# Supporting Information

## Mn-Catalyzed Hydroxyalkylation of α-Trifluoromethylstyrenes with Cyclopropanols: Facile Synthesis of δ-Trifluoromethyl-δ-Hydroxyketones

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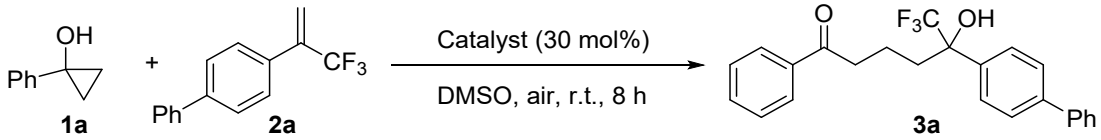
## 1. General information: materials and methods

Unless otherwise mentioned, all chemicals were purchased from commercial sources. All commercial reagents and solvents were ordered from Bidepharm, Energy, Adamas and Macklin. Reagents and solvents were used as received unless otherwise noted. Where necessary, solvents were purified by passing through columns of alumina using a solvent purification system. Air- and moisture sensitive synthesis were performed under nitrogen atmosphere with oven-dried glassware. Column chromatography was performed on silica gel (200-300 mesh). Thin-layer chromatography (TLC) was performed on EM reagents 0.25 mm silica 60-F plates. $^{1}H$ (400 MHz), $^{13}C$ (100 MHz) and $^{19}F$ (376 MHz) NMR spectra were recorded with a Bruker Avance III (400 MHz) spectrometer using tetramethylsilane (TMS) as internal standards. $^{1}H$ NMR spectra are reported in parts per million on the δ scale, and are referenced from the residual protium in the NMR solvent ($CDCl_3$: δ = 7.26 ppm, $CD_3OD$: δ = 3.31 ppm). $^{13}C$ NMR spectra are reported in parts per million on the δ scale, and are referenced from the carbon resonances of the solvent ($CDCl_3$: δ = 77.16 ppm, $CD_3OD$: δ = 49.00 ppm). $^{19}F$ $\{^{1}H\}$ NMR spectra are reported in parts per million on the δ scale. Data are reported as follows: chemical shift [multiplicity (br = broad, s = singlet, d = doublet, t = triplet, m = multiplet), coupling constant(s) in Hertz, integration]. GC-MS analysis was carried out on Agilent 7820A GC system and Angilent 5977B MSD. High-resolution mass spectra (HRMS) were recorded on Agilent GC-QTOF 7200 and Bruker microTOF Q III spectrometer. Melting points (m.p.) were recorded on MP450 melting point apparatus.

## 2. Supporting tables

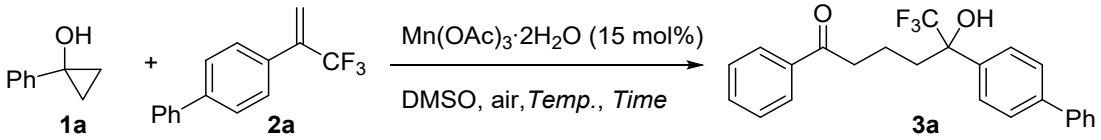
### Table S1. Effect of catalysts




| Entry | Catalyst | Conv. (%) | Yield (%) [b] |
|---|---|---|---|
| 1 | $CuSO_4$·$5H_2O$ | 11 | 4 |
| 2 | $Cu(OTf)_2$ | N.R. | - |
| 3 | $Cu(CH_3CN)_4PF_6$ | 52 | 13 |
| 4 | CuI | 69 | 29 |
| 5 | AgOAc | N.R. | - |
| 6 | $FeCl_3$ | 100 | 36 |
| 7 | $Fe(acac)_2$ | N.R. | - |
| 8 | $Fe(acac)_3$ | N.R. | - |
| 9 | $MnO_2$ | N.R. | - |
| 10 | $Mn(OTf)_2$ | N.R. | - |
| 11 | $Mn(OAc)_3$·$2H_2O$ | 100 | 80 |
| 12 | $Mn(acac)_2$ | 100 | 78 |
| 13 | $Mn(dpm)_3$ | 100 | 60 |
| 14 | $Mn(CO)_5Br$ | 79 | 68 |
| 15 | $Mn_2(CO)_{10}$ | 100 | 78 |
| 16 | $Mn_2(CO)_8Br_2$ | 100 | 76 |

[a] Reactions were performed with **1a** (0.2 mmol) and **2a** (0.1 mmol) in DMSO (1.0 ml). [b] Yields were determined with $^{19}F$ NMR analysis using (trifluoromethoxy)benzene as an internal standard. N.R. = no reaction.

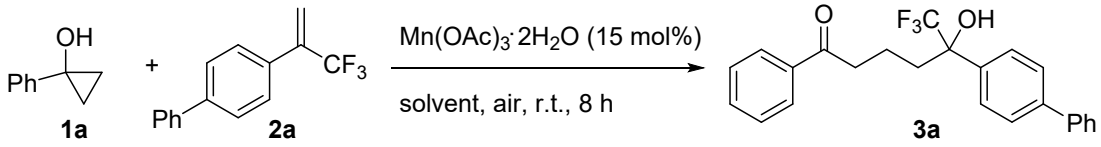
### Table S2. Effect of temperature




| Entry | Temp. (°C) | Time (h) | Yield (%) [b] |
|---|---|---|---|
| 1 | r.t. | 8 | 84 |
| 2 | 50 | 3 | 65 |
| 3 | 80 | 2 | 66 |

[a] Reactions were performed with **1a** (0.2 mmol) and **2a** (0.1 mmol) in DMSO (1.0 ml). [b] Yields were determined with $^{19}F$ NMR analysis using (trifluoromethoxy)benzene as an internal standard.

**Table S3. Effect of solvent**




| Entry | Solvent | Conv. (%) | Yield (%) [b] |
|---|---|---|---|
| 1 | DMSO | 100 | 84 |
| 2 | DMF | 100 | 61 |
| 3 | $CH_3CN$ | 80 | 46 |
| 4 | THF | 66 | 64 |
| 5 | $^{i}$PrOH | 89 | 69 |
| 6 | toluene | 9 | 0 |
| 7 | DCM | 28 | 28 |
| 8 | Sulfolane | 72 | 40 |
| 9 | DMSO:$H_2O$ = 9:1 | 100 | 83 |
| 10 | DMSO:$H_2O$ = 4:1 | 100 | 94 |
| 11 | DMSO:$H_2O$ = 1:1 | 50 | 46 |

[a] Reactions were performed with **1a** (0.2 mmol) and **2a** (0.1 mmol) in solvent (1.0 ml). [b] Yields were determined with $^{19}$F NMR analysis using (trifluoromethoxy)benzene as an internal standard.

## 3. Substrates preparation

### 3.1 Synthesis of cyclopropanols

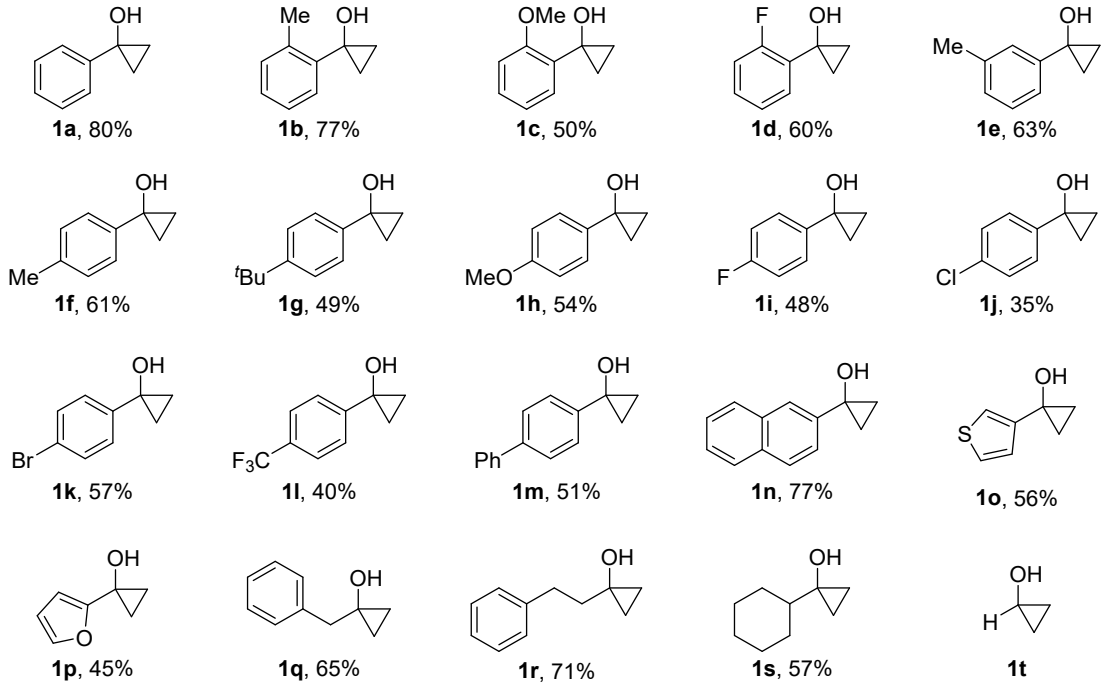
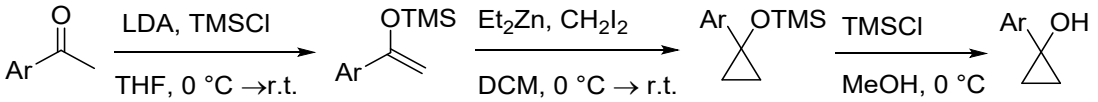



**Figure S1. Cyclopropanols used in this study**

The starting materials cyclopropanols were prepared according to the following procedure. The substrates **1a** – **1n** were prepared according to general procedure A. The substrates **1o** – **1s** were prepared according to general procedure B. The substrate **1t** was commercially available. All cyclopropanols used (**1a** – **1s**) are known compounds and their characterization data are in accordance with the reference report.[1]

*General procedure A:*



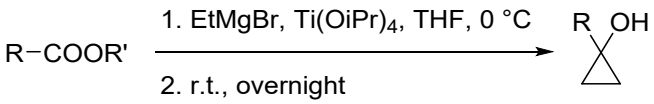

LDA (2 M in THF, 11 mmol, 1.1 equiv.) was added to a 100 mL round-bottomed flask equipped with a stir bar *via* syringe under nitrogen atmosphere at 0 ℃, the ketone (10 mmol, 1.0 equiv.) was added by syringe followed by the addition of chlorotrimethylsilane (1.2 g, 11 mmol, 1.1 equiv.) by syringe. After stirring at room temperature for 2 hours, the mixture was quenched with saturated sodium bicarbonate solution. The reaction mixture was extracted with ethyl acetate (3 × 30 mL), washed

with sodium bicarbonate solution (3 × 30 mL) and brine (3 × 30 mL), and dried over anhydrous $Na_2SO_4$ followed by filtration and concentration. The enol ether was used in the next step without further purification.

The enol ether above, $CH_2I_2$ (4.01 g, 15 mmol, 1.5 equiv.), and $CH_2Cl_2$ (20 mL) were added to a 100 mL round-bottomed flask equipped with a stir bar. The vessel was evacuated and filled with nitrogen gas three times. 7.5 mL of $Et_2Zn$ (2 M in toluene, 15 mmol, 1.5 equiv.) was added *via* syringe at 0 ℃. The mixture was warmed to room temperature and stirred overnight. The mixture was quenched with saturated ammonium chloride solution and the precipitated solid was removed by filtration. The filtrate was extracted with $CH_2Cl_2$ (3 × 30 mL), washed with brine and dried over anhydrous $Na_2SO_4$ followed by filtration and concentration to obtain the crude TMS ether.

The crude TMS ether and methanol (20 mL) were added to a 100 mL round-bottomed flask equipped with a stirring bar. The vessel was evacuated and filled with nitrogen gas three times. A single drop of chlorotrimethylsilane was added *via* syringe at 0 ℃ and the reaction was monitored using TLC. Once completion, the reaction was concentrated to dryness in vacuum and the residue was purified by column chromatography on silica gel (petroleum ether/ethyl acetate = 20:1 to 10:1).

*General procedure B:*




Ester (5 mmol, 1.0 equiv.), titanium isopropoxide (7.5 mmol, 1.5 equiv.) and THF (10 mL) were added to a 50 mL round-bottomed flask equipped with a stirring bar under nitrogen atmosphere. 5 mL of ethylmagnesium bromide (3 M in THF, 3.0 equiv.) was added dropwise by syringe at 0 ℃, then the mixture was warmed to room temperature and stirred overnight. The reaction mixture was quenched with saturated ammonium chloride solution and the precipitate was removed by filtration. The filtrate was extracted with ethyl acetate (3 × 15 mL), washed with brine, and dried over anhydrous

$Na_2SO_4$. After filtration and concentration, the residue was purified by column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1).

### 3.2 Synthesis of alkenes

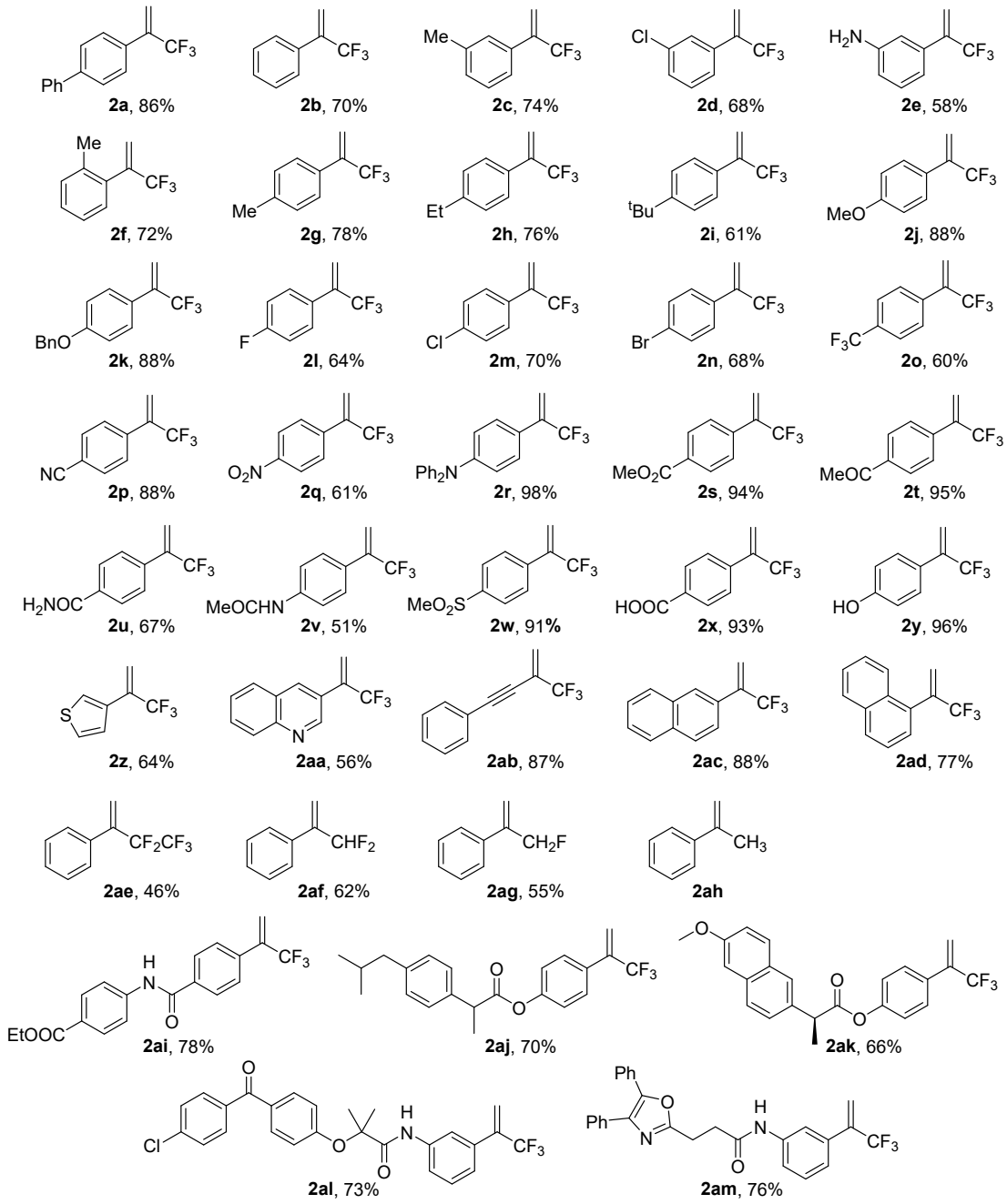
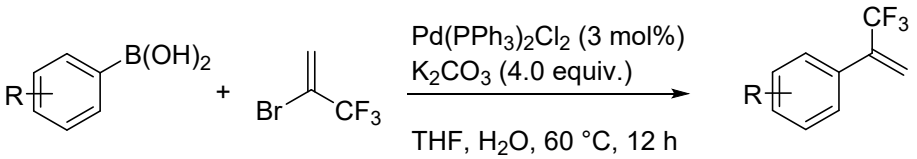



**Figure S2. Fluorinated alkenes used in this study**

The starting materials fluorinated alkenes were prepared according to the following procedure. The substrates **2a, 2c** – **2f**, **2h** – **2w**, **2y** – **2aa**, **2ac**, and **2ad** were prepared according to general procedure C.[2] The substrates **2b**, **2g**, **2ae**, and **2af** were prepared

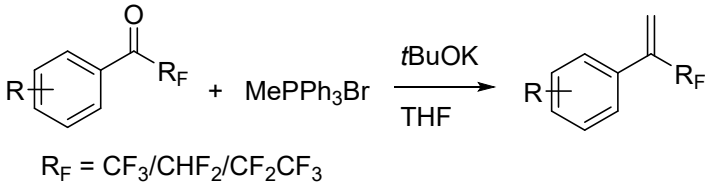
according to general procedure D.[3] The substrate **2x** was prepared according to general procedure E.[2] The substrate **2ab** was prepared according to general procedure F.[4] The substrate **2ag** was prepared according to general procedure G.[5] The substrate **2ai** was prepared according to general procedure H.[4] The substrate **2aj** and **2ak** was prepared according to general procedure I.[3b] The substrate **2al** and **2am** was prepared according to general procedure J.[2] The substrate **2ah** was commercially available. All fluorinated alkenes used (**2a** – **2al**) are known compounds and their characterization data are in accordance with the reference report.

*General procedure C:*



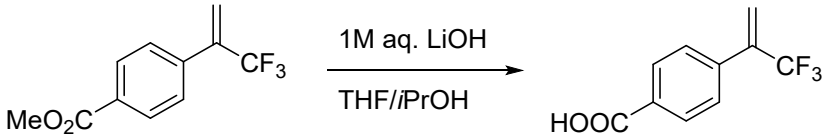

To a 100 mL Schlenk tube equipped a magnetic stir bar, boronic acid (5.0 mmol, 1.0 equiv.), and $Pd(PPh_3)_2Cl_2$ (63.2 mg, 3 mol%) were added. The vessel was evacuated and filled with nitrogen, then THF (20 mL) and aqueous $K_2CO_3$ (2.0 M, 10 mL, 4.0 equiv.) were added. After the addition of 2-bromo-3,3,3-trifluoropropene (1.04 mL, 10 mmol, 2.0 equiv.), the reaction mixture was stirred at 60 ℃ for 12 h. The resultant mixture was cooled to room temperature, quenched with saturated aqueous $NH_4Cl$, and extracted with ethyl acetate (3 × 15 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (petroleum/ethyl acetate) to give the desired trifluoromethyl alkene.

*General procedure D:*



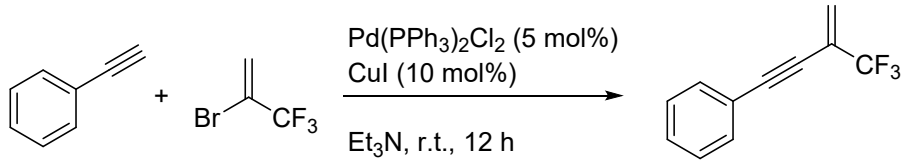
A flame dried Schlenk tube equipped with a magnetic stir bar was charged with methyl triphenylphosphonium bromide (2g, 5.5 mmol, 1.1 equiv.), *t*BuOK (0.62 g, 5.5 mmol, 1.1 equiv.), and THF (10 mL) was added under nitrogen. The resulting solution was stirred for 30 min and cooled to -78 ℃ at which point a solution of trifluoromethyl, difluoromethyl, or pentafluoroethyl ketone (5 mmol, 1 equiv.) in THF (10 mL) was added. The cold bath was removed and the solution was allowed to warm to room temperature over 10 h, and water was added, followed by extraction with petroleum. The combined organic phases were washed with brine and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The residue was purified by column chromatography on silica gel (petroleum) to give the corresponding desired trifluoromethyl, difluoromethyl, or pentafluoroethyl alkene.

*General procedure E:*



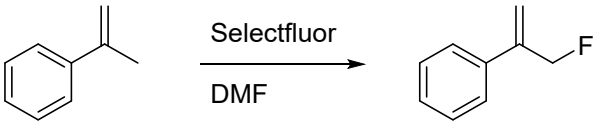

To a 25 mL round bottom flask equipped with a stir bar was added methyl 3-(3,3,3-trifluoroprop-1-en-2-yl)benzoate (0.43 g, 1.86 mmol, 1.0 equiv.) followed by THF (5 mL). The reaction mixture was cooled to 0 ℃ in an ice-water bath. After stirring for 10 min, an aqueous 1M solution of LiOH (2.78 mL, 2.78 mmol, 1.5 equiv.) was added, followed by *i*PrOH (1 mL, 13.32 mmol, 7.18 equiv.). After stirring for 10 min, the ice-bath was removed, and the solution was allowed to stir for 5 h at room temperature. The crude reaction was concentrated in vacuo by rotary evaporation, and the resulting residue was dissolved in $H_2O$ (2.5 mL). The aqueous solution was transferred to a separatory funnel and washed with $Et_2O$ (2 × 1.5 mL). The aqueous layer was then acidified with 1 M aqueous HCl to a pH of ~1 and extracted with ethyl acetate (4 × 2.5 mL). The combined ethyl acetate layers were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure to give the desired carboxylic acid.

*General procedure F:*



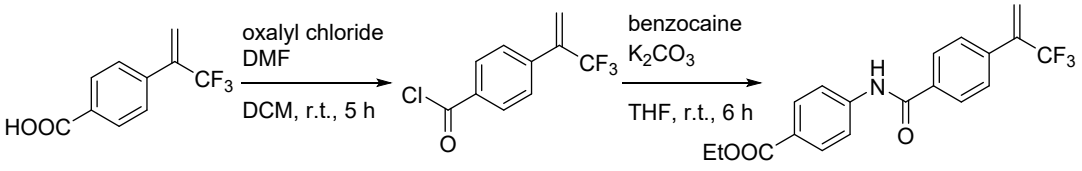

CuI (57.2 mg, 10 mol%) and $Pd(PPh_3)_2Cl_2$ (105.3 mg, 5 mol%) were dissolved in $Et_3N$ (30 mL) under nitrogen at room temperature. To the solution were added 2-bromo-3,3,3-trifluoropropene (0.62 mL, 6.0 mmol, 2.0 equiv.) and phenylacetylene (0.33 mL, 3.0 mmol, 1.0 equiv.). The reaction mixture was left to stir at room temperature for 12 h. The resultant mixture was diluted with saturated aqueous $NH_4Cl$ (20 mL) followed by extraction with $CH_2Cl_2$ (3 × 20 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum) to give the desired enyne.

*General procedure G:*




A solution of $\alpha$-methylstyrene (0.6 g, 5 mmol, 1.1 equiv.) in dry DMF (15 mL) was treated with Selectfluor (1.6 g, 4.5 mmol, 1 equiv.) and the reaction mixture stirred at 75 °C for 4 h. The resultant mixture was cooled to room temperature, water (75 mL) was added and extracted with petroleum (3 × 25 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum) to give the desired product.

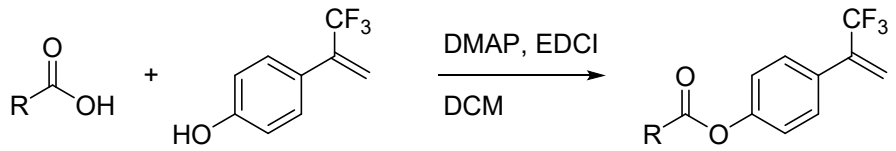
*General procedure H:*



To a mixture of 4-(3,3,3-trifluoroprop-1-en-2-yl)benzoic acid (2 mmol, 432.3 mg, 1 equiv.) and oxalyl chloride (4 mmol, 0.34 mL, 2 equiv.) in dry DCM (8 mL) was added DMF (0.2 mmol, 16 μL, 0.1 equiv.) slowly. The reaction mixture was stirred at room temperature for 5 h, before it was evaporated under vacuum to give the crude acid chloride, which was used in the next step without further purification.

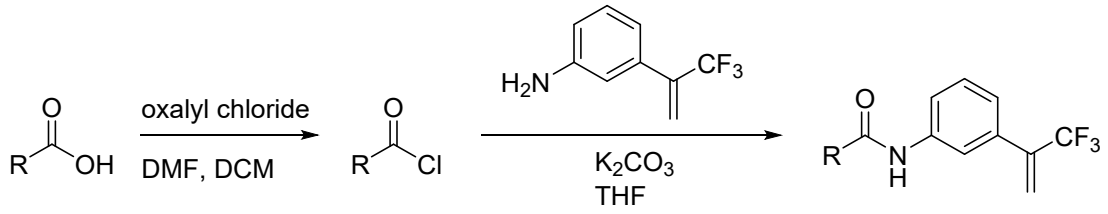
To a solution of benzocaine (2 mmol, 330.4 mg, 1 equiv.) in dry THF (8 mL) was added $K_2CO_3$ (2 mmol, 276.4 mg, 1 equiv.) and the freshly prepared acid chloride (2 mmol, 1 equiv.) The mixture was stirred at room temperature for 6 h before water was added to quench the reaction. The aqueous layer was extracted with ethyl acetate, the combined organic layers were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 5:1) to give the desired trifluoromethyl alkene.

*General procedure I:*




To a solution of 4-(3,3,3-trifluoroprop-1-en-2-yl)phenol (188 mg, 1 mmol, 1 equiv.) in DCM (2.5 mL) was added drug derivatives containing carboxylic acid (2 mmol, 2 equiv.), EDCI (2 mmol, 2 equiv.) and DMAP (12.2 mg, 0.1 mmol, 0.1 equiv.) at 0 ℃, then stirring at room temperature. The reaction was monitored by TLC. Upon completion, the reaction mixture was quenched by aqueous NaCl (7.5 mL) and extracted with DCM (3 × 7.5 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 20:1) to give the desired trifluoromethyl alkene.

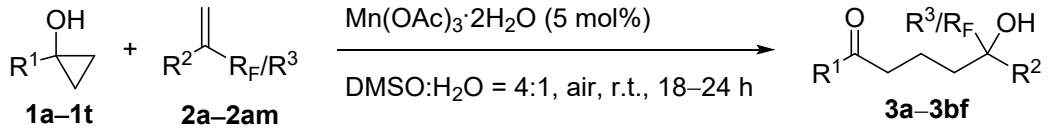
*General procedure J:*



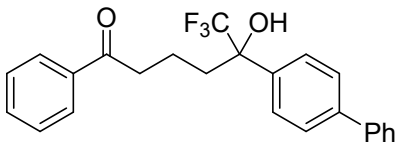

To a mixture of drug derivatives containing carboxylic acid (1.5 mmol, 1 equiv.) and oxalyl chloride (0.26 mL, 3 mmol, 2 equiv.) in dry DCM (6 mL) was added dropwise DMF (12 μL, 10 mol%). The reaction mixture was stirred at room temperature for 6 h. Removal of the solvent in vacuo afforded the desired acid chloride which was used in the next step without further purification.

To a mixture of 3-(3,3,3-trifluoroprop-1-en-2-yl)aniline (0.29 g, 1.5 mmol, 1 equiv.) and $K_2CO_3$ (0.21 g, 1.5 mmol, 1 equiv.) in dry THF (3 mL) was added dropwise a solution of the freshly prepared acid chloride (1.5 mmol, 1 equiv.) in dry THF (3 mL). The mixture was stirred at room temperature for 6 h before water was added to quench the reaction. The resultant mixture was extracted with ethyl acetate (3 × 10 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 10:1) to give the desired trifluoromethyl alkene.

## 4. Synthetic procedures and characterization of products




To a glass tube charged with a stirring bar were added $Mn(OAc)_3 \cdot 2H_2O$ (1.3 mg, 0.005 mmol, 5 mol%), fluorinated alkenes (0.1 mmol, 1 equiv.), cyclopropanols (0.2 mmol, 2 equiv.), $H_2O$ (0.2 mL) and DMSO (0.8 mL). The reaction was stirred at room temperature for 18 – 24 h under open-air conditions (monitored by TLC). After completion of the reaction, the crude mixture was extracted with ethyl acetate. The organic layer was separated and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate) to give the desired compounds.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3a)**

Yellow solid (36.7 mg, 92% yield)

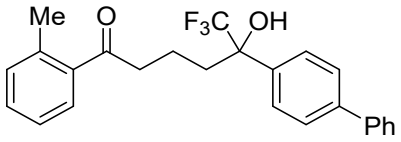
**m.p.** 144.4 – 146.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.93 (d, *J* = 8.0 Hz, 2H), 7.71 – 7.58 (m, 6H), 7.56 (d, *J* = 7.2 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 4H), 7.36 (t, *J* = 7.2 Hz, 1H), 3.78 (s, 1H), 3.13 – 2.94 (m, 2H), 2.43 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.90 – 1.75 (m, 1H), 1.62 – 1.53 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 141.3, 140.6, 136.7, 135.7, 133.6, 128.9, 128.8, 128.2, 127.6, 127.3, 127.2, 127.1, 125.8 (q, *J* = 284.1 Hz), 77.2 (q, *J* = 27.6 Hz), 37.6, 33.9, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.28.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{21}F_3O_2$ 398.1488; Found 398.1490.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(*o*-tolyl)hexan-1-one (3b)**

White solid (33.4 mg, 81% yield)

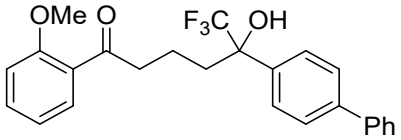
**m.p.** 136.8 – 138.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.70 – 7.57 (m, 7H), 7.48 – 7.42 (m, 2H), 7.41 – 7.33 (m, 2H), 7.23 (t, *J* = 8.0 Hz, 2H), 3.71 (s, 1H), 3.04 – 2.87 (m, 2H), 2.50 (s, 3H), 2.41 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.06 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.87 – 1.74 (m, 1H), 1.60 – 1.50 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 204.5, 141.3, 140.6, 138.6, 137.4, 135.7, 132.3, 131.8, 128.9, 128.7, 127.6, 127.3, 127.21 (q, *J* = 1.2 Hz), 127.16, 126.4 (q, *J* = 284.3 Hz), 125.8, 77.3 (q, *J* = 27.9 Hz), 40.4, 34.0, 21.7, 16.9.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{23}F_3O_2$ 412.1645; Found 412.1647.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(2-methoxyphenyl)hexan-1-one (3c)**

White solid (30.9 mg, 72% yield)

**m.p.** 105.6 – 107.7 ℃.

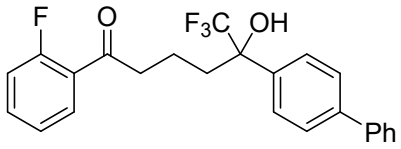
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.72 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.70 – 7.56 (m, 6H), 7.50 – 7.41 (m, 3H), 7.40 – 7.31 (m, 1H), 7.00 (t, *J* = 7.6 Hz, 1H), 6.95 (d, *J* = 8.0 Hz, 1H), 3.87 (s, 3H), 3.83 (s, 1H), 3.15 – 2.92 (m, 2H), 2.40 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.06 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.84 – 1.70 (m, 1H), 1.61 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 202.8, 159.0, 141.2, 140.6, 135.9, 134.1, 130.6, 128.9, 127.8, 127.6, 127.29, 127.28, 127.1, 125.8 (q, *J* = 284.3 Hz), 120.9, 111.7, 77.3

(q, *J* = 27.6 Hz), 55.6, 43.1, 33.9, 16.9.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.31.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_2H_{21}F_3O_2$ 410.1488; Found 410.1486.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-1-(2-fluorophenyl)-5-hydroxyhexan-1-one (3d)**

White solid (32.5 mg, 78% yield)

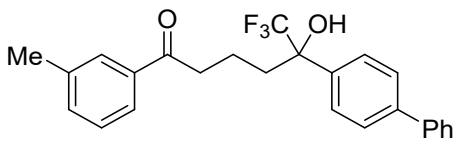
**m.p.** 119.2 – 121.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.87 (td, *J* = 7.6, 2.0 Hz, 1H), 7.71 – 7.58 (m, 6H), 7.52 (dddd, *J* = 8.8, 7.2, 5.2, 2.0 Hz, 1H), 7.48 – 7.42 (m, 2H), 7.39 – 7.33 (m, 1H), 7.23 (td, *J* = 7.6, 1.2 Hz, 1H), 7.12 (ddd, *J* = 11.4, 8.4, 1.2 Hz, 1H), 3.63 (s, 1H), 3.13 – 2.95 (m, 2H), 2.42 (ddd, *J* = 14.4, 10.8, 6.0 Hz, 1H), 2.08 (ddd, *J* = 14.4, 10.4, 4.0 Hz, 1H), 1.90 – 1.77 (m, 1H), 1.63 – 1.49 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 198.8 (d, *J* = 4.2 Hz), 162.3 (d, *J* = 253.5 Hz), 141.3, 140.6, 135.6, 135.1 (d, *J* = 9.1 Hz), 130.8 (d, *J* = 2.6 Hz), 128.9, 127.6, 127.3, 127.2, 127.1, 125.8 (q, *J* = 284.2 Hz), 125.3 (d, *J* = 12.7 Hz), 124.7 (d, *J* = 3.4 Hz), 116.9 (d, *J* = 23.9 Hz), 77.3 (q, *J* = 27.7 Hz), 42.9 (d, *J* = 7.8 Hz), 34.0, 16.6 (d, *J* = 2.1 Hz).

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.29, -108.64.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{20}F_4O_2$ 416.1394; Found 416.1393.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(*m*-tolyl)hexan-1-one (3e)**

White solid (34.2 mg, 83% yield)

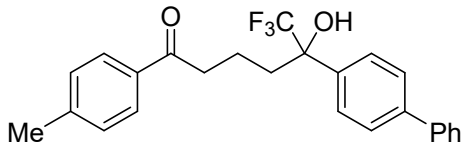
**m.p.** 122.3 – 124.2 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.77 – 7.66 (m, 4H), 7.65 – 7.56 (m, 4H), 7.48 – 7.42 (m, 2H), 7.41 – 7.31 (m, 3H), 3.85 (s, 1H), 3.16 – 2.89 (m, 2H), 2.48 – 2.41 (m, 1H), 2.40 (s, 3H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.88 – 1.75 (m, 1H), 1.66 – 1.52 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.9, 141.3, 140.6, 138.6, 136.8, 135.8, 134.3, 128.9, 128.71, 128.67, 127.6, 127.28, 127.26, 127.1, 125.8 (q, *J* = 284.0 Hz), 125.4, 77.3 (q, *J* = 27.5 Hz), 37.7, 33.9, 21.5, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.30.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{23}F_3O_2$ 412.1645; Found 412.1645.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(*p*-tolyl)hexan-1-one (3f)**

Yellow solid (33.8 mg, 82% yield)

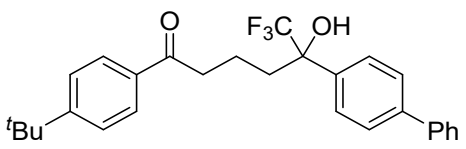
**m.p.** 160.3 – 162.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.82 (d, *J* = 8.0 Hz, 2H), 7.71 – 7.56 (m, 6H), 7.44 (t, *J* = 7.6 Hz, 2H), 7.39 – 7.33 (m, 1H), 7.24 (d, *J* = 8.0 Hz, 2H), 3.98 (s, 1H), 3.09 – 2.92 (m, 2H), 2.46 – 2.36 (m, 1H), 2.40 (s, 3H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.88 – 1.74 (m, 1H), 1.63 – 1.52 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.4, 144.5, 141.3, 140.6, 135.8, 134.2, 129.5, 128.9, 128.3, 127.6, 127.29, 127.26, 127.1, 125.7 (q, *J* = 284.3 Hz), 77.2 (q, *J* = 28.0 Hz), 37.4, 33.8, 21.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.34.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{25}H_{21}F_3O$ 394.1539; Found 394.1537.




**5-([1,1'-biphenyl]-4-yl)-1-(4-(*tert*-butyl)phenyl)-6,6,6-trifluoro-5-hydroxyhexan-**

**1-one (3g)**

Pale yellow solid (26.8 mg, 59% yield)

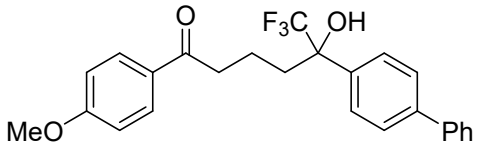
**m.p.** 128.5 – 130.7 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.89 – 7.84 (m, 2H), 7.71 – 7.58 (m, 6H), 7.49 – 7.42 (m, 4H), 7.39 – 7.33 (m, 1H), 3.93 (s, 1H), 3.11 – 2.91 (m, 2H), 2.43 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.88 – 1.74 (m, 1H), 1.65 – 1.53 (m, 1H), 1.33 (s, 9H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.4, 157.4, 141.3, 140.6, 135.8, 134.2, 128.9, 128.2, 127.6, 127.30, 127.29, 127.1, 125.8 (q, *J* = 284.1 Hz), 125.7, 77.2 (q, *J* = 27.8 Hz), 37.5, 35.3, 33.9, 31.2, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{28}H_{29}F_3O_2$ 454.2114; Found 454.2119.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(4-methoxyphenyl)hexan-1-one (3h)**[6]

Yellow solid (39.8 mg, 93% yield)

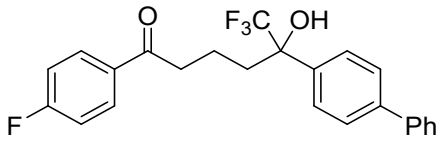
**m.p.** 128.2 – 130.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.94 – 7.85 (m, 2H), 7.73 – 7.66 (m, 2H), 7.65 – 7.57 (m, 4H), 7.48 – 7.41 (m, 2H), 7.40 – 7.31 (m, 1H), 6.94 – 6.88 (m, 2H), 4.18 (s, 1H), 3.85 (s, 3H), 3.06 – 2.88 (m, 2H), 2.42 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.08 (ddd, *J* = 14.4, 9.6, 4.4 Hz, 1H), 1.89 – 1.76 (m, 1H), 1.67 – 1.53 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 199.3, 163.9, 141.2, 140.6, 135.9, 130.5, 129.7, 128.9, 127.6, 127.31, 127.27, 127.1, 125.8 (q, *J* = 284.0 Hz), 77.2 (q, *J* = 27.8 Hz), 113.9, 55.6, 37.2, 33.8, 16.8.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.31.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{23}F_3O_3$ 428.1594; Found 428.1594.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-1-(4-fluorophenyl)-5-hydroxyhexan-1-one (3i)**

White solid (36.2 mg, 87% yield)

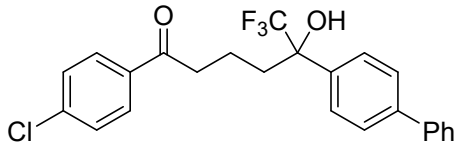
**m.p.** 141.9 – 143.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.98 – 7.91 (m, 2H), 7.70 – 7.57 (m, 6H), 7.48 – 7.42 (m, 2H), 7.39 – 7.33 (m, 1H), 7.15 – 7.08 (m, 2H), 3.75 (s, 1H), 3.08 – 2.92 (m, 2H), 2.41 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.89 – 1.76 (m, 1H), 1.63 – 1.53 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 198.9, 166.1 (d, *J* = 253.8 Hz), 141.3, 140.5, 135.7, 133.1 (q, *J* = 3.1 Hz), 130.9 (d, *J* = 9.3 Hz), 128.9, 127.7, 127.3, 127.2 (q, *J* = 1.5 Hz), 127.1, 125.8 (q, *J* = 284.1 Hz), 115.9 (q, *J* = 21.7 Hz), 77.2 (q, *J* = 27.7 Hz), 37.6, 33.9, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.31, -104.52.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{20}F_4O_2$ 416.1394; Found 416.1395.




**5-([1,1'-biphenyl]-4-yl)-1-(4-chlorophenyl)-6,6,6-trifluoro-5-hydroxyhexan-1-one (3j)**

White solid (38.5 mg, 89% yield)

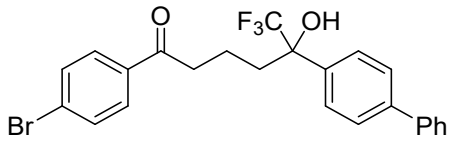
**m.p.** 152.7 – 154.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.88 – 7.81 (m, 2H), 7.70 – 7.55 (m, 6H), 7.49 – 7.39 (m, 4H), 7.39 – 7.33 (m, 1H), 3.57 (s, 1H), 3.07 – 2.89 (m, 2H), 2.42 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.89 – 1.75 (m, 1H), 1.66 – 1.54 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 199.3, 141.4, 140.5, 140.0, 135.6, 135.0, 129.6, 129.1, 128.9, 127.7, 127.3, 127.19, 127.17, 125.8 (q, *J* = 284.6 Hz), 77.3 (q, *J* = 27.8 Hz), 37.6, 33.9, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{20}ClF_3O_2$ 432.1098; Found 432.1100.




**5-([1,1'-biphenyl]-4-yl)-1-(4-bromophenyl)-6,6,6-trifluoro-5-hydroxyhexan-1-one (3k)**

Pale yellow solid (40.6 mg, 85% yield)

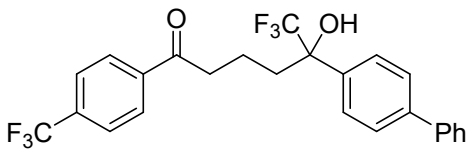
**m.p.** 169.9 – 172.2 °C.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.81 – 7.74 (m, 2H), 7.69 – 7.55 (m, 8H), 7.48 – 7.42 (m, 2H), 7.39 – 7.33 (m, 1H), 3.61 (s, 1H), 3.07 – 2.88 (m, 2H), 2.40 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.91 – 1.75 (m, 1H), 1.60 – 1.53 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 199.5, 141.4, 140.5, 135.6, 135.4, 132.1, 129.7, 129.0, 128.8, 127.7, 127.3, 127.18, 127.17, 125.8 (q, *J* = 284.5 Hz), 77.2 (q, *J* = 27.7 Hz), 37.6, 33.9, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{20}BrF_3O_2$ 476.0593; Found 476.0590.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(4-(trifluoromethyl)phenyl)hexan-1-one (3l)**

White solid (41.0 mg, 88% yield)

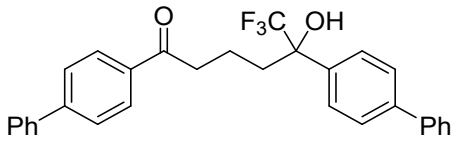
**m.p.** 144.2 – 146.4 °C.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.01 (d, *J* = 8.0 Hz, 2H), 7.71 (d, *J* = 8.0 Hz, 2H), 7.69 – 7.56 (m, 6H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.40 – 7.33 (m, 1H), 3.35 (s, 1H), 3.12 – 2.95 (m, 2H), 2.43 (ddd, *J* = 14.4, 10.0, 6.0 Hz, 1H), 2.09 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.93 – 1.78 (m, 1H), 1.69 – 1.58 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 199.3, 141.5, 140.5, 139.3 (q, *J* = 1.1 Hz), 135.4, 134.8 (q, *J* = 32.5 Hz), 129.0, 128.5, 127.7, 127.3, 127.2, 127.1 (q, *J* = 1.2 Hz), 125.9 (q, *J* = 3.7 Hz), 123.7 (q, *J* = 271.2 Hz), 122.9 (q, *J* = 275.8 Hz), 77.3 (q, *J* = 27.5 Hz), 38.1, 34.0, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -63.16, -80.31.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{20}F_6O_2$ 466.1362; Found 466.1363.




**1,5-di([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxyhexan-1-one (3m)**

White solid (38.4 mg, 81% yield)

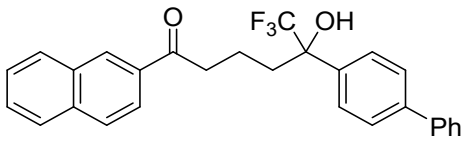
**m.p.** 173.5 – 175.6 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.99 (d, *J* = 8.4 Hz, 2H), 7.71 – 7.65 (m, 4H), 7.64 – 7.57 (m, 6H), 7.50 – 7.38 (m, 5H), 7.38 – 7.33 (m, 1H), 3.86 (s, 1H), 3.16 – 2.97 (m, 2H), 2.44 (ddd, *J* = 14.8, 10.0, 6.8 Hz, 1H), 2.10 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.92 – 1.77 (m, 1H), 1.69 – 1.61 (m, 1H).

$^{13}$C NMR (100 MHz, Chloroform-*d*) δ 200.3, 146.3, 141.3, 140.6, 139.9, 135.7, 135.4, 129.1, 128.9, 128.8, 128.5, 127.6, 127.43, 127.41, 127.29, 127.26, 127.1, 125.8 (q, *J* = 283.6 Hz), 77.2 (q, *J* = 27.3 Hz), 37.7, 33.9, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (ESI)** m/z: $[M+Na]^+$ Calcd. for $C_{30}H_{25}F_3NaO_2$ 497.1699; found: 497.1709.



**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(naphthalen-2-yl)hexan-1-one (3n)**

Pale yellow solid (38.2 mg, 85% yield)

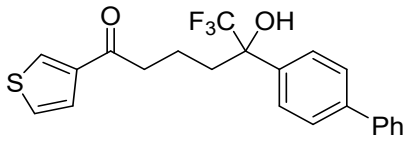
**m.p.** 154.4 – 156.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.43 (s, 1H), 7.99 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.93 (d, *J* = 8.0 Hz, 1H), 7.88 (dd, *J* = 8.4, 5.2 Hz, 2H), 7.73 – 7.51 (m, 8H), 7.44 (t, *J* = 7.6 Hz, 2H), 7.35 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 1H), 3.27 – 3.08 (m, 2H), 2.47 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.13 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.96 – 1.81 (m, 1H), 1.74 – 1.60 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 141.3, 140.6, 135.9, 135.7, 134.0, 132.6, 130.0, 129.7, 128.9, 128.8, 128.7, 127.9, 127.6, 127.28, 127.26, 127.2, 127.0, 125.8 (q, *J* = 284.2 Hz), 123.8, 77.2 (q, *J* = 27.0 Hz), 37.7, 33.9, 16.8.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.30.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{28}H_{23}F_3O_2$ 448.1645; Found 448.1645.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-5-hydroxy-1-(thiophen-3-yl)hexan-1-one (3o)**

White solid (36.8 mg, 91% yield)

**m.p.** 156.8 – 158.4 ℃.

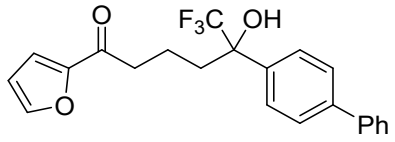
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.02 (dd, *J* = 2.8, 1.2 Hz, 1H), 7.70 – 7.58 (m, 6H), 7.51 (dd, *J* = 5.2, 1.2 Hz, 1H), 7.48 – 7.41 (m, 2H), 7.39 – 7.34 (m, 1H), 7.31 (dd, *J* = 5.2, 2.8 Hz, 1H), 3.87 (s, 1H), 3.03 – 2.85 (m, 2H), 2.41 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.08 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.88 – 1.74 (m, 1H), 1.63 – 1.51 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 195.0, 142.0, 141.3, 140.6, 135.7, 132.4, 128.9, 127.6, 127.3, 127.2 (q, *J* = 1.4 Hz), 127.1, 126.9, 126.7, 125.8 (q, *J* = 283.9 Hz), 77.2

(q, *J* = 28.6 Hz), 38.8, 33.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{22}H_{17}F_3OS$ 386.0947; Found 386.0945.




**5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-1-(furan-2-yl)-5-hydroxyhexan-1-one (3p)**

Pale yellow solid (27.8 mg, 72% yield)

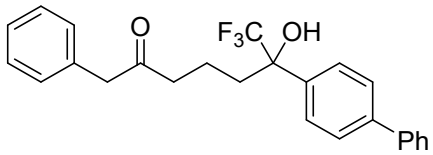
**m.p.** 110.3 – 112.6 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.68 – 7.58 (m, 6H), 7.57 (dd, *J* = 1.6, 0.8 Hz, 1H), 7.48 – 7.41 (m, 2H), 7.38 – 7.33 (m, 1H), 7.18 (dd, *J* = 3.6, 0.8 Hz, 1H), 6.53 (dd, *J* = 3.6, 2.0 Hz, 1H), 3.58 (s, 1H), 2.97 – 2.81 (m, 2H), 2.39 (ddd, *J* = 14.4, 10.4, 6.0 Hz, 1H), 2.08 (ddd, *J* = 14.4, 10.4, 4.8 Hz, 1H), 1.86 – 1.74 (m, 1H), 1.59 – 1.50 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 189.7, 152.7, 146.7, 141.3, 140.6, 135.5, 128.9, 127.6, 127.3, 127.19 (q, *J* = 1.2 Hz), 127.15, 125.8 (q, *J* = 284.9 Hz), 117.5, 112.5, 77.2 (q, *J* = 27.6 Hz), 37.4, 33.9, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.36.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{22}H_{17}F_3O_2$ 370.1175; Found 370.1169.




**6-([1,1'-biphenyl]-4-yl)-7,7,7-trifluoro-6-hydroxy-1-phenylheptan-2-one (3q)**

White solid (32.5 mg, 79% yield)

**m.p.** 115.6 – 117.7 ℃.

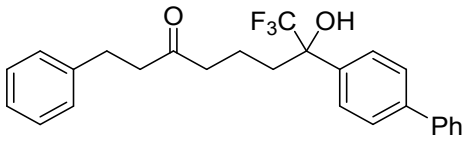
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.62 – 7.57 (m, 6H), 7.48 – 7.41 (m, 2H), 7.39 – 7.26 (m, 4H), 7.19 – 7.14 (m, 2H), 3.65 (s, 2H), 3.42 (s, 1H), 2.49 (t, *J* = 6.4 Hz, 2H), 2.24 (ddd, *J* = 14.4, 10.8, 6.0 Hz, 1H), 1.90 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.65 –

1.54 (m, 1H), 1.40 – 1.31 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 209.2, 141.3, 140.5, 135.5, 134.0, 129.5, 129.0, 128.9, 127.6, 127.4, 127.3, 127.13, 127.11, 125.7 (q, *J* = 283.6 Hz), 77.1 (q, *J* = 27.9 Hz), 50.4, 41.0, 33.8, 16.3.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.33.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{23}F_3O_2$ 412.1645; Found 412.1650.




**7-([1,1'-biphenyl]-4-yl)-8,8,8-trifluoro-7-hydroxy-1-phenyloctan-3-one (3r)**

White solid (32.1 mg, 75% yield)

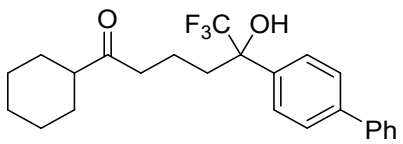
**m.p.** 103.6 – 105.4 ℃.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.65 – 7.58 (m, 6H), 7.48 – 7.42 (m, 2H), 7.39 – 7.34 (m, 1H), 7.30 – 7.24 (m, 2H), 7.22 – 7.13 (m, 3H), 3.56 (s, 1H), 2.89 (t, *J* = 7.6 Hz, 2H), 2.75 – 2.64 (m, 2H), 2.42 (t, *J* = 6.4 Hz, 2H), 2.27 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 1.92 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.69 – 1.55 (m, 1H), 1.44 – 1.32 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 211.0, 141.3, 140.9, 140.5, 135.6, 128.9, 128.7, 128.4, 127.6, 127.3, 127.2, 127.1, 126.4, 125.7 (q, *J* = 284.1 Hz), 77.1 (q, *J* = 27.8 Hz), 44.4, 42.2, 33.8, 29.9, 16.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.30.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{26}H_{25}F_3O_2$ 426.1801; Found 426.1801.




**5-([1,1'-biphenyl]-4-yl)-1-cyclohexyl-6,6,6-trifluoro-5-hydroxyhexan-1-one (3s)**

Yellow solid (28.9 mg, 72% yield)

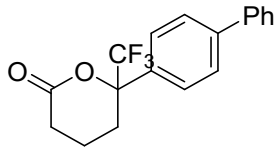
**m.p.** 109.9 – 112.2 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.67 – 7.58 (m, 6H), 7.47 – 7.41 (m, 2H), 7.39 – 7.33 (m, 1H), 3.81 (s, 1H), 2.57 – 2.42 (m, 2H), 2.37 – 2.24 (m, 2H), 1.93 (ddd, *J* = 14.3, 10.1, 4.2 Hz, 1H), 1.83 – 1.73 (m, 4H), 1.68 – 1.56 (m, 2H), 1.45 – 1.29 (m, 3H), 1.25 – 1.12 (m, 2H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 215.3, 141.2, 140.6, 135.8, 128.9, 127.6, 127.3, 127.2, 127.1, 125.8 (q, *J* = 284.1 Hz), 77.1 (q, *J* = 27.8 Hz), 51.0, 39.6, 33.9, 28.6 (d, *J* = 2.4 Hz), 25.9, 25.7 (d, *J* = 1.8 Hz), 16.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.32.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{27}F_3O_2$ 404.1958; Found 404.1956.




**6-([1,1'-biphenyl]-4-yl)-6-(trifluoromethyl)tetrahydro-2*H*-pyran-2-one (2t)**

Pale yellow solid (21.9 mg, 68% yield)

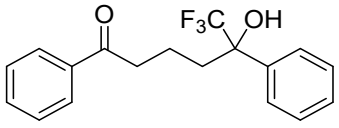
**m.p.** 100.6 – 102.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.68 – 7.56 (m, 6H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.40 – 7.33 (m, 1H), 2.47 – 2.36 (m, 2H), 2.36 – 2.28 (m, 1H), 2.07 (ddd, *J* = 14.8, 10.8, 4.4 Hz, 1H), 1.79 – 1.64 (m, 1H), 1.52 – 1.38 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 178.9, 141.5, 140.5, 135.1, 129.0, 127.7, 127.3, 127.2, 127.0, 125.7 (q, *J* = 284.1 Hz), 77.2 (q, *J* = 27.5 Hz), 34.1, 33.3, 17.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.24.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{18}H_{15}F_3O_2$ 320.1019; Found 320.1015.




**6,6,6-trifluoro-5-hydroxy-1,5-diphenylhexan-1-one (3u)**

Pale yellow solid (25.8 mg, 80% yield)

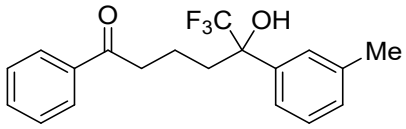
**m.p.** 82.5 – 84.6 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.89 (m, 2H), 7.62 (d, *J* = 7.2 Hz, 2H), 7.59 – 7.54 (m, 1H), 7.48 – 7.43 (m, 2H), 7.43 – 7.38 (m, 2H), 7.37 – 7.32 (m, 1H), 3.79 (s, 1H), 3.10 – 2.92 (m, 2H), 2.39 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.05 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.88 – 1.76 (m, 1H), 1.61 – 1.46 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 136.7, 133.6, 128.8, 128.5, 128.4, 128.2, 126.8, 126.7, 125.7 (q, *J* = 283.9 Hz), 77.3 (q, *J* = 28.0 Hz), 37.6, 33.9, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.38.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{15}F_3O$ 304.1070; Found 304.1068.




**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(m-tolyl)hexan-1-one (3v)**

Pale yellow solid (27.3 mg, 81% yield)

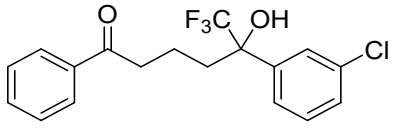
**m.p.** 98.1 – 100.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.88 (m, 2H), 7.60 – 7.54 (m, 1H), 7.49 – 7.41 (m, 3H), 7.38 (d, *J* = 8.0 Hz, 1H), 7.20 (t, *J* = 7.6 Hz, 1H), 7.15 (d, *J* = 7.6 Hz, 1H), 3.66 (s, 1H), 3.10 – 2.91 (m, 2H), 2.38 (s, 3H), 2.37 – 2.30 (m, 1H), 2.03 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.86 – 1.72 (m, 1H), 1.61 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 138.1, 136.7, 136.6, 133.5, 129.2, 128.8, 128.3, 128.2, 127.4, 125.8 (q, *J* = 284.2 Hz), 123.7, 77.2 (q, *J* = 27.5 Hz), 37.7, 34.0, 21.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.30.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{19}H_{19}F_3O_2$ 336.1332; Found 336.1332.




**5-(3-chlorophenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3w)**

White solid (31.1 mg, 87% yield)

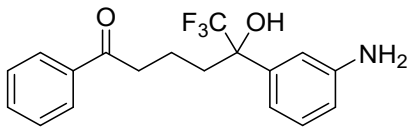
**m.p.** 99.6 – 101.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.93 (d, *J* = 7.6 Hz, 2H), 7.66 (s, 1H), 7.61 – 7.54 (m, 1H), 7.53 – 7.42 (m, 3H), 7.33 (d, *J* = 4.8 Hz, 2H), 4.19 (s, 1H), 3.13 – 2.94 (m, 2H), 2.35 (ddd, *J* = 16.0, 10.4, 6.8 Hz, 1H), 2.04 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.84 – 1.72 (m, 1H), 1.60 – 1.45 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 139.0, 136.6, 134.6, 133.7, 129.7, 128.8, 128.7, 128.2, 127.3 (q, *J* = 1.1 Hz), 125.5 (q, *J* = 284.0 Hz), 125.0 (q, *J* = 1.6 Hz), 77.0 (q, *J* = 28.2 Hz), 37.5, 33.8, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.27.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{14}ClF_3O$ 338.0680; Found 338.0677.




**5-(3-aminophenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3x)**

Yellow solid (28.3 mg, 84% yield)

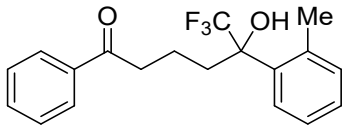
**m.p.** 98.8 – 101.2 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.87 (m, 2H), 7.61 – 7.53 (m, 1H), 7.48 – 7.42 (m, 2H), 7.16 (t, *J* = 8.0 Hz, 1H), 7.01 – 6.97 (m, 1H), 6.93 (d, *J* = 7.6 Hz, 1H), 6.66 (ddd, *J* = 8.0, 2.4, 0.8 Hz, 1H), 3.81 (brs, 2H), 3.07 – 2.91 (m, 2H), 2.29 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.01 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.86 – 1.74 (m, 1H), 1.60 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 146.5, 138.0, 136.7, 133.5, 129.3, 128.8, 128.2, 125.8 (q, *J* = 284.1 Hz), 116.8 (q, *J* = 1.6 Hz), 115.2, 113.8, 77.2 (q, *J* = 27.7 Hz), 37.7, 34.0, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.09.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{18}H_{18}F_3NO_2$ 337.1284; Found 337.1285.




**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(o-tolyl)hexan-1-one (3y)**

Pale yellow solid (22.5 mg, 67% yield)

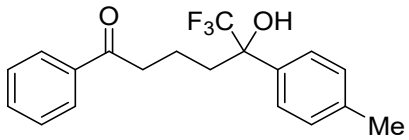
**m.p.** 86.2 – 88.4 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.96 – 7.91 (m, 2H), 7.61 – 7.55 (m, 1H), 7.50 – 7.43 (m, 3H), 7.25 – 7.16 (m, 3H), 3.82 (s, 1H), 3.13 – 2.99 (m, 2H), 2.69 – 2.59 (m, 1H), 2.64 (s, 3H), 1.97 (ddd, *J* = 14.4, 10.4, 4.0 Hz, 1H), 1.88 – 1.78 (m, 1H), 1.74 – 1.62 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 138.8, 136.7, 133.8, 133.6, 133.4, 129.0 (q, *J* = 1.6 Hz), 128.8, 128.5, 128.2, 126.3 (q, *J* = 284.8 Hz), 125.7, 79.6 (q, *J* = 27.9 Hz), 37.6, 34.4, 23.1 (q, *J* = 2.1 Hz), 17.0.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -79.93.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{19}H_{19}F_3O_2$ 336.1332; Found 336.1333.




