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Visible light-induced borylation and arylation of small organic molecules using carbon dots

Tiantong He,[a] Heping Wei,[b] Yuanbo Zhou,[c] Li-ya Jiang,[a] Jonathan B. Baell,[a] Yang Yu,*[c] and Fei Huang*[a]

[a]School of Pharmaceutical Sciences, Nanjing Tech University, Nanjing 211816, P. R. China

[b]School of Food Science and Pharmaceutical Engineering, Nanjing Normal University, Nanjing 210023, P. R. China

[c]School of Environmental Science and Engineering, Nanjing Tech University, Nanjing 211816, P. R. China

*E-mail: yuyang19880421@yeah.net, huangfei0208@yeah.net

Table of contents

1. General considerations

^{1}H and $^{13}C\{^{1}H\}$ NMR spectra were recorded on a Bruker DRX-400 spectrometer and all chemical shift values refer to δ_{TMS} = 0.00 ppm, $CDCl_3$ ($\delta(^{1}H)$, 7.26 ppm; $\delta(^{13}C)$, 77.16 ppm). UV-vis absorption spectra were recorded with a U-3900 UV-vis spectrophotometer. TEM and HRTEM images were obtained by using JEOL JEM2100F transmission electron microscope at an acceleration voltage of 150 kV. XRD patterns were obtained by using an X-ray diffractometer (Bruker, Germany) with Cu-Kα radiation (λ = 1.5178 Å). The 2θ scanning range was from 5° to 80° with a scanning speed of 0.1 °/s. The FT-IR spectra (4000 cm^{-1} to 400 cm^{-1}) in KBr were obtained using Varian Excalibur 3100 FT-IR spectrometer. The Raman spectra performed on laser confocal micro-Raman Spectroscopy (inVia-Reflex). Ultraviolet photoelectron spectroscopy (UPS) was performed on Thermo Scientific ESCALab 250Xi. The gas discharge lamp was used for UPS, with Helium gas admitted and the He I emission line at 21.22 eV employed. The Helium pressure in the analysis chamber during analysis is about 3×10^{-8} mbar. The photoreaction instrument (WPP-TEC-1020SL) was purchased from WATTCAS, China. The light source was blue (395 or 495 nm) LEDs which were positioned on the bottom of the reaction vial at a 4 mm distance. The reaction stand was a custom-made aluminum block with build-in water cooling. Analytical TLC plates, Sigma-Aldrich silica gel $60F_{200}$ were viewed by UV light (254 nm). Column chromatographic purifications were performed on SDZF silica gel 160. All the chemical reagents were purchased from commercial sources and used as received unless otherwise indicated. Compounds **3a-3d**[1], **3e**[2], **3f**[1], **3g**[3], **3h-3i**[1], **3j**[4], **3k-3o**[3], **3p-3v**[1], **3w**[5], **6a-6c**[6], **6d-6f**[7], **6g-6i**[6], **6j**[8], **6k-6l**[6], **6m**[9], **6n**[6], **6o**[10], **6p**[11], **6q-6r**[12], **6s**[13], **6t**[14], **7**[15], **8**[16], **9**[17], **10**[18], **11**[19], **13-15**[20], and **17-19**[21] were known and their spectroscopic features were in good agreement with that reported in the literatures.

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2. Preparation and characterization data of carbon dots

2.1. Preparation of Carbon Dots.

Synthesis of B-CDots, G-CDots, and R-CDots[22]: Blue carbon dots (B-CDots), green carbon dots (G-CDots), and red carbon dots (R-CDots) were synthesized by using different molar ratios of citric acid (CA) to urea in DMF at different temperatures. Typically, B-CDots were prepared via solvothermal synthesis method. A mixture of CA (192 mg, 1 mmol), urea (600 mg, 10 mmol) in 10 mL *N,N*-dimethylformamide (DMF) was stirred at 140 °C for 12 h. After cooling to room temperature, the resultant mixture was evaporated all the volatiles under reduced pressure. The residue was purified by silica gel column chromatography (eluent: DCM/MeOH = 20:1, v/v) to afford the corresponding B-CDots as yellow solids. By adjusting the ratios of CA to urea and the temperature of reaction, CDots with different emissive colors can be synthesized. At the ratio of CA to urea = 0.3 and the temperature at 160 °C, the G-CDots were obtained. At the ratio of CA to urea = 0.8 and the temperature at 180 °C, the R-CDots were obtained.

2.2. The characterization of B-CDots

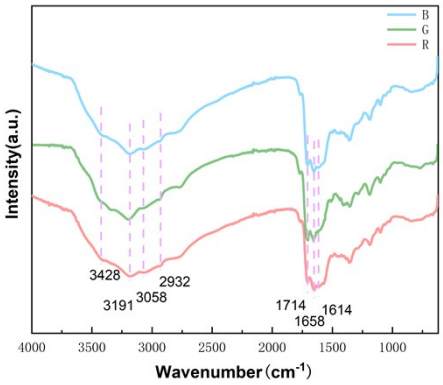


Figure S1 FT-IR spectra of B-CDots, G-CDots, and R-CDots.

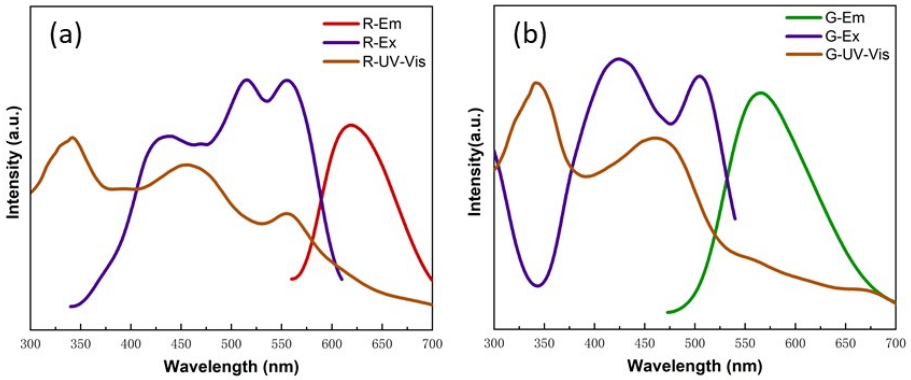


Figure S2 (a) UV–vis, PL emission and PL excitation spectra of R-CDots. Conditions: R-CDots (1.0 mg); solvent: H_2O in a volume of 25 mL under an air atmosphere. Excitation wavelength was 510 nm. (b) UV–vis, PL emission and PL excitation spectra of G-CDots. Conditions: G-CDots (1.0 mg); solvent: H_2O in a volume of 25 mL under an air atmosphere. Excitation wavelength was 430 nm.

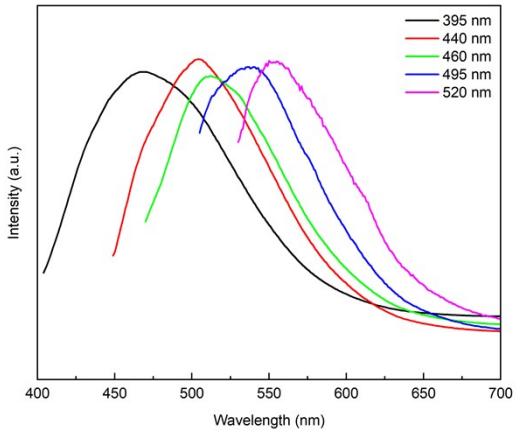


Figure S3 PL emission spectra of B-CDots at different excitation wavelengths. Conditions: B-CDots (1.0 mg); solvent: H_2O in a volume of 25 mL under an air atmosphere.

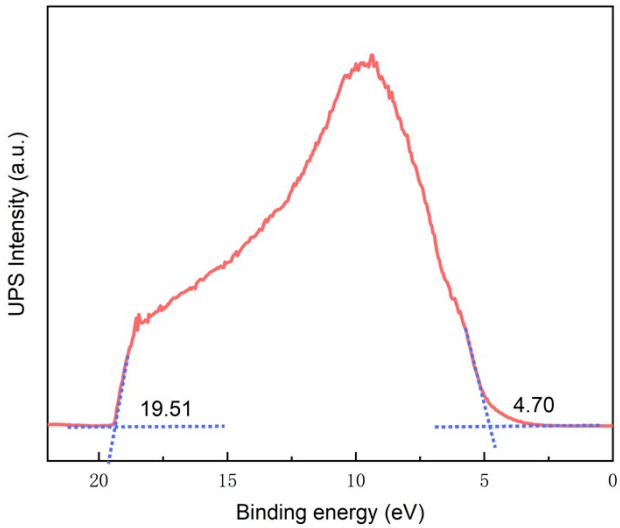


Figure S4 UPS spectrum of B-CDots.

Quantum yield (QY) measurement:

Quinine sulfate (QY=54.6% in 0.1 M H_2SO_4) was selected as the reference for the emission range of 400-480 nm (for B-CDots herein). The QY of a sample was then calculated according to the following equation:

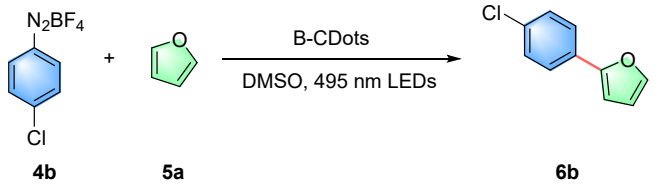
$$\phi = \phi' \times \frac{A'}{I'} \times \frac{I}{A} \times \frac{n^2}{n'^2}$$

Where ϕ is the QY of the testing sample, I is the testing sample's integrated emission intensity, n is the refractive index (1.33 for water), and A is the optical density. The superscript "′" refers to the to the quinine sulfate. The solutions of B-CDots and quinine sulfate were prepared with concentrations adjusted such that the optical absorbance values were between 0–0.1 at 350 nm. The PL spectra were measured and the PL intensity was integrated. QY were determined by comparison of the integrated PL intensity *vs* absorbance curves.

3. Optimization of conditions and experimental procedures

3.1. Screening the optimum reaction conditions for the C−H arylation of haloarenes.

Table S1 Screening the optimum reaction conditions[a]



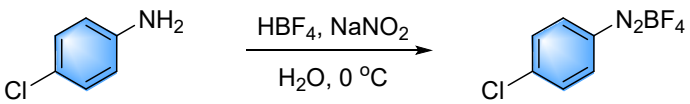
entry	furan (equiv)	blue LEDs (nm)	B-CDots (mg)	solvent	yield (%)
1	10	440	20	DMSO	45
2	10	460	20	DMSO	46
3	10	495	20	DMSO	56
4	10	530	20	DMSO	36
5	10	495	20	H_2O	NR
6	10	495	20	DCE	9
7	10	495	20	toluene	11
8	10	495	20	MeOH	13
9	10	495	20	DMF	19
10	10	495	20	MeCN	8
11	15	495	20	DMSO	69
12	15	495	15	DMSO	68
13	15	495	10	DMSO	70
14[b]	15	495	10	DMSO	53
15[c]	15	495	10	DMSO	24
16	15	--	10	DMSO	NR
17	15	495	--	DMSO	17

[a]Reaction conditions: **4b** (0.5 mmol), **5a** (7.5 mmol), B-CDots, solvent (2 mL), rt, N_2, 2 h, 1 W blue LED, isolated yield. NR = No reaction. [b]air. [c]O_2.

We began our studies using 4-chlorobenzene-diazonium salt **4b** and furan **5a** as the model substrates to optimize the reaction conditions (Table S1). We were delighted to find that irradiation of the diazonium salt **4b** and furan **5a** in the presence of 20 mg B-CDots at room temperature for 2 h in DMSO provided the desired product **6b** in 45% yield (Table S1, entry 1). Then, light sources were investigated and results indicated that 495 nm LEDs was the most effective light source up to 56% yield. (Table S1, entries 2–4). Subsequently, various solvents were screened, such as H_2O, DCE, toluene, MeOH, DMF, and MeCN (Table S1, entries 5–10). DMSO was found to be the best choice for this reaction. Increasing the amount of furan from 10 equiv. to 15 equiv. improved the yield to 69% (Table S1, entry 11). Remarkably, screening the amount of B-CDots revealed that using a lower amount of B-CDots (10 mg) could

give the corresponding product in higher yield up to 70% (Table S1, entries 12–13). However, when the reaction was performed in an air atmosphere, the yield decreased significantly to only 53% (Table S1, entry 14). The reaction was significantly inhibited when carried out in an oxygen atmosphere, resulting in a yield of only 24% (Table S1, entry 15). These results may be attributed to the weak radical-inhibiting properties of oxygen, as the arylation reaction may be undergoes through a radical pathway. Therefore, nitrogen was found to be the optimal atmosphere for this reaction. Control experiments emphasized the crucial role of the light and the B-CDots (Table S1, entries 16–17).

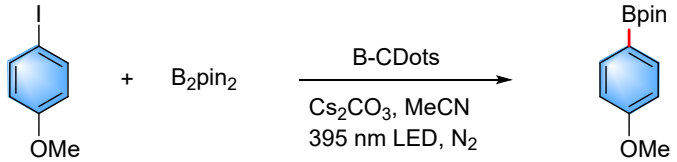
3.2. Preparation of aryldiazonium salts 4.



4b

A typical procedure for the synthesis of aryldiazonium salts (4a-4p)– ***Synthesis of 4b:*** A mixture of the 4-chloroaniline (5 mmol), HBF_4 (48% w/w, 1.2 mL, 10 mmol, 2.1 equiv) and water (2.0 mL) was cooled to 0 °C and a solution of $NaNO_2$ (345 mg, 5 mmol, 1.0 equiv) in water (1.0 mL) was added dropwise. The reaction mixture was stirred at 0 °C for 40 min. The solid was filtered off and washed with diethyl ether (3×5 mL). The aryldiazonium salts was dried in vacuo for 20 min, affording **4b** (1.06 g, 94%) as a white solid.

3.3. General procedure for the synthesis of arylboronates (3).



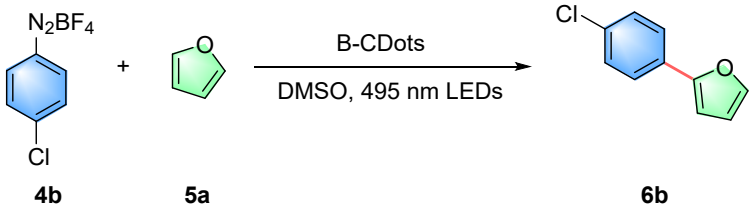
1a **2a** **3a**

The reactions of haloarenes (1) and B_2pin_2 (2)– ***Synthesis of 3a:*** A mixture of 1-iodo-4-methoxybenzene (0.3 mmol), B_2pin_2 (0.6 mmol, 2.0 equiv), B-CDots (15 mg), Cs_2CO_3 (0.6 mmol, 2.0 equiv) and CH_3CN (3.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by 10 W blue LED of the

appropriate wavelength (395 nm) for 24 hours. When reaction was finished, water (5 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over excess anhydrous sodium sulfate, filtered, and concentrated. The resulting crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 25:1, v/v) to afford **3a** (45 mg, 64%) as colorless liquid.

Figure S5 Photograph of the photochemical reaction set-up.

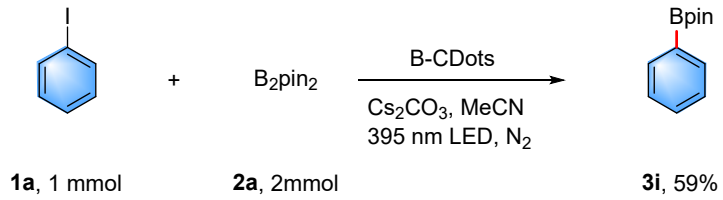
3.4. General procedure for the synthesis of arylated heteroarenes (6).



The reactions of aryldiazonium salts (4) and heteroarenes (5)– *Synthesis of 6b:* A mixture of 4-chlorobenzene-diazonium salt **4b** (0.5 mmol), furan **5a** (7.5 mmol, 15 equiv), B-CDots (10 mg), and DMSO (2.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by 1 W blue LED of the appropriate wavelength (495 nm) for 2 h. When reaction was finished, water (5 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over excess anhydrous sodium sulfate, filtered, and concentrated. The resulting crude mixture was purified by silica gel column

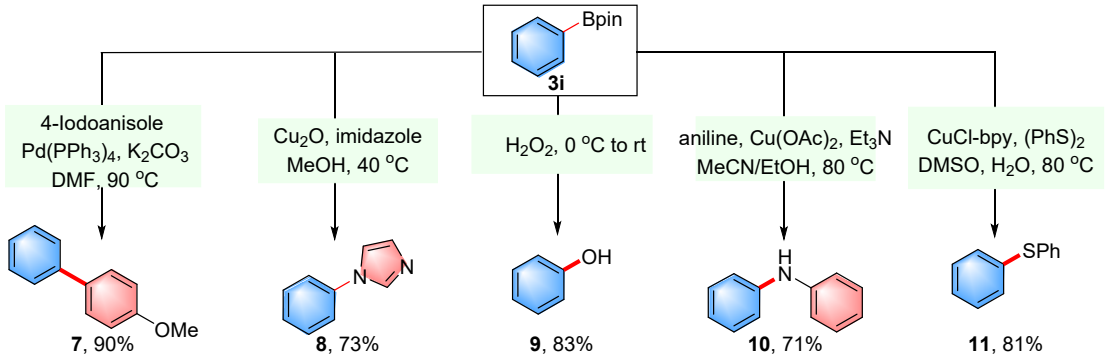
chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford **6b** (62 mg, 70%) as a white solid.

3.5. General procedure for preparative-scale reaction.



The reactions preparative-scale: A mixture of iodobenzene (1.0 mmol), B_2pin_2 (2.0 mmol, 2.0 equiv), B-CDots (50 mg), Cs_2CO_3 (2.0 mmol, 2.0 equiv) and CH_3CN (6.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by 10 W blue LED of the appropriate wavelength (395 nm) for 24 h. When reaction was finished, water (30 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 20 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The resulting crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford **3a** (120 mg, 59%) as colorless liquid.

3.6. Functionalization of arylboronates and synthesis of adiphenine, benactyzineand the core structure of nomifensine.



Scheme S1 Functionalization of arylboronates.

Synthesis of 7: A mixture of $Pd(Ph_3P)_4$ (0.025 mmol), K_2CO_3 (1 mmol), arylboronate **3i** (0.5 mmol) and 4-iodoanisole (1 mmol) was bubbled with N_2 for 15 min. Under nitrogen condition, DMF (3 mL) was sequentially added. The resulting

reaction mixture was stirred at 90 °C for 12 h. When reaction was finished, water (10 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford the corresponding product **7** (82.8 mg, 90%) as a white solid.

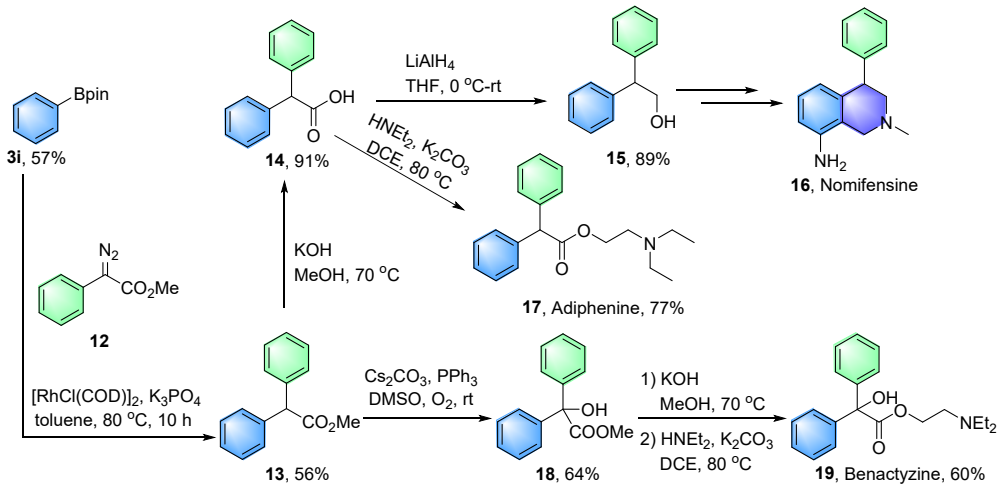
Synthesis of 8: A mixture of arylboronate **3i** (0.3 mmol), Cu_2O (0.03 mmol), imidazole (0.45 mmol) and MeOH (1 mL) was stirred at 40 °C for 12 h. After cooling to room temperature, the organic layers were concentrated. The crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:5, v/v) to give the product **8** (31.5 mg, 73%) as a colorless liquid.

Synthesis of 9: A 25 mL Schlenk tube was charged with arylboronate **3i** (0.5 mmol) and cooled to 0 °C. Then 30% wt. aq. H_2O_2 (392 μL, 5 mmol) was added dropwise. The reaction mixture was stirred at room temperature for 6 h. When reaction was finished, water (10 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford the corresponding product **9** (39 mg, 83%) as a colorless liquid.

Synthesis of 10: A mixture of arylboronate **3i** (1 equiv, 0.30 mmol), amine (2 equiv, 0.60 mmol), $Cu(OAc)_2$ (1 equiv, 0.30 mmol, 54 mg), Et_3N (2 equiv, 0.60 mmol, 61 mg, 84 μL) and MeCN/EtOH (20:1 ratio, 300 μL) was stirred at 80 °C for 48 h. After cooling to room temperature, the reaction mixture was filtered through Celite, and the filtrate was evaporated to give a residue that was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:4, v/v) afford the desired product **10** (36 mg, 71%) as a white solid.

Synthesis of 11: A mixture of CuCl (0.05 mmol), bpy (0.05 mmol), $(PhS)_2$ (0.275 mmol) and arylboronate **3i** (0.5 mmol) was bubbled with N_2 for 10 min. Under

nitrogen condition, DMSO (2 mL), H_2O (1 mL) were sequentially added. The resulting reaction mixture was stirred at 80 °C for 12 h. When reaction was finished, water (10 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford the corresponding product **11** (75 mg, 86%) as a colorless liquid.



Scheme S2 Synthesis of adiphenine, benactyzineand the core structure of nomifensine.

Synthesis of 13: A mixture of arylboronate **3i** (0.28 mmol, 1 equiv), K_3PO_4 (0.28 mmol, 1 equiv), Rh catalyst (1.38 mg, 1 mol%) and dry toluene (0.5 mL) was bubbled with N_2 for 10 min. Under nitrogen atmosphere, diazo compound **12** (0.56 mmol, 2 equiv) was dissolved in 1.0 mL dry toluene and slowly added dropwise. The reaction mixture was stirred at 80 ℃ for 3 h. The reaction mixture was cooled to room temperature and dissolved in 15 mL DCM. The DCM layer was washed with water (2 ×10 mL) and brine (2 ×10 mL). The combined organic layer was dried over anhydrous Na_2SO_4 and concentrated to get the crude product. The crude product was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:6, v/v) to afford the product **13** (63.3 mg, 56%) as a white solid.

Synthesis of 14: A mixture of methyl 2,2-diphenylacetate **13** (91 mg, 0.4 mmol, 1 equiv.), KOH (45 mg, 0.8 mmol, 2 equiv.) and MeOH (4 mL, 0.1M) was stirred at 65 ºC overnight. Then, the reaction was cooled to room temperature, acidified to pH = 2

using a 3M HCl aqueous solution, extracted with AcOEt, dried (Na_2SO_4), filtered and concentrated to afford the product **14** (85 mg, 91%) as a white solid.

Synthesis of 15: THF (3 mL, freshly distilled) was stirred at 0 °C for 5 min, adding $LiAlH_4$ (1.5 mmol) to it and stirring at the same temperature for 5 min. Then, the compound **14** (1 mmol) as dissolved in 3 mL of freshly distilled THF and slowly added to the reaction mixture at 0 °C. The reaction mixture was stirred at room temperature for 12 h. When reaction was finished, water (10 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The crude product was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 12:1, v/v) to afford the corresponding **15** (176 mg, 89%) as a white solid.

Synthesis of 17: A mixture of 2,2-diphenylacetic acid **14** (106 mg, 0.5 mmol, 1 equiv.), Na_2CO_3 (106 mg, 1 mmol, 2 equiv.), diethylamine (207 μL, 2 mmol, 4 equiv.) and 1,2-DCE (2 mL, 0.125 M) was stirred at 80 °C overnight. Then, the reaction was cooled to room temperature and concentrated. The residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 10:1, v/v) to afford the adiphenine **17** (120 mg, 77%) as a transparent oil.

Synthesis of 18: A mixture of methyl 2,2-diphenylacetate **13** (678 mg, 3 mmol, 1 equiv.), Cs_2CO_3 (195 mg, 0.6 mmol, 0.2 equiv.), $P(OEt)_3$ (1 mL, 6 mmol, 2 equiv.) and DMSO (12 mL, 0.25 M) was bubbled with O_2 for 10 min. The reaction mixture was stirred at room temperature for 24 h. Then, the reaction mixture was extracted with AcOEt (3 × 10 mL), washed with brine (10 mL), dried (Na_2SO_4), filtered and concentrated. The residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 12:1, v/v) to afford the product **18** (232 mg, 64%) as a white solid.

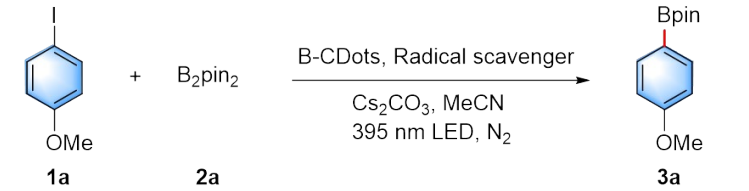
Synthesis of 19: A mixture of methyl 2-hydroxy-2,2-diphenylacetate **18** (150 mg, 0.6 mmol, 1 equiv.), KOH (69 mg, 1.2 mmol, 2 equiv.) and MeOH (6 mL, 0.1 M) was stirred at 65 °C overnight. Then, the reaction was cooled to room temperature, acidified to pH = 2 using a 3M HCl aqueous solution, extracted with AcOEt (3 × 10

mL), dried (Na_2SO_4), filtered and concentrated to afford the product (123 mg, 90 %) as a white solid.

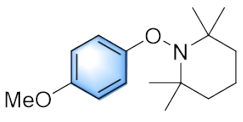
A mixture of the previously prepared 2-hydroxy-2,2diphenylacetic acid (46 mg, 0.2 mmol, 1 equiv.), Na_2CO_3 (42 mg, 0.4 mmol, 2 equiv.), diethylamine (82 μL, 2 mmol, 10 equiv.) and 1,2-DCE (1 mL) was stirred at 80 °C for 2 days. Then, the reaction mixture was extracted with AcOEt (3 × 10 mL), washed with brine (10 mL), dried (Na_2SO_4), filtered and concentrated. The residue was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 8:1, v/v) afforded the title compound **19** (27 mg, 60%) as a transparent oil.

4. Mechanistic investigations and proposed mechanism

4.1. Radical trapping experiments



Radical scavenger	**3a** Yield (%)
TEMPO	16
DPE	35
None	64



20

Detected by HRMS

Scheme S3 Radical trapping experiments of borylation.

Radical trapping study: A mixture of **1a** (0.3 mmol), B_2pin_2 (0.6 mmol, 2.0 equiv), B-CDots (15 mg), Cs_2CO_3 (0.6 mmol, 2.0 equiv), TEMPO or DPE (0.6 mmol, 2.0 equiv), and CH_3CN (3.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by blue LED of the appropriate wavelength (395 nm) for 24 hours. When reaction was finished, water (5 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The resulting crude mixture was purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 25:1, v/v) to afford **3a** (16%, 35% yields, respectively) as

colorless liquid. The crude mixture was analyzed by HRMS, showing that aryl radical was trapped by TEMPO and aryl radical-tempo adduct **20** was detected (Figure S6).

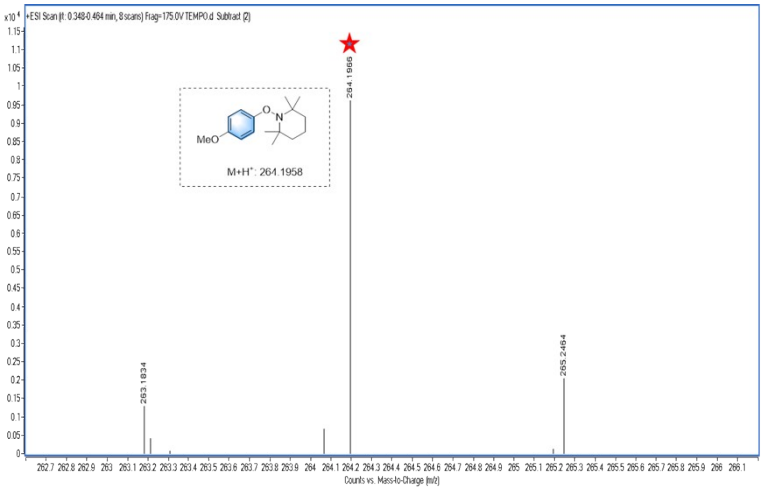
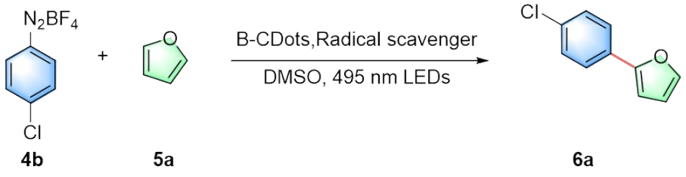
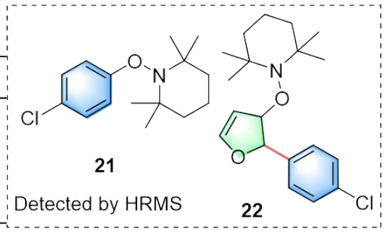


Figure S6 HRMS analysis of the formation of aryl radical-tempo adduct **20**



Radical scavenger	**3a** Yield (%)
TEMPO	21
DPE	30
None	85



Scheme S4 Radical trapping experiments of C–H arylation.

Radical trapping study: A mixture of 4-chlorobenzene-diazonium salt **4b** (0.5 mmol), furan (7.5 mmol, 15 equiv), B-CDots (10 mg), TEMPO or DPE (0.3 mmol, 1.0 equiv), and DMSO (2.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by blue LED of the appropriate wavelength (495 nm) for 2 hours. When reaction was finished, water (5 mL) was added, and the reaction mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic layers were dried over sodium sulfate, filtered, and concentrated. The resulting crude mixture can be purified by silica gel column chromatography (eluent: petroleum ether (60-90 °C)/AcOEt = 100:1, v/v) to afford **6b** (21%, 30% yields, respectively) as a white solid. The crude mixture was analyzed by HRMS, indicating that aryl radical

and furan radical were trapped by TEMPO and aryl radical-tempo adduct **21** (Figure S7) and furan radical-tempo adduct **22** (Figure S8) were detected.

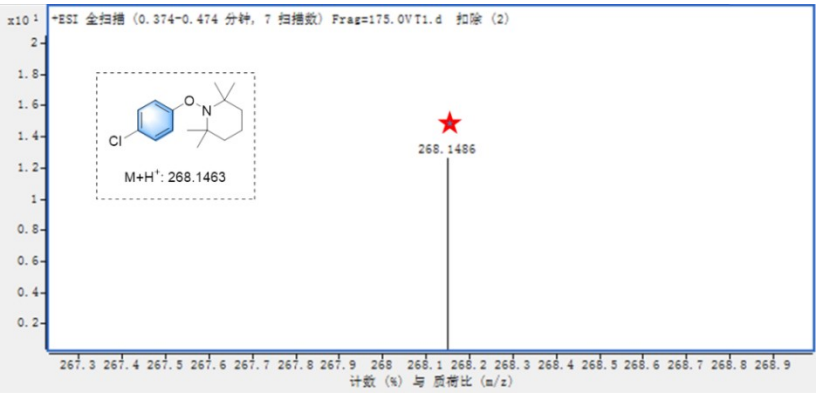


Figure S7 HRMS analysis of the formation of aryl radical-tempo adduct **21**.

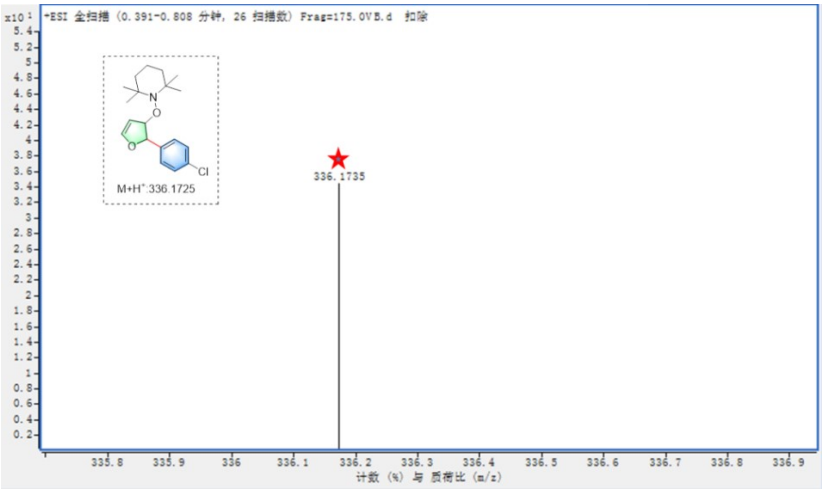


Figure S8 HRMS analysis of the formation of furan radical-tempo adduct **22**.

Intermediate detection study: A mixture of **1a** (0.3 mmol), B_2pin_2 (0.6 mmol, 2.0 equiv), B-CDots (15 mg), Cs_2CO_3 (0.6 mmol, 2.0 equiv), and CH_3CN (3.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by blue LED of the appropriate wavelength (395 nm) for 24 hours. The crude mixture was analyzed by HRMS, which revealed the presence of intermediate **VI**. (Figure S9).

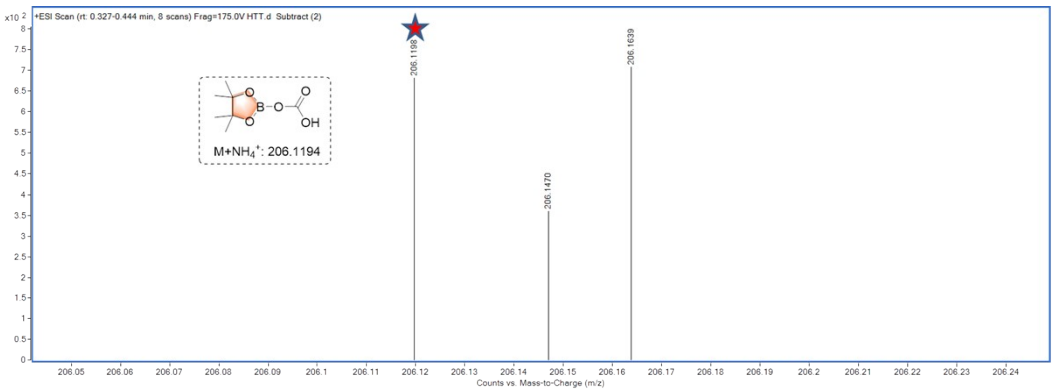


Figure S9 HRMS analysis of the formation of intermediate **VI** with ammonium cation.

4.2. ESR (Electron Spin Resonance) test

A mixture of 1-iodo-4-methylbenzene **1b** (0.3 mmol), B_2pin_2 (0.6 mmol, 2.0 equiv), B-CDots (15 mg), Cs_2CO_3 (0.6 mmol, 2.0 equiv), 5,5-dimethyl-1-pyrroline N-oxide (DMPO, 0.6 mmol, 2.0 equiv) and CH_3CN (3.0 mL) was bubbled with N_2 for 10 min, then sealed and irradiated at room temperature by blue LED of the appropriate wavelength (395 nm) for 10 min. Electron Spin Resonance (ESR) spectrum was recorded on a Bruker EMXplus-6/1 at room temperature and a carbon radical was found (Figure S10).

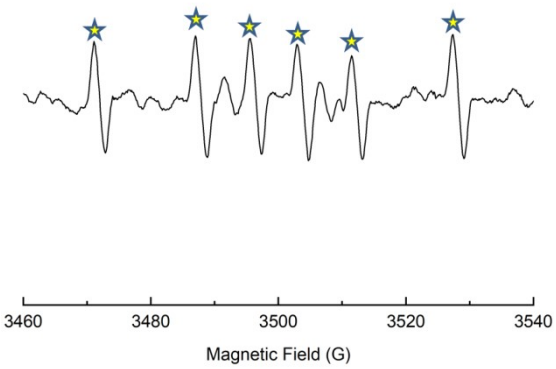


Figure S10 ESR spectrum of a mixture under irradiation of visible light for 10 min.

4.3. Fluorescence quenching experiments

Fluorescence quenching experiments for borylation: Rigorously degassed solutions of each component were prepared under nitrogen atmosphere prior to each set of experiments. In a typical experiment, a 4×10^{-2} mg/mL solution of B-CDots in MeCN was added the appropriate amount of quencher in a quartz cuvette. The

solutions were irradiated at 395 nm and luminescence was measured at 370 nm. The relative intensity I_0/I was calculated as a function of quencher concentration (Figure S11).

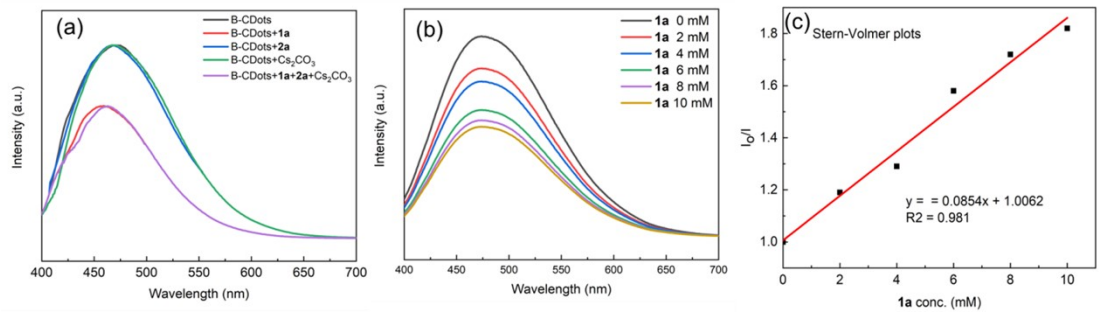


Figure S11 Fluorescence quenching experiments for borylation. (a) Fluorescence quenching of B-CDots by **1a**, **2a** and Cs_2CO_3. (b) Fluorescence emission spectra of B-CDots in different concentrations of 4-iodoanisole **1a** in MeCN. (c) Stern−Volmer plots. Excitation wavelength for fluorescence was set at 370 nm.

Fluorescence quenching experiments for C–H arylation: Rigorously degassed solutions of each component were prepared under nitrogen atmosphere prior to each set of experiments. In a typical experiment, a 4×10^{-2} mg/mL solution of B-CDots in DMSO was added the appropriate amount of quencher in a quartz cuvette. The solutions were irradiated at 495 nm and luminescence was measured at 370 nm. The relative intensity I_0/I was calculated as a function of quencher concentration (Figure S12).

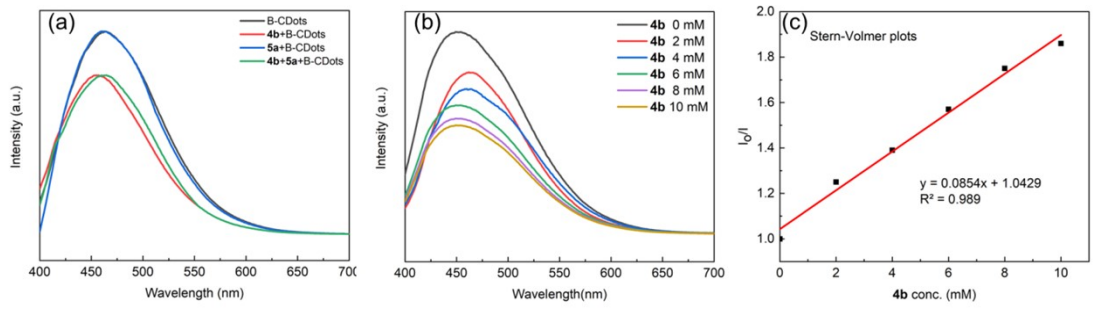
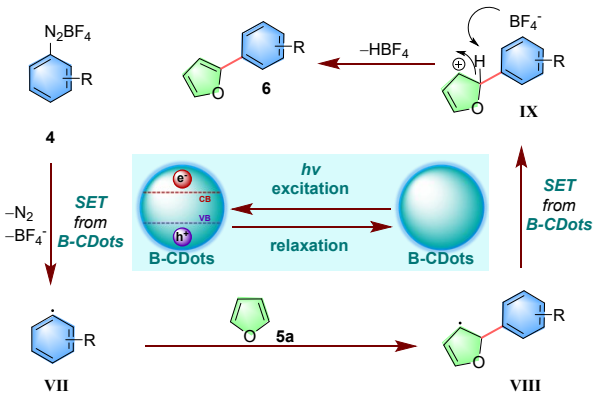


Figure S12 Fluorescence quenching experiments for C–H arylation. (a) Fluorescence quenching of B-CDots by **4b**, and **5a**. (b) Fluorescence emission spectra of B-CDots in different concentrations of aryldiazonium salt **4b** in DMSO. (c) Stern−Volmer plots. Excitation wavelength for fluorescence was set at 370 nm.

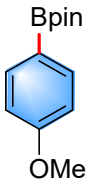
4.4. Proposed mechanism of C–H arylation



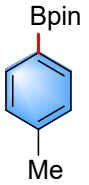
Scheme S5 Proposed mechanism of C–H arylation.

A plausible mechanism was proposed, as depicted in Scheme S5. Under visible-light irradiation, the electron of B-CDots is excited to the conduction band. The B-CDots having high reductive potential could reduce an aryldiazonium salt **4** via a single-electron transfer to furnish the corresponding aryl radical **VII** and release a dinitrogen molecule. The generated aryl radical **VII** reacts with heteroarene **5a** to afford radical intermediate **VIII**, which would be subsequently oxidized by the B-CDots radical cation to form carbocation intermediate. Finally, deprotonation of **IX** would lead to arylation product **6**.

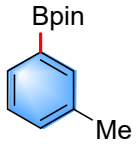
5. Analytical data for compounds



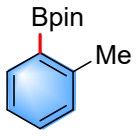
2-(4-Methoxyphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (3a): Colorless liquid. X = Cl, 67%; X = I, 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, J = 8.6 Hz, 2H), 6.90 (d, J = 8.7 Hz, 2H), 3.83 (s, 3H), 1.34 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 162.3, 136.6, 113.4, 83.7, 55.2, 24.9.



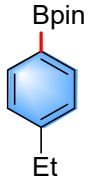
4,4,5,5-Tetramethyl-2-(*p*-tolyl)-1,3,2-dioxaborolane (3b): Colorless liquid. X = Cl, 65%; X = I, 75%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 7.5 Hz, 2H), 7.19 (d, *J* = 7.5 Hz, 2H), 2.37 (s, 3H), 1.35 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 141.5, 134.9, 128.7, 83.8, 24.9, 21.8.



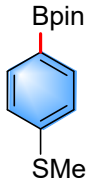
4,4,5,5-Tetramethyl-2-(*m*-tolyl)-1,3,2-dioxaborolane (3c): Colorless liquid. X = I, 67%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (s, 1H), 7.65 – 7.60 (m, 1H), 7.32 – 7.26 (m, 2H), 2.37 (s, 3H), 1.36 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 137.3, 135.5, 132.2, 131.9, 127.8, 83.8, 24.9, 21.4.



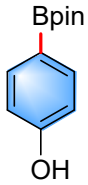
4,4,5,5-Tetramethyl-2-(*o*-tolyl)-1,3,2-dioxaborolane (3d): Colorless liquid. X = I, 61%. ^{1}H NMR (400 MHz, $CDCl_3$) δ (d, *J* = 7.8 Hz, 1H), 7.32 (t, *J* = 7.5 Hz, 1H), 7.16 (t, *J* = 6.3 Hz, 2H), 2.54 (s, 3H), 1.35 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 145.0, 136.0, 130.9, 129.9, 124.8, 83.5, 25.0, 22.4.



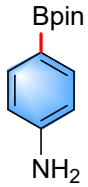
2-(4-Ethylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (3e): Colorless liquid. X = Br, 60%; X = I, 67%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 8.0 Hz, 2H), 7.23 (d, *J* = 8.0 Hz, 2H), 2.67 (q, *J* = 7.6 Hz, 2H), 1.35 (s, 12H), 1.25 (t, *J* = 7.6 Hz, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 147.9, 135.0, 127.5, 83.7, 29.2, 24.9, 15.6.



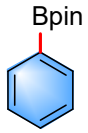
4,4,5,5-Tetramethyl-2-(4-(methylthio)phenyl)-1,3,2-dioxaborolane (3f): White solid. X = Br, 73%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.3 Hz, 2H), 7.22 (d, *J* = 8.3 Hz, 2H), 2.49 (s, 3H), 1.34 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 142.7, 135.2, 125.1, 83.9, 24.9, 15.2.



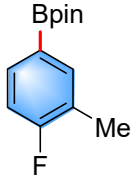
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenol (3g): White solid. X = Cl, 68%; X = Br, 69%; X = I, 74%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.5 Hz, 2H), 6.82 (d, *J* = 8.5 Hz, 2H), 5.45 (s, 1H), 1.33 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 158.5, 136.9, 114.9, 83.8, 24.9.



4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (3h): White solid. X = Cl, 69%; X = Br, 79%; X = I, 75%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.4 Hz, 2H), 6.65 (d, *J* = 8.5 Hz, 2H), 3.84 (s, 2H), 1.32 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 149.4, 136.5, 114.2, 83.4, 24.9.

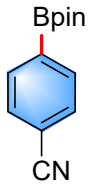


4,4,5,5-Tetramethyl-2-phenyl-1,3,2-dioxaborolane (3i): Colorless liquid. X = I, 66%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, *J* = 7.5 Hz, 2H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.3 Hz, 2H), 1.36 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 134.9, 131.4, 127.8, 83.9, 25.0.

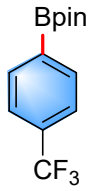


4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)aniline (3j): Colorless liquid. X

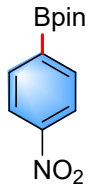
= Br, 54%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 8.4 Hz, 1H), 7.63 – 7.56 (m, 1H), 6.99 (dd, *J* = 10.0, 8.2 Hz, 1H), 2.27 (d, *J* = 1.6 Hz, 3H), 1.34 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 163.8 (d, *J* = 247.0 Hz), 138.5 (d, *J* = 5.6 Hz), 134.4 (d, *J* = 8.3 Hz), 124.4 (d, *J* = 16.3 Hz), 114.7 (d, *J* = 21.3 Hz), 84.0, 24.9, 14.4 (d, *J* = 3.8 Hz).



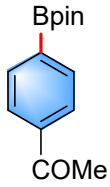
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (3k): White solid. X = Cl, 83%; X = Br, 81%; X = I, 80%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.3 Hz, 1H), 7.63 (d, *J* = 8.3 Hz, 1H), 1.34 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 135.2, 131.3, 119.0, 114.6, 84.6, 24.9.



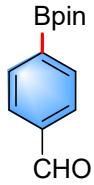
4,4,5,5-Tetramethyl-2-(4-(trifluoromethyl)phenyl)-1,3,2-dioxaborolane (3l): White solid. X = I, 51%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 7.8 Hz, 2H), 7.62 (d, *J* = 7.9 Hz, 2H), 1.36 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 135.2, 132.9 (q, *J* = 32.1 Hz), 124.5 (q, *J* = 3.8 Hz), 124.3 (q, *J* = 272.4 Hz), 84.4, 24.9.



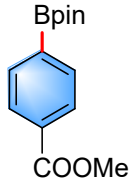
4,4,5,5-Tetramethyl-2-(4-nitrophenyl)-1,3,2-dioxaborolane (3m): White solid. X = I, 71%, X = Br, 69%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (d, *J* = 8.7 Hz, 2H), 7.95 (d, *J* = 8.7 Hz, 2H), 1.35 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 149.9, 135.8, 122.5, 84.7, 24.9.



