# Supplementary Information

## Electrochemical nickel-catalysed defluoroalkylation of gem-difluoroalkenes with alkyl halides

**Yin Liu[‡a], Pengfei Li[‡a], Jun Tan[b], Guangsheng Kou[a], Dengke Ma[*b] and Youai Qiu[*a]**

**[a]State Key Laboratory and Institute of Elemento-Organic Chemistry, Frontiers Science Center for New Organic Matter, College of Chemistry, Nankai University, 94 Weijin Road, Tianjin, 300071, China**

**[b]School of Pharmaceutical Sciences, Capital Medical University, Beijing 100069, China.**

***qiuyouai@nankai.edu.cn**

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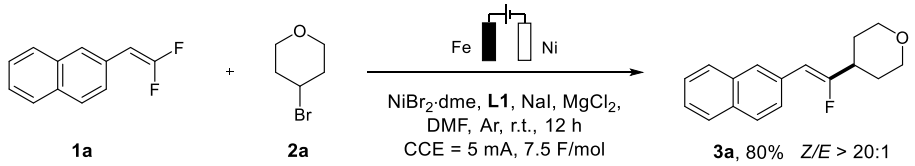
## General Remarks

Catalytic reactions were carried out in undivided electrochemical cells (15 mL) using pre-dried glassware, if not noted otherwise. Solvents were obtained from commercial sources. All the starting materials were obtained from commercial sources or synthesized according to literature methods (>95% purity). Commercially available chemicals were obtained from *Bide Pharmatech Ltd, Tianjin Heowns OPDE Technologies* and *Shanghai Macklin Biochemical Co.* used as received unless otherwise stated. Iron plate electrodes (20.0 mm × 10.0 mm × 0.2 mm, 99.9%; obtained from Dingsheng scientific research metal materials, Hebei, China), Nickel foam electrodes (20.0 mm × 10.0 mm × 0.3 mm, 99.9%; obtained from Guangjiayuan electronic materials Jiangsu, China), were connected using stainless steel adapters. Electrocatalysis was conducted using an HSPY-36-03 potentiostat in constant current mode. Cyclic voltammetry studies were performed using a Shanghai Chenhua CHI760E workstation. Yields refer to isolated compounds, estimated to be >95% purity as determined by $^{1}$H-NMR. Flash chromatography was performed using Silica gel (200-300 mesh) purchased from Qingdao Haiyang Chemical Co., China. NMR spectra were recorded on Bruker AVANCE AV 400 or 600 in the solvent indicated; chemical shifts are given in ppm relative to the residual solvent peak. The high-resolution mass spectrometry (HRMS) data were collected on a MicrOTOF mass spectrometer with ESI mass analyzer. All the synthesis methods of raw materials can be found in the corresponding literature.[1-5]

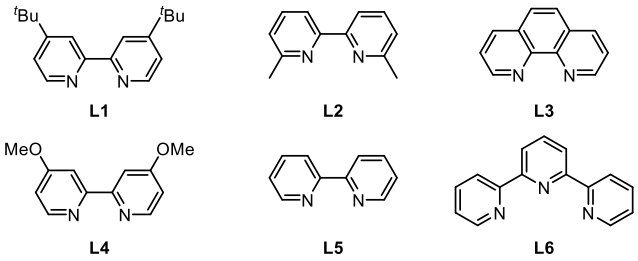
**Table S1: Optimization of the Reaction Conditions**




**1a** **2a** **3a**, 80% *Z*/*E* > 20:1

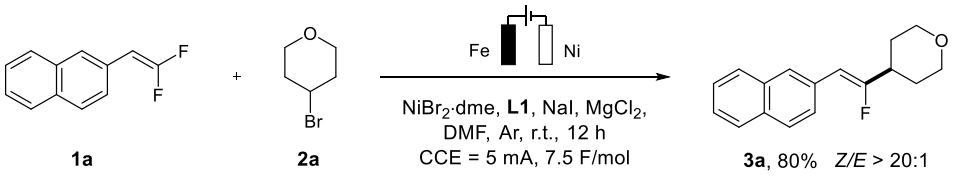
| Entry | Variation | Yield % |
|---|---|---|
| **1** | **none** | **80** |
| 2 | w/o electricity | N.R. |
| 3 | w/o Nickel catalyst | 19 |
| 4 | w/o $MgCl_2$ | 46 |
| 5 | 4 mA | 30 |
| 6 | 6 mA | 63 |
| 7 | Mg(+) as anode | N.D. |
| 8 | Zn(+) as anode | trace |
| 9 | Cu(+) as anode | 19 |
| 10 | Al(+) as anode | 29 |
| 11 | Ni(+) as anode | 16 |
| 12 | Pt(+) as anode, DIPEA (2.0 equiv.) | 3 |
| 13 | GF(+) as anode, DIPEA (2.0 equiv.) | trace |
| 14 | CF(+) as anode, DIPEA (2.0 equiv.) | trace |
| 15 | $Et_4NI$ instead of NaI | 31 |
| 16 | $NH_4I$ instead of NaI | 62 |
| 17 | KI instead of NaI | trace |
| 18 | DMA instead of DMF | 39 |
| 19 | $NiCl_2$·dme instead of $NiBr_2$·dme | 69 |
| 20 | $Ni(OTf)_2$ instead of $NiBr_2$·dme | 63 |
| 21 | $Ni(acac)_2$ instead of $NiBr_2$·dme | 55 |
| 22 | $NiI_2$ instead of $NiBr_2$·dme | 74 |
| 23 | **L2** instead of **L1** | Trace |
| 24 | **L3** instead of **L1** | 63 |
| 25 | **L4** instead of **L1** | 33 |

| | | |
|---|---|---|
| 26 | **L5** instead of **L1** | 54 |
| 27 | **L6** instead of **L1** | 18 |
| 28 | $AlCl_3$ instead of $MgCl_2$ | 55 |
| 29 | LiCl instead of $MgCl_2$ | 62 |
| 30 | LiBr instead of $MgCl_2$ | 34 |
| 31 | $ZnCl_2$ instead of $MgCl_2$ | 40 |




Reaction conditions: Fe plate anode, Ni foam cathode, **1a** (0.3 mmol), **2a** (0.9 mmol, 3.0 equiv.), $NiBr_2$·dme (10 mol%), 4,4'-di-*tert*-butyl-2,2'-bipyridine (**L1**, 20 mol%), $MgCl_2$ (2.0 equiv.), NaI (2.0 equiv.), dry DMF (5.0 mL), constant current = 5.0 mA, r.t., Ar, 12 h. Isolated yield. r.t. = room temperature. DIPEA = *N, N*-diisopropylethylamine. DMF = *N, N*-dimethylformamide. DMA = *N, N* -dimethylacetamide. CCE was constant current electrolysis, the amount of charge was 7.5 F/mol and the current density was 50 $A/m^2$. N.R. = no reaction. N.D. = not detected.

**General Procedure for electrochemical nickel-catalyzed defluoroalkylation of *gem*-difluoroalkenes with alkyl halides**




**1a** **2a** **3a**, 80% *Z*/*E* > 20:1

The electrocatalysis was carried out in an undivided cell with an iron plate anode (20.0 mm × 10.0 mm × 0.2 mm) and a Nickel foam cathode (20.0 mm × 10.0 mm × 0.3 mm). To a 15 mL pre-dried undivided electrochemical cell equipped with a magnetic bar were added **1a** (0.3 mmol, 1.0 equiv.), alkyl bromides (0.9 mmol, 3.0 equiv.), NaI (0.6 mmol, 2.0 equiv.), $MgCl_2$ (0.6 mmol, 2.0 equiv.), $NiBr_2$·dme (0.03 mmol, 0.1 equiv.) and **L1** (0.06 mmol, 0.2 equiv.). Then dry DMF (5 mL) was added after the reaction system was filled with argon. The electrocatalysis was performed at r.t. with a constant current of 5.0 mA and maintained for 12 h. The electrodes were washed with EtOAc (5 mL × 3) in an ultrasonic bath. Then, $H_2O$ (20 mL) was added to the system, and the resulting mixture was extracted with EtOAc (50 mL × 2). The combined organic phase was dried with anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. The crude product was purified by column chromatography to furnish the desired product **3a**. However, some pseudohalides couldn't give good results, which were showed in the Figure **S1**.

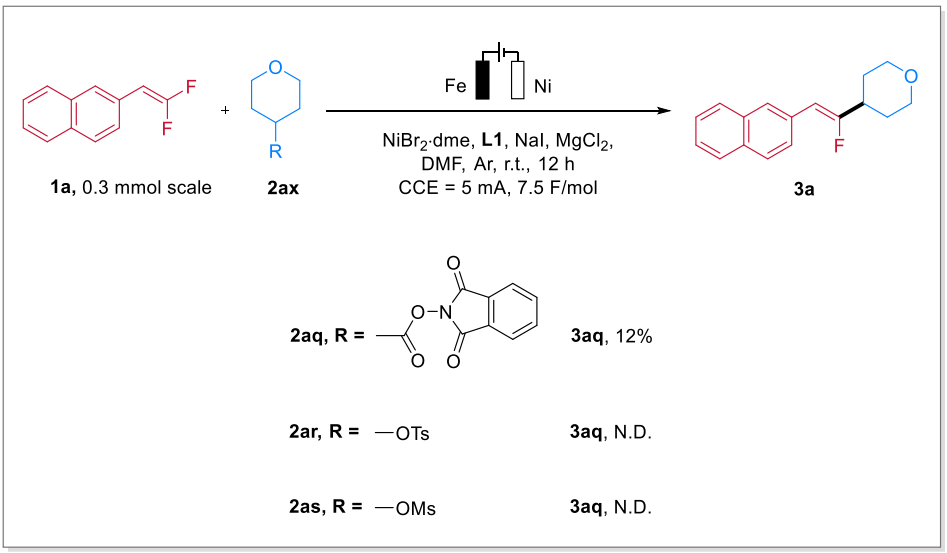



Figure **S1.** Failed results with pseudohalides

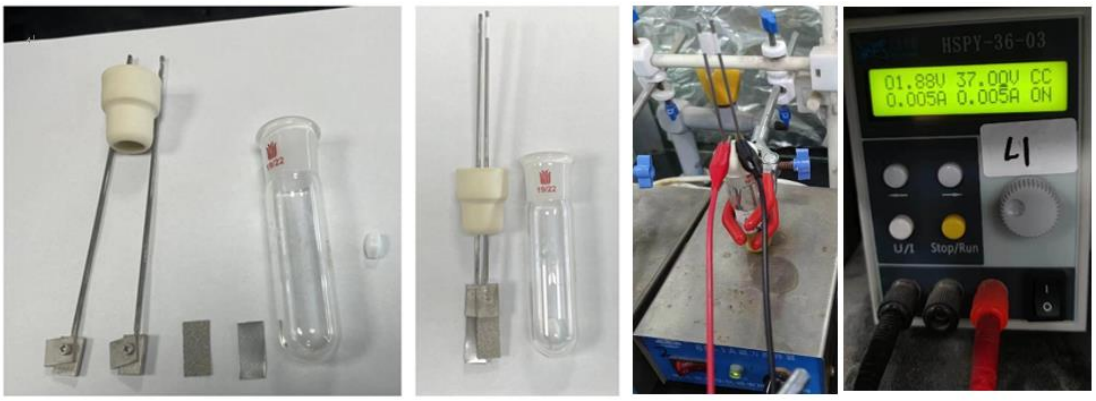
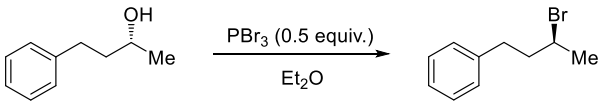



**Figure S2**. Electrolysis set-up

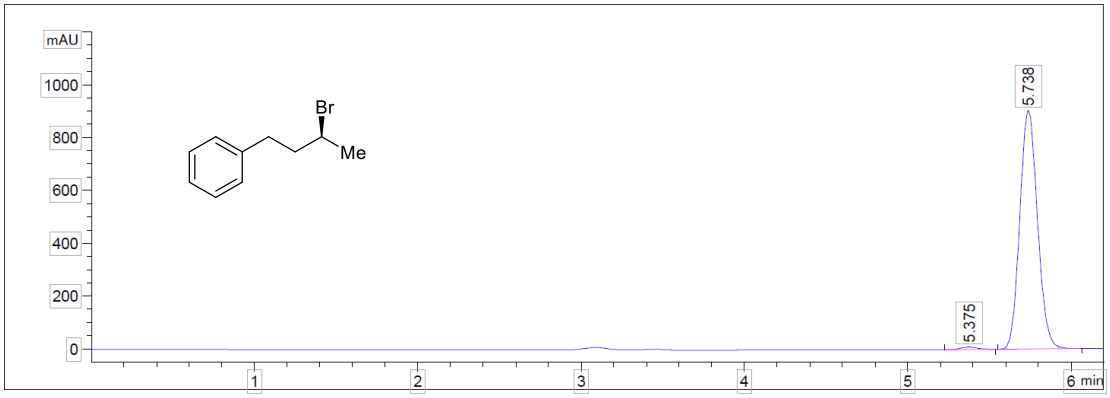
## Mechanistic Experiments

### Electrochemical nickel-catalyzed defluoroalkylation with gem-difluoroalkenes and alkyl halides

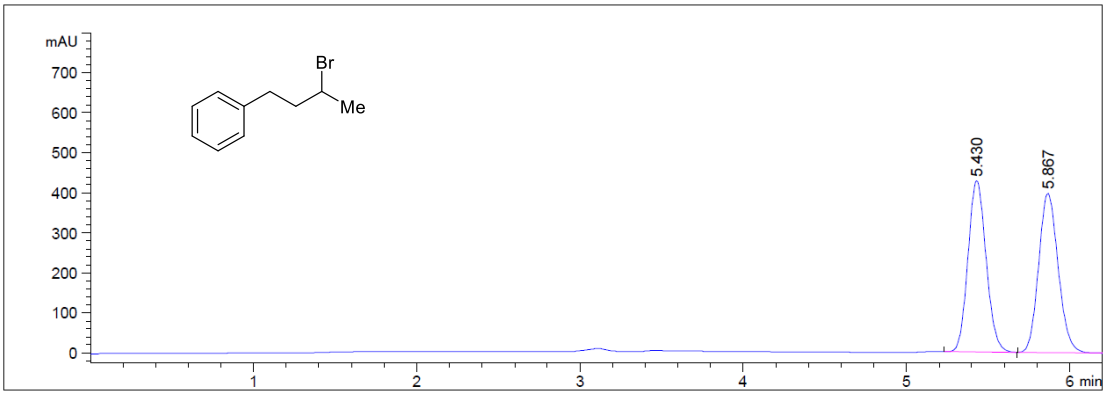
Reaction with chiral alkyl bromide



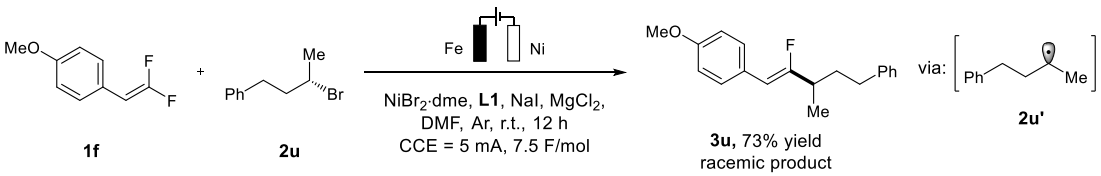

(*S*)-(3-bromobutyl)benzene was synthesized by brominating (*R*)-4-phenylbutan-2-ol according to reference[5,6]. $PBr_3$ (2.5 mmol, 0.5 equiv.) was added dropwise to a 0 ºC ice bath cooled solution of alcohol (5 mmol) in $Et_2O$ (10 mL). The solution was then stirred at r.t. overnight. The reaction was quenched over ice water and stirred for 30 minutes. The aqueous layer was removed and extracted once with $Et_2O$. The organic layers were combined and washed sequentially with a saturated solution of $NaHCO_3$, then brine, dried over $MgSO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by flash chromatography. $^1$H NMR (400 MHz, Chloroform-*d*) δ 7.36 – 7.28 (m, 2H), 7.24 – 7.21 (m, 3H), 4.20 – 4.01 (m, 1H), 2.99 – 2.84 (m, 1H), 2.84 – 2.70 (m, 1H), 2.24 – 2.00 (m, 2H), 1.75 (d, $J$ = 6.7 Hz, 3H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 141.1, 128.7, 128.6, 126.2, 51.1, 42.8, 34.1, 26.7. Physical and spectral data were in accordance with literature data[5,6]. ee = 98%, HPLC analysis of the product: Chiralcel OJ-H column; 10% $^i$PrOH in hexanes; 1.0 mL/min; retention times: 5.738 min (major), 5.375 min (minor).



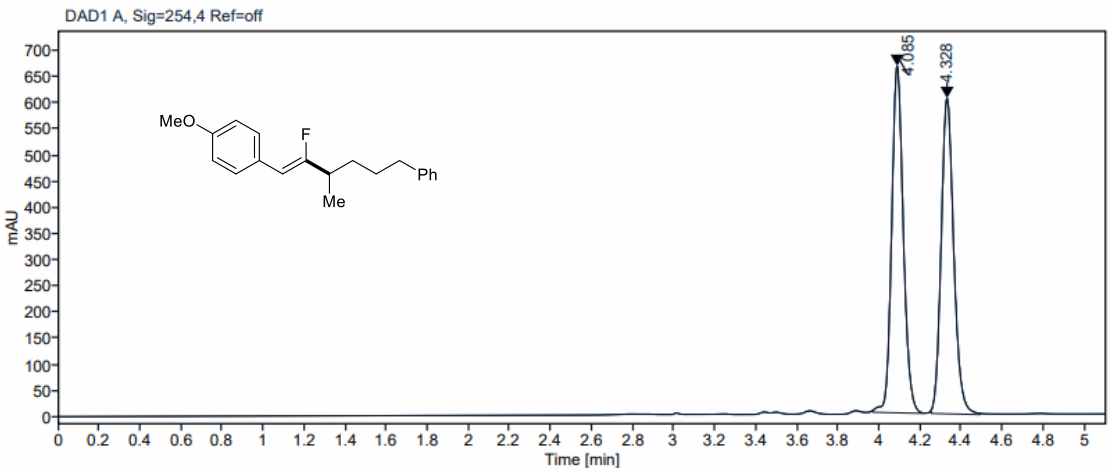

| Peak # | Ret. Time | Area | Height | Area% |
|---|---|---|---|---|
| 1 | 5.375 | 68.30441 | 9.58473 | 1.0012 |
| 2 | 5.738 | 6754.24121 | 902.48572 | 98.9988 |
| Total | | 6822.54562 | 912.07045 | 100.000 |




| Peak # | Ret. Time | Area | Height | Area% |
|---|---|---|---|---|
| 1 | 5.430 | 3303.96826 | 427.81207 | 49.9421 |
| 2 | 5.867 | 3311.63403 | 397.80164 | 50.0579 |
| Total | | 6615.60229 | 825.61371 | 100.000 |

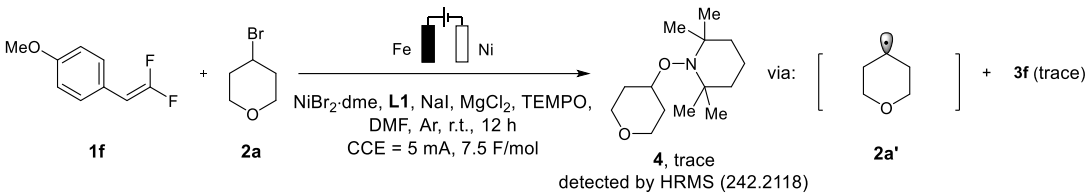


The electrocatalysis was carried out in an undivided cell with an iron plate anode (20.0 mm × 10.0 mm× 0.2 mm) and a Nickel foam cathode (20.0 mm ×10.0 mm × 0.3 mm). To a 15 mL pre-dried undivided electrochemical cell equipped with a magnetic bar were added **1f** (0.3 mmol, 1.0 equiv.), **2u** (0.9 mmol, 3.0 equiv.), NaI (0.6 mmol, 2.0 equiv.), $MgCl_2$ (0.6 mmol, 2.0 equiv.), $NiBr_2$·dme (0.03 mmol, 0.1 equiv.) and **L1** (0.06 mmol, 0.2 equiv.). And dry DMF (5 mL) was added after the reaction system was filled with argon. The electrocatalysis was performed at r.t. with a constant current of 5 mA and maintained for 12 h. The electrodes were washed with EtOAc (5 mL × 3) in an ultrasonic bath. $H_2O$ (20 mL) was added to the system, and the resulting mixture was extracted with EtOAc (50 mL × 2). The combined organic phase was dried with anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. The crude product was purified by column chromatography to furnish the racemic product **3u** in 73% yield. ee = 0%, HPLC analysis of the product: Chiralcel AD-H column; 5% $^i$PrOH in hexanes; 1.0 mL/min; retention times: 4.085 min, 4.328 min.

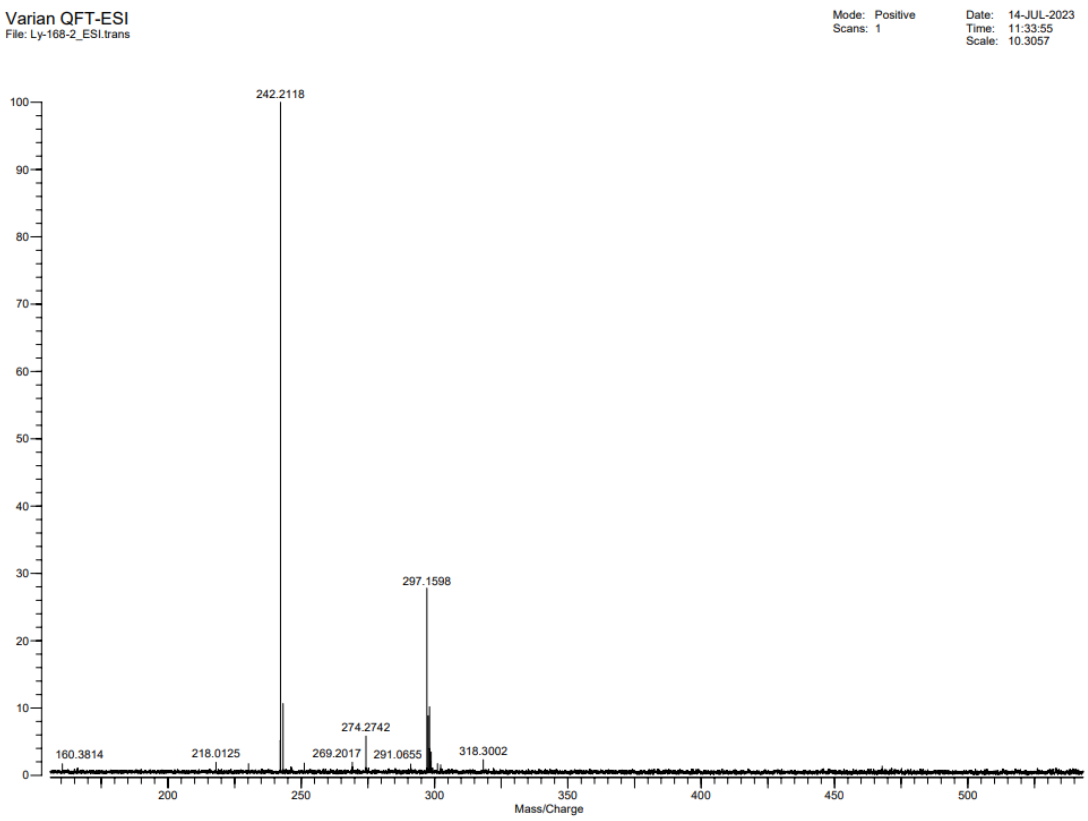



| Peak # | Ret. Time | Area | Height | Area% |
|---|---|---|---|---|
| 1 | 4.085 | 2617.2954 | 662.8463 | 50.4864 |
| 2 | 4.328 | 2566.8665 | 603.3315 | 49.5136 |
| Total | | 5184.1619 | 1266.1778 | 100.000 |

Reaction with TEMPO.




The electrocatalysis was carried out in an undivided cell with an iron plates anode (20.0 mm × 10.0 mm× 0.2 mm) and a Nickel foam cathode (20.0 mm ×10.0 mm × 0.3 mm). To a 15 mL pre-dried undivided electrochemical cell equipped with a magnetic bar were added **1f** (0.3 mmol, 1.0 equiv.), **2a** (0.9 mmol, 3.0 equiv.), TEMPO (0.9 mmol, 3.0 equiv.), $NiBr_2$·dme (0.03 mmol, 0.1 equiv.), **L1** (0.06 mmol, 0.2 equiv.), NaI (0.03 mmol, 0.1 equiv.) and $MgCl_2$ (0.6 mmol, 2.0 equiv.). Then dry DMF (5 mL) was added after the reaction system was filled with argon. The electrocatalysis was performed at room temperature with a constant current of 5 mA maintained for 12 h. The electrodes were washed with EtOAc (5 mL × 3) in an ultrasonic bath. $H_2O$ (20 mL) was added to the system, and the resulting mixture was extracted with EtOAc (50 mL × 2). The combined organic phase was dried with anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. The crude product was purified by column chromatography to furnish the desired product. And **4** was detected by HRMS. m/z calc. for $C_{14}H_{27}NO_2$ $[M+H]^+$ : 242.2120, found: 242.2118.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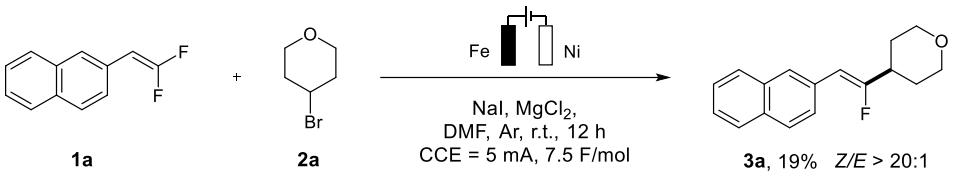
Mode: Positive
Scans: 1
Date: 14-JUL-2023
Time: 11:33:55
Scale: 10.3057
242.2118
297.1598
274.2742
160.3814
218.0125
269.2017
291.0655
318.3002
Mass/Charge

**Electrochemical defluoroalkylation with gem-difluoroalkenes and alkyl halides**




**1a** **2a** **3a**, 19% *Z/E* > 20:1

The electrocatalysis was carried out in an undivided cell with an iron plate anode (20.0 mm × 10.0 mm × 0.2 mm) and a Nickel foam cathode (20.0 mm × 10.0 mm × 0.3 mm). To a 15 mL pre-dried undivided electrochemical cell equipped with a magnetic bar were added **1a** (0.3 mmol, 1.0 equiv.), alkyl bromides (0.9 mmol, 3.0 equiv.), NaI (0.6 mmol, 2.0 equiv.), $MgCl_2$ (0.6 mmol, 2.0 equiv.). Then dry DMF (5 mL) was added after the reaction system was filled with argon. The electrocatalysis was performed at r.t. with a constant current of 5.0 mA and maintained for 12 h. The electrodes were washed with EtOAc (5 mL × 3) in an ultrasonic bath. Then, $H_2O$ (20 mL) was added to the system, and the resulting mixture was extracted with EtOAc (50 mL × 2). The combined organic phase was dried with anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. The crude product was purified by column chromatography to furnish the desired product **3a**.

The possible mechanism was proposed according to corresponding literature.[7] Firstly, the alkyl bromide was reduced at the cathode to form alkyl radical. And the radical addition process occurred between alkyl radical and *gem*-difluoroalkenes to generate **Int III**, after further reduction at the cathode to form Int IV, a β-F elimination could occur to afford target product.

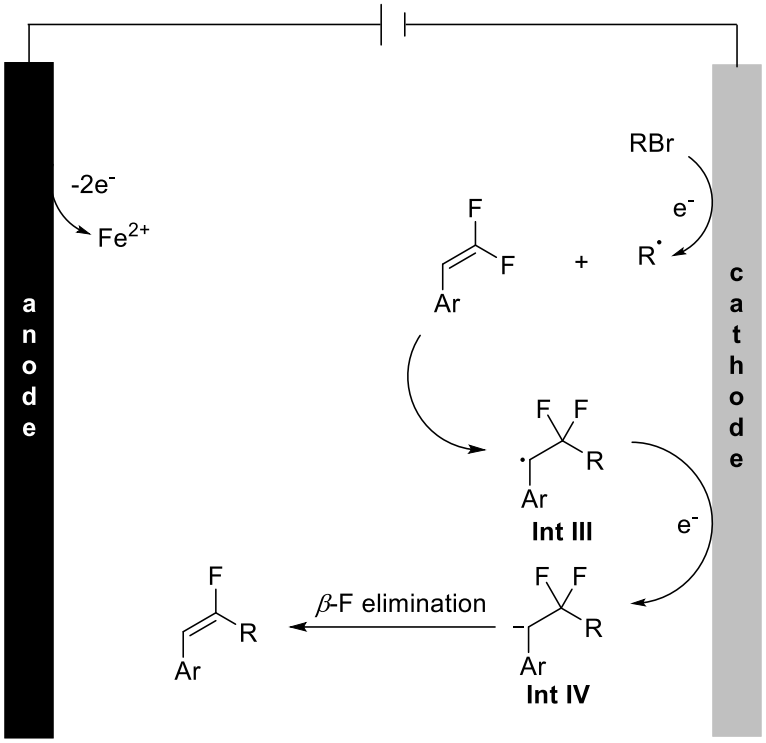



**Figure S3**. Proposal mechanisms

## Cyclic Voltammetry

The cyclic voltammetry was carried out with a Shanghai Chenhua CHI760E workstation. A glassy-carbon (GC) electrode (5 mm-diameter, disk-electrode) was used as the working electrode, Pt wire was used as the counter electrode and an $Ag/Ag^{+}$ electrode was used as the reference electrode. The measurements were carried out at a scan rate of 0.1 V $s^{-1}$ in DMF/$TBAPF_6$ (0.1 M) under reduction conditions. The operation temperature was 298 K.

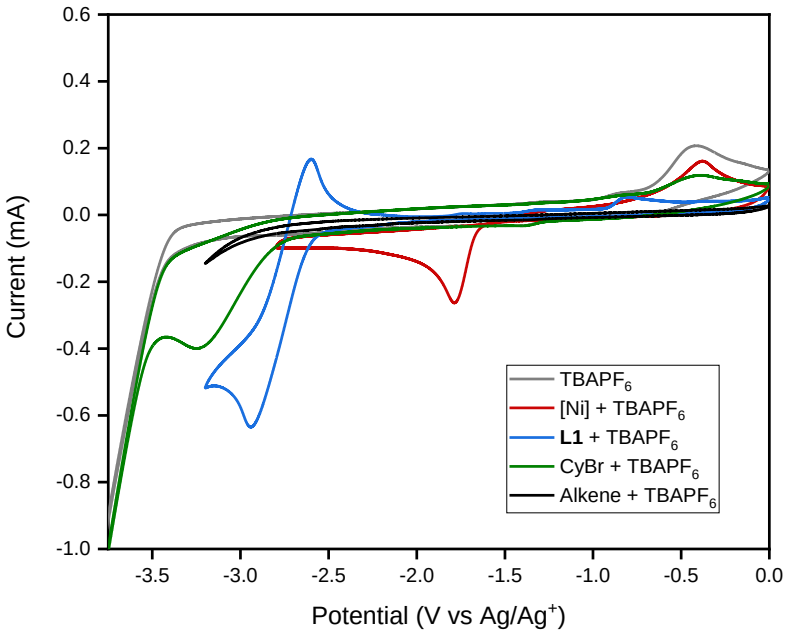



**Figure S4**. Cyclic voltammetry of $TBAPF_6$ (0.1 M), [Ni] ($NiBr_2$·dme, 0.005 M), **L1** (4,4'-di-*tert*-butyl-2,2'-bipyridine, 0.01 M), CyBr (bromocyclohexane, **2w,** 0.01 M) and alkene (1-(2,2-difluorovinyl)-4-methoxybenzene, **1f**, 0.01 M) at 0.1 $Vs^{-1}$ in DMF (10.0 mL).

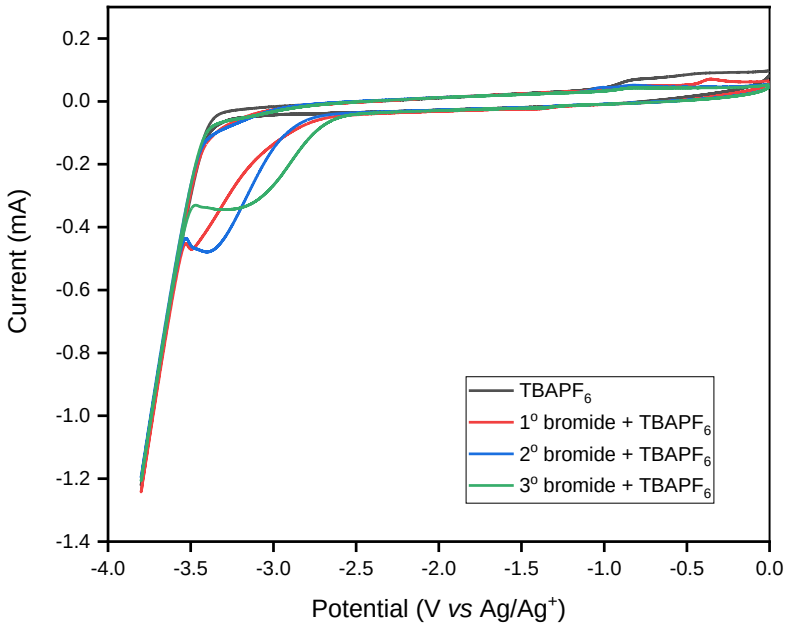



**Figure S5**. Cyclic voltammetry of $TBAPF_6$ (0.01 mM), 1° bromide ((4-bromobutoxy)benzene, **2ah**, 0.01 mM), 2° bromide (bromocyclohexane, **2w**, 0.01 M), 3° bromide ($^t$BuBr, **2aa**, 0.01 M) at 0.1 $Vs^{-1}$ in DMF (10 mL).

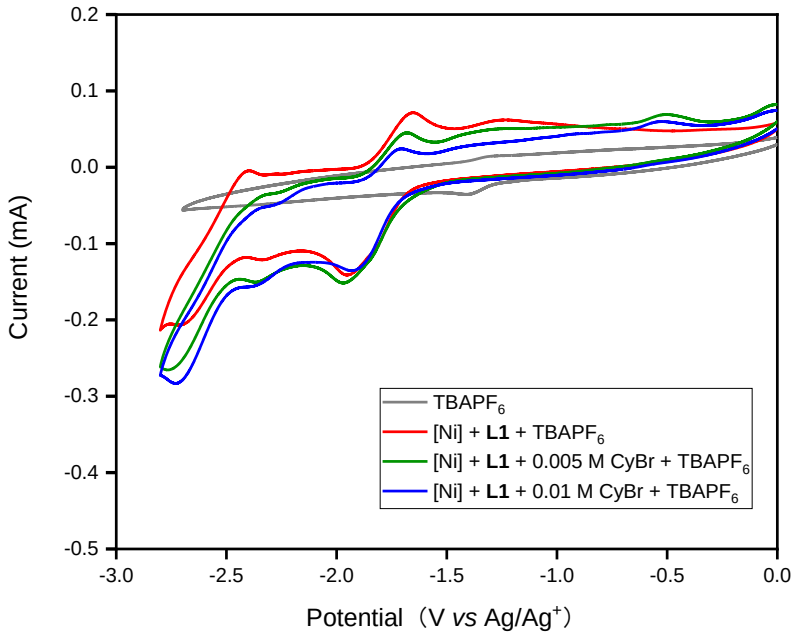



**Figure S6**. Cyclic voltammetry of $TBAPF_6$ (0.01 mM), $NiBr_2$·dme (0.005 M) + **L1** (0.01 M), $NiBr_2$·dme (0.005 M) + **L1** (0.01 M) + **2w** (0.005 M), $NiBr_2$·dme (0.005 M) + **L1** (0.01 M) + **2w** (0.01 M) at 0.1 $Vs^{-1}$ in DMF (10 mL).

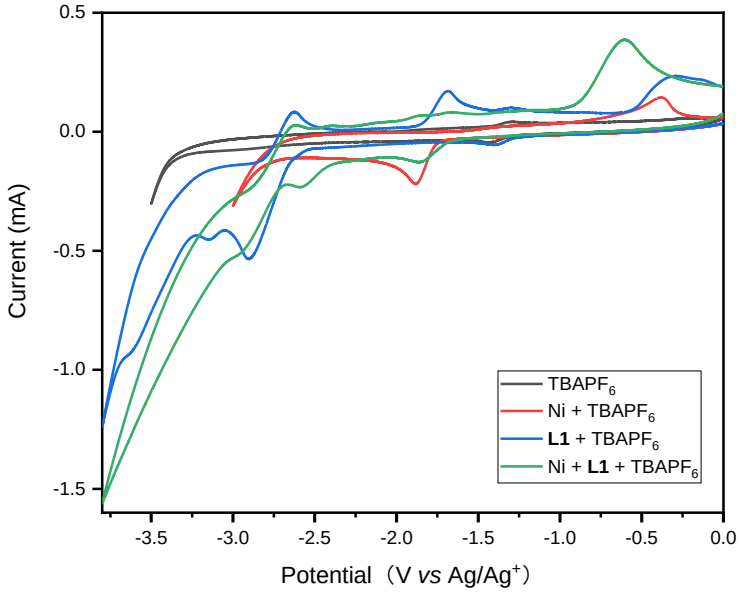



**Figure S7:** Cyclic voltammetry of $TBAPF_6$ (0.1 M), $NiBr_2$·dme (0.005 M), **L1** (0.01 M), $NiBr_2$·dme + **L1** (0.005 M + 0.01 M) at 0.1 $Vs^{-1}$ in DMF (10 mL).

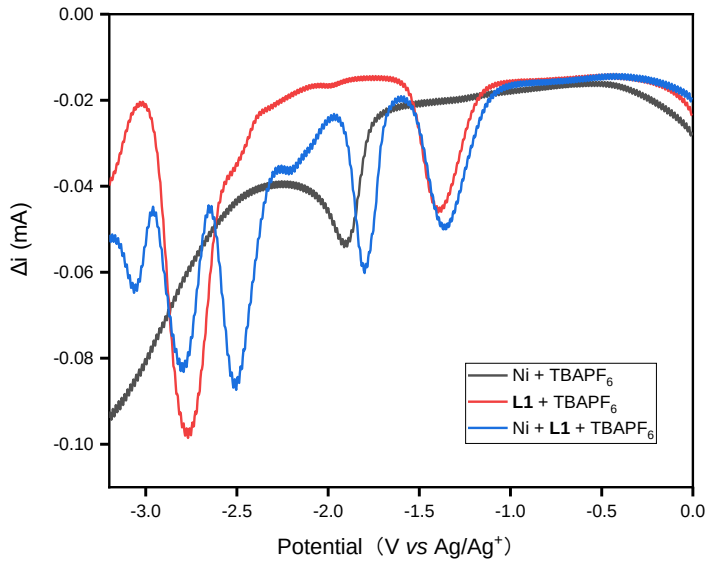
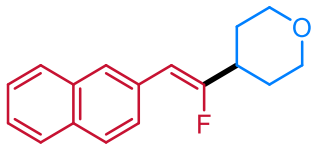



**Figure S8:** Square wave voltammetry of $TBAPF_6$ (0.1 M), $NiBr_2$·dme (0.005 M), **L1** (0.01 M), $NiBr_2$·dme + **L1** (0.005 M + 0.01 M) at 0.1 $Vs^{-1}$ in DMF (10 mL).

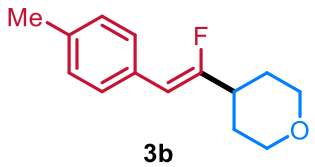
## Characterization Data of Products




**3a**

**(*Z*)-4-(1-Fluoro-2-(naphthalen-2-yl)vinyl)tetrahydro-2*H*-pyran**

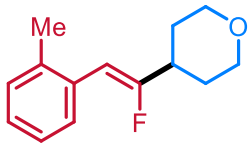
Compound **3a** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3a** (61.4 mg, 80%, *Z*/*E* > 20:1) as a light yellow solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.91 (s, 1H), 7.80 – 7.78 (m, 3H), 7.66 – 7.64 (m, 1H), 7.48 – 7.43 (m, 2H), 5.63 (d, *J* = 40.3 Hz, 1H), 4.09 – 4.06 (m, 2H), 3.51 – 3.45 (m, 2H), 2.62 – 2.51 (m, 1H), 1.90 – 1.86 (m, 2H), 1.82 – 1.72 (m, 2H).$^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.3 (d, *J* = 268.8 Hz), 133.6, 132.5, 131.2 (d, *J* = 2.1 Hz), 128.1 (d, *J* = 6.0 Hz) 127.7, 127.4 (d, *J* = 7.5 Hz), 126. 8 (d, *J* = 7.5 Hz), 126.2, 126.0, 104.7 (d, *J* = 9.0 Hz), 67.7, 39.0 (d, *J* = 25.7 Hz), 29.9 (d, *J* = 3.0 Hz). $^{19}$F NMR of (375 MHz, Chloroform-*d*): δ –106.38. HR-MS (ESI) m/z calc. for $C_{17}H_{18}FO^{+}$ $[M+H]^{+}$ : 257.1336, found: 257.1341.




**3b**

**(*Z*)-4-(1-Fluoro-2-(p-tolyl)vinyl)tetrahydro-2*H*-pyran**

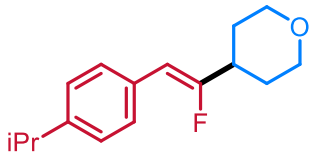
Compound **3b** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3b** (54.1 mg, 82%, *Z*/*E* > 20:1) as colorless liquid. $^{1}$H (400 MHz, Chloroform-*d*) δ 7.39 –7.37 (m, 2H), 7.14 – 7.12 (m, 2H), 5.43 (d, *J* = 40.6 Hz, 1H), 4.07 – 4.03 (m, 2H), 3.49 – 3.42 (m, 2H), 2.55 – 2.44 (m, 1H), 2.34 (s, 3H), 1.85 – 1.81 (m, 2H), 1.78 – 1.67 (m, 2H).$^{13}$C NMR (100 MHz, Chloroform-*d*) δ 162.6 (d, *J* = 266.6 Hz), 136.8, 130.8 (d, *J* = 2.1 Hz), 129.3, 128.5 (d, *J* = 8.1 Hz), 104.4 (d, *J* = 10.1 Hz), 67.7, 38.9 (d, *J* = 26.2 Hz), 29.9 (d, *J* =2.0 Hz), 21.3. $^{19}$F NMR (375 MHz, Chloroform-*d*): δ –107.98. HR-MS (ESI) m/z calc. for $C_{14}H_{18}FO^{+}$ $[M+H]^{+}$ : 221.1336, found: 221.1332.




**3c**

**(*Z*)-4-(1-Fluoro-2-(o-tolyl)vinyl)tetrahydro-2*H*-pyran**

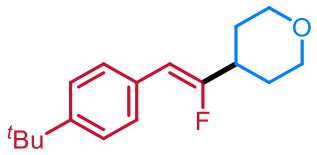
Compound **3c** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3c** (52.1 mg, 79%, *Z*/*E* > 20:1) as colorless liquid. $^{1}$H (400 MHz, Chloroform-*d*) δ 7.61 – 7.59 (m, 1H), 7.19 – 7.13 (m, 3H), 5.60 (d, *J* = 39.3 Hz, 1H), 4.08 – 4.06 (m, 2H), 3.47 (t, *J* = 11.8 Hz, 2H), 2.57 – 2.51 (m, 1H), 2.30 (s, 3H), 1.87 – 1.85 (m, 2H), 1.79 – 1.72 (m, 2H).$^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.9 (d, *J* = 265.8 Hz), 135.7, 132.1, 130.1, 129.3 (d, *J* = 9.0 Hz), 127.1, 126.0, 101.9 (d, *J* = 10.5 Hz), 67.6, 38.9 (d, *J* = 25.7 Hz), 30.0 (d, *J* = 3.0 Hz), 20.3. $^{19}$F NMR (375 MHz, Chloroform-*d*): δ –109.27. HR-MS (ESI) m/z calc. for $C_{14}H_{18}FO^{+}$ $[M+H]^{+}$ : 221.1336, found: 221.1330.




**3d**

**(*Z*)-4-(1-Fluoro-2-(4-isopropylphenyl)vinyl)tetrahydro-2*H*-pyran**

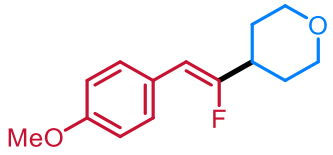
Compound **3d** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3d** (55.8 mg, 75%, *Z*/*E* > 20:1) as light yellow oily liquid. $^{1}$H (400 MHz, Chloroform-*d*) δ 7.43 – 7.41 (m, 2H), 7.20 – 7.18 (m, 2H), 5.45 (d, *J* = 40.6 Hz, 1H), 4.06 – 4.04 (m, 2H), 3.46 (t, *J* = 11.8 Hz, 2H), 2.93 – 2.86 (m, 1H), 2.56 – 2.45 (m, 1H), 1.85 – 1.81 (m, 2H), 1.79 – 1.67 (m, 2H), 1.25 (d, *J* = 6.9 Hz, 6H).$^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.7 (d, *J* = 265.8 Hz), 147.8, 131.2, 128.5 (d, *J* = 7.6 Hz), 126.6, 104.3 (d, *J* = 9.1 Hz), 67.6, 38.9 (d, *J* = 25.7 Hz), 34.0, 29.9, 24.1. $^{19}$F NMR (375 MHz, Chloroform-*d*): δ –107.99. HR-MS (ESI) m/z calc. for $C_{16}H_{22}FO^{+}$ $[M+H]^{+}$ : 249.1649, found: 249.1639.




**3e**

**(*Z*)-4-(2-(4-(Tert-butyl)phenyl)-1-fluorovinyl)tetrahydro-2*H*-pyran**

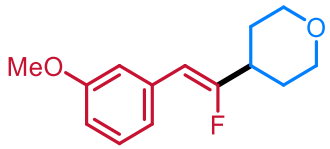
Compound **3e** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3e** (59.0 mg, 75%, *Z*/*E* > 20:1) as light white solid. $^{1}$H (400 MHz, Chloroform-*d*) δ 7.44 – 7.41 (m, 2H), 7.36 – 7.34 (m, 2H), 5.45 (d, *J* = 40.6 Hz, 1H), 4.07 – 4.04 (m, 2H), 3.49 – 3.42 (m, 2H), 2.55 – 2.46 (m, 1H), 1.84 – 1.81 (m, 2H), 1.77 – 1.67 (m, 2H), 1.30 (s, 9H).$^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.8 (d, *J* = 265.8 Hz), 150.0, 130.8, 128.3 (d, *J* = 7.6 Hz), 125.5, 104.2 (d, *J* = 7.6 Hz), 67.6, 38.8 (d, *J* = 25.7 Hz), 34.7, 31.4 (d, *J* = 7.6 Hz), 29.9. $^{19}$F NMR (375 MHz, Chloroform-*d*): δ –107.85. HR-MS (ESI) m/z calc. for $C_{17}H_{24}FO^{+}$ $[M+H]^{+}$ : 263.1806, found: 263.1816.




**3f**

**(*Z*)-4-(1-Fluoro-2-(4-methoxyphenyl)vinyl)tetrahydro-2*H*-pyran**

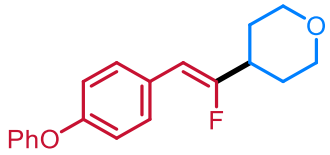
Compound **3f** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3f** (55.2 mg, 78%, *Z*/*E* = 13:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.43 – 7.41 (m, 2H), 6.87 – 6.85 (m, 2H), 5.40 (d, *J* = 40.6 Hz, 1H), 4.06 – 3.99 (m, 2H), 3.81 (s, 3H), 3.48 – 3.36 (m, 2H), 2.53 – 2.44 (m, 1H), 1.84 – 1.81 (m, 2H), 1.77 – 1.66 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 161.9 (d, *J* = 264.3 Hz), 158.5, 129.8 (d, *J* = 7.6 Hz), 126.4, 114.0, 103.9 (d, *J* = 9.1 Hz) 67.7, 55.4, 38.8 (d, *J* = 25.7 Hz), 29.9 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –106.11. HR-MS (ESI) m/z calc. for $C_{14}H_{18}FO_{2}^{+}$ $[M+H]^{+}$ : 237.1285, found: 237.1276.




**3g**

**(*Z*)-4-(1-Fluoro-2-(3-methoxyphenyl)vinyl)tetrahydro-2*H*-pyran**

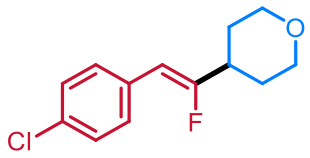
Compound **3g** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3g** (55.2 mg, 75%, *Z*/*E* = 13:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.31 – 7.28 (m, 1H), 7.12 – 7.08 (m, 2H), 6.84 – 6.82 (m, 1H), 5.49 (d, *J* = 40.1 Hz, 1H), 4.12 – 4.08 (m, 2H), 3.86 (s, 3H), 3.53 – 3.47 (m, 2H), 2.60 – 2.51 (m, 1H), 1.89 – 1.86 (m, 2H), 1.83 – 1.72 (m, 2H).$^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.4 (d, *J* = 267.3 Hz) 159.7, 134.9, 129.5, 121.2 (d, *J* = 6.0 Hz), 113.9 (d, *J* = 7.5 Hz), 112.9, 104.5 (d, *J* = 9.0 Hz), 67.6, 55.3, 39.0 (d, *J* =25.7 Hz), 29.9 (d, *J* = 1.5 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –106.11. HR-MS (ESI) m/z calc. for $C_{14}H_{18}FO_2^+$ $[M+H]^+$ : 237.1285, found: 237.1295.




**3h**

**(*Z*)-4-(1-Fluoro-2-(4-phenoxyphenyl)vinyl)tetrahydro-2*H*-pyran**

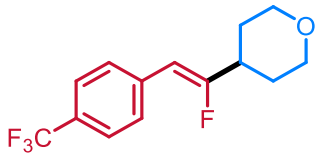
Compound **3h** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3h** (63.5 mg, 71%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.35 – 7.08 (m, 6H), 7.02 – 7.00 (m, 2H), 6.88 – 6.86 (m, 1H), 5.43 (d, *J* = 39.7 Hz, 1H), 4.06 – 4.02 (m, 2H), 3.44 (t, *J* = 11.8 Hz, 2H), 2.53 – 2.44 (m, 1H), 1.83 – 1.80 (m, 2H), 1.76 – 1.65 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.7 (d, *J* = 267.0 Hz), 157.4, 157.3, 135.4, 129.9, 129.8, 123.7 (d, *J* = 7.5 Hz) 123.3, 119.1 (d, *J* = 7.5 Hz), 118.9, 117.7, 104.1 (d, *J* = 7.5 Hz), 67.6, 38.9 (d, *J* = 25.5 Hz), 29.8 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –105.35. HR-MS (ESI) m/z calc. for $C_{19}H_{19}FNaO_2^+$ $[M+Na]^+$ : 321.1261, found: 321.1261.




**3i**

**(*Z*)-4-(2-(4-Chlorophenyl)-1-fluorovinyl)tetrahydro-2*H*-pyran**

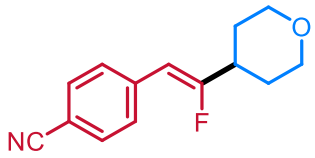
Compound **3i** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3i** (52.6 mg, 73%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.42 – 7.39 (m, 2H), 7.30 – 7.27 (m, 2H), 5.43 (d, *J* = 39.8 Hz, 1H), 4.07 – 4.03 (m, 2H), 3.48 – 3.42 (m, 2H), 2.56 – 2.45 (m, 1H), 1.84 – 1.81 (m, 2H), 1.77 – 1.67 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.6 (d, *J* = 265.5 Hz), 132.6 (d, *J* = 3.0 Hz), 132.1, 129.8 (d, *J* = 7.5 Hz), 128.7, 103.6 (d, *J* = 9.0 Hz), 67.6, 38.8 (d, *J* = 27.2 Hz), 29.8 (d, *J* = 1.5 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –105.99. HR-MS (ESI) m/z calc. for $C_{13}H_{15}ClFO^{+}$ $[M+H]^{+}$ : 241.0790, found: 241.0785




**3j**

**(*Z*)-4-(1-Fluoro-2-(4-(trifluoromethyl)phenyl)vinyl)tetrahydro-2*H*-pyran**

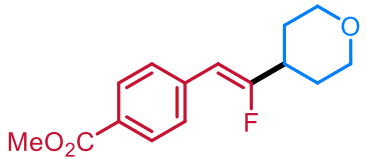
Compound **3j** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3j** (50.1 mg, 61%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.61 – 7.51 (m, 4H), 5.52 (d, *J* = 39.4 Hz, 1H), 4.08 – 4.05 (m, 2H), 3.48 – 3.44 (m, 2H), 2.55 – 2.52 (m, 1H), 1.86 – 1.83 (m, 2H), 1.77 – 1.70 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 164.9 (d, *J* = 270.3 Hz), 137.2, 128.7 (d, *J* = 7.5 Hz), 125.5 (q, *J* = 4.5 Hz), 124.3 (q, *J* = 271.2 Hz), 103.6 (d, *J* = 7.5 Hz), 67.5, 39.0 (d, *J* = 25.7 Hz), 29.7 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –62.53, –103.54. HR-MS (ESI) m/z calc. for $C_{14}H_{15}F_4O^{+}$ $[M+H]^{+}$ : 275.1054, found: 275.1057.




**3k**

**(*Z*)-4-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)benzonitrile**

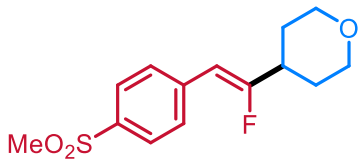
Compound **3k** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3k** (35.3 mg, 51%, *Z*/*E* = 17:1) as white solid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.60 – 7.59 (m, 2H), 7.56 – 7.55 (m, 2H), 5.51 (d, *J* = 39.0 Hz, 1H), 4.08 – 4.05 (m, 2H), 3.46 (t, *J* = 11.9 Hz, 2H), 2.58 – 2.51 (m, 1H), 1.86 – 1.83 (m, 2H), 1.77 – 1.70 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 165.8 (d, *J* = 271.8 Hz), 138.4, 132.4, 129.0 (d, *J* = 7.5 Hz), 119.1, 110.3 (d, *J* = 3.0 Hz), 103.7 (d, *J* = 7.5 Hz), 67.5, 39.0 (d, *J* = 25.7 Hz), 29.7 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –101.18. HR-MS (ESI) m/z calc. for $C_{14}H_{15}FNO^{+}$ $[M+H]^{+}$ : 232.1132, found: 232.1134.




**3l**

**Methyl (*Z*)-4-(2-fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)benzoate**

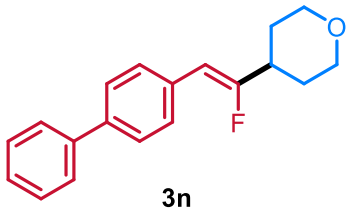
Compound **3l** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3l** (23.8 mg, 30%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 8.00 – 7.97 (m, 2H), 7.55 – 7.52 (m, 2H), 5.52 (d, *J* = 39.7 Hz, 1H), 4.08 – 4.04 (m, 2H), 3.91 (s, 3H), 3.49 – 3.43 (m, 2H), 2.59 – 2.48 (m, 1H), 1.87 – 1.82 (m, 2H), 1.79 – 1.68 (m, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 167.0, 164.9 (d, *J* = 271.7 Hz), 138.3 (d, *J* = 3.0 Hz), 129.9, 128.4 (d, *J* = 7.5 Hz), 104.1 (d, *J* = 8.9 Hz), 67.6, 52.2, 39.0 (d, *J* = 26.3 Hz), 30.2, 29.8 (d, *J* = 2.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –102.86. HR-MS (ESI) m/z calc. for $C_{15}H_{18}FO_{3}^{+}$ $[M+H]^{+}$ : 265.1234, found: 265.1235.




