Supporting Information

Electrochemical C-C Bond Cleavage of Cyclopropanes towards the Synthesis of 1,3-Difunctionalized Molecules

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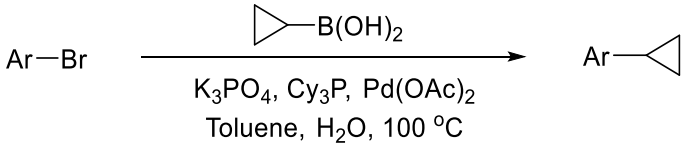
General information

Unless otherwise noted, materials were obtained from commercial suppliers and used without further purification. $PhCF_3$ was purchased from Aladdin. $Et_3N{\cdot}3HF$ (95%) was purchased from Accela ChemBio Co., Ltd. Phenylcyclopropane, 1-bromo-4-cyclopropylbenzene and 1-fluoronaphthalene (98%) were purchased from Bidepharm. Other Arylcyclopropanes were prepared according to literature report. Carbon cloth was purchased from CeTech Co., Ltd. Nickel foam was purchased from KUNSHAN JIAYISHENG ELECTRONICS CO.,LTD. Thin layer chromatography (TLC) employed glass 0.25 mm silica gel plates. Flash chromatography columns were packed with 200-300 mesh silica gel. GC yields were recorded with a Shimadzu GC-2014. GC-MS was recorded by Shimadzu GCMS-QP2010 SE. All new compounds were characterized by ^1H NMR, ^{13}C NMR, ^{19}F NMR and HRMS. The known compounds were characterized by ^1H NMR, ^{13}C NMR and ^{19}F NMR. ^1H and ^{13}C NMR data were recorded with ADVANCE III 400 MHz or JNM-ECZ400 400 MHz with tetramethylsilane as an internal standard. All chemical shifts (δ) were reported in ppm and coupling constants (*J*) in Hz. All chemical shifts were reported relative to tetramethylsilane (0 ppm for ^1H), and $CDCl_3$ (77.16 ppm for ^{13}C), respectively. High resolution mass spectra (HRMS) were measured with Orbitrap Velos Pro，Thermo Scientific or Waters Micromass GCT Premier or Thermo Fisher Scientific LTQ FT Ultra, accurate masses are reported for the molecular ion + proton ($[M+H]^+$), molecular ion + NH_4^+ ($[M+NH_4]^+$) or molecular ion + Na^+ ($[M+Na]^+$).

Experimental section

1) General procedure for synthesis of arylcyclopropanes

General procedure A: Suzuki coupling[1]



General procedure A: Aryl bromide (6 mmol, 1 equiv.), cyclopropylboronic acid (670 mg, 7.8 mmol, 1.3 equiv.), K_3PO_4 (4.46 g, 21.0 mmol, 3.5 equiv.), Cy_3P (168.2 mg, 0.6 mmol, 0.1 equiv.) and $Pd(OAc)_2$ (67.4 mg, 0.3 mmol, 0.05 equiv.) were added to a three-neck flask equipped with a magnetic stir bar, and the resultant mixture was degassed and filled with argon gas. Toluene (40 mL) and water (2 mL) were added. The resultant mixture was heated at 100 ℃ until aryl halide was consumed (more than 5 h, detected by GC-MS). The reaction was cooled to room temperature and diluted with water. The organic layer was separated and the aqueous layer was extracted with ethyl acetate, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The residue was purified by flash column chromatography on silica gel.

The following were prepared according to general procedure A: **S6**[2], **S8**[1], **S14**[3], **S15**[2], **S17**[4], **S18**[2], **S19**[2], **S21**[1], **S22**[5] and **S24**[1] were previously reported.

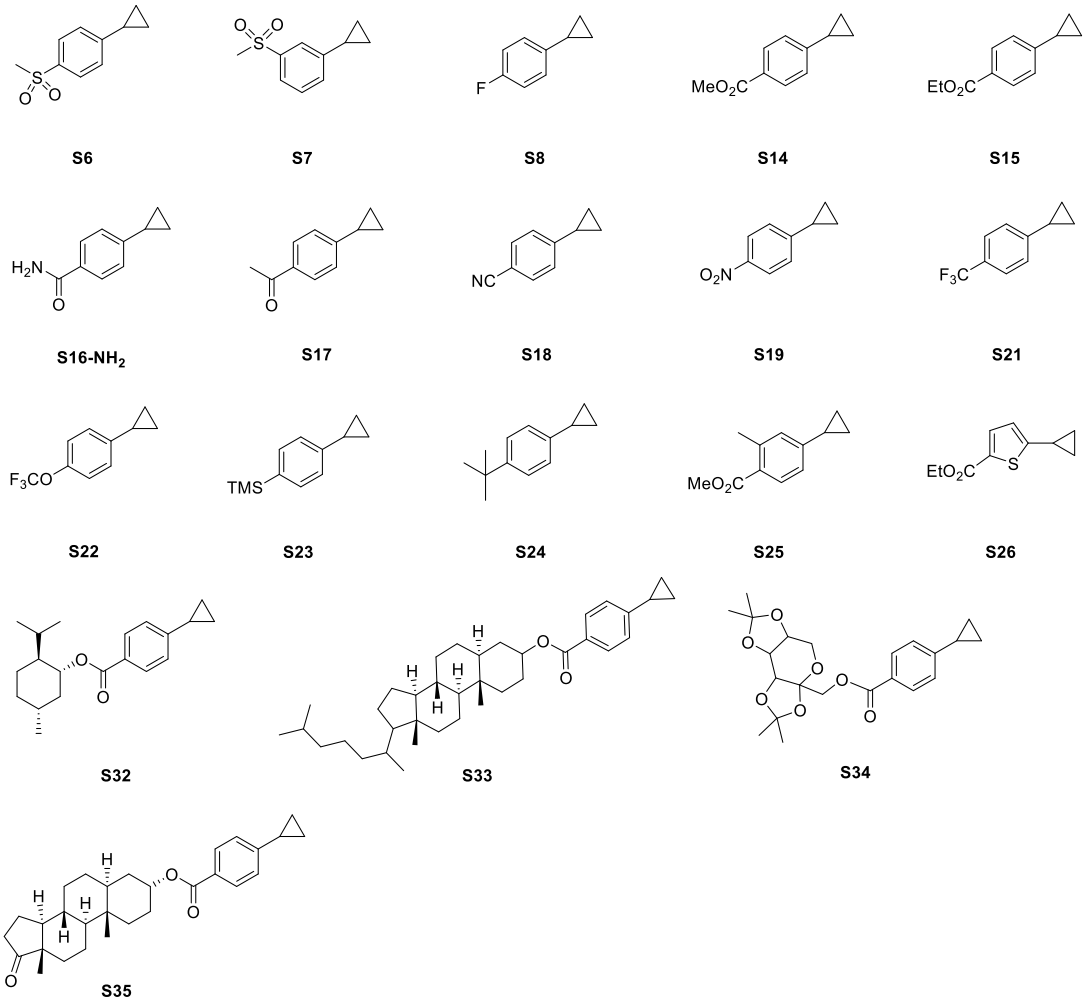
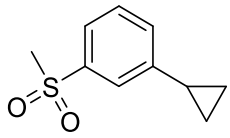
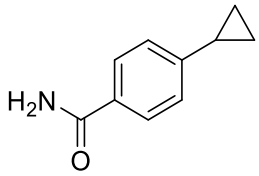


Figure S1

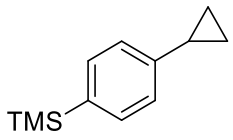
Characterization of unknown product:



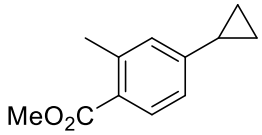
S7. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (ddd, *J* = 7.7, 1.7, 1.2 Hz, 1H), 7.63 (t, *J* = 1.8 Hz, 1H), 7.45 (t, *J* = 7.7 Hz, 1H), 7.37 – 7.30 (m, 1H), 3.05 (s, 3H), 1.99 (tt, *J* = 8.4, 5.1 Hz, 1H), 1.07 (ddd, *J* = 8.4, 6.5, 4.8 Hz, 2H), 0.77 (dt, *J* = 6.6, 4.9 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 146.23, 140.54, 131.05, 129.33, 124.44, 124.29, 44.60, 15.53, 10.00. HRMS (ESI) m/z calculated for $C_{10}H_{13}O_2S$ $(M+H)^+$:197.06308, found: 197.06302.



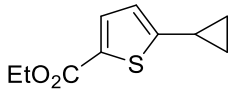
S16-NH$_2$. ^{1}H NMR (400 MHz, DMSO) δ 7.76 (d, *J* = 8.3 Hz, 2H), 7.13 (d, *J* = 8.3 Hz, 2H), 1.96 (tt, *J* = 8.4, 5.0 Hz, 1H), 1.06 – 0.95 (m, 2H), 0.78 – 0.67 (m, 2H). ^{13}C NMR (101 MHz, DMSO) δ 167.84, 147.64, 131.30, 127.63, 125.03, 15.23, 10.23. HRMS (ESI) m/z calculated for $C_{10}H_{12}NO$ $(M+H)^+$: 162.09134, found: 162.09075.



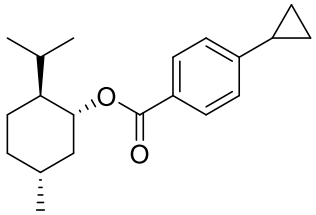
S23. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.0 Hz, 2H), 7.06 (d, *J* = 7.9 Hz, 2H), 1.94 – 1.81 (m, 1H), 0.99 – 0.92 (m, 2H), 0.74 – 0.68 (m, 2H), 0.24 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 144.94, 136.96, 133.49, 125.18, 15.49, 9.53, -0.91. HRMS (EI+) m/z calculated for $C_{12}H_{18}Si$ (M+): 190.1178, found: 190.1185.



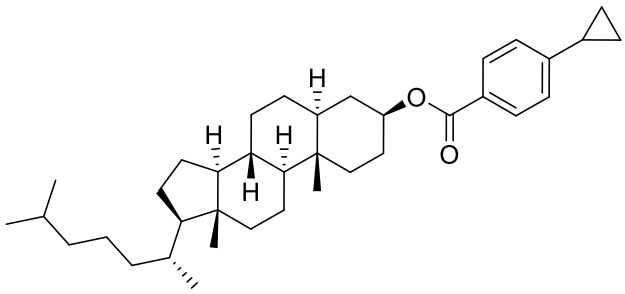
S25. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (d, *J* = 8.1 Hz, 1H), 6.89 (dd, *J* = 11.6, 3.5 Hz, 2H), 3.86 (s, 3H), 2.57 (s, 3H), 1.87 (tt, *J* = 8.4, 5.0 Hz, 1H), 1.04 – 0.98 (m, 2H), 0.77 – 0.71 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.00, 148.97, 140.57, 131.01, 128.98, 126.42, 122.64, 51.73, 22.08, 15.52, 10.13. HRMS (ESI) m/z calculated for $C_{12}H_{15}O_2$ $(M+H)^+$: 191.10666, found: 191.10670.



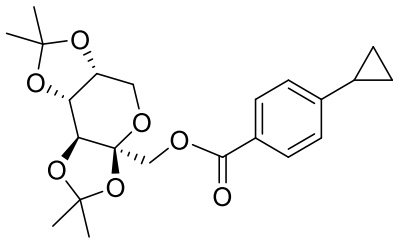
S26. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (d, *J* = 3.8 Hz, 1H), 6.73 (dd, *J* = 3.8, 0.5 Hz, 1H), 4.31 (q, *J* = 7.1 Hz, 2H), 2.10 (dq, *J* = 8.4, 5.0 Hz, 1H), 1.35 (t, *J* = 7.1 Hz, 3H), 1.07 (ddd, *J* = 8.3, 6.6, 4.6 Hz, 2H), 0.78 (dt, *J* = 6.7, 4.7 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.21, 157.01, 133.56, 129.58, 123.30, 60.86, 14.38, 11.93, 11.02. HRMS (ESI) m/z calculated for $C_{10}H_{13}O_2S$ $(M+H)^+$: 197.06308, found: 197.06308.



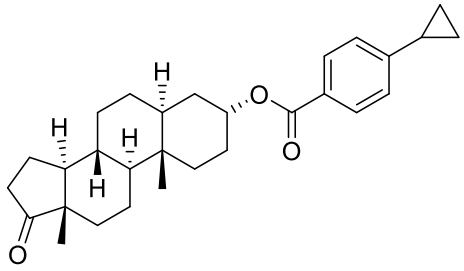
S32. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 – 7.87 (m, 2H), 7.15 – 7.04 (m, 2H), 4.91 (td, *J* = 10.9, 4.4 Hz, 1H), 2.16 – 2.07 (m, 1H), 2.00 – 1.89 (m, 2H), 1.77 – 1.67 (m, 2H), 1.60 – 1.48 (m, 2H), 1.16 – 1.01 (m, 4H), 0.96 – 0.85 (m, 7H), 0.80 – 0.73 (m, 5H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.23, 149.85, 129.74, 128.03, 125.38, 74.64, 47.41, 41.12, 34.47, 31.57, 26.62, 23.77, 22.20, 20.91, 16.67, 15.80, 10.38. HRMS (ESI) m/z calculated for $C_{20}H_{28}O_2Na$ $(M+Na)^+$: 323.19815, found: 323.19800.



S33. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.3 Hz, 2H), 7.08 (d, *J* = 8.3 Hz, 2H), 5.05 – 4.77 (m, 1H), 2.01 – 1.88 (m, 3H), 1.87 – 0.80 (m, 42H), 0.78 – 0.73 (m, 2H), 0.71 – 0.61 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.30, 149.78, 129.70, 128.12, 125.32, 74.23, 56.55, 56.38, 54.35, 44.83, 42.72, 40.11, 39.65, 36.94, 36.30, 35.95, 35.65, 35.62, 34.28, 32.15, 28.78, 28.40, 28.16, 27.74, 24.36, 23.98, 22.99, 22.72, 21.36, 18.81, 15.81, 12.45, 12.22, 10.40. HRMS (DART POSITIVE) m/z calculated for $C_{34}H_{57}O_2$ $(M+H)^+$: 533.4353, found: 533.4352.

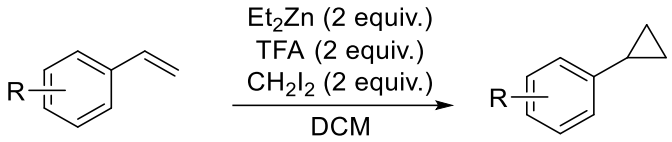


S34. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.4 Hz, 2H), 7.09 (d, *J* = 8.4 Hz, 2H), 4.69 – 4.63 (m, 2H), 4.47 (d, *J* = 2.6 Hz, 1H), 4.34 – 4.23 (m, 2H), 4.01 – 3.74 (m, 2H), 1.98 – 1.89 (m, 1H), 1.55 (s, 3H), 1.47 (s, 3H), 1.37 (s, 3H), 1.35 (s, 3H), 1.12 – 1.01 (m, 2H), 0.82 – 0.72 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.07, 150.38, 129.95, 126.98, 125.43, 109.29, 108.95, 101.84, 70.94, 70.57, 70.23, 65.08, 61.45, 26.68, 26.02, 25.69, 24.15, 15.85, 10.53. HRMS (ESI) m/z calculated for $C_{22}H_{29}O_7$ $(M+H)^+$: 405.19078, found: 405.18947.



S35. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 – 7.87 (m, 2H), 7.09 (d, *J* = 8.3 Hz, 2H), 4.98 – 4.86 (m, 1H), 2.48 – 2.40 (m, 1H), 2.14 – 2.03 (m, 1H), 1.97 – 1.90 (m, 3H), 1.85 – 1.72 (m, 4H), 1.71 – 1.44 (m, 5H), 1.41 – 1.21 (m, 6H), 1.17 – 0.96 (m, 4H), 0.90 (s, 3H), 0.87 (s, 3H), 0.78 – 0.71 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 221.55, 166.29, 149.88, 129.70, 128.01, 125.34, 73.96, 54.43, 51.48, 47.94, 44.83, 36.89, 36.01, 35.84, 35.17, 34.19, 31.65, 30.96, 28.43, 27.67, 21.93, 20.61, 15.81, 13.96, 12.43, 10.42. HRMS (ESI) m/z calculated for $C_{29}H_{39}O_3$ $(M+H)^+$: 435.28937, found: 435.28876.

General procedure B: Simmons-Smith cyclopropanation[6]



General procedure B: To 15 mL distilled DCM was added 10.0 mL Et_2Zn (10.0 mmol, 2 equiv., 1.0 M in hexanes) under N_2 atmosphere. The solution was cooled in an ice bath and a solution of trifluoroacetic acid (0.8 mL, 10.0 mmol, 2 equiv.) in 5 mL DCM was then dripped very slowly into the reaction mixture via syringe. Upon stirring for 20 min, a solution of CH_2I_2 (0.8 mL, 10.0 mmol, 2 equiv.) in 5 mL DCM was added. After an additional 20 min of stirring, a solution of the respective styrene derivative (5.0 mmol, 1 equiv.) in 5 mL DCM was added, and the ice bath was removed. After starting styrene derivative was consumed (detected by GC-MS, 12 h - 3 d), the reaction mixture was quenched with 1M HCl (10 mL) and the phases were separated. The aqueous layer was extracted with DCM. The combined organic layers were washed with saturated $NaHCO_3$, and brine and then dried with Na_2SO_4, filtered and concentrated. The residue was purified by column chromatography to give the title compound.

The following were prepared according to general procedure B, **S9**[1], **S11**[1], **S12**[6], **S13**[7], **S27**[8], **S28**[8], **trans-S30**[9] and **S31**[10] were previously reported.

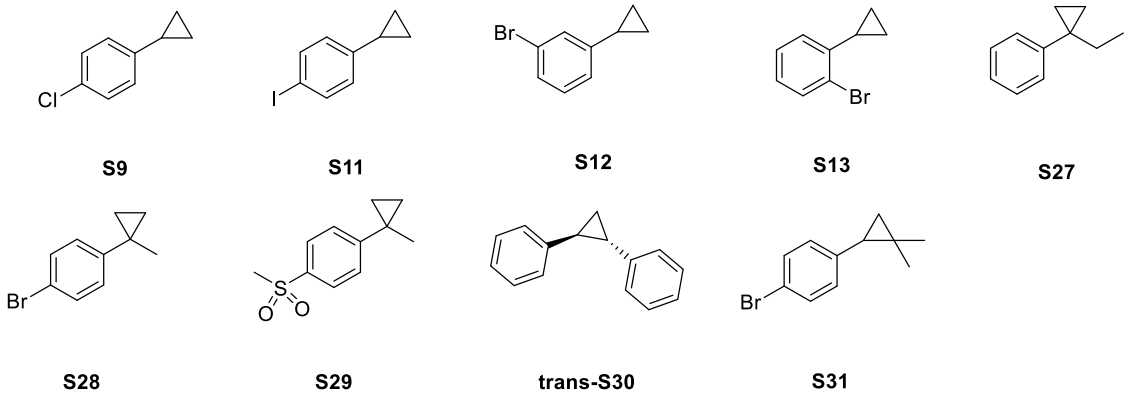
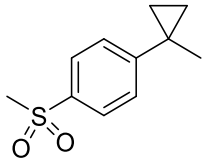
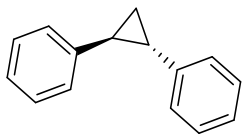


Figure S2

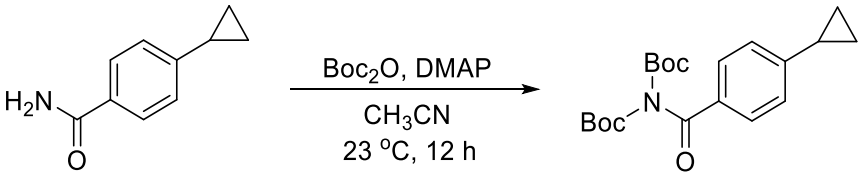


S29. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 – 7.79 (m, 2H), 7.44 – 7.34 (m, 2H), 3.04 (s, 3H), 1.45 (s, 3H), 0.99 – 0.79 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 153.99, 137.38, 127.43, 127.24, 44.74, 24.90, 19.77, 17.10. HRMS (ESI) m/z calcd for $C_{11}H_{15}O_2S$ $(M+H)^+$: 211.07873, found: 211.07854.

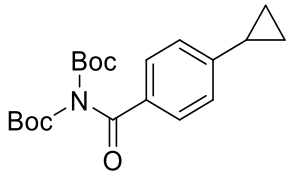


Trans-S30. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 – 7.26 (m, 4H), 7.22 – 7.11 (m, 6H), 2.21 – 2.12 (m, 2H), 1.47 – 1.43 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 142.61, 128.50, 125.85, 28.18, 18.38. The observed spectral data are in agreement with the reported literature.

2) General procedure for synthesis of protected amide[11]



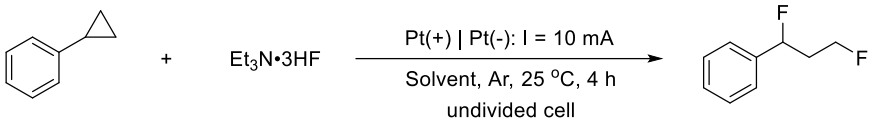
To a flask containing amide (4.6 mmol) was added DMAP (56.7mg, 0.46 mmol, 0.1 equiv.), followed by acetonitrile (23 mL, 0.2 M). Boc_2O (2.03 g, 9.28 mmol, 2.0 equiv.) was added in one portion and the reaction vessel was flushed with N_2. The reaction mixture was allowed to stir at 23 ℃ for 12 h. The mixture was washed with 1.0 M HCl (5 mL) and brine (5 mL). After drying over Na_2SO_4, filtered and the organics were concentrated under reduced pressure.



S16. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 – 7.70 (m, 2H), 7.12 (d, *J* = 8.4 Hz, 2H), 1.96 (ddd, *J* = 13.4, 8.4, 5.0 Hz, 1H), 1.38 (s, 18H), 1.12 – 1.06 (m, 2H), 0.80 (dt, *J* = 6.7, 4.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.04, 151.38, 149.94, 131.14, 129.63, 125.72, 84.19, 27.78, 16.00, 10.84. HRMS (EI+) m/z calculated for $C_{20}H_{27}NO_5Na$ ($M+Na^+$): 384.17814, found: 384.17697.

3) Optimization of Reaction Parameters for 1,3-difluorination

Evaluation of solvents (Table S1):

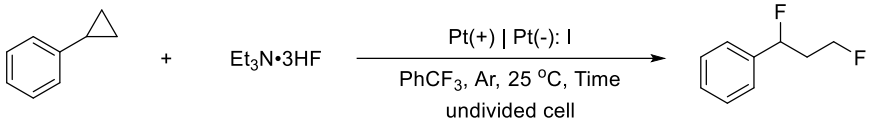


1 **2**

Entry	Solvent	Yield [%][a]
1	CH_3CN	11 %
2	DCE	55 %
3	CH_2Cl_2	27 %
4	Acetone	3 %
5	CH_3NO_2	1 %
6	EtOAc	11 %
7	THF	14 %
8	DME	23 %
9	TBME	9 %
10	PhMe	0 %
11	$PhCF_3$	72 %

Reaction conditions: undivided cell, Pt anode, Pt cathode, **1** (0.5 mmol), Et_3N•3HF (1.2 mL), solvent (4.8 mL), 10 mA. [a] GC Yield using biphenyl as internal standard.

Evaluation of current (Table S2):

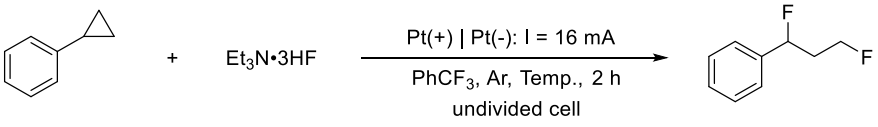


1 **2**

Entry	I, Time	Yield [%][a]
1	5 mA, 8 h	71 %
2	10 mA, 4 h	72 %
3	16 mA, 2 h	77 %
4	20 mA, 96 min	73 %

Reaction conditions: undivided cell, Pt anode, Pt cathode, **1** (0.5 mmol), Et_3N·3HF (1.2 mL), $PhCF_3$ (4.8 mL). [a] GC Yield using biphenyl as internal standard.

Evaluation of reaction temperature (Table S3):

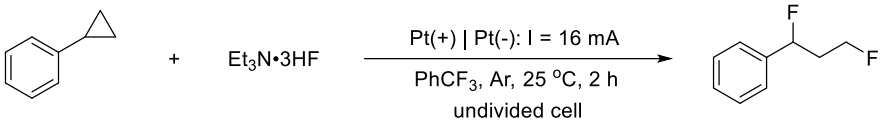


1 **2**

Entry	Temp.	Yield [%][a]
1	0 °C	49 %
2	25 °C	77 %
3	60 °C	55 %

Reaction conditions: undivided cell, Pt anode, Pt cathode, **1** (0.5 mmol), Et_3N•3HF (1.2 mL), $PhCF_3$ (4.8 mL). [a] GC Yield using biphenyl as internal standard.

Evaluation of electrode materials (Table S4):

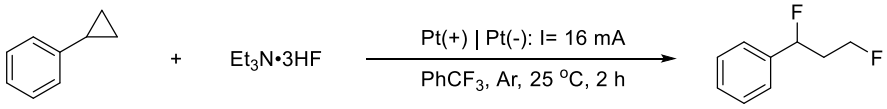


1 **2**

Entry	Electrode	Yield [%][a]
1	Pt(+) | Pt(-)	77 %
2	C cloth(+) | Pt(-)	69 %
3	C rod(+) | Pt(-)	63 %
4	Pt(+) | Ni plate(-)	71 %
5	Pt(+) | Ni foam(-)	74 %

Reaction conditions: undivided cell, Pt anode, Pt cathode, **1** (0.5 mmol), Et_3N•3HF (1.2 mL), $PhCF_3$ (4.8 mL). [a] GC Yield using biphenyl as internal standard.

Evaluation of amount of Et_3N·3HF and electricity (Table S5):



1 **2**

Entry	Variation from standard conditions	Yield [%][a]
9	0.5 mL Et_3N•3HF, 5.5 mL $PhCF_3$	64%
10	5 mL Et_3N•3HF	66%
11	no electric current	N.R.

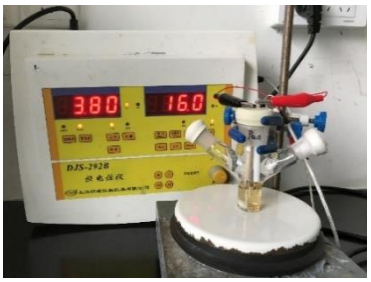
Reaction conditions: undivided cell, Pt anode, Pt cathode, **1** (0.5 mmol), Et_3N•3HF (1.2 mL), $PhCF_3$ (4.8 mL). [a] GC Yield using biphenyl as internal standard.

4) Procedures and analytical data of 1,3-difluorination compounds

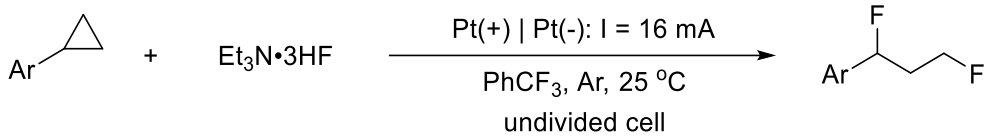
Graphical guide for the set-up: As experiment set-up, a platinum plate electrode anode (15 mm×15 mm×0.3 mm), a platinum plate electrode cathode (15 mm×15 mm×0.3 mm), rubber plugs, an undivided three-necked bottle and a dual display potentiostat (HJS-292B) (made in China) were used.

A) Platinum plate anode and cathode

B) Assembly of electrochemical cell

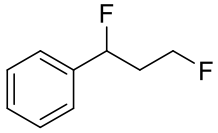


C) Current control electrosis

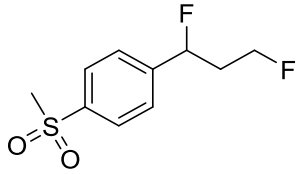


General procedure for the electrolysis: An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped platinum plate (15 mm×15mm×0.3 mm) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode and then charged with argon gas by glove box. Arylcyclopropane (0.1 mmol, 0.25 mmol or 0.5 mmol), $Et_3N{\cdot}3HF$ (1.2 mL) and $PhCF_3$ (4.8 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 16 mA under room temperature (monitored by TLC). The reaction was diluted with water. The organic layer was extracted with CH_2Cl_2, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.

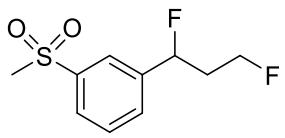
Analytical data of compounds:



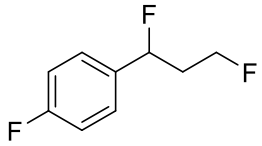
(1,3-Difluoropropyl)benzene (2). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **3** as a colorless oil. NMR Yield = 75% using 1-fluoronaphthalene as internal standard, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.32 (m, 5H), 5.64 (ddd, *J* = 47.8, 9.1, 4.1 Hz, 1H), 4.78 – 4.41 (m, 2H), 2.40 – 2.08 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.54 (d, *J* = 19.5 Hz), 128.72, 128.69 (d, *J* = 2.0 Hz), 125.59 (d, *J* = 6.7 Hz), 90.70 (dd, *J* = 170.7, 4.8 Hz), 80.07 (dd, *J* = 165.0, 4.7 Hz), 38.25 (dd, *J* = 24.1, 19.7 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -178.55, -222.47. HRMS (EI+) m/z calculated for $C_9H_{10}F_2$ (M+): 156.0751, found: 156.0752.



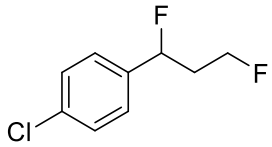
1-(1,3-Difluoropropyl)-4-(methylsulfonyl)benzene (6).[2] 0.5 mmol scale, 200 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 3:1) to give **6** as a yellow solid**.** Yield = 75%, electricity = 4.0 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.1 Hz, 2H), 7.57 (d, *J* = 8.6 Hz, 2H), 5.84 – 5.68 (m, 1H), 4.81 – 4.48 (m, 2H), 3.08 (s, 3H), 2.34 – 2.17 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 145.70 (d, *J* = 19.9 Hz), 140.52 (d, *J* = 1.4 Hz), 127.82, 126.15 (d, *J* = 7.6 Hz), 89.61 (dd, *J* = 173.9, 4.4 Hz), 79.50 (dd, *J* = 165.8, 4.4 Hz), 44.45, 38.17 (dd, *J* = 23.3, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -183.72, -222.41.



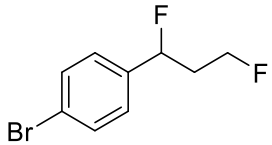
1-(1,3-difluoropropyl)-3-(methylsulfonyl)benzene (7). 0.5 mmol scale, 200 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 3:1) to give **7** as a yellow oil. Yield = 75%, electricity = 4.0 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.90 (m, 2H), 7.69 – 7.60 (m, 2H), 5.86 – 5.66 (m, 1H), 4.86 – 4.45 (m, 2H), 3.09 (s, 3H), 2.38 – 2.17 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.49 (d, *J* = 20.4 Hz), 141.19, 130.68 (d, *J* = 6.9 Hz), 129.92, 127.48 (d, *J* = 1.4 Hz), 124.28 (d, *J* = 7.6 Hz), 89.67 (dd, *J* = 173.6, 4.4 Hz), 79.56 (dd, *J* = 165.9, 4.4 Hz), 44.49, 38.14 (dd, *J* = 23.5, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -181.56, -222.41. HRMS (ESI) m/z calculated for $C_{10}H_{13}F_2O_2S$ $(M+H)^+$:235.05988, found: 235.05975.



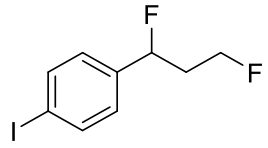
1-(1,3-Difluoropropyl)-4-fluorobenzene (8). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **8** as a colorless oil. Yield = 52%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 – 7.30 (m, 2H), 7.17 – 7.03 (m, 2H), 5.63 (ddd, *J* = 47.6, 9.1, 4.1 Hz, 1H), 4.82 – 4.41 (m, 2H), 2.41 – 2.07 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.91 (dd, *J* = 247.2, 2.1 Hz), 135.34 (dd, *J* = 20.0, 3.2 Hz), 127.58 (dd, *J* = 8.2, 6.5 Hz), 115.75 (d, *J* = 21.7 Hz), 90.16 (dd, *J* = 170.8, 4.6 Hz), 80.00 (dd, *J* = 165.2, 4.7 Hz), 38.25 (dd, *J* = 24.5, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -113.17 (d, *J* = 3.3 Hz), -176.45 (d, *J* = 3.2 Hz), -222.61. HRMS (EI+) m/z calculated for $C_9H_9F_3$ (M+): 174.0656, found: 174.0659.



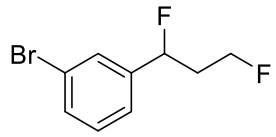
1-chloro-4-(1,3-difluoropropyl)benzene (9). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **9** as a pale yellow oil**.** Yield = 66%, electricity = 2.4 F mol^{-1}. NMR (400 MHz, $CDCl_3$) δ 7.36 (d, *J* = 8.3 Hz, 2H), 7.28 (d, *J* = 8.3 Hz, 2H), 5.62 (ddd, *J* = 47.6, 9.0, 4.1 Hz, 1H), 4.78 – 4.41 (m, 2H), 2.38 – 2.05 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.05 (d, *J* = 19.9 Hz), 134.51 (d, *J* = 2.3 Hz), 128.95, 127.00 (d, *J* = 6.8 Hz), 90.03 (dd, *J* = 171.6, 4.7 Hz), 79.87 (dd, *J* = 165.4, 4.7 Hz), 38.21 (dd, *J* = 24.1, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -178.96, -222.52. HRMS (EI+) m/z calculated for $C_9H_9ClF_2$ (M+): 190.0361, found: 190.0368.



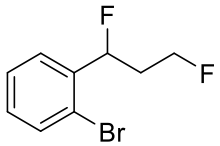
1-Bromo-4-(1,3-difluoropropyl)benzene (10). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **10** as a colorless oil. Yield = 67%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, *J* = 8.0 Hz, 2H), 7.22 (d, *J* = 8.2 Hz, 2H), 5.60 (ddd, *J* = 47.6, 9.0, 4.1 Hz, 1H), 4.78 – 4.41 (m, 2H), 2.37 – 2.05 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 138.57 (d, *J* = 20.0 Hz), 131.90, 127.27 (d, *J* = 6.8 Hz), 122.63 (d, *J* = 2.4 Hz), 90.05 (dd, *J* = 171.8, 4.6 Hz), 79.83 (dd, *J* = 165.5, 4.6 Hz), 38.17 (dd, *J* = 24.0, 19.7 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -179.45, -222.49. HRMS (EI+) m/z calculated for $C_9H_9BrF_2$ (M+): 233.9856, found: 233.9860.



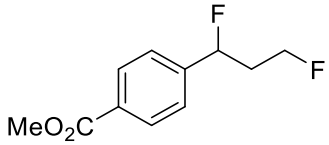
1-(1,3-Difluoropropyl)-4-iodobenzene (11). 0.5 mmol, 140 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **11** as a colorless oil. Yield = 52%, electricity = 2.8 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 7.8 Hz, 2H), 7.09 (d, *J* = 8.1 Hz, 2H), 5.70 – 5.48 (m, 1H), 4.79 – 4.40 (m, 2H), 2.36 – 2.05 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.22 (d, *J* = 19.9 Hz), 137.84, 127.41 (d, *J* = 6.8 Hz), 94.32 (d, *J* = 2.5 Hz), 90.09 (dd, *J* = 171.9, 4.6 Hz), 79.82 (dd, *J* = 165.5, 4.6 Hz), 38.15 (dd, *J* = 23.9, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -180.02, -222.44. HRMS (EI+) m/z calculated for $C_9H_9F_2I$ (M+): 281.9717, found: 281.9723.



1-bromo-3-(1,3-difluoropropyl)benzene (12). 0.5 mmol scale, add 0.5 mL DCE, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **12** as a colorless oil. Yield = 63%, electricity = 2.4 F·mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.46 (m, 2H), 7.36 – 7.27 (m, 2H), 5.65 (ddd, *J* = 47.7, 8.8, 4.3 Hz, 1H), 4.83 – 4.47 (m, 2H), 2.42 – 2.10 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.83 (d, *J* = 19.9 Hz), 131.73 (d, *J* = 1.7 Hz), 130.36, 128.60 (d, *J* = 7.5 Hz), 124.13 (d, *J* = 6.9 Hz), 122.84, 89.80 (dd, *J* = 172.8, 4.6 Hz), 79.79 (dd, *J* = 165.6, 4.6 Hz), 38.24 (dd, *J* = 23.8, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -180.45, -222.52. HRMS (EI+) m/z calculated for $C_9H_9BrF_2$ (M+): 233.9850, found: 233.9853.

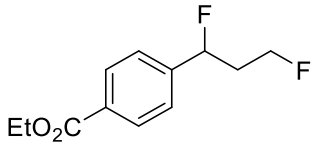


1-Bromo-2-(1,3-difluoropropyl)benzene (13). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **13** as a colorless oil. Yield = 52%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 – 7.45 (m, 2H), 7.39 – 7.35 (m, 1H), 7.21 – 7.17 (m, 1H), 5.95 (ddd, *J* = 47.1, 9.5, 2.7 Hz, 1H), 4.85 – 4.48 (m, 2H), 2.51 – 1.97 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.17 (d, *J* = 21.2 Hz), 132.91, 129.87 (d, *J* = 1.4 Hz), 127.95, 126.74 (d, *J* = 10.3 Hz), 120.61 (d, *J* = 5.9 Hz), 89.83 (dd, *J* = 173.1, 5.2 Hz), 79.97 (dd, *J* = 166.1, 2.9 Hz), 37.08 (dd, *J* = 23.6, 20.0 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -185.12, -222.30 (d, *J* = 1.1 Hz). HRMS (EI+) m/z calculated for $C_9H_9BrF_2$ (M+): 233.9856, found: 233.9858.

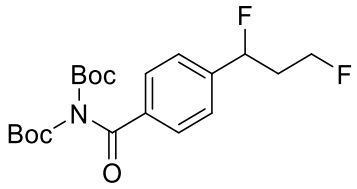


Methyl 4-(1,3-difluoropropyl)benzoate (14). 0.5 mmol scale, 6 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate

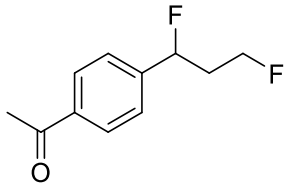
= 100:1) to give **14** as a pale yellow oil. Yield = 56%, electricity = 7.2 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.42 (d, *J* = 8.3 Hz, 2H), 5.81 – 5.61 (m, 1H), 4.81 – 4.44 (m, 2H), 3.92 (s, 3H), 2.35 – 2.14 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.70, 144.51 (d, *J* = 19.6 Hz), 130.33 (d, *J* = 1.6 Hz), 130.02, 125.28 (d, *J* = 7.3 Hz), 90.07 (dd, *J* = 172.7, 4.6 Hz), 79.74 (dd, *J* = 165.6, 4.5 Hz), 52.30, 38.26 (dd, *J* = 23.6, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.45, -222.52. HRMS (ESI) m/z calcd for $C_{11}H_{13}F_2O_2$ $(M+H)^+$: 215.08781, found : 215.08720.



Ethyl 4-(1,3-difluoropropyl)benzoate (15).[2] 0.5 mmol scale, 6 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100:1) to give **15** as a pale yellow oil. Yield = 56%, electricity = 7.2 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.1 Hz, 2H), 7.42 (d, *J* = 8.2 Hz, 2H), 5.84 – 5.60 (m, 1H), 4.82 – 4.43 (m, 2H), 4.39 (q, *J* = 7.1 Hz, 2H), 2.39 – 2.10 (m, 2H), 1.40 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.20 (s), 144.38 (d, *J* = 19.5 Hz), 130.68 (d, *J* = 1.5 Hz), 129.96, 125.22 (d, *J* = 7.3 Hz), 90.08 (dd, *J* = 172.7, 4.6 Hz), 79.73 (dd, *J* = 165.6, 4.5 Hz), 61.18, 38.26 (dd, *J* = 23.6, 19.8 Hz), 14.38. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.34, -222.51.

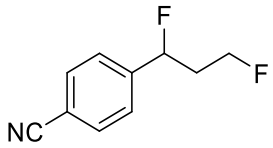


(**16**). 0.25 mmol scale, add 0.5 mL DCE, 10 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 15:1) to give **16** as a white solid**.** Isolated yield = 52%, 27% starting material was recovered, electricity = 23.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.1 Hz, 2H), 7.47 (d, *J* = 8.3 Hz, 2H), 5.89 – 5.58 (m, 1H), 4.87 – 4.44 (m, 2H), 2.37 – 2.11 (m, 2H), 1.39 (s, 18H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 168.92, 149.79, 145.19 (d, *J* = 19.7 Hz), 134.28 (d, *J* = 1.5 Hz), 129.48, 125.49 (d, *J* = 7.4 Hz), 89.86 (dd, *J* = 173.4, 4.5 Hz), 84.54, 79.60 (dd, *J* = 165.9, 4.4 Hz), 38.26 (dd, *J* = 23.5, 19.8 Hz), 27.65. ^{19}F NMR (377 MHz, $CDCl_3$) δ -183.23, -222.45. HRMS (EI+) m/z calculated for $C_{20}H_{27}F_2NO_5Na$ $(M+Na^+)$: 422.17495, found: 422.17328.

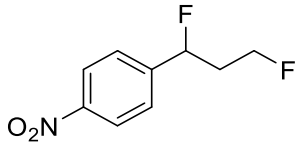


1-(4-(1,3-difluoropropyl)phenyl)ethan-1-one (17).[2] 0.5 mmol scale, 14 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **17** as a pale yellow oil**.** Isolated yield = 42%, electricity = 16.7 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (d, *J* = 8.0 Hz, 2H), 7.45 (d, *J* = 8.4 Hz, 2H), 5.81 – 5.62 (m, 1H), 4.82 – 4.44 (m, 2H), 2.62 (s, 3H), 2.35 – 2.15 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 197.71, 144.66 (d, *J* = 19.6 Hz), 137.16 (d, *J* = 1.4 Hz), 128.76, 125.46 (d, *J* = 7.3 Hz), 90.02 (dd, *J* = 172.8,

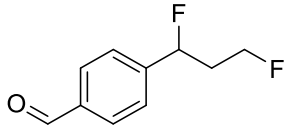
4.6 Hz), 79.71 (dd, *J* = 165.6, 4.5 Hz), 38.20 (dd, *J* = 23.5, 19.8 Hz), 26.74.^{19}F NMR (377 MHz, $CDCl_3$) δ -182.59, -222.45.



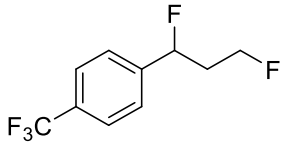
4-(1,3-difluoropropyl)benzonitrile (18).[2] 0.5 mmol scale, 20 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **18** as a pale yellow oil**.** Isolated yield = 49%, electricity = 23.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.1 Hz, 2H), 7.47 (d, *J* = 8.4 Hz, 2H), 5.72 (ddd, *J* = 47.7, 7.9, 5.1 Hz, 1H), 4.82 – 4.46 (m, 2H), 2.33 – 2.15 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 144.79 (d, *J* = 20.0 Hz), 132.59, 125.95 (d, *J* = 7.7 Hz), 118.53, 112.43 (d, *J* = 1.6 Hz), 89.64 (dd, *J* = 174.1, 4.4 Hz), 79.51 (dd, *J* = 166.0, 4.4 Hz), 38.19 (dd, *J* = 23.3, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -183.97, -222.47.



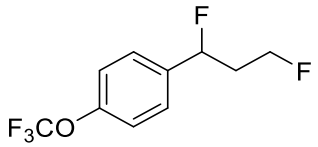
1-(1,3-Difluoropropyl)-4-nitrobenzene (19).[2] 0.5 mmol scale, 3 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **19** as a yellow oil**.** Yield = 49%, electricity = 3.6 F·mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (d, *J* = 8.3 Hz, 2H), 7.54 (d, *J* = 8.9 Hz, 2H), 5.94 – 5.64 (m, 1H), 4.83 – 4.48 (m, 2H), 2.38 – 2.17 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 147.92, 146.72 (d, *J* = 19.9 Hz), 126.10 (d, *J* = 7.7 Hz), 123.96, 89.51 (dd, *J* = 174.4, 4.4 Hz), 79.47 (dd, *J* = 166.0, 4.4 Hz), 38.22 (dd, *J* = 23.2, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -183.95, -222.44.



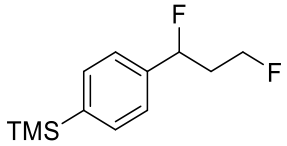
4-(1,3-Difluoropropyl)benzaldehyde (20). 0.5 mmol, 16 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100:1) to give **20** as a yellow oil**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.03 (s, 1H), 7.92 (d, *J* = 8.0 Hz, 2H), 7.53 (d, *J* = 8.1 Hz, 2H), 5.84 – 5.65 (m, 1H), 4.82 – 4.47 (m, 2H), 2.36 – 2.17 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 191.85, 146.20 (d, *J* = 19.6 Hz), 136.46, 130.17, 125.87 (d, *J* = 7.5 Hz), 89.98 (dd, *J* = 173.4, 4.5 Hz), 79.67 (dd, *J* = 165.8, 4.4 Hz), 38.30 (dd, *J* = 23.5, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -183.28, -222.47. HRMS (ESI) m/z calcd for $C_{10}H_{11}F_2O$ $(M+H)^+$: 185.07725, found : 185.07729.



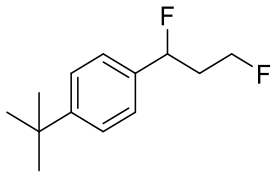
1-(1,3-Difluoropropyl)-4-(trifluoromethyl)benzene (21). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **21** as a colorless oil**.** Yield = 49%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.3 Hz, 2H), 7.47 (d, *J* = 8.0 Hz, 2H), 5.82 – 5.60 (m, 1H), 4.83 – 4.44 (m, 2H), 2.36 – 2.14 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.61 (d, *J* = 21.0 Hz),130.83 (q, *J* = 32.4 Hz), 125.78 (q, *J* = 3.6 Hz), 125.73 (d, *J* = 7.5 Hz), 124.08 (q, *J* = 272.1 Hz), 89.93 (dd, *J* = 173.0, 4.6 Hz), 79.72 (dd, *J* = 165.7, 4.5 Hz), 38.37 (dd, *J* = 23.5, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -62.66, -182.59, -222.58. HRMS (EI+) m/z calculated for $C_{10}H_9F_5$ (M+): 224.0624, found: 224.0616.



1-(1,3-Difluoropropyl)-4-(trifluoromethoxy)benzene (22). 0.25 mmol scale, add 0.5 mL DCE, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (30-60 °C petroleum ether: ethyl acetate = 200:1) to give **22** as a colorless oil. Isolated yield = 53%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 (d, *J* = 8.5 Hz, 2H), 7.25 (d, *J* = 8.8 Hz, 2H), 5.67 (ddd, *J* = 47.6, 9.0, 4.1 Hz, 1H), 4.83 – 4.40 (m, 2H), 2.43 – 2.08 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 149.38, 138.28 (d, *J* = 20.1 Hz), 127.13 (d, *J* = 6.8 Hz), 121.29, 120.56 (q, *J* =258.4 Hz), 89.94 (dd, *J* = 171.8, 4.6 Hz), 79.86 (dd, *J* = 165.5, 4.6 Hz), 38.31 (dd, *J* = 24.0, 19.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -57.90, -179.09, -222.64. HRMS (EI+) m/z calculated for $C_{10}H_9F_5O$ (M+): 240.0574, found: 240.0581.

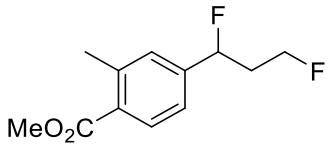


(4-(1,3-Difluoropropyl)phenyl)trimethylsilane (23). 0.25 mmol scale, add 0.5 mL DCE, 110 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **23** as a colorless oil. Yield = 53%, electricity = 4.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 7.7 Hz, 2H), 7.33 (d, *J* = 7.5 Hz, 2H), 5.63 (ddd, *J* = 47.9, 9.1, 4.1 Hz, 1H), 4.84 – 4.39 (m, 2H), 2.41 – 2.07 (m, 2H), 0.27 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.25 (d, *J* = 1.7 Hz), 140.00 (d, *J* = 19.4 Hz), 133.75, 124.90 (d, *J* = 6.7 Hz), 90.69 (dd, *J* = 170.7, 4.8 Hz), 80.13 (dd, *J* = 165.1, 4.6 Hz), 38.23 (dd, *J* = 24.1, 19.7 Hz), -1.04. ^{19}F NMR (377 MHz, $CDCl_3$) δ -179.29, -222.45. HRMS (EI+) m/z calculated for $C_{12}H_{18}F_2Si$ (M+): 228.1146, found: 228.1150.

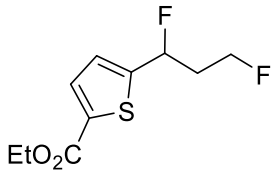


1-(Tert-butyl)-4-(1,3-difluoropropyl)benzene (24). 0.25 mmol, 40 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **24** as a colorless oil**.** Isolated yield = 40%, electricity = 1.6 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 7.4 Hz, 2H), 5.62 (ddd, *J* = 47.9, 9.2, 4.0 Hz, 1H), 4.81 – 4.40 (m, 2H), 2.43 – 2.08 (m, 2H), 1.32 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.82 (d, *J* = 2.2 Hz), 136.47 (d, *J* = 19.5 Hz), 125.67, 125.53 (d, *J* = 6.3 Hz), 90.64 (dd, *J* = 169.7, 4.9

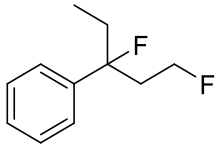
Hz), 80.21 (dd, *J* = 165.0, 4.6 Hz), 38.09 (dd, *J* = 24.3, 19.7 Hz), 34.75, 31.42. ^{19}F NMR (377 MHz, $CDCl_3$) δ -176.63, -222.43. HRMS (EI+) m/z calculated for $C_{13}H_{18}F_2$ (M+): 212.1377, found: 212.1376.



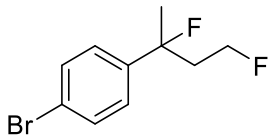
Methyl 4-(1,3-difluoropropyl)-2-methylbenzoate (25). 0.5 mmol scale, 6 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100:1) to give **25** as a colorless oil**.** Yield = 54%, electricity = 7.2 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.6 Hz, 1H), 7.23 – 7.21 (m, 2H), 5.66 (ddd, *J* = 47.9, 8.5, 4.5 Hz, 1H), 4.82 – 4.43 (m, 2H), 3.90 (s, 3H), 2.62 (s, 3H), 2.34 – 2.13 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.73, 143.42 (d, *J* = 19.5 Hz), 140.89, 131.15, 129.72, 128.54 (d, *J* = 7.1 Hz), 122.61 (d, *J* = 7.1 Hz), 90.07 (dd, *J* = 172.4, 4.7 Hz), 79.85 (dd, *J* = 165.5, 4.5 Hz), 52.06, 38.26 (dd, *J* = 23.7, 19.8 Hz), 21.95. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.34, -222.53. HRMS (ESI) m/z calcd for $C_{12}H_{15}F_2O_2$ $(M+H)^+$:229.10346, found : 229.10347.



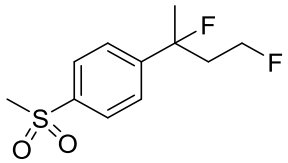
Ethyl 5-(1,3-difluoropropyl)thiophene-2-carboxylate (**26**). 0.25 mmol scale, 80 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100:1) to give **26** as a yellow oil**.** Isolated yield = 56%, electricity = 3.2 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.69 (m, 1H), 7.13 – 6.96 (m, 1H), 5.85 (ddd, *J* = 48.0, 8.9, 4.4 Hz, 1H), 4.84 – 4.45 (m, 2H), 4.36 (q, *J* = 7.1 Hz, 2H), 2.78 – 2.20 (m, 2H), 1.38 (t, *J* = 7.1 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 162.02, 148.51 (d, *J* = 21.3 Hz), 134.55 (d, *J* = 2.6 Hz), 133.11 (d, *J* = 1.4 Hz), 126.23 (d, *J* = 5.8 Hz), 86.15 (dd, *J* = 171.5, 4.8 Hz), 79.50 (dd, *J* = 166.1, 4.4 Hz), 61.51, 37.99 (dd, *J* = 23.8, 19.9 Hz), 14.41. ^{19}F NMR (377 MHz, $CDCl_3$) δ -165.87, -222.91. HRMS (ESI) m/z calcd for $C_{10}H_{13}F_2O_2S$ $(M+H)^+$: 235.05988, found : 235.05981.



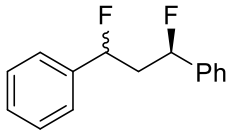
(1,3-Difluoropentan-3-yl)benzene (27).[8] 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **27** as a colorless oil**.** Yield = 67%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 – 7.24 (m, 5H), 4.64 – 4.23 (m, 2H), 2.52 – 2.21 (m, 2H), 2.12 – 1.85 (m, 2H), 0.79 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 141.87 (d, *J* = 22.1 Hz), 128.35 (d, *J* = 1.9 Hz), 127.32 (d, *J* = 0.9 Hz), 124.35 (d, *J* = 10.5 Hz), 98.48 (dd, *J* = 176.3, 7.1 Hz), 80.05 (dd, *J* = 163.8, 5.1 Hz), 40.79 (dd, *J* = 23.1, 19.7 Hz), 33.80 (d, *J* = 23.9 Hz), 7.46 (d, *J* = 4.9 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -162.48 (d, *J* = 1.9 Hz), -220.34 (d, *J* = 2.1 Hz).



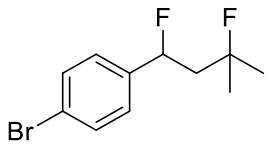
1-Bromo-4-(2,4-difluorobutan-2-yl)benzene (28).[8] 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **28** as a colorless oil**.** Yield = 65%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.3 Hz, 2H), 7.23 (d, *J* = 8.5 Hz, 2H), 4.67 – 4.30 (m, 2H), 2.45 – 2.20 (m, 2H), 1.70 (d, *J* = 22.7 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 143.14 (d, *J* = 22.2 Hz), 131.68 (d, *J* = 1.4 Hz), 125.86 (d, *J* = 9.8 Hz), 121.67 (d, *J* = 1.6 Hz), 95.97 (dd, *J* = 173.7, 5.4 Hz), 79.83 (dd, *J* = 165.0, 5.2 Hz), 42.25 (dd, *J* = 23.8, 19.6 Hz), 27.81 (d, *J* = 24.9 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -148.18 (d, *J* = 2.3 Hz), -219.84 (d, *J* = 2.3 Hz).



1-(2,4-Difluorobutan-2-yl)-4-(methylsulfonyl)benzene (**29**). 0.25 mmol scale, 100 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 3:1) to give **29** as a yellow oil**.** Yield = 81%, electricity = 4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.2 Hz, 2H), 7.57 (d, *J* = 8.5 Hz, 2H), 4.70 – 4.33 (m, 2H), 3.08 (s, 3H), 2.54 – 2.22 (m, 2H), 1.75 (d, *J* = 22.7 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 150.23 (d, *J* = 22.0 Hz), 139.81, 127.73 (d, *J* = 1.7 Hz), 125.09 (d, *J* = 10.1 Hz), 95.86 (dd, *J* = 175.7, 4.6 Hz), 79.45 (dd, *J* = 165.7, 5.1 Hz), 44.54, 42.05 (dd, *J* = 23.5, 19.7 Hz), 27.77 (d, *J* = 24.9 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -149.48 (d, *J* = 2.5 Hz), -219.41 (d, *J* = 2.5 Hz). HRMS (ESI) m/z calcd for $C_{11}H_{15}F_2O_2S$ $(M+H)^+$: 249.07553, found : 249.07550.

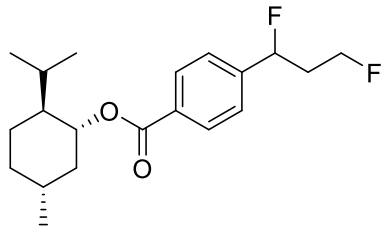


1,3-Difluoro-1,3-diphenylpropane (**30**). 0.5 mmol scale, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **30** as a colorless oil with 1.3:1 diastereoselectivity**.** Isolated **y**ield = 61%, electricity = 2.4 F mol^{-1}. ^{1}H, ^{13}C, ^{19}F spectra are obtained from diastereoisomer mixture**.** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.30 (m, 23.2 H), 5.89 – 5.71 (m, 2.6 H), 5.43 (ddd, *J* = 47.1, 7.8, 6.2 Hz, 2H), 2.90 – 2.75 (m, 1H), 2.44 – 2.15 (m, 3.8 H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.65 (d, *J* = 19.4 Hz), 139.13 (d, *J* = 19.5 Hz), 128.92 (d, *J* = 2.1 Hz), 128.79, 128.74, 128.71 (d, *J* = 1.0 Hz), 125.97 (d, *J* = 6.5 Hz), 125.59 (d, *J* = 6.9 Hz), 91.67 (dd, J = 170.2, 6.5 Hz), 90.63 (dd, *J* = 171.1, 2.3 Hz), 45.63 (t, *J* = 23.4 Hz) 44.42 (t, J = 24.4 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -174.32, -178.23. HRMS (EI+) m/z calculated for $C_{15}H_{14}F_2$ (M+): 232.1064, found: 232.1059.

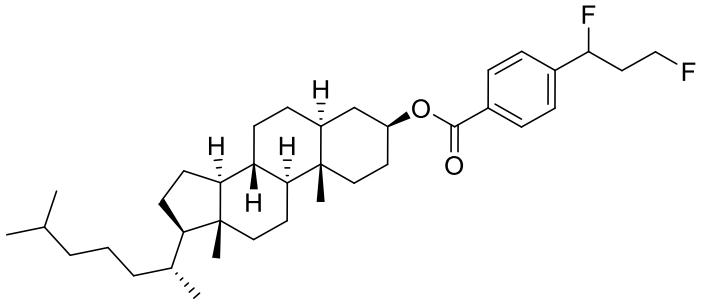


1-Bromo-4-(1,3-difluoro-3-methylbutyl)benzene (31). 0.25 mmol scale, 1 h. After After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 200:1) to give **31** as a colorless oil. Isolated **y**ield = 81%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.49 (m, 2H), 7.22 (d, *J* = 8.3 Hz, 2H), 5.68 (ddd, *J* = 48.4,

9.5, 2.0 Hz, 1H), 2.59 – 1.93 (m, 2H), 1.52 (dd, *J* = 21.7, 1.3 Hz, 3H), 1.43 (d, *J* = 21.7 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.67 (d, *J* = 20.4 Hz), 131.82 (d, *J* = 5.0 Hz), 127.20 (d, *J* = 6.9 Hz), 122.38 (d, *J* = 2.4 Hz), 94.38 (d, *J* = 166.5 Hz), 90.42 (dd, *J* = 171.8, 5.8 Hz), 48.70 (t, *J* = 22.8 Hz), 28.55 (dd, *J* = 24.0, 1.3 Hz), 26.37 (dd, *J* = 24.8, 3.0 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -136.88 (d, *J* = 3.6 Hz), -173.34 (d, *J* = 3.7 Hz). HRMS (EI+) m/z calculated for $C_{11}H_{13}BrF_2$ (M+): 262.0163, found: 262.0159.

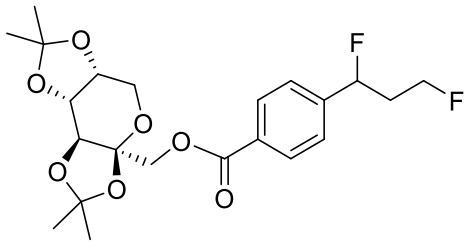


(1R, 2S, 5R)-2-isopropyl-5-methylcyclohexyl 4-(1,3-difluoropropyl)benzoate (**32**). 0.1 mmol scale, add 0.5 ml DCE, 2 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **32** as yellow oil**.** Isolated yield = 86%, electricity = 11.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, *J* = 8.0 Hz, 2H), 7.42 (d, *J* = 8.3 Hz, 2H), 5.71 (ddd, *J* = 47.8, 8.5, 4.5 Hz, 1H), 4.94 (td, *J* = 10.9, 4.4 Hz, 1H), 4.81 – 4.44 (m, 2H), 2.40 – 2.15 (m, 2H), 2.15 – 2.09 (m, 1H), 1.99 – 1.91 (m, 1H), 1.79 – 1.70 (m, 2H), 1.63 – 1.50 (m, 2H), 1.18 – 1.05 (m, 2H), 0.94 – 0.91 (m, 7H), 0.80 (d, *J* = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.72, 144.31 (d, *J* = 19.6 Hz), 131.10, 130.03, 125.26 (d, *J* = 7.2 Hz), 90.13 (dd, *J* = 172.7, 4.6 Hz), 79.78 (dd, *J* = 165.6, 4.5 Hz), 75.13, 47.36, 41.06, 38.33 (dd, *J* = 23.6, 19.8 Hz), 34.41, 31.56, 26.63, 23.73, 22.17, 20.89, 16.63. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.26 (d, *J* = 26.3 Hz), -222.50 (d, *J* = 2.4 Hz). HRMS (ESI) m/z calcd for $C_{20}H_{38}F_2O_2Na$ $(M+Na)^+$: 361.19496, found : 361.19437.

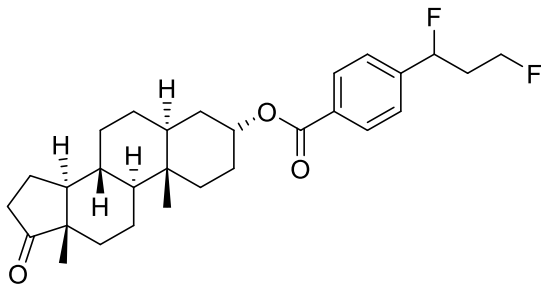


(**33**). 0.1 mmol scale, add 0.5 mL DCE, 4 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 100:1) to give **33** as white solid**.** Isolated yield = 65%, 10% starting material was recovered, electricity = 23.8 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.1 Hz, 2H), 7.40 (d, *J* = 8.3 Hz, 2H), 5.71 (ddd, *J* = 47.7, 8.3, 4.5 Hz, 1H), 5.03 – 4.87 (m, 1H), 4.81 – 4.42 (m, 2H), 2.38 – 2.09 (m, 2H), 2.02 – 1.89 (m, 2H), 1.85 – 0.99 (m, 28H), 0.92 – 0.84 (m, 12H), 0.73 – 0.63 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.73, 144.24 (d, *J* = 19.5 Hz), 131.19, 130.00, 125.18 (d, *J* = 7.2 Hz), 90.12 (dd, *J* = 172.7, 4.5 Hz), 79.78 (dd, *J* = 165.7, 4.5 Hz), 74.68, 56.52, 56.37, 54.33, 44.80, 42.70, 40.09, 39.64, 38.35 (dd, *J* = 23.6, 19.8 Hz), 36.90, 36.29, 35.94, 35.63, 35.59, 34.22, 32.12, 28.76, 28.39, 28.14, 27.69, 24.34, 23.97, 22.97, 22.71, 21.35, 18.80, 12.42, 12.20. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.32 (d,

J = 3.3 Hz), -222.48. HRMS (DART POSITIVE) m/z calcd for $C_{37}H_{60}F_2NO_2$ $(M+NH_4)^+$: 588.4587, found : 588.4589.

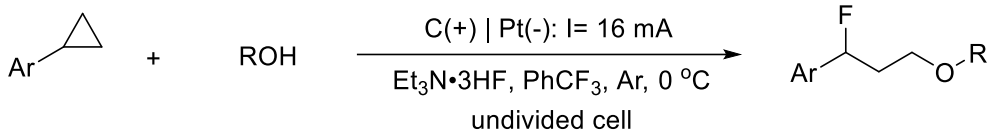


(34). 0.1 mmol scale, add 0.5 mL DCE, 6 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 8:1) to give **34** as colorless oil. Isolated yield = 82%, electricity = 35.8 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (d, J = 8.1 Hz, 2H), 7.43 (d, J = 8.3 Hz, 2H), 5.83 – 5.60 (m, 1H), 4.81 – 4.44 (m, 5H), 4.36 – 4.26 (m, 2H), 3.99 – 3.79 (m, 2H), 2.40 – 2.12 (m, 2H), 1.55 (s, 3H), 1.47 (s, 3H), 1.38 (s, 3H), 1.35 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.55, 144.74 (d, J = 19.6 Hz), 130.20, 130.06, 125.28 (d, J = 7.3 Hz), 109.23, 108.93, 101.68, 90.01 (dd, J = 172.9, 4.6 Hz), 79.70 (dd, J = 165.7, 4.5 Hz), 70.83, 70.61, 70.13, 65.48, 61.41, 38.26 (dd, J = 23.5, 19.8 Hz), 26.60, 25.94, 25.59, 24.07. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.69 (d, J = 8.2 Hz), -222.51. HRMS (ESI) m/z calcd for $C_{22}H_{29}F_2O_7$ $(M+H)^+$: 443.18759, found : 443.18588.