**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(p-tolyl)hexan-1-one (3z)**

White solid (30.3 mg, 90% yield)

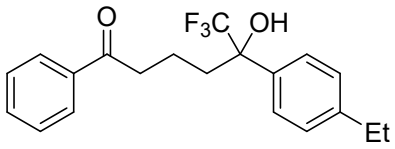
**m.p.** 84.8 – 86.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.94 – 7.88 (m, 2H), 7.60 – 7.53 (m, 1H), 7.51 – 7.41 (m, 4H), 7.21 (d, *J* = 8.0 Hz, 2H), 3.68 (s, 1H), 3.11 – 2.93 (m, 2H), 2.43 – 2.30 (m, 1H), 2.36 (s, 3H), 2.03 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.86 – 1.76 (m, 1H), 1.61 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 138.3, 136.7, 133.7, 133.5, 129.2, 128.8, 128.2, 126.6 (q, *J* = 1.5 Hz), 125.8 (q, *J* = 283.9 Hz), 77.2 (q, *J* = 27.8 Hz), 37.7, 33.9, 21.2, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.50.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{19}H_{17}F_3O$ 318.1226; Found 318.1220.




**5-(4-ethylphenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3aa)**

White solid (30.5 mg, 87% yield)

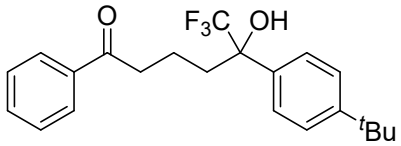
**m.p.** 102.4 – 104.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.88 (m, 2H), 7.60 – 7.54 (m, 1H), 7.53 – 7.41 (m, 4H), 7.23 (d, *J* = 8.0 Hz, 2H), 3.66 (s, 1H), 3.09 – 2.91 (m, 2H), 2.66 (q, *J* = 7.6 Hz, 2H), 2.36 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.04 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.85 – 1.75 (m, 1H), 1.63 – 1.48 (m, 1H), 1.25 (t, *J* = 7.6 Hz, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 144.5, 136.7, 133.9, 133.5, 128.8, 128.2, 127.9, 126.7, 125.8 (q, *J* = 284.2 Hz), 77.2 (q, *J* = 27.8 Hz), 37.7, 33.9, 28.5, 16.7, 15.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.44.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{20}H_{19}F_3O$ 332.1383; Found 332.1378.




**5-(4-(*tert*-butyl)phenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3ab)**

White solid (33.2 mg, 88% yield)

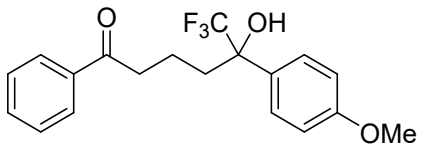
**m.p.** 149.3 – 151.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.96 – 7.87 (m, 2H), 7.60 – 7.54 (m, 1H), 7.53 – 7.35 (m, 6H), 3.47 (s, 1H), 3.08 – 2.90 (m, 2H), 2.37 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.04 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.86 – 1.71 (m, 1H), 1.58 – 1.52 (m, 1H), 1.32 (s, 9H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.5, 151.3, 136.7, 133.6, 133.5, 128.8, 128.2, 126.4, 125.8 (q, *J* = 284.0 Hz), 125.4, 77.2 (q, *J* = 27.6 Hz), 37.8, 34.6, 33.9, 31.4, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.40.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{22}H_{23}F_3O$ 360.1696; Found 360.1690.




**6,6,6-trifluoro-5-hydroxy-5-(4-methoxyphenyl)-1-phenylhexan-1-one (3ac)**

Yellow solid (30.4 mg, 86% yield)

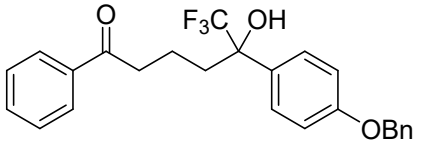
**m.p.** 86.3 – 88.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.88 (m, 2H), 7.60 – 7.54 (m, 1H), 7.54 – 7.42 (m, 4H), 6.95 – 6.89 (m, 2H), 3.81 (s, 3H), 3.62 (s, 1H), 3.11 – 2.91 (m, 2H), 2.35 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.01 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.85 – 1.70 (m, 1H), 1.62 – 1.49 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 159.7, 136.7, 133.5, 128.8, 128.6, 128.2, 128.1, 125.8 (q, *J* = 283.8 Hz), 113.8, 77.0 (q, *J* = 27.7 Hz), 55.4, 37.6, 33.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.72.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{19}H_{19}F_3O_3$ 352.1281; Found 352.1282.




**5-(4-(benzyloxy)phenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3ad)**

Pale yellow solid (35.4 mg, 83% yield)

**m.p.** 135.4 – 137.6 ℃.

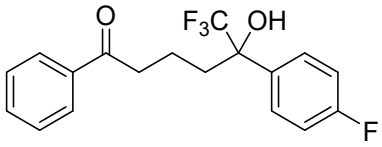
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.96 – 7.88 (m, 2H), 7.61 – 7.54 (m, 1H), 7.52 (d, *J* = 8.4 Hz, 2H), 7.49 – 7.42 (m, 4H), 7.42 – 7.37 (m, 2H), 7.36 – 7.31 (m, 1H), 7.03 – 6.96 (m, 2H), 5.06 (s, 2H), 3.57 (s, 1H), 3.12 – 2.90 (m, 2H), 2.36 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.01 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.86 – 1.71 (m, 1H), 1.59 – 1.50 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 158.9, 137.0, 136.7, 133.5, 128.9, 128.80, 128.77, 128.19, 128.18, 128.1 (q, *J* = 1.4 Hz), 127.7, 125.8 (q, *J* = 284.1 Hz), 114.6,

77.0 (q, *J* = 27.7 Hz), 70.2, 37.6, 33.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.68.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{25}H_{23}F_3O_3$ 428.1594; Found 428.1592.




**6,6,6-trifluoro-5-(4-fluorophenyl)-5-hydroxy-1-phenylhexan-1-one (3ae)**

Pale yellow solid (27.8 mg, 82% yield)

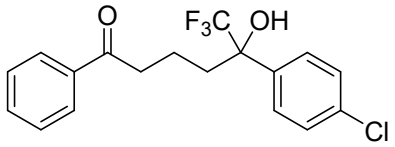
**m.p.** 109.5 – 111.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.89 (m, 2H), 7.63 – 7.55 (m, 3H), 7.49 – 7.43 (m, 2H), 7.12 – 7.03 (m, 2H), 3.95 (s, 1H), 3.11 – 2.93 (m, 2H), 2.36 (ddd, *J* = 14.4, 10.4, 6.8 Hz, 1H), 2.02 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.84 – 1.71 (m, 1H), 1.59 – 1.45 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 164.1, 161.6, 136.6, 133.7, 132.5 (d, *J* = 3.2 Hz), 128.8, 128.7 (q, *J* = 1.5 Hz), 128.2, 115.3 (d, *J* = 21.3 Hz), 77.0 (q, *J* = 28.0 Hz), 37.5, 33.8, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.64, -114.16.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{14}F_4O$ 332.0975; Found 332.0972.




**5-(4-chlorophenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3af)**

Pale yellow solid (32.1 mg, 90% yield)

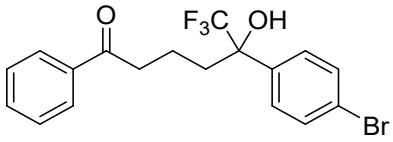
**m.p.** 107.8 – 109.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.88 (m, 2H), 7.62 – 7.53 (m, 3H), 7.51 – 7.43 (m, 2H), 7.40 – 7.33 (m, 2H), 4.02 (s, 1H), 3.10 – 2.95 (m, 2H), 2.35 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.02 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.86 – 1.71 (m, 1H), 1.59 – 1.45 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 136.6, 135.4, 134.6, 133.7, 128.8, 128.6, 128.4 (q, *J* = 1.6 Hz), 128.2, 125.6 (q, *J* = 284.0 Hz), 77.0 (q, *J* = 28.1 Hz), 37.4, 33.7, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.51.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{14}ClF_3O$ 338.0680; Found 338.0678.




**5-(4-bromophenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3ag)**

Pale yellow solid (35.3 mg, 88% yield)

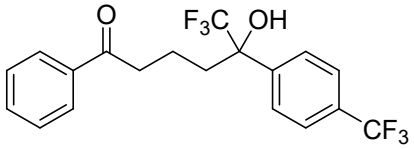
**m.p.** 113.5 – 115.9 ℃.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.89 (m, 2H), 7.61 – 7.55 (m, 1H), 7.55 – 7.43 (m, 6H), 4.02 (s, 1H), 3.10 – 2.95 (m, 2H), 2.35 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.02 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.83 – 1.69 (m, 1H), 1.58 – 1.44 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 136.6, 135.9, 133.7, 131.6, 128.8, 128.7 (q, *J* = 1.4 Hz), 128.2, 125.5 (q, *J* = 283.8 Hz), 122.9, 77.0 (q, *J* = 28.7 Hz), 37.4, 33.7, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.50.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{14}BrF_3O$ 382.0175; Found 382.0169.




**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(4-(trifluoromethyl)phenyl)hexan-1-one (3ah)**

White solid (32.0 mg, 82% yield)

**m.p.** 111.3 – 113.7 ℃.

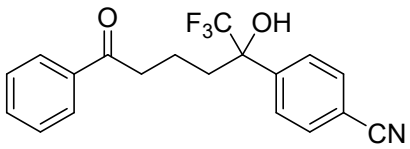
**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.95 – 7.89 (m, 2H), 7.77 (d, *J* = 8.4 Hz, 2H), 7.66 (d, *J* = 8.4 Hz, 2H), 7.61 – 7.55 (m, 1H), 7.50 – 7.42 (m, 2H), 4.25 (s, 1H), 3.14 –

2.94 (m, 2H), 2.41 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.83 – 1.71 (m, 1H), 1.57 – 1.44 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 140.9 (q, *J* = 1.8 Hz), 136.5, 133.8, 130.7 (q, *J* = 32.5 Hz), 128.9, 128.2, 127.4 (q, *J* = 1.5 Hz), 125.5 (q, *J* = 284.1 Hz), 125.4 (q, *J* = 3.8 Hz), 124.1 (q, *J* = 270.5 Hz), 77.1 (q, *J* = 28.1 Hz), 37.4, 33.8, 16.3.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -62.70, -80.26.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{19}H_{14}F_6O$ 372.0943; Found 372.0938.




**4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)benzonitrile (3ai)**

Yellow solid (32.4 mg, 93% yield)

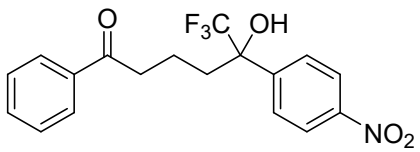
**m.p.** 104.6 – 106.9 ℃.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.97 – 7.89 (m, 2H), 7.81 – 7.67 (m, 4H), 7.63 – 7.56 (m, 1H), 7.51 – 7.43 (m, 2H), 4.38 (s, 1H), 3.13 – 2.96 (m, 2H), 2.40 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.05 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.81 – 1.68 (m, 1H), 1.55 – 1.41 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 142.3, 136.5, 133.9, 132.2, 128.9, 128.2, 127.9, 125.3 (q, *J* = 284.1 Hz), 118.6, 112.5, 77.1 (q, *J* = 28.2 Hz), 37.3, 33.6, 16.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.12.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{19}H_{14}F_3NO$ 329.1022; Found 329.1018.




**6,6,6-trifluoro-5-hydroxy-5-(4-nitrophenyl)-1-phenylhexan-1-one (3aj)**

Pale yellow solid (29.1 mg, 79% yield)

**m.p.** 119.3 – 121.8 ℃.

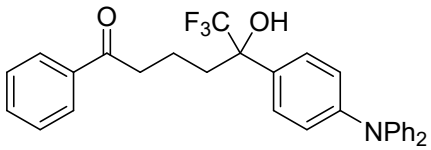
**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 8.25 (d, *J* = 8.8 Hz, 2H), 7.92 (d, *J* = 7.2 Hz,

2H), 7.84 (d, *J* = 8.4 Hz, 2H), 7.59 (t, *J* = 7.2 Hz, 1H), 7.46 (t, *J* = 7.6 Hz, 2H), 4.56 (s, 1H), 3.16 – 2.94 (m, 2H), 2.43 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.09 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.84 – 1.68 (m, 1H), 1.56 – 1.44 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.9, 148.0, 144.2, 136.4, 133.9, 128.9, 128.21, 128.18, 125.3 (q, *J* = 284.2 Hz), 123.5, 77.2 (q, *J* = 28.3 Hz), 37.2, 33.7, 16.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.03.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{14}F_3NO_3$ 349.0920; Found 349.0918.




**5-(4-(diphenylamino)phenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3ak)**

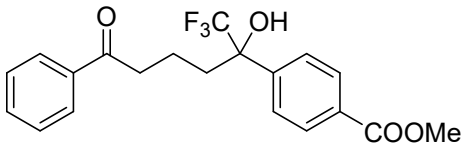
Yellow oil (30.2 mg, 62% yield)

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.97 – 7.91 (m, 2H), 7.61 – 7.54 (m, 1H), 7.49 – 7.39 (m, 4H), 7.29 – 7.24 (m, 4H), 7.12 – 7.07 (m, 4H), 7.07 – 7.02 (m, 4H), 3.57 (s, 1H), 3.17 – 2.95 (m, 2H), 2.34 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.03 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.90 – 1.76 (m, 1H), 1.69 – 1.64 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 147.9, 147.6, 136.7, 133.5, 129.8, 129.5, 128.8, 128.2, 127.6, 125.8 (q, *J* = 284.1 Hz), 124.9, 123.4, 122.4, 77.1 (q, *J* = 27.8 Hz), 37.8, 33.8, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.46.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{30}H_{26}F_3NO_2$ 489.1910; Found 489.1913.




**methyl 4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)benzoate (3al)**

Pale yellow solid (34.8 mg, 92% yield)

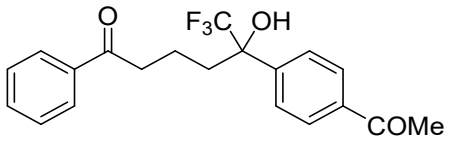
**m.p.** 128.1 – 130.0 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.10 – 8.02 (m, 2H), 7.95 – 7.87 (m, 2H), 7.71 (d, *J* = 8.4 Hz, 2H), 7.61 – 7.52 (m, 1H), 7.49 – 7.40 (m, 2H), 4.22 (s, 1H), 3.92 (s, 3H), 3.11 – 2.92 (m, 2H), 2.40 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.07 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.84 – 1.70 (m, 1H), 1.55 – 1.41 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 166.9, 141.9, 136.6, 133.7, 130.3, 129.6, 128.8, 128.2, 127.0 (q, *J* = 1.5 Hz), 125.5 (q, *J* = 284.1 Hz), 77.3 (q, *J* = 28.0 Hz), 52.3, 37.4, 33.8, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.09.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{20}H_{17}F_3O_3$ 362.1124; Found 362.1122.




**5-(4-acetylphenyl)-6,6,6-trifluoro-5-hydroxy-1-phenylhexan-1-one (3am)**

Yellow solid (35.0 mg, 96% yield)

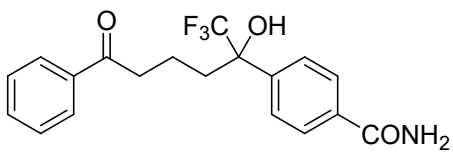
**m.p.** 93.7 – 95.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.01 – 7.96 (m, 2H), 7.95 – 7.89 (m, 2H), 7.74 (d, *J* = 8.0 Hz, 2H), 7.61 – 7.54 (m, 1H), 7.49 – 7.41 (m, 2H), 4.15 (s, 1H), 3.12 – 2.94 (m, 2H), 2.61 (s, 3H), 2.42 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.06 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.83 – 1.73 (m, 1H), 1.56 – 1.43 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 198.0, 142.0, 137.1, 136.6, 133.7, 128.8, 128.4, 128.2, 127.2 (q, *J* = 1.6 Hz), 125.5 (q, *J* = 284.2 Hz), 77.3 (q, *J* = 28.2 Hz), 37.4, 33.8, 26.8, 16.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.13.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{20}H_{17}F_3O_2$ 346.1175; Found 346.1169.




**4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)benzamide (3an)**

White solid (29.6 mg, 81% yield)

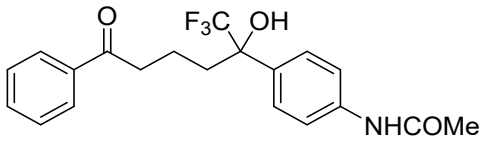
**m.p.** 158.9 – 161.2 ℃.

**$^1$H NMR** (400 MHz, Methanol-$d_4$) δ 7.96 – 7.84 (m, 4H), 7.71 (d, $J$ = 8.0 Hz, 2H), 7.61 – 7.54 (m, 1H), 7.50 – 7.42 (m, 2H), 3.10 – 2.91 (m, 2H), 2.37 (ddd, $J$ = 13.6, 12.0, 4.8 Hz, 1H), 2.11 (ddd, $J$ = 14.0, 11.2, 4.8 Hz, 1H), 1.82 – 1.68 (m, 1H), 1.44 – 1.34 (m, 1H).

**$^{13}$C NMR** (100 MHz, Methanol-$d_4$) δ 202.0, 172.0, 142.7, 138.1, 134.8, 134.3, 129.7, 129.1, 128.4, 128.2, 127.3 (q, $J$ = 284.3 Hz), 78.0 (q, $J$ = 27.5 Hz), 39.1, 34.7, 18.4.

**$^{19}$F NMR** (376 MHz, Methanol-$d_4$) δ -81.37.

**HRMS (ESI)** m/z: $[M+H]^+$ Calcd. for $C_{19}H_{19}F_3NO_3$ 366.1312; found: 366.1325.




***N*-(4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)phenyl)acetamide (3ao)**

Pale yellow solid (29.0 mg, 77% yield)

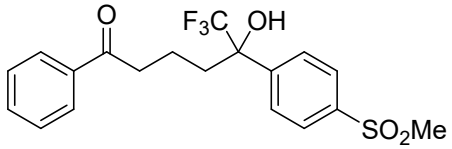
**m.p.** 52.7 – 54.5 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.93 – 7.87 (m, 2H), 7.58 – 7.52 (m, 5H), 7.47 – 7.41 (m, 2H), 4.04 (s, 1H), 3.09 – 2.89 (m, 2H), 2.34 (ddd, $J$ = 14.4, 10.4, 6.4 Hz, 1H), 2.16 (s, 3H), 2.02 (ddd, $J$ = 14.4, 10.4, 4.4 Hz, 1H), 1.83 – 1.70 (m, 1H), 1.58 – 1.45 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 168.9, 138.1, 136.6, 133.6, 132.5, 128.8, 128.2, 127.5, 125.8 (q, $J$ = 283.8 Hz), 119.7, 77.0 (q, $J$ = 27.7 Hz), 37.7, 33.8, 24.6, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.42.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{20}H_{20}F_3NO_3$ 379.1390; Found 379.1392.



**6,6,6-trifluoro-5-hydroxy-5-(4-(methylsulfonyl)phenyl)-1-phenylhexan-1-one (3ap)**

Yellow solid (32.3 mg, 81% yield)

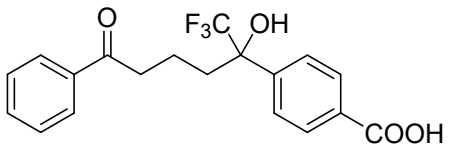
**m.p.** 140.9 – 143.1 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.03 – 7.85 (m, 6H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 2H), 4.44 (s, 1H), 3.10 (s, 3H), 3.08 – 2.98 (m, 2H), 2.45 (ddd, *J* = 14.8, 9.6, 7.2 Hz, 1H), 2.09 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.83 – 1.70 (m, 1H), 1.58 – 1.46 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 143.3, 140.6, 136.5, 133.9, 128.9, 128.22, 128.19 (q, *J* = 1.5 Hz), 127.5, 125.3 (q, *J* = 284.2 Hz), 77.2 (q, *J* = 28.1 Hz), 44.6, 37.3, 33.7, 16.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.09.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{19}H_{17}F_3O_3S$ 382.0845; Found 382.0843.




**4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)benzoic acid (3aq)**

Pale yellow solid (30.0 mg, 82% yield)

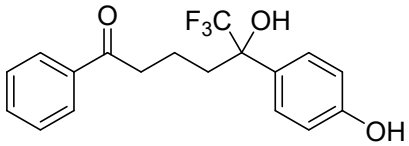
**m.p.** 165.8 – 167.7 ℃.

**$^1$H NMR** (400 MHz, Methanol-$d_4$) δ 8.06 – 7.99 (m, 2H), 7.95 – 7.87 (m, 2H), 7.72 (d, *J* = 8.0 Hz, 2H), 7.61 – 7.54 (m, 1H), 7.49 – 7.42 (m, 2H), 3.10 – 2.92 (m, 2H), 2.36 (ddd, *J* = 14.0, 11.6, 4.8 Hz, 1H), 2.11 (ddd, *J* = 14.0, 11.6, 4.8 Hz, 1H), 1.82 – 1.68 (m, 1H), 1.45 – 1.33 (m, 1H).

**$^{13}$C NMR** (100 MHz, Methanol-$d_4$) δ 202.1, 169.6, 143.8, 138.1, 134.3, 131.9, 130.4, 129.7, 129.1, 128.2, 127.0 (q, *J* = 284.4 Hz), 78.0 (q, *J* = 27.6 Hz), 39.1, 34.7, 18.4.

**$^{19}$F NMR** (376 MHz, Methanol-$d_4$) δ -81.26.

**HRMS (ESI)** m/z: $[M+H]^+$ Calcd. for $C_{19}H_{18}F_3O_4$ 367.1152; found: 367.1163.



**6,6,6-trifluoro-5-hydroxy-5-(4-hydroxyphenyl)-1-phenylhexan-1-one (3ar)**

White solid (27.7 mg, 82% yield)

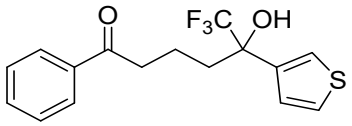
**m.p.** 134.5 – 136.5 ℃.

**$^1$H NMR** (400 MHz, Methanol-$d_4$) δ 7.94 – 7.86 (m, 2H), 7.61 – 7.53 (m, 1H), 7.49 – 7.42 (m, 2H), 7.39 (d, $J$ = 8.8 Hz, 2H), 6.82 – 6.74 (m, 2H), 3.08 – 2.88 (m, 2H), 2.27 (ddd, $J$ = 14.0, 11.6, 4.8 Hz, 1H), 2.03 (ddd, $J$ = 14.0, 11.2, 4.8 Hz, 1H), 1.80 – 1.66 (m, 1H), 1.54 – 1.39 (m, 1H).

**$^{13}$C NMR** (100 MHz, Methanol-$d_4$) δ 202.4, 158.4, 138.1, 134.3, 129.7, 129.2 (q, $J$ = 1.2 Hz), 129.15, 129.10, 127.5 (q, $J$ = 284.0 Hz), 115.8, 77.7 (q, $J$ = 27.4 Hz), 39.2, 34.7, 18.5.

**$^{19}$F NMR** (376 MHz, Methanol-$d_4$) δ -81.80.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{15}F_3O_2$ 320.1019; Found 320.1017.



**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(thiophen-3-yl)hexan-1-one (3as)**

Yellow solid (27.0 mg, 82% yield)

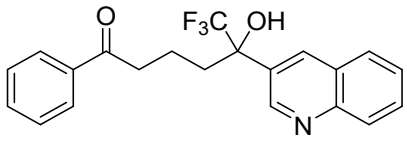
**m.p.** 71.5 – 73.4 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.96 – 7.88 (m, 2H), 7.62 – 7.53 (m, 1H), 7.51 – 7.42 (m, 3H), 7.34 (dd, $J$ = 5.2, 3.2 Hz, 1H), 7.15 (dt, $J$ = 5.2, 1.2 Hz, 1H), 3.62 (s, 1H), 3.13 – 2.89 (m, 2H), 2.24 (ddd, $J$ = 14.4, 10.0, 6.4 Hz, 1H), 2.02 (ddd, $J$ = 14.4, 10.0, 4.4 Hz, 1H), 1.90 – 1.77 (m, 1H), 1.62 – 1.52 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.5, 138.6, 136.7, 133.6, 128.8, 128.2, 126.3, 126.1 (q, $J$ = 1.7 Hz), 125.5 (q, $J$ = 283.6 Hz), 124.0 (q, $J$ = 1.2 Hz), 76.8 (q, $J$ = 28.6 Hz), 37.6, 34.3, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.93.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{16}H_{13}F_3OS$ 310.0634; Found 310.0631.




**6,6,6-trifluoro-5-hydroxy-1-phenyl-5-(quinolin-3-yl)hexan-1-one (3at)**

Pale yellow solid (30.0 mg, 80% yield)

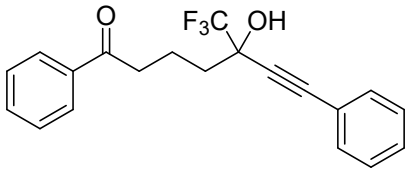
**m.p.** 119.9 – 122.4 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 9.12 (d, *J* = 2.4 Hz, 1H), 8.55 (d, *J* = 2.4 Hz, 1H), 8.16 (d, *J* = 8.4 Hz, 1H), 7.93 – 7.84 (m, 3H), 7.75 (ddd, *J* = 8.4, 6.8, 1.2 Hz, 1H), 7.64 – 7.49 (m, 2H), 7.46 – 7.37 (m, 2H), 5.45 (s, 1H), 3.11 – 2.91 (m, 2H), 2.55 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.20 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.92 – 1.78 (m, 1H), 1.61 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 148.7, 147.6, 136.5, 135.6, 133.6, 130.3, 130.2, 128.9, 128.8, 128.5, 128.1, 127.6, 127.2, 125.7 (q, *J* = 284.4 Hz), 76.6 (q, *J* = 28.5 Hz), 37.5, 33.6, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.15.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{21}H_{18}F_3NO_2$ 373.1284; Found 373.1284.




**5-hydroxy-1,7-diphenyl-5-(trifluoromethyl)hept-6-yn-1-one (3au)**

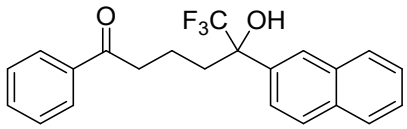
Yellow oil (20.8 mg, 60% yield)

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.00 – 7.93 (m, 2H), 7.60 – 7.53 (m, 1H), 7.48 – 7.42 (m, 4H), 7.39 – 7.28 (m, 3H), 3.40 (s, 1H), 3.15 (td, *J* = 6.8, 1.2 Hz, 2H), 2.25 – 2.13 (m, 2H), 2.11 – 1.94 (m, 2H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.1, 136.9, 133.4, 132.1, 129.4, 128.8, 128.5, 128.2, 124.2 (q, *J* = 283.3 Hz), 121.2, 87.6, 83.6, 72.3 (q, *J* = 31.3 Hz), 38.0, 34.2, 18.1.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -81.65.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{20}H_{17}F_3O_2$ 346.1175; Found 346.1177.




**6,6,6-trifluoro-5-hydroxy-5-(naphthalen-2-yl)-1-phenylhexan-1-one (3av)**

White solid (34.6 mg, 93% yield)

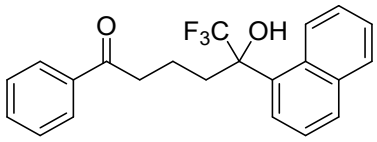
**m.p.** 142.7 – 144.3 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.17 (s, 1H), 7.93 – 7.82 (m, 5H), 7.67 (d, *J* = 8.4 Hz, 1H), 7.58 – 7.49 (m, 3H), 7.46 – 7.40 (m, 2H), 3.98 (s, 1H), 3.11 – 2.93 (m, 2H), 2.52 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.13 (ddd, *J* = 14.4, 10.0, 4.0 Hz, 1H), 1.89 – 1.75 (m, 1H), 1.61 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.6, 136.7, 134.2, 133.6, 133.2, 133.1, 128.8, 128.6, 128.18, 128.16, 127.6, 126.68, 126.67, 126.4, 125.9 (q, *J* = 284.1 Hz), 124.1 (q, *J* = 1.8 Hz), 77.2 (q, *J* = 27.9 Hz), 37.6, 33.9, 16.7.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.02.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{22}H_{19}F_3O_2$ 372.1332; Found 372.1333.




**6,6,6-trifluoro-5-hydroxy-5-(naphthalen-1-yl)-1-phenylhexan-1-one (3aw)**

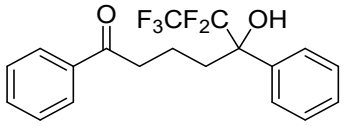
Colorless oil (29.8 mg, 80% yield)

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.93 (s, 1H), 7.95 – 7.83 (m, 4H), 7.77 (d, *J* = 7.2 Hz, 1H), 7.61 – 7.40 (m, 6H), 4.34 (s, 1H), 3.12 – 2.97 (m, 2H), 2.89 (ddd, *J* = 17.6, 15.6, 8.8 Hz, 1H), 2.17 (ddd, *J* = 14.4, 8.4, 5.6 Hz, 1H), 1.85 – 1.72 (m, 2H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 136.7, 135.0, 133.6, 132.5, 131.9, 130.5, 129.1, 128.8, 128.2, 127.8, 127.4, 126.3 (q, *J* = 285.2 Hz), 126.1, 125.5, 124.6, 80.3 (q, *J* = 28.3 Hz), 37.6, 35.0, 17.1.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -78.46.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{22}H_{19}F_3O_2$ 372.1332; Found 372.1332.




**6,6,7,7,7-pentafluoro-5-hydroxy-1,5-diphenylheptan-1-one (3ax)**[7]

White solid (26.4 mg, 71% yield)

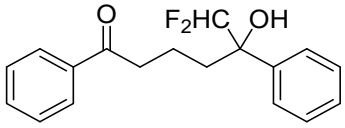
**m.p.** 78.2 – 80.4 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.99 – 7.86 (m, 2H), 7.63 – 7.54 (m, 3H), 7.49 – 7.43 (m, 2H), 7.42 – 7.31 (m, 3H), 4.02 (s, 1H), 3.09 – 2.91 (m, 2H), 2.43 (dddd, *J* = 14.4, 9.2, 6.8, 2.0 Hz, 1H), 2.08 (dddd, *J* = 14.4, 10.0, 4.0, 1.2 Hz, 1H), 1.79 – 1.72 (m, 1H), 1.47 – 1.33 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 136.7, 133.6, 128.8, 128.4, 128.3, 128.2, 126.9, 120.8 – 114.5 (m, 2C, $CF_3CF_2$), 77.4, 37.5, 33.6, 16.3.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -77.79 (s, $CF_3$), -121.38 (d, *J* = 274.5 Hz, 1F, $CF_AF_B$), -123.37 (d, *J* = 274.9 Hz, 1F, $CF_AF_B$).

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{19}H_{15}F_5O$ 354.1038; Found 354.1033.




**6,6-difluoro-5-hydroxy-1,5-diphenylhexan-1-one (3ay)**

Colorless oil (18.5 mg, 61% yield)

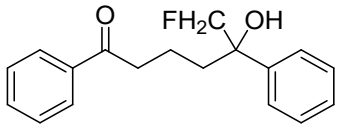
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.93 – 7.87 (m, 2H), 7.58 – 7.51 (m, 3H), 7.47 – 7.36 (m, 4H), 7.35 – 7.29 (m, 1H), 5.72 (t, *J* = 56.4 Hz, 1H), 3.16 (s, 1H), 3.07 – 2.89 (m, 2H), 2.21 (ddd, *J* = 14.0, 10.8, 6.0 Hz, 1H), 1.98 (ddd, *J* = 14.4, 10.4, 4.4 Hz, 1H), 1.87 – 1.76 (m, 1H), 1.62 – 1.49 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.4, 138.6 (t, *J* = 1.7 Hz), 136.8, 133.3, 128.7, 128.5, 128.1, 128.0, 126.4, 117.2 (t, *J* = 248.1 Hz), 76.7 (t, *J* = 20.4 Hz), 38.1, 33.5 (t,

$J$ = 2.1 Hz), 16.9.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -130.3 (dd, $J$ = 403.2, 292.8 Hz).

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{16}F_2O$ 286.1164; Found 286.1170.




**6-fluoro-5-hydroxy-1,5-diphenylhexan-1-one (3az)**

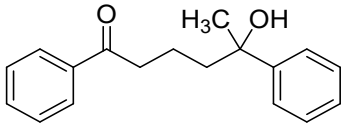
Colorless oil (16.3 mg, 57% yield)

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 9.23 (brs, 1H), 7.98 – 7.91 (m, 2H), 7.62 – 7.53 (m, 1H), 7.49 – 7.42 (m, 4H), 7.41 – 7.36 (m, 2H), 7.34 – 7.29 (m, 1H), 4.91 – 4.64 (m, 2H), 3.03 (t, $J$ = 6.4 Hz, 2H), 2.08 (ddd, $J$ = 14.0, 11.2, 4.4 Hz, 1H), 1.98 (dddd, $J$ = 14.0, 11.2, 5.6, 1.2 Hz, 1H), 1.91 – 1.77 (m, 1H), 1.70 – 1.63 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 201.0, 138.9 (d, $J$ = 2.7 Hz), 136.8, 133.6, 128.8, 128.6, 128.2, 128.0, 125.9, 86.6 (d, $J$ = 17.3 Hz), 84.7 (d, $J$ = 177.0 Hz), 37.7, 32.2 (d, $J$ = 3.1 Hz), 16.6 (d, $J$ = 1.6. Hz).

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -228.82.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{17}FO$ 268.1258; Found 268.1255.



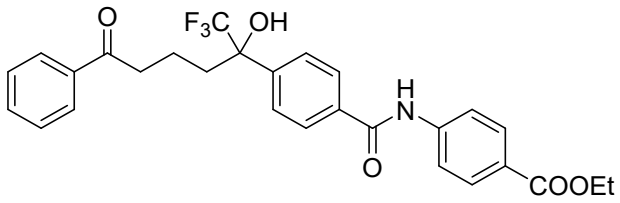

**5-hydroxy-1,5-diphenylhexan-1-one (3ba)**

Colorless oil (22.0 mg, 82% yield)

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 8.65 (s, 1H), 7.99 – 7.89 (m, 2H), 7.60 – 7.52 (m, 1H), 7.49 – 7.42 (m, 4H), 7.40 – 7.33 (m, 2H), 7.29 – 7.24 (m, 1H), 3.10 – 2.95 (m, 2H), 2.05 – 1.89 (m, 2H), 1.86 – 1.68 (m, 2H), 1.60 (s, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.9, 144.4, 136.9, 133.4, 128.7, 128.5, 128.2, 127.3, 125.6, 85.9, 38.0, 37.5, 24.1, 17.6.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{18}H_{18}O$ 250.1352; Found 250.1347.



**ethyl 4-(4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)benzamido)benzoate (3bb)**

Yellow solid (40.6 mg, 79% yield)

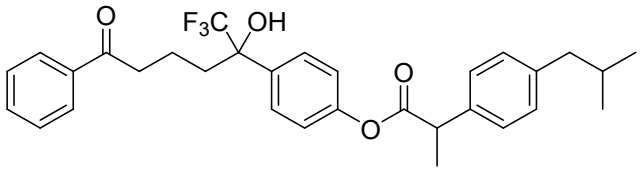
**m.p.** 125.3 – 127.8 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.29 (s, 1H), 8.08 – 8.02 (m, 2H), 7.94 – 7.89 (m, 2H), 7.89 – 7.84 (m, 2H), 7.78 – 7.69 (m, 4H), 7.60 – 7.54 (m, 1H), 7.48 – 7.42 (m, 2H), 4.37 (q, *J* = 7.2 Hz, 2H), 4.25 (s, 1H), 3.10 – 2.93 (m, 2H), 2.39 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.05 (ddd, *J* = 14.4, 10.4, 4.0 Hz, 1H), 1.80 – 1.67 (m, 1H), 1.52 – 1.43 (m, 1H), 1.39 (t, *J* = 7.2 Hz, 3H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.9, 166.3, 165.8, 142.2, 141.1, 136.5, 134.7, 133.8, 131.0, 128.9, 128.2, 127.4, 127.3, 126.4, 125.5 (q, *J* = 284.1 Hz), 119.4, 77.2 (q, *J* = 28.3 Hz), 61.1, 37.5, 33.8, 16.4, 14.5.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.12.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{28}H_{26}F_3NO_5$ 513.1758; Found 513.1756.



**4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)phenyl 2-(4-isobutylphenyl)propanoate (3bc)**

Yellow solid (40.6 mg, 77% yield)

**m.p.** 89.3 – 91.2 ℃.

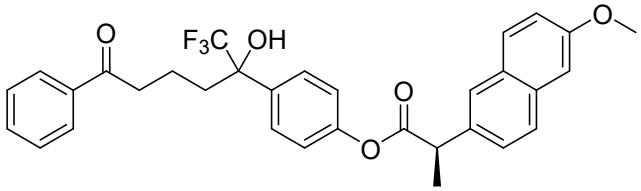
**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.94 – 7.89 (m, 2H), 7.61 – 7.53 (m, 3H), 7.48 – 7.41 (m, 2H), 7.32 – 7.27 (m, 2H), 7.17 – 7.12 (m, 2H), 7.08 – 7.02 (m, 2H), 3.94 (q, *J*

= 7.2 Hz, 1H), 3.93 (s, 1H), 3.07 – 2.90 (m, 2H), 2.47 (d, *J* = 7.2 Hz, 2H), 2.33 (ddd, *J* = 14.4, 10.0, 6.8 Hz, 1H), 2.01 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.94 – 1.81 (m, 1H), 1.81 – 1.71 (m, 1H), 1.61 (d, *J* = 7.2 Hz, 3H), 1.58 – 1.44 (m, 1H), 0.91 (d, *J* = 6.4 Hz, 6H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 173.2, 151.0, 141.0, 137.2, 136.6, 134.2, 133.6, 129.7, 128.8, 128.2, 128.0, 127.3, 125.6 (q, *J* = 283.9 Hz), 121.3, 77.0 (q, *J* = 28.0 Hz), 45.4, 45.2, 37.5, 33.8, 30.3, 22.5, 18.6, 16.5.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.44.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{31}H_{31}F_3O_3$ 508.2220; Found 508.2217.




**4-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)phenyl (2*R*)-2-(6-methoxynaphthalen-2-yl)propanoate (3bd)**

Pale yellow solid (45.7 mg, 83% yield)

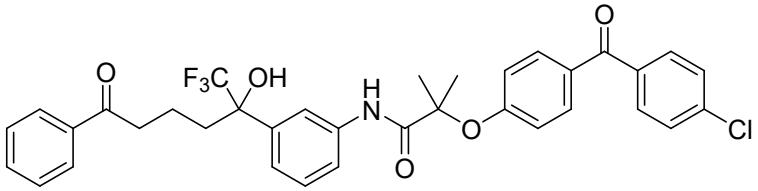
**m.p.** 87.1 – 89.2 ℃.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.90 (d, *J* = 8.0 Hz, 2H), 7.80 – 7.70 (m, 3H), 7.60 – 7.48 (m, 4H), 7.43 (t, *J* = 7.6 Hz, 2H), 7.21 – 7.12 (m, 2H), 7.04 (d, *J* = 8.0 Hz, 2H), 4.10 (q, *J* = 7.2 Hz, 1H), 3.95 (s, 1H), 3.93 (s, 3H), 3.04 – 2.90 (m, 2H), 2.32 (ddd, *J* = 15.6, 10.0, 6.4 Hz, 1H), 2.00 (ddd, *J* = 14.4, 10.4, 4.8 Hz, 1H), 1.79 – 1.72 (m, 1H), 1.71 (s, 3H), 1.55 – 1.45 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 173.1, 157.9, 151.0, 136.6, 135.2, 134.2, 134.0, 133.6, 129.5, 129.1, 128.8, 128.2, 128.0, 127.5, 126.3, 126.2, 125.6 (q, *J* = 284.0 Hz), 121.3, 119.3, 105.7, 77.0 (q, *J* = 27.9 Hz), 55.5, 45.7, 37.5, 33.8, 18.6, 16.5.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.43.

**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{32}H_{29}F_3O_5$ 550.1962; Found 550.1962.



**2-(4-(4-chlorobenzoyl)phenoxy)-2-methyl-*N*-(3-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)phenyl)propanamide (3be)**

Yellow solid (47.3 mg, 74% yield)

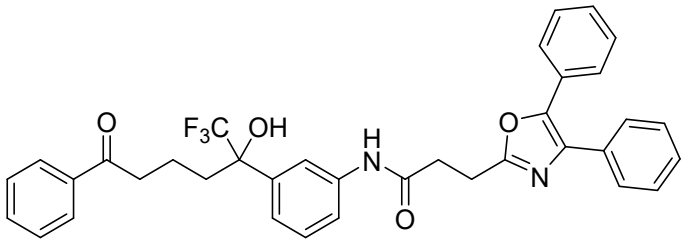
**m.p.** 125.5 – 128.0 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.44 (s, 1H), 7.93 – 7.86 (m, 2H), 7.79 – 7.75 (m, 2H), 7.75 – 7.69 (m, 4H), 7.60 – 7.52 (m, 1H), 7.46 – 7.41 (m, 4H), 7.40 – 7.32 (m, 2H), 7.11 – 7.02 (m, 2H), 4.23 (s, 1H), 3.08 – 2.94 (m, 2H), 2.37 (ddd, *J* = 14.4, 10.0, 6.4 Hz, 1H), 2.03 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.81 – 1.72 (m, 1H), 1.68 (s, 6H), 1.59 – 1.47 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.8, 194.4, 172.5, 158.2, 138.8, 138.0, 137.5, 136.6, 136.1, 133.6, 132.3, 132.1, 131.4, 129.2, 128.79, 128.77, 128.2, 125.7 (q, *J* = 283.8 Hz), 123.1, 120.4, 120.0, 118.6, 82.56, 77.1 (q, *J* = 27.6 Hz), 37.6, 33.8, 25.24, 25.19, 16.5.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.18.

**HRMS (ESI)** m/z: $[M+Na]^+$ Calcd. for $C_{35}H_{31}ClF_3NNaO_5$ 660.1735; found: 660.1727.



**3-(4,5-diphenyloxazol-2-yl)-*N*-(3-(1,1,1-trifluoro-2-hydroxy-6-oxo-6-phenylhexan-2-yl)phenyl)propanamide (3bf)**

White solid (44.1 mg, 72% yield)

**m.p.** 169.8 – 171.9 ℃.

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 8.87 (s, 1H), 7.91 – 7.85 (m, 2H), 7.68 (dq, *J* = 6.6, 2.1 Hz, 1H), 7.66 – 7.60 (m, 3H), 7.57 – 7.52 (m, 3H), 7.43 (t, *J* = 7.6 Hz, 2H),

7.39 – 7.29 (m, 8H), 4.18 (s, 1H), 3.28 (t, *J* = 6.8 Hz, 2H), 3.00 – 2.89 (m, 4H), 2.24 (ddd, *J* = 14.4, 10.4, 6.4 Hz, 1H), 2.24 (ddd, *J* = 14.4, 10.0, 4.4 Hz, 1H), 1.79 – 1.66 (m, 1H), 1.52 – 1.40 (m, 1H).

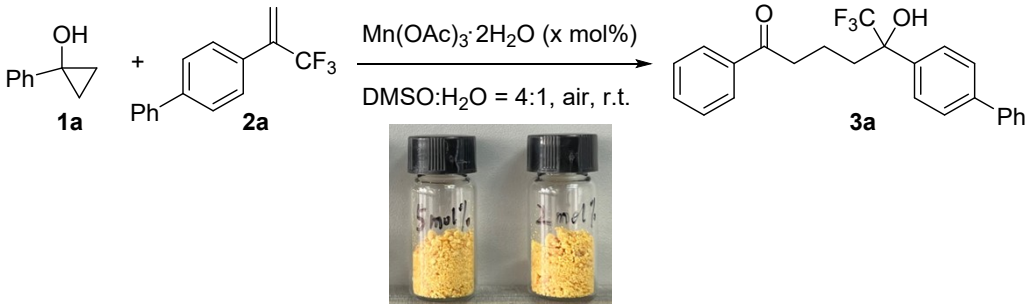
**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 200.7, 170.2, 162.7, 145.9, 138.3, 137.8, 136.7, 134.9, 133.5, 132.3, 129.1, 128.83, 128.81, 128.76, 128.75, 128.4, 128.2, 128.0, 126.6, 125.7 (q, *J* = 284.4 Hz), 122.5, 119.9, 118.2, 77.1 (q, *J* = 28.0 Hz), 37.6, 34.2, 33.7, 24.1, 16.6.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.18.

**HRMS (ESI)** m/z: $[M+H]^+$ Calcd. for $C_{36}H_{32}F_3N_2O_4$ 613.2309; found: 613.2309.

## 5. Synthetic applications

### 5.1 Gram-scale preparation




To a reaction tube charged with a stirring bar were added $Mn(OAc)_3$❿$2H_2O$ (46.9 mg, 0.175 mmol, 5 mol%), 4-(3,3,3-trifluoroprop-1-en-2-yl)-1,1'-biphenyl **2a** (0.87 g, 3.5 mmol, 1 equiv.), 1-phenylcyclopropan-1-ol **1a** (0.94 g, 7 mmol, 2 equiv.), $H_2O$ (7 mL) and DMSO (28 mL). The reaction was stirred at room temperature for 48 h under open-air conditions. The crude mixture was extracted with ethyl acetate. The organic layer was separated and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 5:1) to give the desired compounds **3a** (1.18g, 85% yield) as yellow solid.

To a reaction tube charged with a stirring bar were added $Mn(OAc)_3$❿$2H_2O$ (18.6 mg, 0.07 mmol, 2 mol%), 4-(3,3,3-trifluoroprop-1-en-2-yl)-1,1'-biphenyl **2a** (0.87 g, 3.5 mmol, 1 equiv.), 1-phenylcyclopropan-1-ol **1a** (0.94 g, 7 mmol, 2 equiv.), $H_2O$ (7 mL) and DMSO (28 mL). The reaction was stirred at room temperature for 96 h under open-air conditions. The crude mixture was extracted with ethyl acetate. The organic layer was separated and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 5:1) to give the desired compounds **3a** (1.03g, 74% yield) as yellow solid.

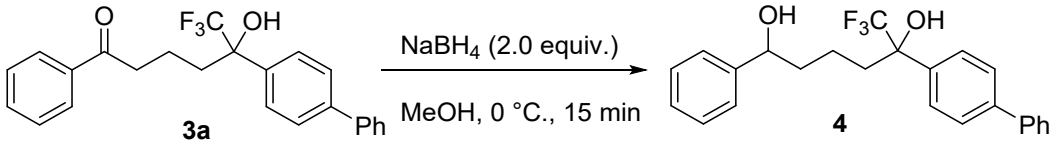
### 5.2 Recycling experiments

To a glass tube charged with a stirring bar were added $Mn(OAc)_3$❿$2H_2O$ (2.7 mg, 0.01 mmol, 10 mol%), 4-(3,3,3-trifluoroprop-1-en-2-yl)-1,1'-biphenyl **2a** (24.8 mg, 0.1

mmol, 1 equiv.), 1-phenylcyclopropan-1-ol **1a** (26.8 mg, 0.2 mmol, 2 equiv.), $H_2O$ (0.2 mL) and DMSO (0.8 mL). The reaction was stirred at room temperature for 12 – 48 h under open-air conditions. The crude mixture was extracted with ethyl acetate. The organic layer was separated and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 5:1) to give the desired compounds **3a**. The aqueous layer was used for the next recycling experiment. The solution was supplemented with DMSO to a total volume of 1.0 mL, and substrates **2a** and **1a** was added to start the next round of reaction.

### 5.3 Synthetic transformations of 3a

*General procedure for synthesis of 5-([1,1'-biphenyl]-4-yl)-6,6,6-trifluoro-1-phenylhexane-1,5-diol (**4**):*[8]




$NaBH_4$ (7.6 mg, 0.2 mmol, 2.0 equiv.) was added at 0 °C to a solution of **3a** (39.8 mg, 0.1 mmol) in MeOH (1.0 mL) at stirring. The reaction mixture was stirred at 0 °C for 15 min and then quenched by the addition of acetic acid until evolution of hydrogen gas was no longer observed. The reaction mixture was concentrated under reduced pressure, then redissolved in DCM (2.0 mL), washed with water and brine. The resulting solution was dried over $Na_2SO_4$ and concentrated under reduced pressure. Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 3:1) afforded **4** (32.0 mg, 80% yield) as a diastereomers mixture (1.7:1 ratio) as white solid.

Isomer major:

**$^1$H NMR** (400 MHz, Chloroform-*d*) δ 7.62 – 7.60 (m, 8H), 7.50 – 7.43 (m, 4H), 7.40 – 7.38 (m, 1H), 7.26 – 7.24 (m, 1H), 4.61 (dd, *J* = 8.4, 4.4 Hz, 1H), 3.43 (s, 1H), 2.36 – 2.30 (m, 2H), 2.15 – 2.06 (m, 1H), 1.89 – 1.81 (m, 1H), 1.76 – 1.72 (m, 1H), 1.62 –

1.54 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 144.5, 141.2, 140.5, 135.7, 128.9, 128.7, 127.8, 127.6, 127.2, 127.1, 127.0, 125.9 (q, *J* = 284.2 Hz), 125.8, 77.4 (q, *J* = 27.7 Hz), 74.8, 38.6, 34.8, 19.1.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -80.00.

Isomer minor:

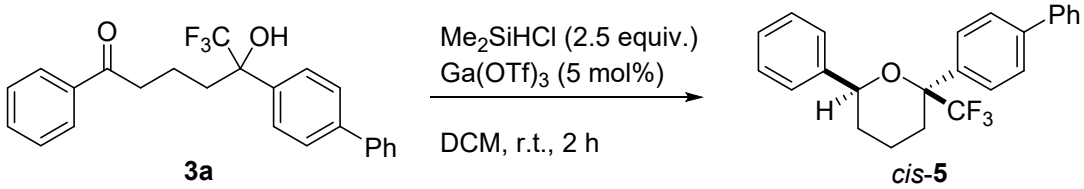
**$^{1}$H NMR** (400 MHz, Chloroform-*d*) for minor δ 7.64 – 7.63 (m, 2H), 7.40 – 7.38 (m, 2H), 7.36 – 7.34 (m, 1H), 7.33 – 7.32 (m, 2H), 7.31 – 7.30 (m, 2H), 7.29 – 7.27 (m, 5H), 4.65 (dd, *J* = 8.4, 4.8 Hz, 1H), 3.59 (s, 1H), 2.29 – 2.26 (m, 1H), 2.22 – 2.17 (m, 1H), 1.80 – 1.77 (m, 1H), 1.71 – 1.64 (m, 2H), 1.51 – 1.43 (m, 1H).

**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 144.4, 141.2, 140.5, 135.6, 128.9, 128.7, 127.9, 127.6, 127.2, 127.1, 127.0, 125.9 (q, *J* = 284.2 Hz), 125.9, 77.4 (q, *J* = 27.7 Hz), 74.4, 38.1, 33.9, 19.2.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) for minor δ -80.11.

**HRMS (EI)** m/z: $[M-H_2O]^+$ Calcd for $C_{24}H_{21}F_3O$ 382.1539; Found 382.1536.

*General procedure for synthesis of cis-2-([1,1'-biphenyl]-4-yl)-6-phenyl-2-(trifluoromethyl)tetrahydro-2H-pyran (cis-**5**):*[9]




**3a** (39.8 mg, 0.1 mmol) dissolved in DCM (1.5 mL) was added to $Ga(OTf)_3$ (2.6 mg, 5 mol%), and then $Me_2SiHCl$ (28 μL, 0.25 mmol, 2.5 equiv.) was added. The mixture was stirred at room temperature for 2 h. The mixture was then filtered and the residue was washed with DCM. The combined filtrate was concentrated under reduced pressure. Purification by flash column chromatography on silica gel (petroleum ether/ethyl acetate = 10:1) afforded *cis*-**5** (28.7 mg, 75% yield) as colorless oil.

**$^{1}$H NMR** (400 MHz, Chloroform-*d*) δ 7.71 – 7.67 (m, 2H), 7.66 – 7.62 (m, 4H), 7.51 – 7.41 (m, 5H), 7.41 – 7.37 (m, 2H), 7.36 – 7.31 (m, 1H), 4.59 (dd, *J* = 11.2, 2.8 Hz, 1H),

2.65 – 2.57 (m, 1H), 2.26 – 2.15 (m, 1H), 1.98 – 1.90 (m, 1H), 1.85 – 1.78 (m, 1H), 1.73 – 1.64 (m, 2H).

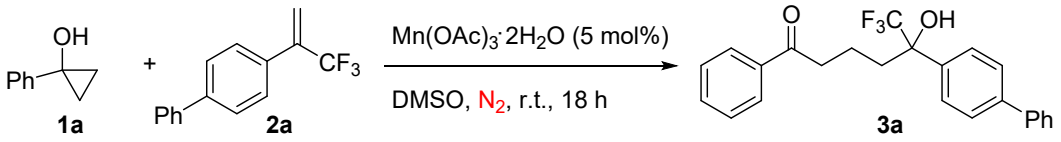
**$^{13}$C NMR** (100 MHz, Chloroform-*d*) δ 142.3, 141.7, 140.5, 132.9, 129.3, 129.0, 128.5, 127.8, 127.7, 127.5, 127.3, 125.9, 124.8 (q, $J$ = 281.8 Hz), 79.8 (q, $J$ = 28.3 Hz), 73.9, 33.4, 25.8, 19.4.

**$^{19}$F NMR** (376 MHz, Chloroform-*d*) δ -81.31.

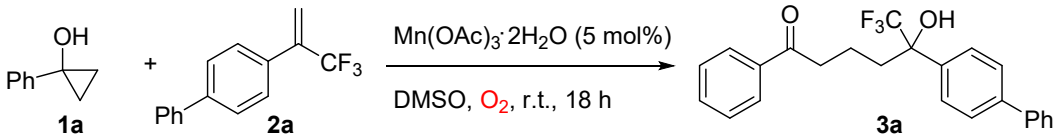
**HRMS (EI)** m/z: $[M]^+$ Calcd for $C_{24}H_{21}F_3O$ 382.1539; Found 382.1539.

## 6. Mechanistic studies

### 6.1 Control experiments

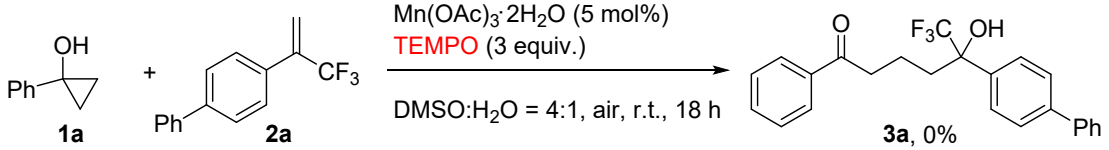



To a Schlenk tube charged with a stirring bar were added $Mn(OAc)_3$⑩$2H_2O$ (1.3 mg, 0.005 mmol, 5 mol%), 4-(3,3,3-trifluoroprop-1-en-2-yl)-1,1'-biphenyl **2a** (24.8 mg, 0.1 mmol, 1 equiv.), 1-phenylcyclopropan-1-ol **1a** (26.8 mg, 0.2 mmol, 2 equiv.), and dry DMSO (1 mL) under nitrogen atmosphere. The reaction was stirred at room temperature for 48 h. The crude mixture was monitored by TLC, the product **3a** was not obtained.




To a Schlenk tube charged with a stirring bar were added $Mn(OAc)_3$⑩$2H_2O$ (1.3 mg, 0.01 mmol, 10 mol%), 4-(3,3,3-trifluoroprop-1-en-2-yl)-1,1'-biphenyl **2a** (24.8 mg, 0.1 mmol, 1 equiv.), 1-phenylcyclopropan-1-ol **1a** (26.8 mg, 0.2 mmol, 2 equiv.), and dry DMSO (1 mL) under oxygen atmosphere. The reaction was stirred at room temperature for 48 h. The crude mixture was extracted with ethyl acetate. The organic layer was separated and dried over anhydrous $Na_2SO_4$, filtered, and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel (petroleum/ethyl acetate = 5:1) to give the desired compounds **3a** (27.9 mg, 70% yield).

### 6.2 Radical suppression experiments




Standard reaction was set up by adding TEMPO (3 equiv.). After the reaction finished, the reaction was monitored by TLC and the target product **3a** was not obtained.


Standard reaction was set up by adding DPE (3 equiv.). The reaction mixture was analyzed by HRMS, the adduct of DPE and **1a** was found (Figure S3). HRMS (ESI) m/z: $[M+H]^+$ Calcd. for $C_{23}H_{21}O$ 313.1587; found: 313.1588.

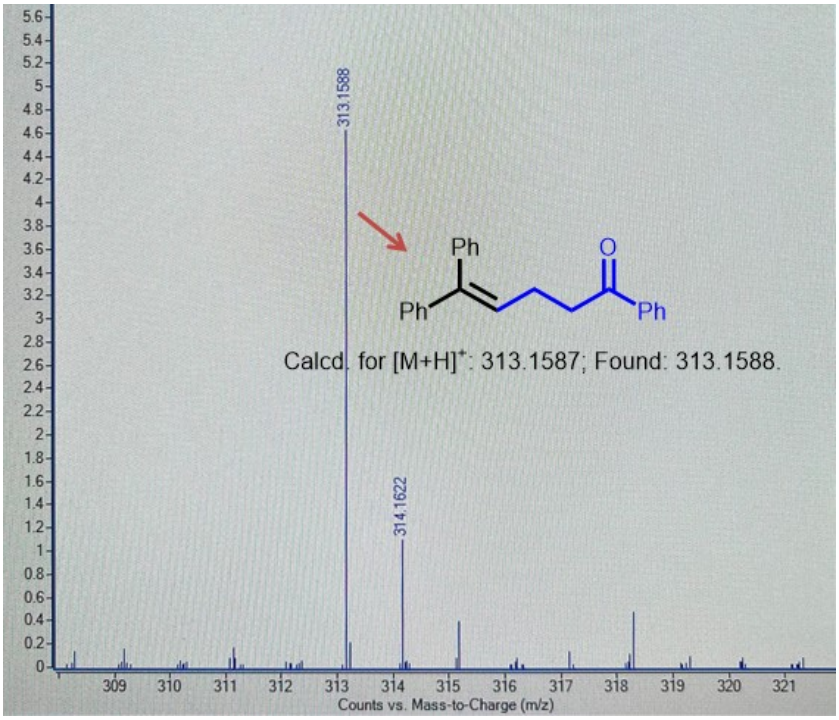
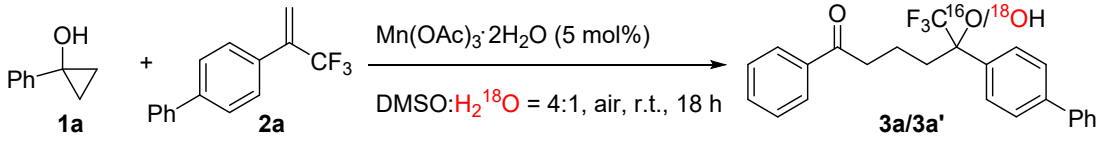



**Figure S3. HRMS spectrum of the adduct of DPE and 1a**

## 6.3 Labelling experiments with $H_2{}^{18}O$ and $^{18}O_2$




Standard reaction was set up by using labeled $H_2{}^{18}O$ instead of $H_2O$. As detected by HRMS (EI) was performed, the labeled $^{18}O$ product **3a′** was not obtained (Figure S4).