**3m**

**(*Z*)-4-(1-Fluoro-2-(4-(methylsulfonyl)phenyl)vinyl)tetrahydro-2*H*-pyran**

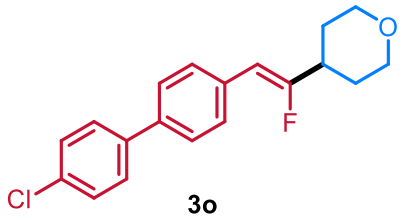
Compound **3m** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3m** (51.1 mg, 60%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.88 – 7.86 (m, 2H), 7.65 – 7.63 (m, 2H), 5.55 (d, *J* = 39.0 Hz, 1H), 4.07 – 4.04 (m, 2H), 3.49 – 3.43 (m, 2H), 3.04 (s, 3H), 2.61 – 2.50 (m, 1H), 1.87 – 1.82 (m, 2H), 1.79 – 1.68 (m, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 165.9 (d, *J* = 273.7 Hz), 139.2 (d, *J* = 2.0 Hz), 138.3 (d, *J* = 3.0 Hz), 129.2 (d, *J* = 8.0 Hz), 127.7, 103.4 (d, *J* = 8.0 Hz), 67.5, 44.7, 39.0 (d, *J* = 25.3 Hz), 29.6 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –101.27. HR-MS (ESI) m/z calc. for $C_{14}H_{17}FNaO_3S^+$ $[M+Na]^+$ : 307.0775, found: 307.0765.




**3n**

**(*Z*)-4-(2-([1,1'-Biphenyl]-4-yl)-1-fluorovinyl)tetrahydro-2*H*-pyran**

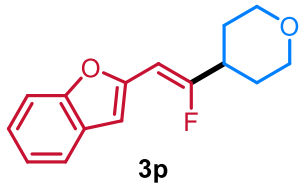
Compound **3n** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3n** (55.0 mg, 65%, *Z*/*E* > 20:1) as light yellow oily liquid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.61 – 7.56 (m, 6H), 7.45 – 7.42 (m, 2H), 7.35 – 7.32 (m, 1H), 5.52 (d, *J* = 40.3 Hz, 1H), 4.07 – 4.05 (m, 2H), 3.48 – 3.44 (m, 2H), 2.58 – 2.50 (m, 1H), 1.86 – 1.84 (m, 2H), 1.78 – 1.71 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.4 (d, *J* = 265.5 Hz), 140.8, 139.7, 132.7, 129.0 (d, *J* = 7.5 Hz), 128.9, 127.4, 127.2, 127.1, 104.2 (d, *J* = 7.5 Hz), 67.6, 38.9 (d, *J* = 25.5 Hz), 29.9 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –106.34. HR-MS (ESI) m/z calc. for $C_{19}H_{19}NaFO^+$ $[M+Na]^+$ : 305.1312, found: 305.1308.




**3o**

**(*Z*)-4-(2-(4'-Chloro-[1,1'-biphenyl]-4-yl)-1-fluorovinyl)tetrahydro-2*H*-pyran**

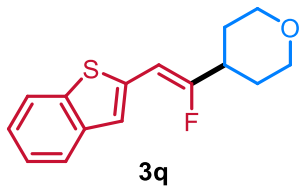
Compound **3o** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3o** (66.4 mg, 70%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.57 – 7.51 (m, 6H), 7.41 – 7.39 (m, 2H), 5.51 (d, J = 40.2 Hz, 1H), 4.08 – 4.05 (m, 2H), 3.50 – 3.34 (m, 2H), 2.58 – 2.49 (m, 1H), 1.87 – 1.84 (m, 2H), 1.80 – 1.70 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 163.6 (d, *J* = 267.3 Hz), 139.3, 138.4, 133.5, 133.1, 129.1, 129.1, 128.3, 127.1, 104.1(d, *J* = 9.0 Hz), 67.6, 39.0 (d, *J* = 27.2 Hz), 29.9 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –105.97. HR-MS (ESI) m/z calc. for $C_{19}H_{19}ClFO^{+}$ $[M+H]^{+}$ : 317.1103, found: 317.1096.




**3p**

**(*Z*)-2-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)benzofuran**

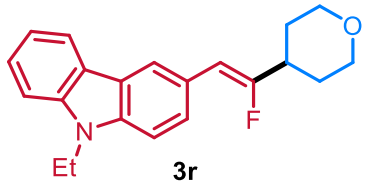
Compound **3p** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3p** (26.6 mg, 36%, *Z*/*E* > 50:1) as white solid.$^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.54 – 7.53 (m, 1H), 7.44 – 7.42 (m, 1H), 7.27 – 7.18 (m, 2H), 6.87 (s, 1H), 5.69 (d, *J* = 38.4 Hz, 1H), 4.08 – 4.04 (m, 2H), 3.50 – 3.43 (m, 2H), 2.63 – 2.52 (m, 1H), 1.88 – 1.84 (m, 2H), 1.78 – 1.68 (m, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 164.5 (d, *J* = 272.7 Hz), 154.0, 150.7 (d, *J* = 2.0 Hz), 129.3, 124.2, 123.0, 120.9, 111.0, 105.5 (d, *J* = 11.1 Hz), 95.9 (d, *J* = 11.1 Hz), 67.5, 38.5 (d, *J* = 25.3 Hz), 29.6 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –97.78. HR-MS (ESI) m/z calc. for $C_{15}H_{16}FO_{2}^{+}$ $[M+H]^{+}$ : 247.1129, found: 247.1122.




**3q**

**(*Z*)-4-(2-(Benzo[b]thiophen-2-yl)-1-fluorovinyl)tetrahydro-2*H*-pyran**

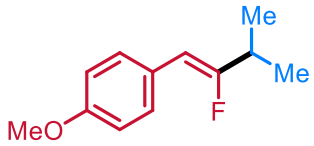
Compound **3q** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 80:1) yielded **3q** (27.5 mg, 35%, *Z*/*E* > 50:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.80 – 7.78 (m, 1H), 7.72 – 7.70 (m, 1H), 7.35 – 7.26 (m, 2H), 7.23 (s, 1H), 5.87 (d, *J* = 38.9 Hz, 1H), 4.09 – 4.04 (m, 2H), 3.50 – 3.43 (m, 2H), 2.63 – 2.52 (m, 1H), 1.88 – 1.84 (m, 2H), 1.79 – 1.69 (m, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 163.5 (d, *J* = 270.7 Hz), 140.1 (d, *J* = 8.0 Hz), 139.4, 136.1 (d, *J* = 4.0 Hz), 124.5, 124.4, 123.3 (d, *J* = 3.0 Hz), 122.7 (d, *J* = 4.0 Hz), 122.2, 99.9 (d, *J* = 12.1 Hz), 67.5, 38.4 (d, *J* = 25.0 Hz), 29.7 (d, *J* = 2.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –101.56. HR-MS (ESI) m/z calc. for $C_{15}H_{16}FOS^{+}$ $[M+H]^{+}$ : 263.0906, found: 263.0910.




**3r**

**(*Z*)-9-Ethyl-3-(2-fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)-9*H*-carbazole**

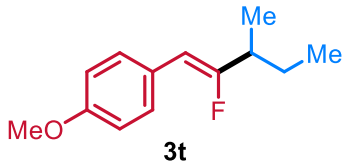
Compound **3r** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 50:1) yielded **3r** (65.9 mg, 68%, *Z*/*E* = 9:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 8.25 (s, 1H), 8.11 – 8.09 (m, 1H), 7.63 – 7.60 (m, 1H), 7.49 – 7.45 (m, 1H), 7.41 – 7.39 (m, 1H), 7.37 – 7.34 (m, 1H), 7.25 – 7.21 (m, 1H), 5.65 (d, *J* = 40.9 Hz, 1H), 4.36 (q, *J* = 7.2 Hz, 2H), 4.10 – 4.06 (m, 2H), 3.52 – 3.46 (m, 2H), 2.61 – 2.51 (m, 1H), 1.91 – 1.87 (m, 2H), 1.84 – 1.74 (m, 2H), 1.43 (t, J = 7.2 Hz, 3H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 161.5 (d, *J* = 264.6 Hz), 140.4, 139.1, 126.7 (d, *J* = 40.9 Hz), 125.9, 124.6, 123.2 (d, *J* = 9.0 Hz), 120.6, 120.5, 119.04, 108.7, 108.5, 105.0 (d, *J* = 9.1 Hz), 67.8, 39.0 (d, *J* = 26.3 Hz), 37.7, 30.1 (d, *J* = 2.0 Hz), 14.0. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –110.55. HR-MS (ESI) m/z calc. for $C_{21}H_{23}FNO^{+}$ $[M+H]^{+}$ : 324.1758, found: 324.1753.




**3s**

**(*Z*)-1-(2-Fluoro-3-methylbut-1-en-1-yl)-4-methoxybenzene**

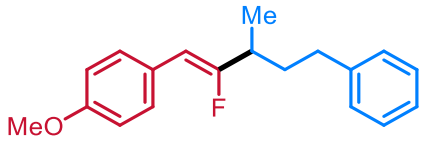
Compound **3s** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3s** (37.8 mg, 65%, *Z*/*E* > 20:1) as colourless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.43 –7.41 (m, 2H), 6.87 – 6.84 (m, 2H), 5.40 (d, *J* = 40.6 Hz, 1H), 3.81 (s, 3H), 2.60 – 2.50 (m, 1H), 1.18 (d, *J* = 6.9 Hz, 6H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 164.6 (d, *J* = 266.6 Hz), 158.3 (d, *J* = 2.0 Hz), 129.7 (d, *J* = 7.5 Hz), 126.8 (d, *J* = 3.0 Hz), 114.0, 102.8 (d, *J* = 9.1 Hz), 55.4, 32.1 (d, *J* = 25.3 Hz), 20.0 (d, *J* = 2.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –109.40. HR-MS (ESI) m/z calc. for $C_{12}H_{15}NaFO^{+}$ $[M+Na]^{+}$ : 217.0999, found: 217.1004. The analytical data corresponds with those reported in the literature. [8]




**3t**

**(*Z*)-1-(2-Fluoro-3-methylpent-1-en-1-yl)-4-methoxybenzene**

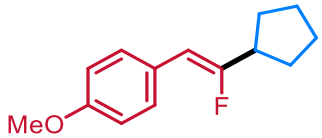
Compound **3t** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3t** (43.1 mg, 69%, *Z*/*E* = 16:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.43 – 7.41 (m, 2H), 6.87 – 6.84 (m, 2H), 5.40 (d, *J* = 40.5 Hz, 1H), 3.81 (s, 3H), 2.35 – 2.21 (m, 1H), 1.68 – 1.57 (m, 1H), 1.50 – 1.39 (m, 1H), 1.16 (d, *J* = 6.9 Hz, 3H), 0.94 (t, *J* = 7.4 Hz, 3H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 163.1 (d, *J* = 267.7 Hz), 158.3 (d, *J* = 3.0 Hz), 129.7 (d, *J* = 8.1 Hz), 126.9, 113.9, 104.3 (d, *J* = 9.1 Hz), 55.4, 39.4 (d, *J* = 25.3 Hz), 26.9, 17.7 (d, *J* = 3.0 Hz), 11.8. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –112.09. HR-MS (ESI) m/z calc. for $C_{13}H_{17}NaFO^{+}$ $[M+Na]^{+}$ : 231.1156, found: 231.1158.




**3u**

**(*Z*)-1-(2-Fluoro-3-methyl-5-phenylpent-1-en-1-yl)-4-methoxybenzene**

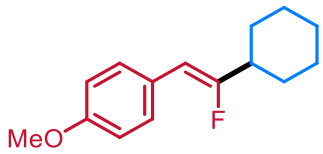
Compound **3u** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3u** (62.2 mg, 73%, *Z*/*E* > 20:1) as light white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.44 – 7.42 (m, 2H), 7.30 – 7.25 (m, 2H), 7.20 – 7.18 (m, 3H), 6.87 – 6.85 (m, 2H), 5.42 (d, *J* = 40.4 Hz, 1H), 3.81 (s, 3H), 2.73 – 2.60 (m, 2H), 2.44 – 2.31 (m, 1H), 1.99 – 1.89 (m, 1H), 1.77 – 1.68 (m, 1H), 1.20 (d, *J* = 6.8 Hz, 3H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.7 (d, *J* = 267.3 Hz), 158.4 (d, *J* = 3.0 Hz), 142.2, 129.7 (d, *J* = 7.5 Hz), 128.5 (d, *J* = 9.0 Hz), 126.7, 126.0, 114.0, 104.8 (d, *J* = 9.0 Hz), 55.4, 37.4 (d, *J* = 25.7 Hz), 35.6, 33.6, 18.2. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –113.27. HR-MS (ESI) m/z calc. for $C_{19}H_{22}FO^{+}$ $[M+H]^{+}$ : 285.1649, found: 285.1651.




**3v**

**(*Z*)-1-(2-Cyclopentyl-2-fluorovinyl)-4-methoxybenzene**

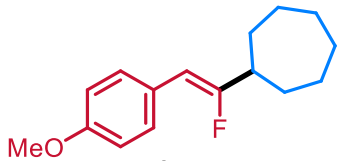
Compound **3v** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3v** (33.7 mg, 51%, *Z*/*E* = 14:1) as colorless liquid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.43 – 7.41 (m, 2H), 6.86 – 6.85 (m, 2H), 5.44 (d, *J* = 40.2 Hz, 1H), 3.81 (s, 3H), 2.73 – 2.67 (m, 1H), 1.90 – 1.87 (m, 2H), 1.75 – 1.58 (m, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.2 (d, *J* = 264.3 Hz), 158.2 (d, *J* = 3.0 Hz), 129.6 (d, *J* = 7.5 Hz), 126.8, 113.9, 103.5 (d, *J* = 9.0 Hz), 55.4, 43.2 (d, *J* = 25.7 Hz), 30.3, 25.6. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –109.70. HR-MS (ESI) m/z calc. for $C_{14}H_{18}FO^{+}$ $[M+H]^{+}$ : 221.1336, found: 221.1325.




**3w**

**(*Z*)-1-(2-Cyclohexyl-2-fluorovinyl)-4-methoxybenzene**

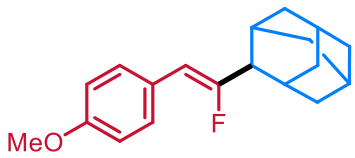
Compound **3w** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3w** (46.3 mg, 66%, *Z*/*E* = 15:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.42 – 7.26 (m, 2H), 6.86 – 6.84 (m, 2H), 5.37 (d, *J* = 41.1 Hz, 1H), 3.80 (s, 3H), 2.25 – 2.16 (m, 1H), 1.95 – 1.94 (m, 2H), 1.81 – 1.77 (m, 2H), 1.70 – 1.69 (m, 1H), 1.38 – 1.26 (m, 5H). $^{13}$C NMR (100 MHz, Chloroform-d) δ164.0 (d, *J* = 266.6 Hz), 158.3 (d, *J* = 3.0 Hz), 135.0, 129.7 (d, *J* = 8.0 Hz), 113.9, 103.0 (d, *J* = 9.1 Hz), 55.4, 41.6 (d, *J* = 25.3 Hz), 30.2 (d, *J* = 2.0 Hz), 26.1, 26.1. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –108.13. HR-MS (ESI) m/z calc. for $C_{15}H_{19}NaFO^{+}$ $[M+Na]^{+}$ : 257.1312, found: 257.1322.




**3x**

**(*Z*)-(1-Fluoro-2-(4-methoxyphenyl)vinyl)cycloheptane**

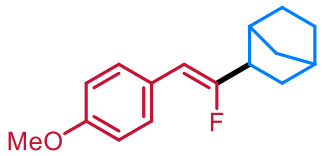
Compound **3x** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3x** (40.1 mg, 54%, *Z*/*E* > 20:1) as l colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.41 – 7.39 (m, 2H), 6.86 – 6.84 (m, 2H), 5.40 (d, *J* = 40.8 Hz, 1H), 3.80 (s, 3H), 2.43 – 2.32 (m, 1H), 1.98 – 1.92 (m, 2H), 1.79 – 1.71 (m, 2H), 1.65 – 1.45 (m, 8H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 164.6 (d, *J* = 267.3 Hz), 158.0 (d, *J* = 3.0 Hz), 129.5 (d, *J* = 7.5 Hz), 126.8, 113.8, 102.7 (d, *J* = 9.0 Hz), 55.3, 43.5 (d, *J* = 22.7 Hz), 31.9, 28.3, 26.4. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –108.28. HR-MS (ESI) m/z calc. for $C_{16}H_{22}FO^{+}$ $[M+H]^{+}$ : 249.1649, found: 249.1649.




**3y**

**(*Z*)-2-(1-Fluoro-2-(4-methoxyphenyl)vinyl)adamantane**

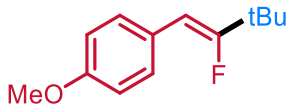
Compound **3y** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3y** (38.6 mg, 45%, *Z*/*E* > 50:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.45 (d, *J* = 8.9 Hz, 2H), 6.86 (d, *J* = 8.8 Hz, 2H), 5.46 (d, *J* = 42.5 Hz, 1H), 3.81 (s, 3H), 2.76 (s, 1H), 2.22 (s, 2H), 2.04 (d, *J* = 12.7 Hz, 2H), 1.93 (d, *J* = 12.6 Hz, 3H), 1.87 – 1.79 (m, 3H), 1.76 (s, 2H), 1.60 (d, J = 13.3 Hz, 2H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 162.0 (d, *J* = 266.6 Hz), 158.3 (d, *J* = 3.0 Hz), 129.7 (d, *J* = 8.0 Hz), 114.0, 105.1 (d, *J* = 10.0 Hz), 55.4, 47.0 (d, *J* = 23.2 Hz), 38.6, 37.9, 32.5, 29.4 (d, *J* = 5.0 Hz), 27.9. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –108.12. HR-MS (ESI) m/z calc. for $C_{19}H_{24}FO^{+}$ $[M+H]^{+}$ : 287.1806, found: 287.1816.




**3z**

**(*Z*)-2-(1-Fluoro-2-(4-methoxyphenyl)vinyl)bicyclo[2.2.1]heptane**

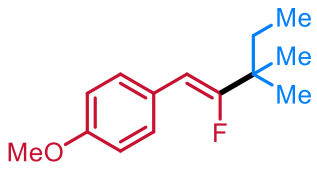
Compound **3z** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3z** (45.0 mg, 61%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.42 – 7.40 (m, 2H), 6.86 – 6.84 (m, 2H), 5.40 (d, *J* = 40.4 Hz, 1H), 3.80 (s, 3H), 2.40 – 2.29 (m, 2H), 1.62 – 1.50 (m, 1H), 1.57 – 1.52 (m, 4H), 1.30 – 1.17 (m, 4H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 163.0 (d, *J* = 264.6 Hz), 158.3, 129.6 (d, *J* = 7.0 Hz), 113.9, 103.5, 55.4, 45.2 (d, *J* = 25.3 Hz), 40.9 (d, *J* = 2.0 Hz), 36.5 (d, *J* = 2.0 Hz), 36.4, 35.3 (d, *J* = 3.0 Hz), 30.1, 28.8. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –106.36. HR-MS (ESI) m/z calc. for $C_{16}H_{20}FO^{+}$ $[M+H]^{+}$ : 247.1498, found: 247.1502.




**3aa**

**(*Z*)-1-(2-Fluoro-3,3-dimethylbut-1-en-1-yl)-4-methoxybenzene**

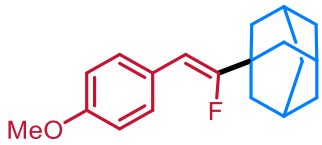
Compound **3aa** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3aa** (53.7 mg, 86%, *Z*/*E* > 50:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.45 – 7.44 (m, 2H), 6.87 – 6.85 (m, 2H), 5.47 (d, J = 41.1 Hz, 1H), 3.81 (s, 3H), 1.22 (s, 9H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 166.8 (d, *J* = 267.3 Hz), 158.2 (d, *J* = 3.0 Hz), 129.7 (d, *J* = 7.5 Hz), 126.8, 113.9, 101.7 (d, *J* = 10.5 Hz), 55.4, 35.5 (d, *J* = 24.2 Hz), 27.6 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –112.36. HR-MS (ESI) m/z calc. for $C_{13}H_{17}NaFO^{+}$ $[M+Na]^{+}$ : 231.1156, found: 231.1149.




**3ab**

**(*Z*)-1-(2-Fluoro-3,3-dimethylpent-1-en-1-yl)-4-methoxybenzene**

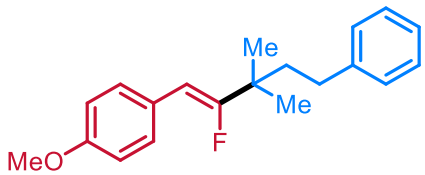
Compound **3ab** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3ab** (45.3 mg, 68%, *Z*/*E* > 30:1) as colorless liquid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.43 (d, *J* = 8.4 Hz, 2H), 6.85 (d, *J* = 8.4 Hz, 2H), 5.43 (d, *J* = 41.4 Hz, 1H), 3.80 (s, 3H), 1.54 – 1.51 (m, 2H), 1.15 (s, 6H), 0.87 – 0.86 (m, 3H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 165.6 (d, *J* = 267.3 Hz), 158.3 (d, *J* = 3.0 Hz), 129.8 (d, *J* = 7.5 Hz), 127.0, 113.9, 103.5 (d, *J* = 9.0 Hz), 55.4, 39.0 (d, *J* = 22.7 Hz), 32.5, 25.3 (d, *J* = 4.5 Hz), 9.2. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –112.80. HR-MS (ESI) m/z calc. for $C_{14}H_{19}NaFO^{+}$ $[M+Na]^{+}$ : 245.1312, found: 245.1310.




**3ac**

**(*Z*)-1-(1-Fluoro-2-(4-methoxyphenyl)vinyl)adamantane**

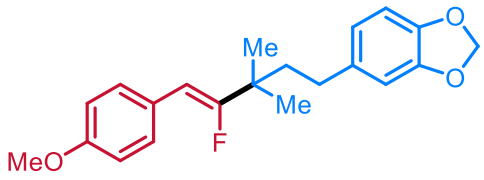
Compound **3ac** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3ac** (42.9 mg, 50%, *Z*/*E* > 50:1) as white solid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.42 (d, *J* = 8.3 Hz, 2H), 6.85 (d, *J* = 8.3 Hz, 2H), 5.35 (d, *J* = 41.7 Hz, 1H), 3.80 (s, 3H), 2.06 – 2.03 (s, 3H), 1.85 – 1.82 (m, 6H), 1.76 – 1.70 (m, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 167.1 (d, *J* = 265.8 Hz), 158.3 (d, *J* = 3.0 Hz), 129.8 (d, *J* = 7.5 Hz), 127.0, 113.9, 101.8 (d, *J* = 10.6 Hz), 55.4, 39.4 (d, *J* = 1.5 Hz), 36.8, 28.2. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –117.08. HR-MS (ESI) m/z calc. for $C_{19}H_{24}FO^{+}$ $[M+H]^{+}$ : 287.1806, found: 287.1796.




**3ad**

**(*Z*)-1-(2-Fluoro-3,3-dimethyl-5-phenylpent-1-en-1-yl)-4-methoxybenzene**

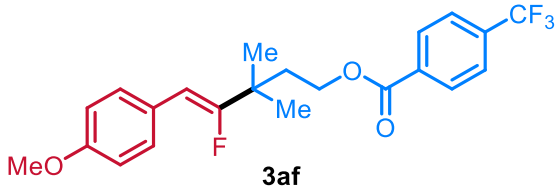
Compound **3ad** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3ad** (60.8 mg, 68%, *Z*/*E* > 50:1) as colorless liquid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.46 – 7.44 (m, 2H), 7.27 – 7.25 (m, 2H), 7.18 – 7.15 (m, 3H), 6.87 – 6.86 (m, 2H), 5.54 (d, *J* = 41.2 Hz, 1H), 3.80 (s, 3H), 2.59 – 2.56 (m, 2H), 1.82 – 1.79 (m, 2H), 1.24 (s, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 165.1 (d, *J* = 267.3 Hz), 158.4, 158.4, 142.8, 129.9 (d, *J* = 7.5 Hz), 128.5, 126.8, 125.8, 114.0, 103.8 (d, *J* = 9.0 Hz), 55.4, 42.2, 38.9 (d, *J* = 22.7 Hz), 31.5, 25.9 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –112.94. HR-MS (ESI) m/z calc. for $C_{20}H_{24}FO^{+}$ $[M+H]^{+}$ : 299.1806, found: 299.1816.




**3ae**

**(*Z*)-5-(4-Fluoro-5-(4-methoxyphenyl)-3,3-dimethylpent-4-en-1-yl)benzo [d][1,3]dioxole**

Compound **3ae** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 100:1) yielded **3ae** (74.9 mg, 73%, *Z*/*E* > 50:1) as colorless liquid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.47 – 7.45 (m, 2H), 6.98 – 6.87 (m, 2H), 6.73 – 6.68 (m, 2H), 6.6 – 6.62 (m, 1H), 5.91 (s, 2H), 5.51 (d, *J* = 41.4 Hz, 1H), 3.82 (s, 3H), 2.54 – 2.49 (m, 2H), 1.79 – 1.75 (m, 2H), 1.25 (s, 6H). 13C NMR (100 MHz, Chloroform-*d*) δ 164.9 (d, *J* = 267.7 Hz), 158.3 (d, *J* = 3.0 Hz), 147.5, 145.5, 136.5, 129.7 (d, *J* = 8.0 Hz), 121.0, 113.8 (d, *J* = 2.0 Hz), 108.9, 108.1, 103.7 (d, *J* = 10.0 Hz), 100.7, 55.3, 42.3, 38.7 (d, *J* = 23.2 Hz), 31.1, 25.7 (d, *J* = 3.0 Hz). $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –112.96. HR-MS (ESI) m/z calc. for $C_{21}H_{24}FO_3^+$ $[M+H]^+$ : 343.1704, found: 3431704.

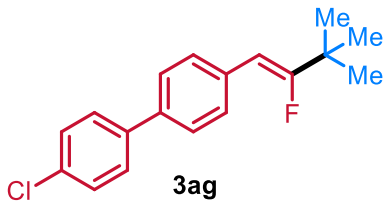



**3af**

**(*Z*)-4-Fluoro-5-(4-methoxyphenyl)-3,3-dimethylpent-4-en-1-yl 4-(trifluoromethyl) benzoate**

Compound **3af** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 100:1) yielded **3af** (86.1 mg, 70%, Z/E > 50:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 8.04 (d, *J* = 8.1 Hz, 2H), 7.53 (d, *J* = 8.2 Hz, 2H), 7.35 (d, *J* = 8.8 Hz, 2H), 6.80 (d, *J* = 8.8 Hz, 2H), 5.50 (d, *J* = 41.3 Hz, 1H), 4.44 (t, *J* = 6.6 Hz, 2H), 3.79 (s, 3H), 2.04 (t, *J* = 6.6 Hz, 2H), 1.30 (s, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 165.5, 164.4 (d, *J* = 267.3 Hz), 158.5, 133.4, 134.3 (q, *J* = 33.2 Hz), 130.1, 129.9 (d, *J* = 7.5 Hz), 126.4, 125.3 (d, *J* = 3.0 Hz), 123.8 (q, *J* = 273.3 Hz), 113.9, 103.8 (d, *J* = 9.1 Hz), 62.6, 55.3, 38.1, 37.6 (d, *J* = 27.2 Hz), 26.2.

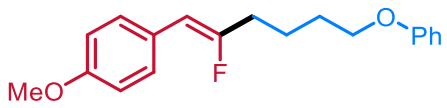
$^{19}$F NMR (375 MHz, Chloroform-*d*) δ –63.15, –112.60. HR-MS (ESI) m/z calc. for $C_{22}H_{23}F_4O_3^+$ $[M+H]^+$ : 411.1583, found: 411.1578.




**3ag**

**(*Z*)-4-Chloro-4'-(2-fluoro-3,3-dimethylbut-1-en-1-yl)-1,1'-biphenyl**

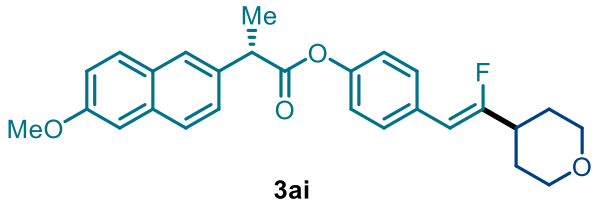
Compound **3ag** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3ag** (69.1 mg, 80%, *Z*/*E* > 50:1) as white solid. $^1$H NMR (400 MHz, Chloroform-*d*) δ 7.59 – 7.51 (m, 6H), 7.42 – 7.40 (m, 2H), 5.58 (d, *J* = 40.6 Hz, 1H), 1.26 (s, 9H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 168.6 (d, *J* = 270.3 Hz), 139.4, 138.1 (d, *J* = 3.0 Hz), 133.7, 133.4, 129.1 (d, *J* = 7.5 Hz), 129.0, 128.3, 127.0, 102.0 (d, *J* = 9.0 Hz), 35.7 (d, *J* = 24.2 Hz), 27.6. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –108.46. HR-MS (ESI) m/z calc. for $C_{18}H_{19}ClF^+$ $[M+H]^+$ : 289.1159, found: 289.1154.




**3ah**

**(*Z*)-1-(2-fluoro-6-phenoxyhex-1-en-1-yl)-4-methoxybenzene**

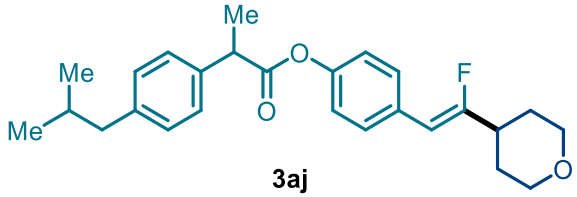
Compound **3ah** was prepared following the general procedure, purification by column chromatography on silica gel (PE) yielded **3ah** (30.6 mg, 34%, *Z*/*E* > 20:1) as white solid. $^1$H NMR (600 MHz, Chloroform-*d*) δ 7.41 – 7.40 (m, 2H), 7.29 – 7.27 (m, 2H), 6.95 – 6.93 (m, 1H), 6.91 – 6.90 (m, 2H), 6.86 – 6.85 (m, 2H), 5.43 (d, *J* = 39.8 Hz, 1H), 4.00 (t, *J* = 6.2 Hz, 2H), 3.81 (s, 3H), 2.42 – 2.37 (m, 2H), 1.89 – 1.86 (m, 2H), 1.81 – 1.78 (m, 2H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 159.4 (d, *J* = 280.9 Hz), 159.1, 129.7, 129.6, 126.7, 120.8, 114.6, 114.0, 105.6 (d, *J* = 9.0 Hz), 67.5, 55.4, 32.9 (d, *J* = 27.2 Hz), 28.7, 23.2. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –104.21. HR-MS (ESI) m/z calc. for $C_{19}H_{22}FO_2^+$ $[M+H]^+$ : 301.1598, found: 301.1589.




**3ai**
from Naproxen

**(*Z*)-4-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenyl (*S*)-2-(6-methoxy-naphthalen-2-yl)propanoate**

Compound **3ai** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30 :1) yielded **3ai** (87.2 mg, 67%, *Z*/*E* = 16:1) as white solid. $^{1}$H NMR (600 MHz, Chloroform-*d*) δ 7.77 – 7.73 (m, 3H), 7.51 – 7.49 (m, 1H), 7.44 – 7.43 (m, 2H), 7.18 – 7.14 (m, 2H), 6.95 – 6.94 (m, 2H), 5.42 (d, *J* = 39.9 Hz, 1H), 4.11 – 4.07 (m, 1H), 4.05 – 4.02 (m, 2H), 3.93 (s, 3H), 3.46 – 3.42 (m, 2H), 2.51 – 2.45 (m, 1H), 1.82 – 1.79 (m, 2H), 1.74 – 1.67 (m, 5H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 173.3, 163.2 (d, *J* = 267.3 Hz), 157.9, 149.6 (d, *J* = 3.0 Hz), 135.3, 134.0, 131.4, 129.5 (d, *J* = 7.5 Hz), 129.1, 127.5, 126.3 (d, *J* = 4.5 Hz), 121.5, 119.3, 105.7, 103.7 (d, *J* = 7.5 Hz), 67.6, 55.5, 45.7, 38.8 (d, *J* = 25.7 Hz), 29.8 (d, *J* = 3.0 Hz), 18.7. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –107.28. HR-MS (ESI) m/z calc. for $C_{27}H_{28}FO_4^+$ $[M+H]^+$ : 435.1966, found: 435.1955.

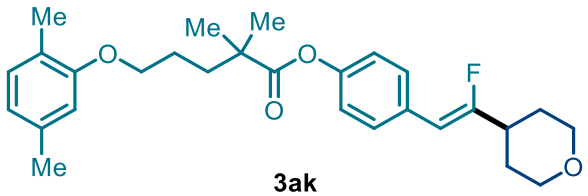



**3aj**
from Ibuprofen

**(*Z*)-4-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenyl 2-(4-isobutylphenyl)propanoate**

Compound **3aj** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3aj** (73.8 mg, 60%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.45 – 7.43 (m, 2H), 7.31 – 7.29 (m, 2H), 7.15 – 7.13 (m, 2H), 6.96 – 6.94 (m, 2H), 5.43 (d, *J* = 40.0 Hz, 1H), 4.06 – 4.03 (m, 2H), 3.95 – 3.90 (m, 1H), 3.48 – 3.41 (t, *J* = 11.7 Hz, 2H), 2.48 – 2.46 (m, 3H),

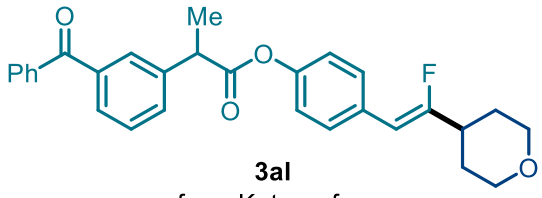
1.90– 1.80 (m, 3H), 1.76 – 1.65 (m, 2H), 1.61 – 1.59 (m, 3H), 0.91 (d, $J$ = 6.6 Hz, 6H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 173.3, 163.1 (d, $J$ = 267.7 Hz), 149.7 (d, $J$ = 3.0 Hz), 141.0, 137.4, 131.3 (d, $J$ = 2.0 Hz), 129.7, 129.5 (d, $J$ = 8.0 Hz), 127.4, 121.5, 103.8 (d, $J$ = 8.0 Hz), 67.6, 45.4, 45.2, 38.9 (d, $J$ = 25.3 Hz), 30.3, 29.8 (d, $J$ = 3.0 Hz), 22.5, 18.7. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –107.33. HR-MS (ESI) m/z calc. for $C_{26}H_{32}FO_3^+$ $[M+H]^+$ : 411.2330, found: 411.2333.




**3ak**
from Gemfibrozil

**(*Z*)-4-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenyl 5-(2,5-dimethyl-phenoxy)-2,2-dimethylpentanoate**

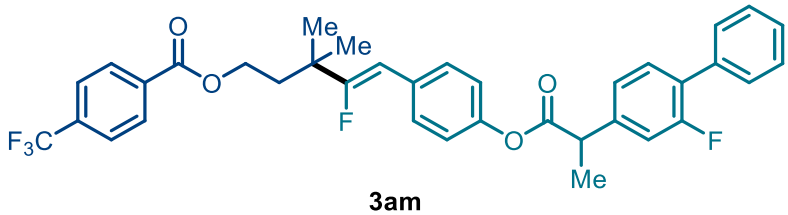
Compound **3ak** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3ak** (70.8 mg, 52%, *Z*/*E* > 20:1) as white solid. $^1$H NMR (600 MHz, Chloroform-*d*) δ 7.47 – 7.46 (m, 2H), 7.01 – 6.97 (m, 3H), 6.67 – 6.66 (m, 1H), 6.62 (s, 1H), 5.45 (d, $J$ = 40.0 Hz, 1H), 4.06 – 4.04 (m, 2H), 3.99 – 3.97 (m, 2H), 3.47 – 3.43 (m, 2H), 2.53 – 2.46 (m, 1H), 2.30 (s, 3H), 2.17 (s, 3H), 1.88 – 1.82 (m, 6H), 1.76 – 1.69 (m, 2H), 1.36 (s, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 176.5, 163.1 (d, $J$ = 267.3 Hz), 157.0, 149.8, 136.7, 131.3, 130.5, 129.6 (d, $J$ = 6.0 Hz), 123.8, 121.6, 120.9, 112.1, 103.8 (J = 7.5 Hz), 67.9, 67.6, 42.6, 38.9 (d, $J$ = 25.7 Hz), 37.3, 29.9, 25.4, 25.3, 21.6, 16.0. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –107.35. HR-MS (ESI) m/z calc. for $C_{28}H_{36}FO_4^+$ $[M+H]^+$ : 455.2592, found: 455.2599.



**3al**
from Ketoprofen

**(*Z*)-4-(2-Fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenyl 2-(3-benzoylphenyl)propanoate**

Compound **3al** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3al** (90.7 mg, 66%, *Z*/*E* > 20:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.85 – 7.81 (m, 3H), 7.74 – 7.72 (m, 1H), 7.65 – 7.58 (m, 2H), 7.52 – 7.41 (m, 5H), 6.98 – 6.95 (m, 2H), 5.44 (d, *J* = 40.0 Hz, 1H), 4.05 – 4.03 (m, 3H), 3.47 – 3.42 (m, 2H), 2.55 – 2.44 (m, 1H), 1.84 – 1.80 (m, 2H), 1.76 – 1.64 (m, 5H). $^{13}$C NMR (100 MHz, Chloroform-*d*) δ 196.6, 172.7, 163.3 (d, *J* = 268.7 Hz), 149.4 (d, *J* = 4.0 Hz), 140.5, 138.3, 137.6, 132.7, 131.7, 131.5 (d, *J* = 3.0 Hz), 130.2, 129.6 (d, *J* = 8.0 Hz), 129.4 (d, *J* = 5.1 Hz), 128.9, 128.5, 121.4, 103.7 (d, *J* = 9.0 Hz), 67.6, 45.7, 38.8 (d, *J* = 26.0 Hz), 29.8 (d, *J* = 3.0 Hz), 18.7. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –107.12. HR-MS (ESI) m/z calc. for $C_{29}H_{27}NaFO_4^+$ $[M+Na]^+$ : 481.1786, found: 481.1774.

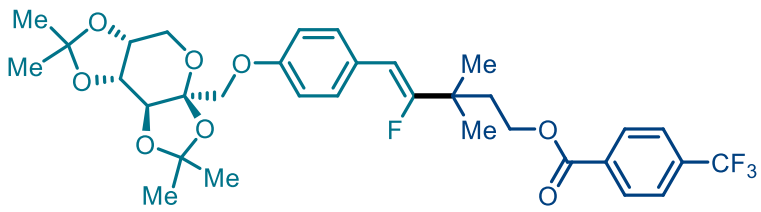


**3am**
from Flurbiprofen

**(*Z*)-4-Fluoro-5-(4-((2-(2-fluoro-[1,1'-biphenyl]-4-yl)propanoyl)oxy)phenyl)-3,3-dimethylpent-4-en-1-yl 4-(trifluoromethyl)benzoate**

Compound **3am** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3am** (89.6 mg, 48%, *Z*/*E* > 30:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 8.02 – 8.00 (m, 2H), 7.58 – 7.53 (m, 4H), 7.47 – 7.43 (m, 3H), 7.39 – 7.35 (m, 3H), 7.27 – 7.21 (m, 2H), 6.94 – 6.91 (m, 2H), 5.53 (d, *J* = 40.6 Hz, 1H), 4.43 (t, *J* = 6.5 Hz, 2H), 3.99 (q, *J* = 7.1 Hz, 1H), 2.04

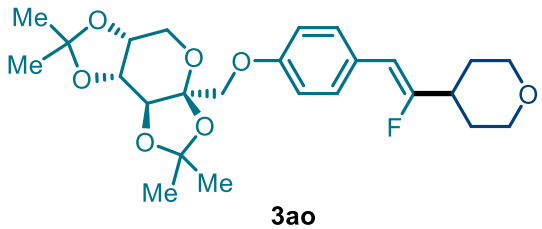
(t, *J* = 6.5 Hz, 2H), 1.66 (d, *J* = 7.2 Hz, 3H), 1.30 (s, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 172.5, 165.8 (d, *J* = 270.3 Hz), 165.5, 160.8, 159.1, 149.4, 141.4 (d, *J* = 7.5 Hz), 135.6, 134.4 (q, *J* = 33.2 Hz), 133.3, 131.5, 131.1 (d, *J* = 4.5 Hz), 130.0, 129.6 (d, *J* = 7.5 Hz), 129.1 (d, *J* = 3.0 Hz), 128.6, 127.9, 125.4 (q, *J* = 4.5 Hz), 123.8 (q, *J* = 273.3 Hz), 123.7 (d, *J* = 3.0 Hz), 121.3, 115.5 (d, *J* = 22.7 Hz), 103.6 (d, *J* = 9.0 Hz), 62.4, 45.3, 38.1, 37.7 (d, *J* = 24.2 Hz), 26.1, 18.5. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –63.10, –109.85, –117.40. HR-MS (ESI) m/z calc. for $C_{36}H_{32}F_5O_4^+$ $[M+H]^+$ : 623.2221, found: 623.2231.




**3an**
from Diacetonefructose

**(*Z*)-4-fluoro-3,3-dimethyl-5-(4-(((3a*S*,5a*R*,8a*R*,8b*S*)-2,2,7,7-tetramethyltetrahydro-3a*H*-bis([1,3]dioxolo)[4,5-b:4',5'-d]pyran-3a-yl)methoxy)phenyl)pent-4-en-1-yl 4-(trifluoromethyl)benzoate**

Compound **3an** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3an** (78.5 mg, 41%, *Z*/*E* > 30:1) as white solid. $^1$H NMR (400 MHz, Chloroform-*d*) δ 8.06 – 8.04 (m, 2H), 7.57 – 7.55 (m, 2H), 7.36 – 7.34 (m, 2H), 6.84 – 6.82 (m, 2H), 5.49 (d, *J* = 41.3 Hz, 1H), 4.66 – 4.63 (m, 1H), 4.55 – 4.54 (m, 1H), 4.42 (t, *J* = 6.7 Hz, 2H), 4.28 – 4.26 (m, 1H), 4.16 – 4.13 (m, 1H), 4.04 – 4.02 (m, 1H), 4.00 – 3.96 (m, 1H), 3.81 – 3.78 (m, 1H), 2.03 (t, *J* = 6.7 Hz, 2H), 1.57 (s, 3H), 1.49 – 1.48 (m, 6H), 1.35 (s, 3H), 1.29 (s, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 165.5, 164.4 (d, *J* = 267.3 Hz), 157.5, 134.4 (q, *J* = 31.7 Hz), 133.5, 130.1, 129.9 (d, *J* = 7.5 Hz), 126.9, 125.4 (d, *J* = 3.0 Hz), 123.8 (q, *J* = 271.8 Hz), 114.7, 109.1 (d, *J* = 13.6 Hz), 103.8 (d, *J* = 10.5 Hz), 102.4, 71.1, 70.4, 70.2, 68.9, 62.6, 61.4, 38.2, 37.6 (d, *J* = 24.2 Hz), 29.9, 26.8, 26.1 (d, *J* = 19.6 Hz), 25.5, 24.2. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –63.10, –112.44. HR-MS (ESI) m/z calc. for $C_{33}H_{39}F_4O_8^+$ $[M+H]^+$ : 639.2581, found: 639.2584.

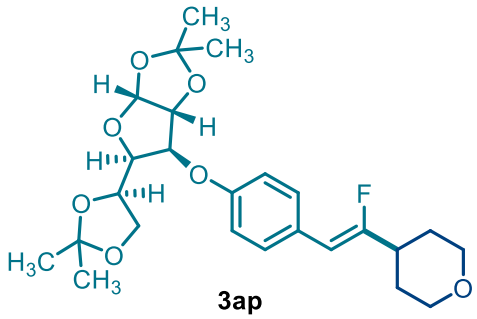


**3ao**

from Diacetonefructose

**(3a*S*,5a*R*,8a*R*,8b*S*)-3a-((4-((*Z*)-2-fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenoxy)methyl)-2,2,7,7-tetramethyltetrahydro-5*H*-bis([1,3]dioxolo)[4,5-b:4',5'-d]pyran**

Compound **3ao** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3ao** (58.5 mg, 42%, *Z/E* = 17:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-d) δ 7.41 – 7.39 (m, 2H), 6.89 – 6.87 (d, J = 8.7 Hz, 2H), 5.39 (d, J = 40.7 Hz, 1H), 4.65 – 4.63 (m, 1H), 4.55 – 4.53 (m, 1H), 4.28 – 4.26 (m, 1H), 4.17 – 4.14 (m, 1H), 4.05 – 4.02 (m, 3H), 3.99 – 3.95 (m, 1H), 3.81 – 3.77 (m, 1H), 3.48 – 3.41 (m, 2H), 2.53 – 2.43 (m, 1H), 1.83 – 1.80 (m, 2H), 1.76 – 1.67 (m, 2H), 1.57 (s, 3H), 1.48 (s, 6H), 1.34 (s, 3H). $^{13}$C NMR (100 MHz, Chloroform-d) δ 162.0 (d, *J* = 265.6 Hz), 157.5 (d, *J* = 3.0 Hz), 129.8 (d, *J* = 8.0 Hz), 126.8 (d, *J* = 3.0 Hz), 114.7, 109.1 (d, *J* = 8.0 Hz), 103.8 (d, *J* = 9.0 Hz), 102.3, 71.1, 70.3, 70.1, 68.9, 67.6, 61.3, 38.8 (d, *J* = 26.0 Hz), 29.9 (d, *J* = 3.0 Hz), 26.7, 26.1, 25.5, 24.1. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –109.59. HR-MS (ESI) m/z calc. for $C_{25}H_{34}FO_7^+$ $[M+H]^+$ : 465.2283, found: 465.2288.



**3ap**

from Diacetone-*D*-glucose

**(3a*R*,5*R*,6*S*,6a*R*)-5-((*R*)-2,2-dimethyl-1,3-dioxolan-4-yl)-6-(4-((*Z*)-2-fluoro-2-(tetrahydro-2*H*-pyran-4-yl)vinyl)phenoxy)-2,2-dimethyltetrahydrofuro[2,3-d][1,3]dioxole**

Compound **3ap** was prepared following the general procedure, purification by column chromatography on silica gel (PE/EA = 30:1) yielded **3ap** (69.6 mg, 50%, *Z/E* = 18:1) as white solid. $^{1}$H NMR (400 MHz, Chloroform-*d*) δ 7.44 – 7.42 (m, 2H), 6.95 – 6.92 (m, 2H), 5.93 – 5.92 (m, 1H), 5.41 (d, *J* = 40.4 Hz, 1H), 4.73 – 4.72 (m, 1H), 4.59 – 4.58 (m, 1H), 4.49 – 4.46 (m, 1H), 4.33 – 4.31 (m, 1H), 4.17 – 4.09 (m, 2H), 4.06 – 4.03 (m, 2H), 3.48 – 3.42 (m, 2H), 2.54 – 2.45 (m, 1H), 1.84 – 1.81 (m, 2H), 1.76 – 1.66 (m, 2H), 1.55 (s, 3H), 1.44 (s, 3H), 1.31 (d, *J* = 7.7 Hz, 6H). $^{13}$C NMR (150 MHz, Chloroform-*d*) δ 162.3 (d, *J* = 264.3 Hz), 155.8 (d, *J* = 1.5 Hz), 130.0 (d, *J* = 7.5 Hz), 127.5, 115.6, 112.2, 109.3, 105.4, 103.7 (d, *J* = 9.0 Hz), 82.3, 80.6, 80.0, 72.4, 67.6, 67.2, 38.8 (d, *J* = 25.6 Hz), 29.9 (d, *J* = 1.5 Hz), 27.0, 26.9, 26.4, 25.4. $^{19}$F NMR (375 MHz, Chloroform-*d*) δ –109.09. HR-MS (ESI) m/z calc. for $C_{25}H_{34}FO_7^+$ $[M+H]^+$ : 465.2283, found: 465.2292.

## Reference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4 A. S. Dudnik, G. C. Fu, *J. Am. Chem. Soc*., 2012, **134**, 10693–10697.

