

Visible Light Induced Deaminative Alkylation of Difluoroenoxy silanes: A Transition Metal Free Strategy

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1. General information.

^1H NMR and ^{13}C NMR spectra were recorded on an Agilent MR400 spectrometer. ^{19}F NMR was recorded on an Agilent MR400 spectrometer (CFCl_3 as outside standard and low field is positive). Chemical shifts (δ) are reported in ppm, and coupling constants (J) are in Hertz (Hz). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. NMR yield was determined by ^{19}F NMR using p-fluorotoluene as an internal standard before working up the reaction.

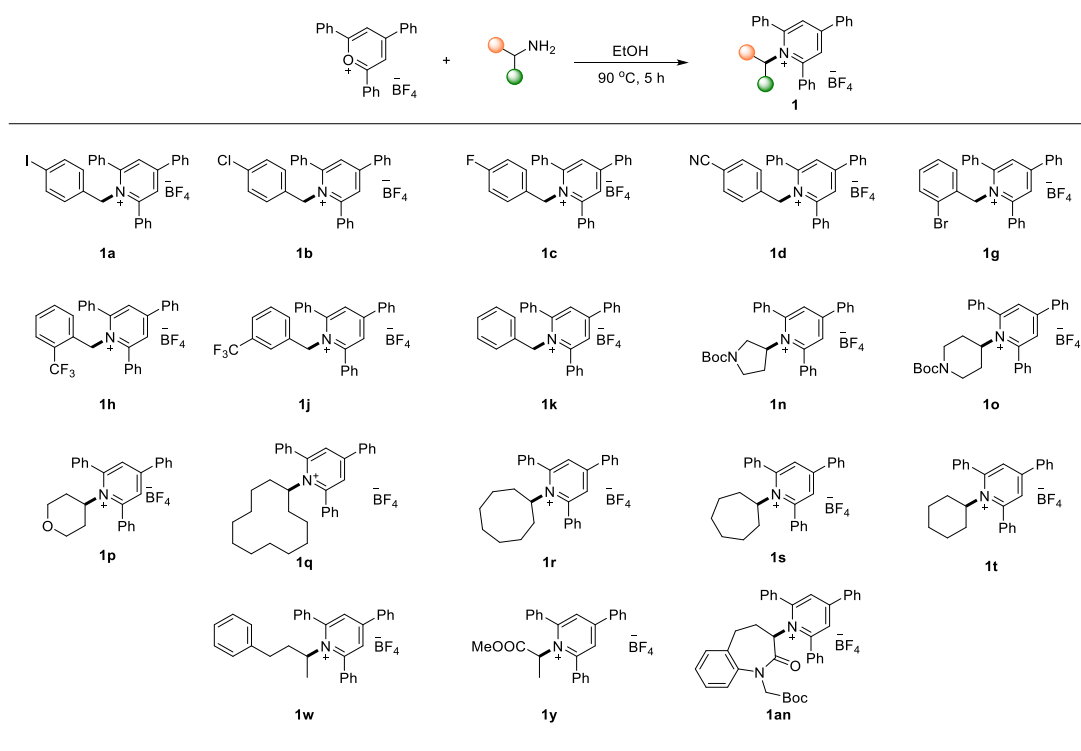
Materials: All reagents were used as received from commercial sources, unless specified otherwise, or prepared as described in the literature. All reagents were weighed and handled in air at room temperature.

2. General procedure for the synthesis of Katritzky salts 1.

1a^[1], 1b^[2], 1c^[2], 1d^[2], 1e^[2], 1f^[2], 1g^[2], 1h^[2], 1i^[2], 1j^[1], 1k^[2], 1l^[2], 1n^[2], 1o^[2], 1p^[2], 1q^[2], 1r^[2], 1s^[2], 1t^[2], 1u^[2], 1v^[2], 1w^[2], 1y^[3], 1aa^[3], 1ab^[2], 1ac^[2], 1ad^[2], 1ae^[2], 1af^[2], 1ag^[2], 1ah^[2], 1ai^[2], 1al^[4], 1am^[5], 1an^[6], were prepared according to previous reported procedures. 1m, 1n, 1z, 1aj, 1ak (unknown Katritzky salts) were prepared according to literature procedures^[2] as described as follows:

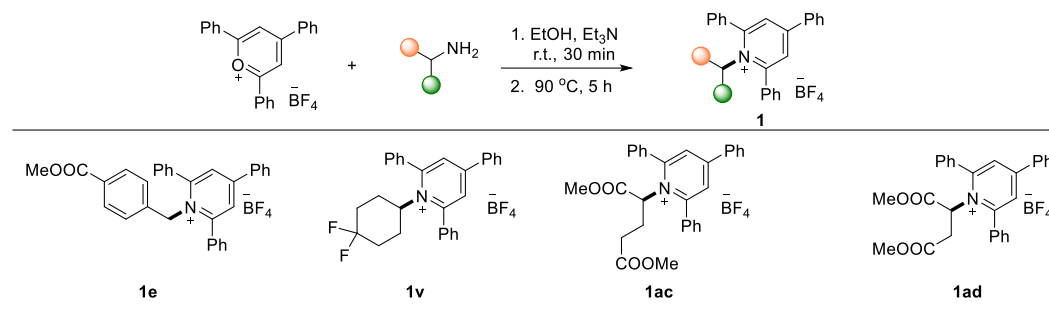
Procedure 2a. A 25 mL Schlenk tube equipped with a magnetic stirrer bar was charged with triphenylpyrylium tetrafluoroborate (2.5 mmol, 1.0 equiv.) and the corresponding primary amine (3.0 mmol, 1.2 equiv., if solid). Ethanol (2.5 mL, 1.0 M) was added followed by the corresponding primary amine (3.0 mmol, 1.2 equiv., if liquid). No precautions were taken to exclude oxygen or water. The reaction mixture was stirred and heated at reflux in an oil bath at 90 °C for 5 h. If precipitation occurred during the reaction, the solid was collected by filtration and washed with Et_2O (3×25 mL). If no precipitation occurred, Et_2O (7.5 mL) was added and the crude mixture was stirred for 1 h. The resulting solid was collected by filtration and washed with Et_2O (3×25 mL). If

precipitation did still not take place, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography, eluting with $\text{CH}_2\text{Cl}_2/\text{MeOH}$.

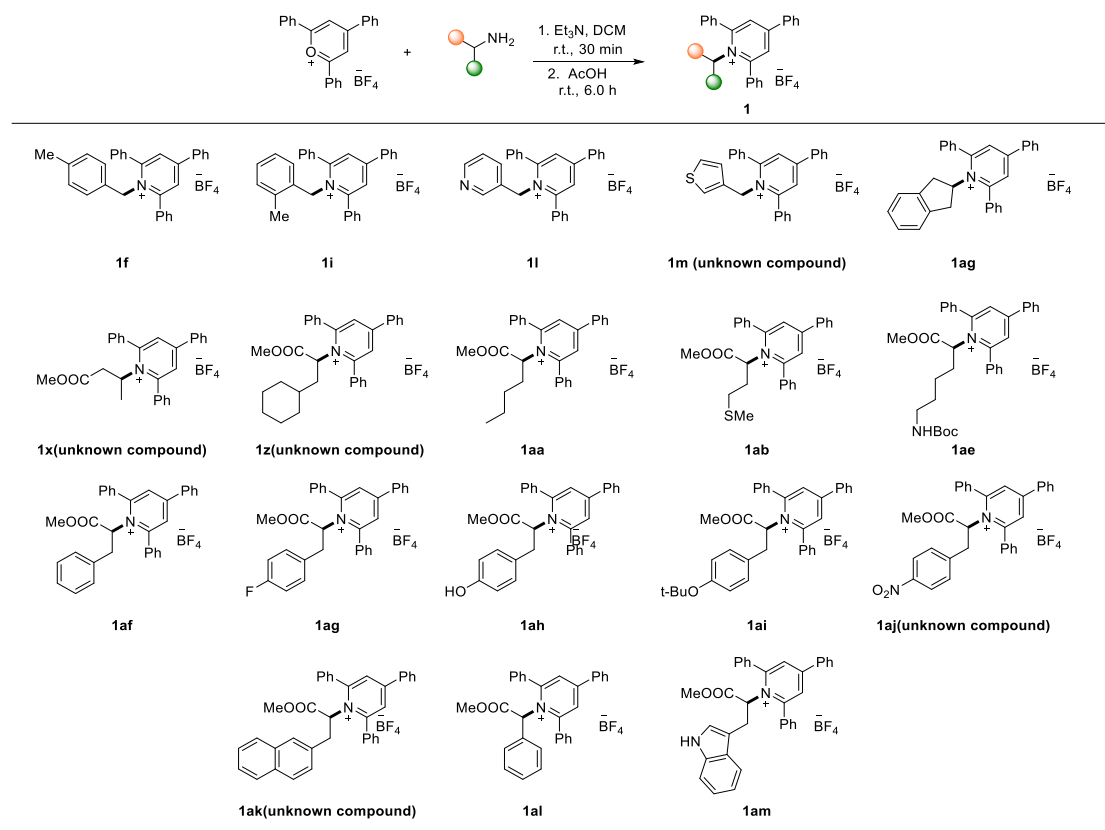


Amine hydrochlorides as starting materials: The corresponding amine hydrochloride (3.0 mmol, 1.2 equiv.) was weighed into a 25 mL Schlenk tube containing a magnetic stirring bar. EtOH (2.5 mL, 1.0 M) and Et_3N (3.0 mmol, 1.2 equiv.) were added successively. The resulting suspension was stirred at room temperature for 30 min. 2,4,6-Triphenylpyrylium tetrafluoroborate (2.5 mmol, 1.0 equiv.) was added in one portion and the reaction mixture was stirred and heated at reflux in an oil bath at 90 °C for 5 h. If precipitation occurred during the reaction, the solid was collected by filtration and washed with H_2O (3×25 mL, to remove $\text{Et}_3\text{N} \cdot \text{HCl}$ salts) and Et_2O (3×25 mL). If no precipitation occurred, Et_2O (7.5 mL) was added and the crude mixture was stirred for 1 h. The resulting solid was collected by filtration and washed with H_2O (3×25 mL, to remove $\text{Et}_3\text{N} \cdot \text{HCl}$ salts) and Et_2O (3×25 mL). If precipitation did still not take place, the solvent was removed under reduced pressure. The crude product was then dissolved in CH_2Cl_2 , washed with H_2O and concentrated

under reduced pressure. The crude product was purified by flash column chromatography, eluting with CH₂Cl₂/MeOH.



Procedure 2b. The triphenylpyrylium tetrafluoroborate (2.5 mmol, 1.0 equiv.) and the corresponding primary amine (2.5 mmol, 1.0 equiv.) was weighed into a 25 ml Schlenk tube containing a magnetic stirring bar. CH₂Cl₂ (5.0 mL, 0.5 M) and then Et₃N (1.0 equiv. for free base amines; 2.0 equiv. for amine hydrochloride salts) were added successively. The mixture was stirred at room temperature for 30 min. Acetic acid (2.0 equiv.) was added and the reaction mixture was stirred at room temperature for 6 h. The reaction mixture was diluted with CH₂Cl₂, washed successively with aq. HCl (1.0 M, 2×25 mL), aq. NaHCO₃ (sat., 2×25 mL) and brine (3×25 mL), dried over anhydrous Na₂SO₄, filtered and concentrated. The crude product was purified by flash column chromatography, eluting with CH₂Cl₂/MeOH.



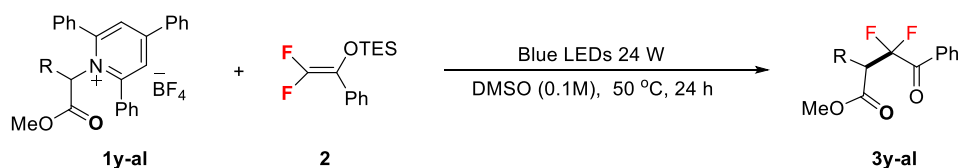
3. General procedure for visible light promoted deaminative difluoroalkylation of aliphatic amines.

Procedure a:



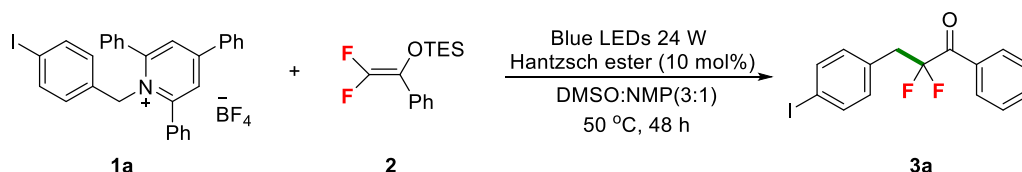
A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the Katritzky salt (**1**) (0.2 mmol, 1.0 equiv.), Hantzsch ester (10-50 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 2.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (0.4 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs. After stirring for 24 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The residue was purified with silica gel chromatography to provide pure product.

Procedure b:

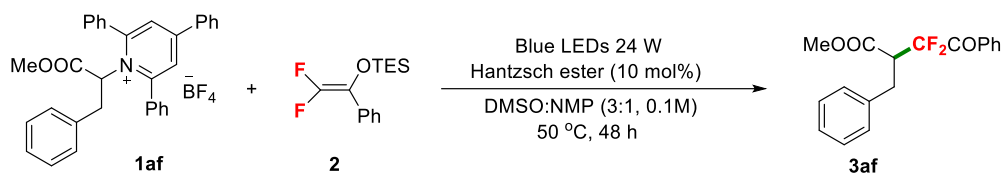


A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the Katritzky salt (**1**) (0.2 mmol, 1.0 equiv.). The tube was evacuated and backfilled with argon three times, followed by DMSO (2.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (0.4 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs. After stirring for 24 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The residue was purified with silica gel chromatography to provide pure product.

4. Detailed procedure for the gram scale synthesis of compound **3a**, **3af**.



A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the **1a** (4.0 mmol, 1.0 equiv.), Hantzsch ester (0.4 mmol, 10 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 16.0 mL) were added with stirring. Difluoroenoxytriethylsilane (**2**) (8.0 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs. After stirring for 48 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The product **3a** (1012 mg, 68% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid.



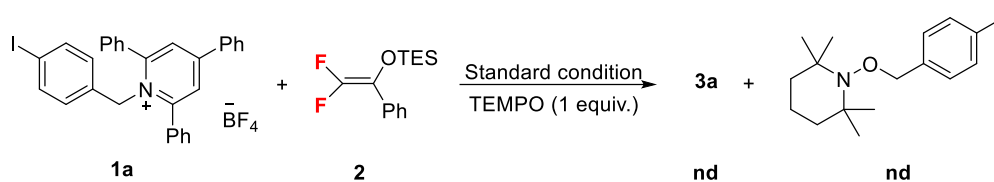
Procedure a: A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the **1af** (4.0 mmol, 1.0 equiv.), Hantzsch ester (0.4 mmol, 10 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 16.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (8.0 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs. After stirring for 48 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The product **3af** (904 mg, 71% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil.



Procedure b: A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the **1af** (4.0 mmol, 1.0 equiv.). The tube was evacuated and backfilled with argon three times, followed by DMSO (16.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (8.0 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs. After stirring for 42 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The product **3af** (777 mg, 61% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil.

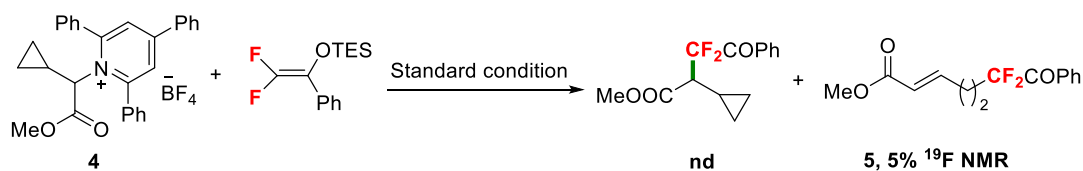
5. Mechanism studies.

5.1 Addition of radical and SET inhibitors.



Typical procedure: A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the Katritzky salt (**1a**) (0.2 mmol, 1.0 equiv.), Hantzsch ester (0.02 mmol, 10 mol%) and TEMPO (0.2 mmol, 1.0 equiv.). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 2.0 mL) were added with stirring. Difluoroenoxytriethylsilane (**2**) (0.4 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs 24 W. After stirring for 24 h, the reaction mixture was cooled to room temperature, monitored by TLC. The reaction was totally suppressed by the addition of a radical scavenger TEMPO (100 mol%), which suggests that the involvement of radical intermediates is likely during the reaction.

5.2 Trapping of intermediates.



Typical procedure: A 25 mL oven-dried Schlenk tube equipped with a magnetic bar was charged with the Katritzky salt (**4**)^[7] (0.2 mmol, 1.0 equiv.), Hantzsch ester (0.02 mmol, 10 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 2.0 mL) were added with stirring. Difluoroenoxytriethylsilane (**2**) (0.4 mmol, 2.0 equiv.) was added subsequently. The tube was screw capped and heated to 50 °C under irradiation of blue LEDs 24 W. After stirring for 24 h, the reaction mixture was cooled to room temperature, diluted with ethyl acetate, washed with H₂O and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The residue was purified with silica gel chromatography to provide

product **5**^[21]. (The yield of the crude ring-opened product **5** was determined to be 5% by ¹⁹F-NMR analysis with p-fluorotoluene as an internal standard). ¹H NMR (400 MHz, CDCl₃) δ 8.11 (d, *J* = 7.6 Hz, 2H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 8.0 Hz, 2H), 7.02 – 6.95 (m, 1H), 5.90 (dt, *J* = 15.6, 1.5 Hz, 1H), 3.73 (s, 3H), 2.54 – 2.48 (m, 2H), 2.42 – 2.30 (m, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ - 100.16 (t, *J* = 17.1 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 188.8 (t, *J* = 31.8 Hz), 166.7, 146.6, 134.5, 131.6, 130.2 (t, *J* = 3.0 Hz), 128.7, 121.9, 119.1 (t, *J* = 254.9 Hz), 51.6, 32.1 (t, *J* = 23.1 Hz), 24.3 (t, *J* = 5.1 Hz).

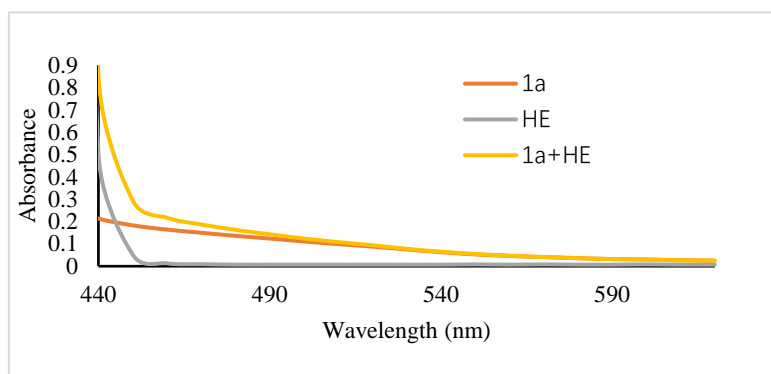
5.3 UV-Vis spectroscopic measurement.

Solution 1: **1a** (0.2 mmol, 1.0 equiv.) were added in DMSO/NMP (4.0 mL, 3:1). The mixture was stirred for 20 minutes and filtered.

Solution 2: Hantzsch ester (0.2 mol, 1.0 equiv.) was added in DMSO/NMP (4.0 mL, 3:1). The mixture was stirred for 20 minutes and filtered.

Solution 3: **1a** (0.2 mmol, 1.0 equiv.) combine Hantzsch ester (0.2 mol, 1 equiv.) was added in DMSO/NMP (4.0 mL, 3:1). The mixture was stirred for 20 minutes and filtered. Performed on UV visible spectrophotometer, recorded in 1 cm path quartz cuvettes using T6 Xinyue visible spectrophotometer (PERSEETM), DMSO/NMP (3:1) as blank sample.

A λ (nm)	1a	HE	1a + HE	A λ (nm)	1a	HE	1a + HE
440	0.213	0.505	0.852	530	0.075	0.007	0.078
450	0.183	0.052	0.295	540	0.063	0.007	0.065
460	0.164	0.013	0.217	550	0.053	0.008	0.055
470	0.15	0.009	0.187	560	0.046	0.007	0.047
480	0.136	0.007	0.163	570	0.041	0.008	0.041
490	0.124	0.007	0.143	580	0.036	0.007	0.036
500	0.111	0.007	0.124	590	0.032	0.007	0.032
510	0.099	0.007	0.108	600	0.03	0.008	0.03
520	0.088	0.007	0.094	610	0.027	0.007	0.026



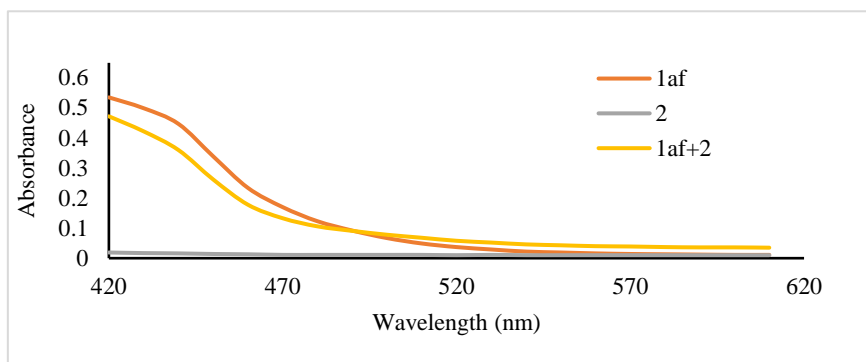
Solution 1: **1af** (0.2 mmol, 1.0 equiv.) were added in DMSO (3.0 mL). The mixture was stirred for 20 minutes and filtered.

Solution 2: Difluoroenoxytriethylsilane (0.4 mol, 2.0 equiv.) was added in DMSO (3.0 mL). The mixture was stirred for 20 minutes and filtered.

Solution 3: **1af** (0.2 mmol, 1.0 equiv.) combine Difluoroenoxytriethylsilane (0.4 mol, 1 equiv.) was added in DMSO (3.0 mL). The mixture was stirred for 20 minutes and filtered.

Performed on UV visible spectrophotometer, recorded in 1 cm path quartz cuvettes using T6 Xinyue visible spectrophotometer (PERSEETM), DMSO (3.0 mL) as blank sample.

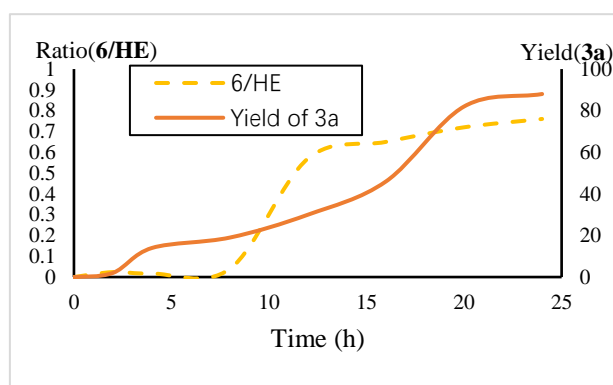
A λ (nm)	1af	2	1af + 2	A λ (nm)	1af	2	1af + 2
420	0.535	0.019	0.472	520	0.037	0.01	0.058
430	0.499	0.017	0.422	530	0.029	0.011	0.052
440	0.447	0.016	0.36	540	0.022	0.01	0.046
450	0.339	0.014	0.262	550	0.019	0.01	0.043
460	0.234	0.013	0.178	560	0.016	0.01	0.04
470	0.17	0.011	0.133	570	0.014	0.01	0.039
480	0.123	0.011	0.106	580	0.013	0.01	0.037
490	0.092	0.011	0.091	590	0.012	0.01	0.036
500	0.067	0.011	0.078	600	0.011	0.01	0.036
510	0.049	0.011	0.068	610	0.011	0.01	0.035



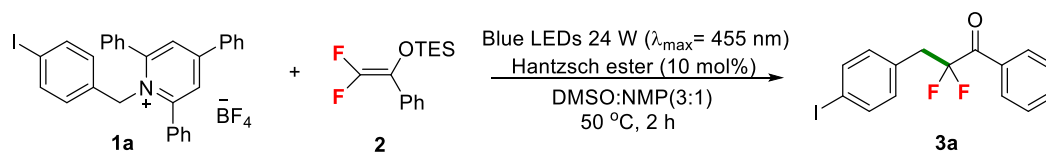
5.4 The time profile of reactions.

Typical procedure: To 25 mL oven-dried Schlenk tube (No.1-8) equipped with a magnetic stirrer bar was charged with the Katritzky salt (**1a**) (0.2 mmol, 1.0 equiv.), Hantzsch ester (0.04 mmol, 20 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 2.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (0.4 mmol, 2.0 equiv.) was added subsequently. The tube 1 was determined by ^1H NMR and ^{19}F NMR immediately. The tube 2-8 were heated to 50 °C and stirring for 2-24 h. After stirring for 2 h, 4 h, 8 h, 12 h, 16 h, 20 h or 24 h, the reaction mixture was cooled to room temperature, then monitored by ^1H NMR and ^{19}F NMR.

Entry	Time (h)	Yield of 3a (^{19}F -NMR)	6 : HE
1	0	0	0
2	2	2	0.024
3	4	14	0.017
4	8	19	0.04
5	12	30	0.57
6	16	46	0.65
7	20	82	0.72
8	24	82.5	0.76



5.5 Determination of the quantum yield [1].



A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the **1a** (0.6 mmol, 1.0 equiv.), Hantzsch ester (0.06 mmol, 10 mol%). The tube was evacuated and backfilled with argon three times, followed by DMSO and NMP (3:1, 6.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (1.2 mmol, 2.0 equiv.) was added subsequently. The tube was stored protected from light. 2.0 mL of this stock solution was transferred to a quartz cuvette under an argon atmosphere. The cuvette was capped with a stopper and sealed with parafilm. The reaction mixture was heated to 50 °C under irradiation of blue LEDs ($\lambda_{\max} = 455$ nm). After stirring for 2 h, the yield determined by HPLC analysis with styrene as an internal standard. The yield of the desired product **3a** was determined to be 4.7 % (8.68×10^{-6} mol). The reaction quantum yield (Φ) was determined using eq 1.

$$\Phi = \frac{\text{mol of product}}{\text{photon flux} \cdot t \cdot f} \quad (1)$$
$$\Phi = \frac{8.68 \times 10^{-6} \text{ mol}}{2.5 \times 10^{-9} \text{ E s}^{-1} \cdot 7200 \cdot 0.943} = 0.51$$



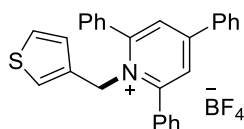
A 25 mL oven-dried Schlenk tube equipped with a magnetic stirrer bar was charged with the **1af** (0.6 mmol, 1.0 equiv.). The tube was evacuated and backfilled with argon three times, followed by DMSO (6.0 mL) with stirring. Difluoroenoxytriethylsilane (**2**) (1.2 mmol, 2.0 equiv.) was added subsequently. The

tube was stored protected from light. 2.0 mL of this stock solution was transferred to a quartz cuvette under an argon atmosphere. The cuvette was capped with a stopper and sealed with parafilm. The reaction mixture was heated to 50 °C under irradiation of blue LEDs ($\lambda_{\text{max}} = 455 \text{ nm}$). After stirring for 2 h, the yield determined by HPLC analysis with styrene as an internal standard. The yield of the desired product 3ad was determined to be 1.3 % ($2.34 \times 10^{-6} \text{ mol}$). The reaction quantum yield (Φ) was determined using eq 1.

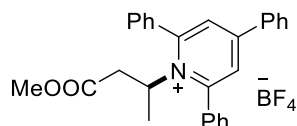
$$\Phi = \frac{\text{mol of product}}{\text{photon flux} \cdot t \cdot f} \quad (1)$$

$$\Phi = \frac{2.34 \times 10^{-6} \text{ mol}}{2.5 \times 10^{-9} \text{ E s}^{-1} \cdot 7200 \cdot 0.868} = 0.15$$

6. Data for compounds 1, 3, 6.

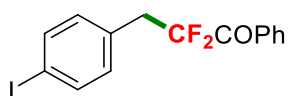


2,4,6-triphenyl-1-(thiophen-2-ylmethyl)pyridin-1-ium tetrafluoroborate (1m). The product (651.0 mg, 53% yield) was purified with silica gel chromatography (DCM/ MeOH = 100:1) as yellow solid. ^1H NMR (400 MHz, CDCl_3) δ 7.84 (s, 2H), 7.72 – 7.71 (m, 2H), 7.66 (d, $J = 6.8 \text{ Hz}$, 4H), 7.52 – 7.47 (m, 9H), 6.06 (s, 1H), 6.39 (s, 1H), 6.26 (s, 1H), 5.71 (s, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -152.62 (minor, $^{11}\text{BF}_4$), -152.67 (major, $^{10}\text{BF}_4$). ^{13}C NMR (101 MHz, CDCl_3) δ 157.0, 156.1, 133.8, 133.6, 132.6, 132.2, 130.9, 129.6, 129.1, 128.9, 128.0, 126.9, 126.5, 125.5, 123.7, 54.0. MS (ESI): m/z (%) 404.1 ($[\text{M}-\text{BF}_4]^+$, 100). HRMS (ESI): calculated for $\text{C}_{28}\text{H}_{22}\text{NS}$ ($[\text{M}-\text{BF}_4]^+$): 404.1467; Found: 404.1469.

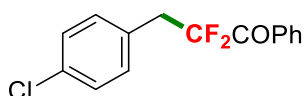


1-(4-methoxy-4-oxobutan-2-yl)-2,4,6-triphenylpyridin-1-ium tetrafluoroborate (1x). The product (520.1 mg, 42% yield) was purified with silica gel chromatography (DCM/ MeOH = 100:1) as yellow solid. ^1H NMR (400 MHz, CDCl_3) δ 7.77 (s, 2H),

7.70 – 7.64 (m, 6H), 7.60 – 7.55 (m, 6H), 7.49 – 7.46 (m, 1H), 7.41 – 7.37 (m, 2H), 5.41 – 5.32 (m, 1H), 3.54 (s, 3H), 2.84 – 2.78 (m, 1H), 2.33 – 2.27 (m, 1H), 1.47 (d, $J = 7.2$ Hz, 3H). ^{19}F NMR (376 MHz, CDCl_3) δ -152.94 (minor, $^{11}\text{BF}_4$), -153.00 (major, $^{10}\text{BF}_4$). ^{13}C NMR (101 MHz, CDCl_3) δ 169.7, 155.1, 133.7, 133.4, 131.9, 130.9, 129.4, 129.1 – 128.6 (m), 128.1, 61.6, 52.1, 39.5, 22.0 (three carbon signal missing due to signal broadening). MS (ESI): m/z (%) 408.2 ($[\text{M}-\text{BF}_4]^+$, 100). HRMS (ESI): calculated for $\text{C}_{28}\text{H}_{26}\text{NO}_2$ ($[\text{M}-\text{BF}_4]^+$): 408.1958; Found: 408.1958.

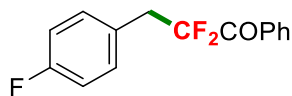


2,2-difluoro-3-(4-iodophenyl)-1-phenylpropan-1-one (3a). The product (60.3 mg, 81% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 8.05 (d, $J = 8.0$ Hz, 2H), 7.66 – 7.61 (m, 3H), 7.48 (t, $J = 7.6$ Hz, 2H), 7.06 (d, $J = 8.0$ Hz, 2H), 3.46 (t, $J = 17.8$ Hz, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -98.48 (t, $J = 17.1$ Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.0 (t, $J = 31.4$ Hz), 137.5, 134.4, 132.8, 131.8 (t, $J = 2.7$ Hz), 130.9 (t, $J = 3.6$ Hz), 130.1 (t, $J = 3.3$ Hz), 128.6, 118.0 (t, $J = 256.3$ Hz), 93.4, 39.5 (t, $J = 23.4$ Hz). MS (EI): m/z (%) 372 (M^+), 105 (100). HRMS (EI): calculated for $\text{C}_{15}\text{H}_{11}\text{F}_2\text{IO}$: 371.9823; Found: 371.9819.

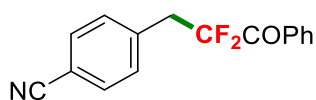


3-(4-Chlorophenyl)-2,2-difluoro-1-phenylpropan-1-one (3b). This compound is known^[2]. The product (44.3 mg, 79% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid. ^1H NMR (400 MHz, CDCl_3) δ 8.05 (d, $J = 7.6$ Hz, 2H), 7.63 (t, $J = 7.4$ Hz, 1H), 7.48 (t, $J = 8.0$ Hz, 2H), 7.31 – 7.24 (m, 4H), 3.49 (t, $J = 17.6$ Hz, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -98.58 (t, $J = 17.7$ Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.1 (t, $J = 31.4$ Hz), 134.4,

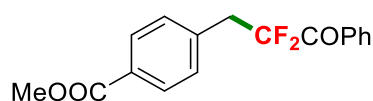
133.7, 132.2, 131.9 (t, $J = 2.5$ Hz), 130.1 (t, $J = 3.4$ Hz), 129.8 (t, $J = 3.7$ Hz), 128.7, 128.6, 118.1 (t, $J = 256.2$ Hz), 39.3 (t, $J = 23.4$ Hz).



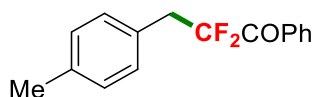
2,2-Difluoro-3-(4-fluorophenyl)-1-phenylpropan-1-one (3c). This compound is known^[2]. The product (40.2 mg, 76% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.04 (d, $J = 7.6$ Hz, 2H), 7.62 (t, $J = 7.4$ Hz, 1H), 7.48 (t, $J = 7.8$ Hz, 2H), 7.29 – 7.27 (m, 2H), 7.01 (t, $J = 8.6$ Hz, 2H), 3.49 (t, $J = 17.8$ Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -98.80 (t, $J = 17.7$ Hz, 2F), -114.95 – -115.02 (m, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 189.3 (t, $J = 31.3$ Hz), 162.4 (d, $J = 247.3$ Hz), 134.3, 132.4 (d, $J = 8.2$ Hz), 132.0 (t, $J = 2.5$ Hz), 130.1 (t, $J = 3.4$ Hz), 128.6, 127.0 – 126.9 (m), 118.2 (t, $J = 256.3$ Hz), 115.3 (d, $J = 21.6$ Hz), 39.2 (t, $J = 23.5$ Hz).



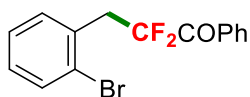
4-(2,2-Difluoro-3-oxo-3-phenylpropyl)benzonitrile (3d). This compound is known^[2]. The product (46.1 mg, 85% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 50:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.06 (d, $J = 8.4$ Hz, 2H), 7.66 – 7.62 (m, 3H), 7.51 – 7.44 (m, 4H), 3.58 (t, $J = 17.4$ Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -97.98 (t, $J = 17.5$ Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 188.5 (t, $J = 31.5$ Hz), 137.0 (t, $J = 3.5$ Hz), 134.6, 132.1, 131.7, 131.6, 130.1 (t, $J = 3.3$ Hz), 128.7, 118.6, 117.9 (t, $J = 257.1$ Hz), 111.6, 39.8 (t, $J = 23.4$ Hz).



Methyl 4-(2,2-difluoro-3-oxo-3-phenylpropyl)benzoate (3e). This compound is known^[2]. The product (51.1 mg, 84% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 50:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.04 (d, *J* = 7.6 Hz, 2H), 7.99 (d, *J* = 8.0 Hz, 2H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.8 Hz, 2H), 7.39 (d, *J* = 8.0 Hz, 2H), 3.90 (s, 3H), 3.57 (t, *J* = 17.6 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -98.24 (t, *J* = 17.7 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 188.9 (t, *J* = 31.4 Hz), 166.8, 136.6 (t, *J* = 3.5 Hz), 134.4, 131.8 (t, *J* = 2.8 Hz), 130.9, 130.1 (t, *J* = 3.3 Hz), 129.6, 129.4, 128.6, 118.1 (t, *J* = 256.5 Hz), 52.1, 39.9 (t, *J* = 23.4 Hz).

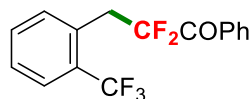


2,2-Difluoro-1-phenyl-3-(p-tolyl)propan-1-one (3f). This compound is known^[2]. The product (33.3 mg, 64% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.06 (d, *J* = 8.0 Hz, 2H), 7.62 (d, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.22 – 7.14 (m, 4H), 3.50 (t, *J* = 18.0 Hz, 2H), 2.35 (s, 3H). ¹⁹F NMR (376 MHz, CDCl₃) δ -98.79 (t, *J* = 17.9 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 189.5 (t, *J* = 31.2 Hz), 137.3, 134.2, 132.1 (t, *J* = 2.7 Hz), 130.7, 130.1 (t, *J* = 3.3 Hz), 129.1, 128.6, 128.0 (t, *J* = 3.6 Hz), 118.3 (t, *J* = 255.5 Hz), 39.7 (t, *J* = 23.3 Hz), 21.1.

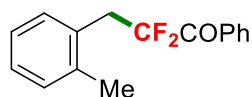


3-(2-Bromophenyl)-2,2-difluoro-1-phenylpropan-1-one (3g). This compound is known^[2]. The product (50.1 mg, 77% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.11 (d, *J* = 8.0 Hz, 2H), 7.65 – 7.59 (m, 2H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.42 (d, *J* = 7.6 Hz, 1H), 7.30 (t, *J* = 7.6 Hz, 1H), 7.17 (t, *J* = 7.8 Hz, 1H), 3.76 (t, *J* = 18.0 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -98.86 (t, *J* = 18.0 Hz, 2F).

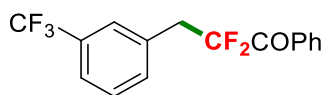
^{13}C NMR (101 MHz, CDCl_3) δ 189.1 (t, $J = 30.9$ Hz), 134.4, 133.1, 132.6, 131.8 (t, $J = 2.6$ Hz), 131.5 (t, $J = 2.6$ Hz), 130.2 (t, $J = 3.4$ Hz), 129.3, 128.6, 127.3, 126.1, 118.2 (t, $J = 256.7$ Hz), 39.3 (t, $J = 23.1$ Hz).



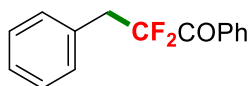
2,2-difluoro-1-phenyl-3-(2-(trifluoromethyl)phenyl)propan-1-one (3h). This compound is known^[2]. The product (45.9 mg, 73% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.12 (d, $J = 8.4$ Hz, 2H), 7.71 (d, $J = 7.6$ Hz, 1H), 7.64 (t, $J = 7.4$ Hz, 1H), 7.58 – 7.41 (m, 5H), 3.77 (t, $J = 18.2$ Hz, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -58.64 (t, $J = 5.8$ Hz, 3F), -98.34 – -98.45 (m, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.0 (t, $J = 31.4$ Hz), 134.4, 133.1, 131.6, 130.5, 130.2 (t, $J = 3.4$ Hz), 130.0, 128.7, 127.7, 126.4 (q, $J = 5.7$ Hz), 124.2 (q, $J = 275.2$ Hz), 117.8 (t, $J = 256.9$ Hz), 35.7 (t, $J = 22.7$ Hz).



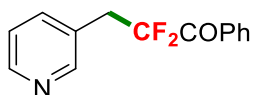
2,2-difluoro-1-phenyl-3-(o-tolyl)propan-1-one (3i). This compound is known^[2]. The product (40.1 mg, 77% yield) was purified with silica gel chromatography Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 8.06 (d, $J = 7.6$ Hz, 2H), 7.62 (t, $J = 7.4$ Hz, 1H), 7.48 (t, $J = 7.8$ Hz, 2H), 7.27 (d, $J = 7.6$ Hz, 1H), 7.22 - 7.15 (m, 3H), 3.57 (t, $J = 18.4$ Hz, 2H), 2.38 (s, 3H). ^{19}F NMR (376 MHz, CDCl_3) δ -98.67 (t, $J = 18.4$ Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.8 (t, $J = 31.3$ Hz), 138.0, 134.2, 132.1 (t, $J = 2.4$ Hz), 131.7, 130.5, 130.1 (t, $J = 3.4$ Hz), 129.8 (t, $J = 2.8$ Hz), 128.6, 127.7, 125.8, 118.8 (t, $J = 255.7$ Hz), 36.7 (t, $J = 23.3$ Hz), 19.9 (t, $J = 1.9$ Hz).



2,2-Difluoro-1-phenyl-3-(3-(trifluoromethyl)phenyl)propan-1-one (3j). This compound is known^[2]. The product (54.7 mg, 87% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.08 (d, *J* = 7.2 Hz, 2H), 7.65 – 7.44 (m, 7H), 3.58 (t, *J* = 17.8 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -62.68 (s, 3F), -98.54 (t, *J* = 17.7 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 188.8 (t, *J* = 31.4 Hz), 134.5, 134.3, 132.4 (t, *J* = 3.5 Hz), 131.7 (t, *J* = 3.0 Hz), 130.8 (q, *J* = 32.3 Hz), 130.2 (t, *J* = 3.3 Hz), 128.8, 128.7, 127.6 (q, *J* = 3.8 Hz), 124.5 (q, *J* = 3.8 Hz), 123.9 (q, *J* = 273.6 Hz), 118.0 (t, *J* = 256.6 Hz), 39.6 (t, *J* = 23.4 Hz).

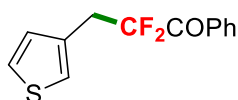


2,2-difluoro-1,3-diphenylpropan-1-one (3k). This compound is known^[2]. The product (36.4 mg, 74% yield) was purified with silica gel chromatography Petroleum ether/ Dichloromethane = 200:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.05 (d, *J* = 8.0 Hz, 2H), 7.62 (t, *J* = 7.6 Hz, 1H), 7.47 (t, *J* = 7.8 Hz, 2H), 7.33 (s, 5H), 3.54 (t, *J* = 17.8 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -98.68 (t, *J* = 17.9 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 189.5 (t, *J* = 31.3 Hz), 134.2, 132.1 (t, *J* = 2.6 Hz), 131.2 (t, *J* = 3.7 Hz), 130.8, 130.1 (t, *J* = 3.4 Hz), 128.6, 128.4, 127.6, 118.3 (t, *J* = 255.7 Hz), 40.1 (t, *J* = 23.4 Hz).

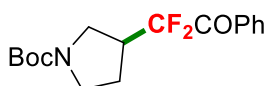


2,2-Difluoro-1-phenyl-3-(pyridin-3-yl)propan-1-one (3l). This compound is known^[2]. The product (40.1 mg, 81% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 10:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.58 – 8.55 (m, 2H), 8.07 (d, *J* = 7.6 Hz, 2H), 7.70 (d, *J* = 7.6 Hz, 1H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.30 – 7.28 (m, 1H), 3.53 (t, *J* =

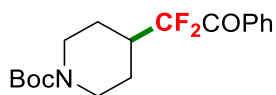
17.6 Hz, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -98.34 (t, J = 17.7 Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 188.6 (t, J = 31.6 Hz), 151.5, 148.7, 138.4, 134.5, 131.6, 130.1 (t, J = 3.3 Hz), 128.7, 127.4 (t, J = 3.0 Hz), 123.3, 117.9 (t, J = 256.6 Hz), 37.2 (t, J = 23.7 Hz).



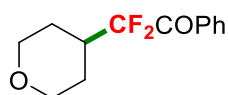
2,2-difluoro-1-phenyl-3-(thiophen-2-yl)propan-1-one (3m). The product (37.8 mg, 75% yield) was purified with silica gel chromatography (Petroleum ether/Dichloromethane = 120:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.04 (d, J = 7.6 Hz, 2H), 7.62 (t, J = 7.4 Hz, 1H), 7.47 (t, J = 7.8 Hz, 2H), 7.29 – 7.27 (m, 1H), 7.19 (s, 1H), 7.06 (d, J = 4.8 Hz, 1H), 3.58 (t, J = 17.4 Hz, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -98.47 (t, J = 17.5 Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.4 (t, J = 31.4 Hz), 134.2, 132.1, 131.0 (t, J = 4.1 Hz), 130.1 (t, J = 3.4 Hz), 129.5, 128.6, 125.6, 124.9, 118.1 (t, J = 256.0 Hz), 34.8 (t, J = 24.2 Hz). MS (ESI): m/z (%) 275 ($[\text{M}+\text{Na}]^+$, 100). HRMS (ESI): calculated for $\text{C}_{13}\text{H}_{10}\text{F}_2\text{OSNa}$ ($[\text{M}+\text{Na}]^+$): 275.0420; Found: 275.0313.



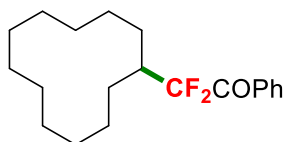
Tert-butyl 3-(1,1-difluoro-2-oxo-2-phenylethyl)pyrrolidine-1-carboxylate (3n). This compound is known^[2]. The product (49.5 mg, 76% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 20:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.11 (d, J = 7.2 Hz, 2H), 7.64 (t, J = 7.4 Hz, 1H), 7.50 (t, J = 7.6 Hz, 2H), 3.68 – 3.14 (m, 6H), 2.16 – 2.08 (m, 1H), 1.45 (s, 9H). ^{19}F NMR (376 MHz, CDCl_3) δ -105.61 – -105.94 (m, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 188.7 (t, J = 32.1 Hz), 154.3, 134.6, 131.7, 130.2 (t, J = 3.3 Hz), 128.7, 119.1 (t, J = 257.1 Hz), 79.5, 45.23, 45.17, 41.7 (br), 28.5, 24.6.



Tert-butyl 4-(1,1-difluoro-2-oxo-2-phenylethyl)piperidine-1-carboxylate (3o). This compound is known^[2]. The product (58.4 mg, 86% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 20:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.63 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 4.19 (br, 2H), 2.69 (t, *J* = 11.8 Hz, 2H), 2.50 – 2.37 (m, 1H), 1.78 (d, *J* = 12.8 Hz, 2H), 1.52 – 1.47 (m, 2H), 1.44 (s, 9H). ¹⁹F NMR (376 MHz, CDCl₃) δ -107.87 (t, *J* = 13.3 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 189.5 (t, *J* = 31.0 Hz), 154.6, 134.3, 132.4, 130.0 (t, *J* = 3.5 Hz), 128.7, 119.4 (t, *J* = 256.5 Hz), 79.6, 43.1 (br), 40.2 (t, *J* = 22.2 Hz), 28.4, 24.2.

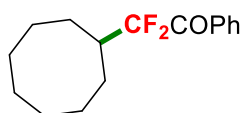


2,2-Difluoro-1-phenyl-2-(tetrahydro-2H-pyran-4-yl)ethan-1-one (3p). This compound is known^[2]. The product (22.6 mg, 47% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 50:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.09 (d, *J* = 8.4 Hz, 2H), 7.64 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 4.04 (d, *J* = 11.2 Hz, 2H), 3.46 – 3.38 (m, 2H), 2.64 – 2.49 (m, 1H), 1.74 – 1.61 (m, 4H). ¹⁹F NMR (376 MHz, CDCl₃) δ -108.57 (d, *J* = 14.3 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 189.4 (t, *J* = 31.0 Hz), 134.3, 132.4 (t, *J* = 2.3 Hz), 130.0 (t, *J* = 3.6 Hz), 128.7, 119.2 (t, *J* = 256.3 Hz), 67.0, 39.1 (t, *J* = 22.4 Hz), 24.8 (t, *J* = 4.4 Hz).

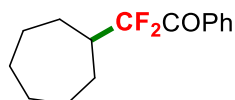


2-Cyclododecyl-2,2-difluoro-1-phenylethan-1-one (3q). This compound is known^[2]. The product (45.8 mg, 71% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ¹H NMR (400 MHz,

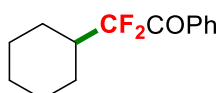
CDCl₃) δ 8.08 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 7.4 Hz, 1H), 7.49 (t, J = 7.8 Hz, 2H), 2.53 – 2.41 (m, 1H), 1.61 – 1.23 (m, 22H). ¹⁹F NMR (376 MHz, CDCl₃) δ -105.25 (d, J = 16.5 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 190.4 (t, J = 30.6 Hz), 134.0, 132.8, 129.9 (t, J = 3.3 Hz), 128.6, 121.6 (t, J = 256.7 Hz), 38.4 (t, J = 20.6 Hz), 24.3, 23.6, 23.5, 23.4, 22.4.



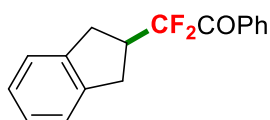
2-Cyclooctyl-2,2-difluoro-1-phenylethan-1-one (3r). This compound is known^[2]. The product (32.5 mg, 61% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ¹H NMR (400 MHz, CDCl₃) δ 8.08 (d, J = 8.0 Hz, 2H), 7.62 (t, J = 7.4 Hz, 1H), 7.49 (t, J = 7.8 Hz, 2H), 2.59 – 2.46 (m, 1H), 1.80 – 1.75 (m, 4H), 1.61 – 1.49 (m, 10H). ¹⁹F NMR (376 MHz, CDCl₃) δ -107.04 (d, J = 15.0 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 190.5 (t, J = 31.0 Hz), 134.0, 132.9, 129.9 (t, J = 3.5 Hz), 128.6, 121.4 (t, J = 256.9 Hz), 41.2 (t, J = 20.4 Hz), 26.6, 26.2, 25.6 (t, J = 4.1 Hz), 25.4.



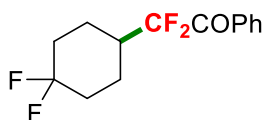
2-Cycloheptyl-2,2-difluoro-1-phenylethan-1-one (3s). This compound is known^[2]. The product (36.3 mg, 72% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ¹H NMR (400 MHz, CDCl₃) δ 8.08 (d, J = 6.8 Hz, 2H), 7.62 (t, J = 7.4 Hz, 1H), 7.49 (t, J = 7.8 Hz, 2H), 2.50 – 2.35 (m, 1H), 1.88 – 1.82 (m, 2H), 1.78 – 1.72 (m, 2H), 1.60 – 1.41 (m, 8H). ¹⁹F NMR (376 MHz, CDCl₃) δ -106.95 (d, J = 16.5 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 190.5 (t, J = 30.8 Hz), 134.0, 132.9, 129.9 (t, J = 3.6 Hz), 128.6, 121.1 (t, J = 256.6 Hz), 43.3 (t, J = 20.7 Hz), 28.2, 26.49, 26.46, 26.4.



2-Cyclohexyl-2,2-difluoro-1-phenylethan-1-one (3t). This compound is known^[2]. The product (41.5 mg, 87% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ¹H NMR (400 MHz, CDCl₃) δ 8.08 (d, *J* = 8.0 Hz, 2H), 7.62 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 2.31 – 2.18 (m, 1H), 1.82 (t, *J* = 9.2 Hz, 4H), 1.70 – 1.68 (m, 1H), 1.34 – 1.16 (m, 5H). ¹⁹F NMR (376 MHz, CDCl₃) δ -108.55 (d, *J* = 15.0 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 190.4 (t, *J* = 30.4 Hz), 134.0, 132.9 (t, *J* = 1.8 Hz), 130.0 (t, *J* = 3.6 Hz), 128.6, 120.3 (t, *J* = 255.5 Hz), 42.1 (t, *J* = 21.8 Hz), 25.9, 25.4, 24.8 (t, *J* = 4.2 Hz).

