Supporting Information

Metal-free remote site-selective radical C(sp^3)–H acyloxylation of amides

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Contents

1. General methods

The ^{1}H and ^{13}C NMR spectra were recorded on a Bruker AVANCE III-400 MHz spectrometer with $CDCl_3$ as the solvent. In $CDCl_3$, the chemical shifts in ^{1}H NMR spectra were determined with $Si(CH_3)_4$ as the internal standard (δ = 0.00 ppm); the chemical shifts in ^{13}C NMR spectra were determined based on the chemical shift of $CDCl_3$ (δ = 77.00 ppm). ^{19}F NMR spectra were recorded at 376 MHz. The coupling constant (s) (*J* value) are reported in Hz (s = singlet, d = doublet, t = triplet, q = quadruplet, m = multiplet or unresolved, br = broad signal). High resolution mass spectra were obtained with the Q-TOF-Premier mass spectrometer. IR spectra were recorde on a Thermo Fisher Nicolet 6700 FTIR spectrometer on a KBr beam splitter. Melting points (m.p.) were measured on an X-4A melting point apparatus were purchased from Shanghai instrument physical optics instrument Co., LTD. and are uncorrected. Blue LEDs (2m, 10 W) were used as the light source. Common glass tubes were used as the reaction vessel for irradiation, and the distance from the light source was about 1.5 cm. Thin layer chromatography (TLC) analyses were performed using Merck silica gel 60 F254 plates and visualized under UV. Flash column chromatography (FCC) was conducted on silica gel (200-300 mesh). Acetonitrile (CH_3CN) and other solvents were treated before use following the standard procedures.

2. Experimental procedures

General procedure for the C(sp^3)–H acyloxylation of amides

A flame-dried 15 mL glass tube equipped with a magnetic stirring bar and a rubber stopper was charged with the amide (0.30 mmol, 1.5 equiv.), $PhI(OAc)_2$ (128.8 mg, 0.40 mmol, 2.0 equiv.), pentafluorobenzoic acid (42.4 mg, 0.2 mmol, 1.0 equiv.), I_2 (25.4 mg, 0.10 mmol, 0.5 equiv.) and 2 mL of CH_3CN. The tube was evacuated and backfilled with argon for three times. The mixture was irradiated under stirring with a 10 W blue LED lamps (at a distance of 1.5 cm) at ambient temperature (30-35 ^{o}C in most cases; a small electric fan was used to dissipate heat emitted by the lamp) for 16

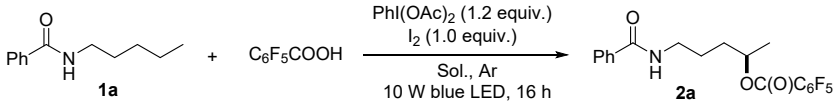
h. Once the reaction was complete as indicated by TLC, the mixture was then poured into an aqueous solution of $Na_2S_2O_3$ (20%, 5 mL), and the product was extracted with CH_2Cl_2 (3×6 mL). The combined organic phases were dried over anhydrous Na_2SO_4, concentrated in vacuo, and the residual was subjected to silica gel column chromatography (eluent: petroleum ether (PE) and ethyl acetate (EA)) to afford the product.

Gram scale preparation of 2a:

A flame-dried 100 mL round bottomed flask equipped with a magnetic stirring bar and a rubber stopper was charged with amide **1a** (1.4 g, 7.5 mmol, 1.5 equiv.), $PhI(OAc)_2$ (3.2 g, 10.0 mmol, 2.0 equiv.), pentafluorobenzoic acid (1.1 g, 5.0 mmol, 1.0 equiv.), I_2 (0.6 g, 2.5 mmol, 0.5 equiv.) and 50 mL CH_3CN. The solution was irradiated with a 10 W blue LED lamps (at a distance of 1.5 cm) under an argon atmosphere (argon balloon) for 16 h. The reaction mixture was then poured into an aqueous solution of $Na_2S_2O_3$ (20%, 50 mL), and the product was extracted with CH_2Cl_2 (3×30 mL). The combined organic phases were dried over anhydrous Na_2SO_4, concentrated in vacuo, and purified by flash column chromatography on silica gel (PE/EA = 6:1 to 5:1) to give **2a** in a yield of 85% (1.7 g).

3. Optimization of reaction conditions

Table S1 Screening of solvent [a]



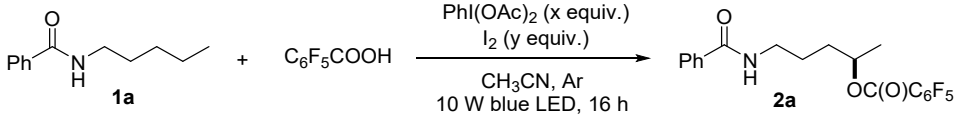
Entry	Solvent	Time (h)	**2a** Yield (%) [b]
1	DCE	16	43
2	DCM	16	40
4	CH_3CN	16	45
5	THF	16	21
6	1,4-dioxane	16	18
7	Toluene	16	0

8	MeOH	16	0
9	DMF	16	0

[a] The reaction was performed under an argon atmosphere on 0.2 mmol scale in 2.0 mL solvent.

[b] Isolated yield after silica gel column chromatography.

Table S2 Screening of mole ratio [a]

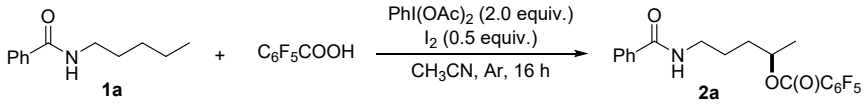


Entry	**1a** (equiv.)	C_6F_5COOH (equiv.)	$PhI(OAc)_2$ (equiv.)	I_2 (equiv.)	Time (h)	**2a** Yield (%) [b]
1	1.0	1.0	1.2	1.0	16	45
2	1.0	1.0	1.5	1.0	16	49
3	1.0	1.0	2.0	1.0	16	58
4	1.0	1.0	2.5	1.0	16	57
5	1.0	1.2	2.0	1.0	16	61
6	1.2	1.0	2.0	1.0	16	66
7	1.5	1.0	2.0	1.0	16	71
8	1.5	1.0	2.0	0.5	16	76
9	1.5	1.0	2.0	0.2	16	21

[a] The reaction was performed under an argon atmosphere on 0.2 mmol scale in 2.0 mL CH_3CN.

[b] Isolated yield after silica gel column chromatography.

Table S3 Screening of light ource [a]



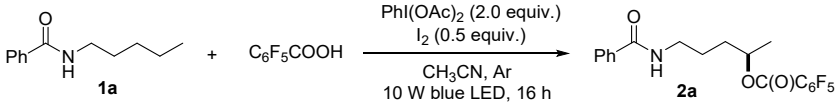
Entry	Light Source	Time (h)	**2a** Yield (%) [b]
1	23 W CFL	16	72
2	Blue LEDs	16	73

3	White LEDs	16	trace

[a] The reaction was performed under an argon atmosphere on 0.2 mmol scale in 2.0 mL CH_3CN.

[b] Isolated yield after silica gel column chromatography.

Table S4 Control experiment [a]

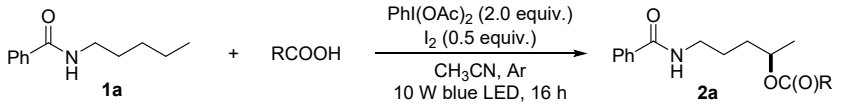


Entry	$PhI(OAc)_2$ (equiv.)	I_2 (equiv.)	Time (h)	**2a** Yield (%) [b]
1 [c]	2.0	0.5	16	0
2 [d]	2.0	0.5	16	0
3	2.0	none	16	0
4	none	2.0	16	0

[a] The reaction was performed under an argon atmosphere on 0.2 mmol scale in 2.0 mL CH_3CN.

[b] Isolated yield after silica gel column chromatography. [c] In the dark. [d] In air.

Table S5 Screening of carboxylic acids [a]

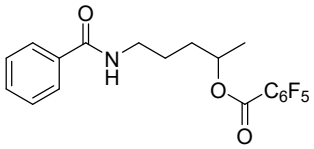


Entry	RCOOH	Time (h)	**2a** Yield (%) [b]
1	Benzoic acid	16	0
2	2,4-Dinitrobenzoic acid	16	0
3	*p*-Nitrobenzoic acid	16	0
4	AcOH	16	0
5	TFA	16	0

[a] The reaction was performed under an argon atmosphere on 0.2 mmol scale in 2.0 mL CH_3CN.

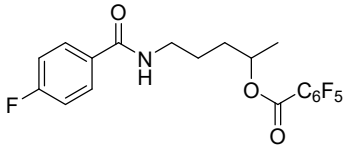
[b] Isolated yield after silica gel column chromatography; TFA: trifluoroacetic acid.

4. Characterization data



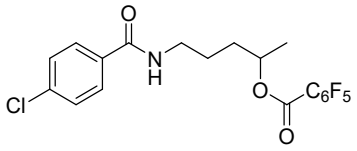
5-Benzamidopentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2a)

White solid obtained by column chromatography (PE/EA = 6:1 to 5:1); 61 mg, 76% yield; reaction time = 16 h; m.p. 97.2-99.0 °C; R_f = 0.30 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78-7.76 (m, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.4 Hz, 2H), 6.56 (t, *J* = 5.8 Hz, 1H), 5.27-5.19 (m, 1H), 3.54-3.43 (m, 2H), 1.82-1.66 (m, 4H), 1.37 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.6, 158.6, 134.5, 131.3, 128.4, 126.8, 74.1, 39.5, 33.0, 25.5, 19.8. (***peaks corresponding to the perfluorinated benzoyl ester moiety were not resolvable due to their anticipated weak intensity; the same for below***). ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.0 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2924, 1734, 1651, 1237, 910, 734. HRMS (ESI) calcd for $C_{19}H_{16}F_5NO_3Na$ $[M+Na]^+$: 424.0943, found: 424.0945.



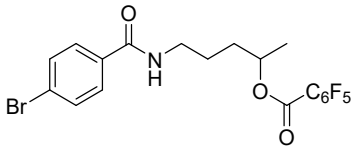
5-(4-Fluorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2b)

Yellowish solid obtained by column chromatography (PE/EA = 7:1 to 5:1); 57 mg, 68% yield; reaction time = 16 h; m.p. 113.5-114.6 °C; R_f = 0.29 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 (dd, J_1 = 8.6 Hz, J_2 = 5.4 Hz, 2H), 7.09 (t, *J* = 8.6 Hz, 2H), 6.31 (s, 1H), 5.27-5.20 (m, 1H), 3.53-3.41 (m, 2H), 1.82-1.68 (m, 4H), 1.37 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.5, 164.7 (d, *J* = 251.8 Hz, 1C), 158.7, 130.7, 129.2 (d, *J* = 8.8 Hz, 1C), 115.6 (d, *J* = 21.8 Hz, 1C), 74.0, 39.7, 33.1, 25.49, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -108.3 (m, 1F), -138.75 (m, 2F), -149.0 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2939, 1736, 1641, 1503, 1237, 997. HRMS (ESI) calcd for $C_{19}H_{15}F_6NO_3Na$ $[M+Na]^+$: 442.0854, found: 442.0858.



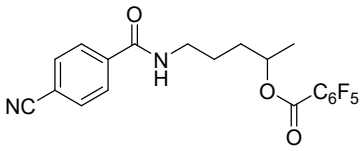
5-(4-Chlorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2c)

Yellowish solid obtained by column chromatography (PE/EA = 6:1); 49 mg, 56% yield; reaction time = 16 h; m.p. 107.2-108.6 °C; R_f = 0.31 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (d, *J* = 8.4 Hz, 2H), 7.36 (d, *J* = 8.4 Hz, 2H), 6.48 (t, *J* = 5.8 Hz, 1H), 5.25-5.18 (m, 1H), 3.51-3.41 (m, 2H), 1.77-1.65 (m, 4H), 1.36 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.6, 158.7, 137.6, 132.9, 128.7, 128.3, 74.0, 39.6, 33.0, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.9 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1735, 1638, 1499, 1236, 997. HRMS (ESI) calcd for $C_{19}H_{15}ClF_5NO_3Na$ $[M+Na]^+$: 458.0558, found: 458.0562.



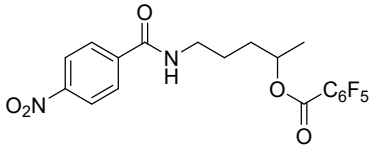
5-(4-Bromobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2d)

White solid obtained by column chromatography (PE/EA = 7:1); 45 mg, 47% yield; reaction time = 16 h; m.p. 93.0-94.5 °C; R_f = 0.31 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.2 Hz, 2H), 7.52 (d, *J* = 8.2 Hz, 2H), 6.51 (s, 1H), 5.25-5.18 (m, 1H), 3.51-3.39 (m, 2H), 1.79-1.64 (m, 4H), 1.36 (d, *J* = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.6, 158.65, 133.3, 131.7, 128.5, 126.0, 74.0, 39.6, 33.0, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.9 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1733, 1504, 1237, 1010. HRMS (ESI) calcd for $C_{19}H_{15}BrF_5NO_3Na$ $[M+Na]^+$: 502.0053, found: 502.0056.



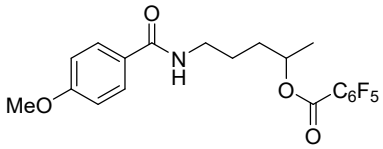
5-(4-Cyanobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2e)

White solid obtained by column chromatography (PE/EA = 6:1 to 4:1); 52 mg, 61% yield; reaction time = 16 h; m.p. 79.1-80.8 °C; R_f = 0.30 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.8 Hz, 2H), 7.72 (d, *J* = 7.8 Hz, 2H), 6.48 (s, 1H), 5.26-5.20 (m, 1H), 3.56-3.43 (m, 2H), 1.82-1.68 (m, 4H), 1.38 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.8, 158.7, 138.4, 132.4, 127.6, 118.0, 115.0, 73.9, 39.8, 33.0, 25.3, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.9 (m, 1F), -160.2 (m, 2F). IR (KBr, cm^{-1}) ν 2839, 1733, 1651, 1499, 1237, 997. HRMS (ESI) calcd for $C_{20}H_{15}F_5N_2O_3Na$ $[M+Na]^+$: 449.0901, found: 449.0906.



5-(4-Nitrobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2f)

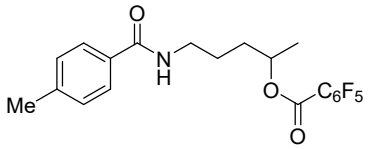
White solid obtained by column chromatography (PE/EA = 5:1 to 4:1); 71 mg, 80% yield; reaction time = 16 h; m.p. 92.8-94.1 °C; R_f = 0.16 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, *J* = 8.7 Hz, 2H), 7.93 (d, *J* = 8.7 Hz, 2H), 6.47 (t, *J* = 5.9 Hz, 1H), 5.28-5.21 m, 1H), 3.59-3.47 (m, 2H), 1.83-1.70 (m, 4H), 1.39 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 158.8, 149.6, 140.1, 128.1, 123.8, 73.9, 39.9, 33.1, 25.3, 19.83. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.7 (m, 1F), -160.2 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1733, 1651, 1524, 1237, 997. HRMS (ESI) calcd for $C_{19}H_{15}F_5N_2O_5Na$ $[M+Na]^+$: 469.0799, found: 469.0804.



5-(4-Methoxybenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2g)

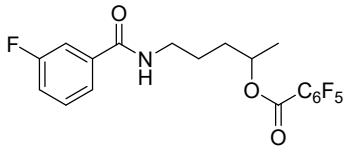
Yellowish solid obtained by column chromatography (PE/EA = 6:1 to 4:1); 64 mg, 74% yield; reaction time = 16 h; m.p. 87.2-88.4 °C; R_f = 0.15 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.8 Hz, 2H), 6.90 (d, *J* = 8.8 Hz, 2H), 6.25 (s, 1H), 5.27-5.20 (m, 1H), 3.84 (s, 3H), 3.52-3.42 (m, 2H), 1.81-1.67 (m, 4H), 1.37 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.1, 162.1, 158.7, 128.6, 126.8, 113.7, 74.1, 55.4, 39.5, 33.1, 25.6, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.1 (m,

1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2919, 1732, 1693, 1502, 1107, 996. HRMS (ESI) calcd for $C_{20}H_{18}F_5NO_4Na$ $[M+Na]^+$: 454.1054, found: 454.1055.



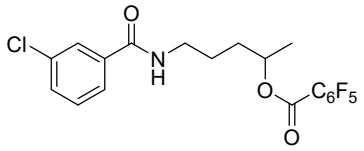
5-(4-Methylbenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2h)

Yellowish solid obtained by column chromatography (PE/EA = 7:1 to 5:1); 38 mg, 45% yield; reaction time = 16 h; m.p. 106.9-108.1 °C; R_f = 0.30 (PE/EA = 3:1). ^1H NMR (400 MHz, $CDCl_3$) δ 7.65 (d, *J* = 7.8 Hz, 2H), 7.20 (d, *J* = 7.8 Hz, 2H), 6.36 (s, 1H), 5.26-5.19 (m, 1H), 3.52-3.42 (m, 2H), 2.37 (s, 3H), 1.80-1.67 (m, 4H), 1.36 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.5, 158.6, 141.8, 131.7, 129.1, 126.8, 74.1, 39.5, 33.1, 25.5, 21.3, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.2 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2935, 1736, 1651, 1504, 1190, 997. HRMS (ESI) calcd for $C_{20}H_{18}F_5NO_3Na$ $[M+Na]^+$: 438.1105, found: 438.1110.



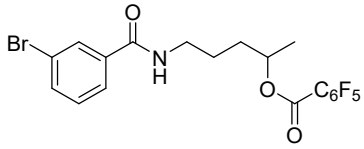
5-(3-Fluorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2i)

White solid obtained by column chromatography (PE/EA = 7:1 to 6:1); 52 mg, 62% yield; reaction time = 16 h; m.p. 76.9-78.7 °C; R_f = 0.26 (PE/EA = 3:1). ^1H NMR (400 MHz, $CDCl_3$) δ 7.52-7.46 (m, 2H), 7.41-7.36 (m, 1H), 7.18 (t, *J* = 8.3 Hz, 1H), 6.42 (s, 1H), 5.26-5.19 (m, 1H), 3.54-3.43 (m, 2H), 1.81-1.66 (m, 4H), 1.37 (d, *J* = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.3 (d, *J* = 2.4 Hz, 1C), 162.7 (d, *J* = 247.8 Hz, 1C), 158.7, 136.8 (d, *J* = 6.8 Hz, 1C), 130.2 (d, *J* = 7.8 Hz), 122.3 (d, *J* = 3.0 Hz, 1C), 118.4 (d, *J* = 21.2 Hz, 1C), 114.3 (d, *J* = 22.8 Hz, 1C), 74.0, 39.7, 33.0, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -111.9 (m, 2F), -138.7 (m, 2F), -149.0 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2919, 1736, 1650, 1499, 1236, 997. HRMS (ESI) calcd for $C_{19}H_{15}F_6NO_3Na$ $[M+Na]^+$: 442.0854, found: 442.0859.



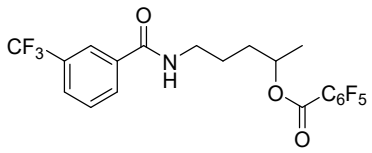
5-(3-Chlorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2j)

White solid obtained by column chromatography (PE/EA = 7:1 to 6:1); 57 mg, 66% yield; reaction time = 16 h; m.p. 71.1-72.2 °C; R_f = 0.31 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 (s, 1H), 7.62 (d, *J* = 7.4 Hz, 1H), 7.43 (d, *J* = 8.0 Hz, 1H), 7.32 (t, *J* = 7.8 Hz, 1H), 6.60 (s, 1H), 5.25-5.17 (m, 1H), 3.51-3.41 (m, 2H), 1.79-1.65 (m, 4H), 1.36 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.3, 158.7, 136.3, 134.6, 131.4, 129.8, 127.2, 125.0, 74.0, 39.7, 33.0, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.0 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1736, 1651, 1499, 1236, 997. HRMS (ESI) calcd for $C_{19}H_{15}ClF_5NO_3Na$ $[M+Na]^+$: 458.0558, found: 458.0563.



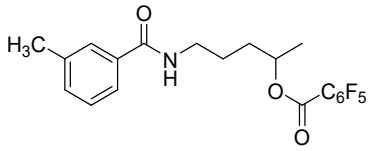
5-(3-Bromobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2k)

White solid obtained by column chromatography (PE/EA = 7:1 to 6:1); 64 mg, 67% yield; reaction time = 16 h; m.p. 61.7-62.8 °C; R_f = 0.30 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (s, 1H), 7.69 (d, *J* = 7.6 Hz, 1H), 7.60 (d, *J* = 7.2 Hz, 1H), 7.28 (t, *J* = 6.0 Hz, 1H), 6.63 (s, 1H), 5.27-5.20 (m, 1H), 3.54-3.43 (m, 2H), 1.84-1.65 (m, 4H), 1.38 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.2, 158.6, 136.5, 134.3, 130.1, 130.1, 125.5, 122.64, 74.0, 39.7, 33.0, 25.4, 19.78. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.0 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1736, 1651, 1471, 1237, 997. HRMS (ESI) calcd for $C_{19}H_{15}BrF_5NO_3Na$ $[M+Na]^+$: 502.0053, found: 502.0058.



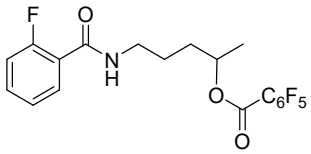
5-(3-(Trifluoromethyl)benzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2l)

White solid obtained by column chromatography (PE/EA = 5:1); 75 mg, 80% yield; reaction time = 16 h; m.p. 62.1-63.3 °C; R_f = 0.20 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.01 (s, 1H), 7.95 (d, *J* = 7.8 Hz, 1H), 7.73 (d, *J* = 9.2 Hz, 1H), 7.57-7.47 (m, 1H), 6.56 (d, *J* = 33.3 Hz, 1H), 5.27-5.19 (m, 1H), 3.56-3.45 (m, 2H), 1.84-1.66 (m, 4H), 1.37 (d, *J* = 3.7 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.2, 158.7, 135.3, 131.1 (d, *J* = 32.7 Hz, 1C), 130.20, 129.2 (d, *J* = 2.6 Hz, 1C), 128.0, 123.8 (d, *J* = 3.9 Hz, 1C), 123.6 (d, *J* = 270.0 Hz, 1C), 74.0, 40.0, 33.1, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -62.84 (d, *J* = 8.2 Hz, 3F), -138.8 (m, 2F), -149.0 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2940, 1736, 1644, 1500, 1327, 1130, 997. HRMS (ESI) calcd for $C_{20}H_{15}F_8NO_3Na$ $[M+Na]^+$: 492.0822, found: 492.0825.



5-(3-Methylbenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2m)

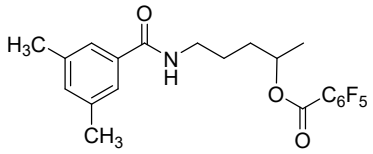
Yellowish solid obtained by column chromatography (PE/EA = 12:1 to 10:1); 35 mg, 42% yield; reaction time = 16 h; m.p. 63.9-65.6 °C; R_f = 0.46 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 (s, 1H), 7.54-7.51 (m, 1H), 7.28 (d, *J* = 13.4 Hz, 2H), 6.27 (s, 1H), 5.28-5.21 (m, 1H), 3.55-3.43 (M, 2H), 2.38 (s, 3H), 1.81-1.70 (m, 4H), 1.38 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.8, 158.7, 138.4, 134.5, 132.2, 128.4, 127.6, 123.7, 74.1, 39.6, 33.1, 25.6, 21.3, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.1 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2934, 1736, 1639, 1500, 1325, 1236, 997. HRMS (ESI) calcd for $C_{20}H_{18}F_5NO_3Na$ $[M+Na]^+$: 438.1105, found: 438.1109.



