Supporting Information

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1. General Considerations

Chemicals and solvents were purchased from commercially available sources and used without any purification. Dry solvents were obtained from a solvent purification system using columns of Al_2O_3 under argon. ^{1}H, ^{13}C and ^{19}F NMR spectra were obtained with Bruker Avance-400 MHz NMR spectrometer with residual solvent peaks or tetramethylsilane as the internal reference. Multiplicities are described using the following abbreviations: s = singlet, bs = broad singlet, d = doublet, dd = doublet of doublet, t = triplet, m = multiplet. High-resolution mass spectra were obtained using a Thermo Q Exactive™ Plus via (ASAP-MS) by the mass spectrometry facility at the University of Wisconsin-Madison (funded by NIH grant: 1S10OD020022-1). Voltammetric experiments and bulk electrolysis reactions were performed using Nuvant Array PGStats (Serial number: APG15091801), from Nuvant System Inc (130 N. West Street Crown Point, Indiana 46307, USA). Compact fluorescent lamp (CFL, spiral, 20 W, 120 V, 60 Hz, 315mA, 1200 lumens, 6500 K) is purchased from Amazon, produced by Sunlite. The cell for bulk electrolysis was made by Tracy Owen Drier, scientific glassblower in Department of Chemistry at University of Wisconsin – Madison. The O-ring seal joint (7646-08 15 mm joints o-ring seal -116) was purchased from Ace Glass Inc. (1430 North West Blvd. Vineland, NJ, USA).

2. CV Studies

For all the voltammetric experiments, a glassy carbon disk electrode (2 mm diameter) and a platinum wire (1.0 cm, spiral wire) were used as working and counter electrodes, respectively. The working electrode potentials were measured versus $Ag/AgNO_3$ reference electrode (internal solution, 0.1 M Bu_4NClO_4 and 0.01 M $AgNO_3$ in CH_3CN). The redox potential of ferrocene/ferrocenium (Fc/Fc^+) was measured (same experimental conditions) and used to provide an internal reference. The potential values were then adjusted relative to Fc/Fc^+, and electrochemical studies in organic solvents were recorded accordingly.

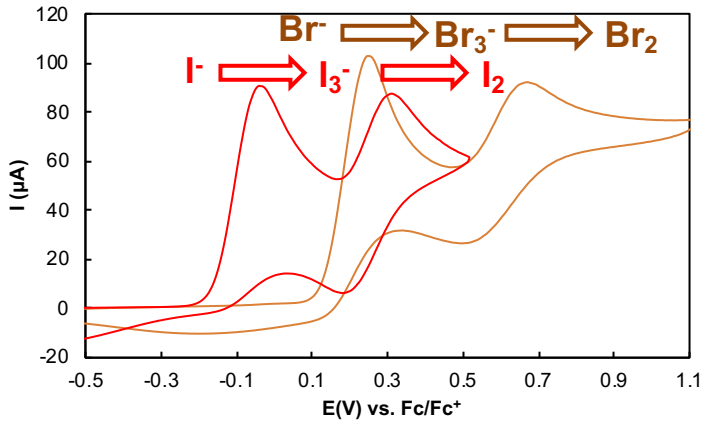


Figure S1. CVs of $^{n}Bu_4NI$ (TBAI) and Et_4NBr (5 mM) in acetonitrile with KPF_6 (0.1 M) as supporting electrolyte, glassy carbon as working electrode (~ 7.0 mm^2) and a platinum wire (1.0 cm, spiral wire) as counter electrode, scan rate = 100 mV/s.

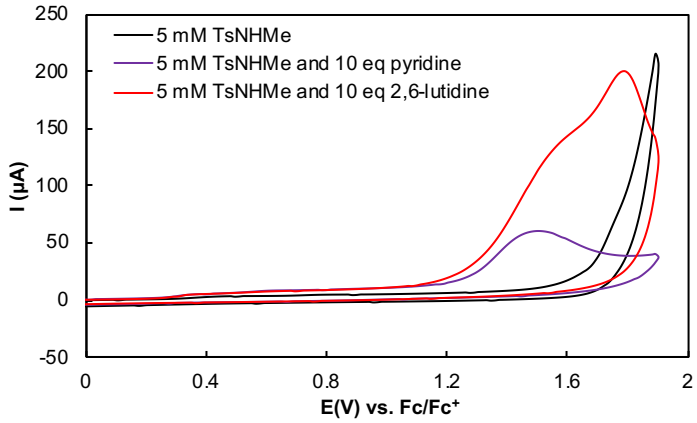
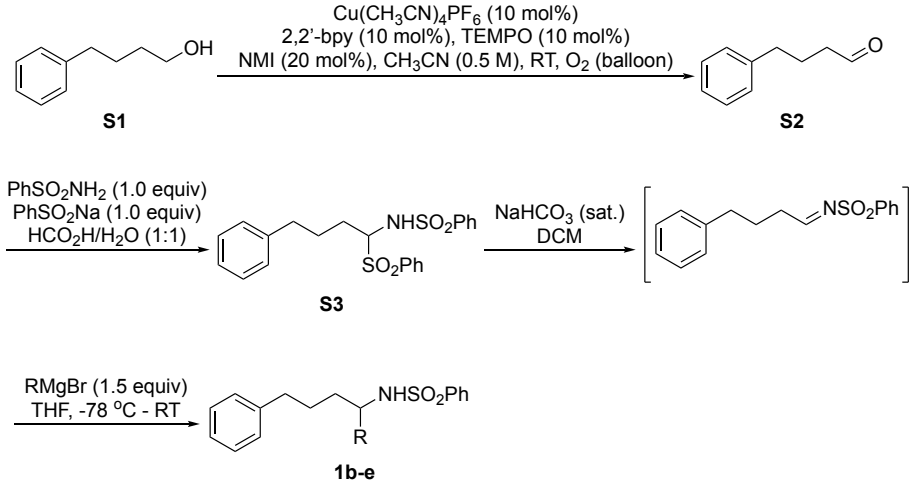


Figure S2. CVs of TsNHMe (5 mM) in acetonitrile with and without base (10 equiv), with $^{n}Bu_4NBF_4$ (0.1 M) as supporting electrolyte, glassy carbon as working electrode (~ 7.0 mm^2) and a platinum wire (1.0 cm, spiral wire) as counter electrode, scan rate = 100 mV/s.

3. Procedures for Substrate Synthesis

3.1 Substrate synthesis procedure 1



The first step was conducted following the reported procedure.[1] To a solution of **S1** (50 mmol) in dry CH_3CN in a 1 L flask were added $[Cu(MeCN)_4]PF_6$ (5 mmol, 10 mol%), 2,2'-dipyridyl (5 mmol, 10 mol%), TEMPO (5 mmol, 10 mol%) and N-methyl imidazole (NMI, 10 mmol, 20 mol%). The solution was purged with oxygen for 5 min and fitted with a septum and a balloon of O_2. The brown reaction mixture was stirred rapidly and monitored by thin layer chromatography (TLC) until no starting

material remained (the reaction color changed to blue). Upon completion, 3 mL of concentrated sulfuric acid was added into the reaction mixture to promote the disproportionation of TEMPO and further stirred for 20 min, simplifying the purification (TLC revealed that TEMPO and **S2** had similar Rf). The reaction mixture was then diluted with 1:1 ethyl acetate:hexane (200 mL) and filtered through a plug of silica. The filtrate was then concentrated and purified by silica column chromatography to give 6 g **S2** as light yellow oil (81%).

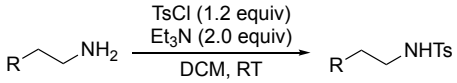
Steps 2-4 were conducted following the reported procedures.[2]

Step 2: Aldehyde **S2** (40.0 mmol), benzenesulfonamide (40.0 mmol, 1.0 equiv) and sodium benzenesulfinate (40.0 mmol, 1.0 equiv) were stirred at room temperature in formic acid (70 mL) and water (70 mL) for 16 hrs. Precipitate was filtered and washed with water then hexane to give **S3** as a white solid, which was used directly for the next step.

Step 3: **S3** was dissolved in dichloromethane (100 mL) and stirred with a solution of aqueous saturated sodium bicarbonate (100 mL) for 1 hours. The organic layer was extracted and dried over sodium bicarbonate. Solvent was removed under reduced pressure to yield crude aldimine, which was used directly for the next step.

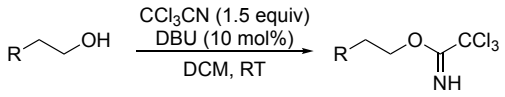
Step 4: Aryl-magnesium bromide (0.5 M in THF, 30 mL, 15 mmol) was added to a stirred solution of above crude aldimine (1/4 crude product of step 3) in THF (15 mL) at –78 °C for 2 hours. The solution was warmed to room temperature and stirred further at room temperature for 1 hour. The reaction was quenched with saturated ammonium chloride (30 mL) and extracted with ethyl acetate. The organic phases were combined, dried over sodium sulfate, and the solvent was evaporated under reduced pressure. The residue was purified via flash column chromatography and recrystallized from ethyl acetate and hexanes to yield sulfonamide **1b-e** (33%~52% yield after three steps).

3.2 Substrate synthesis procedure 2



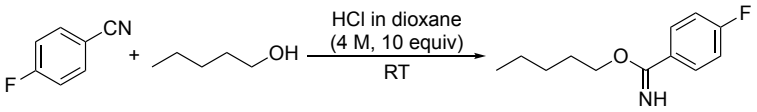
To the solution of amine (1.0 equiv) and tosyl chloride (1.2 equiv) in DCM was added Et_3N (2.0 equiv) dropwise at 0 °C cooling with ice bath. After that, the reaction mixture was warmed to room temperature and stirred overnight. Then the reaction mixture was washed with water (two times) and brine (once), and the aqueous solution was further extracted with DCM. The combined organic phases were dried over anhydrous $MgSO_4$, filtered, concentrated. The residue was purified via flash column chromatography to give the desired products **1a** and **1f-h**.

3.3 Substrate synthesis procedure 3



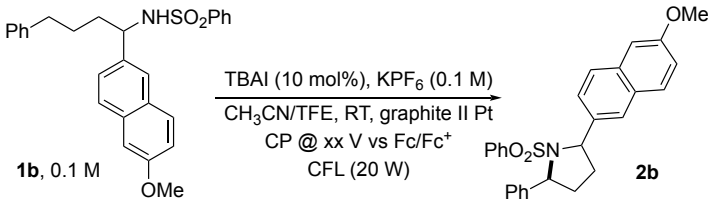
The reaction was conducted following the reported procedure.[3] To a solution of alcohol (1.0 equiv, 0.1 M) in DCM was added trichloroacetonitrile (1.5 equiv) and DBU (0.1 equiv). The reaction was stirred at room temperature, and monitored by TLC until the alcohol was consumed. Upon completion, the mixture was concentrated and purified by silica gel chromatography (hexanes with 2% Et_3N to avoid imidate hydrolysis) to afford the desired products **3a-u**.

3.4 Substrate synthesis procedure 4



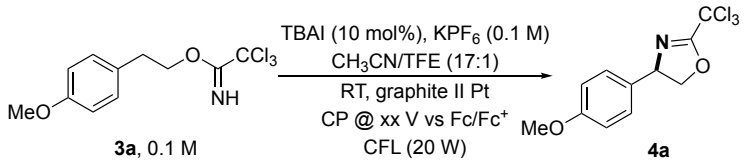
The reaction was conducted following the reported procedure.[4] To a mixture of 1-pentyl alcohol (10 mmol, 1 equiv) and 4-fluorobenzonitrile (10 mmol, 1 equiv) in a well-sealed round-bottom flask was added 4 M HCl in dioxane (25 mL, 100 mmol, 10 equiv). The reaction mixture was stirred at room temperature for 24 hours. After that, it was concentrated and the residue was dissolved in dichloromethane, washed with sat. $NaHCO_3$ and brine. The organic layer was separated, dried with $MgSO_4$, filtered and concentrated in vacuo. The residue was purified by chromatography on silica gel (hexane/EtOAc = 10/1, with 2% Et_3N) to give the desired product **3v** in 51% yield as colorless oil.

4. Optimization of Reaction Conditions



Entry	Potential/V vs Fc/Fc^+	TBAI	Yield/%[a]
1	0.3	10 mol%	4%
2	0.4	10 mol%	70%
3	0.5	10 mol%	75%
4	0.5	-	n.d.
5[b]	0.5	10 mol%	19%
6[c]	0.5	10 mol%	11%
7[d]	0.5	10 mol%	72%
8[e]	0.5	10 mol%	7%
9	0.5	5 mol%	18%
10[f]	0.5	10 mol%	34%

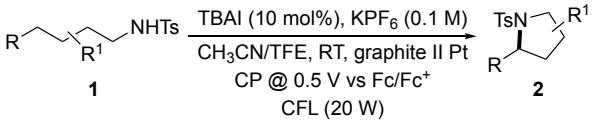
Table S1. [a] The reaction was performed on a 0.5 mmol scale with CH_3CN/TFE (17:1) as co-solvent, ^1H NMR yield was shown with *m*-xylene as internal standard. [b] Without irradiation. [c] Without TFE. [d] With CH_3CN/TFE (34:1) as co-solvent. [e] With $TBABF_4$ as supporting electrolyte. [f] With CH_3CN/HFIP (12:1) as co-solvent. TFE = 2,2,2-Trifluoroethanol. HFIP = 1,1,1,3,3,3-Hexafluoro-2-propanol. n.d. = not detected.



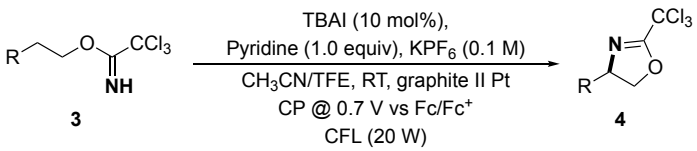
Entry	Potential/V vs Fc/Fc^+	Additive	TBAI	Yield/%
1	0.5	-	10 mol%	54%
2	0.3	-	10 mol%	47%
3	0.7	-	10 mol%	71%
4	0.7	pyridine (0.5 eq.)	10 mol%	78%
5	0.7	pyridine (1 eq.)	10 mol%	82%
6	0.7	pyridine (2 eq.)	10 mol%	74%
7	0.7	2,6-lutidine	10 mol%	62%
8[b]	0.7	pyridine (1 eq.)	10 mol%	n.d.
9[c]	0.7	pyridine (1 eq.)	10 mol%	75%
10[d]	0.7	pyridine (1 eq.)	10 mol%	78%
11[e]	0.7	pyridine (1 eq.)	10 mol%	36%
12[f]	0.7	pyridine (1 eq.)	10 mol%	2%
13[g]	0.7	pyridine (1 eq.)	10 mol%	3%
14	0.7	pyridine (1 eq.)	5 mol%	49%
15	0.7	pyridine (1 eq.)	2.5 mol%	23%
16	0.7	pyridine (1 eq.)	-	n.d.
17[h]	0.2 - 1.0	pyridine (1 eq.)	10 mol%	72%
18[i]	0.3 - 1.0	pyridine (1 eq.)	10 mol%	72%
19[j]	0.7	pyridine (1 eq.)	10 mol%	79%

Table S2. [a] The reaction was performed on a 0.5 mmol scale with CH_3CN/TFE (17:1) as co-solvent, ^1H NMR yield was shown with *m*-xylene as internal standard. [b] Without TFE. [c] With CH_3CN/TFE (34:1) as co-solvent. [d] With CH_3CN/HFIP (12:1) as co-solvent. [e] With CH_3CN/MeOH (31:1) as co-solvent. [f] Without irradiation [g] Under ambient light conditions. [h] Constant current @ 5 mA for 2.5 F/mol. [i] Constant current @ 10 mA for 2.5 F/mol. [j] With RVC as working electrode (30 PPI, 0.635*1*2 cm^3, ~ 24 cm^2) instead of graphite rod, 4.8 h, initial current ~ 20 mA. TFE = 2,2,2-Trifluoroethanol. HFIP = 1,1,1,3,3,3-Hexafluoro-2-propanol. n.d. = not detected.

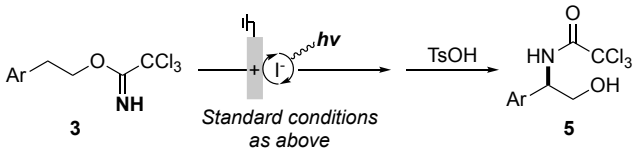
5. Procedures for Electrolysis



General procedure A for pyrrolidine synthesis: Reactions were carried out using an undivided cell equipped with a graphite anode (0.6 cm OD x 6 cm L, ~ 3 cm was immersed in the solution, apparent area ~ 6 cm^2), a platinum wire cathode (1.0 cm, spiral wire) and a Ag/Ag^+ reference electrode. A mixture of **1** (0.5 mmol), KPF_6 (0.5 mmol) as supporting electrolyte, TBAI (0.05 mmol), and TFE (8.0 equiv) in acetonitrile (5 mL) was purged with nitrogen for 20 min, and then electrolyzed at 0.5 V vs Fc/Fc^+ with magnetic stirring. The mixture was irradiated with a CFL (20 W) during bulk electrolysis. The reaction was stopped automatically when the current decreased to 1 mA or manually after full consumption of substrates was detected by TLC. After that, solvent was removed under reduced pressure to leave a residue. The reaction was analyzed by crude ^1H NMR spectroscopy with *m*-xylene as internal standard, followed by chromatography on silica gel to afford the pure products **2**.



General procedure B for oxazoline synthesis: Reactions were carried out using an undivided cell equipped with a graphite anode (0.6 cm OD x 6 cm L, ~ 3 cm was immersed in the solution apparent area ~ 6 cm^2), a platinum wire cathode (1.0 cm, spiral wire) and a Ag/Ag^+ reference electrode. A mixture of **3** (0.5 mmol), KPF_6 (0.5 mmol) as supporting electrolyte, TBAI (0.05 mmol), pyridine (0.5 mmol), and TFE (8.0 equiv) in acetonitrile (5 mL) was purged with nitrogen for 20 min, and then electrolyzed at 0.7 V vs Fc/Fc^+ with magnetic stirring. The mixture was irradiated with CFL (20 W) during bulk electrolysis. The reaction was stopped automatically when the current decreased to 0.5 mA or manually after full consumption of substrates was detected by TLC. After that, solvent was removed under reduced pressure to leave a residue. The reaction was analyzed by crude ^1H NMR spectroscopy with *m*-xylene as internal standard, followed by chromatography on silica gel to afford the pure products **4**.



General procedure C for amino alcohol synthesis: The first step was the same as **general procedure B**, after which the reaction mixture was evaporated under reduced pressure to remove the volatiles. The residue was dissolved in CH_3CN (3 mL), and then *p*-toluenesulfonic acid monohydrate (5.0 equiv), was added and the resulting mixture was stirred at room temperature for 1 h. Then, the

solvent was removed under reduced pressure to leave a residue, which was purified by chromatography on silica gel to afford the pure products **5**.

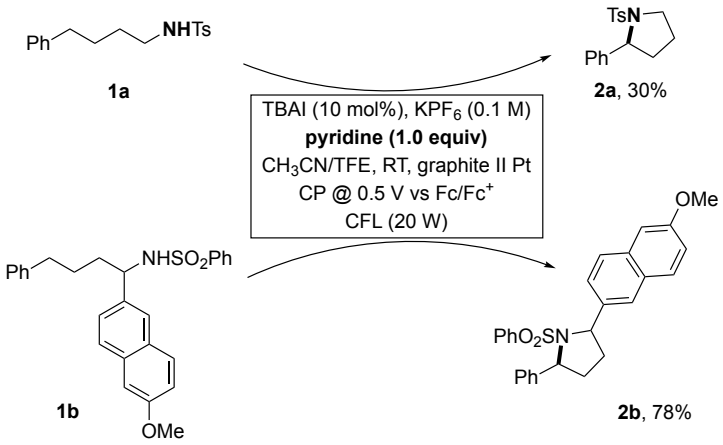
Note 1: The oxazoline products can undergo partial decomposition during column chromatography on silica gel, so Et_3N was added to the eluent.

Note 2: The outer layer of the carbon electrode should be removed with a razor blade or sand paper if it has been used previously.

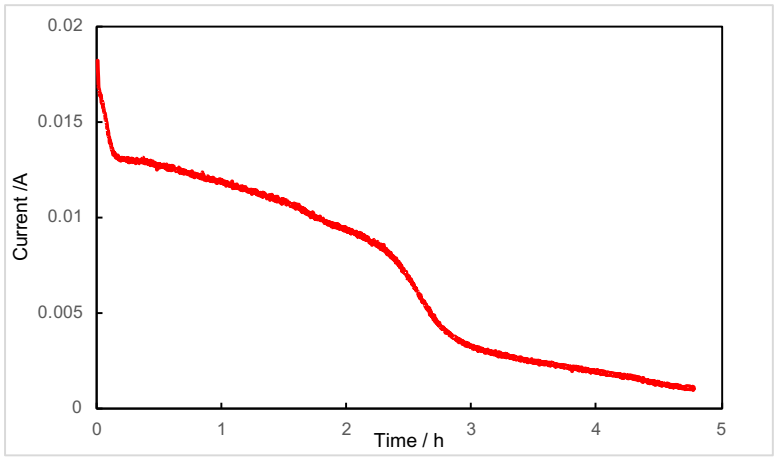
Note 3: Good yield could be obtained under constant current conditions (Table **S2**, entries 17-18), so a simpler two-electrode set-up should also work.

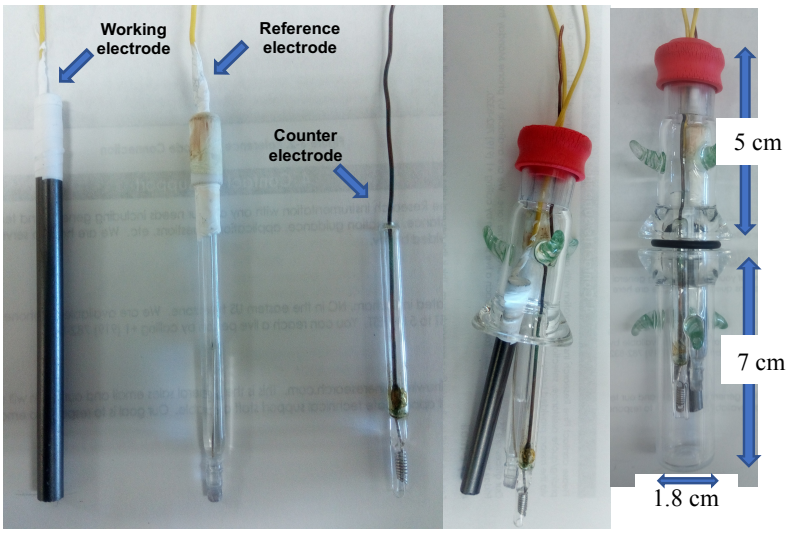
Note 4: As shown in Table **S2**, inclusion of pyridine contributed to the better yield for the reactions of imidates. There are two possibilities to explain this phenomenon: 1) pyridine acts as base to facilitate the *N*-iodo intermediate formation; 2) given the favorable interaction between iodine and pyridine derivatives,[5] pyridine might act as iodine activator rather than a simple base since a stronger base ($CF_3CH_2O^-$) is furnished at the cathodic side.

Note 5: We noted that the inclusion of pyridine did not give any obvious improvement, and may even lead to inferior yield, for the reaction of sulfonamide substrates (see below). For example, comparable yield was obtained for **2b**, while lower yield and mass balance was observed in the reaction of **1a**, possibly a result of pyridine-promoted beta-elimination of HI.



Note 6: The reaction was run under constant potential, so that current (density) would decrease with the consumption of substrate. A typical plot of current vs time is shown below.





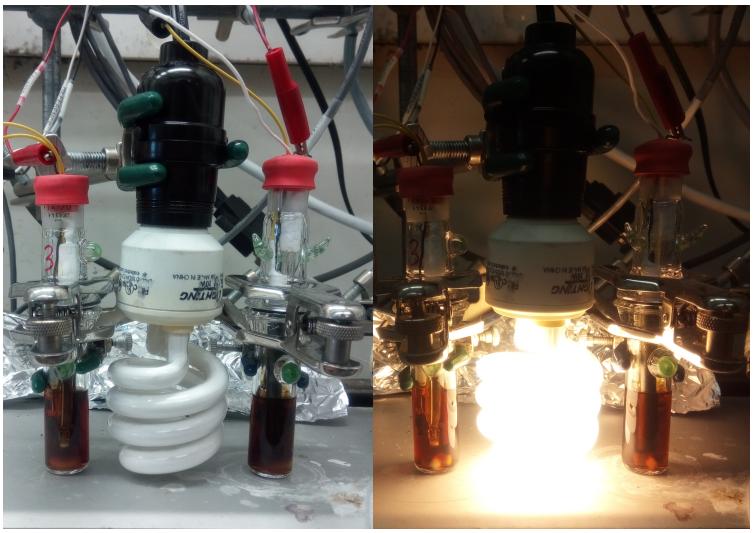


Figure S3. Reaction set-up (undivided cell).

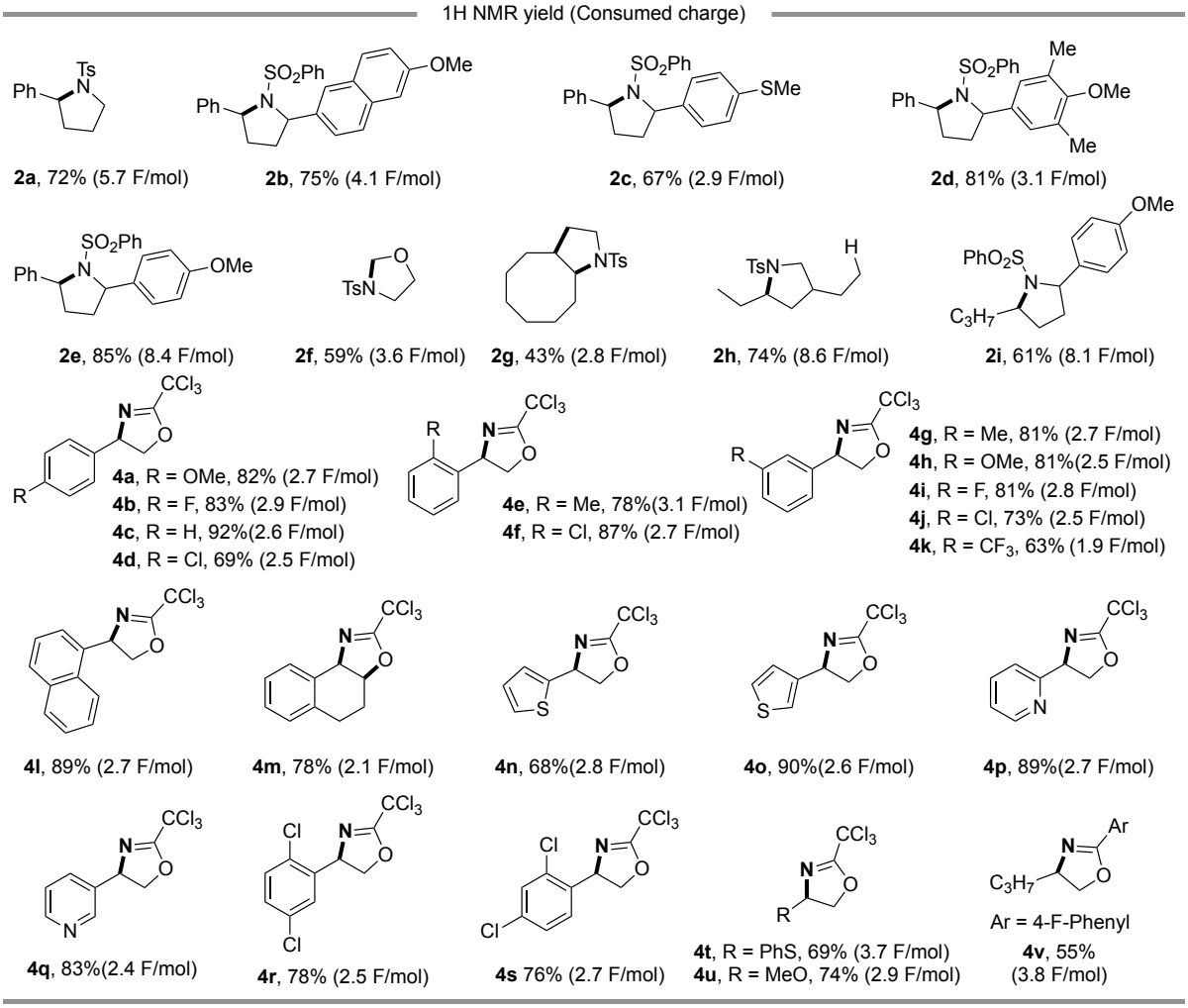
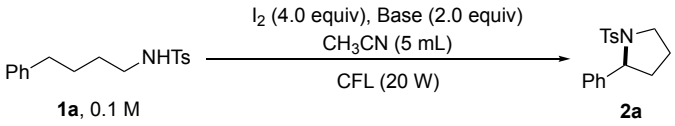


Table S3. Comparison of ^{1}H NMR yields and consumed charge. Note: Isolated yields are provided in Table 3 of the manuscript and in Section 9.2 below.

6. Experiments with Stoichiometric Iodine as Oxidant

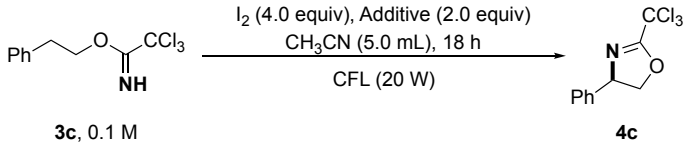
To a glass vial (6 mL) were added substrate **1a** or **3c** (0.5 mmol), I_2 (2.0 mmol, 4.0 equiv), additive/base (1.0 mmol, 2.0 equiv) and CH_3CN (5.0 mL). The resulting mixture was stirred with irradiation by CFL (20 W) at room temperature. After 18h, the reaction was detected by ^{1}H NMR with *m*-xylene as internal standard and the results were shown below (Table **S4**).



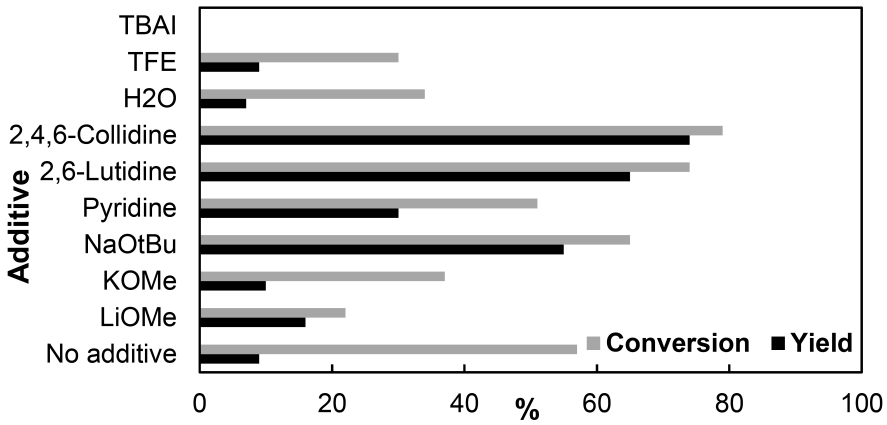
1a, 0.1 M **2a**

Base:	wo base	KOMe	LiOMe	Pyridine	2,6-Lutidine	2,4,6-Collidine
Yield: (conv.)	n.d. (< 3%)	16% (22%)	12% (16%)	10% (10%)	30% (42%)	21% (37%)

Table S4. Reactions of **1a** with iodine as oxidant. The reaction was performed on a 0.5 mmol scale, ^{1}H NMR yield was shown with *m*-xylene as internal standard, conversion of **1a** shown in parenthesis.



3c, 0.1 M **4c**



Scheme S1. Reactions of **3c** with iodine as oxidant. The reaction was performed on a 0.5 mmol scale, yield and conversion were determined by ^{1}H NMR with *m*-xylene as internal standard.

7. Intermolecular Additive Screening

These reactions were conducted following **General Procedure A**. A mixture of **1a** (0.5 mmol), KPF_6 (0.5 mmol) as supporting electrolyte, TBAI (0.05 mmol), additive (0.5 mmol, 1,0 equiv) and TFE (8.0 equiv) in acetonitrile (5 mL) was purged with nitrogen for 20 min, and then electrolyzed at 0.5 V vs Fc/Fc^+ with magnetic stirring. The mixture was irradiated with CFL (20 W) during bulk electrolysis. The reaction was stopped automatically when the current decreased to 1 mA or manually after full consumption of **1a** was detected by TLC. After that, *m*-xylene (0.5 mmol) was added into the reaction mixture, an aliquot (~ 0.2 mL) was removed and diluted with CD_3CN (0.4 mL), which was then analyzed by crude ^1H NMR spectroscopy.

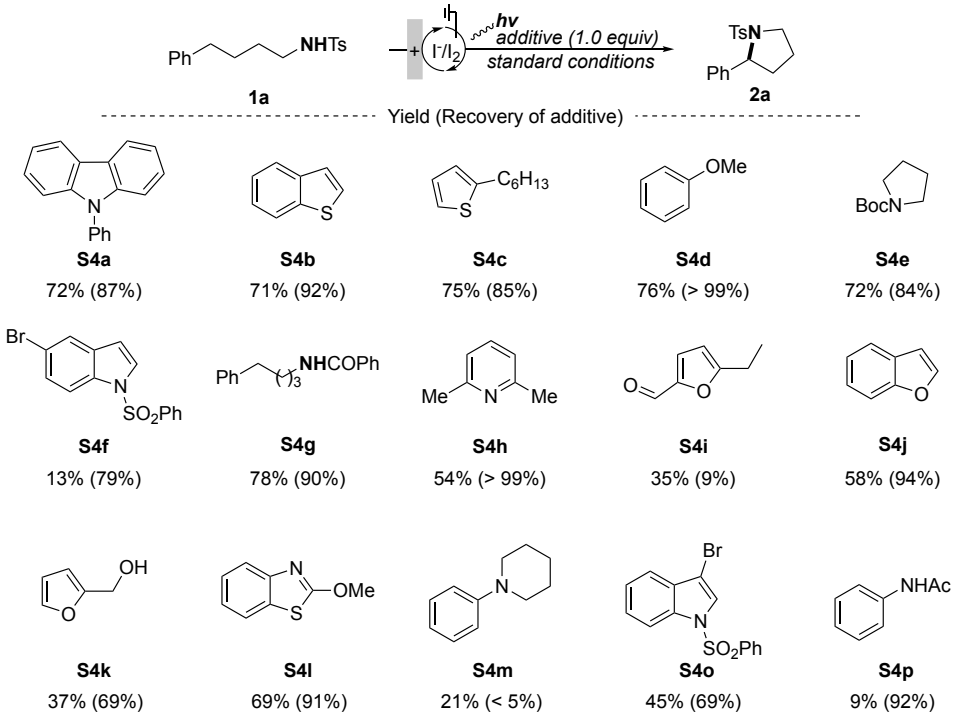


Table S5. Intermolecular additive screen.

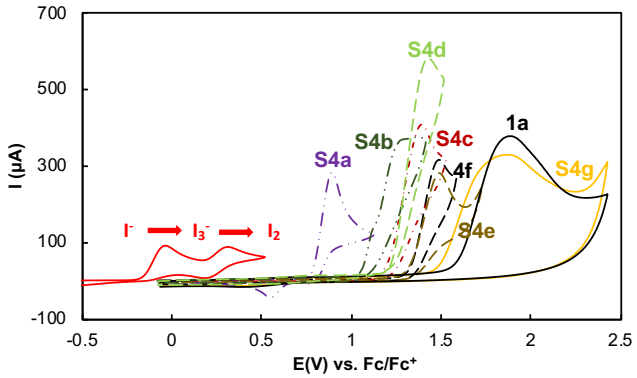
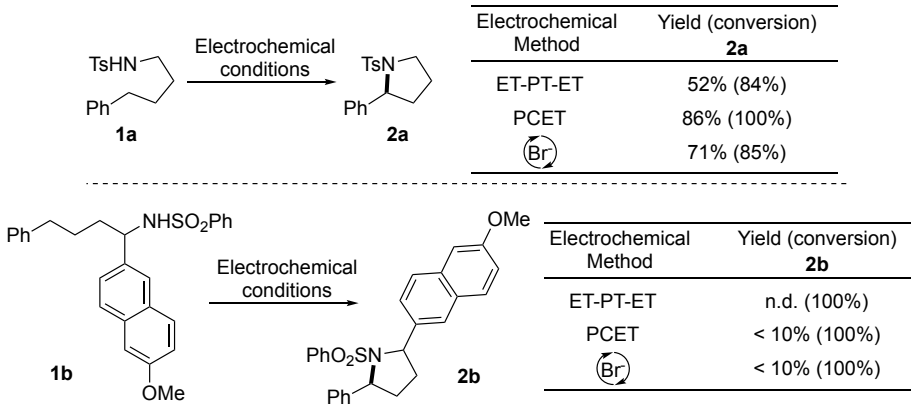


Figure S4. CVs of TBAI, **1a** and **S4a-S4f** (5 mM) in acetonitrile with KPF_6 (0.1 M) as supporting electrolyte, scan rate = 100 mV/s.

8. Control Experiments under Reported Conditions



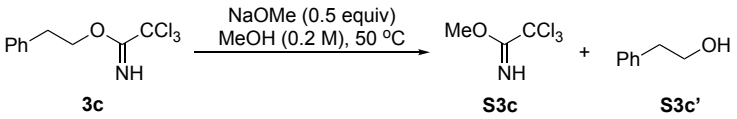
Electrochemical Method	Yield (conversion) **2a**
ET-PT-ET	52% (84%)
PCET	86% (100%)
Br	71% (85%)

Electrochemical Method	Yield (conversion) **2b**
ET-PT-ET	n.d. (100%)
PCET	< 10% (100%)
Br	< 10% (100%)

Scheme S2. Comparison of different strategies.

8.1 Halide-mediated electrochemical dehydrogenative amination[6]

A solution of **1a** or **1b** (0.4 mmol), NaOMe (10.8 mg, 0.2 mmol), and KBr (23.8 mg, 0.2 mmol) in methanol (6 mL) was placed in a vial (10 mL) equipped with two platinum electrodes and a magnetic stirbar. Anodic oxidation was carried out while being heated externally at 65°C under conditions of constant current (100 mA). After 3 hrs (28 F/mol), the reaction was detected by ^{1}H NMR with *m*-xylene as internal standard. The results shown in Scheme **S2** demonstrated that the bromide-mediated system worked well for the simple substrate **1a**, while poor yield and mass balance were observed with **1b**, containing electron-rich aromatic ring. Meanwhile, this system is not applicable to imidate in that the substrate will undergo decomposition under these conditions (Figure **S5**). All these results indicated the limitation in Shono's conditions.



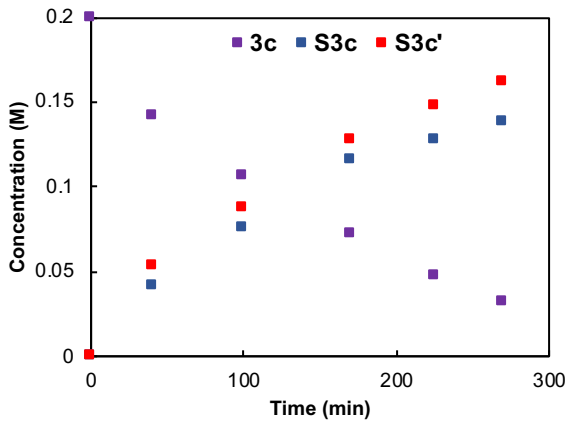


Figure S5. Time course for decomposition of **3c** under Shono's conditions

8.2 Direct electrolysis[7]

A solution of **1a** or **1b** (0.2 mmol) and $^{n}Bu_4NBF_4$ (329 mg, 1 mmol) in 1,1,1,3,3,3-hexafluoro-2-propanol (HFIP, 10 mL) was electrolyzed under constant current (2.5 mA) at room temperature with graphite as anode and platinum wire as cathode. After 4.7 hrs (2.2 F/mol), the reaction was detected by ^{1}H NMR with *m*-xylene as internal standard and the results are shown in Scheme **S2**. The anode potential trace during electrolysis was 1.7-1.8 V vs Fc/Fc^+ (Figure **S6**).

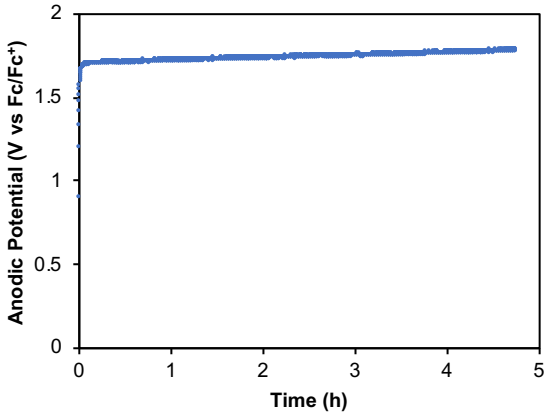


Figure S6. Anode potential trace during reaction of **1a** under ET-PT-ET conditions

An intermolecular additive experiment was also performed by testing the cyclization of **1a** with anisole as an additive (Figure **S7**). The result shown below revealed that oxidation of anisole happened exclusively without consumption of **1a**, which further reflected the poor functional group tolerance of this method.

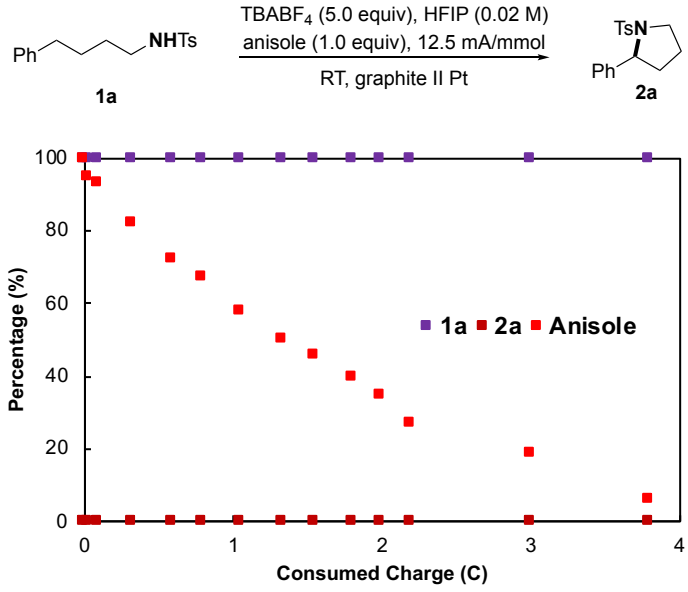


Figure S7. Time course of intermolecular additive screen under direct electrolysis

8.3 Acetate-promoted electrolysis[8]

A solution of **1a** or **1b** (0.2 mmol), NaOAc (0.2 mmol) and $^{n}Bu_4NBF_4$ (0.2 mmol) in a 2:1 mixture of DCE/HFIP (6 mL) was electrolyzed under constant current (7.5 mA) at room temperature with graphite as anode and platinum wire as cathode. After 4 hrs (5.6 F/mol), the reaction was detected by ^{1}H NMR with *m*-xylene as internal standard. The results shown in Scheme **S2** demonstrated that this base-promoted electrolysis protocol still has functional group tolerance issues because of the high anode potential (Figure **S8**).

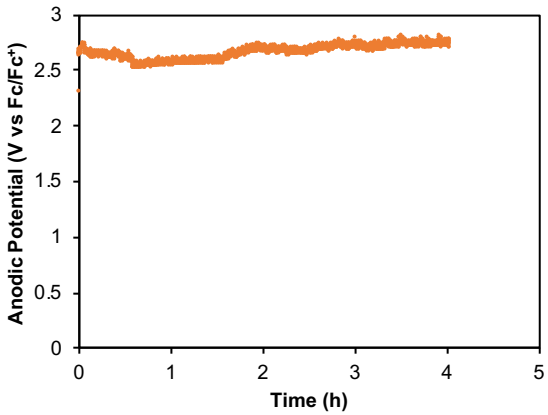
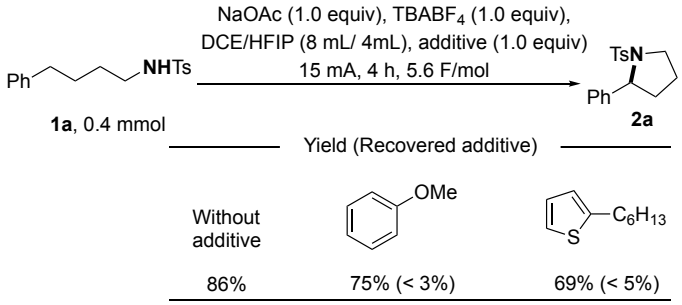


Figure S8. Anode potential trace during reaction of **1a** under PCET conditions

The intermolecular additive screen experiments were also conducted under the PCET conditions with anisole and **S4c** as additives, respectively, however, none of these additives could be recovered after bulk electrolysis (scheme **S3**).



Scheme S3. Intermolecular additive screen under OAc-promoted conditions

The time course of the reaction showed that anisole and substrate **1a** underwent oxidation simultaneously, where decomposition of anisole was faster than conversion of **1a** (Figure **S9**). This result revealed that this PCET protocol could shift the anodic potential negatively compared with ET-PT-ET method. However, such an improvement was not sufficient to exhibit good functional group tolerance.

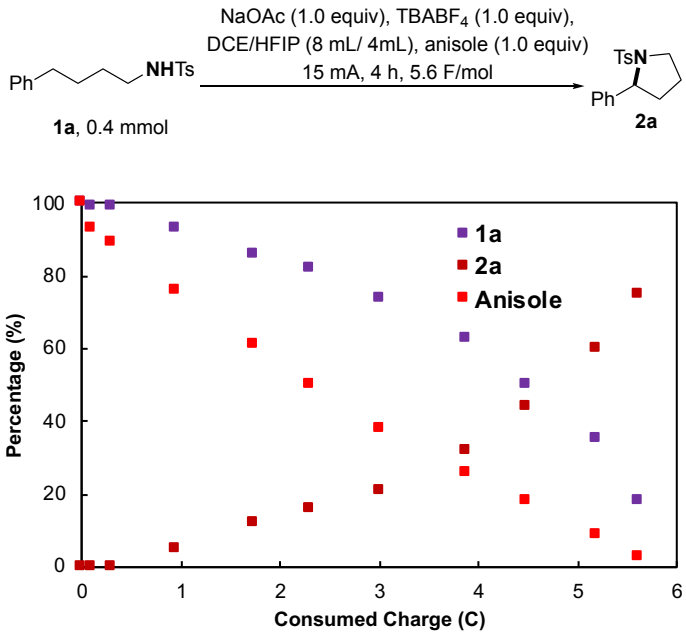
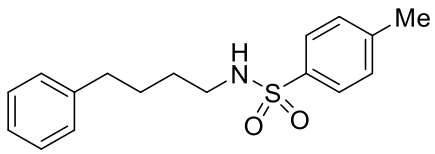


Figure S9. Time course of intermolecular additive screen under OAc-promoted conditions

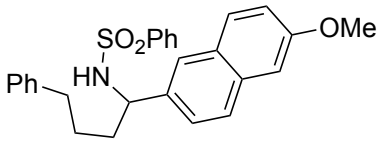
9. Substrate and Product Characterization Data

9.1 Characterization of substrates



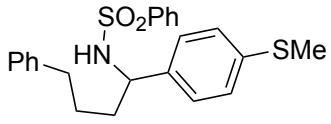
1a

Compound **1a** was prepared according to substrate synthesis procedure 2 and the spectral data are available in the literature.[9] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.66 (d, *J* = 8.2 Hz, 2H), 7.19 (d, *J* = 8.1 Hz, 2H), 7.15 (t, *J* = 7.4 Hz, 2H), 7.07 (t, *J* = 7.3 Hz, 1H), 7.00 (d, *J* = 7.2 Hz, 2H), 4.80 (t, *J* = 6.0 Hz, 1H), 2.84 (q, *J* = 6.6 Hz, 2H), 2.45 (t, *J* = 7.6 Hz, 2H), 2.32 (s, 3H), 1.49 (dt, *J* = 12.1, 7.2 Hz, 2H), 1.43 – 1.35 ppm (m, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 143.2, 141.8, 136.8, 129.6, 128.3, 128.2, 127.0, 125.7, 42.9, 35.1, 29.0, 28.1, 21.4 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 304.1366, measured: 304.1362.



1b

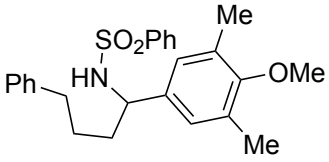
Compound **1b** was prepared according to substrate synthesis procedure 1. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.62 – 7.56 (m, 2H), 7.50 (t, *J* = 8.1 Hz, 2H), 7.31 – 7.25 (m, 2H), 7.22 (t, *J* = 7.3 Hz, 2H), 7.19 – 7.12 (m, 3H), 7.10 (dd, *J* = 8.9, 2.5 Hz, 1H), 7.07 – 7.00 (m, 4H), 5.02 (d, *J* = 7.4 Hz, 1H), 4.45 (q, *J* = 7.4 Hz, 1H), 3.90 (s, 3H), 2.55 (t, *J* = 7.6 Hz, 2H), 1.96 – 1.73 (m, 2H), 1.68 – 1.55 (m, 1H), 1.54 – 1.40 ppm (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 157.7, 141.6, 140.5, 135.3, 133.8, 132.1, 129.2, 128.5, 128.4, 128.34, 128.29, 127.3, 126.9, 125.8, 125.7, 124.4, 119.0, 105.5, 58.4, 55.3, 36.8, 35.2, 27.6 ppm. **HRMS** (**ESI**) Calculated for [M+NH_4^+]: 463.2050, measured: 463.2046.



1c

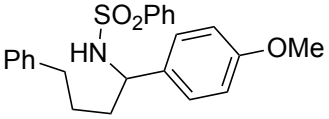
Compound **1c** was prepared according to substrate synthesis procedure 1. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.65 – 7.59 (m, 2H), 7.42 (t, *J* = 7.4 Hz, 1H), 7.29 (t, *J* = 7.8 Hz, 2H), 7.22 (t, *J* = 7.3 Hz, 2H), 7.15 (t, *J* = 7.3 Hz, 1H), 7.04 (d, *J* = 7.1 Hz, 2H), 6.98 (d, *J* = 8.3 Hz, 2H), 6.87 (d, *J* = 8.3 Hz, 2H), 5.26 (d, *J* = 7.5 Hz, 1H), 4.27 (q, *J* = 7.3 Hz, 1H), 2.51 (t, *J* = 7.5 Hz, 2H), 2.40 (s, 3H), 1.78 (tdd, *J* = 10.0, 7.0,

5.2 Hz, 1H), 1.72 – 1.50 (m, 2H), 1.49 – 1.35 ppm (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 141.6, 140.6, 137.5, 137.4, 132.1, 128.7, 128.29, 128.27, 126.97, 126.91, 126.5, 125.8, 57.8, 36.8, 35.1, 27.5, 15.8 ppm. **HRMS** (**ESI**) Calculated for [M+NH_4^+]: 429.1665, measured: 429.16653.



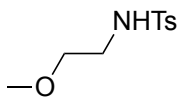
1d

Compound **1d** was prepared according to substrate synthesis procedure 1. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.66 – 7.58 (m, 2H), 7.34 (t, *J* = 7.4 Hz, 1H), 7.26 – 7.16 (m, 4H), 7.12 (t, *J* = 7.3 Hz, 1H), 7.04 (d, *J* = 7.1 Hz, 2H), 6.53 (s, 2H), 5.71 (d, *J* = 8.0 Hz, 1H), 4.20 (q, *J* = 7.6 Hz, 1H), 3.58 (s, 3H), 2.49 (t, *J* = 7.3 Hz, 2H), 2.05 (s, 6H), 1.82 – 1.70 (m, 1H), 1.69 – 1.53 (m, 2H), 1.53 – 1.36 ppm (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 155.7, 141.7, 140.8, 135.5, 131.8, 130.3, 128.23, 128.15, 128.11, 126.85, 126.83, 125.6, 59.4, 57.9, 36.7, 35.1, 27.5, 15.8 ppm. **HRMS** (**ESI**) Calculated for [M+NH_4^+]: 441.2206, measured: 441.2203.



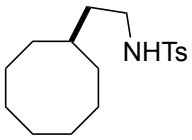
1e

Compound **1e** was prepared according to substrate synthesis procedure 1. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.63 (d, *J* = 7.8 Hz, 2H), 7.40 (t, *J* = 7.3 Hz, 1H), 7.28 (t, *J* = 7.7 Hz, 2H), 7.21 (t, *J* = 7.4 Hz, 2H), 7.14 (t, *J* = 7.2 Hz, 1H), 7.04 (d, *J* = 7.3 Hz, 2H), 6.87 (d, *J* = 8.5 Hz, 2H), 6.62 (d, *J* = 8.5 Hz, 2H), 5.37 (d, *J* = 7.5 Hz, 1H), 4.25 (q, *J* = 7.3 Hz, 1H), 3.71 (s, 3H), 2.50 (t, *J* = 7.5 Hz, 2H), 1.87 – 1.73 (m, 1H), 1.73 – 1.61 (m, 1H), 1.61 – 1.35 ppm (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.7, 141.7, 140.7, 132.7, 132.0, 128.6, 128.28, 128.22, 127.6, 126.9, 125.7, 113.7, 57.7, 55.2, 36.9, 35.2, 27.6 ppm. **HRMS** (**ESI**) Calculated for [M+NH_4^+]: 413.1893, measured: 413.1888.



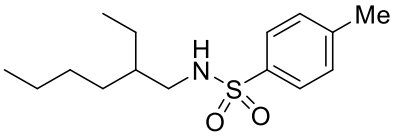
1f

Compound **1f** was prepared according to substrate synthesis procedure 2. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.72 (d, *J* = 8.2 Hz, 2H), 7.28 (d, *J* = 8.1 Hz, 2H), 5.02-5.11 (m, 1H), 3.37 (t, *J* = 5.1 Hz, 2H), 3.23 (s, 3H), 3.08 (t, *J* = 5.1 Hz, 2H), 2.39 ppm (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ = 143.3, 136.8, 129.6, 127.0, 70.4, 58.6, 42.7, 21.4 ppm. **HRMS** (**ESI**) Calculated for [M-H]$^-$: 228.0700, measured: 228.0703.



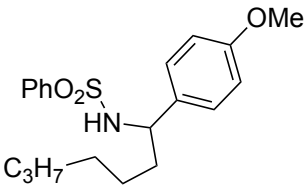
1g

Compound **1g** was prepared according to substrate synthesis procedure 2. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.75 (d, *J* = 8.3 Hz, 2H), 7.30 (d, *J* = 8.0 Hz, 2H), 4.81 – 4.72 (m, 1H), 2.92 (dt, *J* = 7.6, 6.3 Hz, 2H), 2.41 (s, 3H), 1.64 – 1.29 (m, 15H), 1.21 – 1.12 ppm (m, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 143.2, 136.9, 129.6, 127.1, 41.4, 37.5, 34.3, 31.9, 27.1, 26.1, 25.1, 21.5 ppm. **HRMS** (**ESI**) Calculated for $[M-H]^-$: 308.1690, measured: 308.1691.



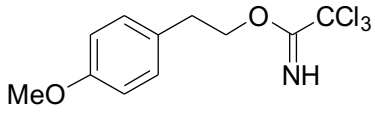
1h

Compound **1h** was prepared according to substrate synthesis procedure 2 and the spectral data are available in the literature.[10] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.70 (d, *J* = 8.2 Hz, 2H), 7.22 (d, *J* = 8.2 Hz, 2H), 5.06 (t, *J* = 6.2 Hz, 1H), 2.74 (t, *J* = 6.1 Hz, 2H), 2.33 (s, 3H), 1.33 – 1.01 (m, 9H), 0.74 (t, *J* = 7.2 Hz, 3H), 0.69 ppm (t, *J* = 7.4 Hz, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 143.0, 136.9, 129.5, 127.0, 45.6, 39.0, 30.4, 28.5, 23.7, 22.7, 21.3, 13.9, 10.5 ppm. **HRMS** (**ESI**) Calculated for $[M+H^+]$: 284.1679, measured: 284.1675.



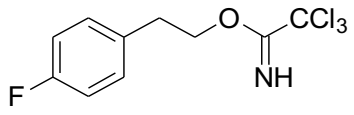
1i

Compound **1i** was prepared according to substrate synthesis procedure 1. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.67 – 7.61 (m, 2H), 7.44 (t, *J* = 7.4 Hz, 1H), 7.33 (t, *J* = 7.7 Hz, 2H), 6.91 (d, *J* = 8.6 Hz, 2H), 6.66 (d, *J* = 8.7 Hz, 2H), 4.86 (d, *J* = 7.1 Hz, 1H), 4.23 (q, *J* = 7.3 Hz, 1H), 3.74 (s, 3H), 1.81 – 1.58 (m, 2H), 1.28 – 1.01 (m, 8H), 0.83 ppm (t, *J* = 7.0 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.8, 140.8, 132.9, 132.1, 128.6, 127.6, 127.0, 113.8, 57.9, 55.2, 37.5, 31.5, 28.7, 25.8, 22.5, 14.0 ppm. **HRMS** (**ESI**) Calculated for $[M+NH_4^+]$: 379.2050, measured: 379.2046.



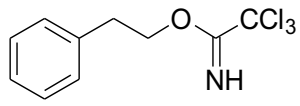
3a

Compound **3a** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.28 (bs, 1H), 7.20 (d, *J* = 8.5 Hz, 2H), 6.85 (d, *J* = 8.5 Hz, 2H), 4.46 (t, *J* = 6.8 Hz, 2H), 3.79 (s, 3H), 3.03 ppm (t, *J* = 6.9 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.8, 158.3, 130.0, 129.6, 113.8, 91.4, 70.1, 55.2, 33.8 ppm.



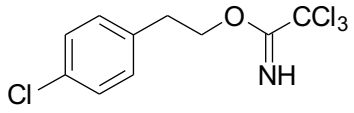
3b

Compound **3b** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.29 (bs, 1H), 7.27 – 7.20 (m, 2H), 7.01 – 6.95 (m, 2H), 4.46 (t, *J* = 6.8 Hz, 2H), 3.05 ppm (t, *J* = 6.8 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.7, 161.7 (d, *J* = 244.3 Hz), 133.3 (d, *J* = 3.2 Hz), 130.5 (d, *J* = 7.9 Hz), 115.2 (d, *J* = 21.2 Hz), 91.3, 69.7 (d, *J* = 1.0 Hz), 33.9 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ -116.47 ppm (s).



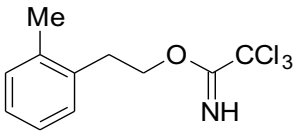
3c

Compound **3c** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 8.28 (bs, 1H), 7.33 – 7.19 (m, 5H), 4.48 (t, *J* = 6.9 Hz, 2H), 3.08 ppm (t, *J* = 6.9 Hz, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 162.7, 137.6, 129.0, 128.4, 126.6, 91.4, 69.8, 34.6 ppm.



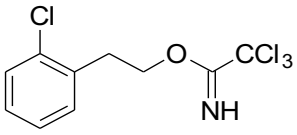
3d

Compound **3d** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.21 (bs, 1H), 7.17 (d, *J* = 8.5 Hz, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 4.37 (t, *J* = 6.7 Hz, 2H), 2.95 ppm (t, *J* = 6.7 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.5, 136.1, 132.3, 130.3, 128.5, 91.3, 69.4, 34.0 ppm. **HRMS** (**ESI**) Calculated for [$M+H^+$]: 299.9511, measured: 299.9509.



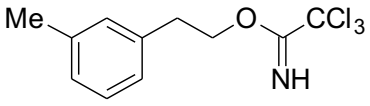
3e

Compound **3e** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.29 (bs, 1H), 7.24 – 7.18 (m, 1H), 7.18 – 7.11 (m, 3H), 4.46 (t, *J* = 7.2 Hz, 2H), 3.09 (t, *J* = 7.2 Hz, 2H), 2.37 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.8, 136.5, 135.6, 130.2, 129.7, 126.7, 126.0, 91.4, 69.1, 31.8, 19.4 ppm.



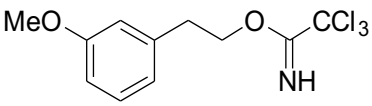
3f

Compound **3f** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.30 (s, 1H), 7.40 – 7.35 (m, 1H), 7.35 – 7.31 (m, 1H), 7.23 – 7.15 (m, 2H), 4.53 (t, *J* = 6.7 Hz, 2H), 3.24 ppm (t, *J* = 6.7 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.7, 135.2, 134.2, 131.4, 129.5, 128.1, 126.7, 91.3, 68.1, 32.4 ppm.



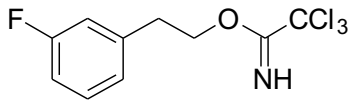
3g

Compound **3g** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.29 (bs, 1H), 7.20 (t, *J* = 7.5 Hz, 1H), 7.11 (s, 1H), 7.08 (d, *J* = 7.6 Hz, 1H), 7.06 (d, *J* = 7.5 Hz, 1H), 4.49 (t, *J* = 7.0 Hz, 2H), 3.06 (t, *J* = 7.0 Hz, 2H), 2.34 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.8, 138.0, 137.5, 129.9, 128.3, 127.3, 126.0, 91.5, 69.9, 34.6, 21.3 ppm.



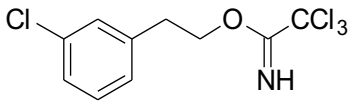
3h

Compound **3h** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.29 (bs, 1H), 7.20 (t, *J* = 7.9 Hz, 1H), 6.87 – 6.80 (m, 2H), 6.77 (dd, *J* = 8.2, 2.5 Hz, 1H), 4.48 (t, *J* = 6.9 Hz, 2H), 3.77 (s, 3H), 3.05 ppm (t, *J* = 6.9 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 159.6, 139.1, 129.3, 121.3, 114.6, 112.0, 91.4, 69.7, 55.0, 34.6 ppm.



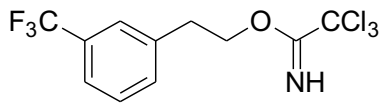
3i

Compound **3i** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.22 (bs, 1H), 7.18 – 7.13 (m, 1H), 6.95 (d, *J* = 7.6 Hz, 1H), 6.90 (d, *J* = 9.8 Hz, 1H), 6.83 (td, *J* = 8.5, 2.4 Hz, 1H), 4.40 (t, *J* = 6.7 Hz, 2H), 2.98 (t, *J* = 6.7 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.8 (d, *J* = 245.6 Hz), 162.6, 140.1 (d, *J* = 7.4 Hz), 129.8 (d, *J* = 8.3 Hz), 124.6 (d, *J* = 2.8 Hz), 116.0 (d, *J* = 21.2 Hz), 113.5 (d, *J* = 21.0 Hz), 91.3, 69.3, 34.3 (d, *J* = 1.7 Hz). **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -113.37 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 283.9807, measured: 283.9803.



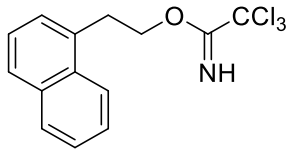
3j

Compound **3j** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.34 (bs, 1H), 7.32 (s, 1H), 7.29 – 7.21 (m, 2H), 7.21 – 7.15 (m, 1H), 4.50 (t, *J* = 6.7 Hz, 2H), 3.09 ppm (t, *J* = 6.7 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 139.6, 134.1, 129.6, 129.3, 127.2, 126.8, 91.3, 69.3, 34.3 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 299.9511, measured: 299.9508.



3k

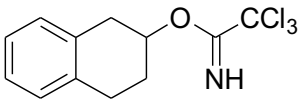
Compound **3k** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.32 (bs, 1H), 7.57 (s, 1H), 7.53 – 7.45 (m, 2H), 7.42 (t, *J* = 7.6 Hz, 1H), 4.51 (t, *J* = 6.5 Hz, 2H), 3.15 ppm (t, *J* = 6.5 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.7, 138.7, 132.5 (q, *J* = 1.0 Hz), 130.7 (q, *J* = 32.1 Hz), 128.9, 126.0 (q, *J* = 3.8 Hz), 124.1 (q, *J* = 272.3 Hz), 123.5 (q, *J* = 3.8 Hz), 91.2, 69.2, 34.5 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -62.59 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 333.9775, measured: 333.9769.



3l

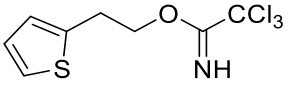
Compound **3l** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.36 (bs, 1H), 8.18 (d, *J* = 8.4 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.78 (dd, *J* = 7.2, 1.9 Hz, 1H), 7.59 – 7.54 (m, 1H), 7.51 (t, *J* = 7.1 Hz, 1H), 7.46 – 7.41 (m, 2H), 4.66 (t, *J* = 7.3 Hz, 2H), 3.59 ppm (t, *J* = 7.3 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.7, 133.8, 133.4, 132.0, 128.8, 127.5, 127.3, 126.2,

125.6, 125.5, 123.7, 91.4, 69.2, 31.6 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 316.0057, measured: 316.0054.



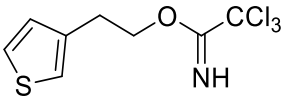
3m

Compound **3m** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[4] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.35 (bs, 1H), 7.18 – 7.07 (m, 4H), 5.42 – 5.33 (m, 1H), 3.26 (dd, *J* = 16.7, 5.1 Hz, 1H), 3.10 – 2.99 (m, 2H), 2.94 – 2.83 (m, 1H), 2.23 – 2.09 ppm (m, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.2, 135.5, 133.4, 129.3, 128.5, 126.0, 125.9, 91.8, 74.7, 33.8, 27.1, 26.3 ppm.



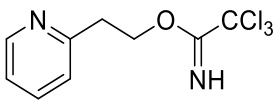
3n

Compound **3n** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.33 (bs, 1H), 7.17 (dd, *J* = 5.0, 1.1 Hz, 1H), 6.97 – 6.92 (m, 2H), 4.52 (t, *J* = 6.7 Hz, 2H), 3.31 ppm (t, *J* = 6.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ = 162.7, 139.5, 126.9, 125.8, 124.0, 91.3, 69.5, 28.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 271.9465, measured: 271.9462.



3o

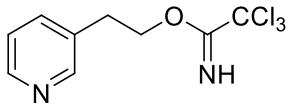
Compound **3o** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.32 (bs, 1H), 7.27 (dd, *J* = 4.9, 3.0 Hz, 1H), 7.11 (d, *J* = 2.1 Hz, 1H), 7.05 (d, *J* = 4.9 Hz, 1H), 4.51 (t, *J* = 6.7 Hz, 2H), 3.13 ppm (t, *J* = 6.7 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.7, 137.7, 128.4, 125.4, 121.8, 91.3, 69.2, 29.1 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 271.9465, measured: 271.9463.



3p

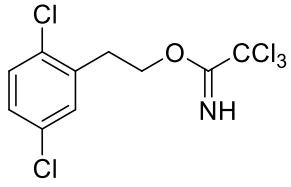
Compound **3p** was prepared according to substrate synthesis procedure 3 and the spectral data are available in the literature.[3]

^{1}H NMR (500 MHz, $CDCl_3$) δ = 8.52 (d, *J* = 4.8 Hz, 1H), 8.28 (bs, 1H), 7.57 (t, *J* = 7.7 Hz, 1H), 7.22 (d, *J* = 7.8 Hz, 1H), 7.11 (dd, *J* = 7.3, 5.1 Hz, 1H), 4.65 (t, *J* = 6.6 Hz, 2H), 3.23 ppm (t, *J* = 6.6 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 157.7, 149.4, 136.2, 123.6, 121.6, 91.3, 68.4, 36.9 ppm.



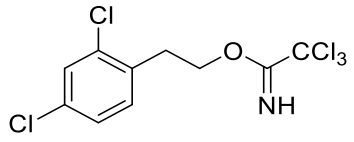
3q

Compound **3q** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.52 (d, *J* = 1.9 Hz, 1H), 8.47 (dd, *J* = 4.8, 1.4 Hz, 1H), 8.30 (bs, 1H), 7.62 – 7.57 (m, 1H), 7.21 (dd, *J* = 7.7, 4.8 Hz, 1H), 4.48 (t, *J* = 6.5 Hz, 2H), 3.07 ppm (t, *J* = 6.5 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 150.4, 148.2, 136.6, 133.3, 123.3, 91.2, 69.1, 31.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 266.9853, measured: 266.9854.



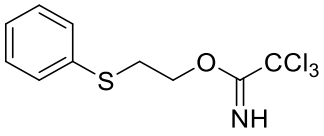
3r

Compound **3r** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.31 (bs, 1H), 7.34 (d, *J* = 2.5 Hz, 1H), 7.29 (dd, *J* = 8.5, 3.6 Hz, 1H), 7.16 (dd, *J* = 8.5, 2.5 Hz, 1H), 4.51 (t, *J* = 6.5 Hz, 2H), 3.20 ppm (t, *J* = 6.5 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 137.0, 132.4, 132.3, 131.5, 130.5, 128.2, 91.2, 67.6, 32.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 333.9121, measured: 333.9118.



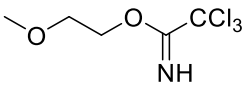
3s

Compound **3s** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.30 (s, 1H), 7.38 (s, 1H), 7.26 (d, *J* = 8.2 Hz, 1H), 7.18 (dd, *J* = 8.2, 1.4 Hz, 1H), 4.50 (t, *J* = 6.5 Hz, 2H), 3.20 ppm (t, *J* = 6.5 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.6, 134.8, 133.9, 133.2, 132.2, 129.3, 127.0, 91.2, 67.8, 31.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 333.9121, measured: 333.9117.



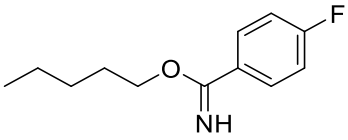
3t

Compound **3t** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.35 (s, 1H), 7.44 (d, *J* = 7.4 Hz, 2H), 7.31 (t, *J* = 7.7 Hz, 2H), 7.22 (t, *J* = 7.4 Hz, 1H), 4.46 (t, *J* = 7.2 Hz, 2H), 3.29 ppm (t, *J* = 7.1 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.4, 135.0, 129.8, 129.0, 126.5, 91.1, 67.5, 31.5 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 297.9621, measured: 297.9619.



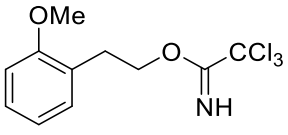
3u

Compound **3u** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.32 (s, 1H), 4.48 – 4.42 (m, 2H), 3.76 – 3.71 (m, 2H), 3.43 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.9, 91.3, 70.0, 68.7, 59.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 219.9693, measured: 219.9693.



3v

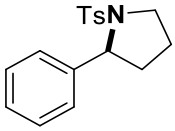
Compound **3v** was prepared according to substrate synthesis procedure 4. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.66 (dd, *J* = 7.6, 5.7 Hz, 2H), 7.46 (bs, 1H), 6.97 (t, *J* = 8.6 Hz, 2H), 4.12 (t, *J* = 6.5 Hz, 2H), 1.79 – 1.62 (m, 2H), 1.40 – 1.22 (m, 4H), 0.83 ppm (t, *J* = 7.1 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 166.3, 164.1 (d, *J* = 251.0 Hz), 129.0 (d, *J* = 3.1 Hz), 128.8 (d, *J* = 8.7 Hz), 115.2 (d, *J* = 21.8 Hz), 65.9, 28.2, 28.2, 22.3, 13.8 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -109.58 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 210.1289, measured: 210.1287.



3w

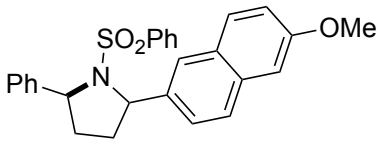
Compound **3w** was prepared according to substrate synthesis procedure 3. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.26 (s, 1H), 7.26 – 7.18 (m, 2H), 6.93 – 6.82 (m, 2H), 4.50 (t, *J* = 7.0 Hz, 2H), 3.84 (s, 3H), 3.13 ppm (t, *J* = 7.0 Hz, 2H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 162.9, 157.6, 130.9, 127.9, 125.7, 120.3, 110.1, 91.5, 68.8, 55.2, 29.4 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 296.0006, measured: 296.0000.

9.2 Characterization of products



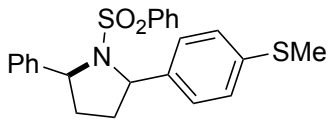
2a

The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (8:1) to afford the product **2a** (107.1 mg, 71% yield) as white solid. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.58 (d, *J* = 8.2 Hz, 2H), 7.26 – 7.09 (m, 7H), 4.69 (dd, *J* = 7.9, 3.6 Hz, 1H), 3.52 (ddd, *J* = 10.0, 6.7, 4.7 Hz, 1H), 3.32 (dt, *J* = 10.2, 7.2 Hz, 1H), 2.32 (s, 3H), 1.96 – 1.82 (m, 1H), 1.80 – 1.65 (m, 2H), 1.60 – 1.48 ppm (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 143.2, 143.0, 134.9, 129.5, 128.2, 127.3, 126.9, 126.0, 63.1, 49.3, 35.6, 23.8, 21.4 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 302.1209, measured: 302.1207.



2b

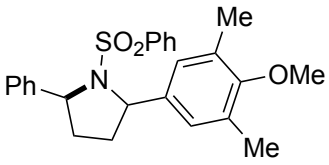
The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (3:1) to afford the product **2b** (159.8 mg, 72% yield) as light yellow solid. *Isomer 1*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.70 – 7.18 (m, 12H), 7.11 (d, *J* = 2.4 Hz, 1H), 7.07 (d, *J* = 2.1 Hz, 1H), 7.00 (t, *J* = 7.9 Hz, 2H), 5.42 (d, *J* = 7.4 Hz, 1H), 5.36 (d, *J* = 7.4 Hz, 1H), 3.91 (s, 3H), 2.75 – 2.59 (m, 2H), 1.94 – 1.79 ppm (m, 2H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ = 157.6, 143.0, 141.3, 137.5, 133.7, 131.4, 129.4, 128.4, 128.3, 128.0, 127.0, 126.9, 126.7, 126.2, 125.3, 125.0, 118.8, 105.5, 64.9, 64.8, 55.3, 33.6, 33.2 ppm. *Isomer 2*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.76 (s, 1H), 7.71 – 7.11 (m, 15H), 5.11 (t, *J* = 6.1 Hz, 1H), 5.00 (t, *J* = 6.2 Hz, 1H), 3.92 (s, 3H), 2.17 – 2.05 ppm (m, 4H). ^{13}C NMR (100 MHz, $CDCl_3$) δ = 157.7, 141.9, 138.3, 136.8, 133.8, 132.5, 128.7, 128.6, 128.4, 127.7, 127.3, 127.1, 127.1, 125.8, 125.5, 118.9, 105.6, 65.28, 65.27, 55.3, 34.0, 33.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 444.1628, measured: 444.1620.



2c

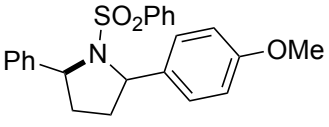
The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (8:1 – 5:1) to afford the product **2c** (133.1 mg, 65% yield) as light yellow solid. *Isomer 1*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.36

– 7.07 (m, 14H), 5.29 (d, *J* = 7.3 Hz, 1H), 5.24 (d, *J* = 7.3 Hz, 1H), 2.68 – 2.54 (m, 2H), 2.47 (s, 3H), 1.87 – 1.72 ppm (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 142.6, 141.4, 139.8, 137.1, 131.5, 128.3, 128.1, 127.1, 126.9, 126.8, 126.6, 126.3, 64.8, 64.4, 33.4, 33.3, 16.0 ppm. *Isomer 2*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.65 – 7.59 (m, 2H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.44 – 7.40 (m, 2H), 7.40 – 7.19 (m, 9H), 4.94 (t, *J* = 6.8 Hz, 1H), 4.90 (t, *J* = 6.6 Hz, 1H), 2.49 (s, 3H), 2.12 – 1.96 ppm (m, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 141.9, 138.8, 138.1, 137.4, 132.6, 128.8, 128.4, 127.7, 127.5, 127.3, 126.9, 126.6, 65.2, 64.8, 34.0, 33.9, 15.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 410.1243, measured: 410.1238.