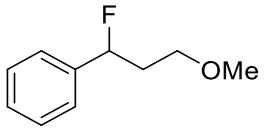


(3R, 5S, 8R, 9S, 10S, 13S, 14S)-10,13-dimethyl-17-oxohexadecahydro-1H-cyclopenta[a]phenanthren-3-yl 4-(1,3-difluoropropyl)benzoate (35). 0.1 mmol scale, add 0.5 mL DCE, 140 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 15:1) to give **35** as white solid**.** Yield = 30%, 36% starting material was recovered, electricity = 13.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, J = 8.1 Hz, 2H), 7.41 (d, J = 8.2 Hz, 2H), 5.71 (ddd, J = 47.7, 8.3, 4.5 Hz, 1H), 5.01 – 4.89 (m, 1H), 4.82 – 4.43 (m, 2H), 2.48 – 2.41 (m, 1H), 2.35 – 2.14 (m, 2H), 2.13 – 2.02 (m, 1H), 2.00 – 1.90 (m, 2H), 1.85 – 1.73 (m, 4H), 1.72 – 1.47 (m, 5H), 1.36 – 1.23 (m, 6H), 1.17 – 0.98 (m, 2H), 0.91 (s, 3H), 0.87 (s, 3H), 0.79 – 0.71 (m, 1H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 221.44, 165.72, 144.30 (d, J = 19.6 Hz), 131.07, 129.99, 125.20 (d, J = 7.2 Hz), 90.11 (dd, J = 172.7, 4.6 Hz), 79.77 (dd, J = 165.6, 4.5 Hz), 74.40, 54.39, 51.45, 47.90, 44.79, 38.32 (dd, J = 23.6, 19.7 Hz), 36.83, 35.97, 35.81, 35.14, 34.12, 31.62, 30.92, 28.40, 27.61, 21.89, 20.59, 13.93, 12.40. ^{19}F NMR (377 MHz, $CDCl_3$) δ -182.32 (d, J = 3.5 Hz), -222.50. HRMS (ESI) m/z calcd for $C_{29}H_{39}F_2O_3$ $(M+H)^+$: 473.28618, found : 473.28513.

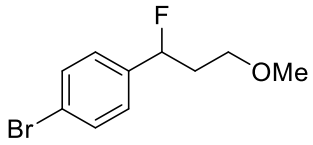
5) Procedures and analytical data of 1,3-oxyfluorination compounds



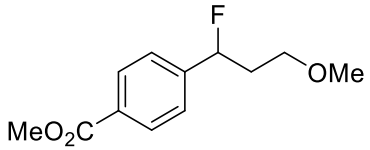
An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped carbon cloth (15 mm×15 mm) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode and then charged with argon gas by glove box. Arylcyclopropane (0.25 mmol), ROH (0.2-0.75 mL), $Et_3N{\cdot}3HF$ (0.8 mL) and $PhCF_3$ (4.8 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 16 mA under 0 °C. The reaction was diluted with water. The organic layer was extracted with CH_2Cl_2, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.



(1-fluoro-3-methoxypropyl)benzene (**3**). 0.25 mmol scale, 0.2 mL MeOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **33** as colorless oil**.** Yield = 76%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.28 (m, 5H), 5.62 (ddd, *J* = 47.9, 9.0, 4.3 Hz, 1H), 3.63 – 3.39 (m, 2H), 3.37 (s, 3H), 2.30 – 1.96 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.22 (d, *J* = 19.6 Hz), 128.62, 128.45 (d, *J* = 2.0 Hz), 125.65 (d, *J* = 6.8 Hz), 91.78 (d, *J* = 169.7 Hz), 68.47 (d, *J* = 4.7 Hz), 58.92, 37.59 (d, *J* = 23.9 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.56. HRMS (ESI) m/z calculated for $C_{10}H_{13}FONa$ $(M+Na)^+$:191.08426, found: 191.08354.

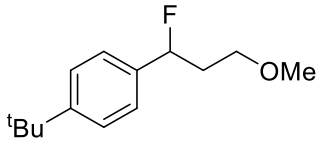


1-Bromo-4-(1-fluoro-3-methoxypropyl)benzene (36). 0.25 mmol scale, 0.2 mL MeOH, 100 min. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **36** as colorless oil**.** Yield = 50%, electricity = 4.0 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.1 Hz, 2H), 7.25 (d, *J* = 8.2 Hz, 2H), 5.62 (ddd, *J* = 47.7, 8.9, 4.3 Hz, 1H), 3.68 – 3.36 (m, 5H), 2.29 – 1.94 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.26 (d, *J* = 20.0 Hz), 131.76, 127.33 (d, *J* = 6.9 Hz), 122.33 (d, *J* = 2.4 Hz), 91.09 (d, *J* = 170.7 Hz), 68.20 (d, *J* = 4.8 Hz), 58.93, 37.52 (d, *J* = 23.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -178.49. HRMS (ESI) m/z calculated for $C_{10}H_{12}BrFONa$ $(M+Na)^+$:268.99478, found: 268.99551.

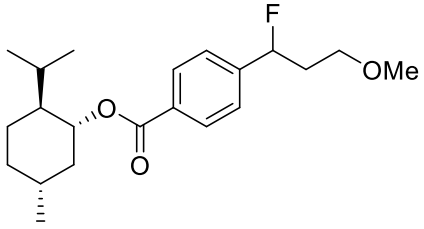


Methyl 4-(1-fluoro-3-methoxypropyl)benzoate (37). 0.25 mmol scale, 0.2 mL MeOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **37** as colorless oil**.** Yield = 69%, electricity = 2.4 F mol^{-1}. ^1H

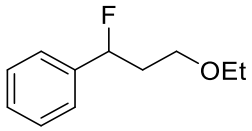
NMR (400 MHz, $CDCl_3$) δ 8.07 (d, *J* = 8.1 Hz, 2H), 7.43 (d, *J* = 8.3 Hz, 2H), 5.70 (ddd, *J* = 47.9, 8.9, 4.2 Hz, 1H), 3.94 (s, 3H), 3.67 – 3.34 (m, 5H), 2.33 – 1.95 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 166.80, 145.27 (d, *J* = 19.7 Hz), 130.04 (d, *J* = 1.5 Hz), 129.90, 125.32 (d, *J* = 7.3 Hz), 91.10 (d, *J* = 171.6 Hz), 68.09 (d, *J* = 4.6 Hz), 58.90, 52.27, 37.62 (d, *J* = 23.4 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -181.50. HRMS (ESI) m/z calculated for $C_{12}H_{15}FO_3Na$ $(M+Na)^+$:249.08974, found: 249.08956.



1-(Tert-butyl)-4-(1-fluoro-3-methoxypropyl)benzene (38). 0.25 mmol scale, 0.2 mL MeOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **38** as colorless oil**.** Yield = 49%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.40 (d, *J* = 8.5 Hz, 2H), 7.31 – 7.26 (m, 2H), 5.59 (ddd, *J* = 48.0, 9.1, 4.2 Hz, 1H), 3.64 – 3.42 (m, 2H), 3.37 (s, 3H), 2.32 – 1.95 (m, 2H), 1.32 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 151.52 (d, *J* = 2.1 Hz), 137.17 (d, *J* = 19.6 Hz), 125.56 (d, *J* = 3.2 Hz), 125.53 (d, *J* = 3.2 Hz), 91.70 (d, *J* = 168.6 Hz), 68.60 (d, *J* = 4.5 Hz), 58.91, 37.40 (d, *J* = 24.1 Hz), 34.73, 31.45. ^{19}F NMR (376 MHz, $CDCl_3$) δ -175.43 – -175.76 (m). HRMS (ESI) m/z calculated for $C_{14}H_{21}FONa$ $(M+Na)^+$:247.14686, found: 247.14703.

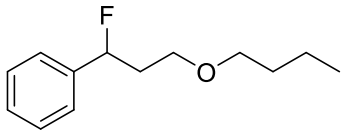


(1R,2S,5R)-2-isopropyl-5-methylcyclohexyl 4-(1-fluoro-3-methoxypropyl)benzoate (39). 0.25 mmol scale, 0.2 mL MeOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **39.** Yield = 56%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, *J* = 8.0 Hz, 2H), 7.41 (d, *J* = 8.1 Hz, 2H), 5.69 (ddd, *J* = 47.9, 8.9, 4.1 Hz, 1H), 4.94 (td, *J* = 10.9, 4.3 Hz, 1H), 3.69 – 3.14 (m, 5H), 2.27 – 1.91 (m, 4H), 1.73 (d, *J* = 12.9 Hz, 2H), 1.61 – 1.49 (m, 2H), 1.13 (dd, *J* = 24.6, 12.4 Hz, 2H), 0.97 – 0.86 (m, 7H), 0.79 (d, *J* = 6.9 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 165.82, 145.07 (d, *J* = 19.7 Hz), 130.79 (d, *J* = 0.9 Hz), 129.90, 125.29 (dd, *J* = 7.3, 1.6 Hz), 91.16 (d, *J* = 171.6 Hz), 75.04, 68.15 (d, *J* = 4.6 Hz), 58.93, 47.35, 41.06, 37.67 (d, *J* = 23.5 Hz), 34.41, 31.55, 26.60, 23.70, 22.17, 20.89, 16.61. ^{19}F NMR (377 MHz, $CDCl_3$) δ -181.28 (d, *J* = 38.0 Hz). HRMS (ESI) m/z calculated for $C_{21}H_{31}FO_3Na$ $(M+Na)^+$:373.21494, found: 373.21467.

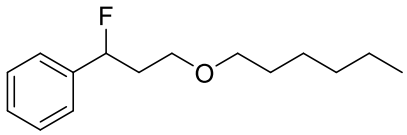


(3-Ethoxy-1-fluoropropyl)benzene (40). 0.25 mmol scale, 0.3 mL EtOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **40** as colorless oil. Yield = 50%, electricity = 2.4 F mol^{-1}. ^1H NMR (400

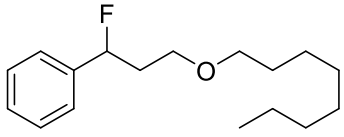
MHz, $CDCl_3$) δ 7.46 – 7.27 (m, 5H), 5.63 (ddd, *J* = 47.9, 8.9, 4.4 Hz, 1H), 3.67 – 3.43 (m, 4H), 2.31 – 1.95 (m, 2H), 1.21 (t, *J* = 7.0 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.26 (d, *J* = 19.5 Hz), 128.57, 128.40 (d, *J* = 1.9 Hz), 125.67 (d, *J* = 6.8 Hz), 91.85 (d, *J* = 169.5 Hz), 66.50, 66.23 (d, *J* = 4.9 Hz), 37.65 (d, *J* = 23.8 Hz), 15.30. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.37. HRMS (ESI) m/z calculated for $C_{11}H_{15}FONa$ $(M+Na)^+$:205.09991, found: 205.09956.



(3-Butoxy-1-fluoropropyl)benzene (41). 0.25 mmol scale, 0.45 mL *n*-BuOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **41** as colorless oil. Yield = 63%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.47 – 7.32 (m, 5H), 5.67 (ddd, *J* = 47.9, 8.8, 4.4 Hz, 1H), 3.69 – 3.45 (m, 4H), 2.36 – 1.99 (m, 2H), 1.65 – 1.57 (m, 2H), 1.50 – 1.38 (m, 2H), 0.97 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.19 (d, *J* = 19.6 Hz), 128.48, 128.30 (d, *J* = 1.9 Hz), 125.60 (d, *J* = 6.7 Hz), 91.80 (d, *J* = 169.4 Hz), 70.95, 66.33 (d, *J* = 5.0 Hz), 37.56 (d, *J* = 23.8 Hz), 31.82, 19.40, 13.98. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.32. HRMS (ESI) m/z calculated for $C_{13}H_{19}FONa$ $(M+Na)^+$:233.13121, found: 233.13198.

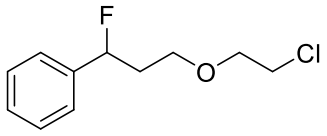


(1-Fluoro-3-(hexyloxy)propyl)benzene (42). 0.25 mmol scale, 0.6 mL 1-hexanol, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **42** as colorless oil. Yield = 69%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.28 (m, 5H), 5.62 (ddd, *J* = 47.9, 8.8, 4.4 Hz, 1H), 3.65 – 3.39 (m, 4H), 2.31 – 1.95 (m, 2H), 1.63 – 1.53 (m, 2H), 1.36 – 1.26 (m, 6H), 0.93 – 0.87 (m, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.29 (d, *J* = 19.6 Hz), 128.56, 128.38 (d, *J* = 1.9 Hz), 125.68 (d, *J* = 6.7 Hz), 91.88 (d, *J* = 169.4 Hz), 71.36, 66.42 (d, *J* = 5.0 Hz), 37.66 (d, *J* = 23.8 Hz), 31.83, 29.79, 25.99, 22.77, 14.20. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.31. HRMS (ESI) m/z calculated for $C_{15}H_{23}FONa$ $(M+Na)^+$:261.16251, found: 261.16197.

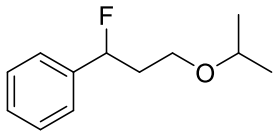


(1-Fluoro-3-(octyloxy)propyl)benzene (43). 0.25 mmol scale, 0.75 mL octanol, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **43** as colorless oil. Yield = 59%, electricity = 2.4 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.31 (m, 5H), 5.68 (ddd, *J* = 47.9, 8.8, 4.4 Hz, 1H), 3.73 – 3.43 (m, 4H), 2.38 – 2.00 (m, 2H), 1.67 – 1.58 (m, 2H), 1.39 – 1.27 (m, 10H), 0.96 – 0.92 (m, *J* = 9.0, 4.8 Hz, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.30 (d, *J* = 19.5 Hz), 128.56, 128.38 (d, *J* = 1.9 Hz), 125.68 (d, *J* = 6.7 Hz), 91.87 (d, *J* = 169.5 Hz), 71.36, 66.41 (d, *J* = 5.0 Hz), 37.66 (d, *J* = 23.8 Hz),

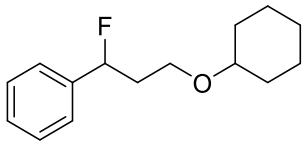
31.98, 29.83, 29.59, 29.42, 26.32, 22.81, 14.25. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.33. HRMS (ESI) m/z calculated for $C_{17}H_{27}FONa$ $(M+Na)^+$:289.19381, found: 289.19352.



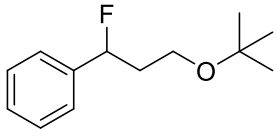
(3-(2-Chloroethoxy)-1-fluoropropyl)benzene (44). 0.25 mmol scale, 0.3 mL $ClCH_2CH_2OH$, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **44** as colorless oil. Yield = 40%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.33 (m, 5H), 5.70 (ddd, *J* = 47.9, 8.9, 4.4 Hz, 1H), 3.81 – 3.55 (m, 6H), 2.37 – 2.03 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 139.97 (d, *J* = 19.5 Hz), 128.53, 128.40 (d, *J* = 2.0 Hz), 125.60 (d, *J* = 6.8 Hz), 91.55 (d, *J* = 169.6 Hz), 71.05, 66.84 (d, *J* = 5.0 Hz), 42.88, 37.39 (d, *J* = 24.0 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.63. HRMS (ESI) m/z calculated for $C_{11}H_{14}FClONa$ $(M+Na)^+$:239.06094, found: 239.06167.



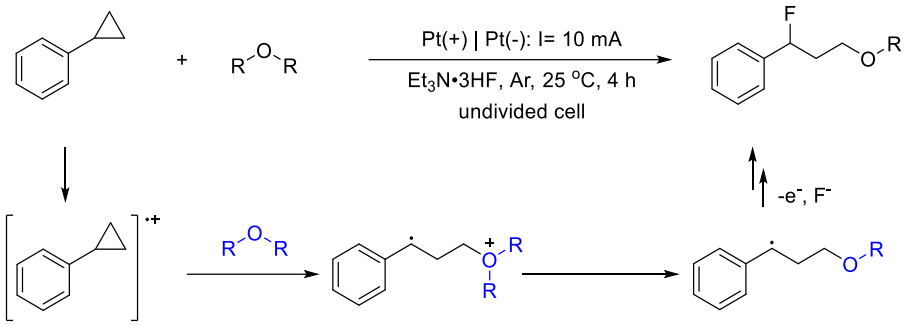
(1-Fluoro-3-isopropoxypropyl)benzene (45). 0.25 mmol scale, 0.3 mL *i*-PrOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **45** as colorless oil. Yield = 47%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.27 (m, 5H), 5.63 (ddd, *J* = 48.0, 8.9, 4.4 Hz, 1H), 3.65 – 3.43 (m, 3H), 2.29 – 1.94 (m, 2H), 1.17 (t, *J* = 6.1 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.32 (d, *J* = 19.5 Hz), 128.56, 128.39 (d, *J* = 2.0 Hz), 125.73 (d, *J* = 6.8 Hz), 91.92 (d, *J* = 169.2 Hz), 71.85, 63.77 (d, *J* = 5.0 Hz), 37.95 (d, *J* = 23.8 Hz), 22.24, 22.21. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.35. HRMS (ESI) m/z calculated for $C_{12}H_{17}FONa$ $(M+Na)^+$:219.11556, found: 219.11487.



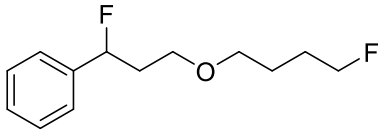
(3-(Cyclohexyloxy)-1-fluoropropyl)benzene (46). 0.25 mmol scale, 0.5 mL cyclohexanol, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **46** as colorless oil. Yield = 62%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.28 (m, 5H), 5.63 (ddd, *J* = 48.0, 8.8, 4.4 Hz, 1H), 3.69 – 3.45 (m, 2H), 3.25 – 3.19 (m, 1H), 2.31 – 1.97 (m, 2H), 1.94 – 1.88 (m, 2H), 1.75 – 1.73 (m, 2H), 1.55 – 1.52 (m, 1H), 1.36 – 1.07 (m, 5H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.35 (d, *J* = 19.5 Hz), 128.55, 128.36 (d, *J* = 2.0 Hz), 125.74 (d, *J* = 6.8 Hz), 91.95 (d, *J* = 169.1 Hz), 77.90, 63.48 (d, *J* = 5.0 Hz), 38.01 (d, *J* = 23.7 Hz), 32.47, 32.31, 25.95, 24.29. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.26. HRMS (ESI) m/z calculated for $C_{15}H_{21}FONa$ $(M+Na)^+$:259.14686, found: 259.14675.



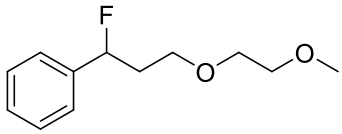
(3-(Tert-butoxy)-1-fluoropropyl)benzene (47). 0.25 mmol scale, 0.45 mL *t*-BuOH, 1 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 150:1) to give **47** as colorless oil. Yield = 50%, electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.28 (m, 5H), 5.63 (ddd, *J* = 48.1, 9.0, 4.2 Hz, 1H), 3.61 – 3.39 (m, 2H), 2.26 – 1.92 (m, 2H), 1.20 (s, 9H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.46 (d, *J* = 19.5 Hz), 128.53, 128.34 (d, *J* = 2.0 Hz), 125.78 (d, *J* = 6.8 Hz), 91.90 (d, *J* = 168.9 Hz), 73.01, 57.34 (d, *J* = 4.8 Hz), 38.34 (d, *J* = 23.6 Hz), 27.65. ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.41. HRMS (ESI) m/z calculated for $C_{13}H_{19}FONa$ $(M+Na)^+$:233.13121, found: 233.13113.



An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped platinum plate (15 mm×15 mm×0.3 mm) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode and then charged with argon gas by glove box. Cyclopropylbenzene (0.5 mmol), $Et_3N{\cdot}3HF$ (1.2 mL) and ether (4.8 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 10 mA under room temperature for 4 h. The reaction was diluted with water. The organic layer was extracted with CH_2Cl_2, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.

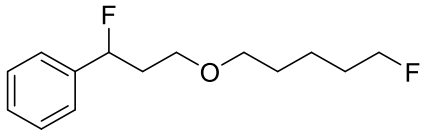


(1-fluoro-3-(4-fluorobutoxy)propyl)benzene (48). 0.5 mmol scale, 4 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 50:1) to give **48** as colorless oil**.** Yield = 43%, electricity = 2.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.29 (m, 5H), 5.60 (ddd, *J* = 47.9, 8.8, 4.4 Hz, 1H), 4.46 (dt, *J* = 47.2, 5.9 Hz, 2H), 3.64 – 3.42 (m, 4H), 2.28 – 1.96 (m, 2H), 1.84 – 1.65 (m, 4H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.22 (d, *J* = 19.6 Hz), 128.55, 128.38 (d, *J* = 1.9 Hz), 125.63 (d, *J* = 6.7 Hz), 91.79 (d, *J* = 169.6 Hz), 84.00 (d, *J* = 164.4 Hz), 70.49, 66.44 (d, *J* = 4.9 Hz), 37.58 (d, *J* = 23.9 Hz), 27.41 (d, *J* = 19.8 Hz), 25.62 (d, *J* = 5.2 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.31, -218.13. HRMS (ESI) m/z calcd for $C_{13}H_{18}F_2ONa$ $(M+Na)^+$: 251.12179, found : 251.12178.



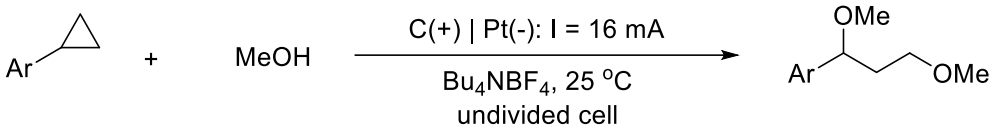
(1-fluoro-3-(2-methoxyethoxy)propyl)benzene (**49**). 0.5 mmol scale, 4 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl

acetate = 10:1) to give **49** as colorless oil**.** Yield = 44%, electricity = 2.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.30 (m, 5H), 5.64 (ddd, *J* = 47.9, 8.9, 4.3 Hz, 1H), 3.71 – 3.50 (m, 6H), 3.40 (s, 3H), 2.31 – 2.00 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.18 (d, *J* = 19.5 Hz), 128.56, 128.39 (d, *J* = 1.9 Hz), 125.66 (d, *J* = 6.7 Hz), 91.73 (d, *J* = 169.5 Hz), 71.97, 70.43, 67.06 (d, *J* = 4.9 Hz), 59.21, 37.44 (d, *J* = 23.8 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.53. HRMS (ESI) m/z calcd for $C_{12}H_{17}FO_2Na$ $(M+Na)^+$: 235.11048, found : 235.11037.

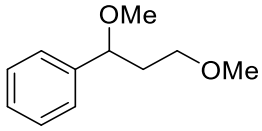


(1-Fluoro-3-((5-fluoropentyl)oxy)propyl)benzene (**50**). 0.5 mmol scale, add 1 mL DCE, 4 h. After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 50:1) to give **50** as colorless oil**.** Yield = 36%, electricity = 2.9 F mol^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.26 (m, 5H), 5.61 (ddd, *J* = 47.9, 8.8, 4.4 Hz, 1H), 4.44 (dt, *J* = 47.3, 6.1 Hz, 2H), 3.63 – 3.41 (m, 4H), 2.28 – 1.96 (m, 2H), 1.79 – 1.57 (m, 4H), 1.53 – 1.43 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 140.21 (d, *J* = 19.5 Hz), 128.53, 128.37 (d, *J* = 2.0 Hz), 125.64 (d, *J* = 6.7 Hz), 91.80 (d, *J* = 169.5 Hz), 84.08 (d, *J* = 164.3 Hz), 70.91, 66.44 (d, *J* = 5.0 Hz), 37.58 (d, *J* = 23.9 Hz), 30.30 (d, *J* = 19.5 Hz), 29.37, 22.04 (d, *J* = 5.5 Hz). ^{19}F NMR (377 MHz, $CDCl_3$) δ -177.27, -218.23. HRMS (ESI) m/z calcd for $C_{14}H_{20}F_2ONa$ $(M+Na)^+$: 265.13744, found : 265.13684.

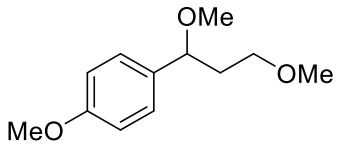
6) Procedures and analytical data of 1,3-dioxygenation compounds



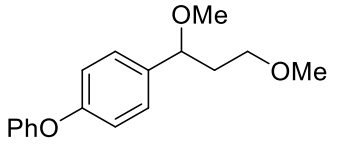
An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped carbon cloth (15 mm×15 mm) as the anode and platinum plate (15 mm×15 mm×0.3 mm) as the cathode and then charged with argon gas by glove box. Arylcyclopropane (0.25 mmol), Bu_4NBF_4 (0.25 mmol) and MeOH (6 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 16 mA for 1 h under room temperature. The reaction mixture was concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.



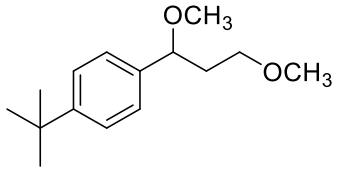
(1,3-Dimethoxypropyl)benzene (**5**). GC yield = 95%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.39 – 7.19 (m, 5H), 4.28 (dd, *J* = 8.1, 5.7 Hz, 1H), 3.53 – 3.42 (m, 1H), 3.37 – 3.26 (m, 4H), 3.20 (s, 3H), 2.11 – 1.80 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.07, 128.48, 127.63, 126.71, 80.73, 69.21, 58.64, 56.69, 38.23. HRMS (ESI) m/z calculated for $C_{11}H_{17}O_2$ $(M+H)^+$: 181.12231, found: 181.12160.



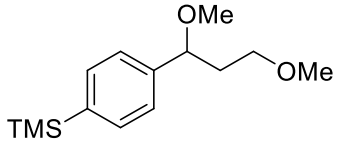
1-(1,3-Dimethoxypropyl)-4-methoxybenzene (51). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) to give **51** as colorless oil. Isolated yield = 74%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.23 – 7.17 (m, 2H), 6.91 – 6.84 (m, 2H), 4.21 (dd, *J* = 7.9, 6.0 Hz, 1H), 3.79 (s, 3H), 3.47 – 3.42 (m, 1H), 3.33 – 3.24 (m, 4H), 3.17 (s, 3H), 2.14 – 1.74 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 159.21, 134.03, 128.00, 113.91, 80.33, 69.39, 58.74, 56.51, 55.35, 38.16. HRMS (ESI) m/z calculated for $C_{12}H_{19}O_3$ $(M+H)^+$: 211.13287, found: 211.13254.



1-(1,3-Dimethoxypropyl)-4-phenoxybenzene (52). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) to give **52** as colorless oil. Isolated yield = 93%, reaction time 50 min, Electricity = 2 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.37 – 7.30 (m, 2H), 7.28 – 7.21 (m, 2H), 7.13 – 7.06 (m, 1H), 7.04 – 6.95 (m, 4H), 4.26 (dd, *J* = 8.0, 5.8 Hz, 1H), 3.52 – 3.45 (m, 1H), 3.38 – 3.27 (m, 4H), 3.21 (s, 3H), 2.14 – 1.78 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-d) δ 157.24, 156.84, 136.80, 129.84, 128.14, 123.40, 119.06, 118.76, 80.27, 69.26, 58.73, 56.68, 38.19. HRMS (ESI) m/z calculated for $C_{17}H_{20}O_3Na$ $(M+Na)^+$: 295.13047, found: 295.13041.

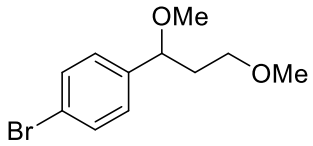


1-(Tert-butyl)-4-(1,3-dimethoxypropyl)benzene (53). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **53** as colorless oil. Isolated yield = 85%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.35 (d, *J* = 8.4 Hz, 2H), 7.21 (d, *J* = 8.3 Hz, 2H), 4.25 (dd, *J* = 8.1, 5.6 Hz, 1H), 3.56 – 3.46 (m, 1H), 3.36 – 3.28 (m, 4H), 3.20 (s, 3H), 2.14 – 1.70 (m, 2H), 1.31 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 150.52, 138.96, 126.42, 125.39, 80.51, 69.40, 58.73, 56.77, 38.19, 34.62, 31.51. HRMS (ESI) m/z calculated for $C_{15}H_{24}O_2Na$ $(M+Na)^+$: 259.16685, found: 259.16656.

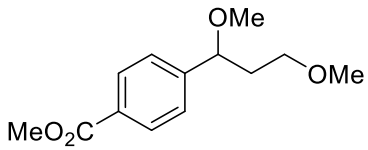


(4-(1,3-Dimethoxypropyl)phenyl)trimethylsilane (54). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **54** as colorless oil. Isolated yield = 85%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.53 – 7.46 (m, 2H), 7.31 – 7.25 (m, 2H), 4.27 (dd, *J* = 8.2, 5.5 Hz, 1H), 3.55 – 3.45 (m, 1H), 3.40 – 3.28

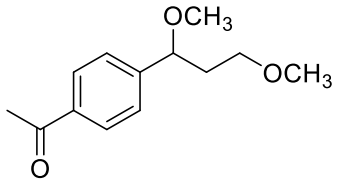
(m, 4H), 3.21 (s, 3H), 2.12 – 1.79 (m, 2H), 0.26 (s, 9H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 142.71, 139.74, 133.58, 126.11, 80.75, 69.31, 58.74, 56.89, 38.28, -0.96. HRMS (ESI) m/z calculated for $C_{14}H_{24}O_2SiNa$ $(M+Na)^+$: 275.14378, found: 275.14359.



1-Bromo-4-(1,3-dimethoxypropyl)benzene (55). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 30:1) to give **55** as colorless oil. Isolated yield = 95%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.46 (dd, *J* = 8.1, 1.5 Hz, 2H), 7.16 (dd, *J* = 8.2, 1.5 Hz, 2H), 4.24 (dd, *J* = 7.8, 6.1 Hz, 1H), 3.50 – 3.41 (m, 1H), 3.38 – 3.21 (m, 4H), 3.18 (s, 3H), 2.08 – 1.72 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 141.21, 131.67, 128.47, 121.42, 80.15, 69.00, 58.73, 56.83, 38.16. HRMS (ESI) m/z calculated for $C_{11}H_{26}BrO_2$ $(M+H)^+$: 259.03282, found: 259.03278.

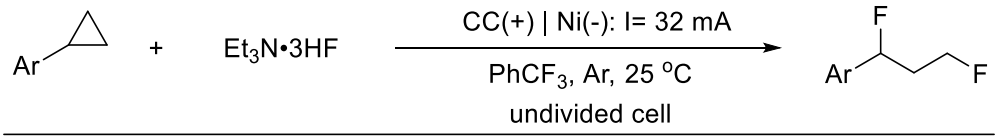


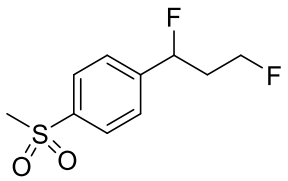
Methyl 4-(1,3-dimethoxypropyl)benzoate (**56**). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) to give **56** as colorless oil. Isolated yield = 85%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.95 (d, *J* = 8.3 Hz, 2H), 7.30 (d, *J* = 8.3 Hz, 2H), 4.28 (dd, *J* = 8.1, 5.6 Hz, 1H), 3.84 (s, 3H), 3.45 – 3.39 (m, 1H), 3.26 – 3.17 (m, 4H), 3.15 (s, 3H), 2.11 – 1.67 (m, 2H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 167.05, 147.60, 129.91, 129.58, 126.67, 80.38, 68.94, 58.74, 57.02, 52.17, 38.15. HRMS (ESI) m/z calculated for $C_{13}H_{18}O_4Na$ $(M+Na)^+$: 261.10973, found: 261.10965.



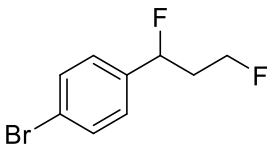
1-(4-(1,3-Dimethoxypropyl)phenyl)ethan-1-one (57). The crude residue was purified by flash column chromatography on silica gel (petroleum ether : ethyl acetate = 20:1) to give **57** as colorless oil. Isolated yield = 84%, Electricity = 2.4 F mol^{-1}. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.93 – 7.86 (m, 2H), 7.39 – 7.36 (m, 2H), 4.33 (dd, *J* = 8.2, 5.5 Hz, 1H), 3.50 – 3.44 (m, 1H), 3.34 – 3.23 (m, 4H), 3.19 (s, 3H), 2.57 (s, 3H), 2.08 – 1.94 (m, 1H), 1.84 – 1.76 (m, 1H). ^{13}C NMR (101 MHz, Chloroform-*d*) δ 197.92, 147.85, 136.65, 128.70, 126.84, 80.33, 68.92, 58.74, 57.05, 38.14, 26.72. HRMS (ESI) m/z calculated for $C_{13}H_{19}O_3$ $(M+H)^+$: 223.13287, found: 223.13293.

7) General procedure for gram scale reaction

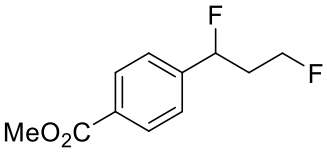




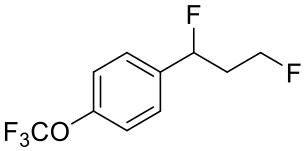
6, 6 mmol,1,26 g, 90%
Reaction time : 32 h



10, 8 mmol, 1.18 g, 63%
Reaction time : 25 h



14, 8 mmol, 1.11g, 65%
Reaction time : 75 h



22, 8 mmol, 1.21g, 63%
Reaction time : 25 h

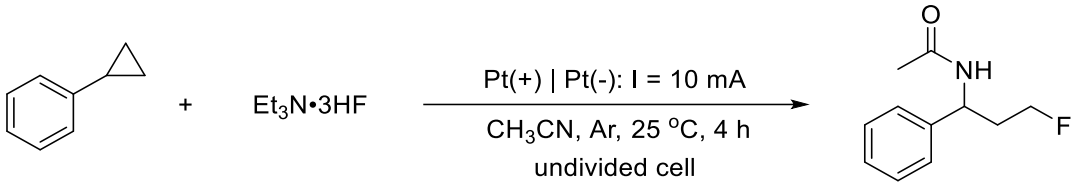
An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped carbon cloth (20 mm×25mm) as the anode and nickel foam (20 mm×25 mm) as the cathode and then charged with argon gas by glove box. Arylcyclopropane (6 or 8 mmol), $Et_3N{\cdot}3HF$ (14.5 mmol, 2.4 mL) and $PhCF_3$ (9.6 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 32 mA under room temperature. Then, the reaction was diluted with water. The organic layer was extracted with CH_2Cl_2, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.

8) Mechanistic study

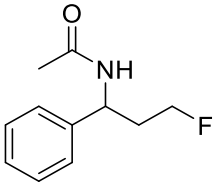
Cyclic voltammetry studies:

Cyclic voltammetry was performed in a three-electrode cell. The working electrode was a Pt electrode, the counter electrode a graphite rod. The reference was an Ag/AgCl electrode submerged in saturated aqueous KCl solution. CH_3CN (10 mL) containing 0.5 mmol $^nBu_4NBF_4$ was tested as blank background. The cyclic voltammogram of cyclopropanes (10 mM) were recorded at room temperature in an electrolyte of $^nBu_4NBF_4$ (50 mM) in MeCN. The scan rate is 100 mV/s.

Trap of benzyl carbonium intermediate:



An oven-dried undivided three-necked bottle equipped with a stir bar. The bottle was equipped platinum plate (15 mm ×15 mm ×0.3 mm) as the anode and platinum plate (15 mm ×15 mm ×0.3 mm) as the cathode and then charged with argon gas by glove box. Phenylcyclopropane (0.5 mmol), $Et_3N{\cdot}3HF$ (1.2 mL) and CH_3CN (4.8 mL) were added. The reaction mixture was stirred and electrolyzed at a constant current of 10 mA under room temperature for 4 h. The reaction was diluted with water. The organic layer was extracted with CH_2Cl_2, dried with anhydrous Na_2SO_4, filtered, and concentrated under reduced pressure. The pure product was obtained by flash column chromatography on silica gel.

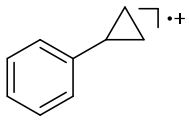


N-(3-fluoro-1-phenylpropyl)acetamide (58). After work-up, the crude residue was purified by flash column chromatography on silica gel (petroleum ether: ethyl acetate: Et_3N = 50:100:0.15) to give product as yellow solid**.** Yield = 43%, electricity = 2.9 F mol^{-1}. ^1H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.22 (m, 5H), 7.00 (d, *J* = 8.0 Hz, 1H), 5.14 (td, *J* = 7.6, 7.2 Hz, 1H), 4.54 – 4.26 (m, 2H), 2.19 – 2.05 (m, 2H), 1.92 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 169.84, 141.47, 128.70, 127.47, 126.49, 81.35 (d, *J* = 164.3 Hz), 50.40 (d, *J* = 4.5 Hz), 36.62 (d, *J* = 19.4 Hz), 23.20. ^{19}F NMR (377 MHz, $CDCl_3$) δ -219.44. HRMS (ESI) m/z calculated for $C_{11}H_{15}FNO$ $(M+H)^+$: 196.11322, found: 196.11252.

9) General Computational Calculation Details

DFT calculations were performed using the M06-2x method[12] with the Gaussian09 program[13]. The 6-311G(d,p) basis set was used for all the elements and $PhCF_3$ was employed as the solvent during the geometry optimization by using SMD model[14]. For the integration grid in the calculations, the parameter int = ultrafine was used. Frequency calculations at the same level of theory have been performed to identify all of the stationary points as minima (zero imaginary frequencies). Grimme's dispersion correction[15] was used during the calculations.

The electrostatic potential surface was generated using Multiwfn[16] and VMD[17].



Thermal correction to Gibbs Free Energy= 0.129230

Sum of electronic and thermal Free Energies= -348.535613

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C	-0.14375600	-0.29413800	0.00052100
C	0.84908300	-1.32790600	0.00031600
C	2.18095900	-1.01290300	-0.00017700
C	2.57627800	0.33858700	-0.00038100
H	1.94814200	2.40616400	0.00000100
H	-0.44652700	1.87386500	0.00085100
H	0.51957000	-2.36003500	0.00049100
H	2.93191100	-1.79277600	-0.00040500
H	3.63070700	0.58715800	-0.00084800
C	-1.51210600	-0.67278800	0.00039600
C	-2.58575300	0.22935600	0.72172500
C	-2.58499700	0.22902900	-0.72264200
H	-1.73075600	-1.73159200	0.00047600
H	-2.17595700	1.07541000	1.25681100
H	-3.30404000	-0.38161800	1.25365300
H	-3.30264600	-0.38216900	-1.25518300
H	-2.17456500	1.07478500	-1.25773400

References

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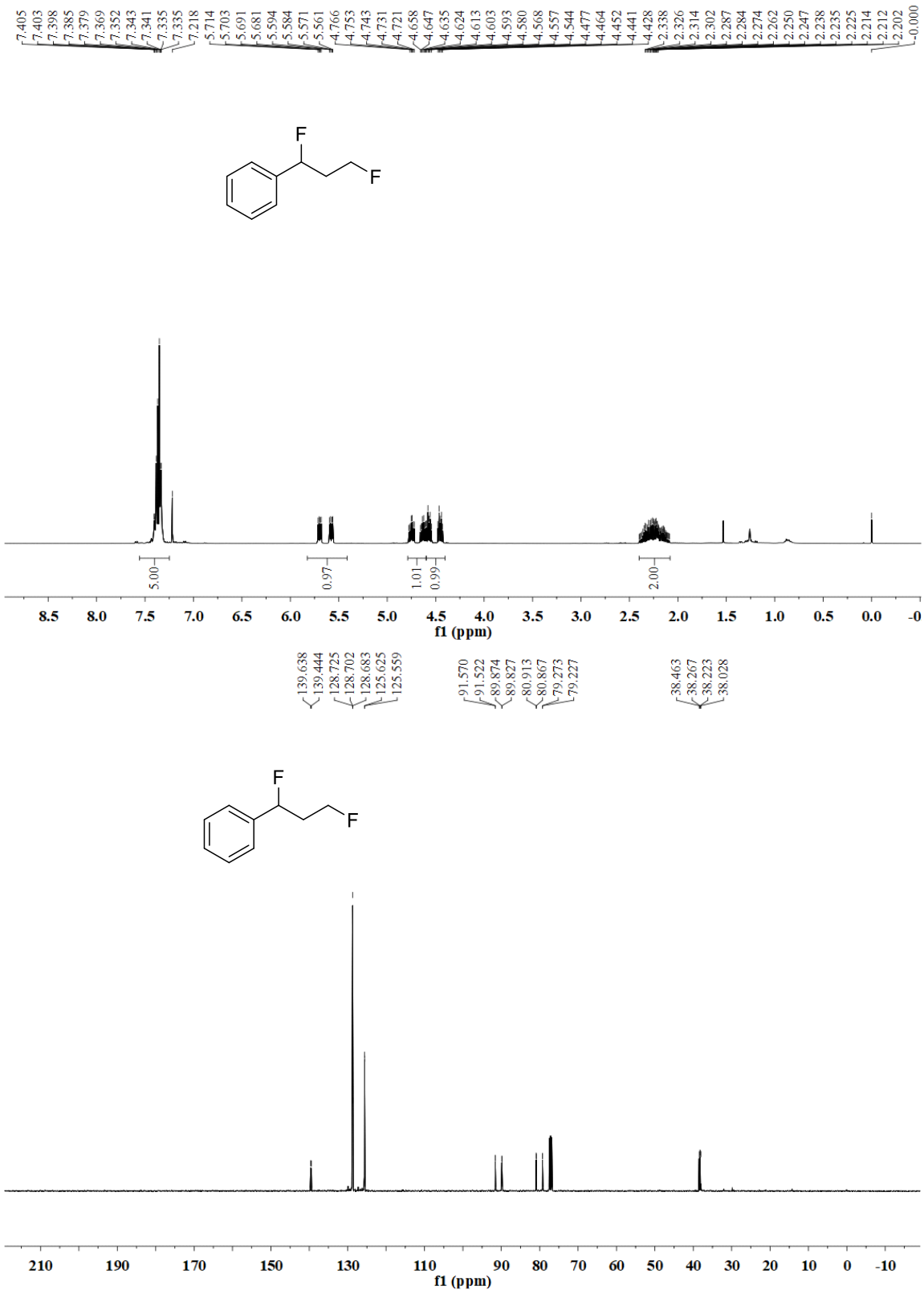
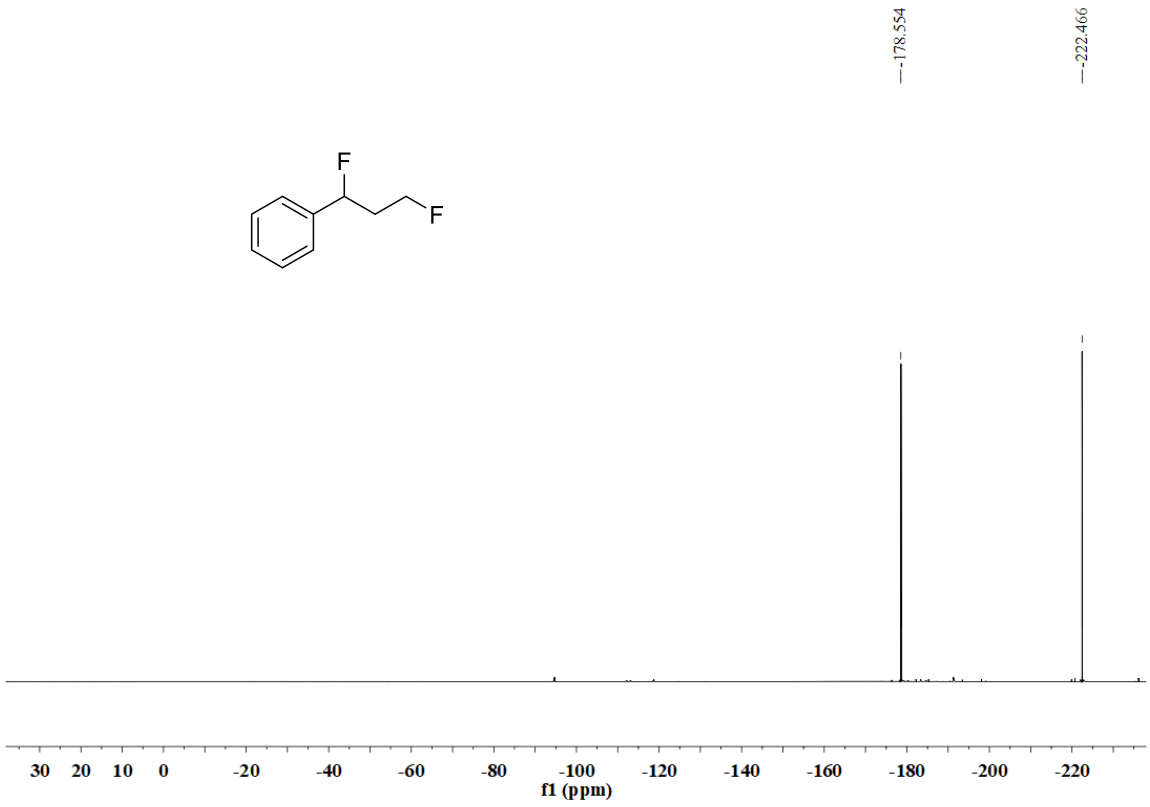
NMR Spectra of Products

2

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30
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-140
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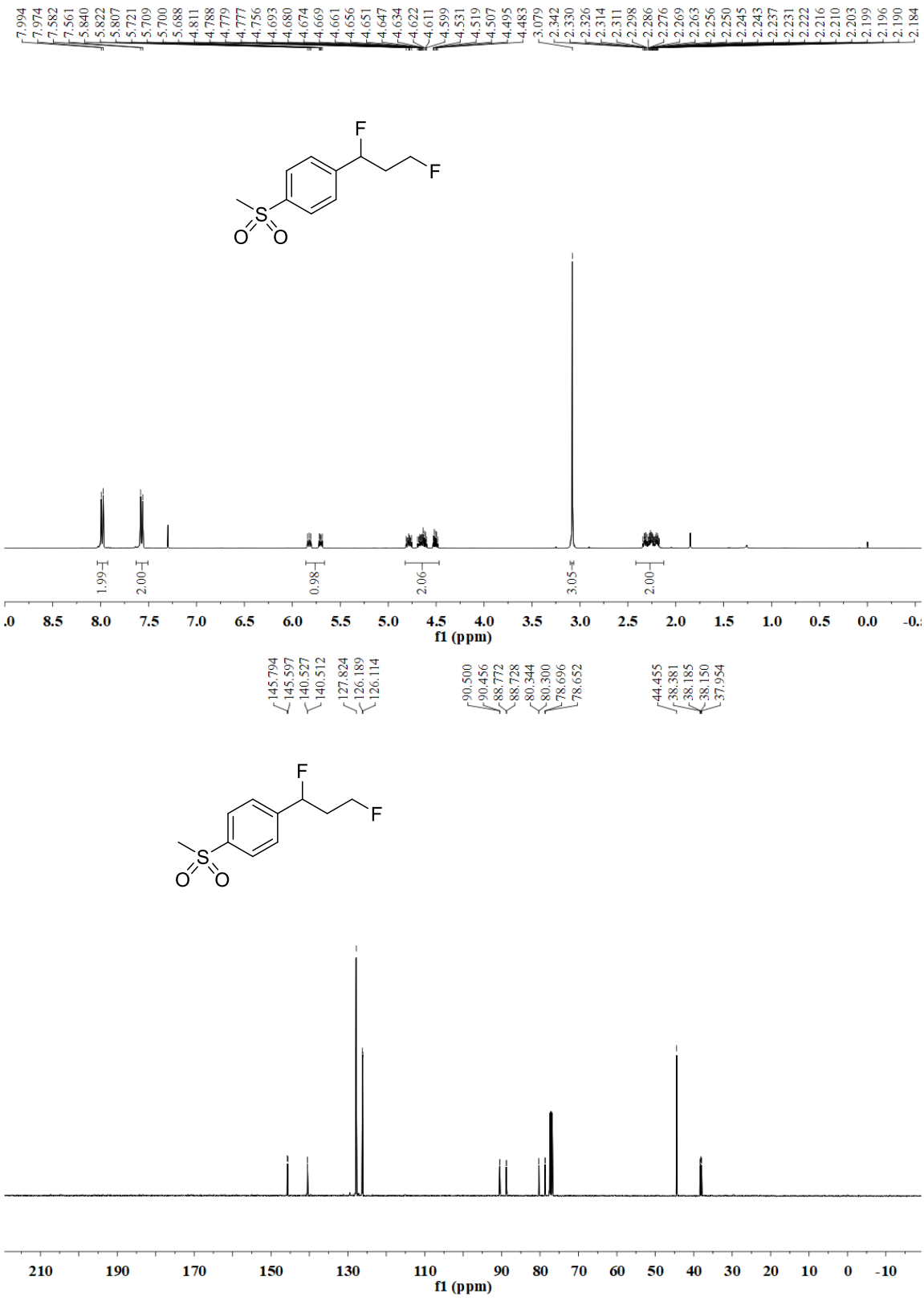
-180
-200
-220
f1 (ppm)

6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4.788
4.779
4.777
4.756
4.693
4.680
4.674
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4.656
4.651
4.647
4.634
4.622
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4.599
4.531
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4.495
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2.330
2.326
2.314
2.311
2.298
2.286
2.276
2.269
2.263
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2.250
2.245
2.243
2.237
2.231
2.222
2.216
2.210
2.203
2.199
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2.190
2.184
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F
S
O
O
1.99
2.00
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2.06
3.05
2.00
f1 (ppm)
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145.597
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126.114
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38.185
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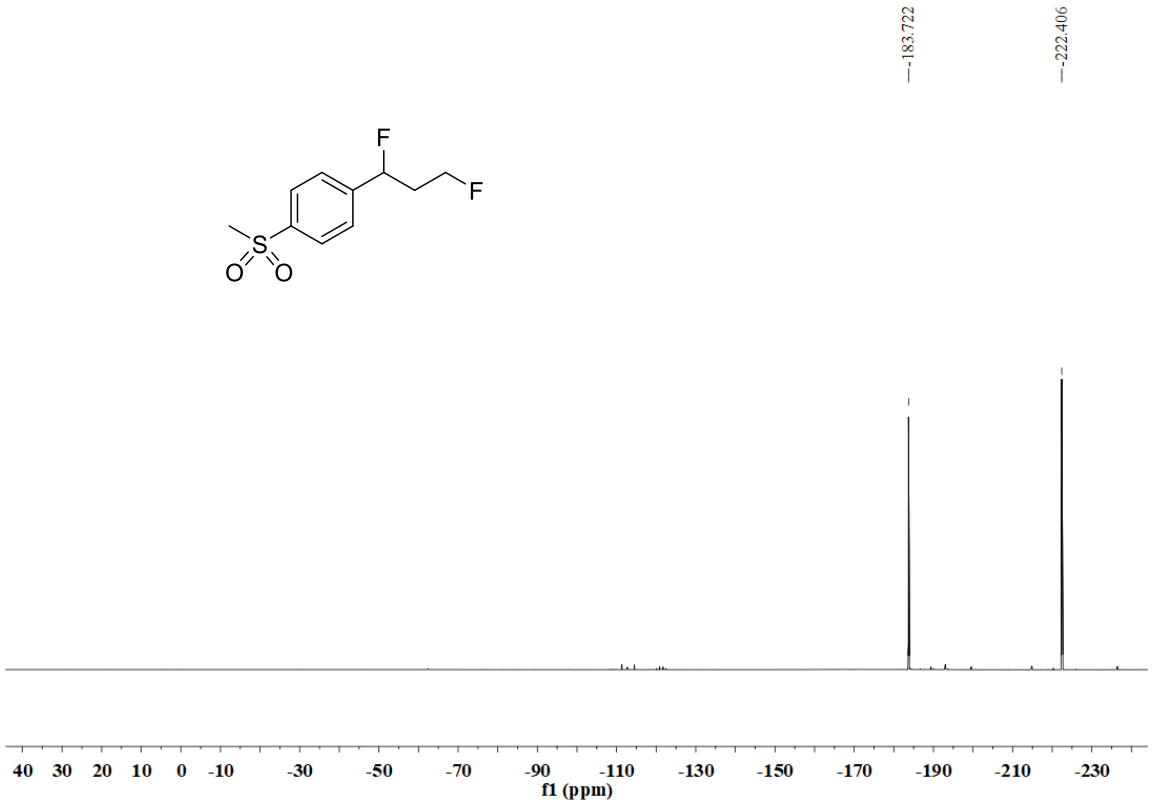
S
O
O
f1 (ppm)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O
O
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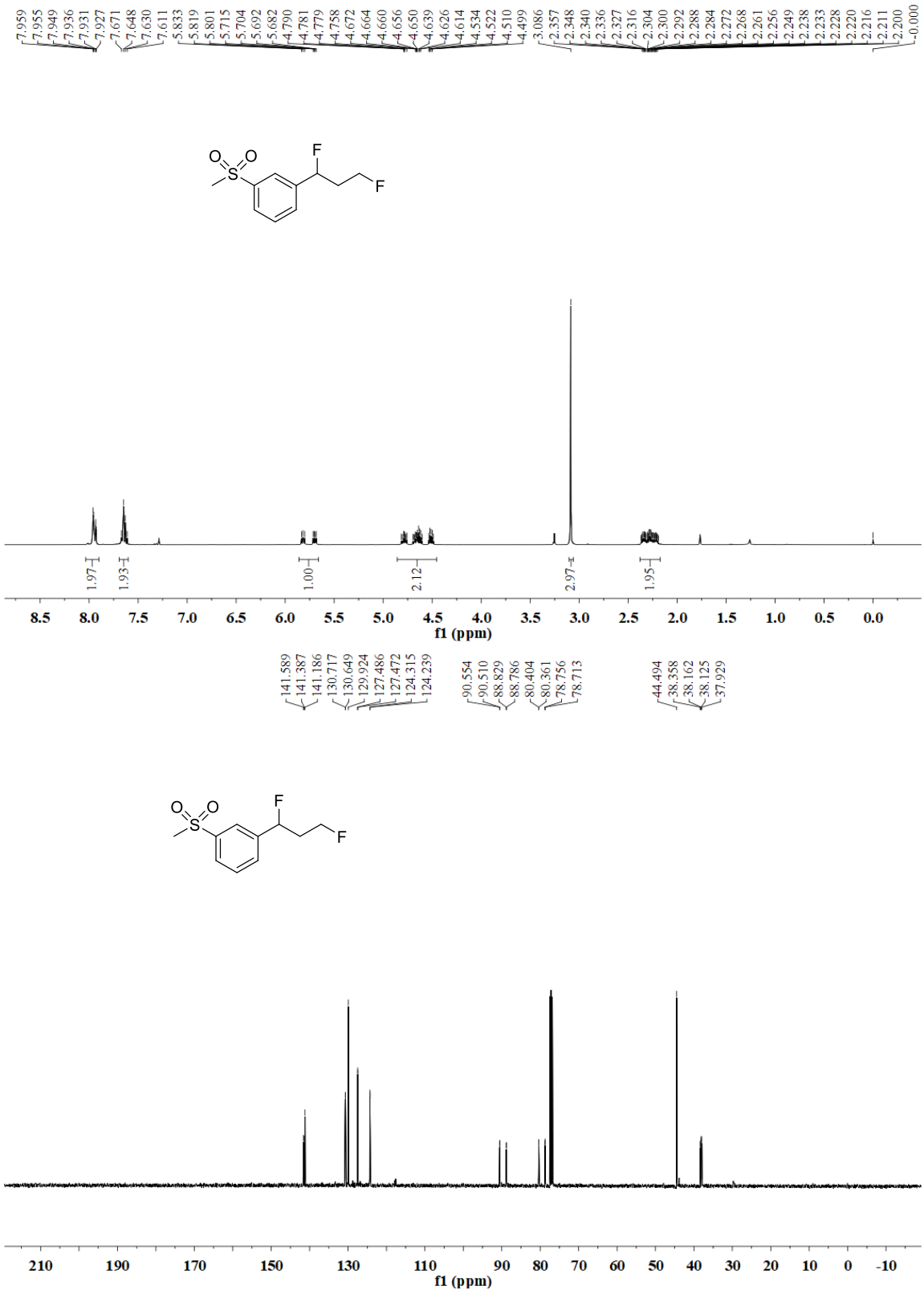
f1 (ppm)

7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S
O
F
F
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2.12
2.97
1.95
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6.5
6.0
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4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
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f1 (ppm)
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130.717
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127.472
124.315
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80.361
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38.162
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O
S
O
F
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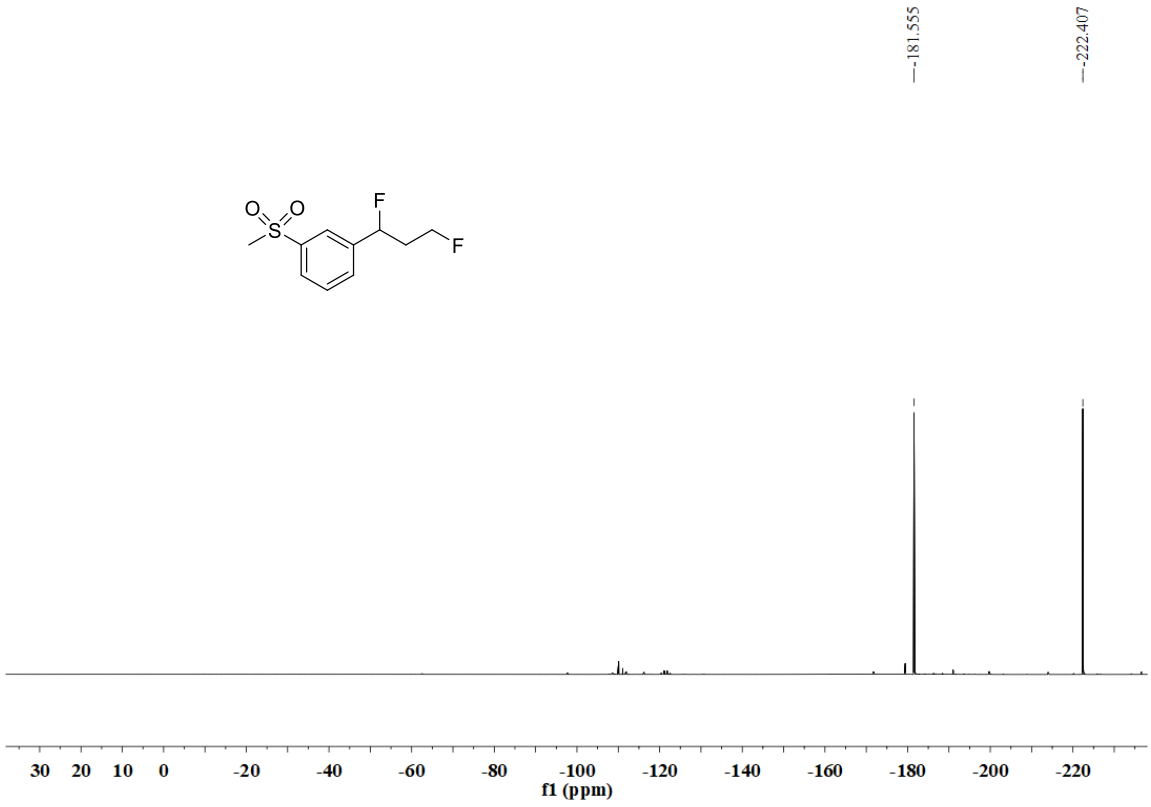
f1 (ppm)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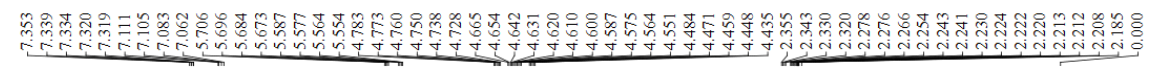
-200
-220
f1 (ppm)