5-(2-Fluorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2n)

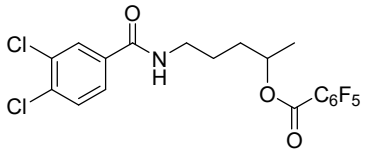
White solid obtained by column chromatography (PE/EA = 10:1 to 6:1); 20 mg, 24% yield; reaction time = 16 h; m.p. 69.6-71.5 °C; R_f = 0.33 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (td, J_1 = 7.8 Hz, J_2 = 1.8 Hz, 1H), 7.50-7.44 (m, 1H), 7.28-7.24

(m, 2H), 7.14-7.09 (m, 1H), 6.77 (s, 1H), 5.29-5.21 (m, 1H), 3.593.48 (m, 2H), 1.83-1.70 (m, 4H), 1.39 (d, J = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4 (d, J = 3.2 Hz), 160.6 (d, J = 246.6 Hz), 158.6, 133.3 (d, J = 9.4 Hz), 132.1 (d, J = 2.2 Hz), 124.8 (d, J = 3.2 Hz), 121.0 (d, J = 11.6 Hz), 116.0 (d, J = 24.8 Hz), 74.1, 39.6, 33.06, 25.4, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -114.0 (m, 2F), -138.7 (m, 2F), -149.2 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2937, 1735, 1653, 1499, 1325, 1237, 997. HRMS (ESI) calcd for $C_{19}H_{15}F_6NO_3Na$ $[M+Na]^+$: 442.0854, found: 442.0857.



5-(3,5-Dimethylbenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2o)

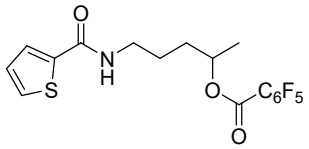
Yellowish solid obtained by column chromatography (PE/EA = 7:1 to 5:1); 32 mg, 37% yield; reaction time = 16 h; m.p. 112.1-113.4 °C; R_f = 0.30 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (s, 2H), 7.11 (s, 1H), 6.31 (t, J = 5.8 Hz, 1H), 5.27-5.20 (m, 1H), 3.53-3.40 (m, 2H), 2.33 (s, 6H), 1.81-1.66 (m, 4H), 1.37 (d, J = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.9, 158.6, 138.2, 134.5, 133.0, 124.6, 74.1, 39.5, 33.1, 25.6, 21.1, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.1 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2918, 1735, 1651, 1500, 1237, 997, 702. HRMS (ESI) calcd for $C_{21}H_{20}F_5NO_3Na$ $[M+Na]^+$: 452.1261, found: 452.1265.



5-(3,4-Dichlorobenzamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2p)

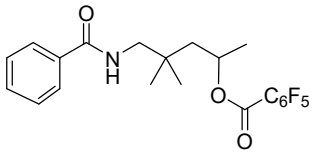
Yellowish solid obtained by column chromatography (PE/EA = 10:1 to 7:1); 63 mg, 67% yield; reaction time = 16 h; m.p. 90.2-91.3 °C; R_f = 0.28 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (d, J = 2.1 Hz, 1H), 7.58 (dd, J_1 = 8.3 Hz, J_2 = 2.1 Hz, 1H), 7.46 (d, J = 8.3 Hz, 1H), 6.58 (s, 1H), 5.26-5.18 (m, 1H), 3.52-3.41 (m, 2H), 1.80-1.66 (m, 4H), 1.36 (d, J = 6.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 158.7, 135.8, 134.3, 133.0, 130.5, 129.1, 126.1, 73.9, 39.8, 33.0, 25.3, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.1 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2939, 1736,

1643, 1499, 1237, 997. HRMS (ESI) calcd for $C_{19}H_{14}Cl_2F_5NO_3Na$ $[M+Na]^+$: 492.0169, found: 492.0171.



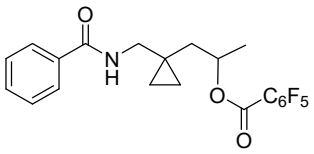
5-(Thiophene-2-carboxamido)pentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2q)

White solid obtained by column chromatography (PE/EA = 6:1 to 4:1); 40 mg, 49% yield; reaction time = 16 h; m.p. 97.2-99.2 °C; R_f = 0.13 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, *J* = 3.8 Hz, 1H), 7.48 (d, *J* = 5.0 Hz, 1H), 7.08 (t, *J* = 4.0 Hz, 1H), 6.22 (s, 1H), 5.29-5.22 (m, 1H), 3.56-3.42 (m, 2H), 1.82-1.68 (m, 4H), 1.39 (d, *J* = 6.2 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 158.7, 138.9, 129.8, 127.9, 127.6, 74.1, 39.5, 33.1, 25.5, 19.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -149.1 (m, 1F), -160.4 (m, 2F). IR (KBr, cm^{-1}) ν 2938, 1735, 1651, 1500, 1325, 1237, 997. HRMS (ESI) calcd for $C_{17}H_{14}F_5NO_3SNa$ $[M+Na]^+$: 430.0514, found: 430.0514.



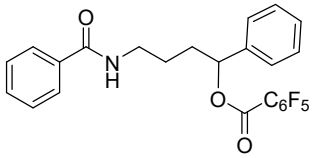
5-Benzamido-4,4-dimethylpentan-2-yl 2,3,4,5,6-pentafluorobenzoate (2r)

White solid obtained by column chromatography (PE/EA = 8:1 to 6:1); 36 mg, 42% yield; reaction time = 16 h; m.p. 109.8-101.4 °C; R_f = 0.32 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.0 Hz, 2H), 7.51 (t, *J* = 7.2 Hz, 1H), 7.43 (t, *J* = 7.4 Hz, 2H), 6.44 (s, 1H), 5.42-5.34 (m, 1H), 3.56 (dd, J_1 = 13.6 Hz, J_2 = 7.6 Hz, 1H), 3.14 (dd, J_1 = 13.6 Hz, J_2 = 5.2 Hz, 1H), 1.90 (dd, J_1 = 15.0 Hz, J_2 = 7.2 Hz, 1H), 1.52 (dd, J_1 = 15.0 Hz, J_2 = 3.8 Hz,, 1H), 1.42 (d, *J* = 6.2 Hz, 3H), 1.01 (d, *J* = 3.6 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.6, 134.7, 131.5, 128.6, 126.8, 72.2, 49.0, 45.1, 34.6, 26.1, 25.3, 22.1. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.7 (m, 1F), -160.2 (m, 2F). IR (KBr, cm^{-1}) ν 2917, 1733, 1643, 1237, 997. HRMS (ESI) calcd for $C_{21}H_{20}F_5NO_3Na$ $[M+Na]^+$: 452.1261, found: 452.1264.



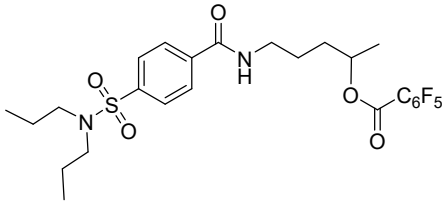
1-(1-(Benzamidomethyl)cyclopropyl)propan-2-yl 2,3,4,5,6-pentafluorobenzoate (2s)

Yellow solid obtained by column chromatography (PE/EA = 12:1 to 10:1); 54 mg, 63% yield; reaction time = 16 h; m.p. 88.4-89.6 °C; R_f = 0.33 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (d, J = 7.0 Hz, 2H), 7.52-7.26 (m, 3H), 6.62 (s, 1H), 5.57-5.55 (m, 1H), 3.56 (dd, J_1 = 14.2 Hz, J_2 = 6.6 Hz, 1H), 3.31 (dd, J_1 = 14.2 Hz, J_2 = 4.9 Hz, 1H), 1.82 (dd, J_1 = 14.2 Hz, J_2 = 7.4 Hz, 1H), 1.67 (dd, J_1 = 14.9 Hz, J_2 = 5.0 Hz, 1H), 1.41 (d, J = 6.3 Hz, 3H), 0.65-0.66 (m, 1H), 0.55-0.39 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.5, 158.9, 134.5, 131.4, 128.5, 126.9, 73.2, 46.0, 41.3, 20.7, 17.6, 11.0, 10.6. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.6 (m, 2F), -148.8 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2919, 1735, 1650, 1498, 1238, 997. HRMS (ESI) calcd for $C_{21}H_{18}F_5NO_3Na$ $[M+Na]^+$: 450.1105, found: 450.1109.



4-Benzamido-1-phenylbutyl 2,3,4,5,6-pentafluorobenzoate (2t)

White solid obtained by column chromatography (PE/EA = 8:1 to 6:1); 70 mg, 75% yield; reaction time = 16 h; m.p. 127.1-128.6 °C; R_f = 0.23 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, J = 7.0 Hz, 2H), 7.53-7.28 (m, 8H), 6.20 (t, J = 5.8 Hz, 1H), 6.05 (d, J = 8.0 Hz, 1H), 3.59-3.45 (m, 2H), 2.21-2.12 (m, 1H), 2.06-1.98 (m, 1H), 1.80-1.62 (m, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 167.6, 138.9, 134.5, 131.5, 128.7, 128.6 (2C), 126.8, 126.6, 78.7, 39.5, 33.6, 25.8. ^{19}F NMR (376 MHz, $CDCl_3$) δ -137.9 (m, 2F), -148.4 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2918, 1736, 1651, 1496, 1228, 1003. HRMS (ESI) calcd for $C_{24}H_{18}F_5NO_3Na$ $[M+Na]^+$: 486.1105, found: 486.1111.



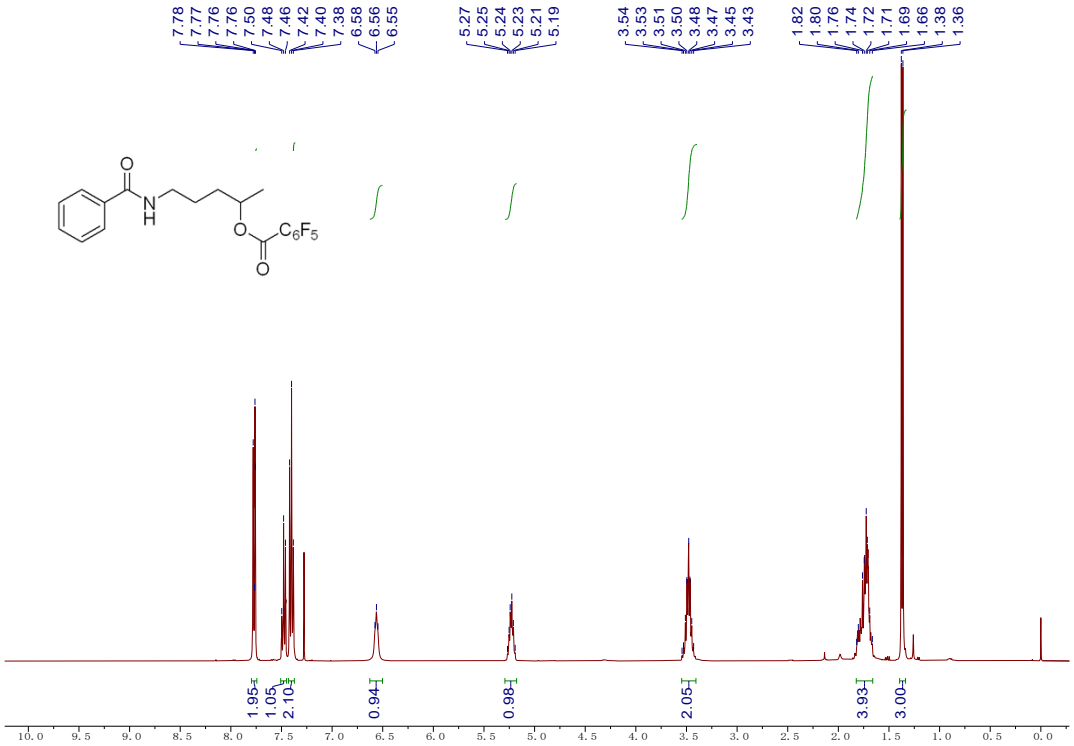
4-(4-(*N*,*N*-dipropylsulfamoyl)benzamido)-1-phenylbutyl 2,3,4,5,6-pentafluoro-benzoate (2u)

Yellow oil obtained by column chromatography (PE/EA = 8:1 to 6:1); 68 mg, 54% yield; reaction time = 16 h; R_f = 0.21 (PE/EA = 3:1). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.0 Hz, 2H), 7.76 (d, *J* = 8.0 Hz, 2H), 6.65 (s, 1H), 5.26-5.19 (m, 1H), 3.55-3.43 (m, 2H), 3.05 (d, *J* = 8.0 Hz, 4H), 1.84-1.67 (m, 4H), 1.56-1.47 (m, 4H), 1.37 (d, *J* = 6.2 Hz, 3H), 0.84 (t, *J* = 7.4 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.3, 158.7, 142.6, 138.2, 127.7, 127.1, 74.0, 49.9, 39.8, 33.0, 25.3, 21.9, 19.8, 11.1. ^{19}F NMR (376 MHz, $CDCl_3$) δ -138.7 (m, 2F), -148.9 (m, 1F), -160.3 (m, 2F). IR (KBr, cm^{-1}) ν 2970, 1734, 1651, 1500, 1326, 1237, 997, 737. HRMS (ESI) calcd for $C_{25}H_{29}F_5N_2O_5SNa$ $[M+Na]^+$: 587.1615, found: 587.1619.

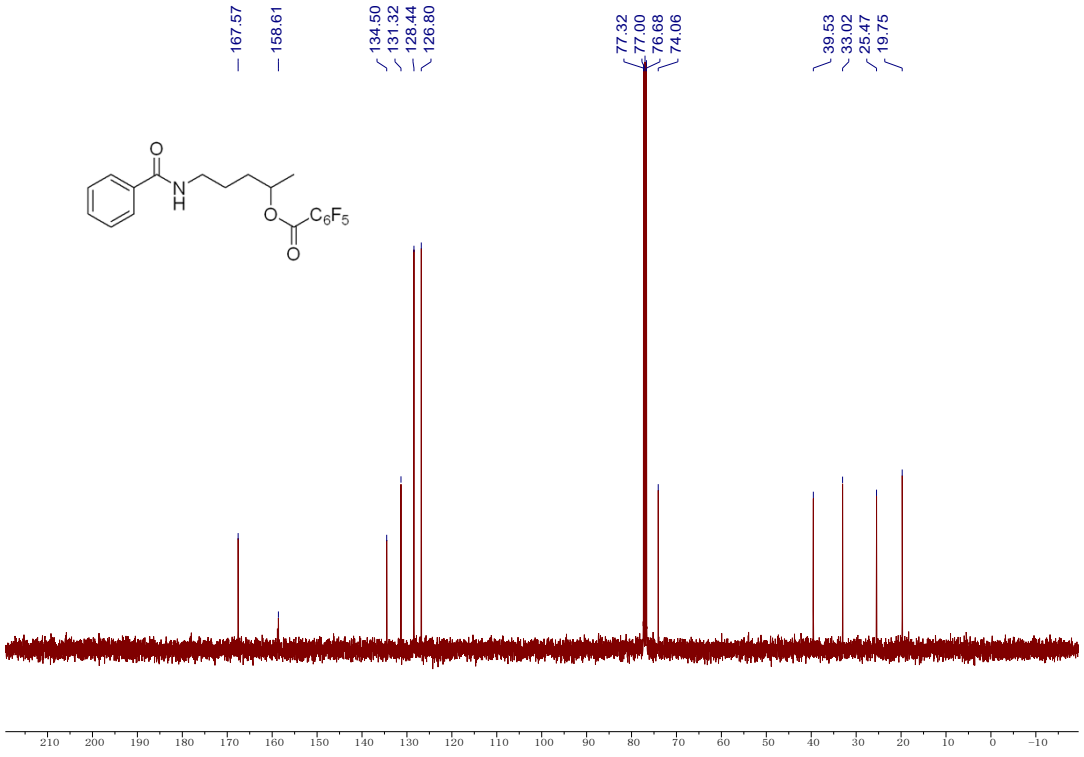
5. ^{1}H and ^{13}C NMR spectra

2a

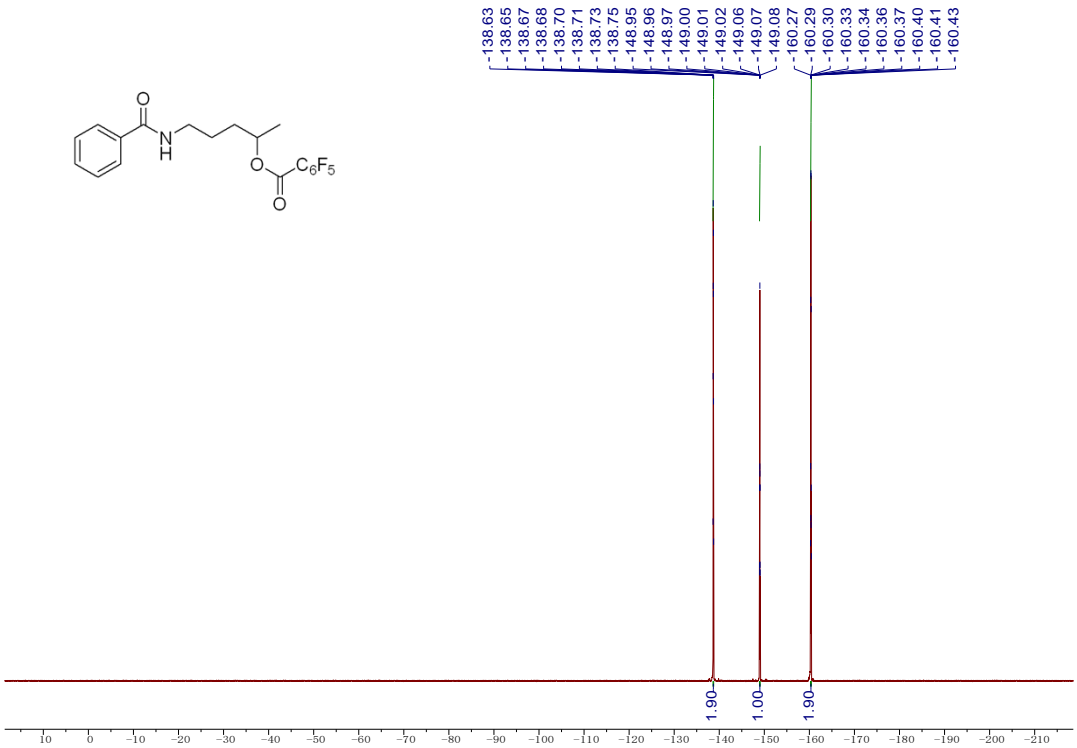
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

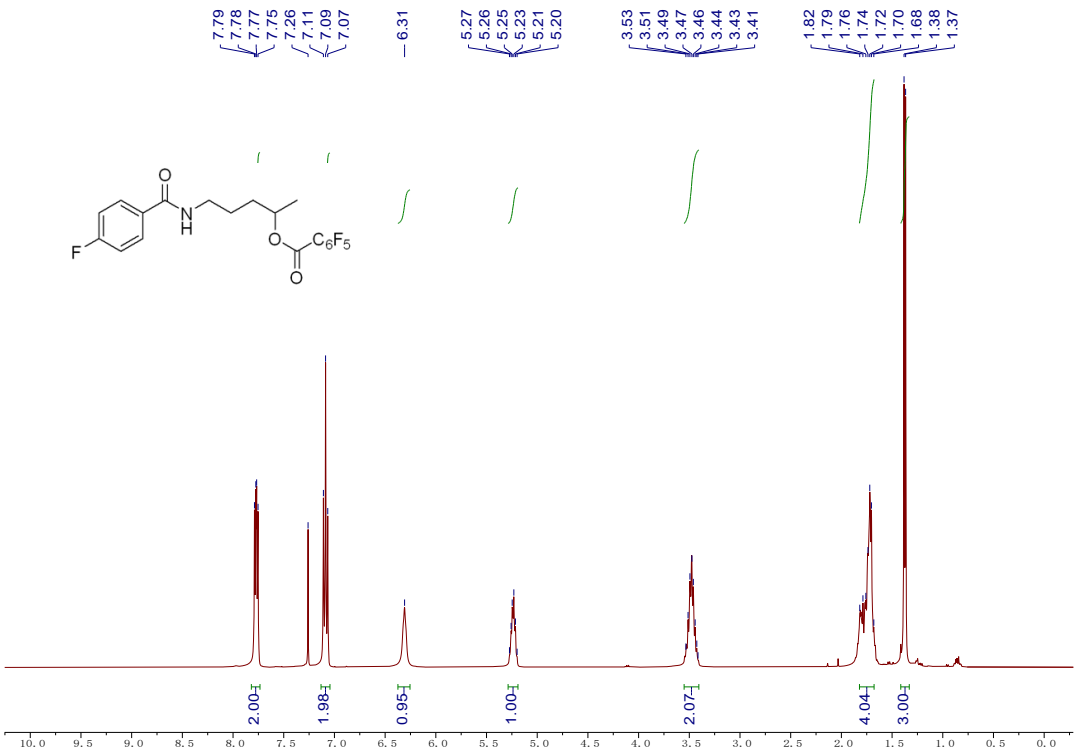


^{19}F NMR ($CDCl_3$, 376 MHz)

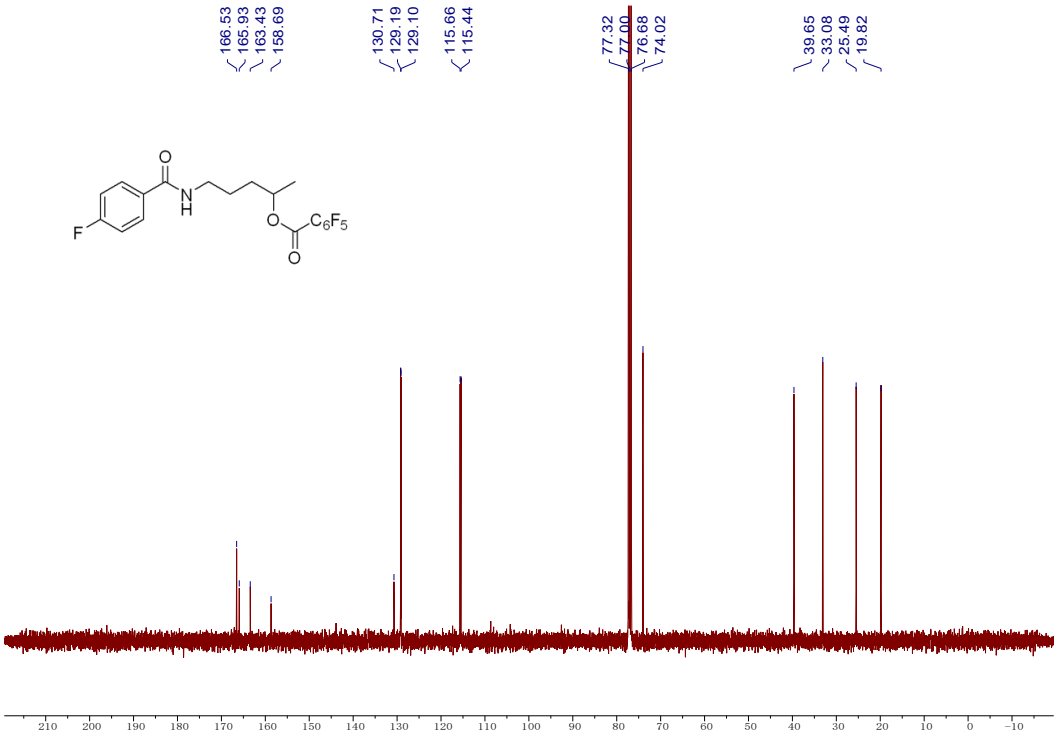


2b

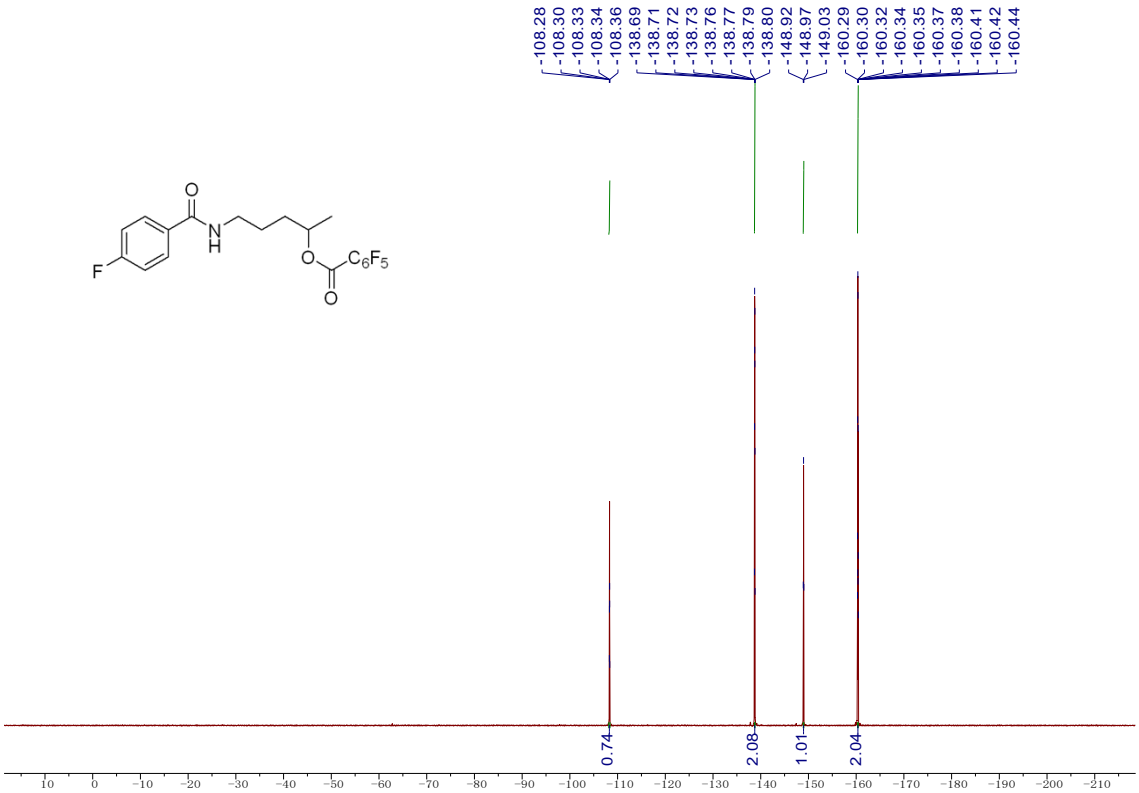
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