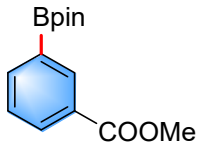
1-(4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)phenyl)ethan-1-one (3n): White solid. X = Cl, 81%; X = Br, 79%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.3 Hz, 2H), 7.88 (d, *J* = 8.3 Hz, 2H), 2.60 (s, 3H), 1.34 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 198.6, 139.1, 135.0, 127.4, 84.3, 26.8, 24.9.



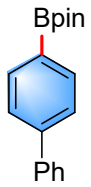
4-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzaldehyde (3o): White solid. X = Br, 66%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.05 (s, 1H), 7.96 (d, *J* = 8.0 Hz, 2H), 7.86 (d, *J* = 8.1 Hz, 2H), 1.36 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 192.8, 138.2, 135.4, 128.8, 84.5, 24.9.



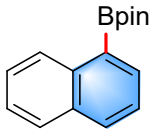
Methyl 4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzoate (3p): White solid. X = Br, 76%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (d, *J* = 8.3 Hz, 2H), 7.86 (d, *J* = 8.3 Hz, 2H), 3.91 (s, 3H), 1.34 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 167.2, 134.8, 132.4, 128.7, 84.3, 52.3, 24.9.



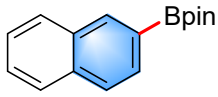
Methyl 3-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzoate (3q): White solid. X = Br, 70%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46 (s, 1H), 8.11 (d, *J* = 7.8 Hz, 1H), 7.97 (d, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.6 Hz, 1H), 3.90 (s, 3H), 1.34 (s, 12H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 167.2, 139.3, 135.9, 132.4, 129.7, 127.9, 84.2, 52.1, 24.9.



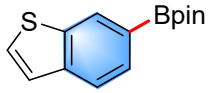
2-([1,1'-Biphenyl]-4-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (3r): White solid. X = I, 68%; X = Br, 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.2 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 4H), 7.48 (t, *J* = 7.5 Hz, 2H), 7.39 (t, *J* = 7.3 Hz, 1H), 1.41 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 144.0, 141.1, 135.4, 128.9, 127.7, 127.3, 126.6, 83.9, 25.0.



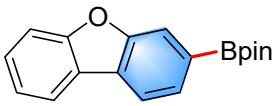
4,4,5,5-Tetramethyl-2-(naphthalen-1-yl)-1,3,2-dioxaborolane (3s): White solid. X = Br, 70%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.82 (d, *J* = 8.4 Hz, 1H), 8.13 (d, *J* = 6.8 Hz, 1H), 7.97 (d, *J* = 8.2 Hz, 1H), 7.87 (d, *J* = 7.5 Hz, 1H), 7.58 (t, *J* = 6.9 Hz, 1H), 7.51 (t, *J* = 6.9 Hz, 2H), 1.46 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 137.1, 135.8, 133.3, 131.7, 128.6, 128.5, 126.5, 125.6, 125.1, 83.8, 25.1.



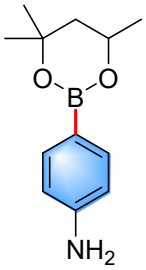
4,4,5,5-Tetramethyl-2-(naphthalen-1-yl)-1,3,2-dioxaborolane (3t): White solid. X = I, 77%; X = Br, 73%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (s, 1H), 7.91 (d, *J* = 7.7 Hz, 1H), 7.89 – 7.80 (m, 3H), 7.57 – 7.45 (m, 2H), 1.41 (s, 13H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 136.4, 135.2, 133.0, 130.5, 128.8, 127.8, 127.1, 127.0, 126.0, 84.0, 25.1.



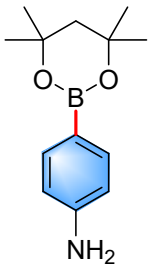
2-(Benzo[*b*]thiophen-6-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (3u): White solid. X = Br, 50%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.39 (d, *J* = 0.6 Hz, 1H), 7.83 (d, *J* = 8.0 Hz, 1H), 7.78 (d, *J* = 8.0 Hz, 1H), 7.52 (d, *J* = 5.4 Hz, 1H), 7.35 (d, *J* = 5.4 Hz, 1H), 1.38 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 141.9, 139.5, 129.9, 129.7, 128.3, 124.0, 123.1, 84.0, 25.0.



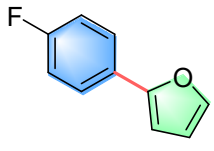
2-(Dibenzo[*b*,*d*]furan-3-yl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (3v): White solid. X = Br, 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.48 (s, 1H), 7.99 (d, *J* = 7.6 Hz, 1H), 7.96 (d, *J* = 8.3 Hz, 1H), 7.59 (d, *J* = 8.3 Hz, 2H), 7.46 (t, *J* = 8.4 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 1.41 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 158.5, 156.3, 133.9, 127.9, 127.3, 124.2, 124.1, 123.0, 120.9, 111.8, 111.3, 84.0, 25.0.



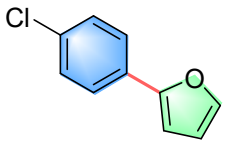
4-(4,4,6-Trimethyl-1,3,2-dioxaborinan-2-yl)aniline (3w): Colorless liquid. X = I, 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.4 Hz, 2H), 6.65 (d, *J* = 8.4 Hz, 2H), 4.36 – 4.26 (m, 1H), 3.75 (s, 2H), 1.83 (dd, *J* = 13.8, 3.0 Hz, 1H), 1.56 (dd, *J* = 13.8, 11.6 Hz, 1H), 1.36 (s, 3H), 1.35 (s, 3H), 1.33 (d, *J* = 6.2 Hz, 3H).^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 148.6, 135.4, 114.2, 70.7, 64.8, 46.2, 31.5, 28.3, 23.4.



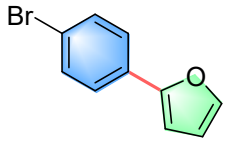
4-(4,4,6,6-Tetramethyl-1,3,2-dioxaborinan-2-yl)aniline (3x): Colorless liquid. X = I, 54%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.3 Hz, 2H), 6.66 (d, *J* = 8.4 Hz, 2H), 3.75 (s, 2H), 1.89 (s, 2H), 1.41 (s, 12H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 148.6, 135.5, 114.2, 70.6, 49.1, 31.9. HRMS (ESI) m/z calcd for $C_{13}H_{21}BNO_2$ [M + H]$^{+}$: 234.1660, found: 234.1664.



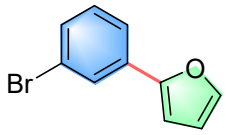
2-(4-Fluorophenyl)furan (6a): White solid, 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.61 (m, 2H), 7.46 (d, *J* = 1.2 Hz, 1H), 7.14 – 7.03 (m, 2H), 6.59 (d, *J* = 3.3 Hz, 1H), 6.47 (dd, *J* = 3.3, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 162.3 (d, *J* = 246.8 Hz), 153.3, 142.2, 127.4, 125.7 (d, *J* = 8.0 Hz), 115.8 (d, *J* = 21.9 Hz), 111.8, 104.8 (d, *J* = 1.3 Hz).



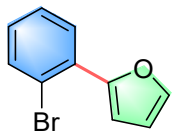
2-(4-Chlorophenyl)furan (6b): White solid, 70%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.6 Hz, 2H), 7.48 (d, *J* = 1.7 Hz, 1H), 7.36 (d, *J* = 8.6 Hz, 2H), 6.65 (d, *J* = 3.4 Hz, 1H), 6.48 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 153.1, 142.4, 133.2, 129.5, 129.0, 125.1, 111.9, 105.6.



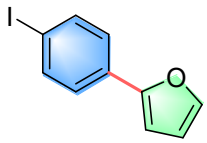
2-(4-Bromophenyl)furan (6c): White solid, 72%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.8 Hz, 2H), 7.50 (d, *J* = 8.8 Hz, 2H), 7.48 (d, *J* = 1.7 Hz, 1H), 6.66 (d, *J* = 3.4 Hz, 1H), 6.48 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 153.1, 142.5, 131.9, 129.9, 125.4, 121.2, 111.9, 105.7.



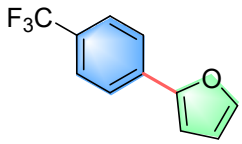
2-(3- Bromophenyl)furan (6d): Yellow liquid, 54%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (t, *J* = 1.7 Hz, 1H), 7.59 (dd, *J* = 7.8, 1.1 Hz, 1H), 7.48 (d, *J* = 1.6 Hz, 1H), 7.38 (ddd, *J* = 8.0, 1.8, 0.9 Hz, 1H), 7.24 (t, *J* = 7.9 Hz, 1H), 6.67 (d, *J* = 3.4 Hz, 1H), 6.48 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 152.5, 142.7, 132.9, 130.3, 130.2, 126.8, 123.0, 122.4, 111.9, 106.2.



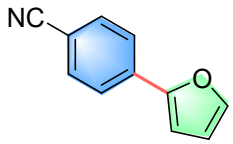
2-(2- Bromophenyl)furan (6e): Yellow liquid, 58%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.68 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.55 (d, *J* = 1.4 Hz, 1H), 7.38 (t, *J* = 8.2 Hz, 1H), 7.22 (d, *J* = 3.4 Hz, 1H), 7.14 (td, *J* = 7.9, 1.7 Hz, 1H), 6.56 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 151.4, 142.3, 134.2, 131.3, 128.9, 128.5, 127.4, 119.7, 111.5, 110.7.



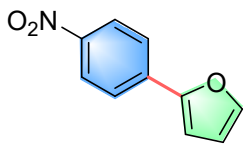
2-(4-Iodophenyl)furan (6f): White solid, 67%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.5 Hz, 2H), 7.47 (d, *J* = 1.7 Hz, 1H), 7.41 (d, *J* = 8.5 Hz, 2H), 6.66 (d, *J* = 3.4 Hz, 1H), 6.48 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 153.1, 142.6, 137.9, 130.4, 125.6, 111.9, 105.8, 92.6.



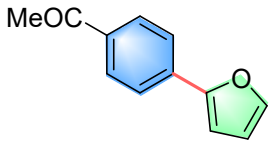
2-(4-(Trifluoromethyl)phenyl)furan (6g): White solid, 54%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.2 Hz, 2H), 7.63 (d, *J* = 8.3 Hz, 2H), 7.52 (d, *J* = 1.4 Hz, 1H), 6.77 (d, *J* = 3.4 Hz, 1H), 6.52 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 152.7, 143.2, 134.1, 129.1 (q, *J* = 32.4 Hz), 125.8 (q, *J* = 3.9 Hz), 124.3 (q, *J* = 271.8 Hz), 123.9, 112.1, 107.1.



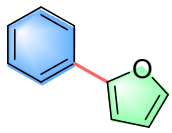
4-(Furan-2-yl)benzonitrile (6h): White solid, 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.5 Hz, 2H), 7.63 (d, *J* = 8.6 Hz, 2H), 7.53 (d, *J* = 1.3 Hz, 1H), 6.80 (d, *J* = 3.4 Hz, 1H), 6.52 (dd, *J* = 3.4, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ151.9, 143.6, 134.6, 132.5, 123.9, 118.9, 112.2, 110.2, 108.1.



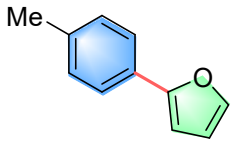
2-(4-Nitrophenyl)furan (6i): White solid, 71%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 – 8.20 (m, 2H), 7.82 – 7.75 (m, 2H), 7.57 (d, *J* = 1.3 Hz, 1H), 6.87 (d, *J* = 3.5 Hz, 1H), 6.55 (dd, *J* = 3.5, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 151.8, 146.5, 144.3, 136.6, 124.4, 124.1, 112.5, 109.1.



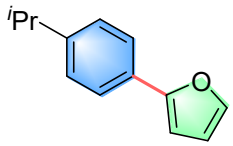
1-(4-(Furan-2-yl)phenyl)ethan-1-one (6j): White solid, 61%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.7 Hz, 2H), 7.72 (d, *J* = 8.6 Hz, 2H), 7.51 (d, *J* = 1.7 Hz, 1H), 6.78 (d, *J* = 3.4 Hz, 1H), 6.50 (dd, *J* = 3.4, 1.8 Hz, 1H), 2.59 (s, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 197.5, 152.9, 143.4, 135.6, 134.9, 129.0, 123.6, 112.2, 107.6, 26.6.



2-Phenylfuran (6k): Colorless liquid, 55%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.2 Hz, 2H), 7.49 (d, *J* = 1.8 Hz, 1H), 7.40 (t, *J* = 7.7 Hz, 2H), 7.28 (t, *J* = 7.4 Hz, 1H), 6.67 (d, *J* = 3.3 Hz, 1H), 6.49 (dd, *J* = 3.3, 1.8 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 154.1, 142.2, 131.0, 128.8, 127.5, 123.9, 111.8, 105.1.

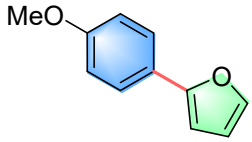


2-(*p*-Tolyl)furan (6l): Colorless liquid, 41%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 (d, *J* = 8.2 Hz, 2H), 7.47 (d, *J* = 1.7 Hz, 1H), 7.22 (d, *J* = 8.1 Hz, 2H), 6.62 (d, *J* = 3.3 Hz, 1H), 6.48 (dd, *J* = 3.3, 1.8 Hz, 1H), 2.39 (s, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 154.3, 141.8, 137.3, 129.5, 128.4, 123.9, 111.7, 104.3, 21.4.

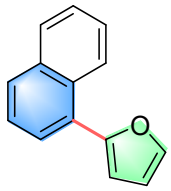


2-(4-Isopropylphenyl)furan (6m): White solid, 45%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.3 Hz, 1H), 7.45 (d, *J* = 1.8 Hz, 1H), 7.25 (d, *J* = 8.2 Hz, 1H),

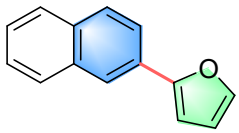
6.60 (d, *J* = 3.3 Hz, 1H), 6.46 (dd, *J* = 3.3, 1.8 Hz, 1H), 3.01 – 2.86 (m, 1H), 1.27 (d, *J* = 6.9 Hz, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 154.2, 148.2, 141.7, 128.6, 126.7, 123.8, 111.5, 104.3, 33.9, 23.9.



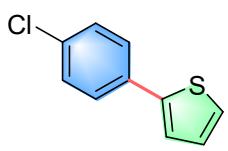
2-(4-Methoxyphenyl)furan (6n): White solid, 35%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.9 Hz, 2H), 7.44 (d, *J* = 1.8 Hz, 1H), 6.94 (d, *J* = 8.9 Hz, 2H), 6.53 (d, *J* = 3.3 Hz, 1H), 6.46 (dd, *J* = 3.3, 1.8 Hz, 1H), 3.84 (s, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 159.2, 154.1, 141.5, 125.4, 124.2, 114.2, 111.7, 103.5, 55.4.



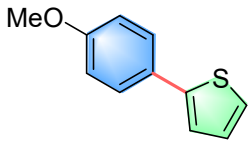
2-(Naphthalen-1-yl)furan (6o): White solid, 54%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.43 (d, *J* = 9.2 Hz, 1H), 7.91 (d, *J* = 7.3 Hz, 1H), 7.86 (d, *J* = 8.2 Hz, 1H), 7.75 (d, *J* = 7.2 Hz, 1H), 7.65 (d, *J* = 1.7 Hz, 1H), 7.58 – 7.50 (m, 3H), 6.75 (d, *J* = 3.3 Hz, 1H), 6.61 (dd, *J* = 3.3, 1.8 Hz, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 153.6, 142.5, 134.1, 130.5, 128.8, 128.7, 128.6, 126.7, 126.3, 126.0, 125.7, 125.5, 111.5, 109.4.



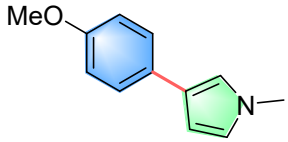
2-(Naphthalen-2-yl)furan (6p): White solid, 56%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (s, 1H), 7.90 – 7.76 (m, 4H), 7.54 (d, *J* = 1.7 Hz, 1H), 7.52 – 7.43 (m, 2H), 6.78 (d, *J* = 3.4 Hz, 1H), 6.53 (dd, *J* = 3.3, 1.8 Hz, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 154.2, 142.5, 133.7, 132.8, 128.5, 128.3, 128.2, 127.9, 126.6, 126.0, 122.5, 122.3, 112.0, 105.7.



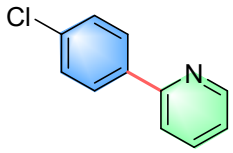
2-(4-Chlorophenyl)thiophene (6q): White solid, 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.5 Hz, 2H), 7.35 (d, *J* = 8.5 Hz, 3H), 7.32 – 7.28 (m, 2H), 7.09 (t, *J* = 4.3 Hz, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 143.2, 133.3, 133.0, 129.1, 128.3, 127.2, 125.3, 123.6.



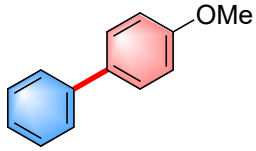
2-(4-Methoxyphenyl)thiophene (6r): White solid, 50%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 8.9 Hz, 2H), 7.24 – 7.19 (m, 2H), 7.06 (dd, *J* = 5.1, 3.6 Hz, 1H), 6.93 (d, *J* = 8.9 Hz, 2H), 3.84 (s, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 159.3, 144.5, 128.1, 127.4, 127.3, 123.9, 122.2, 114.4, 55.5.



3-(4-Methoxyphenyl)-1-methyl-1*H*-pyrrole (6s): White solid, 53%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 9.0 Hz, 2H), 6.98 (d, *J* = 9.0 Hz, 2H), 6.89 (s, 1H), 6.67 (d, *J* = 4.1 Hz, 1H), 6.29 (d, *J* = 4.1 Hz, 1H), 3.95 (s, 3H), 3.87 (s, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 160.9, 147.9, 146.5, 126.0, 123.7, 114.2, 109.9, 98.9, 55.6, 33.4.

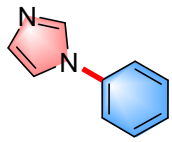


2-(4-Chlorophenyl)pyridine (6t): White solid, 25%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.61 (d, *J* = 4.8 Hz, 1H), 7.86 (d, *J* = 8.7 Hz, 2H), 7.72 – 7.65 (m, 1H), 7.62 (d, *J* = 8.0 Hz, 1H), 7.36 (d, *J* = 8.7 Hz, 2H), 7.18 – 7.14 (m, 1H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 156.4, 149.9, 134.0, 137.0, 135.3, 129.1, 128.3, 122.5, 120.5.

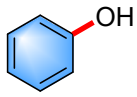


2-(4-Chlorophenyl)pyridine (7): White solid, 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (t, *J* = 8.9 Hz, 4H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.35 (t, *J* = 7.3 Hz, 1H), 7.02 (d, *J*

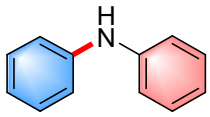
= 8.6 Hz, 2H), 3.88 (s, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 159.2, 140.9, 133.8, 128.8, 128.3, 126.9, 126.8, 114.3, 55.4.



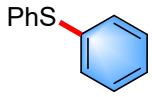
1-Phenyl-1*H*-imidazole (8): Colorless liquid, 73%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (s, 1H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.41 – 7.30 (m, 3H), 7.26 (s, 1H), 7.18 (s, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 137.4, 135.6, 130.4, 129.9, 127.5, 121.5, 118.3.



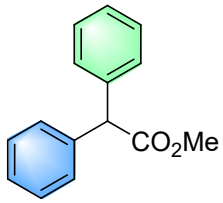
Phenol (9): Colorless liquid, 83%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (t, *J* = 7.8 Hz, 2H), 6.96 (t, *J* = 7.4 Hz, 1H), 6.87 (d, *J* = 7.9 Hz, 2H), 6.17 (s, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 155.5, 129.8, 120.9, 115.5.



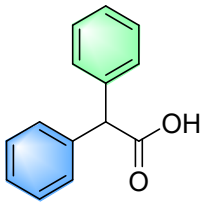
Diphenylamine (10): White solid, 71%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (t, *J* = 7.9 Hz, 4H), 7.18 (d, *J* = 7.8 Hz, 4H), 7.07 (t, *J* = 7.3 Hz, 2H), 5.75 (s, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 143.1, 129.4, 121.0, 117.8.



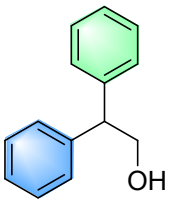
Diphenylsulfane (11): Colorless liquid, 86%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 7.4 Hz, 4H), 7.35 (t, *J* = 7.5 Hz, 4H), 7.29 (t, *J* = 6.8 Hz, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 135.8, 131.1, 129.3, 127.1.



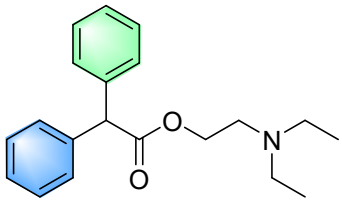
Methyl 2,2-diphenylacetate (13): White solid, 56%. ^{1}H NMR (400 MHz, $CDCl_3$) 7.39 – 7.33 (m, 8H), 7.33 – 7.26 (m, 2H), 5.08 (s, 1H), 3.77 (s, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 173.1, 138.7, 128.7, 128.6, 127.4, 57.1, 52.4.



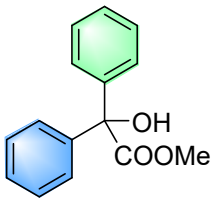
2,2-Diphenylacetic acid (14): White solid, 91%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.15 (s, 1H), 7.40 – 7.33 (m, 8H), 7.32 – 7.27 (m, 2H), 5.08 (s, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 179.0, 138.0, 128.8, 127.6, 57.1.



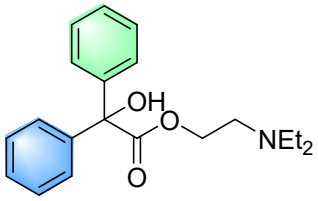
2,2-Diphenylethan-1-ol (15): White solid, 89%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.31 (m, 4H), 7.31 – 7.22 (m, 6H), 4.27 – 4.21 (m, 1H), 4.21 – 4.16 (m, 2H), 1.63 (s, 1H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 141.5, 128.8, 128.4, 126.9, 66.2, 53.7.



2-(Diethylamino)ethyl 2,2-diphenylacetate (17): Transparent oil, 77%. ^{1}H NMR (400 MHz, $CDCl_3$) δ7.37 – 7.30 (m, 8H), 7.30 – 7.24 (m, 2H), 5.06 (s, 1H), 4.25 (t, J = 6.2 Hz, 2H), 2.70 (t, J = 6.2 Hz, 2H), 2.53 (q, J = 7.1 Hz, 4H), 0.99 (t, J = 7.1 Hz, 6H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 172.6, 138.8, 128.7, 128.6, 127.3, 63.6, 57.2, 51.1, 47.6, 11.9.

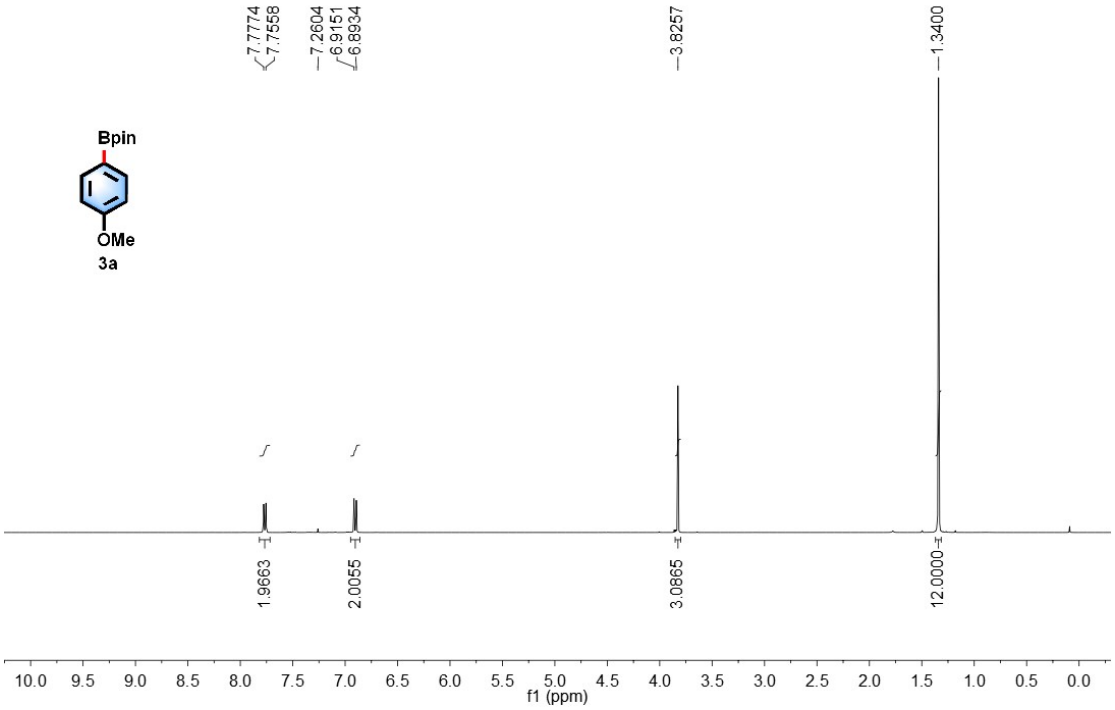


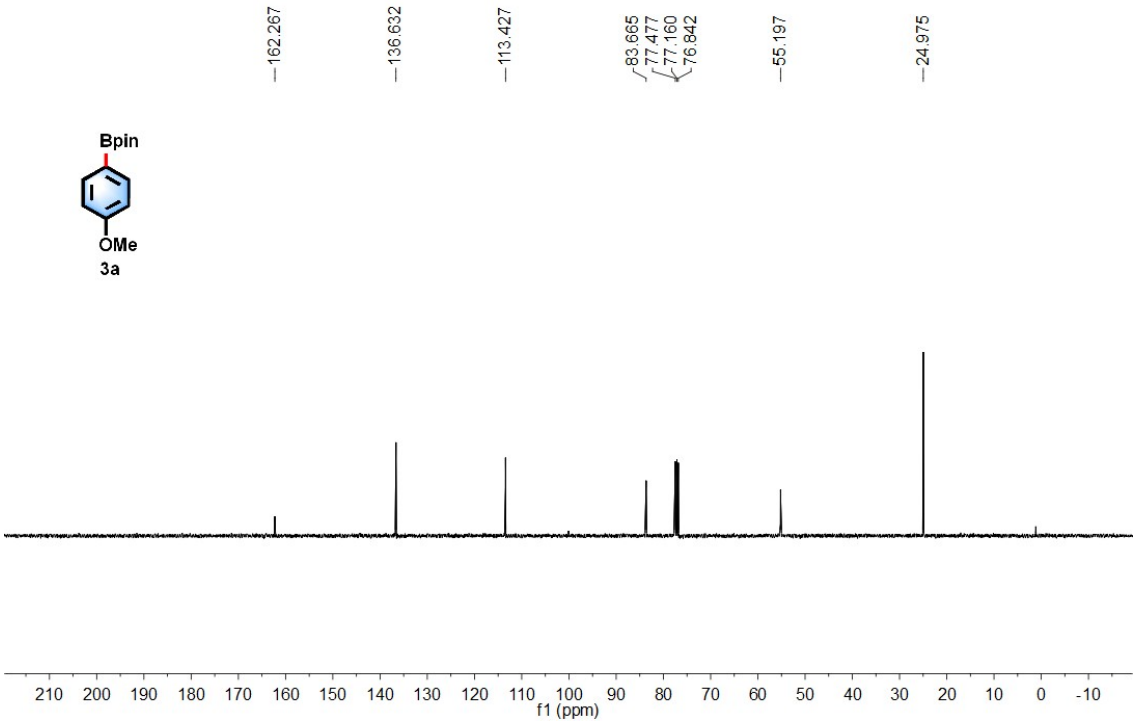
Methyl 2-hydroxy-2,2-diphenylacetate (18): White solid, 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.40 (m, 4H), 7.40 – 7.30 (m, 6H), 4.25 (s, 1H), 3.87 (s, 3H) $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$) δ 175.1, 141.9, 128.3, 128.2, 127.5, 81.2, 53.7.

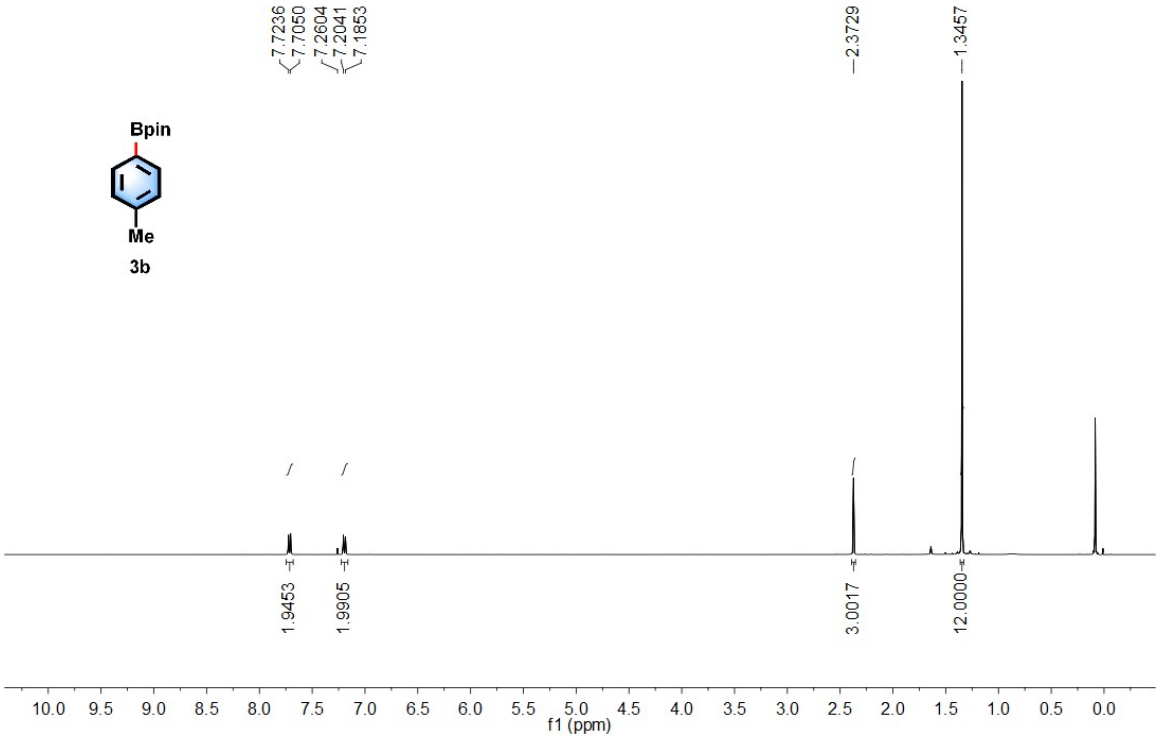


2-(Diethylamino)ethyl 2-hydroxy-2,2-diphenylacetate (19): Transparent oil, 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.39 (m, 4H), 7.38 – 7.27 (m, 6H), 4.42 (s, 1H), 4.33 (t, J = 5.9 Hz, 2H), 2.68 (t, J = 5.9 Hz, 2H), 2.47 (q, J = 7.1 Hz, 4H), 0.95 (t, J = 7.1 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$) δ 174.5, 142.2, 128.1, 128.0, 127.5, 81.2, 65.1, 51.0, 47.3, 11.9.

6. Copies of NMR spectra



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Me
3b
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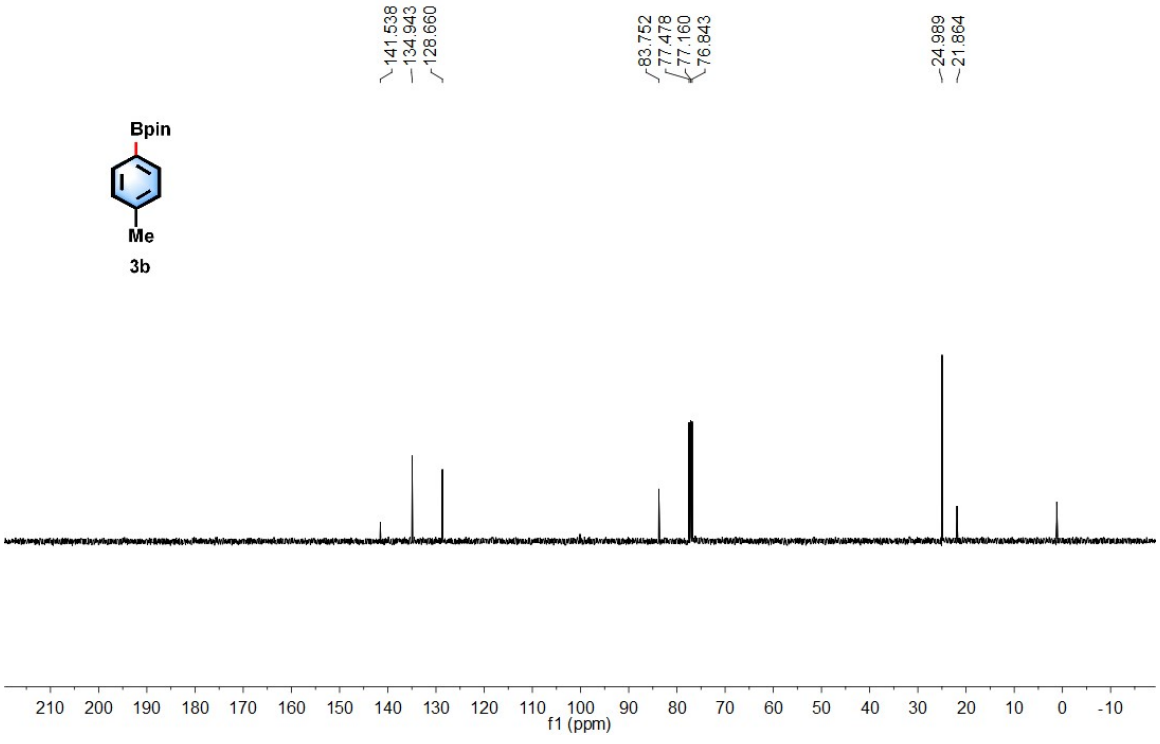
3.0017
12.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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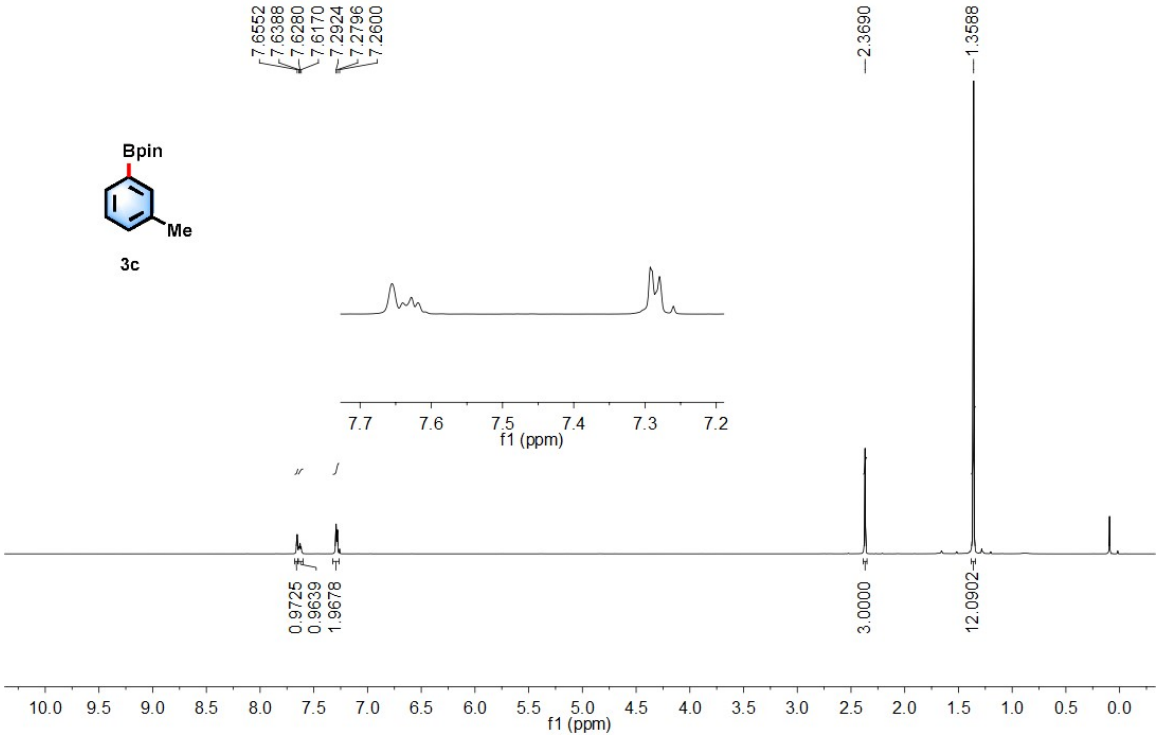
f1 (ppm)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7.6
7.5
7.4
7.3
7.2
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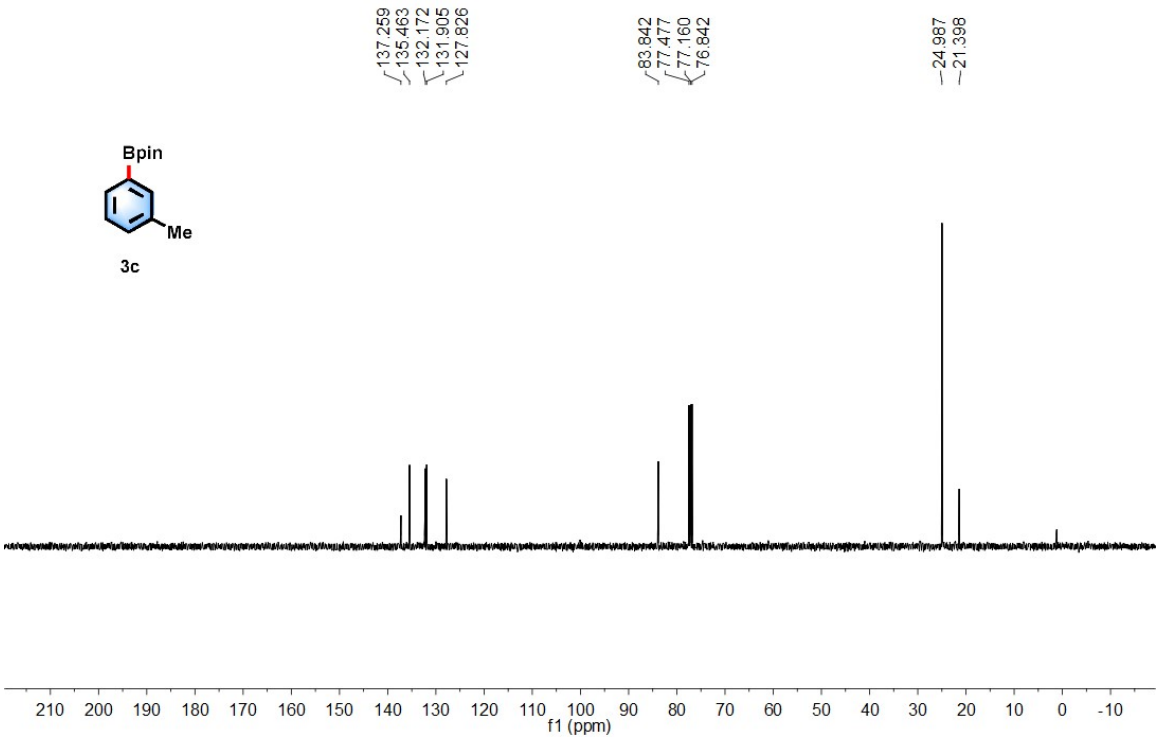
3.0000
12.0902
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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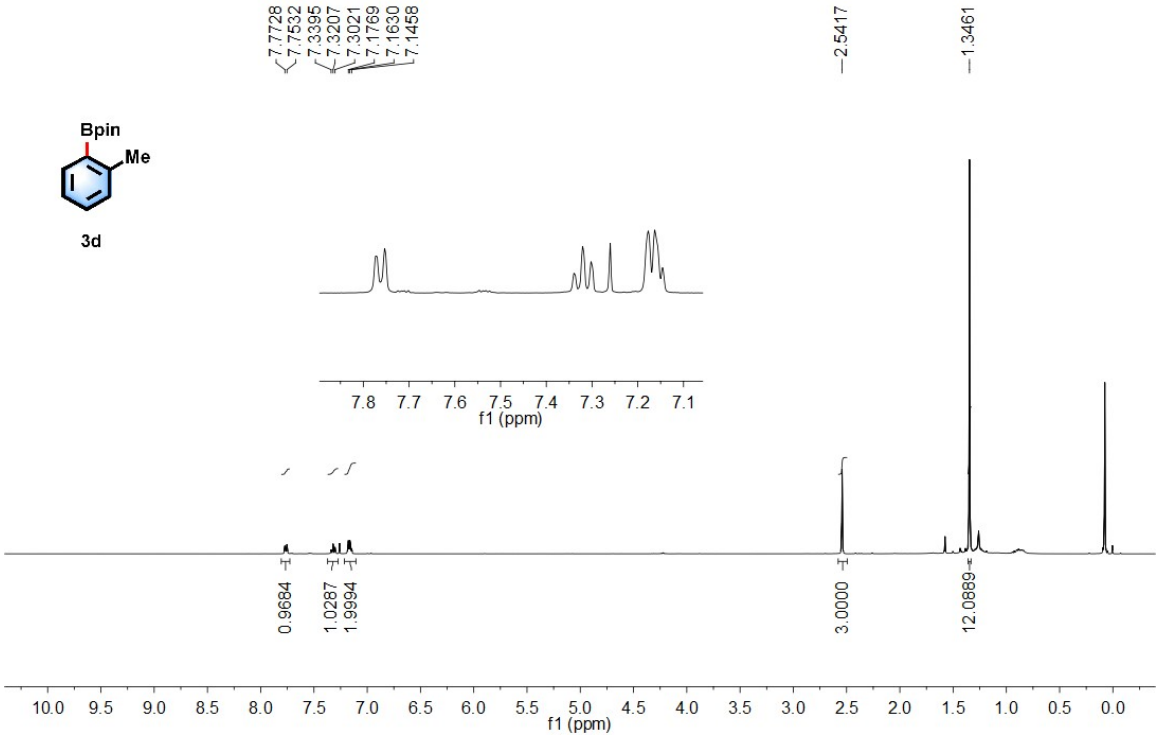
f1 (ppm)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f1 (ppm)
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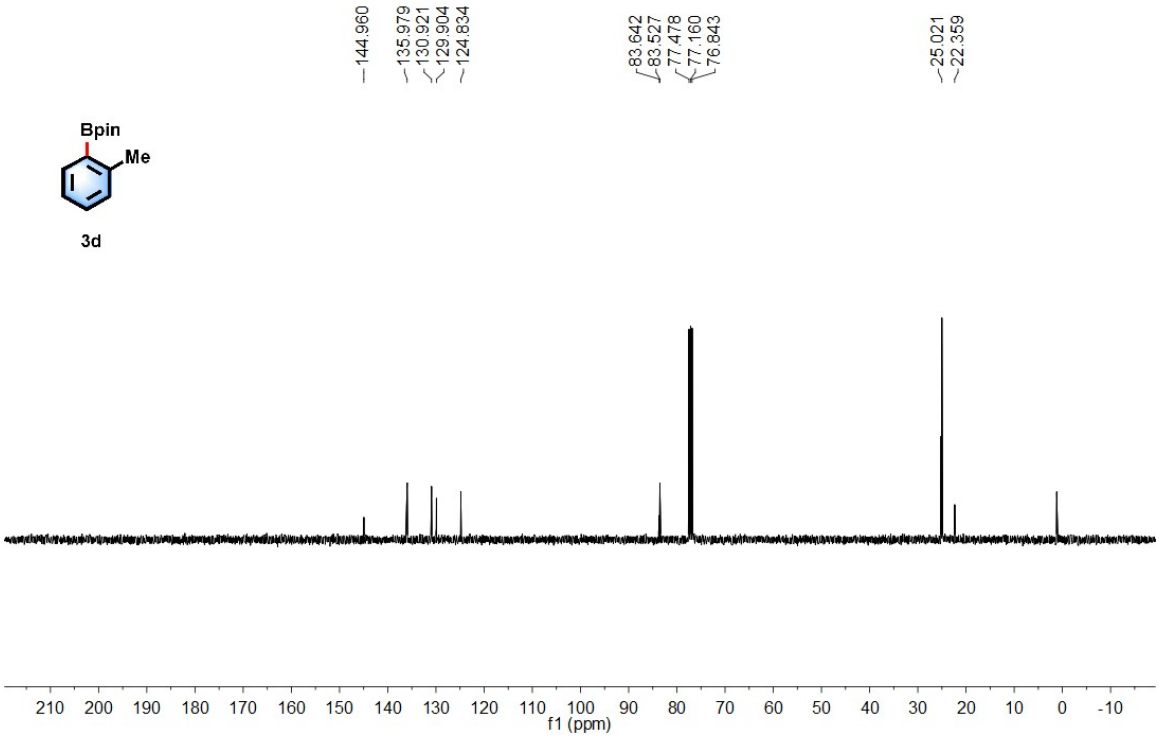
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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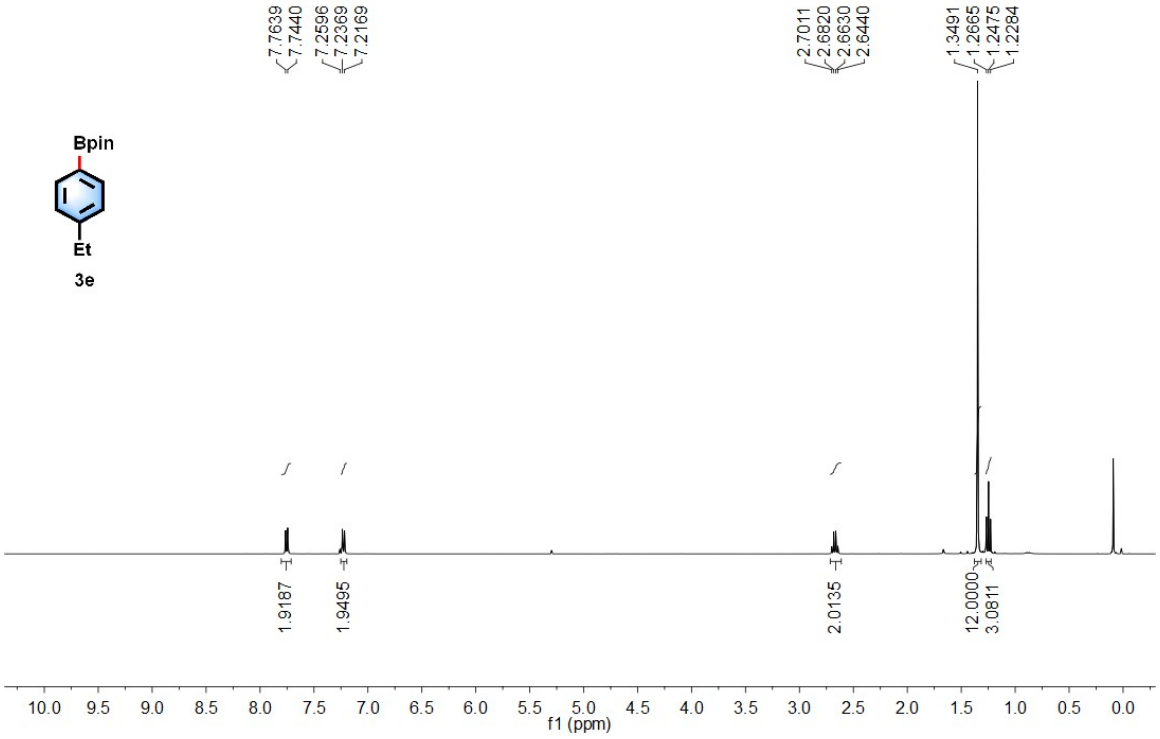
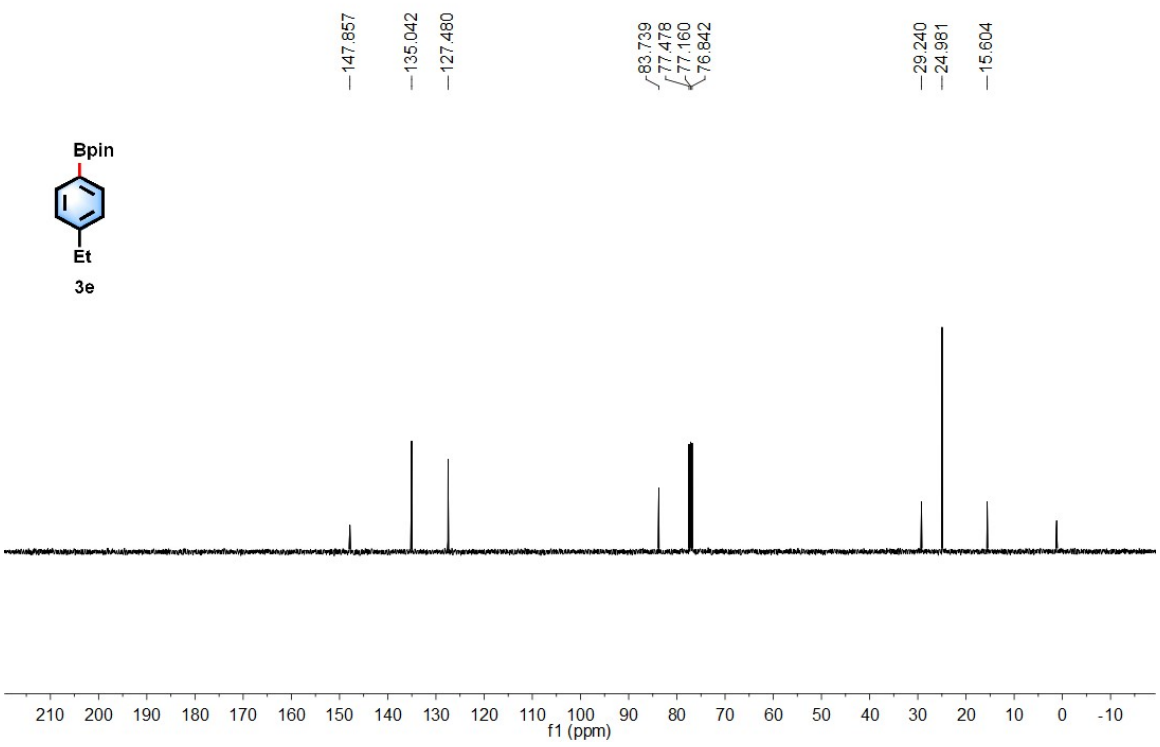
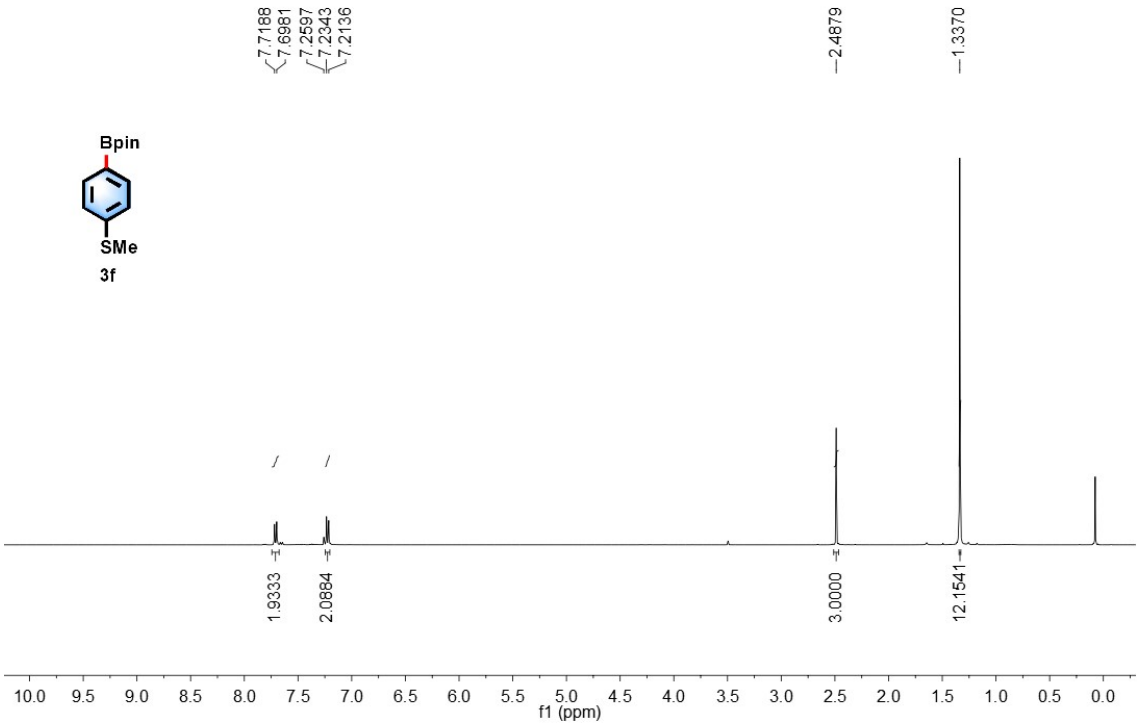
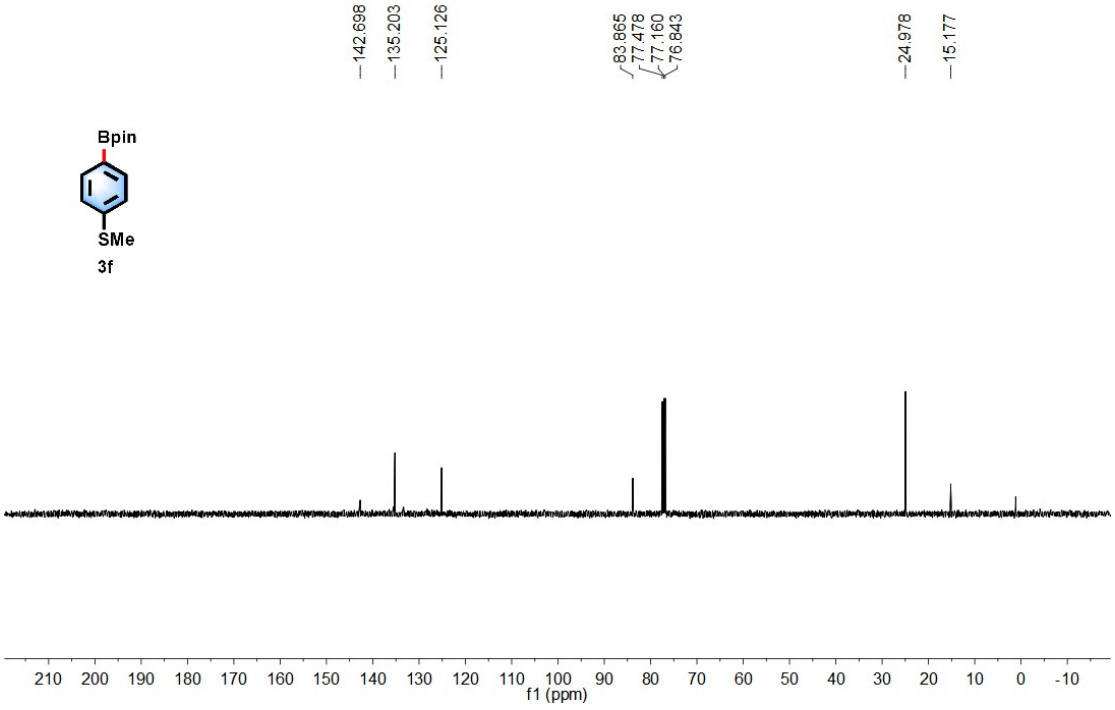
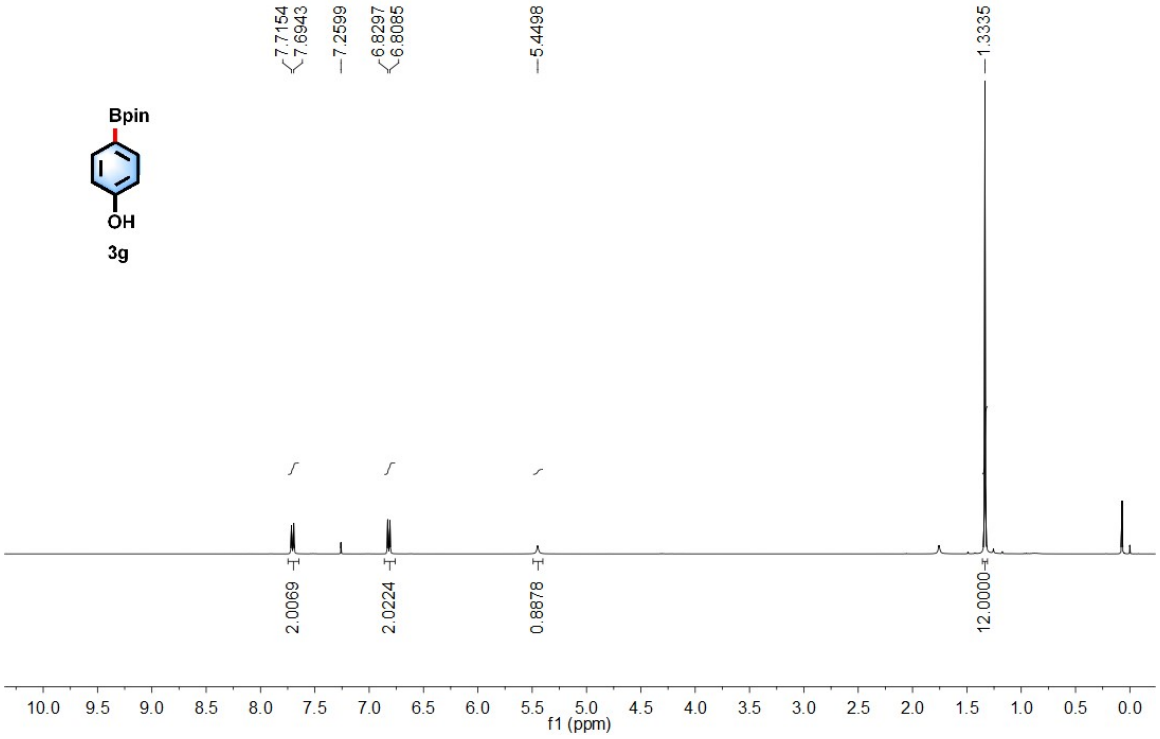
Bpin
Me
3d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