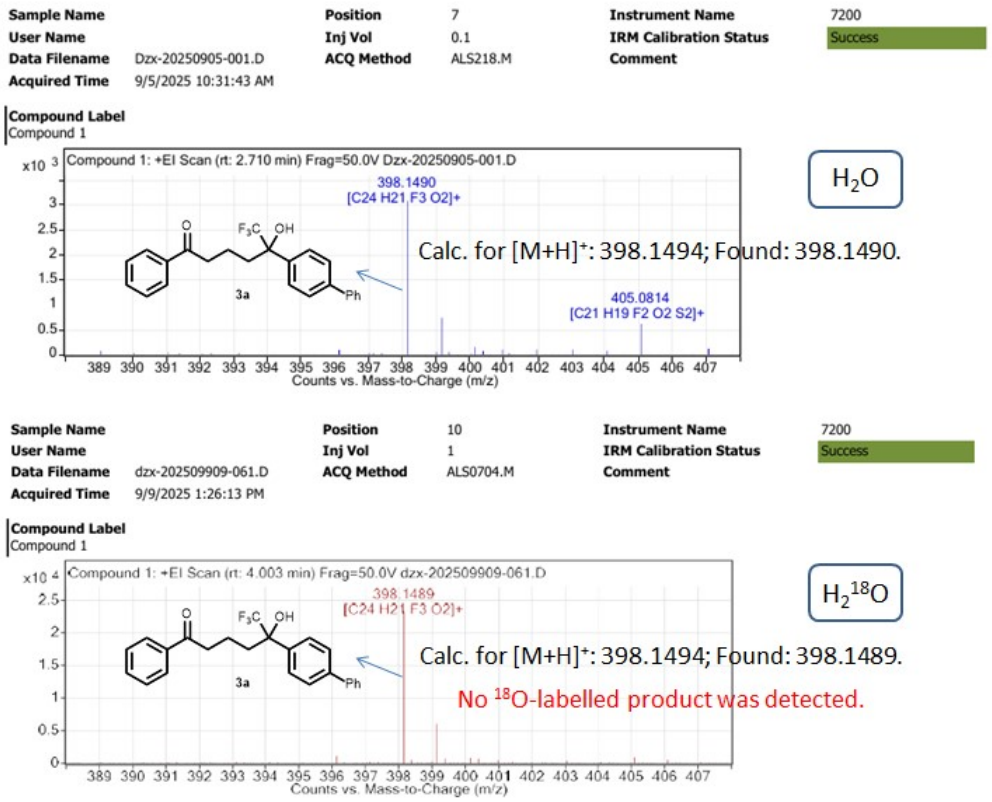
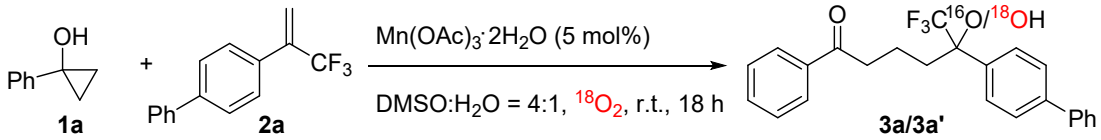



**Figure S4. Comparative HRMS of the labeling experiment by adding $H_2{}^{18}O$ instead of $H_2O$**




Standard reaction was set up by using labeled $^{18}O_2$ instead of air (Figure S5). As detected by HRMS, the labeled $^{18}O$ product **3a′** was found (Figure S6). HRMS (ESI) m/z: $[M–H]^-$ Calcd for $C_{24}H_{20}F_3O^{18}O$ 399.1463; Found 399.1468. Furthermore, the $^{18}O$-labeled peroxide intermediate peroxo-**3a′** was also found (Figure S7). HRMS (ESI) m/z: $[M–H]^-$ Calcd for $C_{24}H_{20}F_3O^{18}O_2$ 417.1455; Found 417.1438.

**Figure S5. Labeling experiment by using $^{18}O_2$**

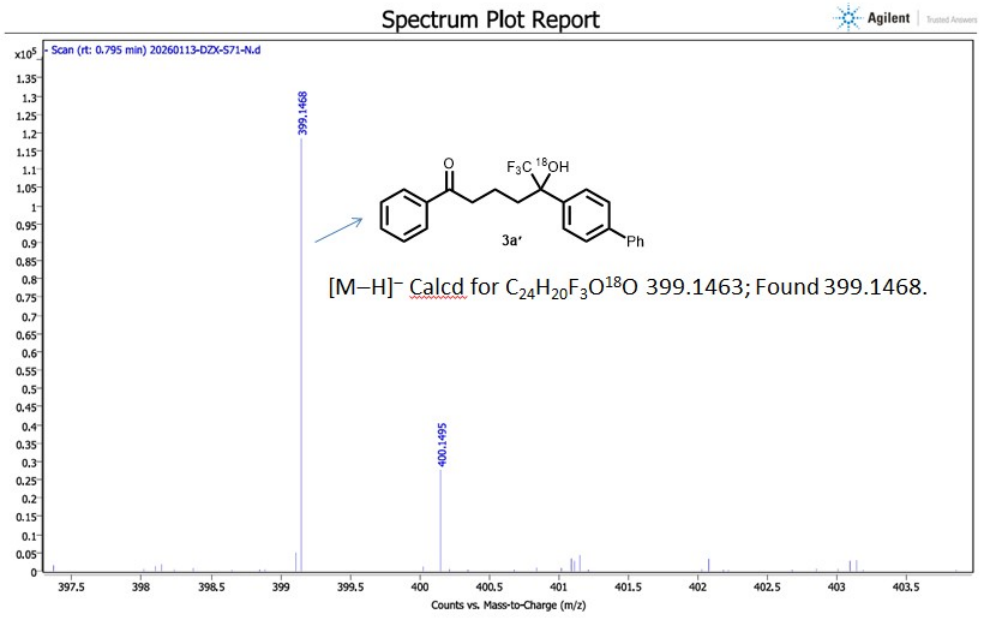



**Figure S6. HRMS of the labeling experiment by using $^{18}O_2$**

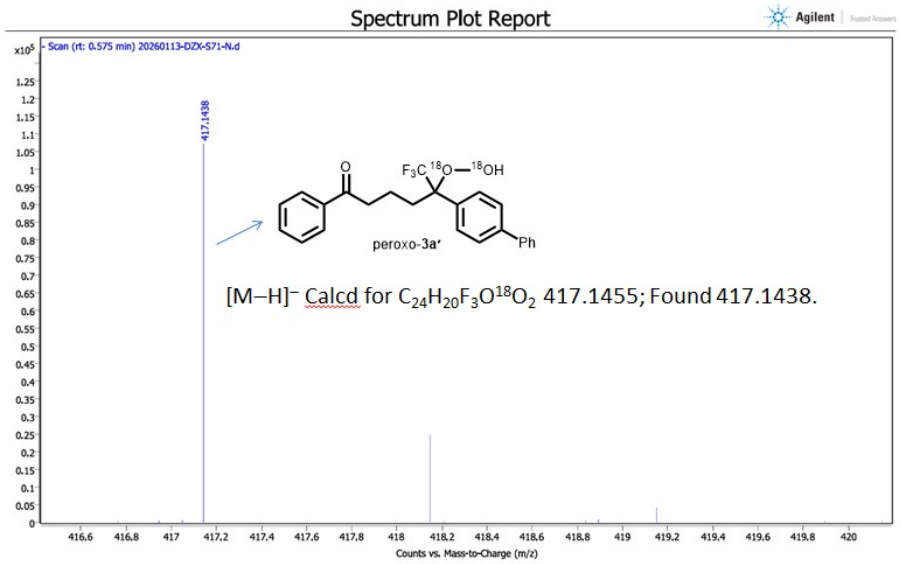
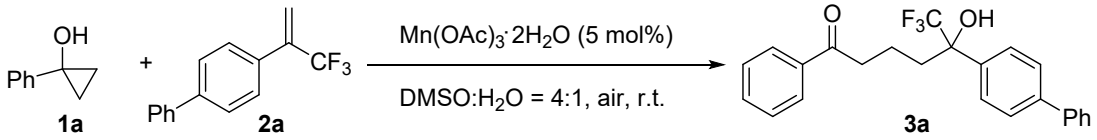



**Figure S7. HRMS of the $^{18}$O-labelled peroxo intermediate peroxo-3a′**

## 6.4 Experimental evidence for the peroxo intermediate E




Standard reaction was set up. After 0.5 h of reaction time, a sample was taken and analyzed by HRMS, the peroxo-**3a** (intermediate **E**) was found (Figure S8). HRMS (ESI) m/z: [M–H]$^-$ Calcd for $C_{24}H_{20}F_3O_3$ 413.1370; Found 413.1368.

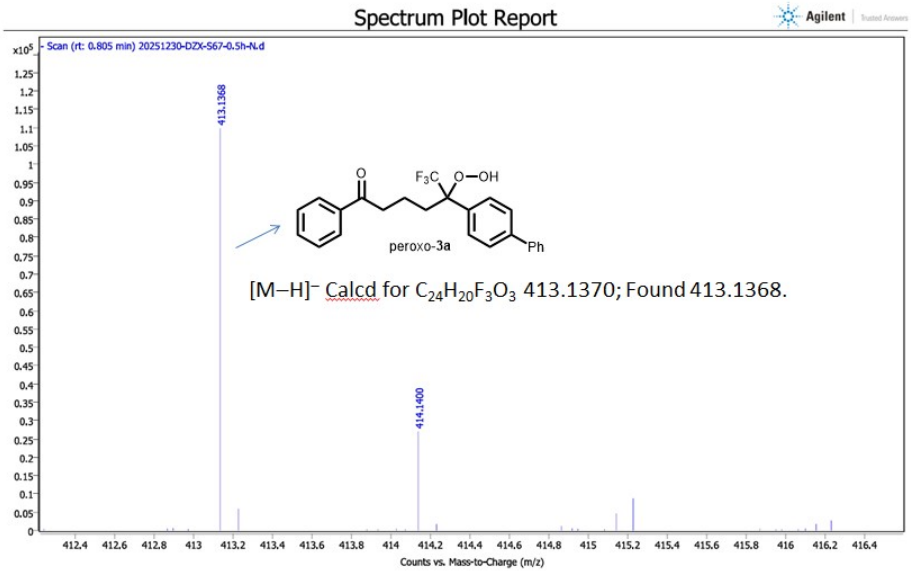



**Figure S8. HRMS of the peroxo intermediate peroxo-3a**

## 7. Green chemistry metrics analysis

To evaluate the green chemistry aspects of the developed reaction, we calculated the green chemistry metrics, including Atom Economy (AE), Atom Efficiency (AEF), Reaction Mass Efficiency (RME), *E*-Factor, Process Mass Intensity (PMI), Turnover Number (TON), and Turnover Frequency (TOF).[10] The chemistry metrics were calculated using the formulas provided below.

$$AE\ (\%) = \frac{Molecular\ Weight\ of\ Product}{Sum\ of\ Molecular\ Weights\ of\ All\ Reactants} \times 100$$

$$AEF\ (\%) = AE \times Yield\%$$

$$RME\ (\%) = \frac{Mass\ of\ Product}{Mass\ of\ Reactants\ Used} \times 100$$

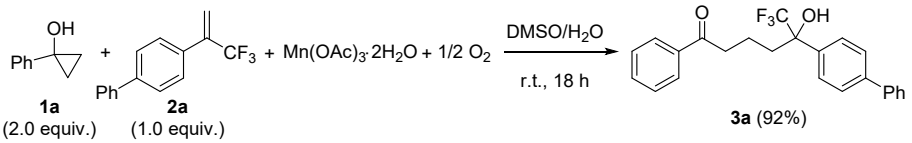
$$E - Factor = \frac{Mass\ of\ Waste}{Mass\ of\ Product}$$

$$PMI = \frac{Total\ Mass\ of\ Inputs\ (Reactants, Solvents, etc.)}{Mass\ of\ Product}$$

$$TON = \frac{Amout\ of\ Product\ (mmol\ scale)}{Amout\ of\ Catalyst\ Used\ (mmol\ scale)}$$

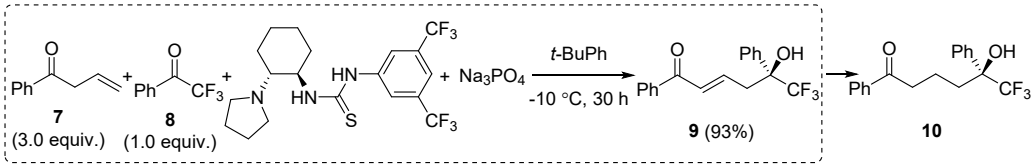
$$TOF = \frac{TON}{Time\ (hour)}$$

**A. Our work**




| | mmol | mg | MW | Green Chemistry Metrics | |
|---|---|---|---|---|---|
| **1a** | 0.2 | 26.8 | 134.18 | **AE (%)** | 75 |
| **2a** | 0.1 | 24.8 | 248.25 | **AEF (%)** | 69 |
| **3a** | 0.092 | 36.7 | 398.43 | **RME (%)** | 69 |
| **Air** | 0.05 | 1.6 | 32.00 | ***E*-Factor** | 29.9 |
| **Catalyst** | 0.005 | 1.3 | 268.10 | **PMI** | 30.9 |
| **Solvent** | | 1080 | | **TON** | 18.4 |
| | | | | **TOF (/h)** | 1.02 |

## B. Jiang group work[6]




| | mmol | mg | MW | Green Chemistry Metrics | |
|---|---|---|---|---|---|
| **7** | 0.3 | 43.9 | 146.19 | **AE (%)** | 52 |
| **8** | 0.1 | 17.4 | 174.12 | **AEF (%)** | 48 |
| **9** | 0.093 | 29.8 | 320.31 | **RME (%)** | 49 |
| **Catalyst** | 0.01 | 4.4 | 439.46 | ***E*-Factor** | 31.4 |
| **$Na_3PO_4$** | 0.2 | 32.8 | 163.94 | **PMI** | 32.4 |
| **Solvent** | | 867 | | **TON** | 9.3 |
| | | | | **TOF (/h)** | 0.3 |

## C. Comparison of Green Chemistry Metrics

| | Our work | Jiang group work |
|---|---|---|
| **AE (%)** | 75 | 52 |
| **AEF (%)** | 69 | 48 |
| **RME (%)** | 69 | 49 |
| ***E*-Factor** | 29.9 | 31.4 |
| **PMI** | 30.9 | 32.4 |
| **TON** | 18.4 | 9.3 |
| **TOF (/h)** | 1.02 | 0.3 |

## 8. X-ray crystallographic data of compound 3u

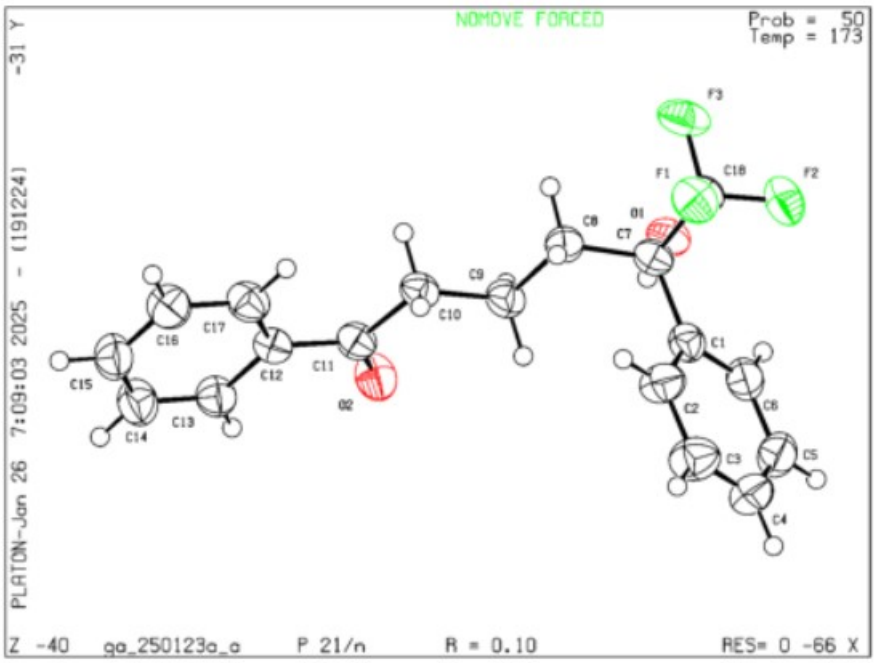



**Figure S9. X-ray structure of compound 3u, CCDC number: 2483414**

**Table S4. Crystal data and structure refinement for compound 3u**

| | | |
|---|---|---|
| Identification code | ga_250123a_a | |
| Empirical formula | $C_{18}H_{17}F_3O_2$ | |
| Formula weight | 322.32 | |
| Temperature | 173(2) K | |
| Wavelength | 1.34139 Å | |
| Crystal system | Monoclinic | |
| Space group | $P2_1/n$ | |
| Unit cell dimensions | a = 6.5279(14) Å | a= 90°. |
| | b = 11.063(2) Å | b= 96.638(9)°. |
| | c = 22.438(5) Å | g = 90°. |
| Volume | 1609.5(6) $Å^3$ | |
| Z | 4 | |
| Density (calculated) | 1.330 $Mg/m^3$ | |
| Absorption coefficient | 0.591 $mm^{-1}$ | |
| F(000) | 672 | |
| Crystal size | 0.200 × 0.030 × 0.020 $mm^3$ | |
| Theta range for data collection | 3.881 to 54.018°. | |
| Index ranges | -7<=h<=7, -13<=k<=13, - | |

| | |
|---|---|
| | 25<=l<=27 |
| Reflections collected | 8934 |
| Independent reflections | 2936 [R(int) = 0.0904] |
| Completeness to theta = 53.594° | 99.6 % |
| Absorption correction | Semi-empirical from equivalents |
| Max. and min. transmission | 0.970 and 0.372 |
| Refinement method | Full-matrix least-squares on $F^2$ |
| Data / restraints / parameters | 2936 / 1 / 213 |
| Goodness-of-fit on $F^2$ | 0.869 |
| Final R indices [I>2sigma(I)] | $R_1$ = 0.1004, $wR_2$ = 0.2451 |
| R indices (all data) | $R_1$ = 0.1442, $wR_2$ = 0.3013 |
| Extinction coefficient | 0.018(3) |
| Largest diff. peak and hole | 0.537 and -0.616 e.$Å^{-3}$ |

**Table S5. Atomic coordinates (×$10^4$) and equivalent isotropic displacement parameters ($Å^2$×$10^3$) for compound 3u. $U_{eq}$ is defined as one third of the trace of the orthogonalized $U_{ij}$ tensor.**

| Atom | x | y | z | U(eq) |
|---|---|---|---|---|
| F(1) | 7424(4) | 4948(2) | 6203(1) | 52(1) |
| F(2) | 10232(4) | 3972(2) | 6453(1) | 56(1) |
| F(3) | 9434(5) | 4521(2) | 5539(1) | 59(1) |
| O(1) | 8992(5) | 2144(3) | 5664(1) | 44(1) |
| O(2) | 1996(5) | 256(3) | 4583(2) | 53(1) |
| C(1) | 6803(7) | 2417(4) | 6476(2) | 41(1) |
| C(2) | 5015(8) | 2810(5) | 6689(2) | 52(1) |
| C(3) | 4460(9) | 2387(5) | 7231(2) | 62(2) |
| C(4) | 5689(9) | 1569(5) | 7562(2) | 60(1) |
| C(5) | 7489(8) | 1158(5) | 7358(2) | 55(1) |
| C(6) | 8032(7) | 1589(4) | 6819(2) | 48(1) |
| C(7) | 7470(7) | 2896(4) | 5881(2) | 40(1) |
| C(8) | 5694(7) | 3144(4) | 5392(2) | 40(1) |
| C(9) | 4496(7) | 2016(4) | 5169(2) | 44(1) |
| C(10) | 2592(7) | 2353(4) | 4748(2) | 39(1) |
| C(11) | 1319(7) | 1286(4) | 4494(2) | 41(1) |
| C(12) | -693(7) | 1501(4) | 4134(2) | 39(1) |
| C(13) | -1925(7) | 515(4) | 3932(2) | 46(1) |

| | | | | |
|---|---|---|---|---|
| C(14) | -3799(8) | 678(5) | 3596(2) | 56(1) |
| C(15) | -4514(8) | 1844(5) | 3451(2) | 54(1) |
| C(16) | -3311(8) | 2822(5) | 3647(2) | 53(1) |
| C(17) | -1440(7) | 2659(4) | 3994(2) | 47(1) |
| C(18) | 8637(7) | 4085(4) | 6021(2) | 43(1) |

**Table S6. Bond lengths [Å] for compound 3u.**

| Bond | Length/Å | Bond | Length/Å |
|---|---|---|---|
| F(1)-C(18) | 1.334(5) | C(8)-H(8A) | 0.9900 |
| F(2)-C(18) | 1.344(5) | C(8)-H(8B) | 0.9900 |
| F(3)-C(18) | 1.343(5) | C(9)-C(10) | 1.517(6) |
| O(1)-C(7) | 1.425(5) | C(9)-H(9A) | 0.9900 |
| O(1)-H(1) | 0.85(4) | C(9)-H(9B) | 0.9900 |
| O(2)-C(11) | 1.230(5) | C(10)-C(11) | 1.516(6) |
| C(1)-C(2) | 1.381(7) | C(10)-H(10A) | 0.9900 |
| C(1)-C(6) | 1.390(6) | C(10)-H(10B) | 0.9900 |
| C(1)-C(7) | 1.545(6) | C(11)-C(12) | 1.480(6) |
| C(2)-C(3) | 1.390(7) | C(12)-C(17) | 1.394(6) |
| C(2)-H(2) | 0.9500 | C(12)-C(13) | 1.399(6) |
| C(3)-C(4) | 1.370(8) | C(13)-C(14) | 1.373(7) |
| C(3)-H(3) | 0.9500 | C(13)-H(13) | 0.9500 |
| C(4)-C(5) | 1.386(8) | C(14)-C(15) | 1.396(7) |
| C(4)-H(4) | 0.9500 | C(14)-H(14) | 0.9500 |
| C(5)-C(6) | 1.383(7) | C(15)-C(16) | 1.379(7) |
| C(5)-H(5) | 0.9500 | C(15)-H(15) | 0.9500 |
| C(6)-H(6) | 0.9500 | C(16)-C(17) | 1.382(7) |
| C(7)-C(8) | 1.527(6) | C(16)-H(16) | 0.9500 |
| C(7)-C(18) | 1.534(6) | C(17)-H(17) | 0.9500 |
| C(8)-C(9) | 1.526(6) | | |

**Table S7. Bond angles [°] for compound 3u.**

| Bond | Angle/° | Bond | Angle/° |
|---|---|---|---|
| C(7)-O(1)-H(1) | 102(5) | C(8)-C(9)-H(9B) | 109.5 |
| C(2)-C(1)-C(6) | 118.3(4) | H(9A)-C(9)-H(9B) | 108.1 |
| C(2)-C(1)-C(7) | 121.7(4) | C(11)-C(10)-C(9) | 114.6(4) |
| C(6)-C(1)-C(7) | 120.1(4) | C(11)-C(10)- | 108.6 |

| | | | |
|---|---|---|---|
| | | H(10A) | |
| C(1)-C(2)-C(3) | 120.8(5) | C(9)-C(10)-H(10A) | 108.6 |
| C(1)-C(2)-H(2) | 119.6 | C(11)-C(10)-H(10B) | 108.6 |
| C(3)-C(2)-H(2) | 119.6 | C(9)-C(10)-H(10B) | 108.6 |
| C(4)-C(3)-C(2) | 120.1(5) | H(10A)-C(10)-H(10B) | 107.6 |
| C(4)-C(3)-H(3) | 120.0 | O(2)-C(11)-C(12) | 121.1(4) |
| C(2)-C(3)-H(3) | 120.0 | O(2)-C(11)-C(10) | 119.3(4) |
| C(3)-C(4)-C(5) | 120.2(5) | C(12)-C(11)-C(10) | 119.6(4) |
| C(3)-C(4)-H(4) | 119.9 | C(17)-C(12)-C(13) | 118.1(4) |
| C(5)-C(4)-H(4) | 119.9 | C(17)-C(12)-C(11) | 122.4(4) |
| C(6)-C(5)-C(4) | 119.2(5) | C(13)-C(12)-C(11) | 119.5(4) |
| C(6)-C(5)-H(5) | 120.4 | C(14)-C(13)-C(12) | 121.2(4) |
| C(4)-C(5)-H(5) | 120.4 | C(14)-C(13)-H(13) | 119.4 |
| C(5)-C(6)-C(1) | 121.4(5) | C(12)-C(13)-H(13) | 119.4 |
| C(5)-C(6)-H(6) | 119.3 | C(13)-C(14)-C(15) | 120.2(5) |
| C(1)-C(6)-H(6) | 119.3 | C(13)-C(14)-H(14) | 119.9 |
| O(1)-C(7)-C(8) | 111.1(4) | C(15)-C(14)-H(14) | 119.9 |
| O(1)-C(7)-C(18) | 102.8(3) | C(16)-C(15)-C(14) | 119.2(5) |
| C(8)-C(7)-C(18) | 108.0(3) | C(16)-C(15)-H(15) | 120.4 |
| O(1)-C(7)-C(1) | 112.0(3) | C(14)-C(15)-H(15) | 120.4 |
| C(8)-C(7)-C(1) | 114.6(4) | C(15)-C(16)-C(17) | 120.7(5) |
| C(18)-C(7)-C(1) | 107.5(4) | C(15)-C(16)-H(16) | 119.7 |
| C(9)-C(8)-C(7) | 114.0(3) | C(17)-C(16)-H(16) | 119.7 |
| C(9)-C(8)-H(8A) | 108.8 | C(16)-C(17)-C(12) | 120.7(4) |
| C(7)-C(8)-H(8A) | 108.8 | C(16)-C(17)-H(17) | 119.7 |
| C(9)-C(8)-H(8B) | 108.8 | C(12)-C(17)-H(17) | 119.7 |
| C(7)-C(8)-H(8B) | 108.8 | F(1)-C(18)-F(3) | 106.7(4) |
| H(8A)-C(8)-H(8B) | 107.6 | F(1)-C(18)-F(2) | 106.5(4) |
| C(10)-C(9)-C(8) | 110.8(4) | F(3)-C(18)-F(2) | 105.9(4) |
| C(10)-C(9)-H(9A) | 109.5 | F(1)-C(18)-C(7) | 112.2(4) |
| C(8)-C(9)-H(9A) | 109.5 | F(3)-C(18)-C(7) | 112.0(4) |
| C(10)-C(9)-H(9B) | 109.5 | F(2)-C(18)-C(7) | 113.1(4) |

**Table S8. Anisotropic displacement parameters ($Å^2×10^3$) for compound 3u. The anisotropic displacement factor exponent takes the form: $-2\pi^2[h^2a^{*2}U^{11}+...+2hk\,a^*b^*U^{12}]$.**

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{23}$ | $U^{13}$ | $U^{12}$ |
|---|---|---|---|---|---|---|
| F(1) | 56(2) | 37(1) | 64(2) | -9(1) | 7(1) | 0(1) |
| F(2) | 47(2) | 49(2) | 70(2) | -8(1) | -6(1) | -5(1) |
| F(3) | 71(2) | 44(2) | 67(2) | -4(1) | 24(2) | -22(1) |
| O(1) | 45(2) | 34(2) | 53(2) | -4(1) | 12(1) | -3(1) |
| O(2) | 52(2) | 34(2) | 69(2) | -2(2) | -6(2) | 2(1) |
| C(1) | 40(2) | 37(2) | 44(2) | -3(2) | 1(2) | -4(2) |
| C(2) | 53(3) | 55(3) | 51(3) | 9(2) | 13(2) | 4(2) |
| C(3) | 60(3) | 66(3) | 63(3) | 7(3) | 20(3) | 6(3) |
| C(4) | 71(4) | 69(3) | 42(3) | 8(2) | 5(2) | -12(3) |
| C(5) | 61(3) | 53(3) | 48(3) | 5(2) | -6(2) | -2(3) |
| C(6) | 43(2) | 48(3) | 52(3) | 1(2) | -4(2) | -4(2) |
| C(7) | 42(2) | 32(2) | 47(2) | -2(2) | 6(2) | -5(2) |
| C(8) | 43(2) | 33(2) | 43(2) | 4(2) | 3(2) | -1(2) |
| C(9) | 45(2) | 36(2) | 50(3) | 1(2) | 2(2) | -6(2) |
| C(10) | 43(2) | 32(2) | 44(2) | -4(2) | 6(2) | -6(2) |
| C(11) | 41(2) | 35(2) | 46(2) | -2(2) | 6(2) | -2(2) |
| C(12) | 38(2) | 36(2) | 43(2) | 0(2) | 8(2) | -2(2) |
| C(13) | 48(3) | 36(2) | 52(3) | 1(2) | 1(2) | -1(2) |
| C(14) | 54(3) | 47(3) | 63(3) | -1(2) | -7(2) | -4(2) |
| C(15) | 44(3) | 63(3) | 53(3) | 0(2) | -3(2) | 0(2) |
| C(16) | 49(3) | 46(3) | 64(3) | 5(2) | 3(2) | 5(2) |
| C(17) | 46(3) | 37(2) | 58(3) | 0(2) | 6(2) | -1(2) |
| C(18) | 43(2) | 38(2) | 49(3) | -1(2) | 6(2) | -6(2) |

**Table S9. Hydrogen coordinates ($×10^4$) and isotropic displacement parameters ($Å2×10^3$) for compound 3u.**

| Atom | x | y | z | U(eq) |
|---|---|---|---|---|
| H(1) | 8400(100) | 1450(40) | 5650(30) | 90(20) |
| H(2) | 4154 | 3377 | 6462 | 63 |
| H(3) | 3227 | 2665 | 7372 | 74 |
| H(4) | 5307 | 1282 | 7933 | 73 |
| H(5) | 8340 | 587 | 7585 | 66 |

| | | | | |
|---|---|---|---|---|
| H(6) | 9272 | 1314 | 6680 | 58 |
| H(8A) | 4729 | 3721 | 5550 | 48 |
| H(8B) | 6253 | 3535 | 5048 | 48 |
| H(9A) | 5394 | 1487 | 4955 | 53 |
| H(9B) | 4081 | 1562 | 5515 | 53 |
| H(10A) | 1707 | 2879 | 4968 | 47 |
| H(10B) | 3025 | 2829 | 4411 | 47 |
| H(13) | -1457 | -282 | 4030 | 55 |
| H(14) | -4612 | -3 | 3462 | 67 |
| H(15) | -5813 | 1961 | 3220 | 65 |
| H(16) | -3775 | 3617 | 3543 | 64 |
| H(17) | -654 | 3343 | 4138 | 56 |

**Table S10. Torsion angles [°] for compound 3u.**

| Bond | Torsion angles/° | Bond | Torsion angles/° |
|---|---|---|---|
| C(6)-C(1)-C(2)-C(3) | -0.1(7) | O(2)-C(11)-C(12)-C(17) | -175.9(4) |
| C(7)-C(1)-C(2)-C(3) | -178.8(5) | C(10)-C(11)-C(12)-C(17) | 2.9(7) |
| C(1)-C(2)-C(3)-C(4) | 0.0(9) | O(2)-C(11)-C(12)-C(13) | 5.4(7) |
| C(2)-C(3)-C(4)-C(5) | -0.1(9) | C(10)-C(11)-C(12)-C(13) | -175.9(4) |
| C(3)-C(4)-C(5)-C(6) | 0.4(8) | C(17)-C(12)-C(13)-C(14) | 1.3(7) |
| C(4)-C(5)-C(6)-C(1) | -0.6(8) | C(11)-C(12)-C(13)-C(14) | -179.9(4) |
| C(2)-C(1)-C(6)-C(5) | 0.4(7) | C(12)-C(13)-C(14)-C(15) | -0.3(8) |
| C(7)-C(1)-C(6)-C(5) | 179.1(4) | C(13)-C(14)-C(15)-C(16) | 0.3(8) |
| C(2)-C(1)-C(7)-O(1) | -163.4(4) | C(14)-C(15)-C(16)-C(17) | -1.3(8) |
| C(6)-C(1)-C(7)-O(1) | 18.0(5) | C(15)-C(16)-C(17)-C(12) | 2.4(8) |
| C(2)-C(1)-C(7)-C(8) | -35.7(6) | C(13)-C(12)-C(17)-C(16) | -2.3(7) |
| C(6)-C(1)-C(7)-C(8) | 145.7(4) | C(11)-C(12)-C(17)-C(16) | 178.9(4) |
| C(2)-C(1)-C(7)-C(18) | 84.4(5) | O(1)-C(7)-C(18)-F(1) | 176.5(3) |
| C(6)-C(1)-C(7)-C(18) | -94.2(5) | C(8)-C(7)-C(18)-F(1) | 58.9(5) |
| O(1)-C(7)-C(8)-C(9) | 63.1(5) | C(1)-C(7)-C(18)-F(1) | -65.2(5) |
| C(18)-C(7)-C(8)-C(9) | 175.1(4) | O(1)-C(7)-C(18)-F(3) | 56.5(4) |
| C(1)-C(7)-C(8)-C(9) | -65.1(5) | C(8)-C(7)-C(18)-F(3) | -61.0(5) |
| C(7)-C(8)-C(9)-C(10) | 172.2(4) | C(1)-C(7)-C(18)-F(3) | 174.8(4) |
| C(8)-C(9)-C(10)-C(11) | 179.0(4) | O(1)-C(7)-C(18)-F(2) | -63.1(5) |
| C(9)-C(10)-C(11)-O(2) | -8.0(6) | C(8)-C(7)-C(18)-F(2) | 179.4(4) |
| C(9)-C(10)-C(11)-C(12) | 173.2(4) | C(1)-C(7)-C(18)-F(2) | 55.2(5) |

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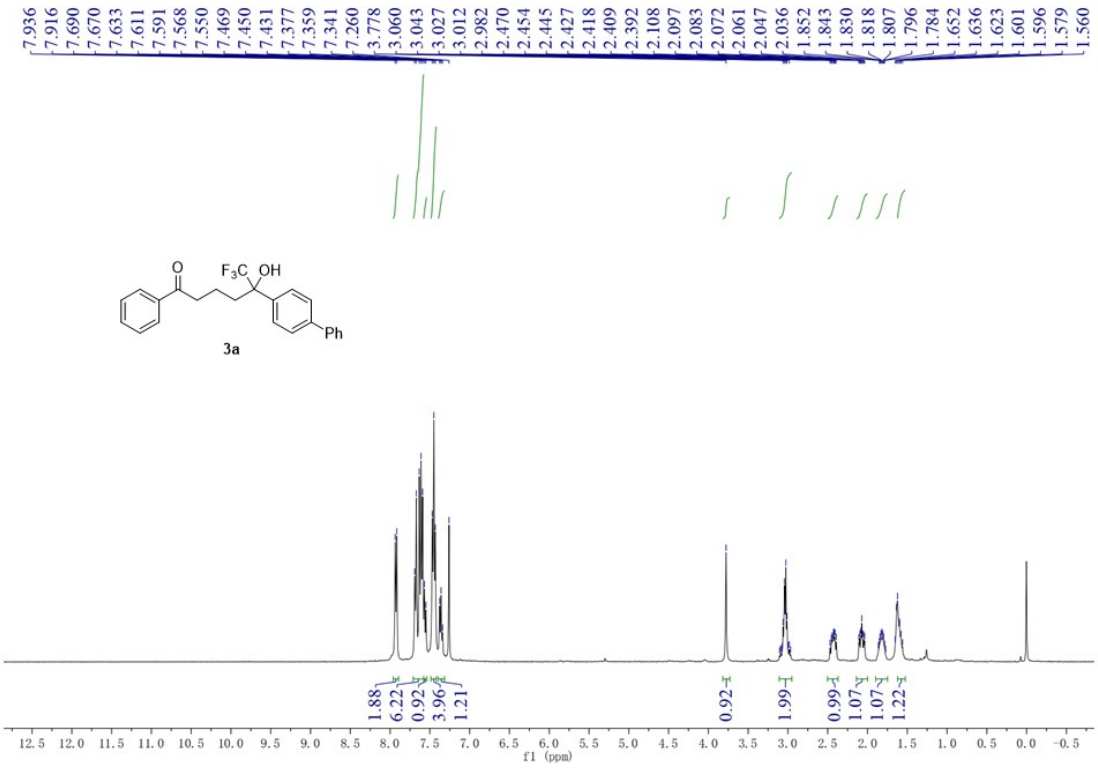
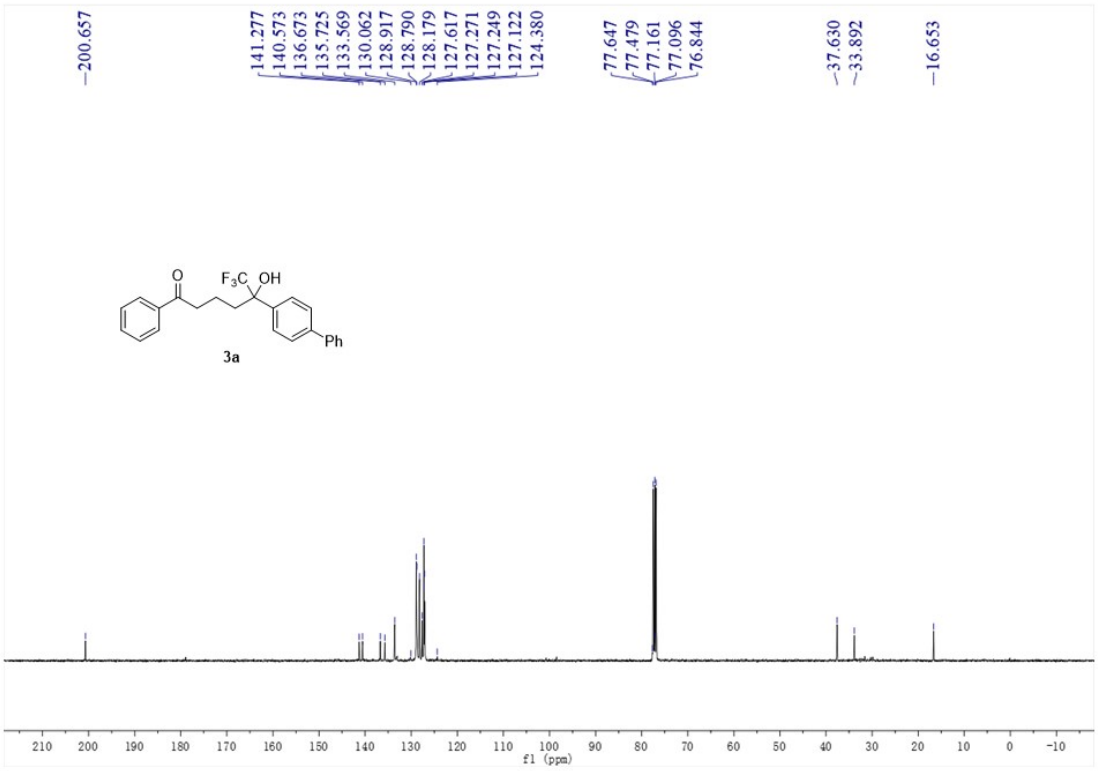
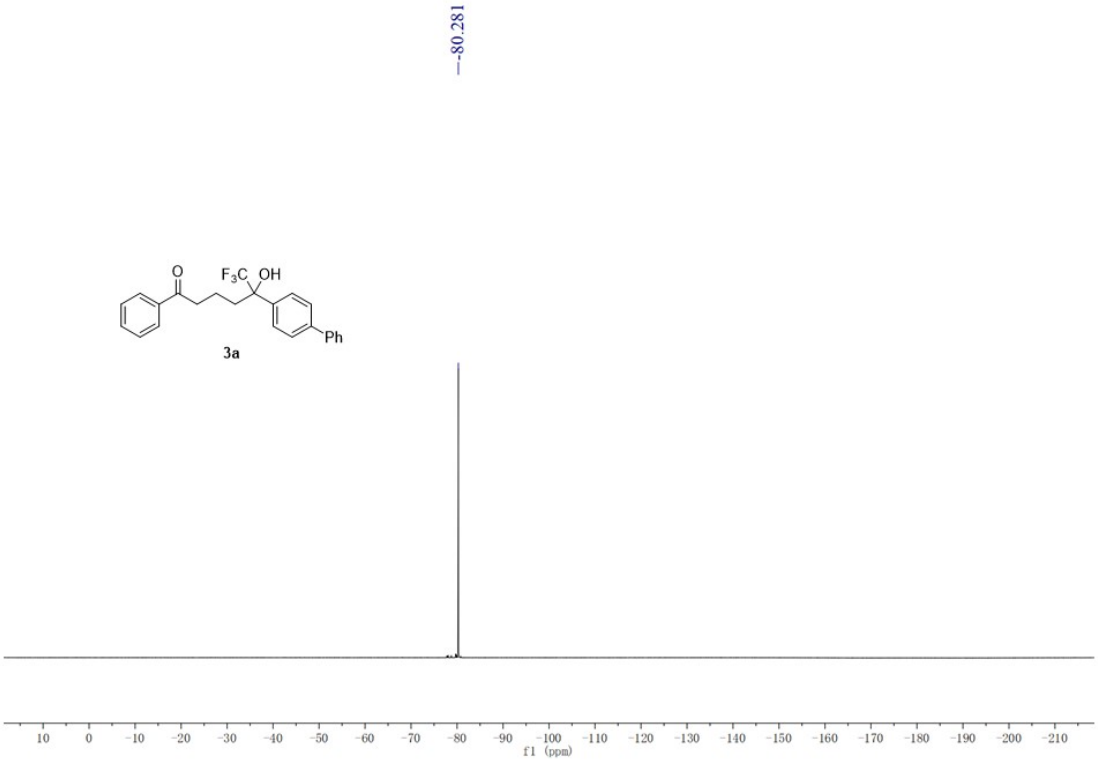
## 10. Copies of NMR spectra

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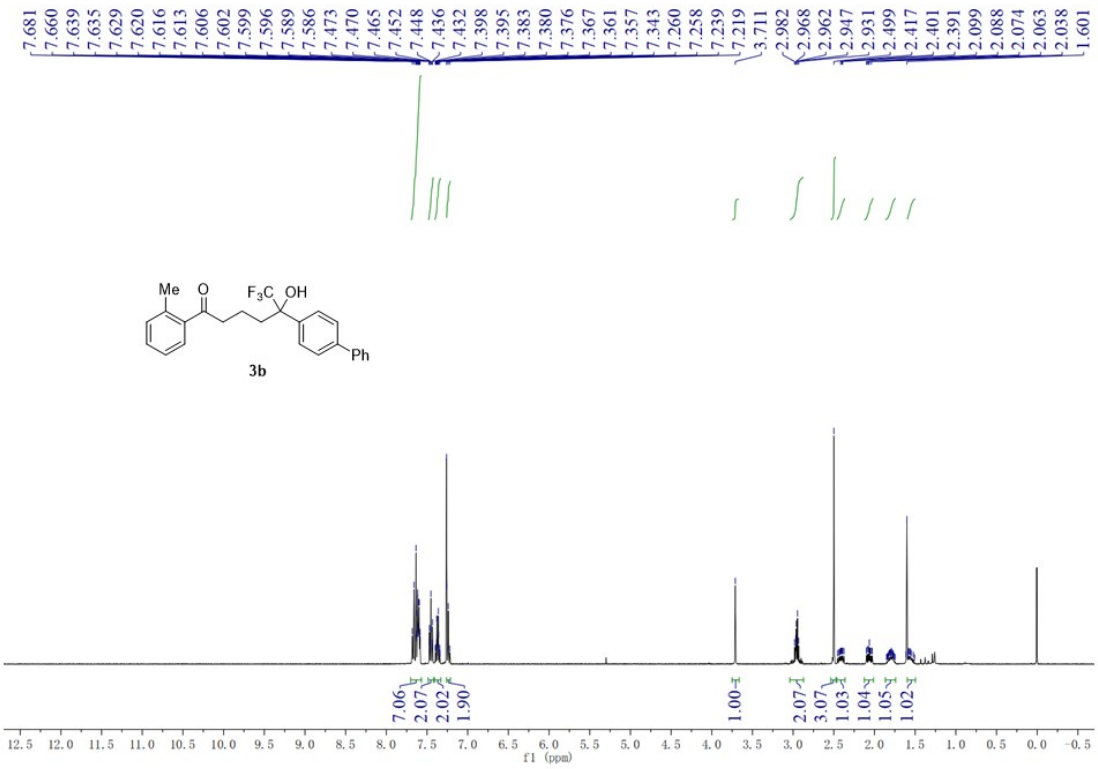
f1 (ppm)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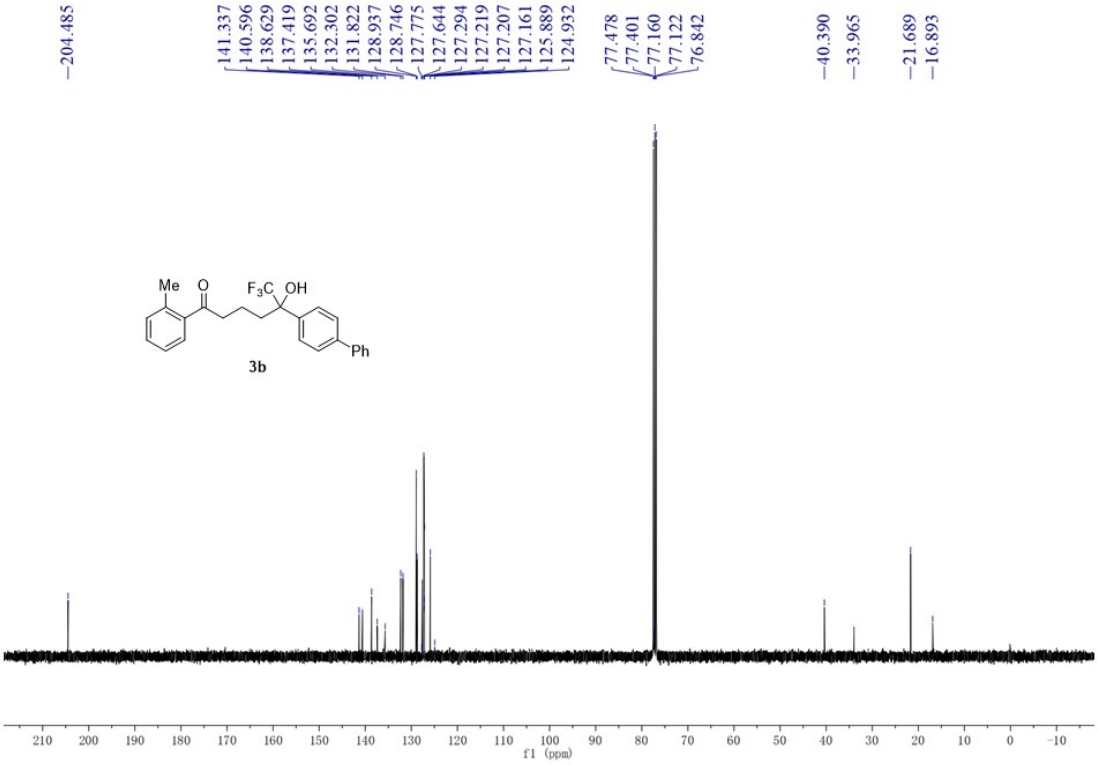
1.02
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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131.822
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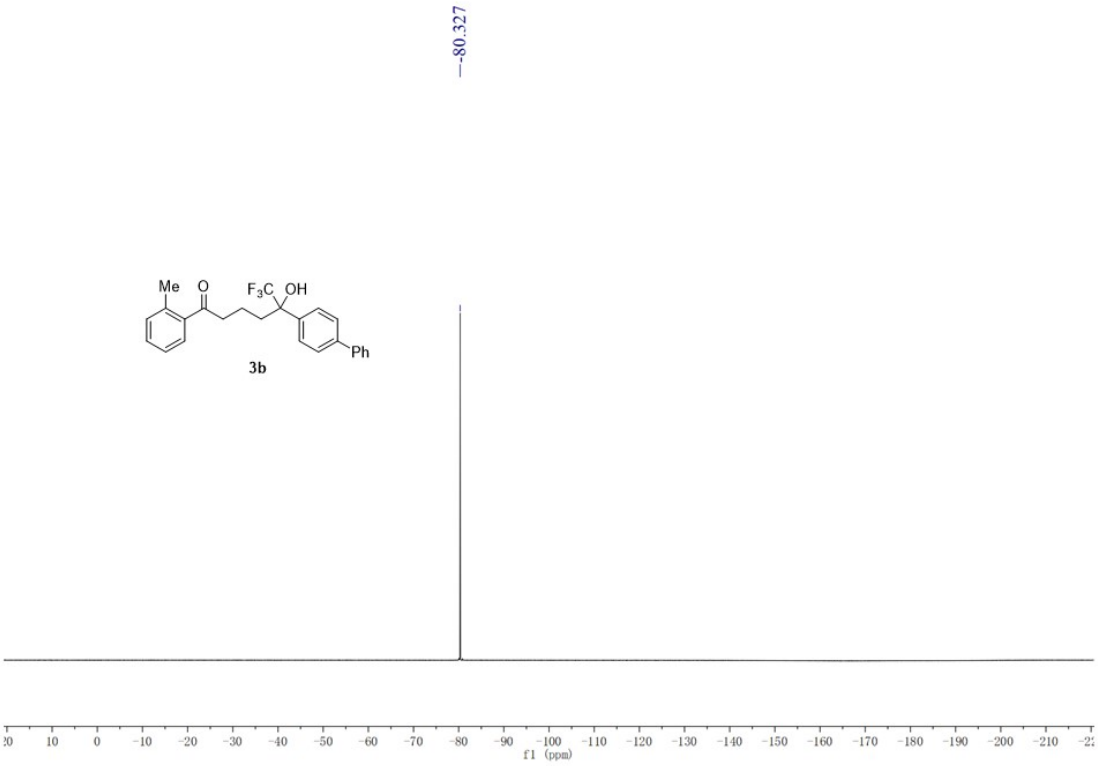
127.775
127.644
127.294
127.219
127.207
127.161
125.889
124.932
77.478
77.401
77.160
77.122
76.842
40.390
33.965
21.689
16.893
Me
O
F3C
OH
Ph
3b
f1 (ppm)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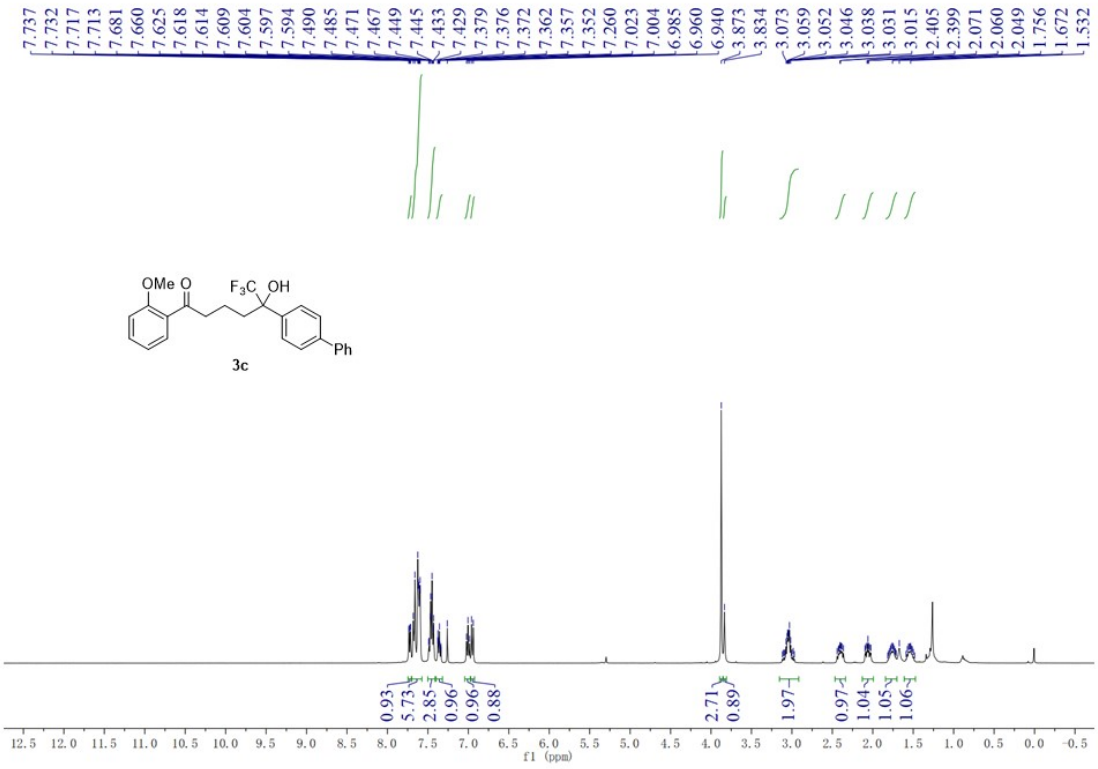
Me
O
F3C
OH
Ph
3b
f1 (ppm)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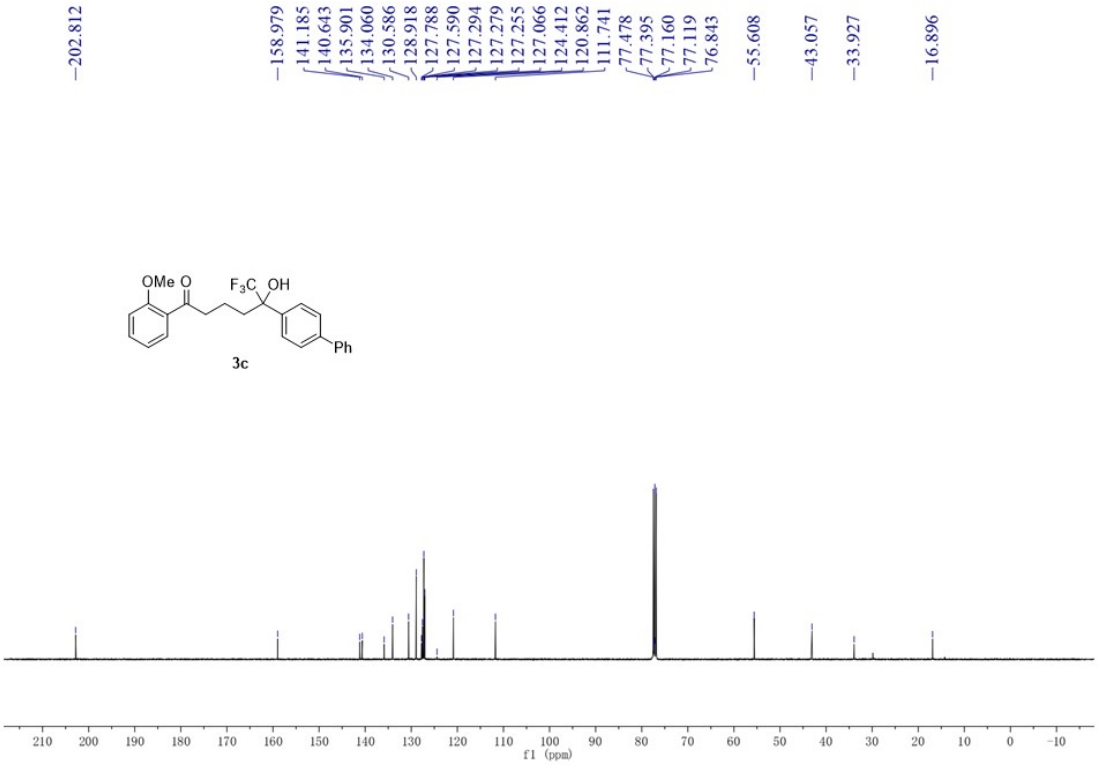
7.618
7.614
7.609
7.604
7.597
7.594
7.490
7.485
7.471
7.467
7.449
7.445
7.433
7.429
7.379
7.376
7.372
7.362
7.357
7.352
7.260
7.023
7.004
6.985
6.960
6.940
3.873
3.834
3.073
3.059
3.052
3.046
3.038
3.031
3.015
2.405
2.399
2.071
2.060
2.049
1.756
1.672
1.532
OMe O
F3C OH
Ph
3c
0.93
5.73
2.85
0.96
0.96
0.88
2.71
0.89
1.97
0.97
1.04
1.05
1.06
f1 (ppm)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128.918
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127.590
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127.279
127.255
127.066
124.412
120.862
111.741
77.478
77.395
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77.119
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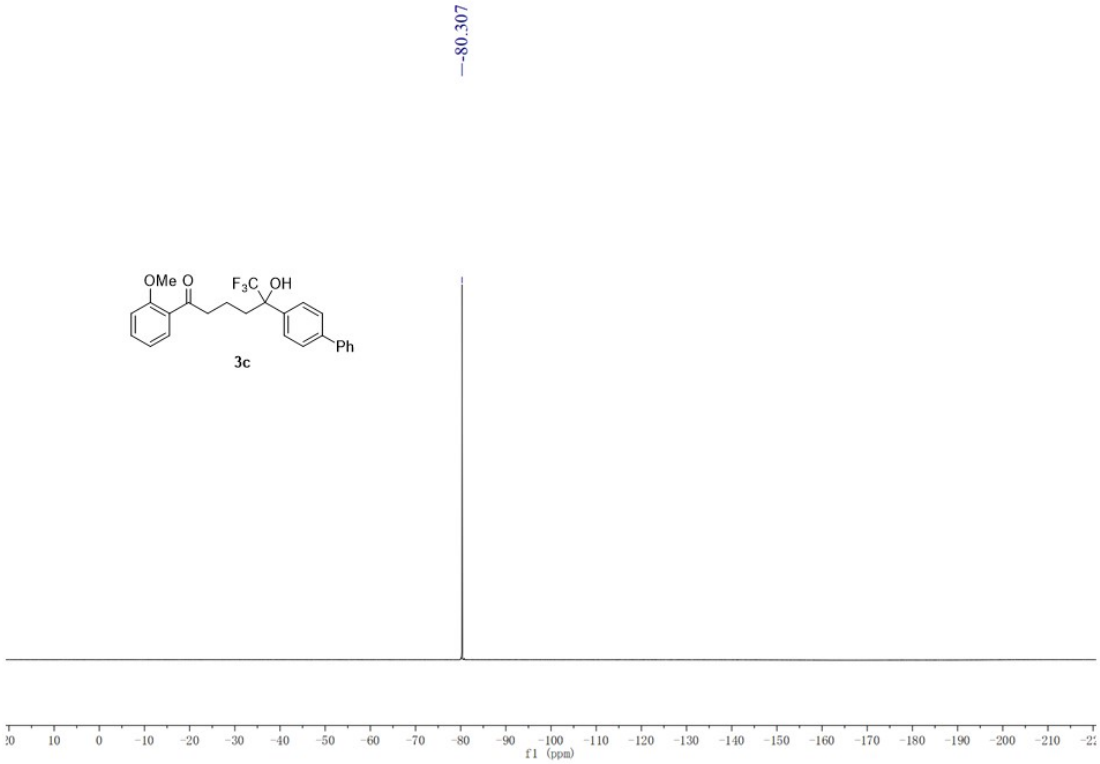
55.608
43.057
33.927
16.896
OMe O
F3C OH
Ph
3c
f1 (ppm)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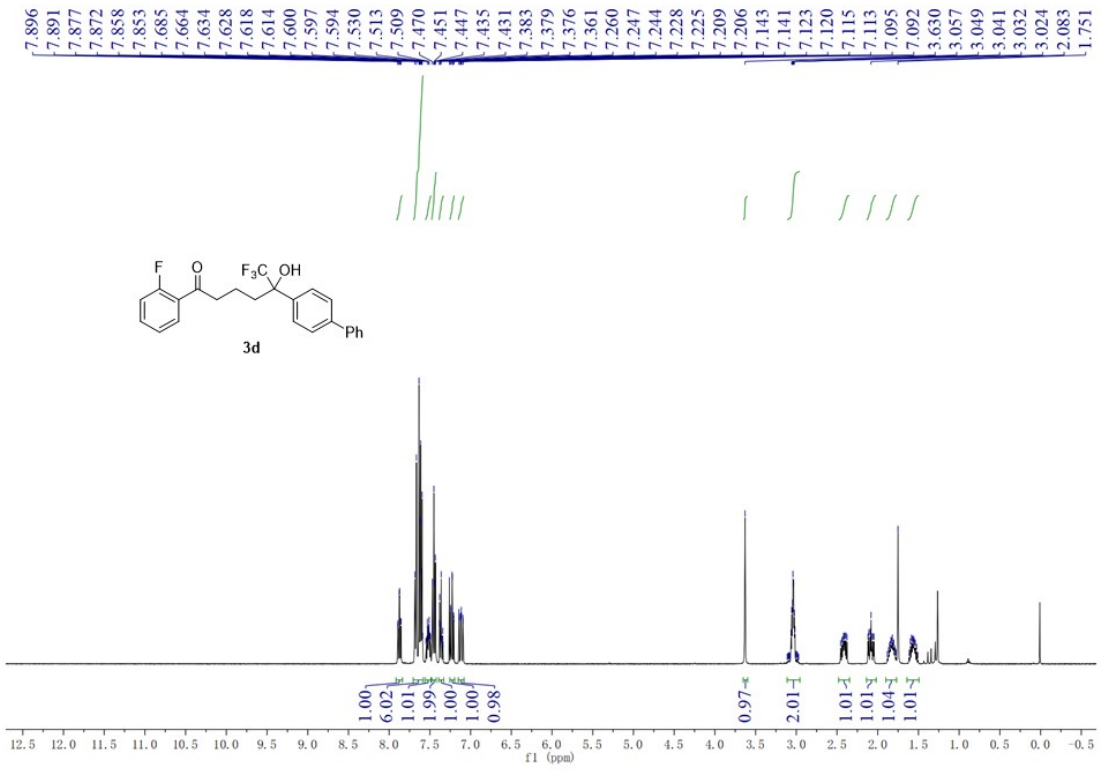
F3C OH
Ph
3c
f1 (ppm)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7.685
7.664
7.634
7.628
7.618
7.614
7.600
7.597
7.594
7.530
7.513
7.509
7.470
7.451
7.447
7.435
7.431
7.383
7.379
7.376
7.361
7.260
7.247
7.244
7.228
7.225
7.209
7.206
7.143
7.141
7.123
7.120
7.115
7.113
7.095
7.092
3.630
3.057
3.049
3.041
3.032
3.024
2.083
1.751
F
O
F3C OH
Ph
3d
1.00
6.02
1.01
1.99
1.00
1.00
0.98
0.97
2.01
1.01
1.01
1.04
1.01
f1 (ppm)