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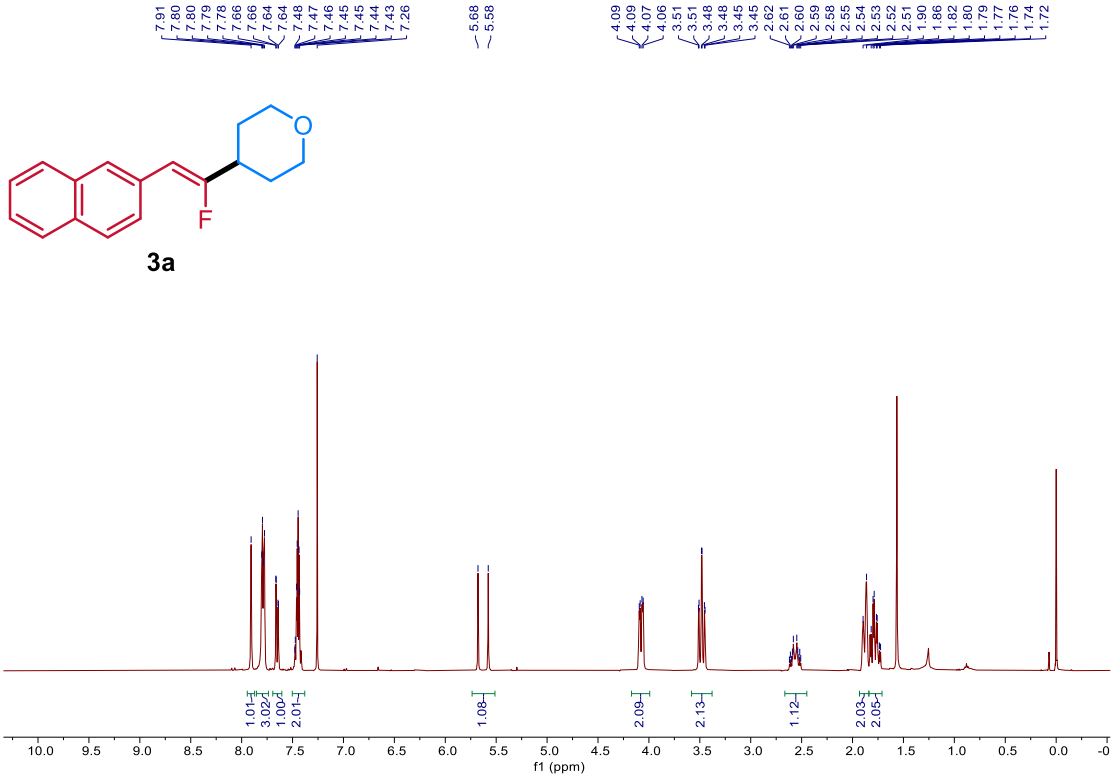
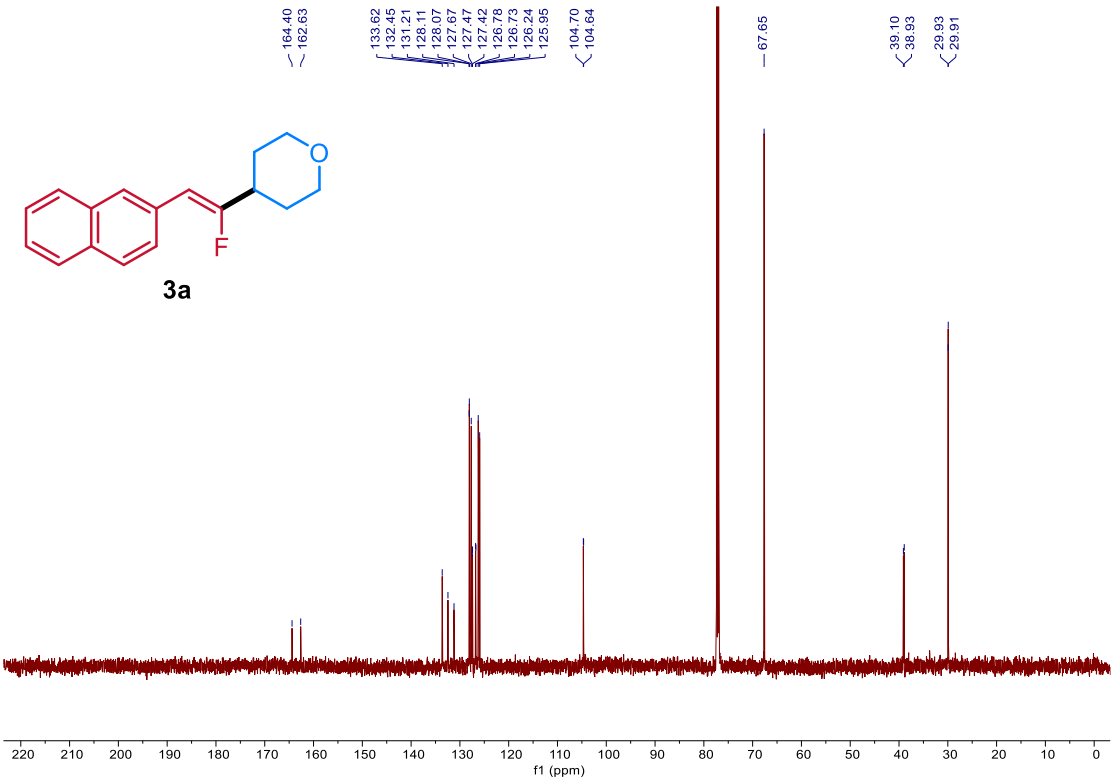
## NMR Spectra

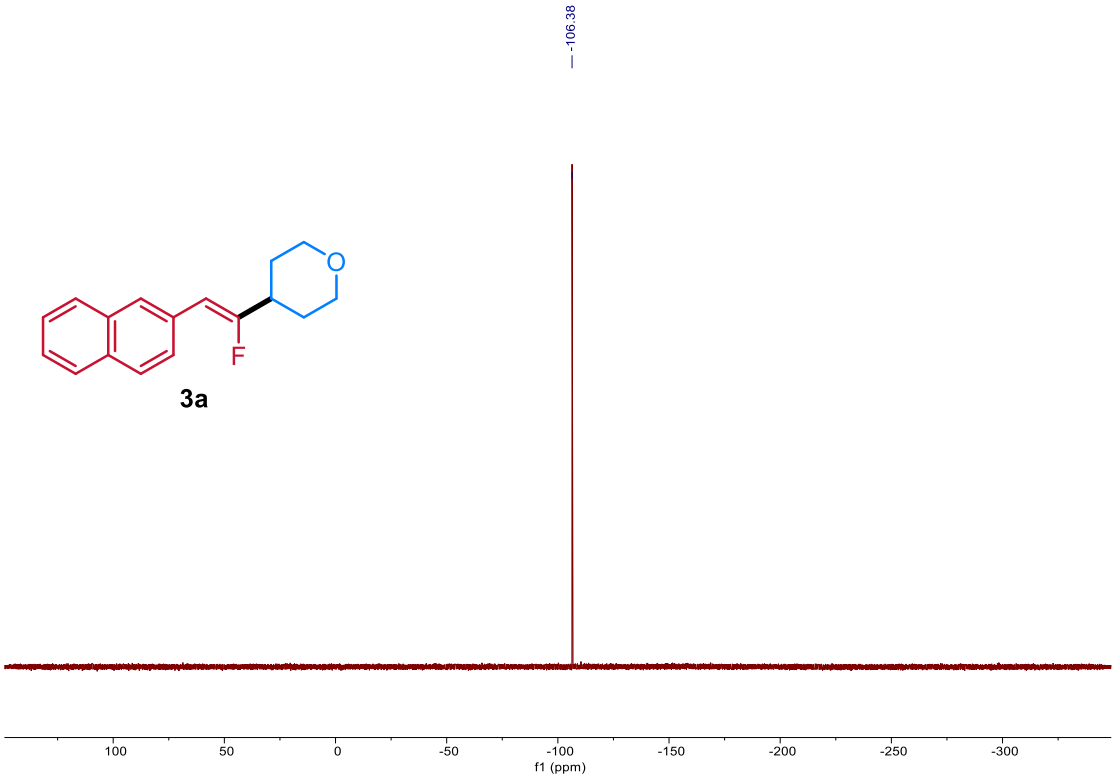
### $^{1}$H NMR of Compound 3a (400 MHz, Chloroform-*d*):



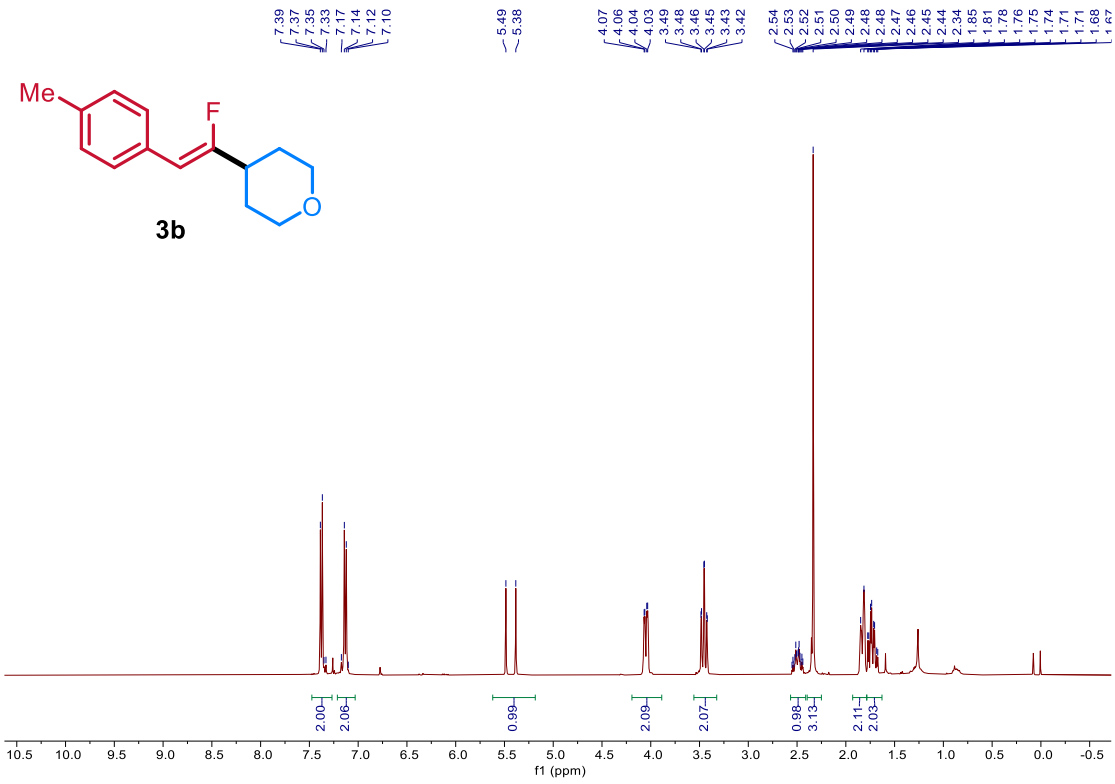

### $^{13}$C NMR of Compound 3a (150 MHz, Chloroform-*d*):



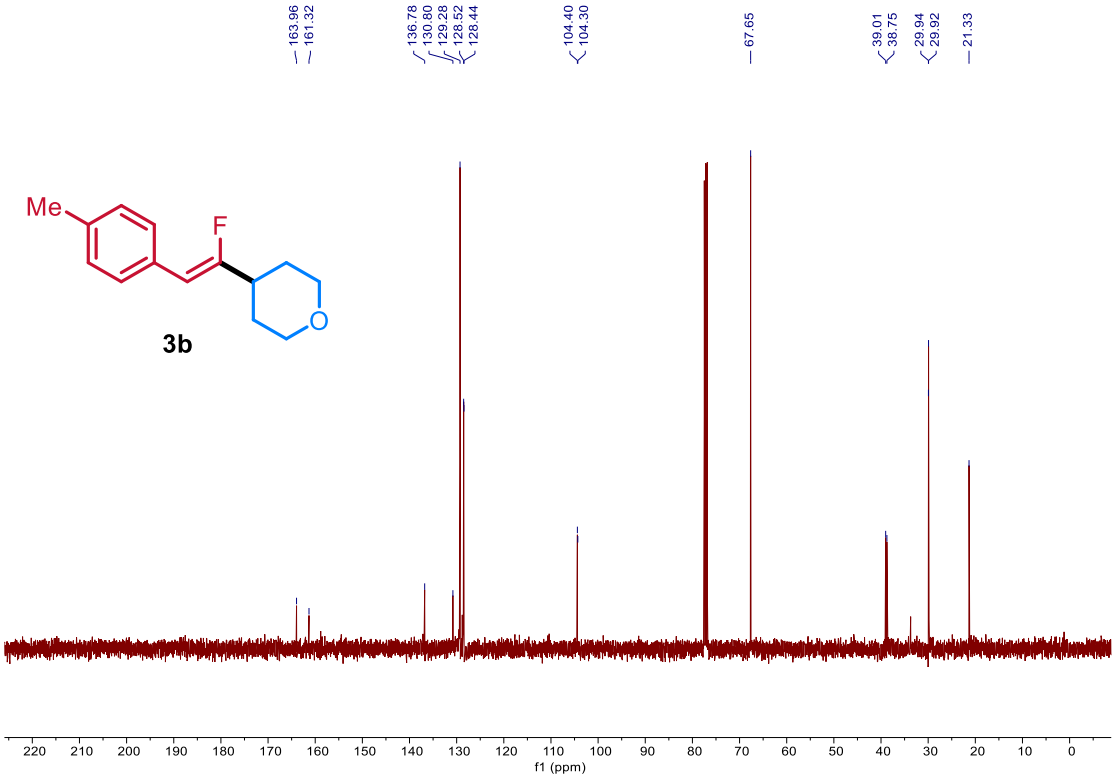
**$^{19}$F NMR of 3a (375 MHz, Chloroform-*d*):**



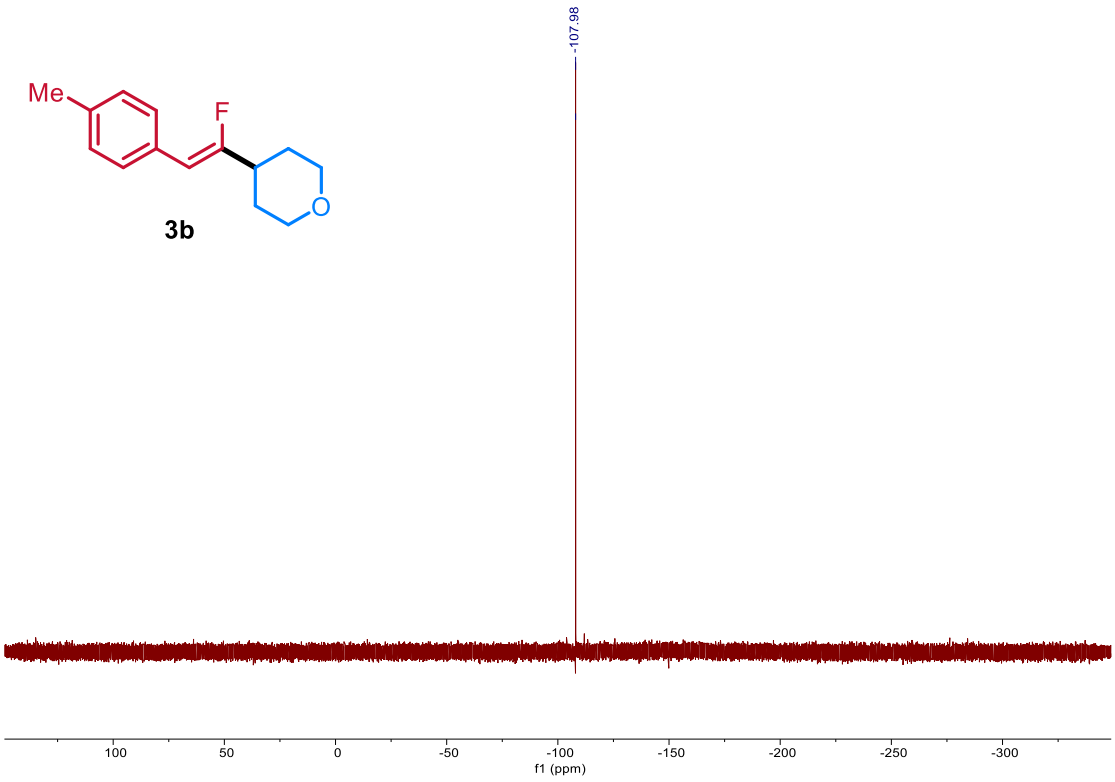

**$^{1}$H NMR of Compound 3b (400 MHz, Chloroform-*d*):**



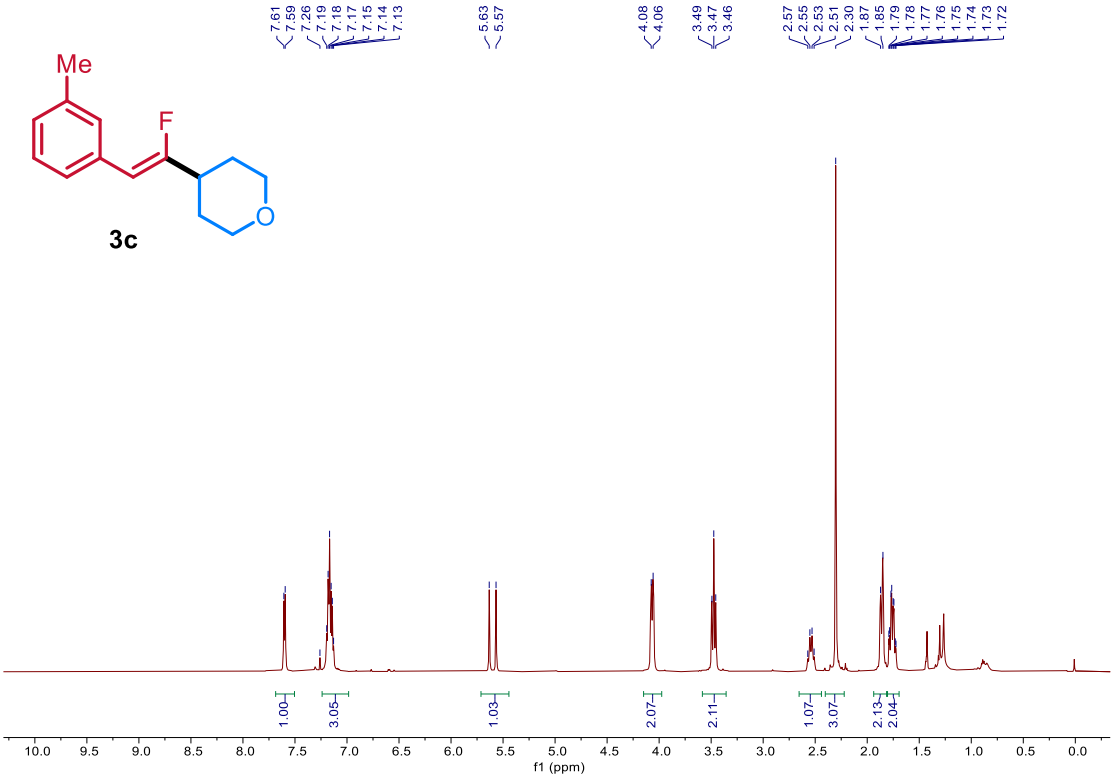
**$^{13}$C NMR of Compound 3b (100 MHz, Chloroform-*d*):**



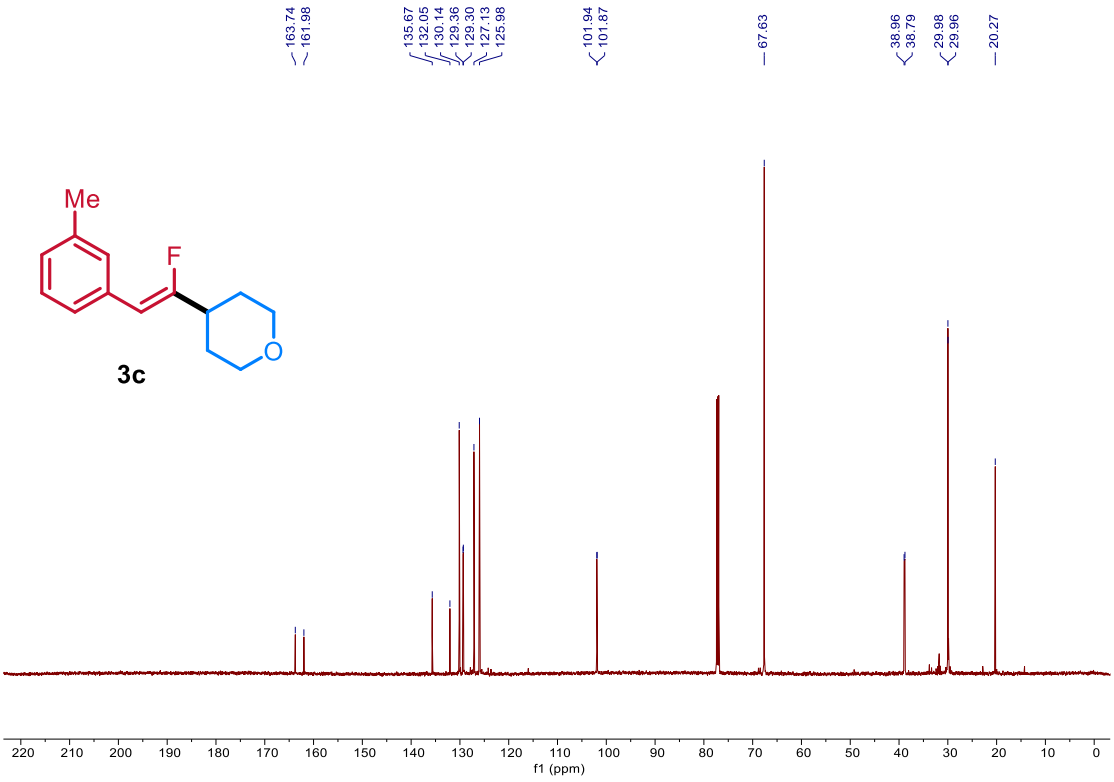

**$^{19}$F NMR of 3b (375 MHz, Chloroform-*d*):**



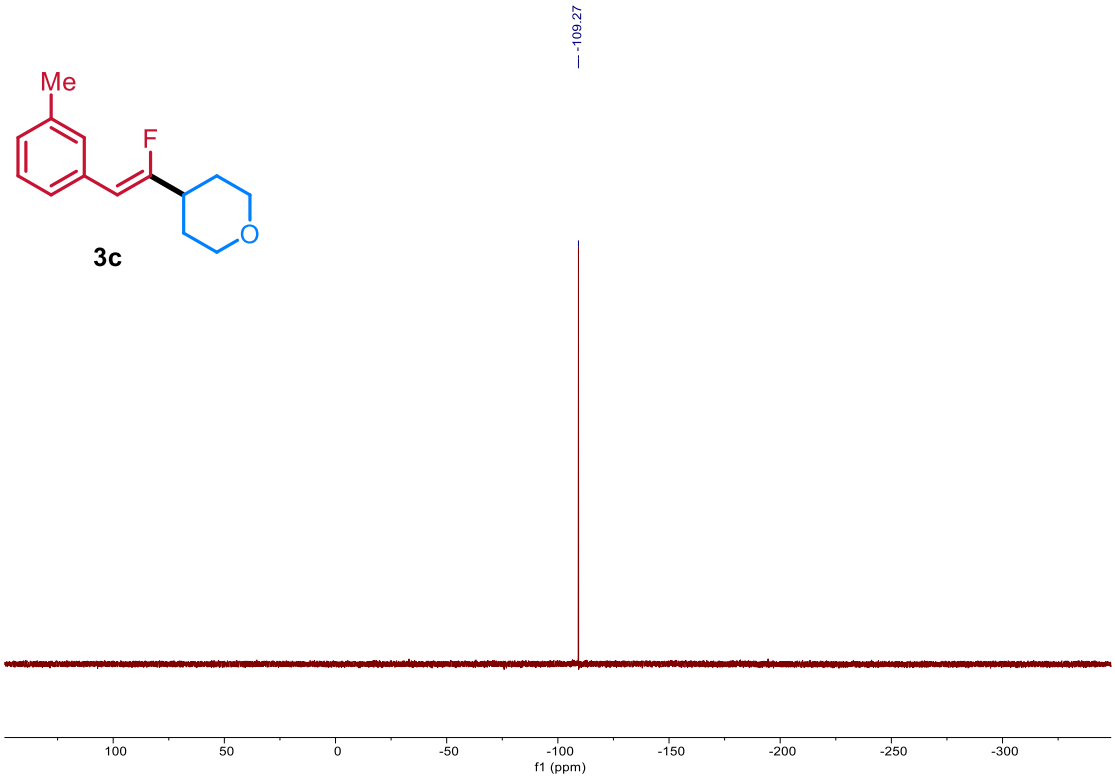
**$^{1}$H NMR of Compound 3c (400 MHz, Chloroform-*d*):**



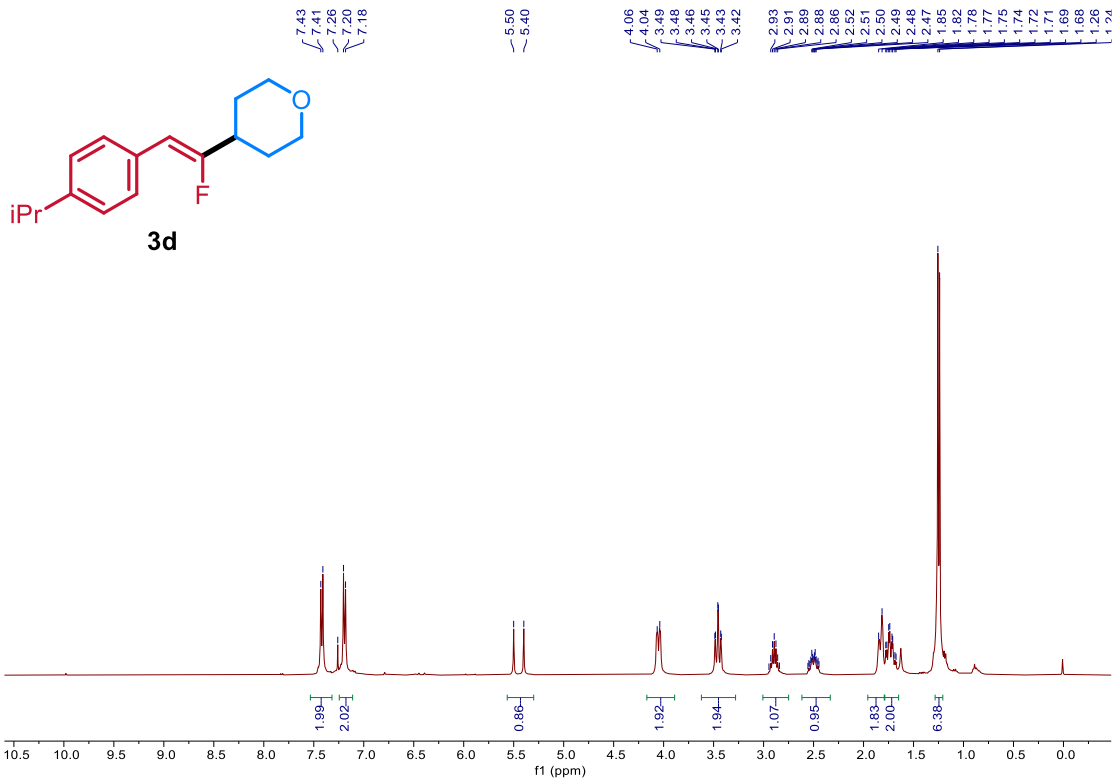

**$^{13}$C NMR of Compound 3c (150 MHz, Chloroform-*d*):**



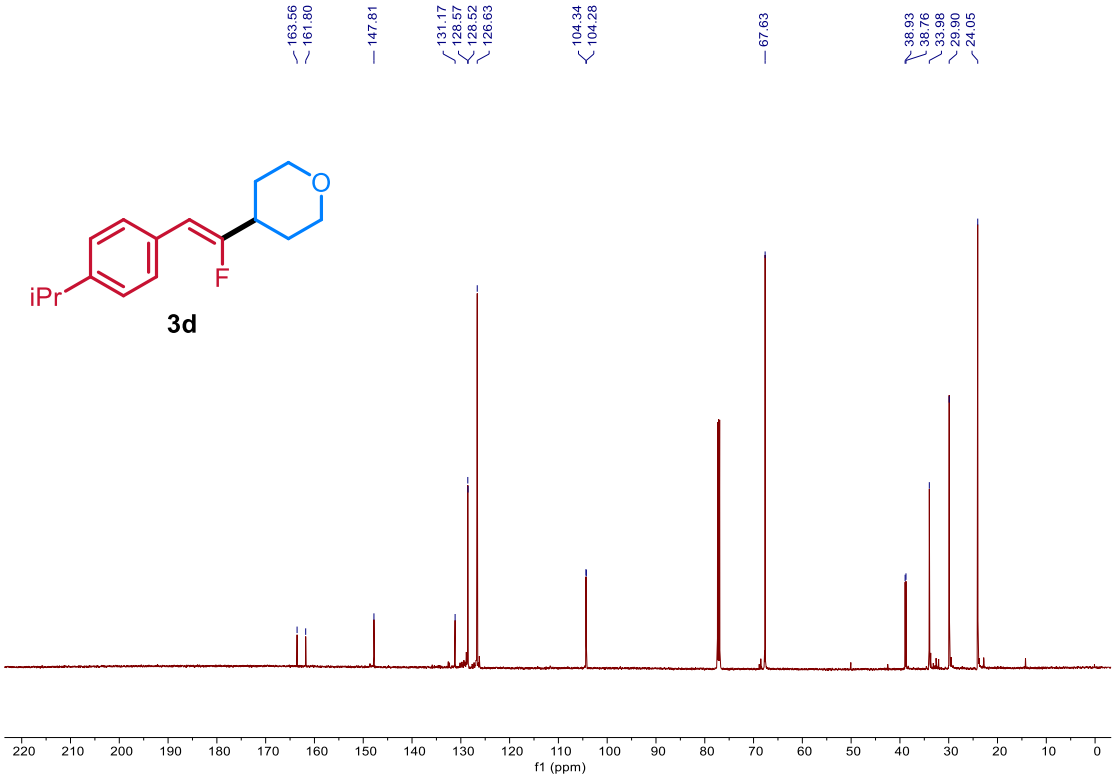
**$^{19}$F NMR of 3c (375 MHz, Chloroform-*d*):**



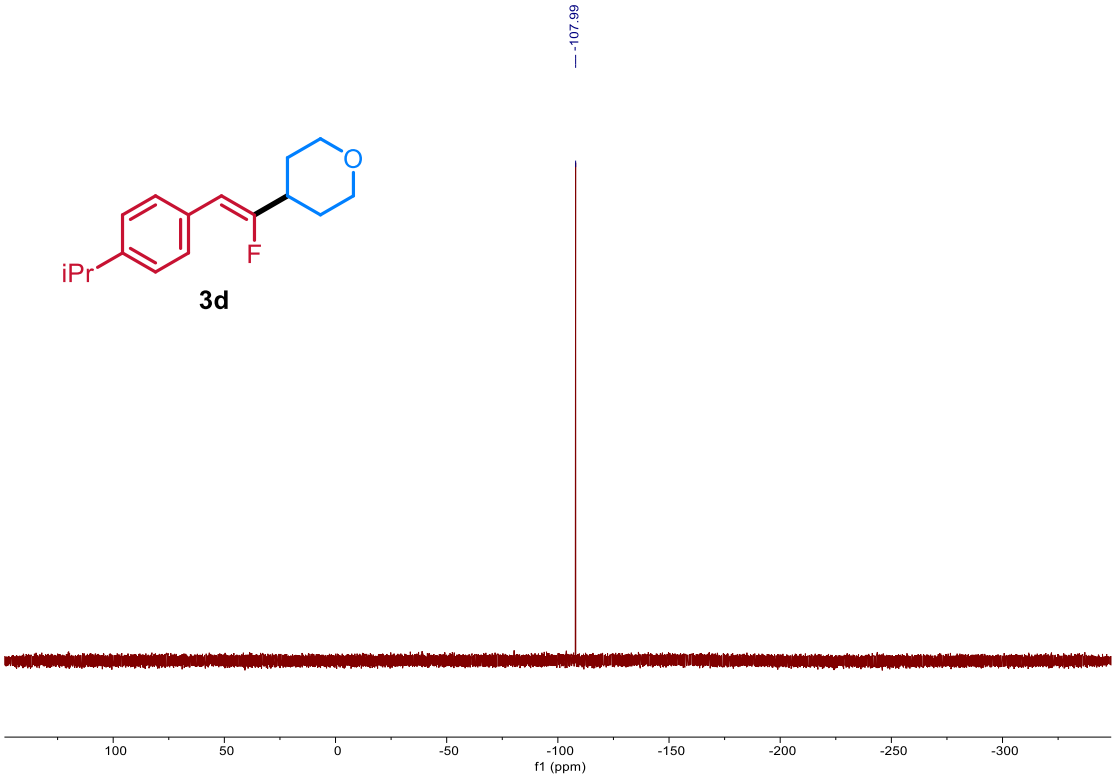

**$^{1}$H NMR of Compound 3d (400 MHz, Chloroform-*d*):**



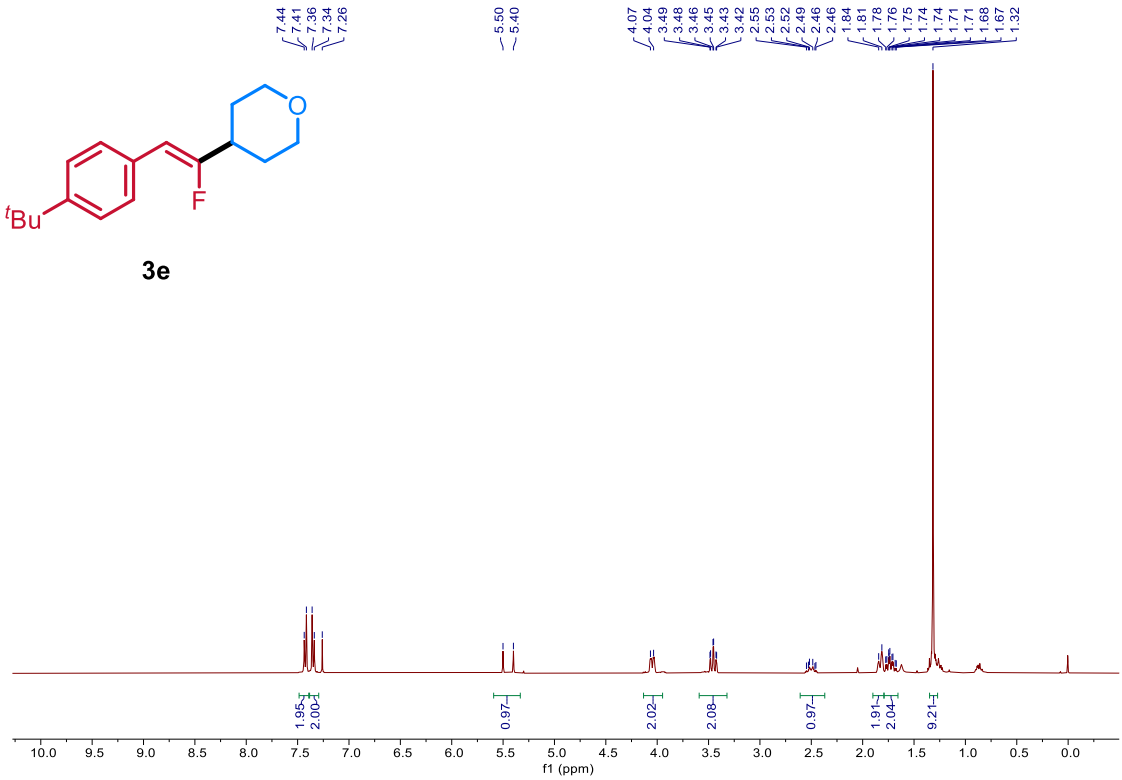
**$^{13}$C NMR of Compound 3d (150 MHz, Chloroform-*d*):**




**$^{19}$F NMR of Compound 3d (375 MHz, Chloroform-*d*):**



**$^{1}$H NMR of Compound 3e (400 MHz, Chloroform-*d*):**

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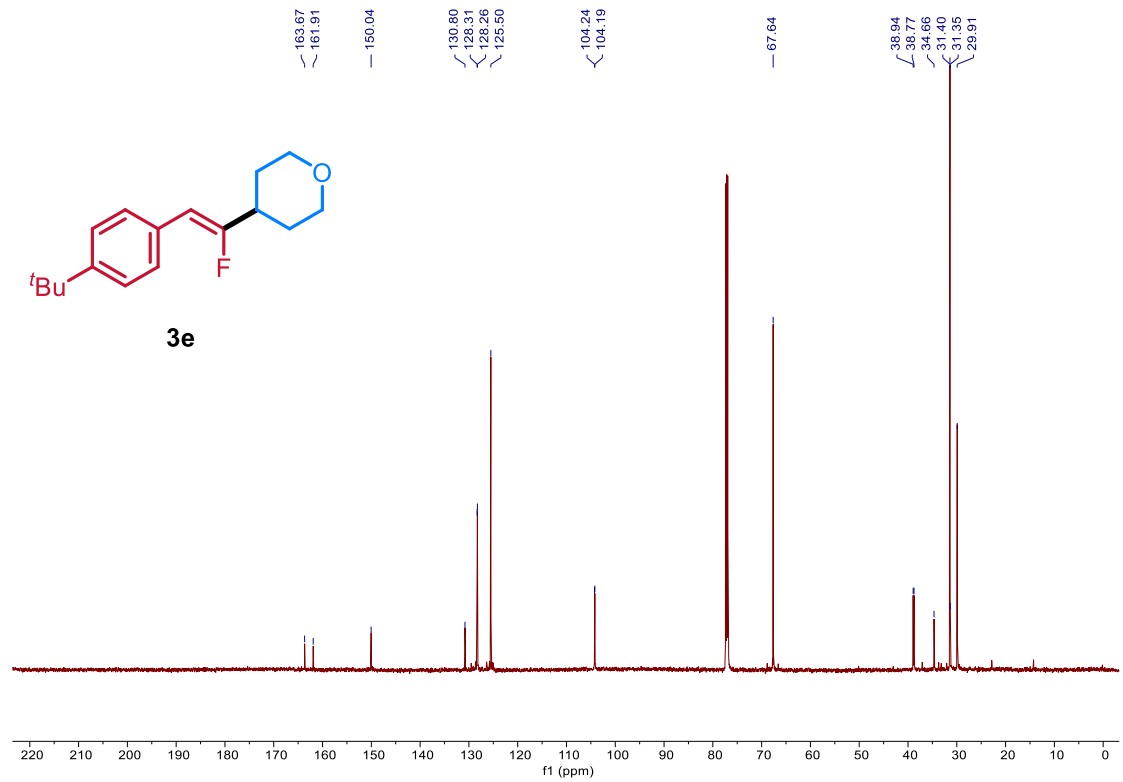
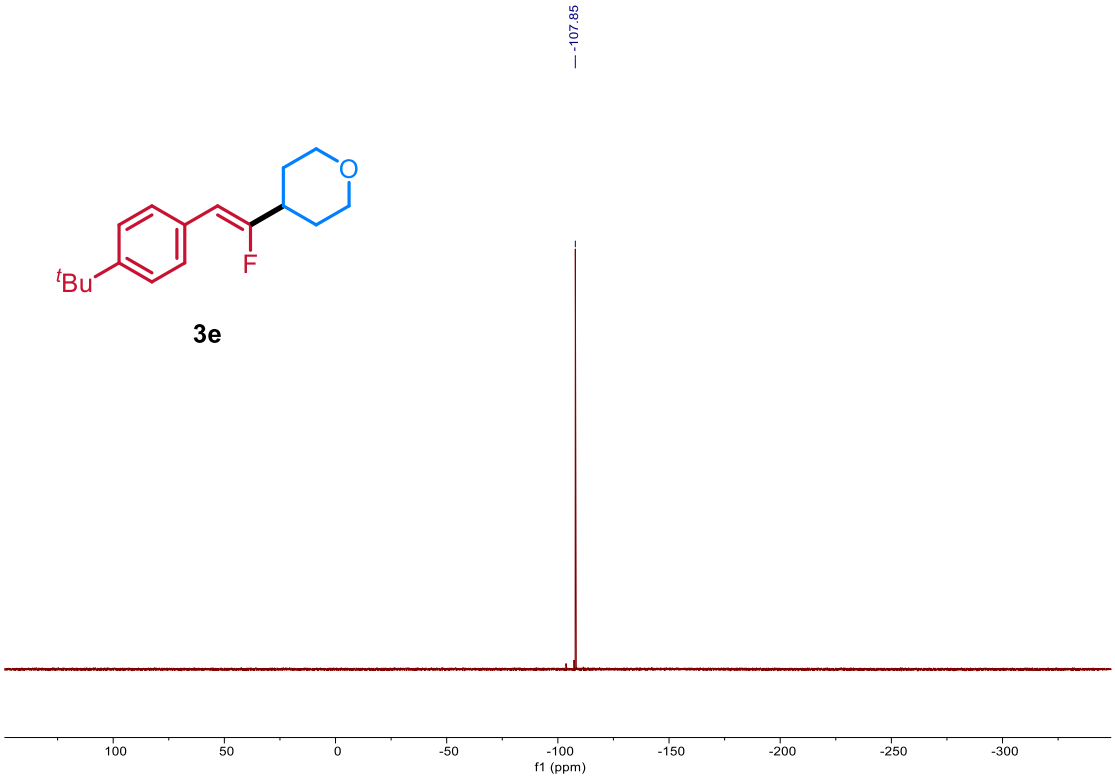
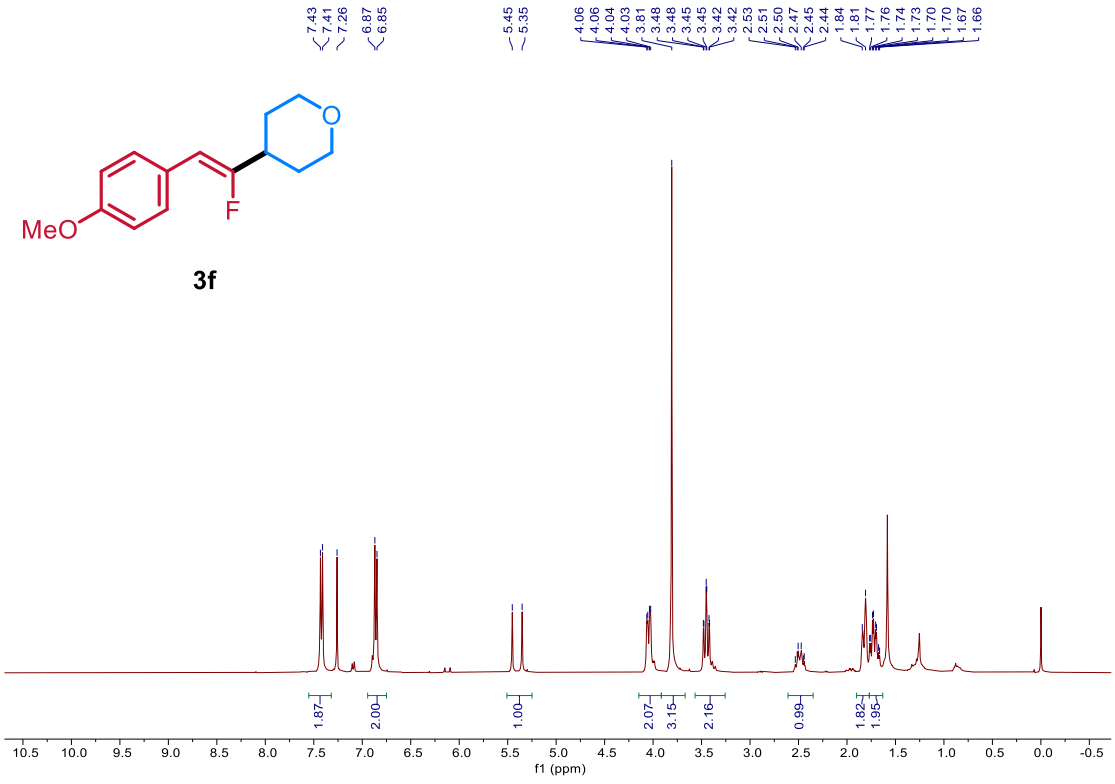


**$^{19}$F NMR of Compound 3e (375 MHz, Chloroform-*d*):**




**$^{1}$H NMR of Compound 3f (400 MHz, Chloroform-*d*):**



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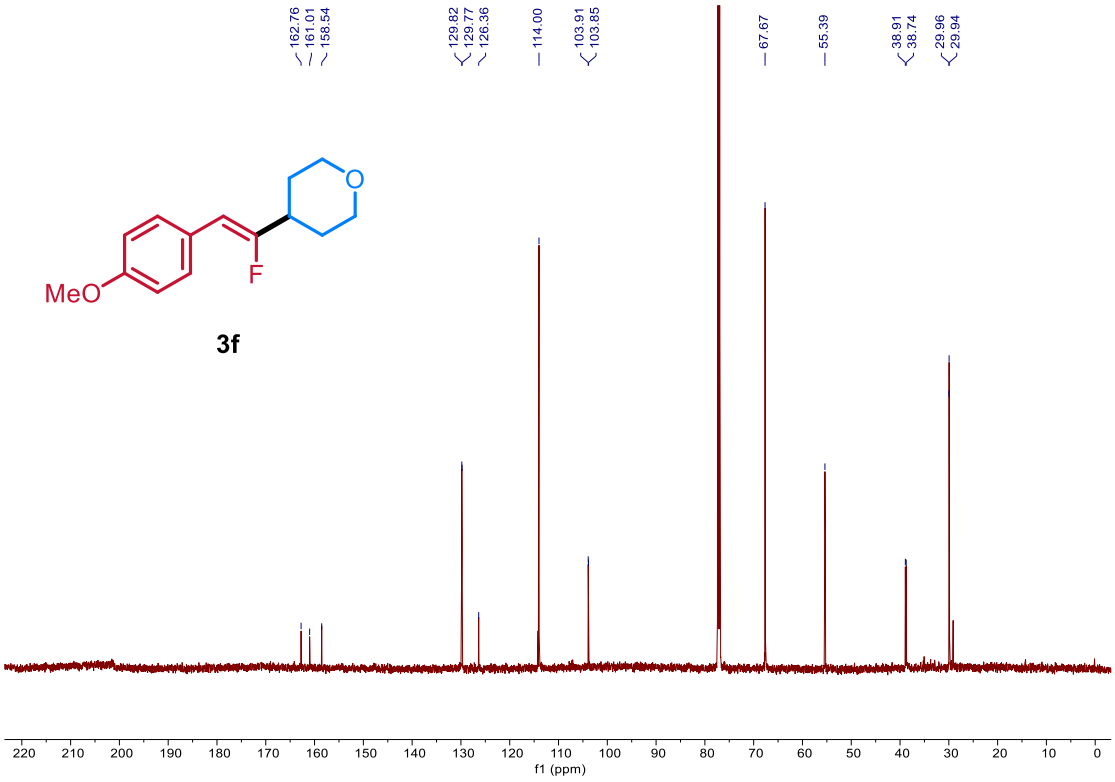
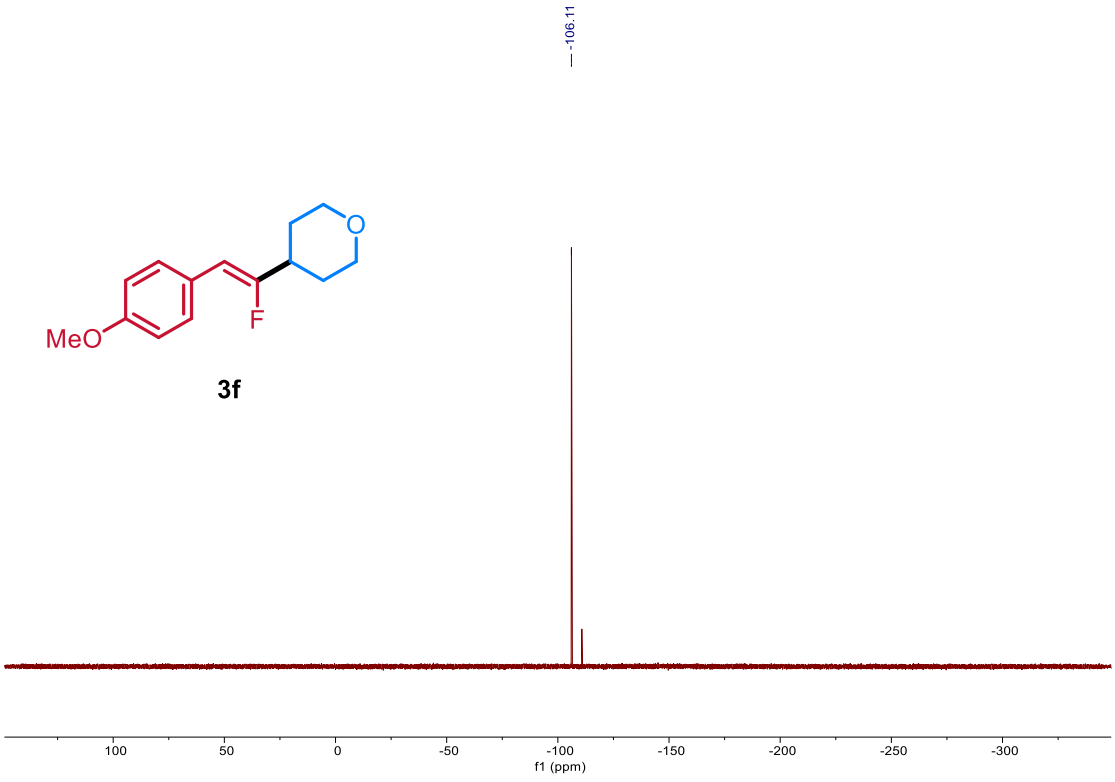
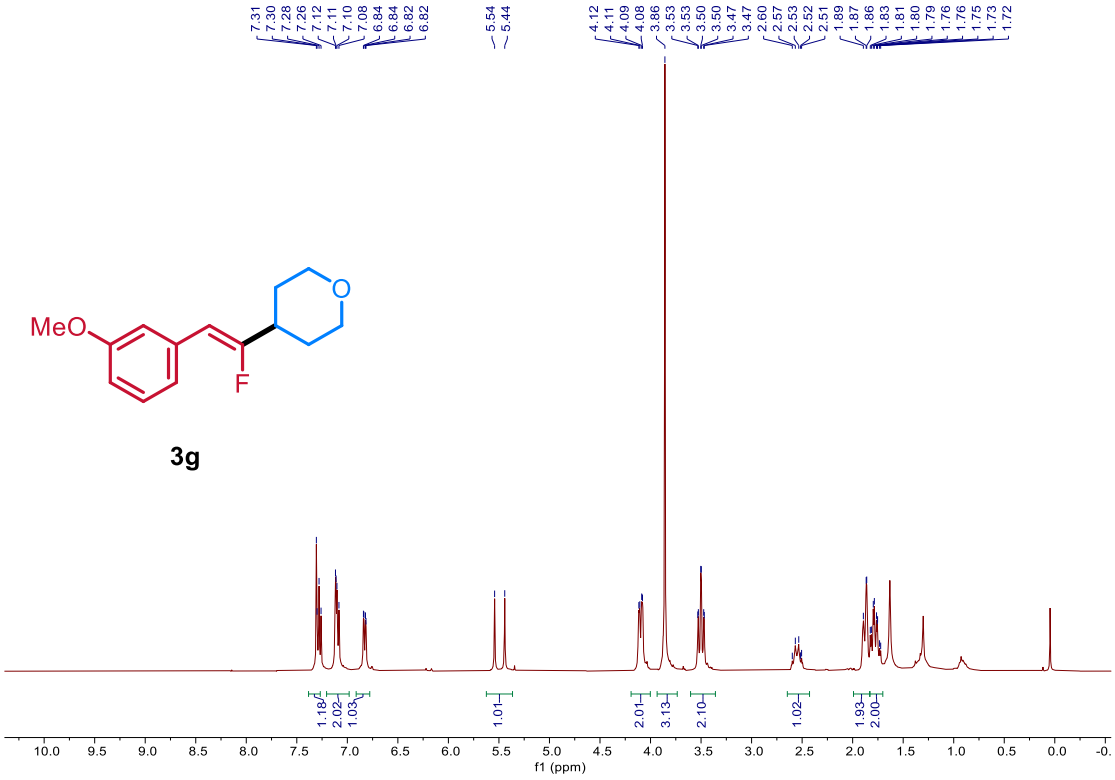


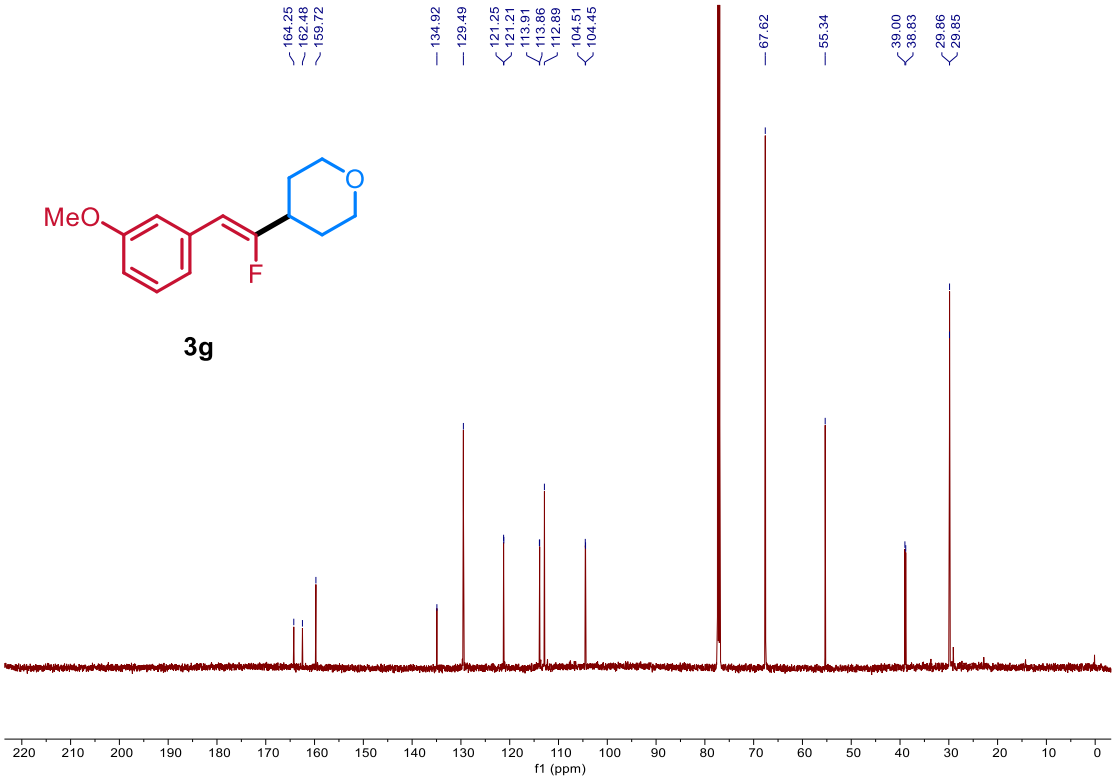

**$^{19}$F NMR of Compound 3f (375 MHz, Chloroform-*d*):**



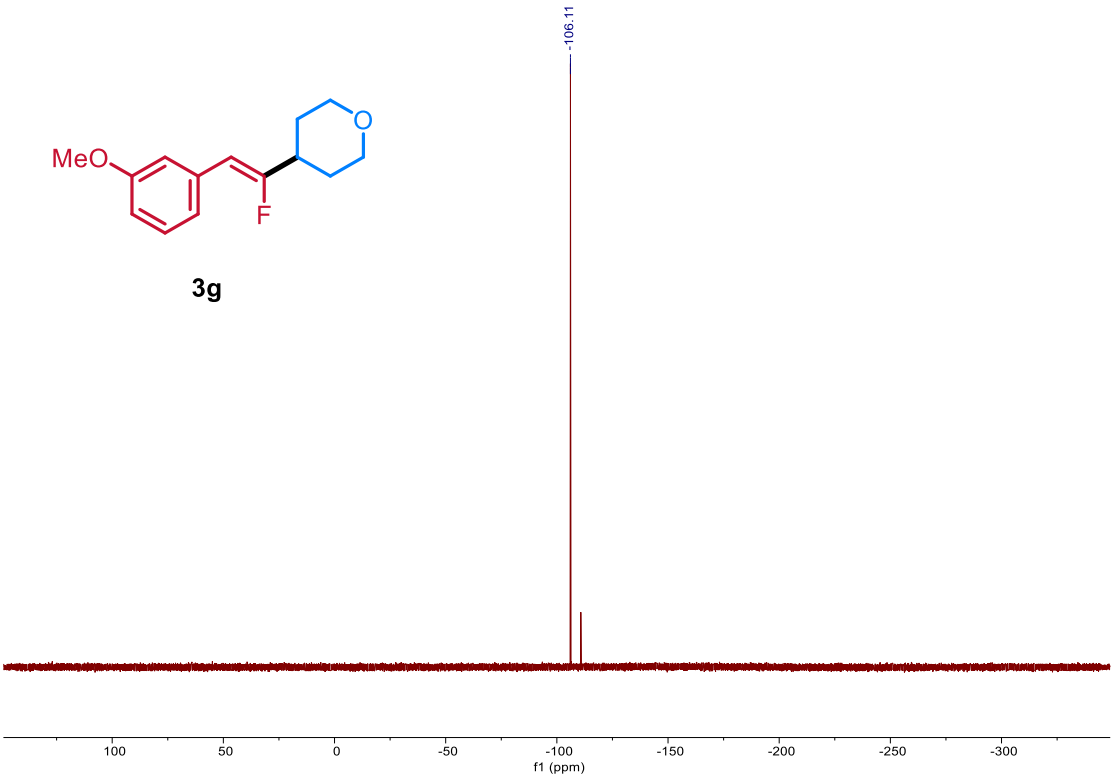
**$^{1}$H NMR of Compound 3g (400 MHz, Chloroform-*d*):**



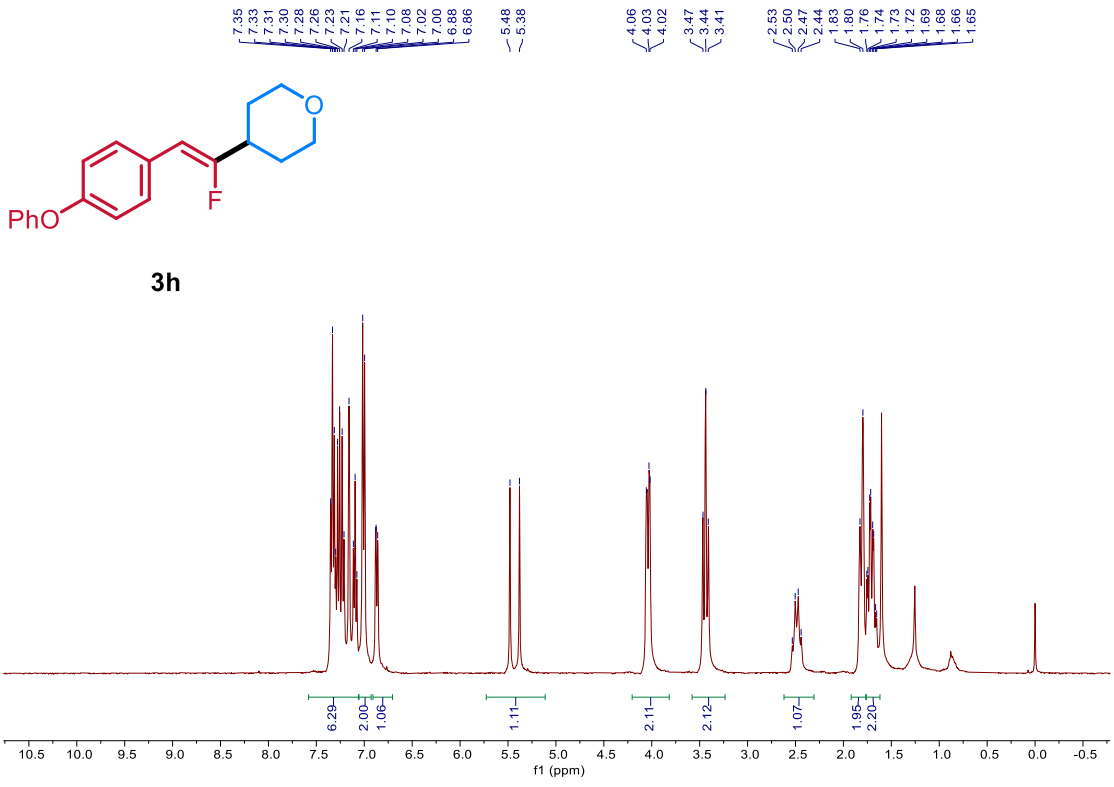

**$^{13}$C NMR of Compound 3g (150 MHz, Chloroform-*d*):**



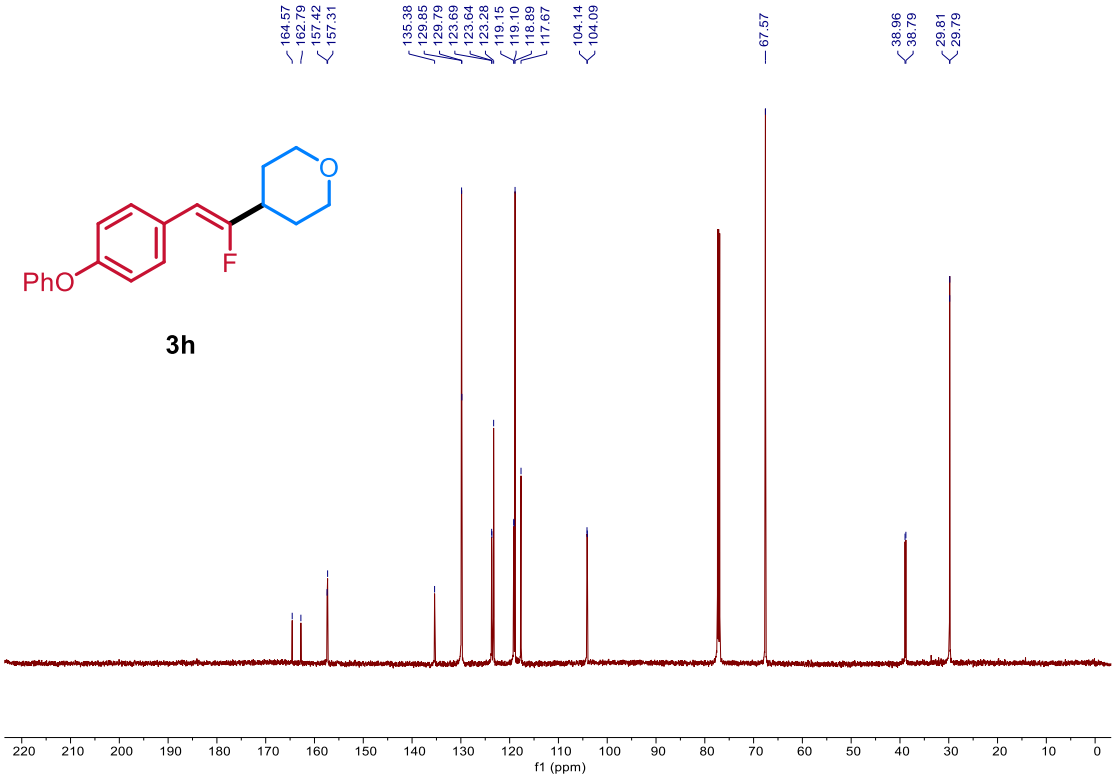
**$^{19}$F NMR of Compound 3g (375 MHz, Chloroform-*d*):**