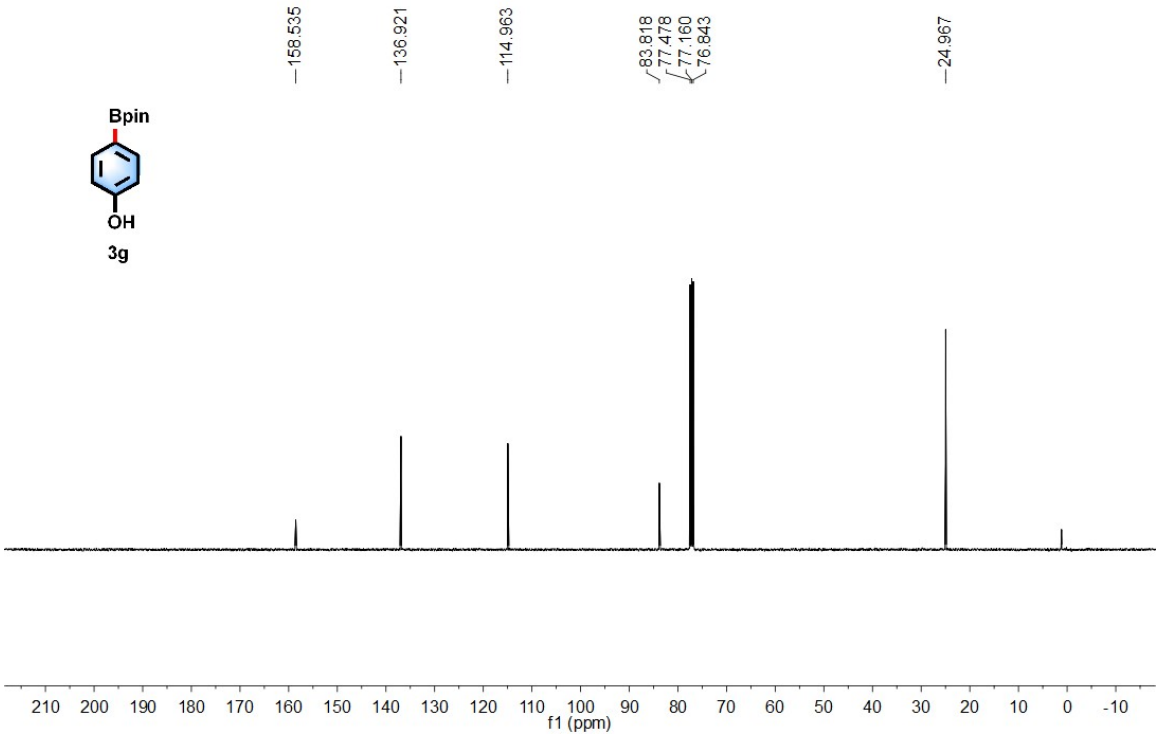

7.7639
7.7440
7.2596
7.2369
7.2169
2.7011
2.6820
2.6630
2.6440
1.3491
1.2665
1.2475
1.2284
Bpin
Et
3e
1.9187
1.9495
2.0135
12.0000
3.0811
f1 (ppm)

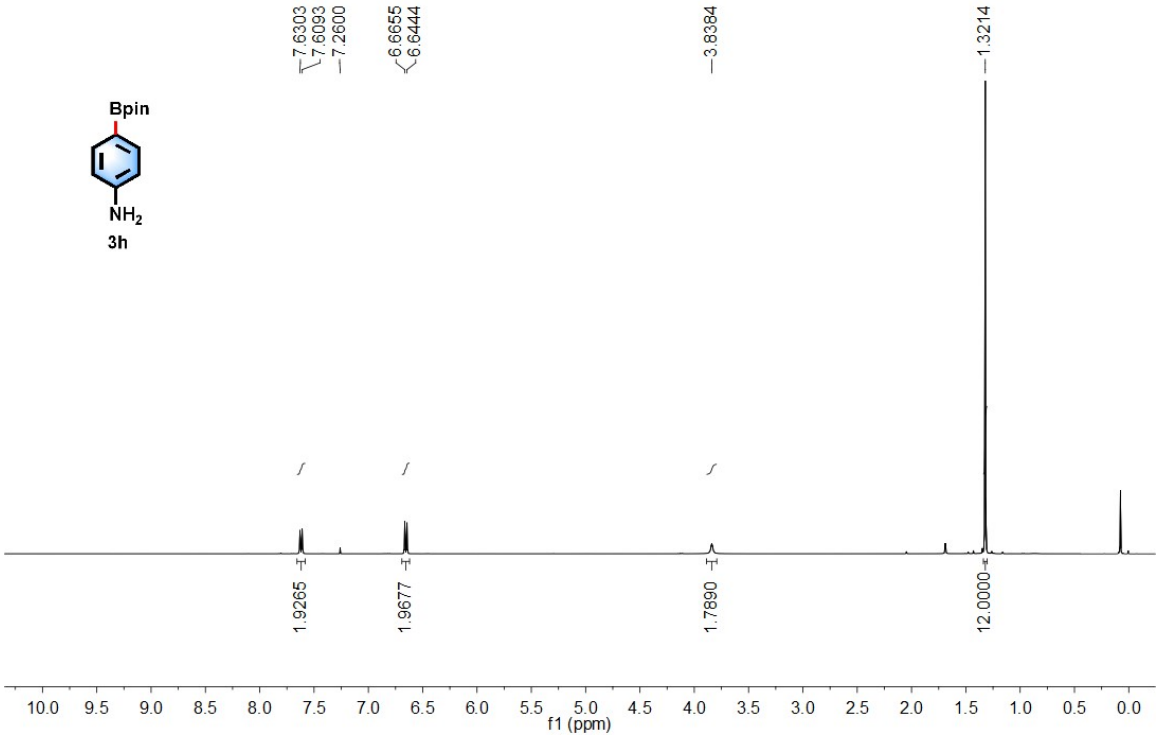

147.857
135.042
127.480
83.739
77.478
77.160
76.842
29.240
24.981
15.604
Bpin
Et
3e
f1 (ppm)

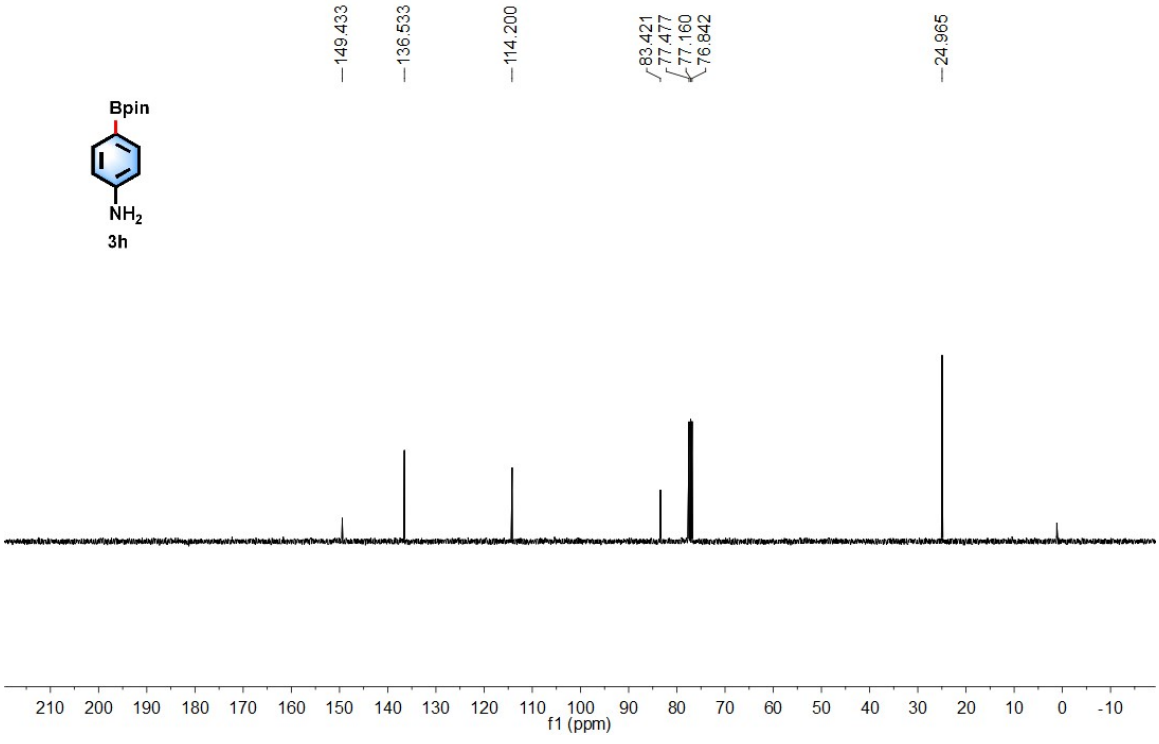

7.7188
7.6981
7.2597
7.2343
7.2136
2.4879
1.3370
Bpin
SMe
3f
1.9333
2.0884
3.0000
12.1541
f1 (ppm)

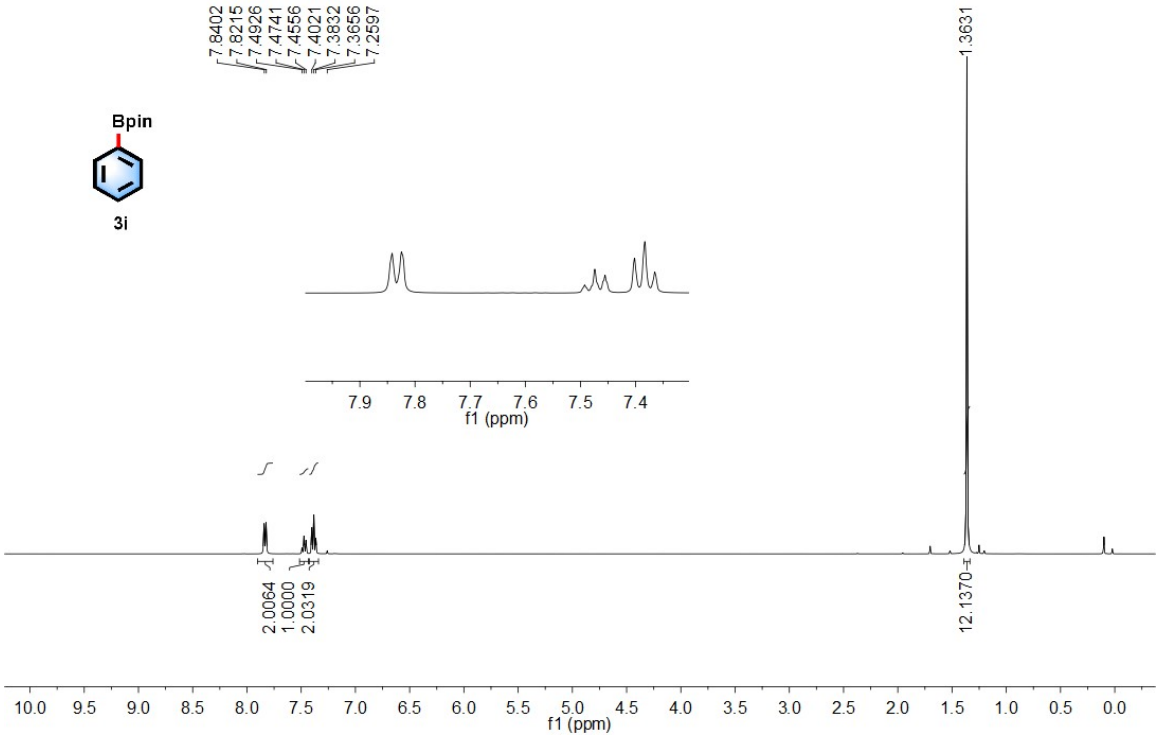

142.698
135.203
125.126
83.865
77.478
77.160
76.843
24.978
15.177
Bpin
SMe
3f
f1 (ppm)

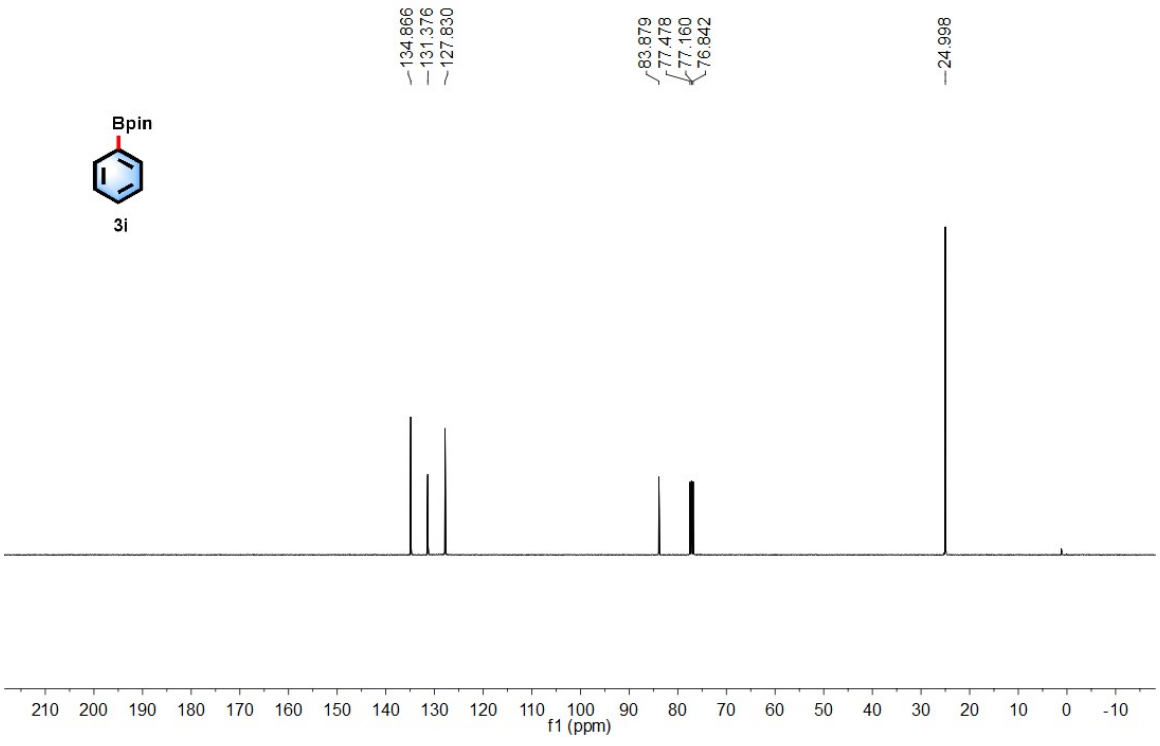

7.7154
7.6943
7.2599
6.8297
6.8085
5.4498
1.3335
Bpin
OH
3g
2.0069
2.0224
0.8878
12.0000
f1 (ppm)

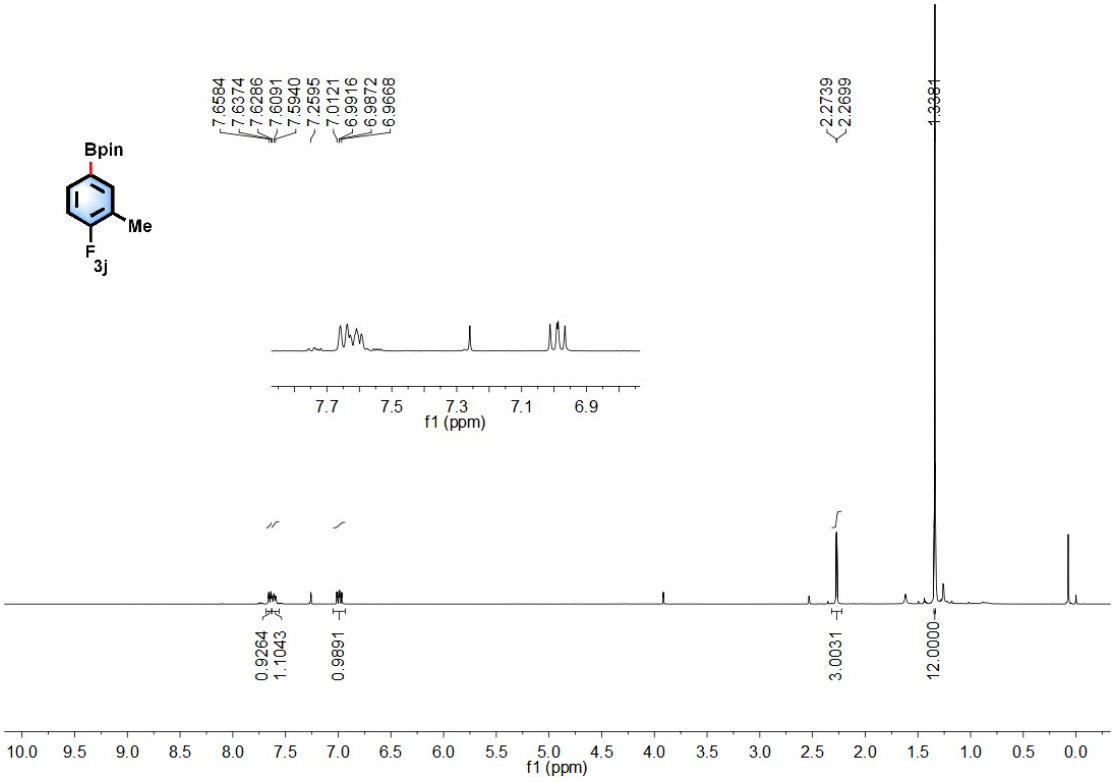

158.535
136.921
114.963
83.818
77.478
77.160
76.843
24.967
Bpin
OH
3g
f1 (ppm)

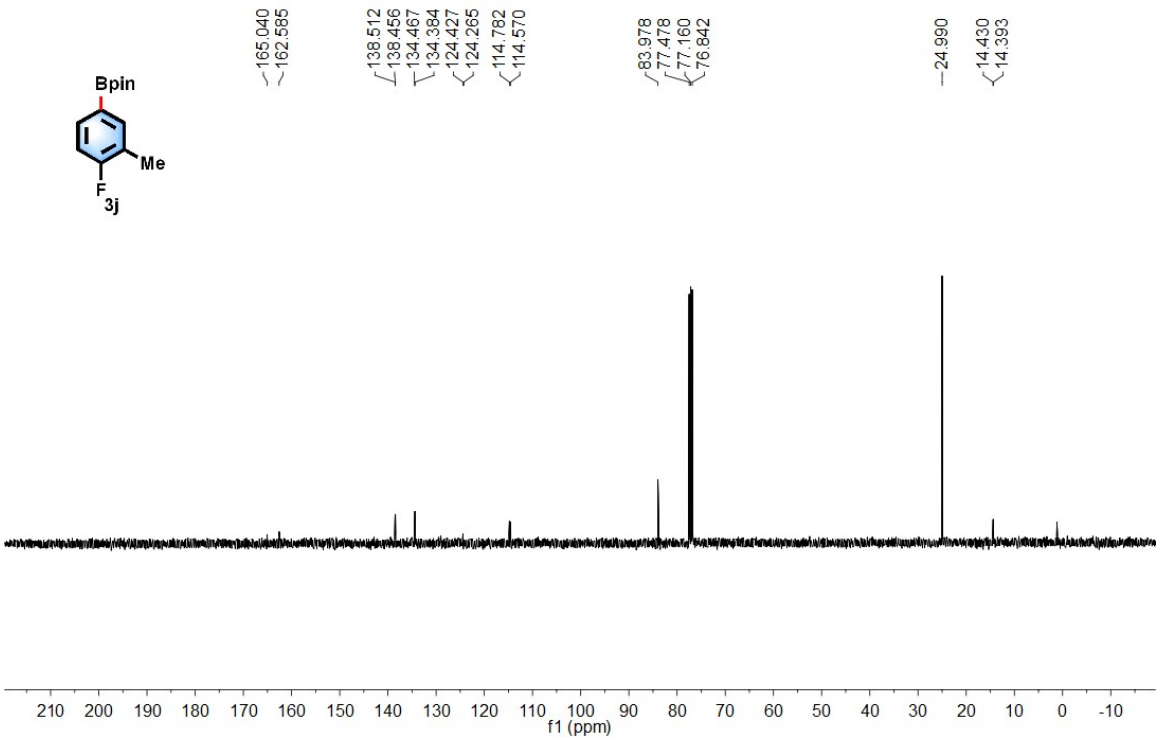

7.6303
7.6093
7.2600
6.6655
6.6444
3.8384
1.3214
Bpin
NH2
3h
1.9265
1.9677
1.7890
12.0000
f1 (ppm)

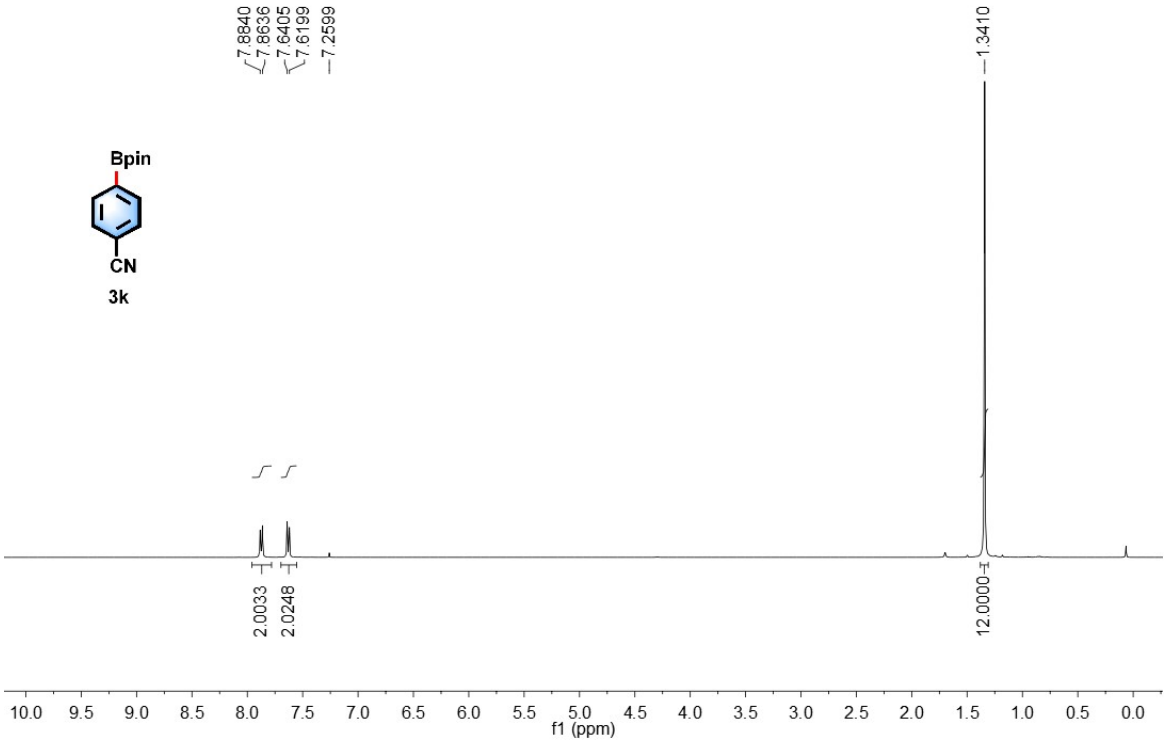

149.433
136.533
114.200
83.421
77.477
77.160
76.842
24.965
Bpin
NH2
3h
f1 (ppm)

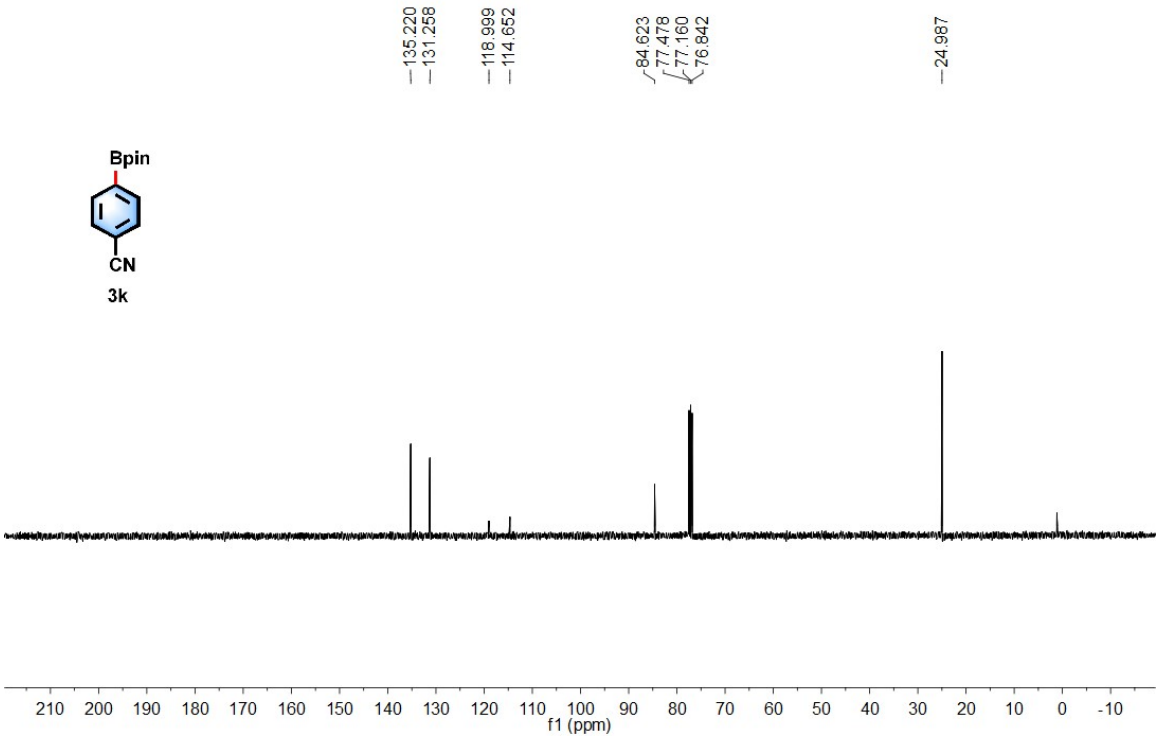

7.8402
7.8215
7.4926
7.4741
7.4556
7.4021
7.3832
7.3656
7.2597
1.3631
Bpin
3i
7.9 7.8 7.7 7.6 7.5 7.4
f1 (ppm)
2.0064
1.0000
2.0319
12.1370
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

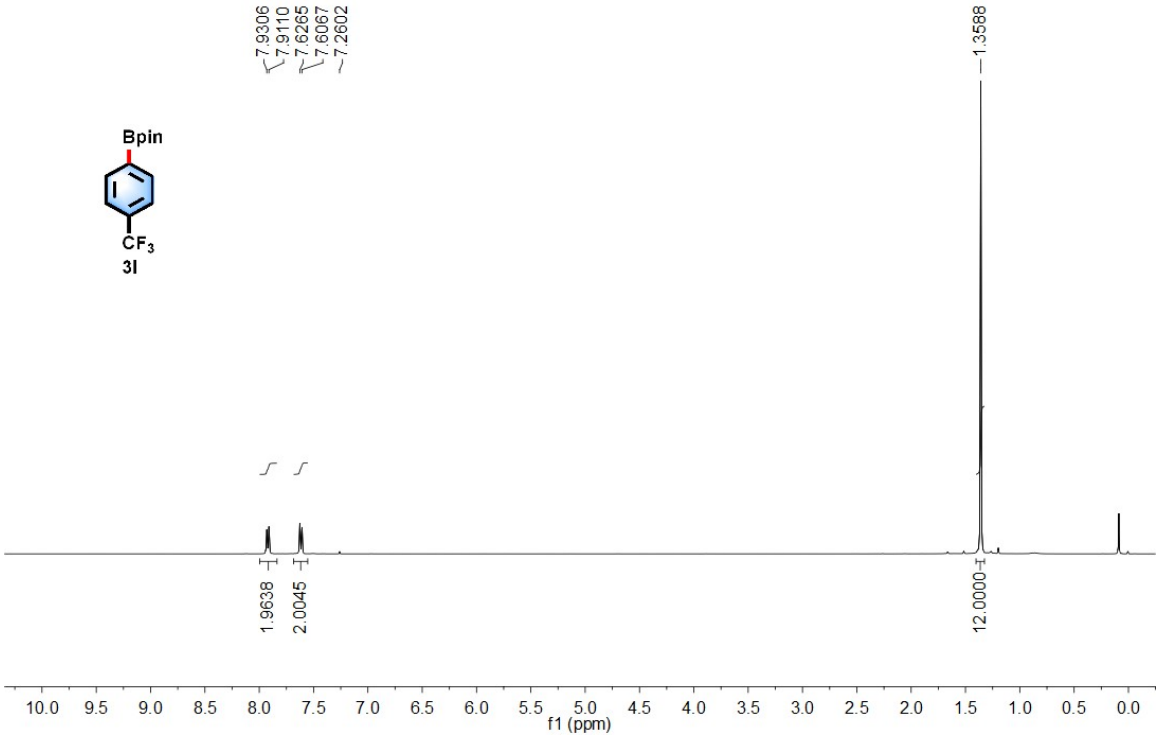

134.866
131.376
127.830
83.879
77.478
77.160
76.842
24.998
Bpin
3i
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

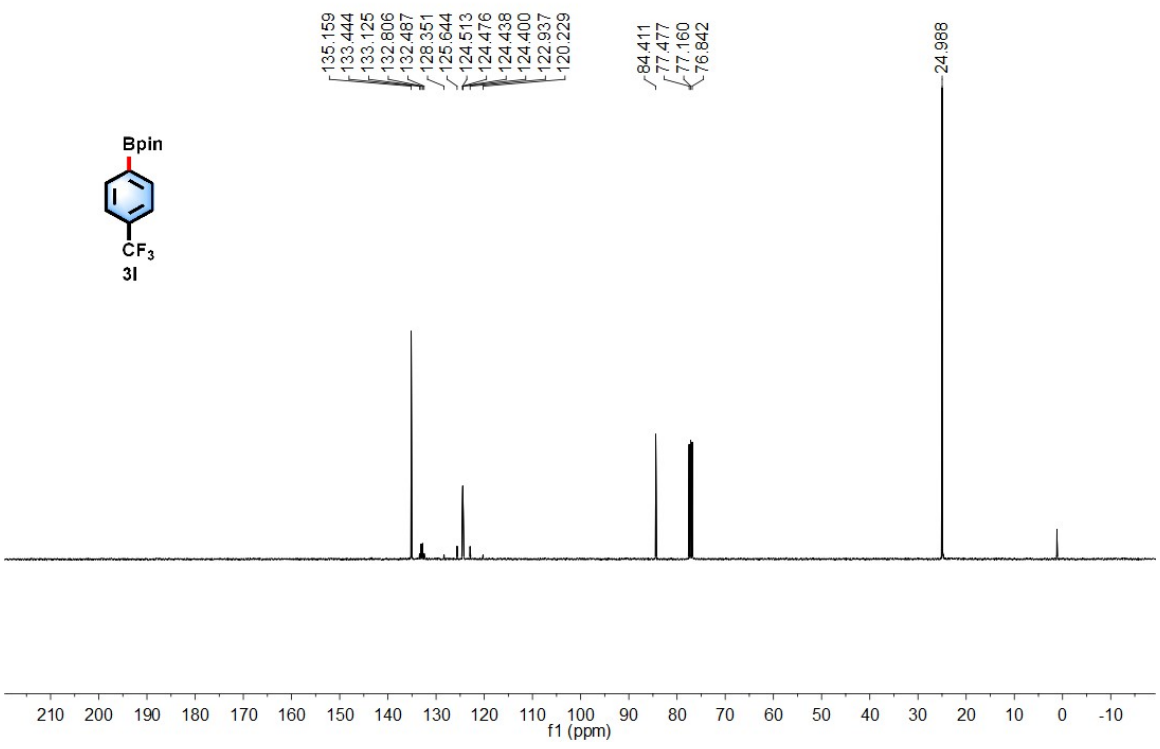

Bpin
Me
F
3j
7.6584
7.6374
7.6286
7.6091
7.5940
7.2595
7.0121
6.9916
6.9872
6.9668
2.2739
2.2699
1.3381
7.7
7.5
7.3
7.1
6.9
f1 (ppm)
0.9264
1.1043
0.9891
3.0031
12.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

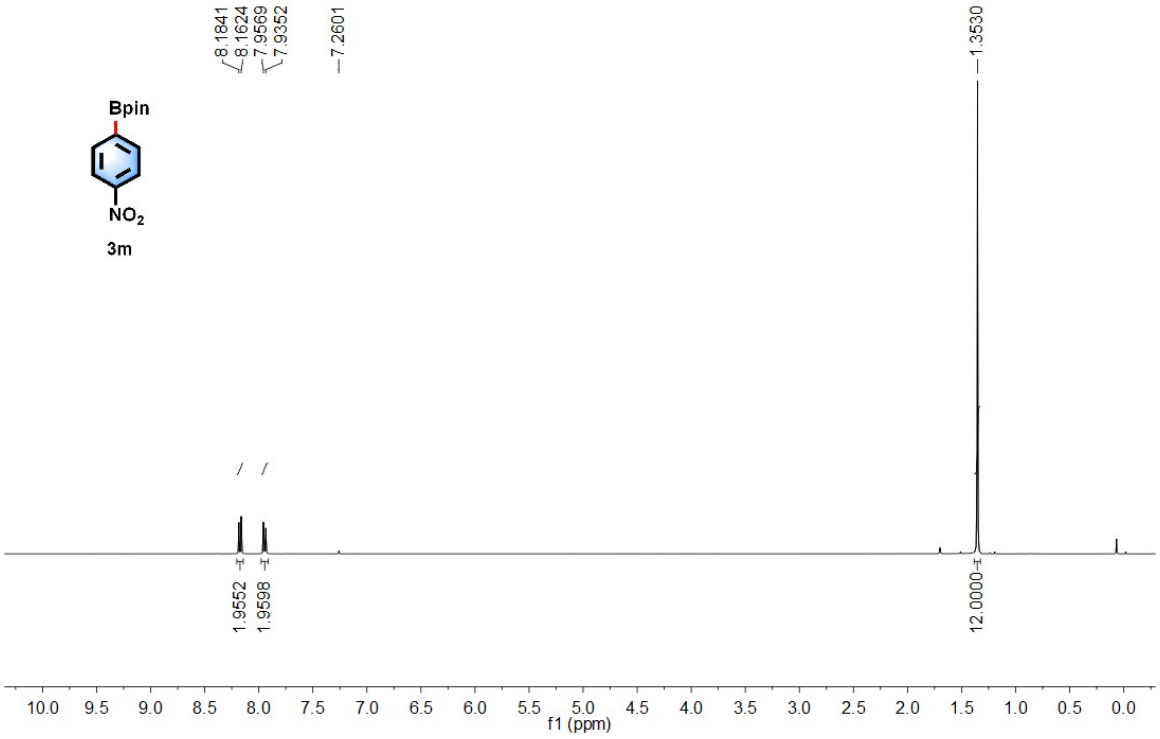

Bpin
Me
F
3j
165.040
162.585
138.512
138.456
134.467
134.384
124.427
124.265
114.782
114.570
83.978
77.478
77.160
76.842
24.990
14.430
14.393
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

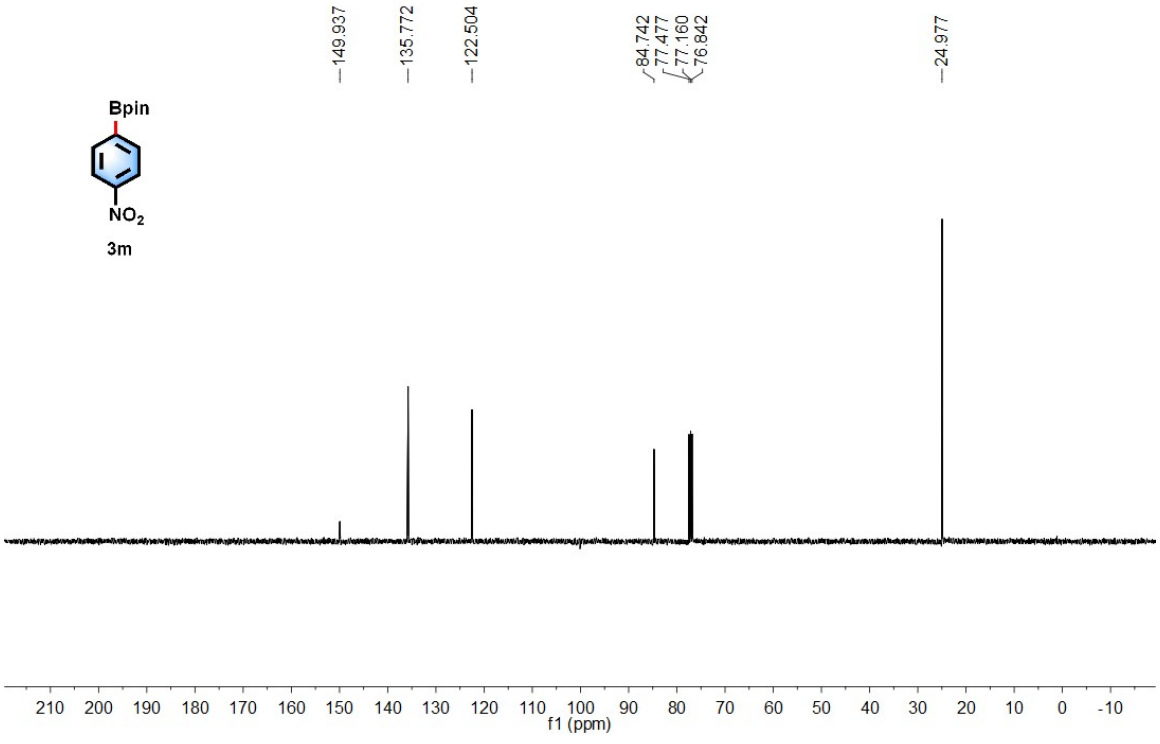

7.8840
7.8636
7.6405
7.6199
7.2599
1.3410
Bpin
CN
3k
2.0033
2.0248
12.0000
f1 (ppm)