8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4.738
4.728
4.665
4.654
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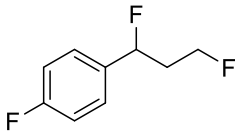
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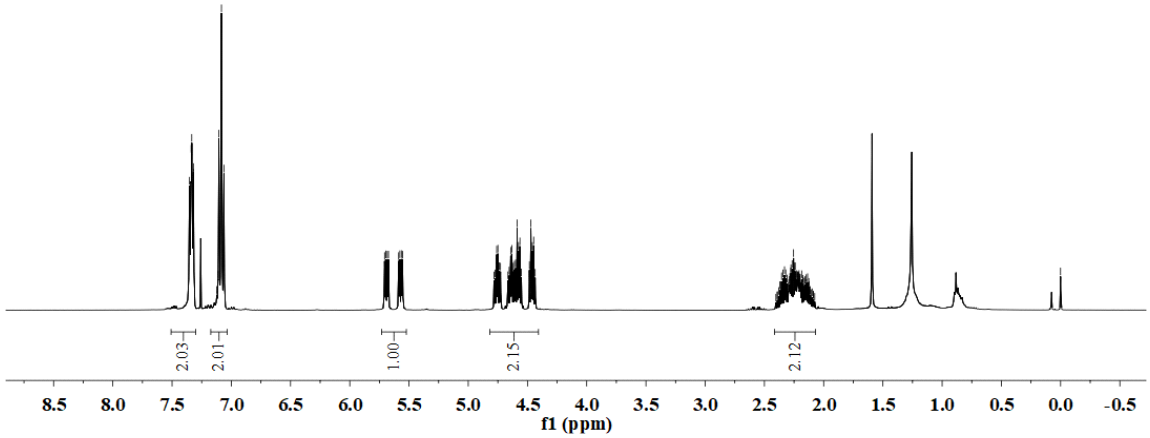
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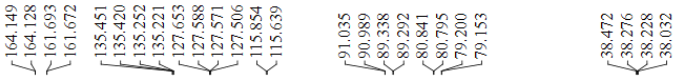
f1 (ppm)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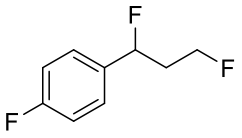
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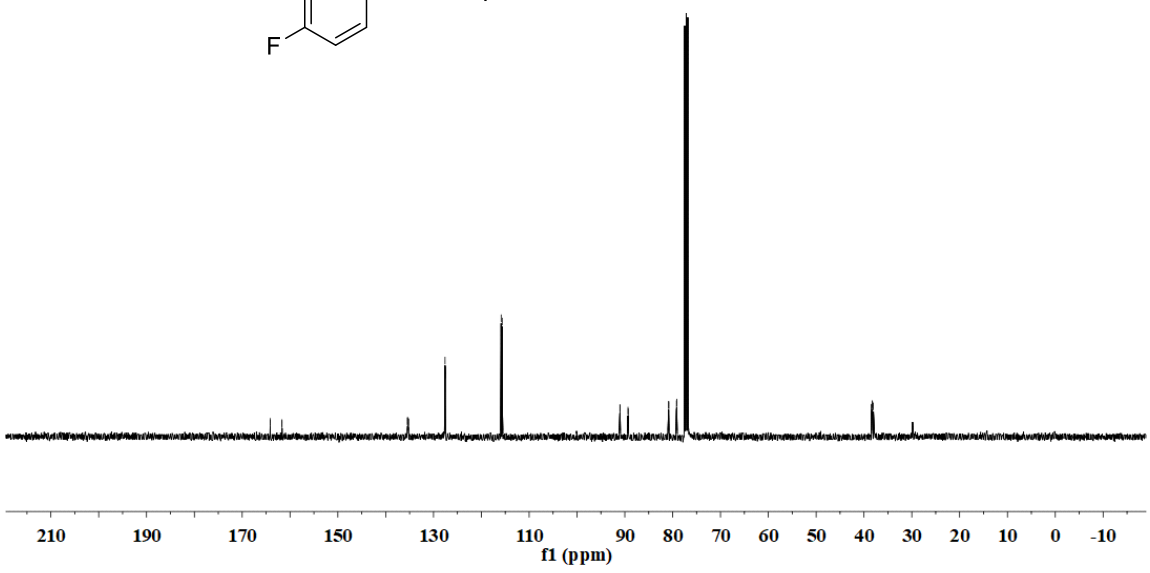
F
F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30
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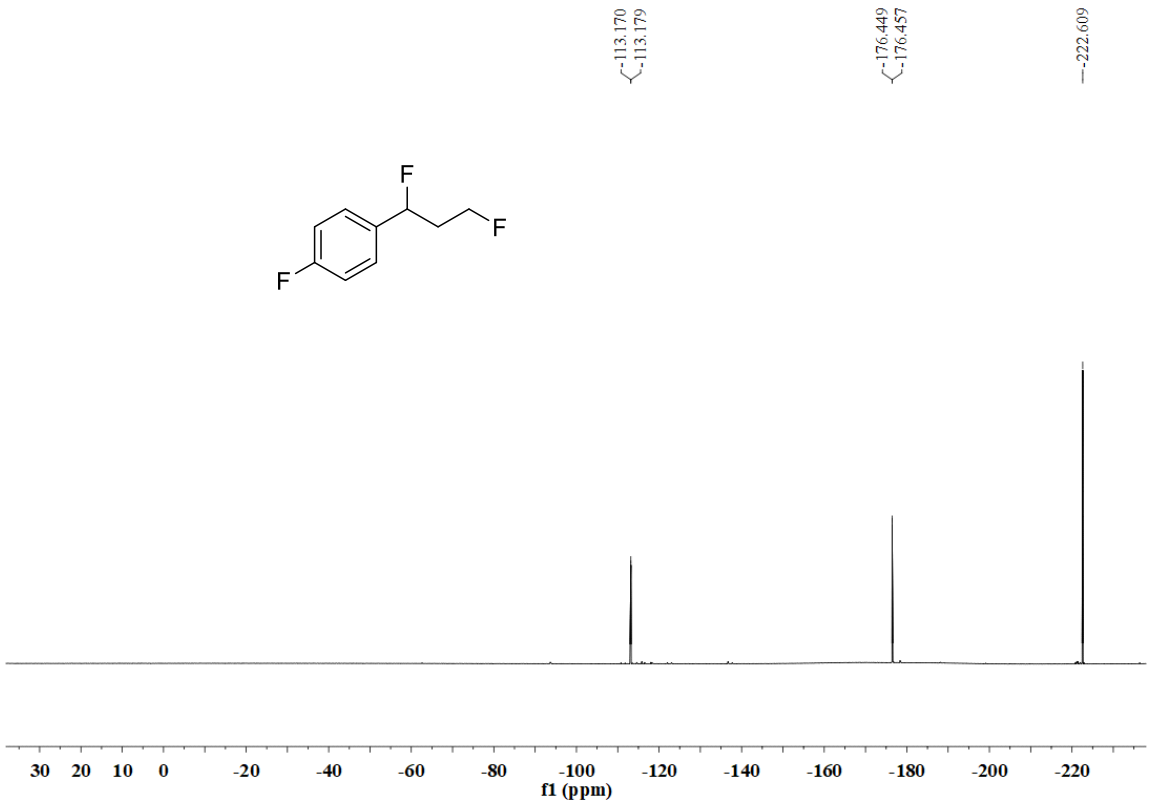
0
-10
f1 (ppm)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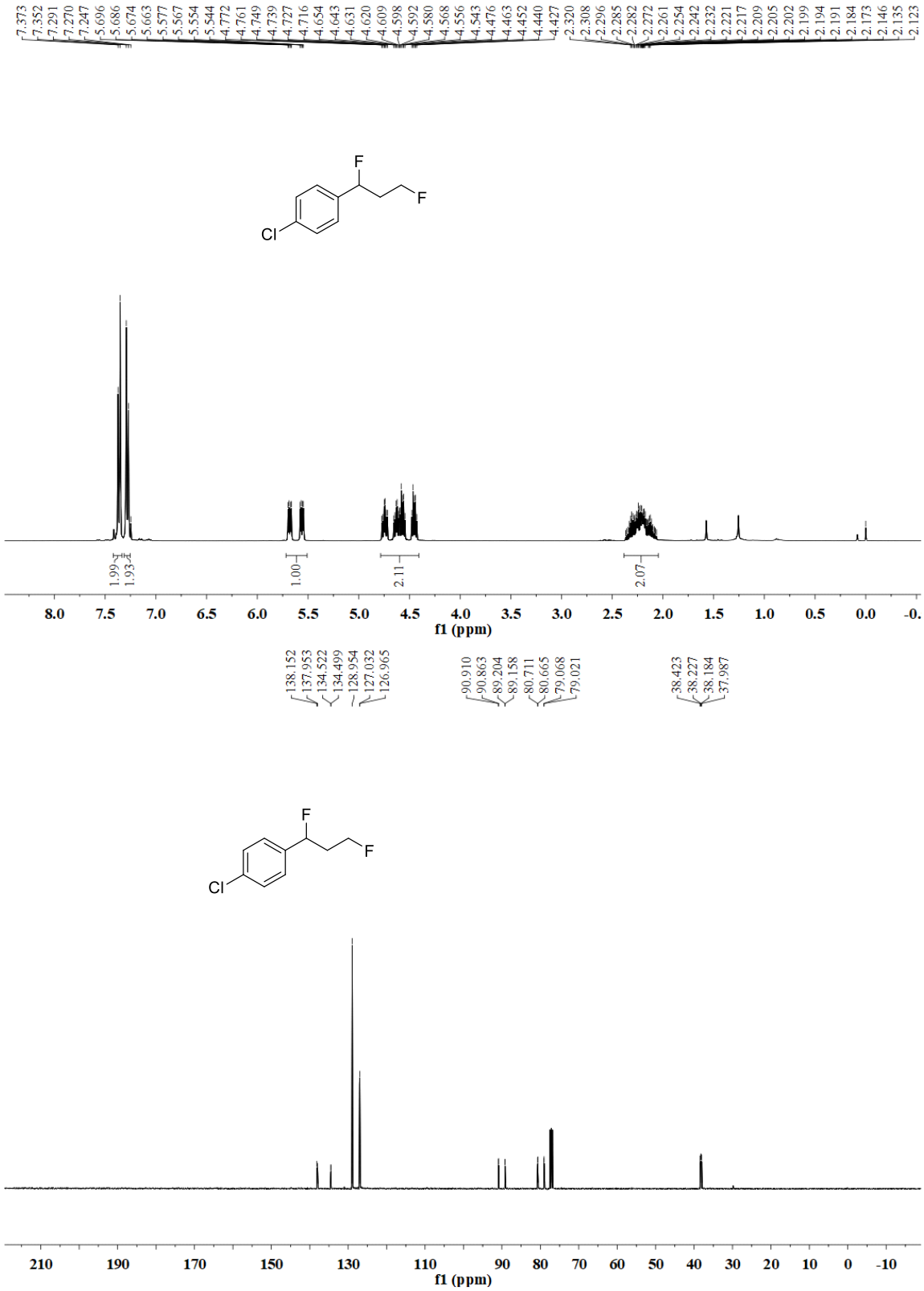
f1 (ppm)

9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F
F
Cl
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f1 (ppm)
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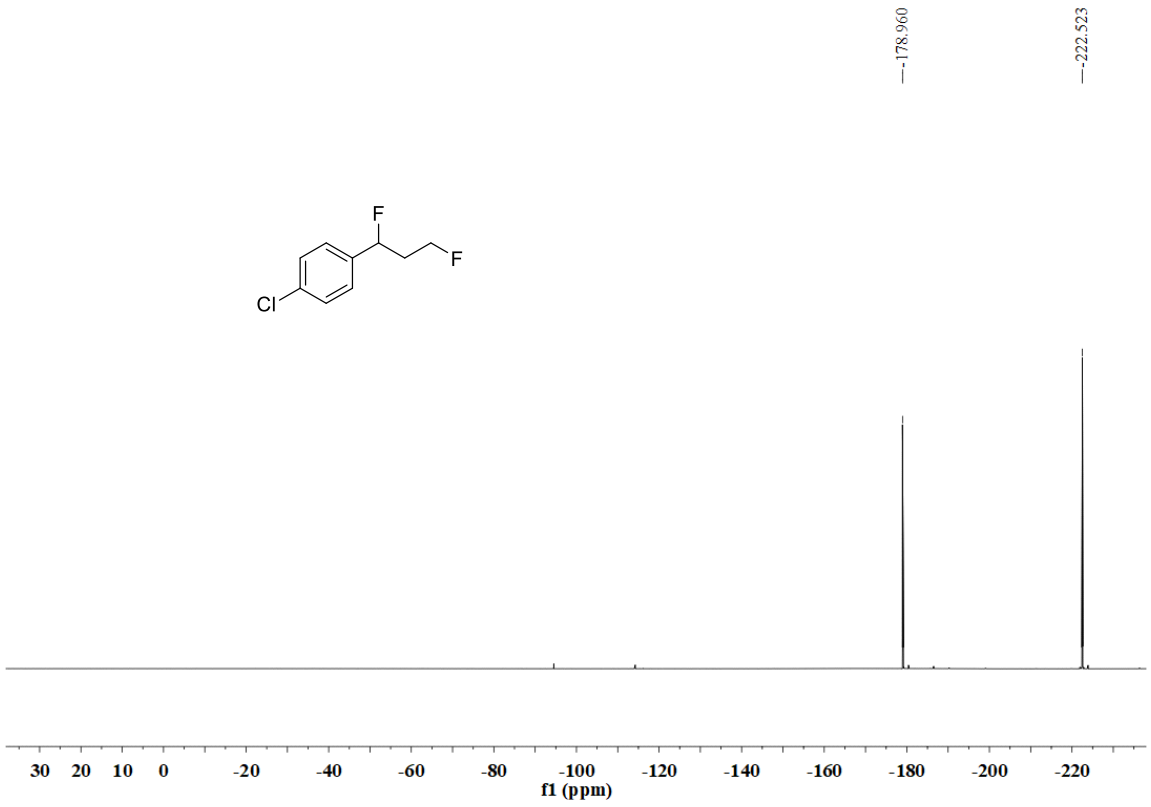
Cl
f1 (ppm)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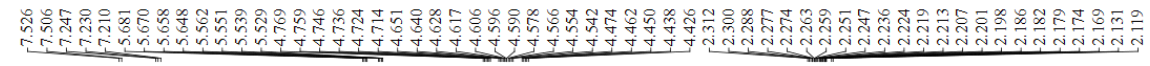
f1 (ppm)

10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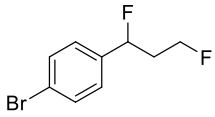
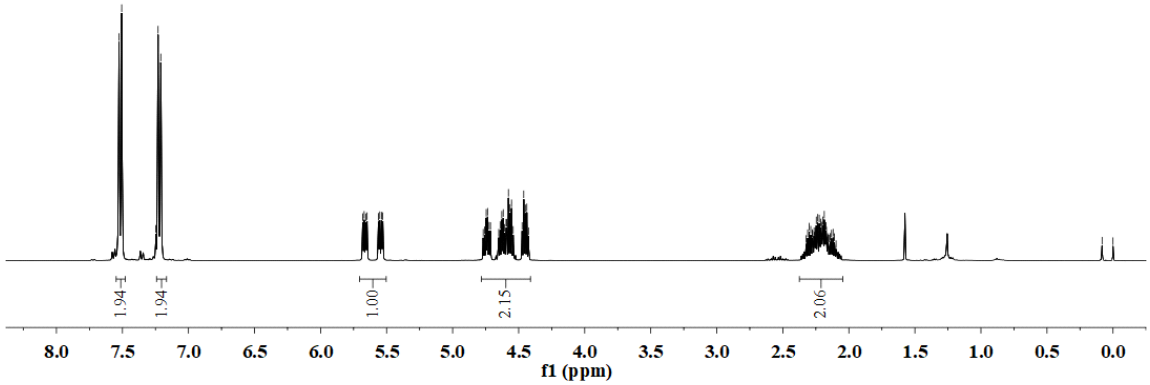
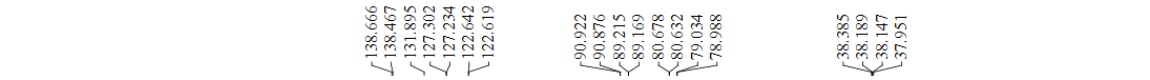
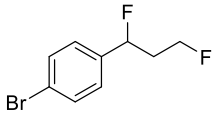
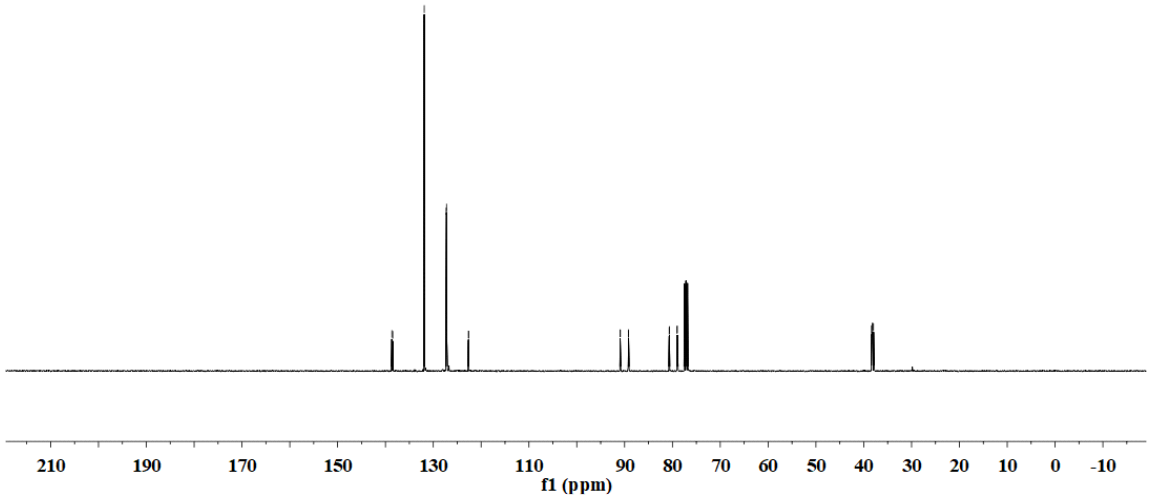
5.670
5.658
5.648
5.562
5.551
5.539
5.529
4.769
4.759
4.746
4.736
4.724
4.714
4.651
4.640
4.628
4.617
4.606
4.596
4.590
4.578
4.566
4.554
4.542
4.474
4.462
4.450
4.438
4.426
2.312
2.300
2.288
2.277
2.274
2.263
2.259
2.251
2.247
2.236
2.224
2.219
2.213
2.207
2.201
2.198
2.186
2.182
2.179
2.174
2.169
2.131
2.119

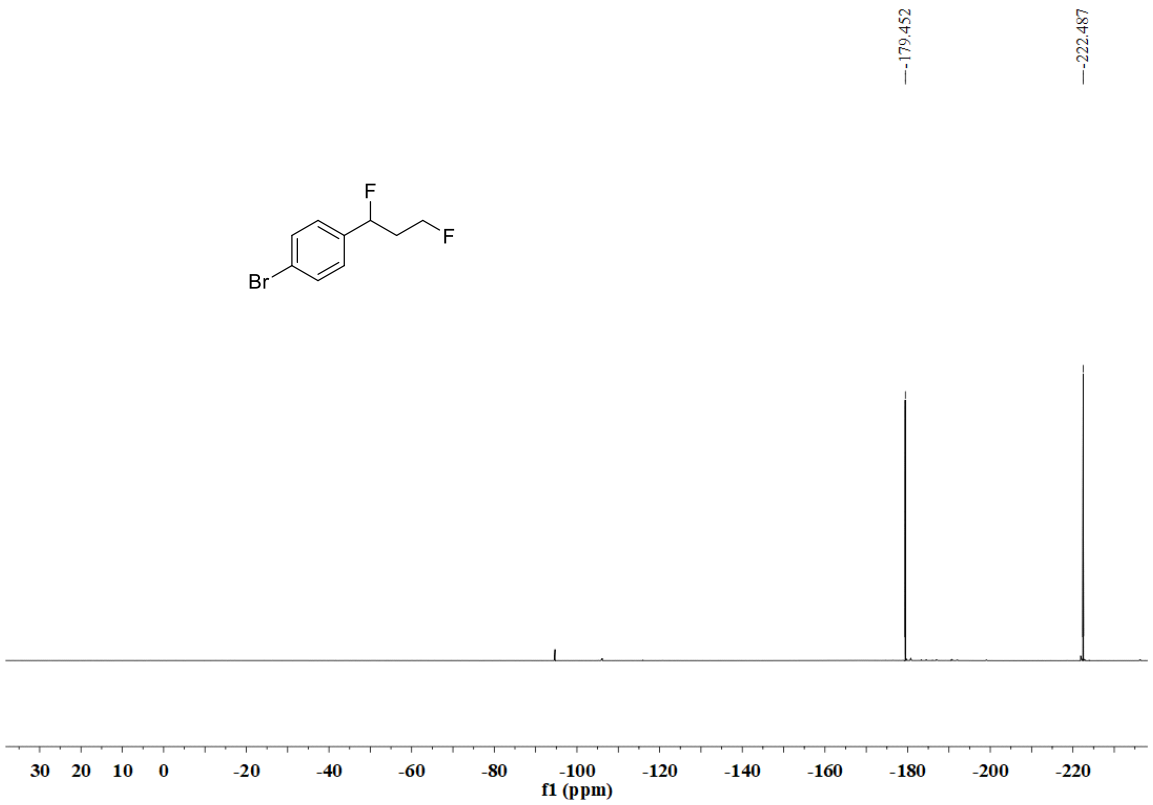

F
F
Br


1.94
1.94
1.00
2.15
2.06
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

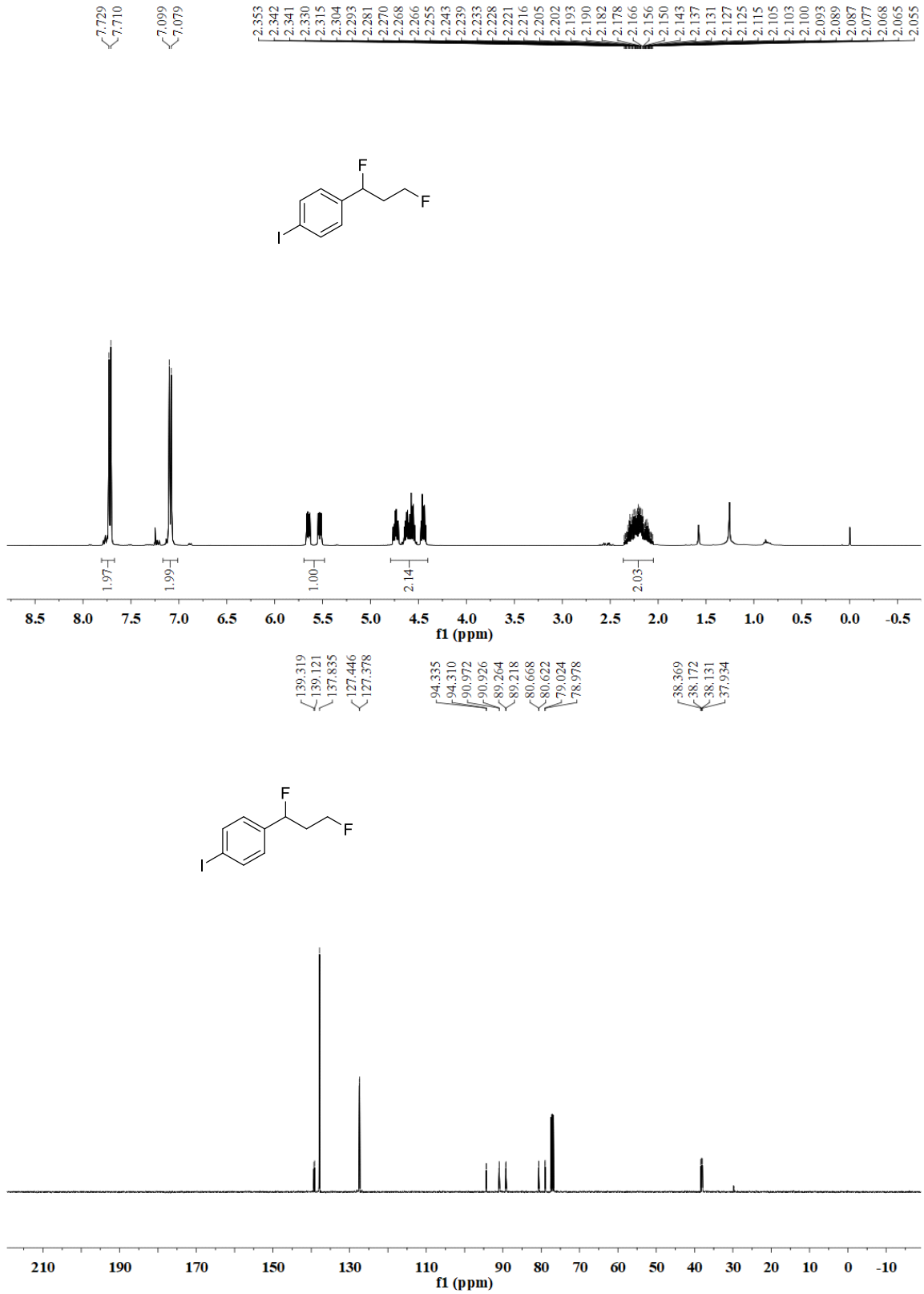

138.666
138.467
131.895
127.302
127.234
122.642
122.619
90.922
90.876
89.215
89.169
80.678
80.632
79.034
78.988
38.385
38.189
38.147
37.951


F
F
Br


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-179.452
-222.487
F
F
Br
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

11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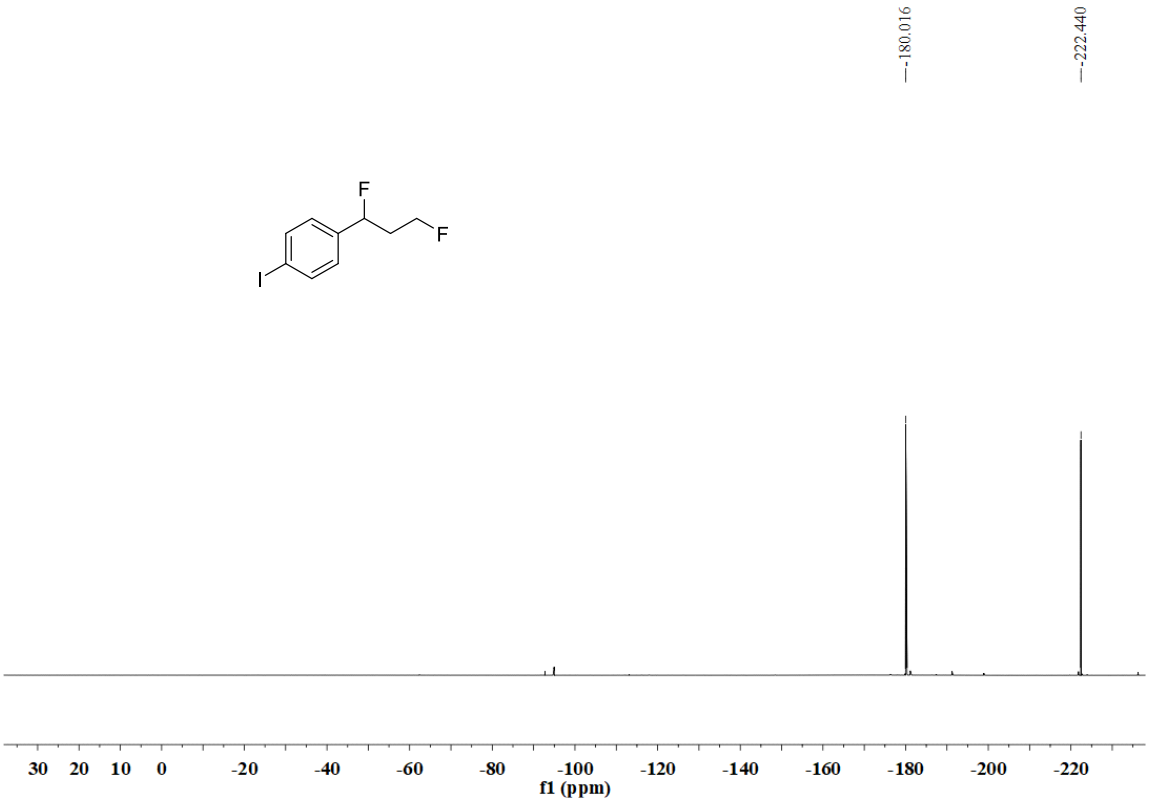
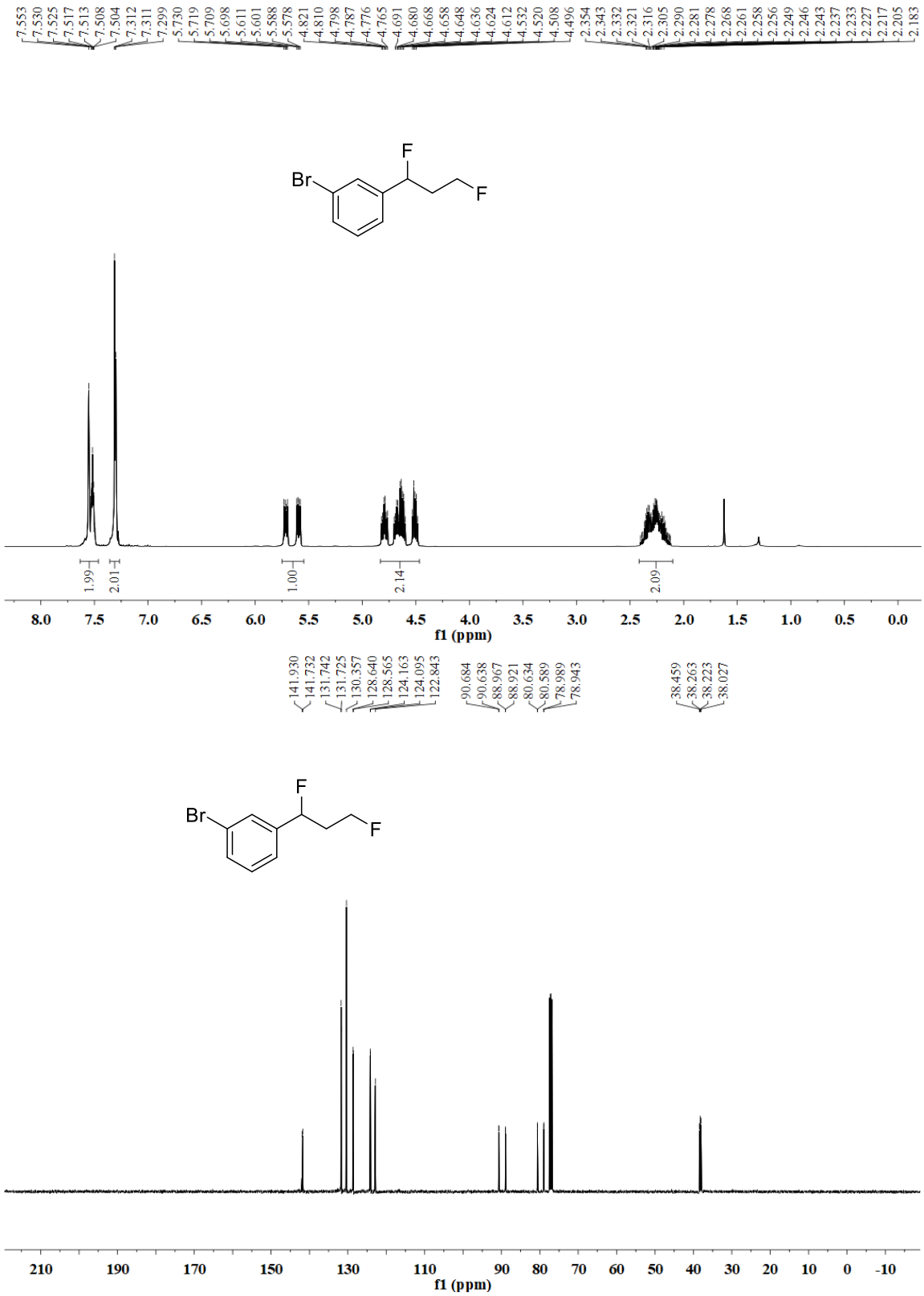
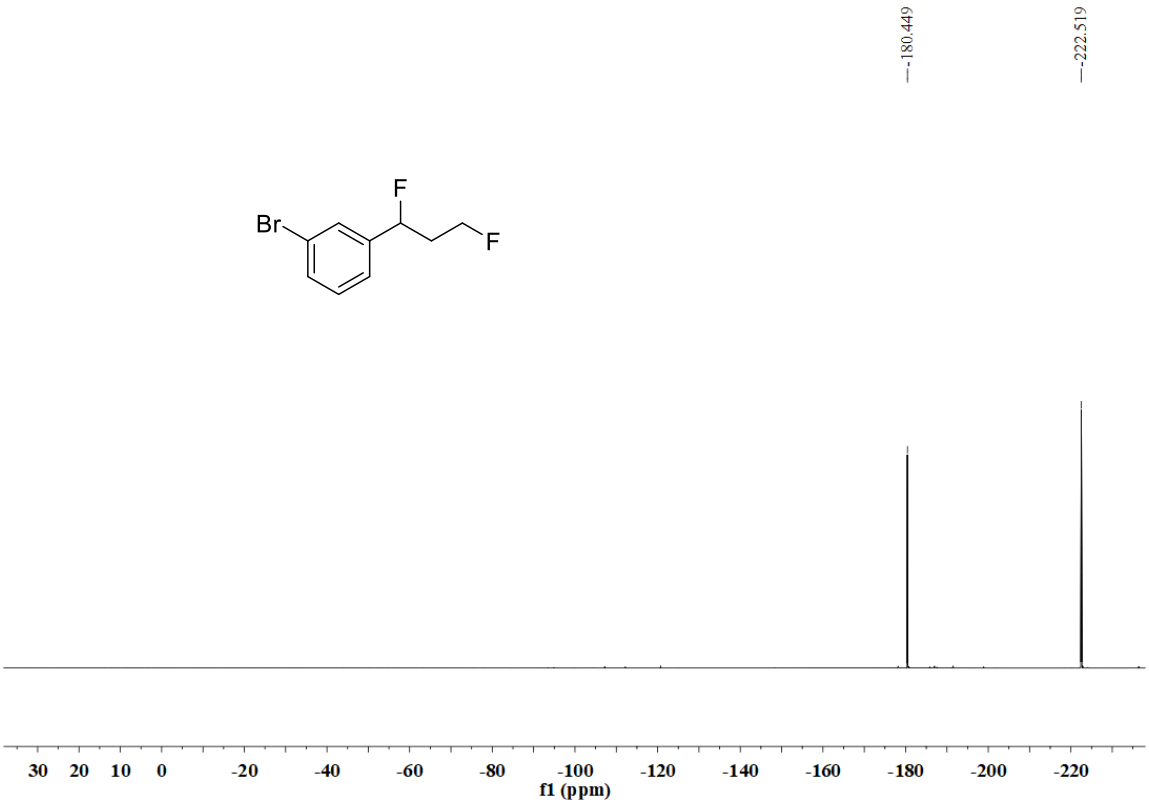
7.710
7.099
7.079
2.353
2.342
2.341
2.330
2.315
2.304
2.293
2.281
2.270
2.268
2.266
2.255
2.243
2.239
2.233
2.228
2.221
2.216
2.205
2.202
2.193
2.190
2.182
2.178
2.166
2.156
2.150
2.143
2.137
2.131
2.127
2.125
2.115
2.105
2.103
2.100
2.093
2.089
2.087
2.077
2.068
2.065
2.055
F
F
I
1.97
1.99
1.00
2.14
2.03
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)
139.319
139.121
137.835
127.446
127.378
94.335
94.310
90.972
90.926
89.264
89.218
80.668
80.622
79.024
78.978
38.369
38.172
38.131
37.934
F
F
I
210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

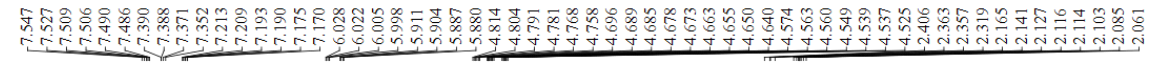

-180.016
-222.440
F
F
I
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

12


7.553
7.530
7.525
7.517
7.513
7.508
7.504
7.312
7.311
7.299
5.730
5.719
5.709
5.698
5.611
5.601
5.588
5.578
4.821
4.810
4.798
4.787
4.776
4.765
4.691
4.680
4.668
4.658
4.648
4.636
4.624
4.612
4.532
4.520
4.508
4.496
2.354
2.343
2.332
2.321
2.316
2.305
2.290
2.281
2.278
2.268
2.261
2.258
2.256
2.249
2.246
2.243
2.237
2.233
2.227
2.217
2.205
2.183
Br
F
F
1.99
2.01
1.00
2.14
2.09
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
141.930
141.732
131.742
131.725
130.357
128.640
128.565
124.163
124.095
122.843
90.684
90.638
88.967
88.921
80.634
80.589
78.989
78.943
38.459
38.263
38.223
38.027
Br
F
F
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-180.449
-222.519
F
Br
F
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

13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7.527
7.509
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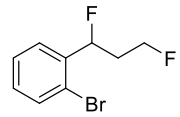
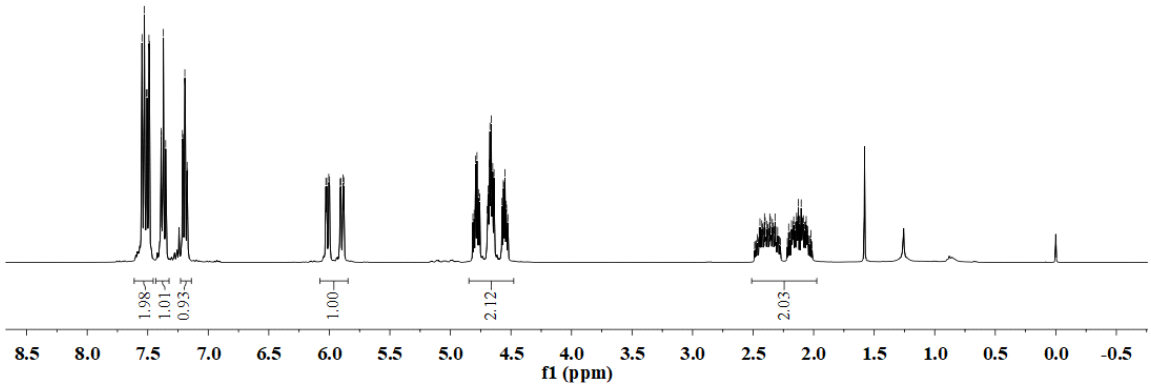
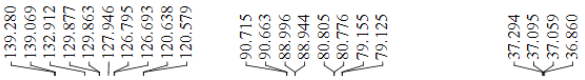
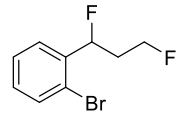
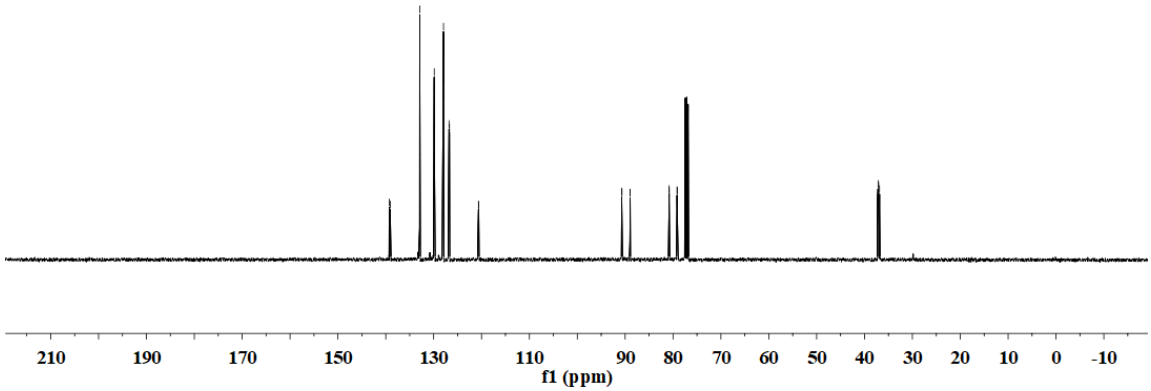
7.490
7.486
7.390
7.388
7.371
7.352
7.213
7.209
7.193
7.190
7.175
7.170
6.028
6.022
6.005
5.998
5.911
5.904
5.887
5.880
4.814
4.804
4.791
4.781
4.768
4.758
4.696
4.689
4.685
4.678
4.673
4.663
4.655
4.650
4.640
4.574
4.563
4.560
4.549
4.539
4.537
4.525
2.406
2.363
2.357
2.319
2.165
2.141
2.127
2.116
2.114
2.103
2.085
2.061

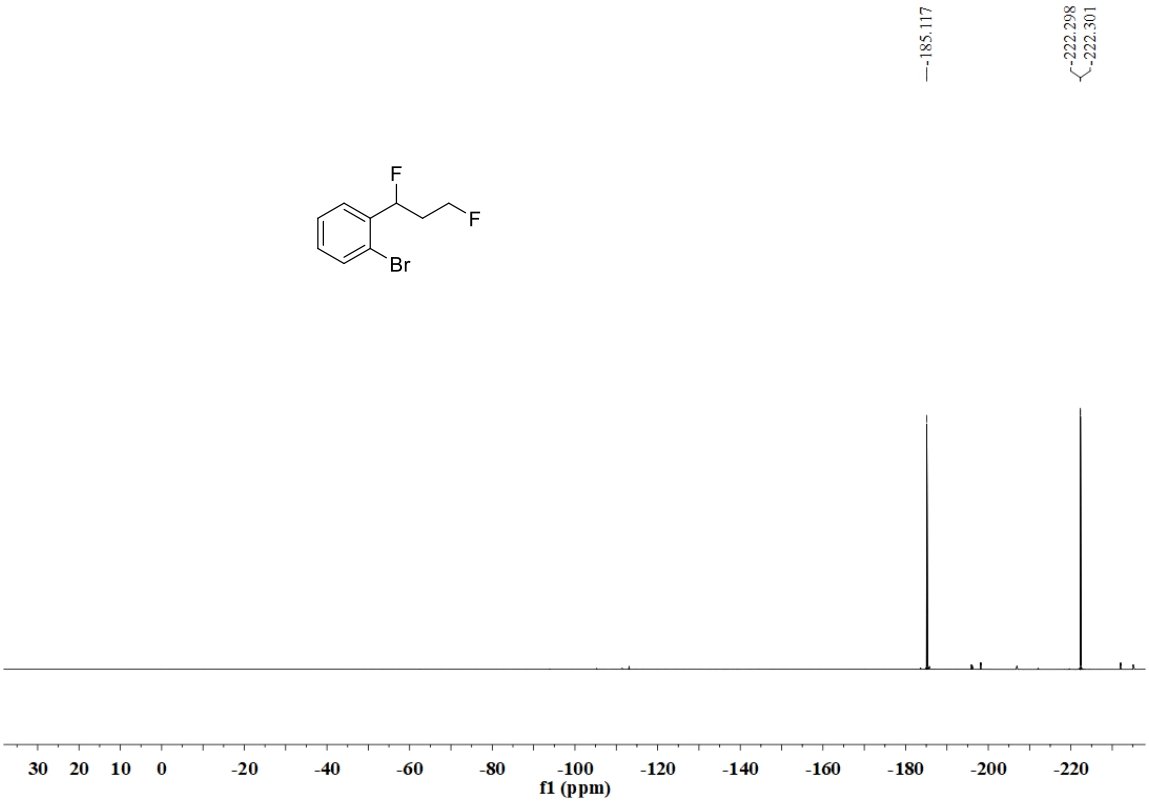

F
F
Br


1.98
1.01
0.93
1.00
2.12
2.03
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

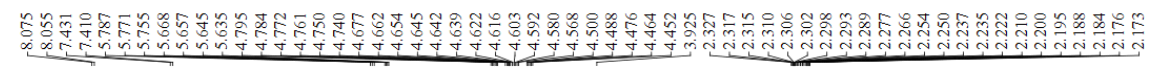

139.280
139.069
132.912
129.877
129.863
127.946
126.795
126.693
120.638
120.579
90.715
90.663
88.996
88.944
80.805
80.776
79.155
79.125
37.294
37.095
37.059
36.860


F
F
Br


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-185.117
-222.298
-222.301
F
F
Br
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

14


8.075
8.055
7.431
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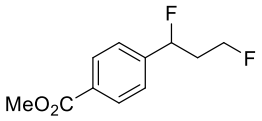
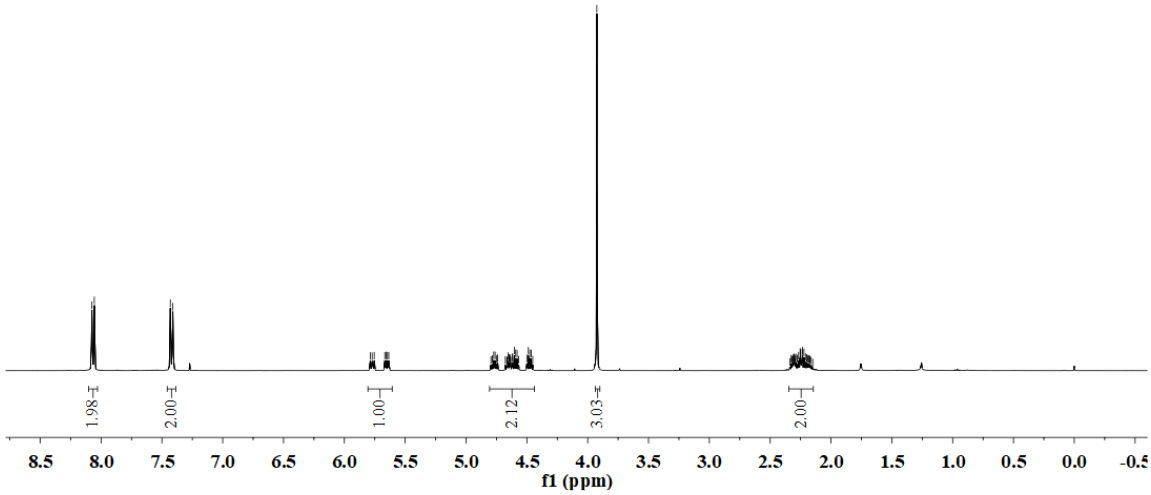
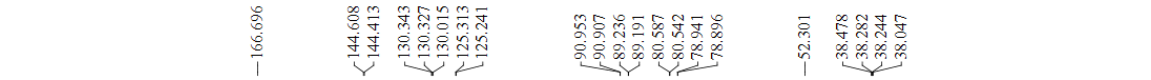
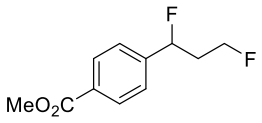
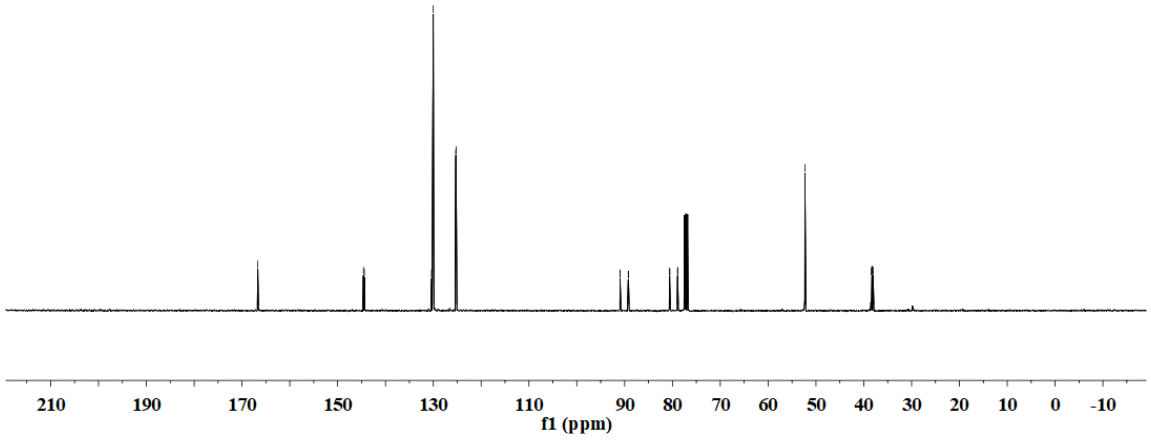
5.787
5.771
5.755
5.668
5.657
5.645
5.635
4.795
4.784
4.772
4.761
4.750
4.740
4.677
4.662
4.654
4.645
4.642
4.639
4.622
4.616
4.603
4.592
4.580
4.568
4.500
4.488
4.476
4.464
4.452
3.925
2.327
2.317
2.315
2.310
2.306
2.302
2.298
2.293
2.289
2.277
2.266
2.254
2.250
2.237
2.235
2.222
2.210
2.200
2.195
2.188
2.184
2.176
2.173

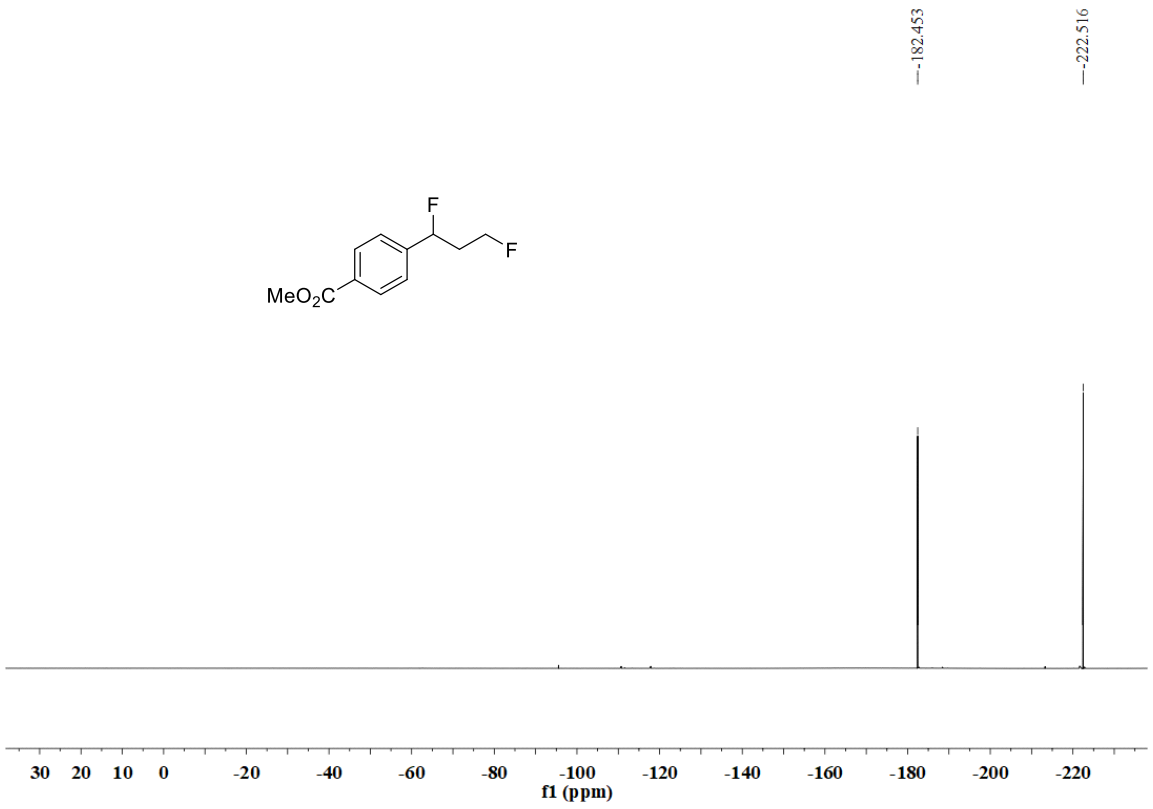

F
F
MeO2C


1.98
2.00
1.00
2.12
3.03
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


166.696
144.608
144.413
130.343
130.327
130.015
125.313
125.241
90.953
90.907
89.236
89.191
80.587
80.542
78.941
78.896
52.301
38.478
38.282
38.244
38.047


F
F
MeO2C


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-182.453
-222.516
F
F
MeO2C
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

15


8.083
8.063
7.427
7.407
5.786
5.773
5.753
5.666
5.656
5.644
5.634
4.792
4.781
4.769
4.758
4.747
4.736
4.651
4.641
4.639
4.618
4.612
4.600
4.588
4.576
4.564
4.496
4.484
4.472
4.460
4.448
4.413
4.395
4.377
4.359
2.325
2.316
2.314
2.304
2.298
2.294
2.287
2.275
2.264
2.252
2.248
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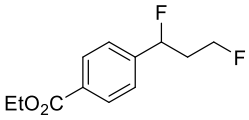
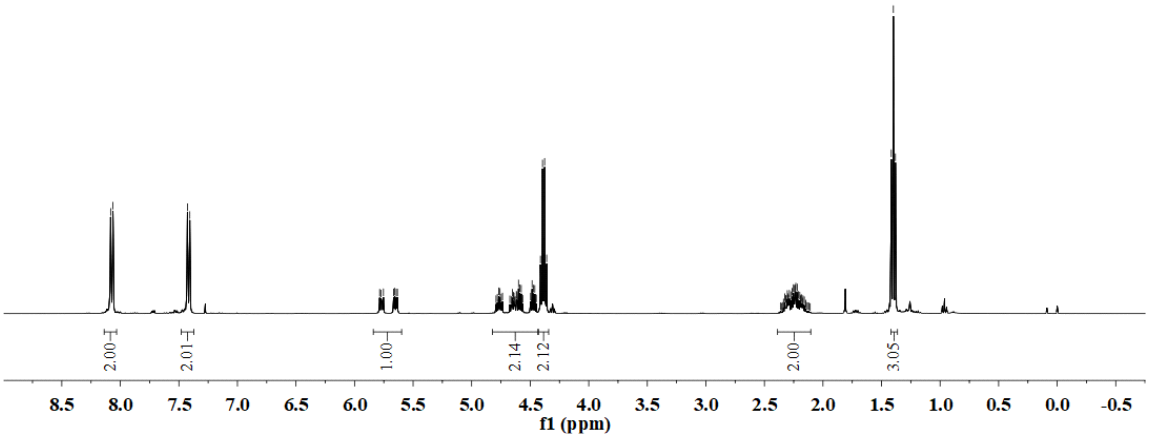
1.381


F
F
EtO2C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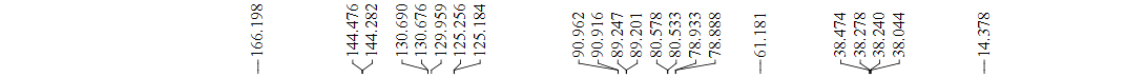
2.01
1.00
2.14
2.12
2.00
3.05
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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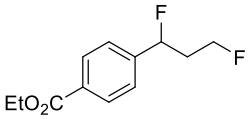
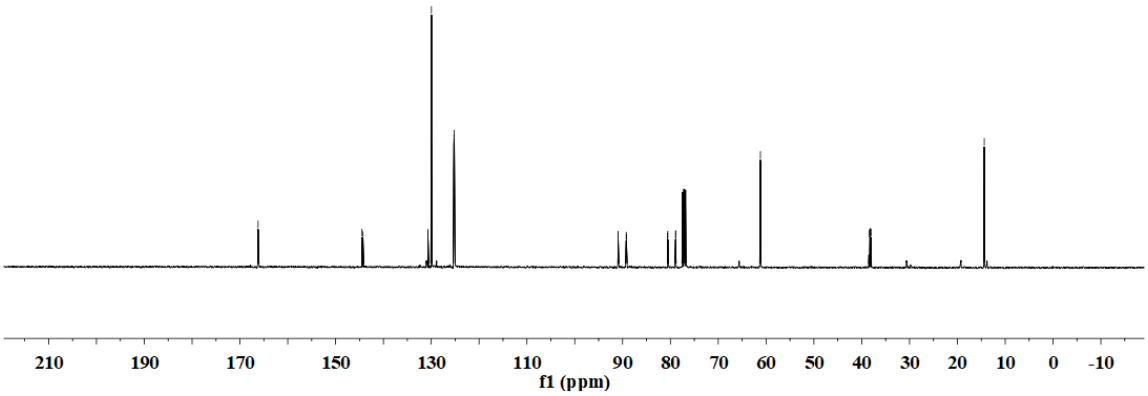
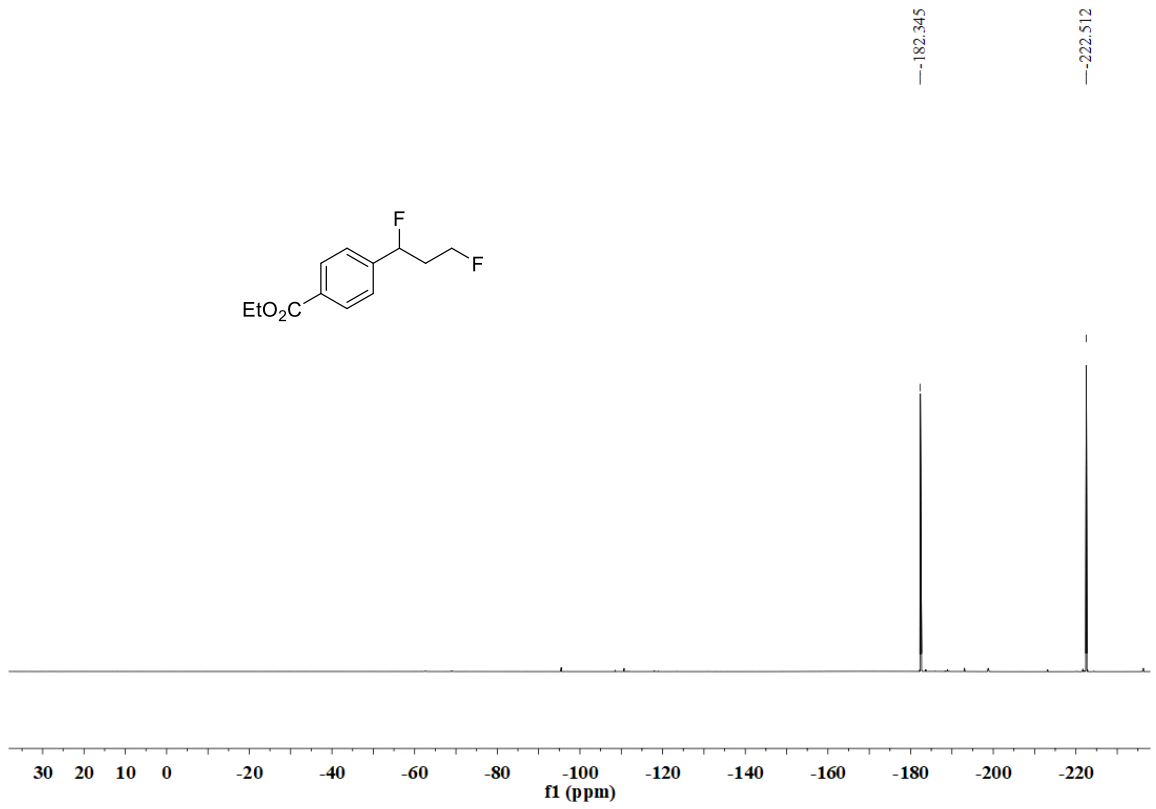
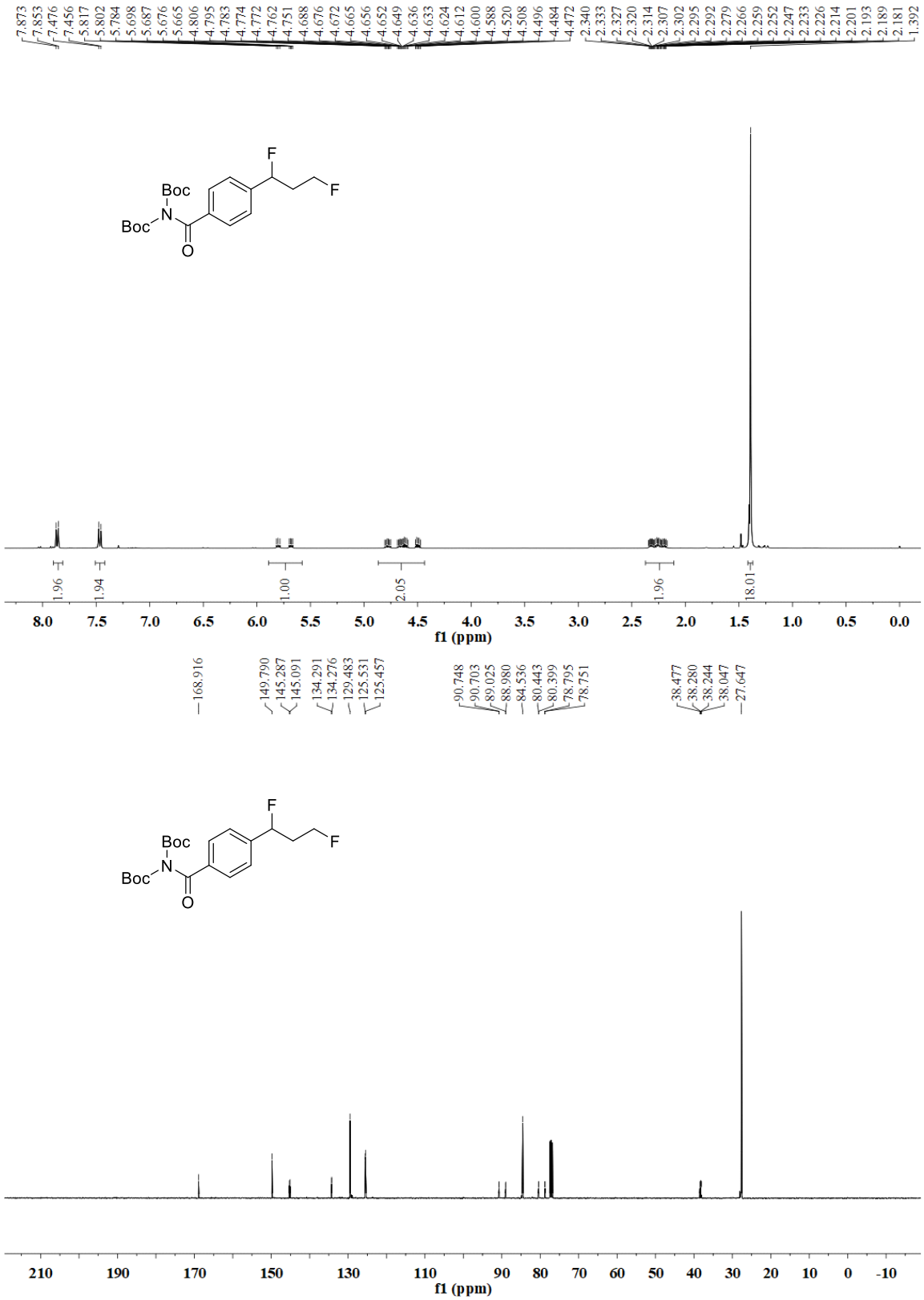
144.476
144.282
130.690
130.676
129.959
125.256
125.184
90.962
90.916
89.247
89.201
80.578
80.533
78.933
78.888
61.181
38.474
38.278
38.240
38.044
14.378


F
F
EtO2C


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-182.345
-222.512
F
F
EtO2C
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

16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4.806
4.795
4.783
4.774
4.772
4.762
4.751
4.688
4.676
4.672
4.665
4.656
4.652
4.649
4.636
4.633
4.624
4.612
4.600
4.588
4.520
4.508
4.496
4.484
4.472
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2.247
2.233
2.226
2.214
2.201
2.193
2.189
2.181
1.392
F
Boc
N
Boc
O
F
1.96
1.94
1.00
2.05
1.96
18.01
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
168.916
149.790
145.287
145.091
134.291
134.276
129.483
125.531
125.457
90.748
90.703
89.025
88.980
84.536
80.443
80.399
78.795
78.751
38.477
38.280
38.244
38.047
27.647
F
Boc
N
Boc
O
F
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190
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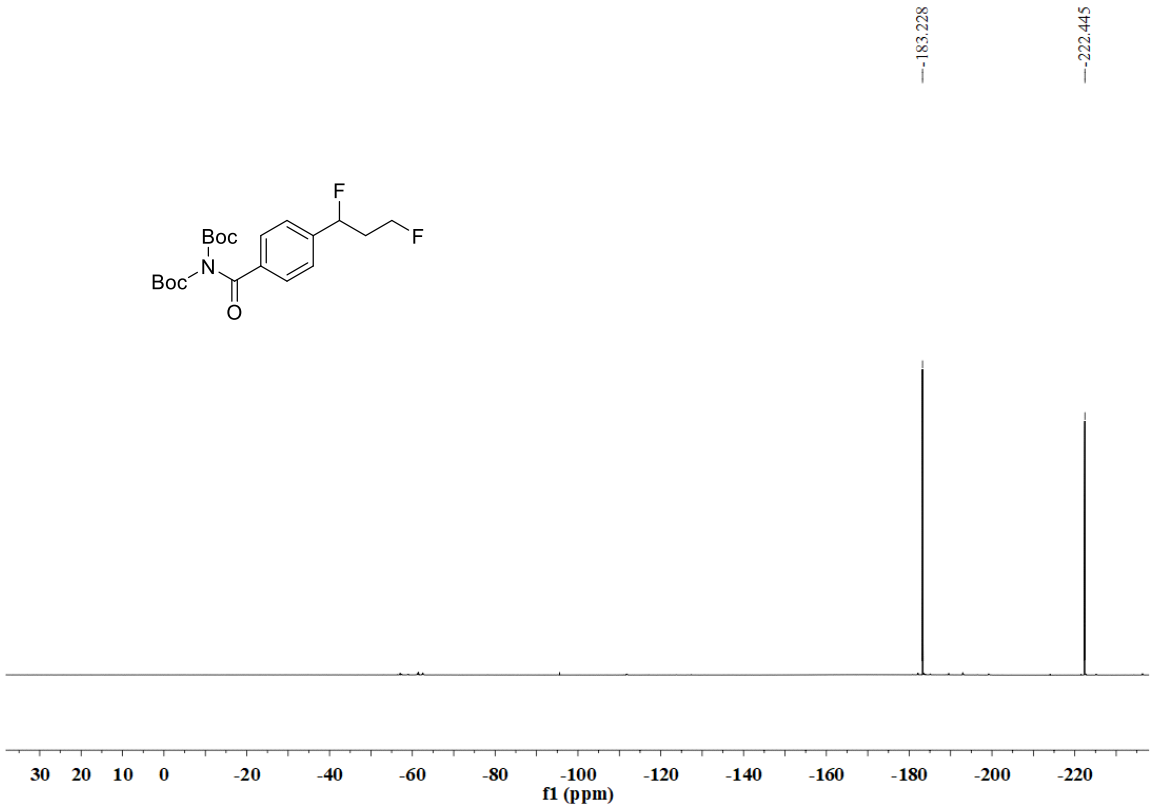
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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-222.445
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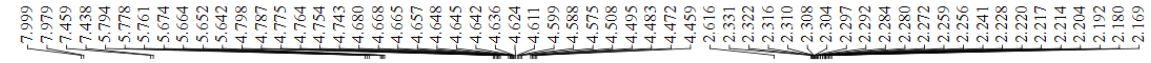
Boc
N
Boc
O
F
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

17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5.674
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5.652
5.642
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4.787
4.775
4.764
4.754
4.743
4.680
4.668
4.665
4.657
4.648
4.645
4.642
4.636
4.624
4.611
4.599
4.588
4.575
4.508
4.495
4.483
4.472
4.459
2.616
2.331
2.322
2.316
2.310
2.308
2.304
2.297
2.292
2.284
2.280
2.272
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2.256
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2.228
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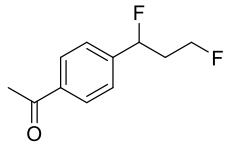
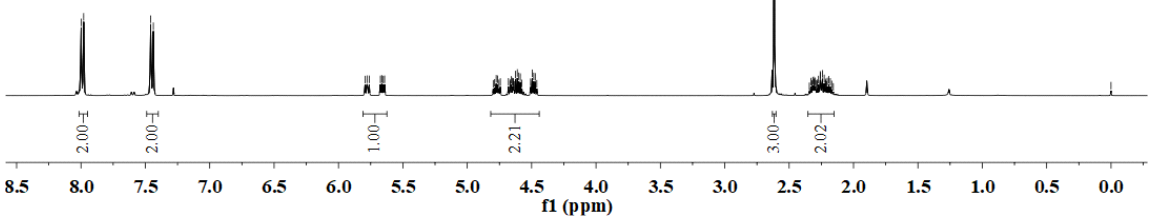
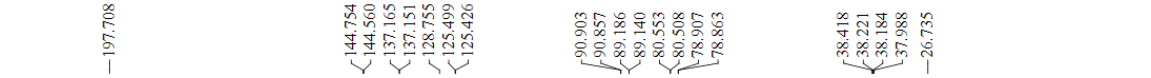
2.214
2.204
2.192
2.180
2.169