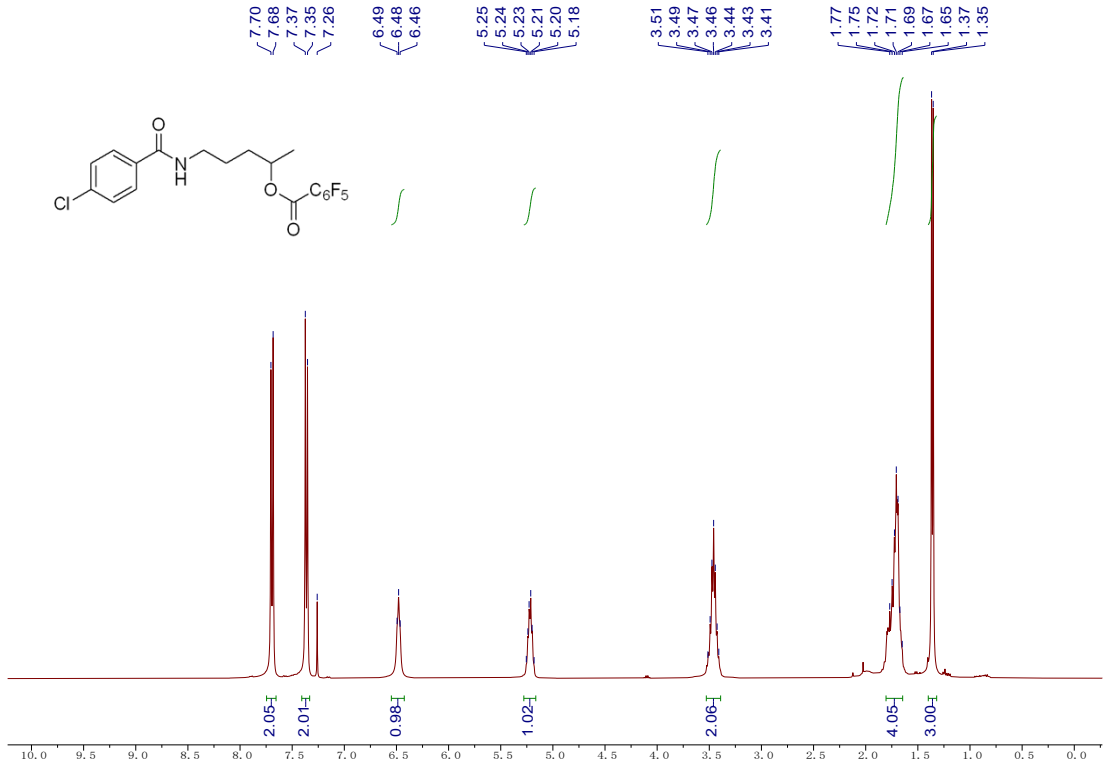


^{19}F NMR ($CDCl_3$, 376 MHz)

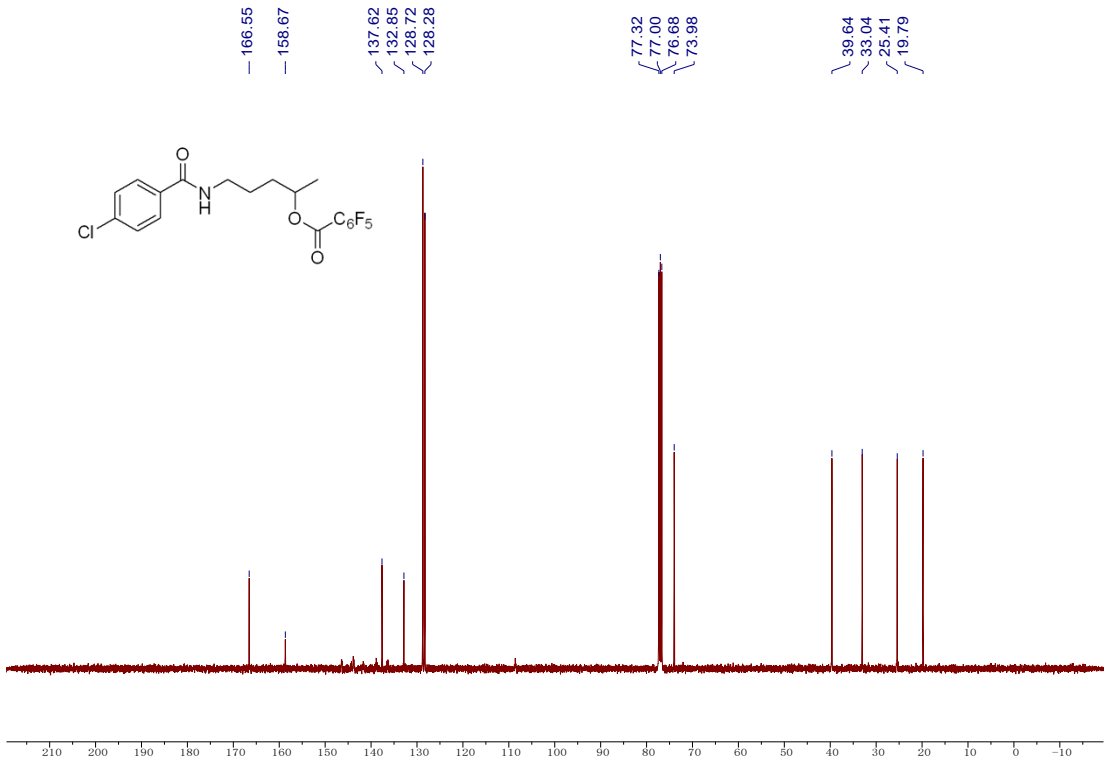


2c

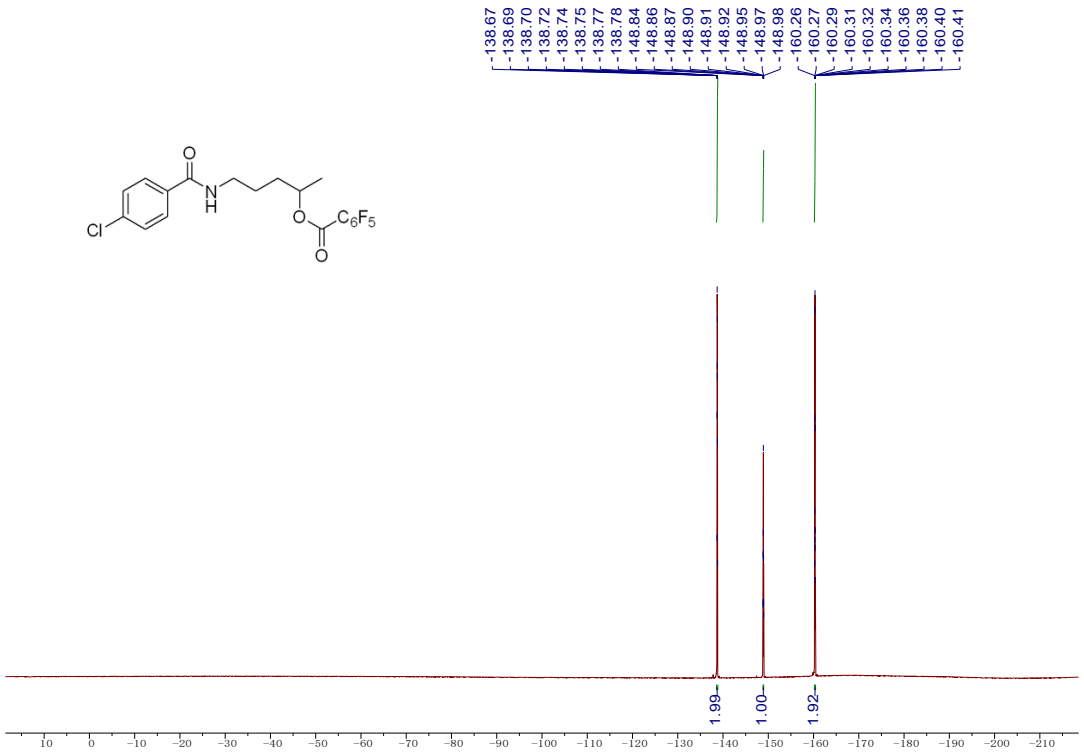
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

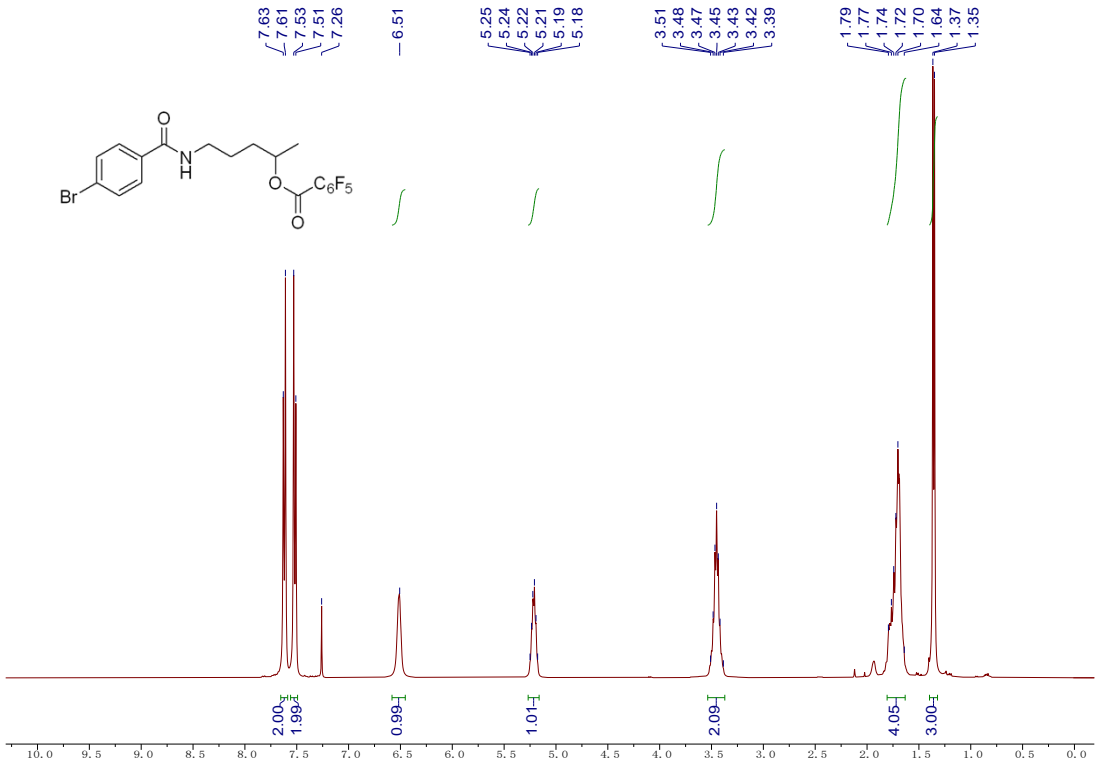


^{19}F NMR ($CDCl_3$, 376 MHz)

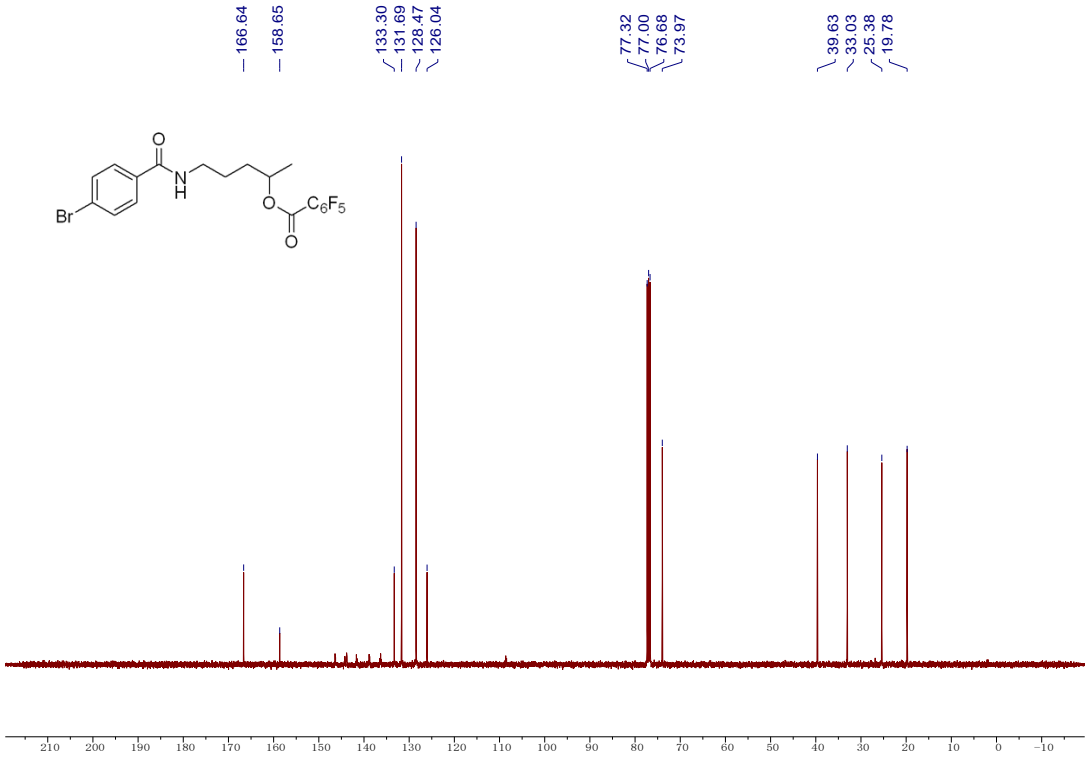


2d

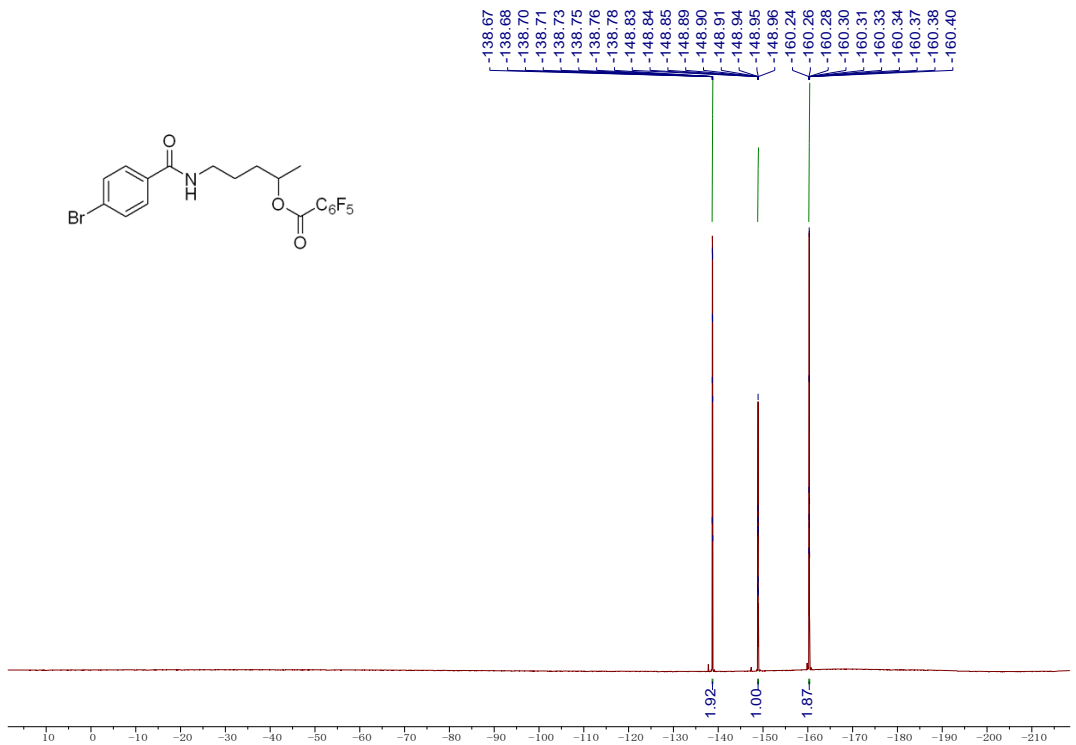
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

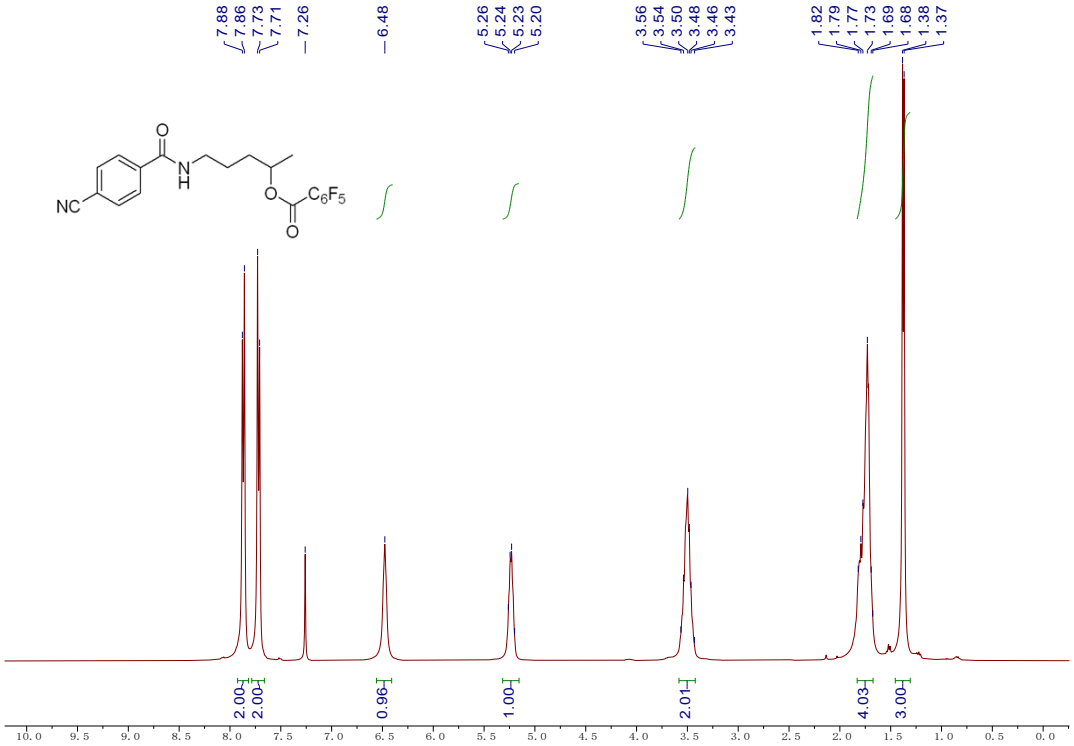


^{19}F NMR ($CDCl_3$, 376 MHz)

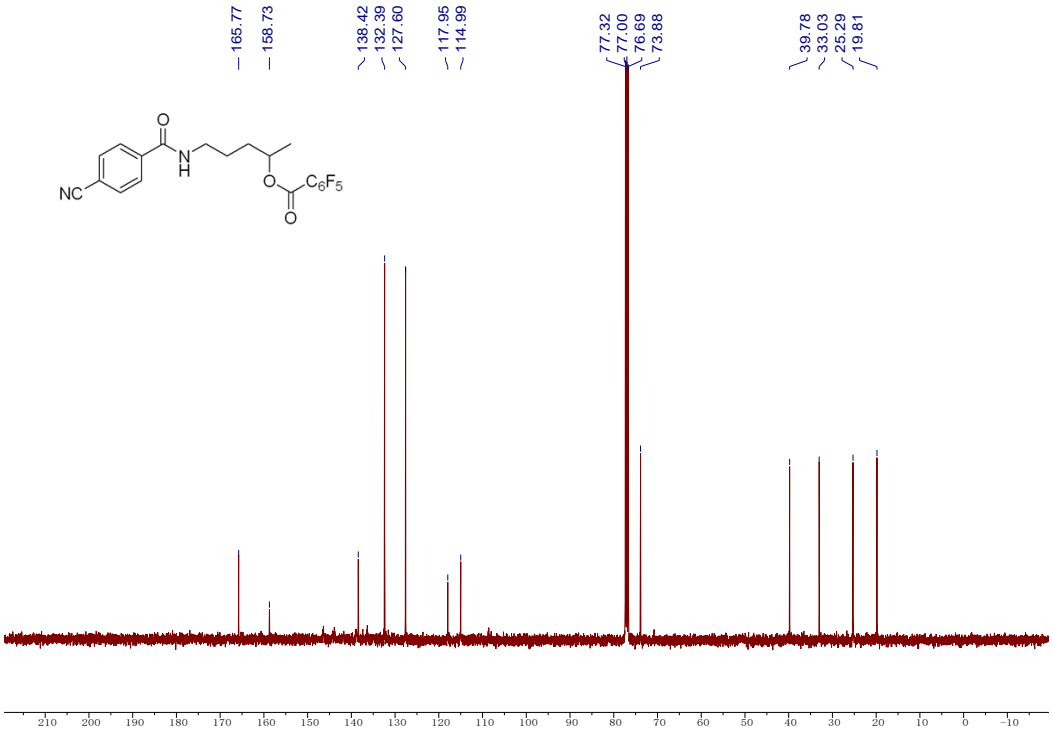


2e

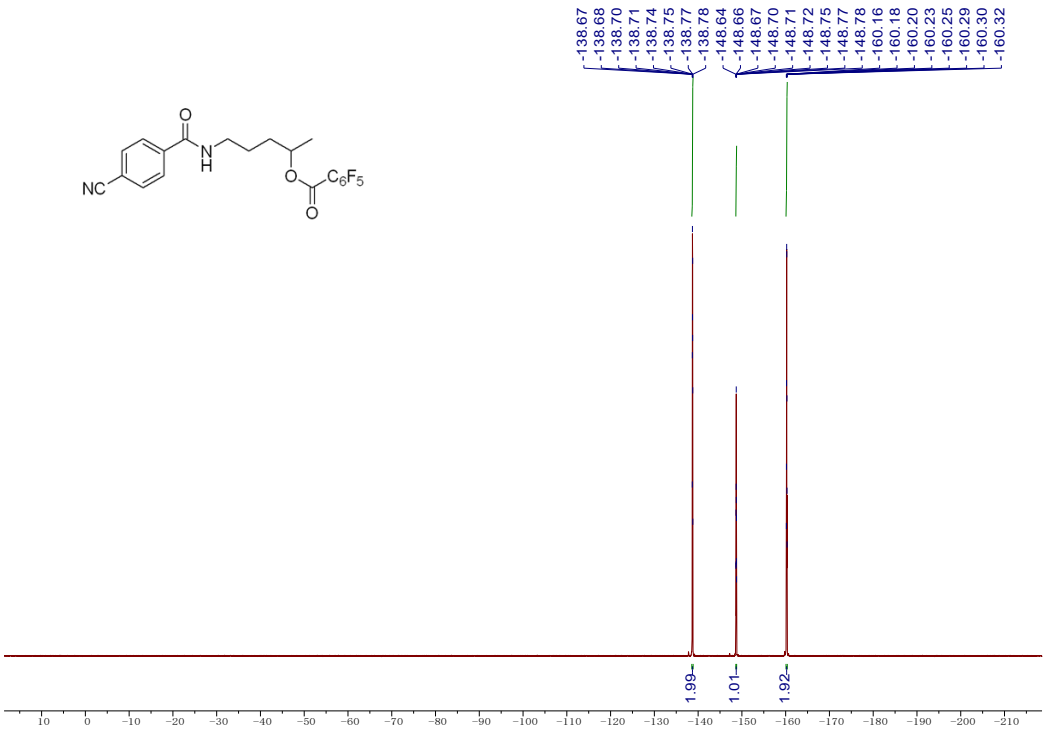
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