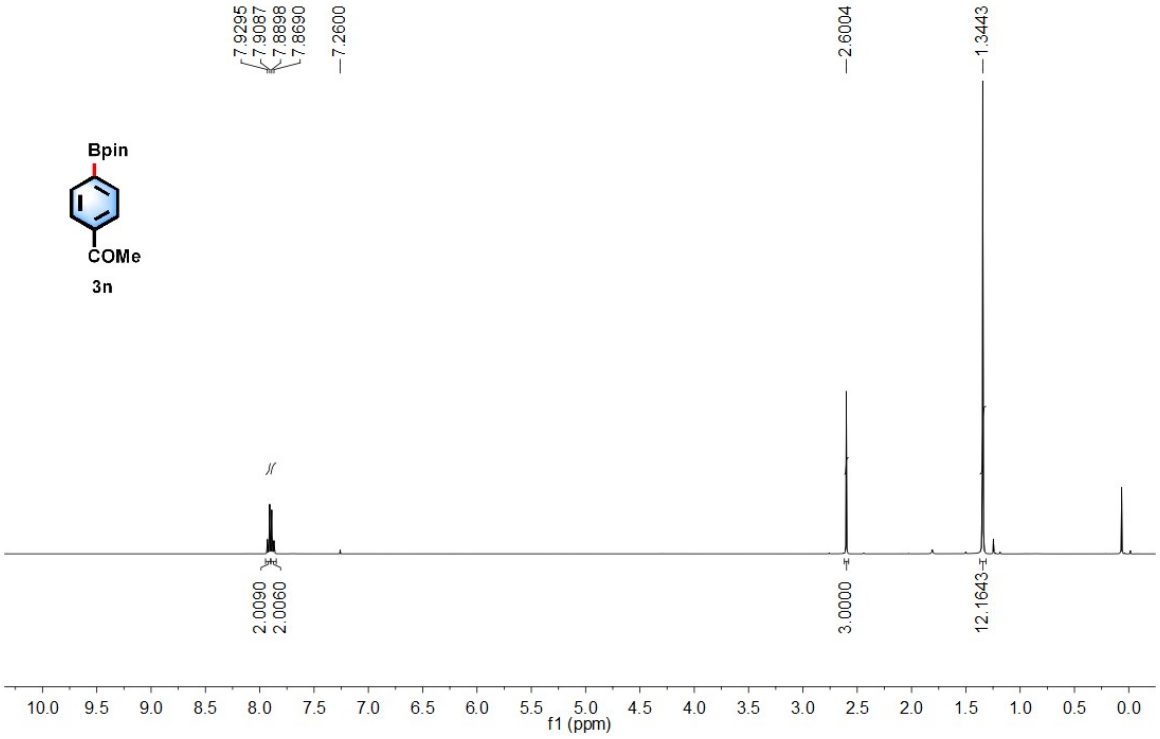

135.220
131.258
118.999
114.652
84.623
77.478
77.160
76.842
24.987
Bpin
CN
3k
f1 (ppm)

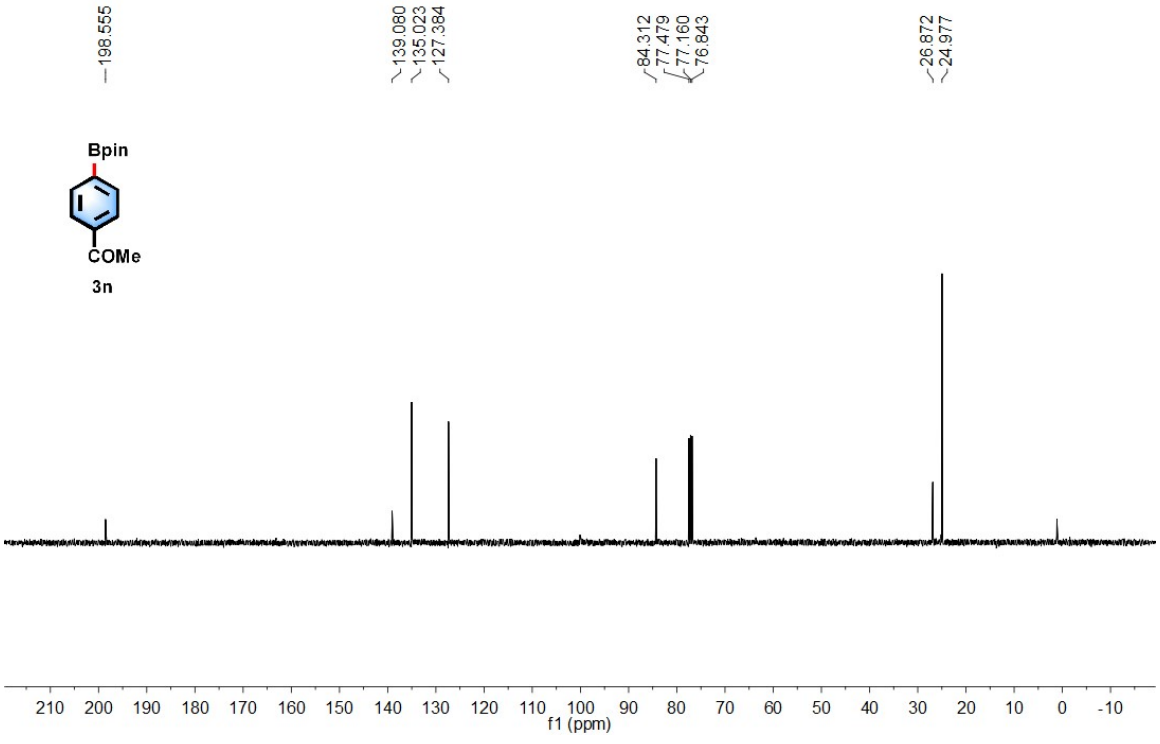

7.9306
7.9110
7.6265
7.6067
7.2602
1.3588
Bpin
CF3
3l
1.9638
2.0045
12.0000
f1 (ppm)

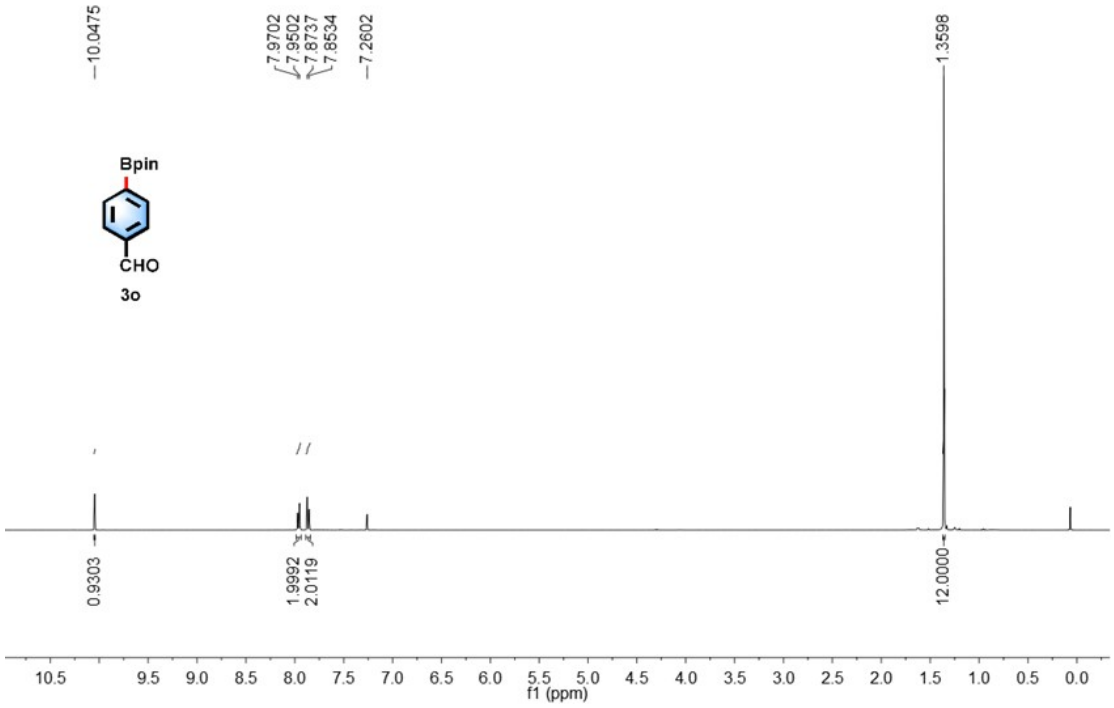

135.159
133.444
133.125
132.806
132.487
128.351
125.644
124.513
124.476
124.438
124.400
122.937
120.229
84.411
77.477
77.160
76.842
24.988
Bpin
CF3
3l
f1 (ppm)

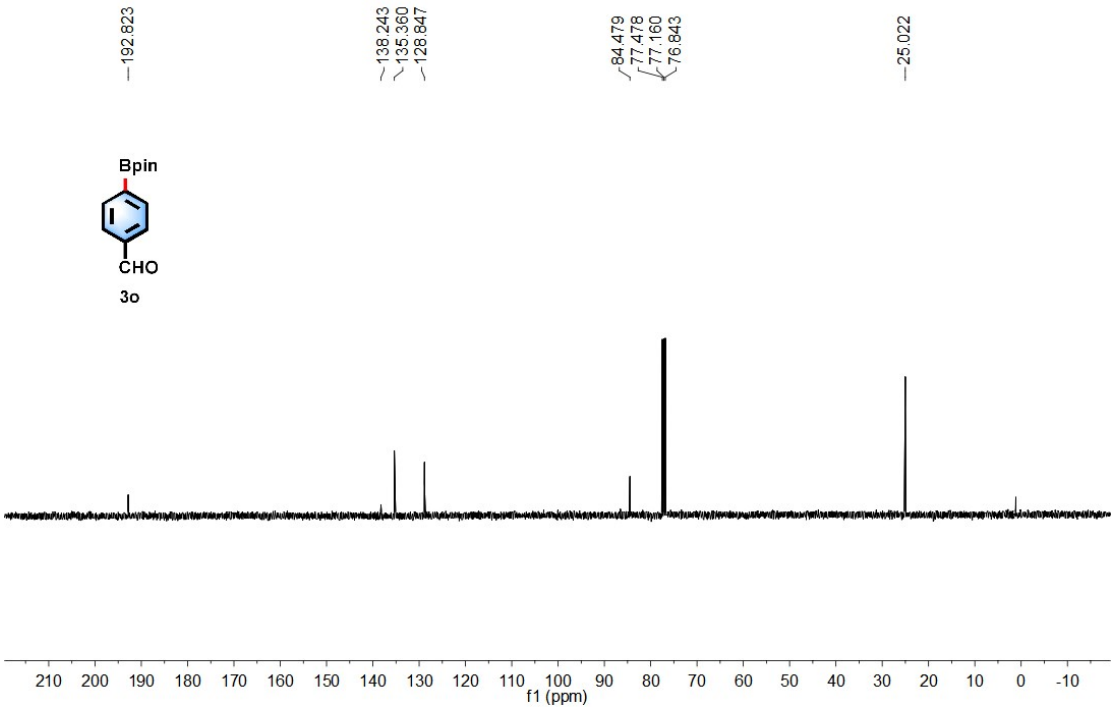

8.1841
8.1624
7.9569
7.9352
7.2601
1.3530
Bpin
NO2
3m
1.9552
1.9598
12.0000
f1 (ppm)

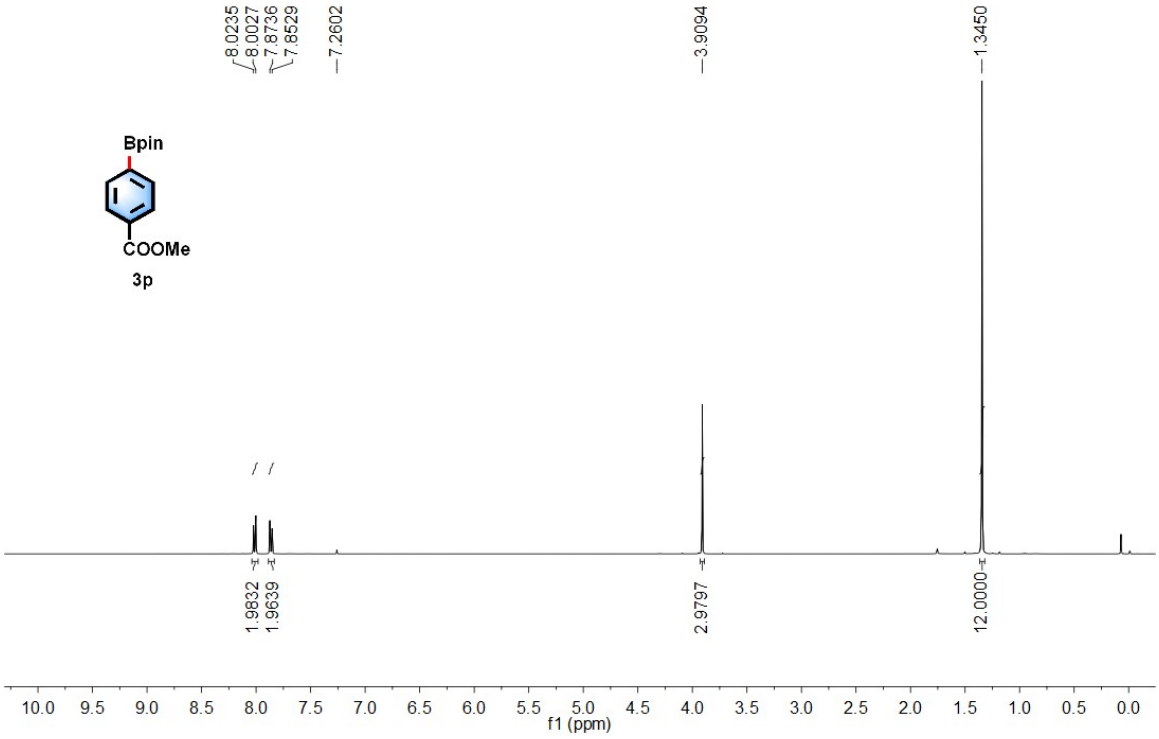

149.937
135.772
122.504
84.742
77.477
77.160
76.842
24.977
Bpin
NO2
3m
f1 (ppm)

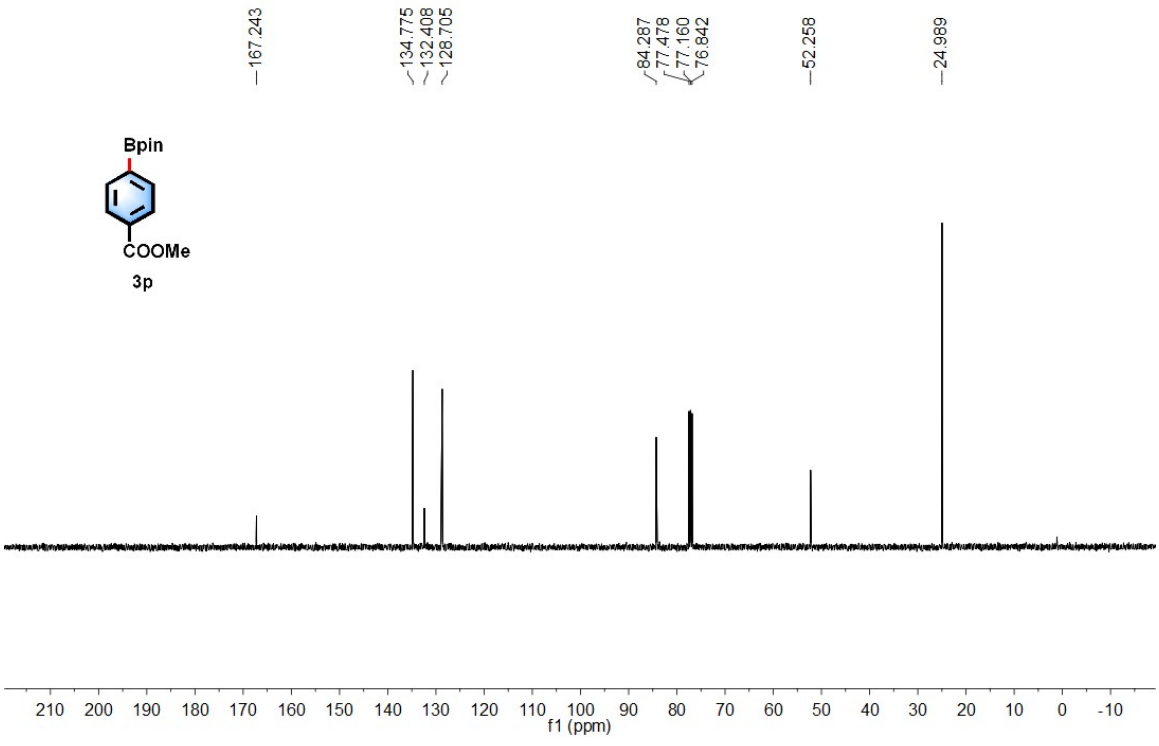

7.9295
7.9087
7.8898
7.8690
7.2600
2.6004
1.3443
Bpin
COMe
3n
2.0090
2.0060
3.0000
12.1643
f1 (ppm)

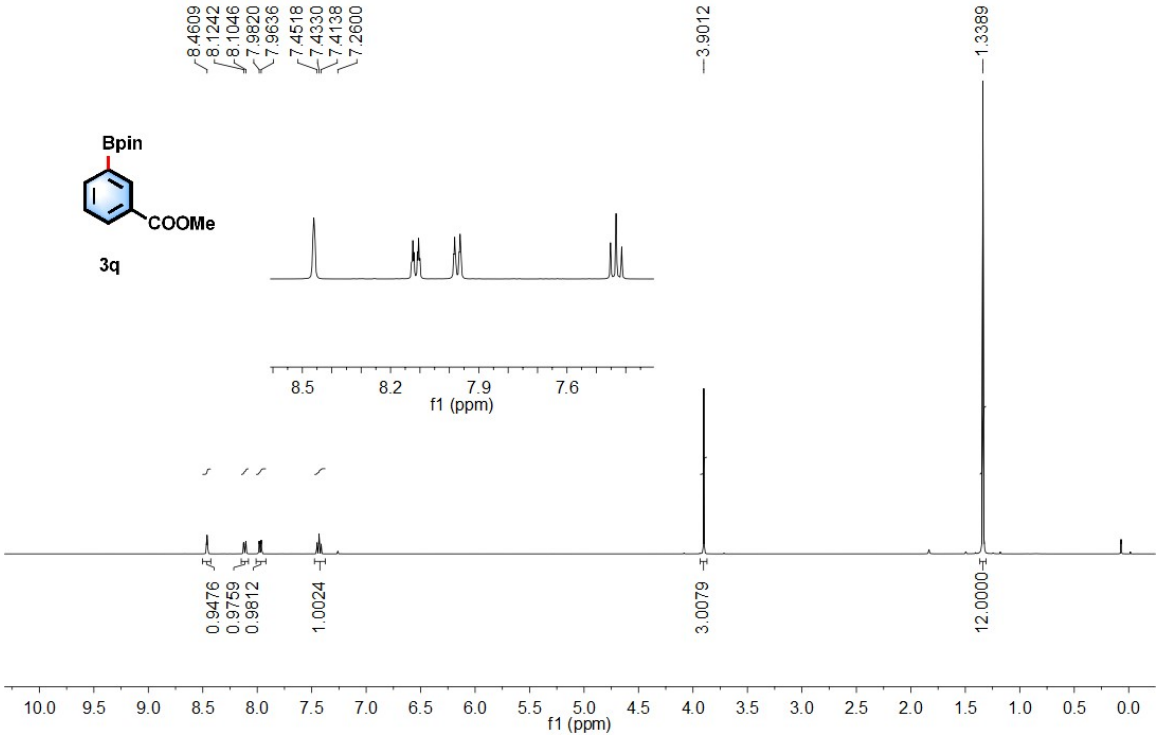

198.555
139.080
135.023
127.384
84.312
77.479
77.160
76.843
26.872
24.977
Bpin
COMe
3n
f1 (ppm)

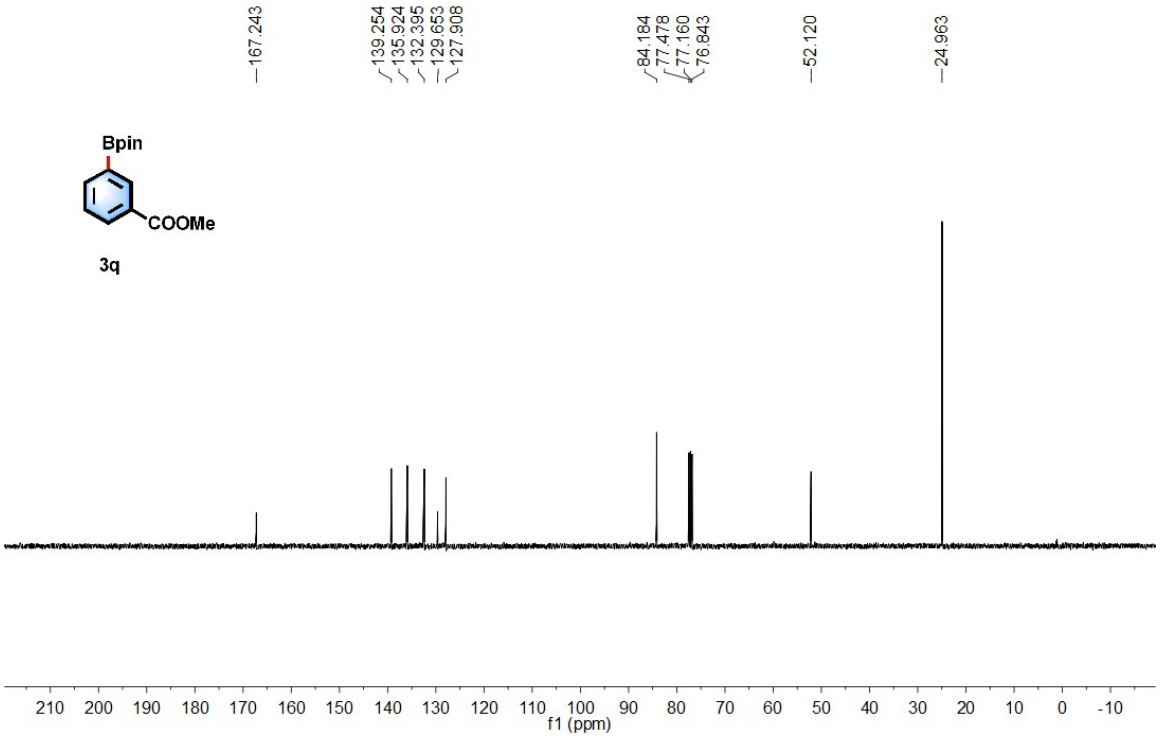

10.0475
7.9702
7.9502
7.8737
7.8534
7.2602
1.3598
Bpin
CHO
3o
0.9303
1.9992
2.0119
12.0000
f1 (ppm)

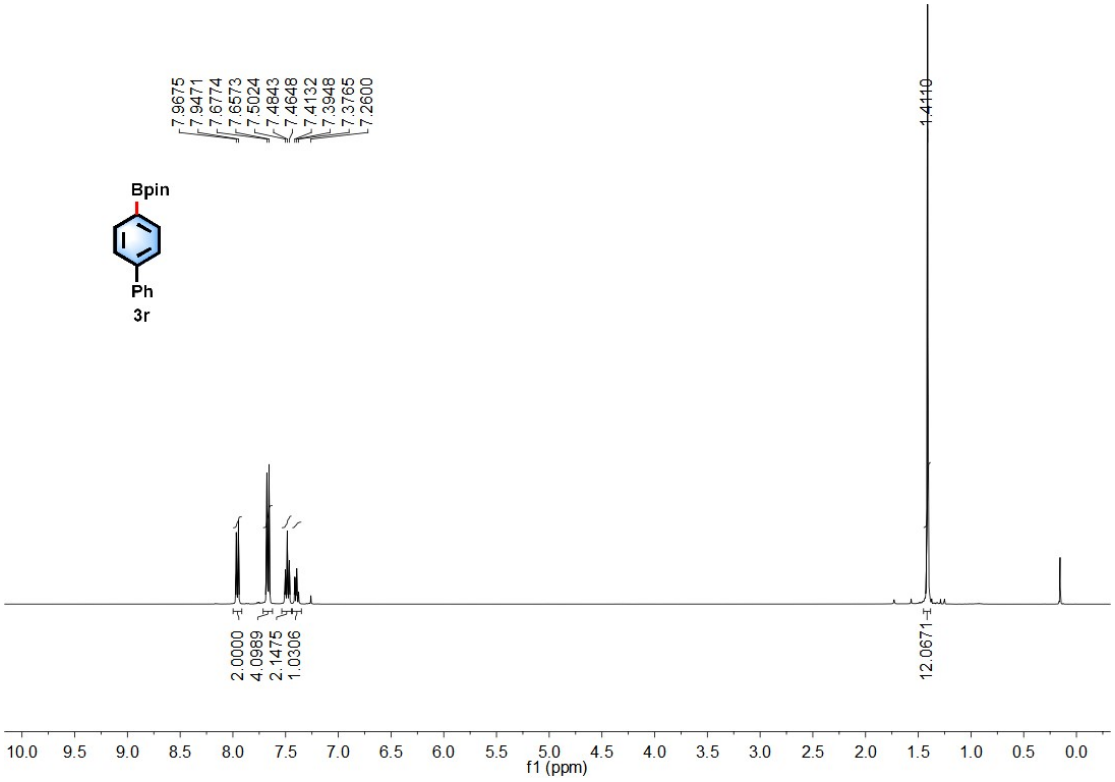

192.823
138.243
135.360
128.847
84.479
77.478
77.160
76.843
25.022
Bpin
CHO
3o
f1 (ppm)

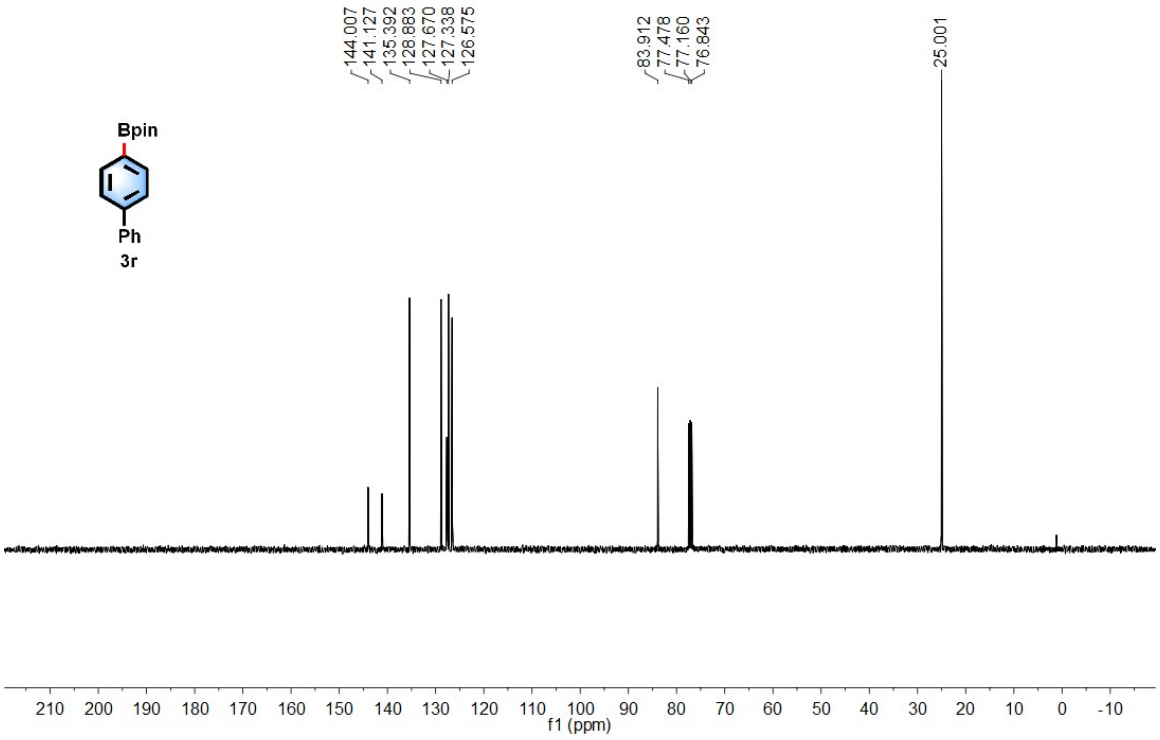

8.0235
8.0027
7.8736
7.8529
7.2602
3.9094
1.3450
Bpin
COOMe
3p
1.9832
1.9639
2.9797
12.0000
f1 (ppm)

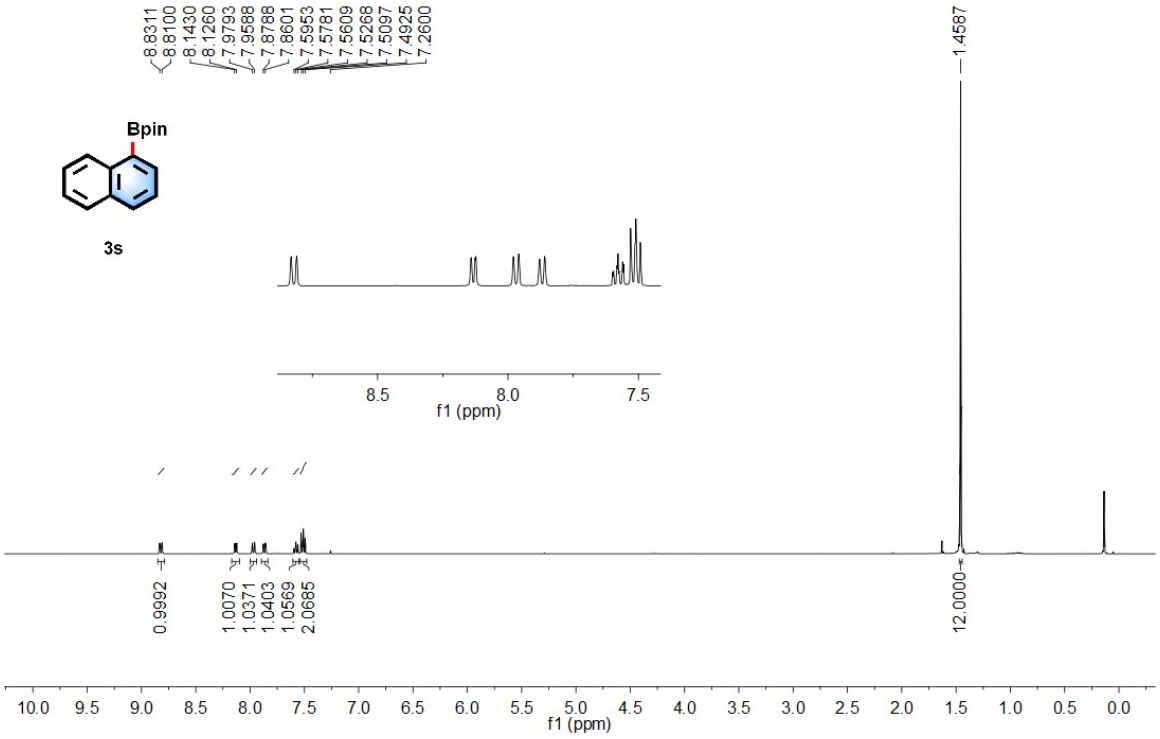

167.243
134.775
132.408
128.705
84.287
77.478
77.160
76.842
52.258
24.989
Bpin
COOMe
3p
f1 (ppm)

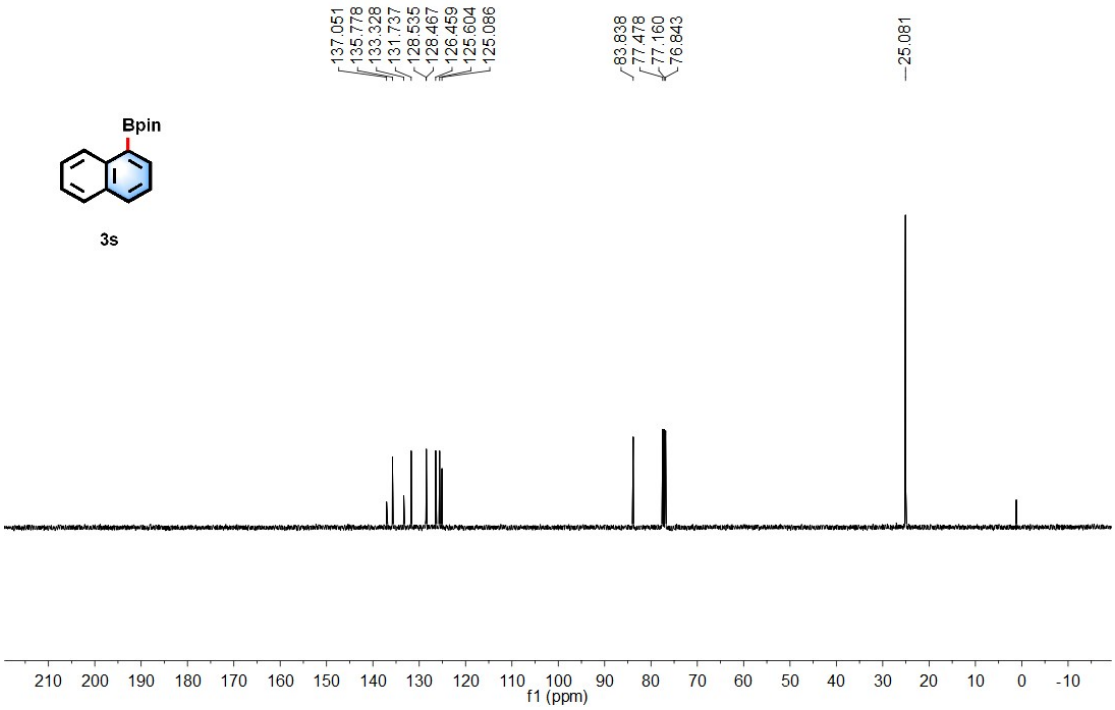

8.4609
8.1242
8.1046
7.9820
7.9636
7.4518
7.4330
7.4138
7.2600
3.9012
1.3389
Bpin
COOMe
3q
8.5
8.2
7.9
7.6
f1 (ppm)
0.9476
0.9759
0.9812
1.0024
3.0079
12.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

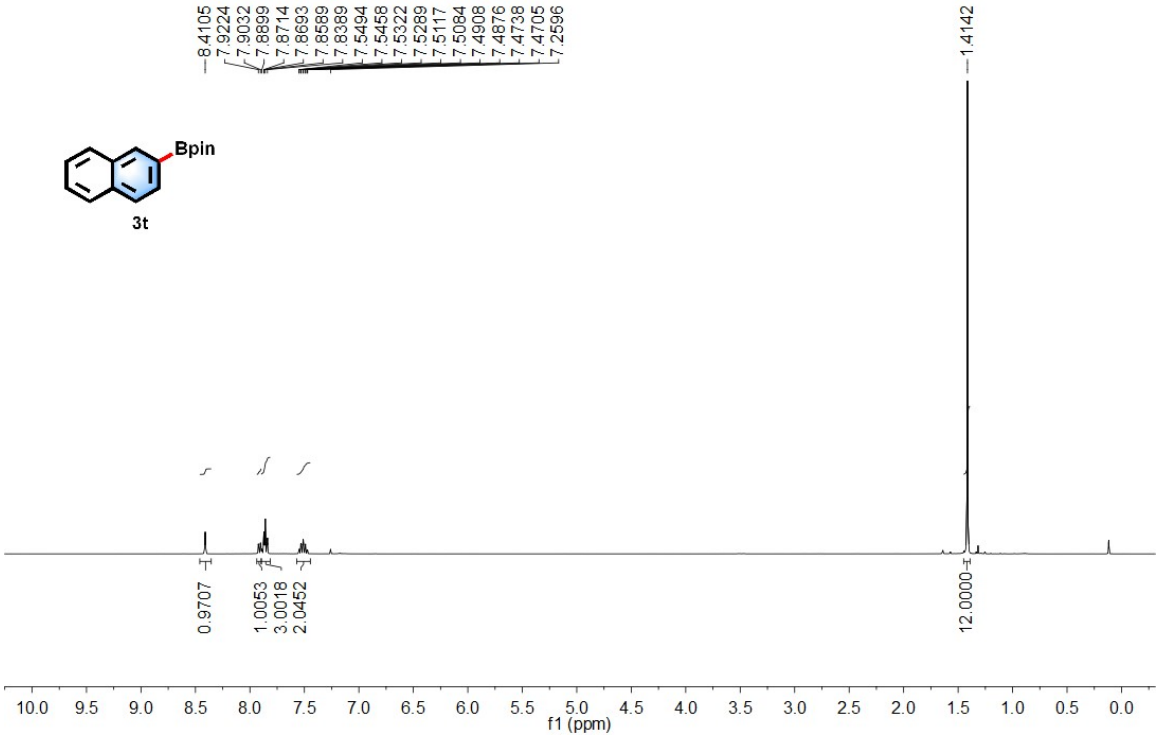

167.243
139.254
135.924
132.395
129.653
127.908
84.184
77.478
77.160
76.843
52.120
24.963
Bpin
COOMe
3q
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

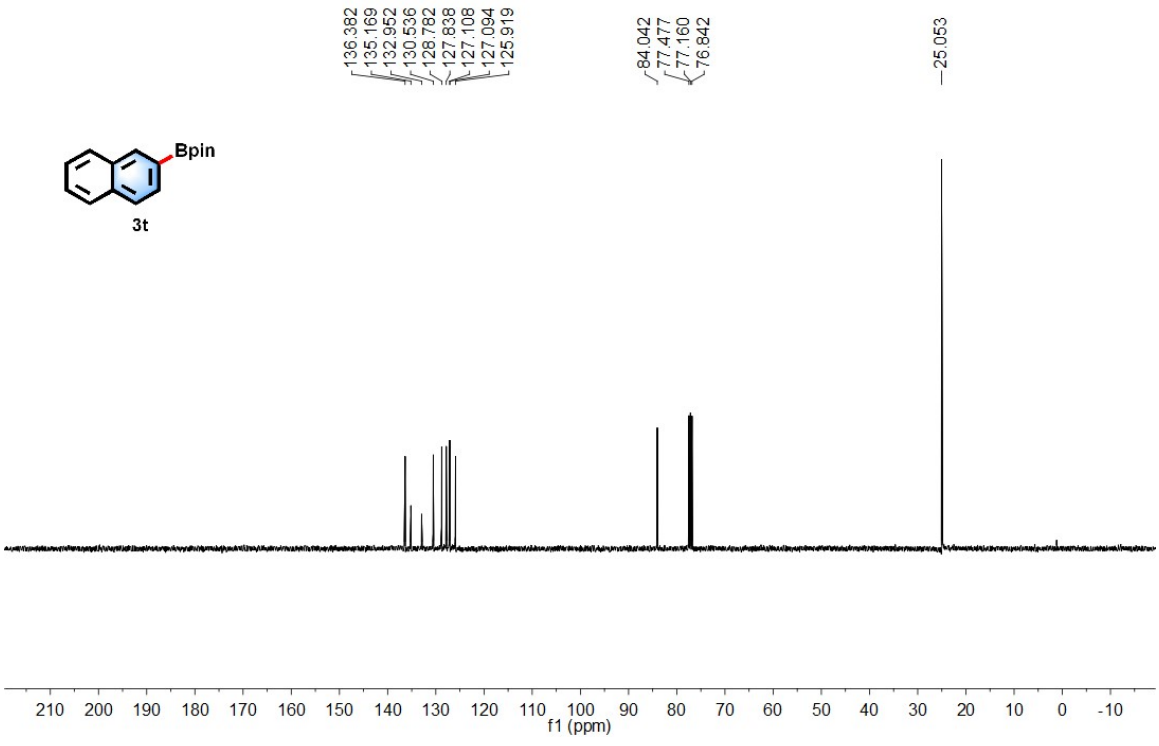

7.9675
7.9471
7.6774
7.6573
7.5024
7.4843
7.4648
7.4132
7.3948
7.3765
7.2600
1.4110
Bpin
Ph
3r
2.0000
4.0989
2.1475
1.0306
12.0671
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

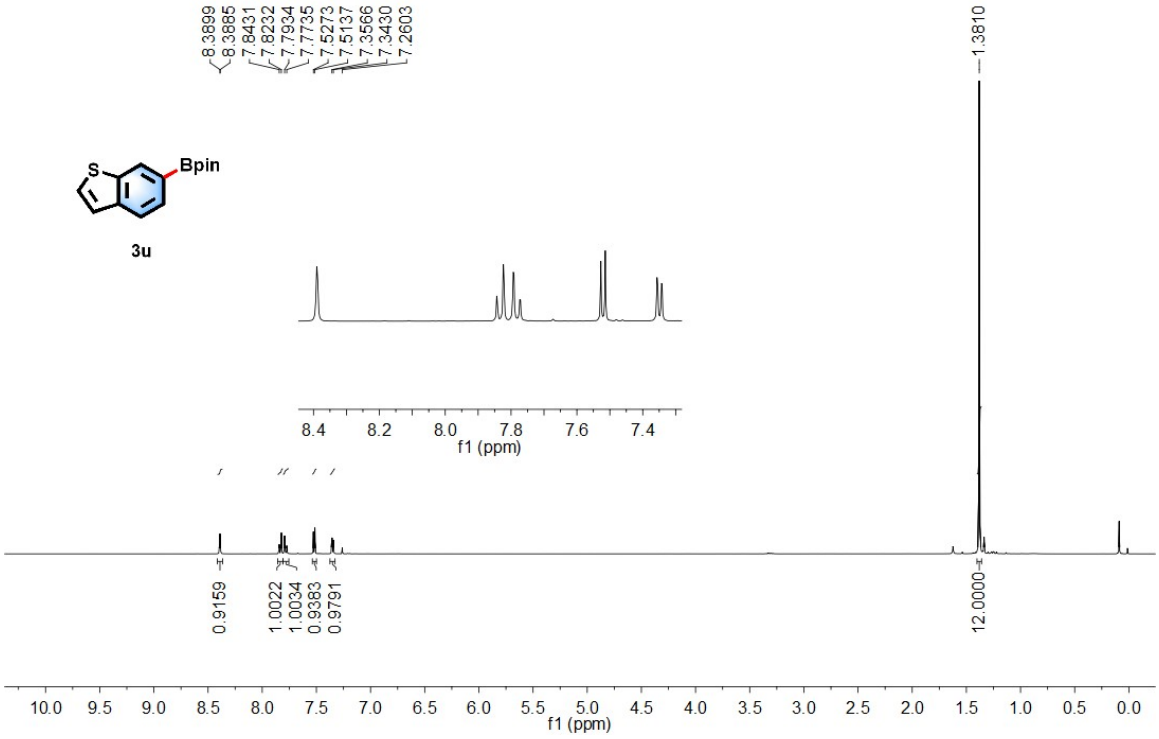

144.007
141.127
135.392
128.883
127.670
127.338
126.575
83.912
77.478
77.160
76.843
25.001
Bpin
Ph
3r
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

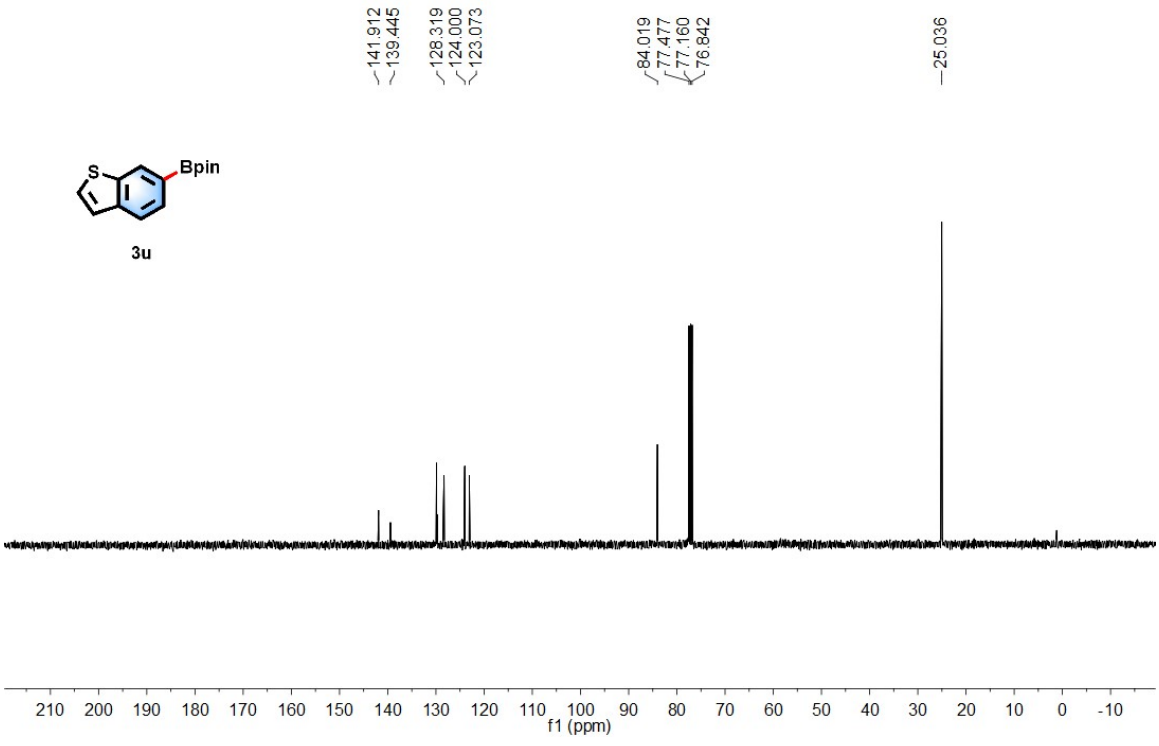

8.8311
8.8100
8.1430
8.1260
7.9793
7.9588
7.8788
7.8601
7.5953
7.5781
7.5609
7.5268
7.5097
7.4925
7.2600
1.4587
Bpin
3s
8.5
8.0
7.5
f1 (ppm)
0.9992
1.0070
1.0371
1.0403
1.0569
2.0685
12.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