F
F
O


2.00
2.00
1.00
2.21
3.00
2.02
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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144.560
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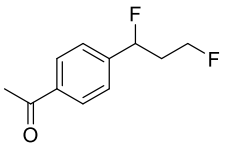
137.151
128.755
125.499
125.426
90.903
90.857
89.186
89.140
80.553
80.508
78.907
78.863
38.418
38.221
38.184
37.988
26.735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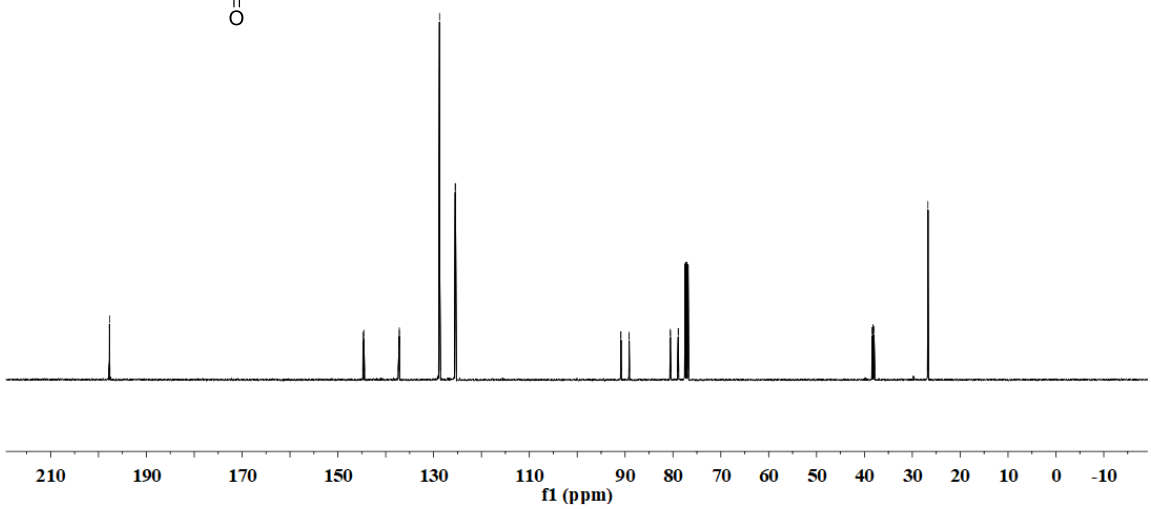
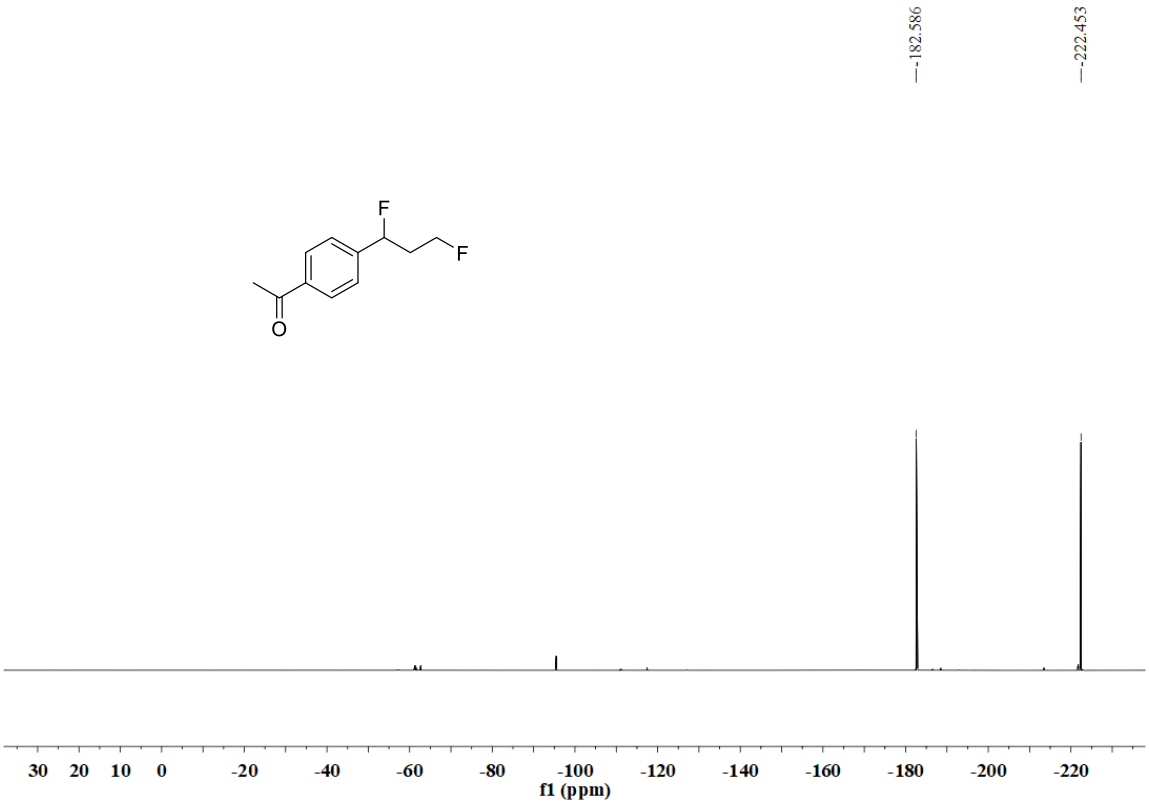
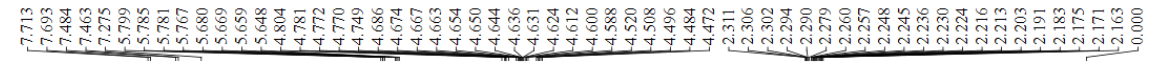
F
O


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-182.586
-222.453
F
F
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

18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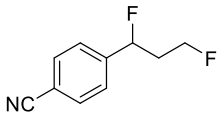
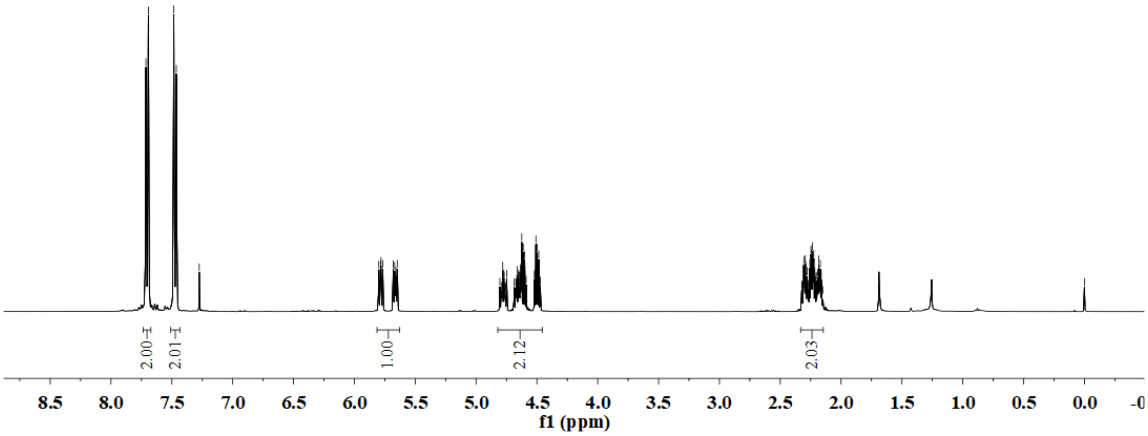
7.484
7.463
7.275
5.799
5.785
5.781
5.767
5.680
5.669
5.659
5.648
4.804
4.781
4.772
4.770
4.749
4.686
4.674
4.667
4.663
4.654
4.650
4.644
4.636
4.631
4.624
4.612
4.600
4.588
4.520
4.508
4.496
4.484
4.472
2.311
2.306
2.302
2.294
2.290
2.279
2.260
2.257
2.248
2.245
2.236
2.230
2.224
2.216
2.213
2.203
2.191
2.183
2.175
2.171
2.163
0.000


F
F
NC


2.00
2.01
1.00
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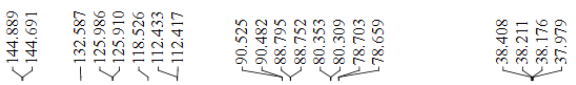
2.03
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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144.691
132.587
125.986
125.910
118.526
112.433
112.417
90.525
90.482
88.795
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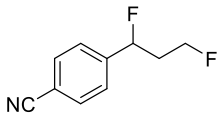
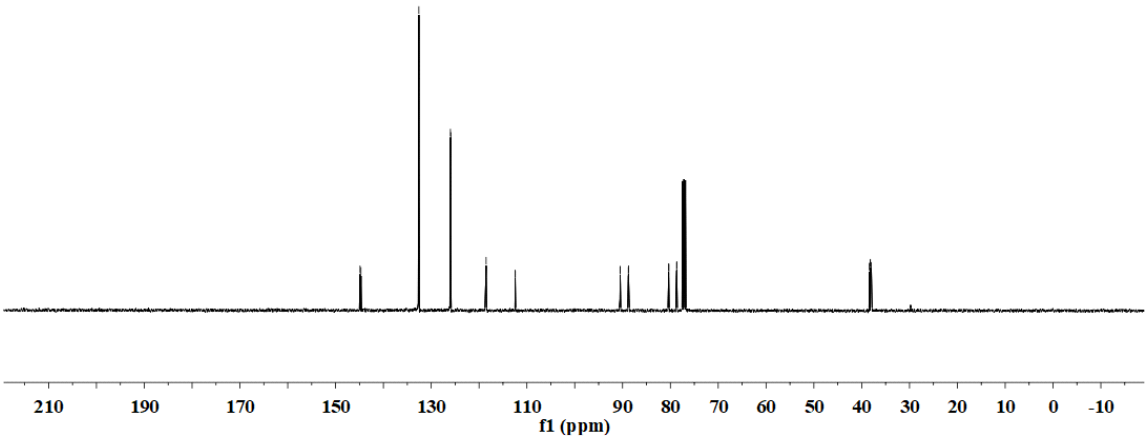
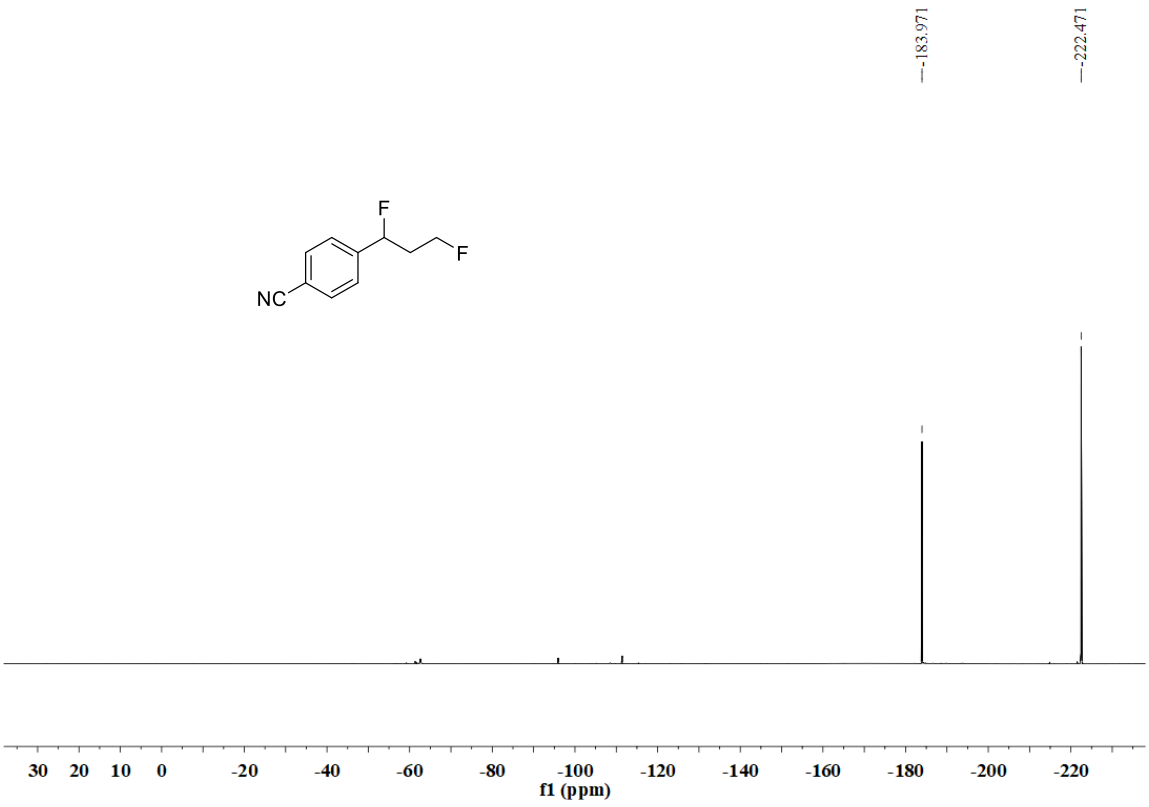
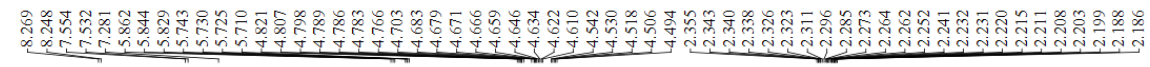
78.659
38.408
38.211
38.176
37.979


F
F
NC


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-183.971
-222.471
F
F
NC
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

19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7.281
5.862
5.844
5.829
5.743
5.730
5.725
5.710
4.821
4.807
4.798
4.789
4.786
4.783
4.766
4.703
4.683
4.679
4.671
4.666
4.659
4.646
4.634
4.622
4.610
4.542
4.530
4.518
4.506
4.494
2.355
2.343
2.340
2.338
2.326
2.323
2.311
2.296
2.285
2.273
2.264
2.262
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2.231
2.220
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2.211
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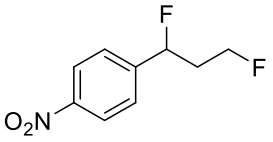
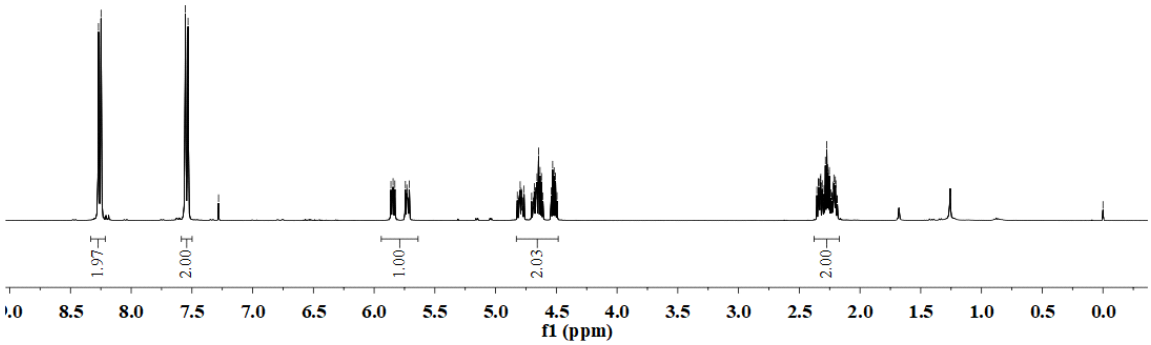
2.203
2.199
2.188
2.186


F
F
O2N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7.5
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6.5
6.0
5.5
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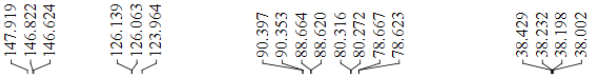
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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126.063
123.964
90.397
90.353
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88.620
80.316
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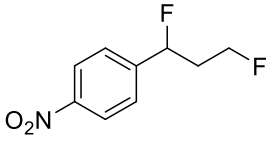
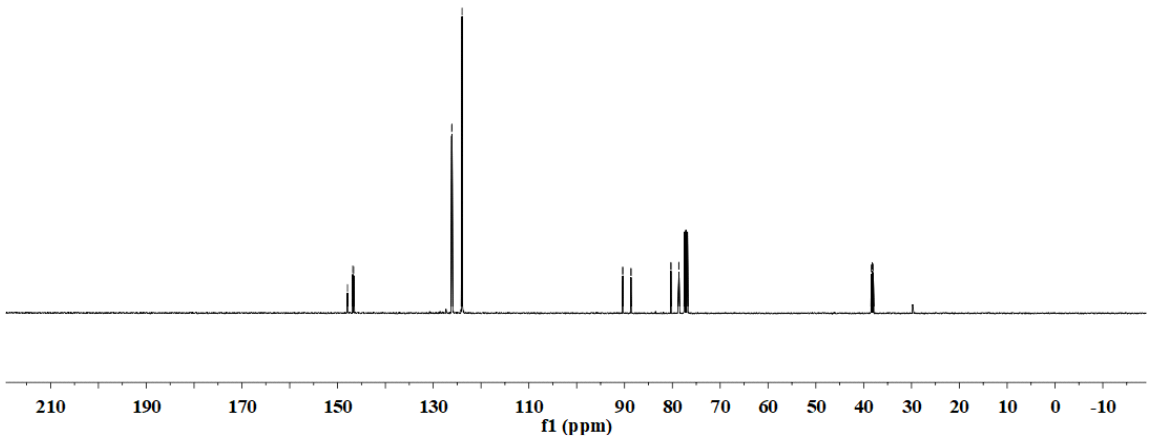
78.623
38.429
38.232
38.198
38.002


F
F
O2N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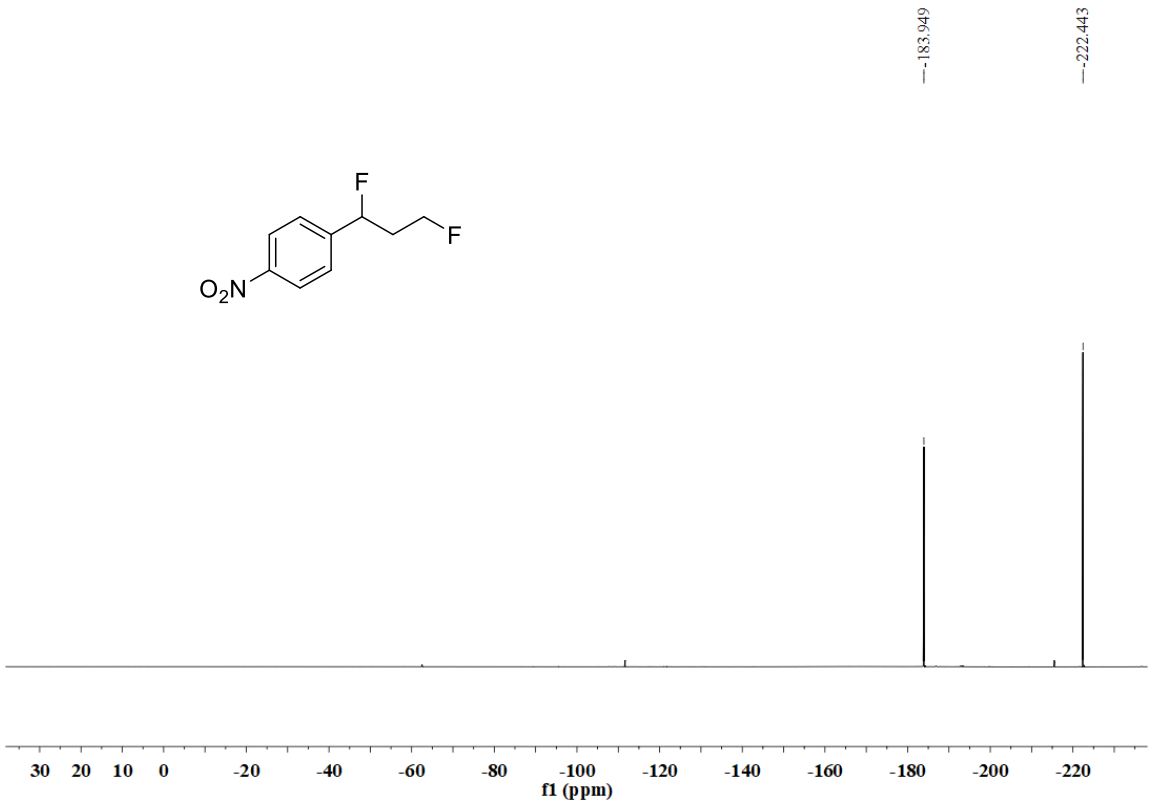
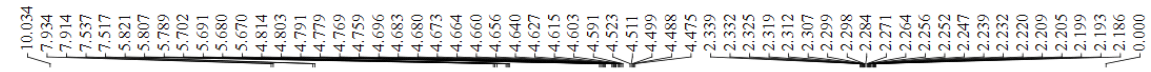
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-183.949
-222.443
F
F
O2N
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

20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7.517
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5.807
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4.791
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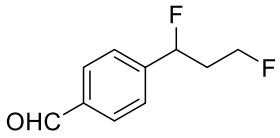
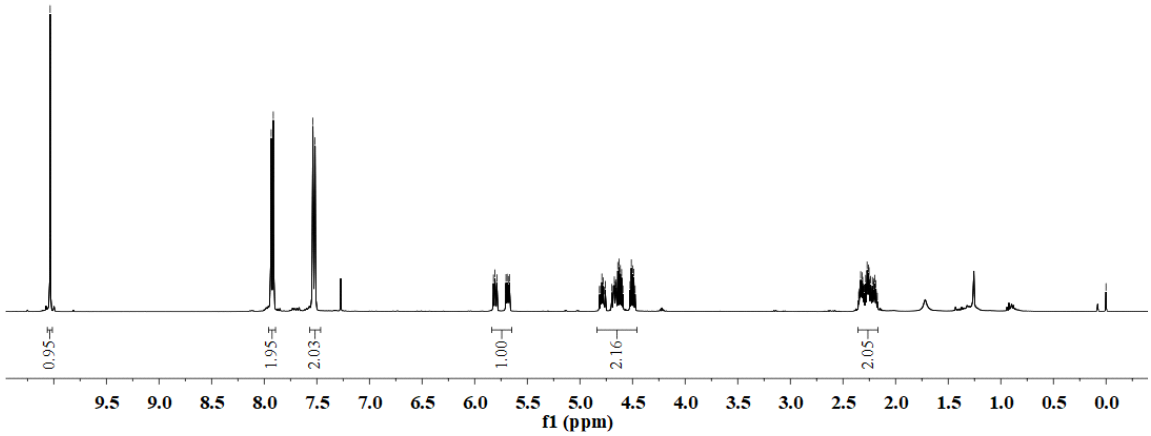

F
F
OHC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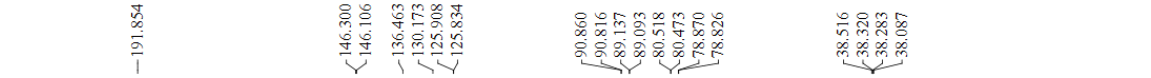
1.95
2.03
1.00
2.16
2.05
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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146.106
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130.173
125.908
125.834
90.860
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89.137
89.093
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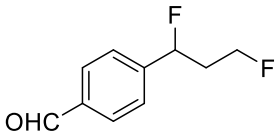
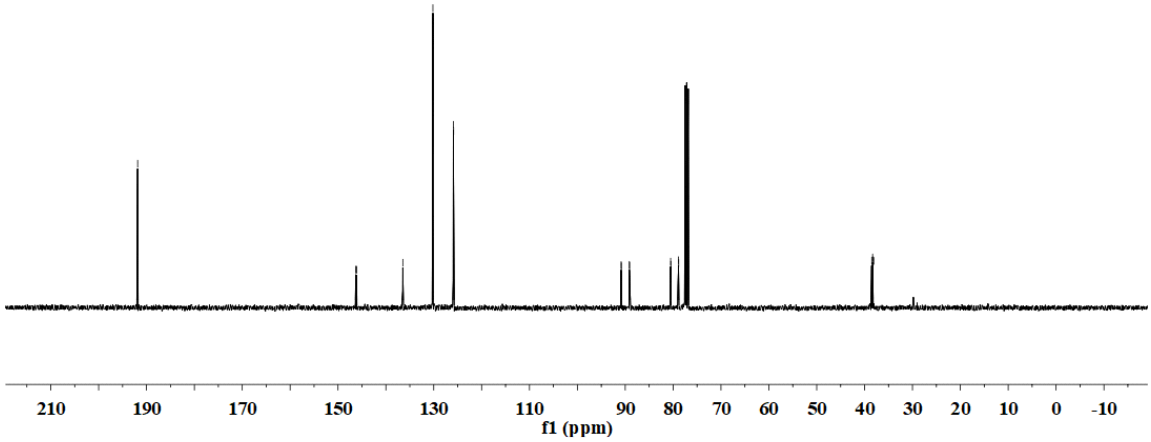
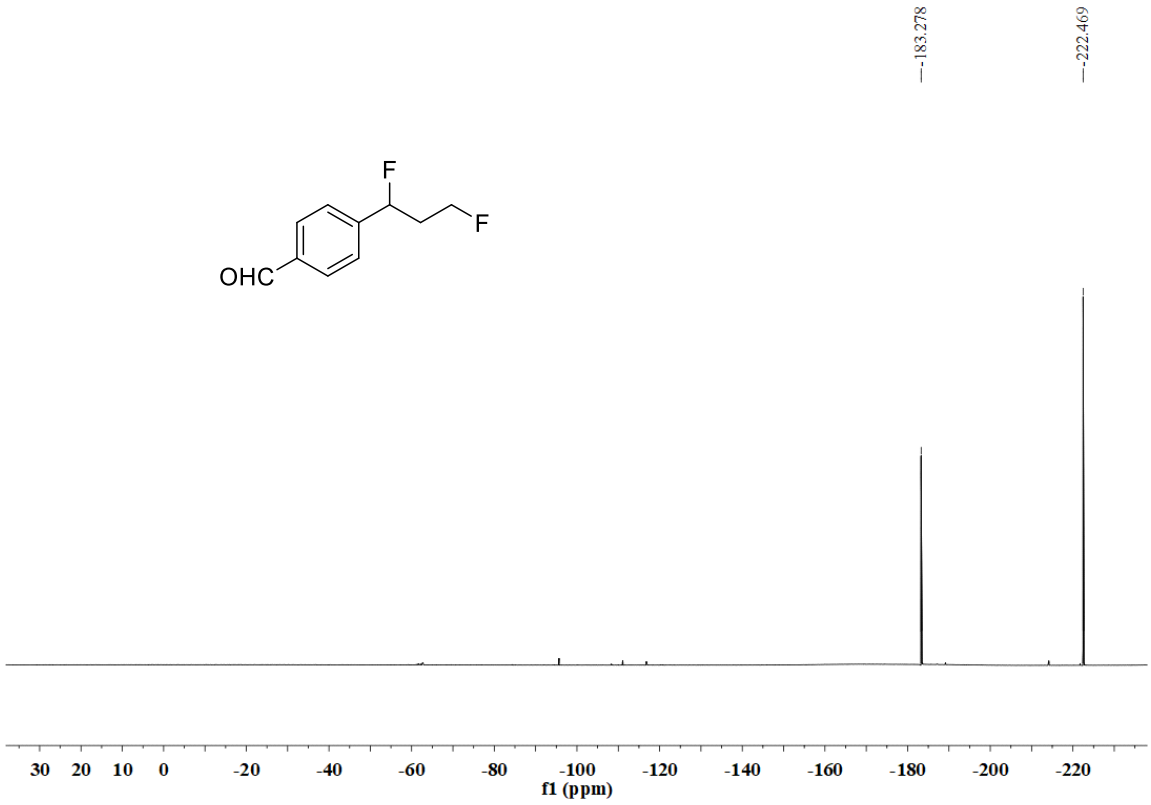
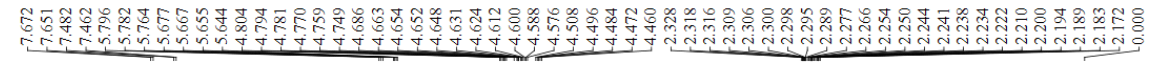
80.473
78.870
78.826
38.516
38.320
38.283
38.087


F
F
OHC


210 190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-183.278
-222.469
F
F
OHC
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

21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5.677
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4.770
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4.663
4.654
4.652
4.648
4.631
4.624
4.612
4.600
4.588
4.576
4.508
4.496
4.484
4.472
4.460
2.328
2.318
2.316
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2.306
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2.298
2.295
2.289
2.277
2.266
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2.250
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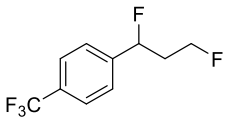
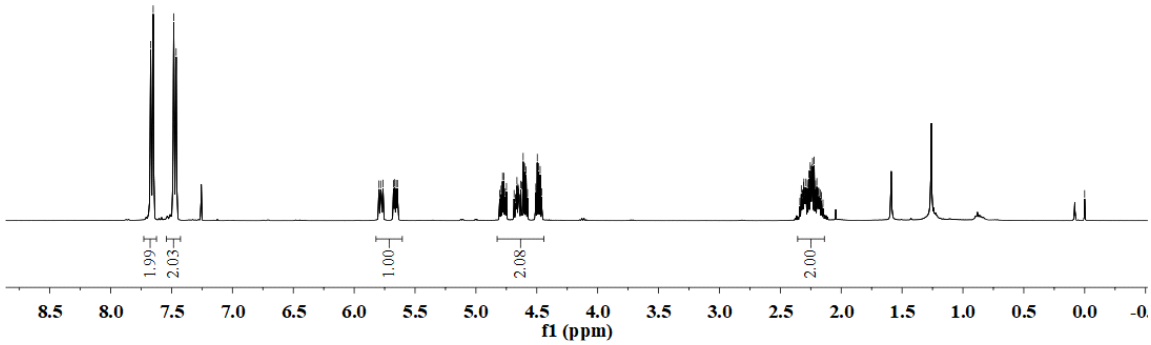
0.000


F
F
F3C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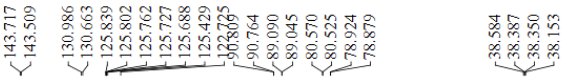
1.00
2.08
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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130.663
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125.802
125.762
125.727
125.688
125.429
122.725
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90.764
89.090
89.045
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80.525
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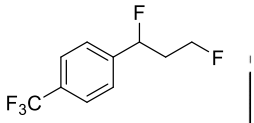
38.350
38.153


F
F
F3C

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190
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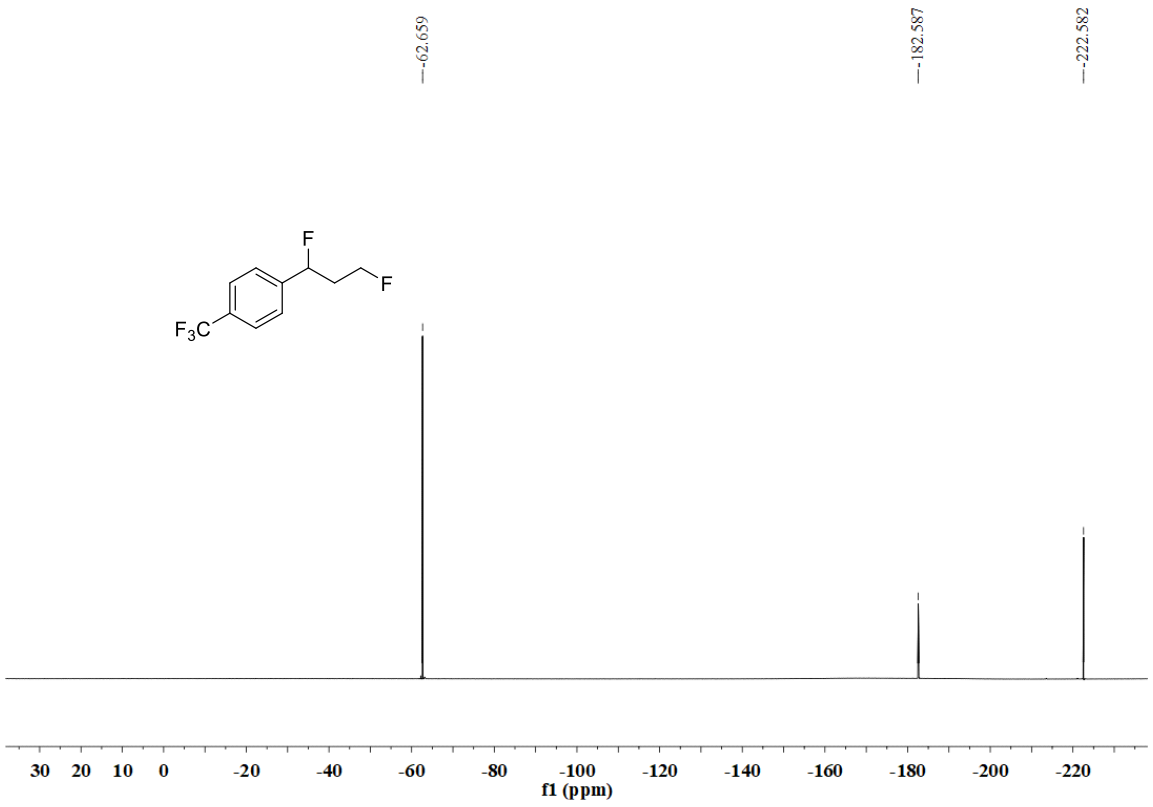
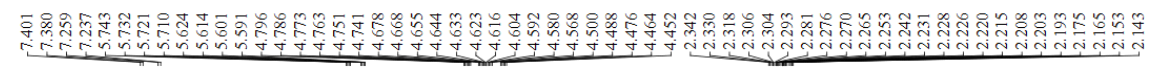
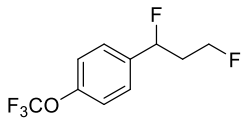
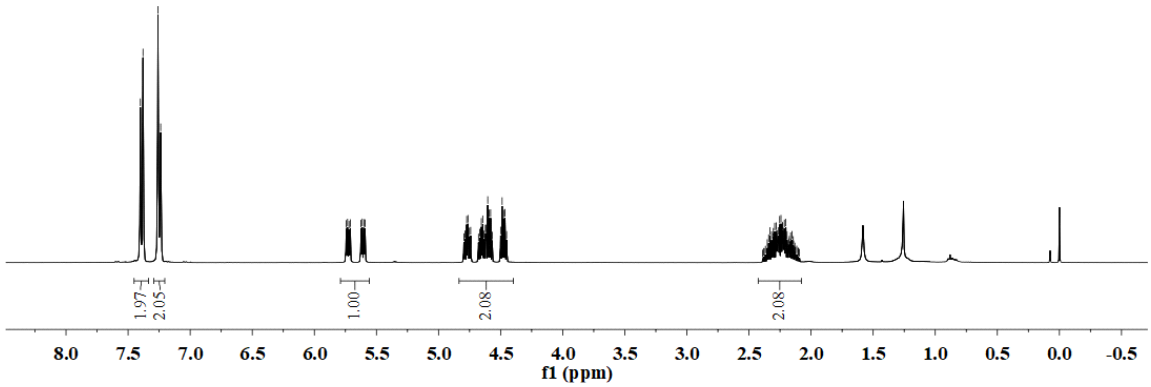
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

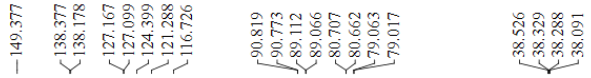

-62.659
-182.587
-222.582
F
F
F3C
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

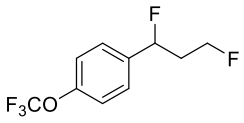
22


7.401
7.380
7.259
7.237
5.743
5.732
5.721
5.710
5.624
5.614
5.601
5.591
4.796
4.786
4.773
4.763
4.751
4.741
4.678
4.668
4.655
4.644
4.633
4.623
4.616
4.604
4.592
4.580
4.568
4.500
4.488
4.476
4.464
4.452
2.342
2.330
2.318
2.306
2.304
2.293
2.281
2.276
2.270
2.265
2.253
2.242
2.231
2.228
2.226
2.220
2.215
2.208
2.203
2.193
2.175
2.165
2.153
2.143

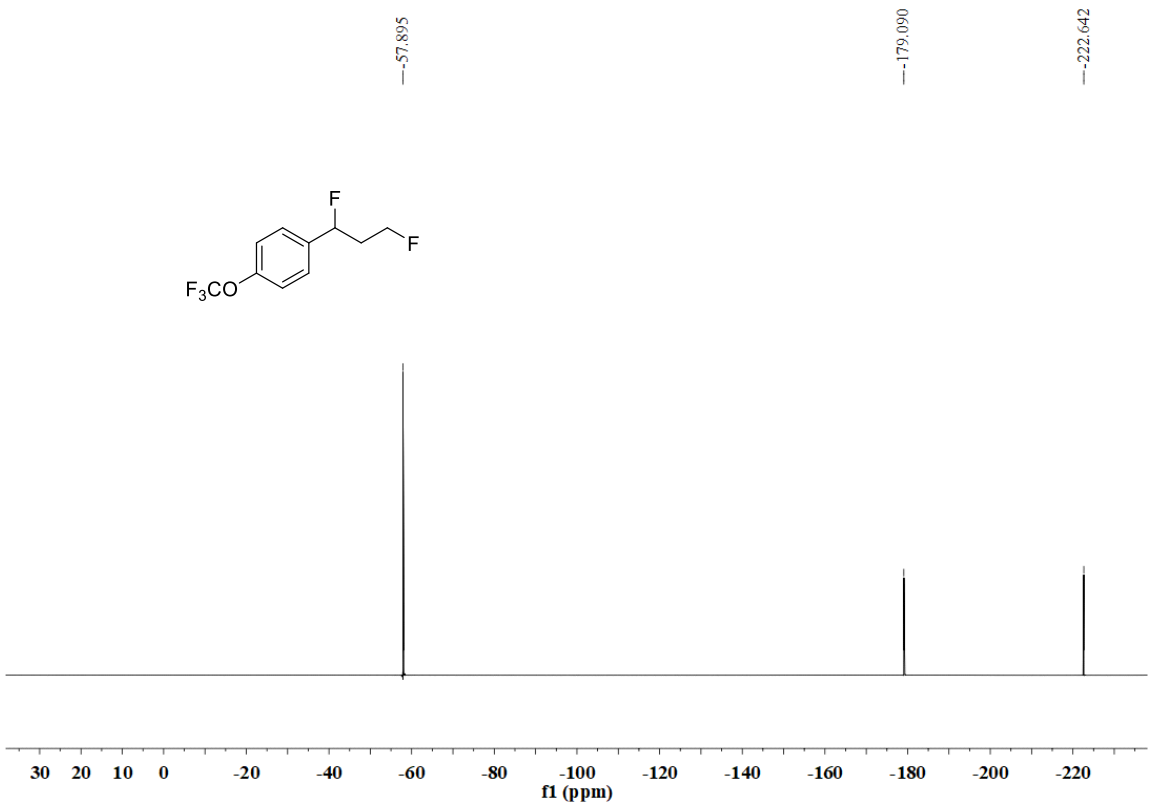

F
F
F3CO


1.97
2.05
1.00
2.08
2.08
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

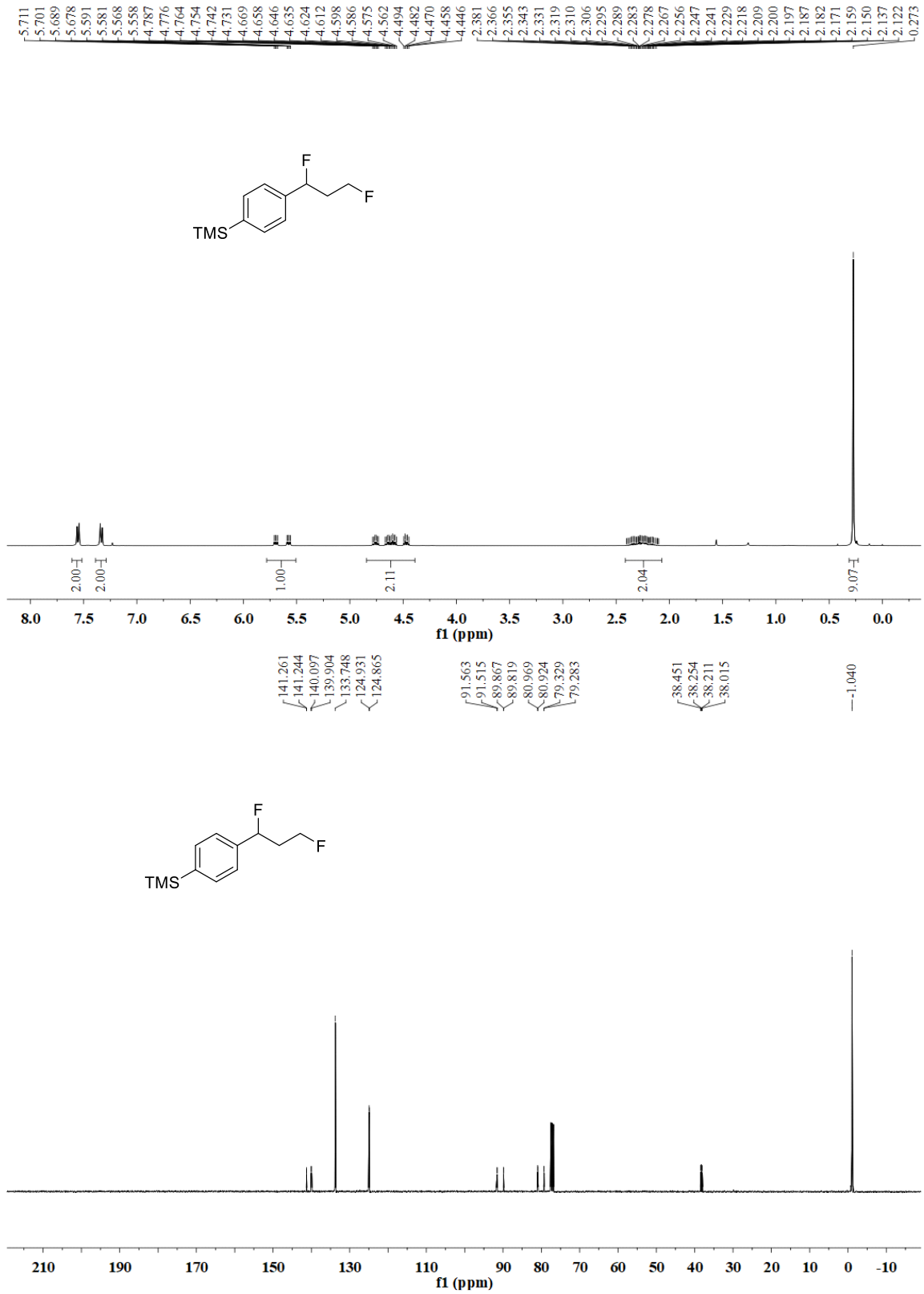

149.377
138.377
138.178
127.167
127.099
124.399
121.288
116.726
90.819
90.773
89.112
89.066
80.707
80.662
79.063
79.017
38.526
38.329
38.288
38.091

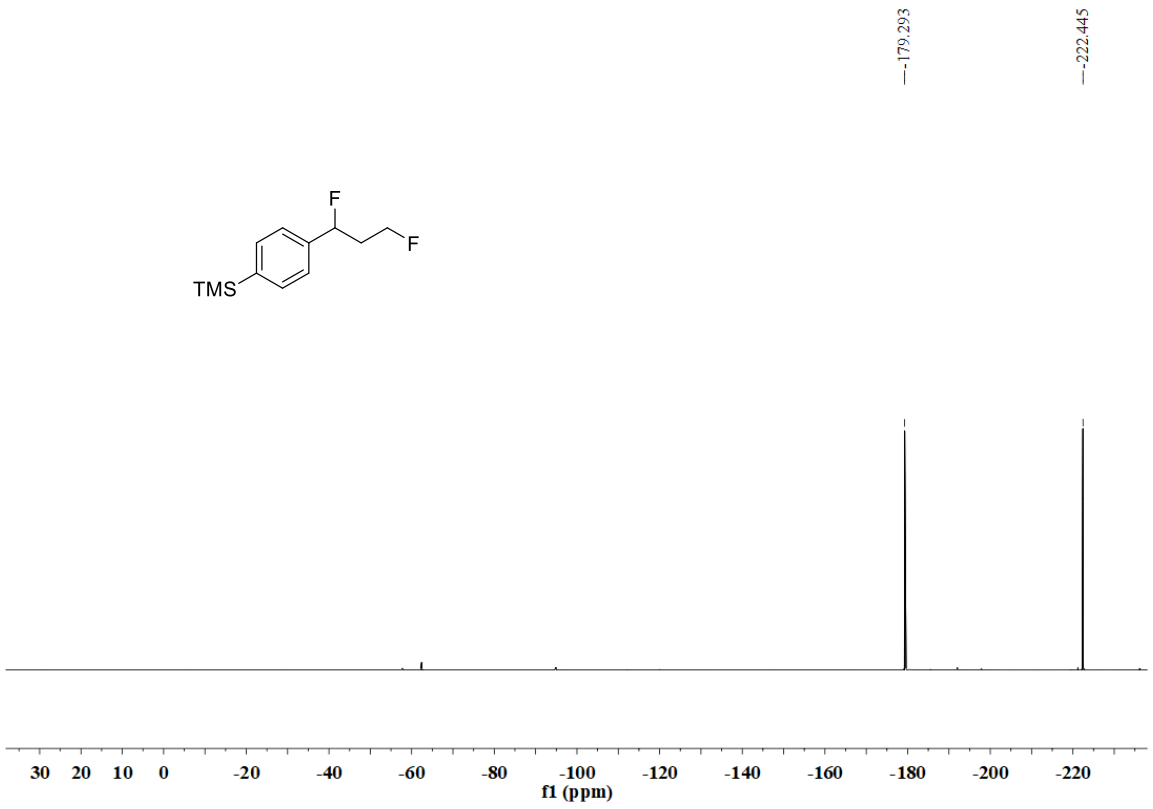

F
F
F3CO

210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

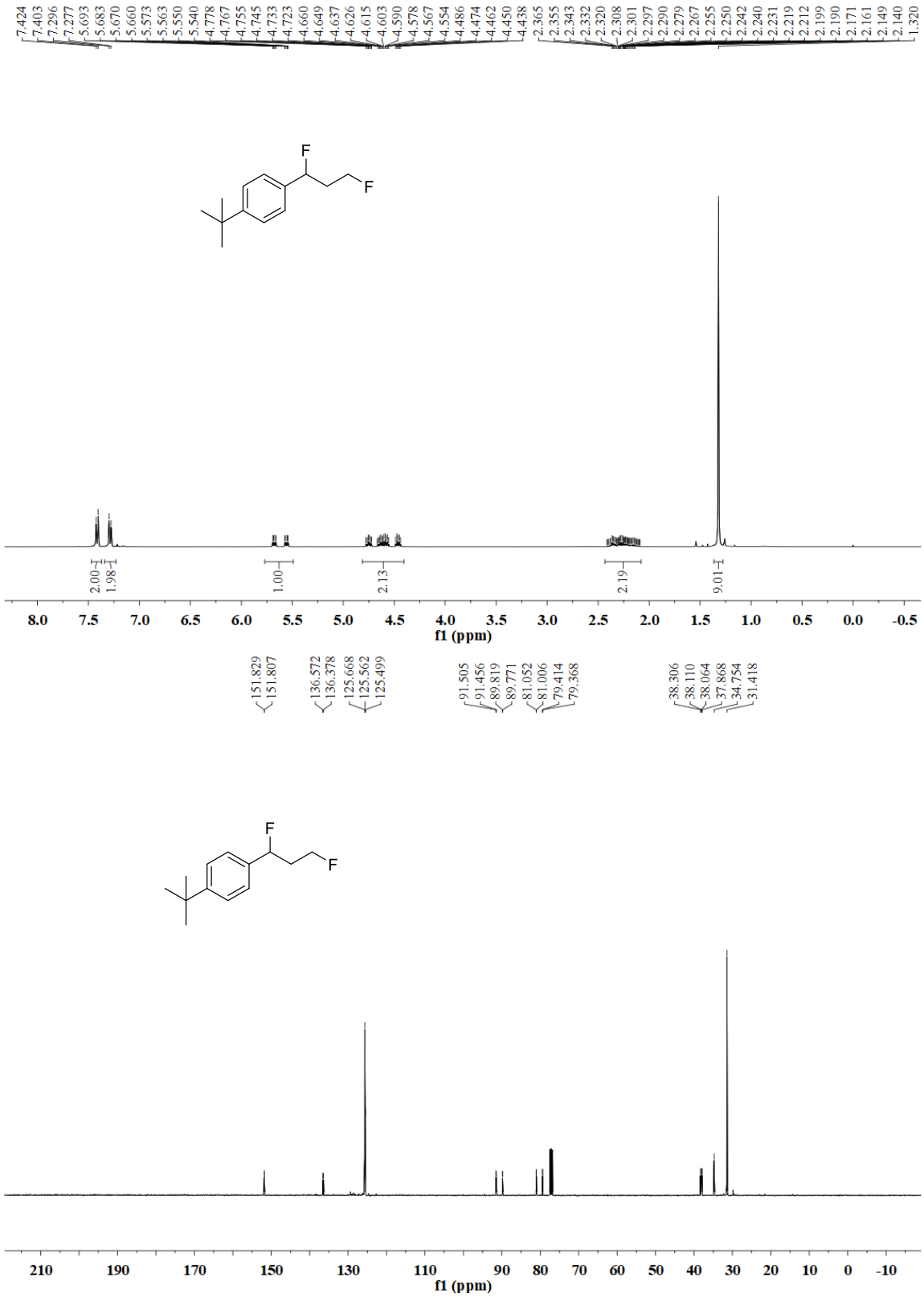

-57.895
-179.090
-222.642
F
F
F3CO
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

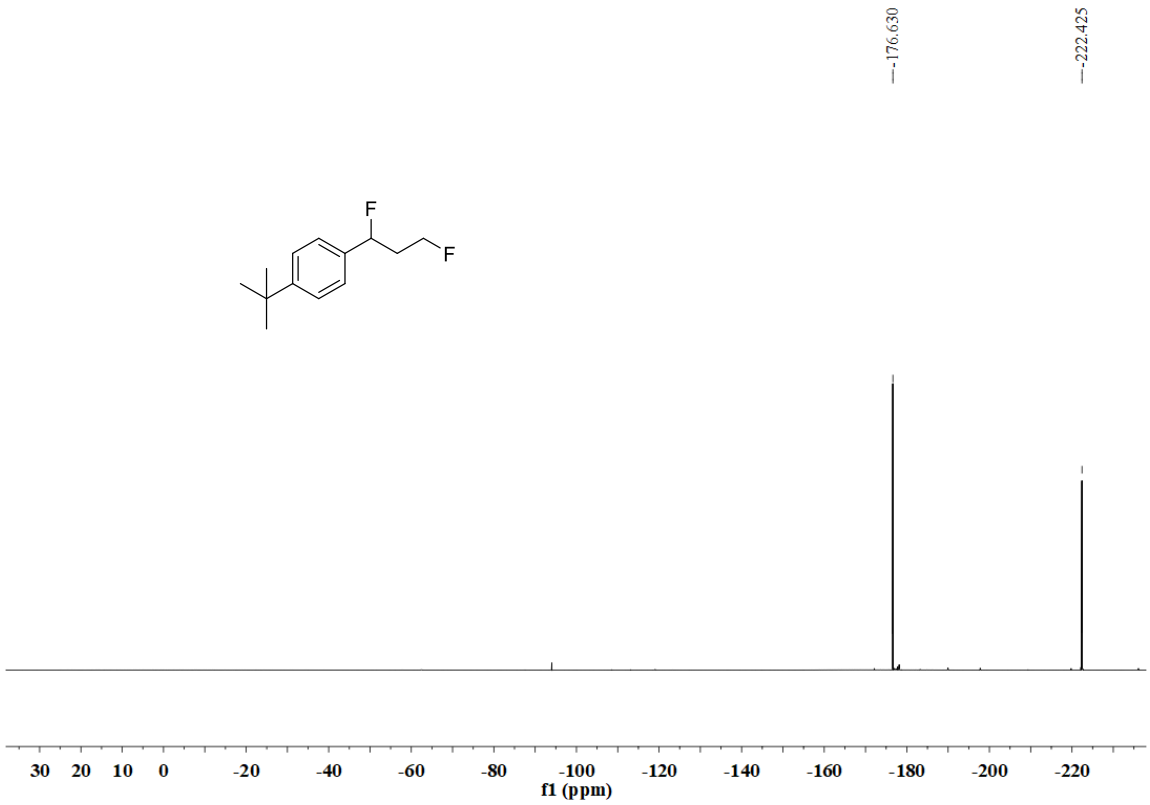
23


5.711
5.701
5.689
5.678
5.591
5.581
5.568
5.558
4.787
4.776
4.764
4.754
4.742
4.731
4.669
4.658
4.646
4.635
4.624
4.612
4.598
4.586
4.575
4.562
4.494
4.482
4.470
4.458
4.446
2.381
2.366
2.355
2.343
2.331
2.319
2.310
2.306
2.295
2.289
2.283
2.278
2.267
2.256
2.247
2.241
2.229
2.218
2.209
2.200
2.197
2.187
2.182
2.171
2.159
2.150
2.137
2.122
0.273
F
F
TMS
2.00
2.00
1.00
2.11
2.04
9.07
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
141.261
141.244
140.097
139.904
133.748
124.931
124.865
91.563
91.515
89.867
89.819
80.969
80.924
79.329
79.283
38.451
38.254
38.211
38.015
-1.040
F
F
TMS
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

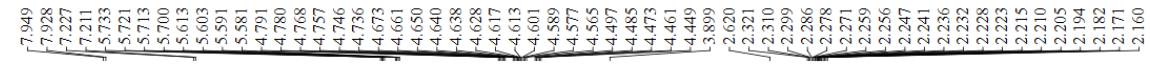

-179.293
-222.445
F
F
TMS
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

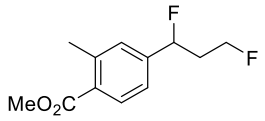
24

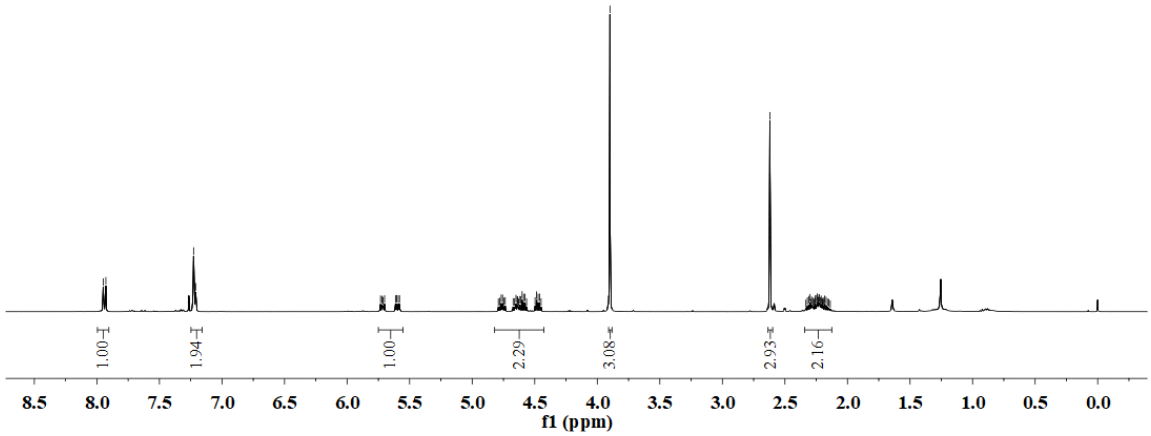

7.424
7.403
7.296
7.277
5.693
5.683
5.670
5.660
5.573
5.563
5.550
5.540
4.778
4.767
4.755
4.745
4.733
4.723
4.660
4.649
4.637
4.626
4.615
4.603
4.590
4.578
4.567
4.554
4.486
4.474
4.462
4.450
4.438
2.365
2.355
2.343
2.332
2.320
2.308
2.301
2.297
2.290
2.279
2.267
2.255
2.250
2.242
2.240
2.231
2.219
2.212
2.199
2.190
2.171
2.161
2.149
2.140
1.320
F
F
2.00
1.98
1.00
2.13
2.19
9.01
f1 (ppm)
151.829
151.807
136.572
136.378
125.668
125.562
125.499
91.505
91.456
89.819
89.771
81.052
81.006
79.414
79.368
38.306
38.110
38.064
37.868
34.754
31.418
F
F
f1 (ppm)

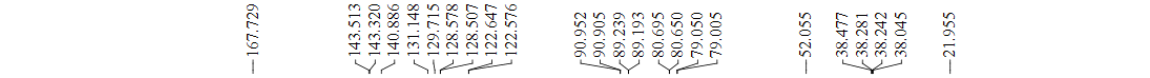

-176.630
-222.425
F
F
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

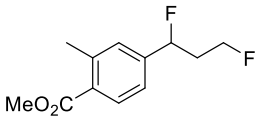
25

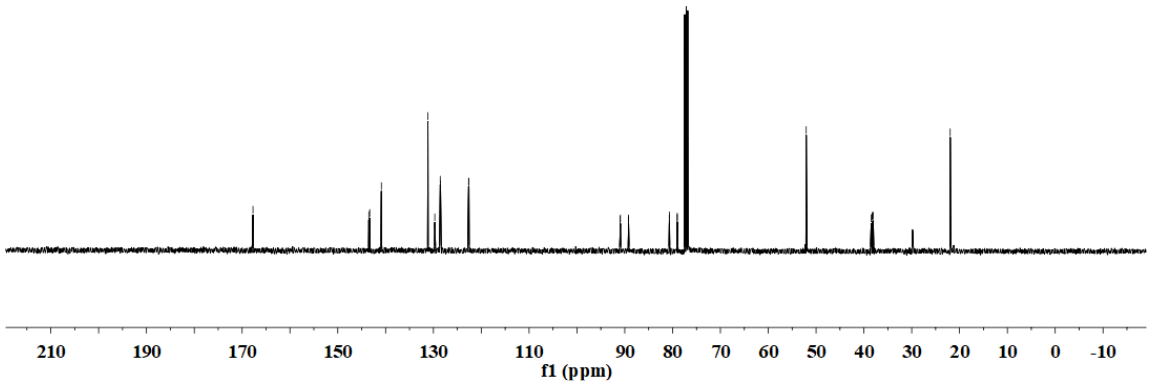

7.949
7.928
7.227
7.211
5.733
5.721
5.713
5.700
5.613
5.603
5.591
5.581
4.791
4.780
4.768
4.757
4.746
4.736
4.673
4.661
4.650
4.640
4.638
4.628
4.617
4.613
4.601
4.589
4.577
4.565
4.497
4.485
4.473
4.461
4.449
3.899
2.620
2.321
2.310
2.299
2.286
2.278
2.271
2.259
2.256
2.247
2.241
2.236
2.232
2.228
2.223
2.215
2.210
2.205
2.194
2.182
2.171
2.160

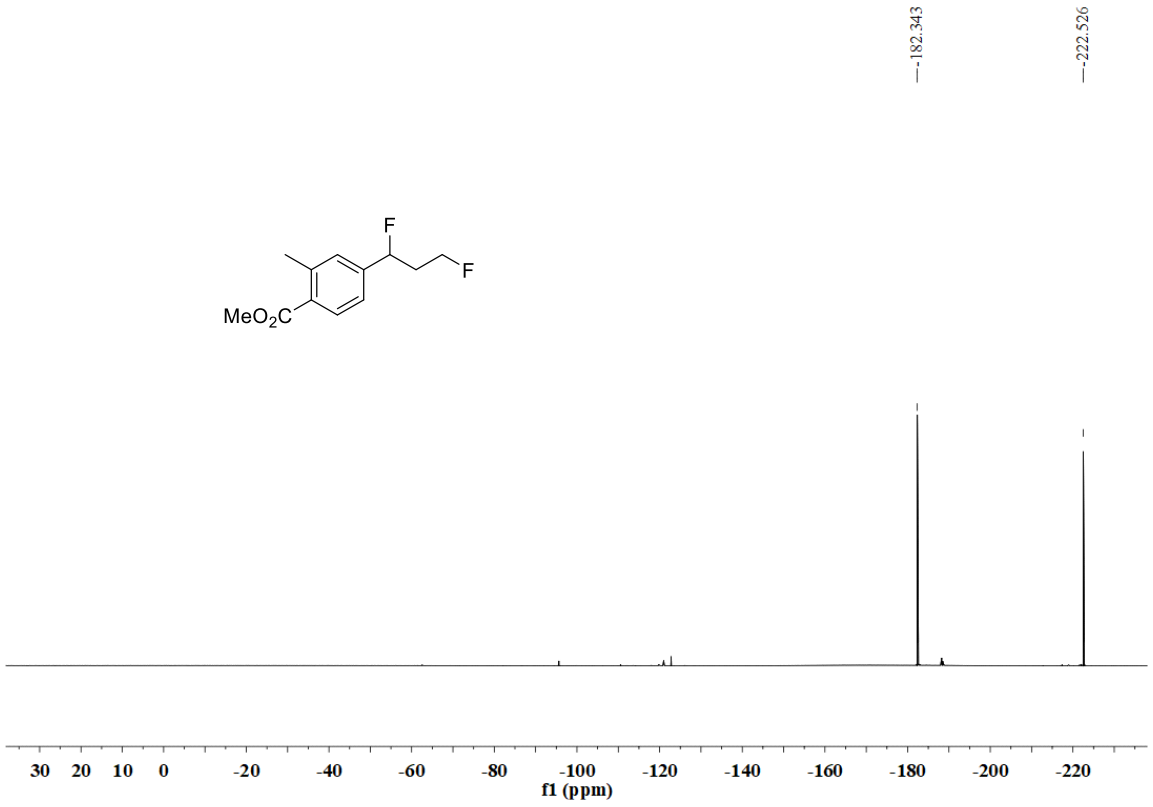

F
F
MeO2C


1.00
1.94
1.00
2.29
3.08
2.93
2.16
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

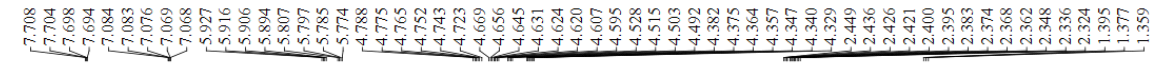

167.729
143.513
143.320
140.886
131.148
129.715
128.578
128.507
122.647
122.576
90.952
90.905
89.239
89.193
80.695
80.650
79.050
79.005
52.055
38.477
38.281
38.242
38.045
21.955

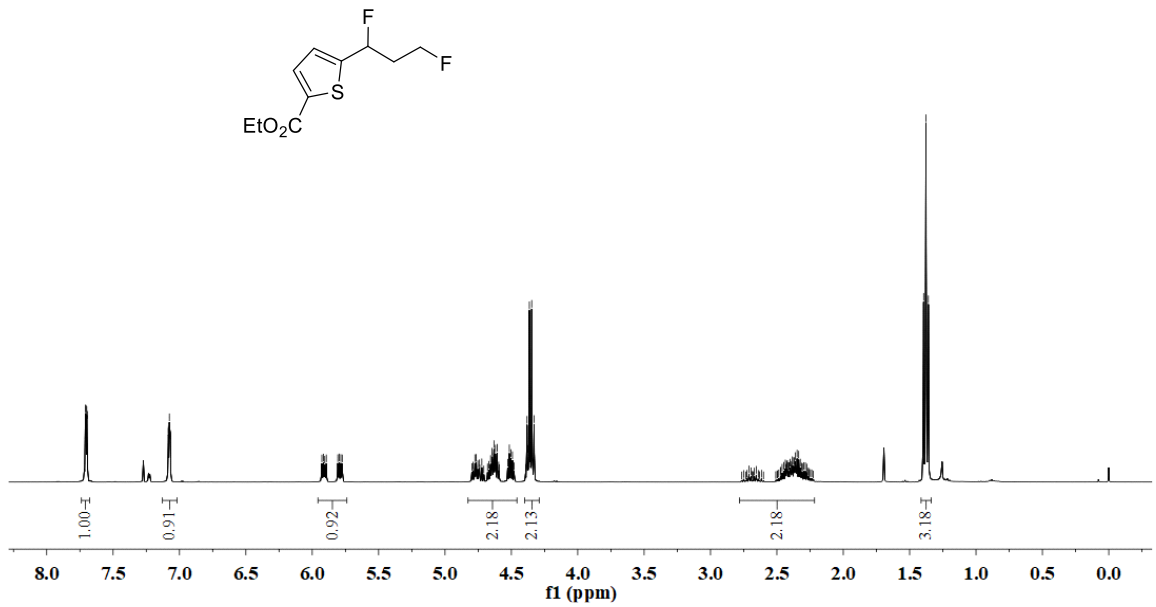

F
F
MeO2C

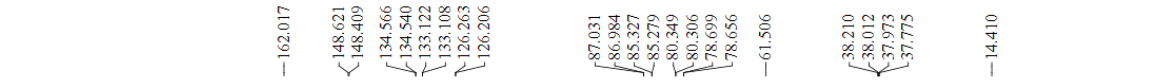

210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

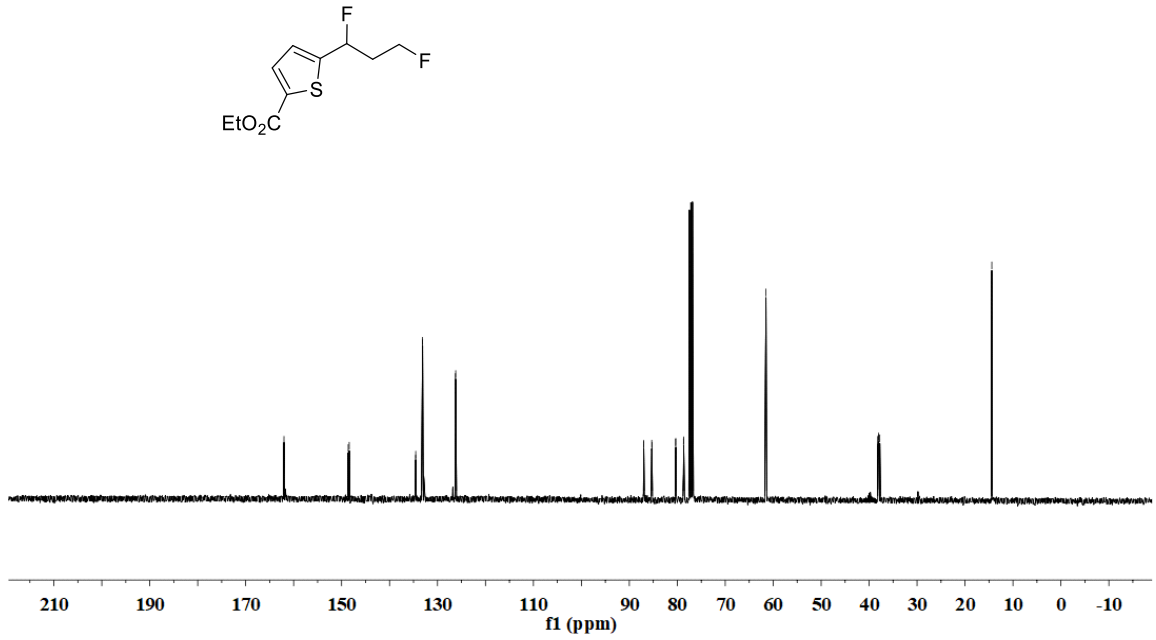

-182.343
-222.526
F
F
MeO2C
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

