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Supporting Information

Direct Electrochemical difluorination and azo-fluorination of *gem*-difluorostyrenes

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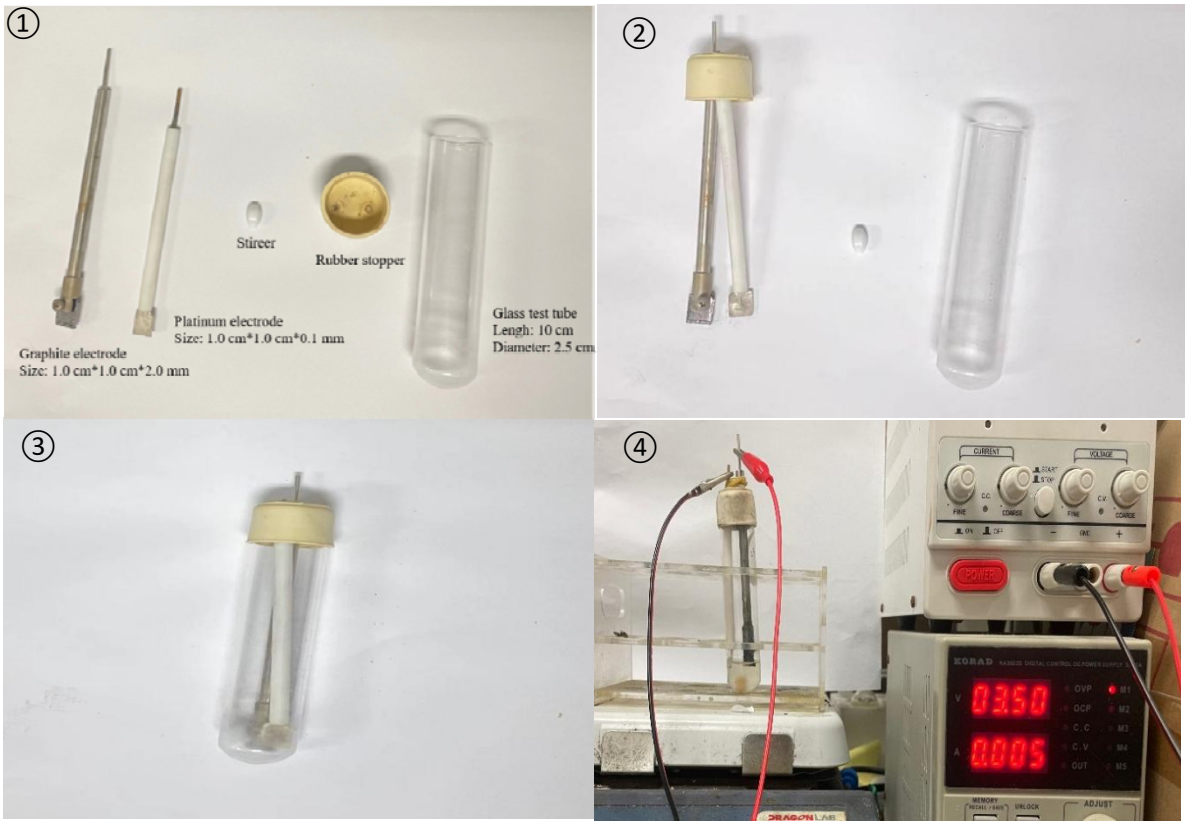
1. Materials and Methods:

All commercially available reagents were used without further purification. Ananlytical grade solvents were bought from Energy Chemical Co., LTD and used without processed. The reactions were carried out under constant cell potential (otherwise noted), an ambient atmosphere, magnetically stirred, and monitored by thin layer chromatography (TLC), visualized by fluorescence quenching under UV light. Flash chromatography was performed on silica gel (200-300 mesh). Cyclic voltammograms were recorded on a CHI 660E potentiostat. The UV spectrum was recorder on a UV-visible absorption instrument (Model: FLA4000, Version: VER 6.0). The instrument for electrolysis is dual display potentiostat (DJS-292B) (made in China). Platinum plate electrodes (10 mm×10 mm×0.1 mm or 30 mm×30 mm×0.1 mm, purity, 99.99%). Graphite electrodes are bought from Jilong Carbon company. All deuterated solvents were purchased from Meryer (Shanghai) chemical technology

Co., LTD. NMR spectra were recorded on a Bruker Ascend 300 spectrometer operating at 300 MHz for ^{1}H acquisitions, 75 MHz for ^{13}C acquisitions and 282 MHz for ^{19}F acquisitions. Chemical shifts were referenced to the residual proton solvent peaks (^{1}H: $CDCl_3$, δ 7.26; $(CD_3)_2SO$, δ 2.50; CD_3OD, δ 3.31; CD_3CN, δ 1.94), solvent ^{13}C signals ($CDCl_3$, δ 77.16; $(CD_3)_2SO$, δ 39.52;CD_3OD, δ 49.00), dissolved or external neat $PhCF_3$ (^{19}F, δ –63.3 relative to $CFCl_3$). Signals are listed in ppm, and multiplicity identified as s = singlet, br = broad, d = doublet, t = triplet, q = quartet, m = multiplet; coupling constants in Hz; integration. High-resolution mass spectra were obtained using Agilent LC-UV-TOFmass spectrometer. Yields refer to purified and spectroscopically pure compounds.

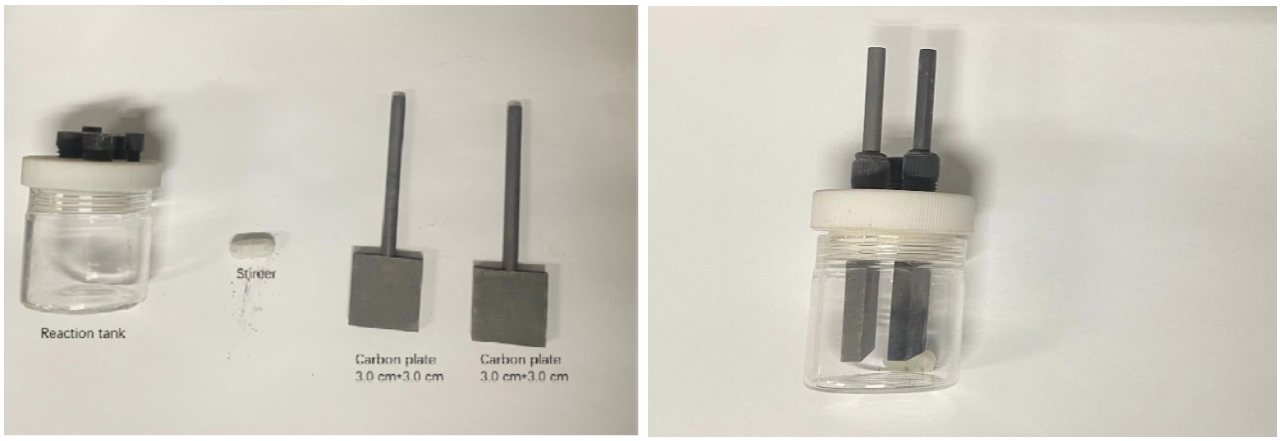
2. Information for reaction set up:

2.1. Small scale reaction:



The detail process for home-made electrolysis equipment (follow the steps 1 to 4): 1) Prepare the materials in picture 1 according to the specific information displayed. 2) push the electrode to pass through the rubber stopper and set the distance between the two electrodes in 1.2 cm as shown in picture 2. The graphite anode was bought from Jinglong special carbon company and the purity of platinum sheet is 99.99%. 3) using the rubber stopper to cap on the glass test tube as in picture 3. 4) the reaction set-up was shown in picture 4.

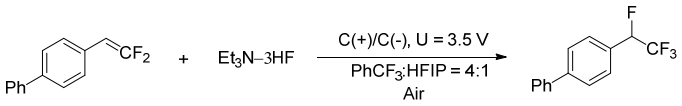
2.2. Large scale reaction:



The large scale reaction setup was using the commercially available equipment bought in Stony-lab (stonyLab.com). The size of carbon electrode is 3.0 cm * 3.0 cm * 0.2 cm. The carbon electrodes can be directly insert into the cell.

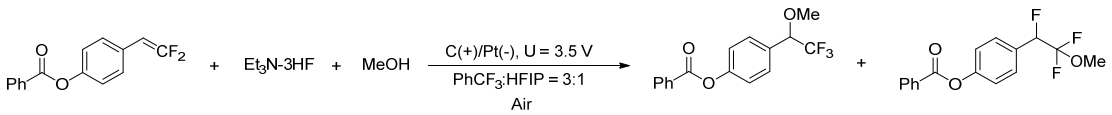
3. General Procedure for compound Synthesis:

3.1. Procedure for the synthesis of 3a:



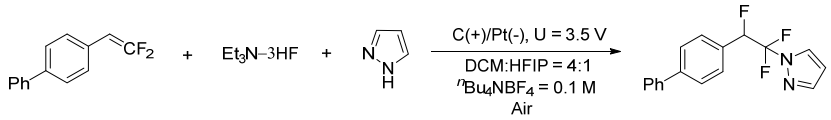
A solution of **1a** (0.5 mmol, 108 mg, 1.0 eq.), Et_3N-3HF (1.0 mL), $PhCF_3$ (4.0 mL), HFIP (1.0 mL) was stirred at rt under air in an oven-dried undivided test tube which was equipped with graphite carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and the cathode. The reaction mixture was stirred and electrolyzed at a constant cell potential of 3.5 V under room temperature and stopped until complete consumption of **1a** (monitored by TLC), around 3 h. The electricity was firstly disconnected and the electrode was removed from the test tube before rinsing twice with dichloromethane. The reaction mixture was poured into the separatory funnel and distilled water was added (10 mL). The mixture was extracted three times with dichloromethane (20 mL). The combined organic layers was dried with anhydrous sodium sulfate, filtered, concentrated, and purified with column chromatography on silica gel or preparative thin layer chromatography (elution: petroleum ether).

3.2. Procedure for the synthesis of 5n/5n’:



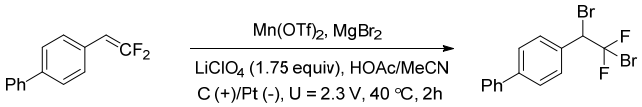
A solution of **1a** (0.5 mmol, 108 mg, 1.0 eq.), Et_3N-3HF (1.0 mL), MeOH (1.0 mL), $PhCF_3$ (3.0 mL), HFIP (1.0 mL) was stirred at rt under air in an oven-dried undivided test tube which was equipped with graphite carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and platinum plate electrode (1.0 cm×1.0 cm×0.1 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a constant cell potential of 3.5 V under room temperature and stopped until complete consumption of **1a** (monitored by TLC), around 4 h. The electricity was firstly disconnected and the electrode was removed from the test tube before rinsing twice with dichloromethane. The reaction mixture was poured into the separatory funnel and distilled water was added (10 mL). The mixture was extracted three times with dichloromethane (20 mL). The combined organic layers was dried with anhydrous sodium sulfate, filtered, concentrated, and purified with column chromatography on silica gel or preparative thin layer chromatography (elution: petroleum ether).

3.3. Procedure for the synthesis of 5b:



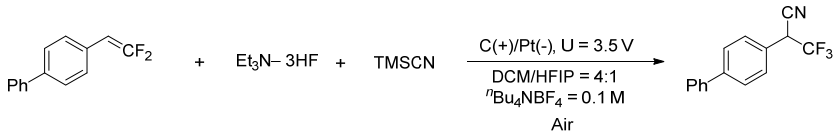
A solution of **1a** (0.5 mmol, 108 mg, 1.0 eq.), Et_3N-3HF (1 mmol, 161 mg, 2.0 eq.), Pyrazole (1.0 mmol, 136 mg, 2.0 eq.), $^{n}Bu_4NBF_4$ (0.1 M), DCM (4.0 mL), HFIP (1.0 mL) was stirred at rt under air in an oven-dried undivided test tube which was equipped with graphite carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and platinum plate electrode (1.0 cm×1.0 cm×0.1 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a constant cell potential of 3.5 V under room temperature and stopped until complete consumption of **1a** (monitored by TLC), around 5 h. The electricity was firstly disconnected and the electrode was removed from the test tube before rinsing twice with dichloromethane. The reaction mixture was poured into the separatory funnel and distilled water was added (10 mL). The mixture was extracted three times with dichloromethane (20 mL). The combined organic layers was dried with anhydrous sodium sulfate, filtered, concentrated, and purified with column chromatography on silica gel or preparative thin layer chromatography (elution: petroleum ether/ethyl acetate).

3.4. Procedure for the synthesis of 7:



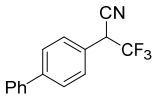
To an oven-dried glass test tube (20.0 mL) equipped with a magnetic stirbar was added $MgBr_2$ (184.0 mg, 1.0 mmol, 2.0 equiv.) and $Mn(OTf)_2$ (5.1 mg, 0.025 mmol, 5 mol%). The glass test tube were fitted with carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and platinum plate electrode (1.0 cm×1.0 cm×0.1 mm) as the cathode, respectively, maintaining a distance of 1.2 cm between the closest point of the two electrodes. The cell was sealed and flushed with nitrogen gas for 5 minutes, followed by addition via syringe of electrolyte solution (0.1 M $LiClO_4$ in MeCN, 5 mL), 1a (108.0 mg, 0.5 mmol, 1 equiv), and acetic acid (1.0 mL). The reaction mixture was then purged with nitrogen gas for another 5 minutes. A nitrogen-filled balloon was adapted through a septum to sustain a nitrogen atmosphere. Electrolysis was initiated at a constant current of 80 mA at 40 °C (oil bath temperature). The reaction was allowed to proceed for 5 h. The whole reaction mixture was then extracted with dichloromethane, the organic layer was dried over Na_2SO_4 , added to silica gel and spin-dried, transferred to a short silica gel column (7-10 cm long, about 50 g) and purified with petroleum ether, then Concentration in vacuo gave pure product (119.0 mg, 69% yield).

3.5. Procedure for the synthesis of 8:



A solution of **1a** (0.5 mmol, 108 mg, 1.0 eq.), Et_3N-3HF (1 mmol, 161 mg, 2.0 eq.), TMSCN (1 mmol, 99 mg, 2.0 eq.), DCM (4.0 mL), HFIP (1.0 mL) was stirred at rt under air in an oven-dried undivided test tube which was equipped with graphite carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and platinum plate electrode (1.0 cm×1.0 cm×0.1 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a constant cell potential of 3.5 V under room temperature and stopped until complete consumption of **1a** (monitored by TLC), around 4 h. The electricity was firstly disconnected and the electrode was removed from the test tube before rinsing twice with dichloromethane. The reaction mixture was poured into the separatory funnel and distilled water was added (10 mL). The mixture was extracted three times with dichloromethane (20 mL). The combined organic layers was used to run GC-MS. The flowing GC-MS result was obtained.

2-([1,1'-biphenyl]-4-yl)-3,3,3-trifluoropropanenitrile (8)



Mass Spectrometry: GCMS (EI-TOF) (m/z): calcd for $C_{15}H_{10}F_3N$, 261.1, found, 262.1.

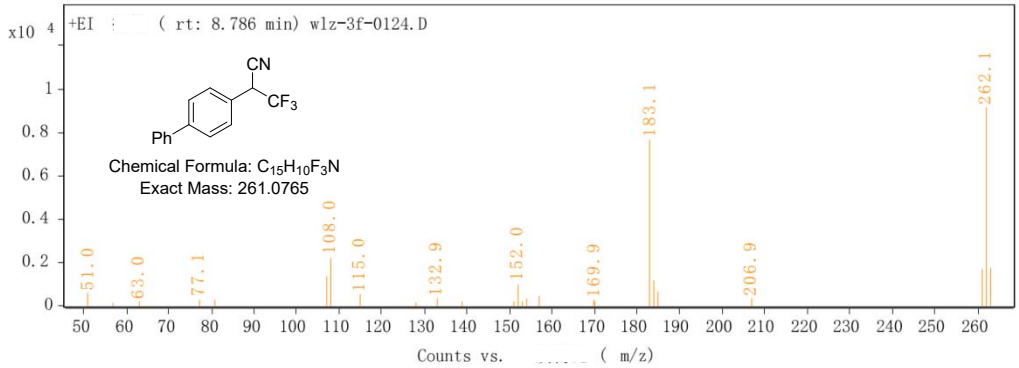
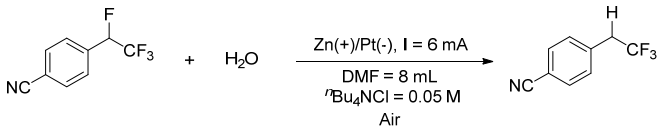


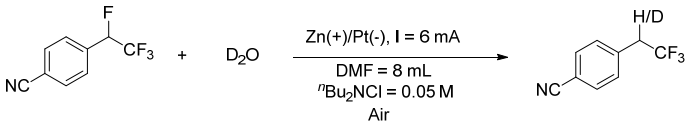
Figure S1 GC-MS information of generation of **8**

3.6. Procedure for the synthesis of 9:



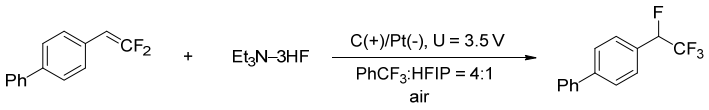
Reaction conditions: undivided cell, Zn plate anode (2 cm×1 cm×0.1 cm), graphite rod cathode (1.0 cm×1.0 cm×2.0 mm), constant current (I = 6 mA), 1 (0.8 mmol), 2 (1.0 μL.), electrolyte, dry DMF (8 mL), air, 26 ºC, 15 h. Separation and purification by HPLC (Beijing chuangxintongheng Model: P-3122605571); Column: Manf. No. K63935, cosmosil packed column; solvent system: Methanol : H_2O = 40% : 60% to 100% :0 for 20 min.

3.7. Procedure for the synthesis of 10:



Reaction conditions: undivided cell, Zn plate anode (2 cm×1 cm×0.1 cm), graphite rod cathode (1.0 cm×1.0 cm×2.0 mm), constant current (I = 6 mA), 1 (0.8 mmol), D_2O (1.0 μL.), electrolyte, dry DMF (8 mL), air, 26 ºC, 15 h. Separation and purification by HPLC (Beijing chuangxintongheng Model: P-3122605571); Column: Manf. No. K63935, cosmosil packed column; solvent system: Methanol : H_2O = 40% : 60% to 100% :0 for 20 min. We got a mixture of **9** and **10**. DMF may also work as proton source.

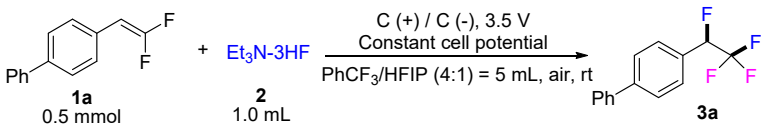
3.8 Procedure for Gram Scale Synthesis:



To an oven-dried reaction tank (50.0 mL) equipped with a magnetic stirbar was added **1a** (10 mmol, 2.16 g, 1.0 eq.), Et_3N-3HF (10.0 mL), $PhCF_3$ (40 mL) and HFIP (10 mL), The glass test tube were fitted with carbon plate (3.0 cm×3.0 cm) as the anode and carbon plate (2.5 cm×2.5 cm) as the cathode, respectively, maintaining a distance of 4.0 cm between the closest point of the two electrodes. Electrolysis was initiated at a constant voltage of 3.5 V at room temperature. The reaction was allowed to proceed for 6 h. After 3h, the anode was replaced for another carbon plate. The whole reaction mixture was then extracted with dichloromethane, the organic layer was dried over Na_2SO_4 , added to silica gel and spin-dried, transferred to a silica gel column and purified with petroleum ether, then Concentration in vacuo gave pure white solid **3a** (1.19 g, 47% yield).

4. Optimization of the reaction:

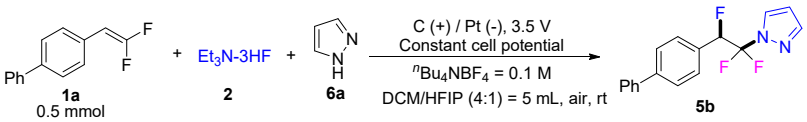
4.1 Optimization table of diflorination reaction.



Entry	Variation from standard conditions	**Yield (3a)**
1	none	65%
2	Py-HF instead of Et_3N-HF	53%
3	Et_3N-HF (0.8 mL)	58%
4	Et_3N-HF (1.2 mL)	64%
5	0.5 mmol nBu_4NPF_6 as electrolyte	55%
6	Pt as cathode	61%
7	Pt as both anode and cathode	trace
8	glassy carbon as both anode and cathode	55%
9	glassy carbon as anode	55%
10	RVC as anode	57%
11	$PhCF_3$ as the solvent	58%
12	HFIP as the solvent	18%
13	under N_2	67%
14	no electricity	0%

Reaction condition: Graphite plate as cathode and anode (1.0 cm * 1.0 cm * 2.0 mm), constant cell potential, **1a** (1.0 equiv, 0.5 mmol), **2a** (1.0 mL), $PhCF_3$/HFIP (4 mL:1 mL), room temperature, Air, 3 h.

4.2 Optimization table of fluoroazotion reaction.

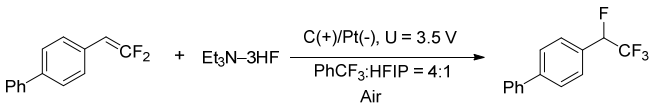


Entry	Variation from standard conditions	Yield (**5b**)[b]
1	none	40%
2	Electrolyzer	trace
3	2:4 = 2:1	33%
4	2:4 = 4:1	11%
5	0.5 mmol nBu$_4$NPF$_6$ as electrolyte	25%
6	graphite as both anode and cathode	28%
7	Pt as both anode and cathode	trace
8	MeCN:DCM = 1:4	27%
9	MeCN:DCM = 2:3	23%
10	MeCN:AcOH = 10:1	15%
11	PhCF$_3$:HFIP = 4:1	40%
12	DCM:HFIP = 3:1	35%
13	PhCl$_2$ as the solvent	trace
14	PhNO$_2$ as the solvent	trace
15	under N$_2$	32%
16	no electricity	0%

Reaction condition: a platinum plate as cathode (1.0 cm * 1.0 cm * 0.1 mm) and a graphite plate as anode (1.0 cm * 1.0 cm * 2.0 mm), constant cell potential, **1a** (1.0 equiv, 0.5 mmol), **2a** (2.0 equiv, 1.0 mmol), **6a** (2.0 equiv, 1.0 mmol), ^{n}Bu$_4$NBF$_4$ (0.1 M), DCM/HFIP (4 mL:1 mL), room temperature, Air, 5 h.

5. Mechanistic studies:

5.1 Cyclic voltametry studies:



Cyclic voltammograms were recorded on a CHI 660E potentiostat. The cyclic voltammograms of compounds **1a, Et$_3$N-3HF,** and **3a** were recorded in an electrolyte of ^{n}Bu$_4$NBF$_4$ (0.1 M) in HFIP/PhCF$_3$ (1:4) using a graphite working electrode (diameter, 2 mm), a Pt wire auxiliary electrode and a SCE reference electrode. The scan rate is 100 mV/s.

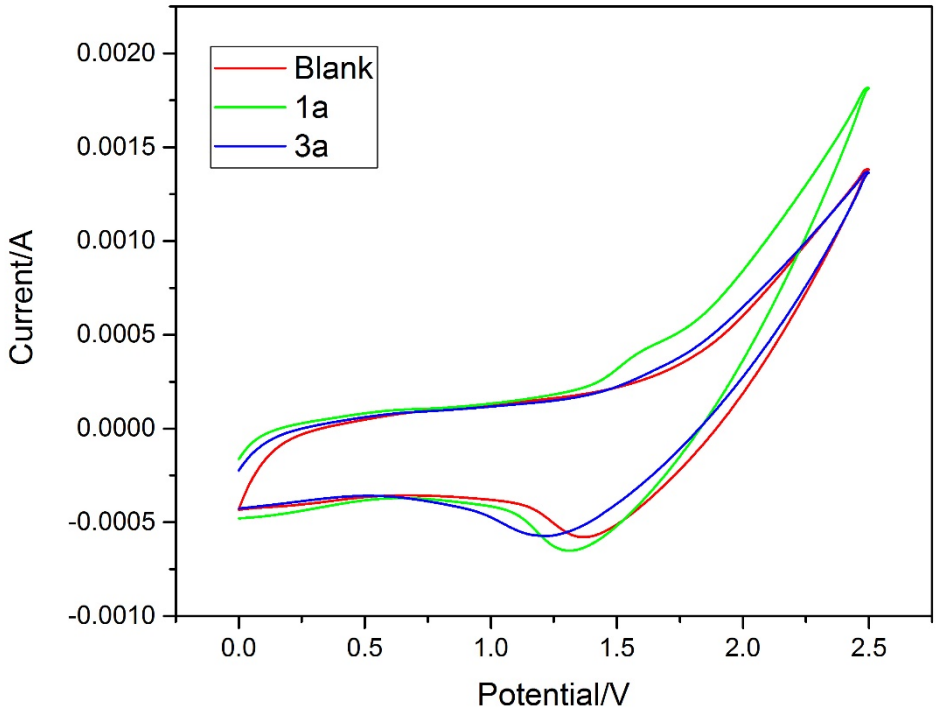
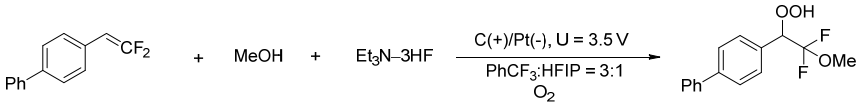


Figure S2 Cyclic voltametry studies of the reaction components

5.2 Radical trapping experiment:



A solution of **1a** (0.5 mmol, 108 mg, 1.0 eq.), Et_3N-3HF (1 mL)， MeOH (1.0 mL), HFIP (1 mL), $PhCF_3$ (3 mL) was stirred at rt under O_2 in an oven-dried undivided test tube which was equipped with carbon plate (1.0 cm×1.0 cm×2.0 mm) as the anode and platinum plate electrodes (1.0 cm×1.0 cm×0.1 mm) as the cathode. The reaction mixture was stirred and electrolyzed at a controlled cell potential of 3.5 V under room temperature and stopped until complete consumption of **1a** (monitored by TLC). The reaction mixture was taken a little bit to run GC-MS and the results were listed below. Compound **13** was detected.

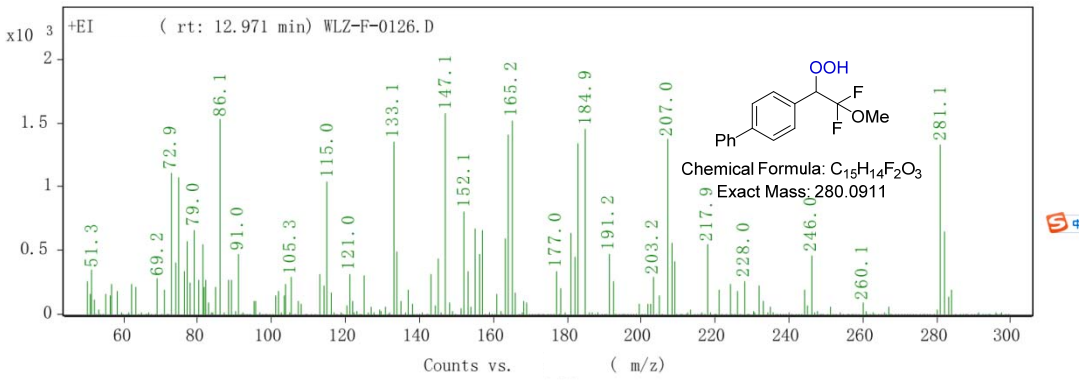


Figure S3 GC-MS information of radical trapping experiment

5.3 Test of normal styrene derivative:

we tried to use 4-vinylbiphenyl as substrate for the electrochemical fluorination reaction. Unfortunately, 4-vinylbiphenyl was totally consumed , but no product could be able to isolated in the resulting messy mixture. The cyclic voltammograms of 4-vinylbiphenyl was also recorded on a CHI 660E potentiostat. The cyclic voltammograms of compound 4-vinylbiphenyl was recorded in an electrolyte of Et_3N-3HF in HFIP/$PhCF_3$ (1:4) using a graphite working electrode (diameter, 2 mm), a Pt wire auxiliary electrode and a SCE reference electrode. The scan rate is 100 mV/s. It can been seen that 4-vinylbiphenyl was easy to oxide in the current electrochemical condition, while no fluorination reaction could happen.

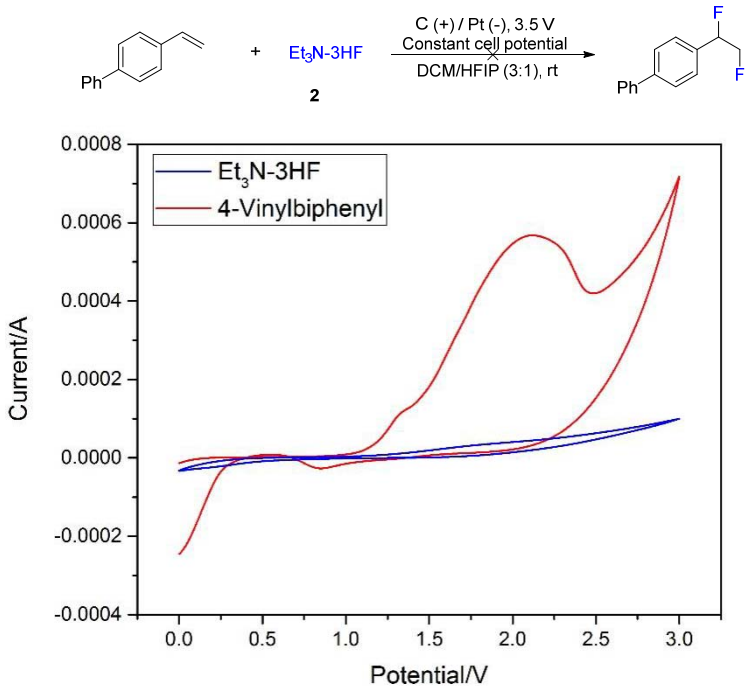
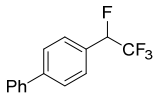


Figure S4 Cyclic voltametry studies of the styrene derivative

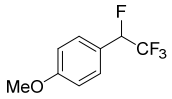
6. Characterization of Products:

4-(1,2,2,2-Tetrafluoroethyl)-1,1'-biphenyl (3a)



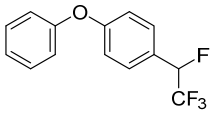
White solid (76 mg, 65 % yield, electrolysis time: 3.2 h, R_f = 0.67 (petroleum ether); M.P. 36.5-38.3 °C; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.67 (d, *J* = 7.9 Hz, 2H), 7.62–7.59 (m, 2H), 7.54 (d, *J* = 8.2 Hz, 2H), 7.50–7.45 (m, 2H), 7.42–7.36 (m, 1H), 5.75–5.54 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 143.6 (d, *J* = 1.9 Hz, 1C), 140.2, 129.1, 128.1, 127.8 (d, *J* = 6.6 Hz, 1C), 127.6, 127.4, 120.6 (qd, *J* = 28.9, 279.6 Hz, 1C), 89.0 (qd, *J* = 35.5, 185.25 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.6 (d, *J* = 7.2 Hz, 3F), -194.1 (dd, *J* = 3.5, 7.0 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{14}H_{11}F_4^+$ ([M + H]$^+$), 255.0791, found, 255.0790.

1-Methoxy-4-(1,2,2,2-tetrafluoroethyl)benzene (3b)



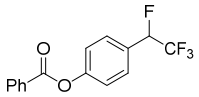
Colorless oil (75 mg, 61 % yield, electrolysis time: 3.6 h, R_f = 0.72 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.39 (d, *J* = 8.5 Hz, 2H), 6.96 (d, *J* = 8.6 Hz, 2H), 5.63–5.42 (m, 1H), 3.84 (s, 3H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 161.4, 129.1 (d, *J* = 5.8 Hz, 1C), 122.6, 122.5 (qd, *J* = 20.3, 321.9 Hz, 1C), 114.3, 89.0 (qd, *J* = 36.4, 219.0 Hz, 1C), 55.5. ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.9 (d, *J* = 13.6 Hz, 3F), -190.1 (dd, *J* = 13.3, 26.8 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_9H_9F_4O^+$ ([M + H]$^+$), 209.0584, found, 209.0575.

1-Phenoxy-4-(1,2,2,2-tetrafluoroethyl)benzene (3c)



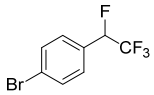
White solid (79 mg, 68 % yield, electrolysis time: 3.4 h, R_f = 0.67 (petroleum ether); M.P. 39.5-40.8 °C; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.45–7.37 (m, 4H), 7.19 (t, *J* = 7.3 Hz, 1H), 7.09–7.05 (m, 4H), 5.67–5.47 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 159.7 (d, *J* = 1.8 Hz, 2C), 156.2, 130.1, 129.1 (d, *J* = 6.2 Hz, 1C) , 124.3, 119.9, 118.4, 117.8 (qd, *J* = 30.2, 235.7 Hz, 1C), 89.2 (qd, *J* = 34.9, 185.3 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.8 (d, *J* = 13.3 Hz, 3F), -191.9 (dd, *J* = 13.1, 26.3 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{14}H_{11}F_4O^+$ ([M + H]$^+$), 271.0741, found, 271.0728.

4-(1,2,2,2-Tetrafluoroethyl)phenyl benzoate (3d)

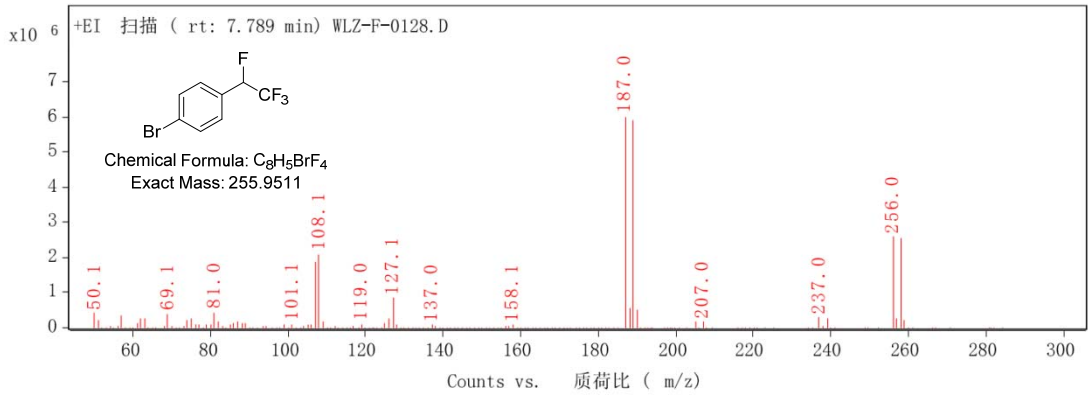


Colorless oil (81 mg, 71 % yield, electrolysis time: 3.9 h, R_f = 0.32 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 8.00 (d, *J* = 7.1 Hz, 2H), 7.38 (t, *J* = 7.1 Hz, 1H), 7.53 (t, *J* = 8.0 Hz, 4H), 7.33 (d, *J* = 8.5 Hz, 2H), 5.74–5.53 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 165.0, 152.7, 134.0, 130.4, 129.3, 128.8 (d, *J* = 4.4 Hz, 1C), 128.7, 127.9 (d, *J* = 20.4 Hz, 1C), 122.4, 120.6 (qd, *J* = 17.4, 279.9 Hz, 1C), 87.1 (qd, *J* = 34.8, 228.8 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.6 (d, *J* = 13.0 Hz, 3F), -193.8 (dd, *J* = 13.1, 25.9 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{11}F_4O_2^+$ ([M + H]$^+$), 299.0690, found, 299.0693.

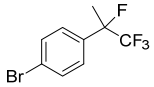
1-Bromo-4-(1,2,2,2-tetrafluoroethyl)benzene (3e)



Colorless oil (64 mg, 55 % yield, electrolysis time: 3.6 h, R_f = 0.47 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.60 (d, *J* = 8.2 Hz, 2H), 7.33 (d, *J* = 8.2 Hz, 2H), 5.56 (dq, *J* = 44.0, 6.0 Hz, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 132.2, 129.3 (d, *J* = 20.0 Hz, 1C), 128.8 (d, *J* = 6.5 Hz, 1C), 125.1 (d, *J* = 2.0 Hz, 1C), 122.1 (qd, *J* = 279.8, 28.8 Hz, 1C), 88.5 (dq, *J* = 186.2, 35.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.9 (d, *J* = 12.6 Hz, 3F), -195.1(dd, *J* = 12.2, 25.7 Hz, 1F). Mass Spectrometry: GCMS (EI-TOF) (m/z): calcd for $C_8H_5BrF_4$, 256.0, found, 256.0.

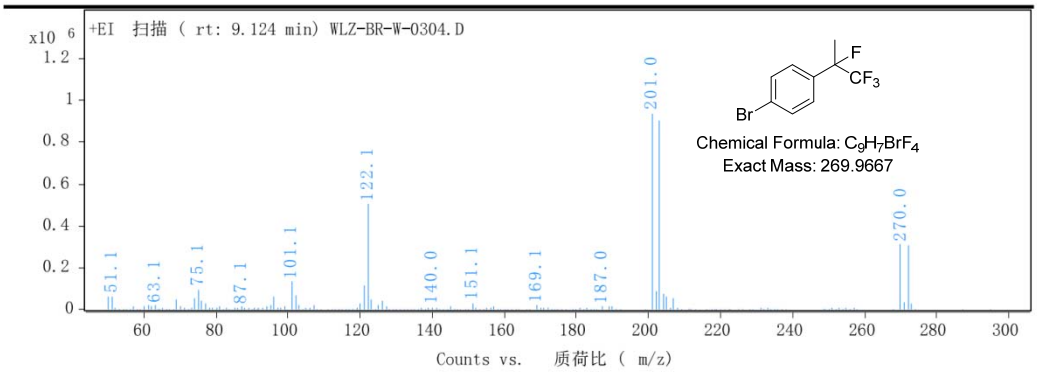


1-Bromo-4-(1,1,1,2-tetrafluoropropan-2-yl)benzene (3f)

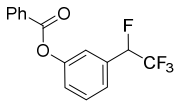


Colorless oil (76 mg, 65 % yield, electrolysis time: 3.8 h, R_f = 0.72 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.56 (d, *J* = 8.4 Hz, 2H), 7.35 (d, *J* = 8.4 Hz, 2H), 1.88 (dq, *J* = 23.0, 1.0 Hz, 3H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 134.7 (d, *J* = 21.8 Hz, 1C), 131.9

(d, J = 1.0 Hz, 1C), 127.5 (d, J = 9.2 Hz, 1C), 124.0 (d, J = 1.4 Hz, 1C), 123.0 (qd, J = 282.4, 30.4 Hz, 1C), 88.5 (dq, J = 184.0, 32.0 Hz, 1C), 20.9 (d, J = 22.8 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -81.5 (d, J = 6.9 Hz, 3F), -163.6 (dd, J = 7.0, 13.9 Hz, 1F). Mass Spectrometry: GCMS (EI-TOF) (m/z): calcd for $C_9H_7BrF_4$, 270.0, found, 270.0.

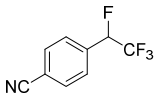


3-(1,2,2,2-Tetrafluoroethyl)phenyl benzoate (3g)



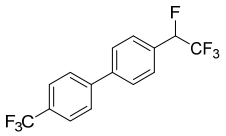
Colorless oil (69 mg, 75 % yield, electrolysis time: 3.6 h, R_f = 0.30 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 8.22 (d, J = 7.2 Hz, 2H), 7.66 (t, J = 7.4 Hz, 1H), 7.53 (t, J = 7.8 Hz, 3H), 7.38 (s, 3H), 5.75–5.54 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 165.0, 151.3, 134.0, 132.0 (d, J = 19.9 Hz, 1C), 130.2 (d, J = 24.2 Hz, 1C), 129.1 (d, J = 36.6 Hz, 1C), 124.7(d, J = 6.6 Hz, 1C), 124.1, 120.7 (d, J = 7.3 Hz, 1C), 119.3 (qd, J = 37.3, 252.1 Hz, 1C), 88.5 (dd, J = 34.9, 186.8 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.6 (d, J = 12.2 Hz, 3F), -195.3 (dd, J = 12.9, 25.7 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{11}F_4O_2^+$ ([M + H]$^+$), 299.0690, found, 299.0676.

4-(1,2,2,2-Tetrafluoroethyl)benzonitrile (3h)



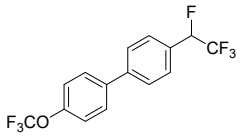
Colorless oil (38 mg, 31 % yield, electrolysis time: 3.2 h, R_f = 0.58 (petroleum ether); ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.76 (d, J = 8.0 Hz, 2H), 7.59 (d, J = 8.1 Hz, 2H), 5.77–5.57 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 139.9 (d, J = 35.0 Hz, 1C), 135.2 (d, J = 22.3 Hz, 1C), 132.7, 127.9 (d, J = 7.4 Hz, 1C), 117.9 (qd, J = 17.5, 234.7 Hz, 1C), 88.3 (qd, J = 35.9, 191.3 Hz, 1C).^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.5 (d, J = 12.5 Hz, 3F), -197.6 (dd, J = 12.7, 25.4 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): $C_9H_6F_4N^+$ ([M + H]$^+$), 204.0431, found, 204.0422.

4-(1,2,2,2-Tetrafluoroethyl)-4'-(trifluoromethyl)-1,1'-biphenyl (3i)



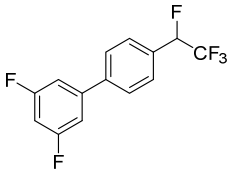
White solid (58 mg, 58 % yield, electrolysis time: 3.2 h, R_f = 0.68 (petroleum ether); M.P. 41.2-43.5 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.75–7.70 (m, 5H), 7.66 (s, 1H), 7.58 (d, *J* = 8.2 Hz, 2H), 5.77–5.56 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 143.8, 142.1, 130.4, 130.1 (d, *J* = 12.9 Hz, 1C), 128.0 (d, *J* = 6.4 Hz, 2C), 127.8 (d, *J* = 6.0 Hz, 2C), 126.1–126.0 (m, 1C), 122.5 (qd, *J* = 28.7, 232.6 Hz, 1C), 87.9 (qd, *J* = 35.6, 185.3 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -62.5 (s, 3F), -78.7(d, *J* = 13.2 Hz, 3F), -194.8 (dd, *J* = 12.7, 25.8 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{10}F_7^+$ ([M + H]$^+$), 323.0665, found, 323.0673.

4-(2,2-Difluorovinyl)-4'-(trifluoromethoxy)-1,1'-biphenyl (3j)



White solid (56 mg, 50 % yield, electrolysis time: 3.3 h, R_f = 0.67 (petroleum ether); M.P. 42.8-45.8 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.61 (t, *J* = 7.9 Hz, 4H), 7.54 (d, *J* = 8.2 Hz, 2H), 7.31 (d, *J* = 8.2 Hz, 2H), 5.78–5.54 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 149.3, 142.2, 138.9, 129.7 (d, *J* = 19.4 Hz, 1C), 128.8, 128.3 (d, *J* = 6.7 Hz, 1C), 127.9 (d, *J* = 6.6 Hz, 1C), 127.5 (d, *J* = 14.5 Hz, 1C), 121.5, 122.4 (qd, *J* = 18.5, 257.1 Hz, 1C), 88.9 (qd, *J* = 34.9, 185.3 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -57.8 (s, 3F), -78.7 (d, *J* = 13.2 Hz, 3F), -194.5 (dd, *J* = 13.2, 26.2 Hz, 1F). Mass Spectrometry:HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{10}F_7O^+$ ([M + H]$^+$), 339.0614, found, 339.0638.

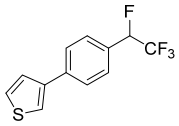
3,5-Difluoro-4'-(1,2,2,2-tetrafluoroethyl)-1,1'-biphenyl (3k)



Colorless oil (58 mg, 50 % yield, electrolysis time: 3.7 h, R_f = 0.68 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.61–7.53 (m, 4H), 7.46–7.38 (m, 1H), 7.02–6.90 (m, 2H), 5.75–5.69 (m, 0.5H), 5.60–5.54 (m, 0.5H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 163.1 (dd, *J* = 11.8, 214.7 Hz, 1C), 159.7 (dd, *J* = 11.7, 215.6 Hz, 1C), 137.4, 131.7–131.5 (m, 1C), 129.8 (d, *J* = 19.7 Hz, 1C), 129.4 (d, *J* = 2.9 Hz, 1C), 127.6 (d, *J* = 6.5 Hz, 1C), 124.5–124.4 (m, 1C), 120.5 (qd, *J* = 29.0, 279.9 Hz, 1C), 112.0 (dd, *J* = 21.1, 3.8 Hz, 1C), 104.7 (t, *J* = 26.3 Hz, 1C), 88.9 (qd, *J* = 34.9, 180.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.6 (d, *J* = 12.7 Hz,

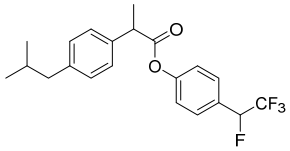
3F), -110.3 (d, *J* = 7.9 Hz, 1F), -113.4 (d, *J* = 7.47 Hz, 1F), -194.7 (dd, *J* = 13.1, 26.3 Hz, 1F). Mass Spectrometry:HRMS (ESI-TOF) (m/z): calcd for $C_{14}H_9F_6^+$ ([M + H]$^+$), 291.0603, found, 291.0614.

3-(4-(1,2,2,2-Tetrafluoroethyl)phenyl)thiophene (3l)



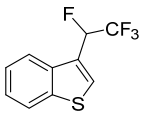
Colorless oil (41 mg, 35 % yield, electrolysis time: 3.5 h, R_f = 0.65 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.67 (d, *J* = 8.2 Hz, 2H), 7.49 (d, *J* = 8.7 Hz, 3H), 7.43–7.37 (m, 2H), 5.71–5.51 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 141.4, 138.1, 129.2 (d, *J* = 82.4, 147.2 Hz, 1C), 127.9 (d, *J* = 6.5 Hz, 1C), 126.8 (d, *J* = 2.8 Hz, 1C), 126.3, 121.5, 120.7 (qd, *J* = 33.1, 263.8 Hz, 1C), 89.0 (qd, *J* = 30.0, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.7 (d, *J* = 12.9 Hz,1F), -194.1 (dd, *J* = 12.5, 26.0 Hz, 1F). Mass Spectrometry:HRMS (ESI-TOF) (m/z): calcd for calcd for $C_{12}H_9F_4S^+$ ([M + H]$^+$), 261.0356, found, 261.0347.