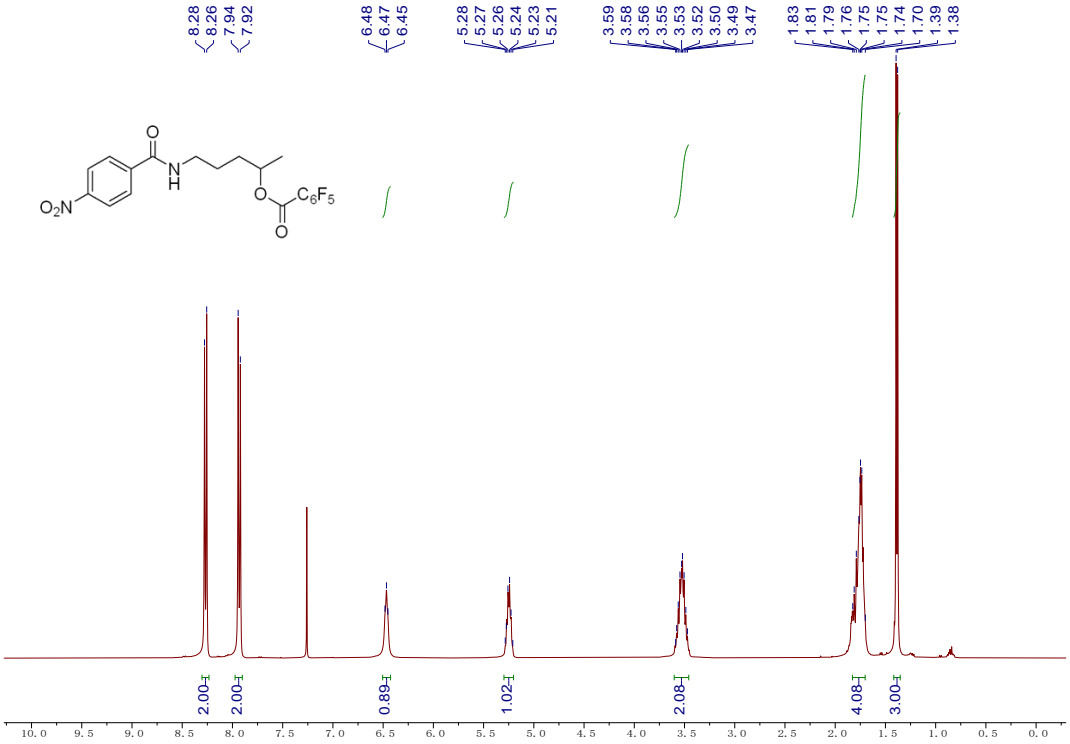


^{19}F NMR ($CDCl_3$, 376 MHz)

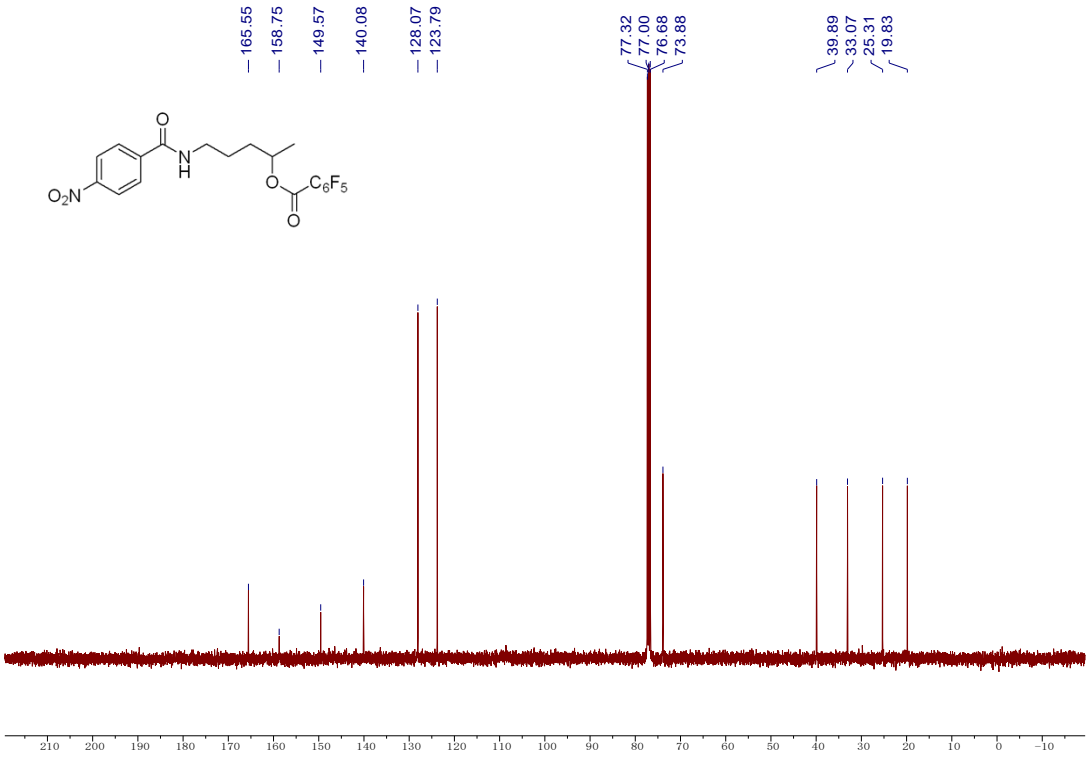


2f

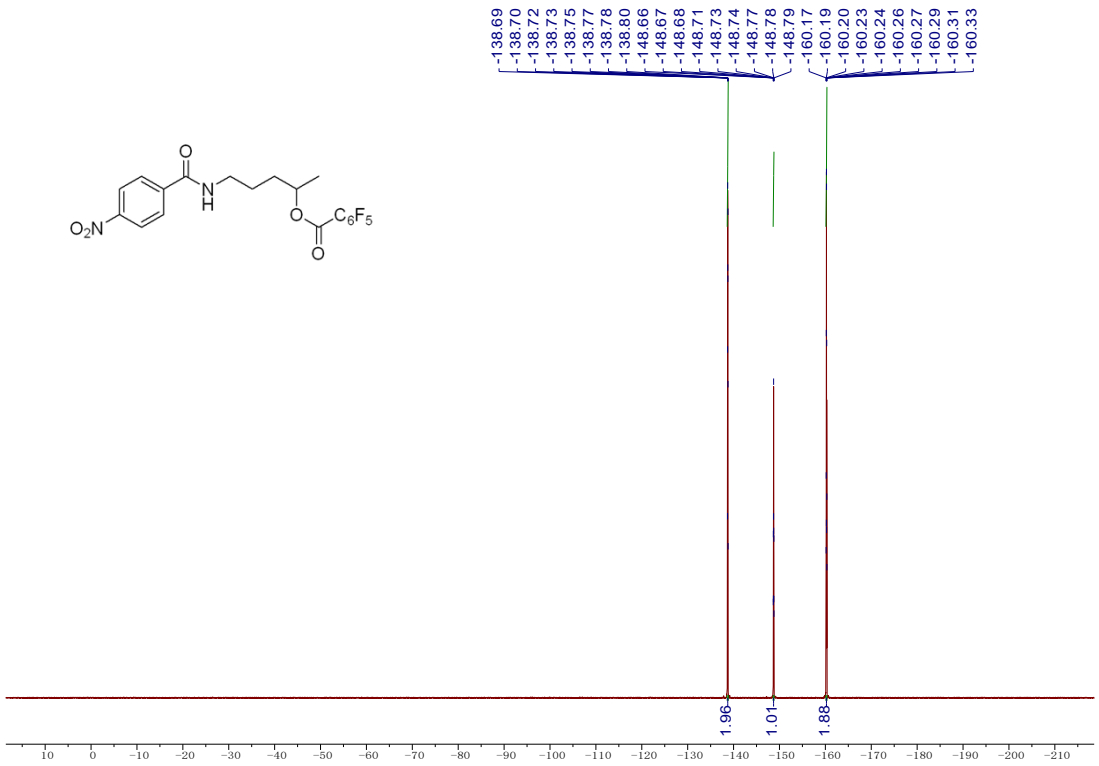
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

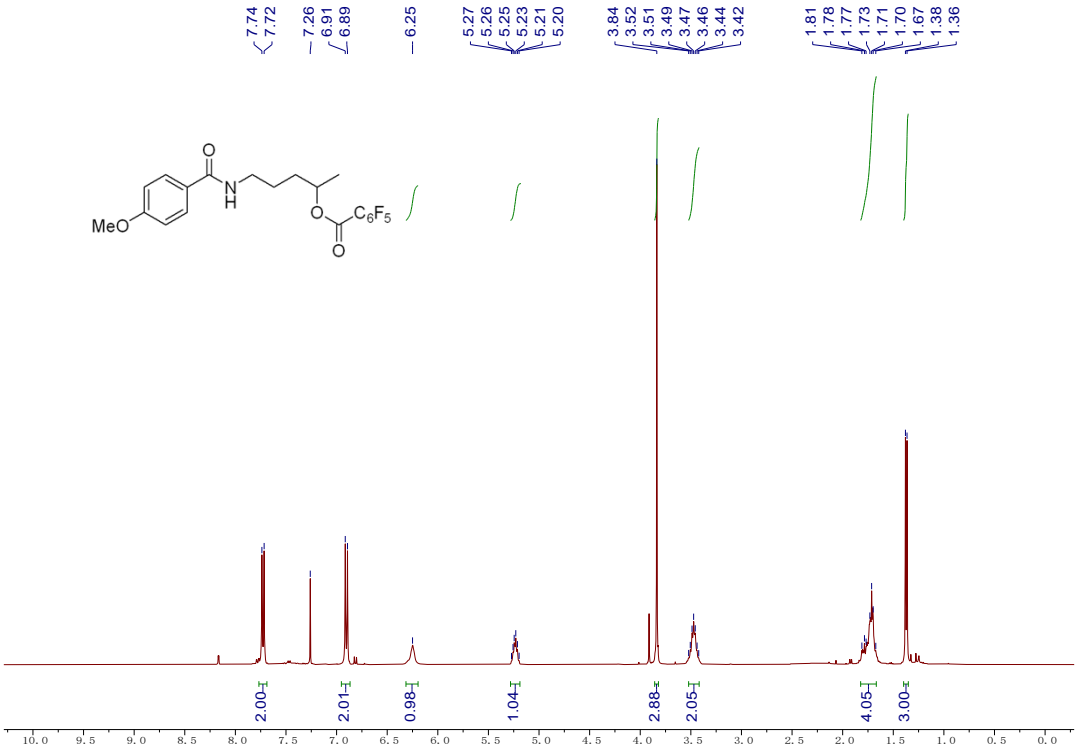


^{19}F NMR ($CDCl_3$, 376 MHz)

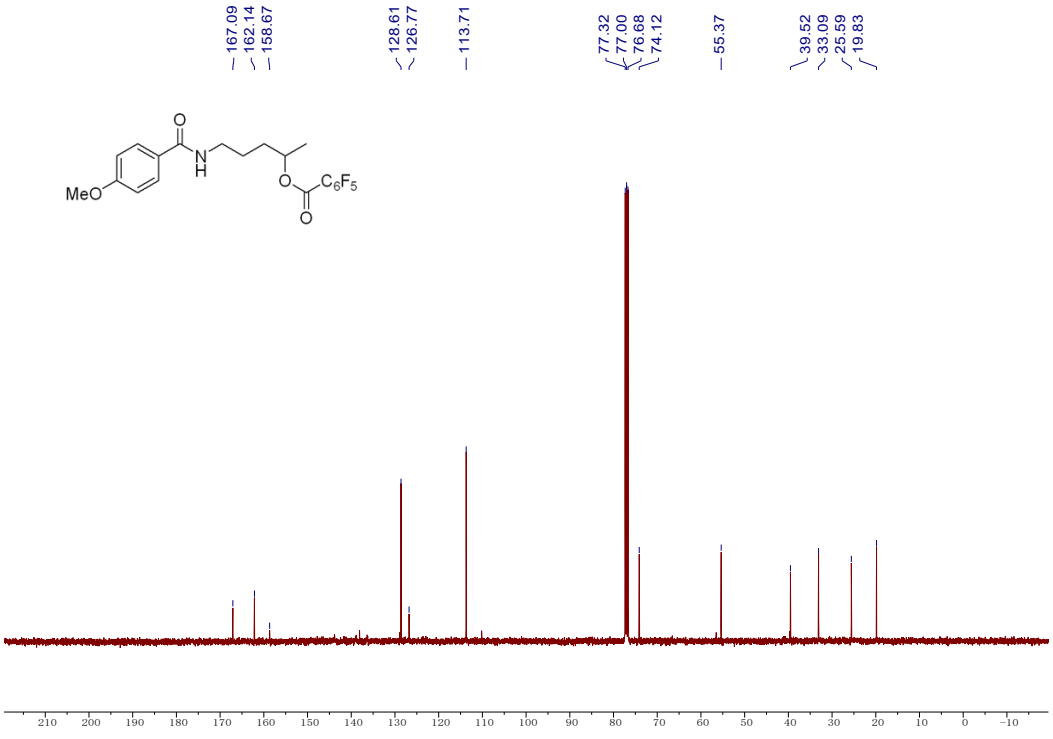


2g

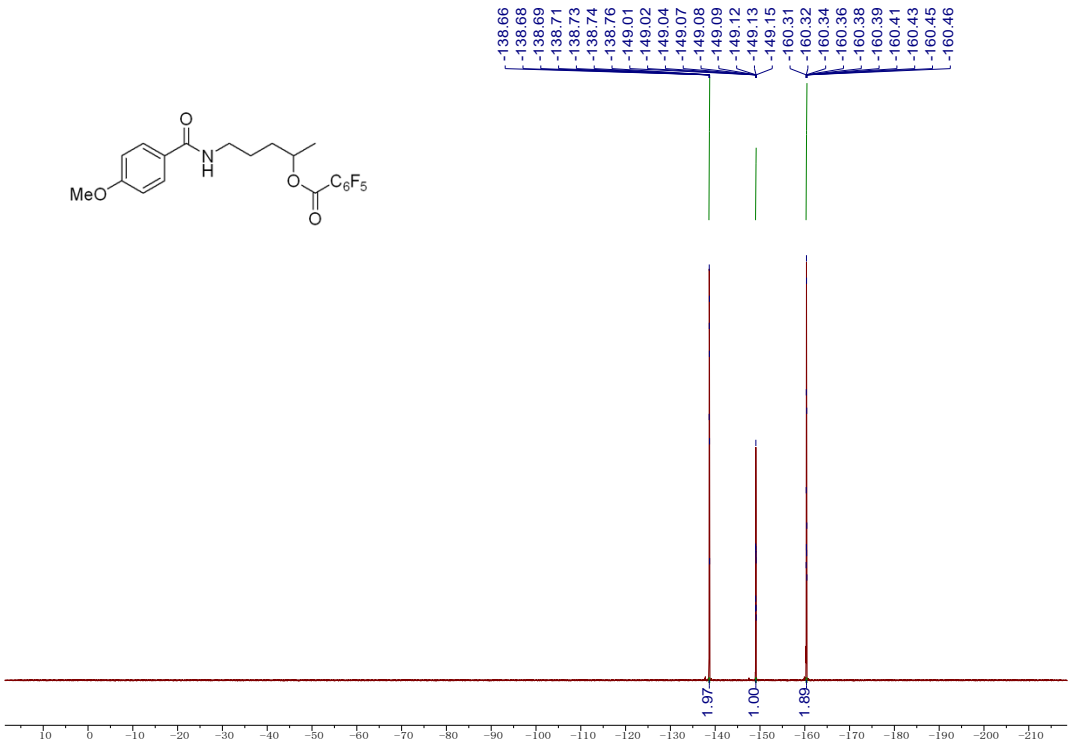
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

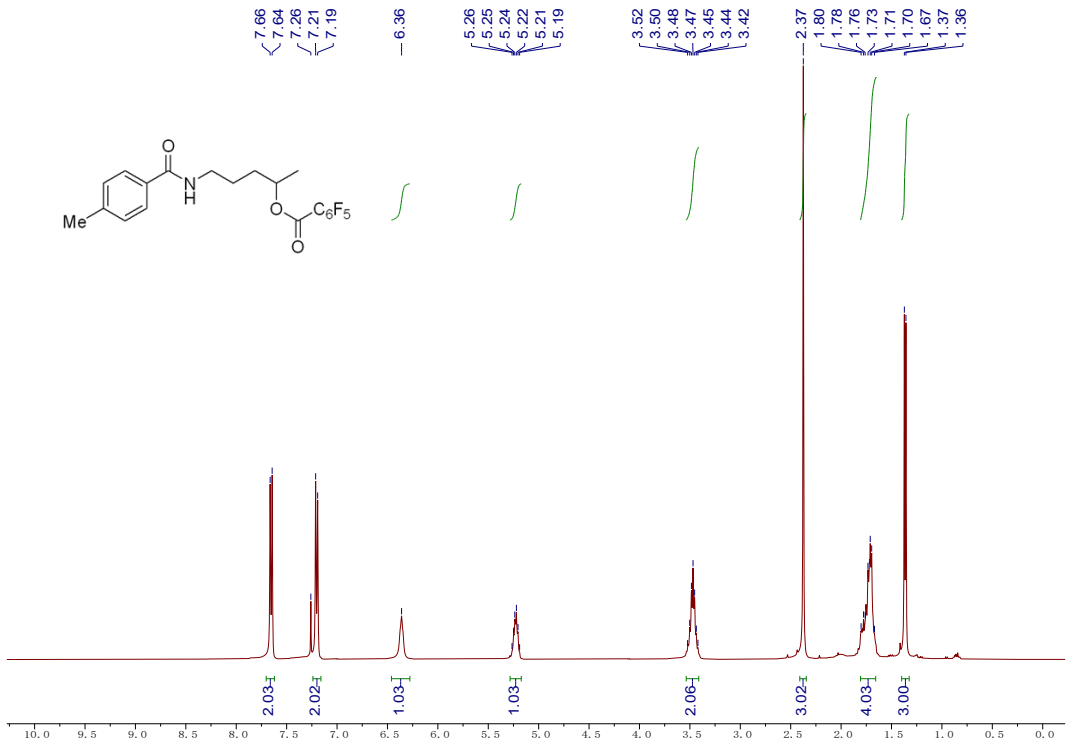


^{19}F NMR ($CDCl_3$, 376 MHz)

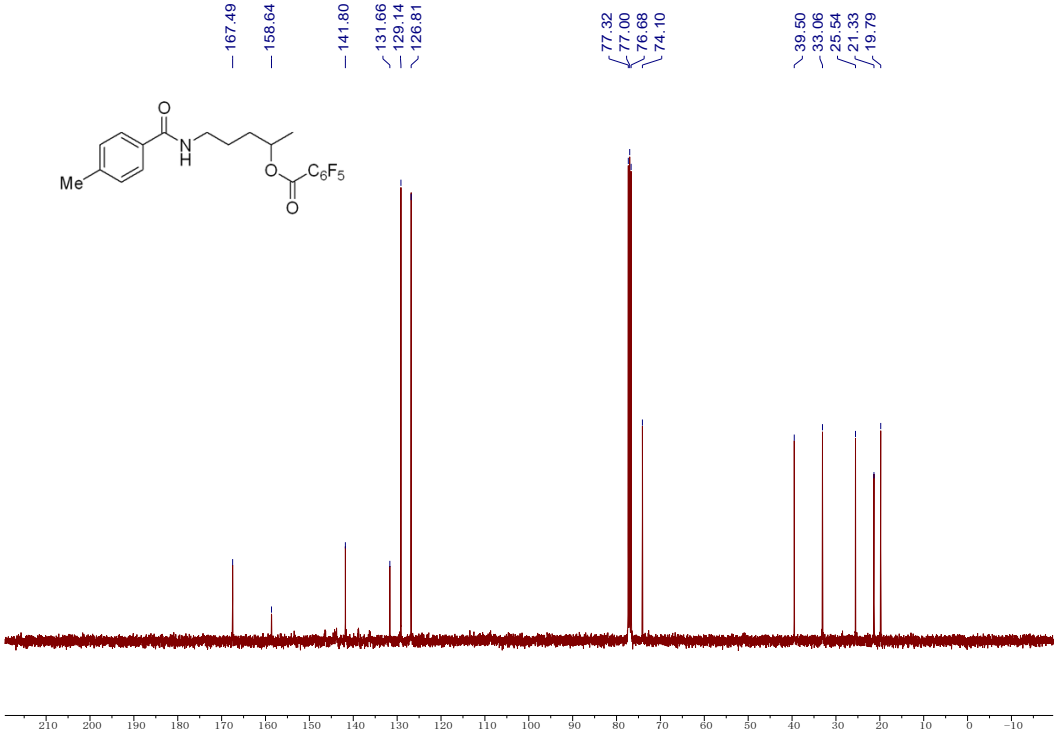


2h

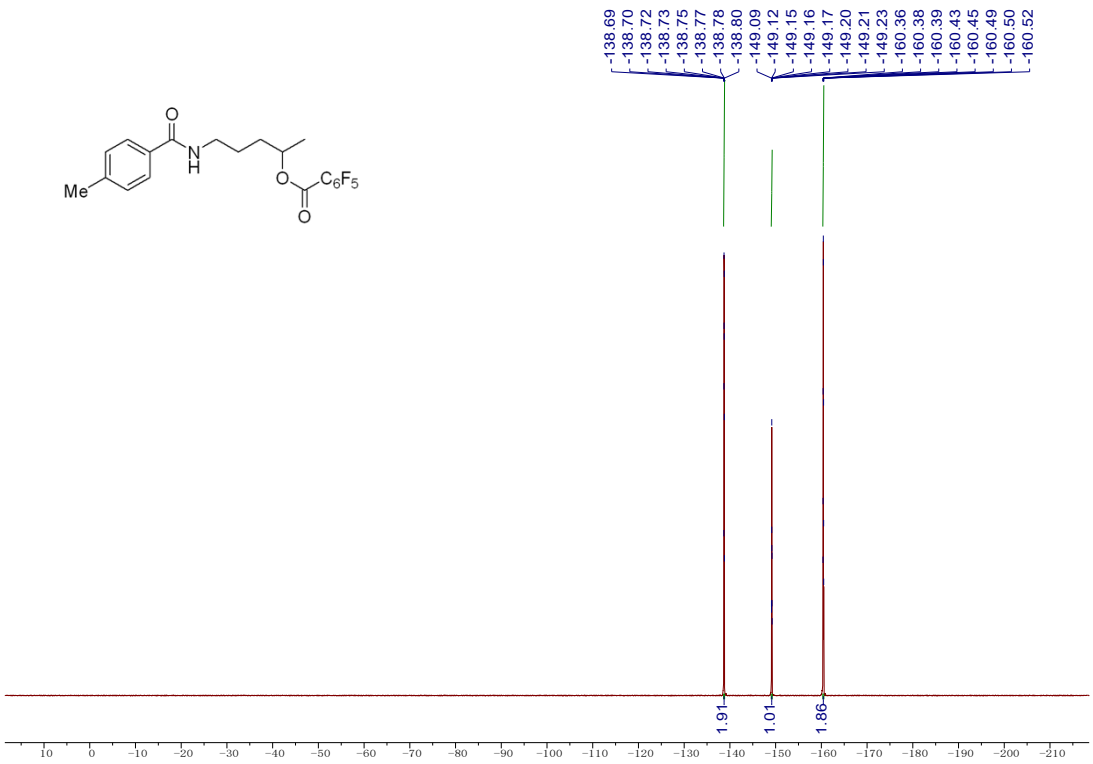
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

