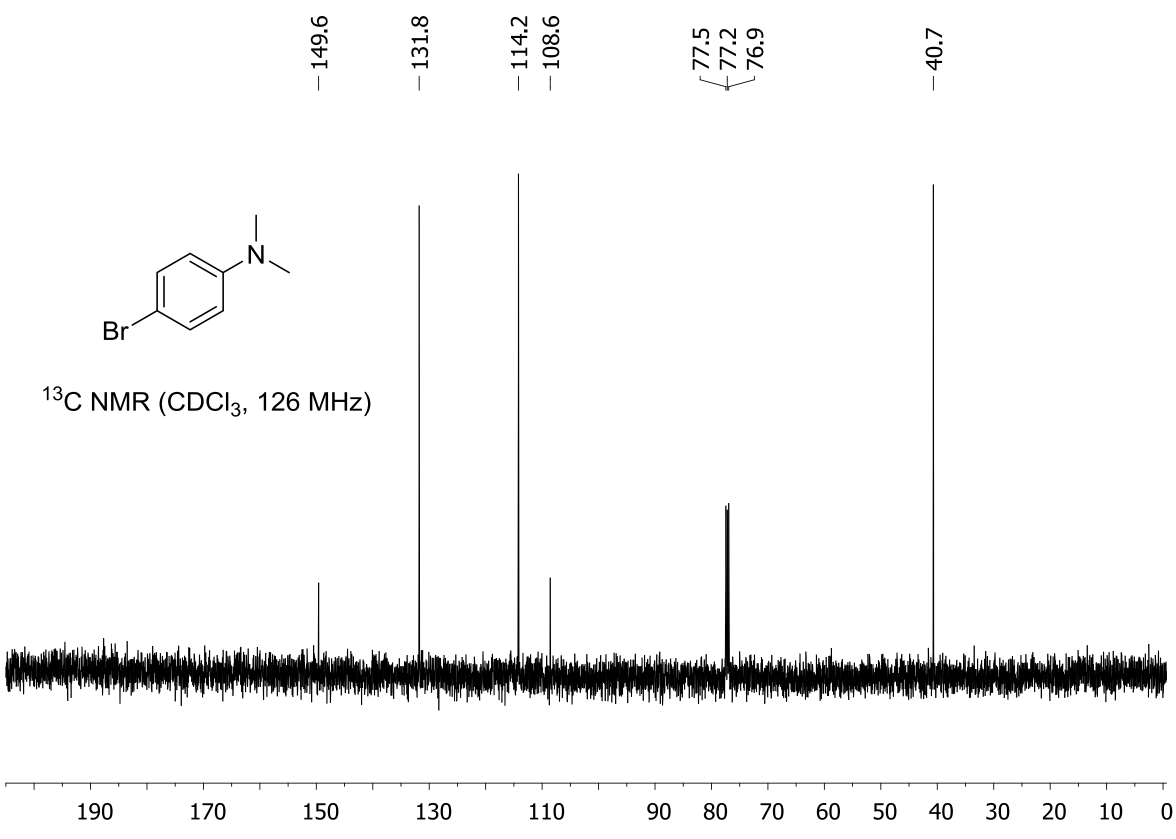

7.26
6.87
6.86
6.78
6.77
3.78
2.88
MeO
N
1H NMR (CDCl3, 600 MHz)
1.80
1.99
3.00
6.16
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

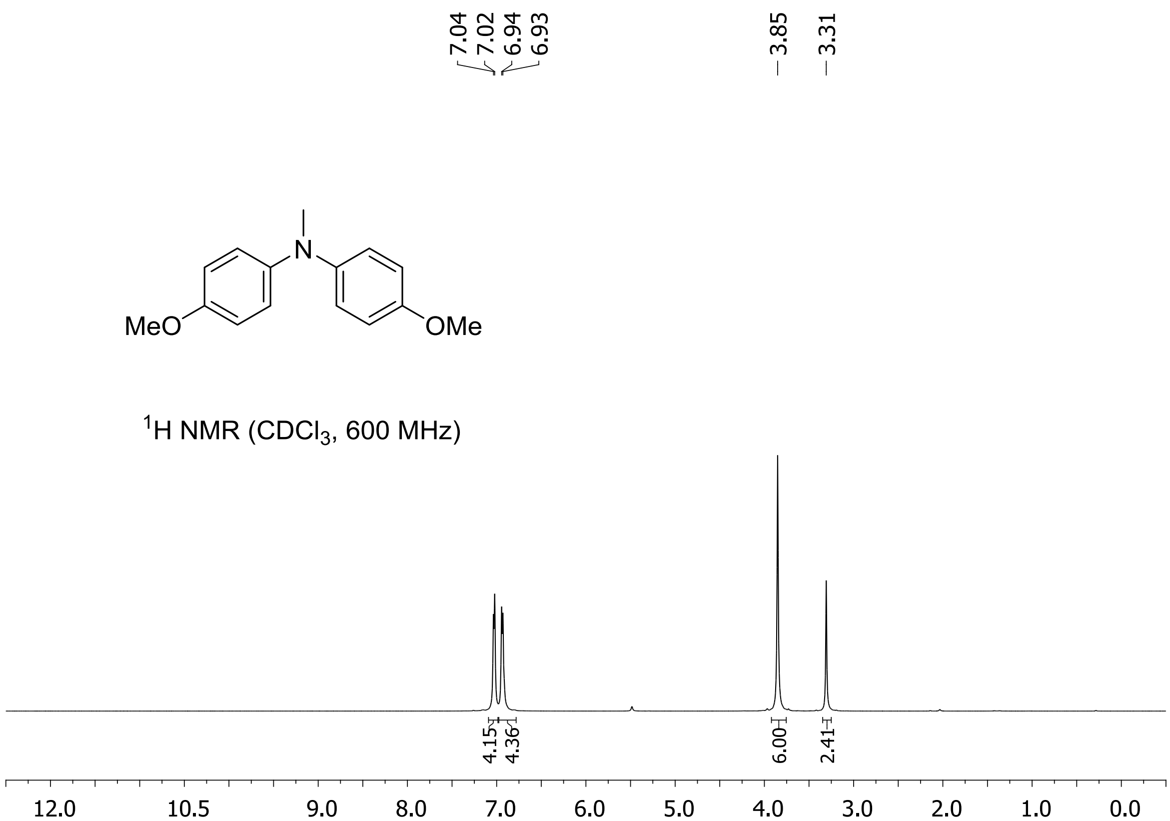

152.1
145.9
115.1
114.8
77.4
77.2
77.0
55.9
42.0
MeO
N
13C NMR (CDCl3, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

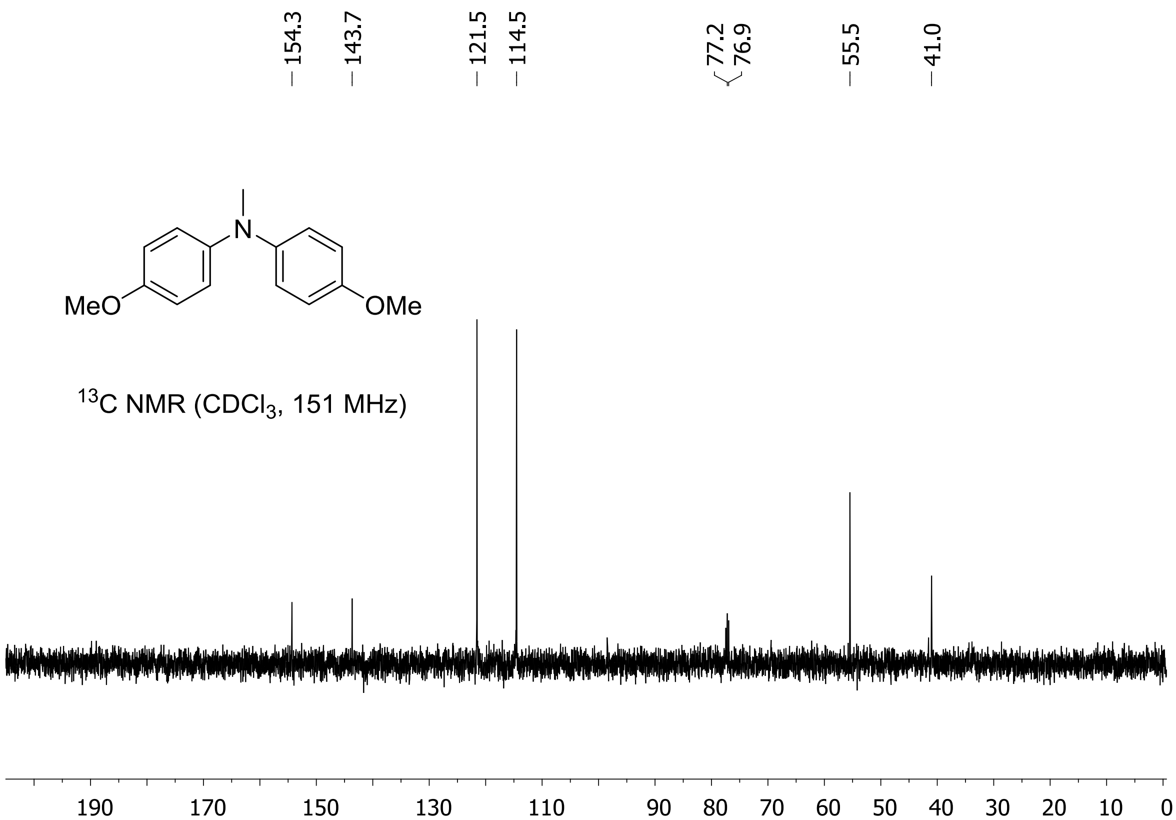

7.26
7.21
7.20
7.20
7.19
7.18
7.18
6.67
6.66
6.66
6.65
6.65
6.64
2.94
N
Cl
1H NMR (CDCl3, 600 MHz)
1.88
1.98
6.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

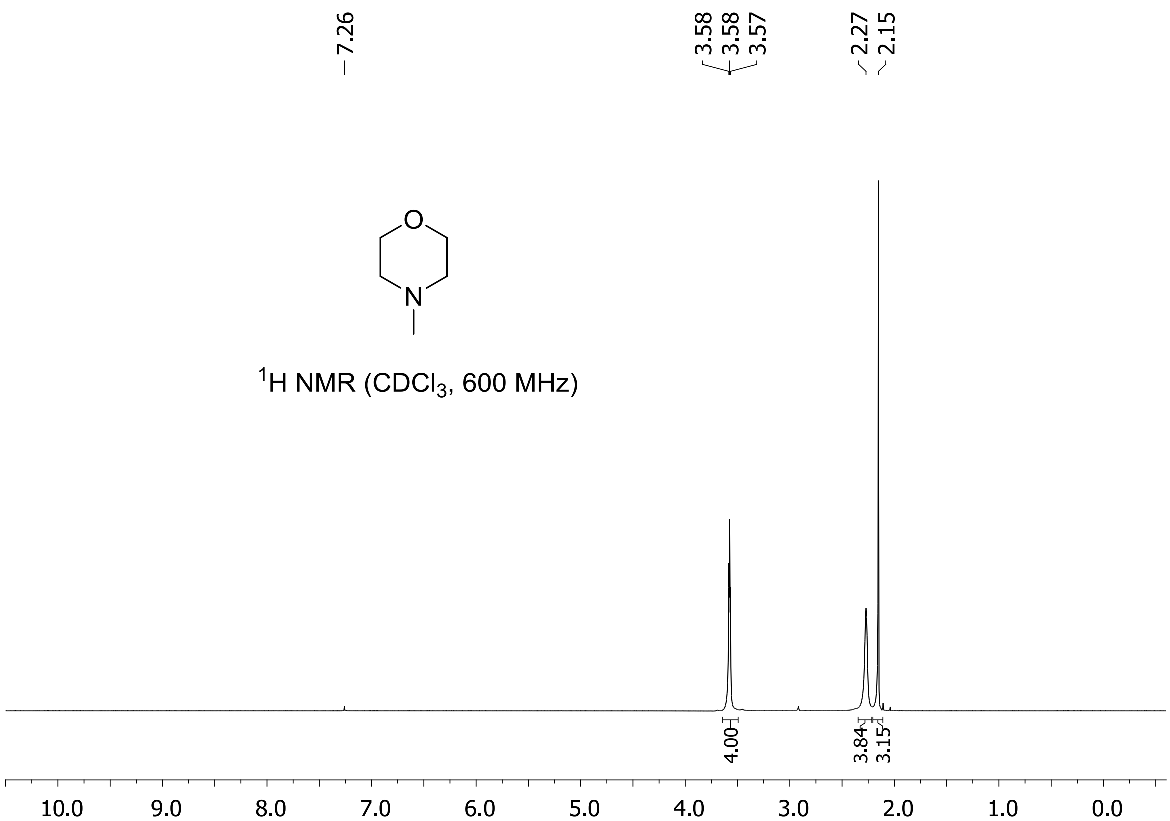

149.3
128.9
121.5
113.8
77.4
77.2
77.0
40.8
N
Cl
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

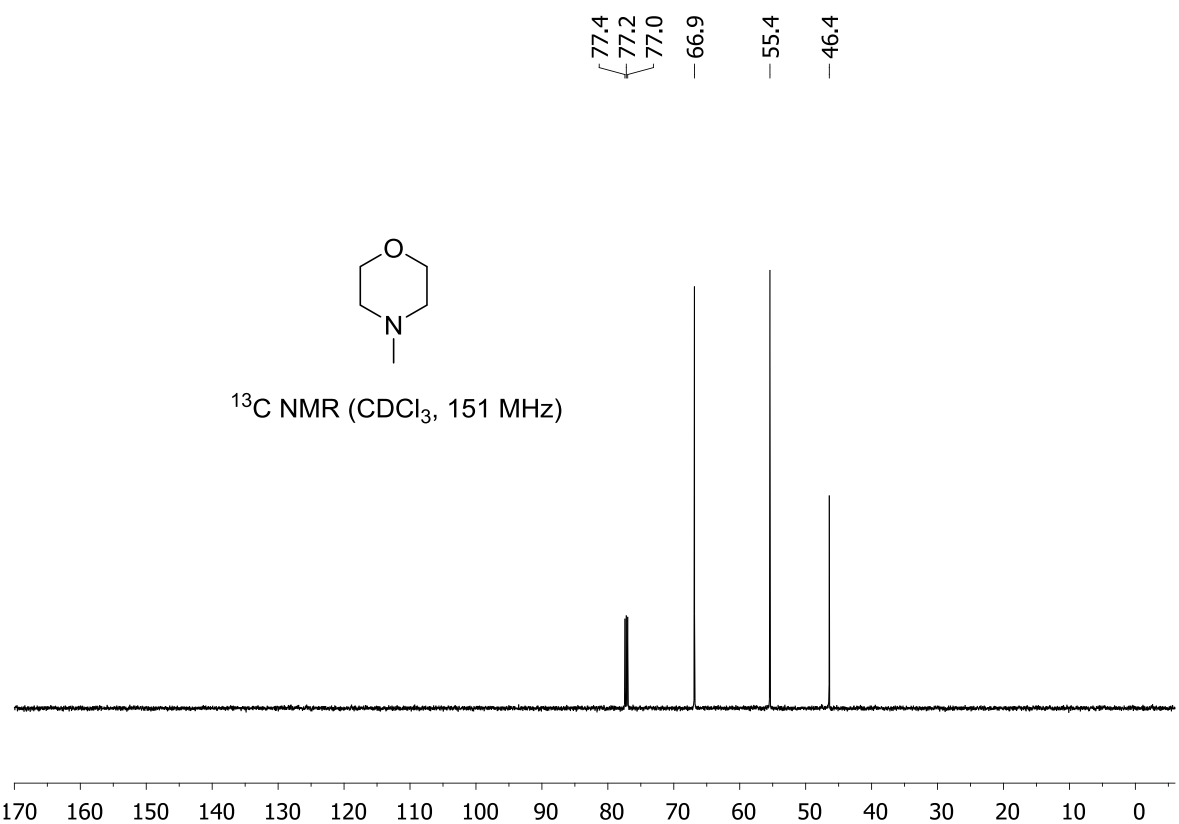

7.33
7.32
7.32
7.31
7.30
7.30
6.61
6.61
6.60
6.60
6.59
6.59
6.58
2.94
2.93
2.93
Br
N
1H NMR (CDCl3, 500 MHz)
1.39
1.69
6.01
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

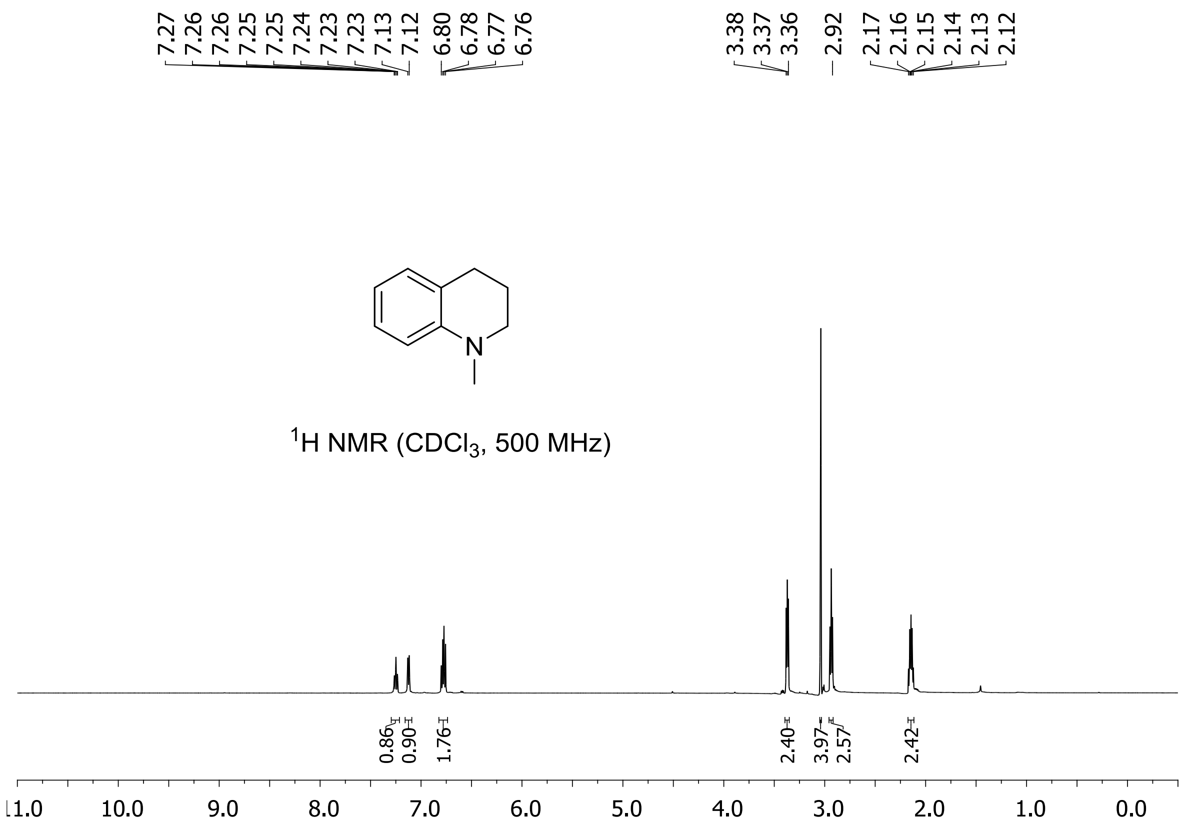

149.6
131.8
114.2
108.6
77.5
77.2
76.9
40.7
Br
N
13C NMR (CDCl3, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

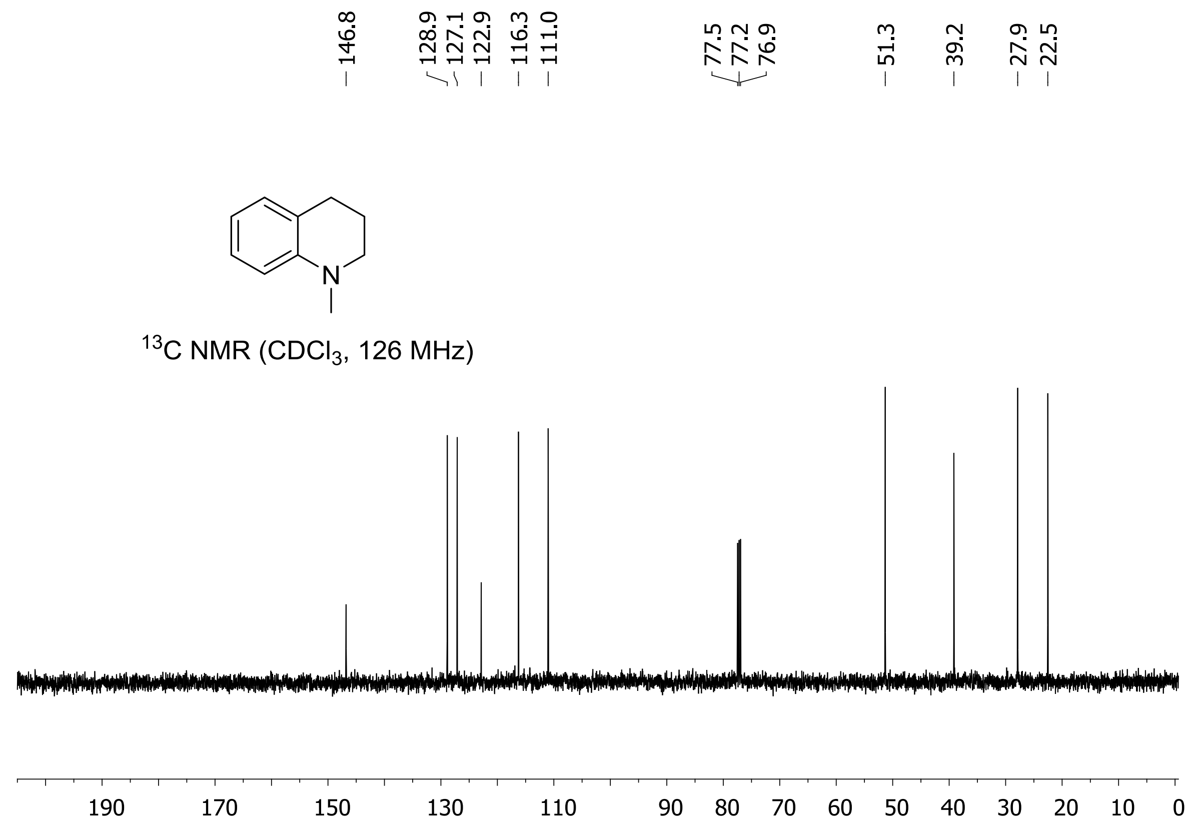

7.04
7.02
6.94
6.93
3.85
3.31
N
MeO
OMe
1H NMR (CDCl3, 600 MHz)
4.15
4.36
6.00
2.41
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

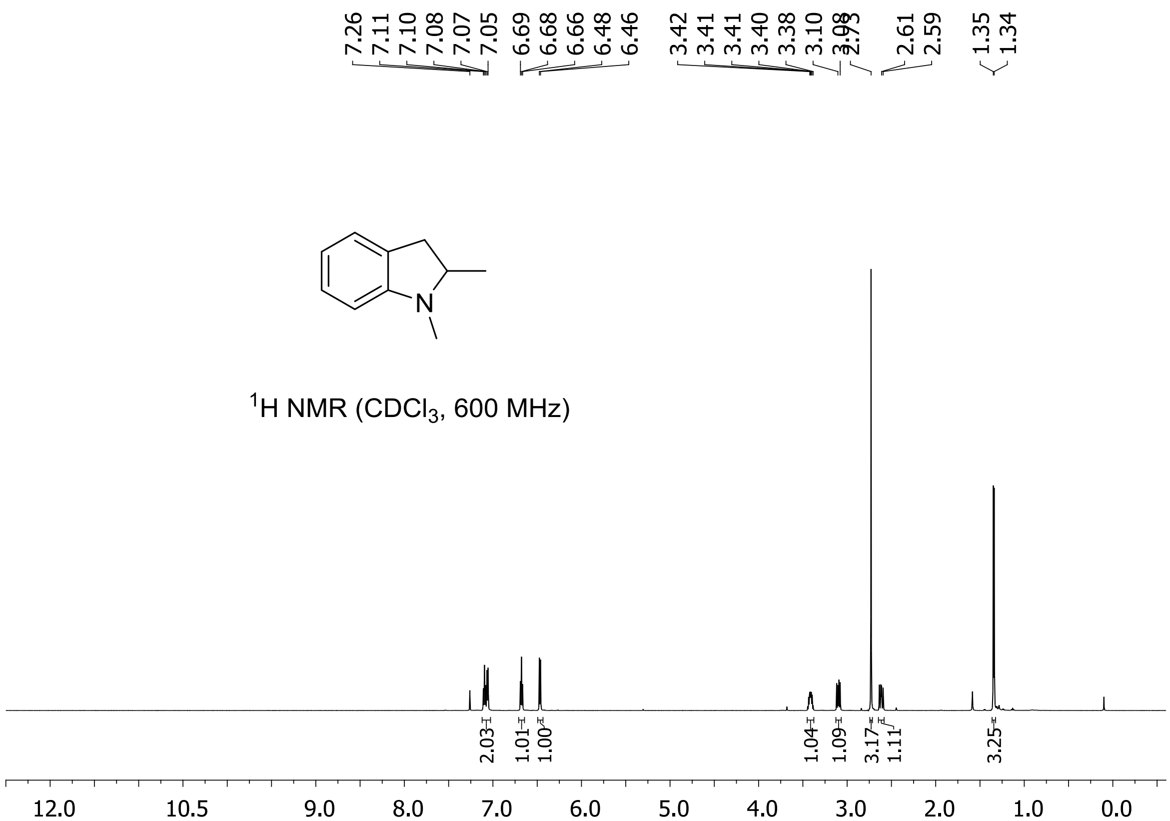

154.3
143.7
121.5
114.5
77.2
76.9
55.5
41.0
N
MeO
OMe
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

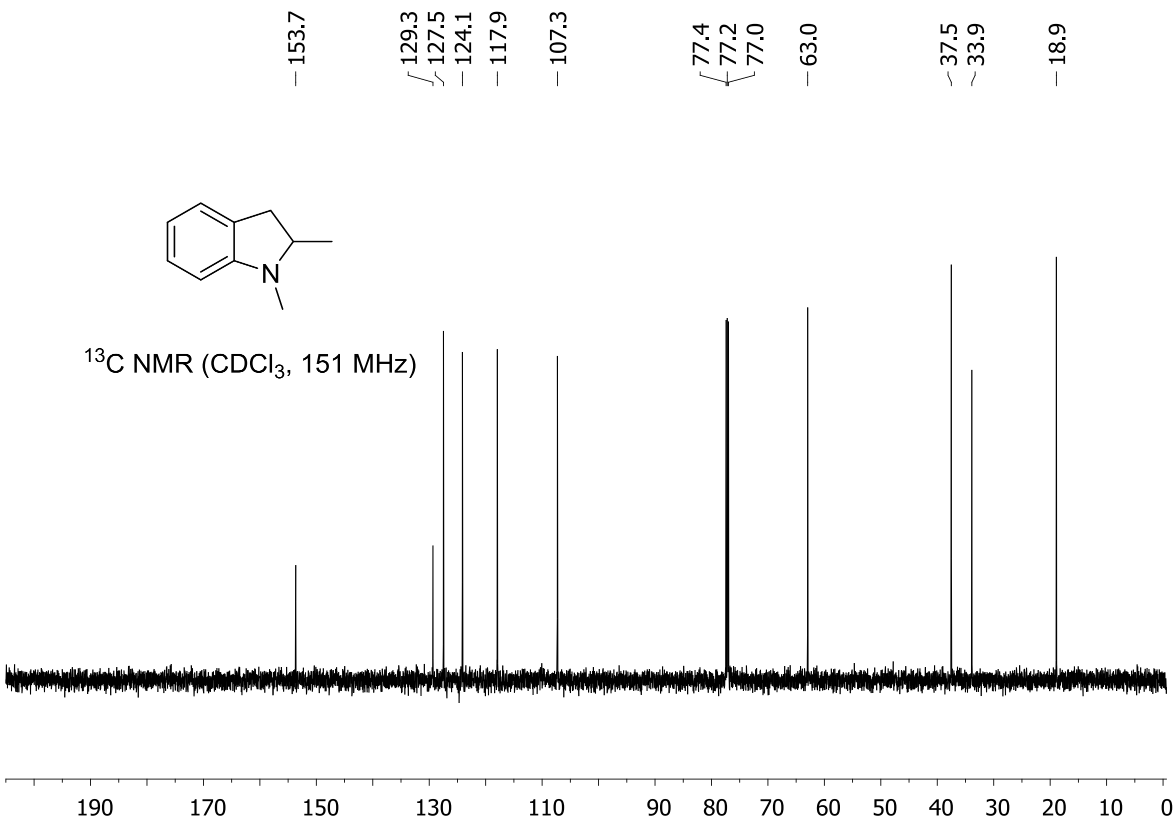

7.26
3.58
3.58
3.57
2.27
2.15
O
N
1H NMR (CDCl3, 600 MHz)
4.00
3.84
3.15
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

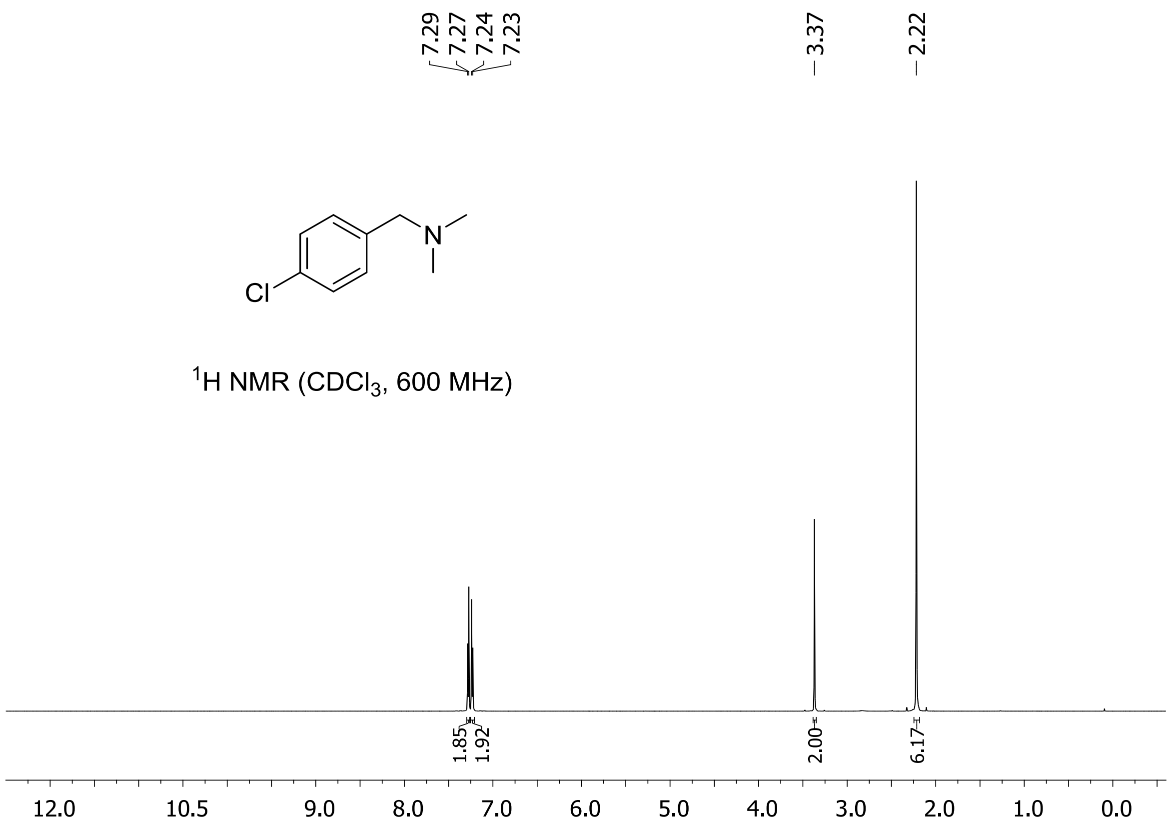

77.4
77.2
77.0
66.9
55.4
46.4
O
N
13C NMR (CDCl3, 151 MHz)
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

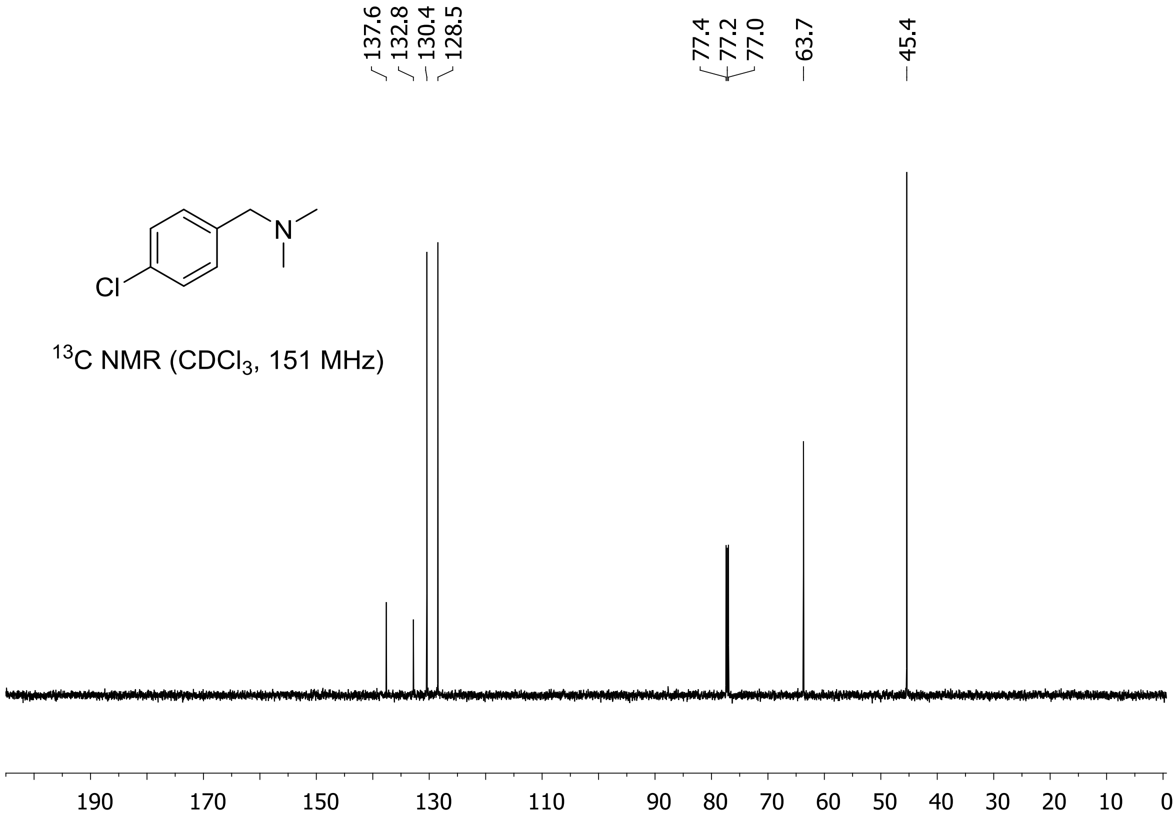

7.27
7.26
7.26
7.25
7.25
7.24
7.23
7.23
7.13
7.12
6.80
6.78
6.77
6.76
3.38
3.37
3.36
2.92
2.17
2.16
2.15
2.14
2.13
2.12
N
^{1}H NMR ($CDCl_3$, 500 MHz)
0.86
0.90
1.76
2.40
3.97
2.57
2.42
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

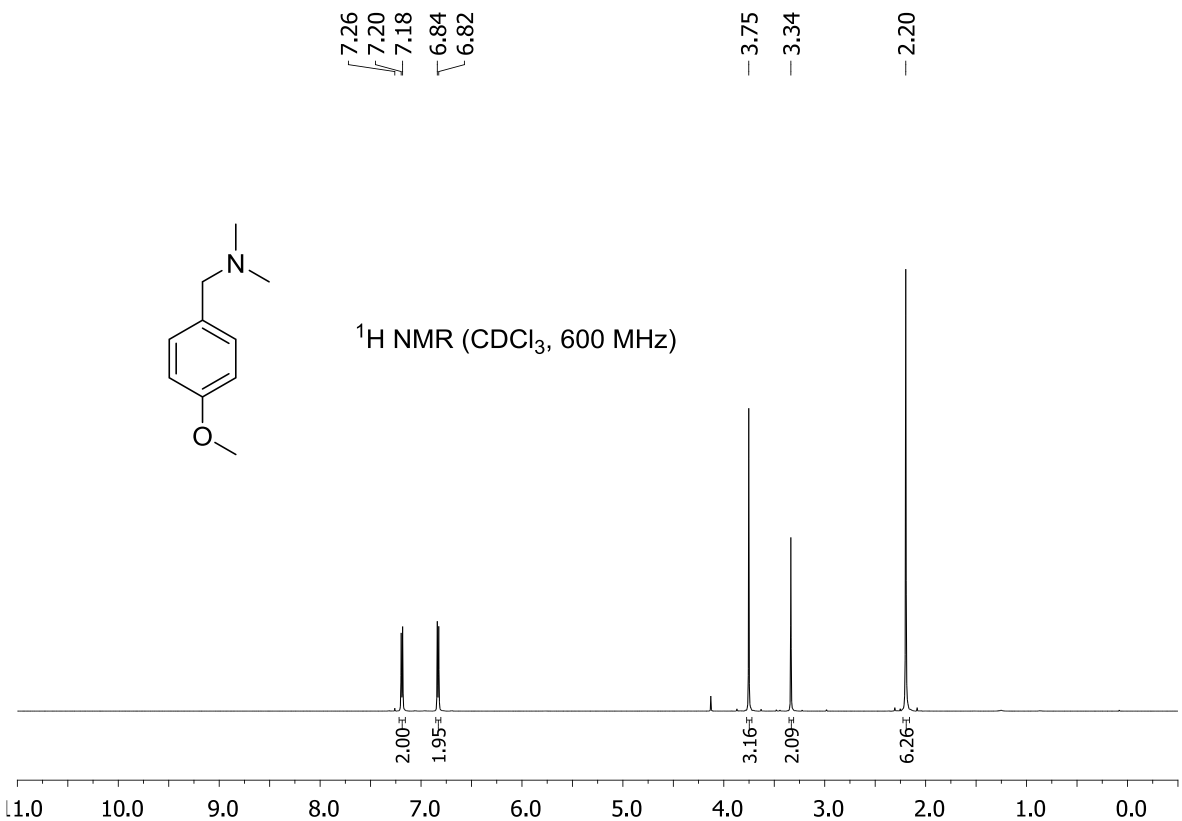

146.8
128.9
127.1
122.9
116.3
111.0
77.5
77.2
76.9
51.3
39.2
27.9
22.5
N
^{13}C NMR ($CDCl_3$, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