198.808
198.766
163.564
161.029
141.295
140.584
135.596
135.110
135.019
130.775
130.749
130.053
128.917
127.617
127.281
127.194
127.133
125.367
125.240
124.683
124.649
124.371
121.529
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77.161
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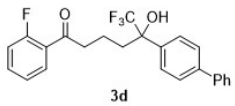
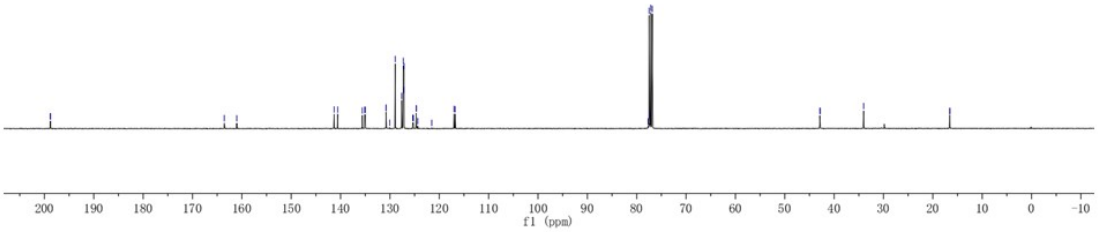
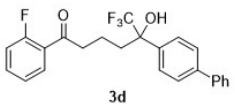
34.011
16.584
16.563



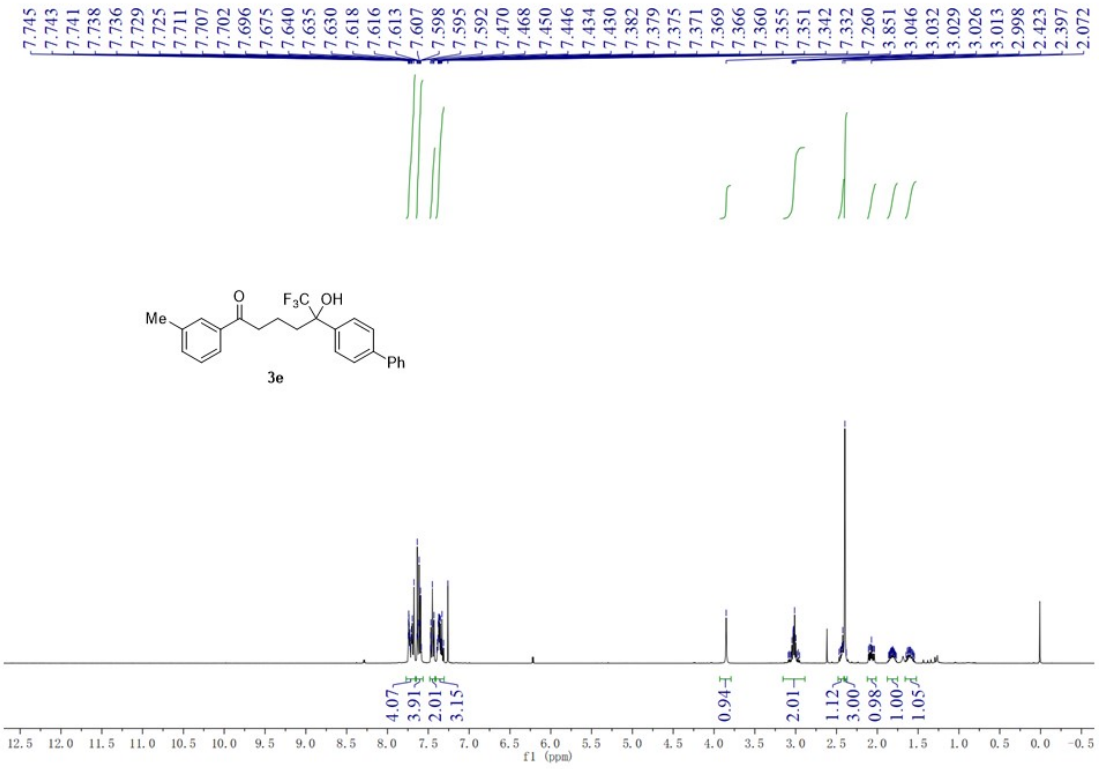

**3d**




-80.288
-108.635




**3d**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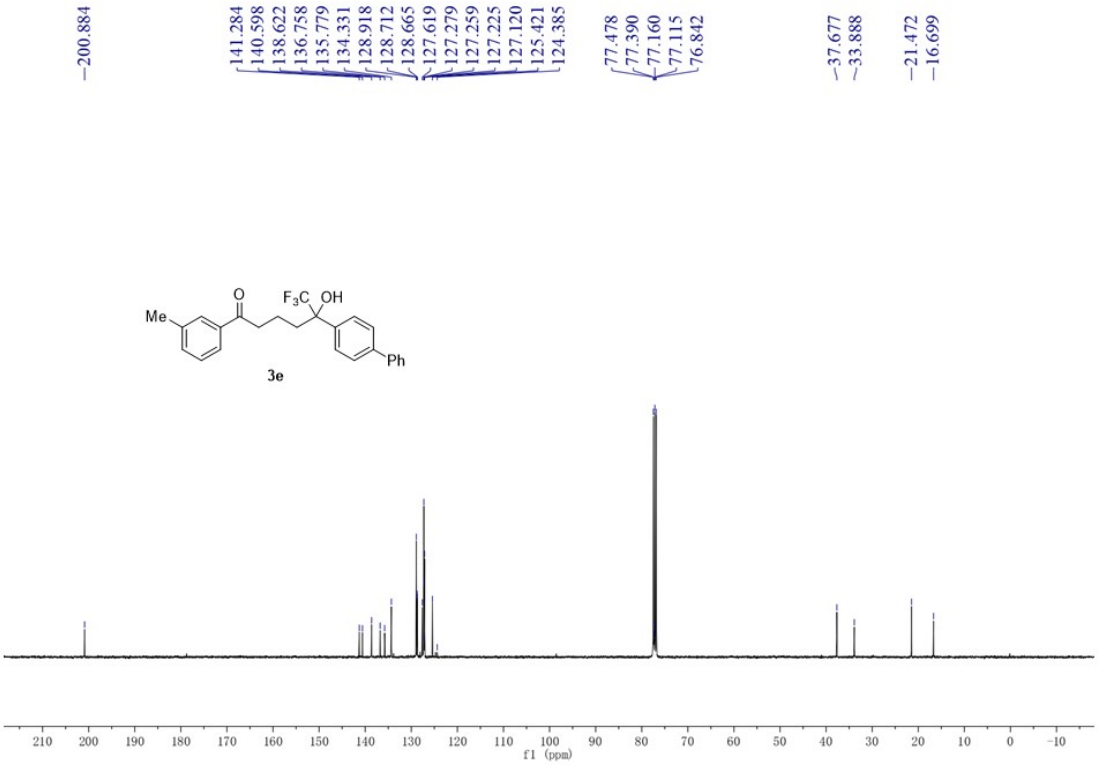
7.729
7.725
7.711
7.707
7.702
7.696
7.675
7.640
7.635
7.630
7.618
7.616
7.613
7.607
7.598
7.595
7.592
7.470
7.468
7.450
7.446
7.434
7.430
7.382
7.379
7.375
7.371
7.369
7.366
7.360
7.355
7.351
7.342
7.332
7.260
3.851
3.046
3.032
3.029
3.026
3.013
2.998
2.423
2.397
2.072
O
F3C
OH
Me
Ph
3e
4.07
3.91
2.01
3.15
0.94
2.01
1.12
3.00
0.98
1.00
1.05
f1 (ppm)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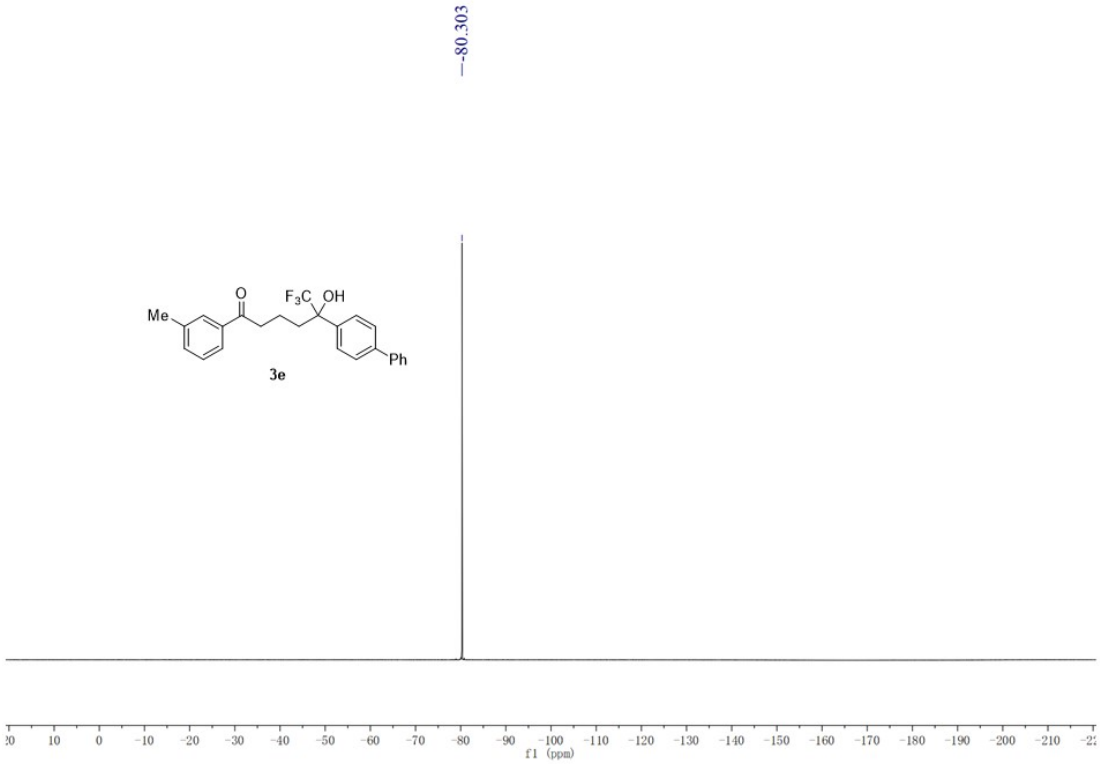
136.758
135.779
134.331
128.918
128.712
128.665
127.619
127.279
127.259
127.225
127.120
125.421
124.385
77.478
77.390
77.160
77.115
76.842
37.677
33.888
21.472
16.699
O
F3C
OH
Me
Ph
3e
f1 (ppm)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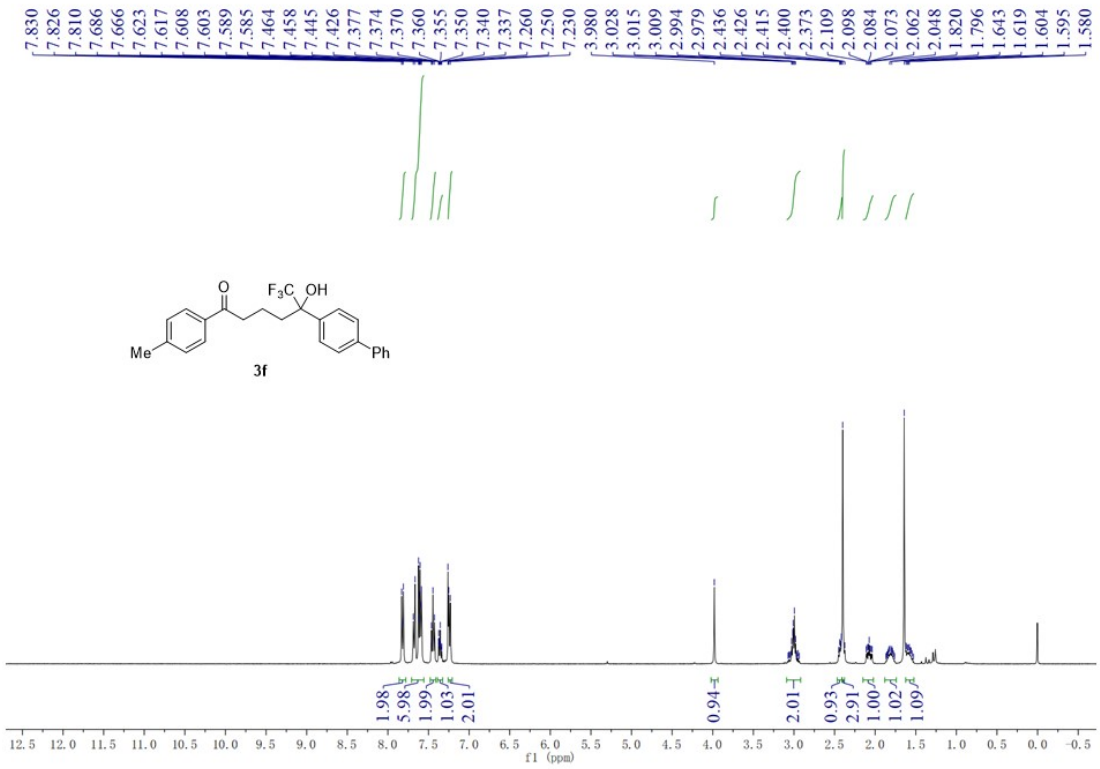
O
F3C
OH
Me
Ph
3e
f1 (ppm)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7.608
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7.589
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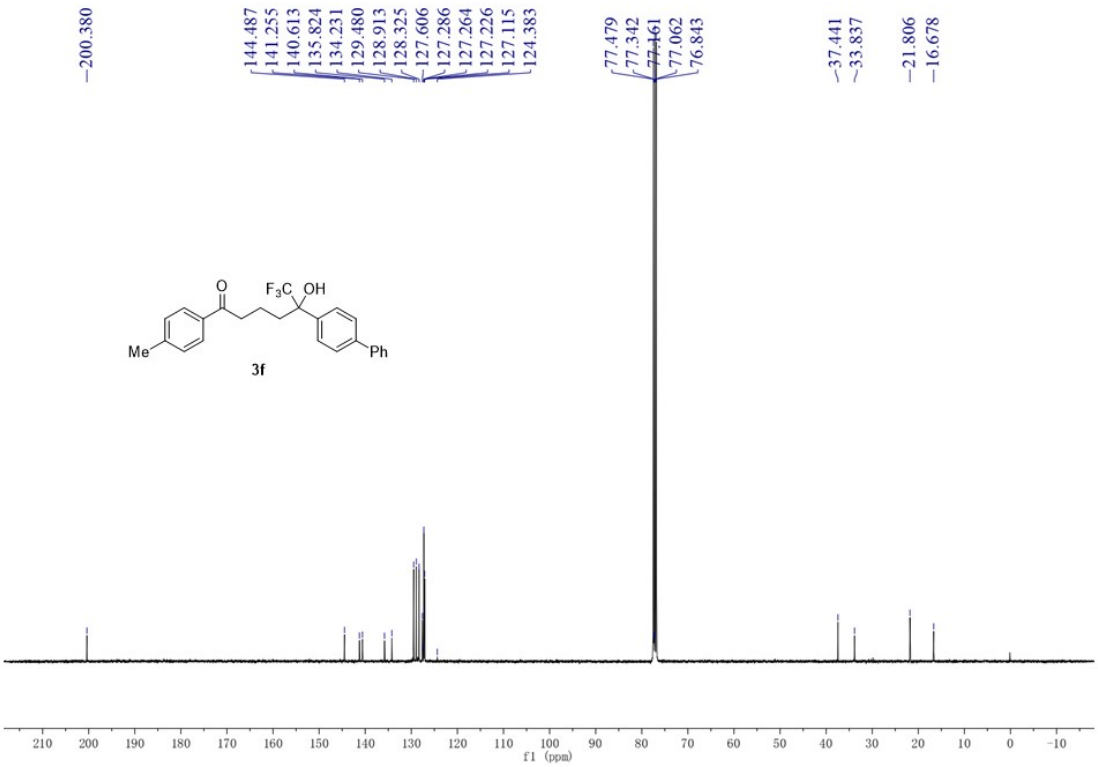
7.464
7.458
7.445
7.426
7.377
7.374
7.370
7.360
7.355
7.350
7.340
7.337
7.260
7.250
7.230
3.980
3.028
3.015
3.009
2.994
2.979
2.436
2.426
2.415
2.400
2.373
2.109
2.098
2.084
2.073
2.062
2.048
1.820
1.796
1.643
1.619
1.604
1.595
1.580
O
F3C
OH
Me
Ph
3f
1.98
5.98
1.99
1.03
2.01
0.94
2.01
0.93
2.91
1.00
1.02
1.09
f1 (ppm)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128.913
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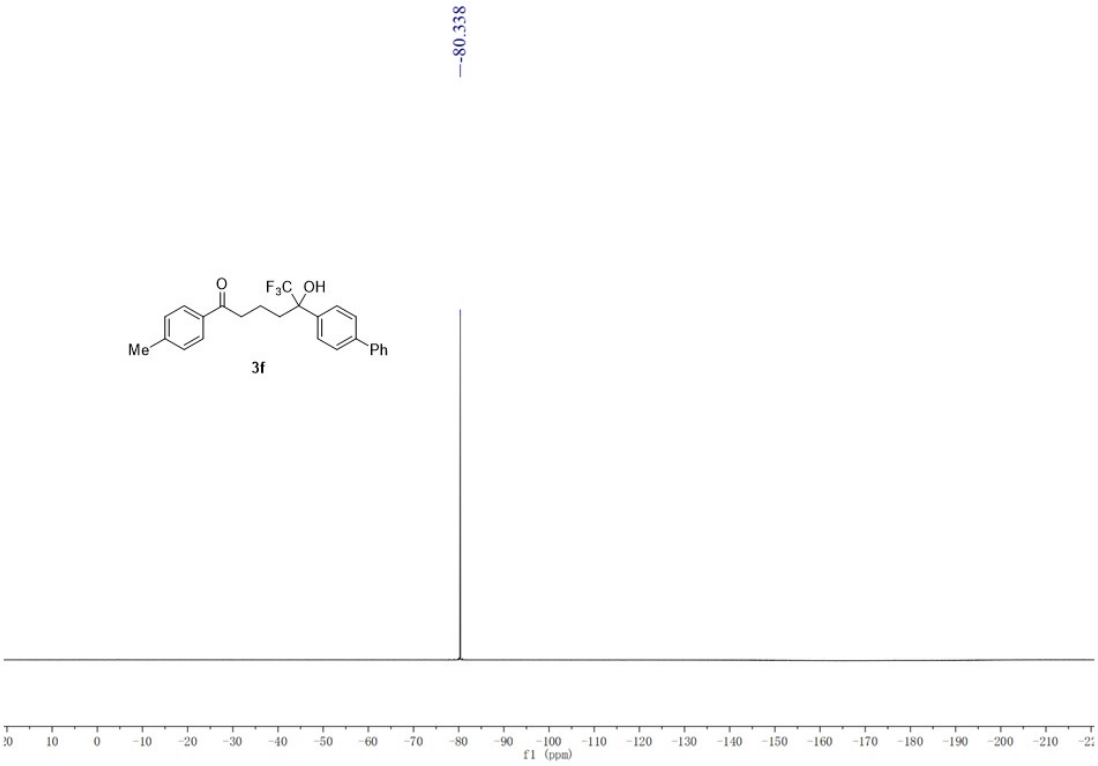
127.286
127.264
127.226
127.115
124.383
77.479
77.342
77.161
77.062
76.843
37.441
33.837
21.806
16.678
O
F3C
OH
Me
Ph
3f
f1 (ppm)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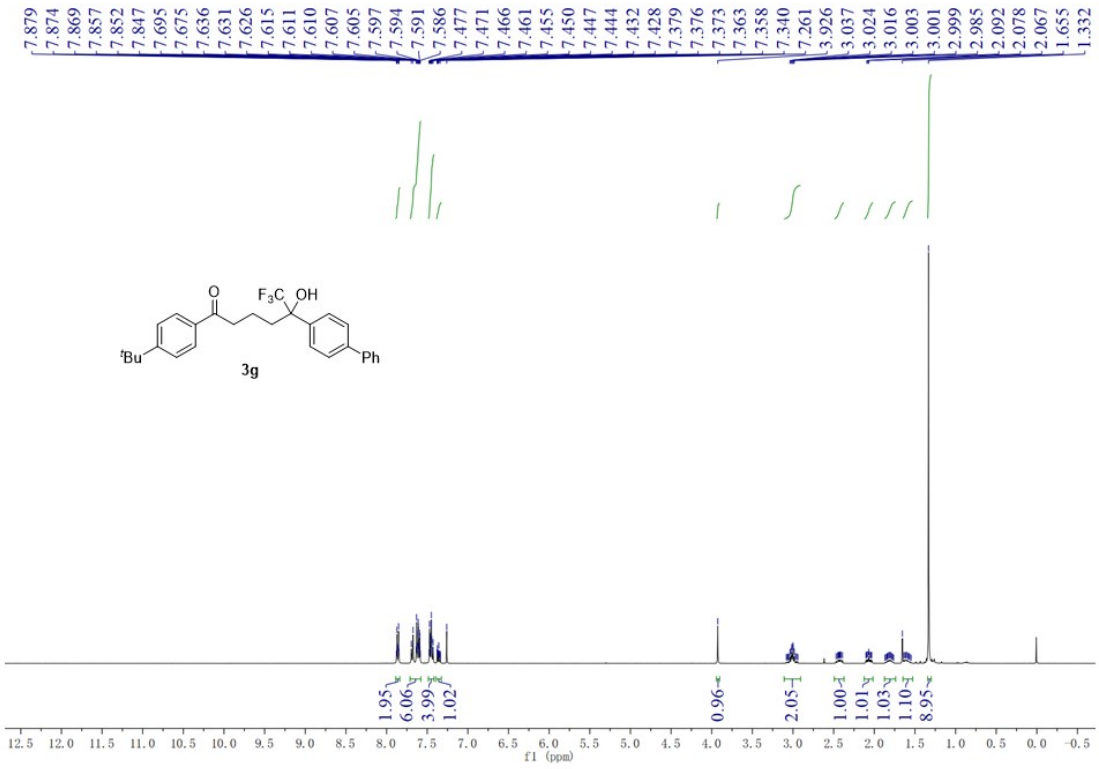
O
F3C
OH
Me
Ph
3f
f1 (ppm)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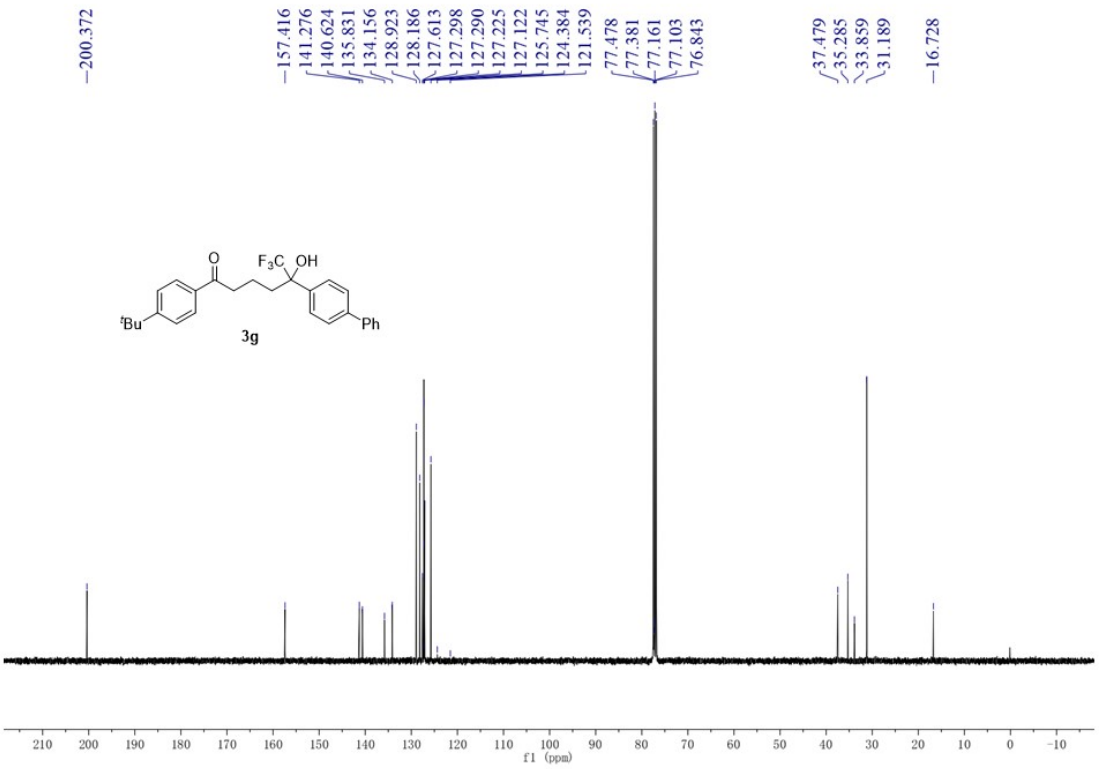
7.695
7.675
7.636
7.631
7.626
7.615
7.611
7.610
7.607
7.605
7.597
7.594
7.591
7.586
7.477
7.471
7.466
7.461
7.455
7.450
7.447
7.444
7.432
7.428
7.379
7.376
7.373
7.363
7.358
7.340
7.261
3.926
3.037
3.024
3.016
3.003
3.001
2.999
2.985
2.092
2.078
2.067
1.655
1.332
O
F3C
OH
tBu
Ph
3g
1.95
6.06
3.99
1.02
0.96
2.05
1.00
1.01
1.03
1.10
8.95
f1 (ppm)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127.298
127.290
127.225
127.122
125.745
124.384
121.539
77.478
77.381
77.161
77.103
76.843
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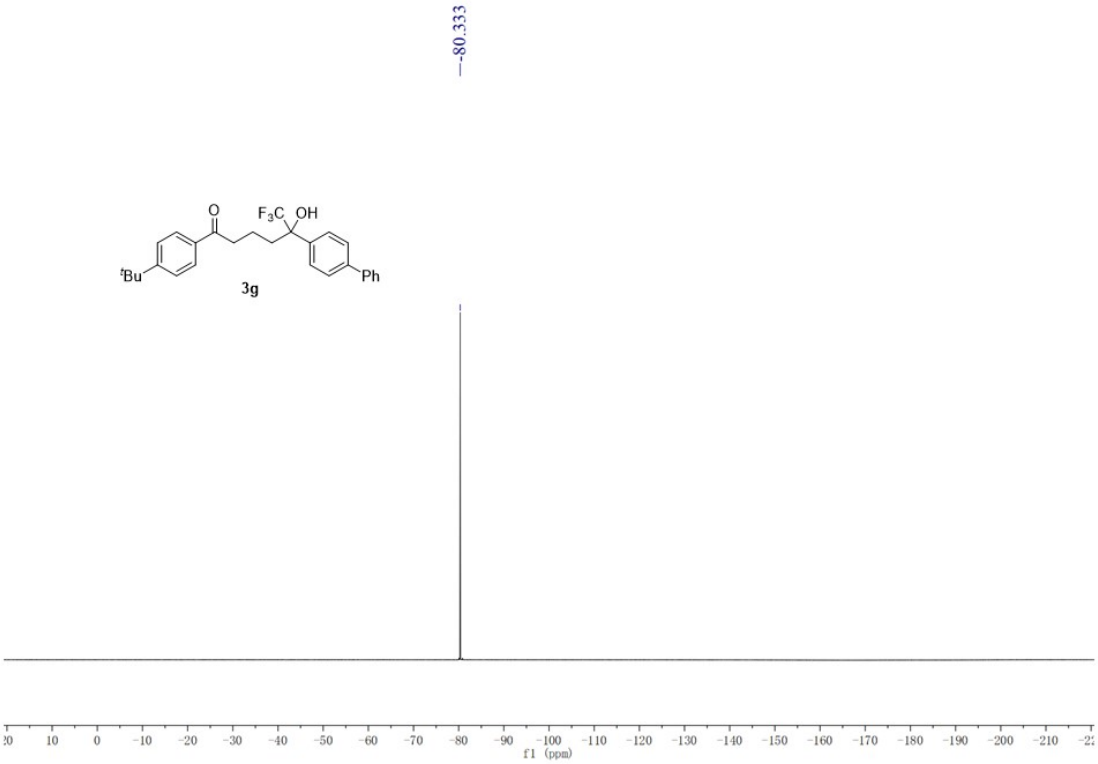
35.285
33.859
31.189
16.728
O
F3C
OH
tBu
Ph
3g
f1 (ppm)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O
F3C
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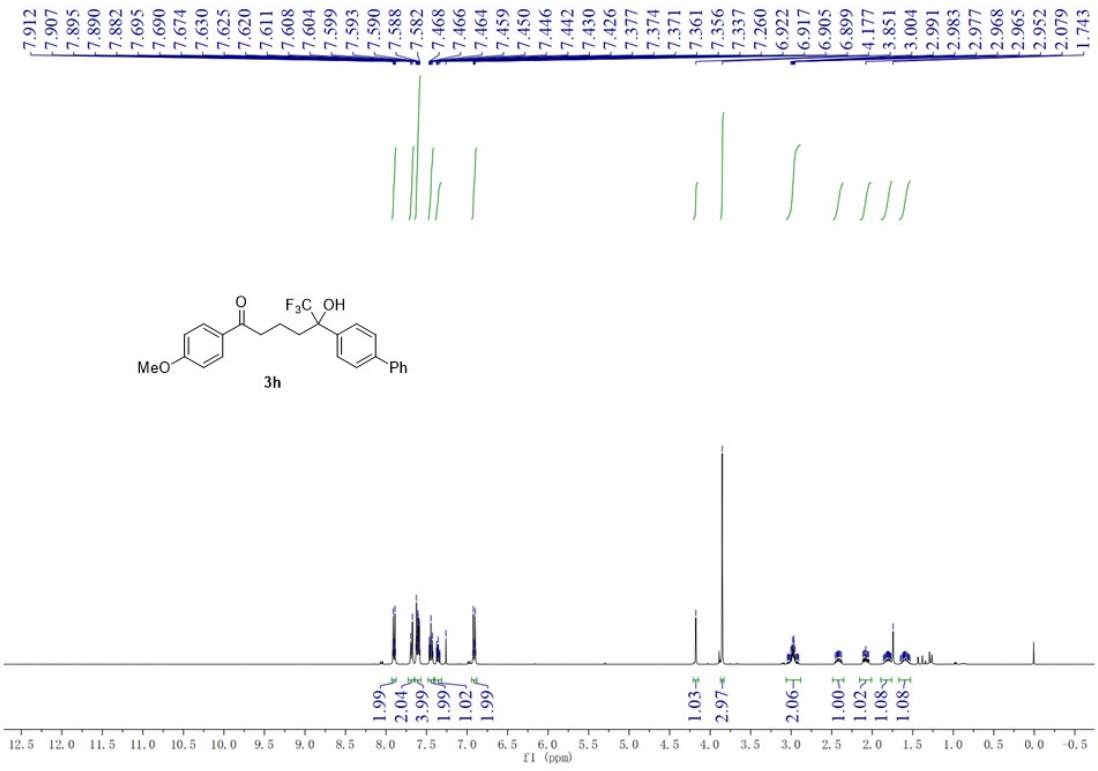
tBu
Ph
3g
f1 (ppm)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7.611
7.608
7.604
7.599
7.593
7.590
7.588
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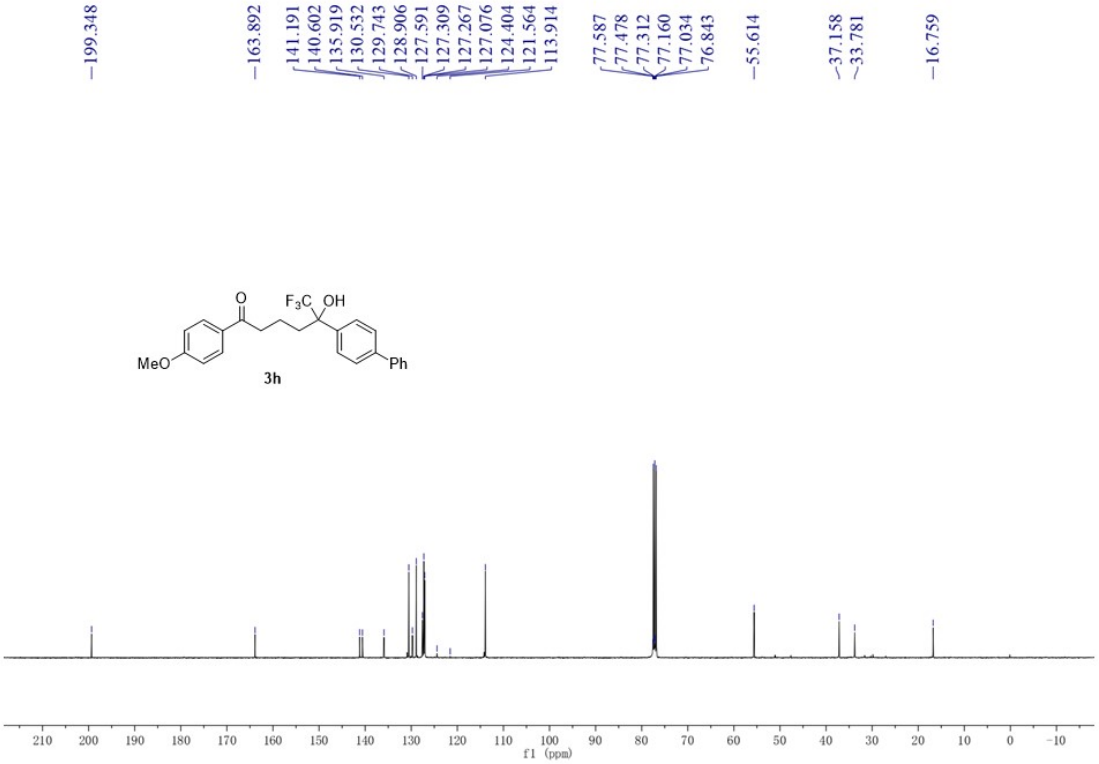
7.468
7.466
7.464
7.459
7.450
7.446
7.442
7.430
7.426
7.377
7.374
7.371
7.361
7.356
7.337
7.260
6.922
6.917
6.905
6.899
4.177
3.851
3.004
2.991
2.983
2.977
2.968
2.965
2.952
2.079
1.743
O
F3C
OH
MeO
Ph
3h
1.99
2.04
3.99
1.99
1.02
1.99
1.03
2.97
2.06
1.00
1.02
1.08
1.08
f1 (ppm)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130.532
129.743
128.906
127.591
127.309
127.267
127.076
124.404
121.564
113.914
77.587
77.478
77.312
77.160
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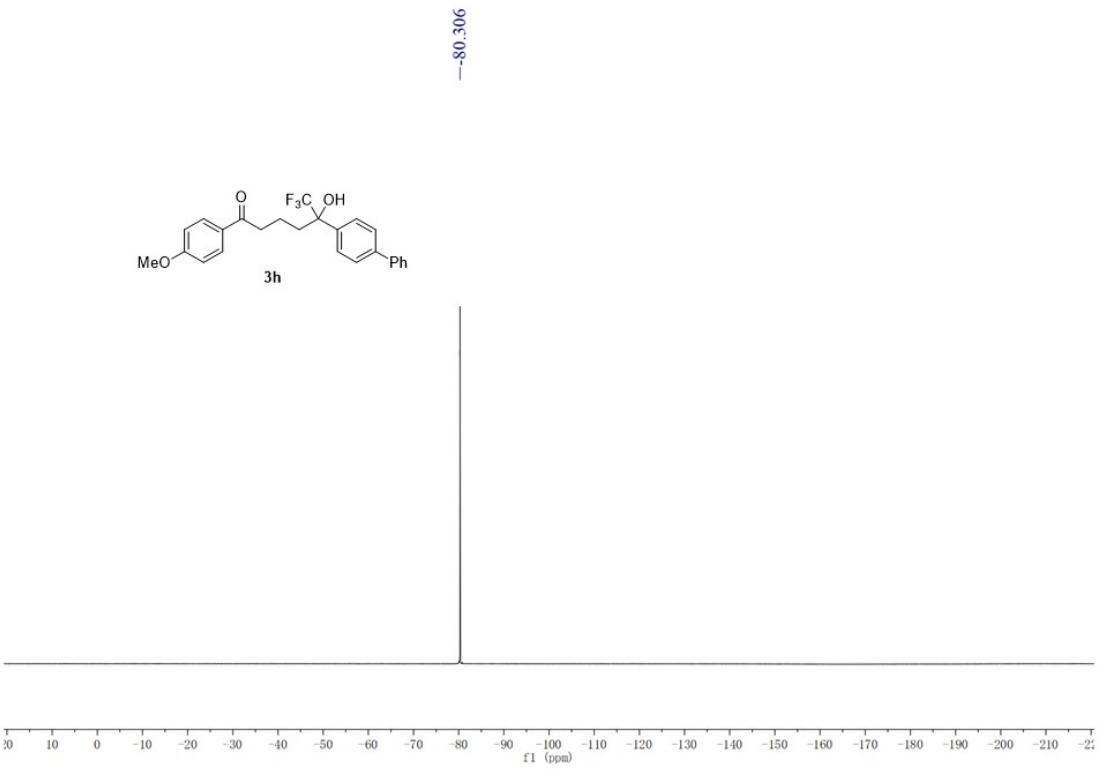
55.614
37.158
33.781
16.759
O
F3C
OH
MeO
Ph
3h
f1 (ppm)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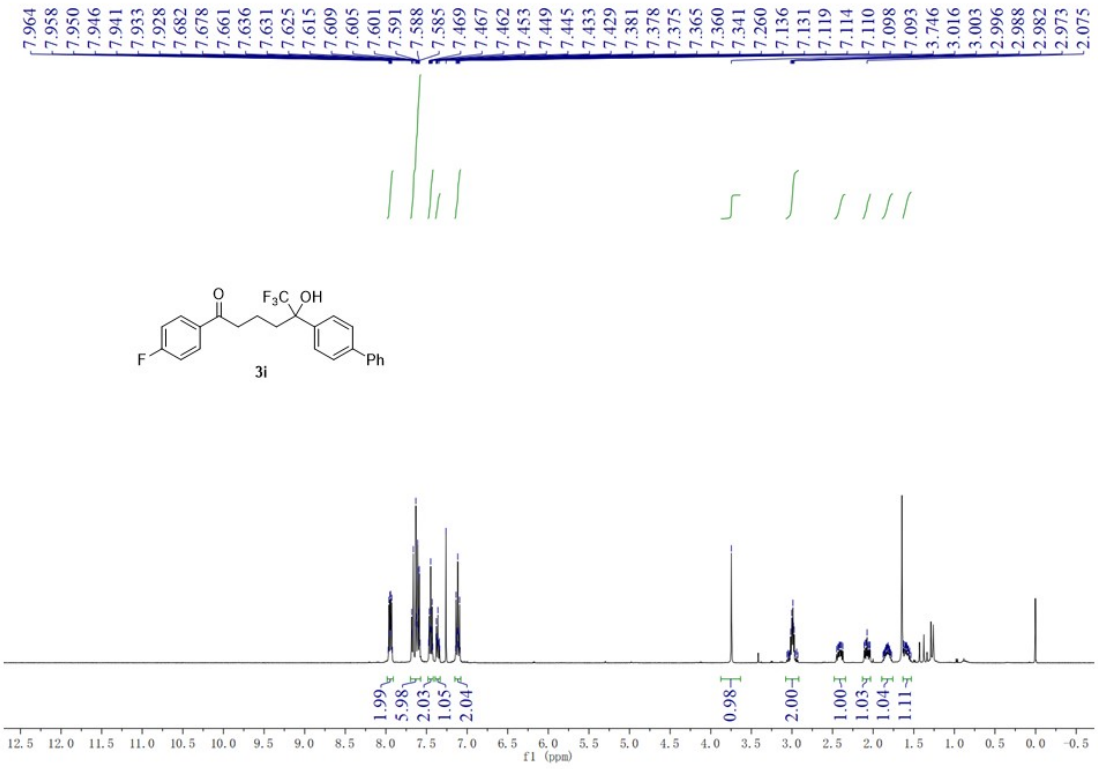
MeO
Ph
3h
f1 (ppm)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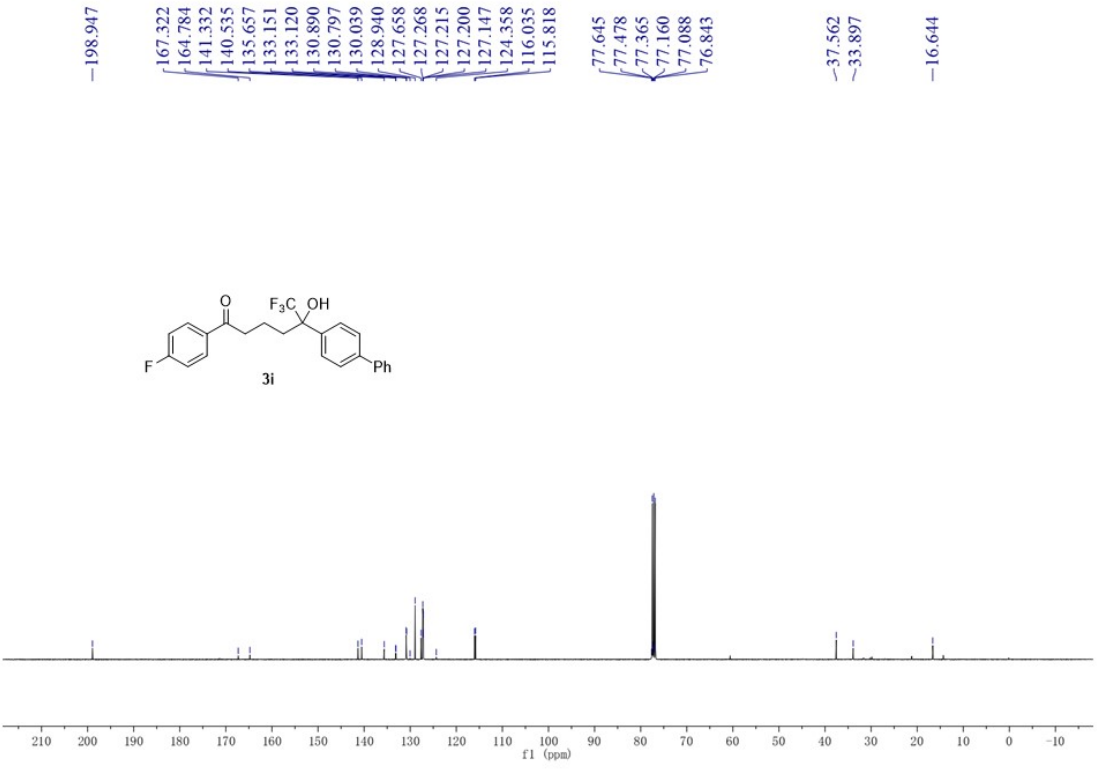
7.636
7.631
7.625
7.615
7.609
7.605
7.601
7.591
7.588
7.585
7.469
7.467
7.462
7.453
7.449
7.445
7.433
7.429
7.381
7.378
7.375
7.365
7.360
7.341
7.260
7.136
7.131
7.119
7.114
7.110
7.098
7.093
3.746
3.016
3.003
2.996
2.988
2.982
2.973
2.075
O
F3C
OH
F
Ph
3i
1.99
5.98
2.03
1.05
2.04
0.98
2.00
1.00
1.03
1.04
1.11
f1 (ppm)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133.120
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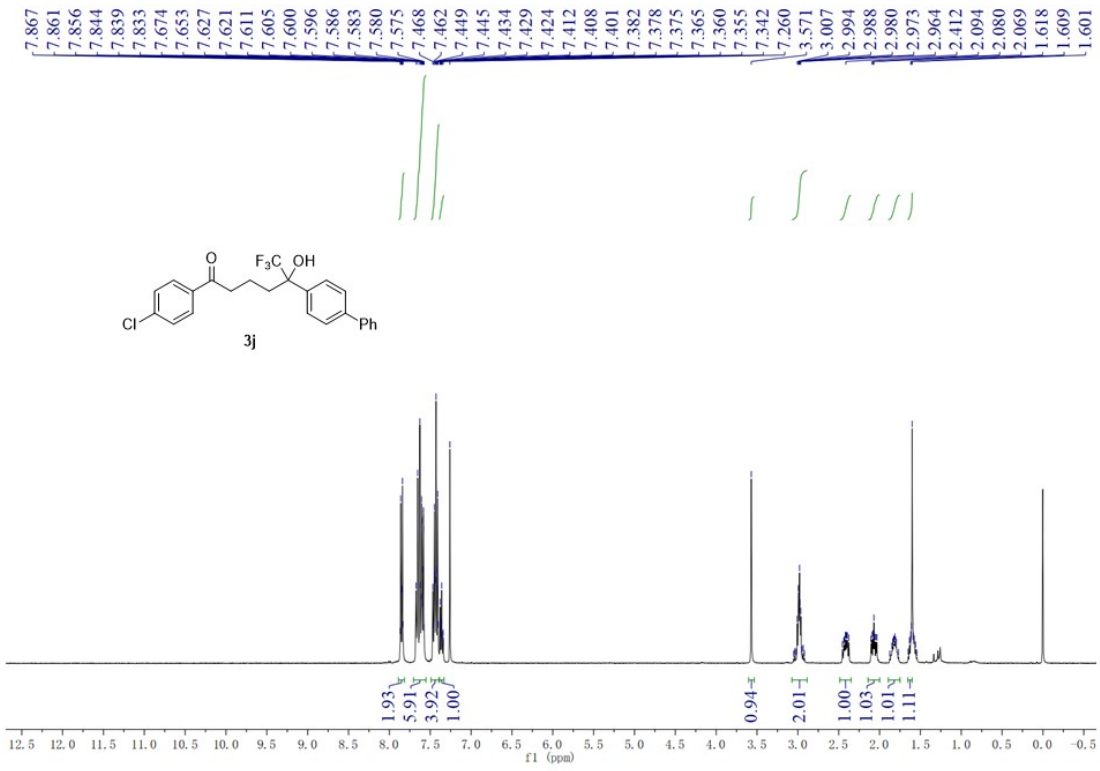
130.797
130.039
128.940
127.658
127.268
127.215
127.200
127.147
124.358
116.035
115.818
77.645
77.478
77.365
77.160
77.088
76.843
37.562
33.897
16.644
O
F3C
OH
F
Ph
3i
f1 (ppm)


-80.312
-104.519
O
F3C
OH
F
Ph
3i
f1 (ppm)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7.674
7.653
7.627
7.621
7.611
7.605
7.600
7.596
7.586
7.583
7.580
7.575
7.468
7.462
7.449
7.445
7.434
7.429
7.424
7.412
7.408
7.401
7.382
7.378
7.375
7.365
7.360
7.355
7.342
7.260
3.571
3.007
2.994
2.988
2.980
2.973
2.964
2.412
2.094
2.080
2.069
1.618
1.609
1.601
O
F3C
OH
Cl
Ph
3j
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3.92
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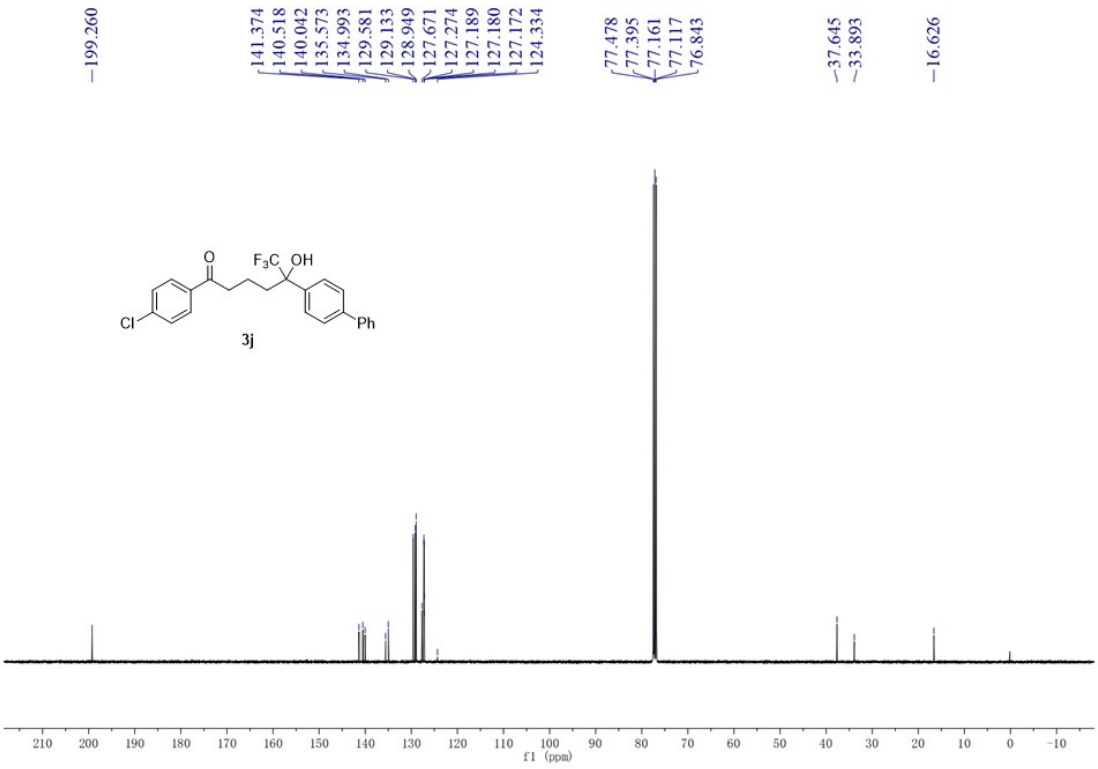
0.94
2.01
1.00
1.03
1.01
1.11
f1 (ppm)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135.573
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129.581
129.133
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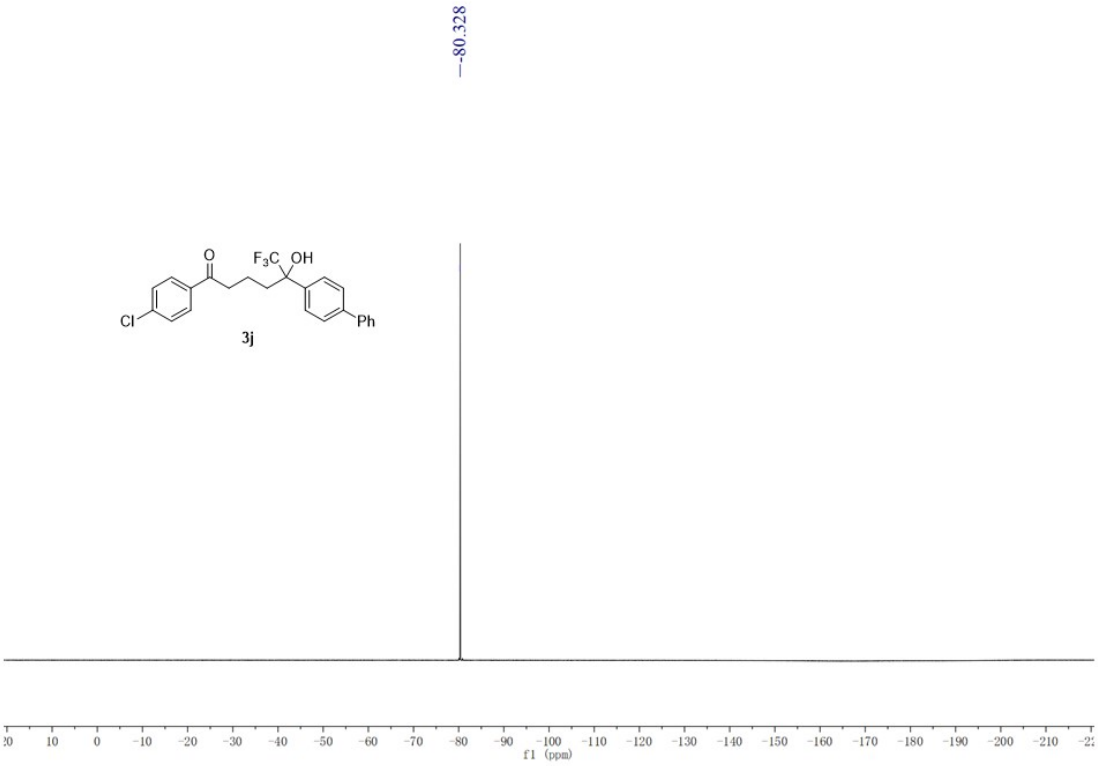
127.189
127.180
127.172
124.334
77.478
77.395
77.161
77.117
76.843
37.645
33.893
16.626
O
F3C
OH
Cl
Ph
3j
f1 (ppm)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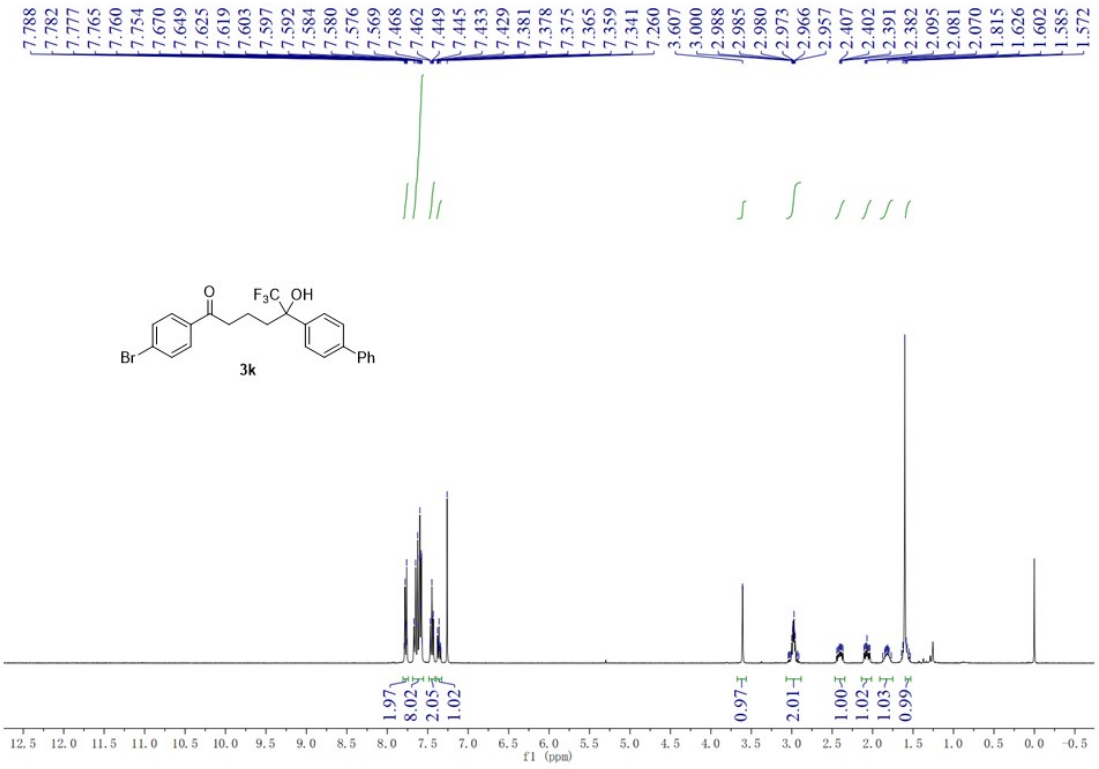
F3C
OH
Cl
Ph
3j
f1 (ppm)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7.670
7.649
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7.619
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7.592
7.584
7.580
7.576
7.569
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7.462
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7.445
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7.378
7.375
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7.359
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7.260
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3.000
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2.973
2.966
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2.407
2.402
2.391
2.382
2.095
2.081
2.070
1.815
1.626
1.602
1.585
1.572
O
F3C
OH
Br
Ph
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0.97
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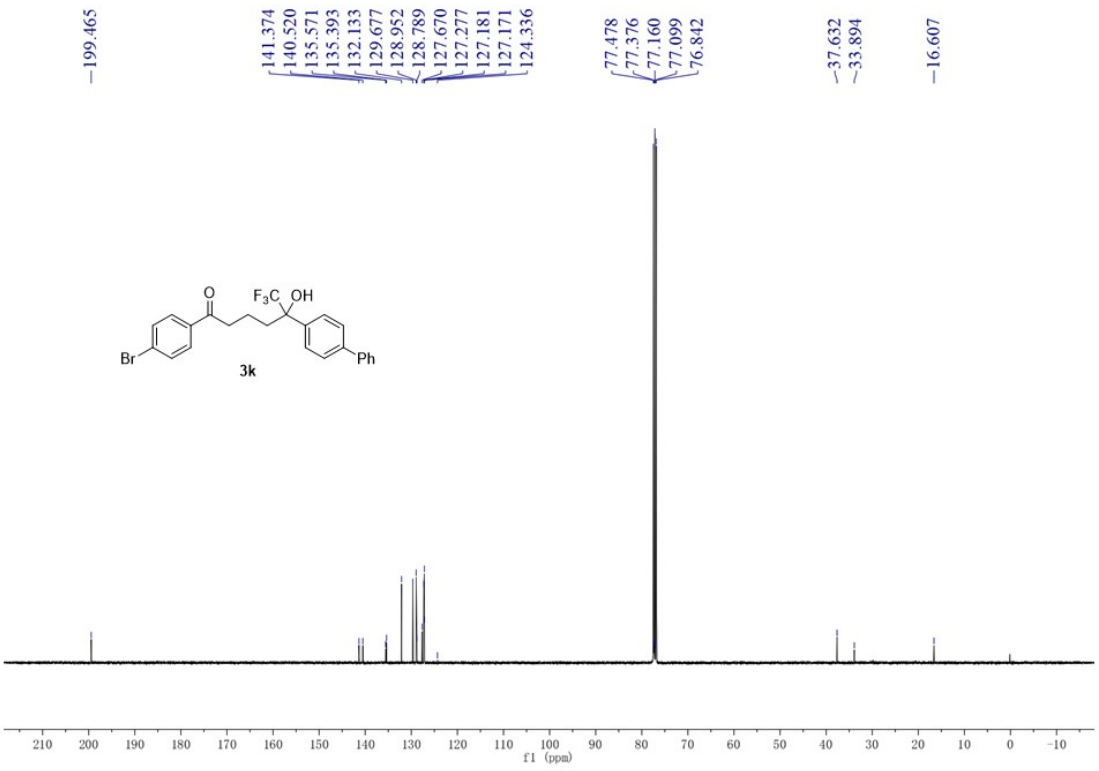
1.02
1.03
0.99
f1 (ppm)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127.171
124.336
77.478
77.376
77.160
77.099
76.842
37.632
33.894
16.607
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OH
Br
Ph
3k
f1 (ppm)