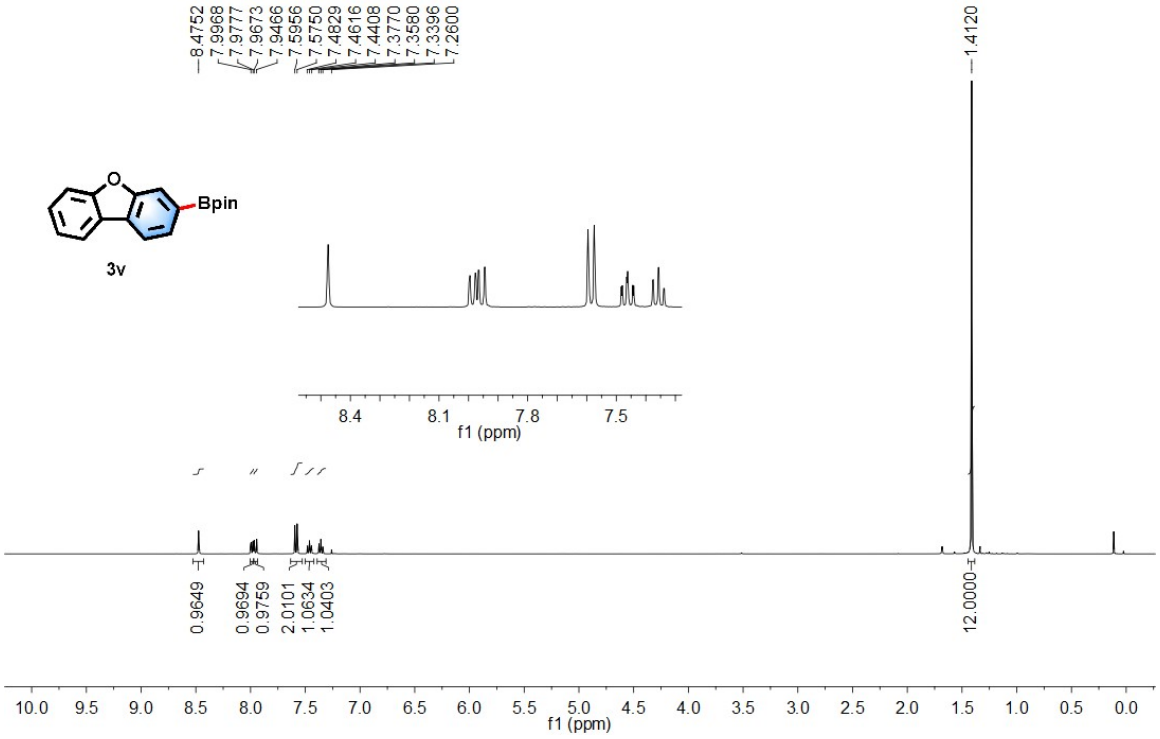

137.051
135.778
133.328
131.737
128.535
128.467
126.459
125.604
125.086
83.838
77.478
77.160
76.843
25.081
Bpin
3s
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.4105
7.9224
7.9032
7.8899
7.8714
7.8693
7.8589
7.8389
7.5494
7.5458
7.5322
7.5289
7.5117
7.5084
7.4908
7.4876
7.4738
7.4705
7.2596
1.4142
Bpin
3t
0.9707
1.0053
3.0018
2.0452
12.0000
f1 (ppm)


136.382
135.169
132.952
130.536
128.782
127.838
127.108
127.094
125.919
84.042
77.477
77.160
76.842
25.053
Bpin
3t
f1 (ppm)


8.3899
8.3885
7.8431
7.8232
7.7934
7.7735
7.5273
7.5137
7.3566
7.3430
7.2603
1.3810
Bpin
S
3u
8.4
8.2
8.0
7.8
7.6
7.4
f1 (ppm)
0.9159
1.0022
1.0034
0.9383
0.9791
12.0000
10.0
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
0.0
f1 (ppm)


141.912
139.445
128.319
124.000
123.073
84.019
77.477
77.160
76.842
25.036
Bpin
S
3u
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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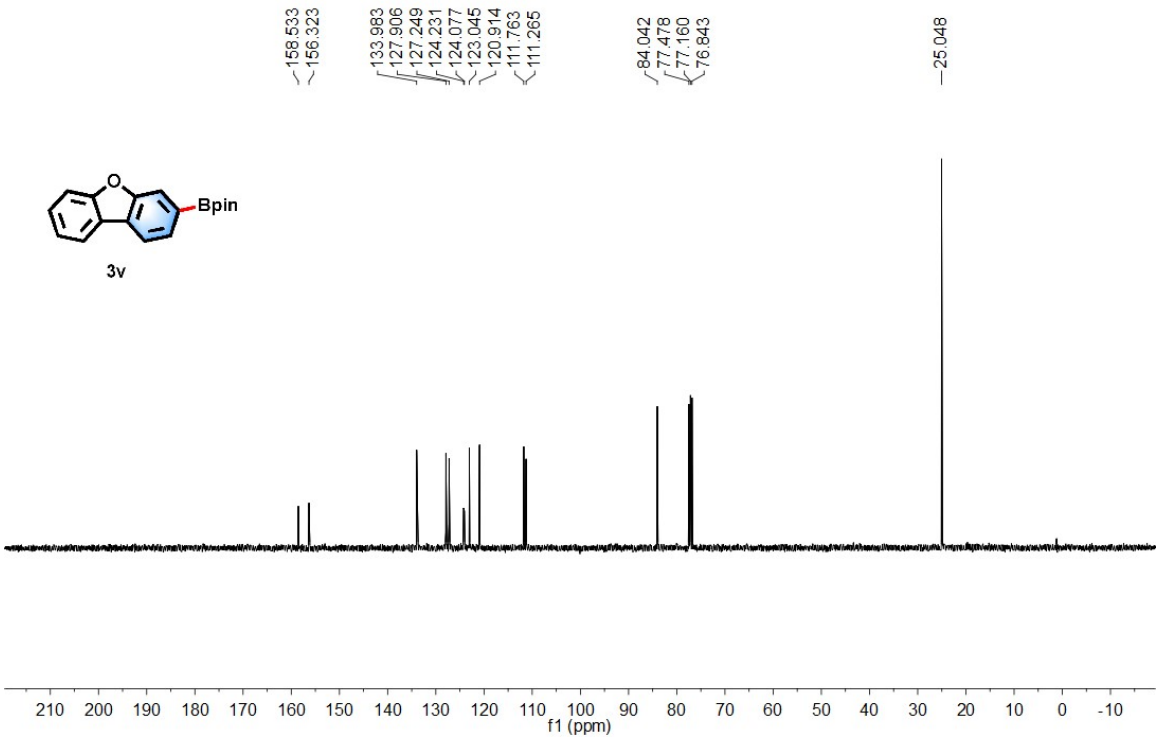
7.9777
7.9673
7.9466
7.5956
7.5750
7.4829
7.4616
7.4408
7.3770
7.3580
7.3396
7.2600
1.4120
Bpin
3v
8.4
8.1
7.8
7.5
f1 (ppm)
0.9649
0.9694
0.9759
2.0101
1.0634
1.0403
12.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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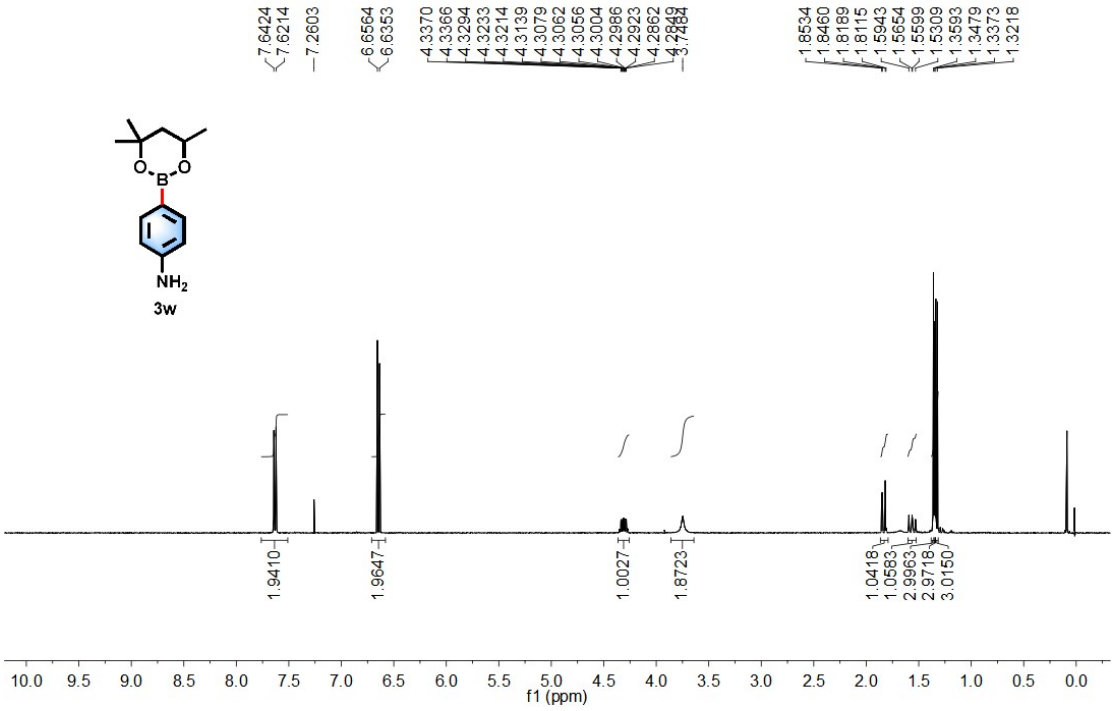
156.323
133.983
127.906
127.249
124.231
124.077
123.045
120.914
111.763
111.265
84.042
77.478
77.160
76.843
25.048
Bpin
3v
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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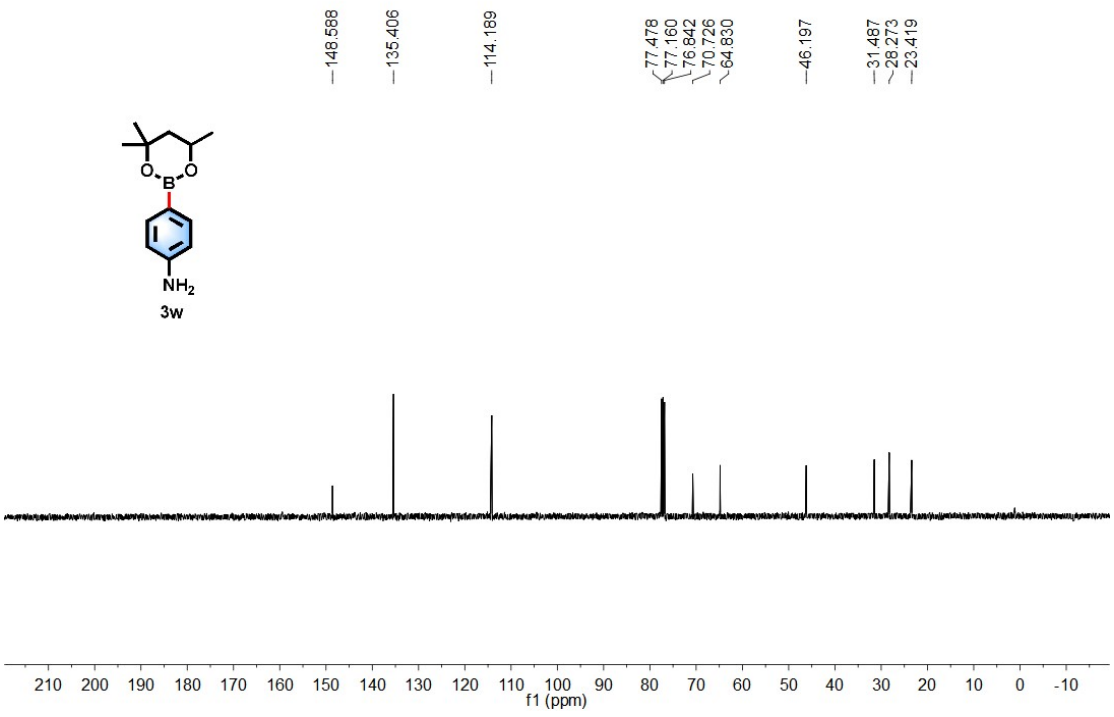
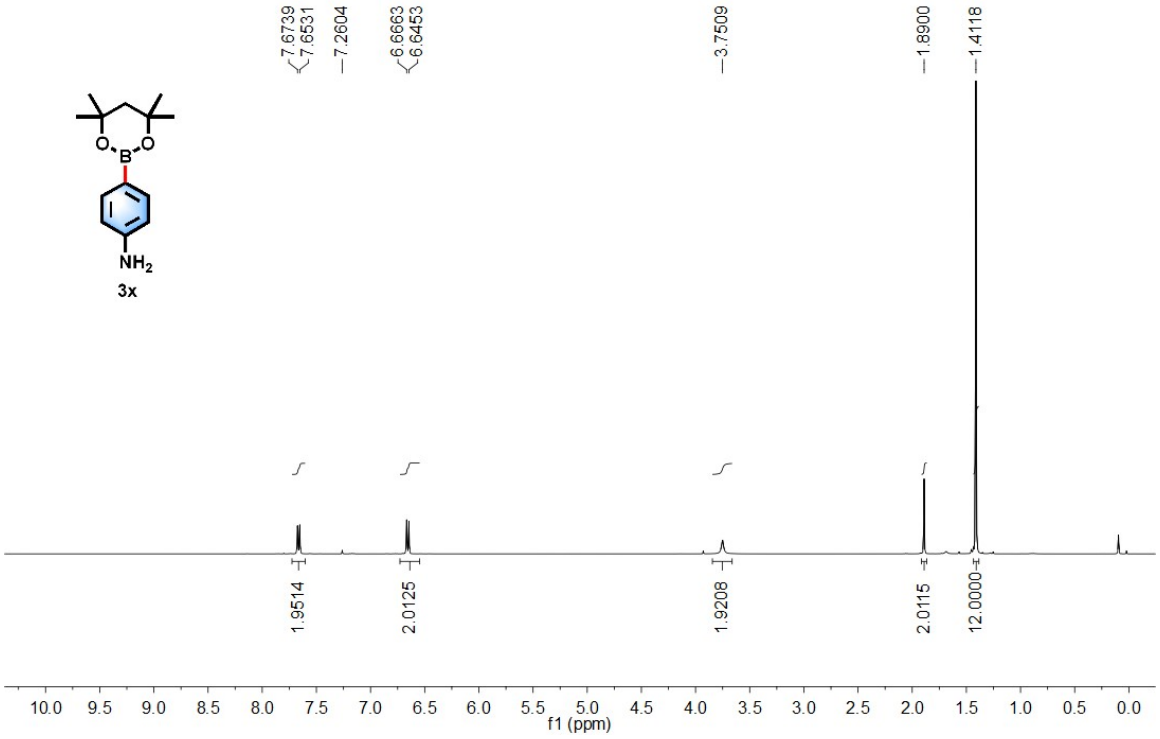
7.6214
7.2603
6.6564
6.6353
4.3370
4.3366
4.3294
4.3233
4.3214
4.3139
4.3079
4.3062
4.3056
4.3004
4.2986
4.2923
4.2862
1.8534
1.8460
1.8189
1.8115
1.5943
1.5654
1.5599
1.5309
1.3593
1.3479
1.3373
1.3218
NH2
3w
1.9410
1.9647
1.0027
1.8723
1.0418
1.0583
2.9963
2.9718
3.0150
10.0 9.5 9.0 8.5 8.0 7.5 7.0 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 0.0
f1 (ppm)