4-(1,2,2,2-tetrafluoroethyl)phenyl 2-(4-isobutylphenyl)propanoate (3m)



White solid (61 mg, 55 % yield, electrolysis time: 3.7 h, R_f = 0.35 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 48.5-50.2 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.45 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 8.1 Hz, 2H), 7.12 (d, *J* = 8.3 Hz, 2H), 5.69–5.48 (m, 1H), 3.98 (dd, *J* = 7.1, 14.2 Hz, 1H), 2.51 (d, *J* = 7.2 Hz, 2H), 1.97–1.83 (m, 1H), 1.64 (d, *J* = 7.1 Hz, 3H), 0.94 (d, *J* = 6.6 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 173.0, 152.7, 141.1, 137.1, 129.7, 128.5 (d, *J* = 6.5 Hz, 1C), 127.7 (d, *J* = 20.2 Hz, 1C), 127.4, 124.2 (d, *J* = 30.3 Hz, 1C), 122.0, 123.7 (qd, *J* = 30.3, 281.2 Hz, 1C), 87.7 (qd, *J* = 37.5, 172.5 Hz, 1C), 45.3 (d, *J* = 17.7 Hz, 1C), 30.3, 22.5, 18.5. ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.8 (d, *J* = 13.0 Hz, 3F), -193.7– -193.9 (m, 1F). Mass Spectrometry:HRMS (ESI-TOF) (m/z): calcd for calcd for $C_{21}H_{23}F_4O_2^+$ ([M + H]$^+$), 383.1629, found, 383.1618.

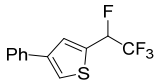
3-(1,2,2,2-tetrafluoroethyl)benzo[*b*]thiophene (3n)



Colorless oil (54 mg, 45 % yield, electrolysis time: 3.6 h, R_f = 0.67 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.92–7.84 (m, 2H), 7.74 (d, *J* = 1.7 Hz, 1H), 7.48–7.39 (m, 2H), 6.07 (dd, *J* = 6.0, 12.1 Hz, 0.5H), 5.92 (dd, *J* = 6.1, 12.1 Hz, 0.5H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 140.4, 136.8, 128.8 (d, *J*

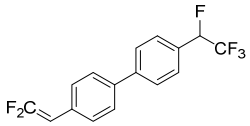
= 8.1 Hz, 1C), 125.4 (d, *J* = 13.2 Hz, 1C), 125.1 (d, *J* = 9.7 Hz, 1C), 123.1, 122.2, 120.3 (qd, *J* = 34.5, 273.7 Hz, 1C), 85.3 (qd, *J* = 35.7, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -77.6 (s, 3F), -192.3 (s, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{10}H_7F_4S^+$ ($[M + H]^+$), 235.0199, found, 235.0172.

4-Phenyl-2-(1,2,2,2-tetrafluoroethyl)thiophene (3o)



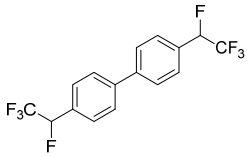
Colorless oil (36 mg, 30 % yield, electrolysis time: 3.7 h, R_f = 0.66 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.58 (d, *J* = 7.1 Hz, 4H), 7.43 (t, *J* = 7.1 Hz, 2H), 7.34 (t, *J* = 7.2 Hz, 1H), 5.95–5.89 (m, 0.5H), 5.80–5.75 (m, 0.5H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 142.7, 135.0, 131.8 (d, *J* = 21.7 Hz, 1C), 129.3 (d, *J* = 5.3 Hz, 1C), 129.1, 127.9, 126.5, 123.6 (d, *J* = 2.9 Hz, 1C), 120.1 (qd, *J* = 30.0, 307.8 Hz, 1C), 85.3 (qd, *J* = 72.9, 180.8 Hz, 0.5C). ^{19}FNMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.4 (d, *J* = 14.2 Hz, 3F), -178.4 (dd, *J* = 72.9, 36.4 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{12}H_9F_4S^+$ ($[M + H]^+$), 261.0356, found, 261.0356.

4-(2,2-Difluorovinyl)-4'-(1,2,2,2-tetrafluoroethyl)-1,1'-biphenyl (3p)



White solid (74 mg, 65 % yield, electrolysis time: 3.5 h, R_f = 0.64 (petroleum ether); M.P. 36.3-37.1 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.67 (d, *J* = 8.1 Hz, 2H), 7.60 (s, 1H), 7.56 (d, *J* = 6.0 Hz, 2H), 7.52 (s, 1H), 7.43 (d, *J* = 8.3 Hz, 2H), 5.74–5.68 (m, 0.5H), 5.60–5.54 (m, 0.5H), 5.37 (d, *J* = 3.7 Hz, 0.5H), 5.29 (d, *J* = 3.7 Hz, 0.5H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 142.8, 138.7, 130.2 (d, *J* = 6.8 Hz, 1C), 129.5, 129.2, 128.3–128.2 (m, 1C), 127.9 (d, *J* = 6.4 Hz,1C), 127.6, 127.4, 120.5 (qd, *J* = 30.5, 281.0 Hz, 1C), 88.7 (qd, *J* = 13.6, 150.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.7 (d, *J* = 13.2 Hz, 2F), -81.4 (d, *J* = 29.5 Hz, 1F), -83.3 (d, *J* = 29.3 Hz, 1F), 194.3 (dd, *J* = 13.1, 26.1 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{16}H_{11}F_6^+$ ($[M + H]^+$), 317.0759, found, 317.0740.

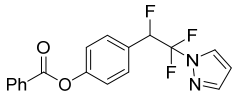
4,4'-Bis(1,2,2,2-tetrafluoroethyl)-1,1'-biphenyl (3q)



White solid (87 mg, 68 % yield, electrolysis time: 3.6 h, R_f = 0.68 (petroleum ether); M.P. 35.2-36.5 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.67 (d, *J* = 8.1 Hz, 4H), 7.56 (d, *J* = 8.2 Hz, 4H), 5.76–5.70 (m, 1H), 5.61–5.55 (m, 1H).

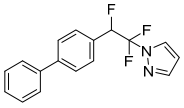
^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 142.4, 130.0 (d, *J* = 19.6 Hz, 2C), 128.0 (d, *J* = 6.5 Hz, 2C), 127.7, 120.5 (qd, *J* = 29.1, 308.1 Hz, 2C), 88.9 (qd, *J* = 34.7, 187.5 Hz, 2C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.7 (d, *J* = 12.9 Hz, 6F), -194.5– -194.7 (m, 2F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{16}H_{11}F_8^+$ ([M + H]$^+$), 355.0728, found, 355.0703.

4-(1,2,2-Trifluoro-2-(1*H*-pyrazol-1-yl)ethyl)phenyl benzoate (5a)



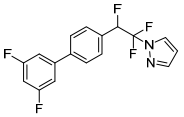
White solid (610mg, 45 % yield, electrolysis time: 5.8 h, R_f = 0.48 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 102.5-105.8 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 8.05 (d, *J* = 7.4 Hz, 2H), 7.59 (d, *J* = 12.4 Hz, 1H), 7.51 (t, *J* = 7.3 Hz, 1H), 7.37 (t, *J* = 7.8 Hz, 2H), 7.31 (d, *J* = 8.5 Hz, 2H), 7.12 (d, *J* = 2.7 Hz, 1H), 7.09 (s, 2H), 6.32–6.11 (m, 2H). ^{13}C NMR (75MHz, $CDCl_3$, 25ºC, δ): 165.0, 152.3, 142.8, 133.9, 130.3, 129.4, 128.8 (d, *J* = 6.9 Hz, 1C), 128.5 (d, *J* = 2.0 Hz, 1C), 128.4, 122.0, 119.9 (t, *J* = 305.2 Hz, 1C), 107.8, 89.7 (qd, *J* = 27.5, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -92.5 (dd, *J* = 13.08 , 207.8 Hz,1F), -96.8 (dd, *J* = 17.8, 207.8 Hz,1F), -193.1 (dd, *J* = 14.0, 17.2 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{18}H_{14}F_3N_2O_2^+$ ([M + H]$^+$), 347.1002, found, 347.1000.

1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-1*H*-pyrazole (5b)



White solid (56 mg, 40 % yield, electrolysis time: 5.3 h, R_f = 0.42 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 114.5-115.7 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.76 (s, 1H), 7.73 (d, *J* =2.1 Hz, 1H), 7.61 (t, *J* = 2.8 Hz, 1H), 6.47 (t, *J* = 7.4 Hz, 4H), 7.46 (t, *J* = 7.1 Hz, 4H), 7.38 (t, *J* = 7.1 Hz, 1H), 6.50–6.28 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 143.0 (d, *J* = 1.7 Hz, 1C), 142.8, 140.3 , 130.1, 129.8, 129.0, 128.4, 127.9 (d, *J* = 4.6 Hz, 2C), 127.3, 120.1 (t, *J* = 202.9 Hz, 1C), 107.7, 90.0 (qd, *J* = 35.5, 172.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -91.8 (dd, *J* = 207.9 , 13.7 Hz, 1F), -97.2 (dd, *J* = 208.0 , 17.9 Hz, 1F), -193.2 (dd, *J* = 13.7, 18.2 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{14}F_3N_2^+$ ([M + H]$^+$), 303.1104, found, 303.1112.

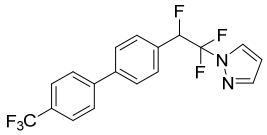
1-(2-(3',5'-Difluoro-[1,1'-biphenyl]-4-yl)-1,1,2-trifluoroethyl)-1*H*-pyrazole (5c)



White solid (40 mg, 30 % yield, electrolysis time: 5.6 h, R_f = 0.41 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 108.5-112.7 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.77–7.73 (m, 2H), 7.56 (d, *J* = 8.2 Hz, 2H), 7.48 (d, *J* = 8.3 Hz, 2H), 7.11–7.08 (m, 2H), 6.85–6.77 (m, 1H), 6.50–6.29 (m, 2H). ^{13}C NMR (75

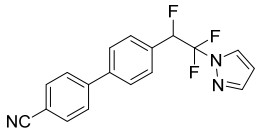
MHz, $CDCl_3$, 25 ºC, δ): 165.1 (d, *J* = 12.9 Hz, 1C), 161.8 (d, *J* = 13.02 Hz, 1C), 143.6 (t, *J* = 9.56 Hz, 1C), 142.8, 140.6, 131.3 (d, *J* = 22.0 Hz, 1C), 128.4, 128.2 (d, *J* = 6.7 Hz, 1C), 127.2, 120.3 (t, *J* = 254.5 Hz, 1C), 110.2 (m, 1C), 107.8, 103.2 (d, *J* = 25.2 Hz, 1C), 90.5 (qd, *J* = 35.7, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -91.8 (dd, *J* = 208.1, 13.6 Hz,1F), -96.9 (dd, *J* = 208.1, 18.0 Hz, 1F), -100.3 (s, 2F), -193.9 (dd, *J* = 13.4, 17.6 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{12}F_5N_2^+$ ($[M + H]^+$), 339.0915, found, 339.0917.

1-(1,1,2-Trifluoro-2-(4'-(trifluoromethyl)-[1,1'-biphenyl]-4-yl)ethyl)-1*H*-pyrazole (5d)



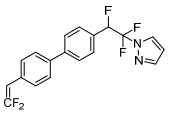
White solid (46 mg, 35 % yield, electrolysis time: 5.4 h, R_f = 0.45 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 103.5-106.9 ℃; NMR Spectroscopy: ^1H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.76 (d, *J* = 9.0 Hz, 2H), 7.70 (s, 4H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.50 (d, *J* = 8.0 Hz, 2H), 6.50–6.29 (m, 2H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC, δ): 143.9, 142.8, 141.6, 131.1 (d, *J* = 20.1 Hz, 1C), 129.9 (t, *J* = 33.3 Hz, 1C), 128.4, 128.2 (d, *J* = 6.7 Hz, 1C), 127.7, 127.5, 126.0 (dd, *J* = 3.7, 7.4 Hz, 1C), 119.0 (t, *J* = 265.7 Hz, 1C), 107.9, 89.7 (qd, *J* = 23.4, 180.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -62.5 (s, 3F), -91.6 (dd, *J* = 13.5, 208.4 Hz, 1F), -97.1 (dd, *J* = 17.9, 208.3 Hz,1F), -193.7 (dd, *J* = 13.7, 17.7 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{18}H_{13}F_6N_2^+$ ($[M + H]^+$), 371.0977, found, 371.0968.

4'-(1,2,2-Trifluoro-2-(1*H*-pyrazol-1-yl)ethyl)-[1,1'-biphenyl]-4-carbonitrile (5e)



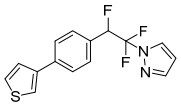
White solid (61 mg, 45% yield, electrolysis time: 5.3 h, R_f = 0.47 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 119.5-204.7 ℃; NMR Spectroscopy: ^1H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.76–7.72 (m, 4H), 7.67 (d, *J* = 5.5 Hz, 2H), 7.60 (d, *J* = 8.3 Hz, 2H), 7.50 (d, *J* = 8.3 Hz, 2H), 6.50–6.29 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 144.8, 142.8, 140.9, 132.8, 131.6 (d, *J* = 20.0 Hz, 1C), 128.3 (t, *J* = 7.7 Hz, 1C), 127.9, 127.4, 118.9, 111.7, 107.9, 89.8 (qd, *J* = 23.9, 180.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -91.5 (dd, *J* = 13.4, 208.3 Hz, 1F), -97.0 (dd, *J* = 17.9, 208.5 Hz,1F), -193.9 (dd, *J* = 13.7, 17.9 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{18}H_{13}F_3N_3^+$ ($[M + H]^+$), 328.1056, found, 328.1039.

1-(2-(4'-(2,2-Difluorovinyl)-[1,1'-biphenyl]-4-yl)-1,1,2-trifluoroethyl)-1*H*-pyrazol e (5f)



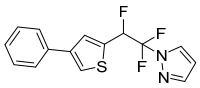
White solid (59 mg, 45 % yield, electrolysis time: 5.5 h, R_f = 0.41 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 112.5-115.7 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.75 (d, *J* = 11.4 Hz, 2H), 7.64–7.60 (m, 4H), 7.55 (d, *J* = 8.1 Hz, 2H), 7.49 (d, *J* = 8.0 Hz, 2H),7.50 –6.28 (m, 2H), 5.73–5.56 (m, 1H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC, δ):142.8, 142.5 (d, *J* = 1.5 Hz, 1C), 141.8 (d, *J* = 1.0 Hz, 1C), 130.9 (d, *J* = 1.6 Hz, 1C), 130.6 (d, *J* = 1.6 Hz, 1C), 130.5, 129.9 (d, *J* = 1.6 Hz, 1C), 129.7, 128.4, 128.1 (d, *J* = 6.7 Hz, 1C), 127.9 (d, *J* = 6.7 Hz, 1C), 127.5 (d, *J* = 17.6 Hz, 1C), 120.0 (t, *J* = 267.3 Hz, 1C), 107.8, 91.6–86.9 (m, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -78.6 (s, 2F) , -91.7 (dd, *J* = 208.2, 13.54 Hz, 1F), -97.2 (dd, *J* = 208.2, 18.0 Hz,1F) , -193.5 – -194.5 (m, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{19}H_{14}F_5N_2^+$ ($[M + H]^+$), 365.1072, found, 365.1057.

1-(1,1,2-Trifluoro-2-(4-(thiophen-3-yl)phenyl)ethyl)-1*H*-pyrazole (5g)



White solid (39 mg, 28 % yield, electrolysis time: 5.7 h, R_f = 0.48 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 108.5-110.7 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.76 (d, *J* = 1.1 Hz, 1H), 7.71 (d, *J* = 2.0 Hz, 2H), 7.61 (d, *J* = 8.0 Hz, 2H), 7.50–7.48 (m, 1H), 7.42 –7.39 (m, 4H), 6.44–6.23 (m, 2H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC, δ): 142.8, 141.5, 137.6, 129.6, 128.4, 128.0 (d, *J* = 6.7 Hz, 1C), 126.7, 126.6, 126.3, 121.3, 118.3 (t, *J* = 210.5 Hz, 1C), 107.8, 90.8 (qd, *J* = 33.5, 112.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -92.3 (dd, *J* = 207.7, 13.8 Hz,1F), -96.9 (dd, *J* = 207.9, 18.2 Hz, 1F), -193.3 (dd, *J* = 13.6, 17.9 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{12}F_3N_2S^+$ ($[M + H]^+$), 309.0668, found, 309.0662.

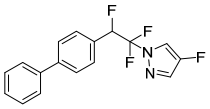
1-(1,1,2-Trifluoro-2-(4-phenylthiophen-2-yl)ethyl)-1*H*-pyrazole (5h)



Colorless oil (25 mg, 18% yield, electrolysis time: 5.3 h, R_f = 0.44 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 102.5-105.2 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.78 (d, *J* = 15.1 Hz, 2H), 7.53 (d, *J* = 7.0 Hz, 3H), 7.45–7.37 (m, 3H), 7.30 (t, *J* = 7.1 Hz, 1H), 6.69 (t, *J* = 8.6 Hz, 0.5H), 6.54 (t, *J* = 10.7 Hz, 0.5H), 6.41 (s, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25ºC,δ): 142.9, 142.3, 135.2, 129.1, 128.9 (d, *J* = 5.4 Hz, 1C), 128.4, 127.7, 126.5, 123.2 (d , *J* = 2.2 Hz, 1C), 128.0, 120.1 (t, *J* = 272.4 Hz , 1C) , 86.7 (qd, *J* = 38.6, 225.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -92.1 (dd, *J* = 36.9, 65.7 Hz, 1F), -95.8 (dd, *J* = 18.7, 206.3 Hz, 1F),

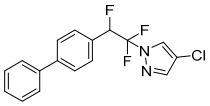
-179.5 (dd, *J* = 15.4, 18.4 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{15}H_{12}F_3N_2S^+$ ([M + H]$^+$), 309.0668, found, 309.0659.

1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-4-fluoro-1*H*-pyrazole (5i)



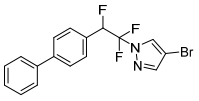
White solid (70 mg, 47% yield, electrolysis time: 5.5 h, R_f = 0.45 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 116.5-118.9 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.62 (t, *J* = 8.6 Hz, 6H), 7.47 (t, *J* = 8.3 Hz, 4H), 7.39 (t, *J* = 7.1 Hz, 1H), 6.45–6.23 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 150.3 (d, *J* = 249.7 Hz, 1C), 141.75 (d, *J* = 222.0 Hz, 1C), 131.0 (d, *J* = 15.0 Hz, 1C), 129.8, 129.5, 129.0, 128.0 (d, *J* = 5.6 Hz, 2C), 127.4 (d, *J* = 5.6 Hz, 2C), 121.2 (t, *J* = 277.8 Hz, 1C), 114.3 (d, *J* = 28.3 Hz, 2C), 89.7 (qd, *J* = 35.5, 165.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -91.1 (dd, *J* = 208.1, 13.5 Hz, 1F), -98.3 (dd, *J* = 208.1, 18.0 Hz,1F), -174.1(s, 1F), -193.1 (dd, *J* = 15.6, 18.0 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{12}F_4N_2Na^+$ ([M + Na]$^+$), 343.0829, found, 343.0829.

1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-4-chloro-1*H*-pyrazole (5j)



White solid (79 mg, 51% yield, electrolysis time: 5.4 h, R_f = 0.45 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 117.2-119.8 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.74 (s, 1H), 7.69 (d, *J* = 0.7 Hz, 1H), 7.62 (t, *J* = 8.3 Hz, 4H), 7.46 (t, *J* = 7.3 Hz, 4H), 7.38 (t, *J* = 7.1 Hz, 1H), 6.42–6.21 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 143.3(d, *J* = 1.7 Hz, 1C), 141.4, 140.3, 129.6, 129.4, 129.0, 128.0 (t, *J* = 3.2 Hz, 1C), 127.4 (d, *J* = 6.9 Hz, 2C), 126.3, 121.4 (t, *J* = 163.7 Hz, 1C), 113.1, 89.2 (qd, *J* = 36.9, 232.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -90.7 (dd, *J* = 208.6, 17.7 Hz,1F), -98.4 (dd, *J* = 208.6, 17.7 Hz, 1F), -193.1 (dd, *J* = 13.9, 18.0 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{13}ClF_3N_2^+$ ([M + H]$^+$), 337.0714, found, 337.0708.

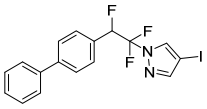
1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-4-bromo-1*H*-pyrazole (5k)



White solid (84 mg, 48 % yield, electrolysis time: 5.6 h, R_f = 0.43 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 120.5-123.9 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.78 (s, 1H), 7.72 (d, *J* = 0.7 Hz, 1H), 7.61 (t, *J* = 8.4 Hz, 4H), 7.46 (t, *J* = 7.2 Hz, 4H), 7.38 (t, *J* = 7.1 Hz, 1H), 6.42–6.21 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 143.4, 143.3 (d, *J* = 1.6 Hz, 1C), 140.3, 129.6, 129.4, 129.0, 128.5, 128.0 (t, *J* = 2.8 Hz,1C), 127.4(d, *J* = 6.8 Hz, 2C), 116.7 (t, *J* = 288.1 Hz, 1C), 96.4, 89.5 (qd, *J* = 35.3, 202.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ):

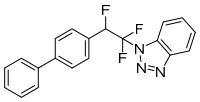
-90.6 (dd, *J* = 208.8, 13.7 Hz,1F), -98.5 (dd, *J* = 208.6, 17.6 Hz, 1F), -193.1 (dd, *J* = 13.4, 17.5 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{13}BrF_3N_2^+$ ([M + H]$^+$), 381.0209, found, 381.0221.

1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-4-iodo-1*H*-pyrazole (5l)



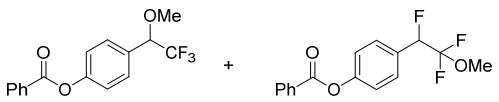
White solid (62 mg, 20% yield, electrolysis time: 5.2 h, R_f = 0.45 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 122.5-124.6 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.81 (s, 1H), 7.76 (s, 1H), 7.61 (t, *J* = 8.3 Hz, 4H), 7.46 (t, *J* = 7.1 Hz, 4H), 7.38 (t, *J* = 7.0 Hz, 1H), 6.42–6.21(m,1H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC,δ): 147.6, 143.3, 140.3, 132.8, 129.7, 129.4, 129.0, 128.0 (t, *J* = 2.9 Hz, 1C), 127.4 (d, *J* = 6.2 Hz, 2C), 120.0 (t, *J* = 294.4 Hz, 1C), 89.8 (qd, *J* = 27.3, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -90.4 (dd, *J* = 208.8, 13.7 Hz,1F), -98.3 (dd, *J* = 208.8, 17.7 Hz, 1F), -193.1 (dd, *J* = 13.5, 17.5 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{13}F_3IN_2^+$ ([M + H]$^+$), 429.0070, found, 429.0062.

1-(2-([1,1'-Biphenyl]-4-yl)-1,1,2-trifluoroethyl)-1*H*-benzo[*d*][1,2,3]triazole (5m)



White solid (69 mg, 30 % yield, electrolysis time: 5.3 h, R_f = 0.45 (petroleum ether/ethyl acetate = 20 : 1 (v/v)); M.P. 123.2-125.4 ℃; NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 8.12 (t, *J* = 8.0 Hz, 1H), 7.66 (t, *J* = 8.0 Hz, 4H), 7.58 (t, *J* = 8.0 Hz, 6H), 7.44 (d, *J* = 7.0 Hz, 2H), 7.36 (d, *J* = 6.7 Hz, 1H), 6.75–6.54 (m, 1H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC,δ):145.9, 143.5, 140.2, 133.1 (d, *J* = 184.6 Hz, 1C), 129.6, 129.0, 128.4 (d, *J* = 6.5 Hz, 1C), 128.0, 127.4 (d, *J* = 11.2 Hz, 1C), 125.5, 120.6, 118.2 (t, *J* = 194.8 Hz, 1C), 111.6–111.4 (m, 1C), 90.6 (qd, *J* = 32.7, 187.5 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -87.6 (t, *J* = 13.3, 0.5F), -88.4 (t, *J* = 13.3 Hz, 0.5F), -96.1 (t, *J* = 16.8 Hz, 0.5F), -96.9 (t, *J* = 17.6 Hz, 0.5F), -191.2 (dd, *J* = 14.1, 30.4 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{20}H_{15}F_3N_3^+$ ([M + H]$^+$),354.1213, found, 354.1210

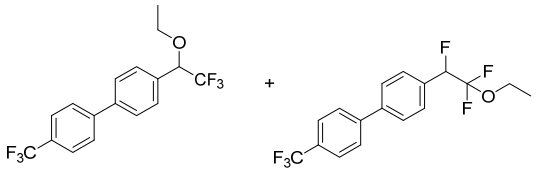
4-(2,2,2-trifluoro-1-methoxyethyl)phenyl benzoate (5n)
4-(1,2,2-trifluoro-2-methoxyethyl)phenyl benzoate (5n')



Colorless oil (79 mg, 55 % yield, electrolysis time: 4.3 h, R_f = 0.45 (petroleum ether/ethyl acetate = 50 : 1 (v/v)); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 8.13 (d, *J* = 7.7 Hz, 4H), 7.56 (t, *J* = 7.2 Hz, 2H), 7.43 (t, *J* = 7.4 Hz, 8H), 7.20 (t, *J* = 4.9 Hz, 4H), 5.51–5.32 (m, 1H), 4.49–4.42 (m, 1H), 3.51 (s, 1H), 3.36 (s,

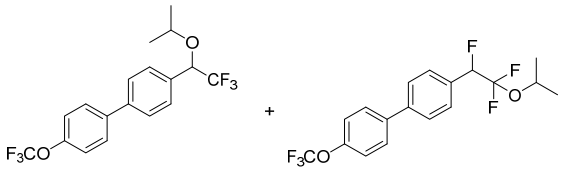
1H) . ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 165.1, 152.0, 133.9, 130.3, 129.5 (d, *J* = 7.4 Hz, 1C), 128.8 (d, *J* = 6.7 Hz, 1C), 122.1, 121.8, 91.3 (dd, *J* = 37.2, 72.2 Hz, 0.5C), 88.7 (dd, *J* = 35.0, 67.8 Hz, 0.5C), 81.1 (dd, *J* = 32.9, 63.9 Hz, 0.5C), 119.3 (t, *J* = 252.1 Hz, 1C), 88.5 (qd, *J* = 34.9, 195.0 Hz, 1C), 58.4, 50.7 (d, *J* = 7.2 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -76.7 (s, 3F), -87.1 (dd, *J* = 12.7, 141.4 Hz, 1F), -89.2 (dd, *J* = 14.4, 141.4 Hz, 1F), -192.0 (t, *J* = 13.5 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{16}H_{14}F_3O_3^+$ ([M + H]$^+$), 311.0890, found, 311.0872.

4-(1-Ethoxy-2,2,2-trifluoroethyl)-4'-(trifluoromethyl)-1,1'-biphenyl (5o)
4-(2-Ethoxy-1,2,2-trifluoroethyl)-4'-(trifluoromethyl)-1,1'-biphenyl (5o')



Colorless oil (64 mg, 52 % yield, electrolysis time: 4.2 h, R_f = 0.45 (petroleum ether/ethyl acetate = 50 : 1 (v/v)); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.73 (s, 8H), 7.66 (d, *J* = 8.2 Hz, 4H), 7.60 (t, *J* = 1.5 Hz, 4H), 5.64–5.45 (m, 1H), 4.73–4.67 (m, 1H), 4.02 (dd, *J* = 7.2, 14.3 Hz, 2H), 3.66 (dd, *J* = 7.1, 14.0 Hz, 2H), 1.33 (d, *J* = 2.6 Hz, 1H), 1.30 (t, *J* = 2.9 Hz, 4H), 1.28 (s, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 144.1, 141.0, 133.0 (t, *J* = 43.5 Hz, 1C), 130.0 (d, *J* = 29.9 Hz, 1C), 128.9, 128.2 (d, *J* = 45.7 Hz, 1C), 127.6 (d, *J* = 3.1 Hz, 1C), 127.3, 125.9 (dd, *J* = 4.5, 8.2 Hz, 1C), 122.6 (t, *J* = 269.8 Hz, 1C), 119.3 (t, *J* = 252.1 Hz, 1C), 90.4 (qd, *J* = 30.1, 247.5 Hz, 1C), 79.5 (d, *J* = 30.9 Hz, 1C), 66.6, 60.1 (t, *J* = 6.4 Hz, 1C), 15.1 (d, *J* = 19.4 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -62.5 (s, 3F), -76.6 (s, 3F), -84.4 (dd, *J* = 13.3, 143.0 Hz, 1F), -85.8 (t, *J* = 14.2, 144.2 Hz, 1F), -192.7 (t, *J* = 13.7 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{17}H_{15}F_6O^+$ ([M + H]$^+$), 349.1022, found, 349.1028.

4-(2,2,2-Trifluoro-1-isopropoxyethyl)-4'-(trifluoromethoxy)-1,1'-biphenyl (5p)
4-(2,2-Difluoro-2-isopropoxy-1-methoxyethyl)-4'-(trifluoromethoxy)-1,1'-biphenyl (5p')

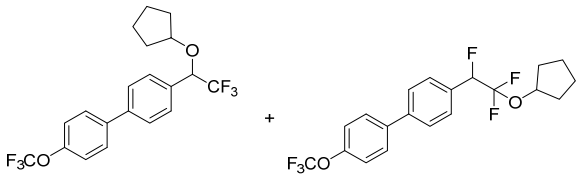


Colorless oil (57 mg, 45 % yield, electrolysis time: 4.5 h, R_f = 0.45 (petroleum ether/ethyl acetate = 50 : 1 (v/v)); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.62 (d, *J* = 2.9 Hz, 2H), 7.59 (d, *J* = 2.7 Hz, 3H), 7.55 (t, *J* = 6.5 Hz, 6H), 7.30 (d, *J* = 8.5 Hz, 4H), 5.57–5.38 (m, 1H), 4.77–4.51 (m, 2H), 3.81–3.68 (m, 1H), 1.27 (t, *J* = 3.2 Hz, 5H), 1.25 (s, 3H), 1.23 (s, 1H), 1.18 (d, *J* = 6.2 Hz, 6H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 149.1, 141.0 (d, *J* = 7.6 Hz, 1C), 139.4, 133.6, 132.4 (d, *J*

= 22.0 Hz, 1C), 128.8, 128.7, 128.1 (d, *J* = 7.0 Hz, 1C), 127.3, 127.0, 121.4, 119.0 (t, *J* = 256.0 Hz, 1C), 91.0 (qd, *J* = 27.5, 187.5 Hz, 1C), 72.3, 69.4 (t, *J* = 5.1 Hz, 1C), 23.4 (d, *J* = 2.5 Hz, 1C), 23.0, 21.4. ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -57.8 (d, *J* = 2.4 Hz, 3F), -76.8 (s, 3F), -82.0 (dd, *J* = 13.6, 144.6 Hz, 1F), -83.3 (dd, *J* = 14.1, 144.2 Hz, 1F), -192.1 (t, *J* = 14.1 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{18}H_{17}F_6O_2^+$ ([M + H]$^+$), 379.1127, found, 379.1115.

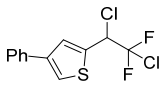
4-(1-(Cyclopentyloxy)-2,2,2-trifluoroethyl)-4'-(trifluoromethoxy)-1,1'-biphenyl (5q)

4-(2-(Cyclopentyloxy)-2,2-difluoro-1-methoxyethyl)-4'-(trifluoromethoxy)-1,1'-biphenyl (5q')



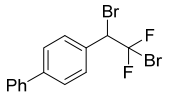
Colorless oil (46 mg, 33 % yield, electrolysis time: 4.6 h, R_f = 0.45 (petroleum ether/ethyl acetate = 50 : 1 (v/v)); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.63 (d, *J* = 2.3 Hz, 2H), 7.60 (d, *J* = 2.2 Hz, 3H), 7.54 (t, *J* = 9.7 Hz, 7H), 7.30 (d, *J* = 8.3 Hz, 4H), 5.57–5.38 (m, 1H), 4.82–4.66 (m, 2H), 4.07 (d, *J* = 3.0 Hz, 1H), 1.80–1.69 (m, 5H), 1.25 (s, 12H), 1.59–1.54 (m, 4H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 149.1, 141.0 (d, *J* = 9.0 Hz, 1C), 139.4 (d, *J* = 3.8 Hz, 1C), 133.4, 132.4 (d, *J* = 20.1 Hz, 1C), 128.9, 128.7, 128.1 (d, *J* = 6.9 Hz, 1C), 127.3, 127.0, 121.4, 119.0 (t, *J* = 255.5 Hz, 1C), 90.9 (qd, *J* = 37.5, 180.0 Hz, 1C), 81.8, 33.5, 33.0, 31.9, 23.5 (d, *J* = 4.9 Hz, 1C). ^{19}F NMR (282MHz, $CDCl_3$, 25 ºC, δ): -57.8 (s, 3F), -76.8 (s, 3F), -81.6 (dd, *J* = 13.8, 144.6 Hz, 1F), -83.3 (dd, *J* = 14.4, 144.2 Hz, 1F), -192.4 (t, *J* = 14.0 Hz, 1F). Mass Spectrometry:HRMS (ESI-TOF) (m/z): calcd for $C_{20}H_{19}F_6O_2^+$ ([M + H]$^+$), 405.1284, found, 405.1264.

2-(1,2-Dichloro-2,2-difluoroethyl)-4-phenylthiophene (6)



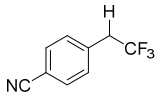
Colorless oil (92 mg, 70 % yield, electrolysis time: 5.3 h, R_f = 0.60 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25º C, δ): 7.57 (d, *J* = 1.6 Hz, 1H), 7.54 (s, 1H), 7.48 (s, 1H), 7.45 (s, 1H), 7.43 (s, 1H), 7.38 (t, *J* = 7.1 Hz, 1H), 7.22 (s, 1H), 5.45–5.40 (m, 1H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC, δ): 138.3, 133.4, 131.8, 131.1, 128.7, 128.1, 128.6, 128.3, 126.5, 122.6, 60.4 (t, *J* = 30.7 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -58.7 (d, *J* = 163.0 Hz, 1F), -60.9 (d, *J* = 163.0 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{12}H_9Cl_2F_2S^+$ ([M + H]$^+$), 292.9765, found, 292.9771.

4-(1,2-Dibromo-2,2-difluoroethyl)-1,1'-biphenyl (7)



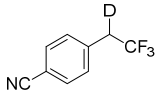
Colorless oil (119 mg, 69 % yield, electrolysis time: 5.2 h, R_f = 0.62 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 ºC, δ): 7.64–7.57 (m, 6H),7.47 (t, *J* = 7.0 Hz, 2H), 7.39 (t, *J* = 7.1 Hz, 1H), 5.43–5.35 (m, 1H). ^{13}CNMR (75 MHz, $CDCl_3$, 25ºC, δ): 143.0, 140.1, 133.3, 130.1, 129.1, 128.1, 127.6, 127.3, 115.6 (t, *J* = 309.2 Hz, 1C), 55.1 (t, *J* = 25.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -45.7 (d, *J* = 156.7 Hz, 1F), -54.8 (d, *J* = 157.0 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{14}H_{11}Br_2F_2^+$ ([M + H]$^+$), 374.9190, found, 374.9169.

4-(2,2,2-Trifluoroethyl)benzonitrile (9)



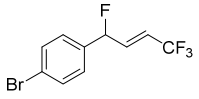
Colorless oil (93 mg, 83 % yield, electrolysis time: 3.1 h, R_f = 0.45 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25º C, δ): 7.67 (d, *J* = 8.0 Hz, 2H), 7.43 (d, *J* = 8.0 Hz, 2H), 3.49–3.39 (m, 2H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 135.3, 132.5, 131.0, 118.3, 112.3, 40.3 (dd, *J* = 30.5, 60.7 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -65.5 (s, 3F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_9H_7F_3N^+$ ([M + H]$^+$), 186.0525, found, 186.0522.

4-(2,2,2-Trifluoroethyl-1-*d*)benzonitrile (10)



Colorless oil (36 mg, 32 % yield, H/D = 7:3, electrolysis time: 3.1 h, R_f = 0.45 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25 º C, δ): 7.67 (d, *J* = 8.1 Hz, 2H), 7.43 (d, *J* = 8.0 Hz, 2H), 3.50–3.39 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 135.3 (d, *J* = 2.8 Hz, 1C), 132.5, 131.0, 127.0 (t, *J* = 188.7 Hz, 1C), 118.3, 112.4, 40.2 (dd, *J* = 29.9, 60.0 Hz, 1C). ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -65.5 (s, 3F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_9H_6DF_3N^+$ ([M + H]$^+$), 187.0588, found, 187.0585.

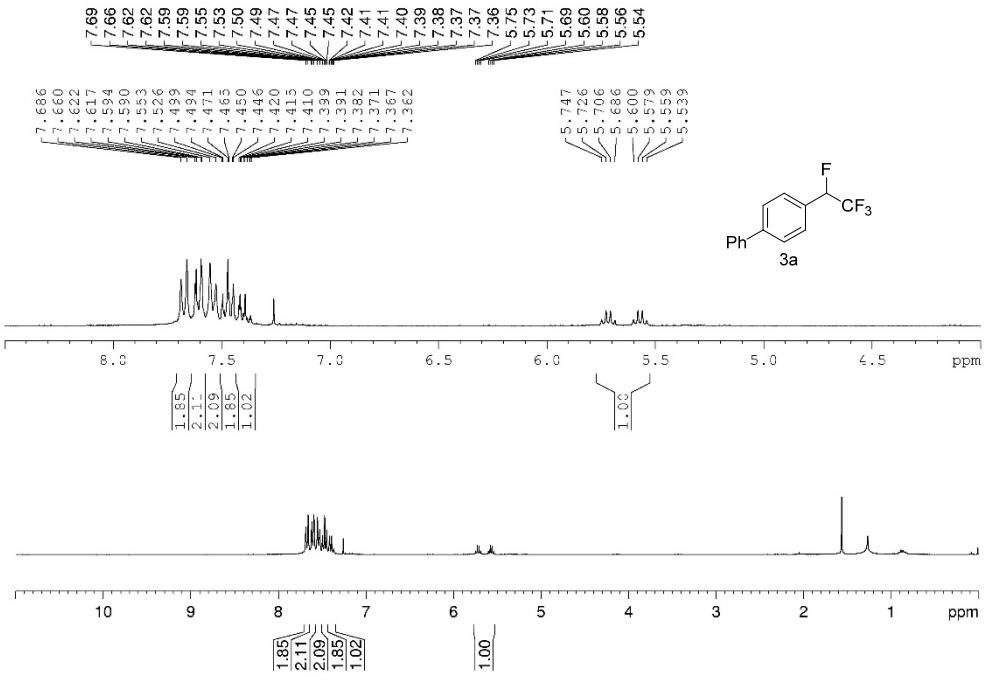
(*E*)-1-Bromo-4-(1,4,4,4-tetrafluorobut-2-en-1-yl)benzene (12)

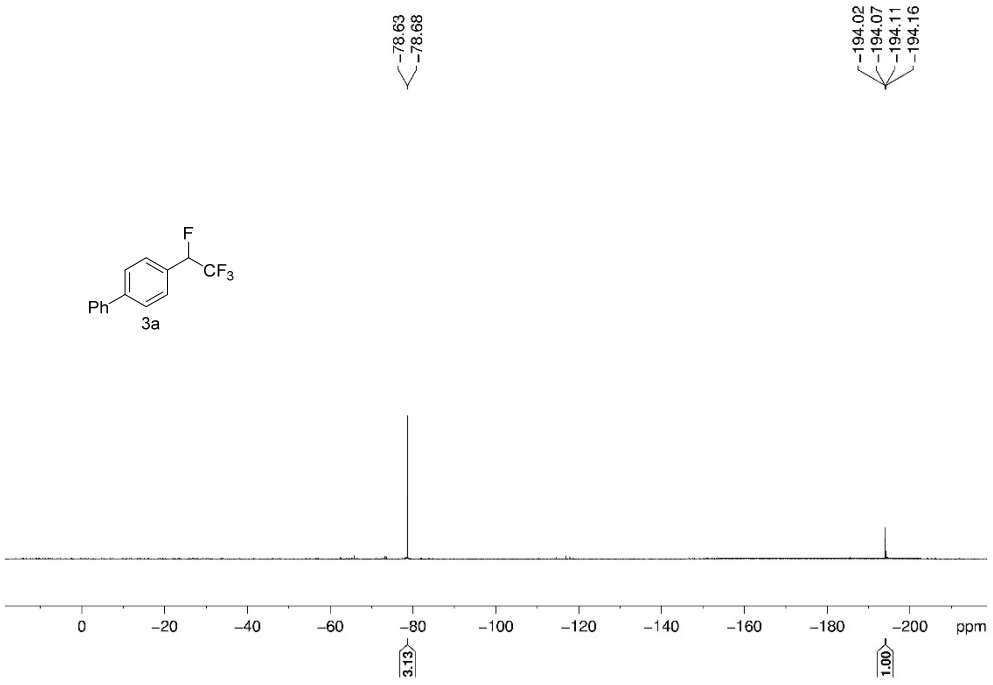


Colorless oil (52 mg, 45 % yield, electrolysis time: 4.2 h, R_f = 0.35 (petroleum ether); NMR Spectroscopy: ^{1}H NMR (300 MHz, $CDCl_3$, 25º C, δ): 7.56 (d, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 7.3 Hz, 2H), 6.58–6.45 (m, 1H), 6.10–5.87 (m, 1H). ^{13}C NMR (75 MHz, $CDCl_3$, 25 ºC, δ): 137.1 (dd, *J* = 6.3, 12.6 Hz, 0.5C), 136.8 (dd, *J* = 6.4, 12.6 Hz, 0.5C), 135.4 (d, *J* = 20.2 Hz, 1C), 132.3, 128.4 (d, *J* = 5.6 Hz, 1C), 123.8 (d, *J* = 3.1

Hz, 1C), 120.5–118.9 (m, 1C), 91.6, 89.3. ^{19}F NMR (282 MHz, $CDCl_3$, 25 ºC, δ): -64.5 (s, 3F), -174.3 (d, J = 1.3 Hz, 1F). Mass Spectrometry: HRMS (ESI-TOF) (m/z): calcd for $C_{10}H_8BrF_4^+$ ([M + H]$^+$), 282.9740, found, 282.9728.