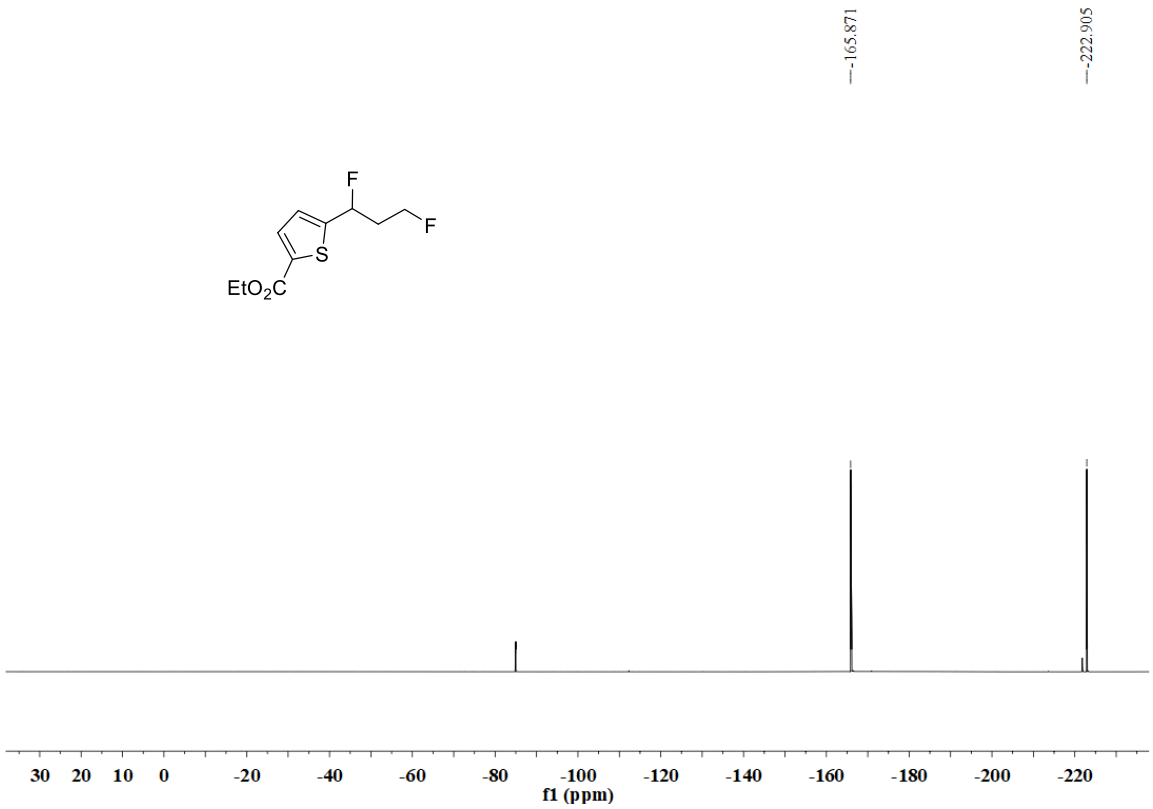
26


7.708
7.704
7.698
7.694
7.084
7.083
7.076
7.069
7.068
5.927
5.916
5.906
5.894
5.807
5.797
5.785
5.774
4.788
4.775
4.765
4.752
4.743
4.723
4.669
4.656
4.645
4.631
4.624
4.620
4.607
4.595
4.528
4.515
4.503
4.492
4.382
4.375
4.364
4.357
4.347
4.340
4.329
2.449
2.436
2.426
2.421
2.400
2.395
2.383
2.374
2.368
2.362
2.348
2.336
2.324
1.395
1.377
1.359

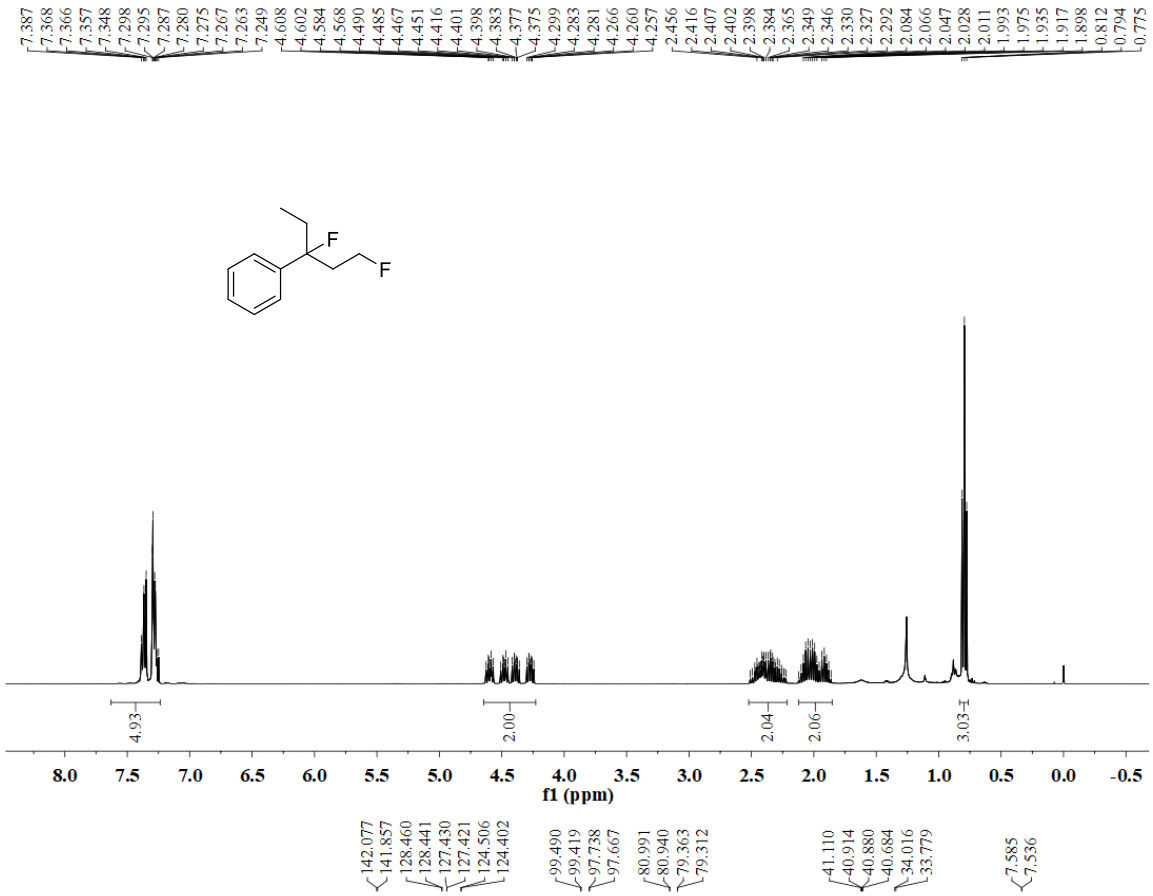

F
F
S
EtO2C
1.00
0.91
0.92
2.18
2.13
2.18
3.18
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

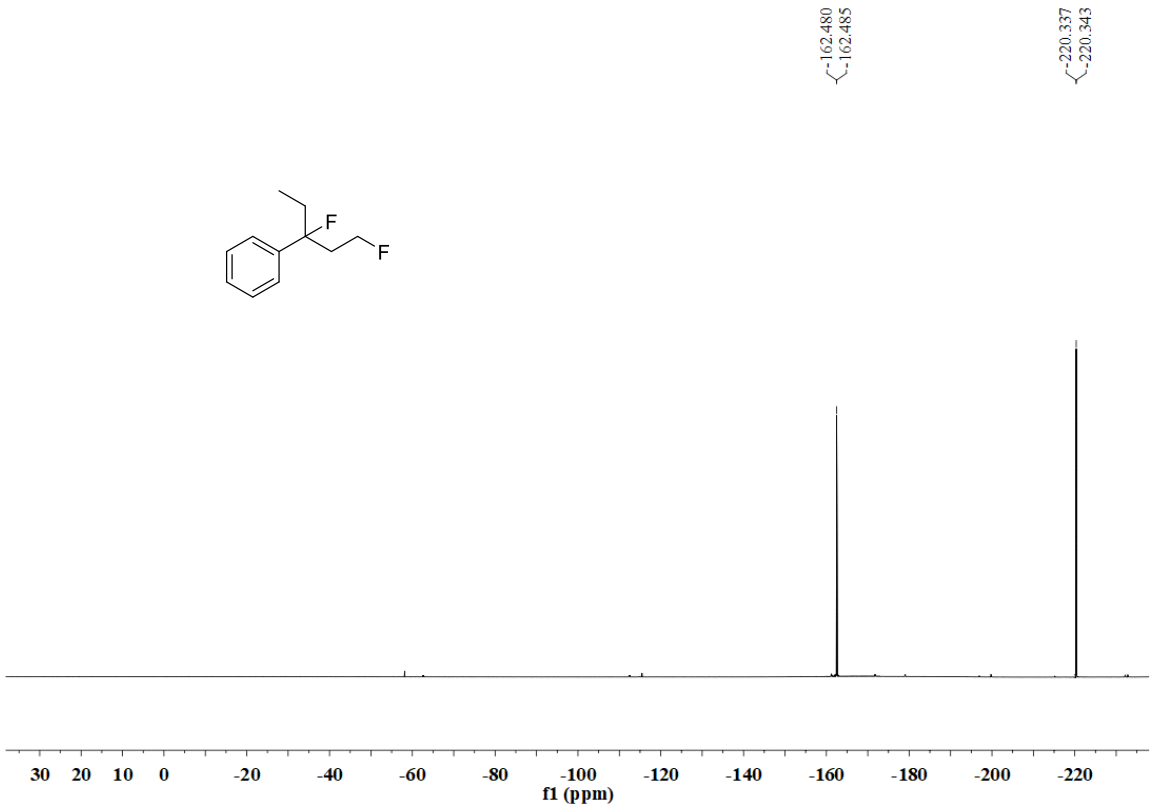

162.017
148.621
148.409
134.566
134.540
133.122
133.108
126.263
126.206
87.031
86.984
85.327
85.279
80.349
80.306
78.699
78.656
61.506
38.210
38.012
37.973
37.775
14.410


F
F
S
EtO2C
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

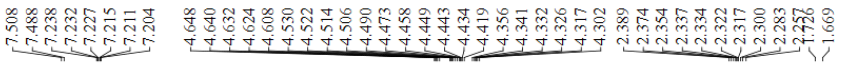

-165.871
-222.905
F
F
S
EtO2C
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

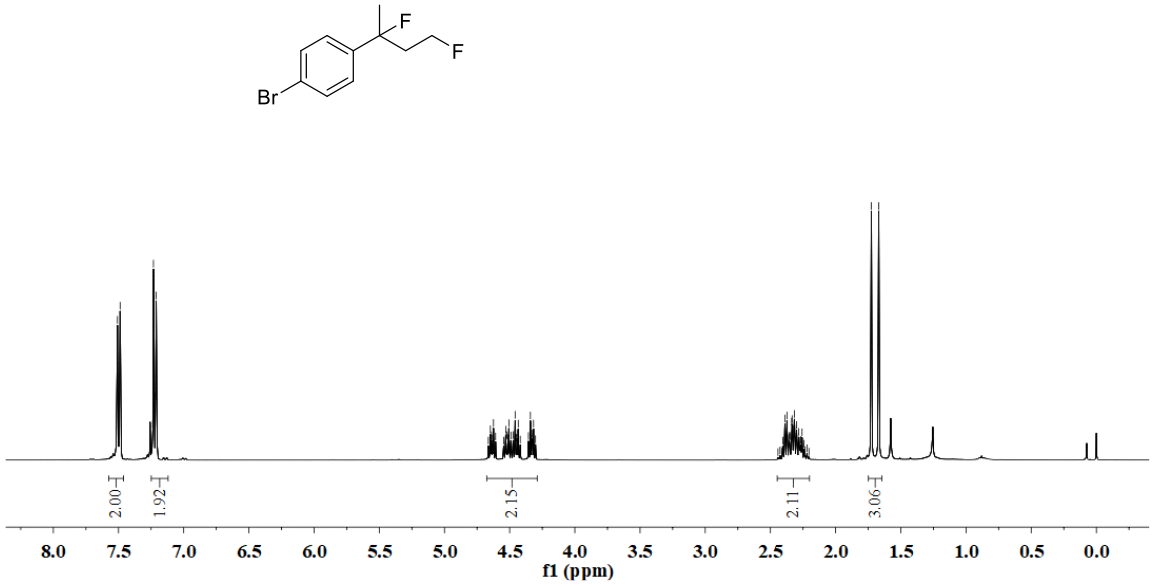
27

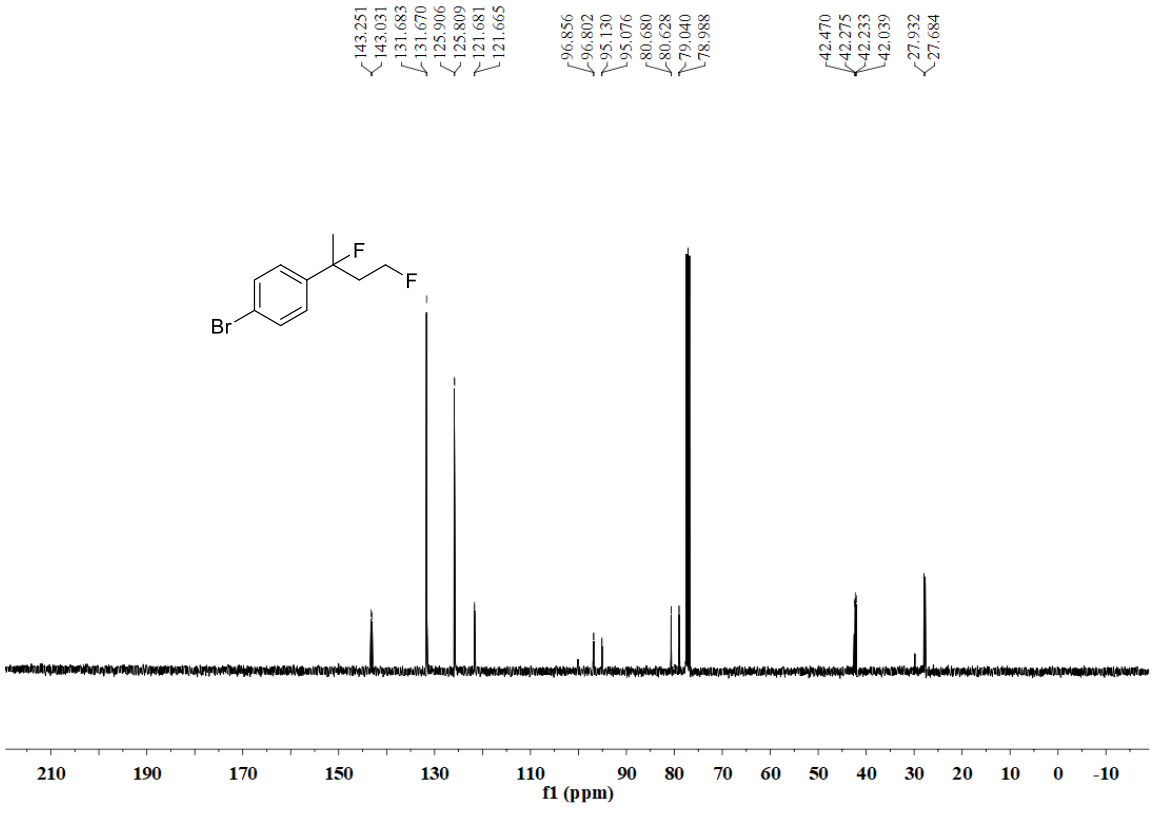

7.387
7.368
7.366
7.357
7.348
7.298
7.295
7.287
7.280
7.275
7.267
7.263
7.249
4.608
4.602
4.584
4.568
4.490
4.485
4.467
4.451
4.416
4.401
4.398
4.383
4.377
4.375
4.299
4.283
4.281
4.266
4.260
4.257
2.456
2.416
2.407
2.402
2.398
2.384
2.365
2.349
2.346
2.330
2.327
2.292
2.084
2.066
2.047
2.028
2.011
1.993
1.975
1.935
1.917
1.898
0.812
0.794
0.775
F
F
4.93
2.00
2.04
2.06
3.03
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)
142.077
141.857
128.460
128.441
127.430
127.421
124.506
124.402
99.490
99.419
97.738
97.667
80.991
80.940
79.363
79.312
41.110
40.914
40.880
40.684
34.016
33.779
7.585
7.536
F
F
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

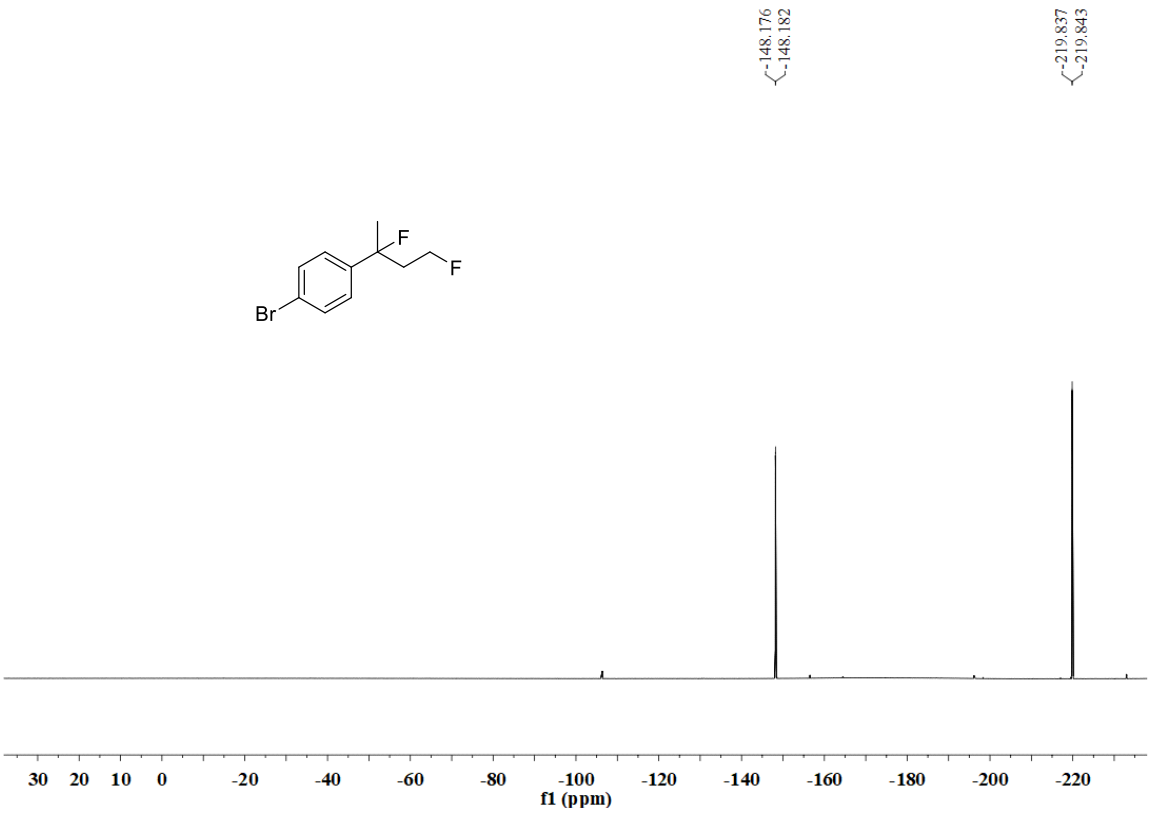

-162.480
-162.485
-220.337
-220.343
F
F
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

28

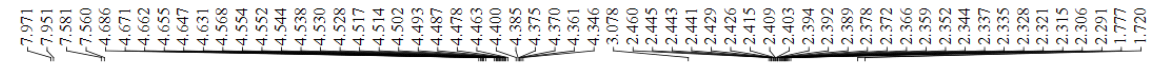

7.508
7.488
7.238
7.232
7.227
7.215
7.211
7.204
4.648
4.640
4.632
4.624
4.608
4.530
4.522
4.514
4.506
4.490
4.473
4.458
4.449
4.443
4.434
4.419
4.356
4.341
4.332
4.326
4.317
4.302
2.389
2.374
2.354
2.337
2.334
2.322
2.317
2.300
2.283
1.726
1.669


F
F
Br
2.00
1.92
2.15
2.11
3.06
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


143.251
143.031
131.683
131.670
125.906
125.809
121.681
121.665
96.856
96.802
95.130
95.076
80.680
80.628
79.040
78.988
42.470
42.275
42.233
42.039
27.932
27.684
F
F
Br
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-148.176
-148.182
-219.837
-219.843
F
F
Br
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

29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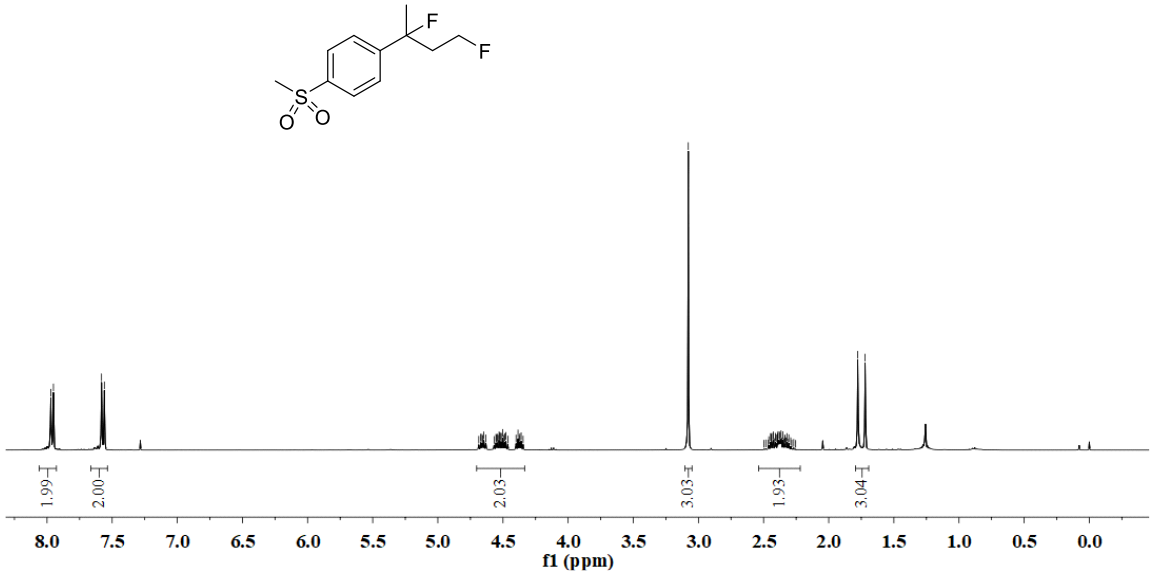
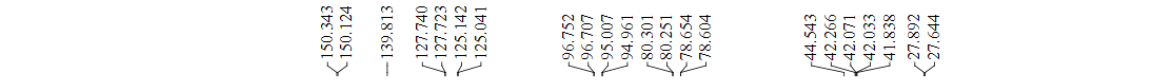
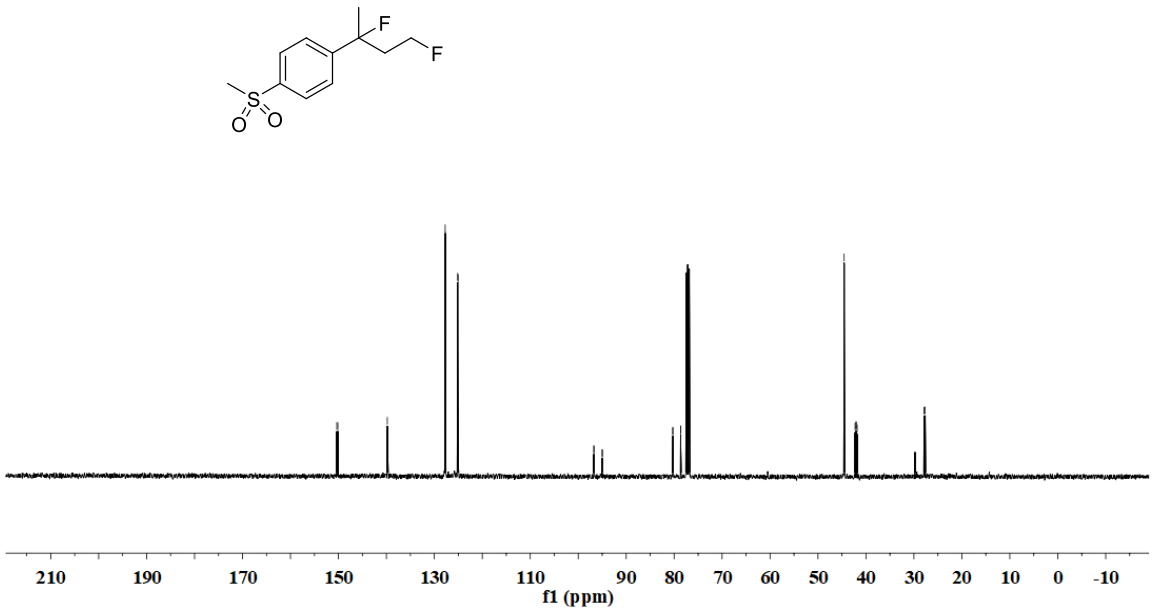
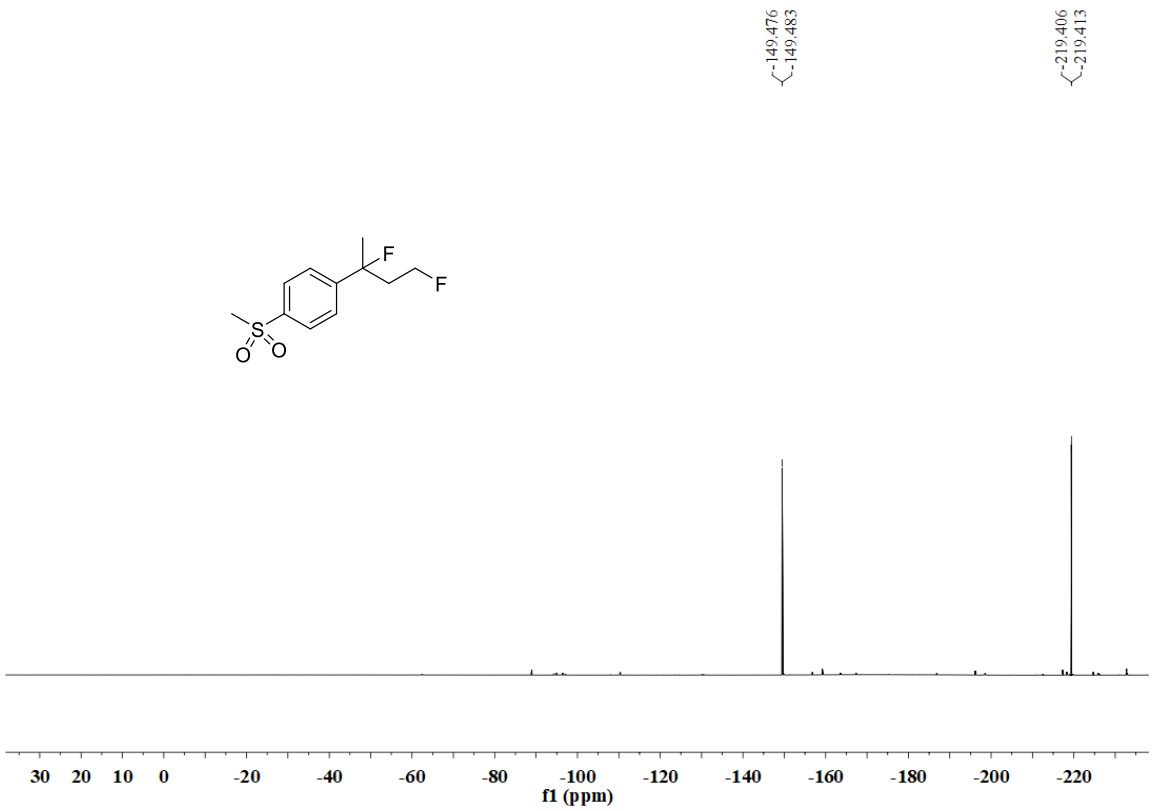
7.951
7.581
7.560
4.686
4.671
4.662
4.655
4.647
4.631
4.568
4.554
4.552
4.544
4.538
4.530
4.528
4.517
4.514
4.502
4.493
4.487
4.478
4.463
4.400
4.385
4.375
4.370
4.361
4.346
3.078
2.460
2.445
2.443
2.441
2.429
2.426
2.415
2.409
2.403
2.394
2.392
2.389
2.378
2.372
2.366
2.359
2.352
2.344
2.337
2.335
2.328
2.321
2.315
2.306
2.291
1.777
1.720

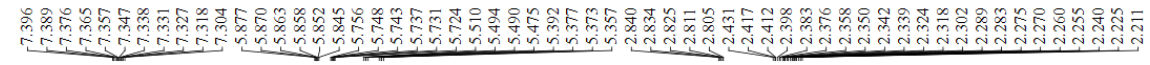

F
F
O
S
O
1.99
2.00
2.03
3.03
1.93
3.04
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

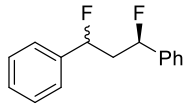

150.343
150.124
139.813
127.740
127.723
125.142
125.041
96.752
96.707
95.007
94.961
80.301
80.251
78.654
78.604
44.543
42.266
42.071
42.033
41.838
27.892
27.644

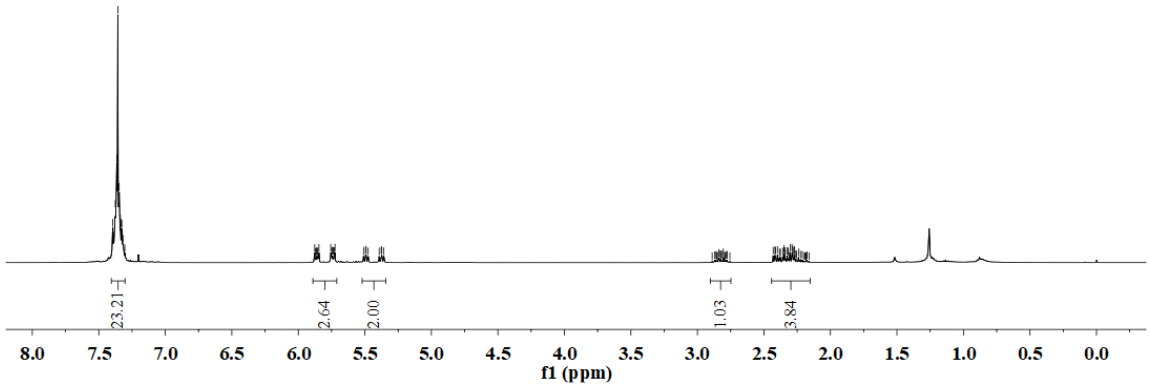

F
F
O
S
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

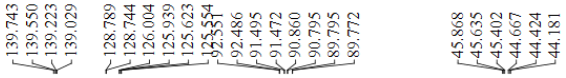

-149.476
-149.483
-219.406
-219.413
F
F
S
O
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

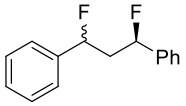
30

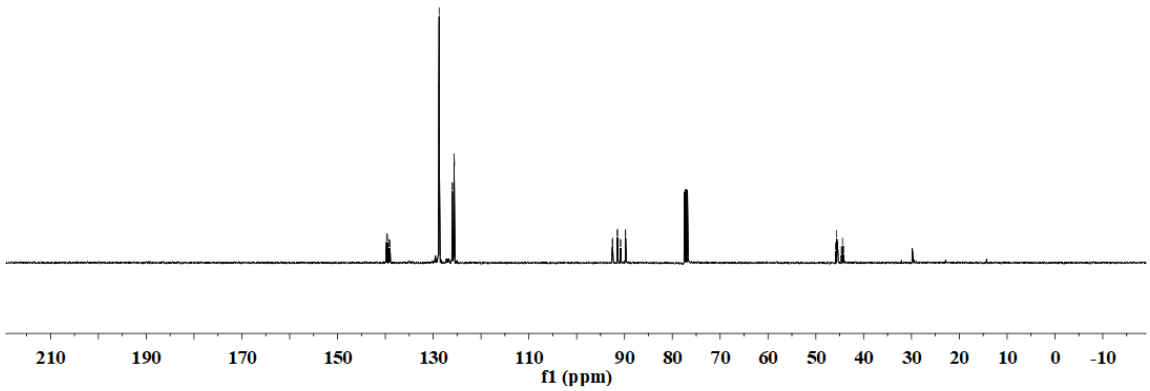

7.396
7.389
7.376
7.365
7.357
7.347
7.338
7.331
7.327
7.318
7.304
5.877
5.870
5.863
5.858
5.852
5.845
5.756
5.748
5.743
5.737
5.731
5.724
5.510
5.494
5.490
5.475
5.392
5.377
5.373
5.357
2.840
2.834
2.825
2.811
2.805
2.431
2.417
2.412
2.398
2.383
2.376
2.358
2.350
2.342
2.339
2.324
2.318
2.302
2.289
2.283
2.275
2.270
2.260
2.255
2.240
2.225
2.211

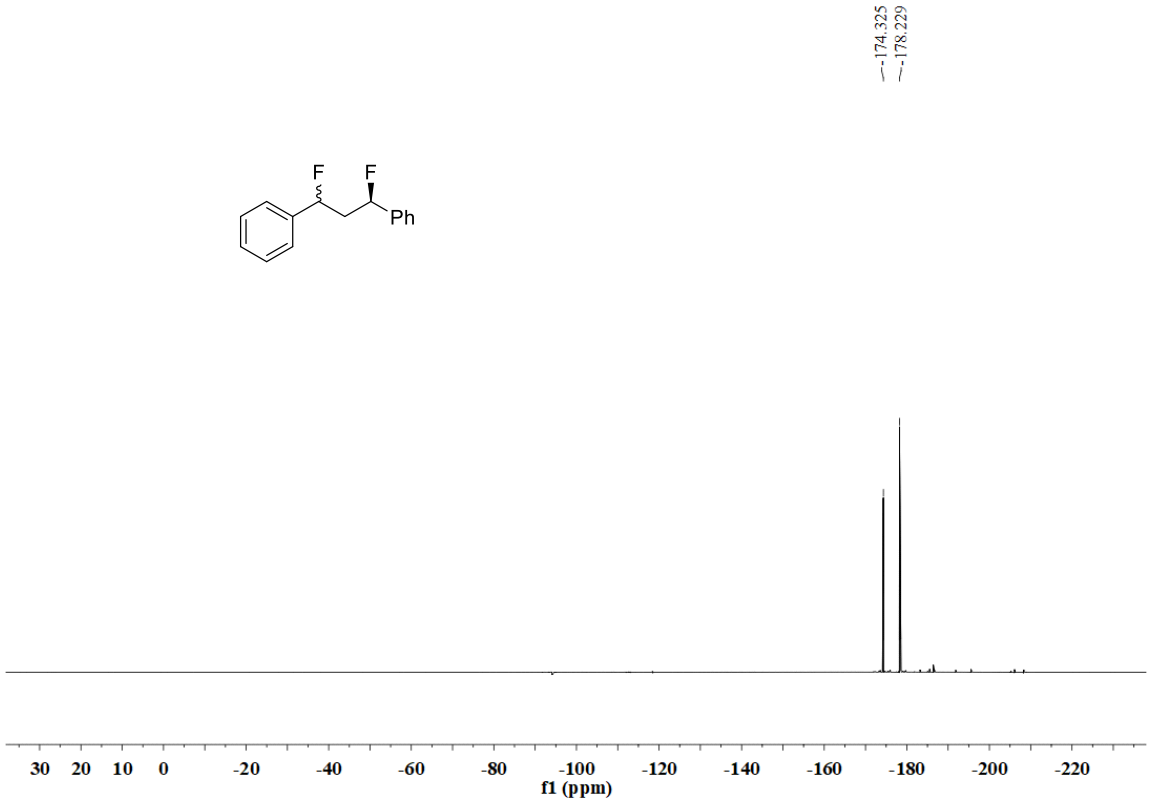

F
F
Ph


23.21
2.64
2.00
1.03
3.84
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

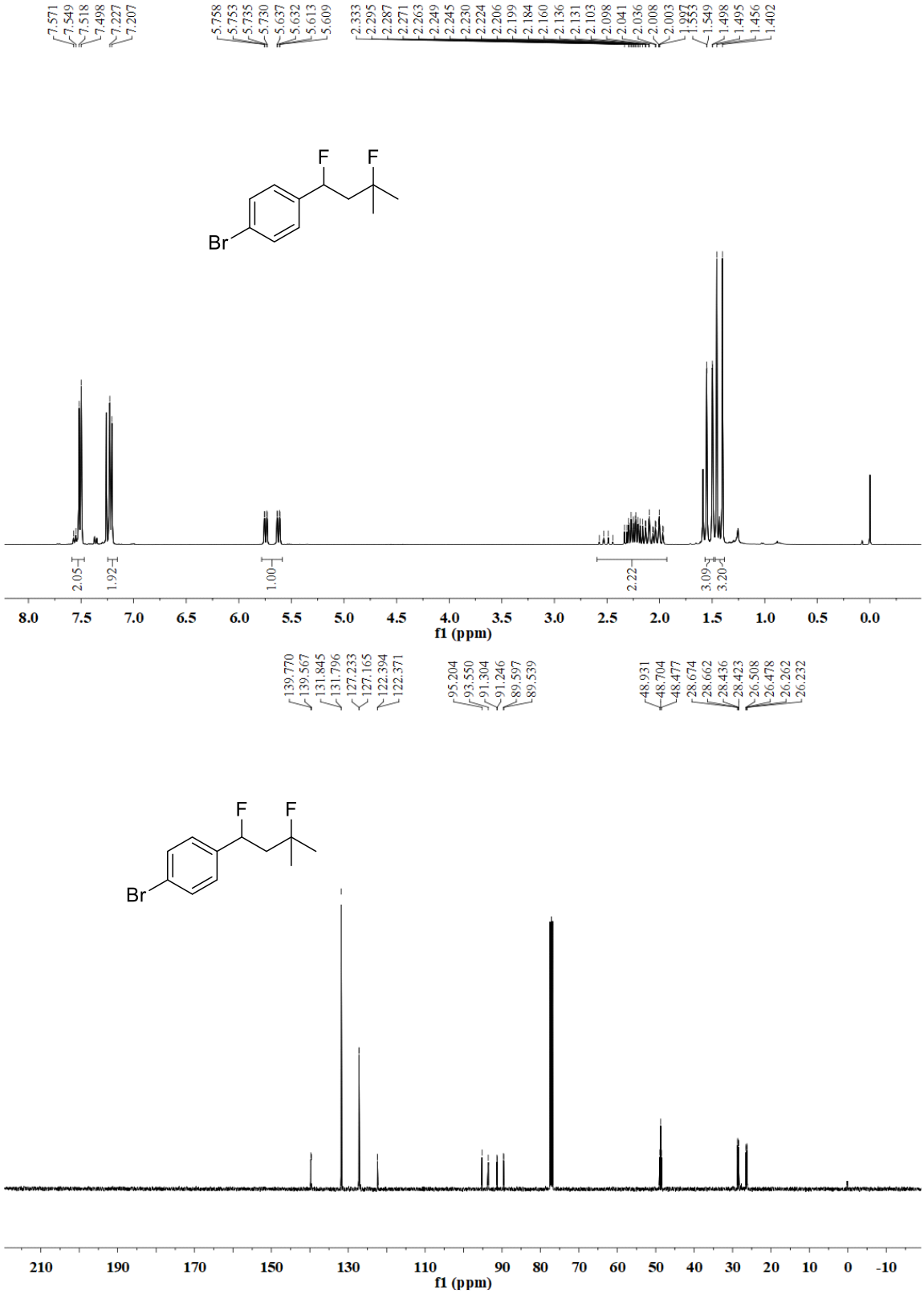

139.743
139.550
139.223
139.029
128.789
128.744
126.004
125.939
125.623
125.554
125.551
92.486
91.495
91.472
90.860
90.795
89.795
89.772
45.868
45.635
45.402
44.667
44.424
44.181

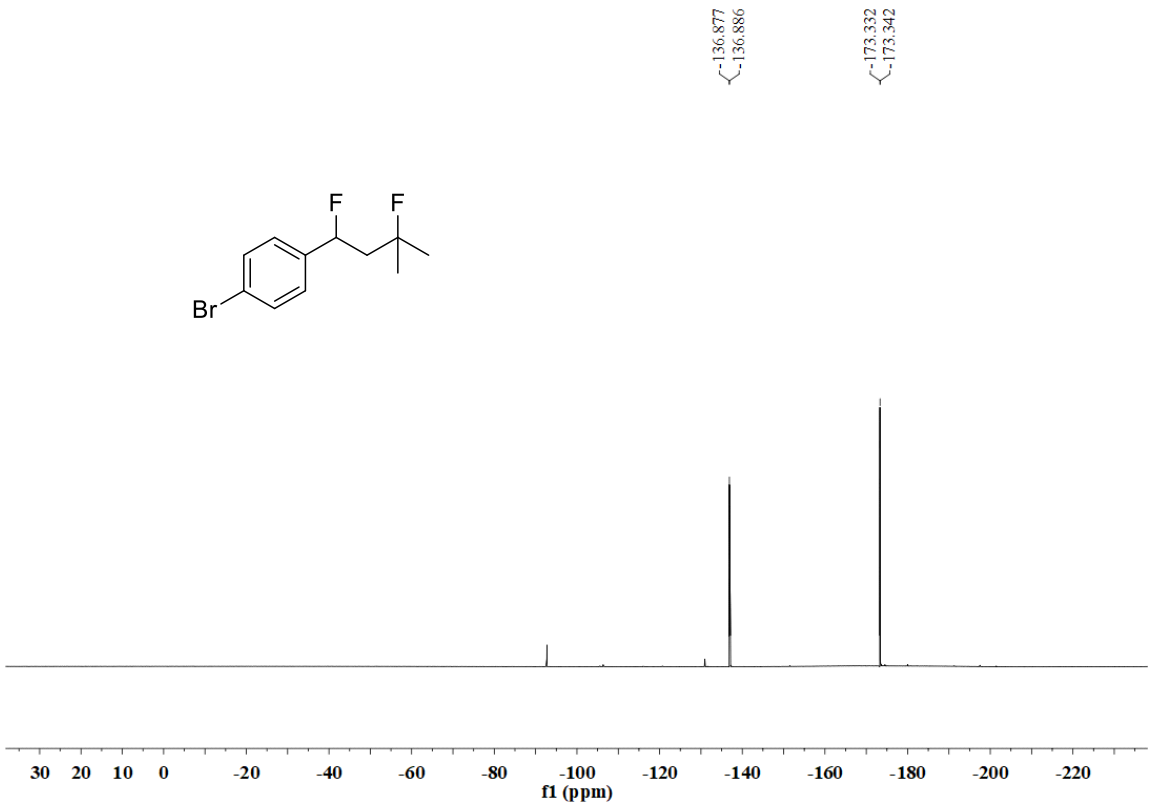

F
F
Ph


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

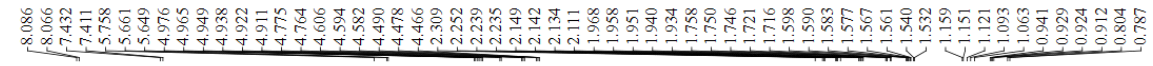

-174.325
-178.229
F
F
Ph
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

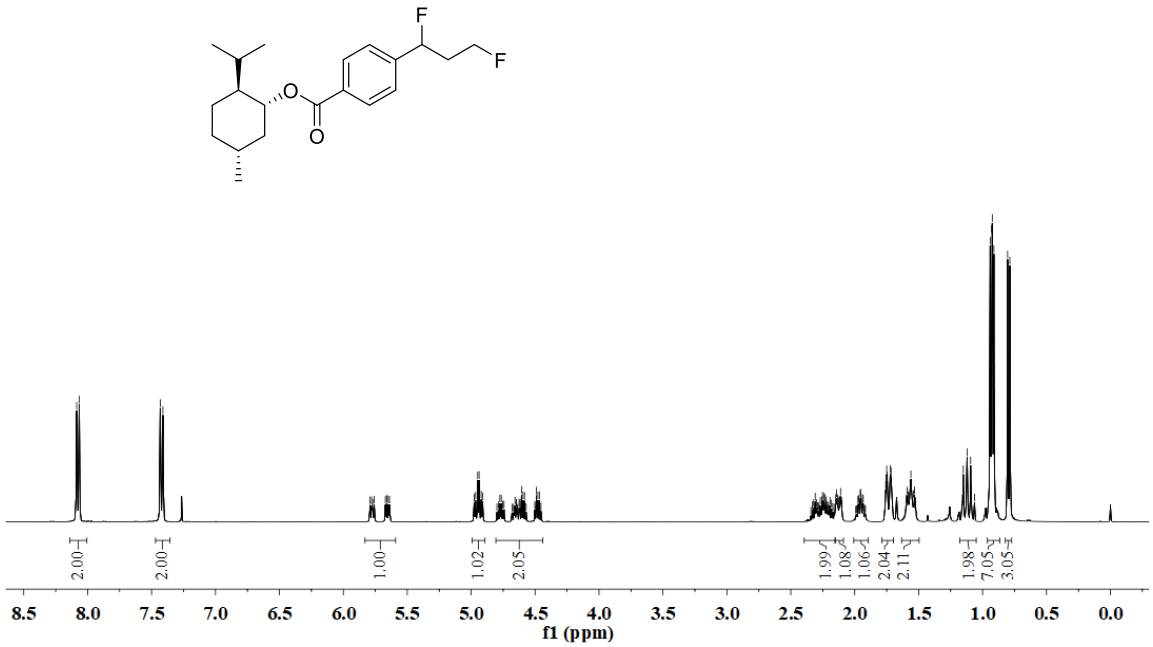
31

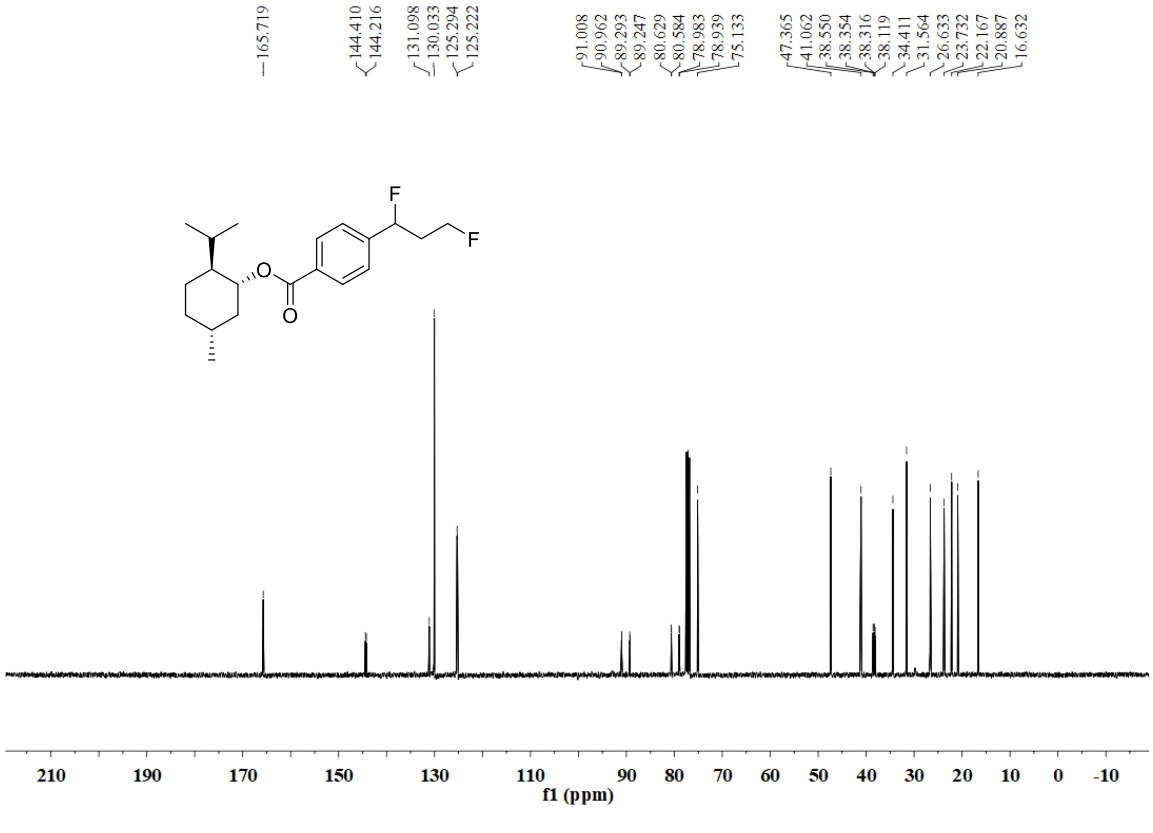

7.571
7.549
7.518
7.498
7.227
7.207
5.758
5.753
5.735
5.730
5.637
5.632
5.613
5.609
2.333
2.295
2.287
2.271
2.263
2.249
2.245
2.230
2.224
2.206
2.199
2.184
2.160
2.136
2.131
2.103
2.098
2.041
2.036
2.008
2.003
1.987
1.553
1.549
1.498
1.495
1.456
1.402
F
F
Br
2.05
1.92
1.00
2.22
3.09
3.20
f1 (ppm)
139.770
139.567
131.845
131.796
127.233
127.165
122.394
122.371
95.204
93.550
91.304
91.246
89.597
89.539
48.931
48.704
48.477
28.674
28.662
28.436
28.423
26.508
26.478
26.262
26.232
F
F
Br
f1 (ppm)

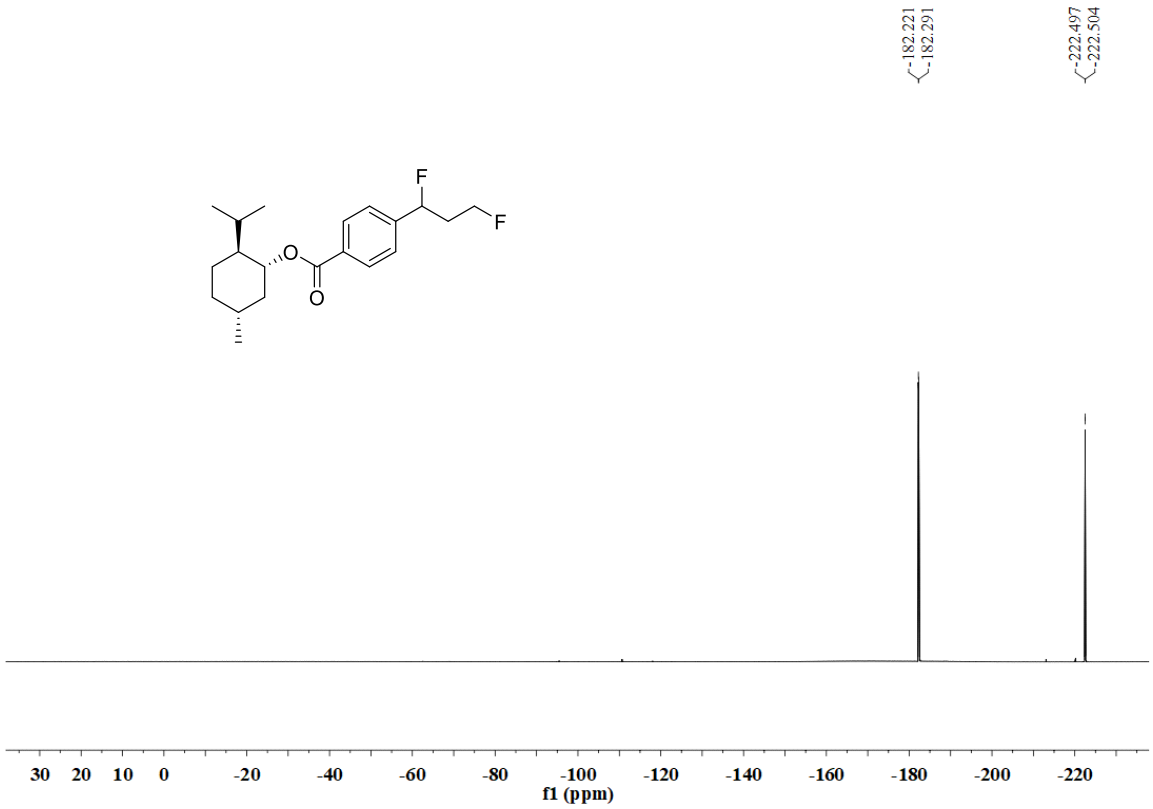

-136.877
-136.886
-173.332
-173.342
F
F
Br
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

32

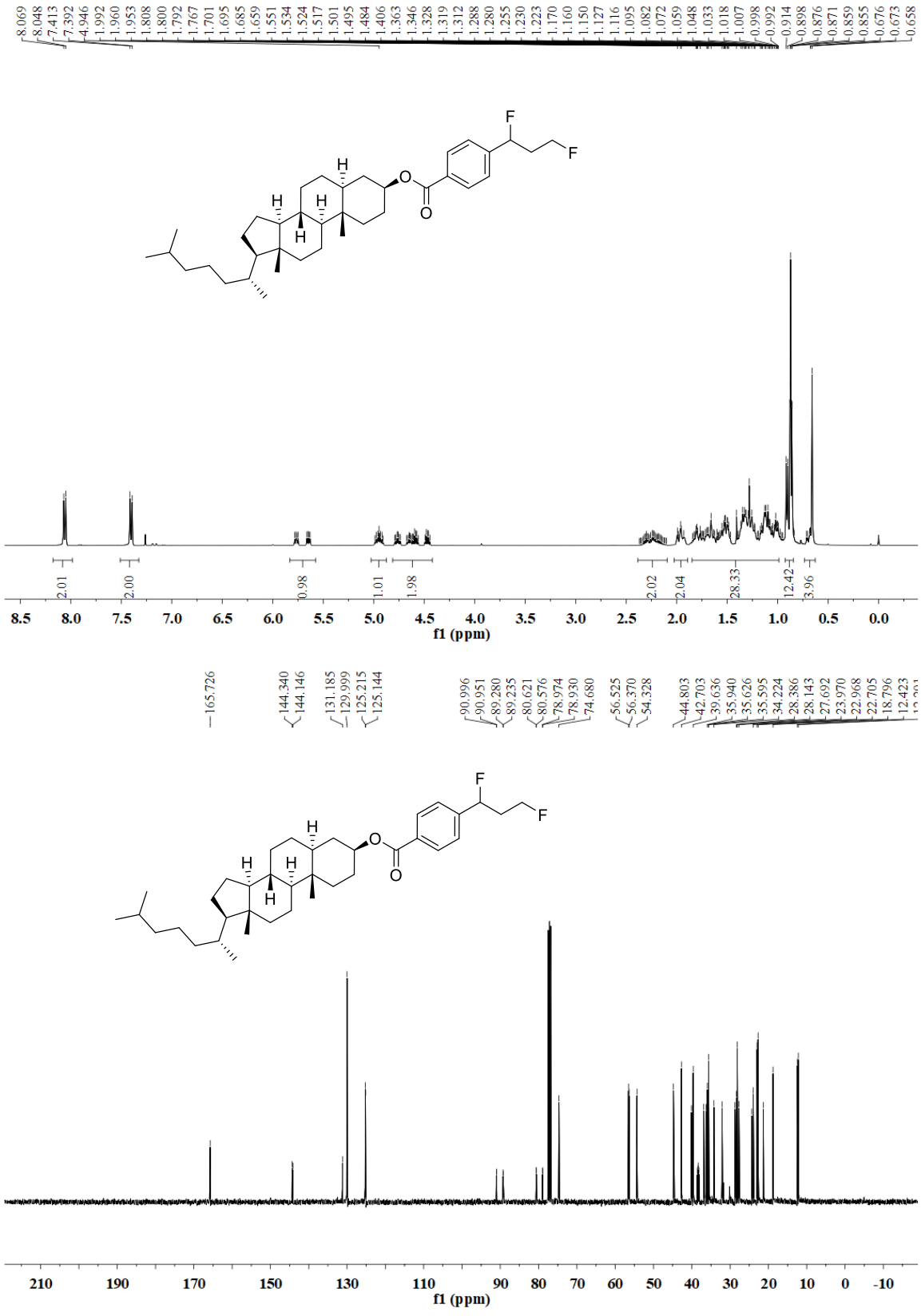

8.086
8.066
7.432
7.411
5.758
5.661
5.649
4.976
4.965
4.949
4.938
4.922
4.911
4.775
4.764
4.606
4.594
4.582
4.490
4.478
4.466
2.309
2.252
2.239
2.235
2.149
2.142
2.134
2.111
1.968
1.958
1.951
1.940
1.934
1.758
1.750
1.746
1.721
1.716
1.598
1.590
1.583
1.577
1.567
1.561
1.540
1.532
1.159
1.151
1.121
1.093
1.063
0.941
0.929
0.924
0.912
0.804
0.787


F
F
O
O
2.00
2.00
1.00
1.02
2.05
1.99
1.08
1.06
2.04
2.11
1.98
7.05
3.05
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


165.719
144.410
144.216
131.098
130.033
125.294
125.222
91.008
90.962
89.293
89.247
80.629
80.584
78.983
78.939
75.133
47.365
41.062
38.550
38.354
38.316
38.119
34.411
31.564
26.633
23.732
22.167
20.887
16.632
F
F
O
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-182.221
-182.291
-222.497
-222.504
F
F
O
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

33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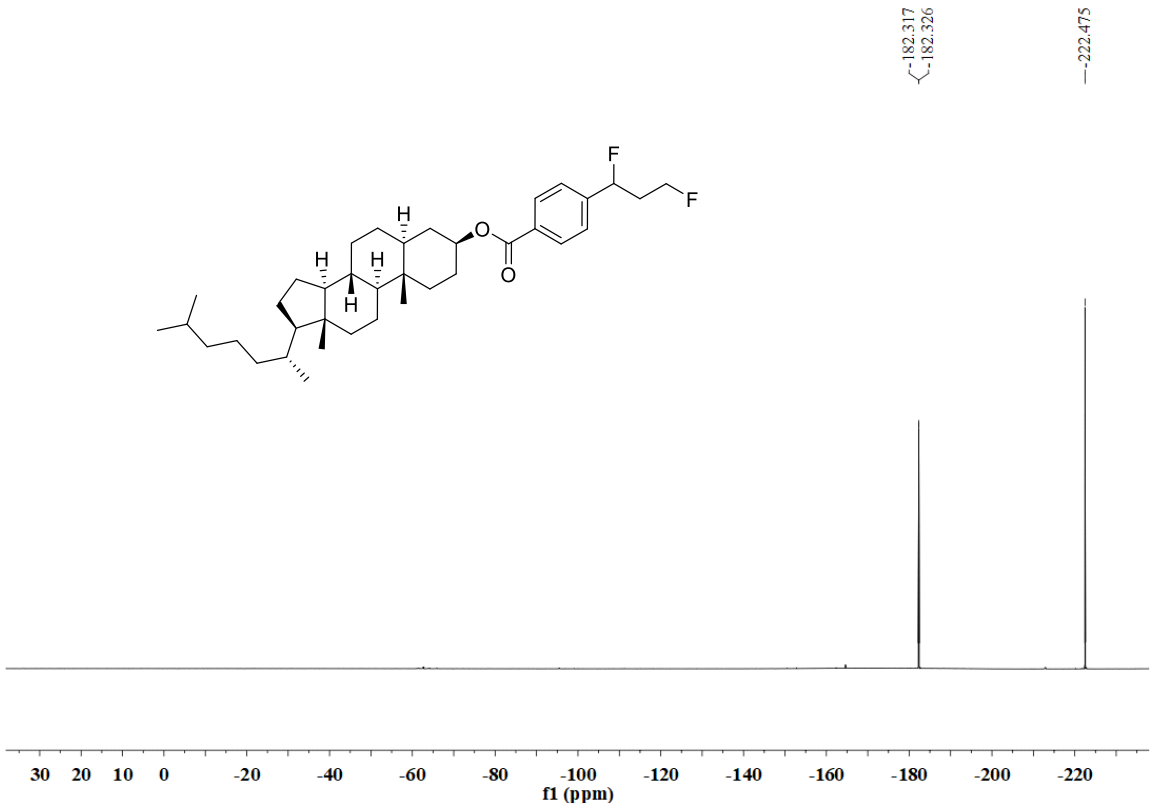
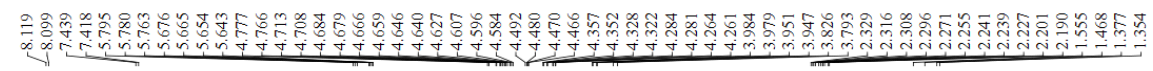
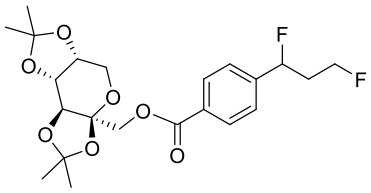
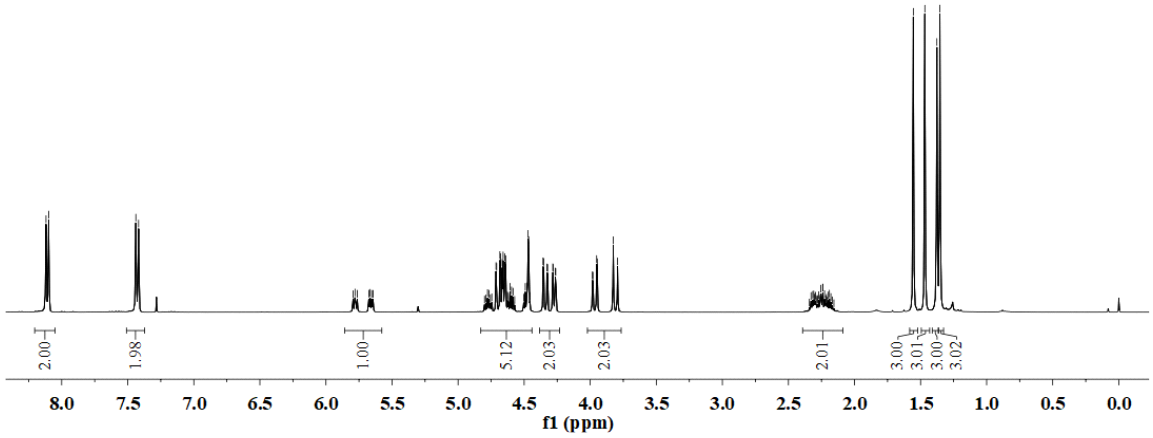
8.048
7.413
7.392
4.946
1.992
1.960
1.953
1.808
1.800
1.792
1.767
1.701
1.695
1.685
1.659
1.551
1.534
1.524
1.517
1.501
1.495
1.484
1.406
1.363
1.346
1.328
1.319
1.312
1.288
1.280
1.255
1.230
1.223
1.170
1.160
1.150
1.127
1.116
1.095
1.082
1.072
1.059
1.048
1.033
1.018
1.007
0.998
0.992
0.914
0.898
0.876
0.871
0.859
0.855
0.676
0.673
0.658
F
F
H
O
O
H
H
H
2.01
2.00
0.98
1.01
1.98
2.02
2.04
28.33
12.42
3.96
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
165.726
144.340
144.146
131.185
129.999
125.215
125.144
90.996
90.951
89.280
89.235
80.621
80.576
78.974
78.930
74.680
56.525
56.370
54.328
44.803
42.703
39.636
35.940
35.626
35.595
34.224
28.386
28.143
27.692
23.970
22.968
22.705
18.796
12.423
F
F
H
O
O
H
H
H
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