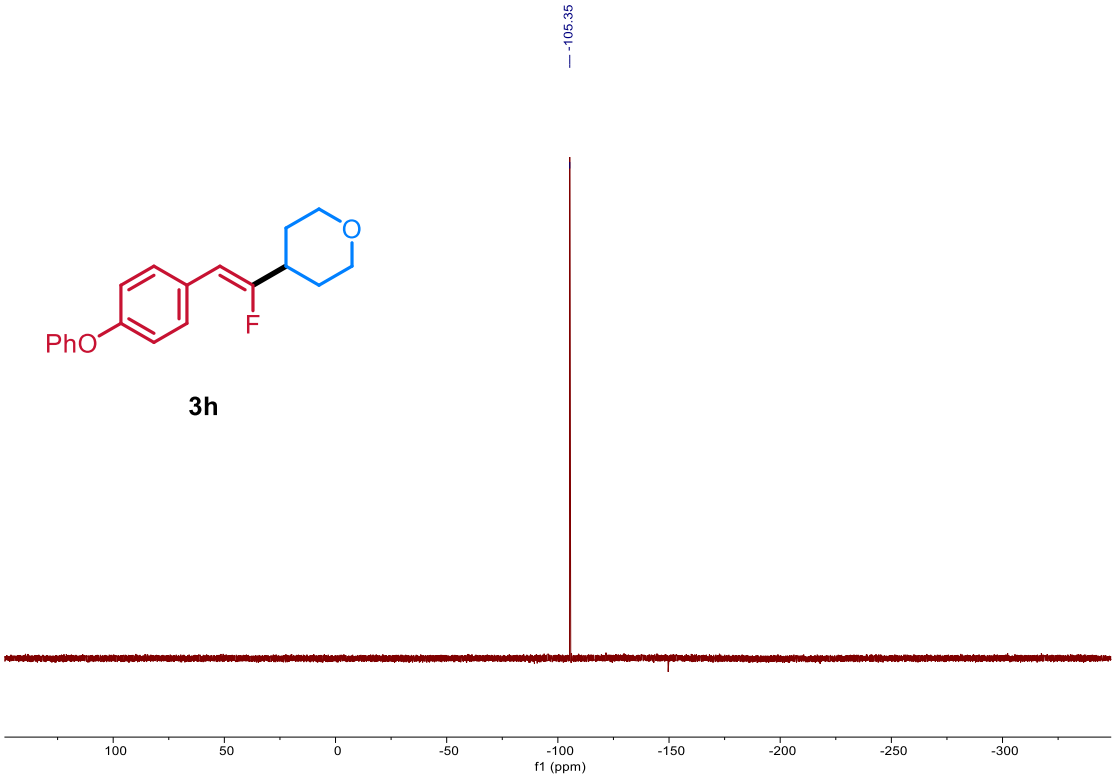

**$^{1}$H NMR of Compound 3h (400 MHz, Chloroform-*d*):**



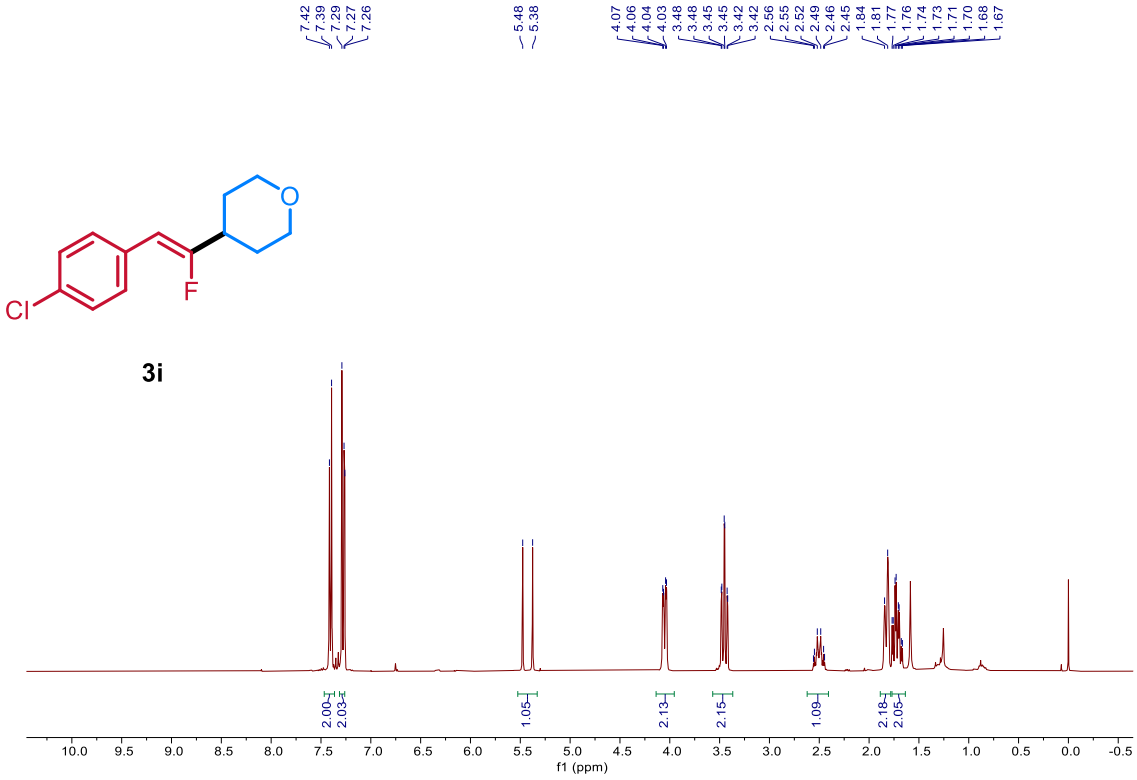
**$^{13}$C NMR of Compound 3h (150 MHz, Chloroform-*d*):**



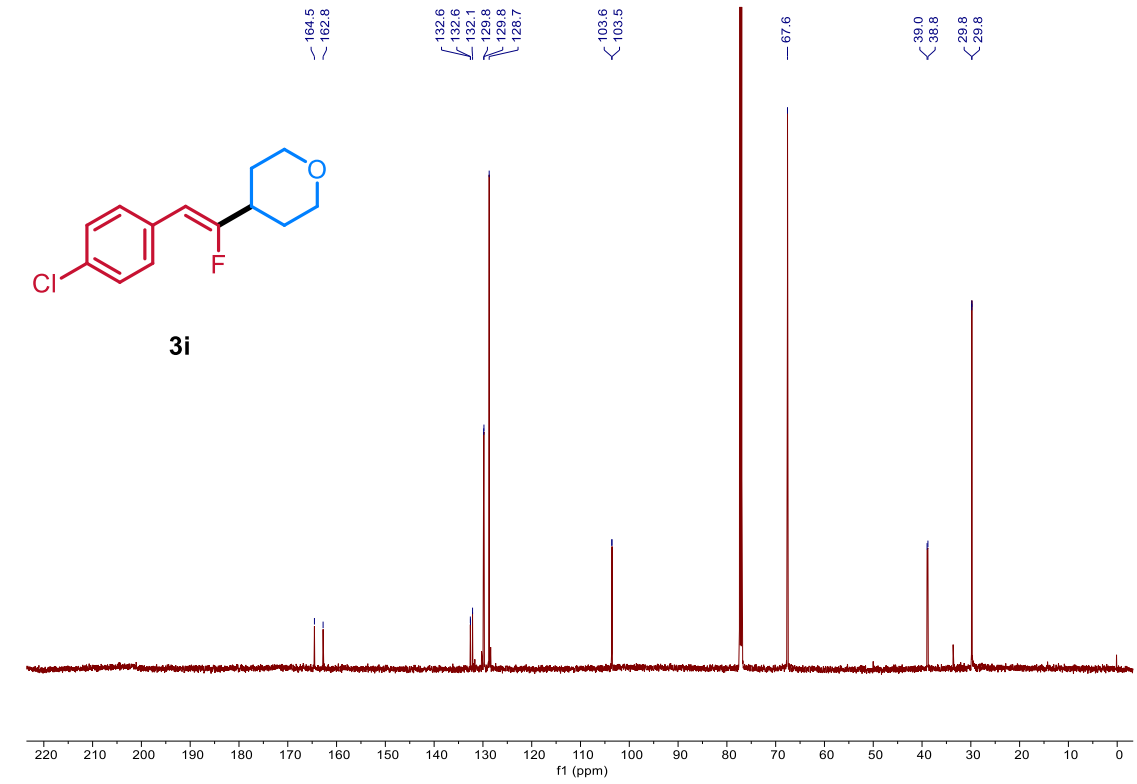

**$^{19}$F NMR of Compound 3g (375 MHz, Chloroform-*d*):**



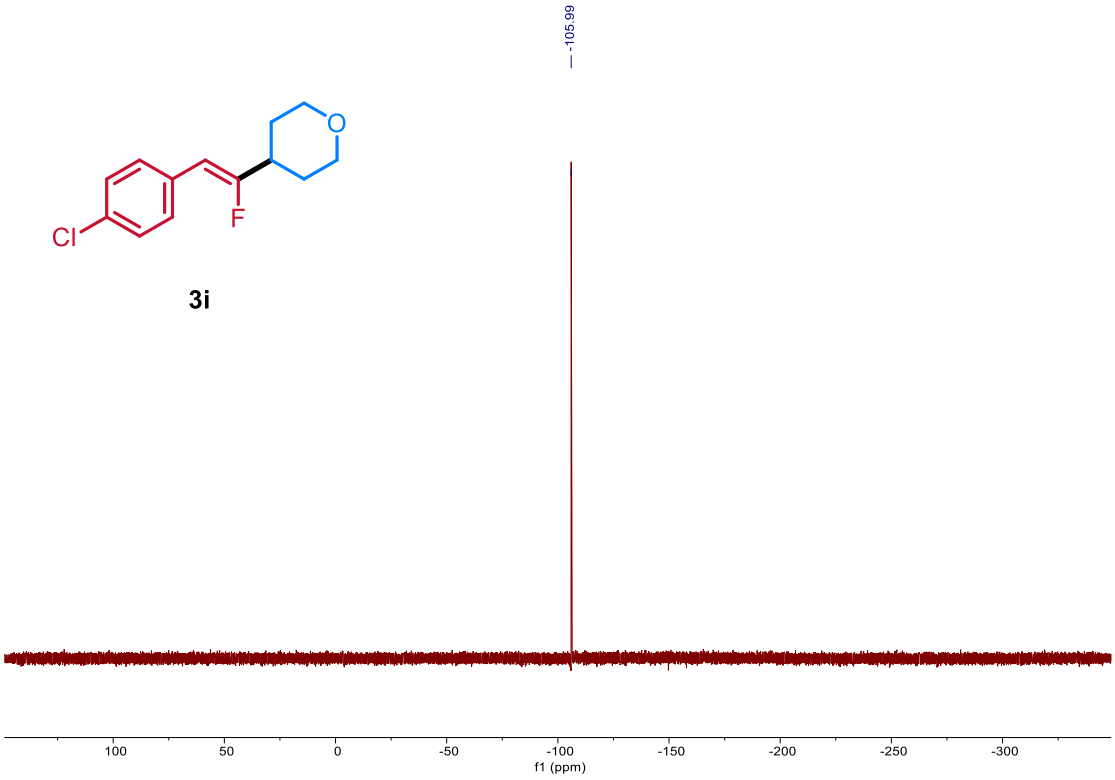
**$^{1}$H NMR of Compound 3i (400 MHz, Chloroform-*d*):**



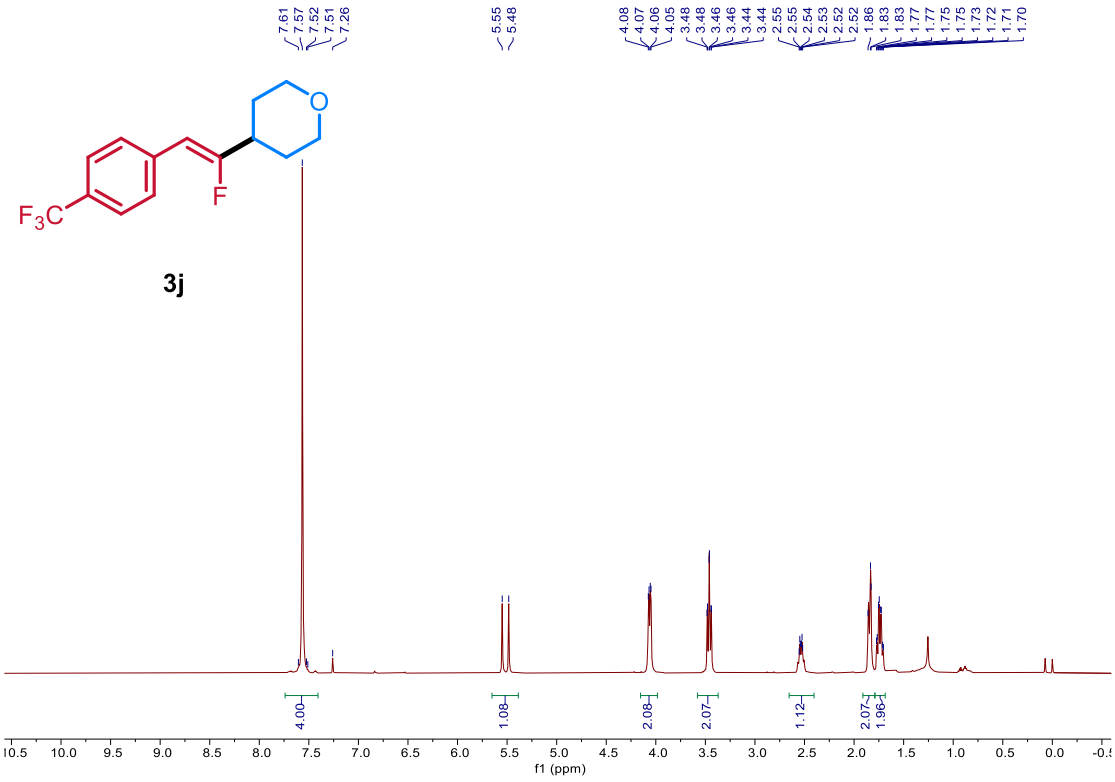

**$^{13}$C NMR of Compound 3i (150 MHz, Chloroform-*d*):**



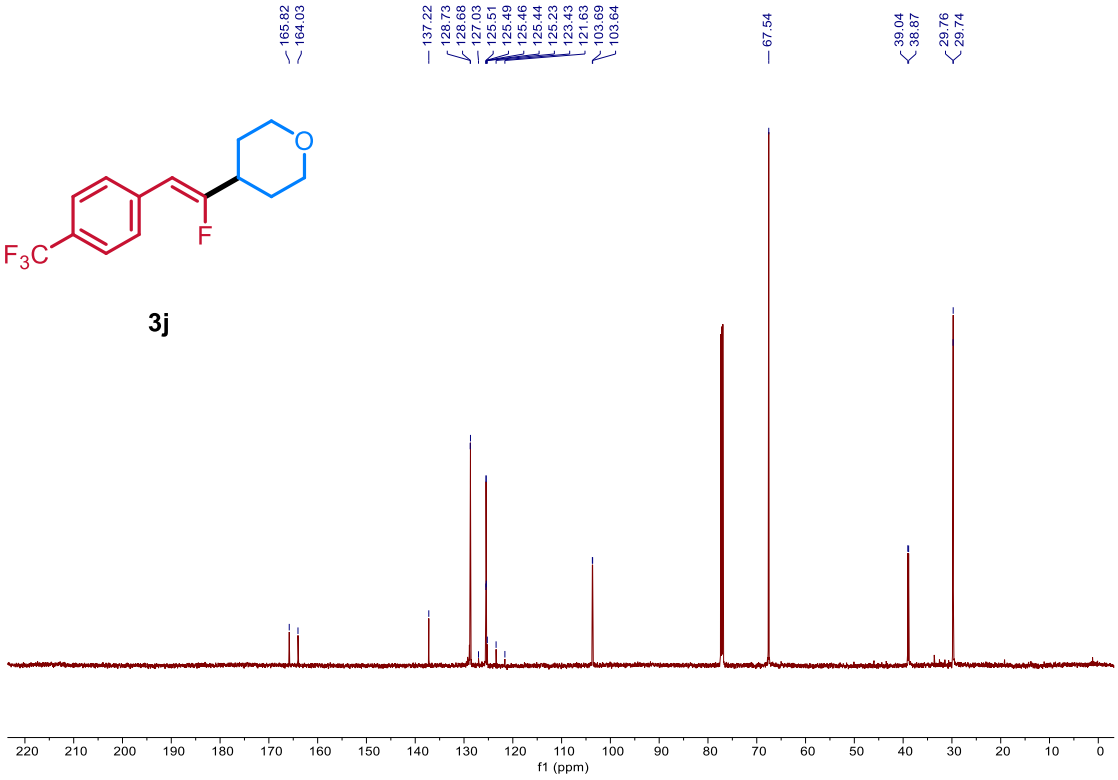
**$^{19}$F NMR of Compound 3i (375 MHz, Chloroform-*d*):**



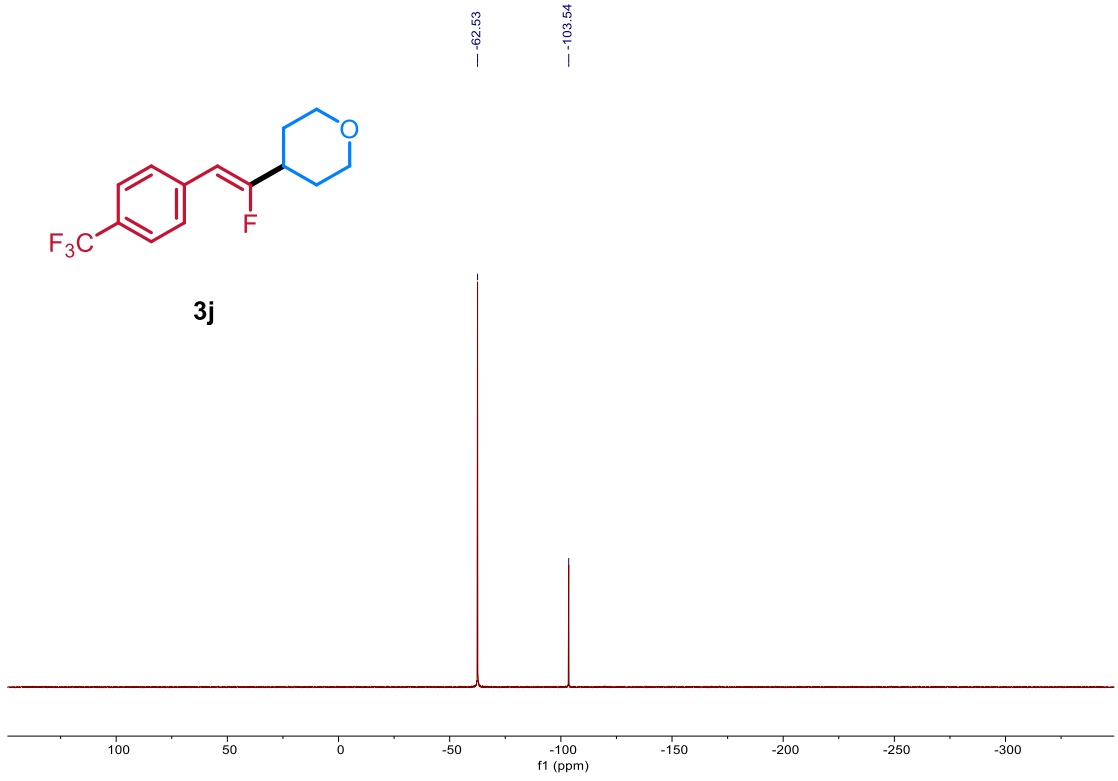

**$^{1}$H NMR of Compound 3j (600 MHz, Chloroform-*d*):**



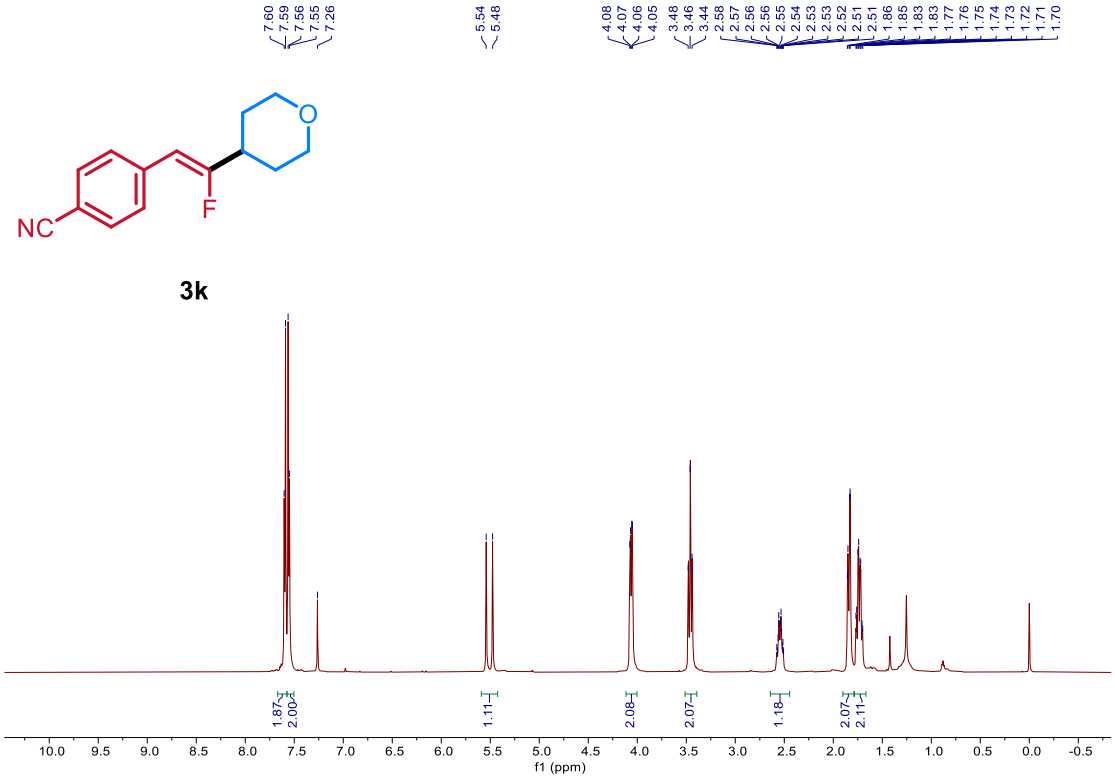
**$^{13}$C NMR of Compound 3i (150 MHz, Chloroform-*d*):**



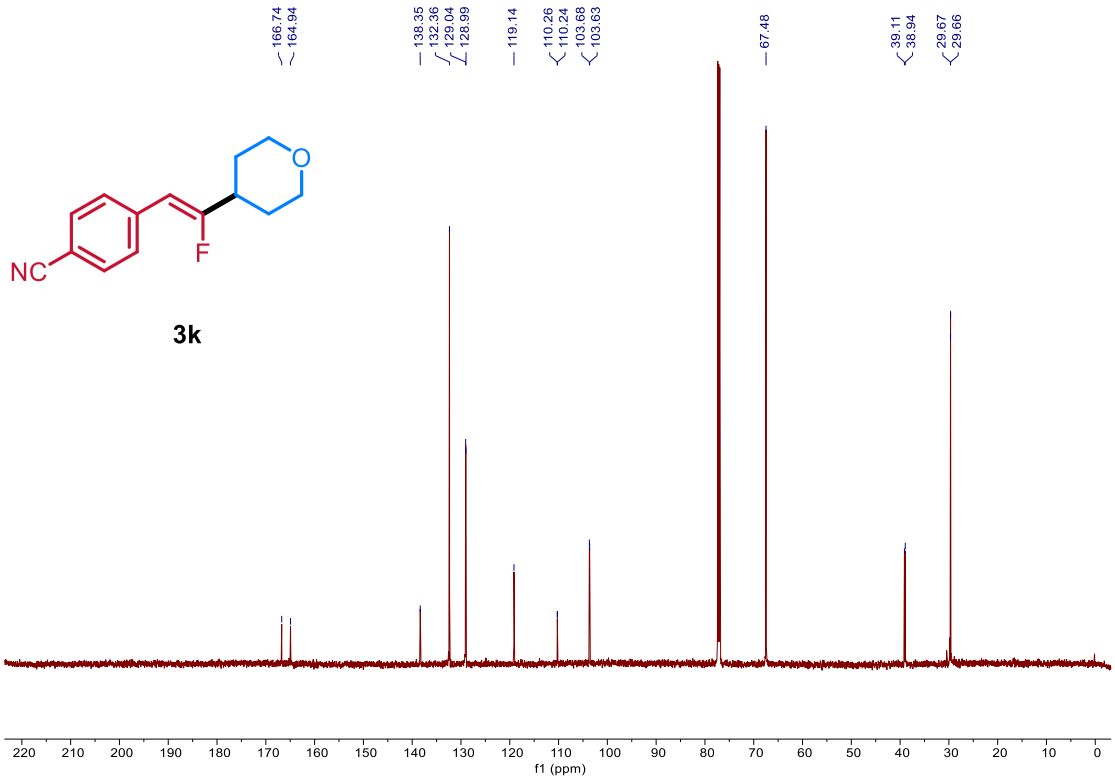

**$^{19}$F NMR of Compound 3j (375 MHz, Chloroform-*d*):**



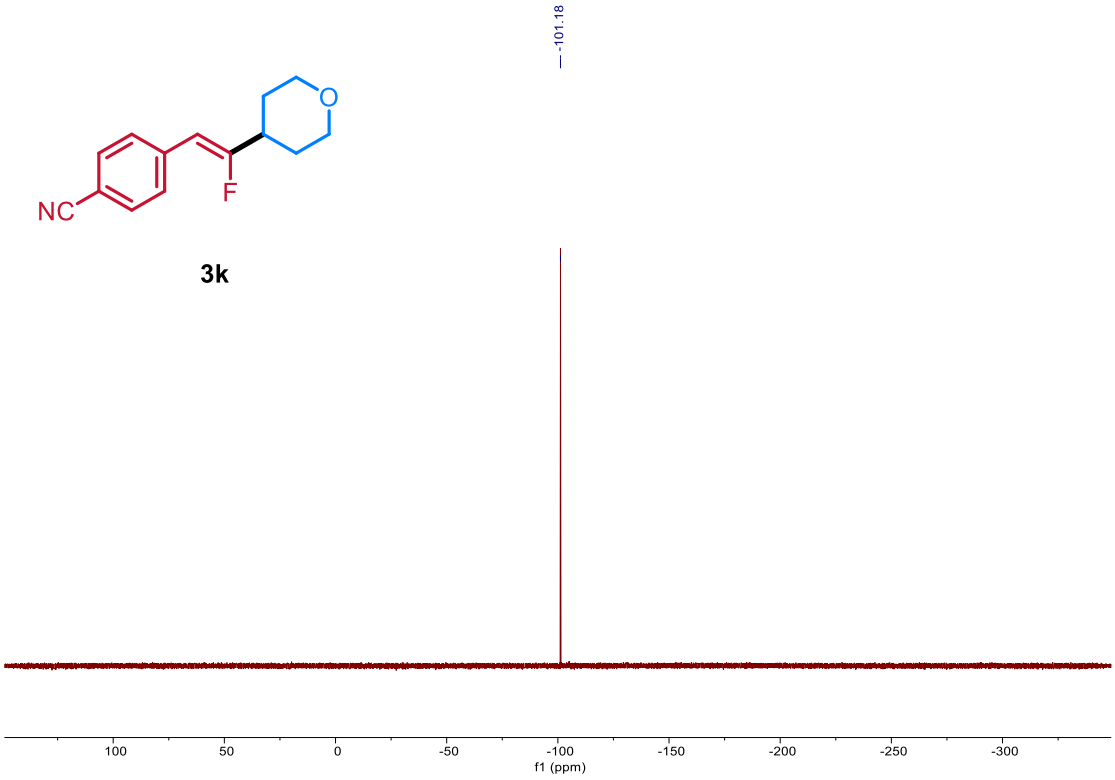
## $^{1}$H NMR of Compound 3k (600 MHz, Chloroform-*d*):



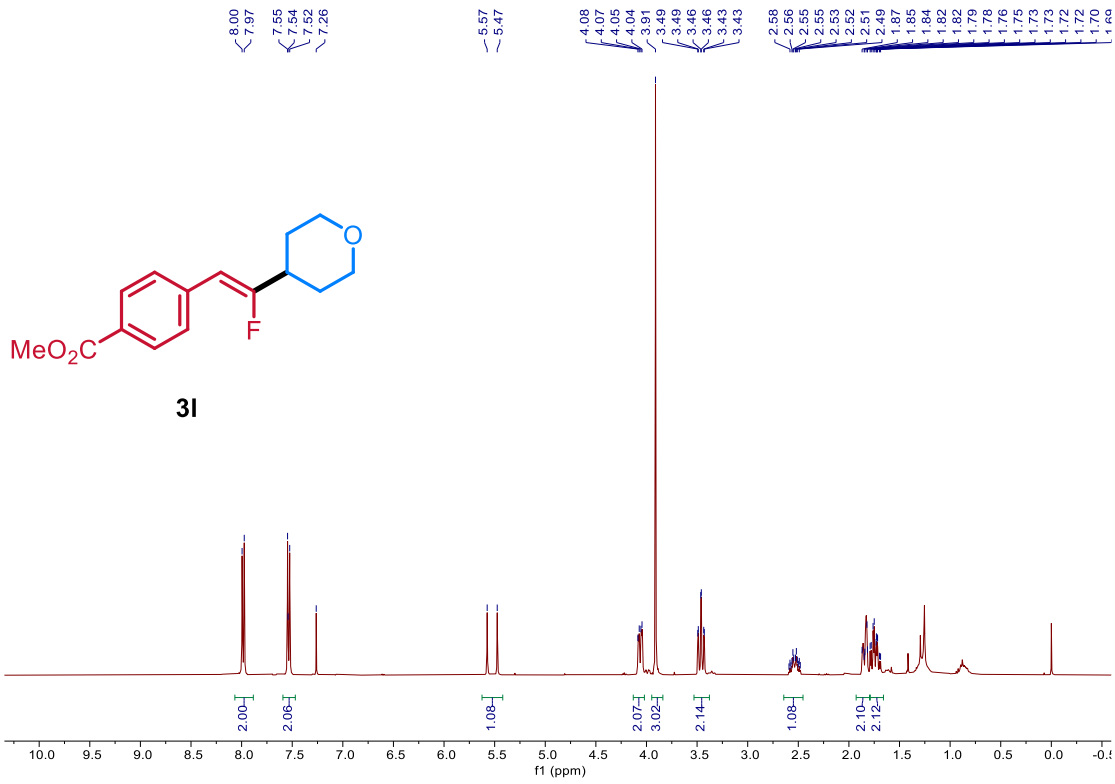

## $^{13}$C NMR of Compound 3k (150 MHz, Chloroform-*d*):



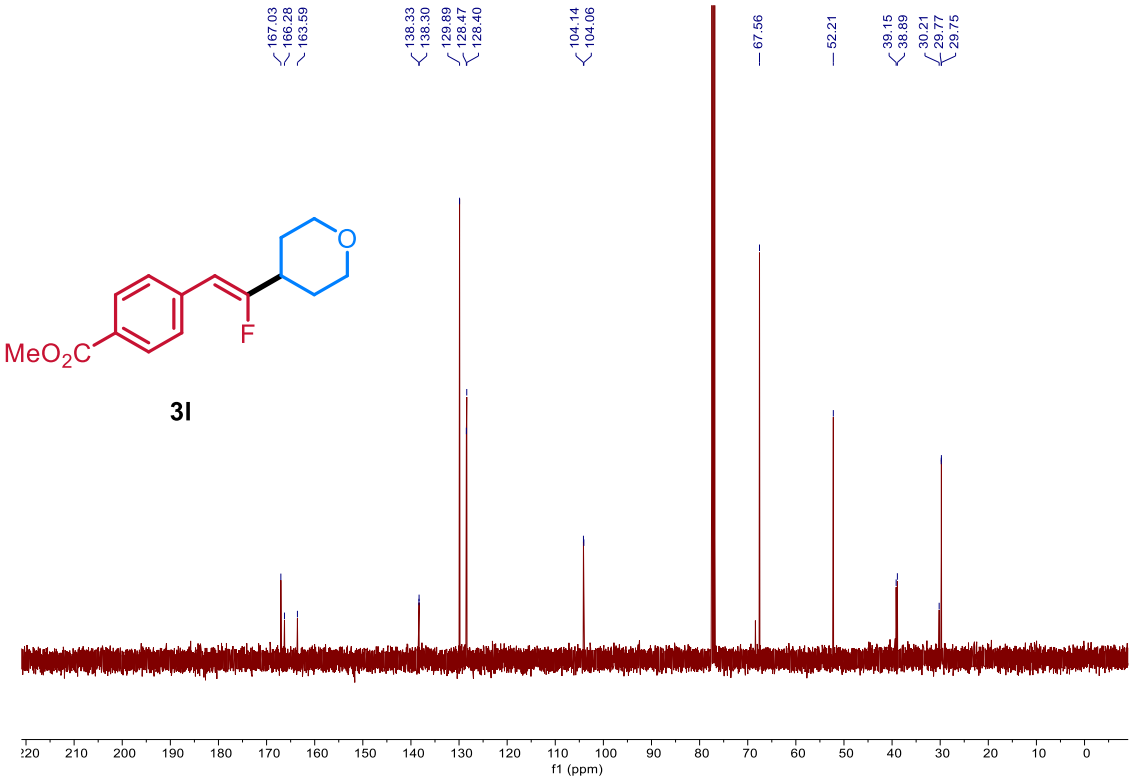
**$^{19}$F NMR of Compound 3k (375 MHz, Chloroform-*d*):**



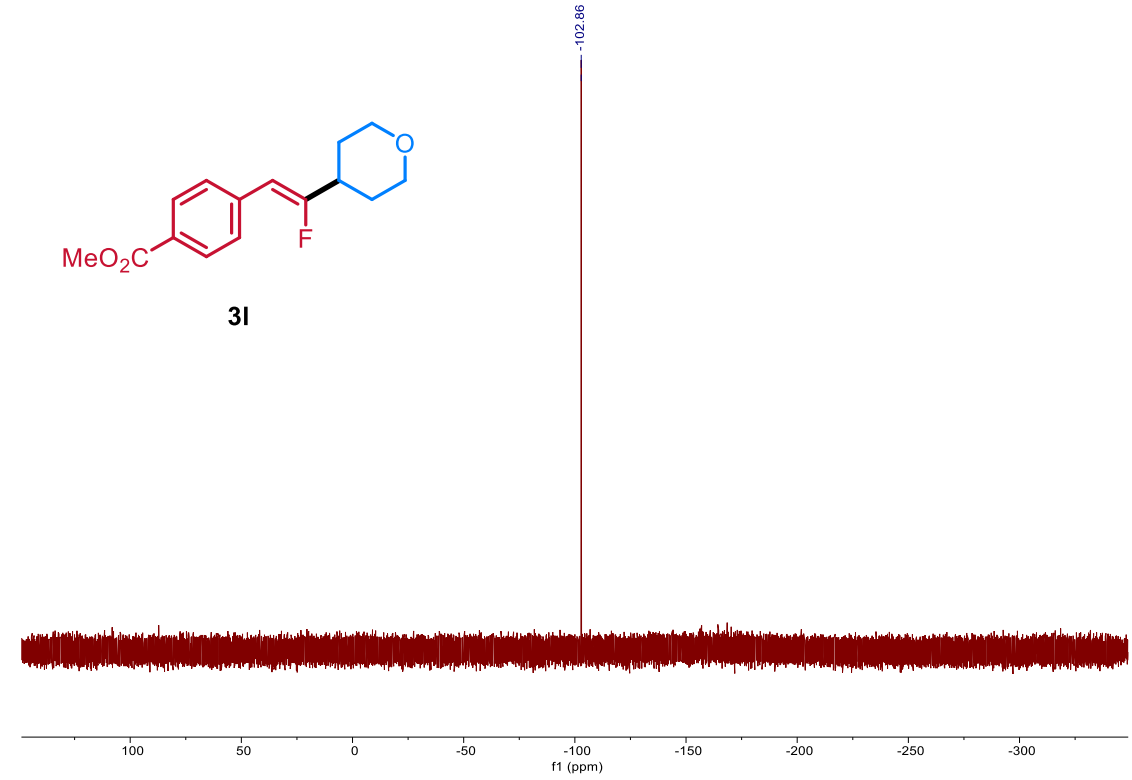

**$^{1}$H NMR of Compound 3l (400 MHz, Chloroform-*d*):**



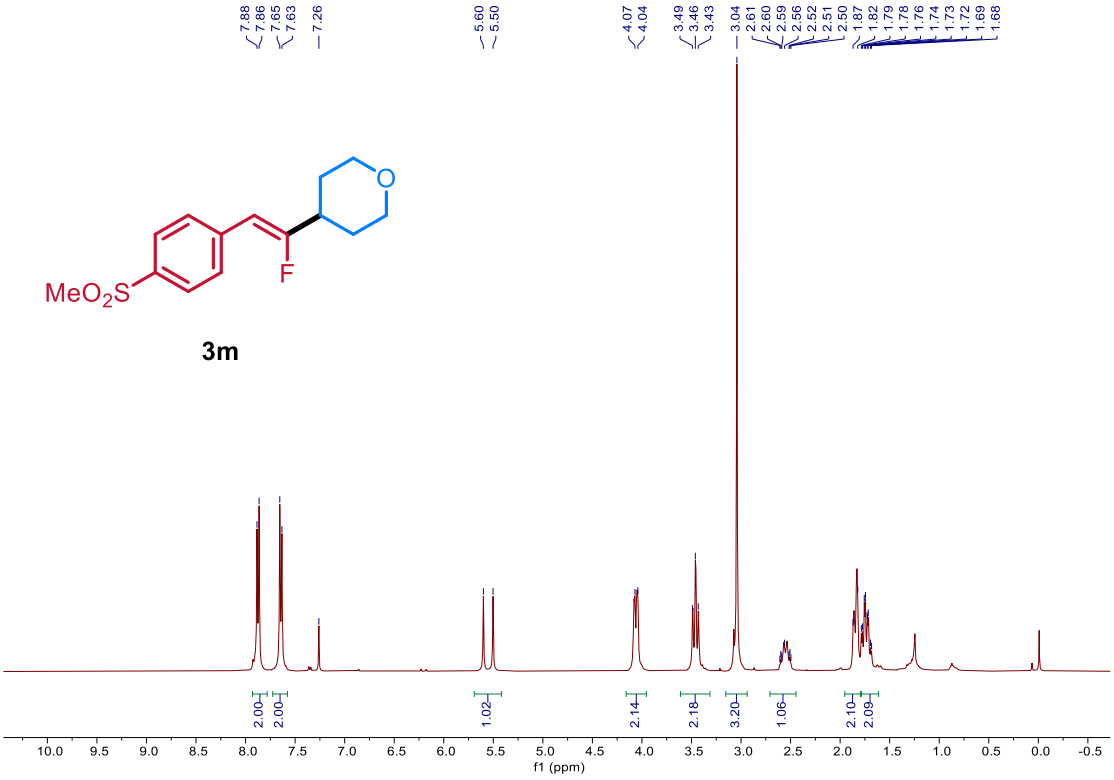
**$^{13}$C NMR of Compound 3l (100 MHz, Chloroform-*d*):**



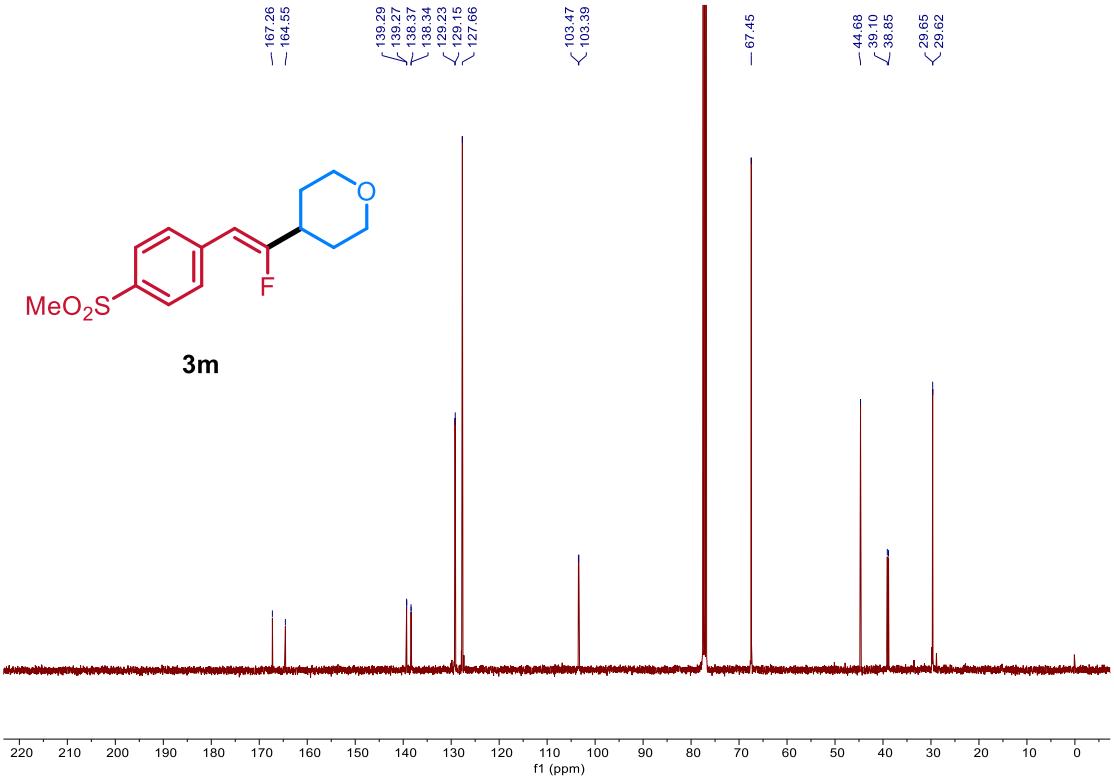

**$^{19}$F NMR of Compound 3l (375 MHz, Chloroform-*d*):**



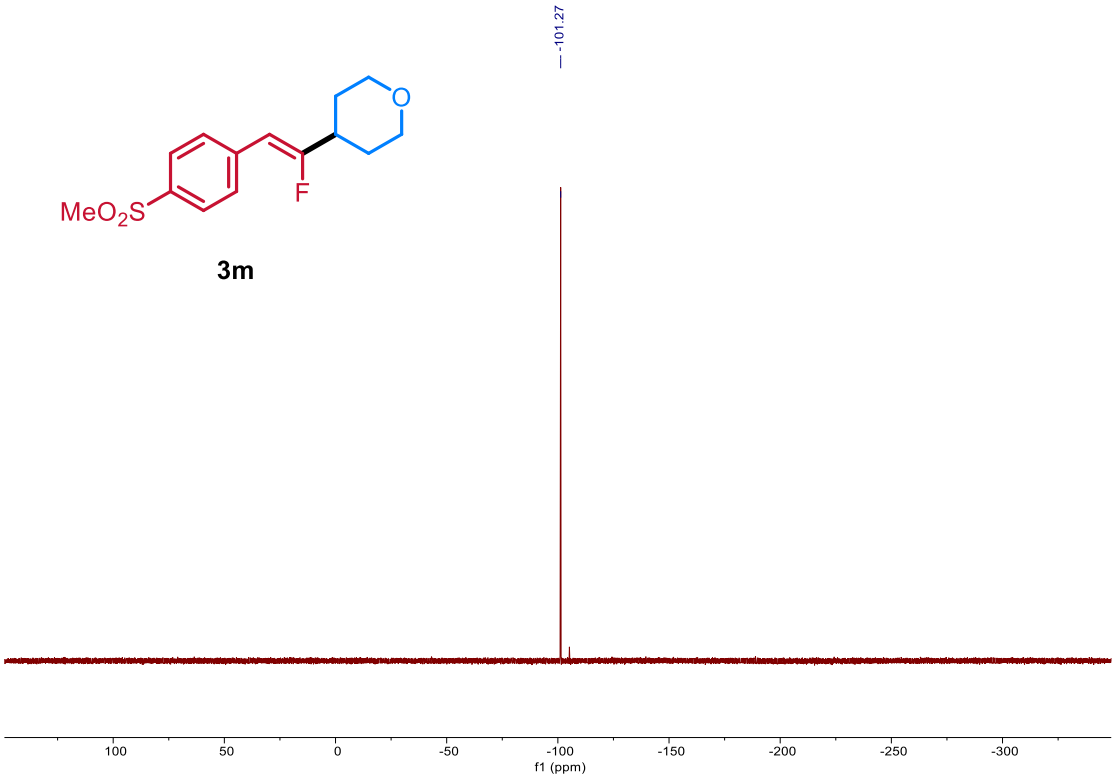
**$^{1}$H NMR of Compound 3m (400 MHz, Chloroform-*d*):**



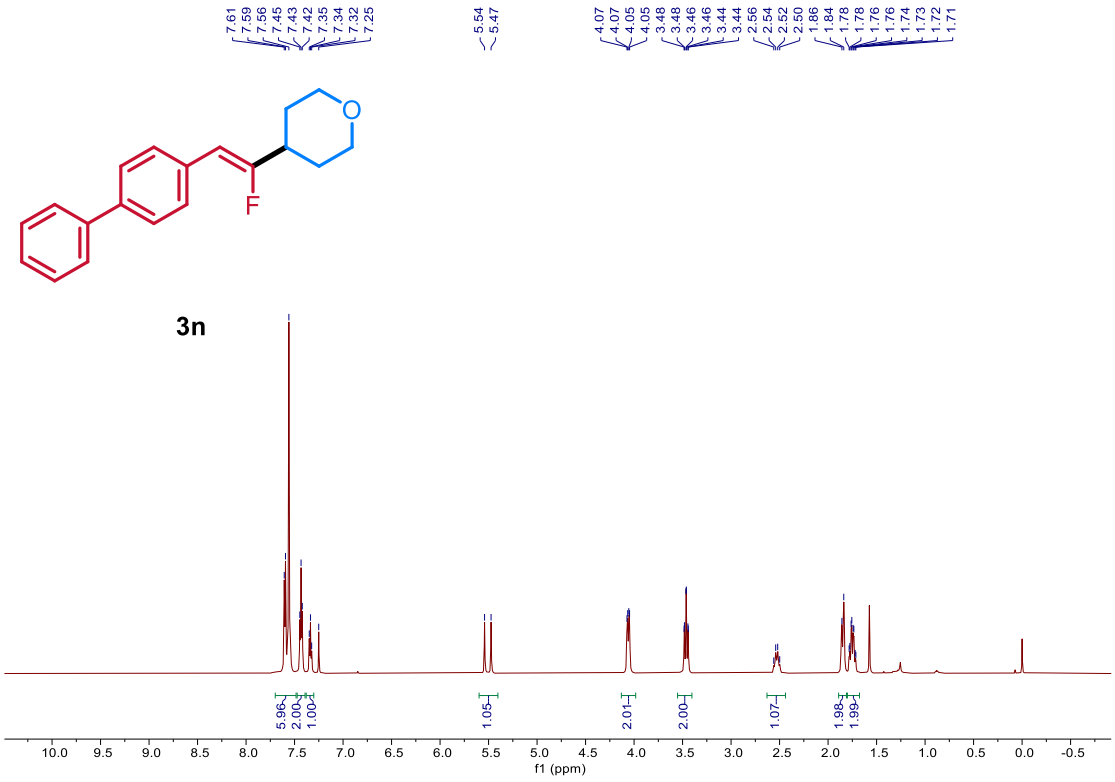

**$^{13}$C NMR of Compound 3m (100 MHz, Chloroform-*d*):**



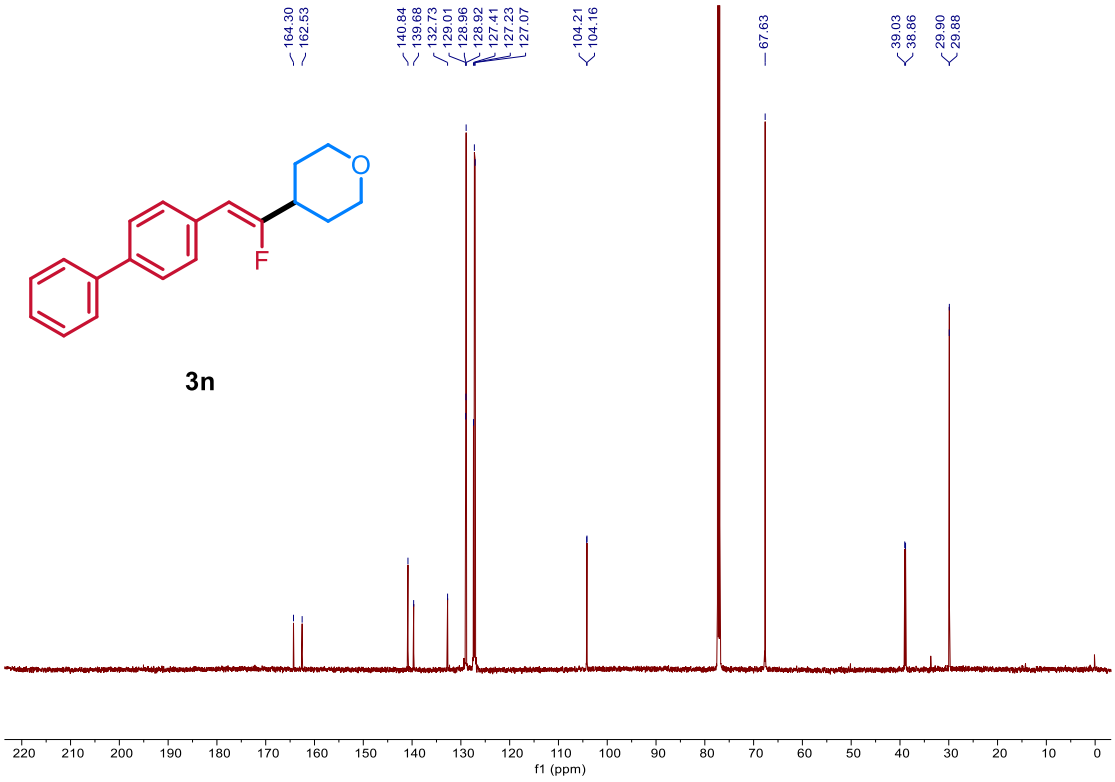
**$^{19}$F NMR of Compound 3m (375 MHz, Chloroform-*d*):**



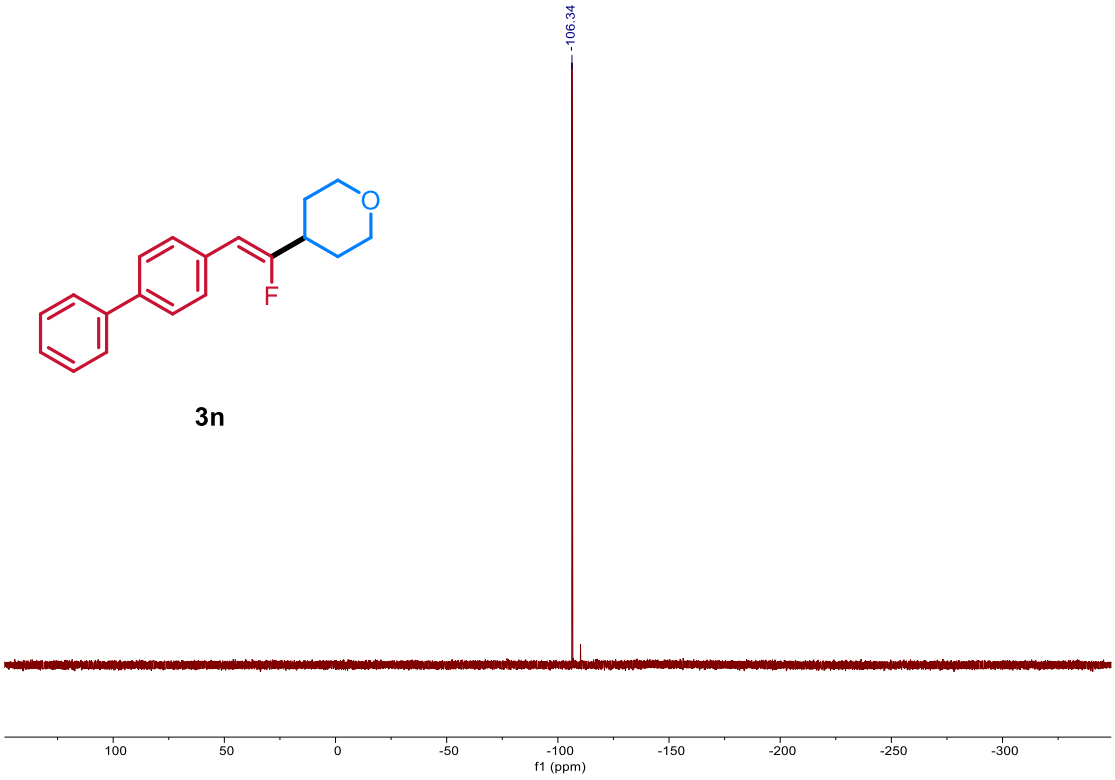

**$^{1}$H NMR of Compound 3n (600 MHz, Chloroform-*d*):**



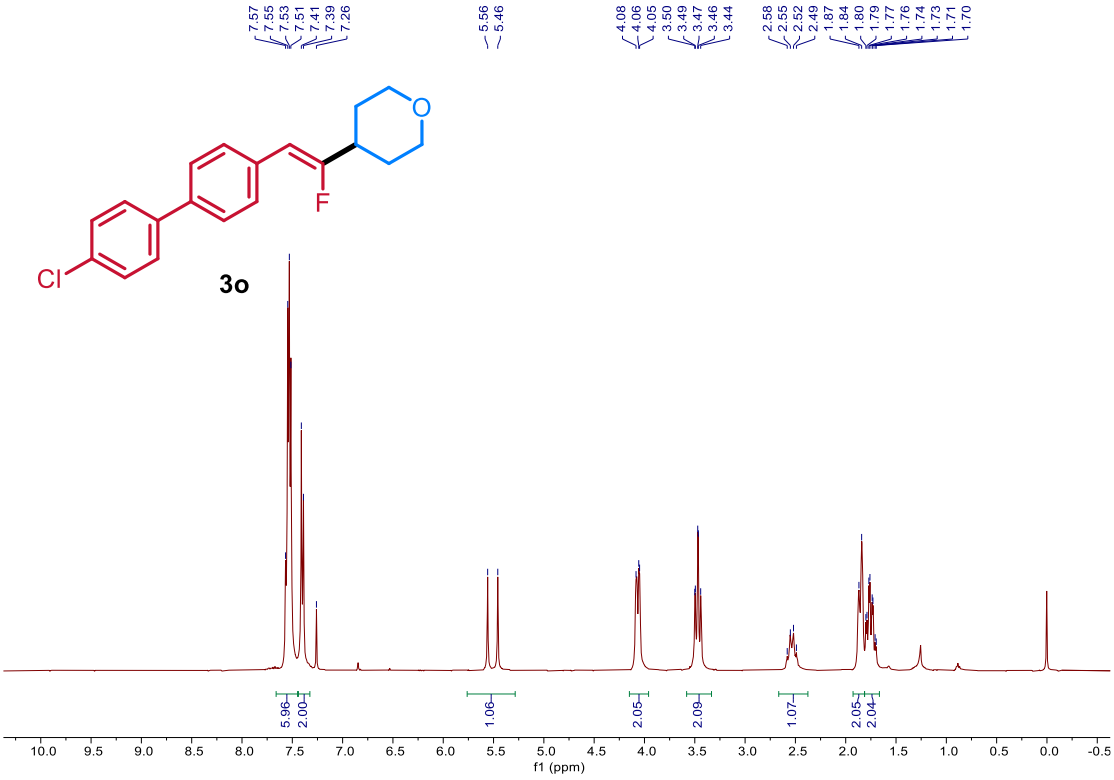
**$^{13}$C NMR of Compound 3n (150 MHz, Chloroform-*d*):**