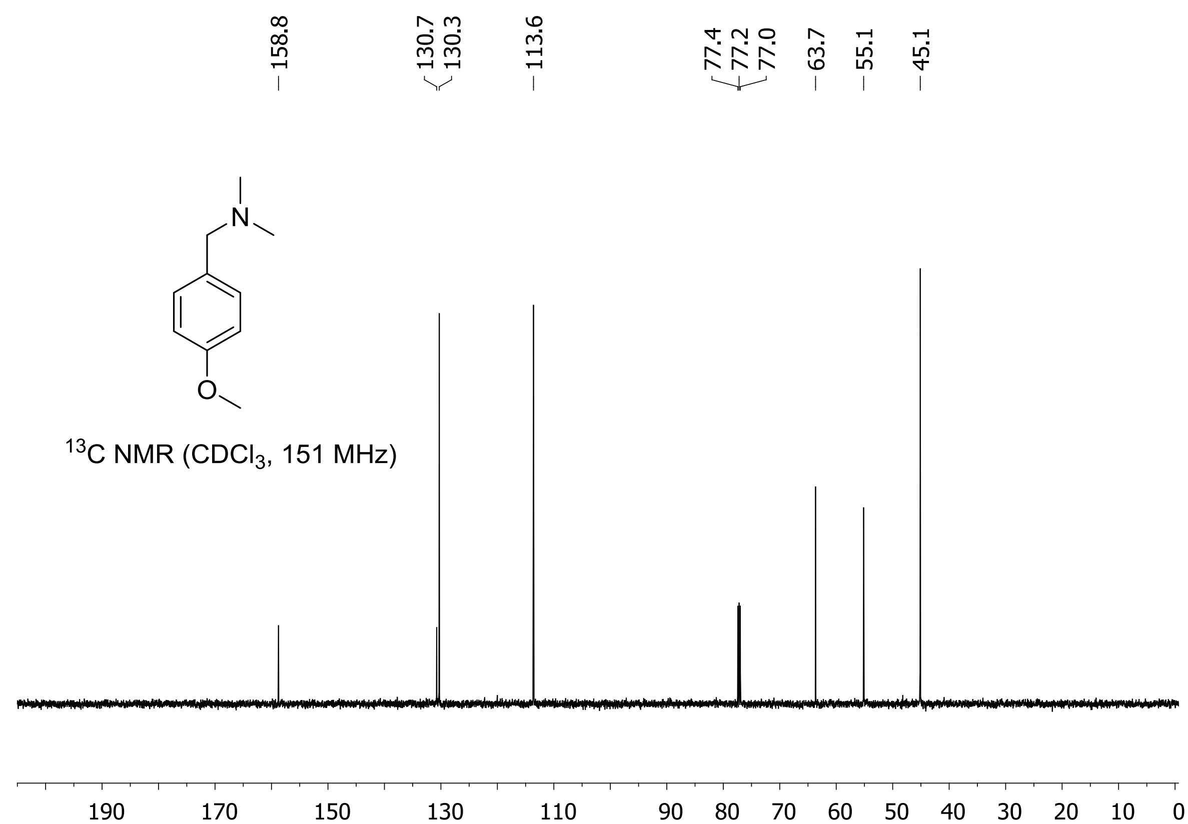

7.26
7.11
7.10
7.08
7.07
7.05
6.69
6.68
6.66
6.48
6.46
3.42
3.41
3.41
3.40
3.38
3.10
3.08
2.73
2.61
2.59
1.35
1.34
N
1H NMR (CDCl3, 600 MHz)
2.03
1.01
1.00
1.04
1.09
3.17
1.11
3.25
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

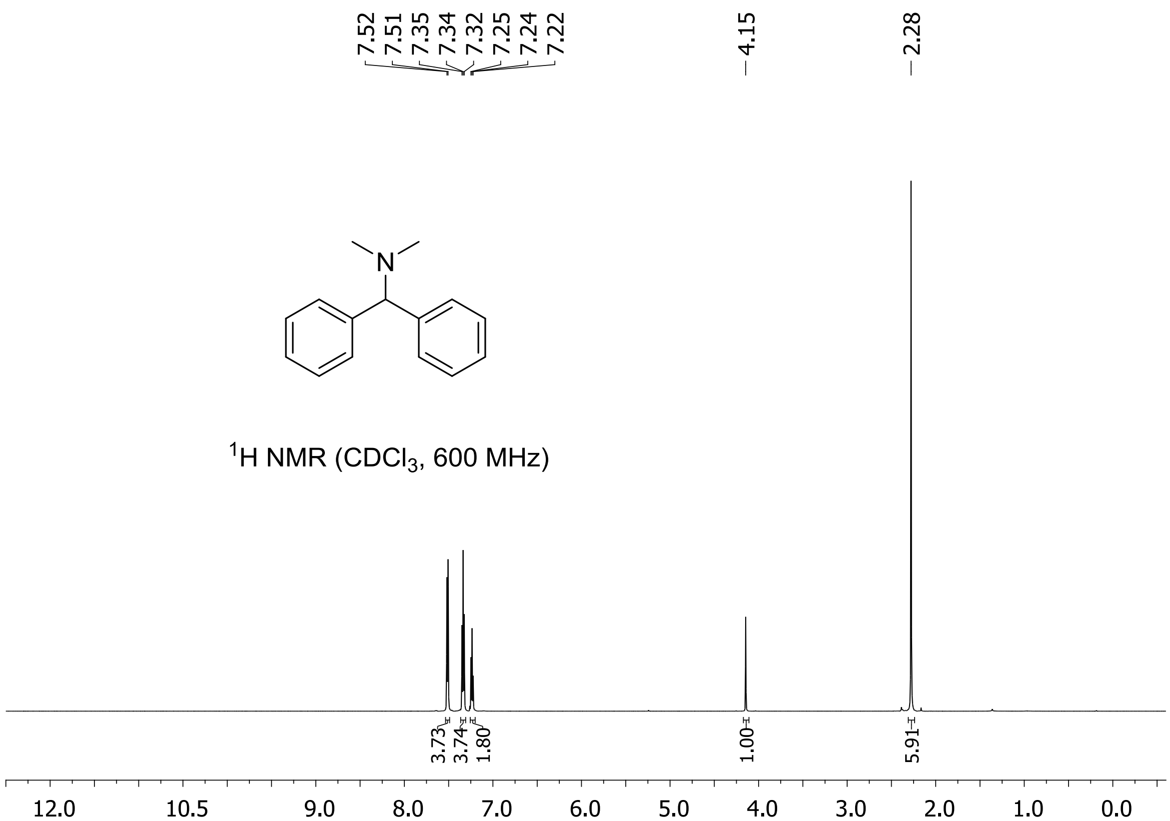

153.7
129.3
127.5
124.1
117.9
107.3
77.4
77.2
77.0
63.0
37.5
33.9
18.9
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

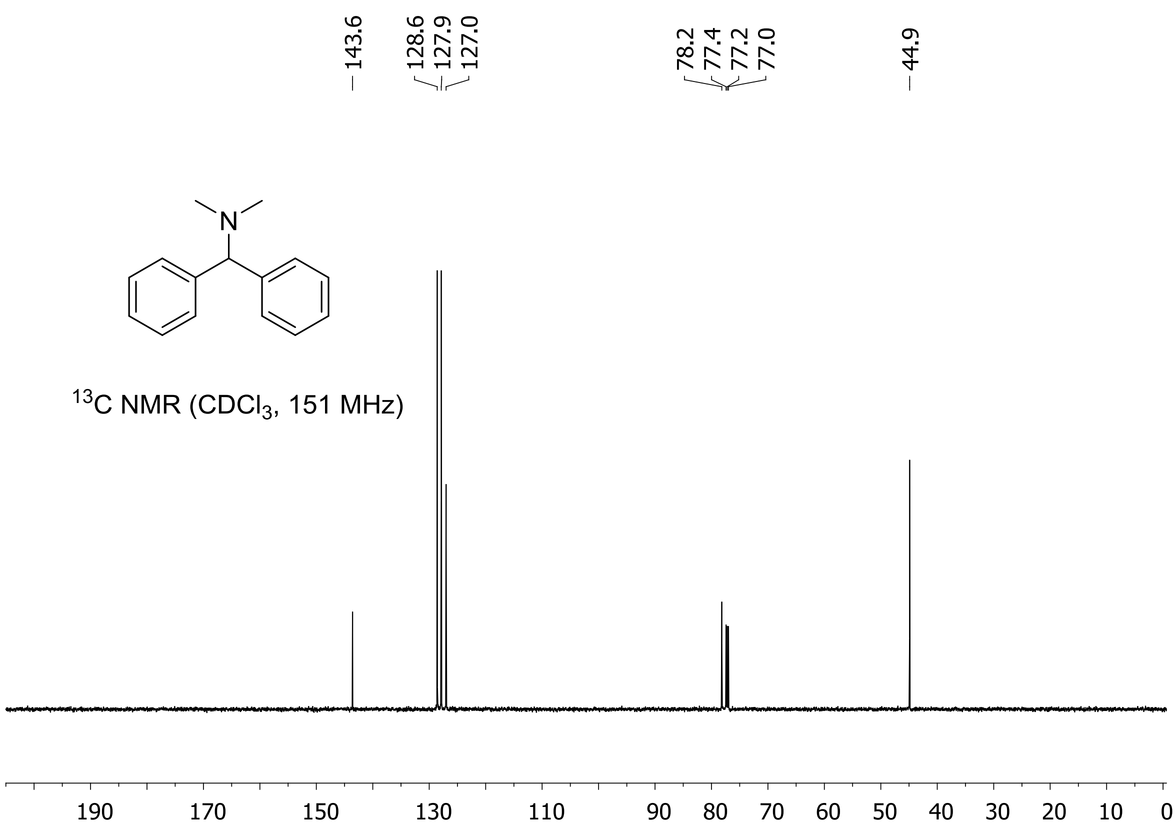

7.29
7.27
7.24
7.23
3.37
2.22
Cl
N
1H NMR (CDCl3, 600 MHz)
1.85
1.92
2.00
6.17
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

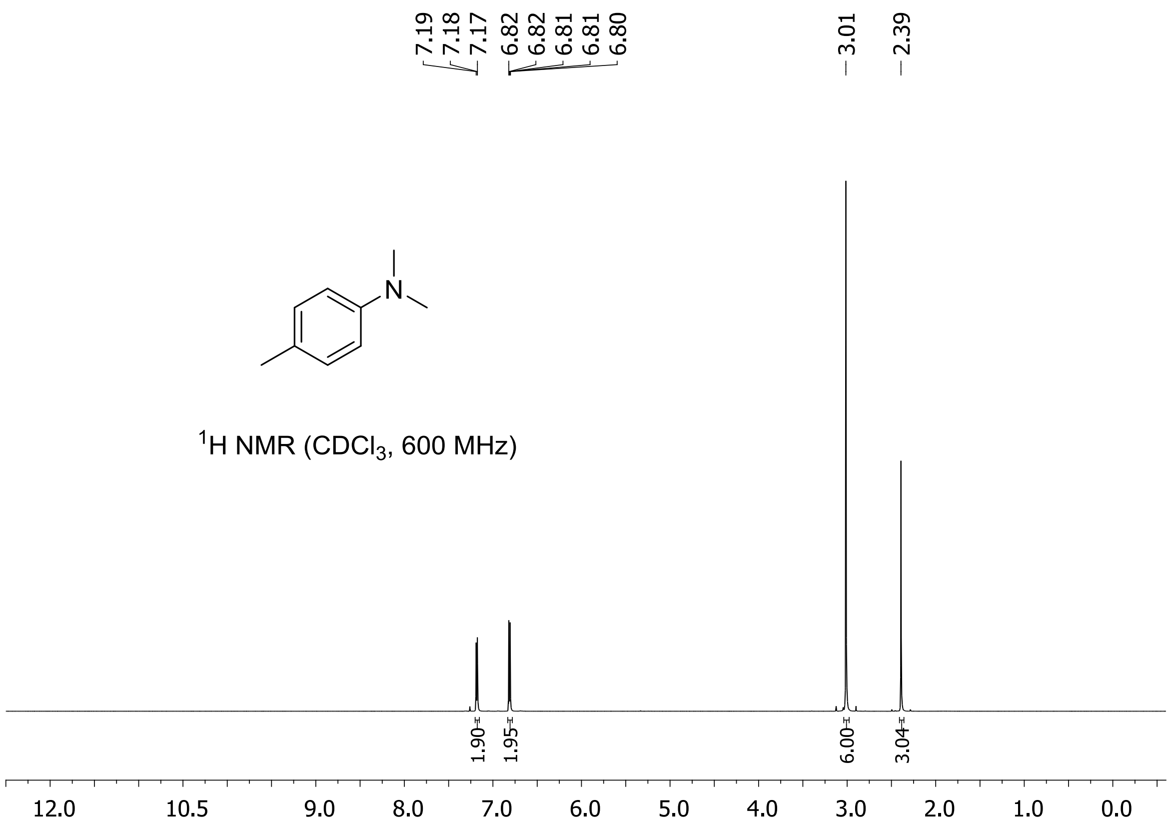

137.6
132.8
130.4
128.5
77.4
77.2
77.0
63.7
45.4
Cl
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

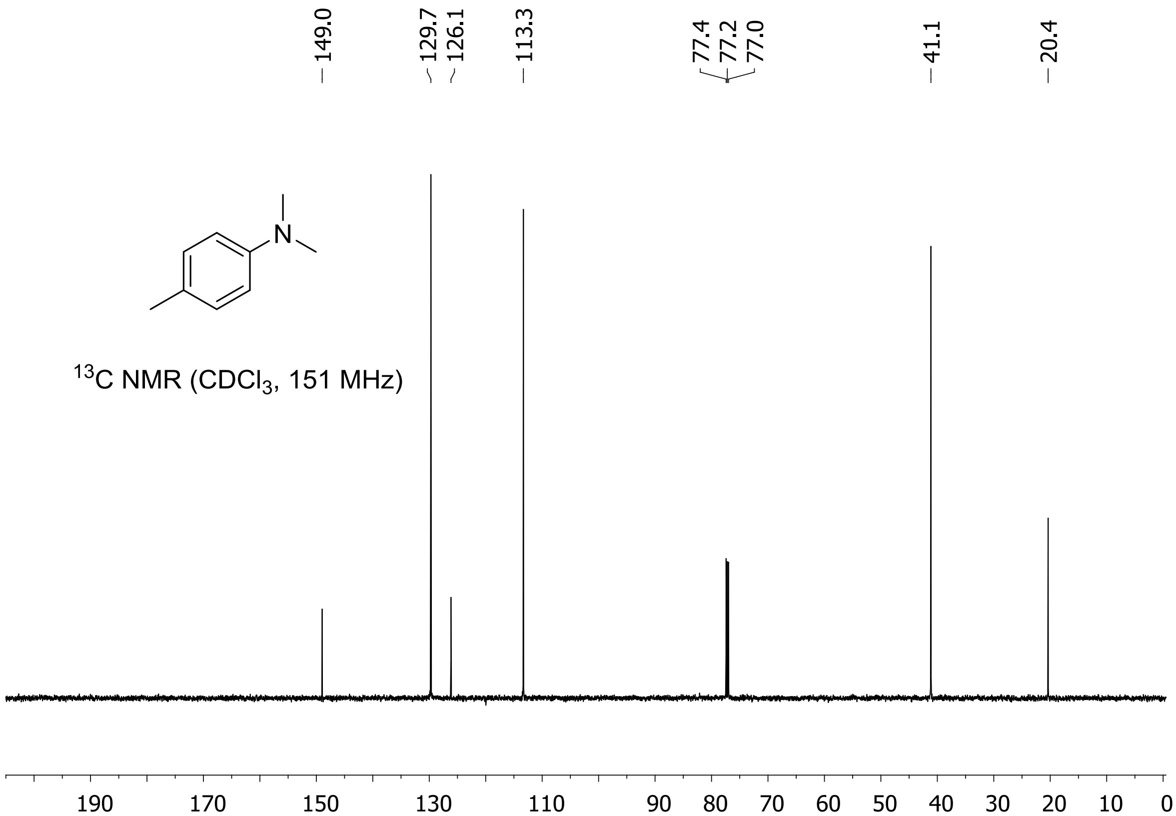

7.26
7.20
7.18
6.84
6.82
3.75
3.34
2.20
N
O
^{1}H NMR (CDCl$_3$, 600 MHz)
2.00
1.95
3.16
2.09
6.26
11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

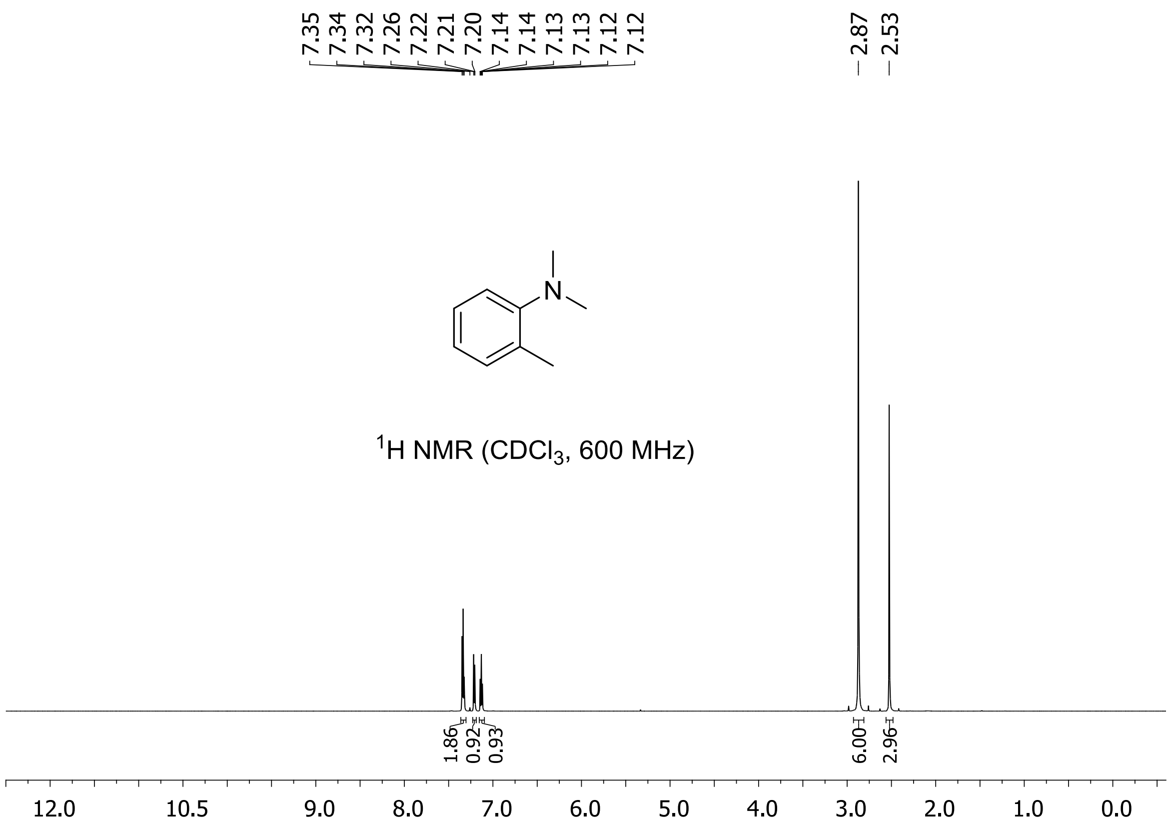

158.8
130.7
130.3
113.6
77.4
77.2
77.0
63.7
55.1
45.1
N
O
^{13}C NMR (CDCl$_3$, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

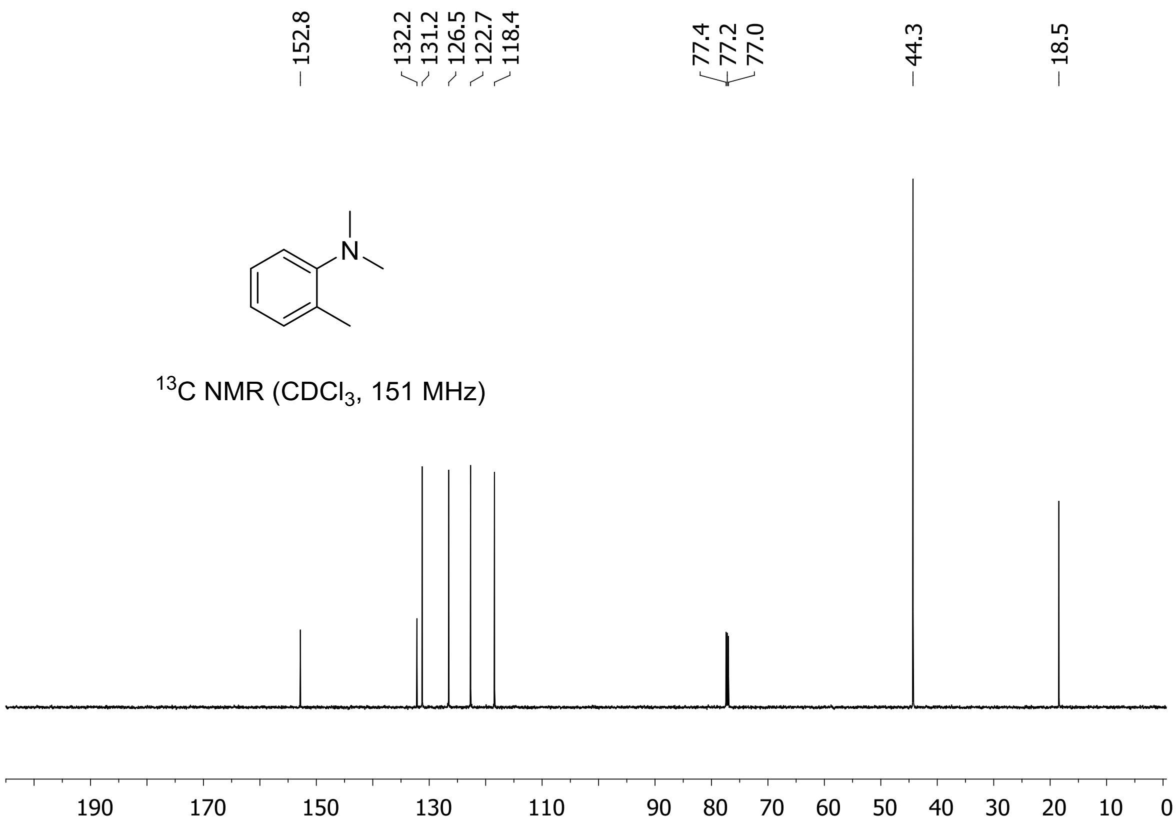

7.52
7.51
7.35
7.34
7.32
7.25
7.24
7.22
4.15
2.28
1H NMR (CDCl3, 600 MHz)
3.73
3.74
1.80
1.00
5.91
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

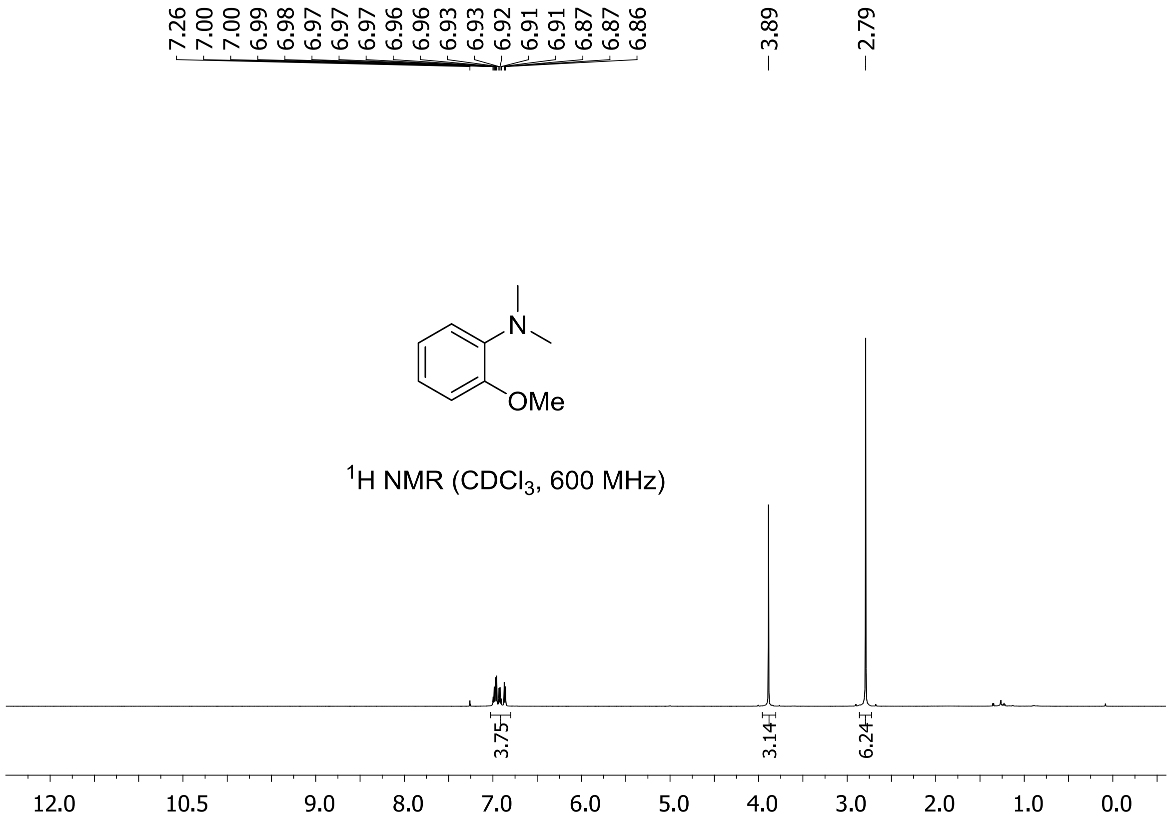

143.6
128.6
127.9
127.0
78.2
77.4
77.2
77.0
44.9
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

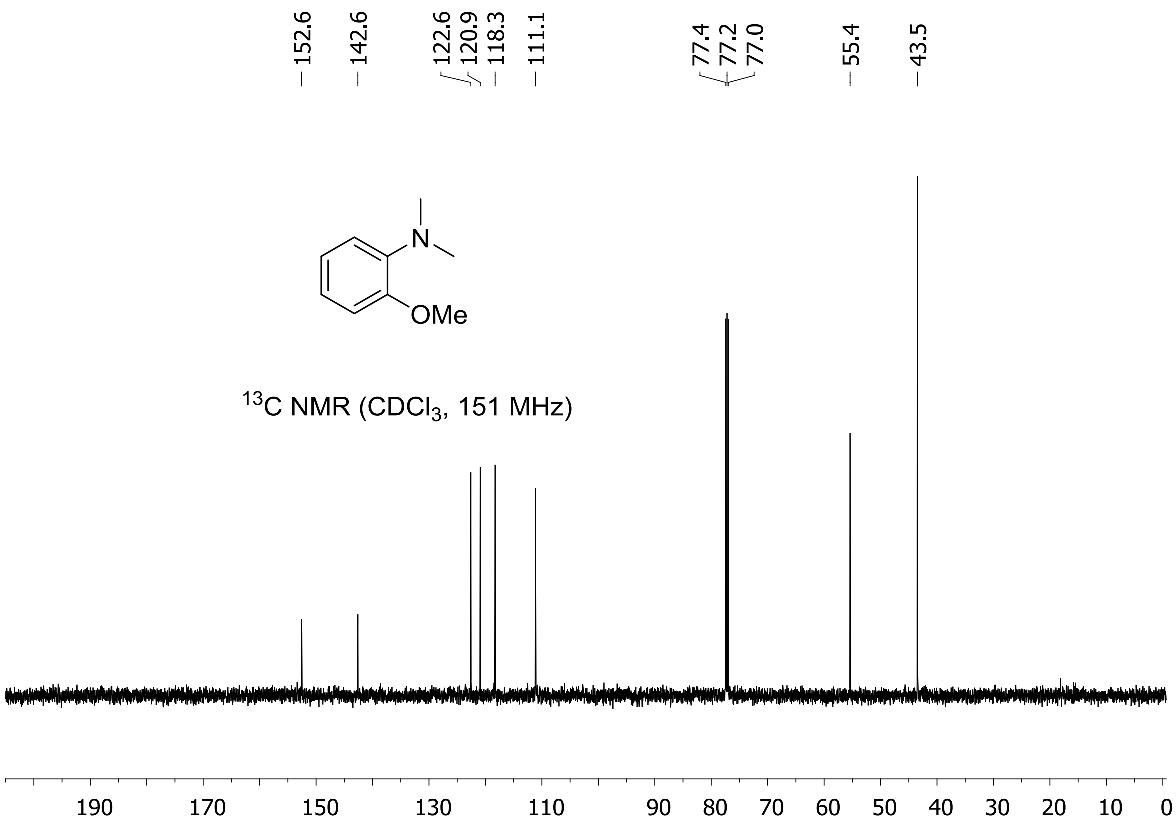

7.19
7.18
7.17
6.82
6.82
6.81
6.81
6.80
3.01
2.39
N
1H NMR (CDCl3, 600 MHz)
1.90
1.95
6.00
3.04
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

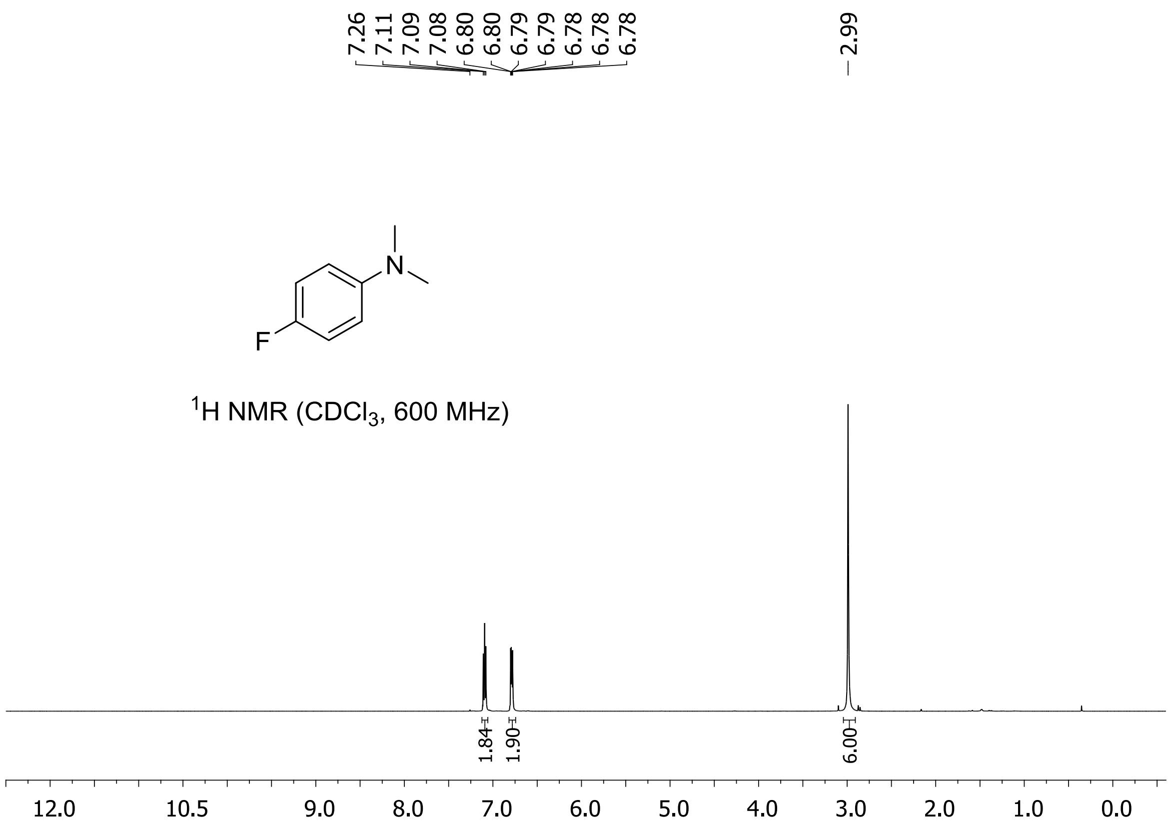

149.0
129.7
126.1
113.3
77.4
77.2
77.0
41.1
20.4
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

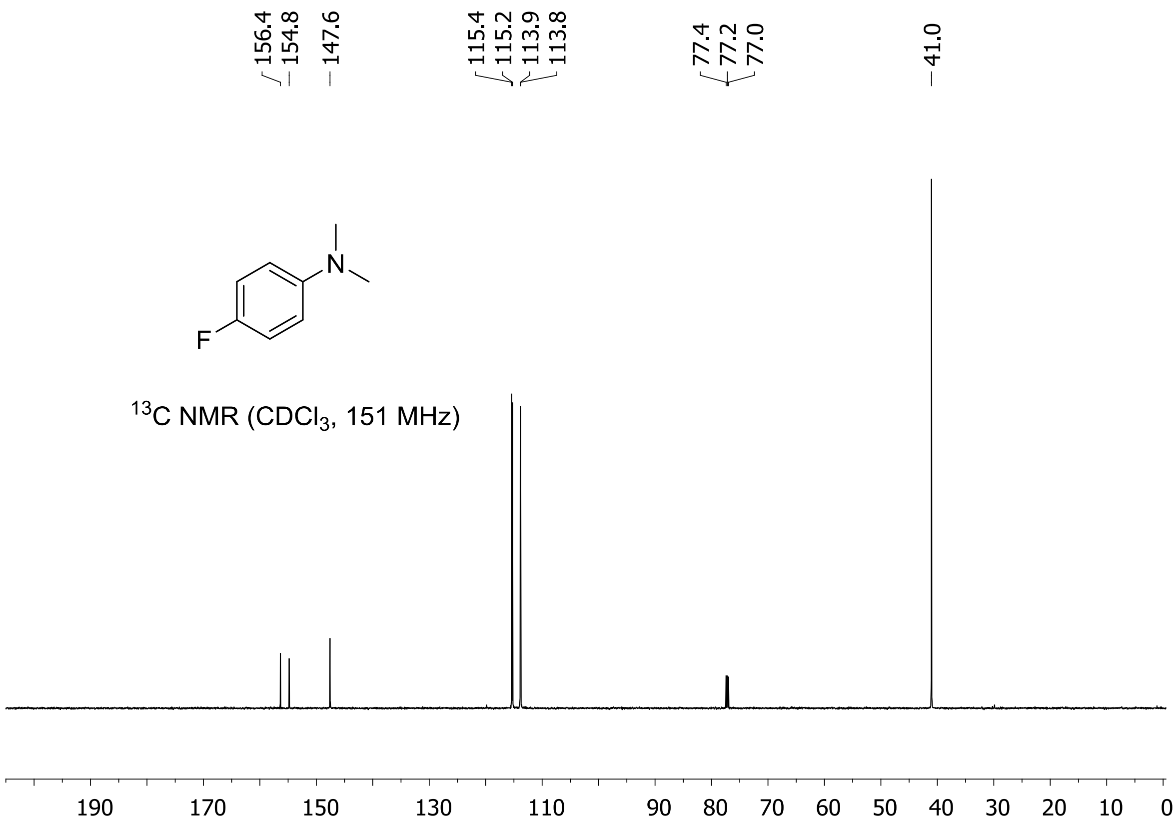

7.35
7.34
7.32
7.26
7.22
7.21
7.20
7.14
7.14
7.13
7.13
7.12
7.12
2.87
2.53
N
^{1}H NMR (CDCl$_3$, 600 MHz)
1.86
0.92
0.93
6.00
2.96
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