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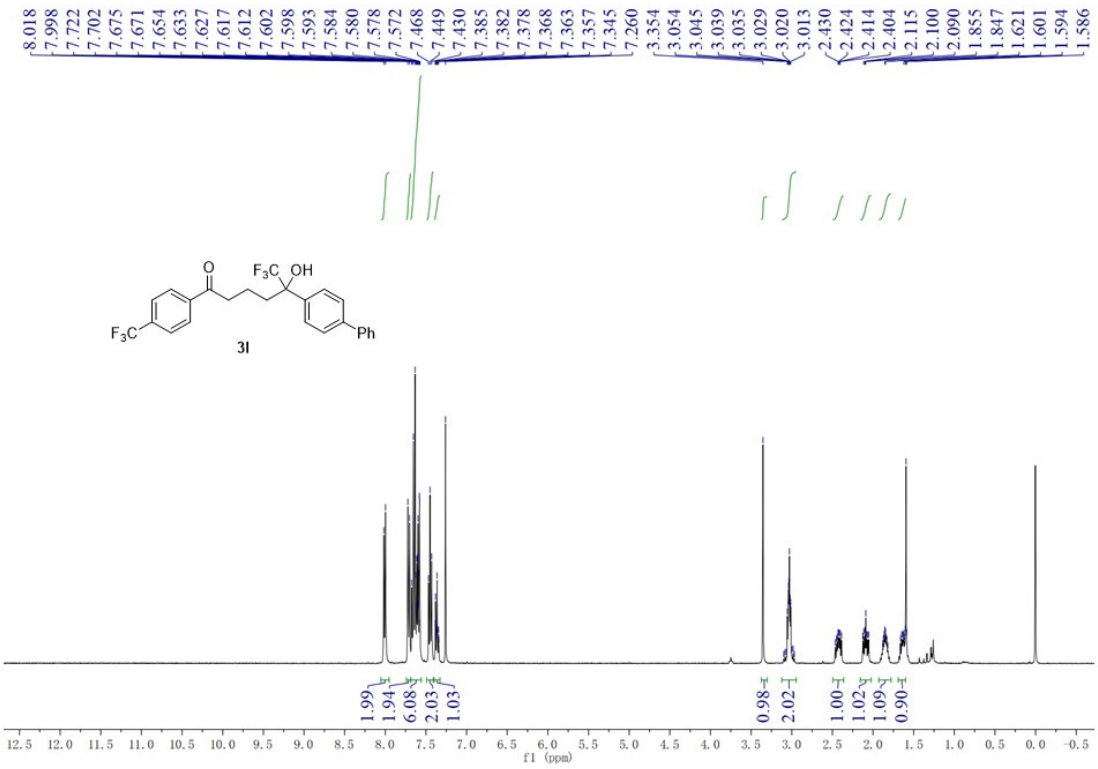
O
F3C
OH
Br
Ph
3k
f1 (ppm)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7.578
7.572
7.468
7.449
7.430
7.385
7.382
7.378
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7.363
7.357
7.345
7.260
3.354
3.054
3.045
3.039
3.035
3.029
3.020
3.013
2.430
2.424
2.414
2.404
2.115
2.100
2.090
1.855
1.847
1.621
1.601
1.594
1.586
O
F3C
OH
F3C
Ph
3l
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1.02
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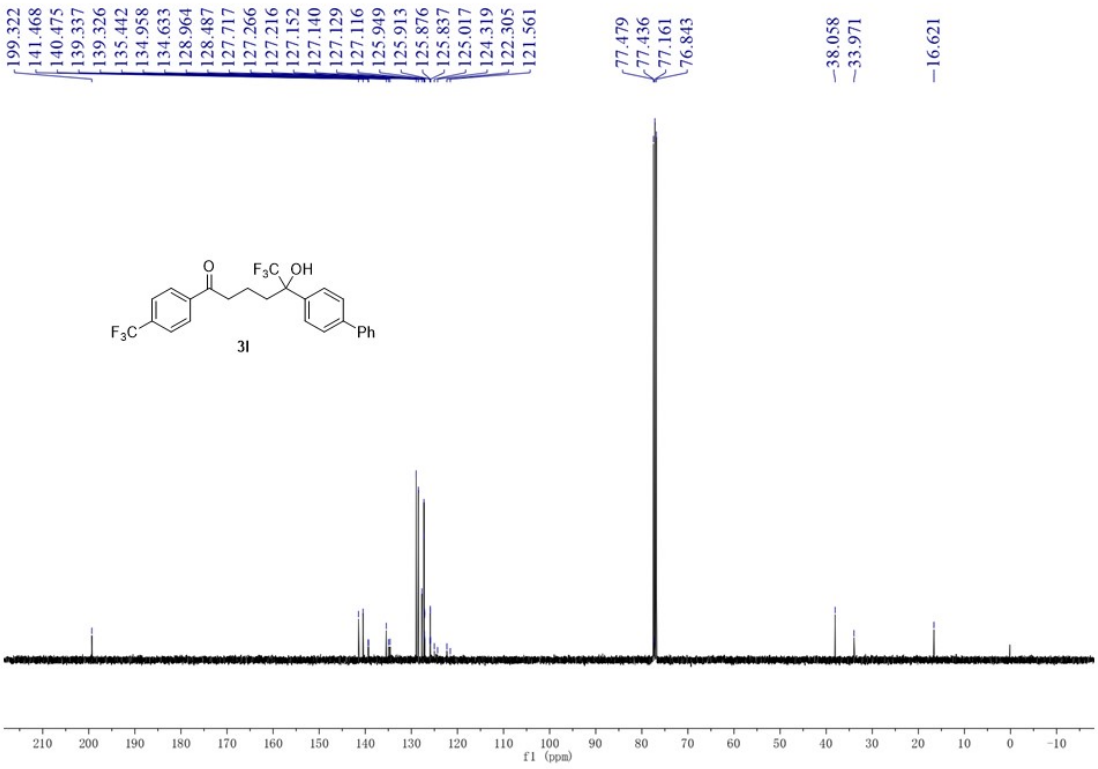
0.90
f1 (ppm)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125.913
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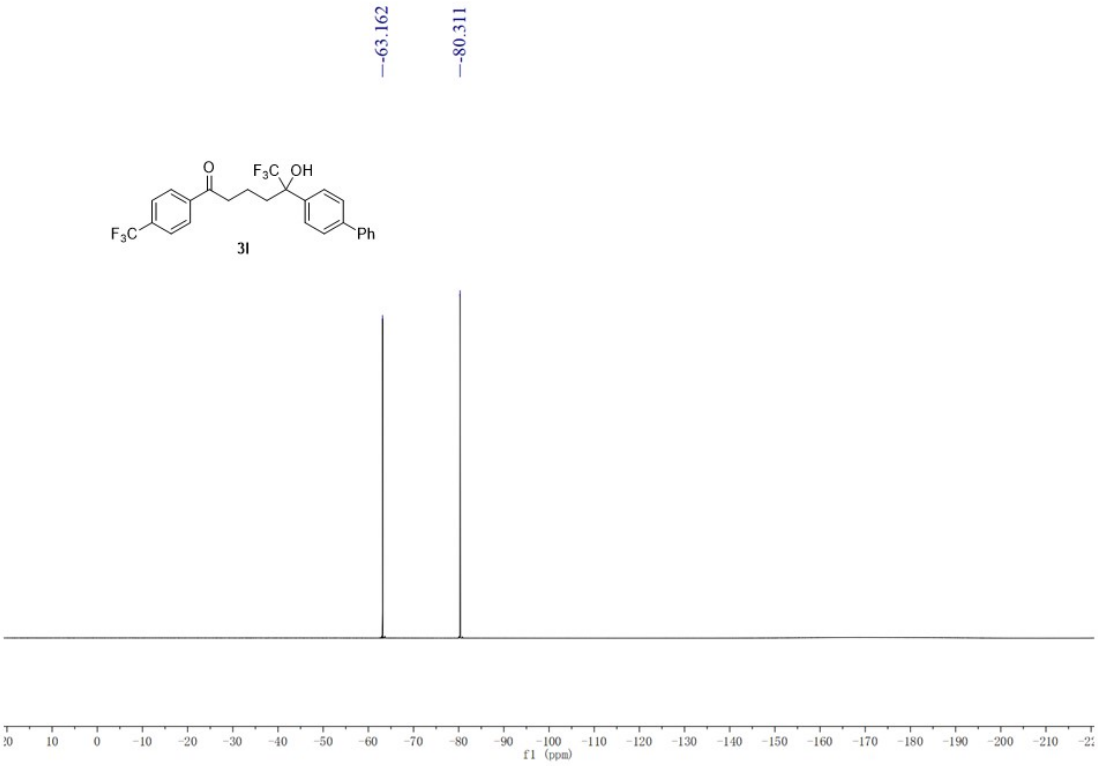
F3C
OH
F3C
Ph
3l
f1 (ppm)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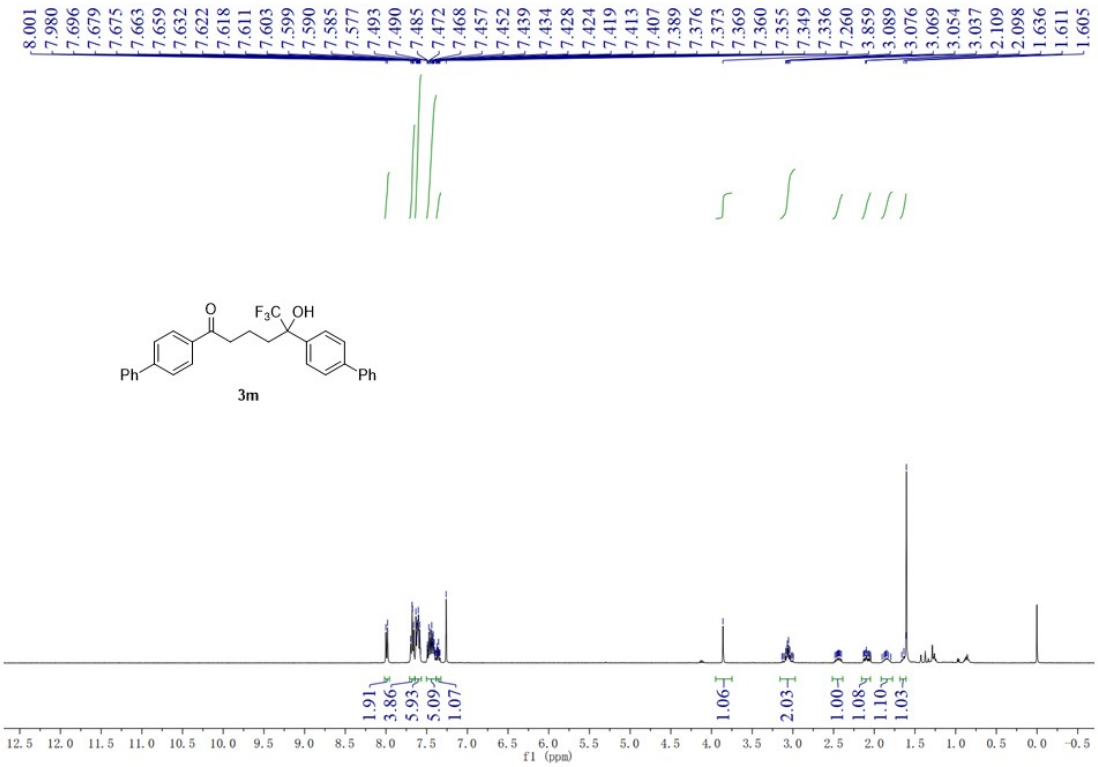
3l
f1 (ppm)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7.585
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7.490
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7.260
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3.089
3.076
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3.037
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2.098
1.636
1.611
1.605
O
F3C
OH
Ph
Ph
3m
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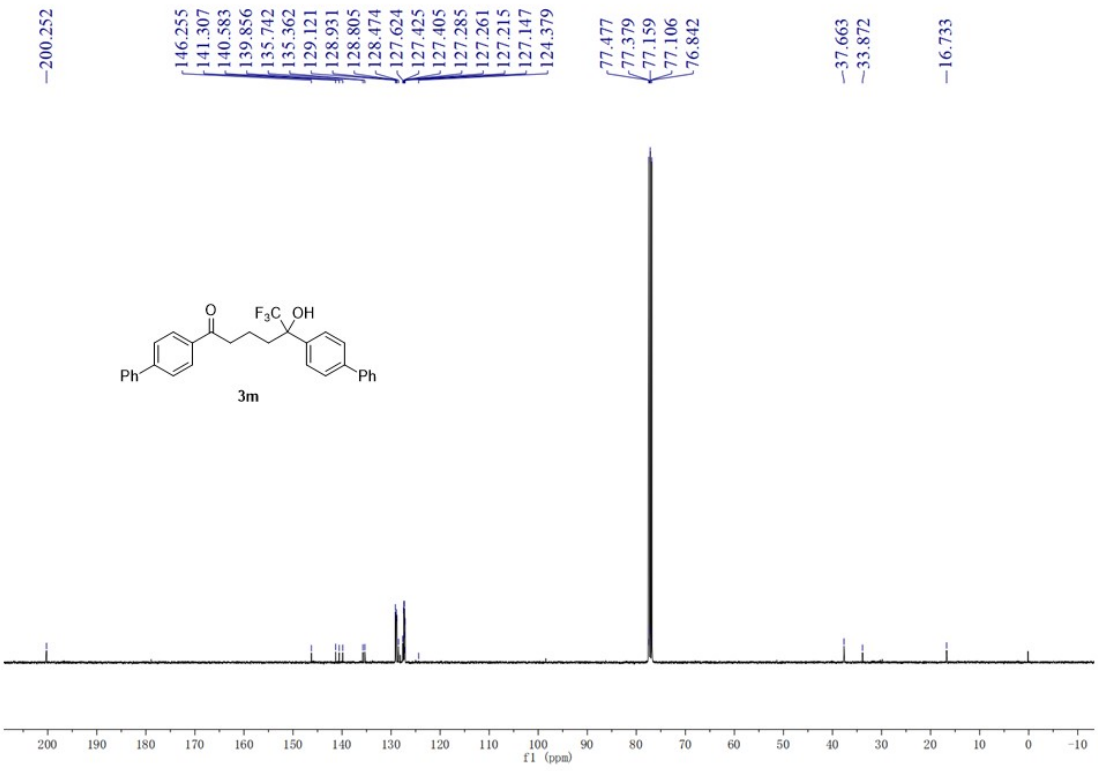
1.03
f1 (ppm)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127.147
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77.379
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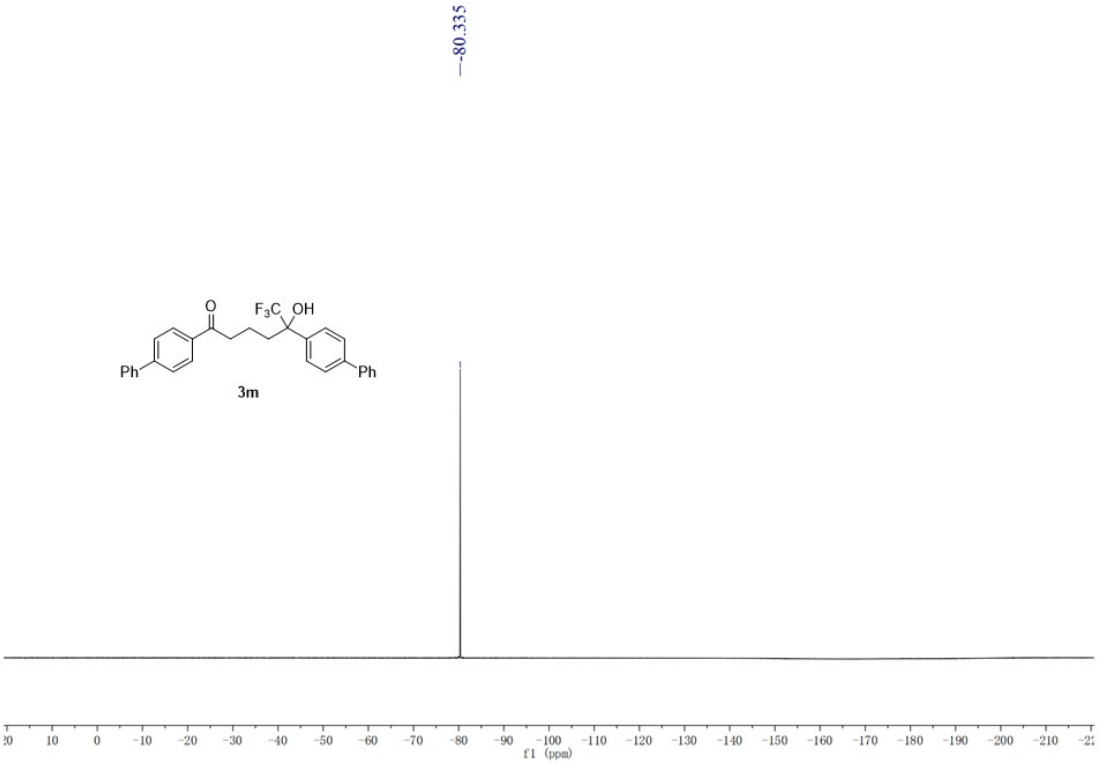
O
F3C
OH
Ph
Ph
3m
f1 (ppm)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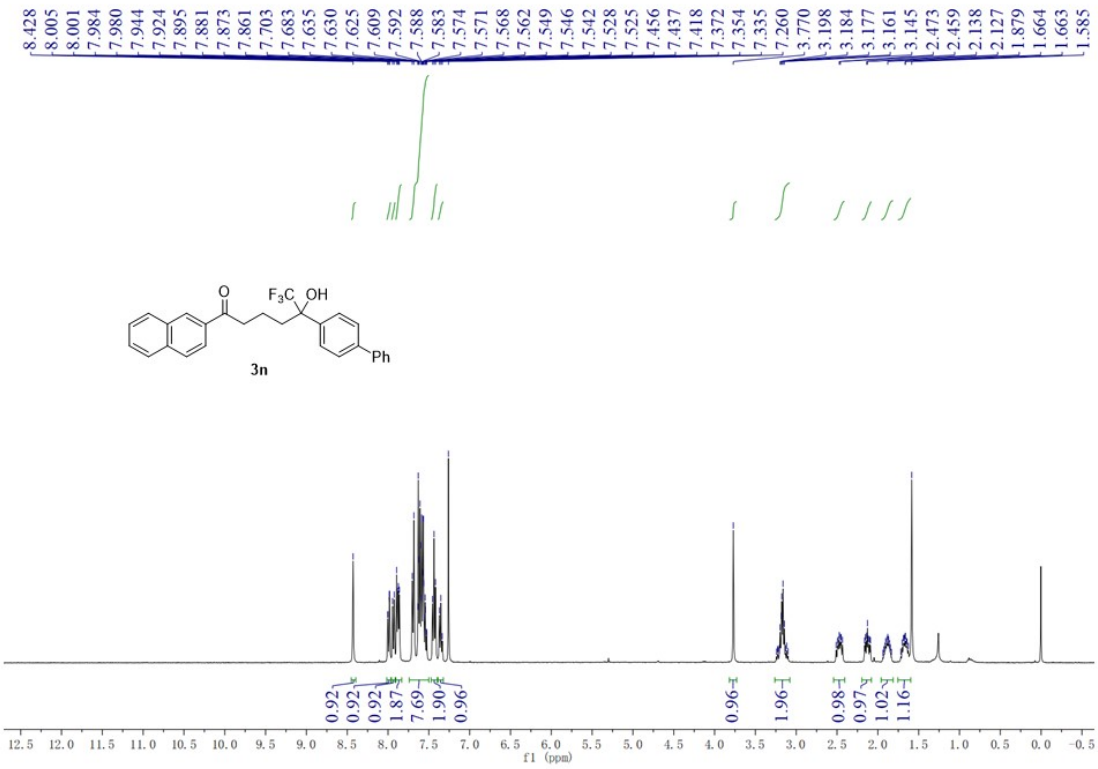
O
F3C
OH
Ph
Ph
3m
f1 (ppm)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8.001
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7.895
7.881
7.873
7.861
7.703
7.683
7.635
7.630
7.625
7.609
7.592
7.588
7.583
7.574
7.571
7.568
7.562
7.549
7.546
7.542
7.528
7.525
7.456
7.437
7.418
7.372
7.354
7.335
7.260
3.770
3.198
3.184
3.177
3.161
3.145
2.473
2.459
2.138
2.127
1.879
1.664
1.663
1.585
O
F3C
OH
Ph
3n
0.92
0.92
0.92
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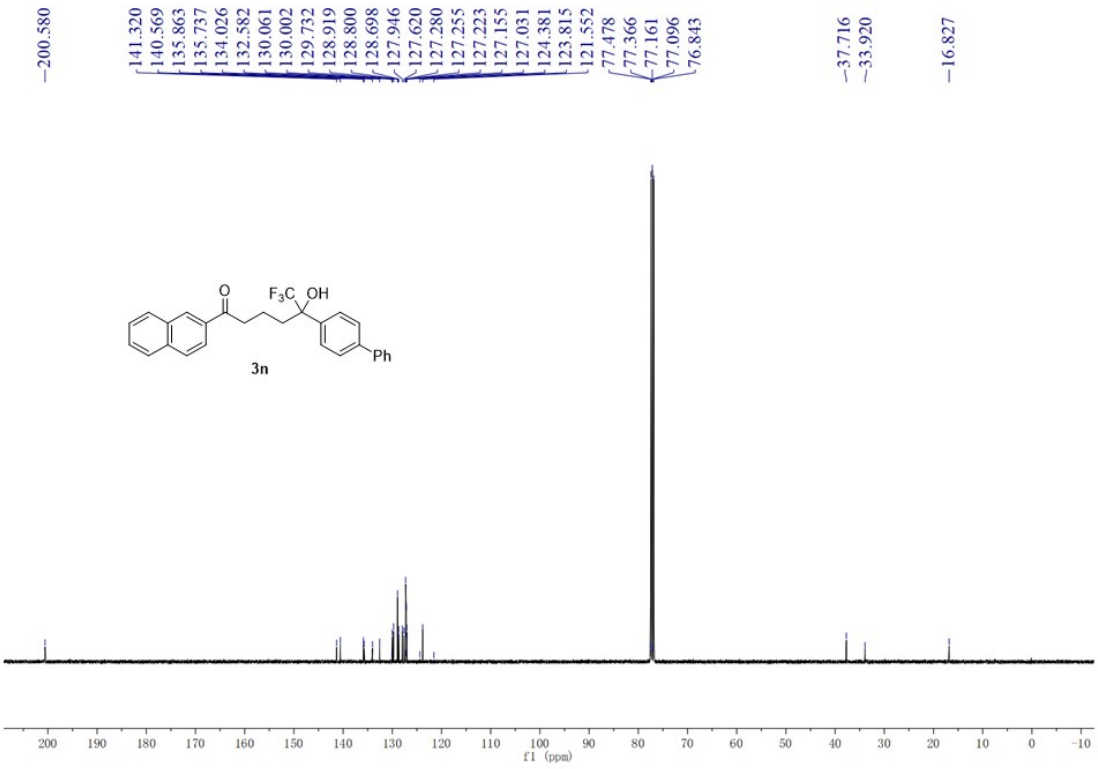
1.90
0.96
0.96
1.96
0.98
0.97
1.02
1.16
f1 (ppm)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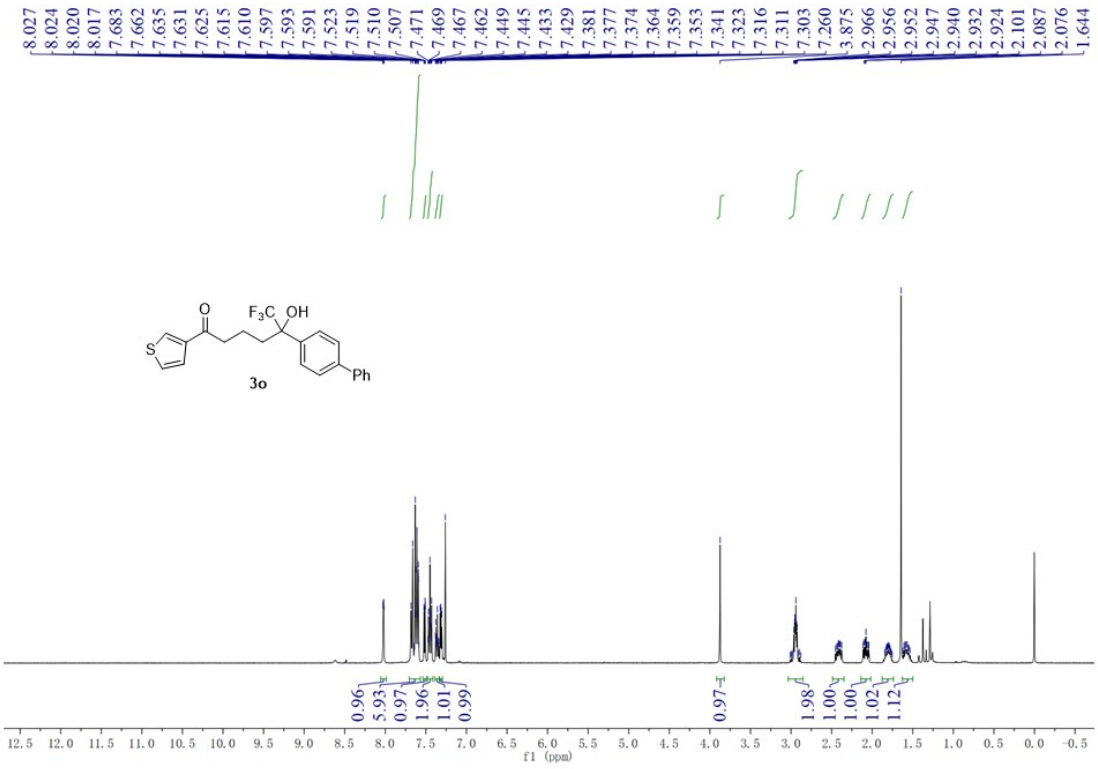
127.946
127.620
127.280
127.255
127.223
127.155
127.031
124.381
123.815
121.552
77.478
77.366
77.161
77.096
76.843
37.716
33.920
16.827
O
F3C
OH
Ph
3n
f1 (ppm)


80.302
O
F3C
OH
Ph
3n
f1 (ppm)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8.024
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7.597
7.593
7.591
7.523
7.519
7.510
7.507
7.471
7.469
7.467
7.462
7.449
7.445
7.433
7.429
7.381
7.377
7.374
7.364
7.359
7.353
7.341
7.323
7.316
7.311
7.303
7.260
3.875
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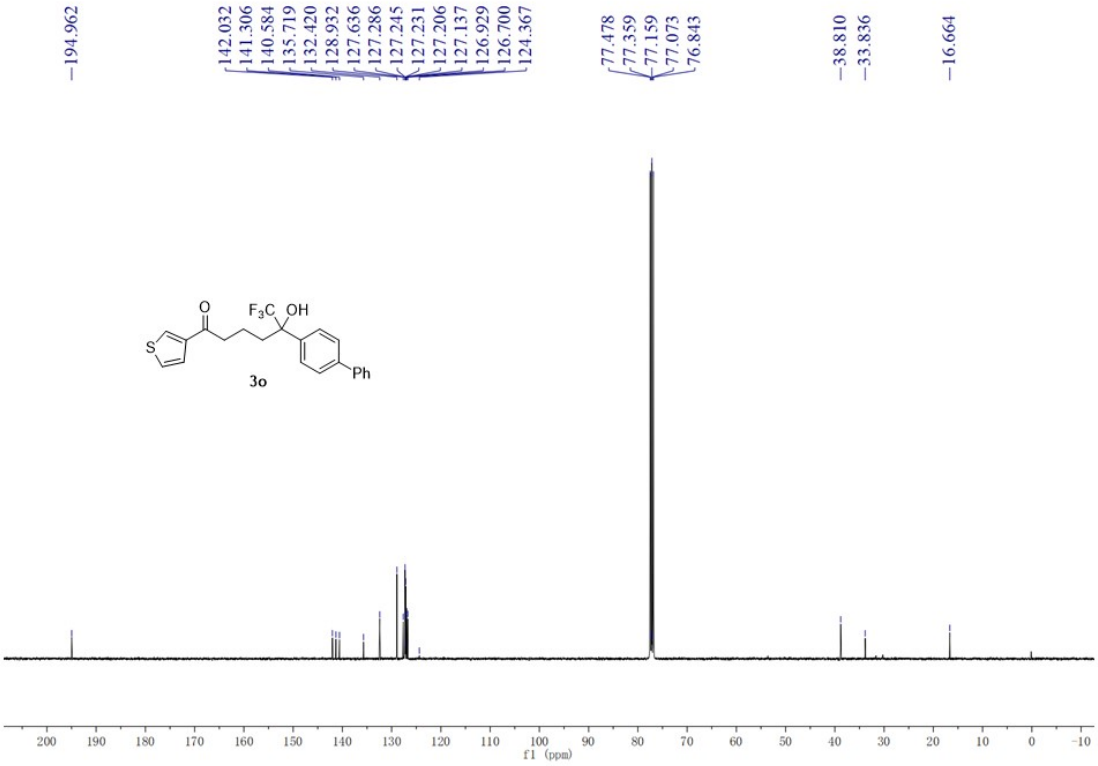
2.956
2.952
2.947
2.940
2.932
2.924
2.101
2.087
2.076
1.644
O
F3C
OH
S
Ph
3o
0.96
5.93
0.97
1.96
1.01
0.99
0.97
1.98
1.00
1.00
1.02
1.12
f1 (ppm)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127.206
127.137
126.929
126.700
124.367
77.478
77.359
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38.810
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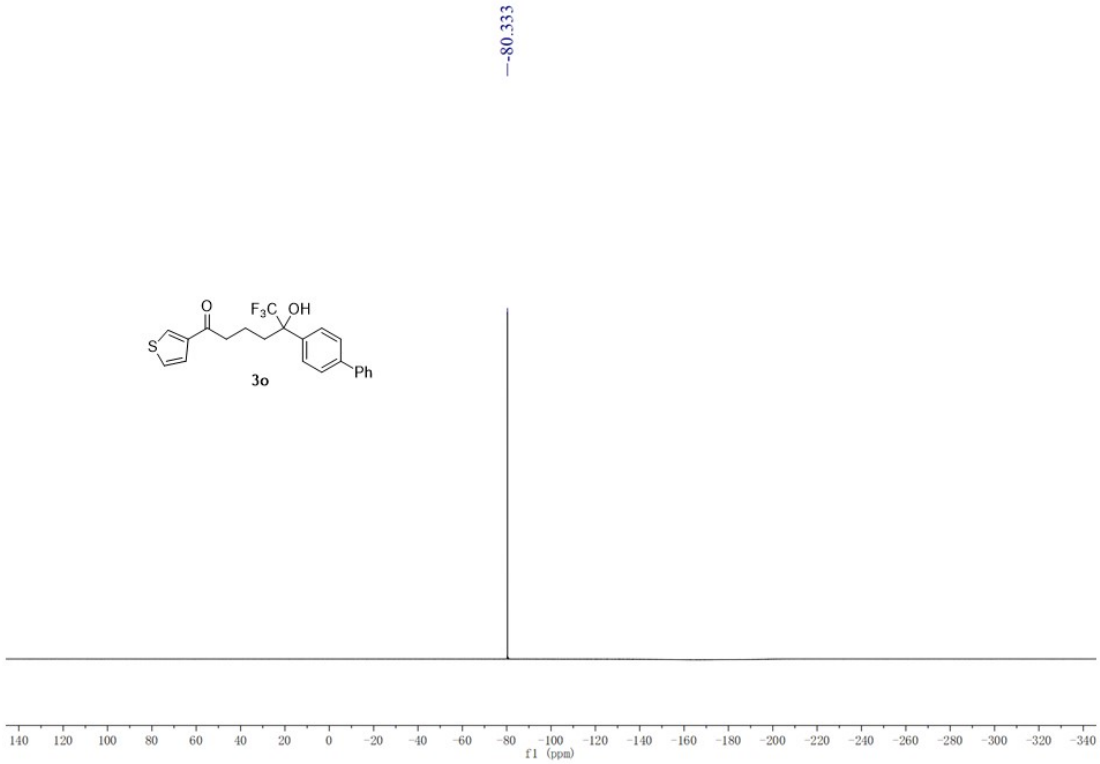
O
F3C
OH
S
Ph
3o
f1 (ppm)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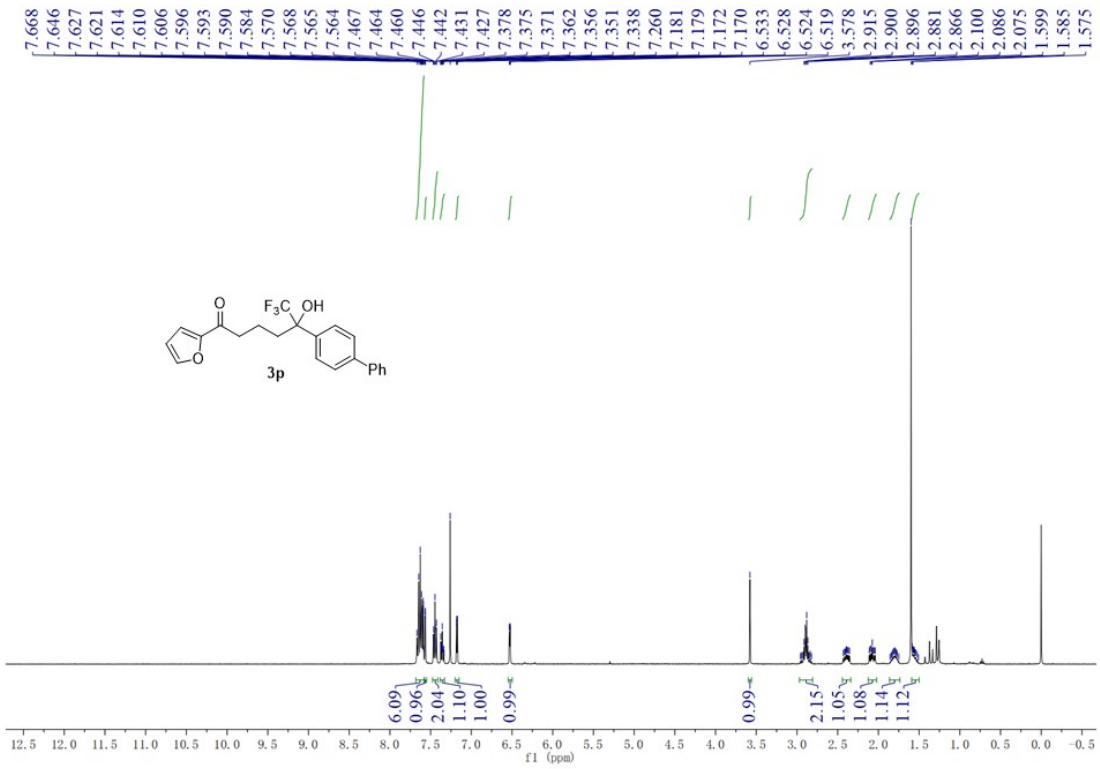
O
F3C
OH
S
Ph
3o
140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -120 -140 -160 -180 -200 -220 -240 -260 -280 -300 -320 -340
f1 (ppm)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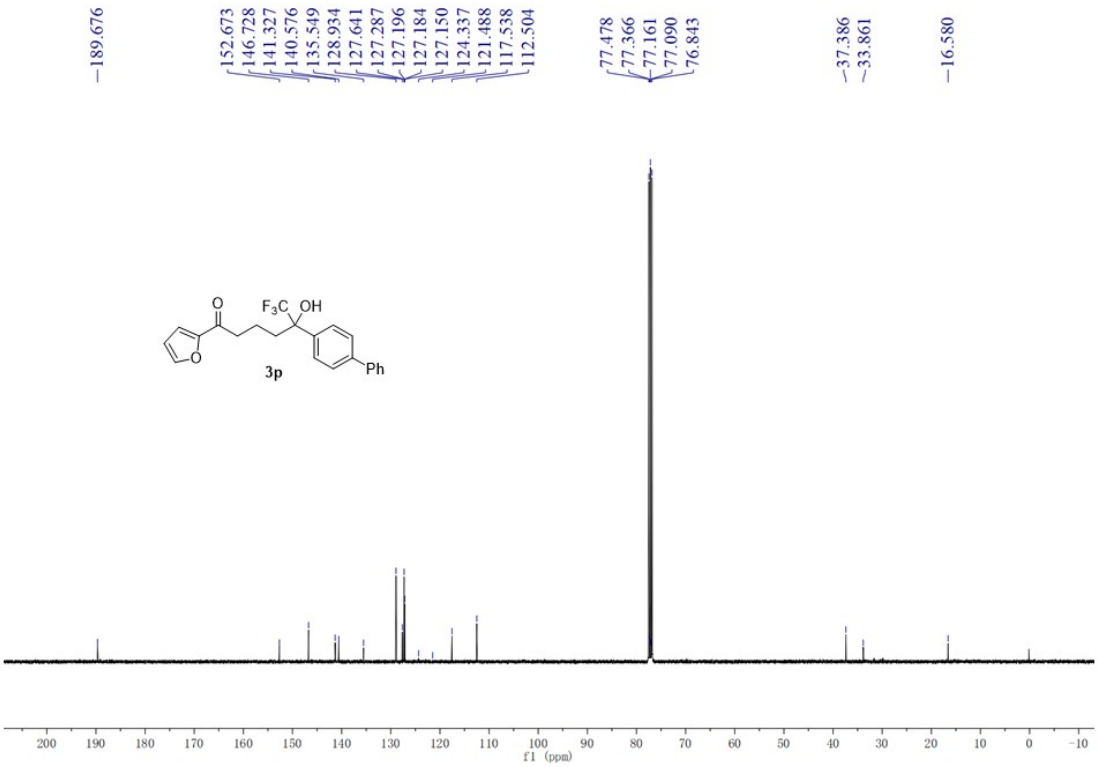
7.570
7.568
7.565
7.564
7.467
7.464
7.460
7.446
7.442
7.431
7.427
7.378
7.375
7.371
7.362
7.356
7.351
7.338
7.260
7.181
7.179
7.172
7.170
6.533
6.528
6.524
6.519
3.578
2.915
2.900
2.896
2.881
2.866
2.100
2.086
2.075
1.599
1.585
1.575
O
F3C
OH
O
Ph
3p
6.09
0.96
2.04
1.10
1.00
0.99
0.99
2.15
1.05
1.08
1.14
1.12
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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127.150
124.337
121.488
117.538
112.504
77.478
77.366
77.161
77.090
76.843
37.386
33.861
16.580
O
F3C
OH
O
Ph
3p
f1 (ppm)


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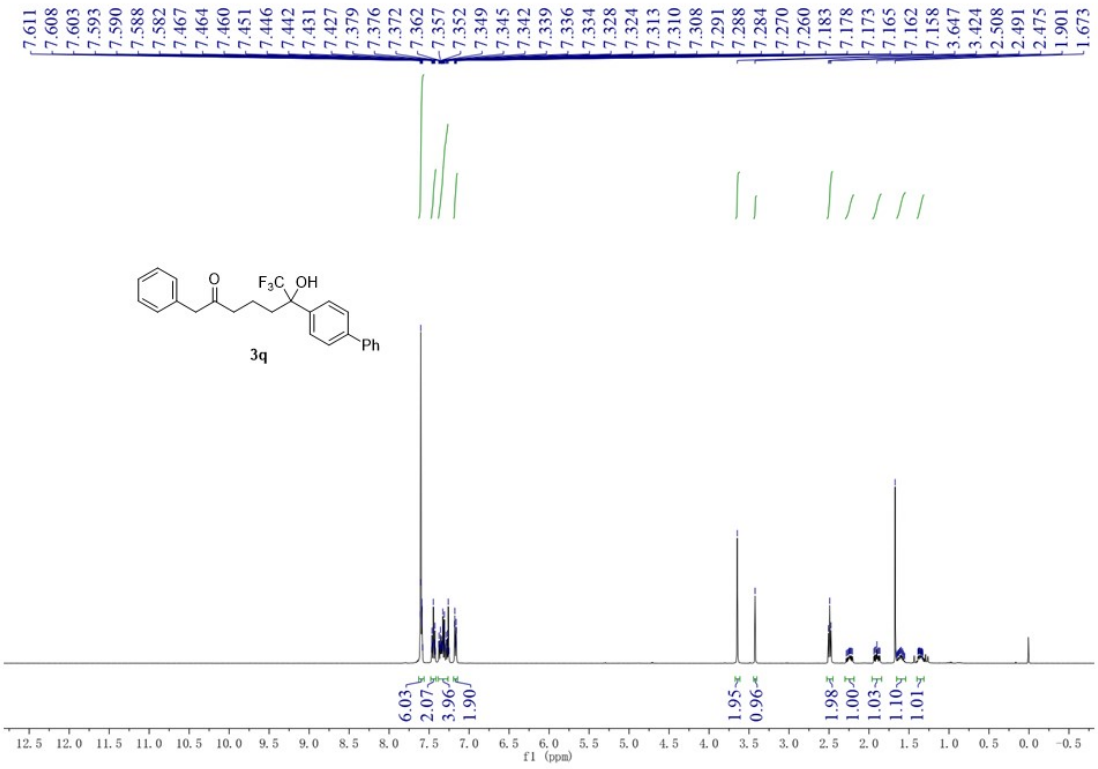
F3C
OH
O
Ph
3p
f1 (ppm)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7.588
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7.467
7.464
7.460
7.451
7.446
7.442
7.431
7.427
7.379
7.376
7.372
7.362
7.357
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7.345
7.342
7.339
7.336
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7.324
7.313
7.310
7.308
7.291
7.288
7.284
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7.260
7.183
7.178
7.173
7.165
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7.158
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3.424
2.508
2.491
2.475
1.901
1.673
O
F3C
OH
Ph
3q
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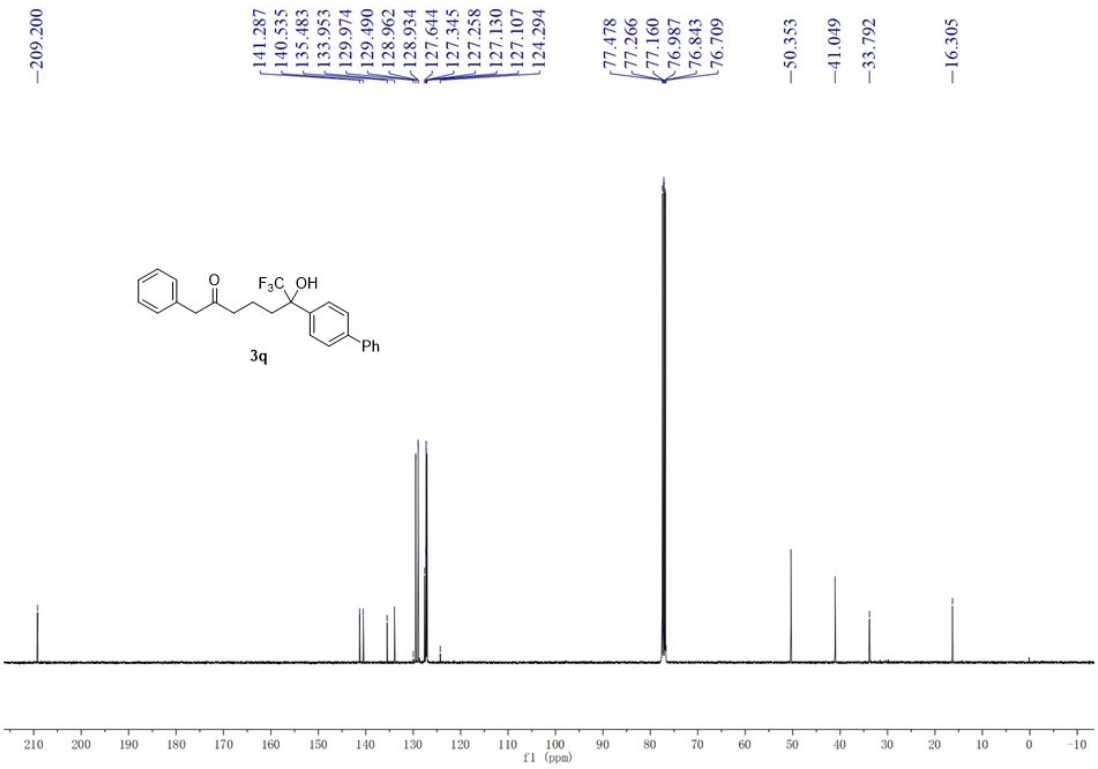
1.03
1.10
1.01
f1 (ppm)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124.294
77.478
77.266
77.160
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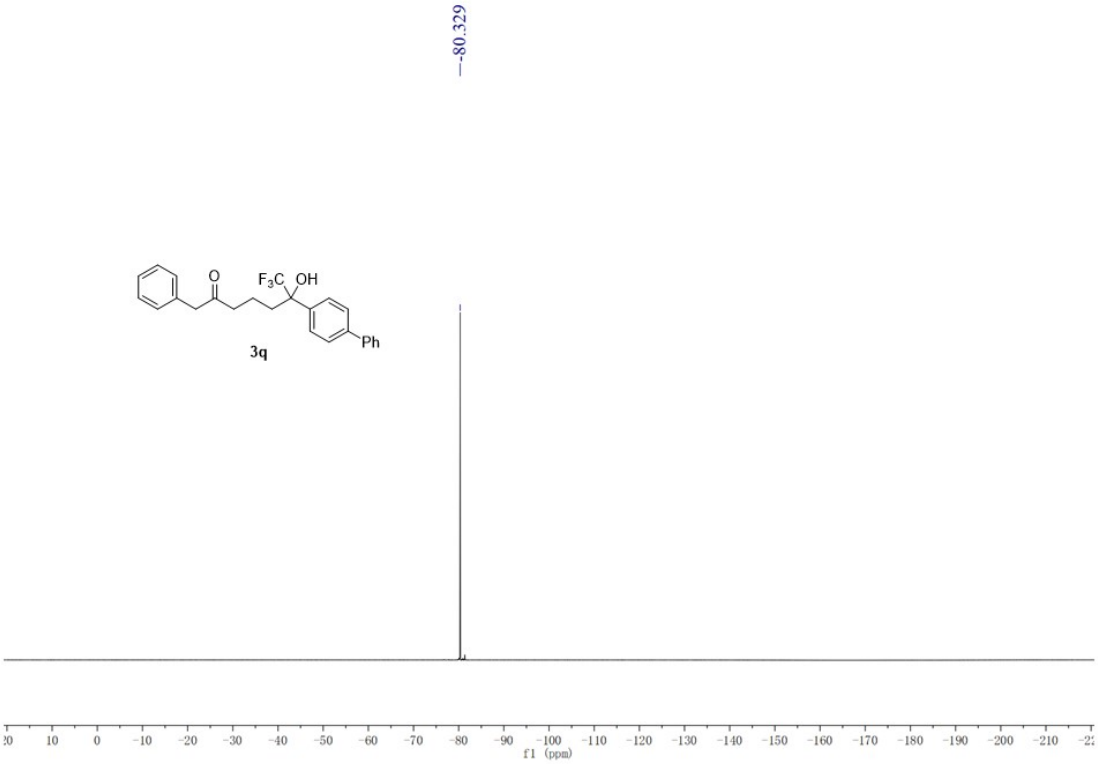
76.709
50.353
41.049
33.792
16.305
O
F3C
OH
Ph
3q
f1 (ppm)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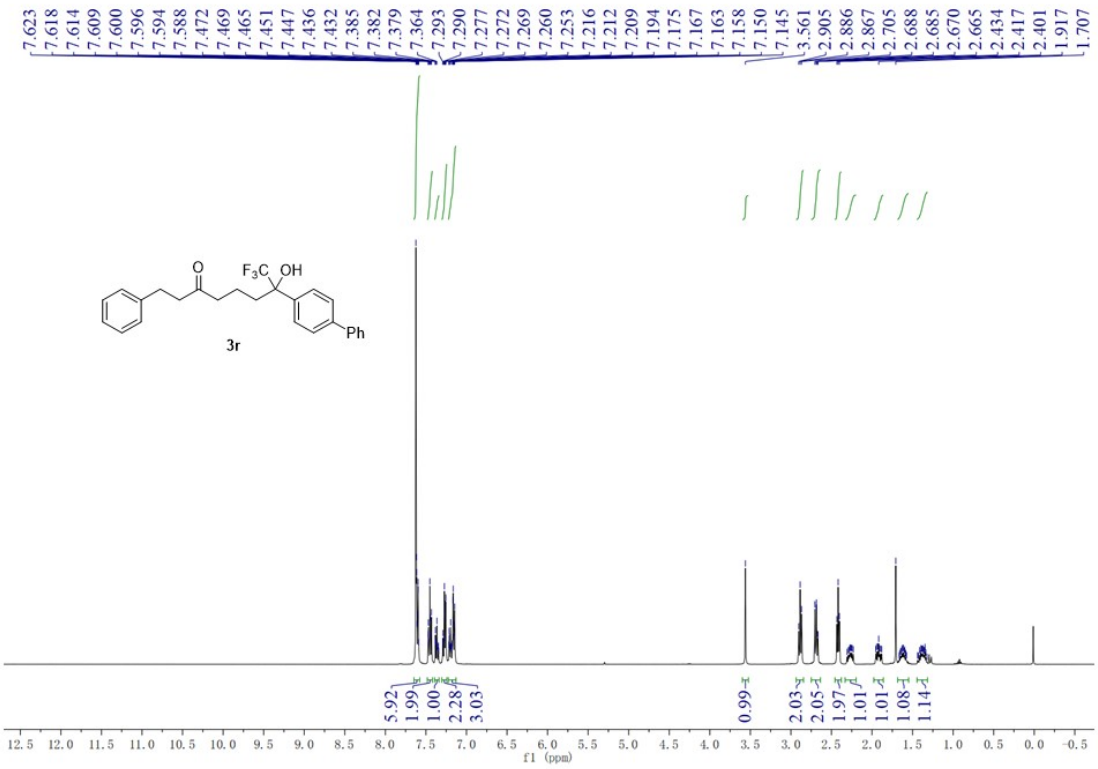
F3C
OH
Ph
3q
f1 (ppm)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7.594
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7.447
7.436
7.432
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7.253
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1.917
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O
F3C
OH
Ph
3r
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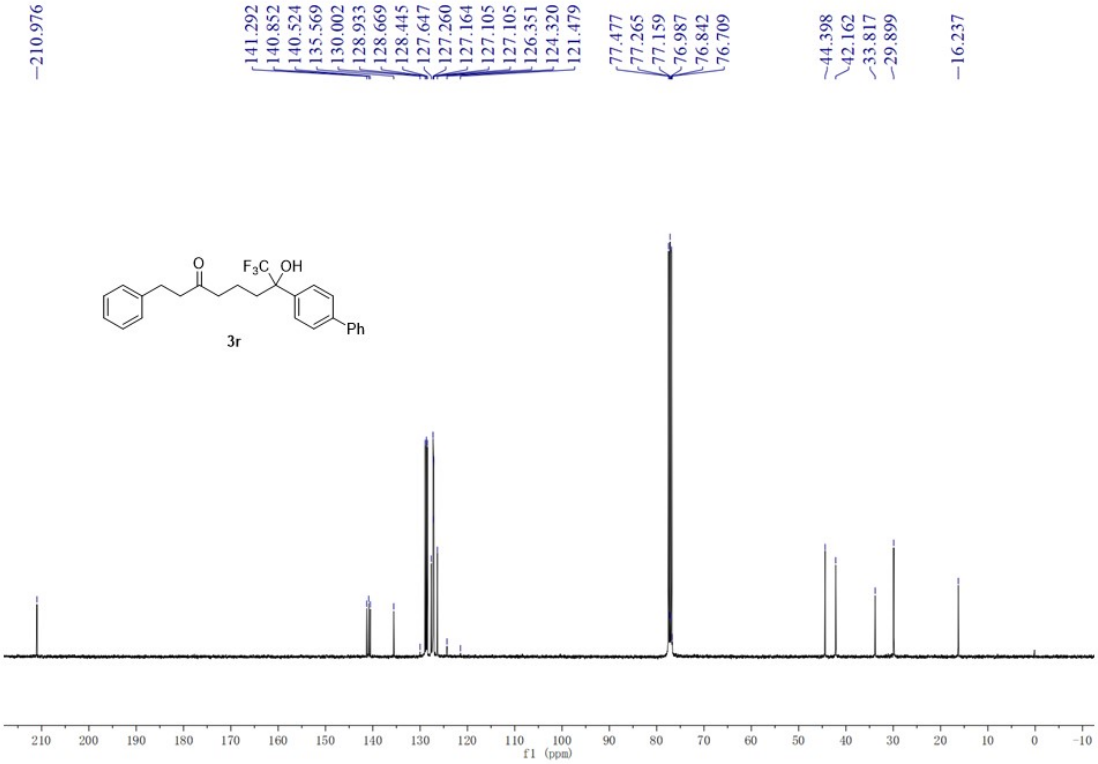
f1 (ppm)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127.105
127.105
126.351
124.320
121.479
77.477
77.265
77.159
76.987
76.842
76.709
44.398
42.162
33.817
29.899
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O
F3C
OH
Ph
3r
f1 (ppm)