2d

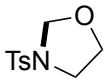
The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (3:1) to afford the product **2d** (166.7 mg, 79% yield) as light yellow viscous oil. *Isomer 1*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.41 – 7.19 (m, 8H), 7.15 (t, *J* = 7.8 Hz, 2H), 6.70 (s, 2H), 5.28 (d, *J* = 7.8 Hz, 1H), 5.19 (d, *J* = 8.0 Hz, 1H), 3.68 (s, 3H), 2.70 – 2.49 (m, 2H), 2.14 (s, 6H), 1.80 (dd, *J* = 11.6, 5.9 Hz, 1H), 1.74 ppm (dd, *J* = 11.8, 6.0 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 155.9, 143.4, 141.5, 137.3, 131.4, 130.3, 128.3, 127.9, 127.0, 127.0, 126.8, 126.0, 64.9, 64.3, 59.6, 33.7, 33.0, 16.1 ppm. *Isomer 2*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.61 – 7.55 (m, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.46 (d, *J* = 7.3 Hz, 2H), 7.41 – 7.23 (m, 5H), 6.99 (s, 2H), 4.97 (t, *J* = 6.3 Hz, 1H), 4.85 (t, *J* = 5.8 Hz, 1H), 3.70 (s, 3H), 2.22 (s, 6H), 2.08 – 1.94 ppm (m, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 156.0, 142.0, 138.4, 136.8, 132.4, 130.4, 128.5, 128.3, 127.7, 127.4, 127.3, 127.1, 64.98, 64.92, 59.6, 34.3, 33.7, 16.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 422.1784, measured: 422.1778.



2e

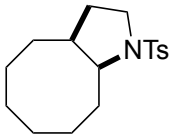
The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (5:1) to afford the product **2e** (161.3 mg, 82% yield) as light yellow solid. *Isomer 1*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.43 – 7.05 (m, 12H), 6.71 (d, *J* = 8.7 Hz, 2H), 5.27 (d, *J* = 7.6 Hz, 1H), 5.24 (d, *J* = 7.5 Hz, 1H), 3.77 (s, 3H), 2.67 – 2.50 (m, 2H), 1.86 – 1.70 ppm (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.6, 142.9, 141.5, 134.7,

131.4, 128.2, 128.0, 127.6, 127.0, 126.7, 126.2, 113.6, 64.7, 64.2, 55.2, 33.5, 33.3 ppm. *Isomer 2*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.65 – 7.58 (m, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.6 Hz, 2H), 7.37 – 7.05 (m, 7H), 6.85 (d, *J* = 8.6 Hz, 2H), 4.93 (t, *J* = 6.4 Hz, 1H), 4.88 (t, *J* = 5.9 Hz, 1H), 3.79 (s, 3H), 2.08 – 1.93 ppm (m, 4H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.7, 142.0, 138.1, 133.8, 132.4, 128.6, 128.3, 128.1, 127.6, 127.2, 126.8, 113.7, 65.0, 64.7, 55.2, 34.0, 33.8 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 394.1471, measured: 394.1468.



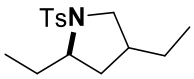
2f

The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (3:1) to afford the product **2f** (64.9 mg, 57% yield) as white solid. The spectral data are available in the literature.[8] **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.73 (d, *J* = 8.4 Hz, 2H), 7.32 (d, *J* = 8.1 Hz, 2H), 4.83 (s, 2H), 3.65 (t, *J* = 6.7 Hz, 2H), 3.42 (t, *J* = 6.7 Hz, 2H), 2.42 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 144.2, 134.0, 129.8, 127.7, 80.7, 66.0, 46.0, 21.5 ppm.



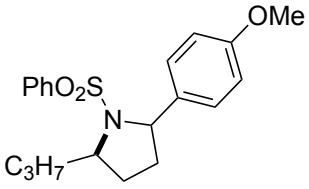
2g

The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (3:1) to afford the product **2g** (67.7 mg, 44% yield) as white solid. *Major isomer*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.70 (d, *J* = 8.2 Hz, 3H), 7.30 (d, *J* = 8.0 Hz, 2H), 3.70 (dd, *J* = 9.9, 6.1 Hz, 1H), 3.37 – 3.31 (m, 1H), 2.84 – 2.79 (m, 1H), 2.41 (s, 3H), 1.97 – 1.90 (m, 1H), 1.84 – 1.25 (m, 12H), 1.14 – 1.03 ppm (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ 143.0, 134.5, 129.5, 127.4, 63.8, 46.3, 42.6, 33.0, 32.0, 29.6, 28.1, 25.50, 25.49, 25.2, 21.4 ppm. *Minor isomer*: **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.70 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 7.9 Hz, 2H), 3.59 – 3.47 (m, 2H), 3.11 (td, *J* = 12.3, 5.0 Hz, 1H), 2.41 (s, 3H), 2.30 – 2.21 (m, 1H), 2.06 – 1.97 (m, 1H), 1.84 – 1.22 (11, H), 0.81 – 0.59 ppm (m, 2H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 143.0, 136.1, 129.5, 127.2, 64.6, 47.3, 44.3, 37.1, 35.3, 34.8, 26.7, 26.6, 24.2, 22.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 308.1679, measured: 308.1677.



2h

The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (5:1) to afford the product **2h** (94.3 mg, 67% yield) as colorless oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.2 Hz, 2H), 7.28 (d, *J* = 8.2 Hz, 2H), 3.64 – 3.42 (m, 2H), 2.83 (dd, *J* = 11.3, 10.5 Hz, 0.5H), 2.59 (t, *J* = 9.5 Hz, 0.5H), 2.40 (s, 3H), 2.15 – 1.92 (m, 1.5H), 1.82 (dqd, *J* = 15.1, 7.5, 4.2 Hz, 0.5H), 1.69 (ddd, *J* = 12.4, 6.2, 1.4 Hz, 0.5H), 1.61 – 1.40 (m, 1H), 1.37 – 0.97 (m, 3.5H), 0.87 (t, *J* = 7.4 Hz, 1.5H), 0.86 (t, *J* = 7.4 Hz, 1.5H), 0.80 (t, *J* = 7.6 Hz, 1.5H), 0.76 ppm (t, *J* = 7.4 Hz, 1.5H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ (143.05, 143.03), (135.4, 134.4), (129.50, 129.42), (127.4, 127.2), (62.2, 61.7), (54.5, 54.0), (39.7, 38.7), (37.7, 35.7), (29.4, 29.3), (25.8, 25.3), 21.4, (12.5, 12.4), (10.5, 9.7) ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 282.1522, measured: 282.1521.

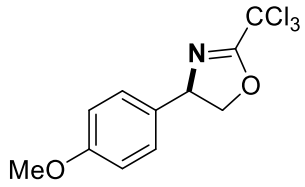


2i

The reaction was conducted in a 0.5 mmol scale following the general procedure A and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (8:1) to afford the product **2i** (113.5mg, 63% yield) as colorless viscous oil.

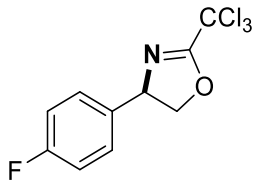
Major isomer (*cis*): **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.83 – 7.75 (m, 2H), 7.57 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 2H), 7.27 (d, *J* = 8.6 Hz, 2H), 6.84 (d, *J* = 8.7 Hz, 2H), 4.66 (t, *J* = 6.8 Hz, 1H), 3.85 – 3.80 (m, 1H), 3.79 (s, 3H), 2.07 – 1.96 (m, 1H), 1.92 – 1.79 (m, 2H), 1.65 – 1.48 (m, 3H), 1.46 – 1.31 (m, 2H), 0.97 ppm (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.6, 138.2, 134.7, 132.4, 128.9, 127.6, 127.4, 113.7, 64.1, 62.1, 55.2, 39.0, 34.3, 29.7, 19.9, 14.0 ppm.

Minor isomer (*trans*): **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.45 – 7.41 (m, 2H), 7.38 (t, *J* = 7.4 Hz, 1H), 7.24 (t, *J* = 7.8 Hz, 2H), 6.89 (d, *J* = 8.6 Hz, 2H), 6.61 (d, *J* = 8.7 Hz, 2H), 4.93 (d, *J* = 8.2 Hz, 1H), 4.15 – 4.05 (m, 1H), 3.74 (s, 3H), 2.47 – 2.32 (m, 1H), 2.24 – 2.04 (m, 2H), 1.78 (dd, *J* = 12.7, 7.1 Hz, 1H), 1.71 (dd, *J* = 12.4, 7.1 Hz, 1H), 1.58 – 1.46 (m, 1H), 1.37 – 1.23 (m, 2H), 0.94 ppm (t, *J* = 7.3 Hz, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 158.5, 141.9, 134.3, 131.4, 128.2, 127.9, 126.7, 113.4, 63.3, 61.7, 55.2, 36.9, 33.4, 28.2, 19.7, 14.0 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 360.1628, measured: 360.1624.



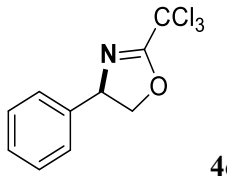
4a

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (20:1) with 2% Et_3N to afford the product **4a** (107.1 mg, 73% yield) as colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.18 (d, *J* = 8.7 Hz, 2H), 6.91 (d, *J* = 8.7 Hz, 2H), 5.37 (dd, *J* = 10.0, 8.2 Hz, 1H), 4.95 (dd, *J* = 10.0, 8.6 Hz, 1H), 4.48 (t, *J* = 8.3 Hz, 1H), 3.80 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.3, 159.5, 132.3, 127.8, 114.3, 86.6, 78.3, 69.6, 55.3 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 293.9850, measured: 293.9847.



4b

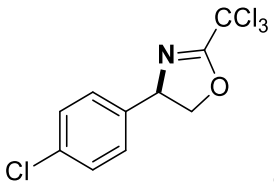
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (30:1) with 2% Et_3N to afford the product **4b** (105.6 mg, 75% yield) as light yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.28 – 7.20 (m, 2H), 7.13 – 7.03 (m, 2H), 5.42 (dd, *J* = 10.1, 8.2 Hz, 1H), 4.99 (dd, *J* = 10.1, 8.6 Hz, 1H), 4.47 ppm (t, *J* = 8.4 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 163.7, 162.5 (d, *J* = 247.0 Hz), 135.9 (d, *J* = 3.2 Hz), 128.3 (d, *J* = 8.3 Hz), 115.9 (d, *J* = 21.7 Hz), 86.4, 78.2, 69.4 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -113.69 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 281.9650, measured: 281.9648.



4c

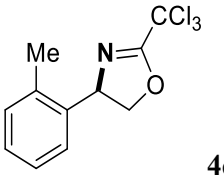
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (30:1) with 2% Et_3N to afford the product **4c** (112.4 mg, 85% yield) as light yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.34 – 7.15 (m, 5H), 5.35 (dd, *J* = 10.1, 8.2 Hz, 1H), 4.91 (dd, *J* = 10.1, 8.6 Hz, 1H), 4.43 ppm (t, *J* = 8.4 Hz,

1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 163.5, 140.1, 128.9, 128.2, 126.5, 86.5, 78.2, 70.0 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 263.9744, measured: 263.9744.



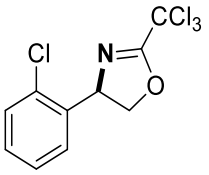
4d

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (40:1) with 2% Et_3N to afford the product **4d** (90.6 mg, 61% yield) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.45 – 7.31 (m, 2H), 7.26 – 7.11 (m, 2H), 5.41 (dd, *J* = 10.1, 8.2 Hz, 1H), 4.98 (dd, *J* = 10.1, 8.7 Hz, 1H), 4.46 ppm (t, *J* = 8.4 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 163.9, 138.6, 134.1, 129.2, 127.9, 86.4, 78.0, 69.4 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 297.9355, measured: 297.9355.



4e

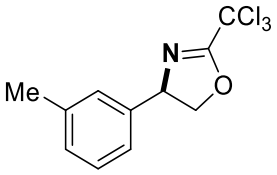
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (30:1) with 2% Et_3N to afford the product **4e** (92.9 mg, 67% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.28 – 7.15 (m, 4H), 5.63 (dd, *J* = 10.2, 8.7 Hz, 1H), 5.03 (dd, *J* = 10.3, 8.4 Hz, 1H), 4.37 ppm (t, *J* = 8.5 Hz, 1H), 2.32 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.5, 138.6, 134.5, 130.5, 127.9, 126.7, 125.9, 86.5, 77.6, 67.1, 19.5 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 277.9901, measured: 277.9899.



4f

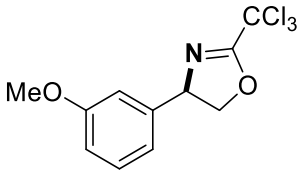
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (40:1) with 2% Et_3N to afford the product **4f** (111.6 mg, 75% yield) as colorless oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.42 – 7.23 (m, 4H), 5.78 (dd, *J* = 10.3, 8.6 Hz, 1H), 5.14 (dd, *J* = 10.4, 8.6 Hz, 1H), 4.37 ppm (t, *J* = 8.6 Hz,

1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 164.2, 138.4, 132.0, 129.4, 129.2, 127.5, 127.4, 86.4, 77.6, 67.3 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 297.9355, measured: 297.9353.



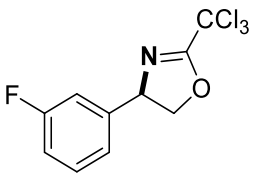
4g

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ethyl acetate (30:1) with 2% Et_3N to afford the product **4g** (99.7 mg, 72% yield) as colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.27 (t, *J* = 7.7 Hz, 1H), 7.14 (d, *J* = 7.6 Hz, 1H), 7.07 (s, 1H), 7.06 (d, *J* = 7.4 Hz, 1H), 5.39 (dd, *J* = 10.0, 8.4 Hz, 1H), 4.98 (dd, *J* = 10.1, 8.6 Hz, 1H), 4.51 (t, *J* = 8.4 Hz, 1H), 2.37 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.5, 140.0, 138.7, 129.0, 128.9, 127.2, 123.6, 86.6, 78.2, 70.0, 21.4 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 277.9901, measured: 277.9900.



4h

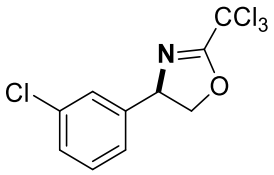
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (20:1) with 2% Et_3N to afford the product **4h** (110.9 mg, 76% yield) as light yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.21 (t, *J* = 7.9 Hz, 1H), 6.80 – 6.74 (m, 2H), 6.73 – 6.69 (m, 1H), 5.31 (dd, *J* = 10.1, 8.1 Hz, 1H), 4.88 (dd, *J* = 10.1, 8.6 Hz, 1H), 4.42 (t, *J* = 8.3 Hz, 1H), 3.72 ppm (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 163.6, 160.0, 141.7, 130.0, 118.7, 113.5, 112.2, 86.5, 78.1, 69.9, 55.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 293.9850, measured: 293.9848.



4i

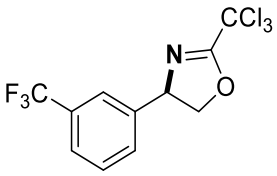
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (20:1) with 2% Et_3N to

afford the product **4i** (104.3 mg, 74% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.35 (td, *J* = 8.0, 5.9 Hz, 1H), 7.07 – 6.95 (m, 3H), 5.43 (dd, *J* = 10.1, 8.3 Hz, 1H), 5.00 (dd, *J* = 10.2, 8.7 Hz, 1H), 4.48 ppm (t, *J* = 8.4 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 164.0, 163.1 (d, *J* = 247.2 Hz), 142.6 (d, *J* = 7.0 Hz), 130.6 (d, *J* = 8.3 Hz), 122.2 (d, *J* = 3.0 Hz), 115.2 (d, *J* = 21.1 Hz), 113.6 (d, *J* = 22.2 Hz), 86.4, 78.0, 69.5 ppm (d, *J* = 1.9 Hz). **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -111.83 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 281.9650, measured: 281.9648.



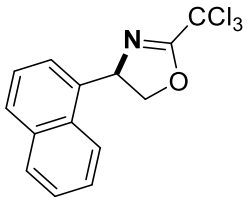
4j

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (40:1) with 2% Et_3N to afford the product **4j** (99.8 mg, 67% yield) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.30 – 7.04 (m, 4H), 5.33 (dd, *J* = 10.1, 8.4 Hz, 1H), 4.92 (dd, *J* = 10.1, 8.7 Hz, 1H), 4.39 ppm (t, *J* = 8.5 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 164.0, 142.0, 134.8, 130.3, 128.4, 126.8, 124.7, 86.3, 77.9, 69.5 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 297.9355, measured: 297.9354.



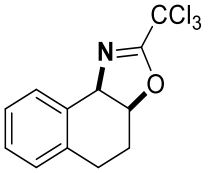
4k

The reaction was conducted in a 0.5 mmol scale following the general procedure B with 2,6-lutidine instead of pyridine, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (100:1) with 2% Et_3N to afford the product **4k** (86.2 mg, 52% yield) as colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.60 (d, *J* = 7.8 Hz, 1H), 7.57 – 7.50 (m, 2H), 7.46 (d, *J* = 7.6 Hz, 1H), 5.50 (dd, *J* = 10.0, 8.4 Hz, 1H), 5.04 (dd, *J* = 10.0, 8.9 Hz, 1H), 4.50 ppm (t, *J* = 8.5 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 164.3, 141.1, 131.3 (q, *J* = 32.5 Hz), 129.9 (q, *J* = 0.9 Hz), 129.6, 125.2 (q, *J* = 3.7 Hz), 123.8 (q, *J* = 272.4 Hz), 123.5 (q, *J* = 3.8 Hz), 86.3, 77.9, 69.6 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ = -62.71 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 331.9618, measured: 331.9616.



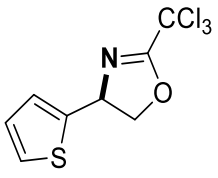
4l

The reaction was conducted in a 0.5 mmol scale following the general procedure B with RVC as working electrode, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (10:1) with 2% Et_3N to afford the product **4l** (129.8 mg, 83% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.94 – 7.91 (m, 1H), 7.84 (dd, *J* = 7.3, 1.7 Hz, 1H), 7.73 (d, *J* = 8.0 Hz, 1H), 7.59 – 7.49 (m, 4H), 6.15 (dd, *J* = 10.2, 8.7 Hz, 1H), 5.24 (dd, *J* = 10.4, 8.4 Hz, 1H), 4.44 ppm (t, *J* = 8.5 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.6, 136.3, 133.8, 130.1, 129.2, 128.4, 126.6, 125.8, 125.7, 123.4, 122.3, 86.6, 77.9, 66.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 313.9901, measured: 313.9898.



4m

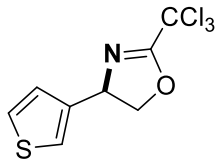
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (40:1) with 1% Et_3N to afford the product **4m** (99.8 mg, 69% yield) as white solid. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.54 – 7.47 (m, 1H), 7.31 – 7.19 (m, 2H), 7.15 (d, *J* = 7.3 Hz, 1H), 5.48 – 5.39 (m, 2H), 2.82 (ddd, *J* = 15.2, 11.5, 3.6 Hz, 1H), 2.63 (dt, *J* = 15.6, 4.5 Hz, 1H), 2.30 (ddt, *J* = 13.9, 4.9, 3.5 Hz, 1H), 1.96 – 1.85 ppm (m, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 162.5, 138.3, 132.5, 130.0, 128.4, 127.8, 127.2, 86.8, 82.8, 67.8, 28.1, 24.3 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 289.9901, measured: 289.9899.



4n

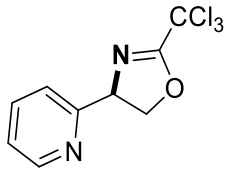
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (15:1) with 2% Et_3N to afford the product **4n** (82.3 mg, 61% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.29 (dd, *J* = 4.8, 1.3 Hz, 1H), 7.04 – 6.96 (m, 2H), 5.68 (dd, *J* = 9.8, 7.9 Hz, 1H), 4.96 (dd, *J* = 9.7, 8.9 Hz,

1H), 4.61 ppm (t, J = 8.2 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.6, 142.9, 127.1, 125.5, 124.9, 86.4, 78.0, 65.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 269.9308, measured: 269.9308.



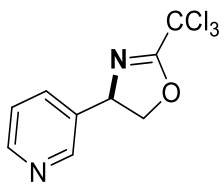
4o

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (15:1) with 2% Et_3N to afford the product **4o** (106.3 mg, 79% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.36 (dd, J = 5.0, 3.0 Hz, 1H), 7.22 (d, J = 2.7 Hz, 1H), 7.01 (d, J = 5.0 Hz, 1H), 5.51 (dd, J = 9.9, 7.9 Hz, 1H), 4.92 (dd, J = 9.9, 8.6 Hz, 1H), 4.53 ppm (t, J = 8.2 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 163.4, 140.7, 127.1, 125.5, 122.1, 86.5, 77.4, 66.0 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 269.9308, measured: 269.9305.



4p

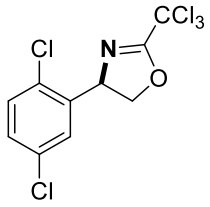
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (5:1) with 2% Et_3N to afford the product **4p** (113.6 mg, 86% yield) as light yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.60 – 8.53 (m, 1H), 7.70 (td, J = 7.7, 1.7 Hz, 1H), 7.41 (d, J = 7.8 Hz, 1H), 7.23 – 7.20 (m, 1H), 5.56 (dd, J = 10.3, 8.3 Hz, 1H), 5.03 (dd, J = 10.3, 8.6 Hz, 1H), 4.86 ppm (t, J = 8.4 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 164.0, 159.0, 149.6, 137.0, 122.9, 121.5, 86.5, 76.5, 70.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 264.9697, measured: 264.9696.



4q

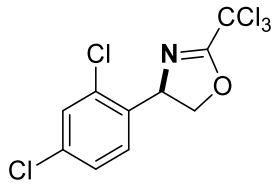
The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (5:1) with 2% Et_3N to afford

the product **4q** (98.8 mg, 75% yield) as yellow oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 8.56 (d, *J* = 4.7 Hz, 1H), 8.52 (d, *J* = 1.5 Hz, 1H), 7.57 (d, *J* = 7.9 Hz, 1H), 7.31 (dd, *J* = 7.9, 4.8 Hz, 1H), 5.45 (dd, *J* = 9.9, 8.4 Hz, 1H), 5.01 (dd, *J* = 10.3, 8.6 Hz, 1H), 4.47 ppm (t, *J* = 8.4 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 164.2, 149.7, 148.2, 135.6, 134.0, 123.8, 86.2, 77.7, 67.7 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 264.9697, measured: 264.9696.



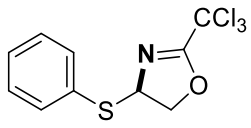
4r

The reaction was conducted in a 0.5 mmol scale following the general procedure B with 2,6-lutidine instead of pyridine, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (80:1) with 2% Et_3N to afford the product **4r** (111.3 mg, 67% yield) as colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.34 (s, 1H), 7.34 (d, *J* = 9.9 Hz, 2H), 7.26 (dd, *J* = 8.5, 2.5 Hz, 1H), 5.72 (dd, *J* = 10.2, 8.9 Hz, 1H), 5.16 (dd, *J* = 10.4, 8.8 Hz, 1H), 4.35 ppm (t, *J* = 8.7 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 164.7, 140.1, 133.5, 130.6, 130.2, 129.3, 127.7, 86.3, 77.2, 67.1 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 331.8965, measured: 331.8964.



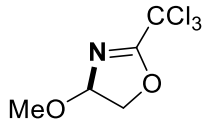
4s

The reaction was conducted in a 0.5 mmol scale following the general procedure B with 2,6-lutidine instead of pyridine, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (80:1) with 2% Et_3N to afford the product **4s** (117.8 mg, 71% yield) as yellow oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.42 (s, 1H), 7.32 – 7.27 (m, 2H), 5.71 (dd, *J* = 10.4, 8.6 Hz, 1H), 5.13 (dd, *J* = 10.4, 8.7 Hz, 1H), 4.34 ppm (t, *J* = 8.6 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 164.5, 137.0, 134.5, 132.6, 129.3, 128.4, 127.7, 86.3, 77.4, 66.9 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 331.8965, measured: 331.8963.



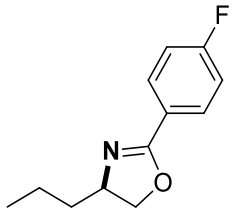
4t

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (30:1) with 2% Et_3N to afford the product **4t** (88.9 mg, 60% yield) as colorless oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.57 – 7.50 (m, 2H), 7.37 – 7.29 (m, 3H), 5.52 (dd, *J* = 9.7, 6.4 Hz, 1H), 4.85 (t, *J* = 9.7 Hz, 1H), 4.55 ppm (dd, *J* = 9.7, 6.4 Hz, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 163.7, 135.0, 129.3, 129.1, 129.0, 85.9, 75.7, 72.2 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 295.9465, measured: 295.9464.



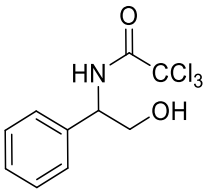
4u

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (12:1) with 2% Et_3N to afford the product **4u** (70.5 mg, 65% yield) as colorless oil. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 5.53 (dd, *J* = 7.4, 5.0 Hz, 1H), 4.61 (dd, *J* = 10.1, 7.4 Hz, 1H), 4.41 (dd, *J* = 10.1, 5.0 Hz, 1H), 3.54 ppm (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 165.4, 97.8, 86.6, 75.7, 56.3 ppm. **HRMS** (**ESI**) Calculated for [M+H$^+$]: 217.9537, measured: 217.9537.



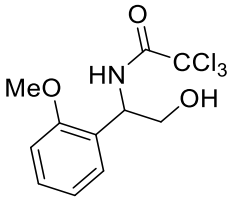
4v

The reaction was conducted in a 0.5 mmol scale following the general procedure B, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (15:1) with 2% Et_3N to afford the product **4v** (53.9 mg, 52% yield) as colorless oil. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.93 (dd, *J* = 8.4, 5.6 Hz, 2H), 7.07 (t, *J* = 8.4 Hz, 2H), 4.47 (td, *J* = 8.4, 0.8 Hz, 1H), 4.31 – 4.21 (m, 1H), 4.01 (td, *J* = 8.0, 0.6 Hz, 1H), 1.78 – 1.65 (m, 1H), 1.59 – 1.34 (m, 3H), 0.96 ppm (t, *J* = 7.0 Hz, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 164.6 (d, *J* = 251.4 Hz), 162.4, 130.4 (d, *J* = 8.8 Hz), 124.2 (d, *J* = 3.2 Hz), 115.3 (d, *J* = 21.9 Hz), 72.7, 66.6, 38.1, 19.1, 14.1 ppm. **^{19}F NMR** (377 MHz, $CDCl_3$) δ -108.58 ppm (s). **HRMS** (**ESI**) Calculated for [M+H$^+$]: 208.1132, measured: 208.1131.



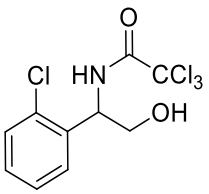
5a

The reaction was conducted in a 0.5 mmol scale following the general procedure C, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (5:1) to afford the product **5a** (92.9 mg, 66% yield) as white solid. **^{1}H NMR** (400 MHz, $CDCl_3$) δ = 7.51 (bs, 1H), 7.43 – 7.36 (m, 2H), 7.36 – 7.28 (m, 3H), 5.03 (dt, *J* = 8.0, 4.0 Hz, 1H), 4.04 – 3.87 (m, 2H), 2.16 ppm (bs, 1H). **^{13}C NMR** (100 MHz, $CDCl_3$) δ = 161.8, 137.5, 129.0, 128.2, 126.4, 92.5, 65.3, 56.7 ppm. **HRMS** (**ESI**) Calculated for [M+Na^+]: 303.9669, measured: 303.9669.



5b

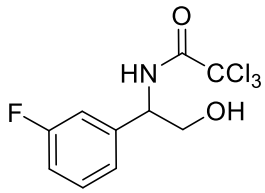
The reaction was conducted in a 0.5 mmol scale following the general procedure C, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (3:1) to afford the product **5b** (90.2 mg, 58% yield) as light yellow solid. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 8.09 (d, *J* = 7.7 Hz, 1H), 7.32 (td, *J* = 8.2, 1.6 Hz, 1H), 7.24 (dd, *J* = 7.5, 1.4 Hz, 1H), 6.98 (t, *J* = 7.5 Hz, 1H), 6.95 (d, *J* = 8.3 Hz, 1H), 5.22 (dt, *J* = 8.4, 5.9 Hz, 1H), 3.93 (dd, *J* = 11.3, 6.3 Hz, 1H), 3.91 – 3.86 (m, 4H), 2.05 ppm (bs, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 161.7, 156.9, 129.6, 129.1, 124.6, 121.2, 111.20 (s), 92.8, 64.4, 55.5, 55.5 ppm. **HRMS** (**ESI**) Calculated for [M+H^+]: 311.9956, measured: 311.9954.



5c

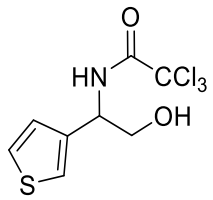
The reaction was conducted in a 0.5 mmol scale following the general procedure C, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (5:1) to afford the product **5c** (105.5 mg, 67% yield) as white solid. **^{1}H NMR** (500 MHz, CD_3CN) δ = 7.91 (s, 1H), 7.47 – 7.40 (m, 2H), 7.37 – 7.28 (m, 2H), 5.29 (td, *J* = 7.1, 4.5 Hz, 1H), 3.86 (dt, *J* = 11.6, 4.7 Hz, 1H), 3.77 (dt, *J* = 11.6, 6.5 Hz, 1H), 3.28 ppm (t, *J* = 6.0 Hz, 1H). **^{13}C NMR** (125 MHz, CD_3CN) δ = 162.5, 137.2,

133.7, 130.7, 130.4, 128.9, 128.4, 93.4, 63.4, 56.0 ppm. **HRMS** (**ESI**) Calculated for [M+Na$^+$]: 337.9280, measured: 337.9278.



5d

The reaction was conducted in a 0.5 mmol scale following the general procedure C, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (5:1) to afford the product **5d** (80.6 mg, 54% yield) as white solid. **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 (d, *J* = 5.3 Hz, 1H), 7.36 (td, *J* = 7.8, 6.2 Hz, 1H), 7.11 (d, *J* = 7.7 Hz, 1H), 7.07 – 6.98 (m, 2H), 5.02 (dt, *J* = 7.4, 4.2 Hz, 1H), 4.02 (dt, *J* = 11.4, 4.3 Hz, 1H), 3.95 (dt, *J* = 11.3, 4.0 Hz, 1H), 1.94 ppm (t, *J* = 5.2 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ 163.1 (d, *J* = 247.3 Hz), 161.7, 140.2 (d, *J* = 6.9 Hz), 130.6 (d, *J* = 8.3 Hz), 122.1 (d, *J* = 3.0 Hz), 115.2 (d, *J* = 21.1 Hz), 113.6 (d, *J* = 22.4 Hz), 92.4, 65.1, 56.1 ppm (d, *J* = 1.7 Hz). **^{19}F NMR** (377 MHz, $CDCl_3$) δ -111.70 ppm (s). **HRMS** (**ESI**) Calculated for [M+Na$^+$]: 321.9575, measured: 321.9576.



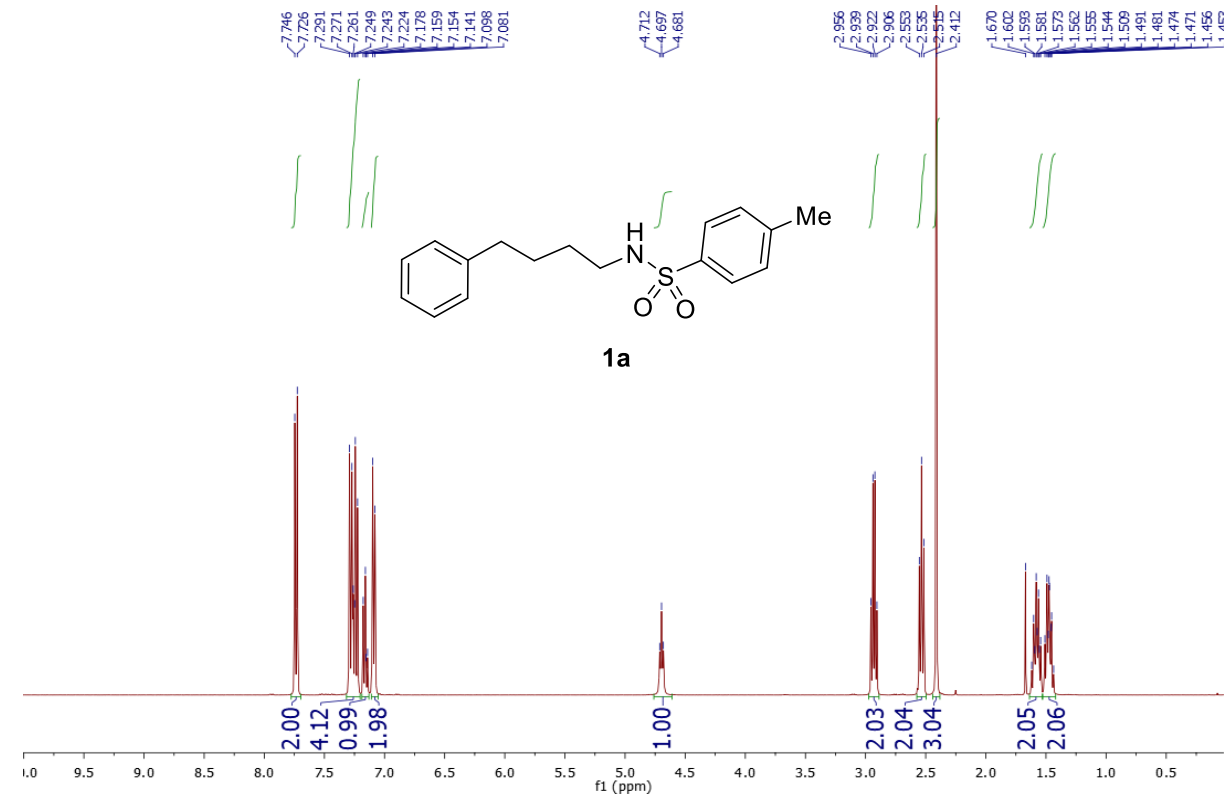
5e

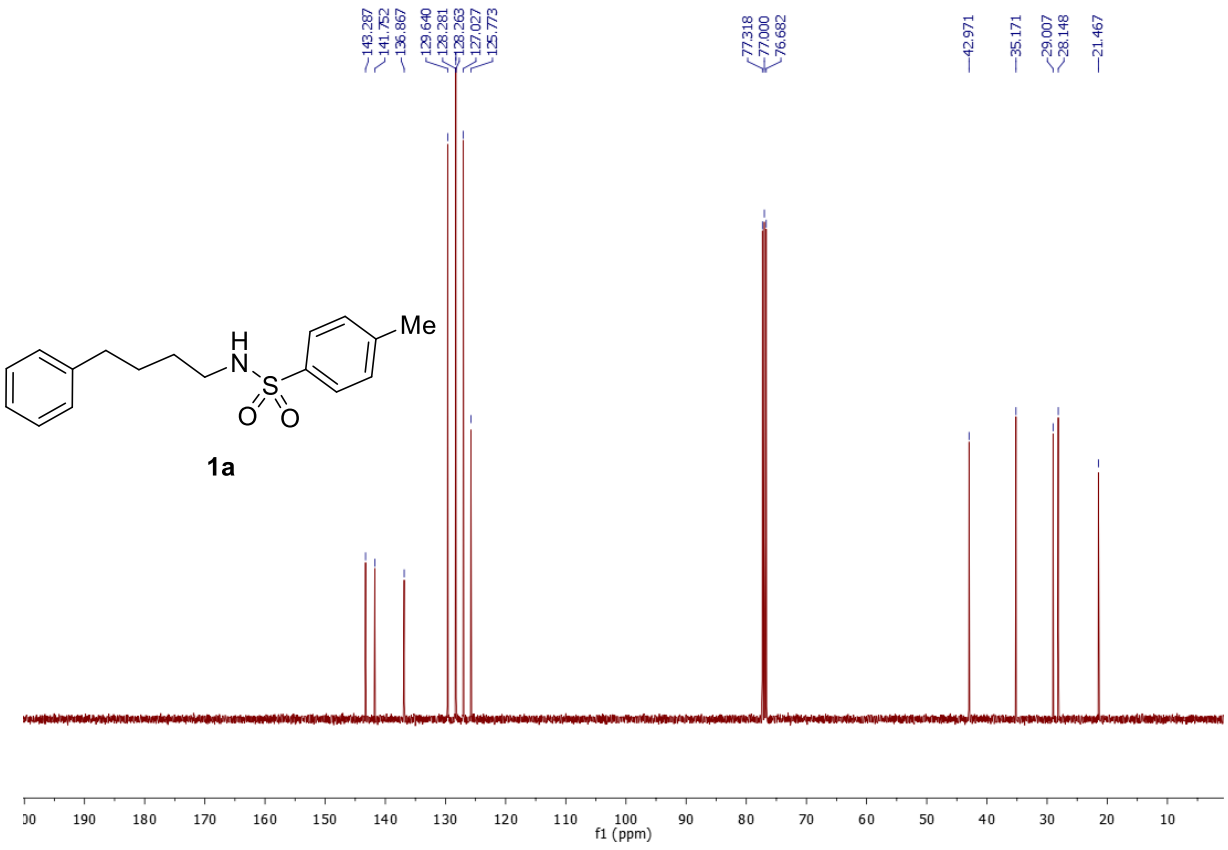
The reaction was conducted in a 0.5 mmol scale following the general procedure C, and the residue was purified by column chromatography on silica gel with hexane/ ethyl acetate (4:1) to afford the product **5e** (84.8 mg, 59% yield) as light yellow solid. **^{1}H NMR** (500 MHz, $CDCl_3$) δ = 7.43 (d, *J* = 6.7 Hz, 1H), 7.36 (dd, *J* = 5.0, 3.0 Hz, 1H), 7.25 – 7.23 (m, 1H), 7.06 (dd, *J* = 5.0, 1.0 Hz, 1H), 5.15 (dt, *J* = 8.1, 4.2 Hz, 1H), 4.18 – 3.75 (m, 2H), 2.30 ppm (bs, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$) δ = 161.7, 138.3, 127.1, 125.9, 122.2, 92.5, 64.6, 52.9 ppm. **HRMS** (**ESI**) Calculated for [M+Na$^+$]: 309.9234, measured: 309.9232.

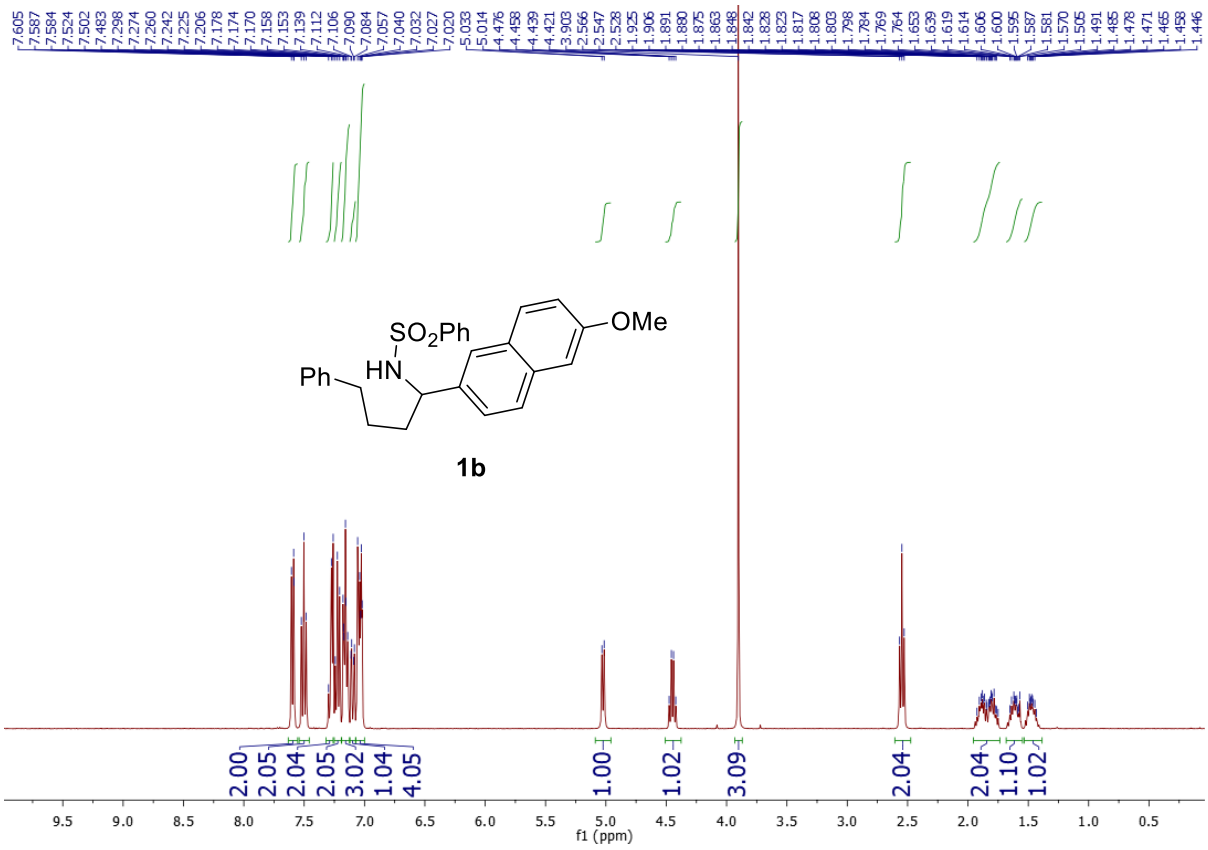
10. References

[1] J. M. Hoover; S. S. Stahl, *J. Am. Chem. Soc.* **2011**, *133*, 16901.
[2] E. A. Wappes, S. C. Fosu, T. C. Chopko, D. A. Nagib, *Angew. Chem. Int. Ed.* **2016**, *55*, 9974.
[3] E. A. Wappes, K. M. Nakafuku, D. A. Nagib, *J. Am. Chem. Soc.* **2017**, *139*, 10204.
[4] X.-Q. Mou, X.-Y. Chen, G. Chen, G. He, *Chem. Commun.* **2018**, *54*, 515.
[5] a) G. Cavallo, P. Metrangolo, R. Milani, T. Pilati, A. Priimagi, G. Resnati, G. Terraneo, *Chem. Rev.* **2016**, *116*, 2478; b) S. S. Barton, R. H. Pottier, *J. Chem. Soc., Perkin Trans. 2*, **1984**, 731; c) O. K. Poleshchuk, V. Branchadell, B. Brycki, A. V. Fateev, A. C. Legon, *J. Mol. Struct.: THEOCHEM* **2006**, *760*, 175.
[6] T. Shono, Y. Matsumura, S. Katoh, K. Takeuchi, K. Sasaki, T. Kamada, R. Shimizu, *J. Am. Chem. Soc.* **1990**, 112, 2368.
[7] S. Herold, D. Bafaluy, K. Muñiz, *Green Chem.*, **2018**, *20*, 3191.
[8] X. Hu, G. Zhang, F. Bu, L. Nie, A. Lei, *ACS Catal.* **2018**, *8*, 9370.
[9] P. Evans, T. McCabe, B. S. Morgan, S. Reau, *Org. Lett.* **2005**, *7*, 43.
[10] N. R. Paz, D. Rodríguez-Sosa, H. Valdés, R. Marticorena, D. Melián, M. B. Copano, C. C. González, A. J. Herrera, *Org. Lett.* **2015**, *17*, 2370.

11. NMR Spectra



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2.04
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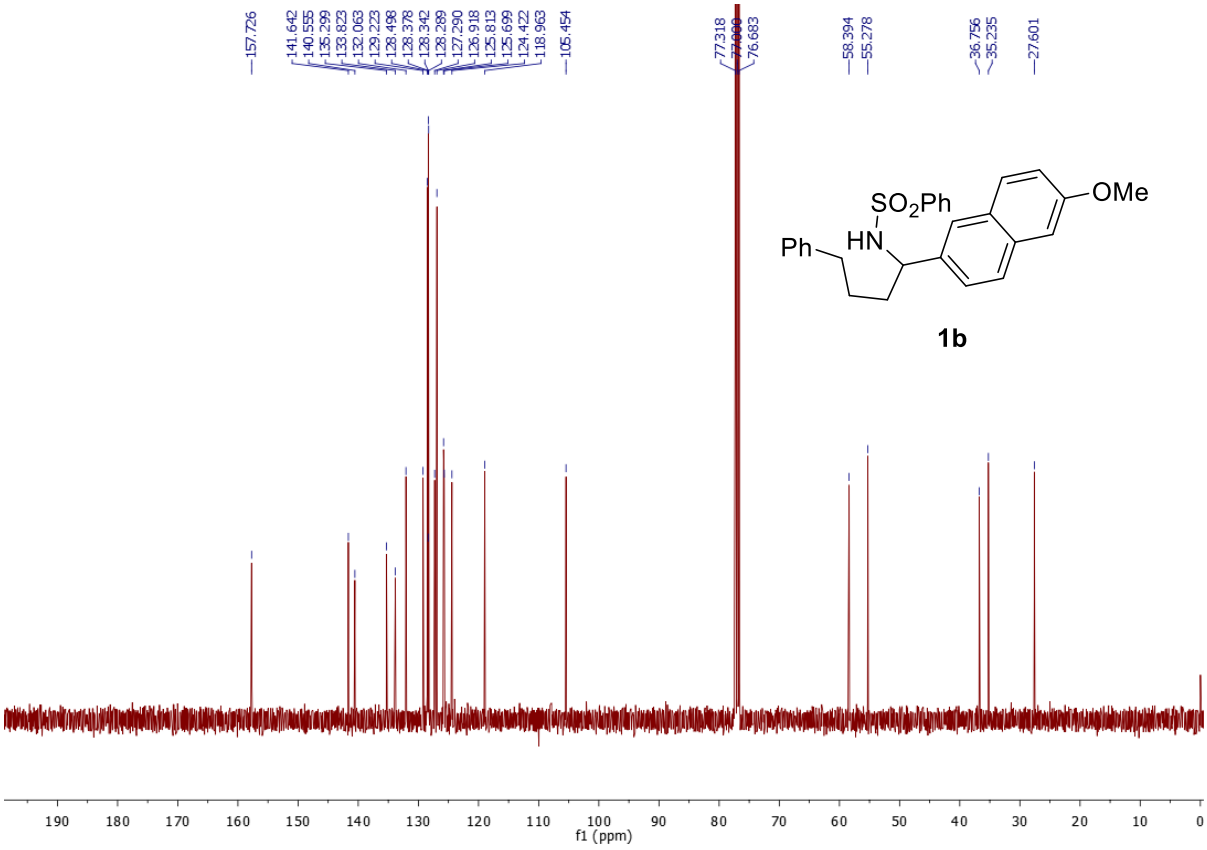
1.02
f1 (ppm)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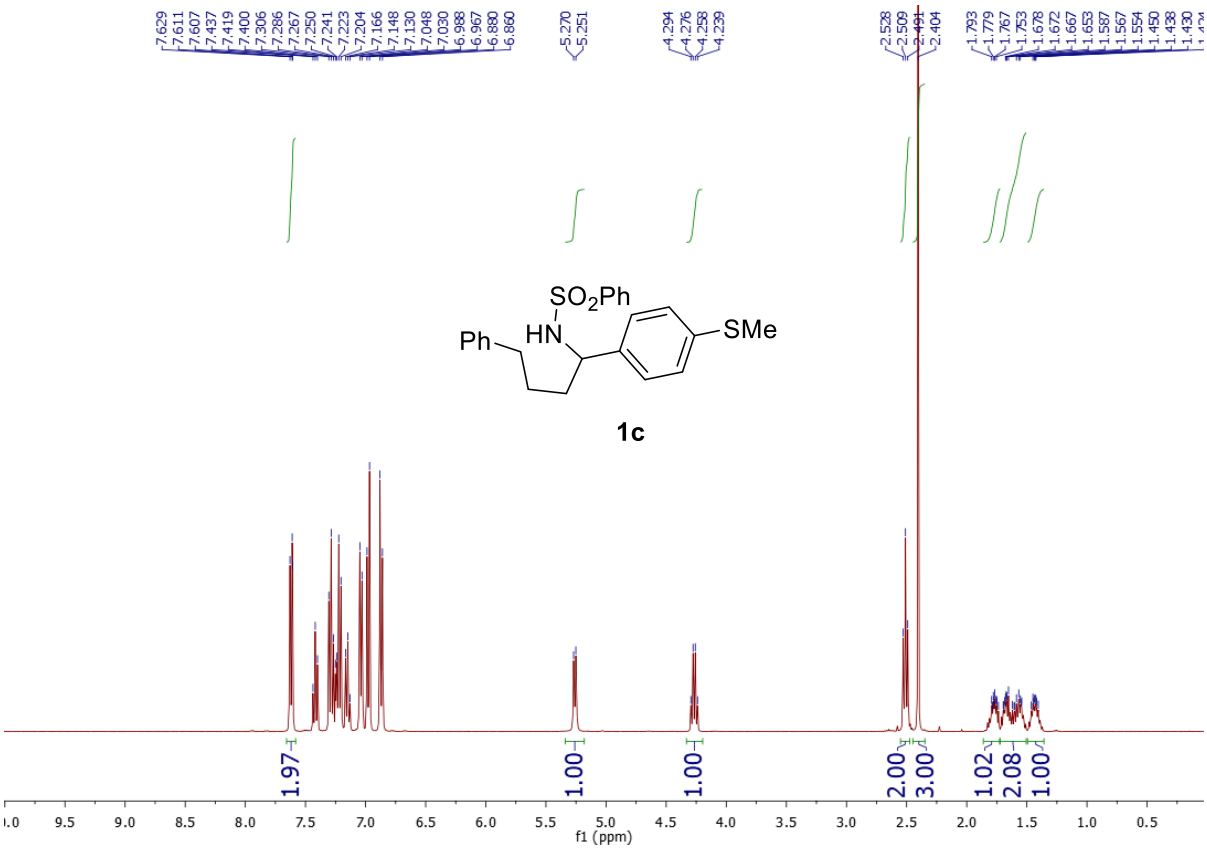
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7.204
7.166
7.148
7.130
7.048
7.030
6.988
6.967
6.880
6.860
5.270
5.251
4.294
4.276
4.258
4.239
2.528
2.509
2.491
2.404
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1.779
1.767
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1.678
1.672
1.667
1.653
1.587
1.567
1.554
1.450
1.438
1.430
SO2Ph
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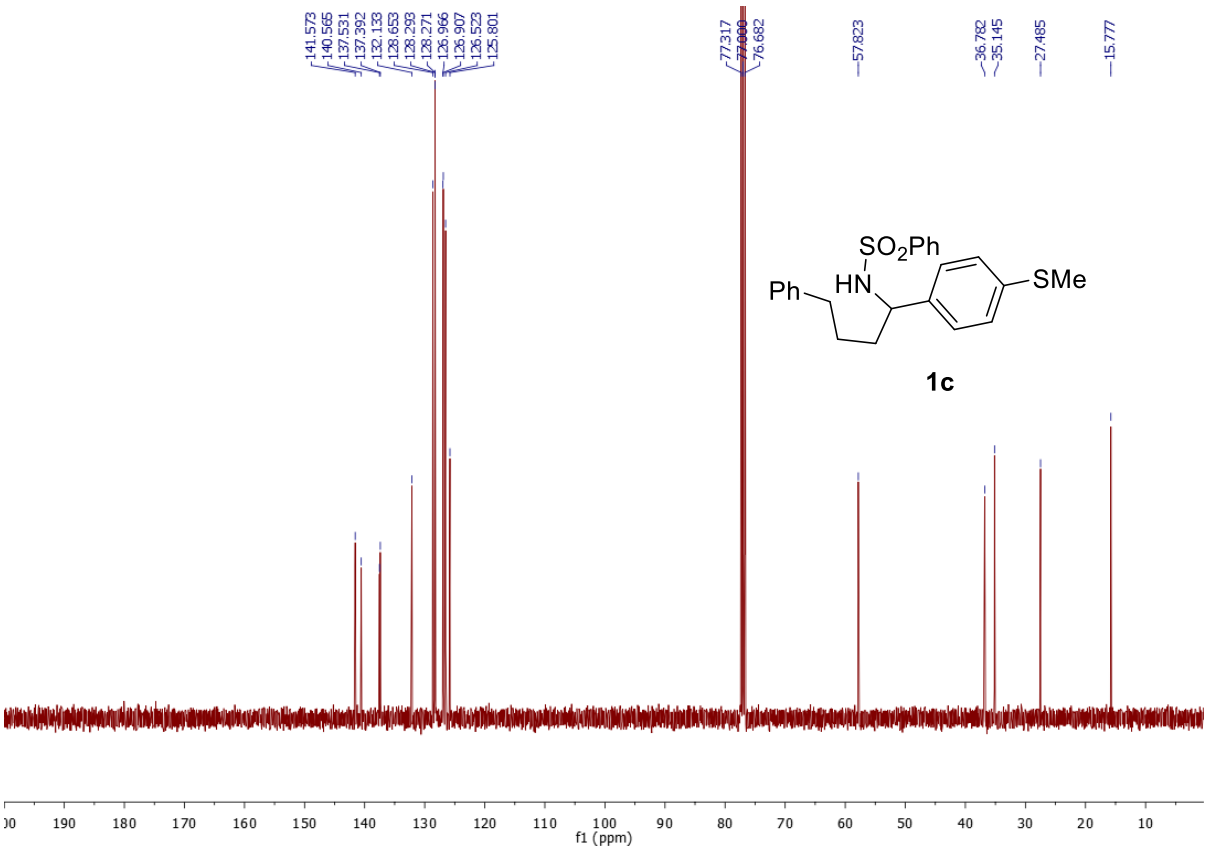
f1 (ppm)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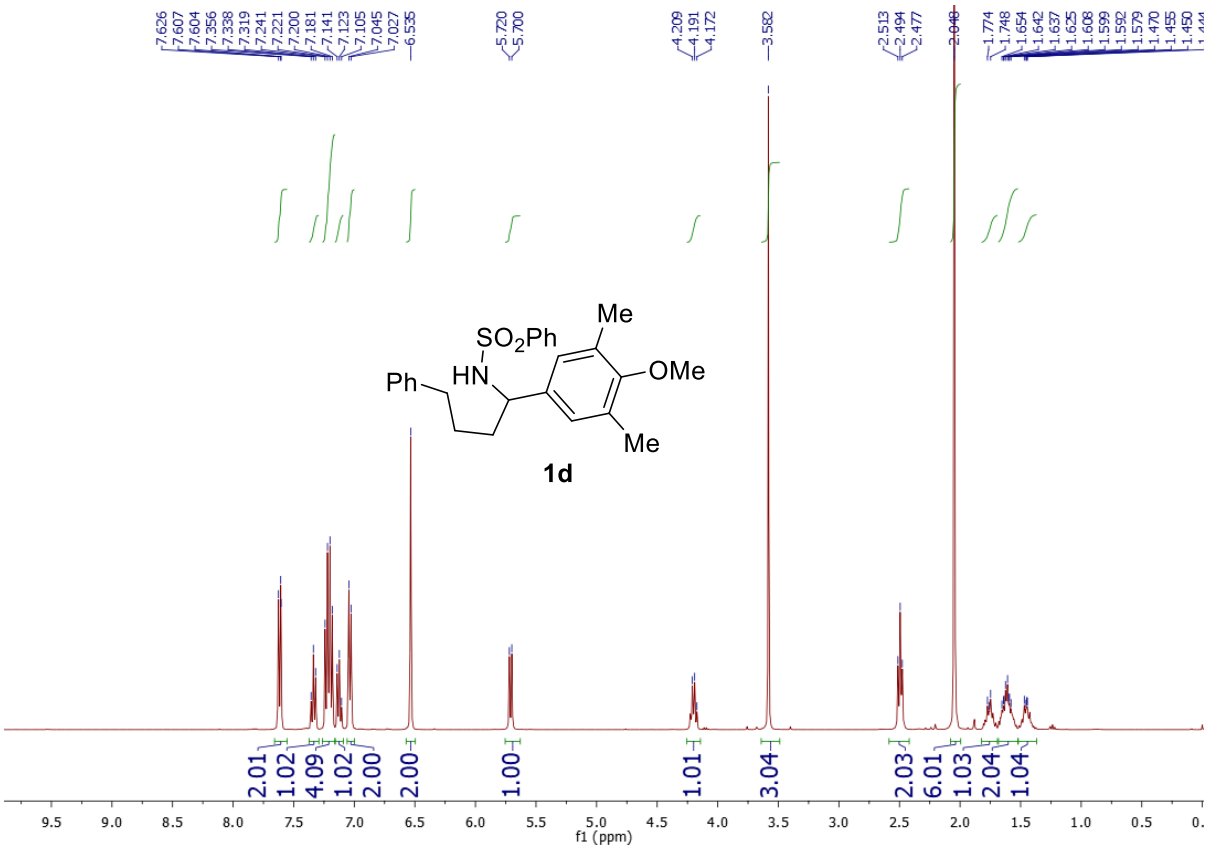
Ph
SMe
1c
f1 (ppm)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7.045
7.027
6.535
5.720
5.700
4.209
4.191
4.172
3.582
2.513
2.494
2.477
2.048
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1.748
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1.642
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1.625
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1.599
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1.579
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1.455
1.450
SO2Ph
HN
Ph
Me
OMe
Me
1d
2.01
1.02
4.09
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1.04
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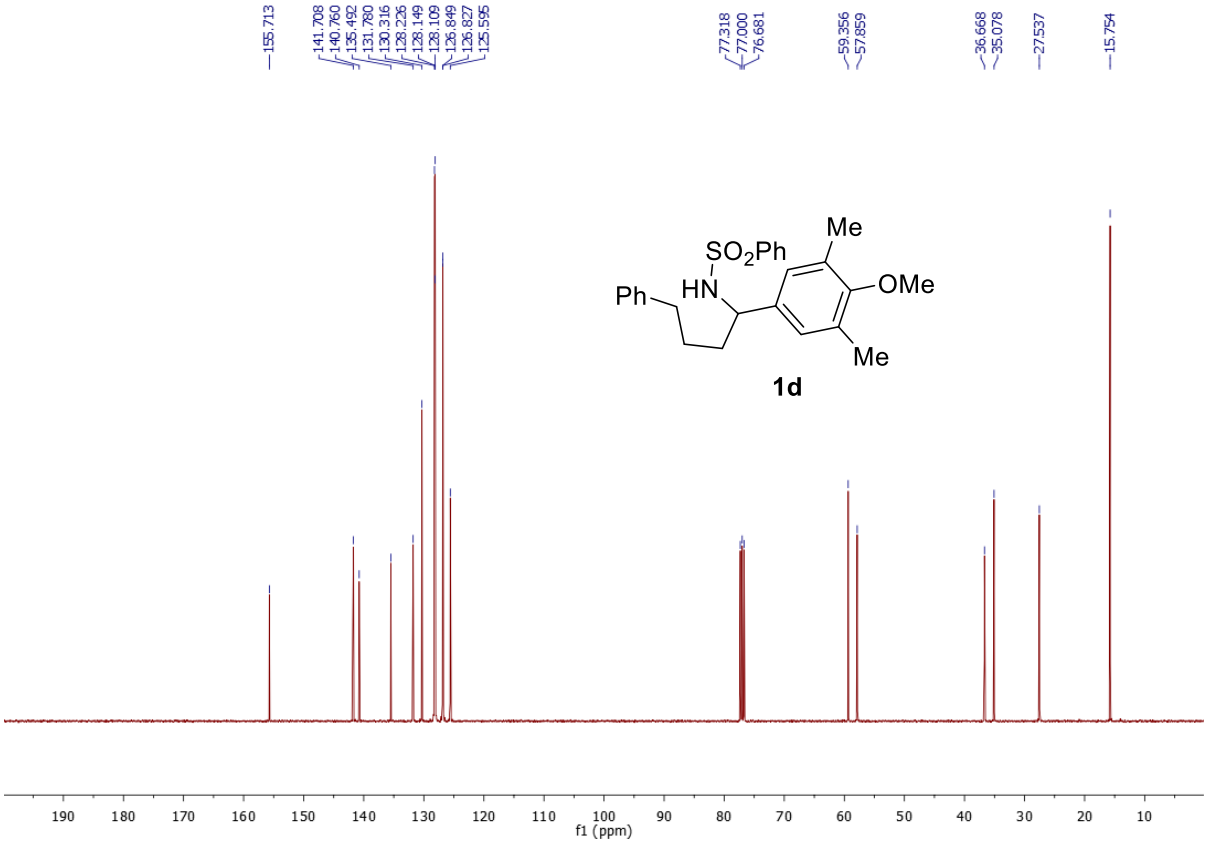
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77.000
76.681
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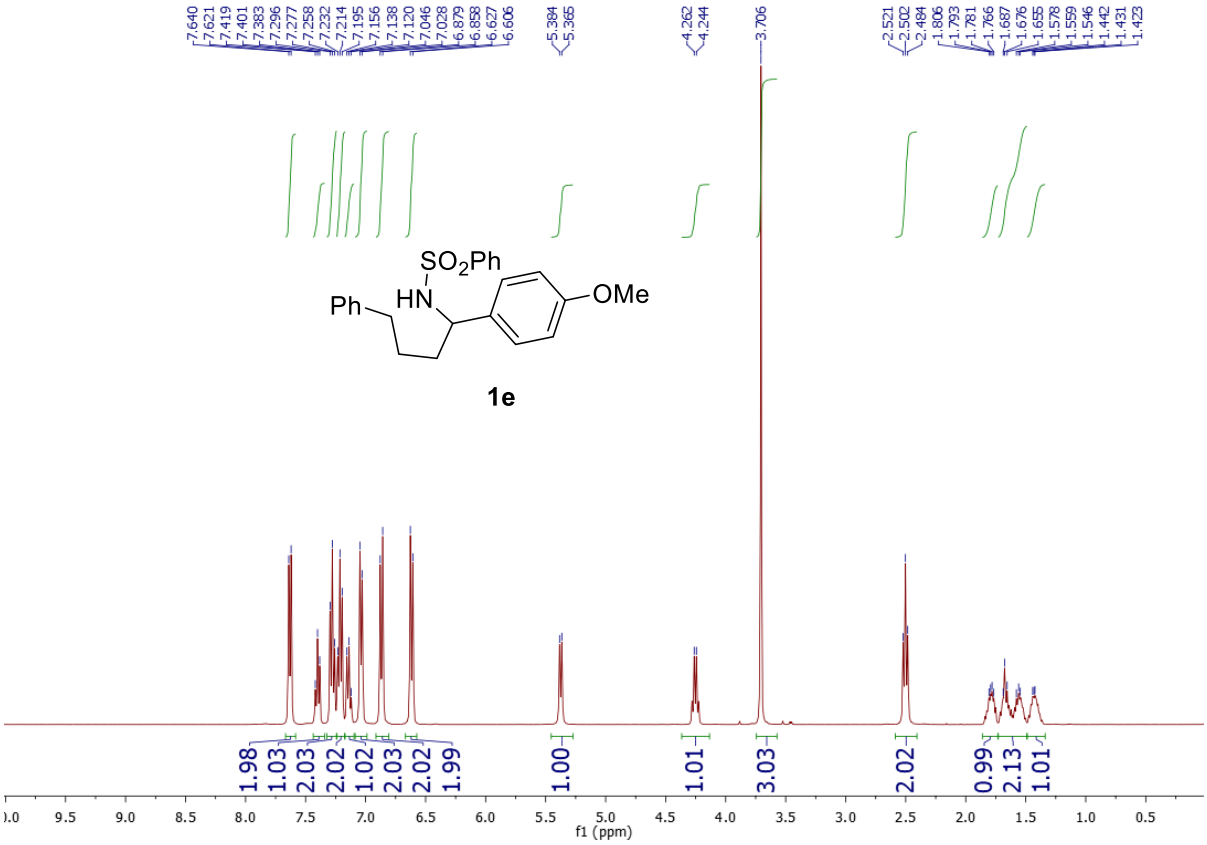
HN
Ph
Me
OMe
Me
1d
f1 (ppm)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7.046
7.028
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6.627
6.606
5.384
5.365
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4.244
3.706
2.521
2.502
2.484
1.806
1.793
1.781
1.766
1.687
1.676
1.655
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1.559
1.546
1.442
1.431
1.423
SO2Ph
HN
Ph
OMe
1e
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2.03
2.02
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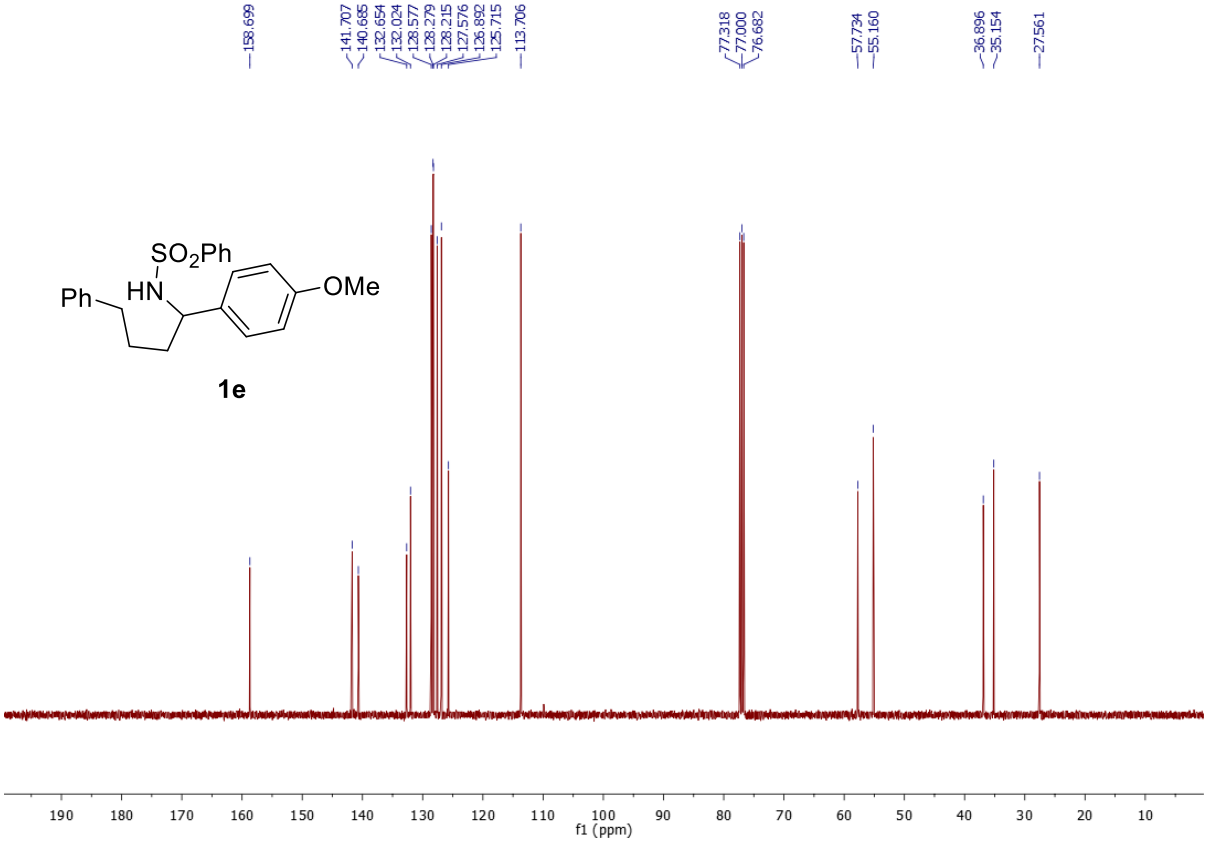
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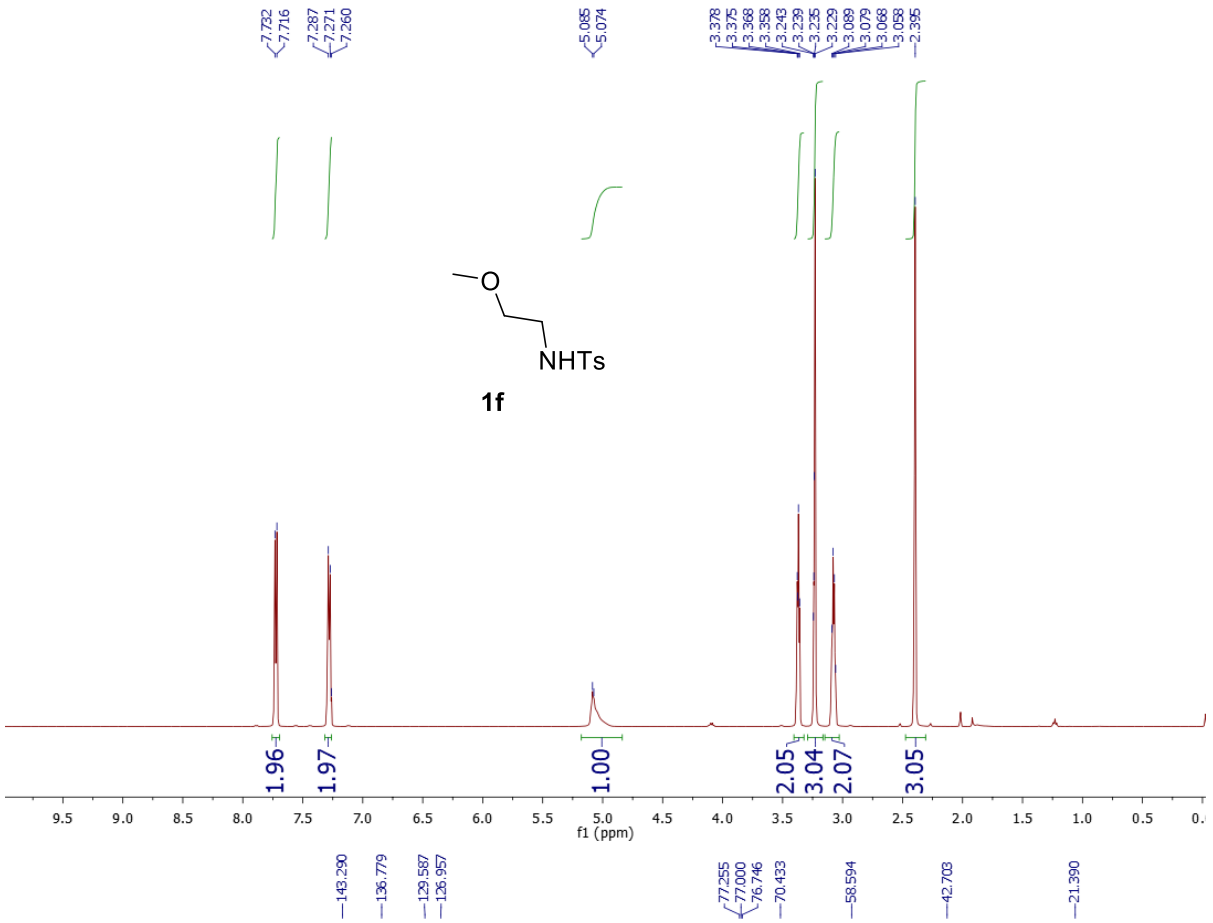
SO2Ph
HN
Ph
OMe
1e
f1 (ppm)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3.239
3.235
3.229
3.089
3.079
3.068
3.058
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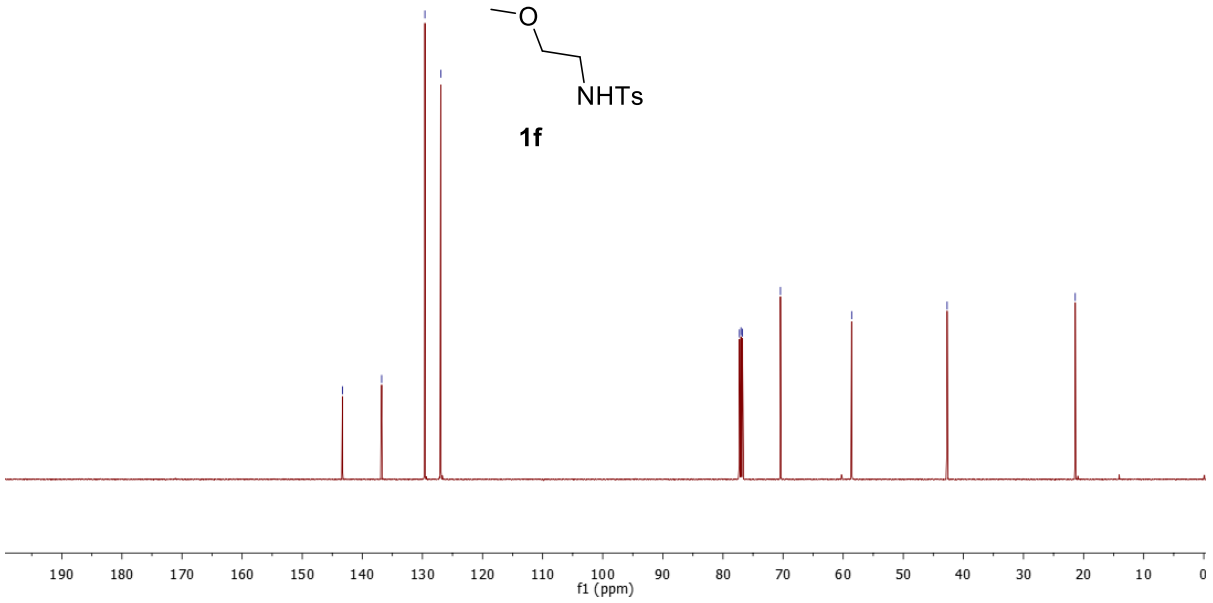
2.05
3.04
2.07
3.05
f1 (ppm)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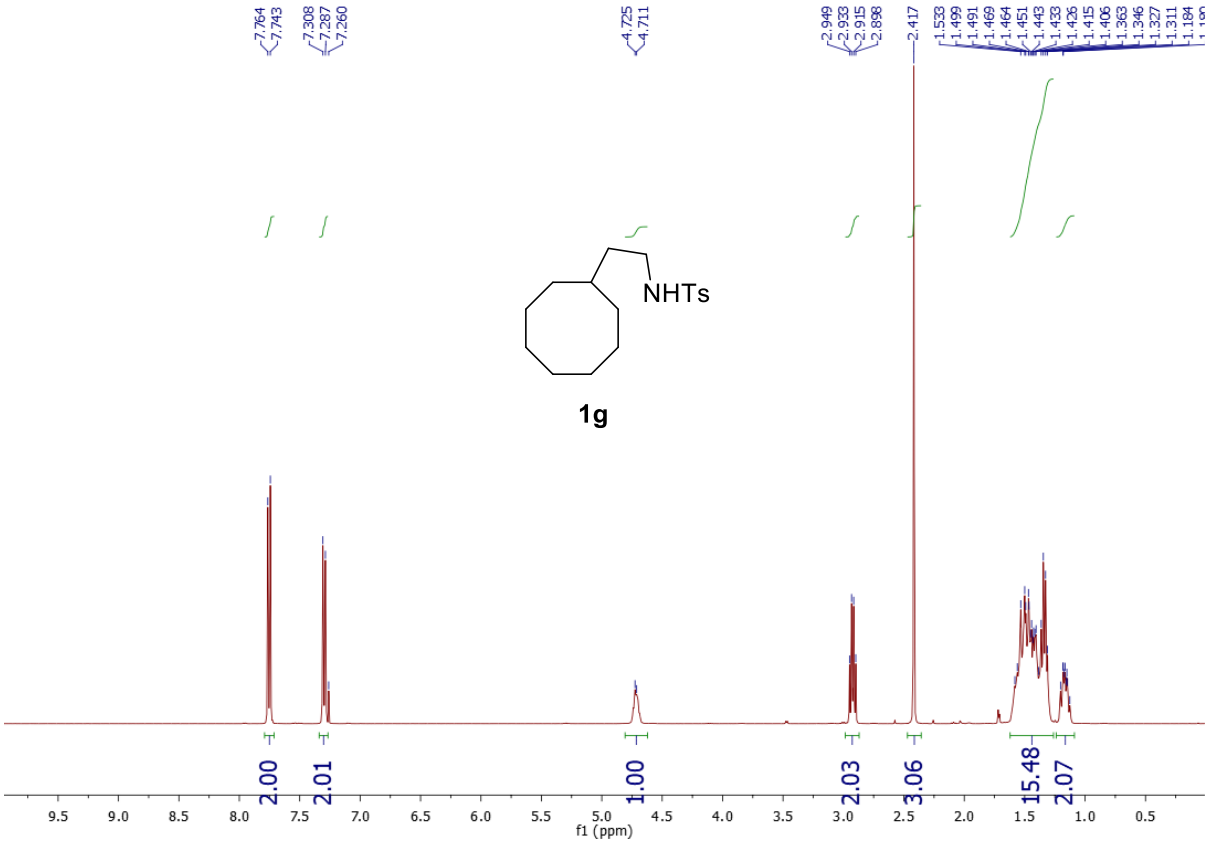
NHTs
1f
f1 (ppm)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1.499
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1.451
1.443
1.433
1.426
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1.346
1.327
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2.07
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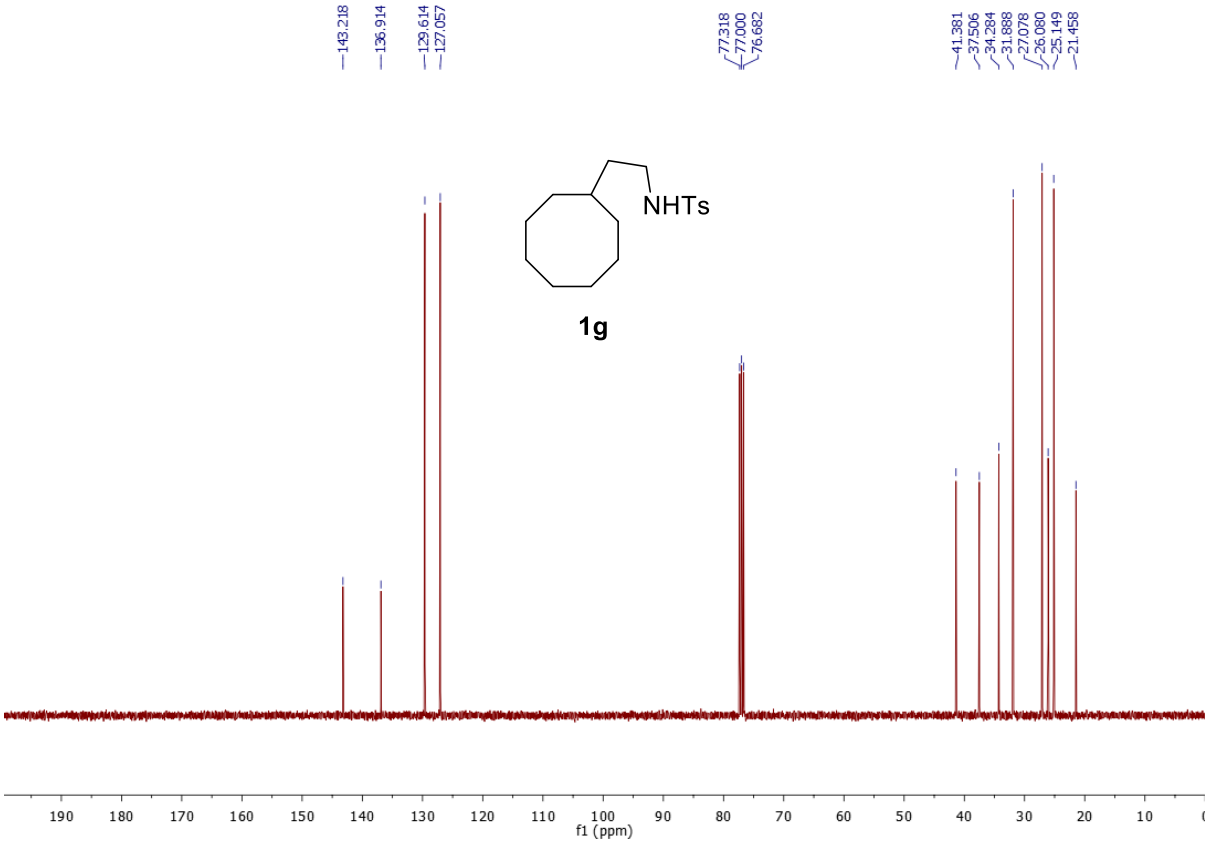
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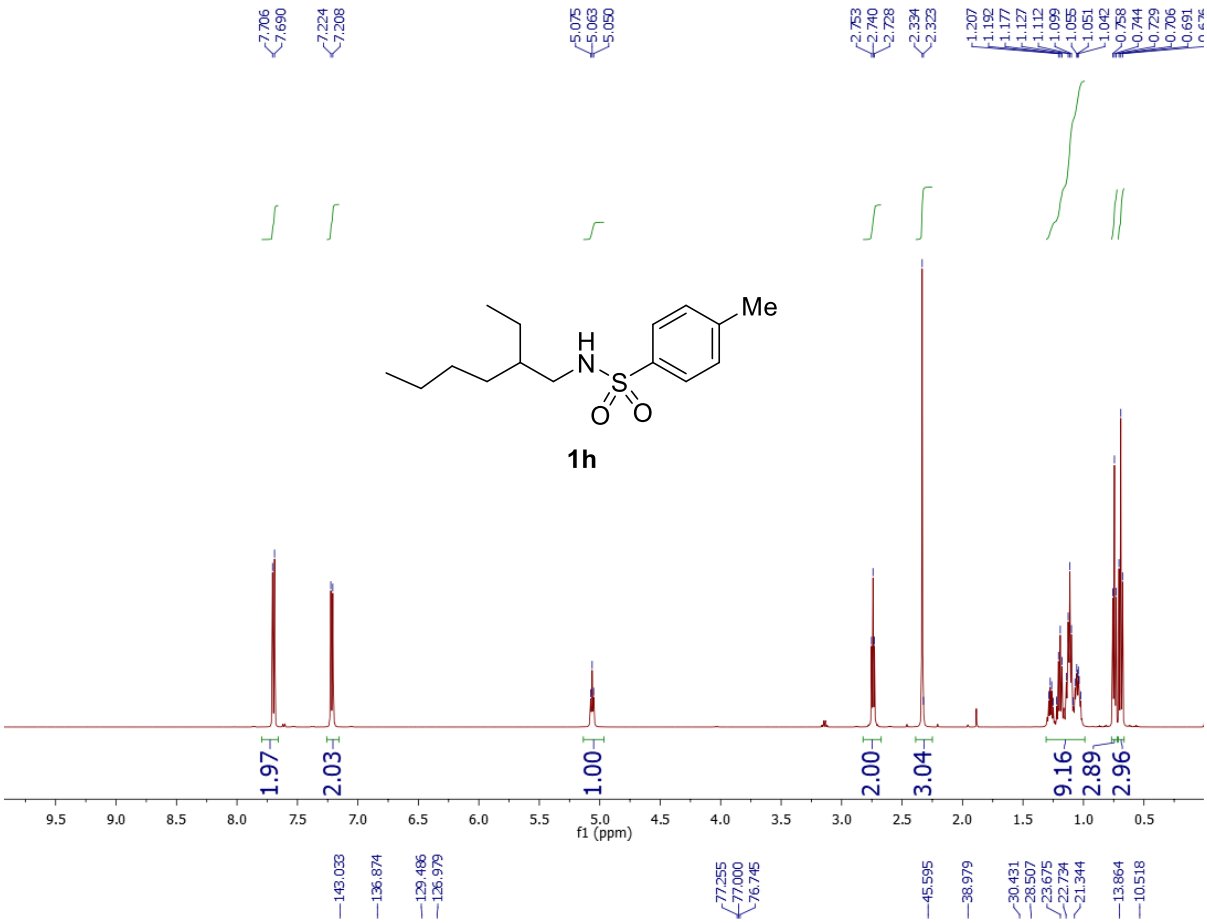
NHTs
1g
f1 (ppm)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1.099
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1.051
1.042
0.758
0.744
0.729
0.706
0.691
Me
H
N
S
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1h
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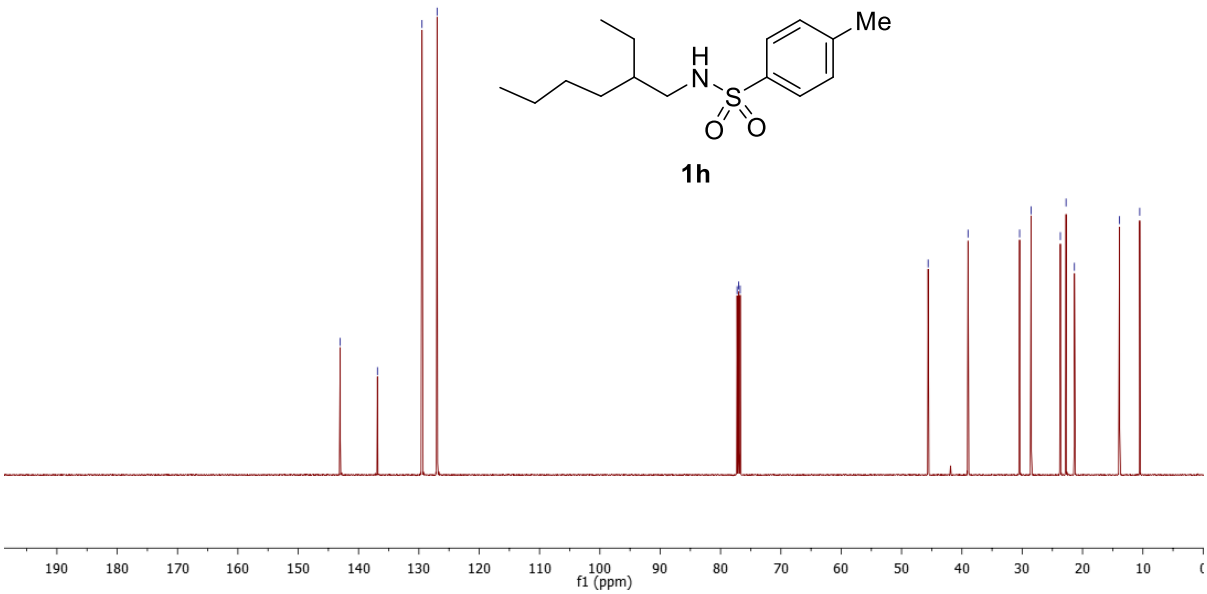
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O
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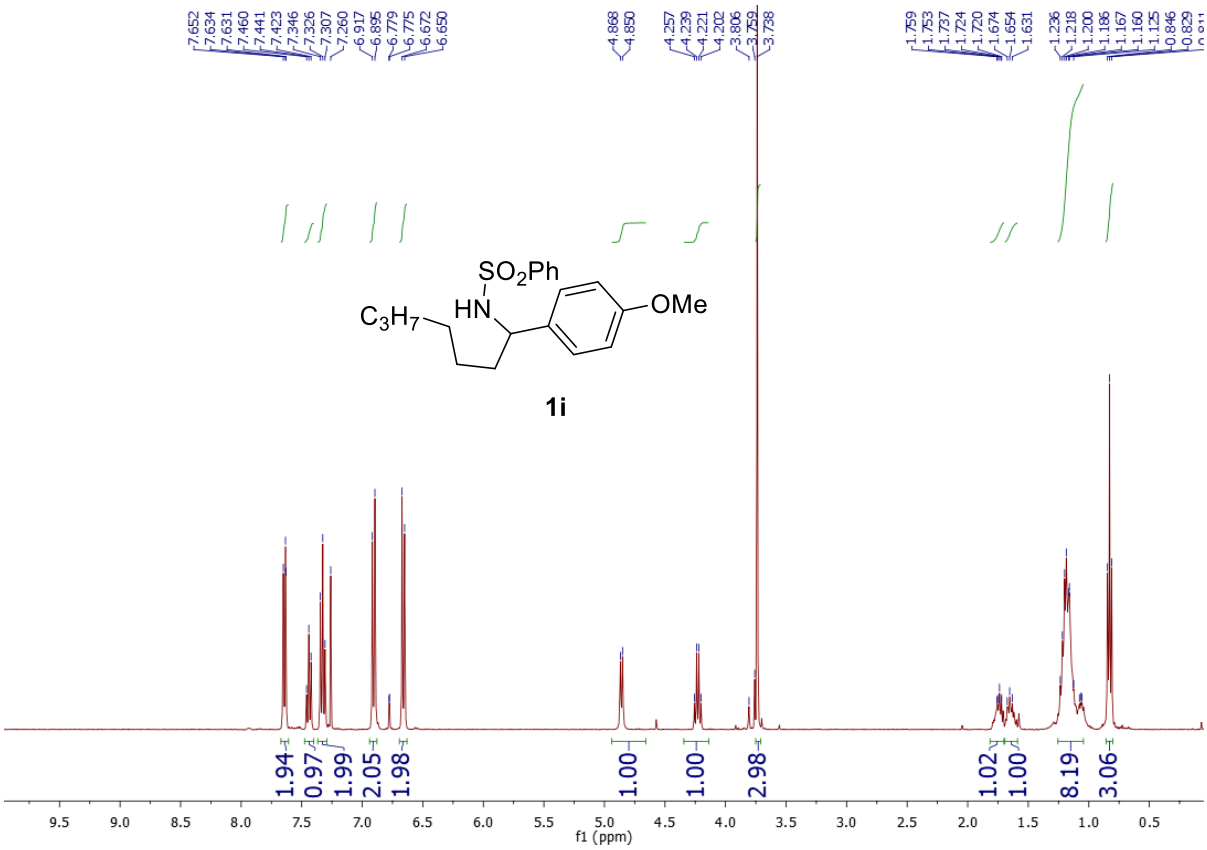
f1 (ppm)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3.738
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1.753
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1.674
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1.125
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SO2Ph
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C3H7
OMe
1i
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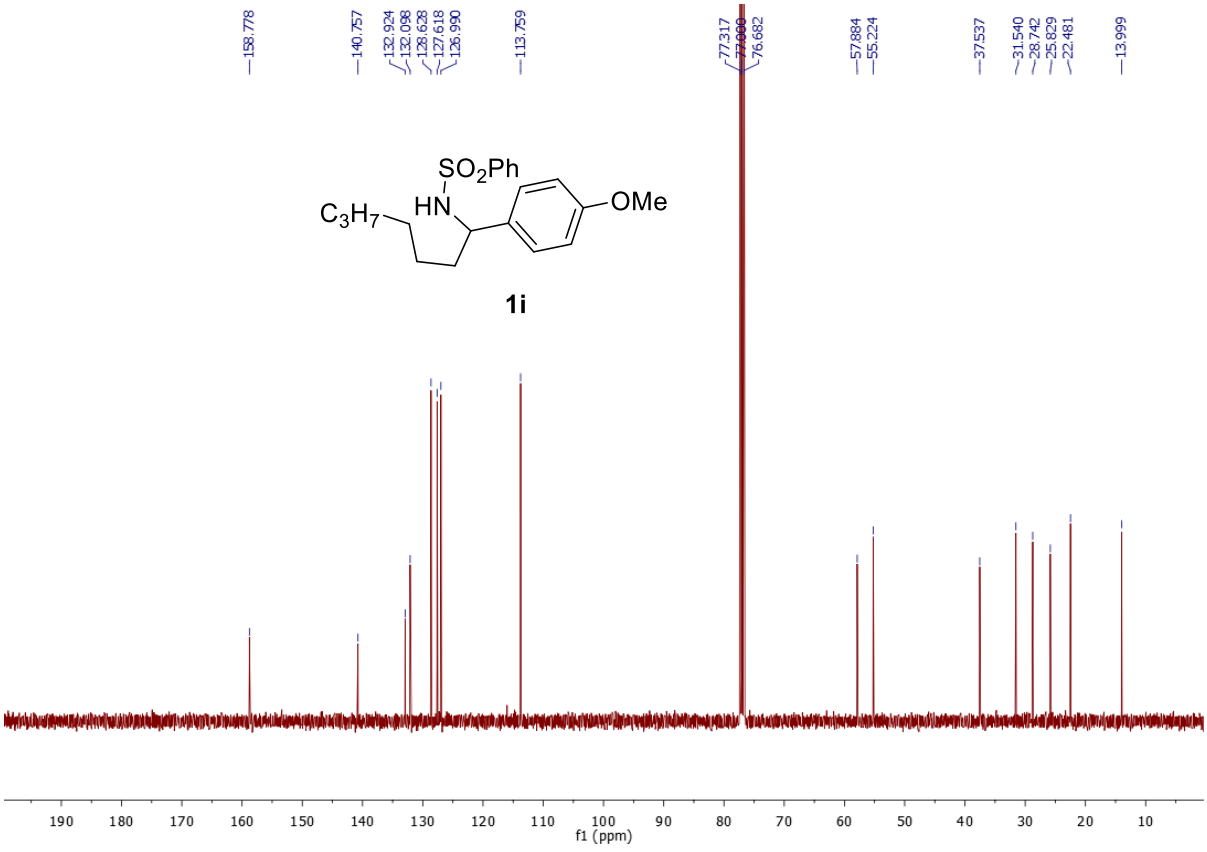
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22.481
13.999
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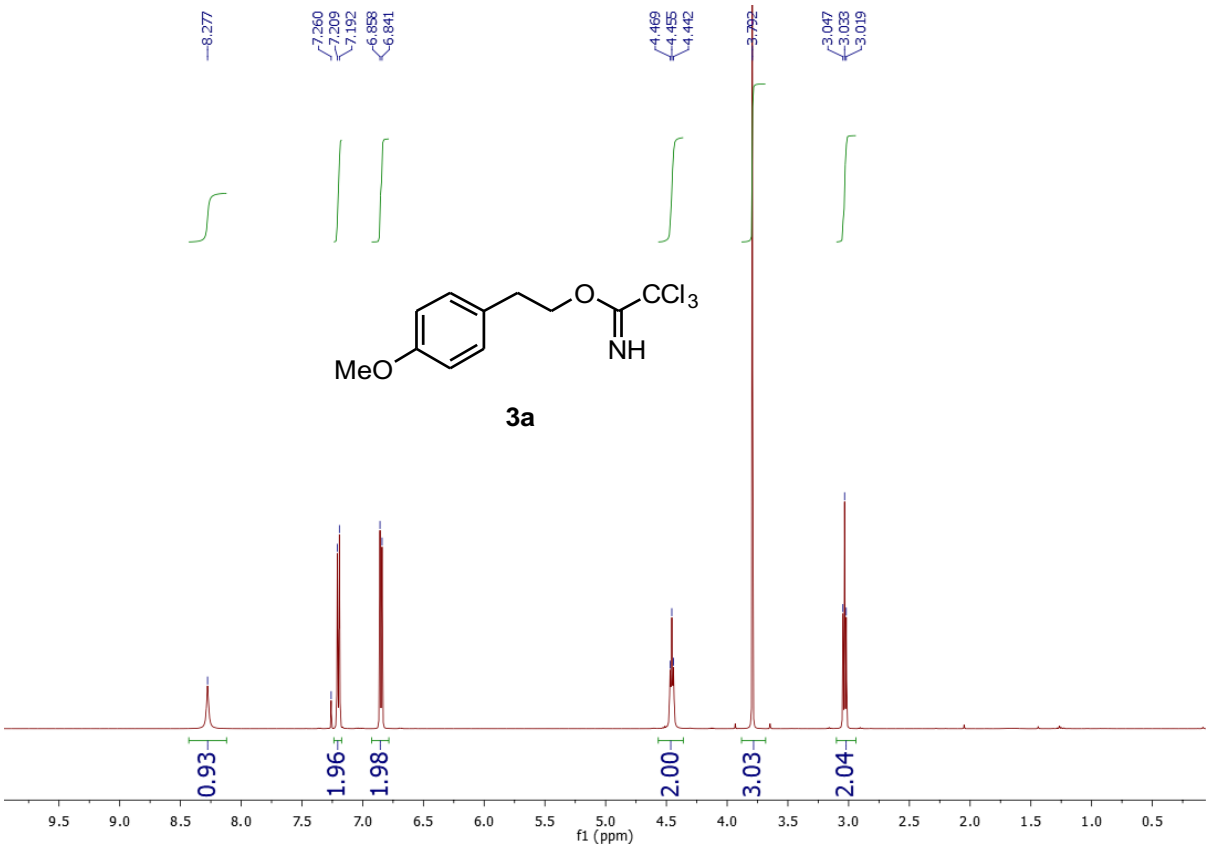
HN
C3H7
OMe
1i
f1 (ppm)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NH
MeO
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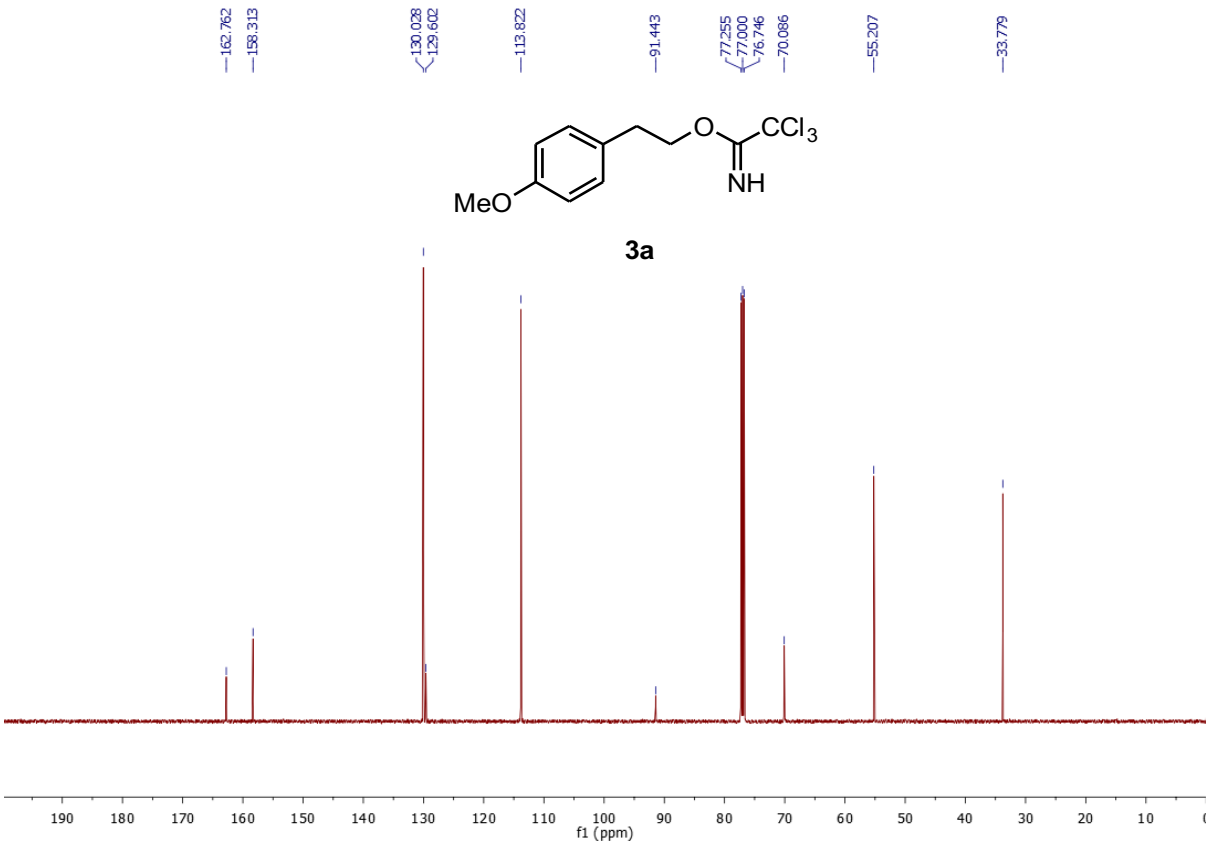
2.04
f1 (ppm)