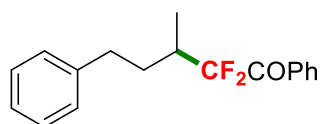


2-(2,3-Dihydro-1H-inden-2-yl)-2,2-difluoro-1-phenylethan-1-one (3u). This compound is known^[2]. The product (40.8 mg, 75% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as colorless oil. ¹H NMR (400 MHz, CDCl₃) δ 8.17 (d, *J* = 7.6 Hz, 2H), 7.66 (t, *J* = 7.4 Hz, 1H), 7.53 (t, *J* = 7.8 Hz, 2H), 7.24 – 7.16 (m, 4H), 3.54 – 3.37 (m, 1H), 3.21 (d, *J* = 1.6 Hz, 2H), 3.18 (d, *J* = 2.8 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -105.6 (d, *J* = 16.5 Hz, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 189.3 (t, *J* = 31.8 Hz), 141.3, 134.3, 132.2 (t, *J* = 2.3 Hz), 130.2 (t, *J* = 3.4 Hz), 128.7, 126.6, 124.4, 120.2 (t, *J* = 255.7 Hz), 42.4 (t, *J* = 22.5 Hz), 32.8 (t, *J* = 4.6 Hz).

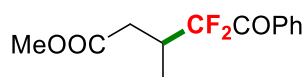


2-(4,4-difluorocyclohexyl)-2,2-difluoro-1-phenylethan-1-one (3v). This compound is known^[2]. The product (39.5 mg, 72% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 200:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.09 (d, *J* = 7.6 Hz, 2H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 2.46 – 2.33 (m, 1H), 2.22 – 2.18 (m, 2H), 1.97 – 1.95 (m, 2H), 1.83 – 1.63 (m, 4H). ¹⁹F NMR (376 MHz, CDCl₃) δ -92.23 (d, *J* = 237.3 Hz, 1F), -102.42 – -103.23 (m,

1F), -107.02 (d, $J = 14.3$ Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.4 (t, $J = 31.1$ Hz), 134.4, 132.3 (t, $J = 2.1$ Hz), 130.1 (t, $J = 3.6$ Hz), 128.7, 122.5 (dd, $J = 243.5, 240.9$ Hz), 119.5 (td, $J = 257.0, 2.2$ Hz), 39.6 (td, $J = 22.0, 1.1$ Hz), 32.7 (dd, $J = 25.7, 23.8$ Hz), 21.5 – 21.3(m).

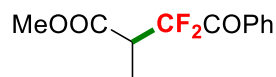


2,2-Difluoro-3-methyl-1,5-diphenylpentan-1-one (3w). This compound is known^[2]. The product (35.2 mg, 61% yield) was purified with silica gel chromatography (Petroleum ether/ Dichloromethane = 150:1) as colorless oil. ^1H NMR (400 MHz, CDCl_3) δ 8.03 (d, $J = 8.0$ Hz, 2H), 7.62 (t, $J = 7.4$ Hz, 1H), 7.47 (t, $J = 7.8$ Hz, 2H), 7.26 (t, $J = 7.6$ Hz, 2H), 7.19 – 7.14 (m, 3H), 2.84 – 2.77 (m, 1H), 2.62 – 2.54 (m, 1H), 2.49 – 2.35 (m, 1H), 2.05 – 1.96 (m, 1H), 1.67 – 1.58 (m, 1H), 1.13 (d, $J = 6.8$ Hz, 3H). ^{19}F NMR (376 MHz, CDCl_3) δ -107.58 (t, $J = 16.7$ Hz, 2F). ^{13}C NMR (101 MHz, CDCl_3) δ 190.0 (t, $J = 30.5$ Hz), 141.3, 134.1, 132.6, 129.9 (t, $J = 3.6$ Hz), 128.6, 128.4, 128.3, 126.0, 120.7 (t, $J = 256.4$ Hz), 37.0 (t, $J = 21.7$ Hz), 33.0, 30.6 (t, $J = 3.8$ Hz), 12.2 (t, $J = 5.1$ Hz).

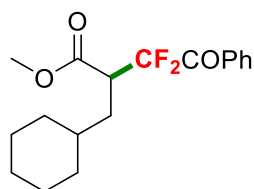


Methyl-4,4-difluoro-3-methyl-5-oxo-5-phenylpentanoate (3x). The product (33.3 mg, 65% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.09 (d, $J = 8.0$ Hz, 2H), 7.64 (t, $J = 7.2$ Hz, 1H), 7.50 (t, $J = 7.6$ Hz, 2H), 3.70 (s, 3H), 3.13 – 2.97 (m, 1H), 2.77 (m, 1H), 2.35 (m, 1H), 1.11 (d, $J = 6.8$ Hz, 3H). ^{19}F NMR (376 MHz, CDCl_3) δ -105.41 (dd, $J = 278.4, 11.8$ Hz, 1F), -110.67 (dd, $J = 278.4, 17.9$ Hz, 1F). ^{13}C NMR (101 MHz, CDCl_3) δ 189.1 (t, $J = 30.6$ Hz), 172.1, 134.4, 132.2 (t, $J = 2.0$ Hz), 130.0 (t, $J = 3.4$ Hz), 128.7, 119.8 (dd, $J = 257.8, 256.3$ Hz), 51.9, 34.7 (t, $J = 22.2$ Hz), 34.2

(t, $J = 4.4$ Hz), 13.2 (t, $J = 4.8$ Hz). MS (ESI): m/z (%) 279 ($[M+Na]^+$, 100). HRMS (ESI): calculated for $C_{13}H_{14}F_2O_3Na$ ($[M+Na]^+$): 279.0911; Found: 279.0803.

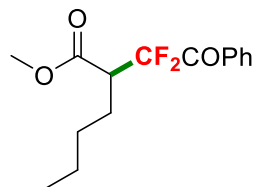


Methyl-3,3-difluoro-2-methyl-4-oxo-4-phenylbutanoate (3y). The product (32.9 mg, 68% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/Ethyl acetate = 100:1) as pale yellow oil. 1H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, $J = 8.0$ Hz, 2H), 7.64 (t, $J = 7.8$ Hz, 1H), 7.50 (t, $J = 7.8$ Hz, 2H), 3.69 (s, 3H), 3.63 – 3.50 (m, 1H), 1.46 (d, $J = 7.6$ Hz, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -101.41 (dd, $J = 293.3$, 9.0 Hz, 1F), -109.42 (dd, $J = 293.3$, 19.9 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 189.2 (t, $J = 30.8$ Hz), 170.7 (d, $J = 10.8$ Hz), 134.2, 132.1, 130.0, 128.6, 117.7 (dd, $J = 264.1$, 254.8 Hz), 52.3, 43.6 (t, $J = 23.7$ Hz), 9.8 (t, $J = 4.6$ Hz). MS (ESI): m/z (%) 265 ($[M+Na]^+$, 100). HRMS (ESI): calculated for $C_{12}H_{12}F_2O_3Na$ ($[M+Na]^+$): 265.0755; Found: 265.0647.

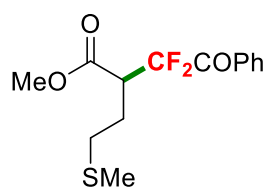


Methyl-2-(cyclohexylmethyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3z). The product (48.7 mg, 75% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/Ethyl acetate = 150:1) as pale yellow oil. 1H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, $J = 8.0$ Hz, 2H), 7.64 (t, $J = 7.4$ Hz, 1H), 7.50 (t, $J = 7.8$ Hz, 2H), 3.71 (s, 3H), 3.56 – 3.45 (m, 1H), 1.89 – 1.82 (m, 2H), 1.70 – 1.58 (m, 4H), 1.25 – 1.13 (m, 4H), 1.00 – 0.83 (m, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -102.24 (dd, $J = 292.9$, 13.5 Hz, 1F), -104.29 (dd, $J = 293.3$, 15.8 Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.8 (t, $J = 30.9$ Hz), 170.5 (d, $J = 8.6$ Hz), 134.3, 132.0 (t, $J = 2.8$ Hz), 130.1 (t, $J = 3.4$ Hz), 128.7, 118.0 (dd, $J = 262.7$, 258.2 Hz), 52.2, 46.7 (dd, $J = 23.4$, 21.2 Hz), 35.3, 33.7,

32.8 (t, $J = 3.1$ Hz), 32.1, 26.4, 26.0 (d, $J = 15.4$ Hz). MS (ESI): m/z (%) 325 ($[M+H]^+$, 100). HRMS (ESI): calculated for $C_{18}H_{23}F_2O_3$ ($[M+H]^+$): 325.1611; Found: 325.1537.

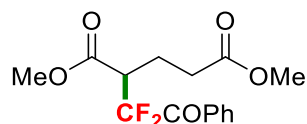


Methyl-2-(1,1-difluoro-2-oxo-2-phenylethyl)hexanoate (3aa). The product (40.9 mg, 72% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/Ethyl acetate = 150:1) as pale yellow oil. 1H NMR (400 MHz, $CDCl_3$) δ 8.08 (d, $J = 8.0$ Hz, 2H), 7.63 (t, $J = 7.4$ Hz, 1H), 7.49 (t, $J = 7.8$ Hz, 2H), 3.71 (s, 3H), 3.44 – 3.33 (m, 1H), 1.93 – 1.79 (m, 2H), 1.43 – 1.33 (m, 4H), 0.91 (t, $J = 6.8$ Hz, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -101.70 (dd, $J = 294.6, 11.5$ Hz, 1F), -104.80 (dd, $J = 294.8, 16.5$ Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.9 (dd, $J = 31.6, 30.6$ Hz), 170.3 (d, $J = 8.6$ Hz), 134.3, 132.0 (t, $J = 2.9$ Hz), 130.1 (t, $J = 3.4$ Hz), 128.6, 117.9 (dd, $J = 263.3, 257.2$ Hz), 52.1, 49.2 (dd, $J = 23.8, 21.2$ Hz), 29.4, 25.2 (t, $J = 3.6$ Hz), 22.4, 13.7. MS (ESI): m/z (%) 307 ($[M+Na]^+$, 100). HRMS (ESI): calculated for $C_{15}H_{18}F_2O_3Na$ ($[M+Na]^+$): 307.1116; Found: 307.1224.

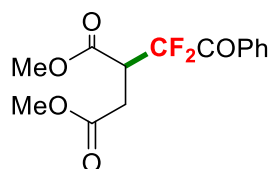


Methyl 3,3-difluoro-2-(2-(methylthio)ethyl)-4-oxo-4-phenylbutanoate (3ab). This compound is known^[2]. The product (49.6 mg, 82% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/Ethyl acetate = 100:1) as pale yellow oil. 1H NMR (400 MHz, $CDCl_3$) δ 8.06 (d, $J = 8.4$ Hz, 2H), 7.63 (t, $J = 7.6$ Hz, 1H), 7.49 (t, $J = 7.8$ Hz, 2H), 3.75 – 3.62 (m, 4H), 2.69 – 2.67 (m, 1H), 2.60 – 2.55 (m, 1H), 2.28 – 2.15 (m, 2H), 2.10 (s, 3H). ^{19}F NMR (376 MHz, $CDCl_3$) δ -100.76 (dd, $J = 293.7, 11.7$ Hz, 1F), -105.22 (dd, $J = 293.5, 18.2$ Hz, 1F). ^{13}C NMR (101 MHz, $CDCl_3$) δ 188.6

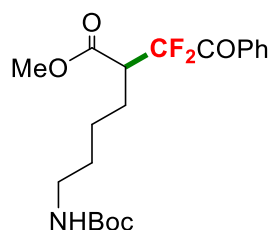
(t, $J = 30.9$ Hz), 169.7 (d, $J = 9.6$ Hz), 134.4, 131.8, 130.0 (t, $J = 3.4$ Hz), 128.7, 117.8 (dd, $J = 264.0, 257.4$ Hz), 52.3, 47.8 (t, $J = 22.7$ Hz), 31.6, 24.7, 15.0.



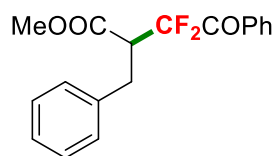
Dimethyl 2-(1,1-difluoro-2-oxo-2-phenylethyl)pentanedioate (3ac). This compound is known^[2]. The product (44.6 mg, 71% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 10:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.07 (d, $J = 7.6$ Hz, 2H), 7.64 (t, $J = 7.4$ Hz, 1H), 7.50 (t, $J = 7.8$ Hz, 2H), 3.70 (s, 3H), 3.69 (s, 3H), 3.56 – 3.46 (m, 1H), 2.60 – 2.43 (m, 2H), 2.29 – 2.17 (m, 2H). ^{19}F NMR (376 MHz, CDCl_3) δ -100.21 – -100.99 (m, 1F), -105.72 – -106.51 (m, 1F). ^{13}C NMR (101 MHz, CDCl_3) δ 188.6 (t, $J = 30.7$ Hz), 172.7, 169.6 (d, $J = 10.2$ Hz), 134.4, 131.8 (t, $J = 2.7$ Hz), 130.1 (t, $J = 2.9$ Hz), 128.7, 117.7 (dd, $J = 264.6, 256.8$ Hz), 52.3, 51.8, 48.1 (dd, $J = 23.7, 21.7$ Hz), 31.4, 20.5 (t, $J = 4.0$ Hz).



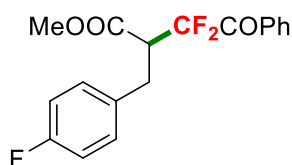
Dimethyl 2-(1,1-difluoro-2-oxo-2-phenylethyl)succinate (3ad). This compound is known^[2]. The product (46.8 mg, 78% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 10:1) as pale yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 8.06 (d, $J = 7.6$ Hz, 2H), 7.65 (t, $J = 7.4$ Hz, 1H), 7.51 (t, $J = 7.8$ Hz, 2H), 4.12 – 4.02 (m, 1H), 3.74 (s, 3H), 3.68 (s, 3H), 3.08 – 3.01 (m, 1H), 2.87 – 2.81 (m, 1H). ^{19}F NMR (376 MHz, CDCl_3) δ -99.74 (dd, $J = 288.0, 10.5$ Hz, 1F), -105.58 (dd, $J = 288.2, 18.2$ Hz, 1F). ^{13}C NMR (101 MHz, CDCl_3) δ 188.1 (t, $J = 29.9$ Hz), 171.2, 168.5 (dd, $J = 7.3, 2.5$ Hz), 134.5, 131.8, 130.0 (t, $J = 3.1$ Hz), 128.7, 117.3 (dd, $J = 262.5, 259.1$ Hz), 52.7, 52.3, 45.9 (t, $J = 23.1$ Hz), 30.0 (t, $J = 4.1$ Hz).



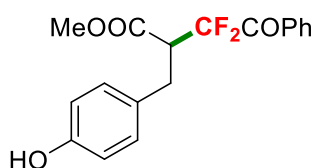
Methyl 6-((tert-butoxycarbonyl)amino)-2-(1,1-difluoro-2-oxo-2-phenylethyl)hexanoate (3ae). This compound is known^[21]. The product (71.1 mg, 89% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 10:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 4.55 (br, 1H), 3.70 (s, 3H), 3.44 – 3.33 (m, 1H), 3.12 (s, 2H), 1.97 – 1.80 (m, 2H), 1.59 – 1.50 (m, 4H), 1.42 (s, 9H). ¹⁹F NMR (376 MHz, CDCl₃) δ -101.45 (dd, *J* = 295.0, 11.5 Hz, 1F), -104.96 (dd, *J* = 294.8, 17.3 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.7 (t, *J* = 31.1 Hz), 170.1 (d, *J* = 9.5 Hz), 155.9, 134.4, 131.8 (t, *J* = 2.7 Hz), 130.1 (t, *J* = 3.2 Hz), 128.6, 117.7 (dd, *J* = 263.8, 257.2 Hz), 79.1, 52.2, 49.0 (dd, *J* = 23.8, 21.3 Hz), 40.1, 29.8, 28.3, 25.1 (t, *J* = 3.6 Hz), 24.5.



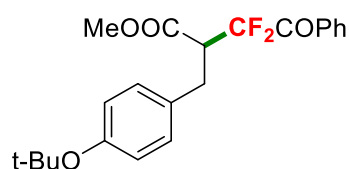
Methyl 2-benzyl-3,3-difluoro-4-oxo-4-phenylbutanoate (3af). This compound is known^[21]. The product (52.2 mg, 82% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 70:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.11 (d, *J* = 8.0 Hz, 2H), 7.66 (t, *J* = 7.2 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 2H), 7.32 – 7.24 (m, 5H), 3.78 – 3.67 (m, 1H), 3.58 (s, 3H), 3.19 (d, *J* = 7.2 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -101.90 (dd, *J* = 294.9, 13.7 Hz, 1F), -103.69 (dd, *J* = 295.0, 15.2 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.4 (t, *J* = 31.0 Hz), 169.5, 137.4, 134.5, 131.8, 130.1 (t, *J* = 3.3 Hz), 128.9, 128.7, 128.5, 126.8, 117.6 (dd, *J* = 263.4, 259.5 Hz), 52.1, 51.5 (dd, *J* = 23.0, 21.1 Hz), 31.7 (t, *J* = 4.3 Hz).



Methyl 3,3-difluoro-2-(4-fluorobenzyl)-4-oxo-4-phenylbutanoate (3ag). This compound is known^[2]. The product (58.5 mg, 87% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.10 (d, *J* = 7.6 Hz, 2H), 7.65 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.8 Hz, 2H), 7.22 – 7.18 (m, 2H), 7.01 – 6.96 (m, 2H), 3.74 – 3.63 (m, 1H), 3.58 (s, 3H), 3.16 (d, *J* = 7.2 Hz, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -101.88 (dd, *J* = 295.9, 13.2 Hz, 1F), -103.55 (dd, *J* = 295.9, 14.7 Hz, 1F), -116.02 (s, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.3 (t, *J* = 30.9 Hz), 169.3 (d, *J* = 7.7 Hz), 161.8 (d, *J* = 246.2 Hz), 134.6, 133.1 (d, *J* = 3.1 Hz), 131.7 (t, *J* = 2.9 Hz), 130.5 (d, *J* = 8.1 Hz), 130.1 (t, *J* = 3.4 Hz), 128.7, 117.5 (dd, *J* = 263.5, 259.7 Hz), 115.4 (d, *J* = 21.5 Hz) 52.2, 51.5 (t, *J* = 22.2 Hz), 30.9 (t, *J* = 4.5 Hz).

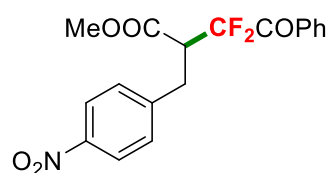


Methyl 3,3-difluoro-2-(4-hydroxybenzyl)-4-oxo-4-phenylbutanoate (3ah). The product (58.2 mg, 87% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.10 (d, *J* = 7.6 Hz, 2H), 7.65 (t, *J* = 7.6 Hz, 1H), 7.50 (t, *J* = 7.8 Hz, 2H), 7.07 (d, *J* = 8.4 Hz, 2H), 6.74 (d, *J* = 8.4 Hz, 2H), 5.66 (br, 1H), 3.73 – 3.62 (m, 1H), 3.58 (s, 3H), 3.12 – 3.10 (m, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -102.04 (dd, *J* = 295.5, 13.9 Hz, 1F), -103.40 (dd, *J* = 295.5, 15.4 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.5 (t, *J* = 31.1 Hz), 169.9 (d, *J* = 7.3 Hz), 154.6, 134.6, 131.7, 130.2 (t, *J* = 3.4 Hz), 130.1, 129.1, 128.7, 117.5 (t, *J* = 261.4 Hz), 115.4, 52.2, 51.7 (t, *J* = 21.9 Hz), 30.9 (t, *J* = 4.4 Hz). MS (ESI): *m/z* (%) 357 ([M+Na]⁺, 100). HRMS (ESI): calculated for C₁₈H₁₆F₂O₄Na ([M+Na]⁺): 357.1017; Found: 357.0908.

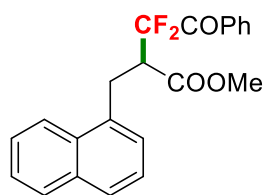


Methyl -2-(4-(tert-butoxy)benzyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3ai).

This compound is known^[2]. The product (66.4 mg, 85% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.10 (d, *J* = 7.6 Hz, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.8 Hz, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 6.92 (d, *J* = 8.4 Hz, 2H), 3.74 – 3.63 (m, 1H), 3.54 (s, 3H), 3.15 (s, 1H), 3.13 (d, *J* = 2.8 Hz, 1H). ¹⁹F NMR (376 MHz, CDCl₃) δ -101.99 (dd, *J* = 295.5, 13.5 Hz, 1F), -103.72 (dd, *J* = 295.2, 15.4 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.4 (t, *J* = 30.9 Hz), 169.5 (d, *J* = 8.2 Hz), 154.1, 134.5, 132.2, 131.8 (t, *J* = 2.7 Hz), 130.1 (t, *J* = 3.2 Hz), 129.3, 128.7, 124.2, 117.5 (dd, *J* = 263.2, 259.5 Hz), 78.3, 52.0, 51.5 (dd, *J* = 23.0, 20.8 Hz), 31.1 (t, *J* = 4.4 Hz), 28.8.

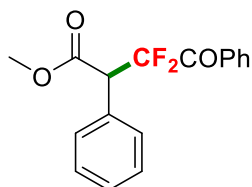


Methyl-3,3-difluoro-2-(4-nitrobenzyl)-4-oxo-4-phenylbutanoate (3aj). The product (51.6 mg, 71% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 50:1) as pale yellow solid. ¹H NMR (400 MHz, CDCl₃) δ 8.18 (d, *J* = 8.8 Hz, 2H), 8.10 (d, *J* = 7.6 Hz, 2H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.52 (t, *J* = 7.8 Hz, 2H), 7.43 (d, *J* = 8.4 Hz, 2H), 3.81 – 3.70 (m, 1H), 3.60 (s, 3H), 3.31 – 3.28 (m, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -101.72 (dd, *J* = 297.2, 13.0 Hz, 1F), -104.25 (dd, *J* = 297.0, 15.4 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.1 (t, *J* = 30.8 Hz), 168.8 (d, *J* = 8.0 Hz), 147.0, 145.2, 134.7, 131.4, 130.2, 130.0, 128.8, 123.8, 117.4 (dd, *J* = 264.2, 260.0 Hz), 52.4, 50.7 (t, *J* = 22.2 Hz), 31.5 (t, *J* = 4.3 Hz). MS (ESI): *m/z* (%) 386 ([M+Na]⁺, 100). HRMS (ESI): calculated for C₁₈H₁₅F₂NO₅Na ([M+Na]⁺): 386.0813; Found: 386.0918.



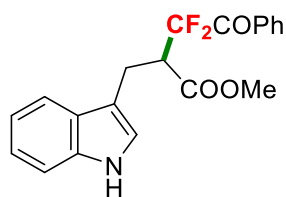
Methyl-3,3-difluoro-2-(naphthalen-1-ylmethyl)-4-oxo-4-phenylbutanoate(3ak).

The product (67.8 mg, 92% yield, procedure b) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 100:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.18 – 8.13 (m, 3H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.80 – 7.78 (m, 1H), 7.67 (t, *J* = 7.4 Hz, 1H), 7.60 – 7.50 (m, 4H), 7.43 – 7.39 (m, 2H), 3.89 – 4.00 (m, 1H), 3.78 (dd, *J* = 14.0, 4.0 Hz, 1H), 3.62 – 3.55 (m, 1H), 3.49 (s, 3H). ¹⁹F NMR (376 MHz, CDCl₃) δ -102.27 (dd, *J* = 297.0, 14.3 Hz, 1F), -103.47 (dd, *J* = 297.2, 14.5 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 188.4 (t, *J* = 31.1 Hz), 169.5 (d, *J* = 7.2 Hz), 134.6, 134.0, 133.2, 131.8, 131.7, 130.2 (t, *J* = 3.3 Hz), 129.0, 128.8, 127.9, 127.6, 126.5, 125.7, 125.4, 117.8 (dd, *J* = 262.7, 260.1 Hz), 52.1, 50.5 (t, *J* = 21.9 Hz), 29.2 (t, *J* = 4.5 Hz). MS (ESI): *m/z* (%) 369 ([M+H]⁺, 100). HRMS (ESI): calculated for C₂₂H₁₉F₂O₃ ([M+H]⁺): 369.1300; Found: 369.1224.



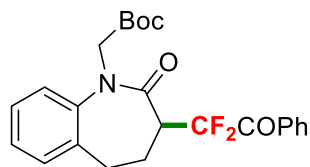
Methyl-3,3-difluoro-4-oxo-2,4-diphenylbutanoate (3al). This compound is known^[8].

The product (44.4 mg, 73% yield, procedure a) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 150:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.63 (t, *J* = 7.4 Hz, 1H), 7.49 (t, *J* = 7.8 Hz, 2H), 7.43 – 7.39 (m, 5H), 4.72 (dd, *J* = 22.4, 8.8 Hz, 1H), 3.72 (s, 3H). ¹⁹F NMR (376 MHz, CDCl₃) δ -99.35 (dd, *J* = 300.2, 8.8 Hz, 1F), -107.53 (dd, *J* = 300.4, 22.2 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 189.3 (t, *J* = 32.6, 29.5 Hz), 168.9 (d, *J* = 12.8 Hz, 1F), 135.0, 134.4, 132.0 (t, *J* = 3.1 Hz), 130.3, 130.2 (dd, *J* = 4.4, 2.2 Hz), 128.70, 128.67, 128.6, 116.4 (dd, *J* = 267.8, 254.1 Hz), 54.4 (dd, *J* = 25.2, 20.6 Hz), 52.6.



Methyl 2-((1H-indol-3-yl)methyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3am).

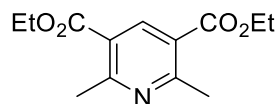
The product (36.5 mg, 51% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 5:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.13 (d, *J* = 7.6 Hz, 2H), 8.08 (s, 1H), 7.66 (t, *J* = 7.8 Hz, 2H), 7.52 (t, *J* = 7.8 Hz, 2H), 7.35 (d, *J* = 8.0 Hz, 1H), 7.23 – 7.13 (m, 2H), 7.04 (s, 1H), 3.93 – 3.82 (m, 1H), 3.57 (s, 3H), 3.44 – 3.31 (m, 2H). ¹⁹F NMR (376 MHz, CDCl₃) δ -102.09 – -103.92 (m, 2F). ¹³C NMR (101 MHz, CDCl₃) δ 188.4 (t, *J* = 30.6 Hz), 169.9, 136.1, 134.4, 131.8, 130.1 (t, *J* = 3.4 Hz), 128.7, 127.0, 122.7, 122.1, 119.6, 118.5, 117.7 (t, *J* = 261.1 Hz), 111.5, 111.2, 52.1, 50.6 (t, *J* = 21.7 Hz), 21.7 (t, *J* = 4.8 Hz). MS (ESI): *m/z* (%) 380 ([M+Na]⁺, 100). HRMS (ESI): calculated for C₂₀H₁₇F₂NO₃Na ([M+Na]⁺): 380.1176; Found: 380.1068.



Tert-butyl 2-(3-(1,1-difluoro-2-oxo-2-phenylethyl)-2-oxo-2,3,4,5-tetrahydro-1H-benzo[b]azepin-1-yl)acetate (3an).

The product (37.8 mg, 44% yield) was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 30:1) as pale yellow oil. ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, *J* = 8.0 Hz, 2H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 7.36 – 7.31 (m, 1H), 7.29 – 7.27 (m, 1H), 7.24 – 7.20 (m, 2H), 4.66 (d, *J* = 17.2 Hz, 1H), 4.19 (d, *J* = 17.2 Hz, 1H), 3.62 – 3.50 (m, 1H), 3.44 – 3.35 (m, 1H), 2.78 – 2.65 (m, 2H), 2.40 – 2.30 (m, 1H), 1.39 (s, 9H). ¹⁹F NMR (376 MHz, CDCl₃) δ -107.77 (d, *J* = 20.3 Hz, 1F), -108.55 (d, *J* = 20.3 Hz, 1F). ¹³C NMR (101 MHz, CDCl₃) δ 189.9 (dd, *J* = 33.2, 28.4 Hz), 169.5 (d, *J* = 12.3 Hz), 167.6, 141.3, 135.7, 133.8, 132.6, 130.1 (d, *J* = 5.0 Hz), 129.4, 128.4, 127.9, 126.9, 122.5, 118.2 (dd, *J* = 268.8, 247.8 Hz), 82.0, 50.6, 45.6 (dd, *J* = 25.7, 19.9 Hz), 28.5, 27.9, 23.8. MS

(ESI): m/z (%) 452 ([M+Na]⁺, 100). HRMS (ESI): calculated for C₂₄H₂₅F₂NO₄Na ([M+Na]⁺): 452.1752; Found: 452.1645.



Diethyl 2,6-dimethylpyridine-3,5-dicarboxylate (6). This compound is known^[9]. The product was purified with silica gel chromatography (Petroleum ether/ Ethyl acetate = 10:1) as white solid. ¹H NMR (400 MHz, CDCl₃) δ 8.67 (s, 1 H), 4.38 (q, J = 6.8 Hz, 4 H), 2.84 (s, 6 H), 1.40 (t, J = 6.8 Hz, 6 H); ¹³C NMR (101 MHz, CDCl₃) δ 165.7, 162.1, 141.3, 123.3, 61.5, 24.6, 14.3.

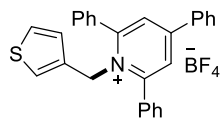
7. References.

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8. Copies of NMR spectra of 1, 3, 5, 6.

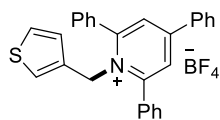
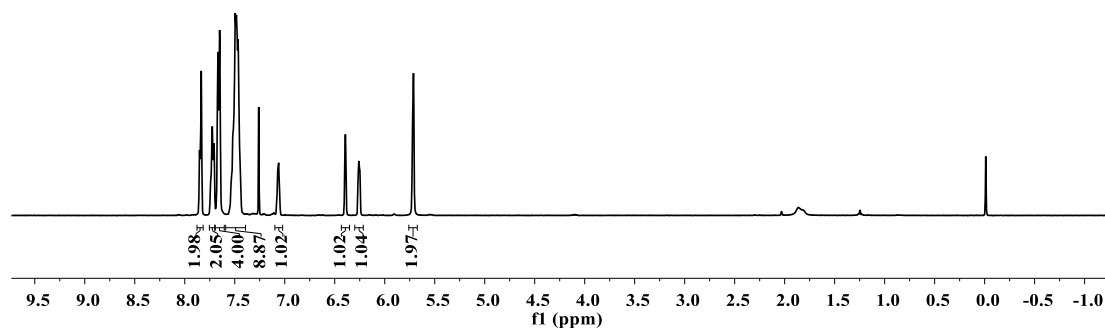
2,4,6-triphenyl-1-(thiophen-2-ylmethyl)pyridin-1-ium tetrafluoroborate (1m).

7.852
7.835
7.725
7.707
7.668
7.651
7.517
7.495
7.484
7.467
7.260
7.068
7.061
6.394
6.259
6.249
— 5.712
2.029
1.851
1.247
— -0.011



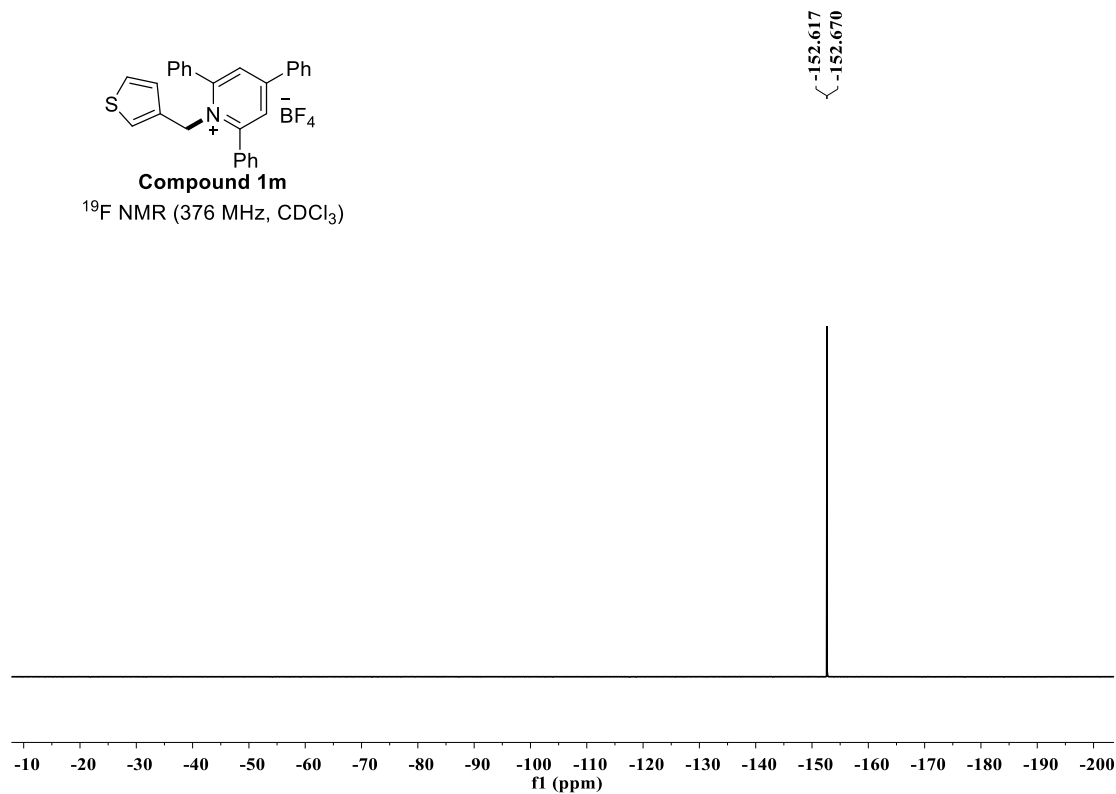
Compound 1m

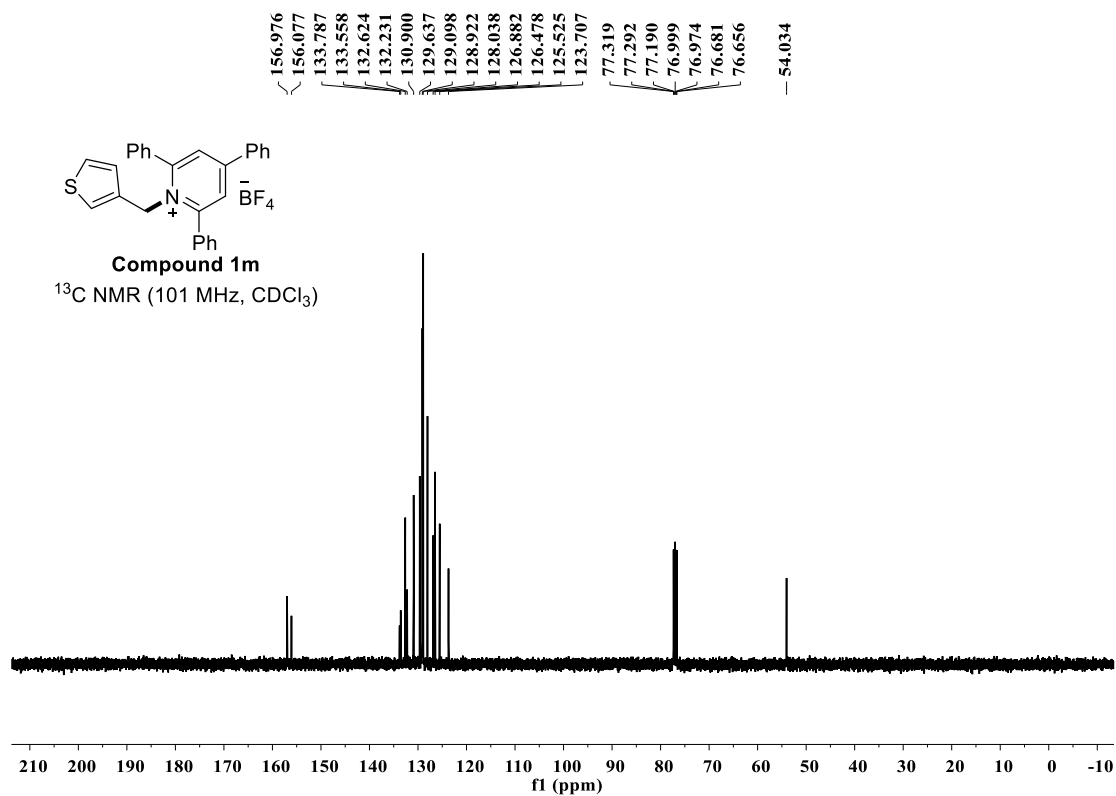
¹H NMR (400 MHz, CDCl₃)



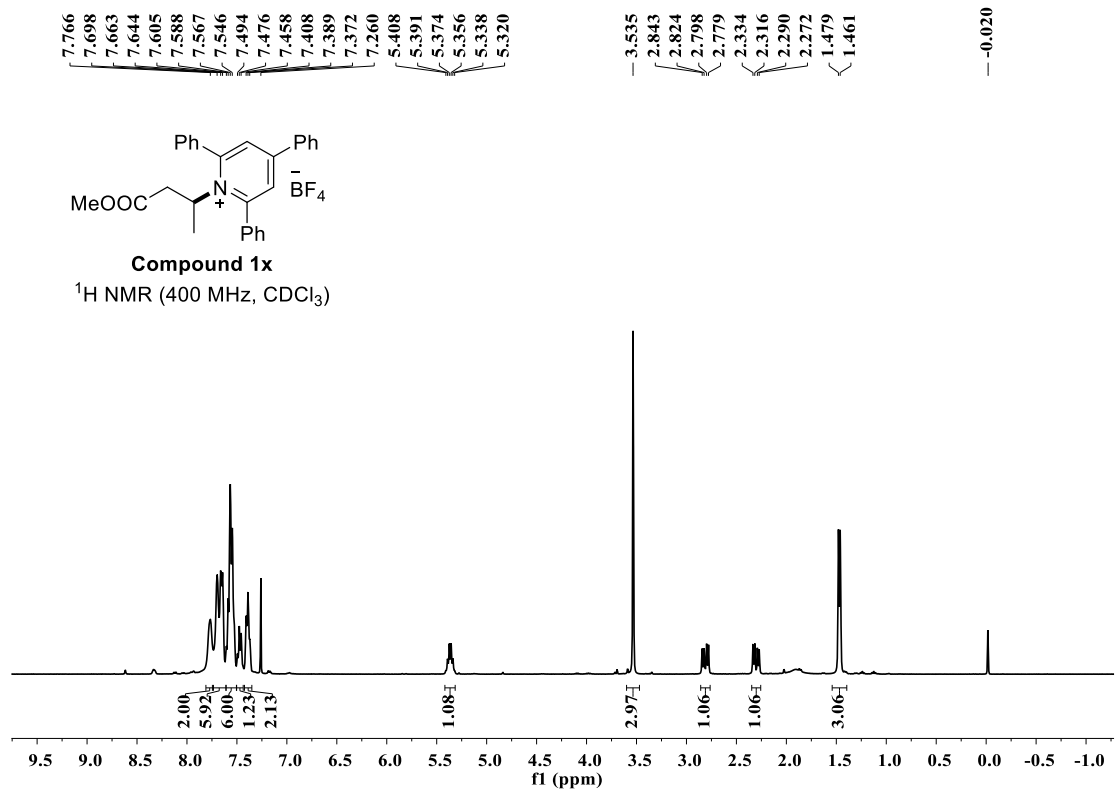
Compound 1m

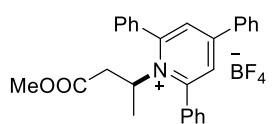
¹⁹F NMR (376 MHz, CDCl₃)





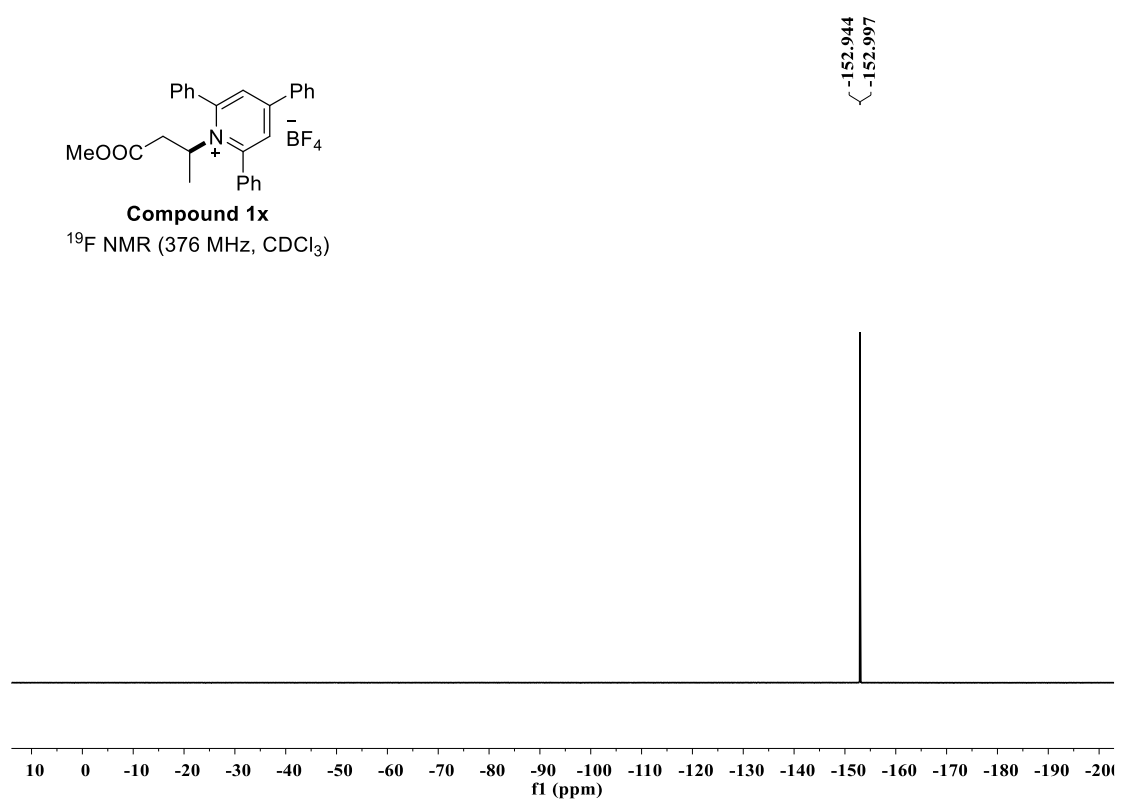
1-(4-methoxy-4-oxobutan-2-yl)-2,4,6-triphenylpyridin-1-ium tetrafluoroborate (1x).



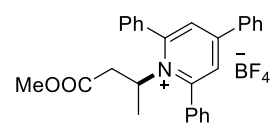


Compound 1x

¹⁹F NMR (376 MHz, CDCl₃)

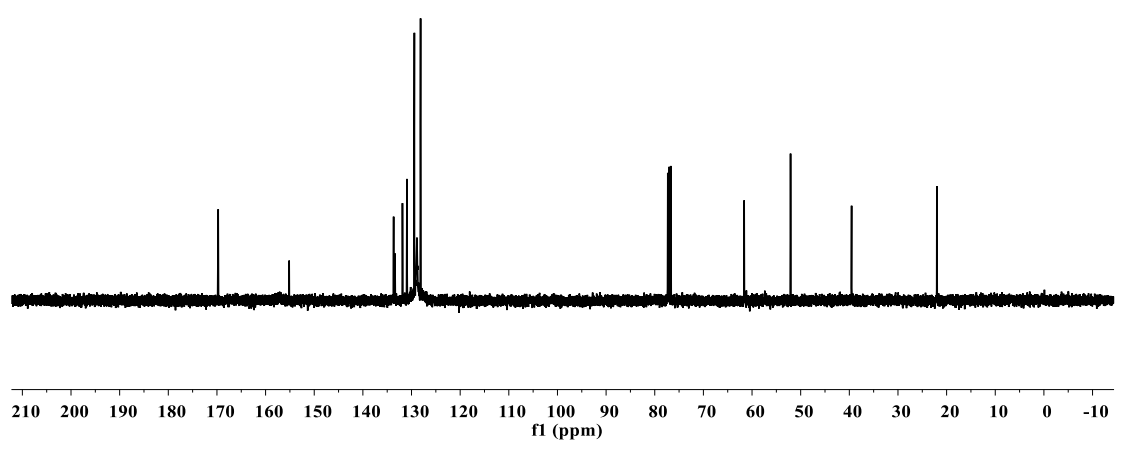


- 169.738
- 155.149
- 133.679
- 133.400
- 131.864
- 130.938
- 129.408
- 129.139
- 129.059
- 129.022
- 128.968
- 128.891
- 128.830
- 128.749
- 128.677
- 128.645
- 128.137
- 77.318
- 77.201
- 76.999
- 76.681
- 61.615
- 52.081
- 39.533
- 22.009

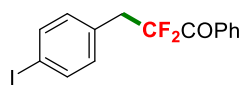


Compound 1x

¹³C NMR (101 MHz, CDCl₃)

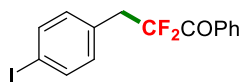
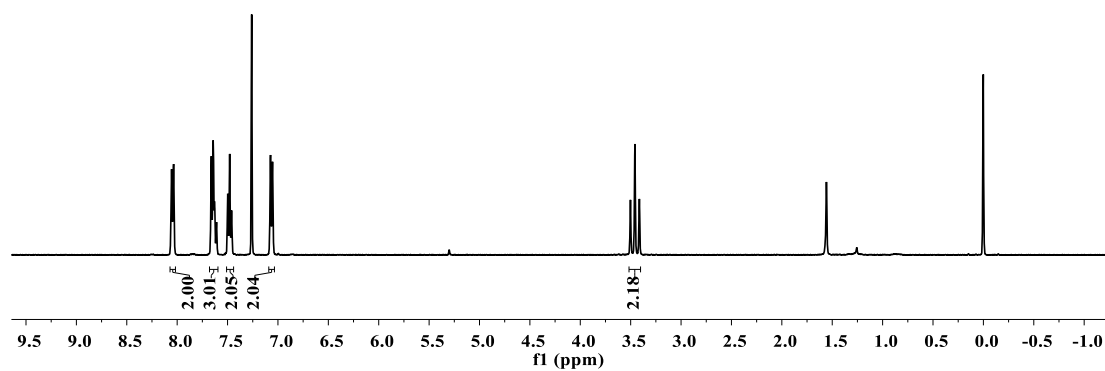


2,2-difluoro-3-(4-iodophenyl)-1-phenylpropan-1-one (3a.)



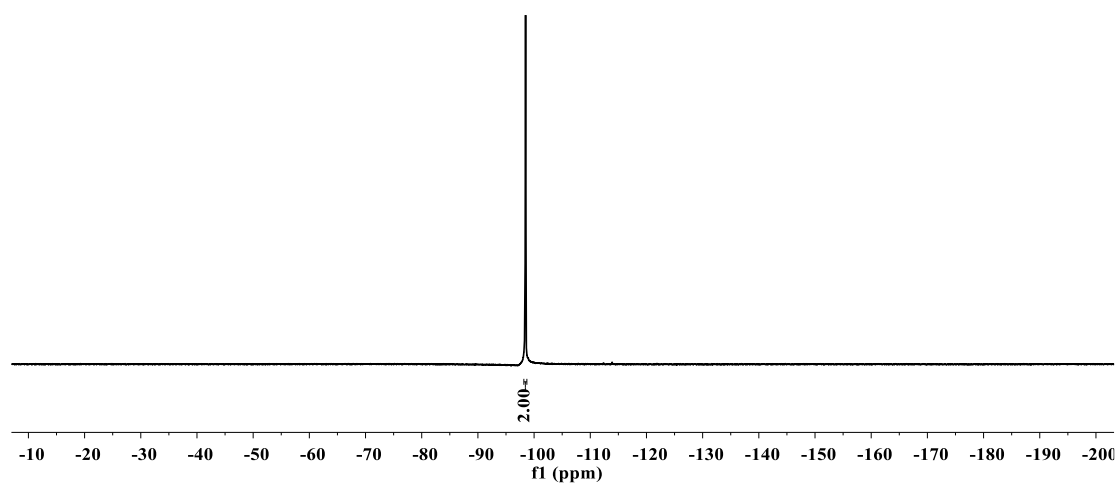
Compound 3a

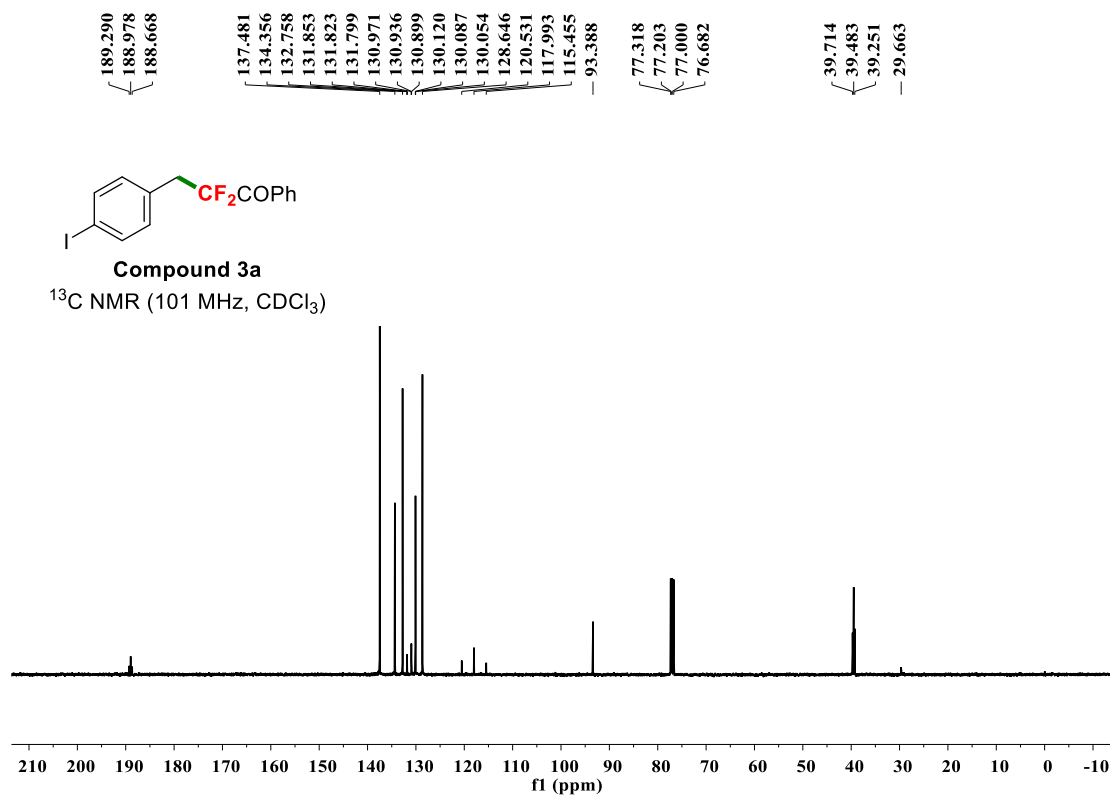
^1H NMR (400 MHz, CDCl_3)



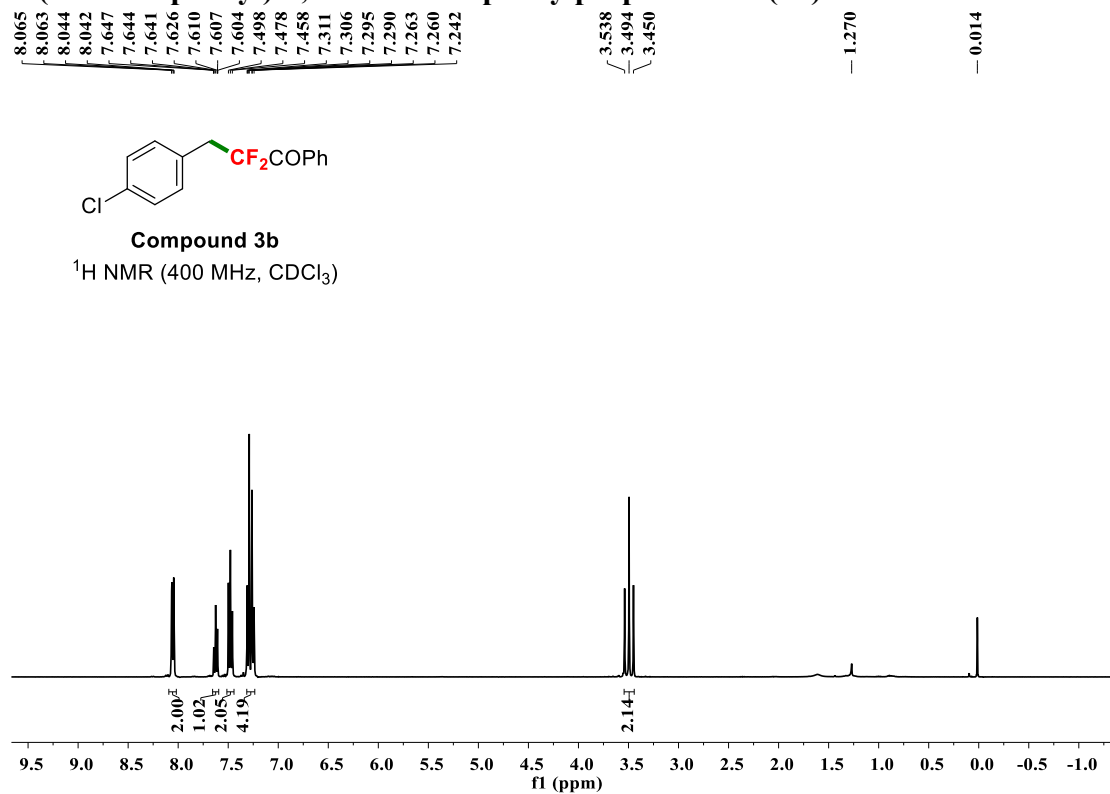
Compound 3a

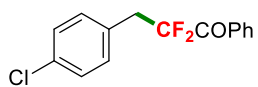
^{19}F NMR (376 MHz, CDCl_3)





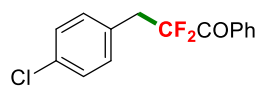
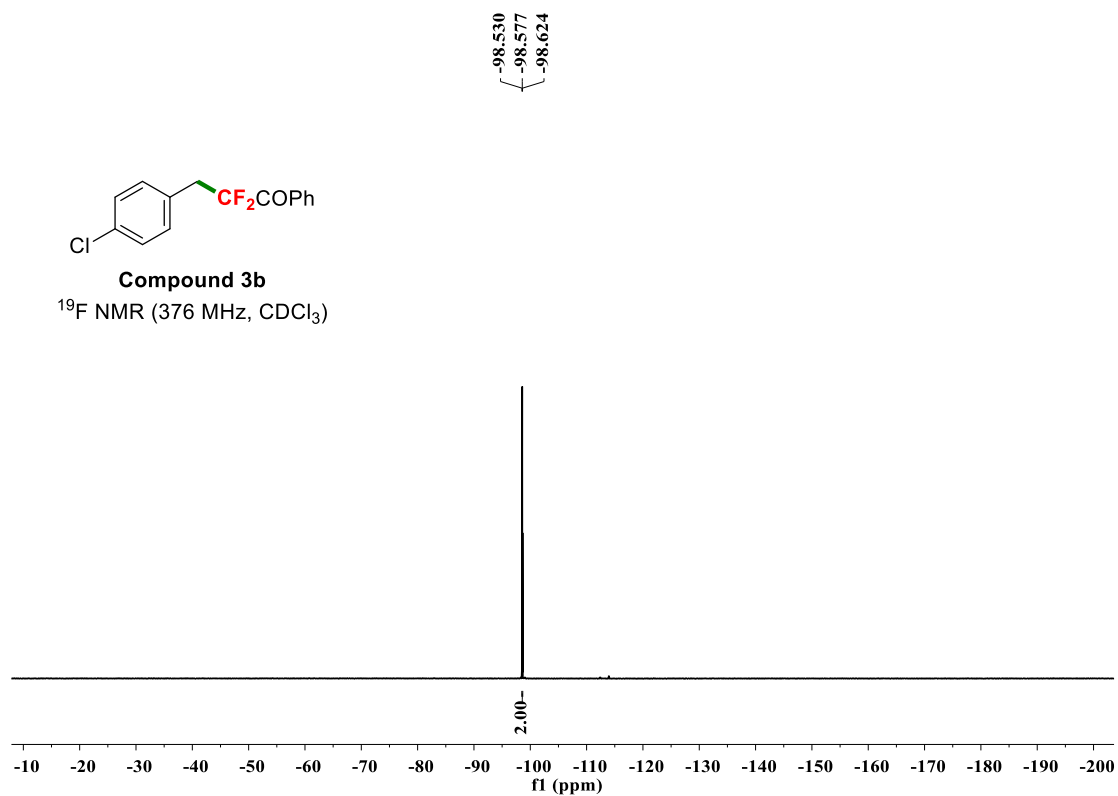
3-(4-Chlorophenyl)-2,2-difluoro-1-phenylpropan-1-one (3b).