7. NMR Spectrum：

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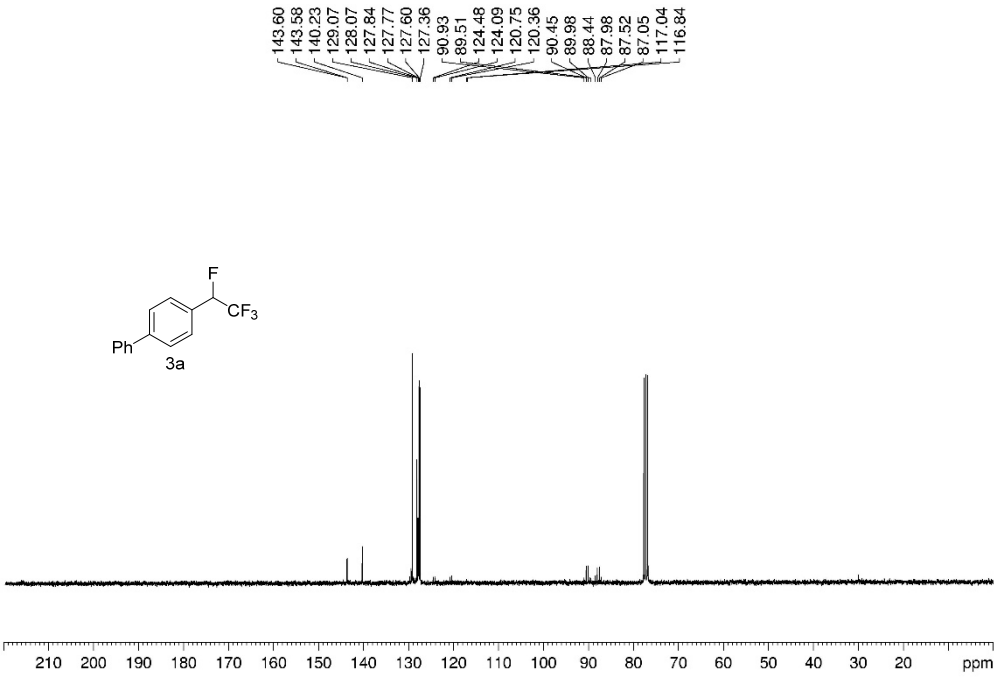
-78.68
-194.02
-194.07
-194.11
-194.16
F
CF3
Ph
3a
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.13
1.00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127.77
127.60
127.36
90.93
89.51
124.48
124.09
120.75
120.36
90.45
89.98
88.44
87.98
87.52
87.05
117.04
116.84
F
CF3
Ph
3a
210
200
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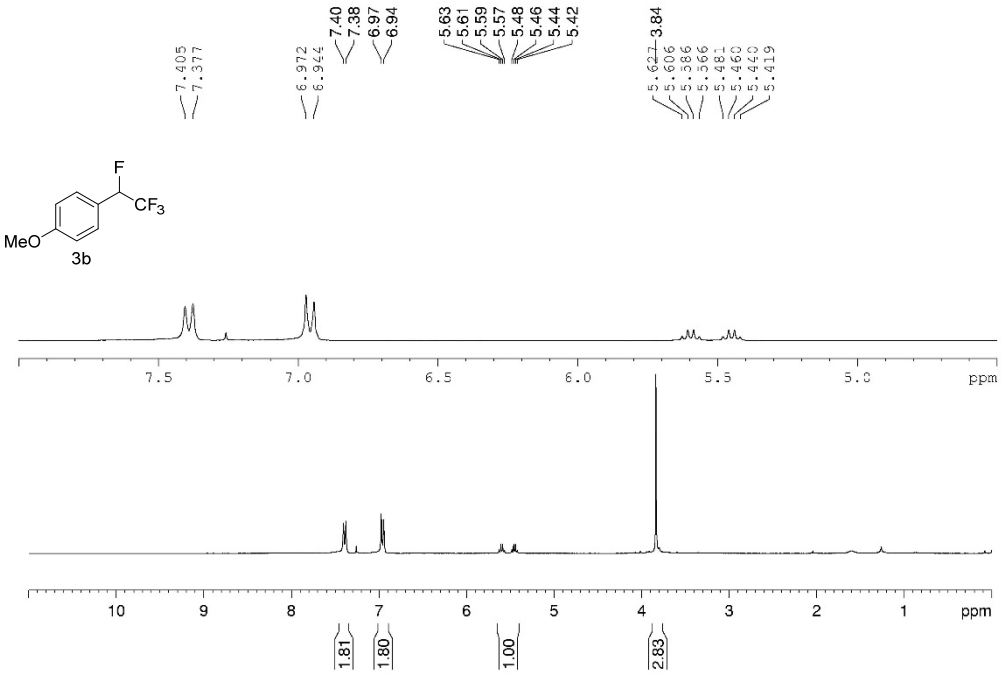
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.377
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7.40
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6.94
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5.61
5.59
5.57
5.48
5.46
5.44
5.42
5.627
5.606
5.586
5.566
5.481
5.460
5.440
5.419
3.84
F
CF3
MeO
3b
7.5
7.0
6.5
6.0
5.5
5.0
ppm
10
9
8
7
6
5
4
3
2
1
ppm
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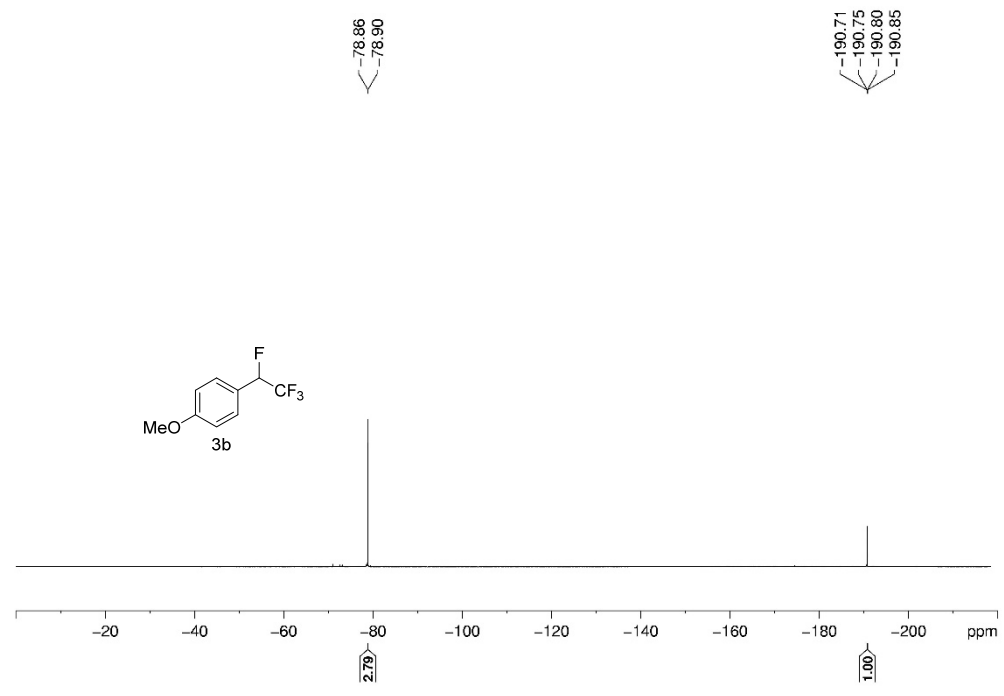
1.00
2.83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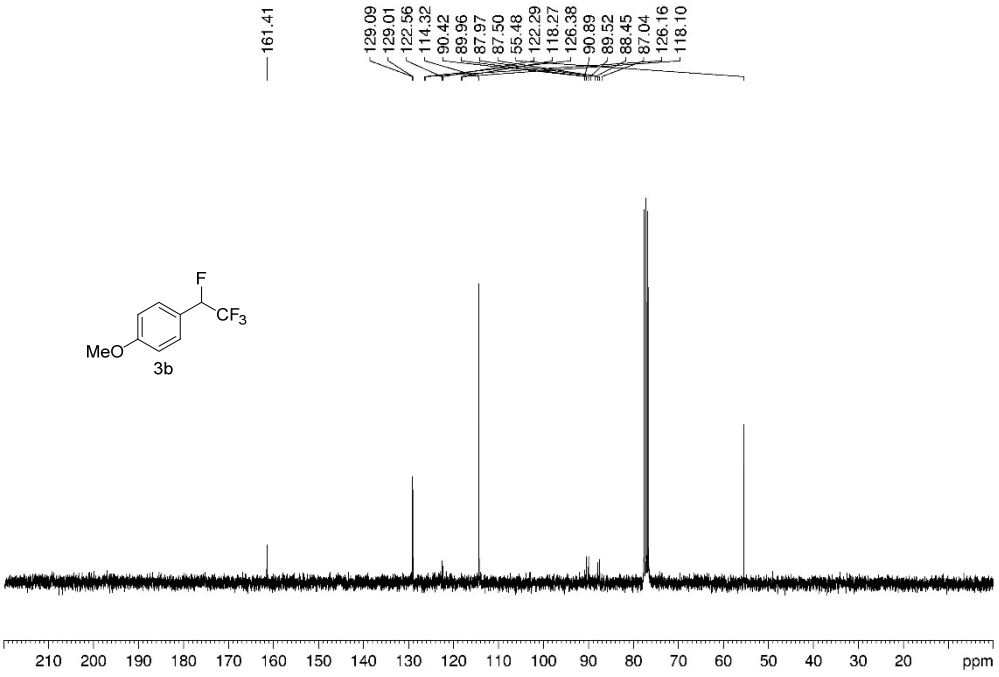
-78.90
-190.71
-190.75
-190.80
-190.85
F
CF3
MeO
3b
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.79
1.00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129.01
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114.32
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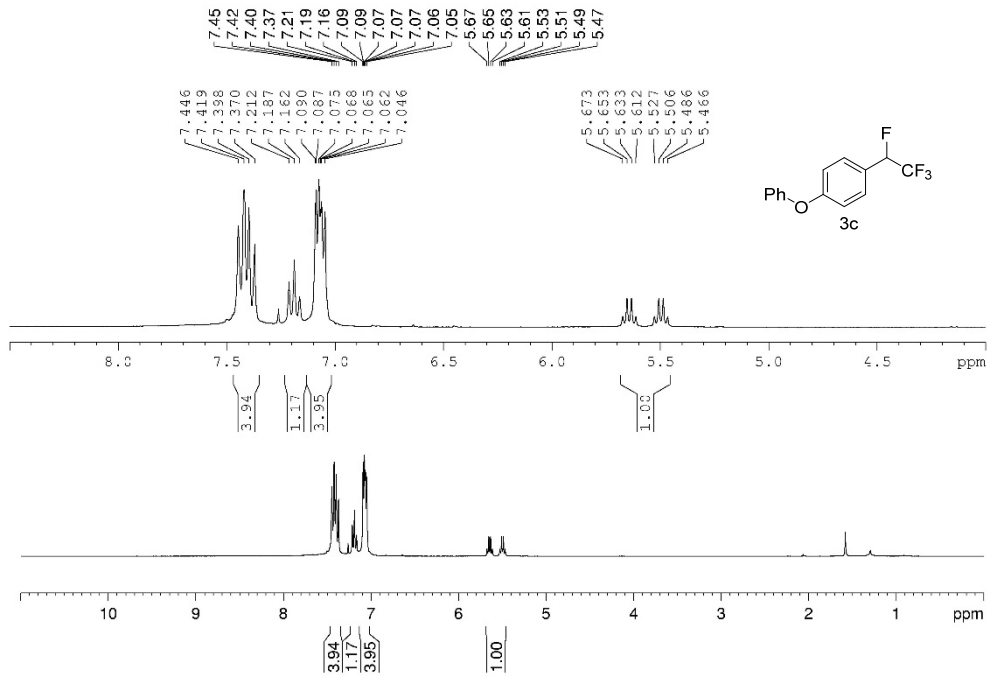
87.97
87.50
55.48
122.29
118.27
126.38
90.89
89.52
88.45
87.04
126.16
118.10
F
CF3
MeO
3b
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.42
7.40
7.37
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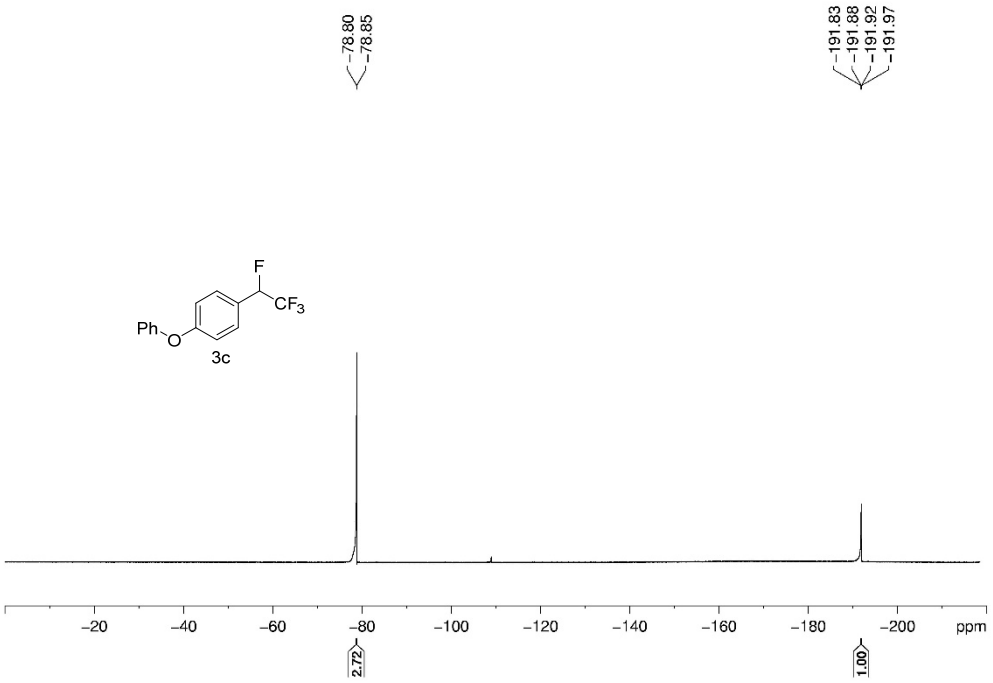
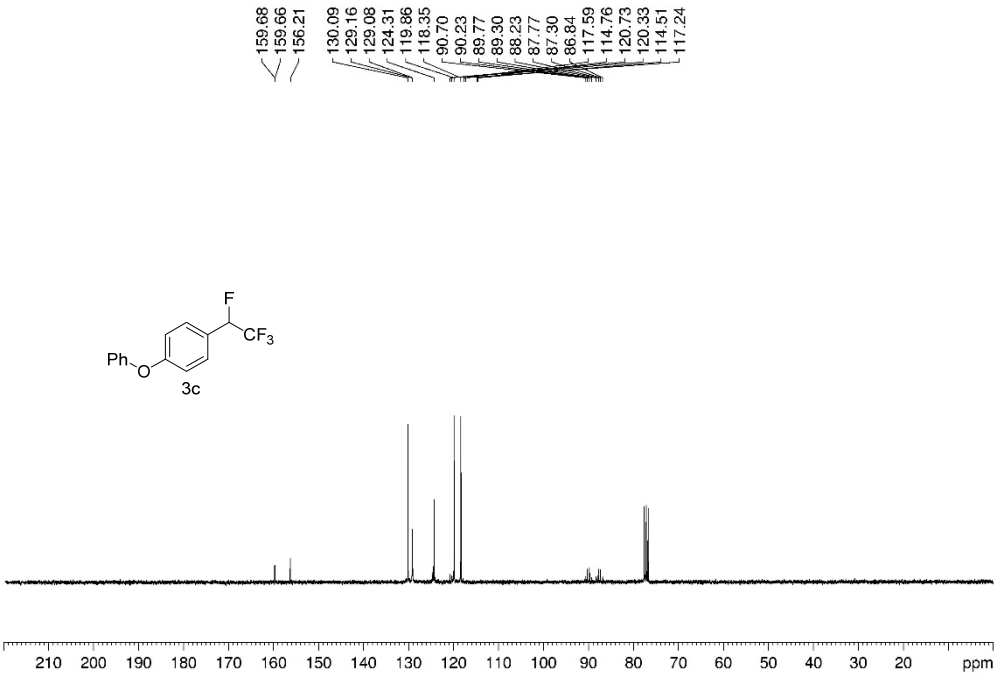
7.19
7.16
7.09
7.09
7.07
7.07
7.07
7.06
7.05
5.67
5.65
5.63
5.61
5.53
5.51
5.49
5.47
7.446
7.419
7.398
7.370
7.212
7.187
7.162
7.090
7.087
7.075
7.068
7.065
7.062
7.046
5.673
5.653
5.633
5.612
5.527
5.506
5.486
5.466
F
CF3
Ph
O
3c
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
3.94
1.17
3.95
1.00
10 9 8 7 6 5 4 3 2 1 ppm
3.94
1.17
3.95
1.00


-78.80
-78.85
-191.83
-191.88
-191.92
-191.97
F
CF3
Ph
O
3c
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.72
1.00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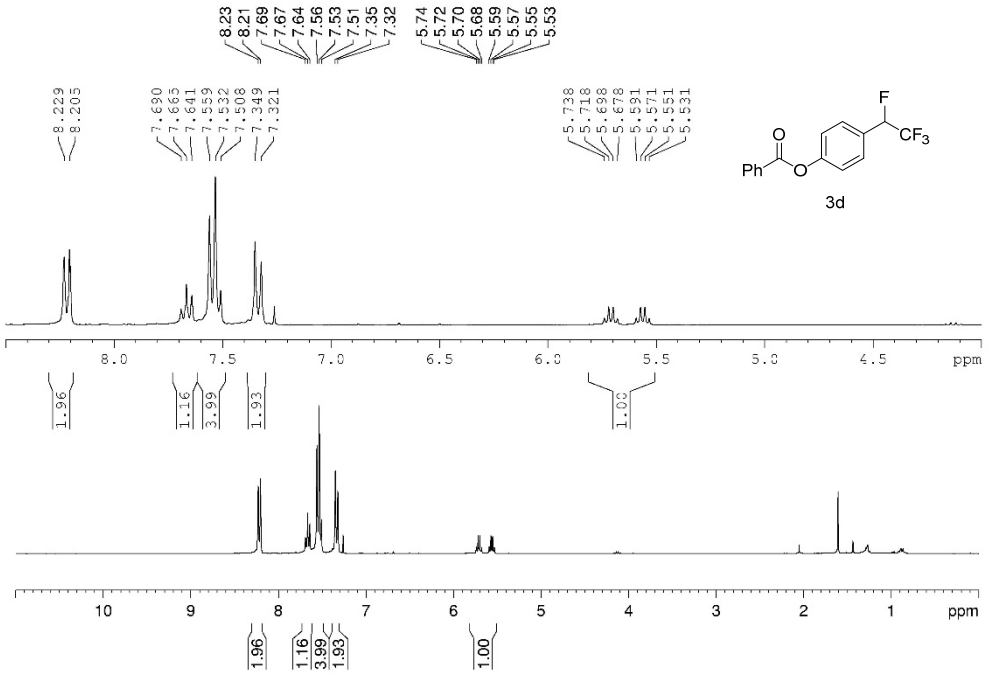
159.66
156.21
130.09
129.16
129.08
124.31
119.86
118.35
90.70
90.23
89.77
89.30
88.23
87.77
87.30
86.84
117.59
114.76
120.73
120.33
114.51
117.24
F
CF3
Ph
O
3c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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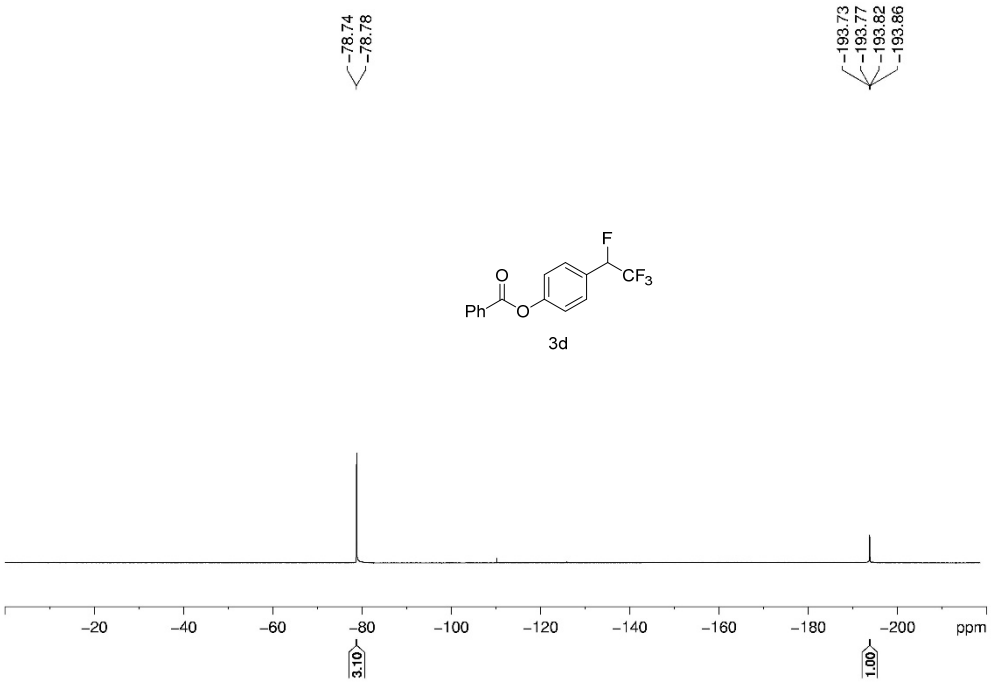
7.67
7.64
7.56
7.53
7.51
7.35
7.32
5.74
5.72
5.70
5.68
5.59
5.57
5.55
5.53
8.229
8.205
7.690
7.665
7.641
7.559
7.532
7.508
7.349
7.321
5.738
5.718
5.698
5.678
5.591
5.571
5.551
5.531
F
CF3
O
Ph
O
3d
ppm
1.96
1.16
3.99
1.93
1.00


-78.74
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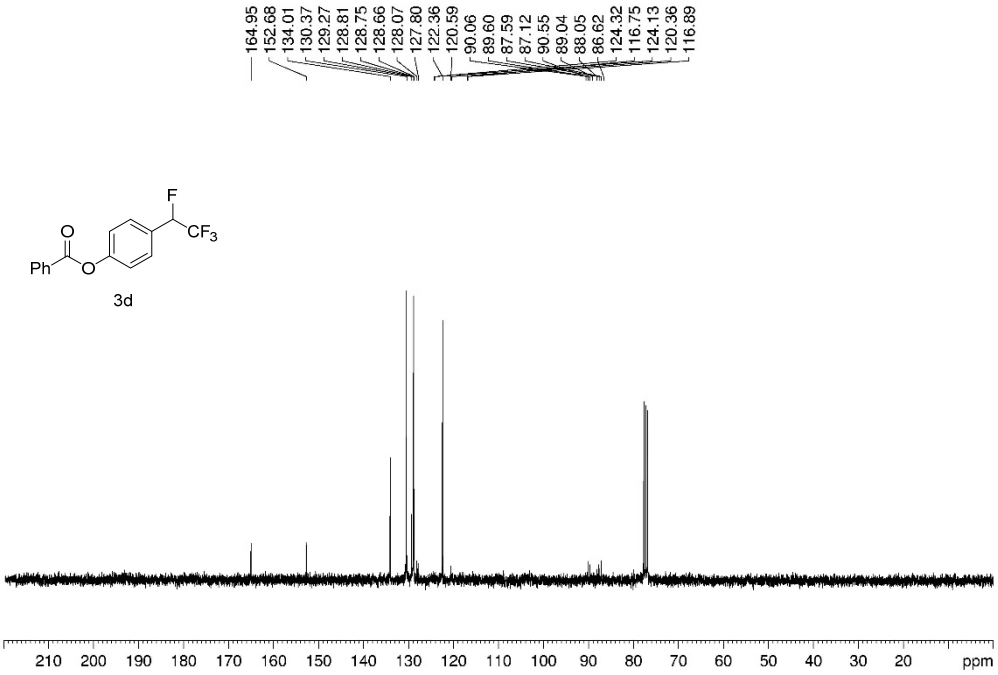
-193.73
-193.77
-193.82
-193.86
F
CF3
O
Ph
O
3d
ppm
3.10
1.00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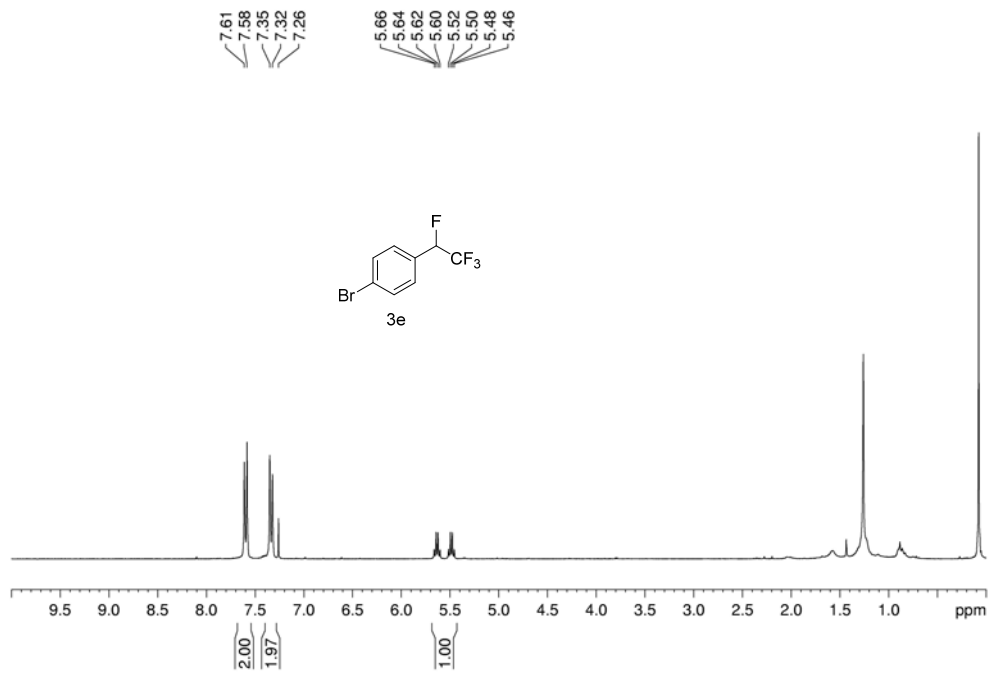
152.68
134.01
130.37
129.27
128.81
128.75
128.66
128.07
127.80
122.36
120.59
90.06
89.60
87.59
87.12
90.55
89.04
88.05
86.62
124.32
116.75
124.13
120.36
116.89
F
CF3
O
Ph
O
3d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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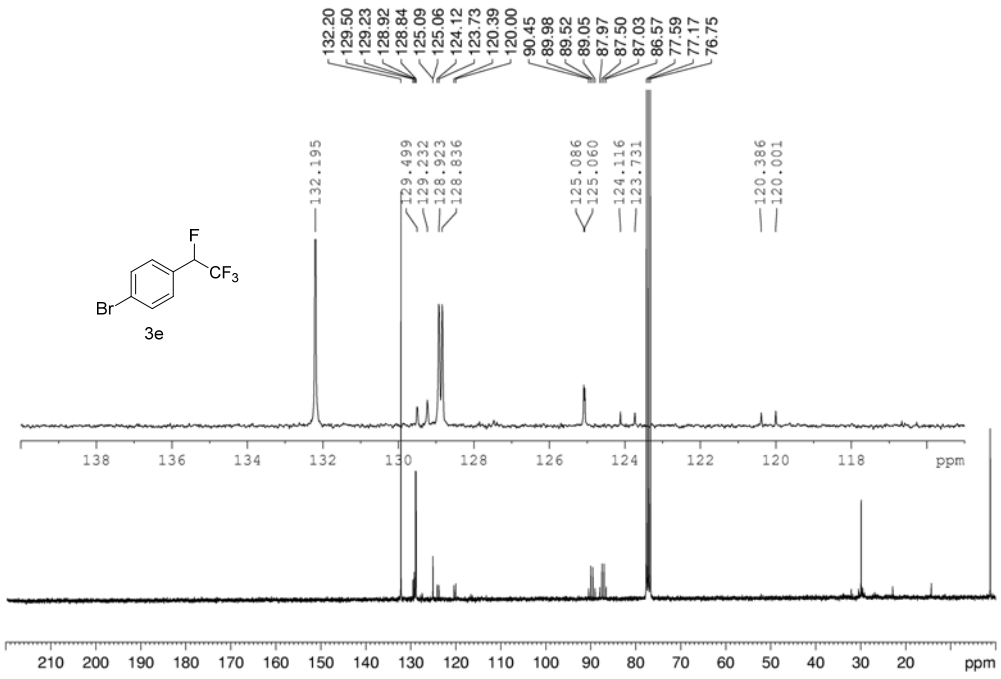
7.58
7.35
7.32
7.26
5.66
5.64
5.62
5.60
5.52
5.50
5.48
5.46
F
CF3
Br
3e
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 ppm
2.00
1.97
1.00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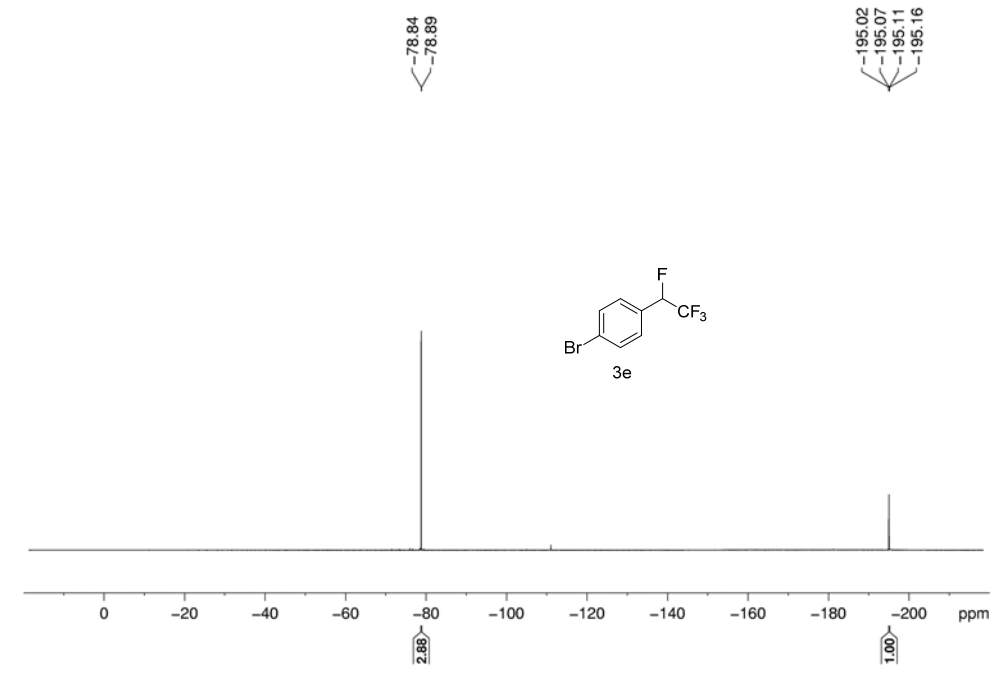
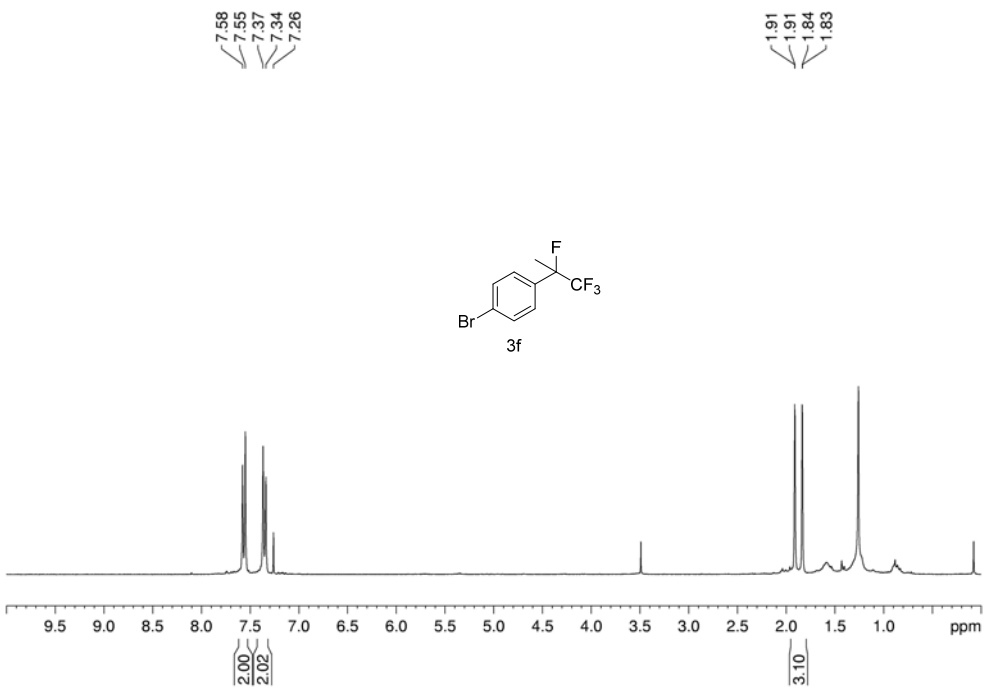
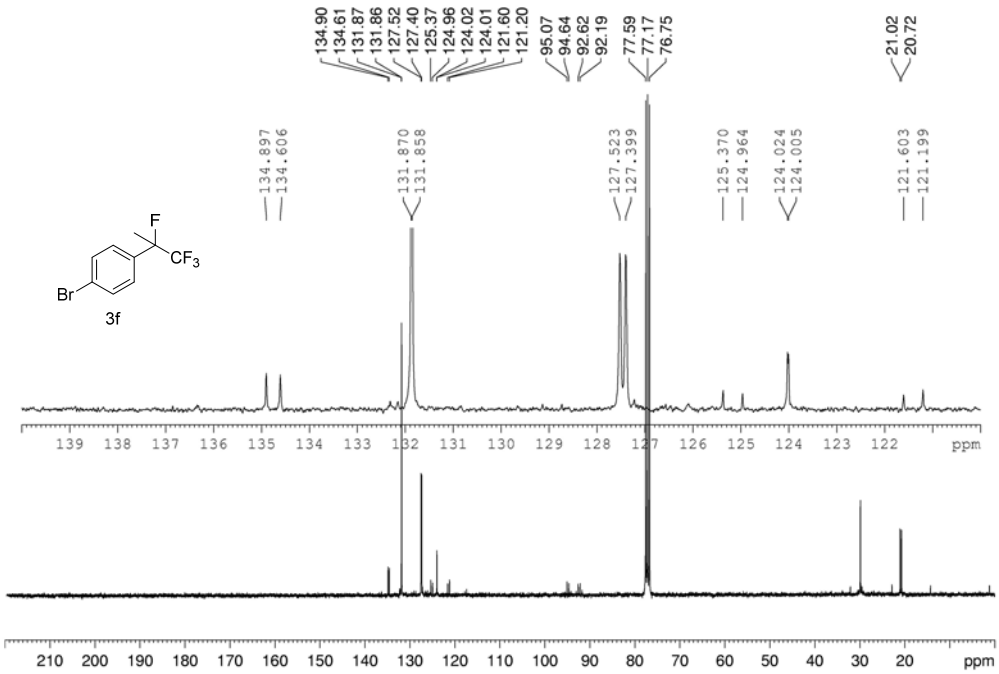
129.50
129.23
128.92
128.84
125.09
125.06
124.12
123.73
120.39
120.00
90.45
89.98
89.52
89.05
87.97
87.50
87.03
86.57
77.59
77.17
76.75
132.195
129.499
129.232
128.923
128.836
125.086
125.060
124.116
123.731
120.386
120.001
F
CF3
Br
3e
138
136
134
132
130
128
126
124
122
120
118
ppm
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm


-78.84
-78.89
-195.02
-195.07
-195.11
-195.16
F
CF3
Br
3e
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.88
1.00


7.58
7.55
7.37
7.34
7.26
1.91
1.91
1.84
1.83
F
CF3
Br
3f
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 ppm
2.00
2.02
3.10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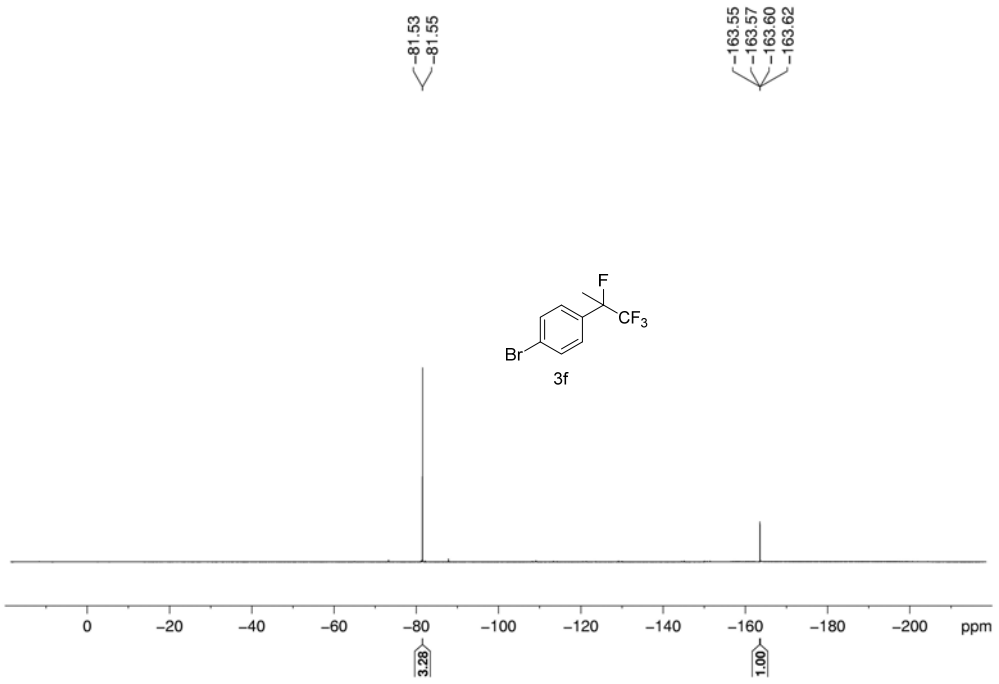
131.87
131.86
127.52
127.40
125.37
124.96
124.02
124.01
121.60
121.20
95.07
94.64
92.62
92.19
77.59
77.17
76.75
21.02
20.72
134.897
134.606
131.870
131.858
127.523
127.399
125.370
124.964
124.024
124.005
121.603
121.199
F
CF3
Br
3f
139 138 137 136 135 134 133 132 131 130 129 128 127 126 125 124 123 122 ppm
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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-81.55
-163.55
-163.57
-163.60
-163.62
F
CF3
Br
3f
0
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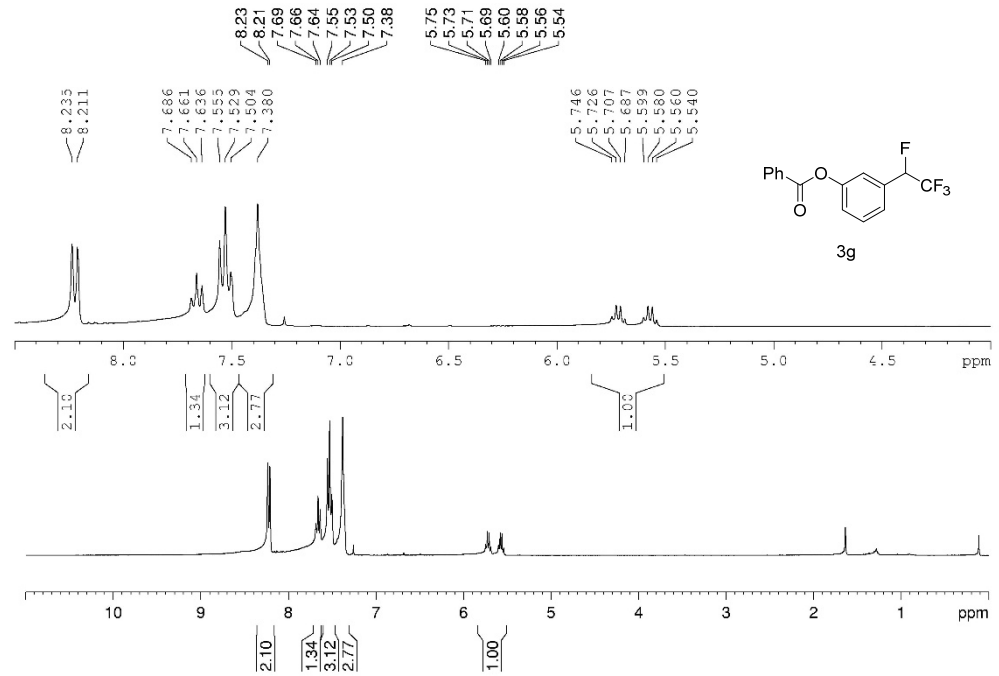
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.28
1.00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8.21
7.69
7.66
7.64
7.55
7.53
7.50
7.38
5.75
5.73
5.71
5.69
5.60
5.58
5.56
5.54
8.233
8.211
7.686
7.661
7.636
7.555
7.529
7.504
7.380
5.746
5.726
5.707
5.687
5.599
5.580
5.560
5.540
Ph
O
O
F
CF3
3g
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
2.10
1.34
3.12
2.77
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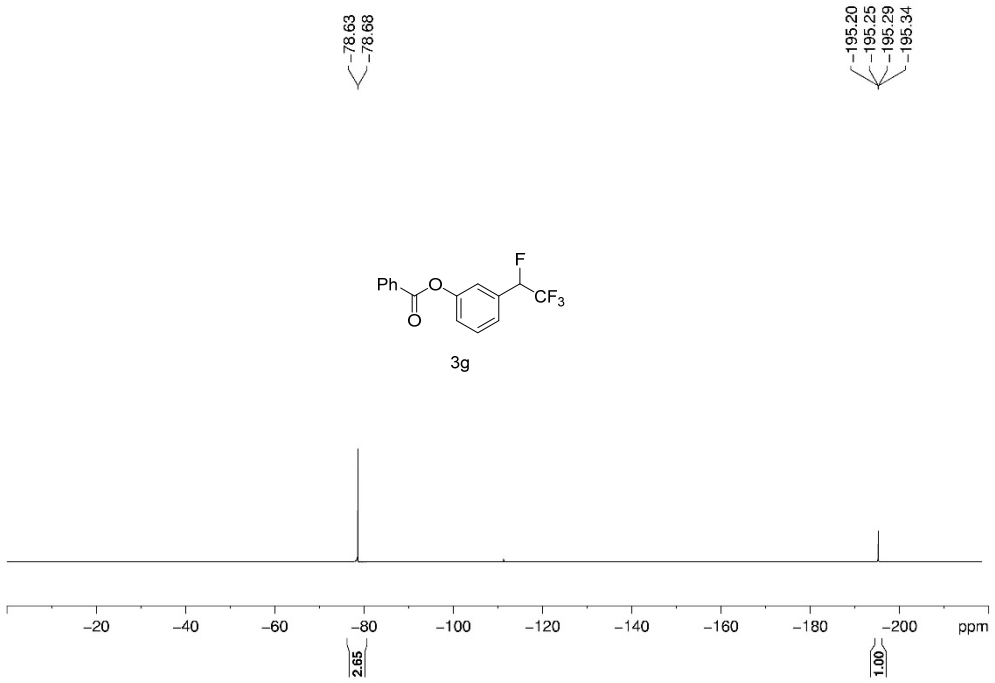
10
9
8
7
6
5
4
3
2
1
ppm
2.10
1.34
3.12
2.77
1.00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-78.68
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-195.25
-195.29
-195.34
F
Ph
O
O
CF3
3g
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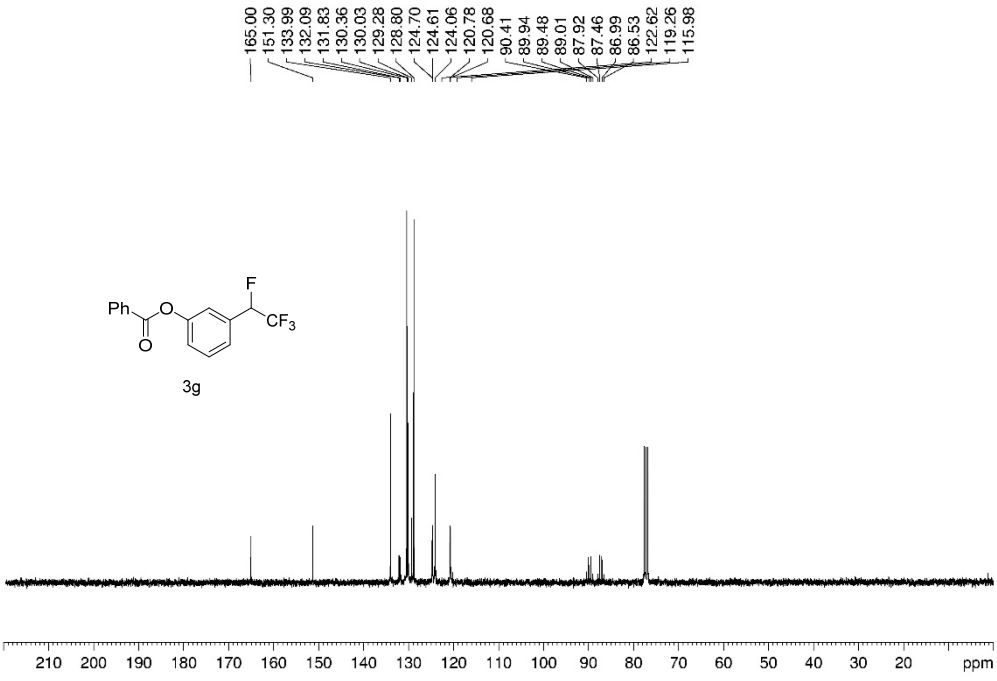
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.65
1.00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151.30
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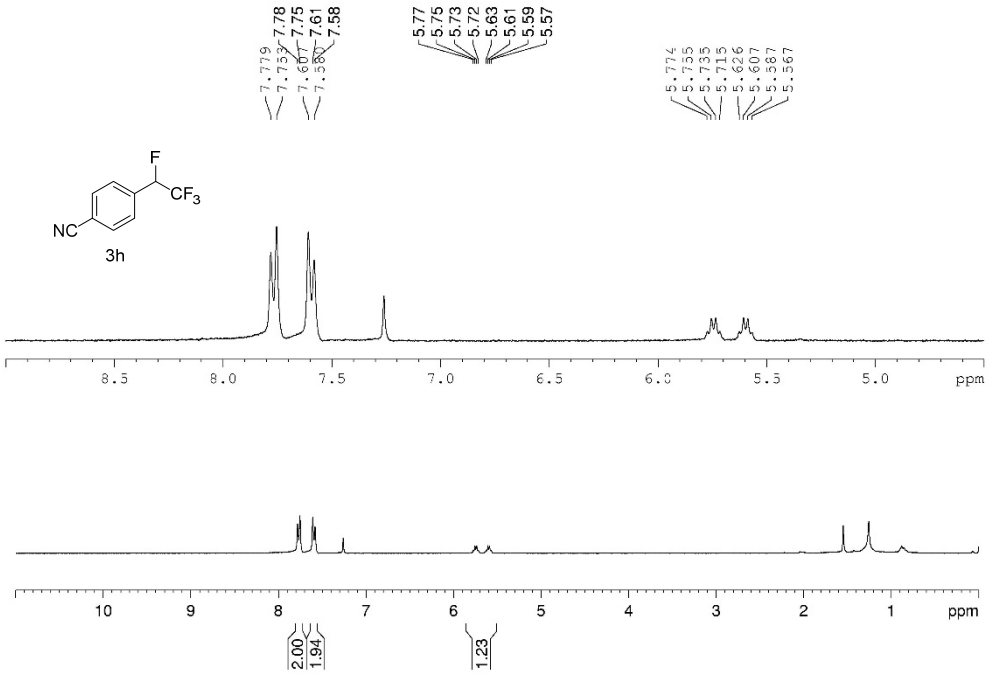
131.83
130.36
130.03
129.28
128.80
124.70
124.61
124.06
120.78
120.68
90.41
89.94
89.48
89.01
87.92
87.46
86.99
86.53
122.62
119.26
115.98
F
Ph
O
O
CF3
3g
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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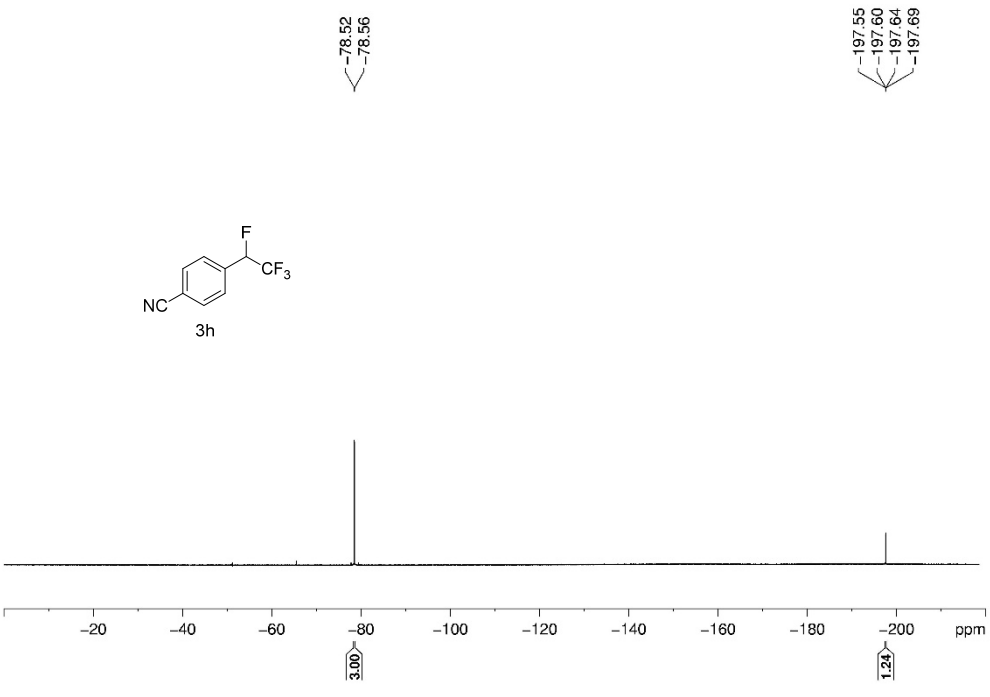
7.78
7.75
7.607
7.61
7.580
7.58
5.77
5.75
5.73
5.72
5.63
5.61
5.59
5.57
5.774
5.755
5.735
5.715
5.626
5.607
5.587
5.567
F
CF3
NC
3h
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
ppm
10
9
8
7
6
5
4
3
2
1
ppm
2.00
1.94
1.23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-197.55
-197.60
-197.64
-197.69
F
CF3
NC
3h
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-40
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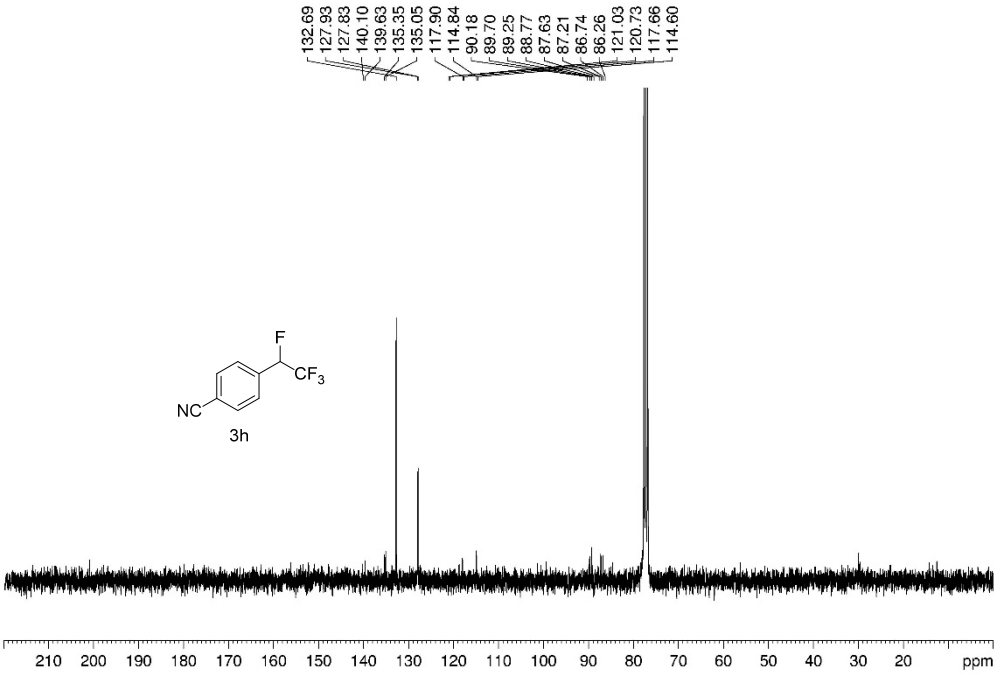
-140
-160
-180
-200
ppm
3.00
1.24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127.93
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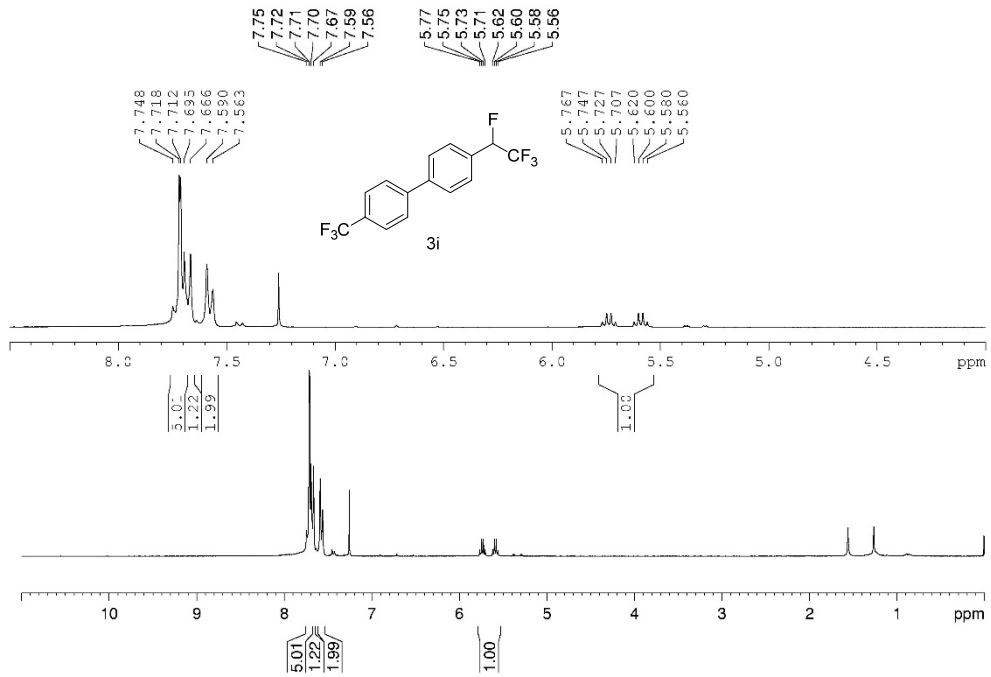
139.63
135.35
135.05
117.90
114.84
90.18
89.70
89.25
88.77
87.63
87.21
86.74
86.26
121.03
120.73
117.66
114.60
F
CF3
NC
3h
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.67
7.59
7.56
5.77
5.75
5.73
5.71
5.62
5.60
5.58
5.56
7.748
7.718
7.712
7.695
7.666
7.590
7.563
5.767
5.747
5.727
5.707
5.620
5.600
5.580
5.560
F
CF3
F3C
3i
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
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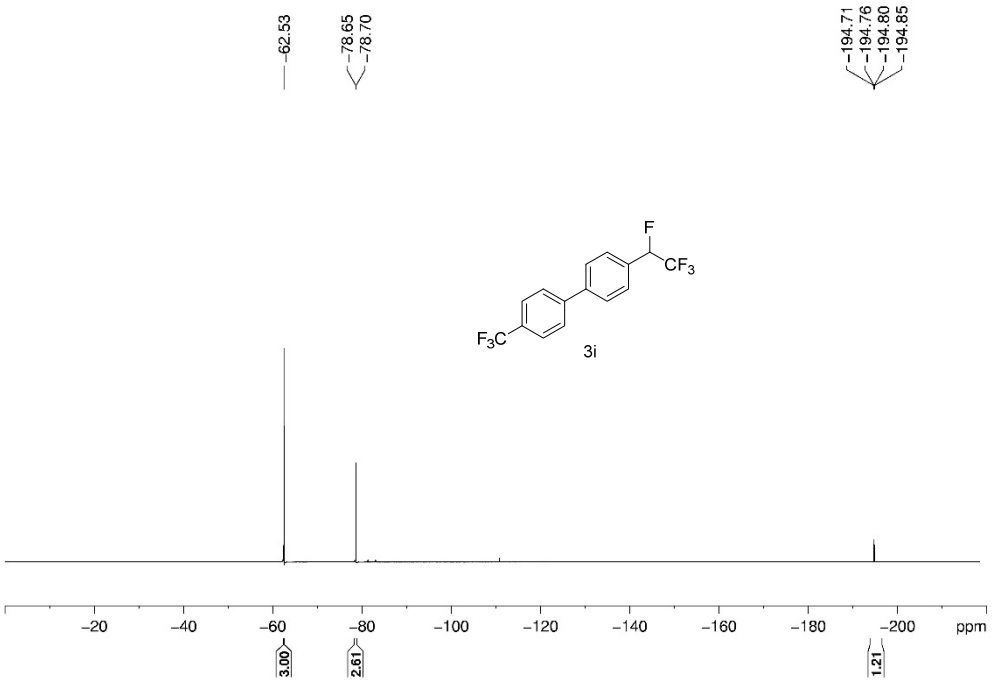
1.22
1.99
1.00
10 9 8 7 6 5 4 3 2 1 ppm
5.01
1.22
1.99
1.00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-78.70
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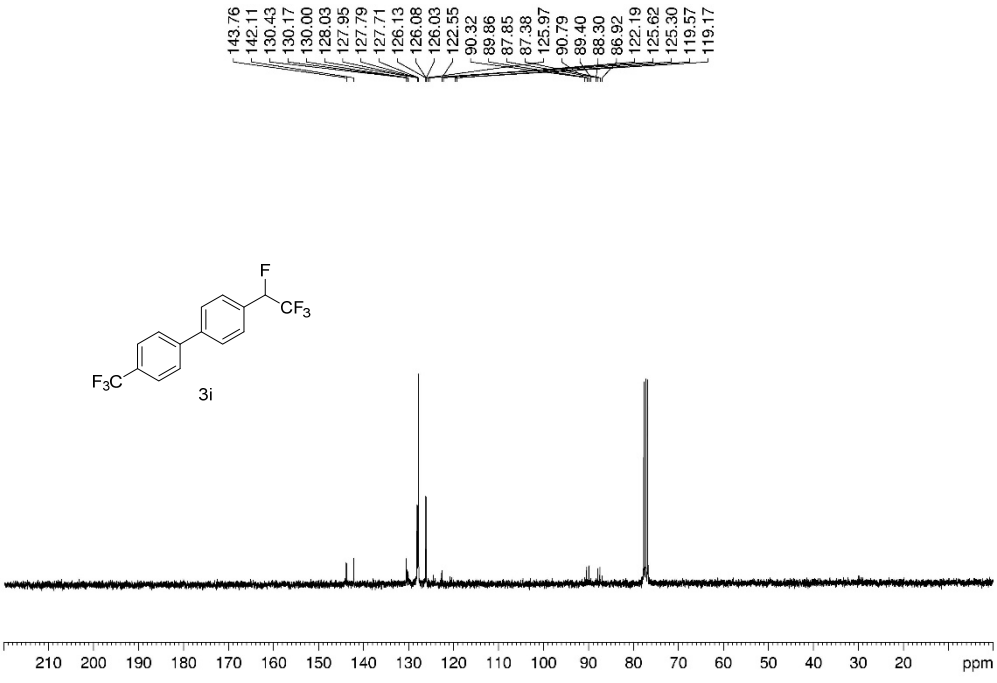
-194.76
-194.80
-194.85
F
CF3
F3C
3i
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.00
2.61
1.21