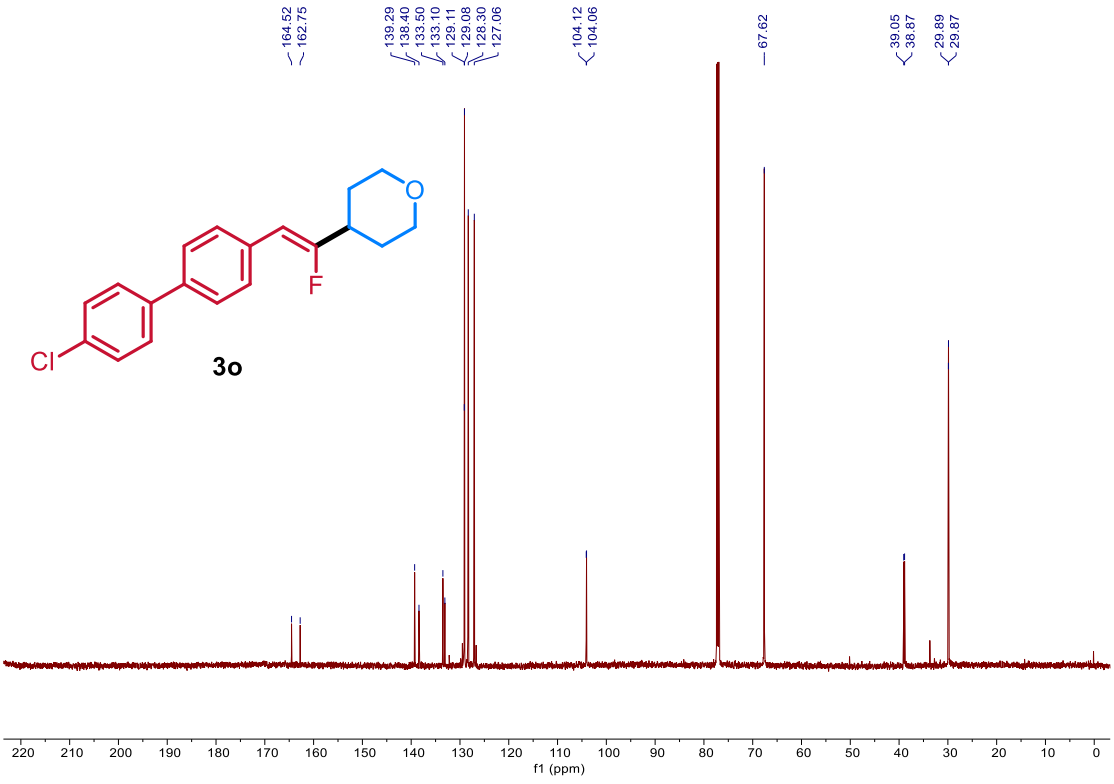

**$^{19}$F NMR of Compound 3n (375 MHz, Chloroform-*d*):**



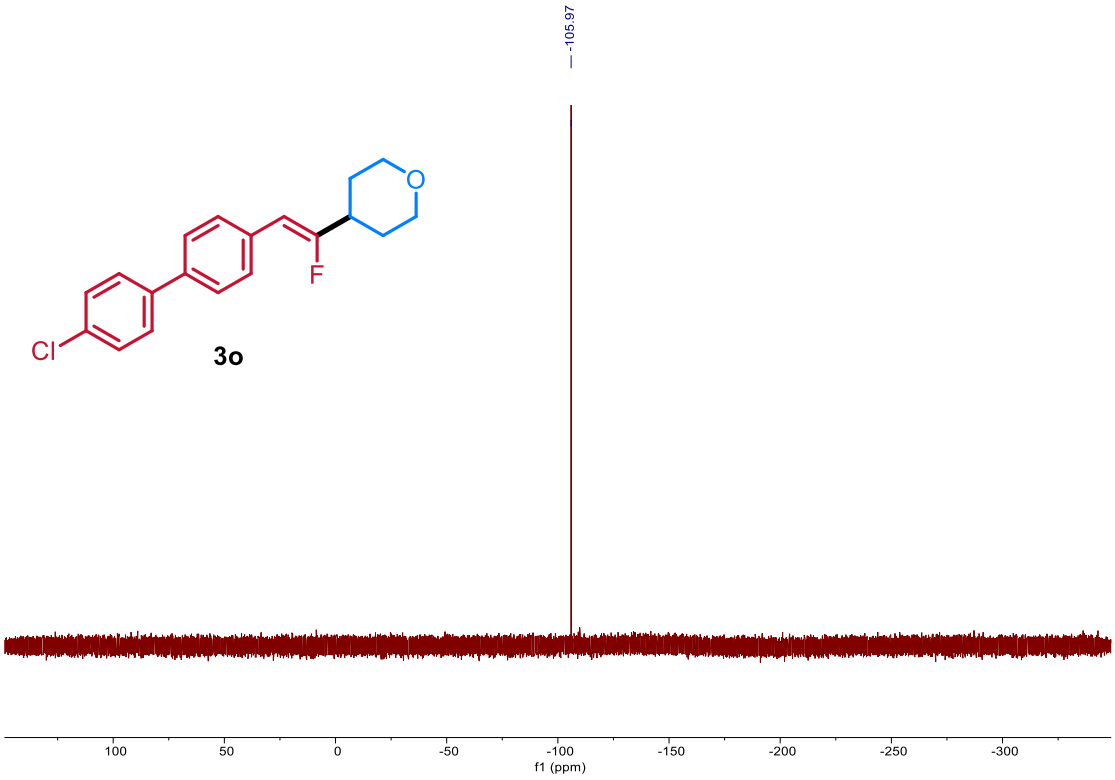
**$^{1}$H NMR of Compound 3o (600 MHz, Chloroform-*d*):**



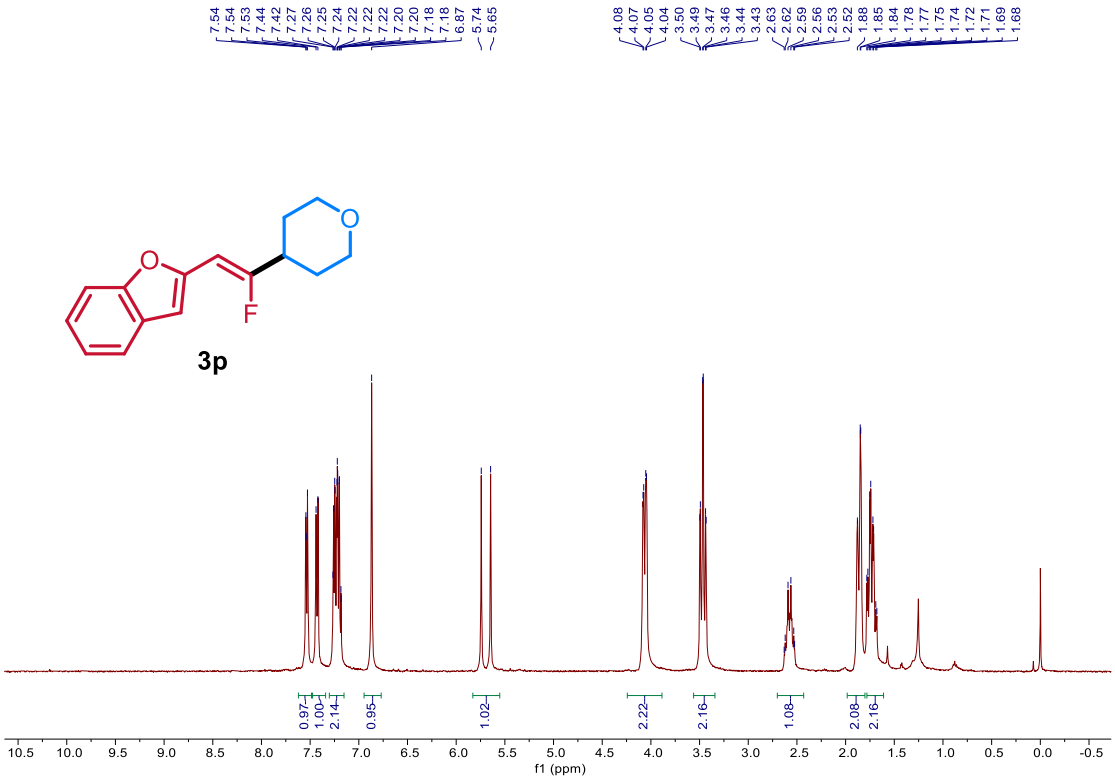

**$^{13}$C NMR of Compound 3o (150 MHz, Chloroform-*d*):**



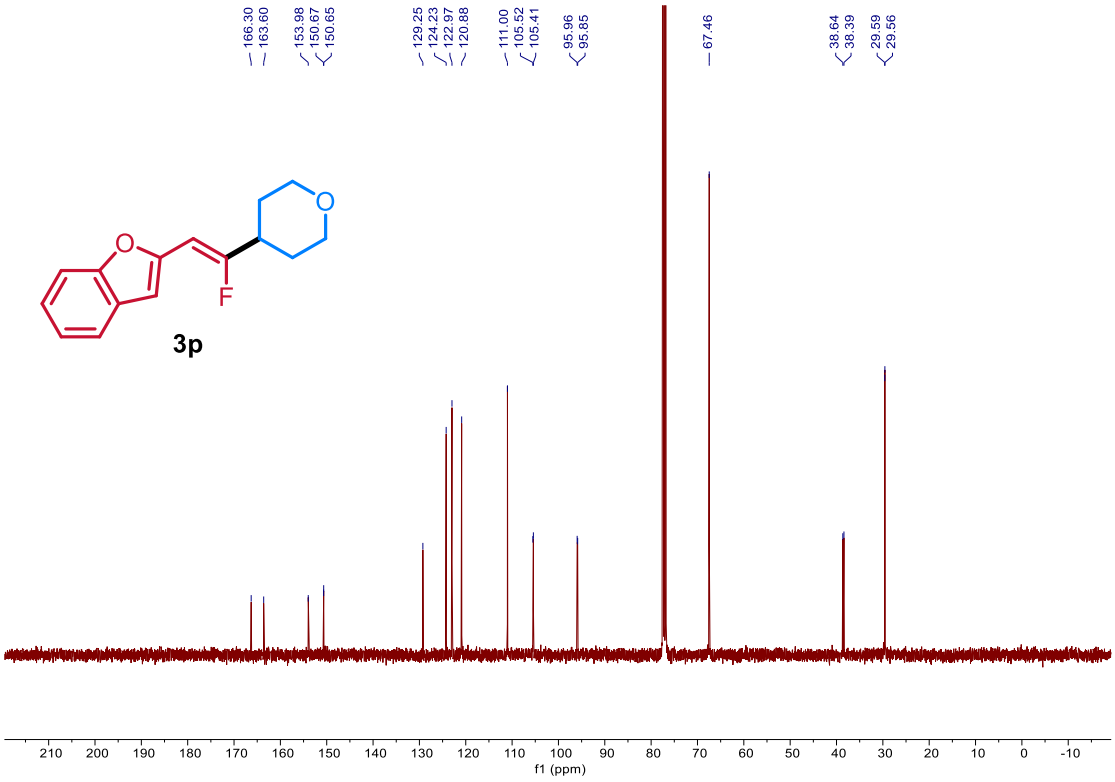
**$^{19}$F NMR of Compound 3o (375 MHz, Chloroform-*d*):**



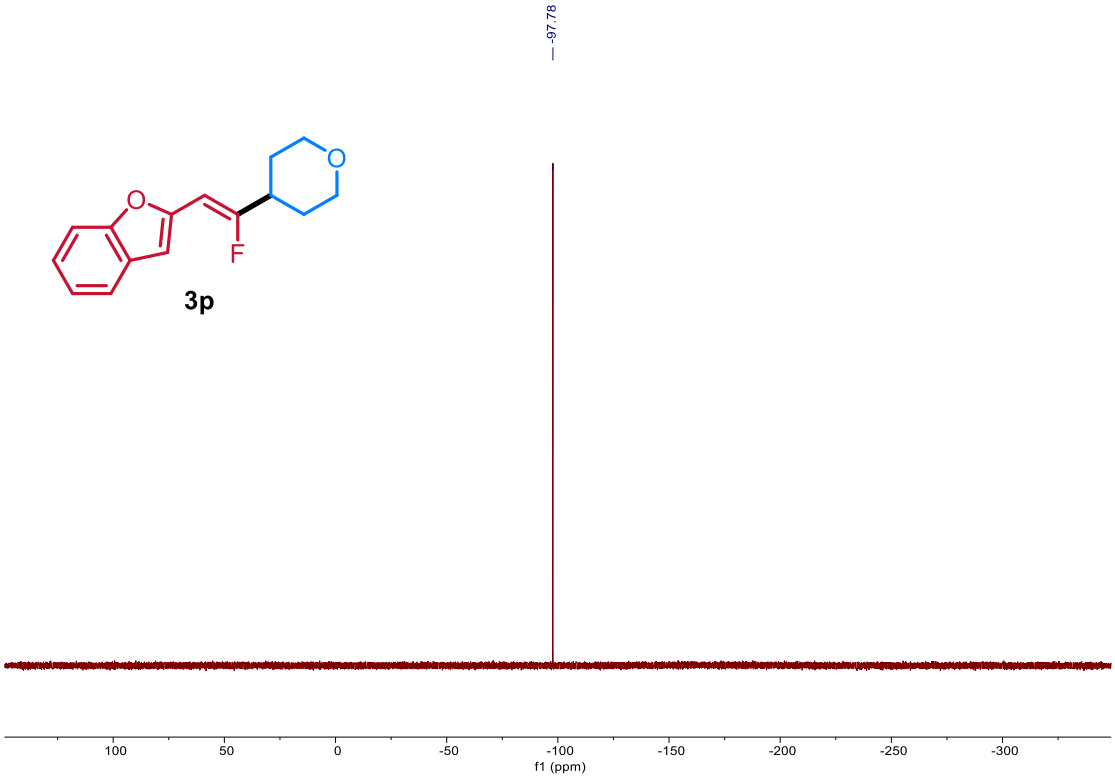

**$^{1}$H NMR of Compound 3p (400 MHz, Chloroform-*d*):**



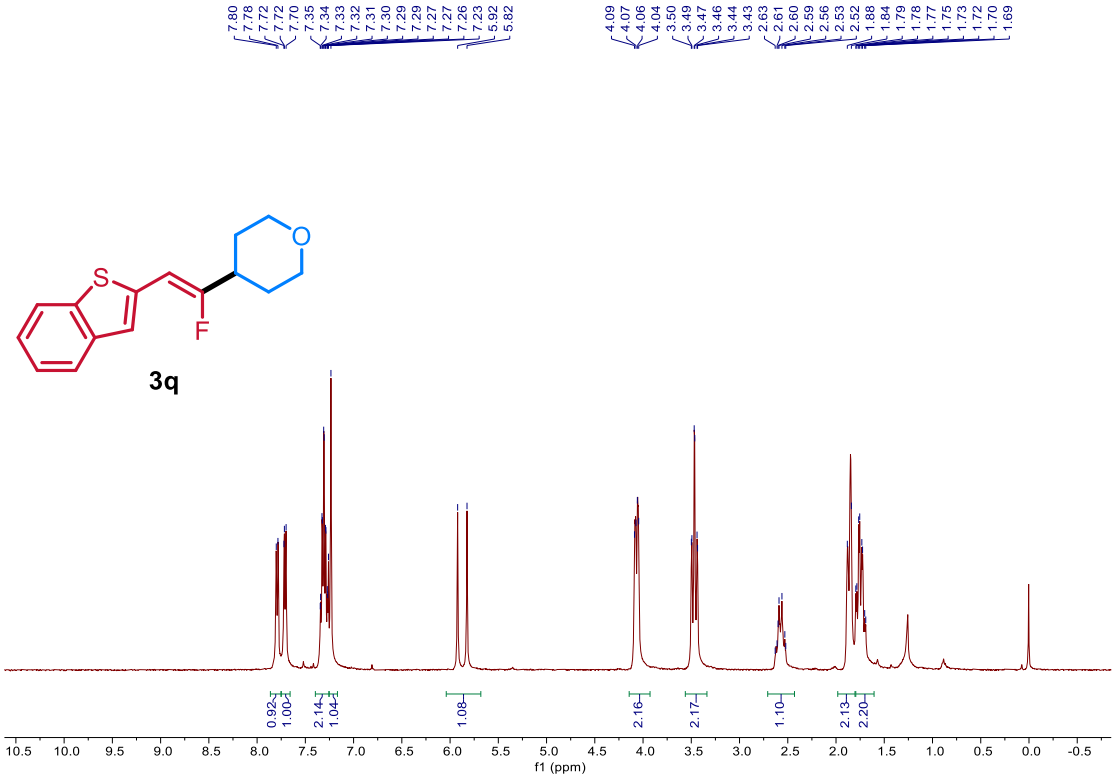
**$^{13}$C NMR of Compound 3p (100 MHz, Chloroform-*d*):**



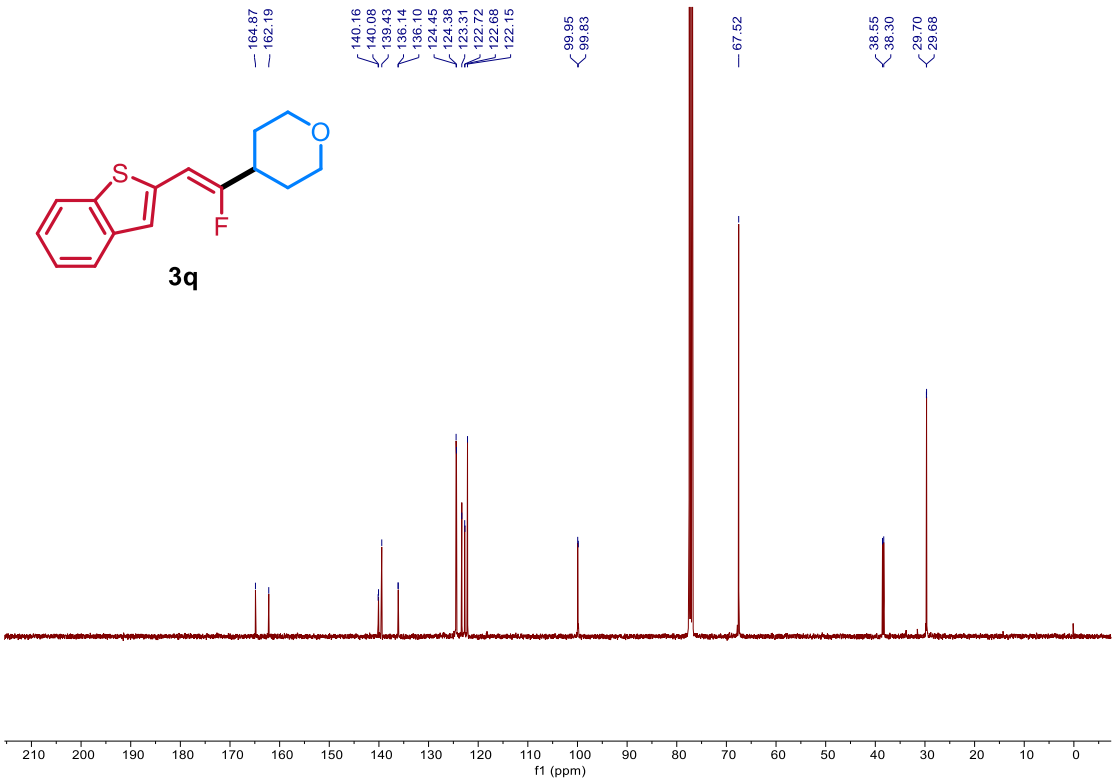

**$^{19}$F NMR of Compound 3p (375 MHz, Chloroform-*d*):**



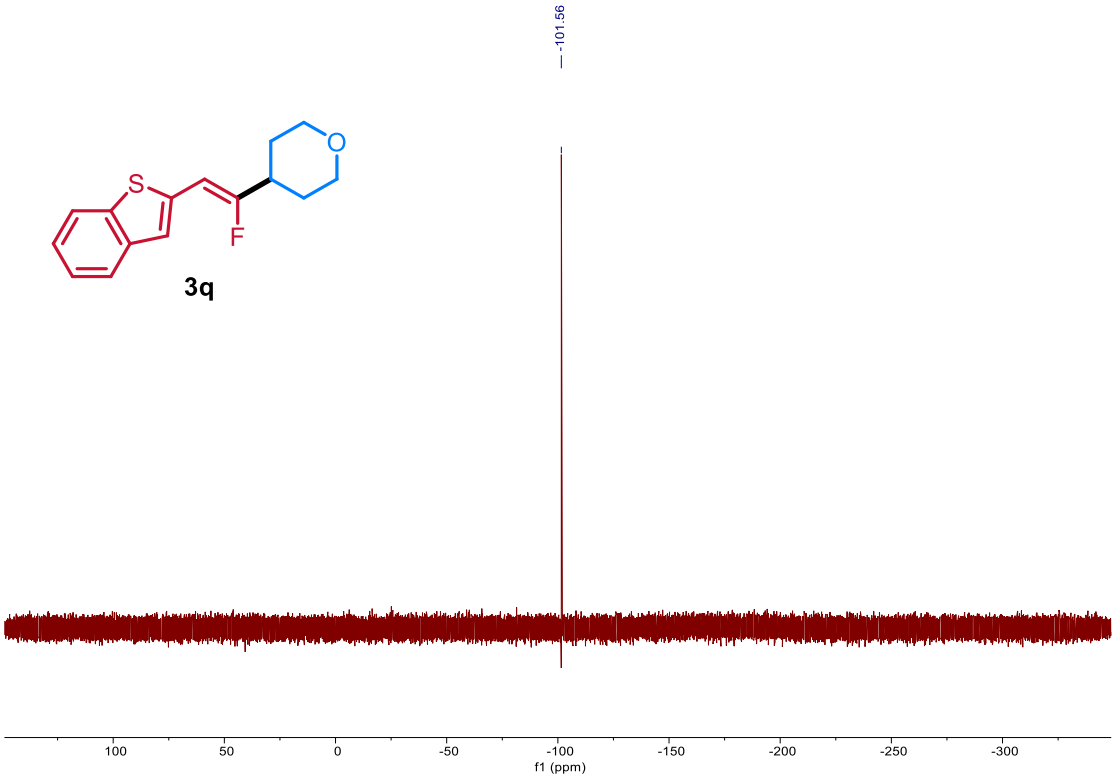
## $^{1}$H NMR of Compound 3q (400 MHz, Chloroform-*d*):



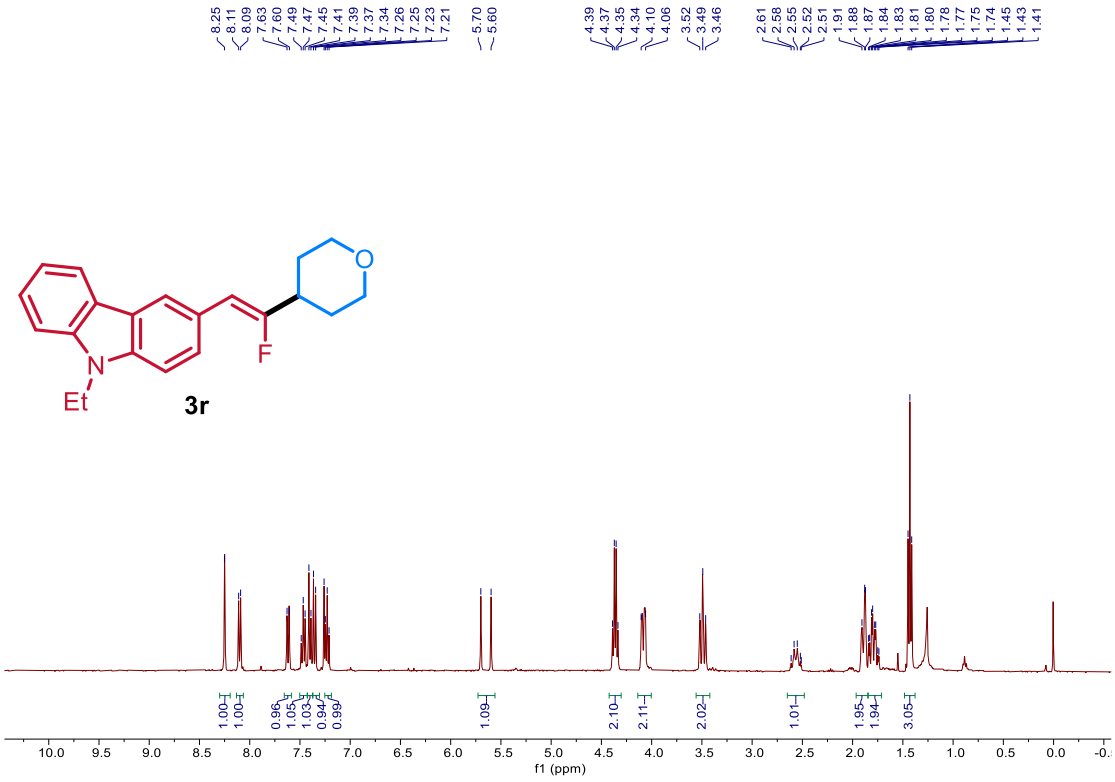

## $^{13}$C NMR of Compound 3q (100 MHz, Chloroform-*d*):



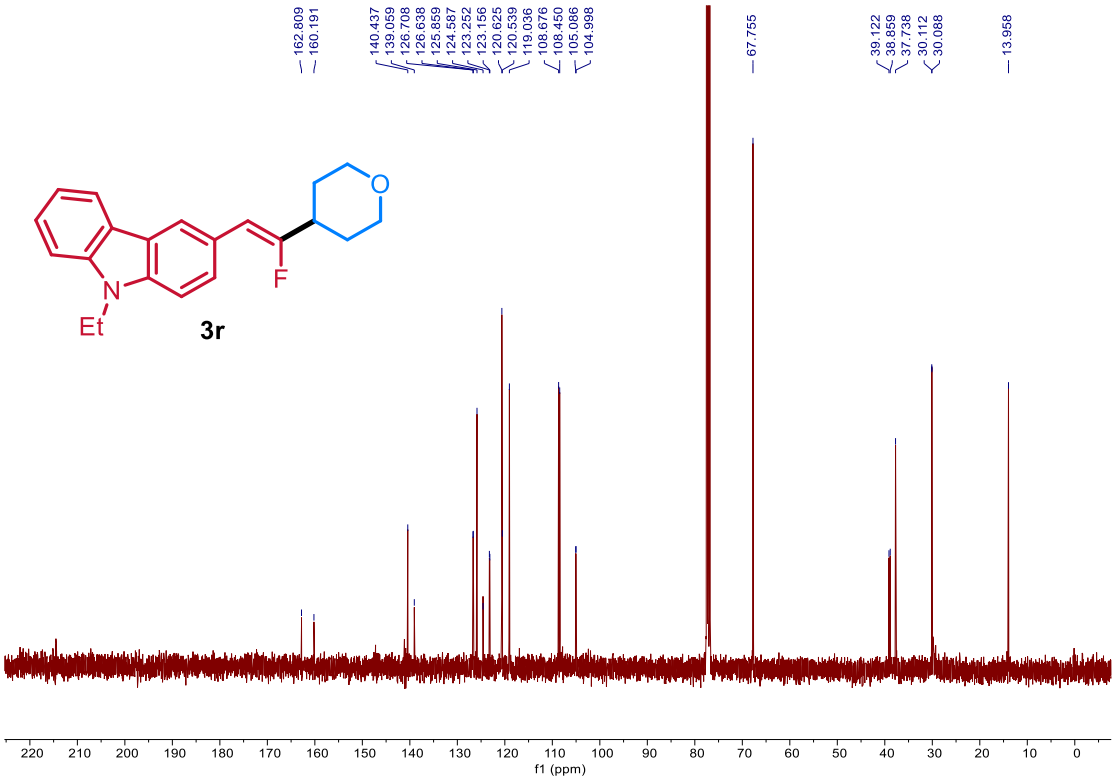
**$^{19}$F NMR of Compound 3q (375 MHz, Chloroform-*d*):**



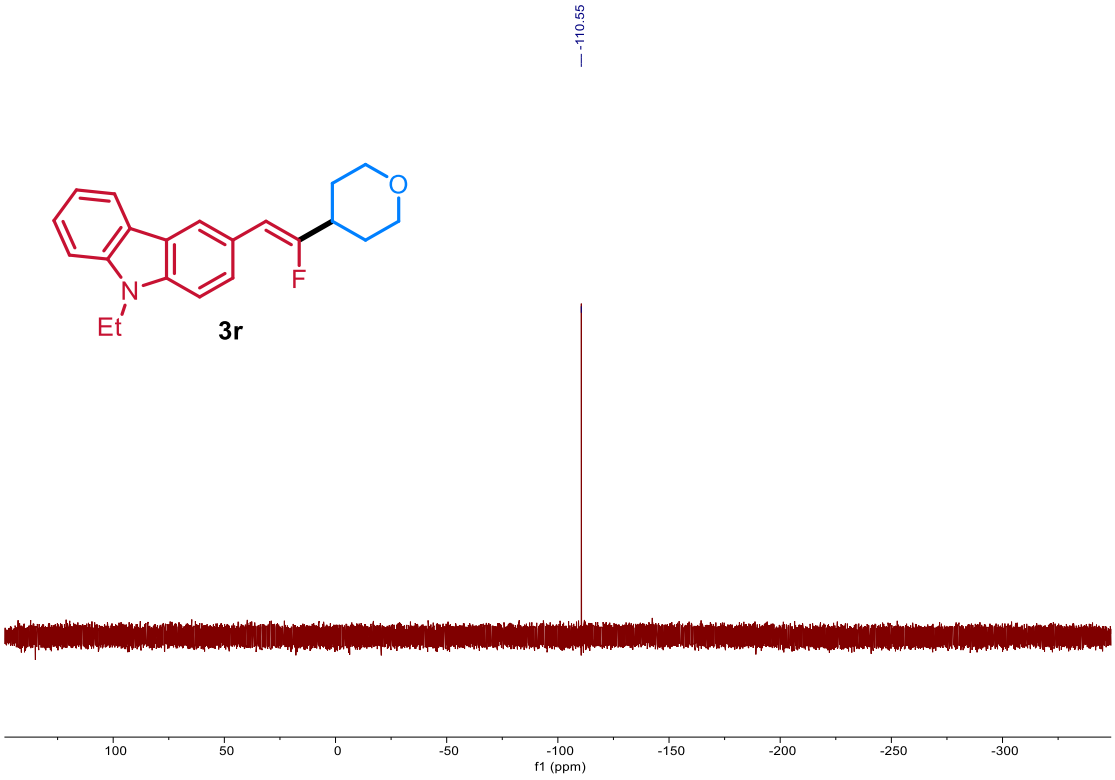

**$^{1}$H NMR of Compound 3r (400 MHz, Chloroform-*d*):**



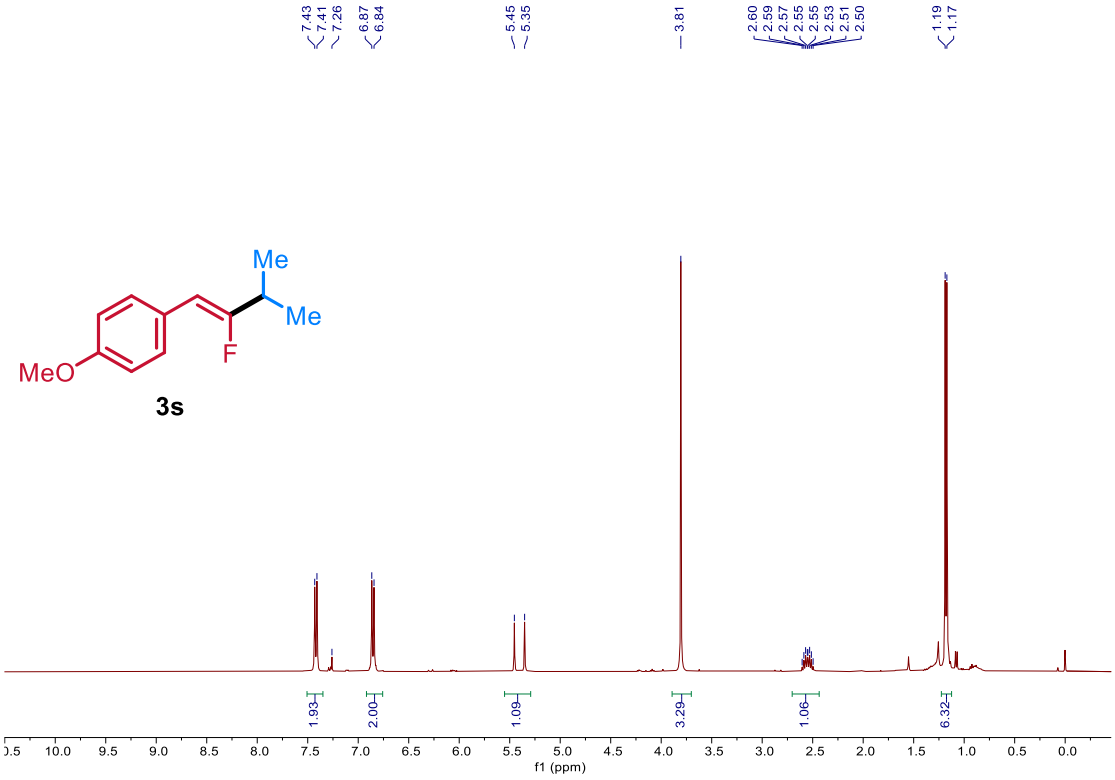
**$^{13}$C NMR of Compound 3r (100 MHz, Chloroform-*d*):**



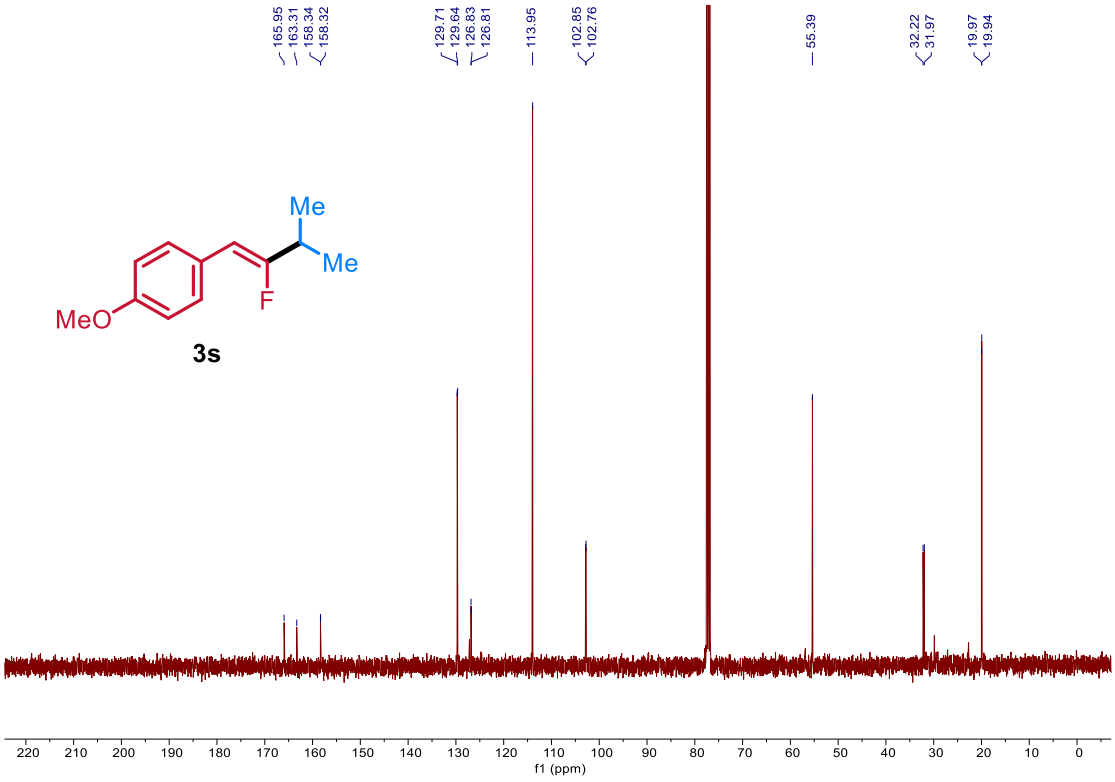

**$^{19}$F NMR of Compound 3r (375 MHz, Chloroform-*d*):**



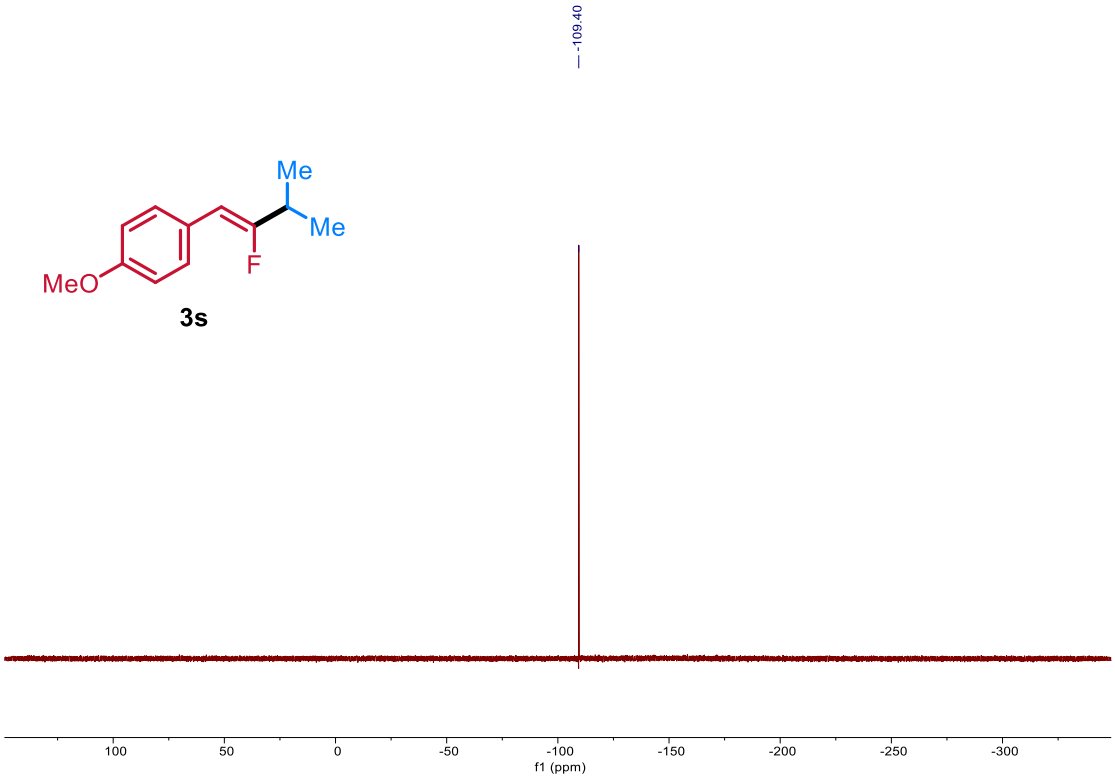
## $^{1}$H NMR of Compound 3s (400 MHz, Chloroform-*d*):



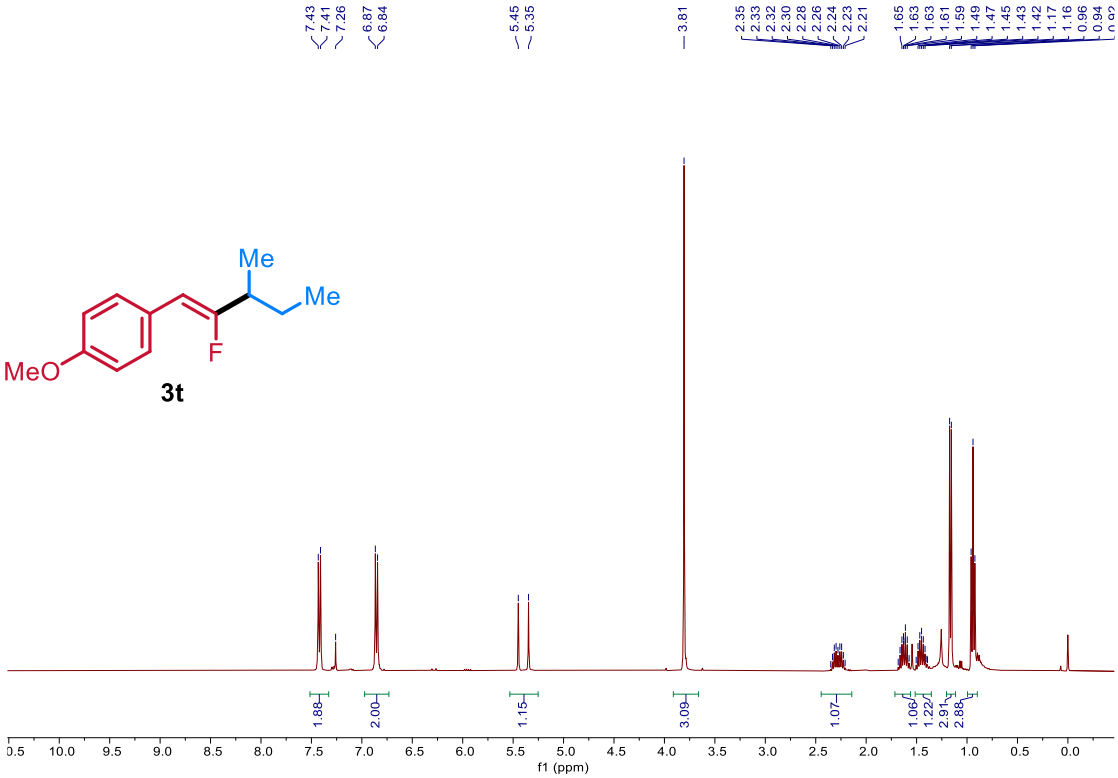

## $^{13}$C NMR of Compound 3s (100 MHz, Chloroform-*d*):



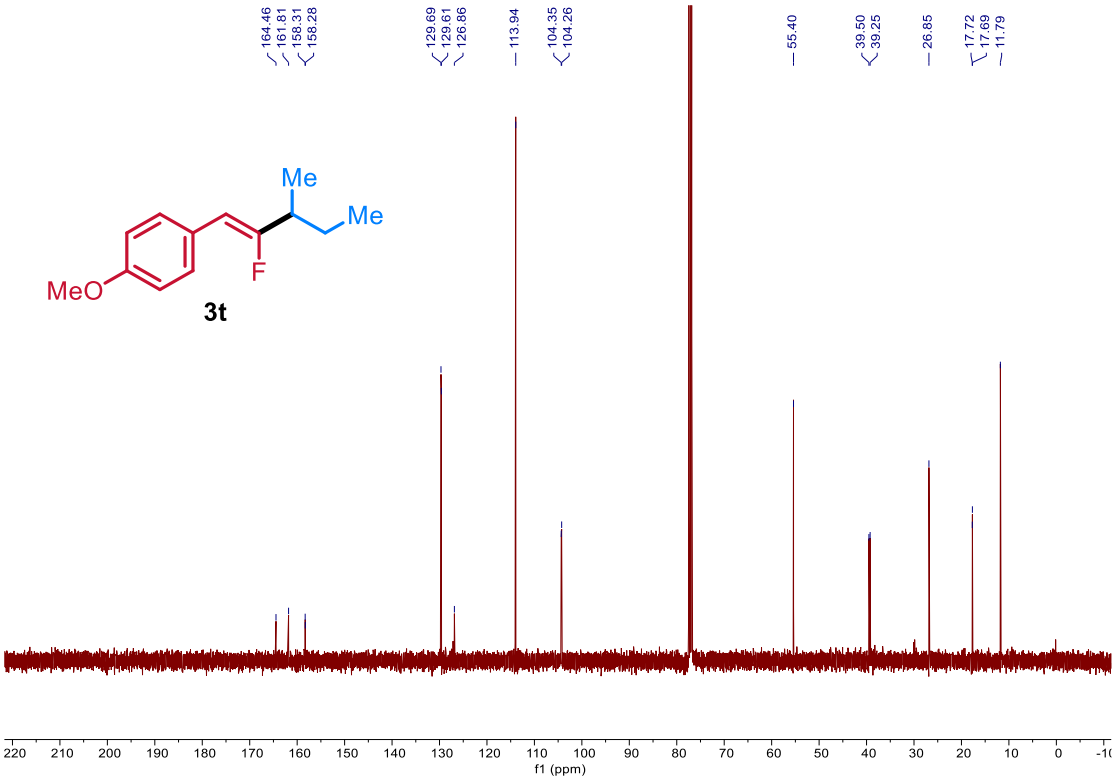
**$^{19}$F NMR of Compound 3s (375 MHz, Chloroform-*d*):**



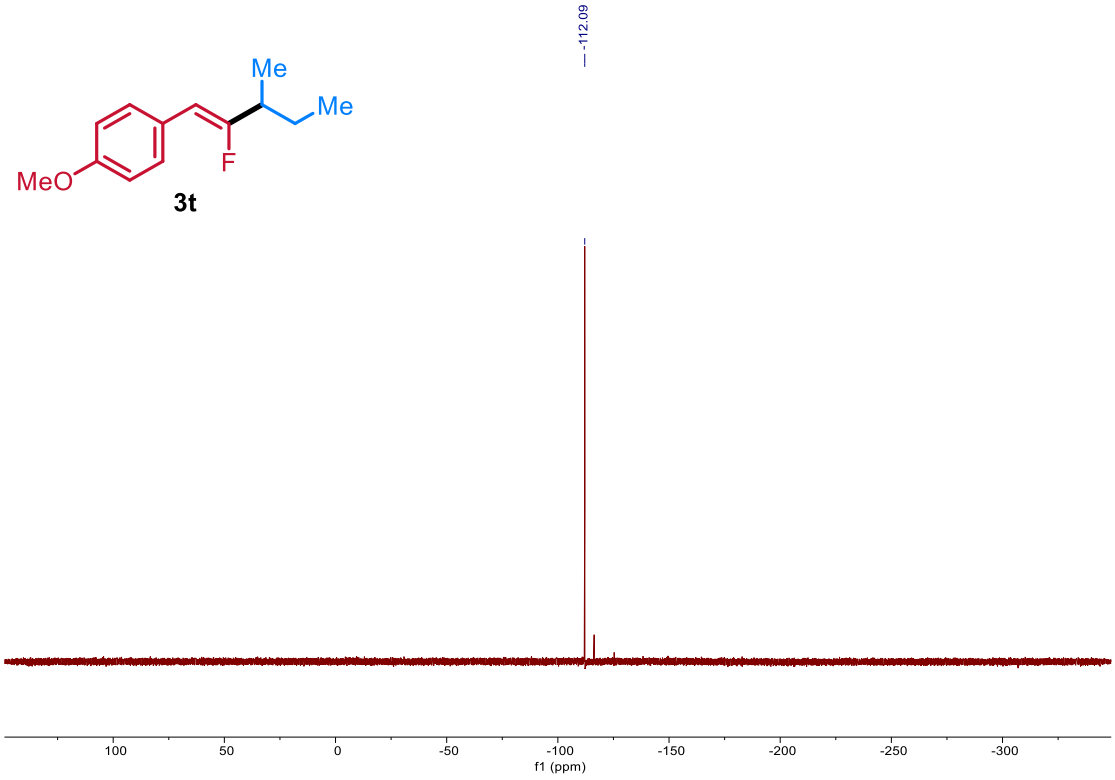

**$^{1}$H NMR of Compound 3t (400 MHz, Chloroform-*d*):**



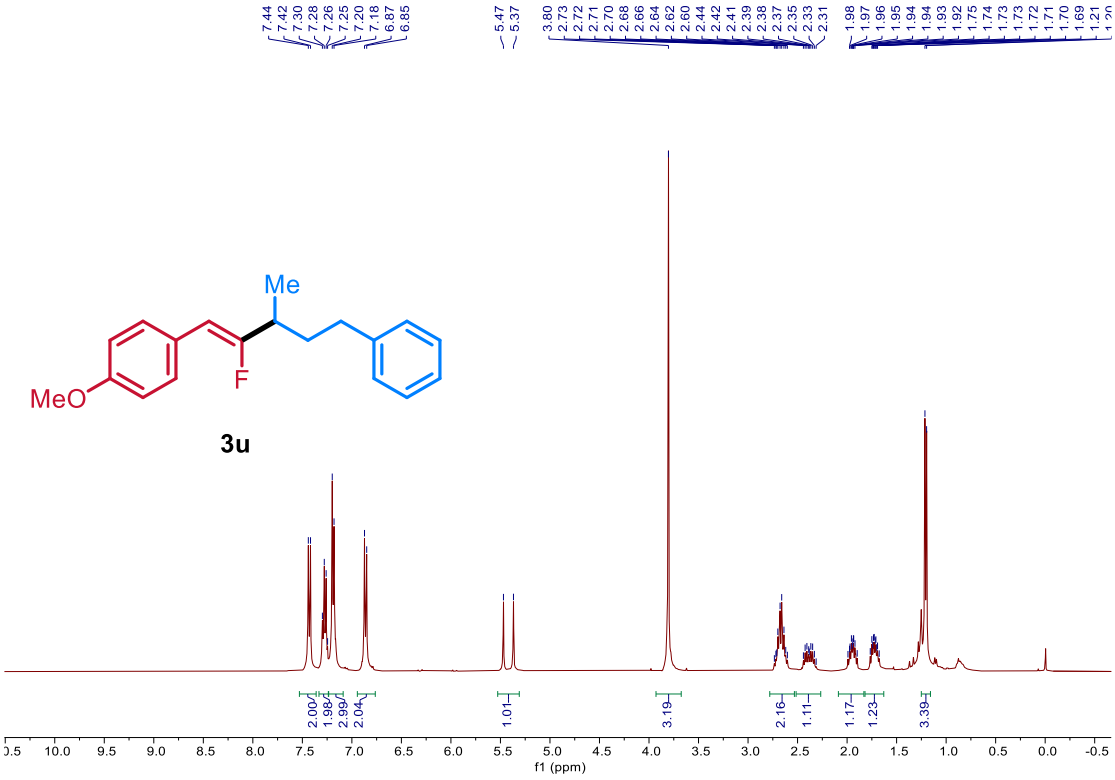
**$^{13}$C NMR of Compound 3t (100 MHz, Chloroform-*d*):**



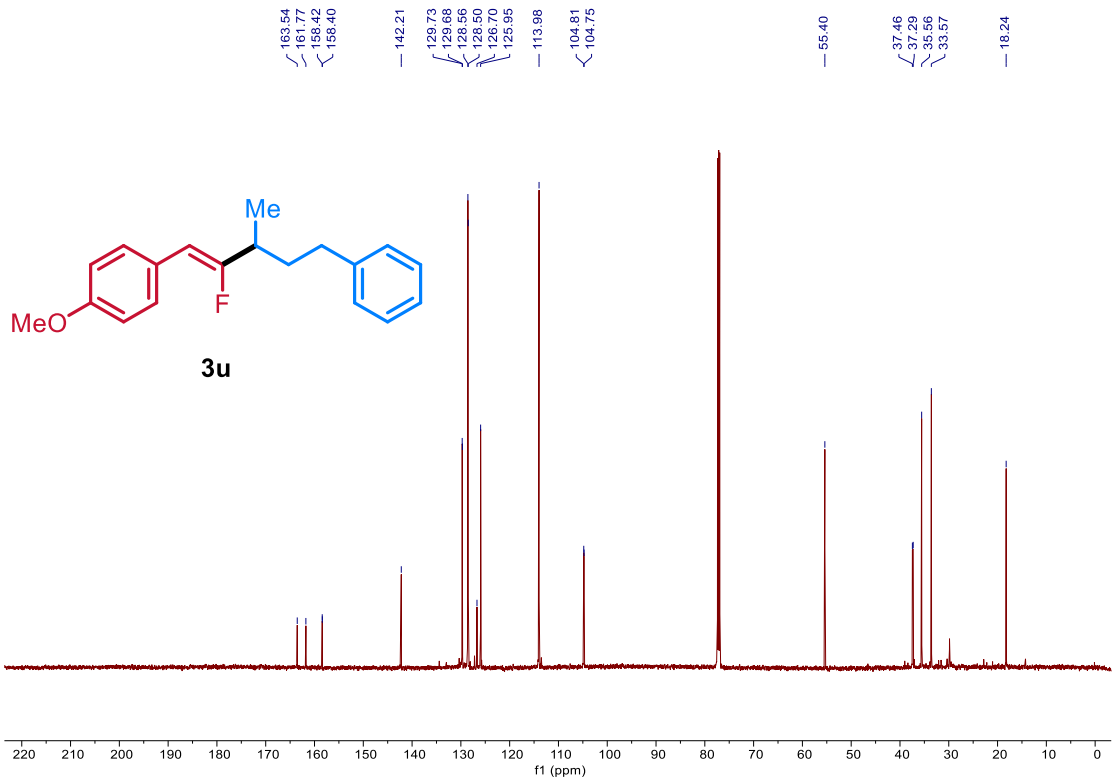

**$^{19}$F NMR of Compound 3t (375 MHz, Chloroform-*d*):**



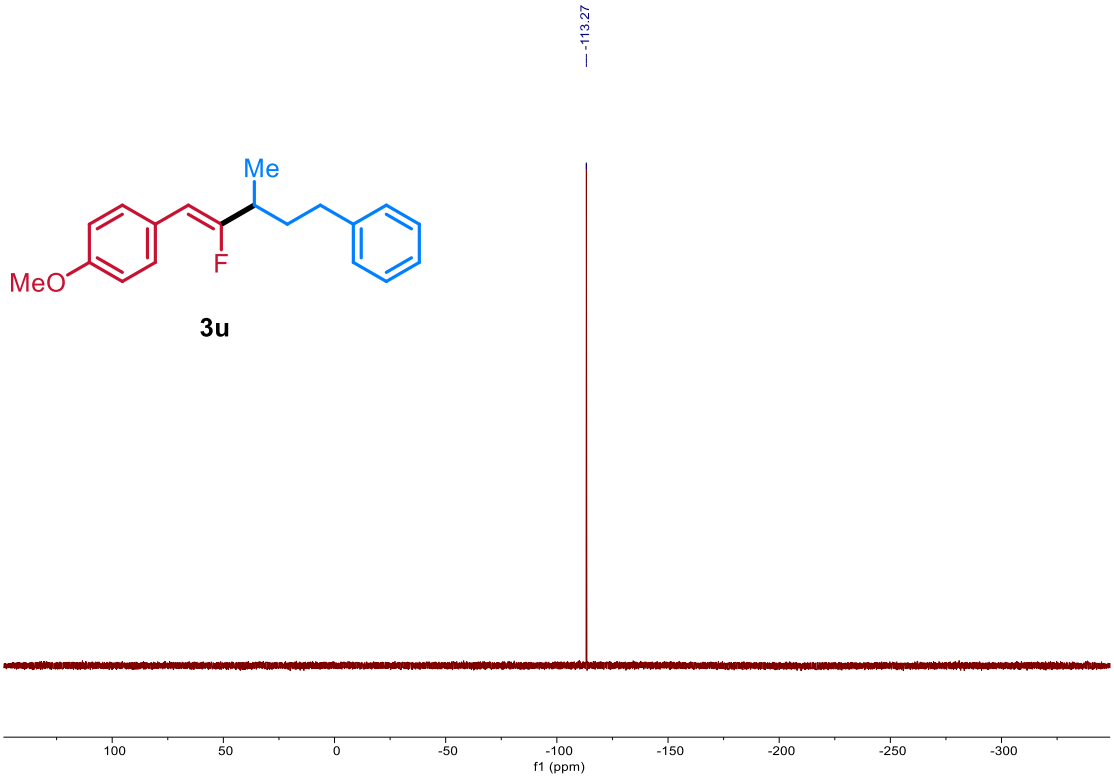
## $^{1}$H NMR of Compound 3u (400 MHz, Chloroform-*d*):