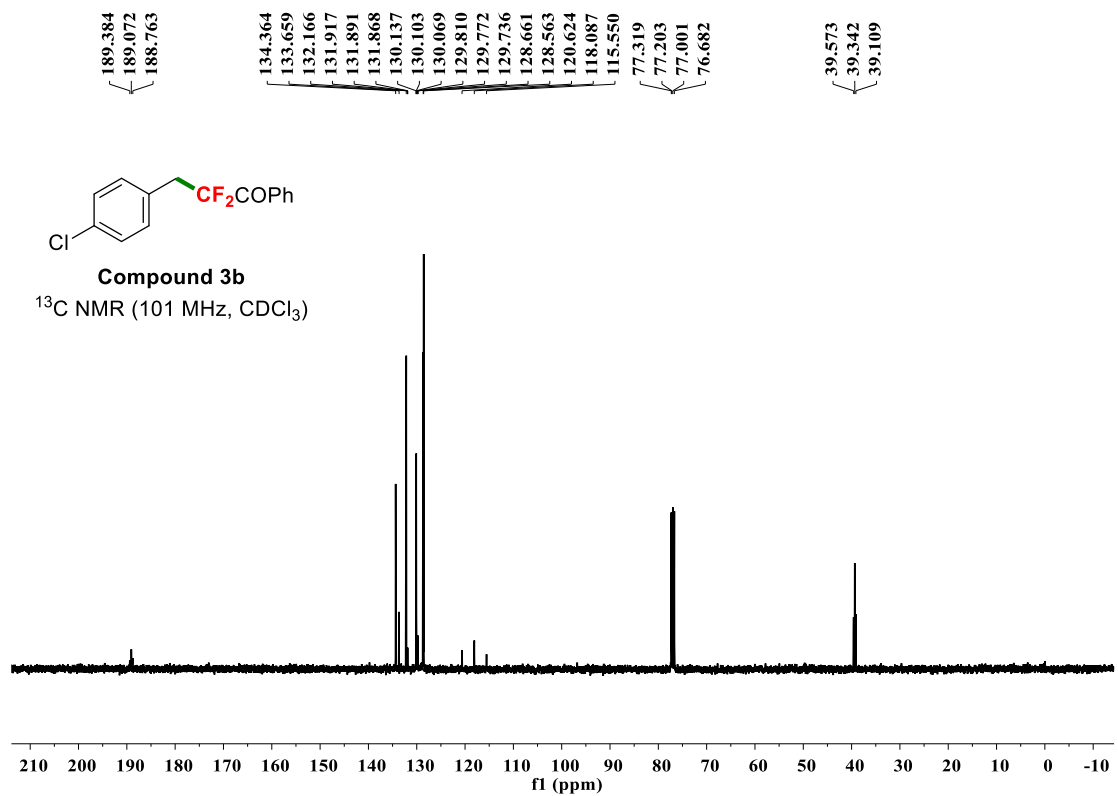
Compound 3b

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

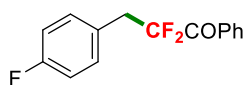
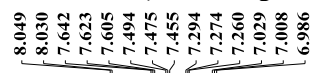


Compound 3b

^{13}C NMR (101 MHz, CDCl_3)

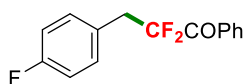
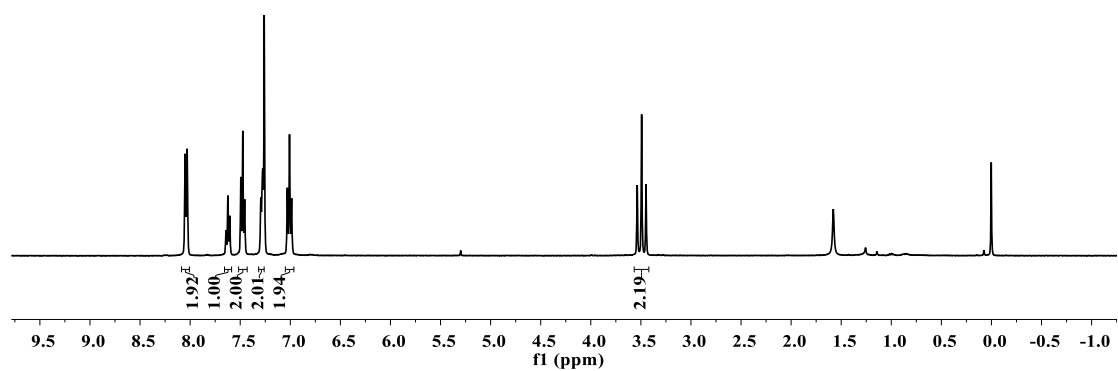


2,2-Difluoro-3-(4-fluorophenyl)-1-phenylpropan-1-one (3c).



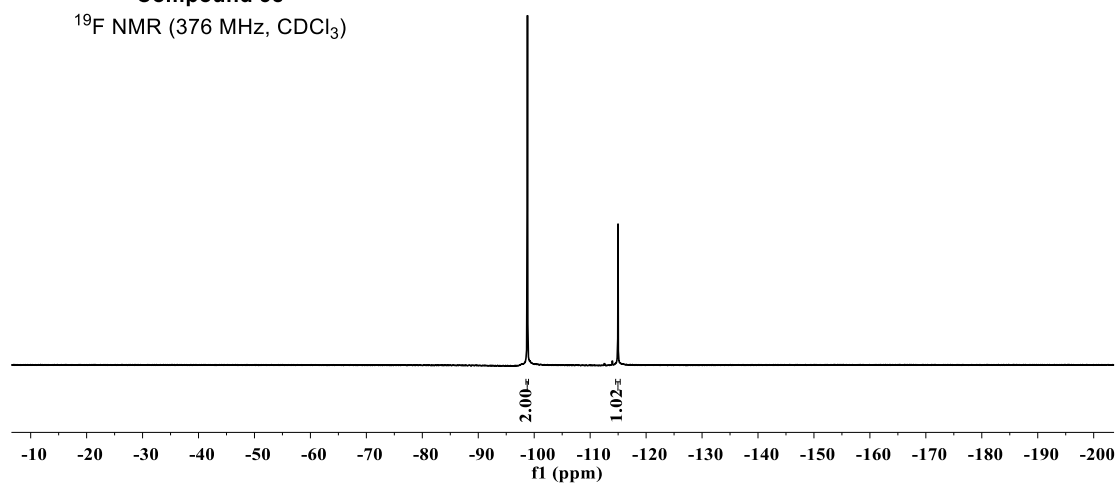
Compound 3c

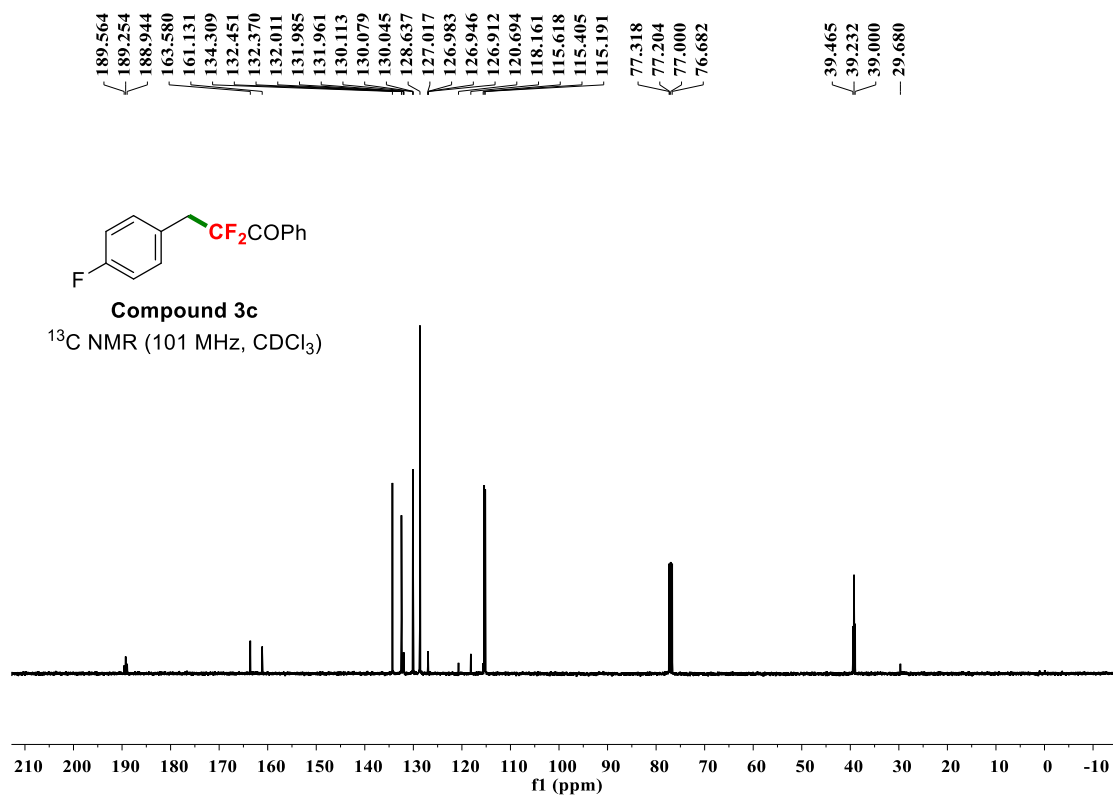
¹H NMR (400 MHz, CDCl₃)



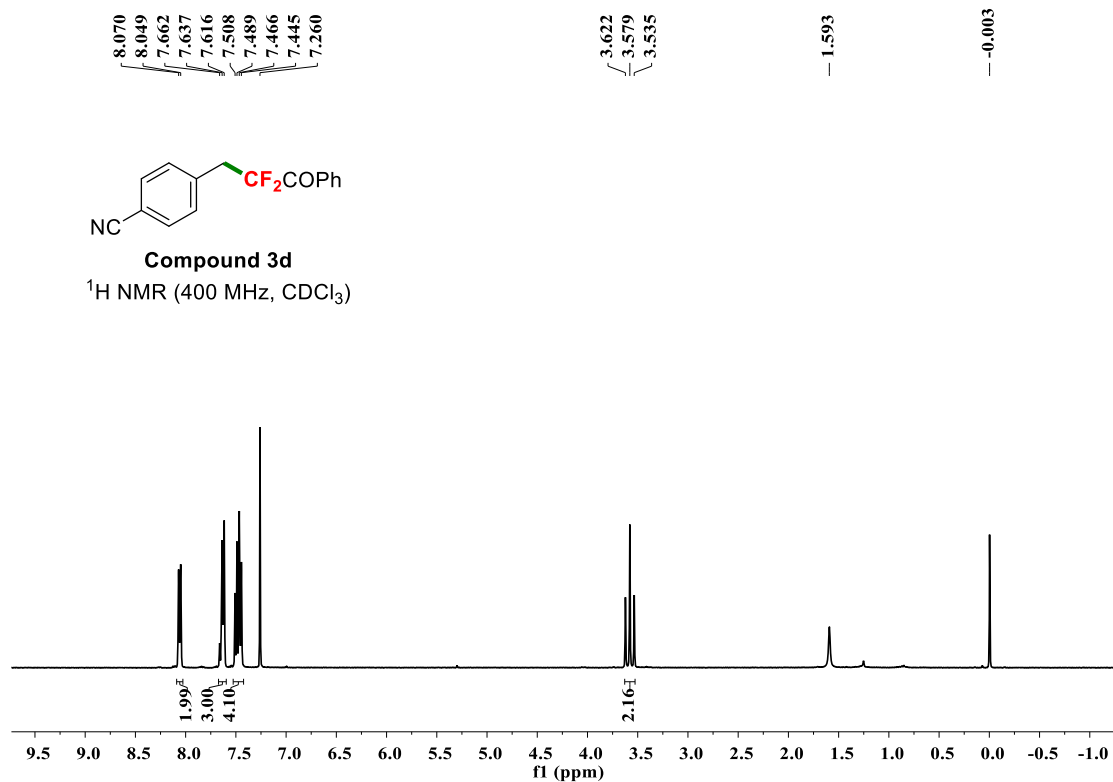
Compound 3c

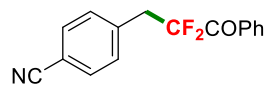
¹⁹F NMR (376 MHz, CDCl₃)





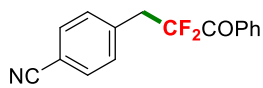
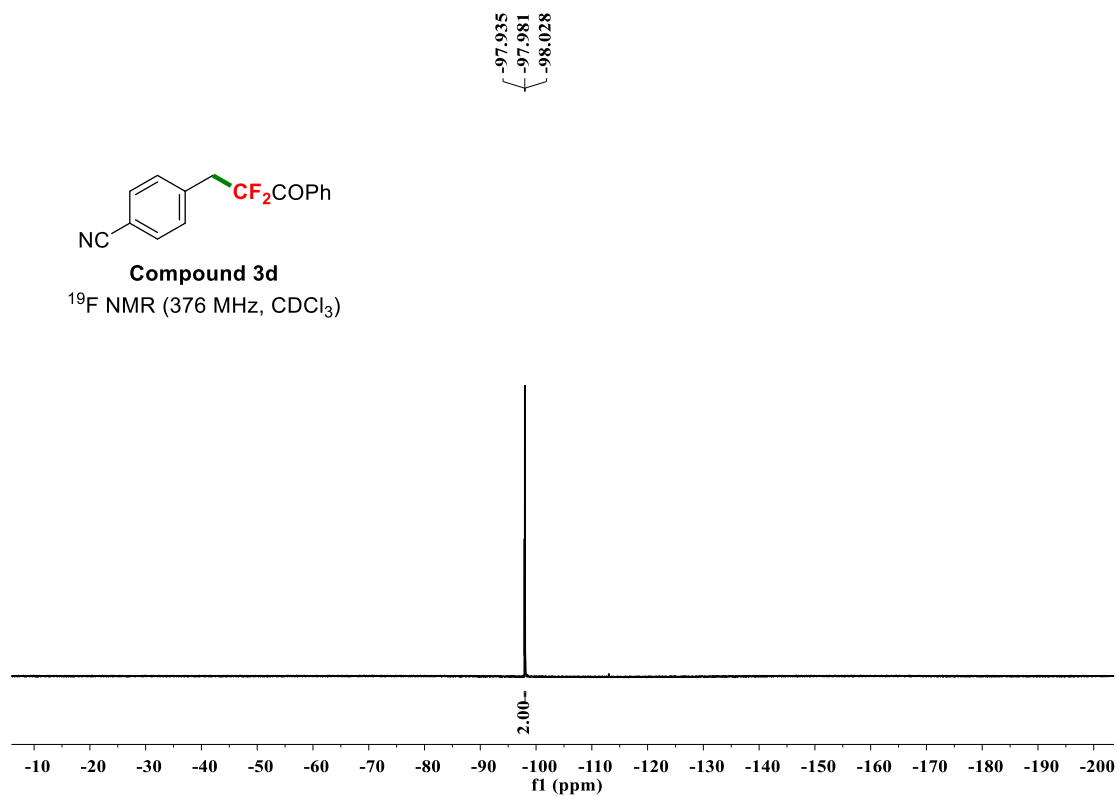
4-(2,2-Difluoro-3-oxo-3-phenylpropyl)benzonitrile (3d).





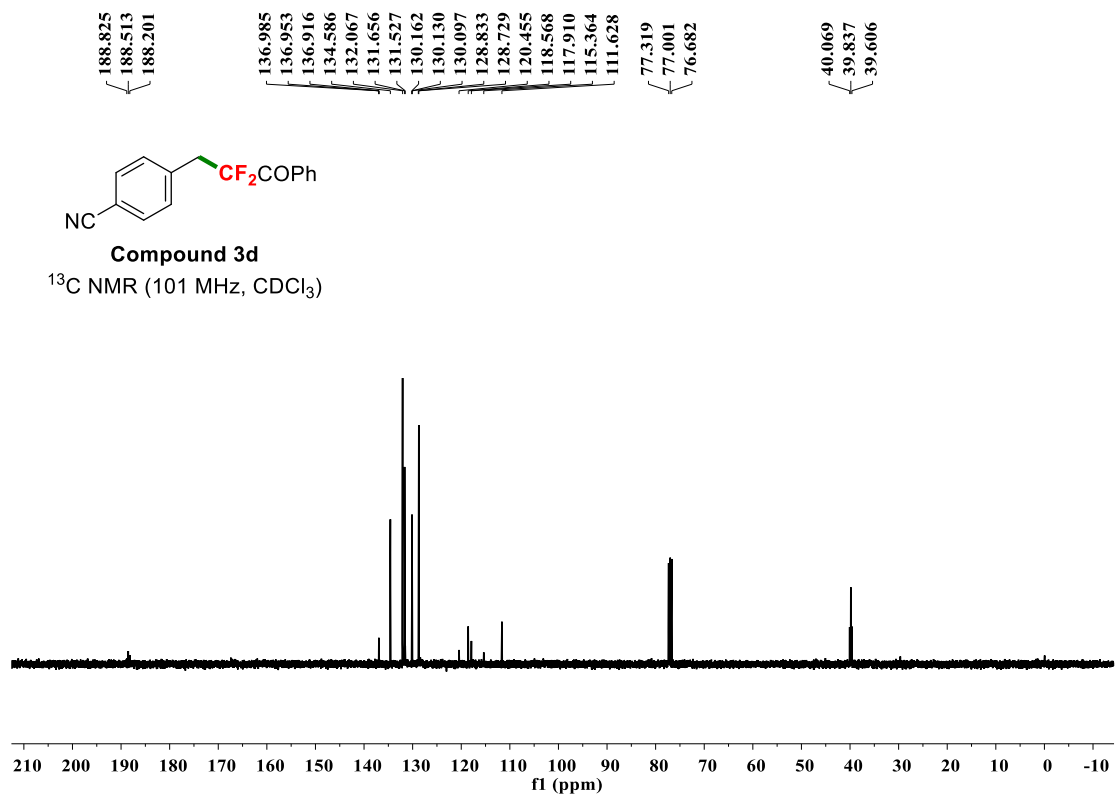
Compound 3d

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

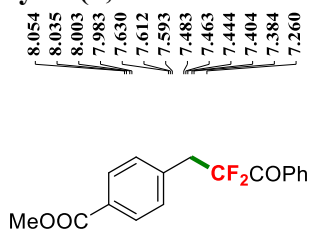


Compound 3d

^{13}C NMR (101 MHz, CDCl_3)

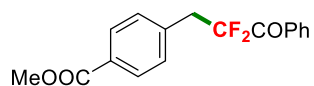
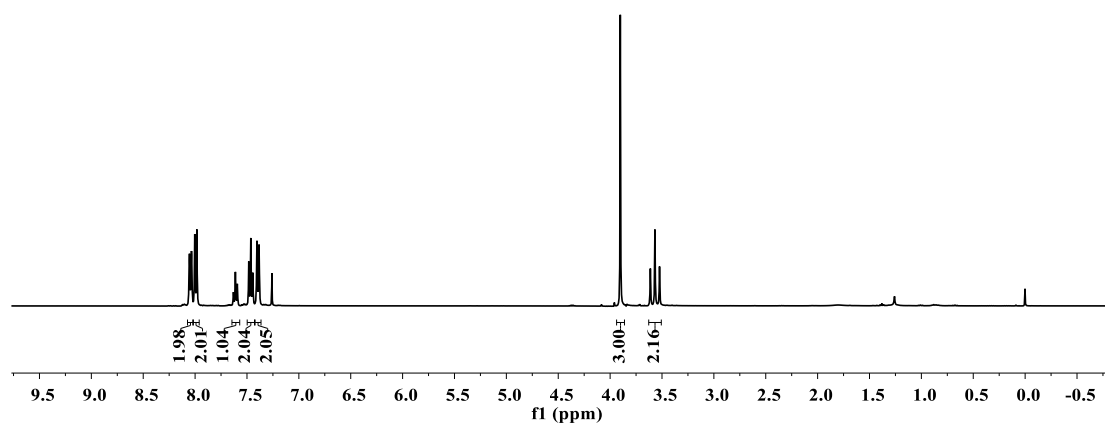


Methyl 4-(2,2-difluoro-3-oxo-3-phenylpropyl)benzoate (3e).



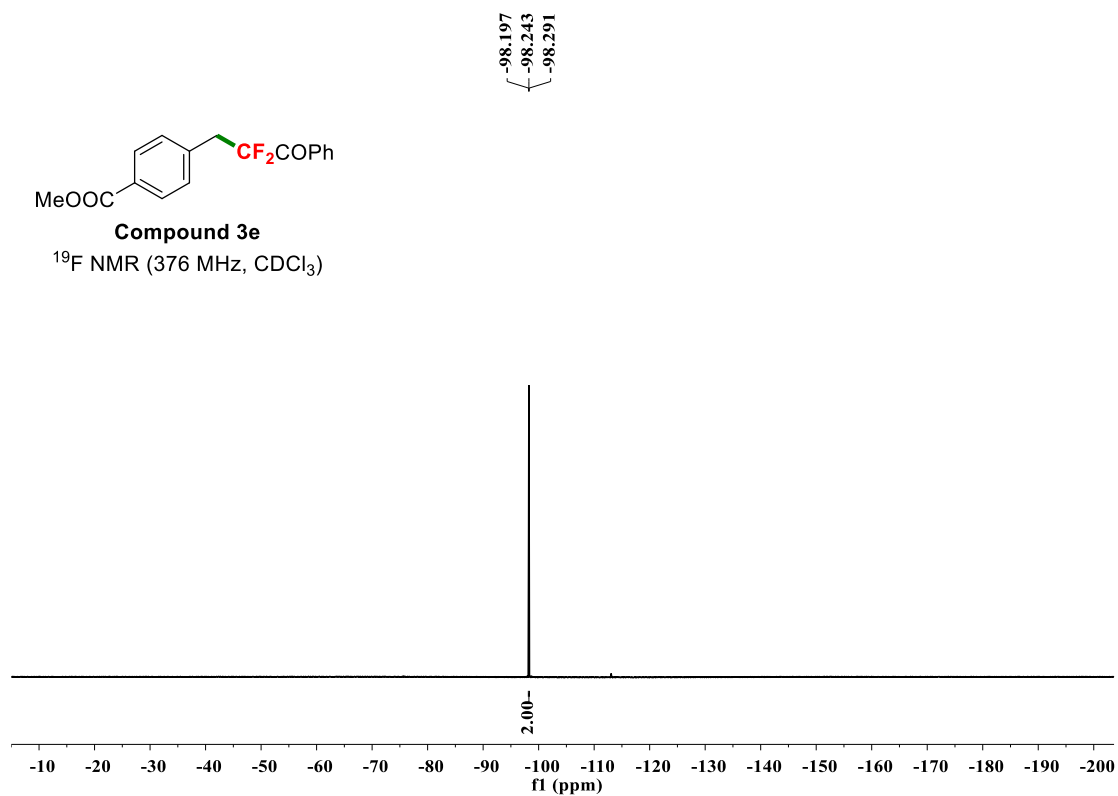
Compound 3e

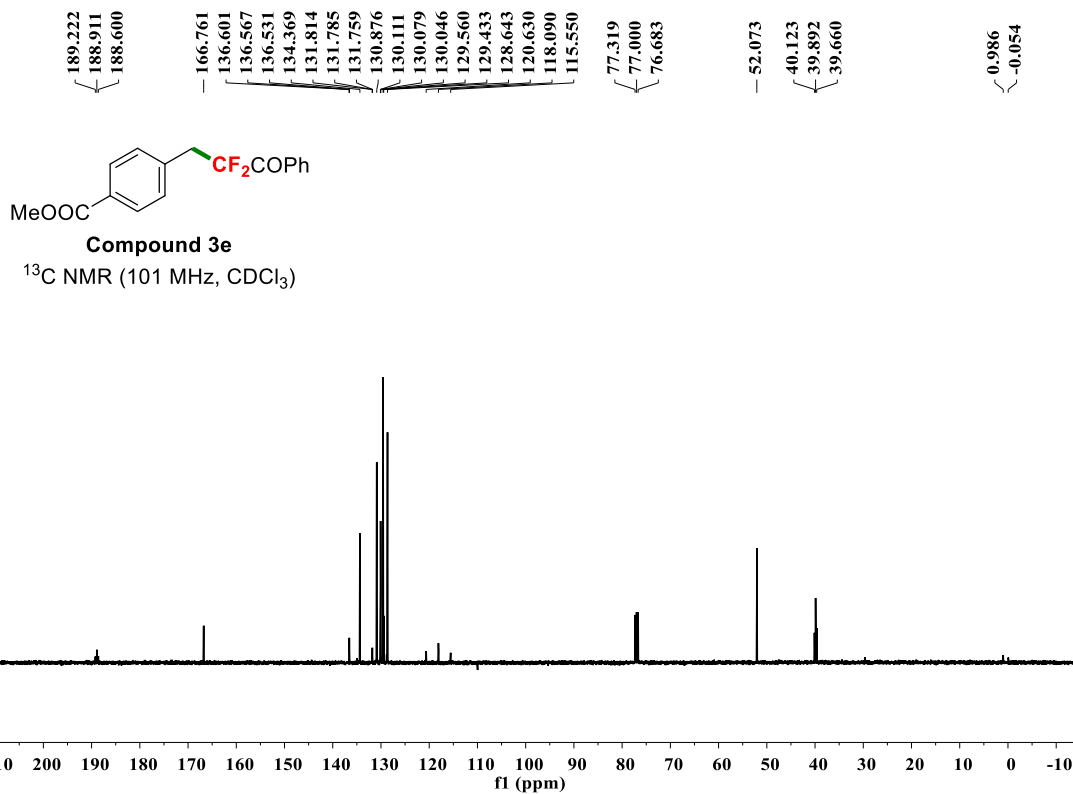
¹H NMR (400 MHz, CDCl₃)



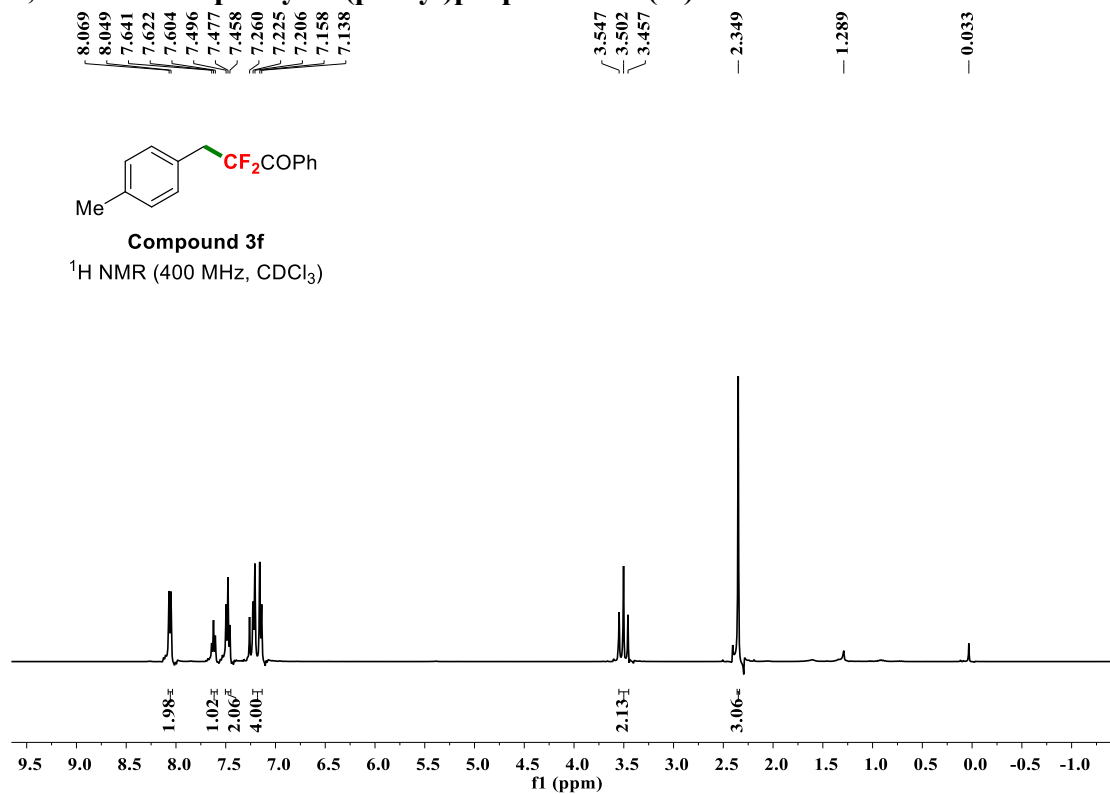
Compound 3e

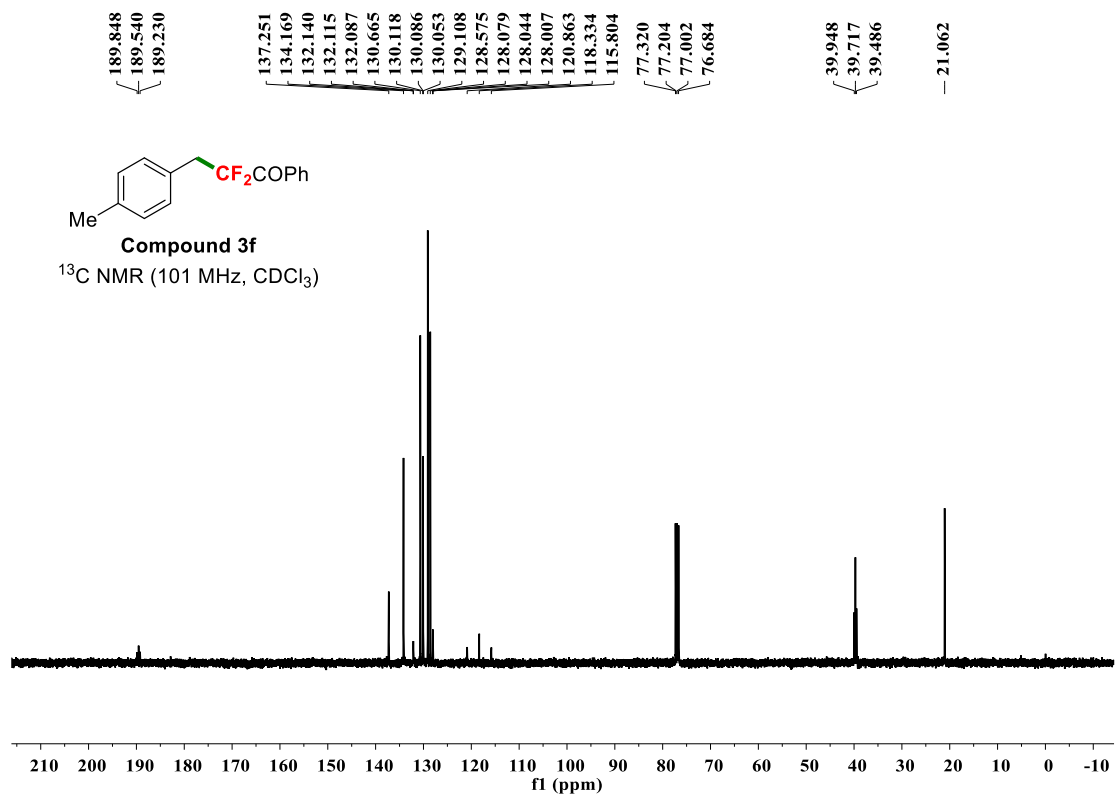
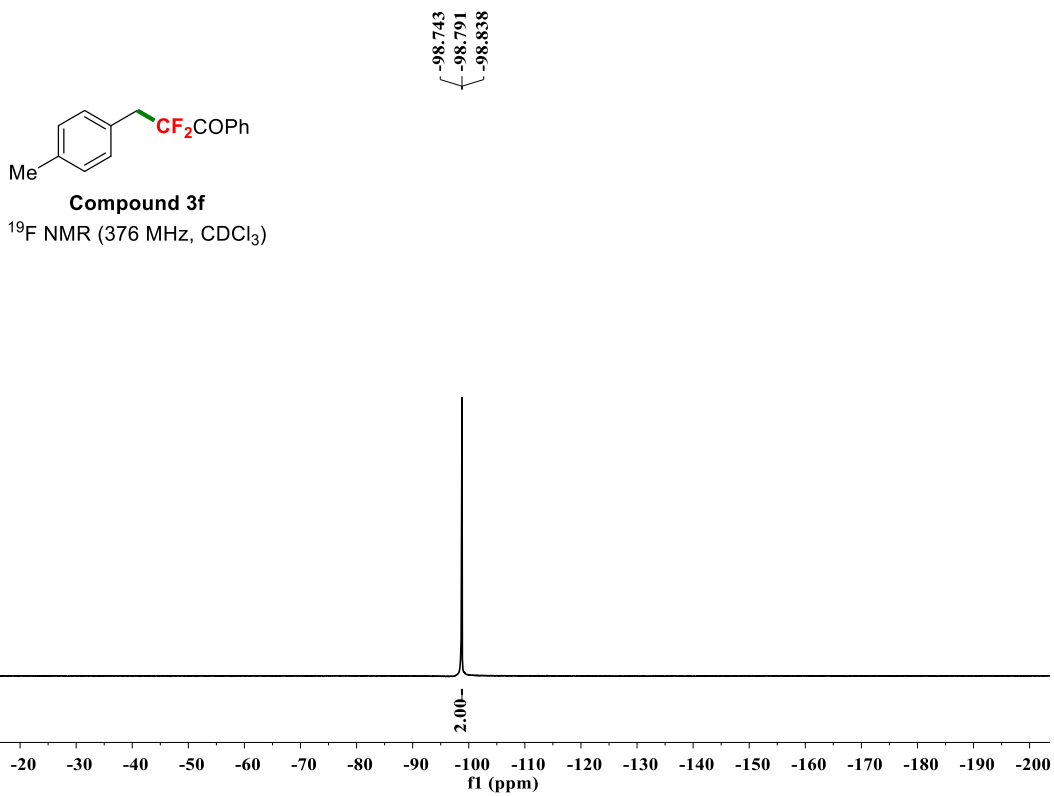
¹⁹F NMR (376 MHz, CDCl₃)



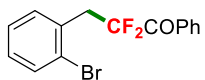
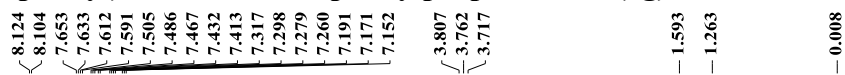


2,2-Difluoro-1-phenyl-3-(p-tolyl)propan-1-one (3f).



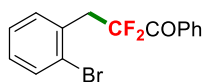
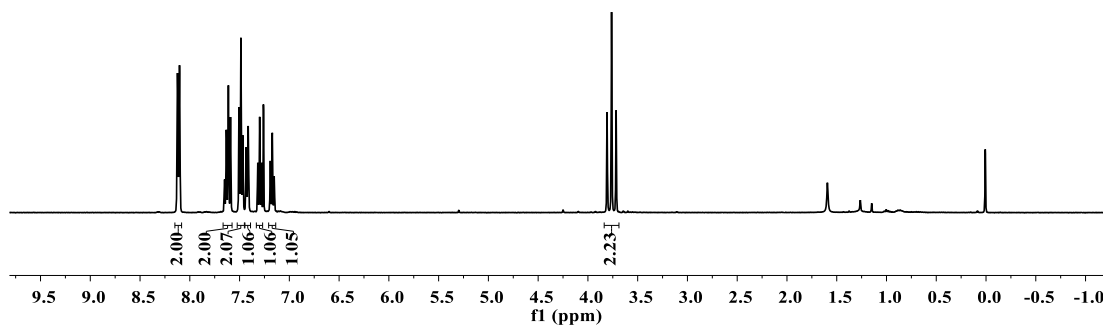


3-(2-Bromophenyl)-2,2-difluoro-1-phenylpropan-1-one (3g).



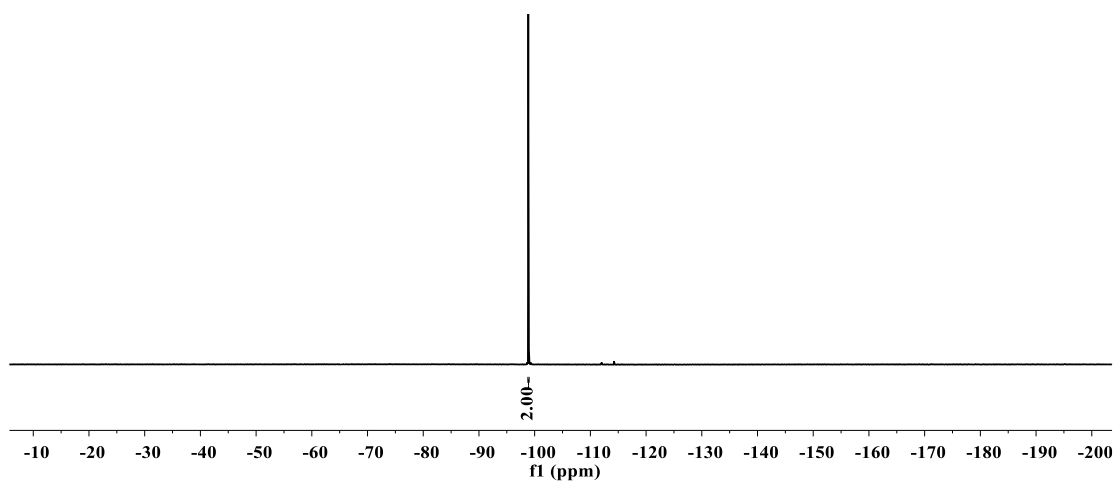
Compound 3g

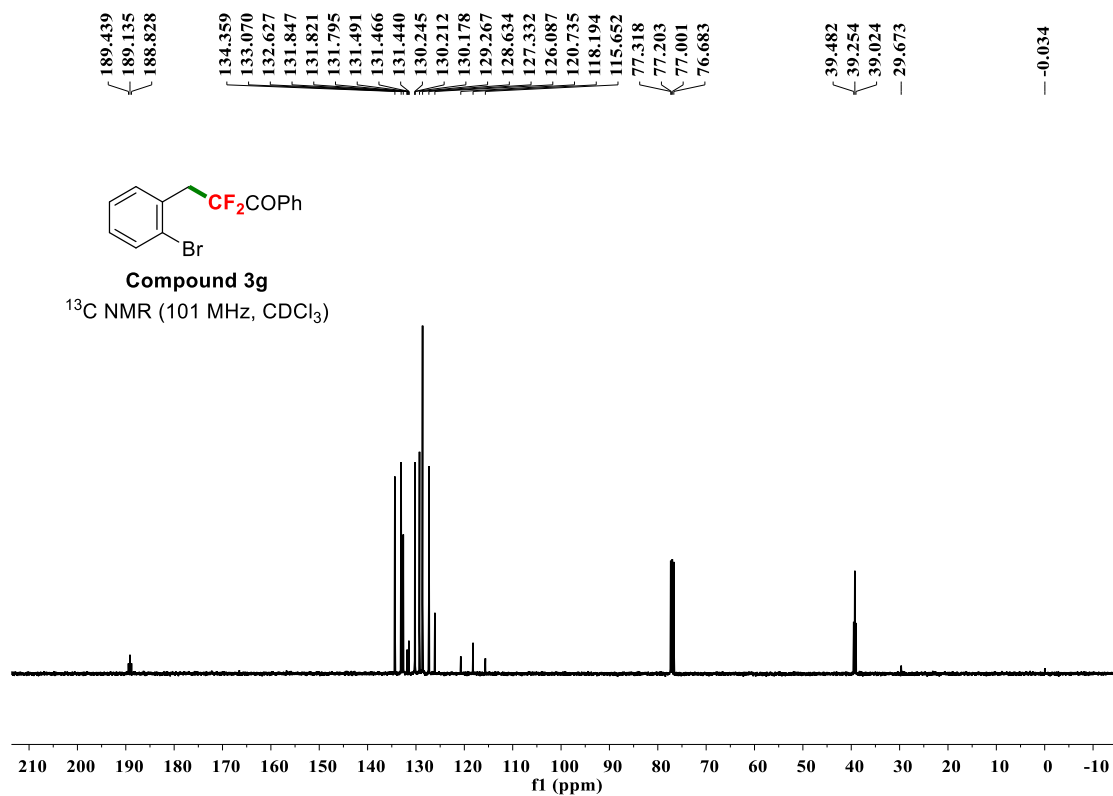
¹H NMR (400 MHz, CDCl₃)



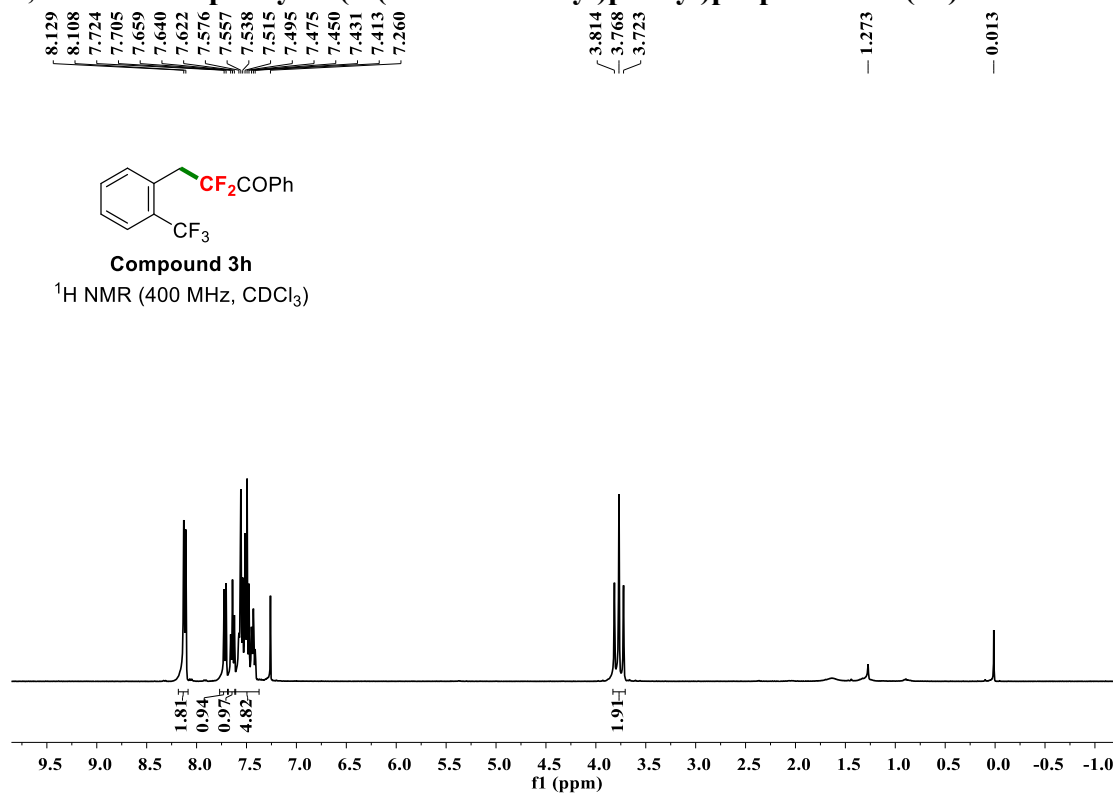
Compound 3g

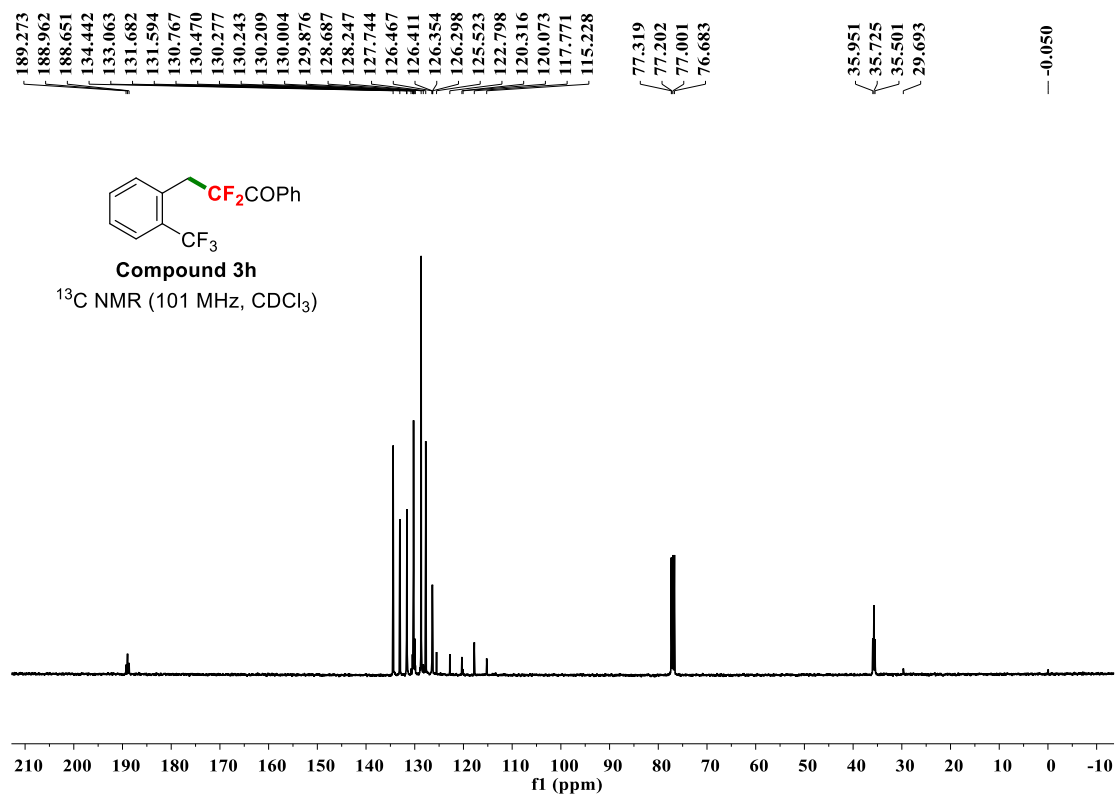
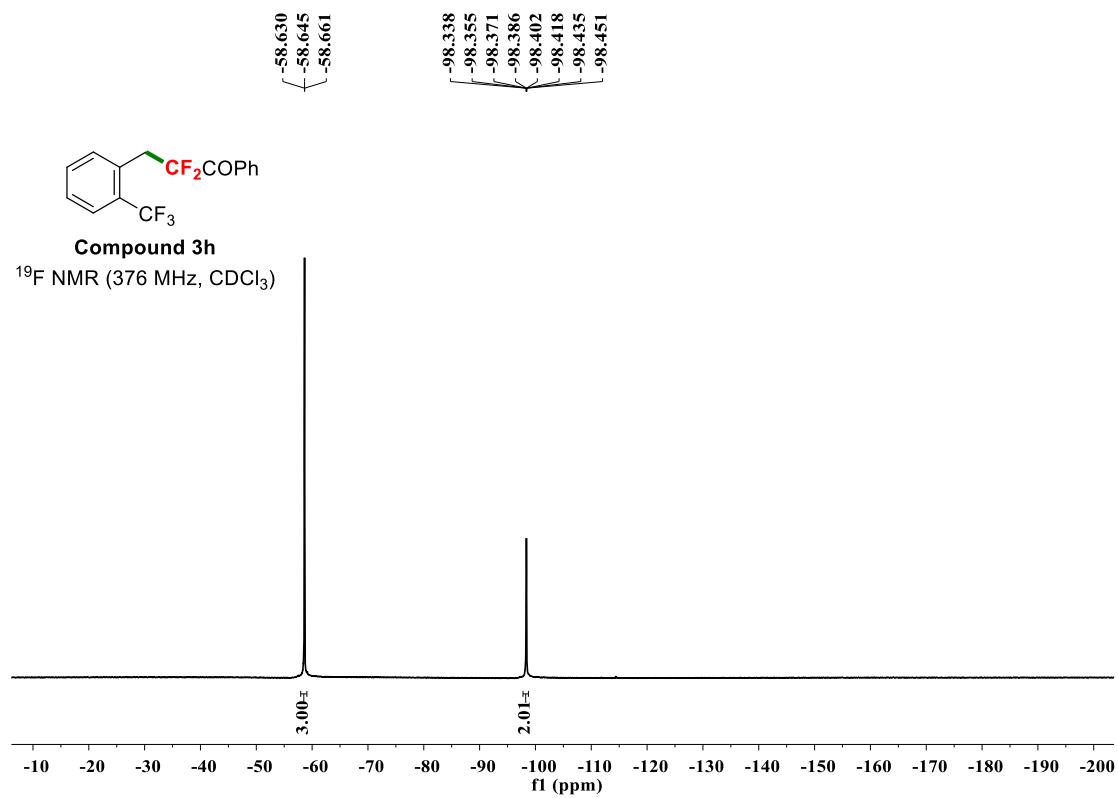
¹⁹F NMR (376 MHz, CDCl₃)



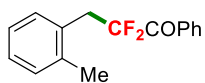
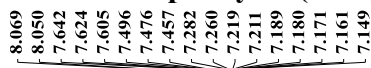


2,2-difluoro-1-phenyl-3-(2-(trifluoromethyl)phenyl)propan-1-one (3h).