143.76
142.11
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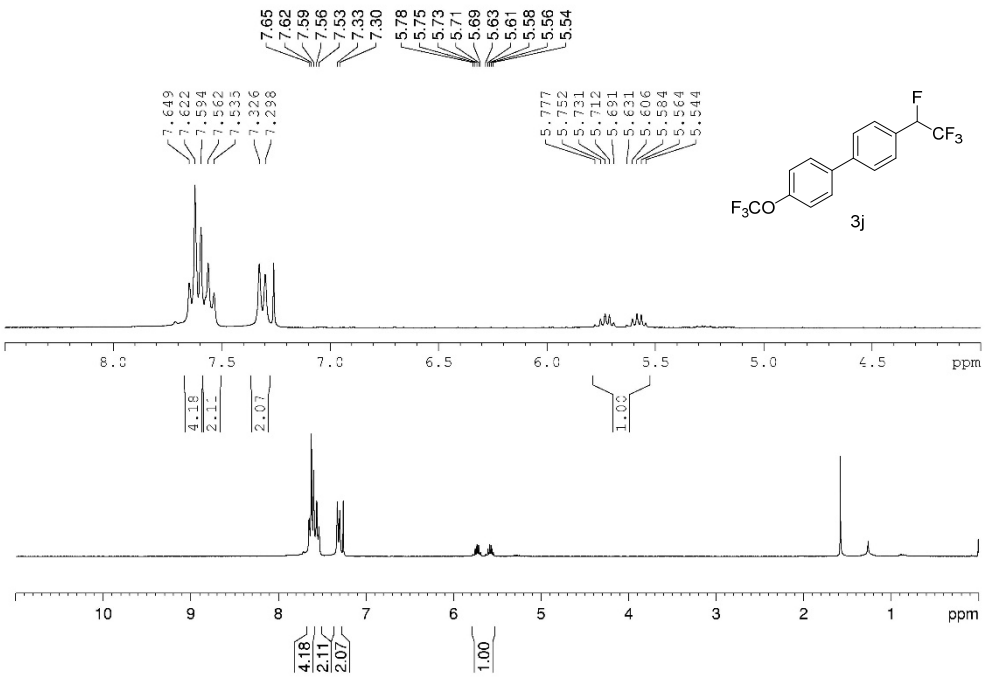
130.17
130.00
128.03
127.95
127.79
127.71
126.13
126.08
126.03
122.55
90.32
89.86
87.85
87.38
125.97
90.79
89.40
88.30
86.92
122.19
125.62
125.30
119.57
119.17
F
CF3
F3C
3i
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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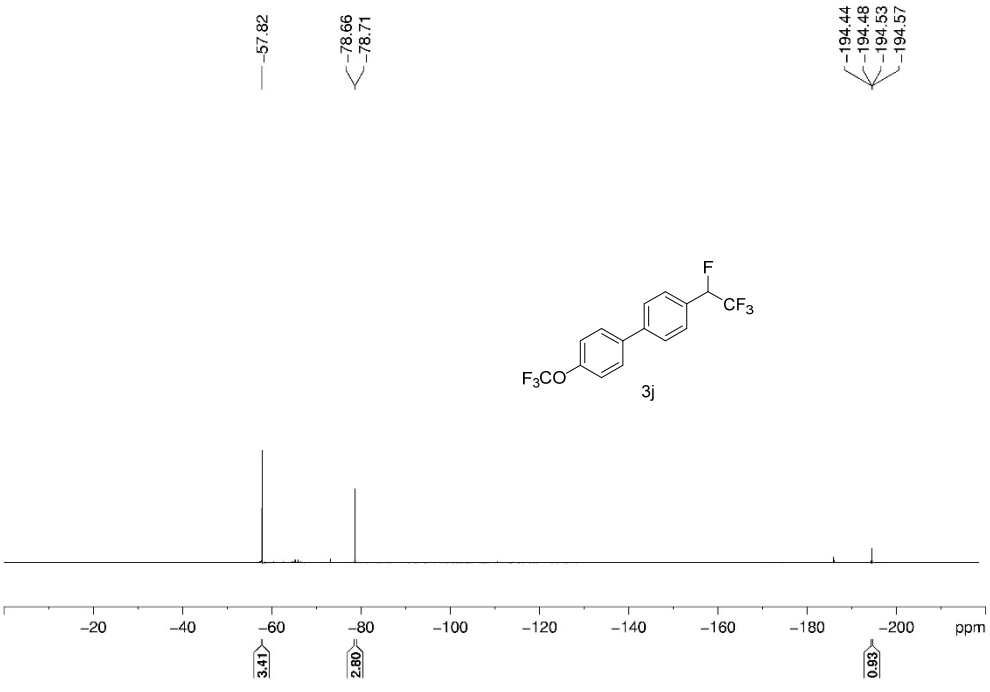
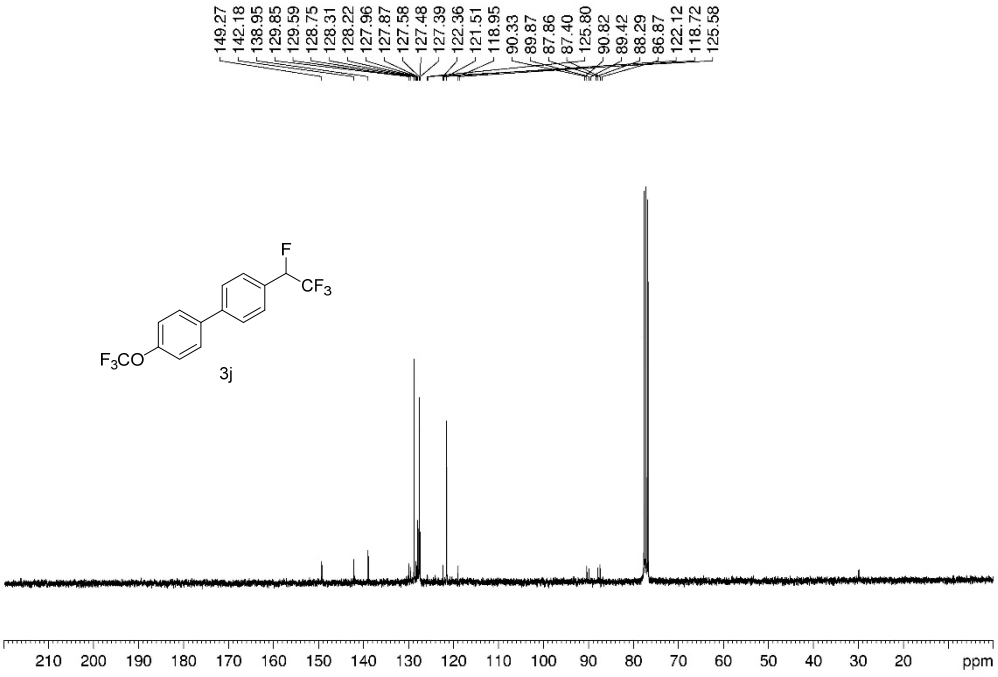
7.56
7.53
7.33
7.30
5.777
5.752
5.731
5.712
5.691
5.631
5.606
5.584
5.564
5.544
5.78
5.75
5.73
5.71
5.69
5.63
5.61
5.58
5.56
5.54
F
CF3
F3CO
3j
ppm
4.18
2.11
2.07
1.00


−57.82
−78.66
−78.71
−194.44
−194.48
−194.53
−194.57
F
CF3
F3CO
3j
ppm
3.41
2.80
0.93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128.75
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128.22
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127.58
127.48
127.39
122.36
121.51
118.95
90.33
89.87
87.86
87.40
125.80
90.82
89.42
88.29
86.87
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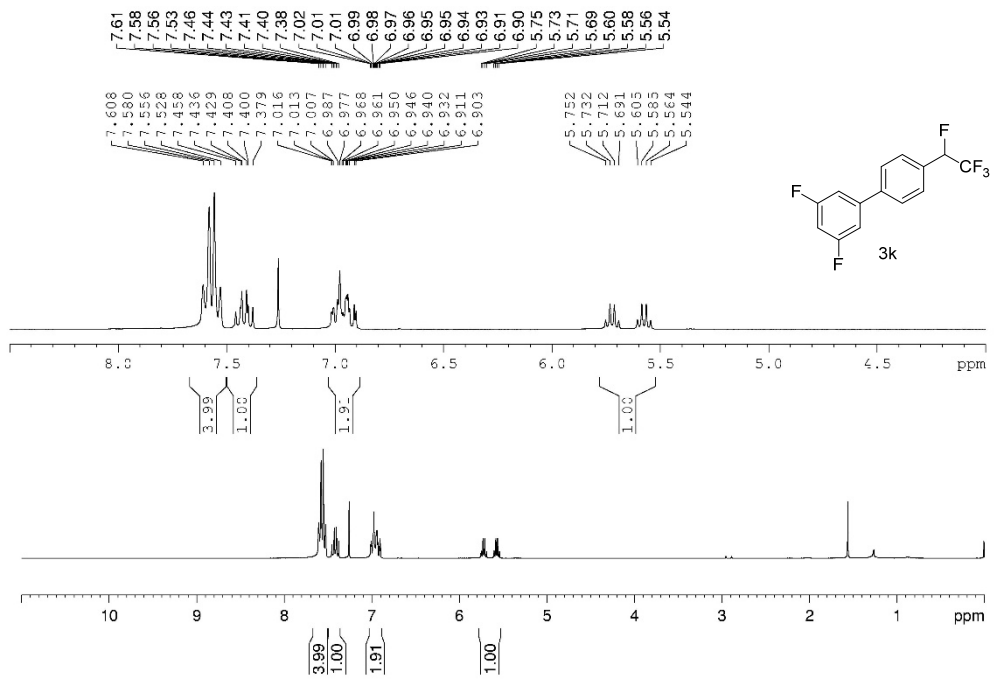
118.72
125.58
F
CF3
F3CO
3j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.41
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7.01
7.01
6.99
6.98
6.97
6.96
6.95
6.95
6.94
6.93
6.91
6.90
5.75
5.73
5.71
5.69
5.60
5.58
5.56
5.54
F
CF3
F
F
3k
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
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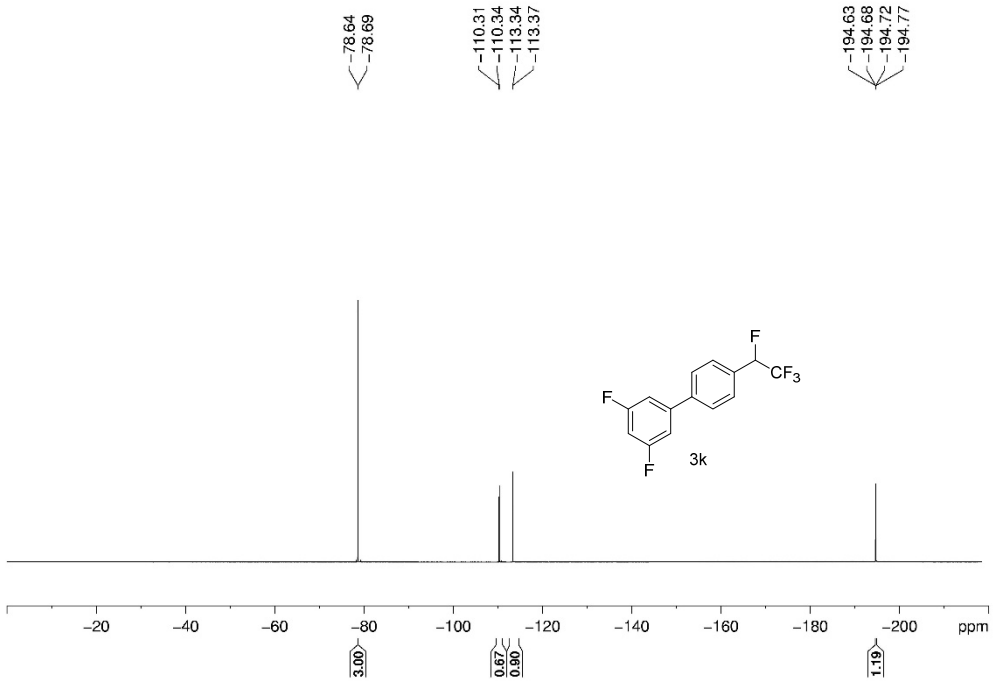
1.08
1.91
1.00
10 9 8 7 6 5 4 3 2 1 ppm
3.99
1.00
1.91
1.00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-110.31
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-113.34
-113.37
-194.63
-194.68
-194.72
-194.77
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CF3
F
F
3k
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
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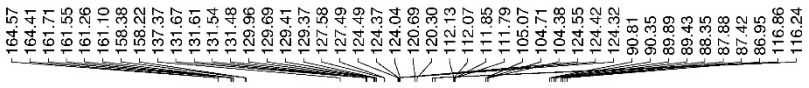
1.19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158.22
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131.67
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131.54
131.48
129.96
129.69
129.41
129.37
127.58
127.49
124.49
124.37
124.04
120.69
120.30
112.13
112.07
111.85
111.79
105.07
104.71
104.38
124.55
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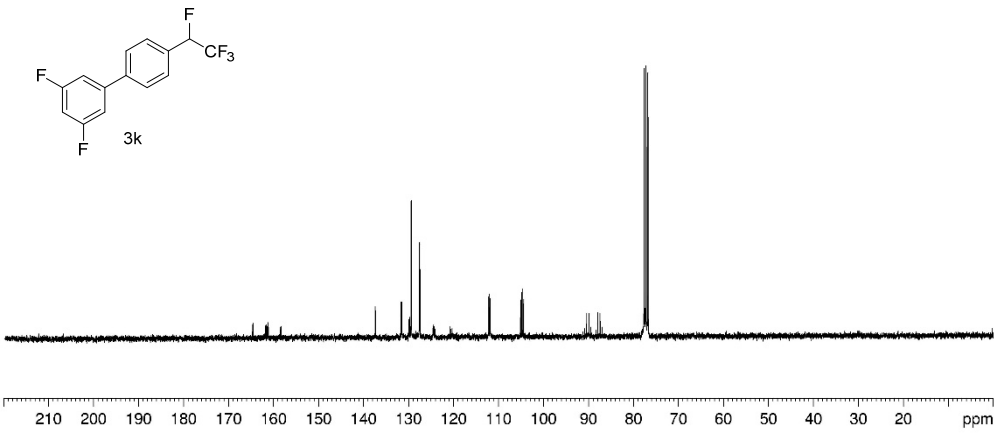
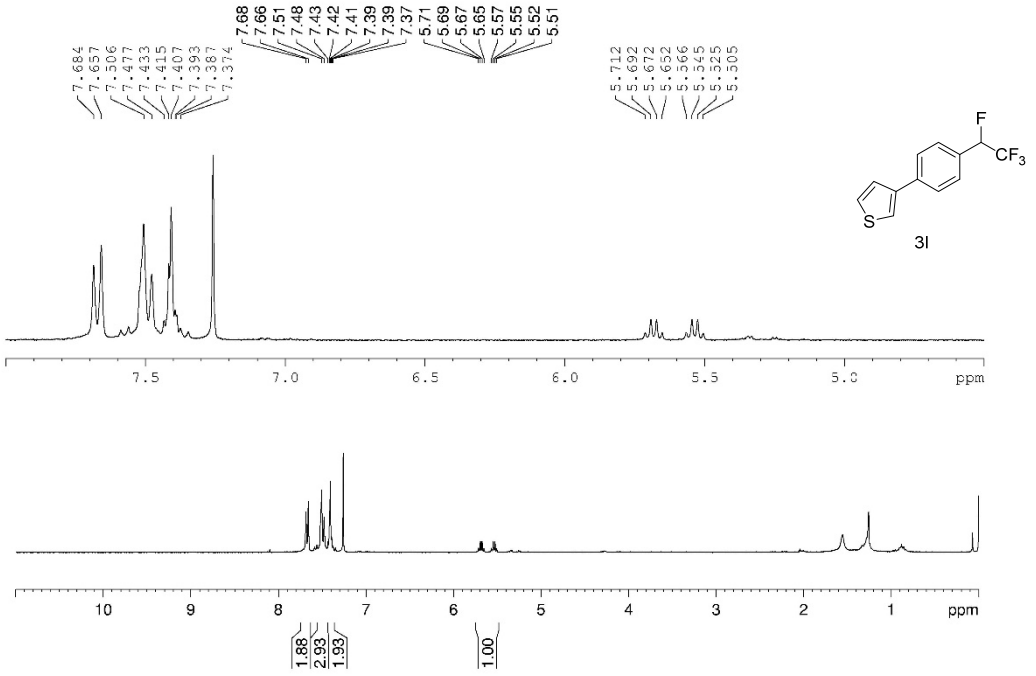
90.81
90.35
89.89
89.43
88.35
87.88
87.42
86.95
116.86
116.24


F
CF3
F
F
3k
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.657
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7.68
7.66
7.51
7.48
7.43
7.42
7.41
7.39
7.39
7.37
5.71
5.69
5.67
5.65
5.57
5.55
5.52
5.51
5.712
5.692
5.672
5.652
5.366
5.345
5.325
5.305
F
CF3
S
3l
7.5
7.0
6.5
6.0
5.5
5.0
ppm
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9
8
7
6
5
4
3
2
1
ppm
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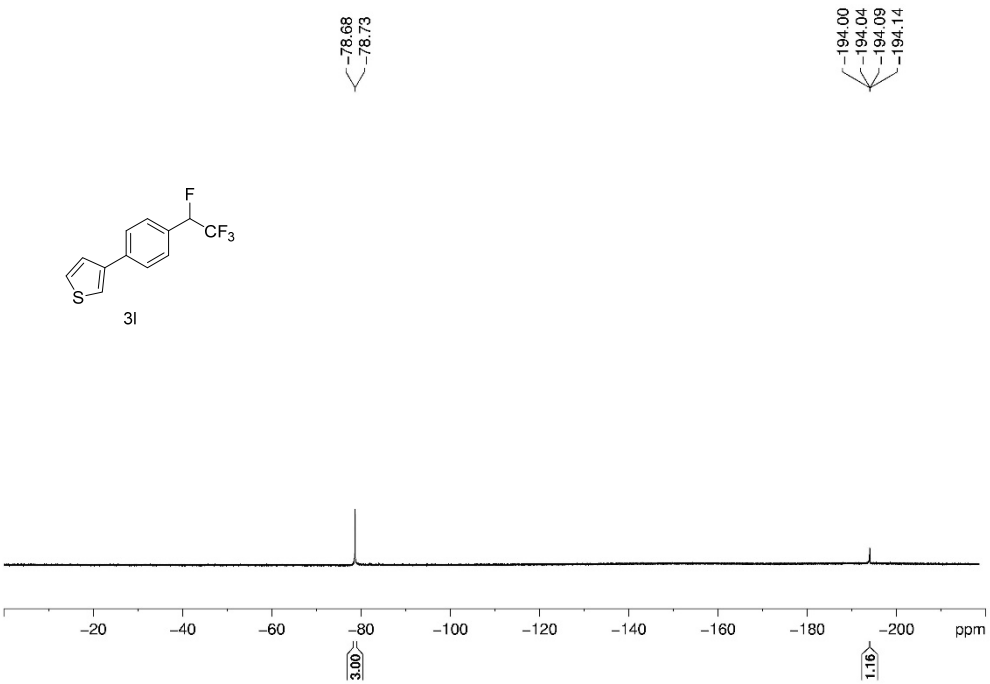
2.93
1.93
1.00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-78.73
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-194.04
-194.09
-194.14
F
CF3
S
3l
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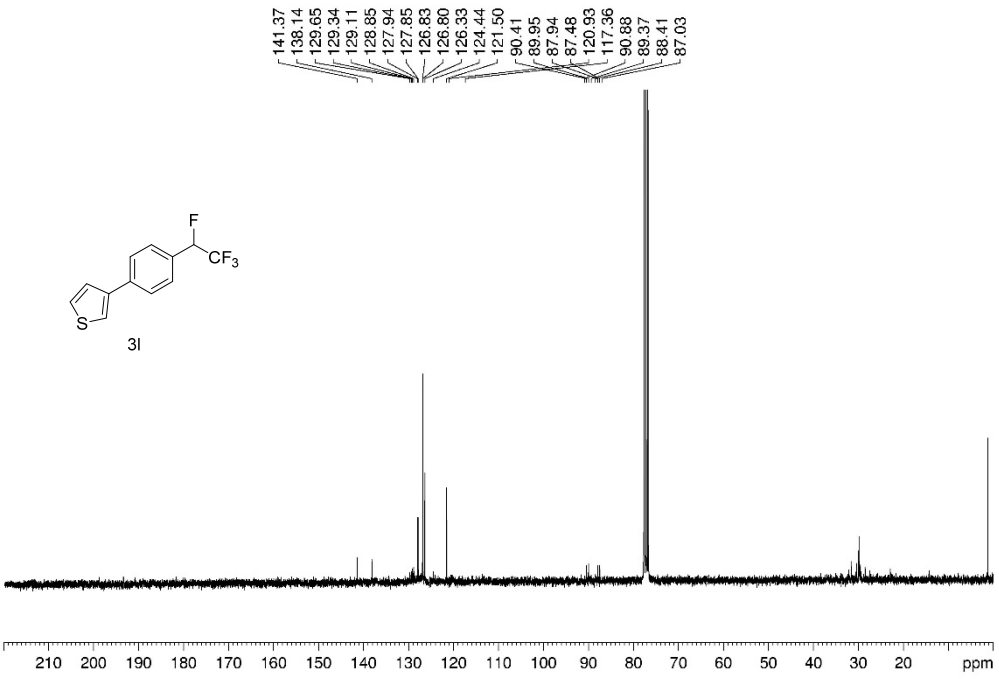
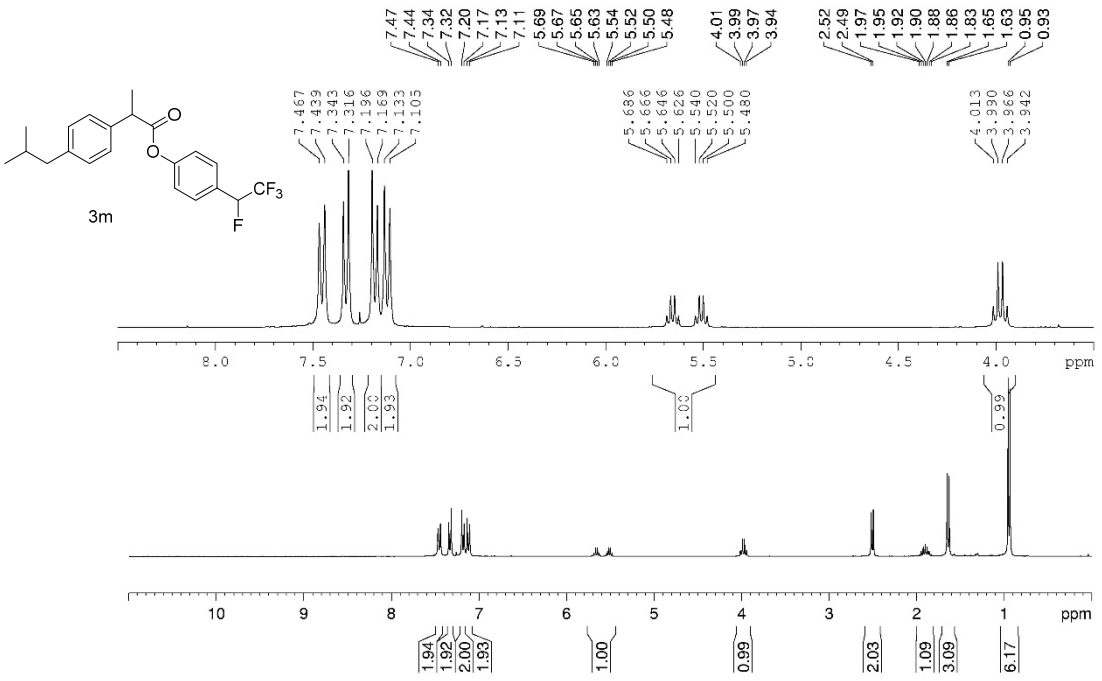
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.00
1.16