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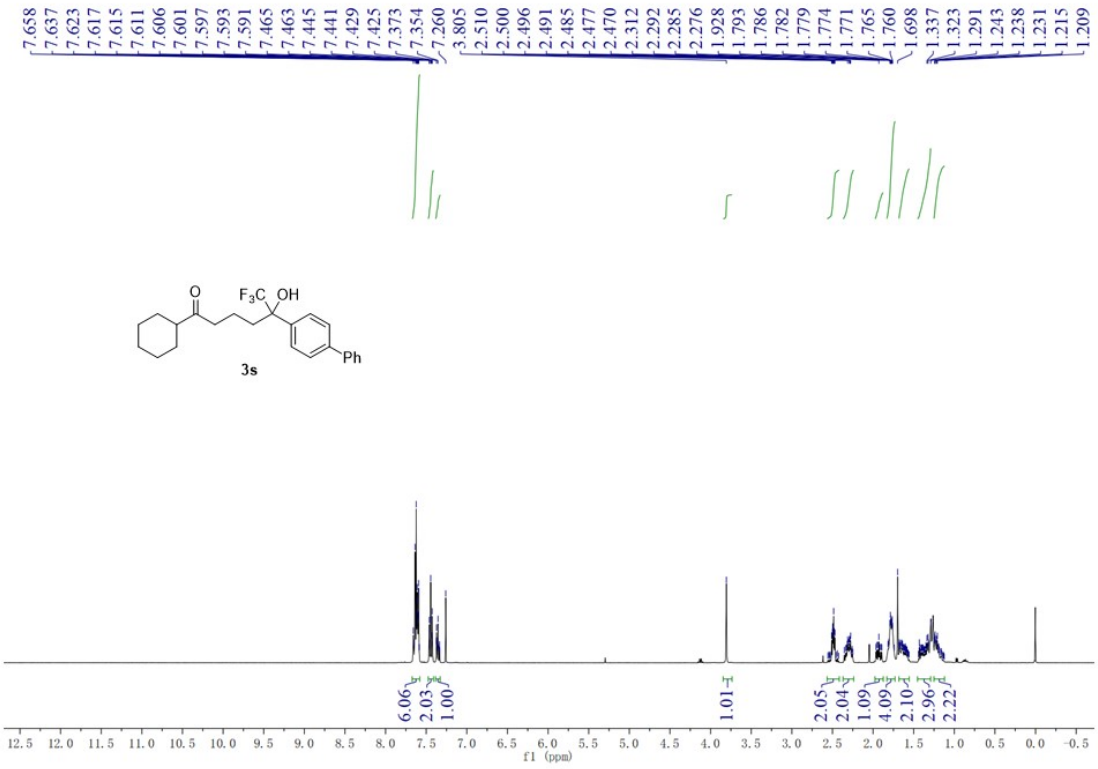
OH
Ph
3r
f1 (ppm)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7.463
7.445
7.441
7.429
7.425
7.373
7.354
7.260
3.805
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2.485
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2.292
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1.774
1.771
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1.760
1.698
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1.323
1.291
1.243
1.238
1.231
1.215
1.209
O
F3C
OH
Ph
3s
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2.10
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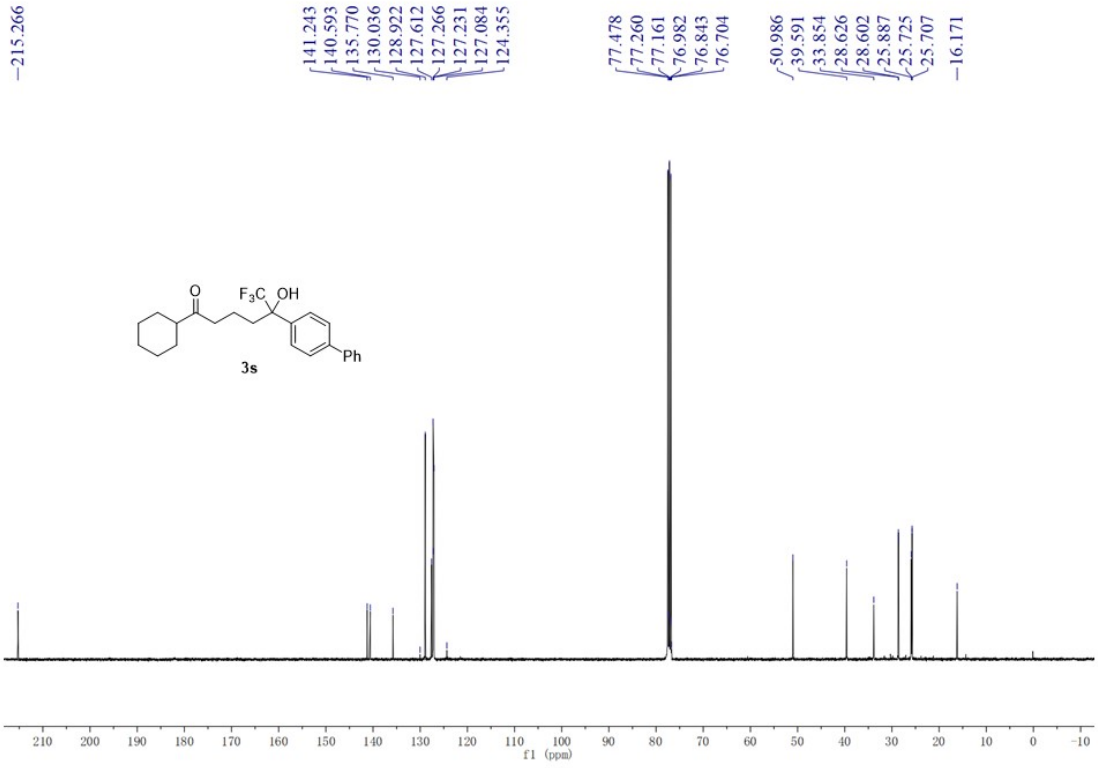
2.22
f1 (ppm)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50.986
39.591
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25.707
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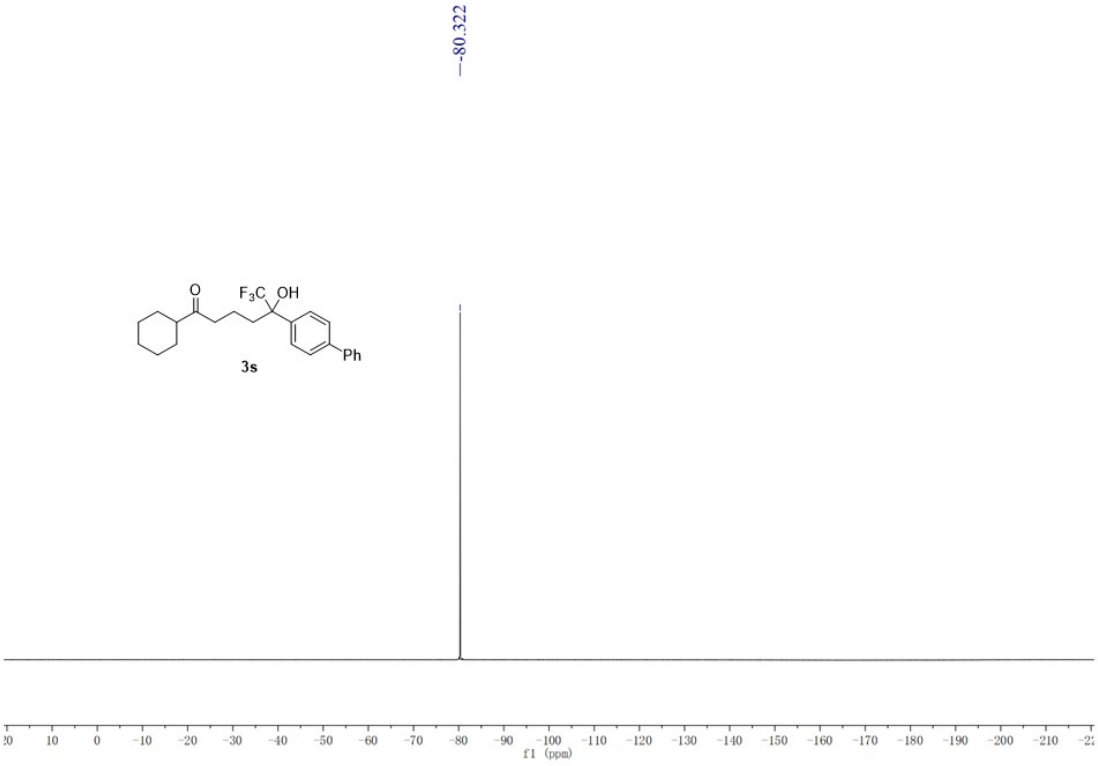
O
F3C
OH
Ph
3s
f1 (ppm)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OH
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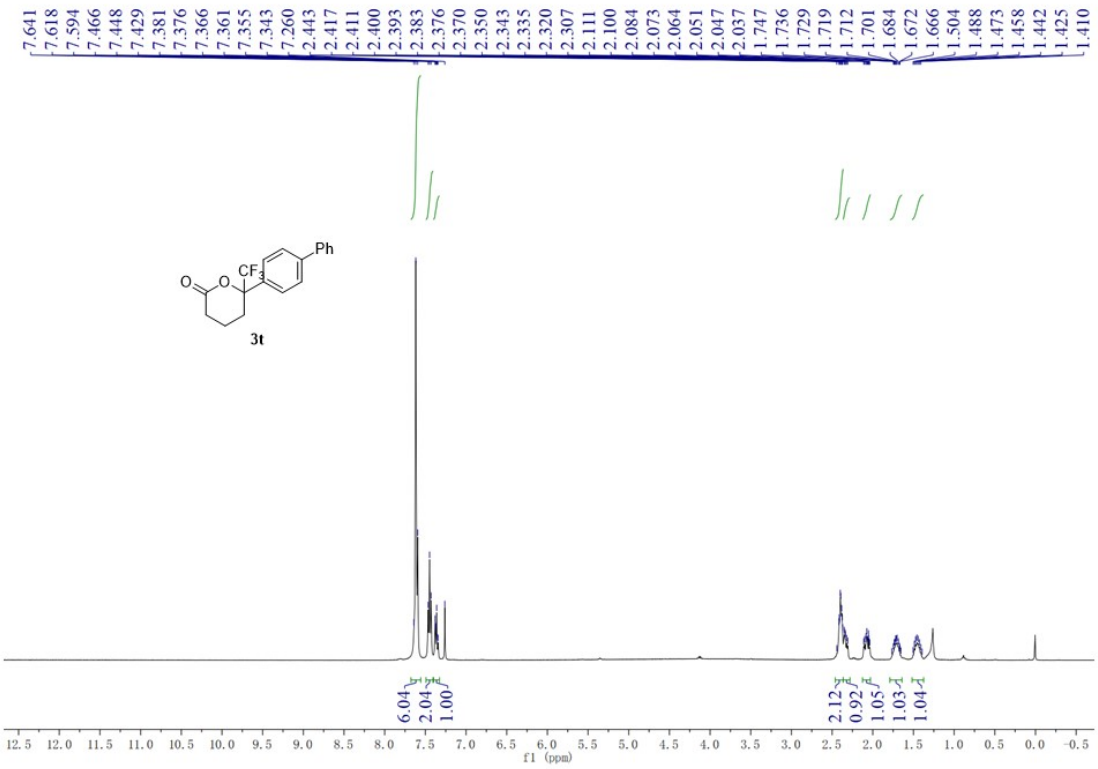
3s
f1 (ppm)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1.410
Ph
CF3
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O
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0.92
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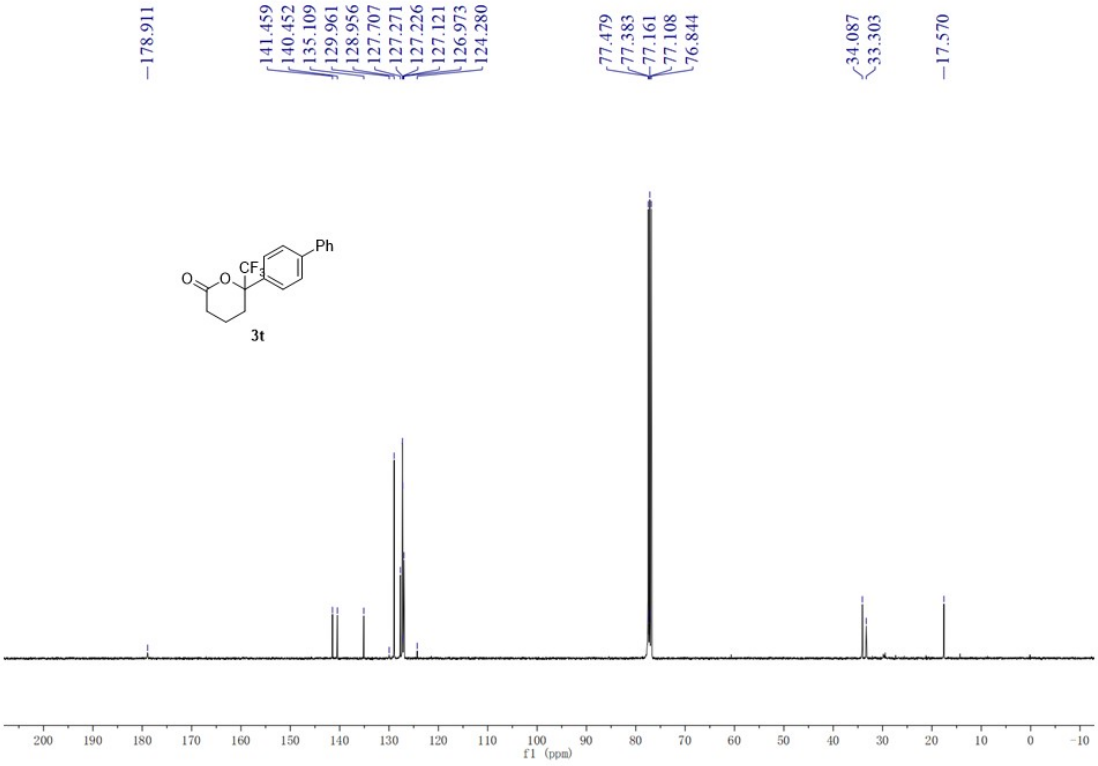
1.03
1.04
f1 (ppm)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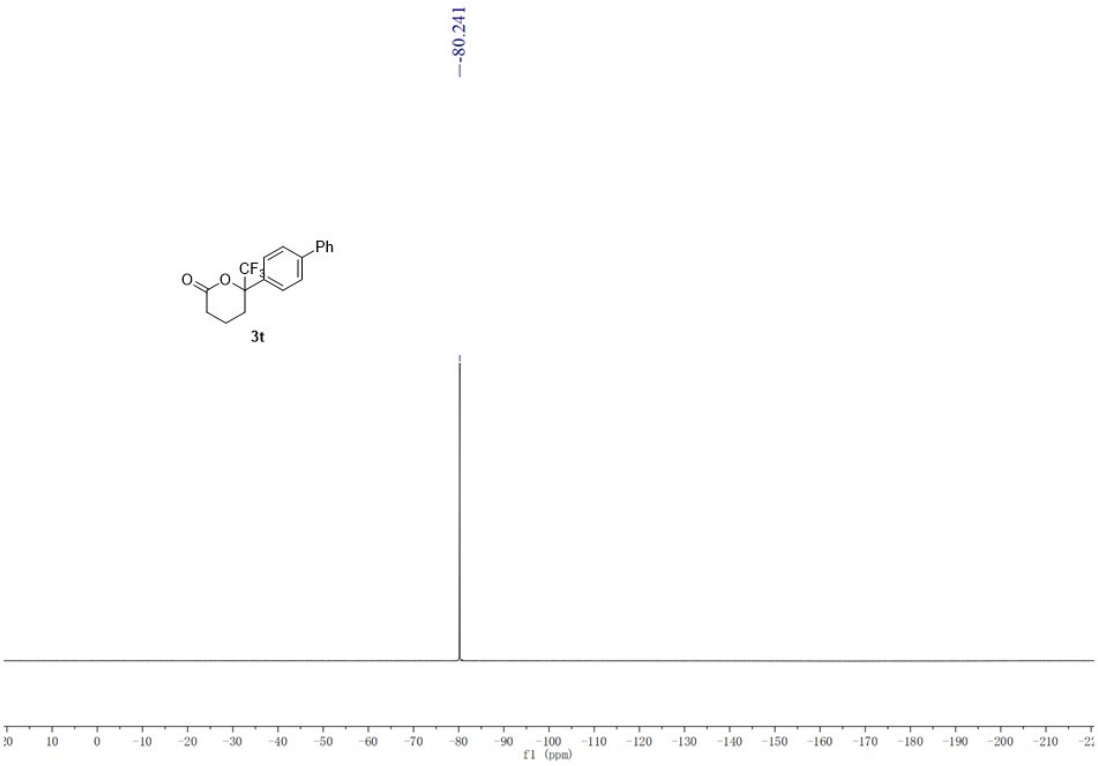
77.479
77.383
77.161
77.108
76.844
34.087
33.303
17.570
Ph
CF3
O
O
3t
f1 (ppm)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O
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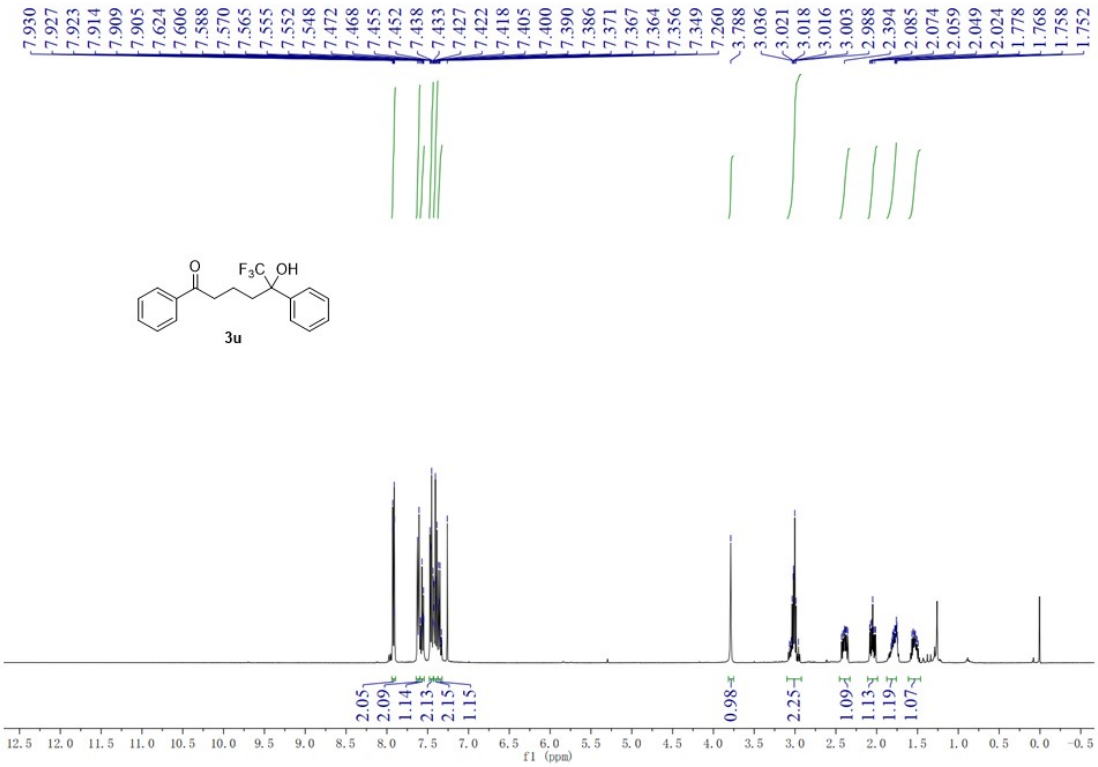
f1 (ppm)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7.570
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7.555
7.552
7.548
7.472
7.468
7.455
7.452
7.438
7.433
7.427
7.422
7.418
7.405
7.400
7.390
7.386
7.371
7.367
7.364
7.356
7.349
7.260
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3.018
3.016
3.003
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2.394
2.085
2.074
2.059
2.049
2.024
1.778
1.768
1.758
1.752
O
F3C
OH
3u
2.05
2.09
1.14
2.13
2.15
1.15
0.98
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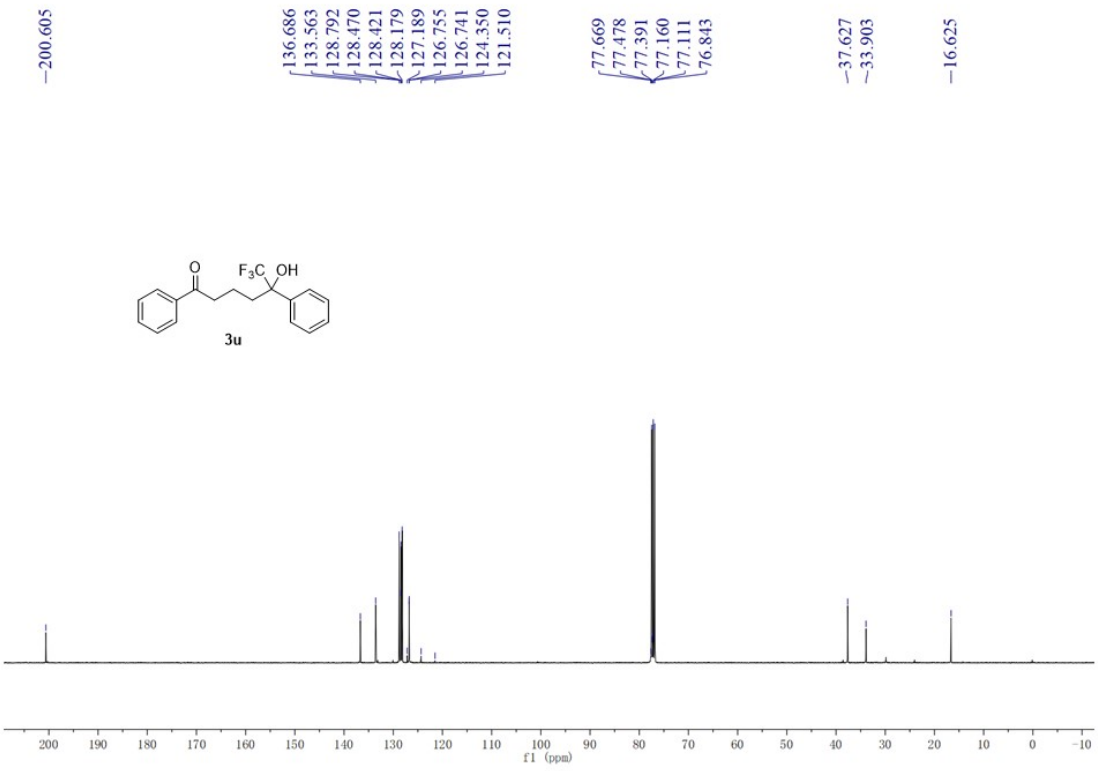
1.09
1.13
1.19
1.07
f1 (ppm)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77.111
76.843
37.627
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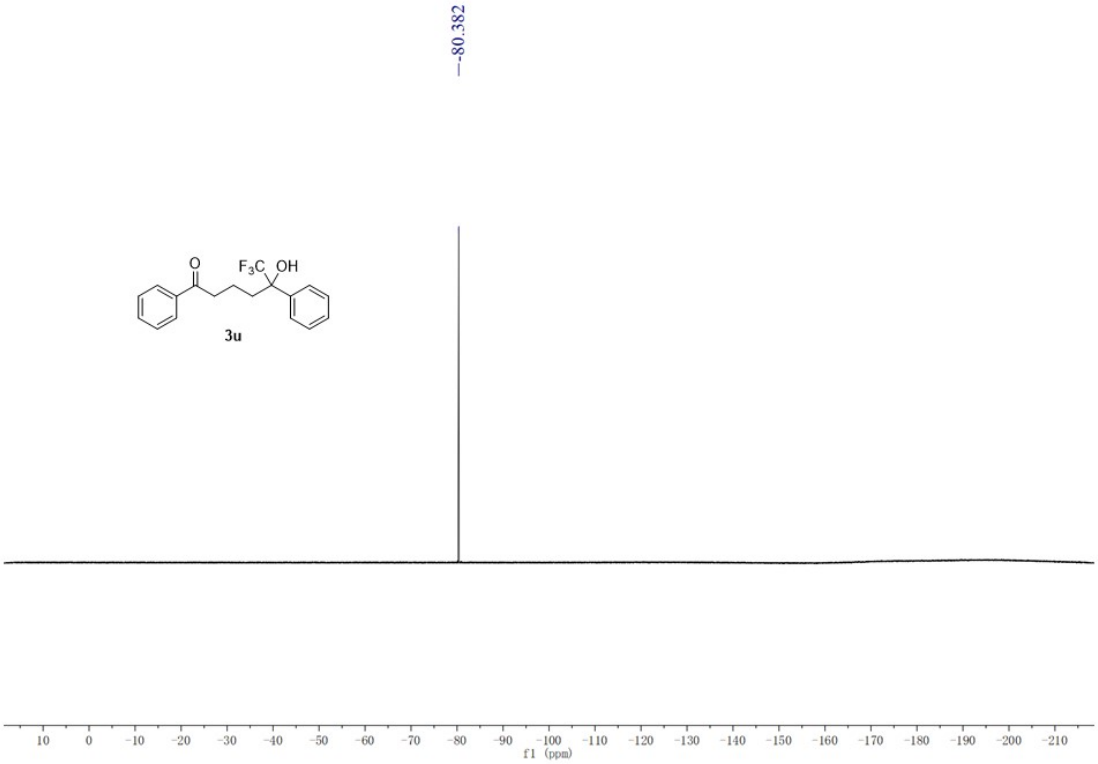
16.625
O
F3C
OH
3u
f1 (ppm)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O
F3C
OH
3u
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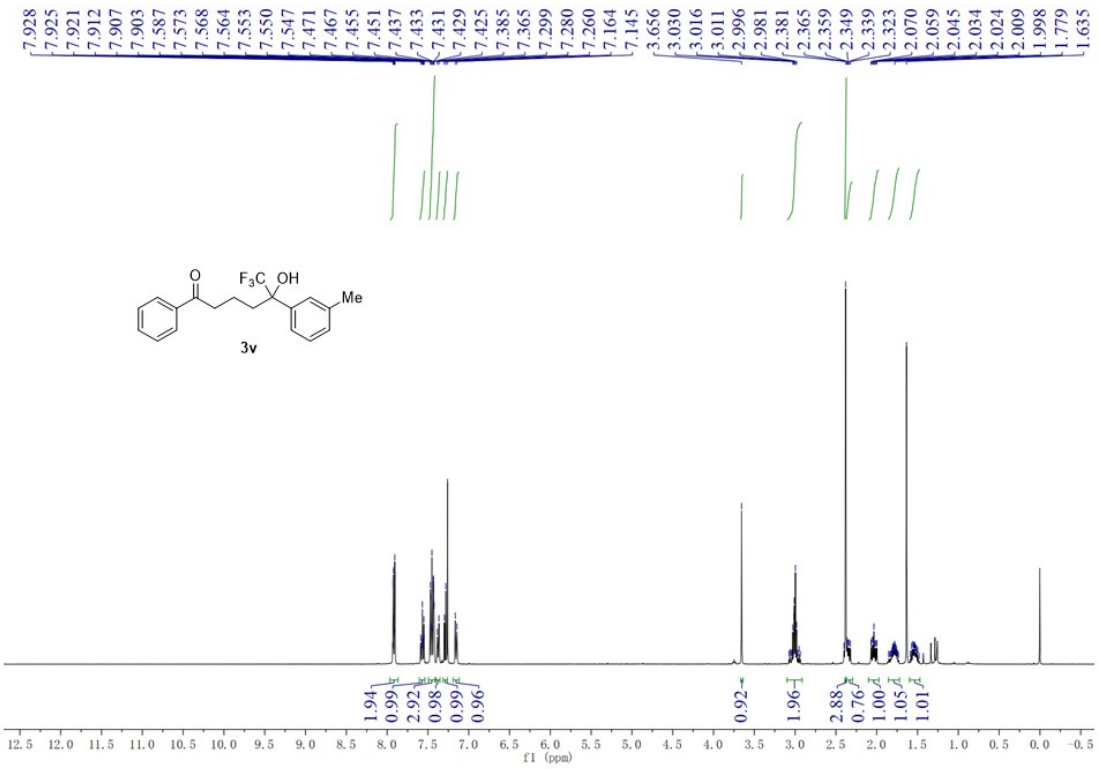
f1 (ppm)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7.573
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7.550
7.547
7.471
7.467
7.455
7.451
7.437
7.433
7.431
7.429
7.425
7.385
7.365
7.299
7.280
7.260
7.164
7.145
3.656
3.030
3.016
3.011
2.996
2.981
2.381
2.365
2.359
2.349
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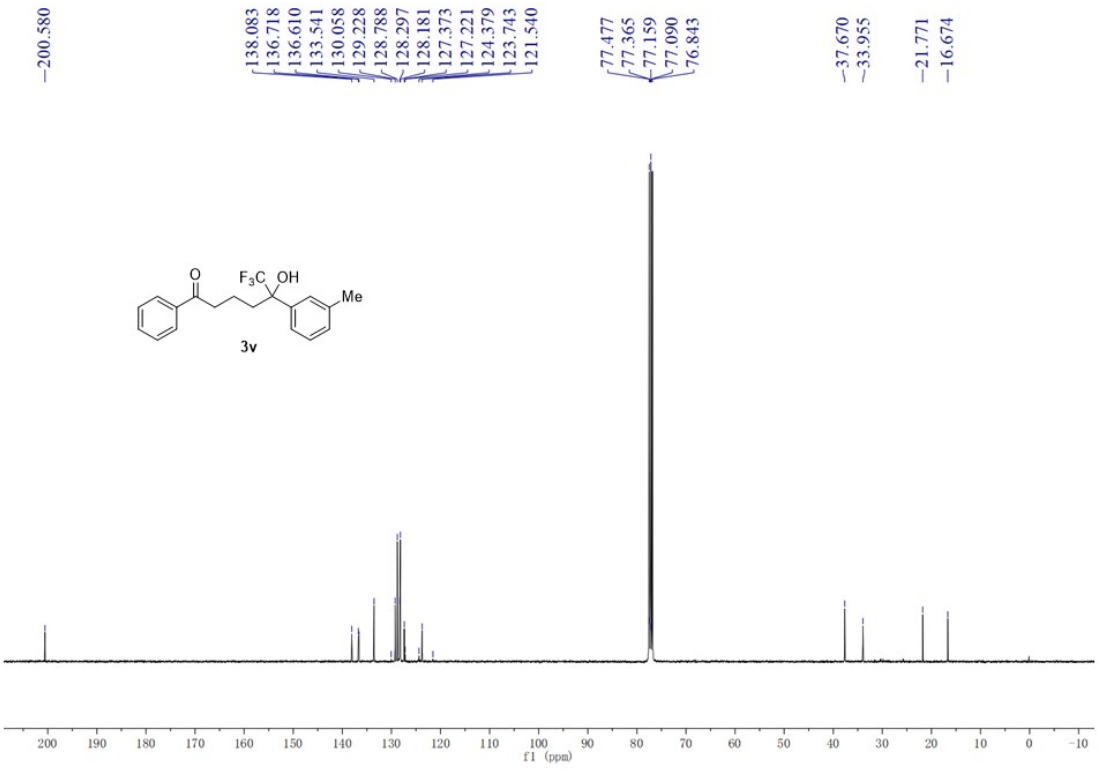
2.323
2.070
2.059
2.045
2.034
2.024
2.009
1.998
1.779
1.635
O
F3C
OH
Me
3v
1.94
0.99
2.92
0.98
0.99
0.96
0.92
1.96
2.88
0.76
1.00
1.05
1.01
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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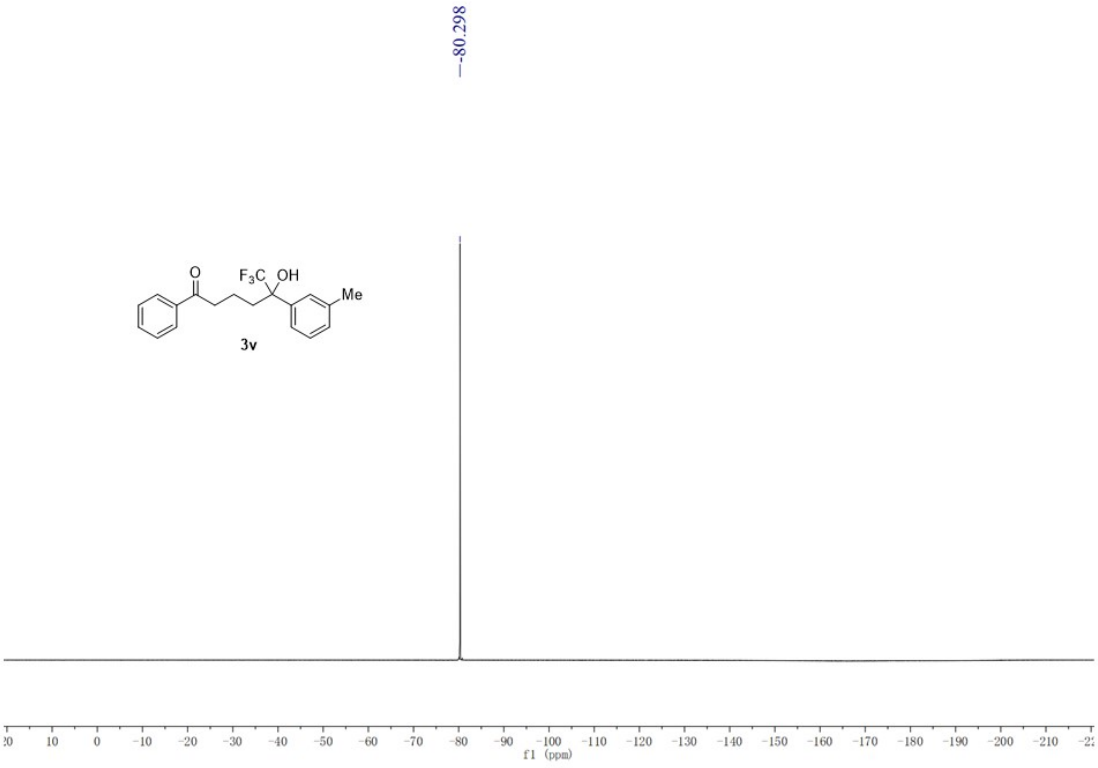
128.297
128.181
127.373
127.221
124.379
123.743
121.540
77.477
77.365
77.159
77.090
76.843
37.670
33.955
21.771
16.674
O
F3C
OH
Me
3v
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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O
F3C
OH
Me
3v
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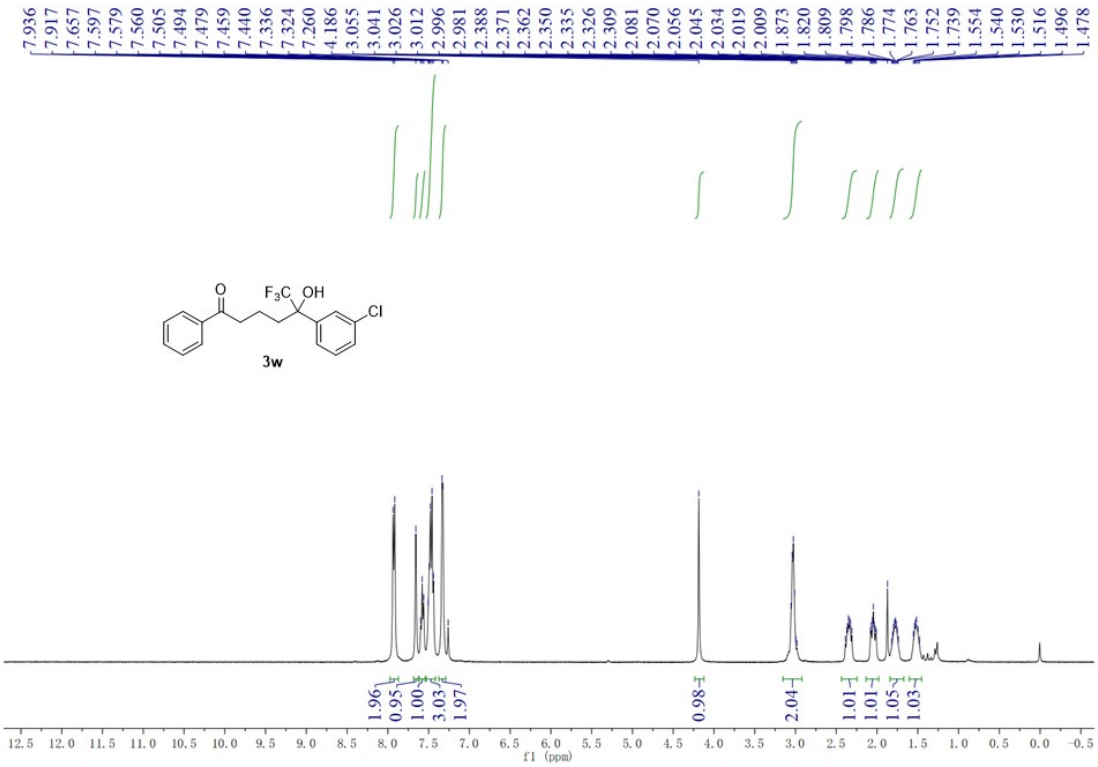
f1 (ppm)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7.597
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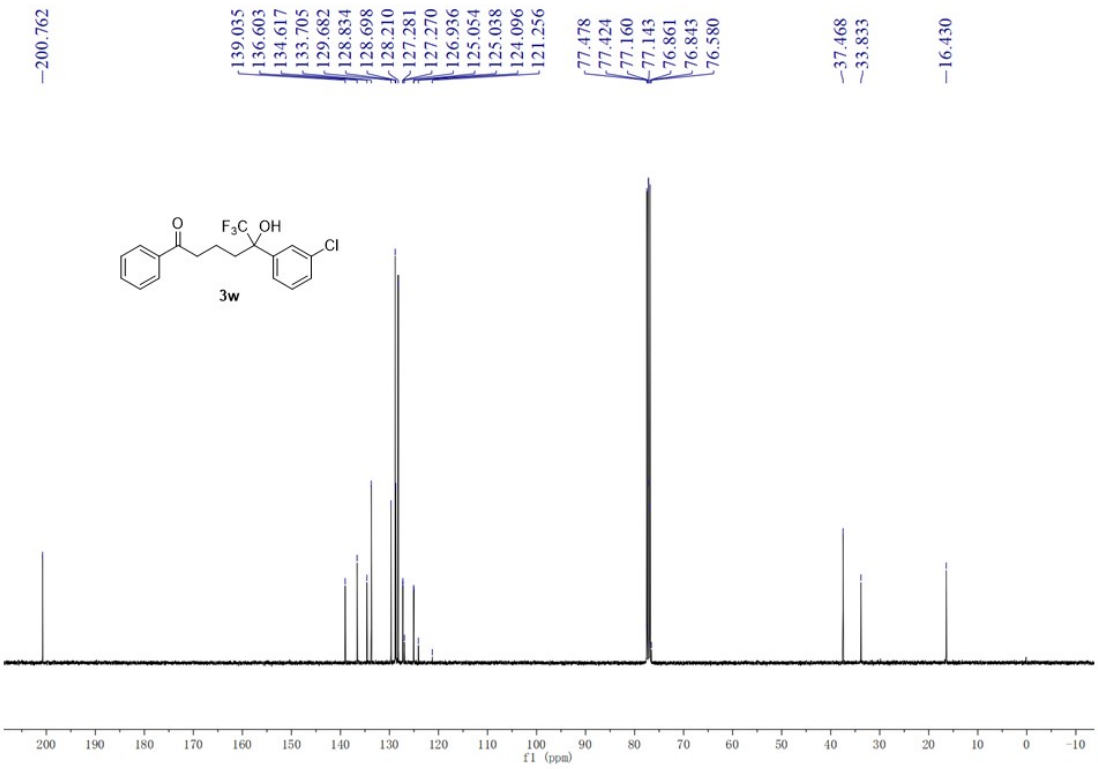
7.560
7.505
7.494
7.479
7.459
7.440
7.336
7.324
7.260
4.186
3.055
3.041
3.026
3.012
2.996
2.981
2.388
2.371
2.362
2.350
2.335
2.326
2.309
2.081
2.070
2.056
2.045
2.034
2.019
2.009
1.873
1.820
1.809
1.798
1.786
1.774
1.763
1.752
1.739
1.554
1.540
1.530
1.516
1.496
1.478
O
F3C
OH
Cl
3w
1.96
0.95
1.00
3.03
1.97
0.98
2.04
1.01
1.01
1.05
1.03
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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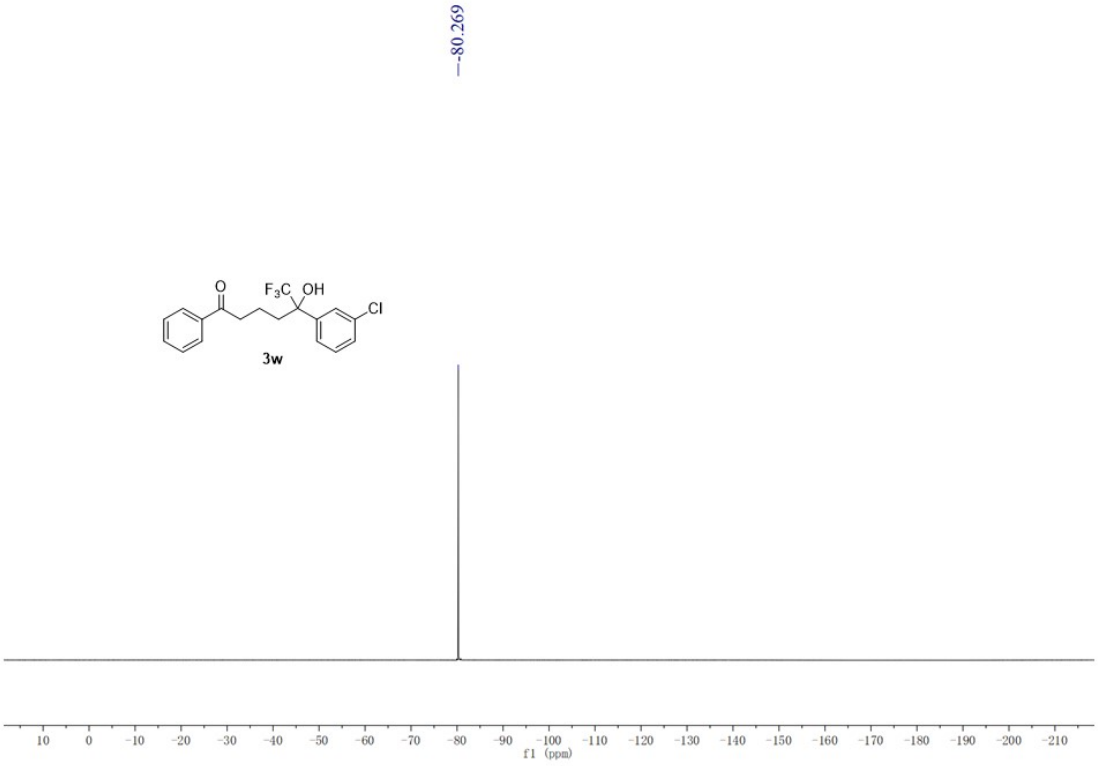
128.834
128.698
128.210
127.281
127.270
126.936
125.054
125.038
124.096
121.256
77.478
77.424
77.160
77.143
76.861
76.843
76.580
37.468
33.833
16.430
O
F3C
OH
Cl
3w
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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O
F3C OH
Cl
3w
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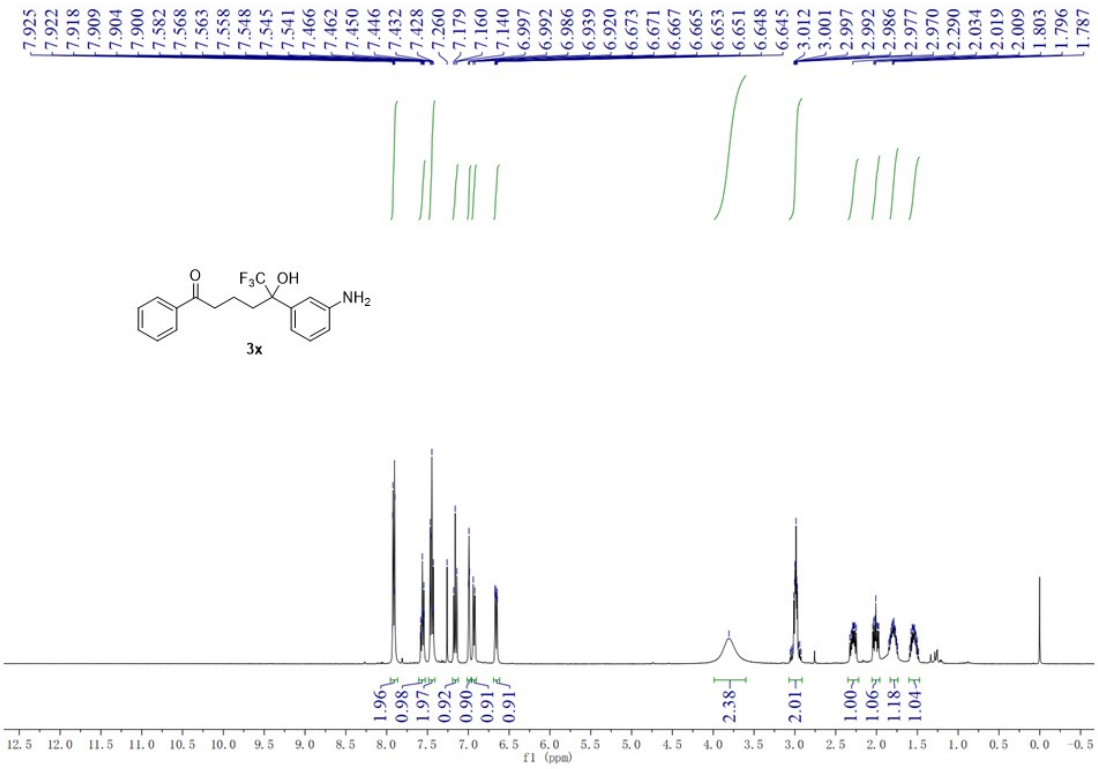
f1 (ppm)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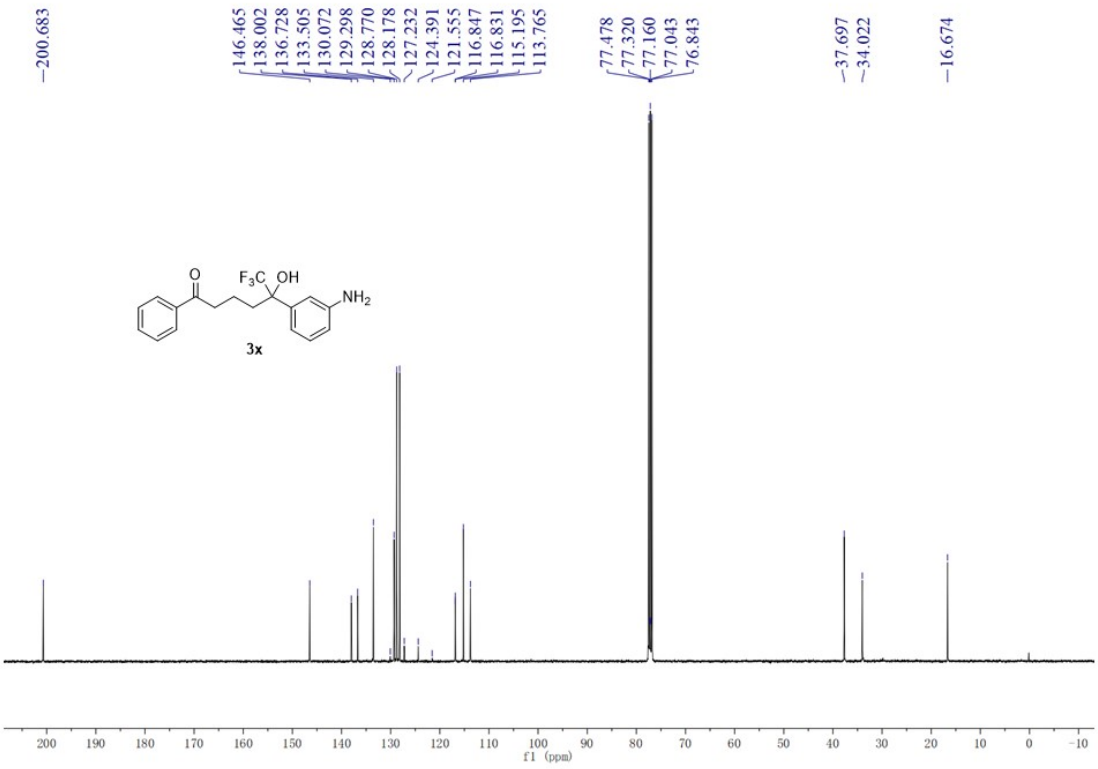
7.563
7.558
7.548
7.545
7.541
7.466
7.462
7.450
7.446
7.432
7.428
7.260
7.179
7.160
7.140
6.997
6.992
6.986
6.939
6.920
6.673
6.671
6.667
6.665
6.653
6.651
6.648
6.645
3.012
3.001
2.997
2.992
2.986
2.977
2.970
2.290
2.034
2.019
2.009
1.803
1.796
1.787
O
F3C OH
NH2
3x
1.96
0.98
1.97
0.92
0.90
0.91
0.91
2.38
2.01
1.00
1.06
1.18
1.04
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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127.232
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121.555
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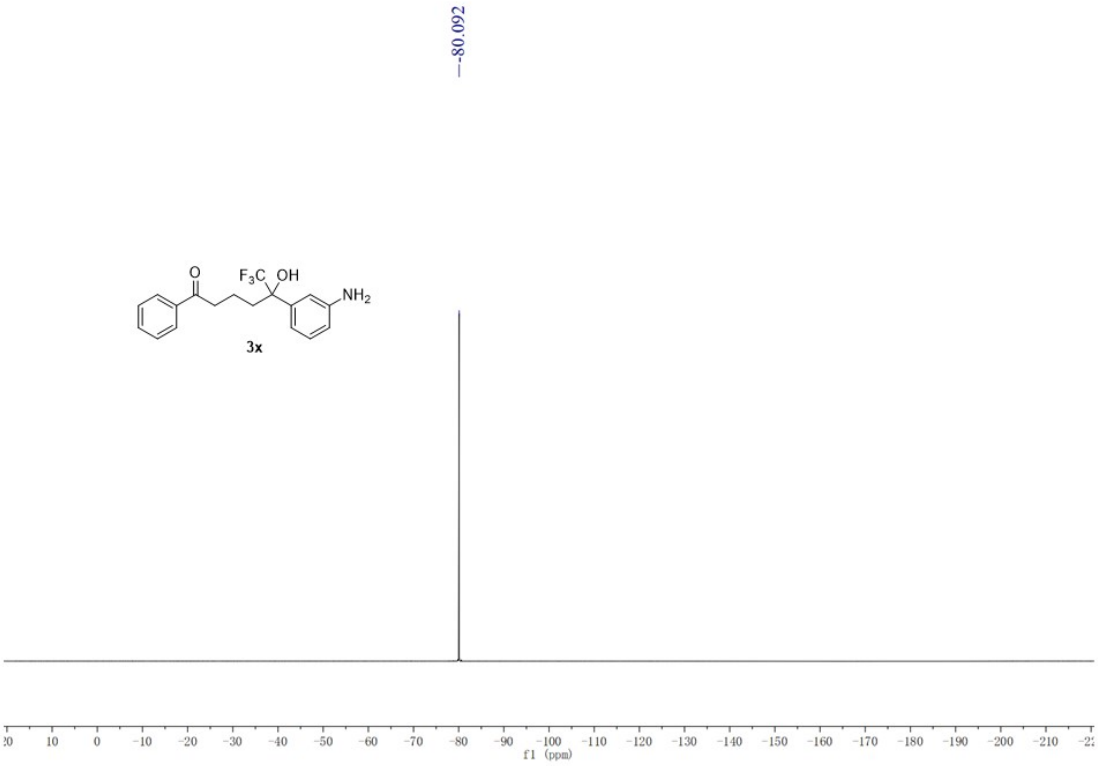
116.831
115.195
113.765
77.478
77.320
77.160
77.043
76.843
37.697
34.022
16.674
O
F3C
OH
NH2
3x
f1 (ppm)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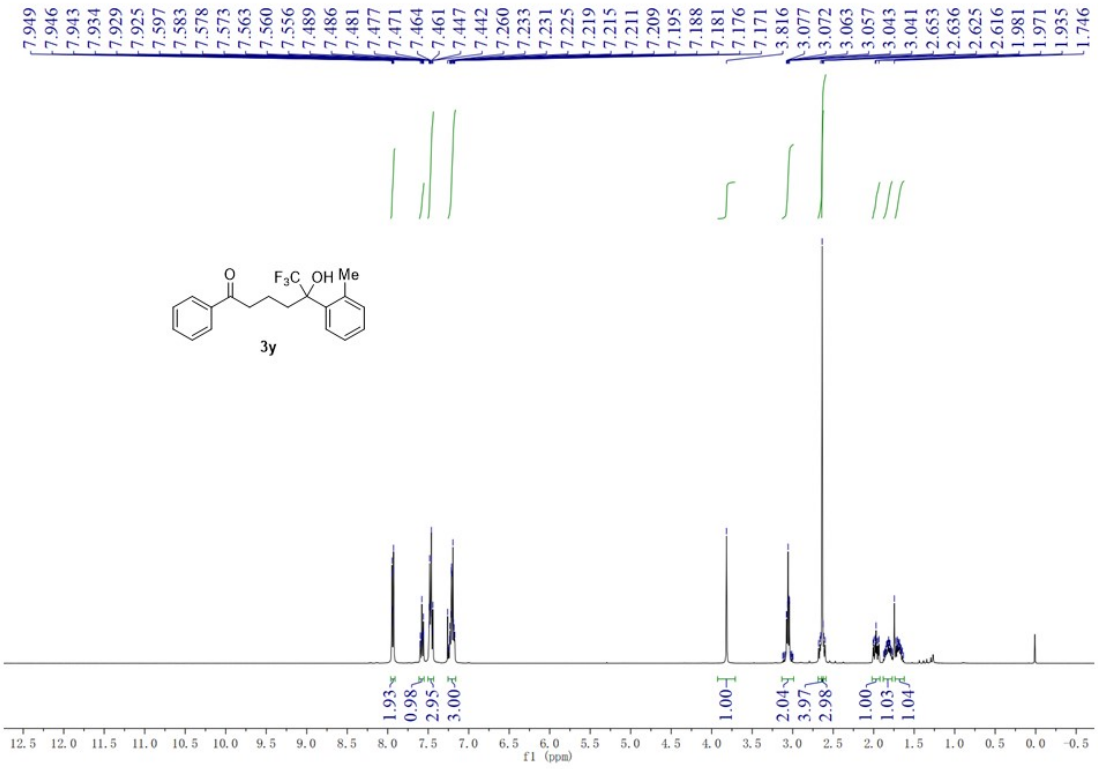
O
F3C
OH
NH2
3x
f1 (ppm)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7.556
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7.486
7.481
7.477
7.471
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7.461
7.447
7.442
7.260
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7.231
7.225
7.219
7.215
7.211
7.209
7.195
7.188
7.181
7.176
7.171
3.816
3.077
3.072
3.063
3.057
3.043
3.041
2.653
2.636
2.625
2.616
1.981
1.971
1.935
1.746
O
F3C
OH
Me
3y
1.93
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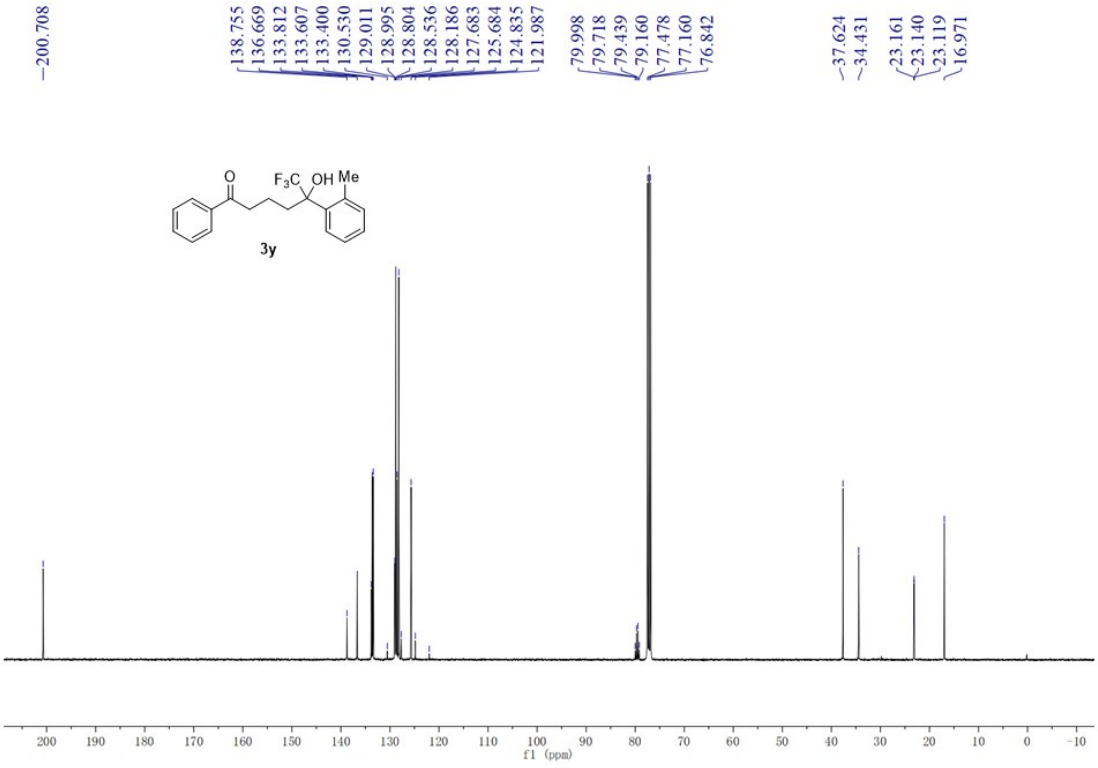
3.00
1.00
2.04
3.97
2.98
1.00
1.03
1.04
f1 (ppm)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128.186
127.683
125.684
124.835
121.987
79.998
79.718
79.439
79.160
77.478
77.160
76.842
37.624
34.431
23.161
23.140
23.119
16.971
O
F3C
OH
Me
3y
f1 (ppm)


-79.930
O
F3C
OH
Me
3y
f1 (ppm)
7.925
7.922
7.918
7.905
7.901
7.586
7.572
7.567
7.563
7.552
7.549
7.545
7.495
7.474
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7.465
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7.450
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7.196
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3.011
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2.034
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2.009
1.998
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1.778
1.768
1.759
1.747
1.736
1.562
1.552
1.537
O
F3C
OH
Me
3z
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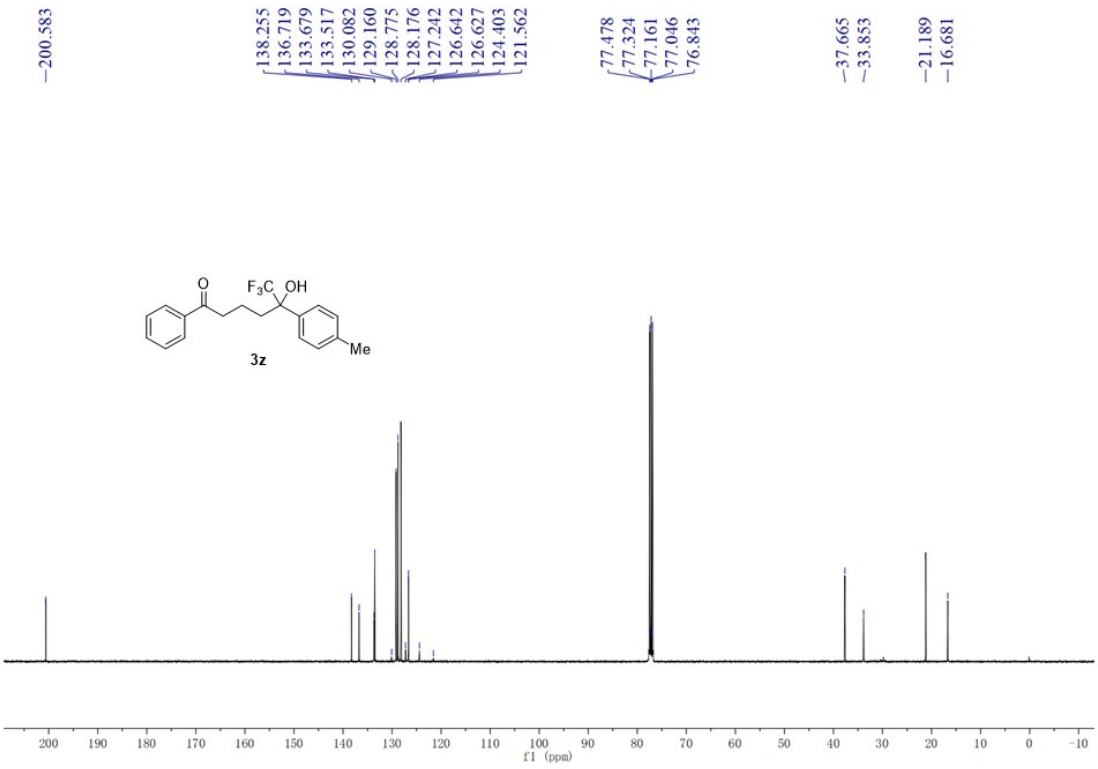
3.95
1.90
0.98
2.02
3.99
1.00
0.97
1.05
f1 (ppm)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128.775
128.176
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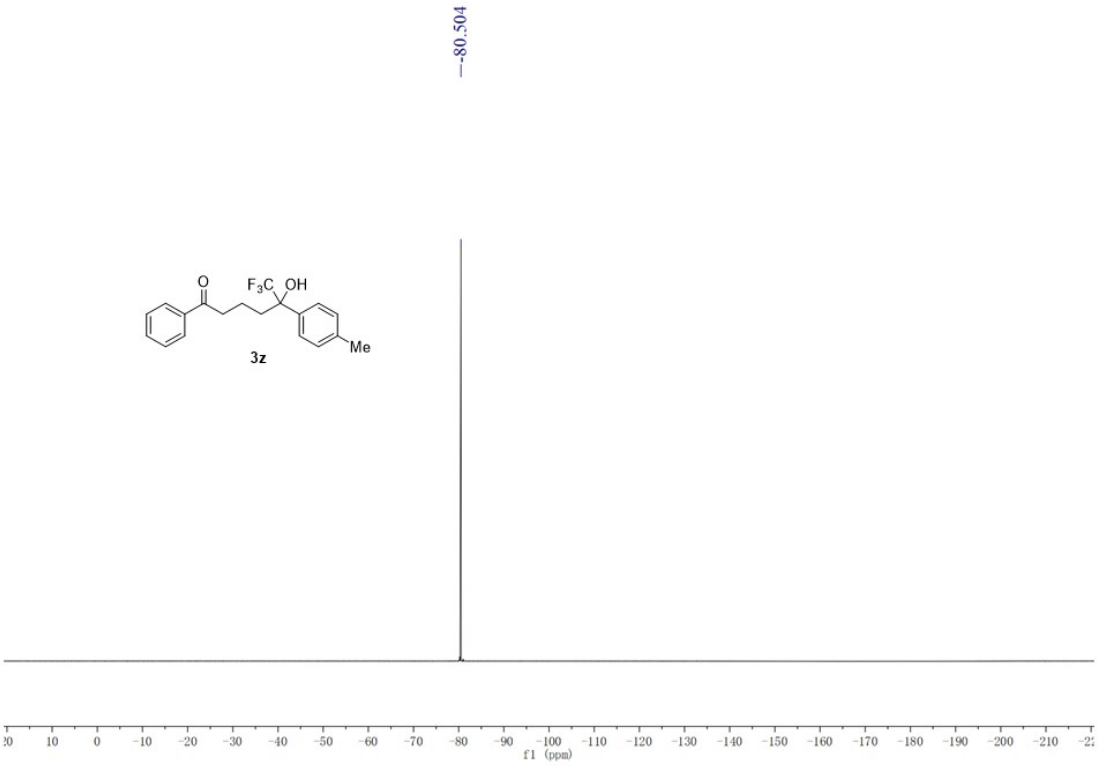
126.642
126.627
124.403
121.562
77.478
77.324
77.161
77.046
76.843
37.665
33.853
21.189
16.681
O
F3C
OH
Me
3z
f1 (ppm)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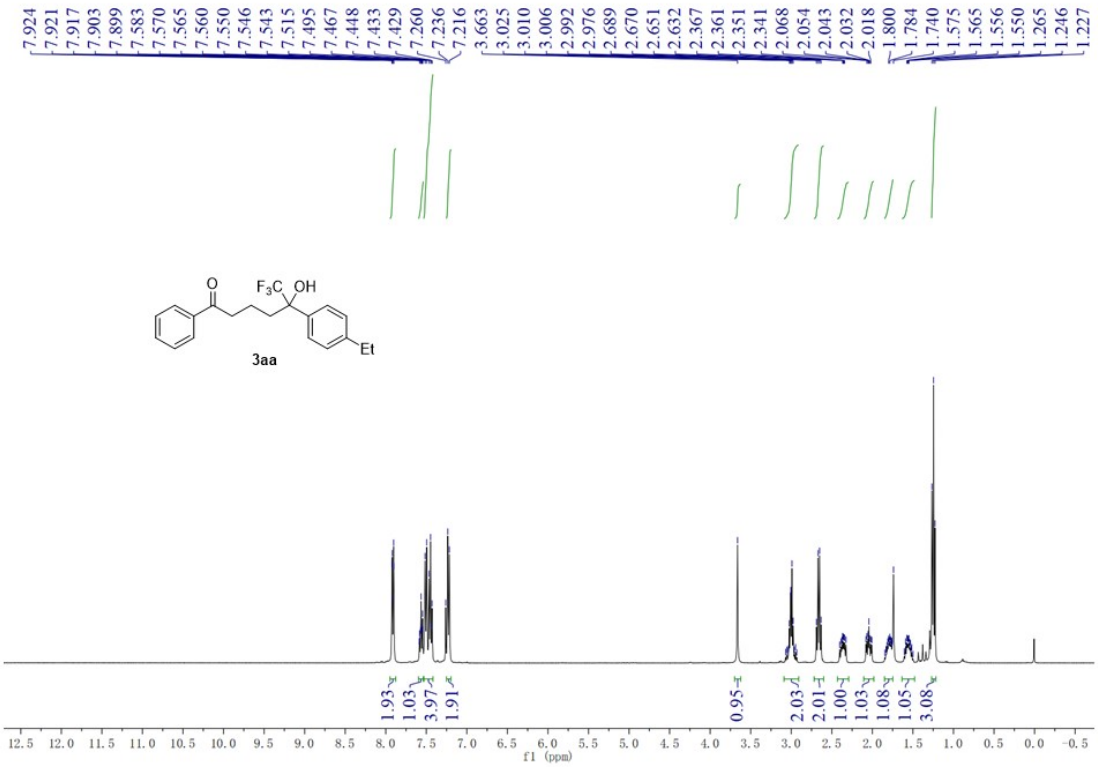
OH
Me
3z
f1 (ppm)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7.550
7.546
7.543
7.515
7.495
7.467
7.448
7.433
7.429
7.260
7.236
7.216
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3.025
3.010
3.006
2.992
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2.689
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2.632
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2.361
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2.341
2.068
2.054
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2.032
2.018
1.800
1.784
1.740
1.575
1.565
1.556
1.550
1.265
1.246
1.227
O
F3C
OH
Et
3aa
1.93
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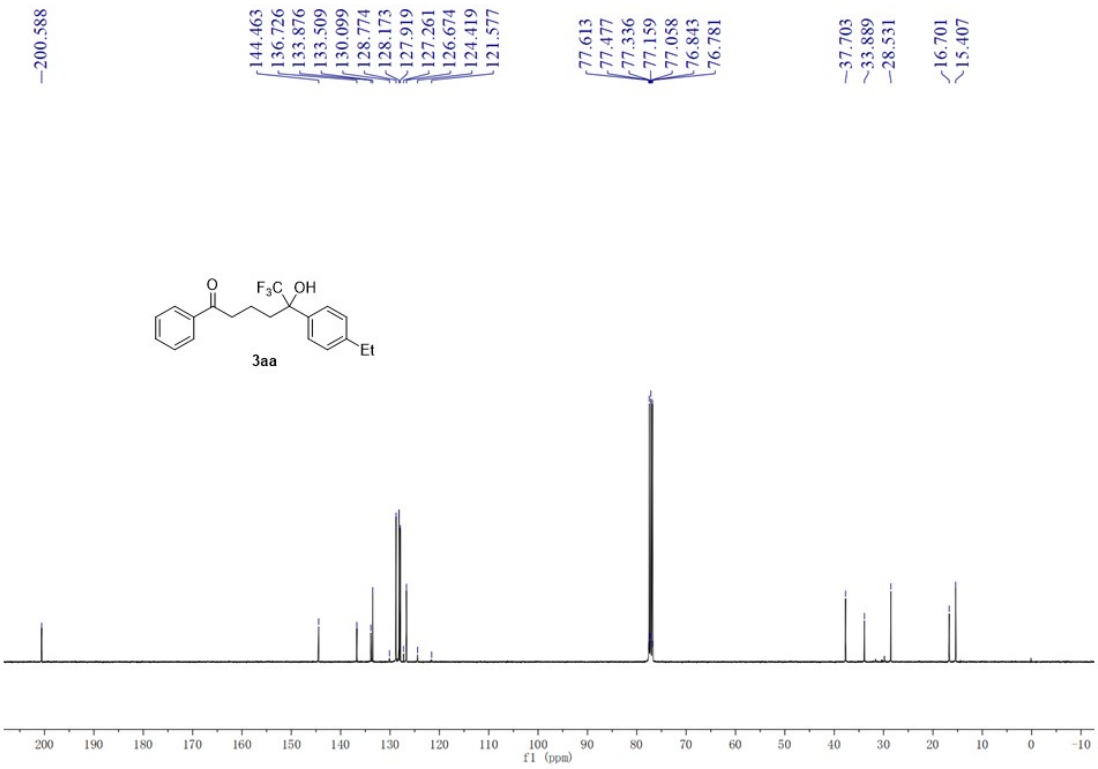
1.00
1.03
1.08
1.05
3.08
f1 (ppm)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127.261
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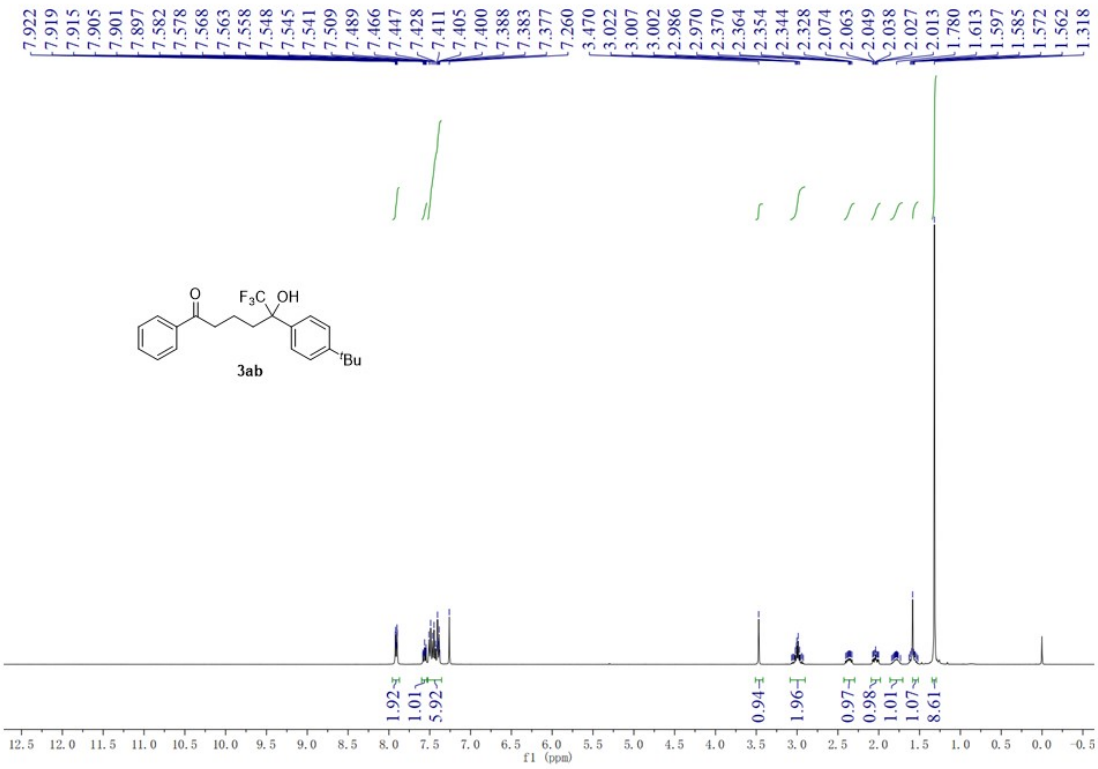
124.419
121.577
77.613
77.477
77.336
77.159
77.058
76.843
76.781
37.703
33.889
28.531
16.701
15.407
O
F3C
OH
Et
3aa
f1 (ppm)