3a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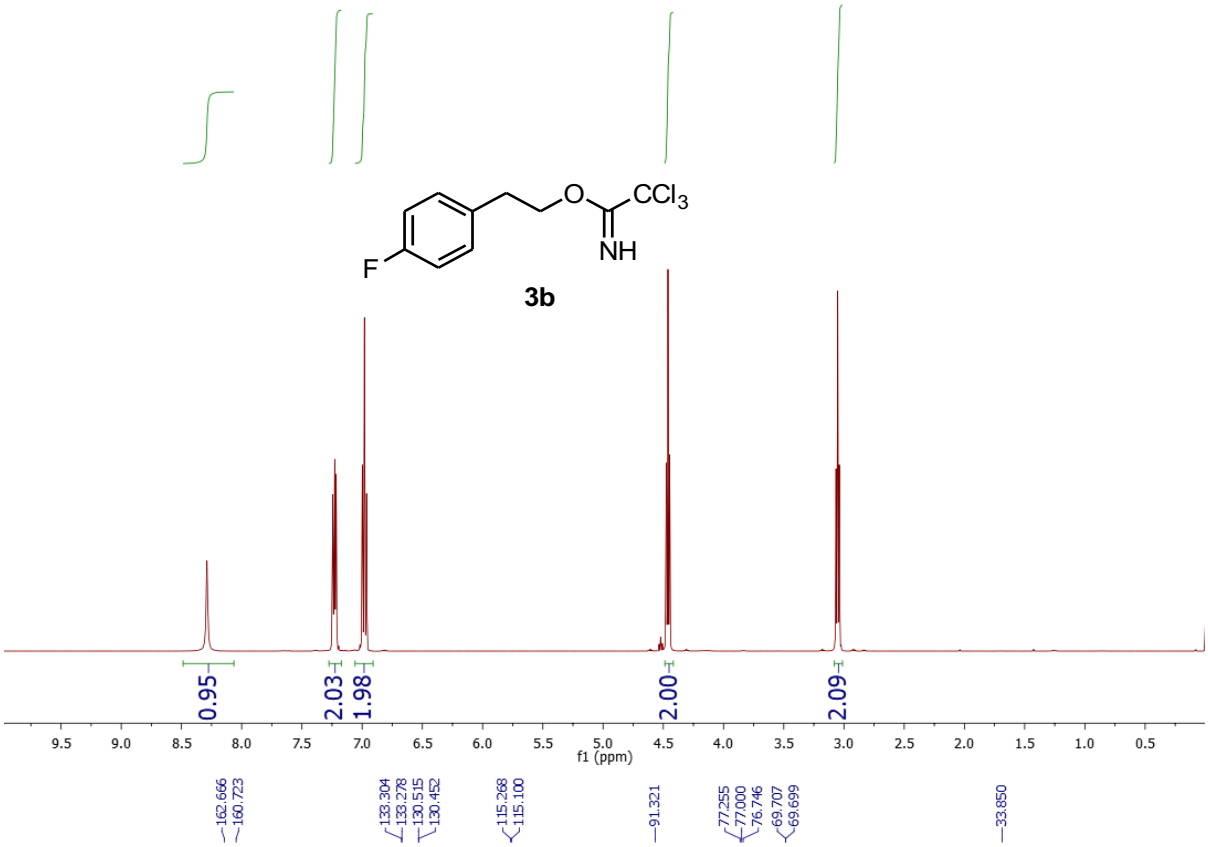
f1 (ppm)

3a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3b
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77.000
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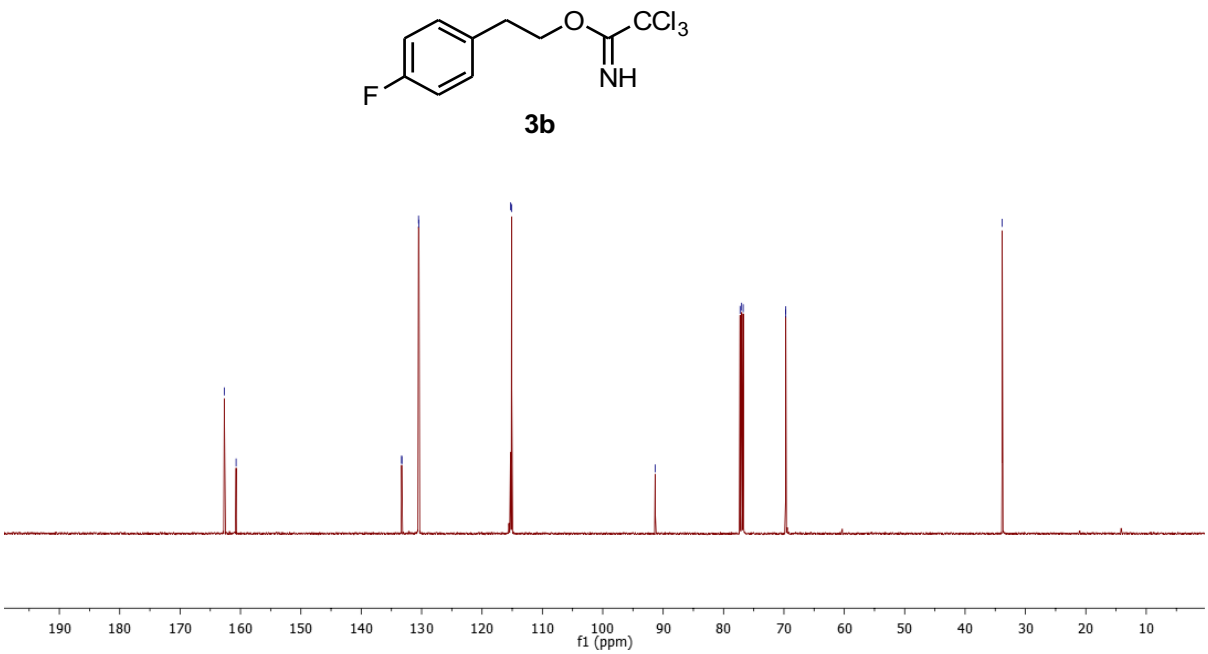
33.850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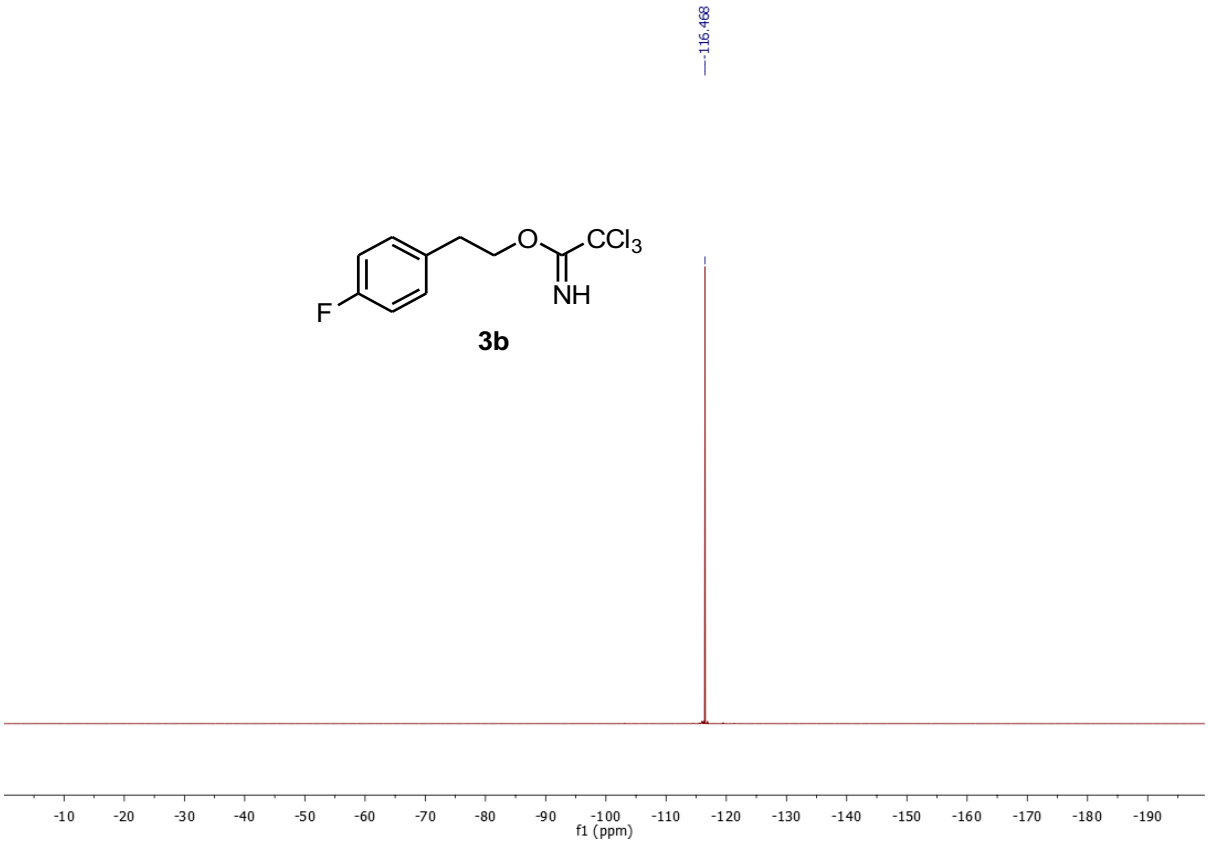
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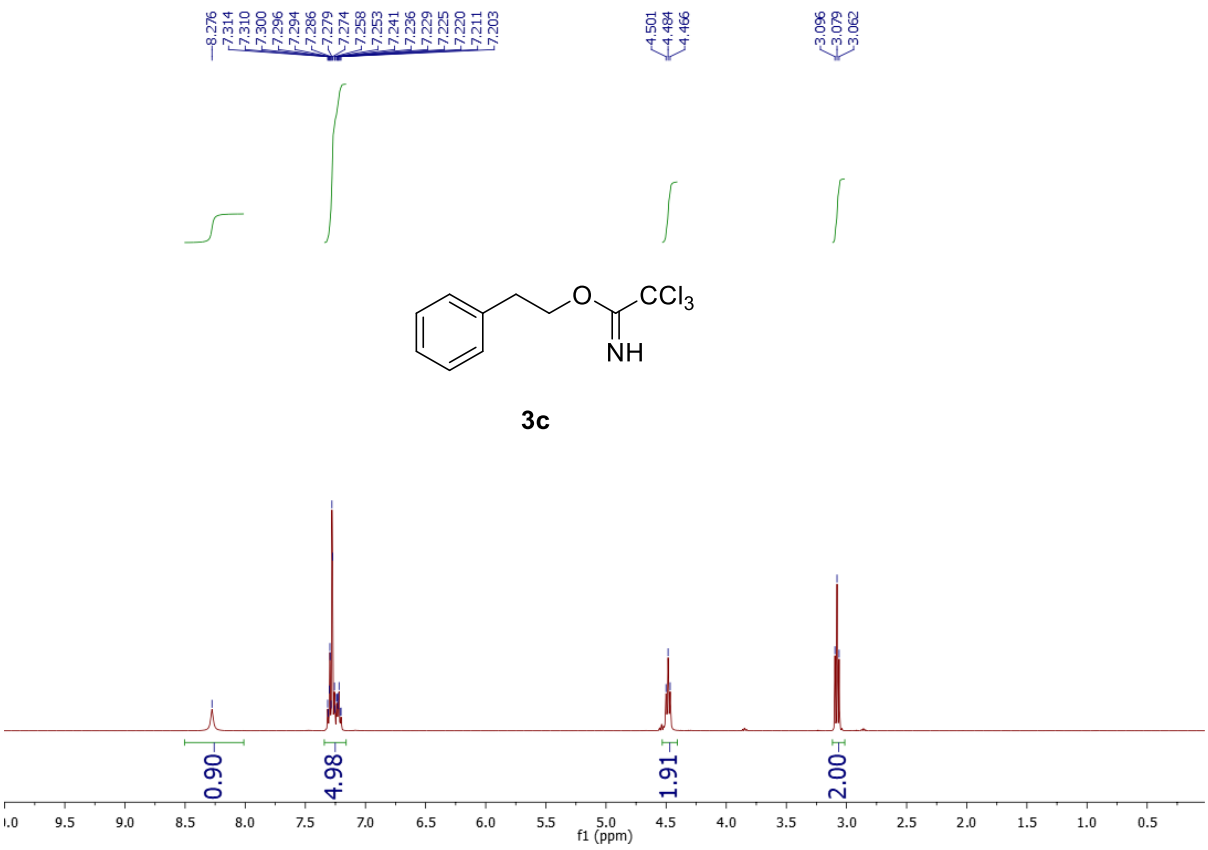
f1 (ppm)

3b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7.241
7.236
7.229
7.225
7.220
7.211
7.203
4.501
4.484
4.466
3.096
3.079
3.062
O
CCl3
NH
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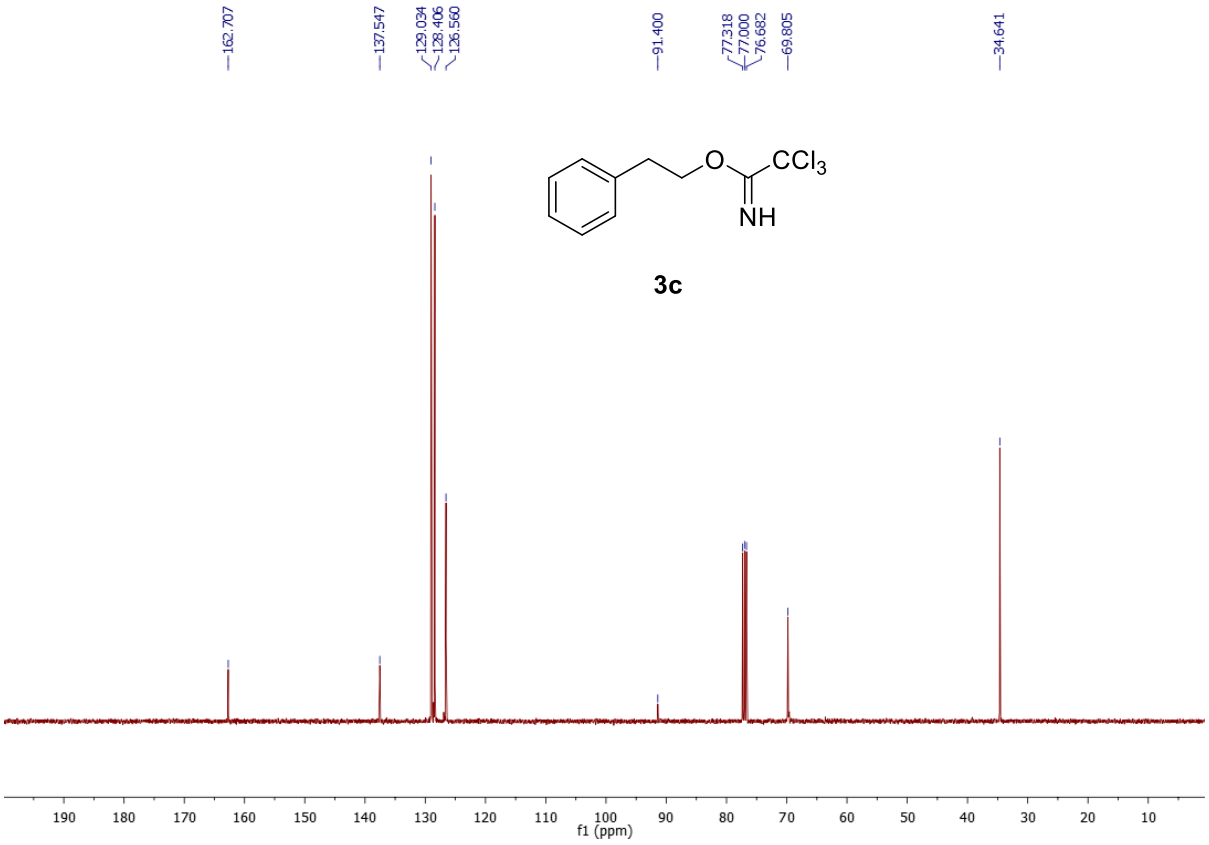
4.98
1.91
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

3c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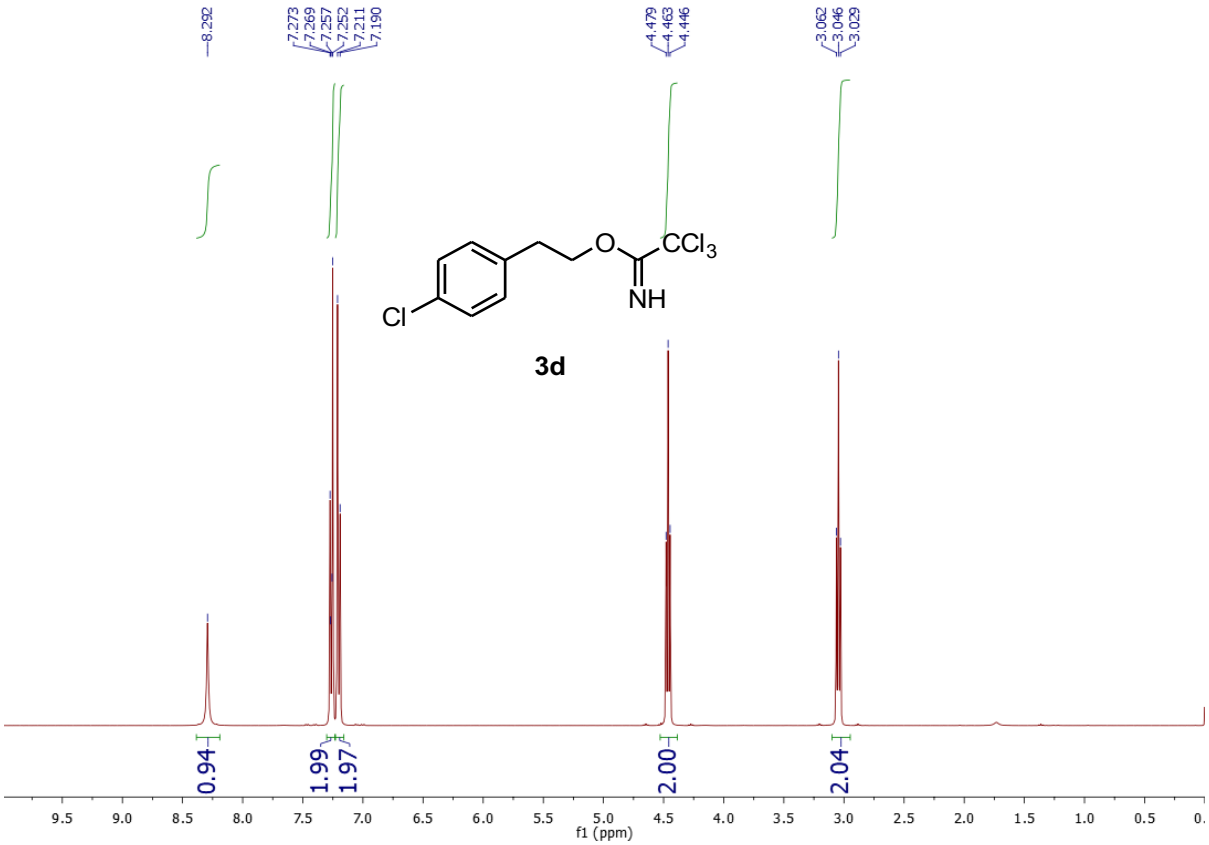
NH
f1 (ppm)

3c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2.04
f1 (ppm)

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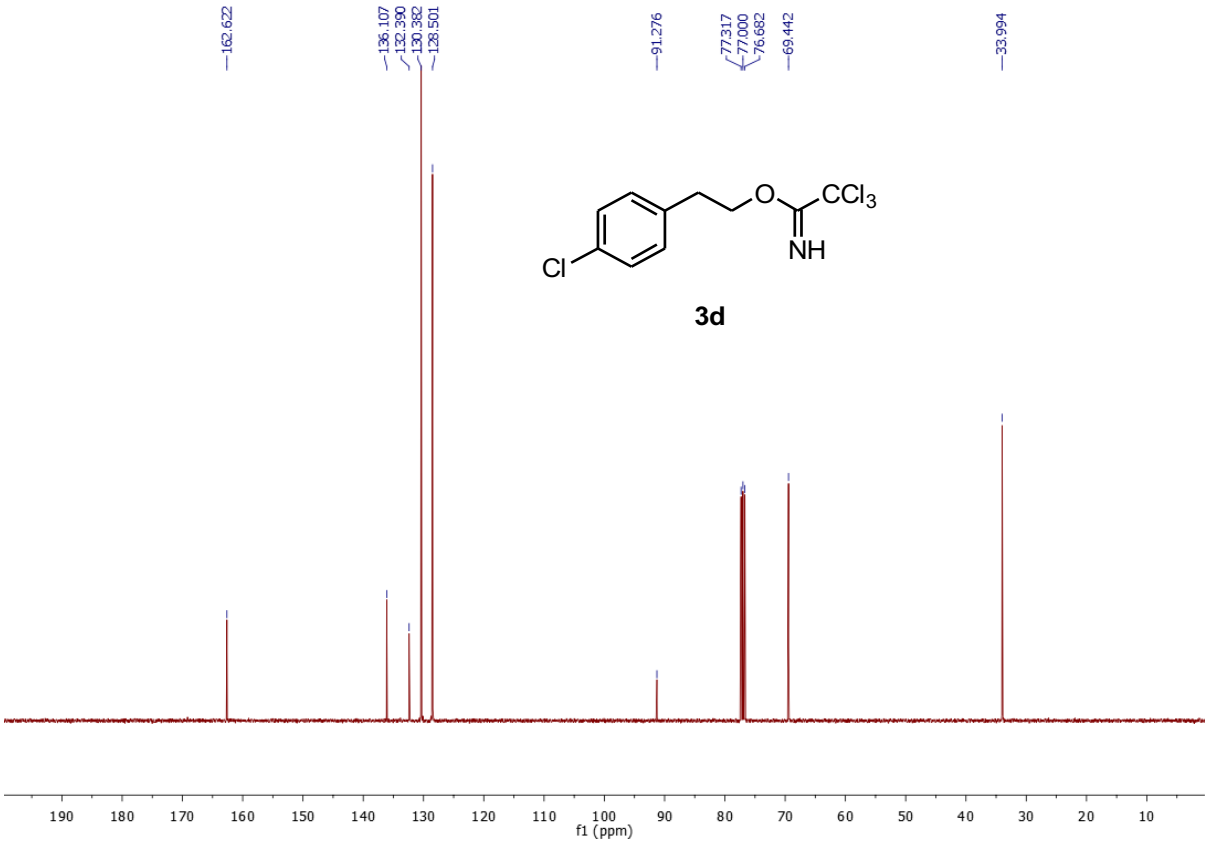
NH
Cl

3d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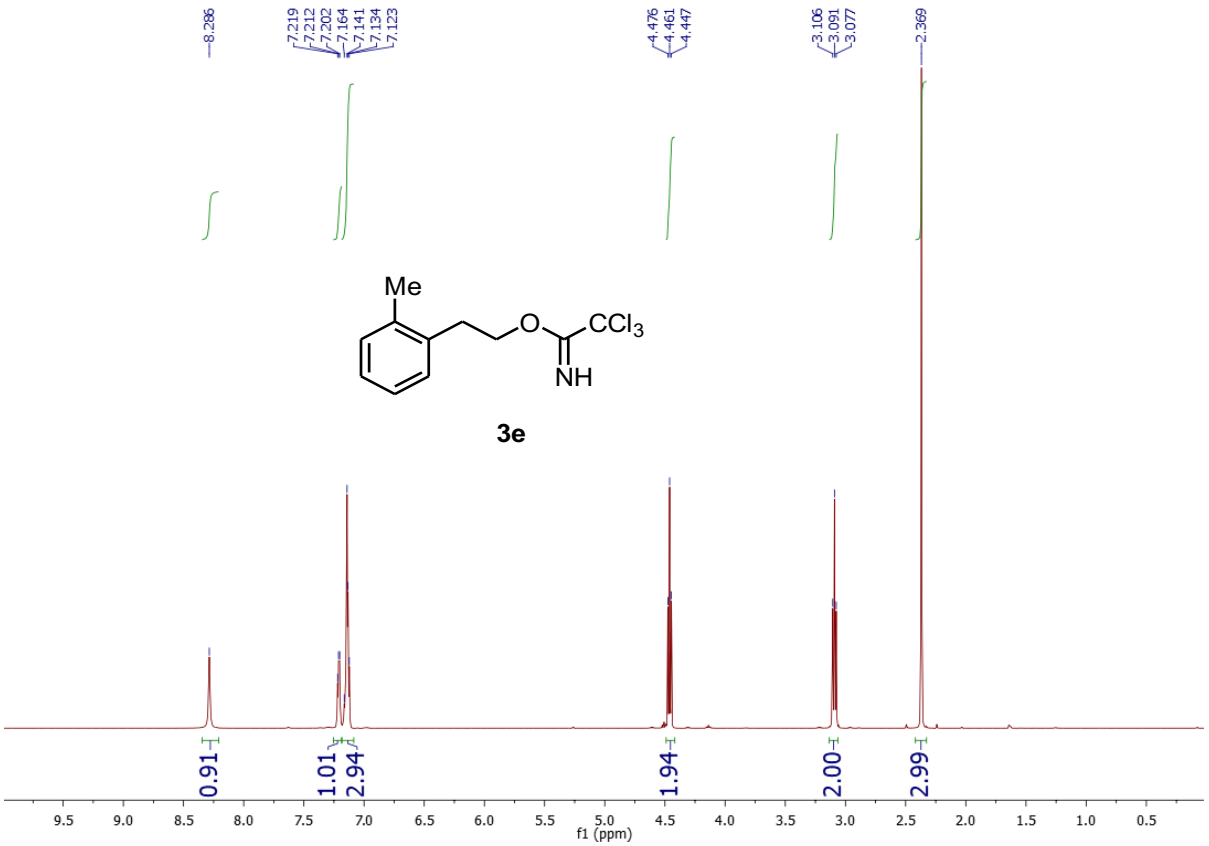
NH
Cl
f1 (ppm)

3d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4.447
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3.091
3.077
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CCl3
NH
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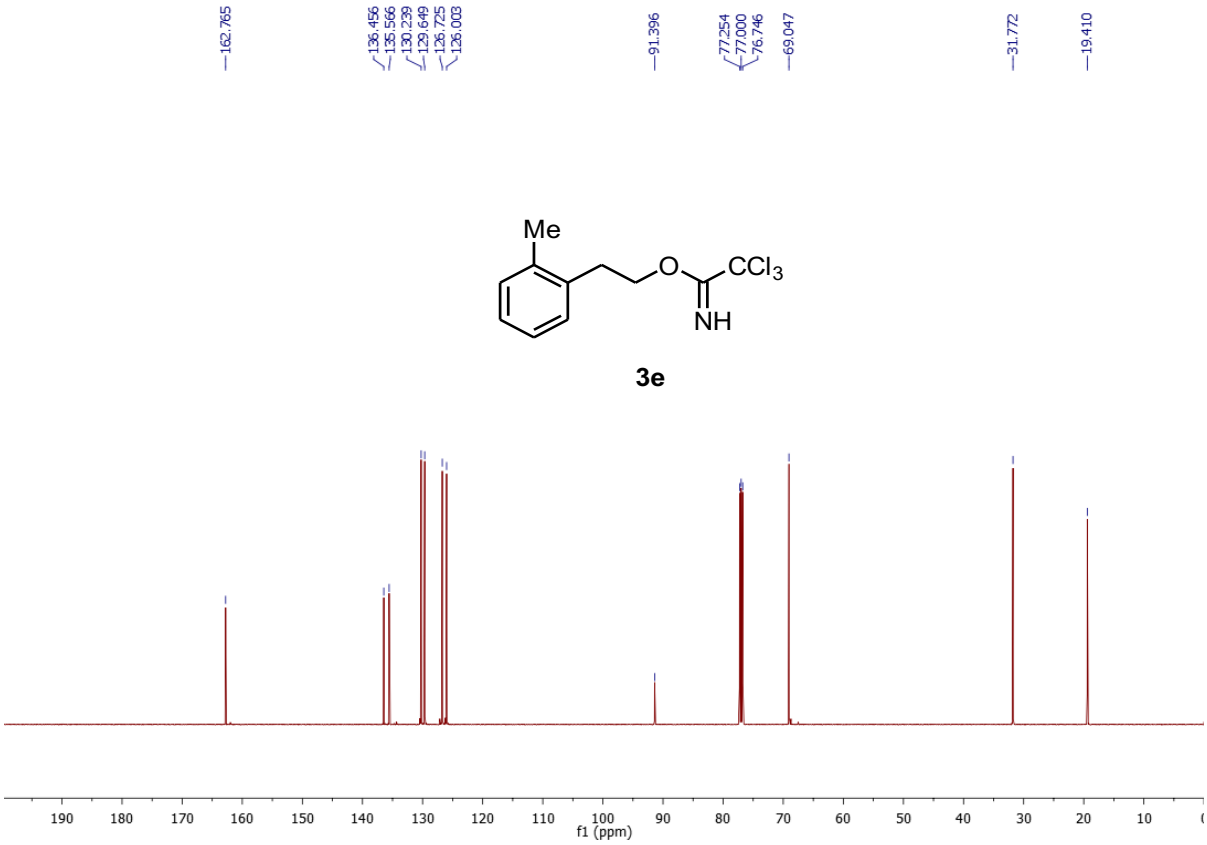
1.94
2.00
2.99
f1 (ppm)

3e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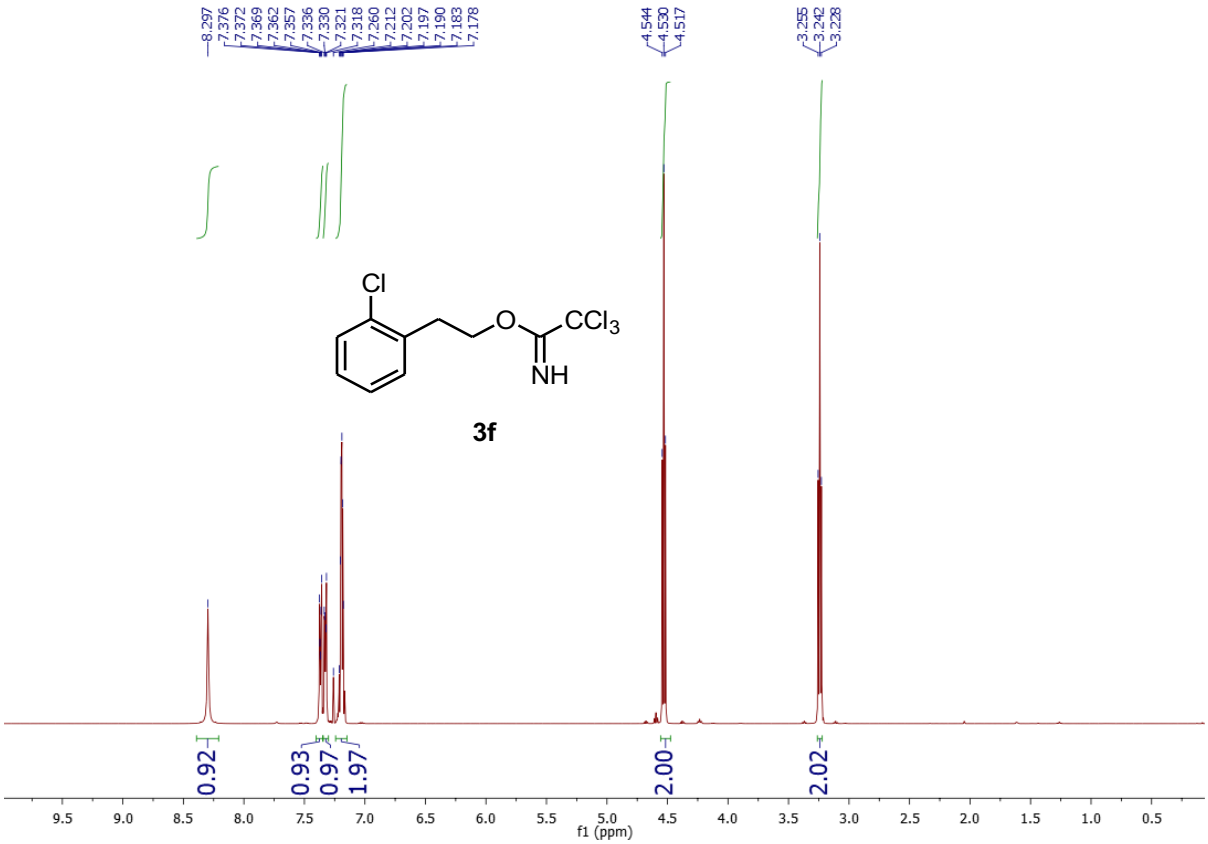
31.772
19.410
Me
O
CCl3
NH
3e
f1 (ppm)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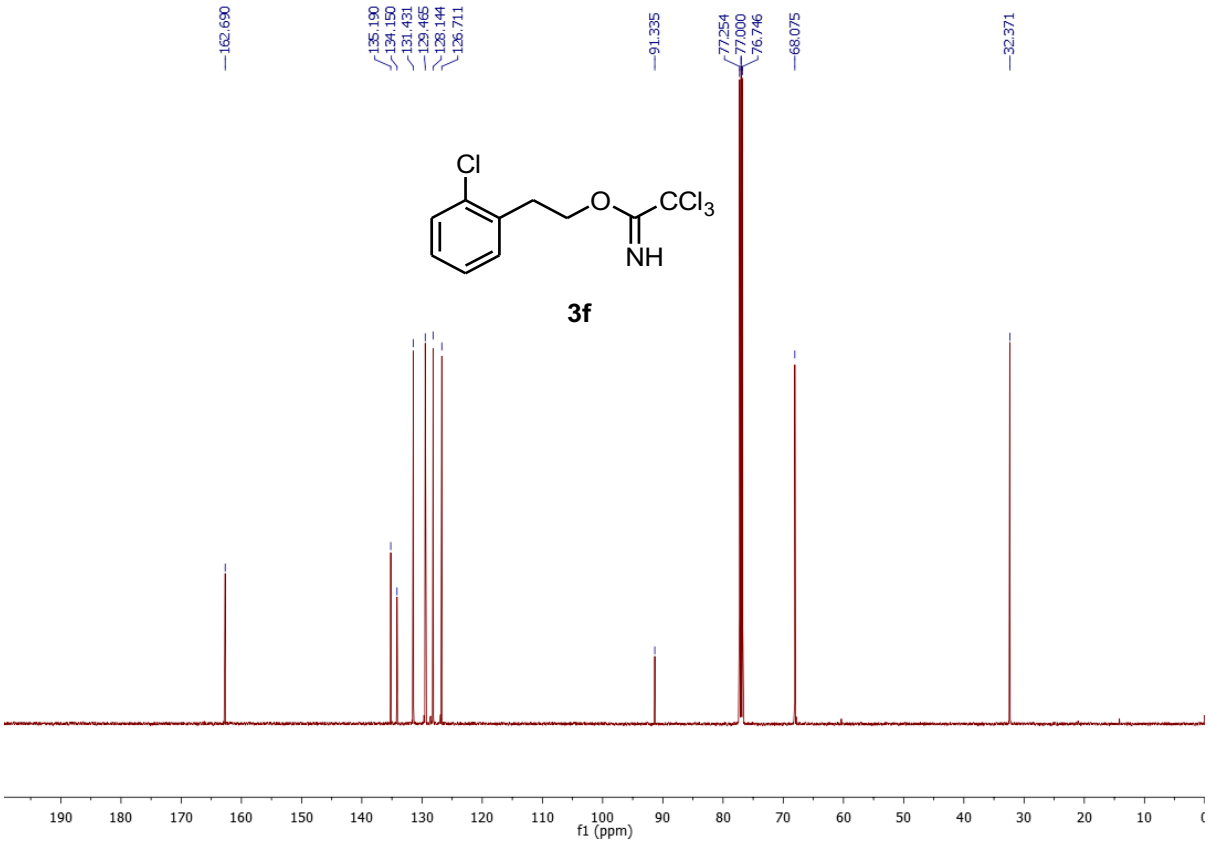
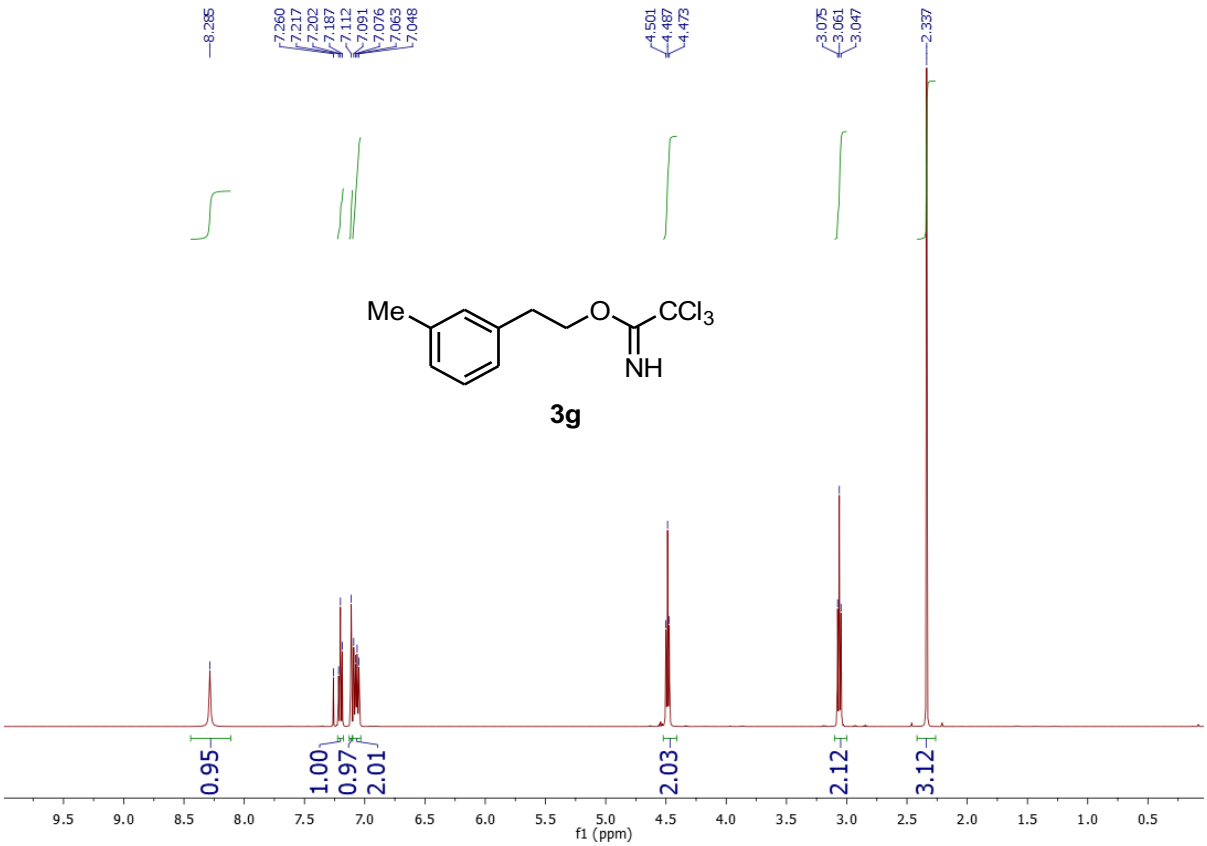
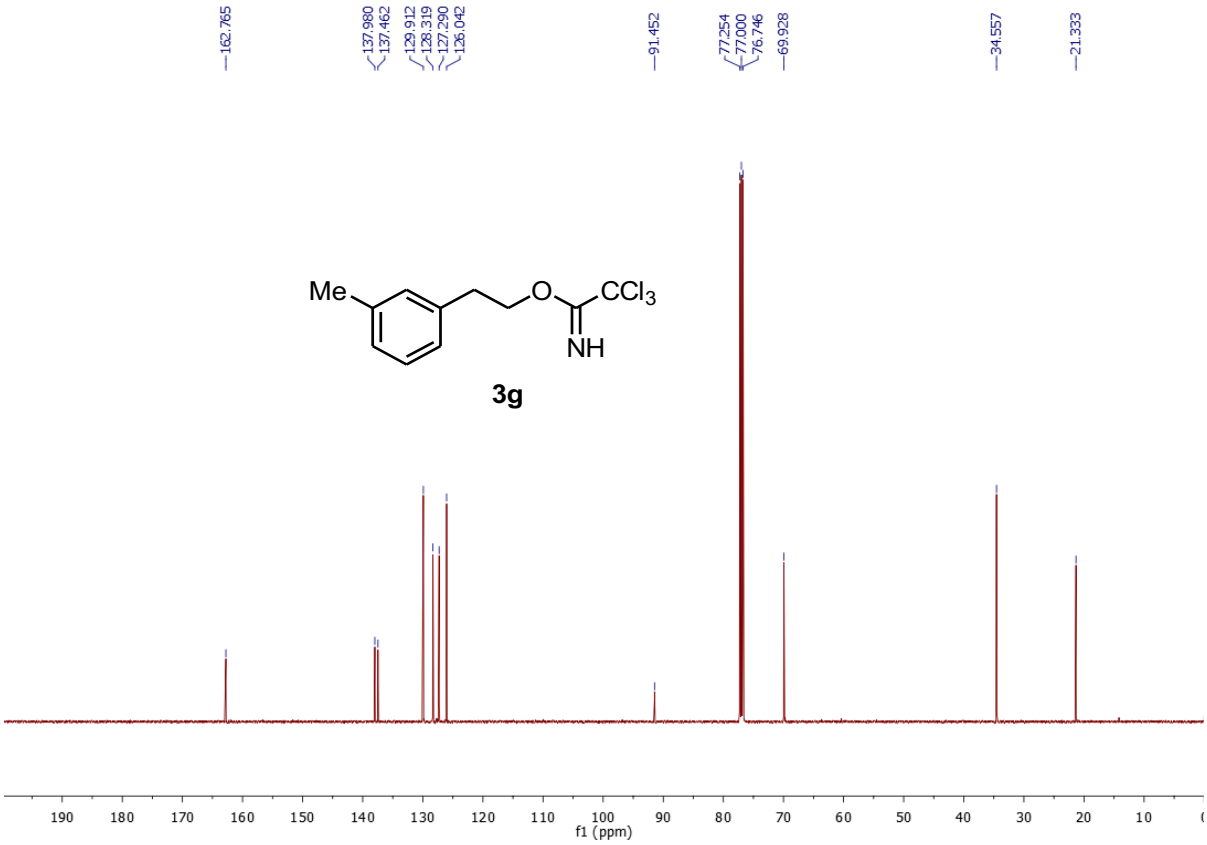
7.372
7.369
7.362
7.357
7.336
7.330
7.321
7.318
7.260
7.212
7.202
7.197
7.190
7.183
7.178
4.544
4.530
4.517
3.255
3.242
3.228
Cl
O
CCl3
NH
3f
0.92
0.93
0.97
1.97
2.00
2.02
f1 (ppm)


162.690
135.190
134.150
131.431
129.465
128.144
126.711
91.335
77.254
77.000
76.746
68.075
32.371
Cl
O
CCl3
NH
3f
f1 (ppm)


8.285
7.260
7.217
7.202
7.187
7.112
7.091
7.076
7.063
7.048
4.501
4.487
4.473
3.075
3.061
3.047
2.337
Me
O
CCl3
NH
3g
0.95
1.00
0.97
2.01
2.03
2.12
3.12
f1 (ppm)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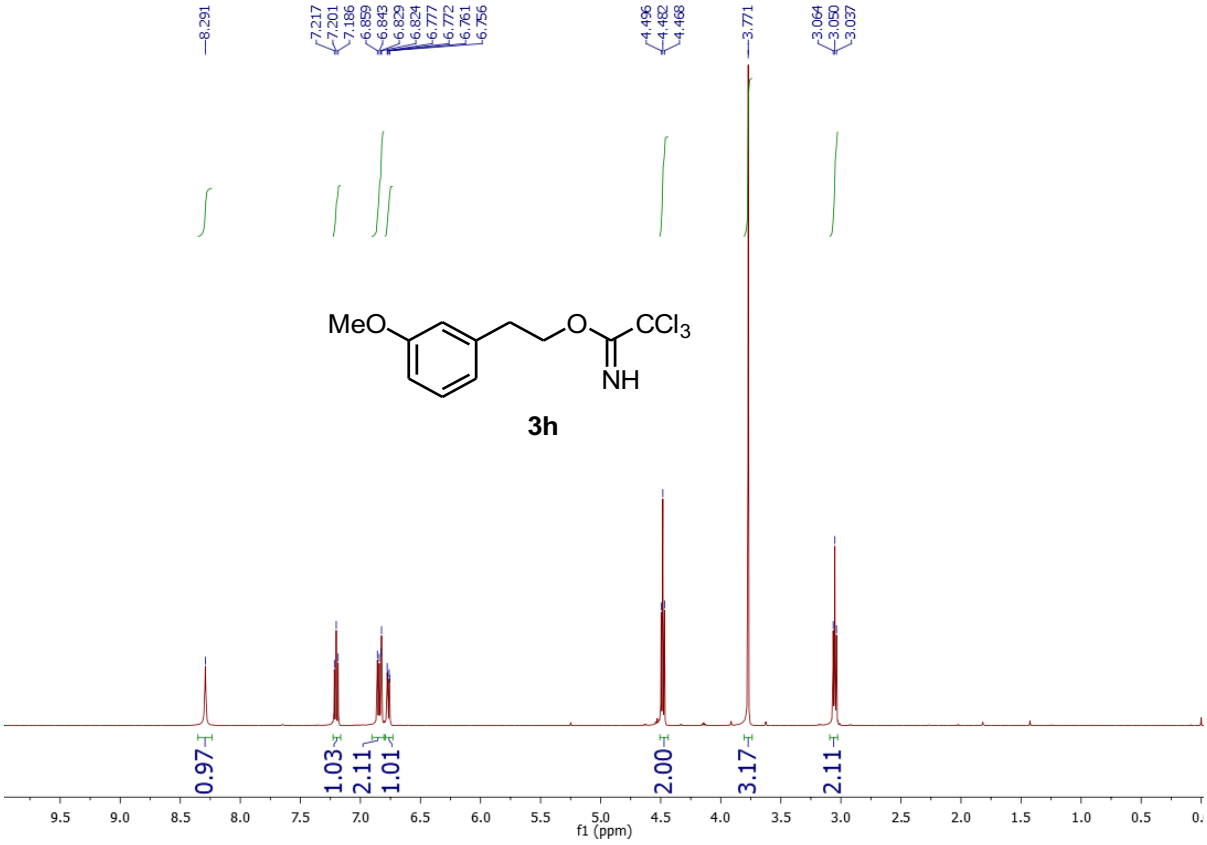
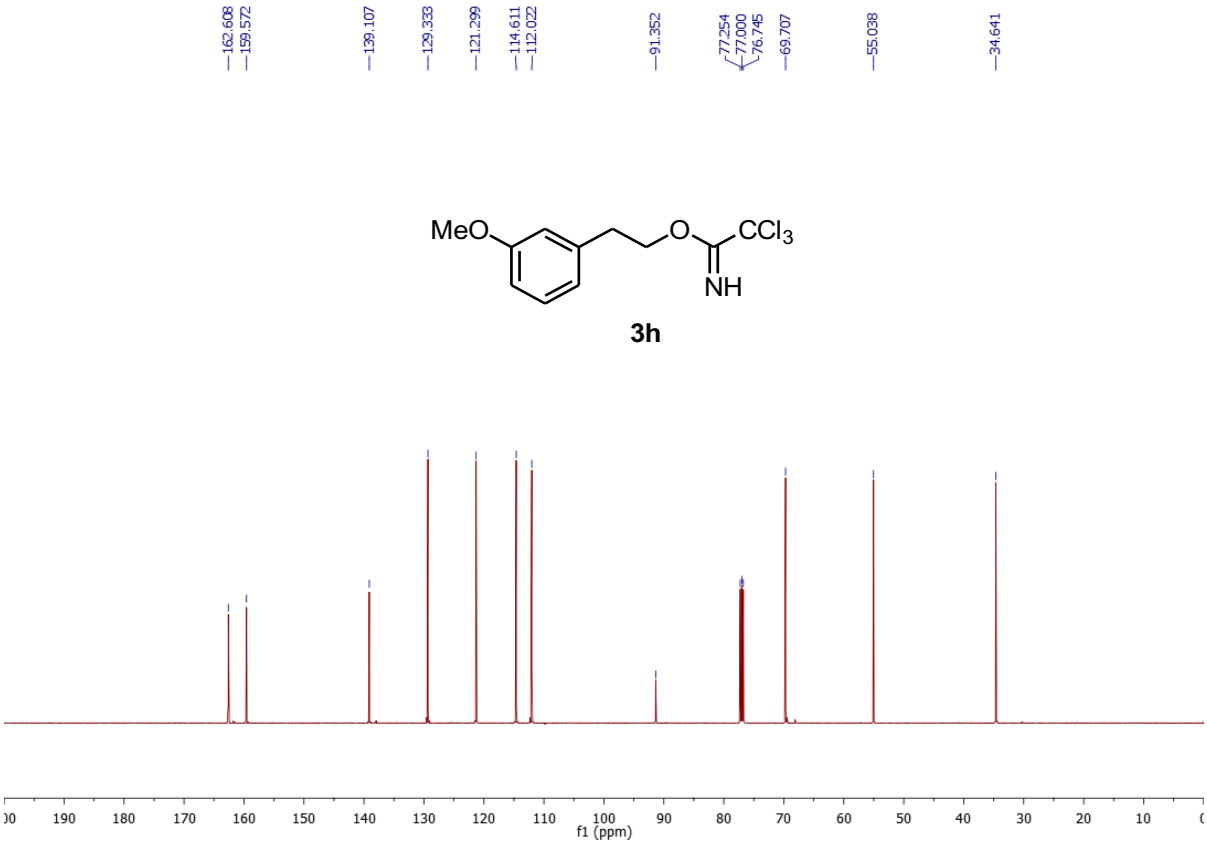
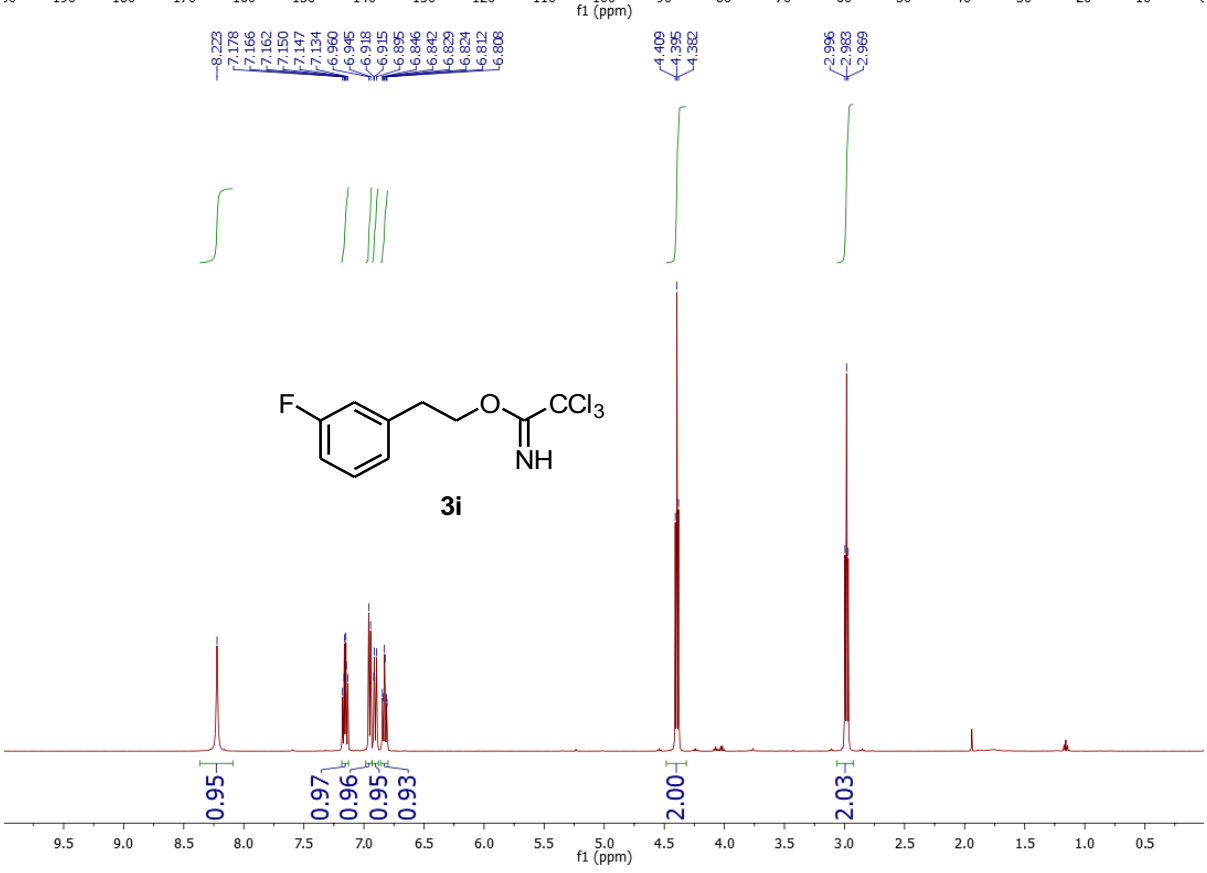
137.980
137.462
129.912
128.319
127.290
126.042
91.452
77.254
77.000
76.746
69.928
34.557
21.333
Me
O
CCl3
NH
3g
f1 (ppm)