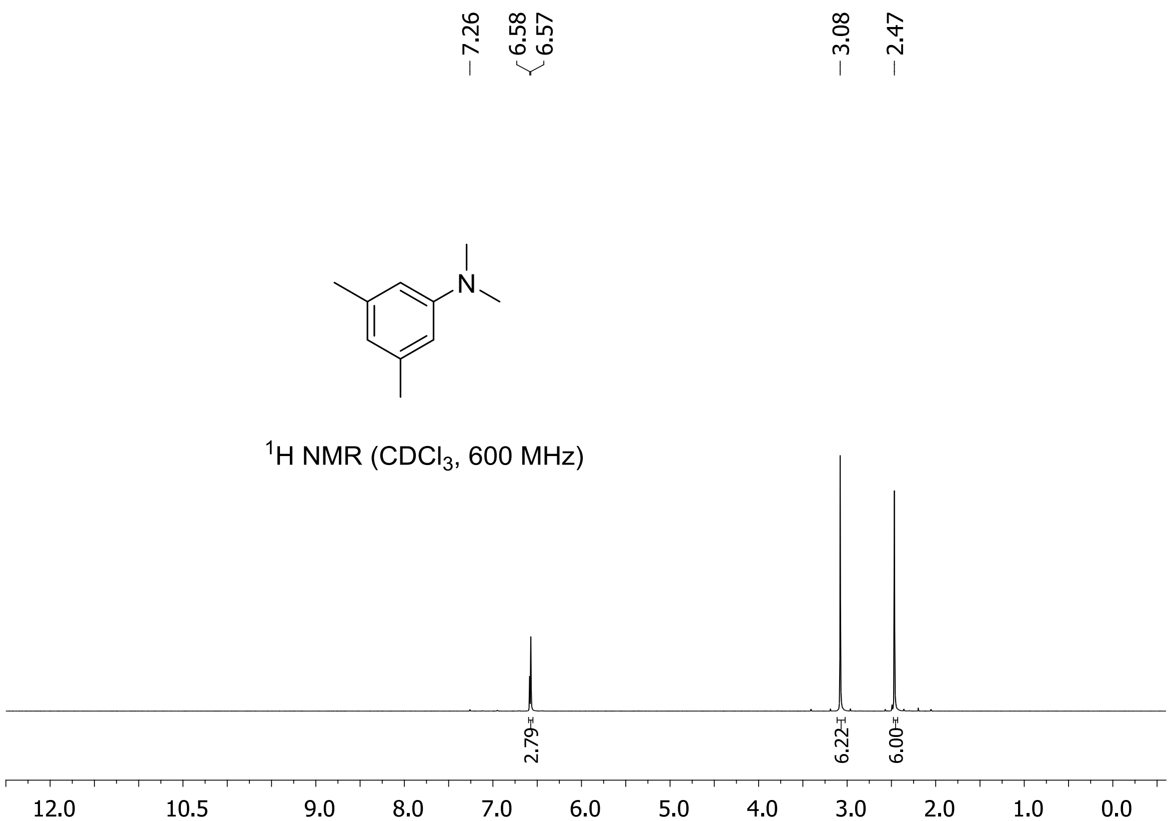

152.8
132.2
131.2
126.5
122.7
118.4
77.4
77.2
77.0
44.3
18.5
N
^{13}C NMR (CDCl$_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

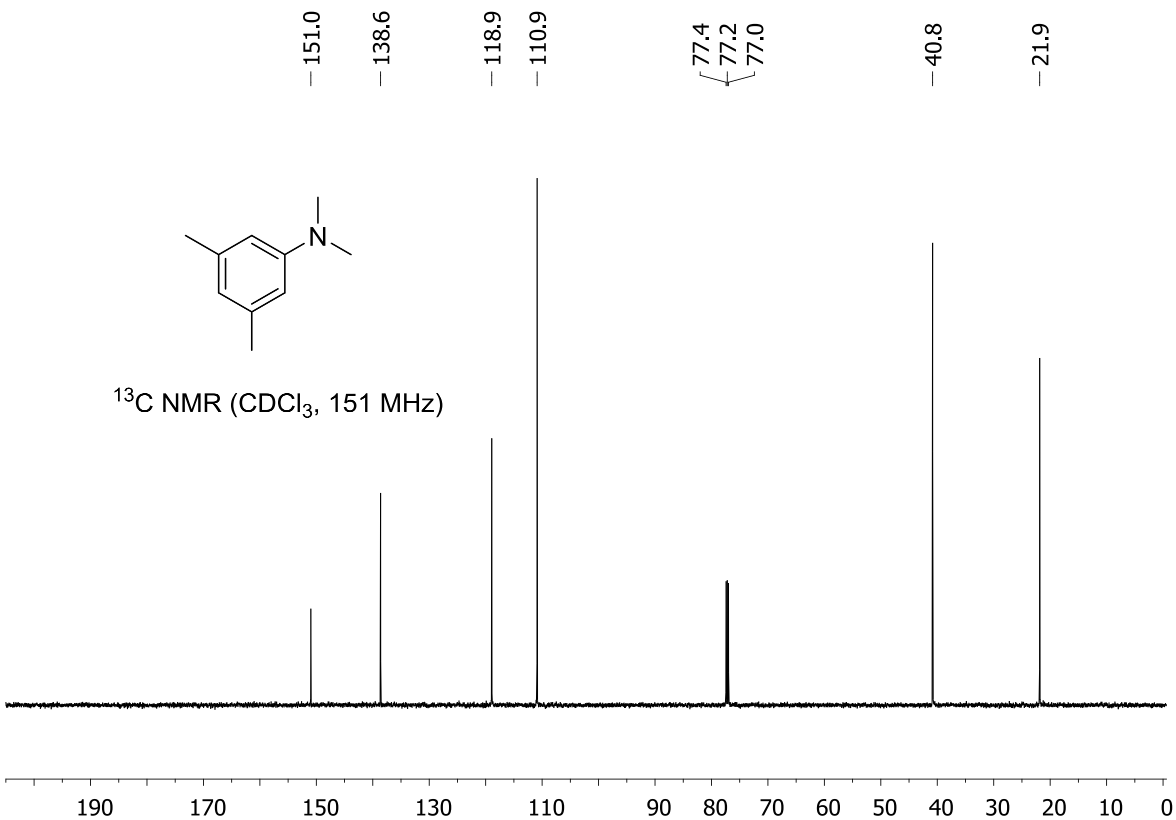

7.26
7.00
7.00
6.99
6.98
6.97
6.97
6.97
6.96
6.96
6.93
6.93
6.92
6.91
6.91
6.87
6.87
6.86
3.89
2.79
N
OMe
1H NMR (CDCl3, 600 MHz)
3.75
3.14
6.24
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

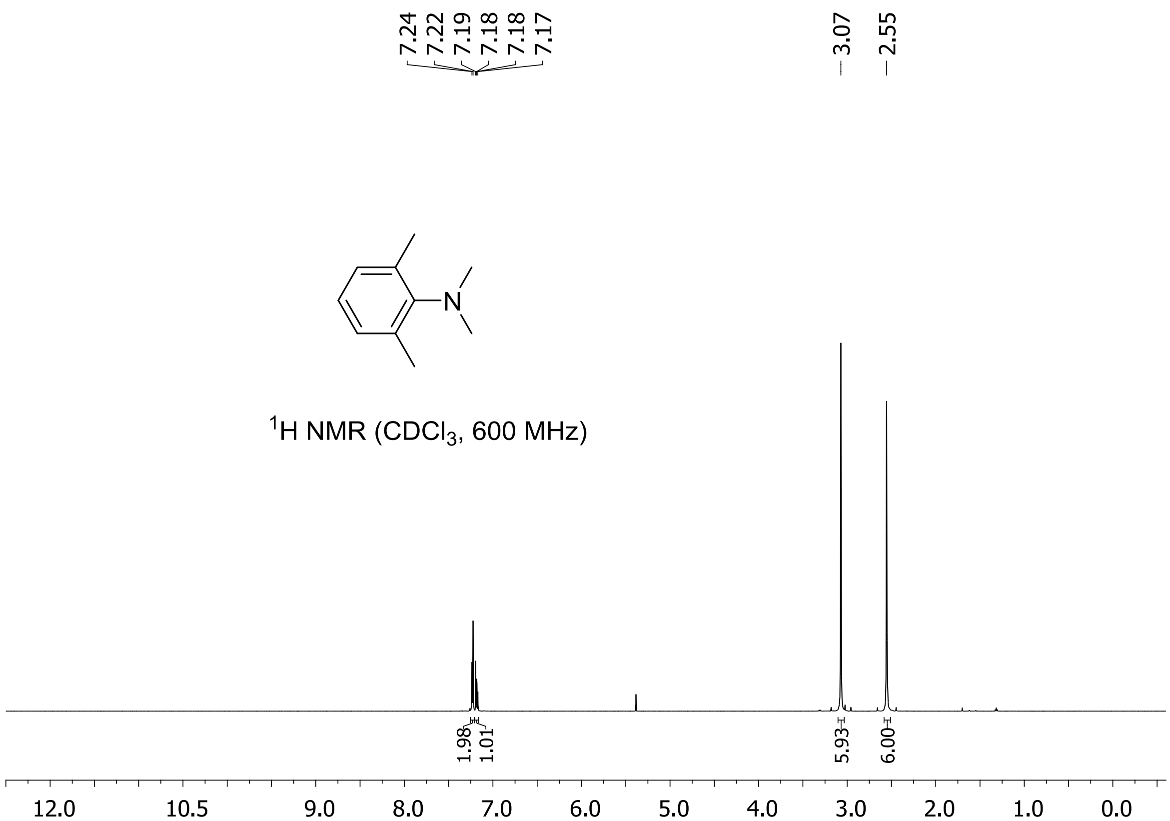

152.6
142.6
122.6
120.9
118.3
111.1
77.4
77.2
77.0
55.4
43.5
N
OMe
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

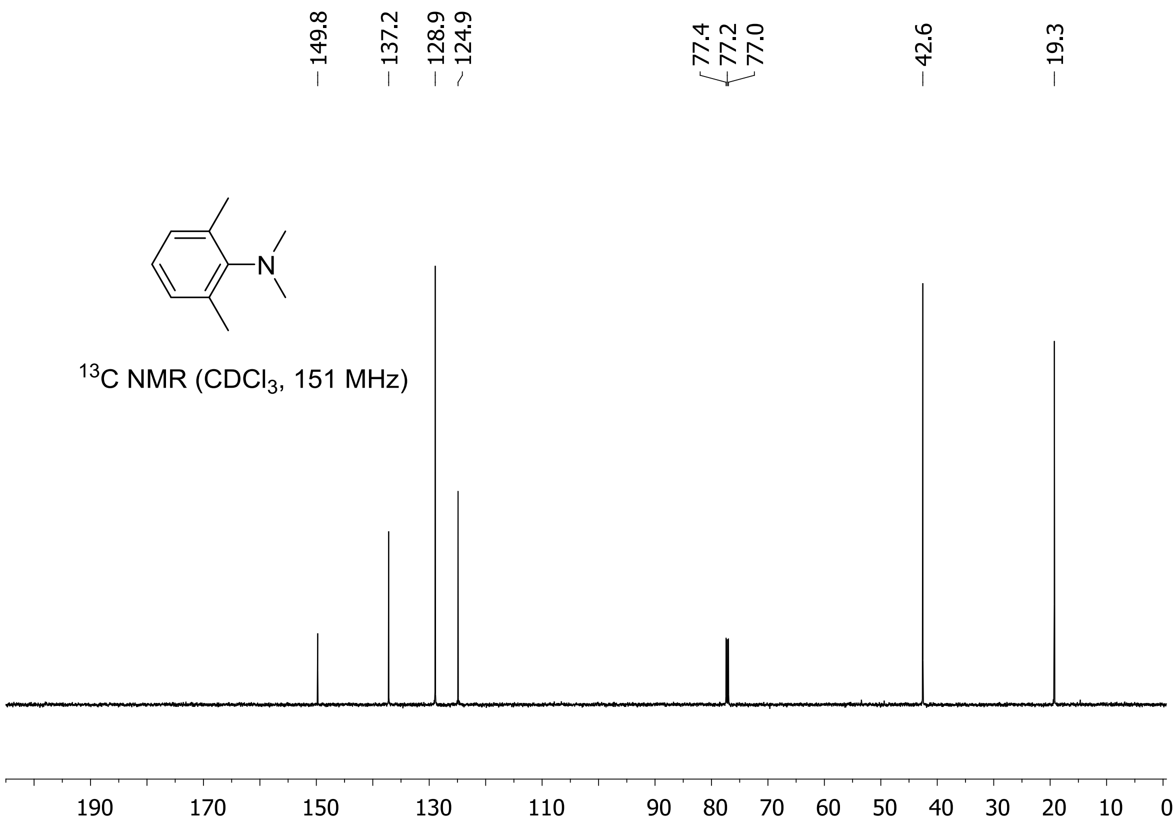

7.26
7.11
7.09
7.08
6.80
6.80
6.79
6.79
6.78
6.78
6.78
2.99
F
N
1H NMR (CDCl3, 600 MHz)
1.84
1.90
6.00
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

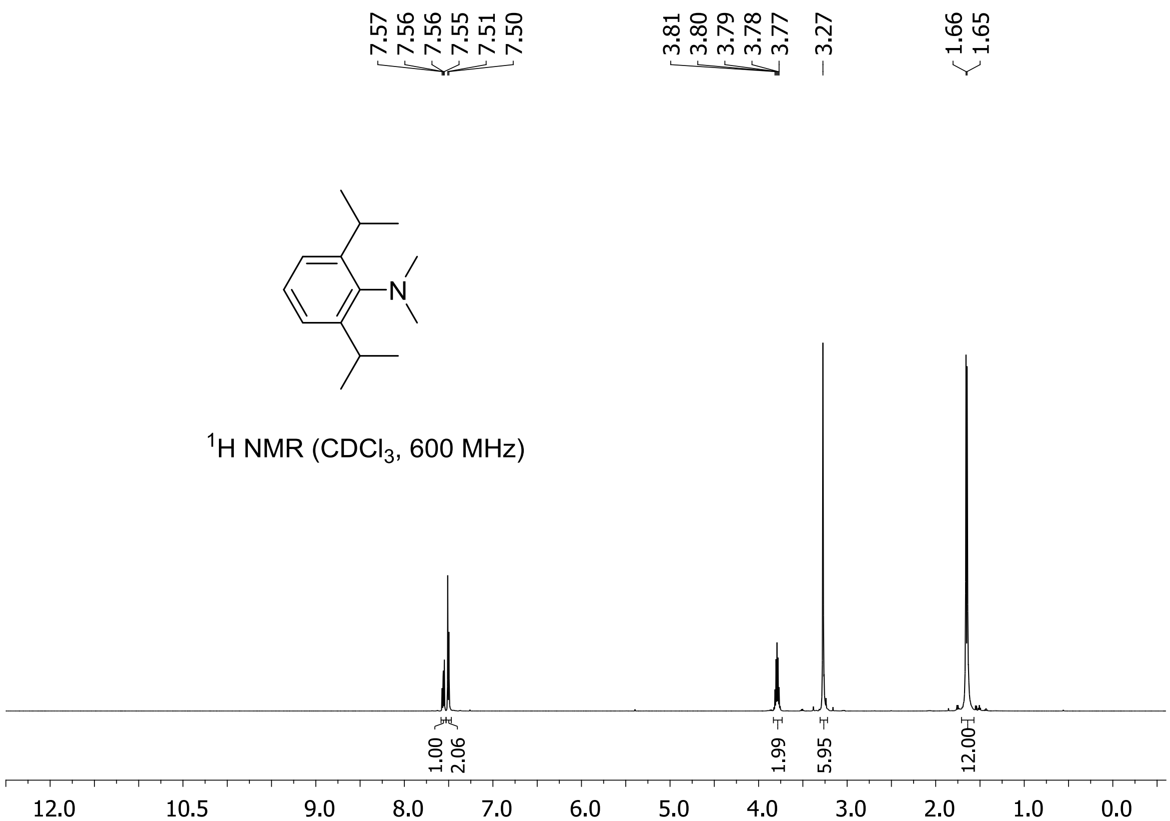

156.4
154.8
147.6
115.4
115.2
113.9
113.8
77.4
77.2
77.0
41.0
F
N
13C NMR (CDCl3, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

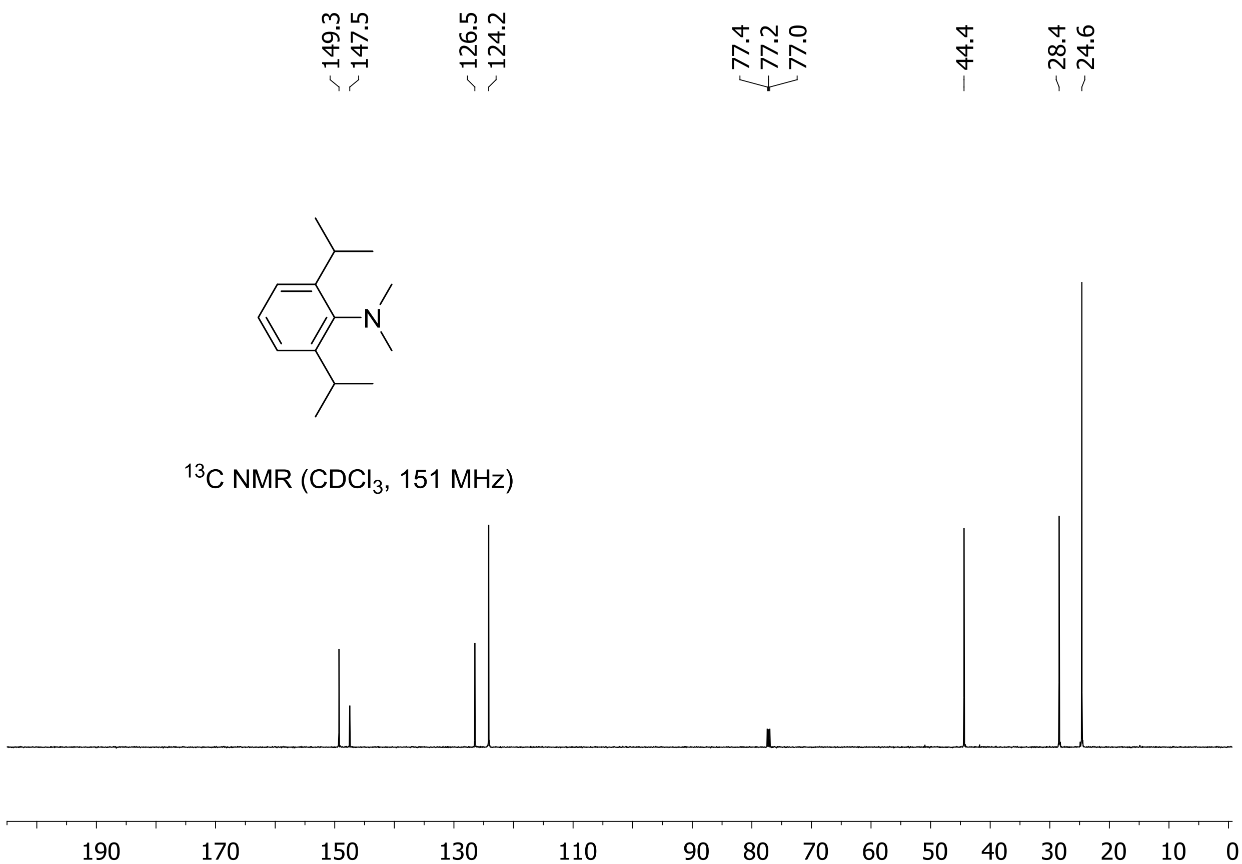

7.26
6.58
6.57
3.08
2.47
N
1H NMR (CDCl3, 600 MHz)
2.79
6.22
6.00
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

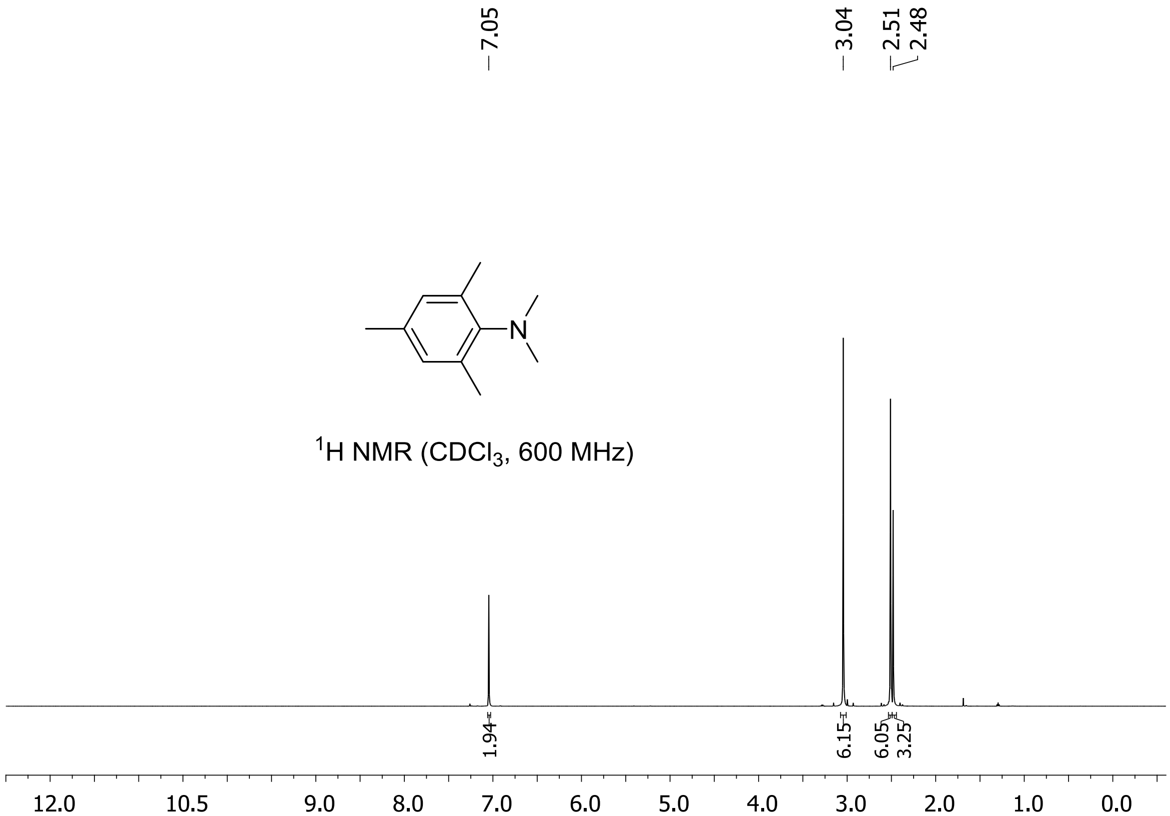

151.0
138.6
118.9
110.9
77.4
77.2
77.0
40.8
21.9
N
13C NMR (CDCl3, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

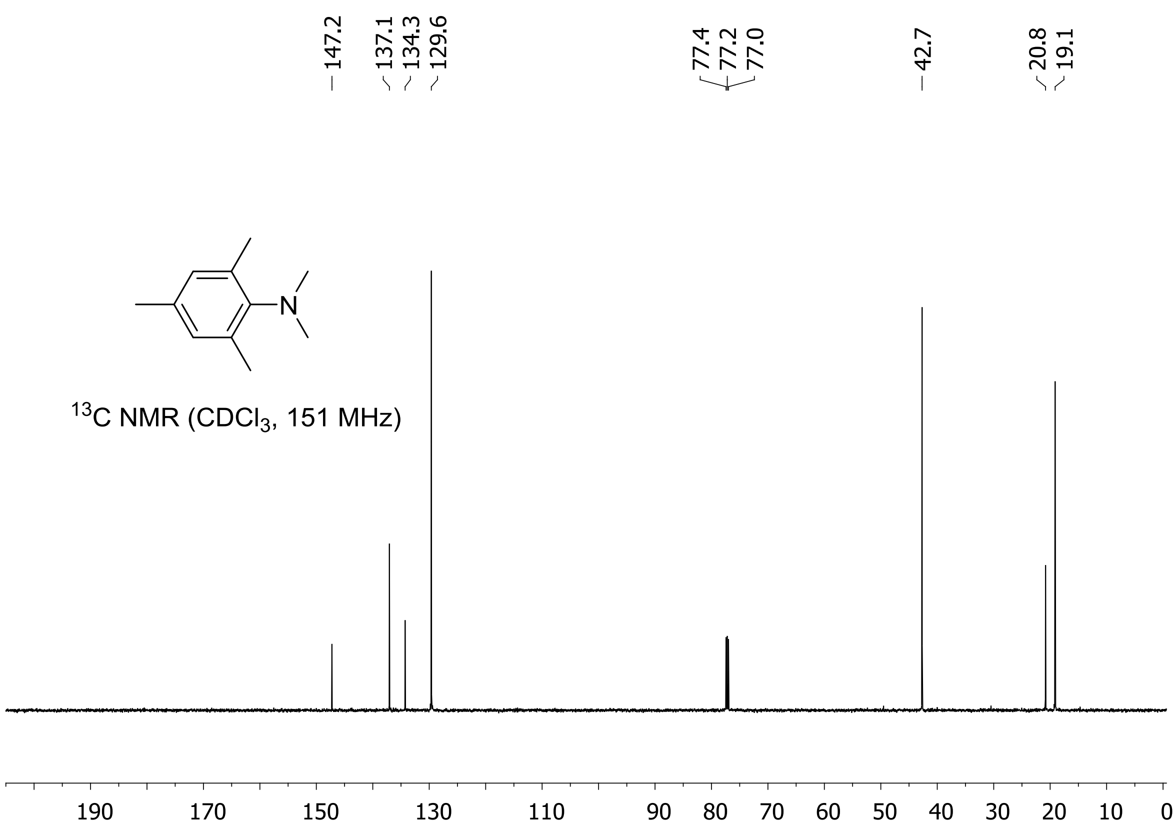

7.24
7.22
7.19
7.18
7.18
7.17
3.07
2.55
N
1H NMR (CDCl3, 600 MHz)
1.98
1.01
5.93
6.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

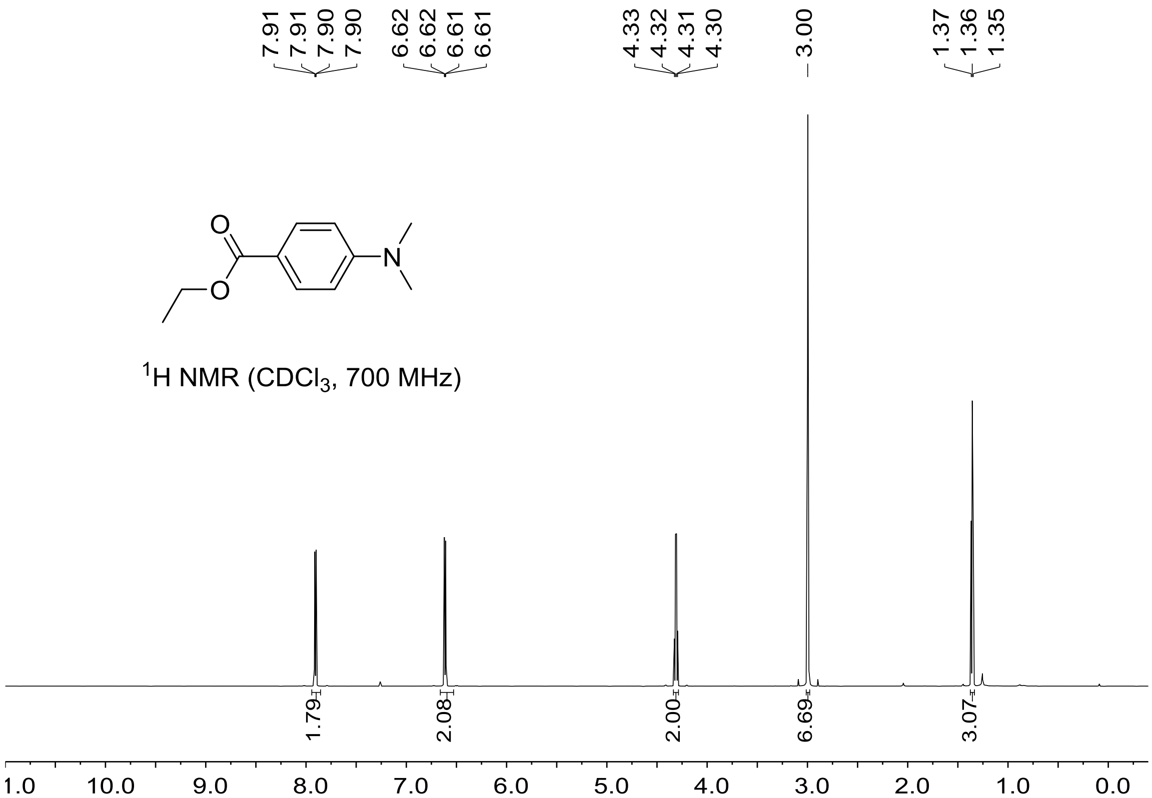

149.8
137.2
128.9
124.9
77.4
77.2
77.0
42.6
19.3
N
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

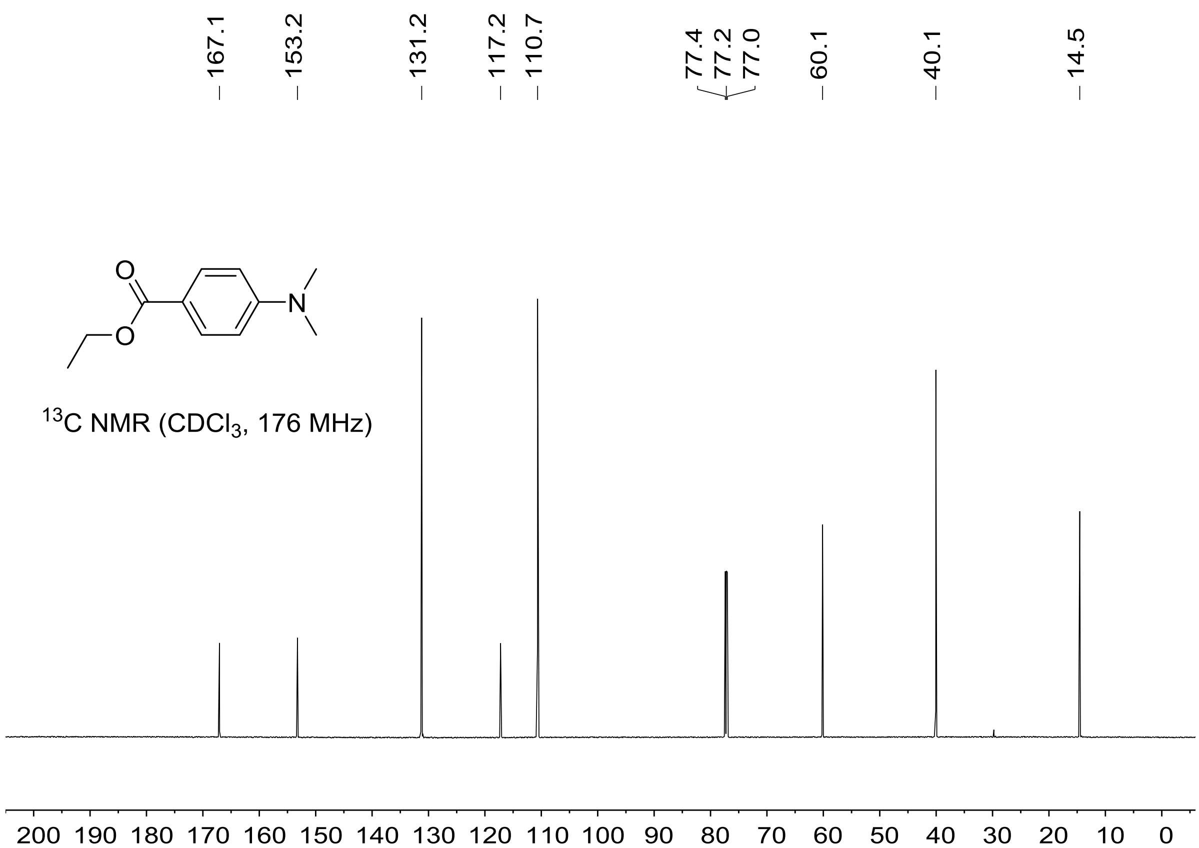

7.57
7.56
7.56
7.55
7.51
7.50
3.81
3.80
3.79
3.78
3.77
3.27
1.66
1.65
N
^{1}H NMR ($CDCl_3$, 600 MHz)
1.00
2.06
1.99
5.95
12.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

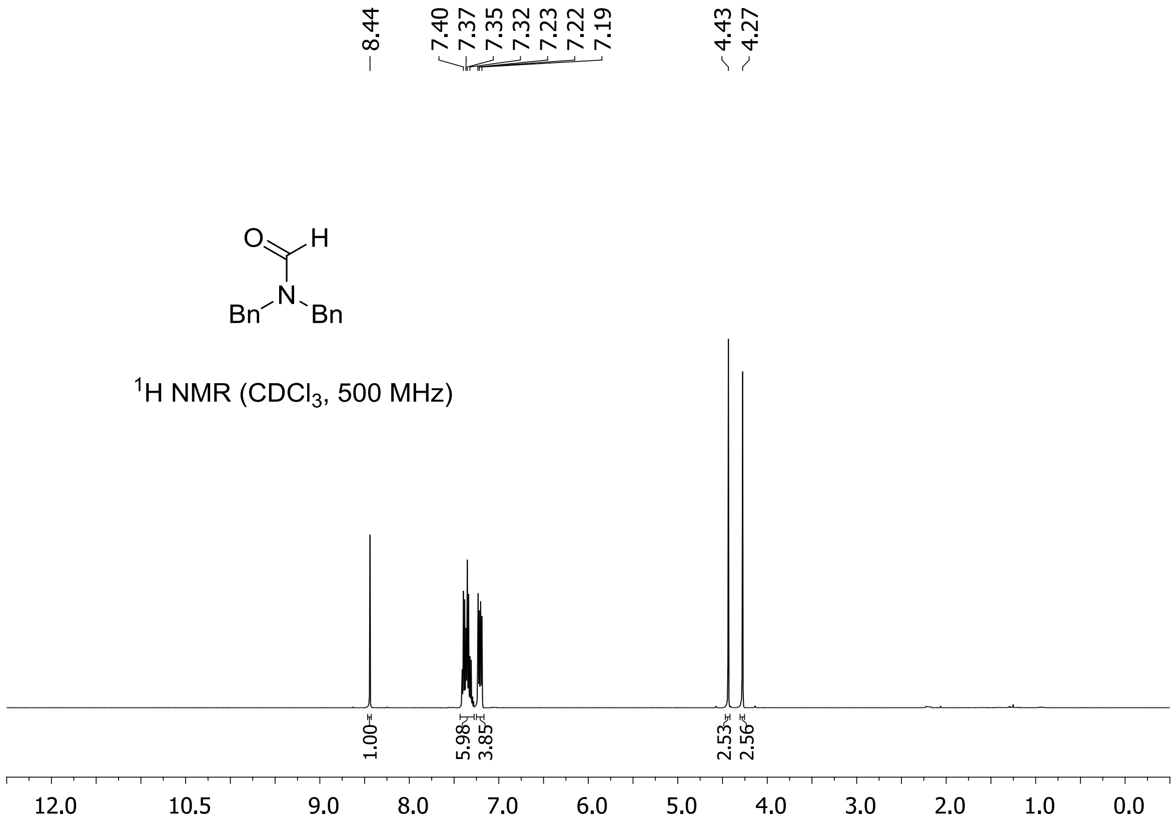

149.3
147.5
126.5
124.2
77.4
77.2
77.0
44.4
28.4
24.6
N
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


7.05
3.04
2.51
2.48
1H NMR (CDCl3, 600 MHz)
1.94
6.15
6.05
3.25
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

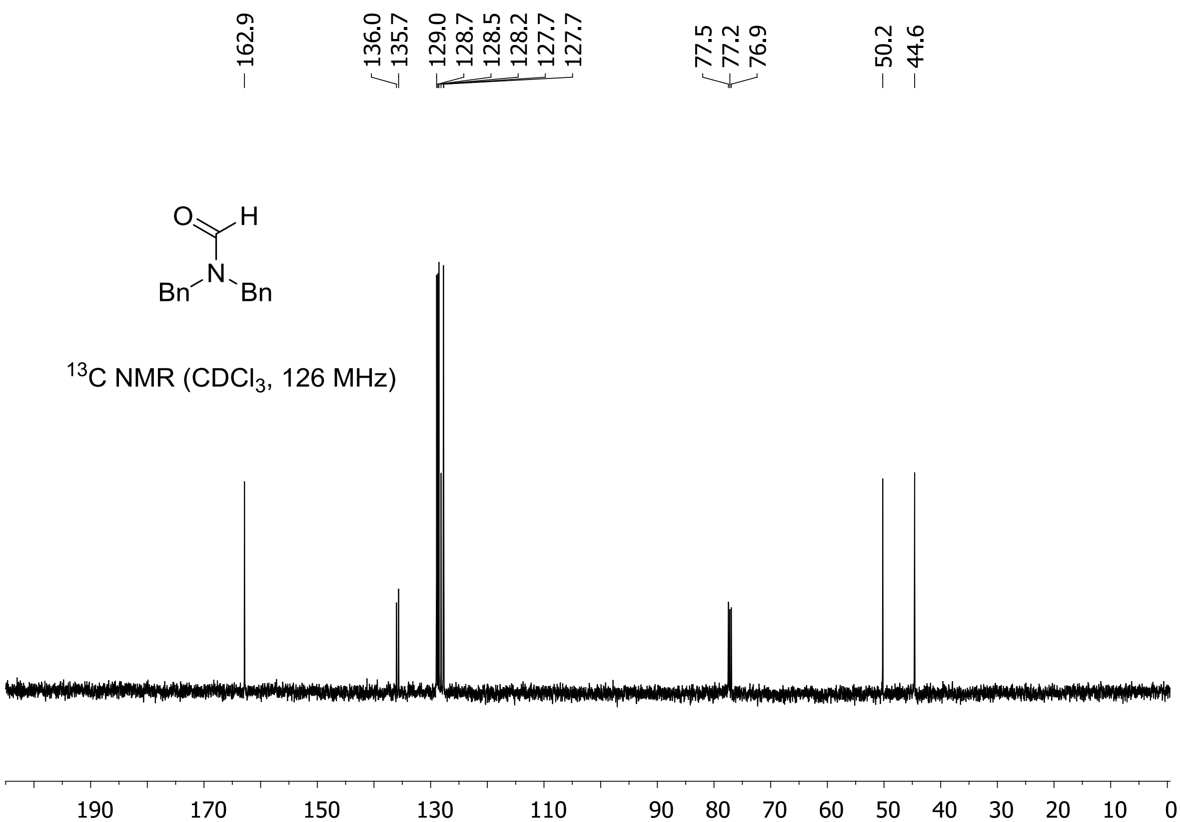

147.2
137.1
134.3
129.6
77.4
77.2
77.0
42.7
20.8
19.1
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