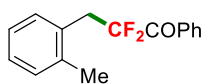
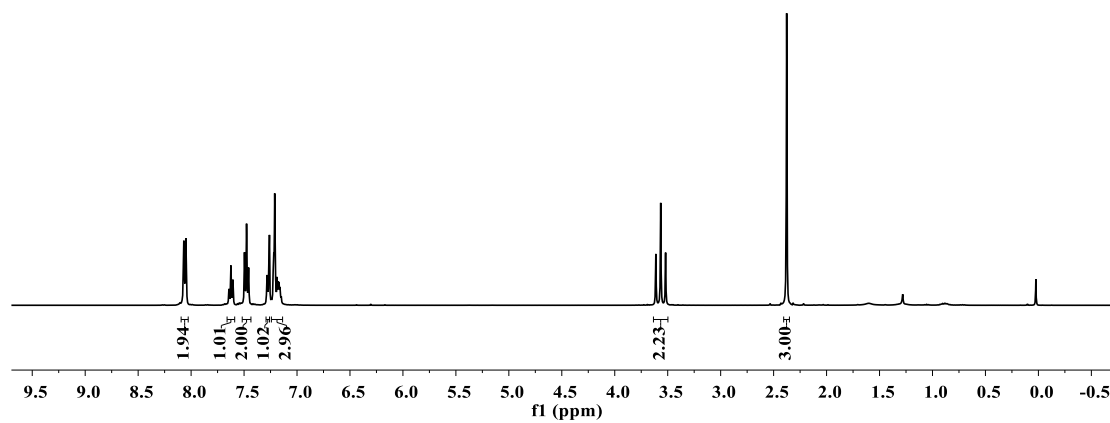


2,2-difluoro-1-phenyl-3-(o-tolyl)propan-1-one (3i).



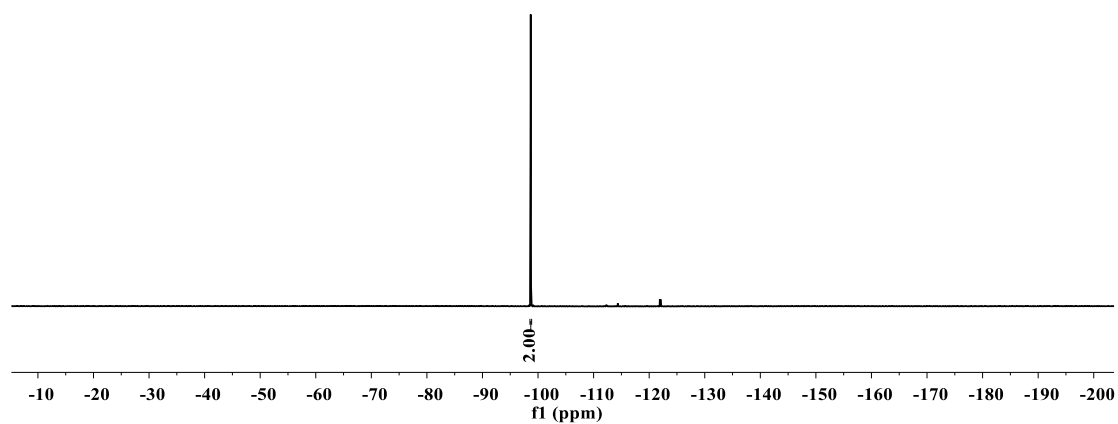
Compound 3i

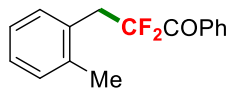
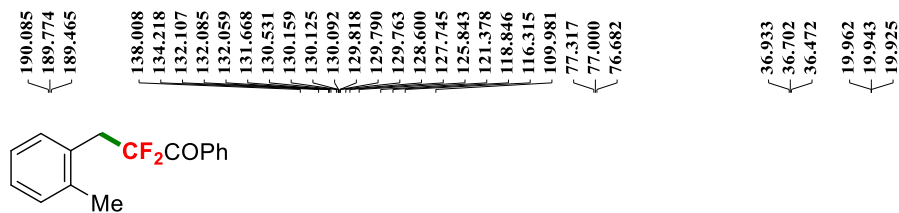
¹H NMR (400 MHz, CDCl₃)



Compound 3i

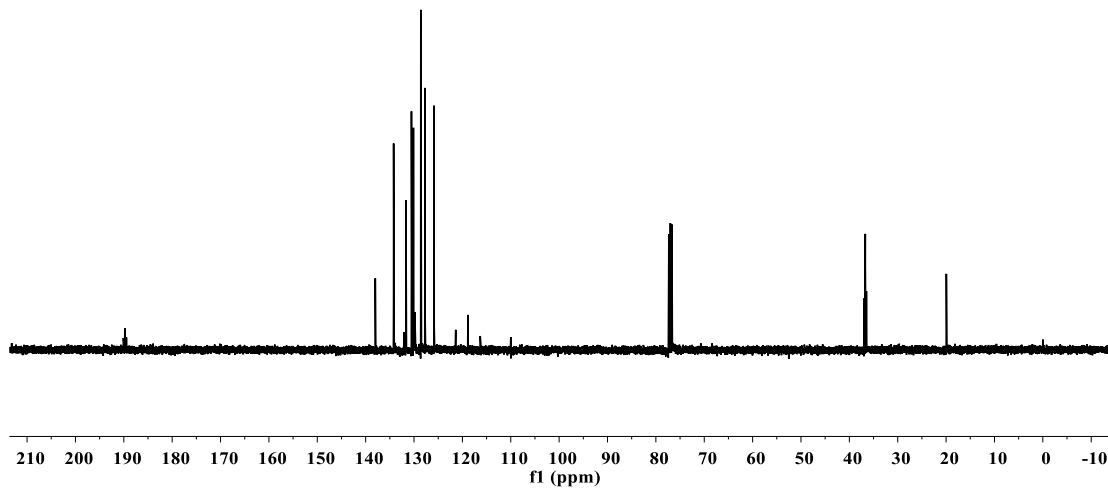
¹⁹F NMR (376 MHz, CDCl₃)



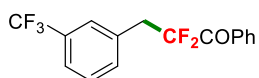


Compound 3i

¹³C NMR (400 MHz, CDCl₃)

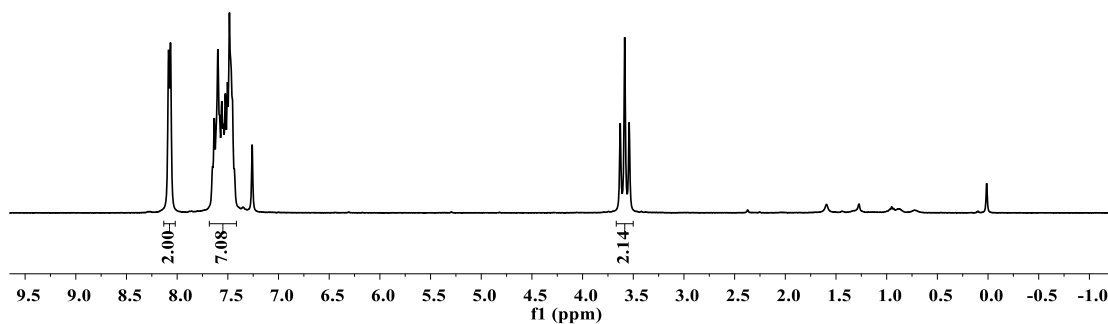


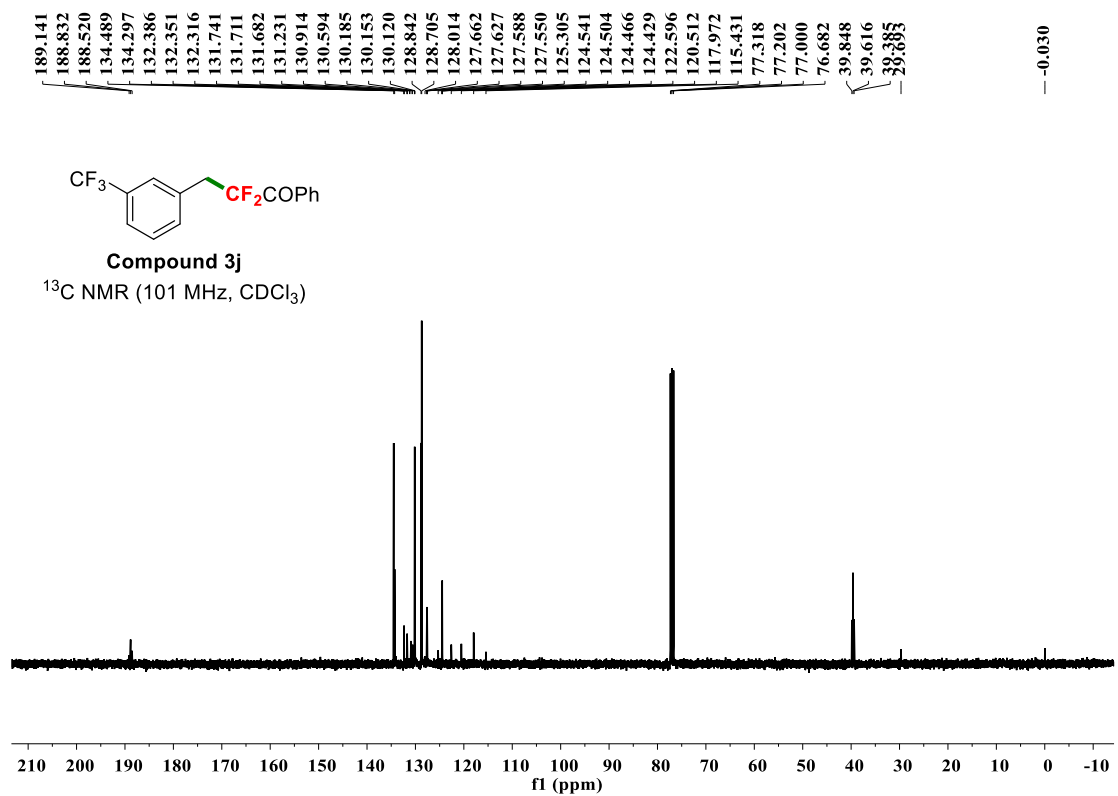
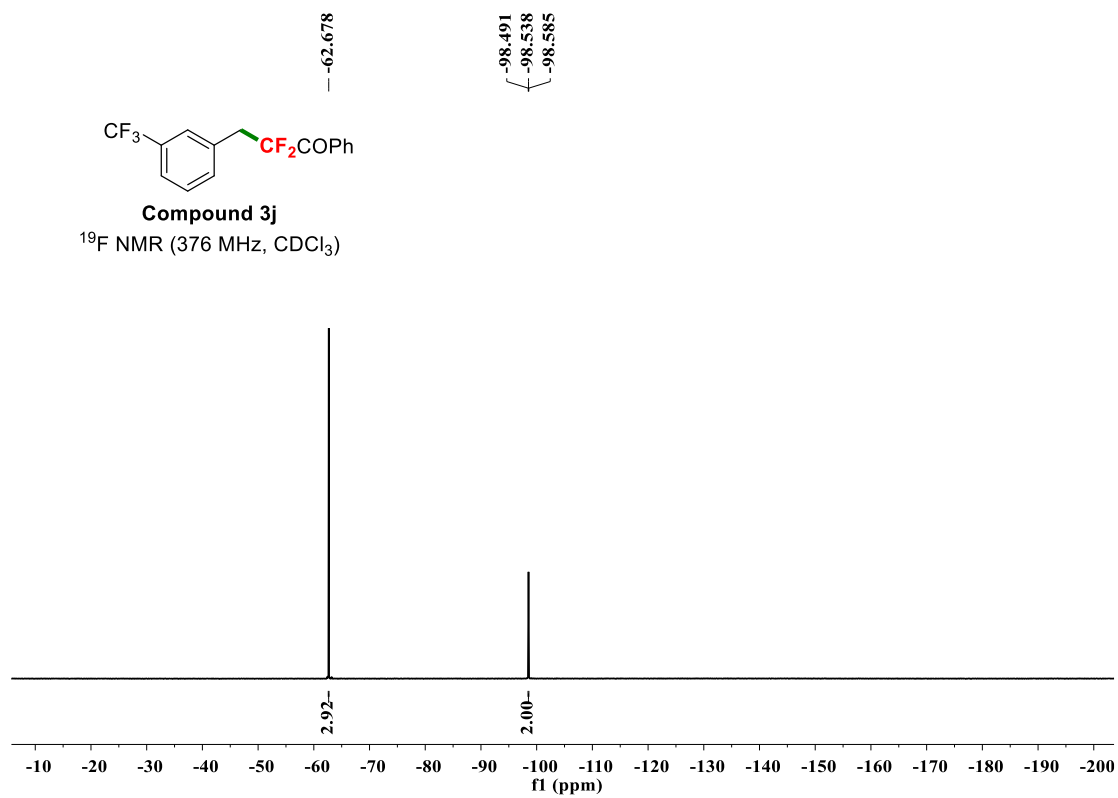
2,2-difluoro-1-phenyl-3-(3-(trifluoromethyl)phenyl)propan-1-one (3j).



Compound 3j

¹H NMR (400 MHz, CDCl₃)



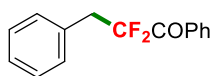


2,2-difluoro-1,3-diphenylpropan-1-one (3k).

8.059
8.039
7.636
7.617
7.598
7.490
7.471
7.451
7.326
7.260

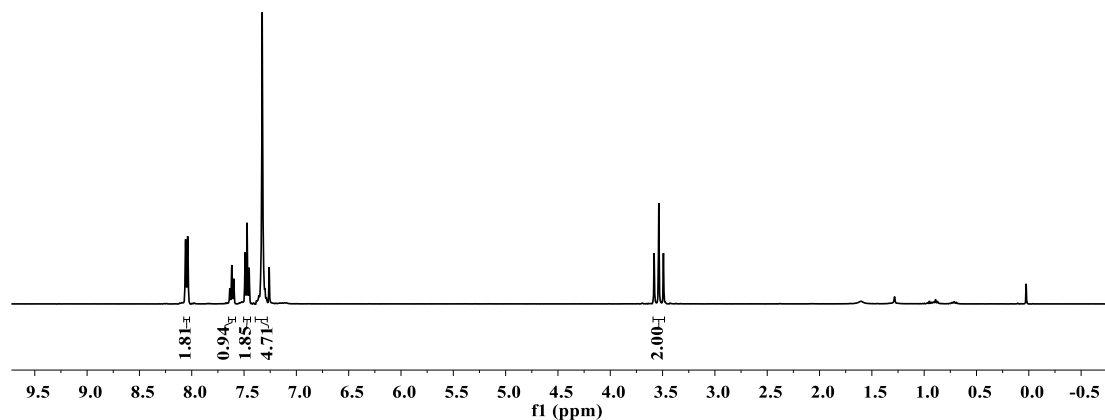
3.581
3.536
3.492

-0.025

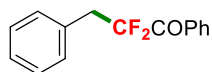


Compound 3k

¹H NMR (400 MHz, CDCl₃)

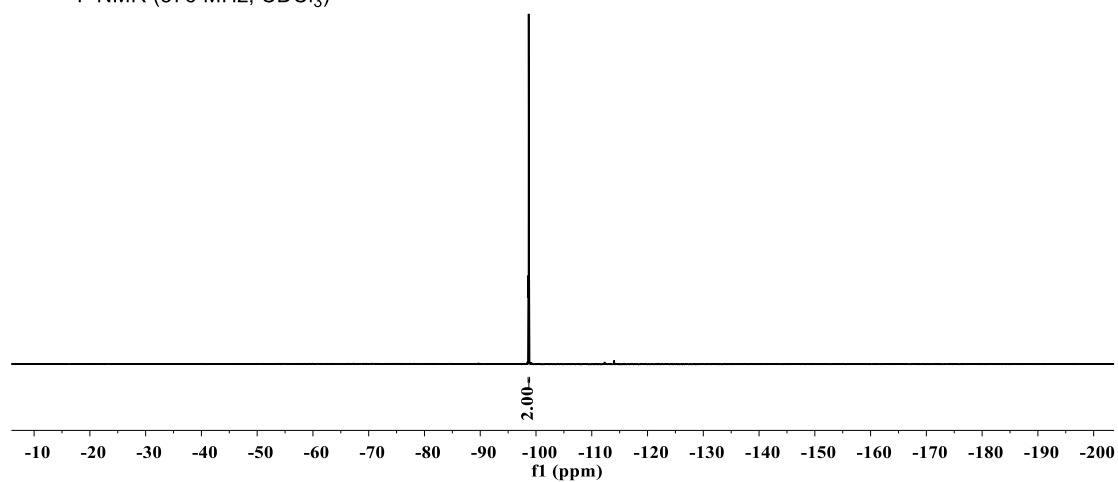


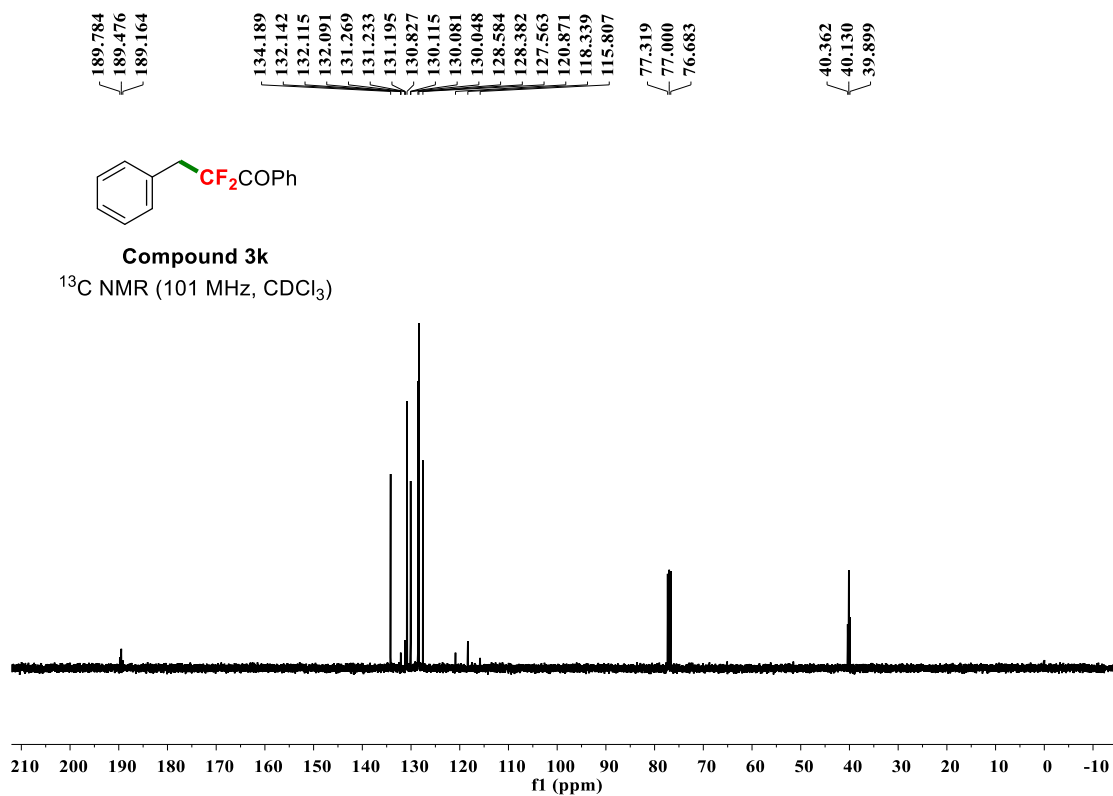
-98.633
-98.681
-98.728



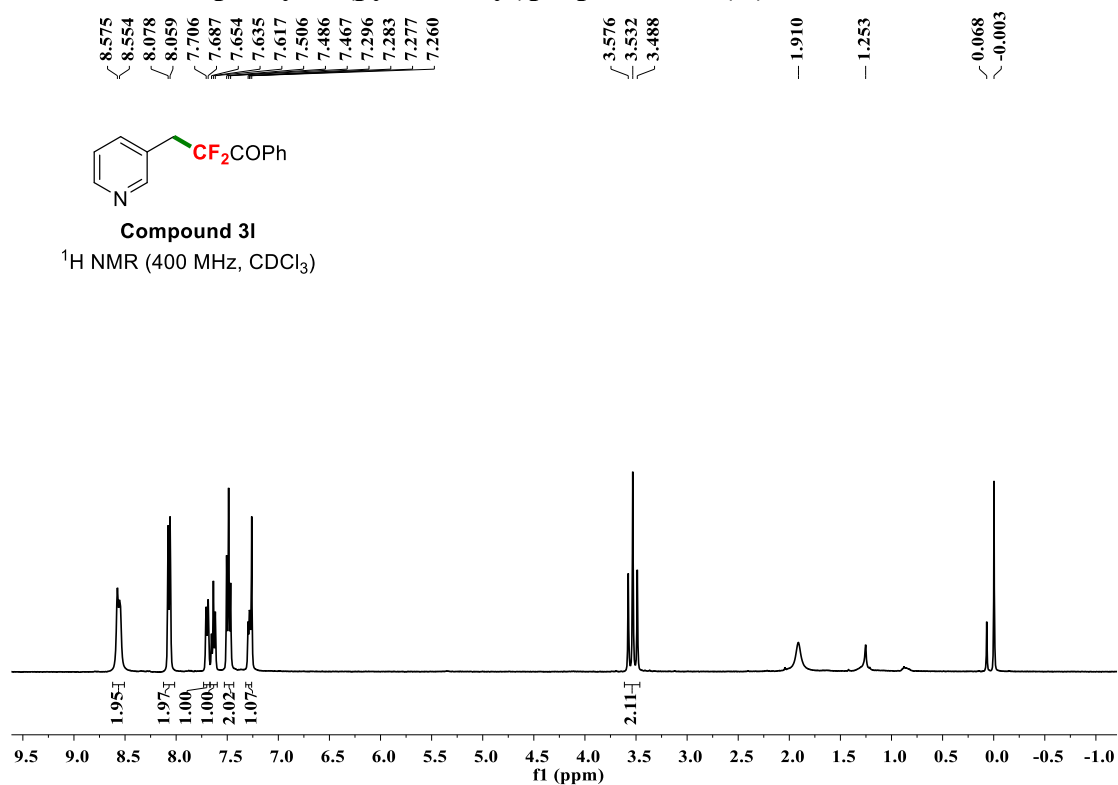
Compound 3k

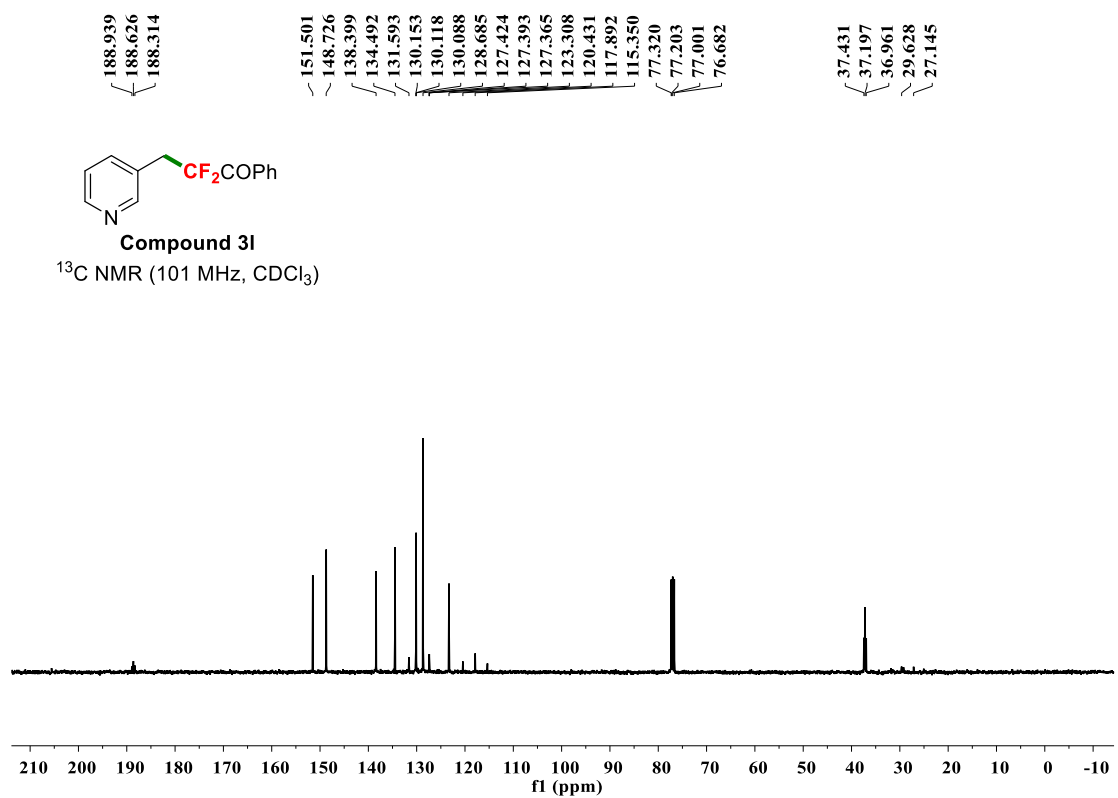
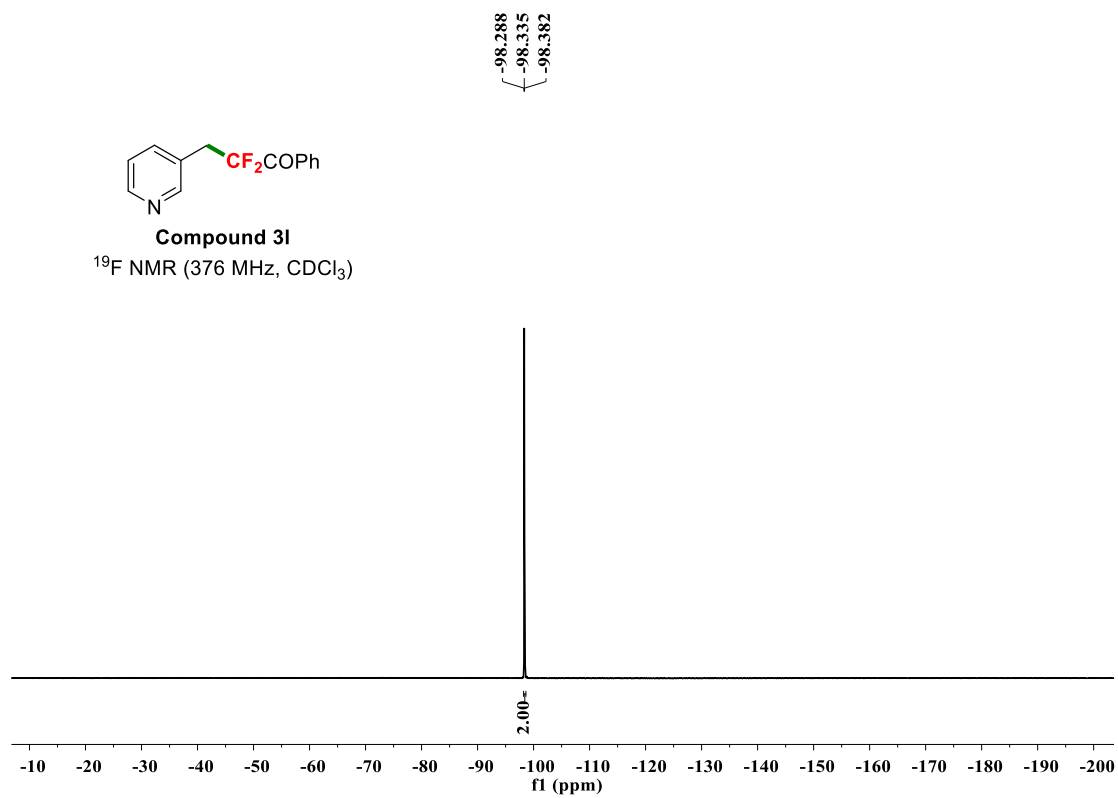
¹⁹F NMR (376 MHz, CDCl₃)



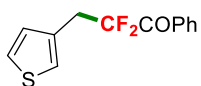
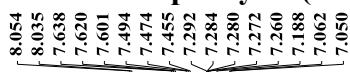


2,2-Difluoro-1-phenyl-3-(pyridin-3-yl)propan-1-one (3l).



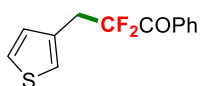
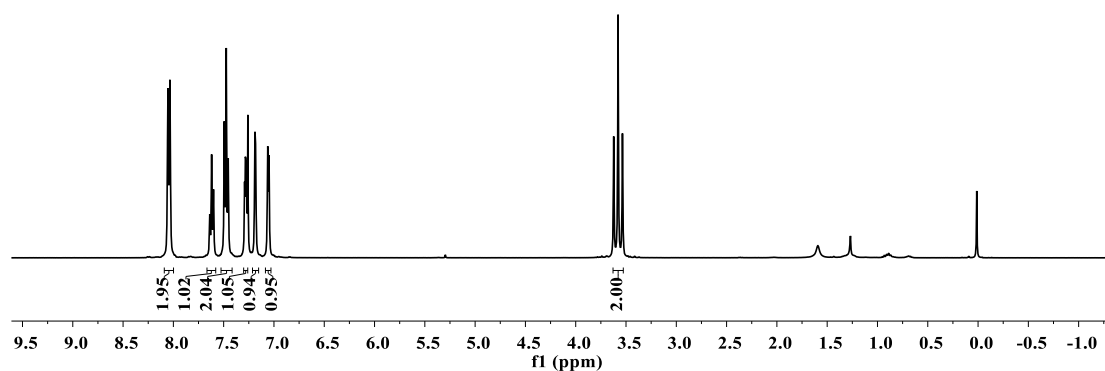


2,2-difluoro-1-phenyl-3-(thiophen-2-yl)propan-1-one (3m).



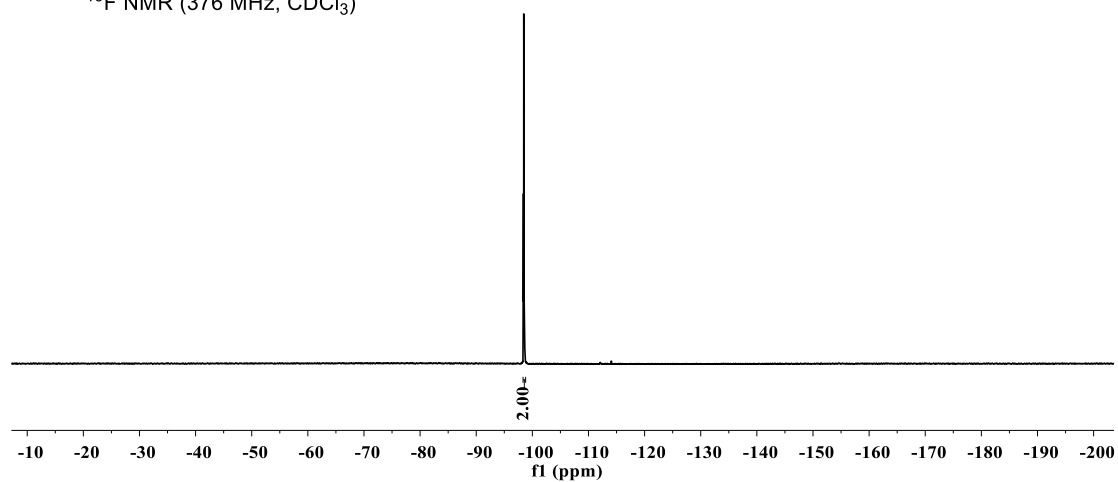
Compound 3m

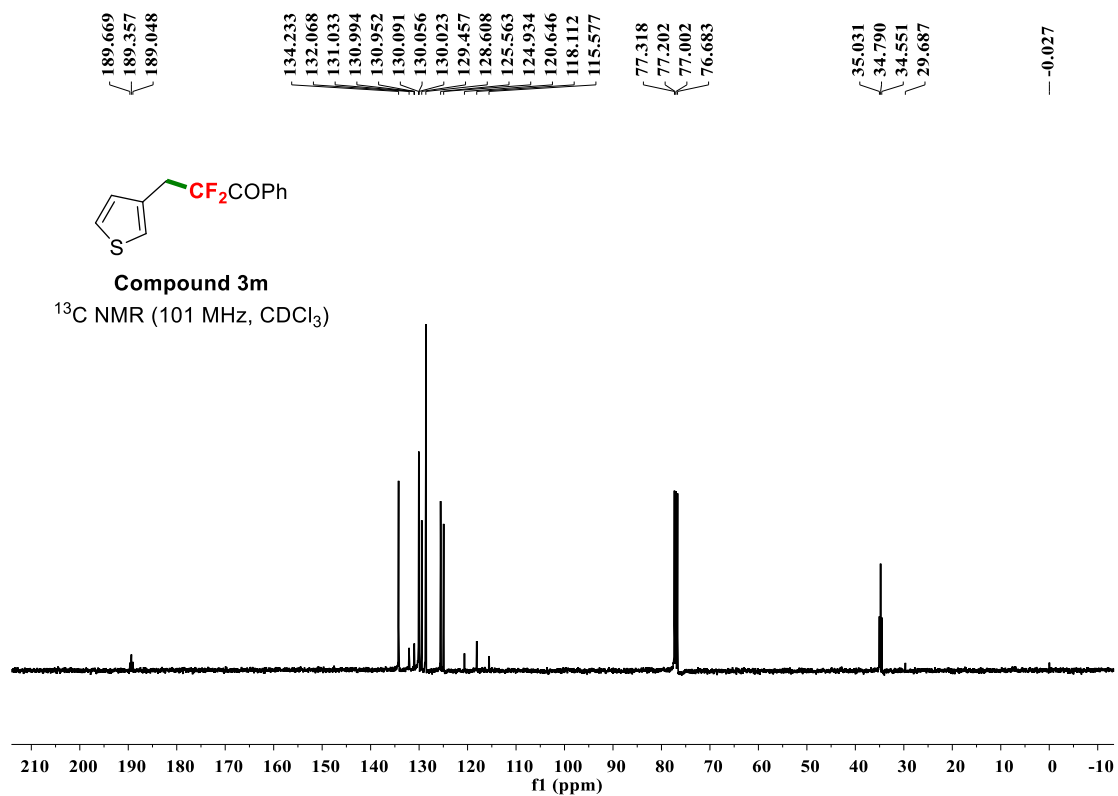
¹H NMR (400 MHz, CDCl₃)



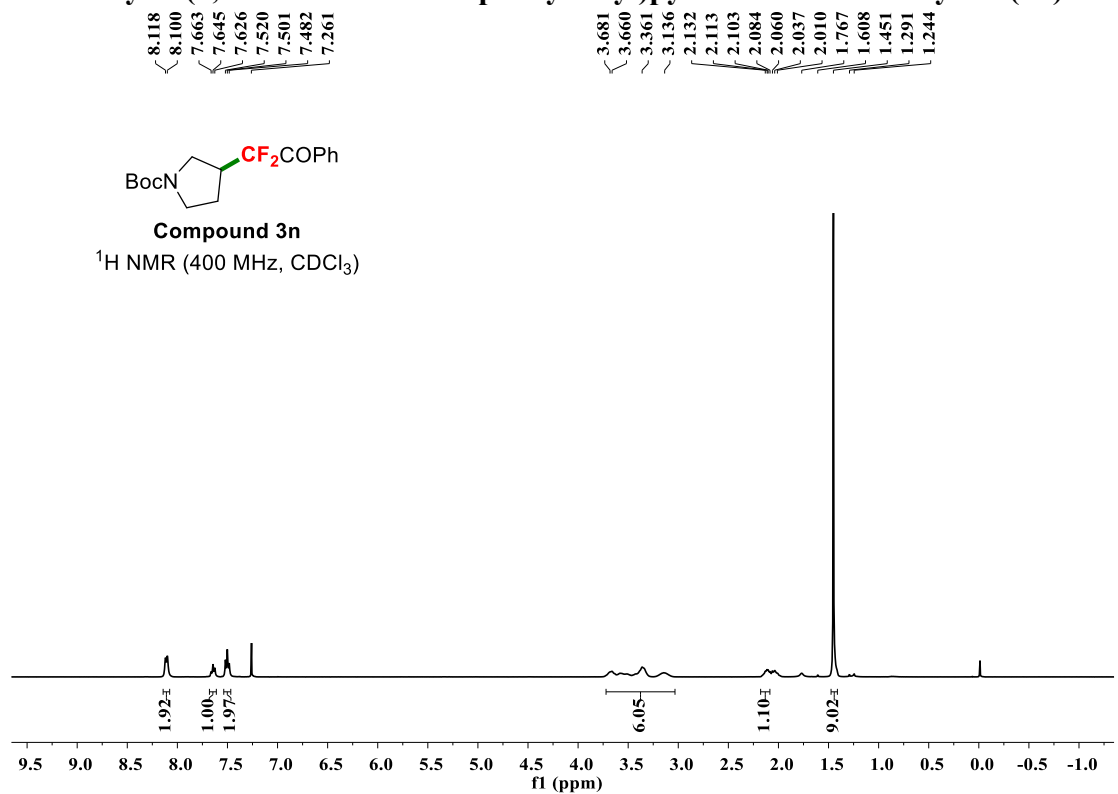
Compound 3m

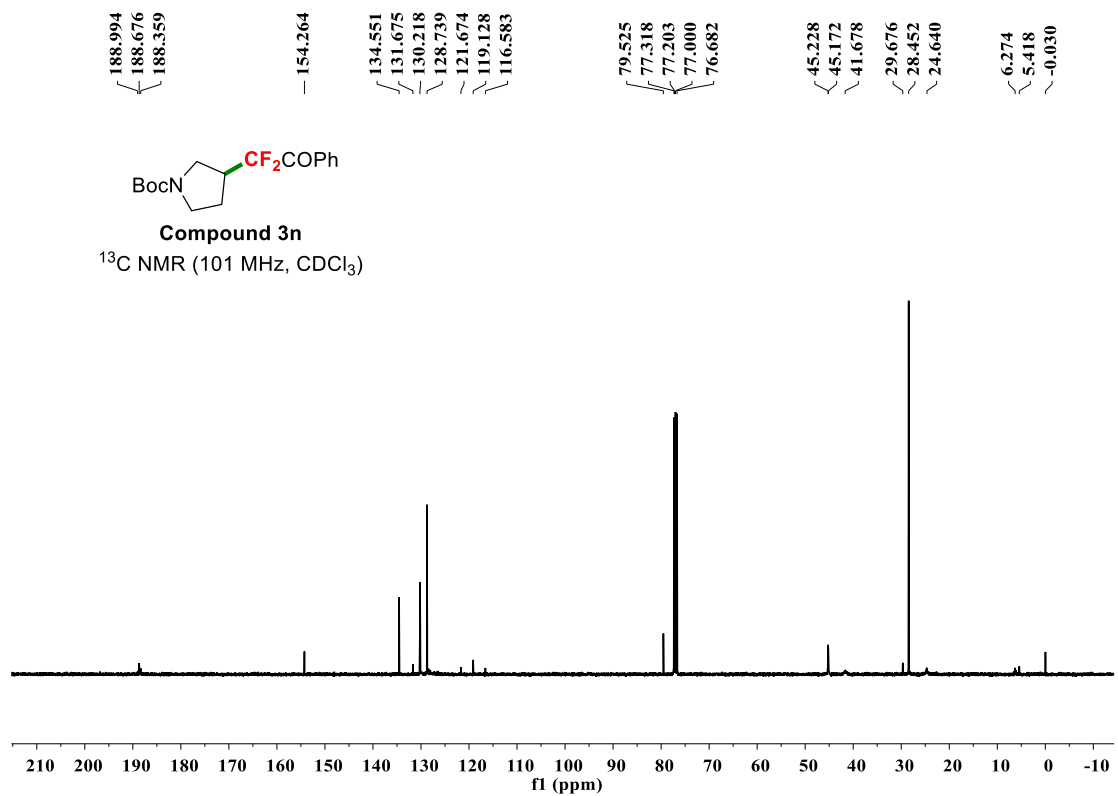
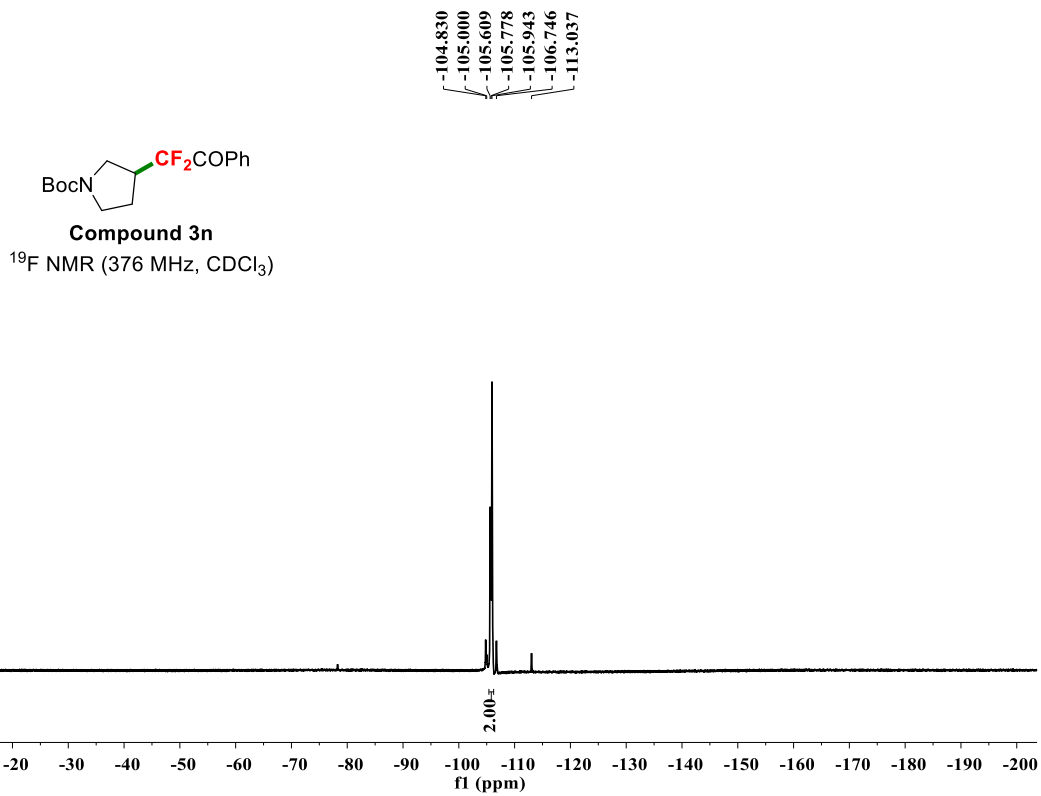
¹⁹F NMR (376 MHz, CDCl₃)



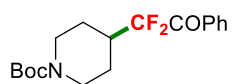
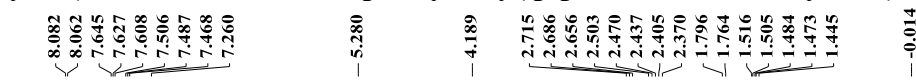


Tert-butyl 3-(1,1-difluoro-2-oxo-2-phenylethyl)pyrrolidine-1-carboxylate (3n).



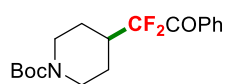
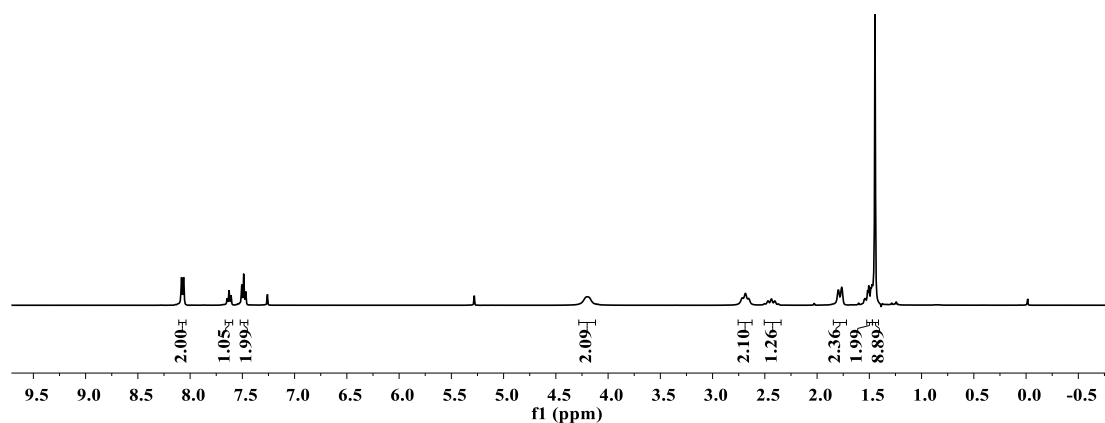


Tert-butyl 4-(1,1-difluoro-2-oxo-2-phenylethyl)piperidine-1-carboxylate (3o).