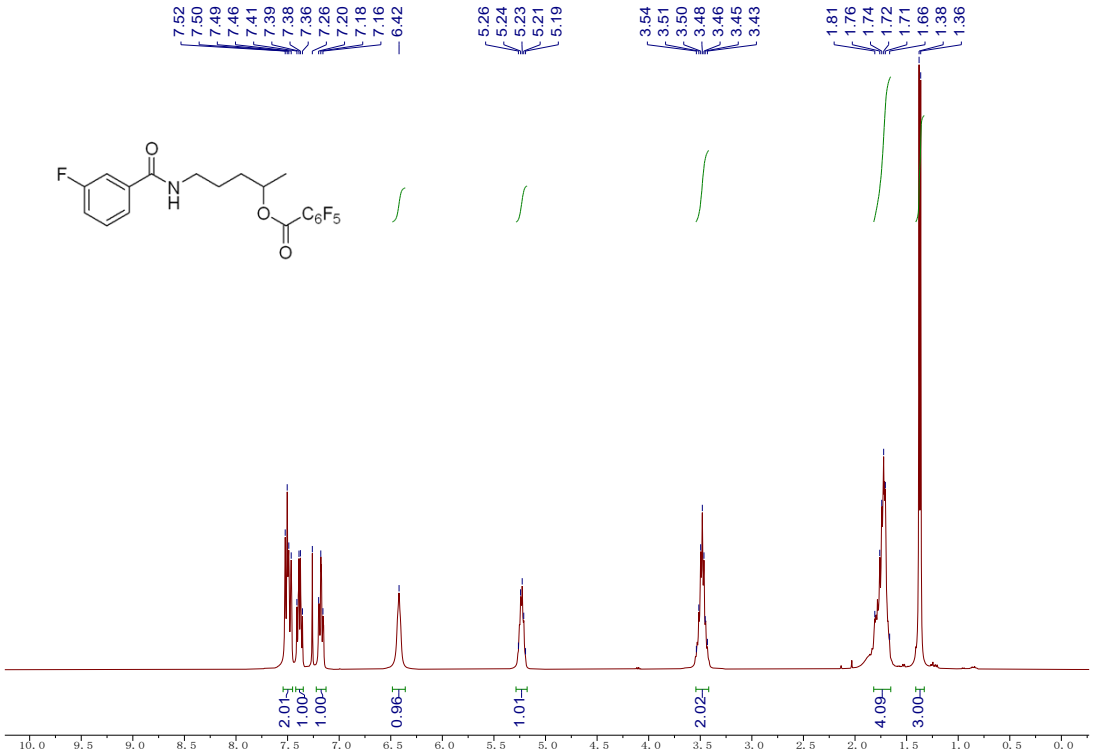


^{19}F NMR ($CDCl_3$, 376 MHz)

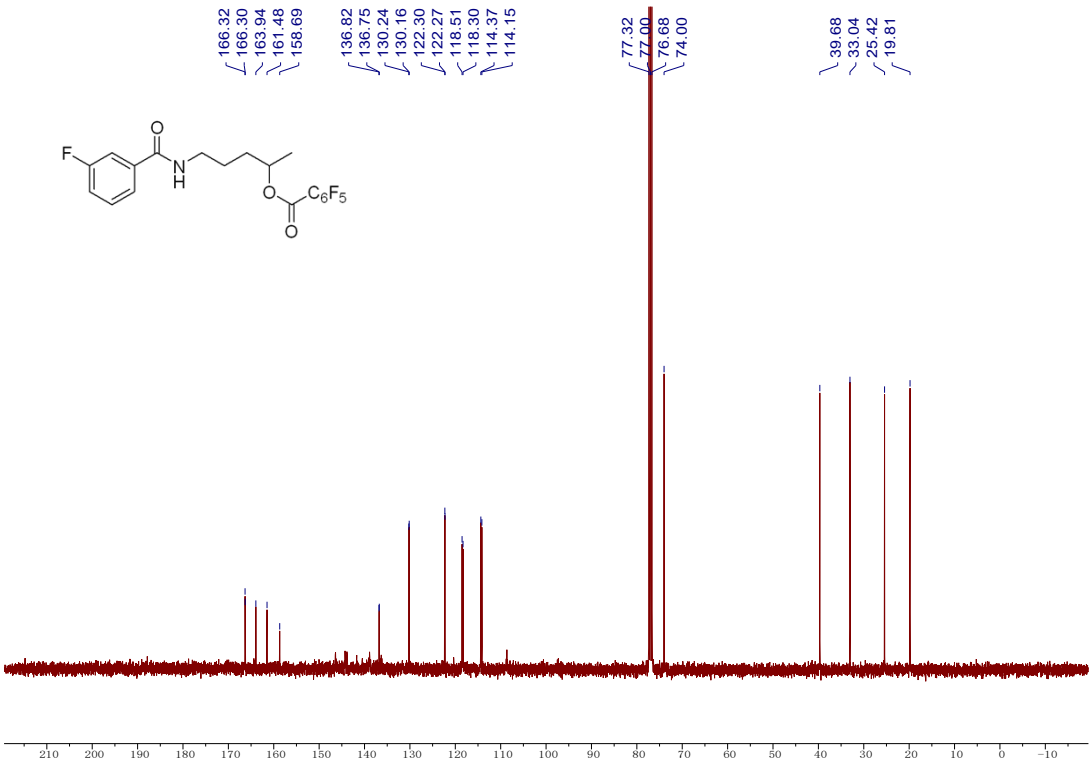


2i

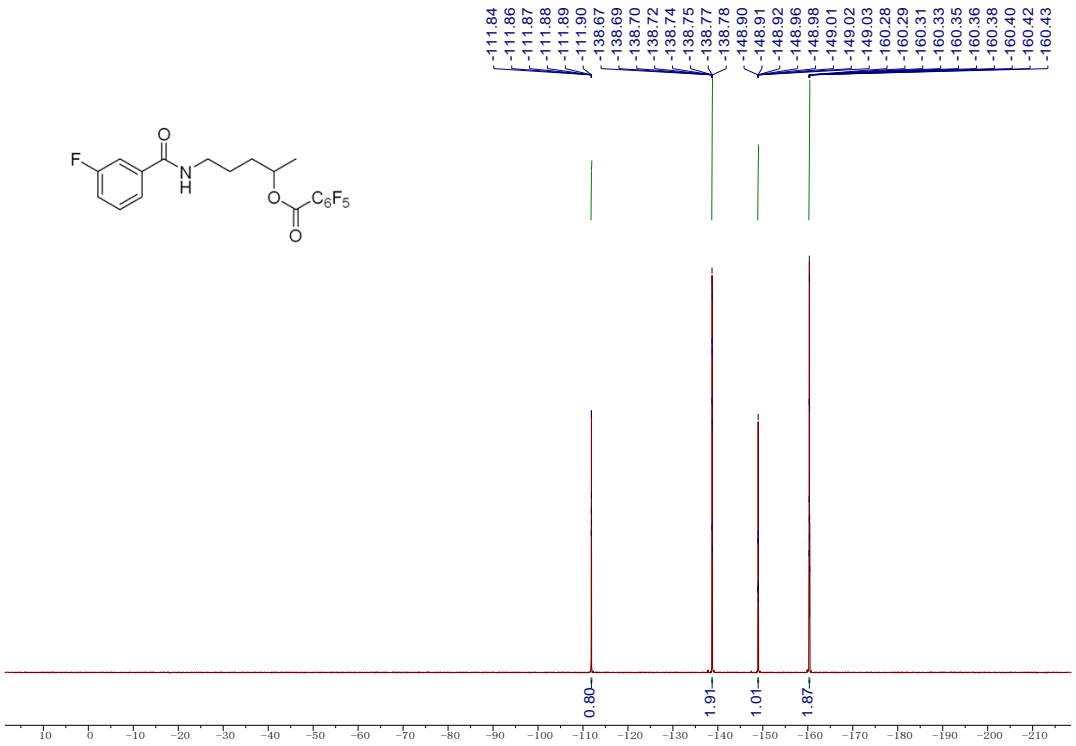
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

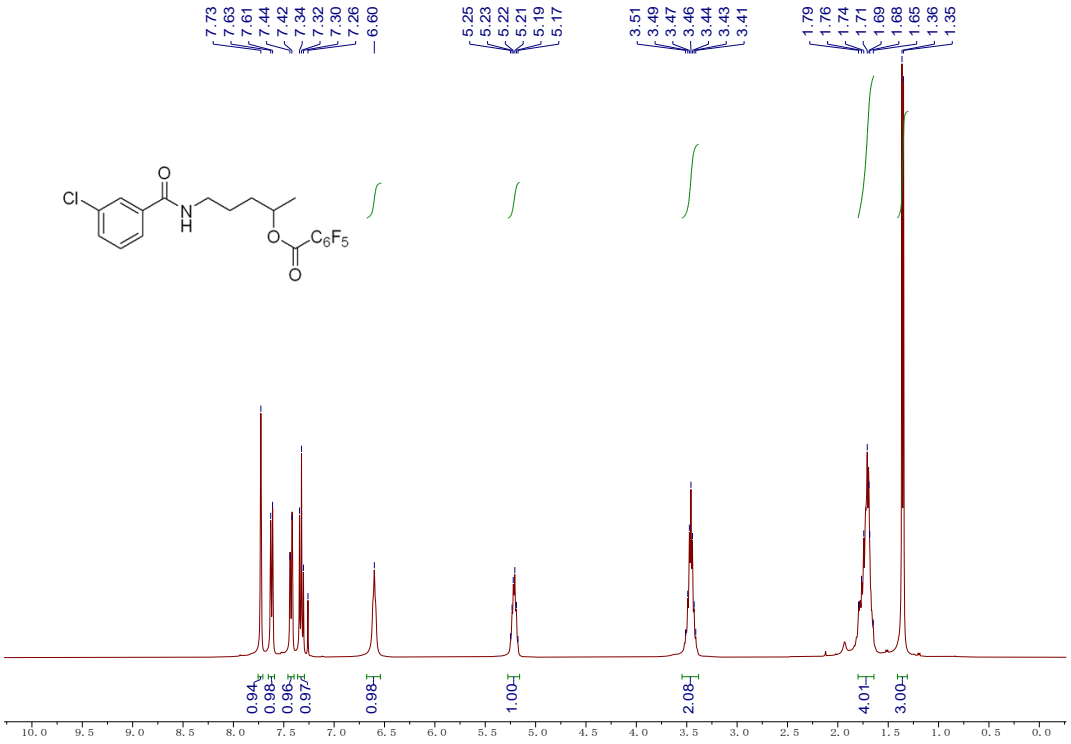


^{19}F NMR ($CDCl_3$, 376 MHz)

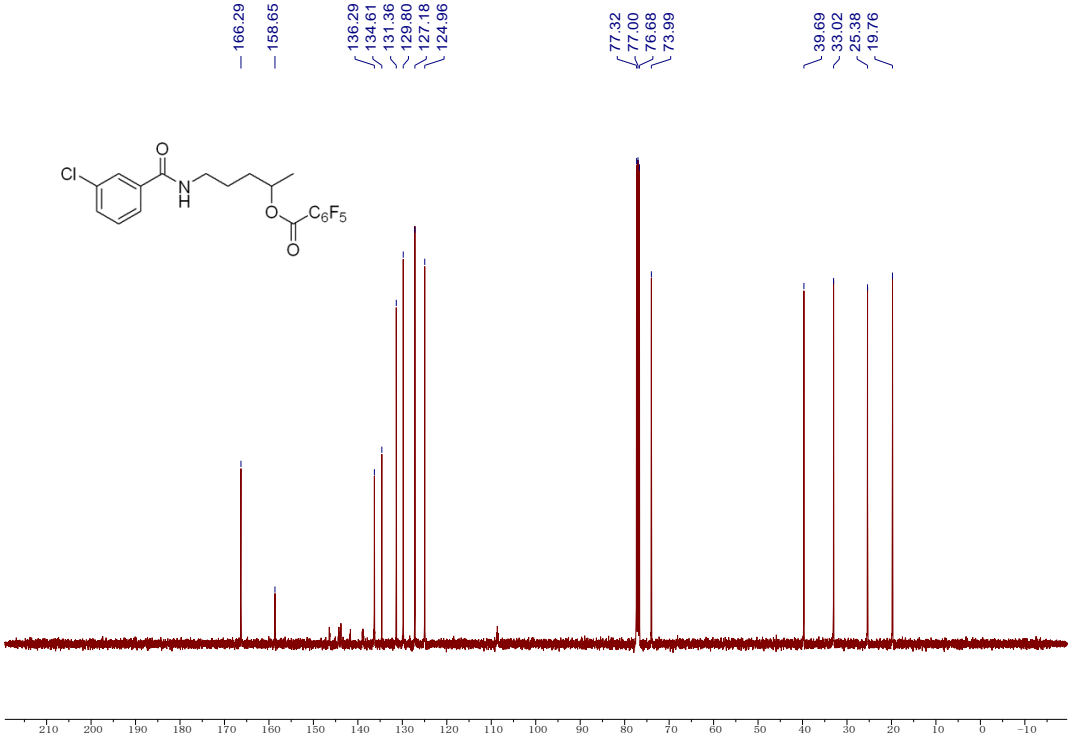


2j

^{1}H NMR ($CDCl_3$, 400 MHz)



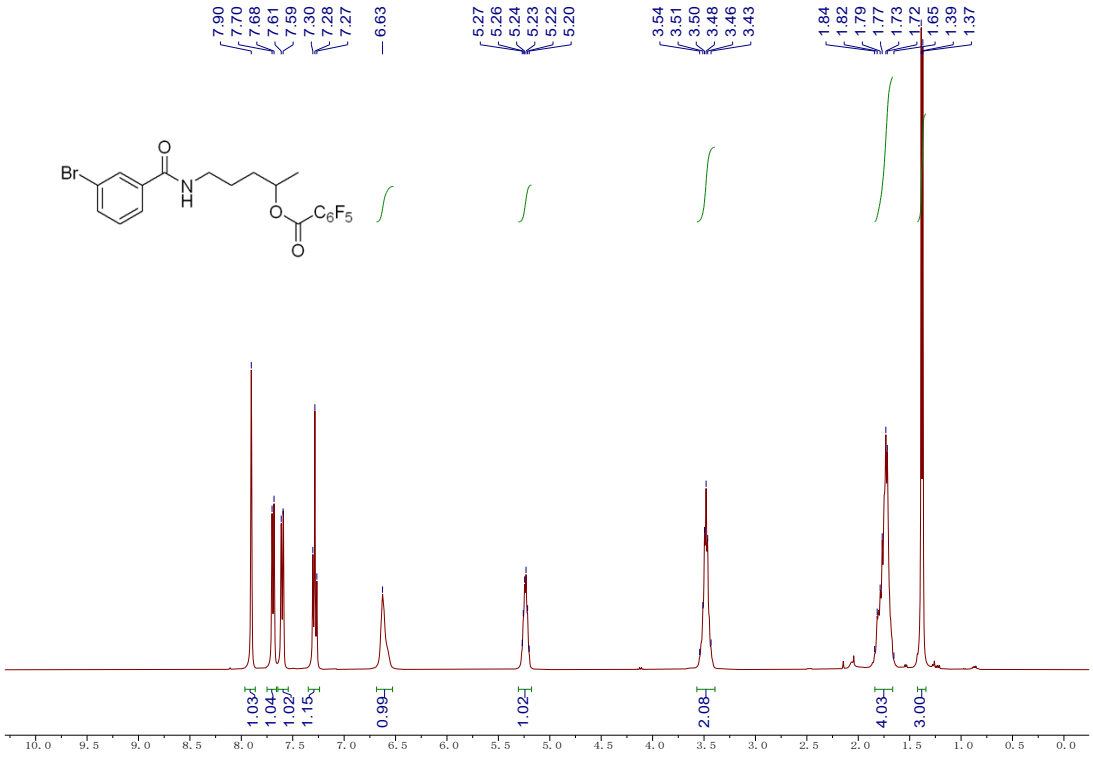
^{13}C NMR ($CDCl_3$, 100 MHz)



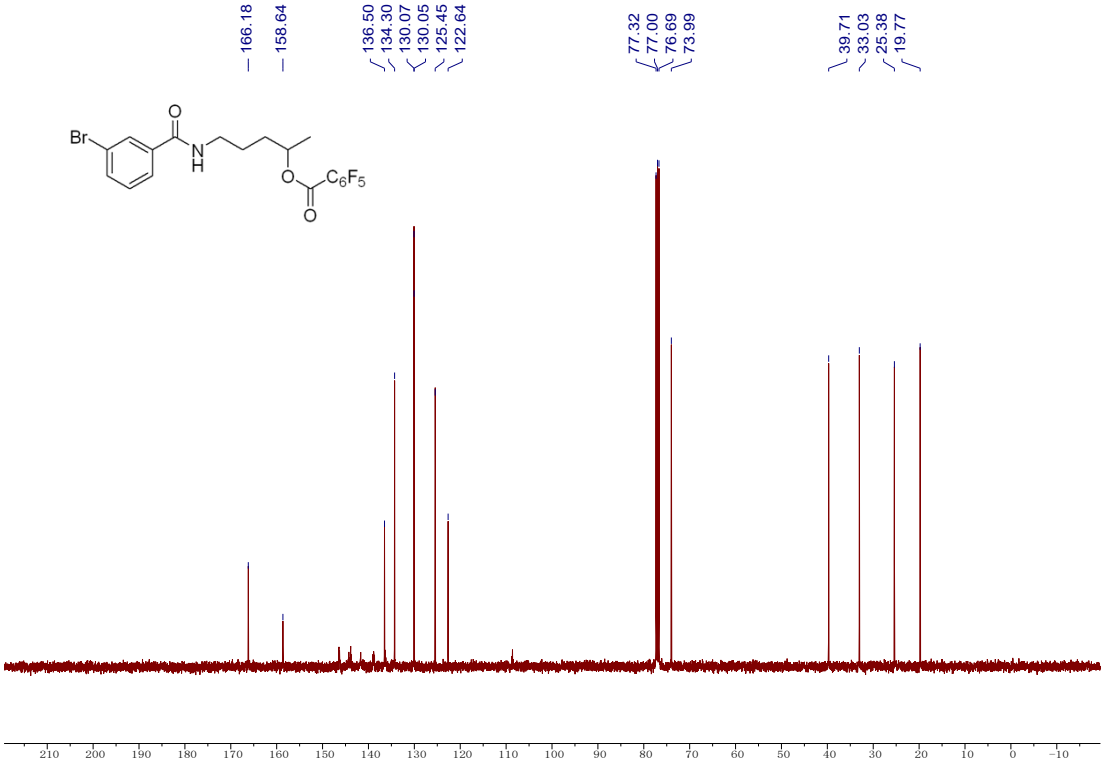
^{19}F NMR ($CDCl_3$, 376 MHz)

2k

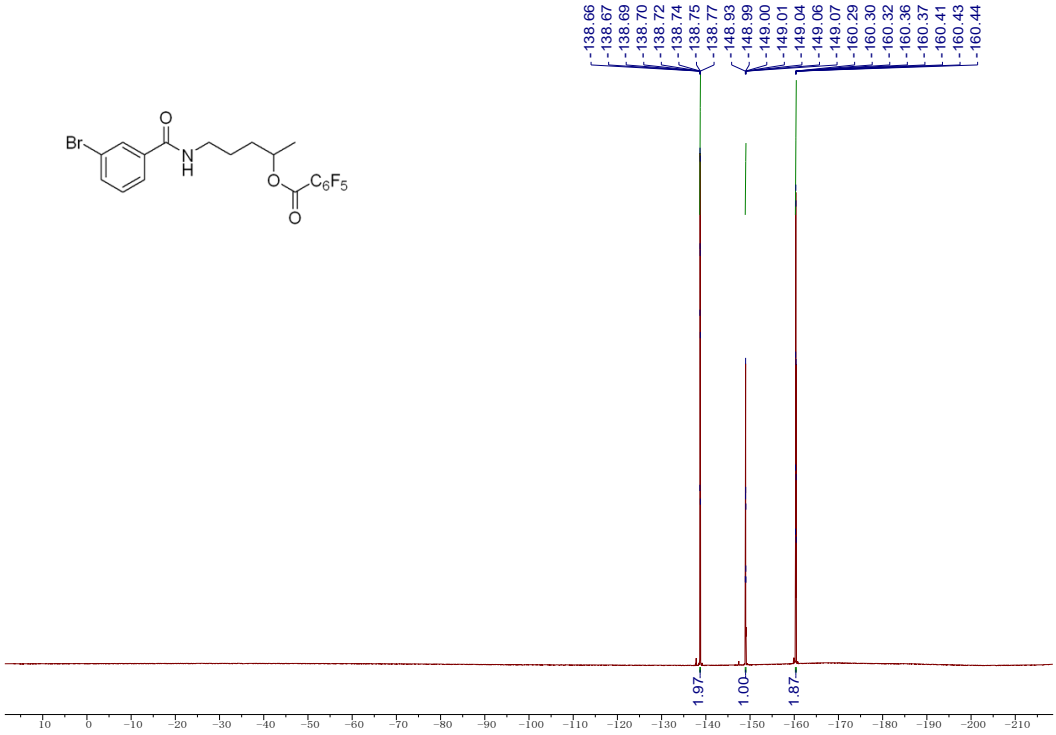
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

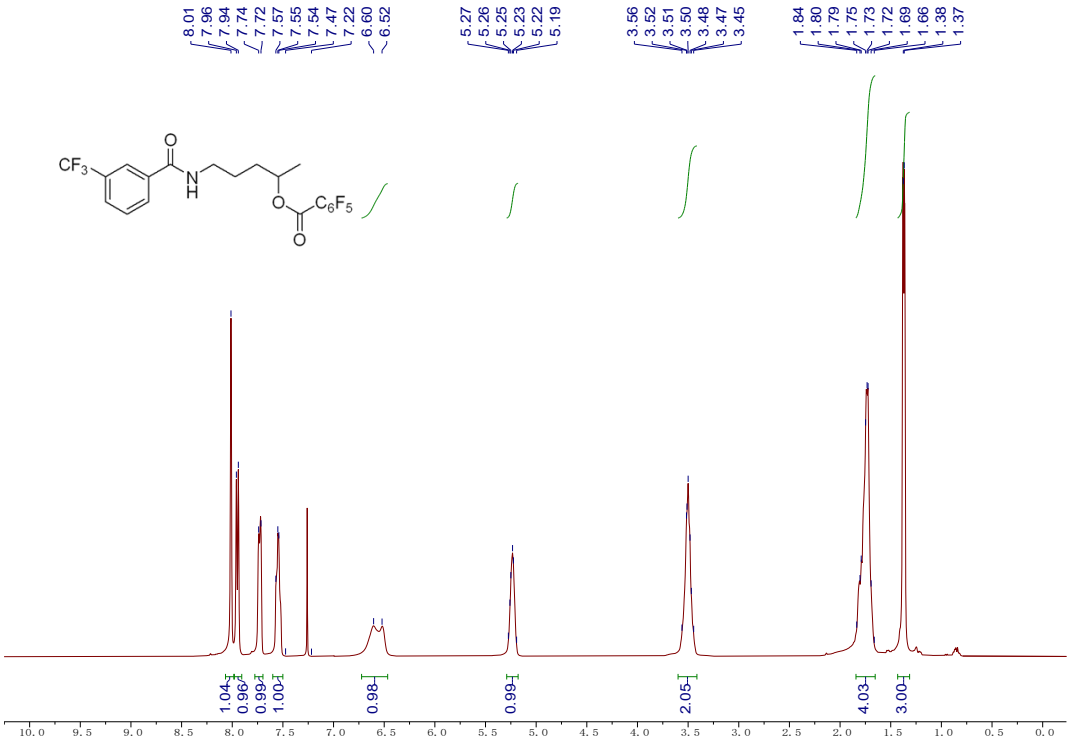


^{19}F NMR ($CDCl_3$, 376 MHz)