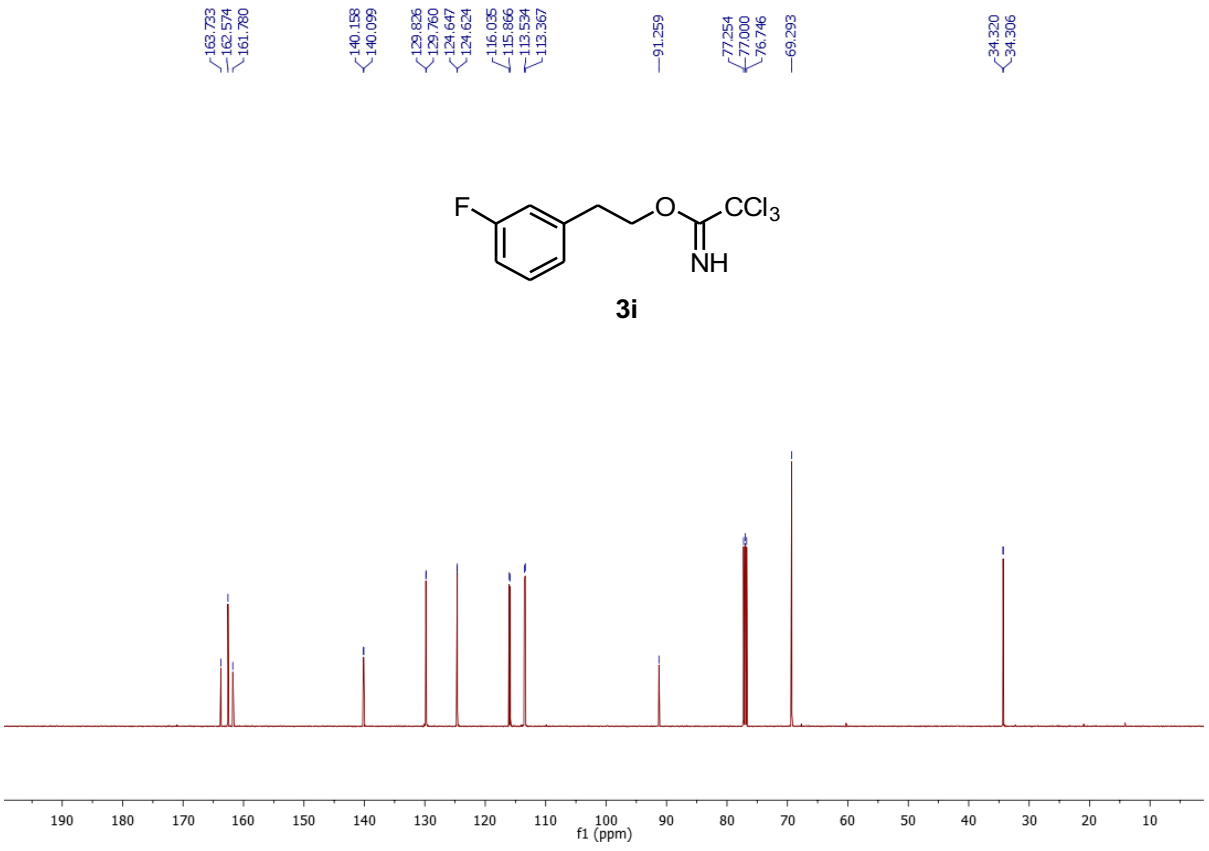

8.291
7.217
7.201
7.186
6.859
6.843
6.829
6.824
6.777
6.772
6.761
6.756
4.496
4.482
4.468
3.771
3.064
3.050
3.037
MeO
O
CCl3
NH
3h
0.97
1.03
2.11
1.01
2.00
3.17
2.11
f1 (ppm)


162.608
159.572
139.107
129.333
121.299
114.611
112.022
91.352
77.254
77.000
76.745
69.707
55.038
34.641
MeO
O
CCl3
NH
f1 (ppm)

3h


8.223
7.178
7.166
7.162
7.150
7.147
7.134
6.960
6.945
6.918
6.915
6.895
6.846
6.842
6.829
6.824
6.812
6.808
4.409
4.395
4.382
2.996
2.983
2.969
F
O
CCl3
NH
0.95
0.97
0.96
0.95
0.93
2.00
2.03
f1 (ppm)

3i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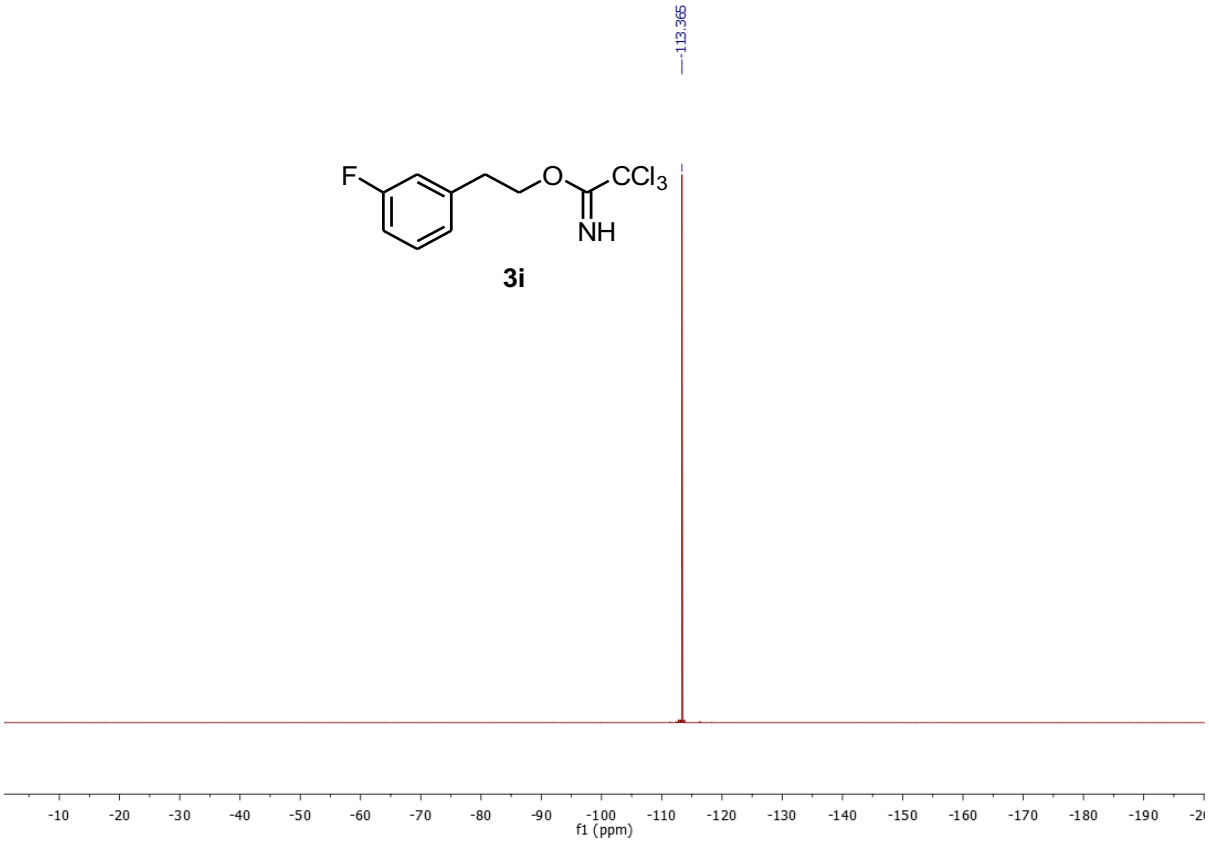
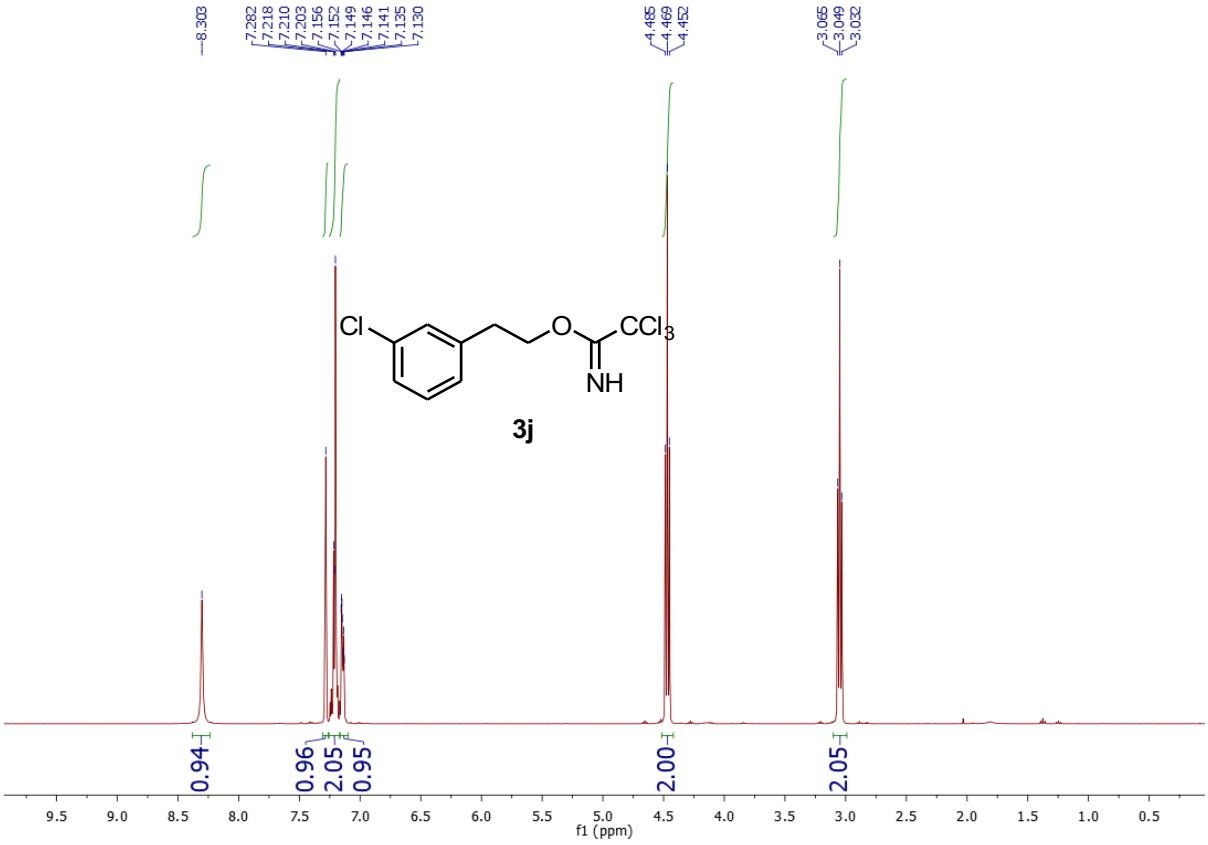
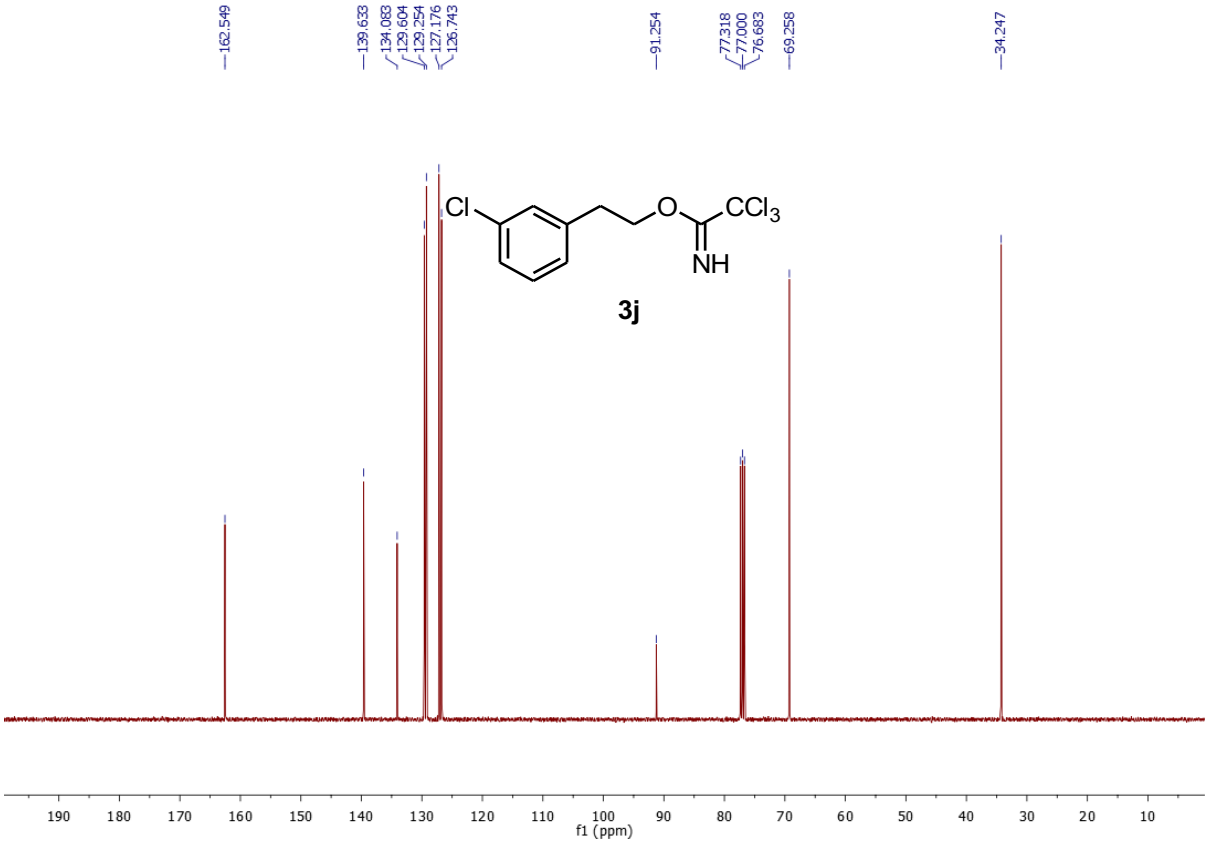
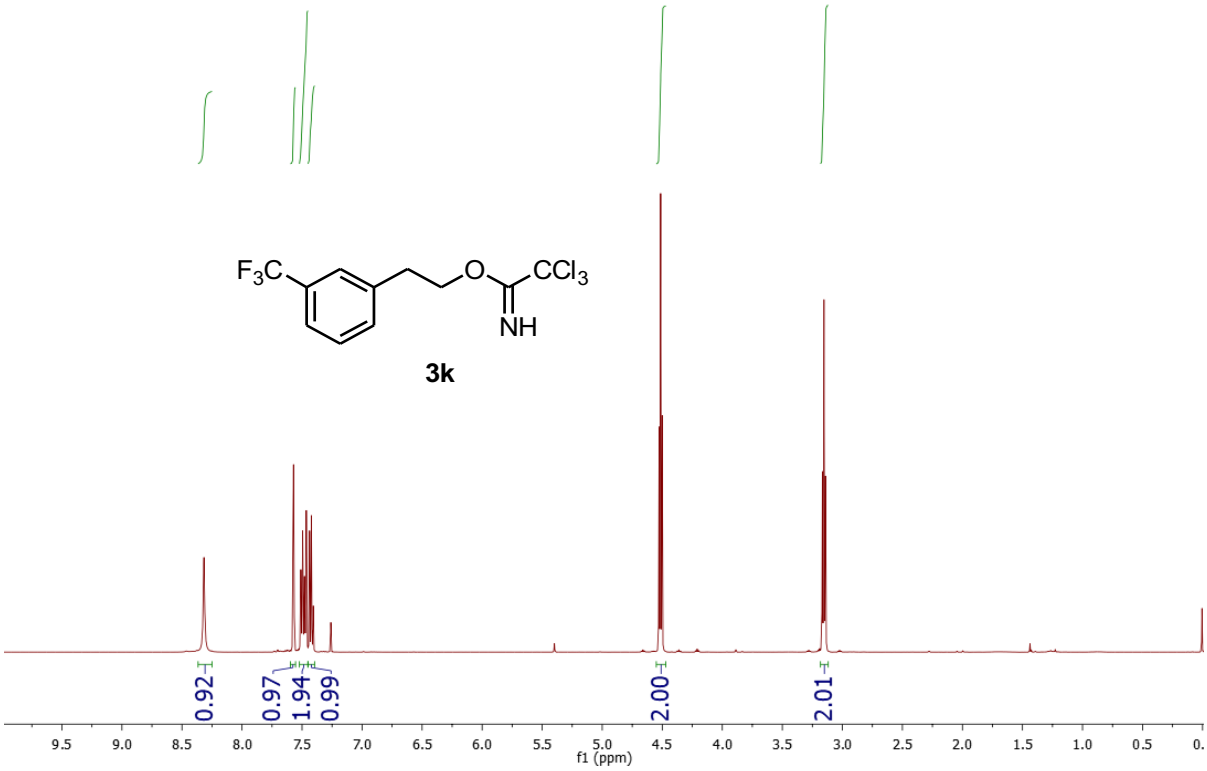
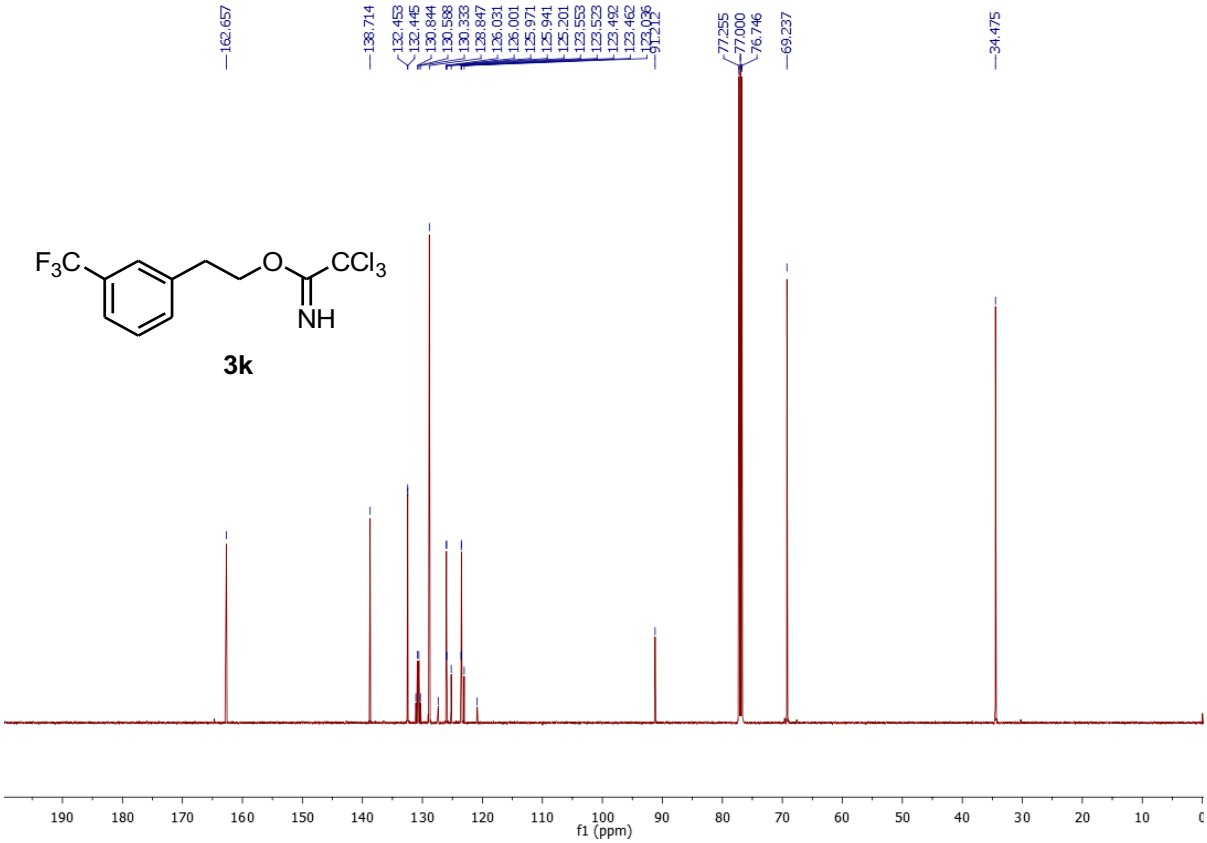
162.574
161.780
140.158
140.099
129.826
129.760
124.647
124.624
116.035
115.866
113.534
113.367
91.259
77.254
77.000
76.746
69.293
34.320
34.306
F
O
CCl3
NH
3i
f1 (ppm)


-113.365
F
O
CCl3
NH
3i
f1 (ppm)


8.303
7.282
7.218
7.210
7.203
7.156
7.152
7.149
7.146
7.141
7.135
7.130
4.485
4.469
4.452
3.065
3.049
3.032
Cl
O
CCl3
NH
3j
0.94
0.96
2.05
0.95
2.00
2.05
f1 (ppm)


162.549
139.633
134.083
129.604
129.254
127.176
126.743
91.254
77.318
77.000
76.683
69.258
34.247
Cl
O
CCl3
NH
3j
f1 (ppm)


F3C
O
CCl3
NH
3k
0.92
0.97
1.94
0.99
2.00
2.01
f1 (ppm)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132.453
132.445
130.844
130.588
130.333
128.847
126.031
126.001
125.971
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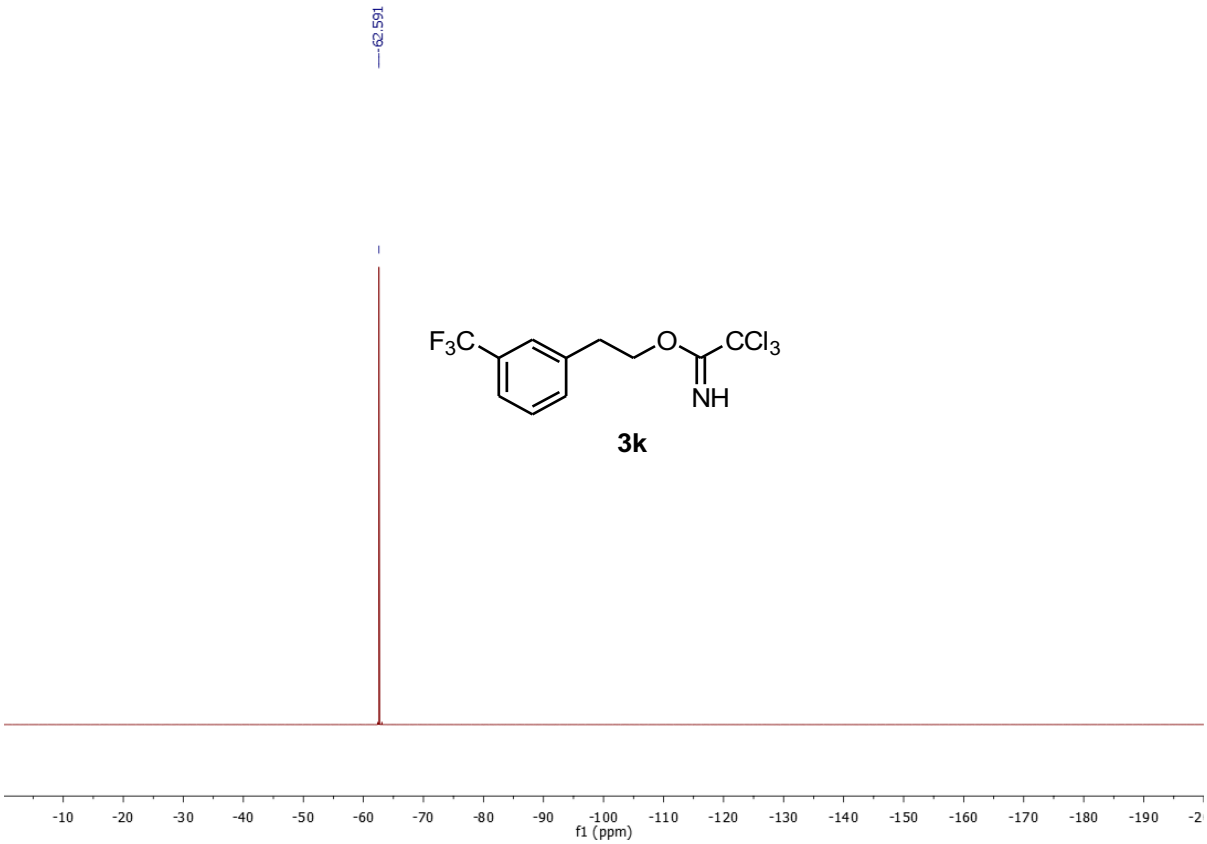
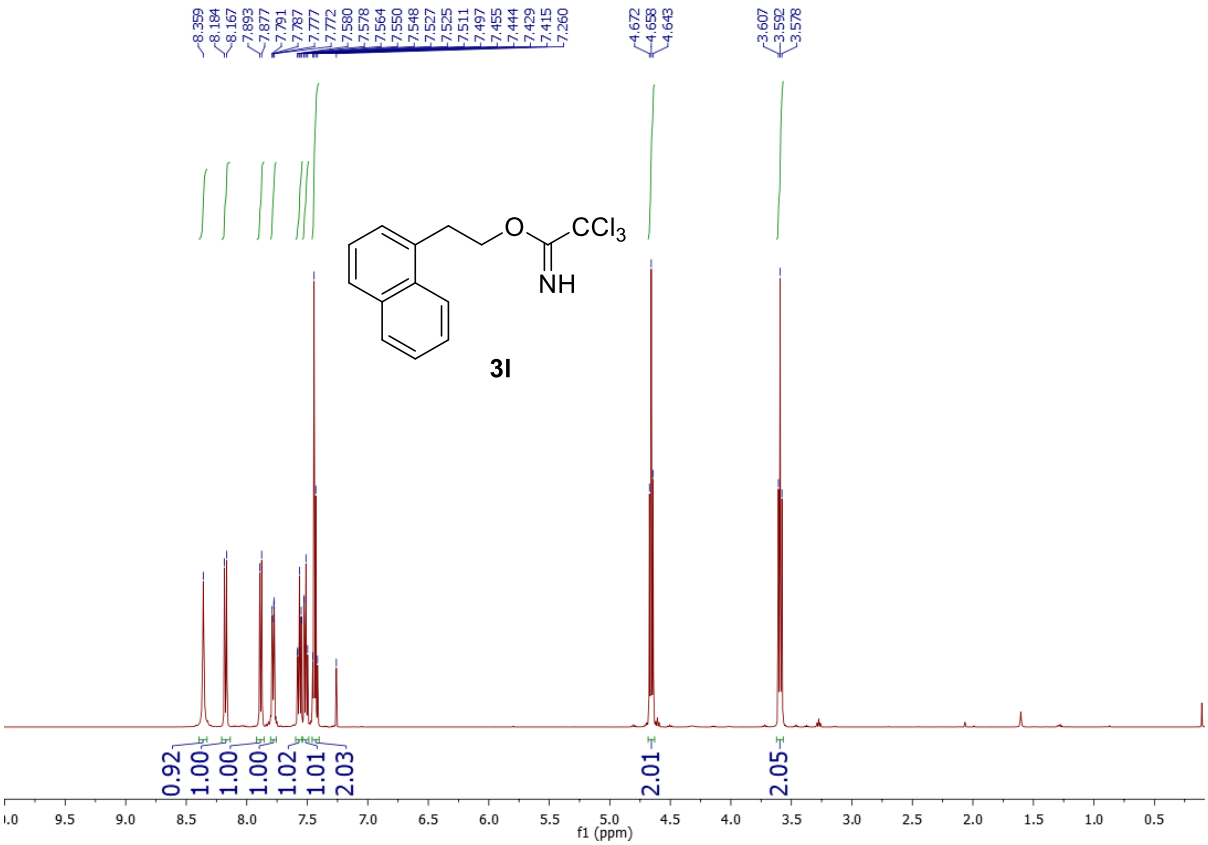
125.201
123.553
123.523
123.492
123.462
91.212
77.255
77.000
76.746
69.237
34.475
F3C
O
CCl3
NH
3k
f1 (ppm)


-62.591
F3C
O
CCl3
NH
3k
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)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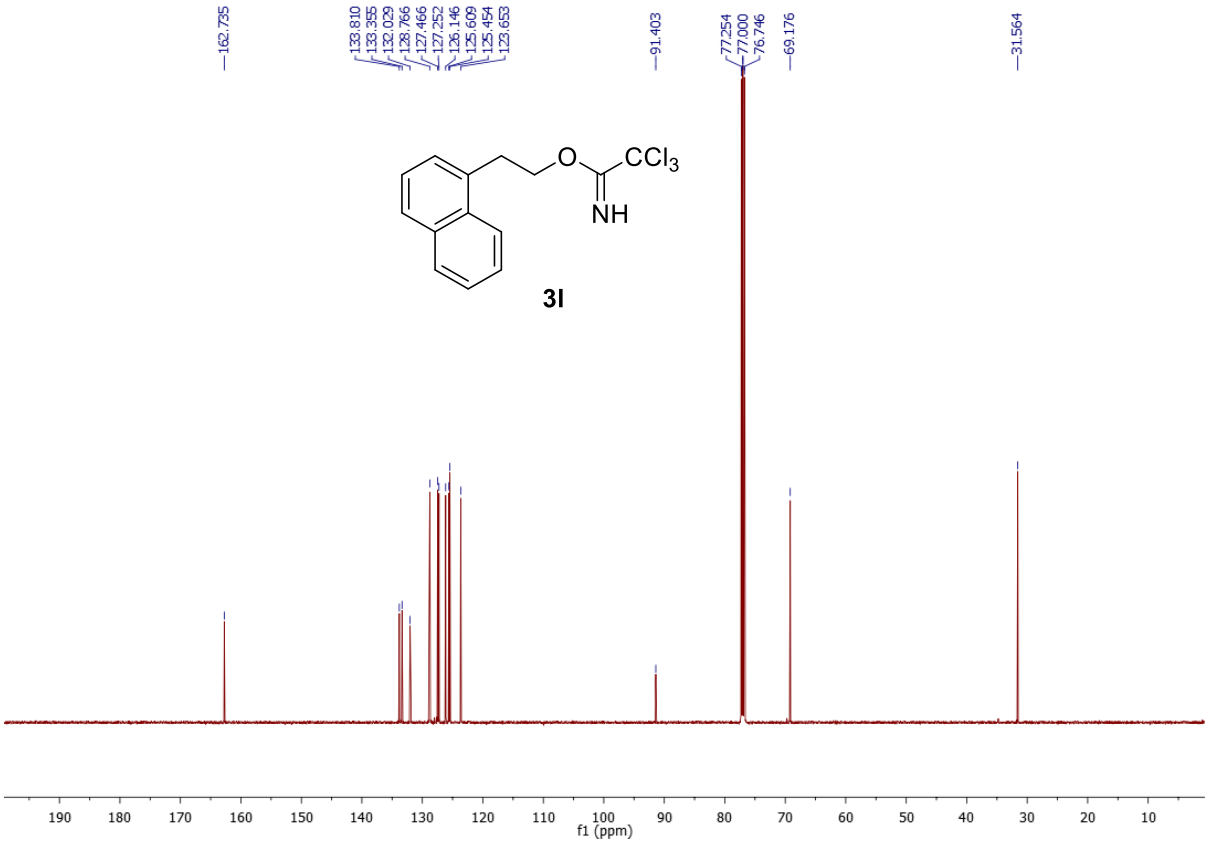
7.877
7.791
7.787
7.777
7.772
7.580
7.578
7.564
7.550
7.548
7.527
7.525
7.511
7.497
7.455
7.444
7.429
7.415
7.260
4.672
4.658
4.643
3.607
3.592
3.578
O
CCl3
NH
3l
0.92
1.00
1.00
1.00
1.02
1.01
2.03
2.01
2.05
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)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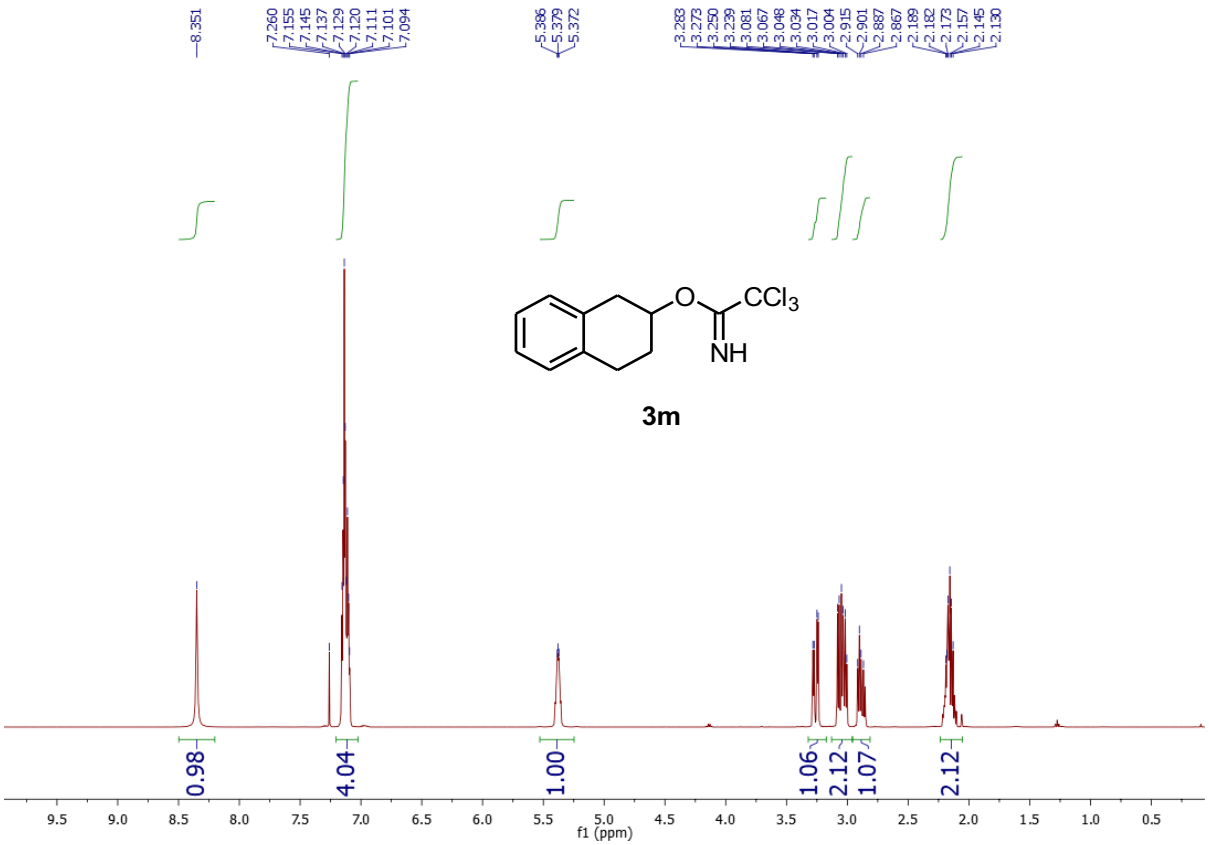
133.810
133.355
132.029
128.766
127.466
127.252
126.146
125.609
125.454
123.653
91.403
77.254
77.000
76.746
69.176
31.564
O
CCl3
NH
3l
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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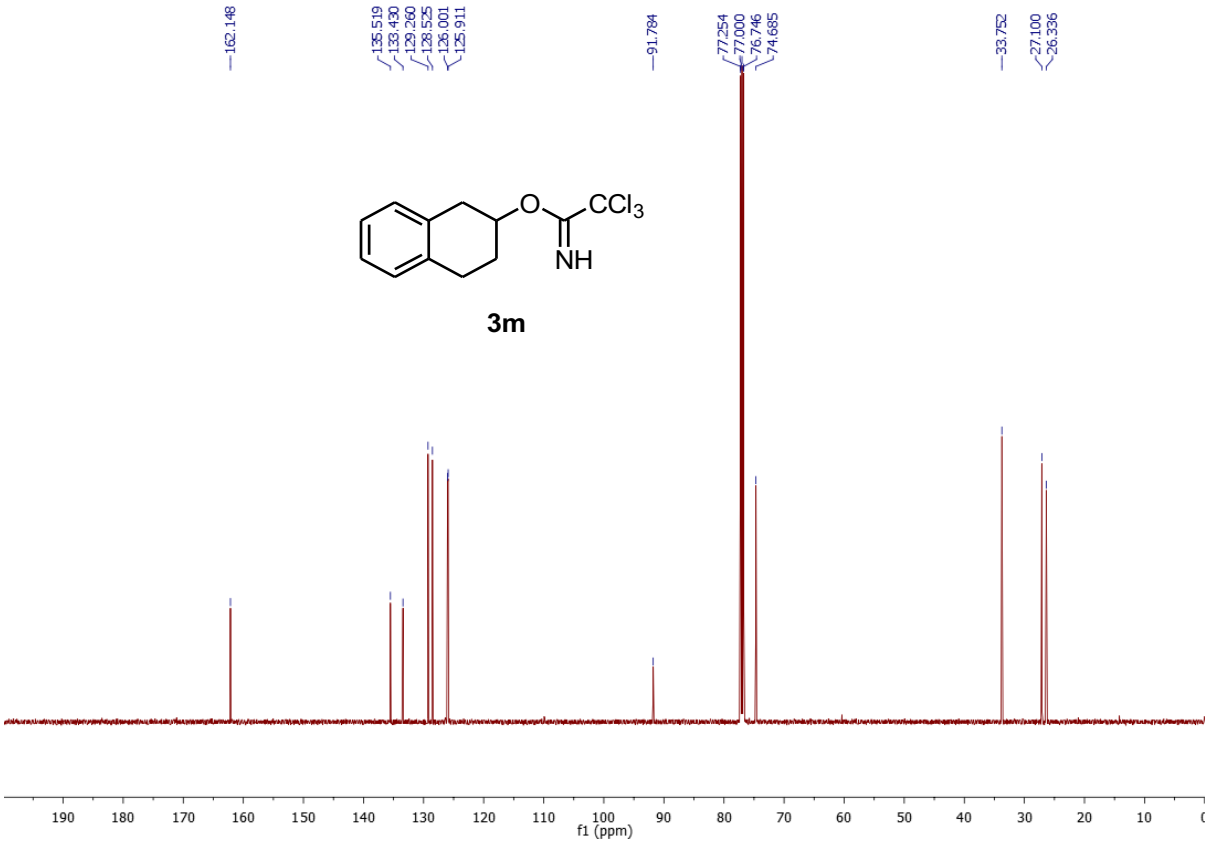
7.155
7.145
7.137
7.129
7.120
7.111
7.101
7.094
5.386
5.379
5.372
3.283
3.273
3.250
3.239
3.081
3.067
3.048
3.034
3.017
3.004
2.915
2.901
2.887
2.867
2.189
2.182
2.173
2.157
2.145
2.130
O
CCl3
NH
3m
0.98
4.04
1.00
1.06
2.12
1.07
2.12
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)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135.519
133.430
129.260
128.525
126.001
125.911
91.784
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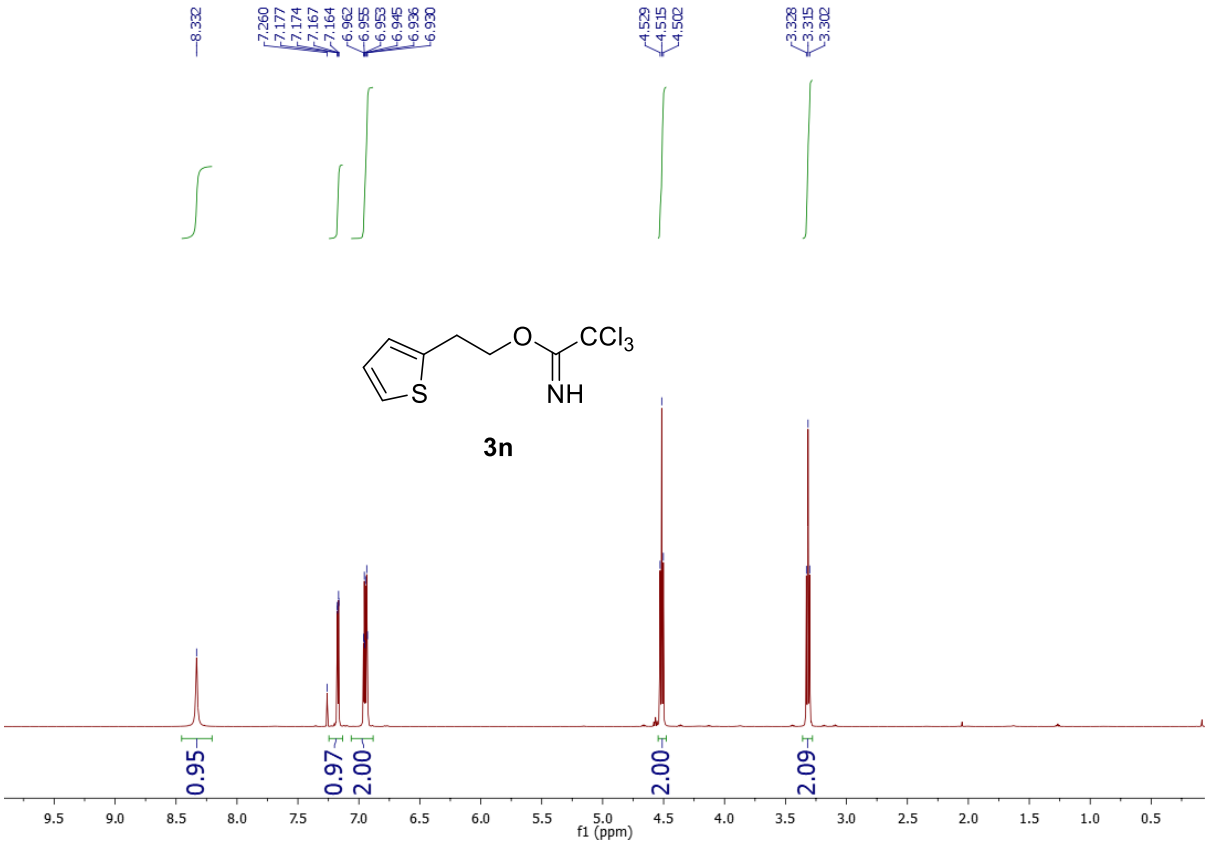
77.000
76.746
74.685
33.752
27.100
26.336
O
CCl3
NH
f1 (ppm)

3m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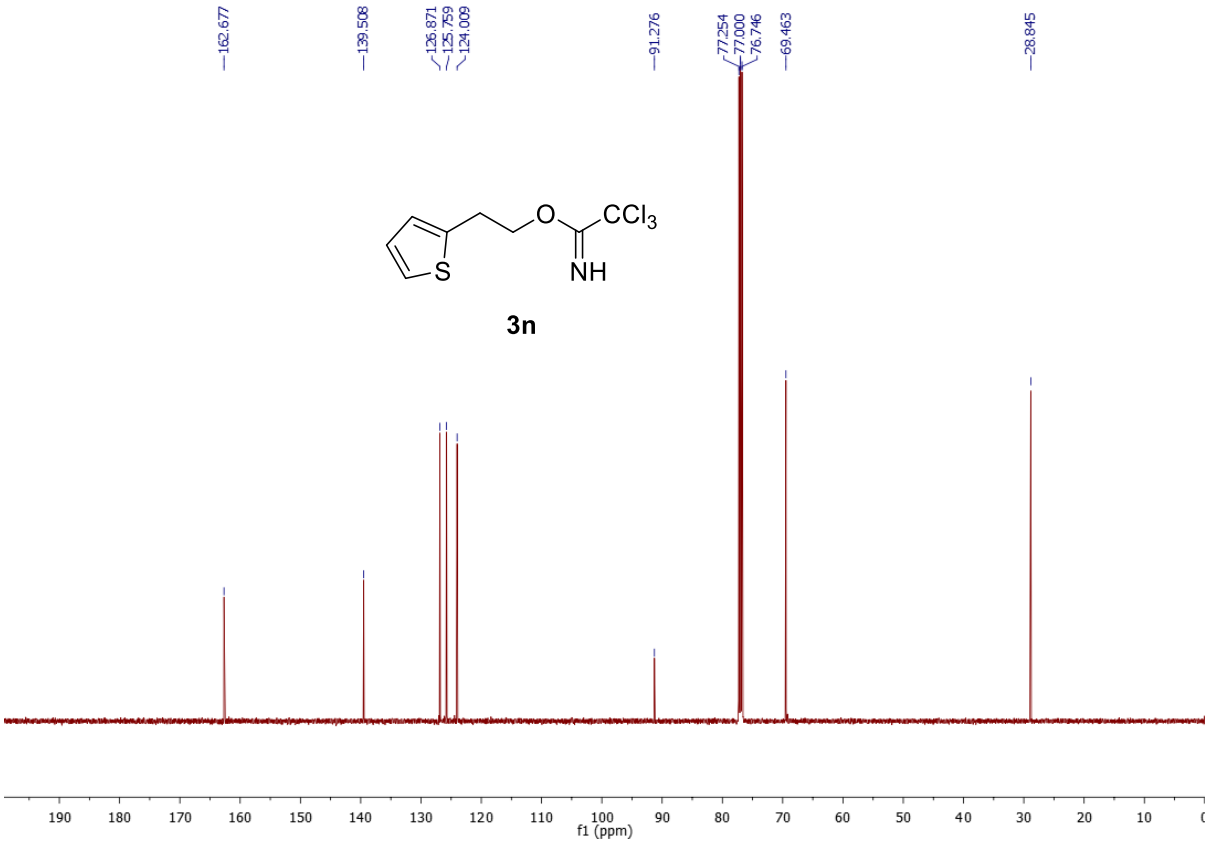
7.174
7.167
7.164
6.962
6.955
6.953
6.945
6.936
6.930
4.529
4.515
4.502
3.328
3.315
3.302
0.95
0.97
2.00
2.00
2.09
S
O
CCl3
NH
f1 (ppm)

3n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139.508
126.871
125.759
124.009
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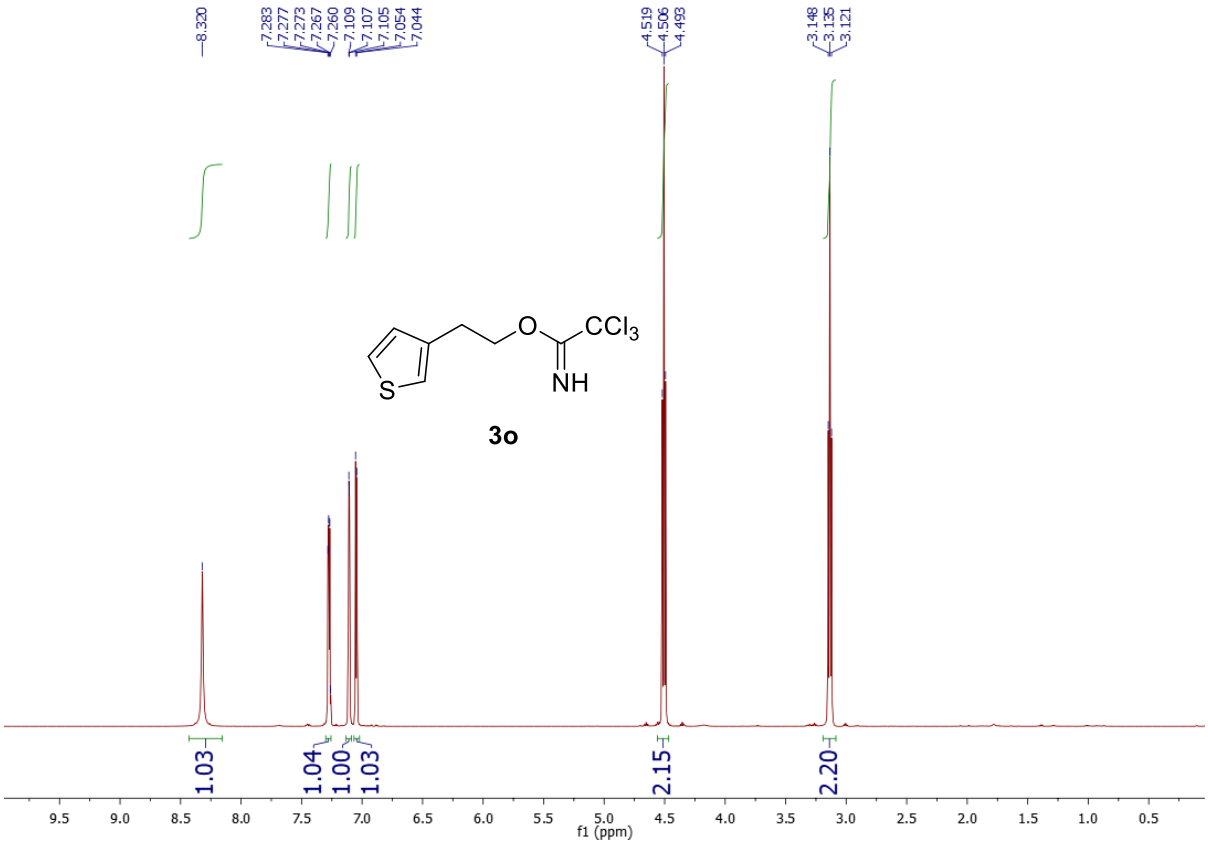
77.000
76.746
69.463
28.845
O
CCl3
NH
S
3n
f1 (ppm)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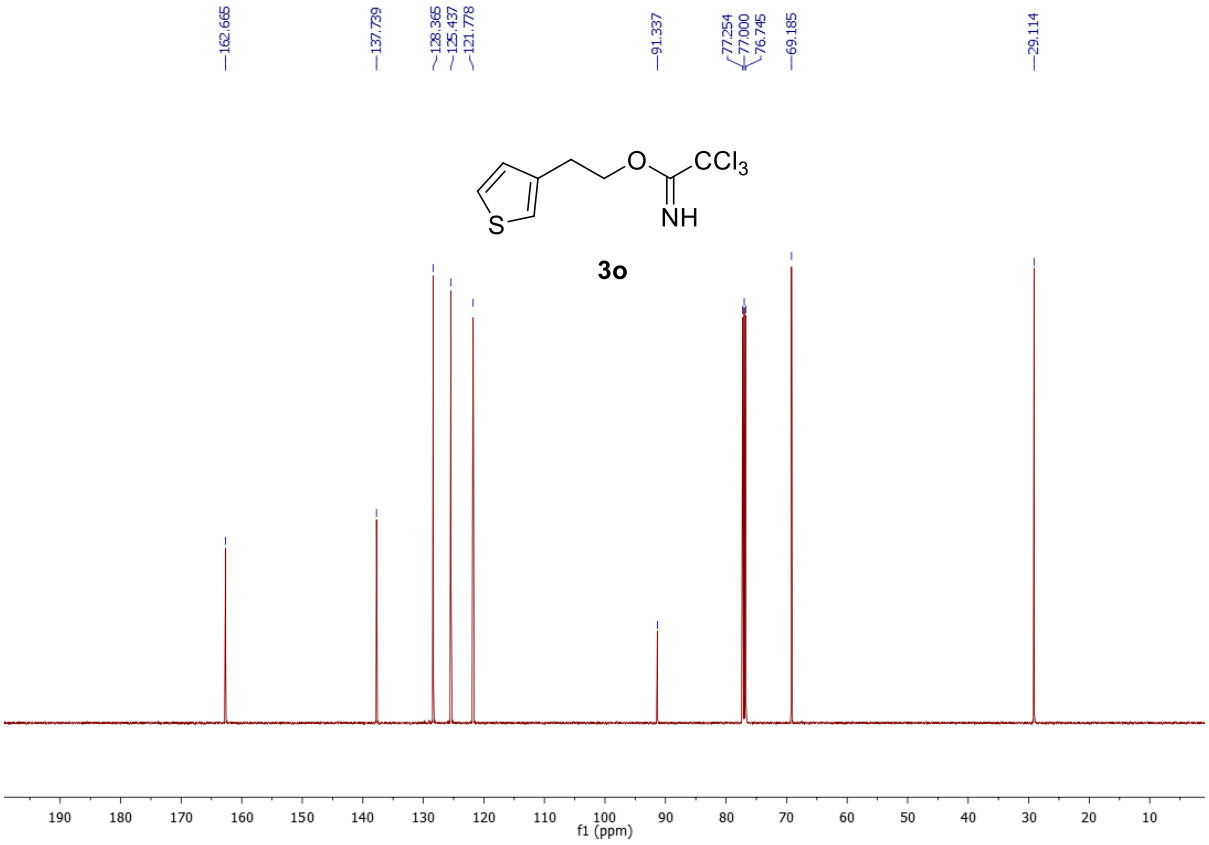
7.260
7.109
7.107
7.105
7.054
7.044
4.519
4.506
4.493
3.148
3.135
3.121
O
CCl3
NH
S
3o
1.03
1.04
1.00
1.03
2.15
2.20
f1 (ppm)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77.000
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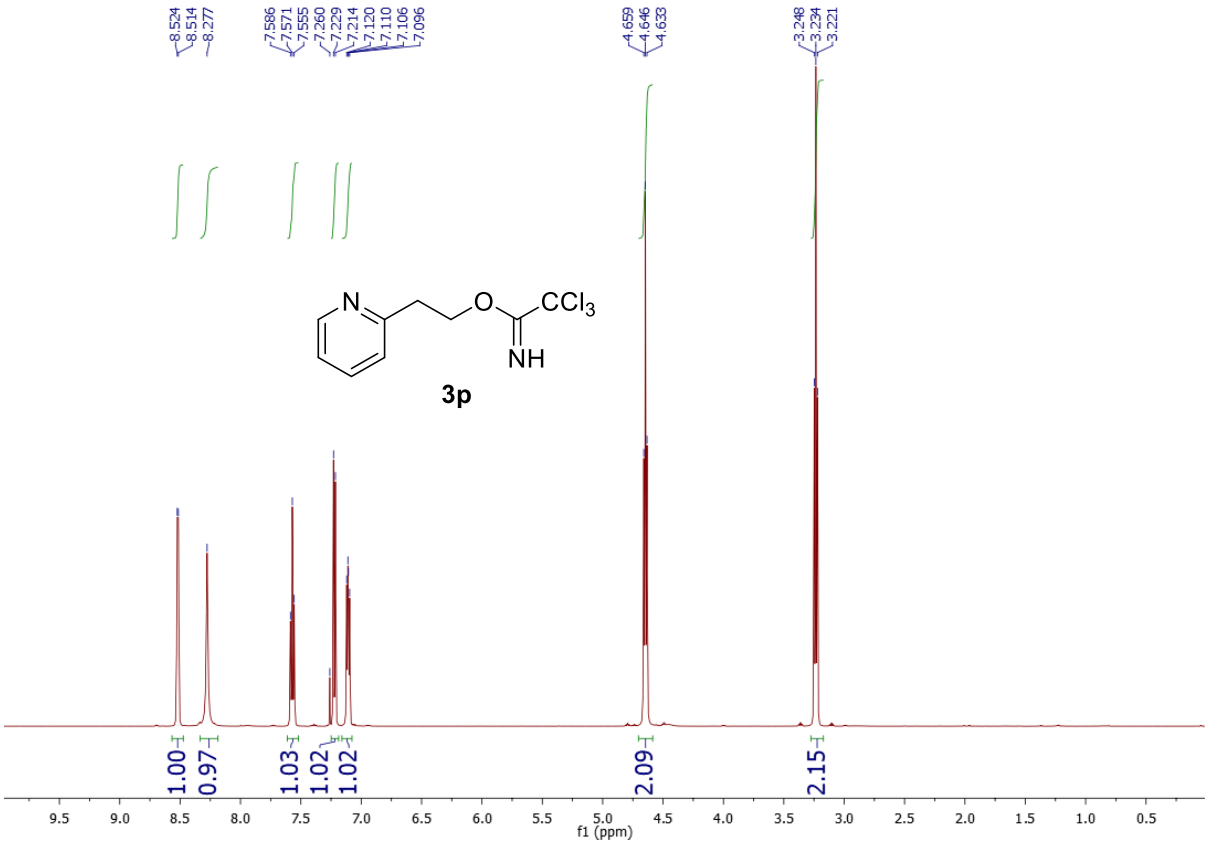
69.185
29.114
O
CCl3
NH
S
3o
f1 (ppm)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8.514
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7.586
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7.555
7.260
7.229
7.214
7.120
7.110
7.106
7.096
4.659
4.646
4.633
3.248
3.234
3.221
N
O
CCl3
NH
3p
1.00
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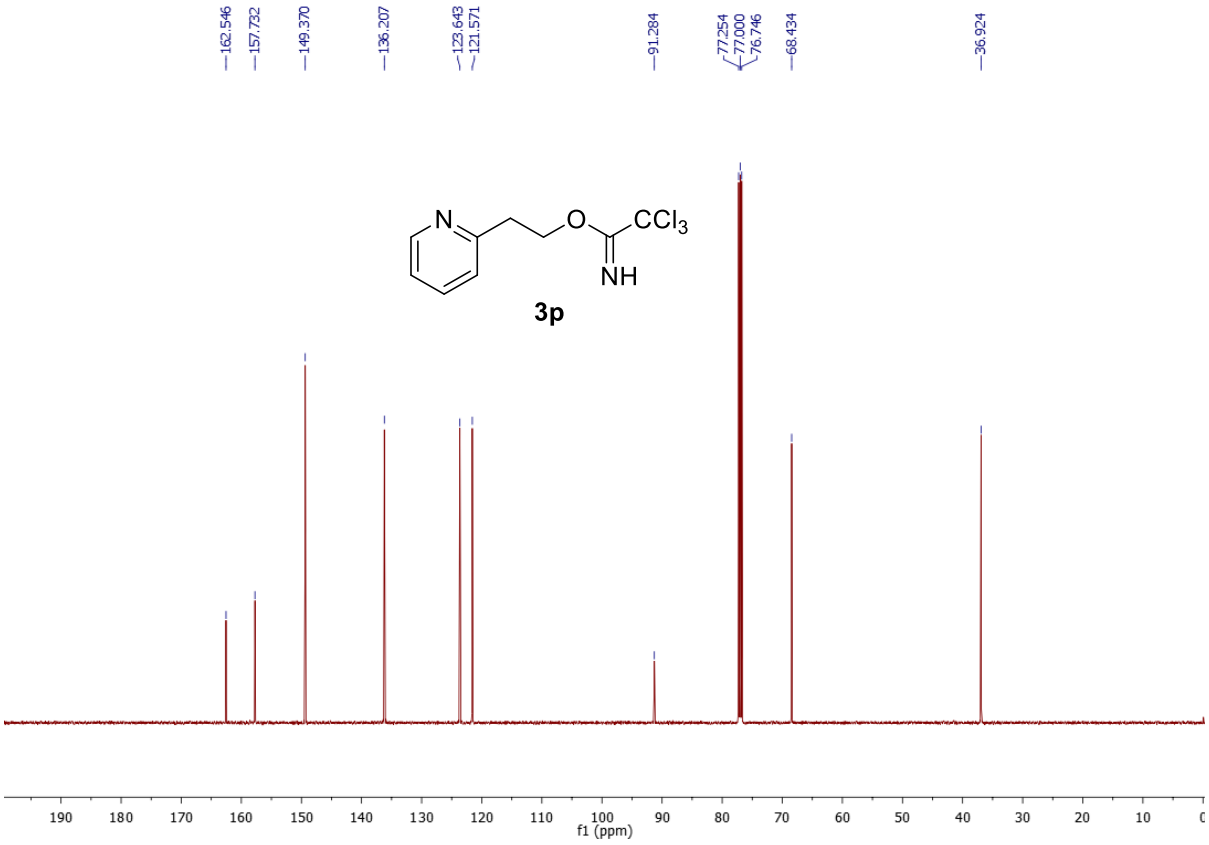
1.03
1.02
1.02
2.09
2.15
f1 (ppm)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77.000
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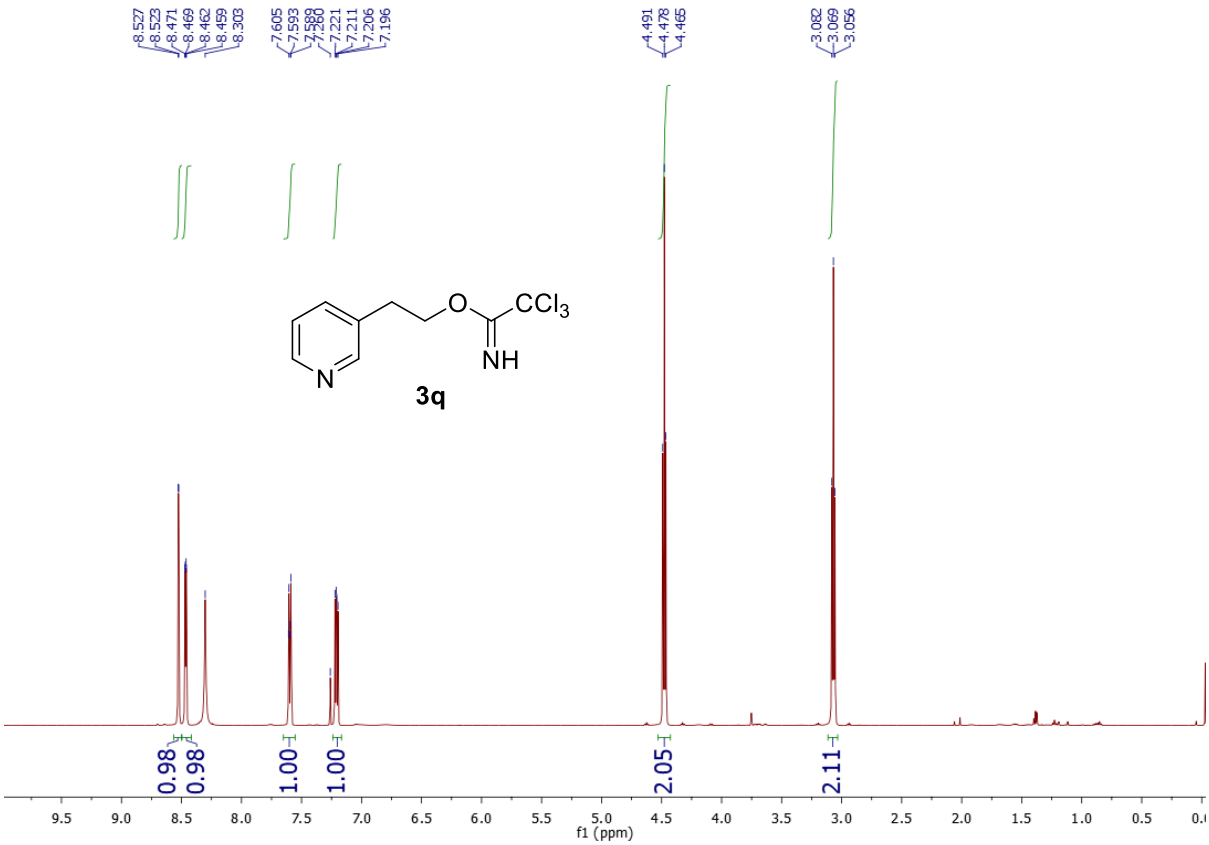
68.434
36.924
N
O
CCl3
NH
3p
f1 (ppm)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8.469
8.462
8.459
8.303
7.605
7.593
7.589
7.580
7.221
7.211
7.206
7.196
4.491
4.478
4.465
3.082
3.069
3.056
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NH
N
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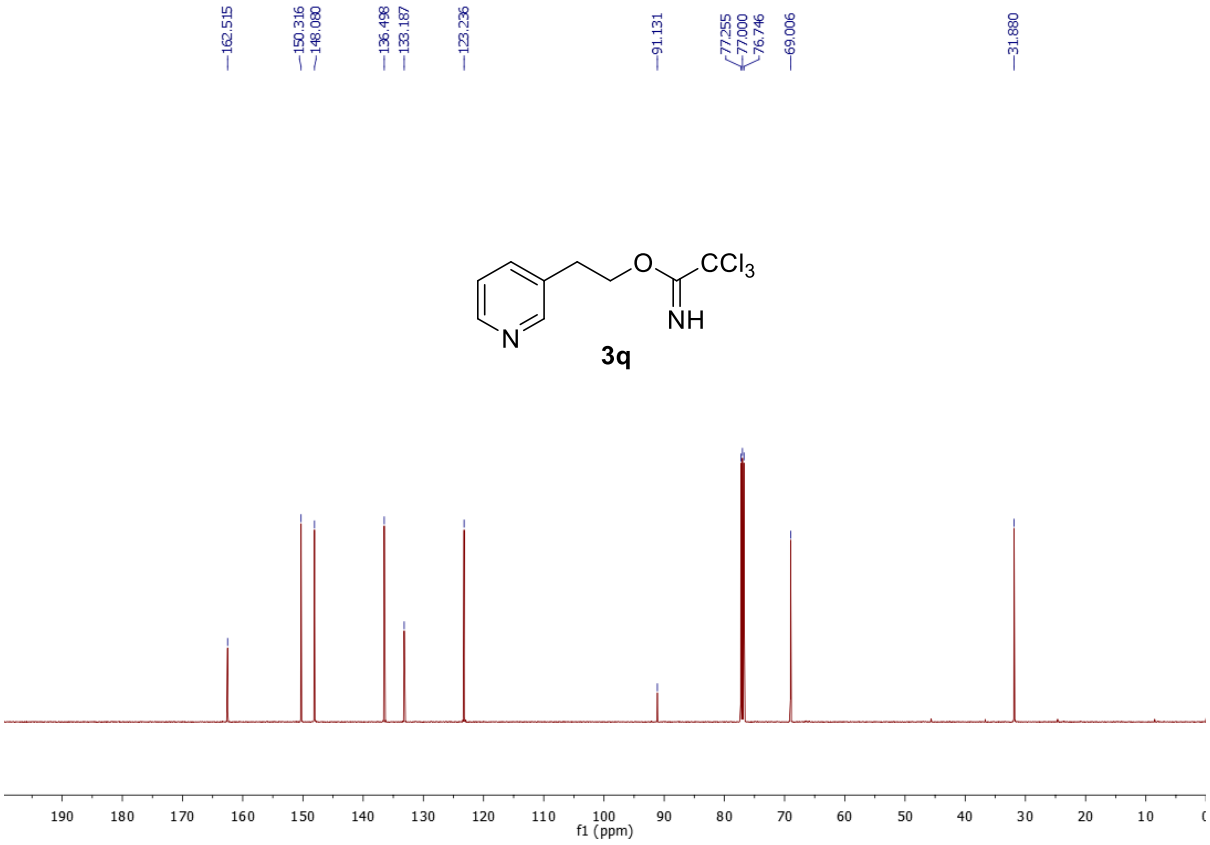
1.00
2.05
2.11
f1 (ppm)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69.006
31.880
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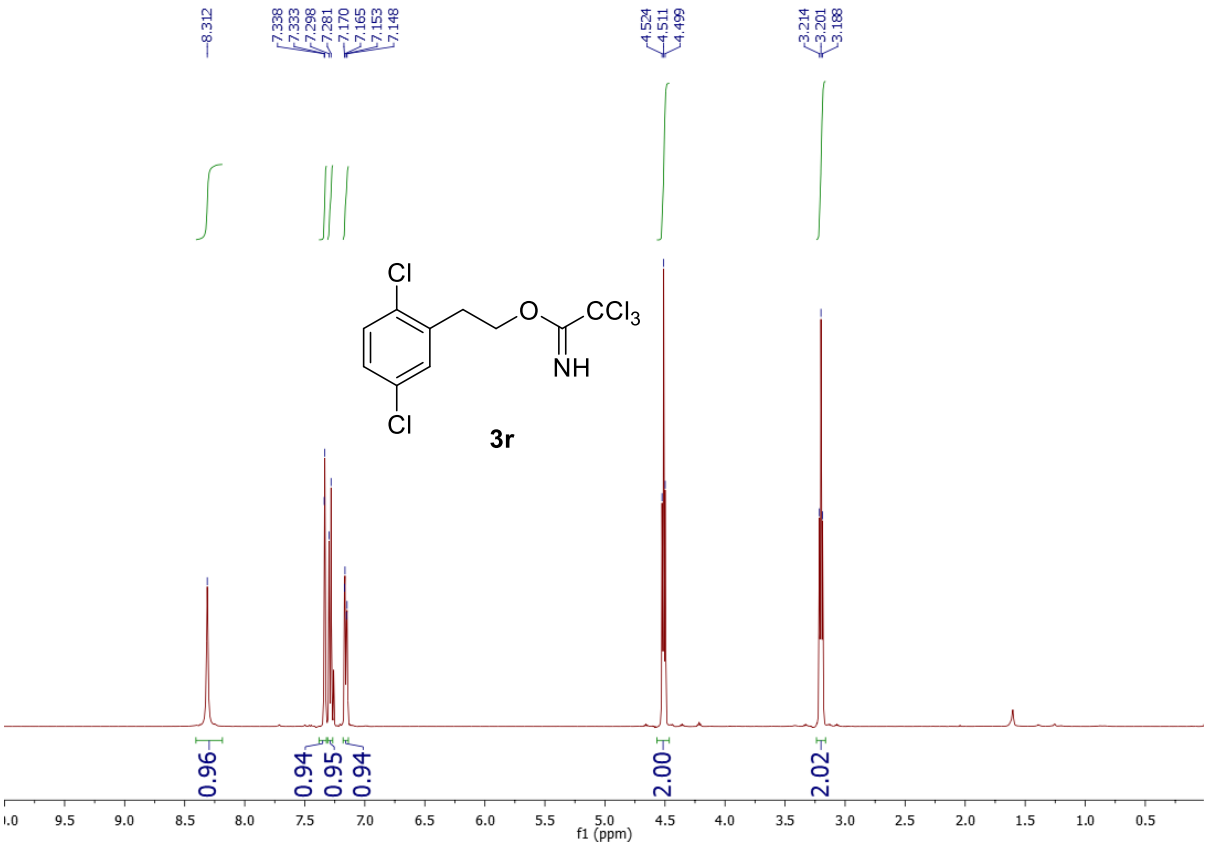
CCl3
NH
N
3q
f1 (ppm)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7.170
7.165
7.153
7.148
4.524
4.511
4.499
3.214
3.201
3.188
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O
CCl3
NH
Cl
3r
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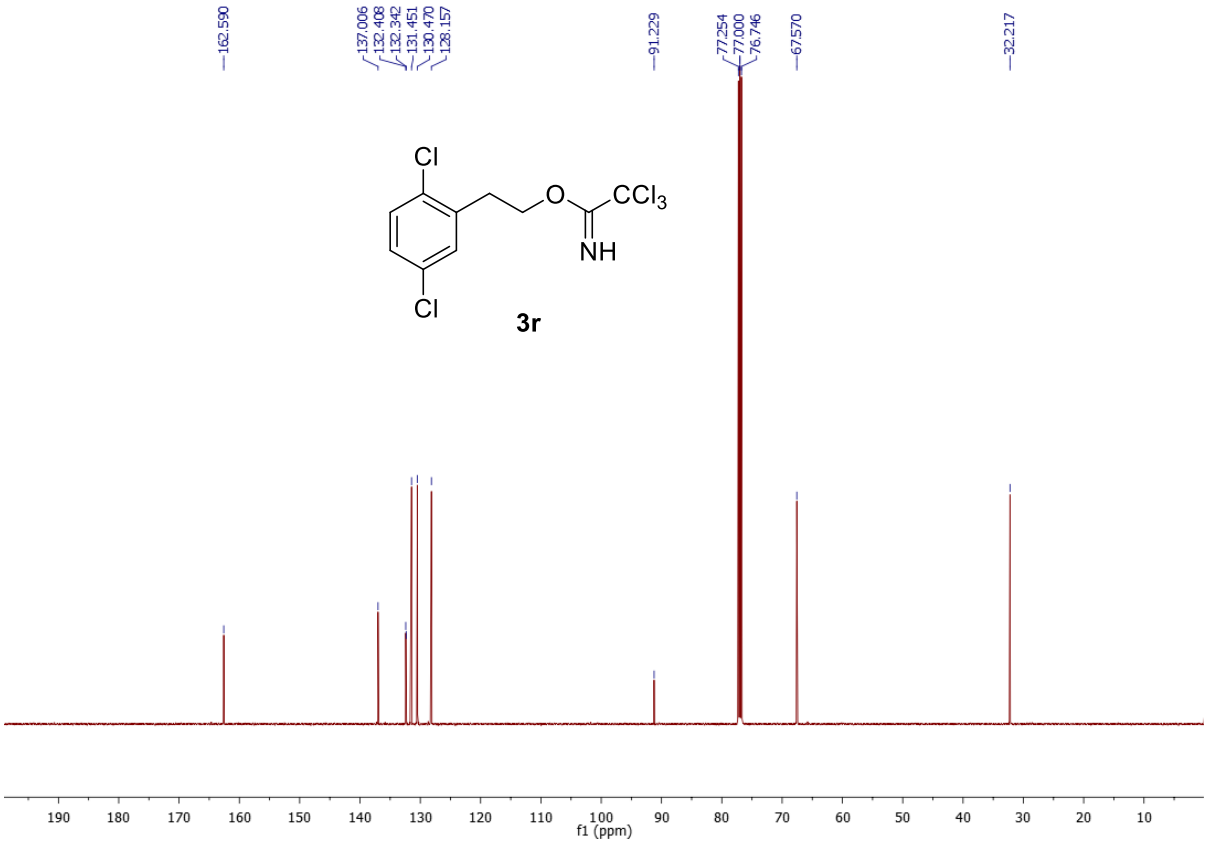
0.94
2.00
2.02
f1 (ppm)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137.006
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132.342
131.451
130.470
128.157
91.229
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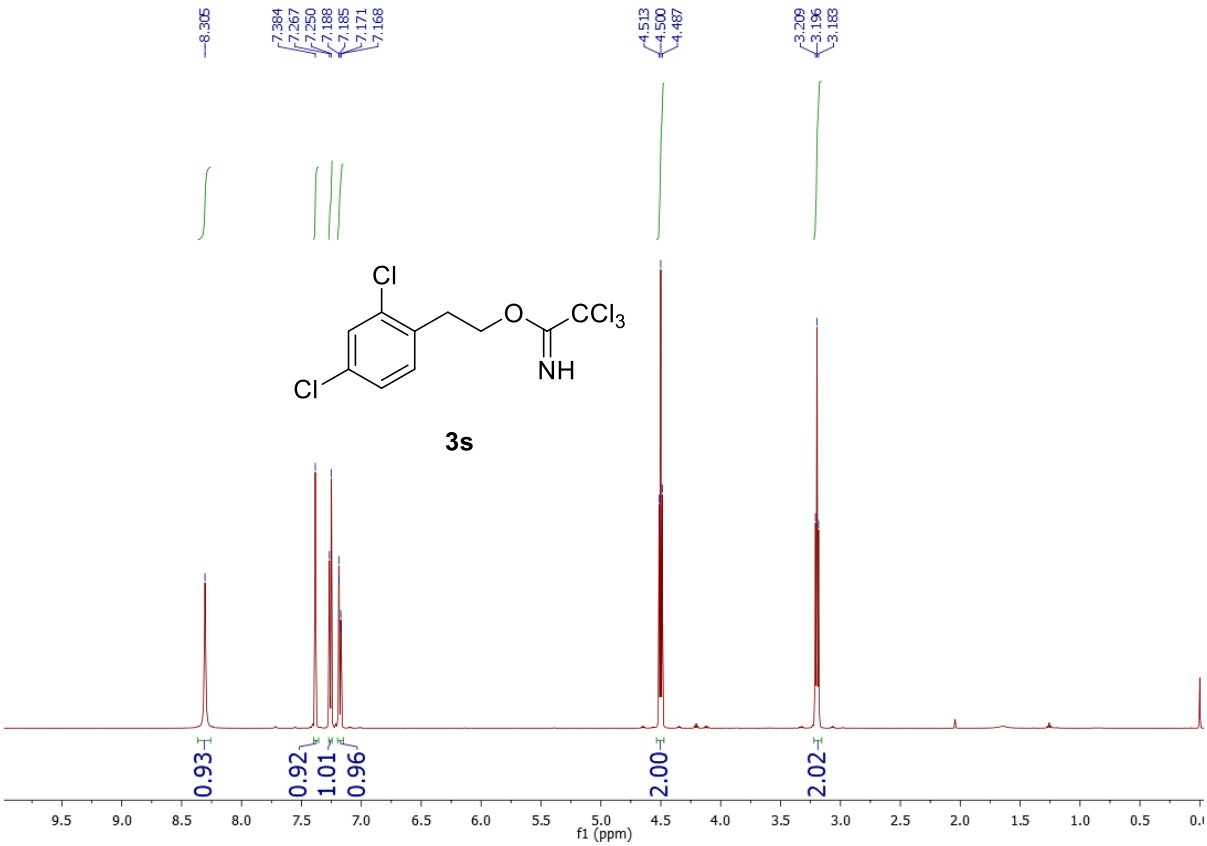
77.000
76.746
67.570
32.217
Cl
O
CCl3
NH
Cl
3r
f1 (ppm)