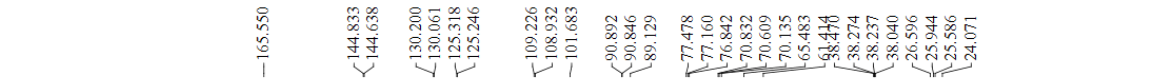

-182.317
-182.326
-222.475
F
F
H
H
H
O
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

34


8.119
8.099
7.439
7.418
5.795
5.780
5.763
5.676
5.665
5.654
5.643
4.777
4.766
4.713
4.708
4.684
4.679
4.666
4.659
4.646
4.640
4.627
4.607
4.596
4.584
4.492
4.480
4.470
4.466
4.357
4.352
4.328
4.322
4.284
4.281
4.264
4.261
3.984
3.979
3.951
3.947
3.826
3.793
2.329
2.316
2.308
2.296
2.271
2.255
2.241
2.239
2.227
2.201
2.190
1.555
1.468
1.377
1.354


F
F
O
O
O
O
O
O


2.00
1.98
1.00
5.12
2.03
2.03
2.01
3.00
3.01
3.00
3.02
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


165.550
144.833
144.638
130.200
130.061
125.318
125.246
109.226
108.932
101.683
90.892
90.846
89.129
77.478
77.160
76.842
70.832
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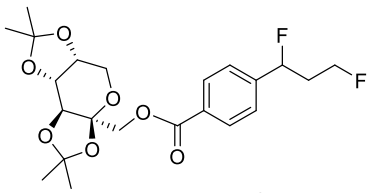
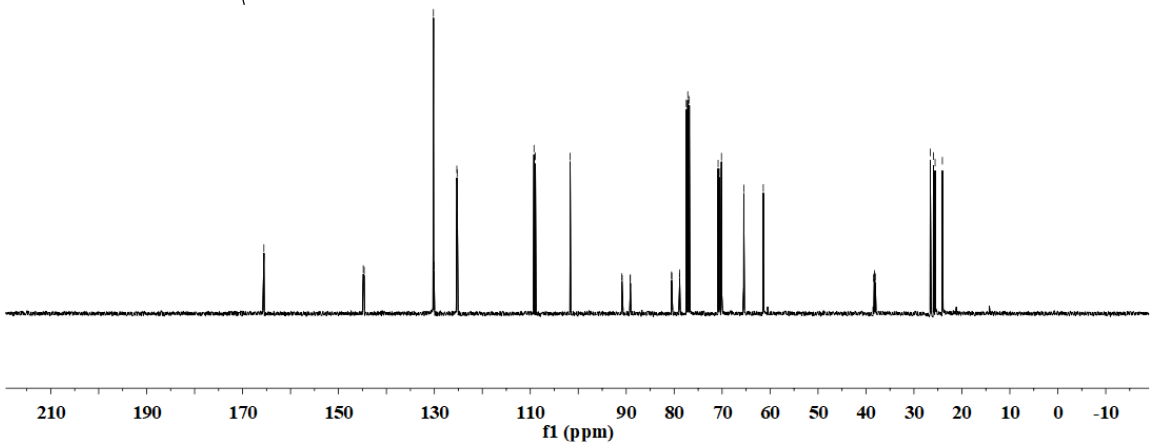
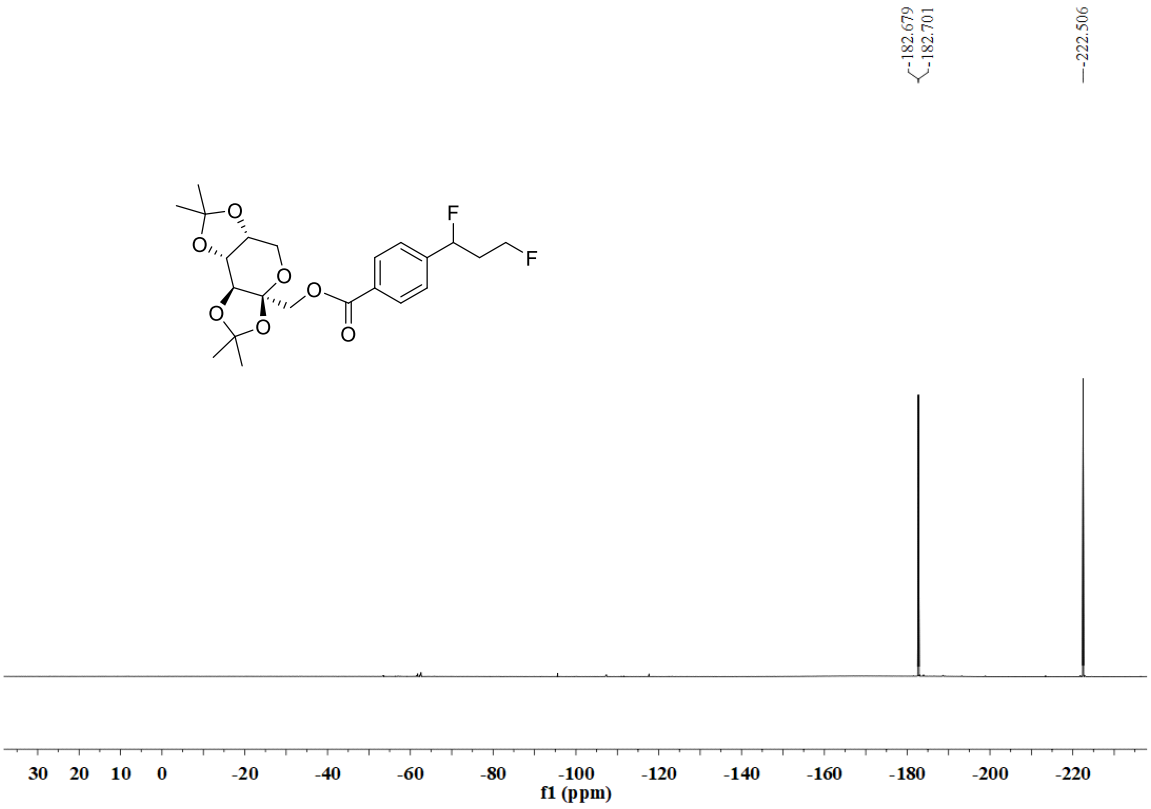
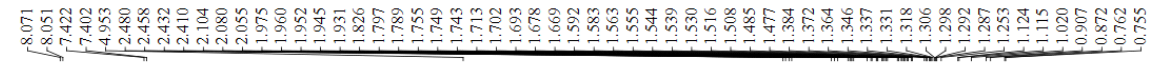
38.237
38.040
26.596
25.944
25.586
24.071

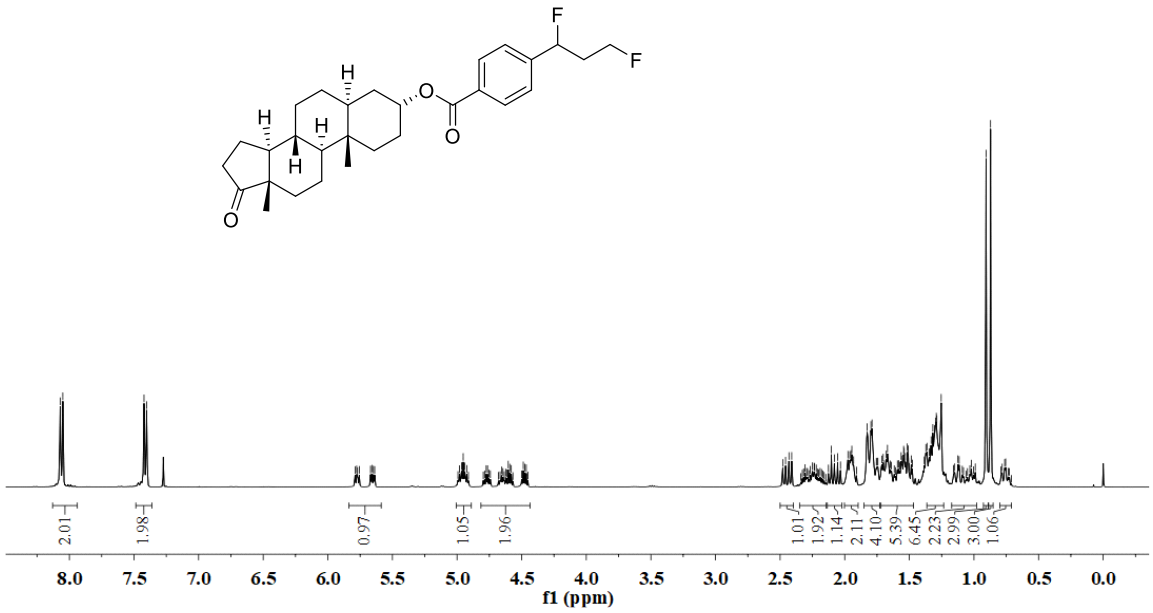

F
F
O
O
O
O
O
O


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

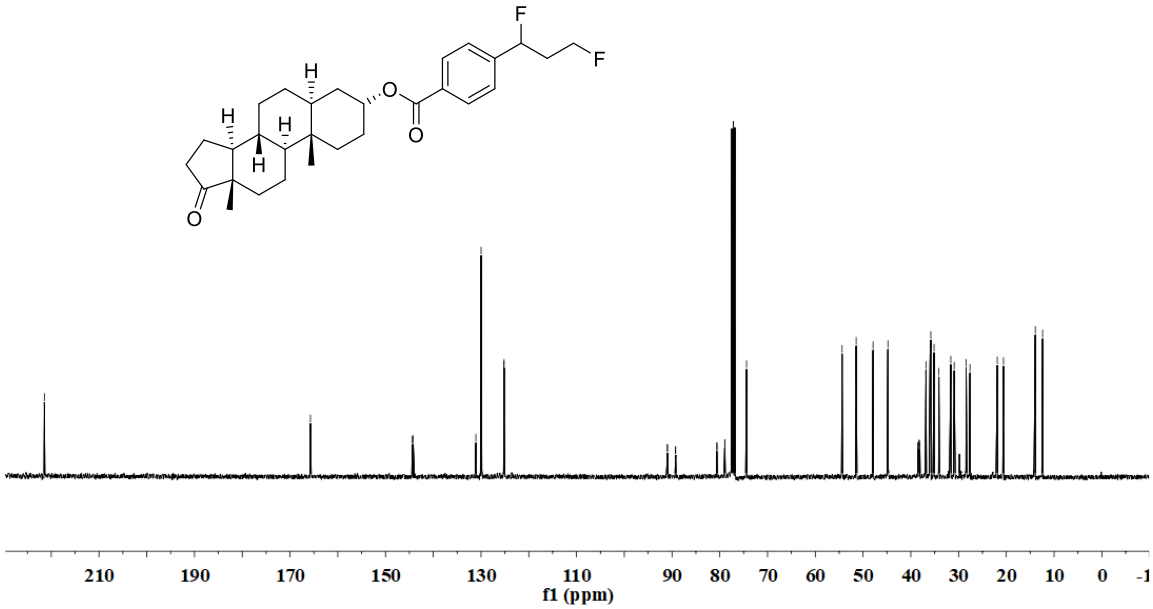

-182.679
-182.701
-222.506
F
F
O
O
O
O
O
O
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

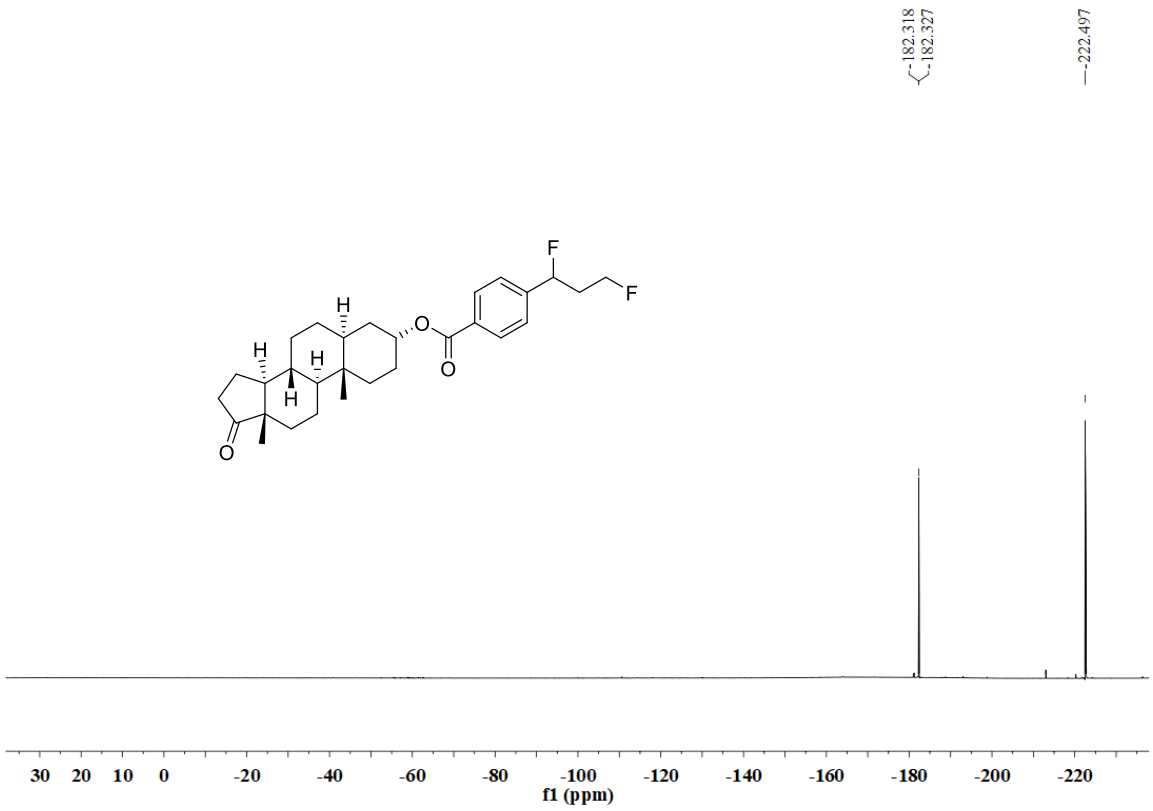
35


8.071
8.051
7.422
7.402
4.953
2.480
2.458
2.432
2.410
2.104
2.080
2.055
1.975
1.960
1.952
1.945
1.931
1.826
1.797
1.789
1.755
1.749
1.743
1.713
1.702
1.693
1.678
1.669
1.592
1.583
1.563
1.555
1.544
1.539
1.530
1.516
1.508
1.485
1.477
1.384
1.372
1.364
1.346
1.337
1.331
1.318
1.306
1.298
1.292
1.287
1.253
1.124
1.115
1.020
0.907
0.872
0.762
0.755

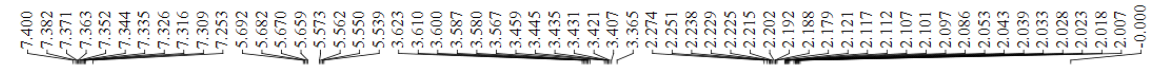

F
F
H
H
H
O
O
O
2.01
1.98
0.97
1.05
1.96
1.01
1.92
1.14
2.11
4.10
5.39
6.45
2.23
2.99
3.00
1.06
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

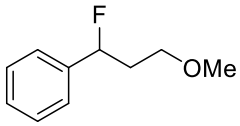

221.445
165.716
144.397
144.203
131.071
129.985
125.233
125.161
90.993
90.947
89.277
89.232
80.619
80.574
78.974
78.929
74.401
54.393
51.445
47.905
44.790
38.340
36.831
35.970
35.807
35.135
34.123
31.620
30.919
28.396
27.607
21.894
20.591
13.934

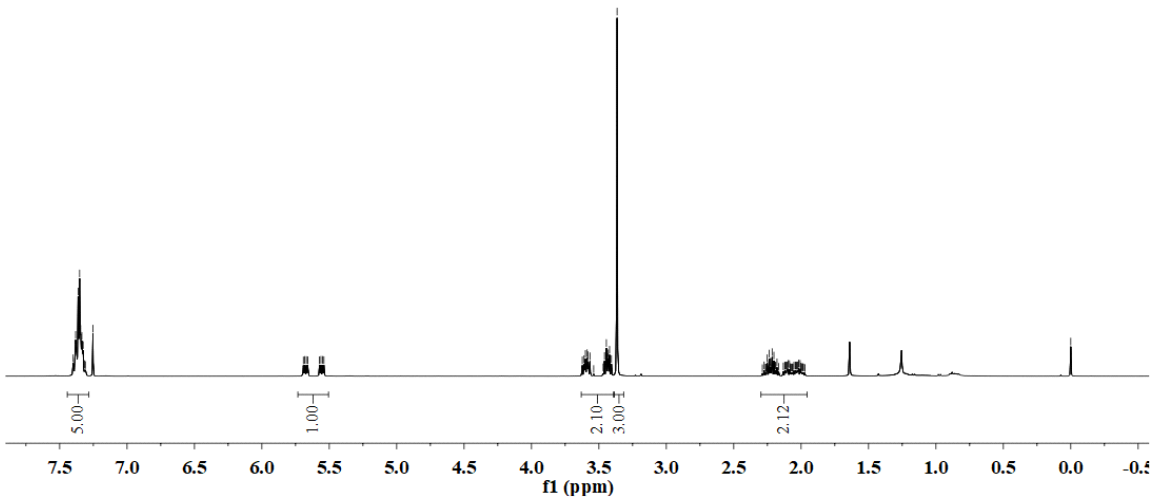

F
F
H
H
H
O
O
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-1
f1 (ppm)


-182.318
-182.327
-222.497
F
F
H
H
H
O
O
O
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

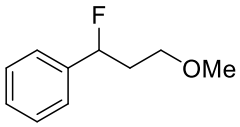
3

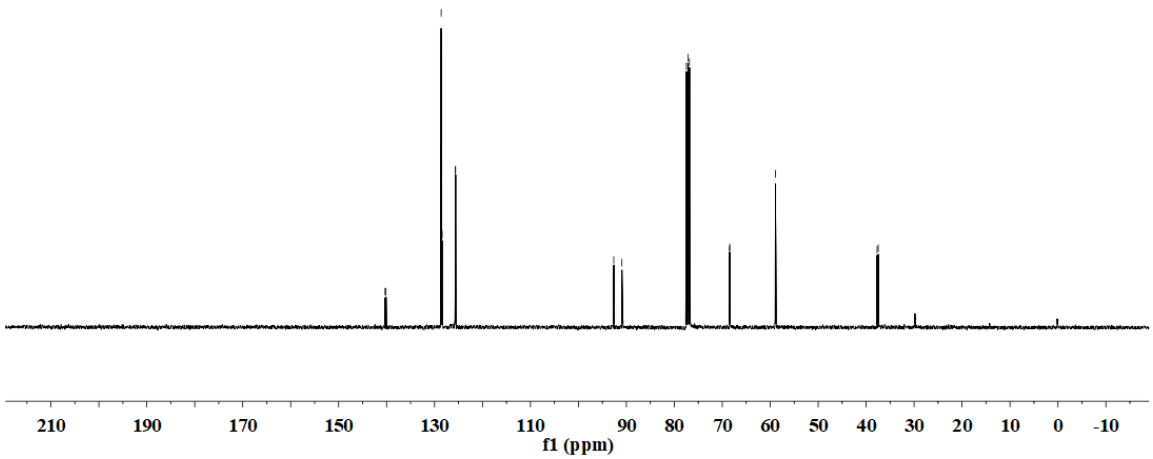

7.400
7.382
7.371
7.363
7.352
7.344
7.335
7.326
7.316
7.309
7.253
5.692
5.682
5.670
5.659
5.573
5.562
5.550
5.539
3.623
3.610
3.600
3.587
3.580
3.567
3.459
3.445
3.435
3.431
3.421
3.407
3.365
2.274
2.251
2.238
2.229
2.225
2.215
2.202
2.192
2.188
2.179
2.121
2.117
2.112
2.107
2.101
2.097
2.086
2.053
2.043
2.039
2.033
2.028
2.023
2.018
2.007
-0.000

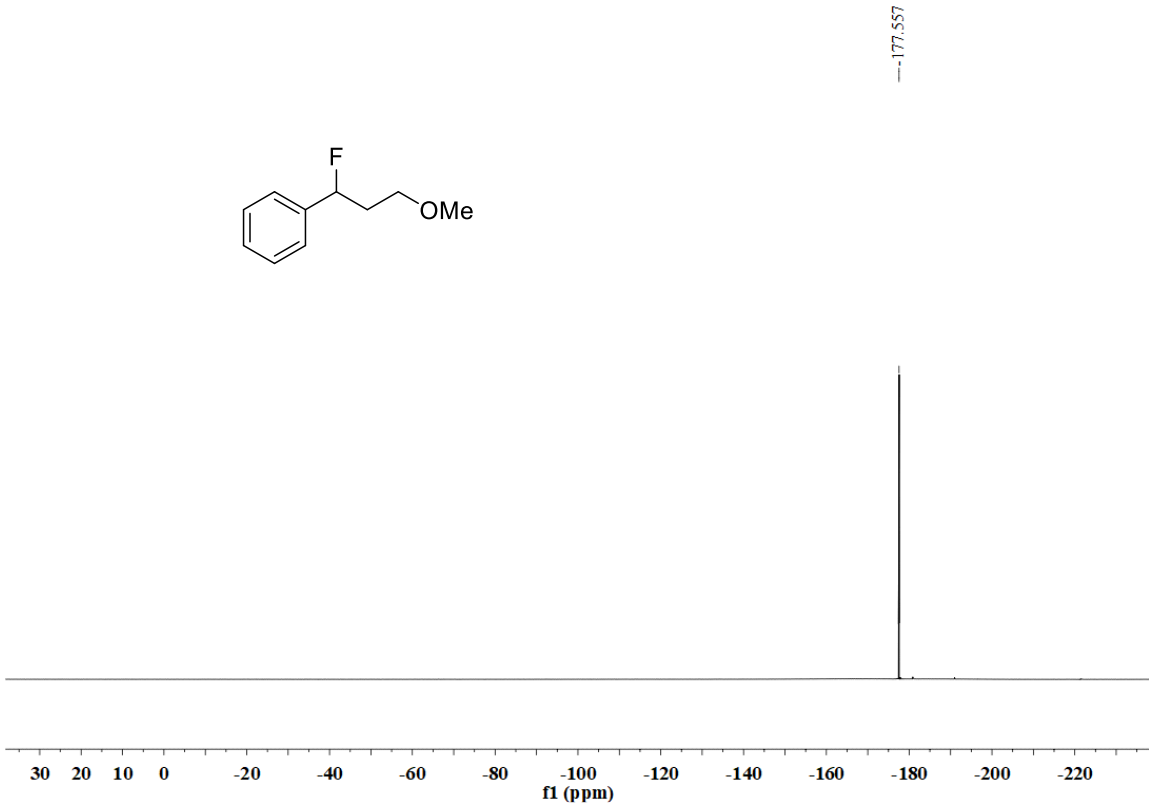

F
OMe


5.00
1.00
2.10
3.00
2.12
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

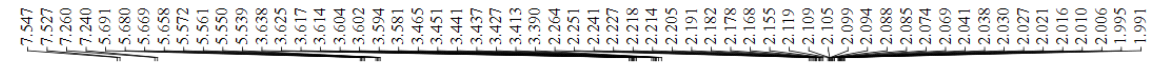

140.319
140.124
128.620
128.460
128.441
125.683
125.616
92.623
90.938
77.478
77.160
76.843
68.490
68.443
58.922
37.709
37.472

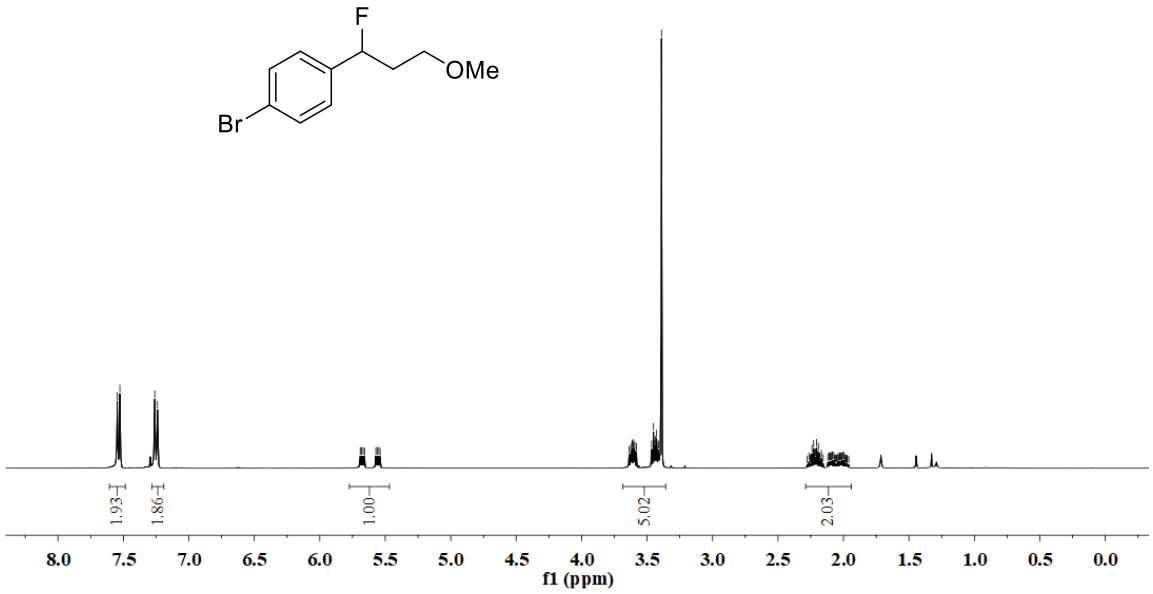

F
OMe

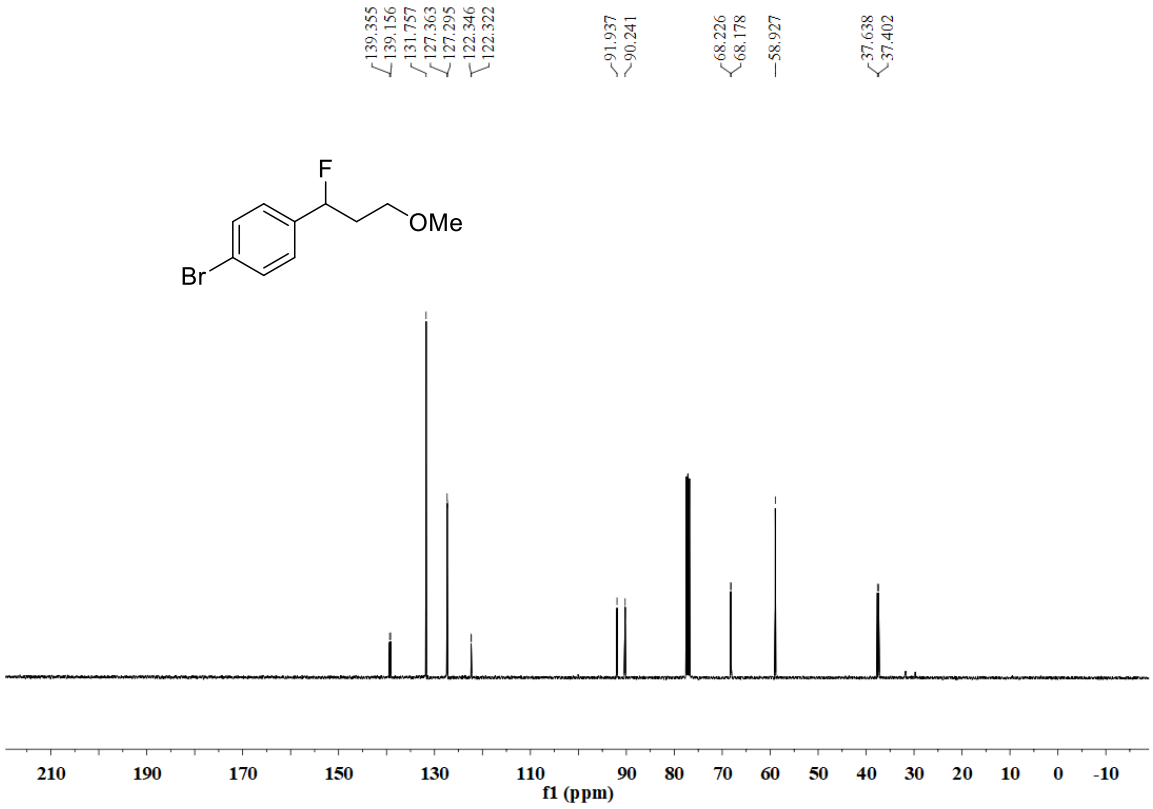

210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

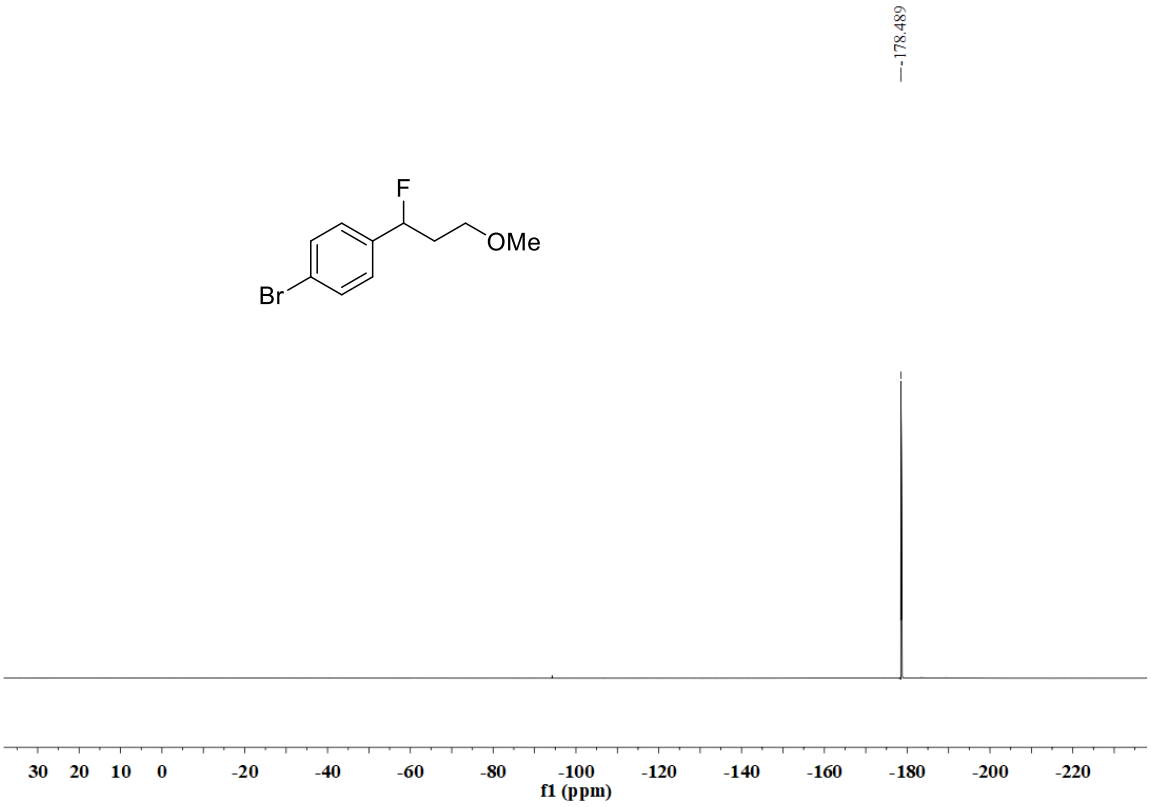

-177.557
F
OMe
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

36

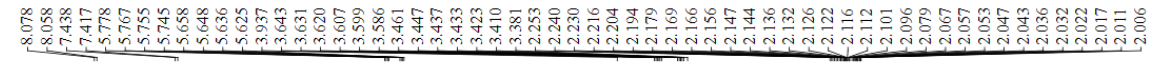

7.547
7.527
7.260
7.240
5.691
5.680
5.669
5.658
5.572
5.561
5.550
5.539
3.638
3.625
3.617
3.614
3.604
3.602
3.594
3.581
3.465
3.451
3.441
3.437
3.427
3.413
3.390
2.264
2.251
2.241
2.227
2.218
2.214
2.205
2.191
2.182
2.178
2.168
2.155
2.119
2.109
2.105
2.099
2.094
2.088
2.085
2.074
2.069
2.041
2.038
2.030
2.027
2.021
2.016
2.010
2.006
1.995
1.991

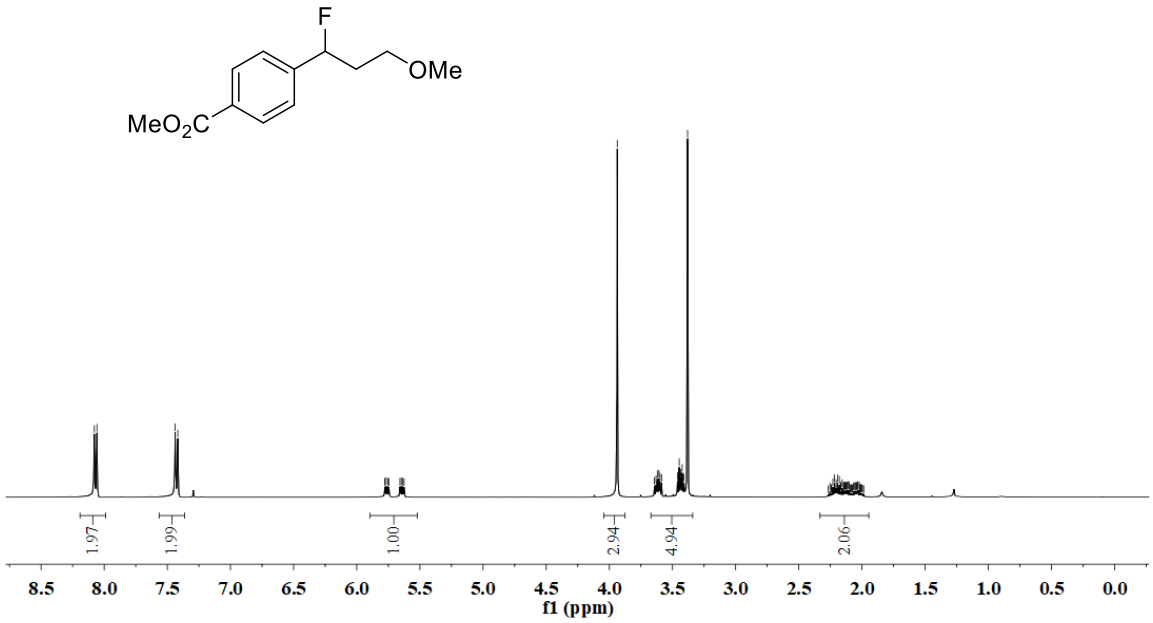

F
OMe
Br
1.93
1.86
1.00
5.02
2.03
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


139.355
139.156
131.757
127.363
127.295
122.346
122.322
91.937
90.241
68.226
68.178
58.927
37.638
37.402
F
OMe
Br
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

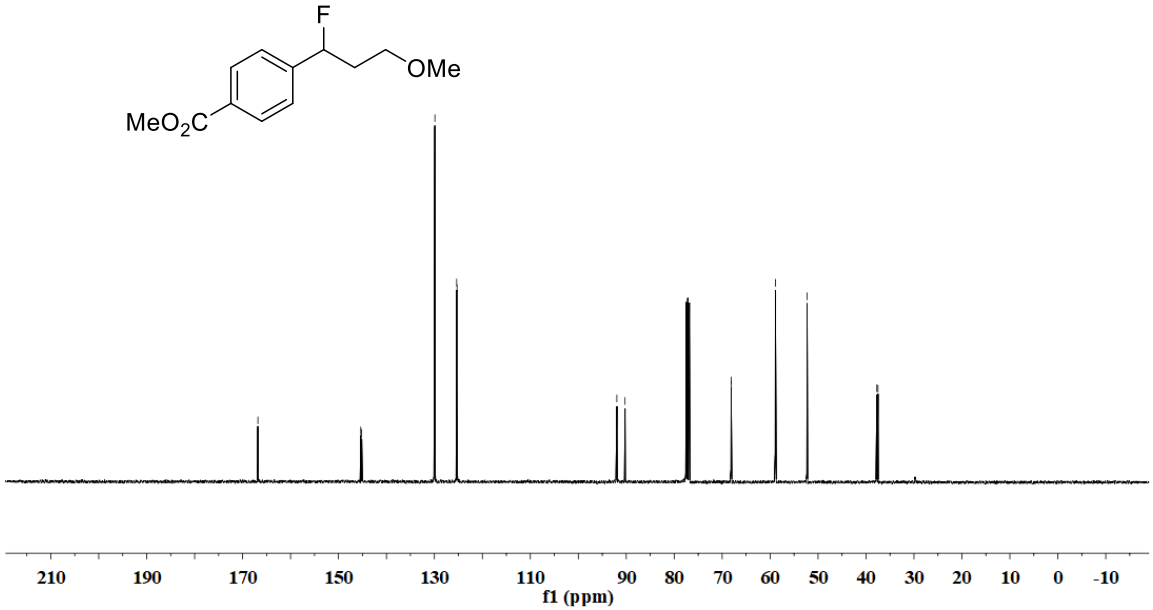

-178.489
F
OMe
Br
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

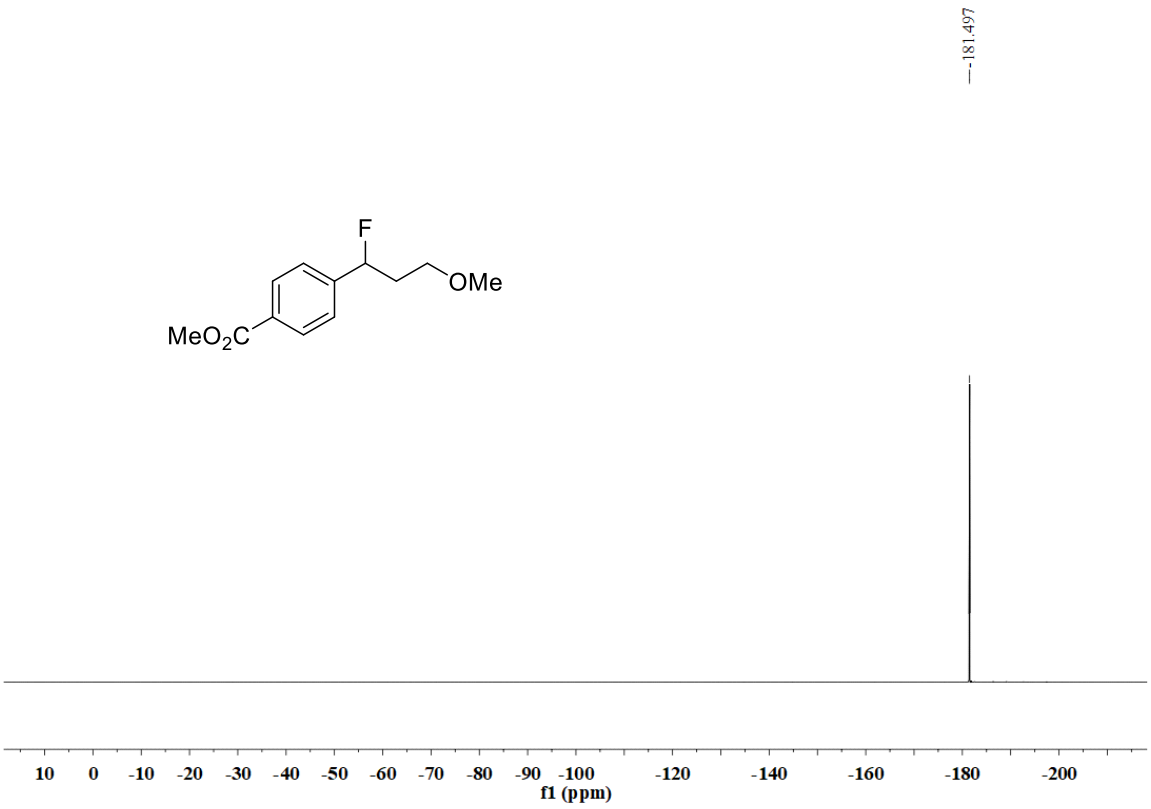
37


8.078
8.058
7.438
7.417
5.778
5.767
5.755
5.745
5.658
5.648
5.636
5.625
3.937
3.643
3.631
3.620
3.607
3.599
3.586
3.461
3.447
3.437
3.433
3.423
3.410
3.381
2.253
2.240
2.230
2.216
2.204
2.194
2.179
2.169
2.166
2.156
2.147
2.144
2.136
2.132
2.126
2.122
2.116
2.112
2.101
2.096
2.079
2.067
2.057
2.053
2.047
2.043
2.036
2.032
2.022
2.017
2.011
2.006

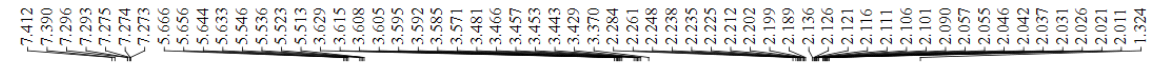

F
OMe
MeO2C
1.97
1.99
1.00
2.94
4.94
2.06
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

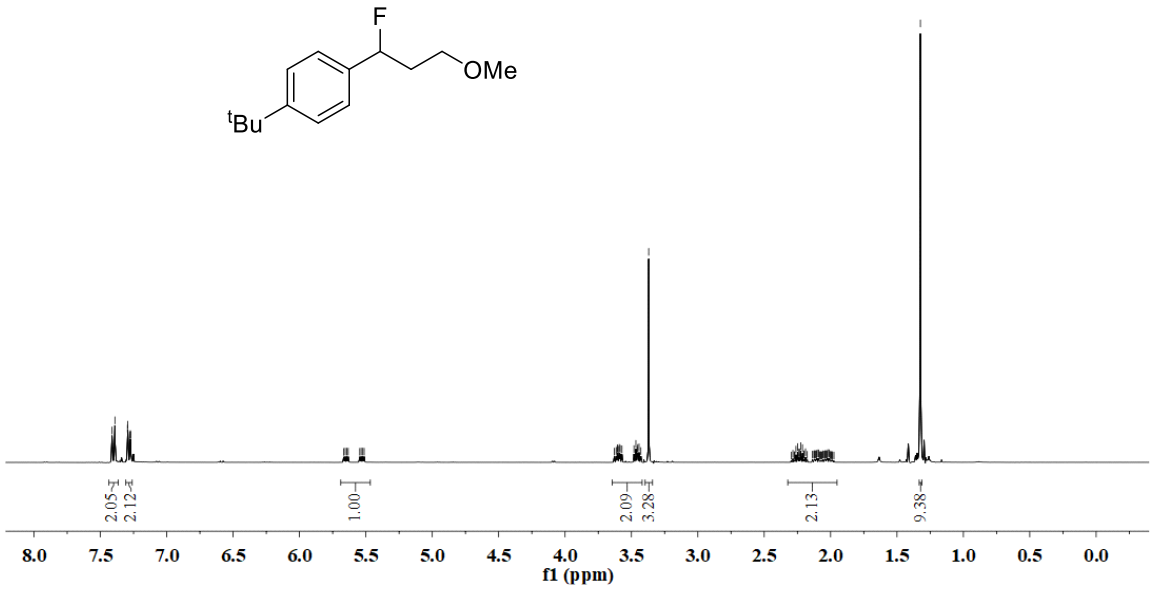

166.802
145.364
145.169
130.052
130.037
129.898
125.354
125.281
91.957
90.252
68.117
68.070
58.897
52.275
37.737
37.505

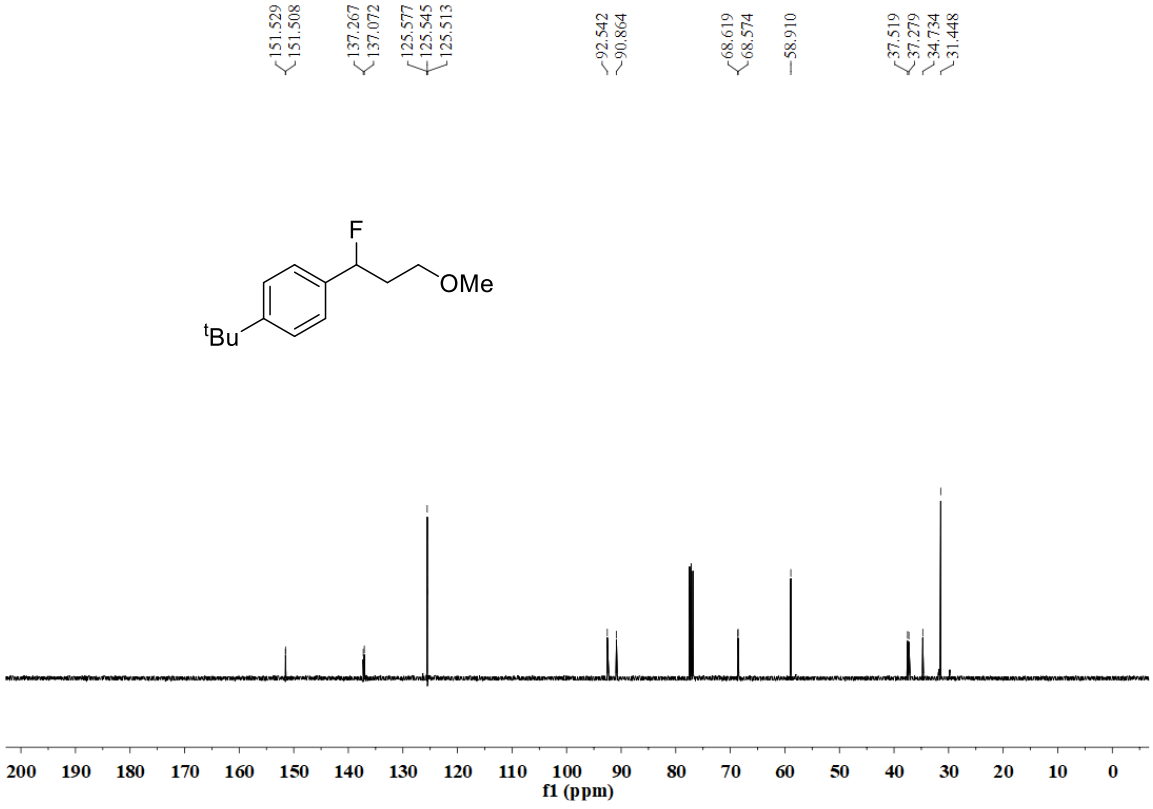

F
OMe
MeO2C
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

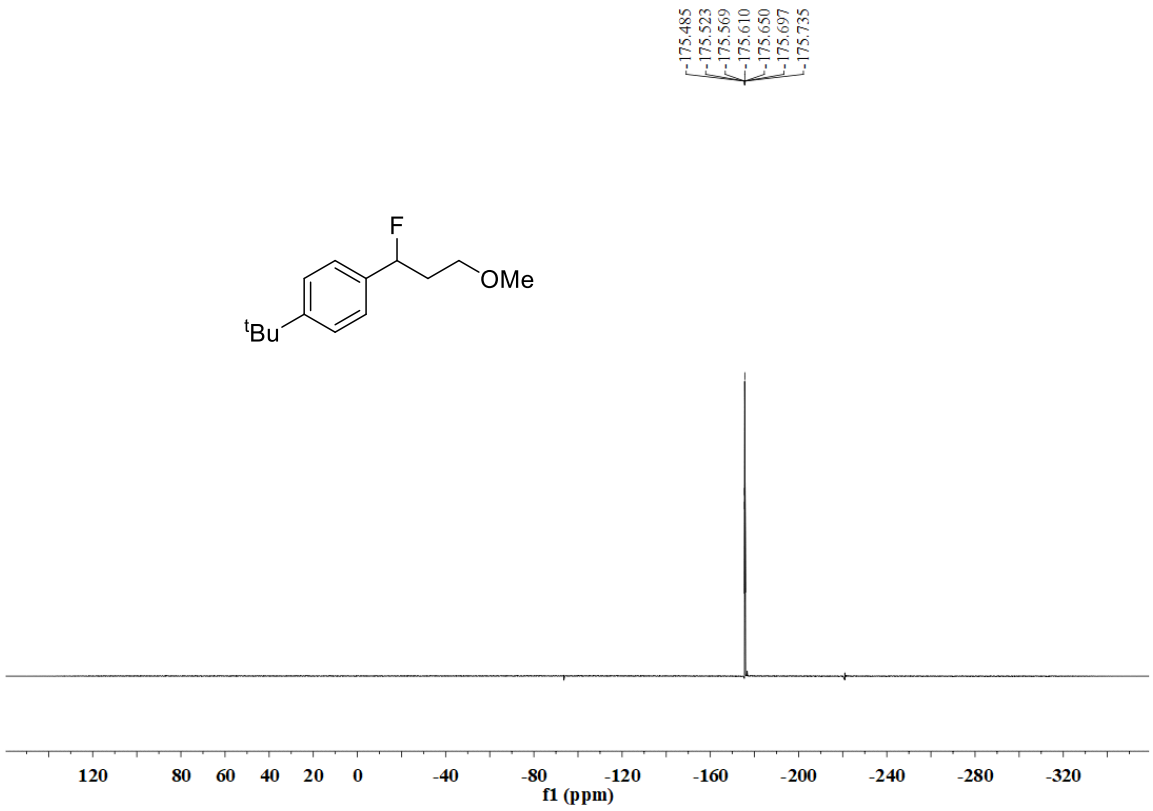

-181.497
F
OMe
MeO2C
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140 -160 -180 -200
f1 (ppm)

38

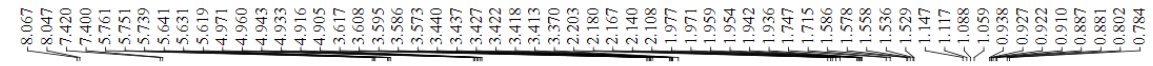

7.412
7.390
7.296
7.293
7.275
7.274
7.273
5.666
5.656
5.644
5.633
5.546
5.536
5.523
5.513
3.629
3.615
3.608
3.605
3.595
3.592
3.585
3.571
3.481
3.466
3.457
3.453
3.443
3.429
3.370
2.284
2.261
2.248
2.238
2.235
2.225
2.212
2.202
2.199
2.189
2.136
2.126
2.121
2.116
2.111
2.106
2.101
2.090
2.057
2.055
2.046
2.042
2.037
2.031
2.026
2.021
2.011
1.324

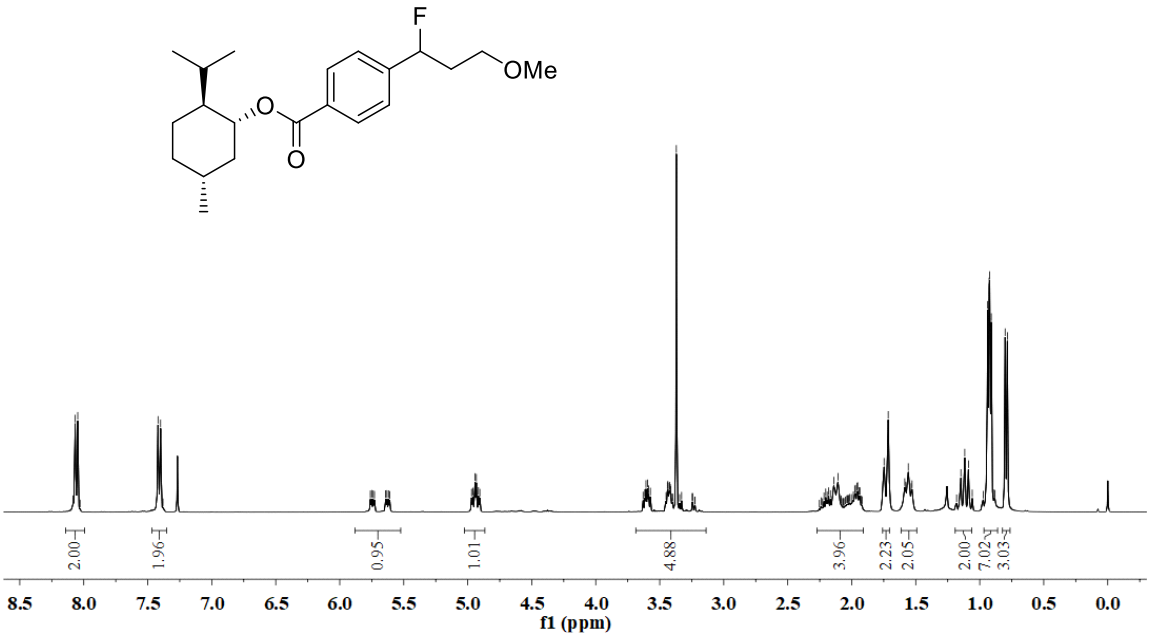

F
OMe
tBu
2.05
2.12
1.00
2.09
3.28
2.13
9.38
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

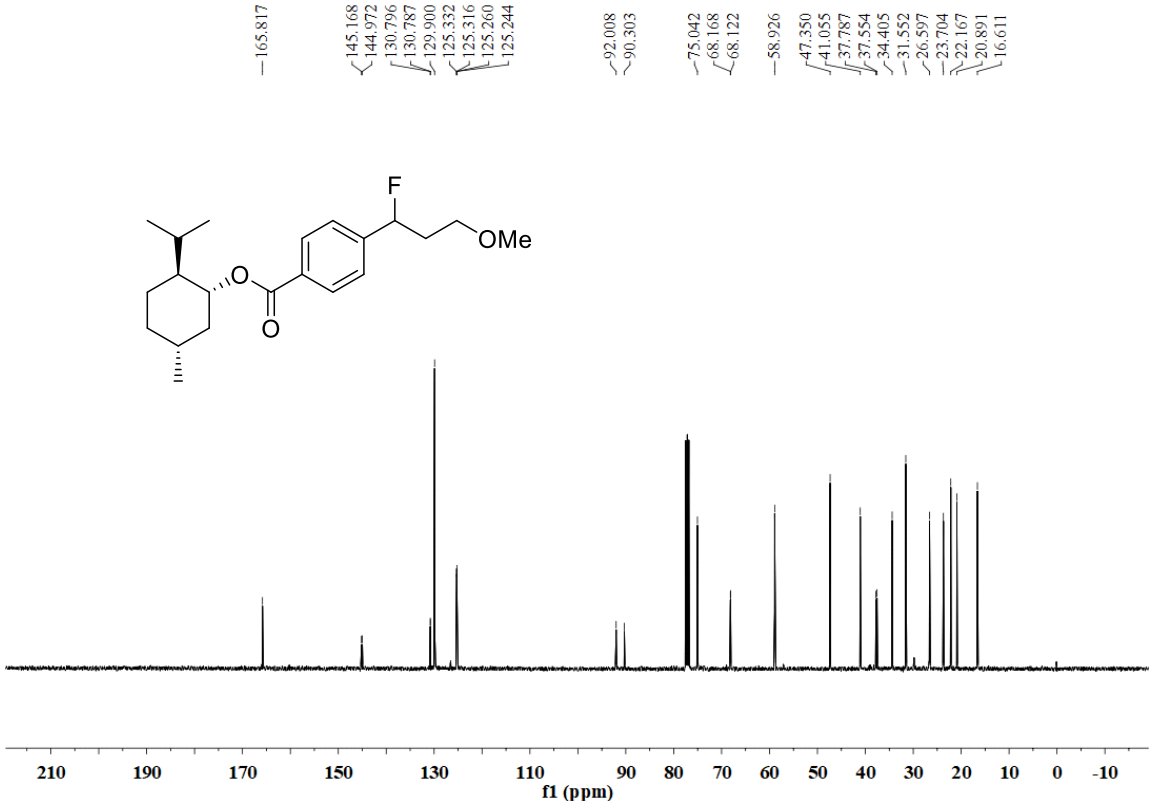

151.529
151.508
137.267
137.072
125.577
125.545
125.513
92.542
90.864
68.619
68.574
58.910
37.519
37.279
34.734
31.448
F
OMe
tBu
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

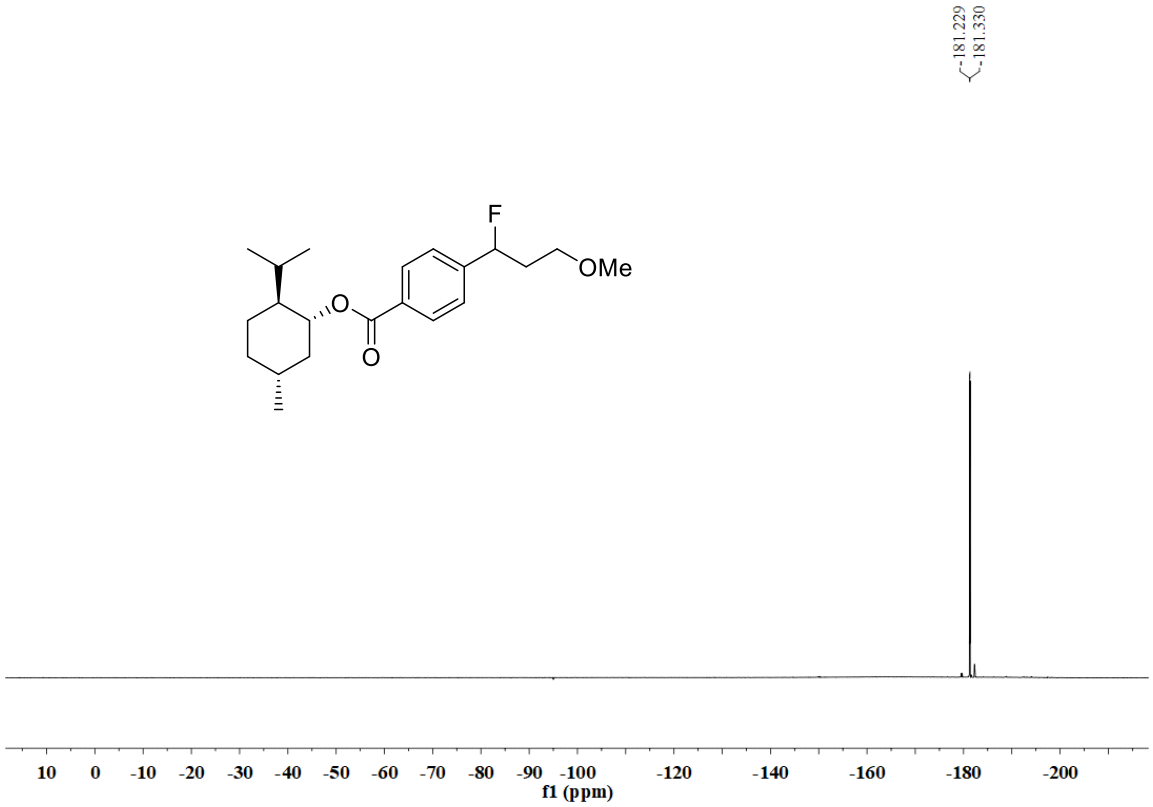

175.485
175.523
175.569
175.610
175.650
175.697
175.735
F
OMe
tBu
120
80
60
40
20
0
-40
-80
-120
-160
-200
-240
-280
-320
f1 (ppm)

39

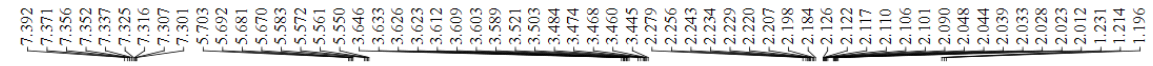

8.067
8.047
7.420
7.400
5.761
5.751
5.739
5.641
5.631
5.619
4.971
4.960
4.943
4.933
4.916
4.905
3.617
3.608
3.595
3.586
3.573
3.440
3.437
3.427
3.422
3.418
3.413
3.370
2.203
2.180
2.167
2.140
2.108
1.977
1.971
1.959
1.954
1.942
1.936
1.747
1.715
1.586
1.578
1.558
1.536
1.529
1.147
1.117
1.088
1.059
0.938
0.927
0.922
0.910
0.887
0.881
0.802
0.784

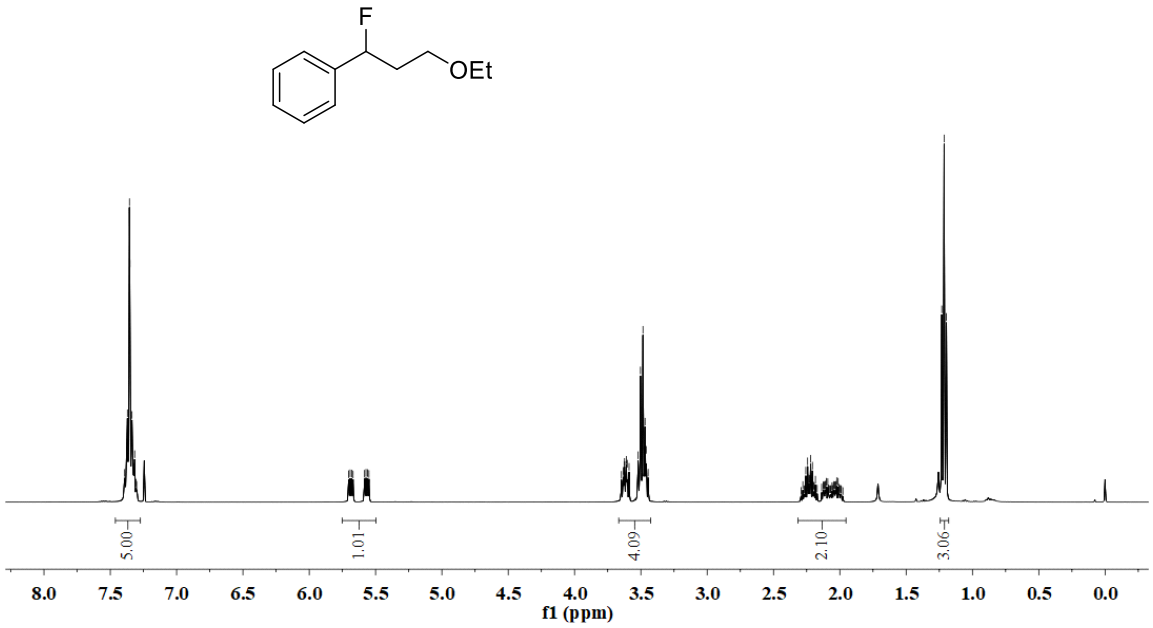

F
OMe
O
O
2.00
1.96
0.95
1.01
4.88
3.96
2.23
2.05
2.00
7.02
3.03
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

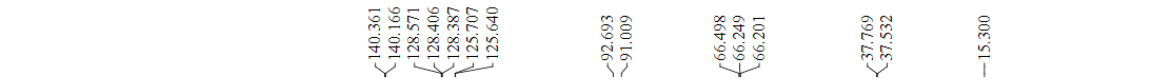

165.817
145.168
144.972
130.796
130.787
129.900
125.332
125.316
125.260
125.244
92.008
90.303
75.042
68.168
68.122
58.926
47.350
41.055
37.787
37.554
34.405
31.552
26.597
23.704
22.167
20.891
16.611
F
OMe
O
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