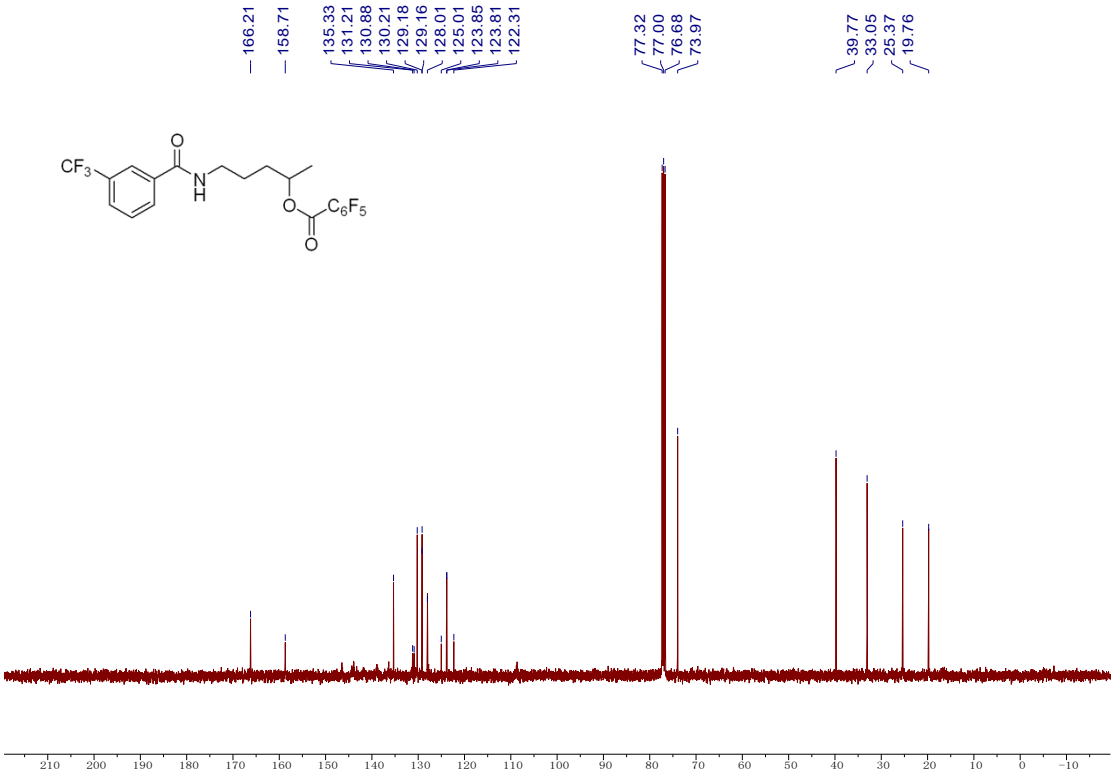


2l

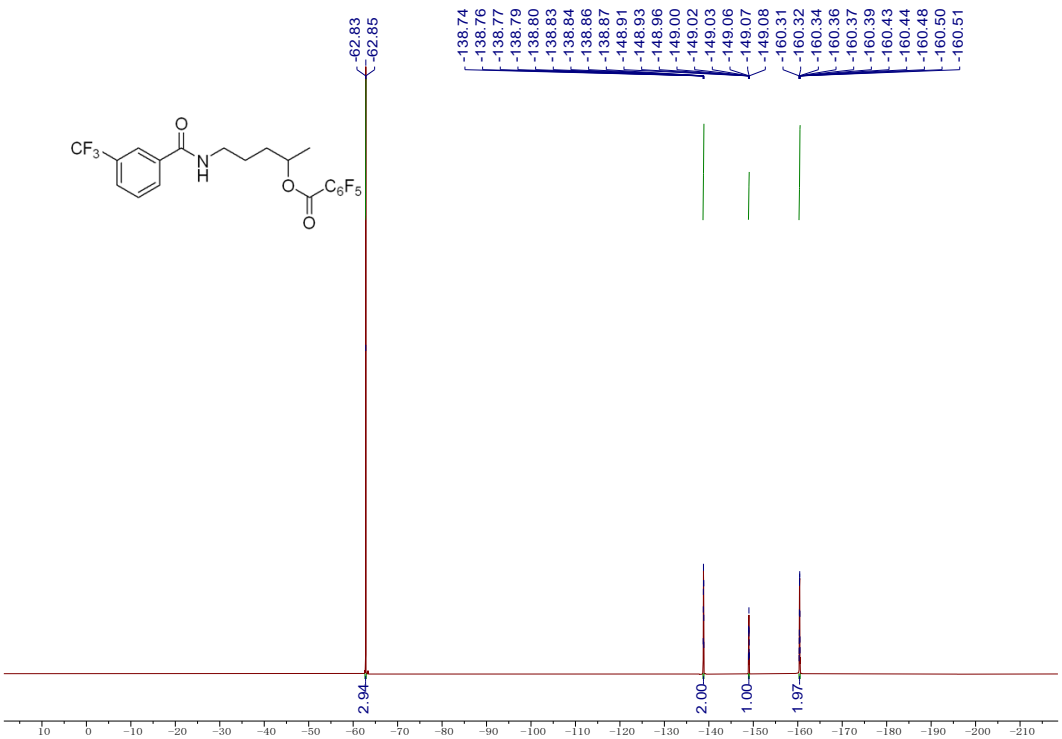
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

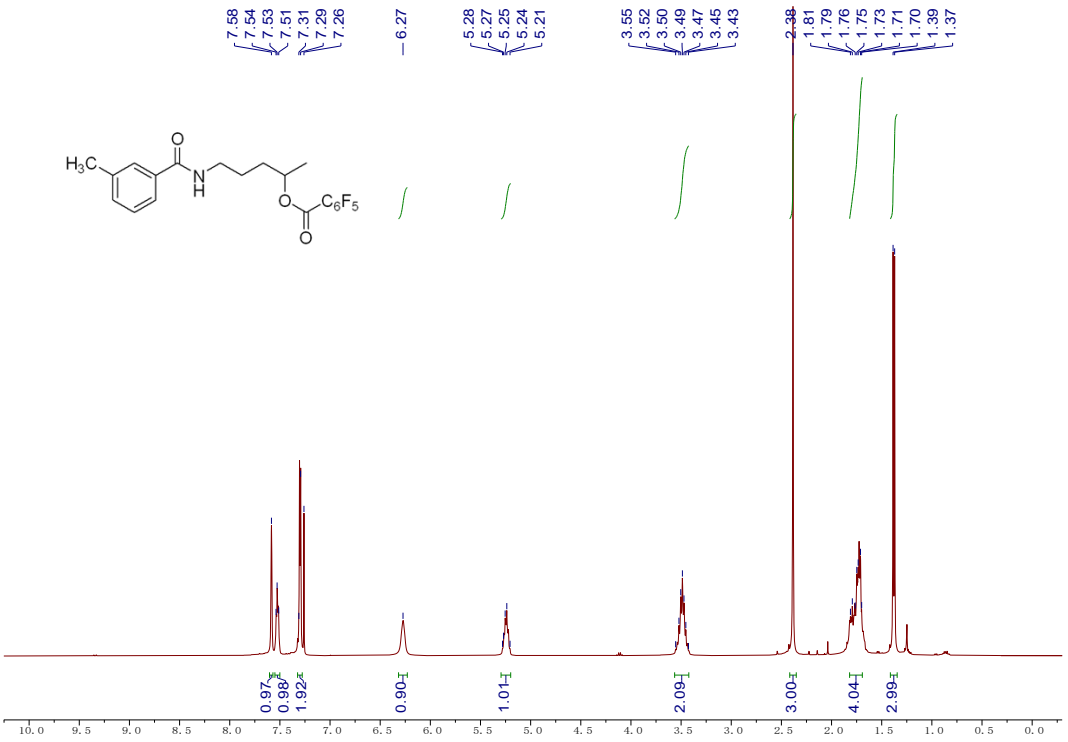


^{19}F NMR ($CDCl_3$, 376 MHz)

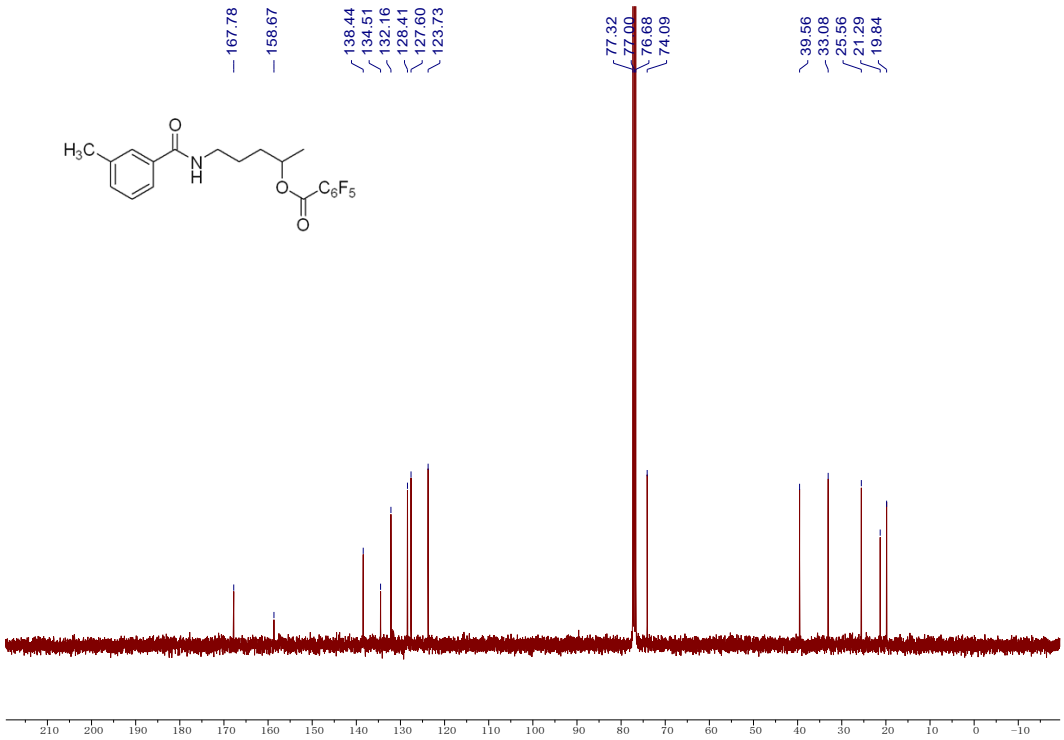


2m

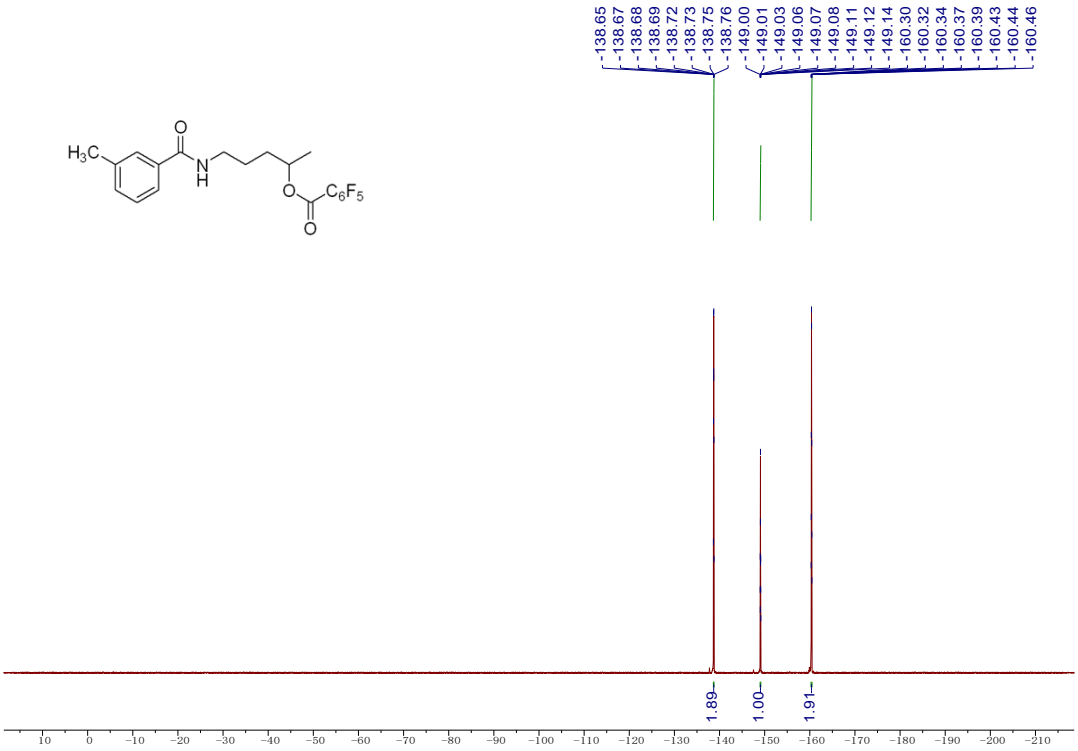
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

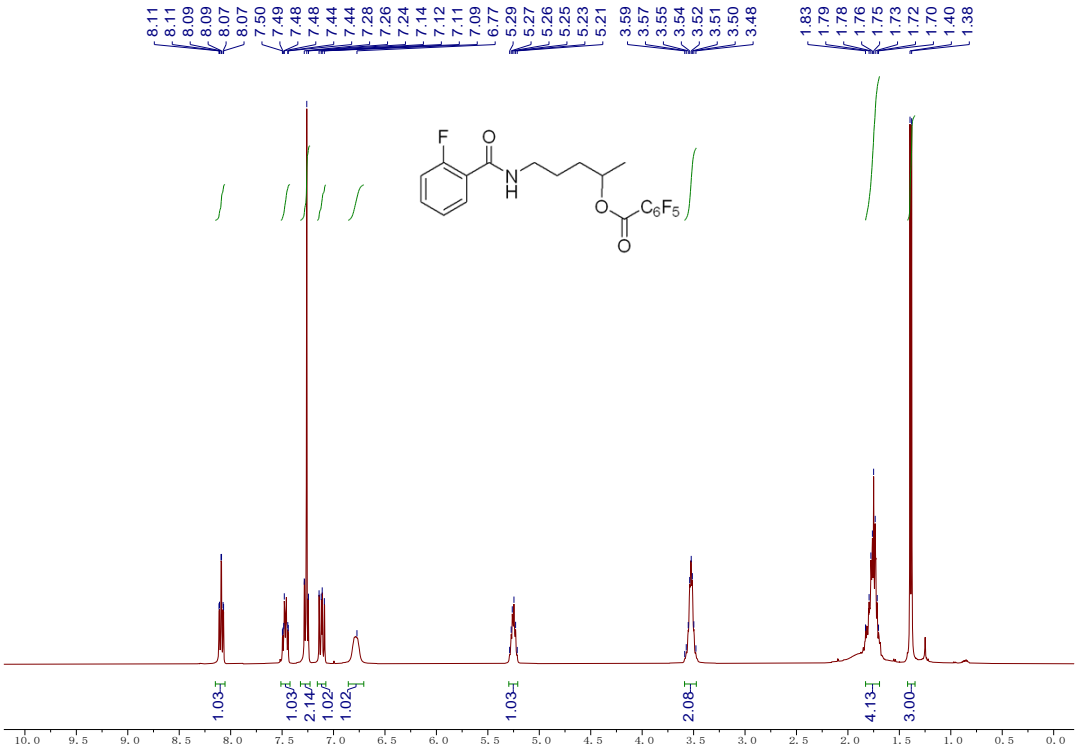


^{19}F NMR ($CDCl_3$, 376 MHz)

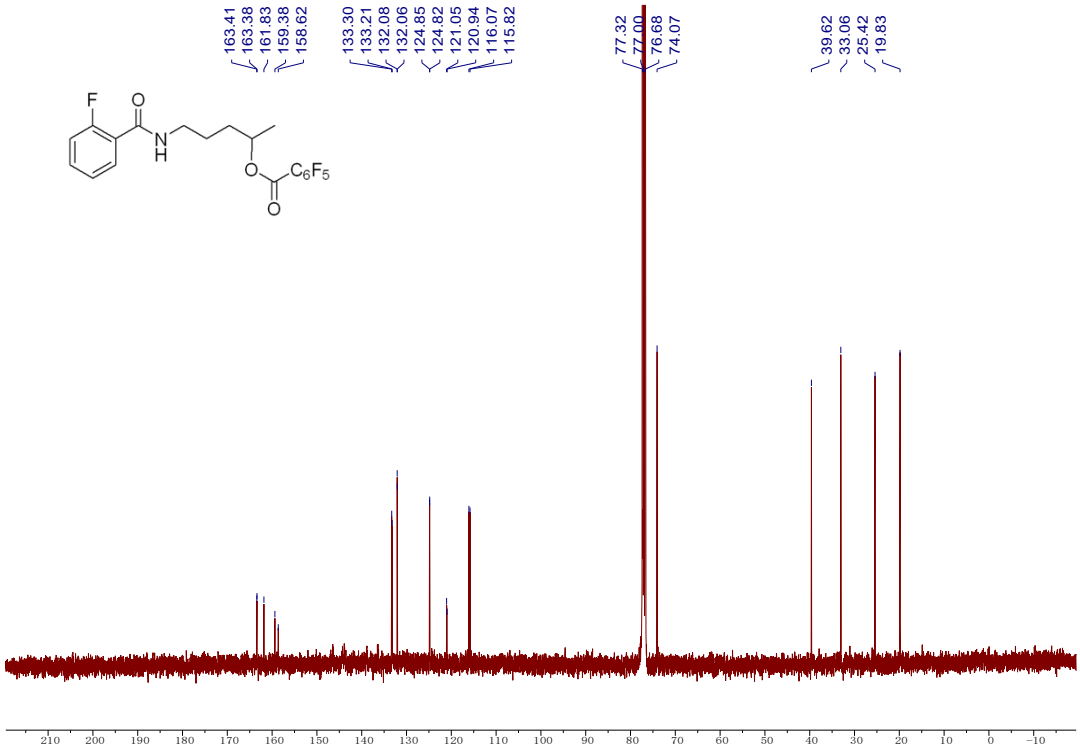


2n

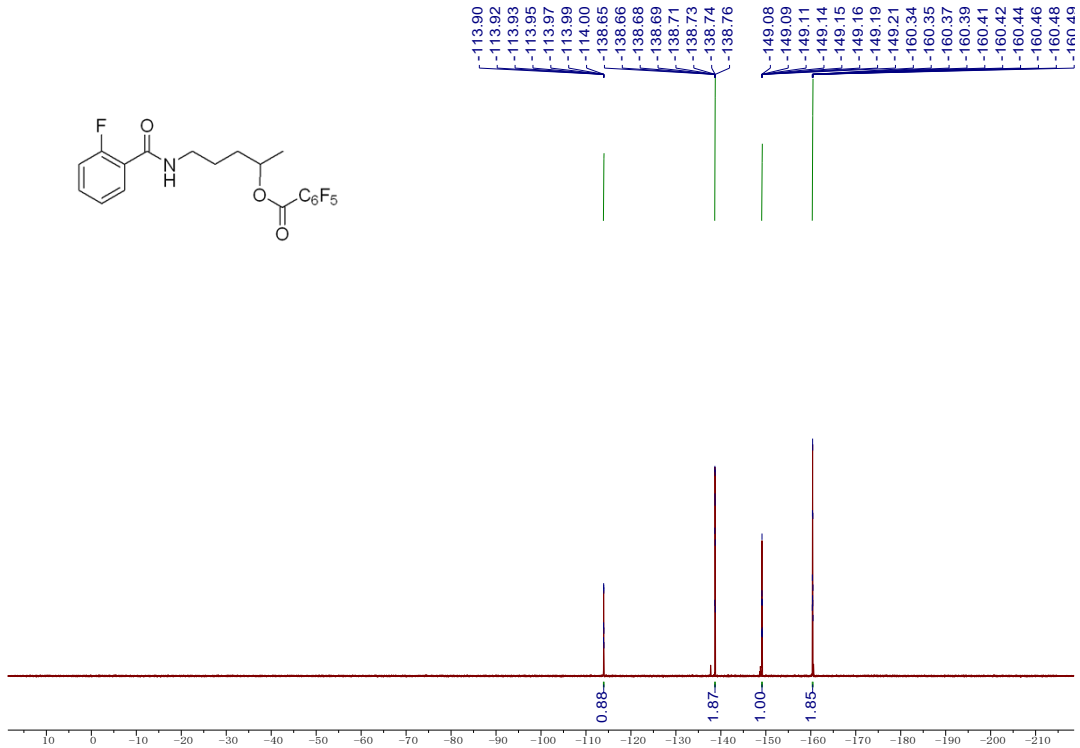
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

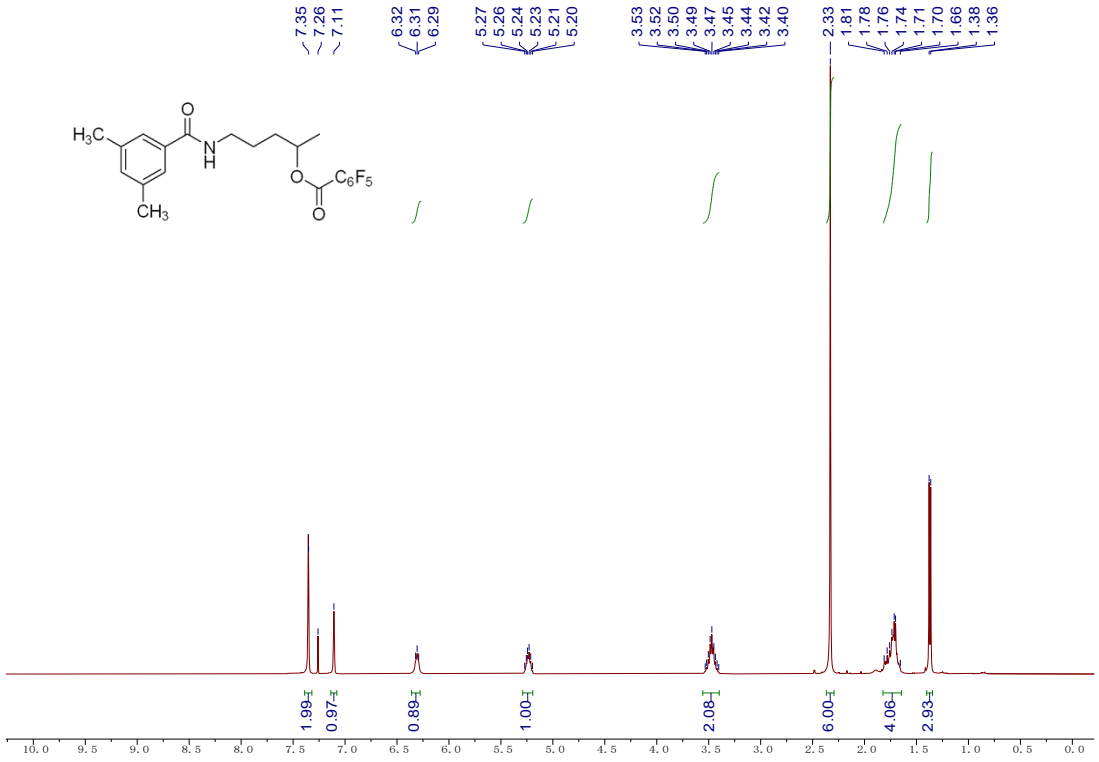


^{19}F NMR ($CDCl_3$, 376 MHz)