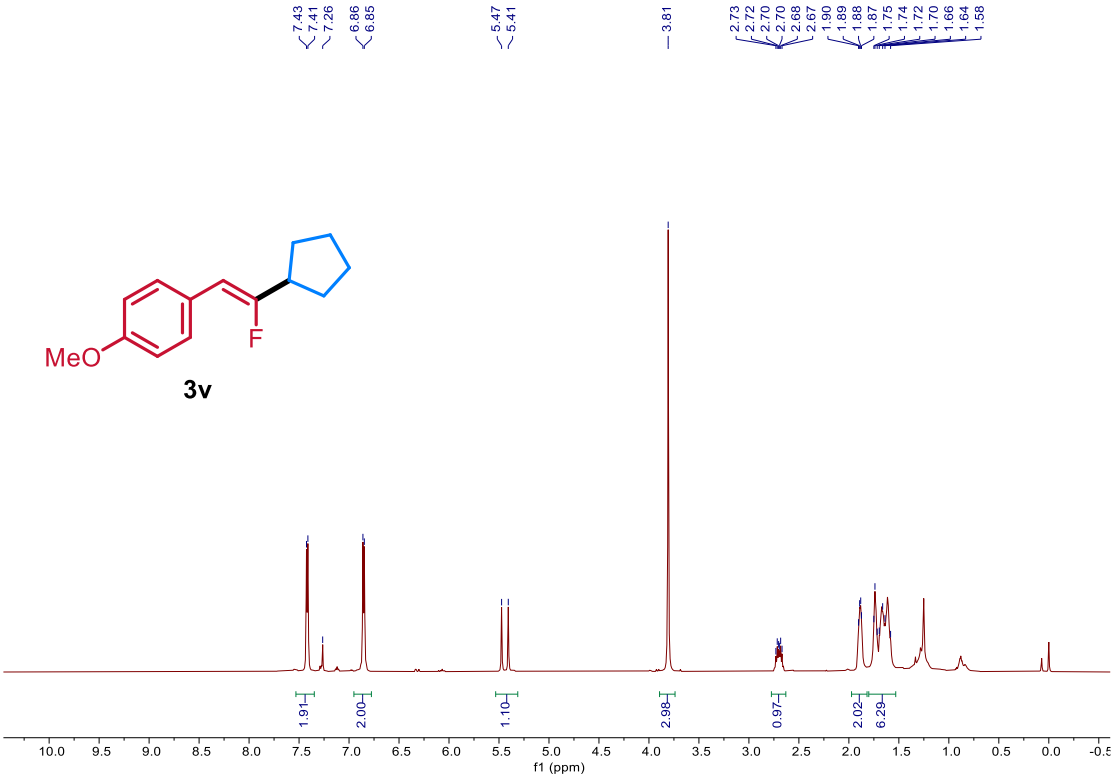

## $^{13}$C NMR of Compound 3u (150 MHz, Chloroform-*d*):



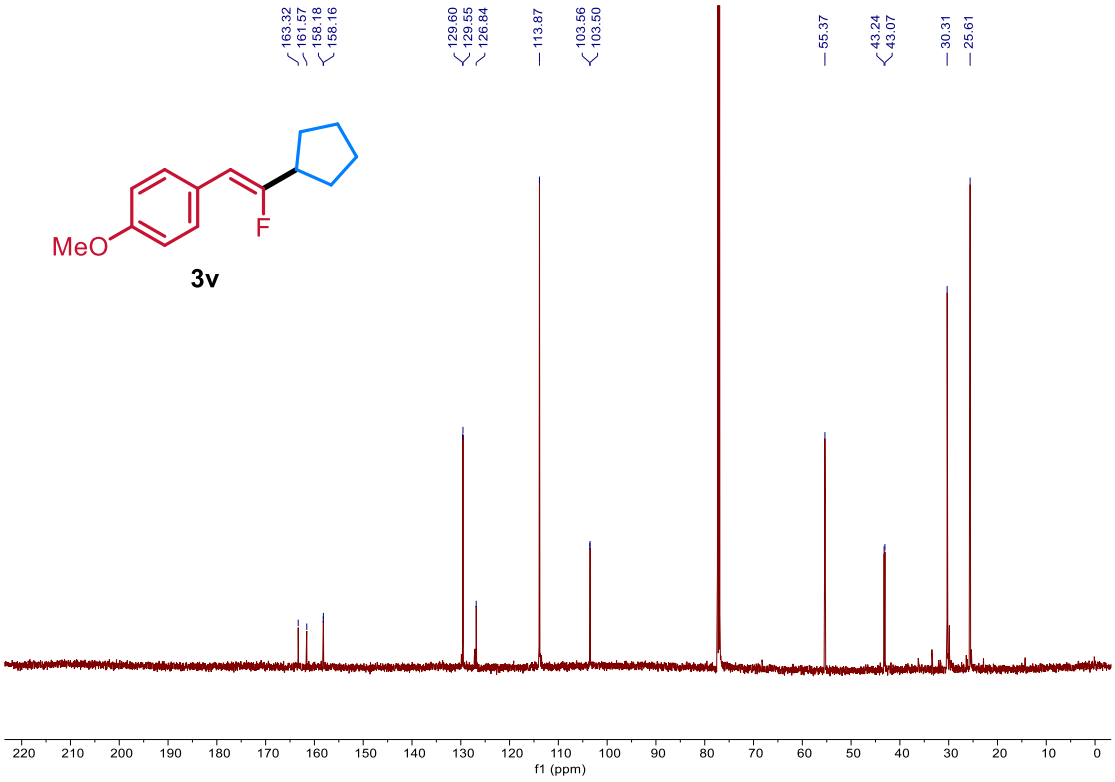
**$^{19}$F NMR of Compound 3u (375 MHz, Chloroform-*d*):.**



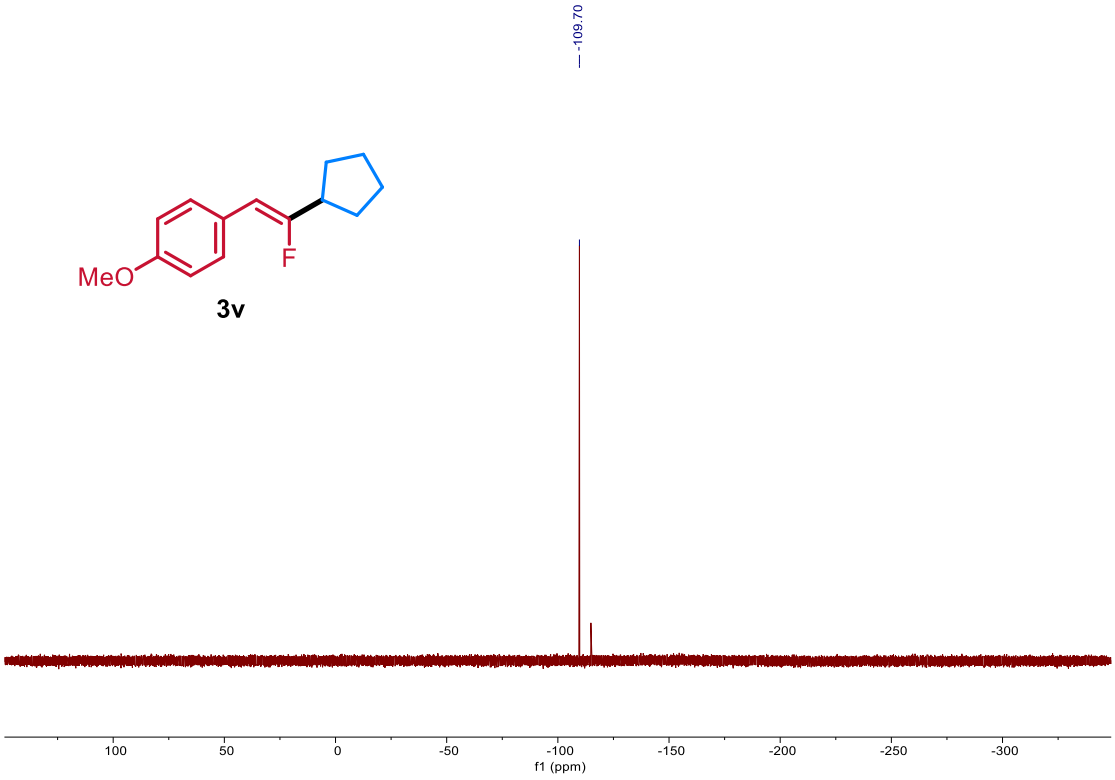

**$^{1}$H NMR of Compound 3v (600 MHz, Chloroform-*d*):**



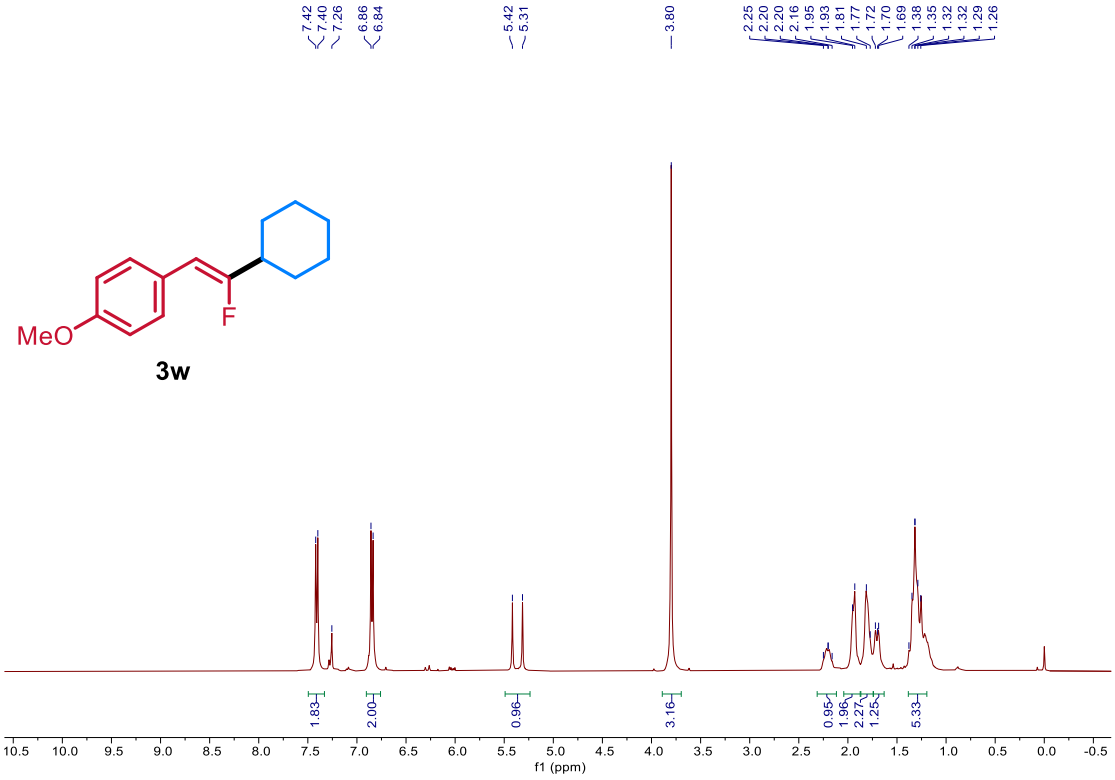
**$^{13}$C NMR of Compound 3v (150 MHz, Chloroform-*d*):**



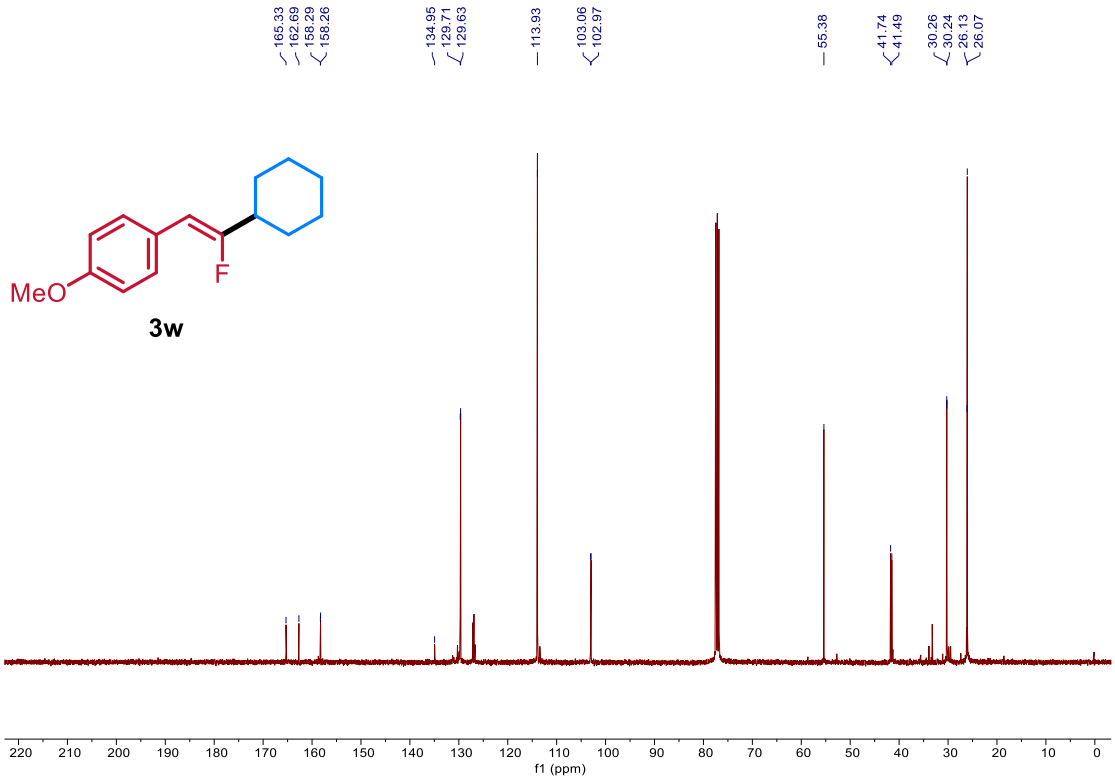

**$^{19}$F NMR of Compound 3v (375 MHz, Chloroform-*d*):**



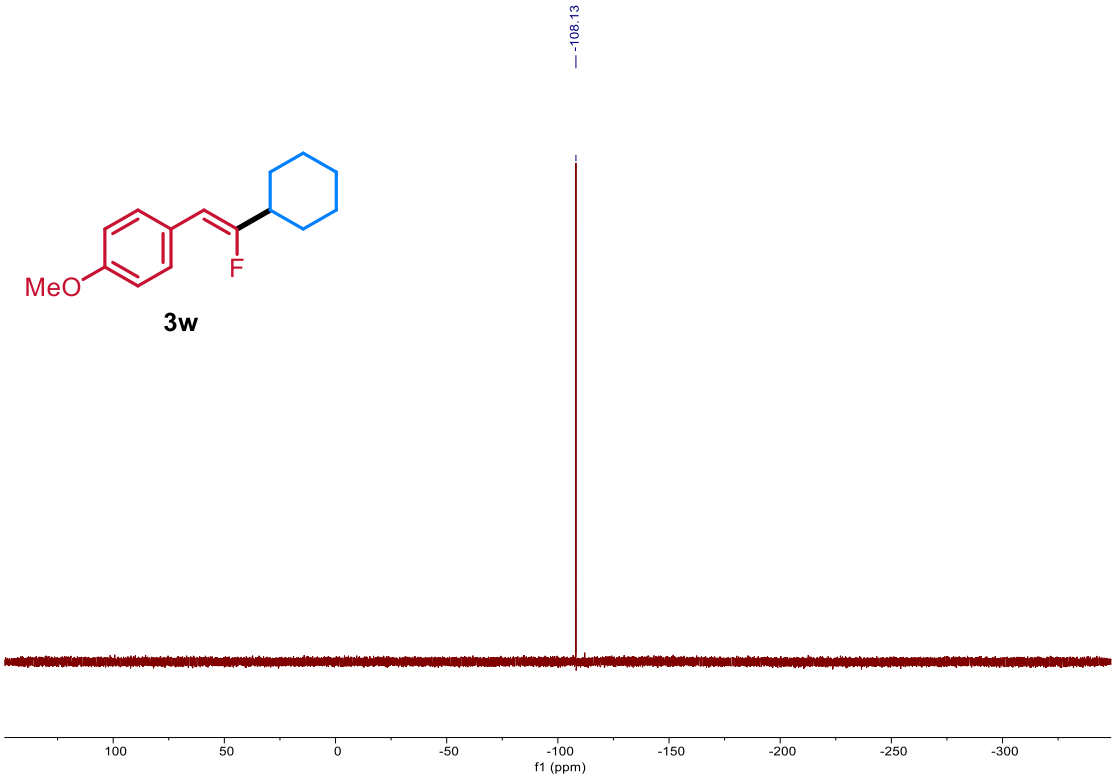
## $^{1}$H NMR of Compound 3w (400 MHz, Chloroform-*d*):



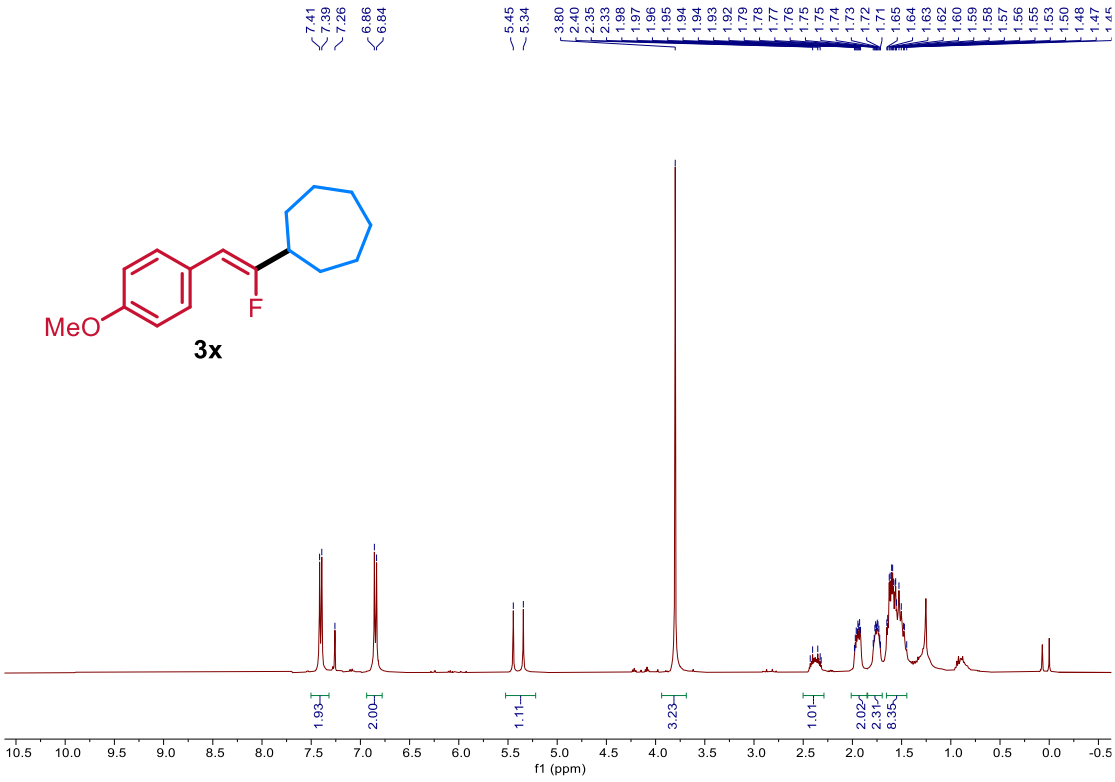

## $^{13}$C NMR of Compound 3w (100 MHz, Chloroform-*d*):



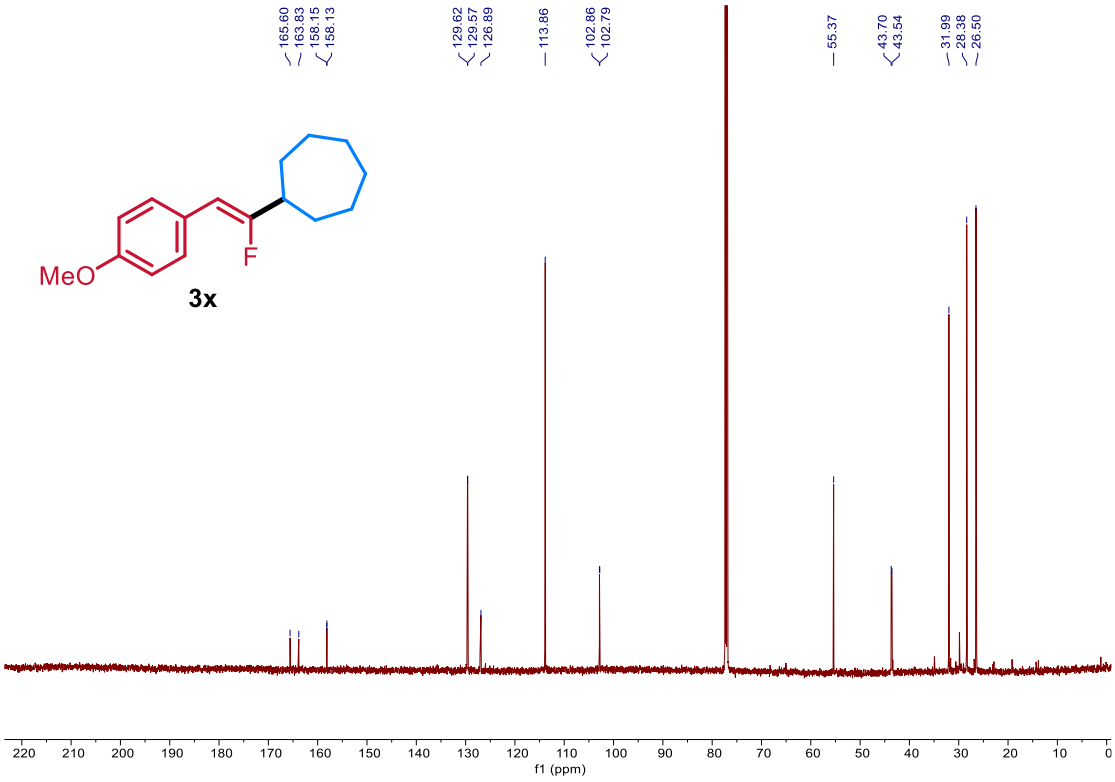
**$^{19}$F NMR of Compound 3w (375MHz, Chloroform-*d*):**



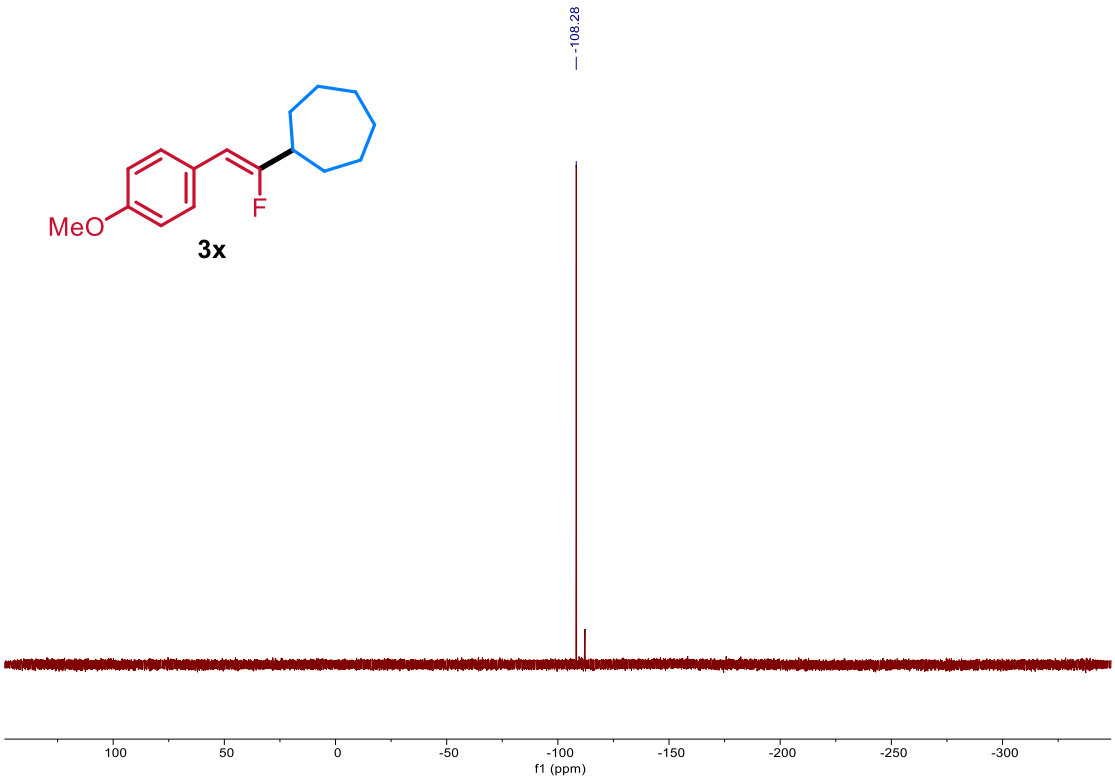

**$^{1}$H NMR of Compound 3x (400 MHz, Chloroform-*d*):**



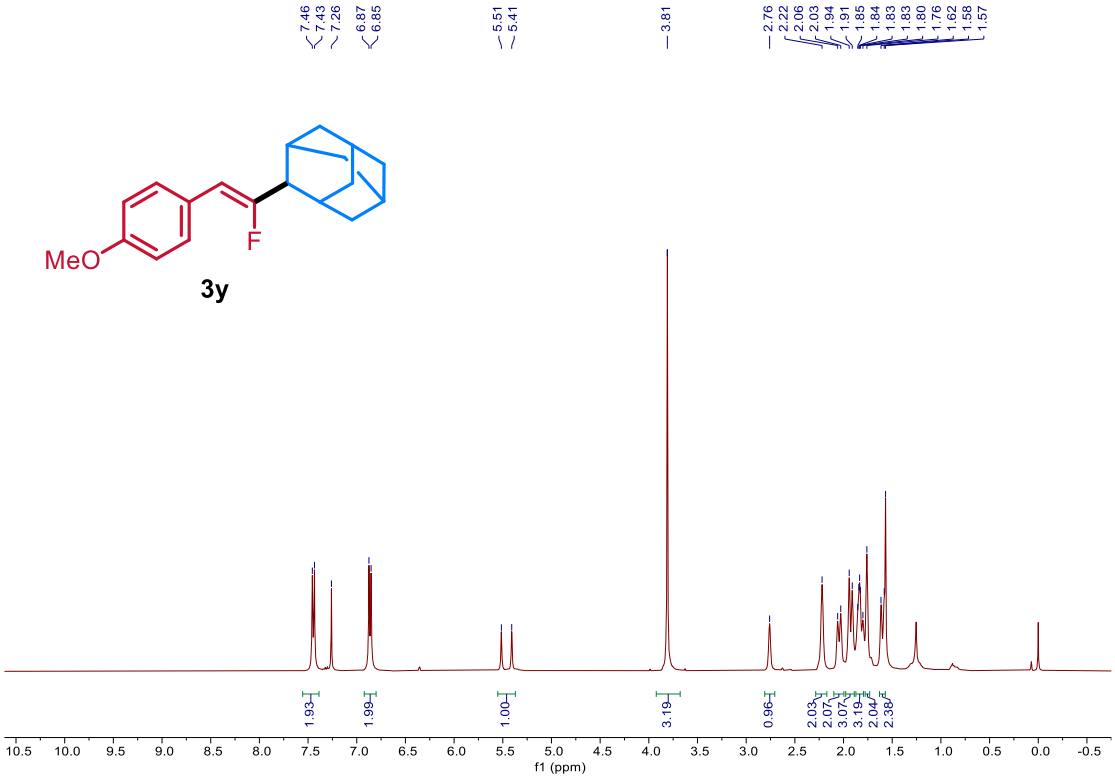
**$^{13}$C NMR of Compound 3x (150 MHz, Chloroform-*d*):**



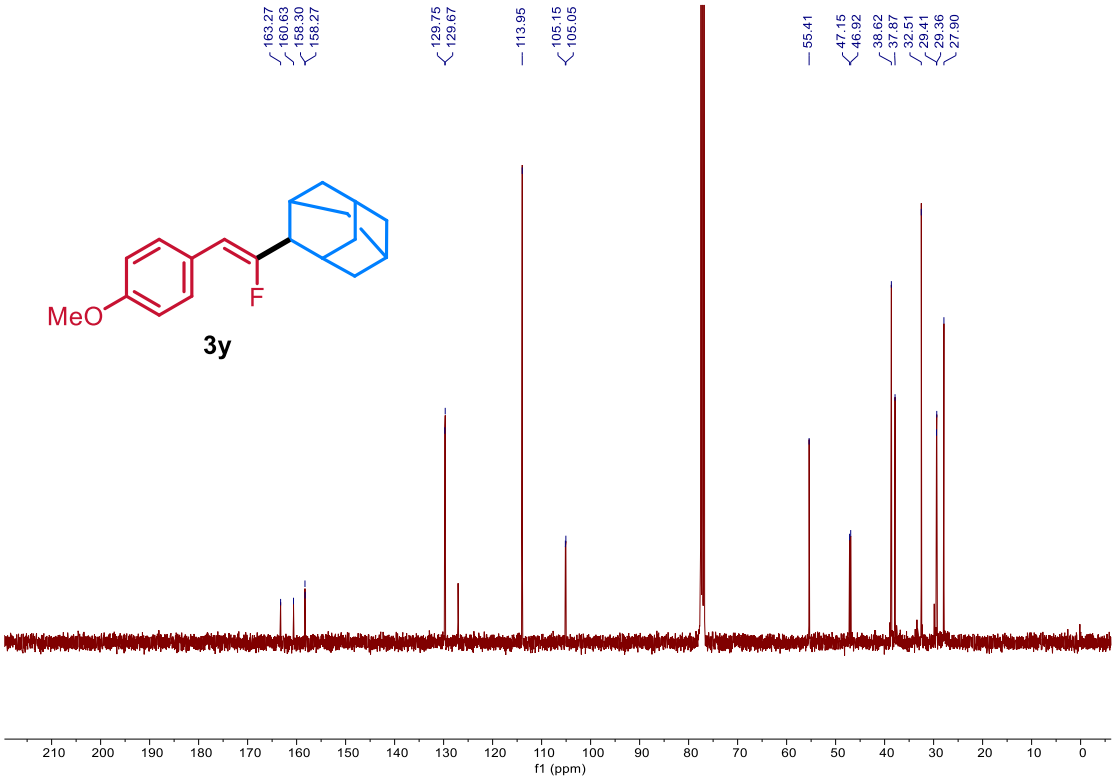

**$^{19}$F NMR of Compound 3x (375 MHz, Chloroform-*d*):**



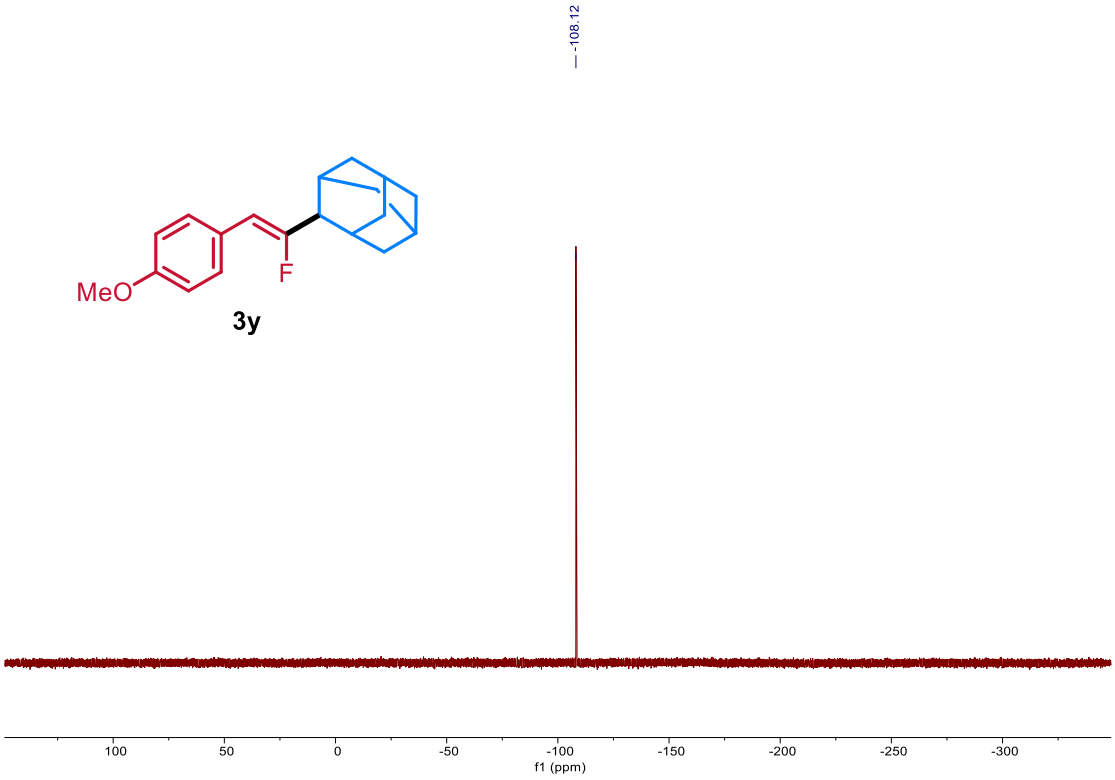
**$^{1}$H NMR of Compound 3y (400 MHz, Chloroform-*d*):**



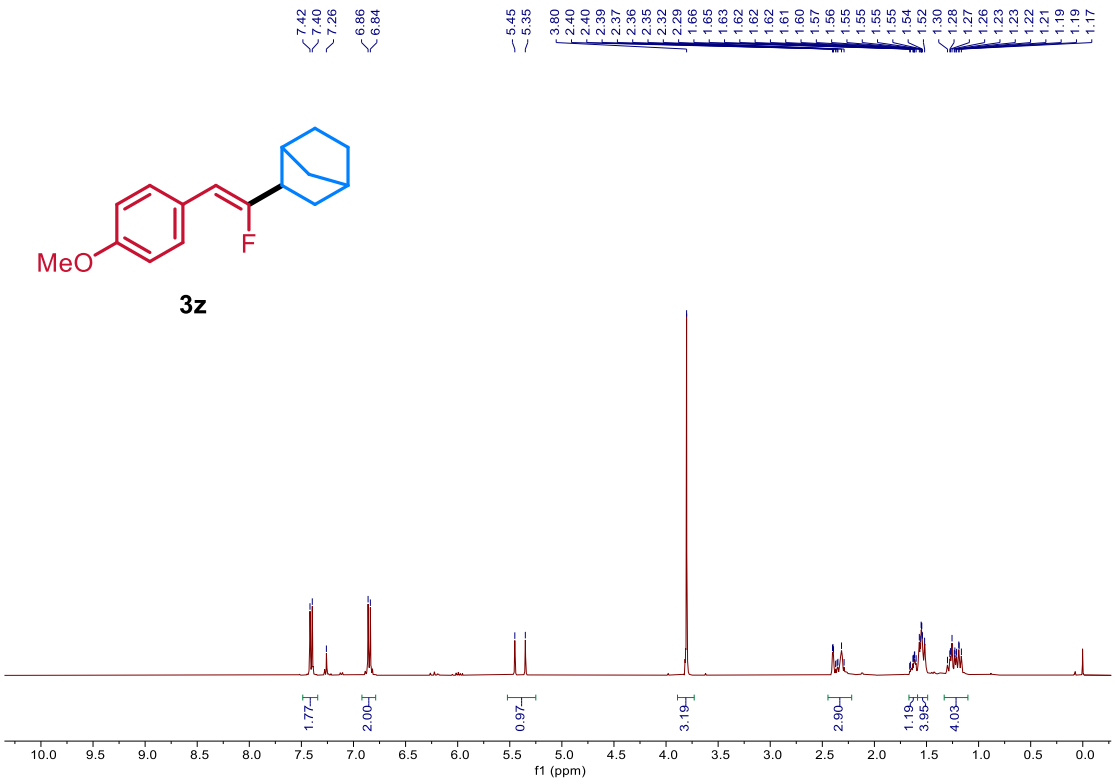

**$^{13}$C NMR of Compound 3y (100 MHz, Chloroform-*d*):**



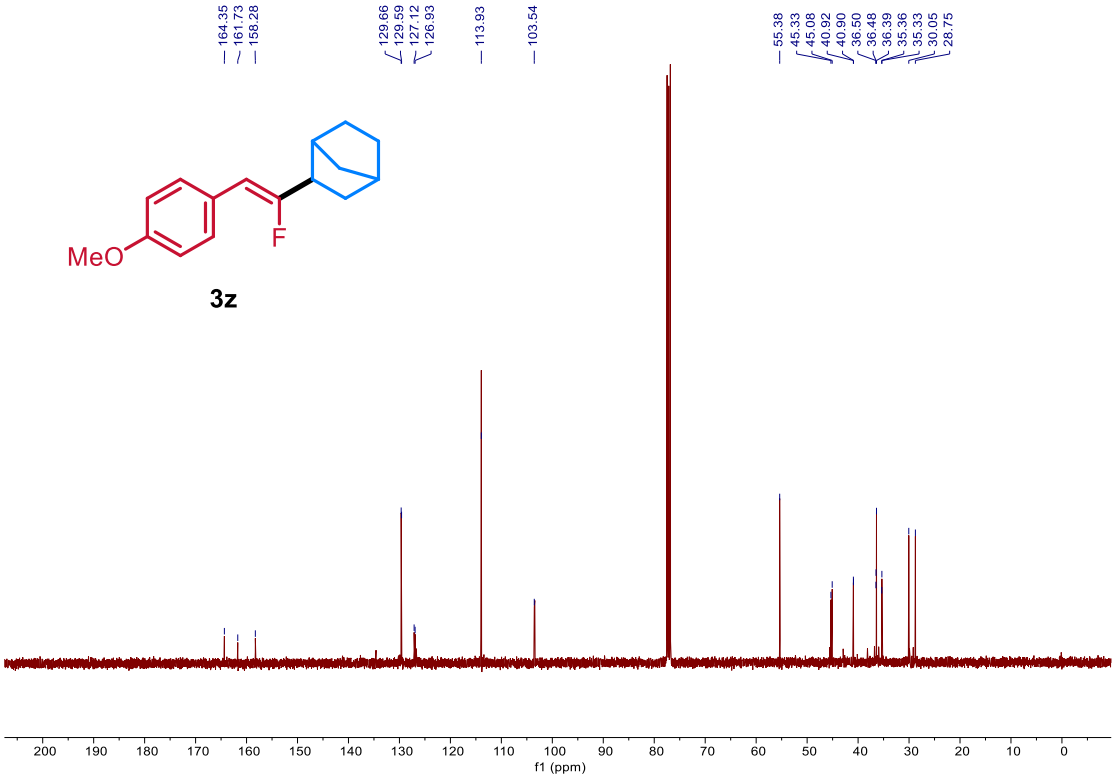
**$^{19}$F NMR of Compound 3y (375 MHz, Chloroform-*d*):**



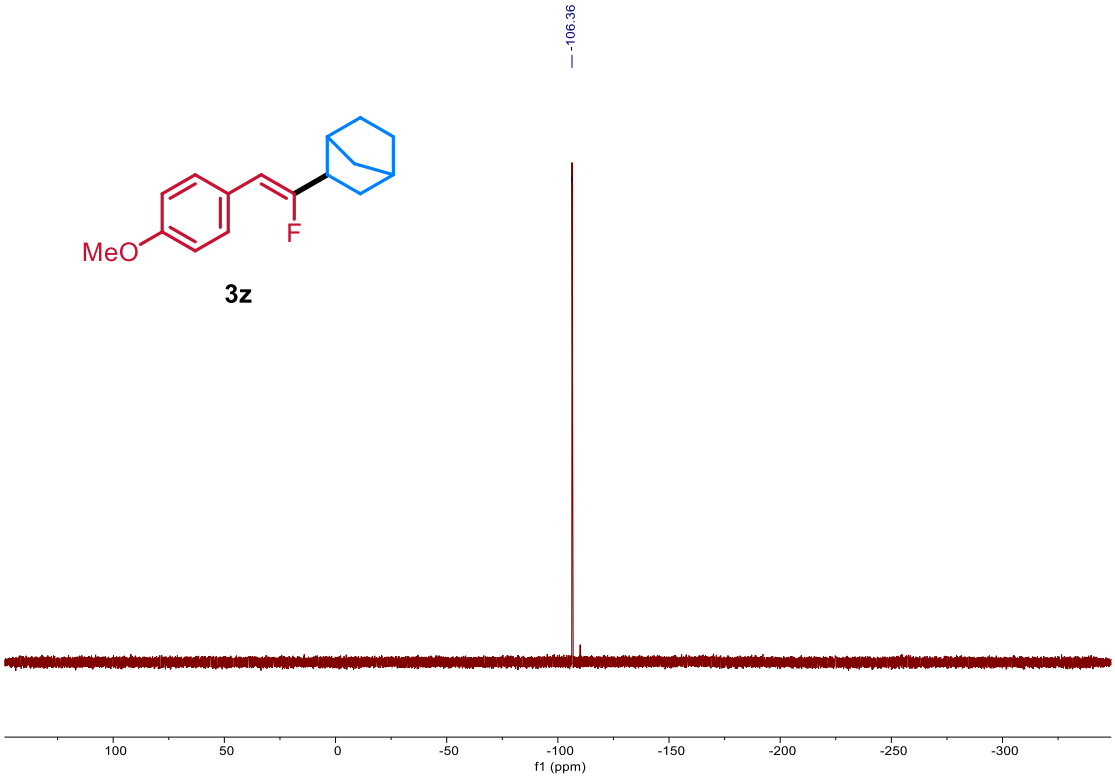

**$^{1}$H NMR of Compound 3z (400 MHz, Chloroform-*d*):**



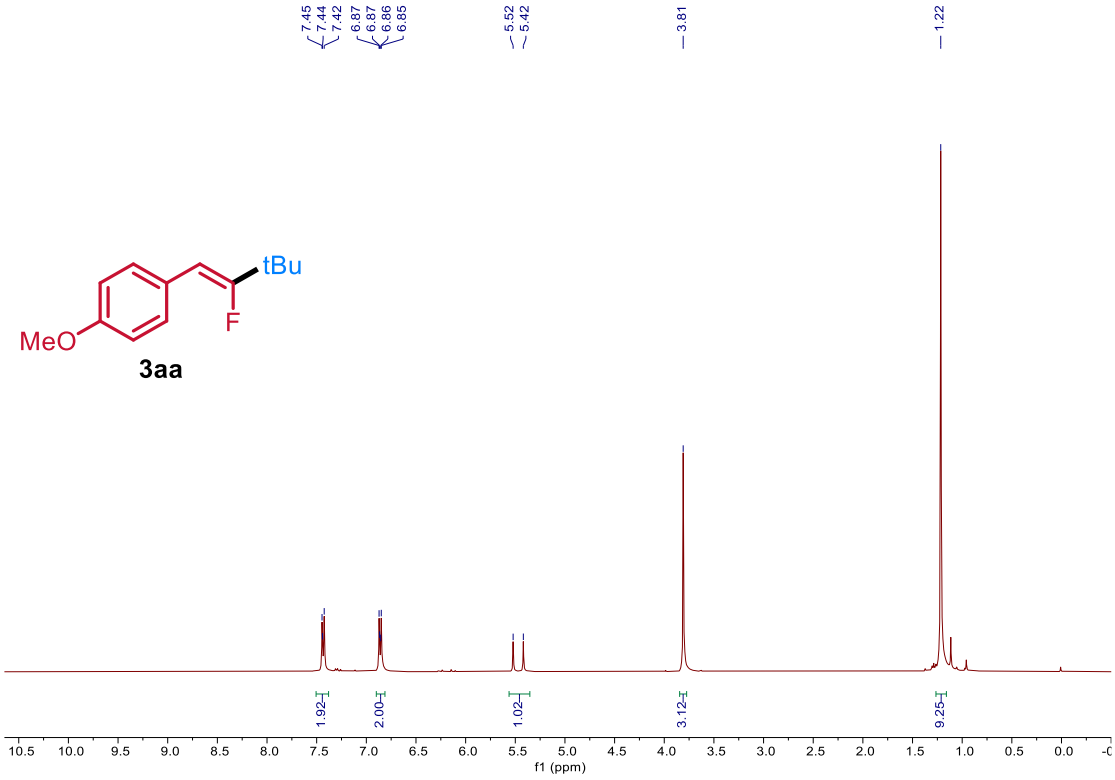
**$^{13}$C NMR of Compound 3z (100 MHz, Chloroform-*d*):**



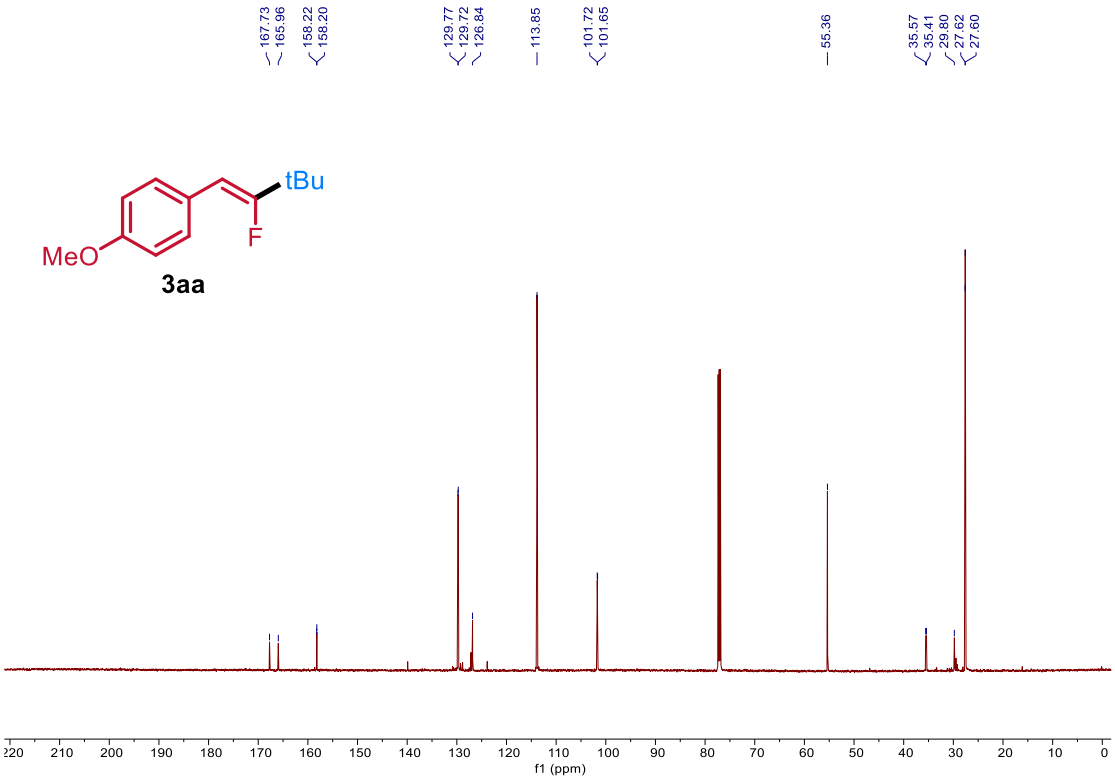

**$^{19}$F NMR of Compound 3z (375 MHz, Chloroform-*d*):**



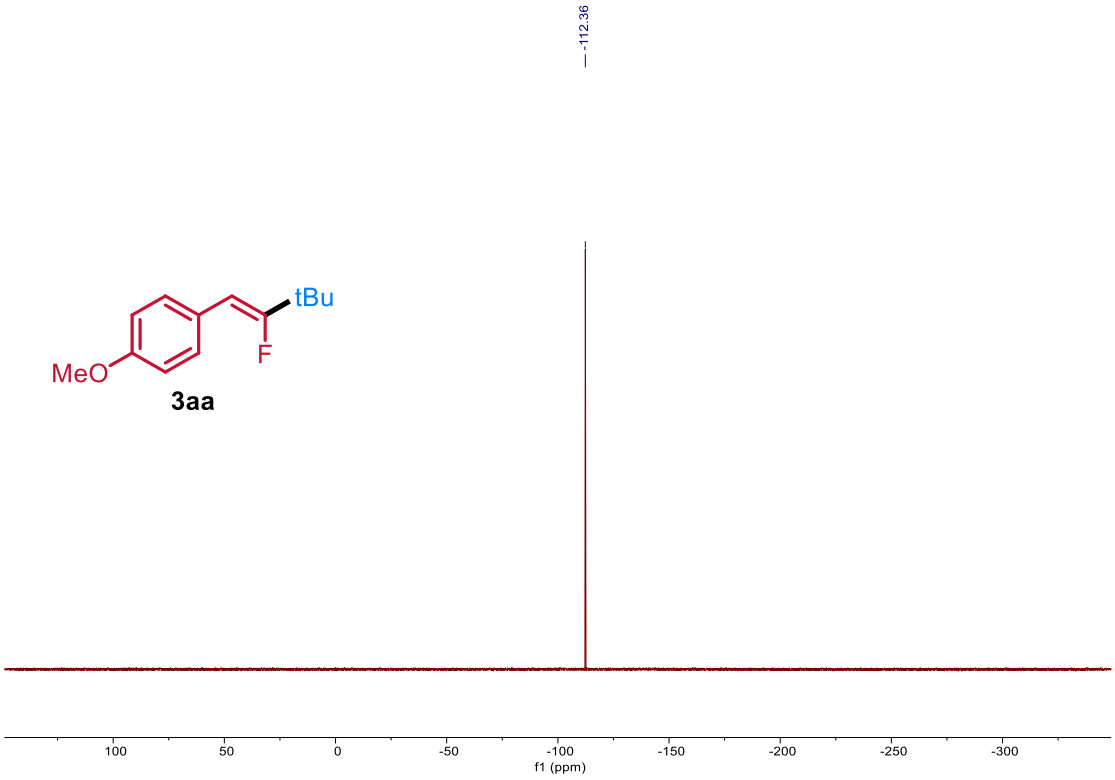
## $^{1}$H NMR of Compound 3aa (400 MHz, Chloroform-*d*):



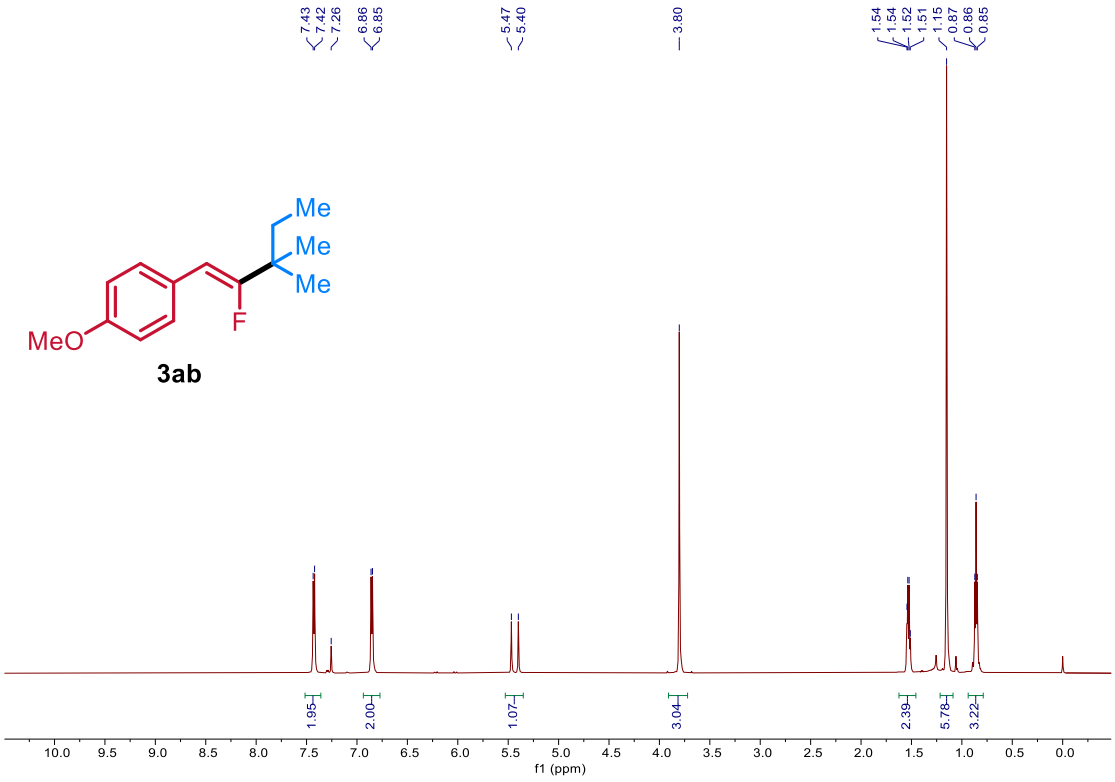

## $^{13}$C NMR of Compound 3aa (100 MHz, Chloroform-*d*):



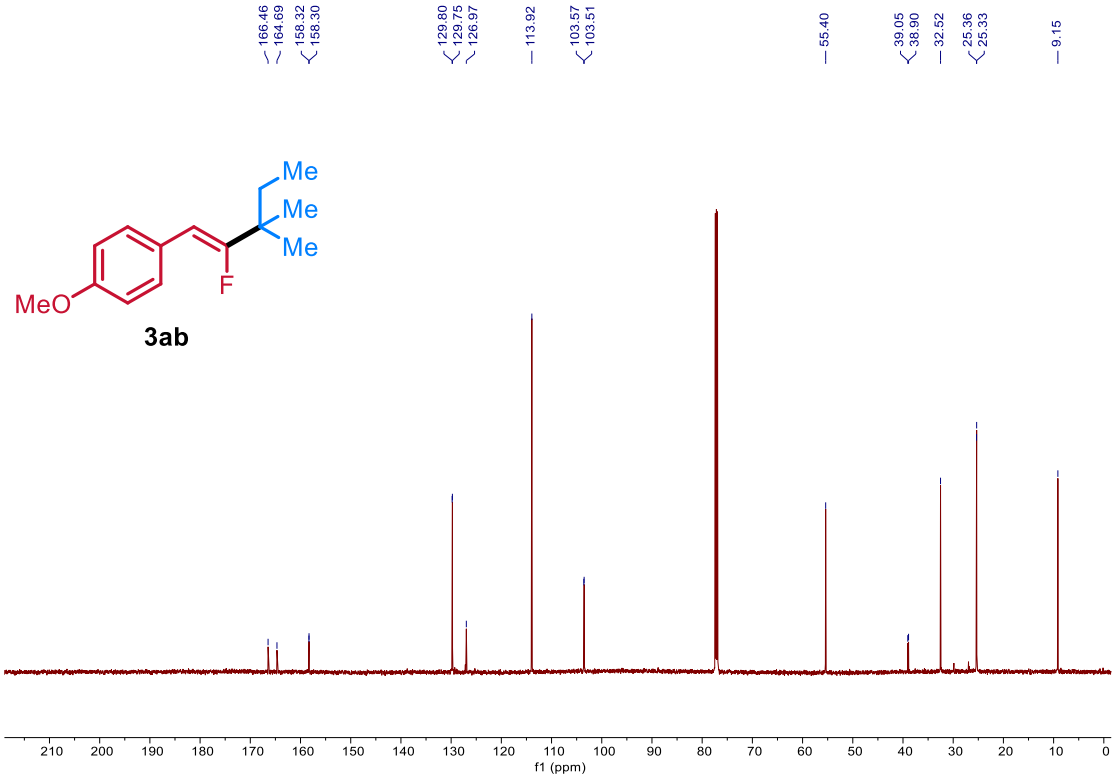
**$^{19}$F NMR of Compound 3aa (375 MHz, Chloroform-*d*):**