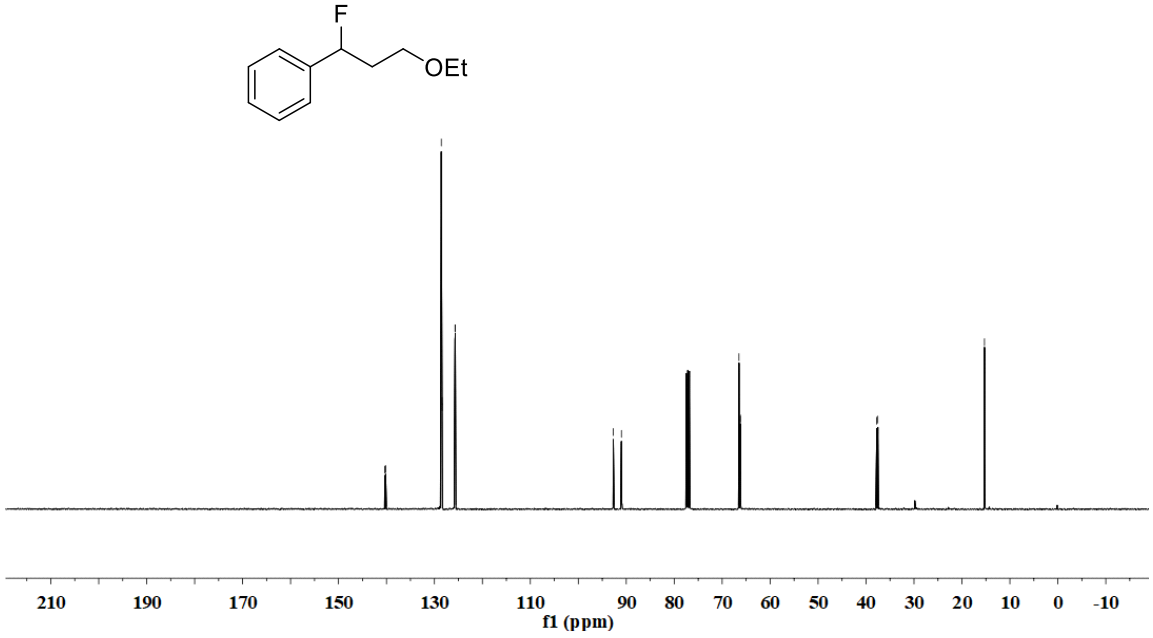

-181.229
-181.330
F
OMe
O
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

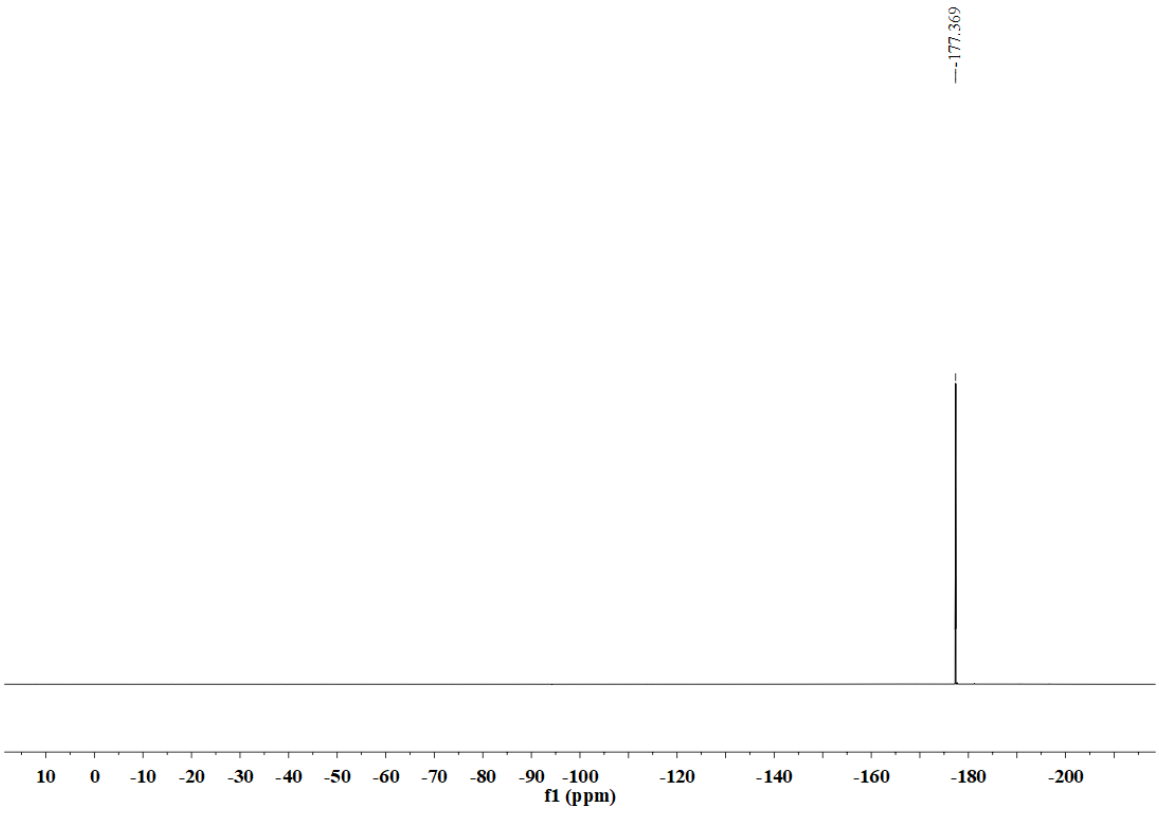
40


7.392
7.371
7.356
7.352
7.337
7.325
7.316
7.307
7.301
5.703
5.692
5.681
5.670
5.583
5.572
5.561
5.550
3.646
3.633
3.626
3.623
3.612
3.609
3.603
3.589
3.521
3.503
3.484
3.474
3.468
3.460
3.445
2.279
2.256
2.243
2.234
2.229
2.220
2.207
2.198
2.184
2.126
2.122
2.117
2.110
2.106
2.101
2.090
2.048
2.044
2.039
2.033
2.028
2.023
2.012
1.231
1.214
1.196

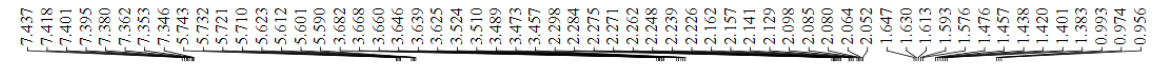

F
OEt
5.00
1.01
4.09
2.10
3.06
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

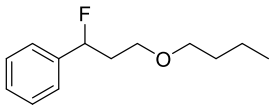

140.361
140.166
128.571
128.406
128.387
125.707
125.640
92.693
91.009
66.498
66.249
66.201
37.769
37.532
15.300

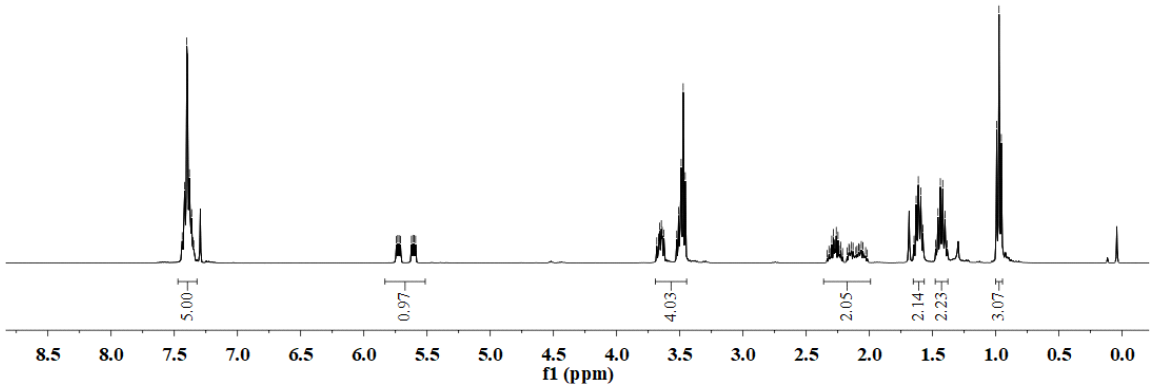

F
OEt
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

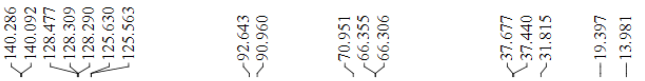

-177.369
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

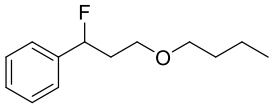
41

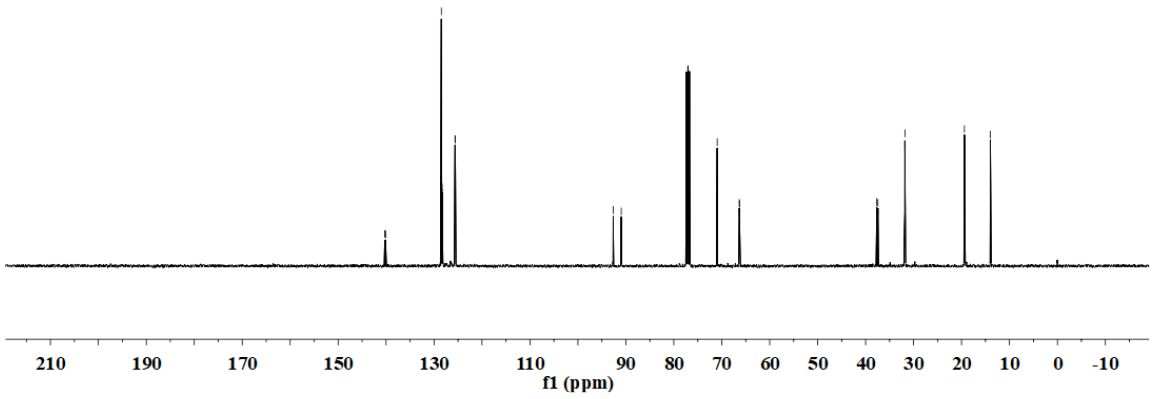

7.437
7.418
7.401
7.395
7.380
7.362
7.353
7.346
5.743
5.732
5.721
5.710
5.623
5.612
5.601
5.590
3.682
3.668
3.660
3.646
3.639
3.625
3.524
3.510
3.489
3.473
3.457
2.298
2.284
2.275
2.271
2.262
2.248
2.239
2.226
2.162
2.157
2.141
2.129
2.098
2.085
2.080
2.064
2.052
1.647
1.630
1.613
1.593
1.576
1.476
1.457
1.438
1.420
1.401
1.383
0.993
0.974
0.956

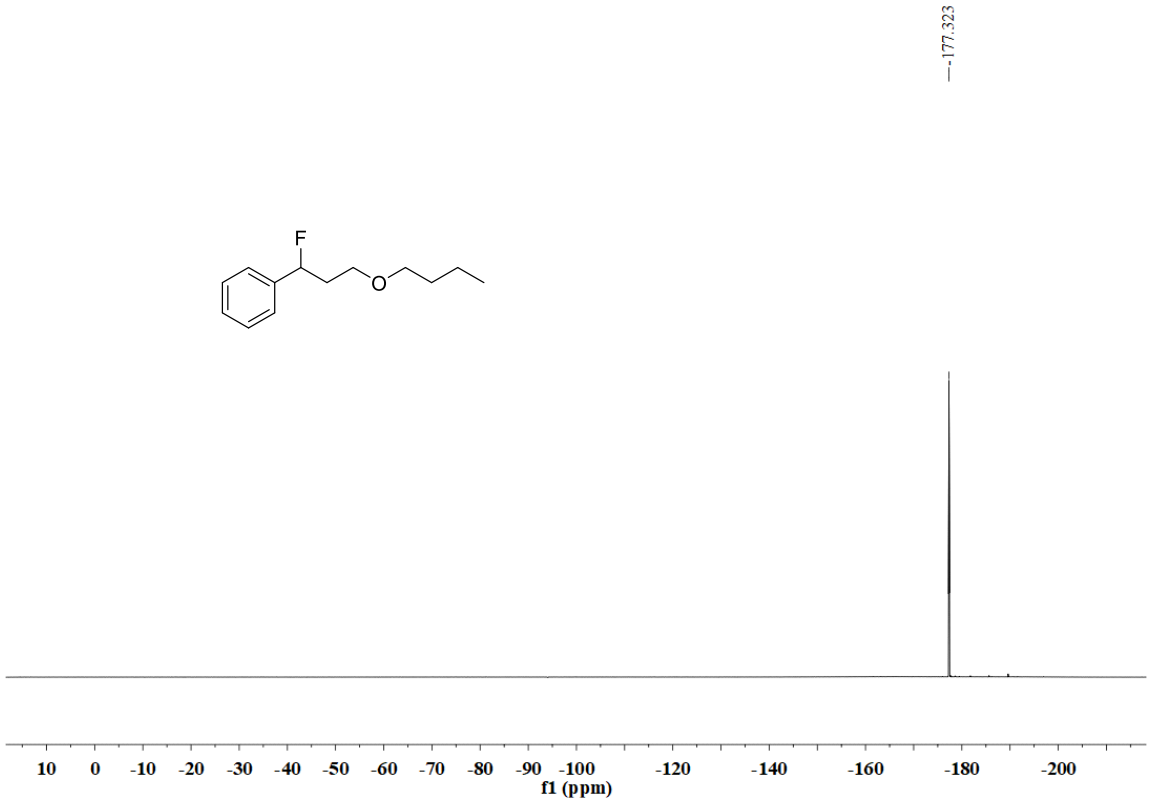

F
O


5.00
0.97
4.03
2.05
2.14
2.23
3.07
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

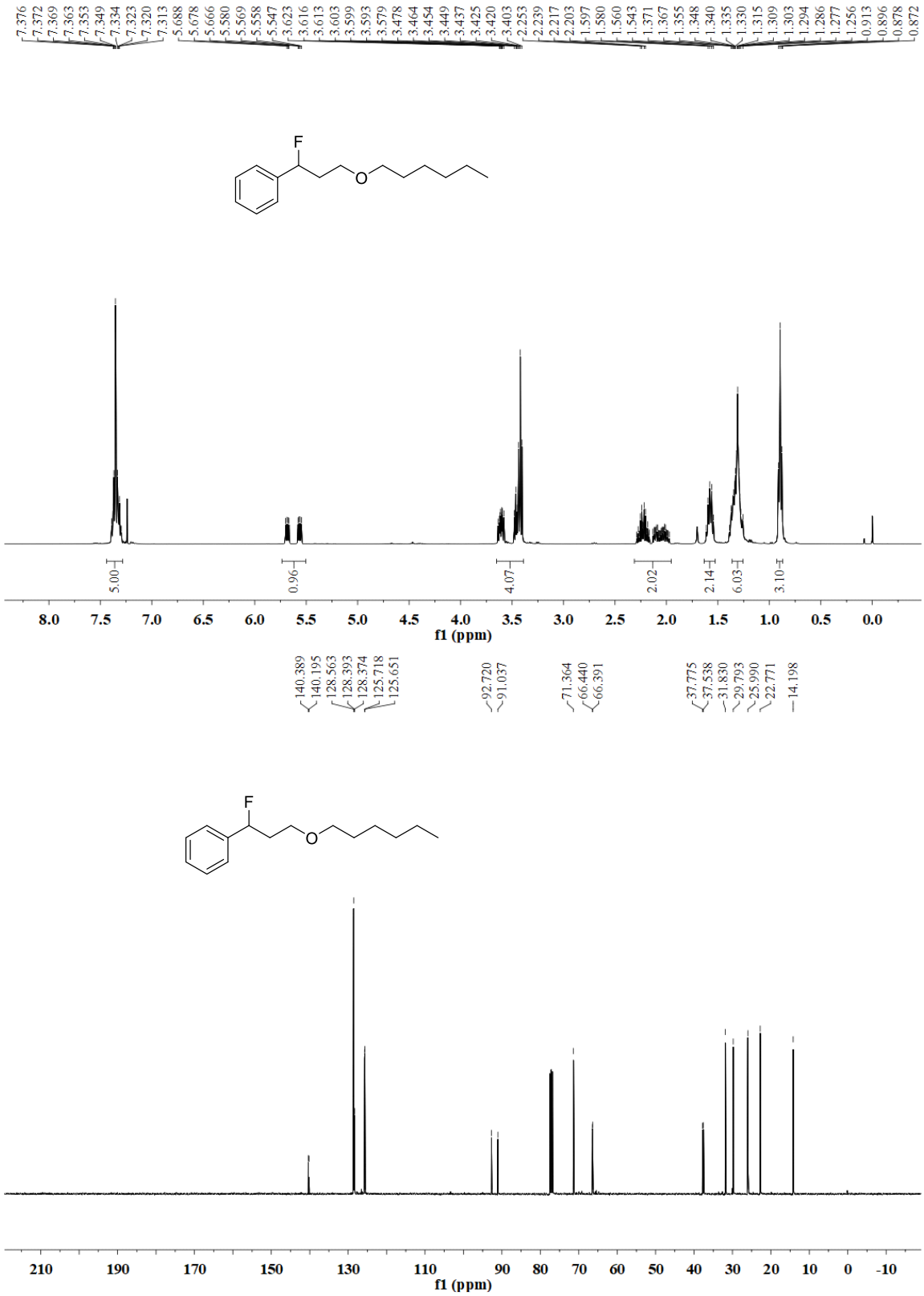

140.286
140.092
128.477
128.309
128.290
125.630
125.563
92.643
90.960
70.951
66.355
66.306
37.677
37.440
31.815
19.397
13.981

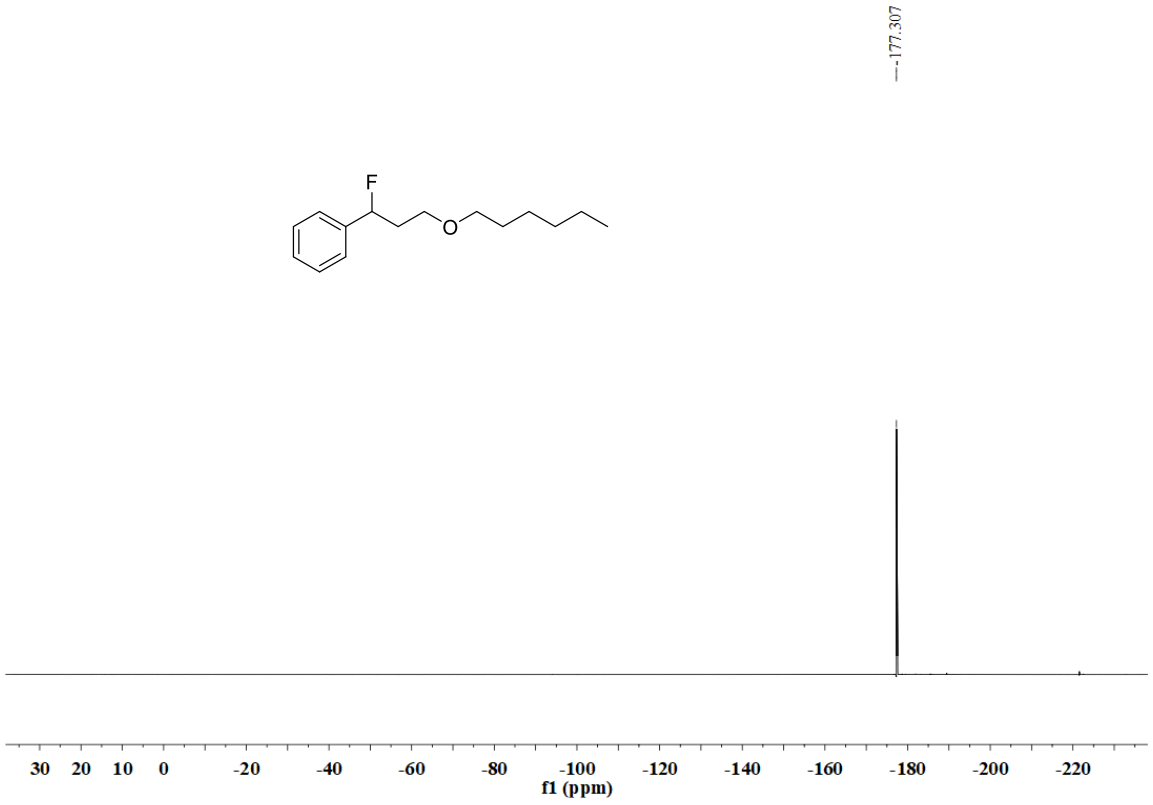

F
O


210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

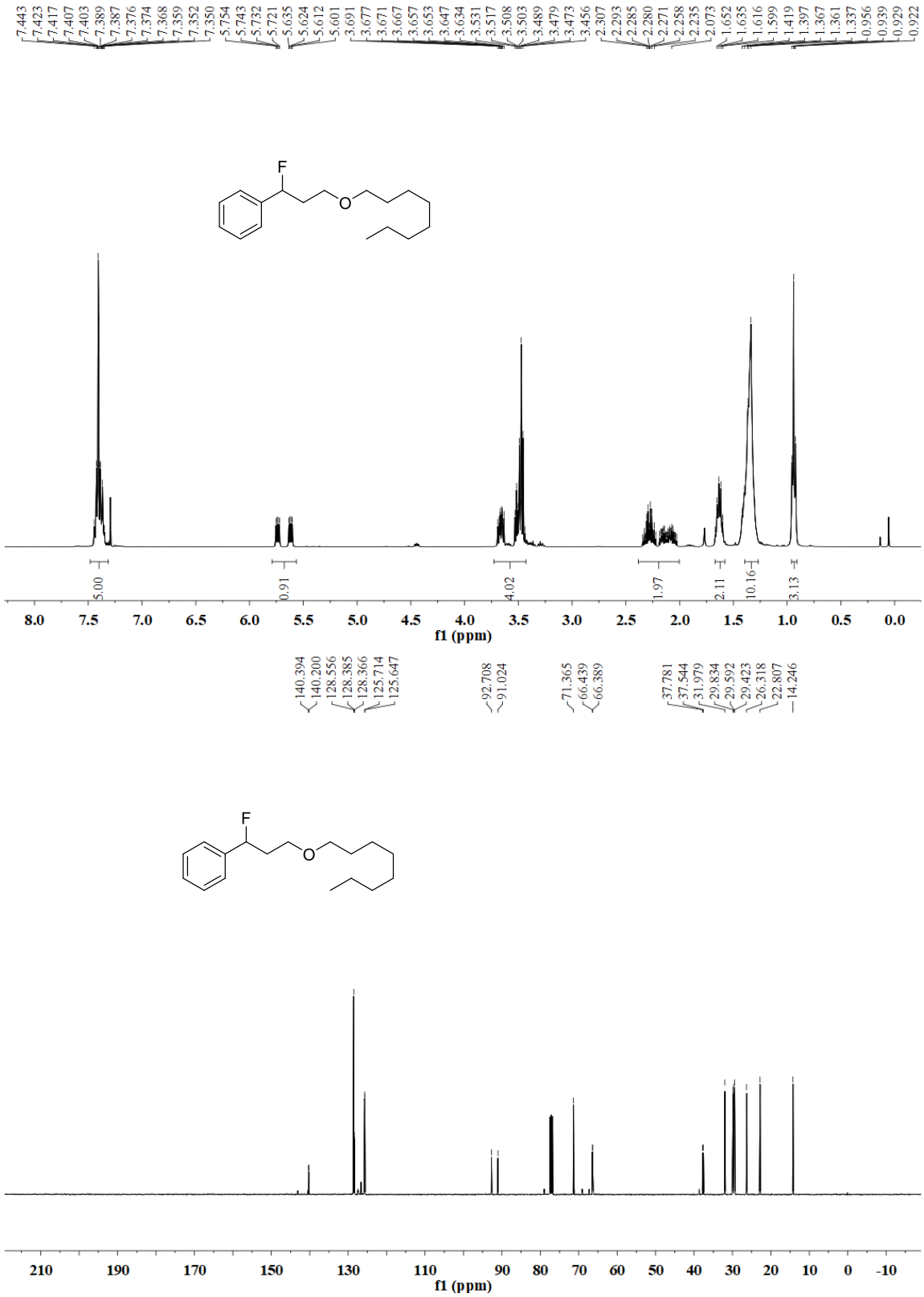

-177.323
F
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

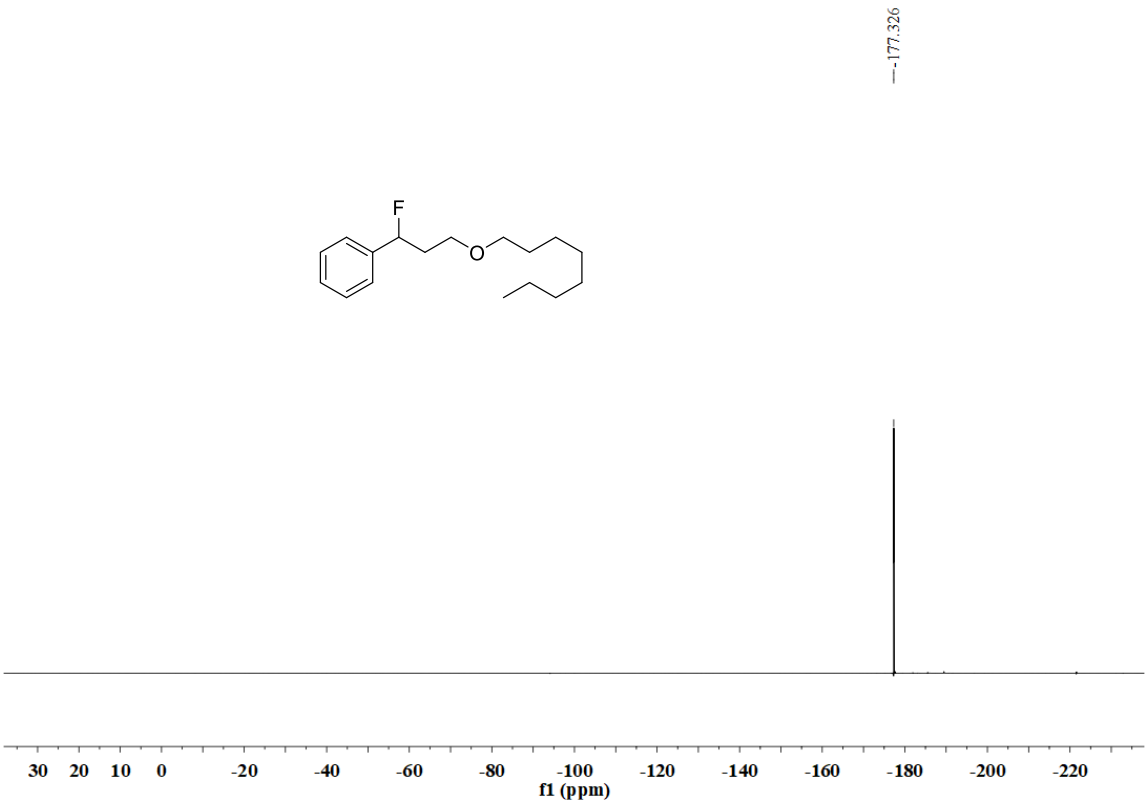
42


7.376
7.372
7.369
7.363
7.353
7.349
7.334
7.323
7.320
7.313
5.688
5.678
5.666
5.580
5.569
5.558
5.547
3.623
3.616
3.613
3.603
3.599
3.593
3.579
3.478
3.464
3.454
3.449
3.437
3.425
3.420
3.403
2.253
2.239
2.217
2.203
1.597
1.580
1.560
1.543
1.371
1.367
1.355
1.348
1.340
1.335
1.330
1.315
1.309
1.303
1.294
1.286
1.277
1.256
0.913
0.896
0.878
0.872
F
O
5.00
0.96
4.07
2.02
2.14
6.03
3.10
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
140.389
140.195
128.563
128.393
128.374
125.718
125.651
92.720
91.037
71.364
66.440
66.391
37.775
37.538
31.830
29.793
25.990
22.771
14.198
F
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

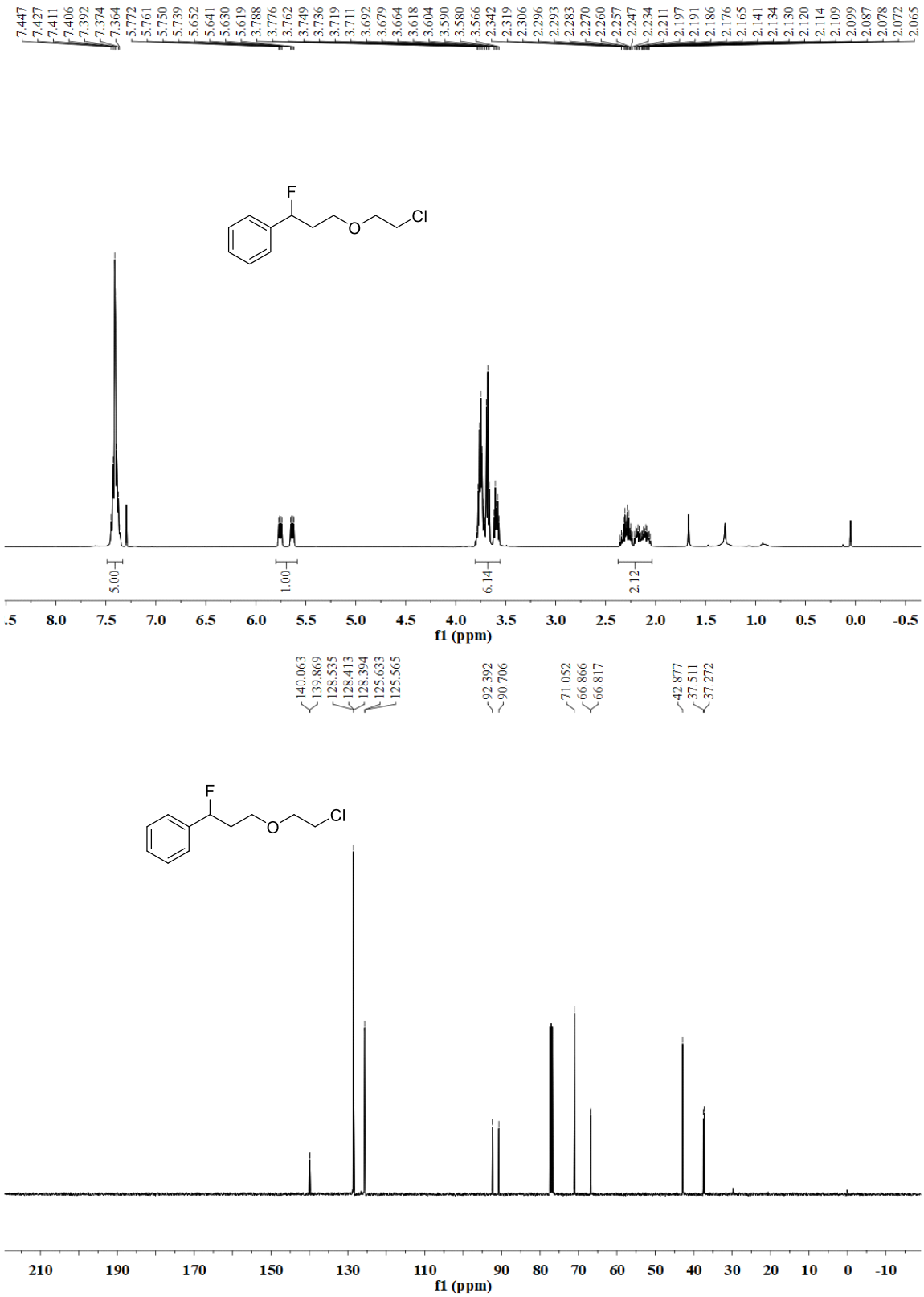

-177.307
F
O
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)

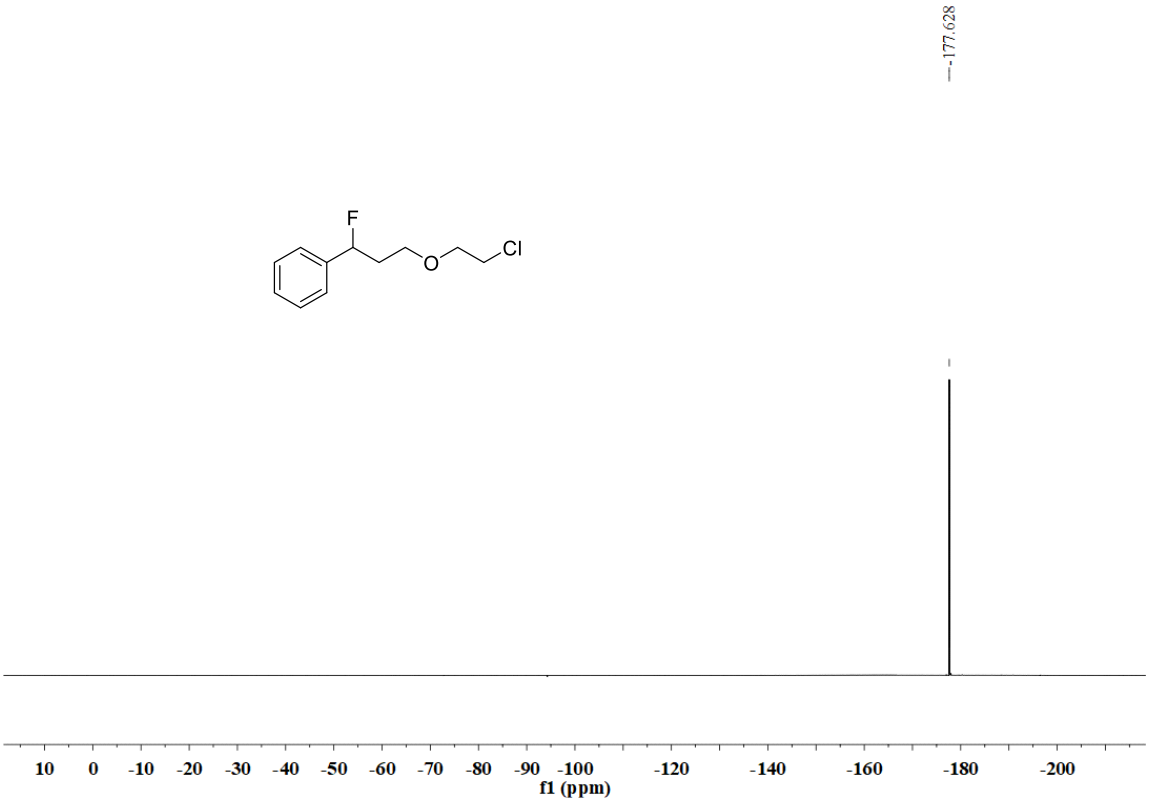
43


7.443
7.423
7.417
7.407
7.403
7.389
7.387
7.376
7.374
7.368
7.359
7.352
7.350
5.754
5.743
5.732
5.721
5.635
5.624
5.612
5.601
3.691
3.677
3.671
3.667
3.657
3.653
3.647
3.634
3.531
3.517
3.508
3.503
3.489
3.479
3.473
3.456
2.307
2.293
2.285
2.280
2.271
2.258
2.235
2.073
1.652
1.635
1.616
1.599
1.419
1.397
1.367
1.361
1.337
0.956
0.939
0.929
0.922
F
O
5.00
0.91
4.02
1.97
2.11
10.16
3.13
f1 (ppm)
140.394
140.200
128.556
128.385
128.366
125.714
125.647
92.708
91.024
71.365
66.439
66.389
37.781
37.544
31.979
29.834
29.592
29.423
26.318
22.807
14.246
f1 (ppm)

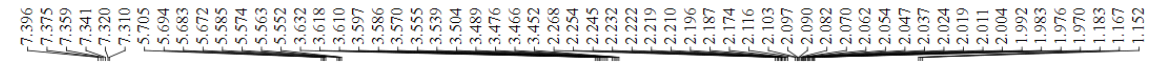

-177.326
F
O
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

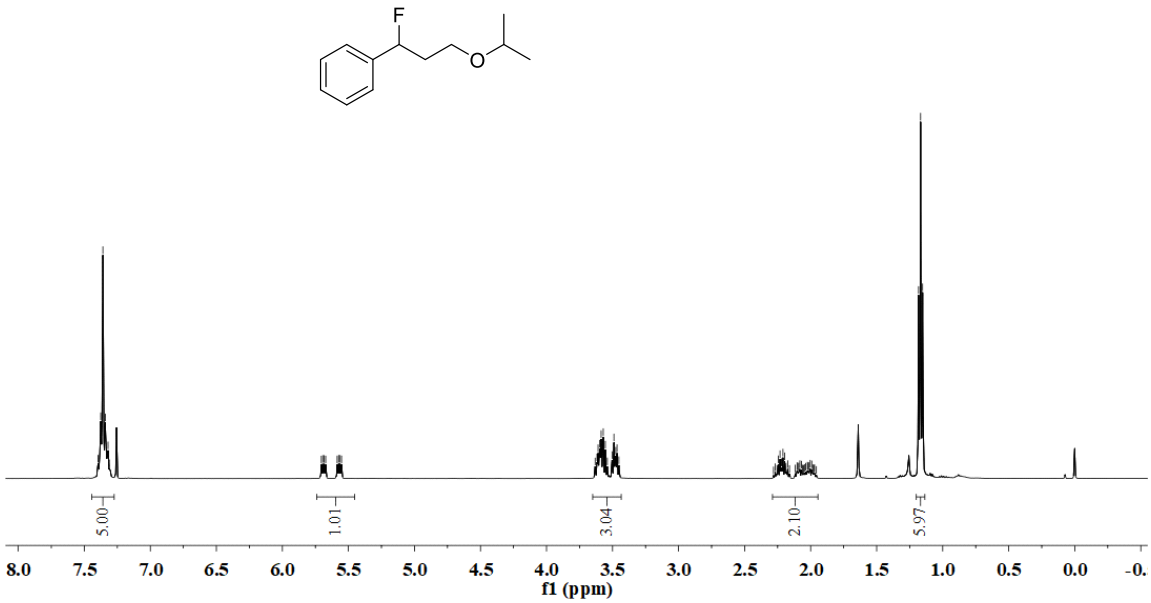
44

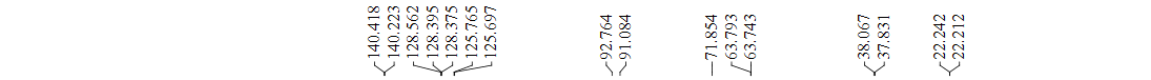

7.447
7.427
7.411
7.406
7.392
7.374
7.364
5.772
5.761
5.750
5.739
5.652
5.641
5.630
5.619
3.788
3.776
3.762
3.749
3.736
3.719
3.711
3.692
3.679
3.664
3.618
3.604
3.590
3.580
3.566
2.342
2.319
2.306
2.296
2.293
2.283
2.270
2.260
2.257
2.247
2.234
2.211
2.197
2.191
2.186
2.176
2.165
2.141
2.134
2.130
2.120
2.114
2.109
2.099
2.087
2.078
2.072
2.065
F
O
Cl
5.00
1.00
6.14
2.12
f1 (ppm)
140.063
139.869
128.535
128.413
128.394
125.633
125.565
92.392
90.706
71.052
66.866
66.817
42.877
37.511
37.272
f1 (ppm)

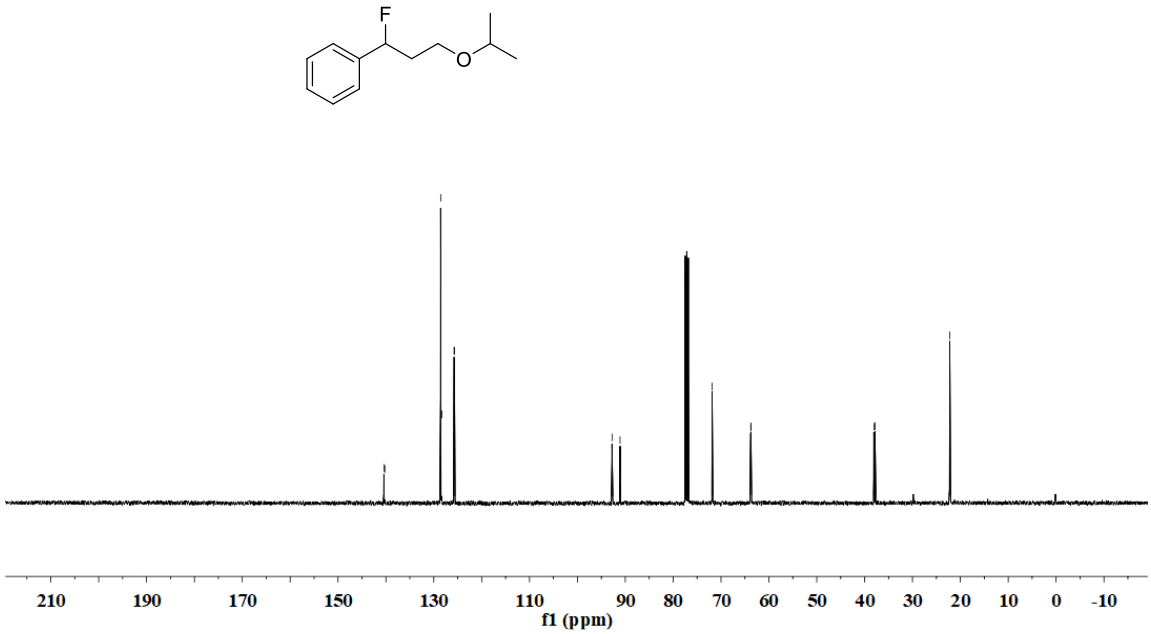

-177.628
F
O
Cl
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

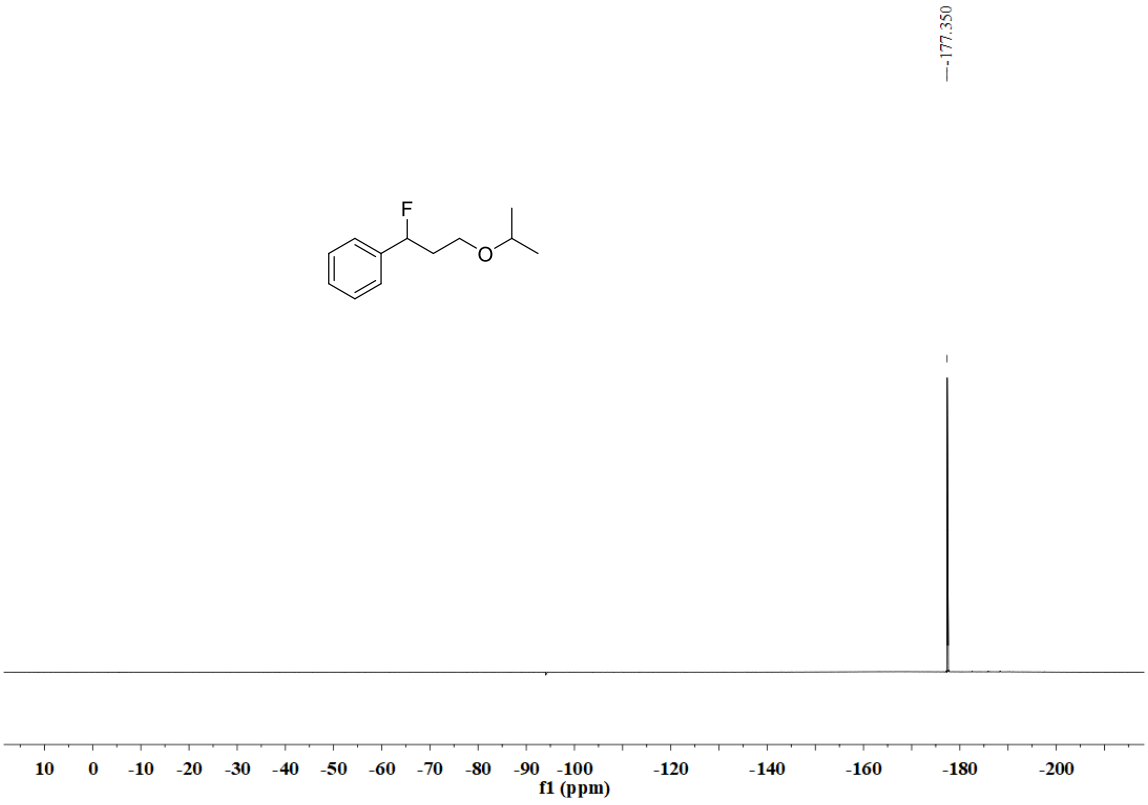
45


7.396
7.375
7.359
7.341
7.320
7.310
5.705
5.694
5.683
5.672
5.585
5.574
5.563
5.552
3.632
3.618
3.610
3.597
3.586
3.570
3.555
3.539
3.504
3.489
3.476
3.466
3.452
2.268
2.254
2.245
2.232
2.222
2.219
2.210
2.196
2.187
2.174
2.116
2.103
2.097
2.090
2.082
2.070
2.062
2.054
2.047
2.037
2.024
2.019
2.011
2.004
1.992
1.983
1.976
1.970
1.183
1.167
1.152

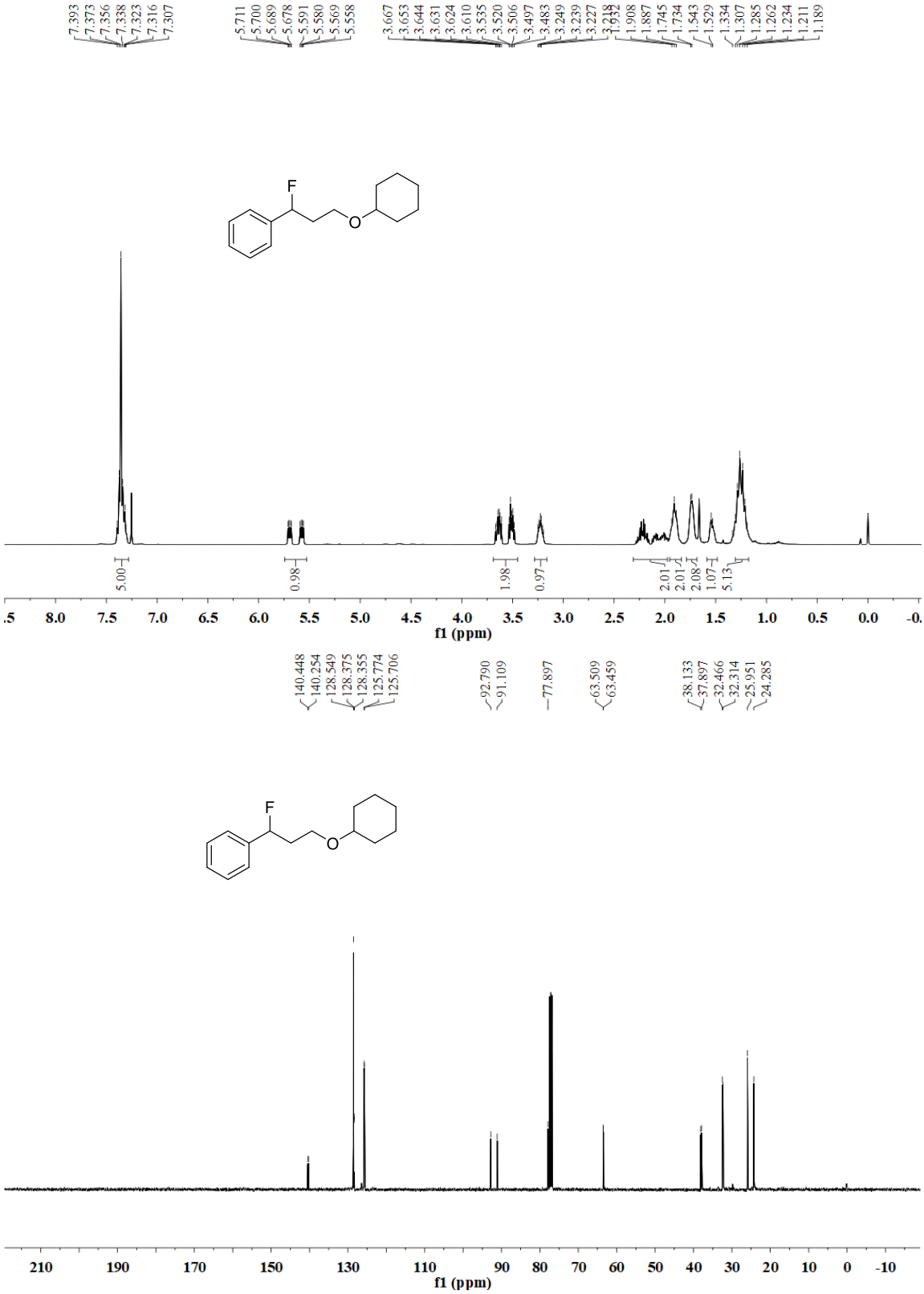

F
O
5.00
1.01
3.04
2.10
5.97
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

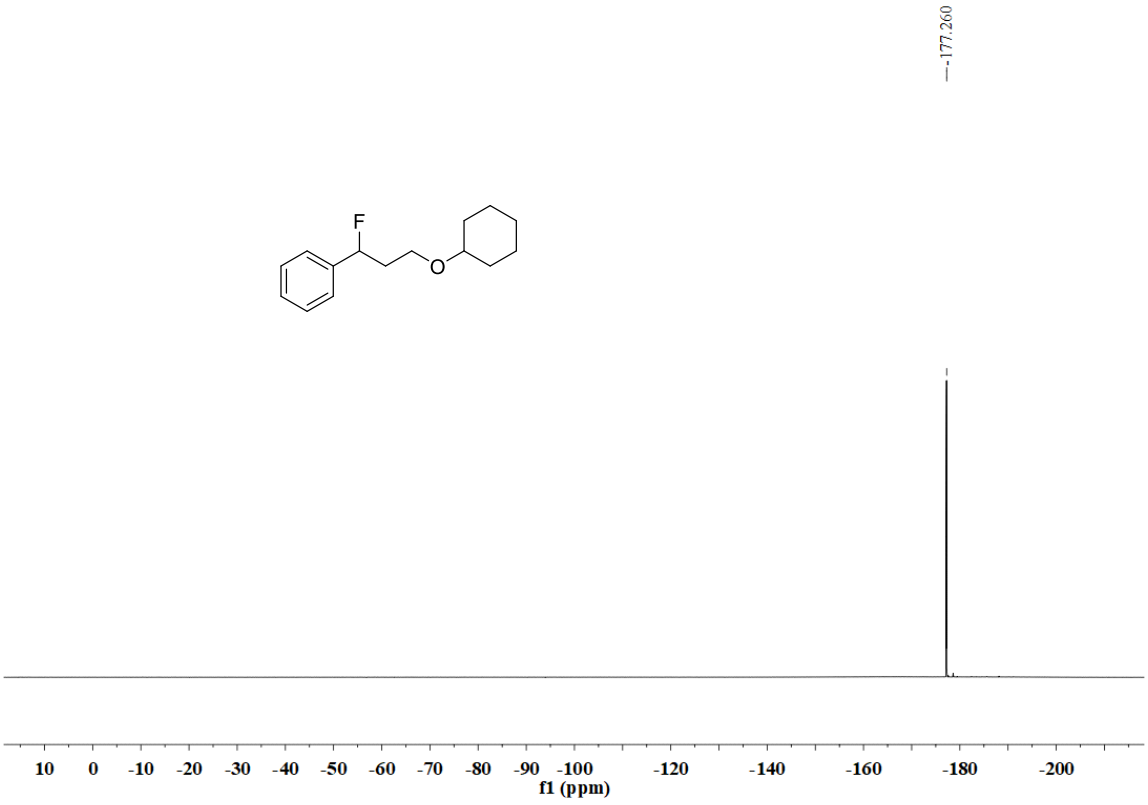

140.418
140.223
128.562
128.395
128.375
125.765
125.697
92.764
91.084
71.854
63.793
63.743
38.067
37.831
22.242
22.212


F
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

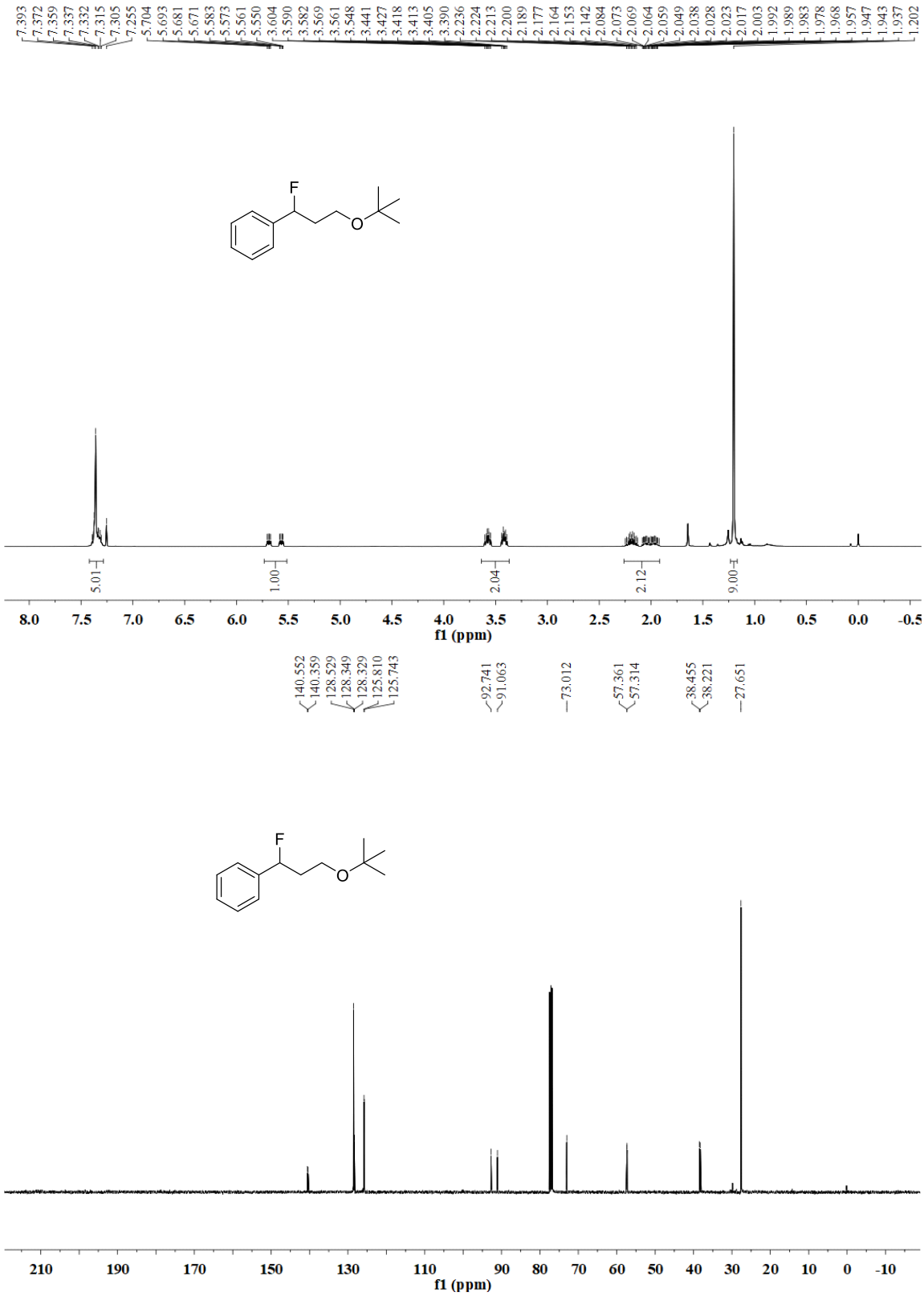

-177.350
F
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

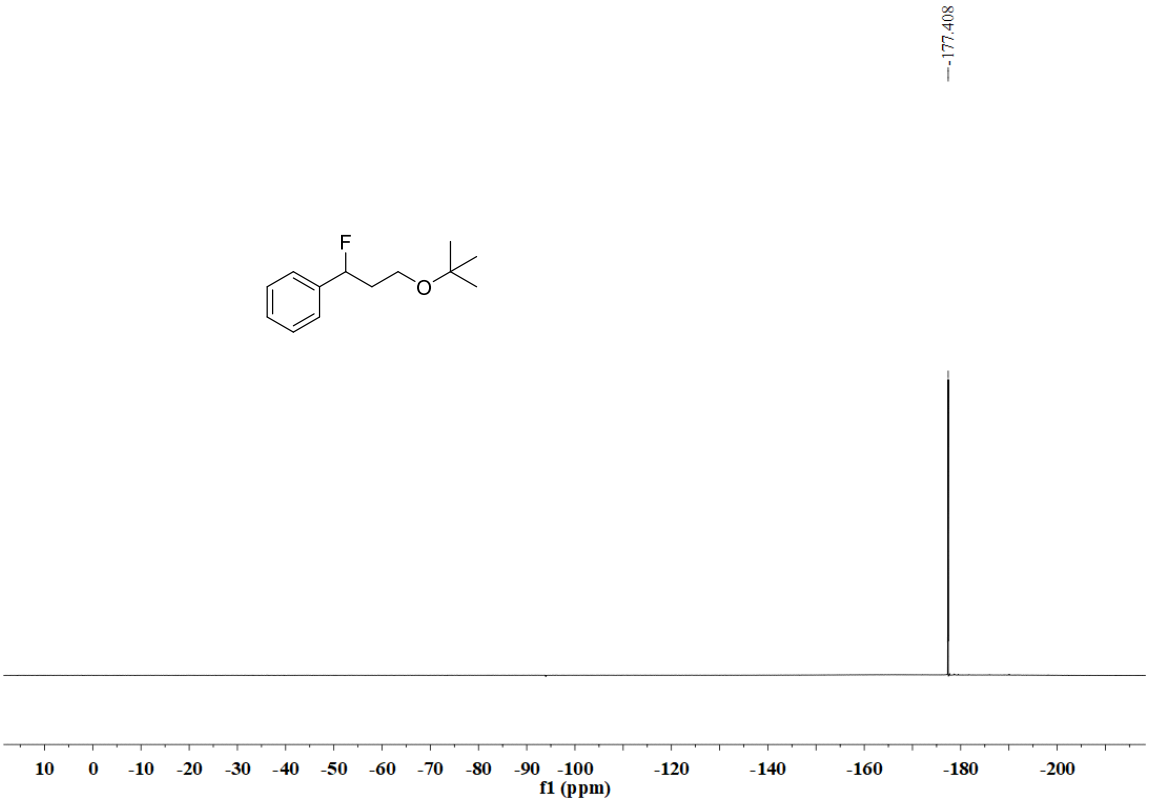
46


7.393
7.373
7.356
7.338
7.323
7.316
7.307
5.711
5.700
5.689
5.678
5.591
5.580
5.569
5.558
3.667
3.653
3.644
3.631
3.624
3.610
3.535
3.520
3.506
3.497
3.483
3.249
3.239
3.227
1.908
1.887
1.745
1.734
1.543
1.529
1.334
1.307
1.285
1.262
1.234
1.211
1.189
F
O
5.00
0.98
1.98
0.97
2.01
2.01
2.08
1.07
5.13
f1 (ppm)
140.448
140.254
128.549
128.375
128.355
125.774
125.706
92.790
91.109
77.897
63.509
63.459
38.133
37.897
32.466
32.314
25.951
24.285
F
O
f1 (ppm)

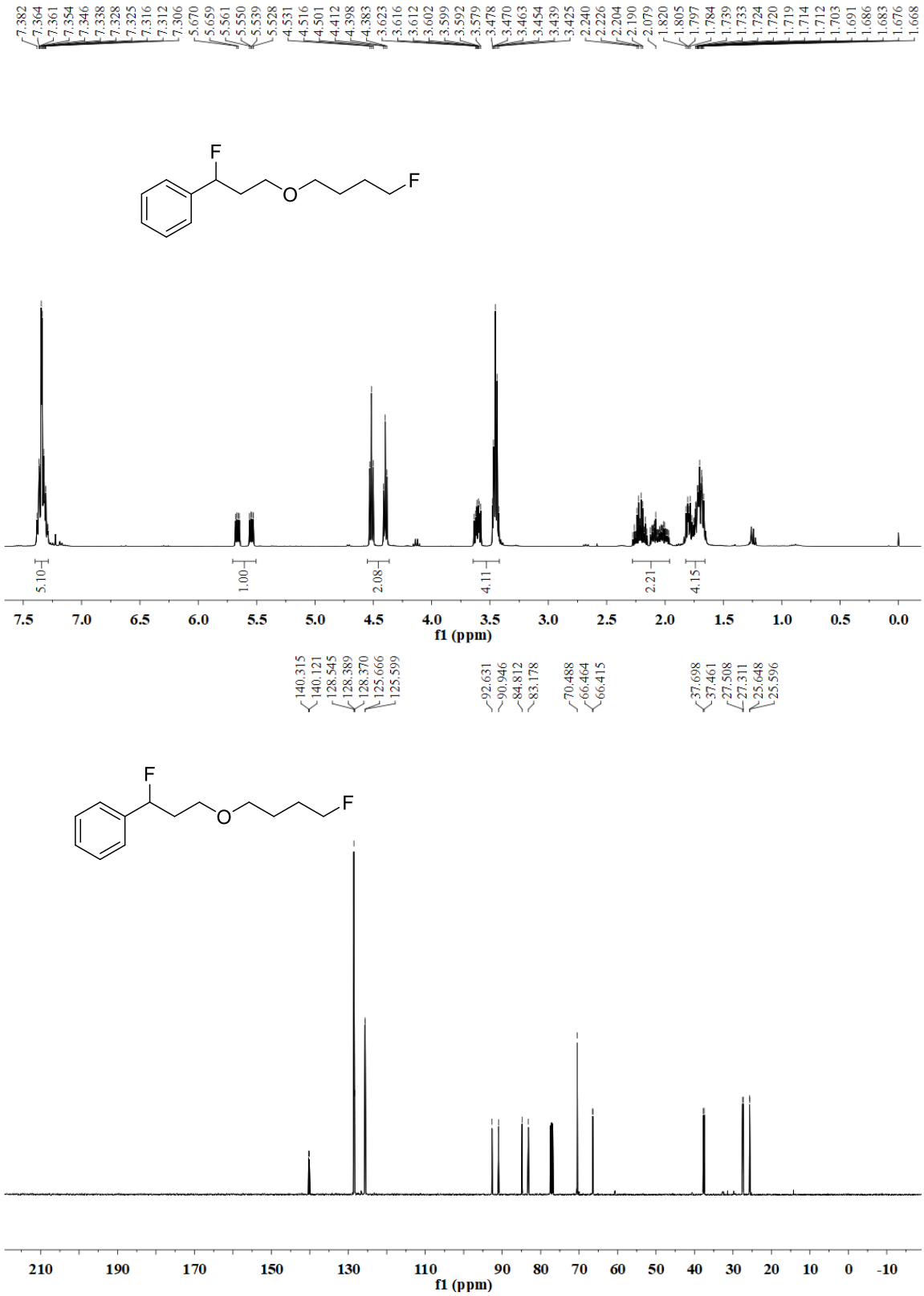

-177.260
F
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

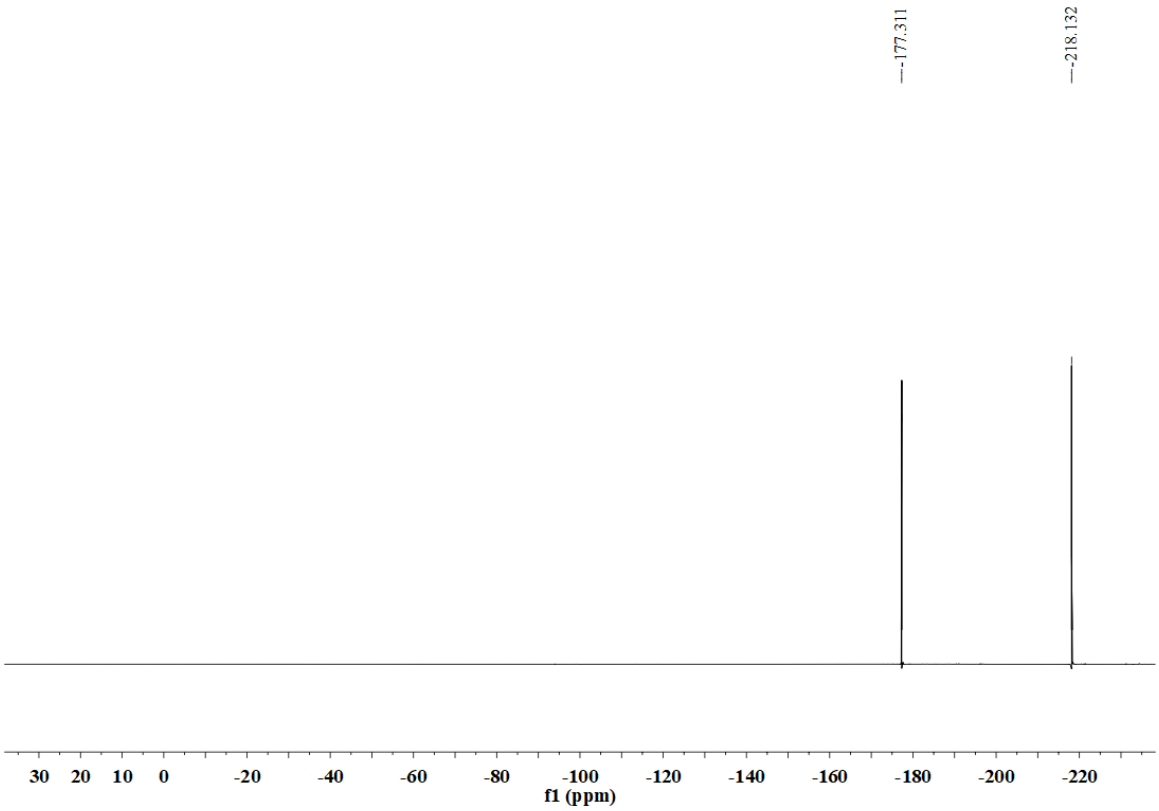
47


7.393
7.372
7.359
7.337
7.332
7.315
7.305
7.255
5.704
5.693
5.681
5.671
5.583
5.573
5.561
5.550
3.604
3.590
3.582
3.569
3.561
3.548
3.441
3.427
3.418
3.413
3.405
3.390
2.236
2.224
2.213
2.200
2.189
2.177
2.164
2.153
2.142
2.084
2.073
2.069
2.064
2.059
2.049
2.038
2.028
2.023
2.017
2.003
1.992
1.989
1.983
1.978
1.968
1.957
1.947
1.943
1.937
1.202
F
O
5.01
1.00
2.04
2.12
9.00
f1 (ppm)
140.552
140.359
128.529
128.349
128.329
125.810
125.743
92.741
91.063
73.012
57.361
57.314
38.455
38.221
27.651
F
O
f1 (ppm)