7.91 7.91 7.90 7.90 6.62 6.62 6.61 6.61 4.33 4.32 4.31 4.30 3.00 1.37 1.36 1.35
O
O
N
1H NMR (CDCl3, 700 MHz)
1.79
2.08
2.00
6.69
3.07
1.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

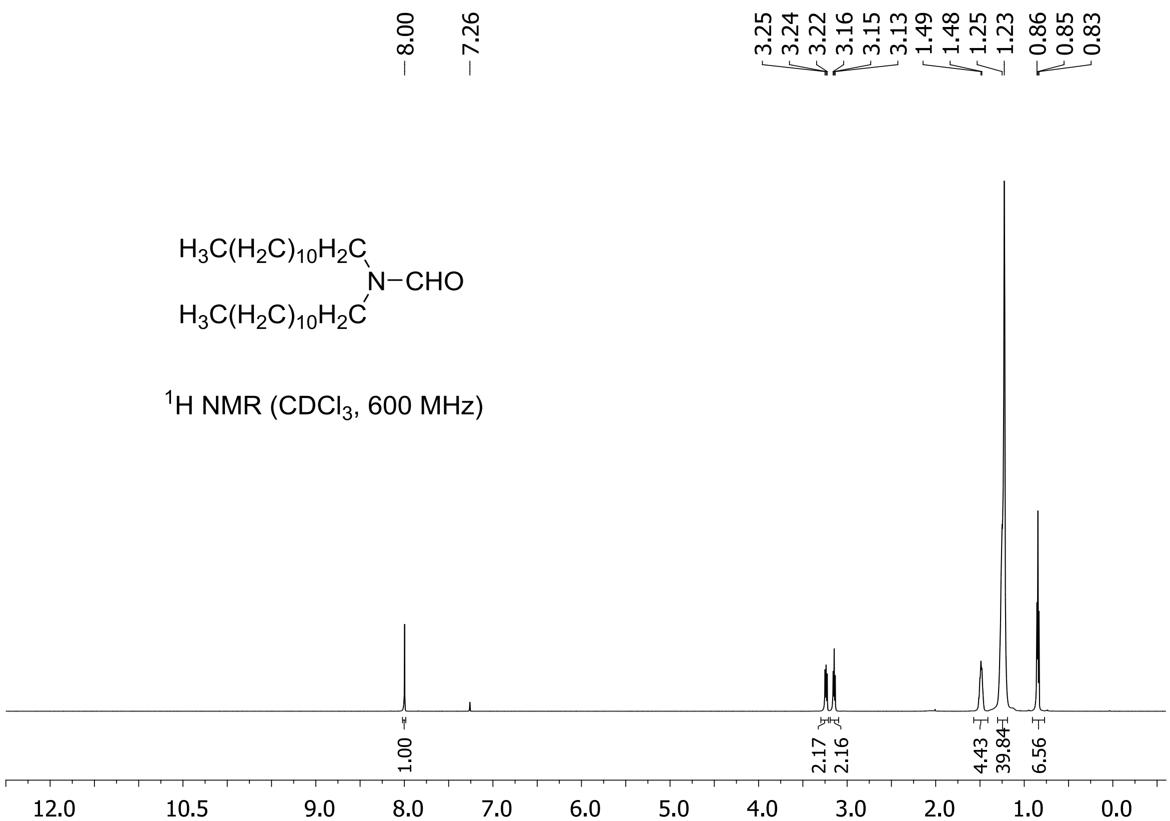

167.1 153.2 131.2 117.2 110.7 77.4 77.2 77.0 60.1 40.1 14.5
O
O
N
13C NMR (CDCl3, 176 MHz)
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

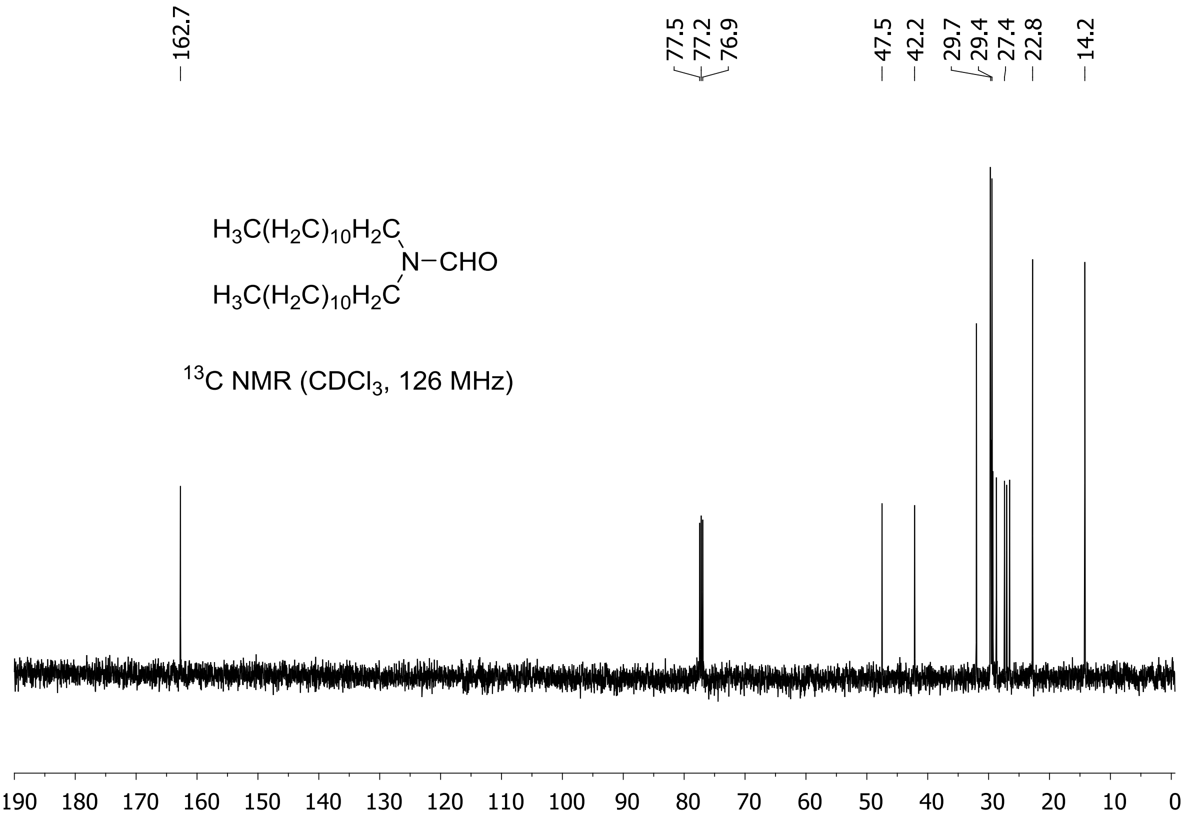


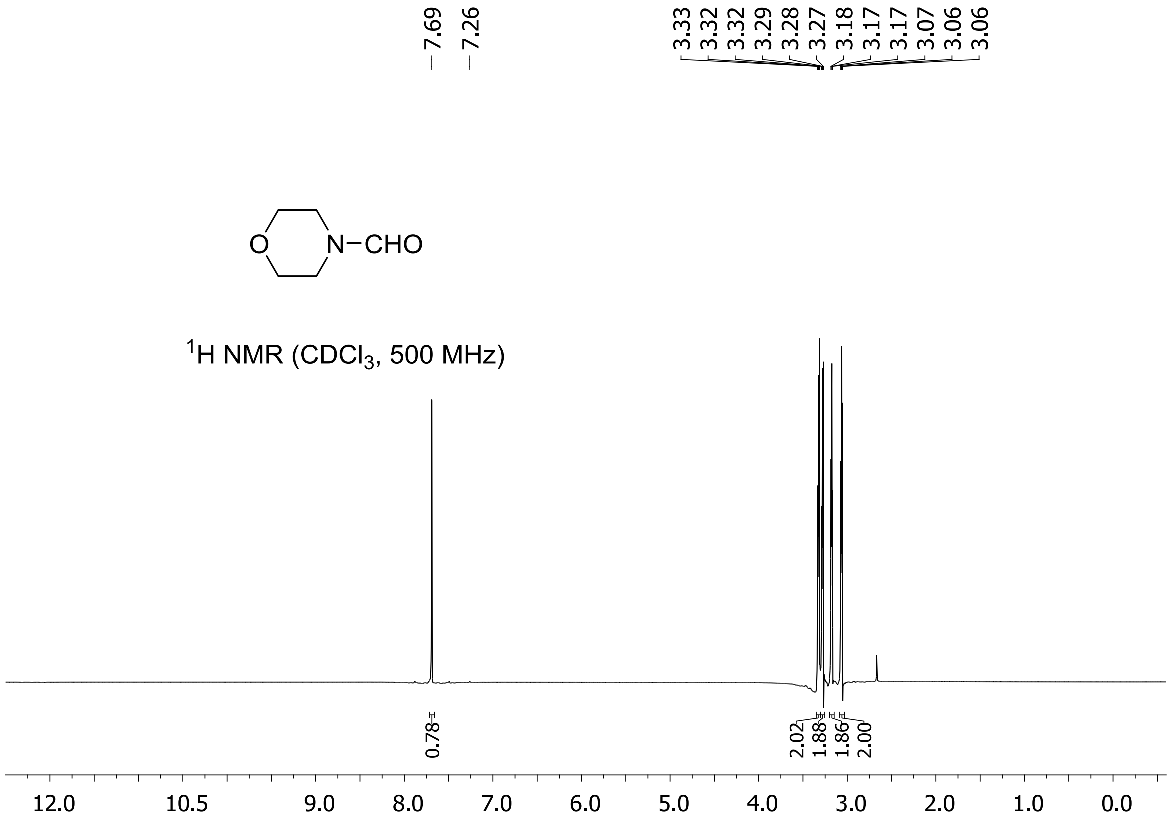
8.44
7.40
7.37
7.35
7.32
7.23
7.22
7.19
4.43
4.27
O
H
N
Bn
Bn
^{1}H NMR ($CDCl_3$, 500 MHz)
1.00
5.98
3.85
2.53
2.56
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

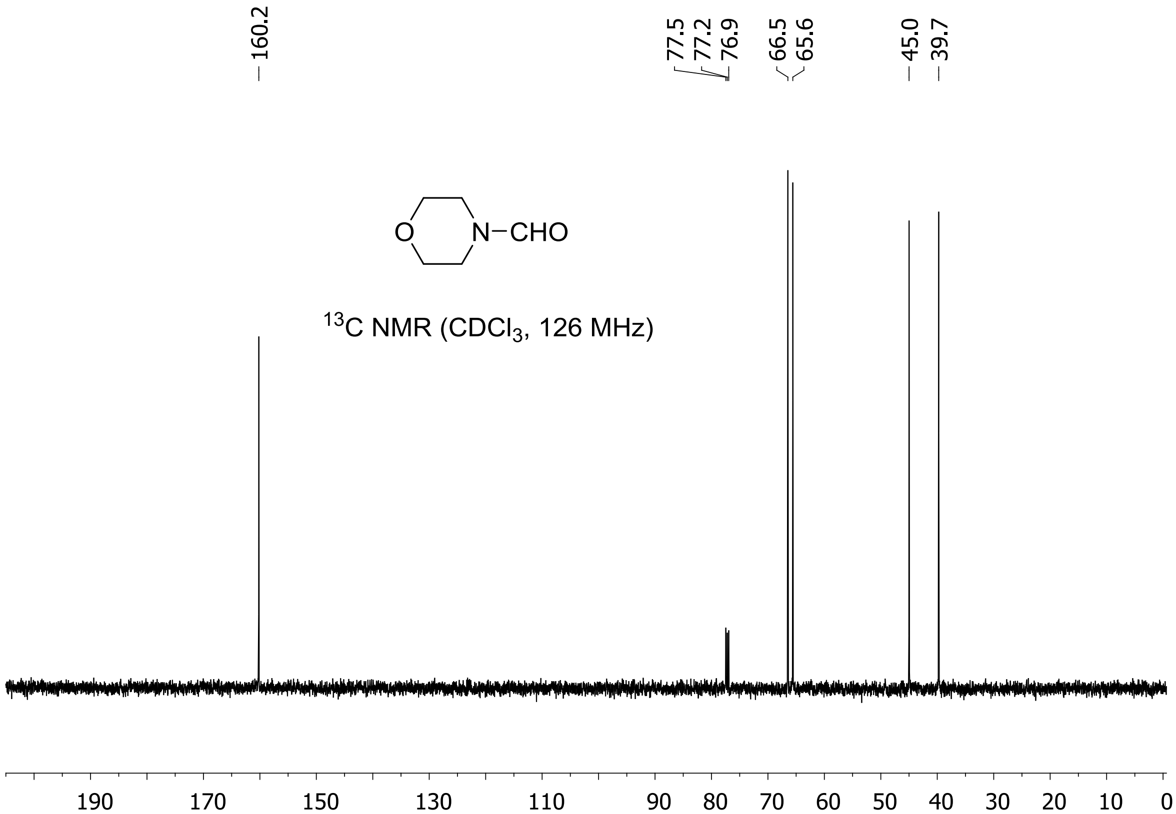


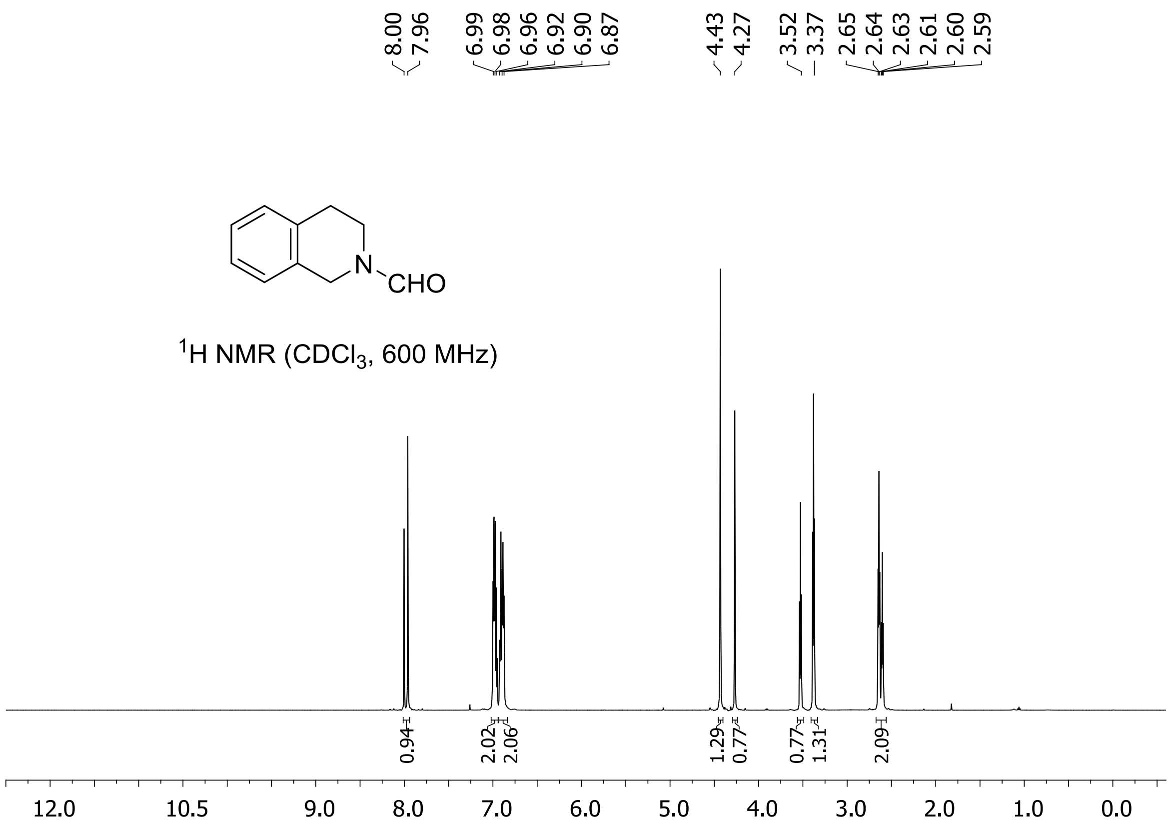
162.9
136.0
135.7
129.0
128.7
128.5
128.2
127.7
127.7
77.5
77.2
76.9
50.2
44.6
O
H
N
Bn
Bn
^{13}C NMR ($CDCl_3$, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


8.00
7.26
3.25
3.24
3.22
3.16
3.15
3.13
1.49
1.48
1.25
1.23
0.86
0.85
0.83
H3C(H2C)10H2C
N−CHO
H3C(H2C)10H2C
1H NMR (CDCl3, 600 MHz)
1.00
2.17
2.16
4.43
39.84
6.56
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

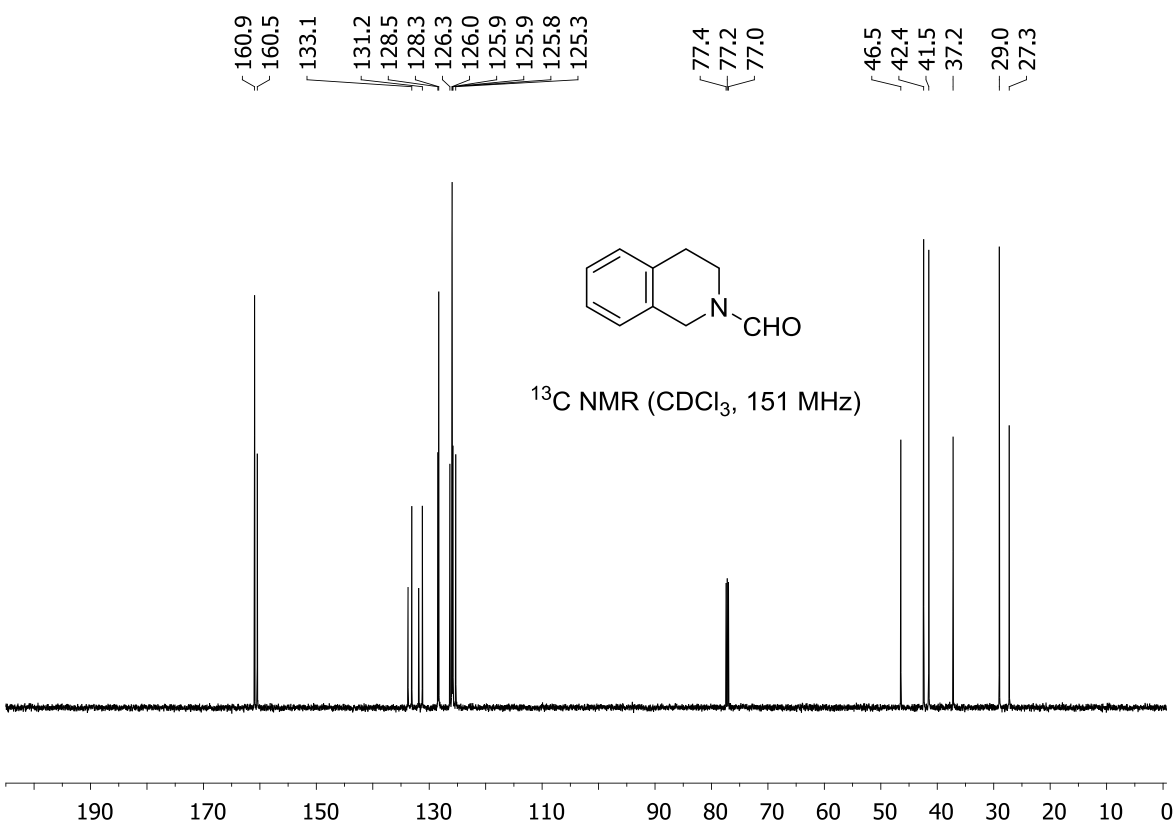

162.7
77.5
77.2
76.9
47.5
42.2
29.7
29.4
27.4
22.8
14.2
H3C(H2C)10H2C
N−CHO
H3C(H2C)10H2C
13C NMR (CDCl3, 126 MHz)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


7.69
7.26
3.33
3.32
3.32
3.29
3.28
3.27
3.18
3.17
3.17
3.07
3.06
3.06
O
N−CHO
1H NMR (CDCl3, 500 MHz)
0.78
2.02
1.88
1.86
2.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

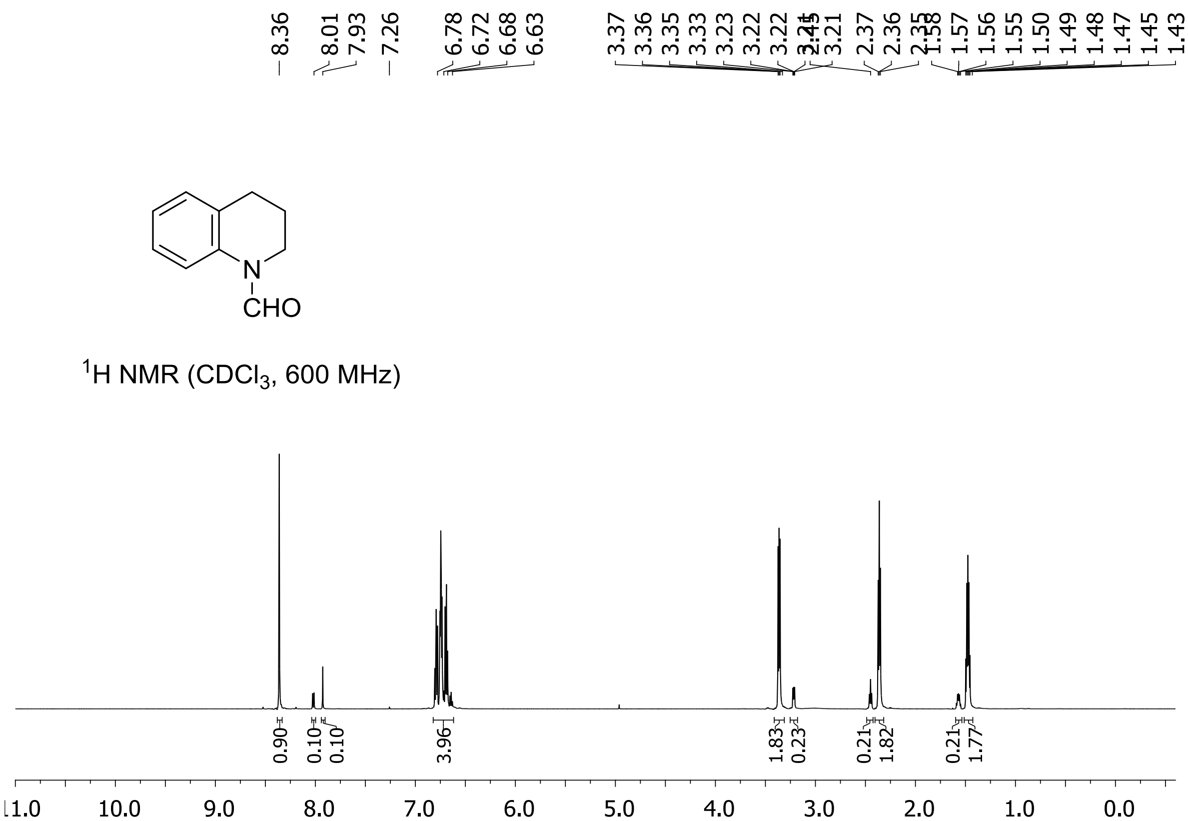

160.2
77.5
77.2
76.9
66.5
65.6
45.0
39.7
O
N−CHO
13C NMR (CDCl3, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

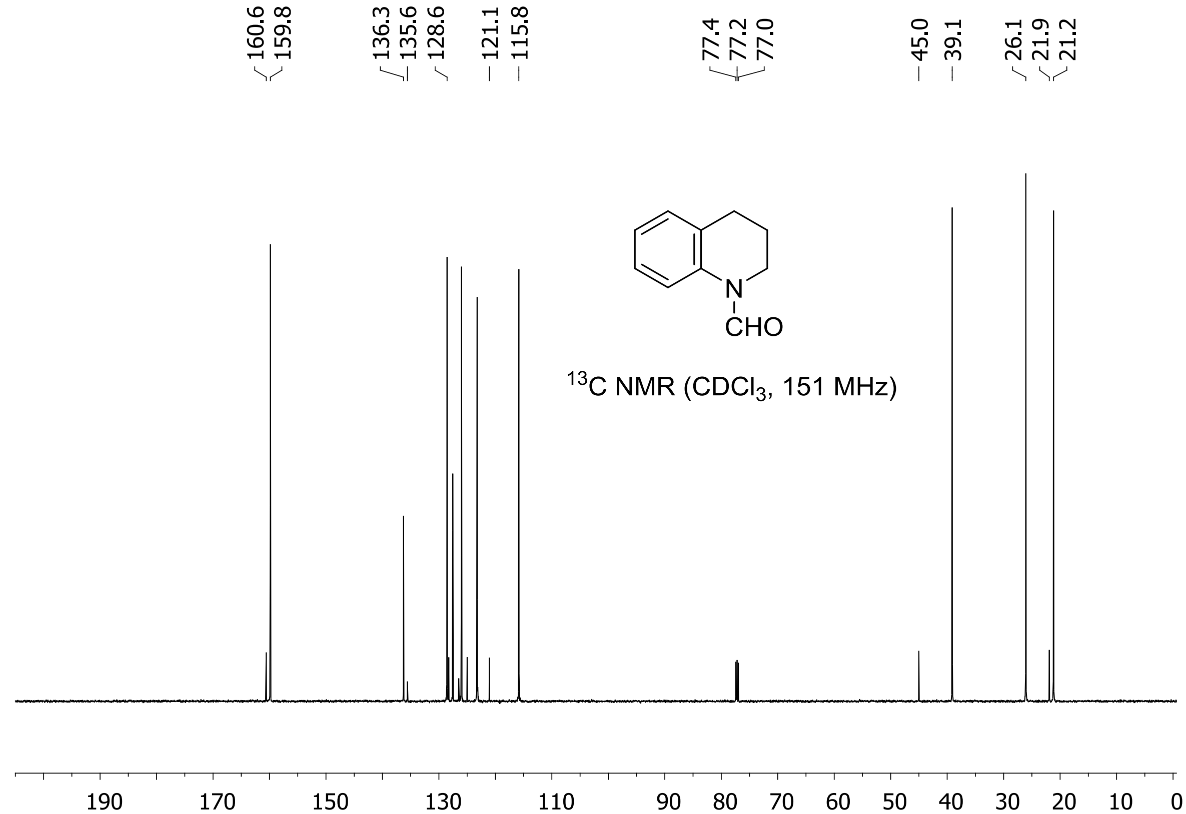


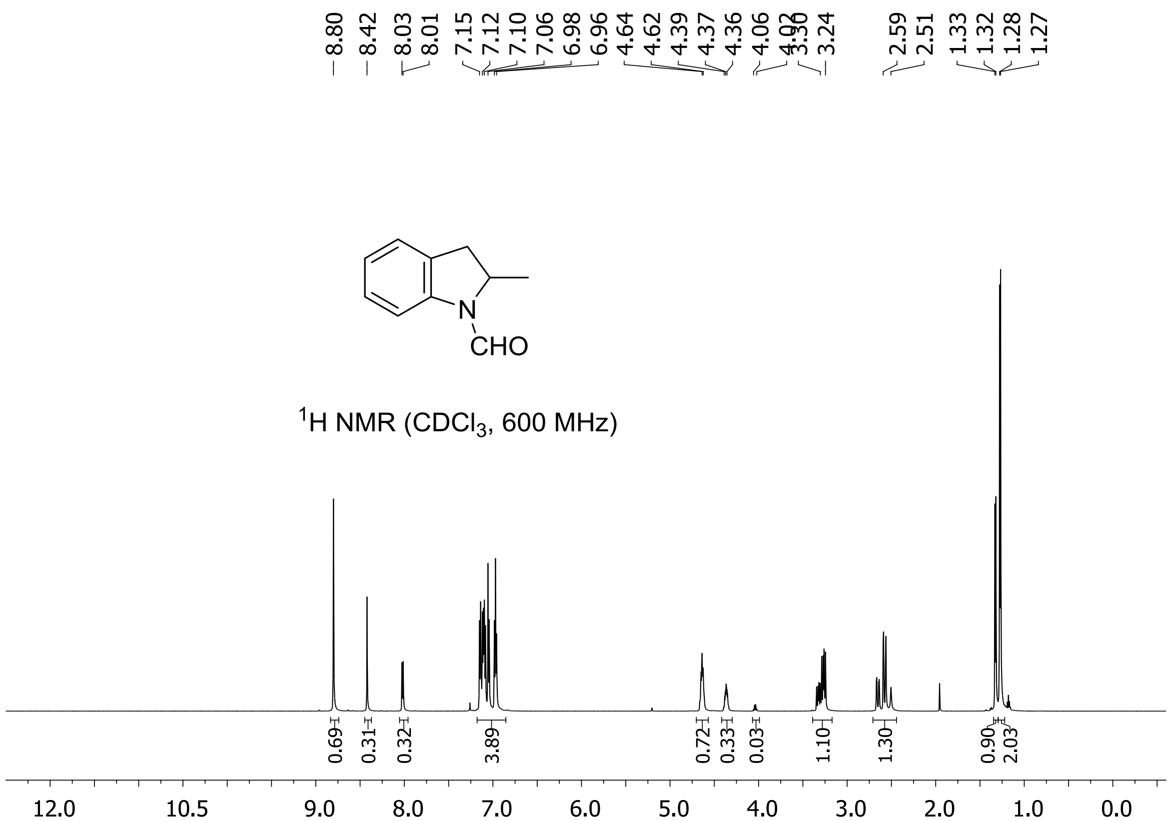
8.00
7.96
6.99
6.98
6.96
6.92
6.90
6.87
4.43
4.27
3.52
3.37
2.65
2.64
2.63
2.61
2.60
2.59
N
CHO
1H NMR (CDCl3, 600 MHz)
0.94
2.02
2.06
1.29
0.77
0.77
1.31
2.09
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

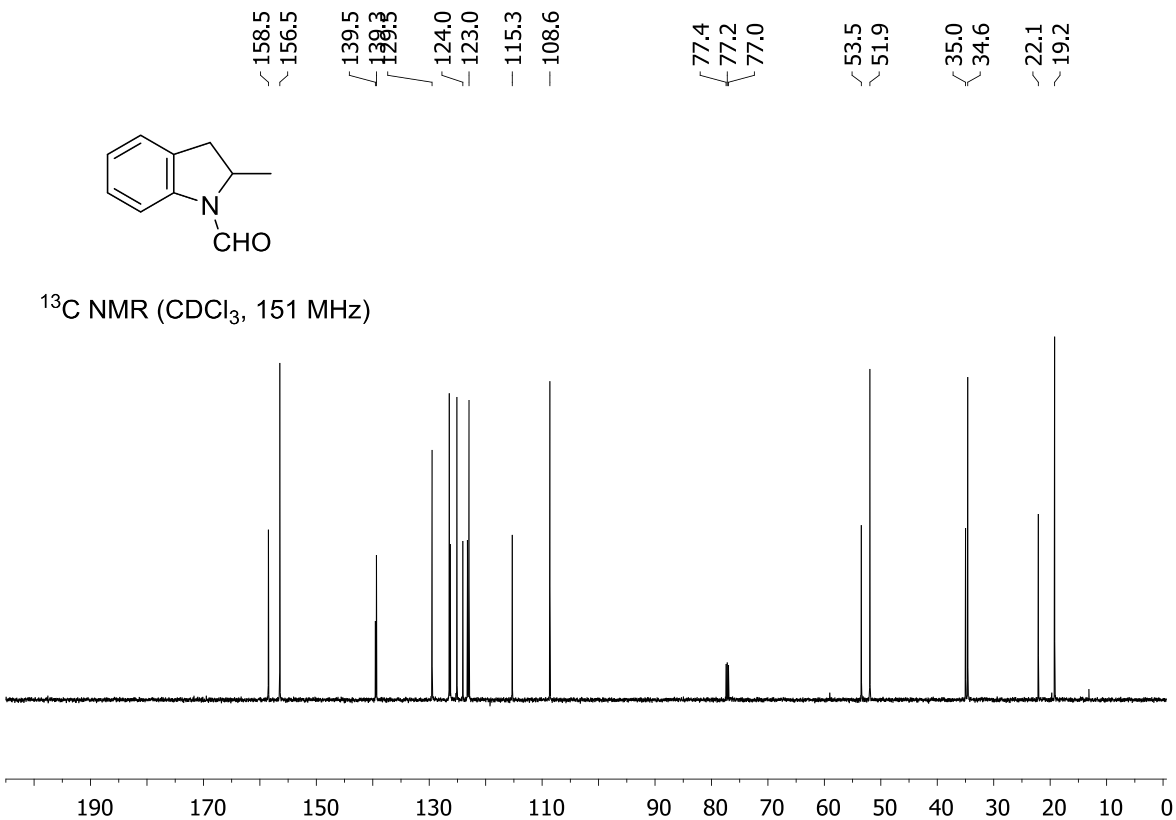


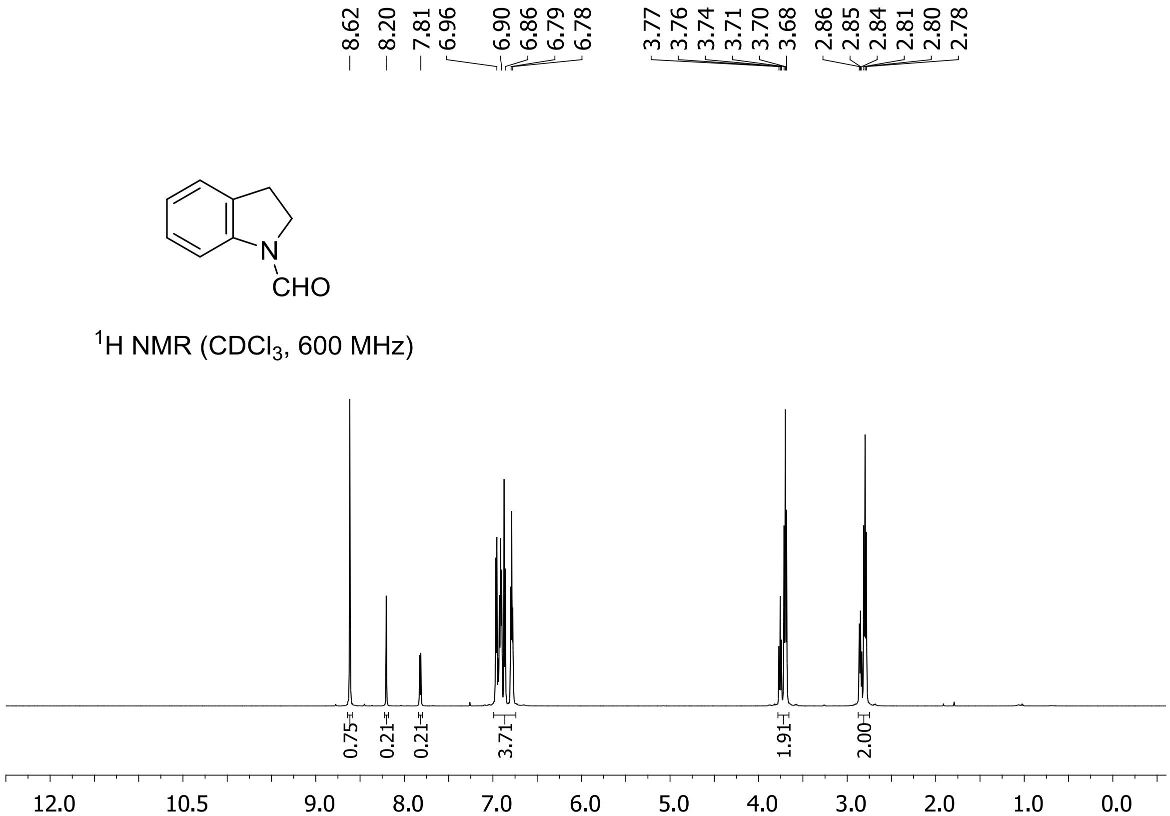
160.9
160.5
133.1
131.2
128.5
128.3
126.3
126.0
125.9
125.9
125.8
125.3
77.4
77.2
77.0
46.5
42.4
41.5
37.2
29.0
27.3
N
CHO
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