8.305
7.384
7.267
7.250
7.188
7.185
7.171
7.168
4.513
4.500
4.487
3.209
3.196
3.183
Cl
O
CCl3
NH
Cl
3s
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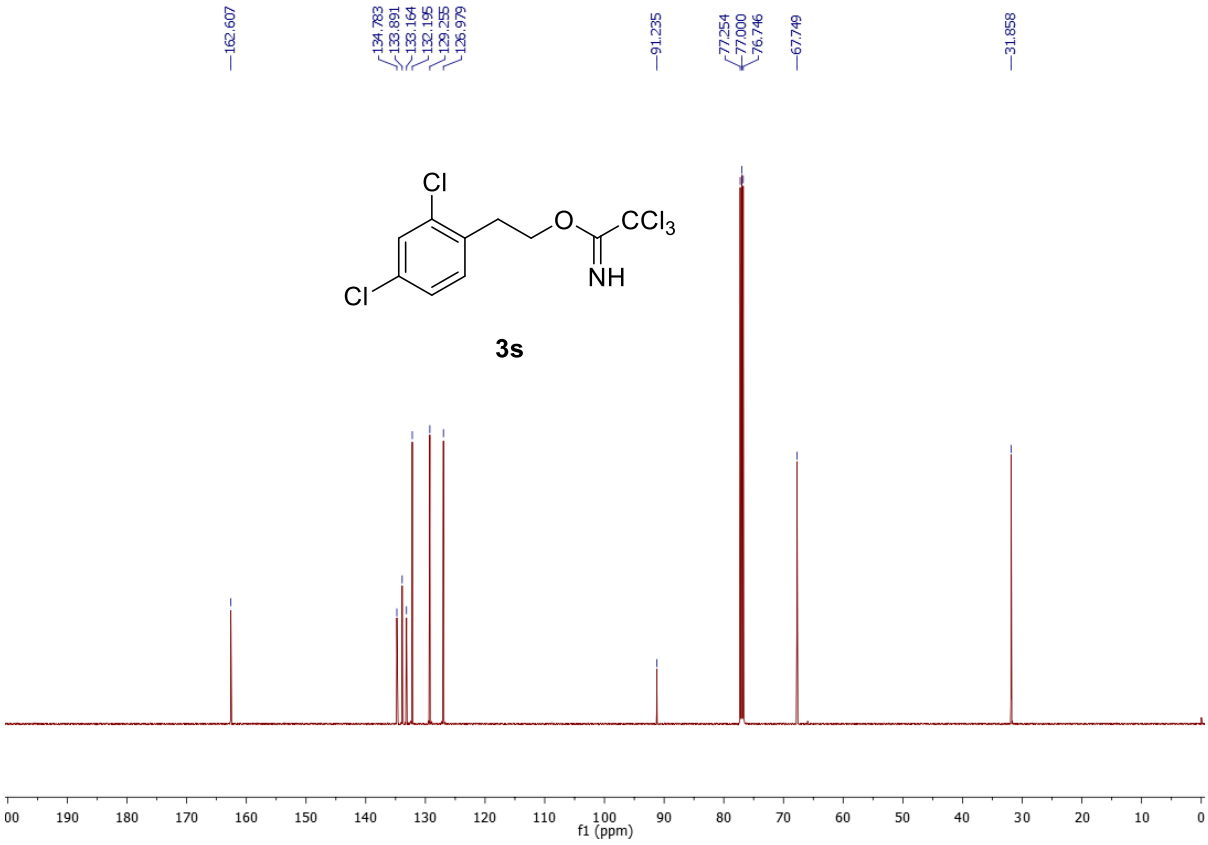
1.01
0.96
2.00
2.02
f1 (ppm)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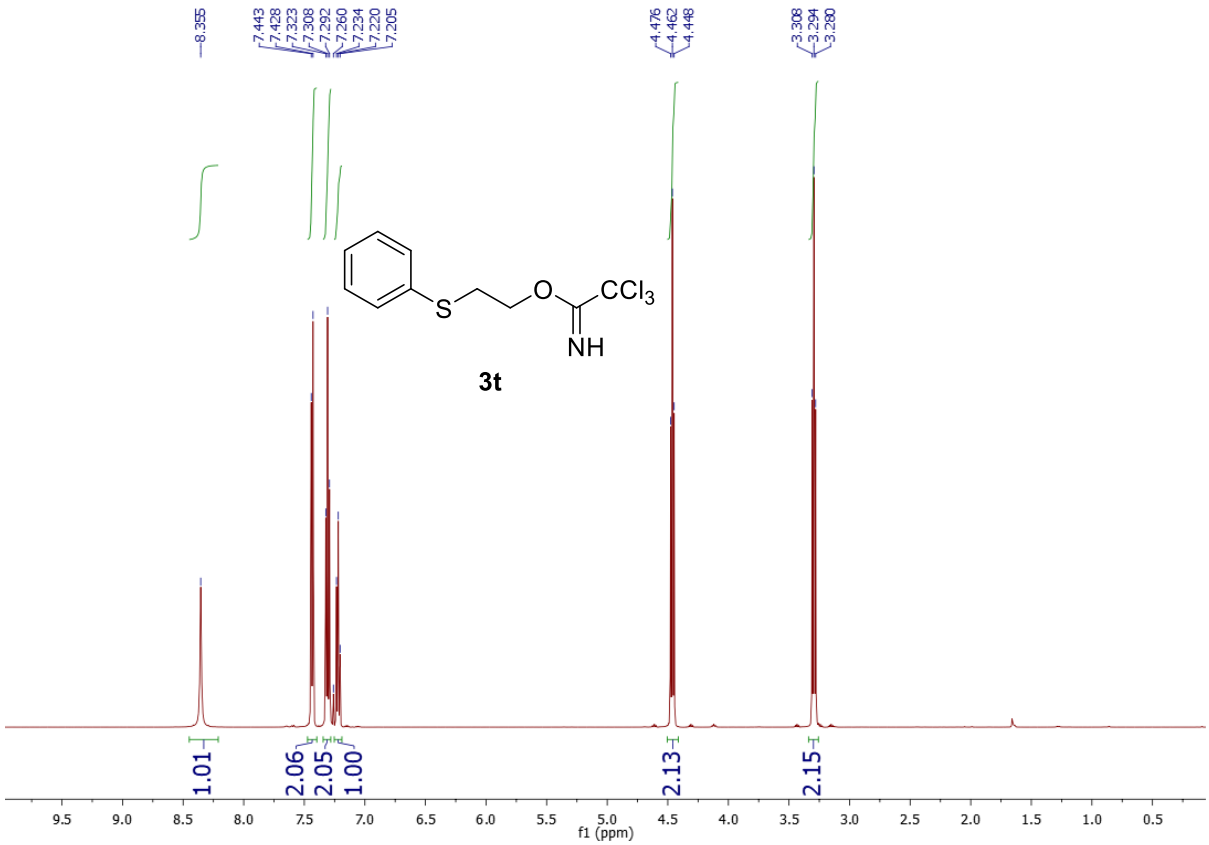
134.783
133.891
133.164
132.195
129.255
126.979
91.235
77.254
77.000
76.746
67.749
31.858
Cl
Cl
O
CCl3
NH
3s
f1 (ppm)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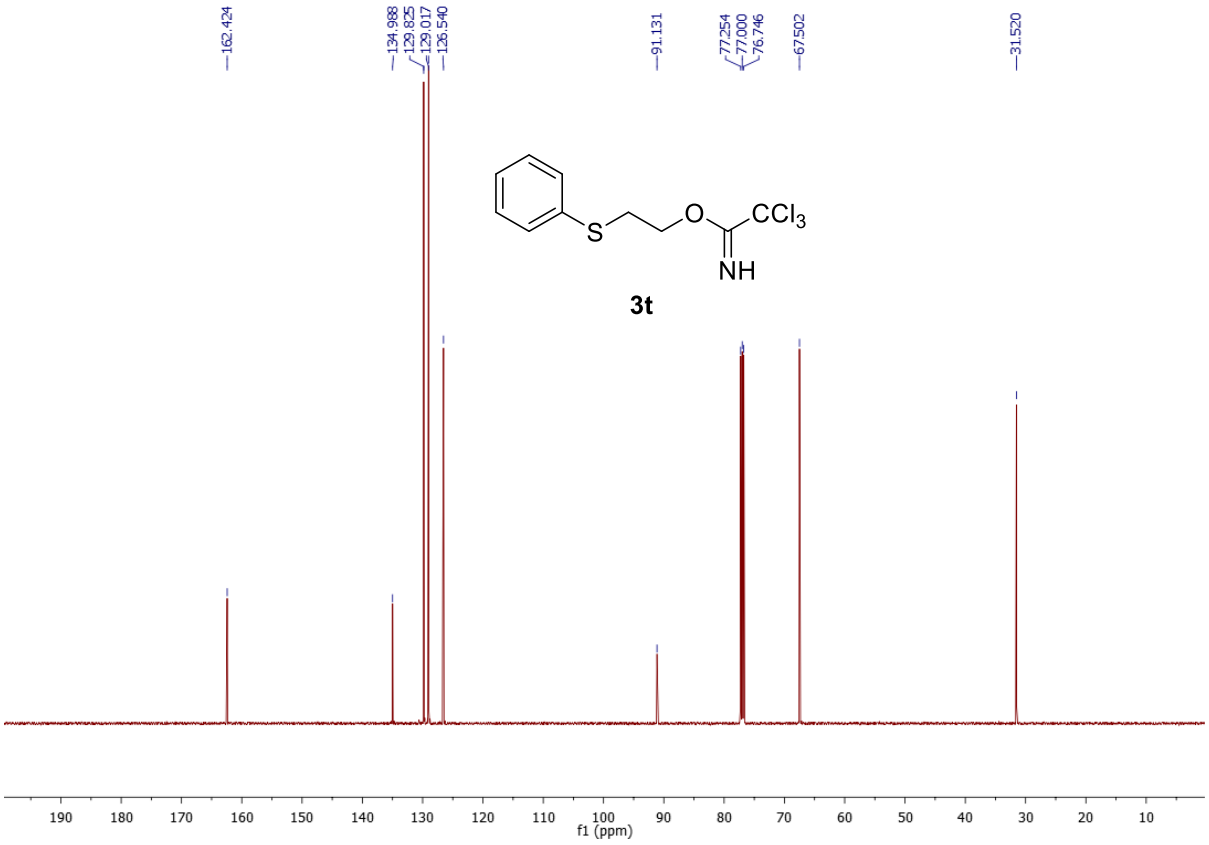
7.260
7.234
7.220
7.205
4.476
4.462
4.448
3.308
3.294
3.280
S
O
CCl3
NH
3t
1.01
2.06
2.05
1.00
2.13
2.15
f1 (ppm)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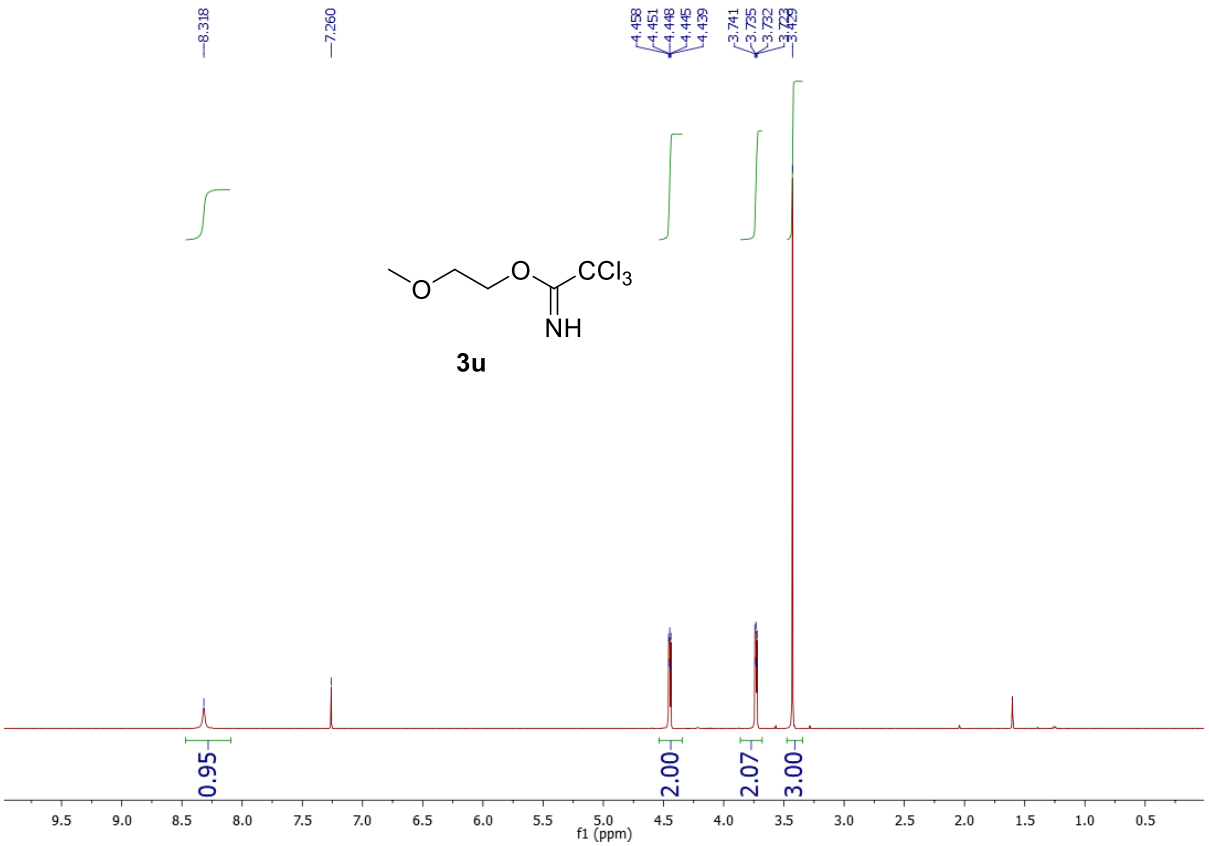
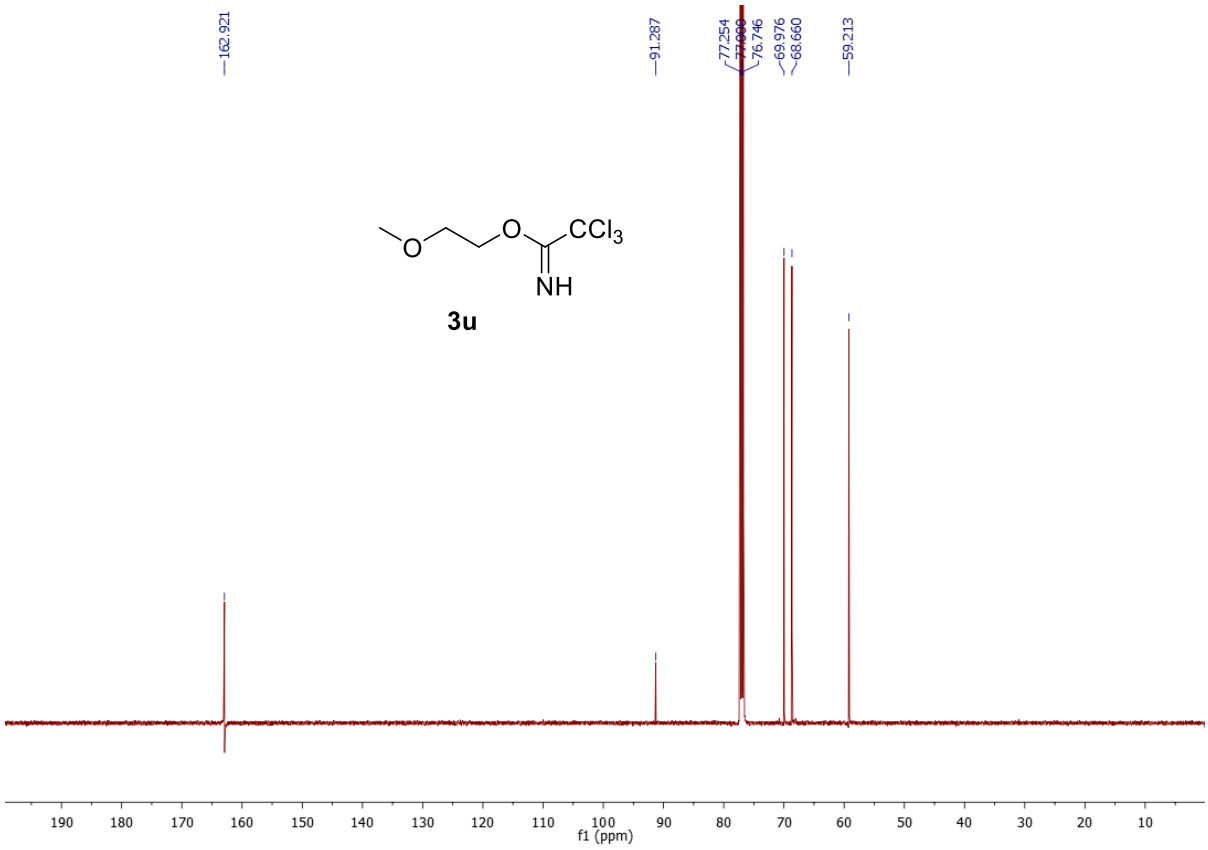
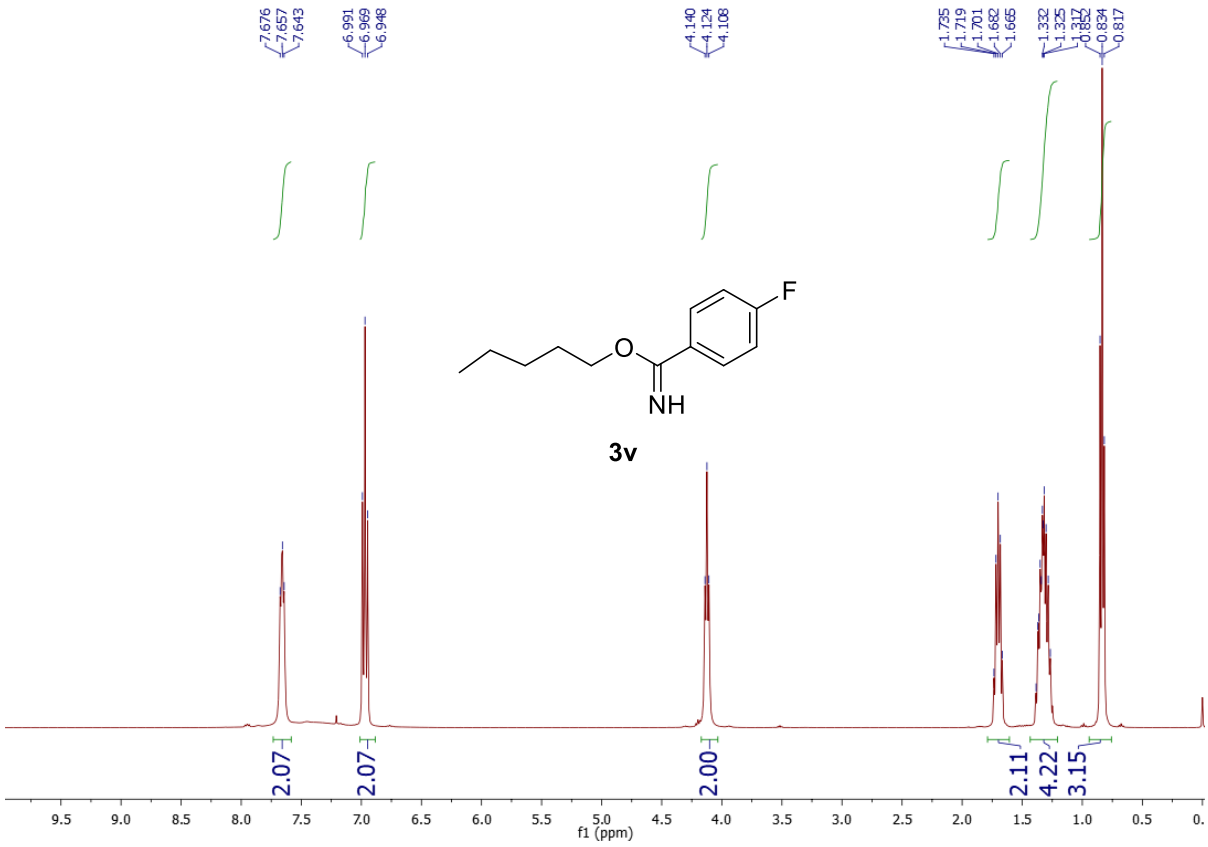
77.254
77.000
76.746
67.502
31.520
S
O
CCl3
NH
f1 (ppm)

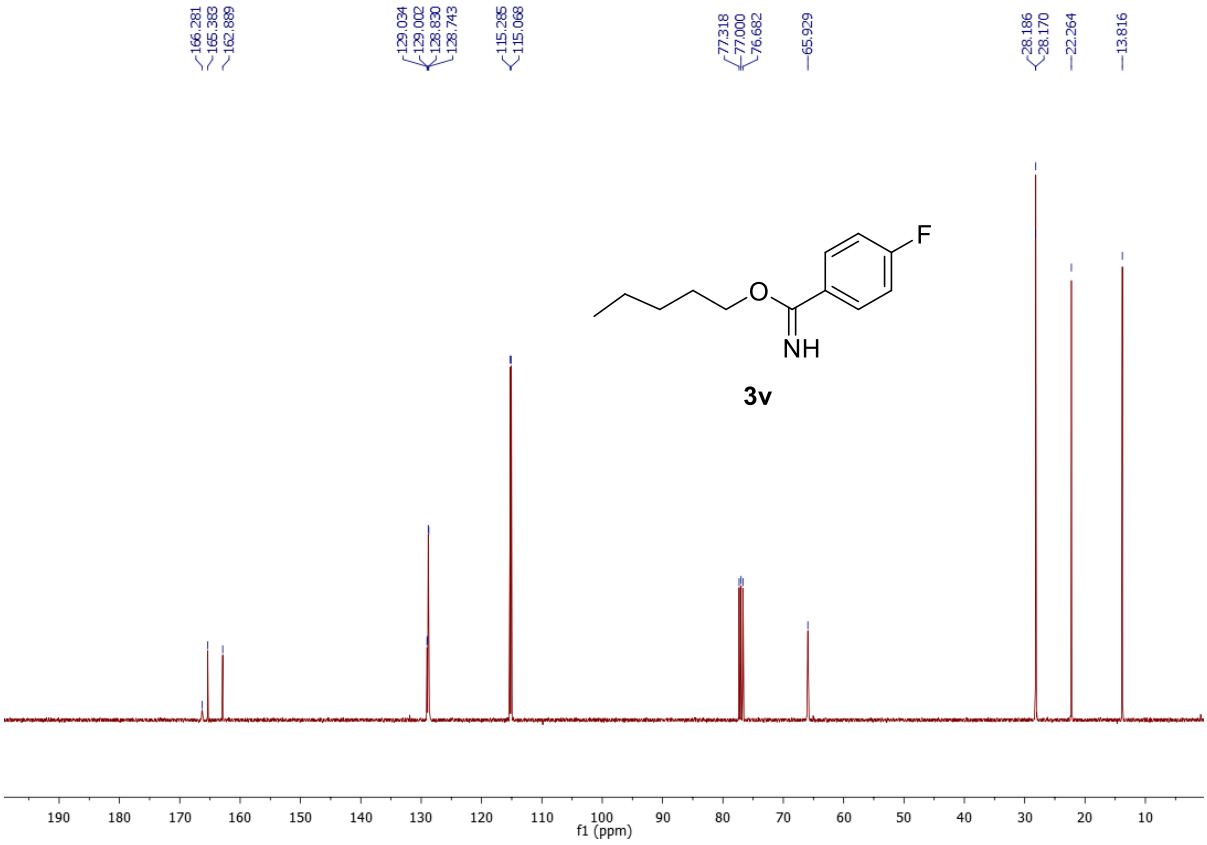
3t

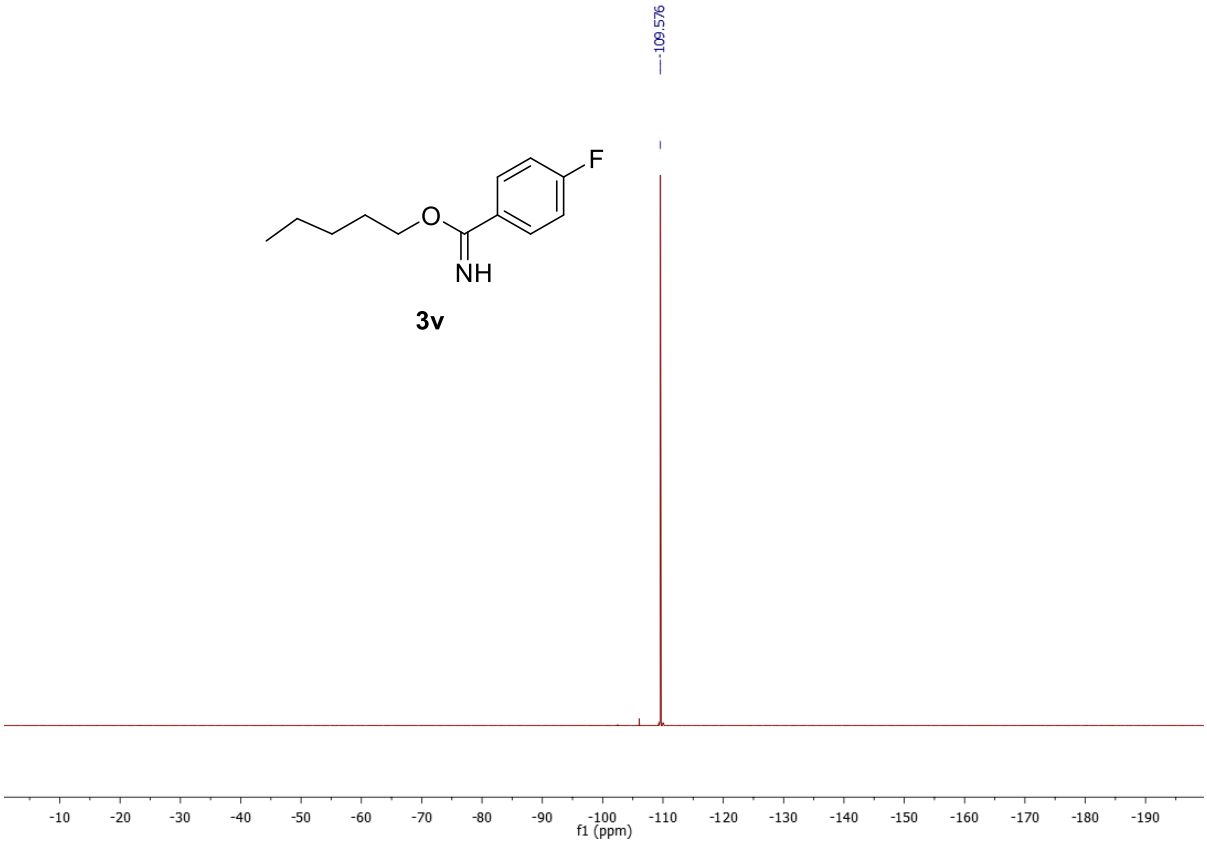

8.318
7.260
4.458
4.451
4.448
4.445
4.439
3.741
3.735
3.732
3.723
3.429
O
O
CCl3
NH
0.95
2.00
2.07
3.00
f1 (ppm)

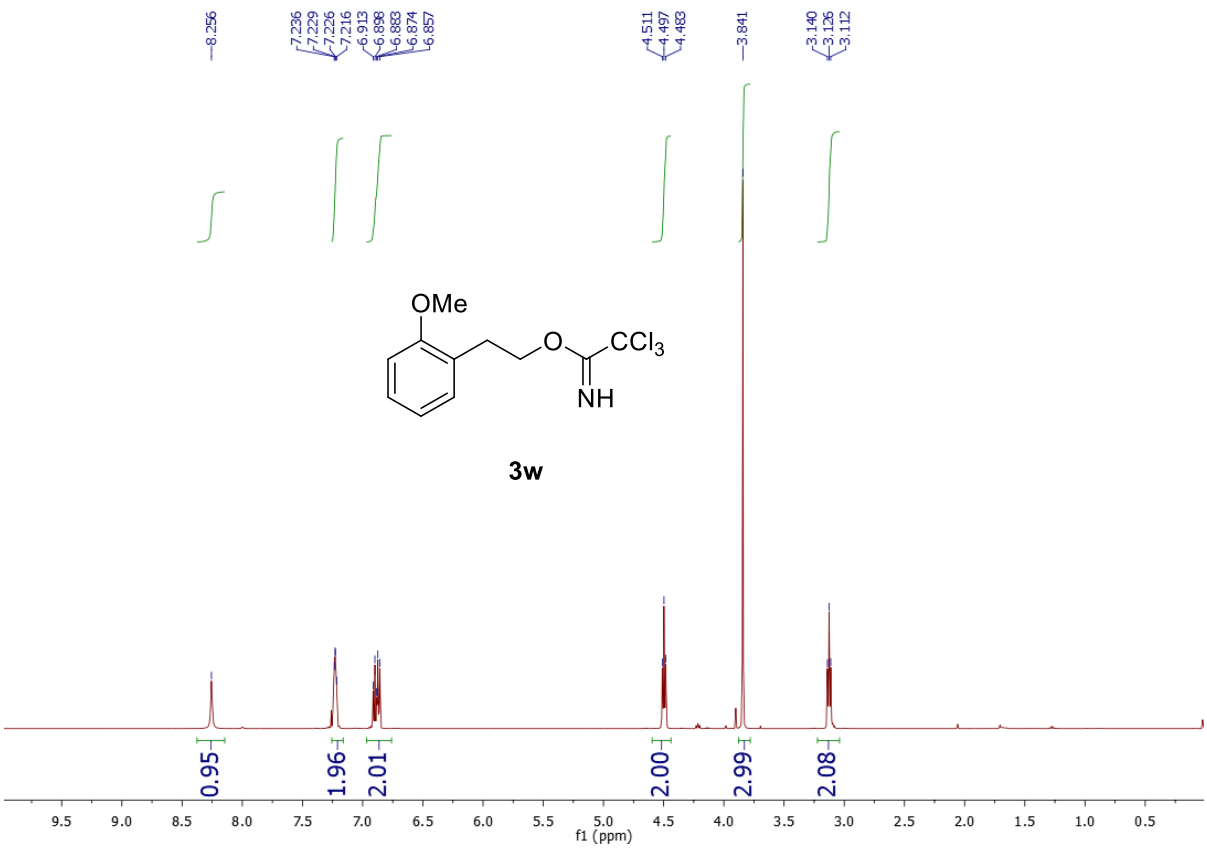
3u


162.921
91.287
77.254
77.000
76.746
69.976
68.660
59.213
O
O
CCl3
NH
3u
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

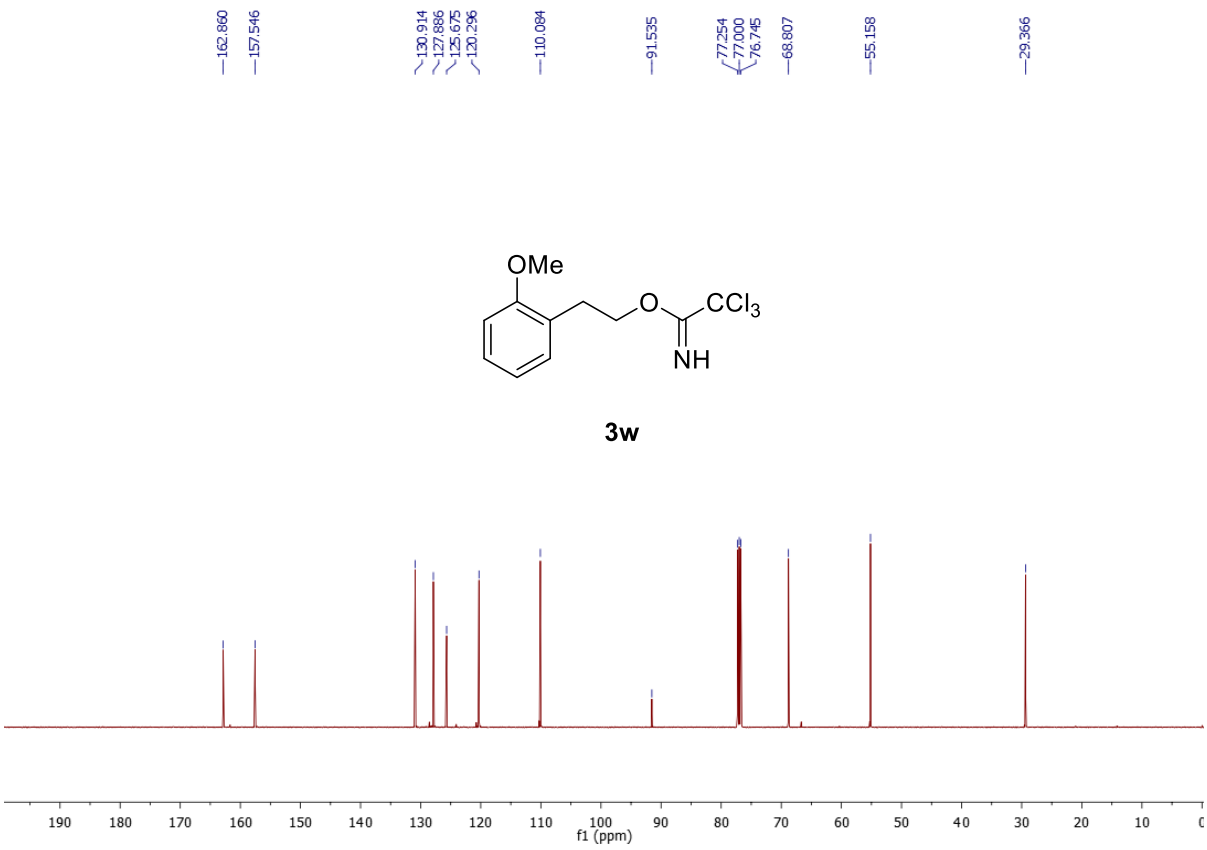

7.676
7.657
7.643
6.991
6.969
6.948
4.140
4.124
4.108
1.795
1.719
1.701
1.682
1.665
1.332
1.325
0.852
0.834
0.817
F
O
NH
3v
2.07
2.07
2.00
2.11
4.22
3.15
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.
f1 (ppm)


166.281
165.383
162.889
129.034
129.002
128.830
128.743
115.285
115.068
77.318
77.000
76.682
65.929
28.186
28.170
22.264
13.816
F
O
NH
3v
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)


-109.576
F
O
NH
3v
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)

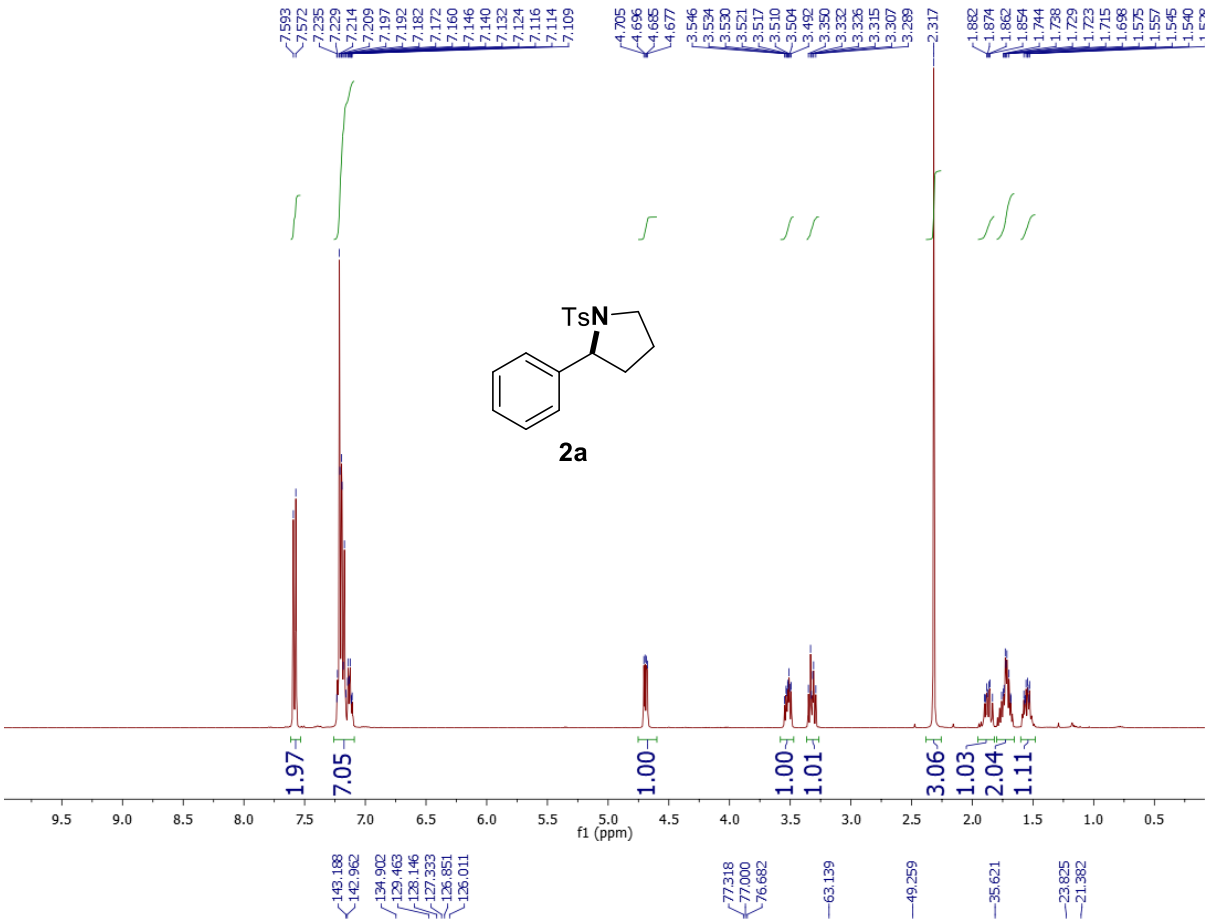

8.256
7.236
7.229
7.226
7.216
6.913
6.898
6.883
6.874
6.857
4.511
4.497
4.483
3.841
3.140
3.126
3.112
OMe
O
CCl3
NH
0.95
1.96
2.01
2.00
2.99
2.08
f1 (ppm)

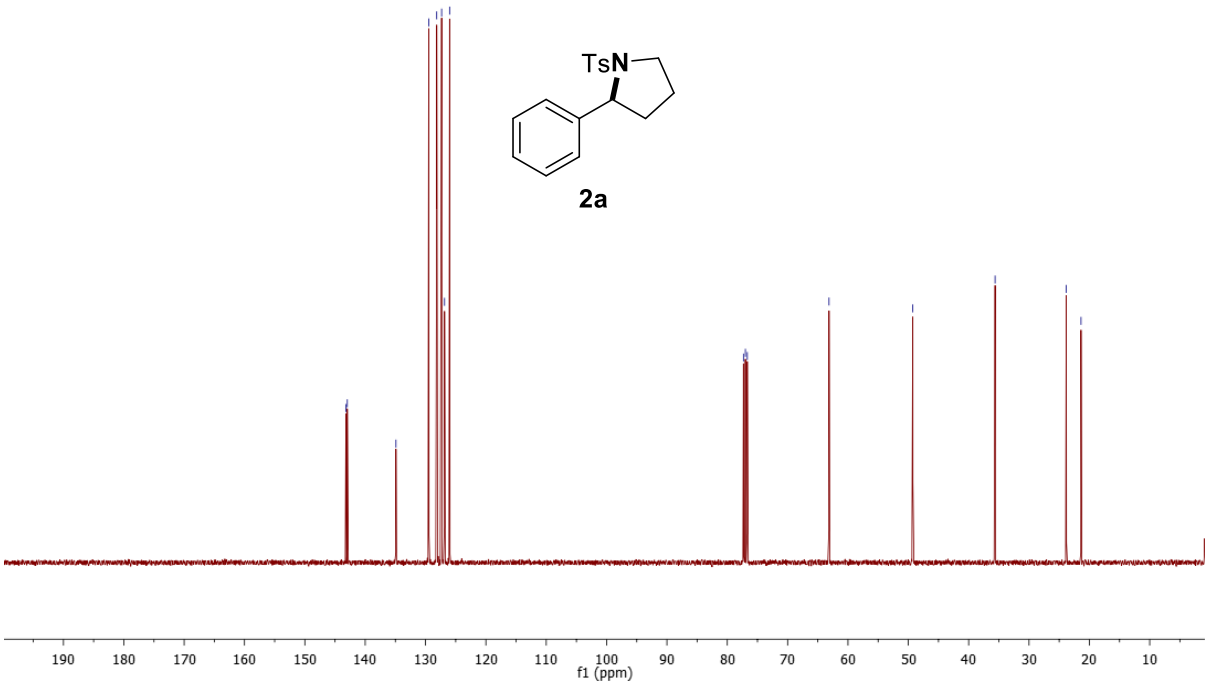
3w

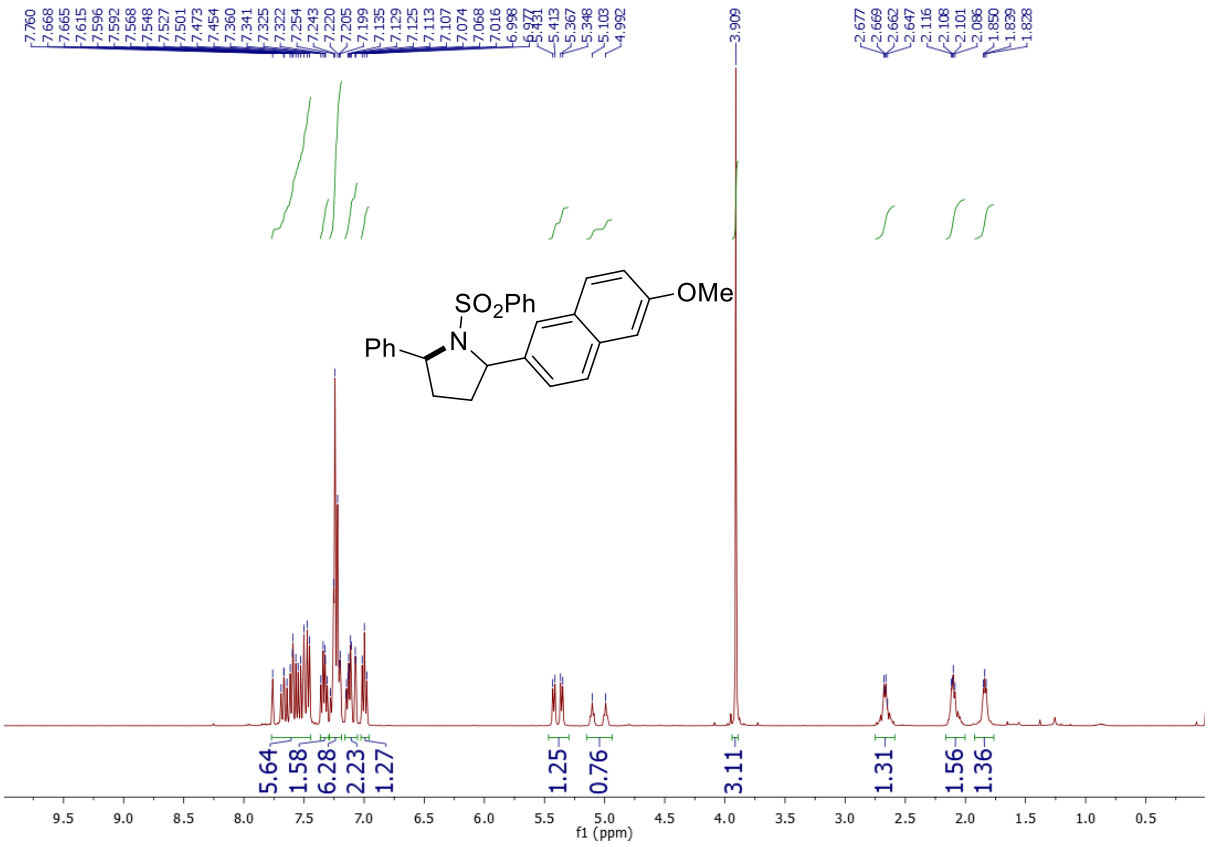

162.860
157.546
130.914
127.886
125.675
120.296
110.084
91.535
77.254
77.000
76.745
68.807
55.158
29.366
f1 (ppm)

OMe
O
CCl3
NH

3w


TsN
2a
f1 (ppm)


TsN
2a
f1 (ppm)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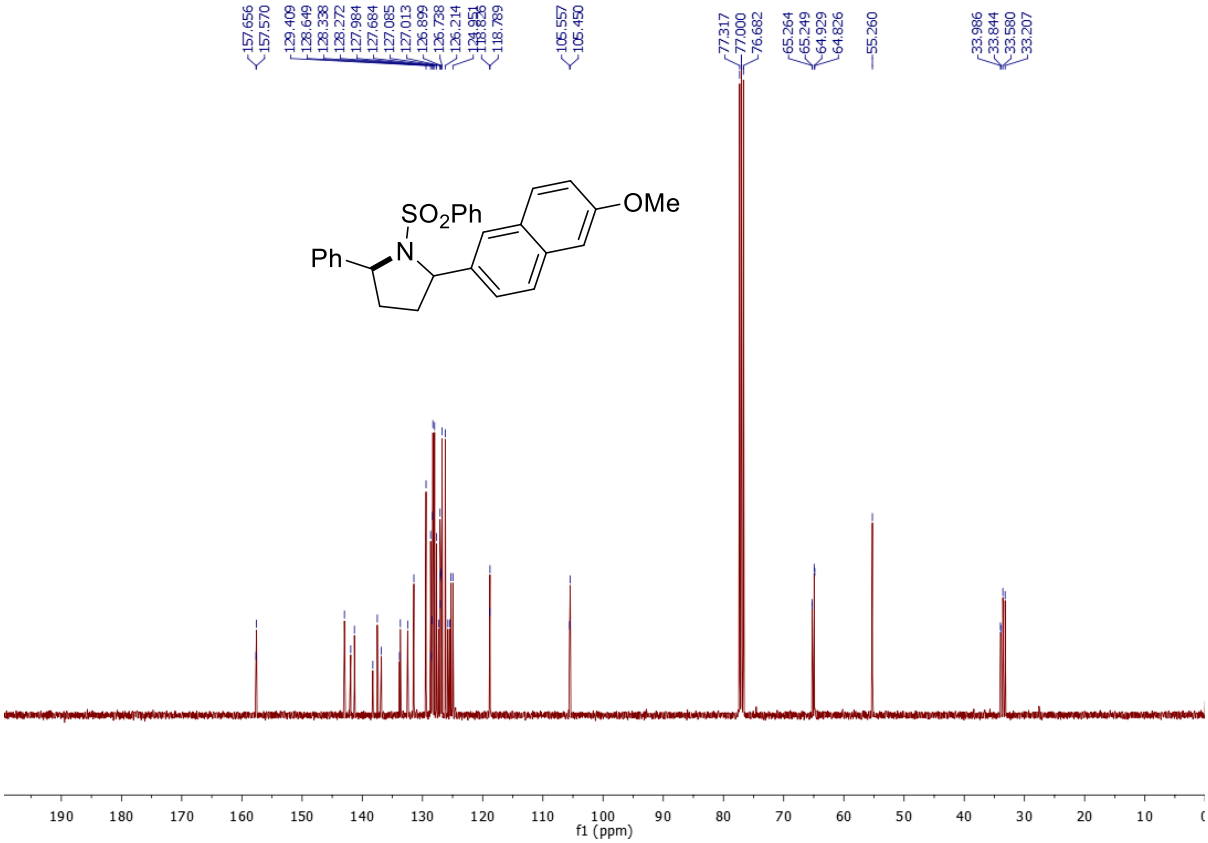
7.665
7.615
7.596
7.592
7.568
7.548
7.527
7.501
7.473
7.454
7.360
7.341
7.325
7.322
7.254
7.243
7.220
7.205
7.199
7.135
7.129
7.125
7.113
7.107
7.074
7.068
7.016
6.998
5.413
5.367
5.348
5.103
4.992
3.909
2.677
2.669
2.662
2.647
2.116
2.108
2.101
2.086
1.850
1.839
1.828
SO2Ph
N
Ph
OMe
5.64
1.58
6.28
2.23
1.27
1.25
0.76
3.11
1.31
1.56
1.36
f1 (ppm)


157.656
157.570
129.409
128.649
128.338
128.272
127.984
127.684
127.085
127.013
126.899
126.738
126.214
118.789
105.557
105.450
77.317
77.000
76.682
65.264
65.249
64.929
64.826
55.260
33.986
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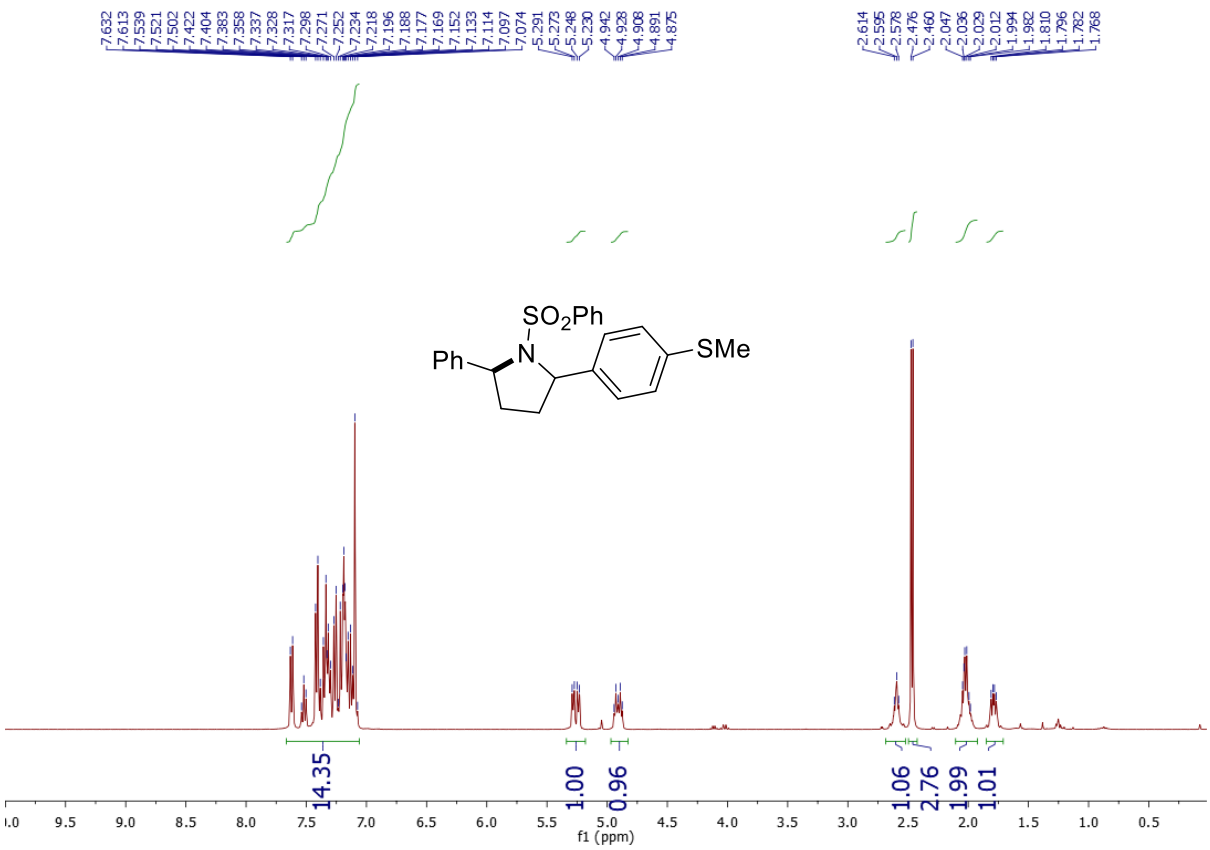
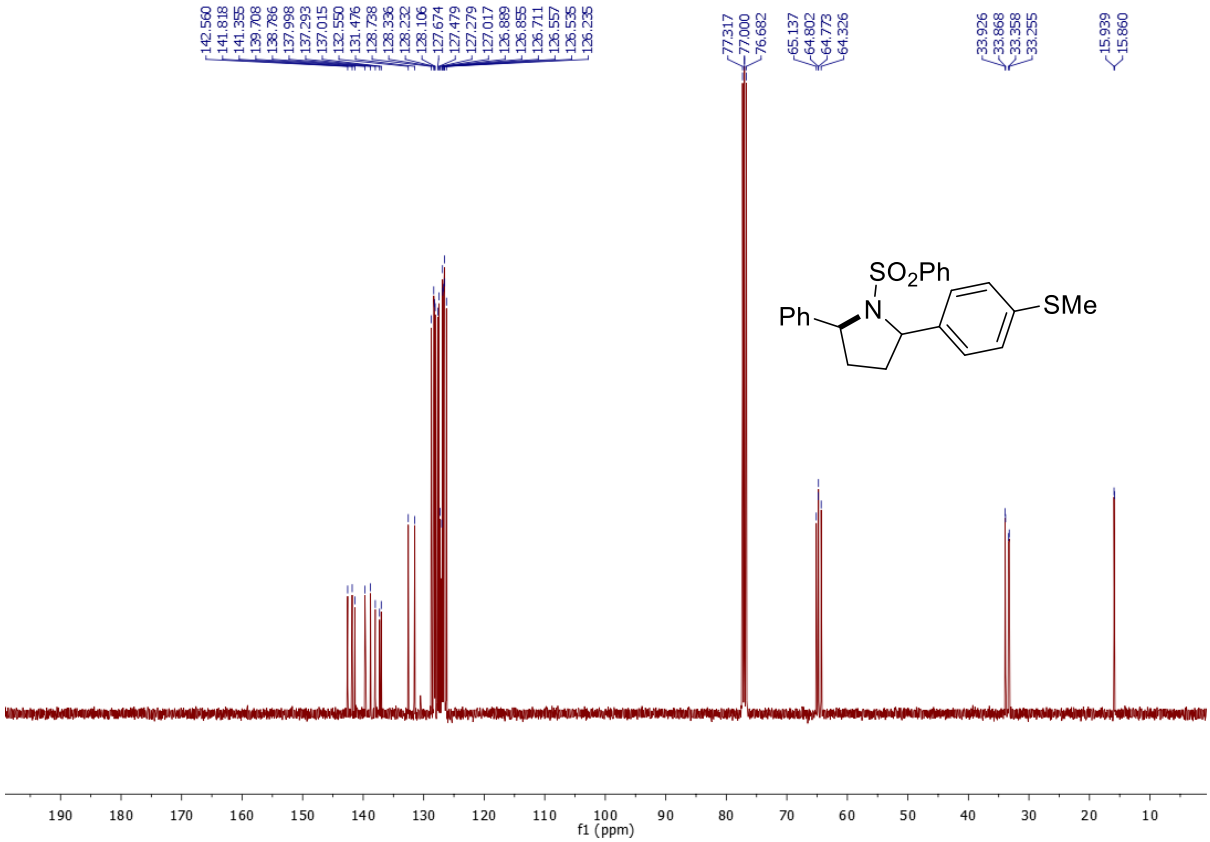
33.580
33.207
SO2Ph
N
Ph
OMe
f1 (ppm)


7.632
7.613
7.539
7.521
7.502
7.422
7.404
7.383
7.358
7.337
7.328
7.317
7.298
7.271
7.252
7.234
7.218
7.196
7.188
7.177
7.169
7.152
7.133
7.114
7.097
7.074
5.291
5.273
5.248
5.230
4.942
4.928
4.908
4.891
4.875
2.614
2.595
2.578
2.476
2.460
2.047
2.036
2.029
2.012
1.994
1.982
1.810
1.796
1.782
1.768
SO2Ph
N
Ph
SMe
14.35
1.00
0.96
1.06
2.76
1.99
1.01
f1 (ppm)


142.560
141.818
141.355
139.708
138.786
137.998
137.293
137.015
132.550
131.476
128.738
128.336
128.232
128.106
127.674
127.479
127.279
127.017
126.889
126.855
126.711
126.557
126.535
126.235
77.317
77.000
76.682
65.137
64.802
64.773
64.326
33.926
33.868
33.358
33.255
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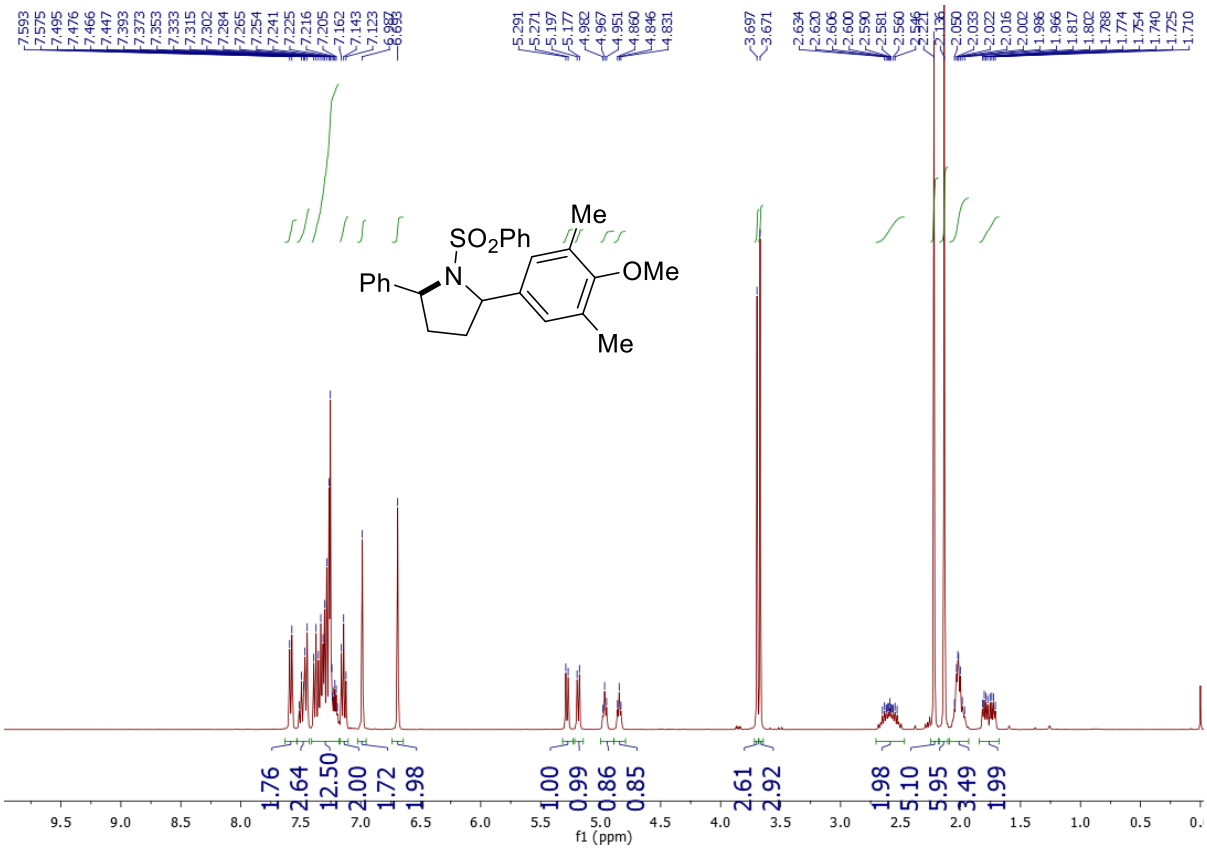
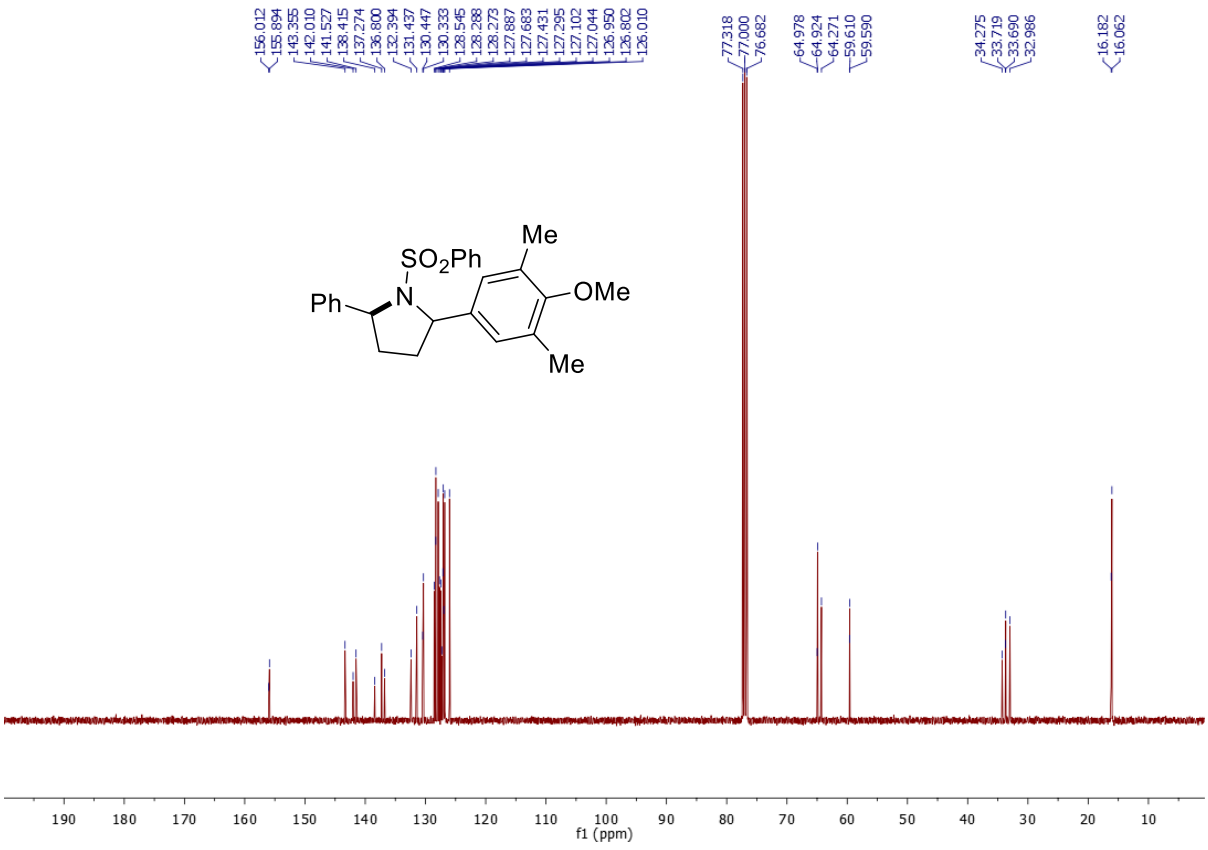
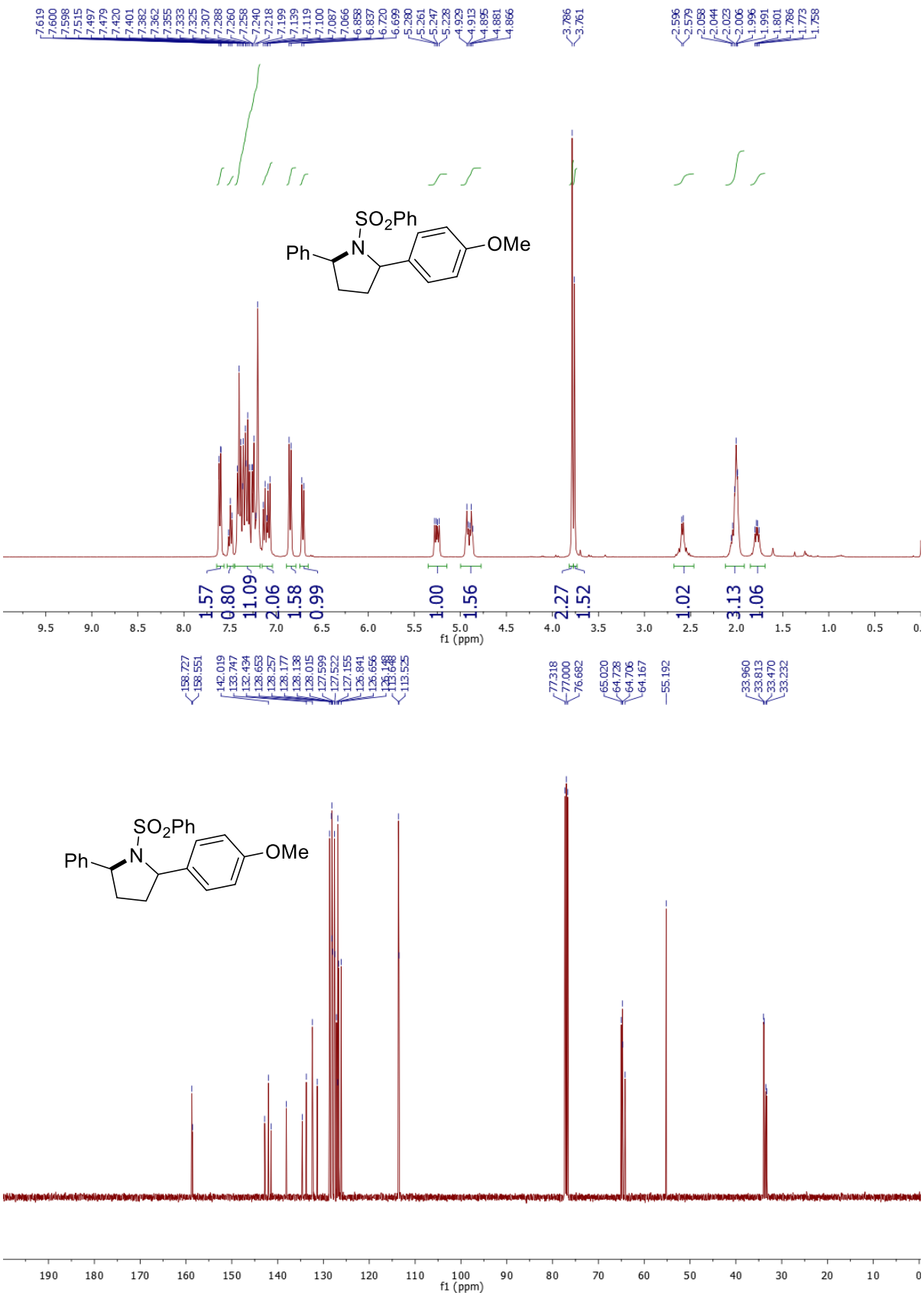
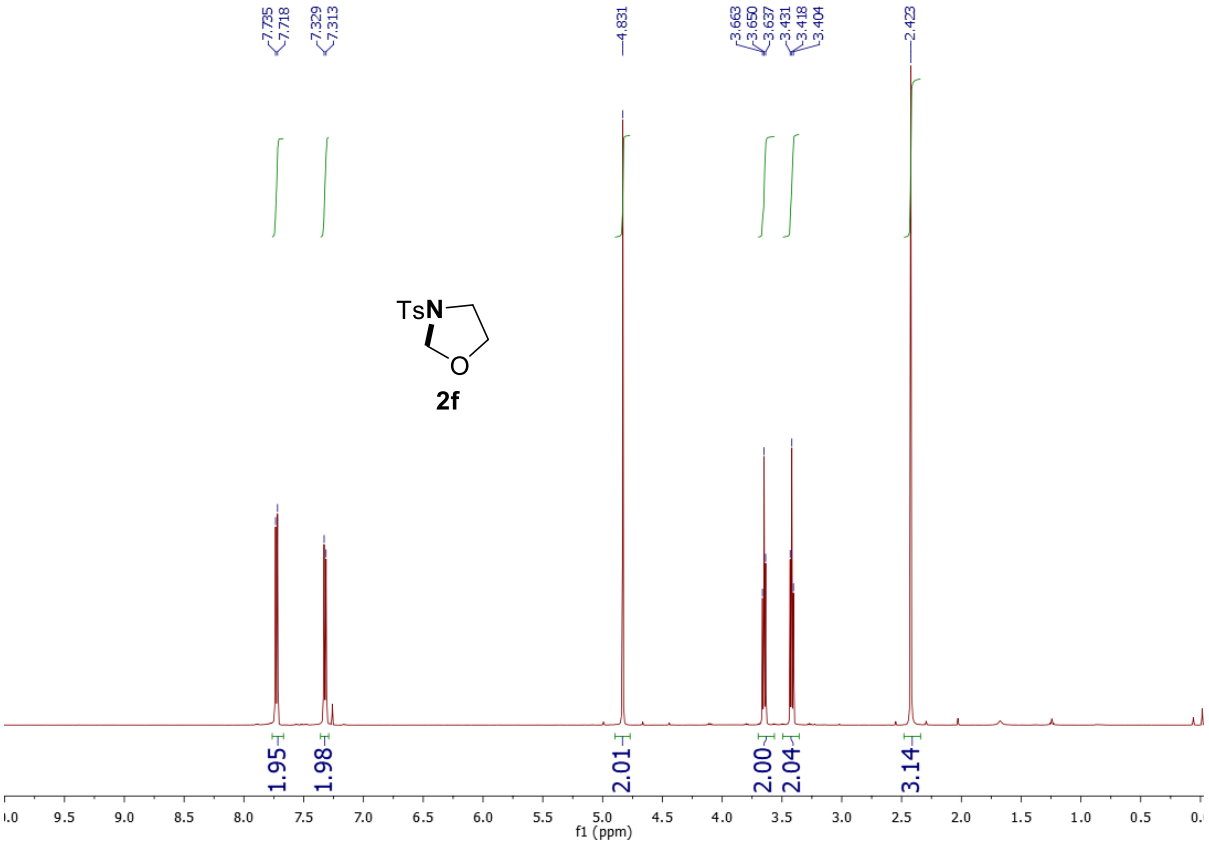
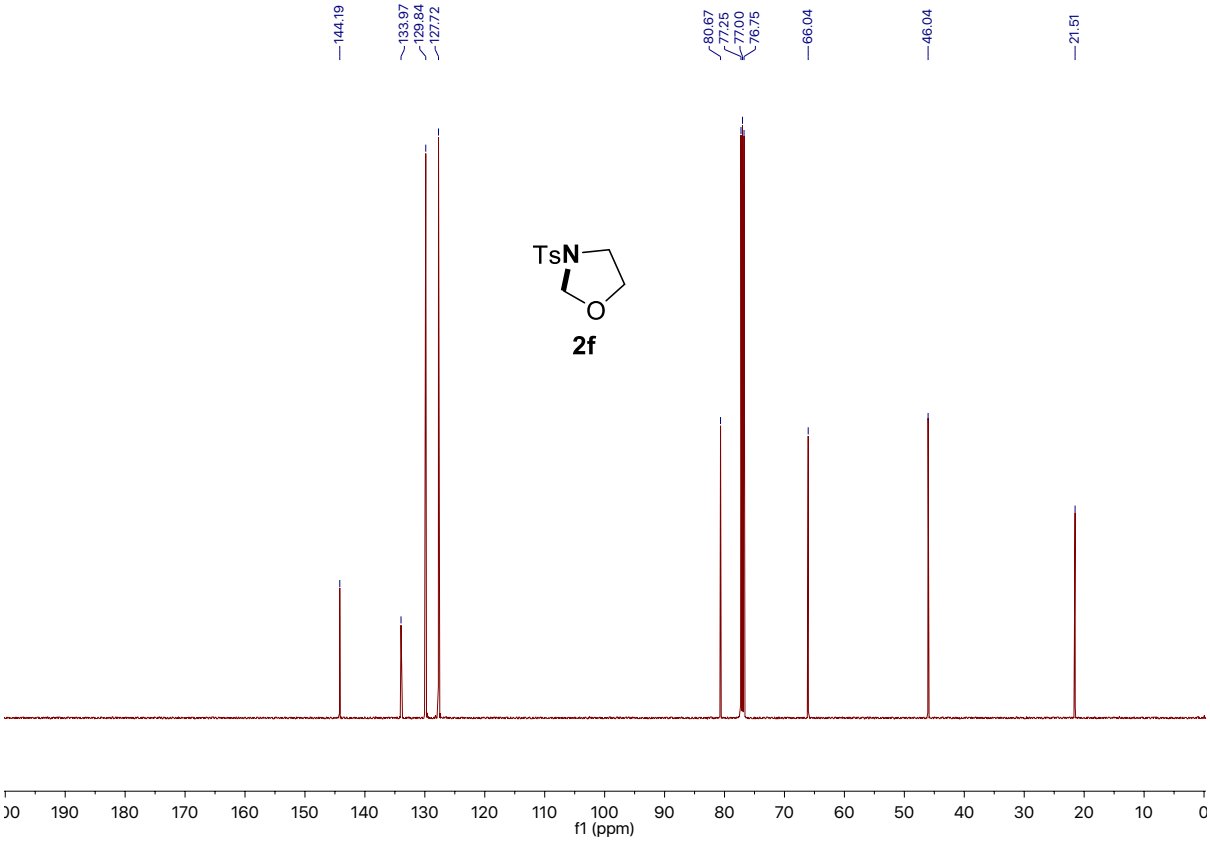
15.860
SO2Ph
N
Ph
SMe
f1 (ppm)


Me
SO2Ph
N
Ph
OMe
Me
1.76
2.64
12.50
2.00
1.72
1.98
1.00
0.99
0.86
0.85
2.61
2.92
1.98
5.10
5.95
3.49
1.99
f1 (ppm)


Me
SO2Ph
N
Ph
OMe
Me
f1 (ppm)


SO2Ph
N
Ph
OMe
f1 (ppm)


7.735
7.718
7.329
7.313
4.831
3.663
3.650
3.637
3.431
3.418
3.404
2.423
TsN
O
2f
1.95
1.98
2.01
2.00
2.04
3.14
f1 (ppm)