141.37
138.14
129.65
129.34
129.11
128.85
127.94
127.85
126.83
126.80
126.33
124.44
121.50
90.41
89.95
87.94
87.48
120.93
117.36
90.88
89.37
88.41
87.03
F
CF3
S
3l
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.32
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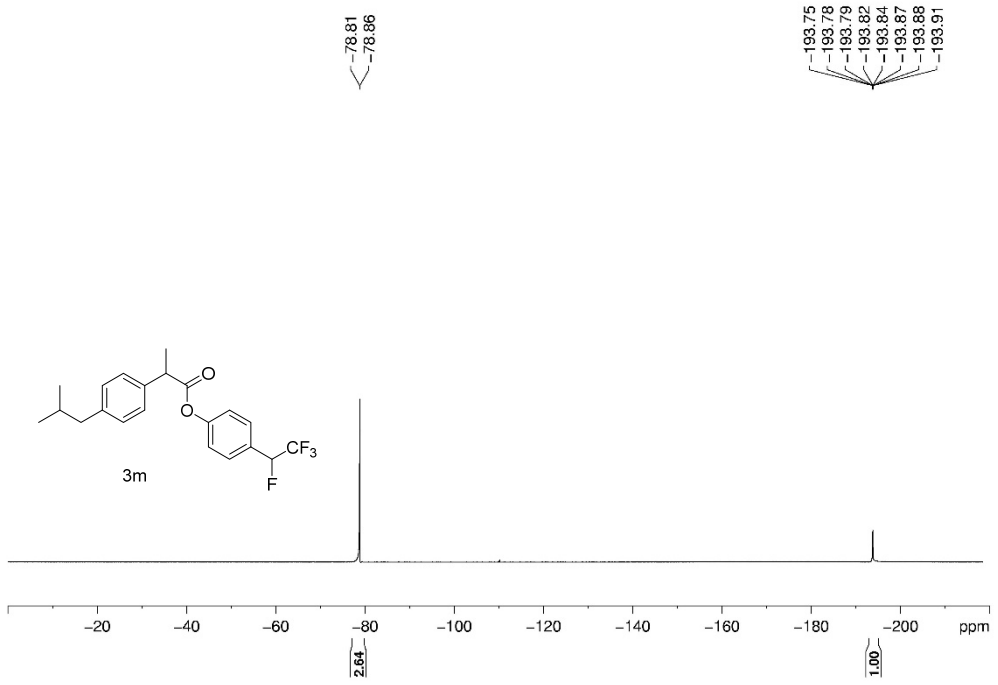
7.17
7.13
7.11
5.69
5.67
5.65
5.63
5.54
5.52
5.50
5.48
4.01
3.99
3.97
3.94
2.52
2.49
1.97
1.95
1.92
1.90
1.88
1.86
1.83
1.65
1.63
0.95
0.93
O
O
CF3
F
3m
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 ppm
1.94
1.92
2.00
1.93
1.00
0.99
10 9 8 7 6 5 4 3 2 1 ppm
1.94
1.92
2.00
1.93
1.00
0.99
2.03
1.09
3.09
6.17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-78.86
-193.75
-193.78
-193.79
-193.82
-193.84
-193.87
-193.88
-193.91
3m
CF3
F
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-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
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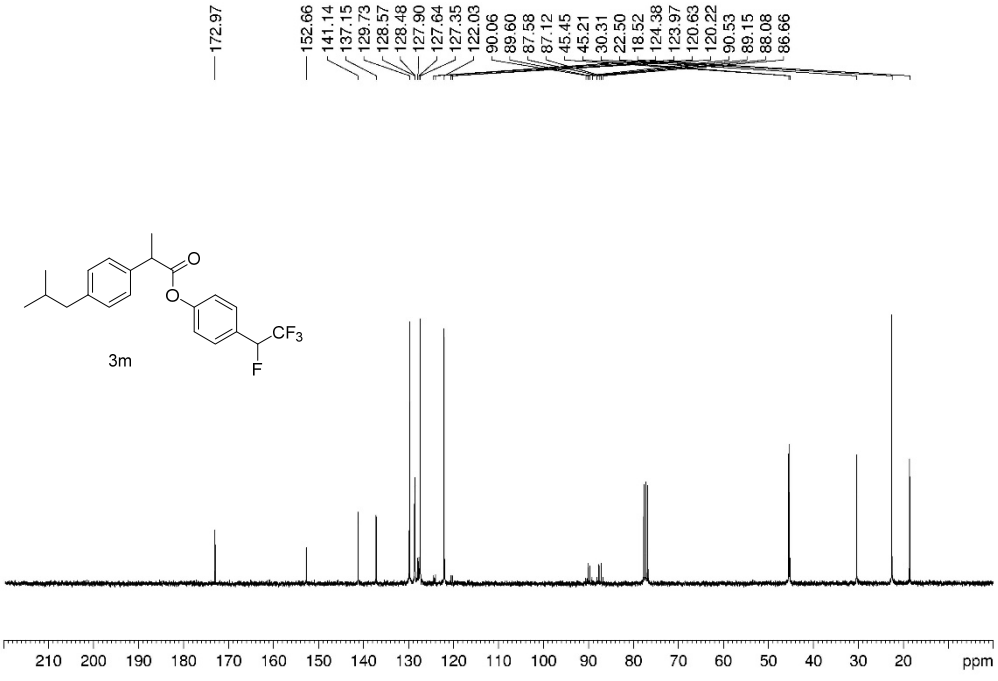
1.00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152.66
141.14
137.15
129.73
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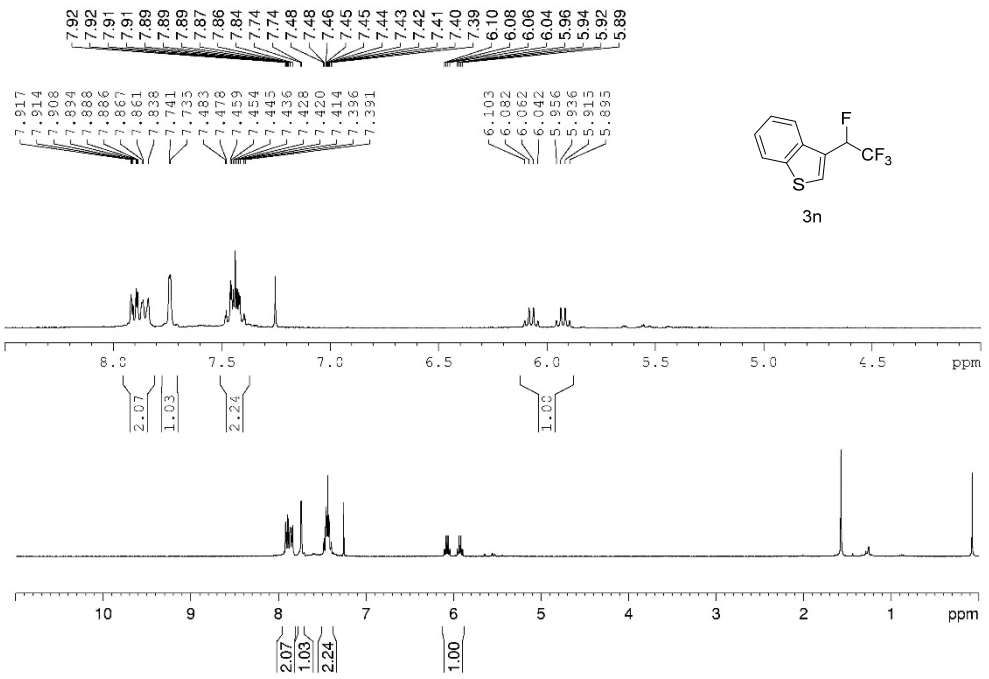
128.48
127.90
127.64
127.35
122.03
90.06
89.60
87.58
87.12
45.45
45.21
30.31
22.50
18.52
124.38
123.97
120.63
120.22
90.53
89.15
88.08
86.66
3m
CF3
F
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.92
7.91
7.91
7.89
7.89
7.89
7.87
7.86
7.84
7.74
7.74
7.48
7.46
7.45
7.45
7.44
7.43
7.42
7.41
7.40
7.39
6.10
6.08
6.06
6.04
5.96
5.94
5.92
5.89
7.917
7.914
7.908
7.894
7.888
7.886
7.867
7.861
7.838
7.741
7.735
7.483
7.478
7.459
7.454
7.445
7.436
7.428
7.420
7.414
7.396
7.391
6.103
6.082
6.062
6.042
5.956
5.936
5.915
5.895
F
CF3
S
3n
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
2.07
1.03
2.24
1.00
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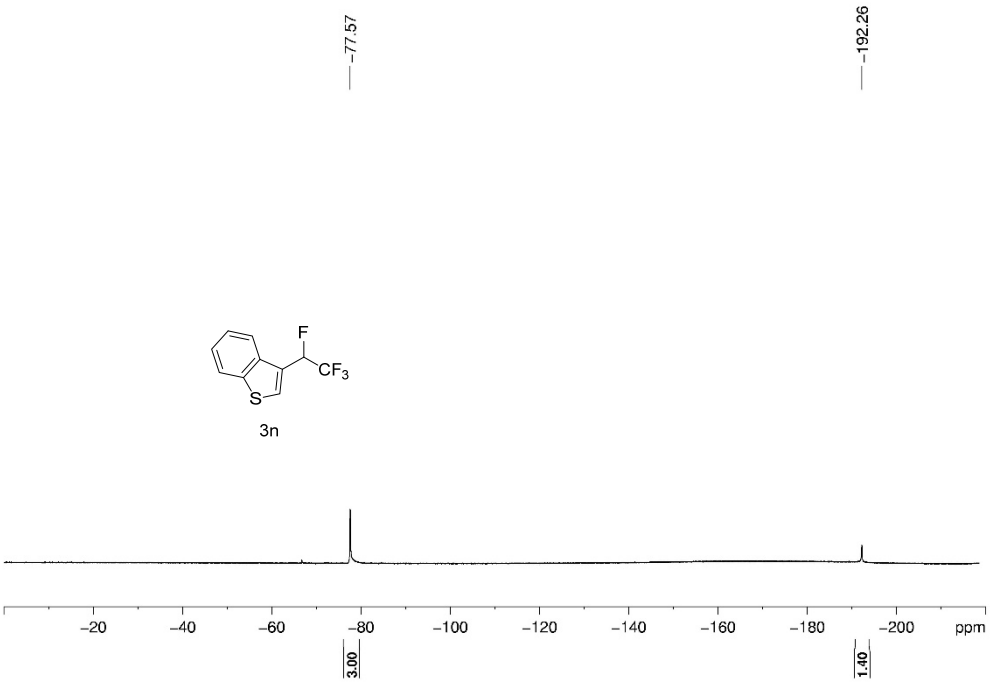
9
8
7
6
5
4
3
2
1
ppm
2.07
1.03
2.24
1.00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F
CF3
S
3n
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-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
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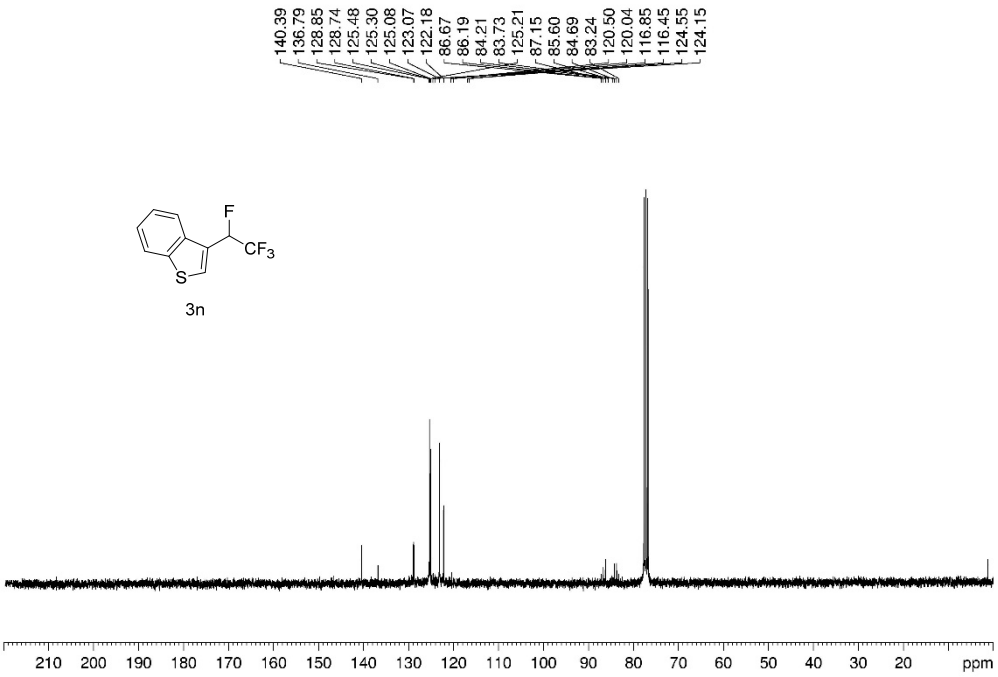
1.40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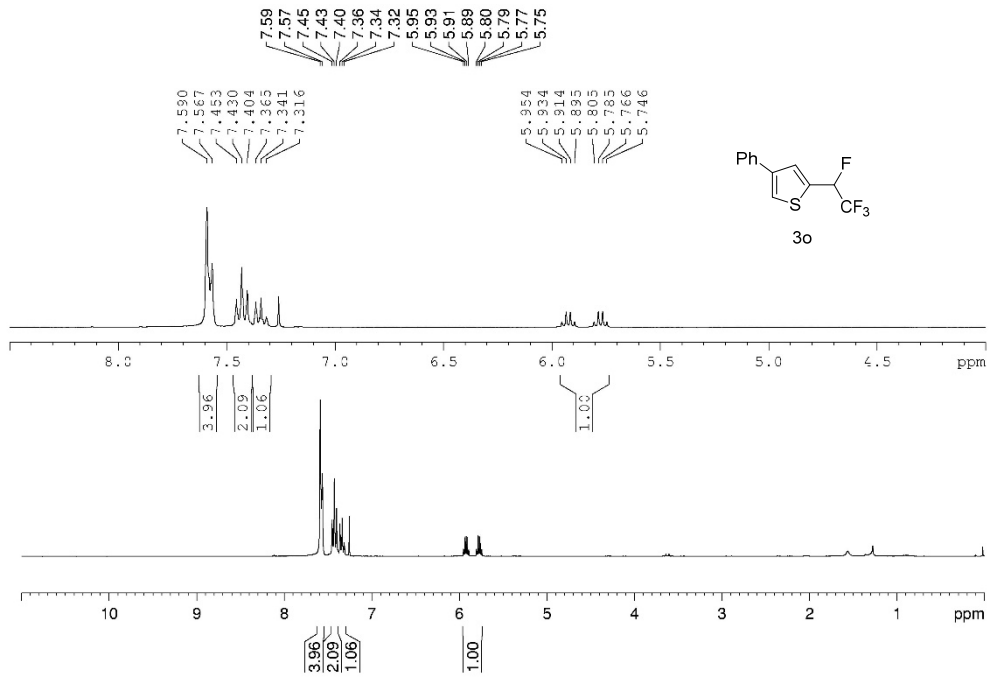
136.79
128.85
128.74
125.48
125.30
125.08
123.07
122.18
86.67
86.19
84.21
83.73
125.21
87.15
85.60
84.69
83.24
120.50
120.04
116.85
116.45
124.55
124.15
F
CF3
S
3n
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.45
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7.40
7.36
7.34
7.32
5.95
5.93
5.91
5.89
5.80
5.79
5.77
5.75
7.590
7.567
7.453
7.430
7.404
7.365
7.341
7.316
5.954
5.934
5.914
5.895
5.805
5.785
5.766
5.746
Ph
F
S
CF3
3o
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
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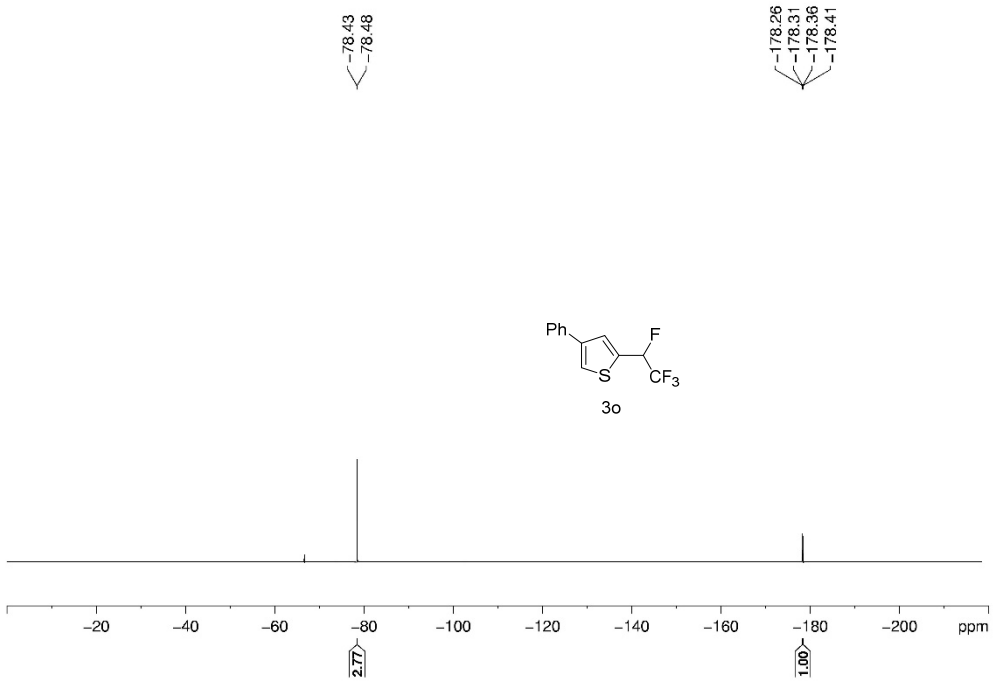
2.09
1.06
1.00
10 9 8 7 6 5 4 3 2 1 ppm
3.96
2.09
1.06
1.00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-78.48
-178.26
-178.31
-178.36
-178.41
Ph
F
S
CF3
3o
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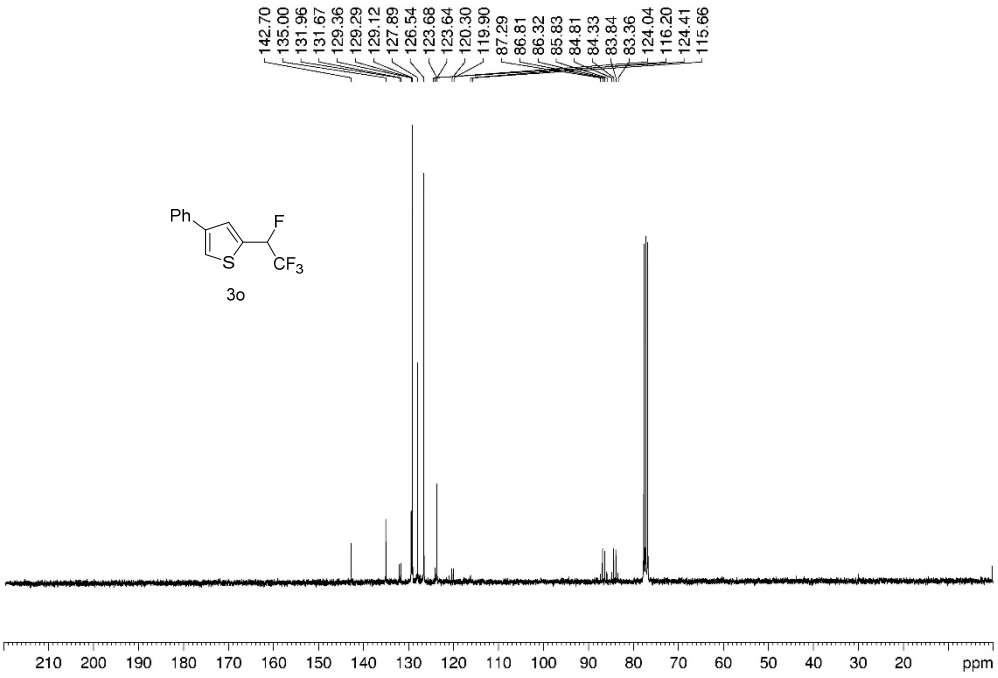
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.77
1.00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135.00
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127.89
126.54
123.68
123.64
120.30
119.90
87.29
86.81
86.32
85.83
84.81
84.33
83.84
83.36
124.04
116.20
124.41
115.66
Ph
F
S
CF3
3o
210
200
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180
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160
150
140
130
120
110
100
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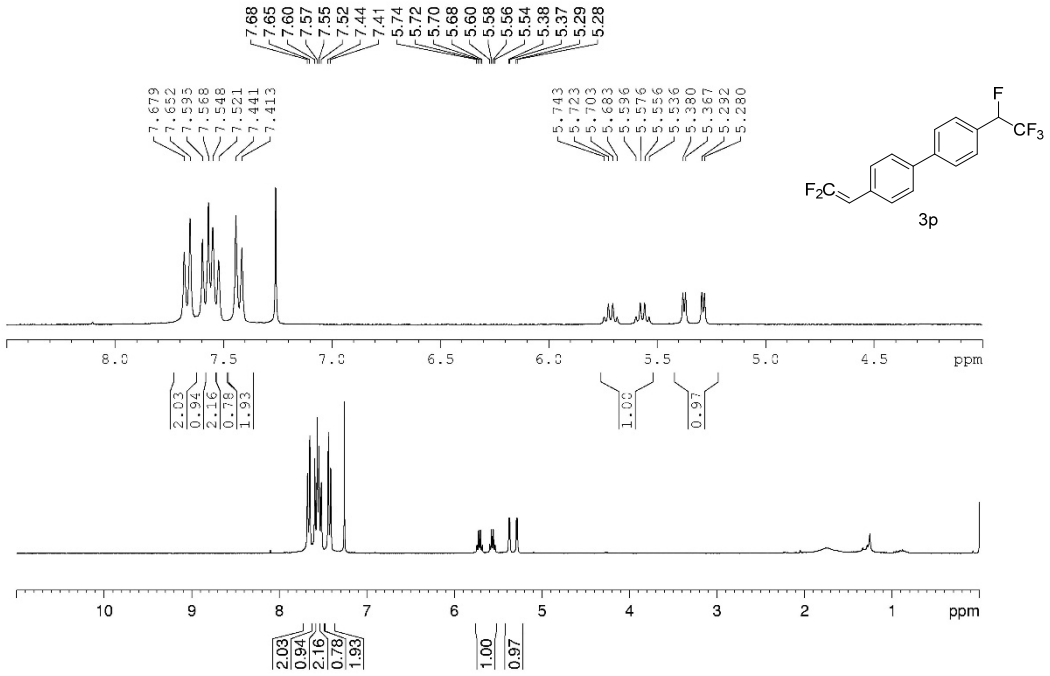
80
70
60
50
40
30
20
ppm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7.41
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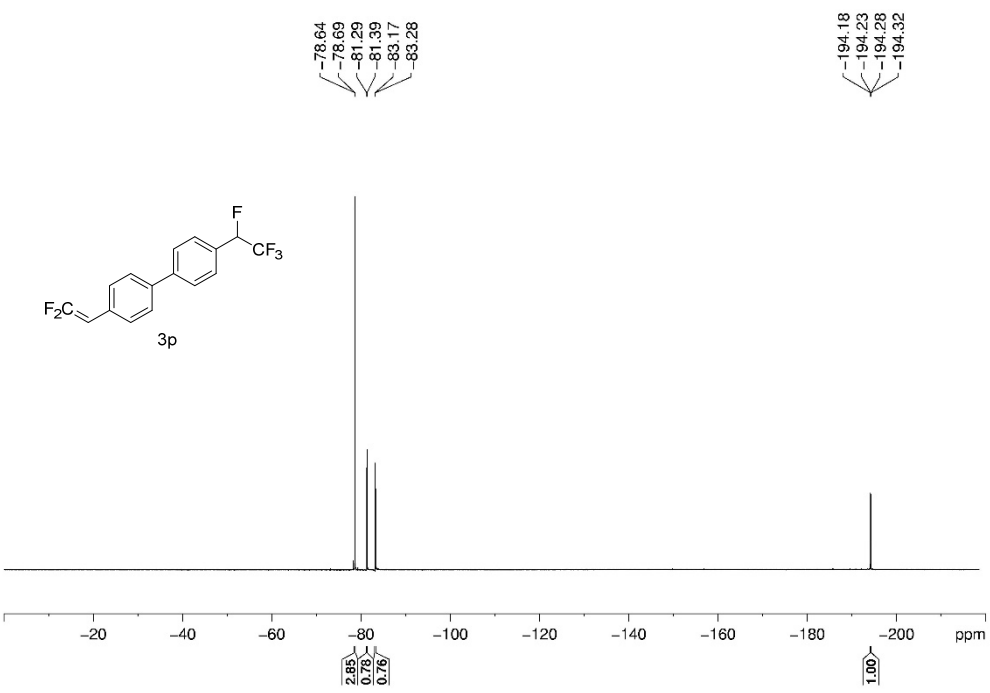
5.72
5.70
5.68
5.60
5.58
5.56
5.54
5.38
5.37
5.29
5.28
7.679
7.652
7.595
7.568
7.548
7.521
7.441
7.413
5.743
5.723
5.703
5.683
5.596
5.576
5.556
5.536
5.380
5.367
5.292
5.280
F
CF3
F2C
3p
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
2.03
0.94
2.16
0.78
1.93
1.00
0.97
10
9
8
7
6
5
4
3
2
1
ppm
2.03
0.94
2.16
0.78
1.93
1.00
0.97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-81.39
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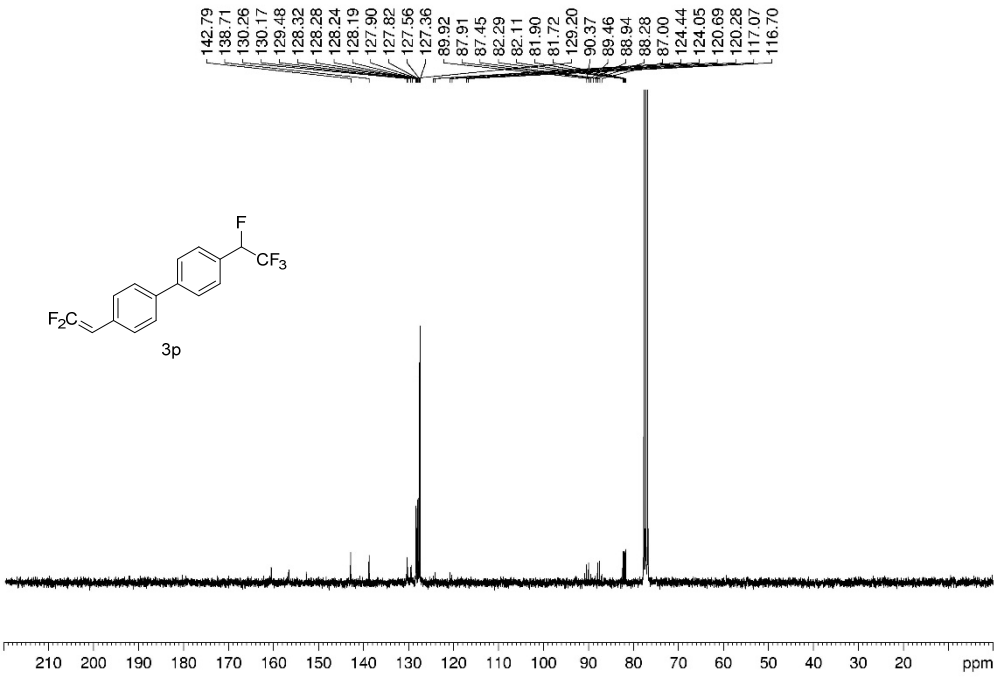
-83.28
-194.18
-194.23
-194.28
-194.32
F
CF3
F2C
3p
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
2.85
0.78
0.76
1.00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128.24
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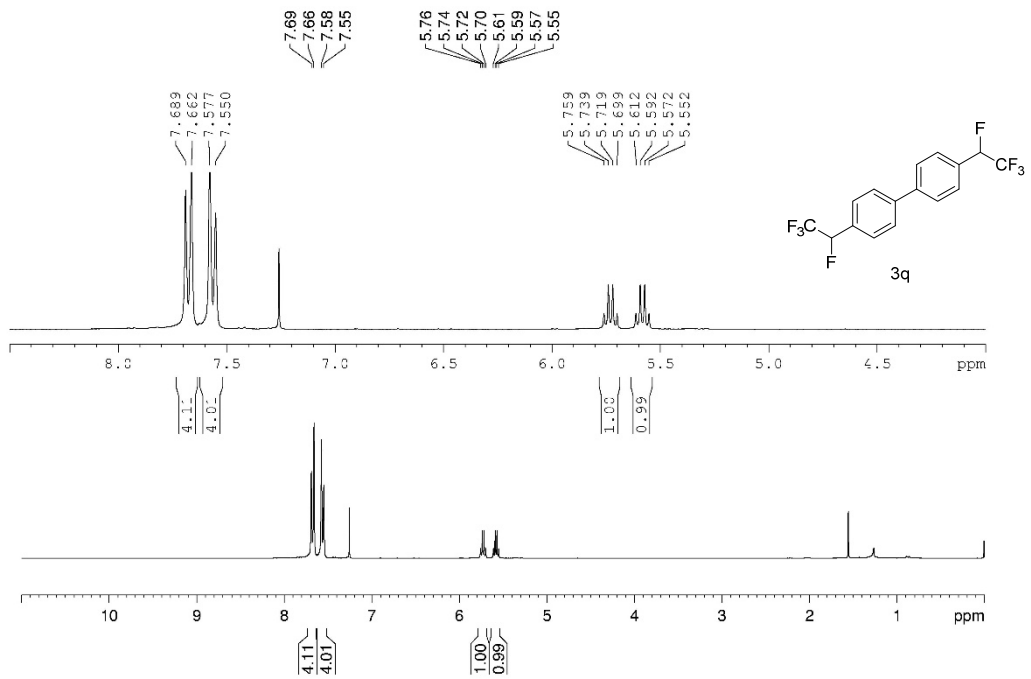
127.56
127.36
89.92
87.91
87.45
82.29
82.11
81.90
81.72
129.20
90.37
89.46
88.94
88.28
87.00
124.44
124.05
120.69
120.28
117.07
116.70
F
CF3
F2C
3p
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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5.74
5.72
5.70
5.61
5.59
5.57
5.55
7.689
7.662
7.577
7.550
5.759
5.739
5.719
5.699
5.612
5.592
5.572
5.552
F
CF3
F3C
F
3q
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
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4.01
1.00
0.99
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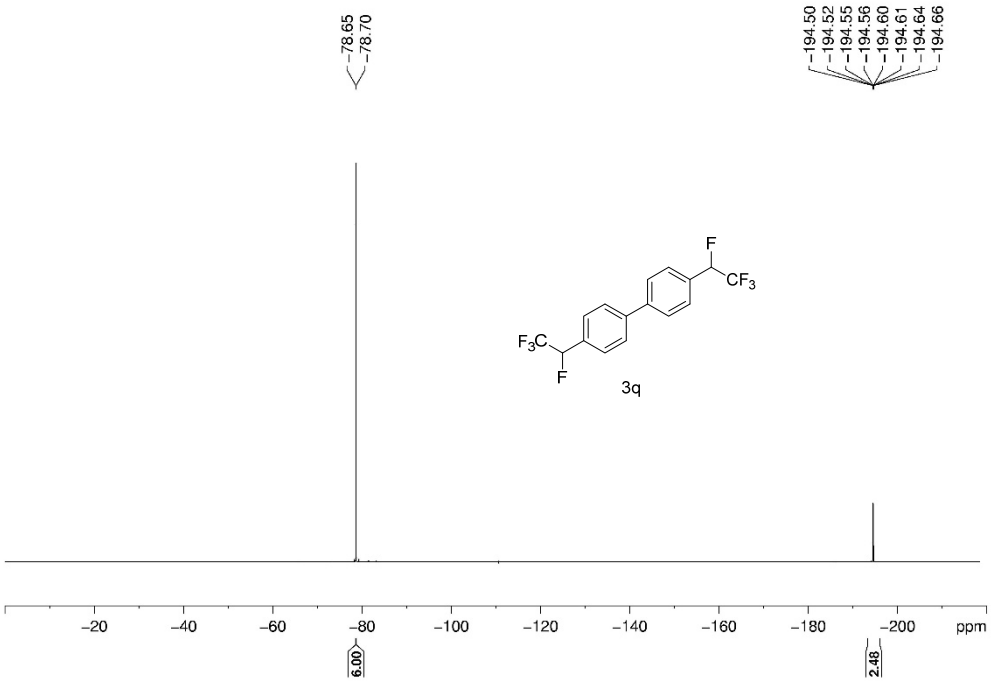
4.11
4.01
1.00
0.99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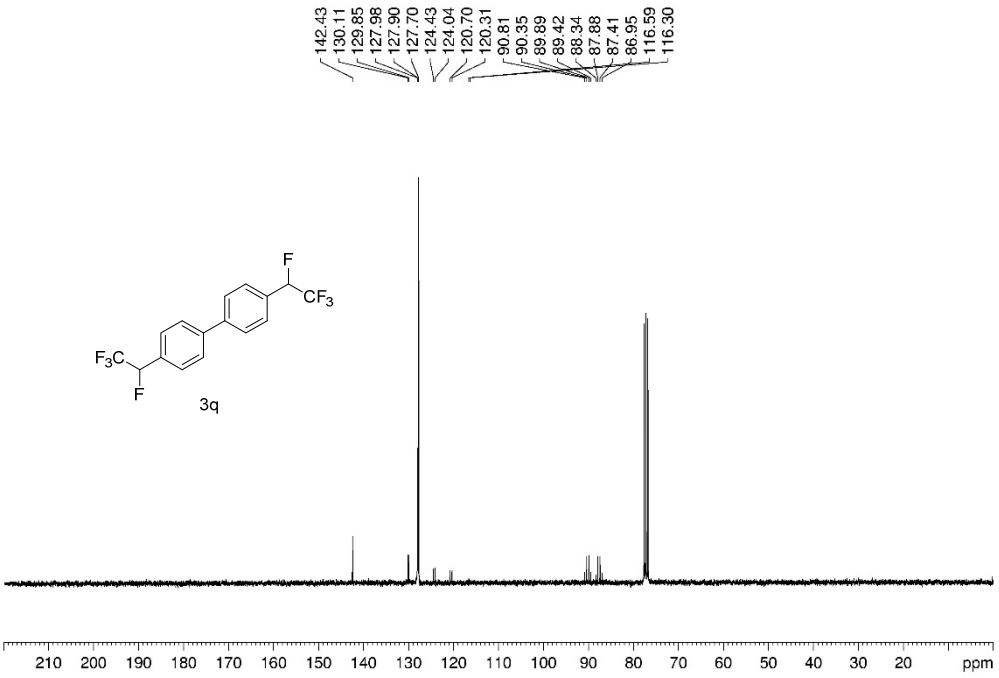
-194.50
-194.52
-194.55
-194.56
-194.60
-194.61
-194.64
-194.66
F
CF3
F3C
F
3q
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
6.00
2.48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127.70
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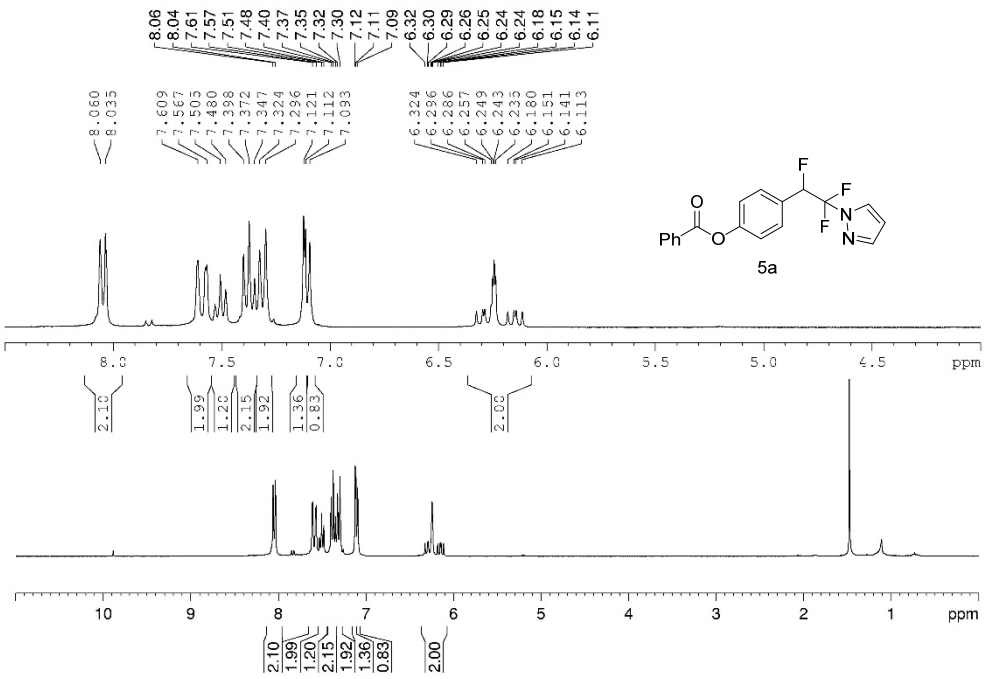
124.04
120.70
120.31
90.81
90.35
89.89
89.42
88.34
87.88
87.41
86.95
116.59
116.30
F
CF3
F3C
F
3q
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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8.04
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7.48
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7.35
7.32
7.30
7.12
7.11
7.09
6.32
6.30
6.29
6.26
6.25
6.24
6.24
6.18
6.15
6.14
6.11
8.060
8.035
7.609
7.567
7.505
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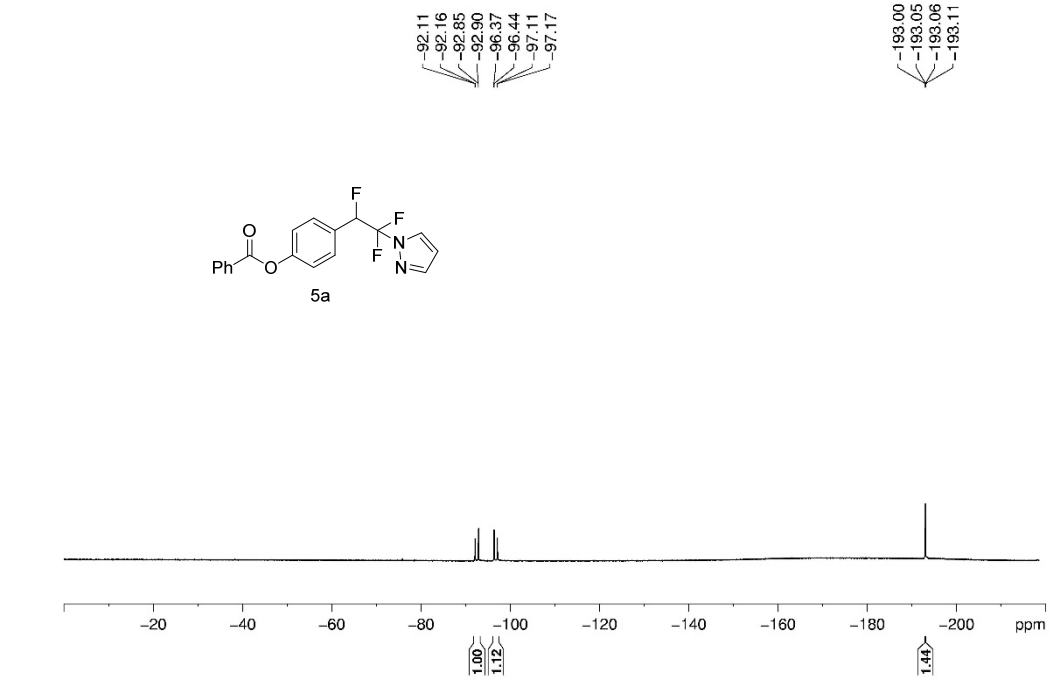
7.398
7.372
7.347
7.324
7.296
7.121
7.112
7.093
6.324
6.296
6.286
6.257
6.249
6.243
6.235
6.180
6.151
6.141
6.113
F
F
F
O
Ph
O
N
N
5a
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
2.10
1.99
1.20
2.15
1.92
1.36
0.83
2.00
10
9
8
7
6
5
4
3
2
1
ppm
2.10
1.99
1.20
2.15
1.92
1.36
0.83
2.00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-193.05
-193.06
-193.11
F
F
F
O
Ph
O
N
N
5a
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-180
-200
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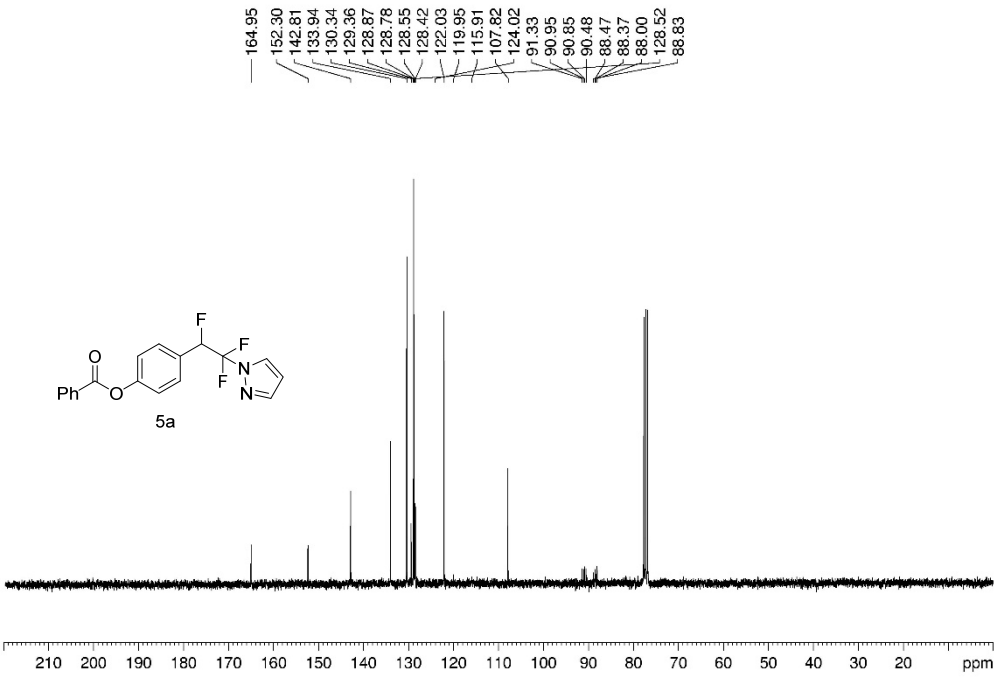
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119.95
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107.82
124.02
91.33
90.95
90.85
90.48
88.47
88.37
88.00
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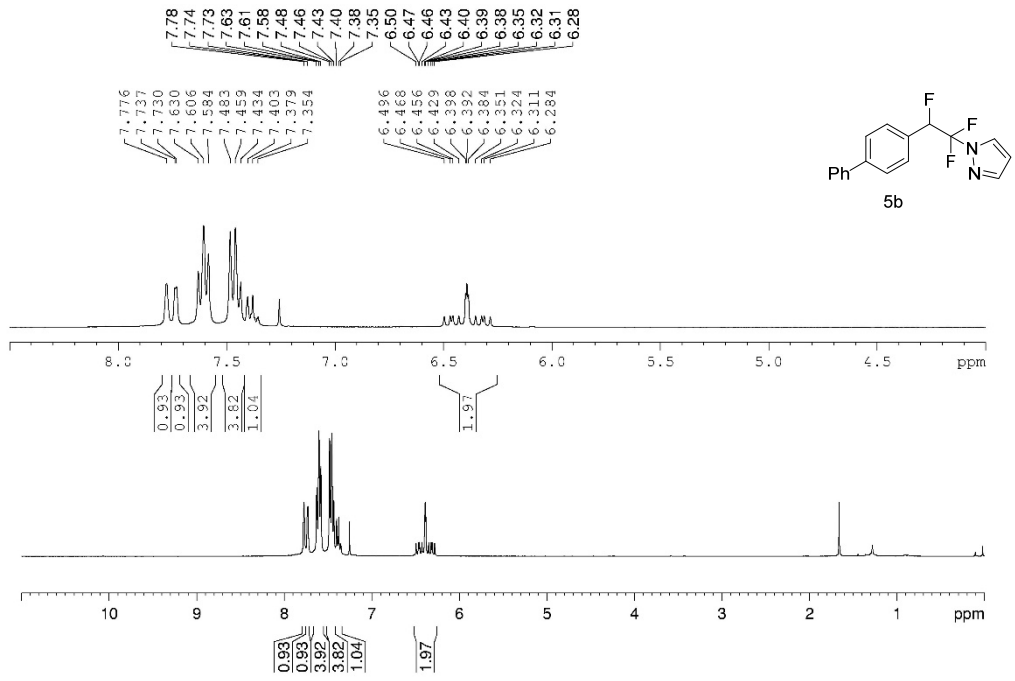
F
F
O
Ph
O
N
N
5a
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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6.50
6.47
6.46
6.43
6.40
6.39
6.38
6.35
6.32
6.31
6.28
F
F
F
Ph
N
N
5b
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
0.93
0.93
3.92
3.82
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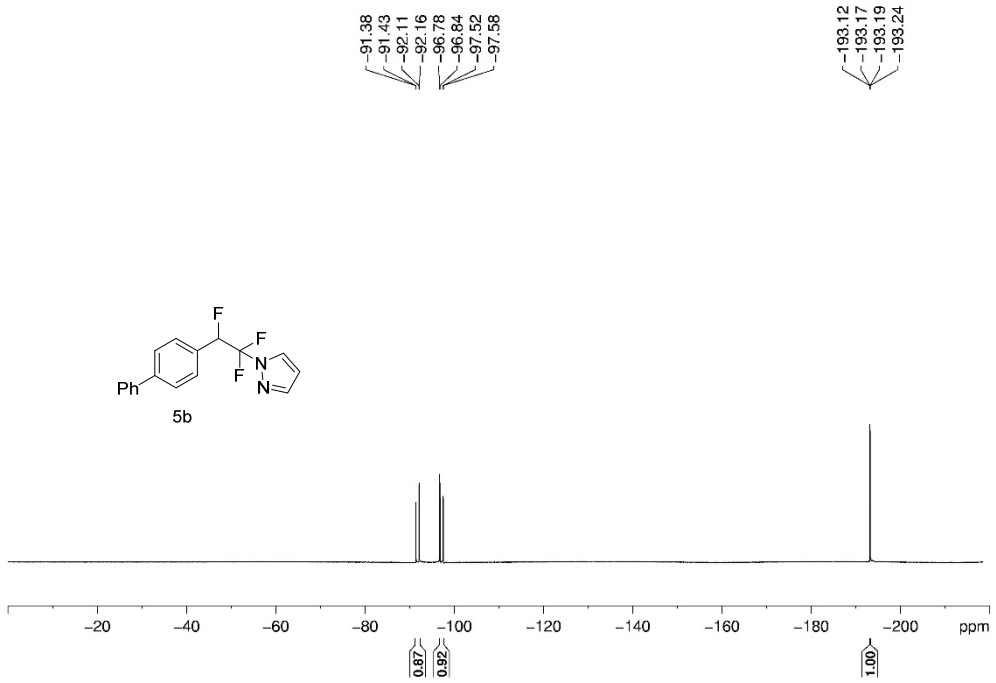
1.97
10 9 8 7 6 5 4 3 2 1 ppm
0.93
0.93
3.92
3.82
1.04
1.97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-193.24
F
F
F
N
N
Ph
5b
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ppm
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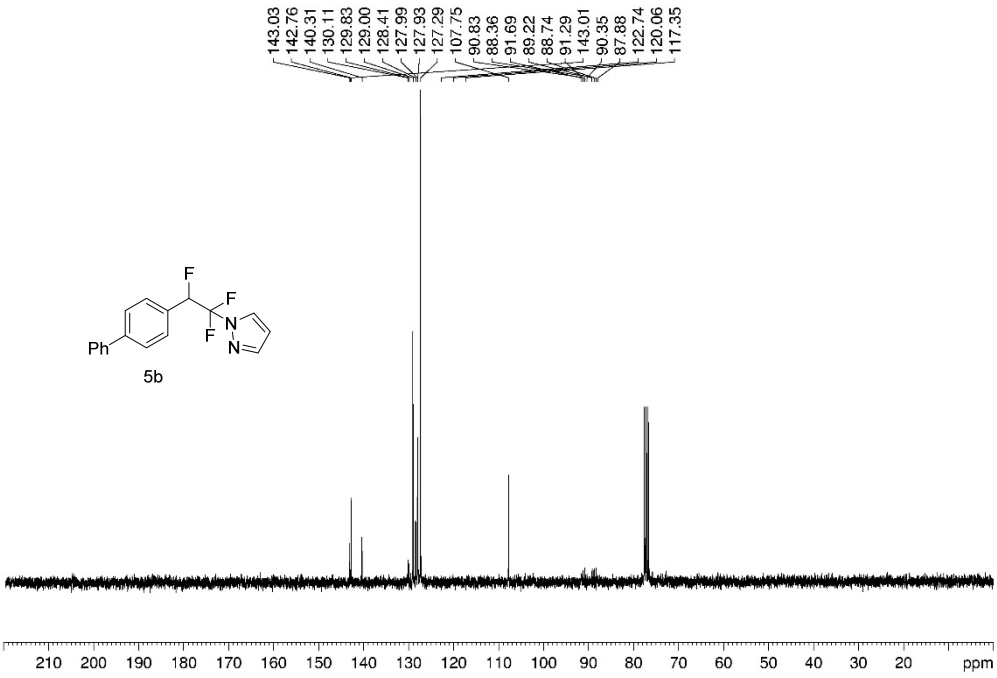
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91.69
89.22
88.74
91.29
143.01
90.35
87.88
122.74
120.06
117.35
F
F
F
N
N
Ph
5b
210
200
190
180
170
160
150
140
130
120
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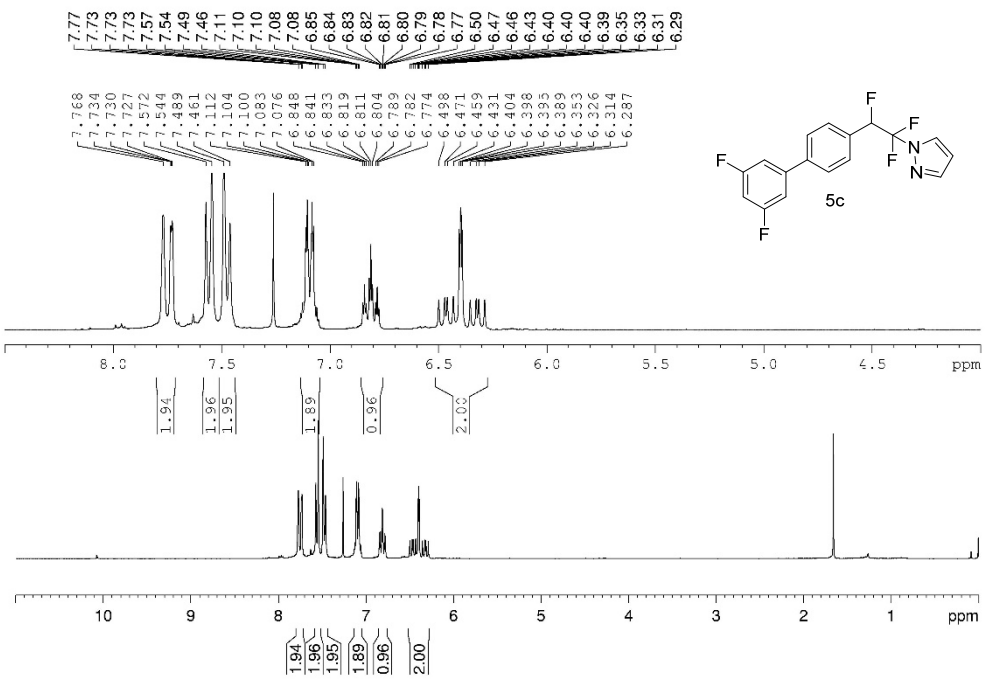
90
80
70
60
50
40
30
20
ppm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7.49
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7.10
7.10
7.08
7.08
6.85
6.84
6.83
6.82
6.81
6.80
6.79
6.78
6.77
6.50
6.47
6.46
6.43
6.40
6.40
6.40
6.39
6.35
6.33
6.31
6.29
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7.544
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7.461
7.112
7.104
7.100
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7.076
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6.841
6.833
6.819
6.811
6.804
6.789
6.782
6.774
6.498
6.471
6.459
6.431
6.404
6.398
6.395
6.389
6.353
6.326
6.314
6.287
F
F
F
N
N
F
F
5c
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
1.94
1.96
1.95
1.89
0.96
2.03
10
9
8
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4
3
2
1
ppm
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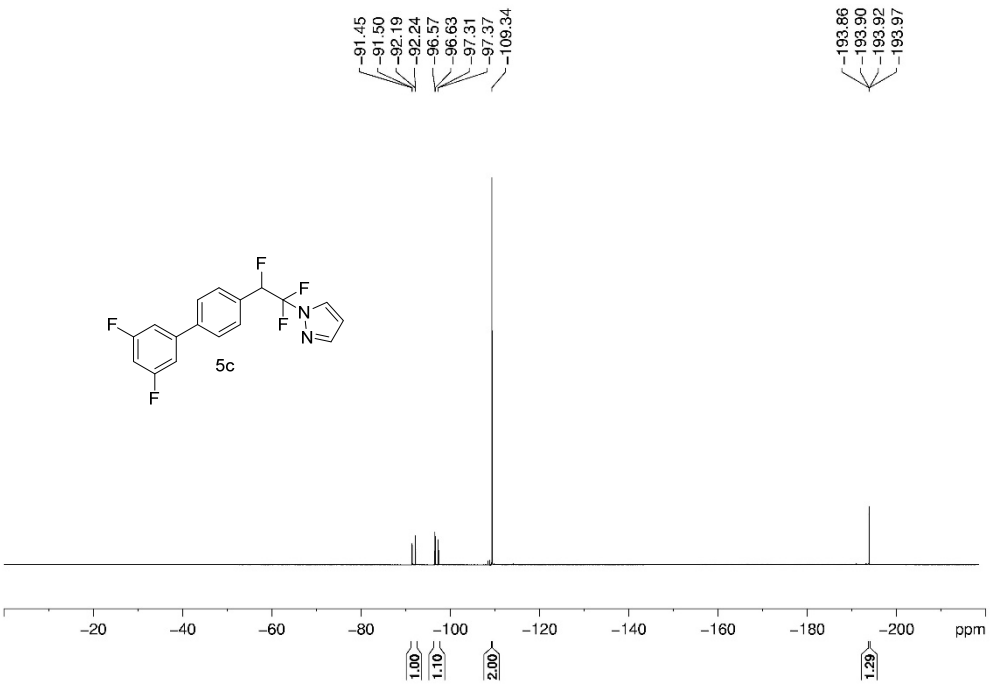
1.96
1.95
1.89
0.96
2.00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-193.92
-193.97
F
F
F
N
N
F
F
5c
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-40
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-100
-120
-140
-160
-180
-200
ppm
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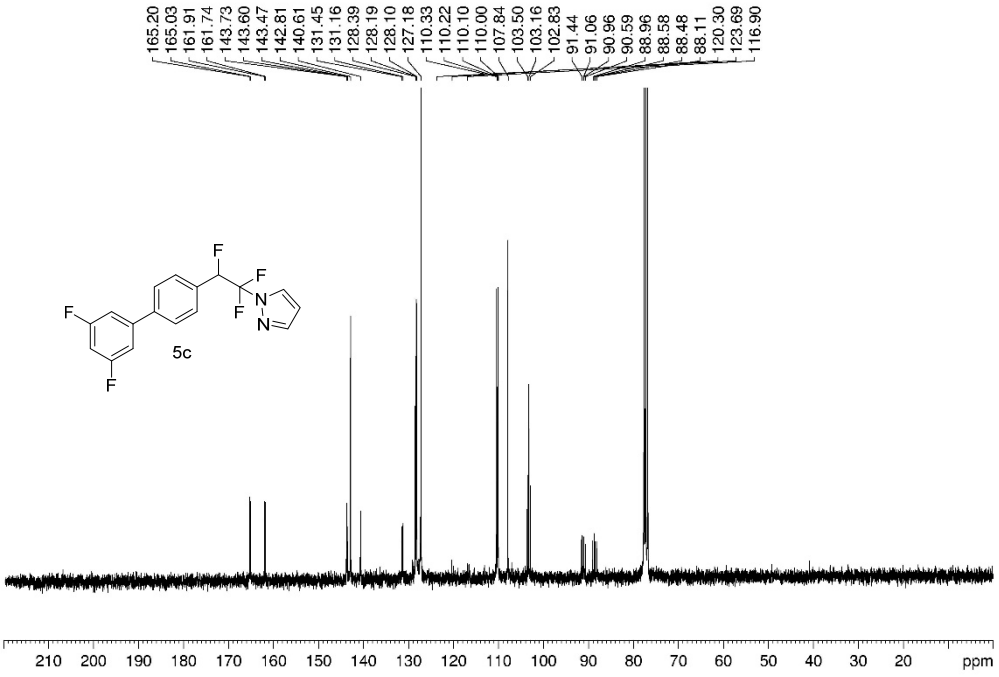
1.10
2.00
1.29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131.16
128.39
128.19
128.10
127.18
110.33
110.22
110.10
110.00
107.84
103.50
103.16
102.83
91.44
91.06
90.96
90.59
88.96
88.58
88.48
88.11
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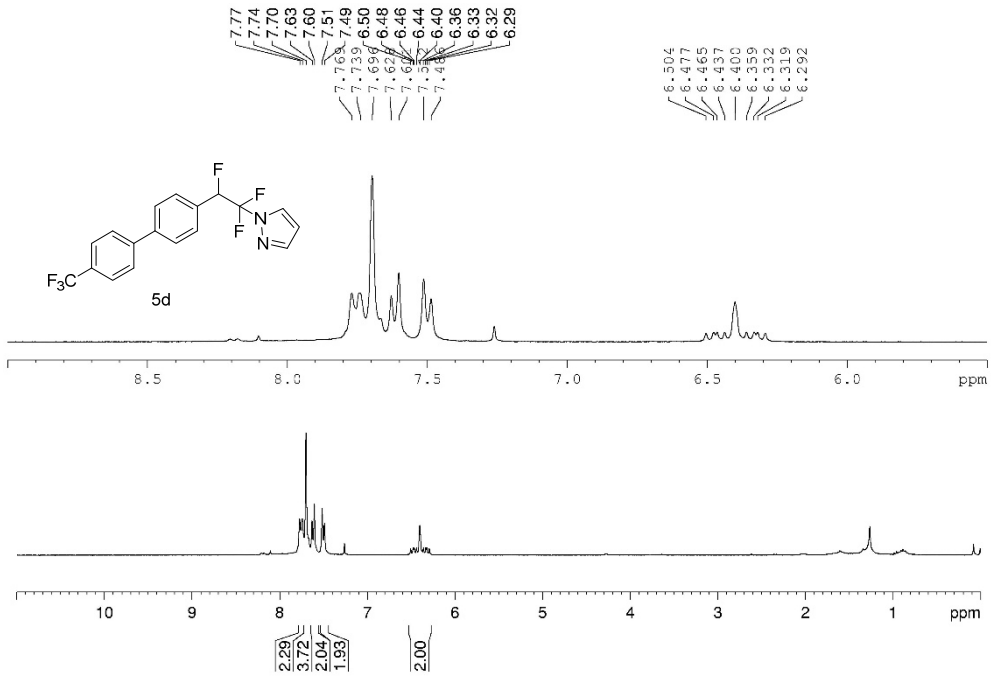
F
F
F
F
N
N
5c
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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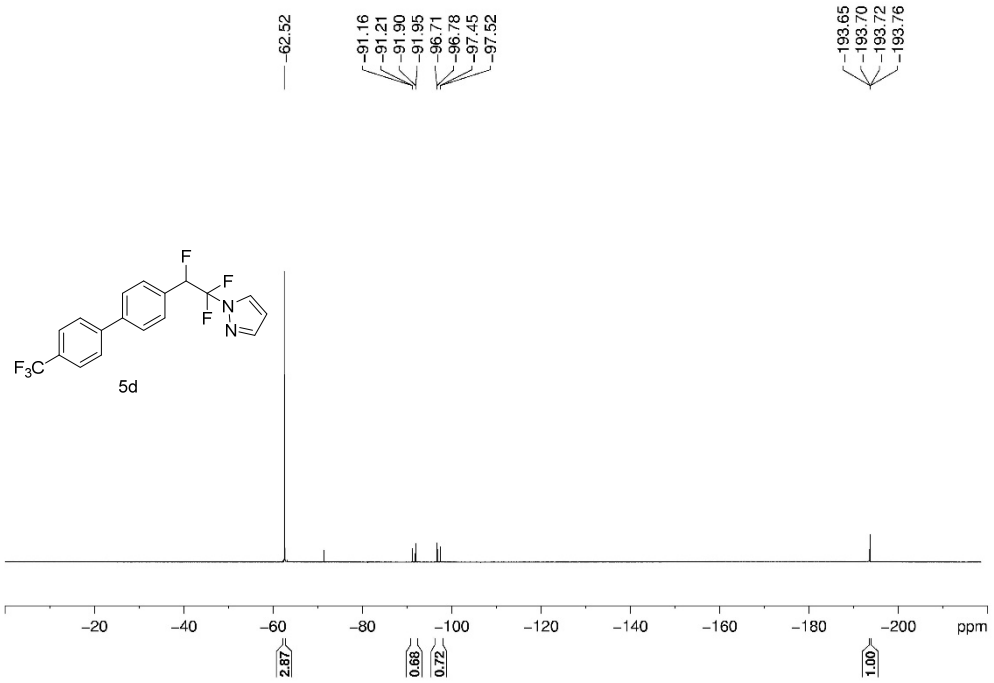
7.63
7.60
7.51
7.49
6.50
6.48
6.46
6.44
6.40
6.36
6.33
6.32
6.29
6.504
6.477
6.465
6.437
6.400
6.359
6.332
6.319
6.292
F
F
F
F
N
N
F3C
5d
8.5 8.0 7.5 7.0 6.5 6.0 ppm
10 9 8 7 6 5 4 3 2 1 ppm
2.29
3.72
2.04
1.93
2.00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-97.45
-97.52
-193.65
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-193.72
-193.76
F
F
F
N
N
F3C
5d
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
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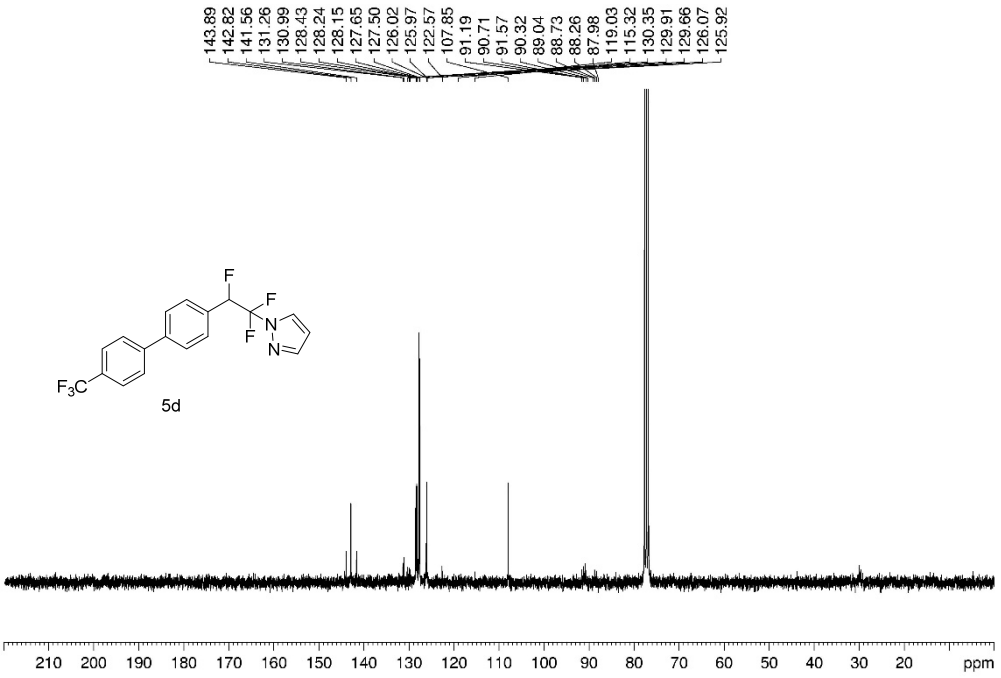
0.68
0.72
1.00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128.15
127.65
127.50
126.02
125.97
122.57
107.85
91.19
90.71
91.57
90.32
89.04
88.73
88.26
87.98
119.03
115.32
130.35
129.91
129.66
126.07
125.92
F
F
F
N
N
F3C
5d
210
200
190
180
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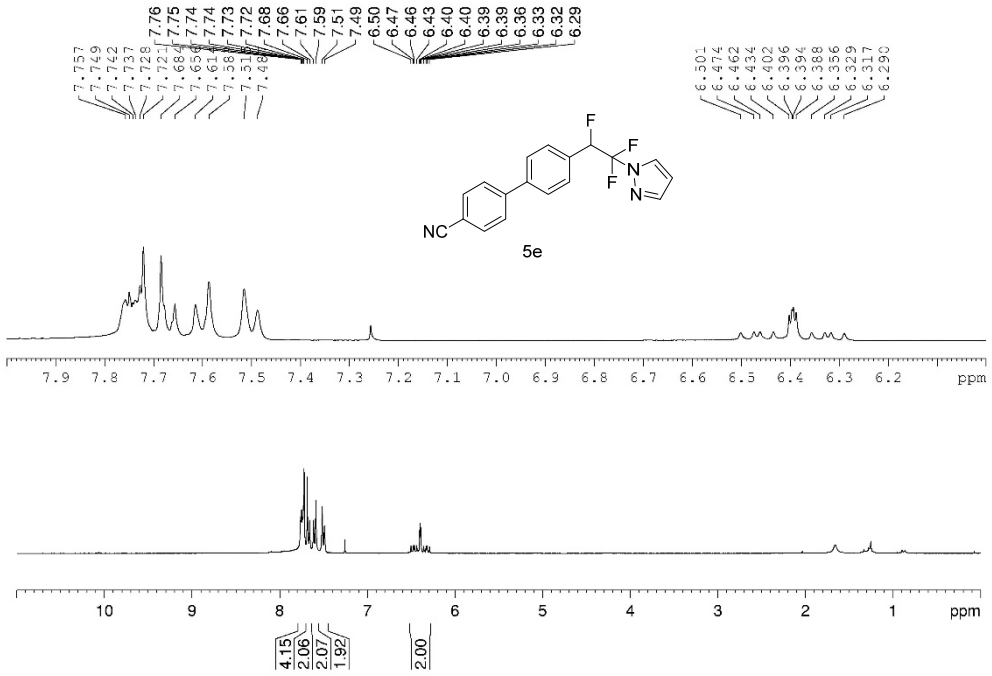
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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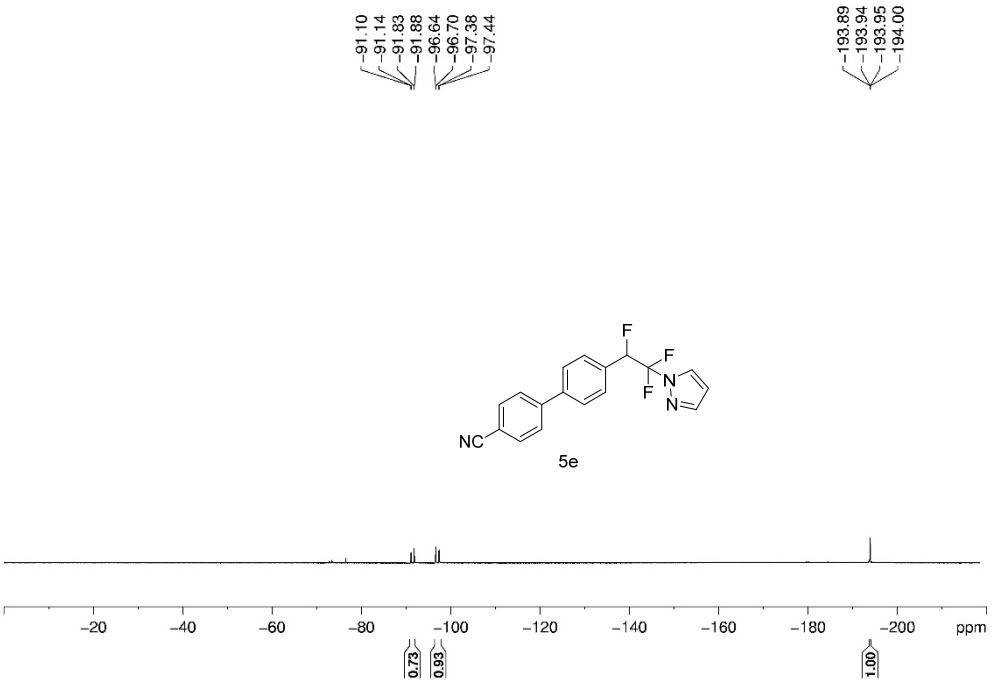
7.61
7.59
7.51
7.49
6.50
6.47
6.46
6.43
6.40
6.40
6.39
6.39
6.36
6.33
6.32
6.29
F
F
F
N
N
NC
5e
7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 ppm
10 9 8 7 6 5 4 3 2 1 ppm
4.15
2.06
2.07
1.92
2.00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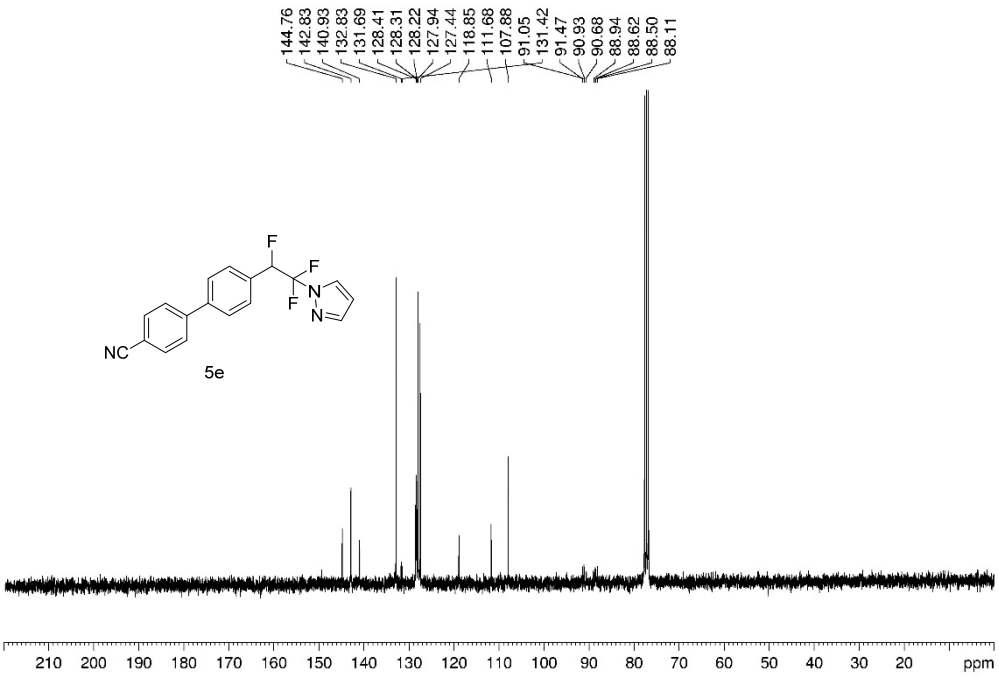
-91.83
-91.88
-96.64
-96.70
-97.38
-97.44
-193.89
-193.94
-193.95
-194.00
F
F
F
N
N
NC
5e
-20 -40 -60 -80 -100 -120 -140 -160 -180 -200 ppm
0.73
0.93
1.00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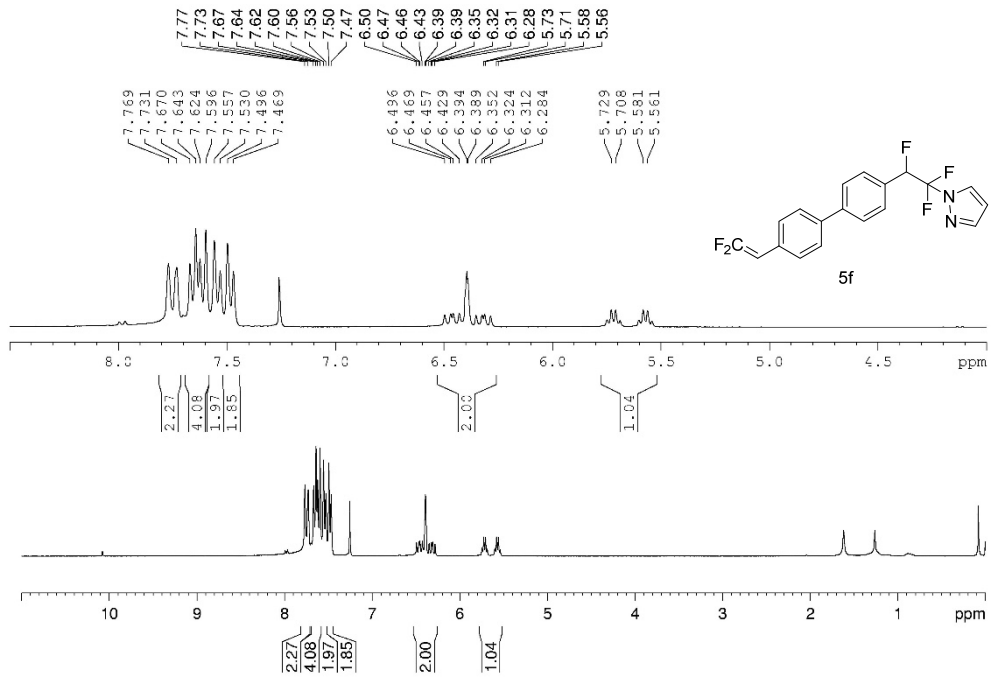
128.31
128.22
127.94
127.44
118.85
111.68
107.88
91.05
131.42
91.47
90.93
90.68
88.94
88.62
88.50
88.11
F
F
F
N
N
NC
5e
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.47
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6.47
6.46
6.43
6.39
6.39
6.35
6.32
6.31
6.28
5.73
5.71
5.58
5.56
7.769
7.731
7.670
7.643
7.624
7.596
7.557
7.530
7.496
7.469
6.496
6.469
6.457
6.429
6.394
6.389
6.352
6.324
6.312
6.284
5.729
5.708
5.581
5.561
F
F
F
N
N
F2C
5f
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
2.27
4.08
1.97
1.85
2.00
1.04
10 9 8 7 6 5 4 3 2 1 ppm
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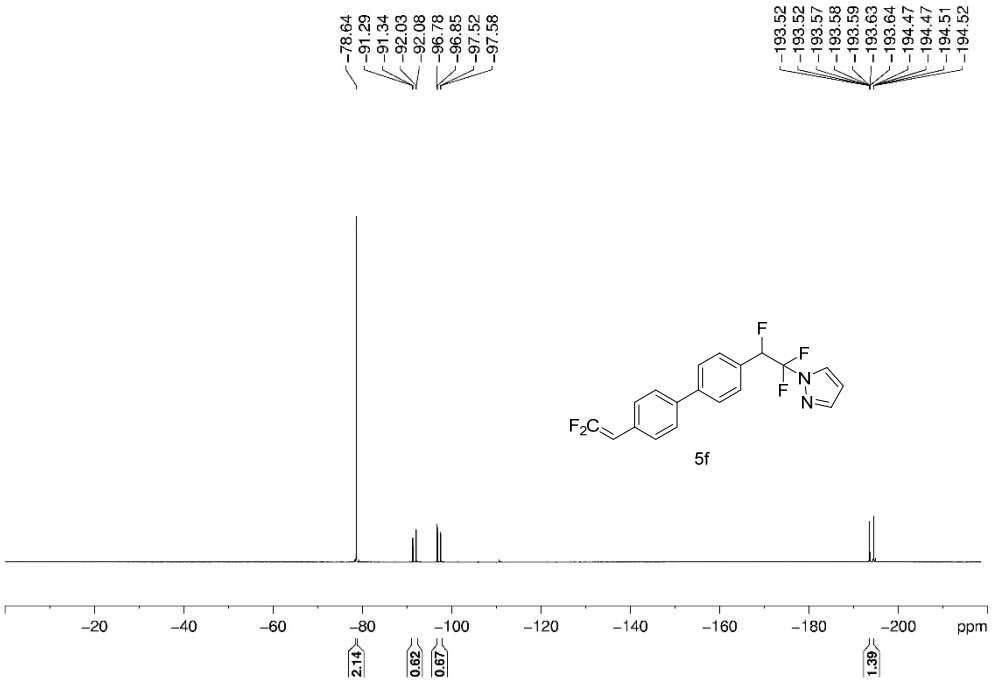
4.08
1.97
1.85
2.00
1.04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-97.52
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-193.57
-193.58
-193.59
-193.63
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-194.51
-194.52
F
F
F
N
N
F2C
5f
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-100
-120
-140
-160
-180
-200
ppm
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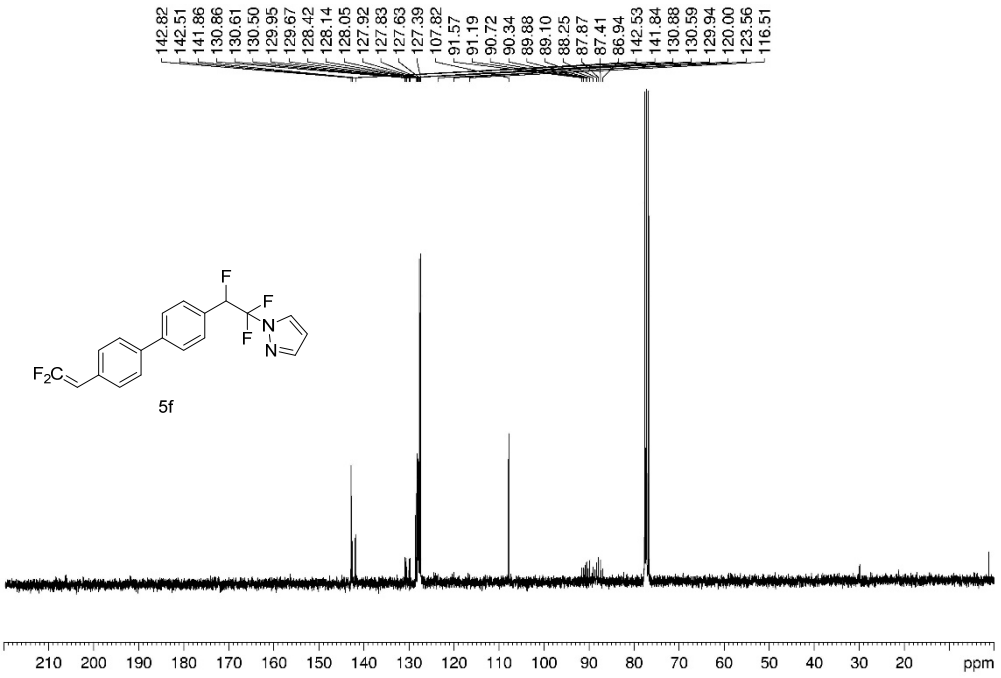
0.67
1.39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130.86
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129.67
128.42
128.14
128.05
127.92
127.83
127.63
127.39
107.82
91.57
91.19
90.72
90.34
89.88
89.10
88.25
87.87
87.41
86.94
142.53
141.84
130.88
130.59
129.94
120.00
123.56
116.51
F
F
F
N
N
F2C
5f
210
200
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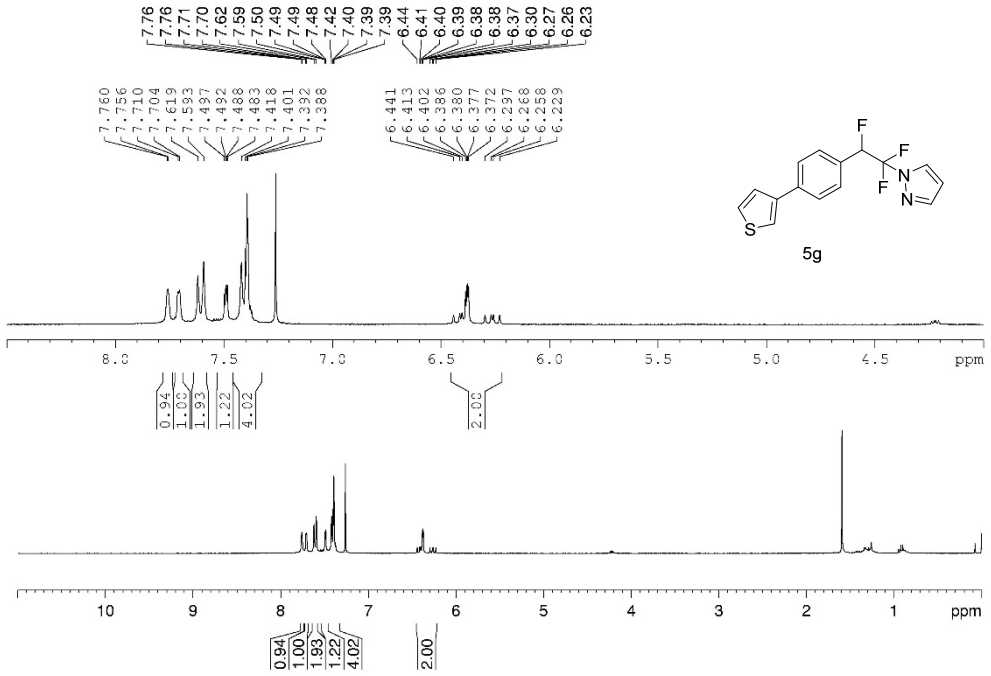
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.48
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7.40
7.39
7.39
6.44
6.41
6.40
6.39
6.38
6.38
6.37
6.30
6.27
6.26
6.23
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7.710
7.704
7.619
7.593
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7.492
7.488
7.483
7.418
7.401
7.392
7.388
6.441
6.413
6.402
6.386
6.380
6.377
6.372
6.297
6.268
6.258
6.229
F
F
F
N
N
S
5g
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
0.94
1.00
1.93
1.22
4.02
2.00
10
9
8
7
6
5
4
3
2
1
ppm
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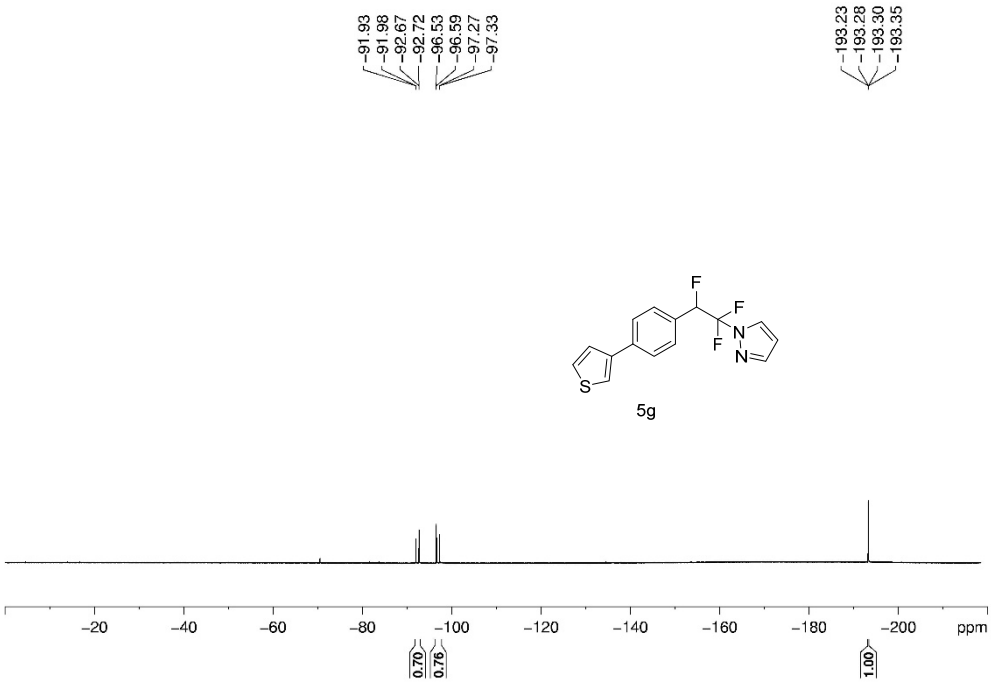
1.00
1.93
1.22
4.02
2.00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-97.27
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-193.23
-193.28
-193.30
-193.35
F
F
F
N
N
S
5g
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-60
-80
-100
-120
-140
-160
-180
-200
ppm
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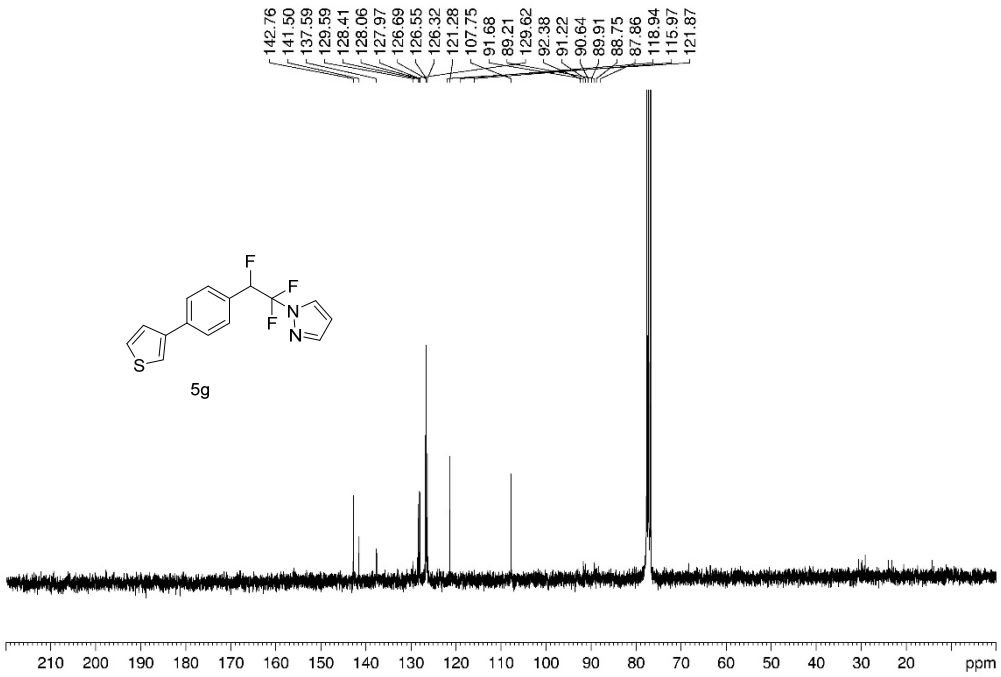
0.76
1.00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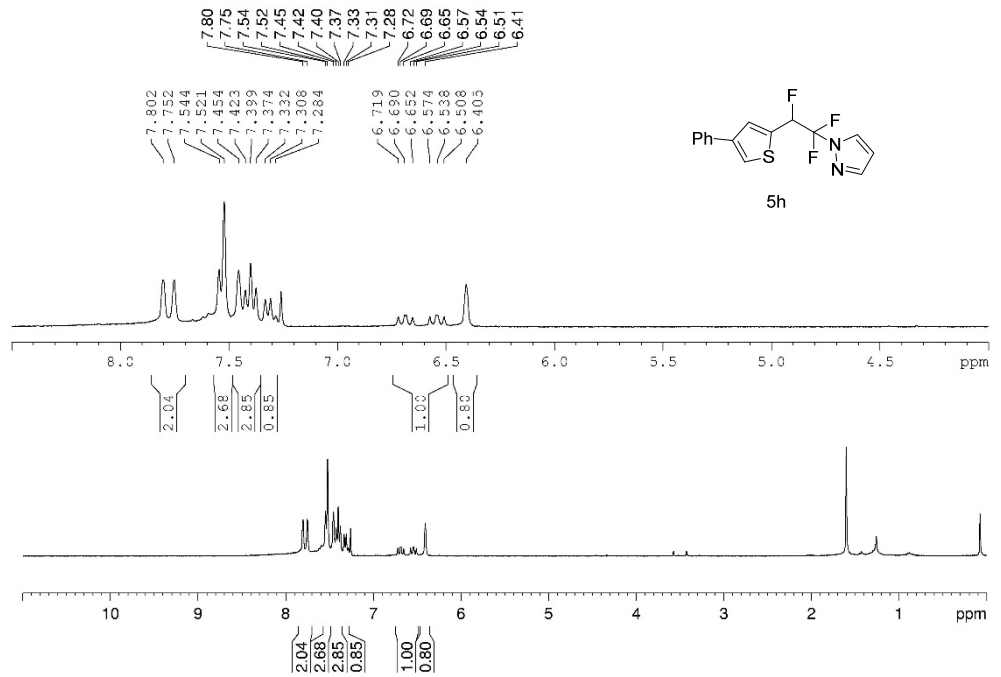
126.69
126.55
126.32
121.28
107.75
91.68
89.21
129.62
92.38
91.22
90.64
89.91
88.75
87.86
118.94
115.97
121.87
F
F
F
N
N
S
5g
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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6.69
6.65
6.57
6.54
6.51
6.41
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7.544
7.521
7.454
7.423
7.399
7.374
7.332
7.308
7.284
6.719
6.690
6.652
6.574
6.538
6.508
6.405
Ph
F
F
F
N
N
S
5h
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
2.04
2.68
2.85
0.85
1.00
0.80
10 9 8 7 6 5 4 3 2 1 ppm
2.04
2.68
2.85
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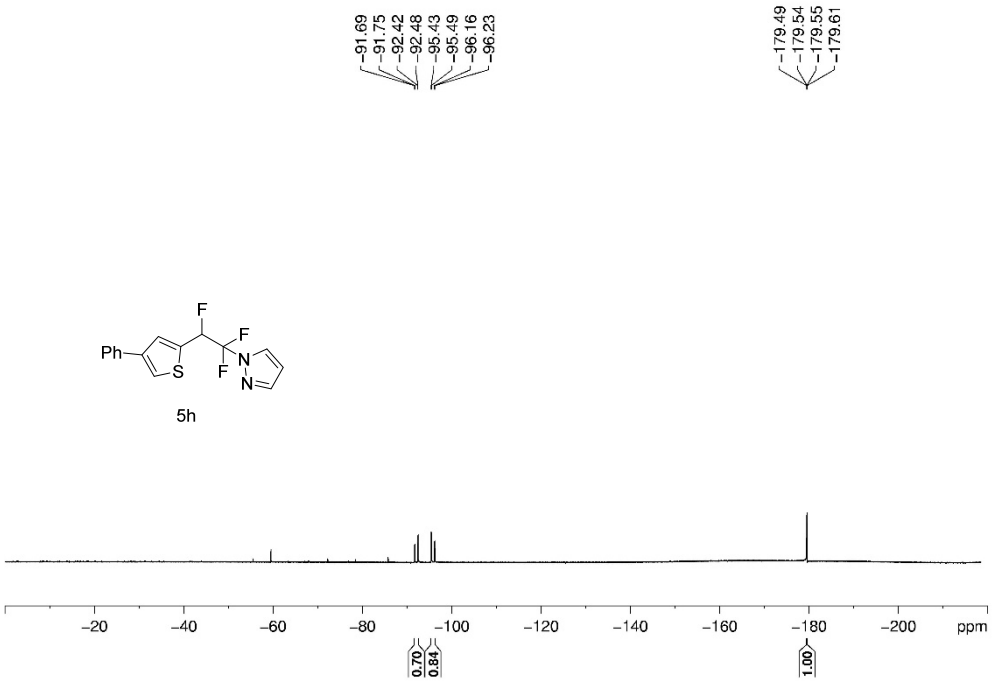
1.00
0.80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-95.49
-96.16
-96.23
-179.49
-179.54
-179.55
-179.61
F
Ph
F
N
F
S
N
5h
-20
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-60
-80
-100
-120
-140
-160
-180
-200
ppm
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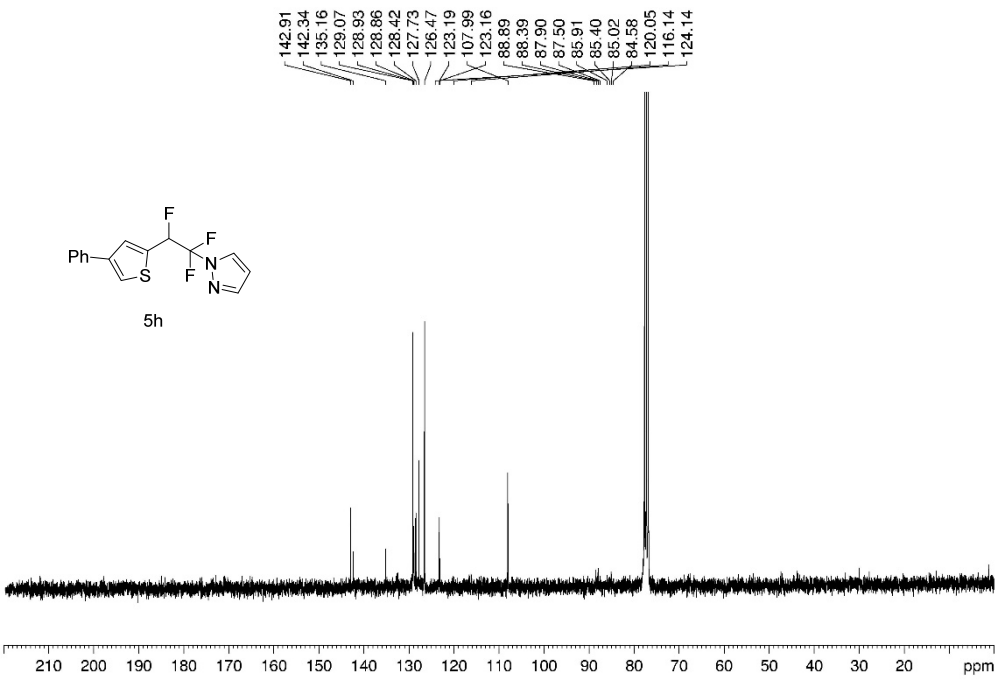
1.00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123.19
107.99
123.16
88.89
88.39
87.90
87.50
85.91
85.40
85.02
84.58
120.05
116.14
124.14
F
Ph
F
N
F
S
N
5h
210
200
190
180
170
160
150
140
130
120
110
100
90
80
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20
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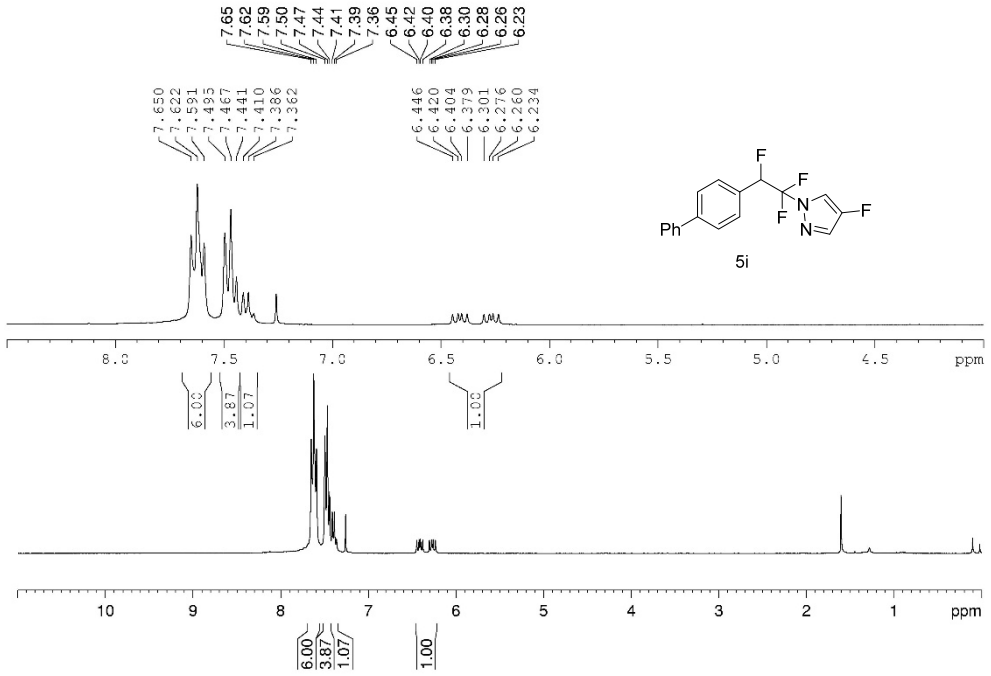
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6.38
6.30
6.28
6.26
6.23
7.650
7.622
7.591
7.495
7.467
7.441
7.410
7.386
7.362
6.446
6.420
6.404
6.379
6.301
6.276
6.260
6.234
F
F
F
N
N
F
Ph
5i
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
6.00
3.87
1.07
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ppm
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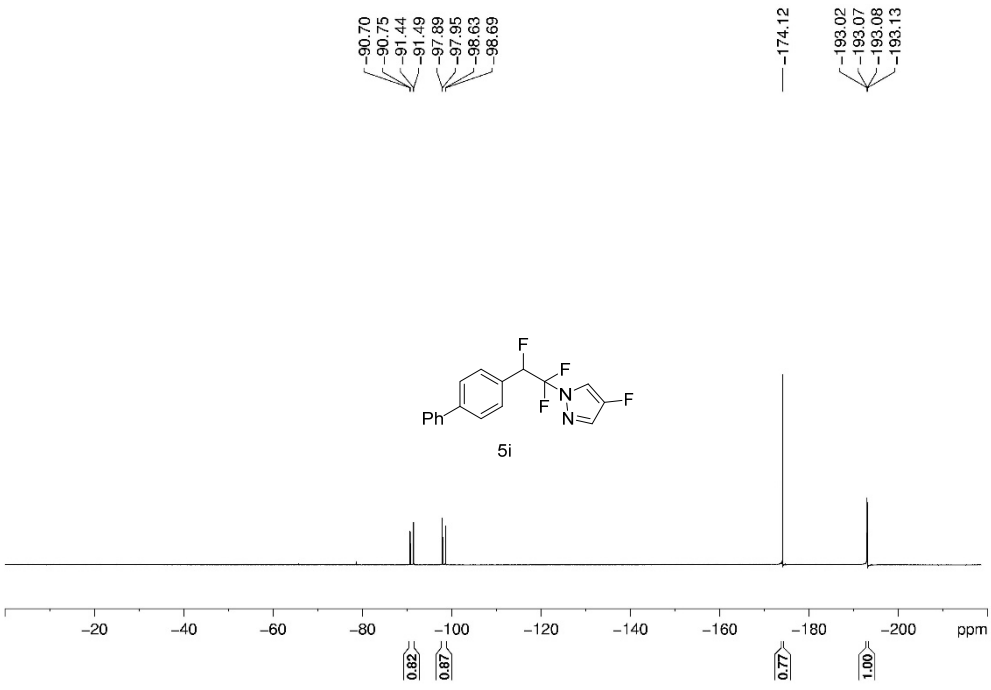
1.00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-98.63
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-174.12
-193.02
-193.07
-193.08
-193.13
F
F
F
N
N
F
Ph
5i
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-100
-120
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ppm
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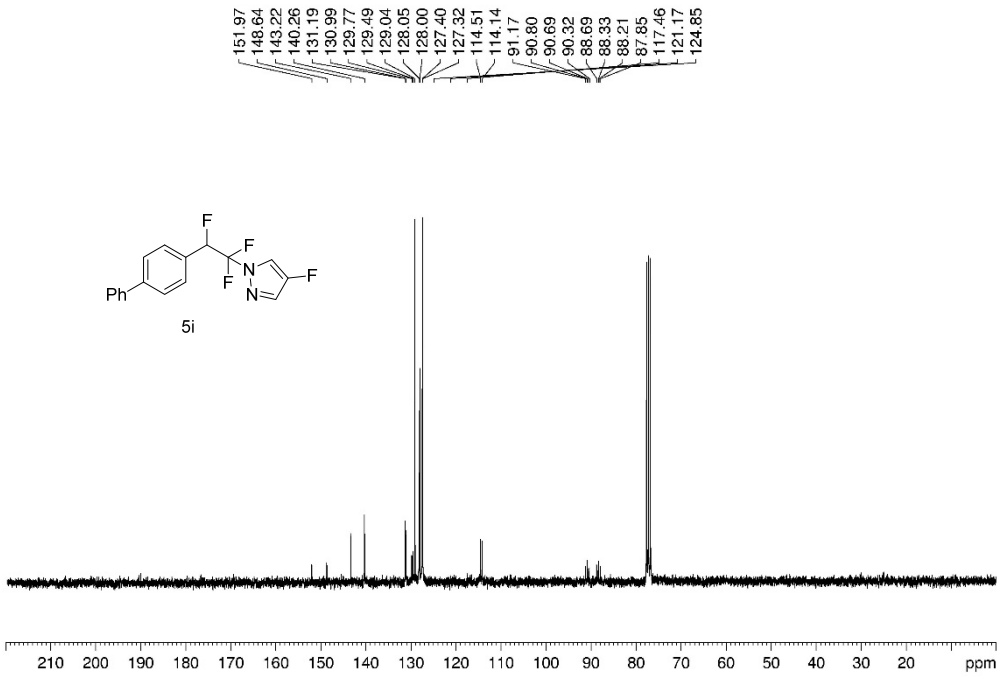
1.00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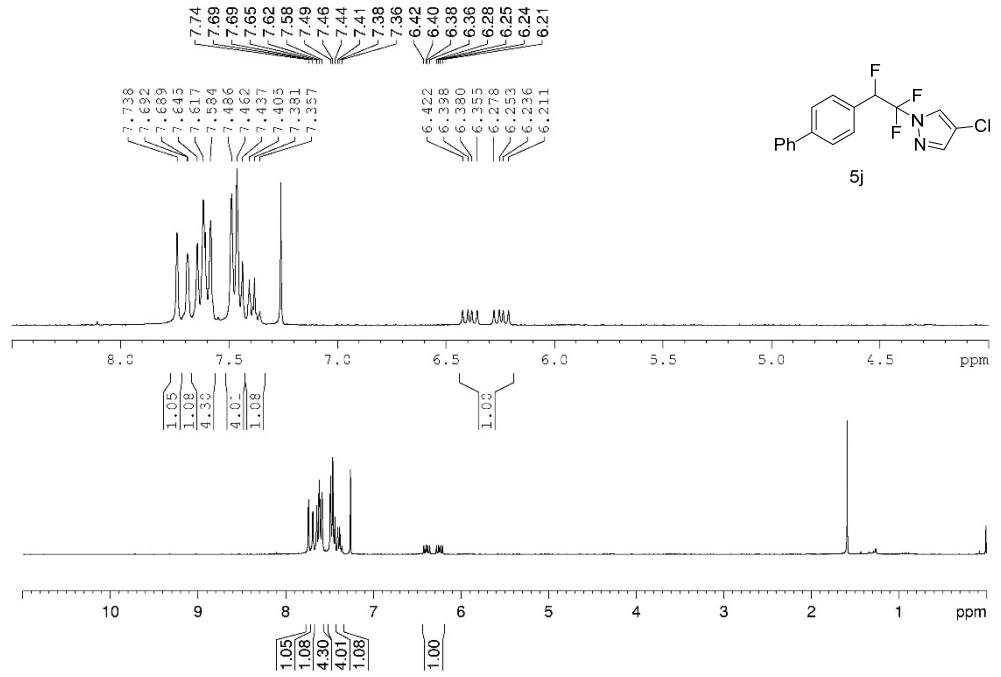
114.51
114.14
91.17
90.80
90.69
90.32
88.69
88.33
88.21
87.85
117.46
121.17
124.85
F
F
F
N
N
F
Ph
5i
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.46
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7.38
7.36
6.42
6.40
6.38
6.36
6.28
6.25
6.24
6.21
7.738
7.692
7.689
7.645
7.617
7.584
7.486
7.462
7.437
7.405
7.381
7.357
6.422
6.398
6.380
6.355
6.278
6.253
6.236
6.211
F
F
F
N
N
Cl
Ph
5j
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
1.05
1.08
4.30
4.01
1.08
1.00
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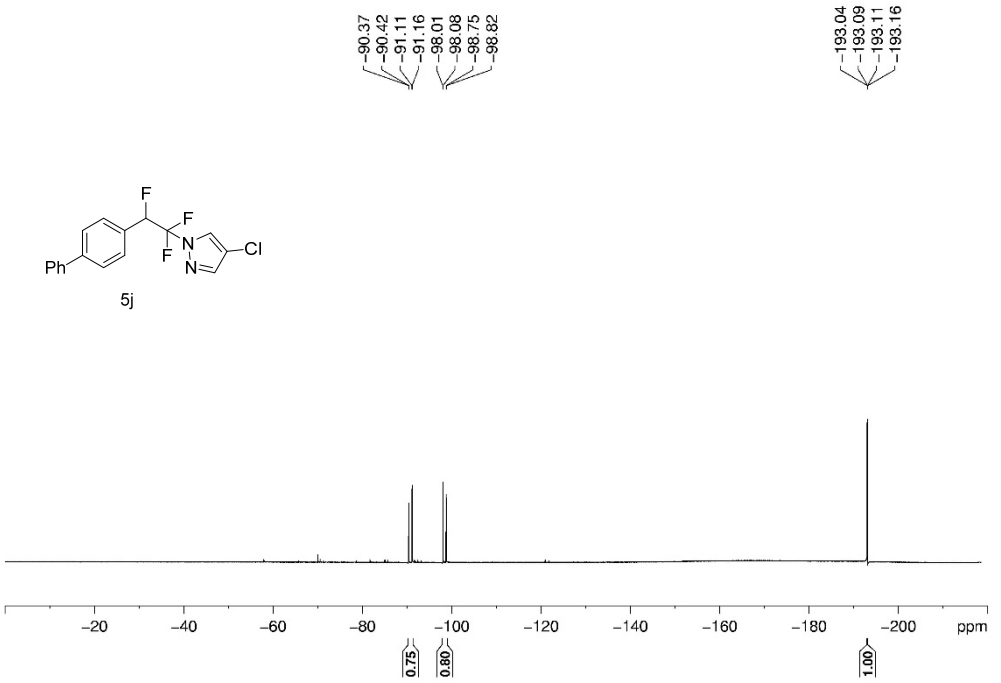
1.05
1.08
4.30
4.01
1.08
1.00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-98.08
-98.75
-98.82
-193.04
-193.09
-193.11
-193.16
F
F
F
N
N
Cl
Ph
5j
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-60
-80
-100
-120
-140
-160
-180
-200
ppm
0.75
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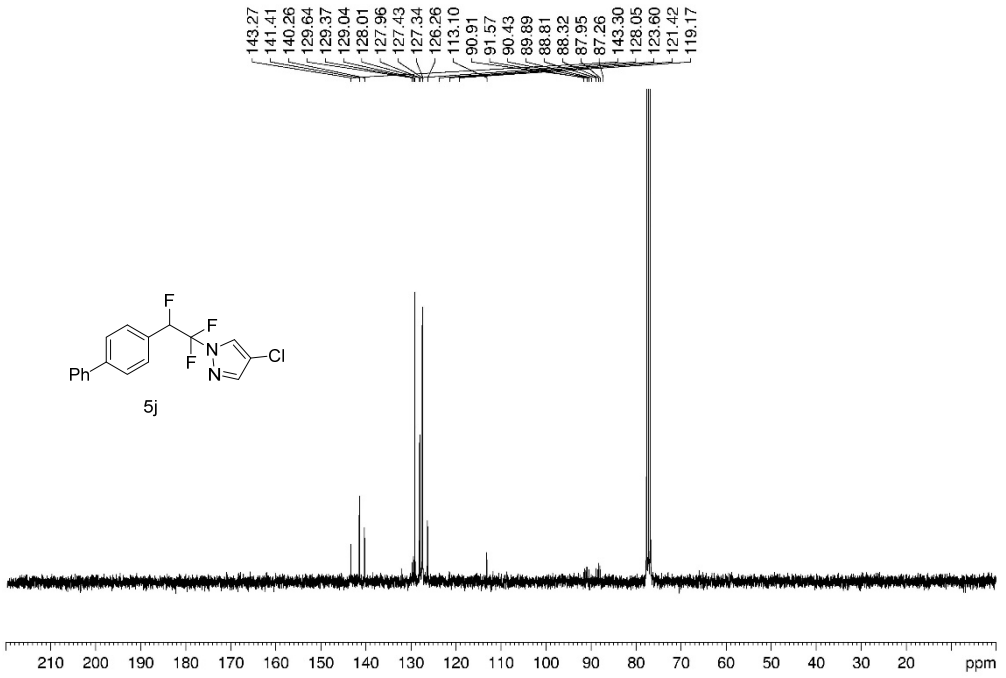
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90.91
91.57
90.43
89.89
88.81
88.32
87.95
87.26
143.30
128.05
123.60
121.42
119.17
F
F
F
N
N
Cl
Ph
5j
210
200
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180
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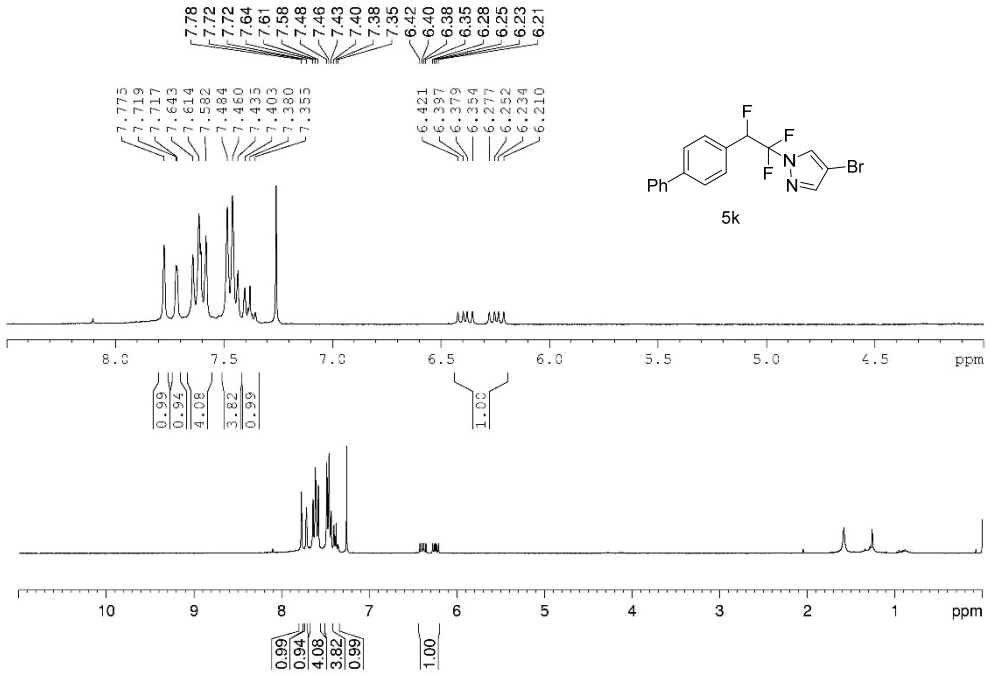
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.72
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7.58
7.48
7.46
7.43
7.40
7.38
7.35
6.42
6.40
6.38
6.35
6.28
6.25
6.23
6.21
7.775
7.719
7.717
7.643
7.614
7.582
7.484
7.460
7.435
7.403
7.380
7.355
6.421
6.397
6.379
6.354
6.277
6.252
6.234
6.210
F
F
F
N
N
Br
Ph
5k
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
0.99
0.94
4.08
3.82
0.99
1.05
10
9
8
7
6
5
4
3
2
1
ppm
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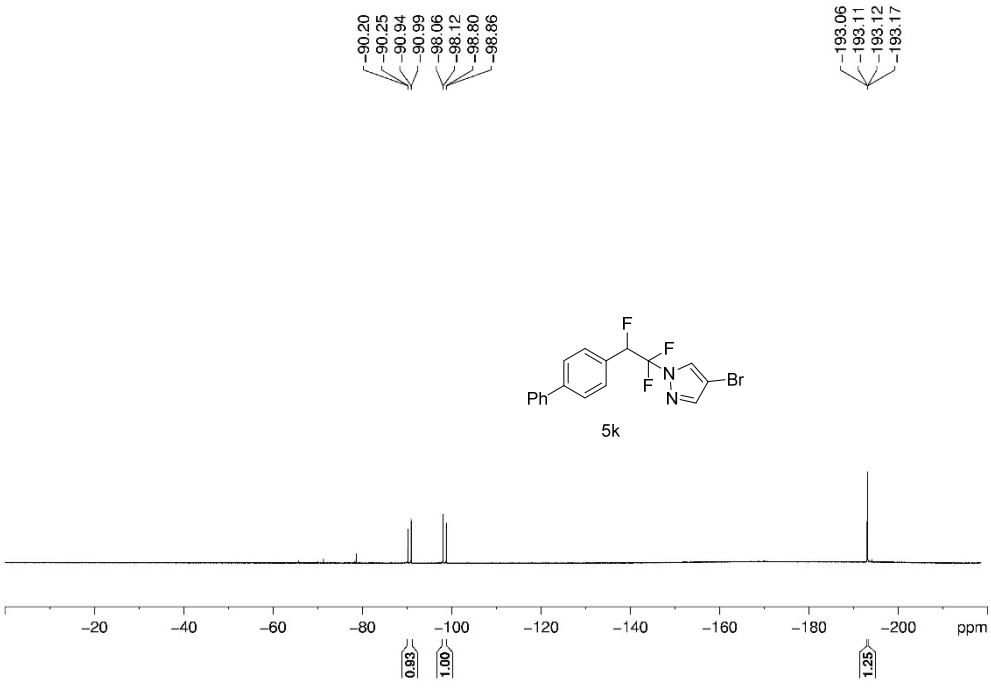
0.94
4.08
3.82
0.99
1.00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-98.80
-98.86
-193.06
-193.11
-193.12
-193.17
F
F
F
N
N
Br
Ph
5k
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-60
-80
-100
-120
-140
-160
-180
-200
ppm
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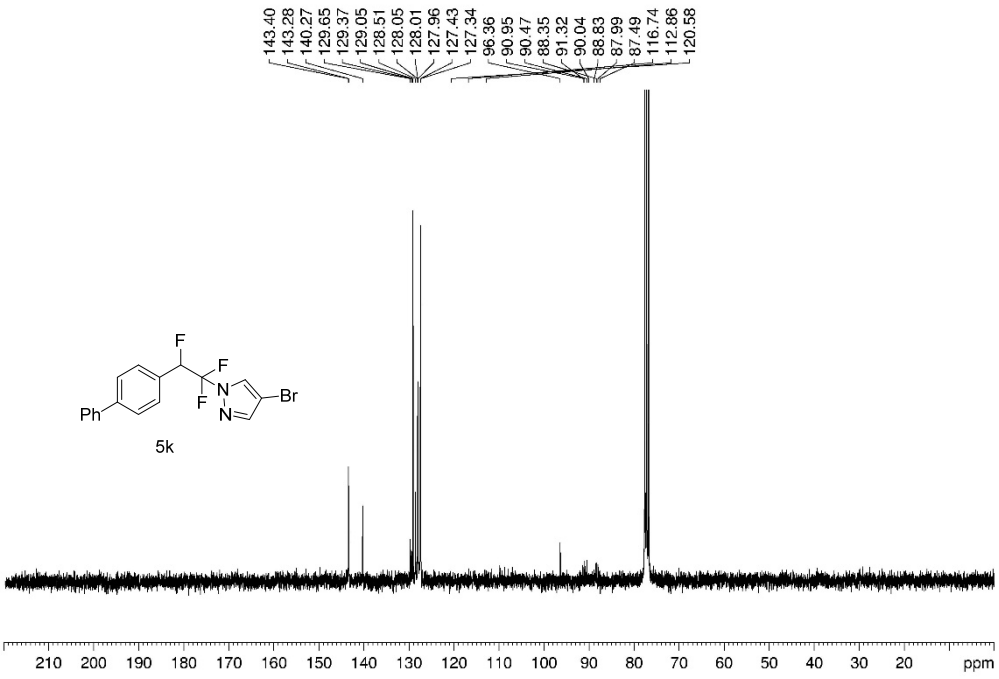
1.00
1.25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129.65
129.37
129.05
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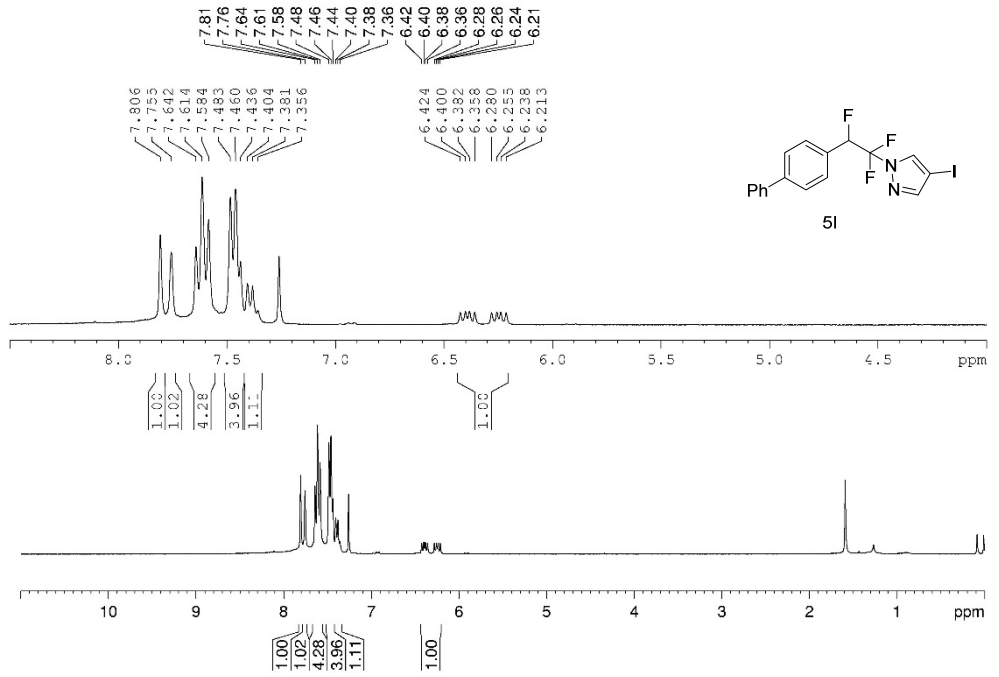
128.05
128.01
127.96
127.43
127.34
96.36
90.95
90.47
88.35
91.32
90.04
88.83
87.99
87.49
116.74
112.86
120.58
F
F
F
N
N
Br
Ph
5k
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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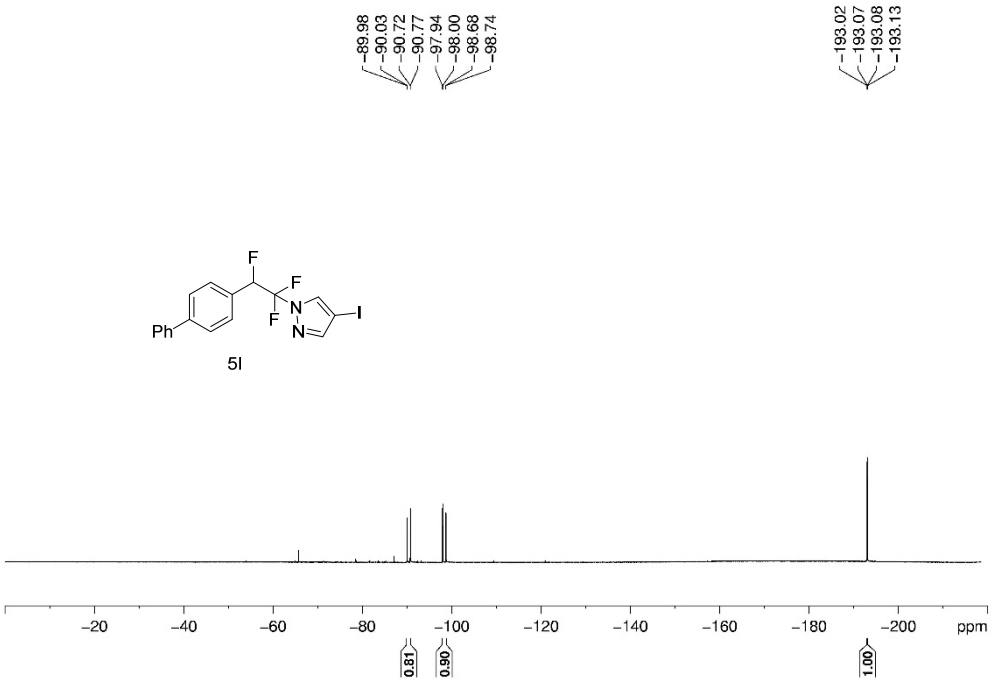
7.44
7.40
7.38
7.36
6.42
6.40
6.38
6.36
6.28
6.26
6.24
6.21
7.806
7.755
7.642
7.614
7.584
7.483
7.460
7.436
7.404
7.381
7.356
6.424
6.400
6.382
6.358
6.280
6.255
6.238
6.213
F
F
F
N
N
I
Ph
5l
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
1.00
1.02
4.28
3.96
1.11
1.00
10 9 8 7 6 5 4 3 2 1 ppm
1.00
1.02
4.28
3.96
1.11
1.00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-90.77
-97.94
-98.00
-98.68
-98.74
-193.02
-193.07
-193.08
-193.13
F
F
F
N
N
I
Ph
5l
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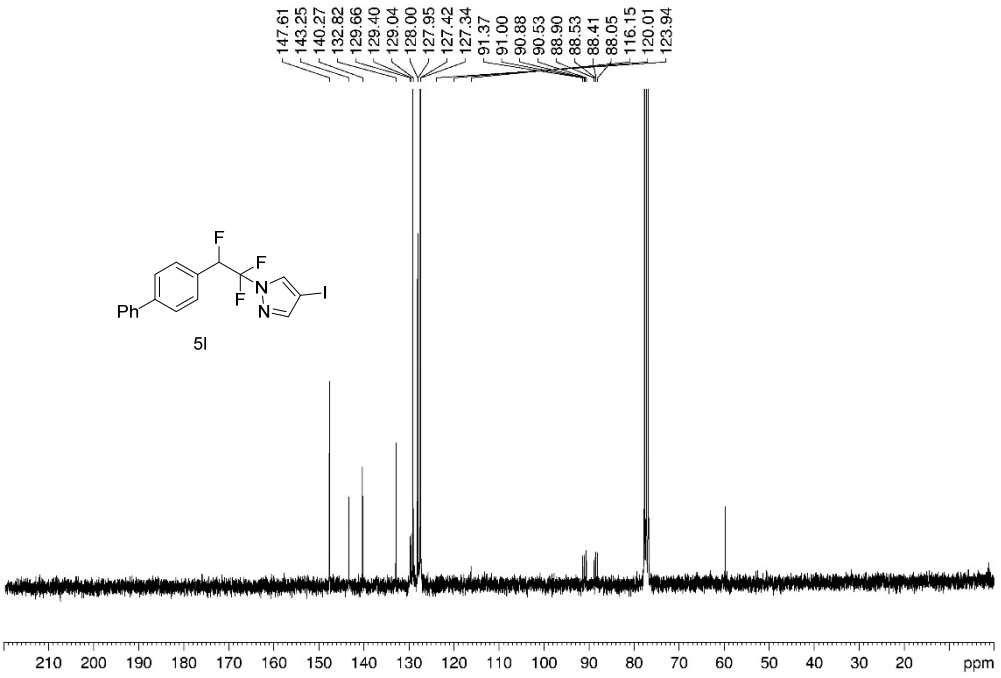
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
0.81
0.90
1.00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129.40
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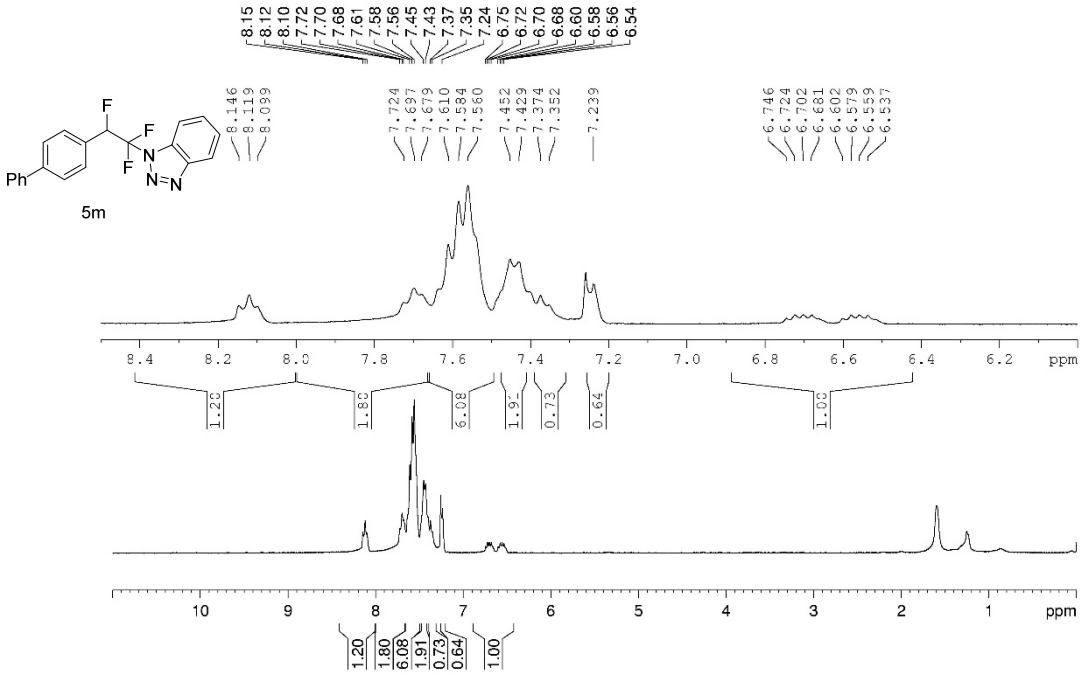
128.00
127.95
127.42
127.34
91.37
91.00
90.88
90.53
88.90
88.53
88.41
88.05
116.15
120.01
123.94
F
F
F
N
N
I
Ph
5l
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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7.68
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7.58
7.56
7.45
7.43
7.37
7.35
7.24
6.75
6.72
6.70
6.68
6.60
6.58
6.56
6.54
8.146
8.119
8.099
7.724
7.697
7.679
7.610
7.584
7.560
7.452
7.429
7.374
7.352
7.239
6.746
6.724
6.702
6.681
6.602
6.579
6.559
6.537
F
F
F
N
N=N
Ph
5m
ppm
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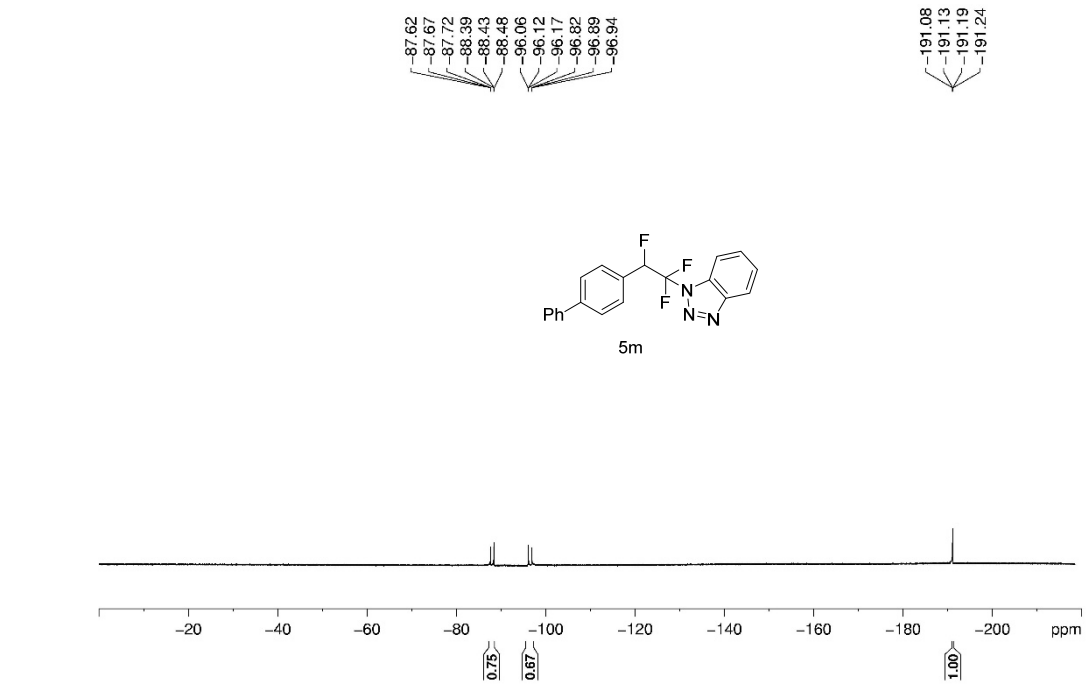
1.00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-88.48
-96.06
-96.12
-96.17
-96.82
-96.89
-96.94
-191.08
-191.13
-191.19
-191.24
F
F
F
N
N=N
Ph
5m
ppm
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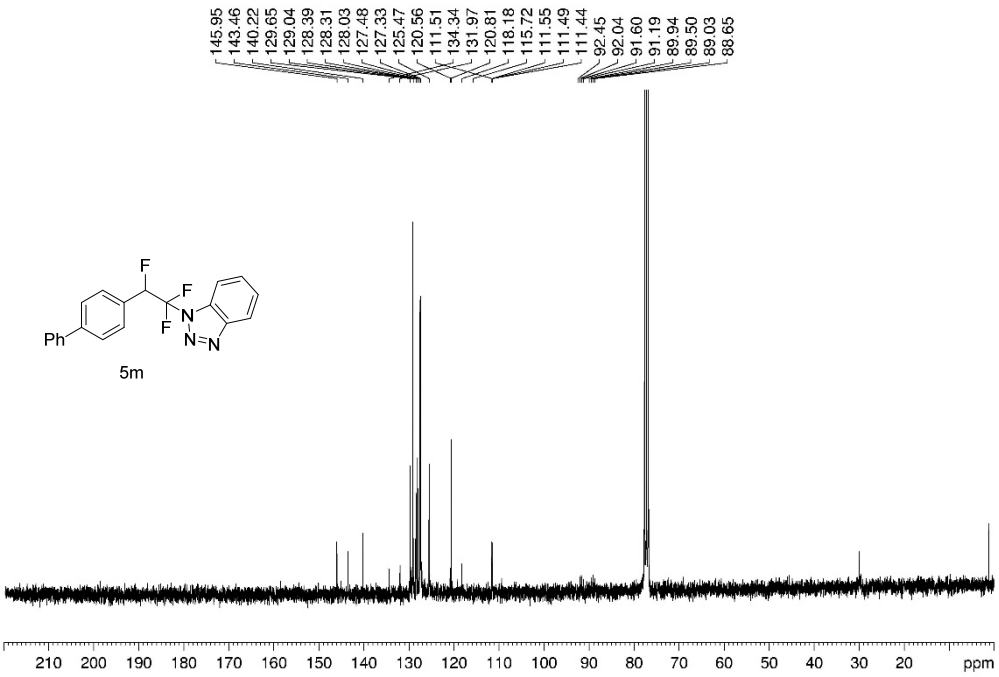
1.00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120.56
111.51
134.34
131.97
120.81
118.18
115.72
111.55
111.49
111.44
92.45
92.04
91.60
91.19
89.94
89.50
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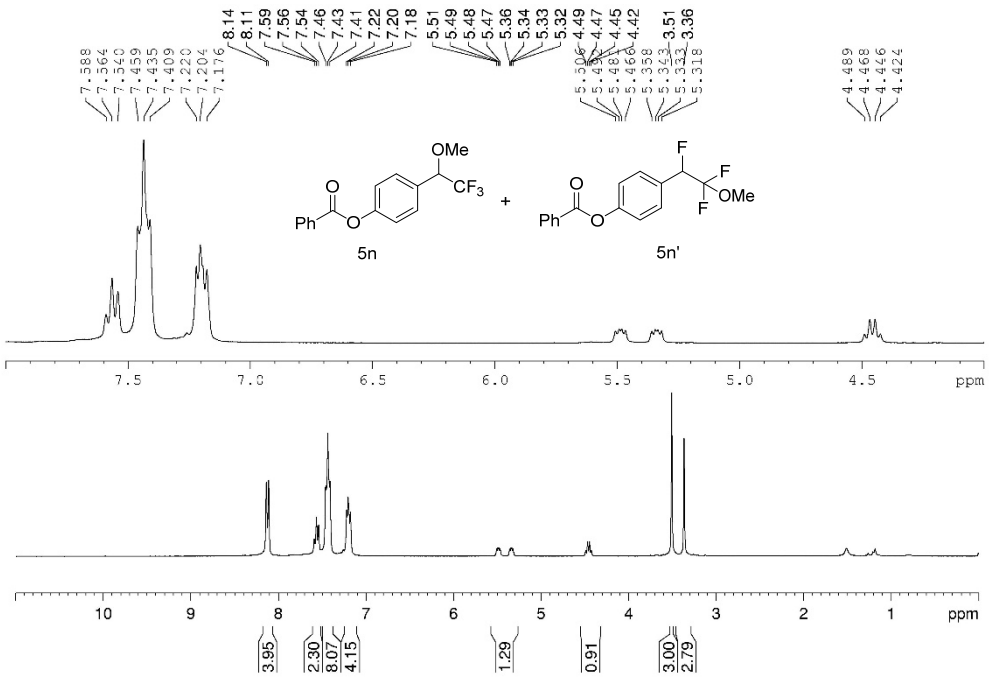
88.65
F
F
F
N
N
N
Ph
5m
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.43
7.41
7.22
7.20
7.18
5.51
5.49
5.48
5.47
5.36
5.34
5.33
5.32
4.49
4.47
4.45
4.42
3.51
3.36
7.588
7.564
7.550
7.459
7.435
7.409
7.220
7.204
7.176
5.506
5.481
5.466
5.358
5.343
5.332
5.318
4.489
4.468
4.446
4.424
OMe
CF3
O
Ph
O
5n
+
F
F
OMe
F
O
Ph
O
5n'
7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
10 9 8 7 6 5 4 3 2 1 ppm
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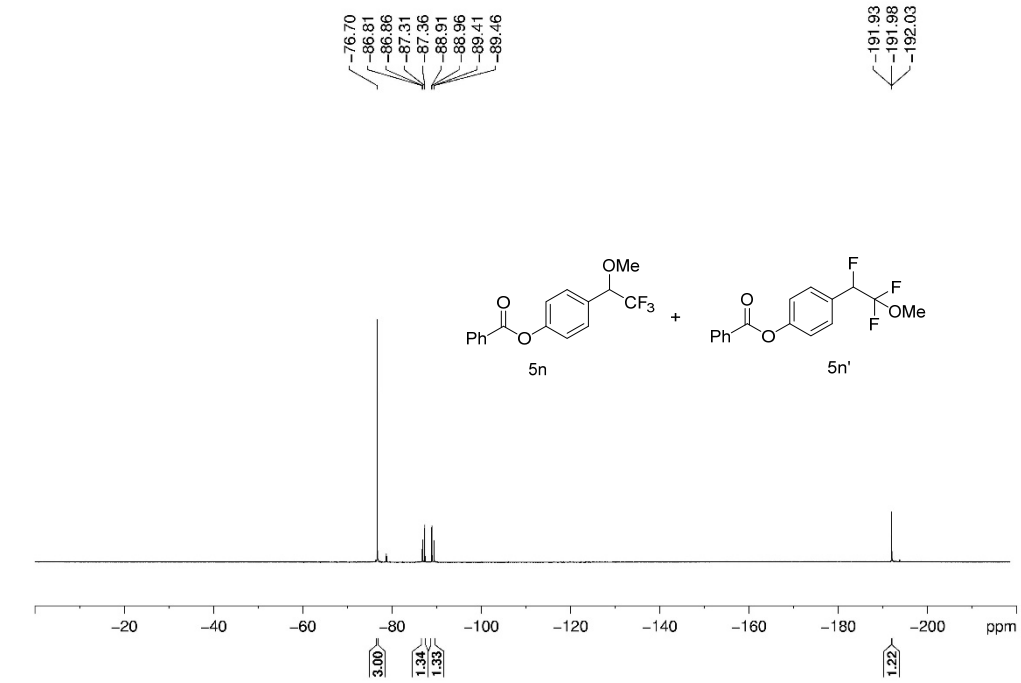
2.30
8.07
4.15
1.29
0.91
3.00
2.79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-88.96
-89.41
-89.46
-191.93
-191.98
-192.03
OMe
CF3
O
Ph
O
5n
+
F
F
OMe
F
5n'
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
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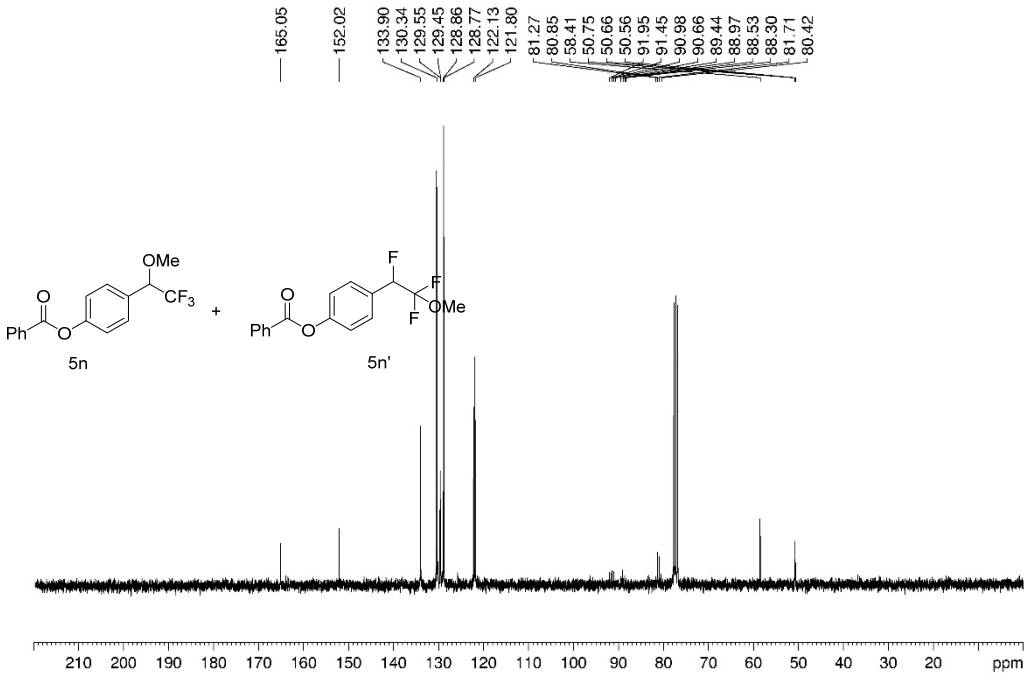
1.33
1.22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81.27
80.85
58.41
50.75
50.66
50.56
91.95
91.45
90.98
90.66
89.44
88.97
88.53
88.30
81.71
80.42
OMe
CF3
O
Ph
O
5n
+
F
F
F
OMe
5n'
210
200
190
180
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160
150
140
130
120
110
100
90
80
70
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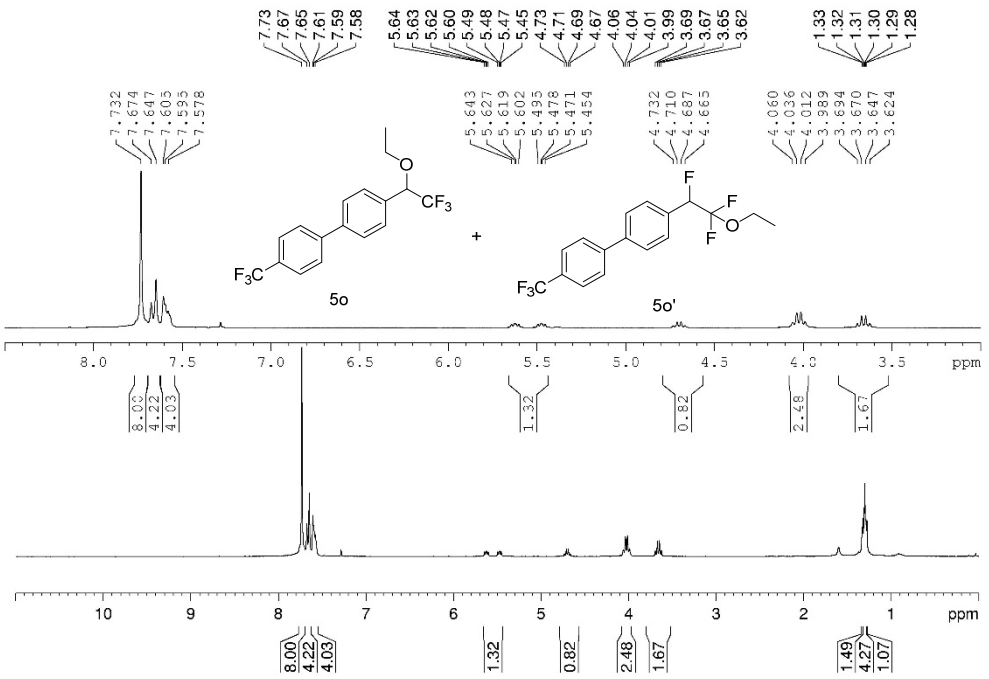
50
40
30
20
ppm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5.63
5.62
5.60
5.49
5.48
5.47
5.45
4.73
4.71
4.69
4.67
4.06
4.04
4.01
3.99
3.69
3.67
3.65
3.62
1.33
1.32
1.31
1.30
1.29
1.28
7.732
7.674
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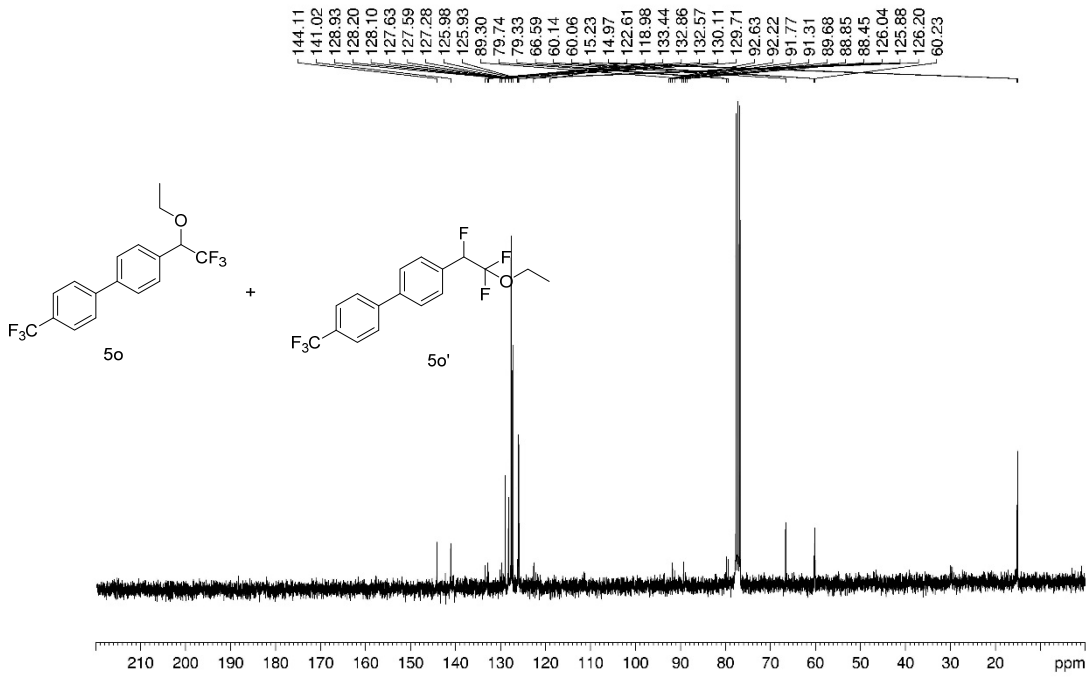
7.605
7.595
7.578
5.643
5.627
5.619
5.602
5.495
5.478
5.471
5.454
4.732
4.710
4.687
4.665
4.060
4.036
4.012
3.989
3.694
3.670
3.647
3.624
O
CF3
F3C
5o
+
F
F
F
O
F3C
5o'
ppm
8.00
4.22
4.03
1.32
0.82
2.48
1.67
1.49
4.27
1.07