148.588
135.406
114.189
77.478
77.160
76.842
70.726
64.830
46.197
31.487
28.273
23.419
NH2
3w
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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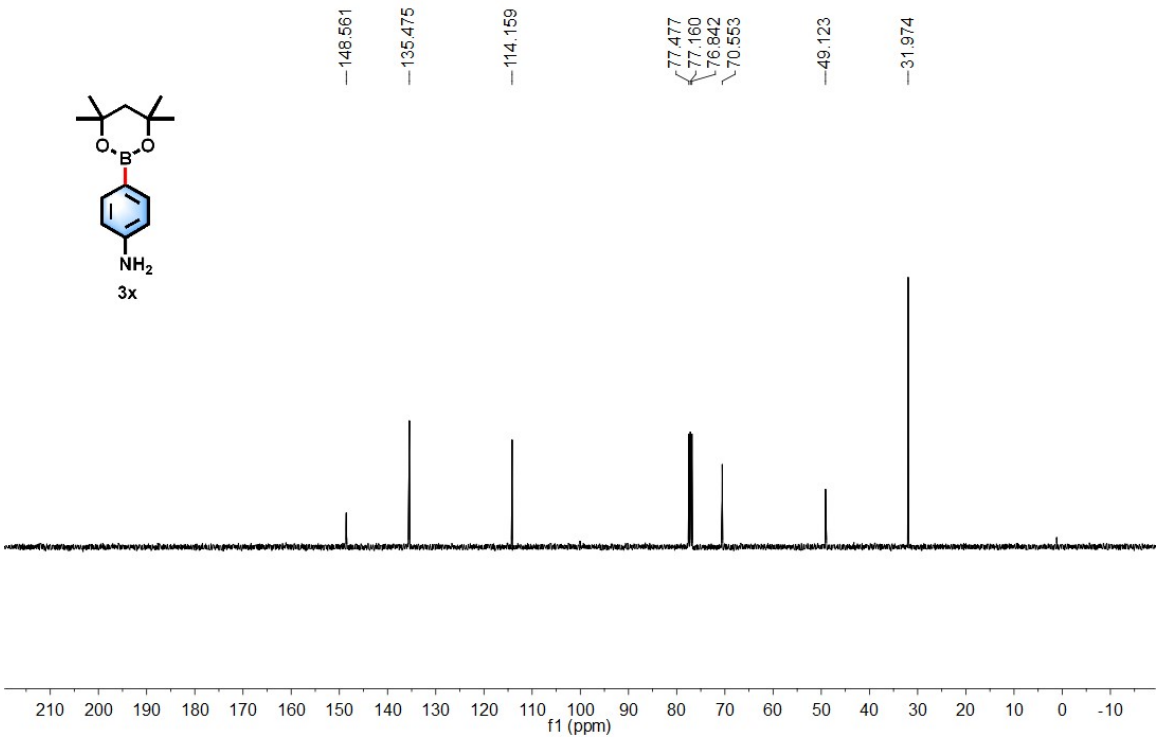
7.6531
7.2604
6.6663
6.6453
3.7509
1.8900
1.4118
1.9514
2.0125
1.9208
2.0115
12.0000
f1 (ppm)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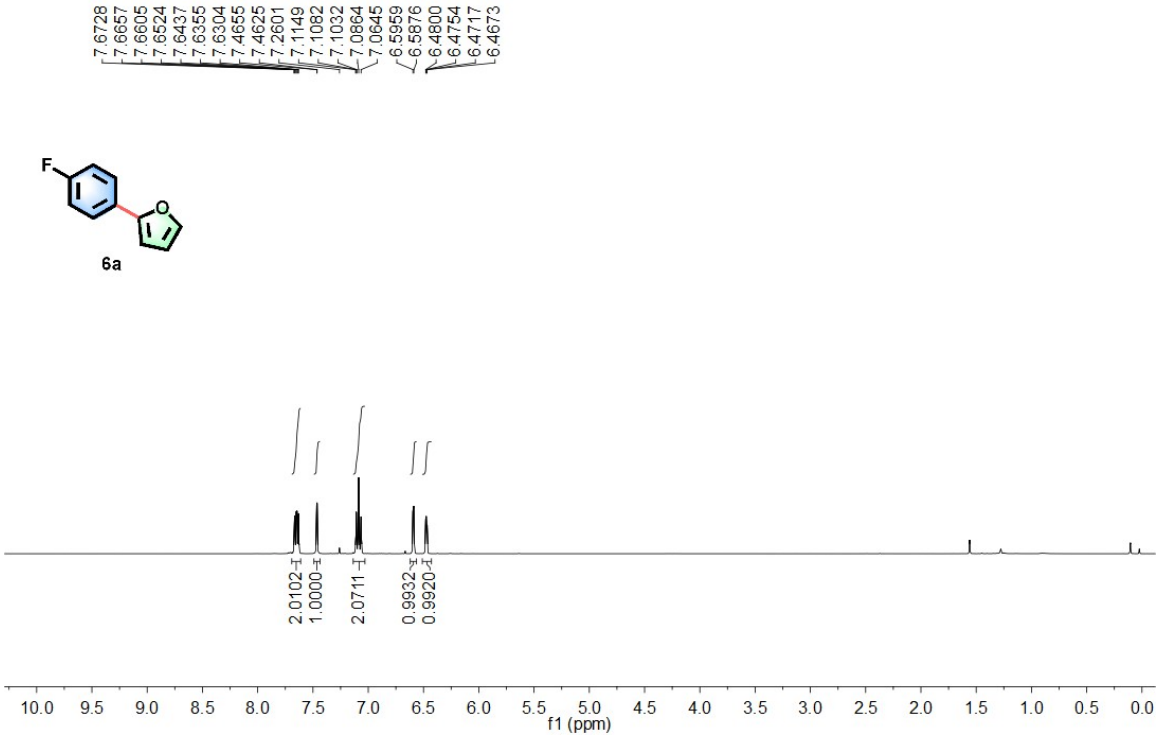
135.475
114.159
77.477
77.160
76.842
70.553
49.123
31.974
f1 (ppm)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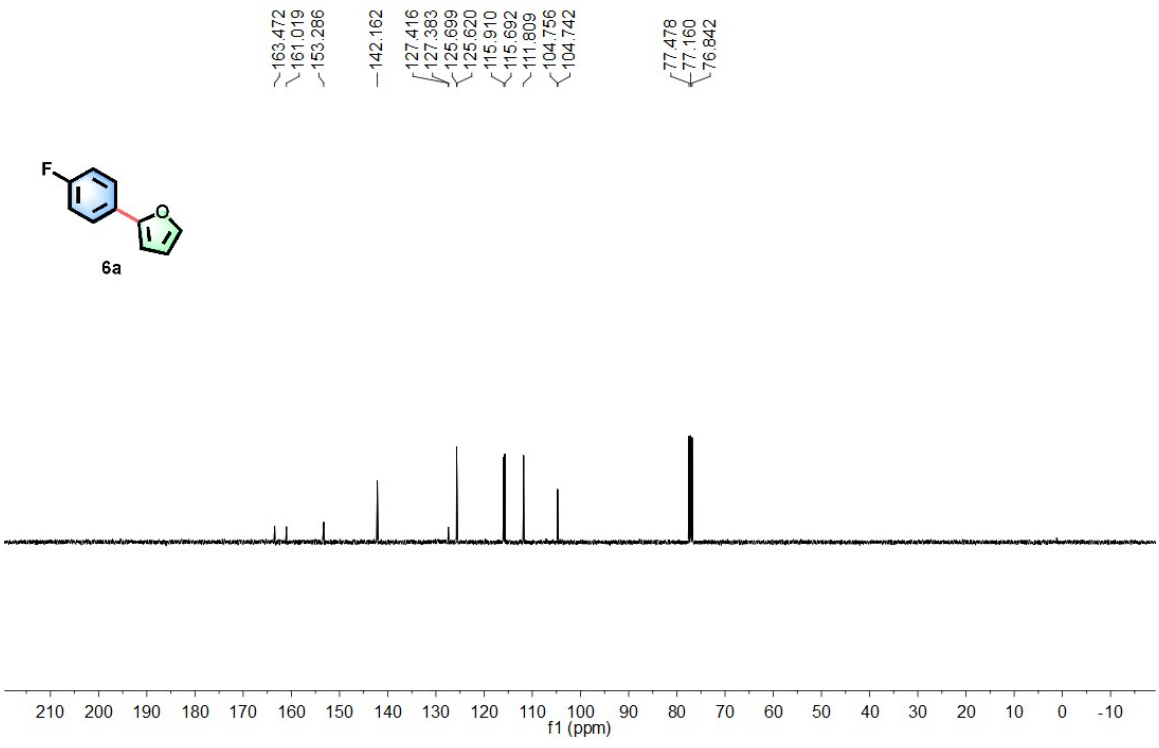
7.6657
7.6605
7.6524
7.6437
7.6355
7.6304
7.4655
7.4625
7.2601
7.1149
7.1082
7.1032
7.0864
7.0645
6.5959
6.5876
6.4800
6.4754
6.4717
6.4673
F
O
6a
2.0102
1.0000
2.0711
0.9932
0.9920
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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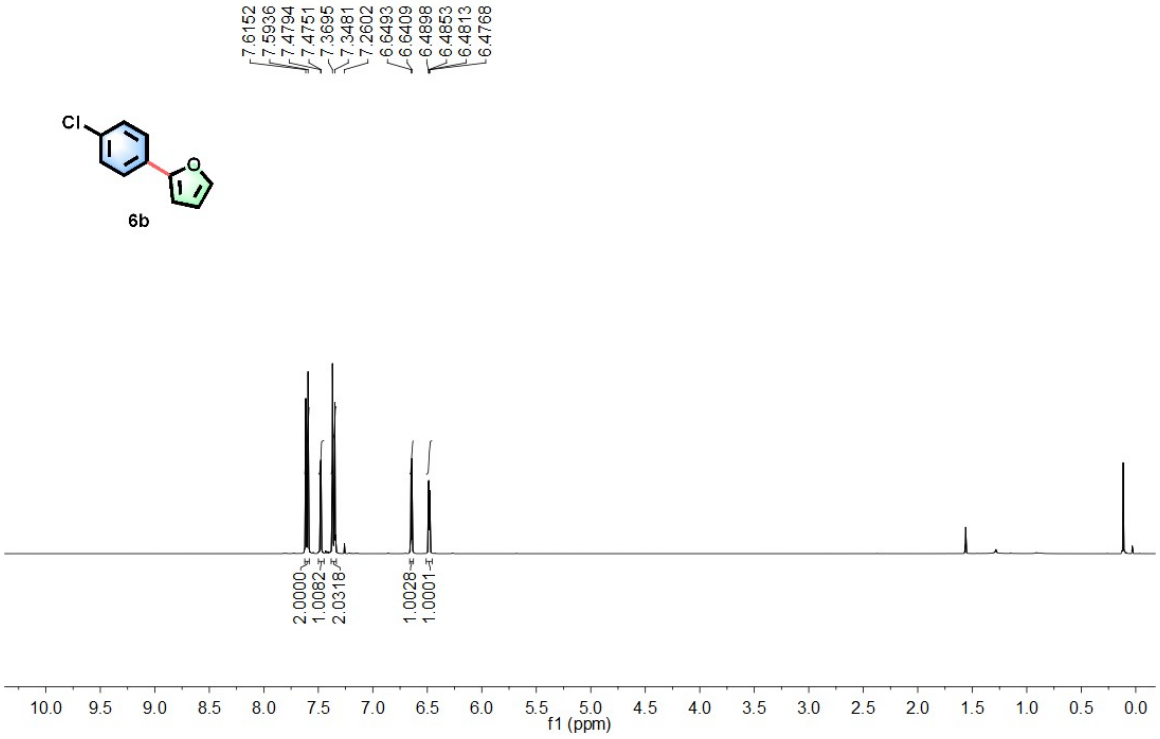
161.019
153.286
142.162
127.416
127.383
125.699
125.620
115.910
115.692
111.809
104.756
104.742
77.478
77.160
76.842
F
O
6a
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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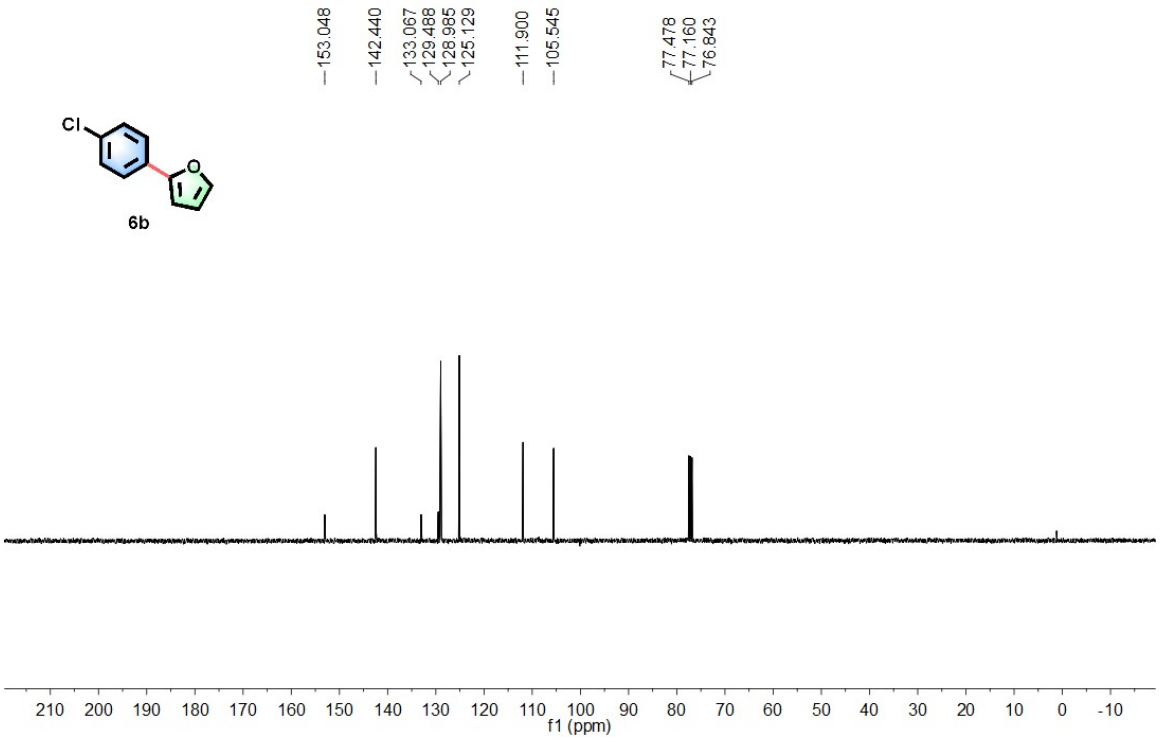
7.5936
7.4794
7.4751
7.3695
7.3481
7.2602
6.6493
6.6409
6.4898
6.4853
6.4813
6.4768
Cl
O
6b
2.0000
1.0082
2.0318
1.0028
1.0001
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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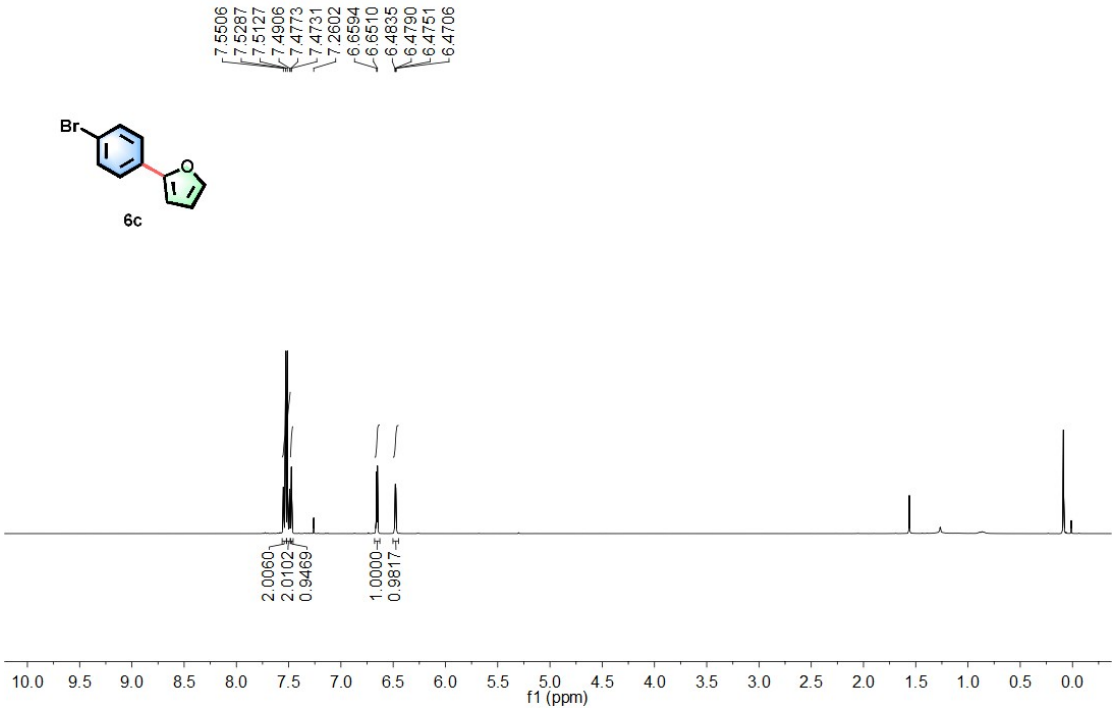
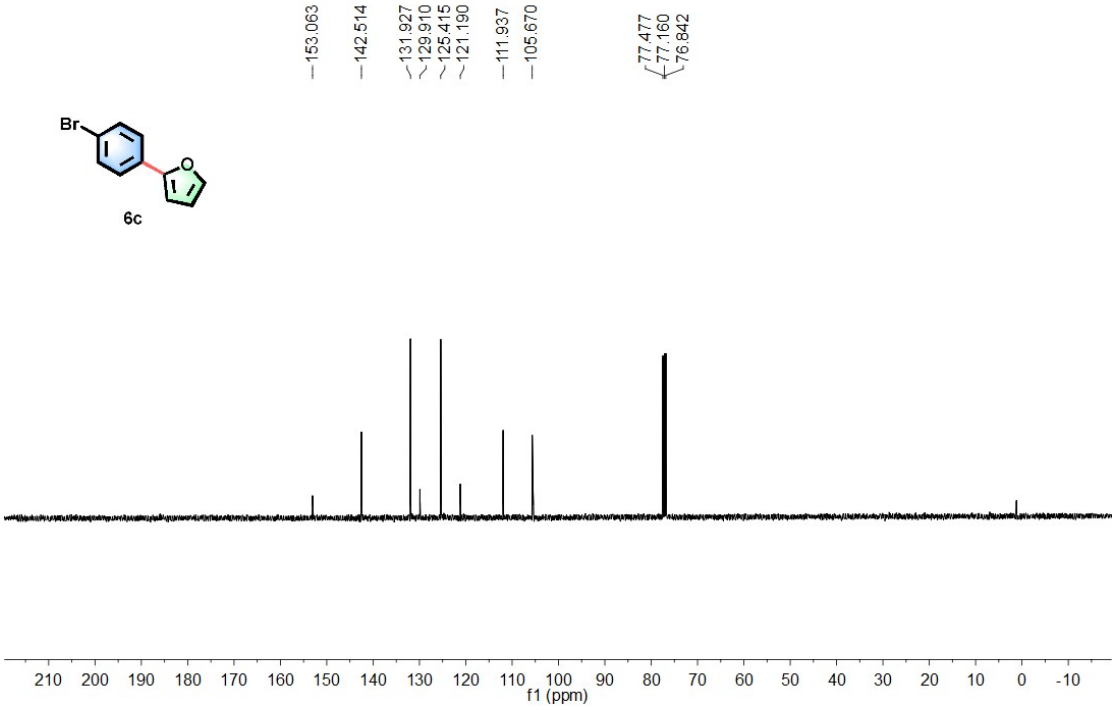
142.440
133.067
129.488
128.985
125.129
111.900
105.545
77.478
77.160
76.843
Cl
O
6b
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.5506
7.5287
7.5127
7.4906
7.4773
7.4731
7.2602
6.6594
6.6510
6.4835
6.4790
6.4751
6.4706
Br
O
6c
2.0060
2.0102
0.9469
1.0000
0.9817
10.0 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 0.0
f1 (ppm)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131.927
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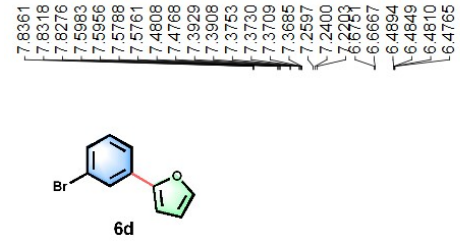
121.190
111.937
105.670
77.477
77.160
76.842
Br
O
6c
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.8276
7.5983
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7.5788
7.5761
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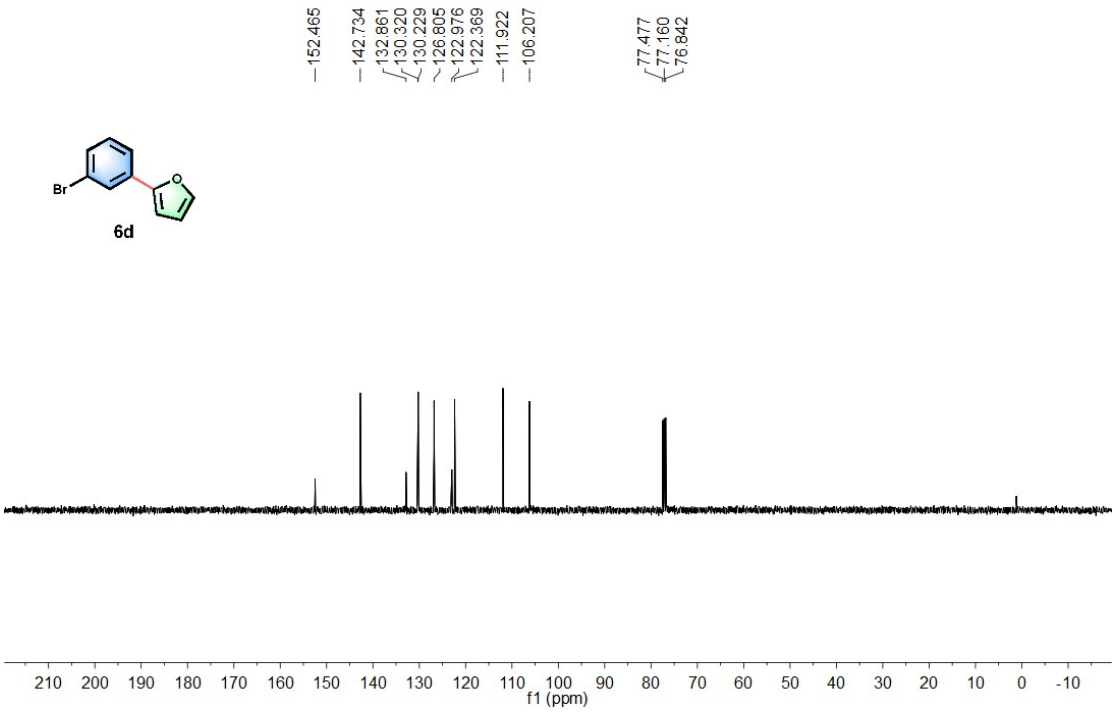
7.4768
7.3929
7.3908
7.3753
7.3730
7.3709
7.3685
7.2597
7.2400
7.2203
6.6751
6.6667
6.4894
6.4849
6.4810
6.4765
Br
6d
1.0000
1.0369
1.0084
1.0446
1.1043
1.0344
1.0288
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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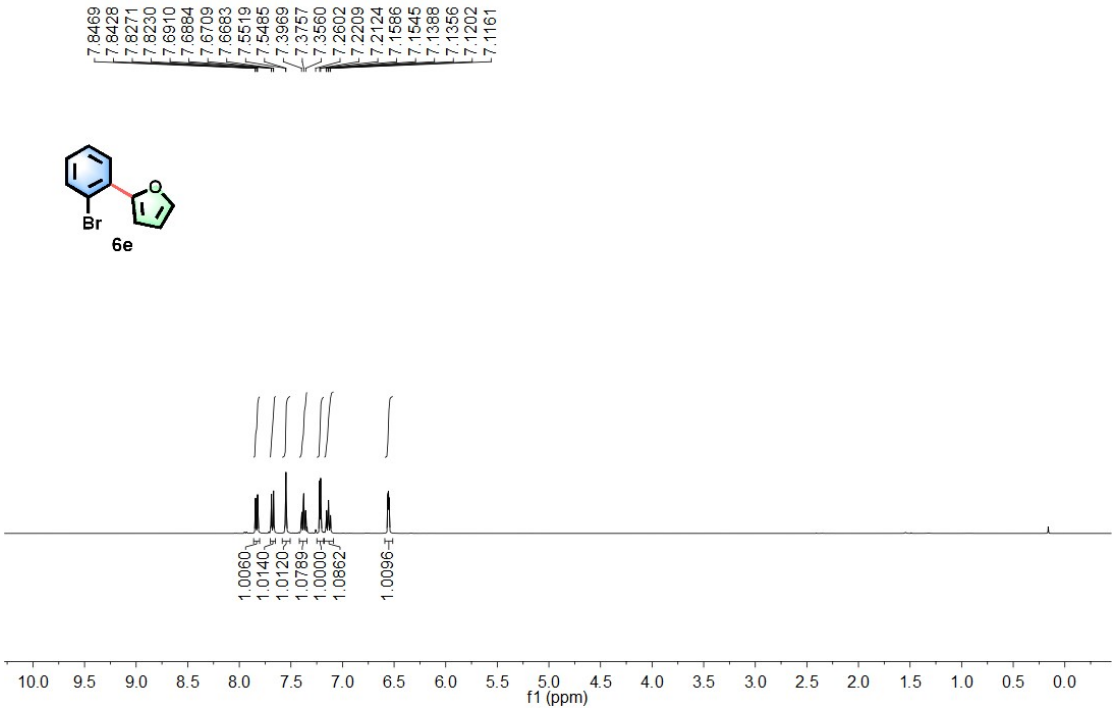
142.734
132.861
130.320
130.229
126.805
122.976
122.369
111.922
106.207
77.477
77.160
76.842
Br
6d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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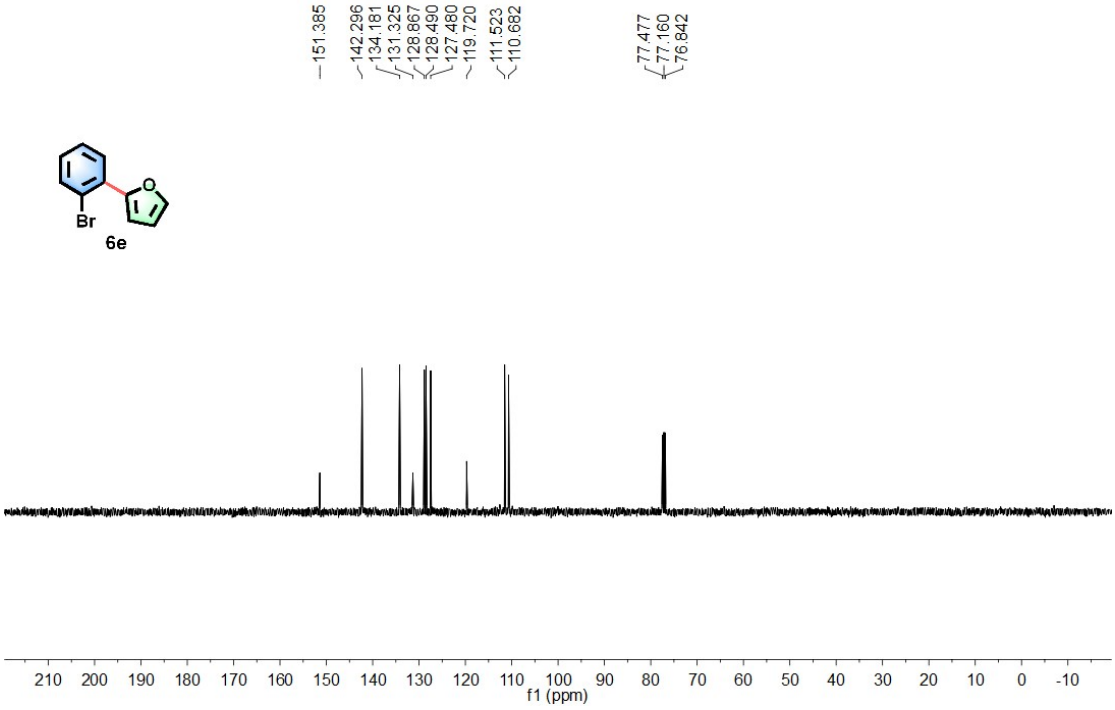
7.8428
7.8271
7.8230
7.6910
7.6884
7.6709
7.6683
7.5519
7.5485
7.3969
7.3757
7.3560
7.2602
7.2209
7.2124
7.1586
7.1545
7.1388
7.1356
7.1202
7.1161
Br
O
6e
1.0060
1.0140
1.0120
1.0789
1.0000
1.0862
1.0096
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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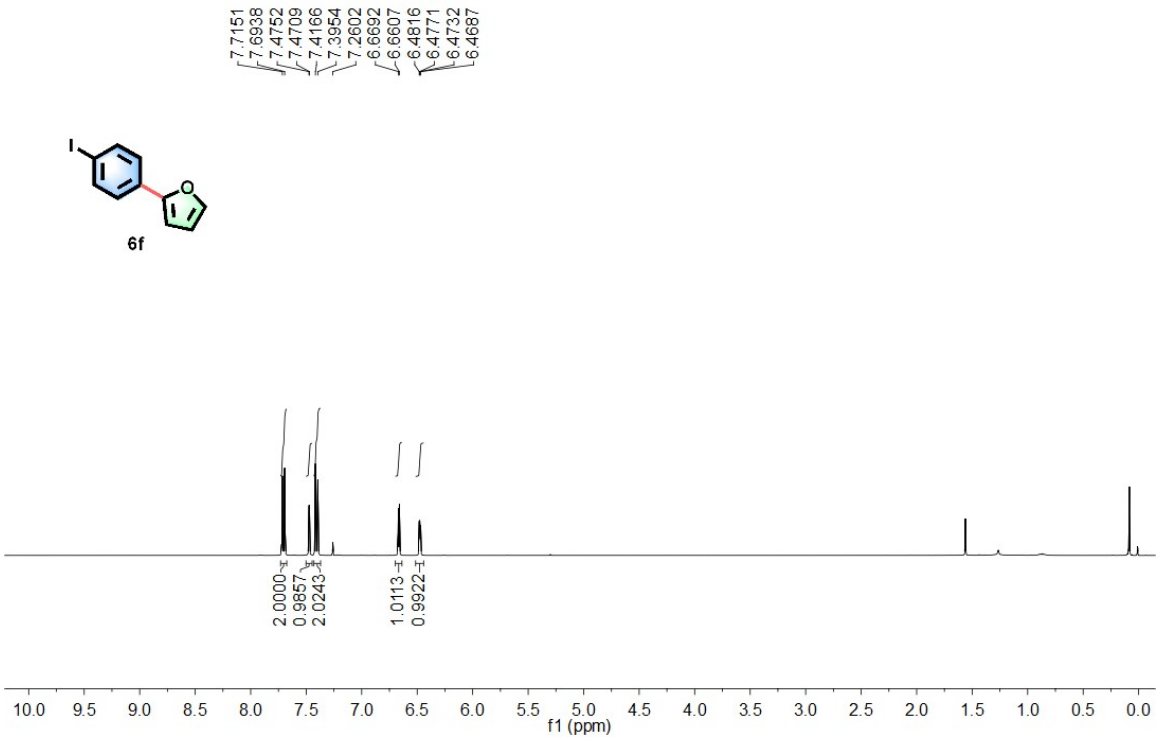
131.325
128.867
128.490
127.480
119.720
111.523
110.682
77.477
77.160
76.842
Br
O
6e
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.4709
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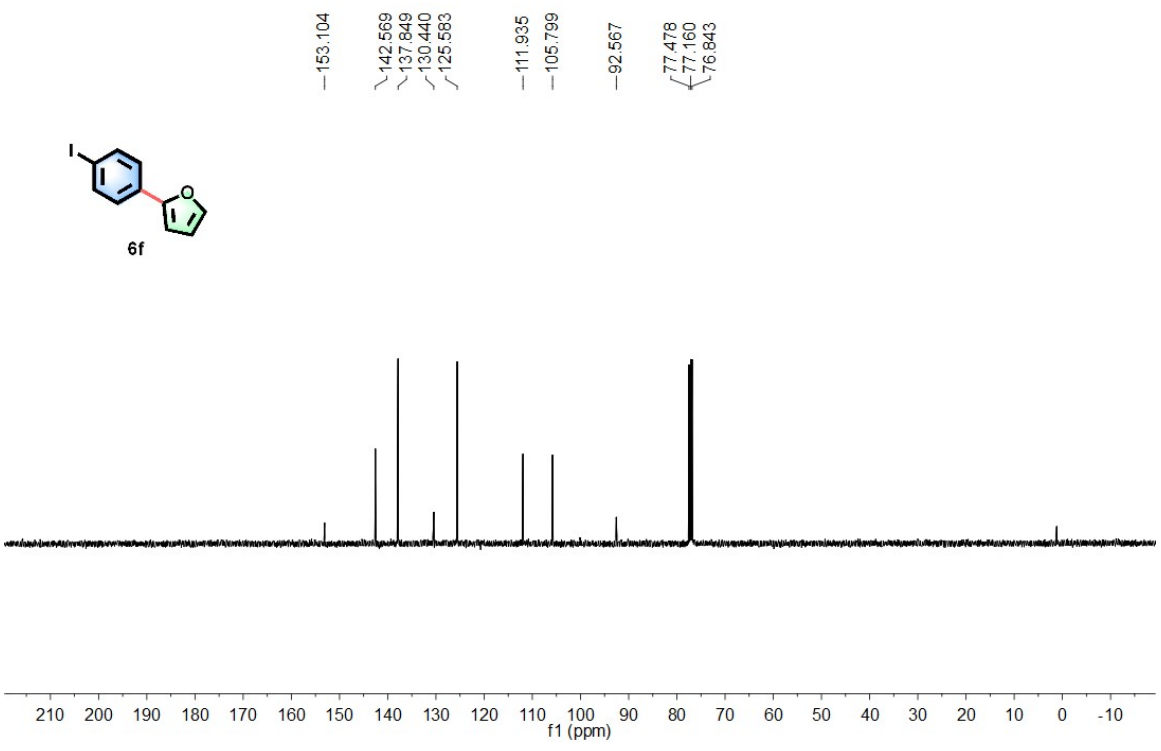
7.3954
7.2602
6.6692
6.6607
6.4816
6.4771
6.4732
6.4687
I
O
6f
2.0000
0.9857
2.0243
1.0113
0.9922
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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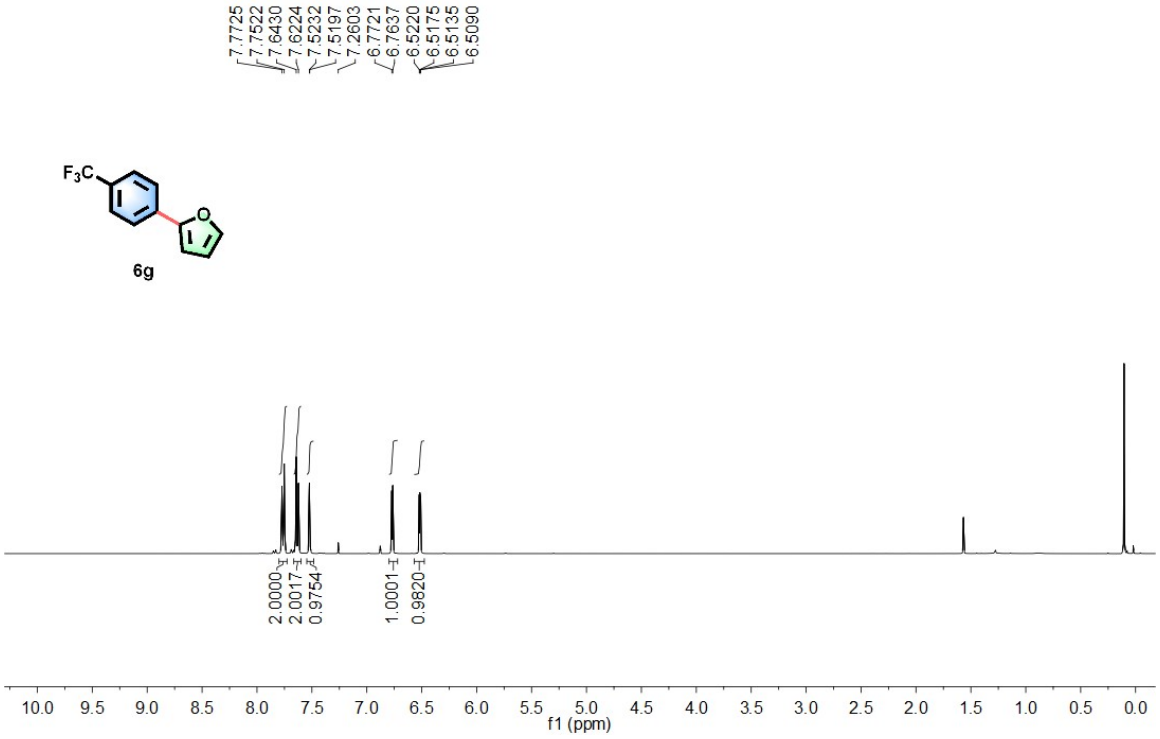
111.935
105.799
92.567
77.478
77.160
76.843
I
O
6f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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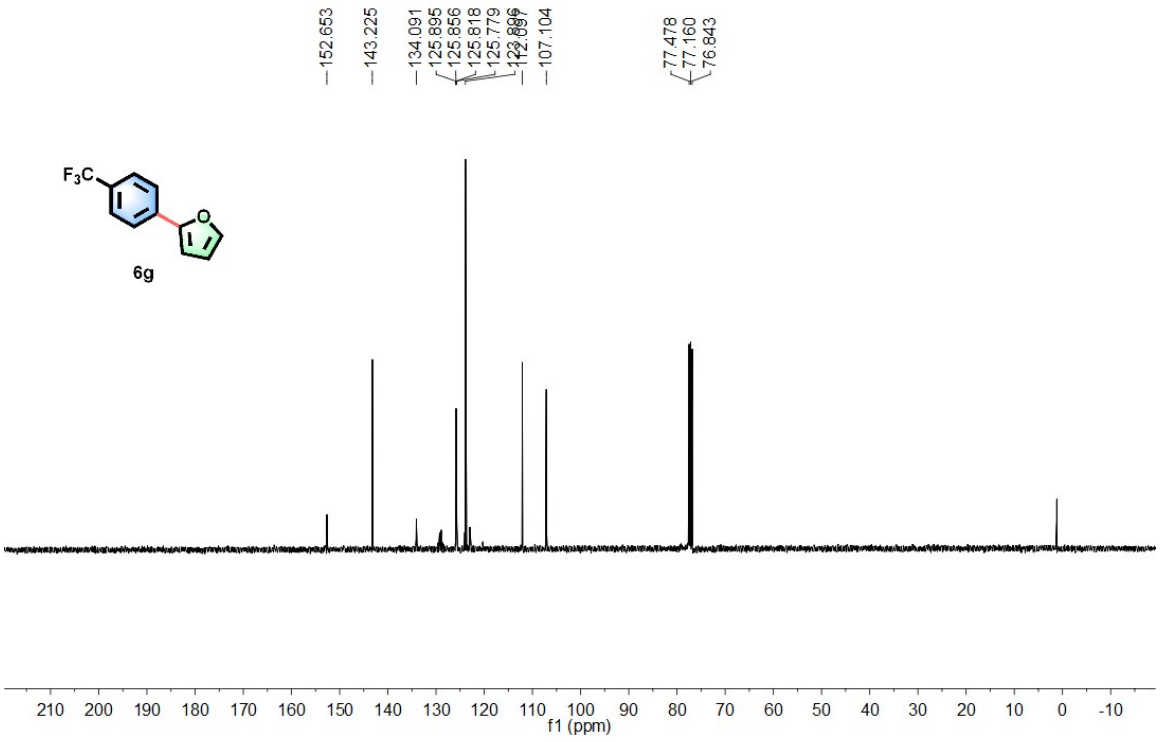
7.6430
7.6224
7.5232
7.5197
7.2603
6.7721
6.7637
6.5220
6.5175
6.5135
6.5090
F3C
6g
2.0000
2.0017
0.9754
1.0001
0.9820
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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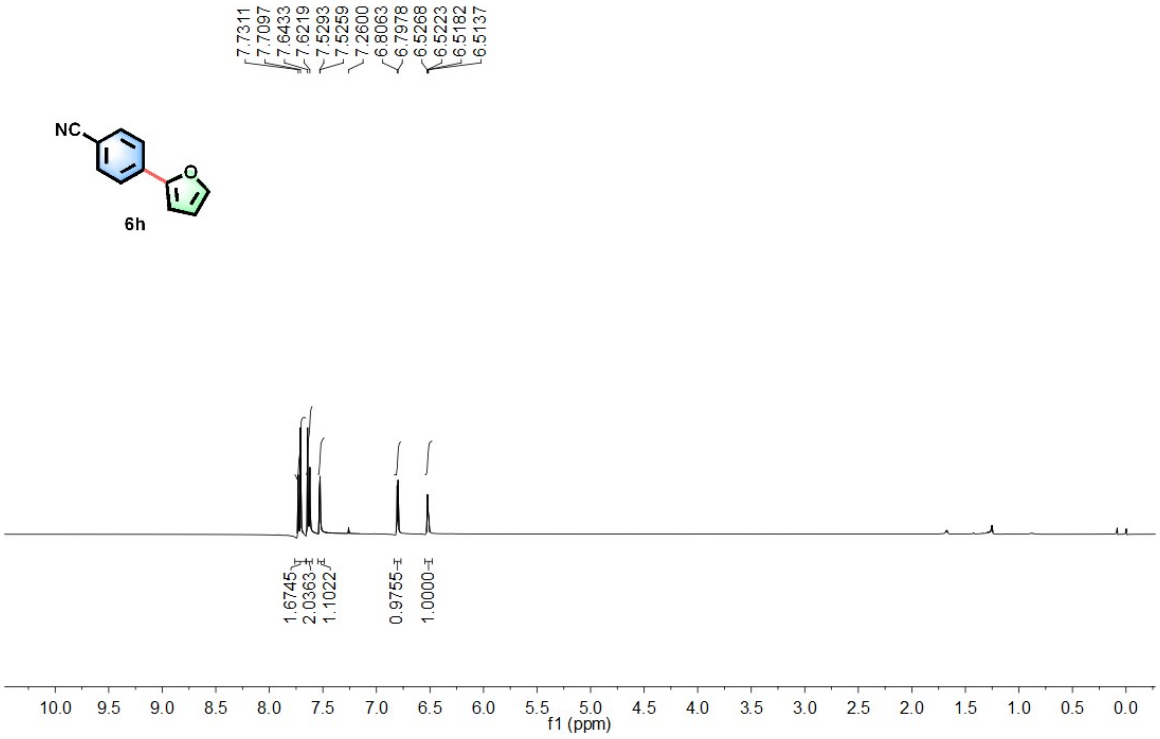
125.818
125.779
123.896
122.697
107.104
77.478
77.160
76.843
F3C
6g
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.2600
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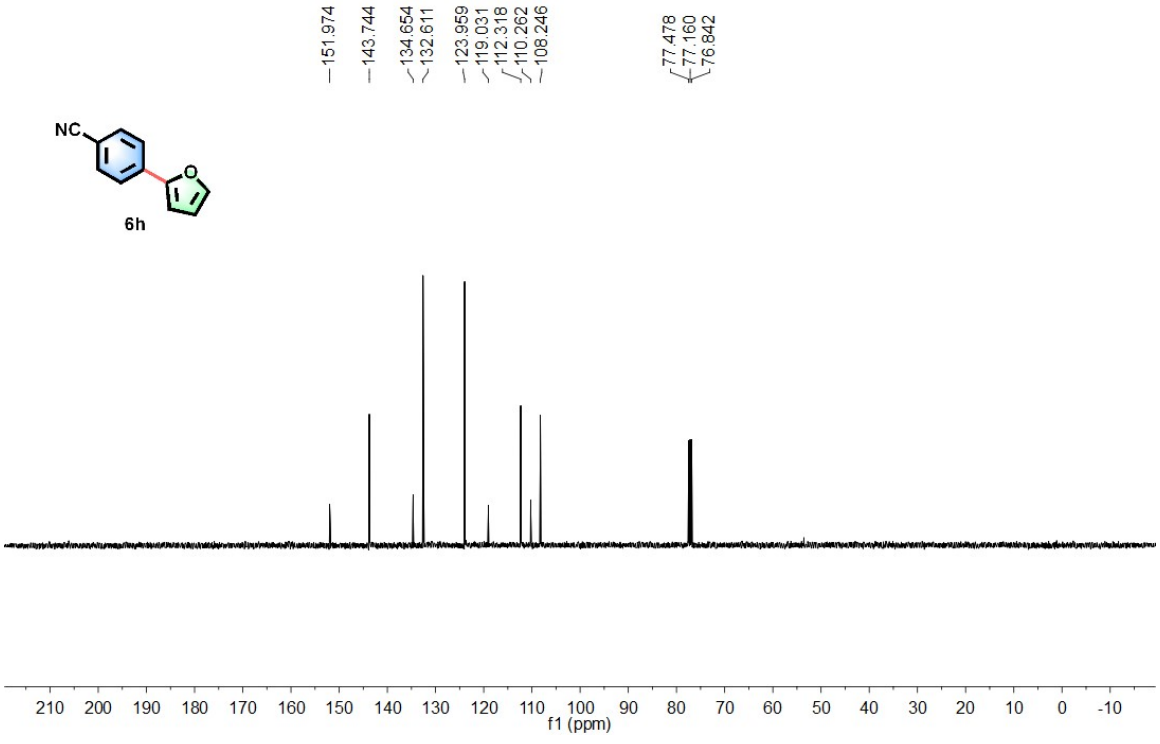
6.7978
6.5268
6.5223
6.5182
6.5137
NC
O
6h
1.6745
2.0363
1.1022
0.9755
1.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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110.262
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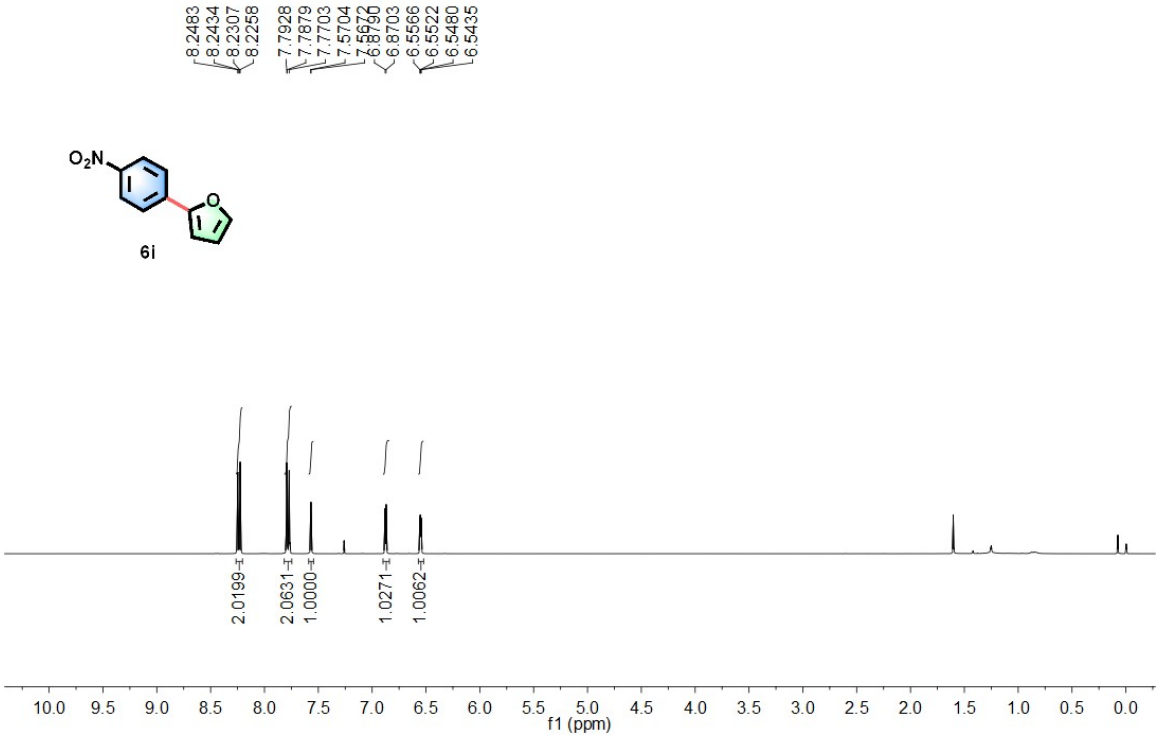
76.842
NC
O
6h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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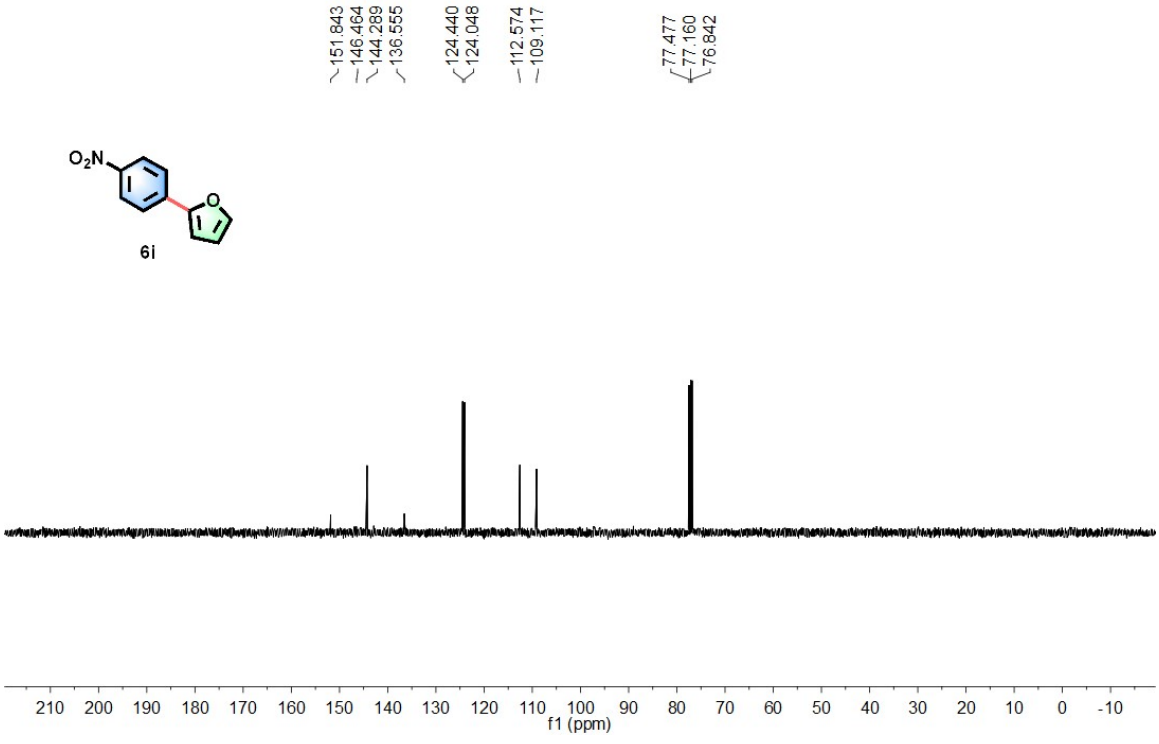
6.8703
6.5566
6.5522
6.5480
6.5435
O2N
O
6i
2.0199
2.0631
1.0000
1.0271
1.0062
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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124.048
112.574
109.117
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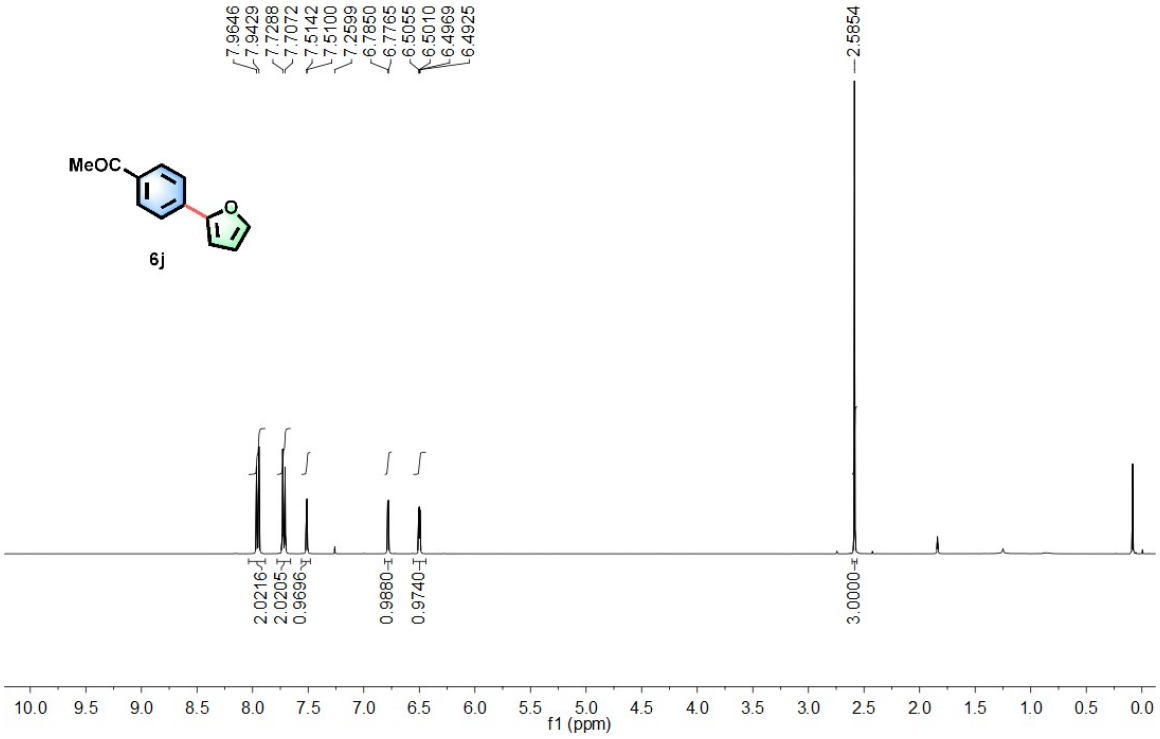
76.842
O2N
O
6i
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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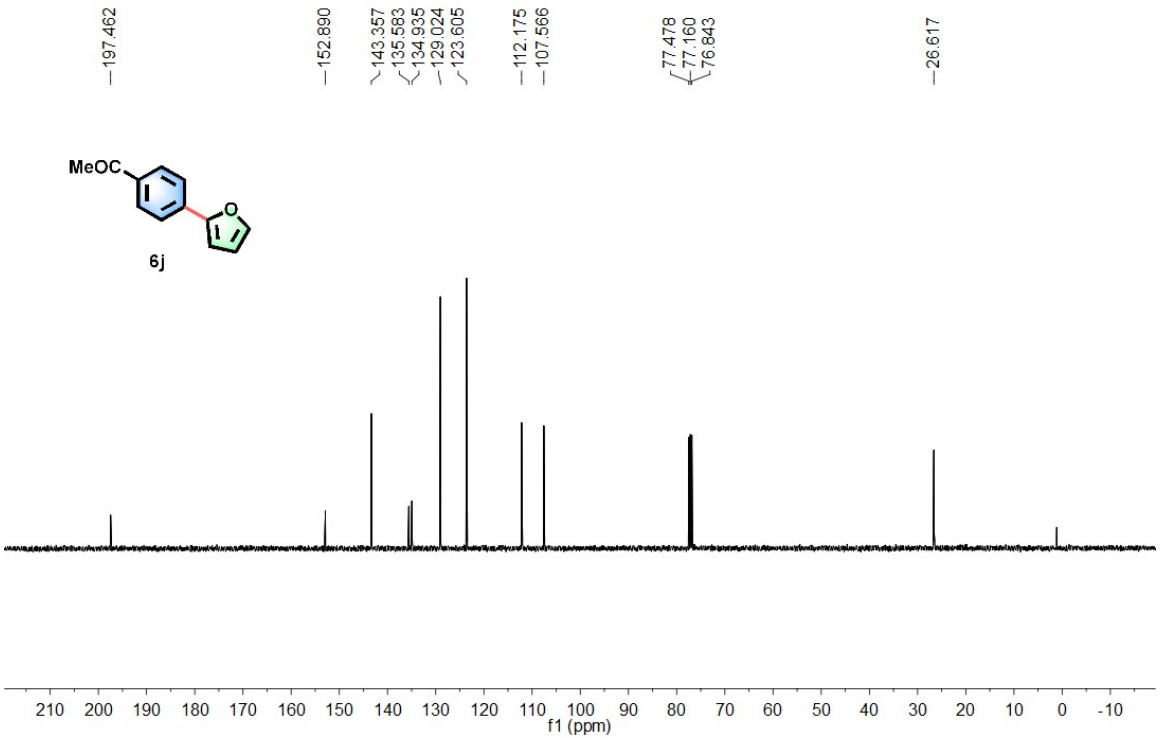
6.5010
6.4969
6.4925
2.5854
MeOC
O
6j
2.0216
2.0205
0.9696
0.9880
0.9740
3.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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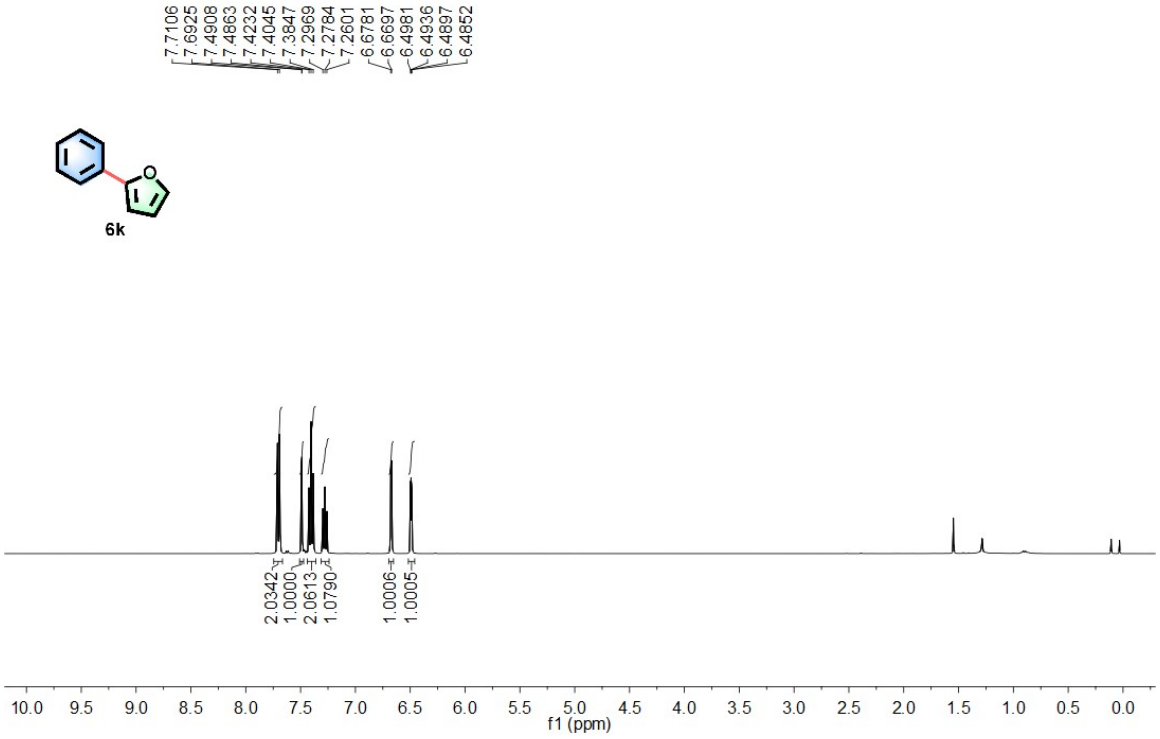
107.566
77.478
77.160
76.843
26.617
MeOC
O
6j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.2784
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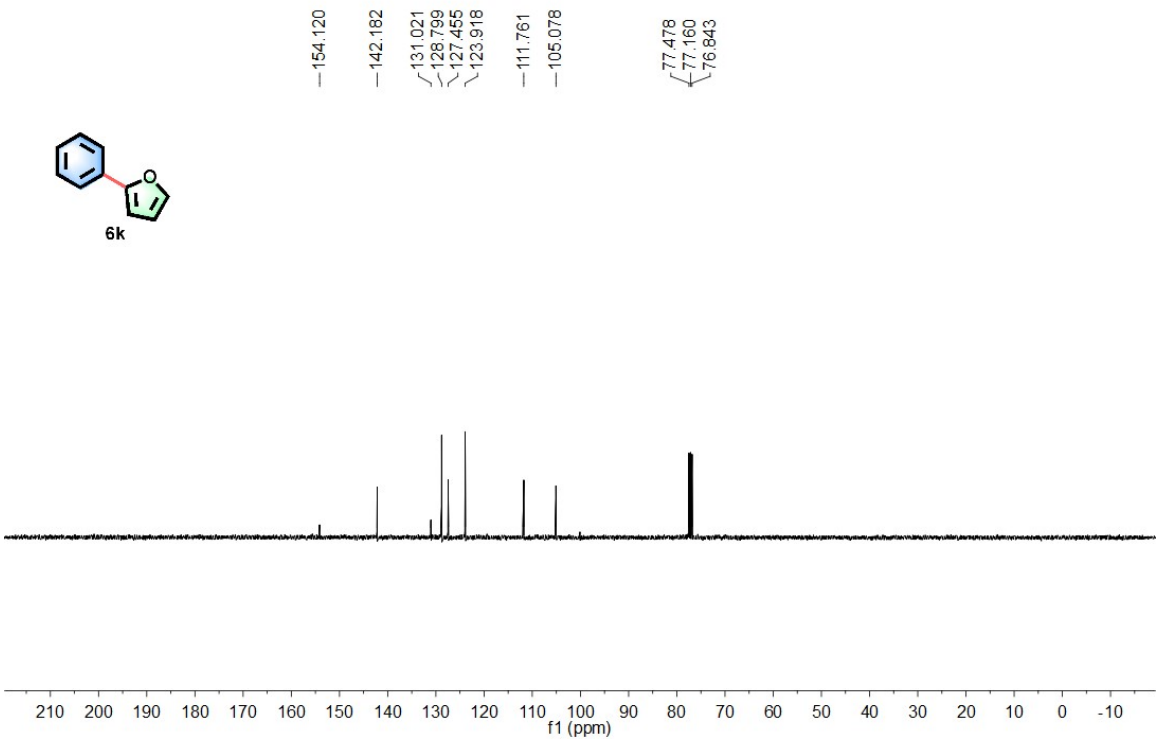
6.6697
6.4981
6.4936
6.4897
6.4852
6k
2.0342
1.0000
2.0613
1.0790
1.0006
1.0005
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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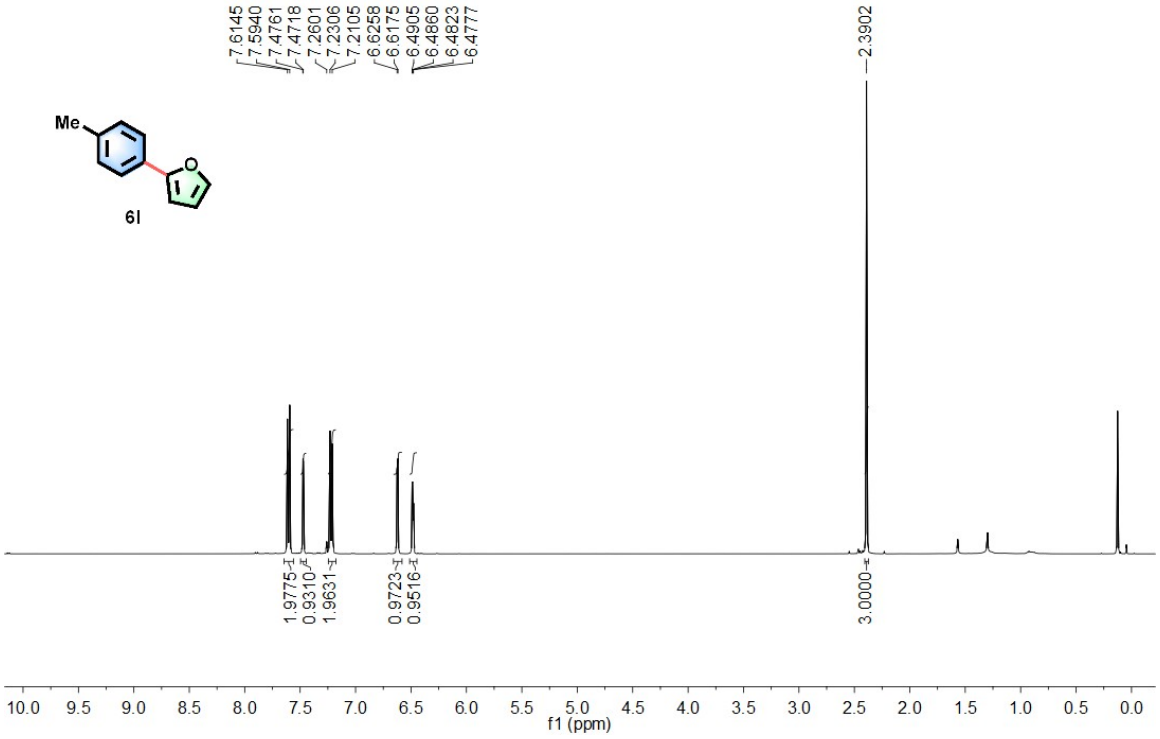
76.843
6k
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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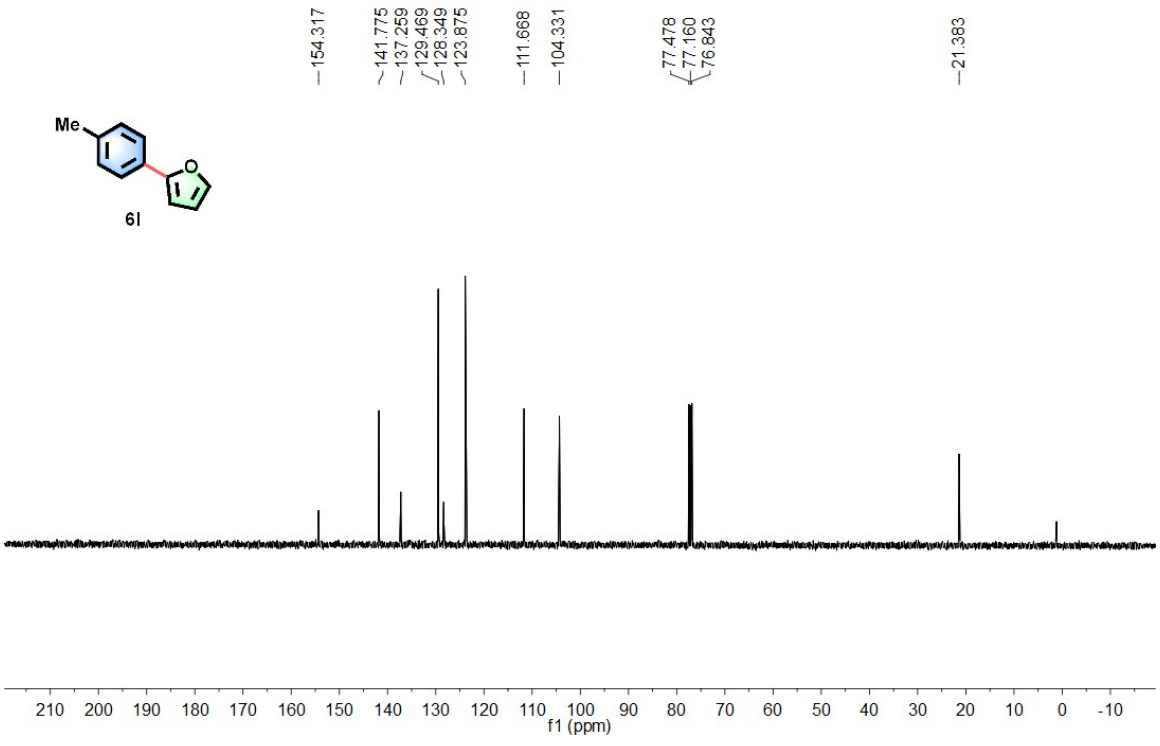
7.5940
7.4761
7.4718
7.2601
7.2306
7.2105
6.6258
6.6175
6.4905
6.4860
6.4823
6.4777
2.3902
Me
O
6l
1.9775
0.9310
1.9631
0.9723
0.9516
3.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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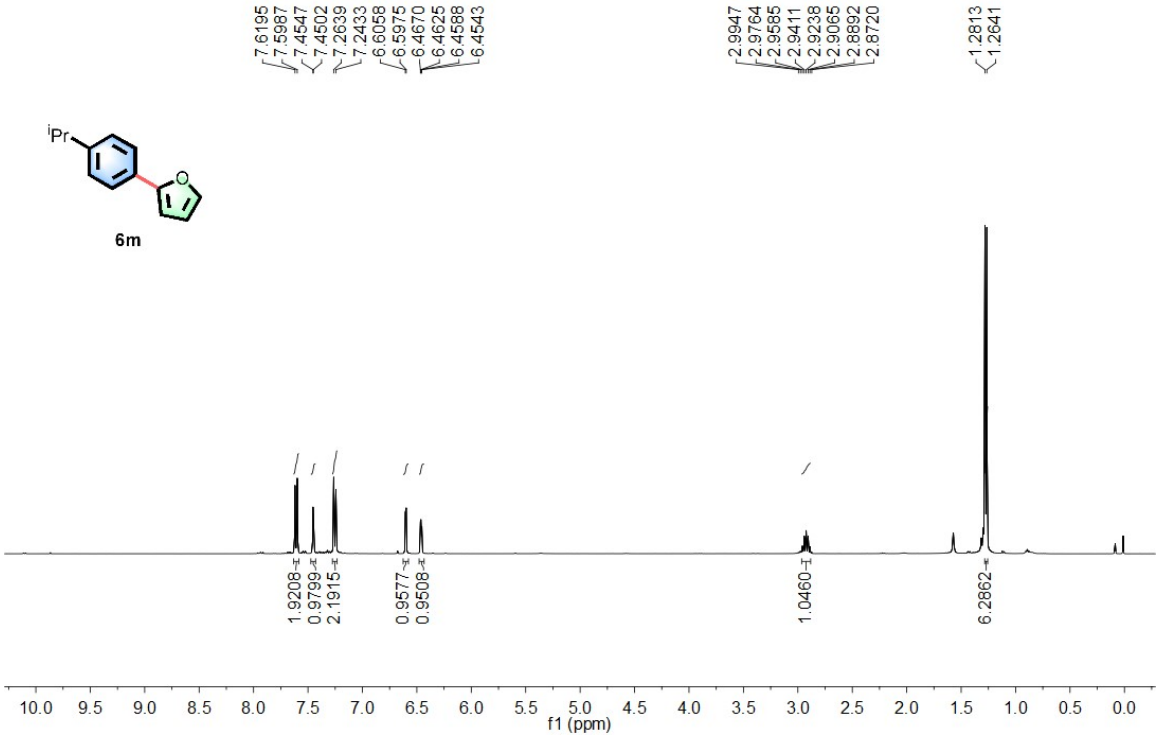
141.775
137.259
129.469
128.349
123.875
111.668
104.331
77.478
77.160
76.843
21.383
Me
O
6l
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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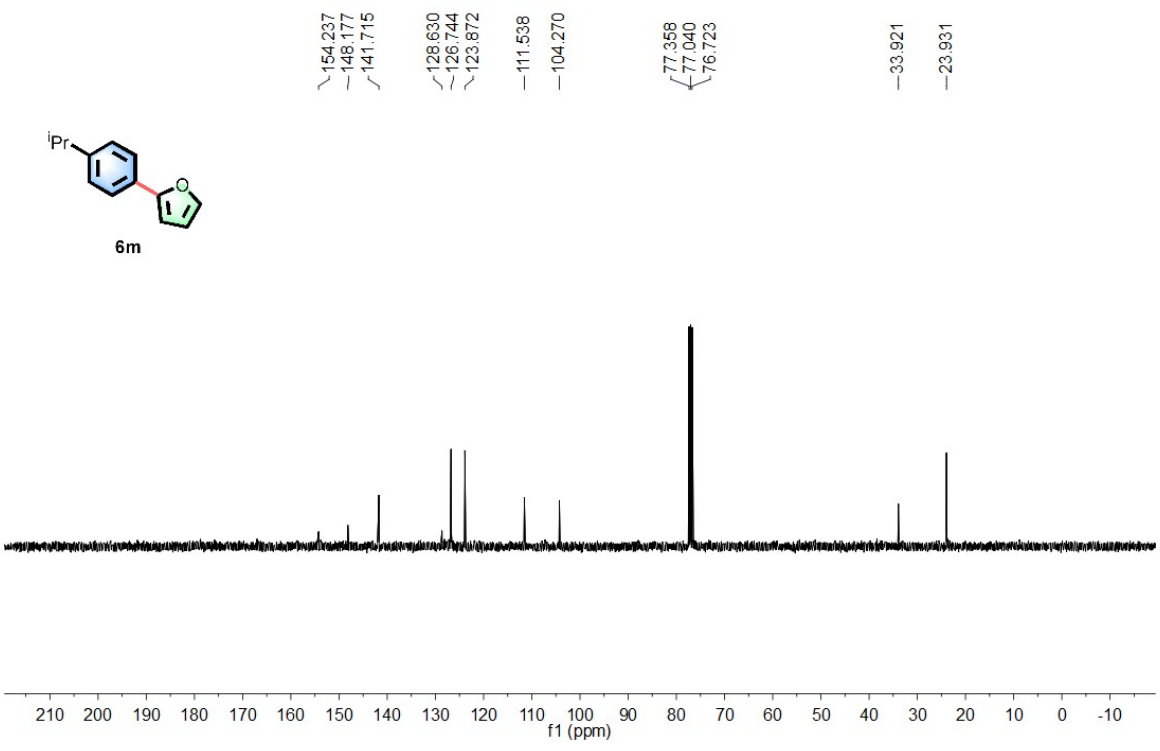
7.4547
7.4502
7.2639
7.2433
6.6058
6.5975
6.4670
6.4625
6.4588
6.4543
2.9947
2.9764
2.9585
2.9411
2.9238
2.9065
2.8892
2.8720
1.2813
1.2641
iPr
O
6m
1.9208
0.9799
2.1915
0.9577
0.9508
1.0460
6.2862
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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141.715
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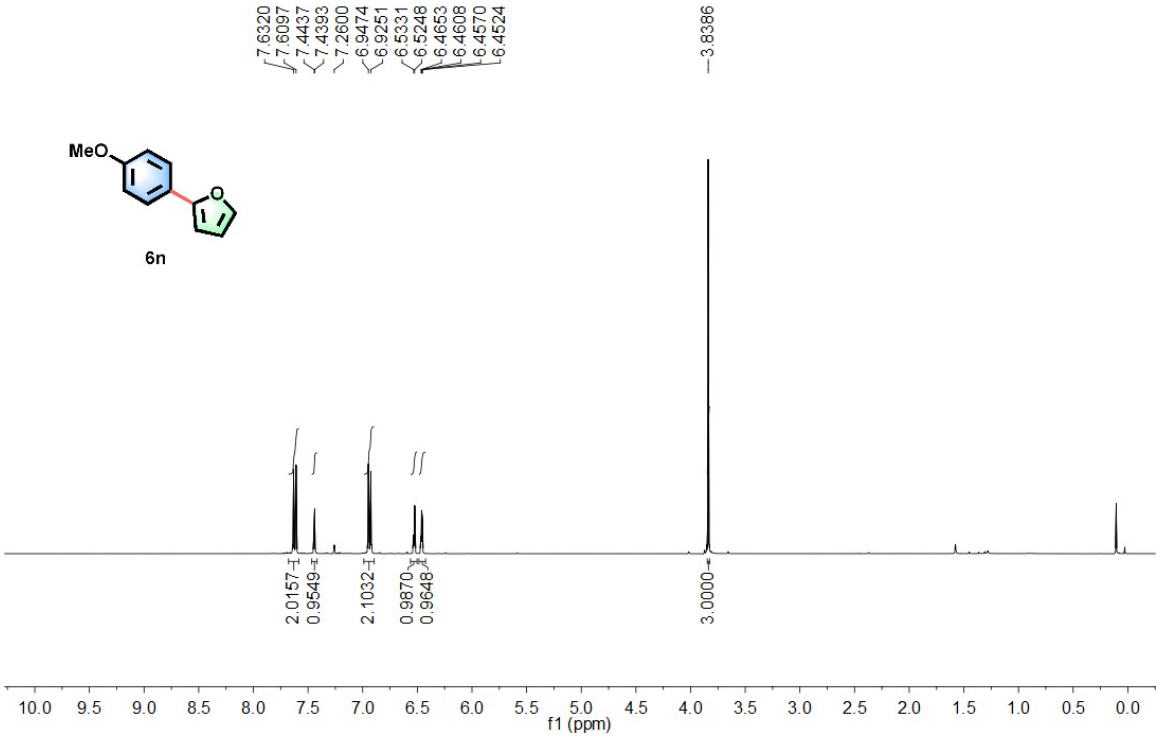
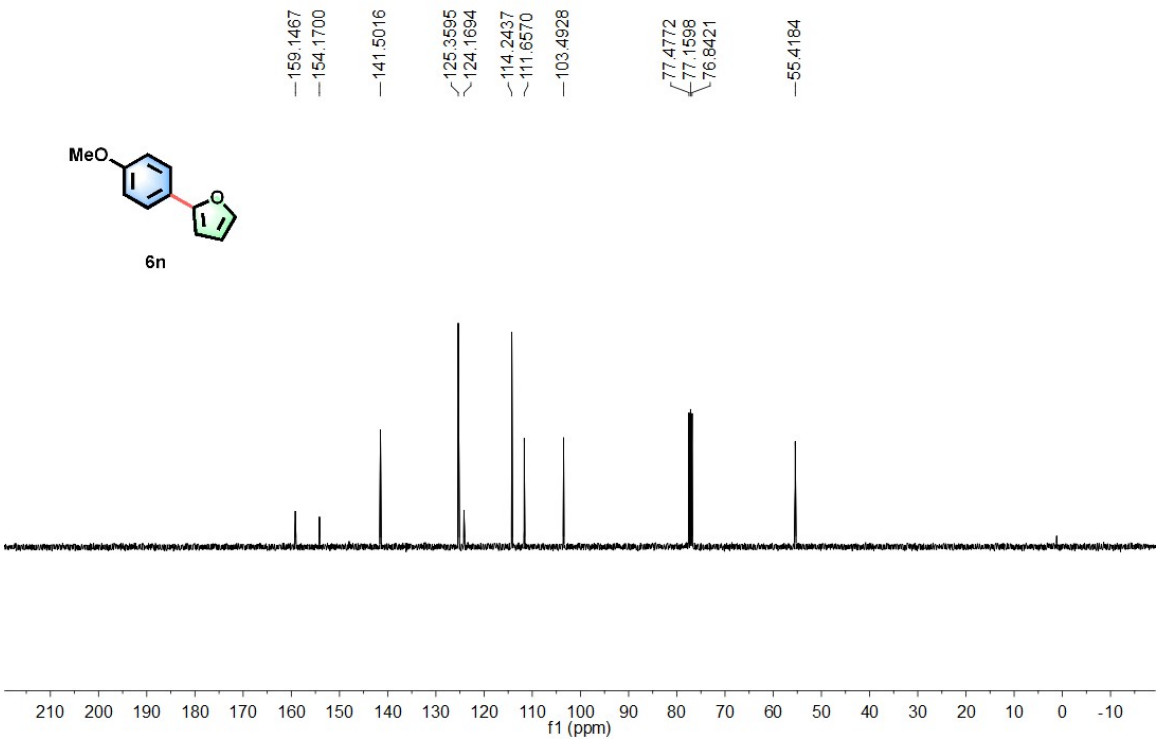
123.872
111.538
104.270
77.358
77.040
76.723
33.921
23.931
iPr
O
6m
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.6320
7.6097
7.4437
7.4393
7.2600
6.9474
6.9251
6.5331
6.5248
6.4653
6.4608
6.4570
6.4524
3.8386
MeO
O
6n
2.0157
0.9549
2.1032
0.9870
0.9648
3.0000
10.0 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 0.0
f1 (ppm)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141.5016
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124.1694
114.2437
111.6570
103.4928
77.4772
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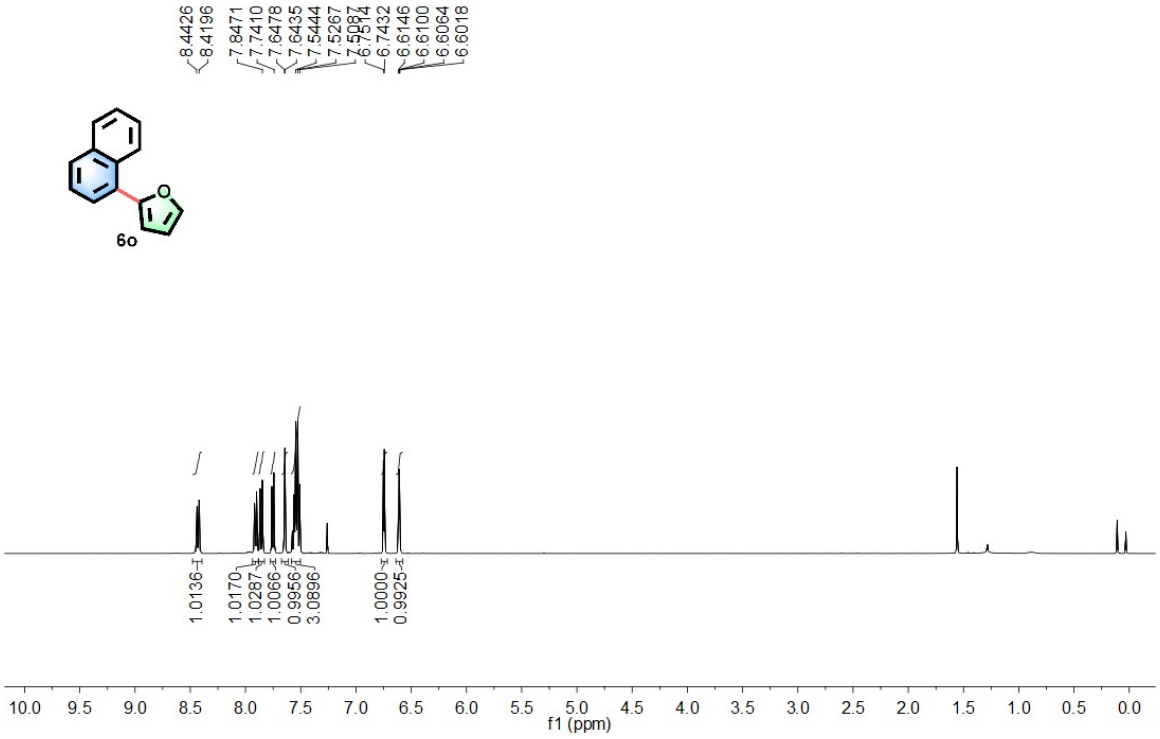
76.8421
55.4184
MeO
O
6n
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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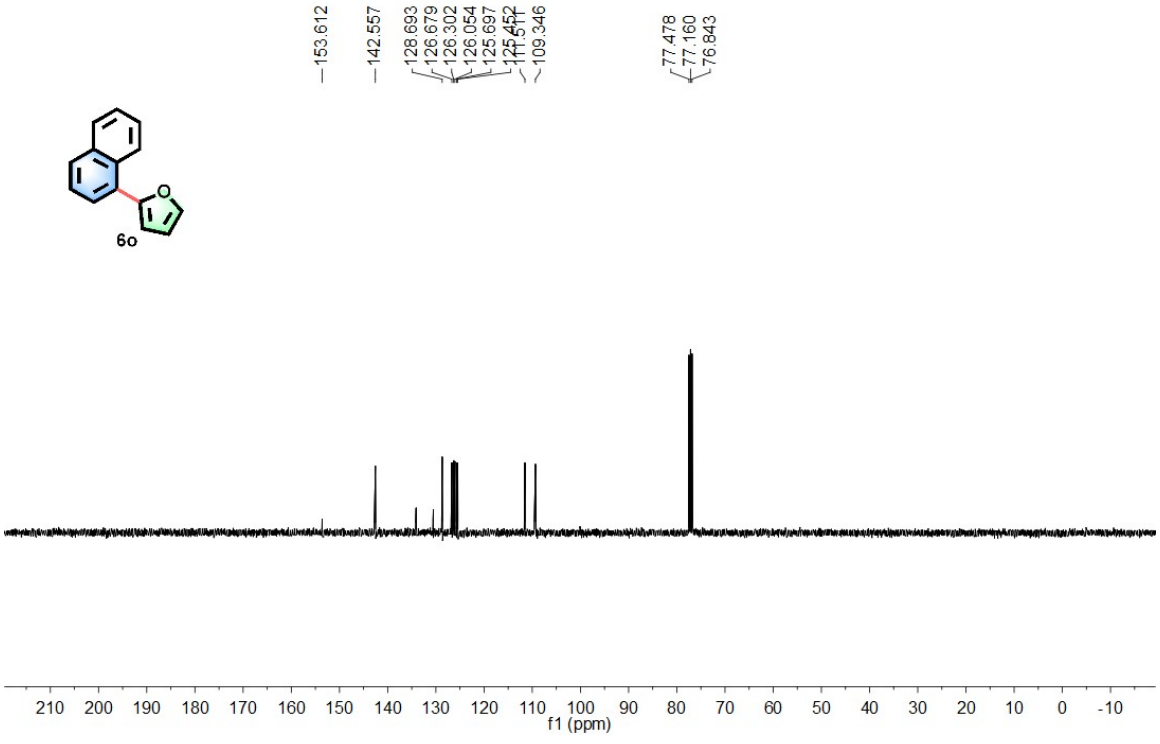
8.4196
7.8471
7.7410
7.6478
7.6435
7.5444
7.5267
7.5087
7.5014
6.7432
6.6146
6.6100
6.6064
6.6018
6o
1.0136
1.0170
1.0287
1.0066
0.9956
3.0896
1.0000
0.9925
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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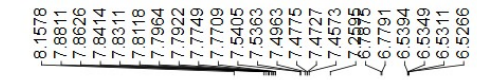
142.557
128.693
126.679
126.302
126.054
125.697
111.511
109.346
77.478
77.160
76.843
6o
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.1578
7.8811
7.8626
7.8414
7.8311
7.8118
7.7964
7.7922
7.7749
7.7709
7.5405
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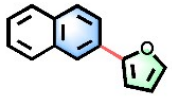
6.7791
6.5394
6.5349
6.5311
6.5266