144.19
133.97
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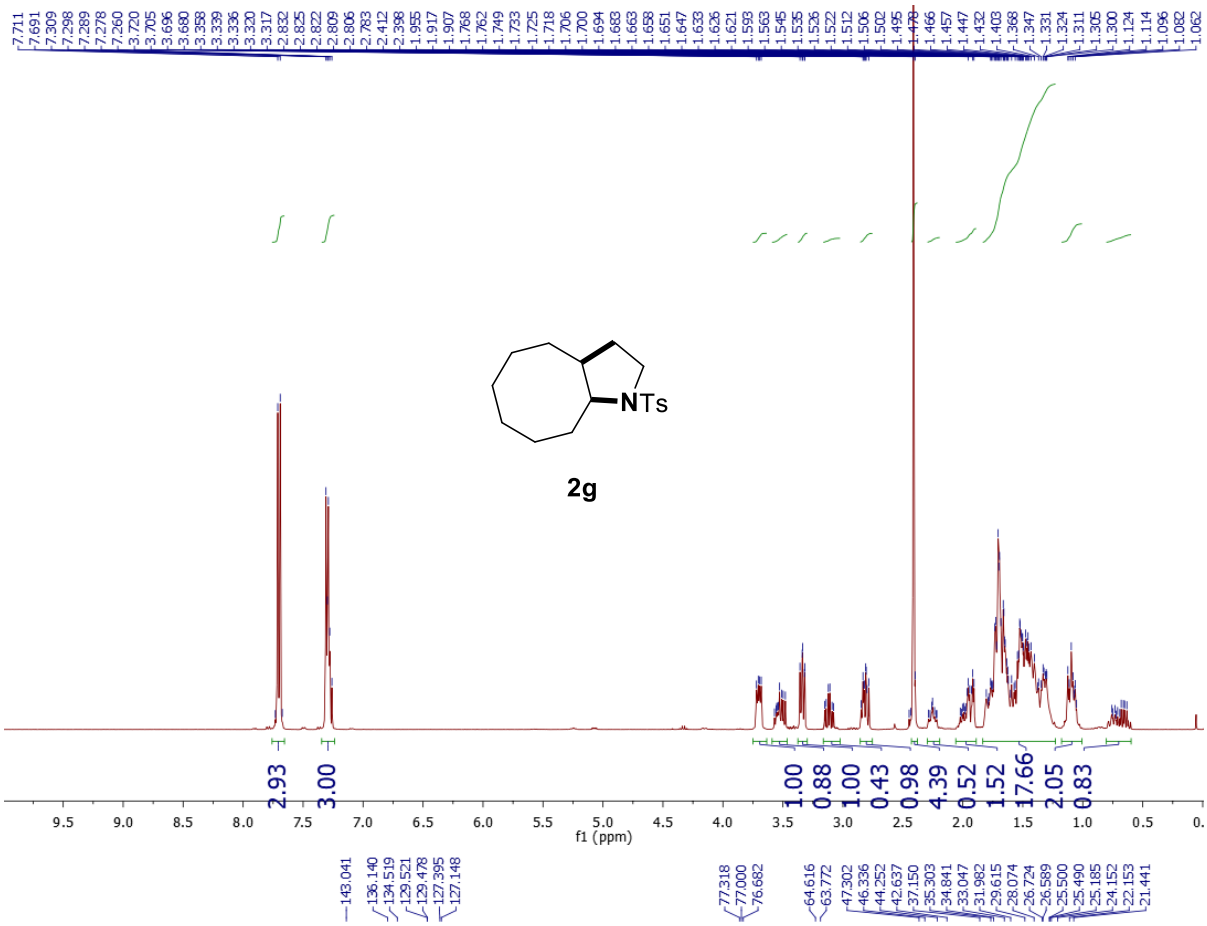
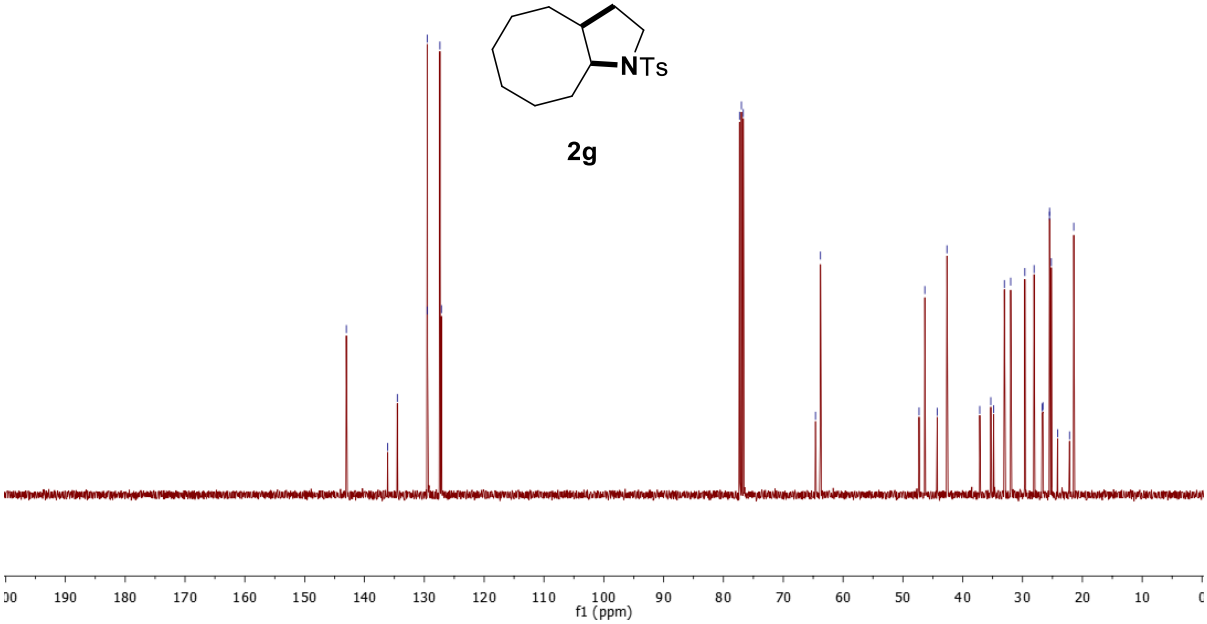
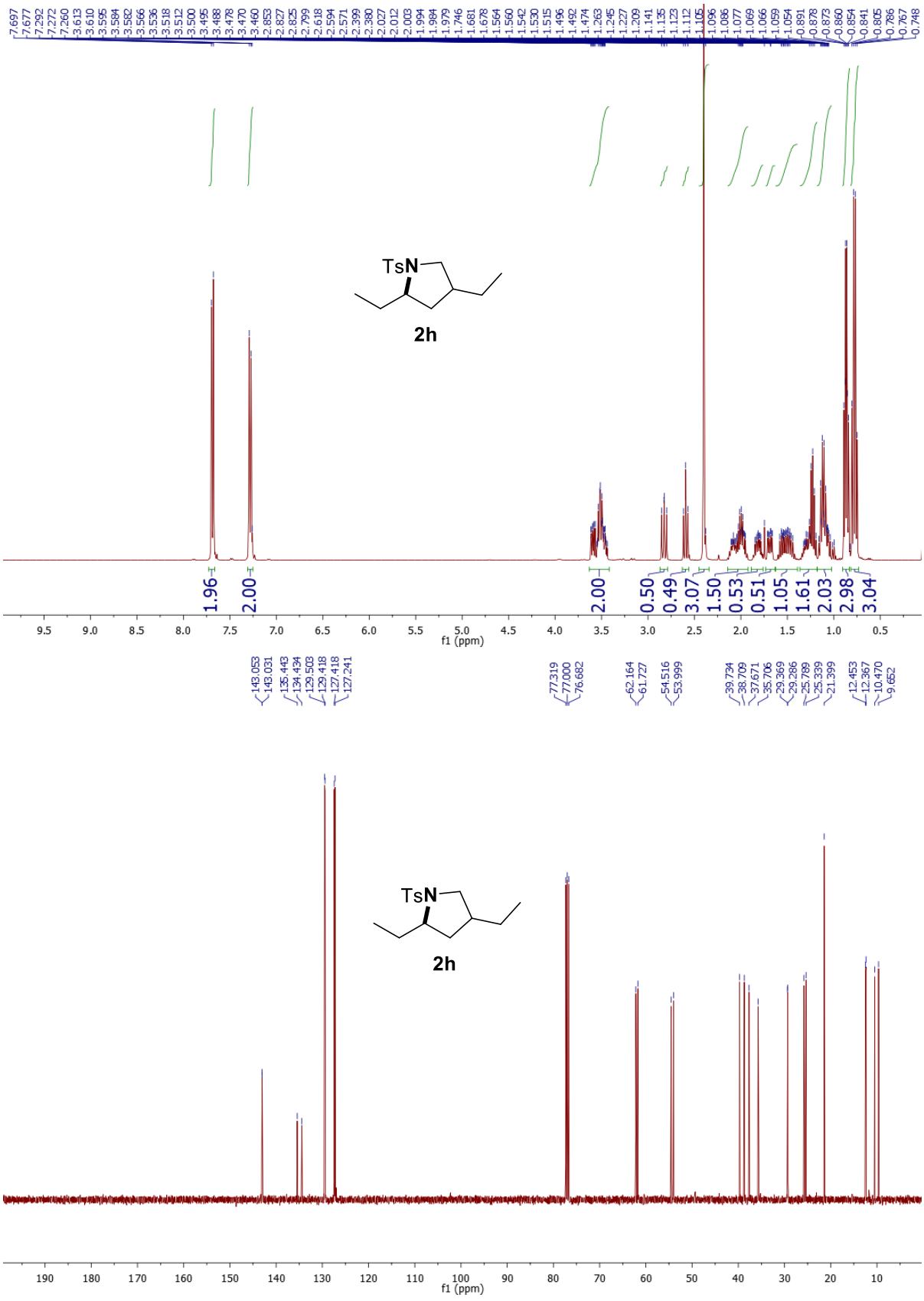
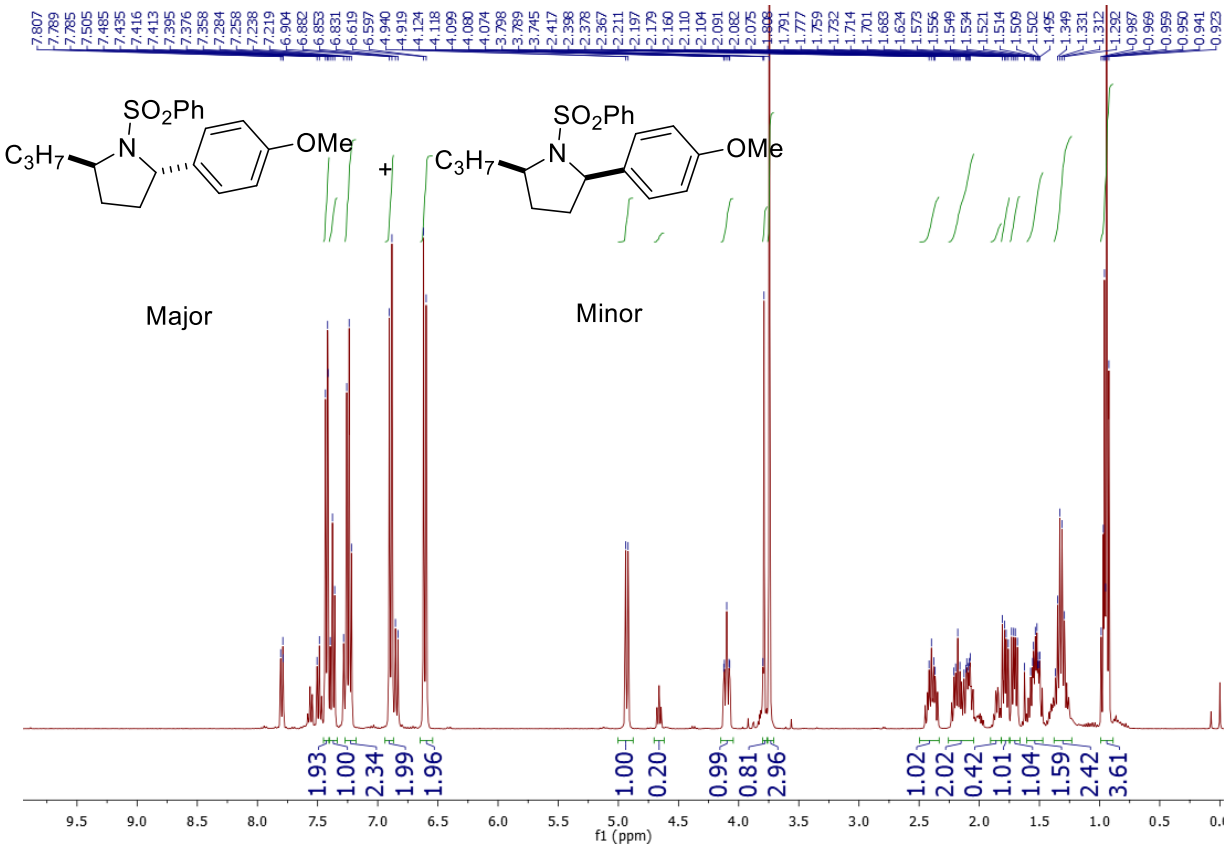
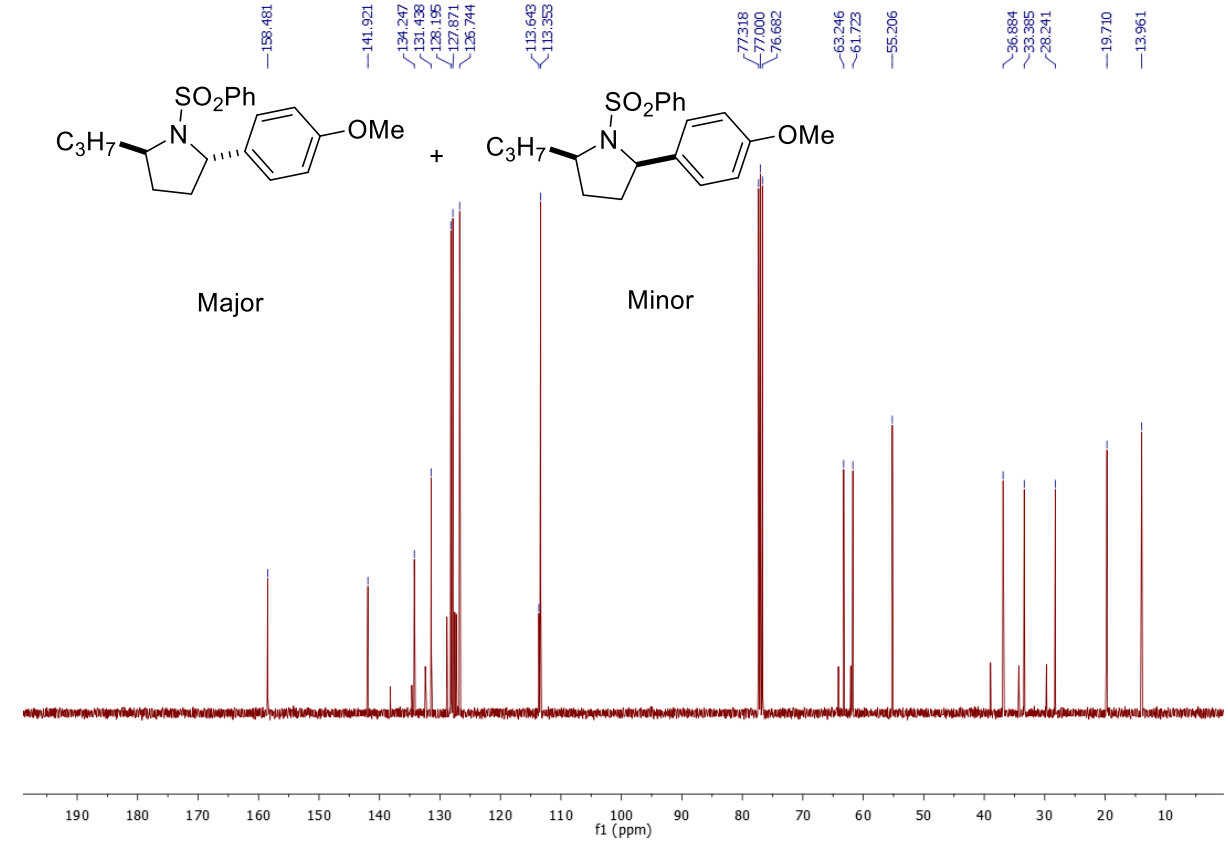
127.72
80.67
77.25
77.00
76.75
66.04
46.04
21.51
TsN
O
2f
f1 (ppm)

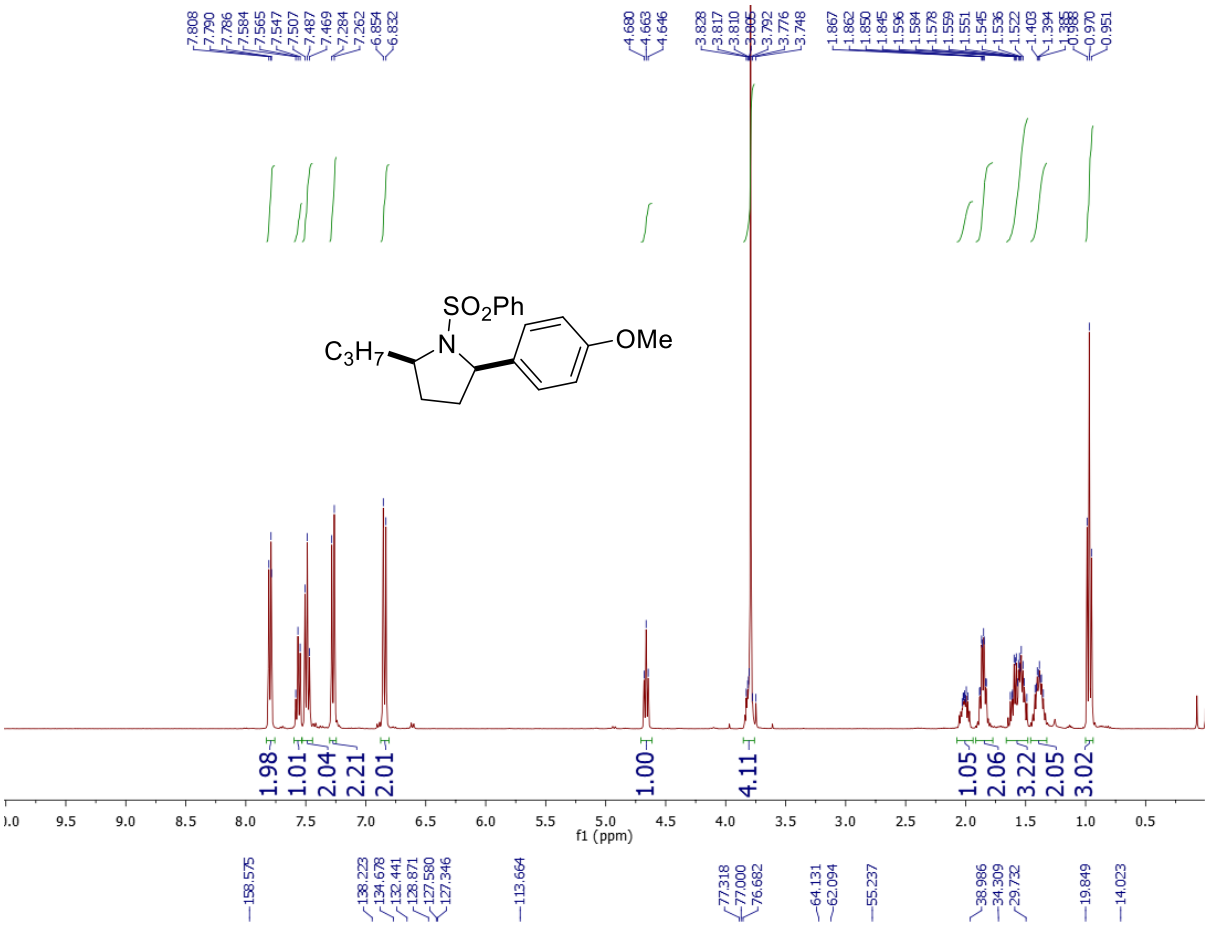

NTs
2g
2.93
3.00
1.00
0.88
1.00
0.43
0.98
4.39
0.52
1.52
17.66
2.05
0.83
f1 (ppm)


NTs
2g
f1 (ppm)


TsN
2h
f1 (ppm)
TsN
2h
f1 (ppm)


SO2Ph
N
C3H7
OMe
+
Major
Minor
f1 (ppm)


SO2Ph
N
C3H7
OMe
+
Major
Minor
f1 (ppm)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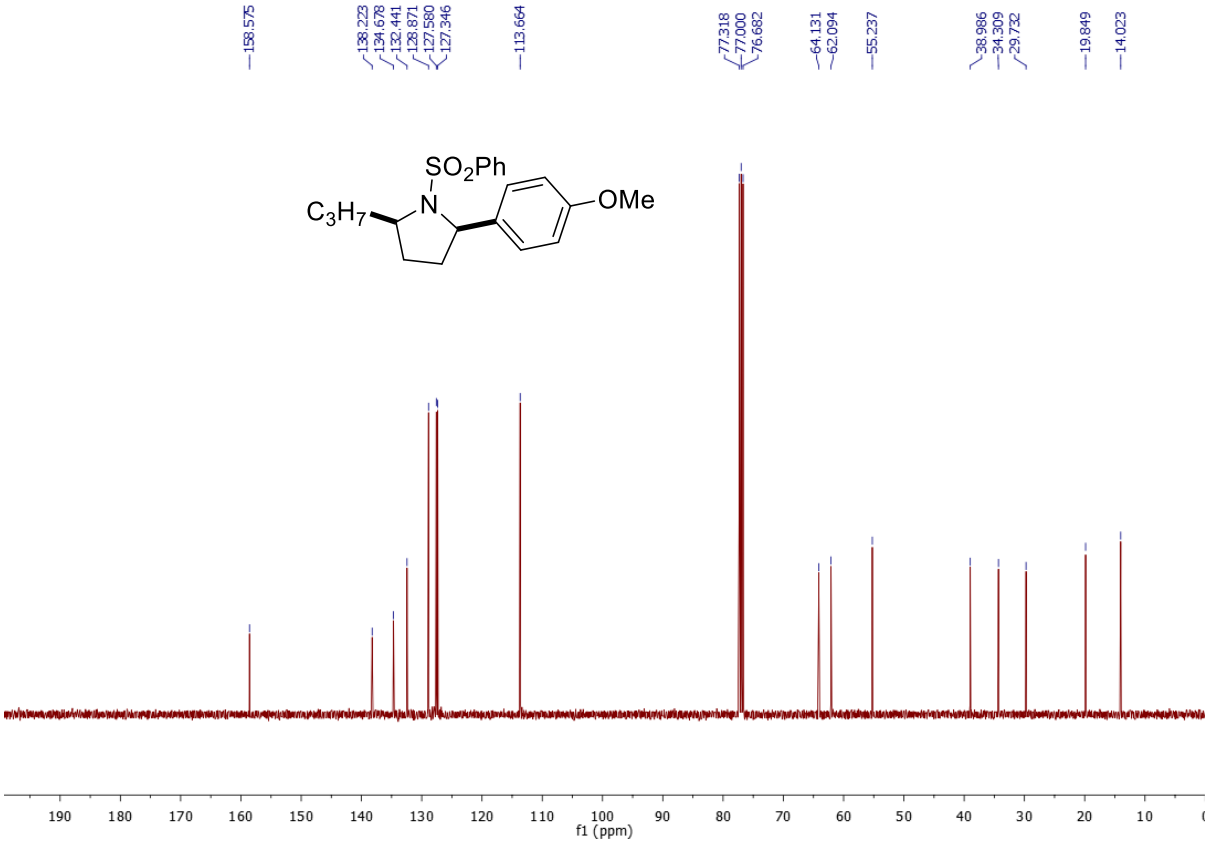
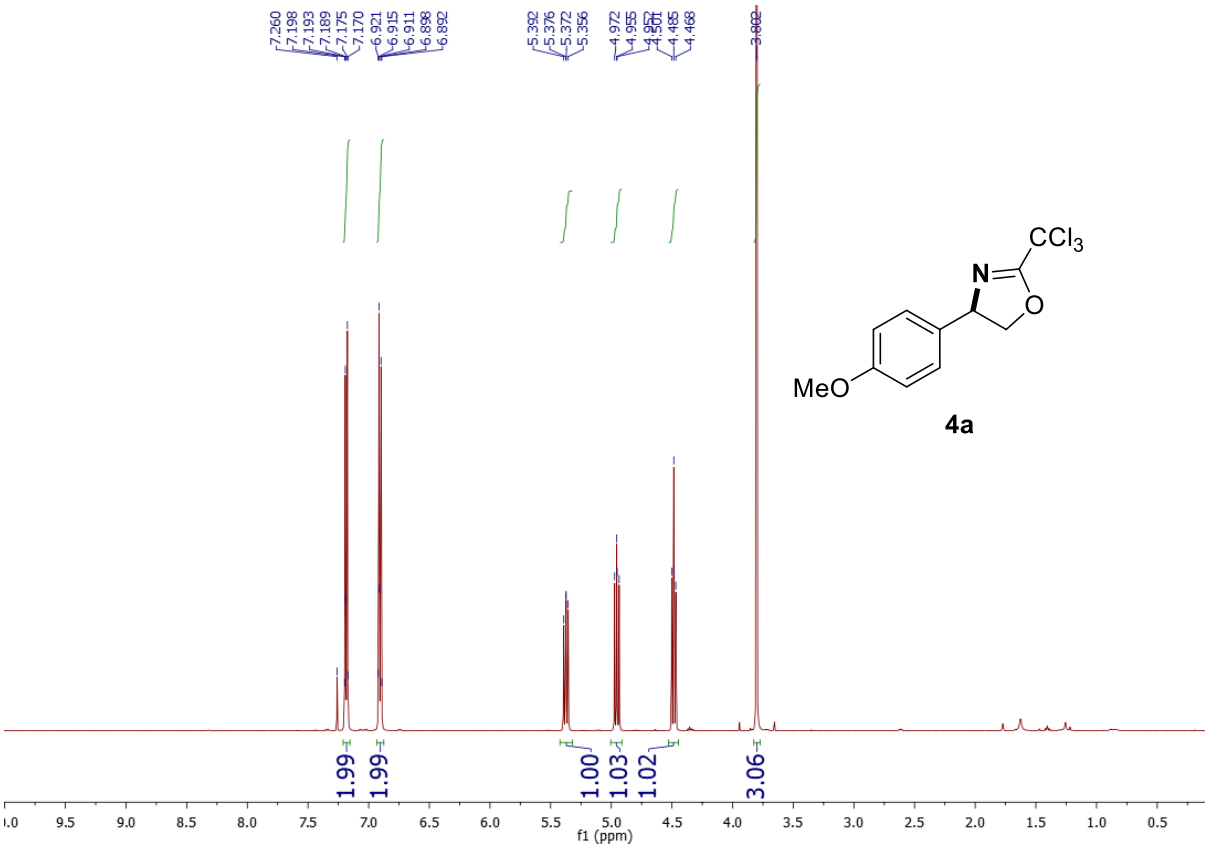
7.584
7.565
7.547
7.507
7.487
7.469
7.284
7.262
6.854
6.832
4.680
4.663
4.646
3.828
3.817
3.810
3.792
3.776
3.748
1.867
1.862
1.850
1.845
1.596
1.584
1.578
1.559
1.551
1.545
1.536
1.522
1.403
1.394
0.970
0.951
SO2Ph
N
C3H7
OMe
1.98
1.01
2.04
2.21
2.01
1.00
4.11
1.05
2.06
3.22
2.05
3.02
f1 (ppm)


158.575
138.223
134.678
132.441
128.871
127.580
127.346
113.664
77.318
77.000
76.682
64.131
62.094
55.237
38.986
34.309
29.732
19.849
14.023
SO2Ph
N
C3H7
OMe
f1 (ppm)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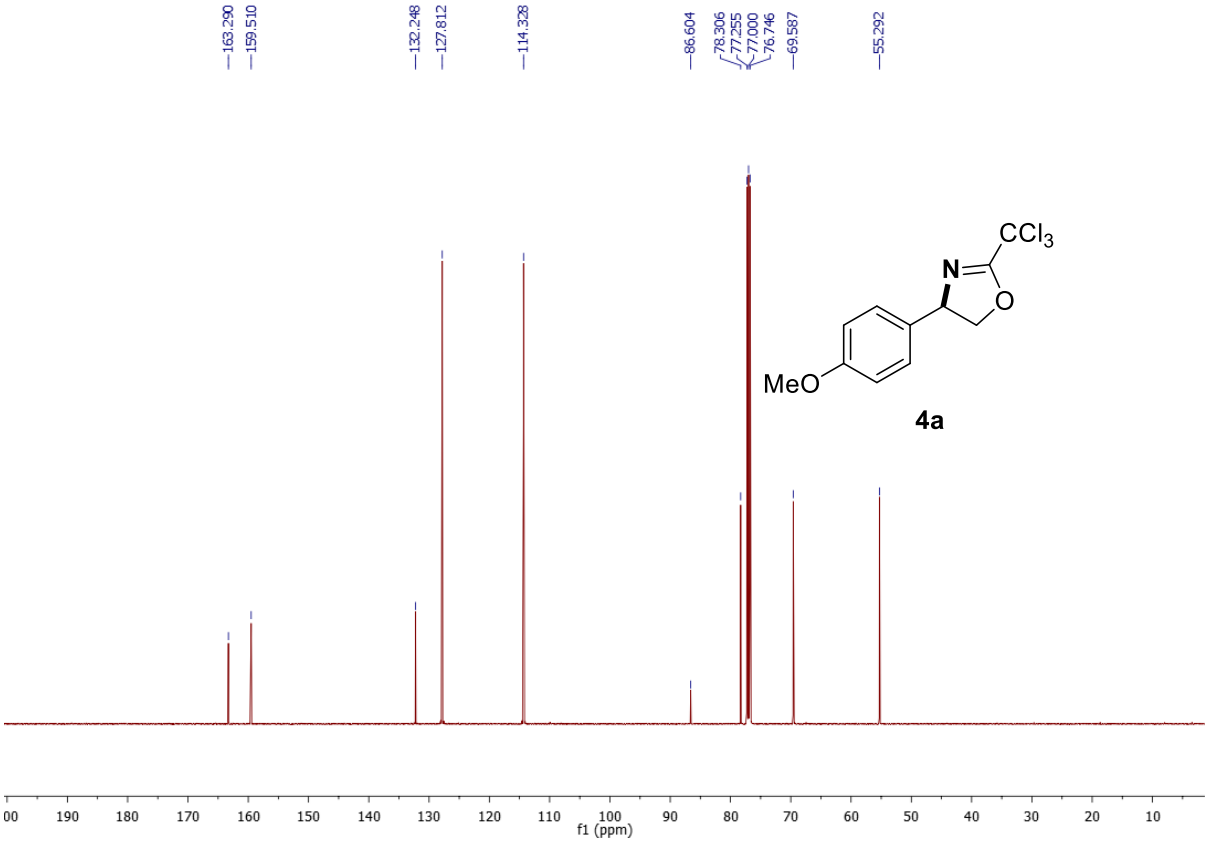
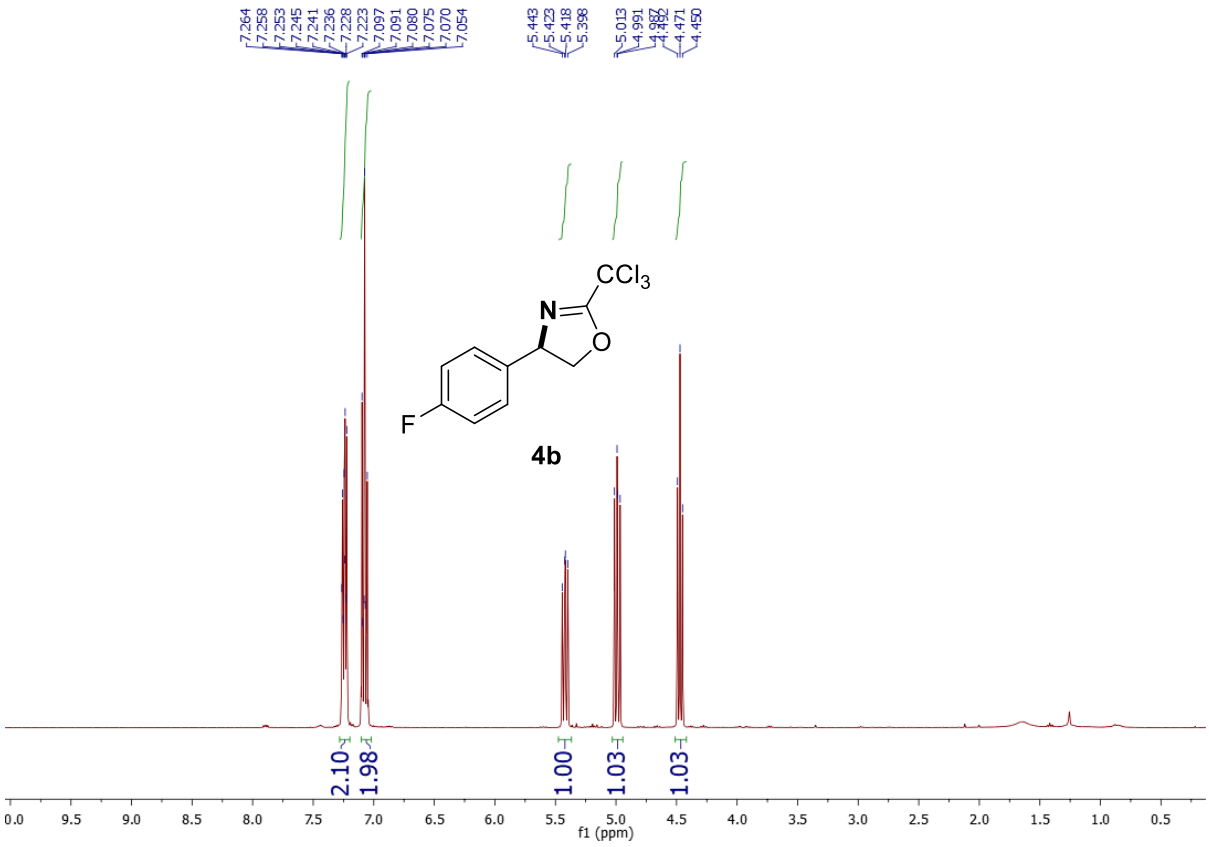
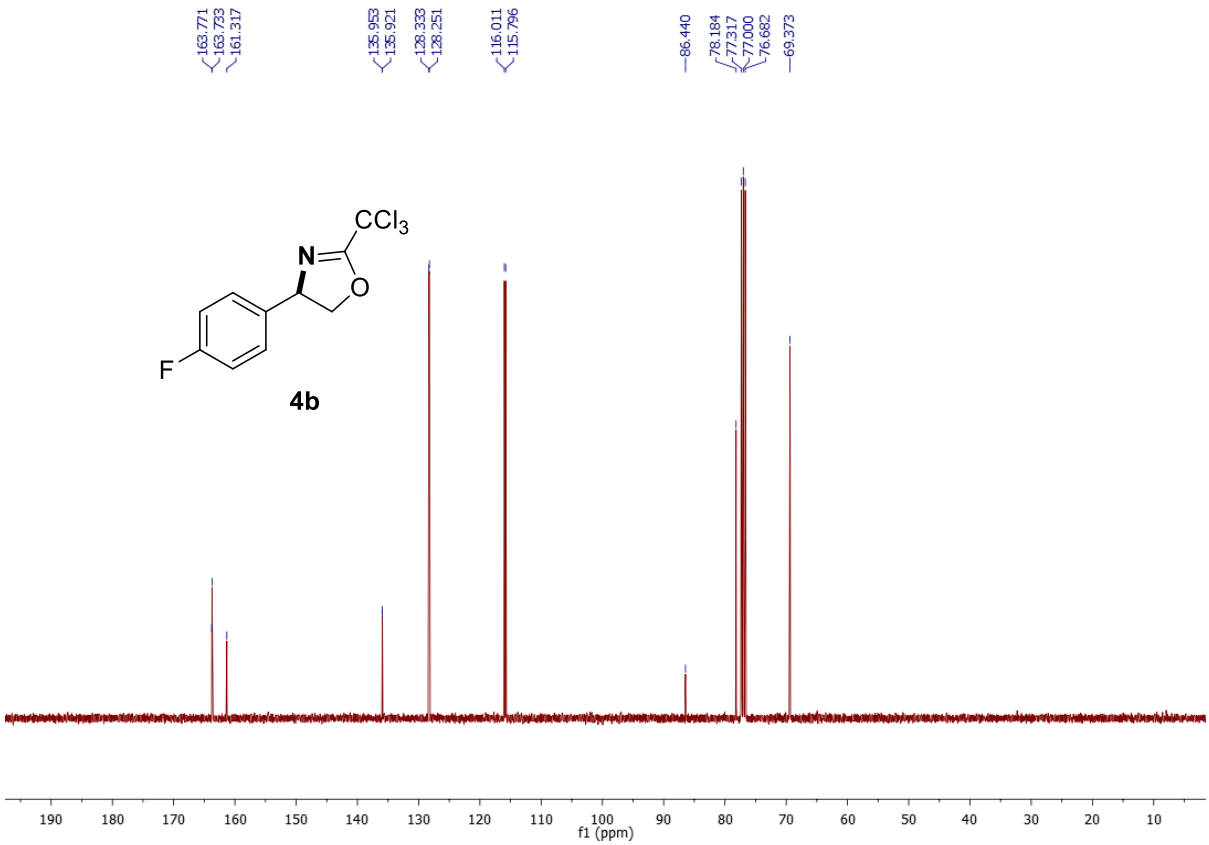
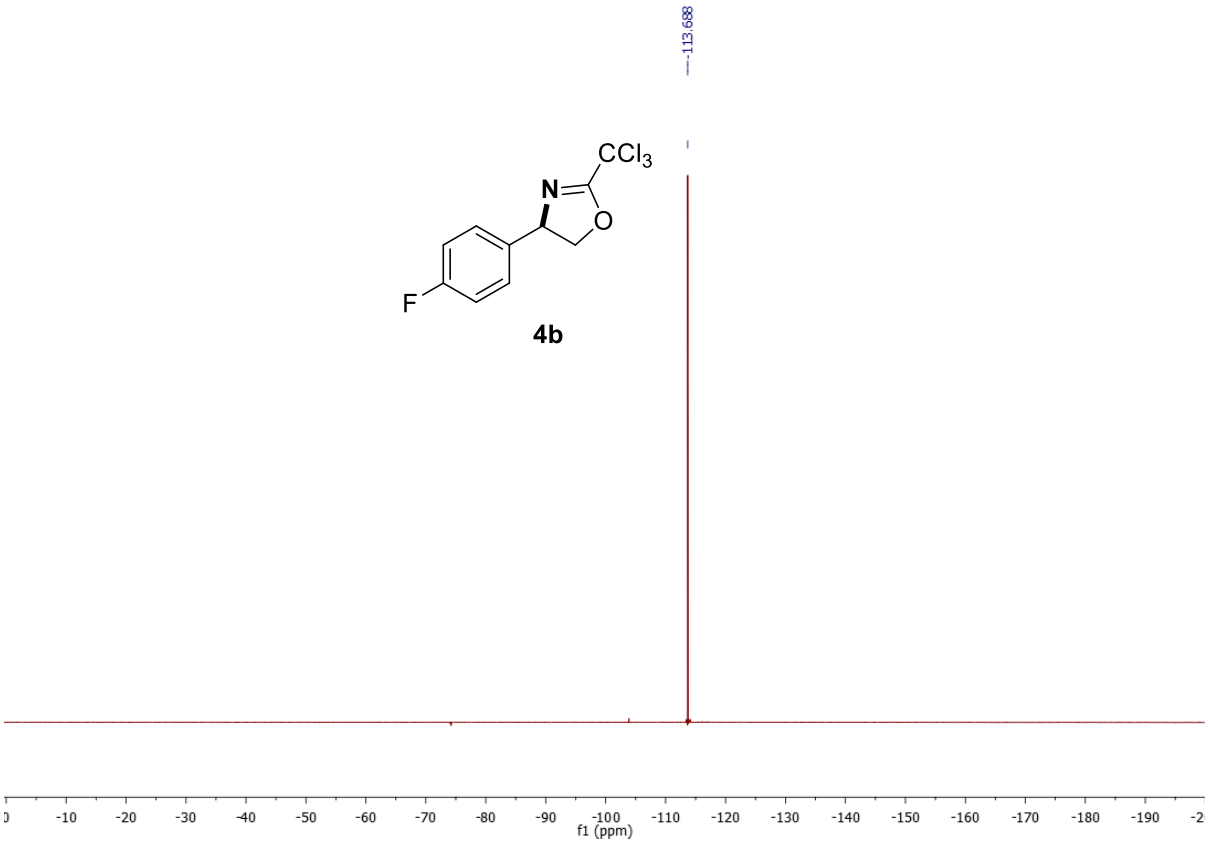
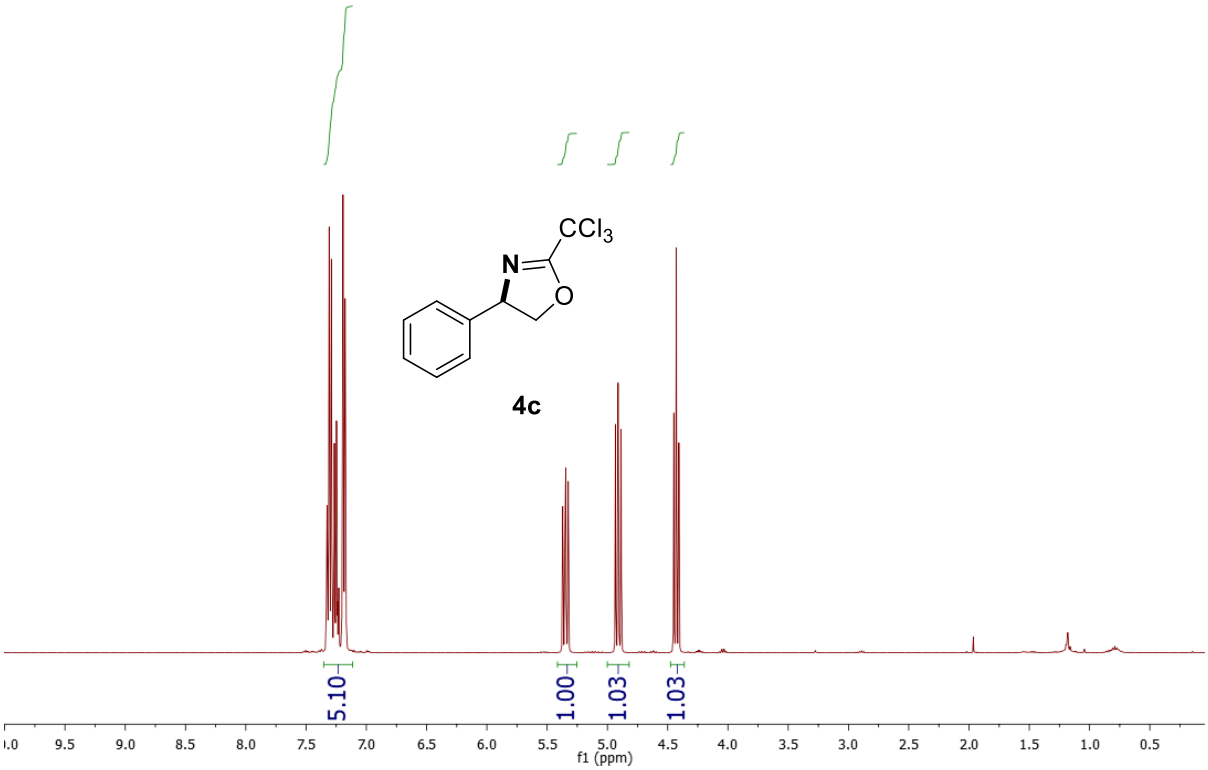
7.198
7.193
7.189
7.175
7.170
6.921
6.915
6.911
6.898
6.892
5.392
5.376
5.372
5.356
4.972
4.955
4.952
4.501
4.485
4.468
3.862
1.99
1.99
1.00
1.03
1.02
3.06
f1 (ppm)
CCl3
N
O
MeO
4a

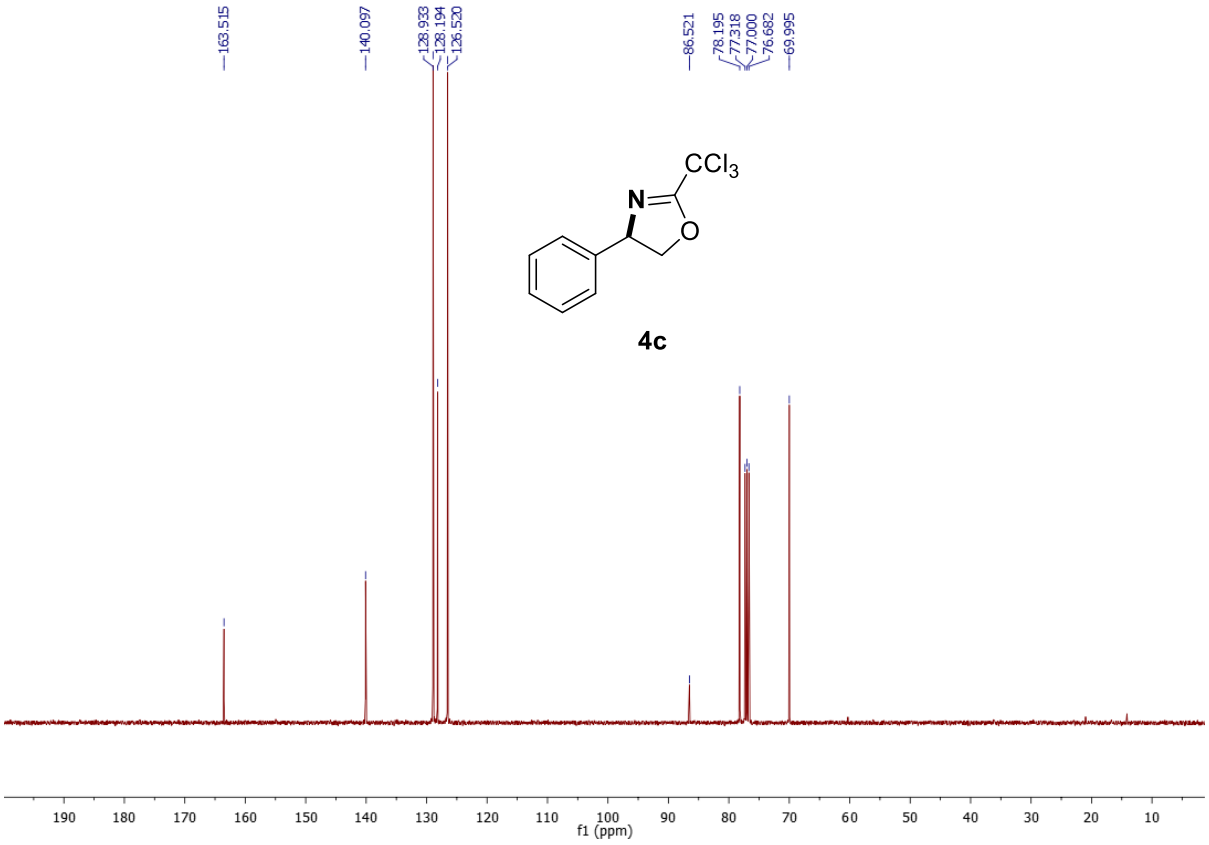

163.290
159.510
132.248
127.812
114.328
86.604
78.306
77.255
77.000
76.746
69.587
55.292
f1 (ppm)
CCl3
N
O
MeO
4a

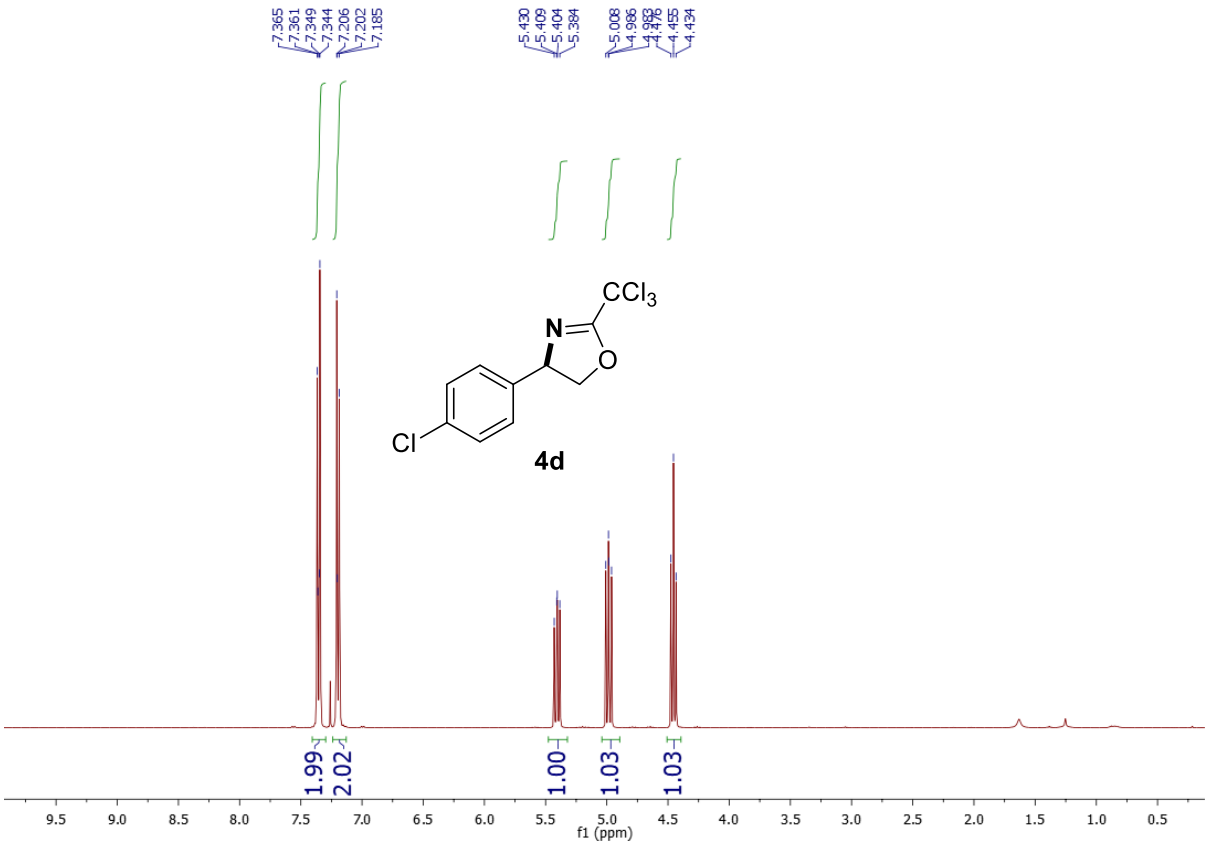

7.264
7.258
7.253
7.245
7.241
7.236
7.228
7.223
7.097
7.091
7.080
7.075
7.070
7.054
5.443
5.423
5.418
5.398
5.013
4.991
4.471
4.450
CCl3
N
O
F
4b
2.10
1.98
1.00
1.03
1.03
f1 (ppm)

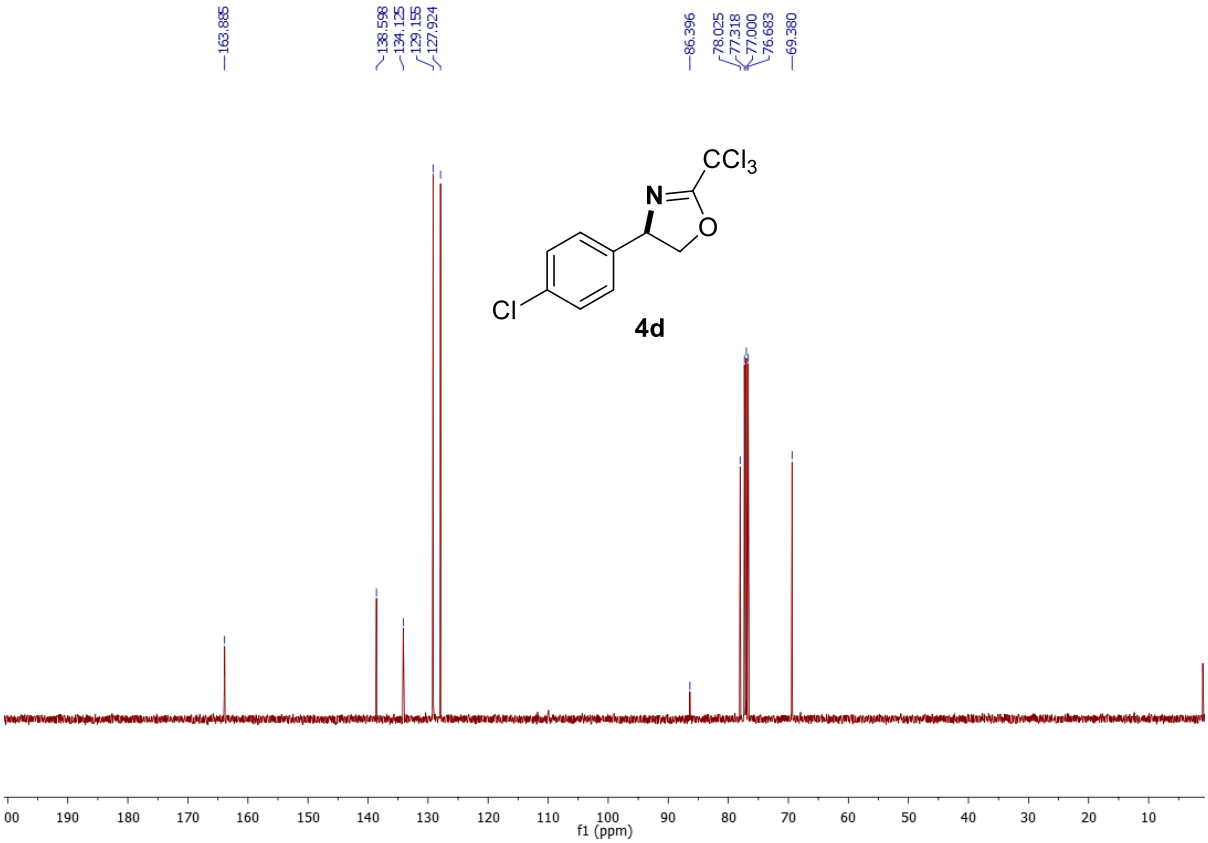

163.771
163.733
161.317
135.953
135.921
128.333
128.251
116.011
115.796
86.440
78.184
77.317
77.000
76.682
69.373
CCl3
N
O
F
4b
f1 (ppm)

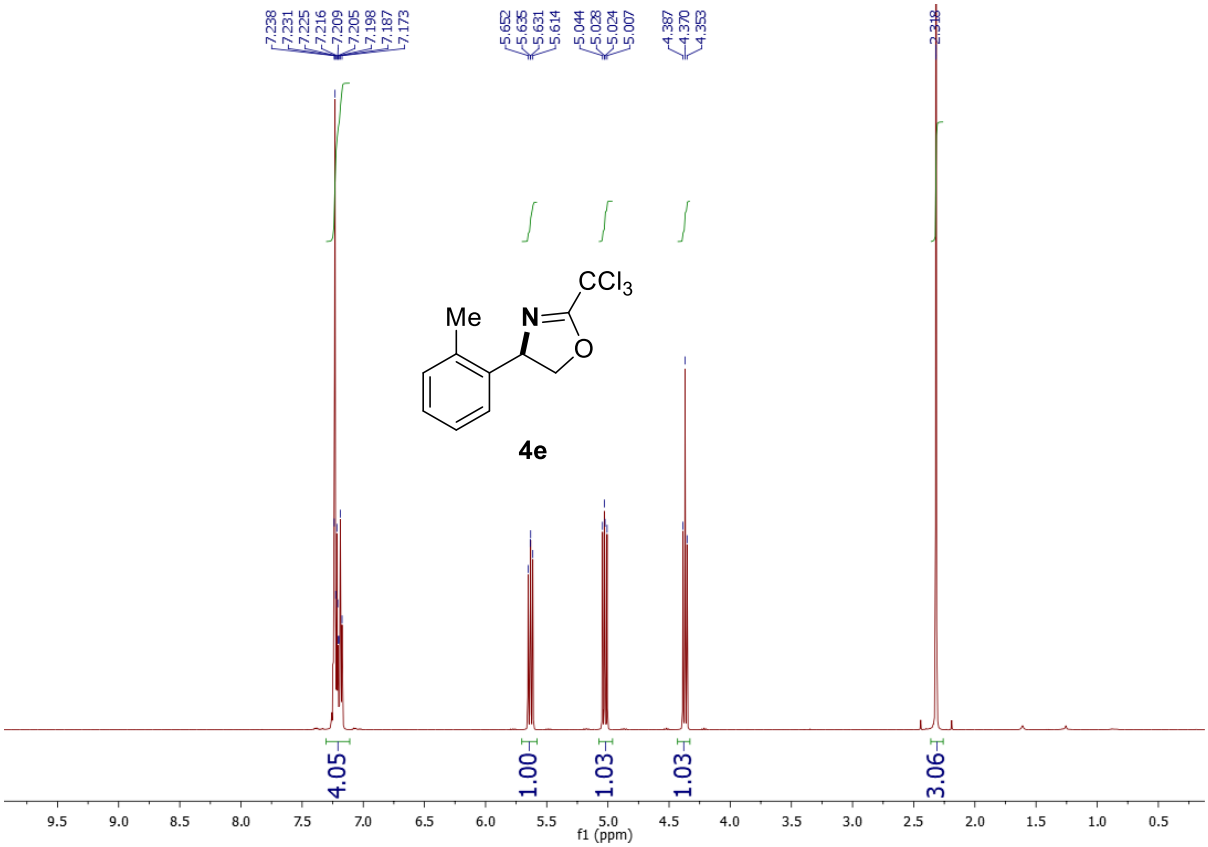

-113.688
CCl3
N
O
F
4b
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)

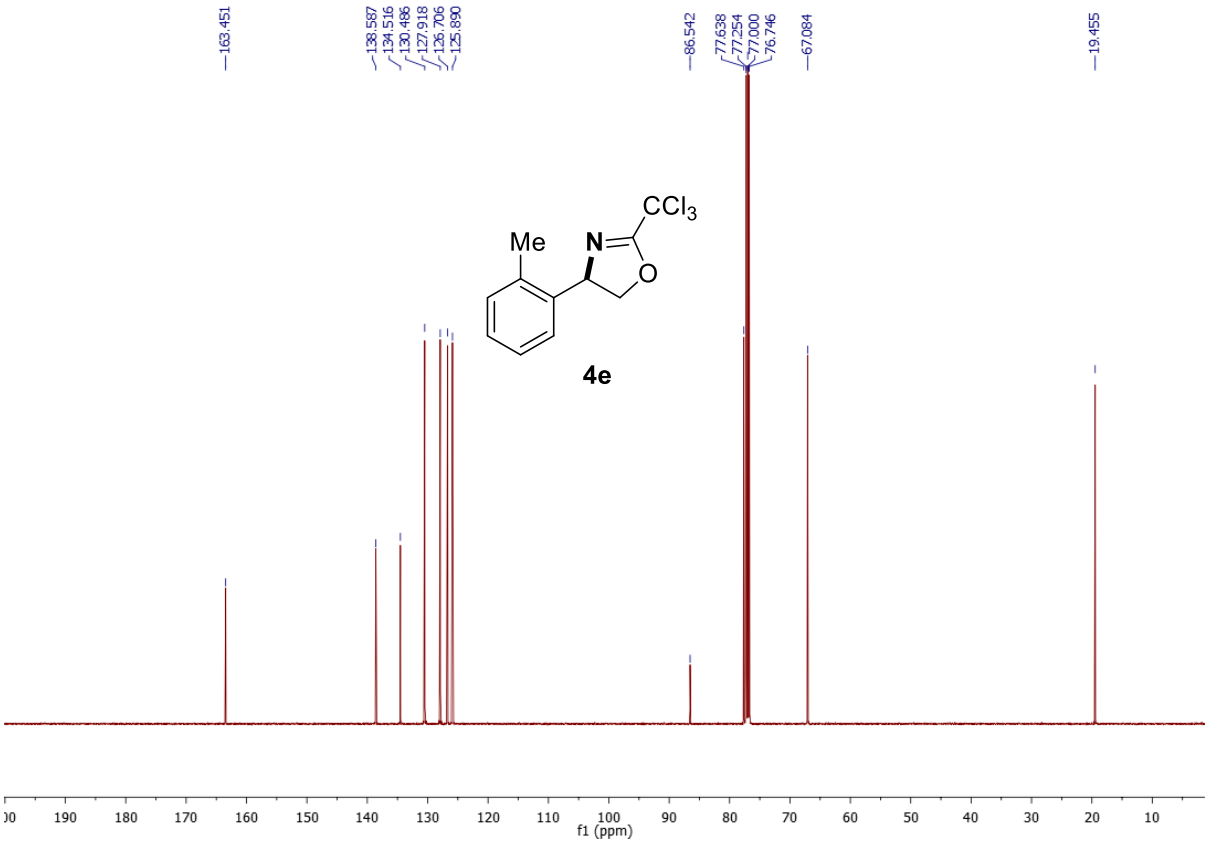

CCl3
N
O
4c
5.10
1.00
1.03
1.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


163.515
140.097
128.933
128.194
126.520
86.521
78.195
77.318
77.000
76.682
69.995
CCl3
N
O
4c
f1 (ppm)


7.365
7.361
7.349
7.344
7.206
7.202
7.185
5.430
5.409
5.404
5.384
5.008
4.986
4.983
4.476
4.455
4.434
CCl3
N
O
Cl
4d
1.99
2.02
1.00
1.03
1.03
f1 (ppm)


163.885
138.598
134.125
129.155
127.924
86.396
78.025
77.318
77.000
76.683
69.380
CCl3
N
O
Cl
4d
f1 (ppm)


7.238
7.231
7.225
7.216
7.209
7.205
7.198
7.187
7.173
5.652
5.635
5.631
5.614
5.044
5.028
5.024
5.007
4.387
4.370
4.353
2.318
CCl3
Me
N
O
4e
4.05
1.00
1.03
1.03
3.06
f1 (ppm)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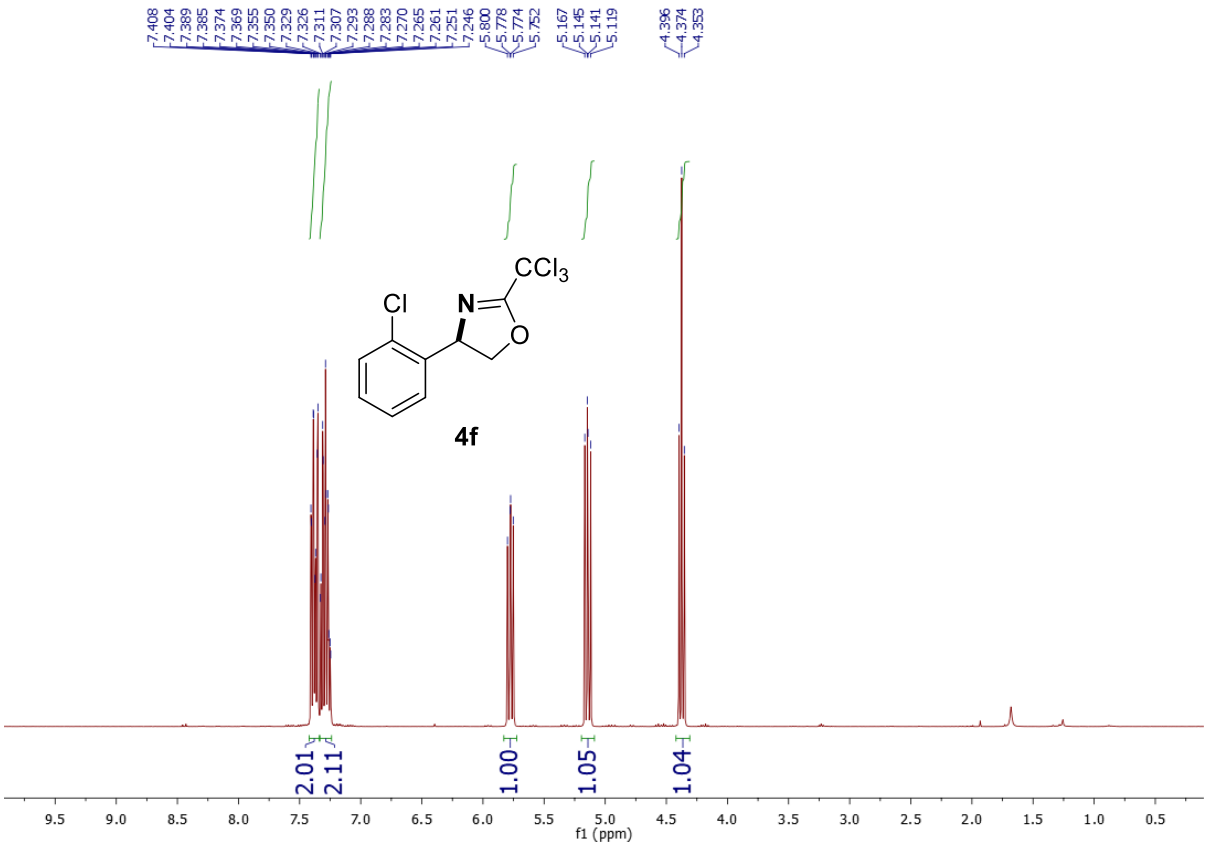
138.587
134.516
130.486
127.918
126.706
125.890
86.542
77.638
77.254
77.000
76.746
67.084
19.455
CCl3
Me
N
O
4e
f1 (ppm)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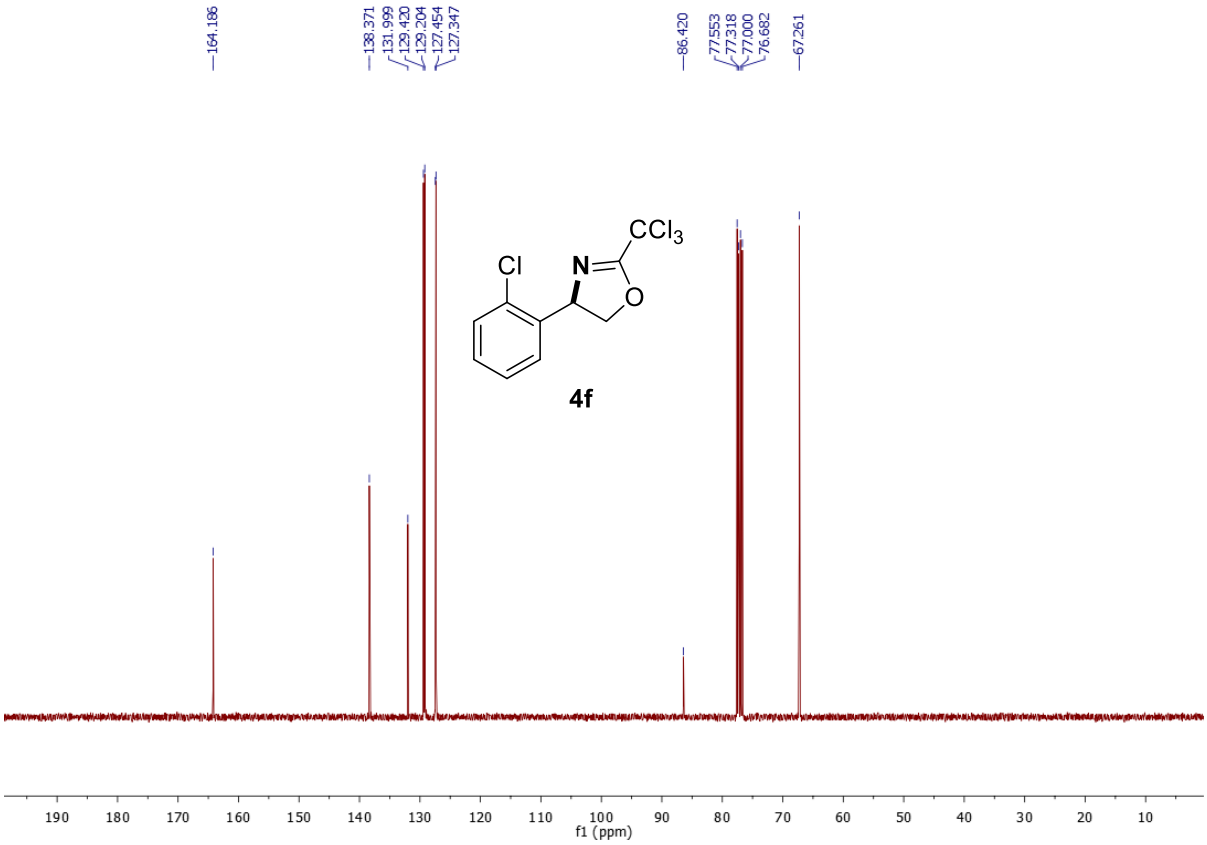
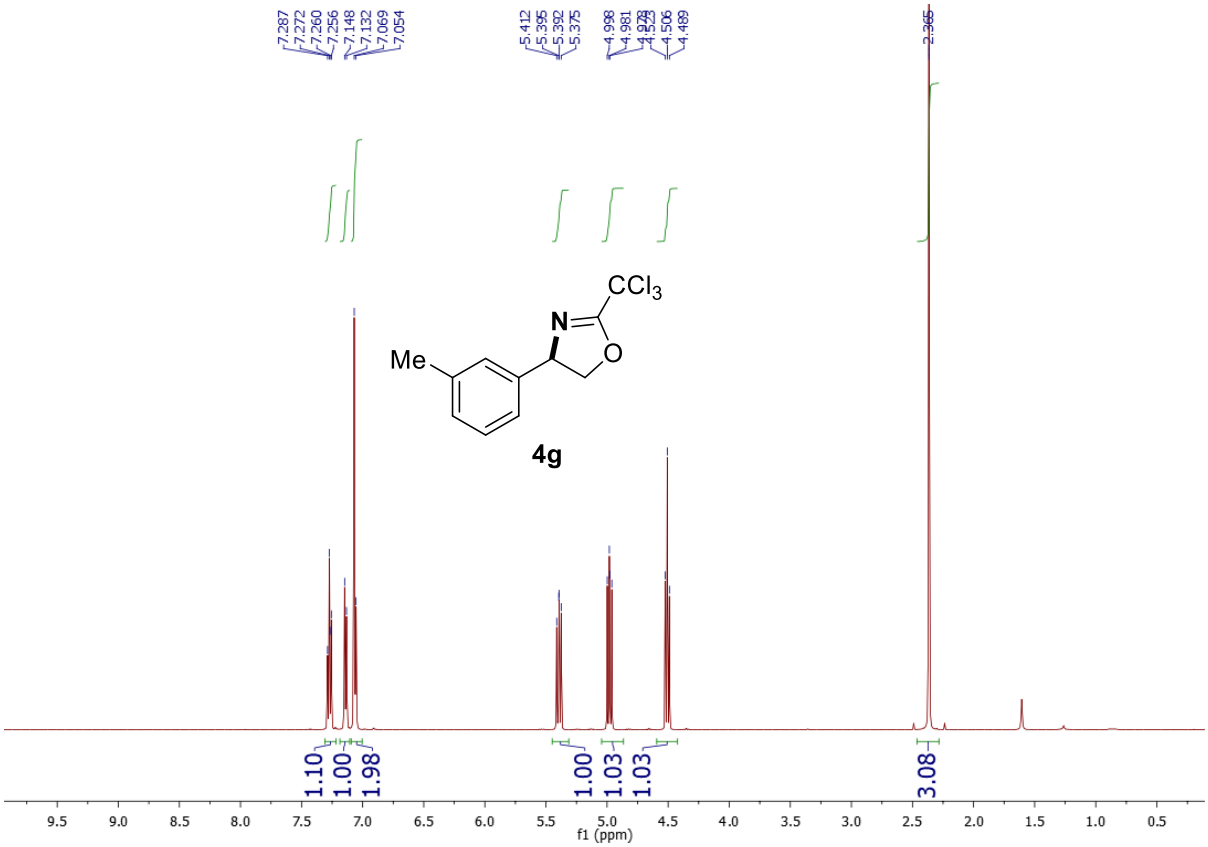
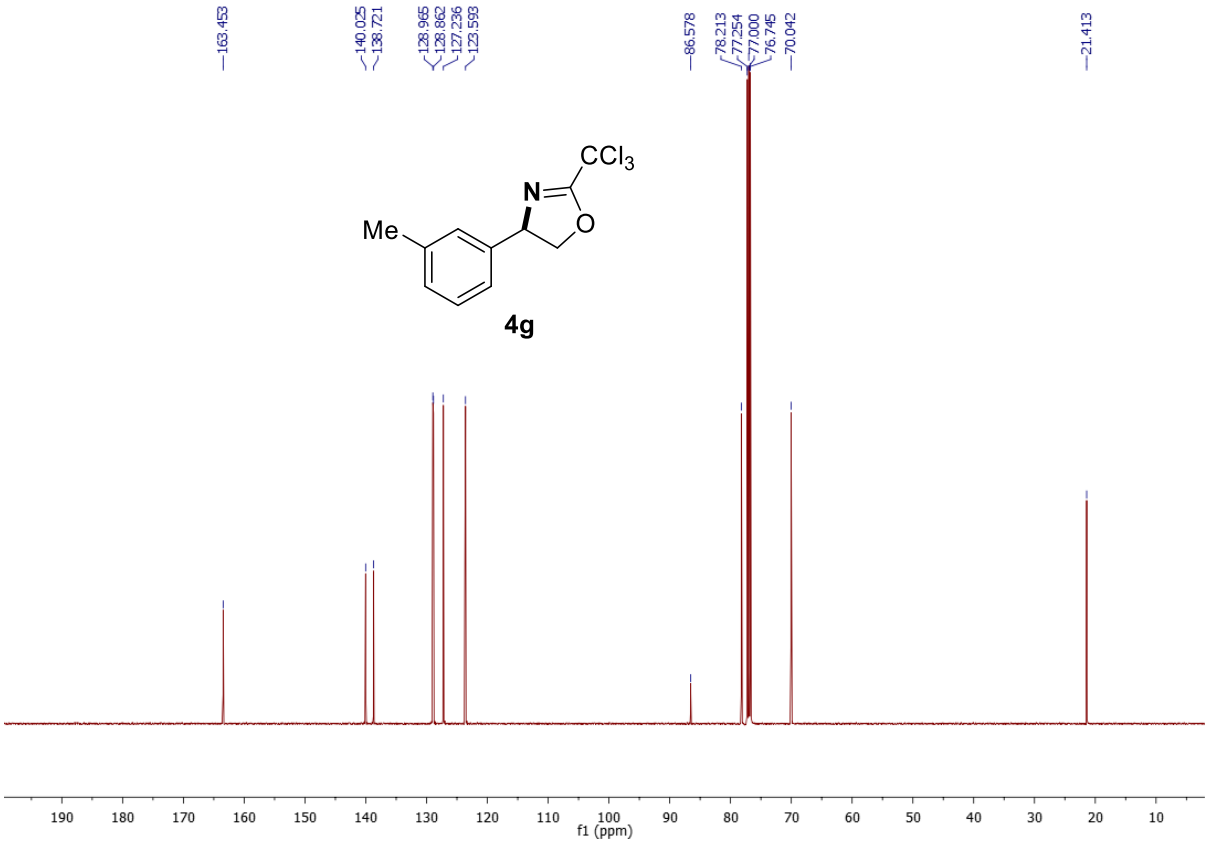
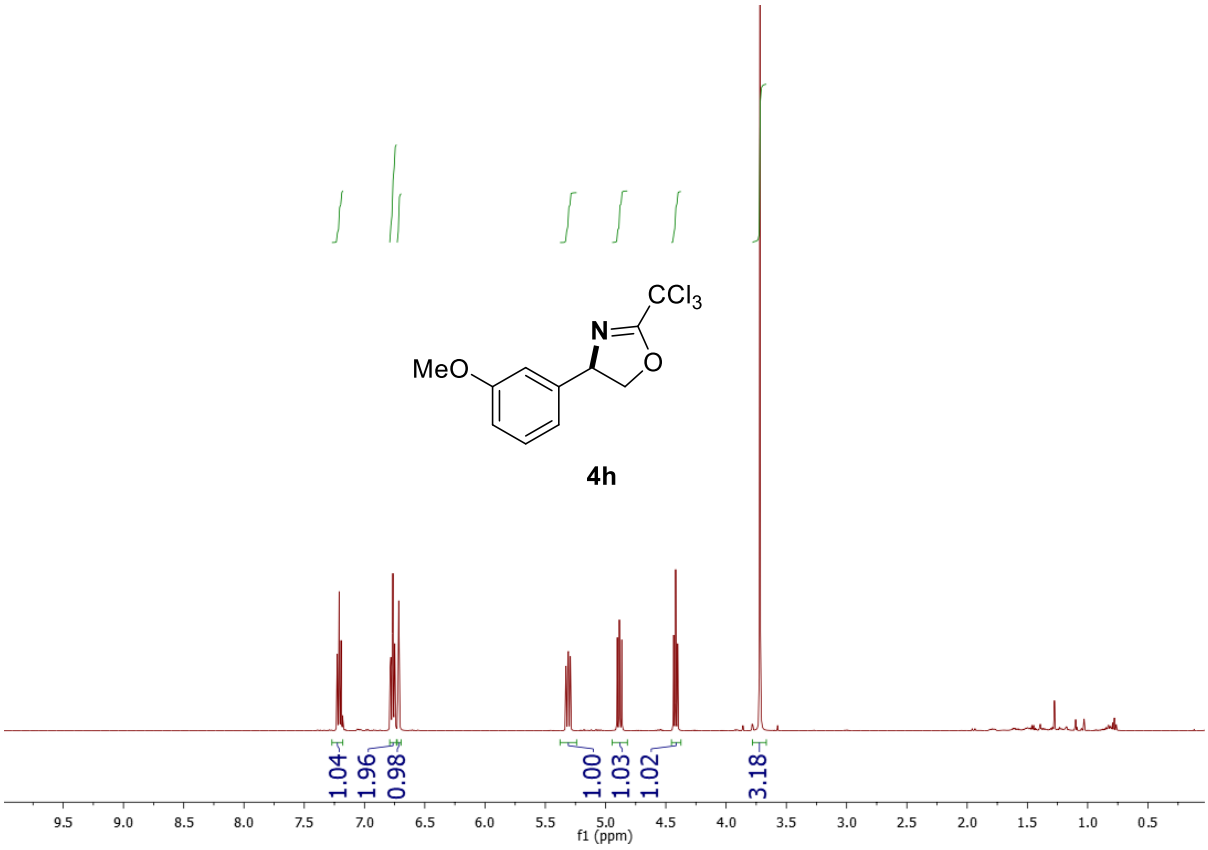
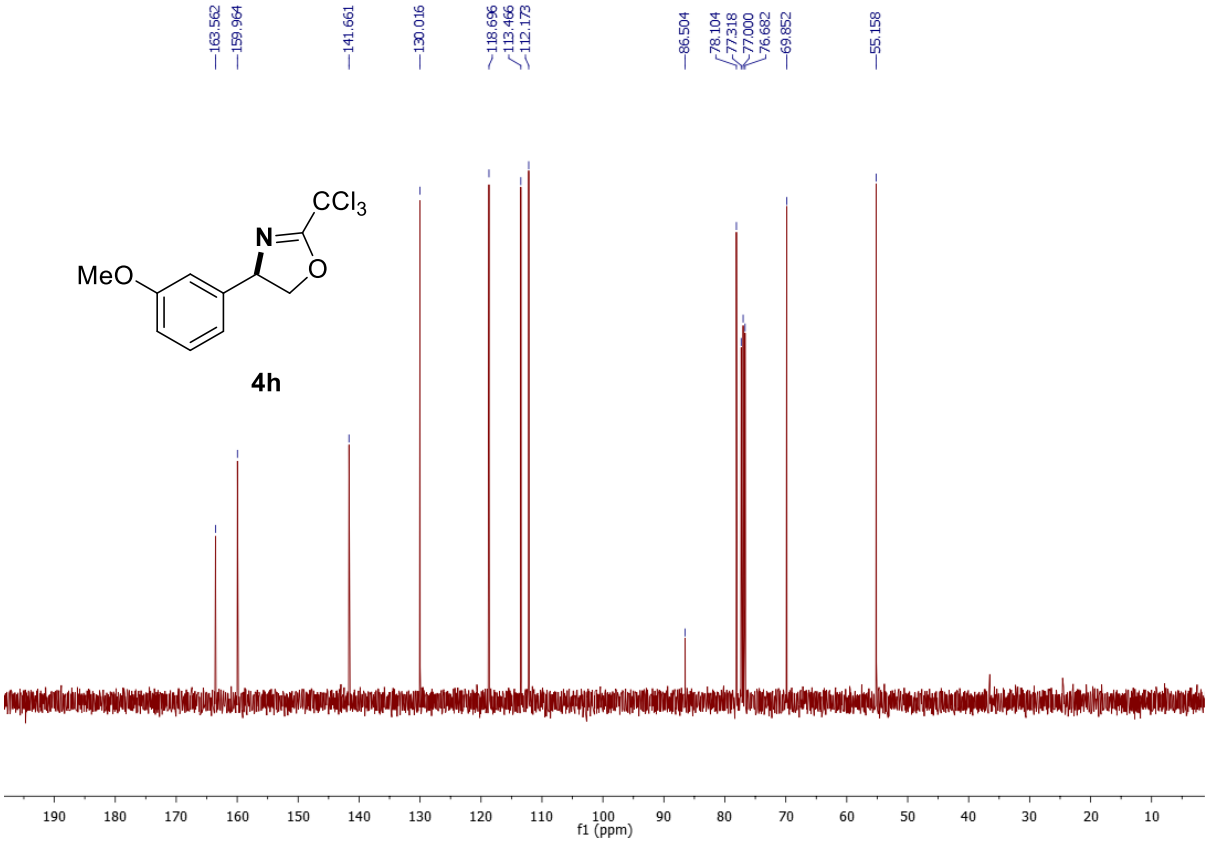
7.389
7.385
7.374
7.369
7.355
7.350
7.329
7.326
7.311
7.307
7.293
7.288
7.283
7.270
7.265
7.261
7.251
7.246
5.800
5.778
5.774
5.752
5.167
5.145
5.141
5.119
4.396
4.374
4.353
CCl3
Cl
N
O
4f
2.01
2.11
1.00
1.05
1.04
f1 (ppm)