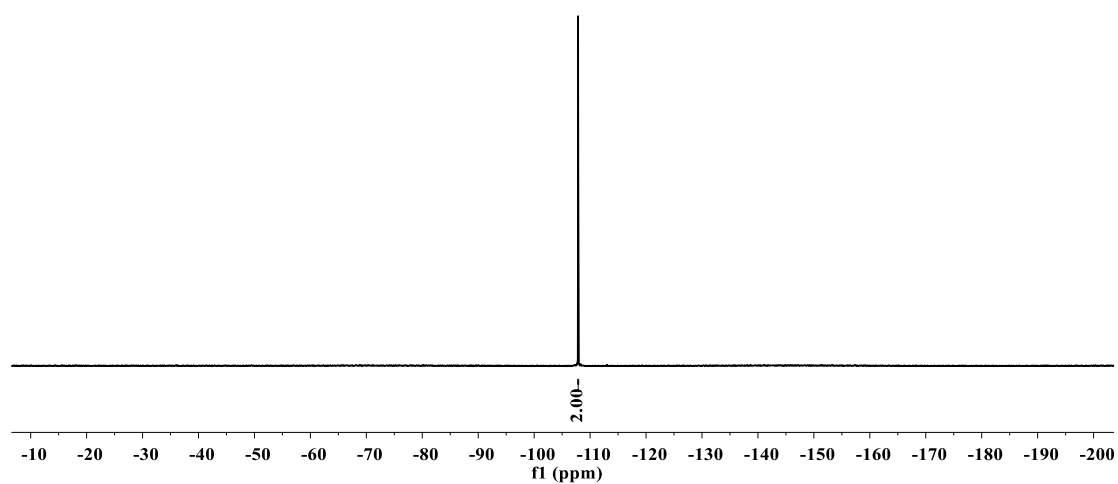
Compound 3o

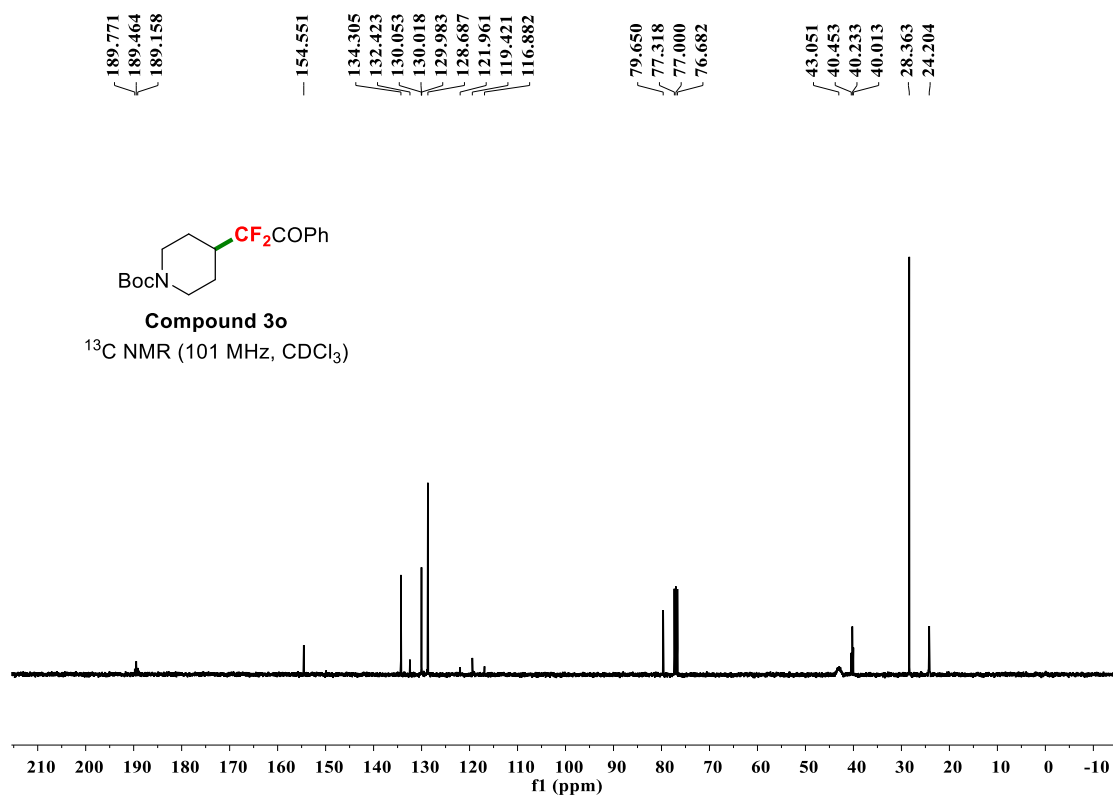
¹H NMR (400 MHz, CDCl₃)



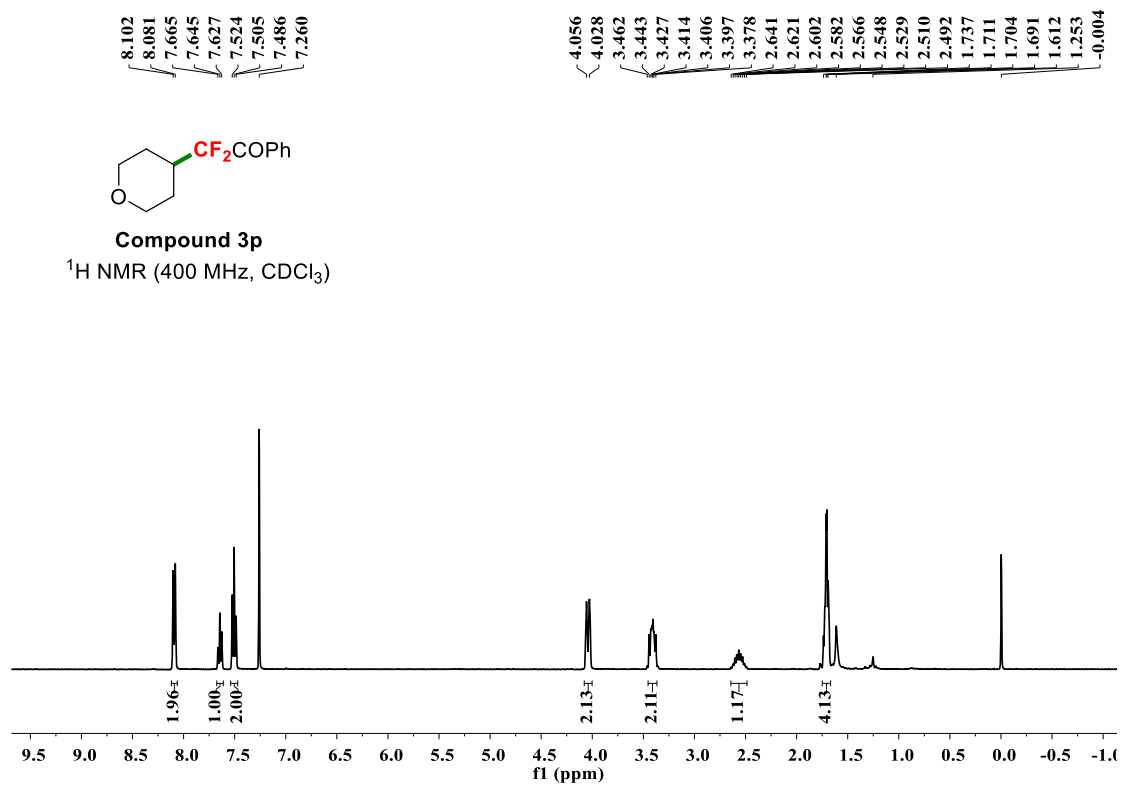
Compound 3o

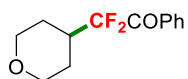
¹⁹F NMR (376 MHz, CDCl₃)





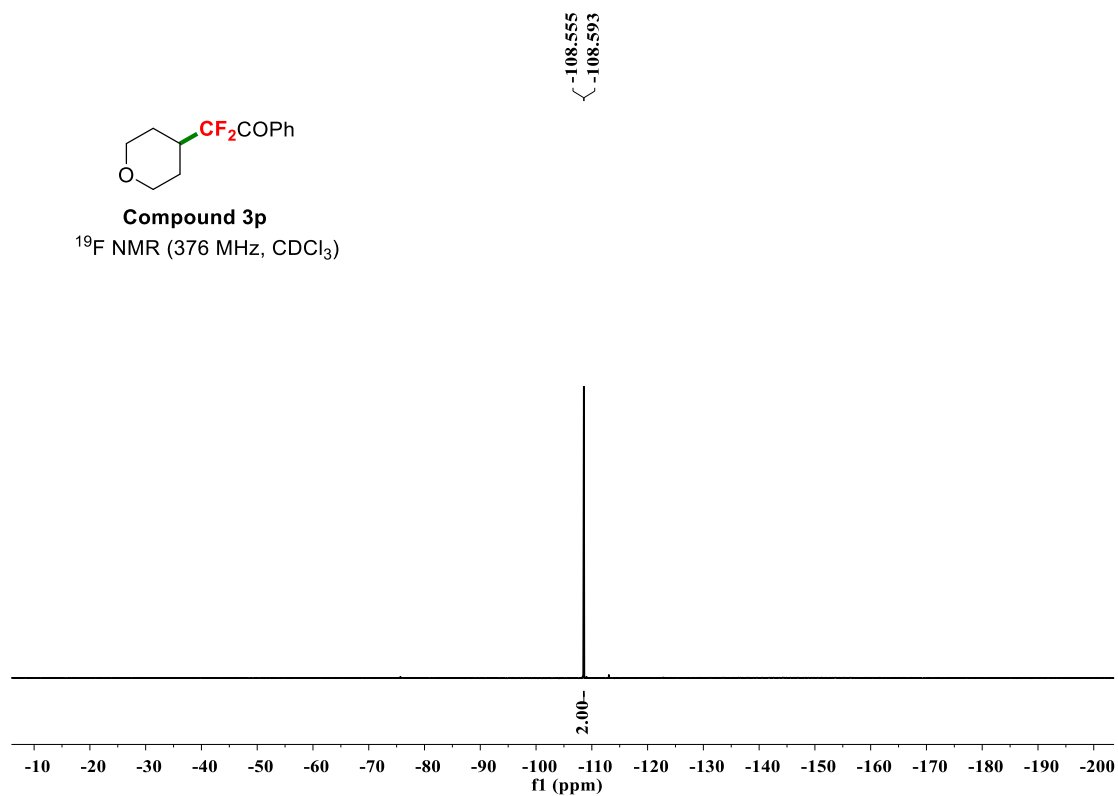
2,2-Difluoro-1-phenyl-2-(tetrahydro-2H-pyran-4-yl)ethan-1-one (3p).





Compound 3p

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



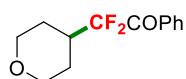
189.756
189.449
189.142

134.335
132.419
132.396
132.373
130.071
130.036
130.000
128.706
121.727
119.190
116.652

77.318
77.202
77.000
76.681
67.038

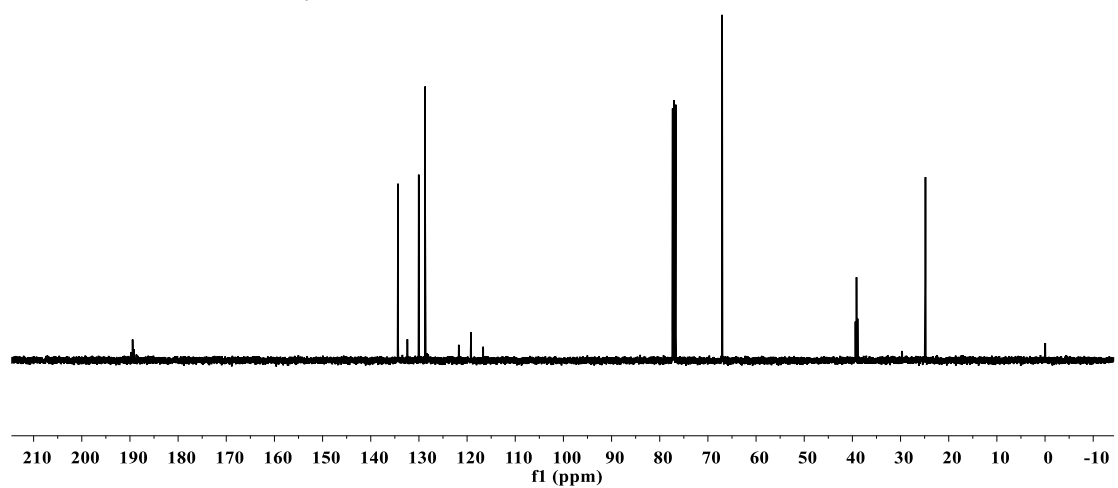
39.365
39.143
38.921
29.669
24.869
24.825
24.782

-0.042

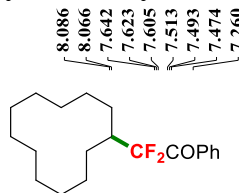


Compound 3p

^{13}C NMR (101 MHz, CDCl_3)

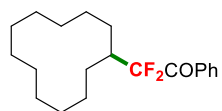
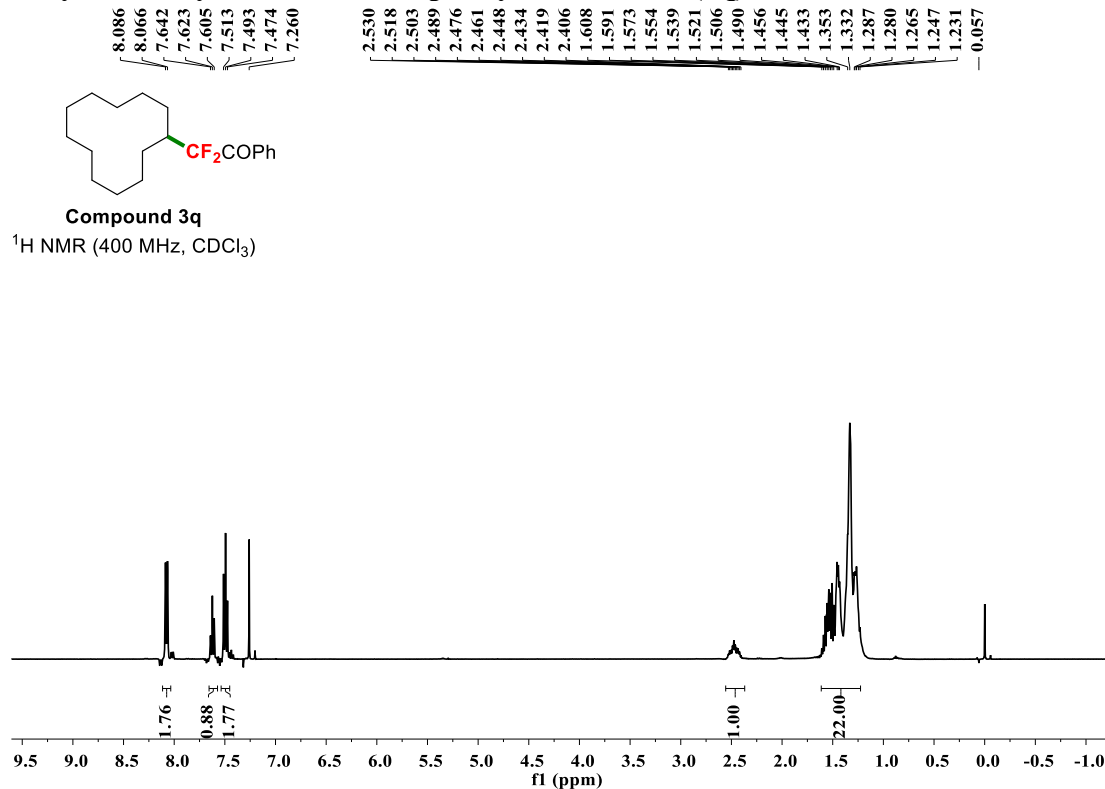


2-Cyclododecyl-2,2-difluoro-1-phenylethan-1-one (3q).



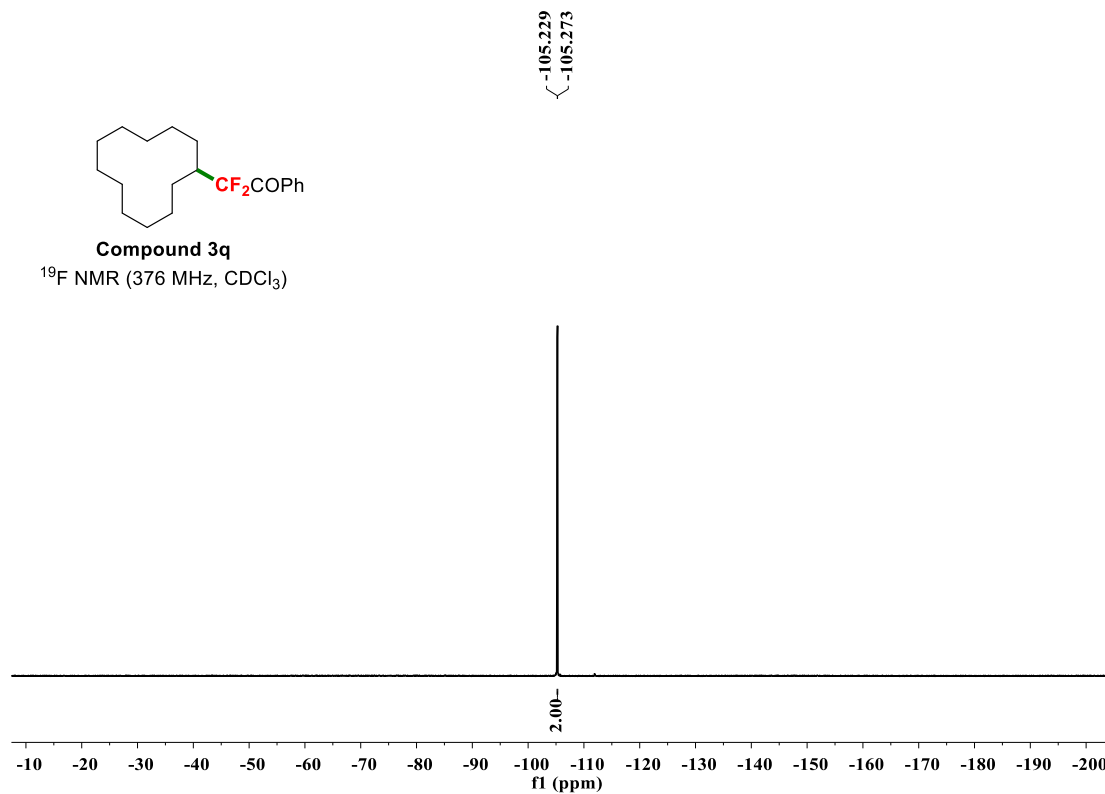
Compound 3q

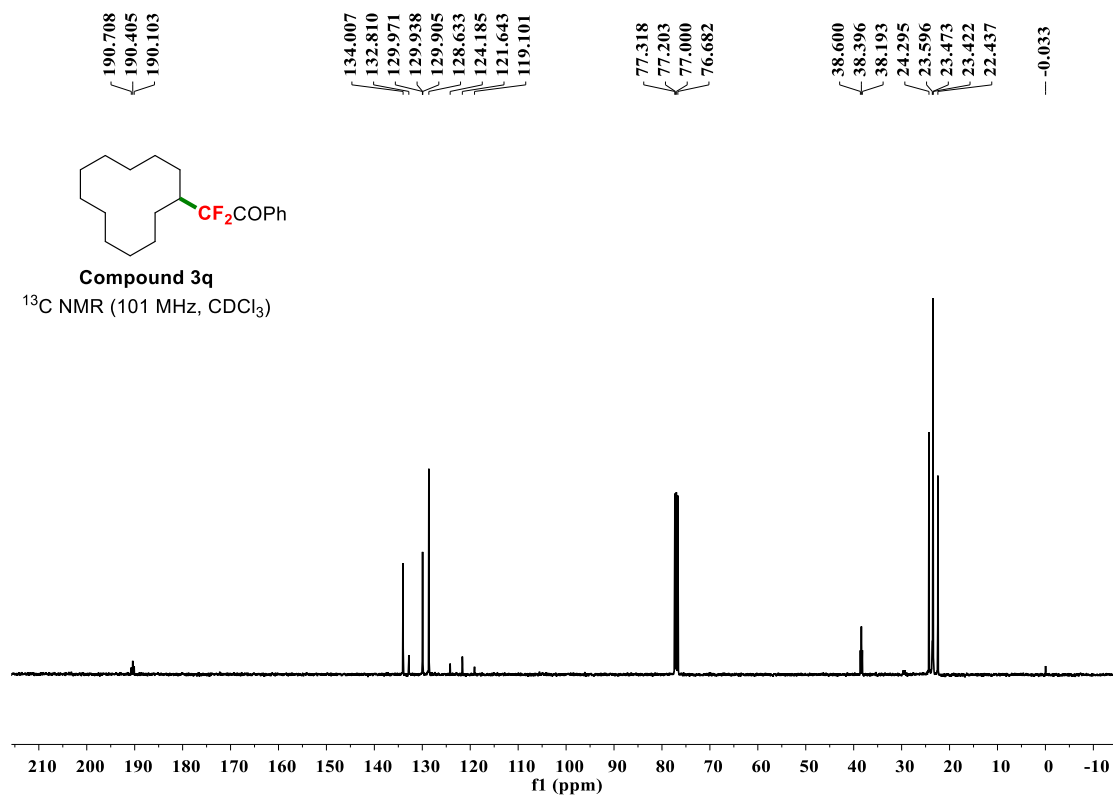
¹H NMR (400 MHz, CDCl₃)



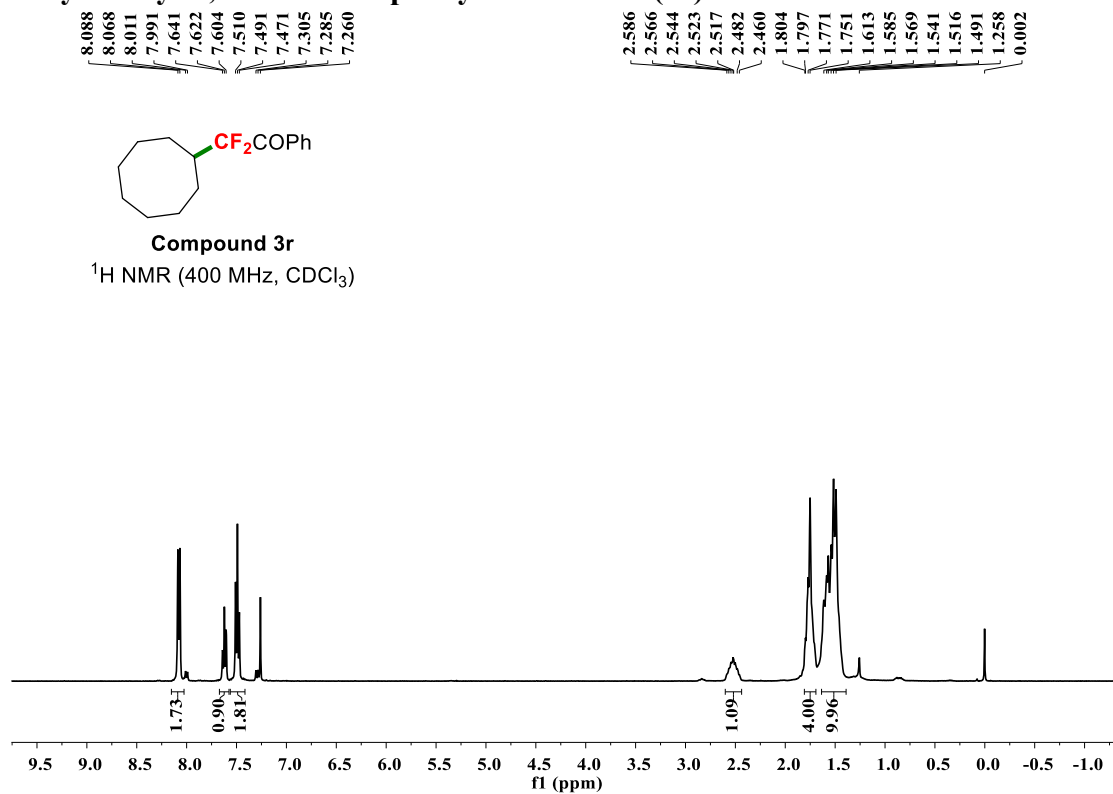
Compound 3q

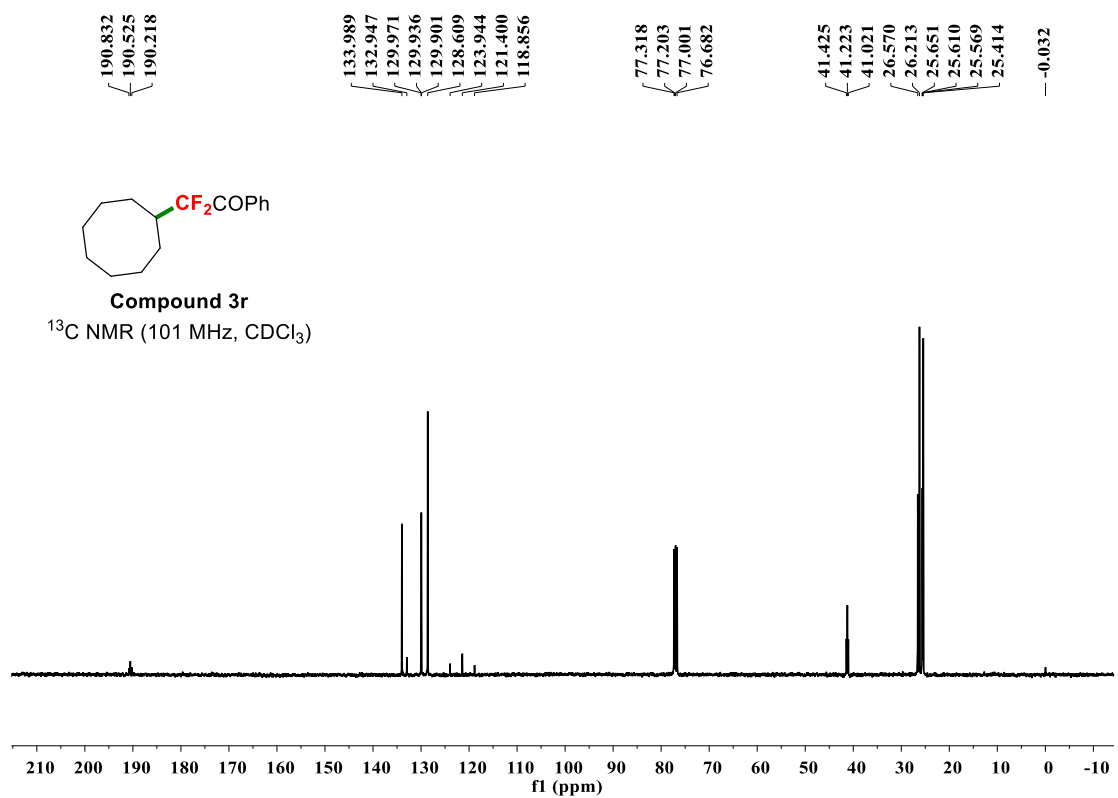
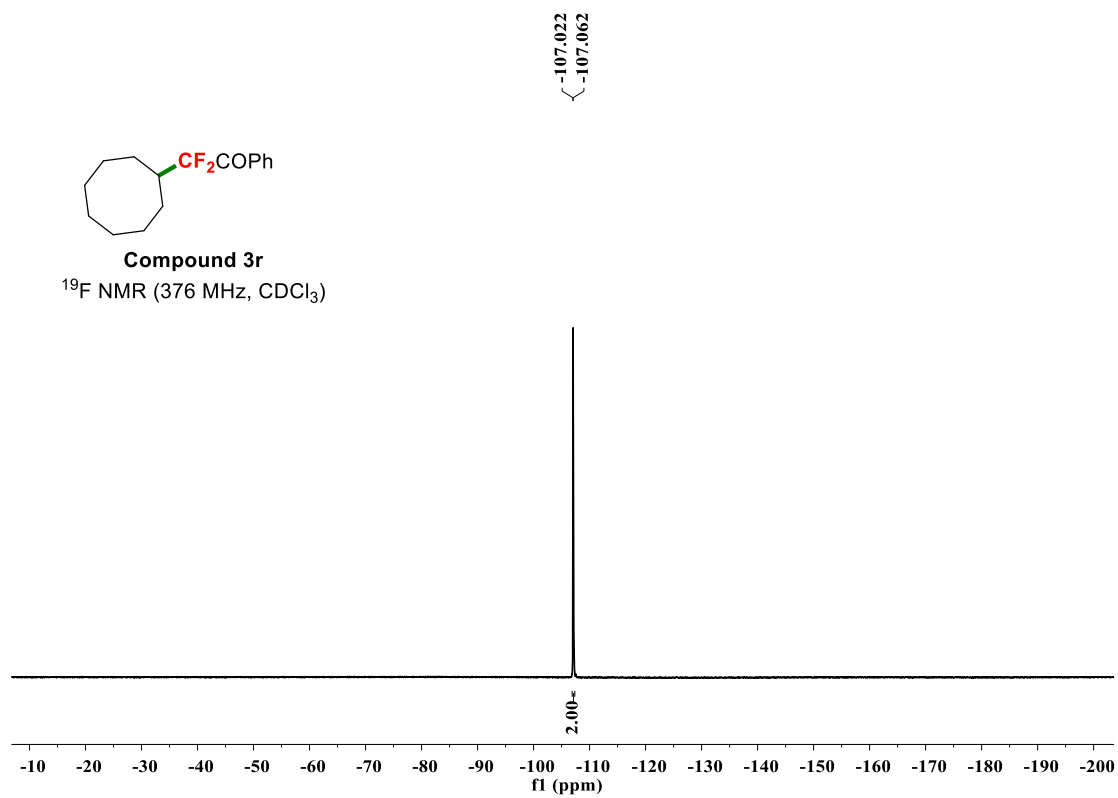
¹⁹F NMR (376 MHz, CDCl₃)





2-Cyclooctyl-2,2-difluoro-1-phenylethan-1-one (3r).





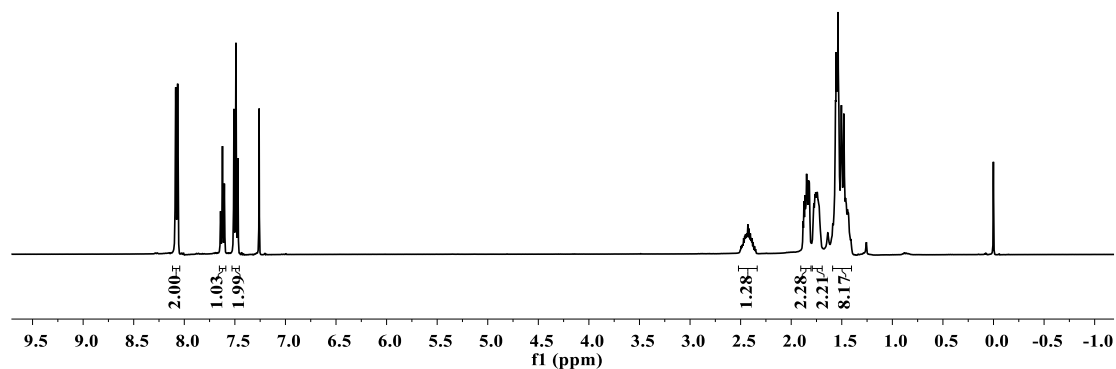
2-Cycloheptyl-2,2-difluoro-1-phenylethan-1-one (3s).

8.085
8.065
7.641
7.622
7.604
7.509
7.489
7.470
7.260
2.444
2.437
2.428
2.418
2.404
1.883
1.874
1.864
1.856
1.848
1.840
1.830
1.821
1.779
1.776
1.765
1.758
1.749
1.741
1.732
1.724
1.724
1.638
1.589
1.579
1.572
1.563
1.555
1.546
1.537
1.530
1.527
1.512
1.503
1.485
1.479
1.463
1.456
1.446
1.441
1.435
0.001

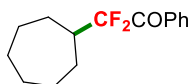


Compound 3s

^1H NMR (400 MHz, CDCl_3)

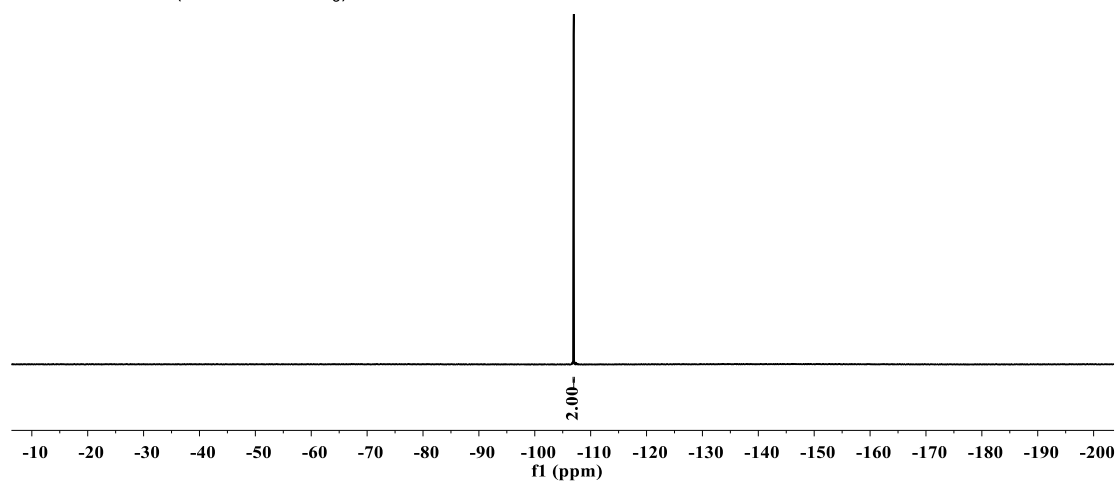


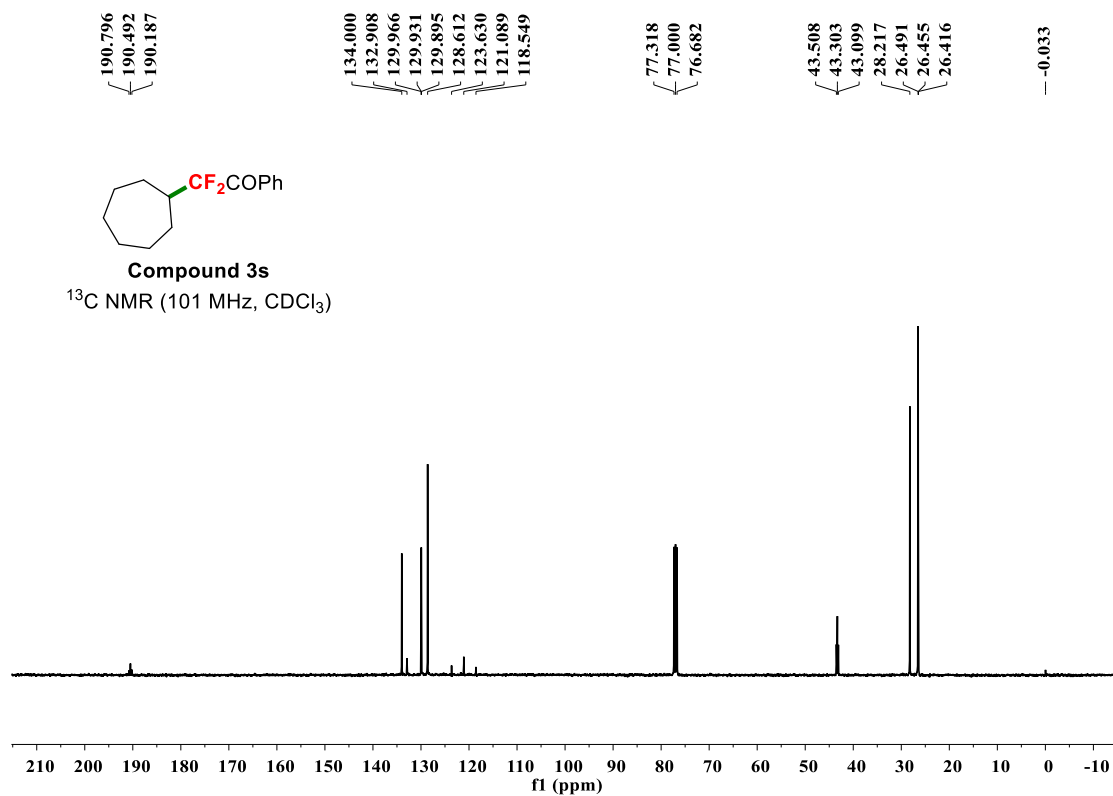
-106.925
-106.969



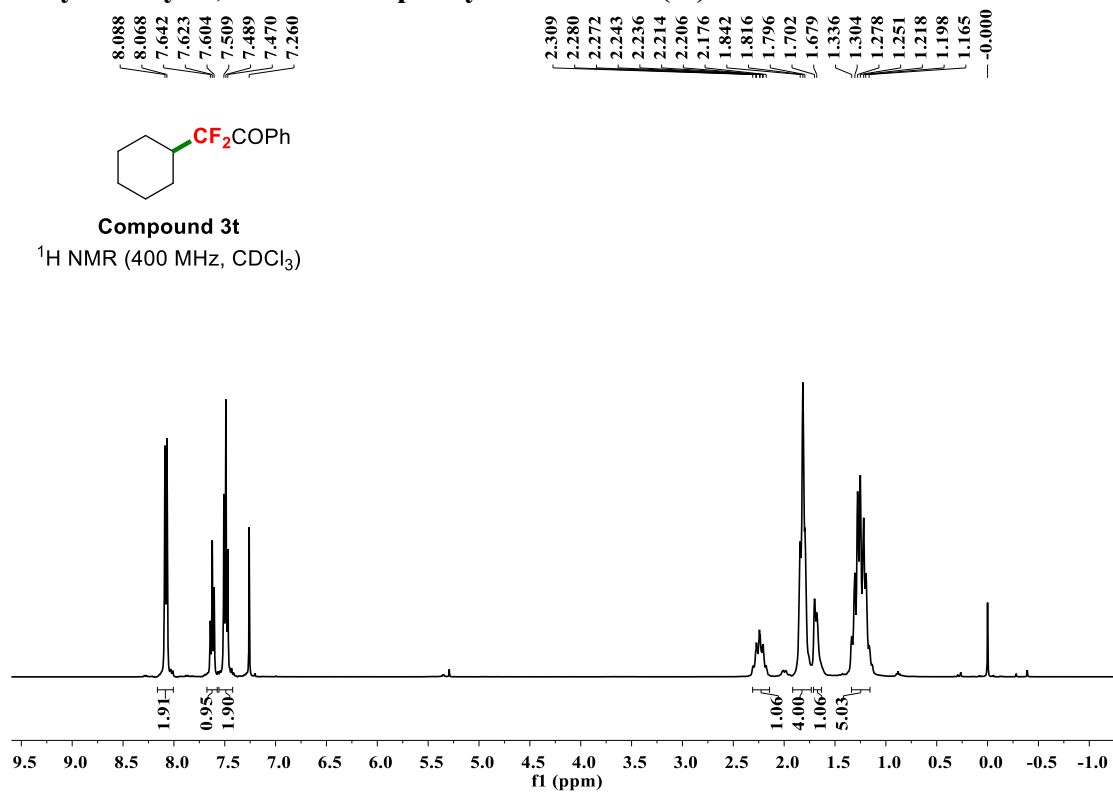
Compound 3s

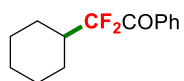
^{19}F NMR (376 MHz, CDCl_3)





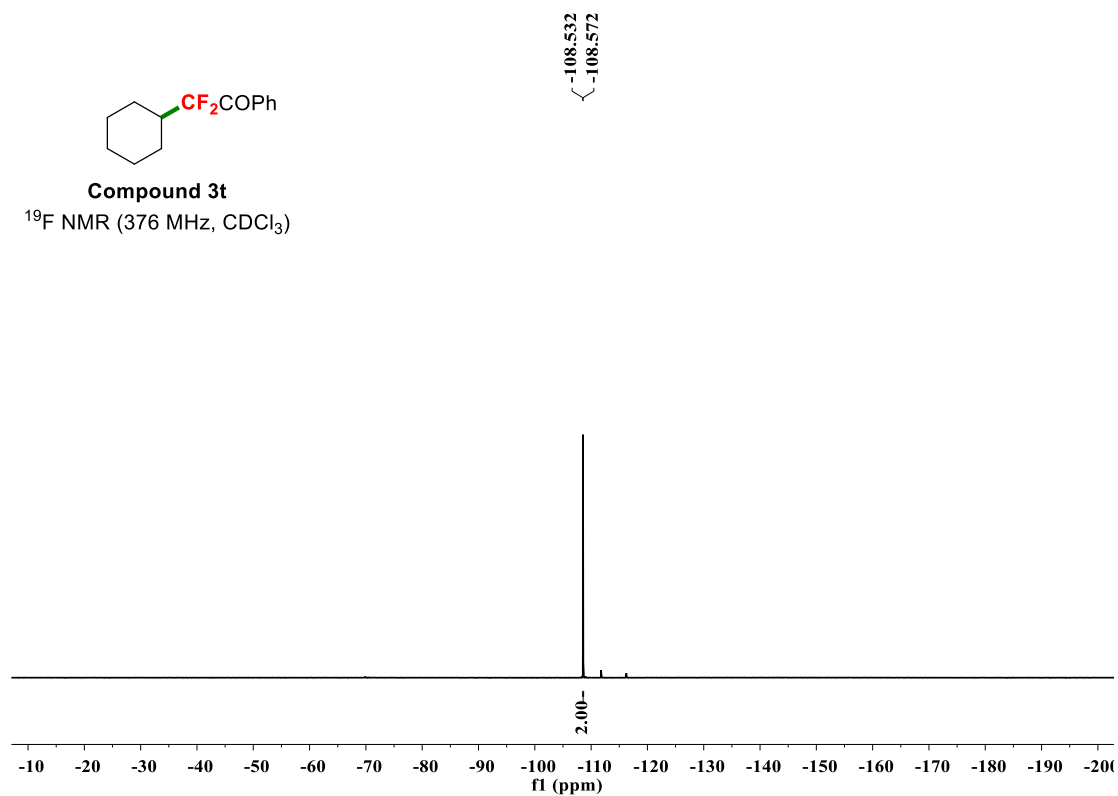
2-Cyclohexyl-2,2-difluoro-1-phenylethan-1-one (3t).





Compound 3t

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

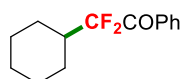


190.674
190.374
190.073

134.036
132.918
132.900
132.882
130.008
129.936
129.972
128.626
122.829
120.299
117.769

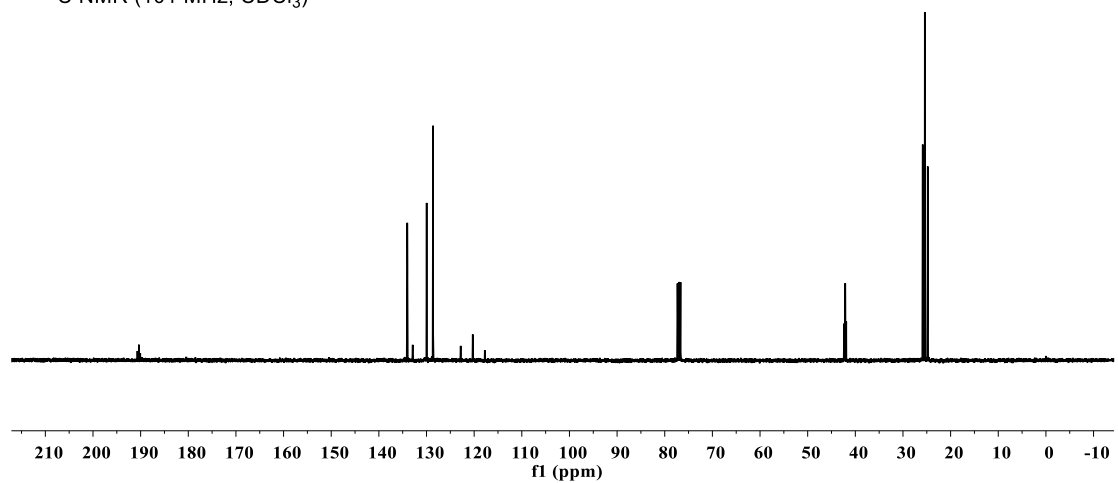
77.319
77.203
77.001
76.683

42.331
42.115
41.900
25.853
25.420
24.841
24.799
24.757



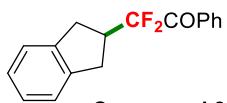
Compound 3t

^{13}C NMR (101 MHz, CDCl_3)



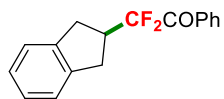
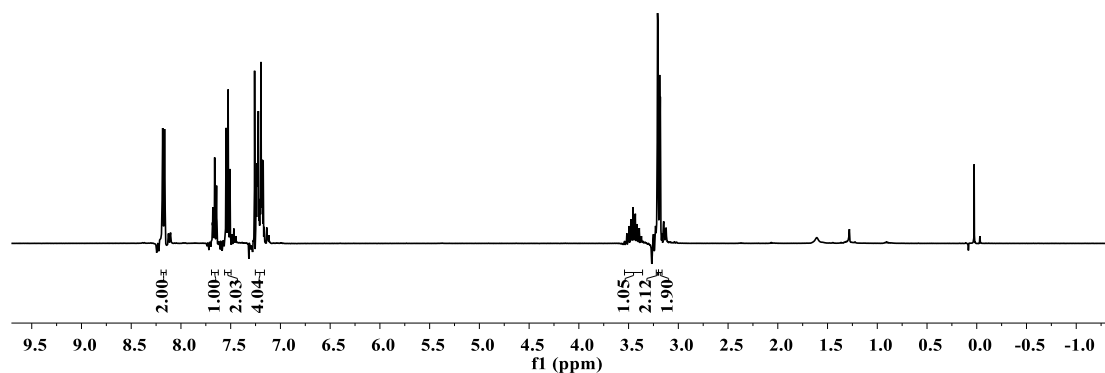
2-(2,3-Dihydro-1H-inden-2-yl)-2,2-difluoro-1-phenylethan-1-one (3u).

8.186
8.184
8.165
8.162
8.104
7.683
7.679
7.676
7.665
7.661
7.657
7.645
7.642
7.639
7.546
7.526
7.507
7.468
7.260
7.244
7.235
7.232
7.222
7.213
7.205
7.196
7.187
7.182
7.173
7.164
7.137
3.495
3.477
3.455
3.437
3.432
3.415
3.411
3.392
3.229
3.209
3.205
3.188
3.181
3.150
3.142
3.130
3.123
1.281
0.026



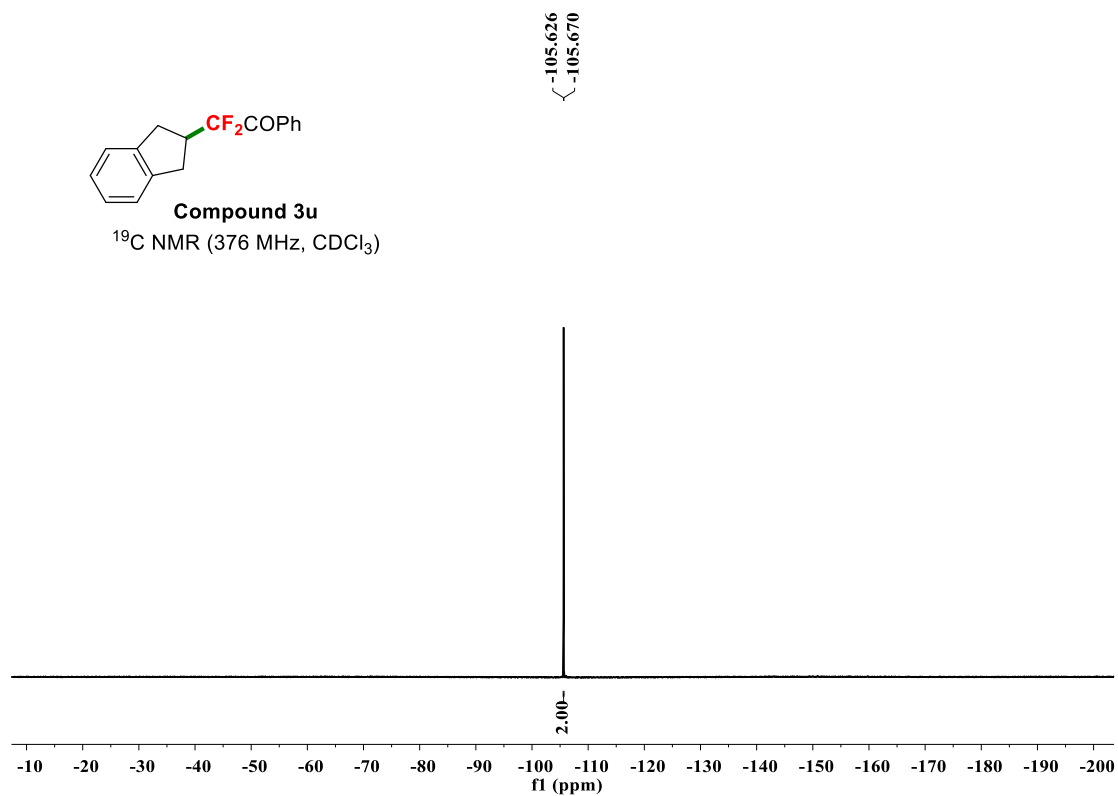
Compound 3u

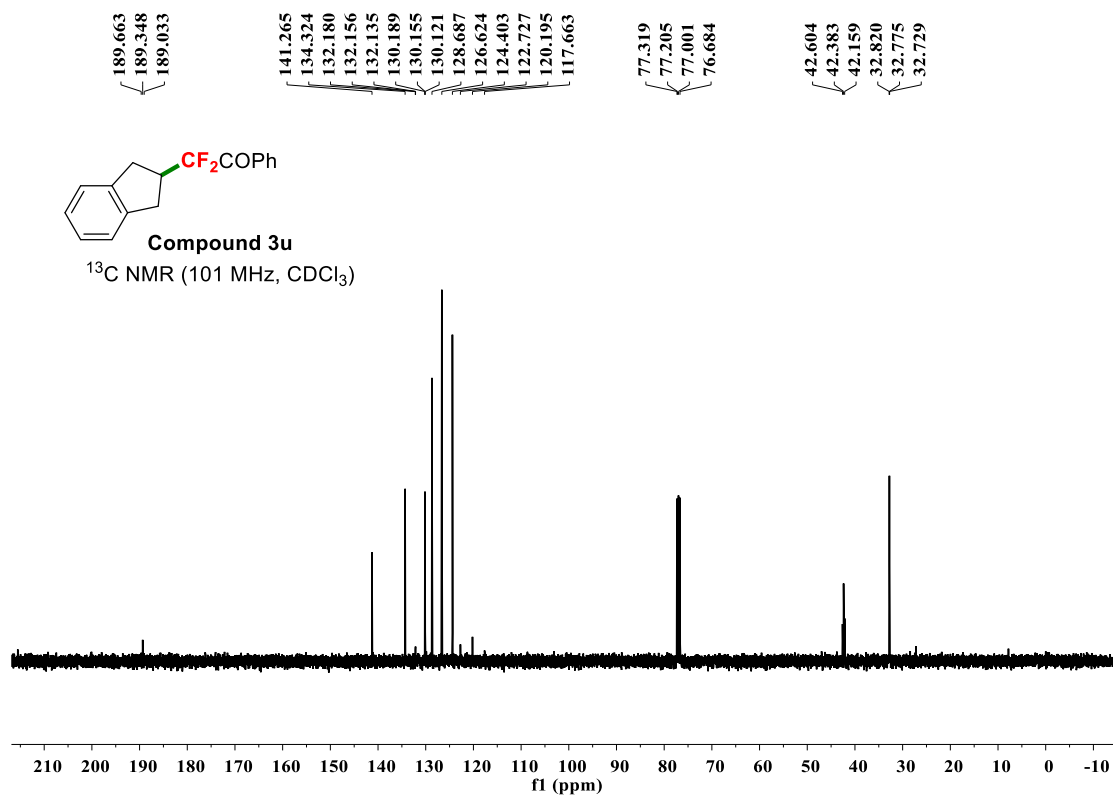
¹H NMR (400 MHz, CDCl₃)



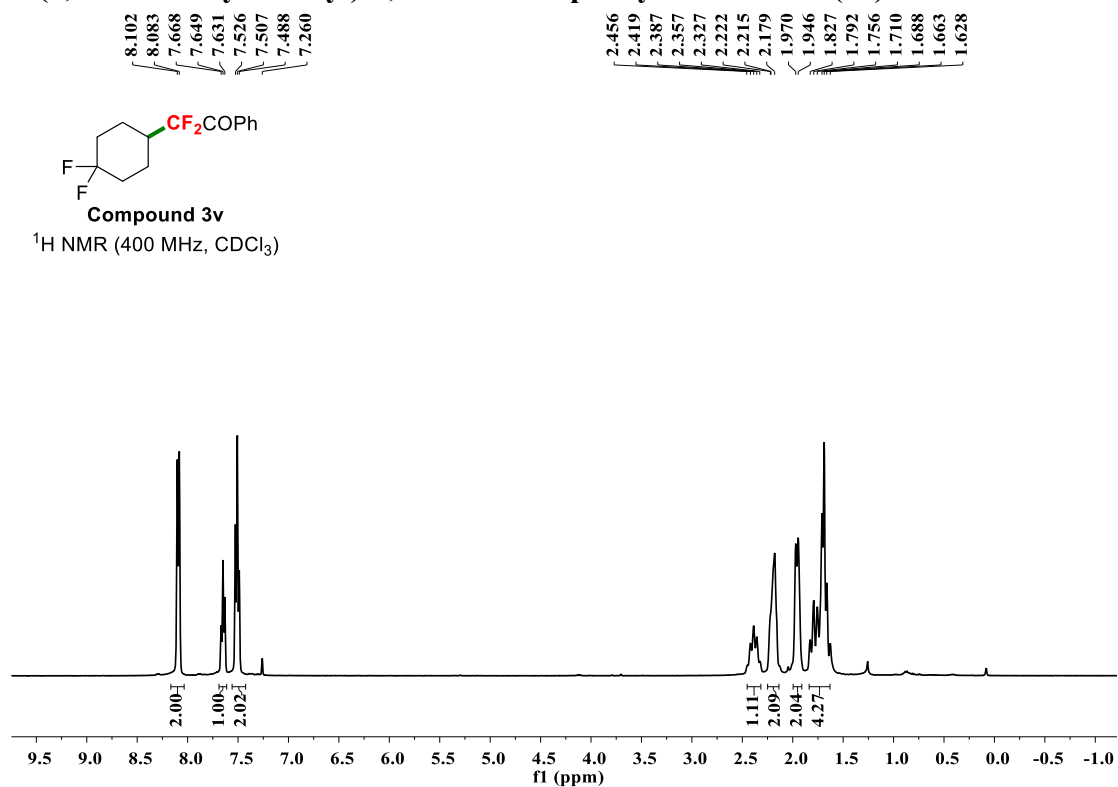
Compound 3u

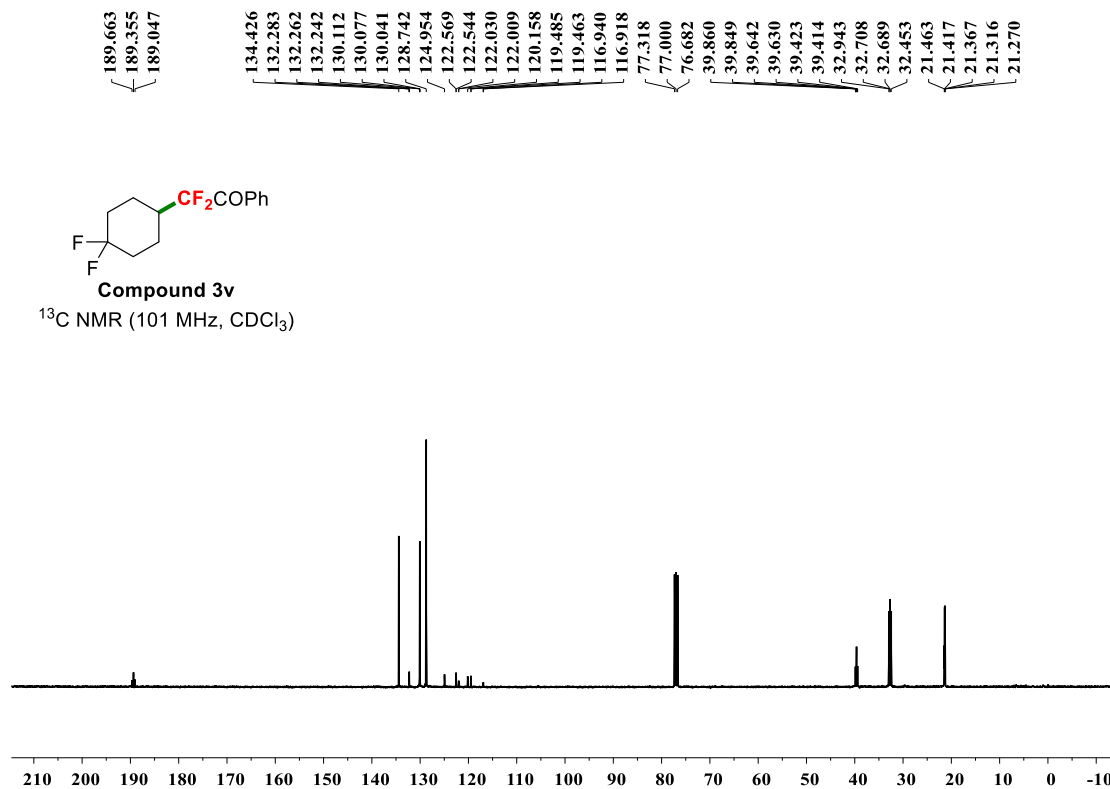
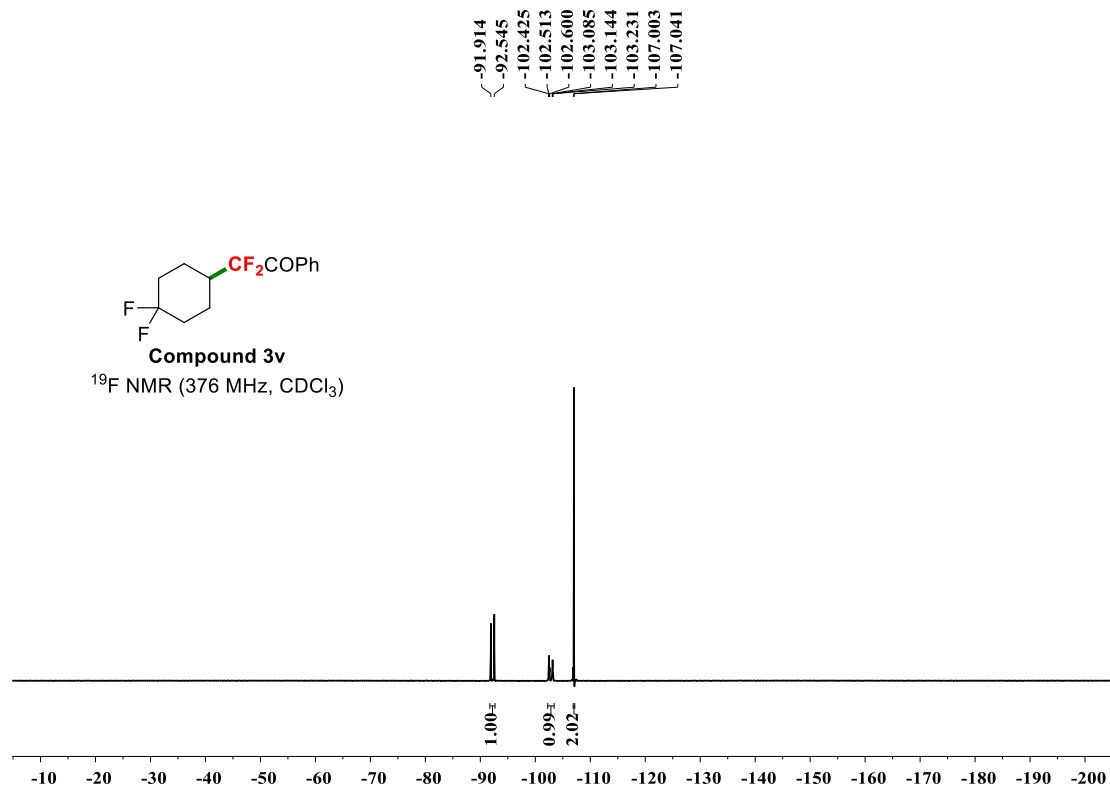
¹³C NMR (376 MHz, CDCl₃)





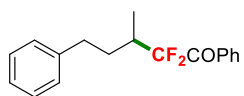
2-(4,4-difluorocyclohexyl)-2,2-difluoro-1-phenylethan-1-one (3v).