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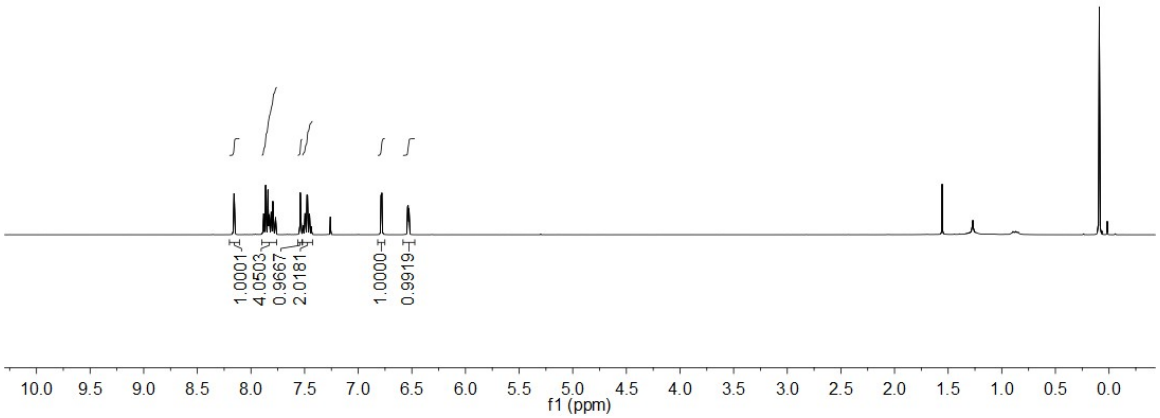
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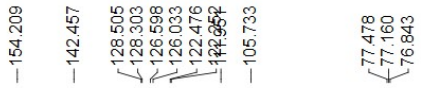
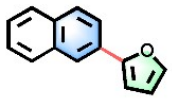
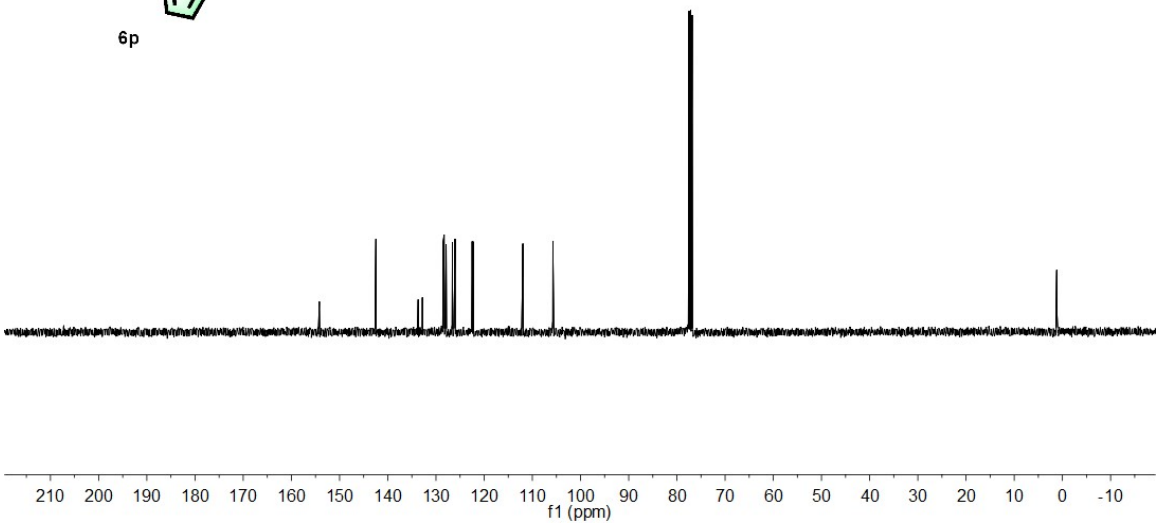
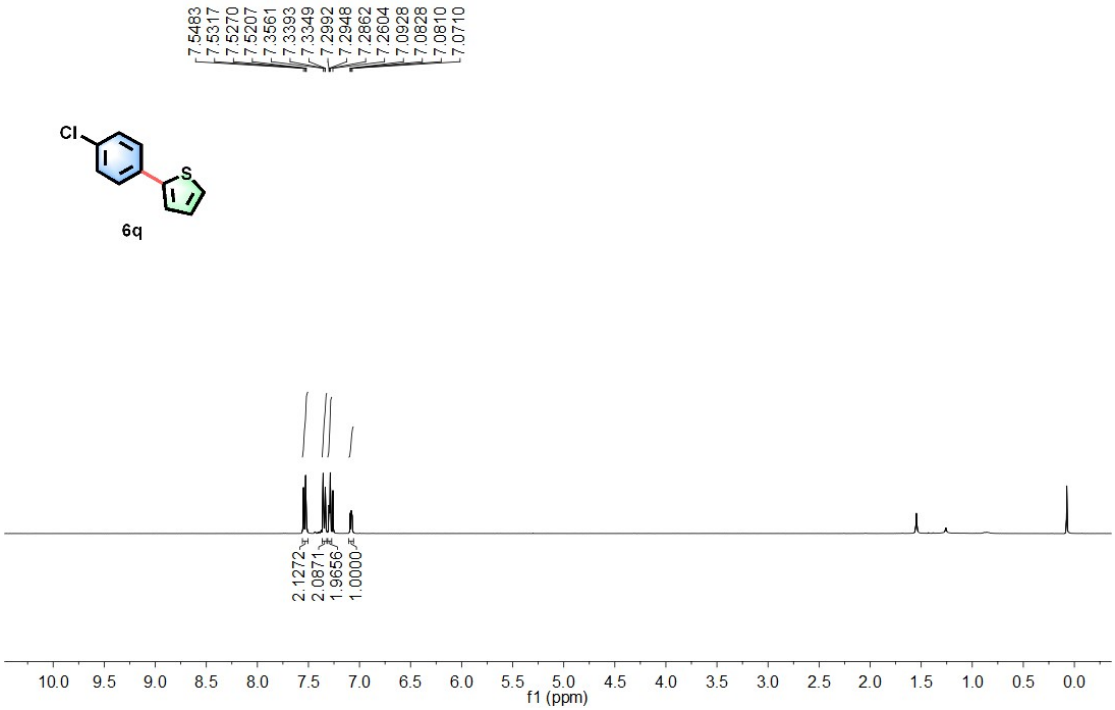
4.0503
0.9667
2.0181
1.0000
0.9919
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


154.209
142.457
128.505
128.303
126.598
126.033
122.476
105.733
77.478
77.160
76.843



6p


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.3393
7.3349
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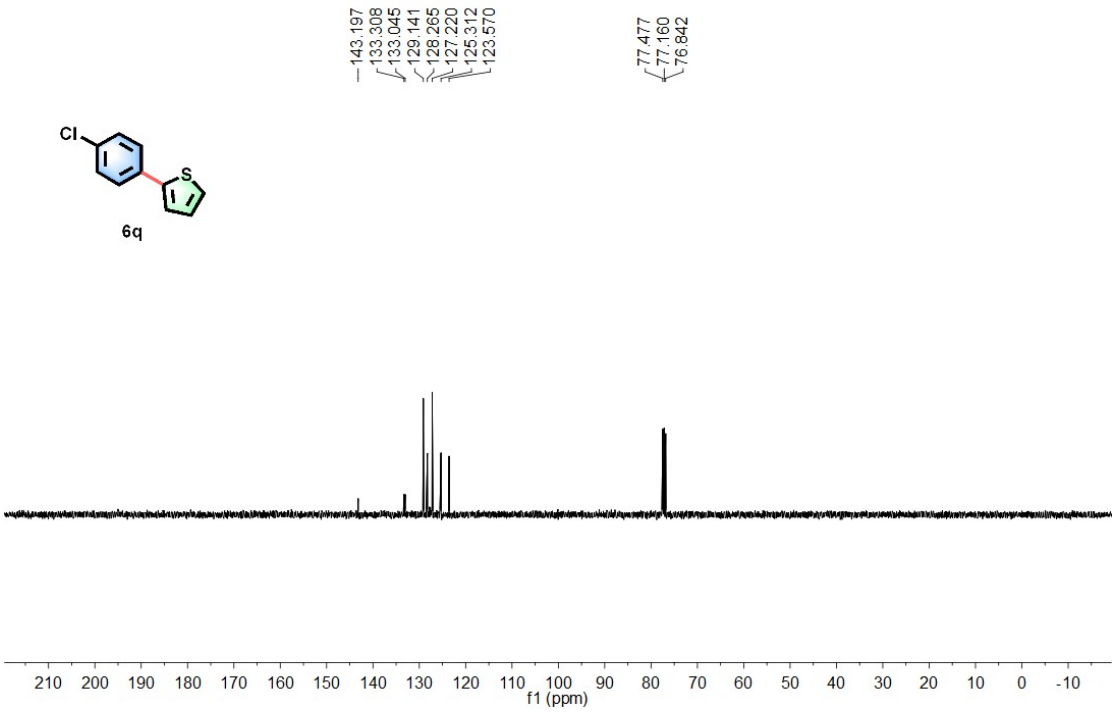
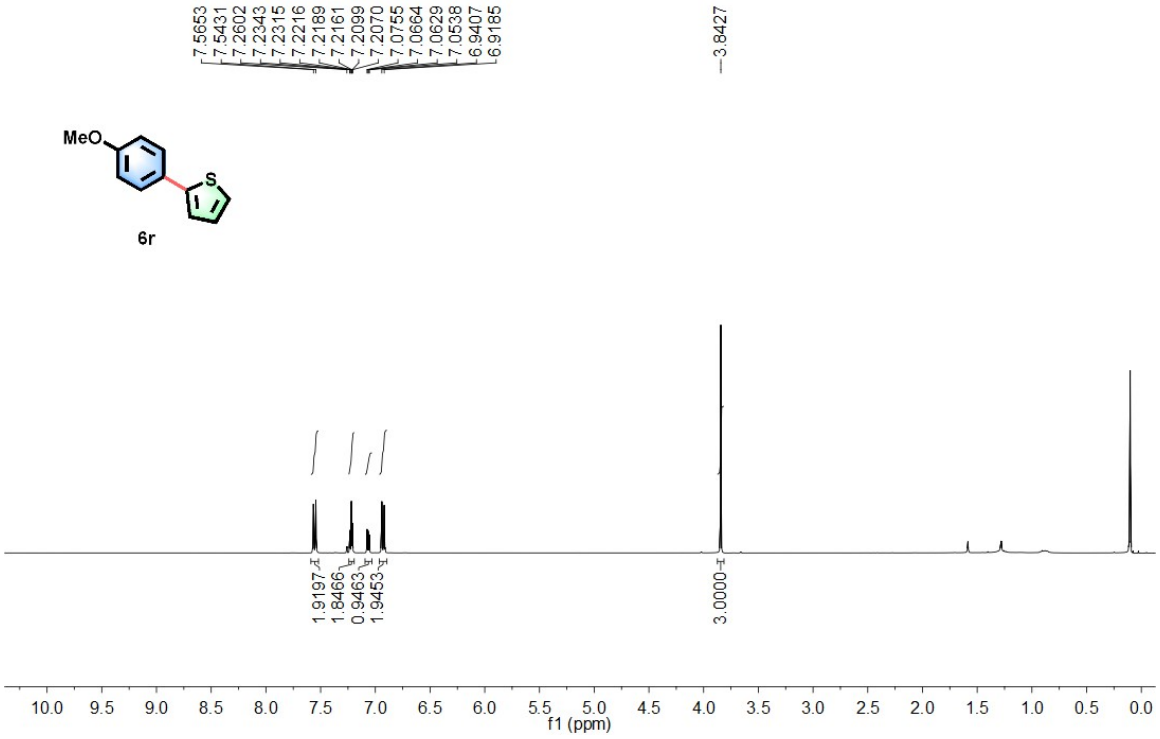
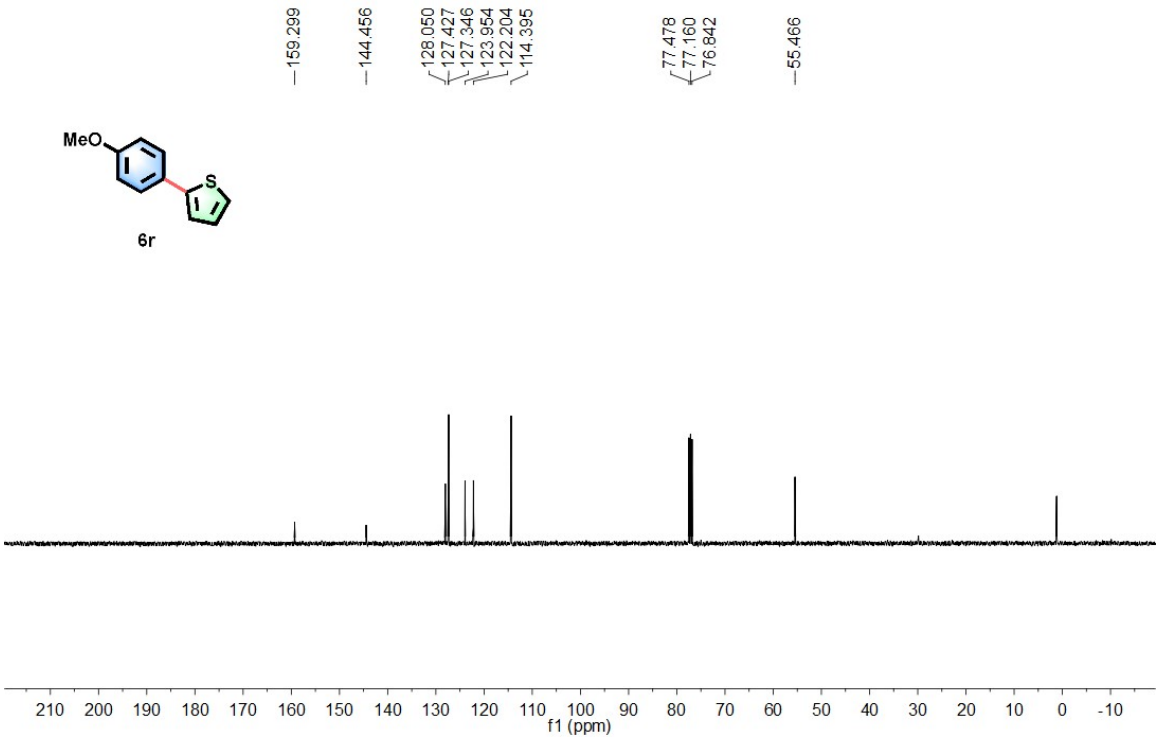
7.2948
7.2862
7.2604
7.0928
7.0828
7.0810
7.0710
Cl
S
6q
2.1272
2.0871
1.9656
1.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


143.197
133.308
133.045
129.141
128.265
127.220
125.312
123.570
77.477
77.160
76.842
Cl
S
6q
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.5653
7.5431
7.2602
7.2343
7.2315
7.2216
7.2189
7.2161
7.2099
7.2070
7.0755
7.0664
7.0629
7.0538
6.9407
6.9185
3.8427
MeO
S
6r
1.9197
1.8466
0.9463
1.9453
3.0000
10.0 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 0.0
f1 (ppm)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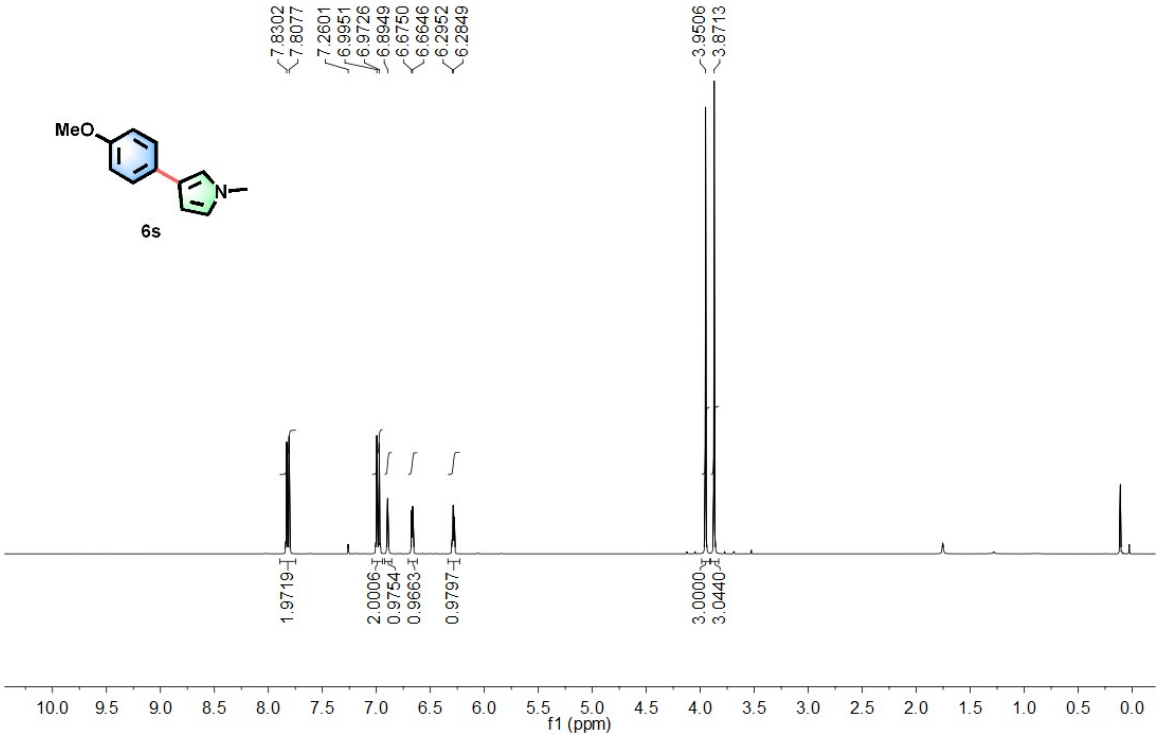
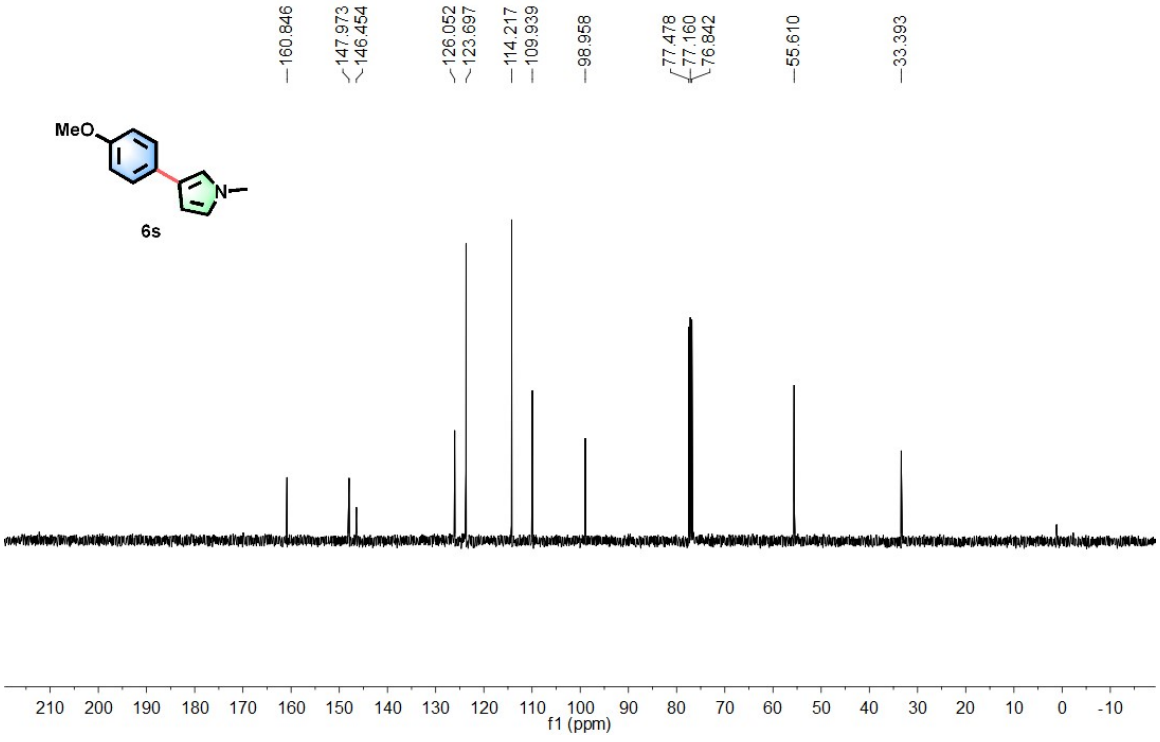
127.346
123.954
122.204
114.395
77.478
77.160
76.842
55.466
MeO
S
6r
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.8302
7.8077
7.2601
6.9951
6.9726
6.8949
6.6750
6.6646
6.2952
6.2849
3.9506
3.8713
MeO
N
6s
1.9719
2.0006
0.9754
0.9663
0.9797
3.0000
3.0440
10.0 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 0.0
f1 (ppm)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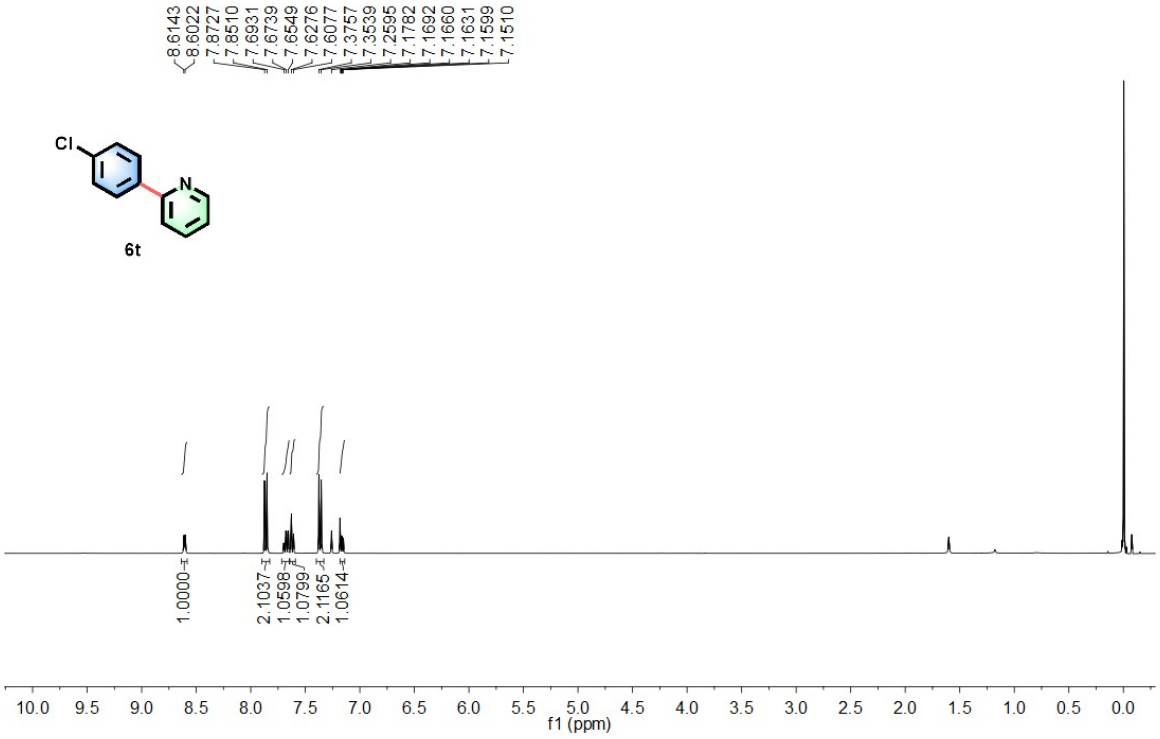
98.958
77.478
77.160
76.842
55.610
33.393
MeO
N
6s
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


8.6143
8.6022
7.8727
7.8510
7.6931
7.6739
7.6549
7.6276
7.6077
7.3757
7.3539
7.2595
7.1782
7.1692
7.1660
7.1631
7.1599
7.1510
Cl
N
6t
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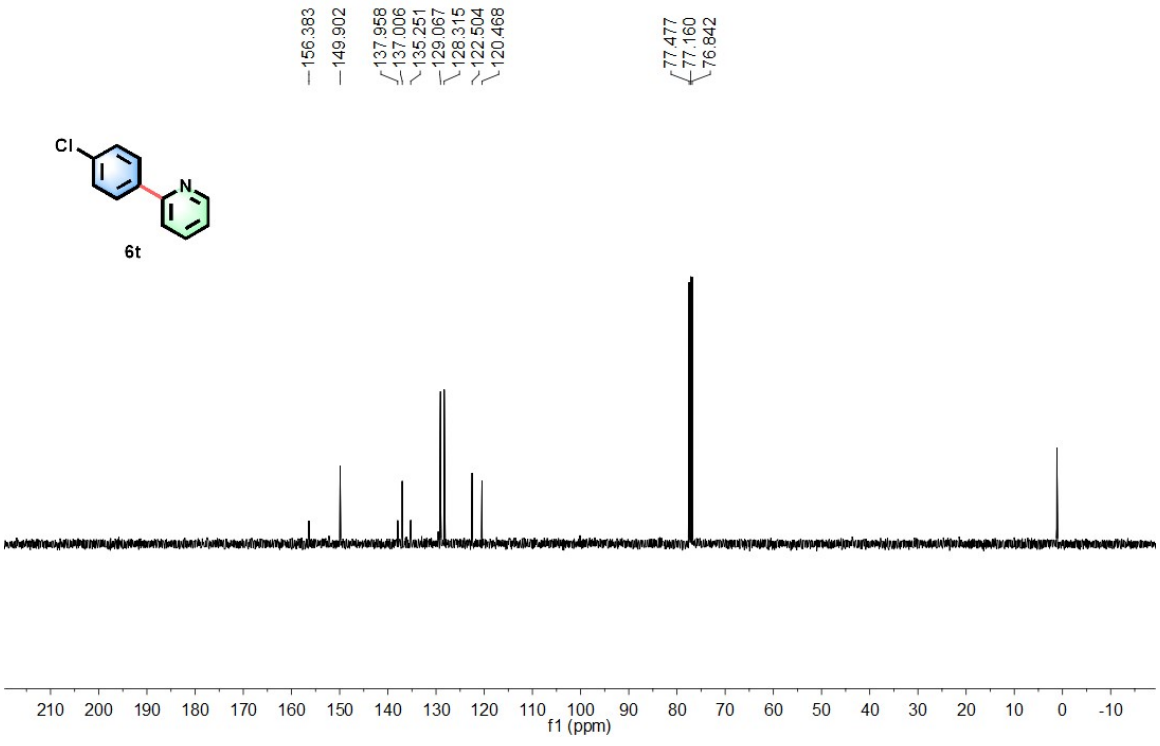
2.1037
1.0598
1.0799
2.1165
1.0614
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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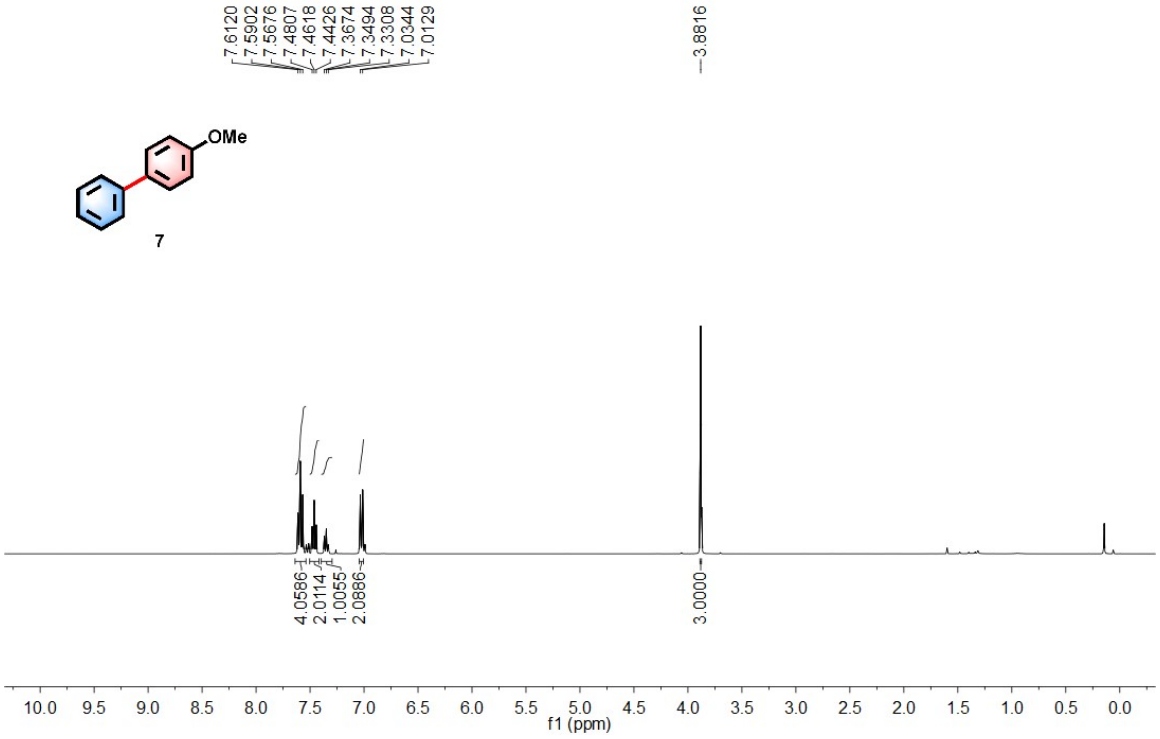
137.958
137.006
135.251
129.067
128.315
122.504
120.468
77.477
77.160
76.842
Cl
N
6t
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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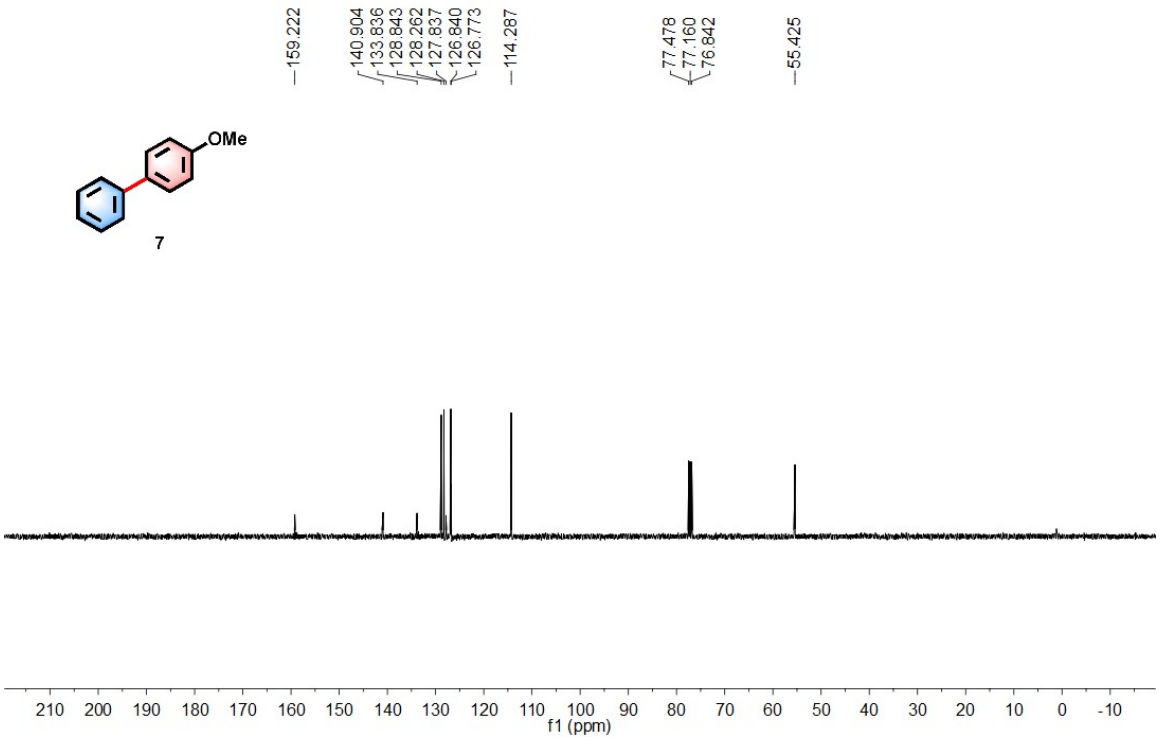
7.4618
7.4426
7.3674
7.3494
7.3308
7.0344
7.0129
3.8816
OMe
7
4.0586
2.0114
1.0055
2.0886
3.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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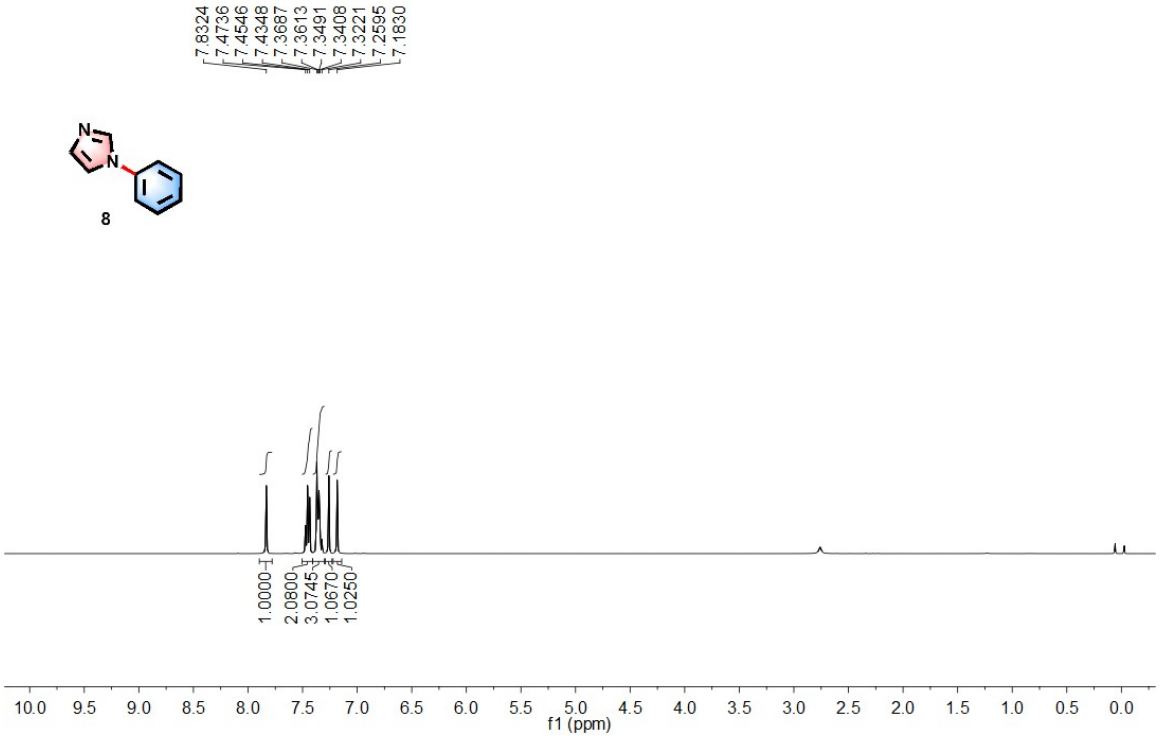
140.904
133.836
128.843
128.262
127.837
126.840
126.773
114.287
77.478
77.160
76.842
55.425
OMe
7
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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7.3221
7.2595
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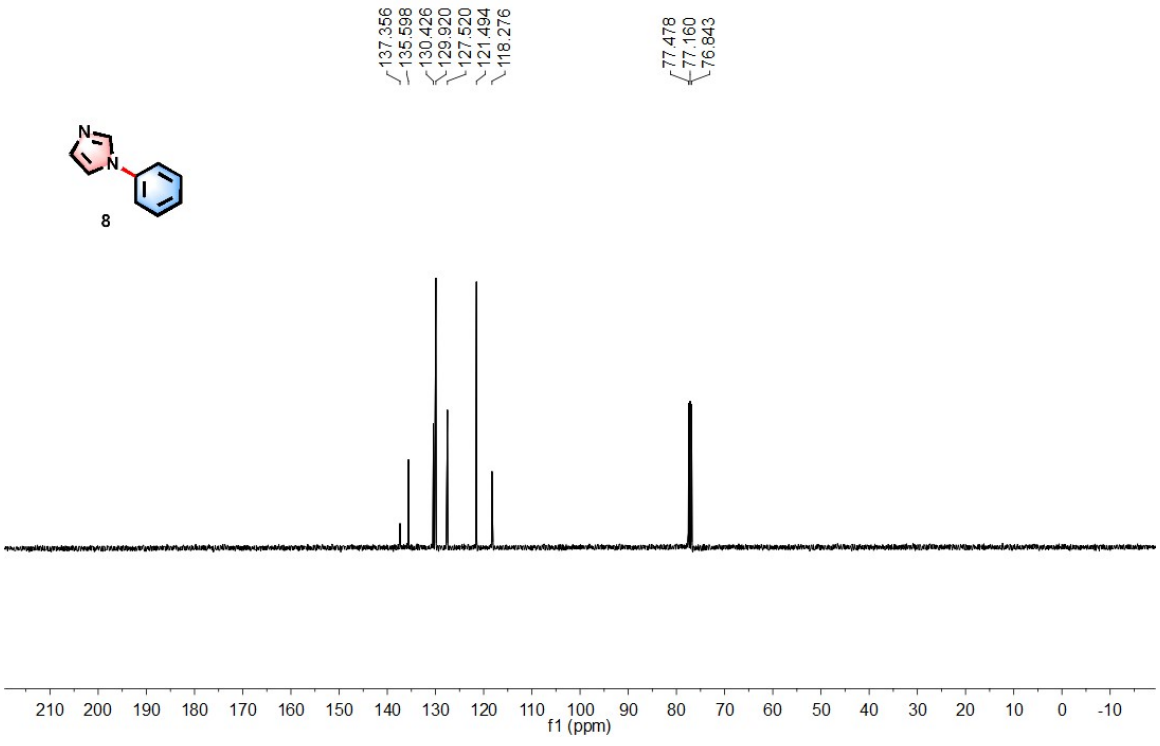
8
1.0000
2.0800
3.0745
1.0670
1.0250
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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127.520
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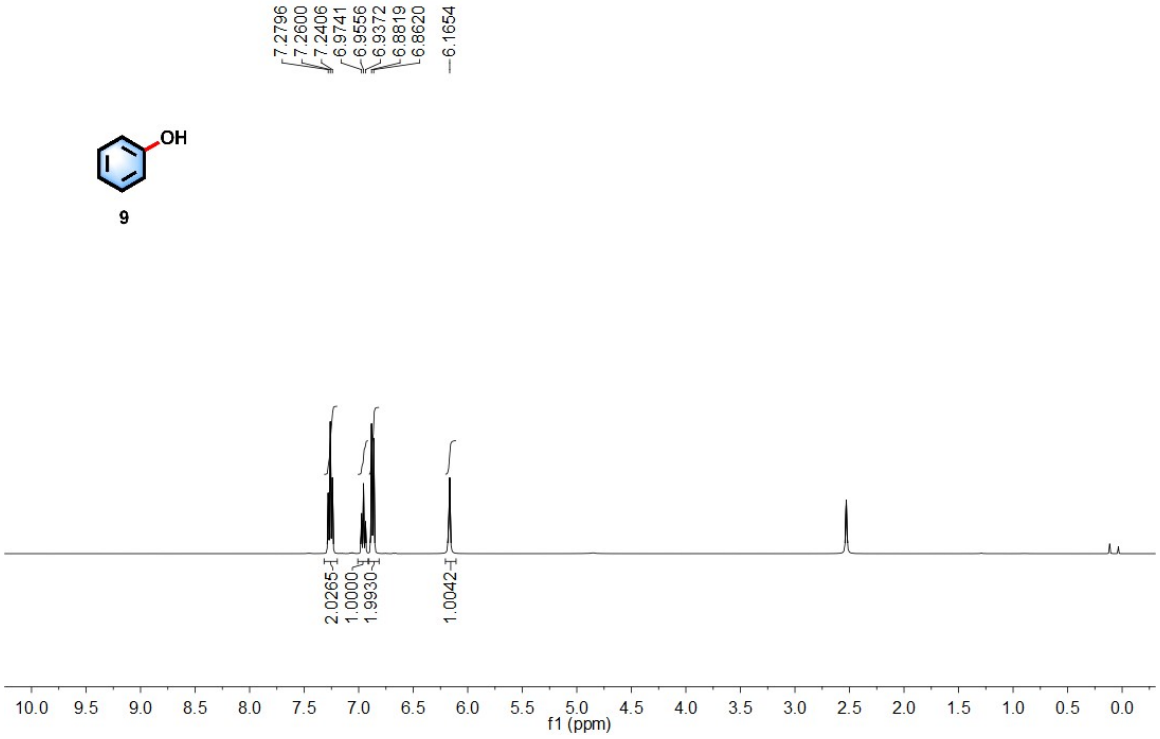
118.276
77.478
77.160
76.843
8
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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6.9741
6.9556
6.9372
6.8819
6.8620
6.1654
OH
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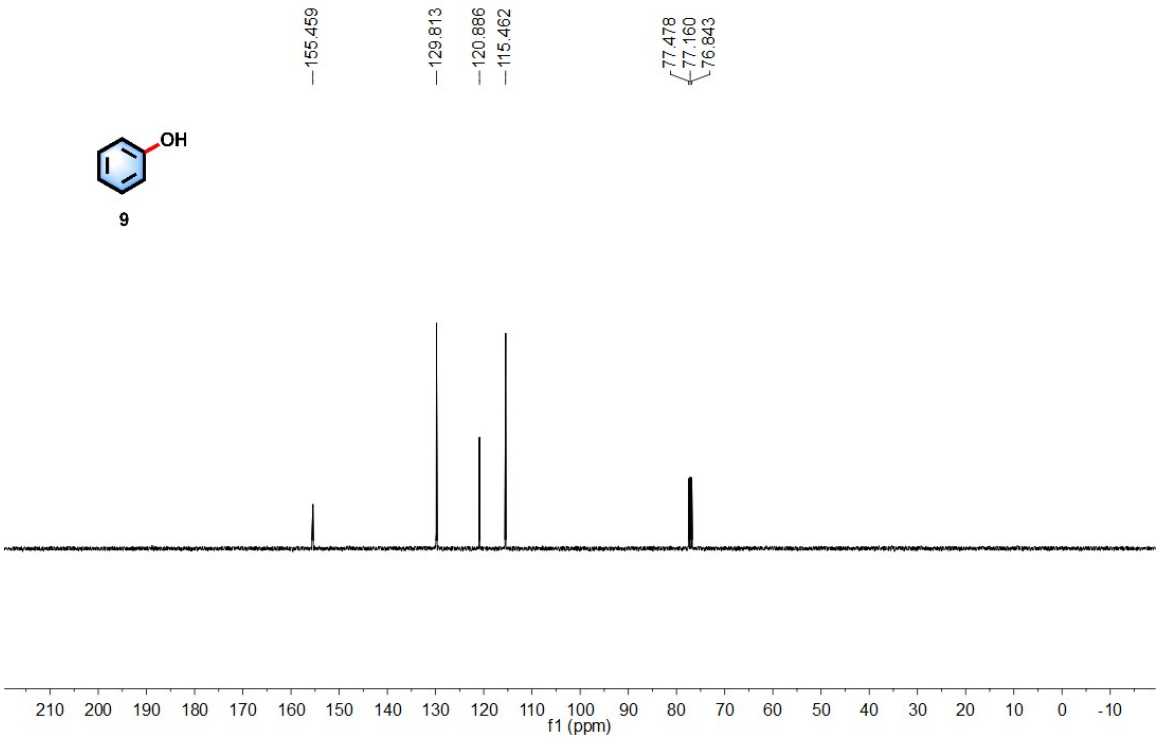
2.0265
1.0000
1.9930
1.0042
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