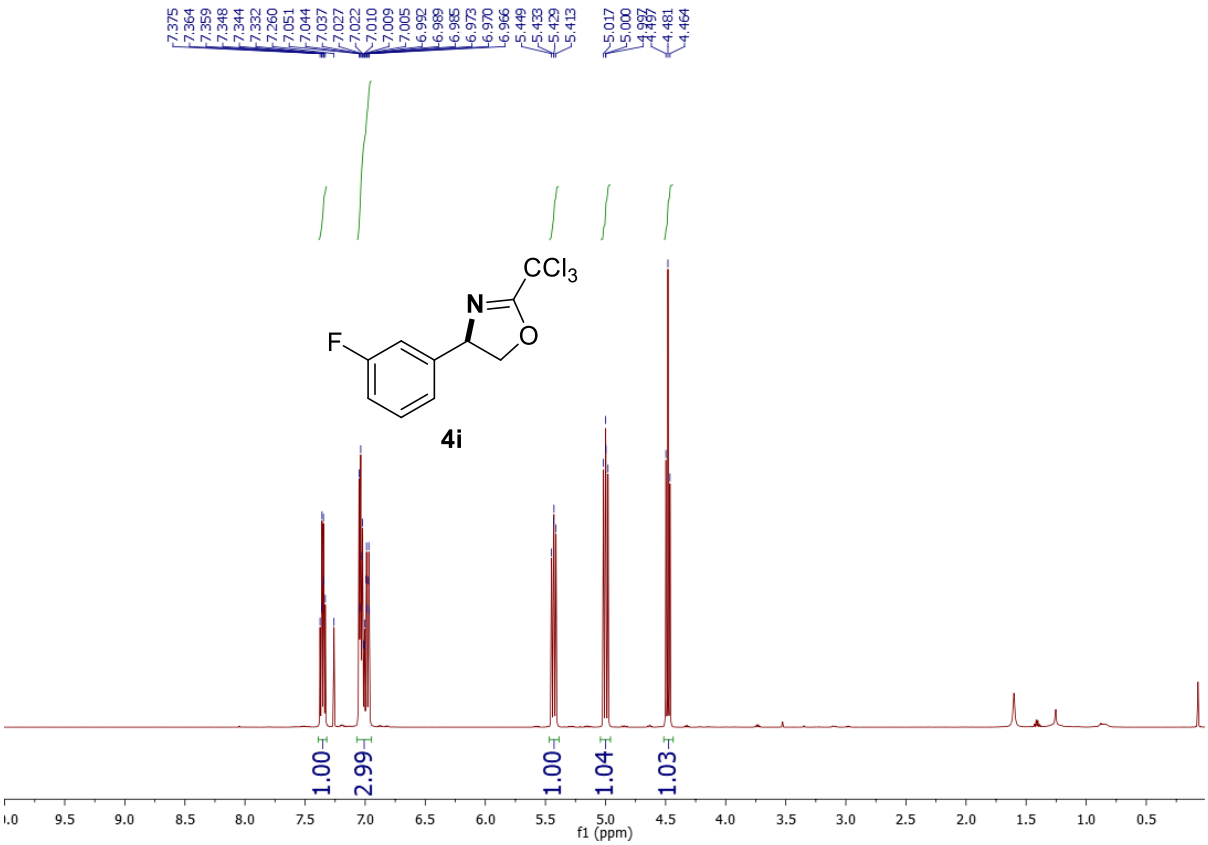

164.186
138.371
131.999
129.420
129.204
127.454
127.347
86.420
77.553
77.318
77.000
76.682
67.261
CCl3
Cl
N
O
4f
f1 (ppm)

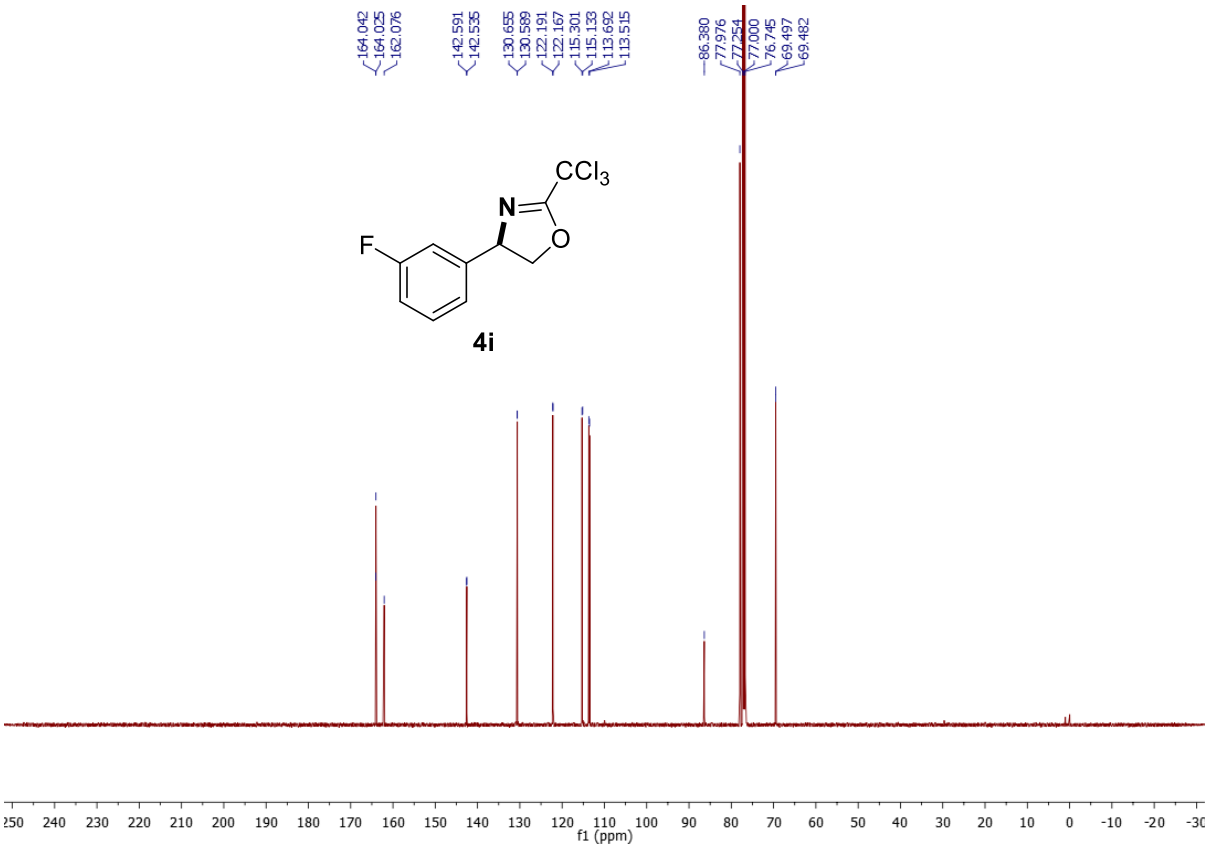

7.287
7.272
7.260
7.256
7.148
7.132
7.069
7.054
5.412
5.395
5.392
5.375
4.998
4.981
4.506
4.489
2.365
CCl3
N
O
Me
4g
1.10
1.00
1.98
1.00
1.03
1.03
3.08
f1 (ppm)

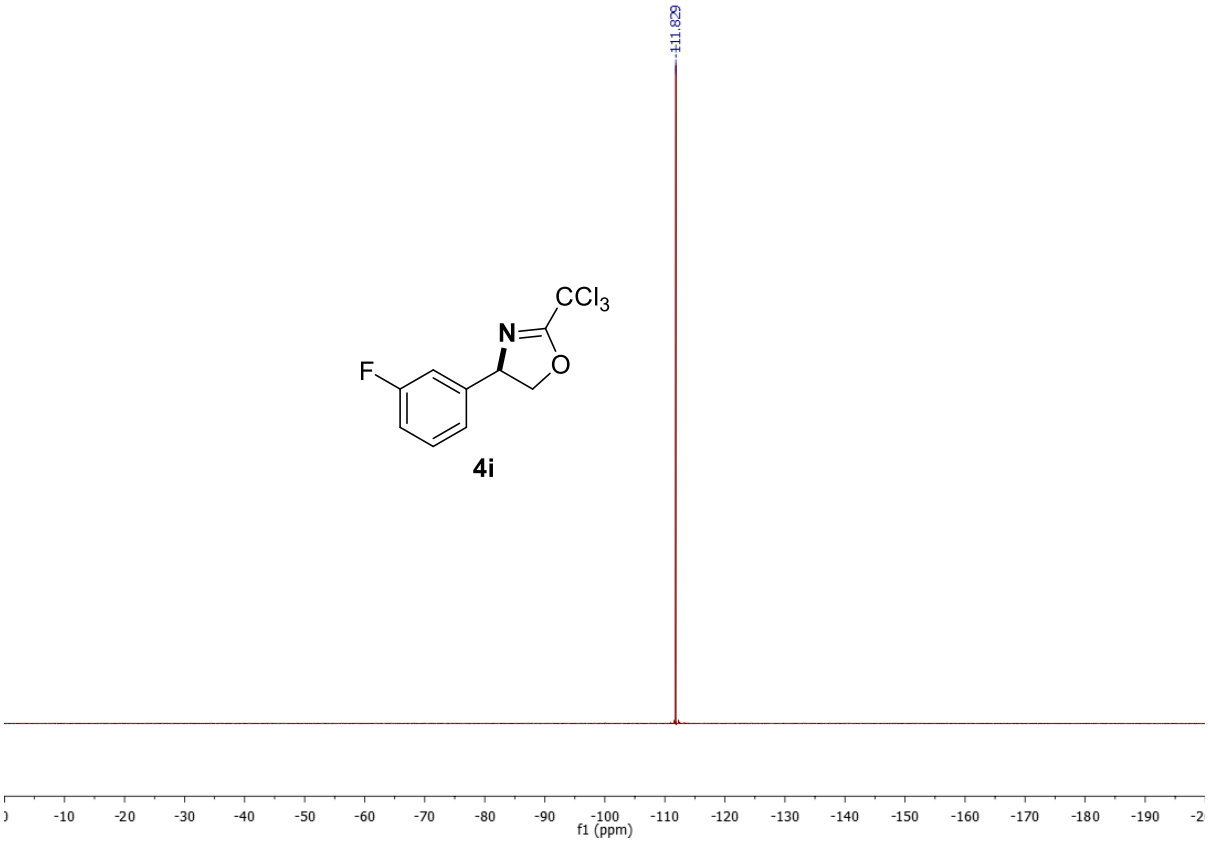

163.453
140.025
138.721
128.965
128.862
127.236
123.593
86.578
78.213
77.254
77.000
76.745
70.042
21.413
CCl3
N
O
Me
4g
f1 (ppm)

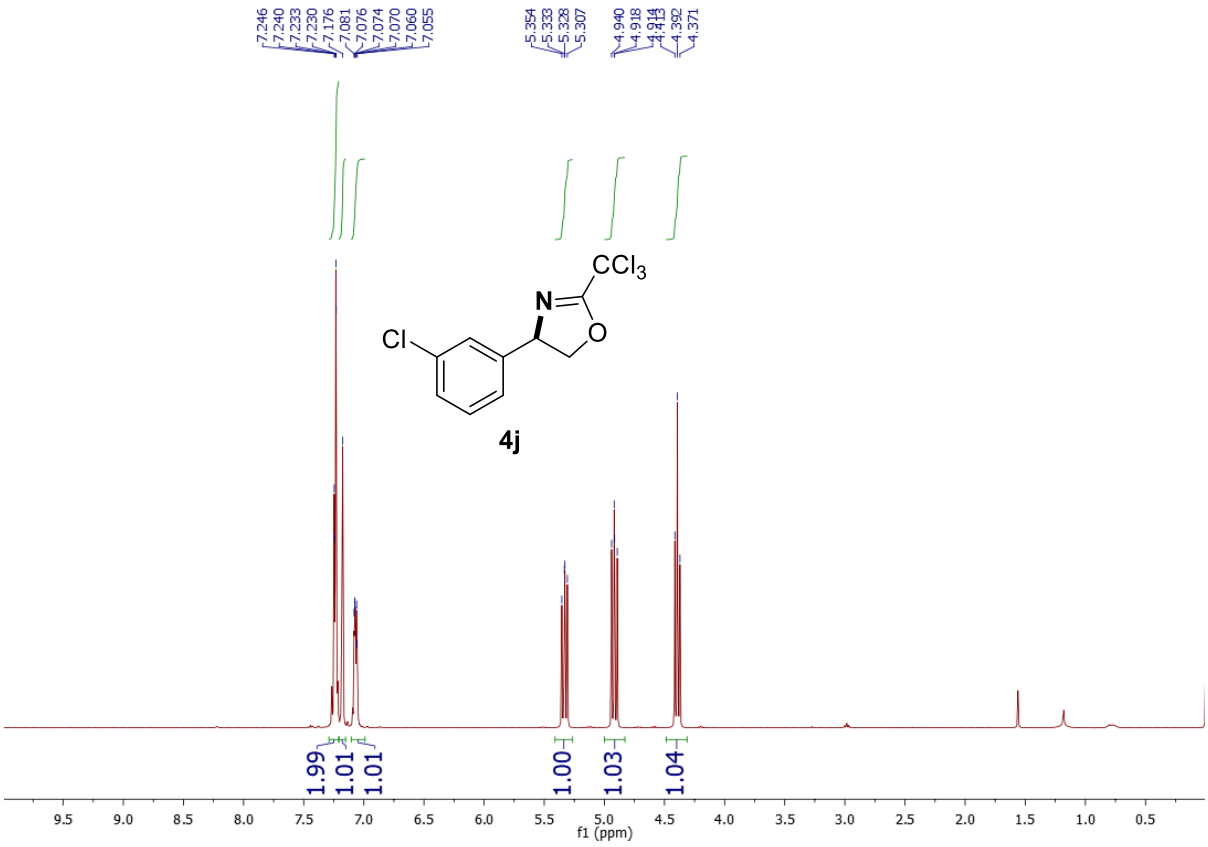

CCl3
N
O
MeO
4h
1.04
1.96
0.98
1.00
1.03
1.02
3.18
f1 (ppm)

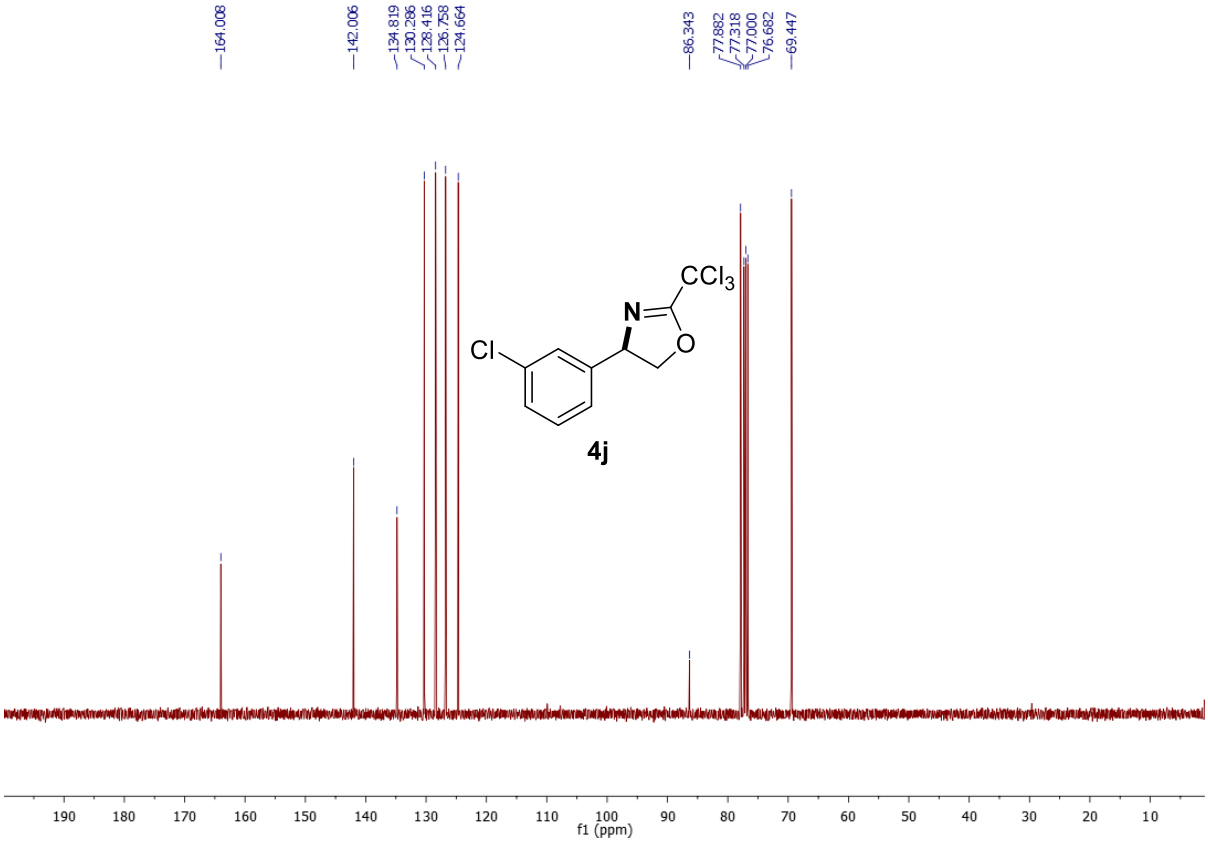

163.562
159.964
141.661
130.016
118.696
113.466
112.173
86.504
78.104
77.318
77.000
76.682
69.852
55.158
CCl3
N
O
MeO
4h
f1 (ppm)

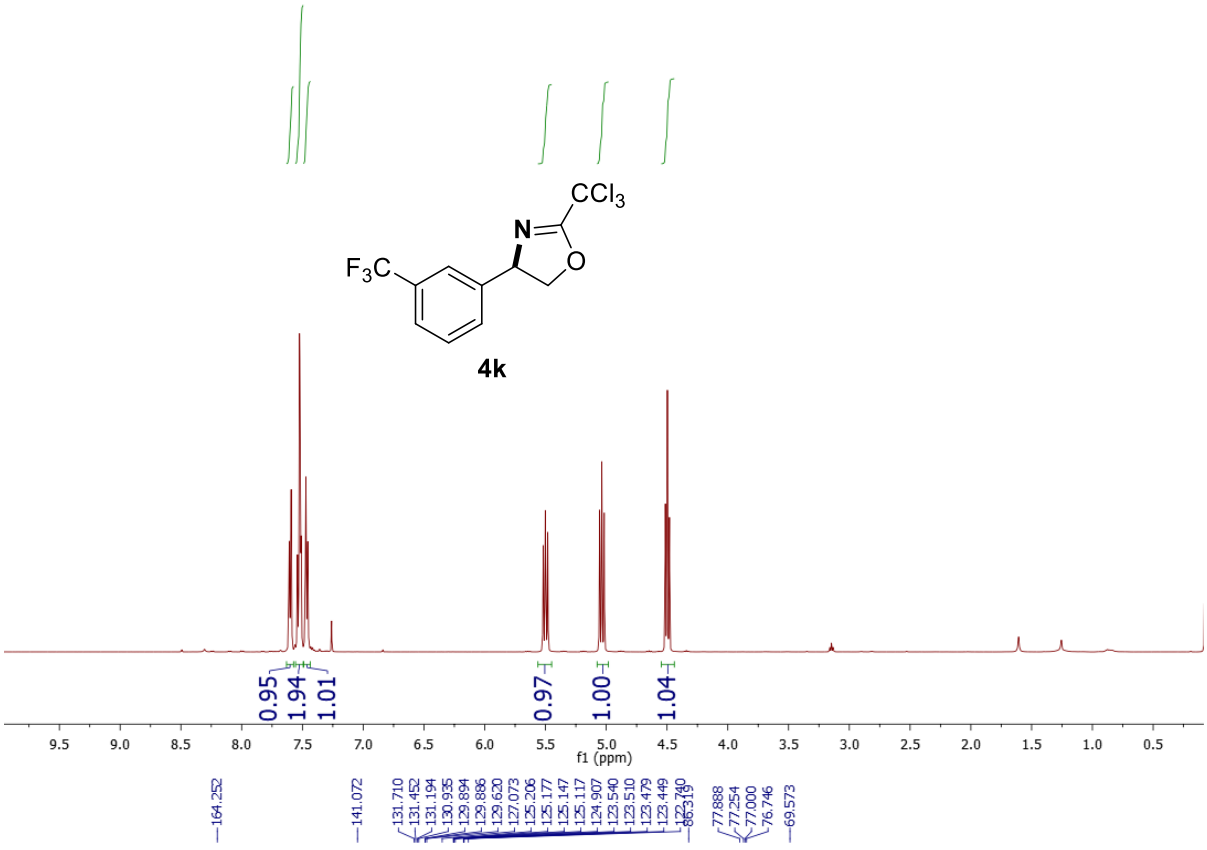

7.375
7.364
7.359
7.348
7.344
7.332
7.260
7.051
7.044
7.037
7.027
7.022
7.010
7.009
7.005
6.992
6.989
6.985
6.973
6.970
6.966
5.449
5.433
5.429
5.413
5.017
5.000
4.497
4.481
4.464
CCl3
N
O
F
4i
1.00
2.99
1.00
1.04
1.03
f1 (ppm)

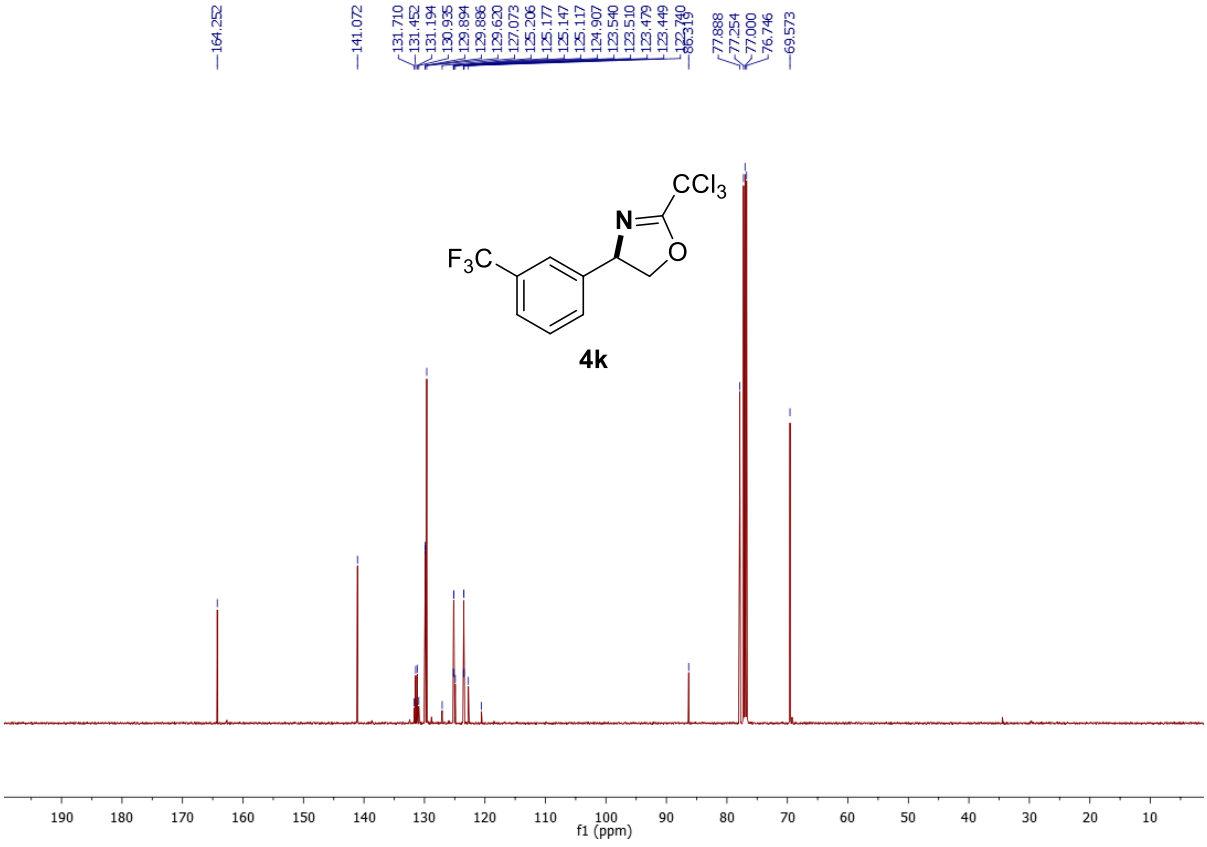

164.042
164.025
162.076
142.591
142.535
130.655
130.589
122.191
122.167
115.301
115.133
113.692
113.515
86.380
77.976
77.254
77.000
76.745
69.497
69.482
CCl3
N
O
F
4i
f1 (ppm)

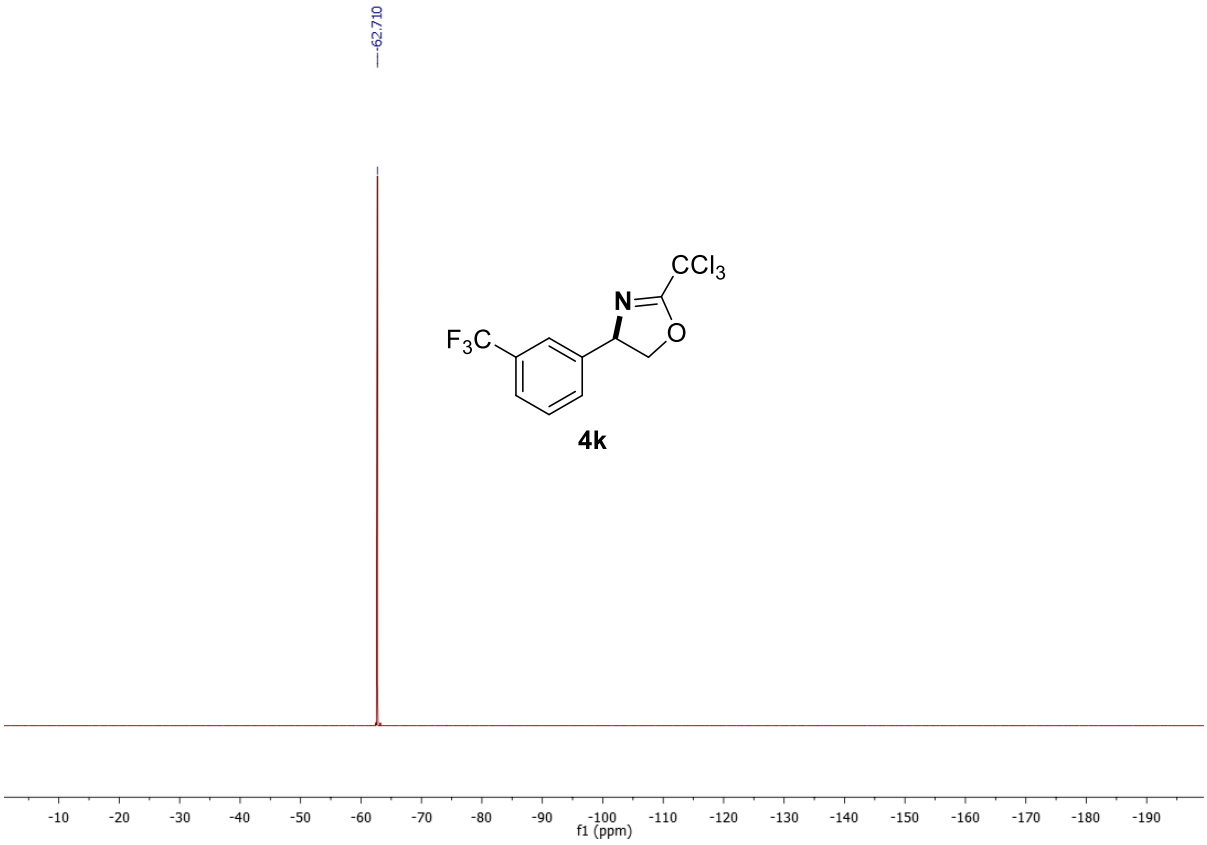

111.829
CCl3
N
O
F
4i
f1 (ppm)

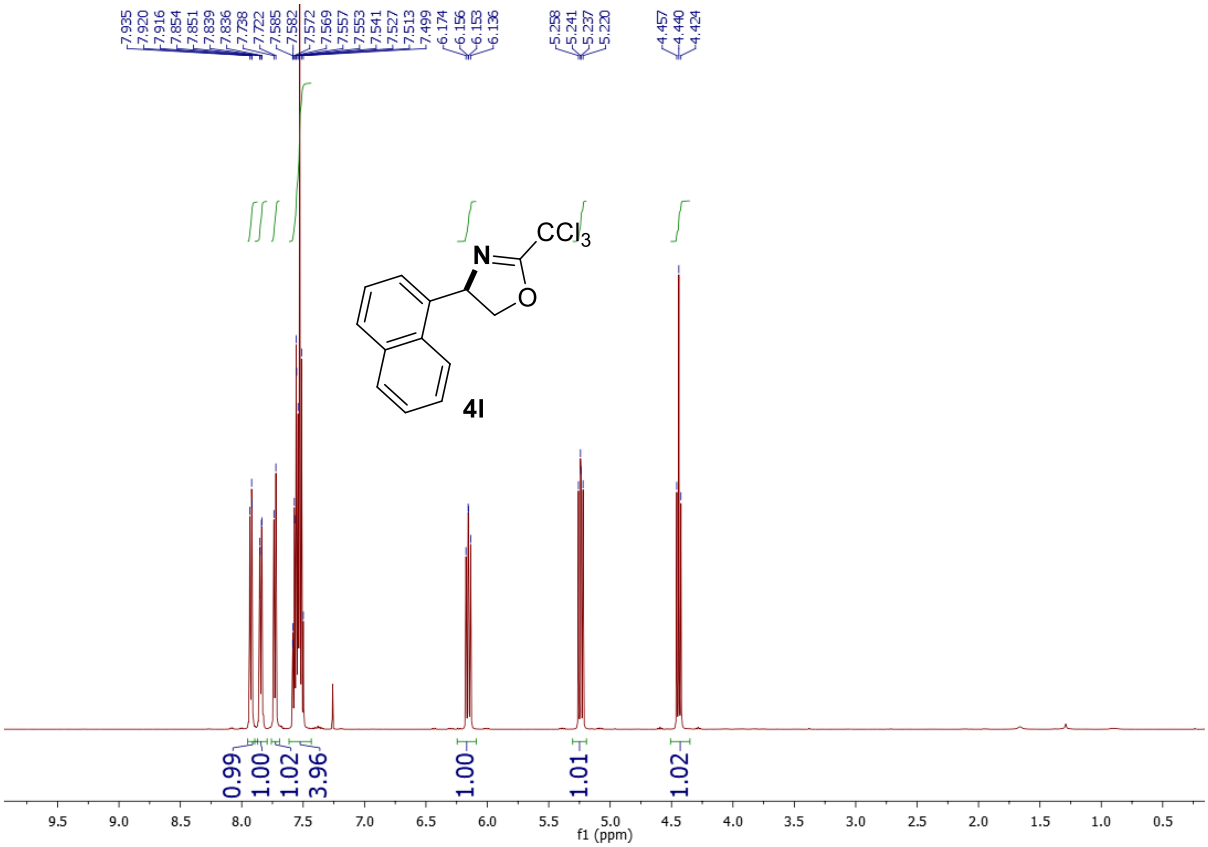

7.246
7.240
7.233
7.230
7.176
7.081
7.076
7.074
7.070
7.060
7.055
5.354
5.333
5.328
5.307
4.940
4.918
4.914
4.392
4.371
CCl3
N
O
Cl
4j
1.99
1.01
1.01
1.00
1.03
1.04
f1 (ppm)

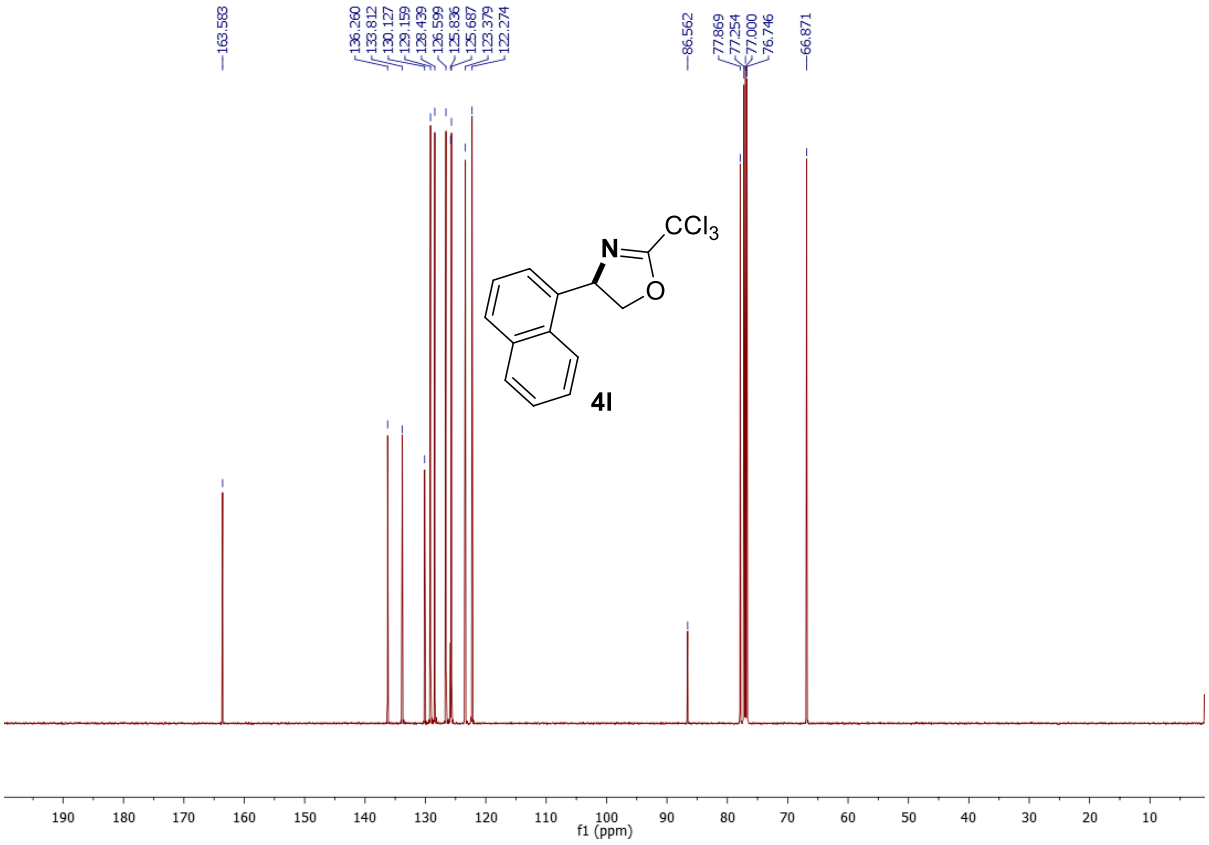

164.008
142.006
134.819
130.286
128.416
126.758
124.664
86.343
77.882
77.318
77.000
76.682
69.447
CCl3
N
O
Cl
4j
f1 (ppm)

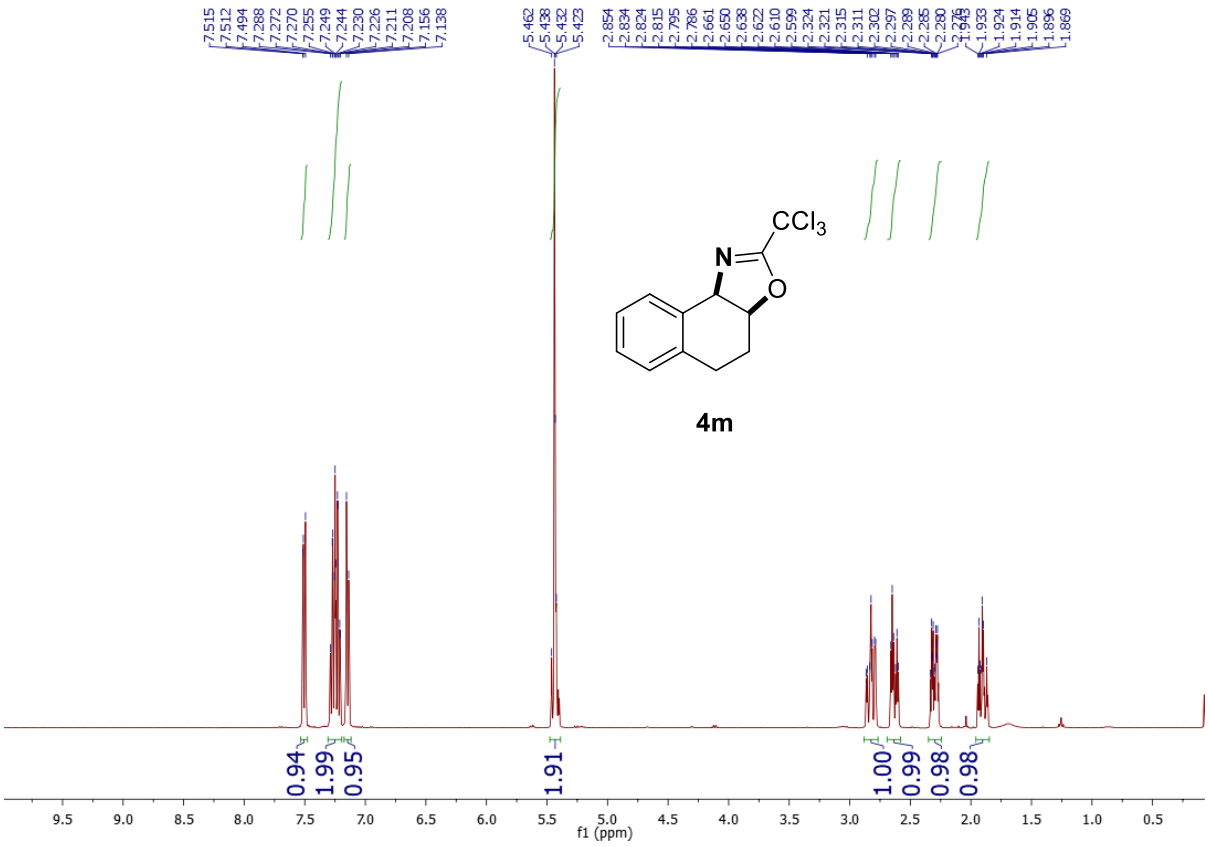

CCl3
N
O
F3C
4k
0.95
1.94
1.01
0.97
1.00
1.04
f1 (ppm)

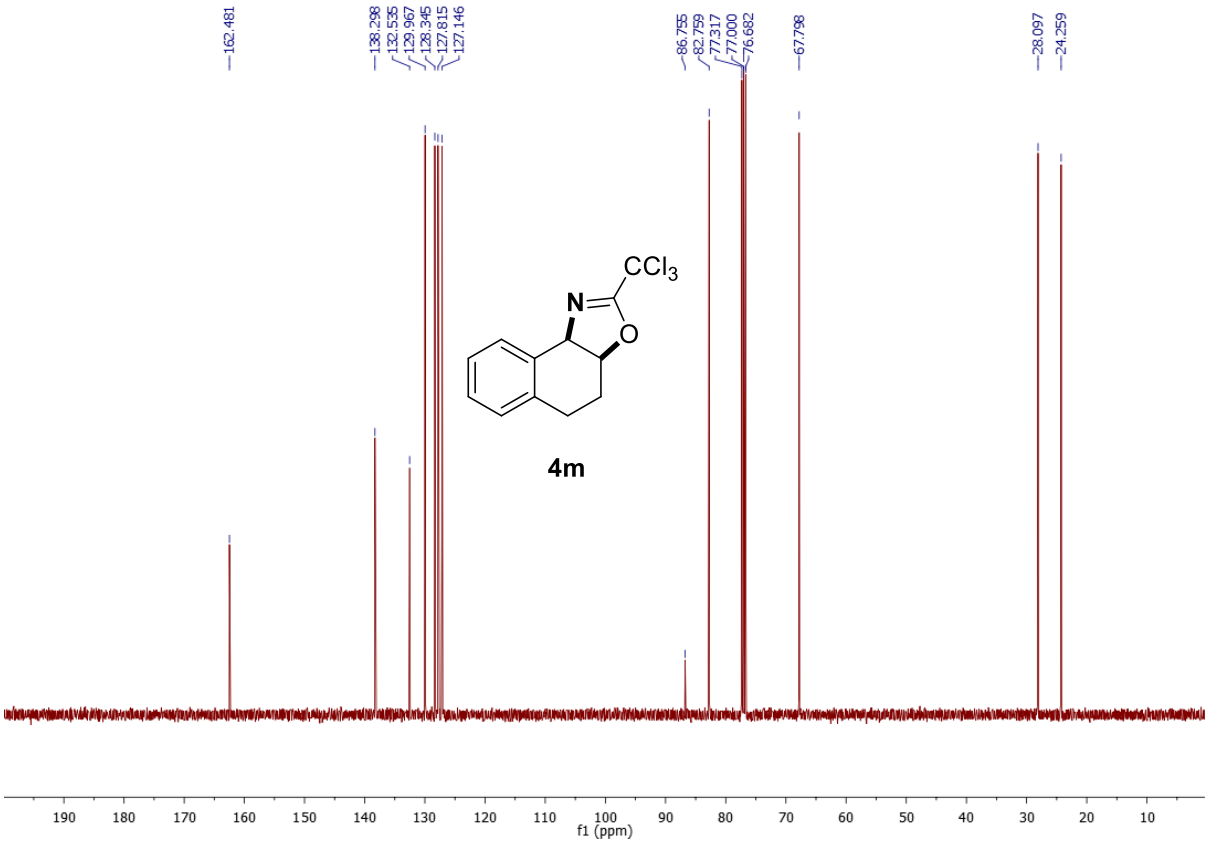

CCl3
N
O
F3C
4k
f1 (ppm)


-62.710
CCl3
N
O
F3C
4k
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)


7.935
7.920
7.916
7.854
7.851
7.839
7.836
7.738
7.722
7.585
7.582
7.572
7.569
7.557
7.553
7.541
7.527
7.513
7.499
6.174
6.156
6.153
6.136
5.258
5.241
5.237
5.220
4.457
4.440
4.424
CCl3
N
O
4l
0.99
1.00
1.02
3.96
1.00
1.01
1.02
9.5 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
f1 (ppm)


163.583
136.260
133.812
130.127
129.159
128.439
126.599
125.836
125.687
123.379
122.274
86.562
77.869
77.254
77.000
76.746
66.871
CCl3
N
O
4l
f1 (ppm)


7.515
7.512
7.494
7.288
7.272
7.270
7.255
7.249
7.244
7.230
7.226
7.211
7.208
7.156
7.138
5.462
5.438
5.432
5.423
2.854
2.834
2.824
2.815
2.795
2.786
2.661
2.650
2.638
2.622
2.610
2.599
2.324
2.321
2.315
2.311
2.302
2.297
2.289
2.285
2.280
1.933
1.924
1.914
1.905
1.896
1.869
CCl3
N
O
4m
0.94
1.99
0.95
1.91
1.00
0.99
0.98
0.98
f1 (ppm)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138.298
132.535
129.967
128.345
127.815
127.146
86.755
82.759
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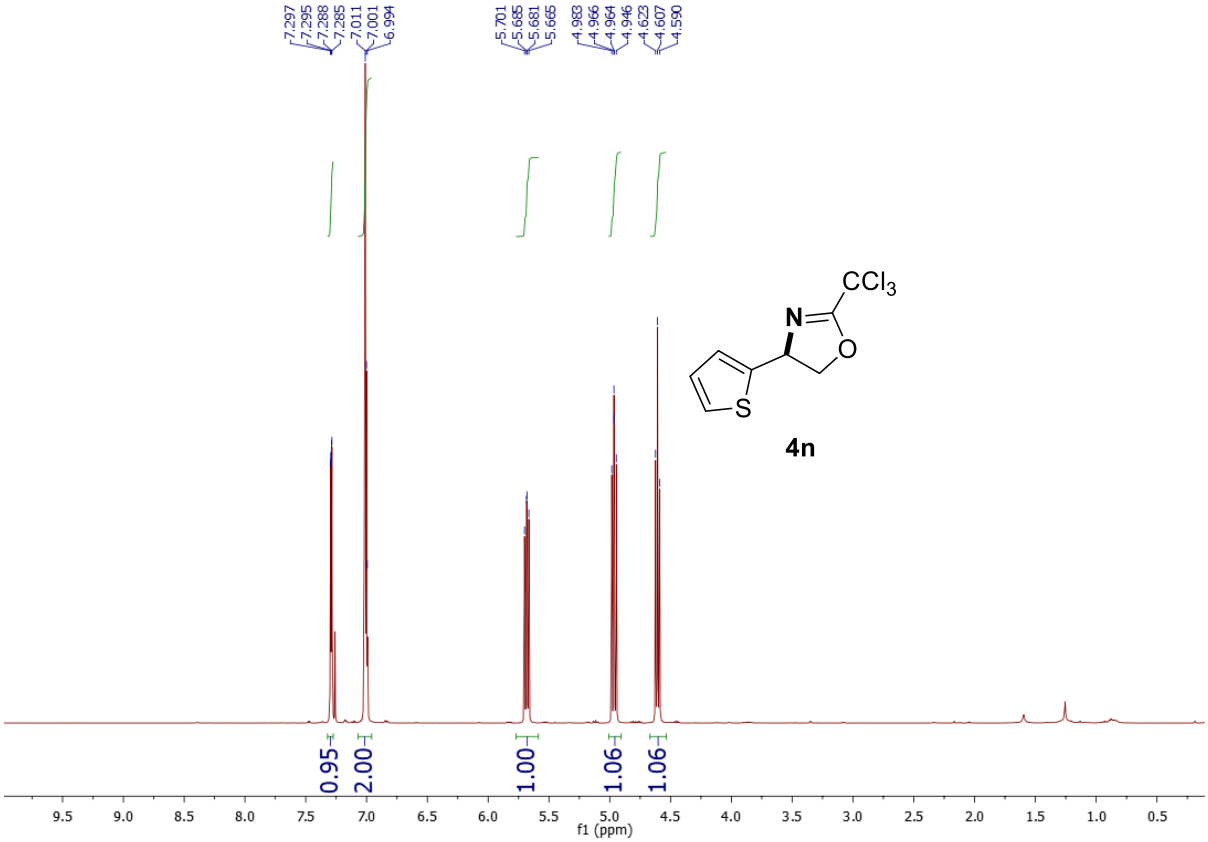
77.000
76.682
67.798
28.097
24.259
CCl3
N
O
4m
f1 (ppm)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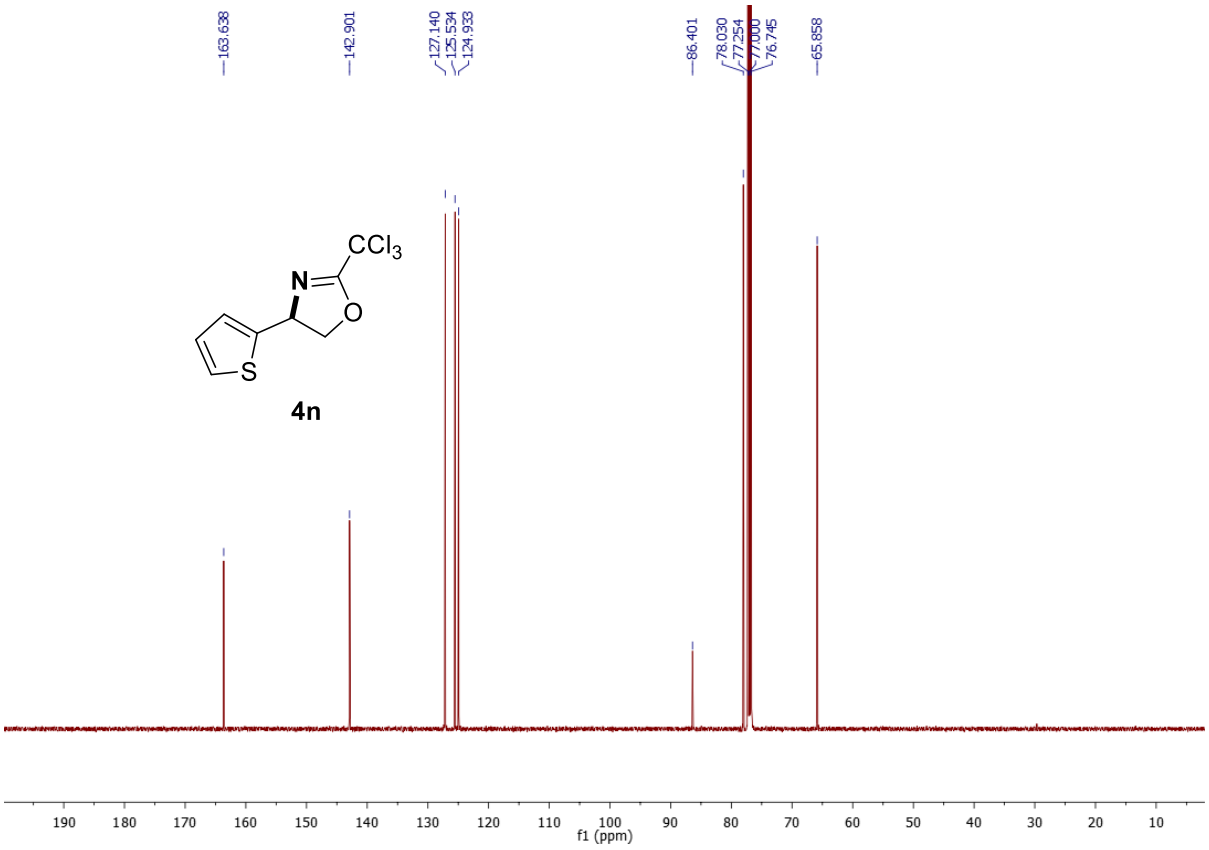
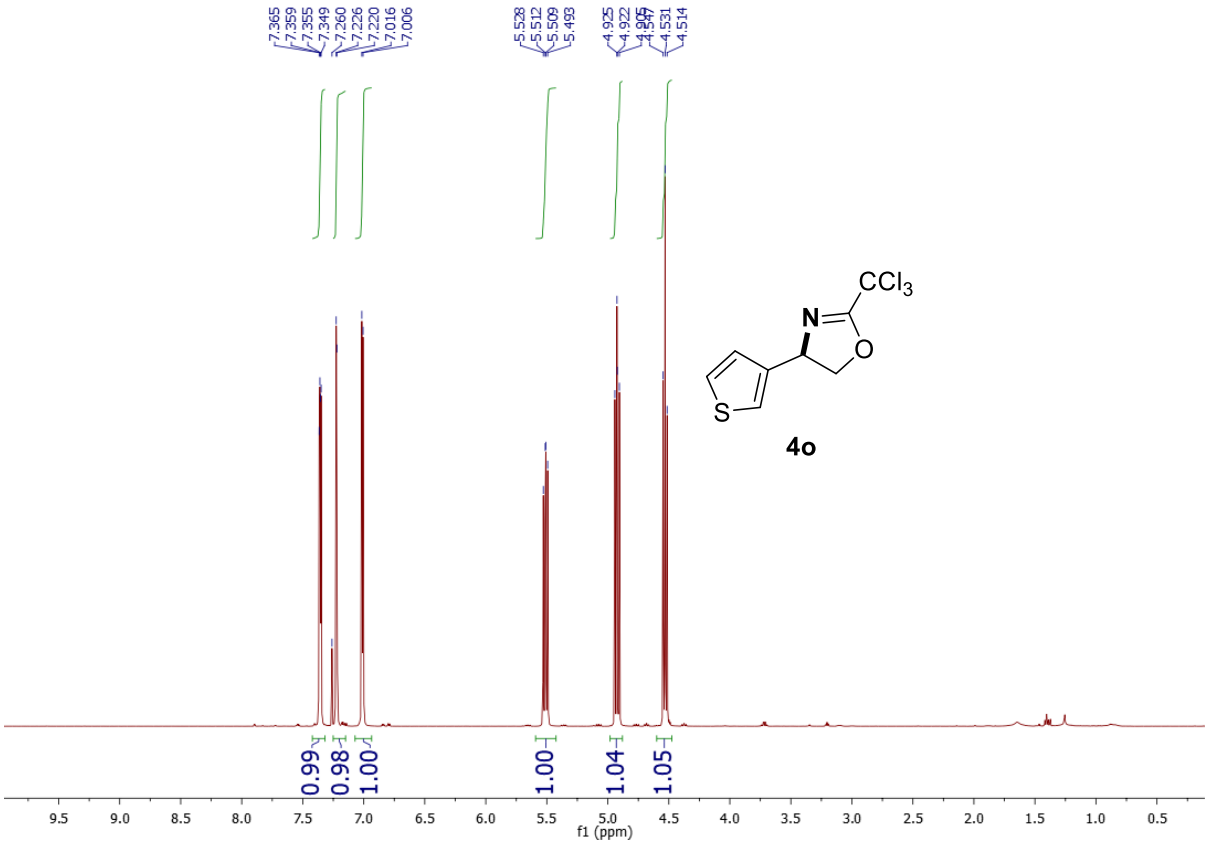
7.288
7.285
7.011
7.001
6.994
5.701
5.685
5.681
5.665
4.983
4.966
4.964
4.946
4.623
4.607
4.590
CCl3
N
O
S
4n
0.95
2.00
1.00
1.06
1.06
f1 (ppm)


163.638
142.901
127.140
125.534
124.933
86.401
78.030
77.254
77.000
76.745
65.858
CCl3
N
O
S
4n
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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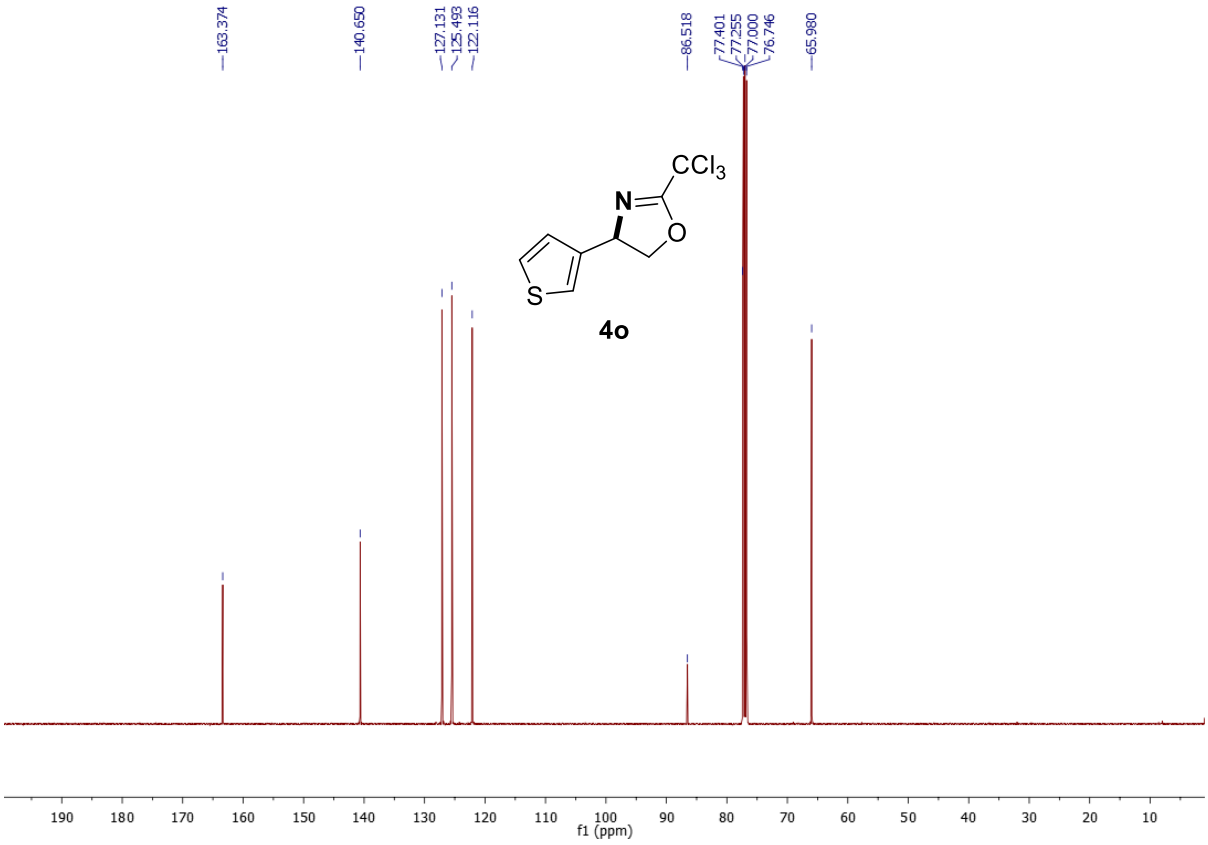
7.359
7.355
7.349
7.260
7.226
7.220
7.016
7.006
5.528
5.512
5.509
5.493
4.935
4.922
4.531
4.514
CCl3
N
O
S
4o
0.99
0.98
1.00
1.00
1.04
1.05
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)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125.493
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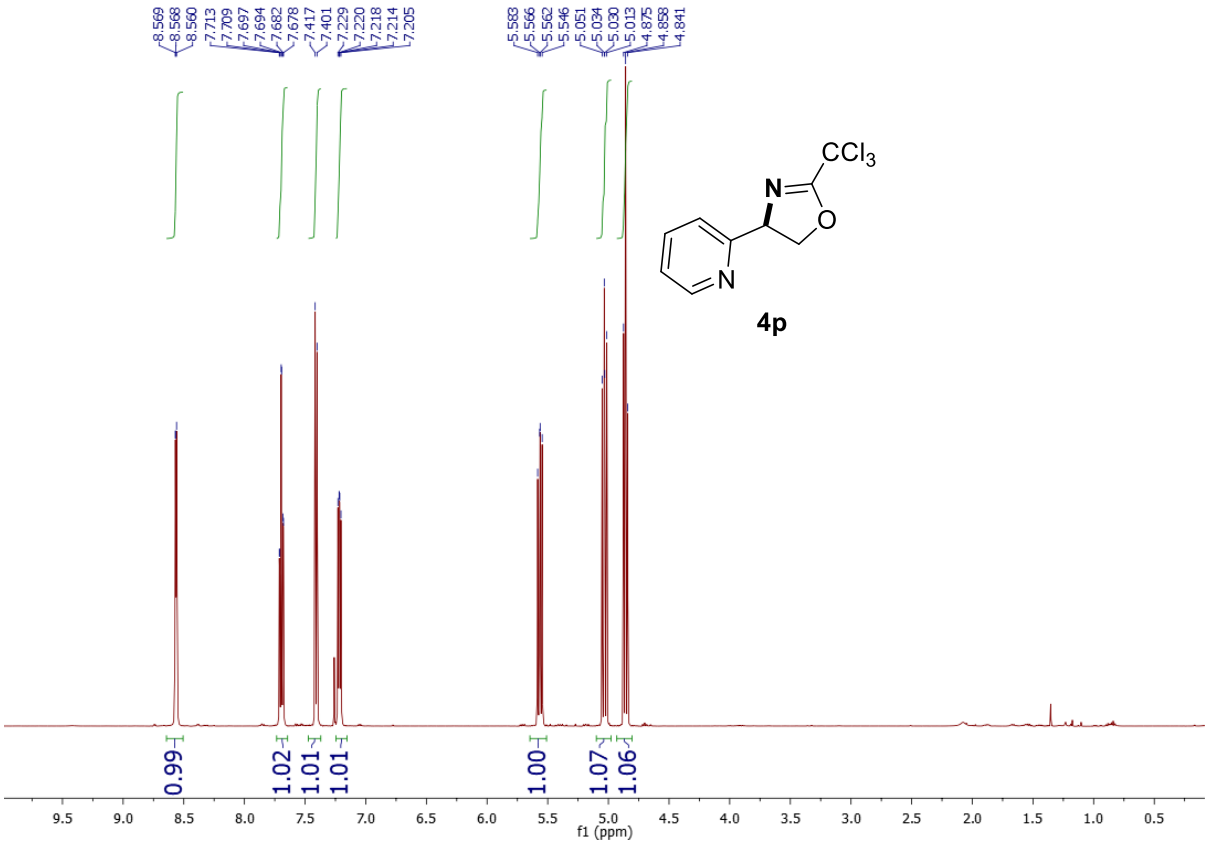
77.255
77.000
76.746
65.980
CCl3
N
O
S
4o
f1 (ppm)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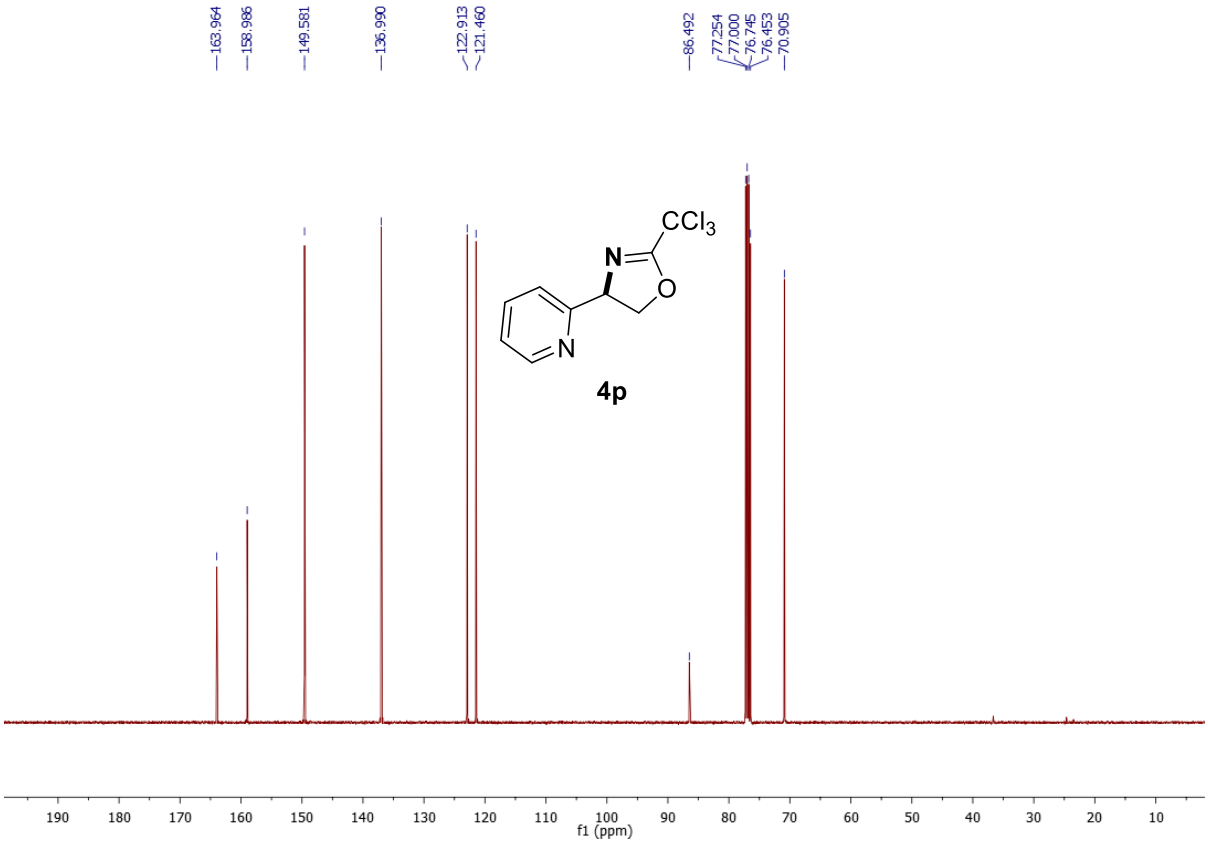
8.560
7.713
7.709
7.697
7.694
7.682
7.678
7.417
7.401
7.229
7.220
7.218
7.214
7.205
5.583
5.566
5.562
5.546
5.051
5.034
5.030
5.013
4.875
4.858
4.841
CCl3
N
O
N
4p
0.99
1.02
1.01
1.01
1.00
1.07
1.06
f1 (ppm)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158.986
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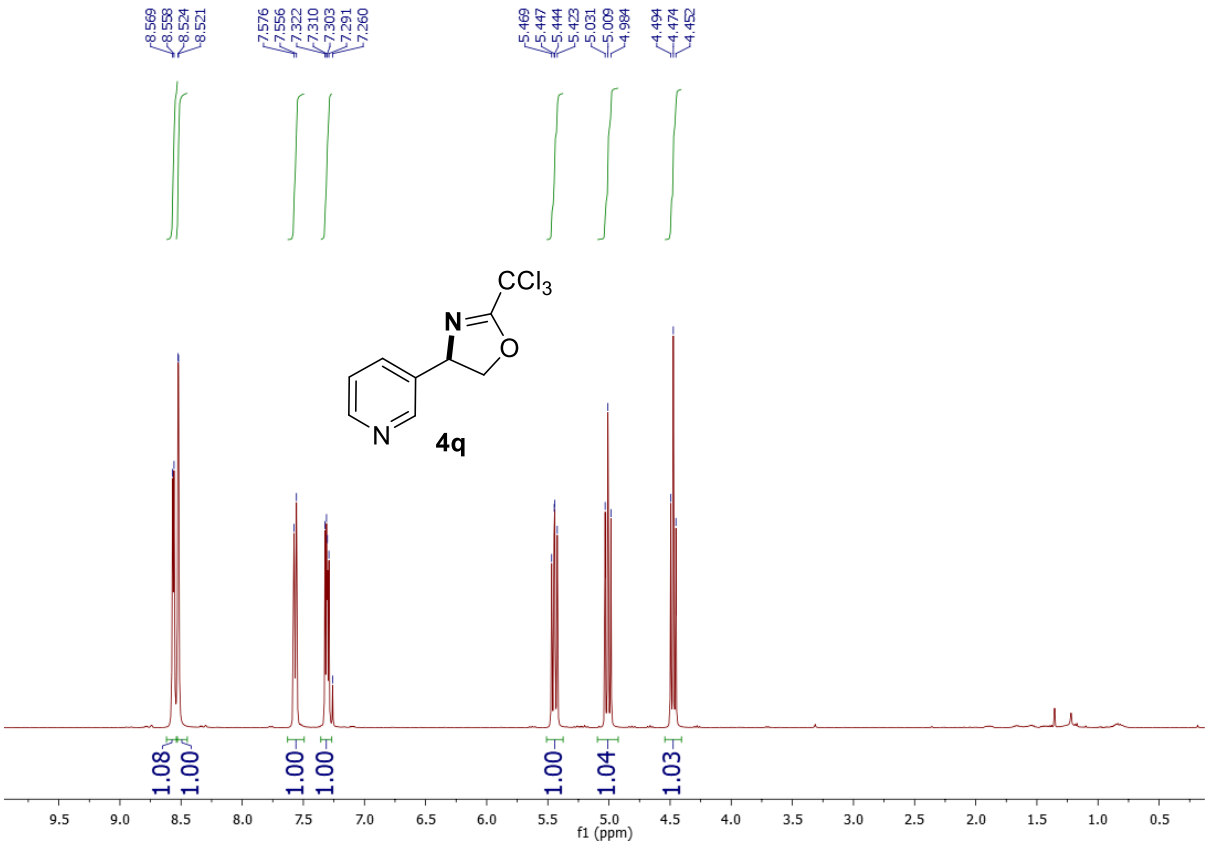
136.990
122.913
121.460
86.492
77.254
77.000
76.745
76.453
70.905
CCl3
N
O
N
4p
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)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8.521
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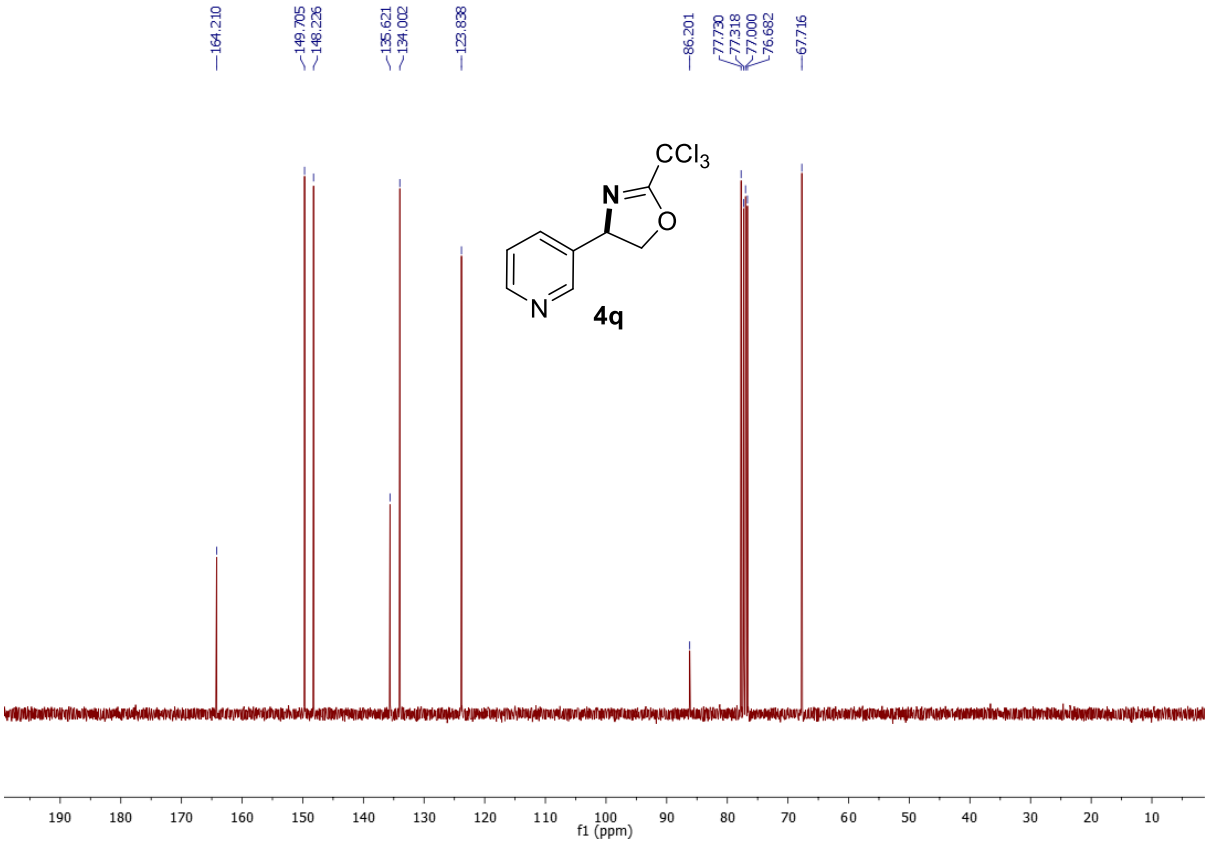
7.556
7.322
7.310
7.303
7.291
7.260
5.469
5.447
5.444
5.423
5.031
5.009
4.984
4.494
4.474
4.452
CCl3
N
O
N
4q
1.08
1.00
1.00
1.00
1.00
1.04
1.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