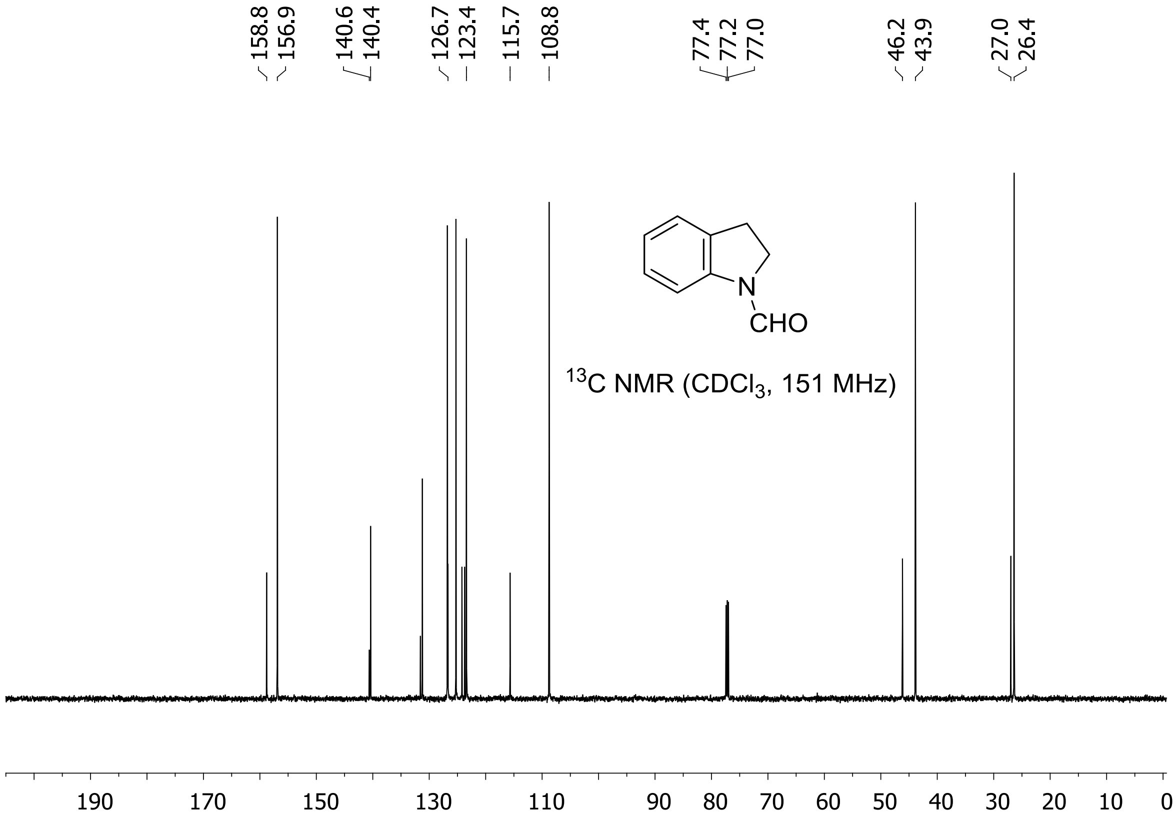

8.36
8.01
7.93
7.26
6.78
6.72
6.68
6.63
3.37
3.36
3.35
3.33
3.23
3.22
3.22
3.21
2.37
2.36
2.35
1.58
1.57
1.56
1.55
1.50
1.49
1.48
1.47
1.45
1.43
N
CHO
^{1}H NMR (CDCl$_3$, 600 MHz)
0.90
0.10
0.10
3.96
1.83
0.23
0.21
1.82
0.21
1.77
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

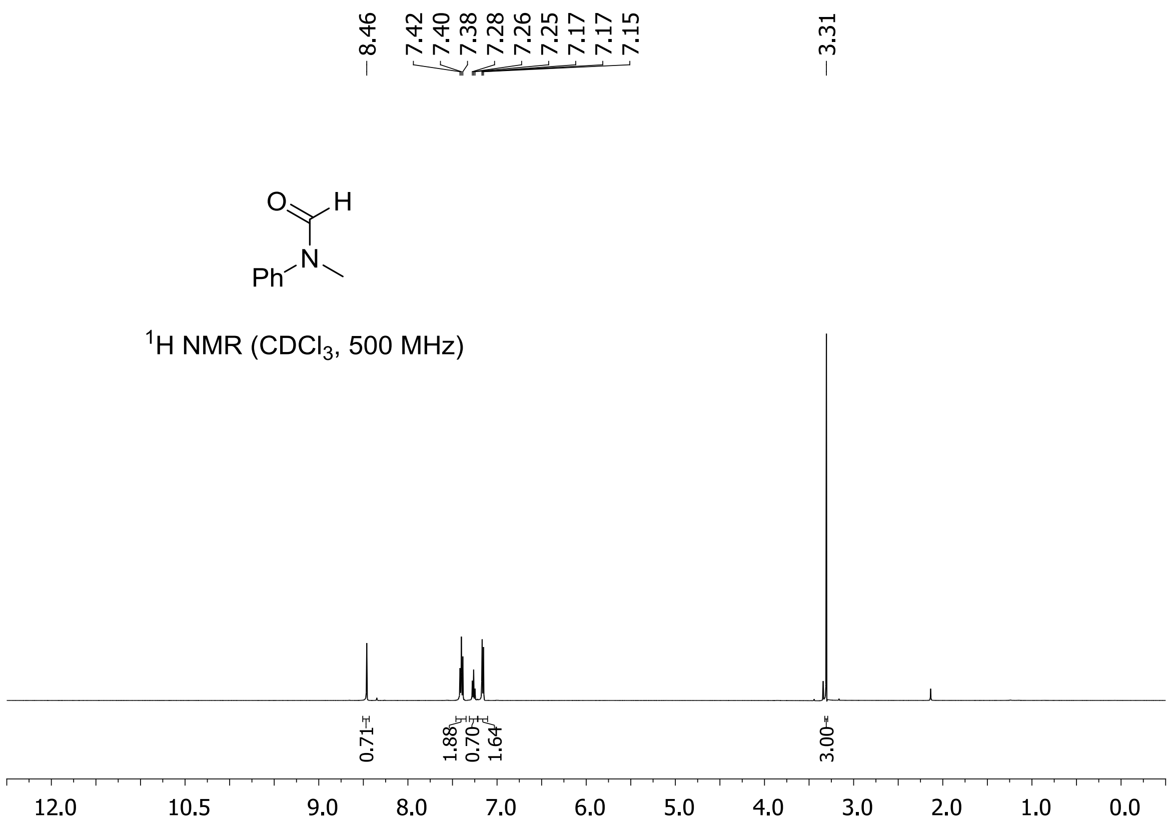

160.6
159.8
136.3
135.6
128.6
121.1
115.8
77.4
77.2
77.0
45.0
39.1
26.1
21.9
21.2
N
CHO
^{13}C NMR (CDCl$_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

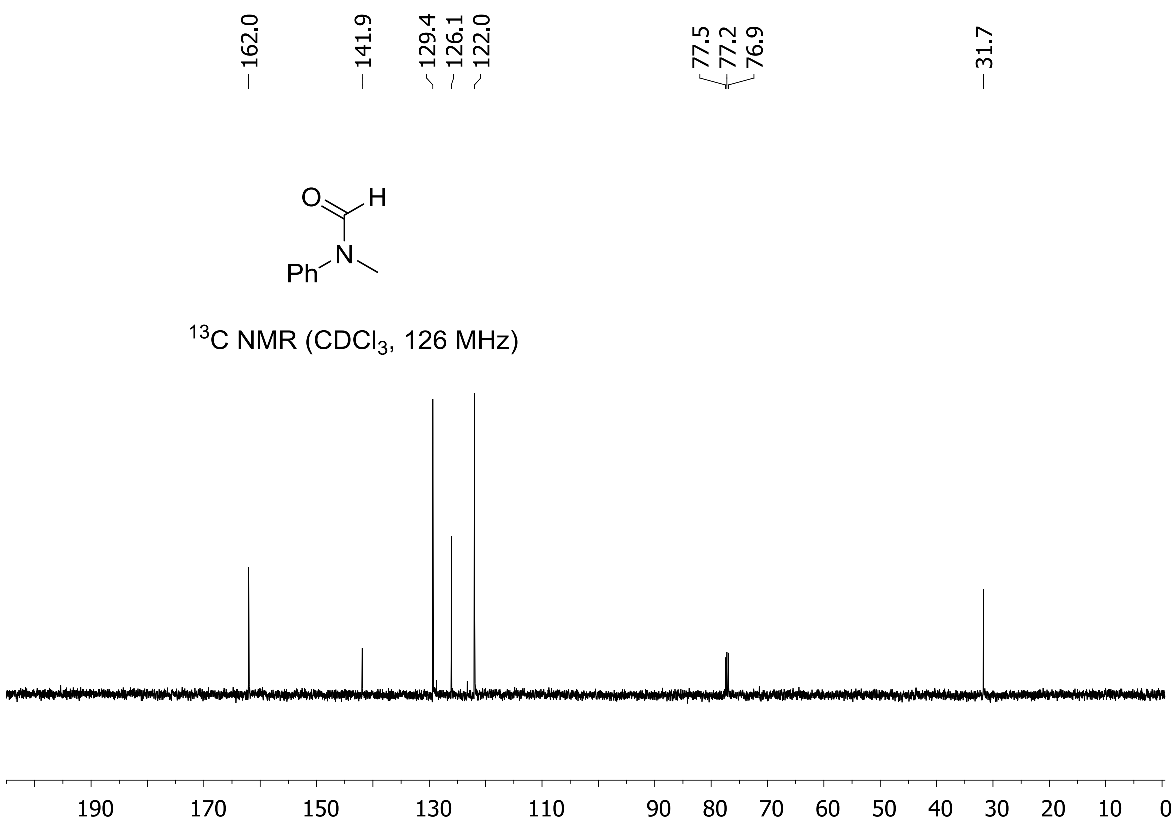

8.80
8.42
8.03
8.01
7.15
7.12
7.10
7.06
6.98
6.96
4.64
4.62
4.39
4.37
4.36
4.06
3.24
2.59
2.51
1.33
1.32
1.28
1.27
N
CHO
1H NMR (CDCl3, 600 MHz)
0.69
0.31
0.32
3.89
0.72
0.33
0.03
1.10
1.30
0.90
2.03
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

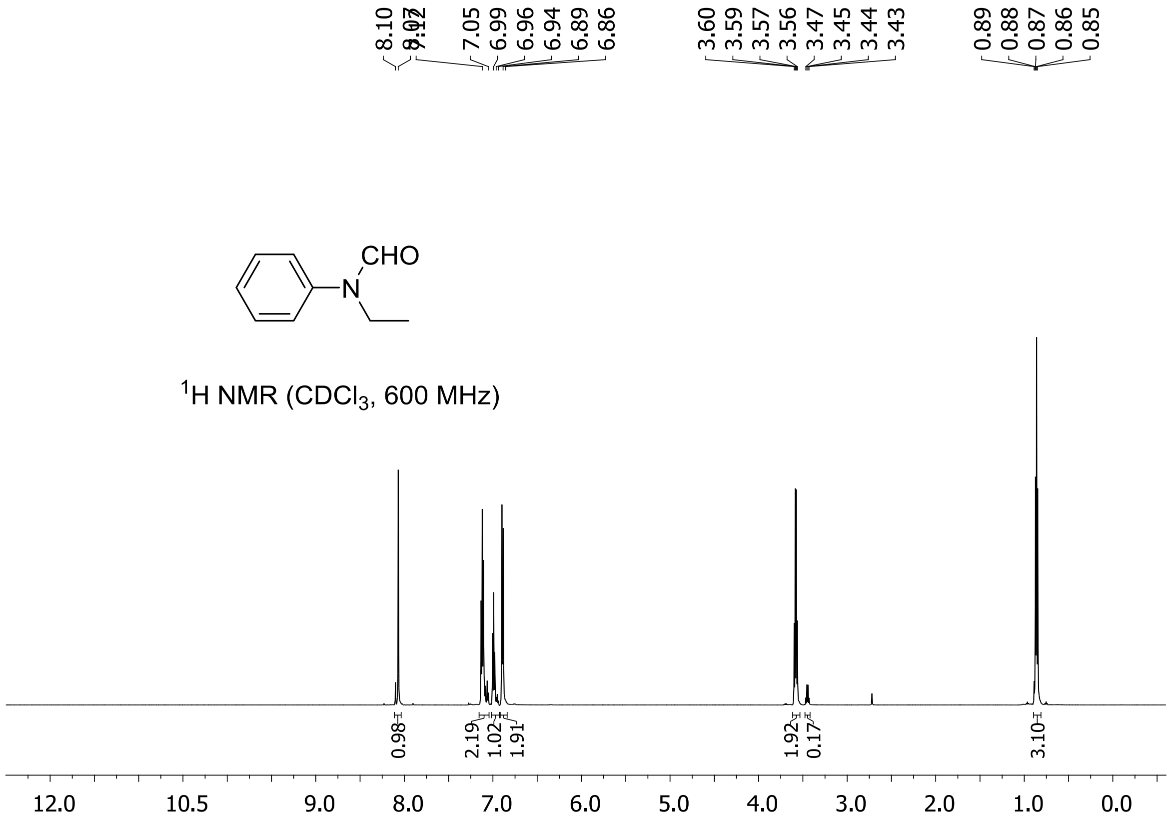

158.5
156.5
139.5
124.0
123.0
115.3
108.6
77.4
77.2
77.0
53.5
51.9
35.0
34.6
22.1
19.2
N
CHO
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

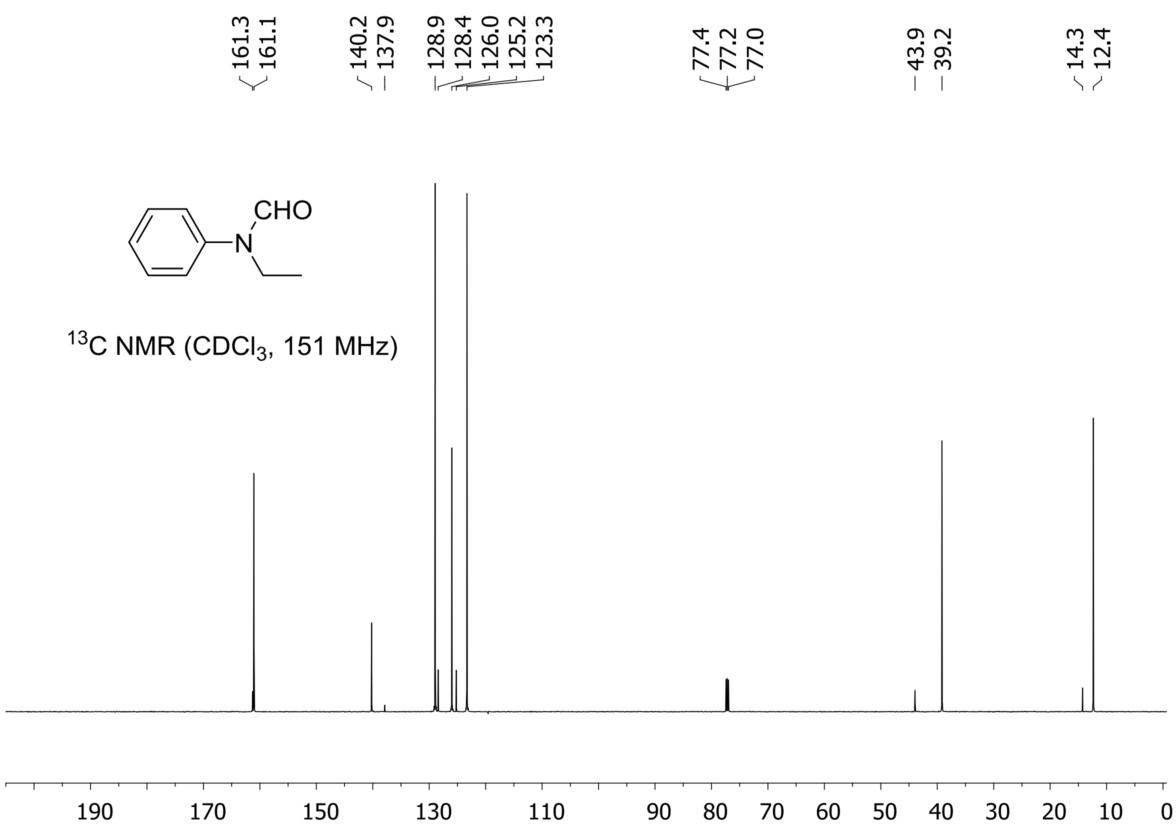

8.62
8.20
7.81
6.96
6.90
6.86
6.79
6.78
3.77
3.76
3.74
3.71
3.70
3.68
2.86
2.85
2.84
2.81
2.80
2.78
N
CHO
1H NMR (CDCl3, 600 MHz)
0.75
0.21
0.21
3.71
1.91
2.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

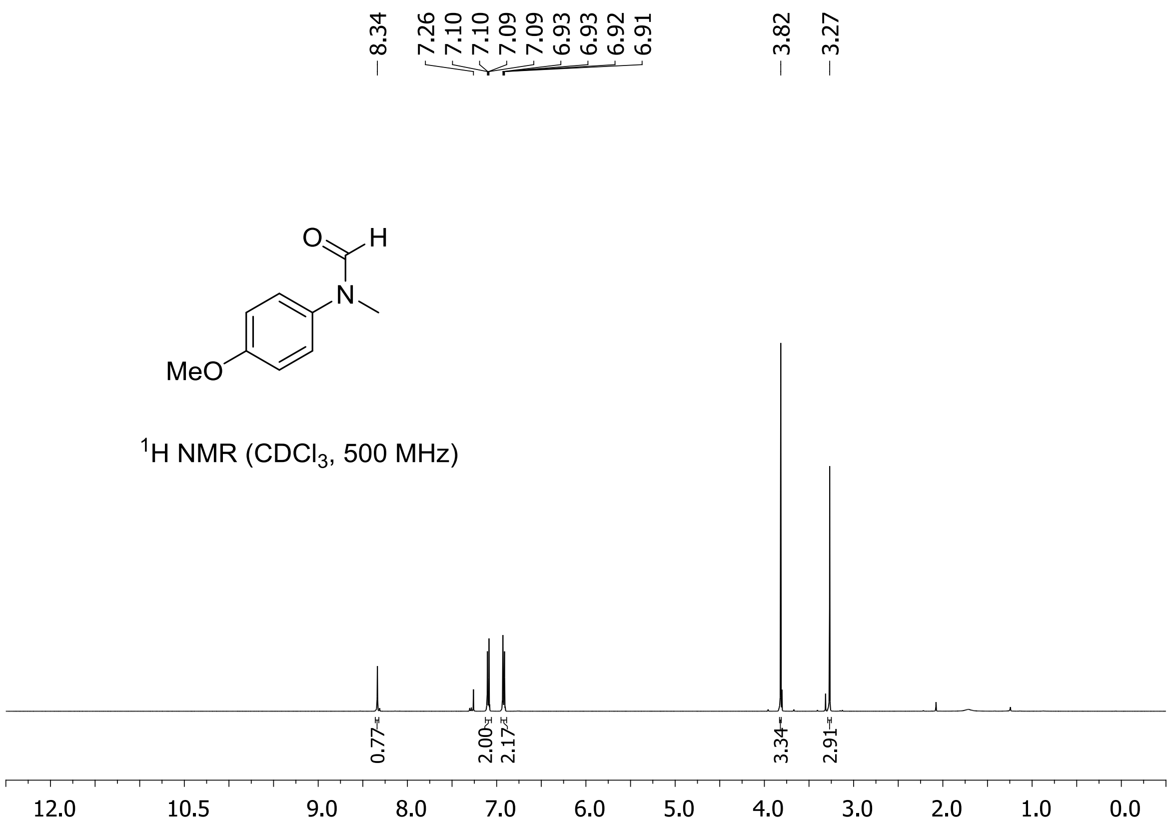

158.8
156.9
140.6
140.4
126.7
123.4
115.7
108.8
77.4
77.2
77.0
46.2
43.9
27.0
26.4
N
CHO
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

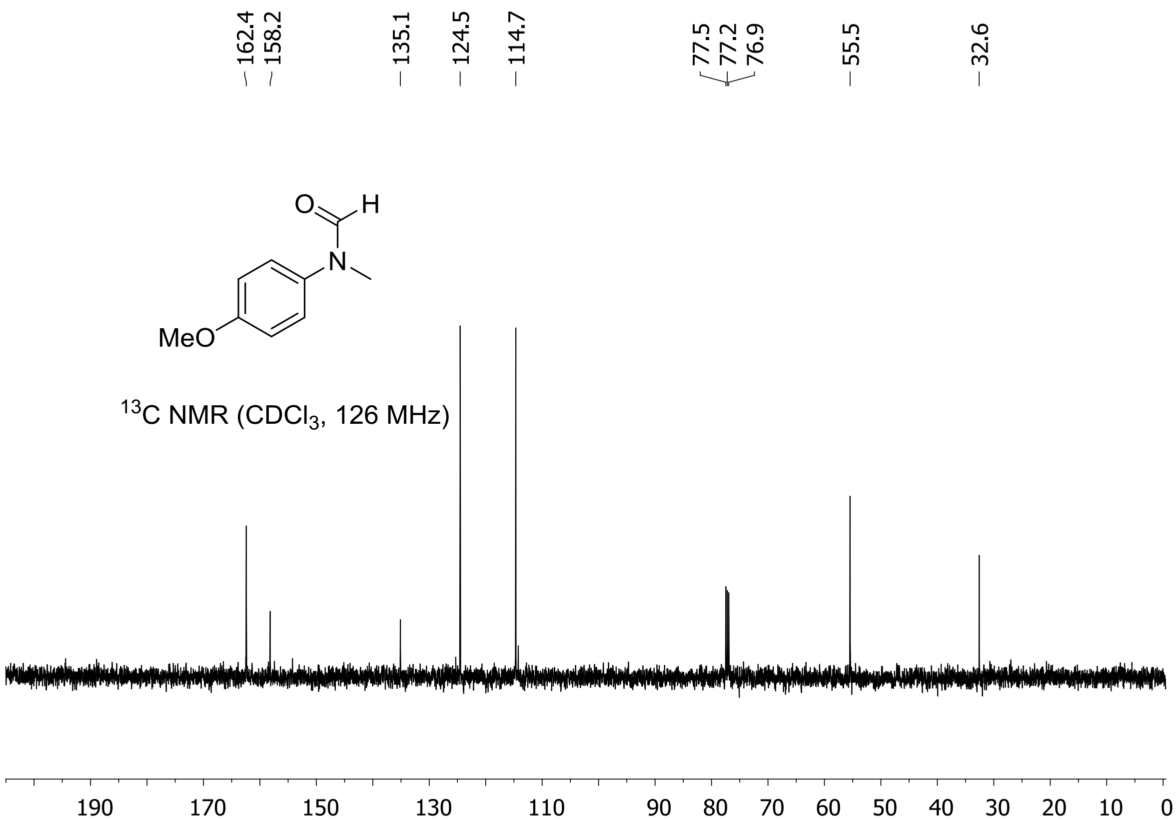

8.46
7.42
7.40
7.38
7.28
7.26
7.25
7.17
7.17
7.15
3.31
O
H
N
Ph
¹H NMR (CDCl₃, 500 MHz)
0.71
1.88
0.70
1.64
3.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

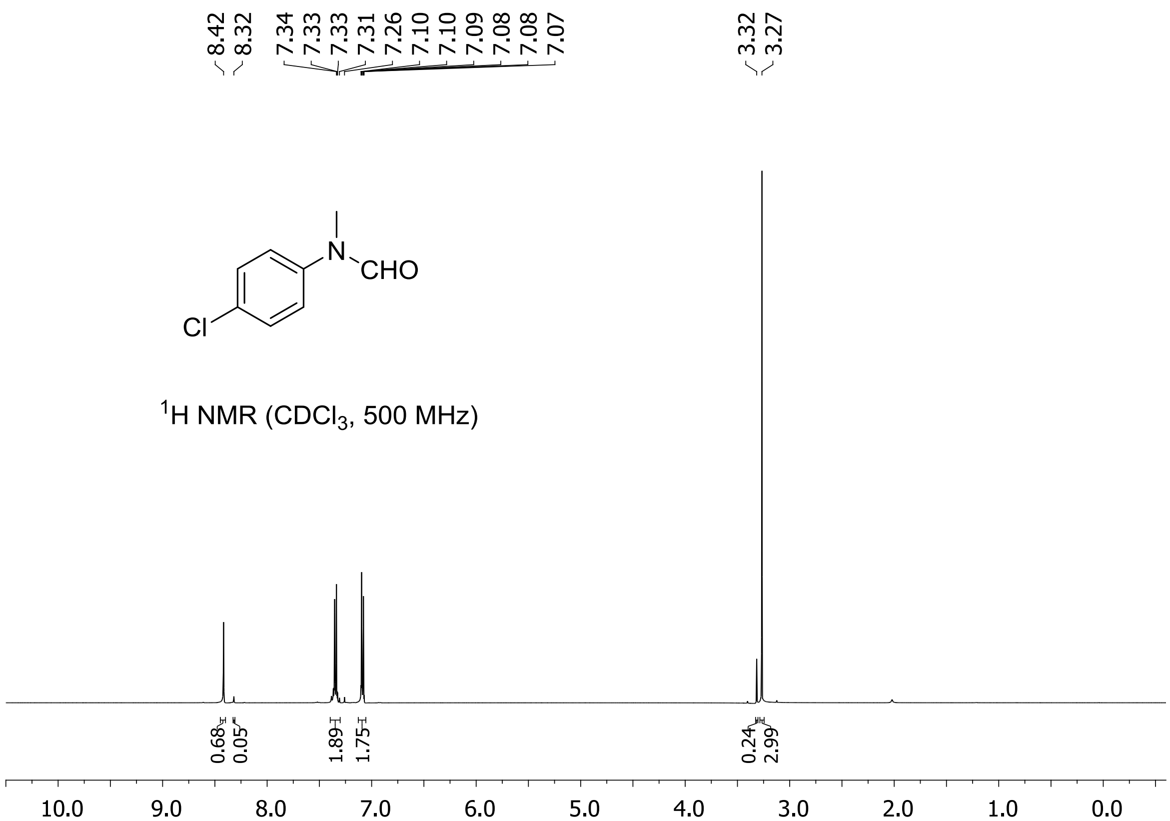

162.0
141.9
129.4
126.1
122.0
77.5
77.2
76.9
31.7
O
H
N
Ph
¹³C NMR (CDCl₃, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

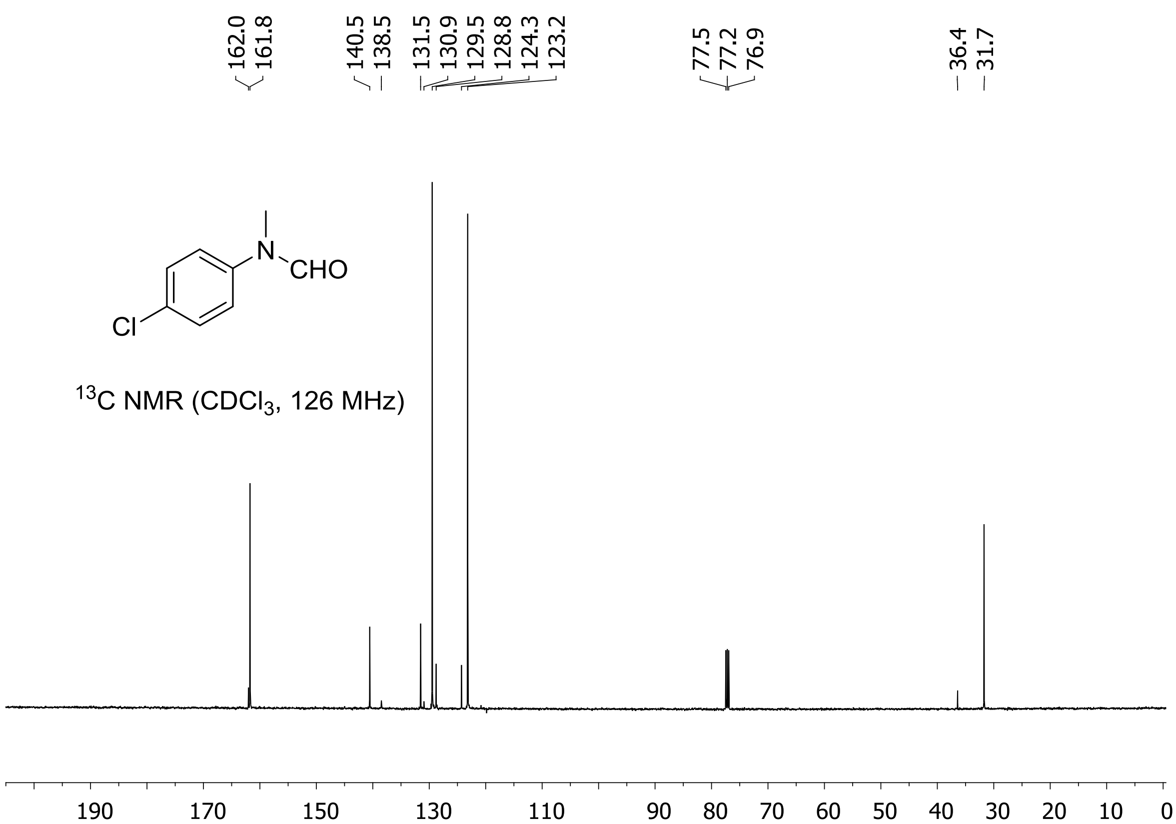

8.10
8.07
7.12
7.05
6.99
6.96
6.94
6.89
6.86
3.60
3.59
3.57
3.56
3.47
3.45
3.44
3.43
0.89
0.88
0.87
0.86
0.85
CHO
N
^{1}H NMR ($CDCl_3$, 600 MHz)
0.98
2.19
1.02
1.91
1.92
0.17
3.10
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

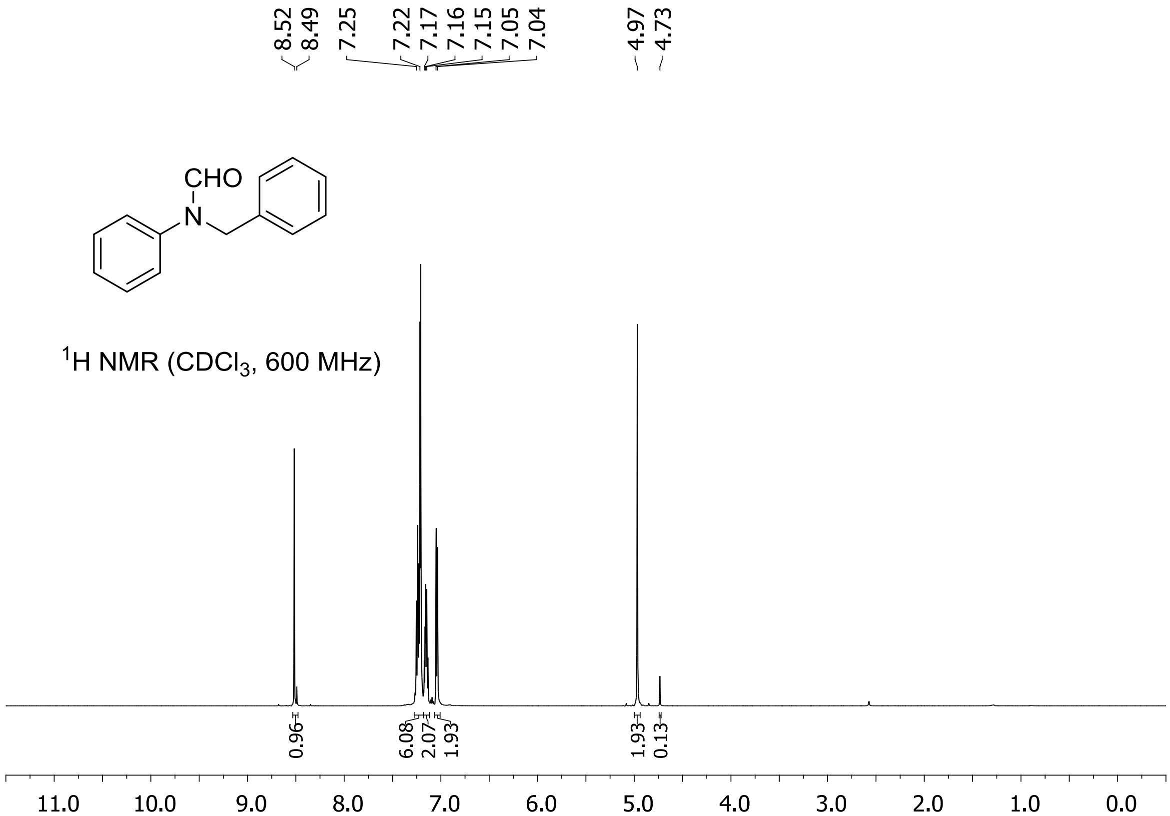

161.3
161.1
140.2
137.9
128.9
128.4
126.0
125.2
123.3
77.4
77.2
77.0
43.9
39.2
14.3
12.4
CHO
N
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

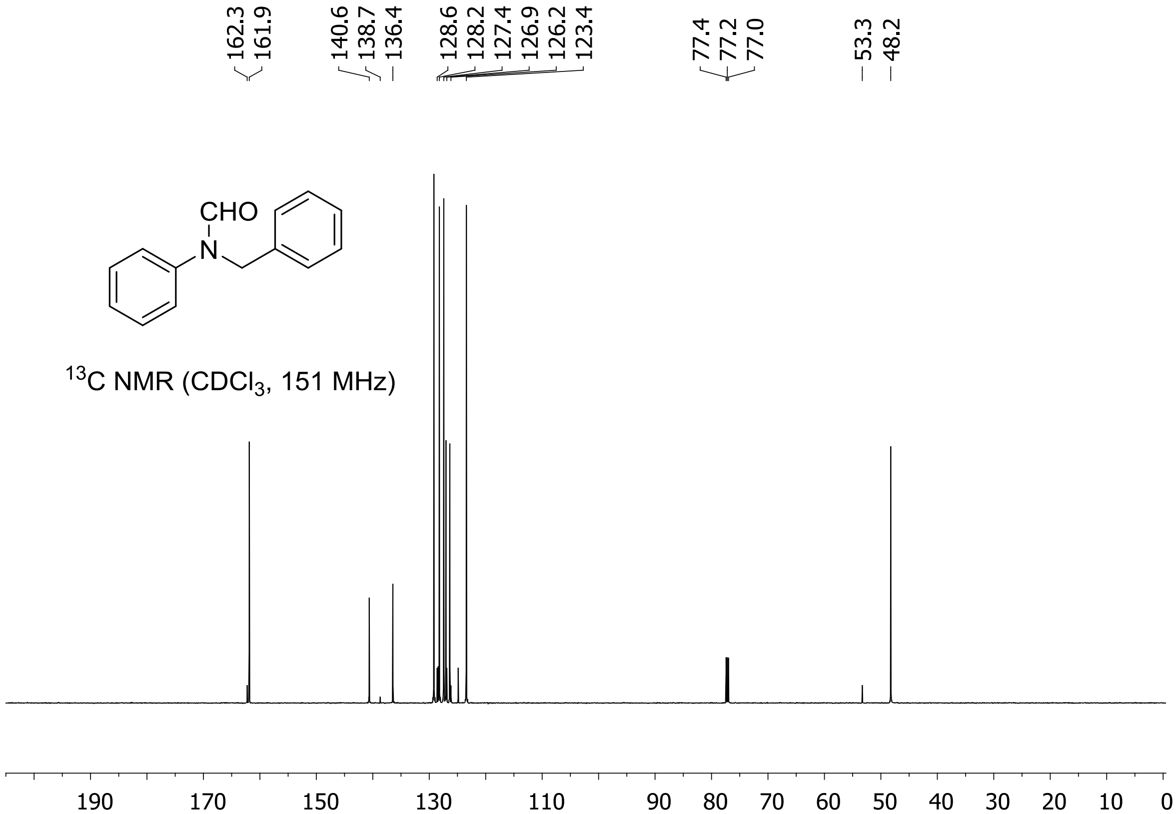

8.34
7.26
7.10
7.10
7.09
7.09
6.93
6.93
6.92
6.91
3.82
3.27
O
H
N
MeO
¹H NMR (CDCl₃, 500 MHz)
0.77
2.00
2.17
3.34
2.91
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