-80.438
O
F3C
OH
Et
3aa
f1 (ppm)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7.545
7.541
7.509
7.489
7.466
7.447
7.428
7.411
7.405
7.400
7.388
7.383
7.377
7.260
3.470
3.022
3.007
3.002
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2.970
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2.364
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2.344
2.328
2.074
2.063
2.049
2.038
2.027
2.013
1.780
1.613
1.597
1.585
1.572
1.562
1.318
O
F3C
OH
tBu
3ab
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5.92
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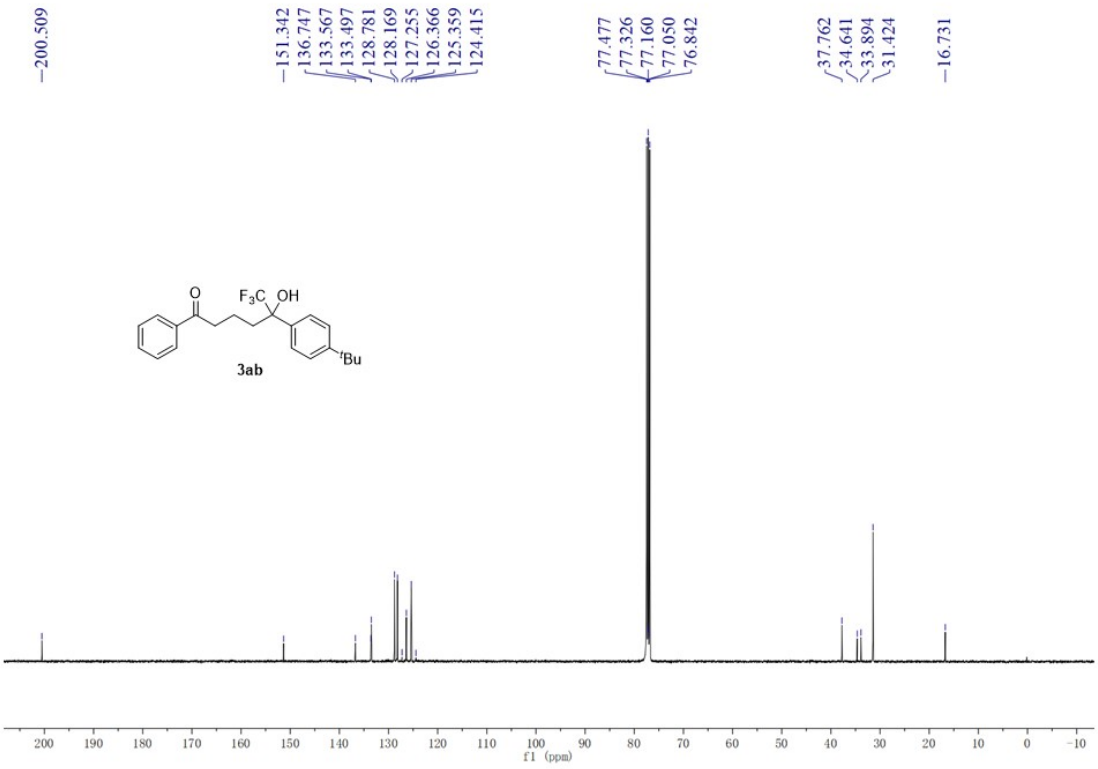
0.97
0.98
1.01
1.07
8.61
f1 (ppm)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77.326
77.160
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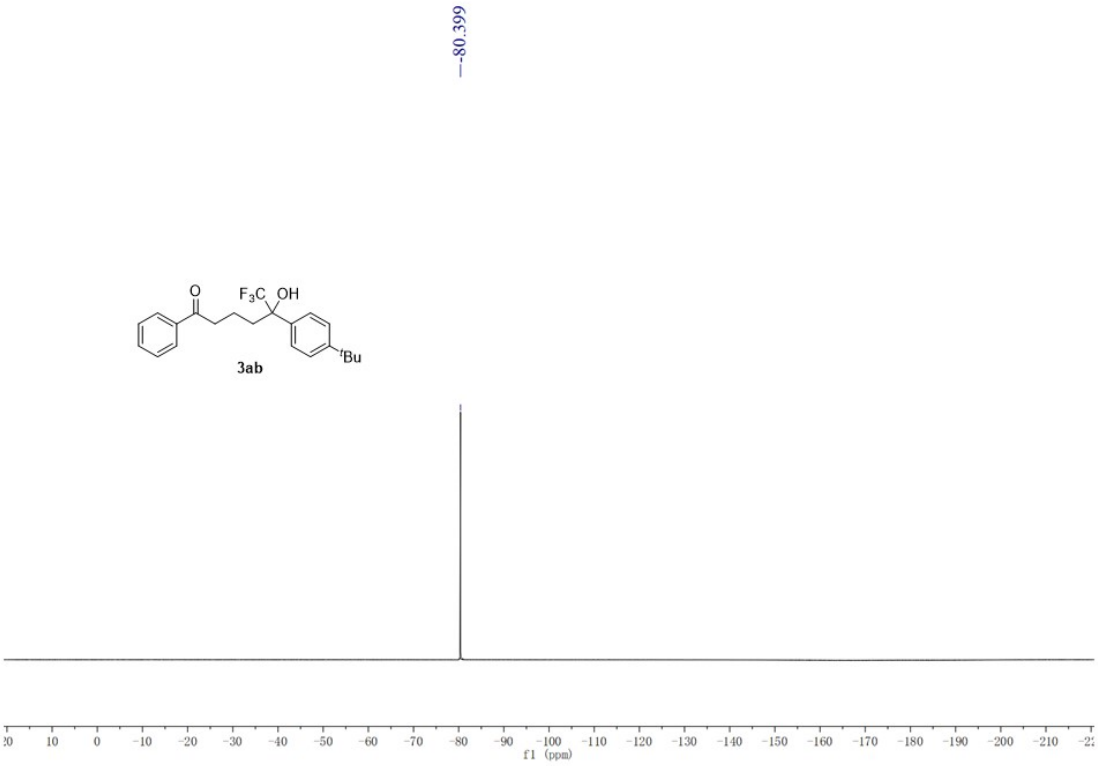
34.641
33.894
31.424
16.731
O
F3C
OH
tBu
3ab
f1 (ppm)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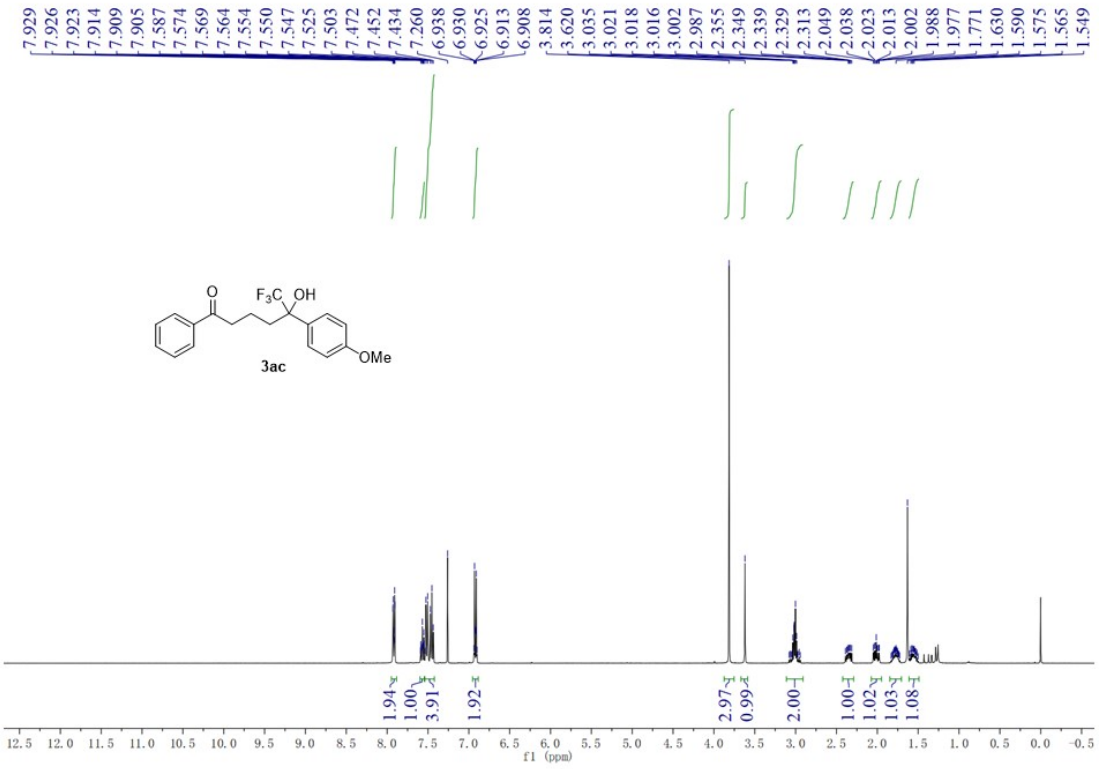
O
F3C
OH
tBu
3ab
f1 (ppm)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6.908
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3.016
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2.002
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1.977
1.771
1.630
1.590
1.575
1.565
1.549
O
F3C
OH
OMe
3ac
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1.92
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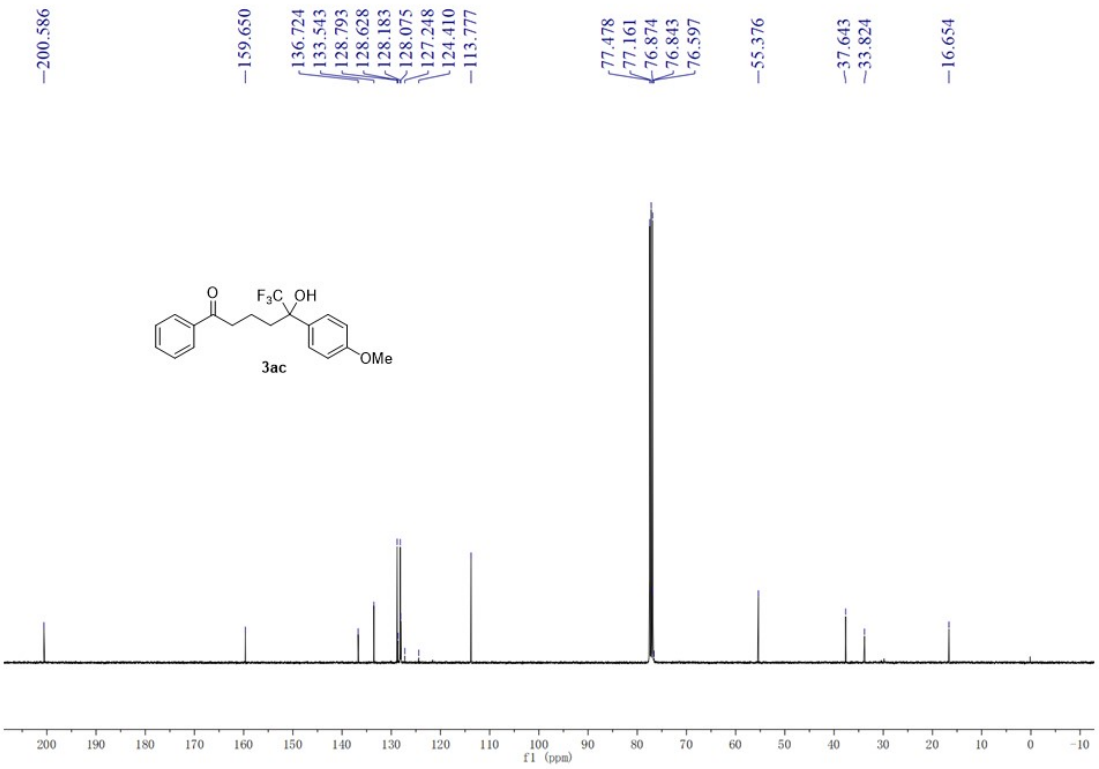
1.00
1.02
1.03
1.08
f1 (ppm)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77.161
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33.824
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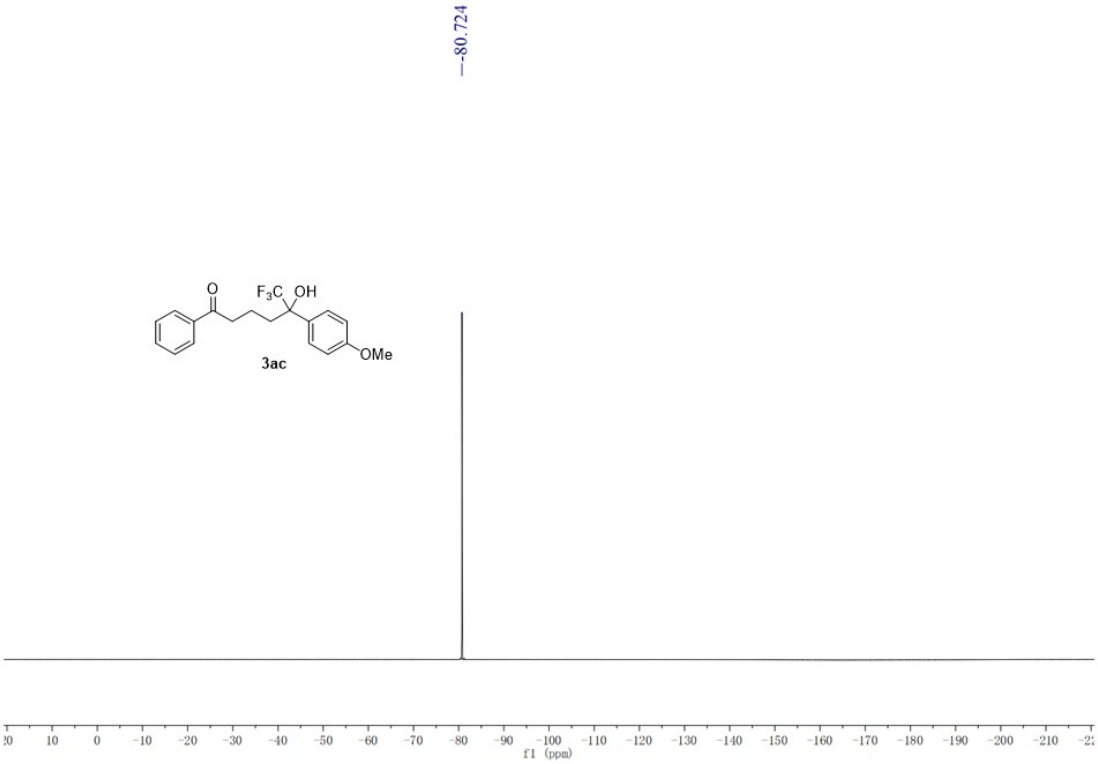
F3C
OH
OMe
3ac
f1 (ppm)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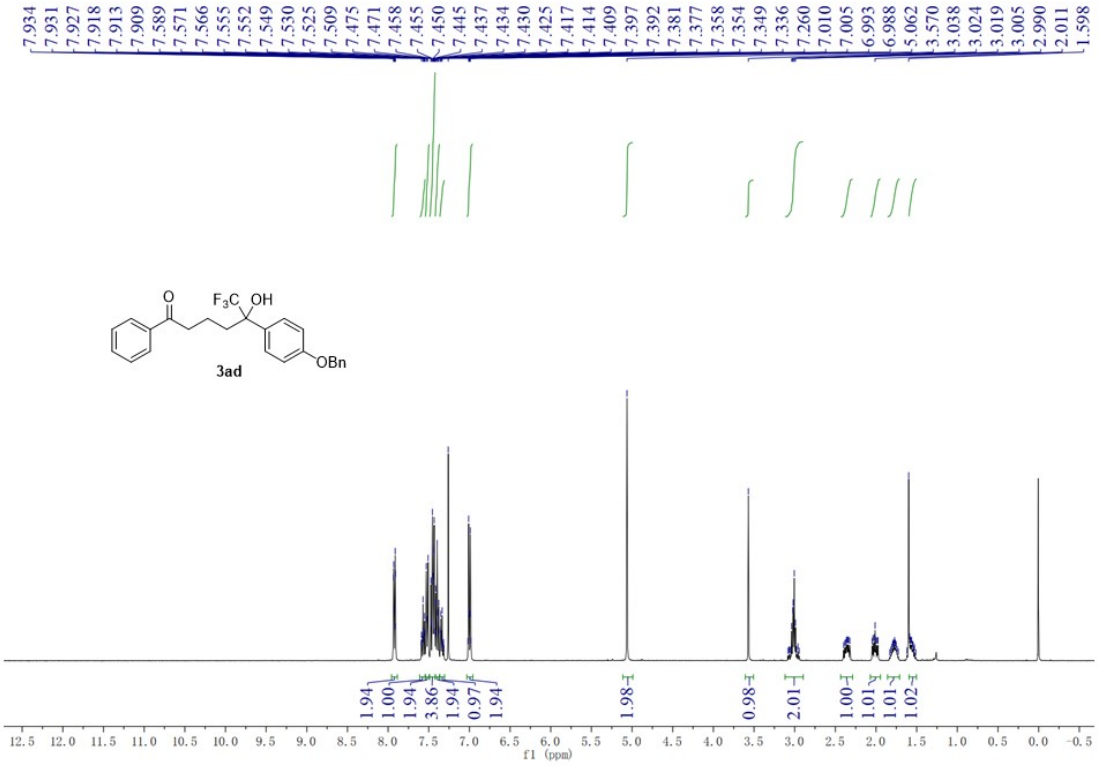
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7.549
7.530
7.525
7.509
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7.471
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7.455
7.450
7.445
7.437
7.434
7.430
7.425
7.417
7.414
7.409
7.397
7.392
7.381
7.377
7.358
7.354
7.349
7.336
7.260
7.010
7.005
6.993
6.988
5.062
3.570
3.038
3.024
3.019
3.005
2.990
2.011
1.598
O
F3C OH
OBn
3ad
1.94
1.00
1.94
3.86
1.94
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1.94
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0.98
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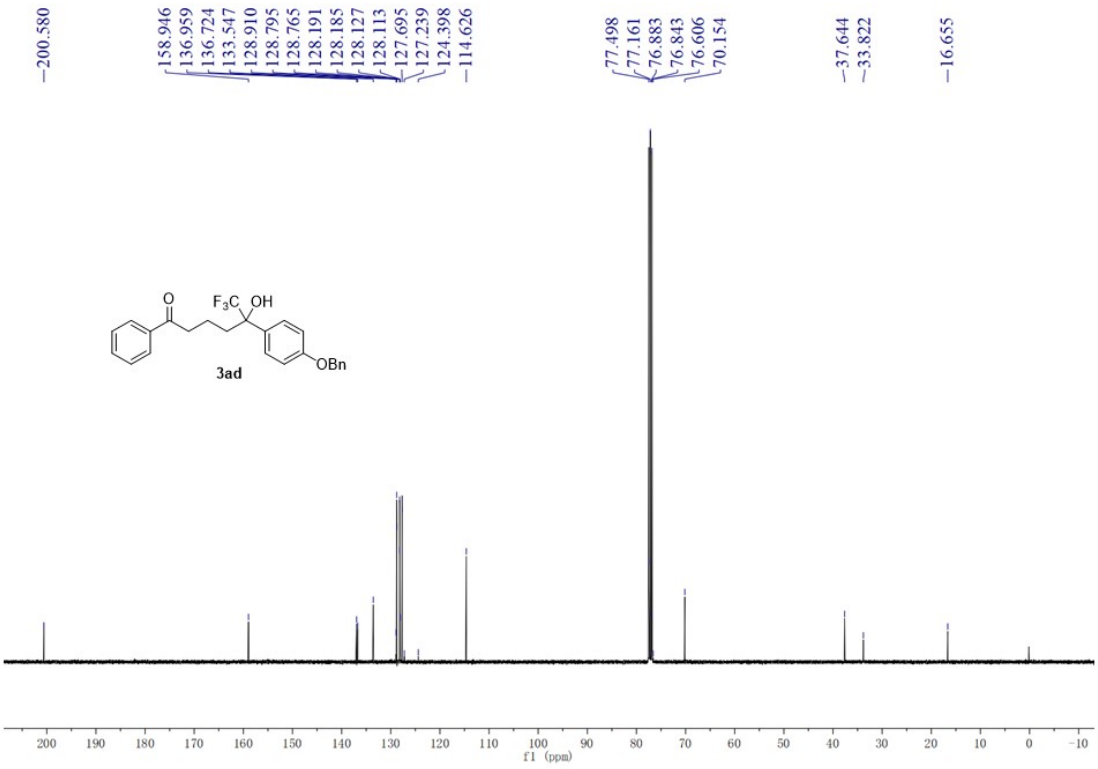
1.00
1.01
1.01
1.02
f1 (ppm)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124.398
114.626
77.498
77.161
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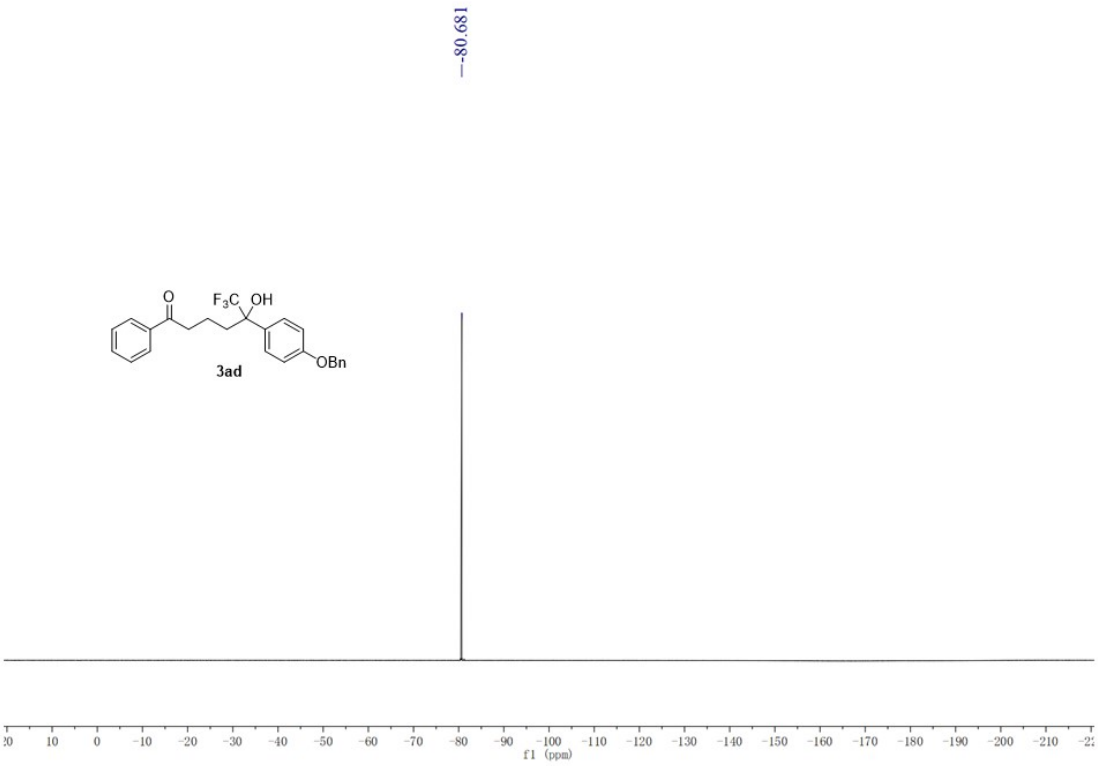
F3C
OH
OBn
3ad
f1 (ppm)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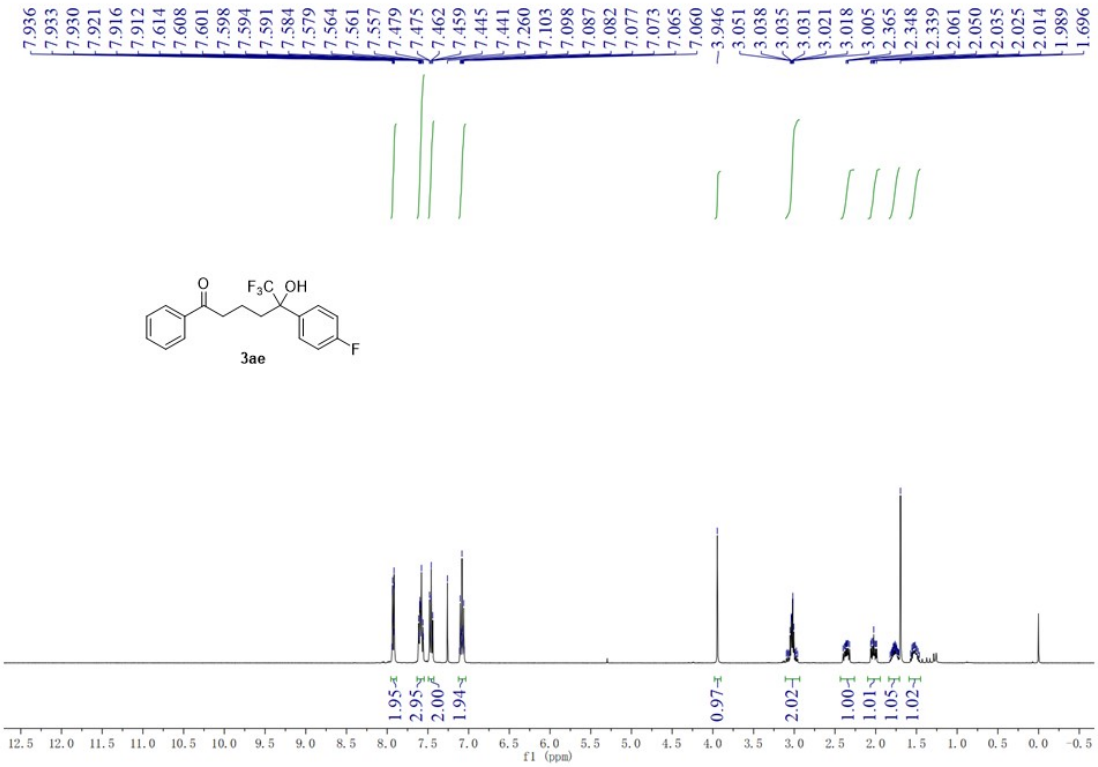
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7.564
7.561
7.557
7.479
7.475
7.462
7.459
7.445
7.441
7.260
7.103
7.098
7.087
7.082
7.077
7.073
7.065
7.060
3.946
3.051
3.038
3.035
3.031
3.021
3.018
3.005
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2.348
2.339
2.061
2.050
2.035
2.025
2.014
1.989
1.696
O
F3C
OH
F
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1.94
0.97
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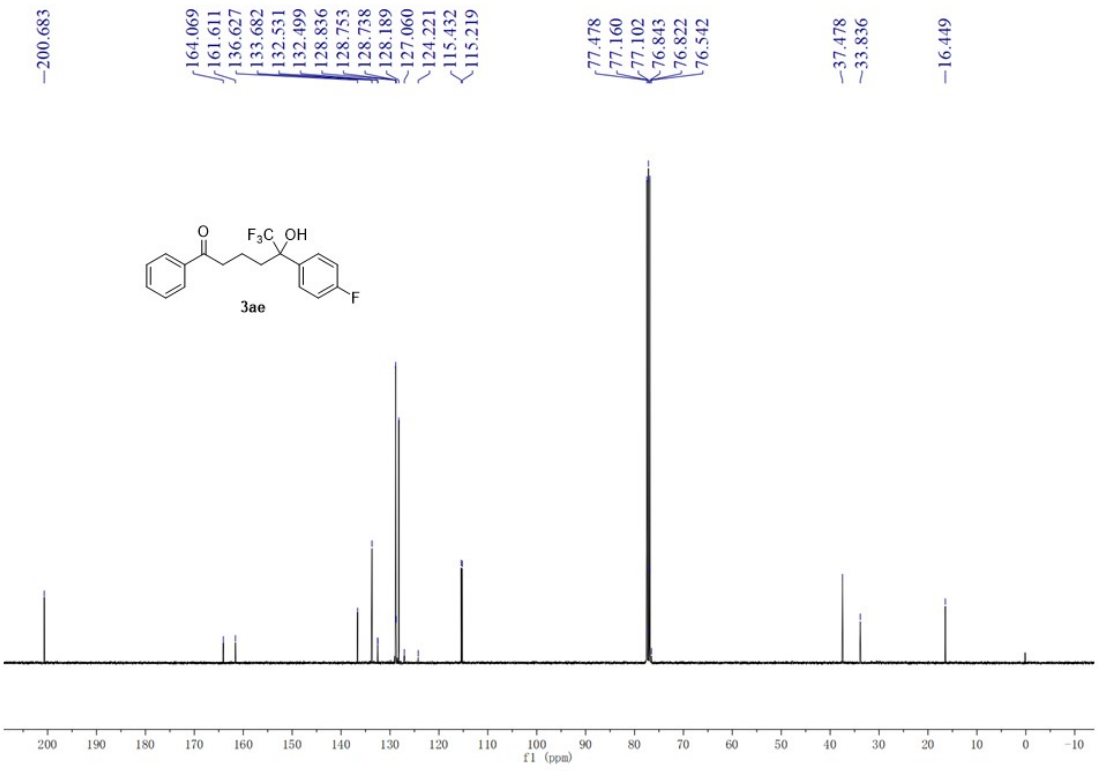
1.00
1.01
1.05
1.02
f1 (ppm)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115.432
115.219
77.478
77.160
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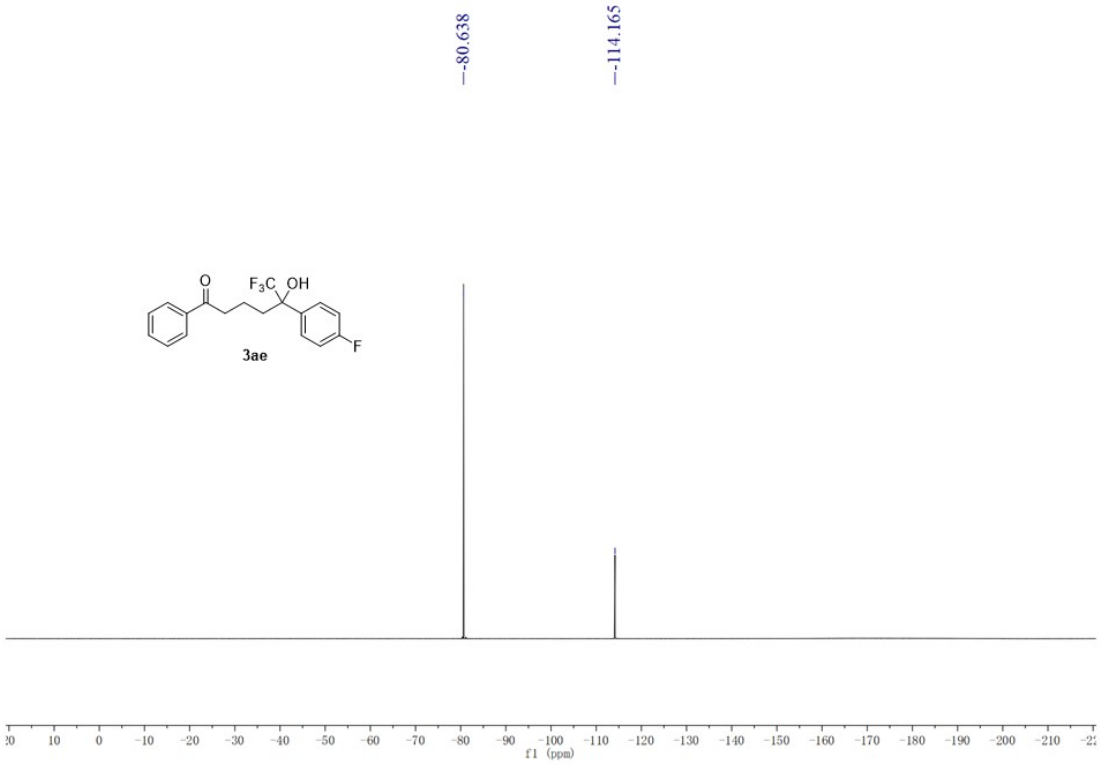
16.449
O
F3C
OH
F
3ae
f1 (ppm)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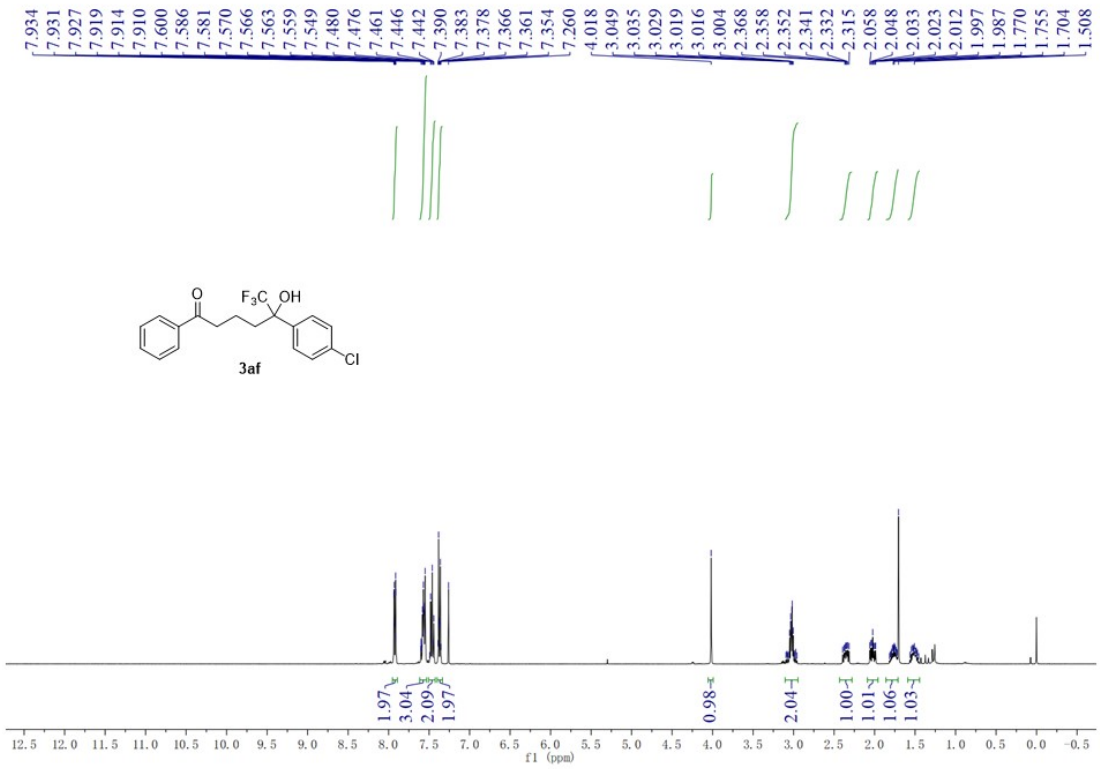
F3C OH
F
3ae
f1 (ppm)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7.563
7.559
7.549
7.480
7.476
7.461
7.446
7.442
7.390
7.383
7.378
7.366
7.361
7.354
7.260
4.018
3.049
3.035
3.029
3.019
3.016
3.004
2.368
2.358
2.352
2.341
2.332
2.315
2.058
2.048
2.033
2.023
2.012
1.997
1.987
1.770
1.755
1.704
1.508
O
F3C OH
Cl
3af
1.97
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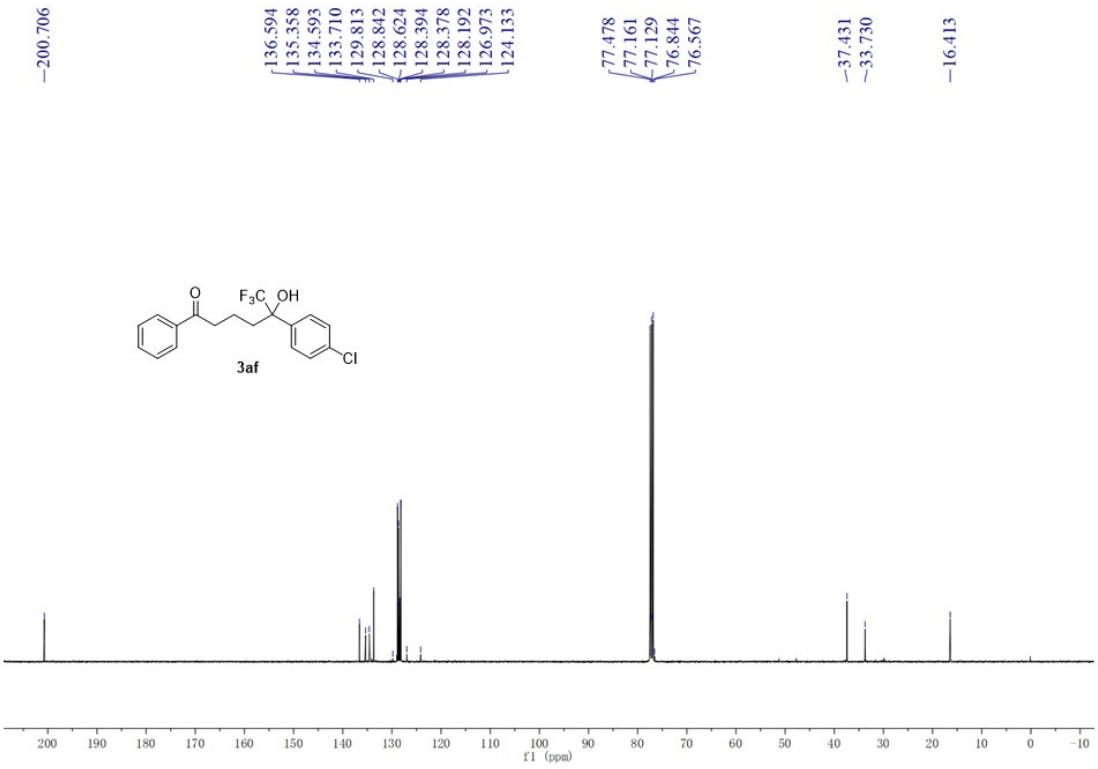
2.09
1.97
0.98
2.04
1.00
1.01
1.06
1.03
f1 (ppm)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128.192
126.973
124.133
77.478
77.161
77.129
76.844
76.567
37.431
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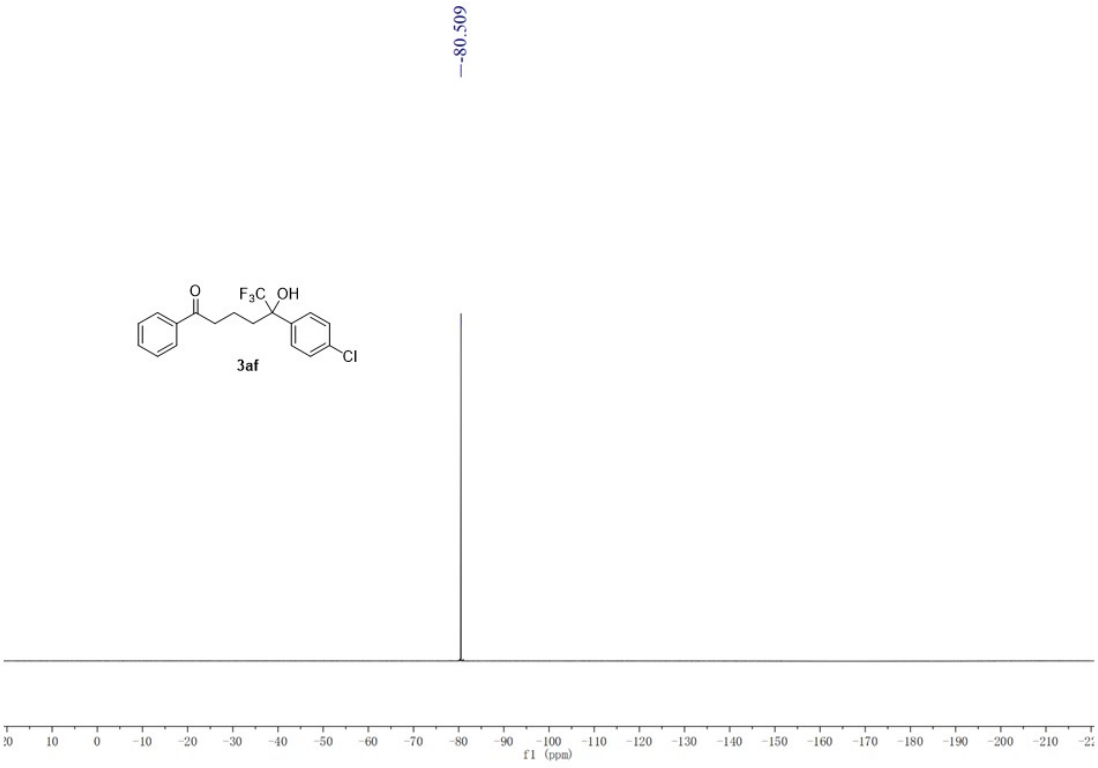
O
F3C
OH
Cl
3af
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-80.509
O
F3C
OH
Cl
3af
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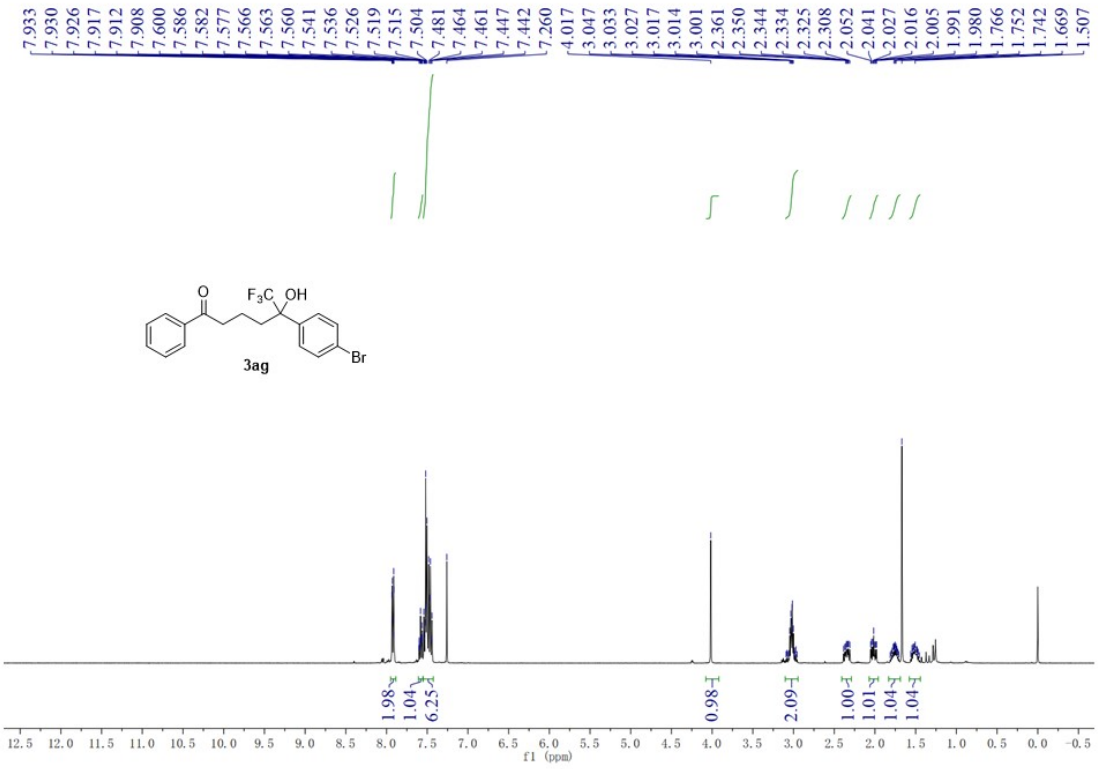
f1 (ppm)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7.560
7.541
7.536
7.526
7.519
7.515
7.504
7.481
7.464
7.461
7.447
7.442
7.260
4.017
3.047
3.033
3.027
3.017
3.014
3.001
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2.350
2.344
2.334
2.325
2.308
2.052
2.041
2.027
2.016
2.005
1.991
1.980
1.766
1.752
1.742
1.669
1.507
O
F3C
OH
Br
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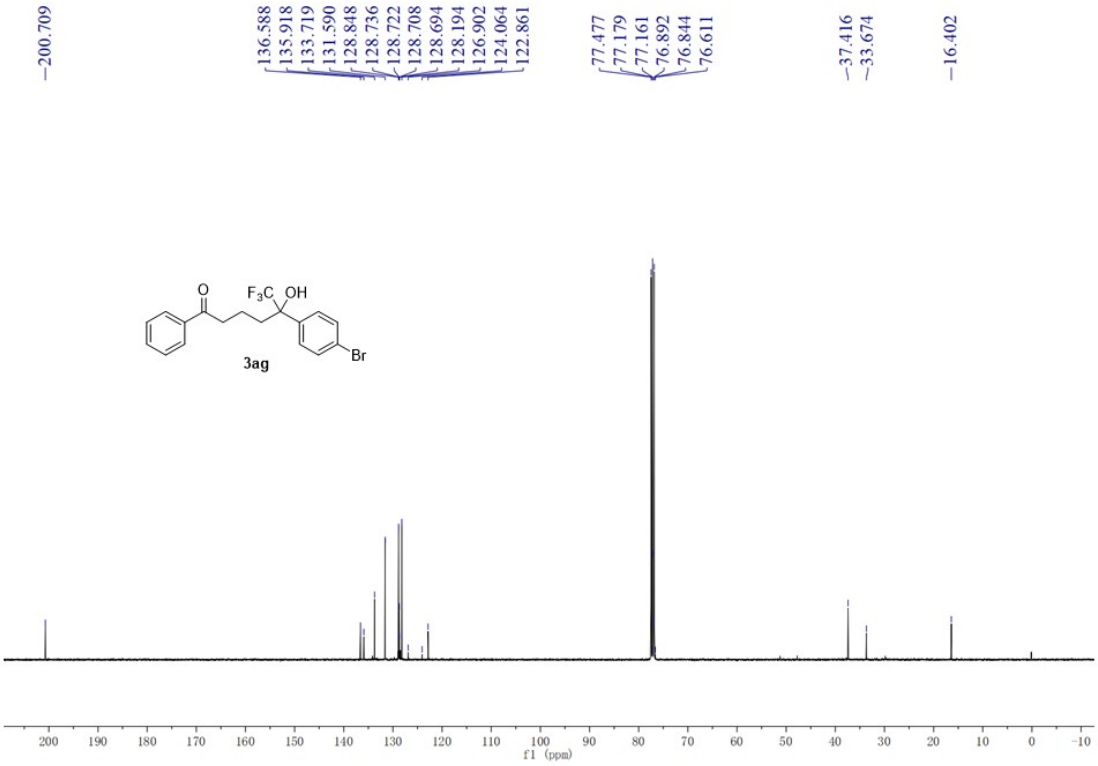
1.04
6.25
0.98
2.09
1.00
1.01
1.04
1.04
f1 (ppm)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122.861
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77.179
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76.611
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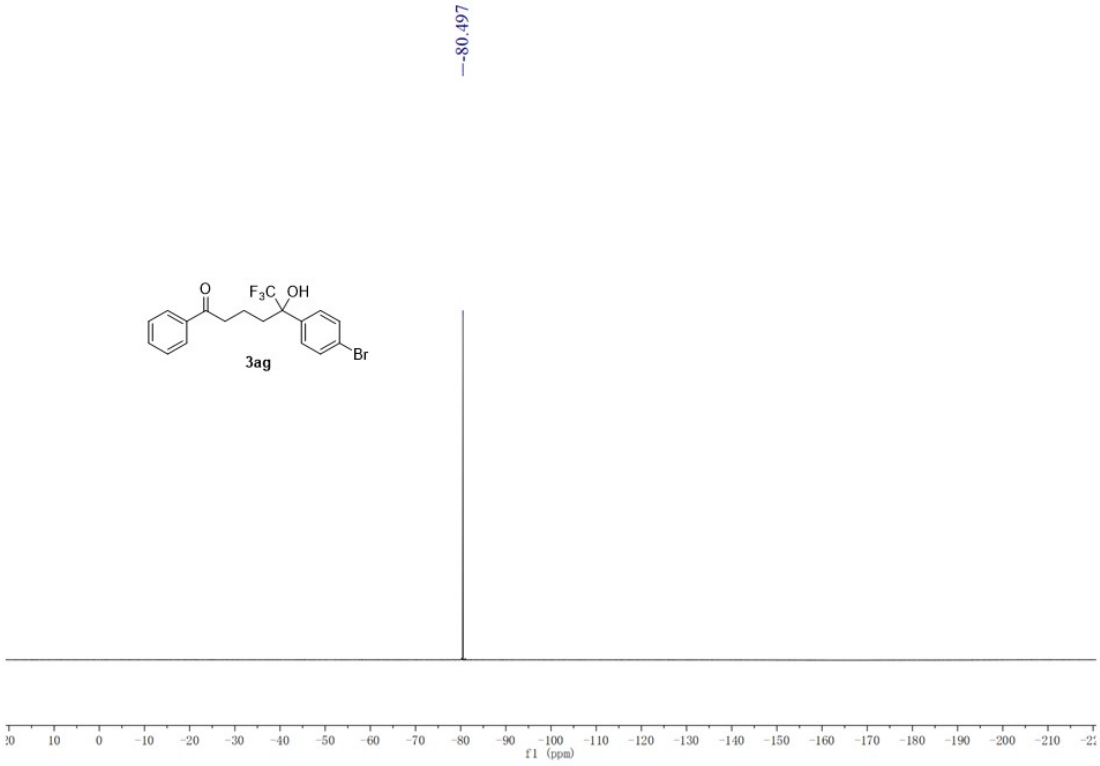
O
F3C
OH
Br
3ag
f1 (ppm)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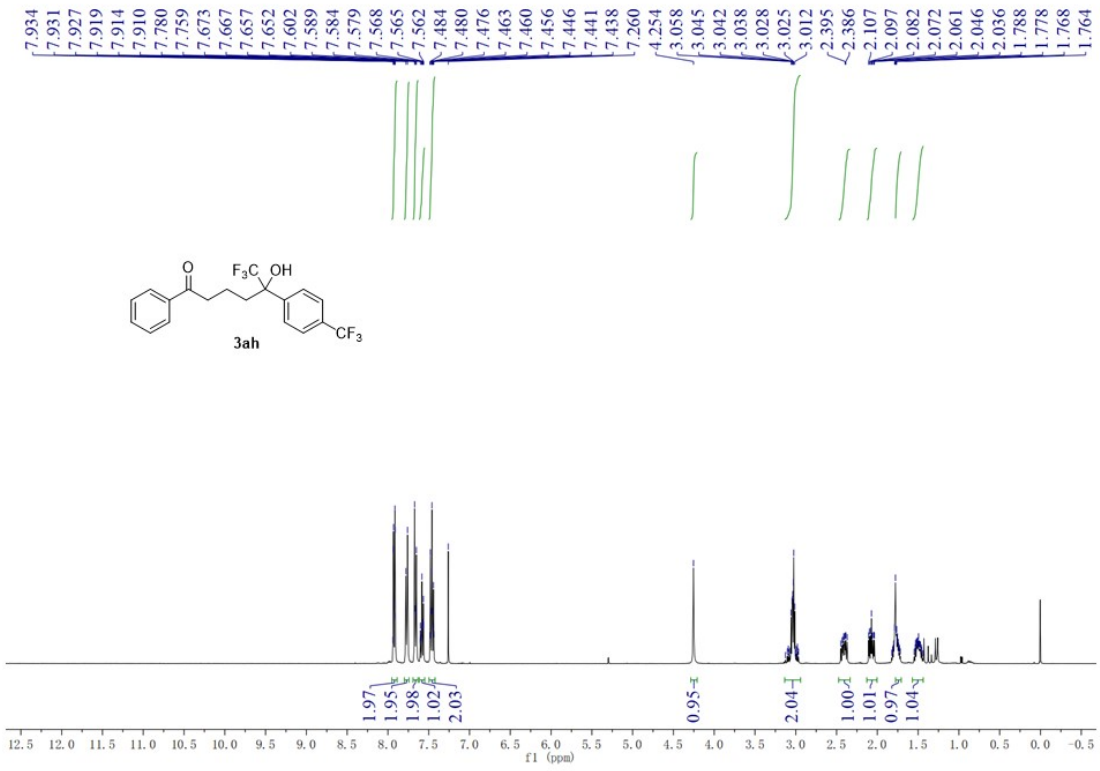
OH
Br
3ag
f1 (ppm)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7.589
7.584
7.579
7.568
7.565
7.562
7.484
7.480
7.476
7.463
7.460
7.456
7.446
7.441
7.438
7.260
4.254
3.058
3.045
3.042
3.038
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3.025
3.012
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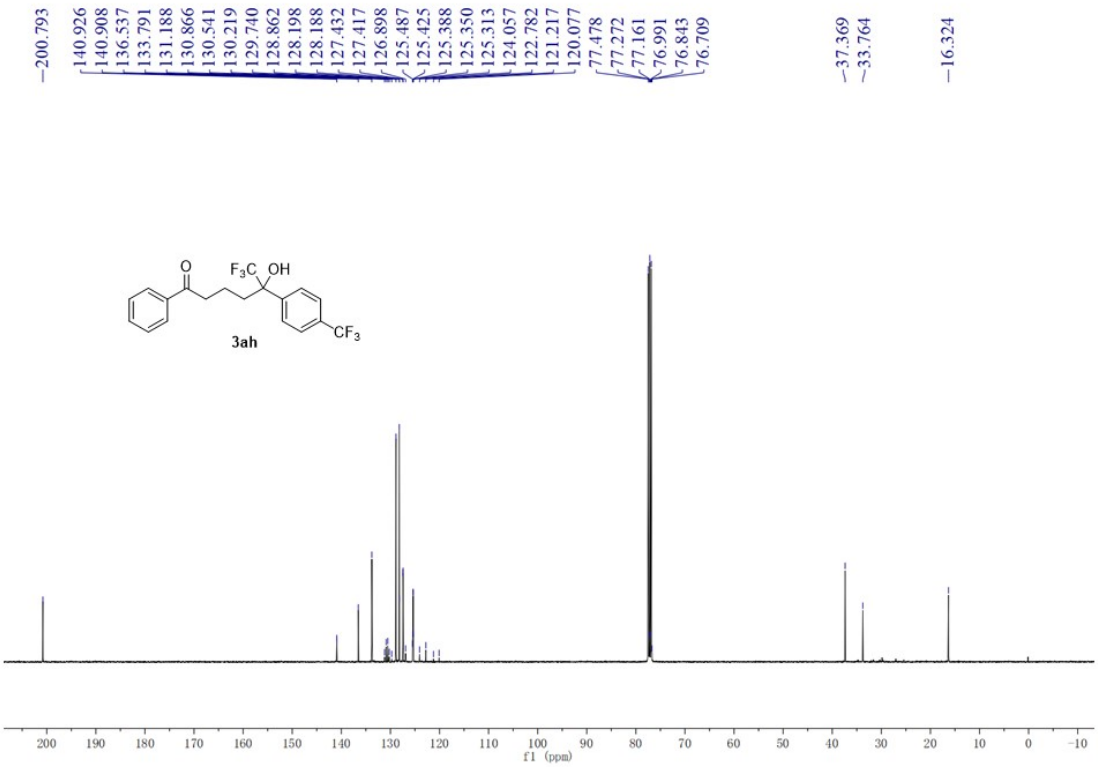
2.082
2.072
2.061
2.046
2.036
1.788
1.778
1.768
1.764
O
F3C
OH
CF3
3ah
1.97
1.95
1.98
1.02
2.03
0.95
2.04
1.00
1.01
0.97
1.04
f1 (ppm)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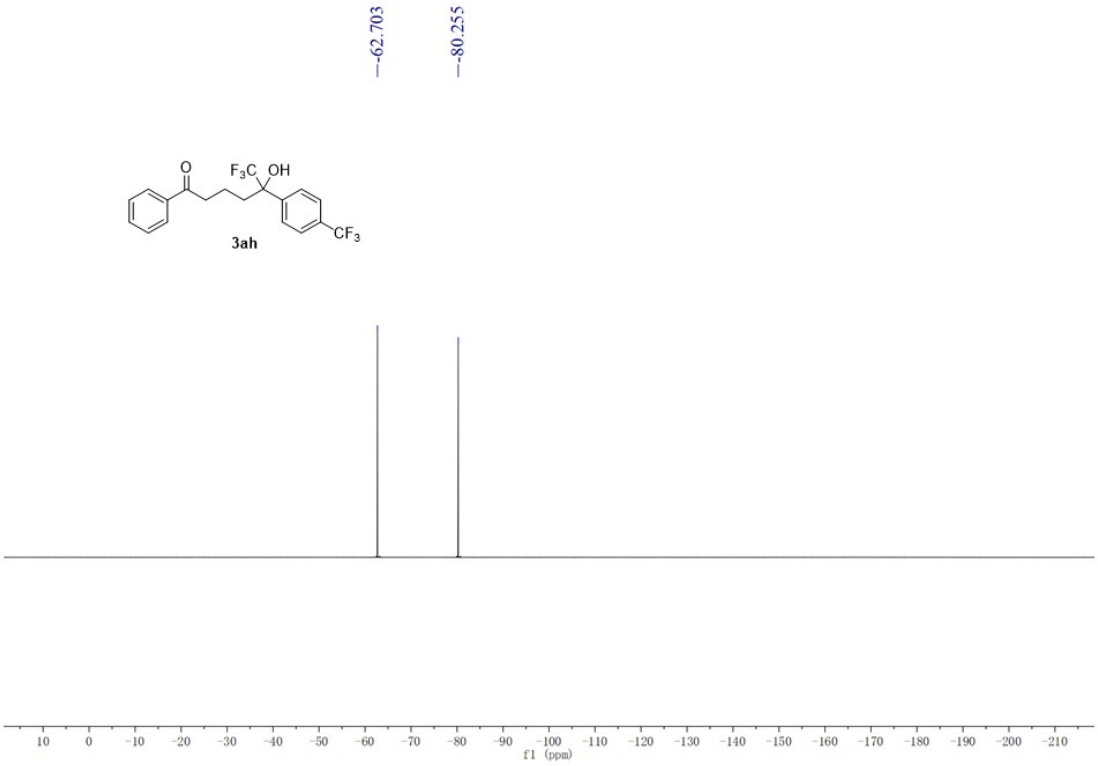
127.432
127.417
126.898
125.487
125.425
125.388
125.350
125.313
124.057
122.782
121.217
120.077
77.478
77.272
77.161
76.991
76.843
76.709
37.369
33.764
16.324
O
F3C
OH
CF3
3ah
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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OH
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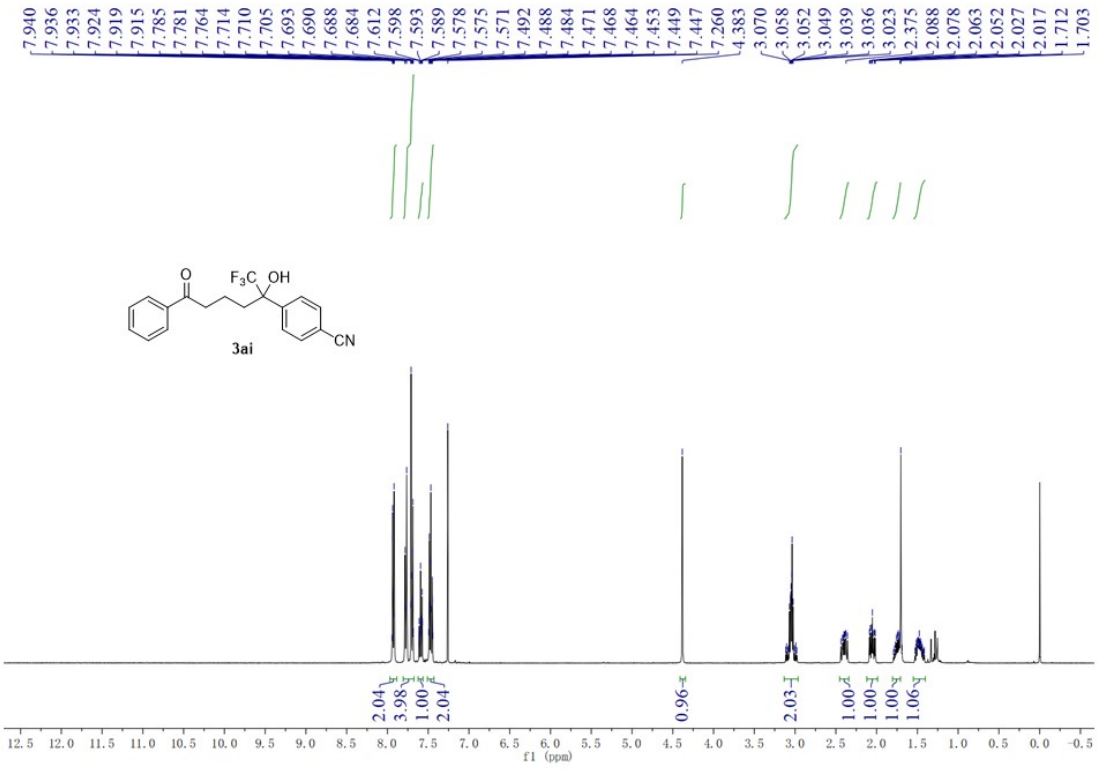
f1 (ppm)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7.714
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7.488
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7.468
7.464
7.453
7.449
7.447
7.260
4.383
3.070
3.058
3.052
3.049
3.039
3.036
3.023
2.375
2.088
2.078
2.063
2.052
2.027
2.017
1.712
1.703
O
F3C
OH
CN
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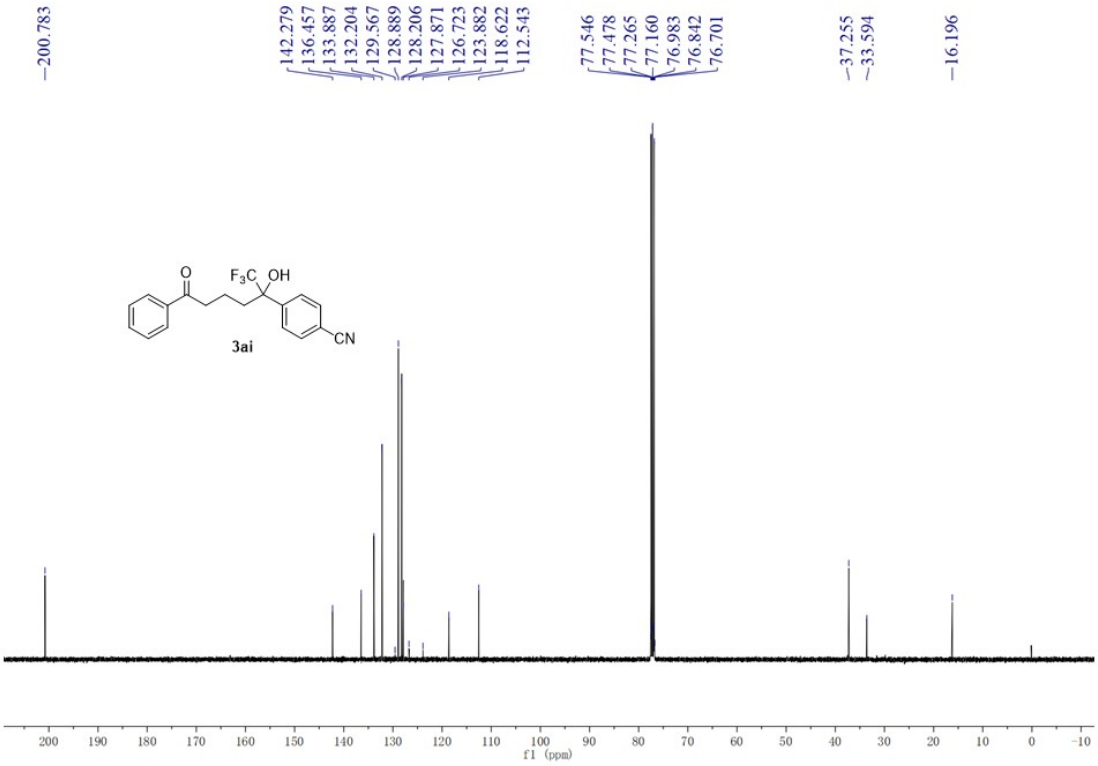
1.00
1.00
1.06
f1 (ppm)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112.543
77.546
77.478
77.265
77.160
76.983
76.842
76.701
37.255
33.594
16.196
O
F3C
OH
CN
3ai
f1 (ppm)