155.459
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115.462
77.478
77.160
76.843
OH
9
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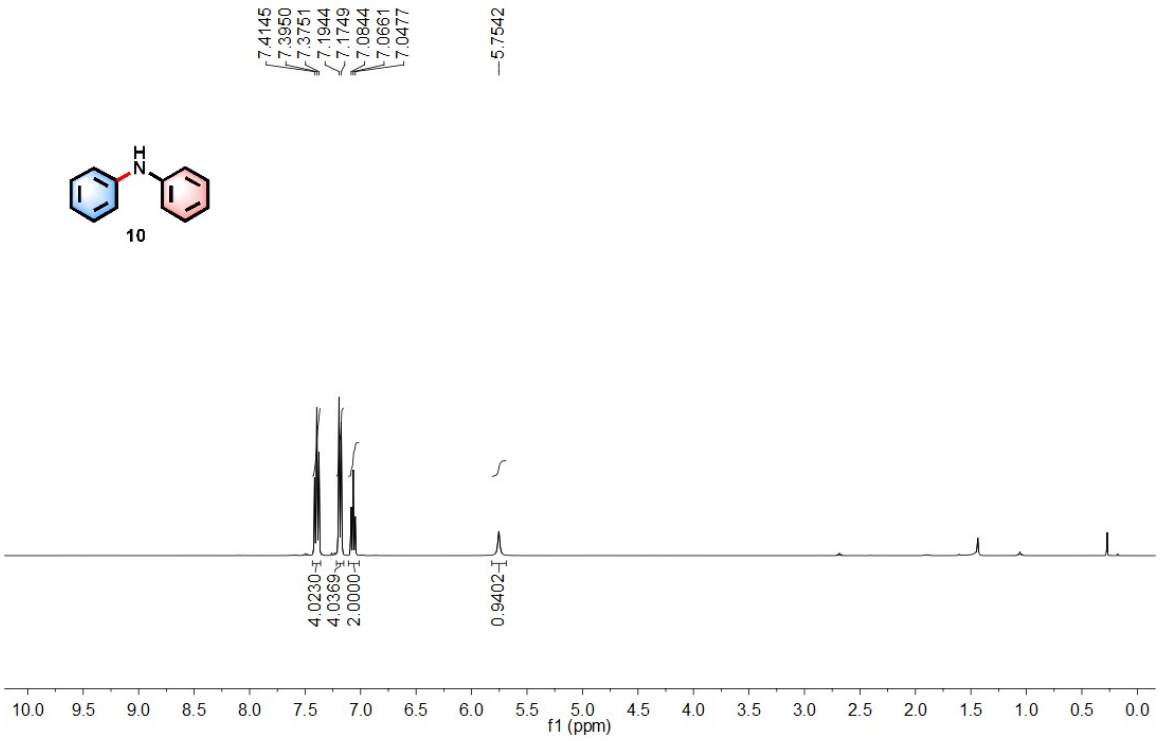
f1 (ppm)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7.3751
7.1944
7.1749
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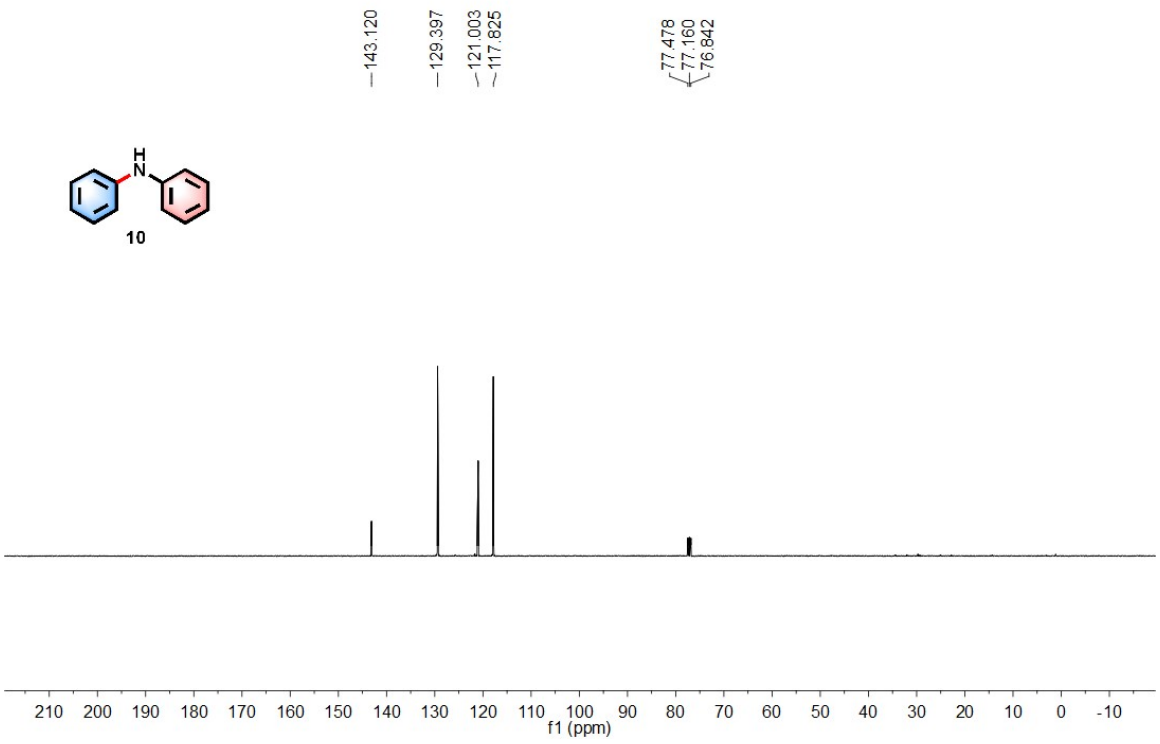
7.0661
7.0477
5.7542
10
4.0230
4.0369
2.0000
0.9402
f1 (ppm)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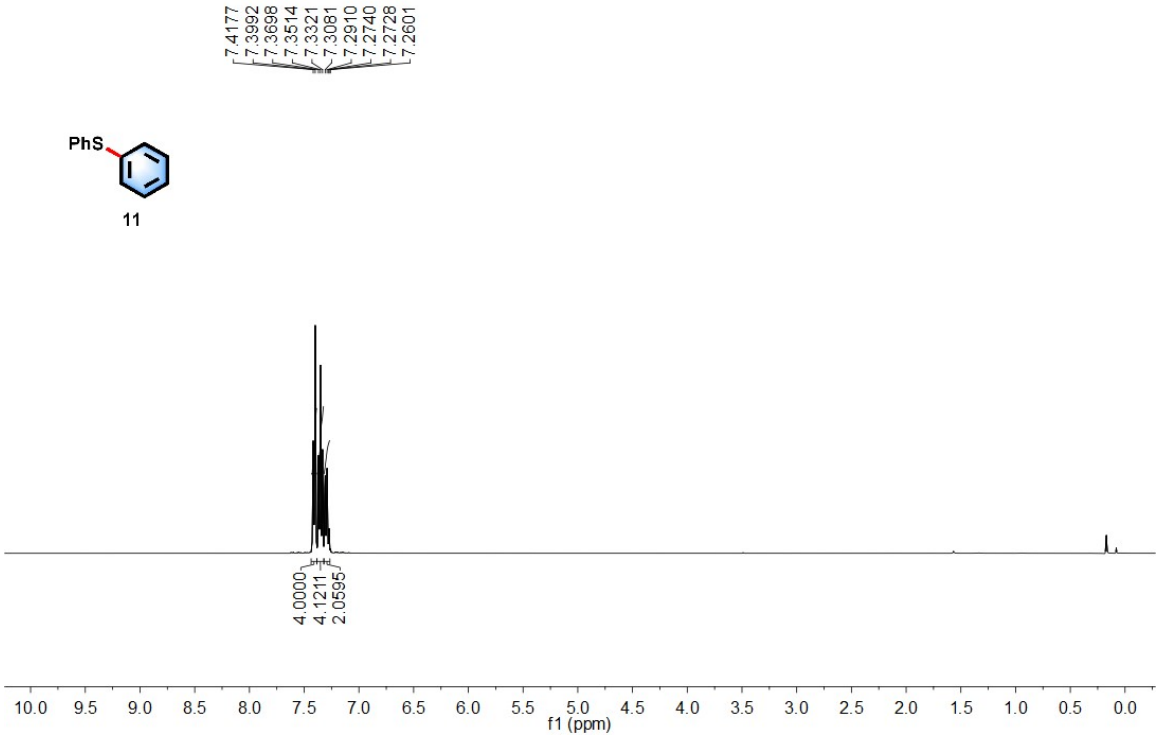
121.003
117.825
77.478
77.160
76.842
10
f1 (ppm)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7.2728
7.2601
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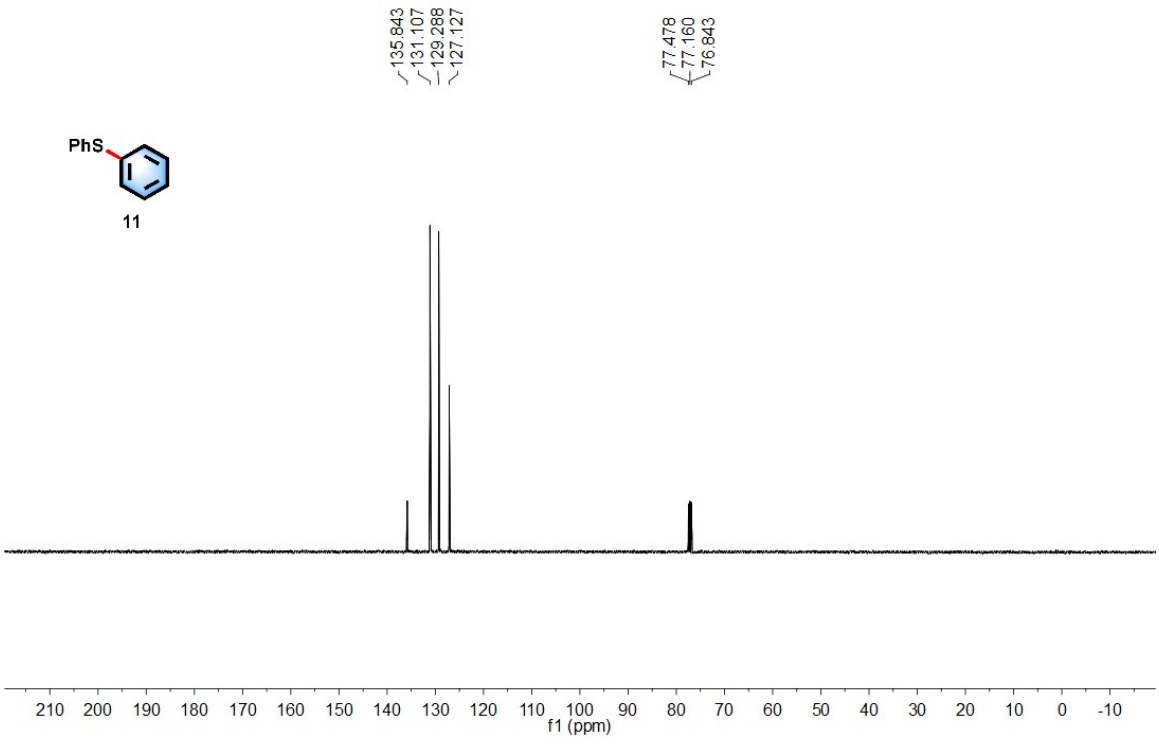
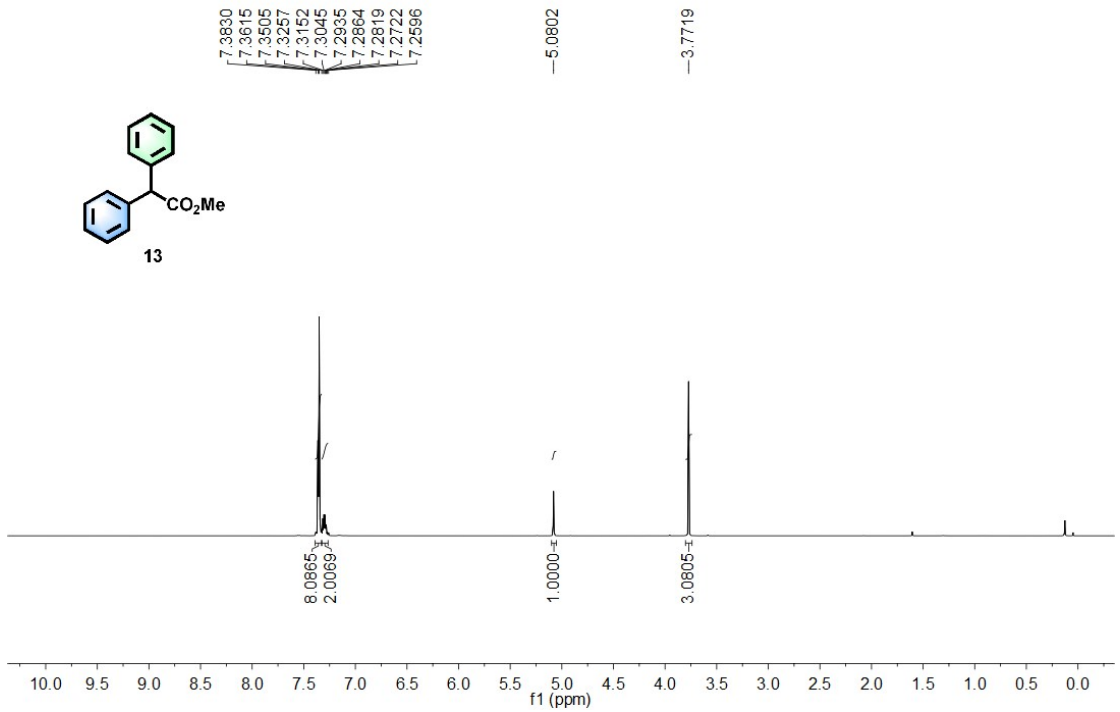
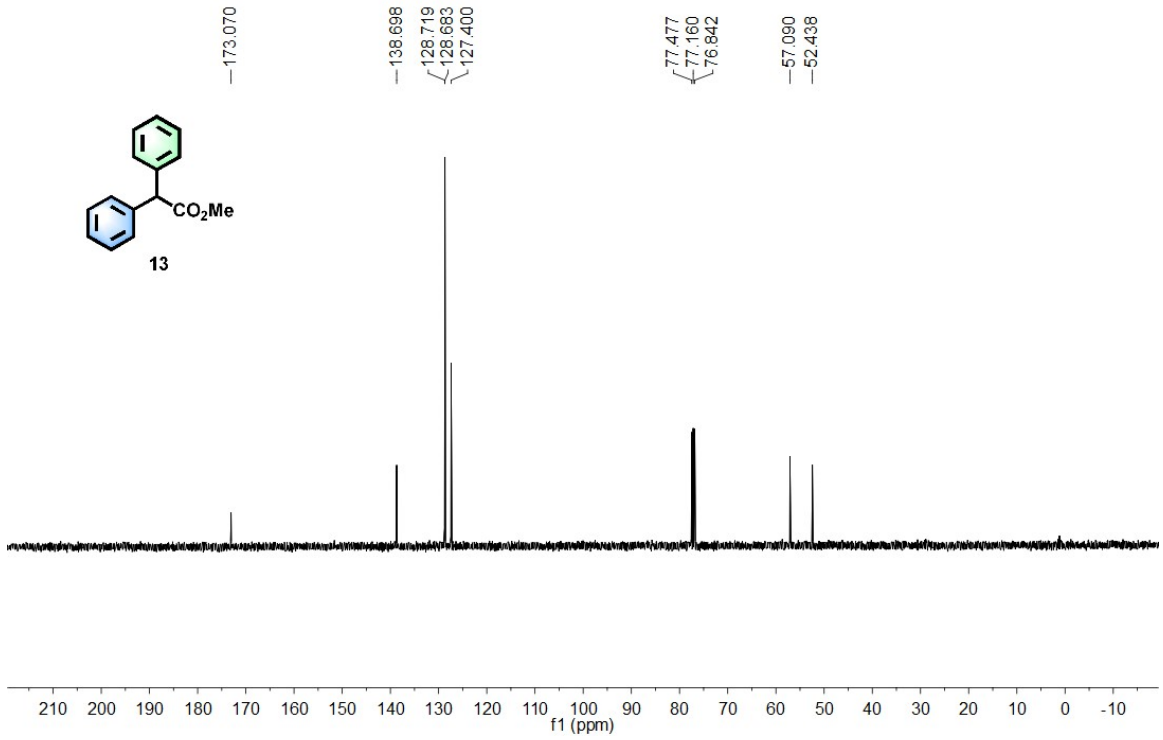
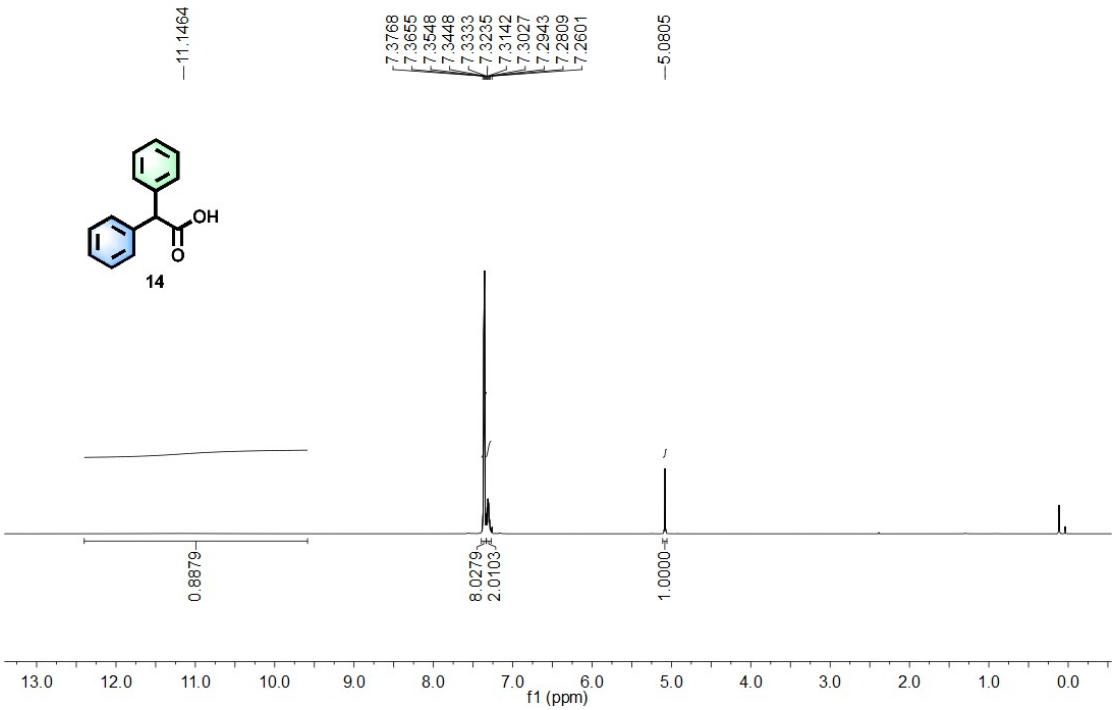
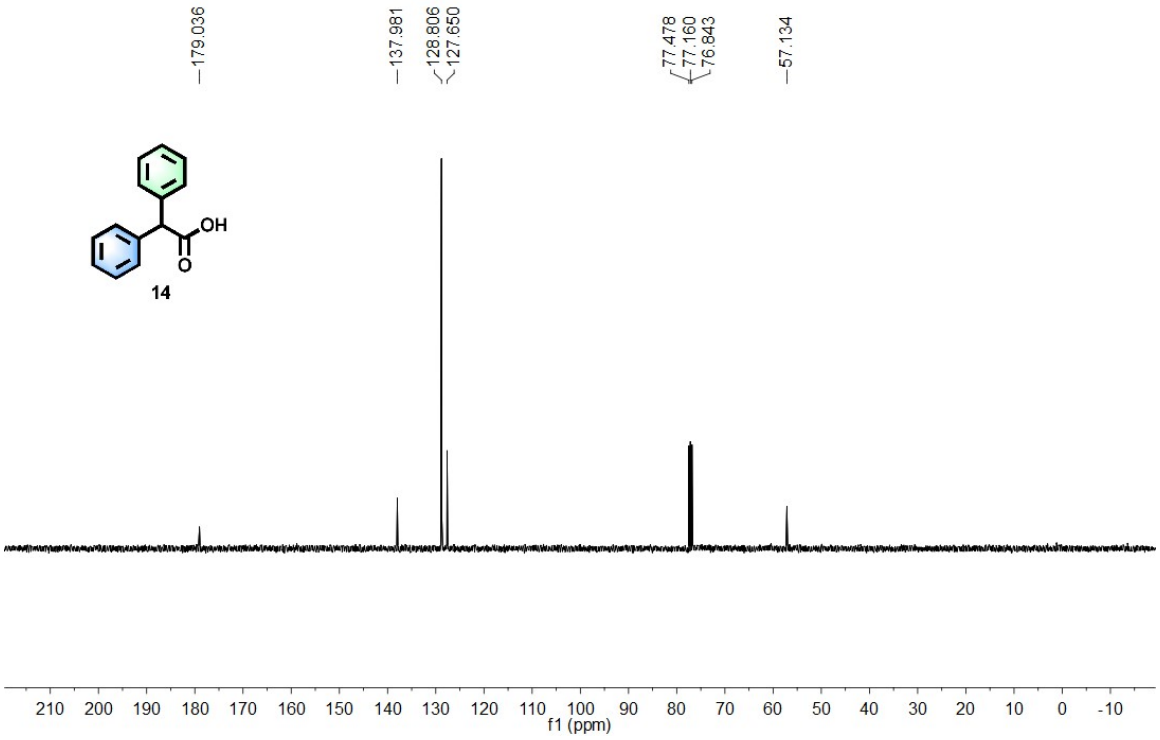
4.0000
4.1211
2.0595
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

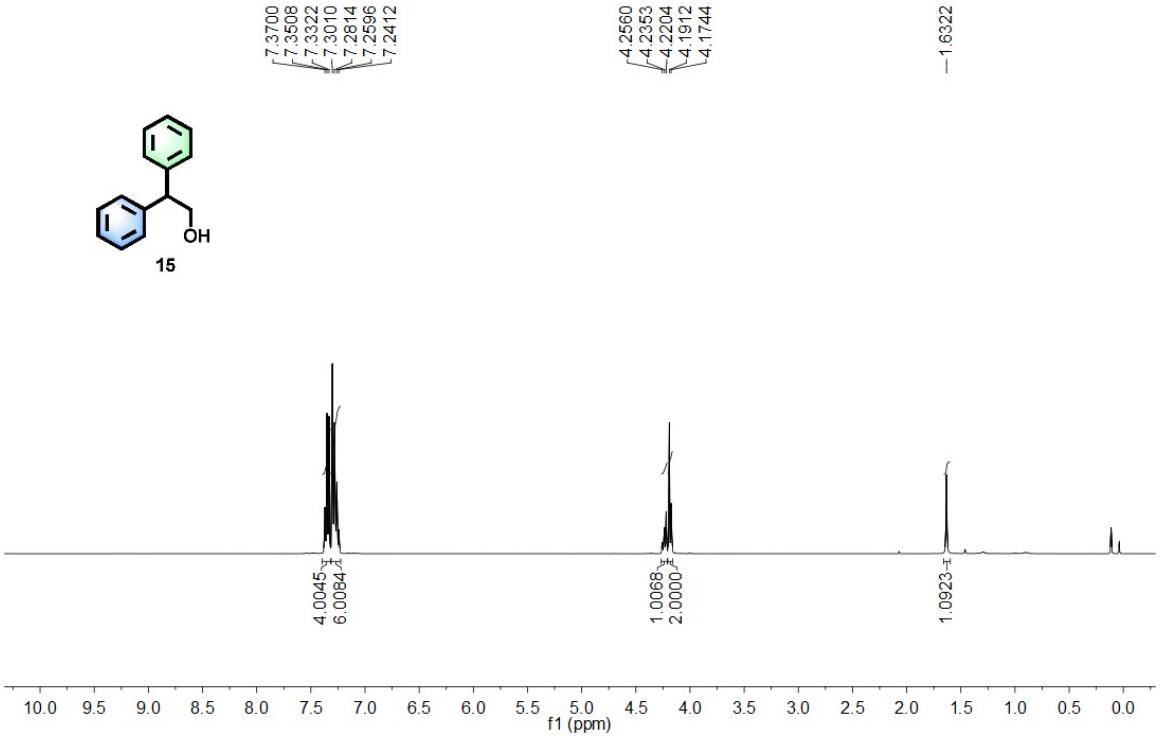

135.843
131.107
129.288
127.127
77.478
77.160
76.843
PhS
11
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

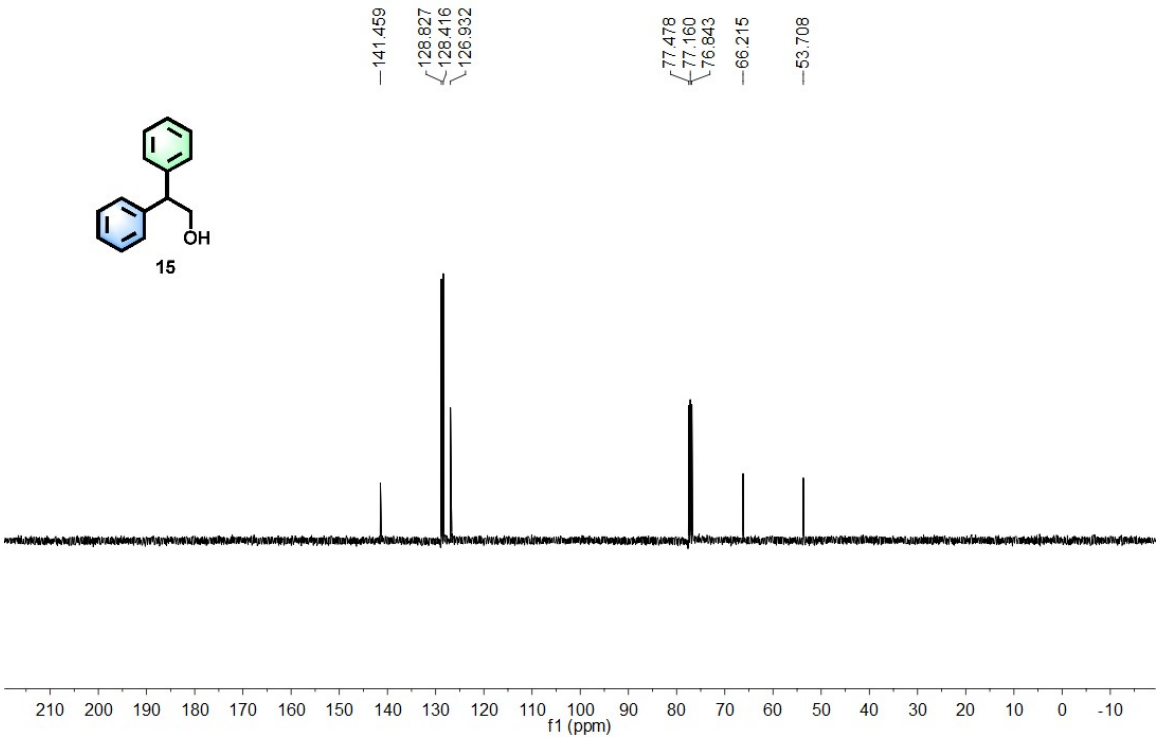

7.3830
7.3615
7.3505
7.3257
7.3152
7.3045
7.2935
7.2864
7.2819
7.2722
7.2596
5.0802
3.7719
CO2Me
13
8.0865
2.0069
1.0000
3.0805
f1 (ppm)

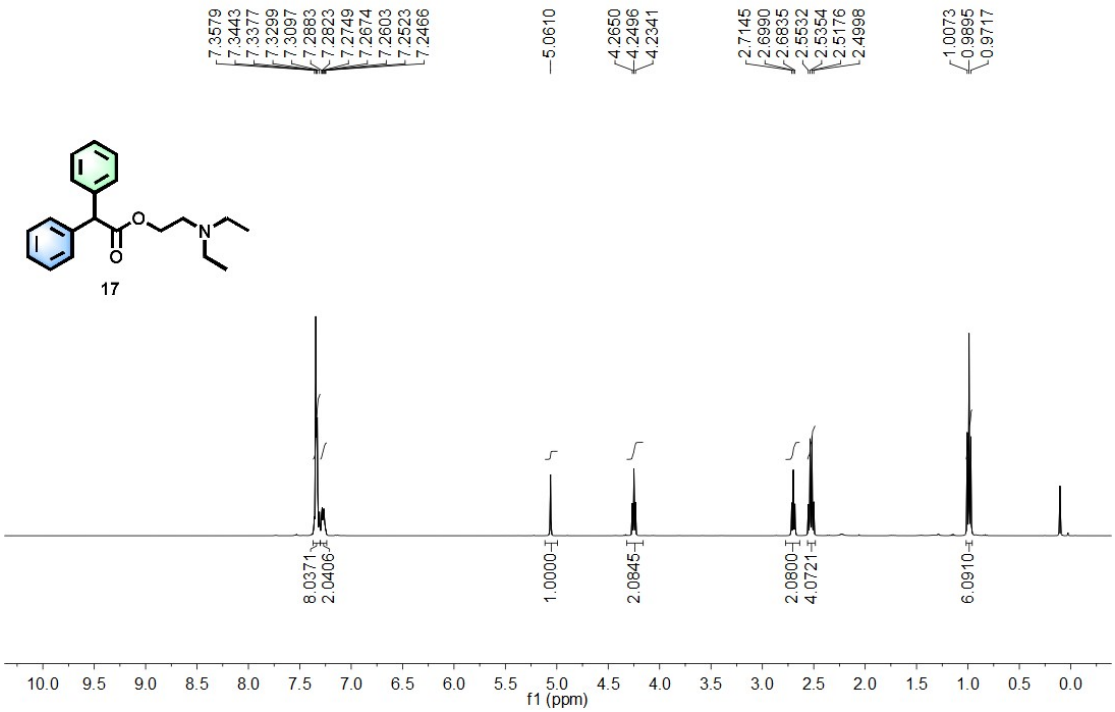

173.070
138.698
128.719
128.683
127.400
77.477
77.160
76.842
57.090
52.438
CO2Me
13
f1 (ppm)

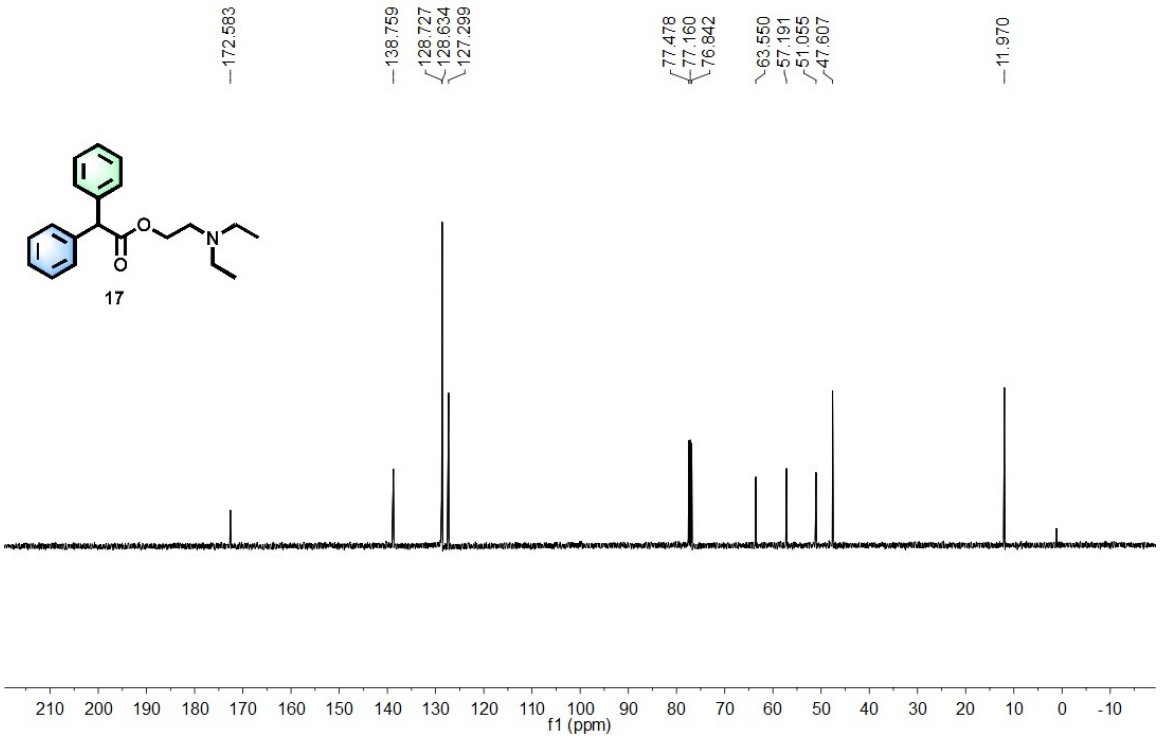

11.1464
7.3768
7.3655
7.3548
7.3448
7.3333
7.3235
7.3142
7.3027
7.2943
7.2809
7.2601
5.0805
OH
O
14
0.8879
8.0279
2.0103
1.0000
13.0 12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
f1 (ppm)

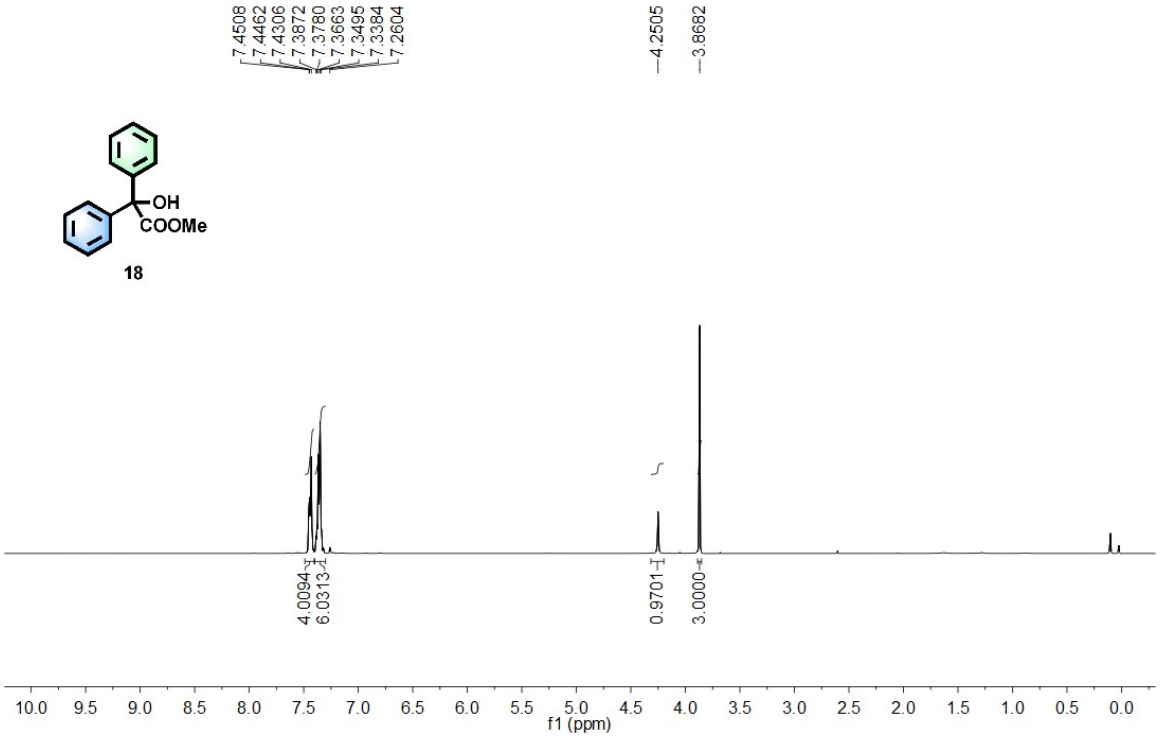

179.036
137.981
128.806
127.650
77.478
77.160
76.843
57.134
OH
O
14
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

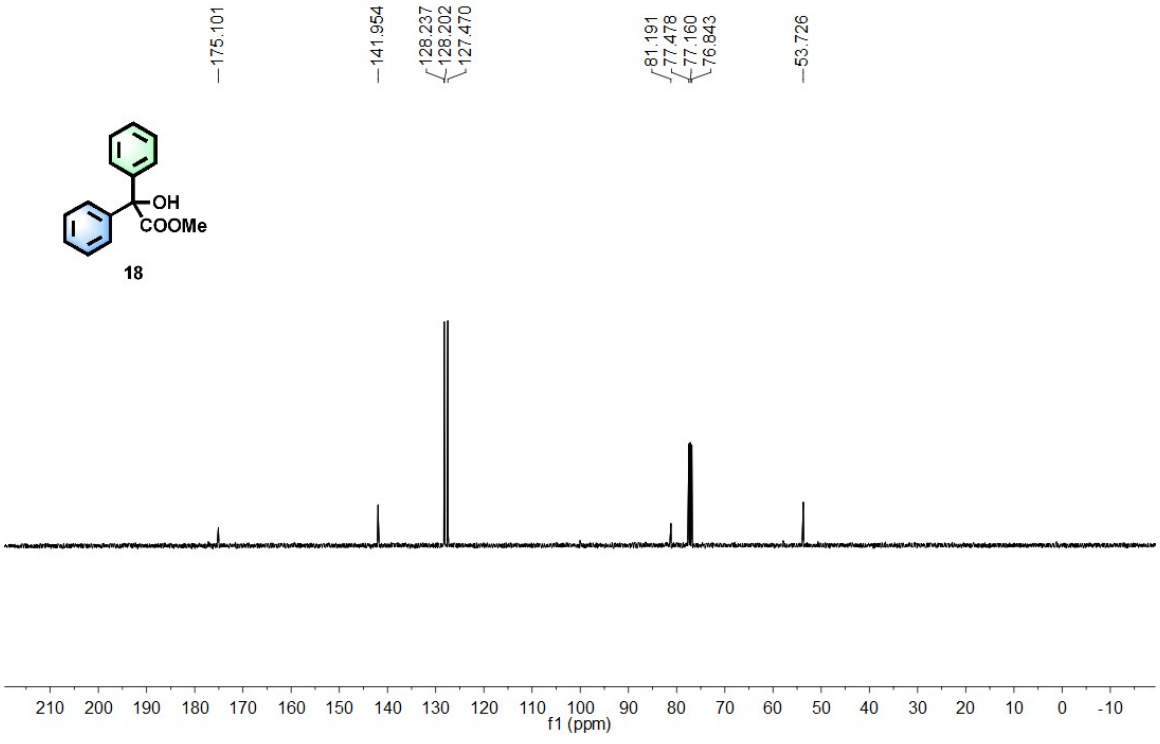

7.3700
7.3508
7.3322
7.3010
7.2814
7.2596
7.2412
4.2560
4.2353
4.2204
4.1912
4.1744
1.6322
OH
15
4.0045
6.0084
1.0068
2.0000
1.0923
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

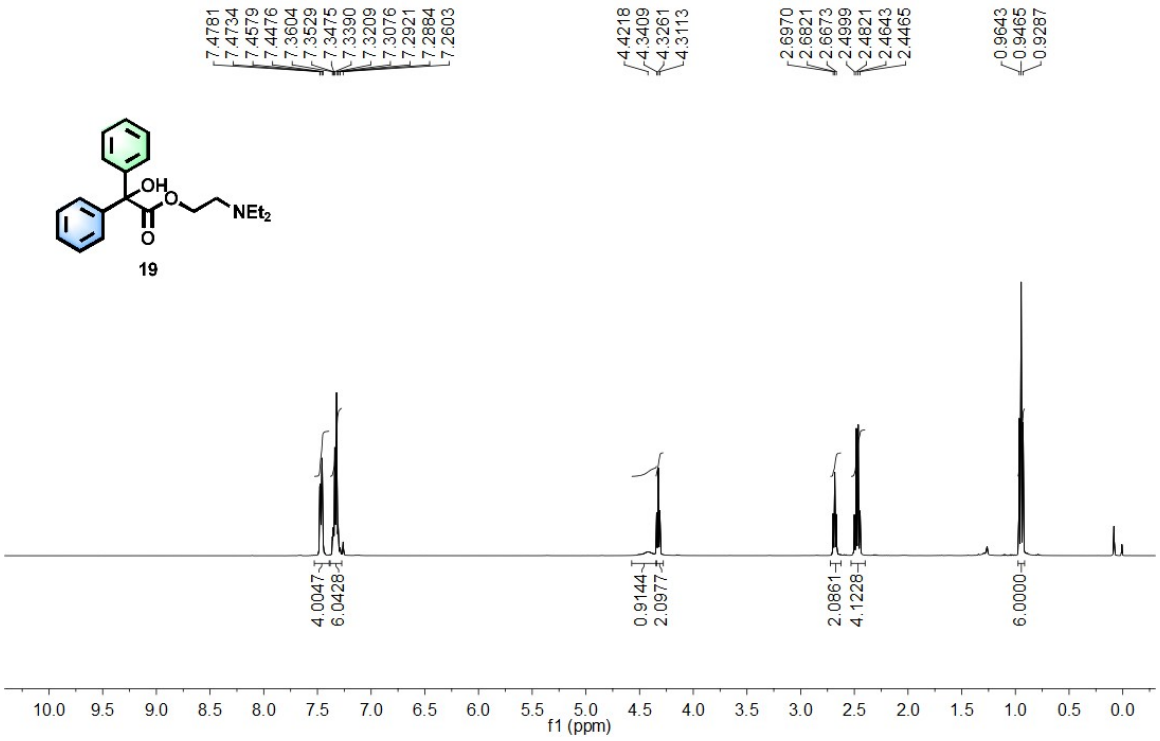

141.459
128.827
128.416
126.932
77.478
77.160
76.843
66.215
53.708
OH
15
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


7.3579
7.3443
7.3377
7.3299
7.3097
7.2883
7.2823
7.2749
7.2674
7.2603
7.2523
7.2466
5.0610
4.2650
4.2496
4.2341
2.7145
2.6990
2.6835
2.5532
2.5354
2.5176
2.4998
1.0073
0.9895
0.9717
17
8.0371
2.0406
1.0000
2.0845
2.0800
4.0721
6.0910
f1 (ppm)


172.583
138.759
128.727
128.634
127.299
77.478
77.160
76.842
63.550
57.191
51.055
47.607
11.970
17
f1 (ppm)


7.4508
7.4462
7.4306
7.3872
7.3780
7.3663
7.3495
7.3384
7.2604
4.2505
3.8682
OH
COOMe
18
4.0094
6.0313
0.9701
3.0000
10.0 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 0.0
f1 (ppm)


175.101
141.954
128.237
128.202
127.470
81.191
77.478
77.160
76.843
53.726
OH
COOMe
18
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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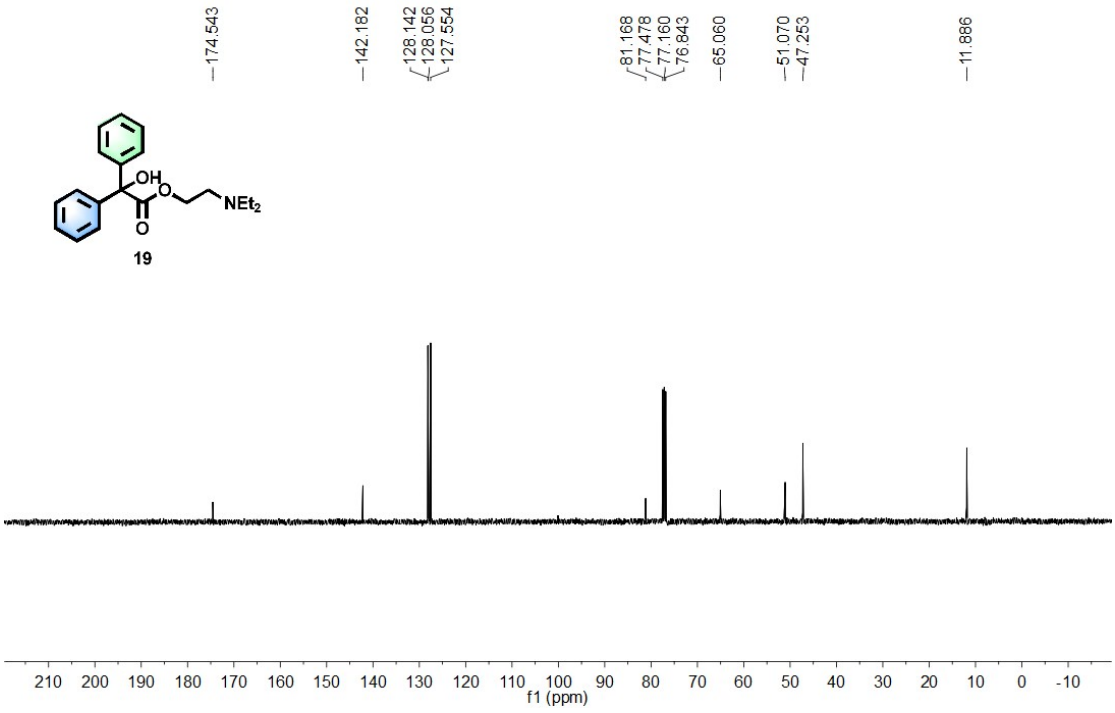
7.4734
7.4579
7.4476
7.3604
7.3529
7.3475
7.3390
7.3209
7.3076
7.2921
7.2884
7.2603
4.4218
4.3409
4.3261
4.3113
2.6970
2.6821
2.6673
2.4999
2.4821
2.4643
2.4465
0.9643
0.9465
0.9287
OH
O
O
NEt2
19
4.0047
6.0428
0.9144
2.0977
2.0861
4.1228
6.0000
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


174.543
142.182
128.142
128.056
127.554
81.168
77.478
77.160
76.843
65.060
51.070
47.253
11.886
OH
O
O
NEt2
19
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)