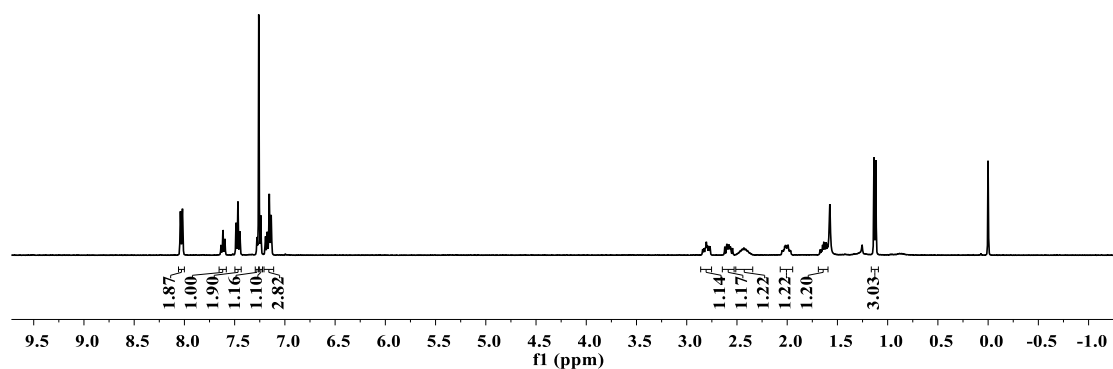
2,2-Difluoro-3-methyl-1,5-diphenylpentan-1-one (3w).

8.039, 8.019, 7.634, 7.617, 7.597, 7.486, 7.467, 7.447, 7.278, 7.260, 7.240, 7.193, 7.176, 7.155, 7.136, 2.841, 2.829, 2.815, 2.805, 2.794, 2.781, 2.769, 2.621, 2.602, 2.579, 2.563, 2.544, 2.454, 2.440, 2.431, 2.408, 2.033, 2.025, 2.017, 2.008, 1.999, 1.991, 1.984, 1.672, 1.658, 1.648, 1.635, 1.624, 1.612, 1.600, 1.576, 1.255, 1.136, 1.119, 0.001

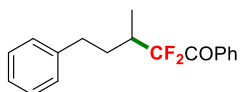


Compound 3w

^1H NMR (400 MHz, CDCl_3)

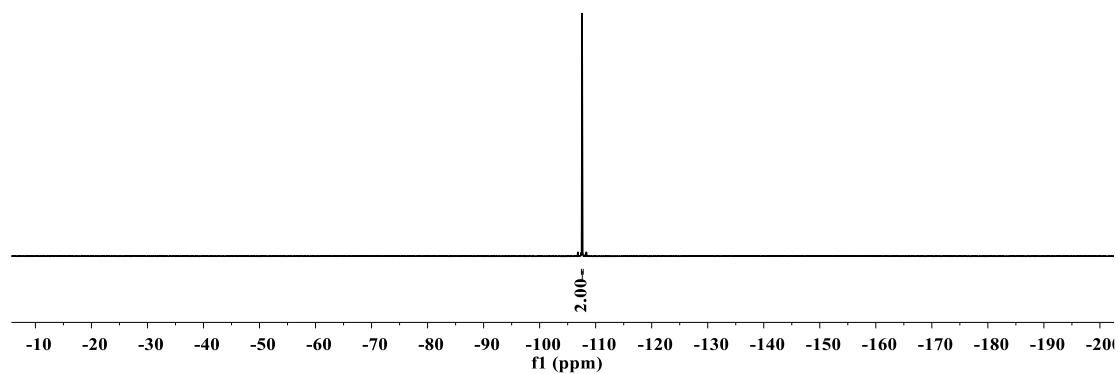


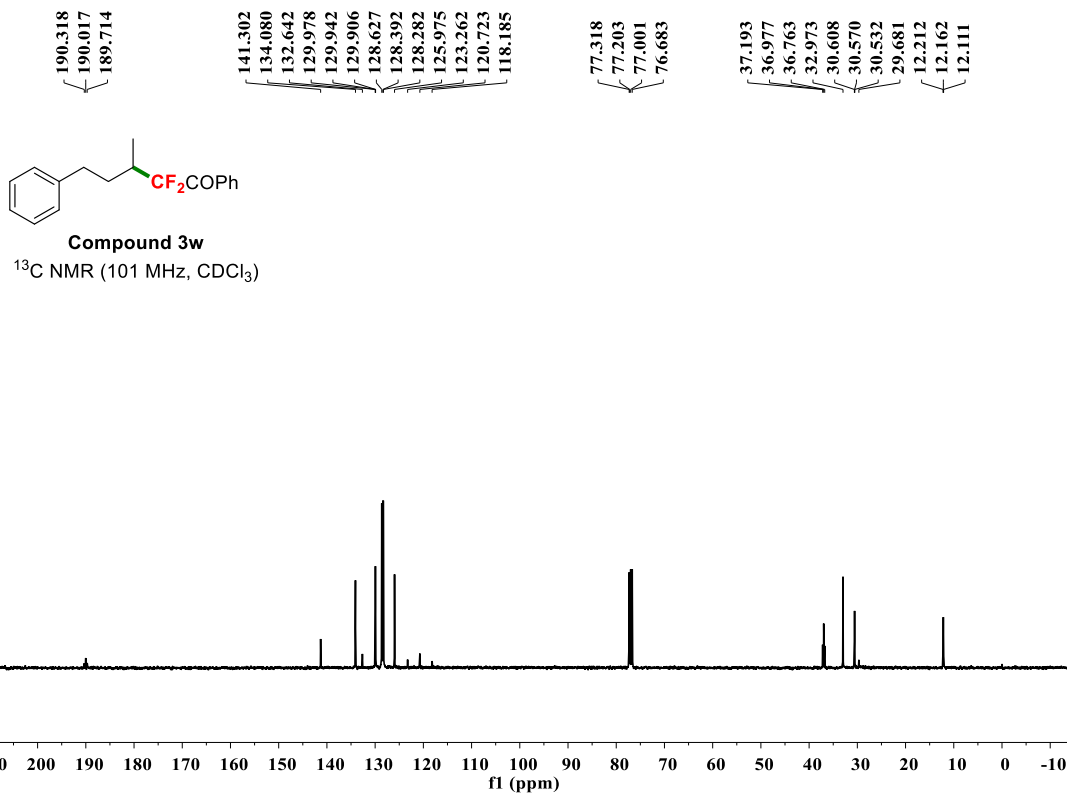
-107.533, -107.579, -107.622



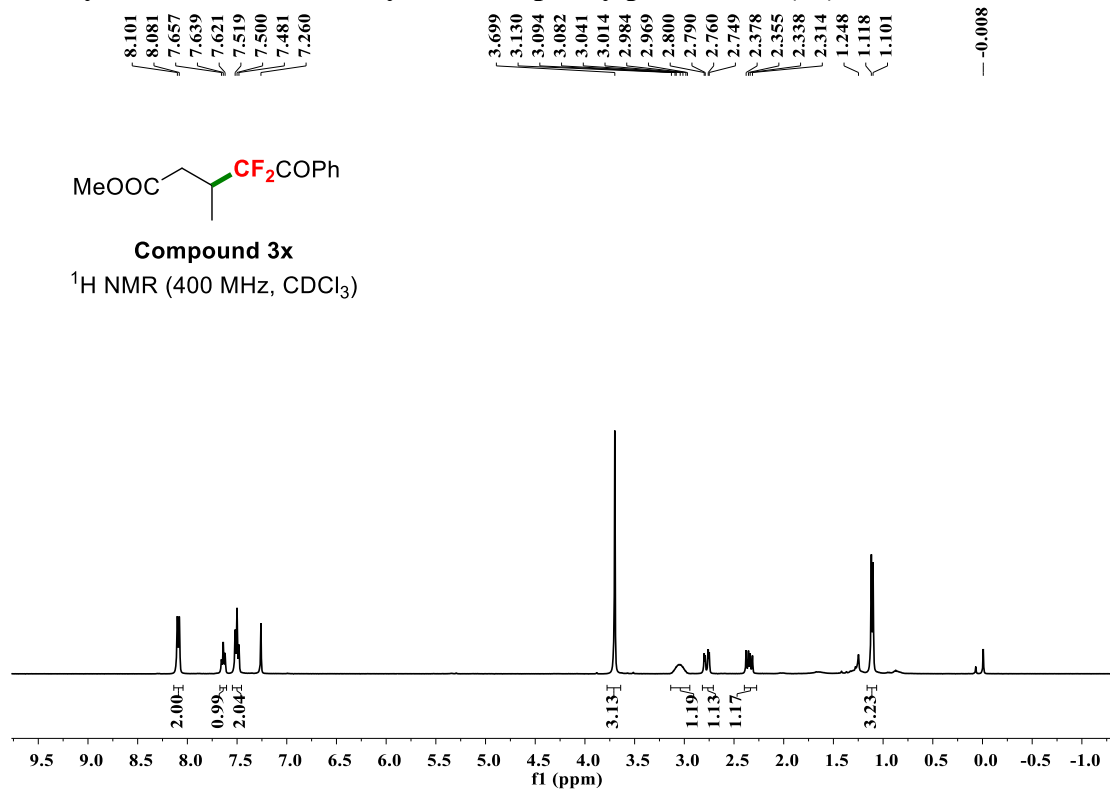
Compound 3w

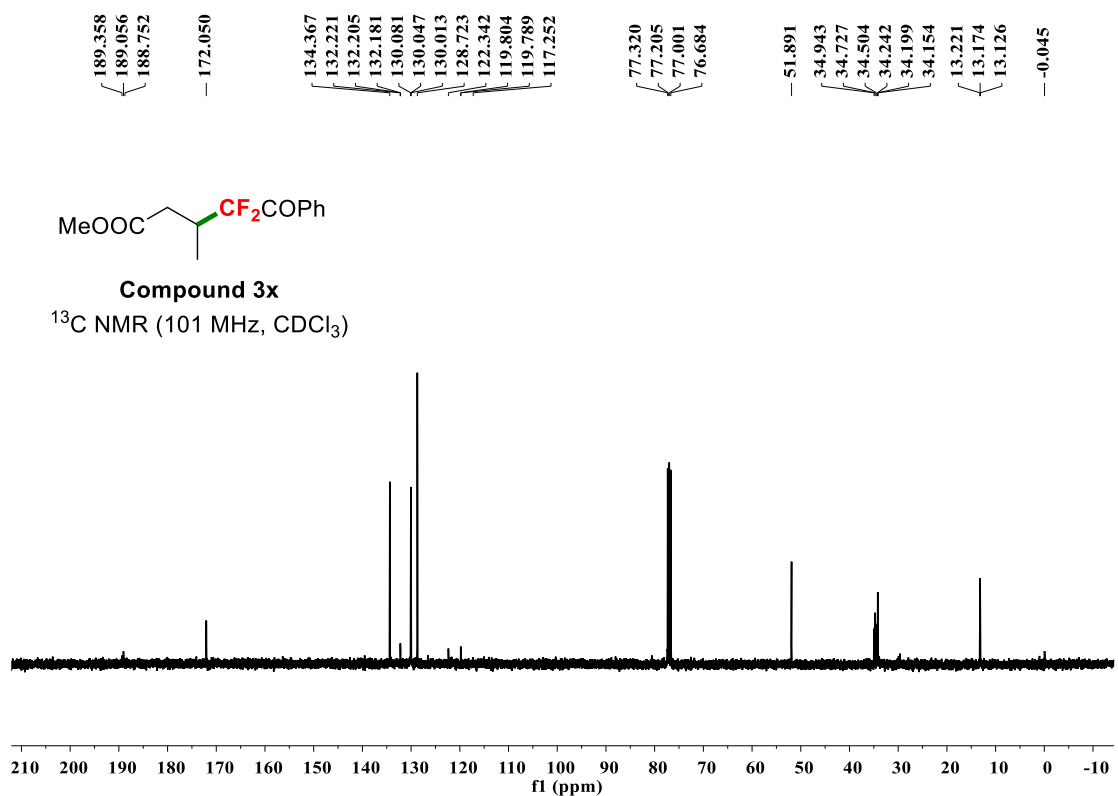
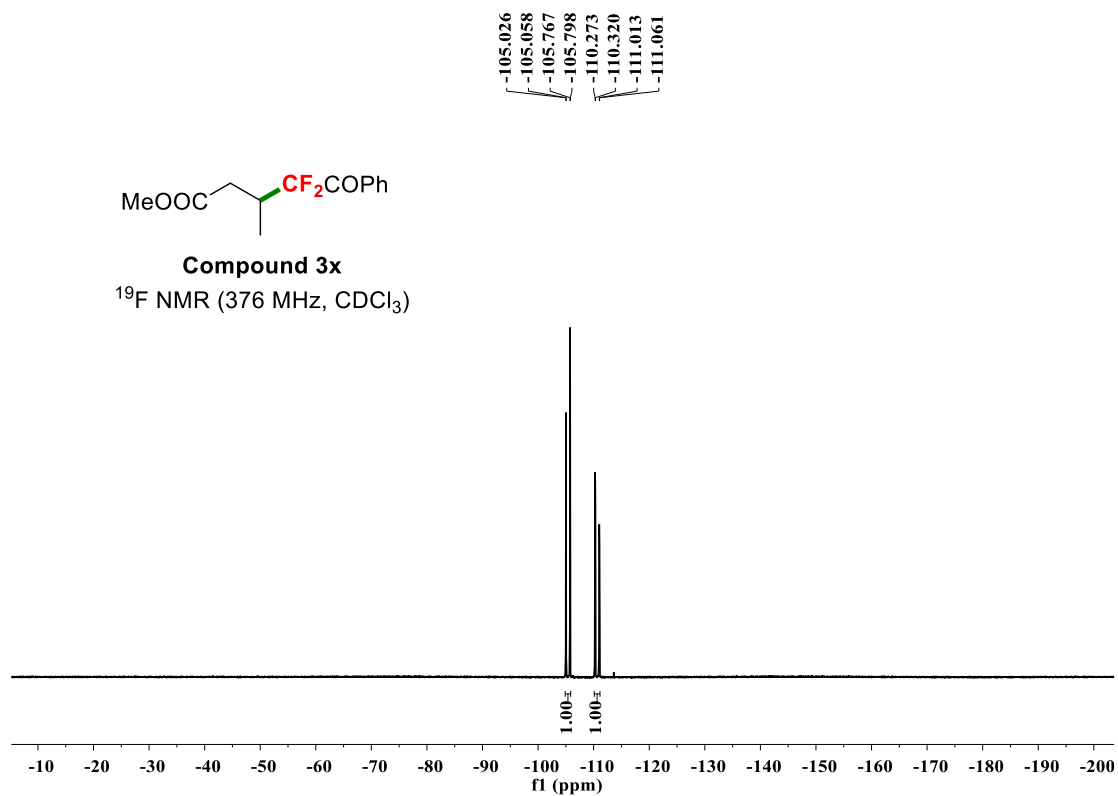
^{19}F NMR (376 MHz, CDCl_3)



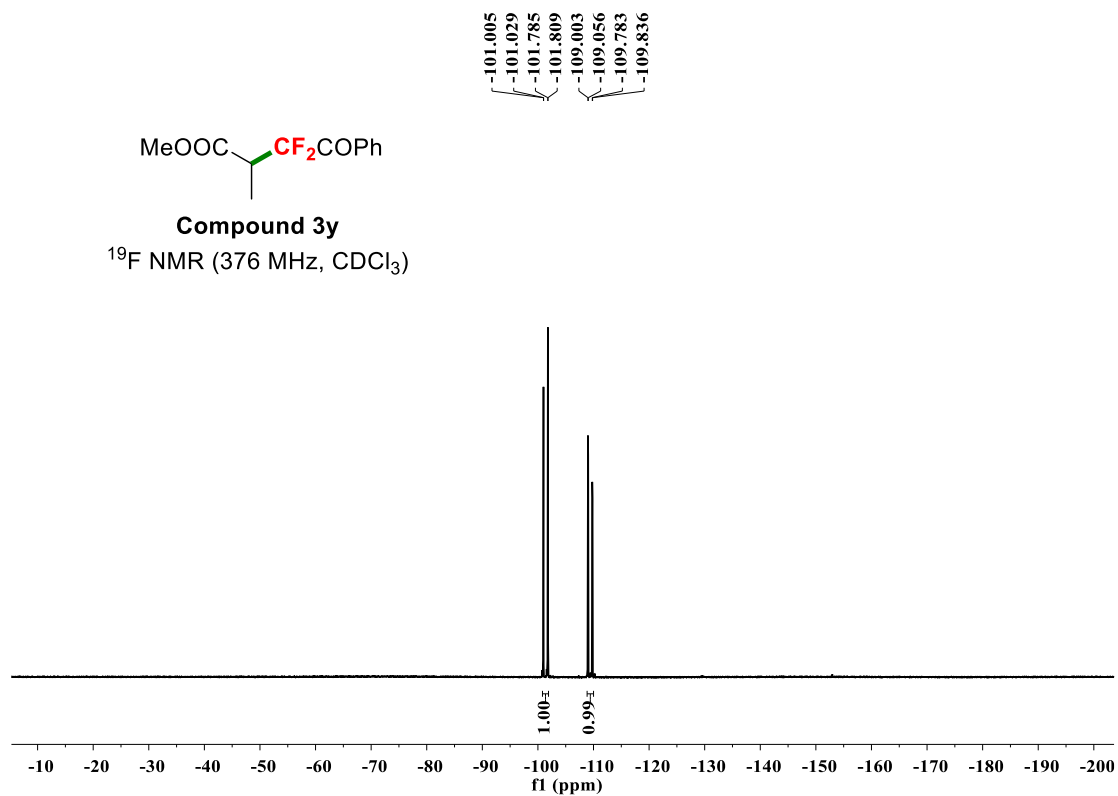
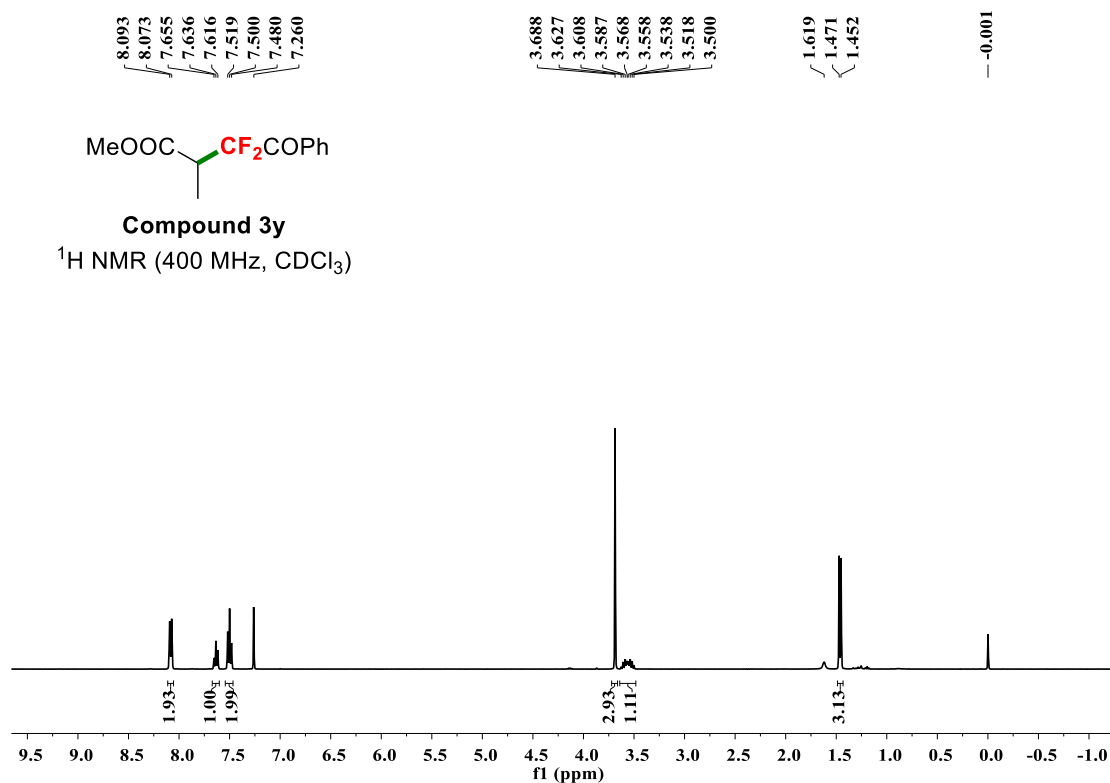


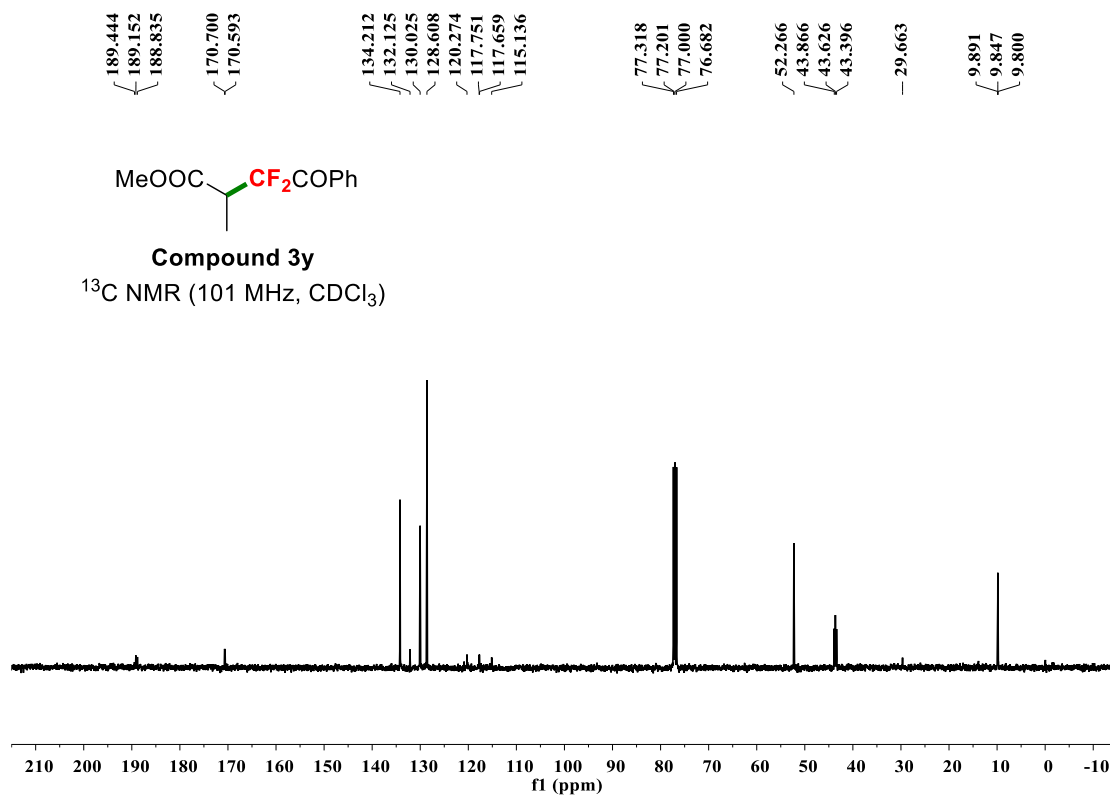
Methyl-4,4-difluoro-3-methyl-5-oxo-5-phenylpentanoate (3x).



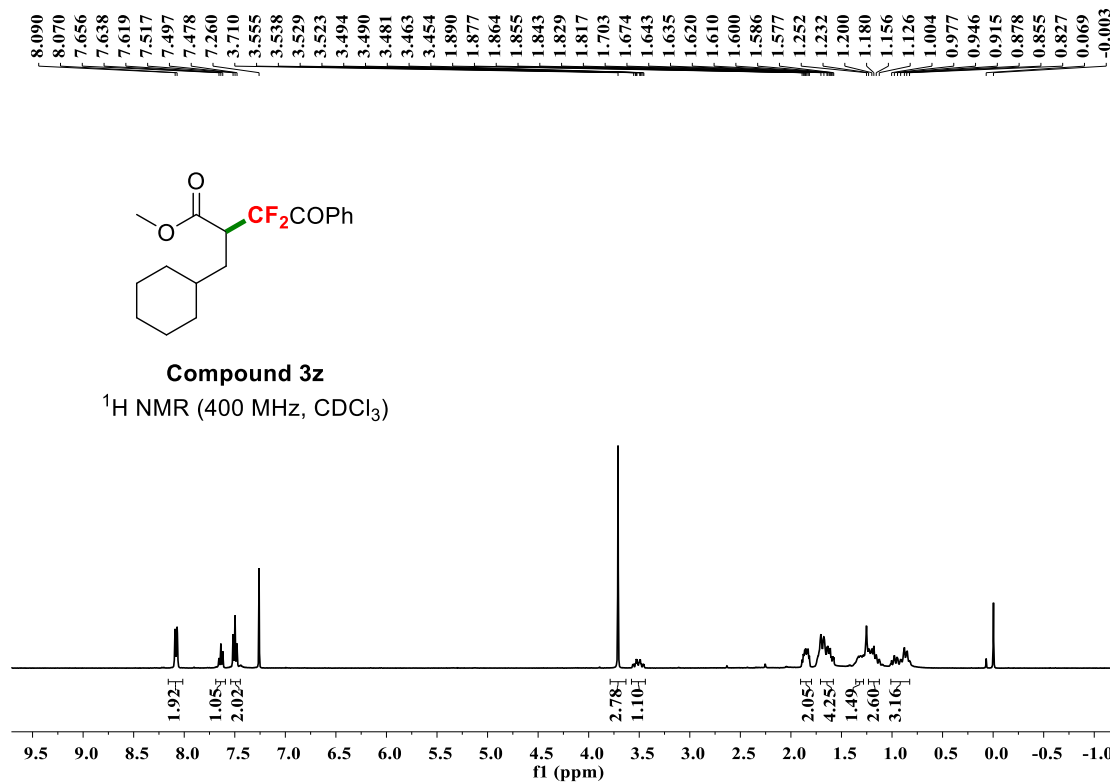


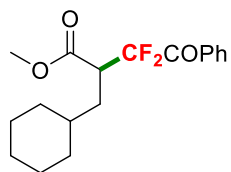
Methyl-3,3-difluoro-2-methyl-4-oxo-4-phenylbutanoate (3y).





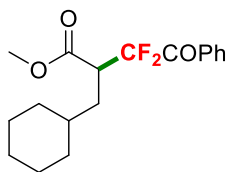
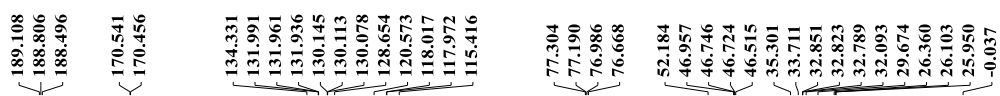
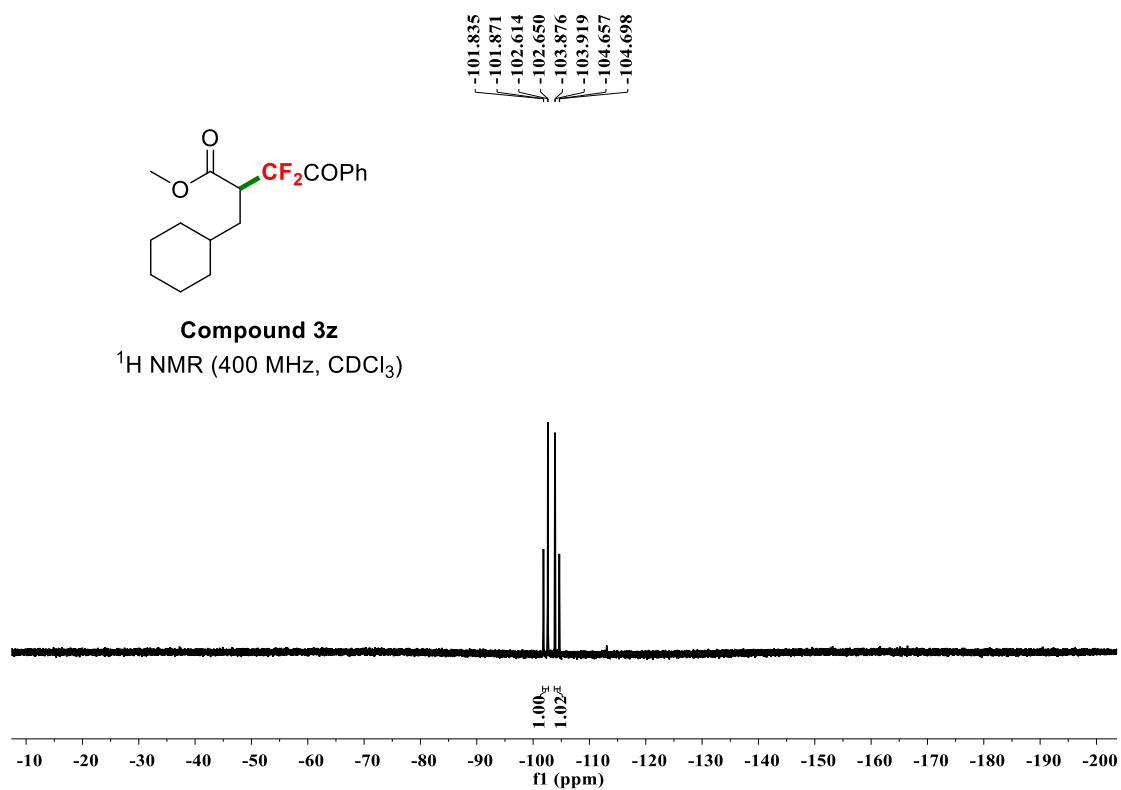
Methyl-2-(cyclohexylmethyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3z).





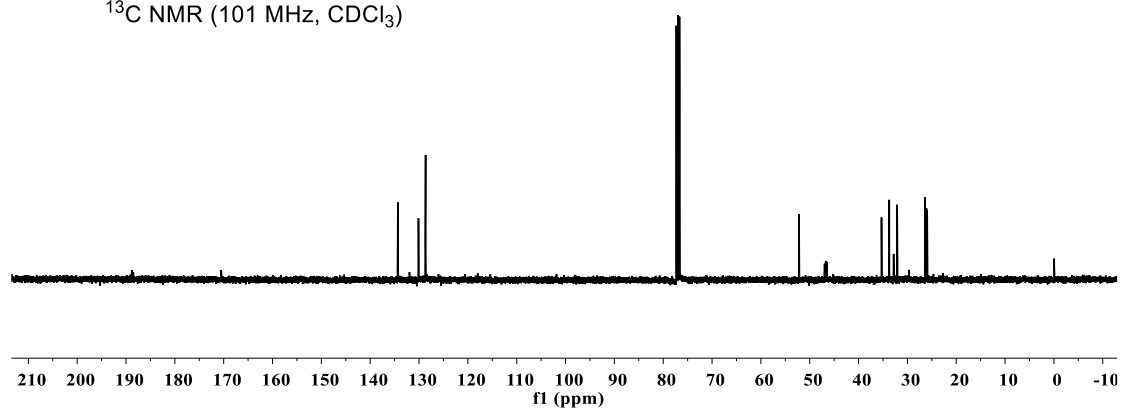
Compound 3z

^1H NMR (400 MHz, CDCl_3)



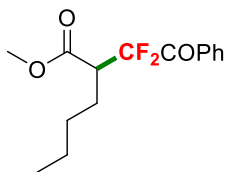
Compound 3z

^{13}C NMR (101 MHz, CDCl_3)



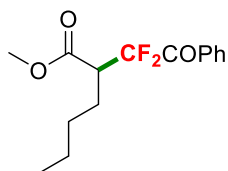
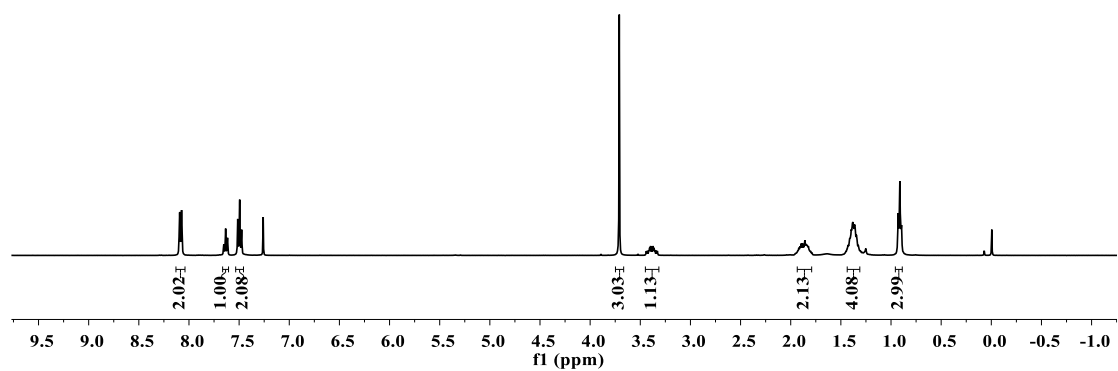
Methyl-2-(1,1-difluoro-2-oxo-2-phenylethyl)hexanoate (3aa).

8.093, 8.073, 7.653, 7.634, 7.616, 7.514, 7.494, 7.475, 7.260, 3.709, 3.440, 3.429, 3.415, 3.407, 3.397, 3.385, 3.373, 3.364, 3.354, 3.341, 3.330, 1.929, 1.919, 1.907, 1.896, 1.883, 1.872, 1.859, 1.846, 1.838, 1.824, 1.800, 1.789, 1.428, 1.411, 1.396, 1.384, 1.379, 1.360, 1.345, 1.328, 0.929, 0.912, 0.895, 0.070, -0.005



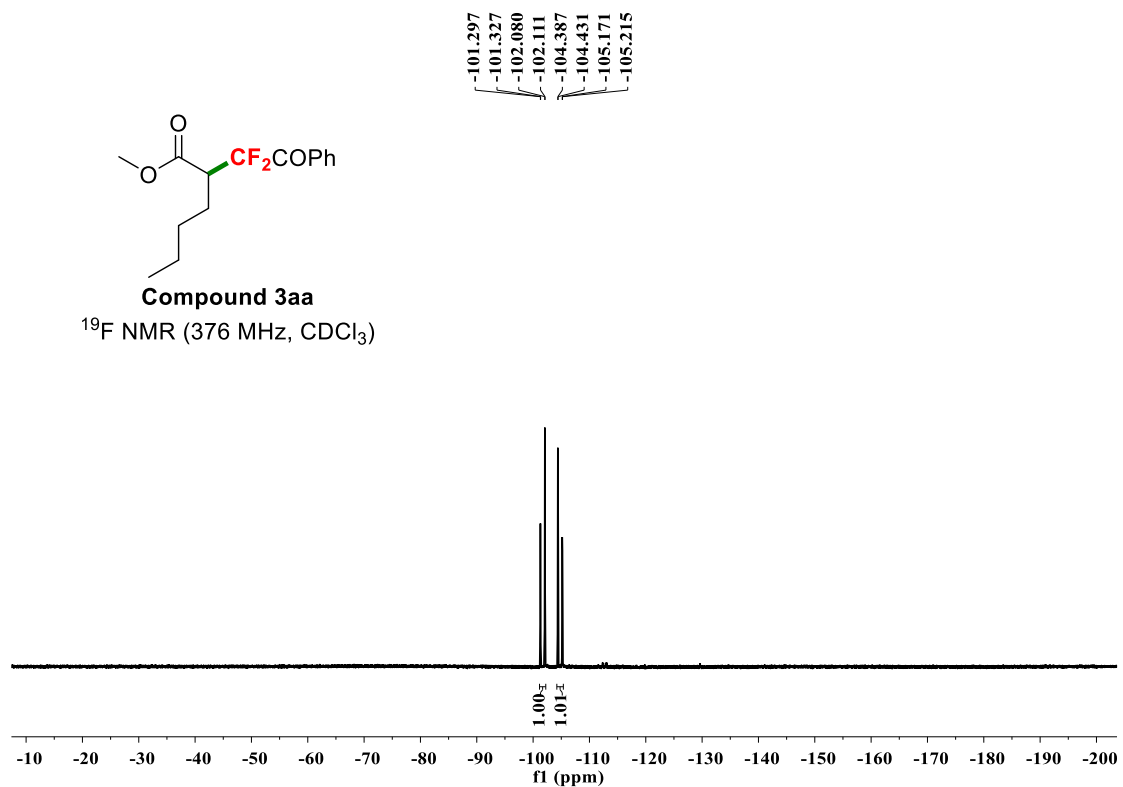
Compound 3aa

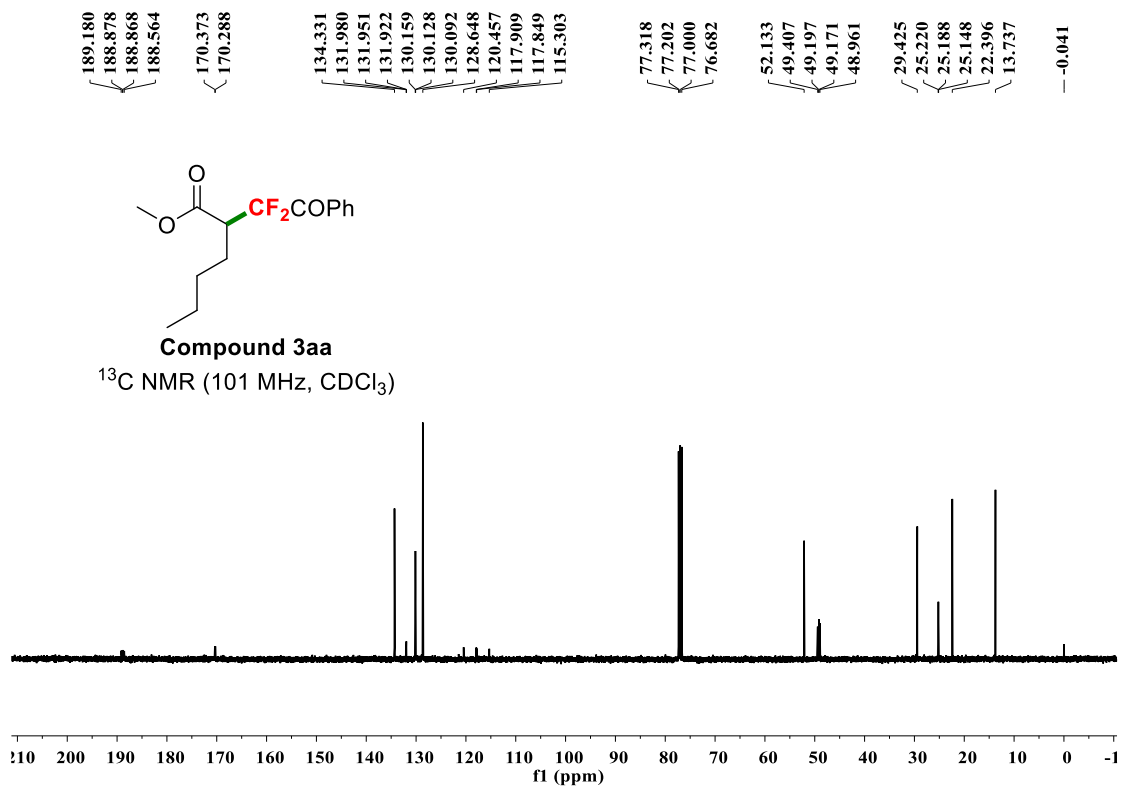
¹H NMR (400 MHz, CDCl₃)



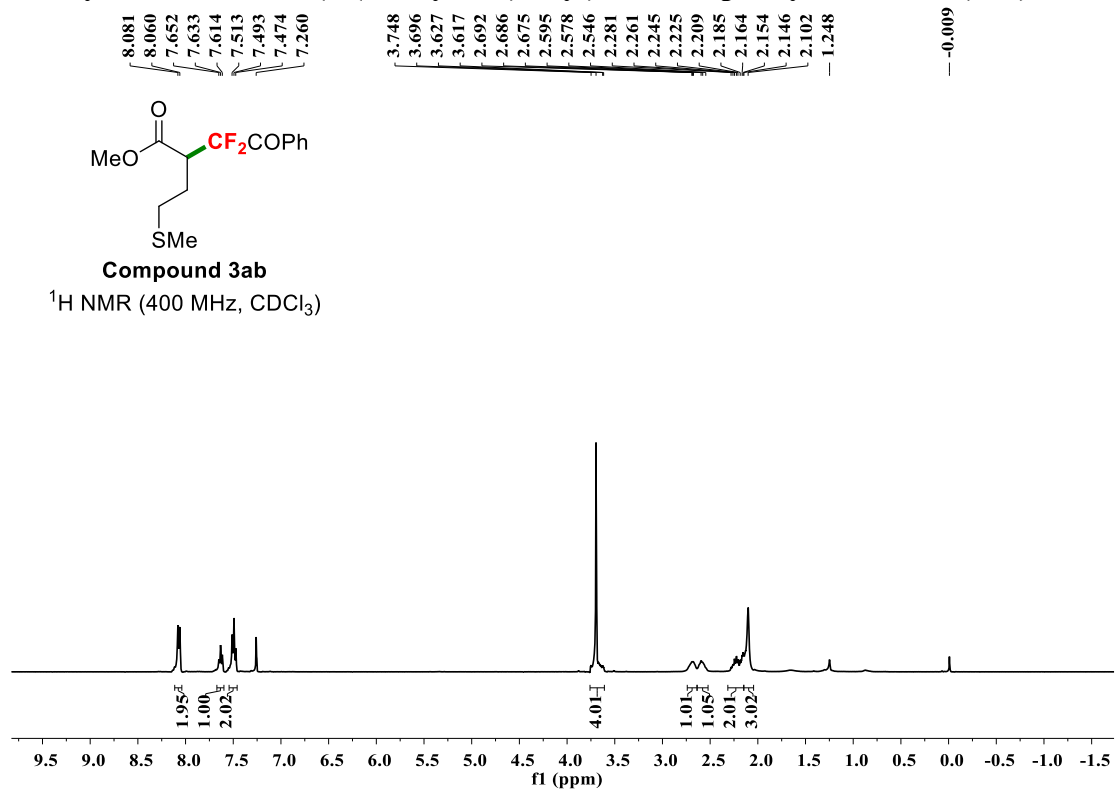
Compound 3aa

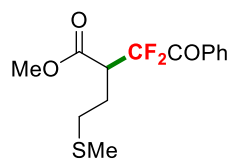
¹⁹F NMR (376 MHz, CDCl₃)





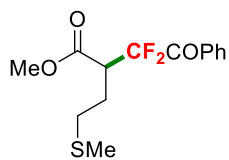
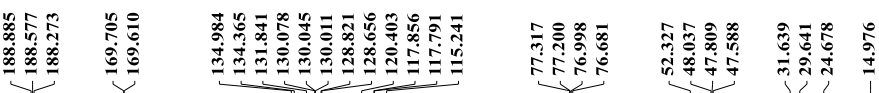
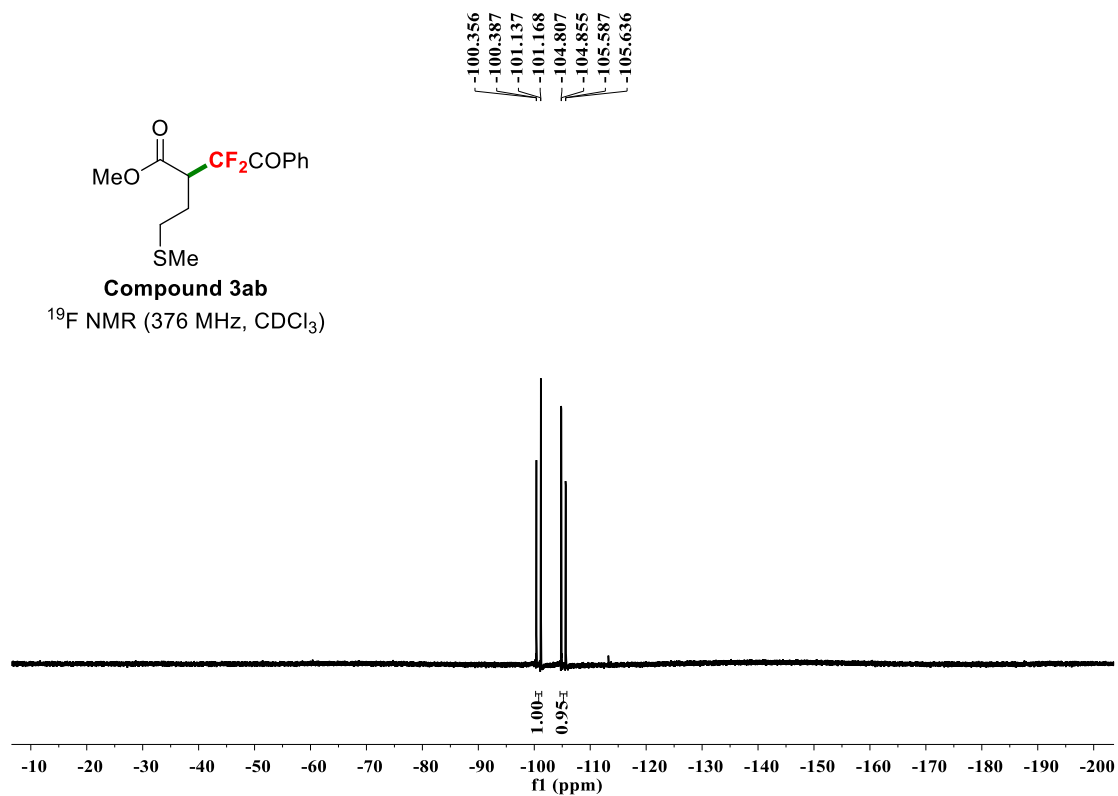
Methyl 3,3-difluoro-2-(2-(methylthio)ethyl)-4-oxo-4-phenylbutanoate (3ab).