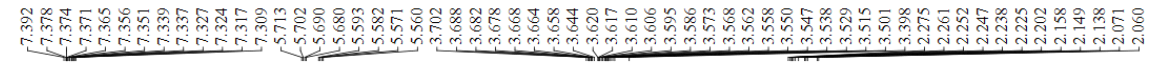

-177.408
F
O
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

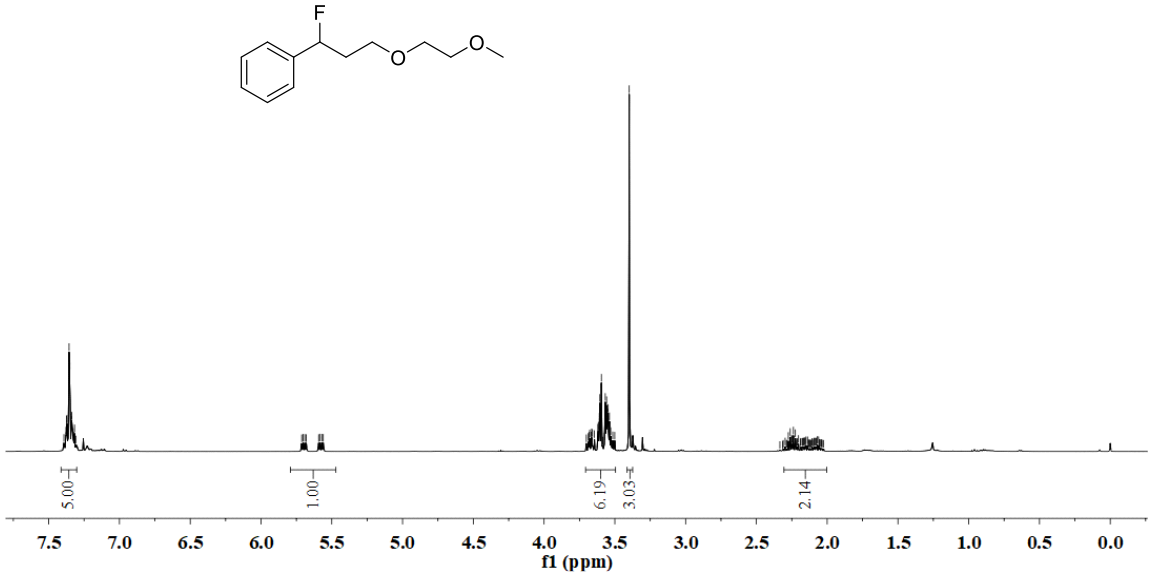
48

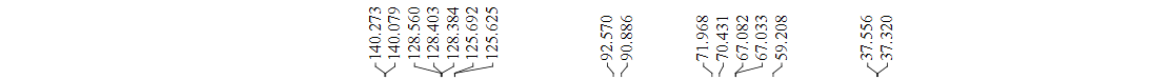

7.382
7.364
7.361
7.354
7.346
7.338
7.328
7.325
7.316
7.312
7.306
5.670
5.659
5.561
5.550
5.539
5.528
4.531
4.516
4.501
4.412
4.398
4.383
3.623
3.616
3.612
3.602
3.599
3.592
3.579
3.478
3.470
3.463
3.454
3.439
3.425
2.240
2.226
2.204
2.190
2.079
1.820
1.805
1.797
1.784
1.739
1.733
1.724
1.720
1.719
1.714
1.712
1.703
1.691
1.686
1.683
1.676
1.668
F
O
F
5.10
1.00
2.08
4.11
2.21
4.15
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
140.315
140.121
128.545
128.389
128.370
125.666
125.599
92.631
90.946
84.812
83.178
70.488
66.464
66.415
37.698
37.461
27.508
27.311
25.648
25.596
F
O
F
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

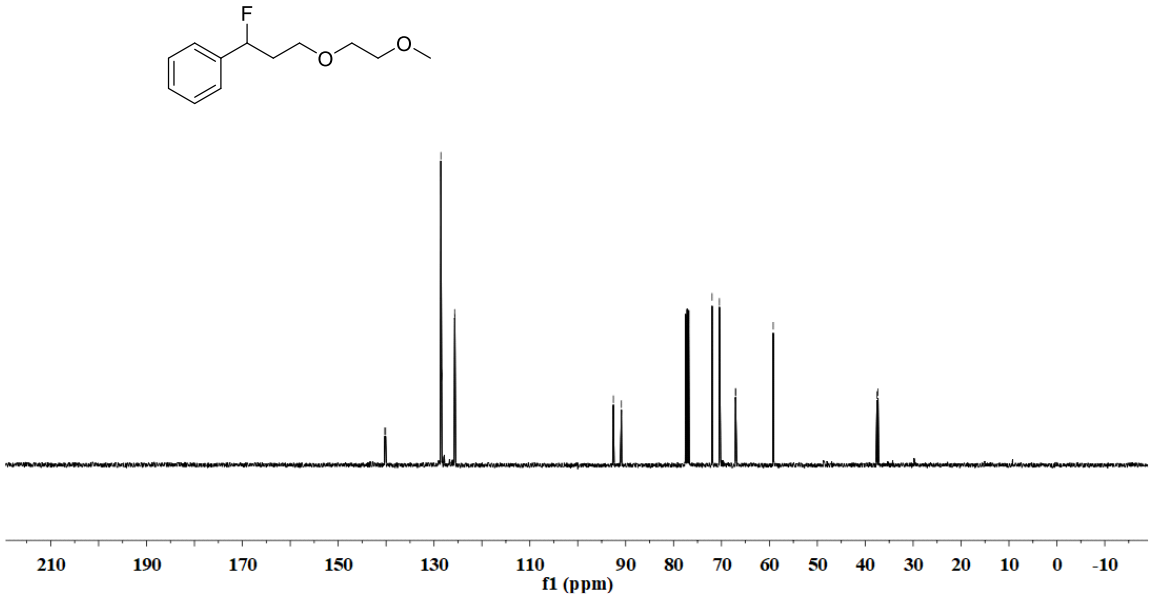

-177.311
-218.132
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

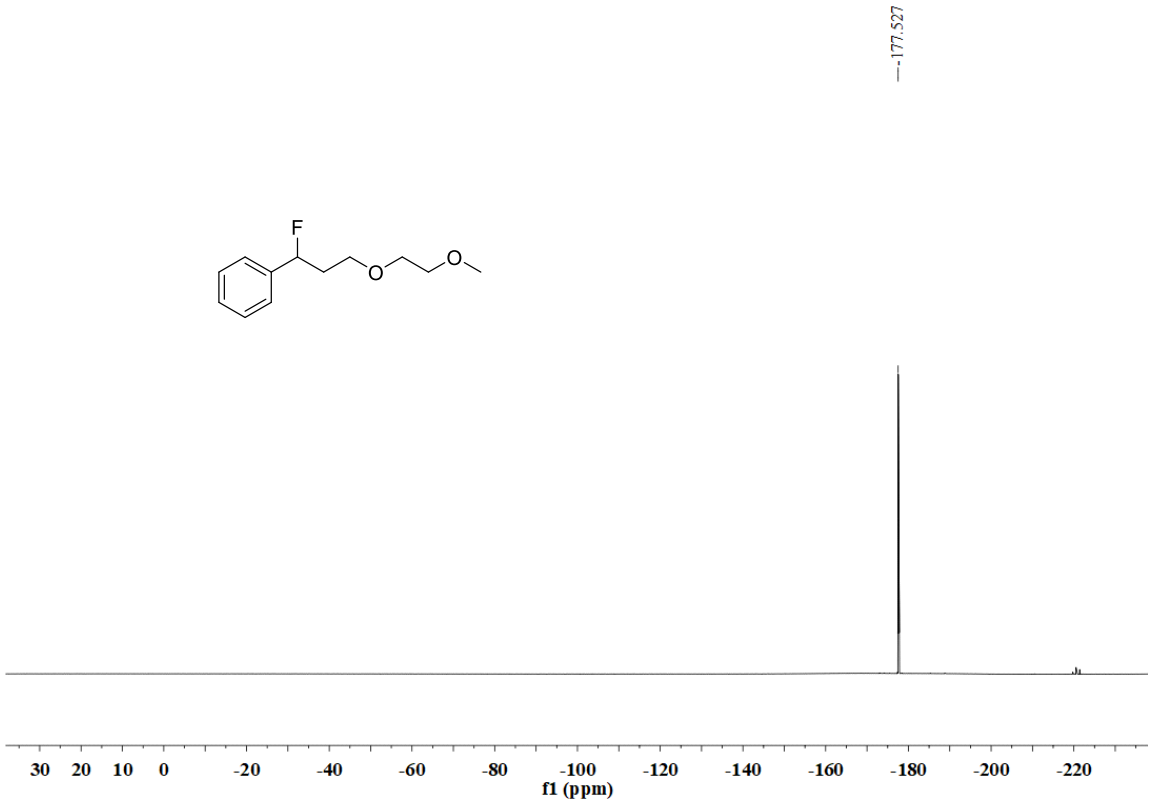
49


7.392
7.378
7.374
7.371
7.365
7.356
7.351
7.339
7.337
7.327
7.324
7.317
7.309
5.713
5.702
5.690
5.680
5.593
5.582
5.571
5.560
3.702
3.688
3.682
3.678
3.668
3.664
3.658
3.644
3.620
3.617
3.610
3.606
3.595
3.586
3.573
3.568
3.562
3.558
3.550
3.547
3.538
3.529
3.515
3.501
3.398
2.275
2.261
2.252
2.247
2.238
2.225
2.202
2.158
2.149
2.138
2.071
2.060

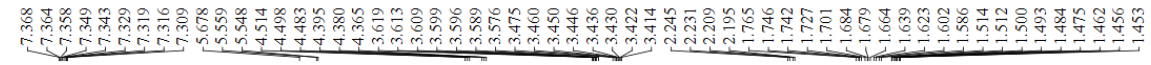

F
O
O
5.00
1.00
6.19
3.03
2.14
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

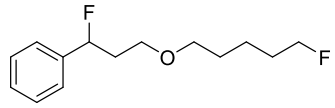

140.273
140.079
128.560
128.403
128.384
125.692
125.625
92.570
90.886
71.968
70.431
67.082
67.033
59.208
37.556
37.320

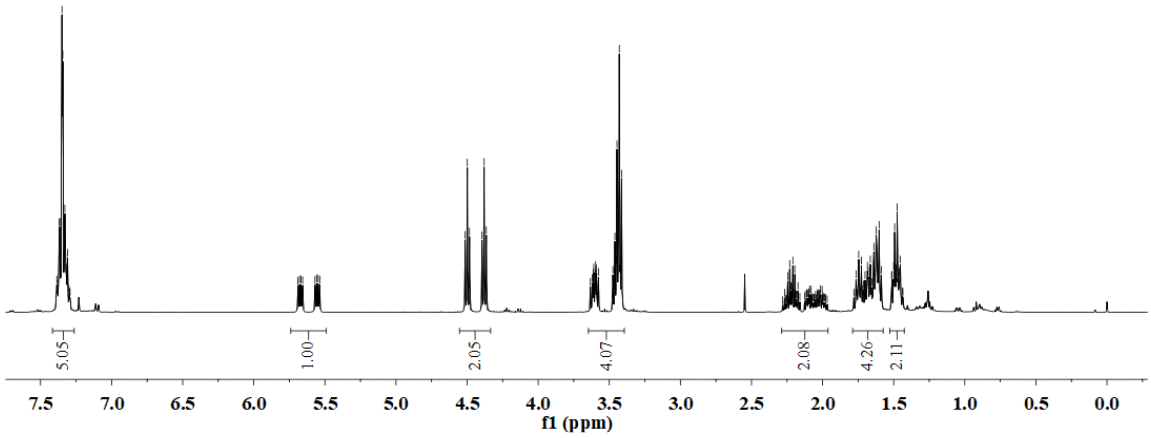

F
O
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

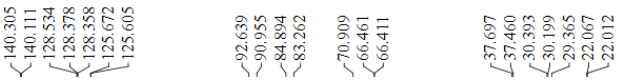

-177.527
F
O
O
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

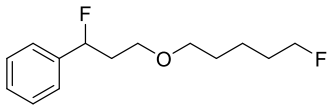
50

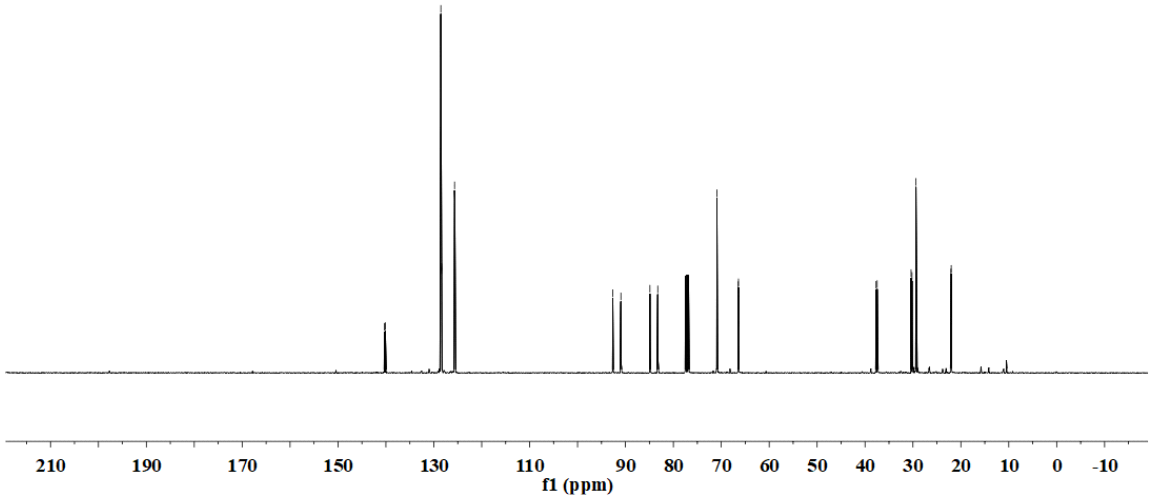

7.368
7.364
7.358
7.349
7.343
7.329
7.319
7.316
7.309
5.678
5.559
5.548
4.514
4.498
4.483
4.395
4.380
4.365
3.619
3.613
3.609
3.599
3.596
3.589
3.576
3.475
3.460
3.450
3.446
3.436
3.430
3.422
3.414
2.245
2.231
2.209
2.195
1.765
1.746
1.742
1.727
1.701
1.684
1.679
1.664
1.639
1.623
1.602
1.586
1.514
1.512
1.500
1.493
1.484
1.475
1.462
1.456
1.453

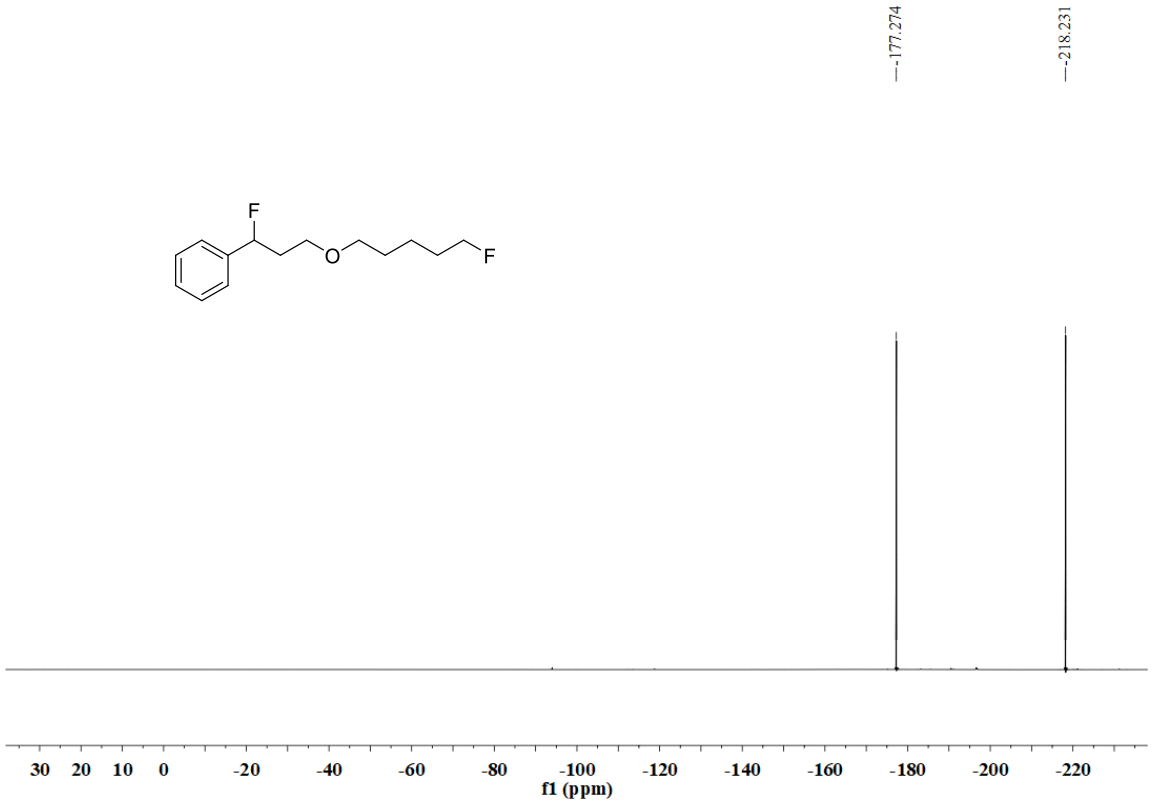

F
O
F


5.05
1.00
2.05
4.07
2.08
4.26
2.11
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

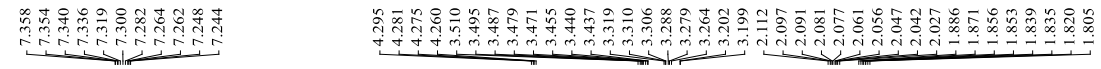

140.305
140.111
128.534
128.378
128.358
125.672
125.605
92.639
90.955
84.894
83.262
70.909
66.461
66.411
37.697
37.460
30.393
30.199
29.365
22.067
22.012

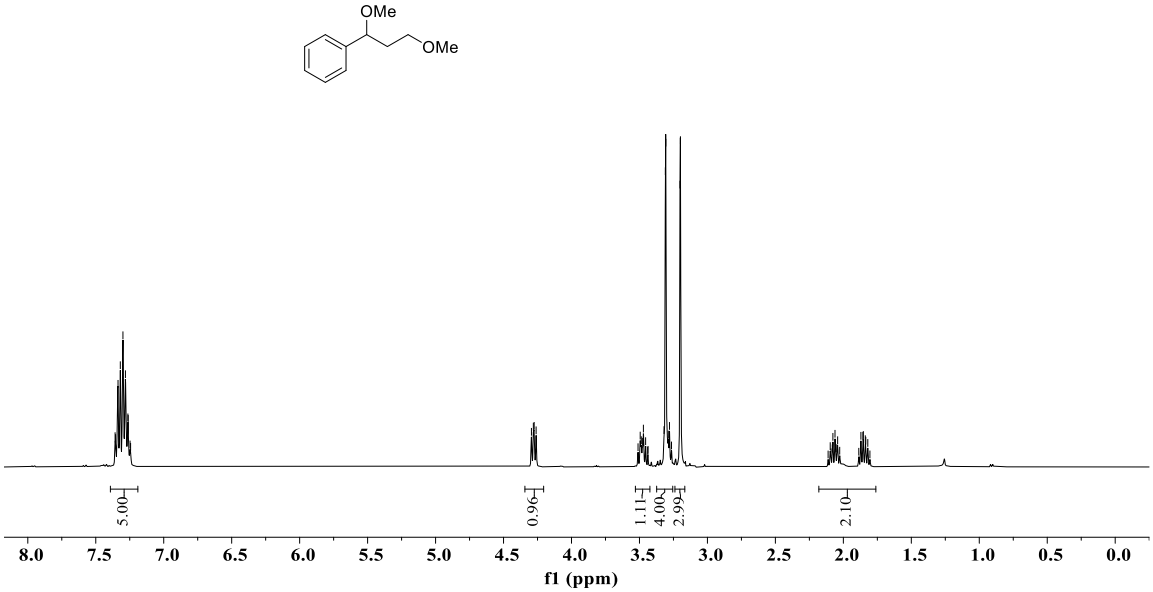

F
O
F

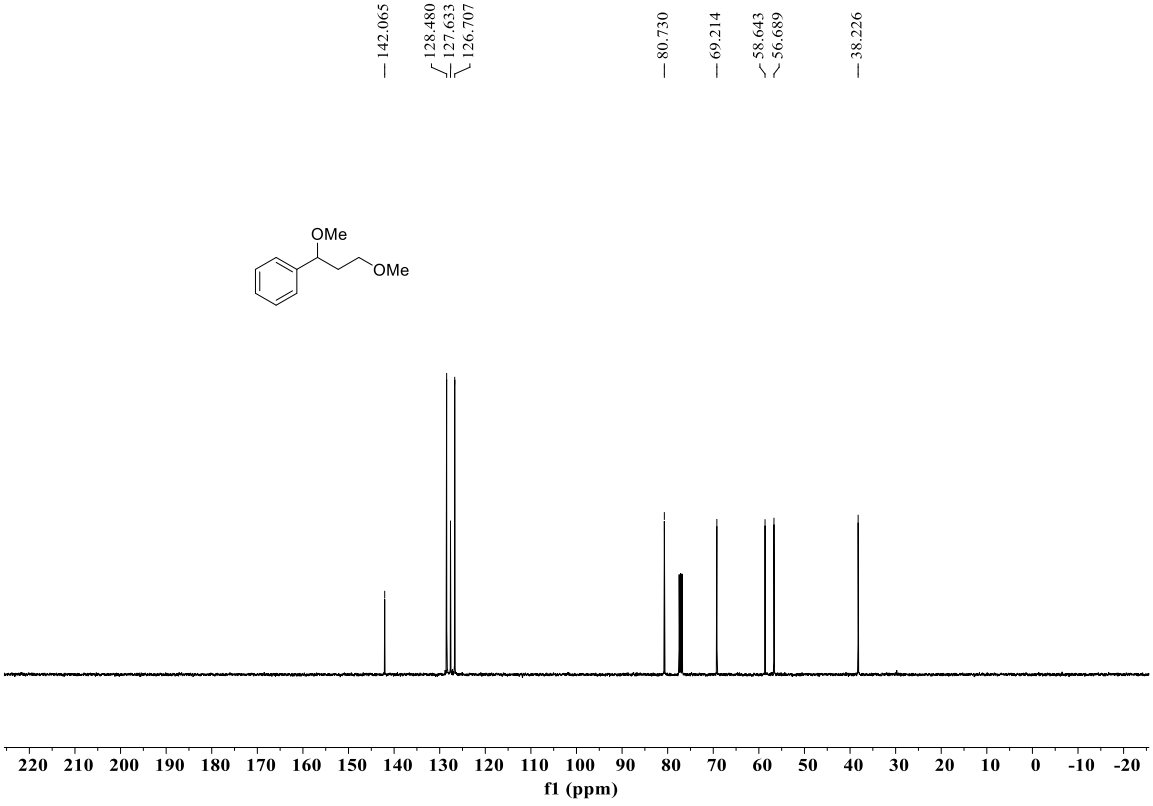

210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-177.274
-218.231
F
O
F
30
20
10
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
f1 (ppm)

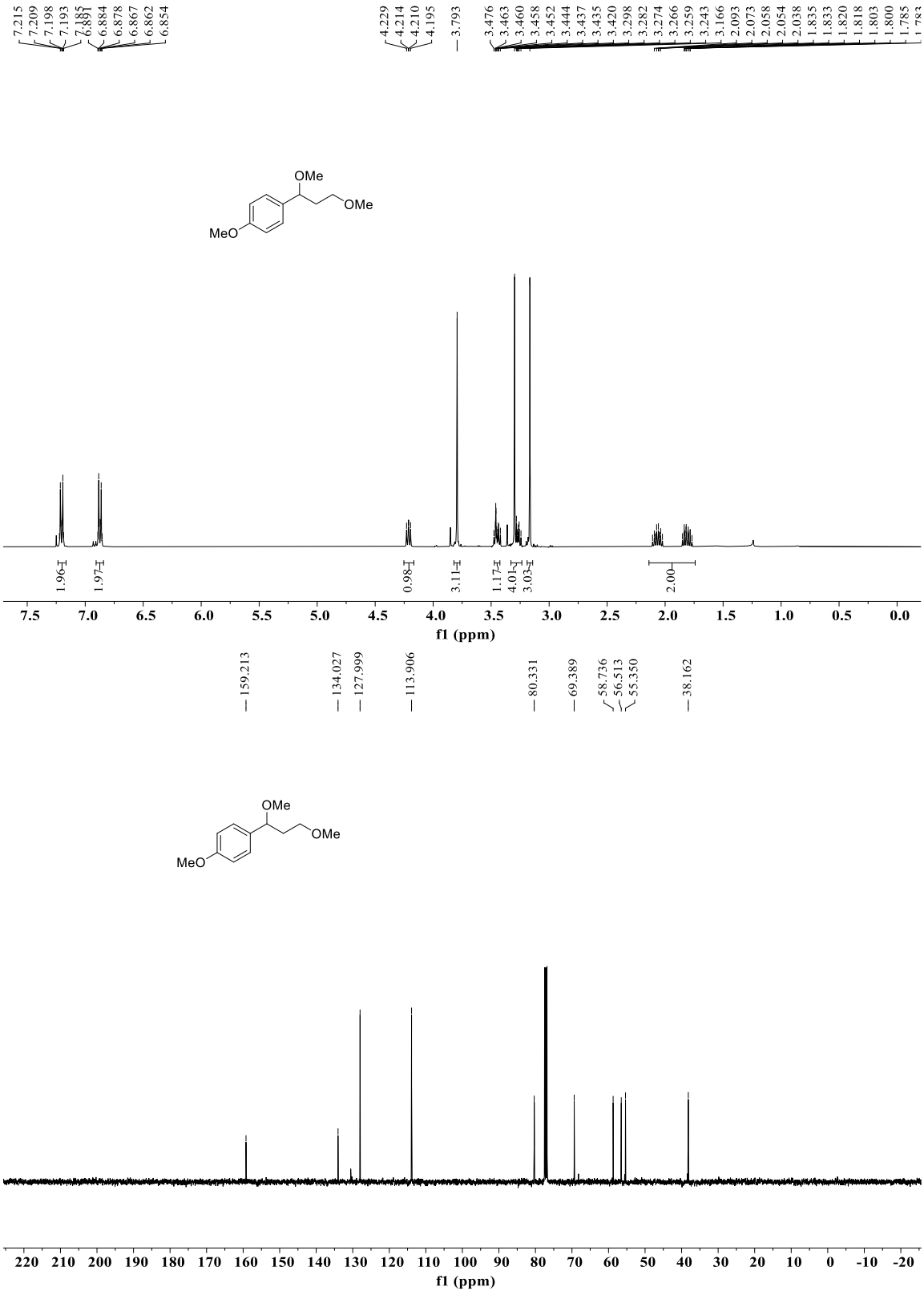
5


7.358
7.354
7.340
7.336
7.319
7.300
7.282
7.264
7.262
7.248
7.244
4.295
4.281
4.275
4.260
3.510
3.495
3.487
3.479
3.471
3.455
3.440
3.437
3.319
3.310
3.306
3.288
3.279
3.264
3.202
3.199
2.112
2.097
2.091
2.081
2.077
2.061
2.056
2.047
2.042
2.027
1.886
1.871
1.856
1.853
1.839
1.835
1.820
1.805

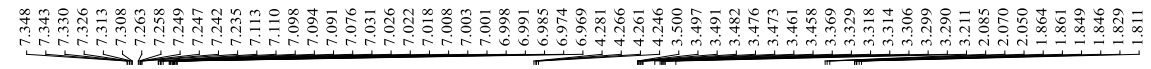

OMe
OMe
5.00
0.96
1.11
4.00
2.99
2.10
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

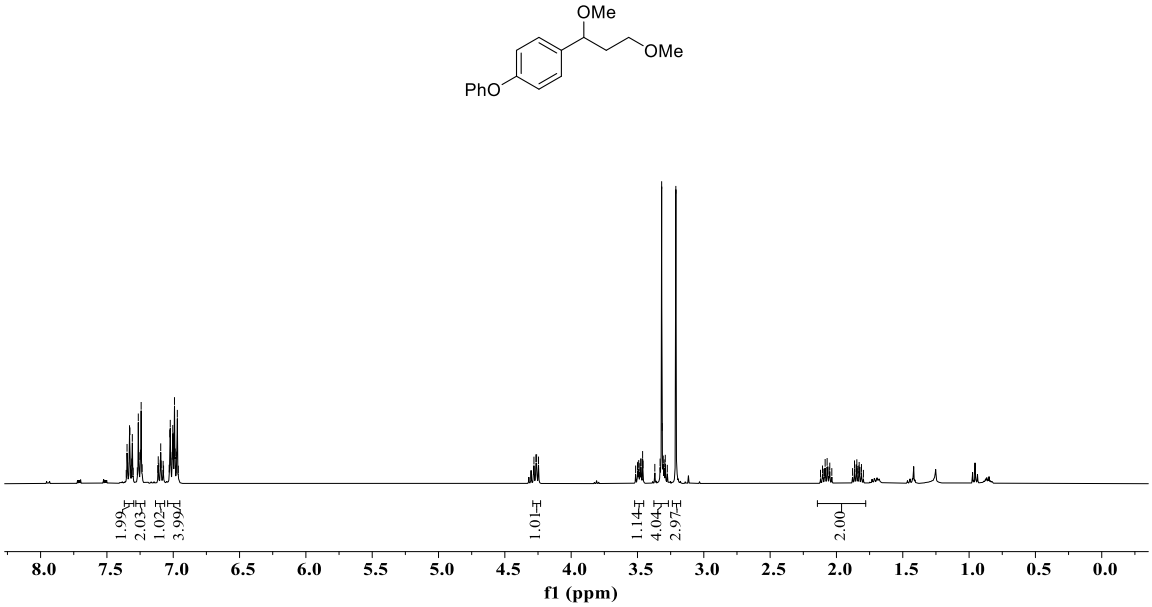

142.065
128.480
127.633
126.707
80.730
69.214
58.643
56.689
38.226
OMe
OMe
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)

51

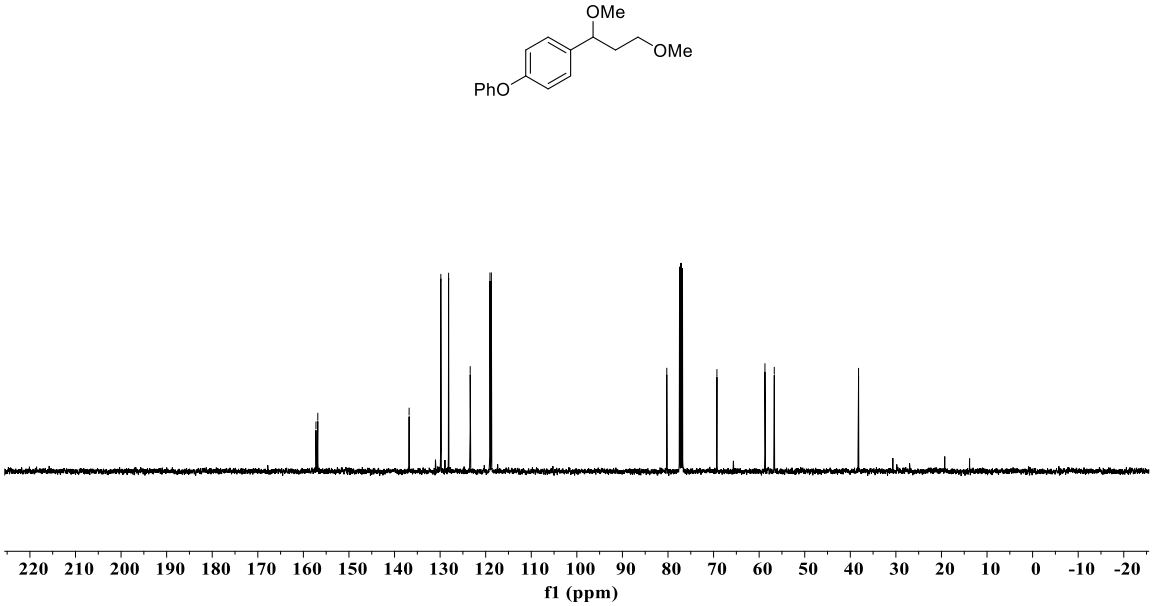

7.215
7.209
7.198
7.193
7.185
6.884
6.878
6.867
6.862
6.854
4.229
4.214
4.210
4.195
3.793
3.476
3.463
3.460
3.458
3.452
3.444
3.437
3.435
3.420
3.298
3.282
3.274
3.266
3.259
3.243
3.166
2.093
2.073
2.058
2.054
2.038
1.835
1.833
1.820
1.818
1.803
1.800
1.785
OMe
OMe
MeO
1.96
1.97
0.98
3.11
1.17
4.01
3.03
2.00
f1 (ppm)
159.213
134.027
127.999
113.906
80.331
69.389
58.736
56.513
55.350
38.162
OMe
OMe
MeO
f1 (ppm)

52

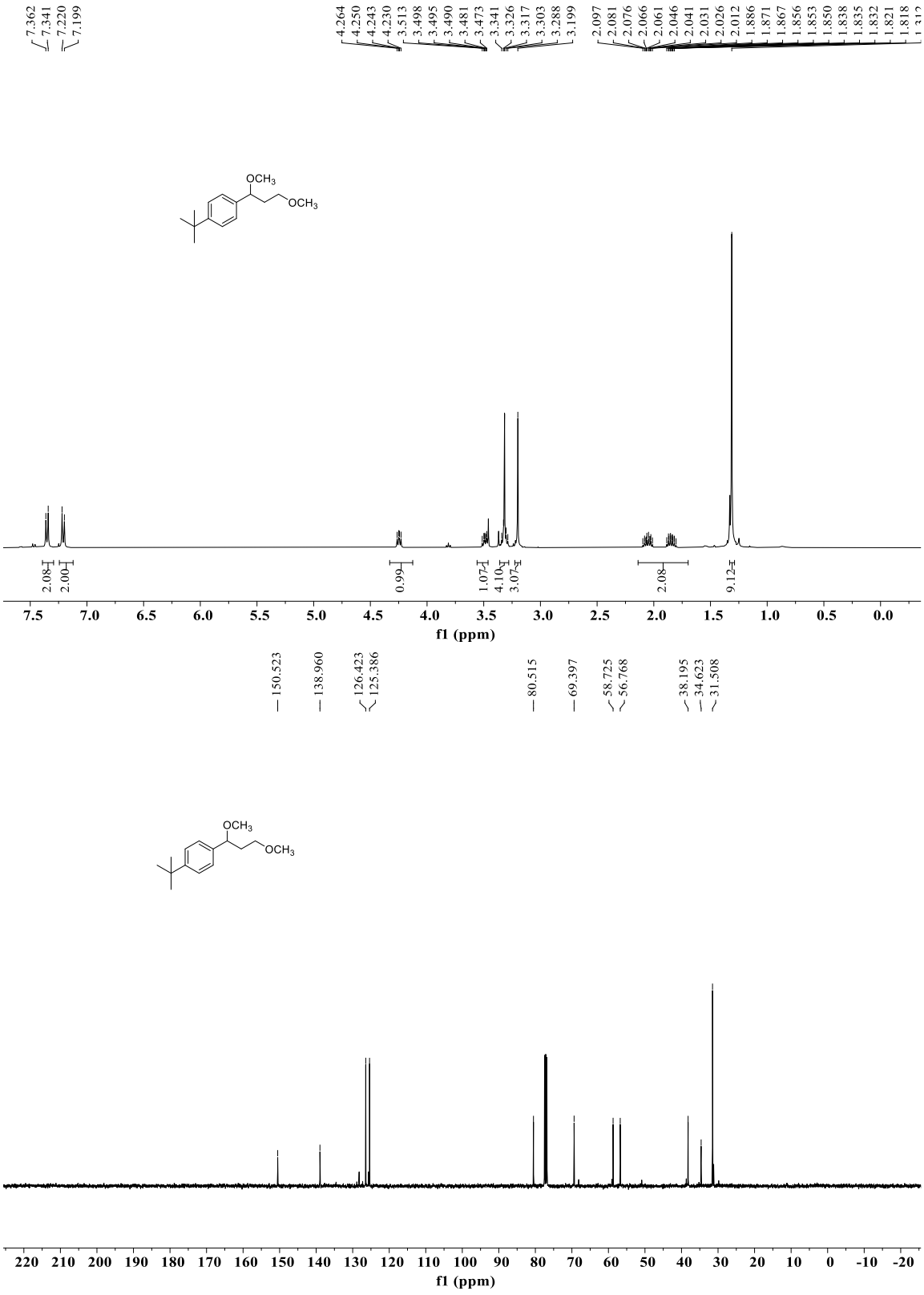

7.348
7.343
7.330
7.326
7.313
7.308
7.263
7.258
7.249
7.247
7.242
7.235
7.113
7.110
7.098
7.094
7.091
7.076
7.031
7.026
7.022
7.018
7.008
7.003
7.001
6.998
6.991
6.985
6.974
6.969
4.281
4.266
4.261
4.246
3.500
3.497
3.491
3.482
3.476
3.473
3.461
3.458
3.369
3.329
3.318
3.314
3.306
3.299
3.290
3.211
2.085
2.070
2.050
1.864
1.861
1.849
1.846
1.829
1.811


OMe
OMe
PhO
1.99
2.03
1.02
3.99
1.01
1.14
4.04
2.97
2.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

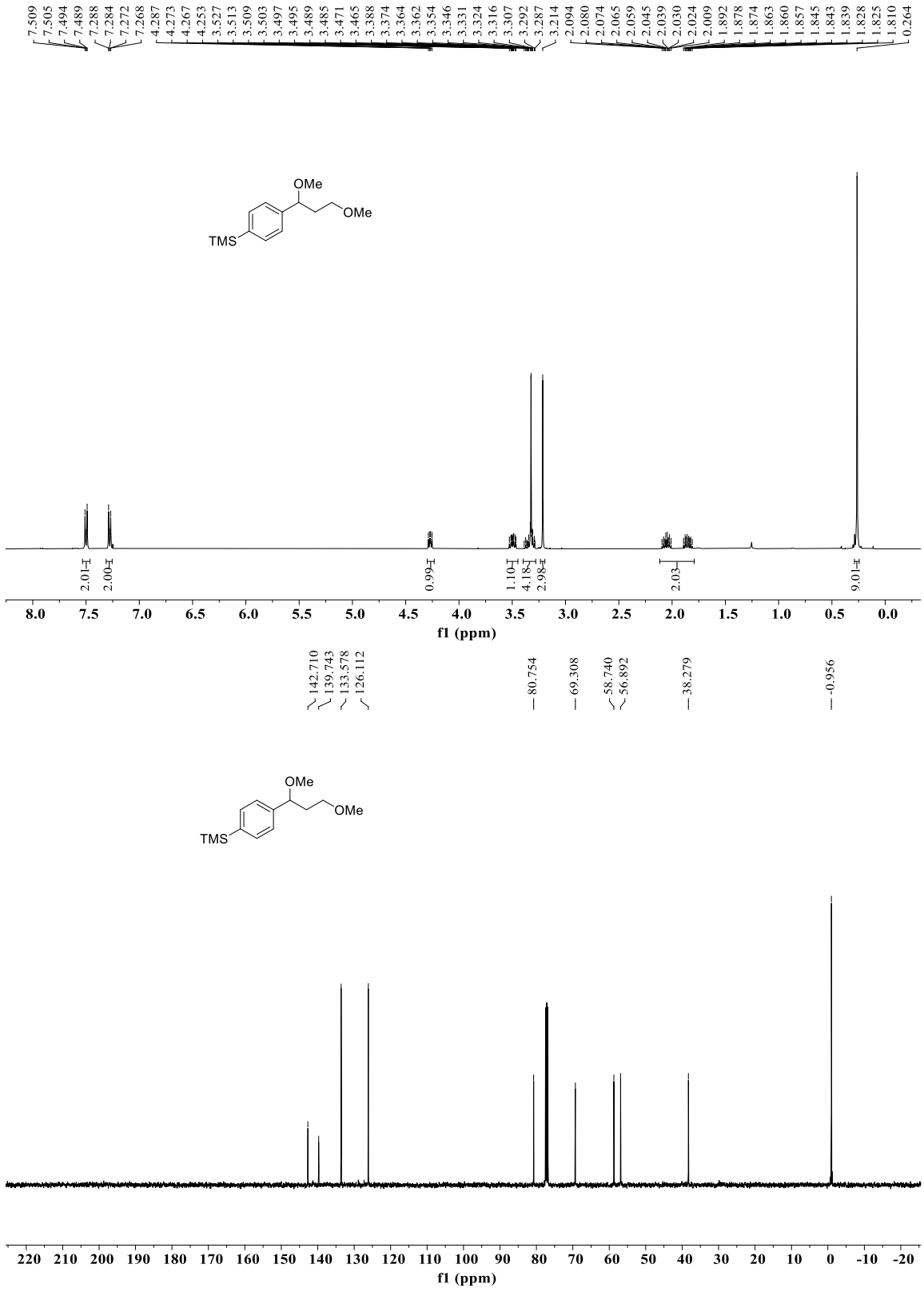

157.241
156.839
136.803
129.845
128.139
123.397
119.063
118.757
80.266
69.264
58.730
56.682
38.189


OMe
OMe
PhO
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)

53

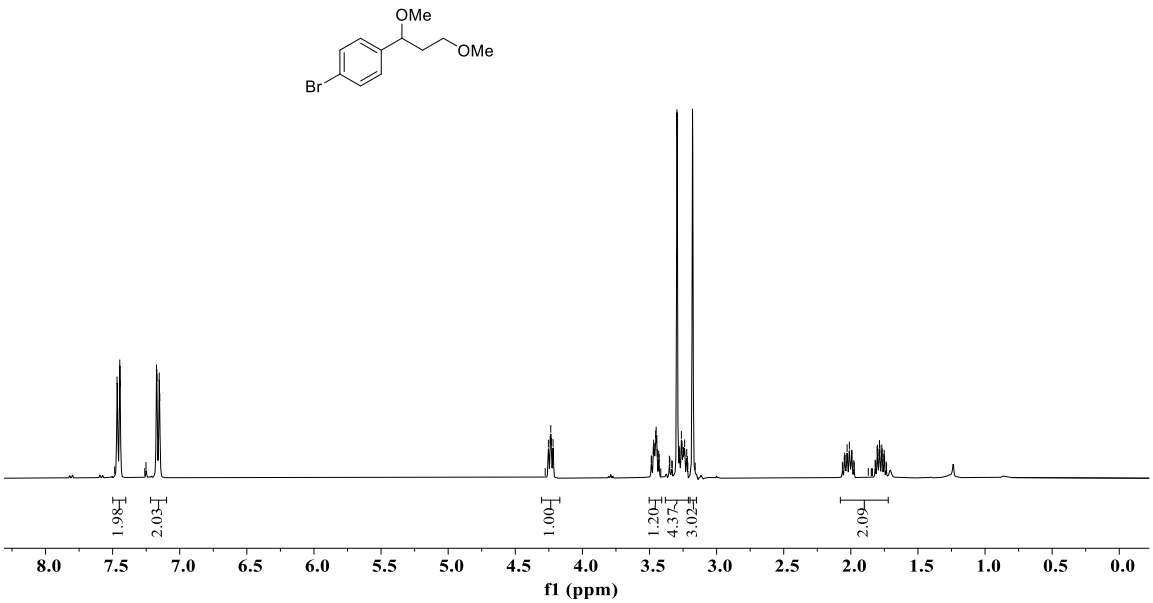

7.362
7.341
7.220
7.199
4.264
4.250
4.243
4.230
3.513
3.498
3.495
3.490
3.481
3.473
3.341
3.326
3.317
3.303
3.288
3.199
2.097
2.081
2.076
2.066
2.061
2.046
2.041
2.031
2.026
2.012
1.886
1.871
1.867
1.856
1.853
1.850
1.838
1.835
1.832
1.821
1.818
OCH3
OCH3
2.08
2.00
0.99
1.07
4.10
3.07
2.08
9.12
f1 (ppm)
150.523
138.960
126.423
125.386
80.515
69.397
58.725
56.768
38.195
34.623
31.508
OCH3
OCH3
f1 (ppm)

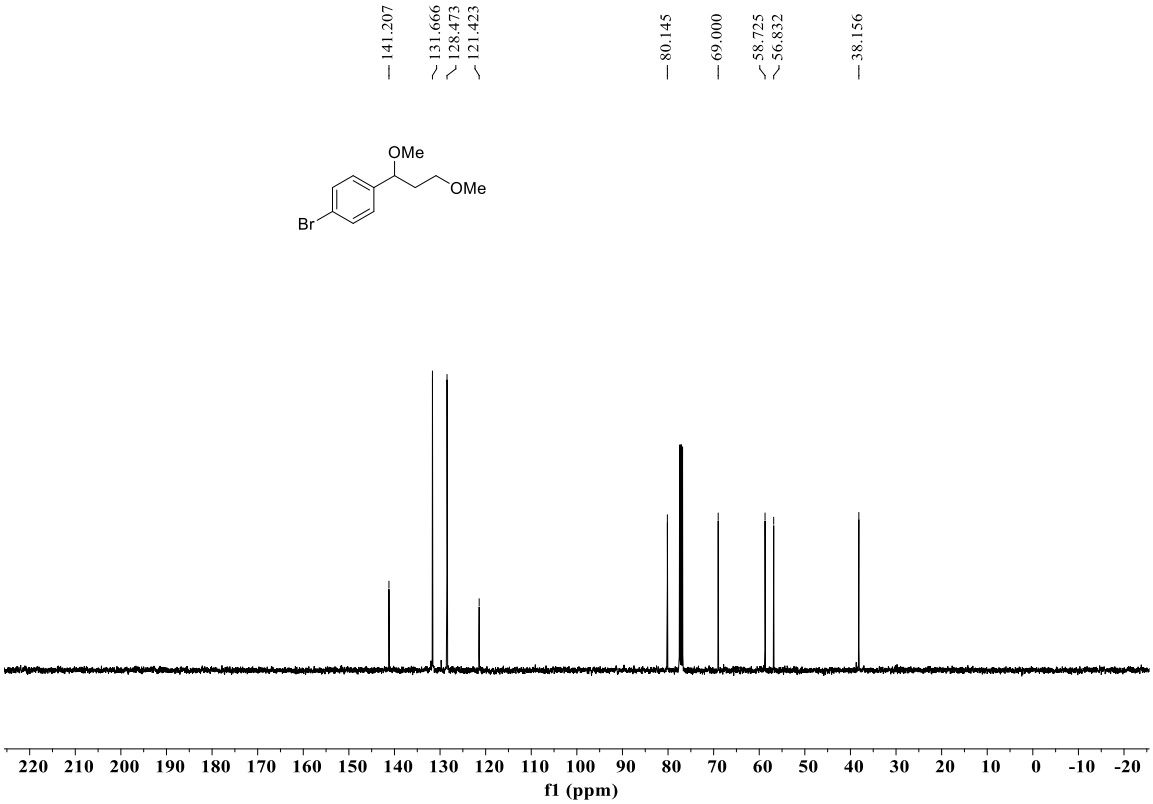
54


7.509
7.505
7.494
7.489
7.288
7.284
7.272
7.268
4.287
4.273
4.267
4.253
3.527
3.513
3.509
3.503
3.497
3.495
3.489
3.485
3.471
3.465
3.388
3.374
3.364
3.362
3.354
3.346
3.331
3.324
3.316
3.307
3.292
3.287
3.214
2.094
2.080
2.074
2.065
2.059
2.045
2.039
2.030
2.024
2.009
1.892
1.878
1.874
1.863
1.860
1.857
1.845
1.843
1.839
1.828
1.825
1.810
0.264
OMe
OMe
TMS
2.01
2.00
0.99
1.10
4.18
2.98
2.03
9.01
f1 (ppm)
142.710
139.743
133.578
126.112
80.754
69.308
58.740
56.892
38.279
-0.956
OMe
OMe
TMS
f1 (ppm)

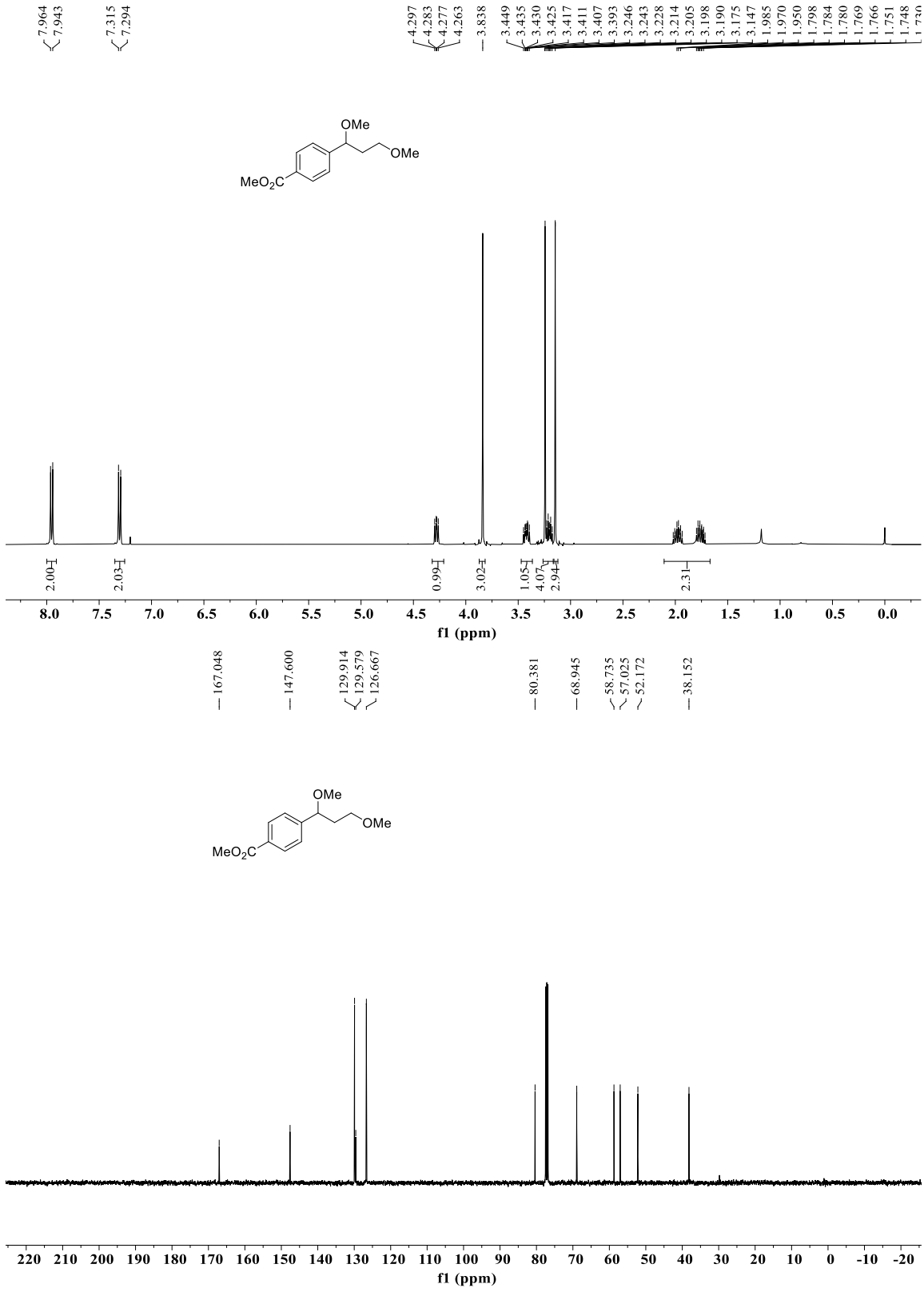
55


7.467
7.463
7.447
7.443
7.173
7.169
7.153
7.149
4.253
4.240
4.236
4.231
4.218
3.487
3.484
3.472
3.469
3.464
3.454
3.450
3.445
3.442
3.431
3.428
3.352
3.349
3.298
3.296
3.292
3.278
3.275
3.263
3.258
3.249
3.247
3.238
3.223
3.218
3.180
2.049
2.046
2.043
2.028
2.011
1.995
1.991
1.978
1.819
1.804
1.801
1.790
1.787
1.784
1.772
1.769
1.766
1.754
1.752
1.748

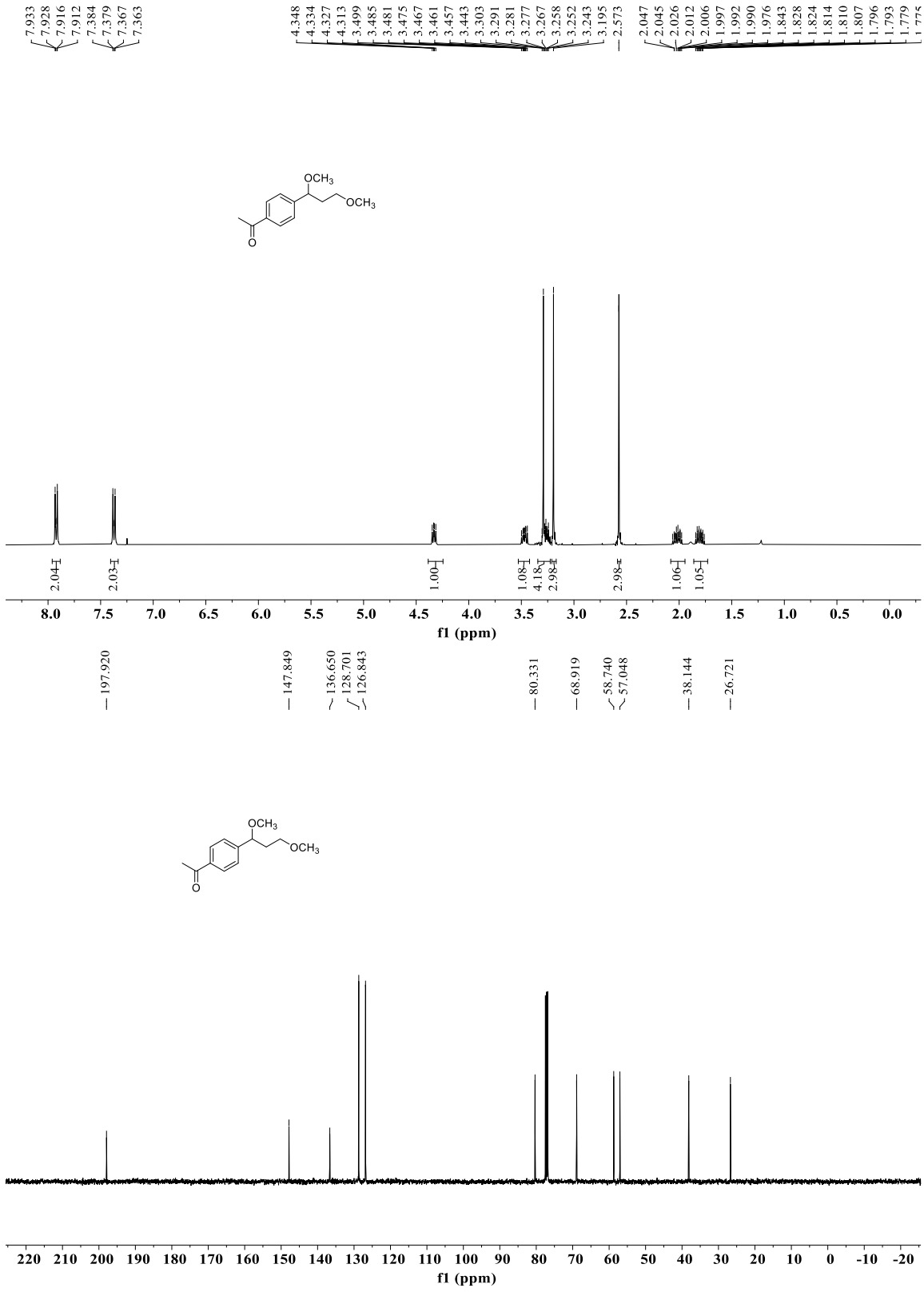

OMe
OMe
Br
1.98
2.03
1.00
1.20
4.37
3.02
2.09
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


141.207
131.666
128.473
121.423
80.145
69.000
58.725
56.832
38.156
OMe
OMe
Br
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)

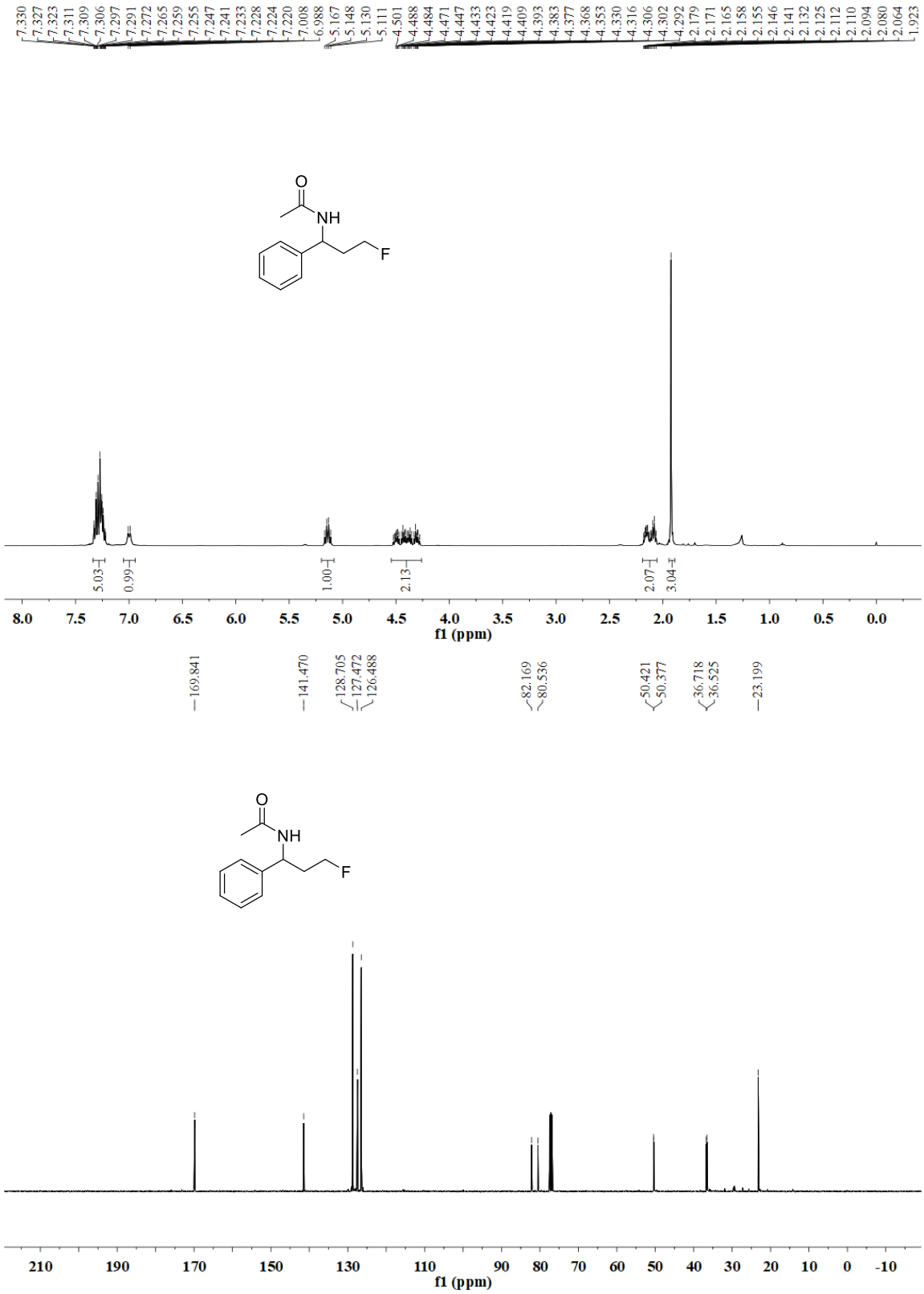
56

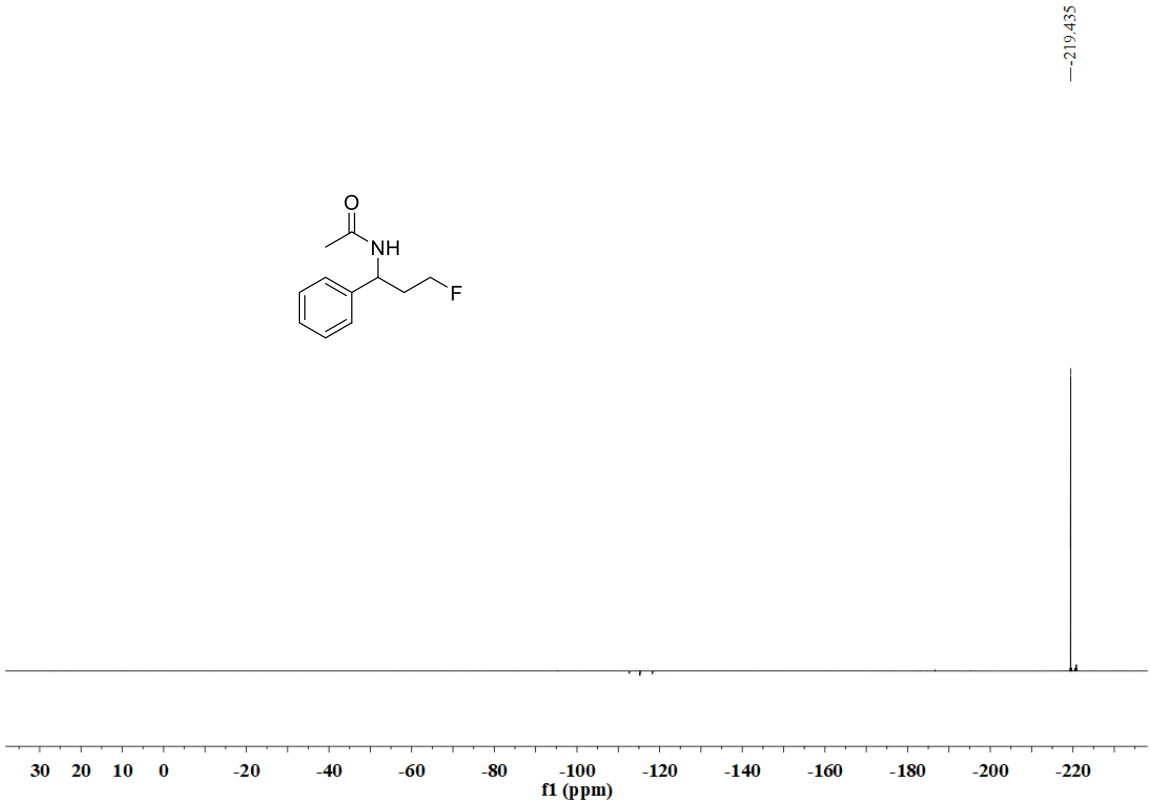

7.964
7.943
7.315
7.294
4.297
4.283
4.277
4.263
3.838
3.449
3.435
3.430
3.425
3.417
3.411
3.407
3.393
3.246
3.243
3.228
3.214
3.205
3.198
3.190
3.175
3.147
1.985
1.970
1.950
1.798
1.784
1.780
1.769
1.766
1.751
1.748
OMe
OMe
MeO2C
2.00
2.03
0.99
3.02
1.05
4.07
2.94
2.31
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)
167.048
147.600
129.914
129.579
126.667
80.381
68.945
58.735
57.025
52.172
38.152
OMe
OMe
MeO2C
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

57


7.933
7.928
7.916
7.912
7.384
7.379
7.367
7.363
4.348
4.334
4.327
4.313
3.499
3.485
3.481
3.475
3.467
3.461
3.457
3.443
3.303
3.291
3.281
3.277
3.267
3.258
3.252
3.243
3.195
2.573
2.047
2.045
2.026
2.012
2.006
1.997
1.992
1.990
1.976
1.843
1.828
1.824
1.814
1.810
1.807
1.796
1.793
1.779
OCH3
OCH3
O
2.04
2.03
1.00
1.08
4.18
2.98
2.98
1.06
1.05
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)
197.920
147.849
136.650
128.701
126.843
80.331
68.919
58.740
57.048
38.144
26.721
OCH3
OCH3
O
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

58


7.330
7.327
7.323
7.311
7.309
7.306
7.297
7.291
7.272
7.265
7.259
7.255
7.247
7.241
7.233
7.228
7.224
7.220
7.008
6.988
5.167
5.148
5.130
5.111
4.501
4.488
4.484
4.471
4.447
4.433
4.423
4.419
4.409
4.393
4.383
4.377
4.368
4.353
4.330
4.316
4.306
4.302
4.292
2.179
2.171
2.165
2.158
2.155
2.146
2.141
2.132
2.125
2.112
2.110
2.094
2.080
2.064
1.923
O
NH
F
5.03
0.99
1.00
2.13
2.07
3.04
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)
169.841
141.470
128.705
127.472
126.488
82.169
80.536
50.421
50.377
36.718
36.525
23.199
O
NH
F
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


-219.435
O
NH
F
30 20 10 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220
f1 (ppm)