−62.47
−76.59
−84.09
−84.14
−84.60
−84.65
−85.51
−85.56
−86.02
−86.07
−192.64
−192.69
−192.74
O
CF3
F3C
5o
+
F
F
F
O
F3C
5o'
ppm
6.16
2.62
1.36
1.48
1.40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127.28
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125.93
89.30
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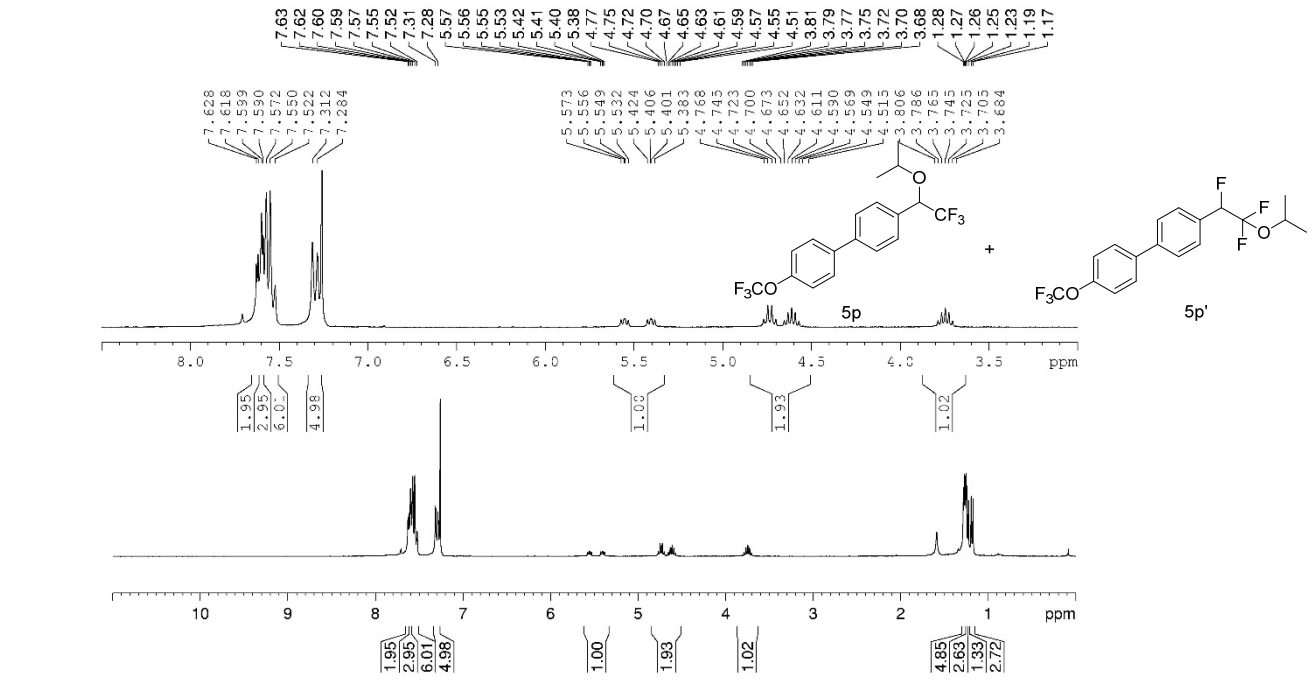
79.33
66.59
60.14
60.06
15.23
14.97
122.61
118.98
133.44
132.86
132.57
130.11
129.71
92.63
92.22
91.77
91.31
89.68
88.85
88.45
126.04
125.88
126.20
60.23
O
CF3
F3C
5o
+
F
F
F
O
F3C
5o'
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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5.57
5.56
5.55
5.53
5.42
5.41
5.40
5.38
4.77
4.75
4.72
4.70
4.67
4.65
4.63
4.61
4.59
4.57
4.55
4.51
3.81
3.79
3.77
3.75
3.72
3.70
3.68
1.28
1.27
1.26
1.25
1.23
1.19
1.17
7.628
7.618
7.599
7.590
7.572
7.550
7.522
7.312
7.284
5.573
5.556
5.549
5.532
5.424
5.406
5.401
5.383
4.768
4.745
4.723
4.700
4.673
4.652
4.632
4.611
4.590
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4.549
4.515
3.806
3.786
3.765
3.745
3.725
3.705
3.684
O
CF3
F3CO
5p
+
F
F
F
O
F3CO
5p'
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 ppm
1.95
2.95
6.01
4.98
1.00
1.93
1.02
1.02
10 9 8 7 6 5 4 3 2 1 ppm
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1.02
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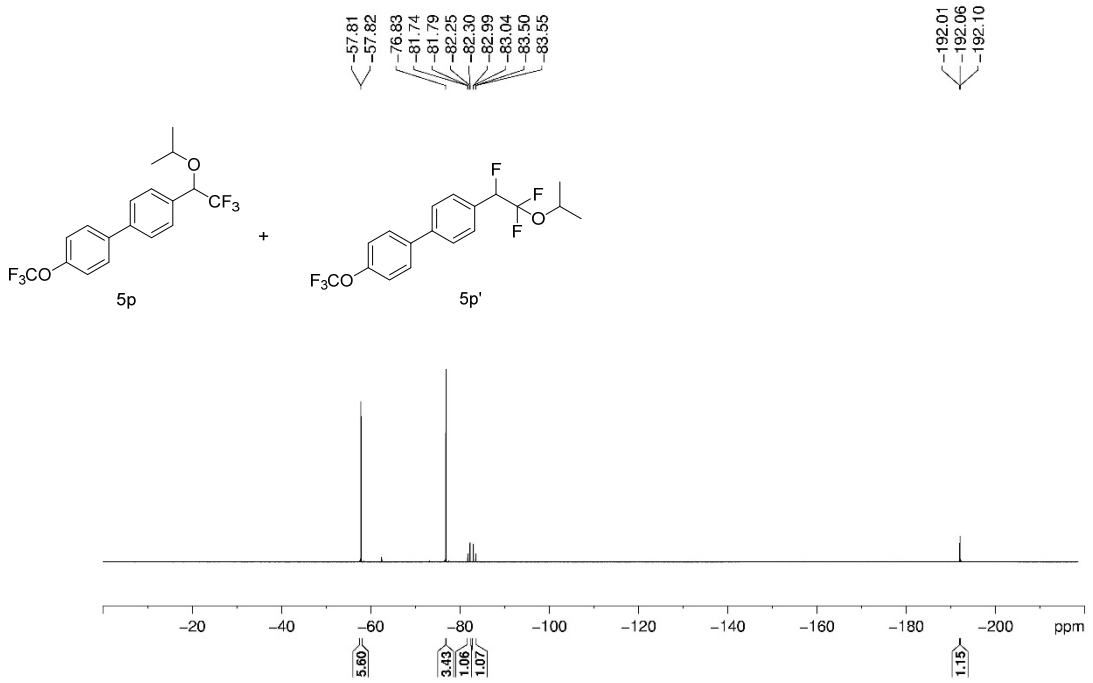
2.72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-82.30
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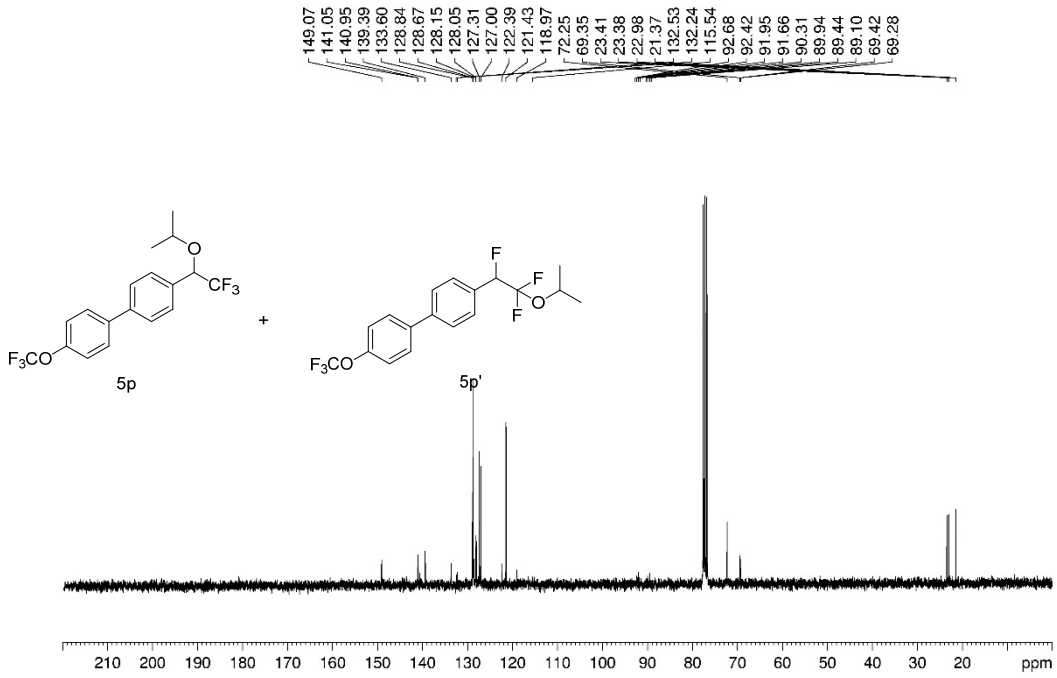
-83.04
-83.50
-83.55
-192.01
-192.06
-192.10
5p
5p'
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
5.60
3.43
1.06
1.07
1.15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118.97
72.25
69.35
23.41
23.38
22.98
21.37
132.53
132.24
115.54
92.68
92.42
91.95
91.66
90.31
89.94
89.44
89.10
69.42
69.28
5p
5p'
210
200
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150
140
130
120
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100
90
80
70
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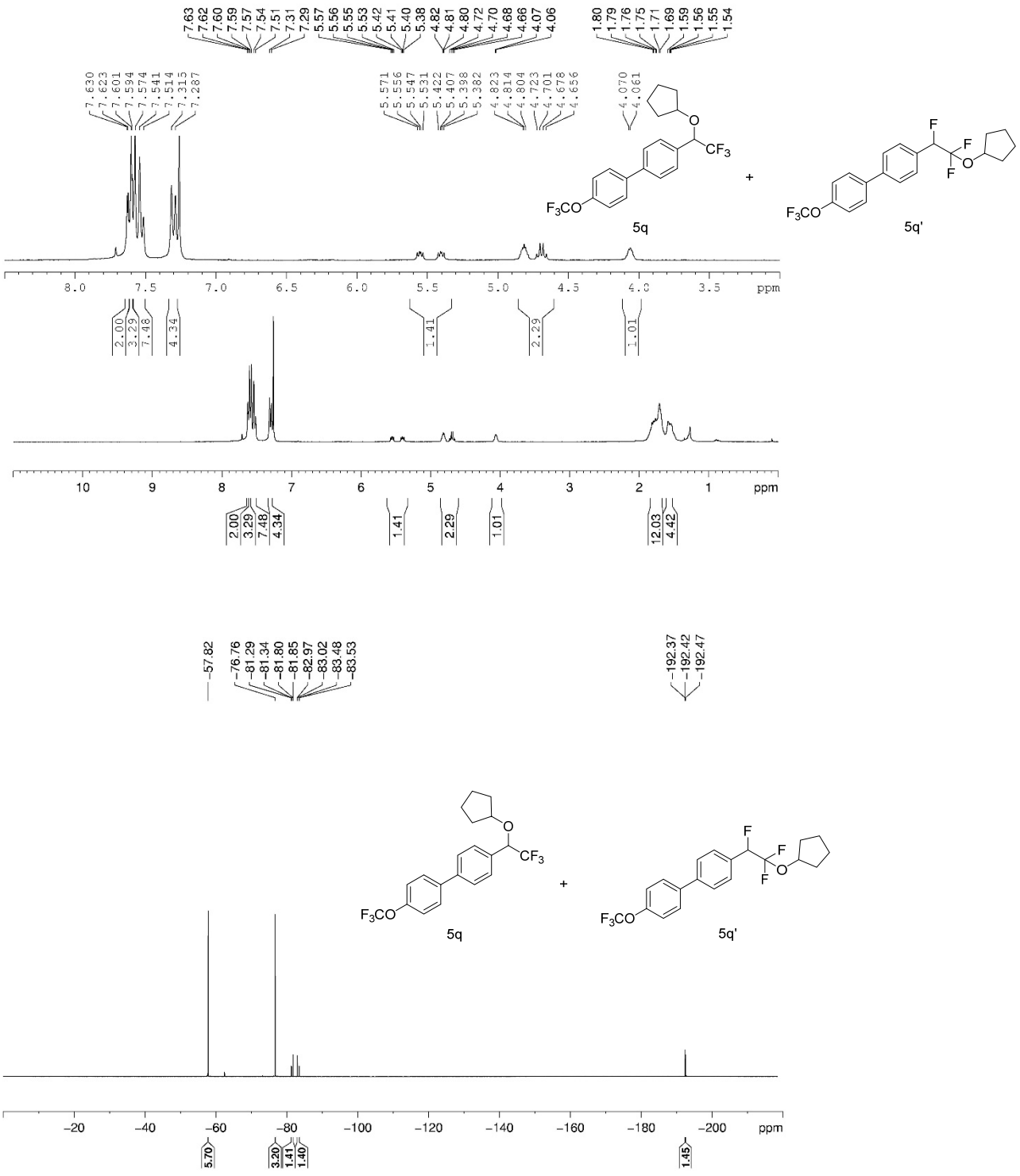
50
40
30
20
ppm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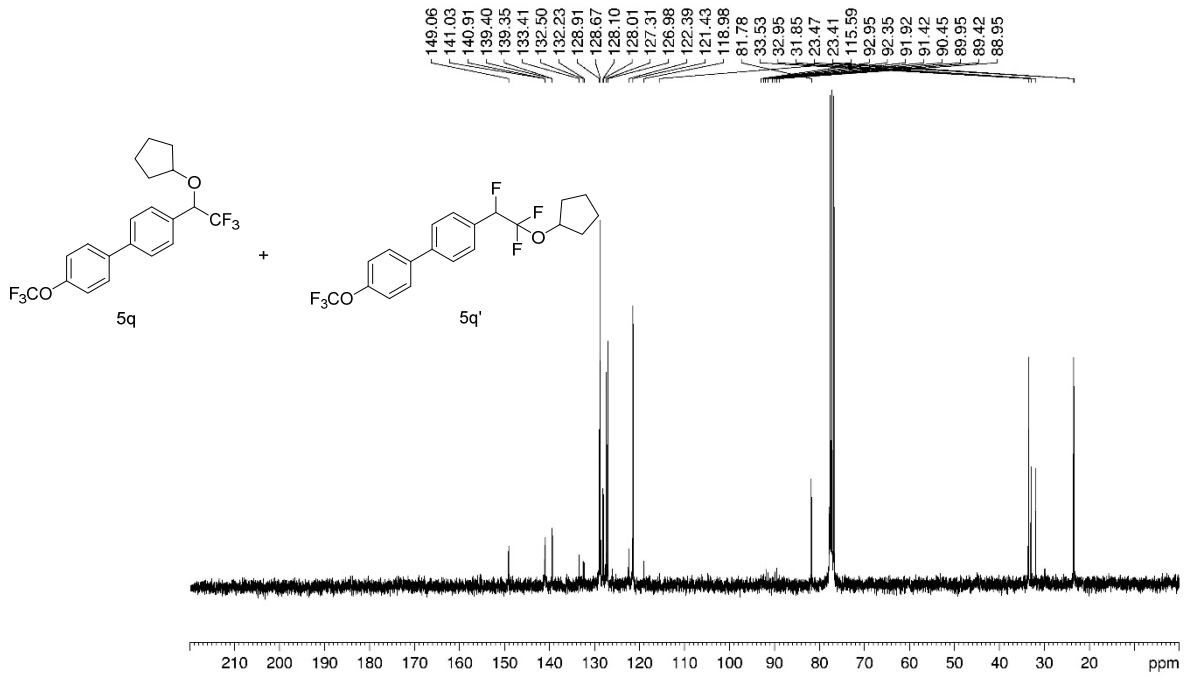
7.60
7.59
7.57
7.54
7.51
7.31
7.29
5.57
5.56
5.55
5.53
5.42
5.41
5.40
5.38
4.82
4.81
4.80
4.72
4.70
4.68
4.66
4.07
4.06
1.80
1.79
1.76
1.75
1.71
1.69
1.59
1.56
1.55
1.54
7.630
7.623
7.601
7.594
7.574
7.541
7.514
7.315
7.287
5.571
5.556
5.547
5.531
5.422
5.407
5.398
5.382
4.823
4.814
4.804
4.723
4.701
4.678
4.656
4.070
4.061
O
CF3
F3CO
5q
+
F
F
F
O
F3CO
5q'
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
ppm
2.00
3.29
7.48
4.34
1.41
2.29
1.01
10
9
8
7
6
5
4
3
2
1
ppm
2.00
3.29
7.48
4.34
1.41
2.29
1.01
12.03
4.42
-57.82
-76.76
-81.29
-81.34
-81.80
-81.85
-82.97
-83.02
-83.48
-83.53
-192.37
-192.42
-192.47
O
CF3
F3CO
5q
+
F
F
F
O
F3CO
5q'
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
5.70
3.20
1.41
1.40
1.45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132.23
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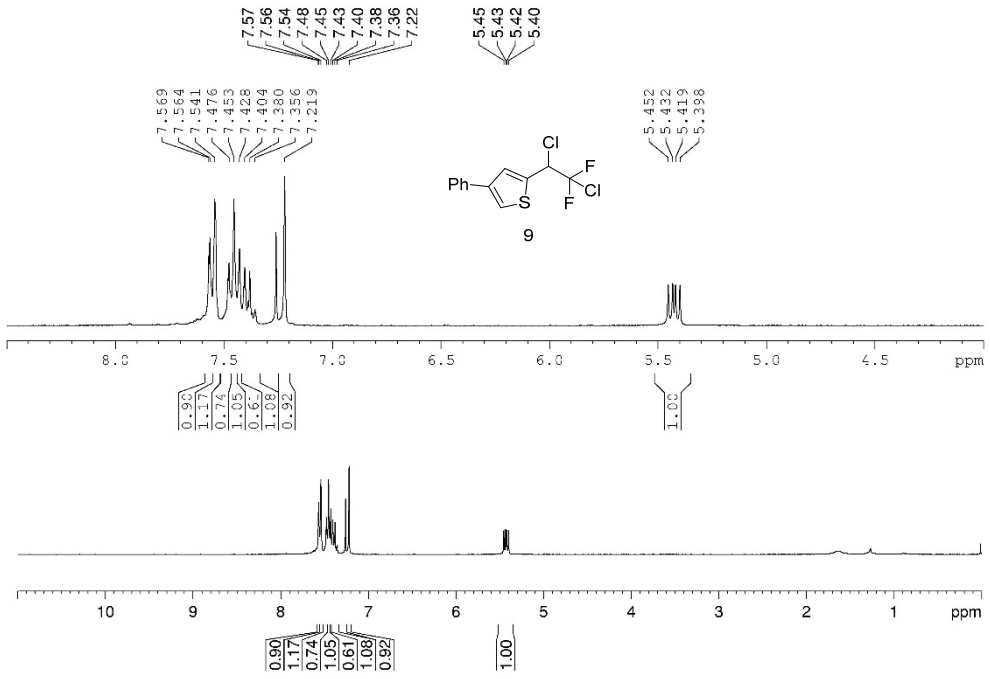
128.01
127.31
126.98
122.39
121.43
118.98
81.78
33.53
32.95
31.85
23.47
23.41
115.59
92.95
92.35
91.92
91.42
90.45
89.95
89.42
88.95
O
CF3
F3CO
5q
+
F
F
F
O
F3CO
5q'
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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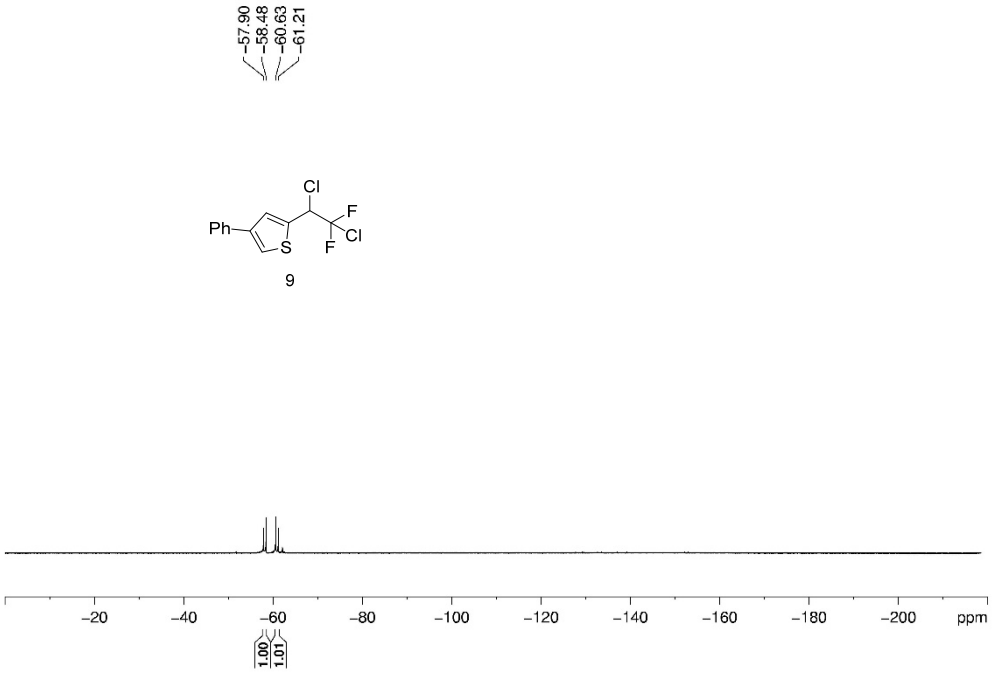
7.56
7.54
7.48
7.45
7.43
7.40
7.38
7.36
7.22
5.45
5.43
5.42
5.40
7.569
7.564
7.541
7.476
7.453
7.428
7.404
7.380
7.356
7.219
5.452
5.432
5.419
5.398
Cl
F
Cl
F
Ph
S
9
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 ppm
0.93
1.17
0.74
1.05
0.61
1.08
0.92
1.00
10 9 8 7 6 5 4 3 2 1 ppm
0.90
1.17
0.74
1.05
0.61
1.08
0.92
1.00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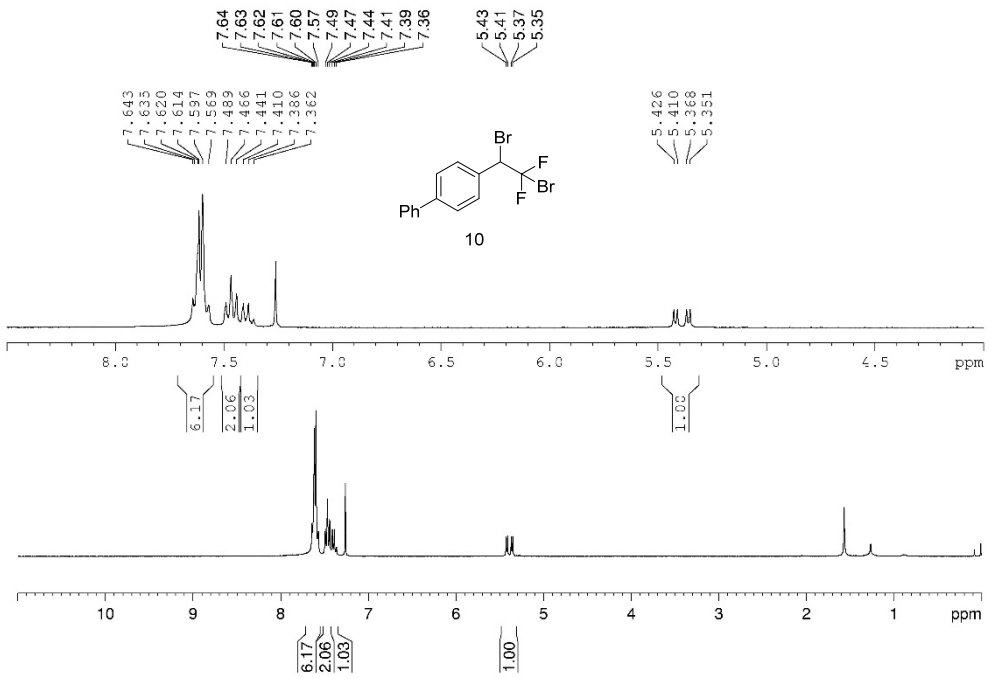
-58.48
-60.63
-61.21
Cl
F
Cl
F
Ph
S
9
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
1.00
1.01
138.28
133.43
131.84
131.13
128.75
128.60
128.26
126.52
122.60
60.82
60.41
60.01
Cl
F
Cl
F
Ph
S
9
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm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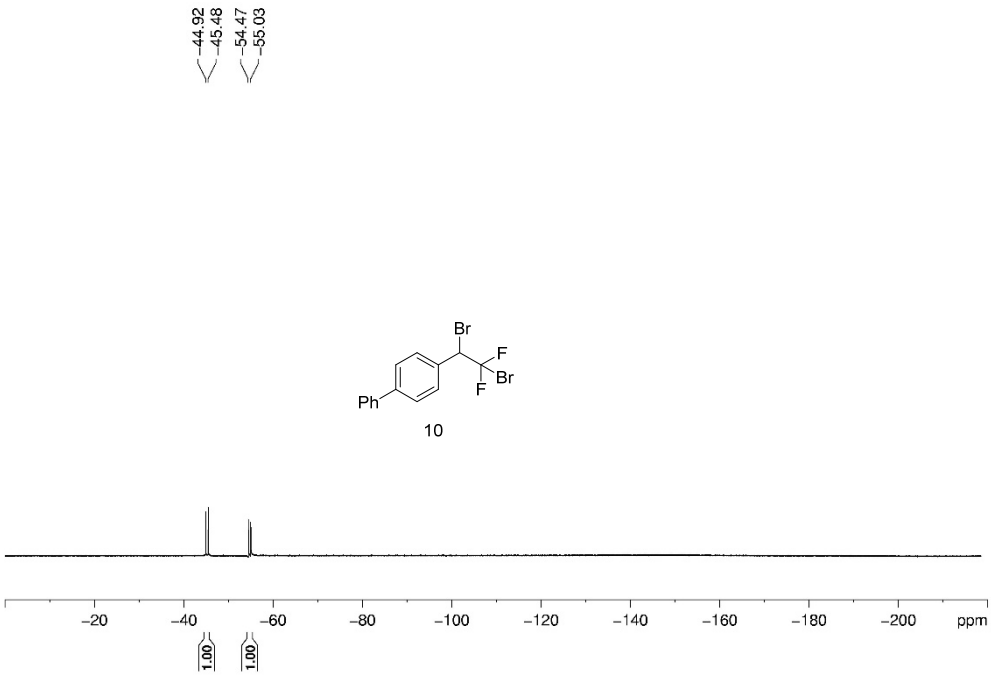
7.61
7.60
7.57
7.49
7.47
7.44
7.41
7.39
7.36
5.43
5.41
5.37
5.35
7.643
7.635
7.620
7.614
7.597
7.569
7.489
7.466
7.441
7.410
7.386
7.362
5.426
5.410
5.368
5.351
Br
F
Br
F
Ph
10
ppm
6.17
2.06
1.03
1.03
1.00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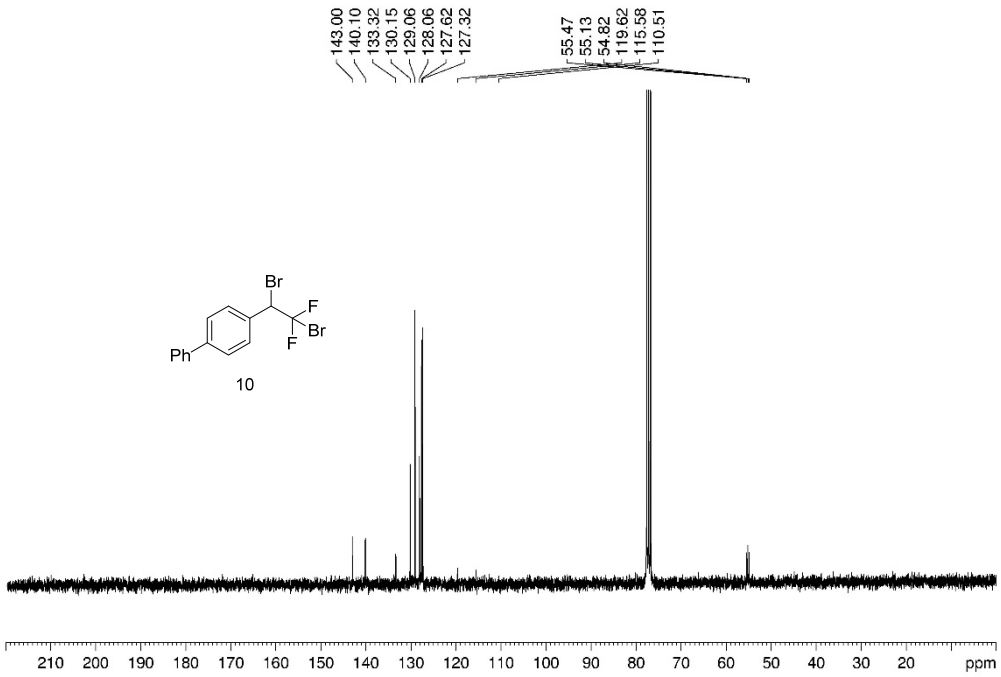
-45.48
-54.47
-55.03
Br
F
Br
F
Ph
10
ppm
1.00
1.00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140.10
133.32
130.15
129.06
128.06
127.62
127.32
55.47
55.13
54.82
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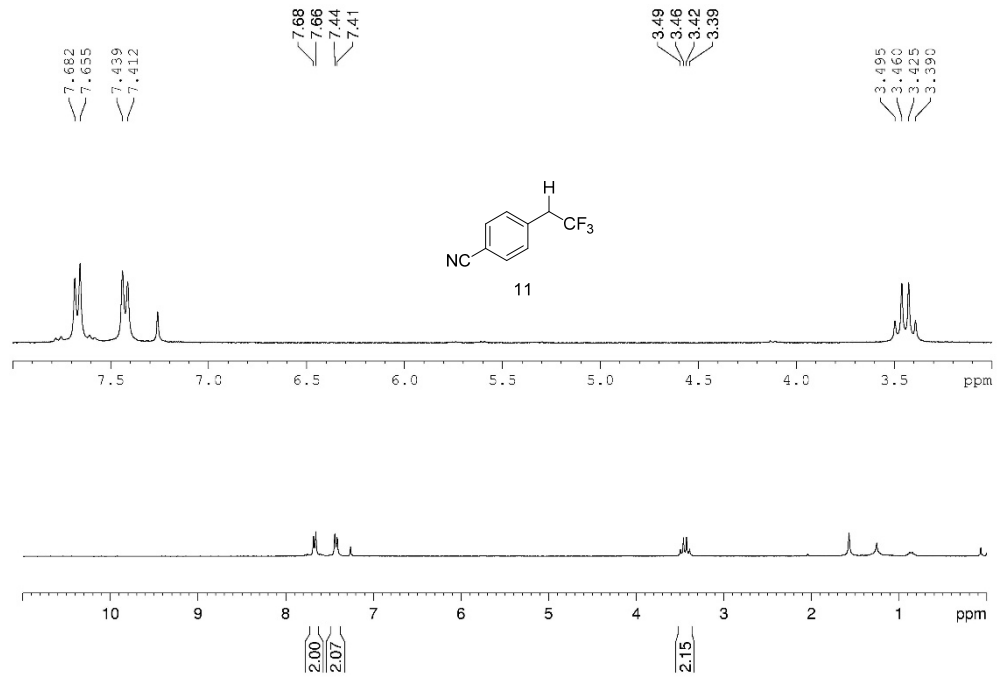
115.58
110.51
Br
F
Br
F
Ph
10
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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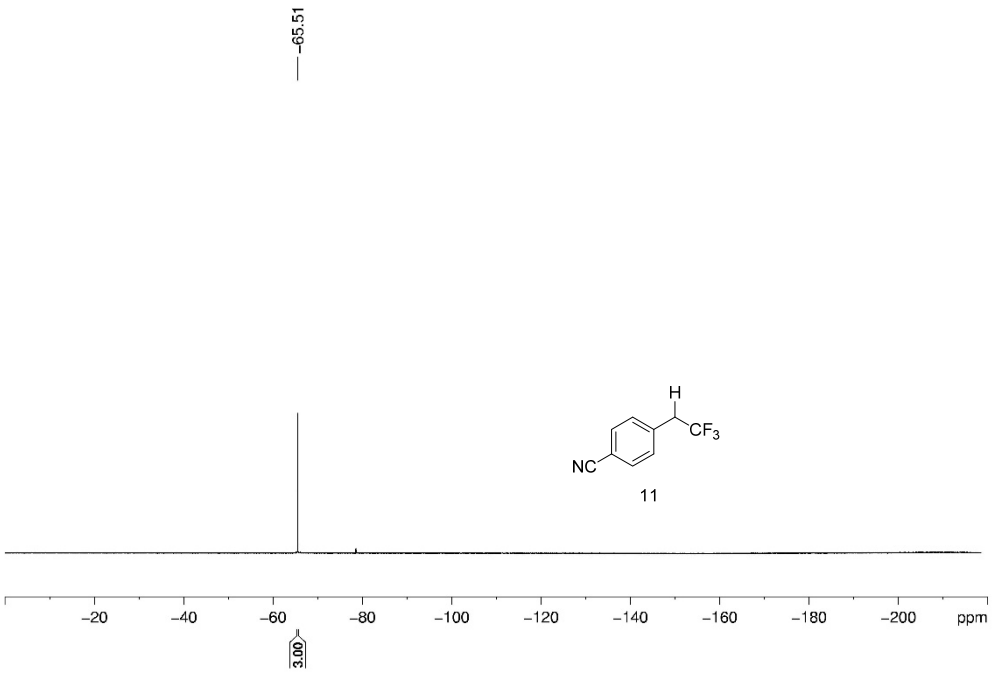
7.655
7.439
7.412
7.68
7.66
7.44
7.41
3.49
3.46
3.42
3.39
3.495
3.460
3.425
3.390
H
CF3
NC
11
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 ppm
10 9 8 7 6 5 4 3 2 1 ppm
2.00
2.07
2.15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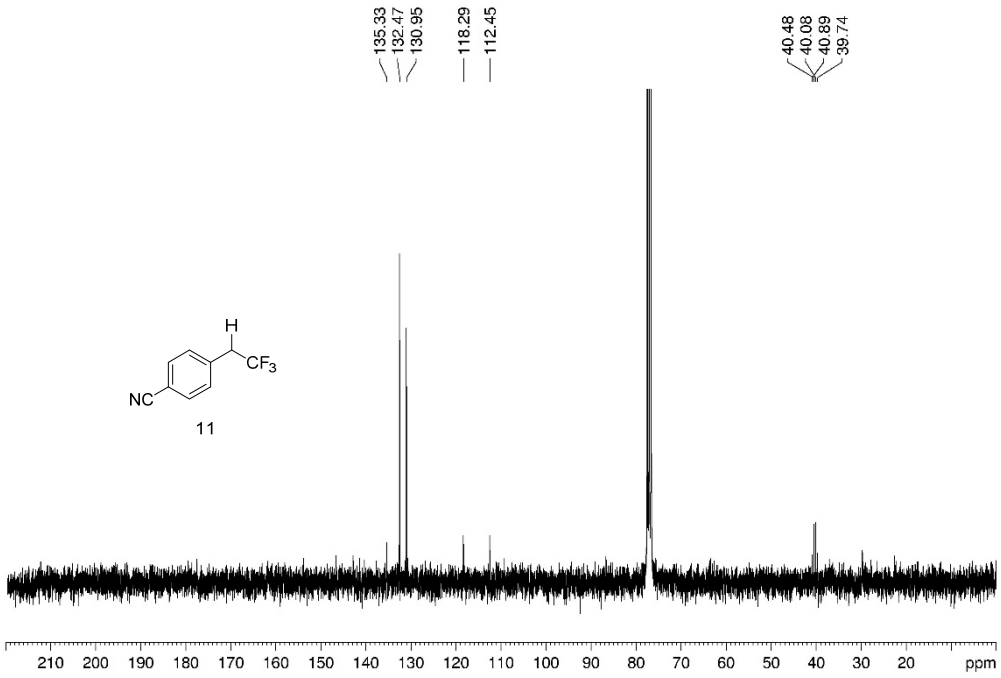
H
CF3
NC
11
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.00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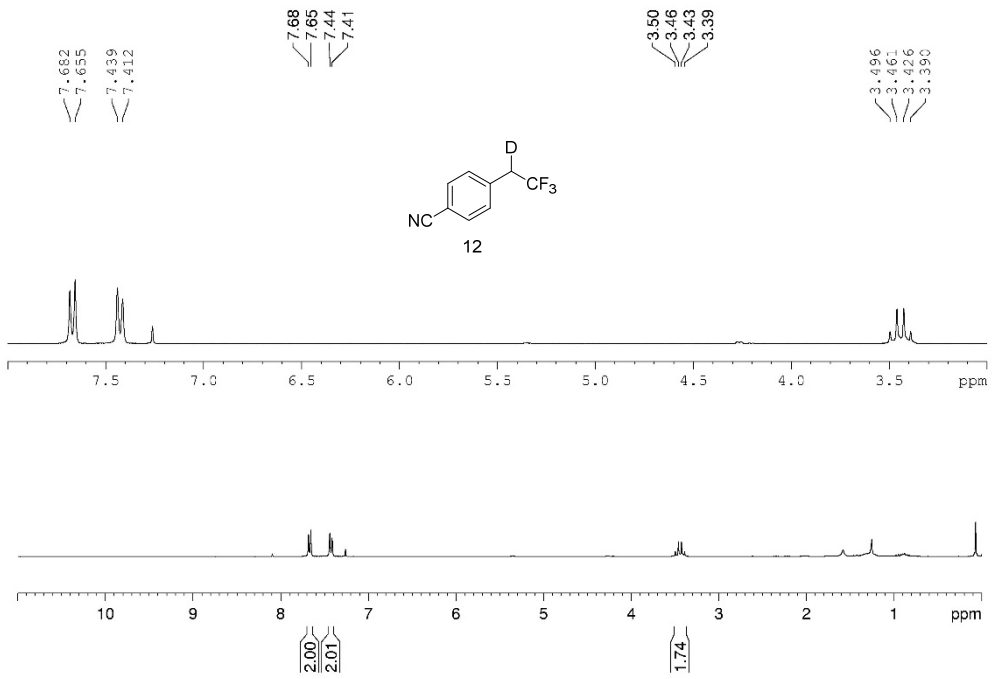
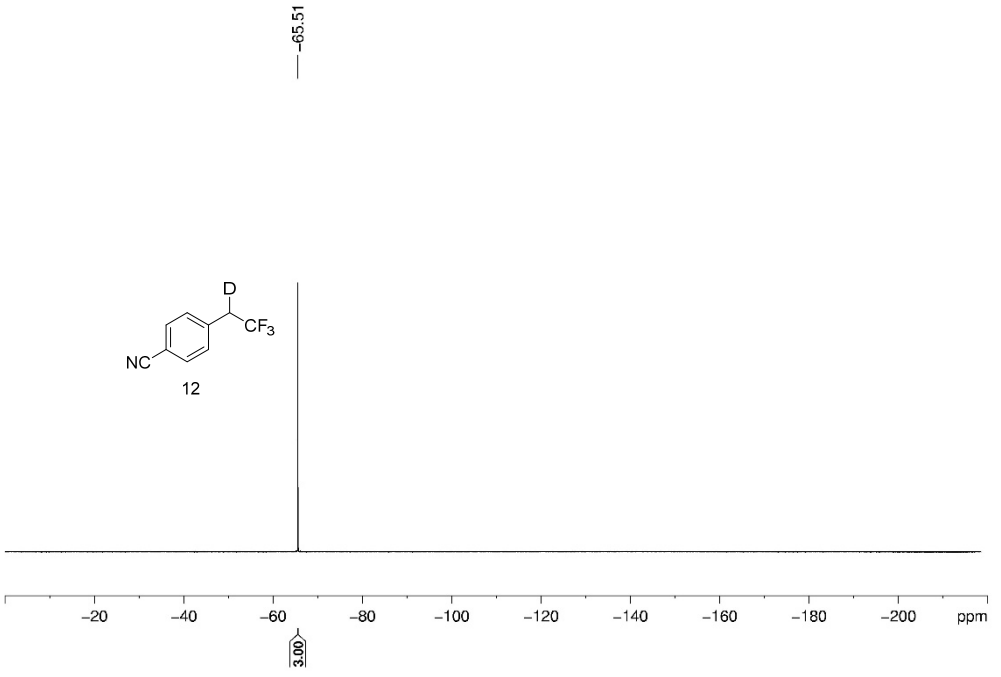
132.47
130.95
118.29
112.45
40.48
40.08
40.89
39.74
H
CF3
NC
11
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm


7.682
7.655
7.439
7.412
7.68
7.65
7.44
7.41
3.50
3.46
3.43
3.39
3.496
3.461
3.426
3.390
D
CF3
NC
12
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
ppm
10
9
8
7
6
5
4
3
2
1
ppm
2.00
2.01
1.74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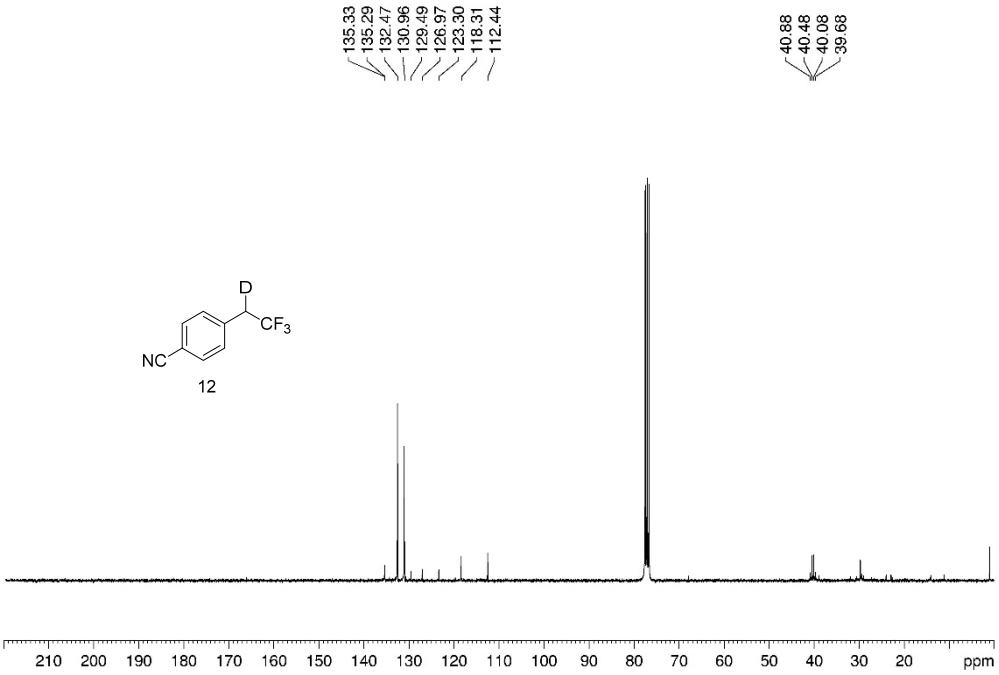
D
CF3
NC
12
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
ppm
3.00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132.47
130.96
129.49
126.97
123.30
118.31
112.44
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40.08
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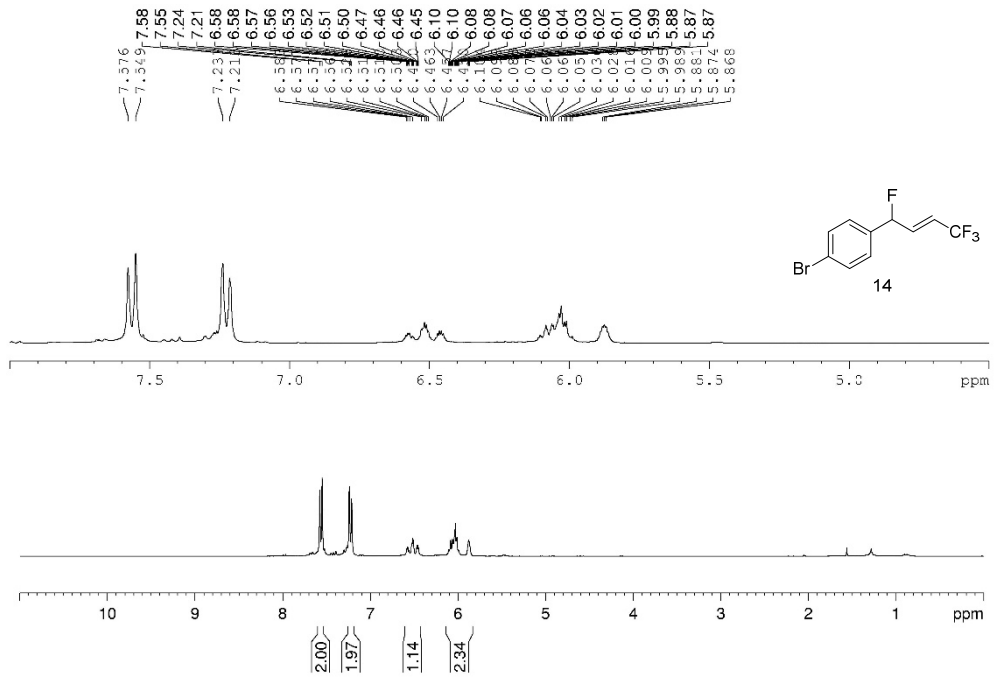
NC
12
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 ppm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7.21
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6.58
6.57
6.56
6.53
6.52
6.51
6.50
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6.46
6.46
6.45
6.10
6.08
6.07
6.06
6.06
6.04
6.03
6.02
6.01
6.00
5.99
5.88
5.87
5.87
F
CF3
Br
14
7.5 7.0 6.5 6.0 5.5 5.0 ppm