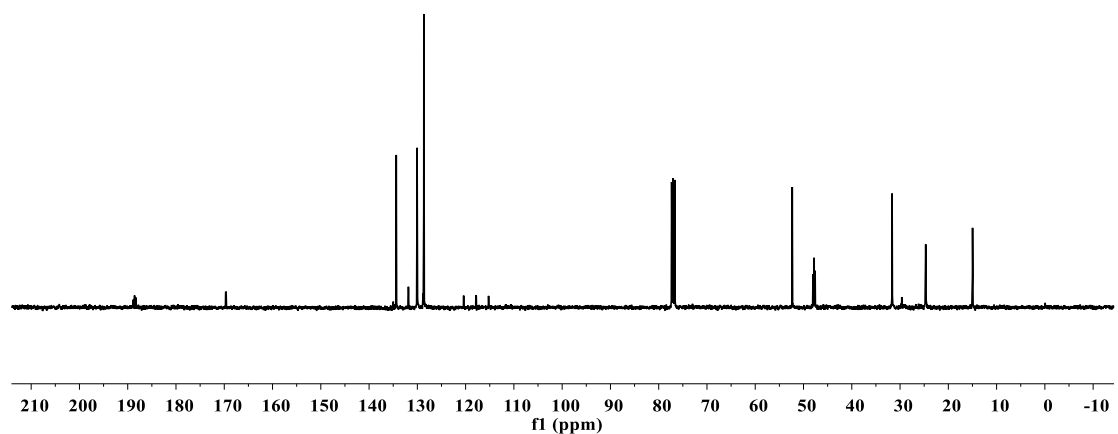
Compound 3ab

¹⁹F NMR (376 MHz, CDCl₃)

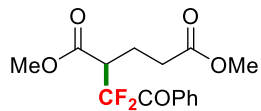
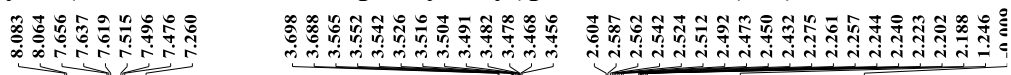


Compound 3ab

¹³C NMR (101 MHz, CDCl₃)

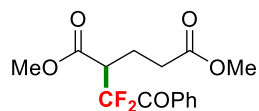
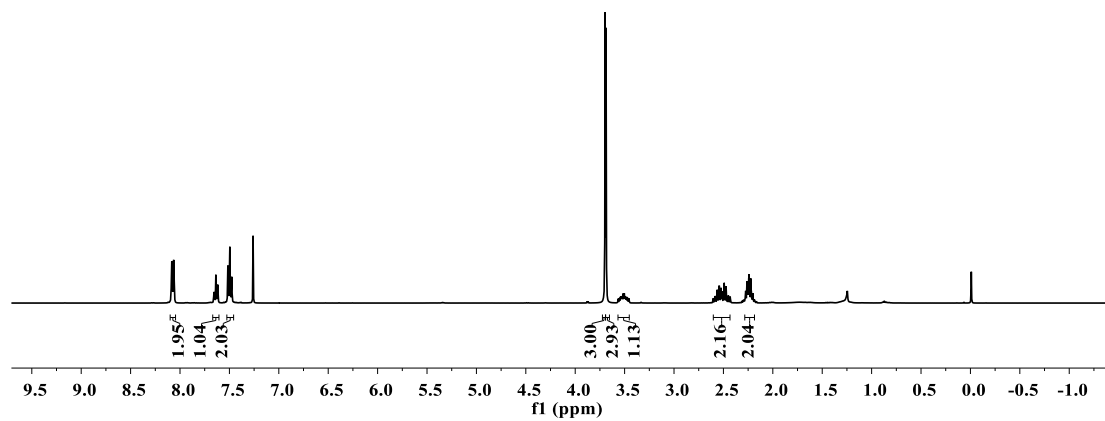


Dimethyl 2-(1,1-difluoro-2-oxo-2-phenylethyl)pentanedioate (3ac).



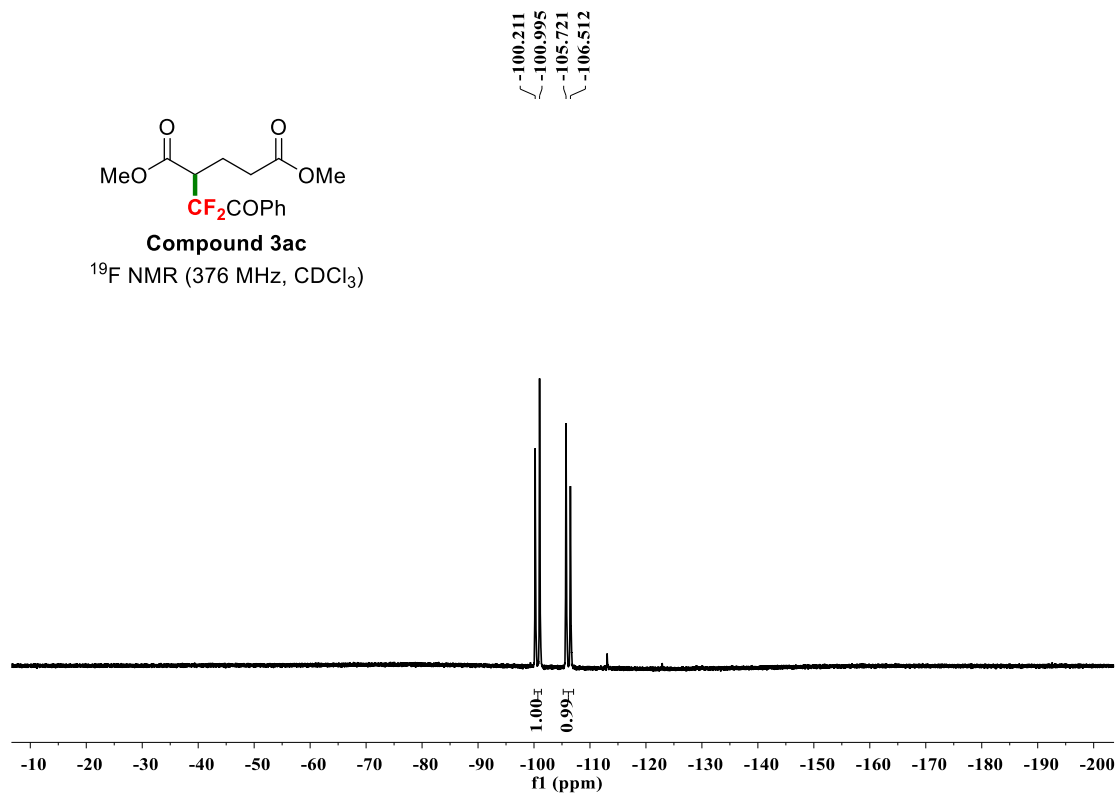
Compound 3ac

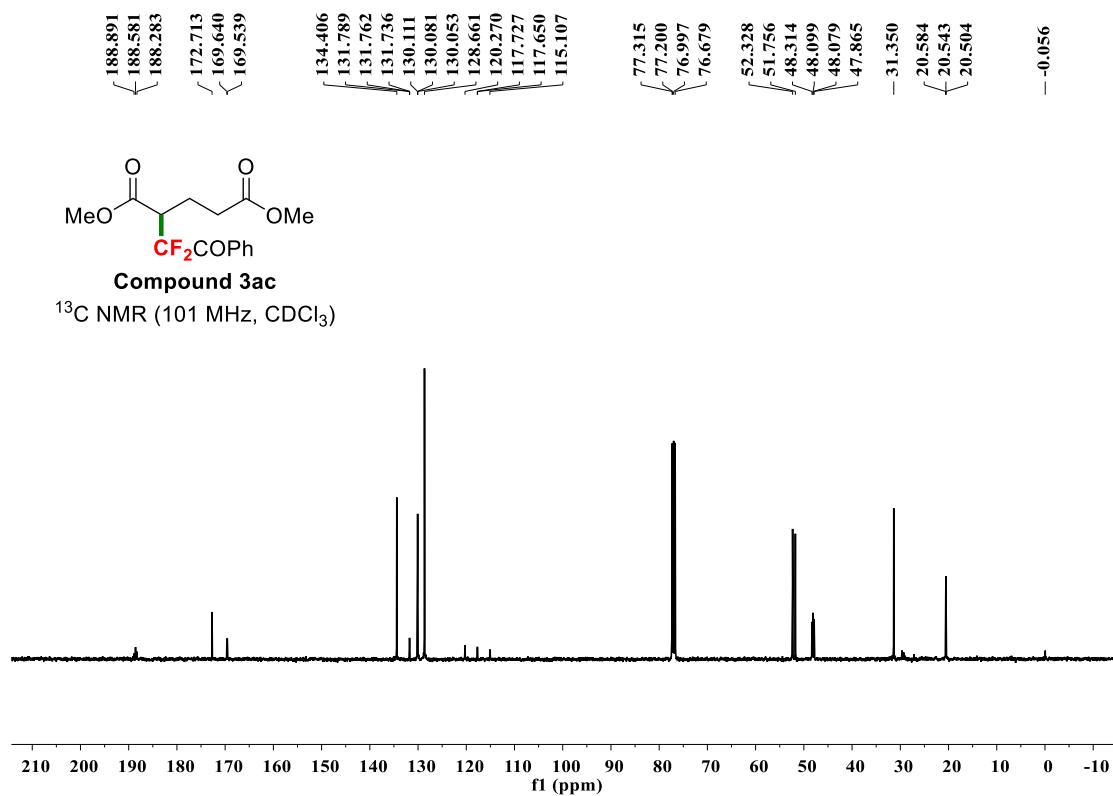
¹H NMR (400 MHz, CDCl₃)



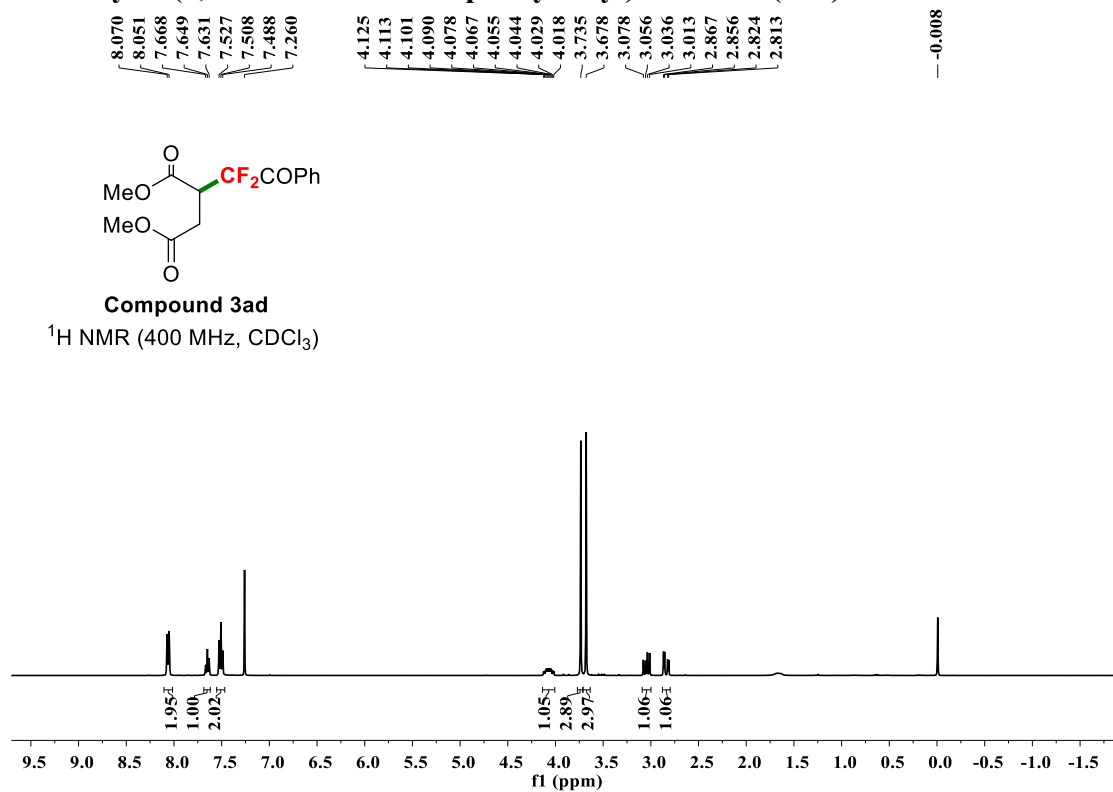
Compound 3ac

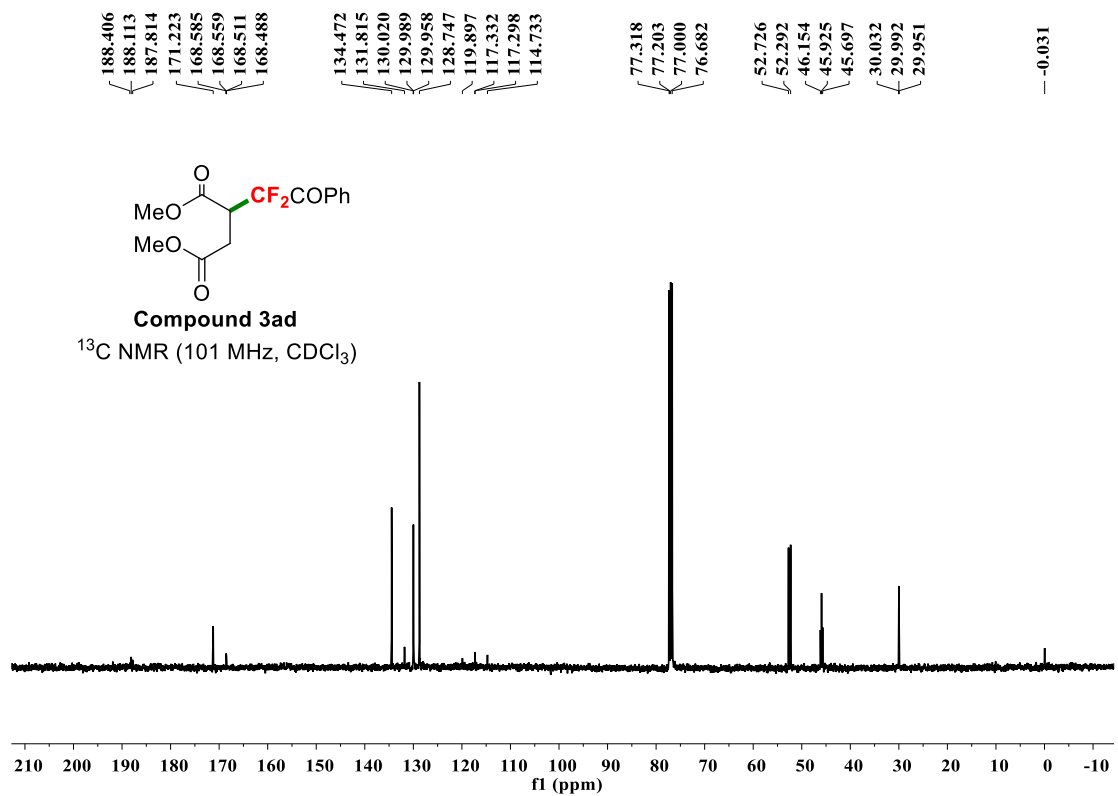
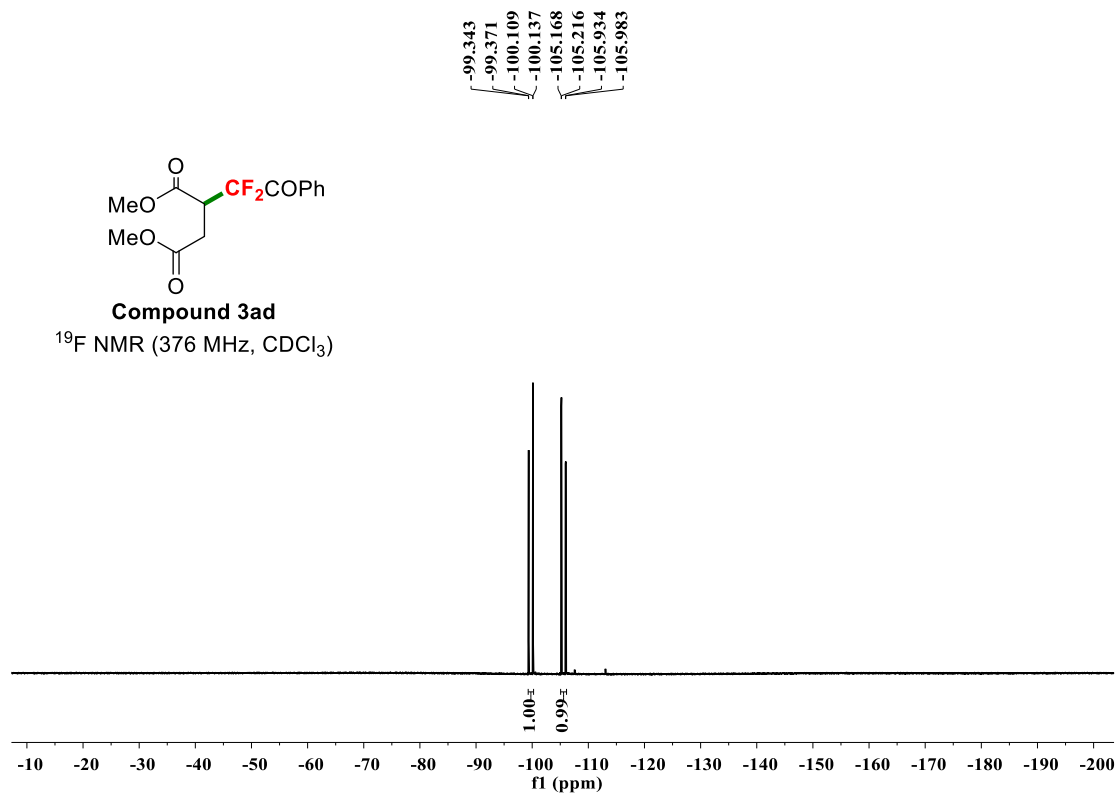
¹⁹F NMR (376 MHz, CDCl₃)



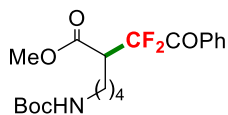
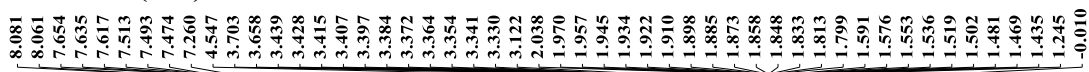


Dimethyl 2-(1,1-difluoro-2-oxo-2-phenylethyl)succinate (3ad).



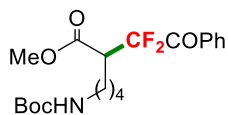
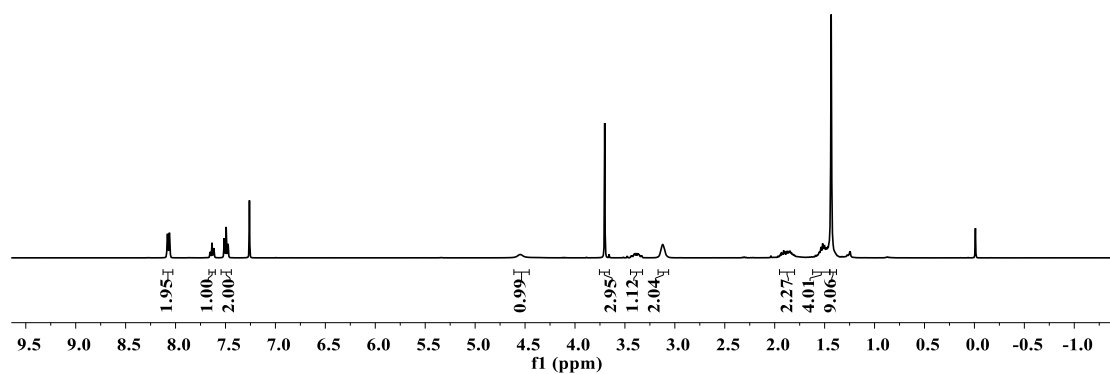


Methyl 6-((tert-butoxycarbonyl)amino)-2-(1,1-difluoro-2-oxo-2-phenylethyl)-hexanoate (3ae).



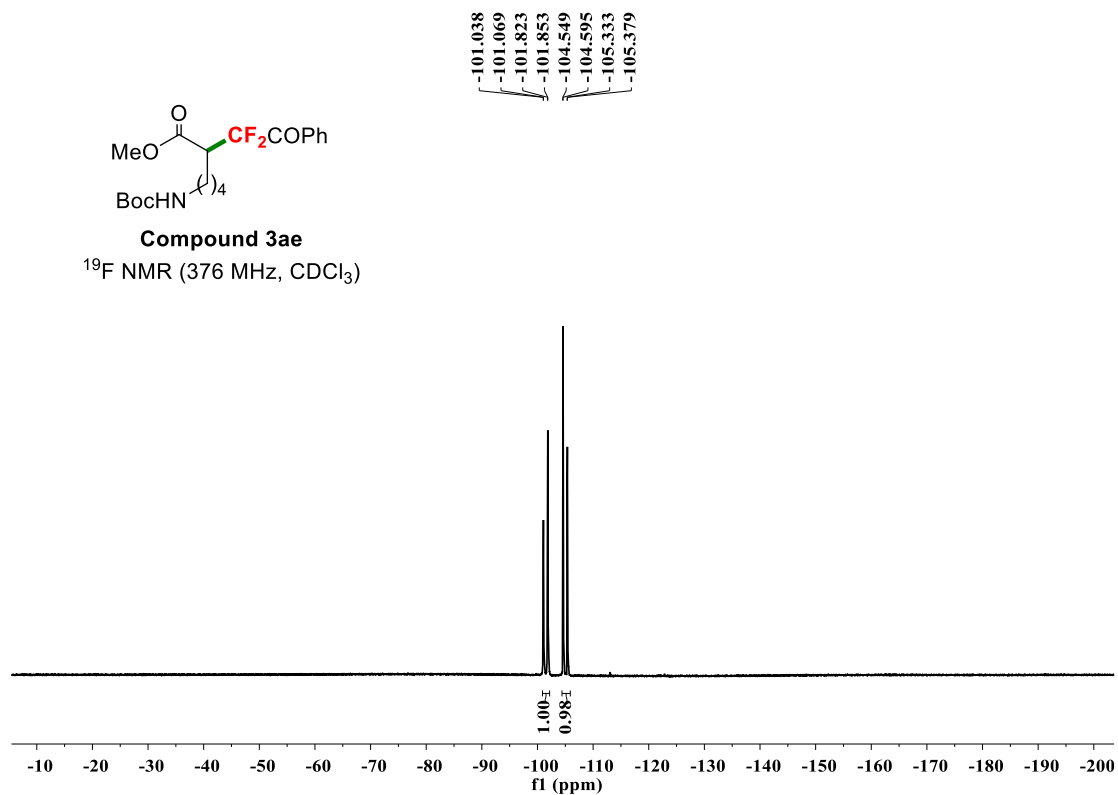
Compound 3ae

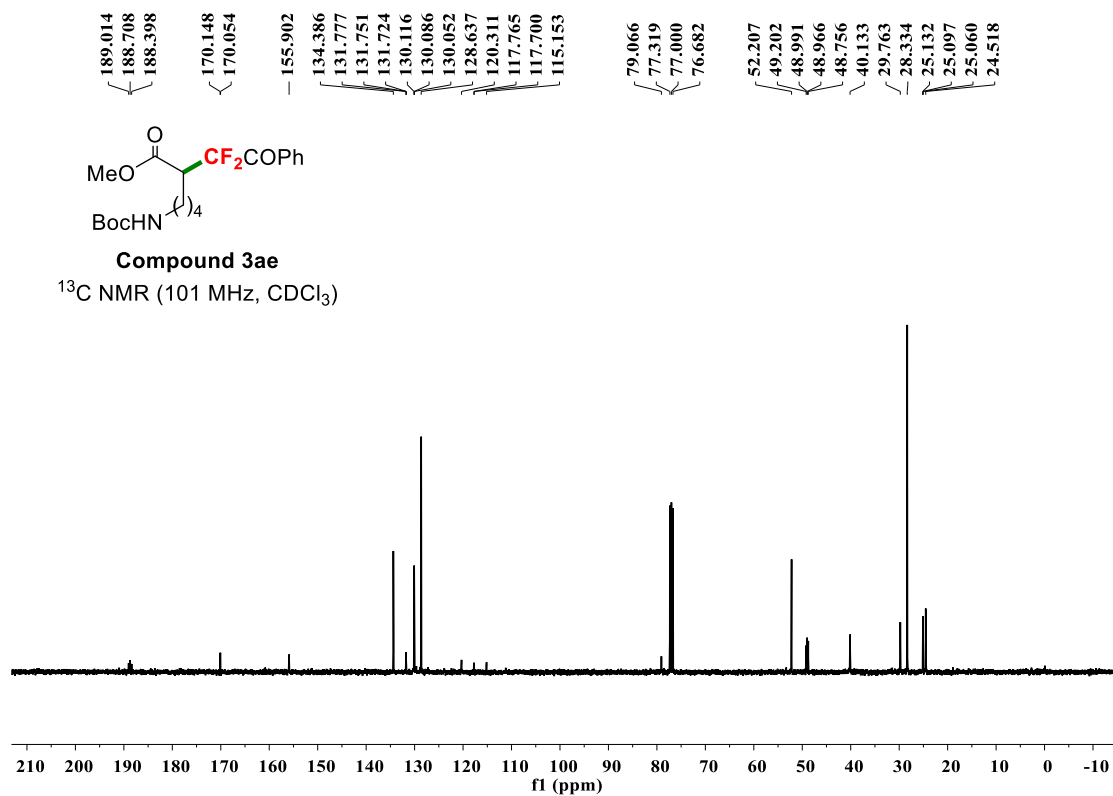
¹H NMR (400 MHz, CDCl₃)



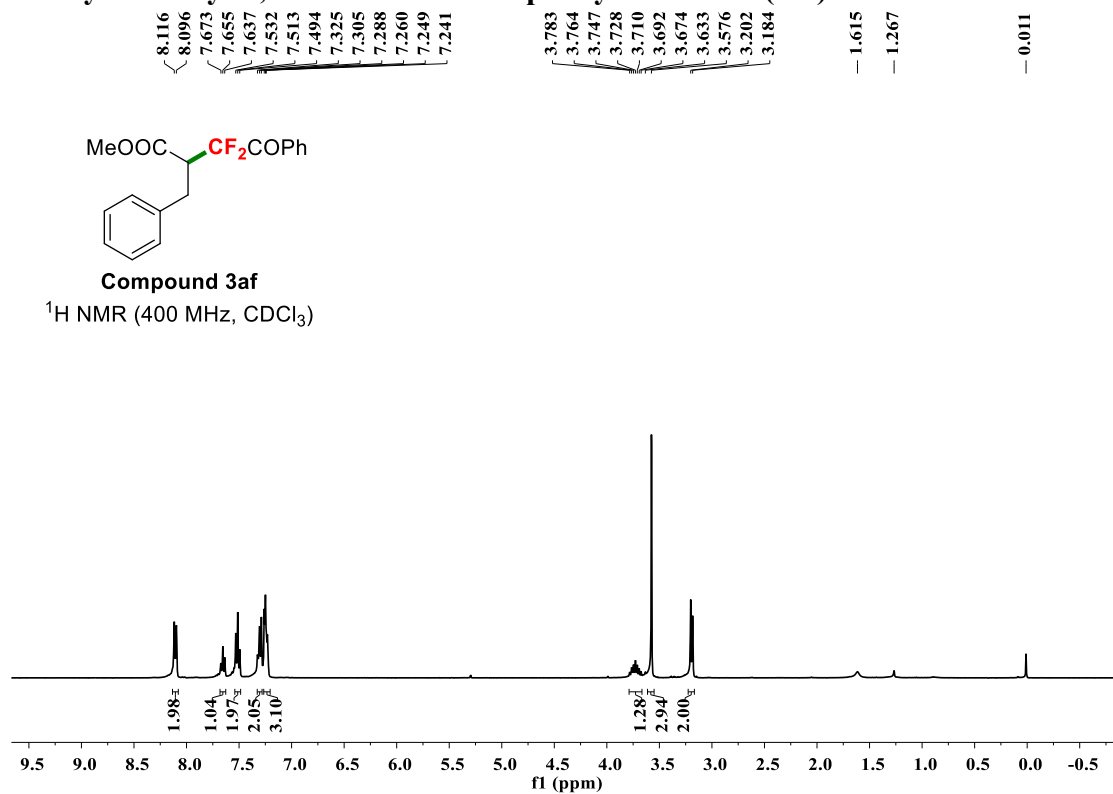
Compound 3ae

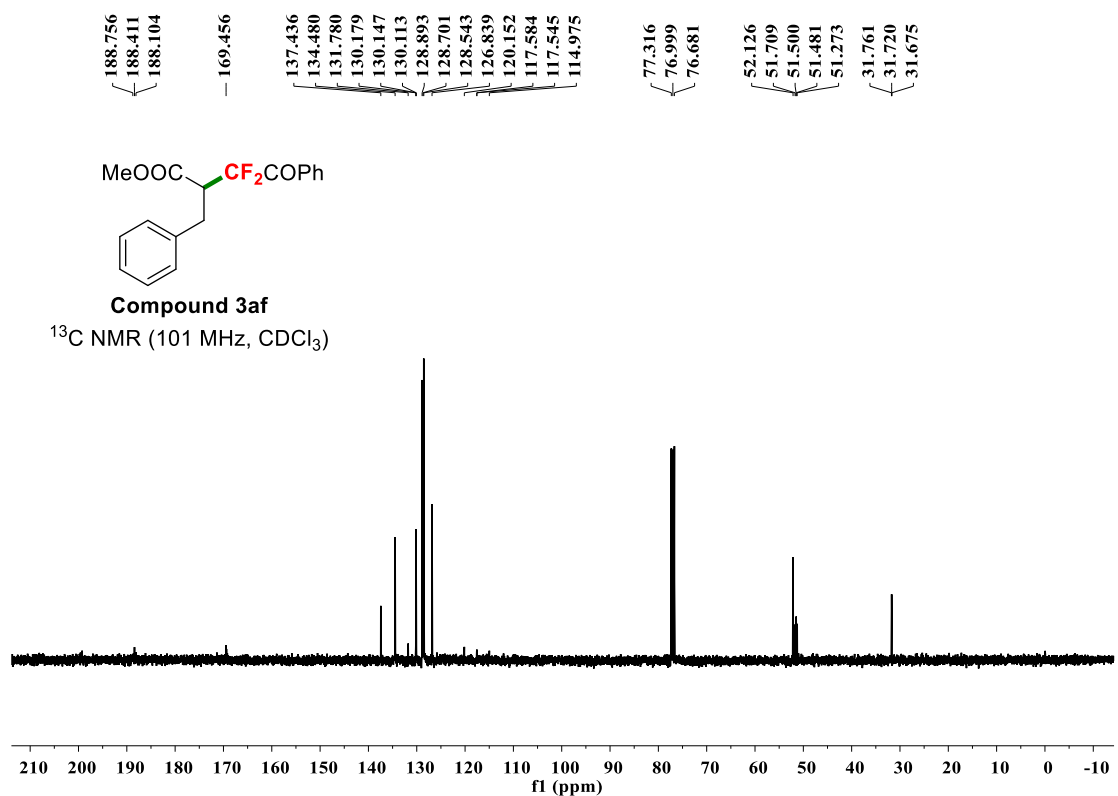
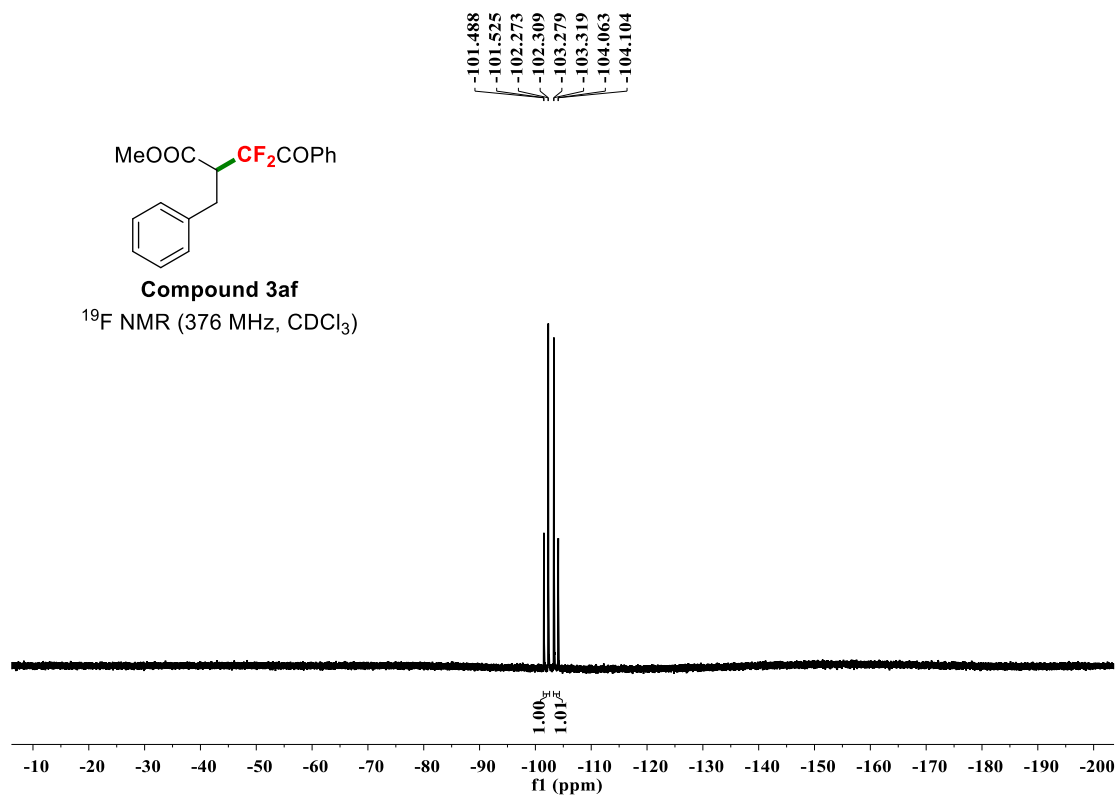
¹⁹F NMR (376 MHz, CDCl₃)



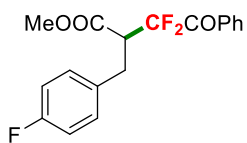
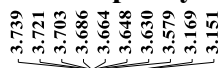
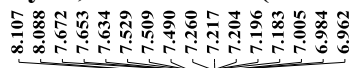


Methyl 2-benzyl-3,3-difluoro-4-oxo-4-phenylbutanoate (3af).



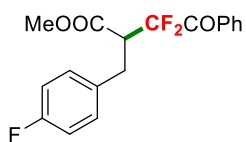
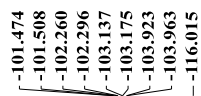
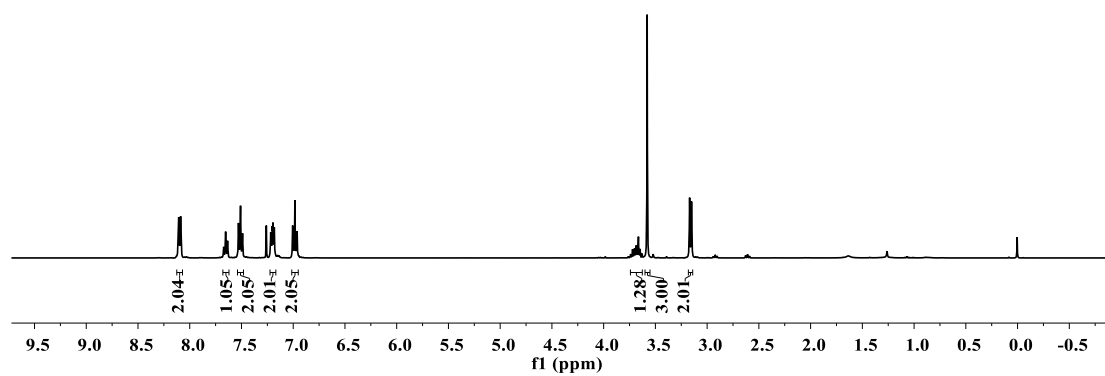


Methyl 3,3-difluoro-2-(4-fluorobenzyl)-4-oxo-4-phenylbutanoate (3ag).



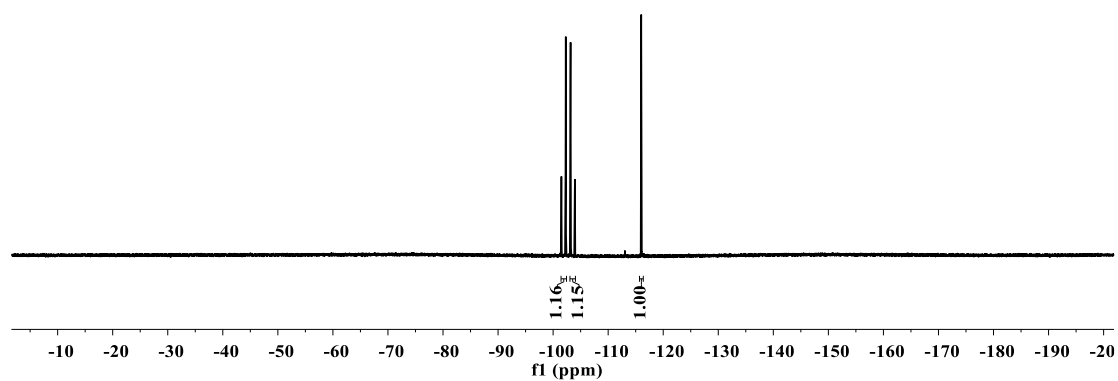
Compound 3ag

¹H NMR (400 MHz, CDCl₃)

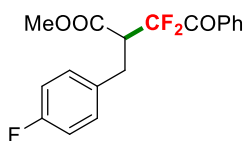


Compound 3ag

¹⁹F NMR (376 MHz, CDCl₃)

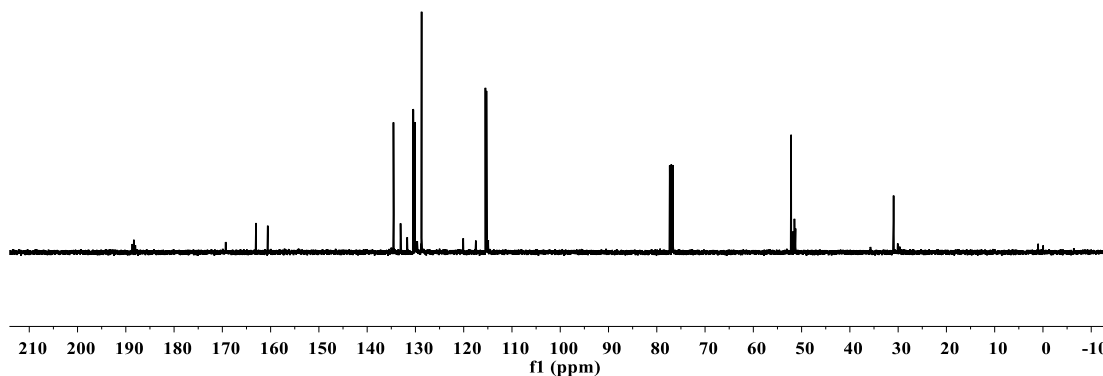


188.645
188.341
188.033
169.336
169.260
163.033
160.595
134.551
133.110
133.079
131.727
131.694
131.669
130.491
130.411
130.180
130.147
130.113
129.710
129.630
128.841
128.725
120.095
117.524
117.487
115.498
115.285
115.119
114.915
77.317
77.203
77.000
76.683
52.170
51.703
51.604
51.483
51.264
30.986
30.942
30.896
30.079
29.678
0.993
-0.048



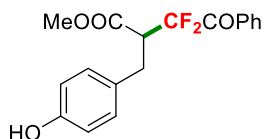
Compound 3ag

^{13}C NMR (101 MHz, CDCl_3)



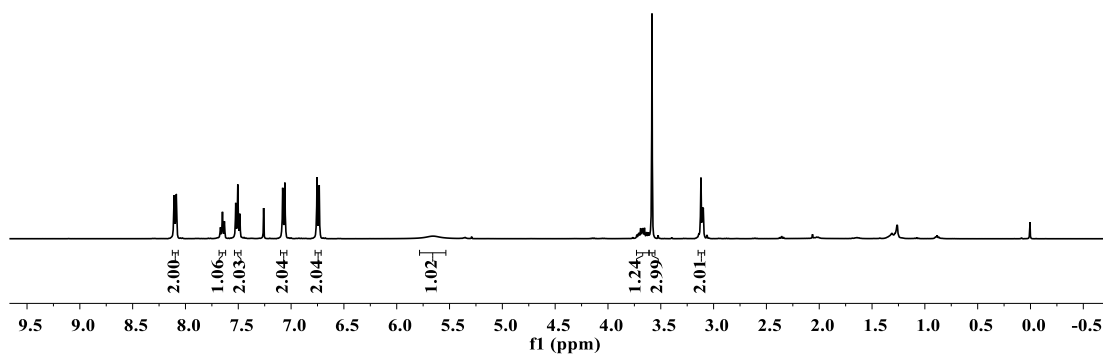
Methyl 3,3-difluoro-2-(4-hydroxybenzyl)-4-oxo-4-phenylbutanoate (3ah).

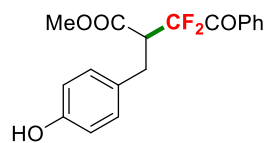
8.106
8.087
7.669
7.650
7.631
7.524
7.504
7.485
7.260
7.080
7.059
6.755
6.734
5.663
3.727
3.712
3.705
3.691
3.671
3.654
3.632
3.617
3.583
3.120
3.105
3.098
-1.259
-0.005



Compound 3ah

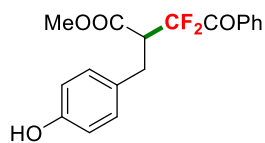
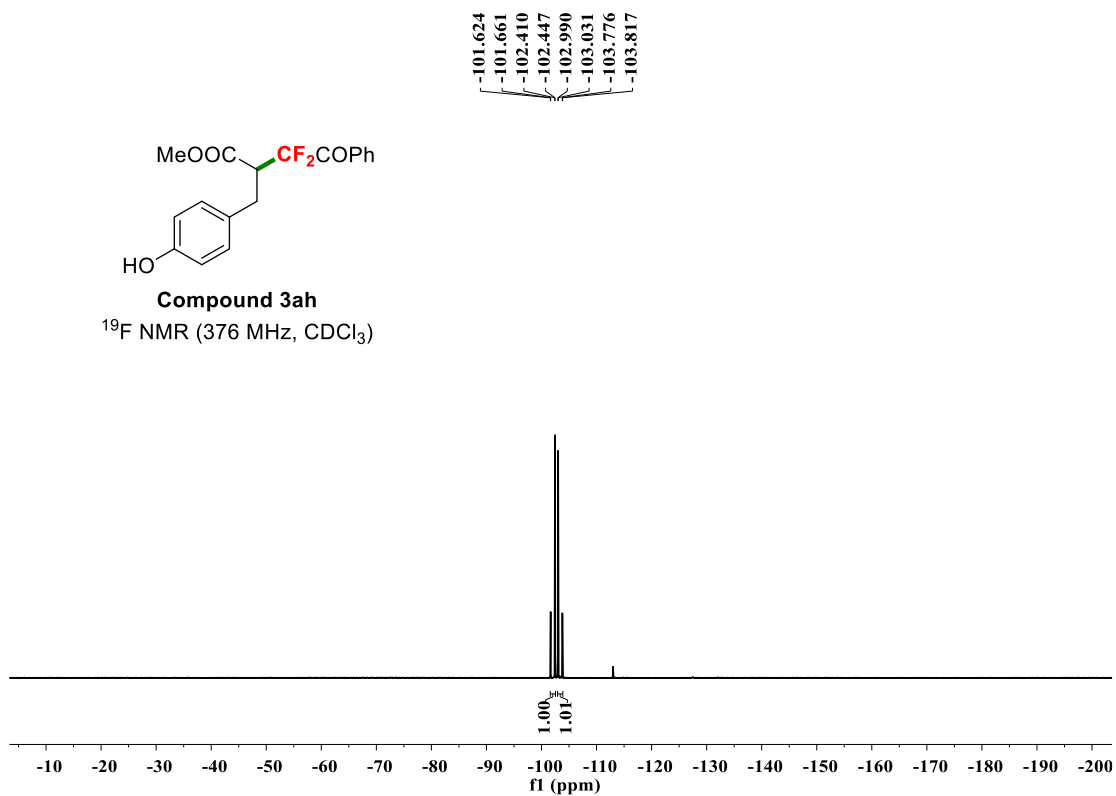
^1H NMR (400 MHz, CDCl_3)





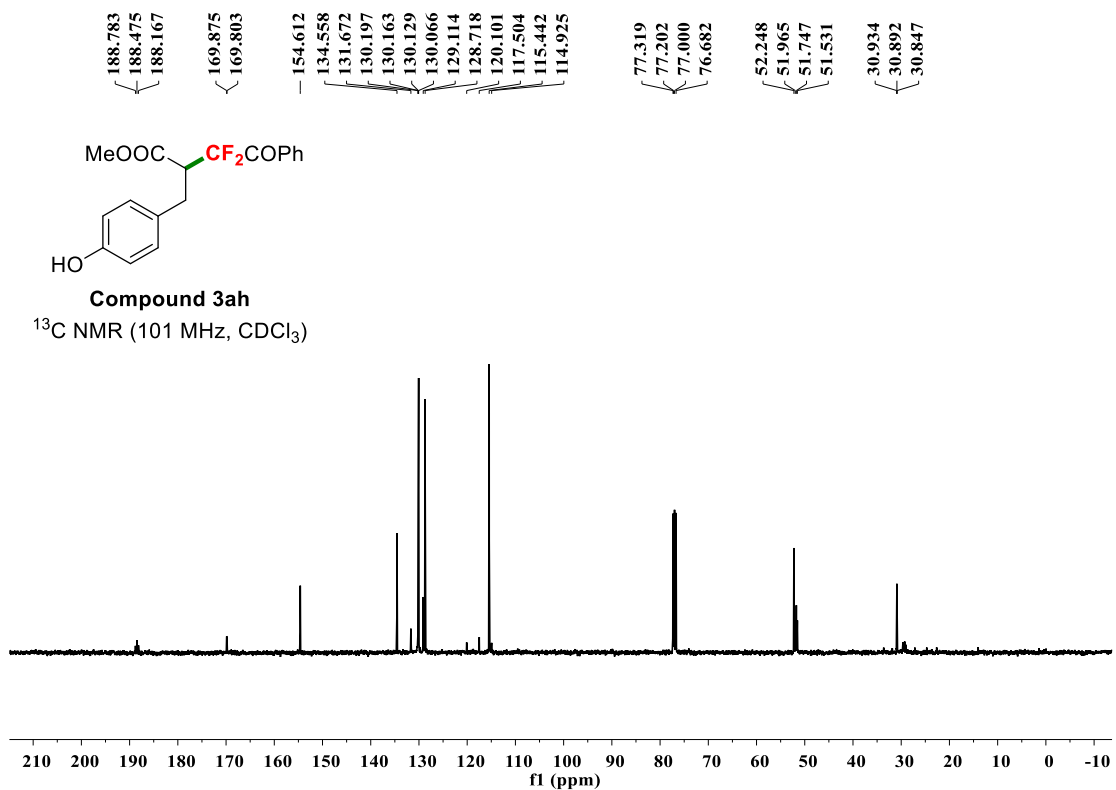
Compound 3ah

¹⁹F NMR (376 MHz, CDCl₃)



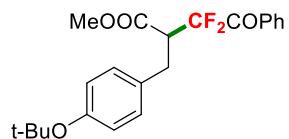
Compound 3ah

¹³C NMR (101 MHz, CDCl₃)



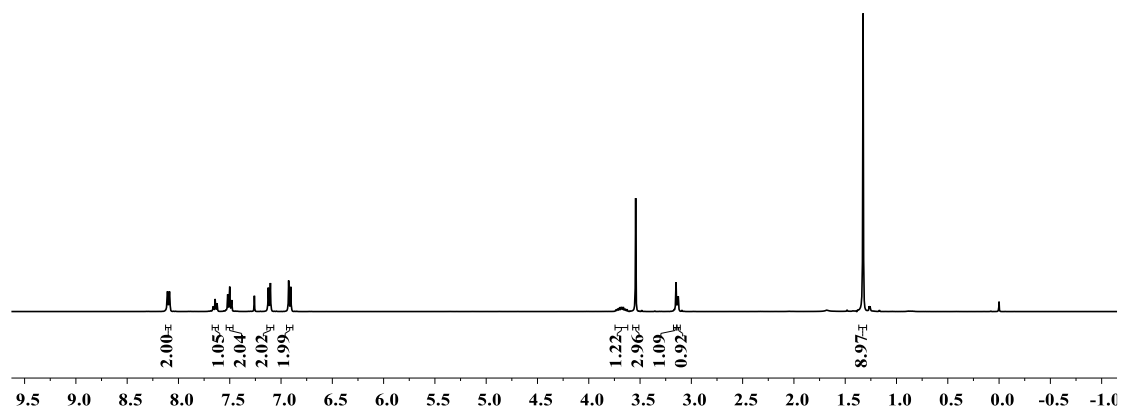
Methyl -2-(4-(tert-butoxy)benzyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3ai).