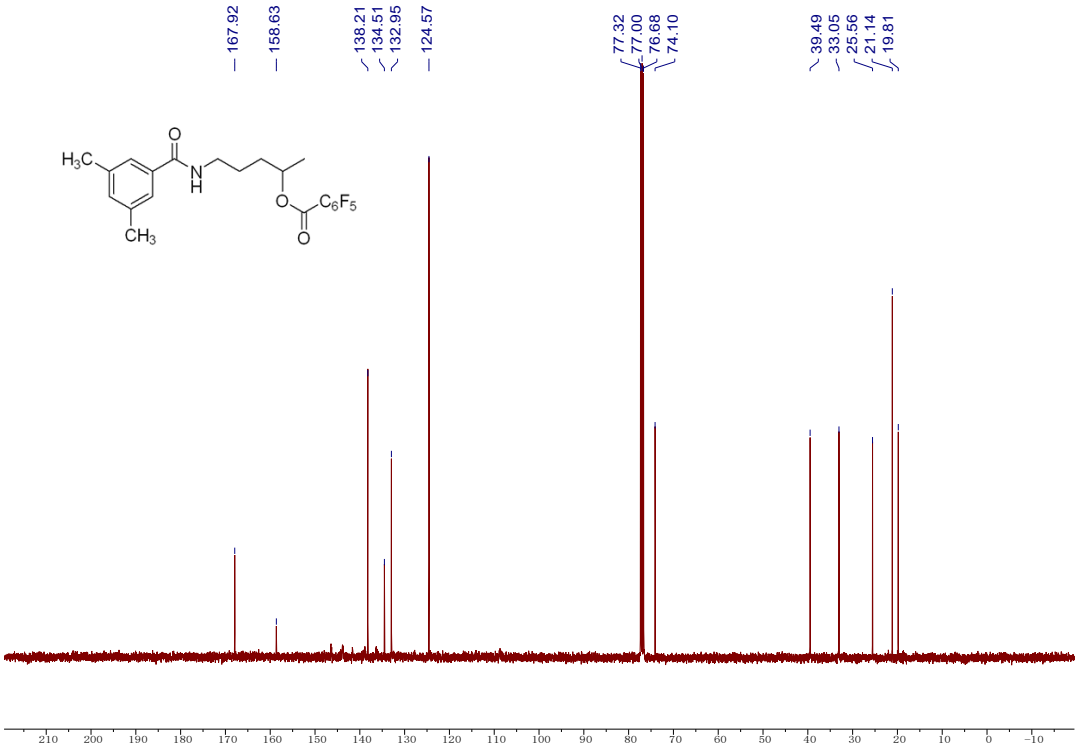


2o

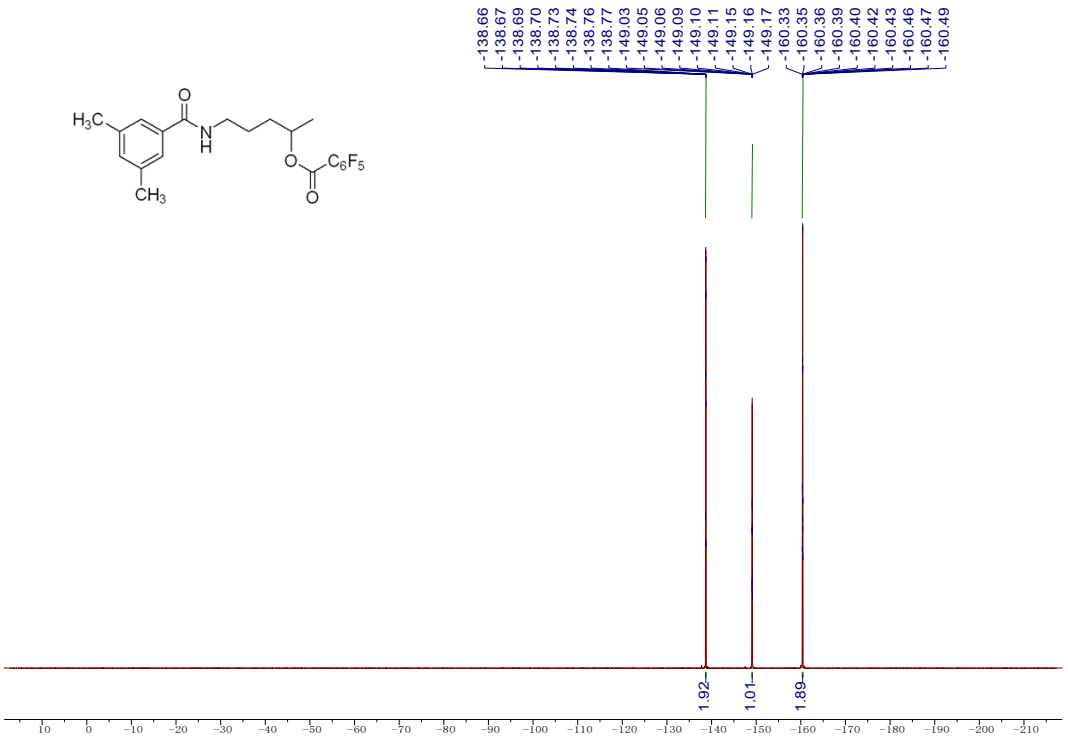
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

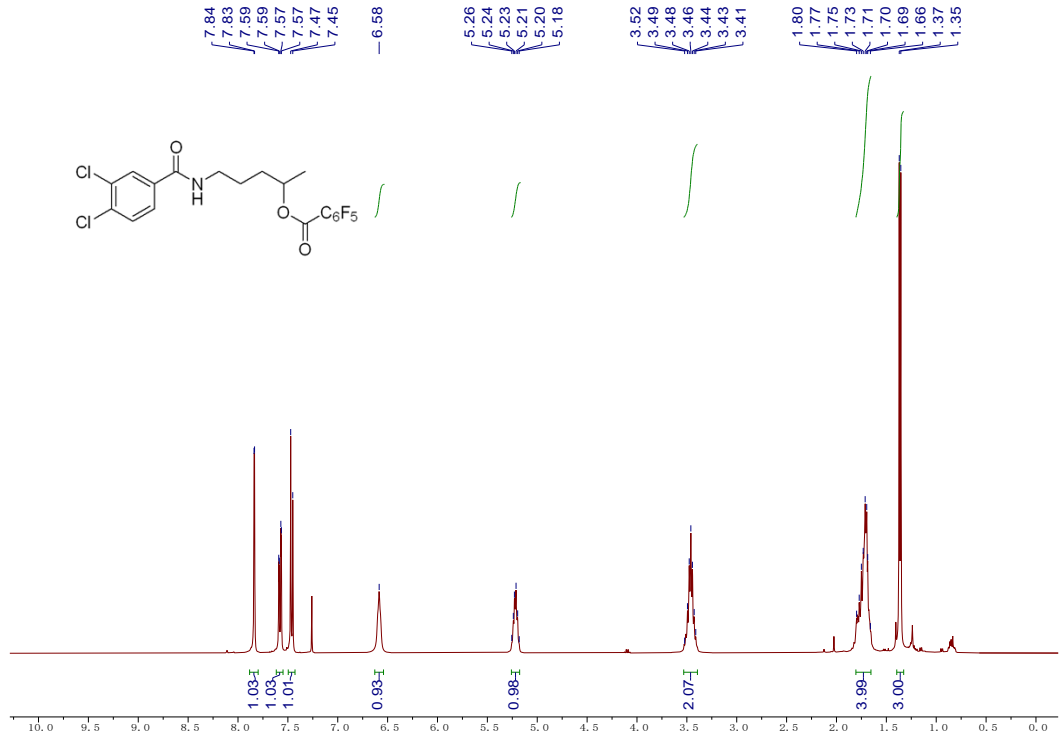


^{19}F NMR ($CDCl_3$, 376 MHz)

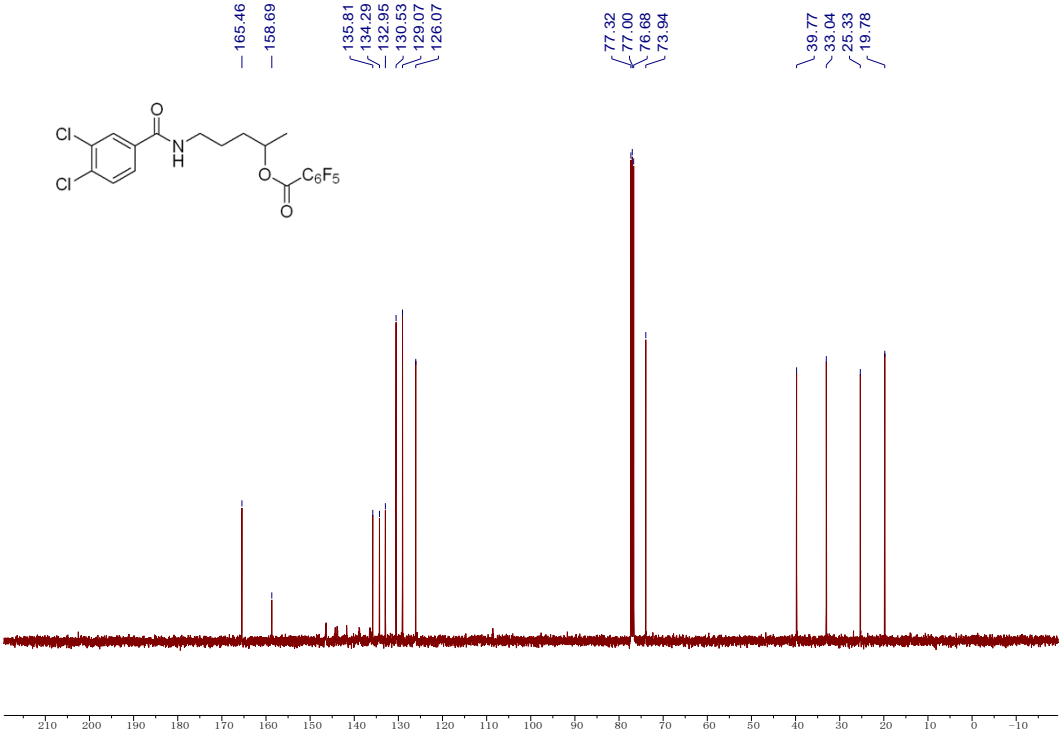


2p

^{1}H NMR ($CDCl_3$, 400 MHz)



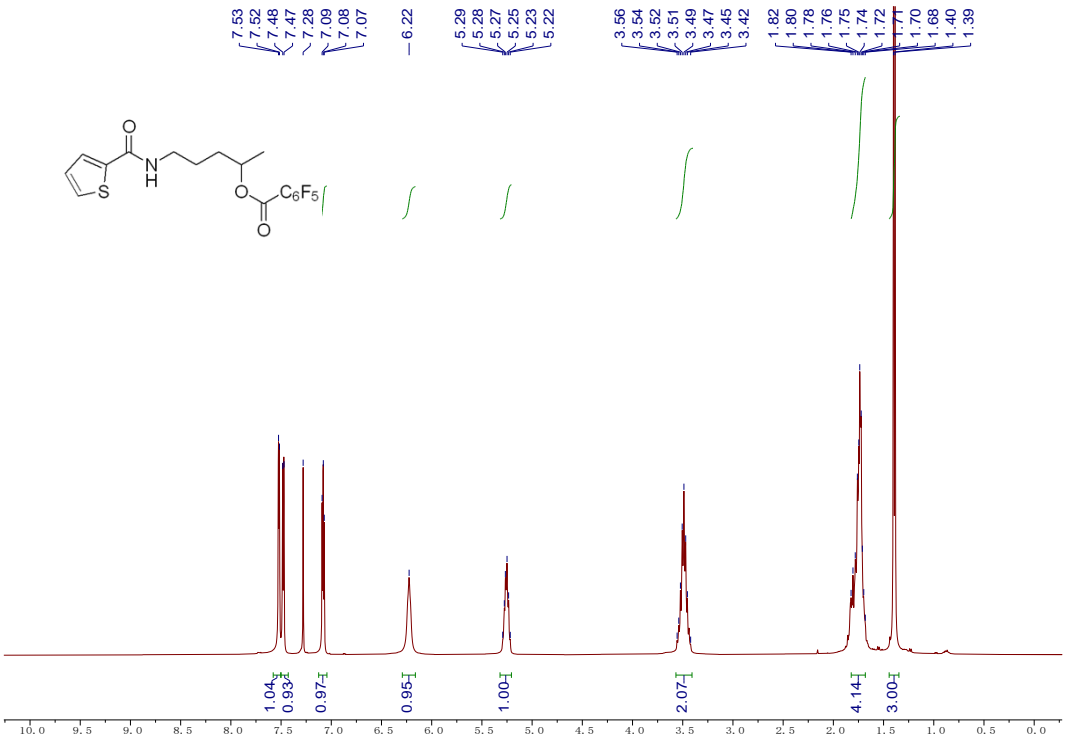
^{13}C NMR ($CDCl_3$, 100 MHz)



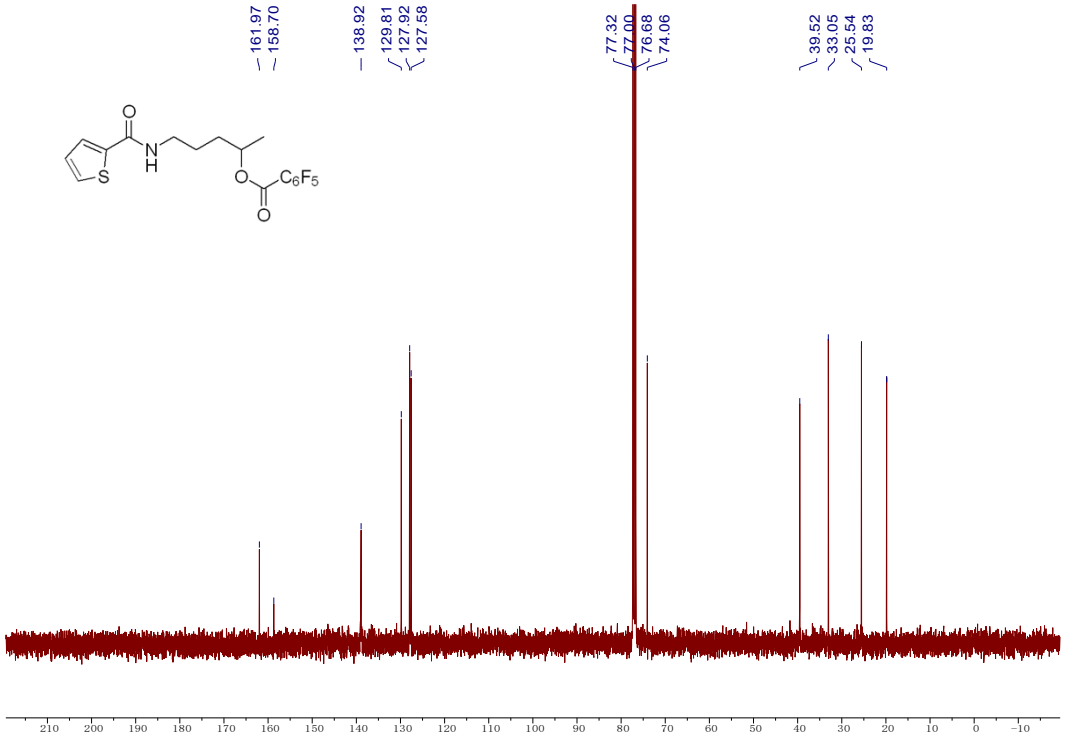
^{19}F NMR ($CDCl_3$, 376 MHz)

2q

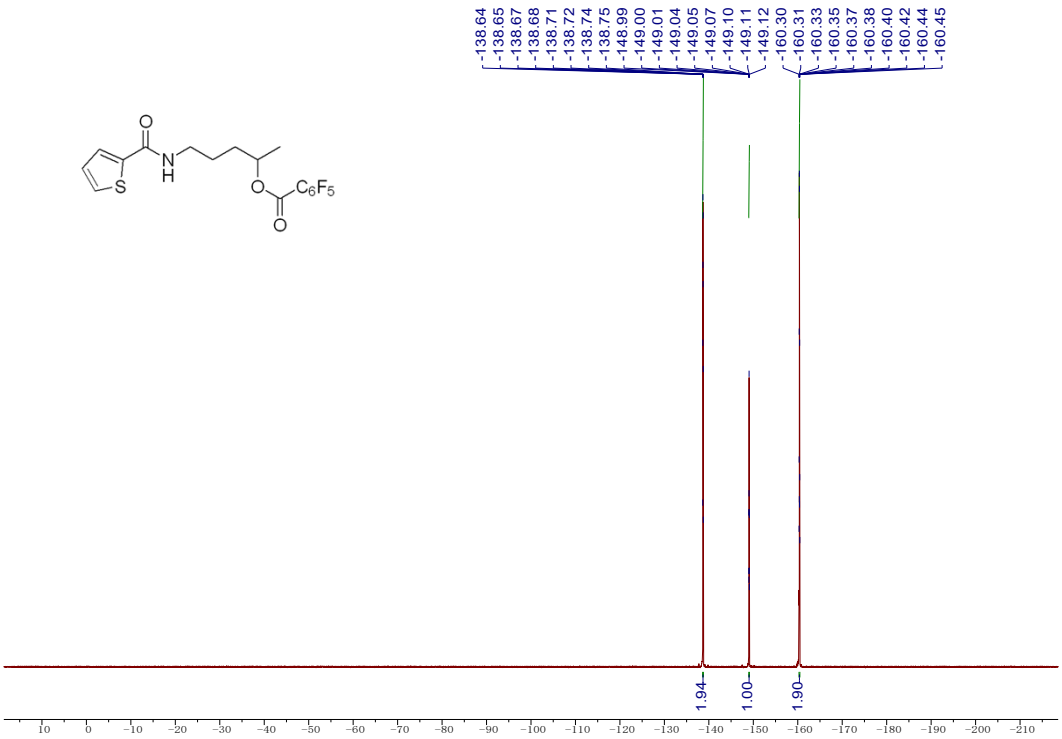
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

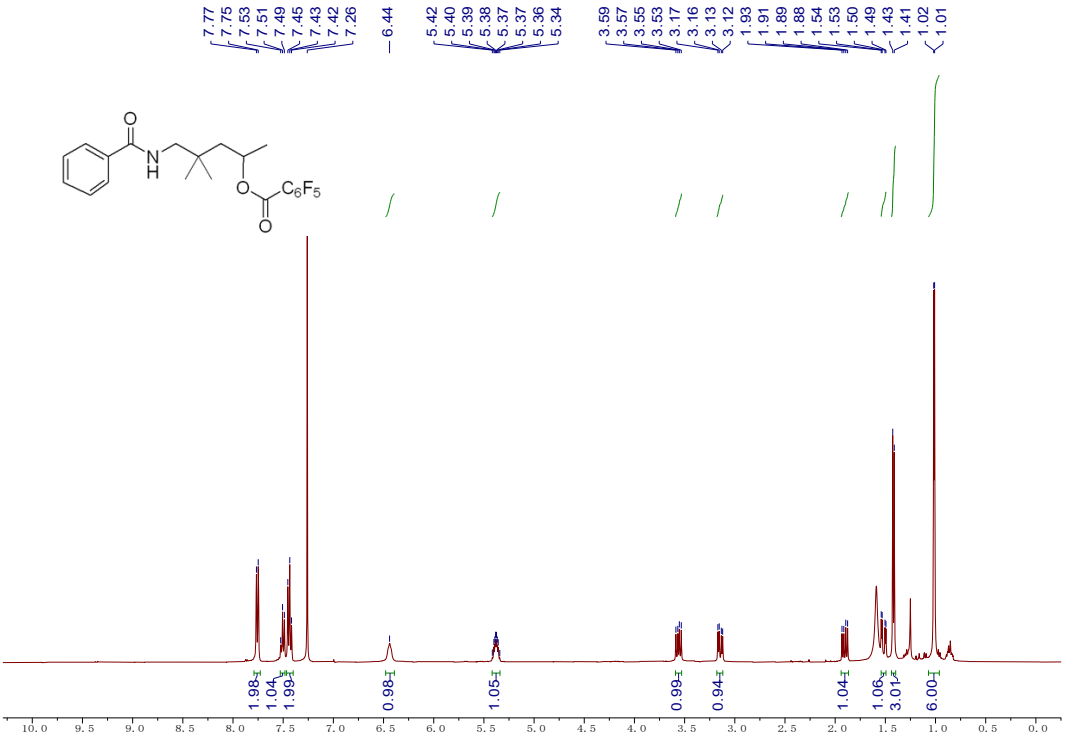


^{19}F NMR ($CDCl_3$, 376 MHz)

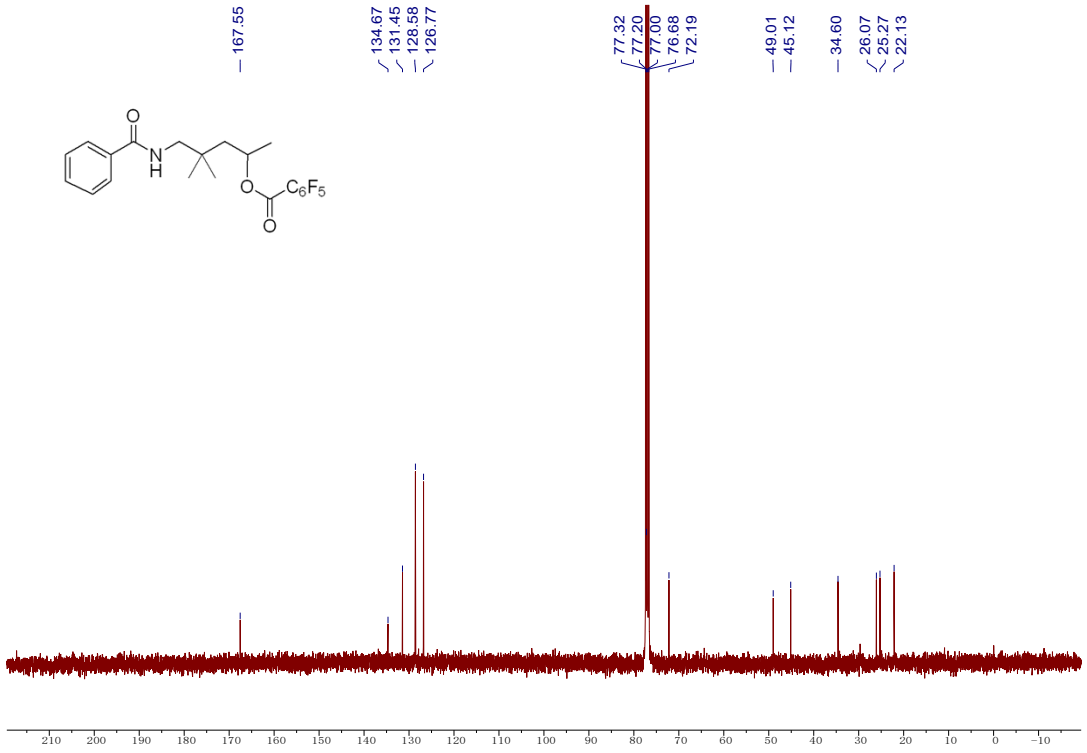


2r

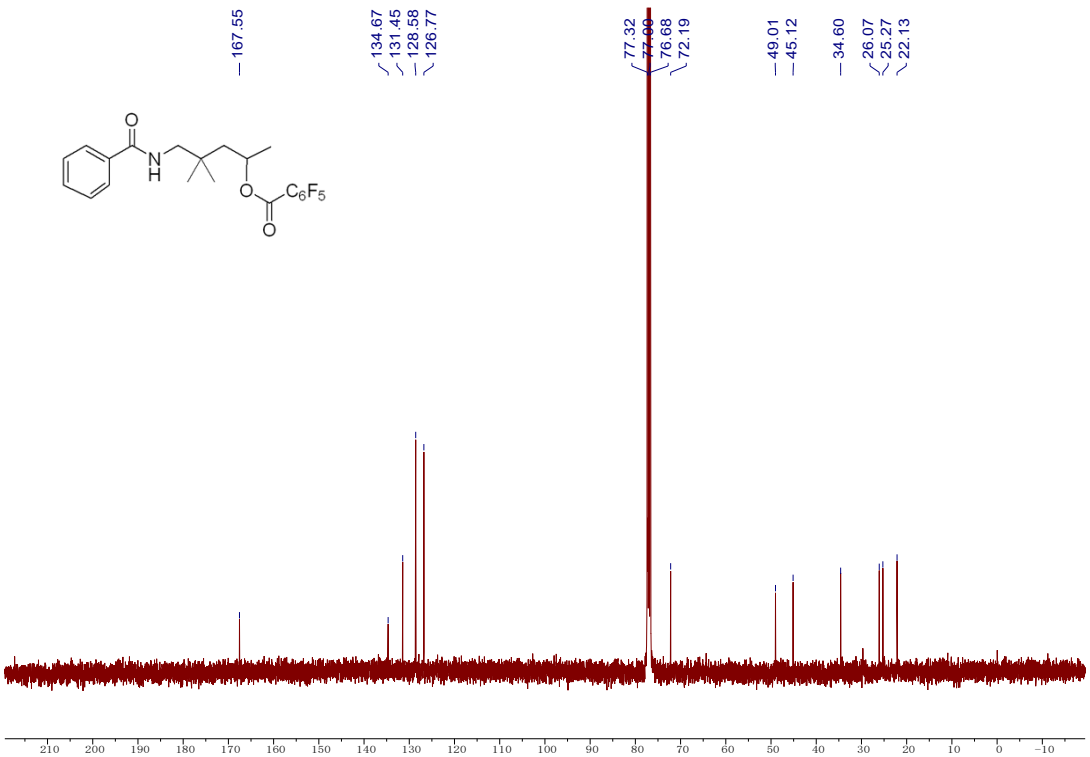
^{1}H NMR ($CDCl_3$, 400 MHz)