10 9 8 7 6 5 4 3 2 1 ppm
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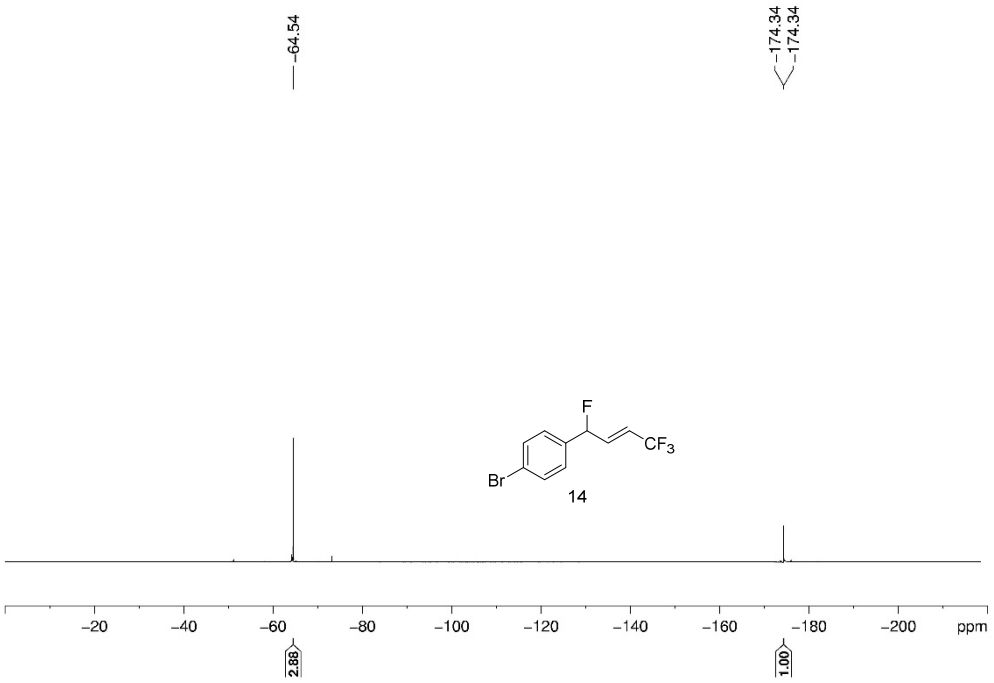
1.97
1.14
2.34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-174.34
F
CF3
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-60
-80
-100
-120
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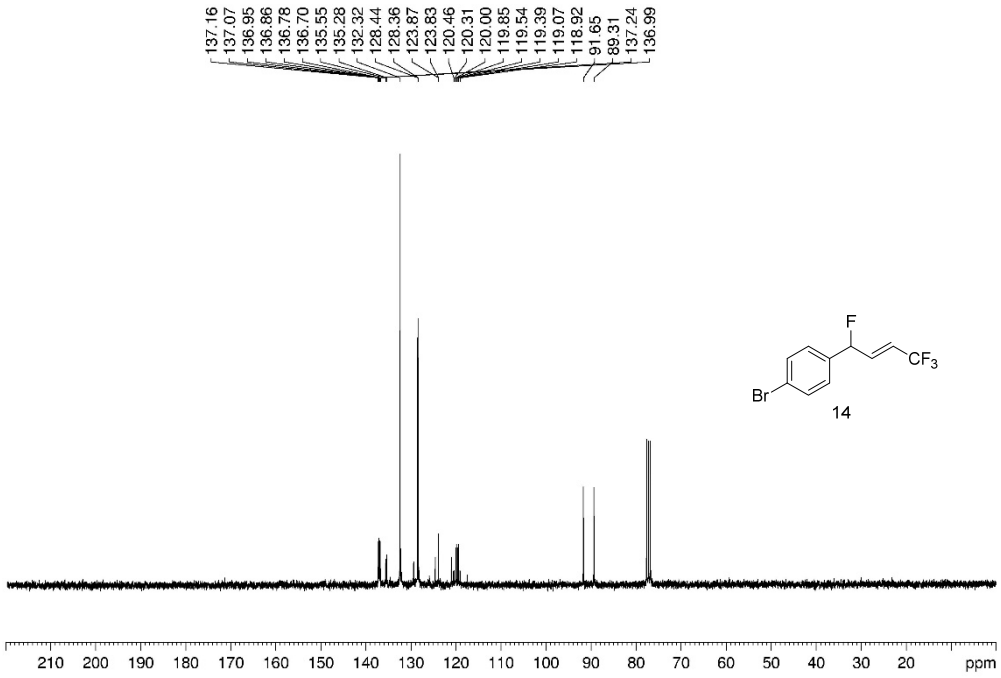
-160
-180
-200
ppm
2.88
1.00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136.70
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135.28
132.32
128.44
128.36
123.87
123.83
120.46
120.31
120.00
119.85
119.54
119.39
119.07
118.92
91.65
89.31
137.24
136.99
F
CF3
Br
14
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
ppm