8.107, 8.088, 7.661, 7.642, 7.624, 7.520, 7.500, 7.481, 7.260, 7.125, 7.104, 6.926, 6.905, 3.736, 3.720, 3.714, 3.699, 3.681, 3.664, 3.648, 3.641, 3.626, 3.543, 3.149, 3.134, 3.127, 1.326, 0.000

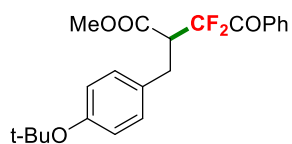


Compound 3ai

¹H NMR (400 MHz, CDCl₃)

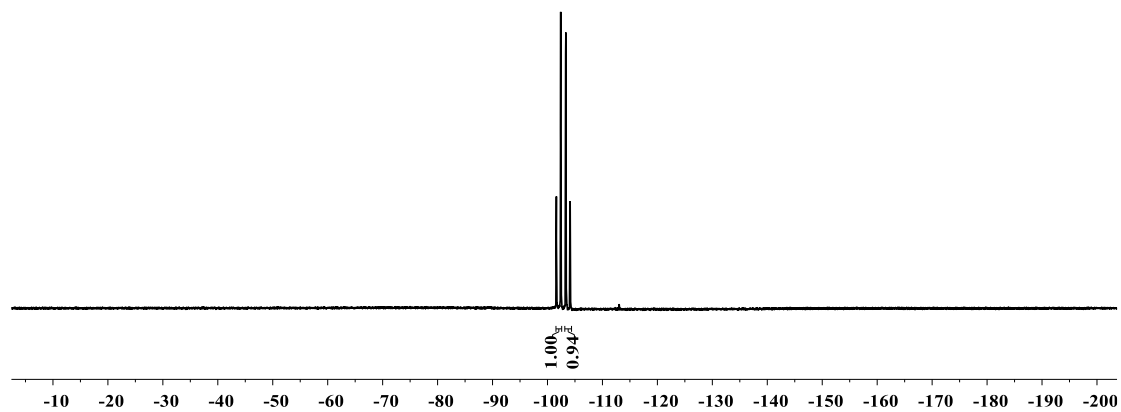


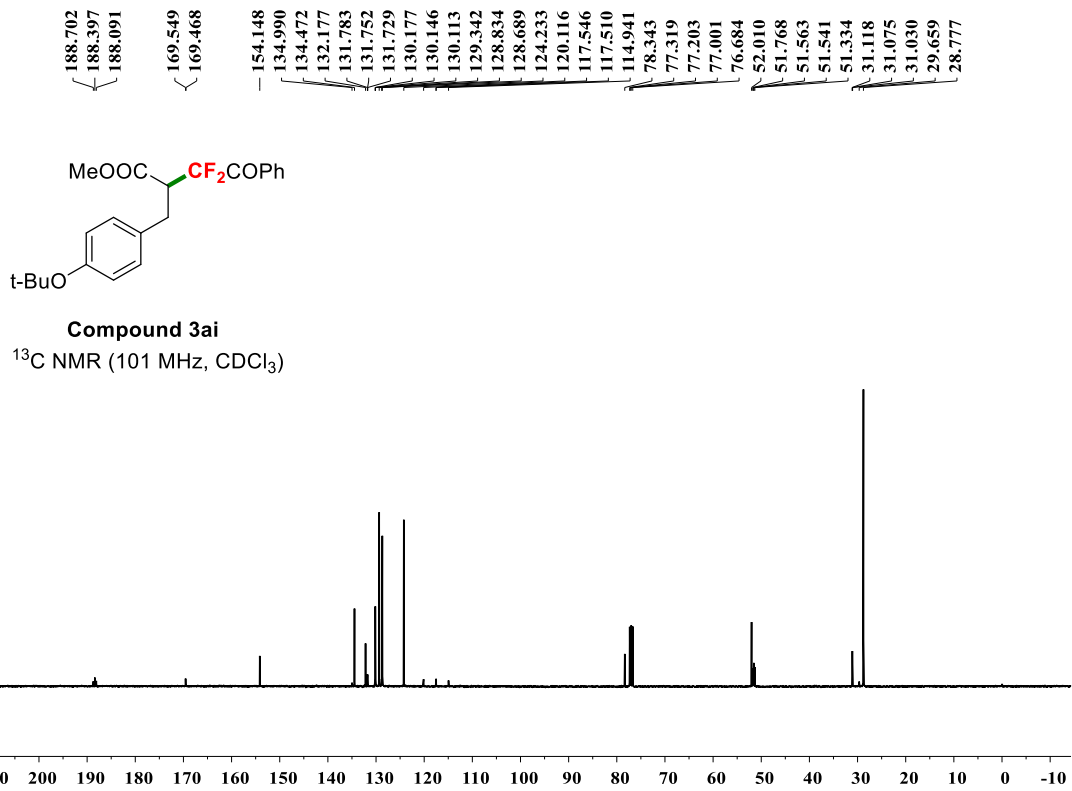
-101.584, -101.620, -102.370, -102.406, -103.303, -103.344, -104.088, -104.129



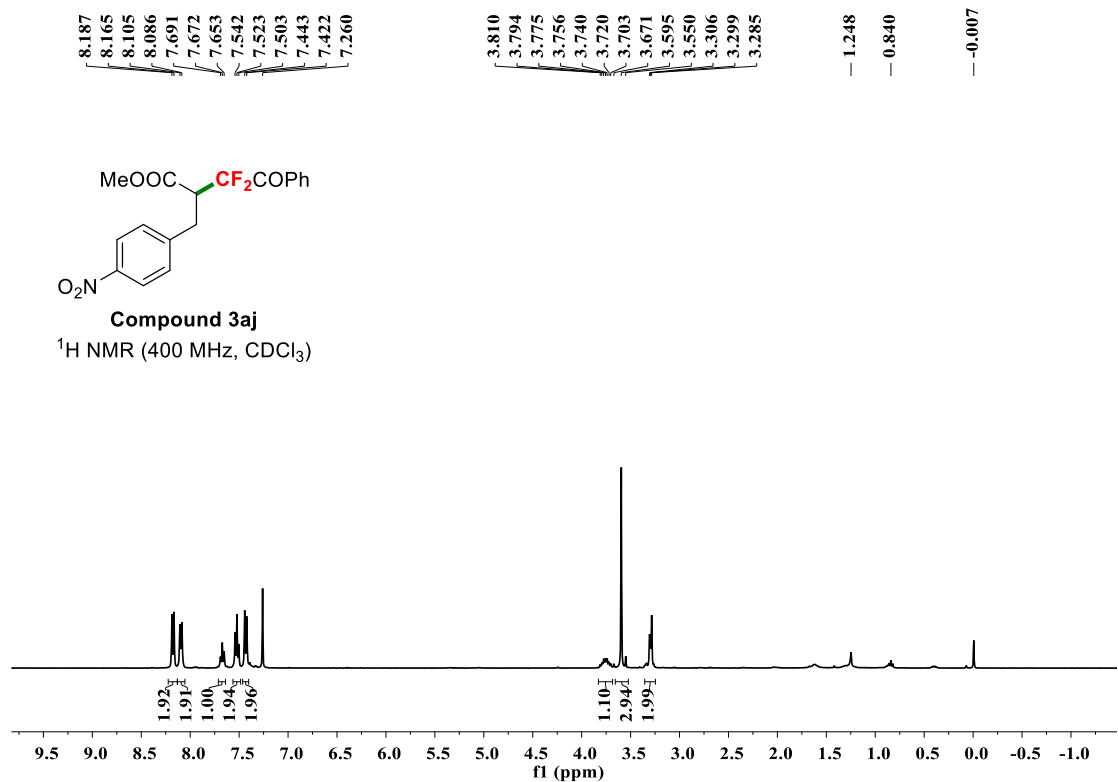
Compound 3ai

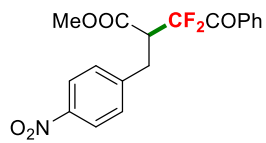
¹⁹F NMR (376 MHz, CDCl₃)





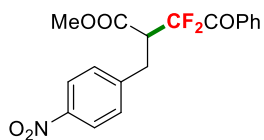
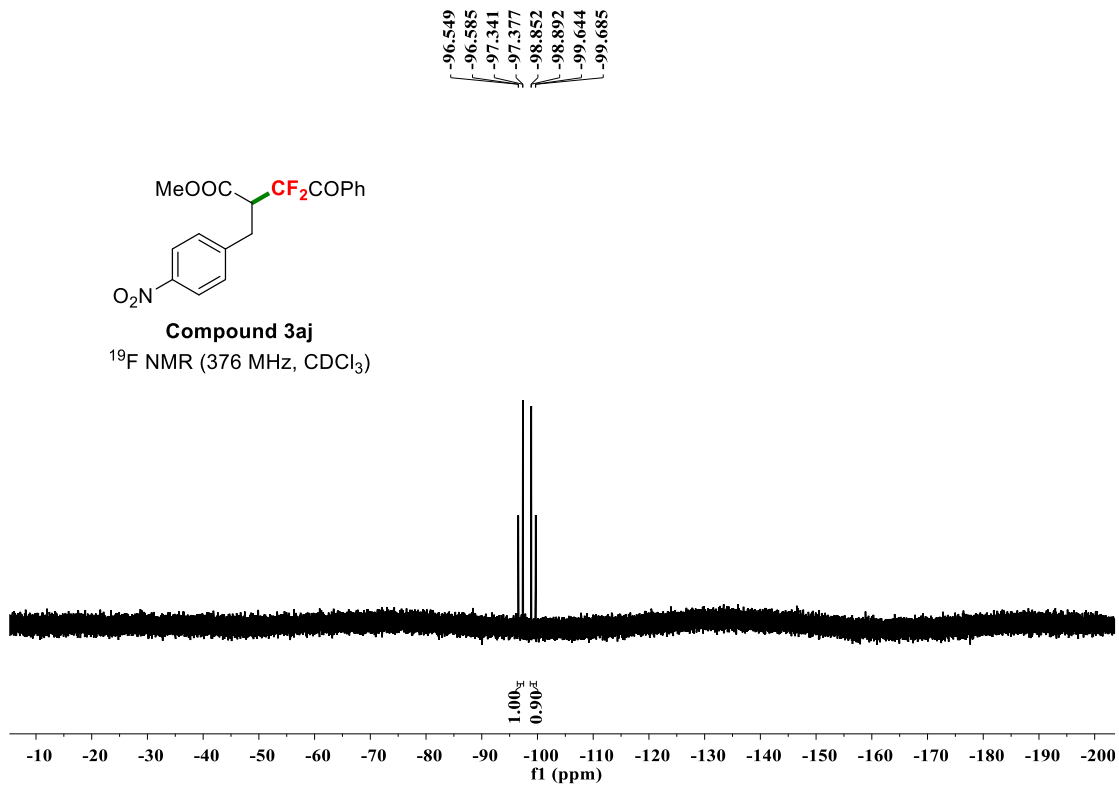
Methyl-3,3-difluoro-2-(4-nitrobenzyl)-4-oxo-4-phenylbutanoate (3aj).





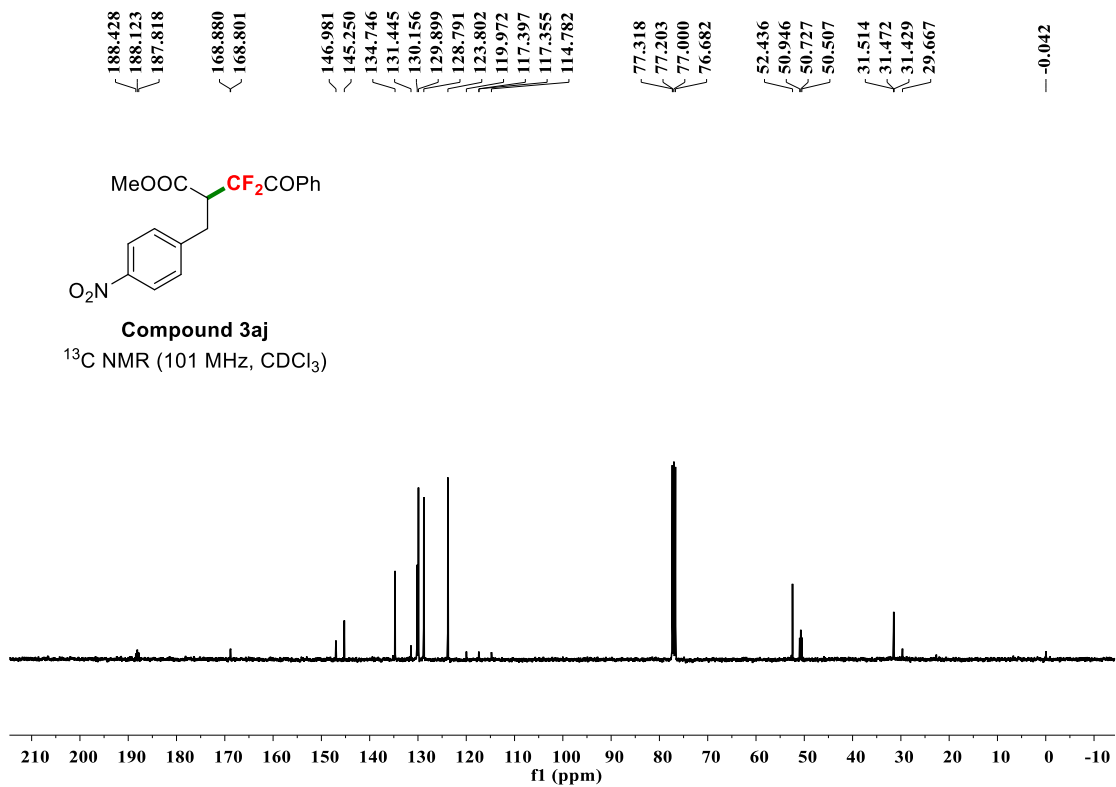
Compound 3aj

¹⁹F NMR (376 MHz, CDCl₃)

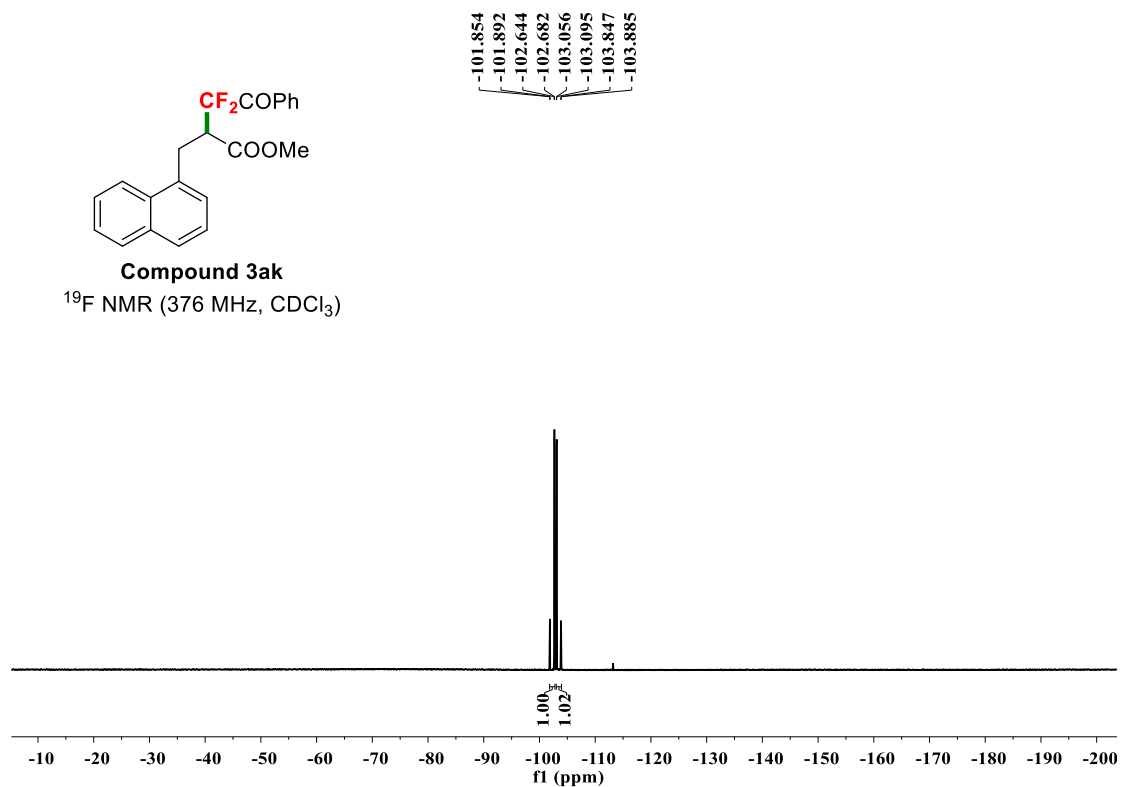
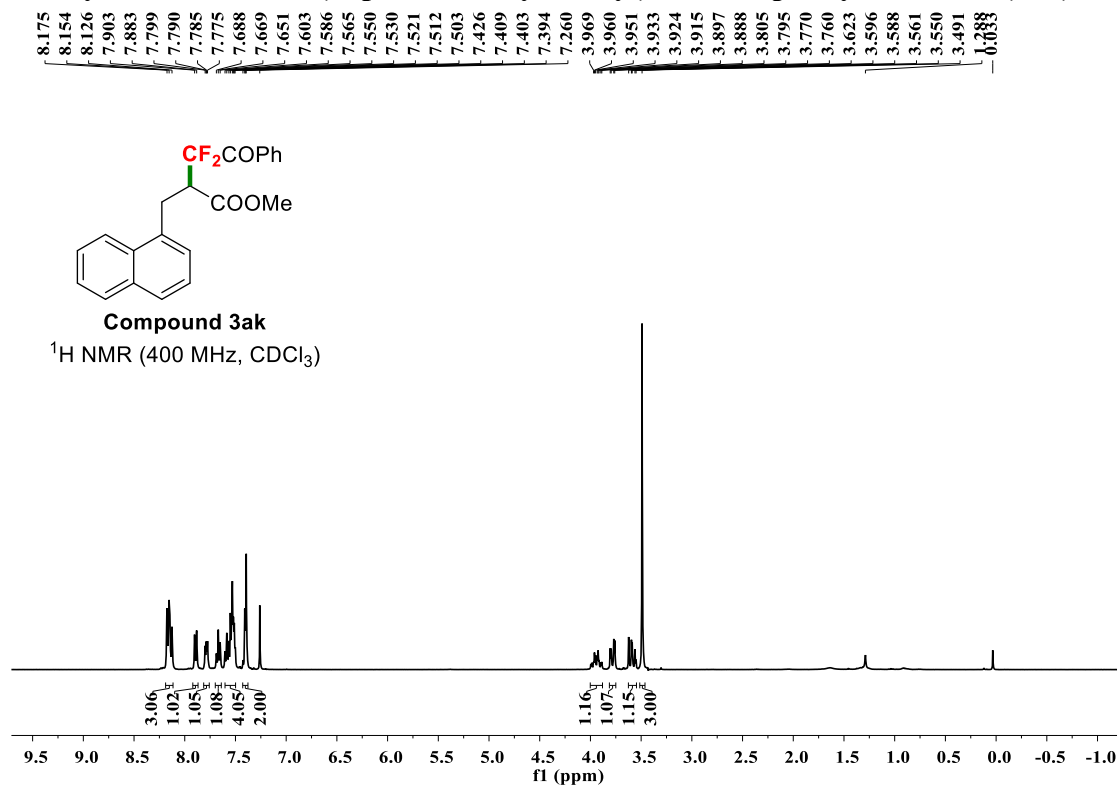


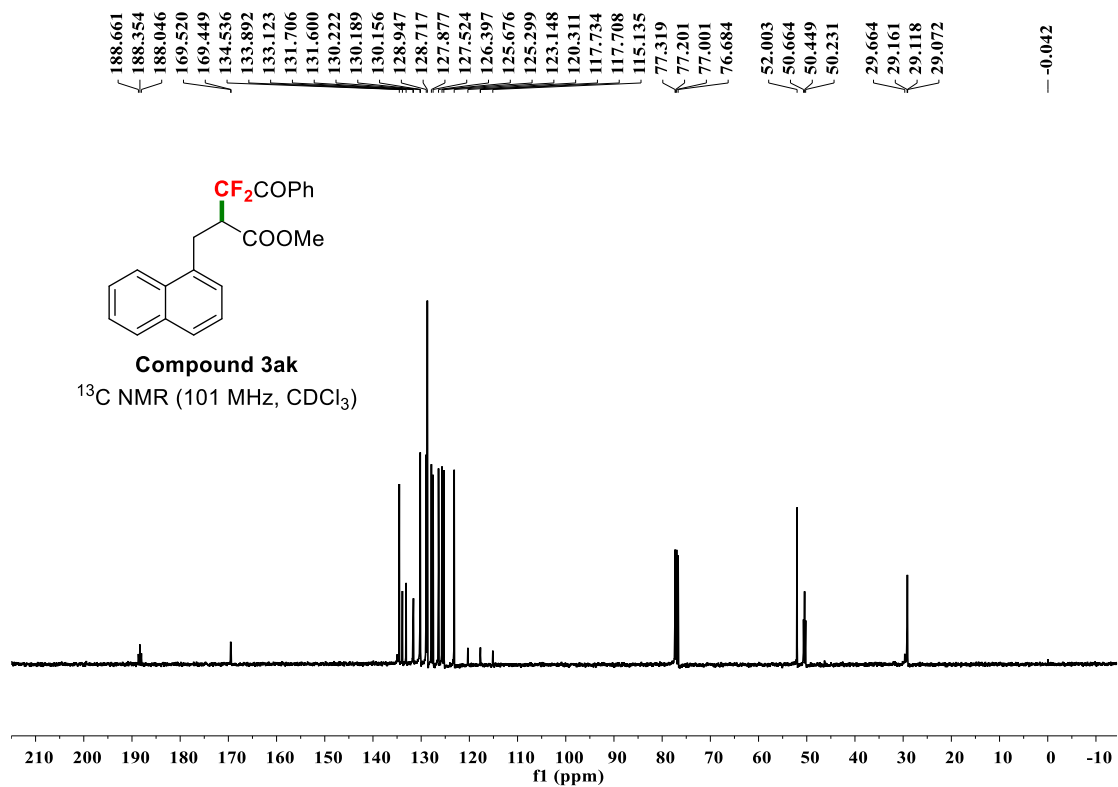
Compound 3aj

¹³C NMR (101 MHz, CDCl₃)

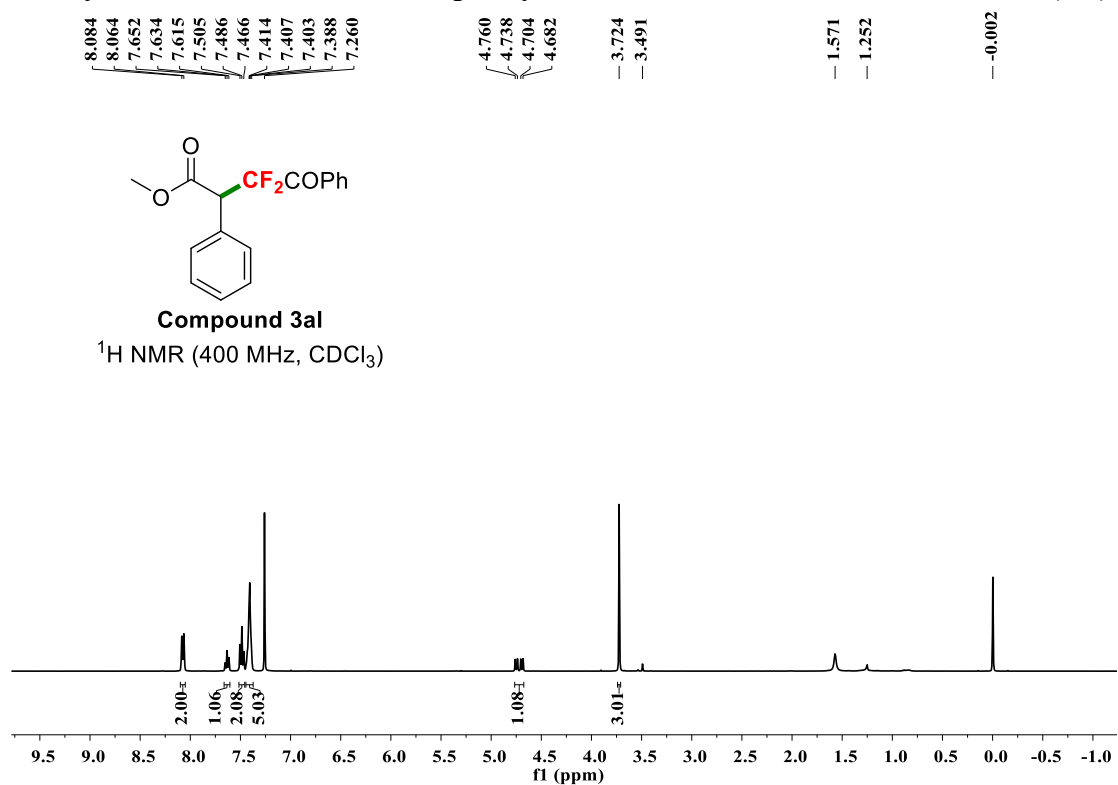


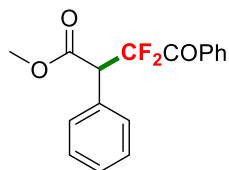
Methyl-3,3-difluoro-2-(naphthalen-1-ylmethyl)-4-oxo-4-phenylbutanoate(3ak).





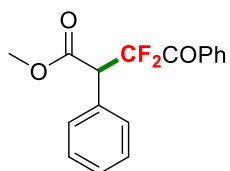
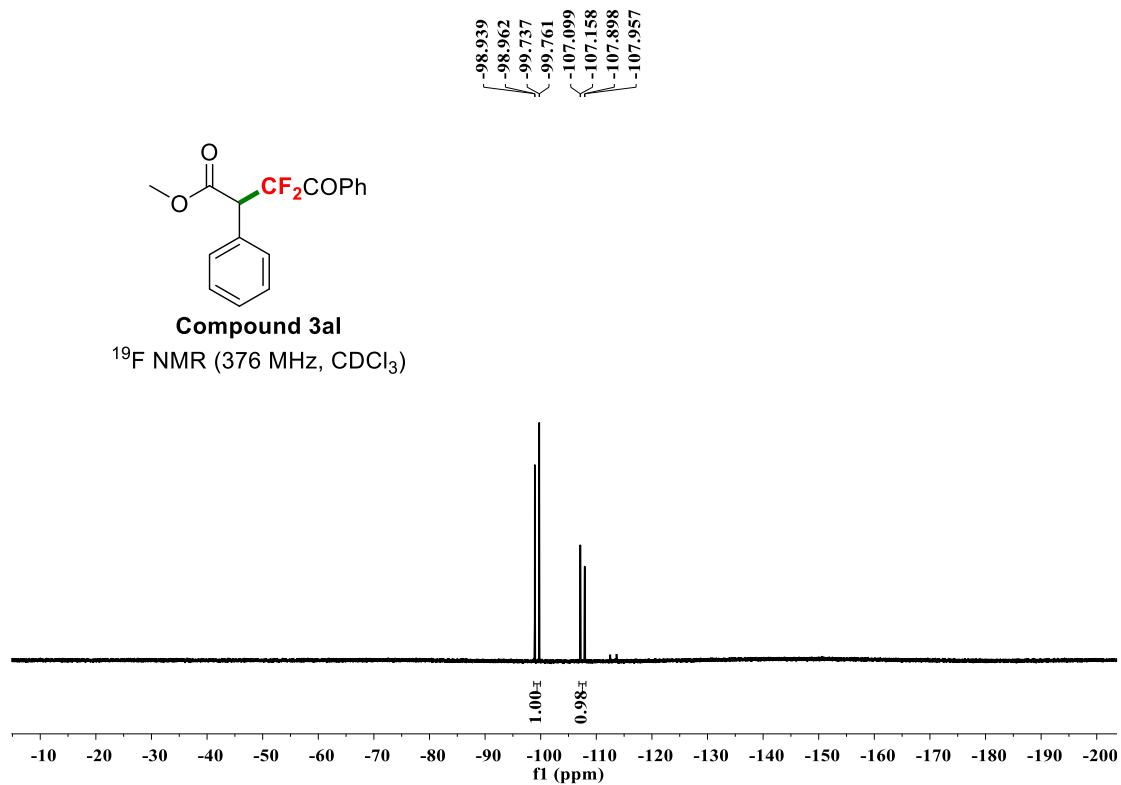
Methyl-3,3-difluoro-4-oxo-2,4-diphenylbutanoate (3al).





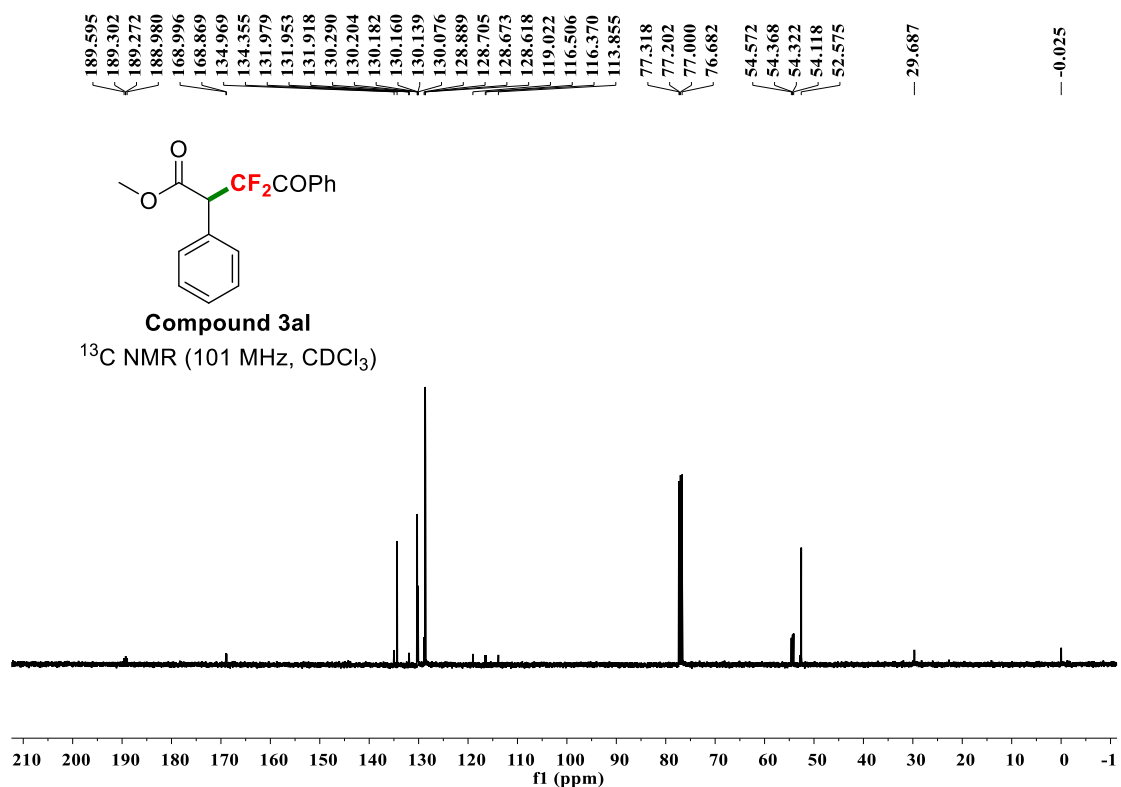
Compound 3al

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

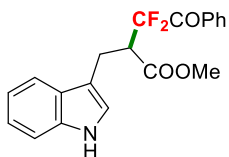
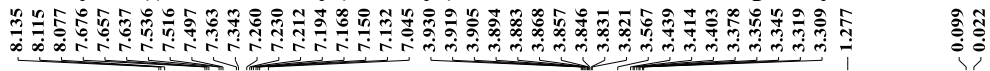


Compound 3al

^{13}C NMR (101 MHz, CDCl_3)

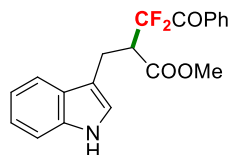
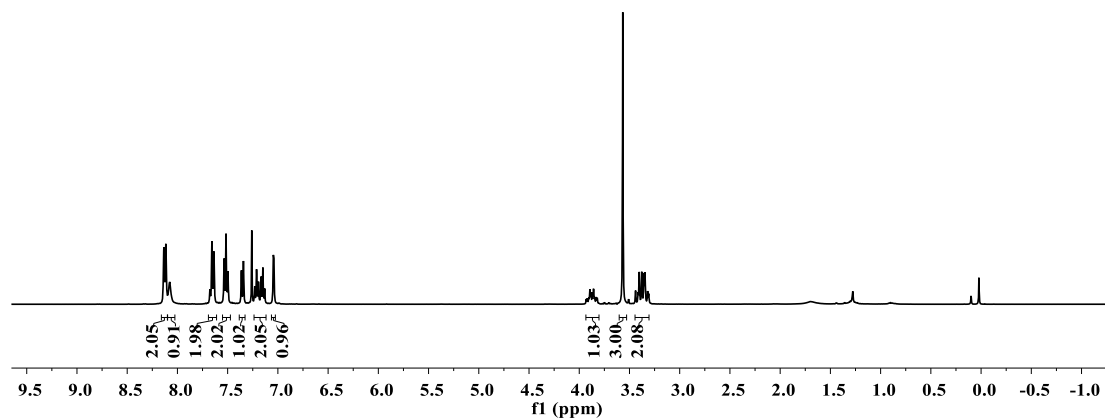


Methyl 2-((1H-indol-3-yl)methyl)-3,3-difluoro-4-oxo-4-phenylbutanoate (3am).



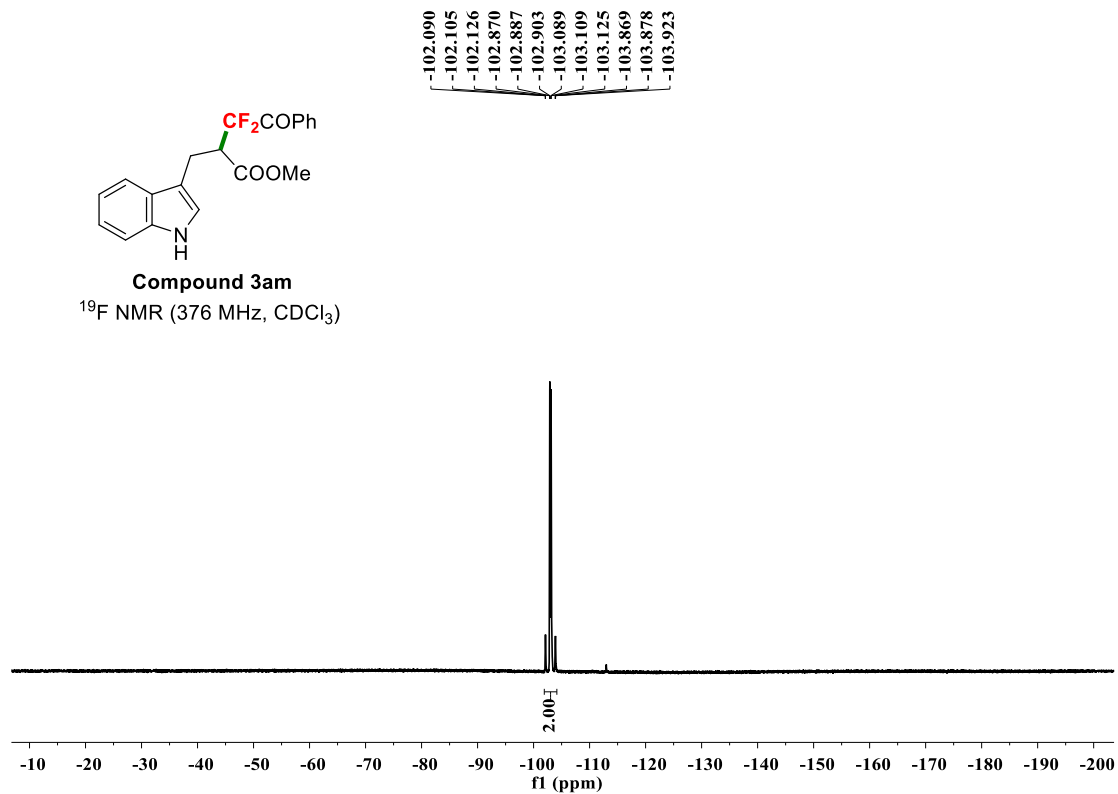
Compound 3am

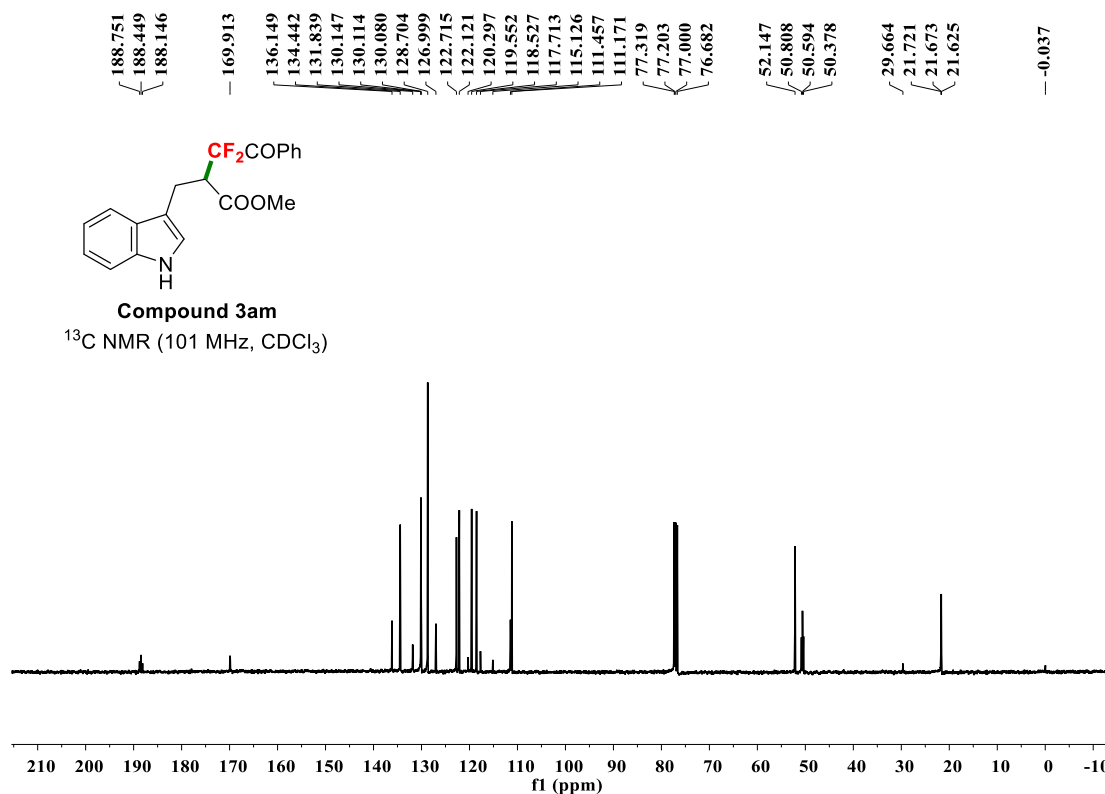
¹H NMR (400 MHz, CDCl₃)



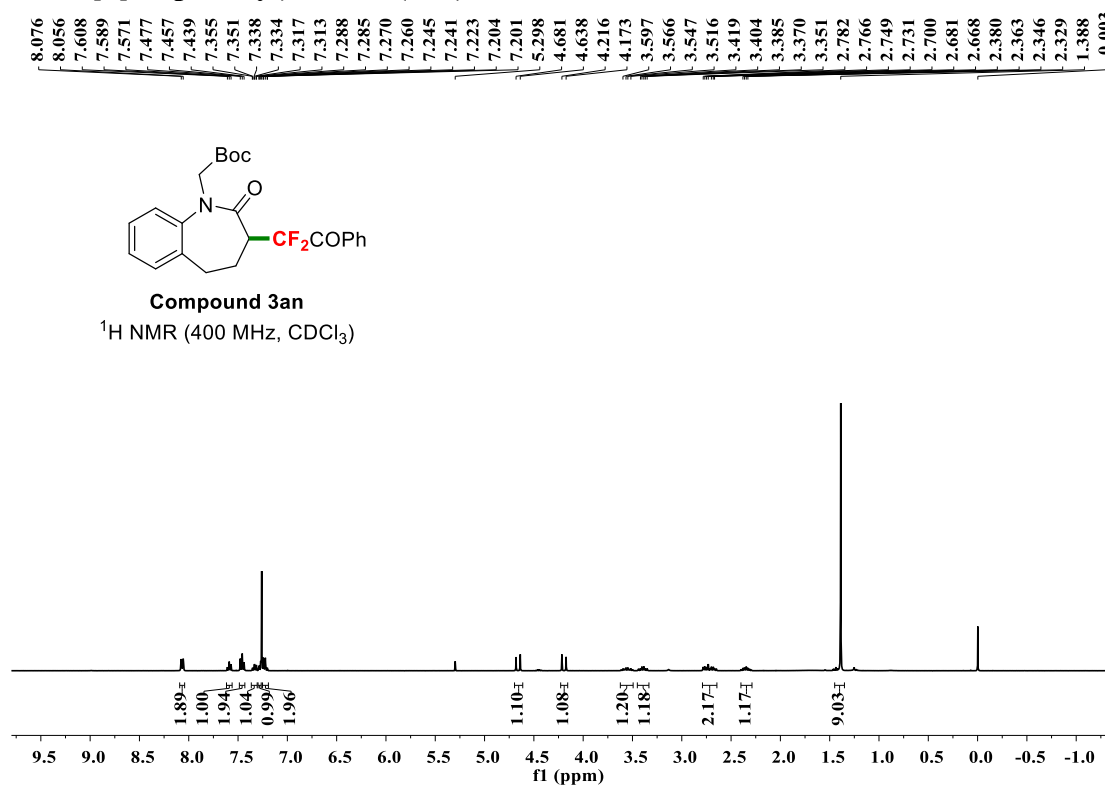
Compound 3am

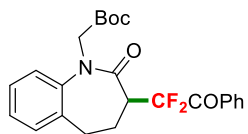
¹⁹F NMR (376 MHz, CDCl₃)





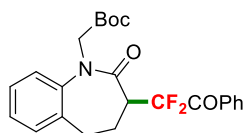
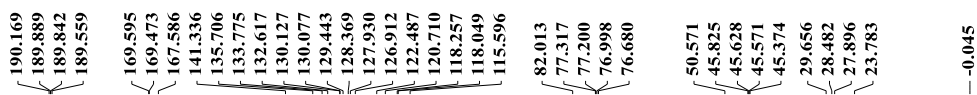
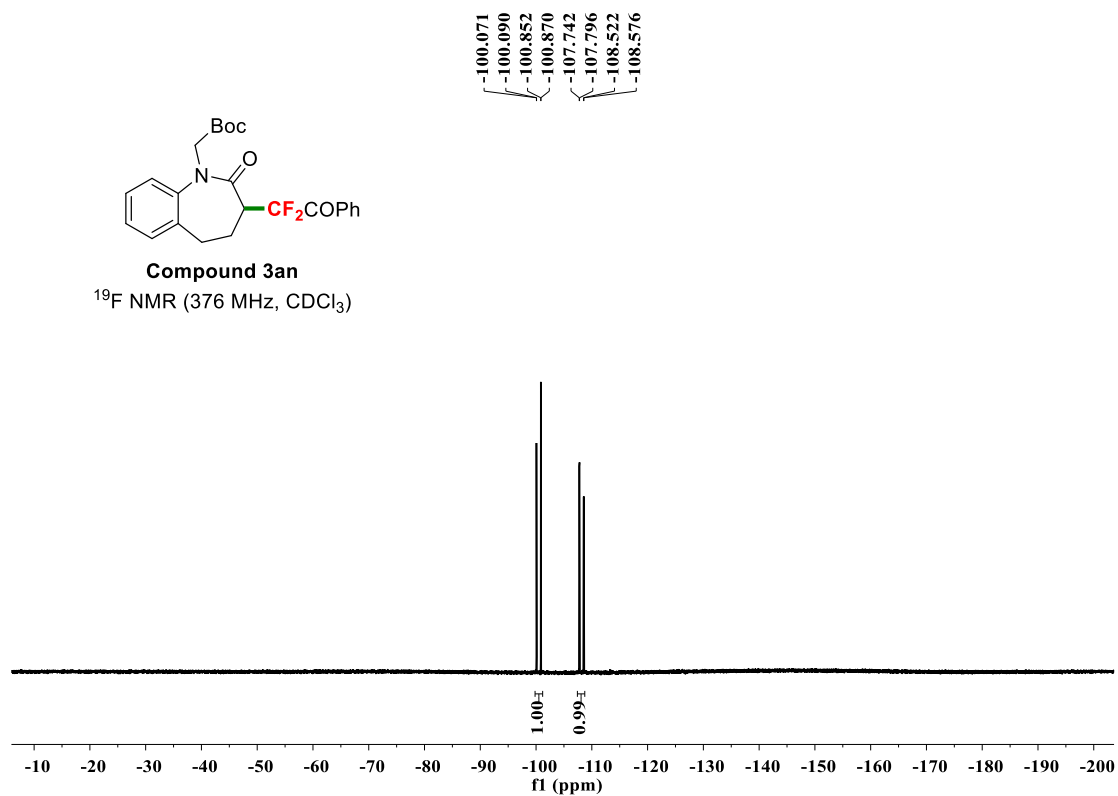
Tert-butyl 2-(3-(1,1-difluoro-2-oxo-2-phenylethyl)-2-oxo-2,3,4,5-tetrahydro-1H-benzo[b]azepin-1-yl)acetate (3an).





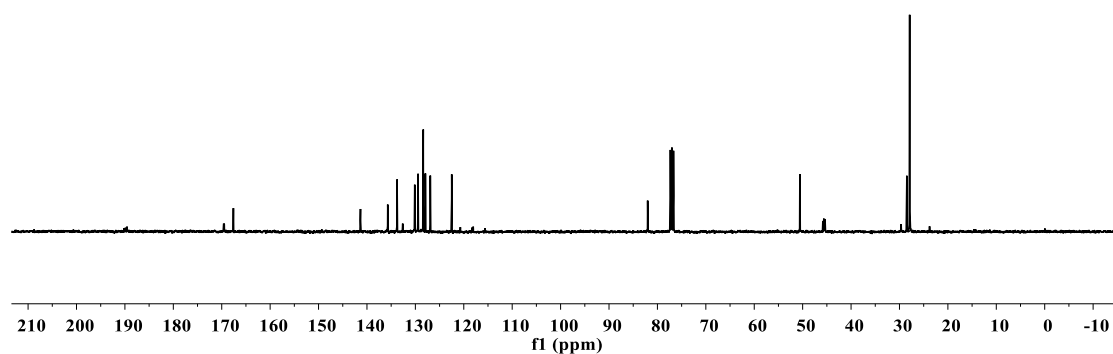
Compound 3an

¹⁹F NMR (376 MHz, CDCl₃)



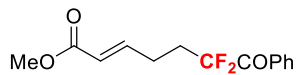
Compound 3an

¹³C NMR (101 MHz, CDCl₃)



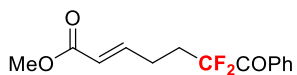
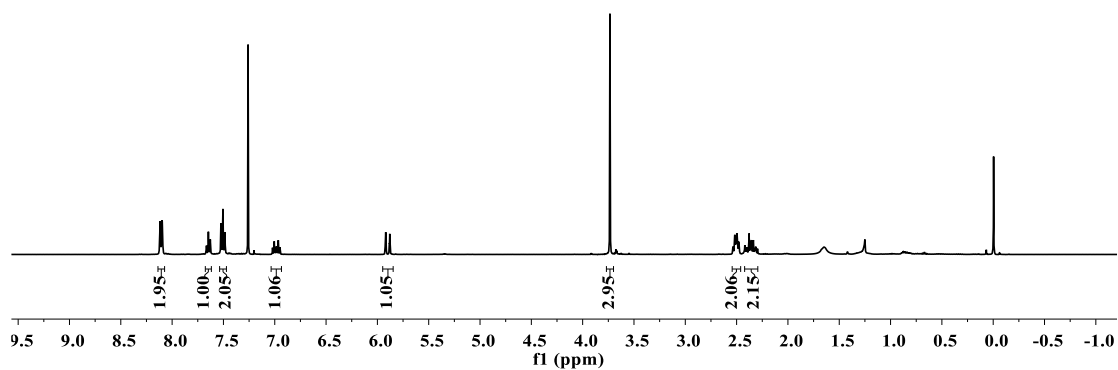
Methyl (*E*)-6,6-difluoro-7-oxo-7-phenylhept-2-enoate (5).

8.116
8.097
7.665
7.646
7.628
7.525
7.505
7.485
7.260
7.021
7.005
6.988
6.982
6.966
6.949
5.923
5.919
5.915
5.883
5.880
5.876
3.734
2.535
2.518
2.498
2.481
2.420
2.410
2.398
2.379
2.366
2.356
2.337
2.323
2.314
2.296
1.648
— 1.250
— -0.004



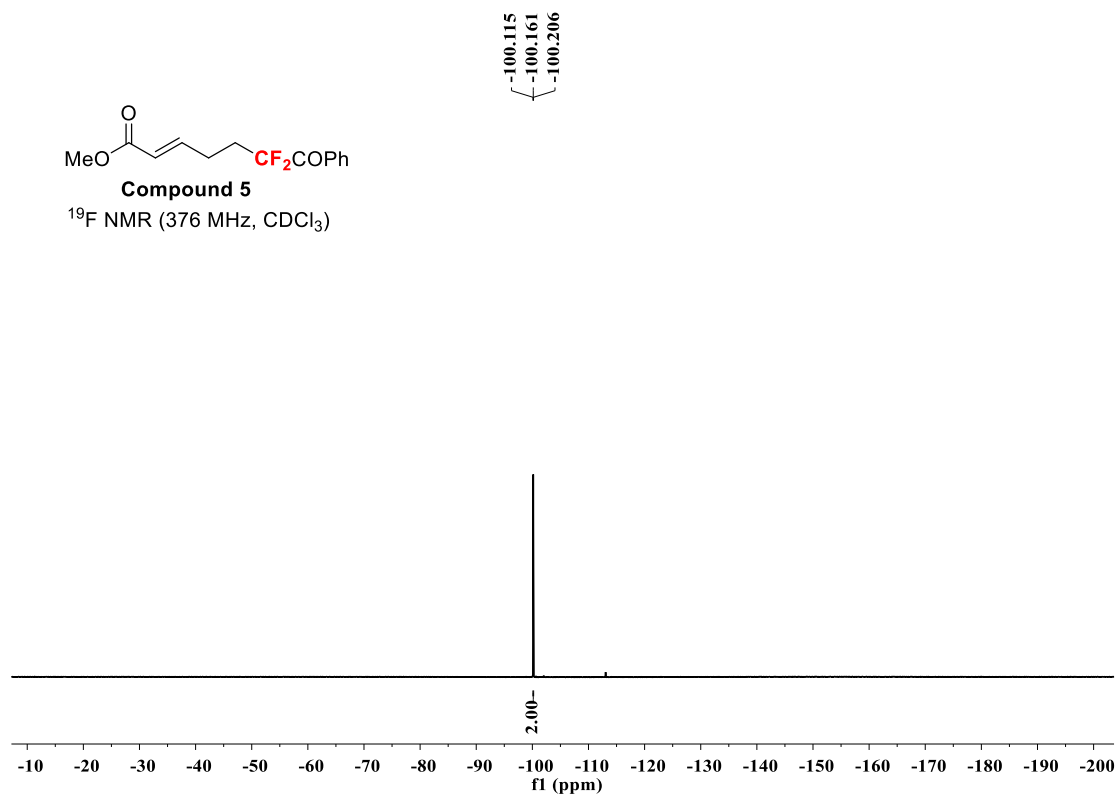
Compound 5

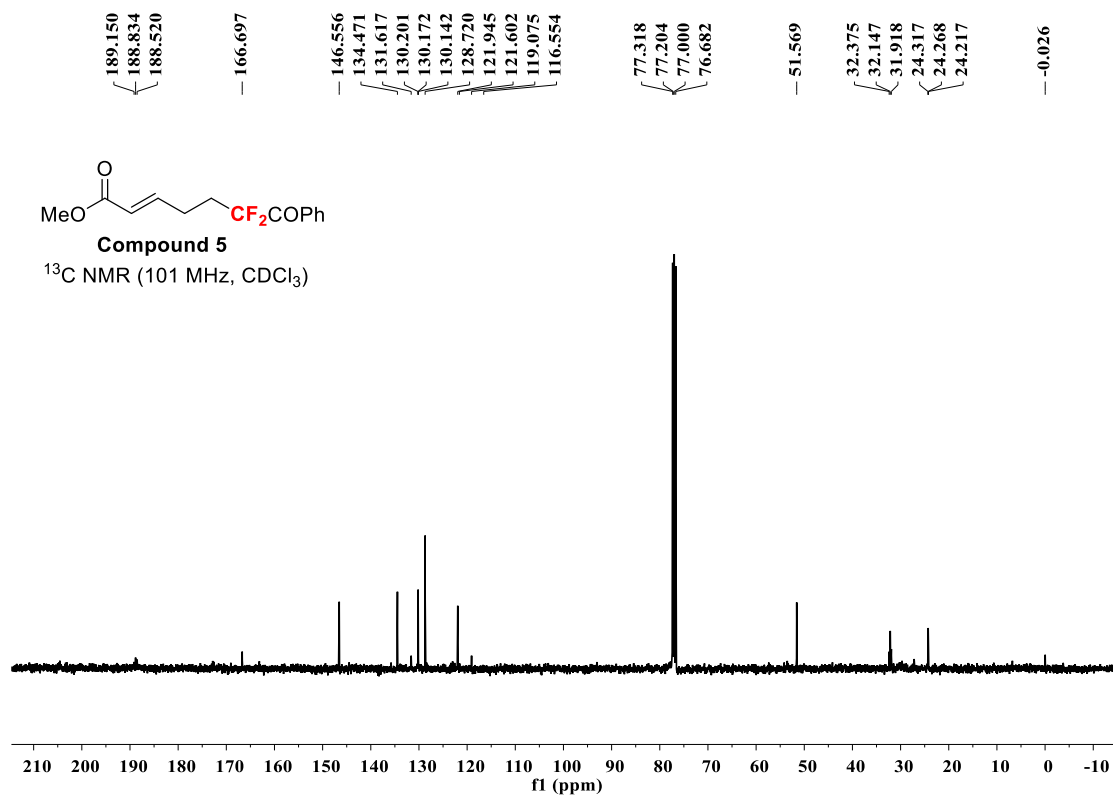
¹H NMR (400 MHz, CDCl₃)



Compound 5

¹⁹F NMR (376 MHz, CDCl₃)





Diethyl 2,6-dimethylpyridine-3,5-dicarboxylate (6).