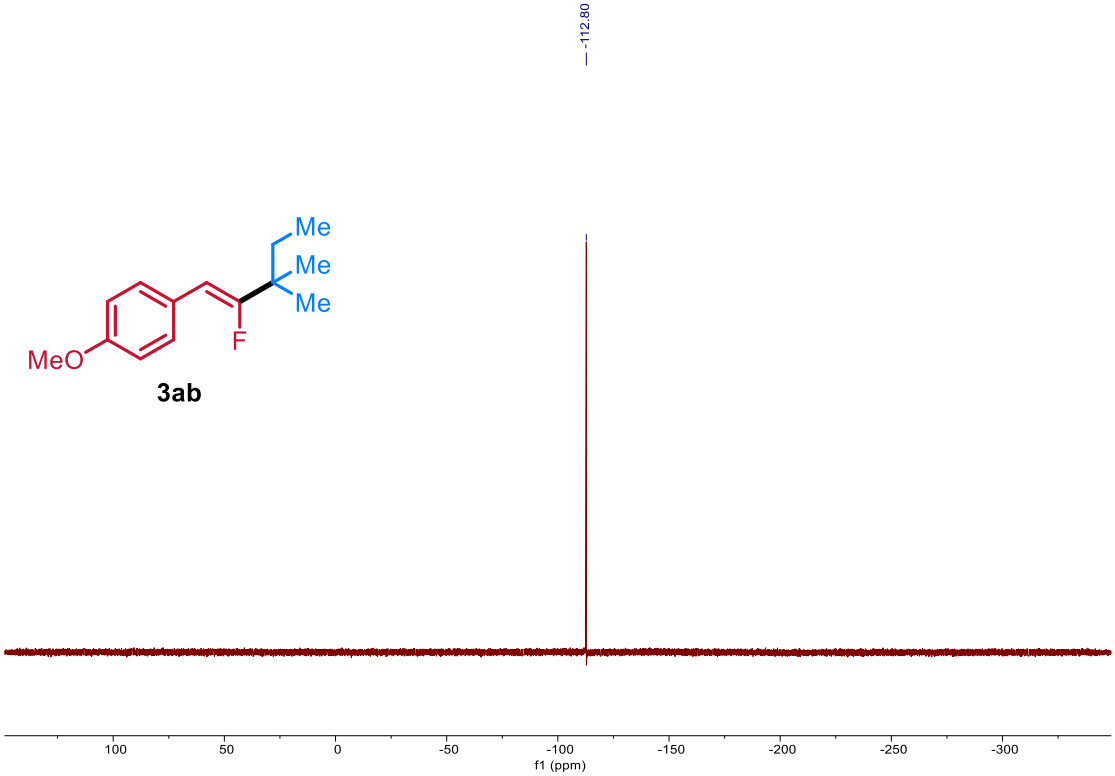

**$^{1}$H NMR of Compound 3ab (600 MHz, Chloroform-*d*):**



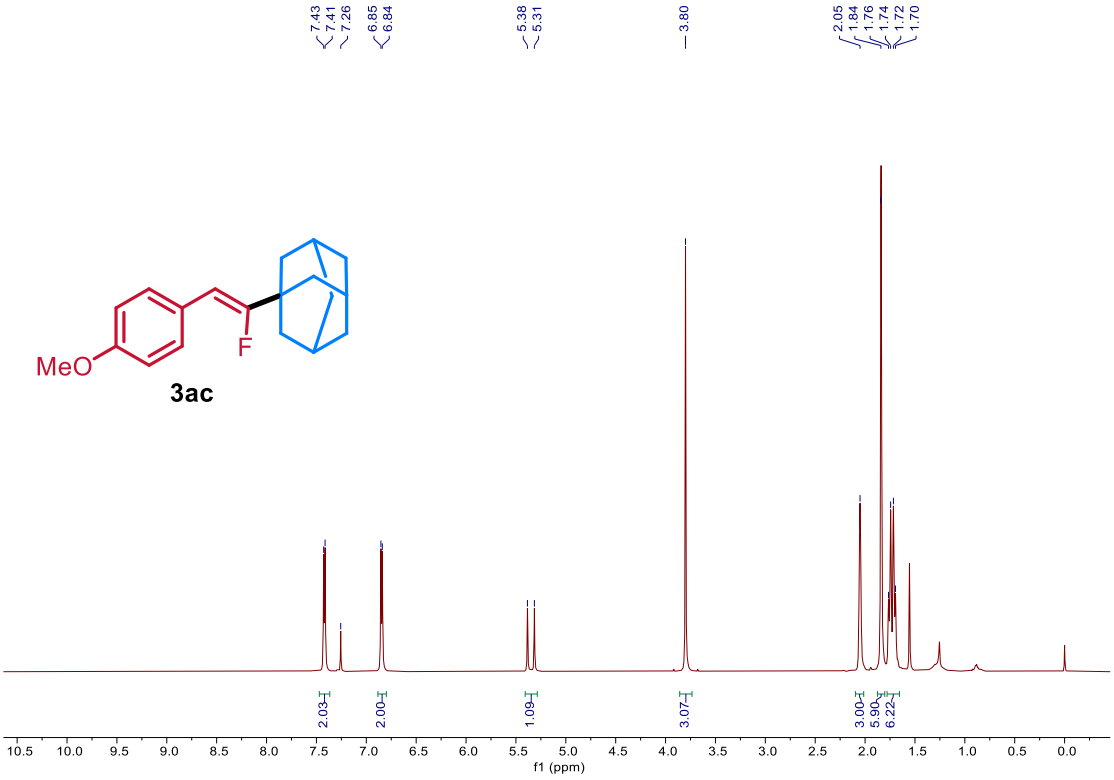
## $^{13}$C NMR of Compound 3ab (150 MHz, Chloroform-*d*):



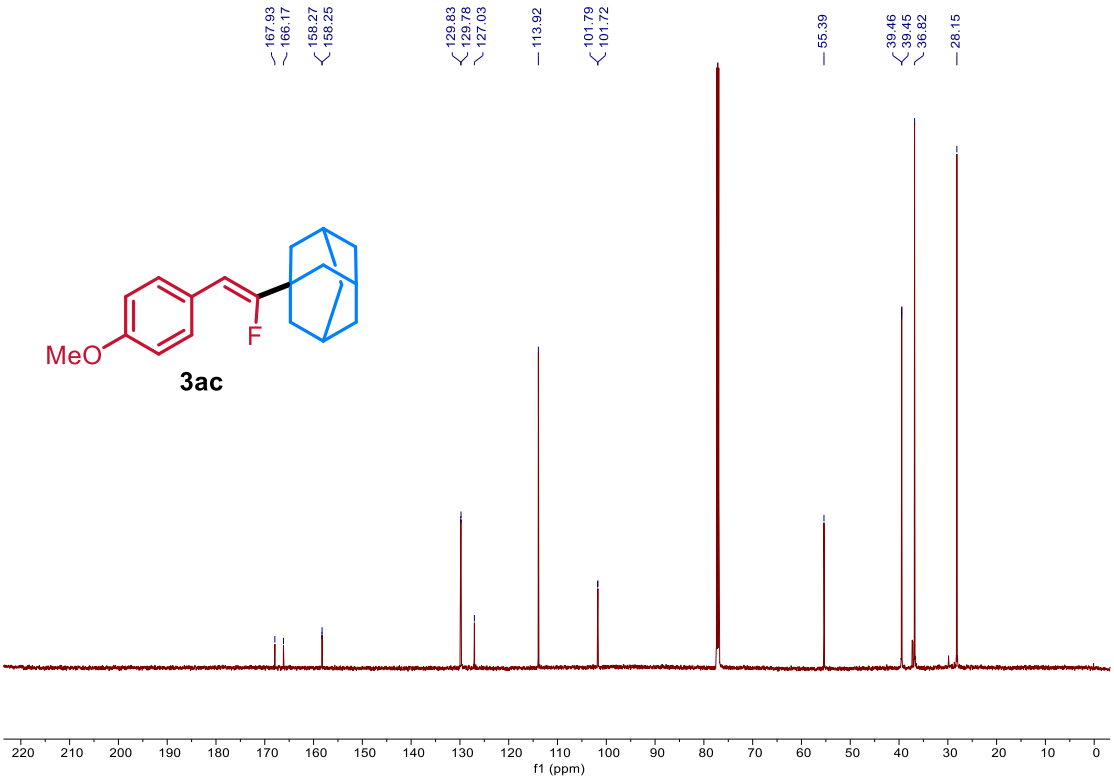

## $^{19}$F NMR of Compound 3ab (375 MHz, Chloroform-*d*):



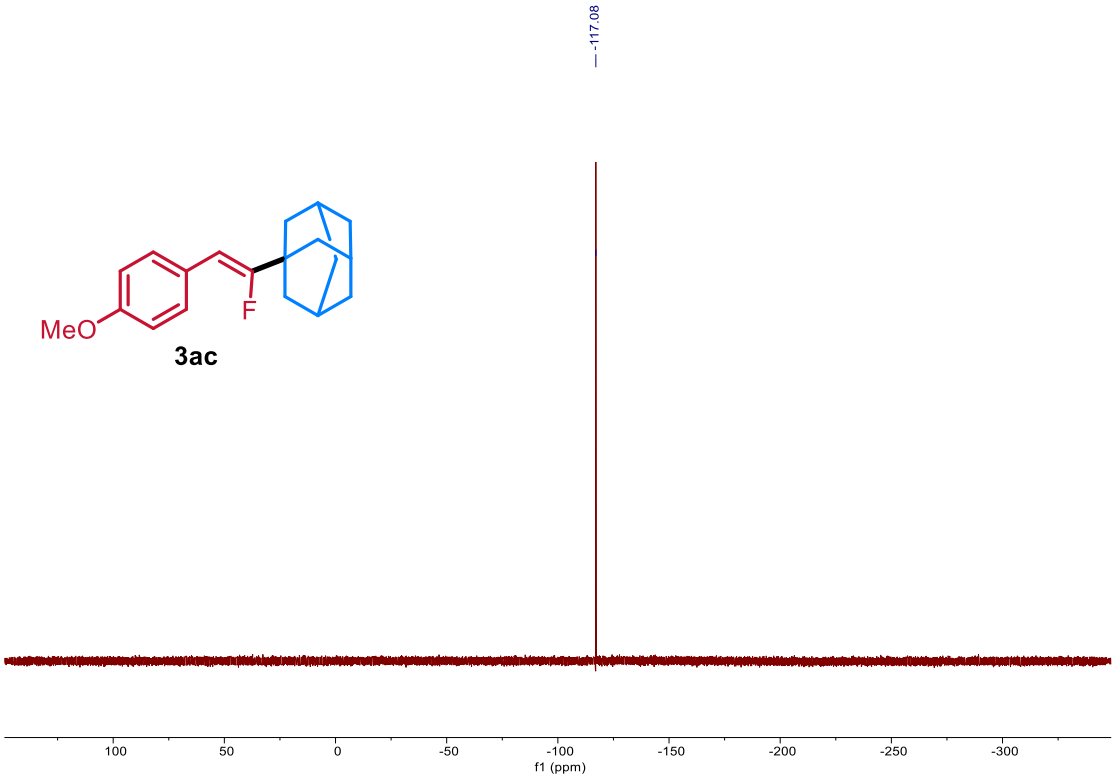
## $^{1}$H NMR of Compound 3ac (600 MHz, Chloroform-*d*):



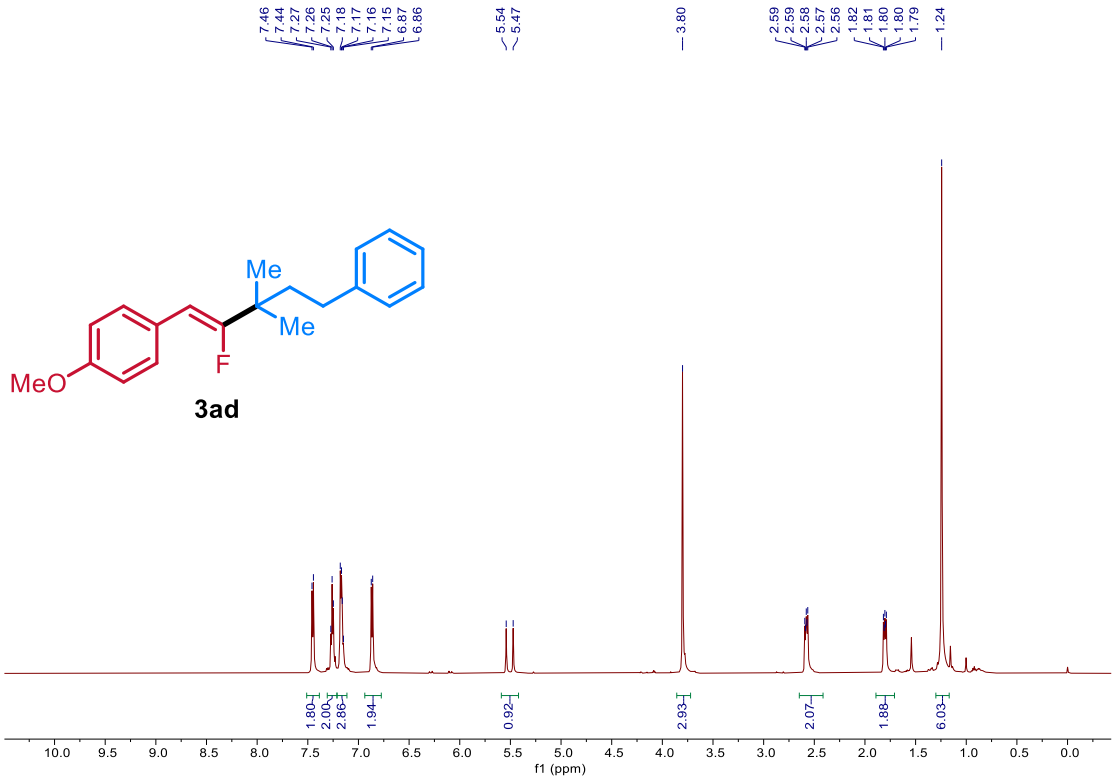

## $^{13}$C NMR of Compound 3ac (150 MHz, Chloroform-*d*):



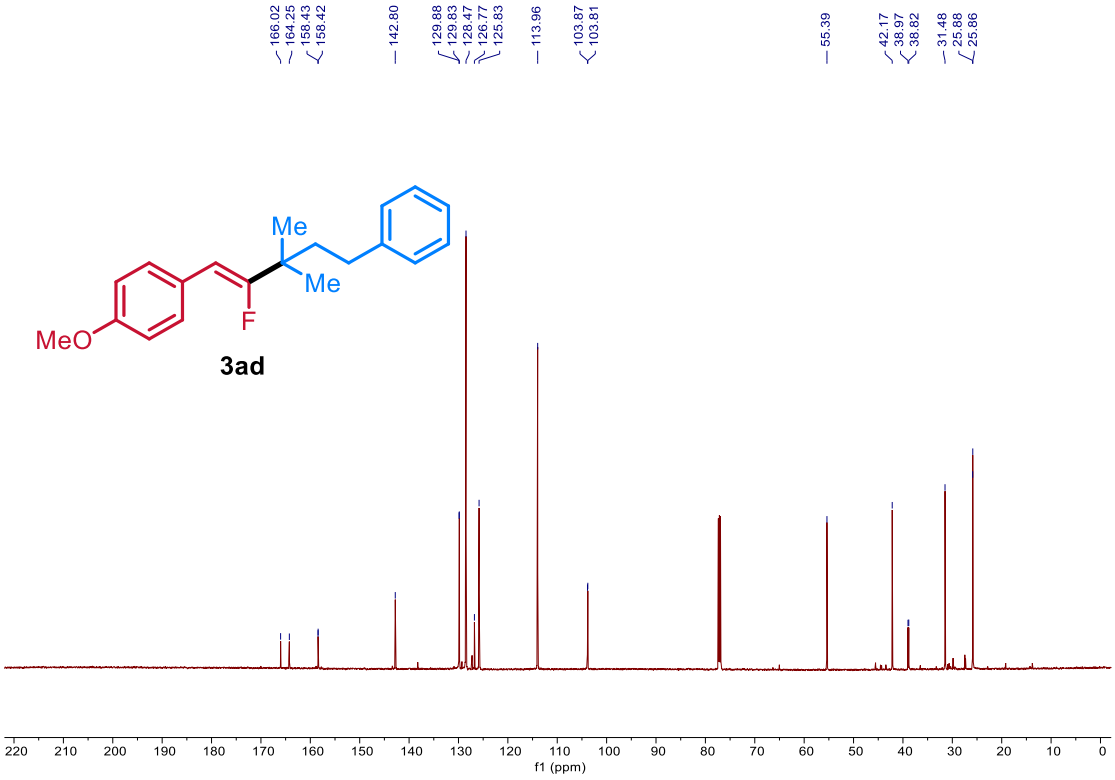
**$^{19}$F NMR of Compound 3ac (375 MHz, Chloroform-*d*):**



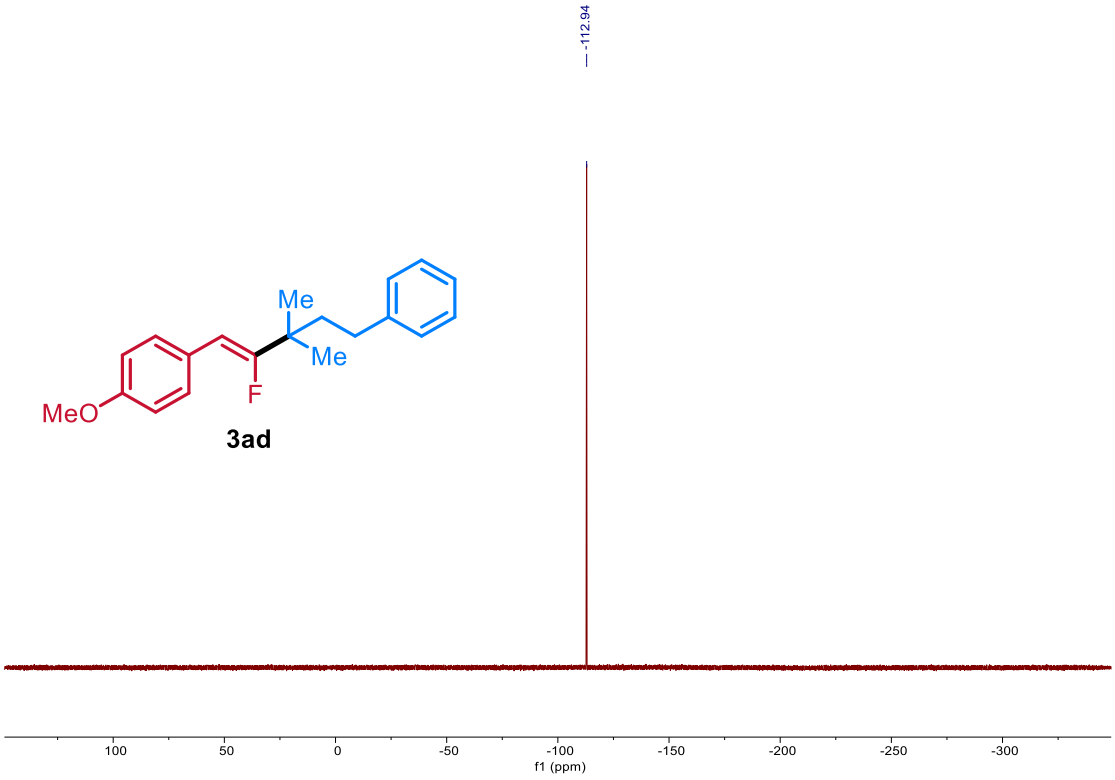

**$^{1}$H NMR of Compound 3ad (600 MHz, Chloroform-*d*):**



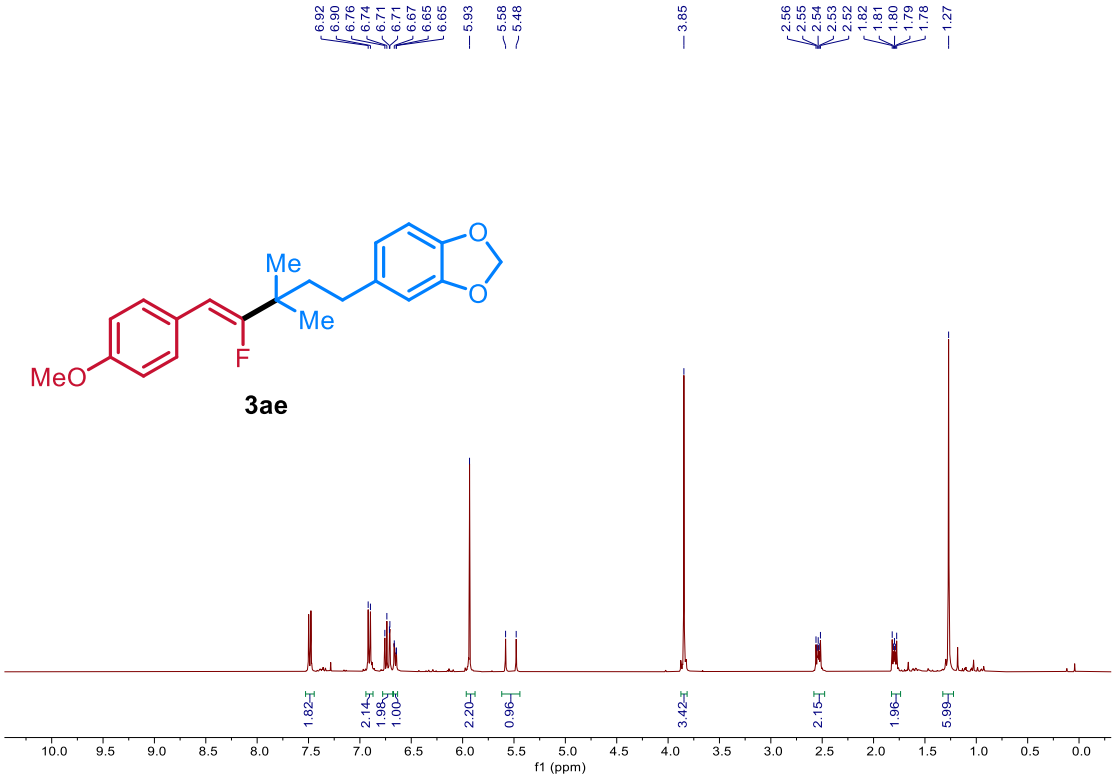
**$^{13}$C NMR of Compound 3ad (150 MHz, Chloroform-*d*):**



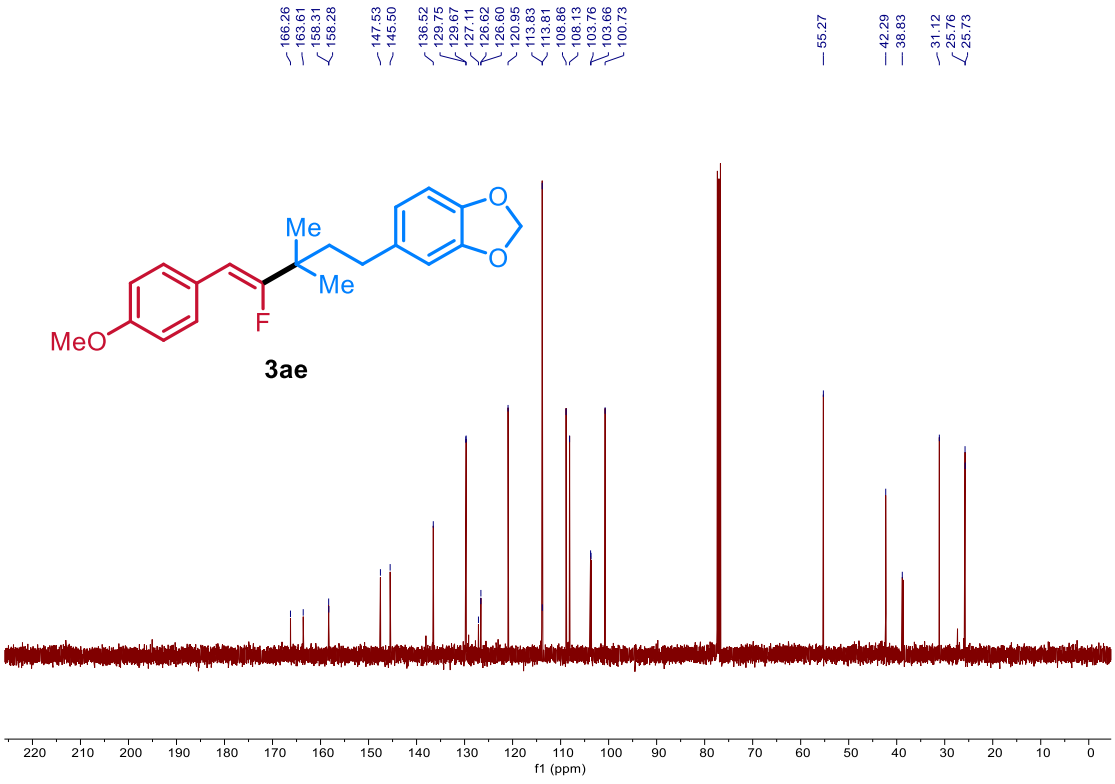

**$^{19}$F NMR of Compound 3ad (375 MHz, Chloroform-*d*):**



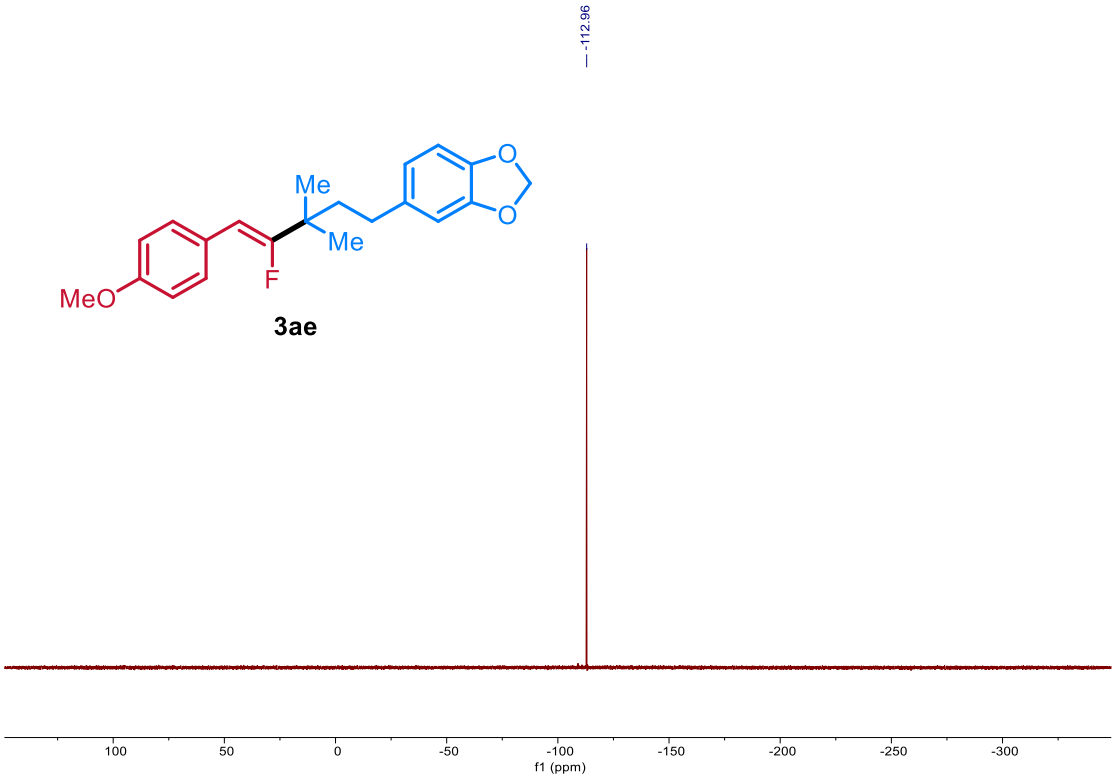
## $^{1}$H NMR of Compound 3ae (600 MHz, Chloroform-*d*):



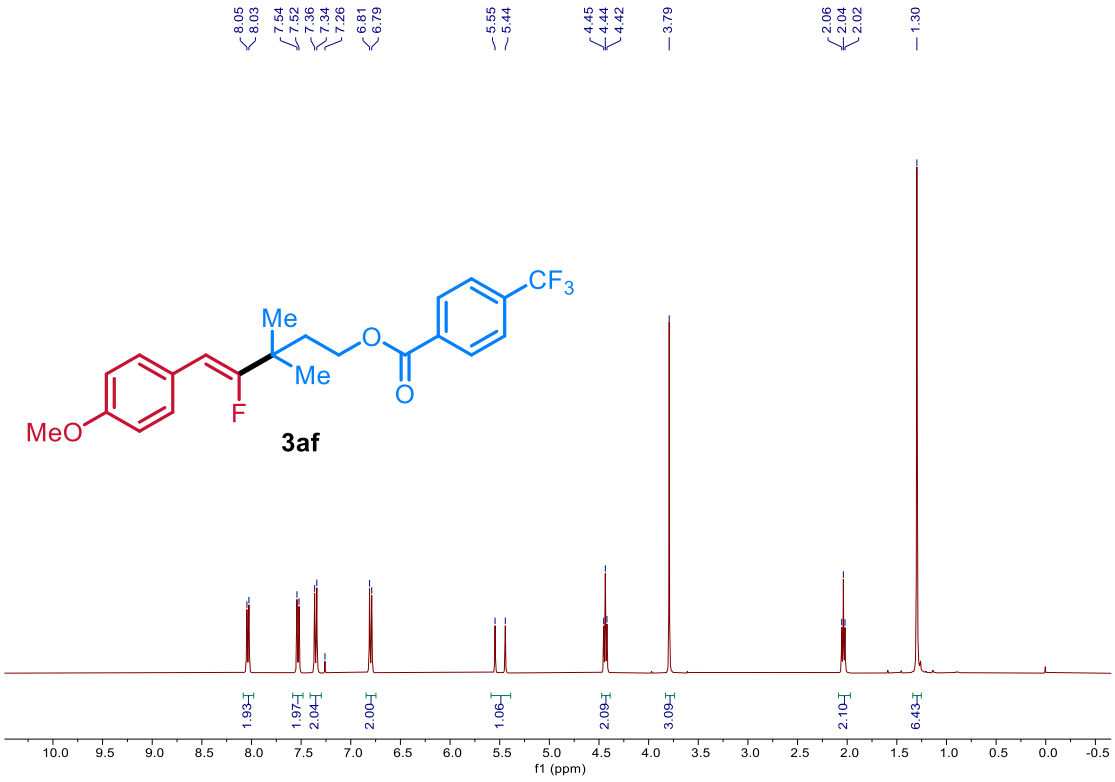

## $^{13}$C NMR of Compound 3ae (150 MHz, Chloroform-*d*):



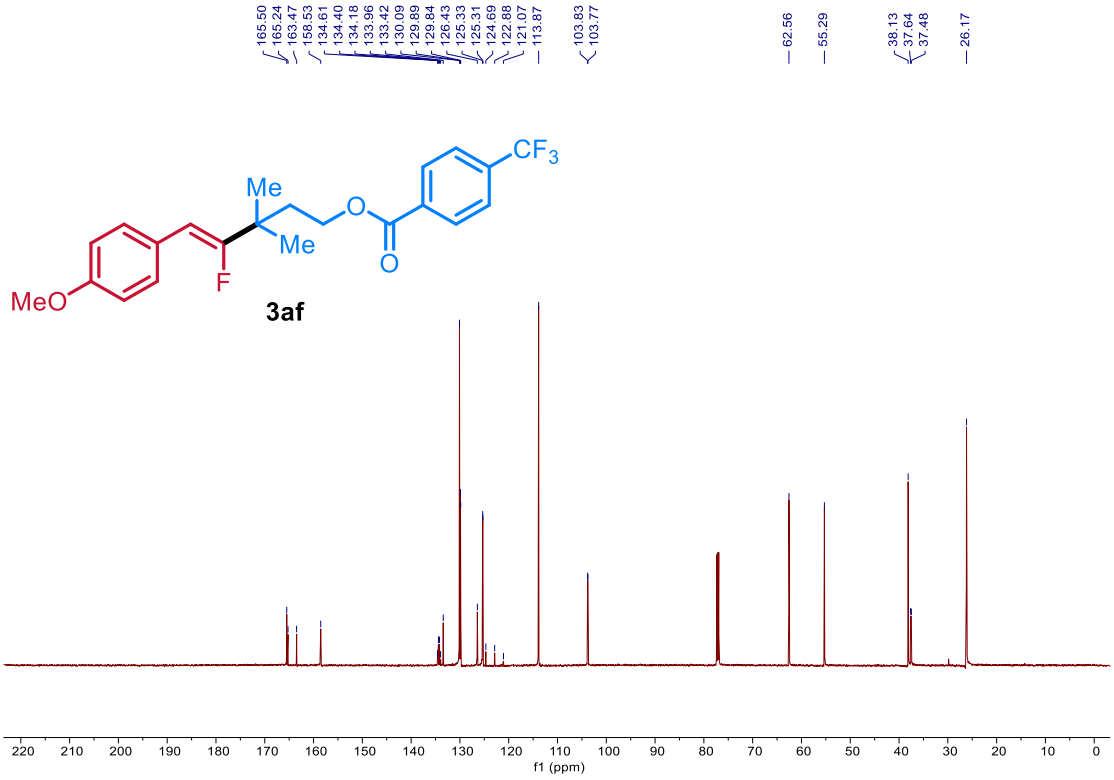
**$^{19}$F NMR of Compound 3ae (375 MHz, Chloroform-*d*):**



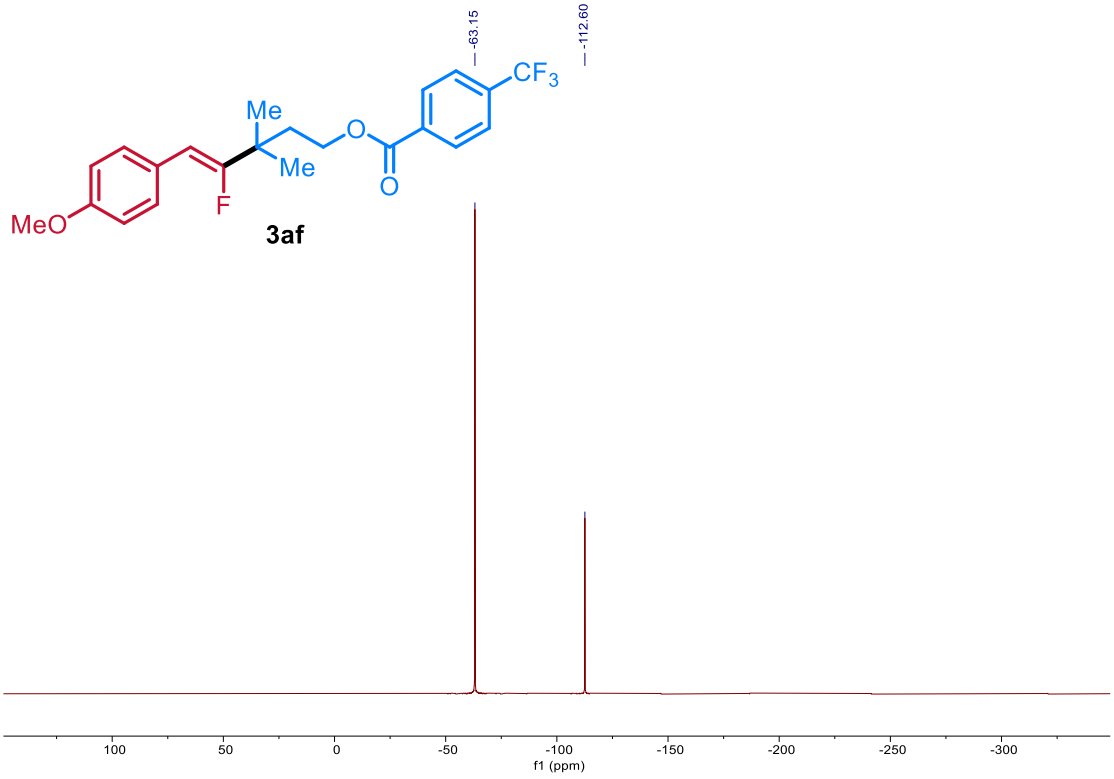

**$^{1}$H NMR of Compound 3af (400 MHz, Chloroform-*d*):**



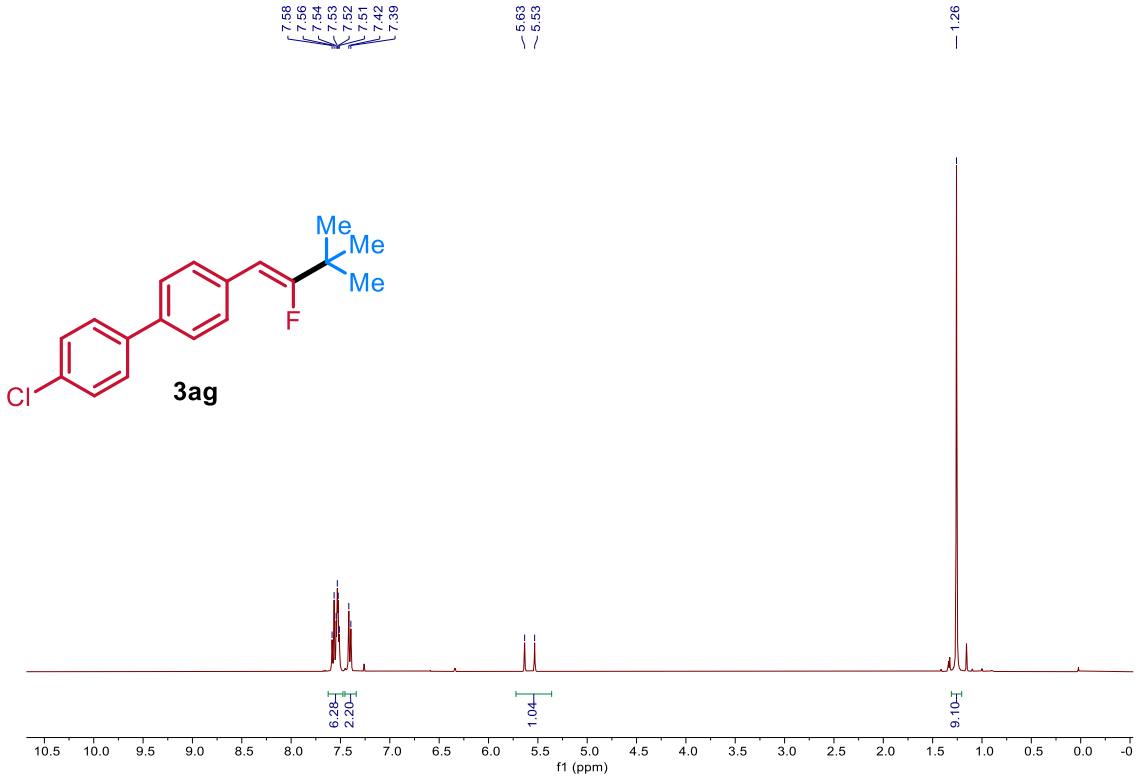
**$^{13}$C NMR of Compound 3ad (150 MHz, Chloroform-*d*):**



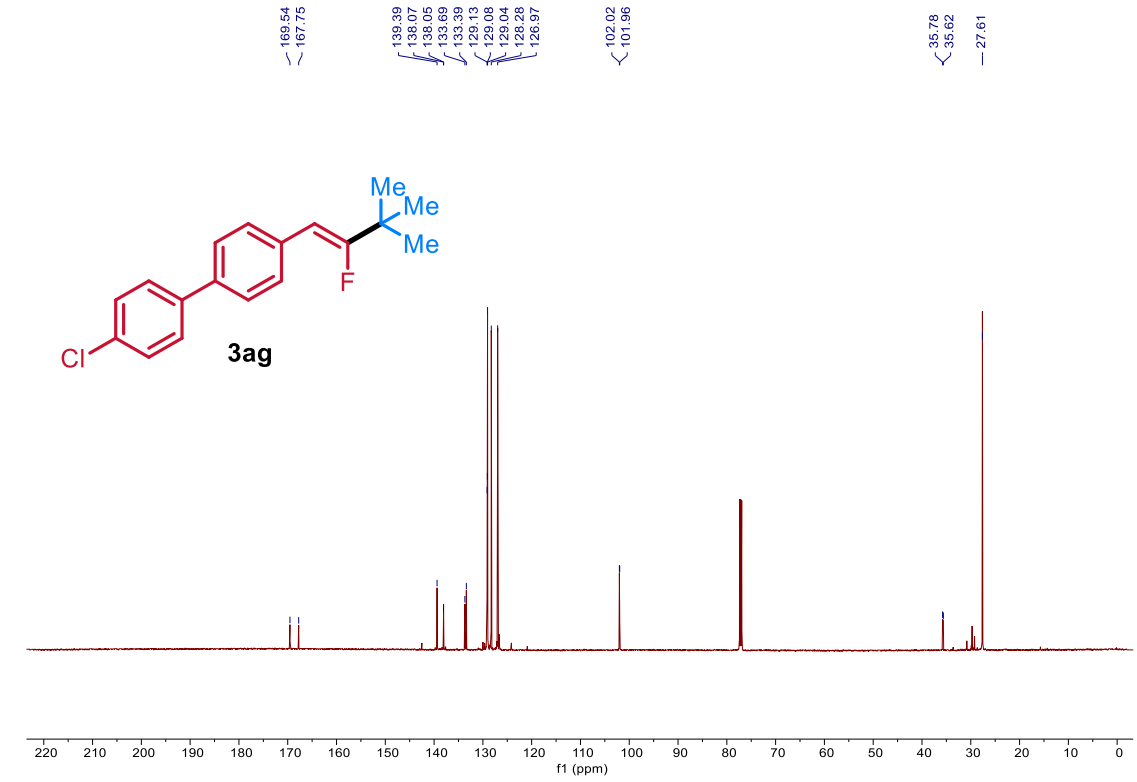

**$^{19}$F NMR of Compound 3ad (375 MHz, Chloroform-*d*):**



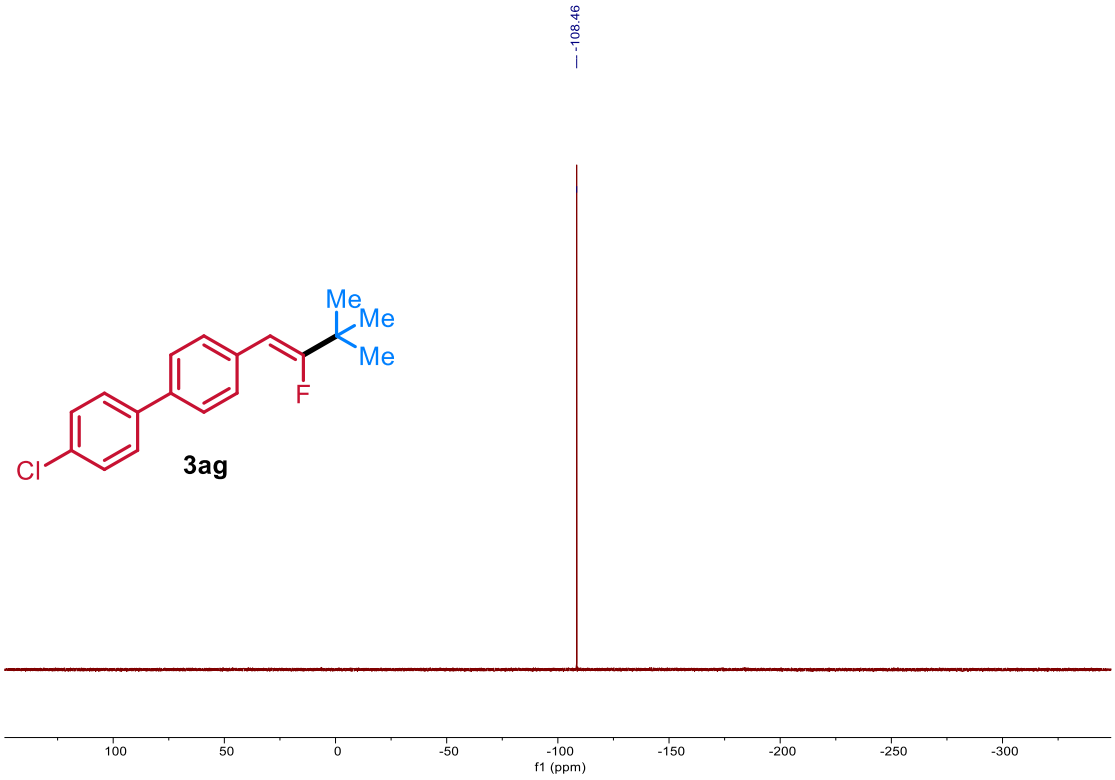
**$^{1}$H NMR of Compound 3ag (400 MHz, Chloroform-*d*):**



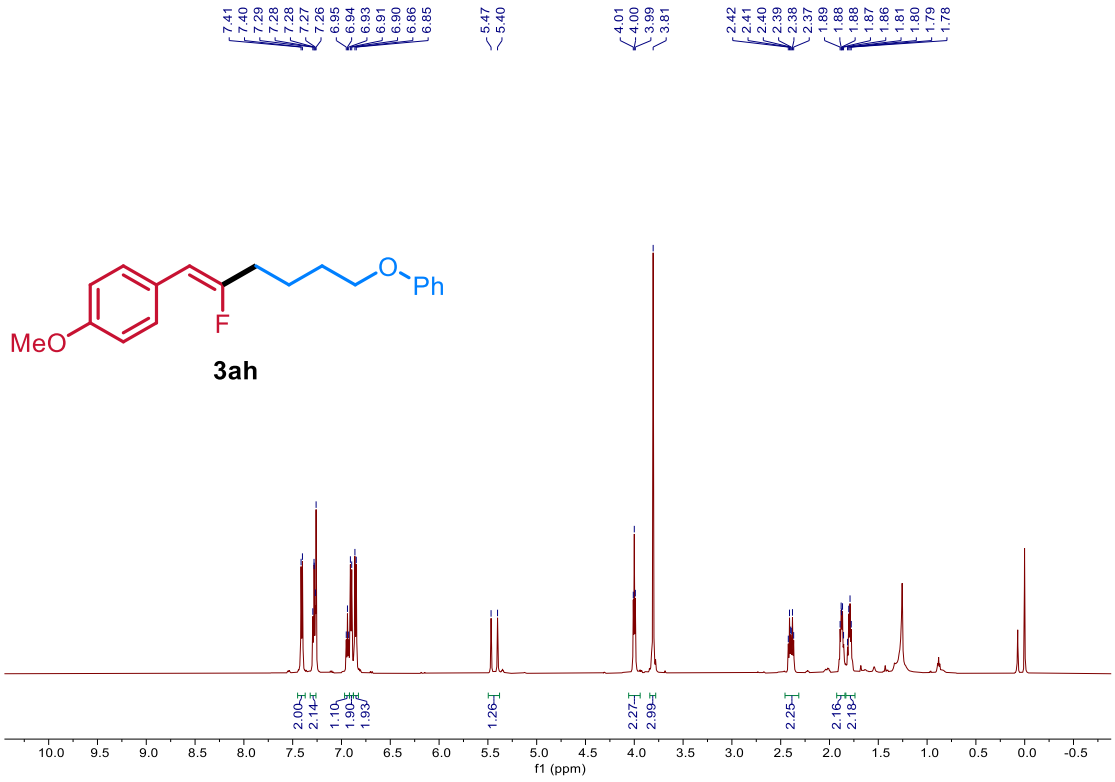

**$^{13}$C NMR of Compound 3ag (150 MHz, Chloroform-*d*):**



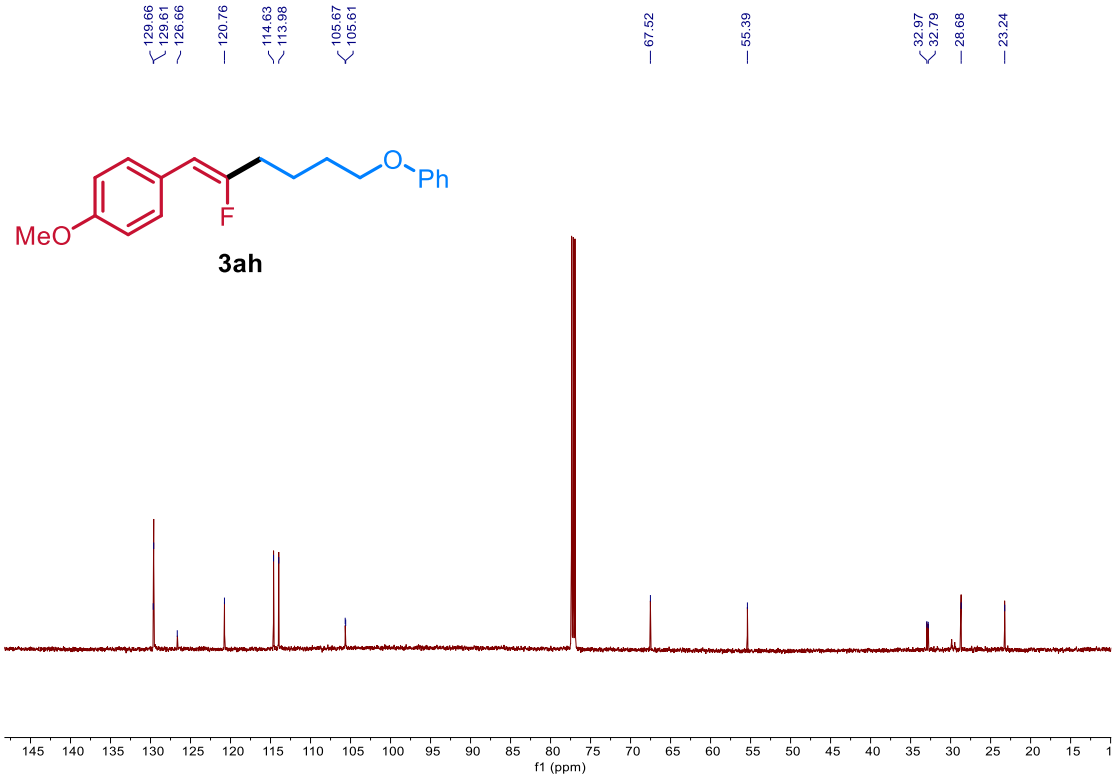
**$^{19}$F NMR of Compound 3ag (375 MHz, Chloroform-*d*): δ - 108.46 (s, 1F)**



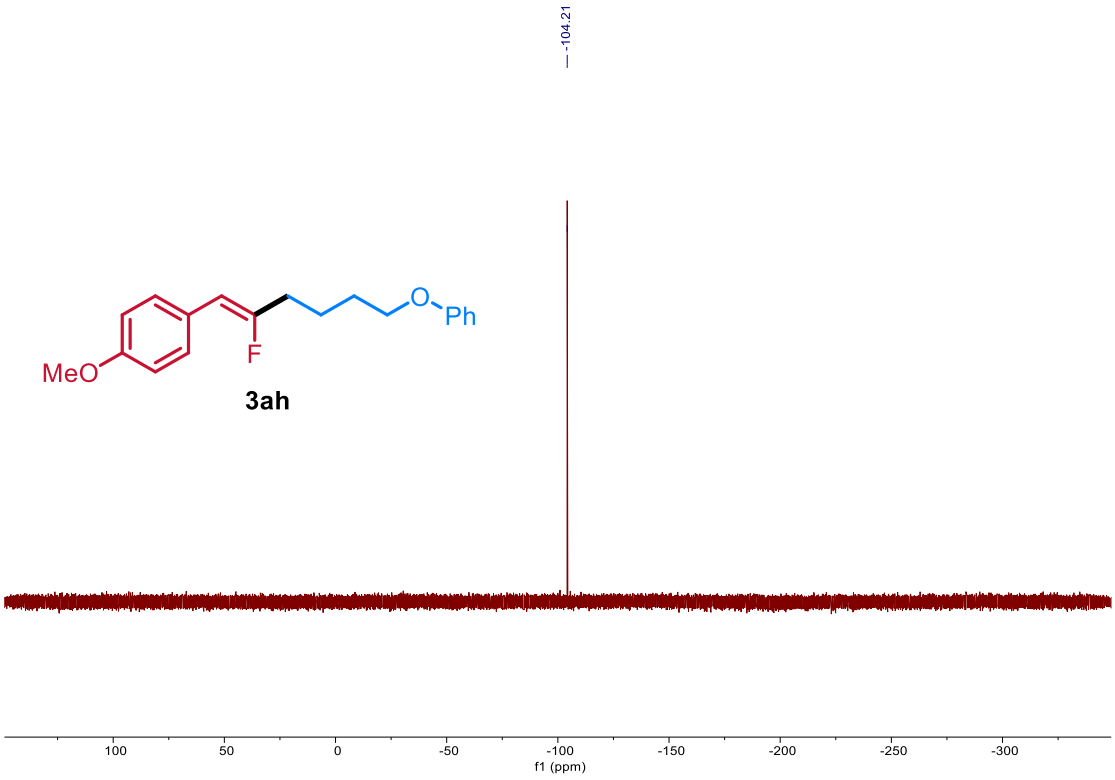

**$^{1}$H NMR of Compound 3ah (400 MHz, Chloroform-*d*):**



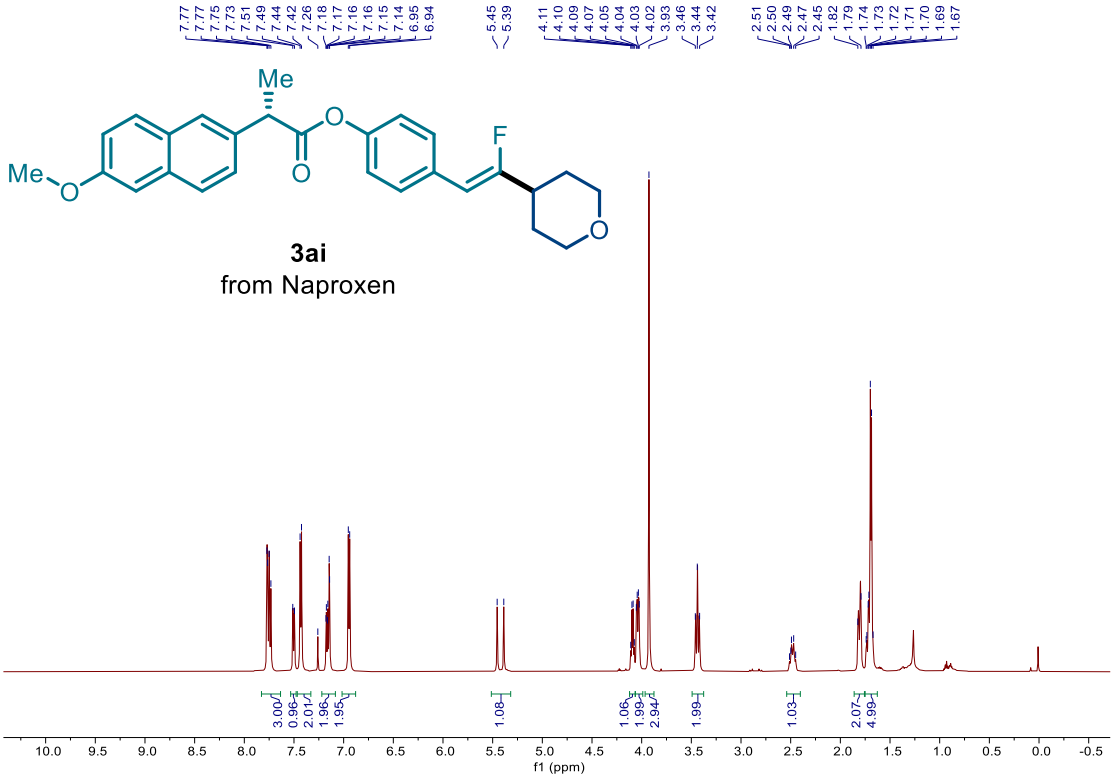
**$^{13}$C NMR of Compound 3ah (150 MHz, Chloroform-*d*):**



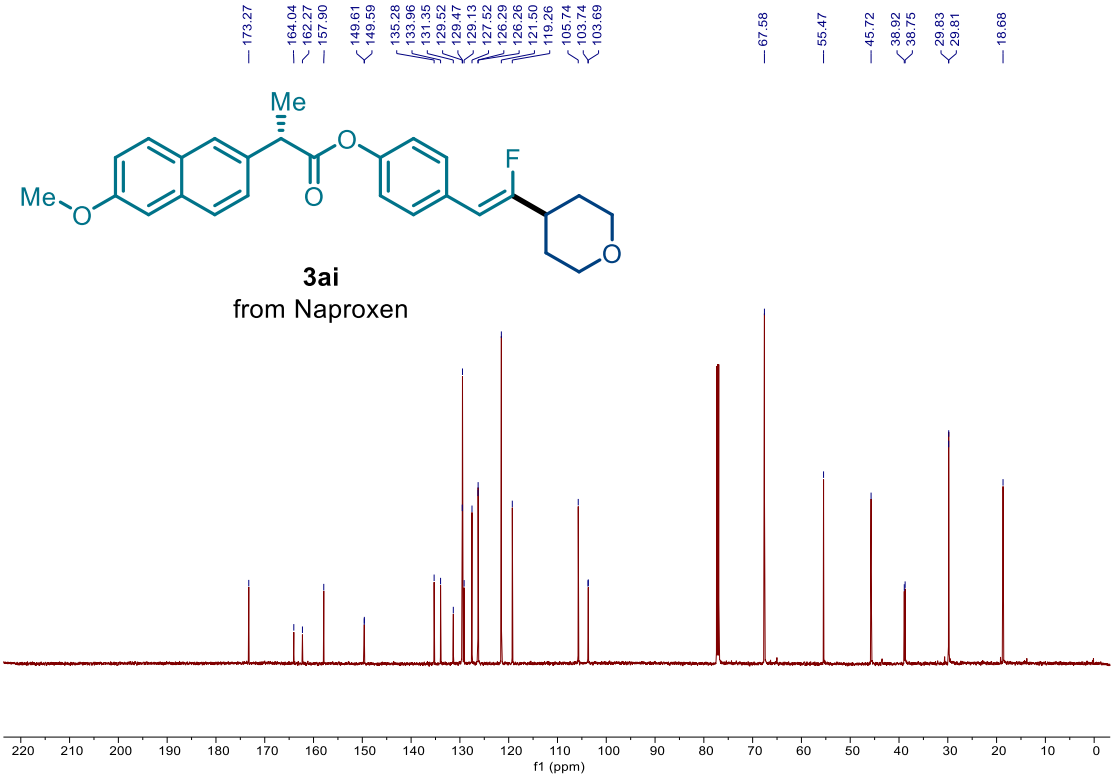

**$^{19}$F NMR of Compound 3ah (375 MHz, Chloroform-*d*):**



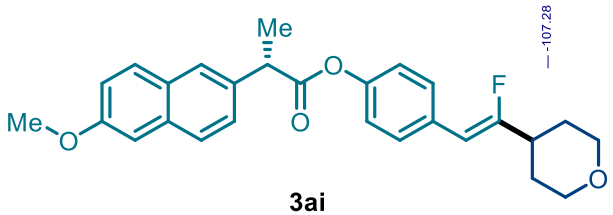
**$^{1}$H NMR of Compound 3ai (600 MHz, Chloroform-*d*):**