164.210
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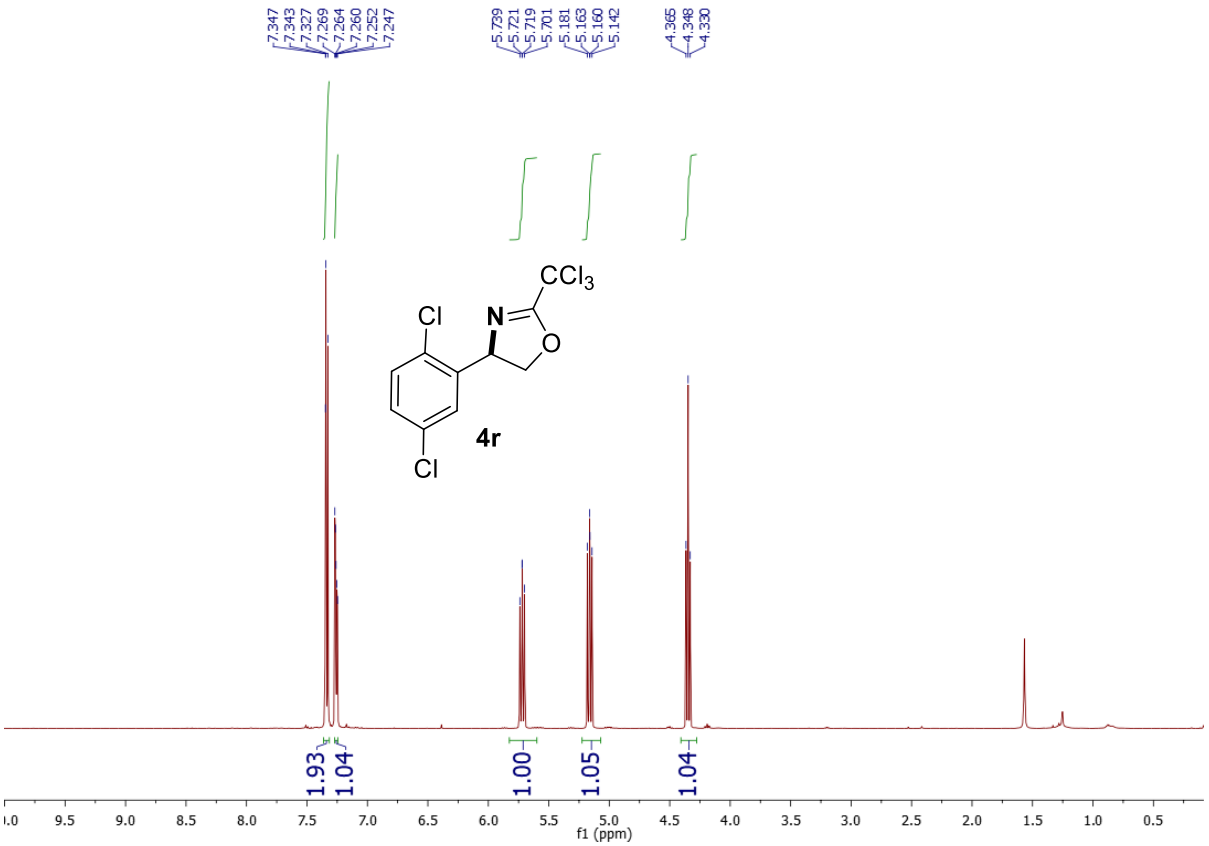
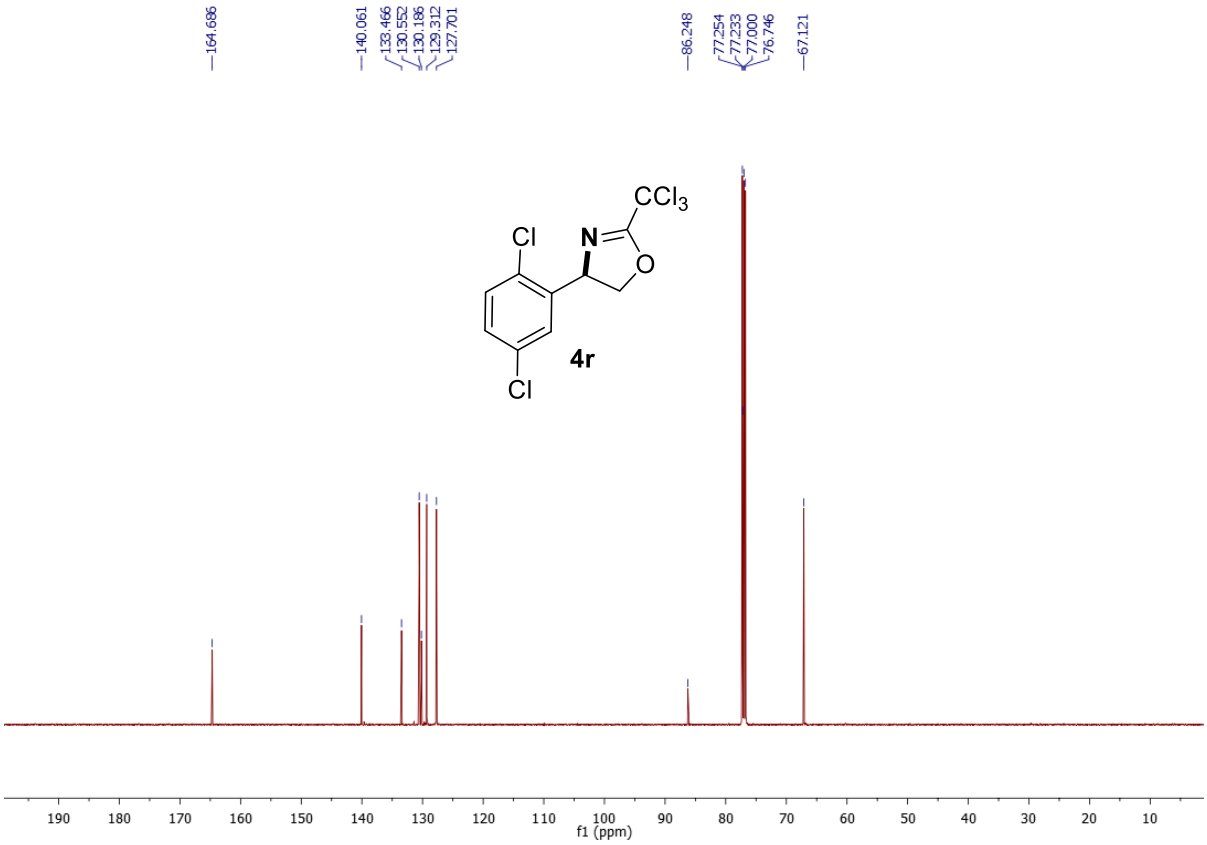
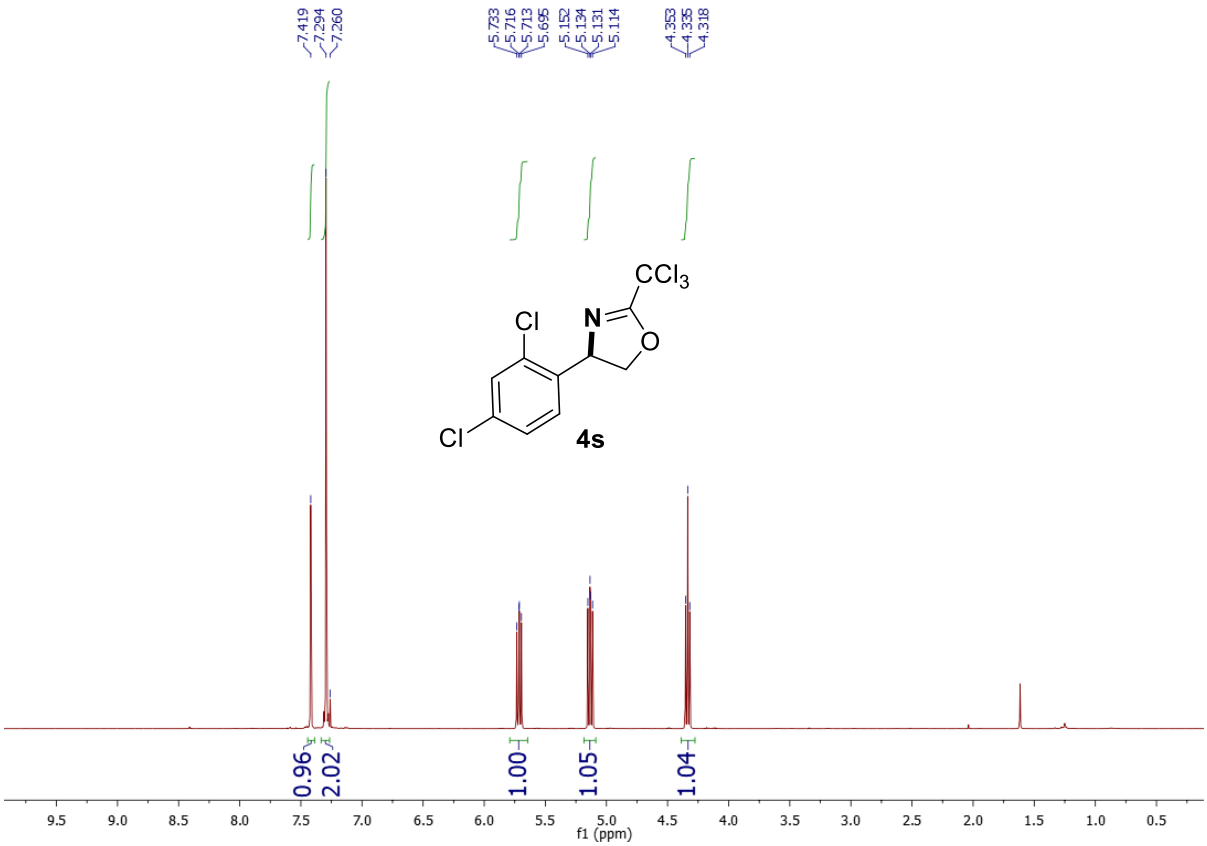
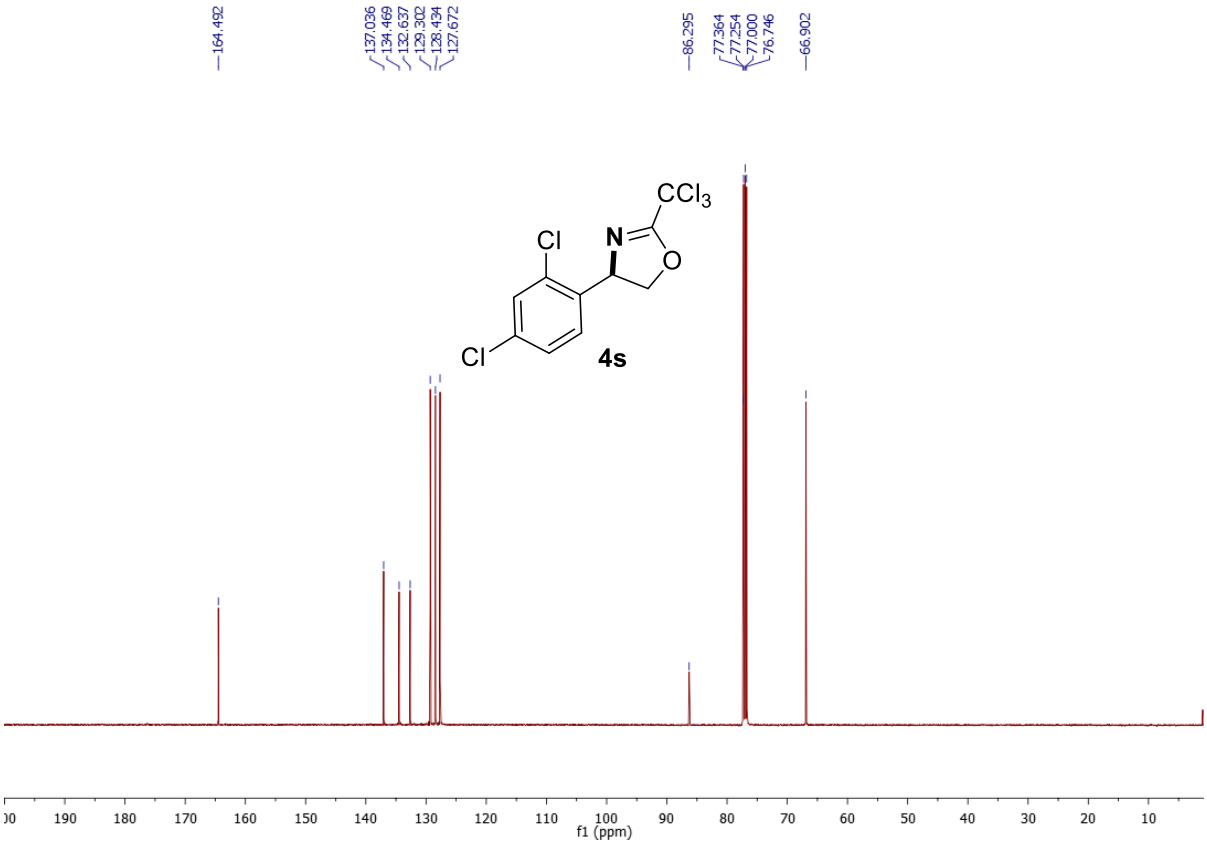
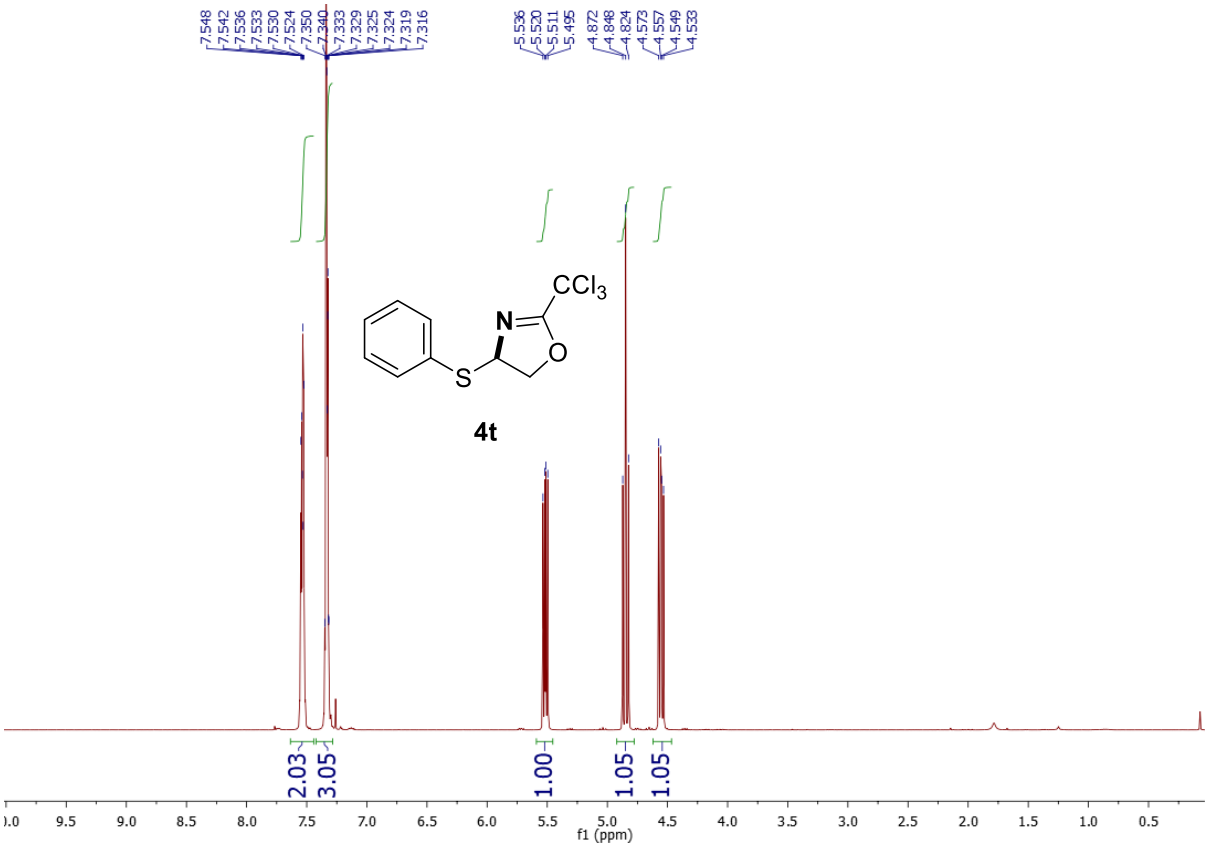
135.621
134.002
123.838
86.201
77.730
77.318
77.000
76.682
67.716
CCl3
N
O
N
4q
f1 (ppm)

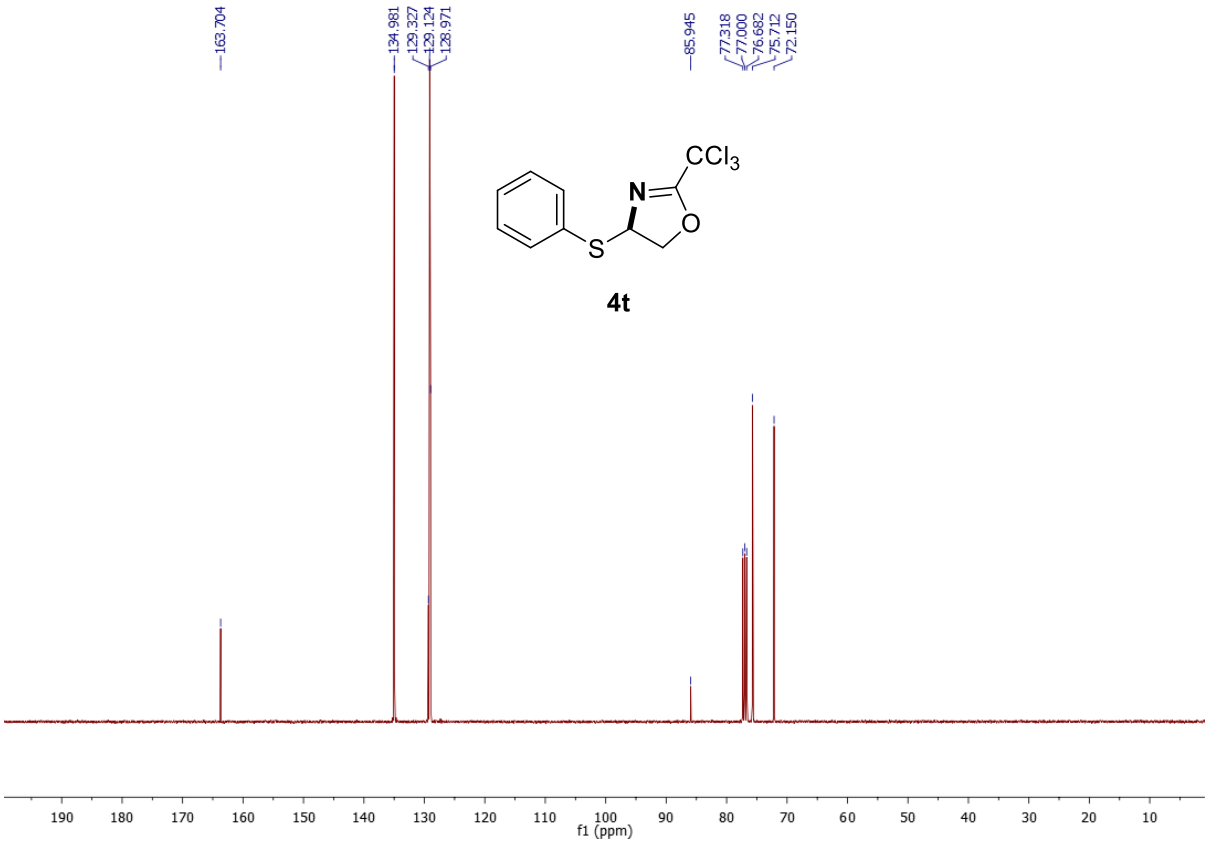

7.347
7.343
7.327
7.269
7.264
7.260
7.252
7.247
5.739
5.721
5.719
5.701
5.181
5.163
5.160
5.142
4.365
4.348
4.330
CCl3
Cl
N
O
Cl
4r
1.93
1.04
1.00
1.05
1.04
f1 (ppm)

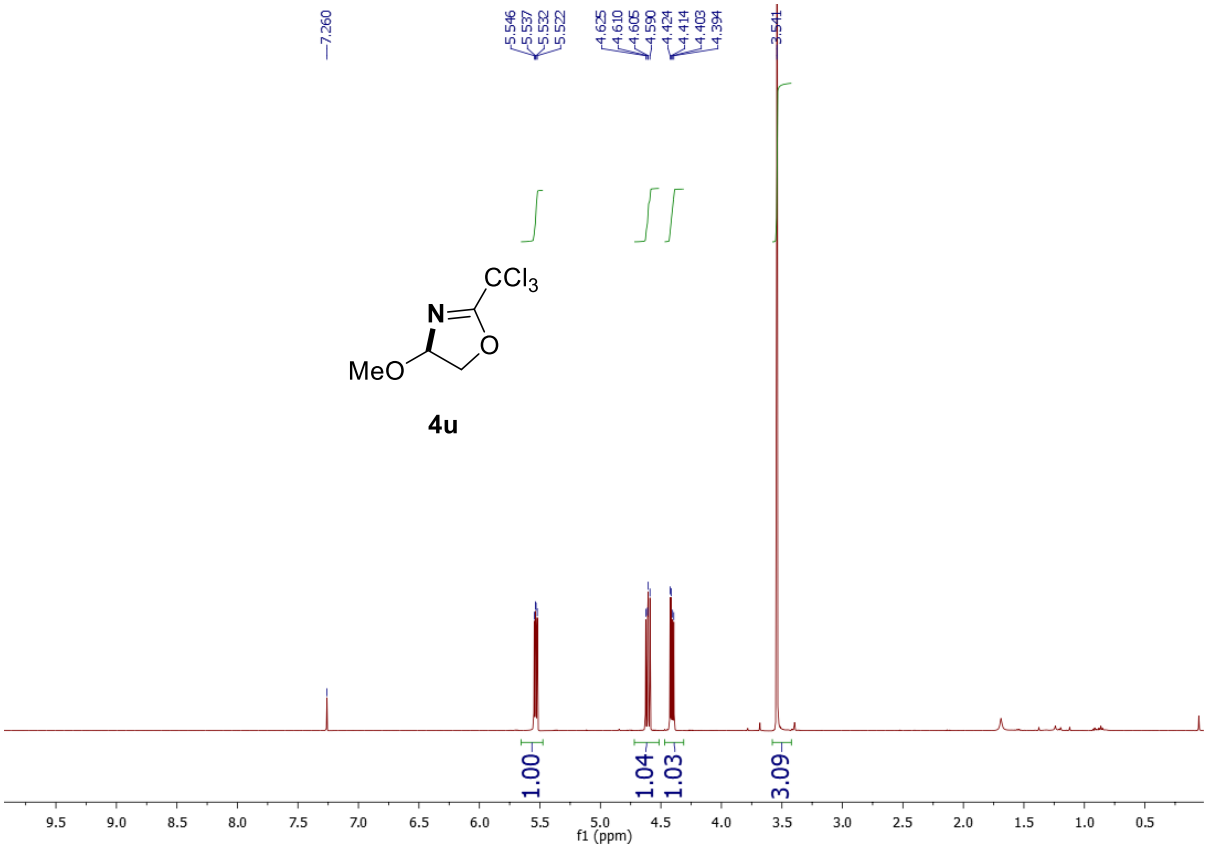

164.686
140.061
133.466
130.552
130.186
129.312
127.701
86.248
77.254
77.233
77.000
76.746
67.121
CCl3
Cl
N
O
Cl
4r
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

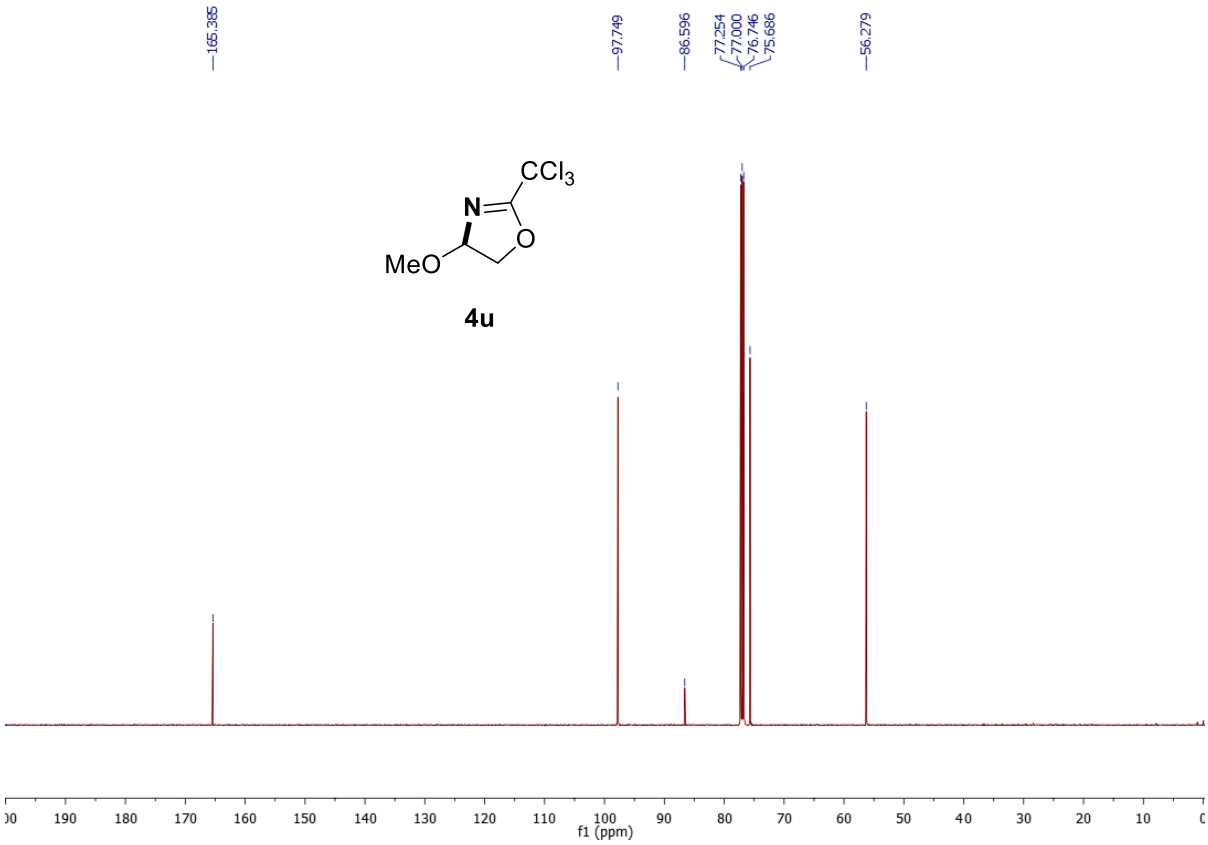

7.419
7.294
7.260
5.733
5.716
5.713
5.695
5.152
5.134
5.131
5.114
4.353
4.335
4.318
CCl3
Cl
N
O
Cl
4s
0.96
2.02
1.00
1.05
1.04
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)


164.492
137.036
134.469
132.637
129.302
128.434
127.672
86.295
77.364
77.254
77.000
76.746
66.902
CCl3
N
O
Cl
Cl
4s
f1 (ppm)

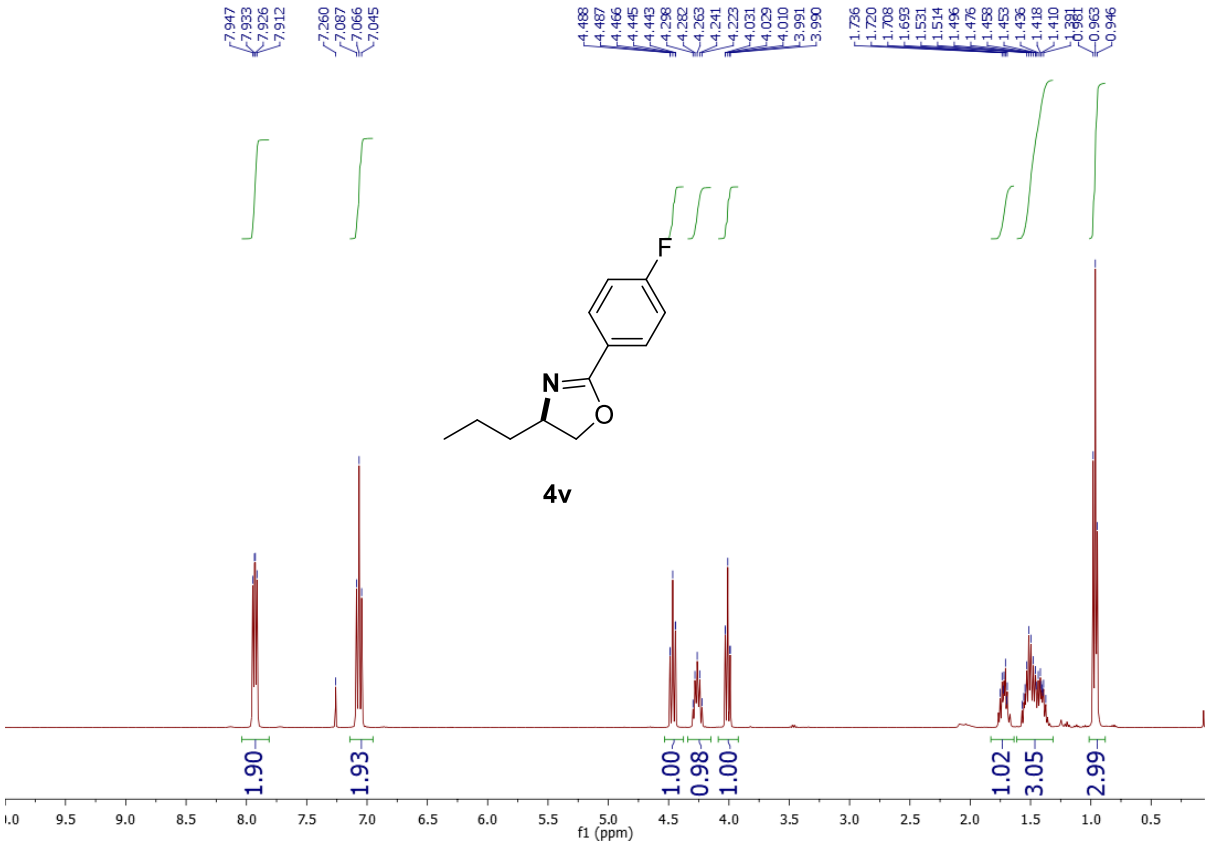

7.548
7.542
7.536
7.533
7.530
7.524
7.350
7.340
7.333
7.329
7.325
7.324
7.319
7.316
5.536
5.520
5.511
5.495
4.872
4.848
4.824
4.573
4.557
4.549
4.533
CCl3
N
O
S
4t
2.03
3.05
1.00
1.05
1.05
f1 (ppm)


163.704
134.981
129.327
129.124
128.971
85.945
77.318
77.000
76.682
75.712
72.150
CCl3
N
O
S
4t
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

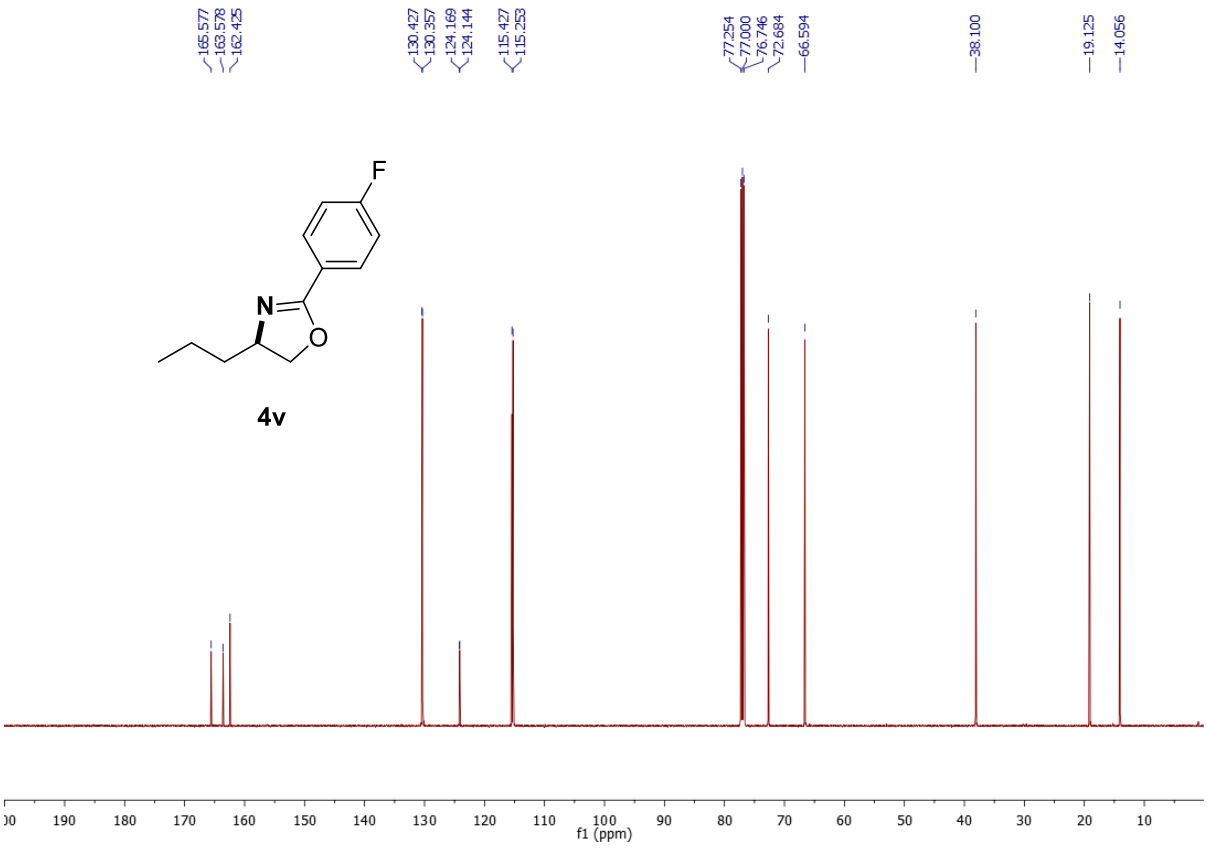

7.260
5.546
5.537
5.532
5.522
4.625
4.610
4.605
4.590
4.424
4.414
4.403
4.394
3.541
CCl3
N
O
MeO
4u
1.00
1.04
1.03
3.09
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f1 (ppm)

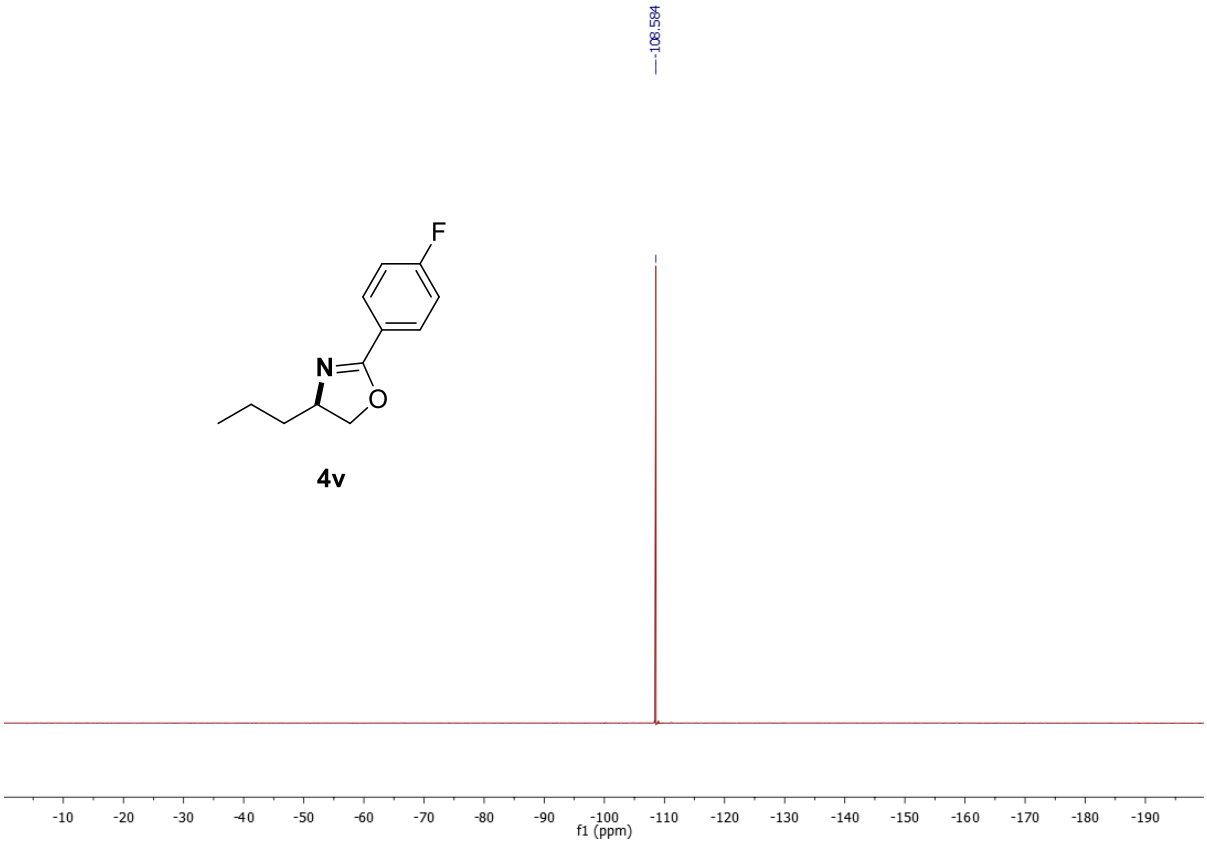

165.385
97.749
86.596
77.254
77.000
76.746
75.686
56.279
CCl3
N
O
MeO
f1 (ppm)

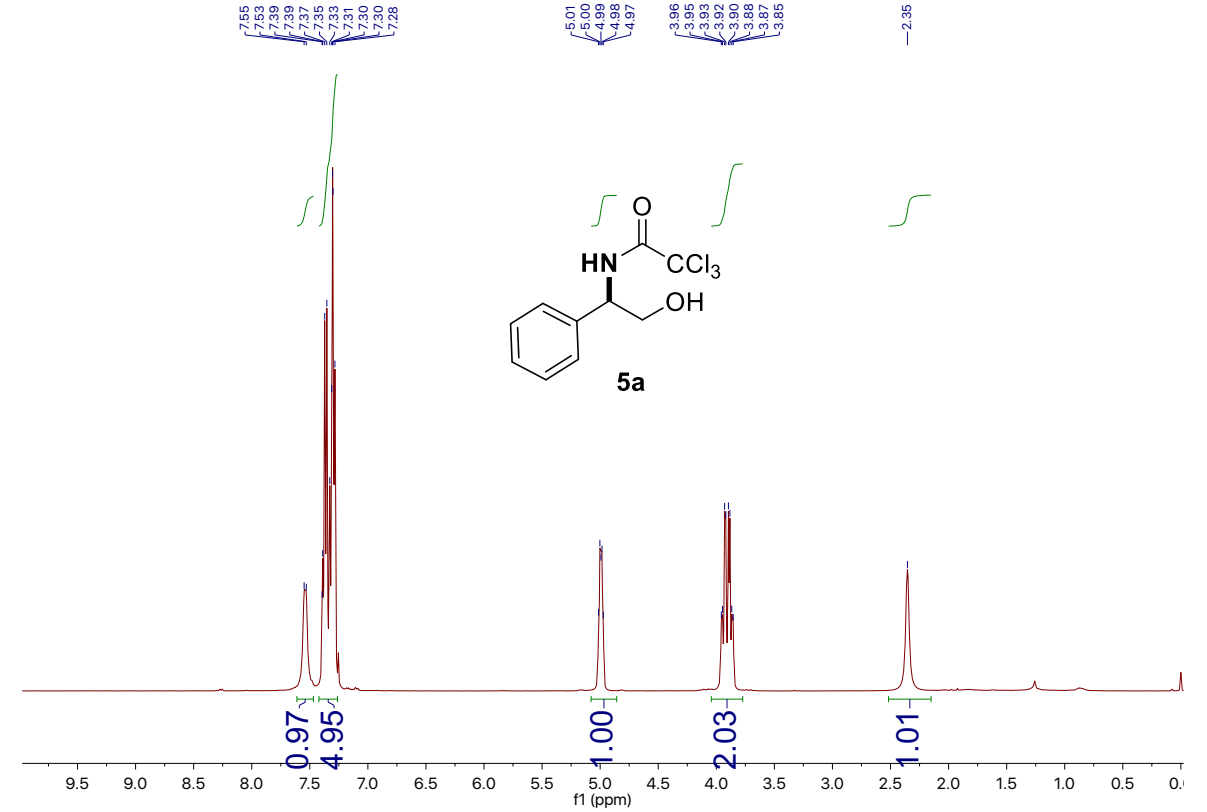
4u

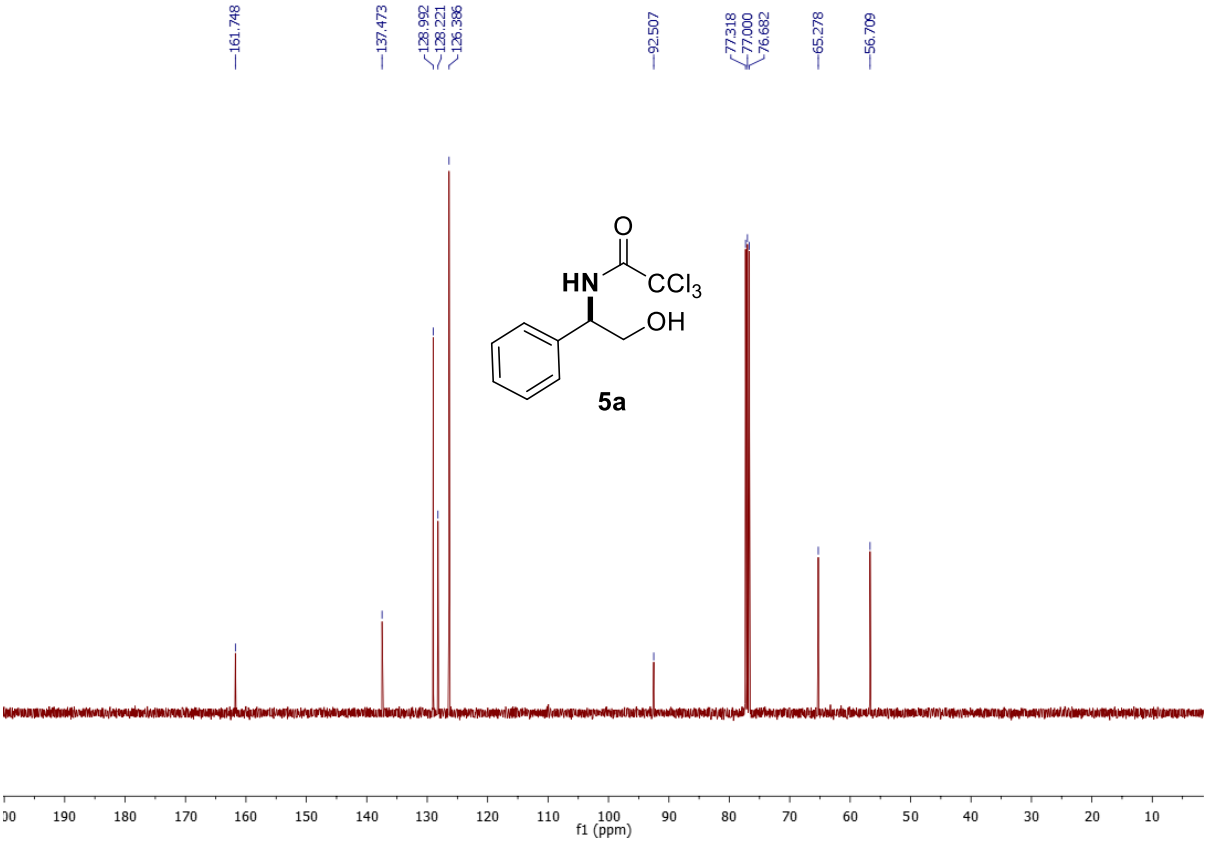

7.947
7.933
7.926
7.912
7.260
7.087
7.066
7.045
4.488
4.487
4.466
4.445
4.443
4.298
4.282
4.263
4.241
4.223
4.031
4.029
4.010
3.991
3.990
1.736
1.720
1.708
1.693
1.531
1.514
1.496
1.476
1.458
1.453
1.436
1.418
1.410
1.391
0.981
0.963
0.946
F
N
O
1.90
1.93
1.00
0.98
1.00
1.02
3.05
2.99
f1 (ppm)

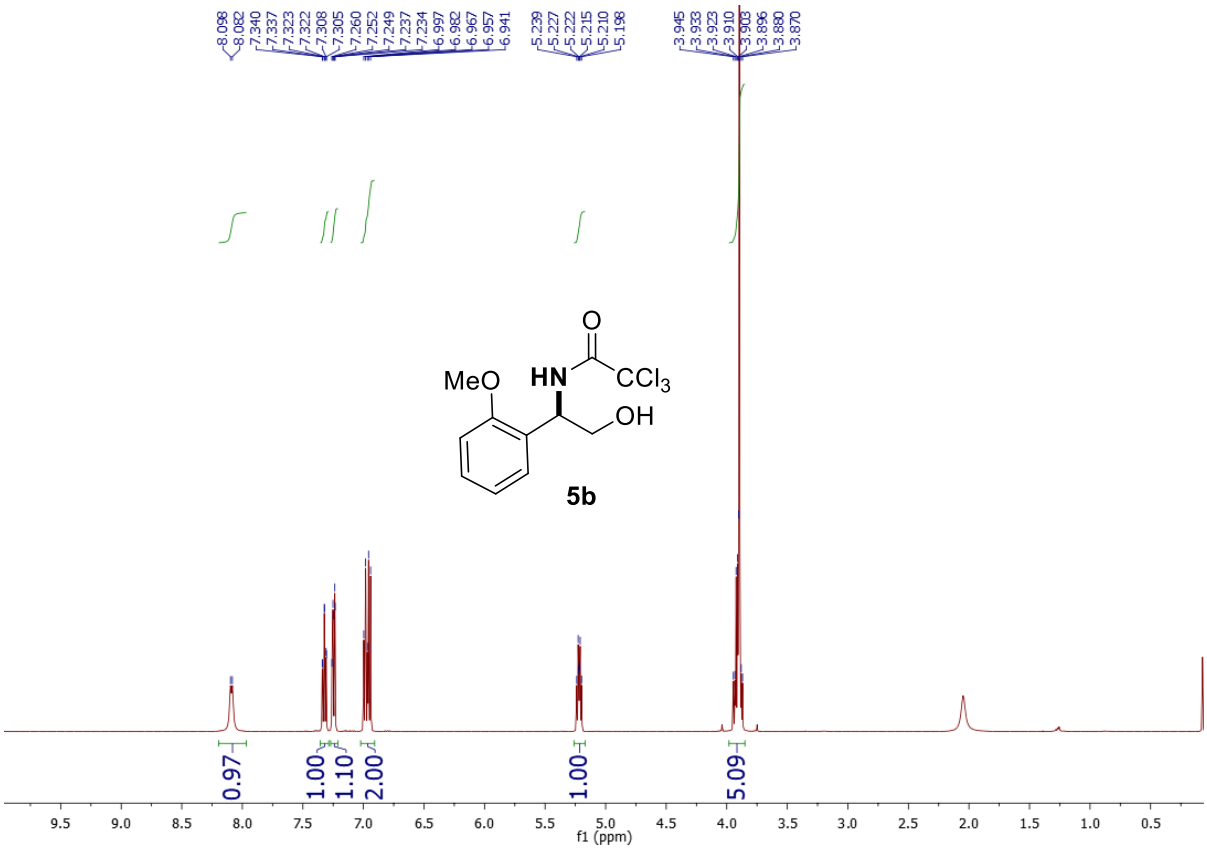
4v

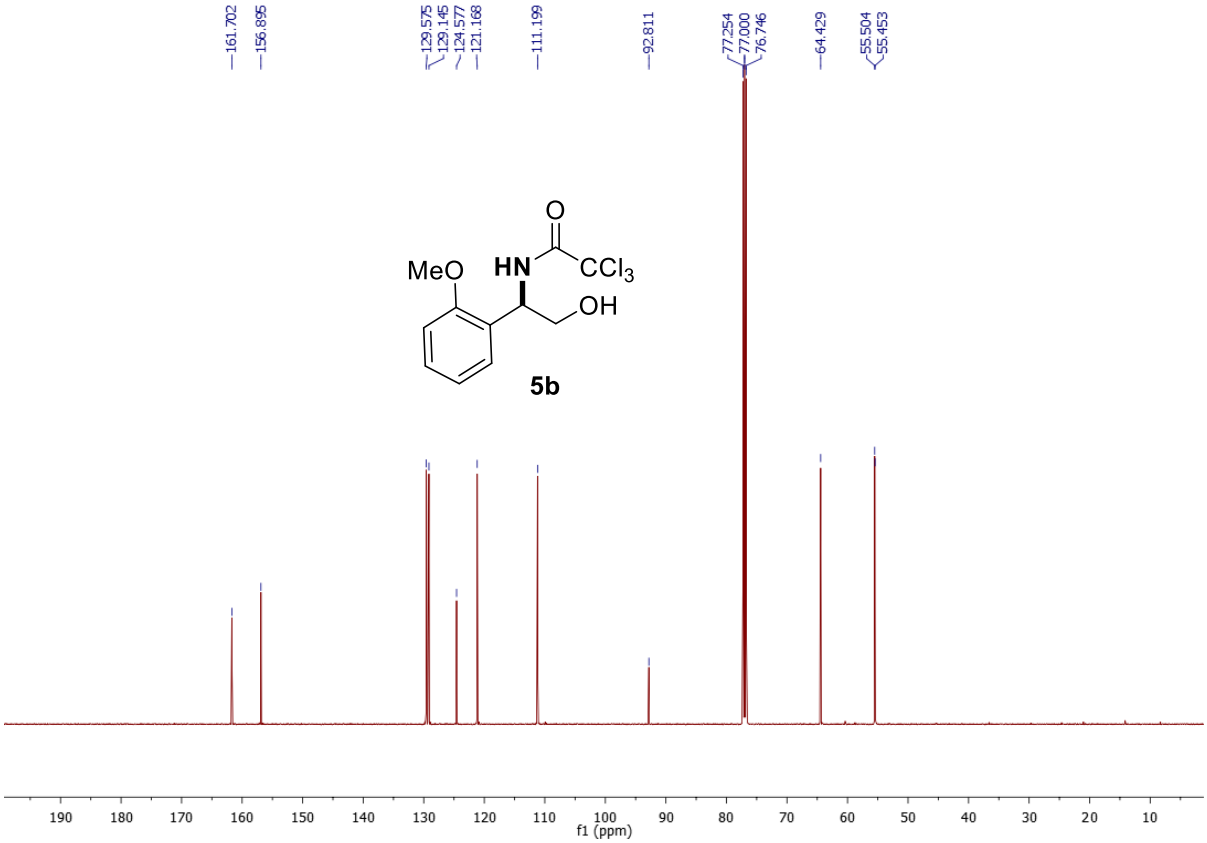

165.577
163.578
162.425
130.427
130.357
124.169
124.144
115.427
115.253
77.254
77.000
76.746
72.684
66.594
38.100
19.125
14.056
F
N
O
4v
f1 (ppm)

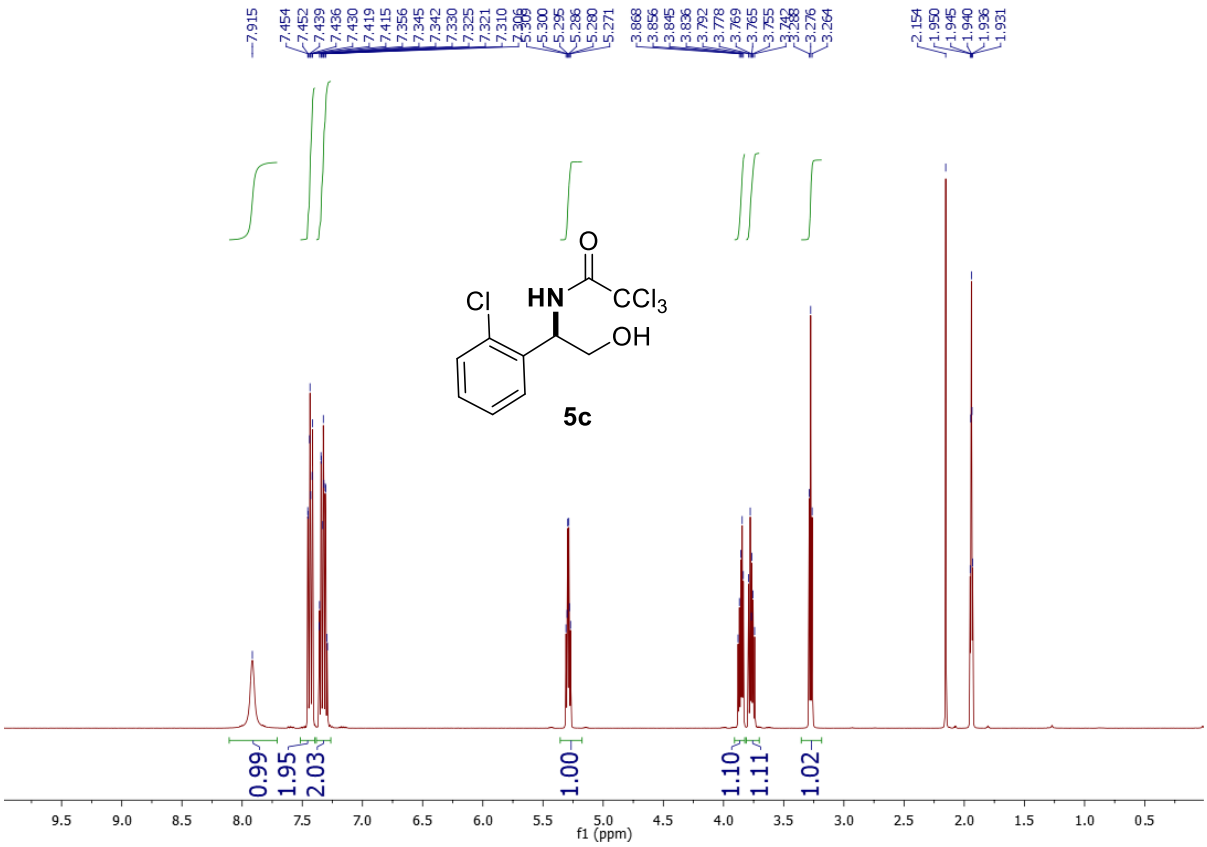

-108.584
F
N
O
4v
f1 (ppm)

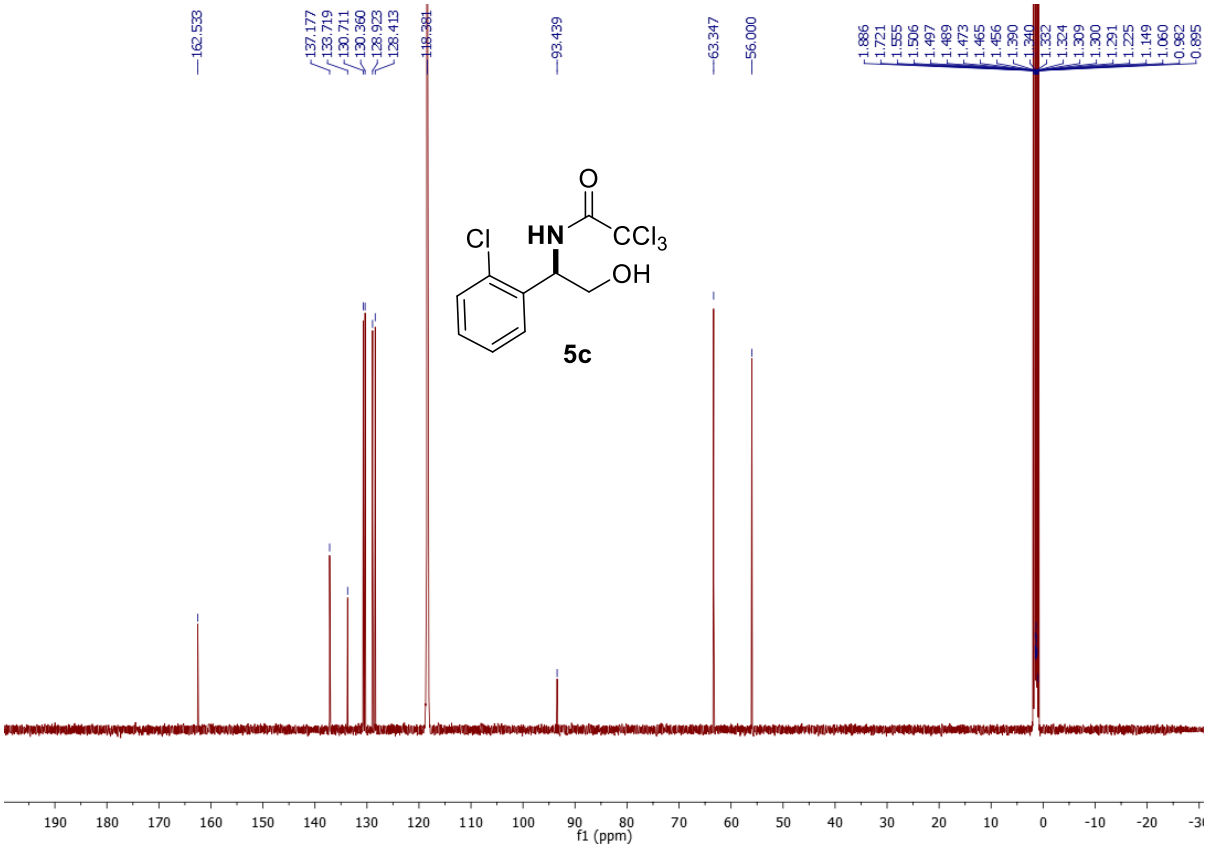

7.55
7.53
7.39
7.39
7.37
7.35
7.33
7.31
7.30
7.30
7.28
5.01
5.00
4.99
4.98
4.97
3.96
3.95
3.93
3.92
3.90
3.88
3.87
3.85
2.35
O
HN
CCl3
OH
5a
0.97
4.95
1.00
2.03
1.01
f1 (ppm)

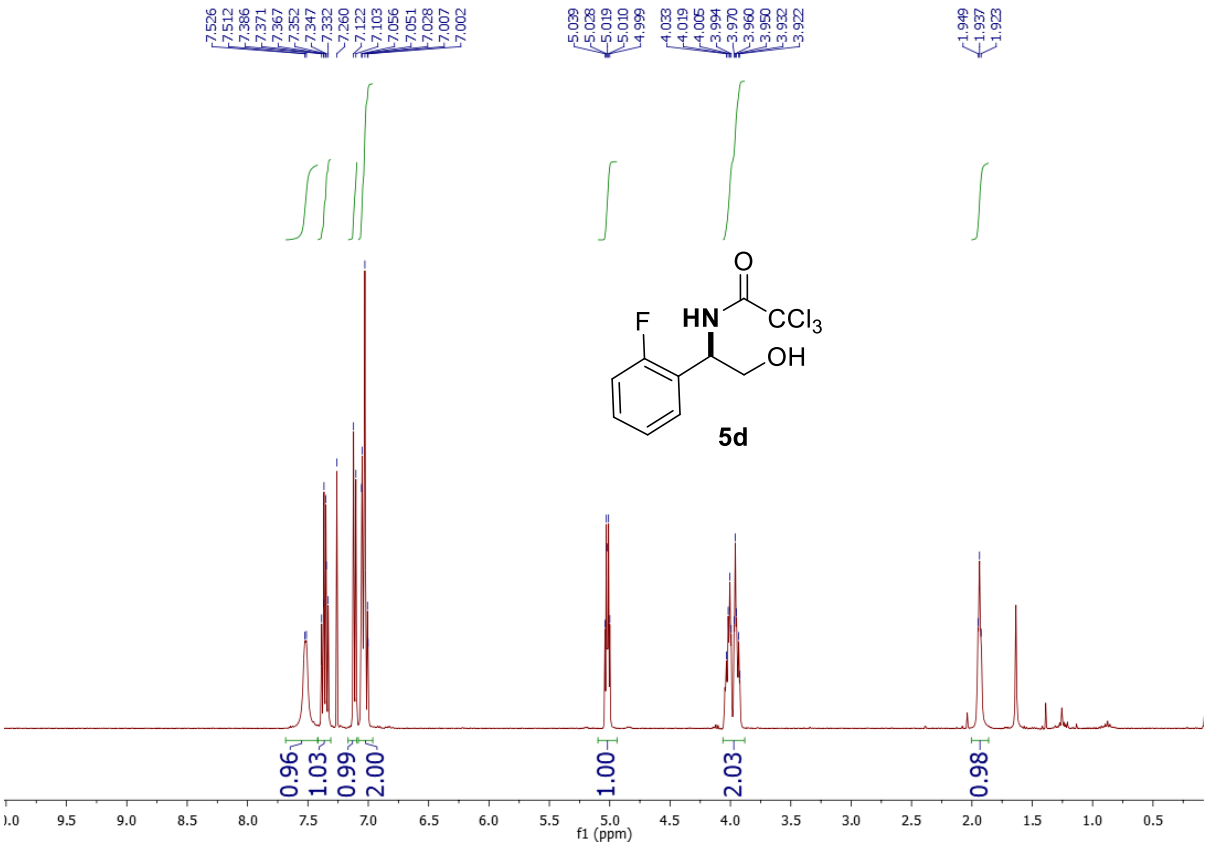

161.748
137.473
128.992
128.221
126.386
92.507
77.318
77.000
76.682
65.278
56.709
O
HN
CCl3
OH
5a
f1 (ppm)

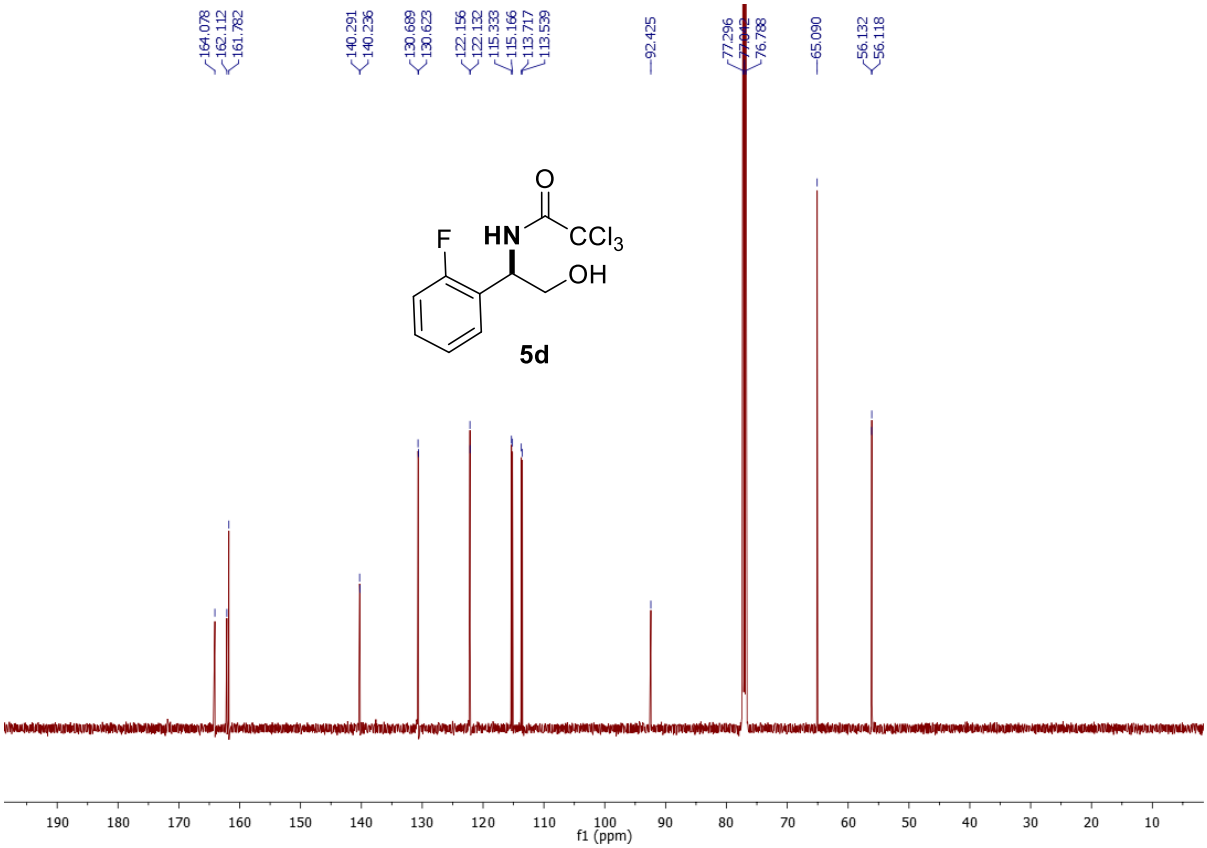

8.098
8.082
7.340
7.337
7.323
7.322
7.308
7.305
7.260
7.252
7.249
7.237
7.234
6.997
6.982
6.967
6.957
6.941
5.239
5.227
5.222
5.215
5.210
5.198
3.945
3.933
3.923
3.910
3.903
3.896
3.880
3.870
MeO
HN
O
CCl3
OH
5b
0.97
1.00
1.10
2.00
1.00
5.09
f1 (ppm)

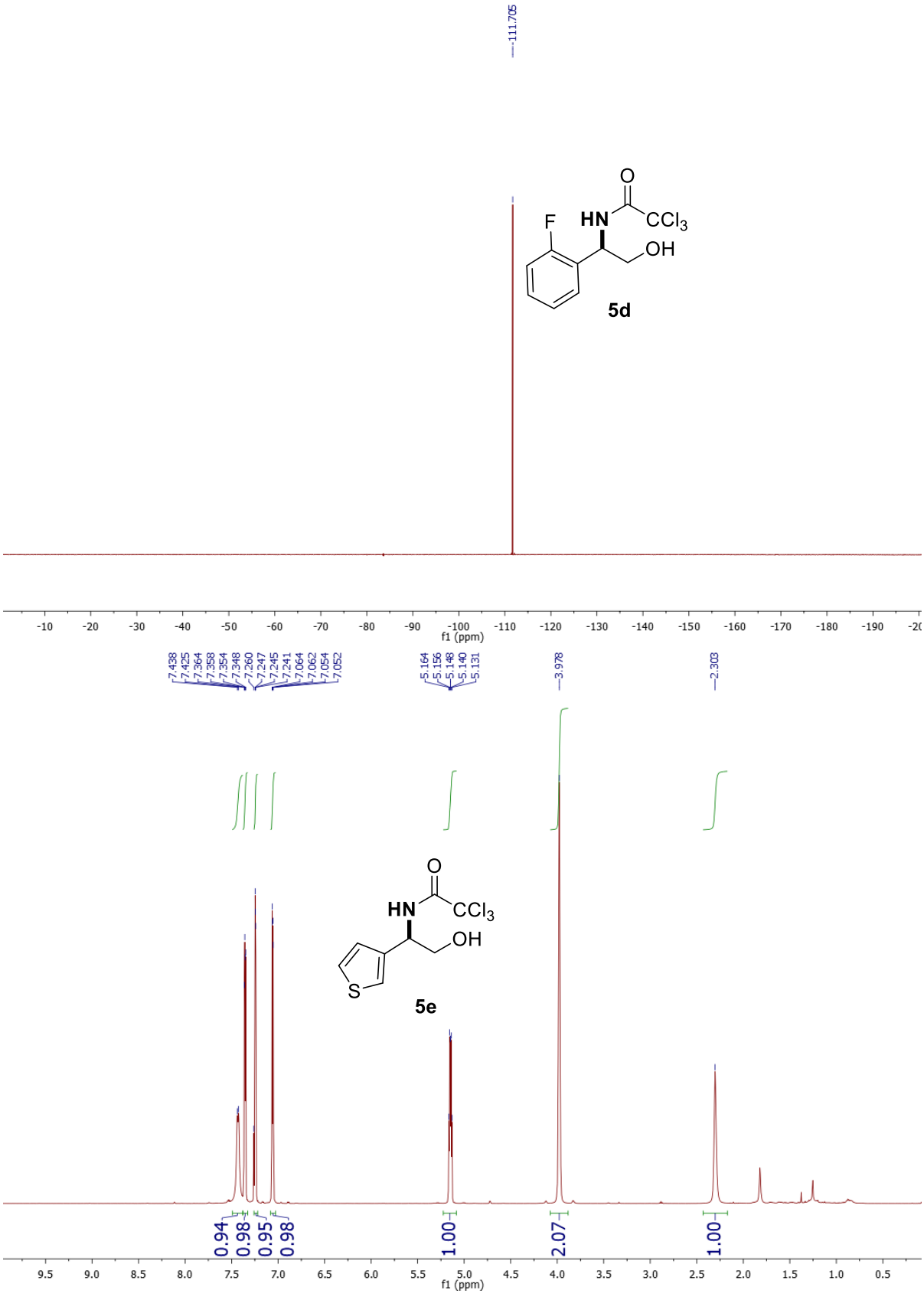

161.702
156.895
129.575
129.145
124.577
121.168
111.199
92.811
77.254
77.000
76.746
64.429
55.504
55.453
MeO
HN
O
CCl3
OH
5b
f1 (ppm)

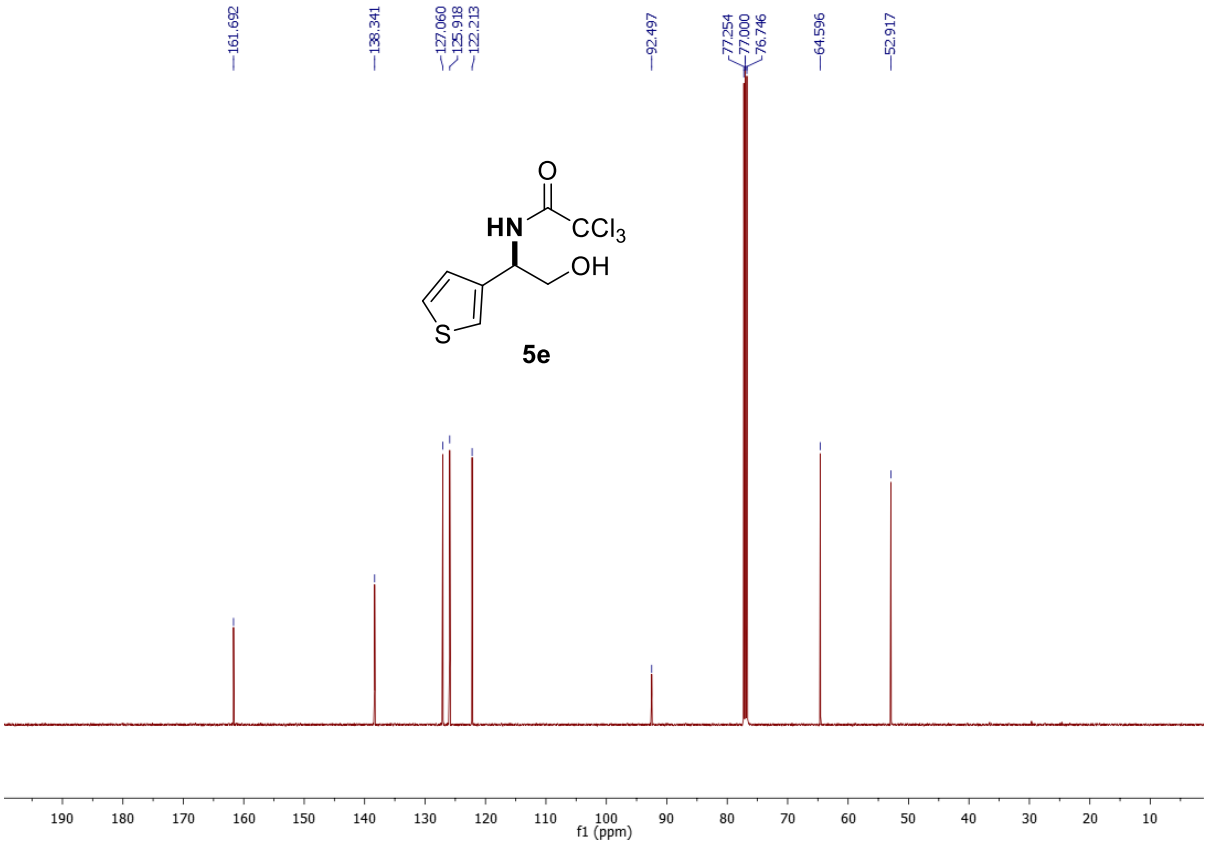

7.915
7.454
7.452
7.439
7.436
7.430
7.419
7.415
7.356
7.345
7.342
7.330
7.325
7.321
7.310
5.300
5.295
5.286
5.280
5.271
3.868
3.856
3.845
3.836
3.792
3.778
3.769
3.765
3.755
3.276
3.264
2.154
1.950
1.945
1.940
1.936
1.931
O
HN
CCl3
Cl
OH
5c
0.99
1.95
2.03
1.00
1.10
1.11
1.02
f1 (ppm)


162.533
137.177
133.719
130.711
130.360
128.923
128.413
118.381
93.439
63.347
56.000
1.886
1.721
1.555
1.506
1.497
1.489
1.473
1.465
1.456
1.390
1.340
1.332
1.324
1.309
1.300
1.291
1.225
1.149
1.060
0.982
0.895
O
HN
CCl3
Cl
OH
5c
f1 (ppm)


7.526
7.512
7.386
7.371
7.367
7.352
7.347
7.332
7.260
7.122
7.103
7.056
7.051
7.028
7.007
7.002
5.039
5.028
5.019
5.010
4.999
4.033
4.019
4.005
3.994
3.970
3.960
3.950
3.932
3.922
1.949
1.937
1.923
O
HN
CCl3
F
OH
5d
0.96
1.03
0.99
2.00
1.00
2.03
0.98
f1 (ppm)


164.078
162.112
161.782
140.291
140.236
130.689
130.623
122.156
122.132
115.333
115.166
113.717
113.539
92.425
77.296
77.042
76.788
65.090
56.132
56.118
O
HN
CCl3
F
OH
5d
f1 (ppm)


-111.705
F
HN
O
CCl3
OH
5d
f1 (ppm)
7.438
7.425
7.364
7.358
7.354
7.348
7.260
7.247
7.245
7.241
7.064
7.062
7.054
7.052
5.164
5.156
5.148
5.140
5.131
3.978
2.303
HN
O
CCl3
OH
S
5e
0.94
0.98
0.95
0.98
1.00
2.07
1.00
f1 (ppm)


161.692
138.341
127.060
125.918
122.213
92.497
77.254
77.000
76.746
64.596
52.917
O
HN
CCl3
OH
S
5e
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)