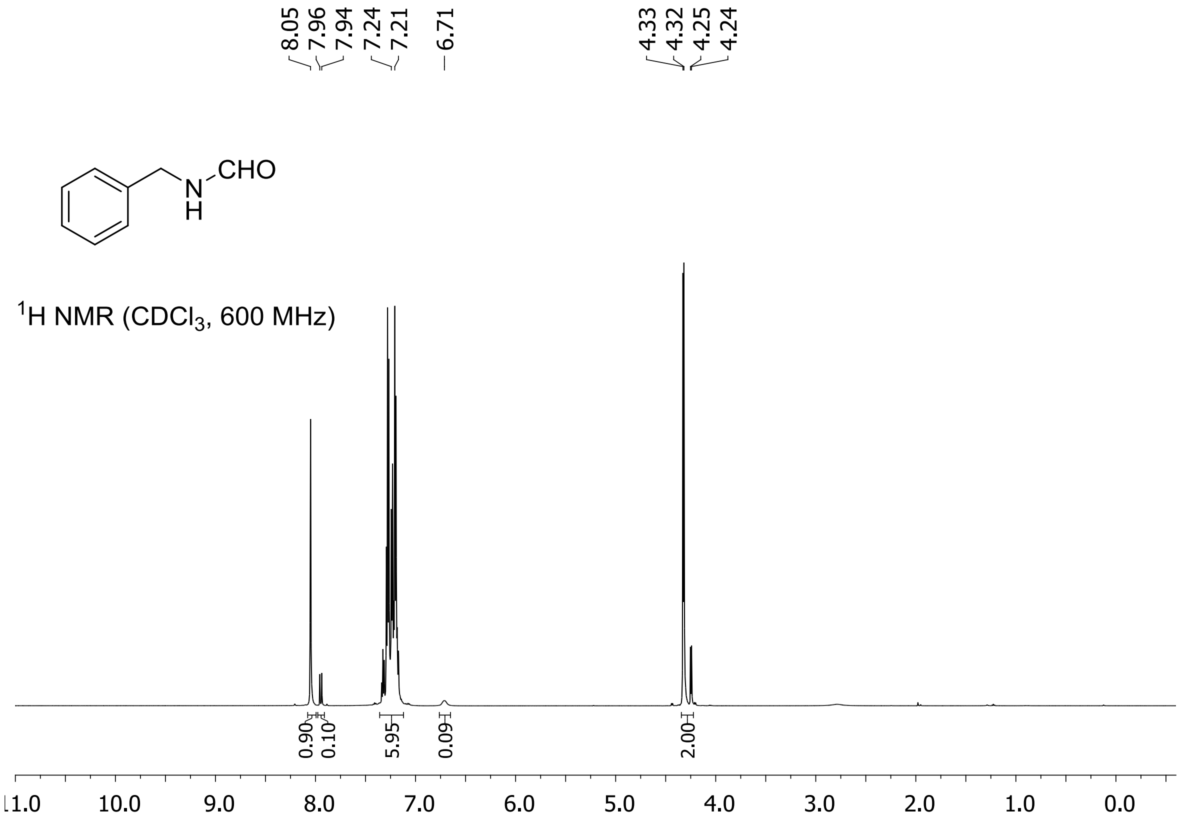

162.4
158.2
135.1
124.5
114.7
77.5
77.2
76.9
55.5
32.6
O
H
N
MeO
¹³C NMR (CDCl₃, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

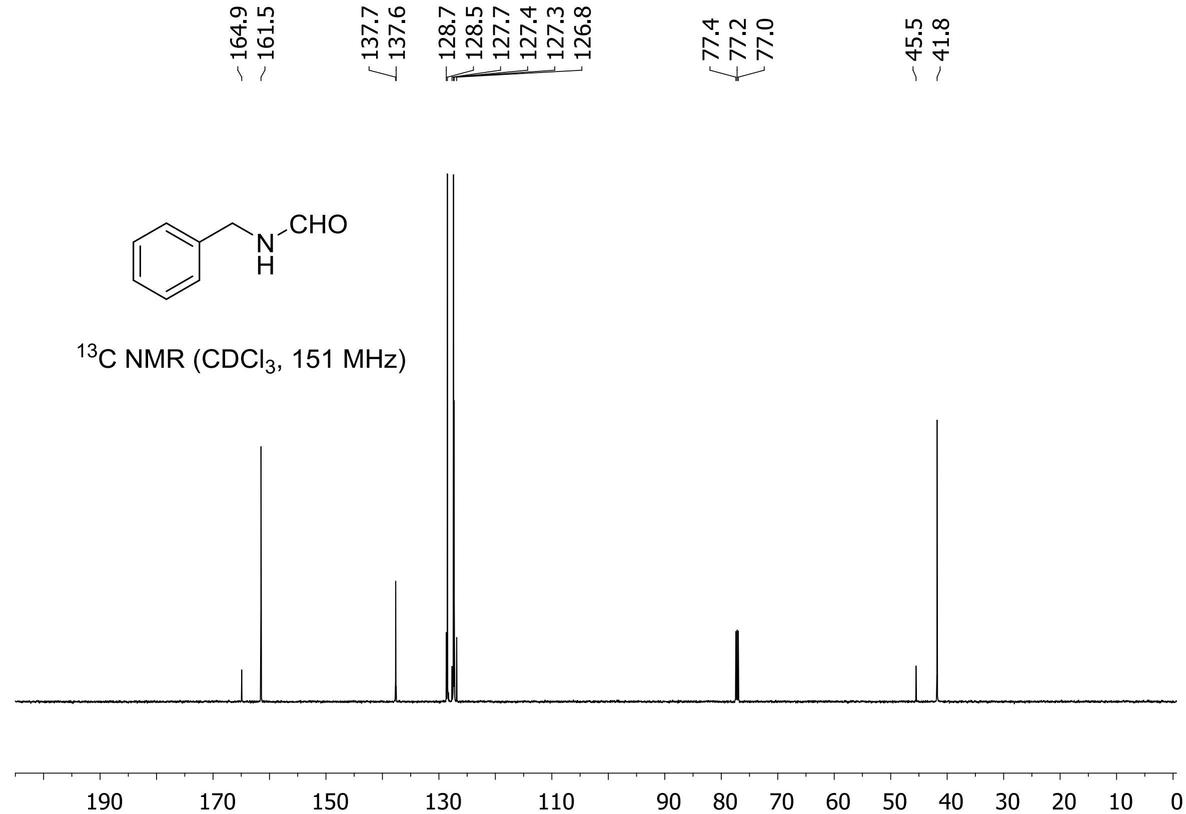

8.42
8.32
7.34
7.33
7.33
7.31
7.26
7.10
7.10
7.09
7.08
7.08
7.07
3.32
3.27
N
CHO
Cl
1H NMR (CDCl3, 500 MHz)
0.68
0.05
1.89
1.75
0.24
2.99
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

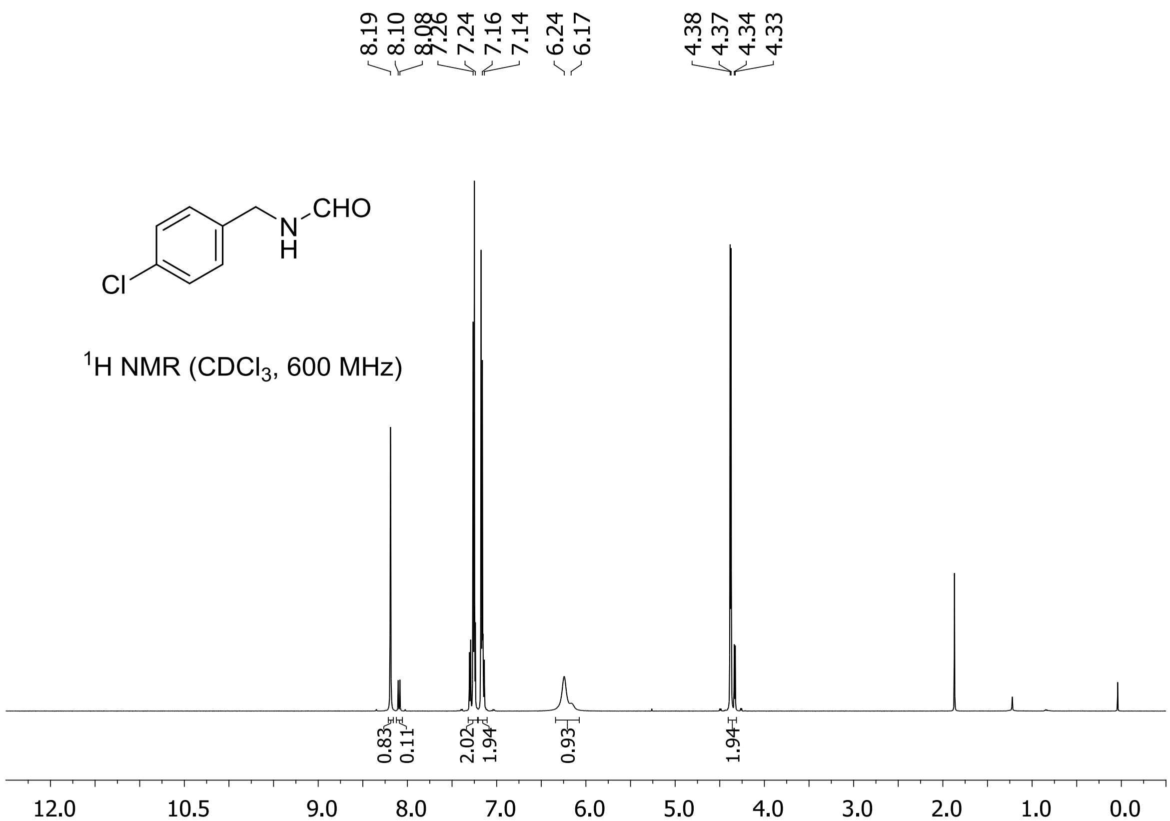

162.0
161.8
140.5
138.5
131.5
130.9
129.5
128.8
124.3
123.2
77.5
77.2
76.9
36.4
31.7
N
CHO
Cl
13C NMR (CDCl3, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

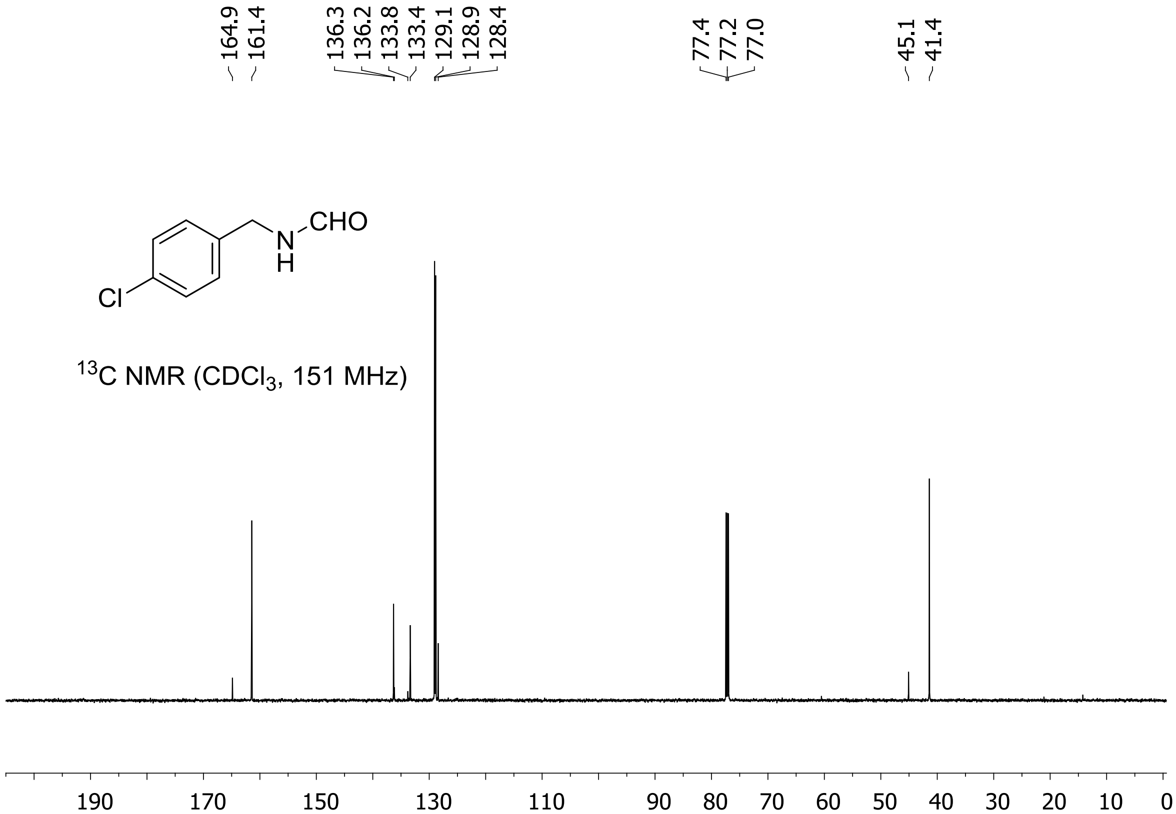

8.52
8.49
7.25
7.22
7.17
7.16
7.15
7.05
7.04
4.97
4.73
CHO
N
^{1}H NMR ($CDCl_3$, 600 MHz)
0.96
6.08
2.07
1.93
1.93
0.13
11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

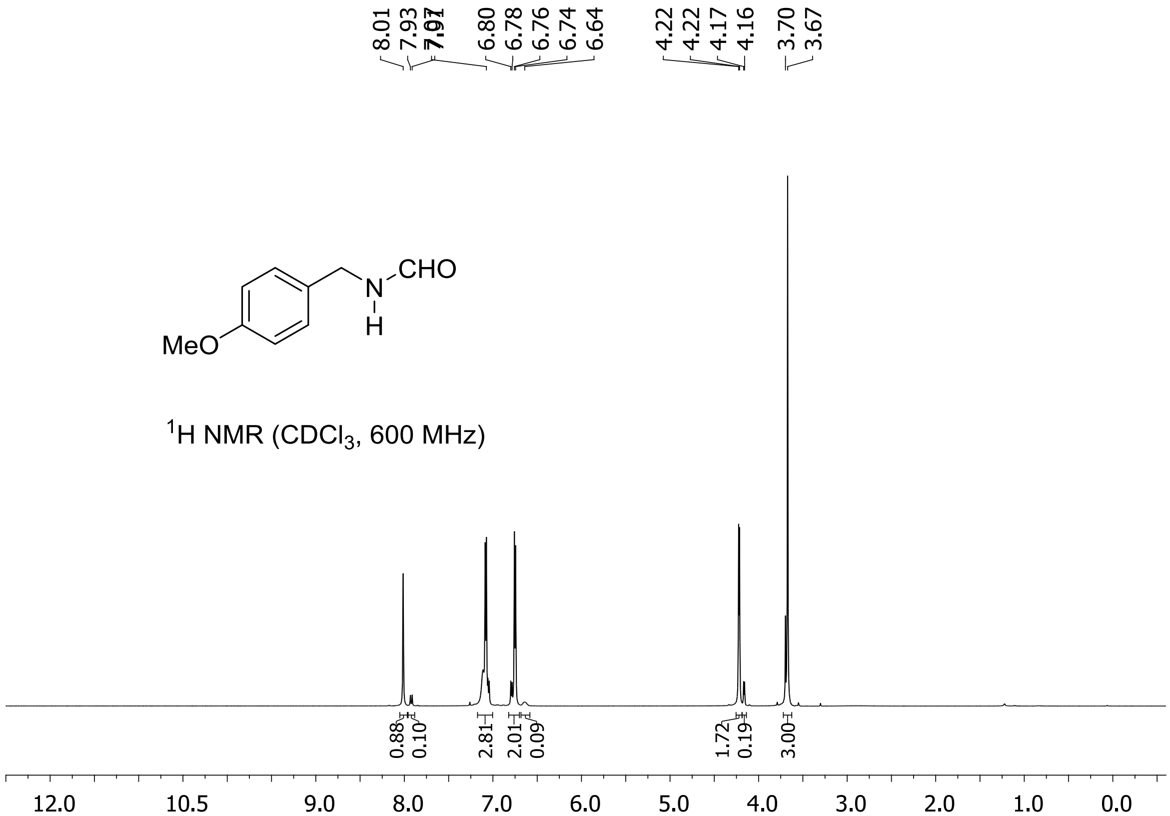

162.3
161.9
140.6
138.7
136.4
128.6
128.2
127.4
126.9
126.2
123.4
77.4
77.2
77.0
53.3
48.2
CHO
N
^{13}C NMR ($CDCl_3$, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

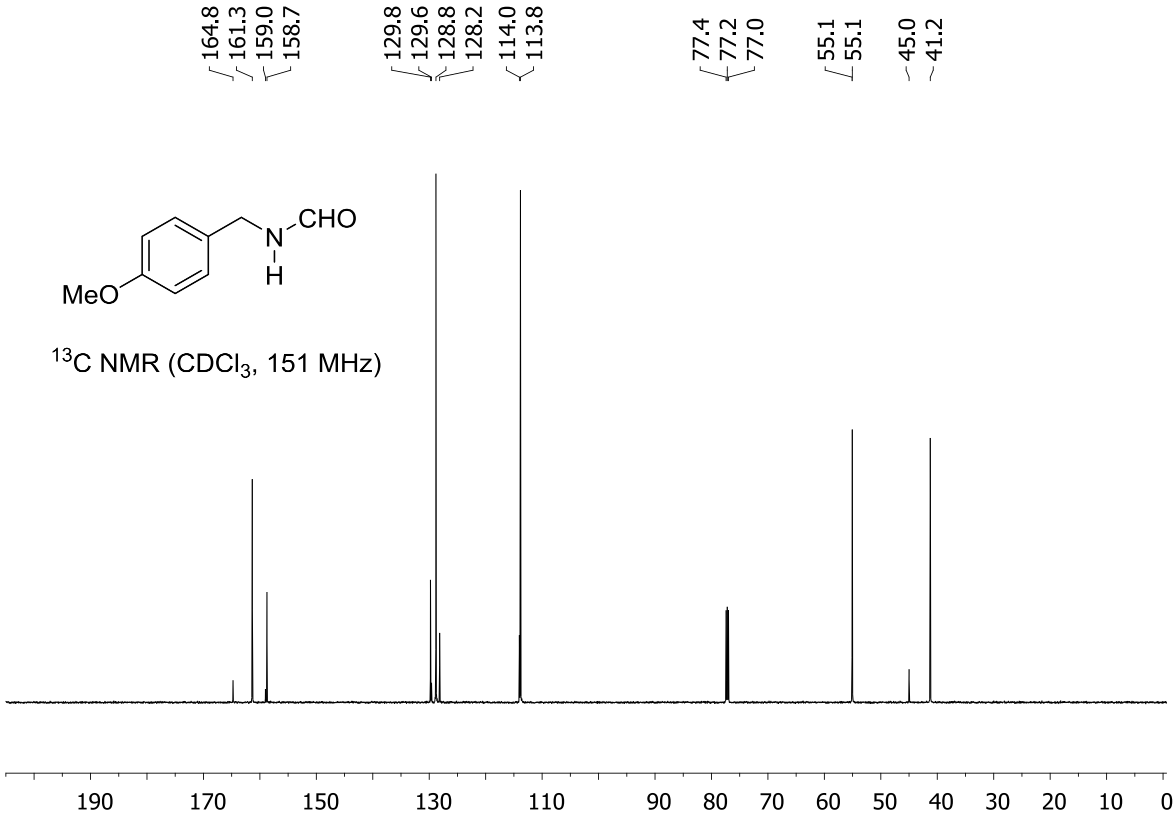

8.05
7.96
7.94
7.24
7.21
6.71
4.33
4.32
4.25
4.24
N
H
CHO
1H NMR (CDCl3, 600 MHz)
0.90
0.10
5.95
0.09
2.00
11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

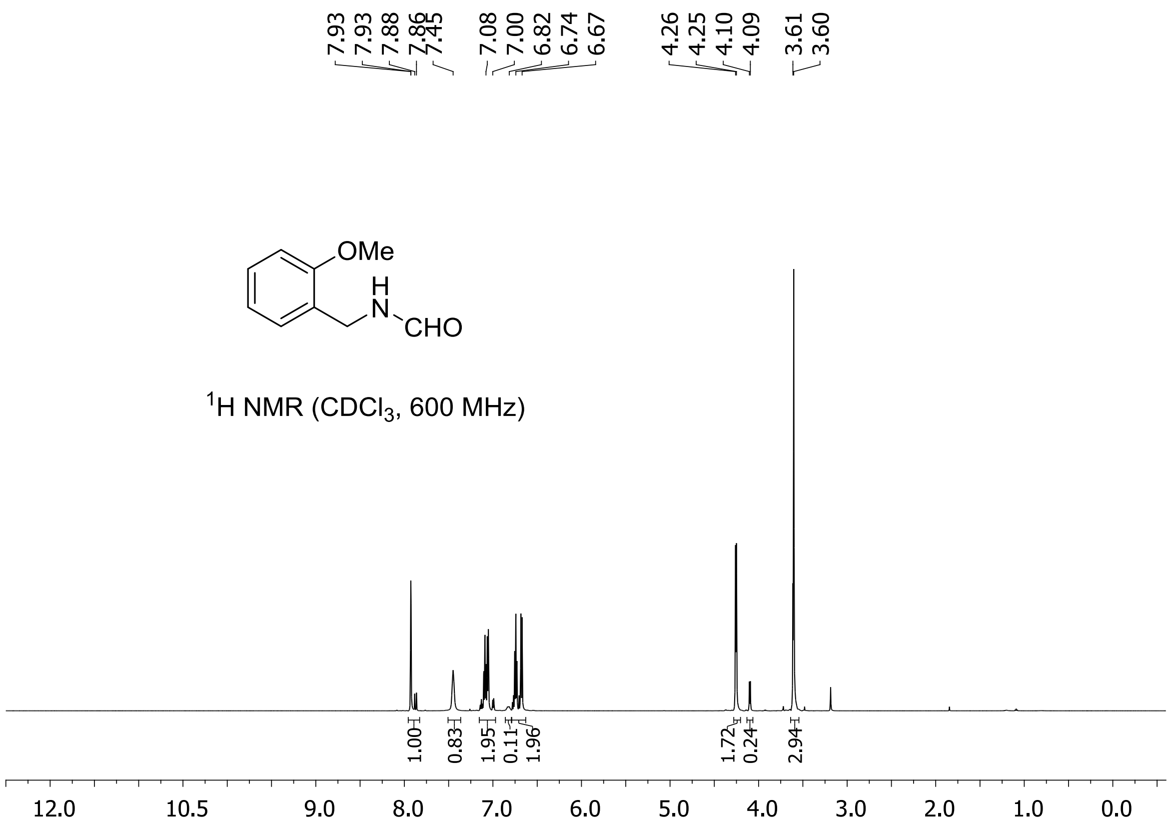

164.9
161.5
137.7
137.6
128.7
128.5
127.7
127.4
127.3
126.8
77.4
77.2
77.0
45.5
41.8
N
H
CHO
13C NMR (CDCl3, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

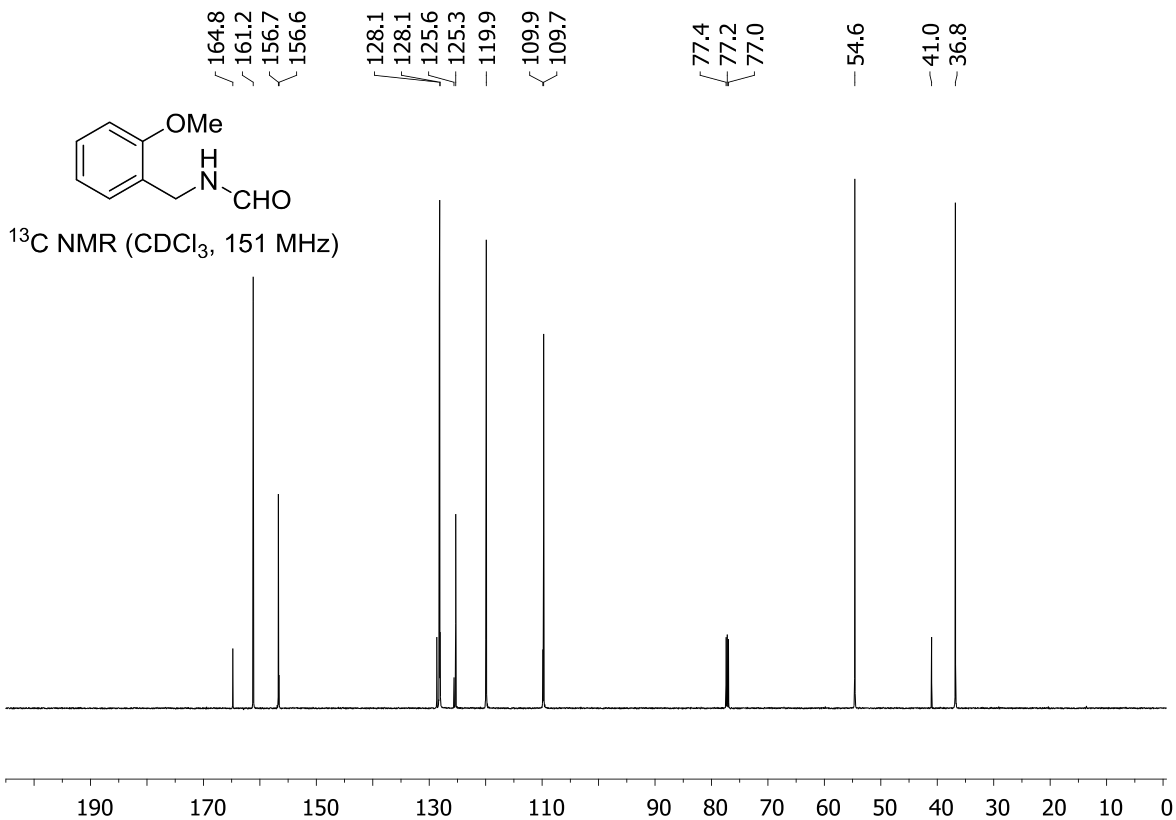

8.19
8.10
8.08
7.26
7.24
7.16
7.14
6.24
6.17
4.38
4.37
4.34
4.33
N
H
CHO
Cl
^{1}H NMR ($CDCl_3$, 600 MHz)
0.83
0.11
2.02
1.94
0.93
1.94
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

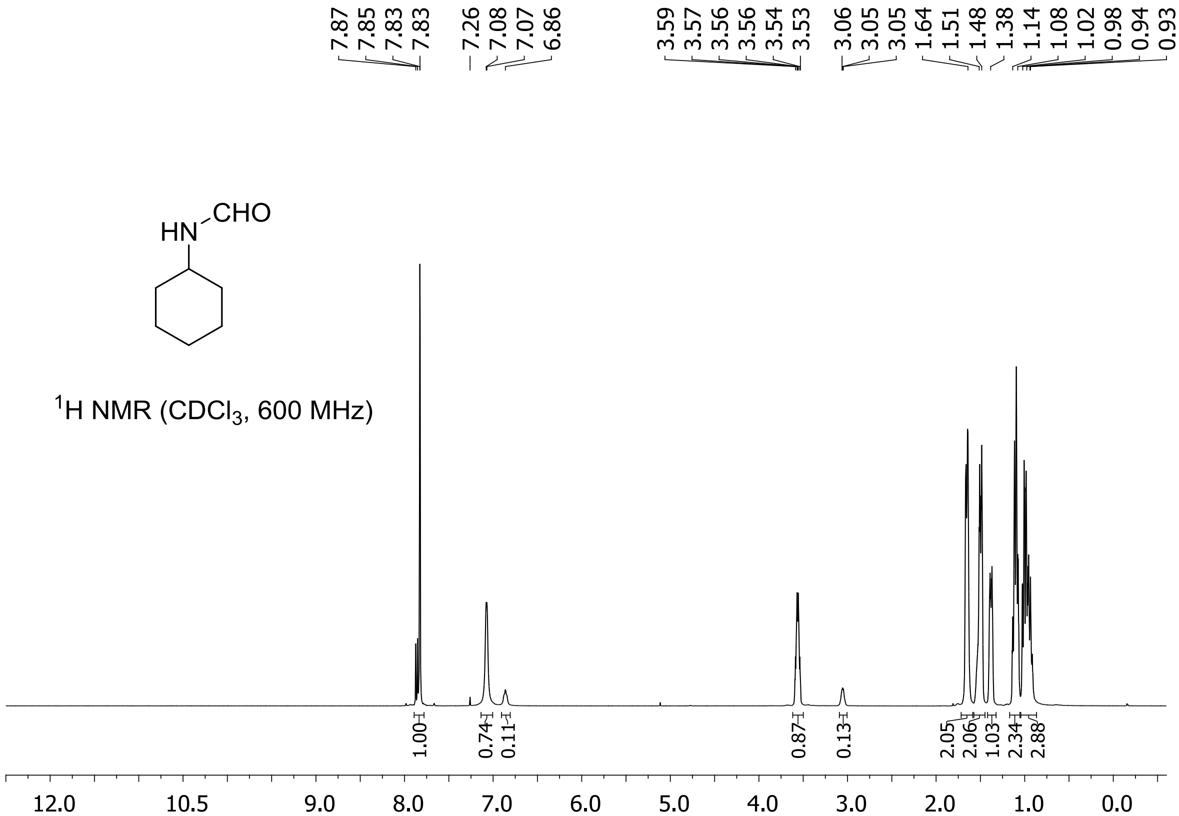

164.9
161.4
136.3
136.2
133.8
133.4
129.1
128.9
128.4
77.4
77.2
77.0
45.1
41.4
N
H
CHO
Cl
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

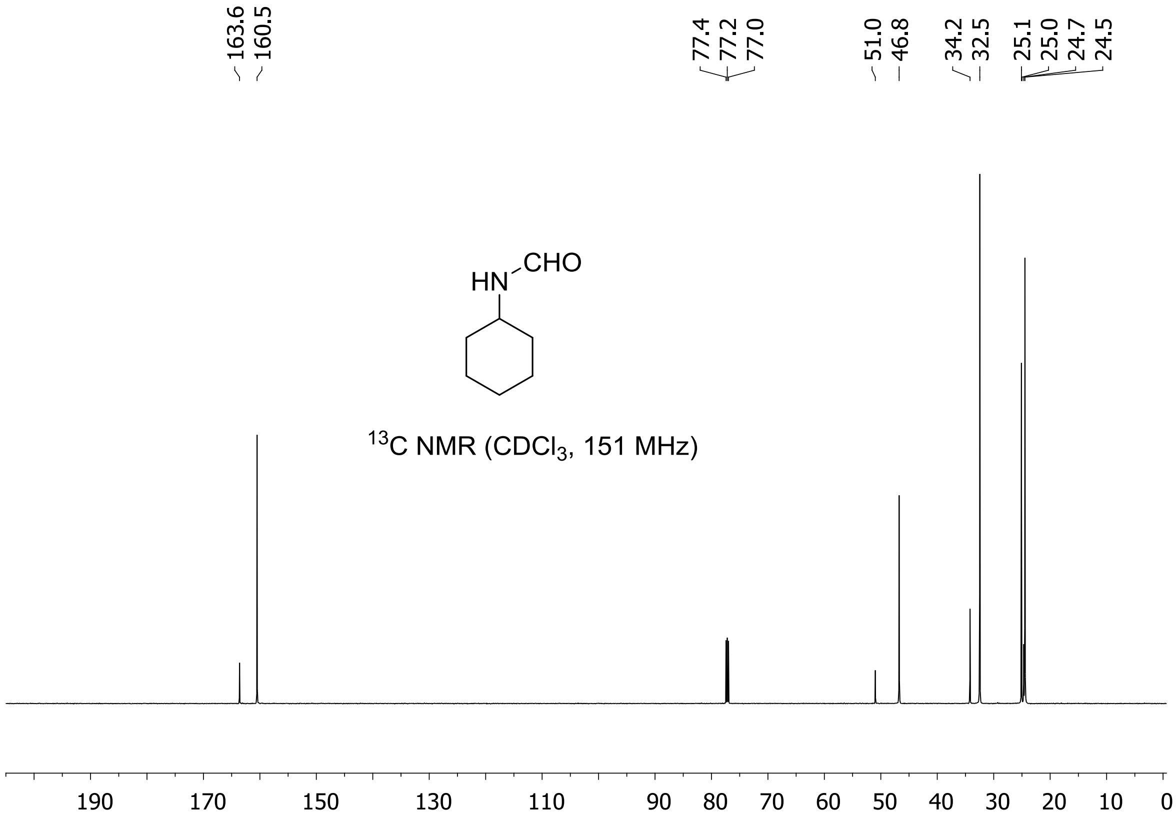

8.01
7.93
7.07
7.07
6.80
6.78
6.76
6.74
6.64
4.22
4.22
4.17
4.16
3.70
3.67
MeO
N
H
CHO
¹H NMR (CDCl₃, 600 MHz)
0.88
0.10
2.81
2.01
0.09
1.72
0.19
3.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

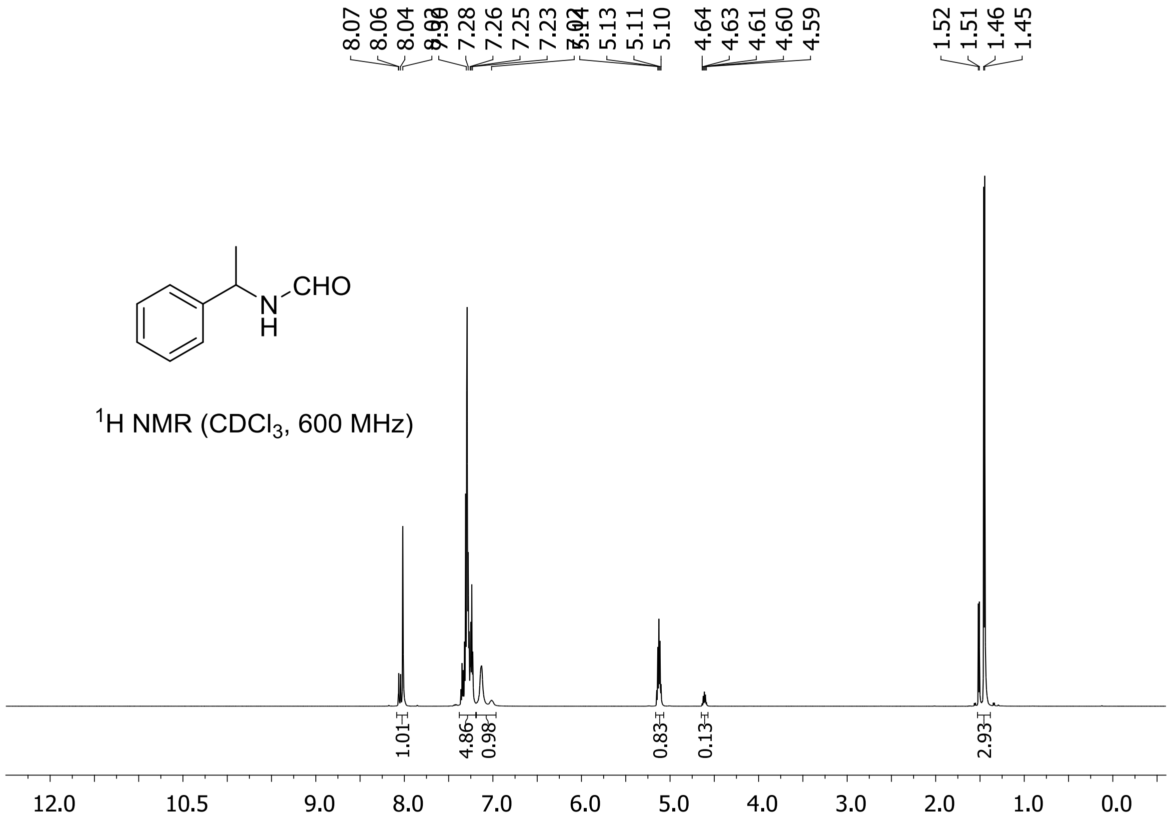

164.8
161.3
159.0
158.7
129.8
129.6
128.8
128.2
114.0
113.8
77.4
77.2
77.0
55.1
55.1
45.0
41.2
MeO
N
H
CHO
¹³C NMR (CDCl₃, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


7.93
7.93
7.88
7.86
7.45
7.08
7.00
6.82
6.74
6.67
4.26
4.25
4.10
4.09
3.61
3.60
OMe
H
N
CHO
^{1}H NMR ($CDCl_3$, 600 MHz)
1.00
0.83
1.95
0.11
1.96
1.72
0.24
2.94
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

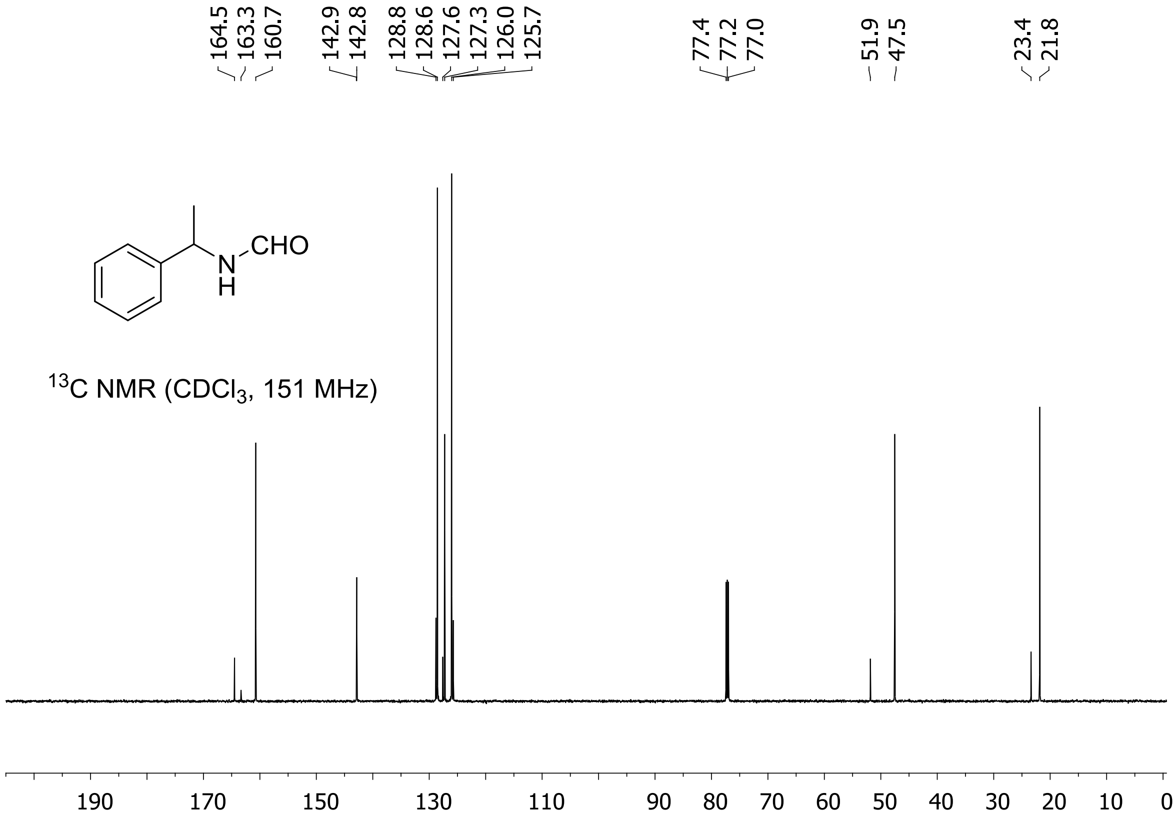

164.8
161.2
156.7
156.6
128.1
128.1
125.6
125.3
119.9
109.9
109.7
77.4
77.2
77.0
54.6
41.0
36.8
OMe
H
N
CHO
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