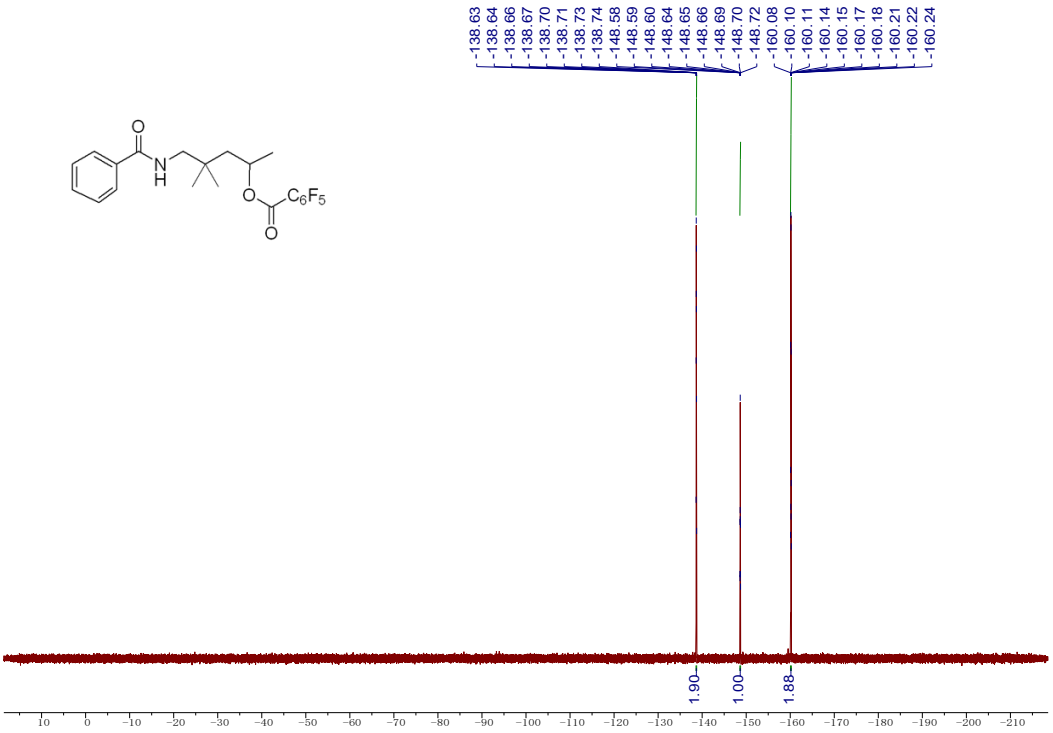
^{13}C NMR ($CDCl_3$, 100 MHz)



^{19}F NMR ($CDCl_3$, 376 MHz)

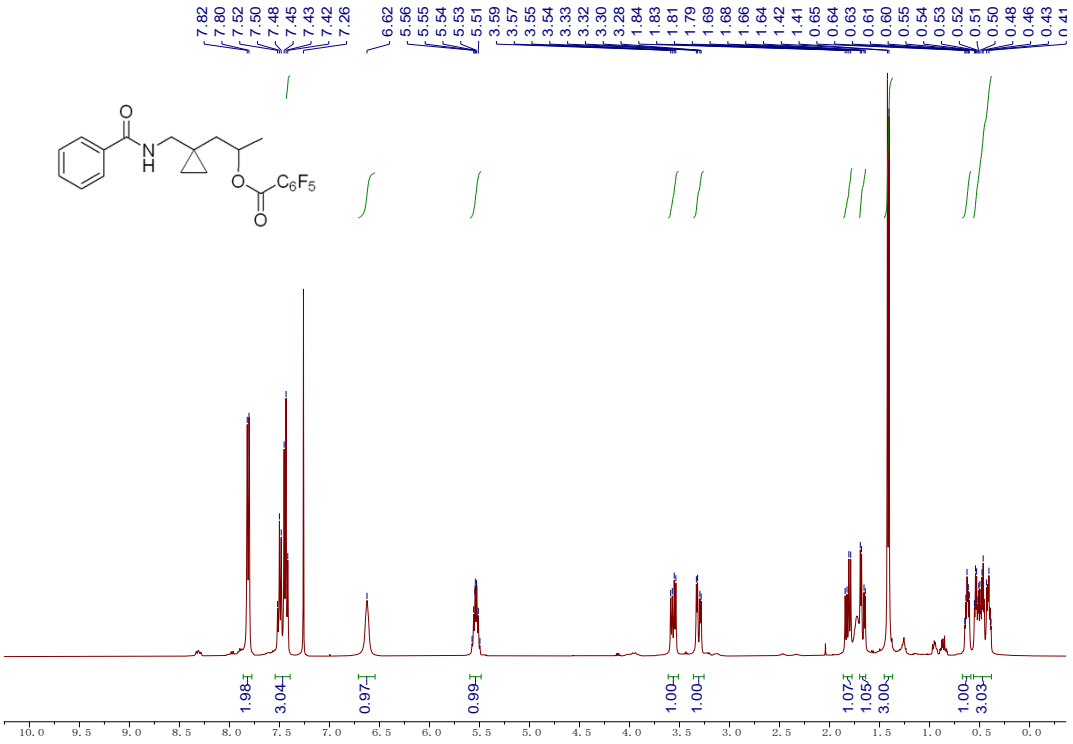


^{19}F NMR ($CDCl_3$, 376 MHz)

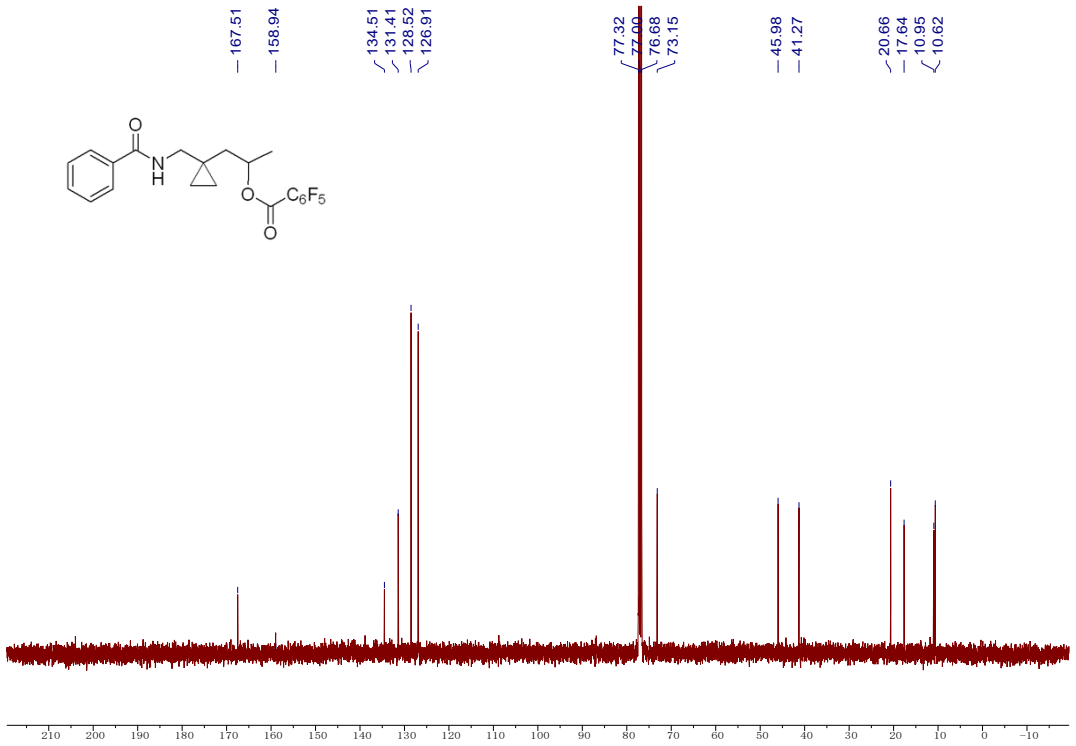


2s

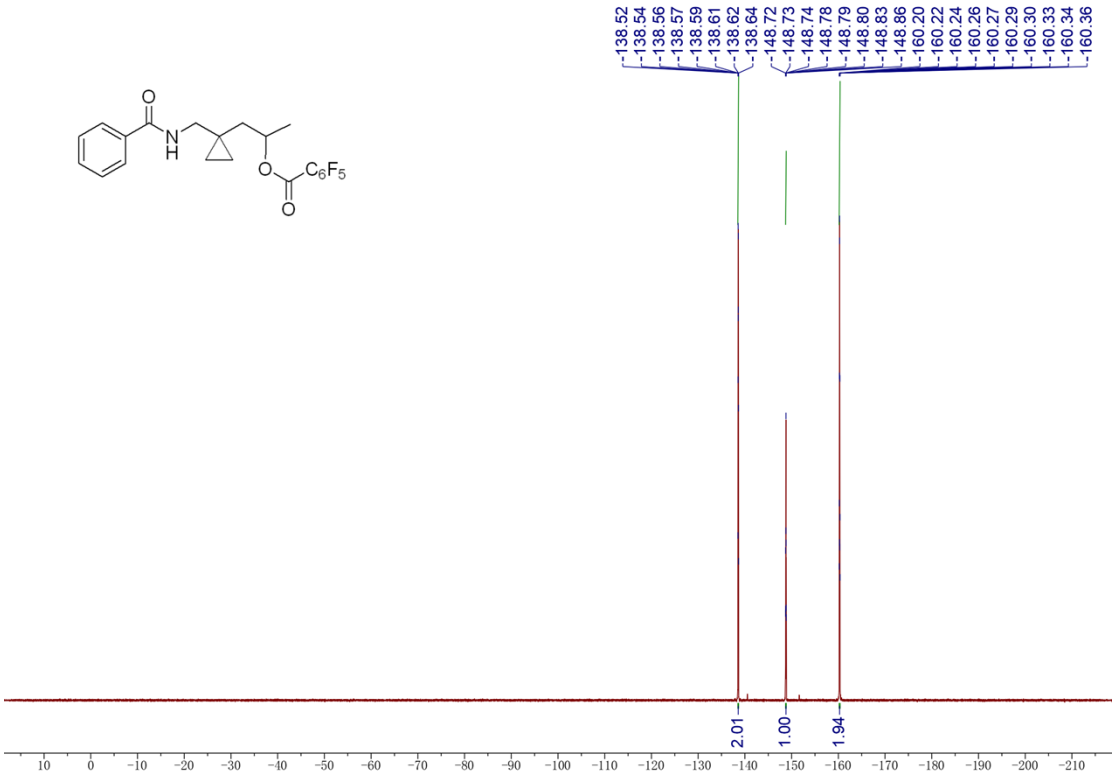
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

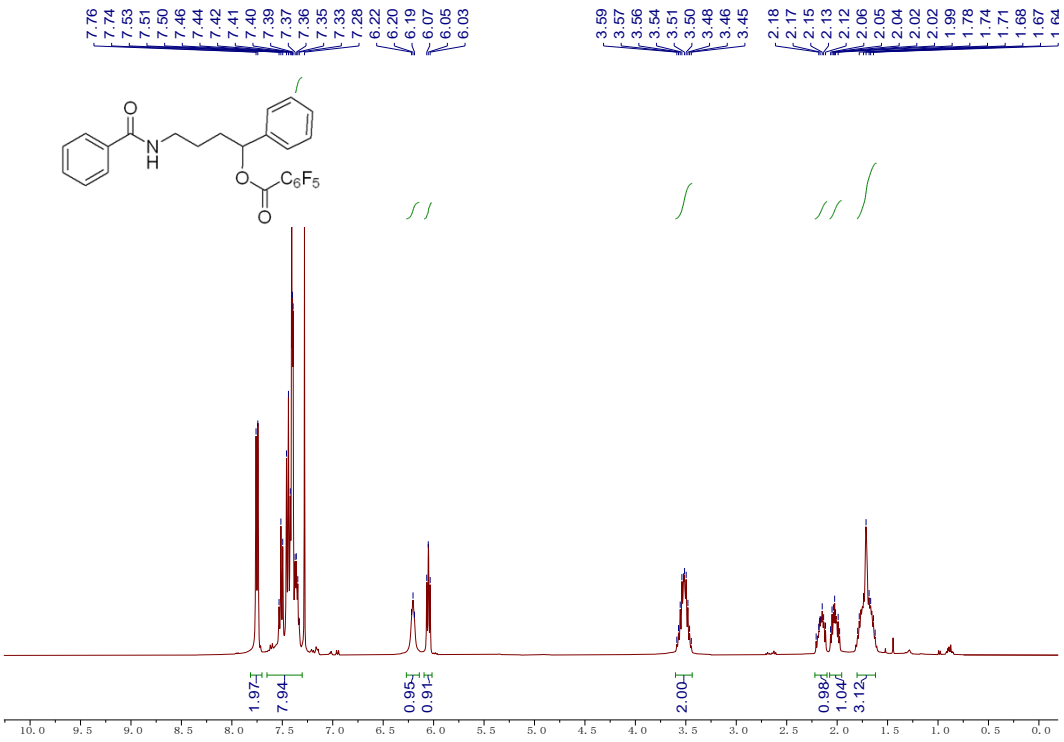


^{19}F NMR ($CDCl_3$, 376 MHz)

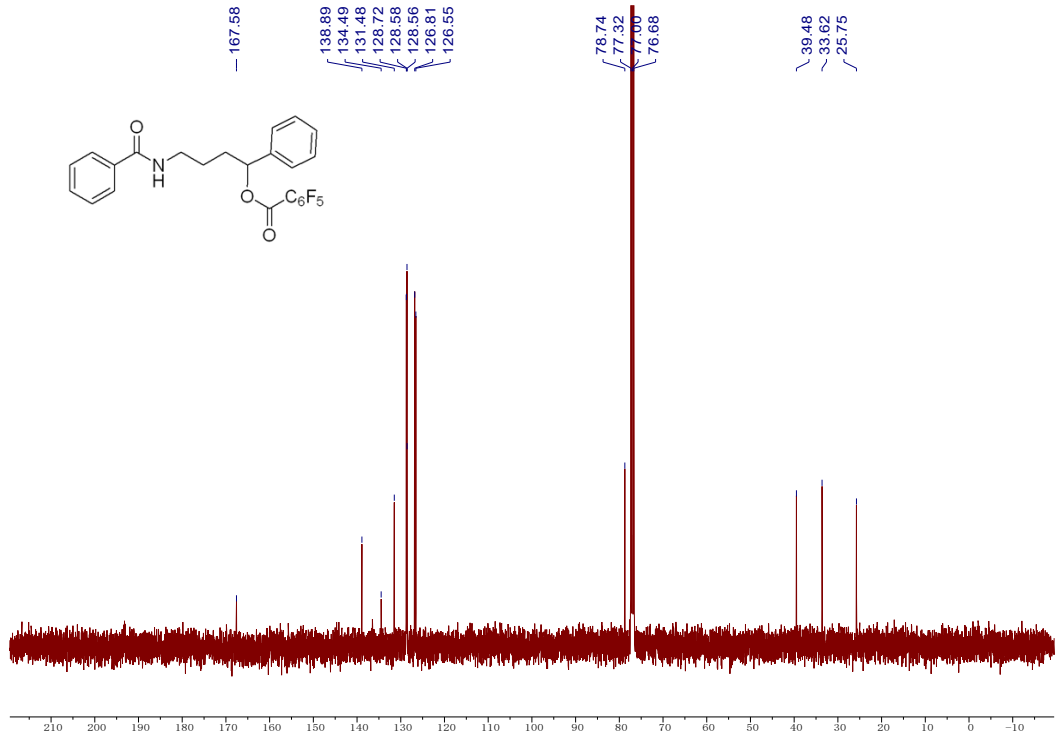


2t

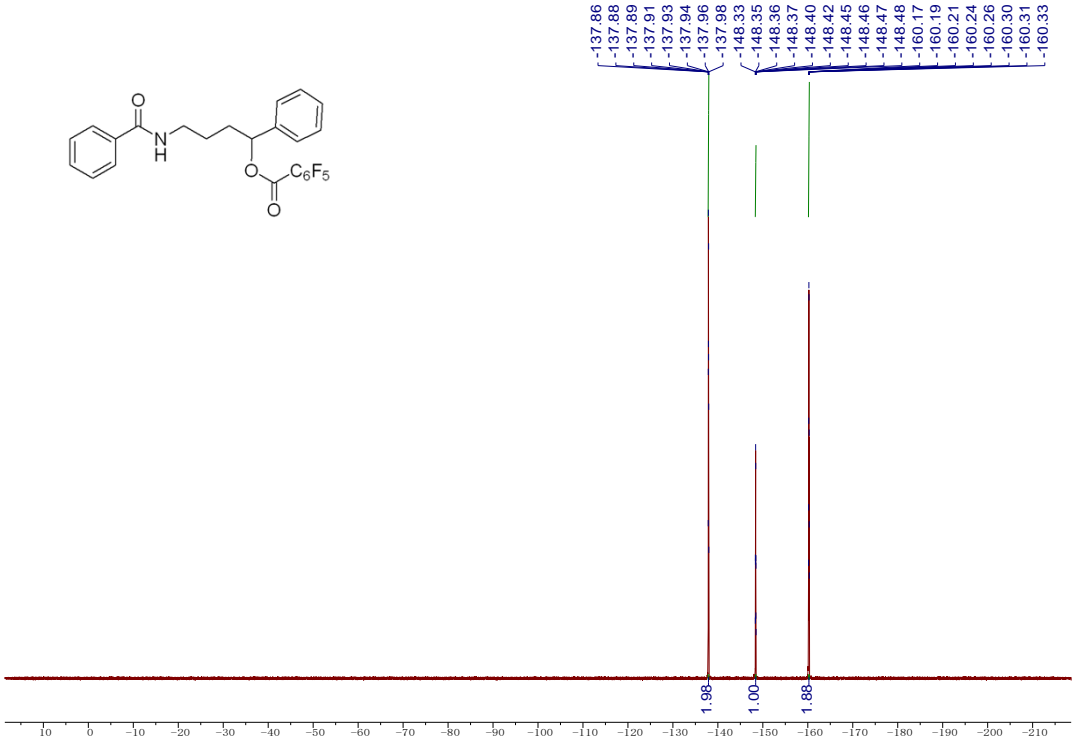
^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)

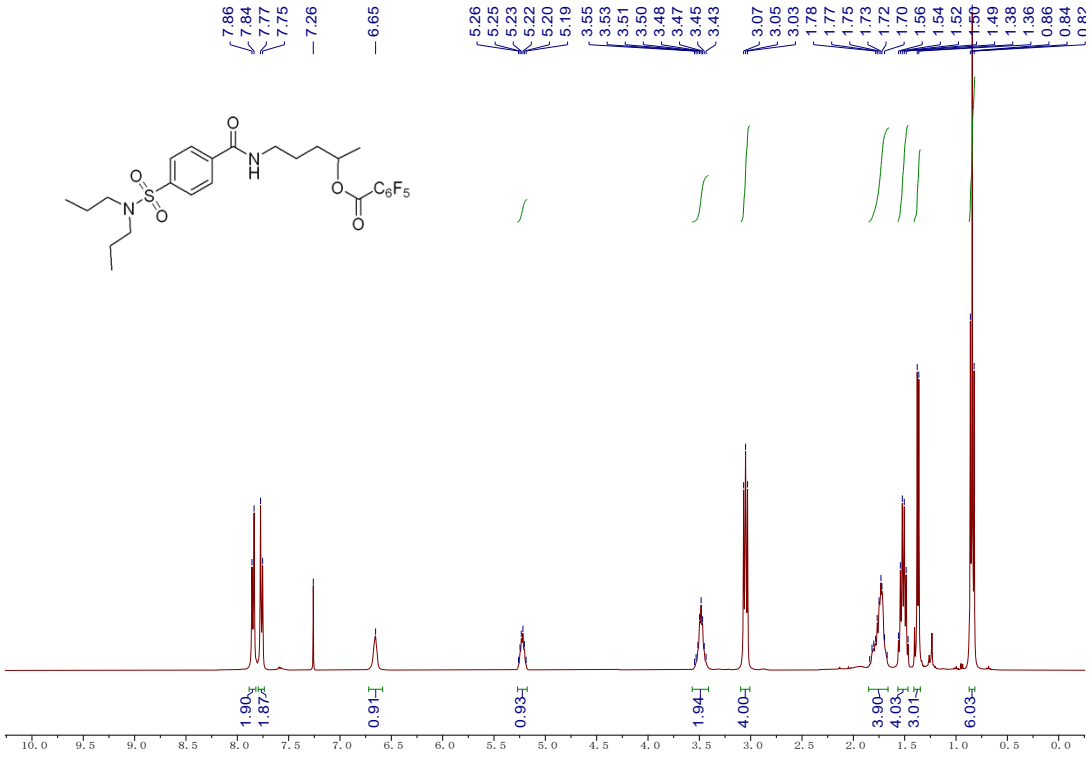


^{19}F NMR ($CDCl_3$, 376 MHz)

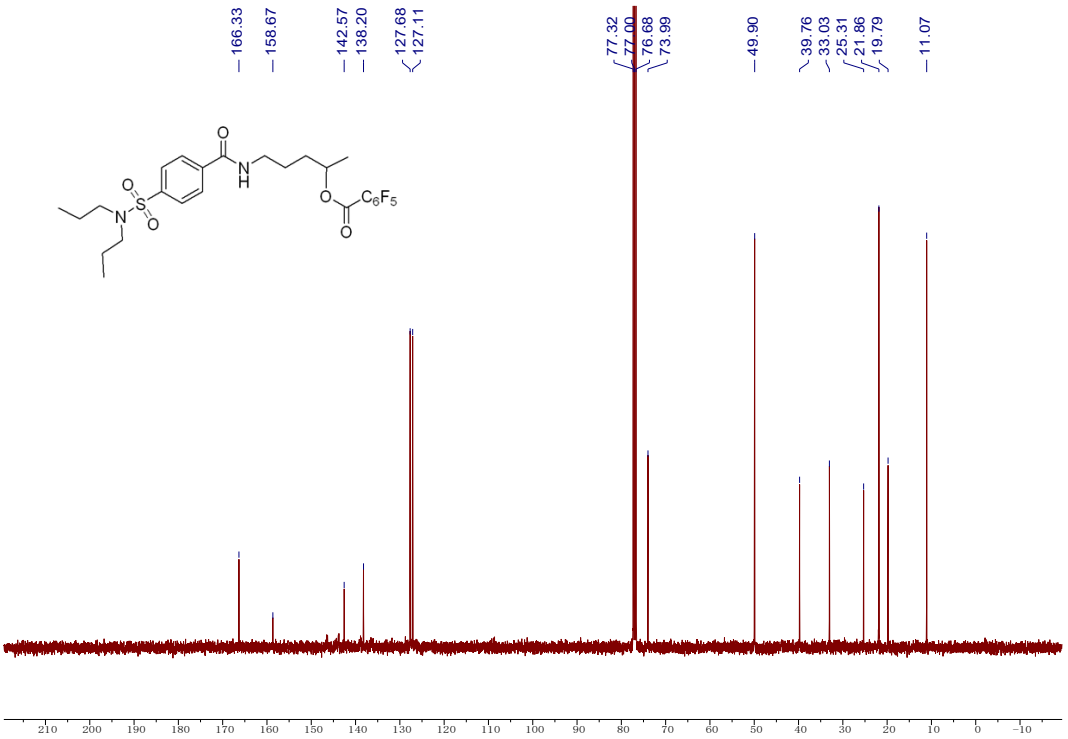


2u

^{1}H NMR ($CDCl_3$, 400 MHz)



^{13}C NMR ($CDCl_3$, 100 MHz)



^{19}F NMR ($CDCl_3$, 376 MHz)