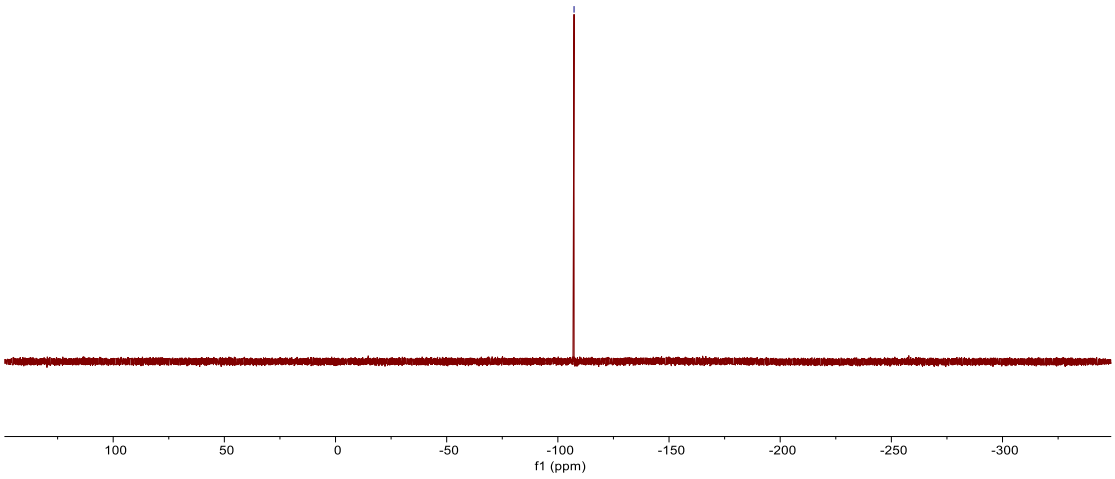

**$^{13}$C NMR of Compound 3ai (150 MHz, Chloroform-*d*):**



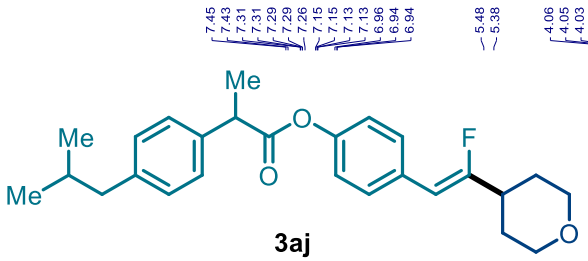
**$^{19}$F NMR of Compound 3ai (375 MHz, Chloroform-*d*):**




**3ai**
from Naproxen

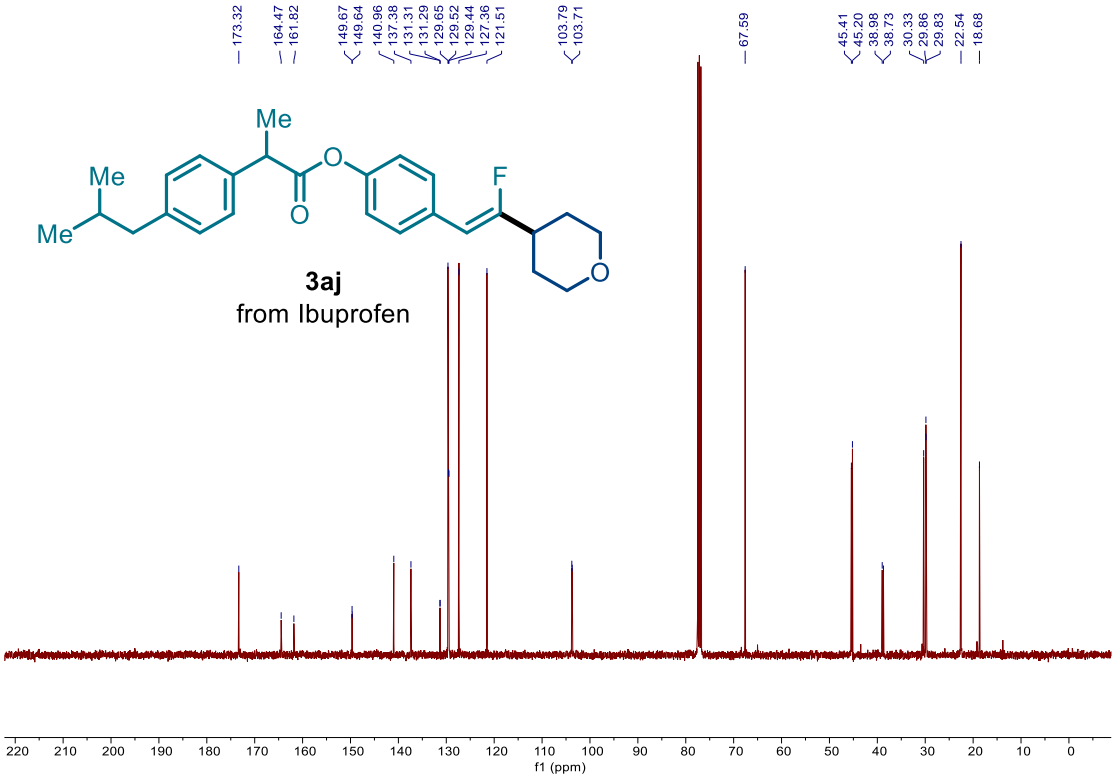



**$^{1}$H NMR of Compound 3aj (400 MHz, Chloroform-*d*):**

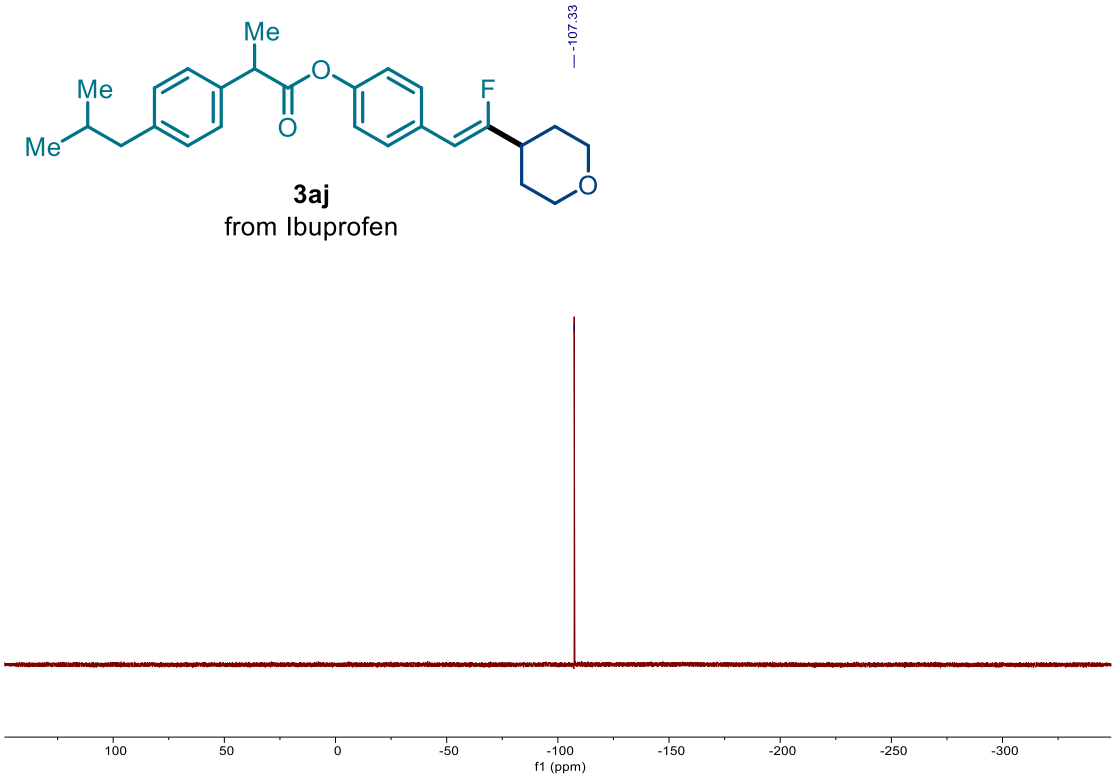



**3aj**
from Ibuprofen

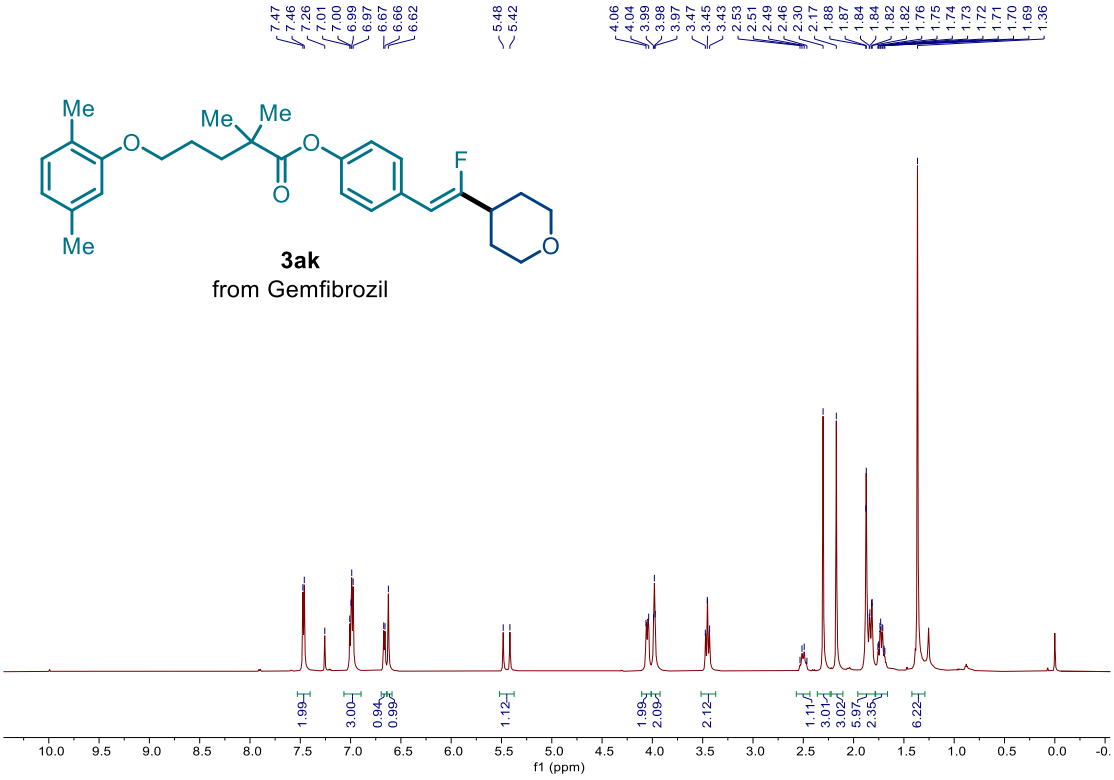
**$^{13}$C NMR of Compound 3aj (150 MHz, Chloroform-*d*):**



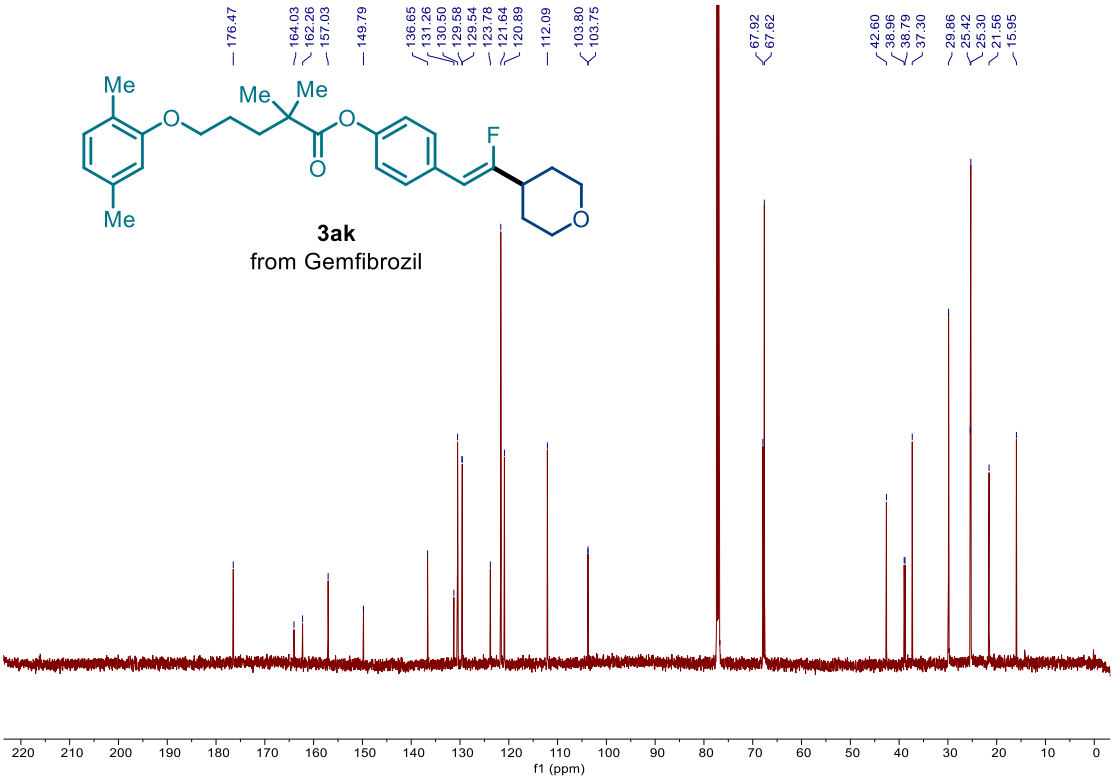

**$^{19}$F NMR of Compound 3aj (375 MHz, Chloroform-*d*):**



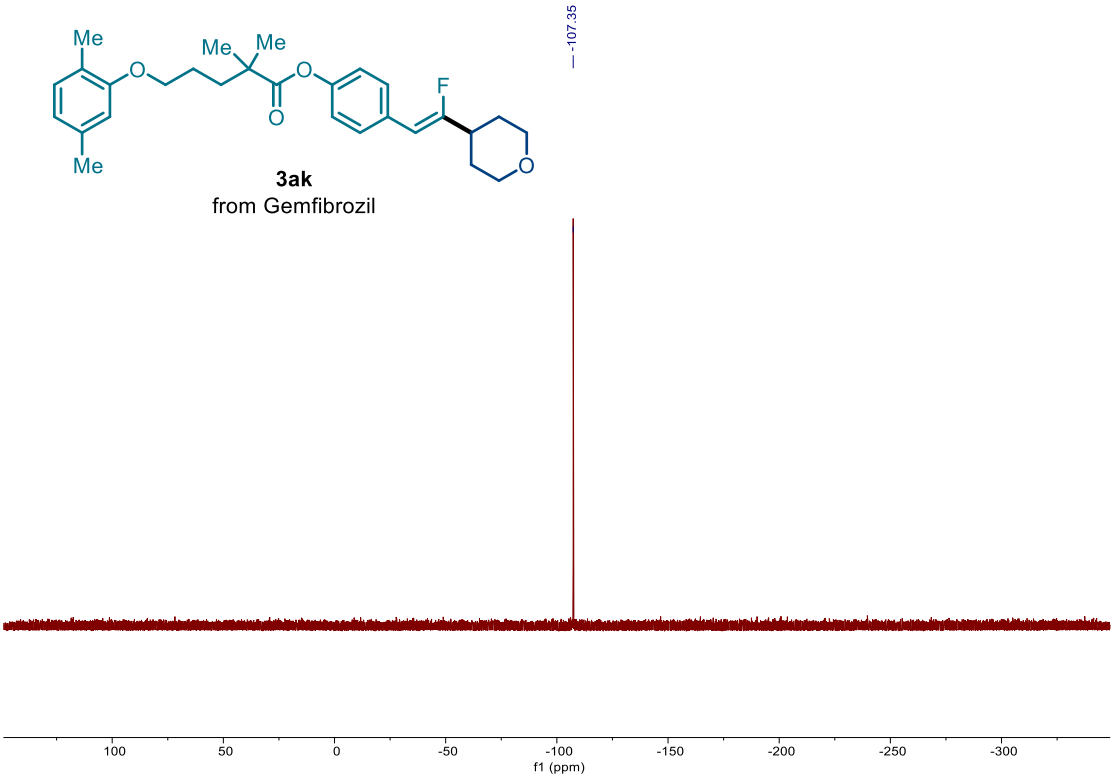
## $^{1}$H NMR of Compound 3ak (600 MHz, Chloroform-*d*):




## $^{13}$C NMR of Compound 3ak (150 MHz, Chloroform-*d*):

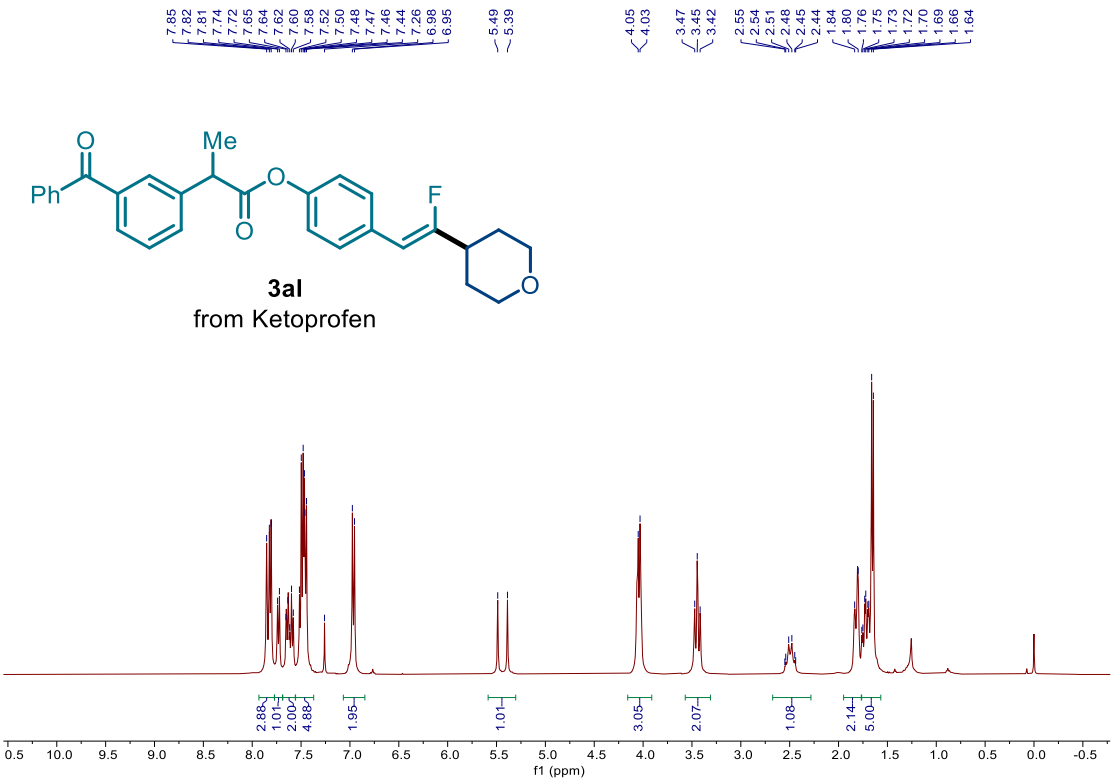


## $^{19}$F NMR of Compound 3ak (375 MHz, Chloroform-*d*):



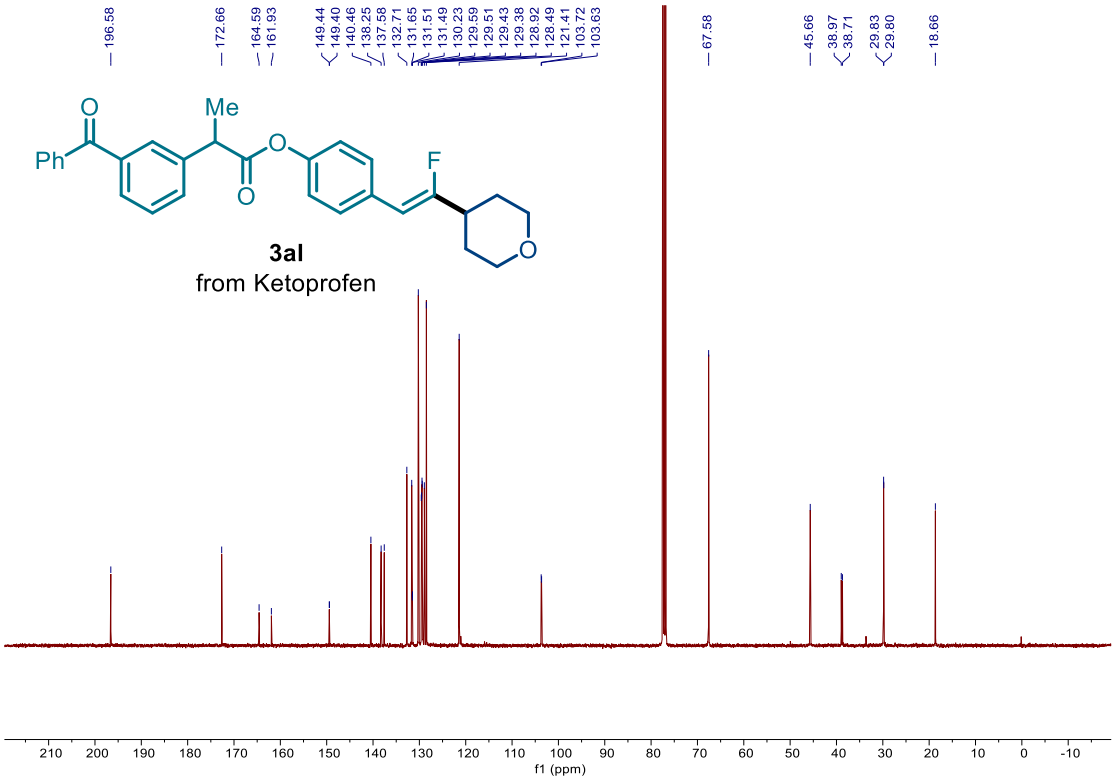

**3ak**
from Gemfibrozil

## $^{1}$H NMR of Compound 3al (400 MHz, Chloroform-*d*):

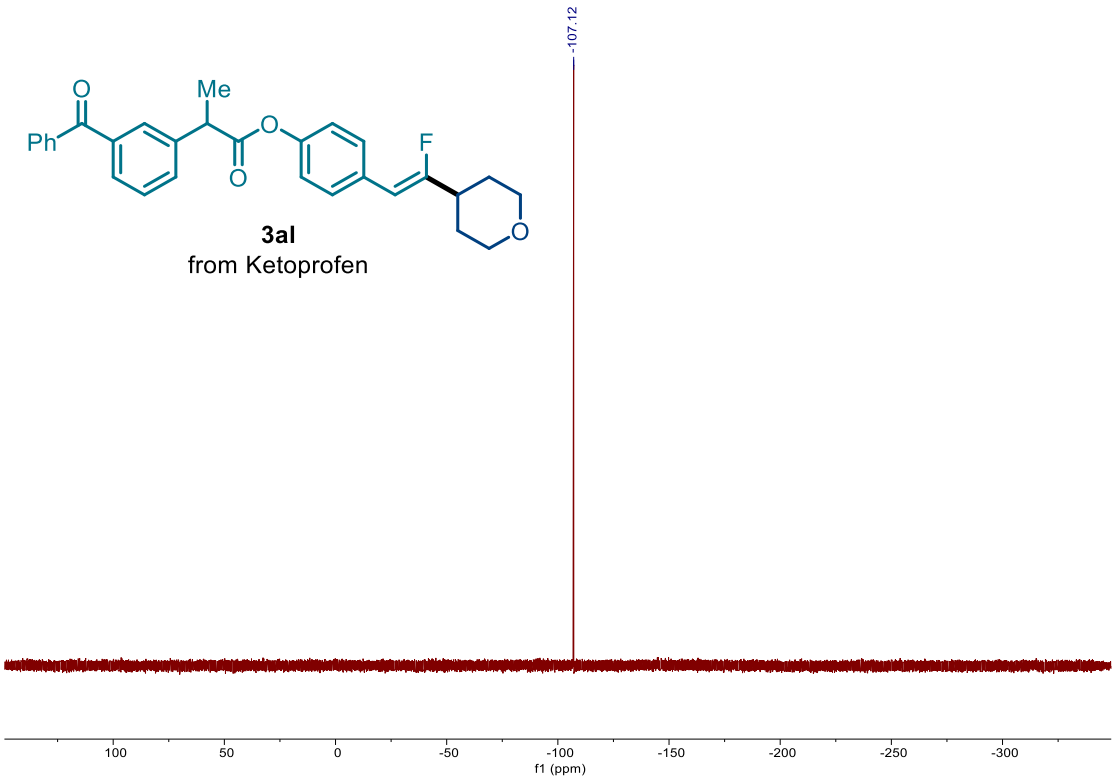



**3al**
from Ketoprofen

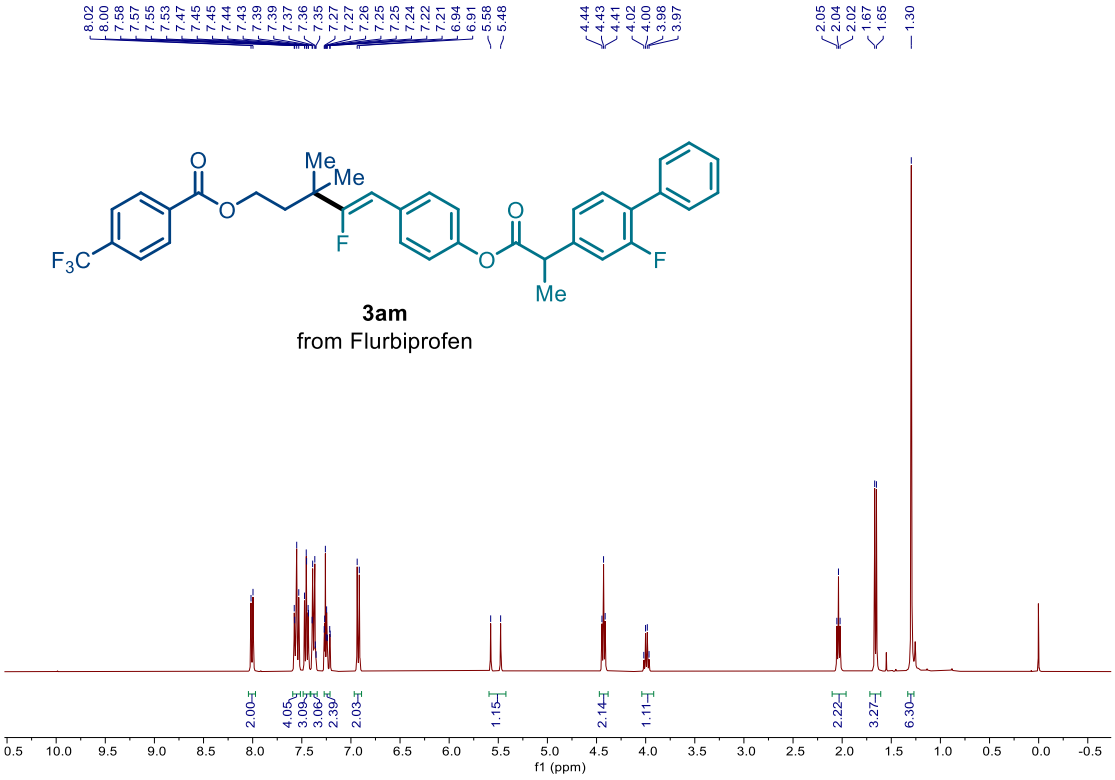
**$^{13}$C NMR of Compound 3al (100 MHz, Chloroform-*d*):**



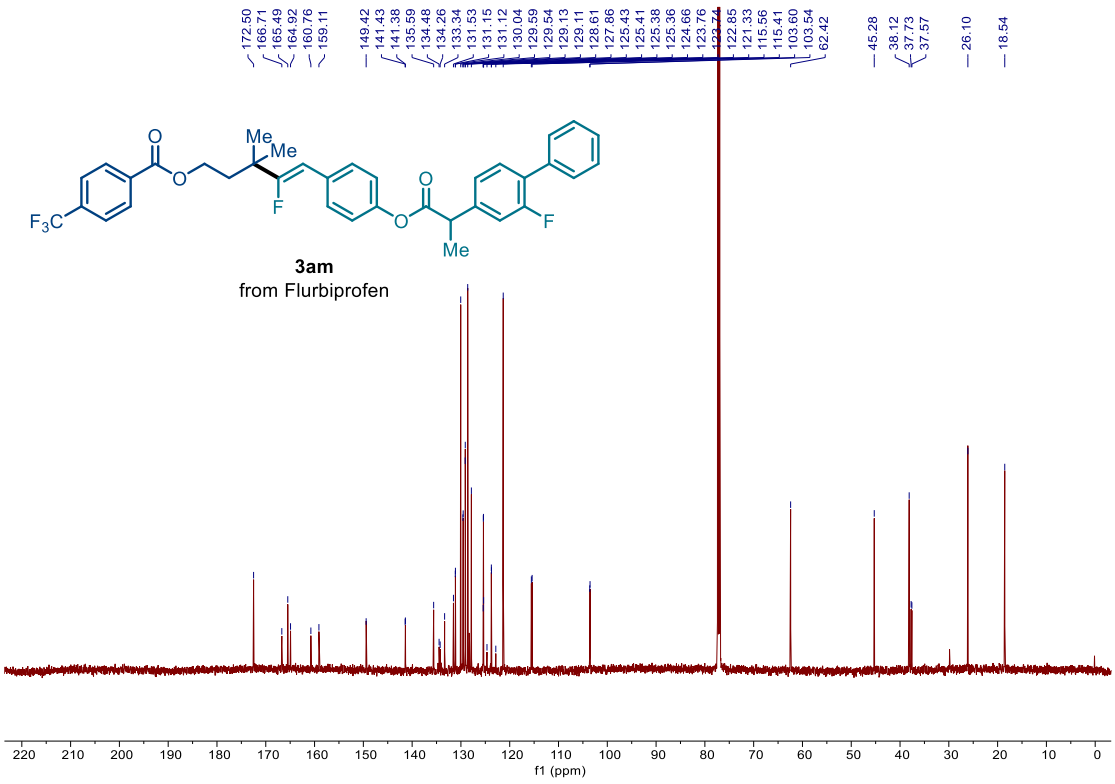

**$^{19}$F NMR of Compound 3al (375 MHz, Chloroform-*d*):**



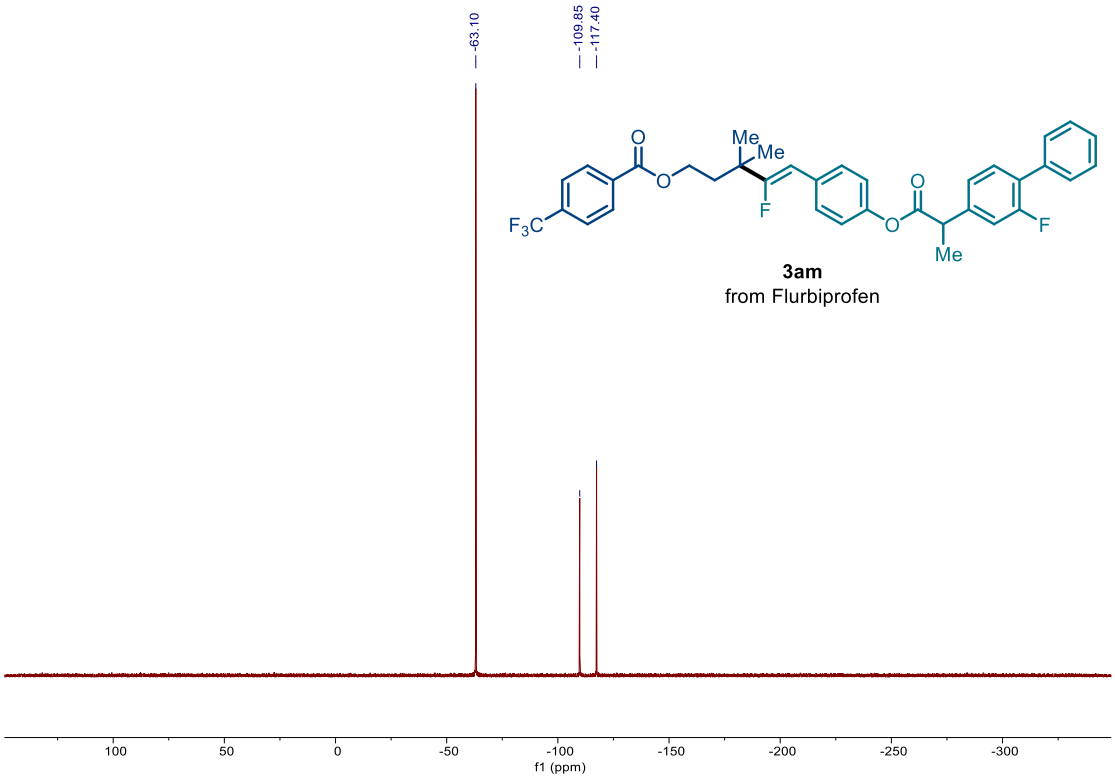
## $^{1}$H NMR of Compound 3am (400 MHz, Chloroform-*d*):



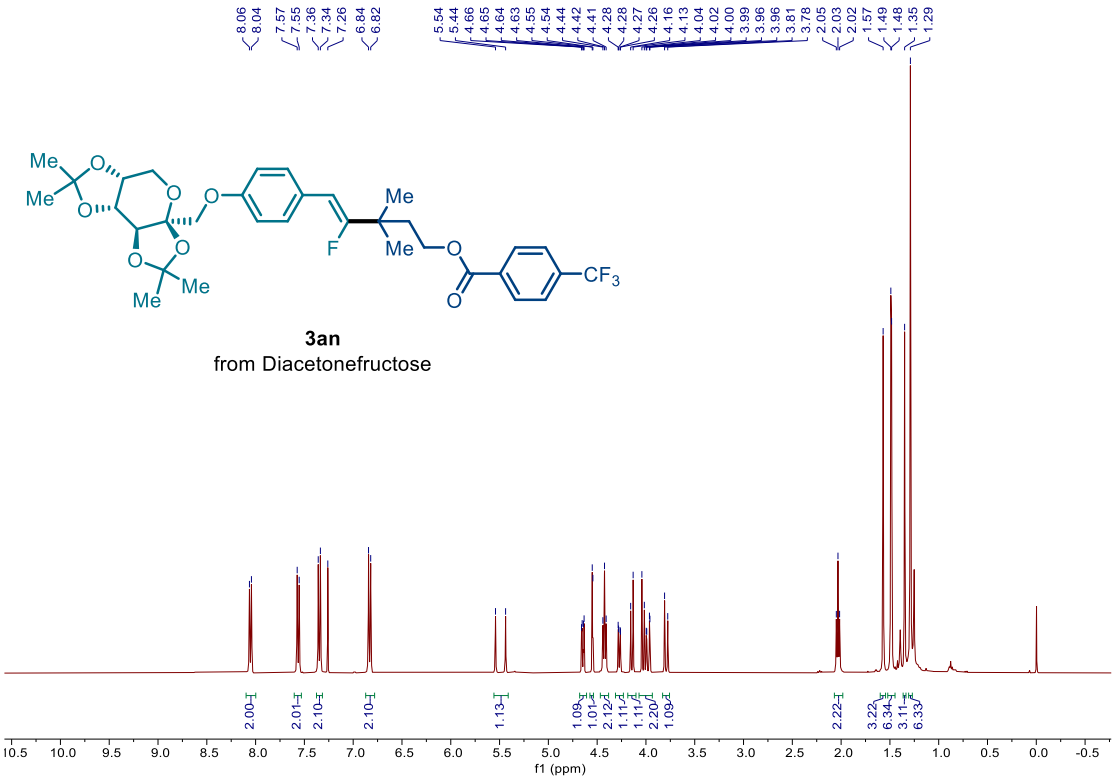

## $^{13}$C NMR of Compound 3am (150 MHz, Chloroform-*d*):



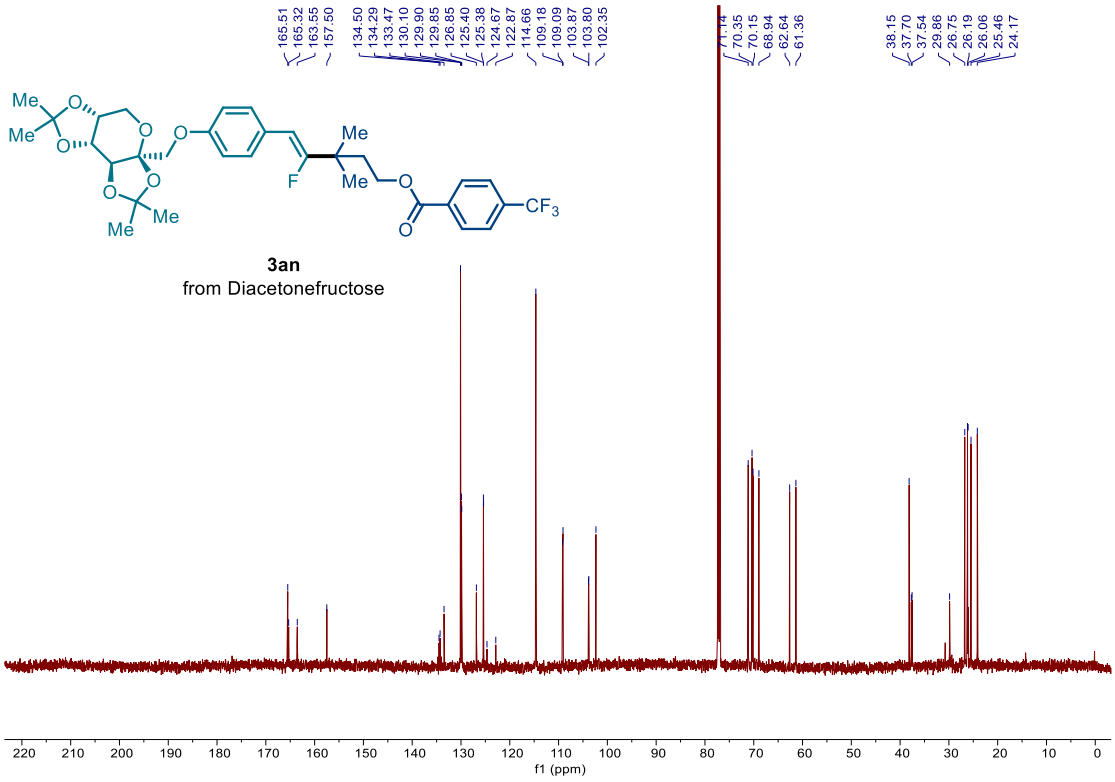
## $^{19}$F NMR of Compound 3am (375 MHz, Chloroform-*d*):



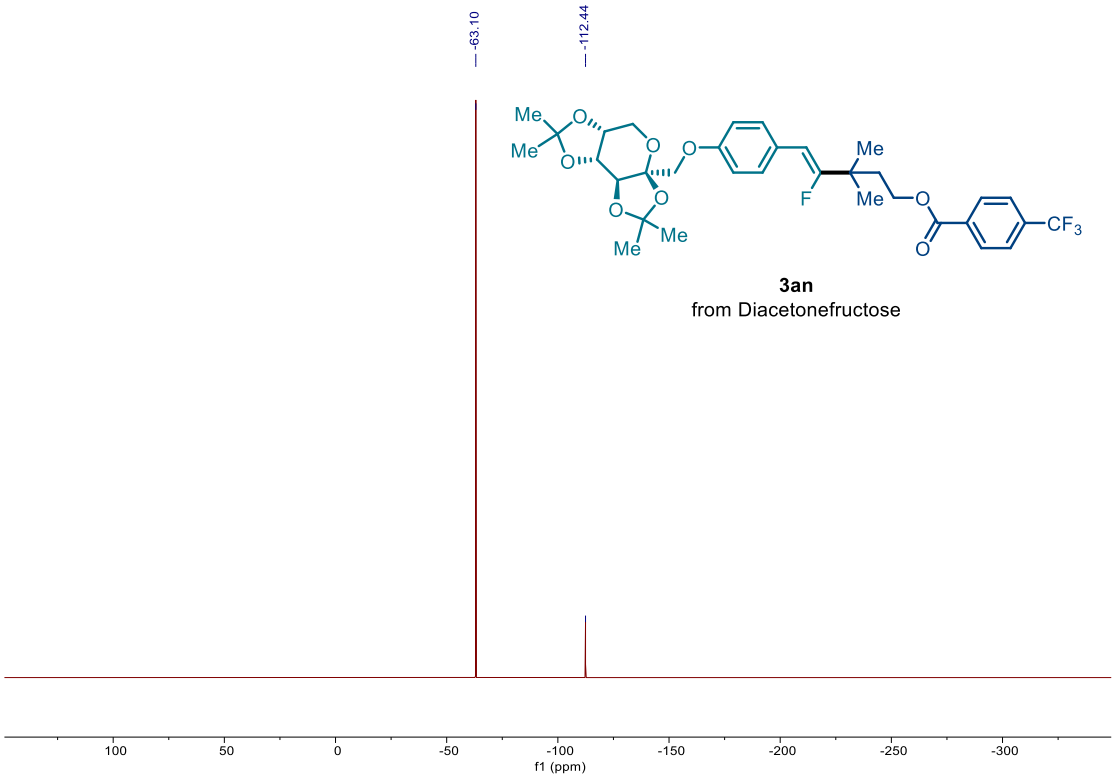

## $^{1}$H NMR of Compound 3an (400 MHz, Chloroform-*d*):



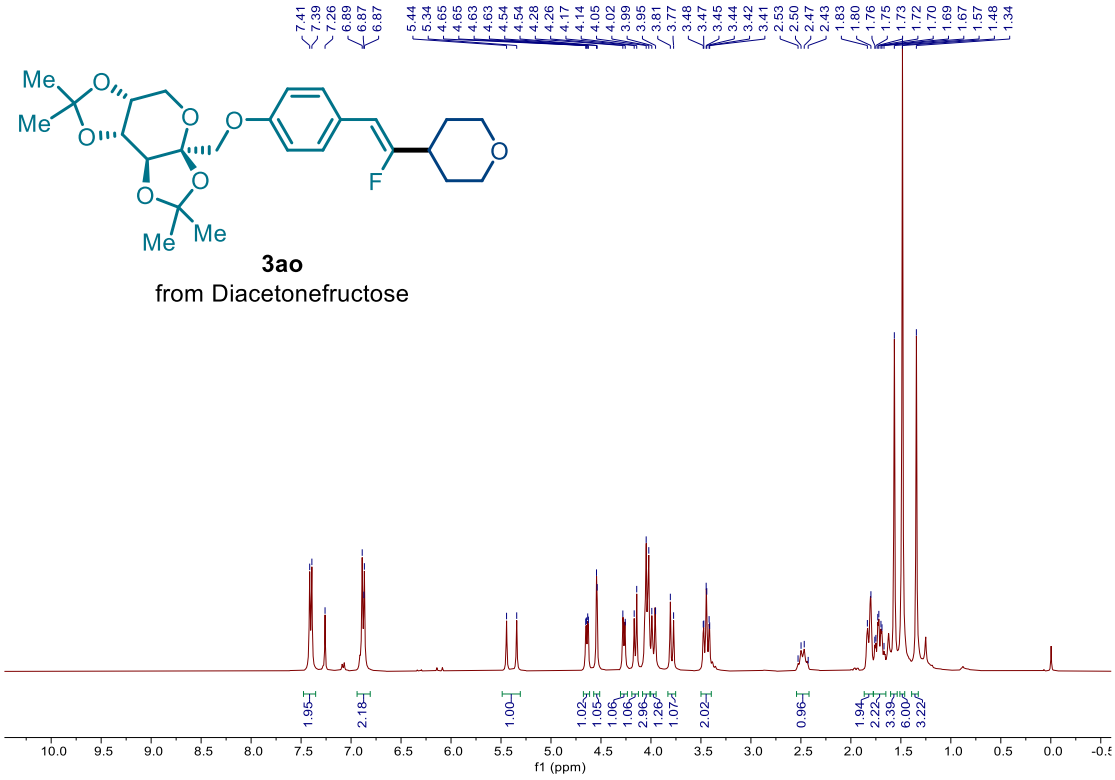
## $^{13}$C NMR of Compound 3an (150 MHz, Chloroform-*d*):



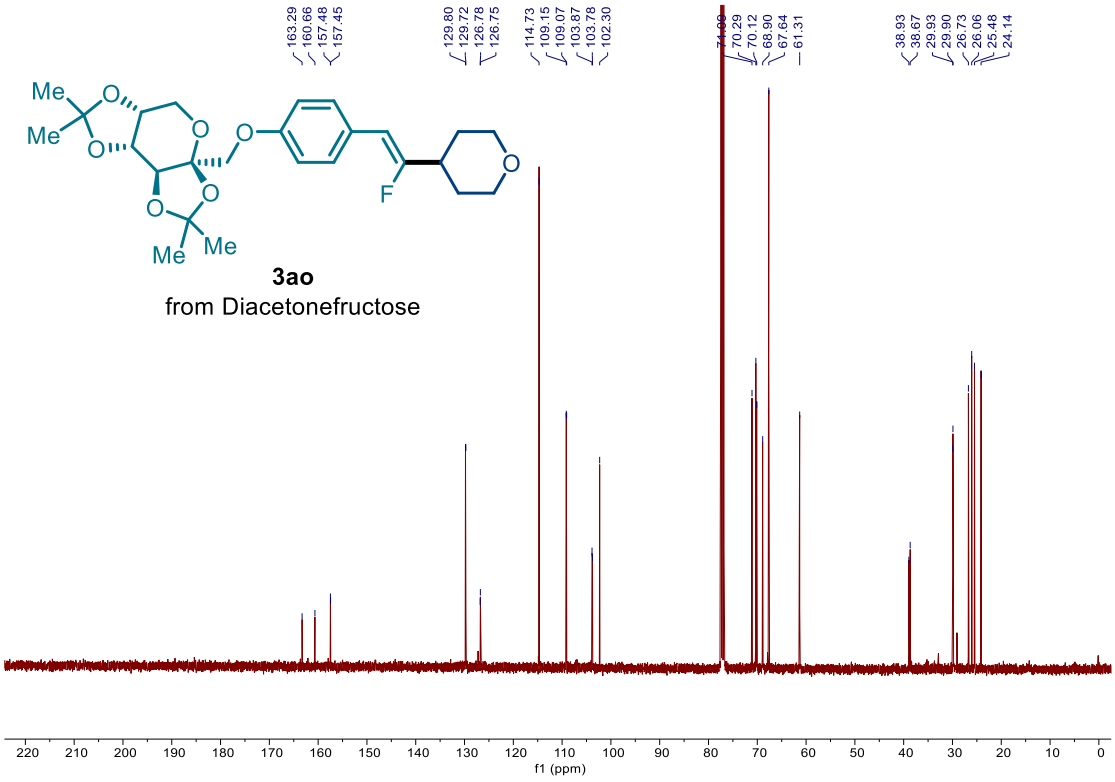

## $^{19}$F NMR of Compound 3an (375 MHz, Chloroform-*d*):



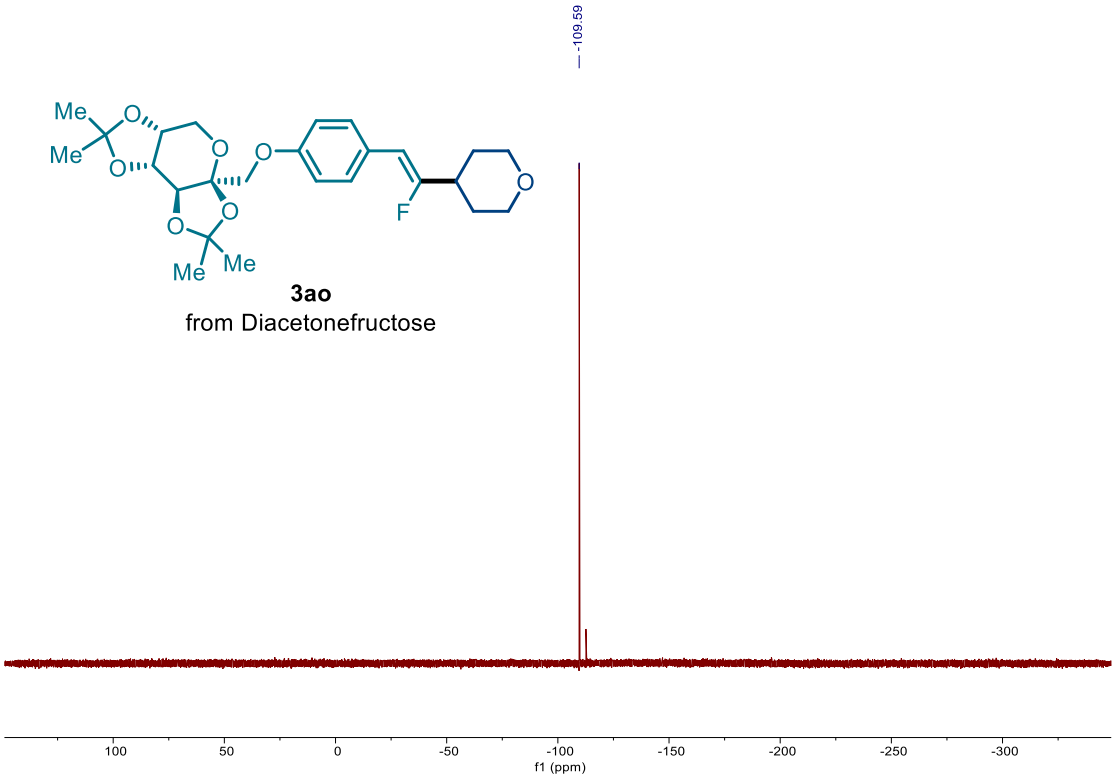
**$^{1}$H NMR of Compound 3ao (400 MHz, Chloroform-*d*):**



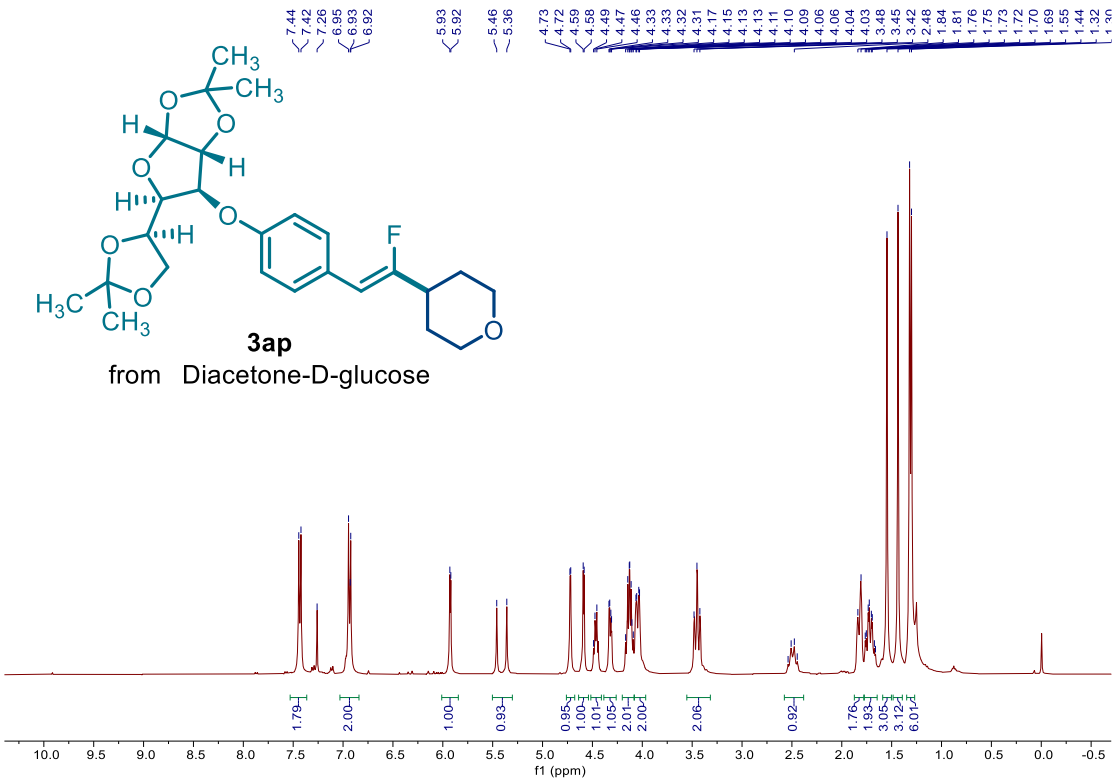

**$^{13}$C NMR of Compound 3ao (100 MHz, Chloroform-*d*):**



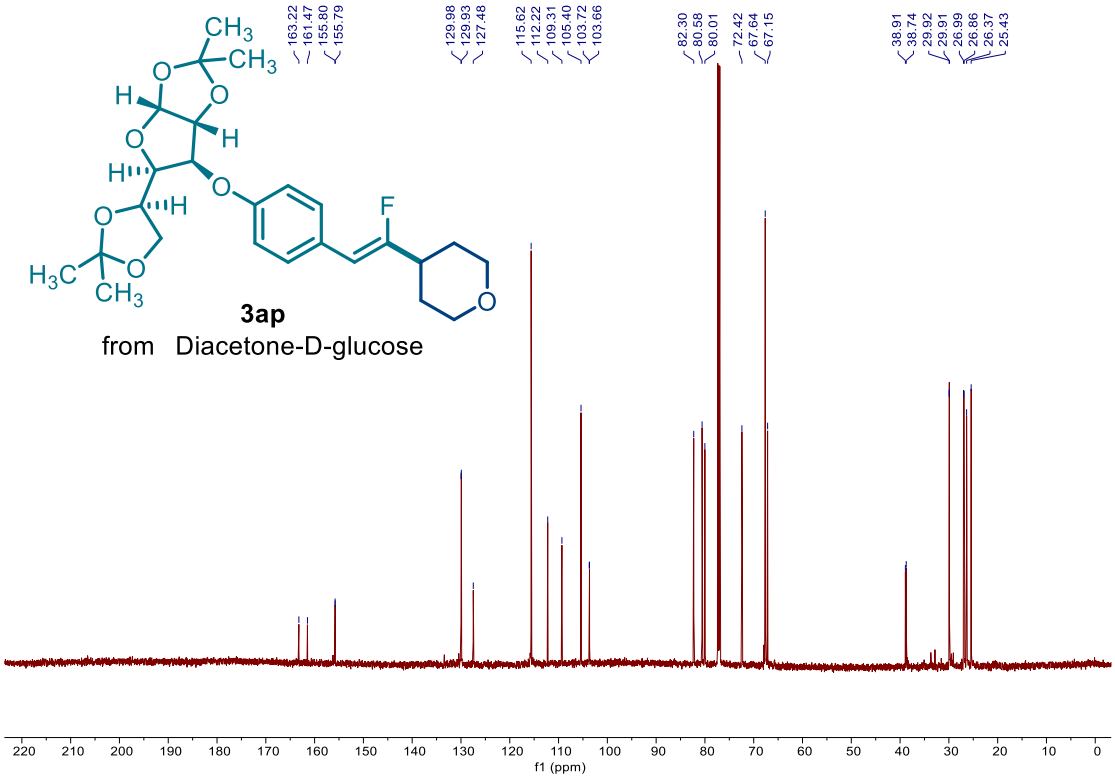
**$^{19}$F NMR of Compound 3ao (375 MHz, Chloroform-*d*):**




**$^{1}$H NMR of Compound 3ap (400 MHz, Chloroform-*d*):**



**$^{13}$C NMR of Compound 3ap (150 MHz, Chloroform-*d*):**




**$^{19}$F NMR of Compound 3ap (375 MHz, Chloroform-*d*):**