HN CHO
1H NMR (CDCl3, 600 MHz)
7.87 7.85 7.83 7.83 7.26 7.08 7.07 6.86 3.59 3.57 3.56 3.56 3.54 3.53 3.06 3.05 3.05 1.64 1.51 1.48 1.38 1.14 1.08 1.02 0.98 0.94 0.93
1.00 0.74 0.11 0.87 0.13 2.05 2.06 1.03 2.34 2.88
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

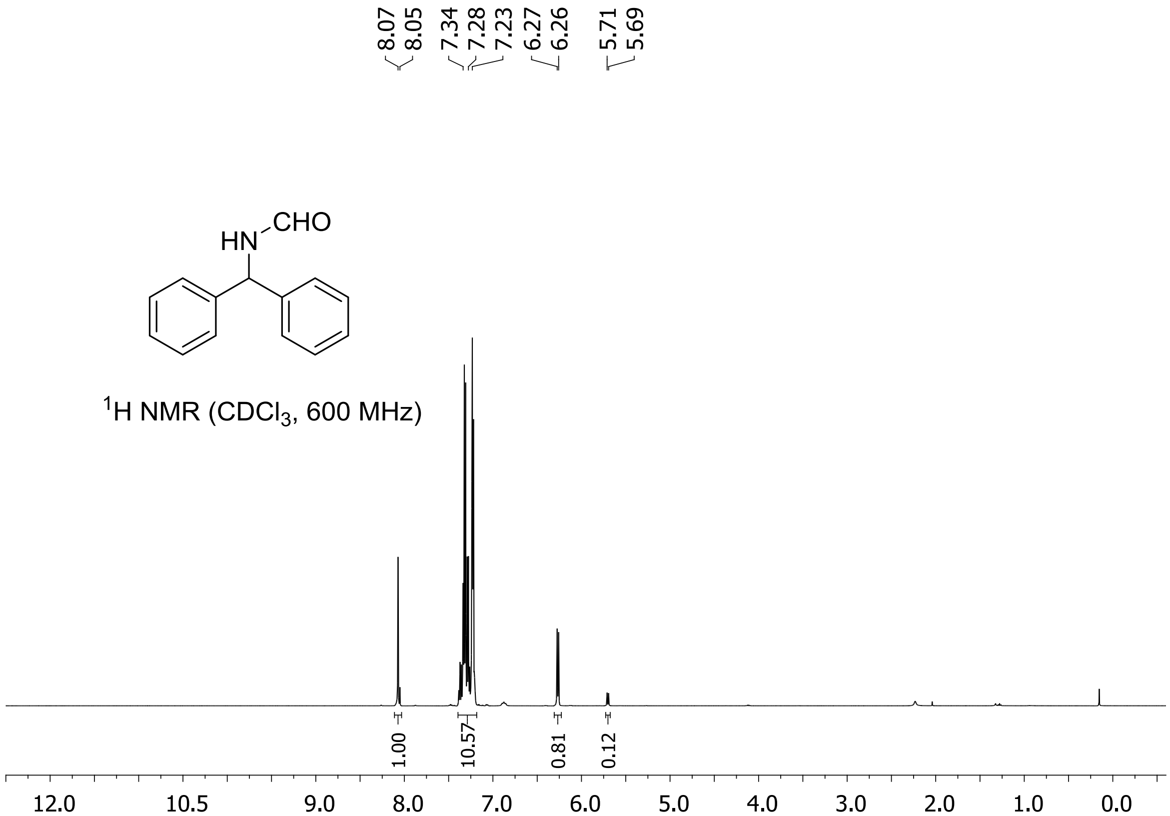

HN CHO
13C NMR (CDCl3, 151 MHz)
163.6 160.5 77.4 77.2 77.0 51.0 46.8 34.2 32.5 25.1 25.0 24.7 24.5
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

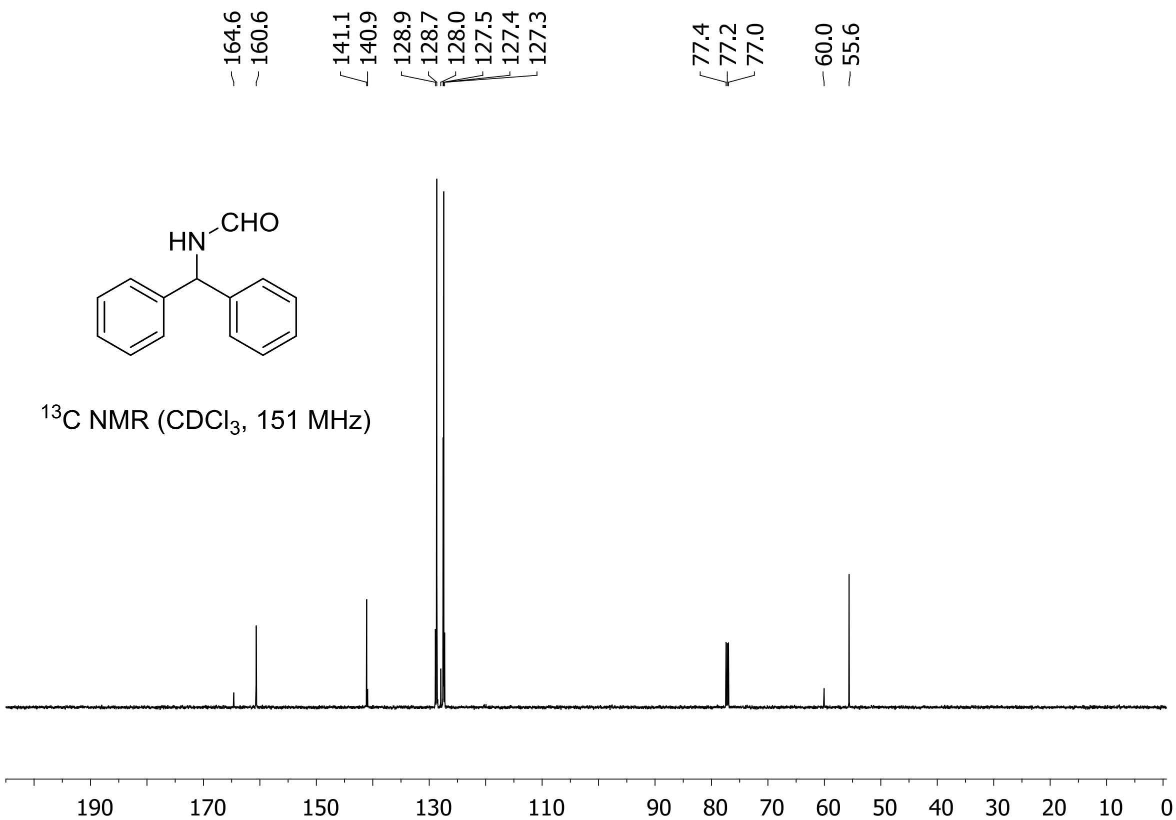


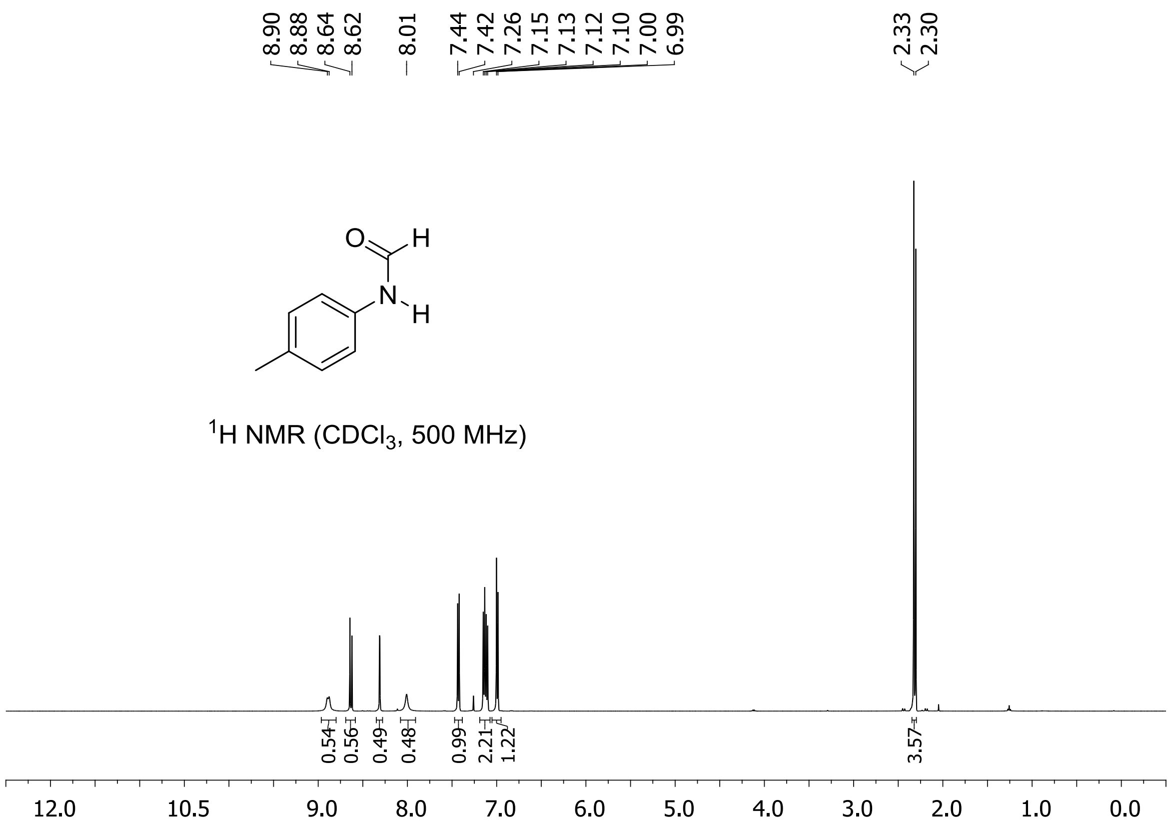
CHO
N
H
1H NMR (CDCl3, 600 MHz)
8.07 8.06 8.04 7.28 7.26 7.25 7.23 5.13 5.11 5.10 4.64 4.63 4.61 4.60 4.59 1.52 1.51 1.46 1.45
1.01 4.86 0.98 0.83 0.13 2.93
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0

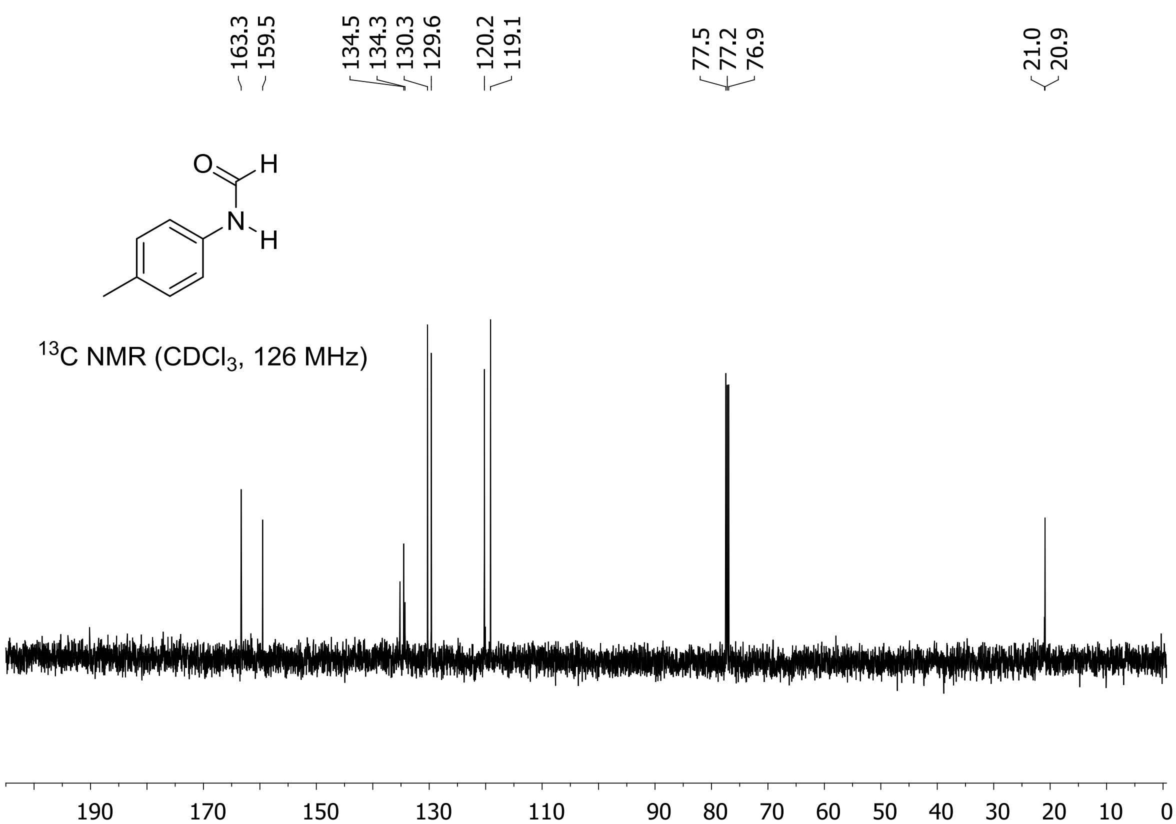


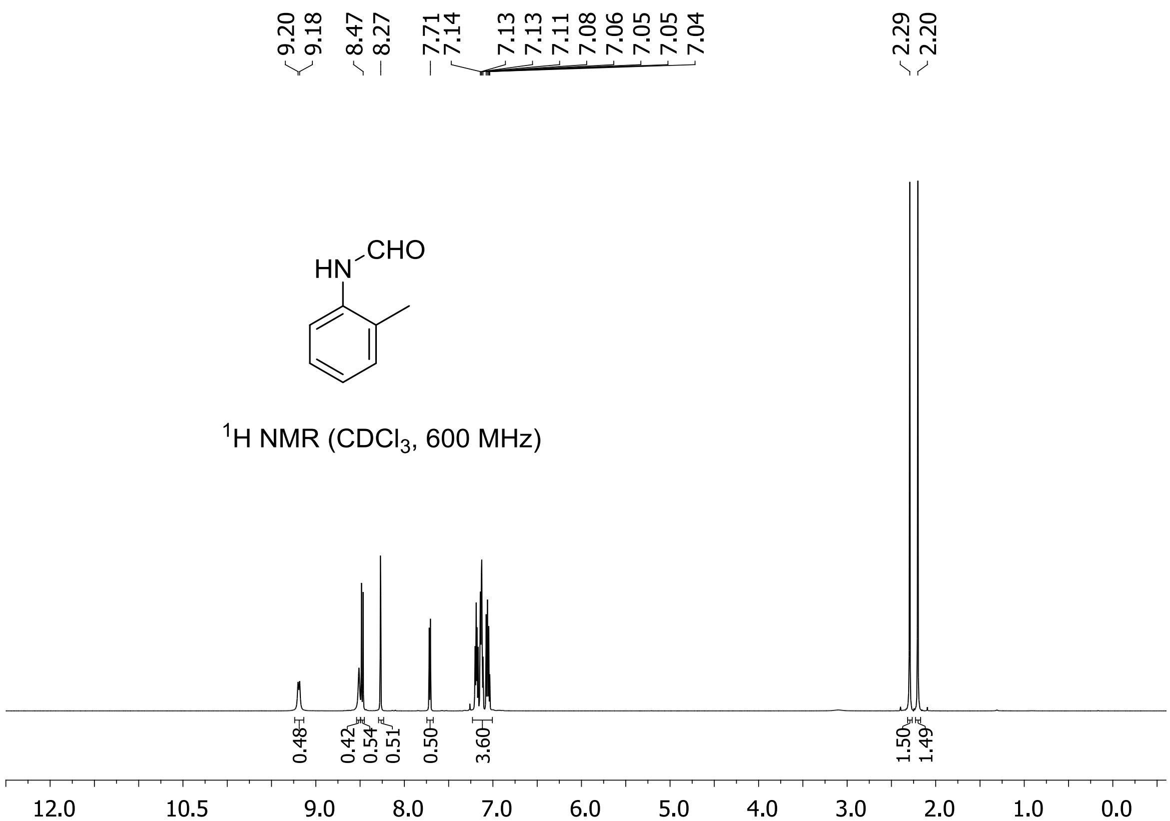
CHO
N
H
13C NMR (CDCl3, 151 MHz)
164.5 163.3 160.7 142.9 142.8 128.8 128.6 127.6 127.3 126.0 125.7 77.4 77.2 77.0 51.9 47.5 23.4 21.8
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0

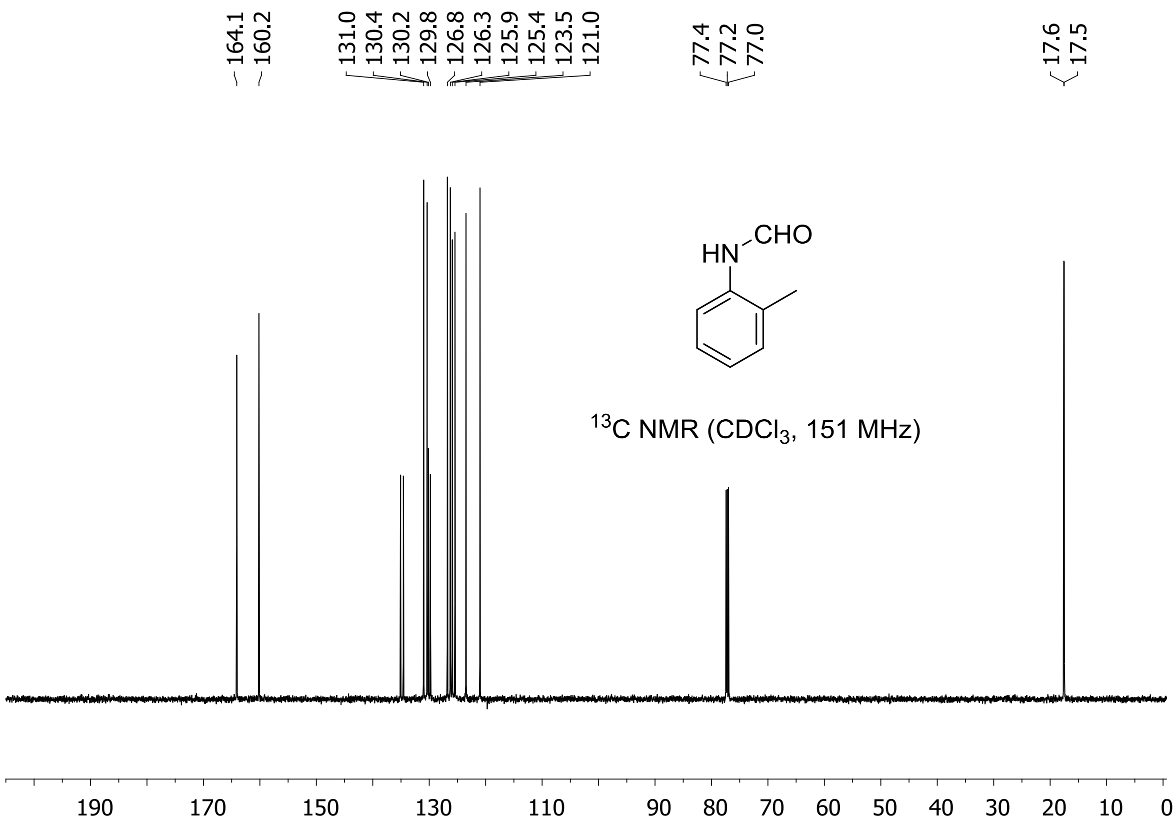

8.07
8.05
7.34
7.28
7.23
6.27
6.26
5.71
5.69
HN
CHO
^{1}H NMR ($CDCl_3$, 600 MHz)
1.00
10.57
0.81
0.12
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

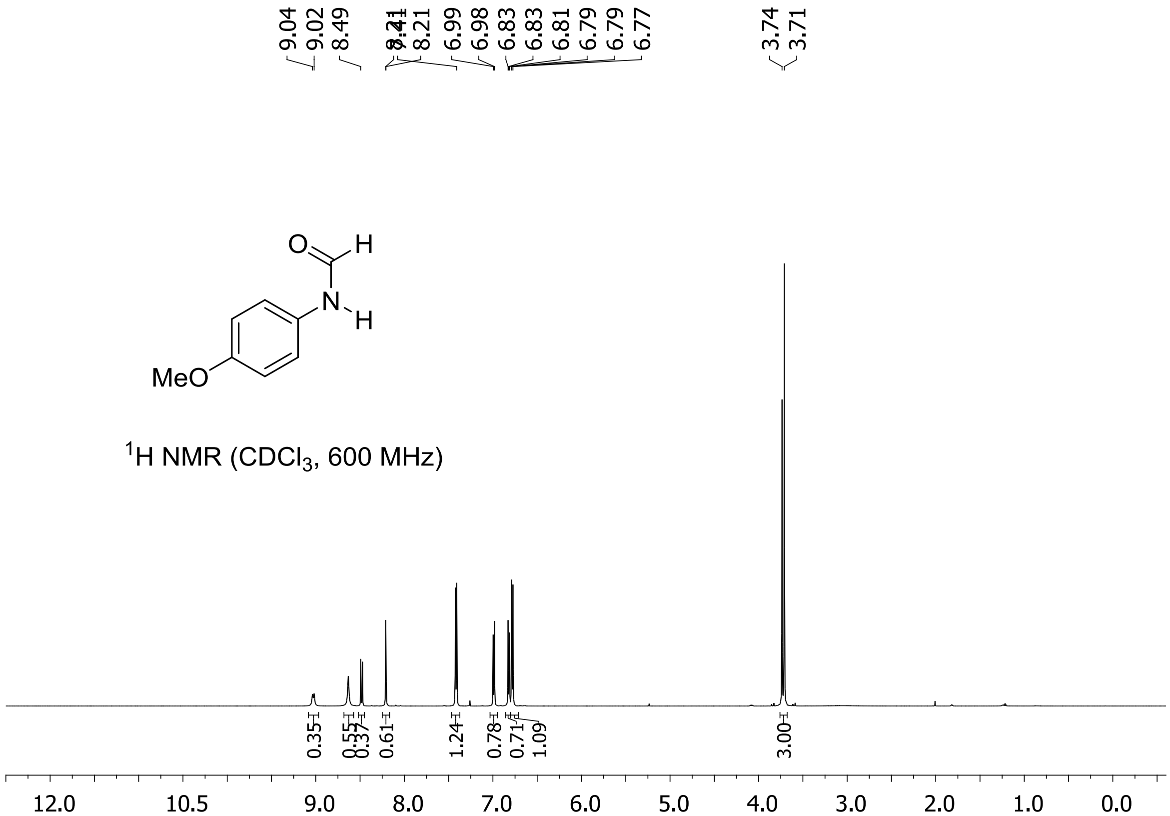

164.6
160.6
141.1
140.9
128.9
128.7
128.0
127.5
127.4
127.3
77.4
77.2
77.0
60.0
55.6
HN
CHO
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

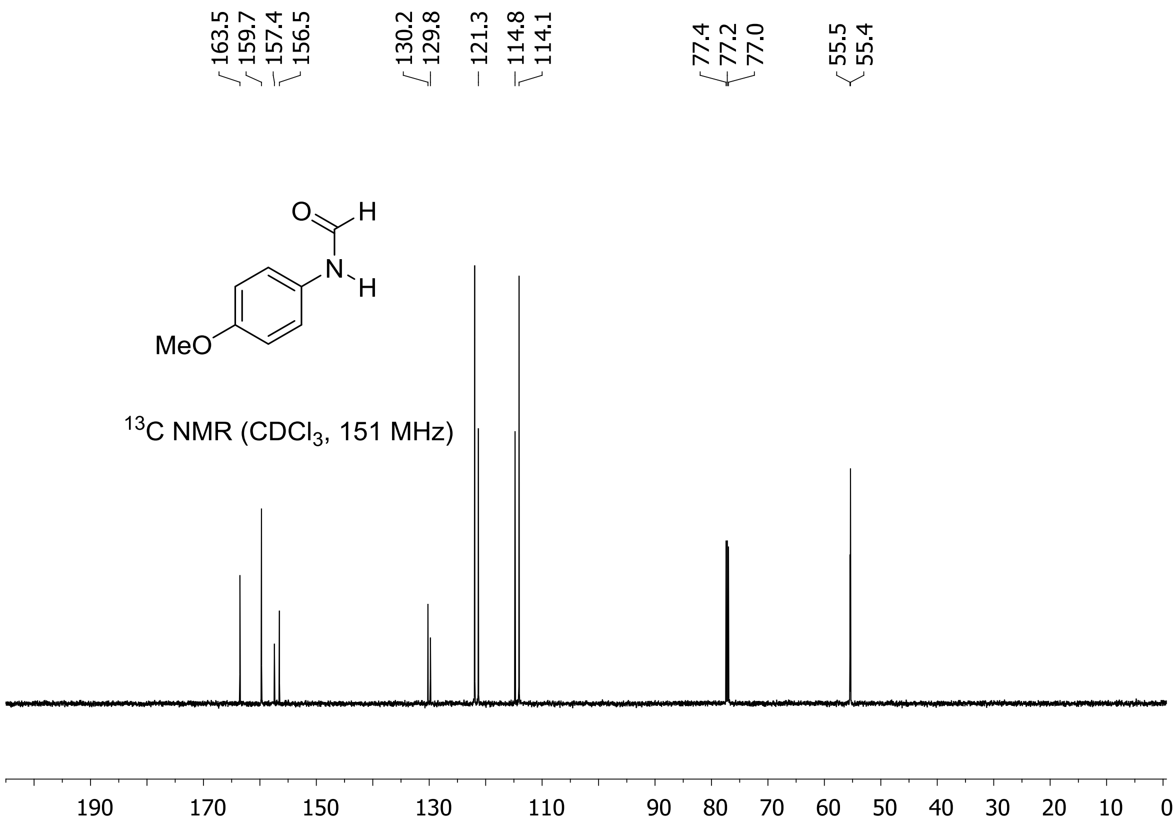

8.90
8.88
8.64
8.62
8.01
7.44
7.42
7.26
7.15
7.13
7.12
7.10
7.00
6.99
2.33
2.30
O
H
N
H
1H NMR (CDCl3, 500 MHz)
0.54
0.56
0.49
0.48
0.99
2.21
1.22
3.57
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

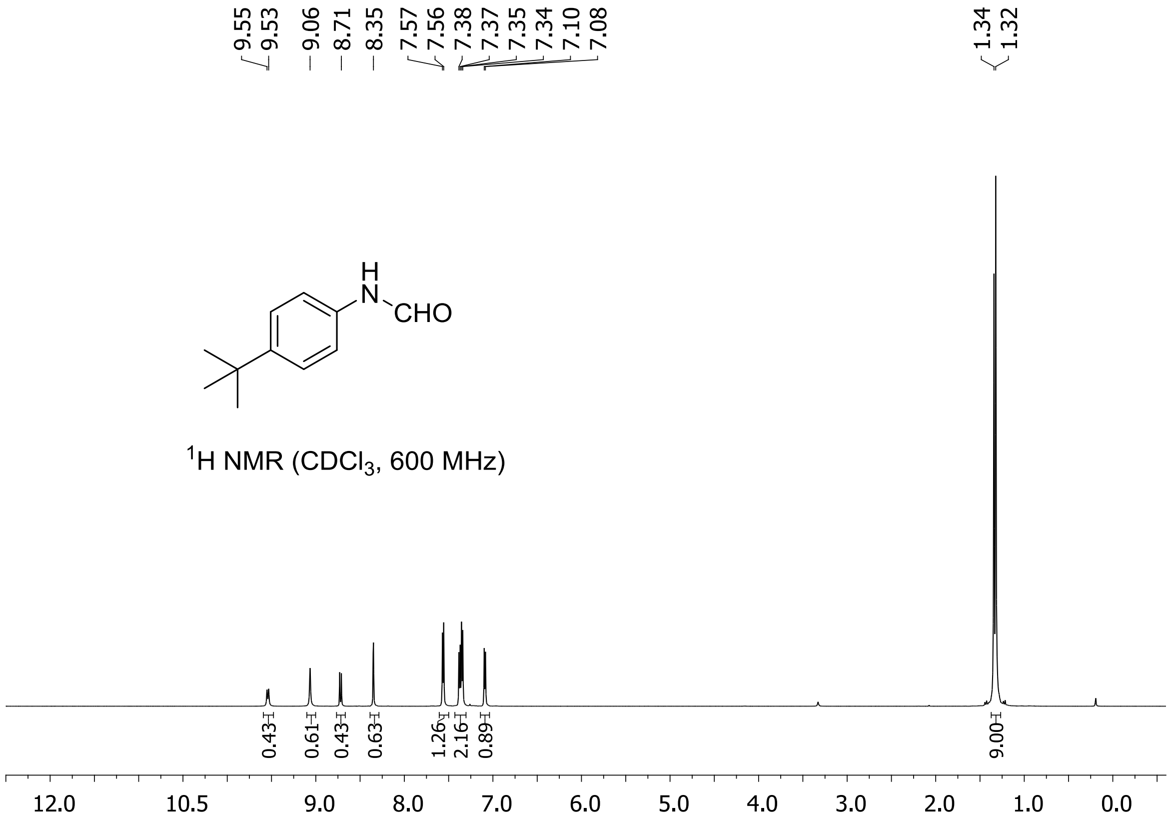

163.3
159.5
134.5
134.3
130.3
129.6
120.2
119.1
77.5
77.2
76.9
21.0
20.9
O
H
N
H
13C NMR (CDCl3, 126 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

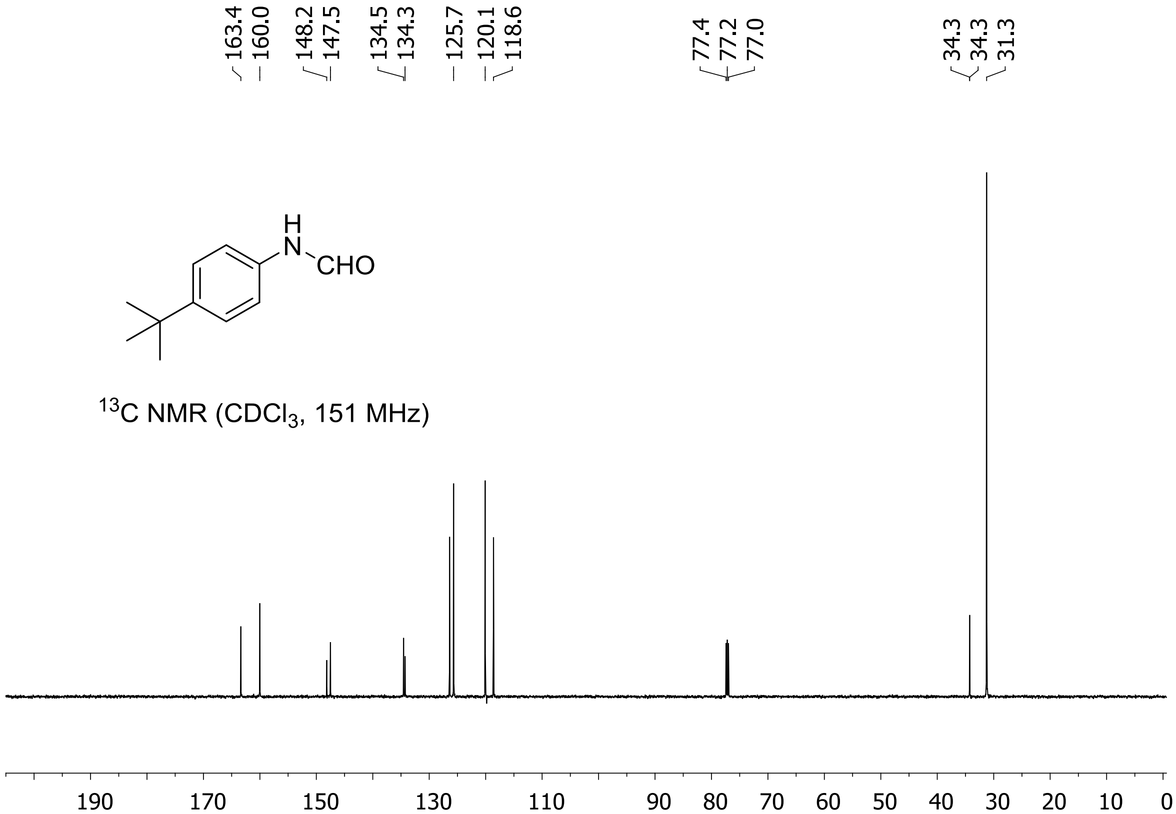

9.20
9.18
8.47
8.27
7.71
7.14
7.13
7.13
7.11
7.08
7.06
7.05
7.05
7.04
2.29
2.20
HN
CHO
^{1}H NMR (CDCl$_3$, 600 MHz)
0.48
0.42
0.54
0.51
0.50
3.60
1.50
1.49
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

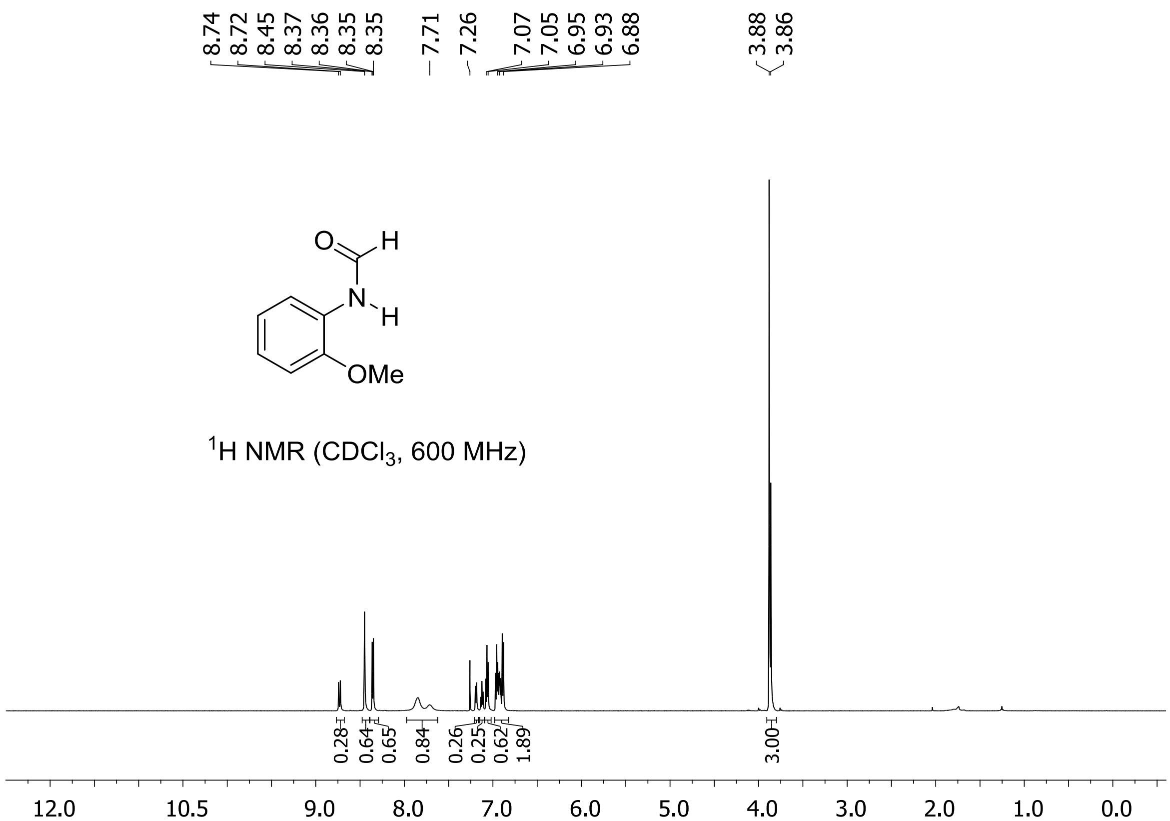

164.1
160.2
131.0
130.4
130.2
129.8
126.8
126.3
125.9
125.4
123.5
121.0
77.4
77.2
77.0
17.6
17.5
HN
CHO
^{13}C NMR (CDCl$_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


9.04
9.02
8.49
8.21
6.99
6.98
6.83
6.81
6.79
6.77
3.74
3.71
O
H
N
H
MeO
1H NMR (CDCl3, 600 MHz)
0.35
0.55
0.37
0.61
1.24
0.78
0.71
1.09
3.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

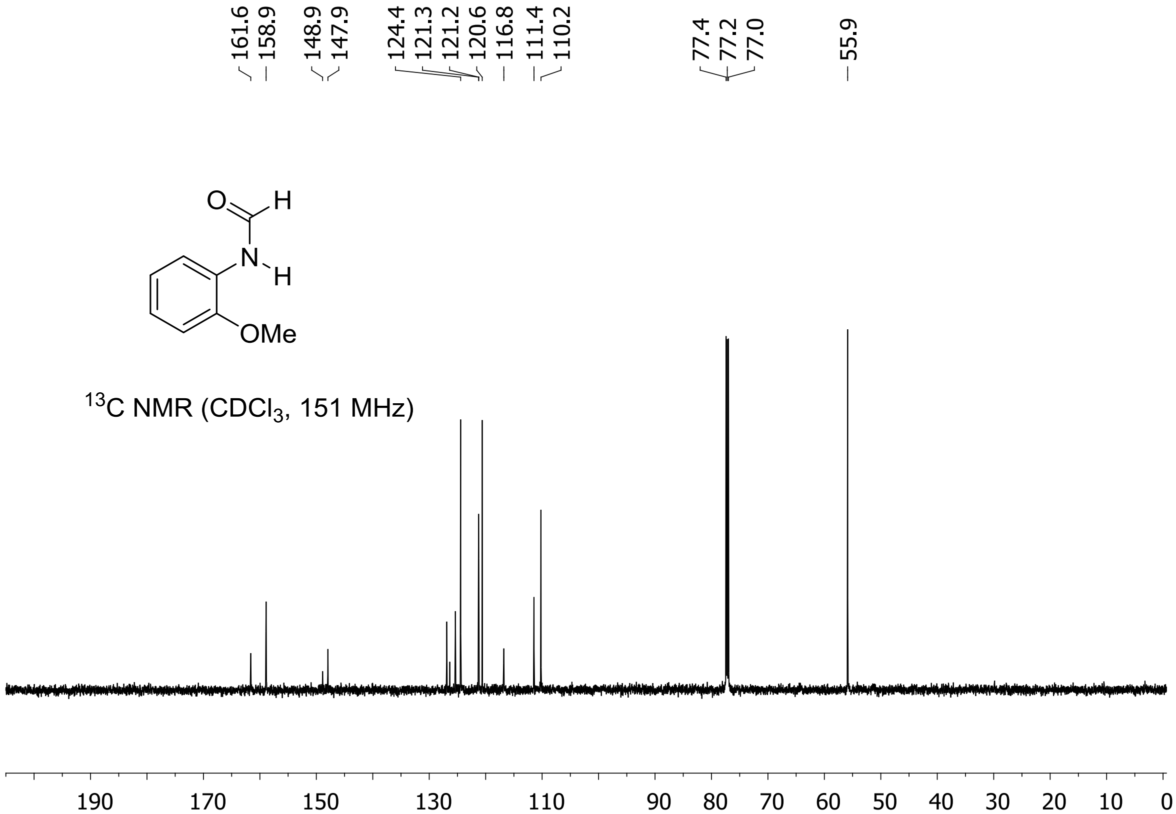

163.5
159.7
157.4
156.5
130.2
129.8
121.3
114.8
114.1
77.4
77.2
77.0
55.5
55.4
O
H
N
H
MeO
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0


9.55
9.53
9.06
8.71
8.35
7.57
7.56
7.38
7.37
7.35
7.34
7.10
7.08
1.34
1.32
H
N
CHO
1H NMR (CDCl3, 600 MHz)
0.43
0.61
0.43
0.63
1.26
2.16
0.89
9.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

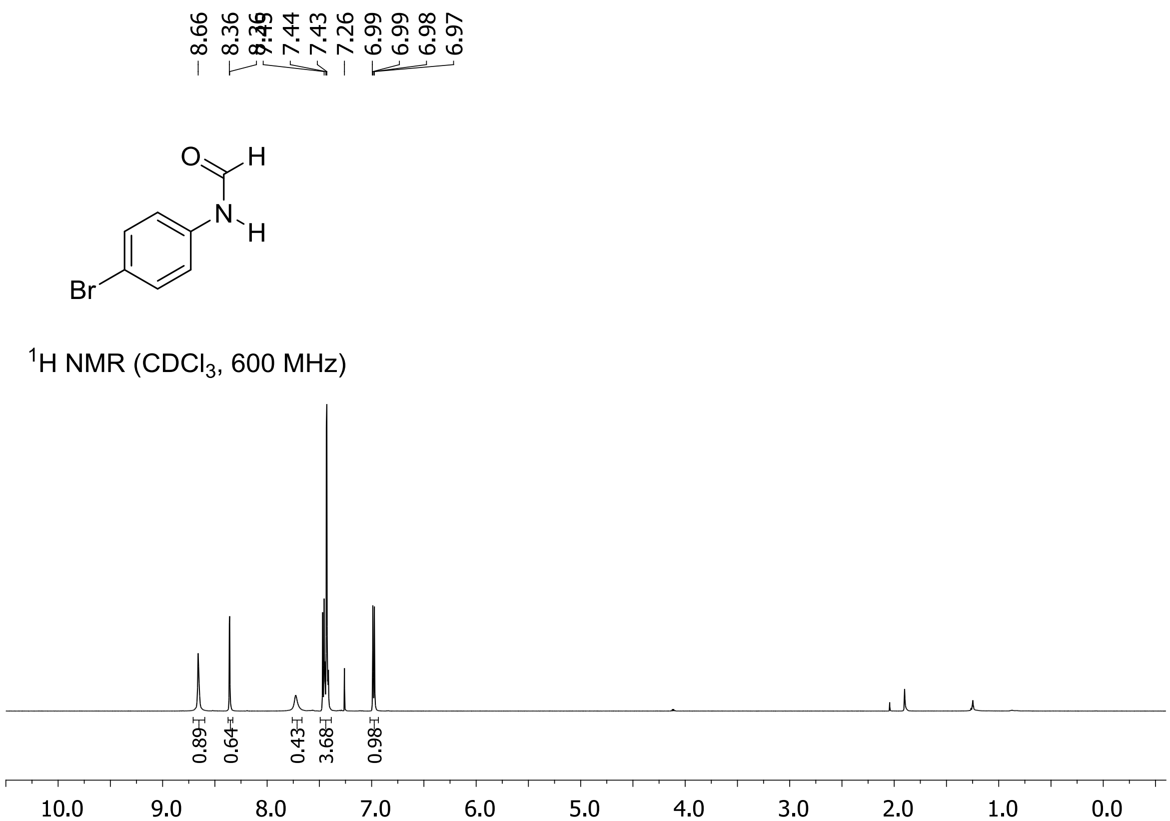

163.4
160.0
148.2
147.5
134.5
134.3
125.7
120.1
118.6
77.4
77.2
77.0
34.3
34.3
31.3
H
N
CHO
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

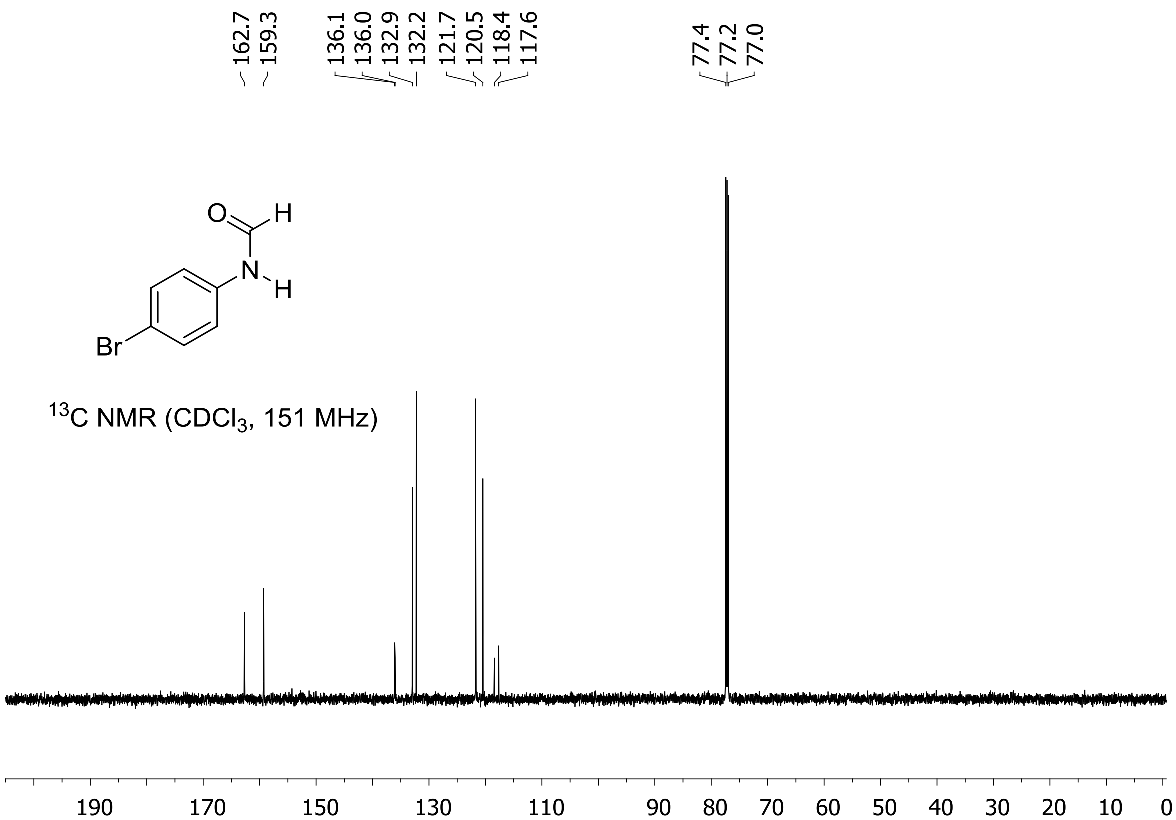


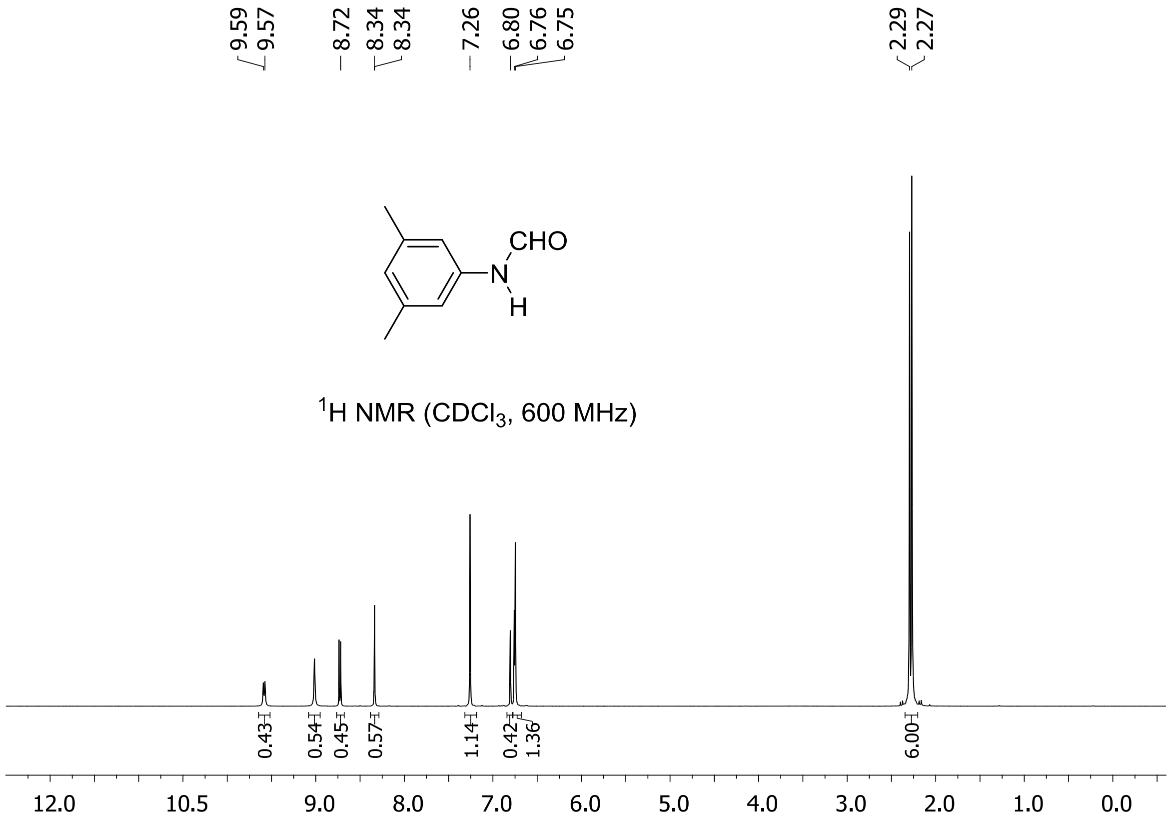
8.74
8.72
8.45
8.37
8.36
8.35
8.35
7.71
7.26
7.07
7.05
6.95
6.93
6.88
3.88
3.86
O
H
N
H
OMe
^{1}H NMR ($CDCl_3$, 600 MHz)
0.28
0.64
0.65
0.84
0.26
0.25
0.62
1.89
3.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

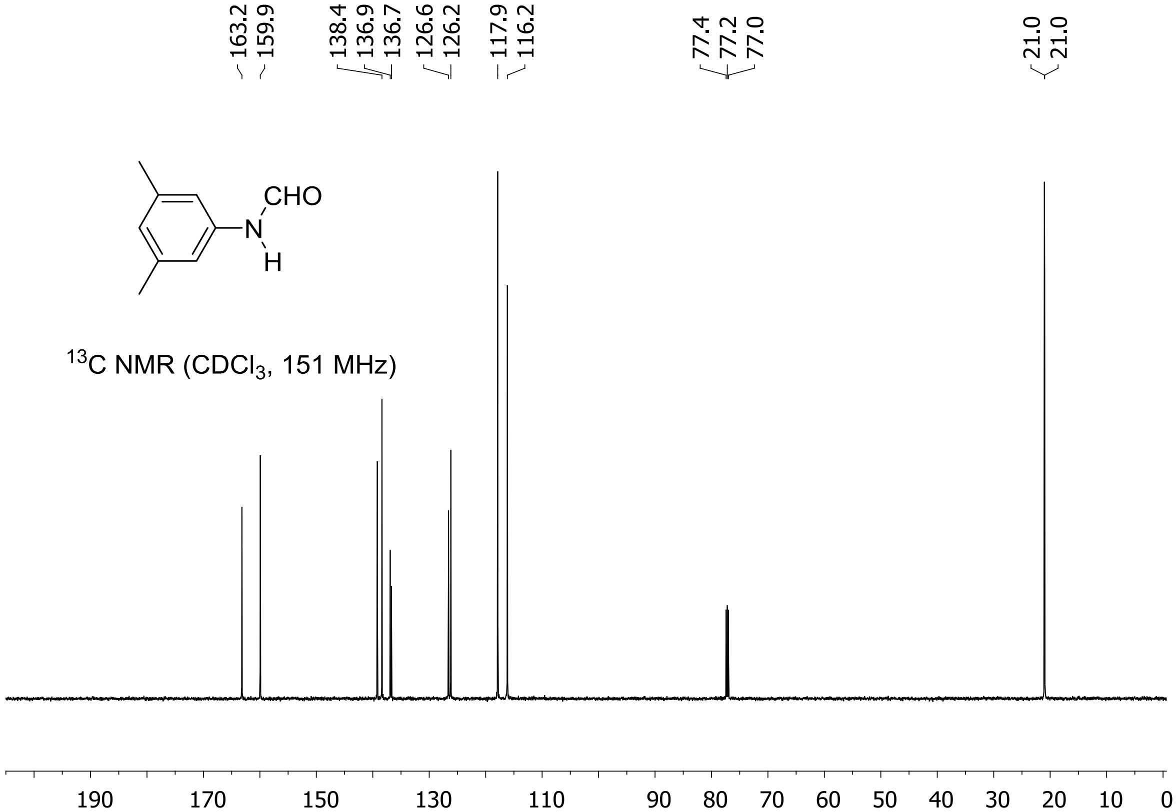


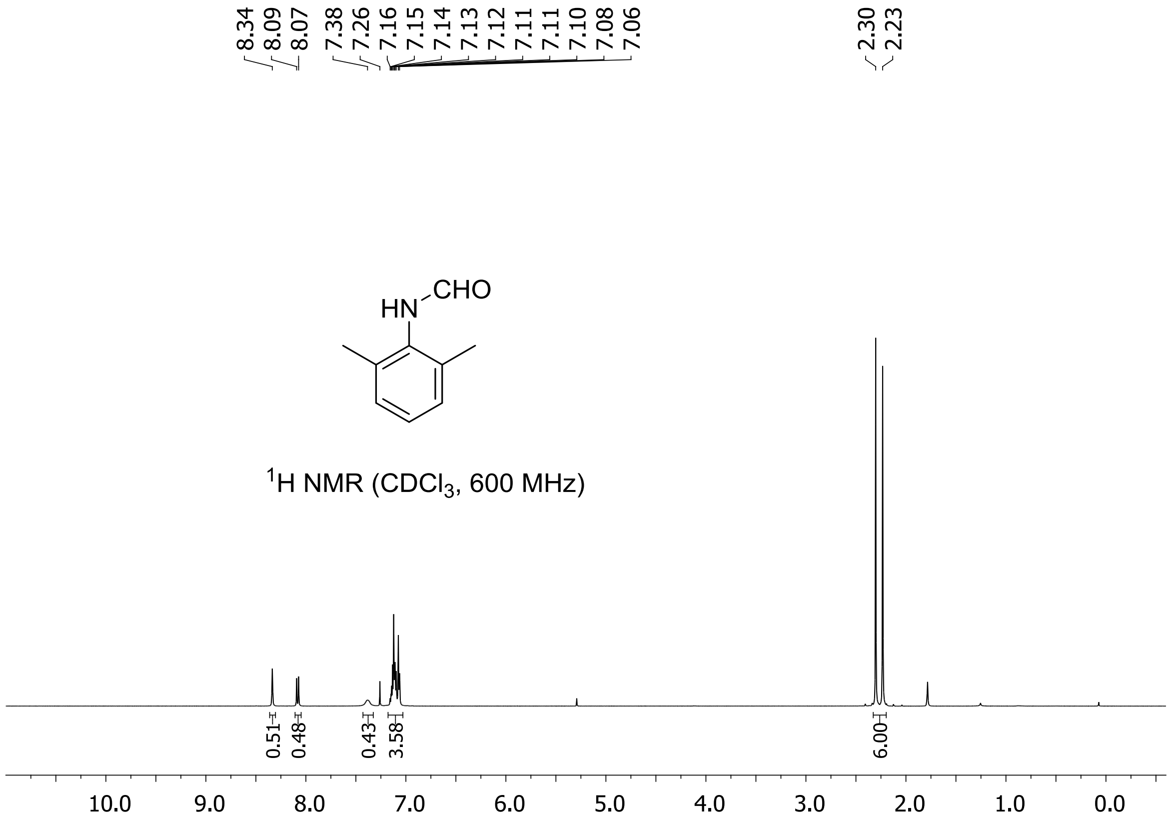
161.6
158.9
148.9
147.9
124.4
121.3
121.2
120.6
116.8
111.4
110.2
77.4
77.2
77.0
55.9
O
H
N
H
OMe
^{13}C NMR ($CDCl_3$, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

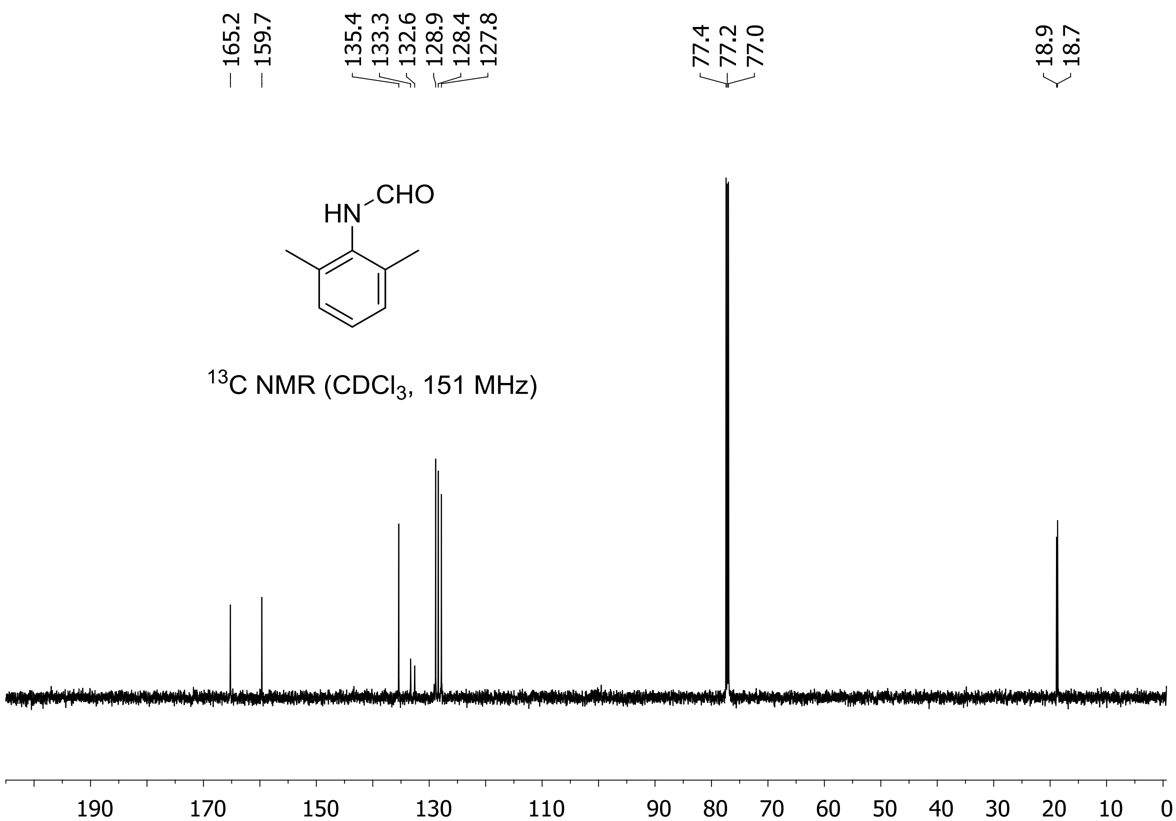

8.66
8.36
8.36
7.45
7.44
7.43
7.26
6.99
6.99
6.98
6.97
O
H
N
H
Br
1H NMR (CDCl3, 600 MHz)
0.89
0.64
0.43
3.68
0.98
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

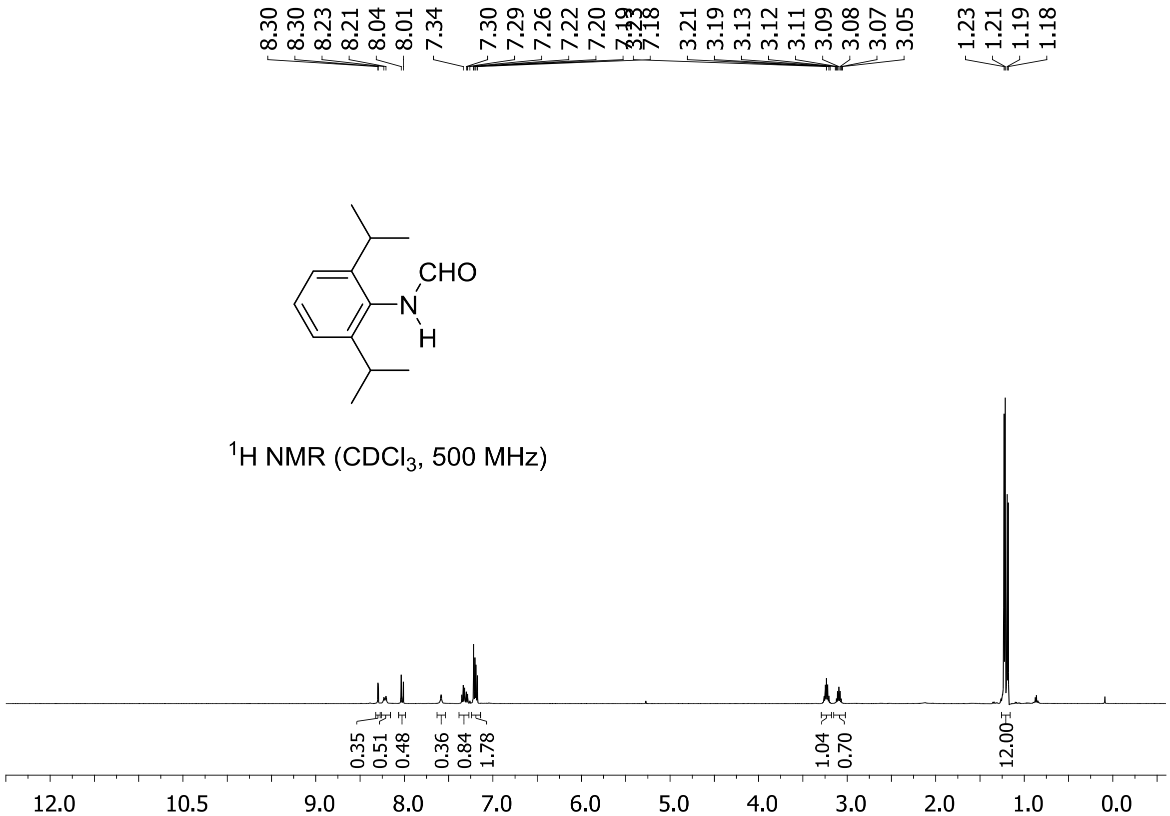

162.7
159.3
136.1
136.0
132.9
132.2
121.7
120.5
118.4
117.6
77.4
77.2
77.0
O
H
N
H
Br
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

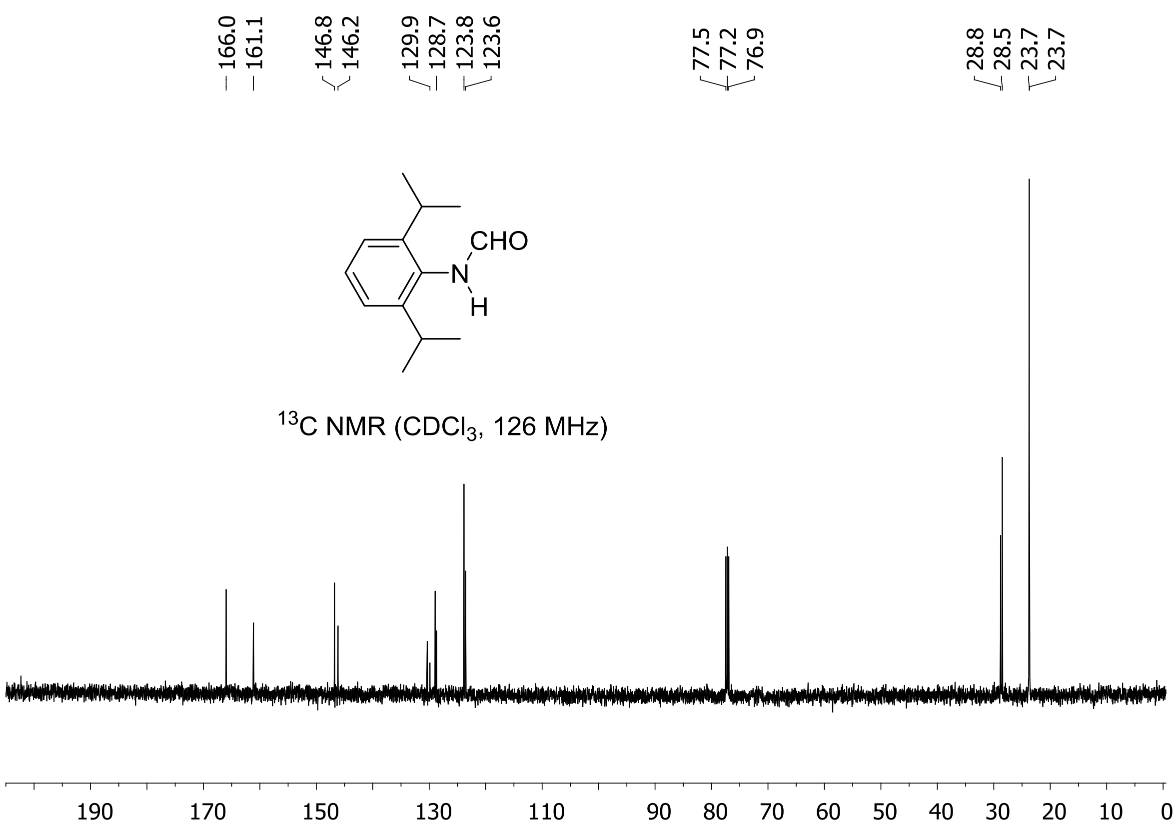

9.59
9.57
8.72
8.34
8.34
7.26
6.80
6.76
6.75
2.29
2.27
CHO
N
H
1H NMR (CDCl3, 600 MHz)
0.43
0.54
0.45
0.57
1.14
0.42
1.36
6.00
12.0
10.5
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

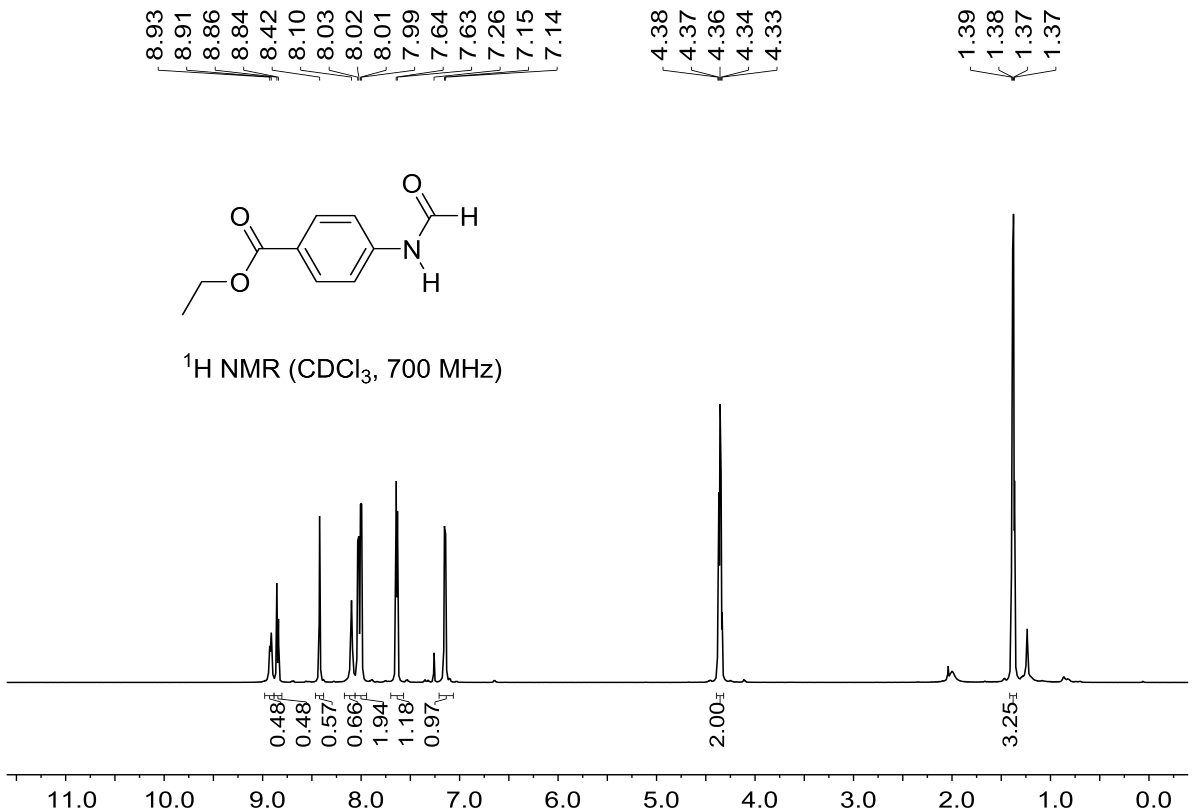

163.2
159.9
138.4
136.9
136.7
126.6
126.2
117.9
116.2
77.4
77.2
77.0
21.0
21.0
CHO
N
H
13C NMR (CDCl3, 151 MHz)
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0

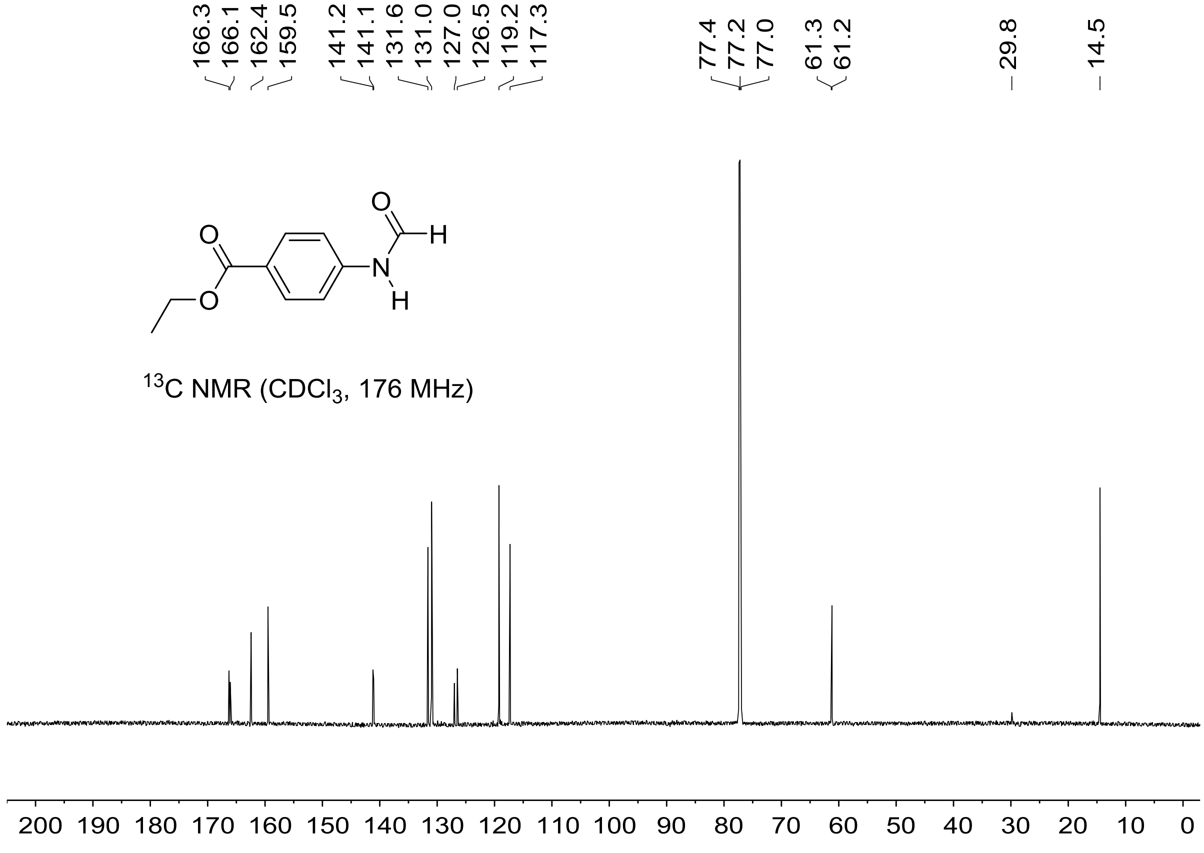

8.34
8.09
8.07
7.38
7.26
7.16
7.15
7.14
7.13
7.12
7.11
7.11
7.10
7.08
7.06
2.30
2.23
HN CHO
^{1}H NMR ($CDCl_3$, 600 MHz)
0.51
0.48
0.43
3.58
6.00
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0


165.2
159.7
135.4
133.3
132.6
128.9
128.4
127.8
77.4
77.2
77.0
18.9
18.7
HN CHO
^{13}C NMR ($CDCl_3$, 151 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0


8.30 8.30 8.23 8.21 8.04 8.01 7.34 7.30 7.29 7.26 7.22 7.20 7.19 7.18 3.21 3.19 3.13 3.12 3.11 3.09 3.08 3.07 3.05 1.23 1.21 1.19 1.18
CHO
N
H
1H NMR (CDCl3, 500 MHz)
0.35 0.51 0.48 0.36 0.84 1.78 1.04 0.70 12.00
12.0 10.5 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0


166.0 161.1 146.8 146.2 129.9 128.7 123.8 123.6 77.5 77.2 76.9 28.8 28.5 23.7 23.7
CHO
N
H
13C NMR (CDCl3, 126 MHz)
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0


8.93
8.91
8.86
8.84
8.42
8.10
8.03
8.02
8.01
7.99
7.64
7.63
7.26
7.15
7.14
4.38
4.37
4.36
4.34
4.33
1.39
1.38
1.37
1.37
O
H
N
O
O
H
¹H NMR (CDCl3, 700 MHz)
0.48
0.48
0.57
0.66
1.94
1.18
0.97
2.00
3.25
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0


166.3
166.1
162.4
159.5
141.2
141.1
131.6
131.0
127.0
126.5
119.2
117.3
77.4
77.2
77.0
61.3
61.2
29.8
14.5
O
H
N
O
O
H
¹³C NMR (CDCl3, 176 MHz)
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0