-80.123
O
F3C OH
CN
3ai
f1 (ppm)


8.261
8.239
7.936
7.918
7.855
7.834
7.606
7.588
7.569
7.481
7.462
7.443
7.260
4.559
3.081
3.069
3.065
3.061
3.050
3.036
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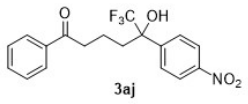
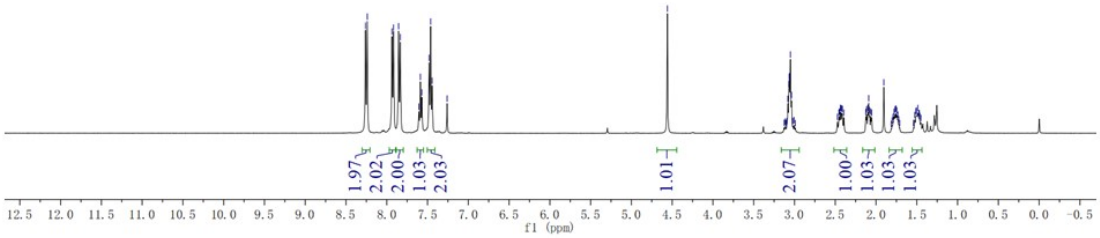
1.449


O
F3C OH
NO2
3aj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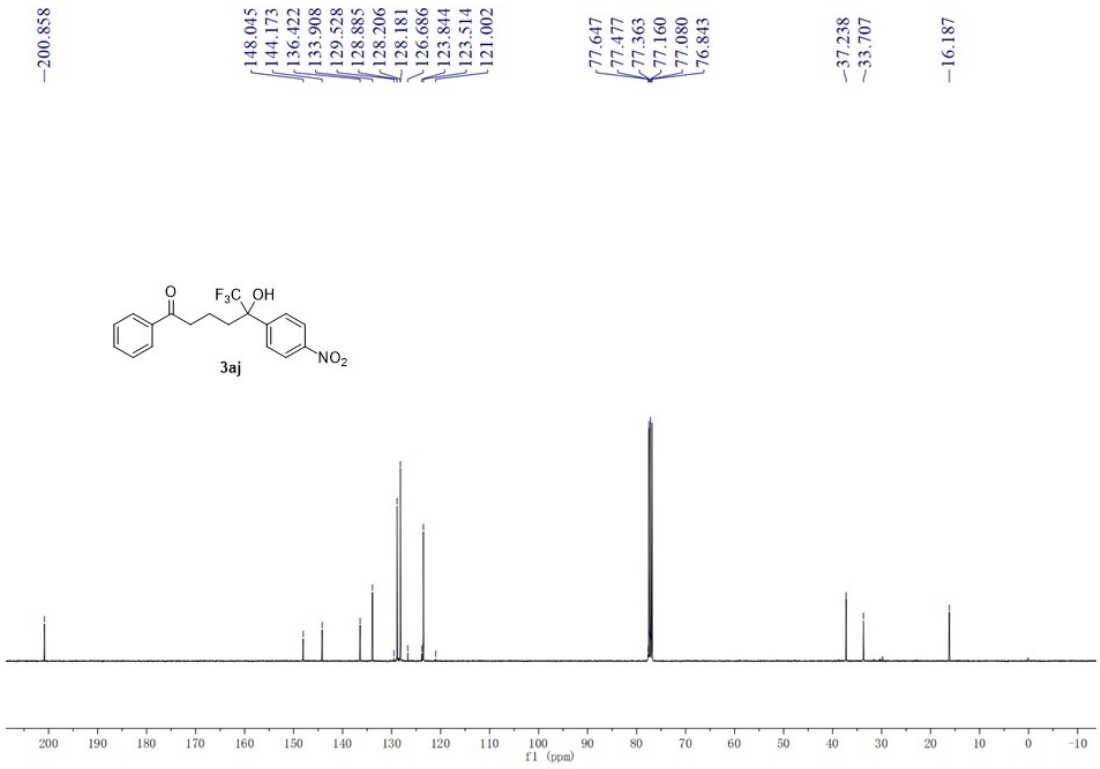
2.00
1.03
2.03
1.01
2.07
1.00
1.03
1.03
1.03
f1 (ppm)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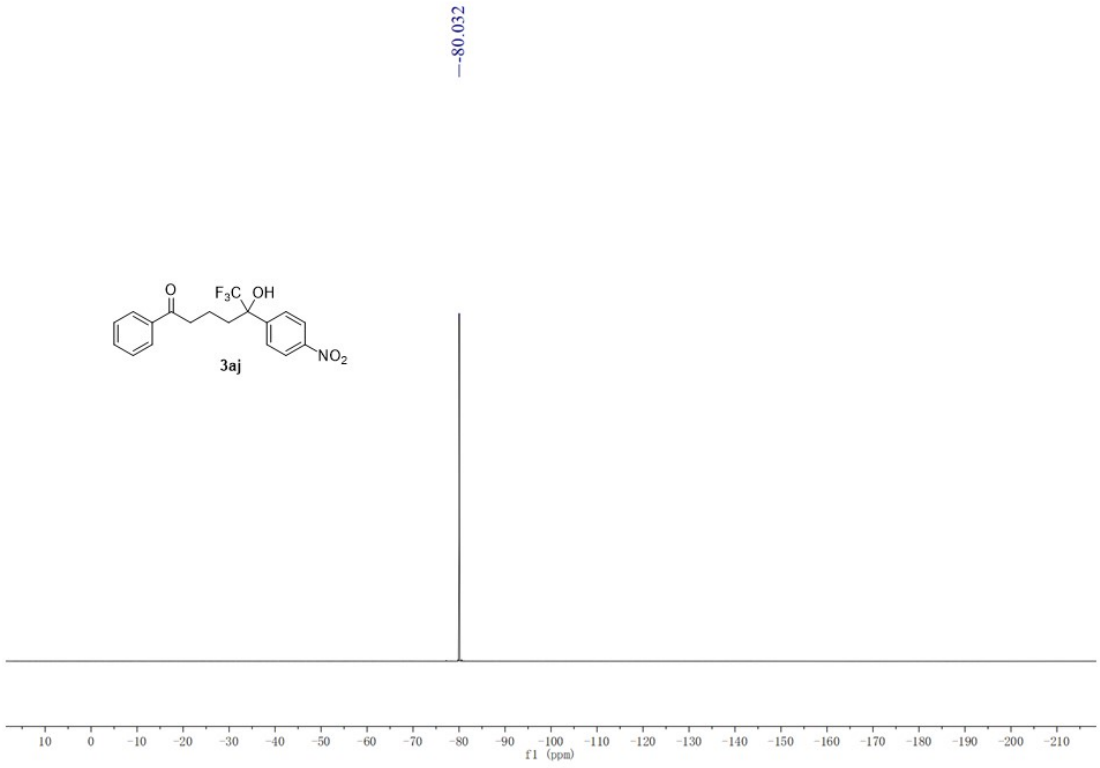
77.647
77.477
77.363
77.160
77.080
76.843
37.238
33.707
16.187
O
F3C
OH
NO2
3aj
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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OH
NO2
3aj
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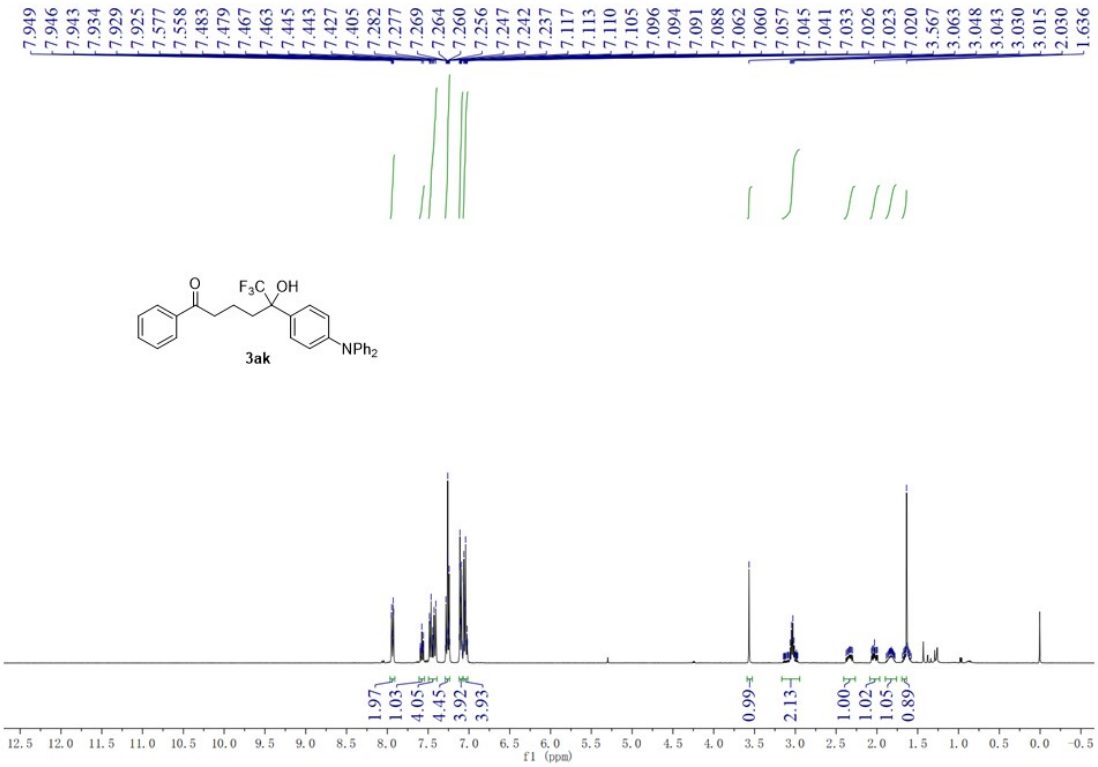
f1 (ppm)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7.256
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7.242
7.237
7.117
7.113
7.110
7.105
7.096
7.094
7.091
7.088
7.062
7.060
7.057
7.045
7.041
7.033
7.026
7.023
7.020
3.567
3.063
3.048
3.043
3.030
3.015
2.030
1.636
O
F3C
OH
NPh2
3ak
1.97
1.03
4.05
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2.13
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1.02
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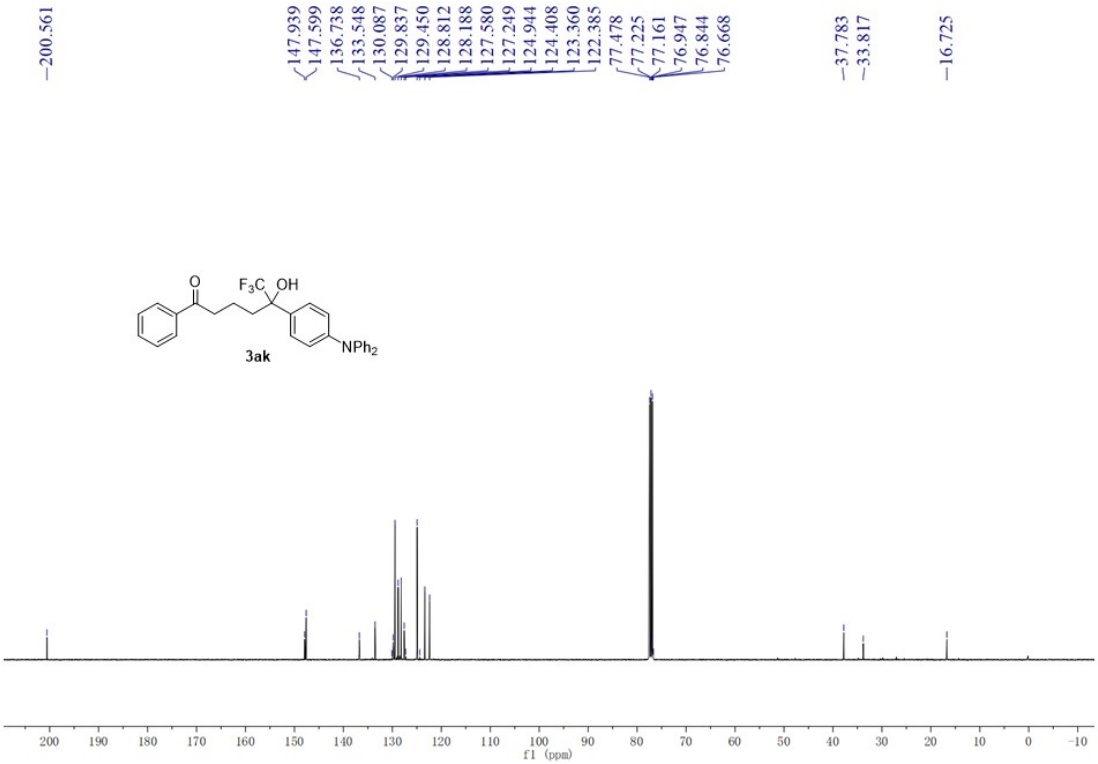
0.89
f1 (ppm)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127.249
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123.360
122.385
77.478
77.225
77.161
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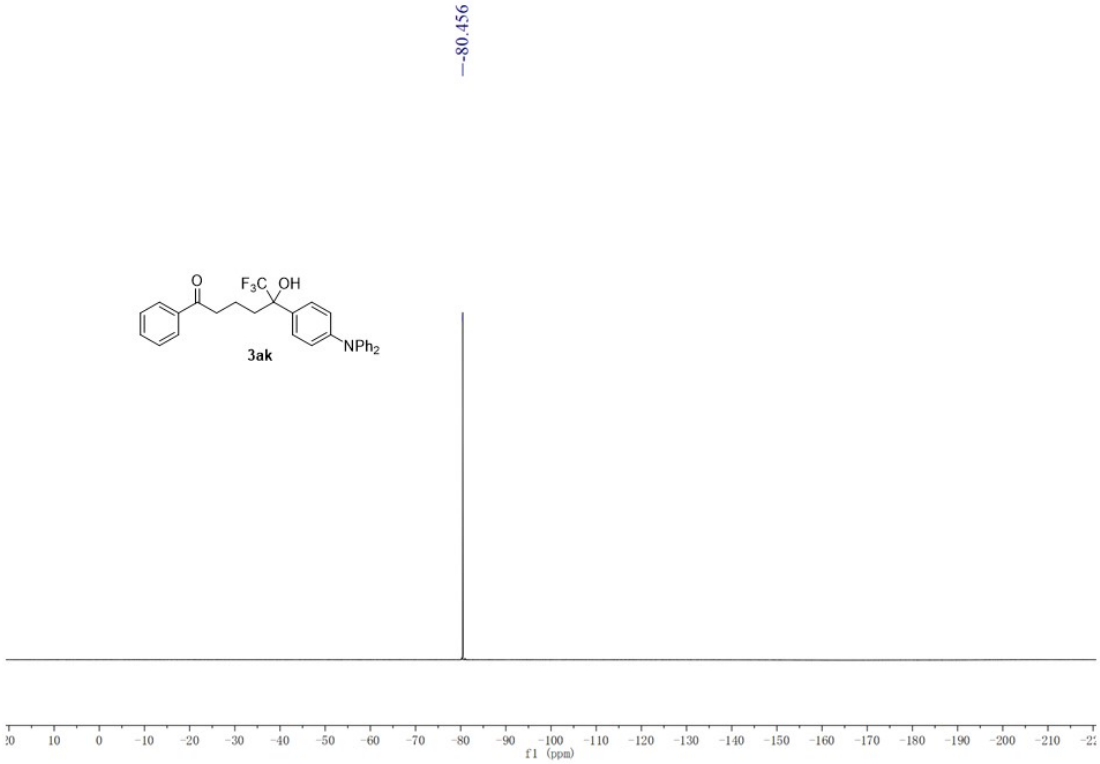
76.668
37.783
33.817
16.725
O
F3C
OH
NPh2
3ak
f1 (ppm)


-80.456
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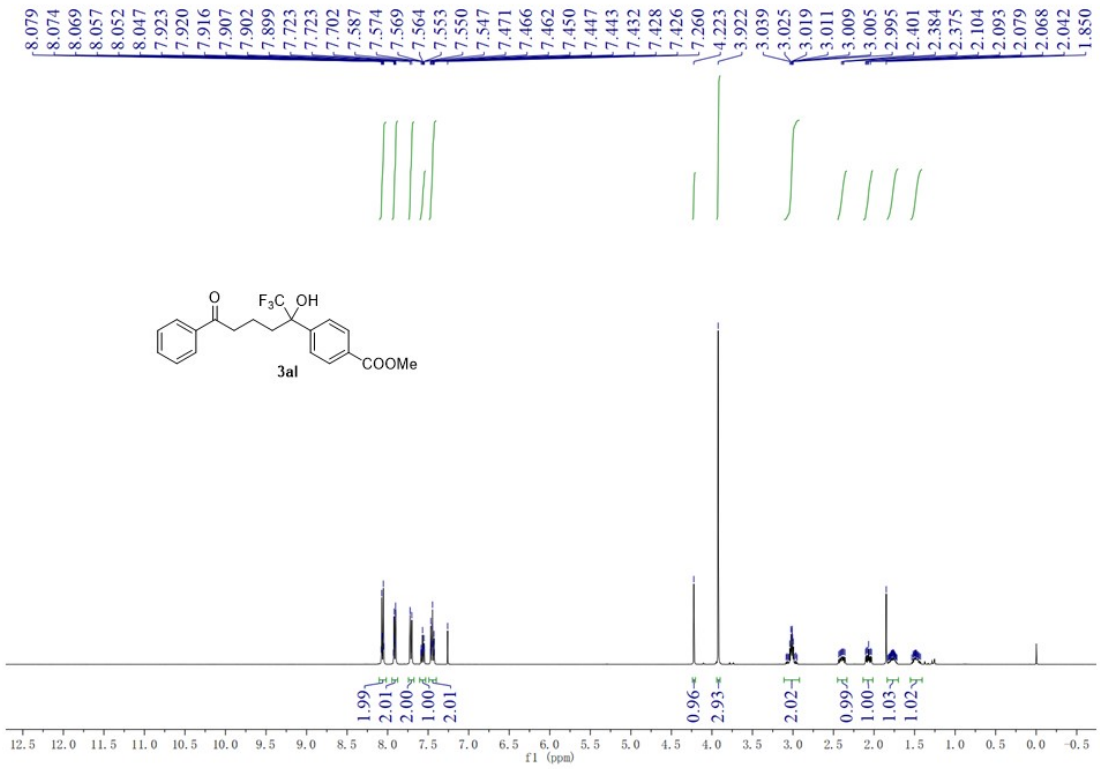
OH
NPh2
3ak
f1 (ppm)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8.069
8.057
8.052
8.047
7.923
7.920
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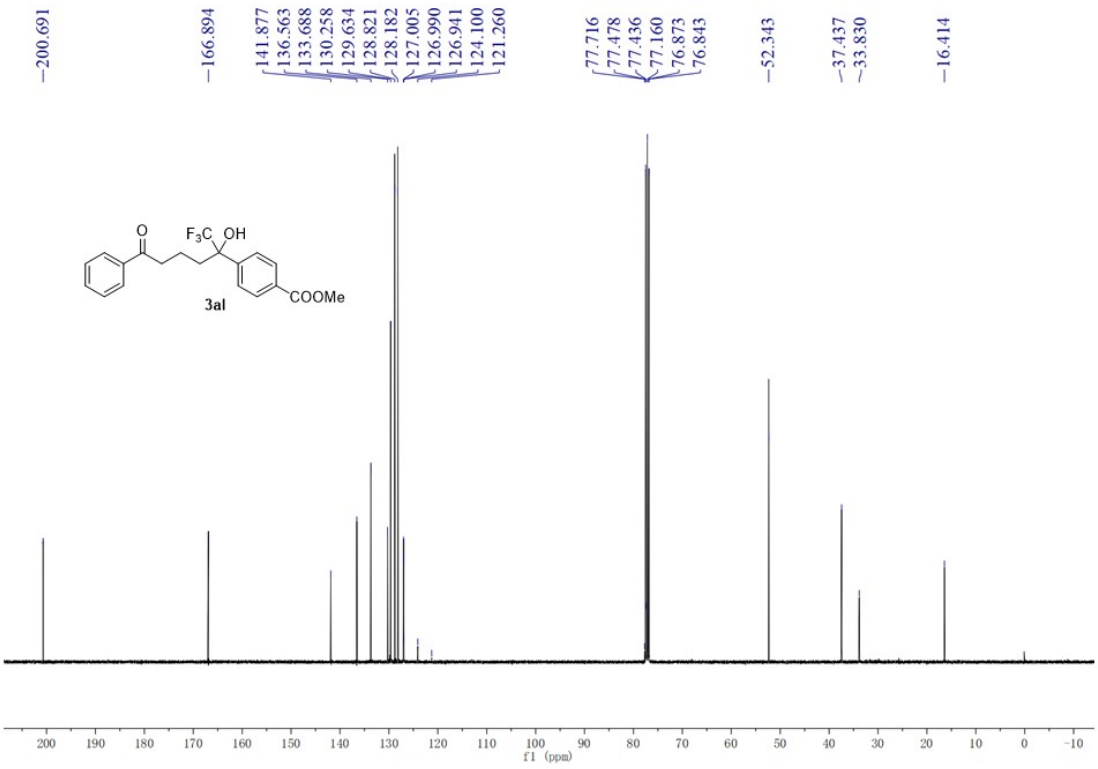
7.902
7.899
7.723
7.723
7.702
7.587
7.574
7.569
7.564
7.553
7.550
7.547
7.471
7.466
7.462
7.450
7.447
7.443
7.432
7.428
7.426
7.260
4.223
3.922
3.039
3.025
3.019
3.011
3.009
3.005
2.995
2.401
2.384
2.375
2.104
2.093
2.079
2.068
2.042
1.850
O
F3C
OH
COOMe
3al
1.99
2.01
2.00
1.00
2.01
0.96
2.93
2.02
0.99
1.00
1.03
1.02
f1 (ppm)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129.634
128.821
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127.005
126.990
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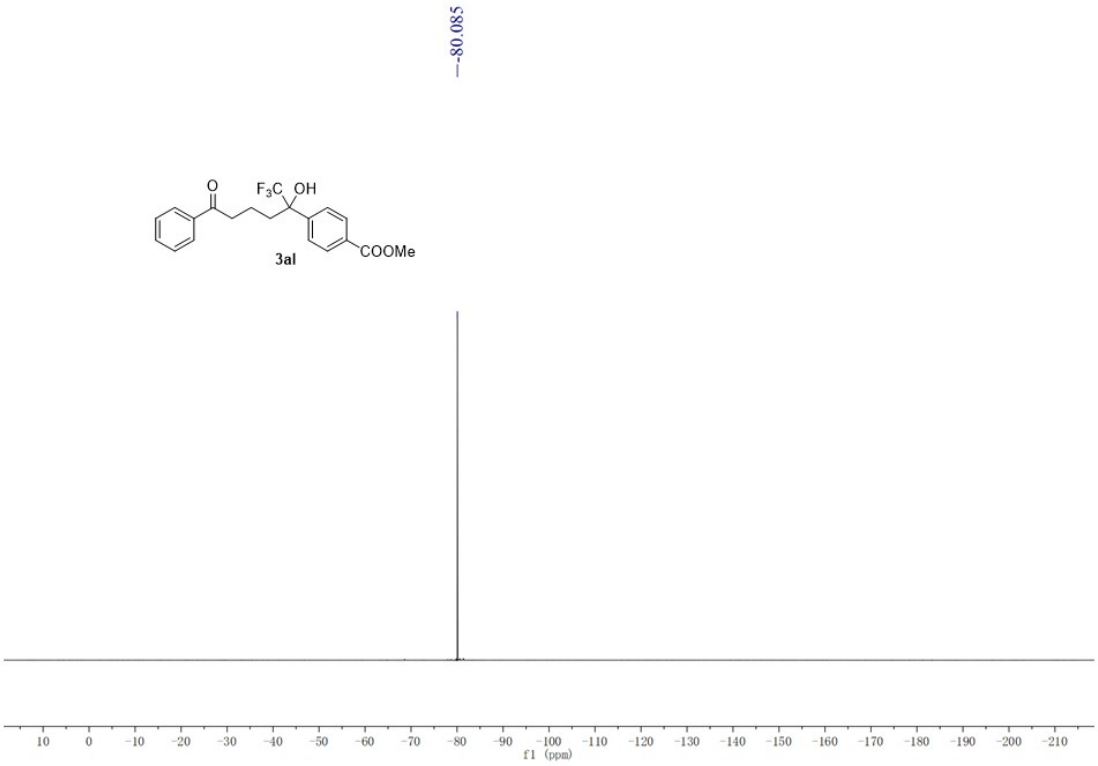
124.100
121.260
77.716
77.478
77.436
77.160
76.873
76.843
52.343
37.437
33.830
16.414
O
F3C OH
COOMe
3al
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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F3C OH
COOMe
3al
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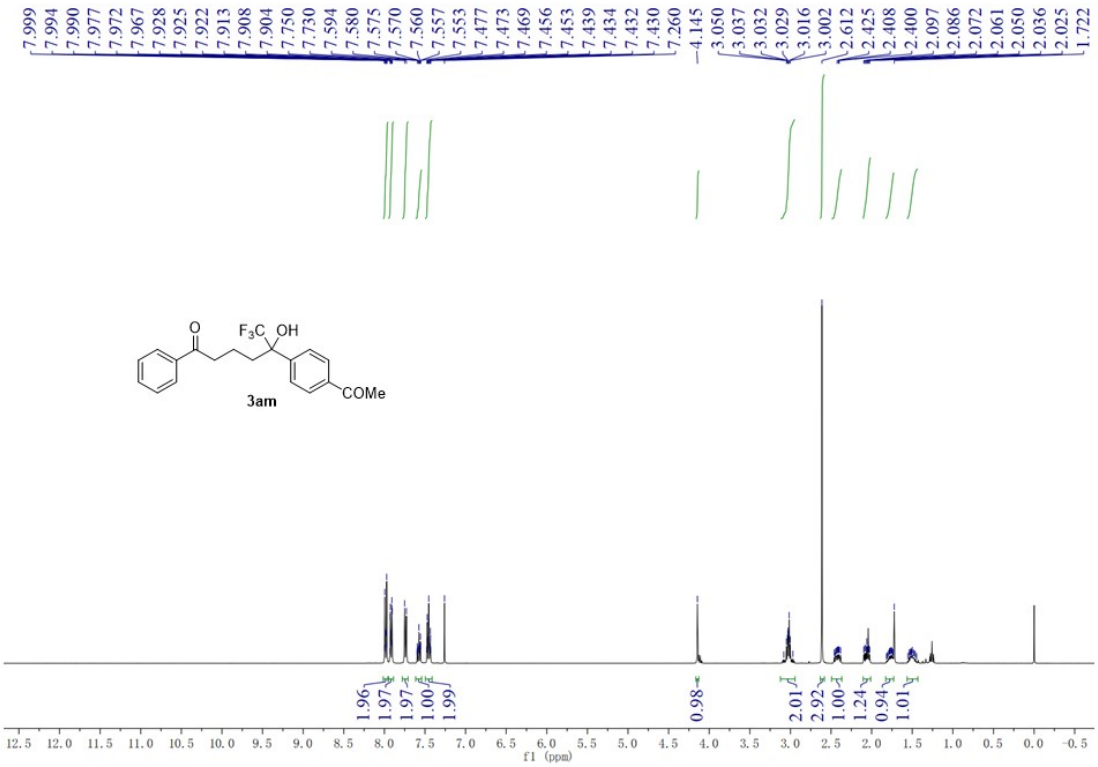
f1 (ppm)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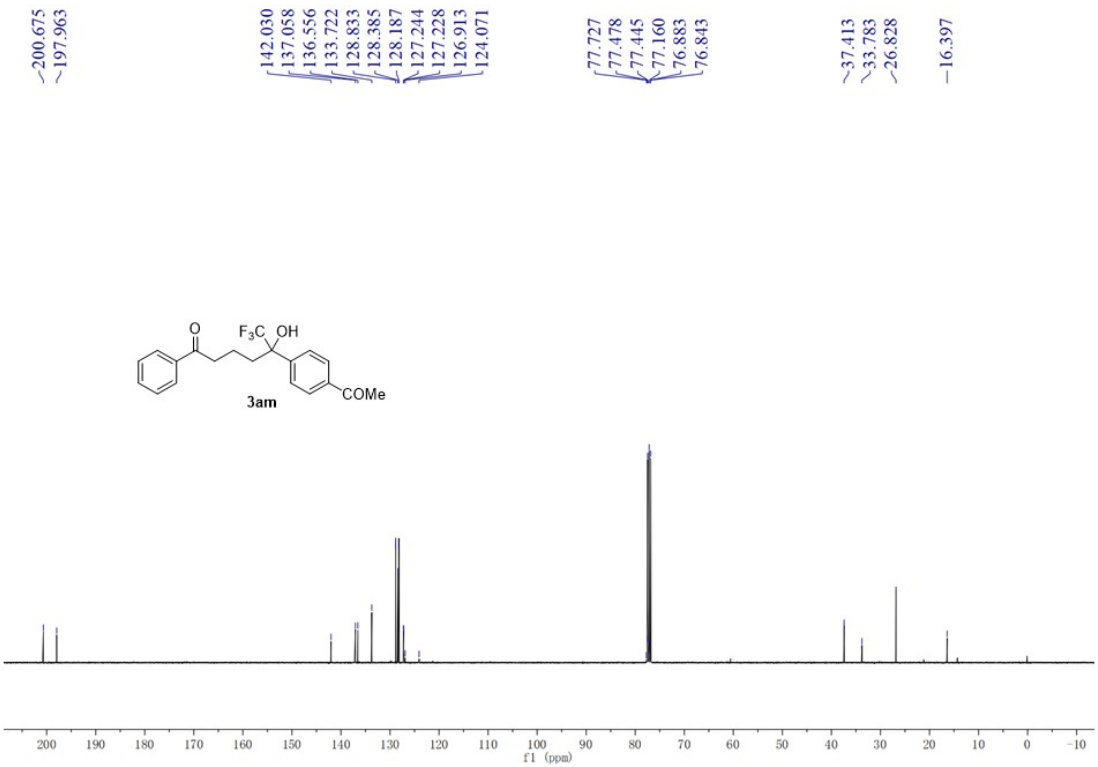
7.925
7.922
7.913
7.908
7.904
7.750
7.730
7.594
7.580
7.575
7.570
7.560
7.557
7.553
7.477
7.473
7.469
7.456
7.453
7.439
7.434
7.432
7.430
7.260
4.145
3.050
3.037
3.032
3.029
3.016
3.002
2.612
2.425
2.408
2.400
2.097
2.086
2.072
2.061
2.050
2.036
2.025
1.722
O
F3C
OH
COMe
3am
1.96
1.97
1.97
1.00
1.99
0.98
2.01
2.92
1.00
1.24
0.94
1.01
f1 (ppm)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128.385
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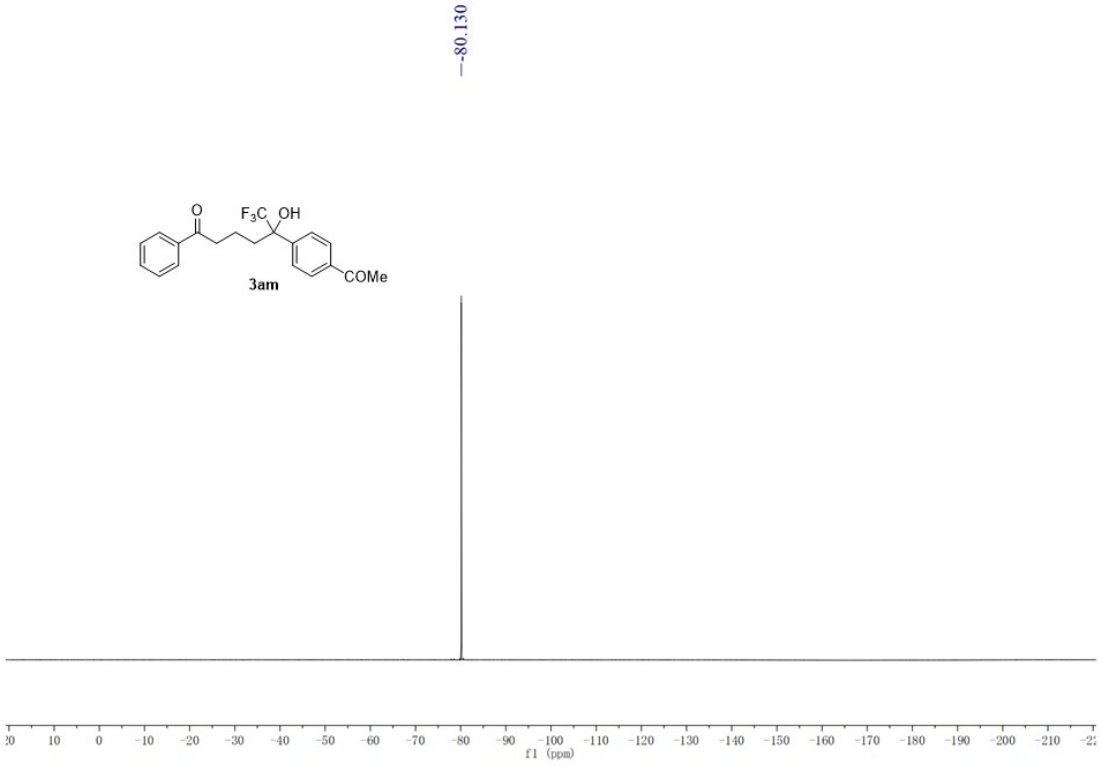
127.244
127.228
126.913
124.071
77.727
77.478
77.445
77.160
76.883
76.843
37.413
33.783
26.828
16.397
O
F3C
OH
COMe
3am
f1 (ppm)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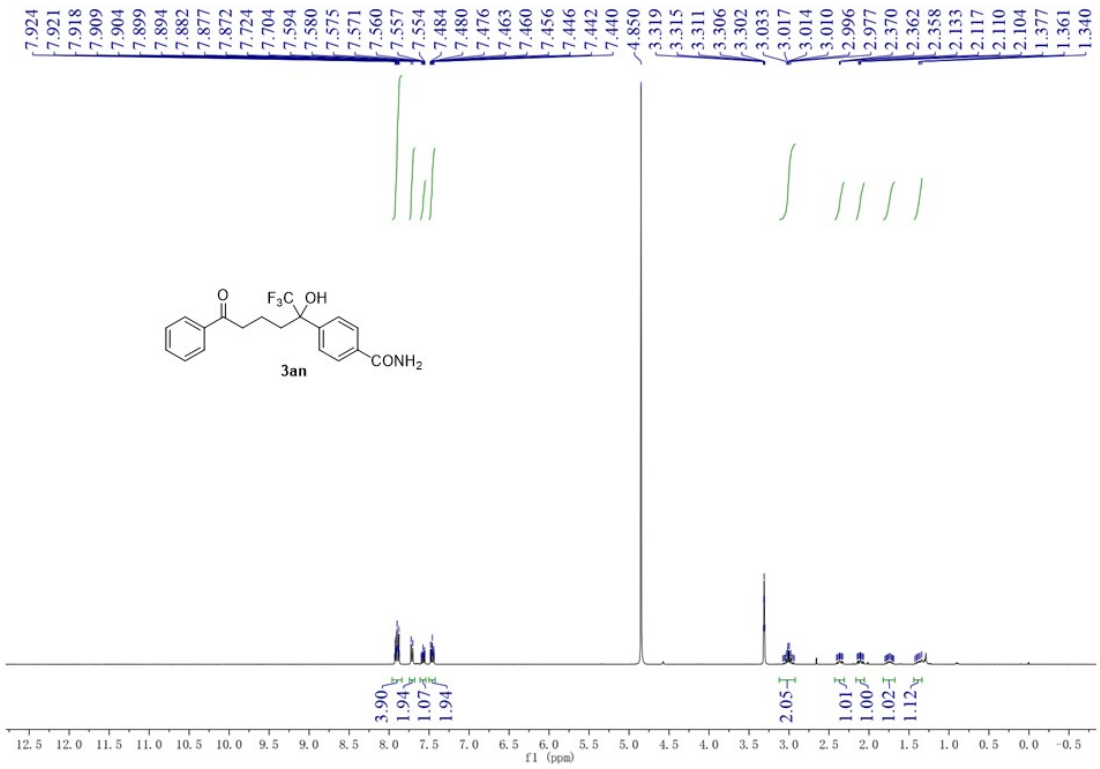
O
F3C OH
COMe
3am
f1 (ppm)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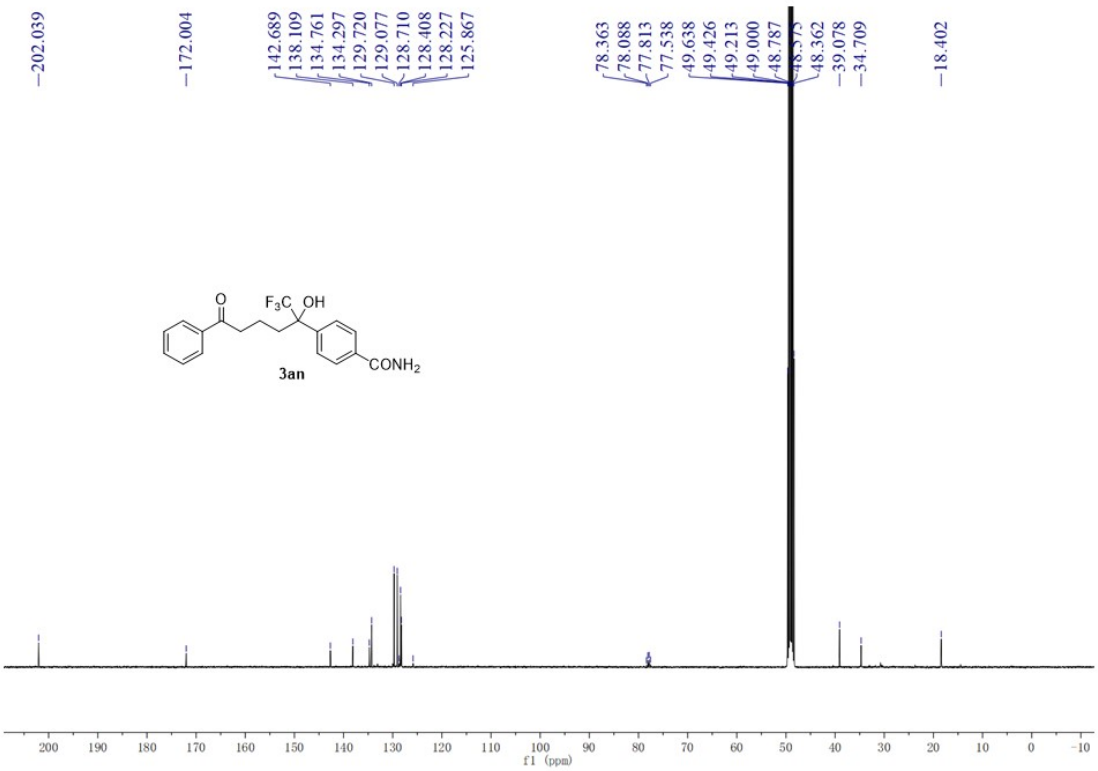
7.909
7.904
7.899
7.894
7.882
7.877
7.872
7.724
7.704
7.594
7.580
7.575
7.571
7.560
7.557
7.554
7.484
7.480
7.476
7.463
7.460
7.456
7.446
7.442
7.440
4.850
3.319
3.315
3.311
3.306
3.302
3.033
3.017
3.014
3.010
2.996
2.977
2.370
2.362
2.358
2.133
2.117
2.110
2.104
1.377
1.361
1.340
O
F3C OH
CONH2
3an
3.90
1.94
1.07
1.94
2.05
1.01
1.00
1.02
1.12
f1 (ppm)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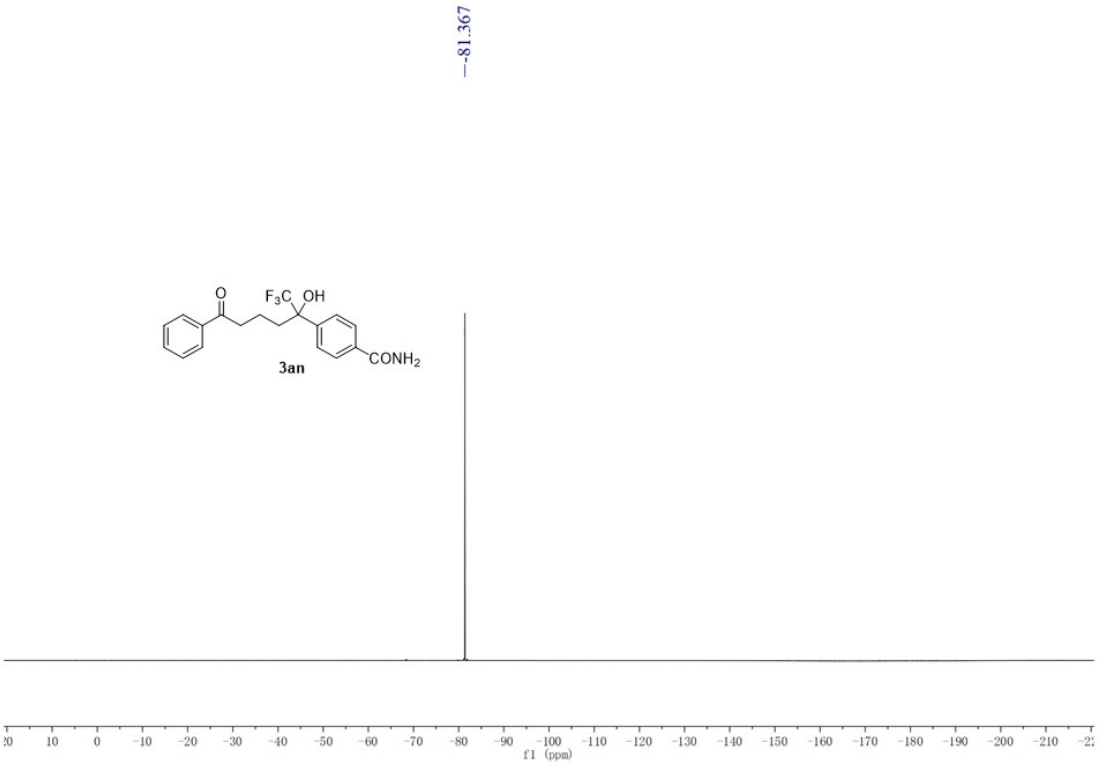
134.761
134.297
129.720
129.077
128.710
128.408
128.227
125.867
78.363
78.088
77.813
77.538
49.638
49.426
49.213
49.000
48.787
48.362
39.078
34.709
18.402
O
F3C
OH
CONH2
3an
f1 (ppm)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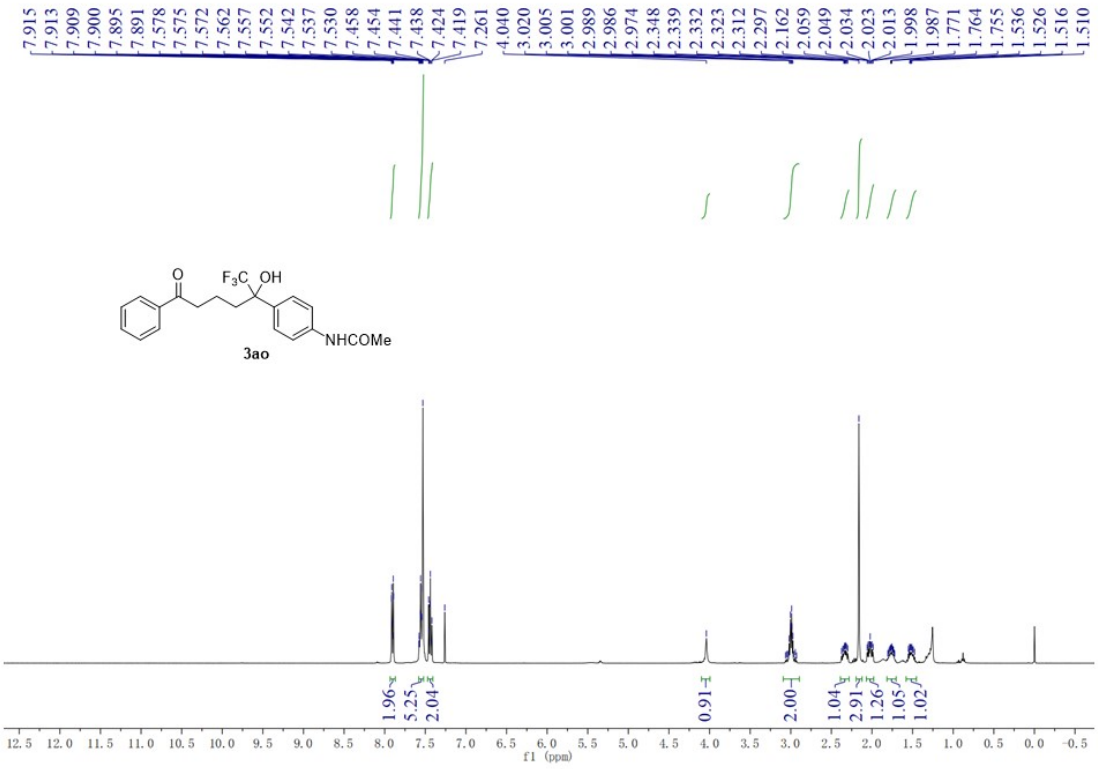
O
F3C
OH
CONH2
3an
f1 (ppm)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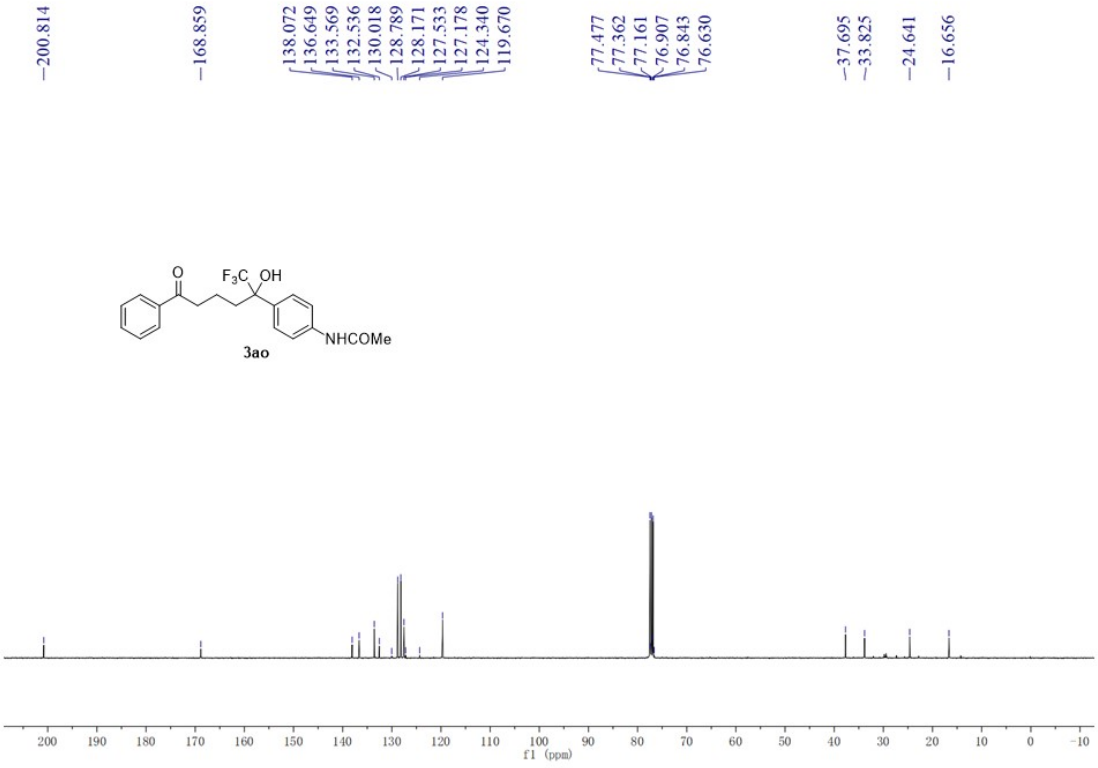
7.900
7.895
7.891
7.578
7.575
7.572
7.562
7.557
7.552
7.542
7.537
7.530
7.458
7.454
7.441
7.438
7.424
7.419
7.261
4.040
3.020
3.005
3.001
2.989
2.986
2.974
2.348
2.339
2.332
2.323
2.312
2.297
2.162
2.059
2.049
2.034
2.023
2.013
1.998
1.987
1.771
1.764
1.755
1.536
1.526
1.516
1.510
O
F3C
OH
NHCOMe
3ao
1.96
5.25
2.04
0.91
2.00
1.04
2.91
1.26
1.05
1.02
f1 (ppm)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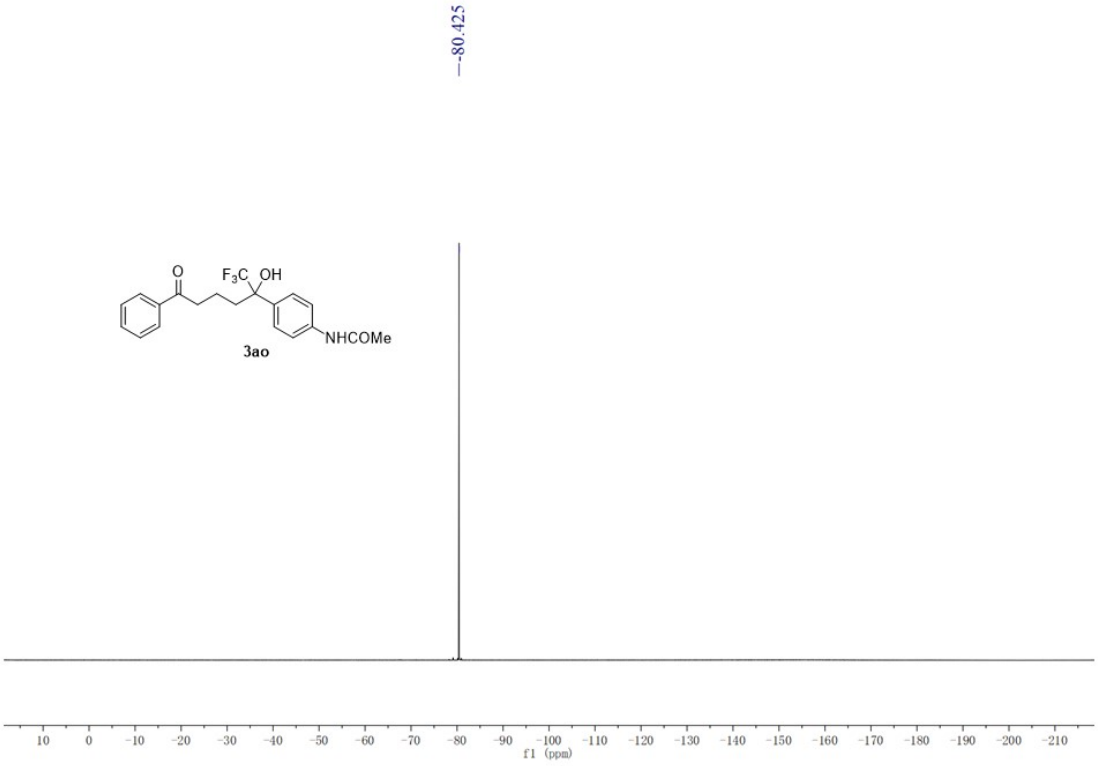
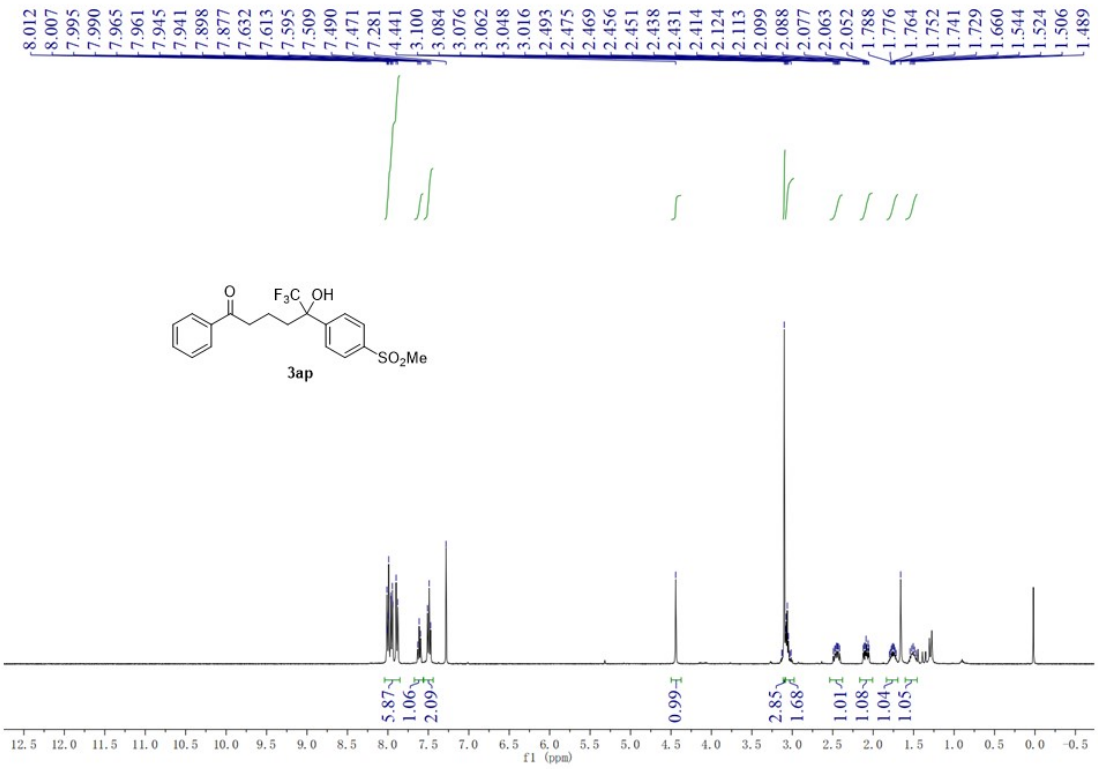
128.789
128.171
127.533
127.178
124.340
119.670
77.477
77.362
77.161
76.907
76.843
76.630
37.695
33.825
24.641
16.656
O
F3C
OH
NHCOMe
3ao
f1 (ppm)


-80.425
O
F3C OH
NHCOMe
3ao
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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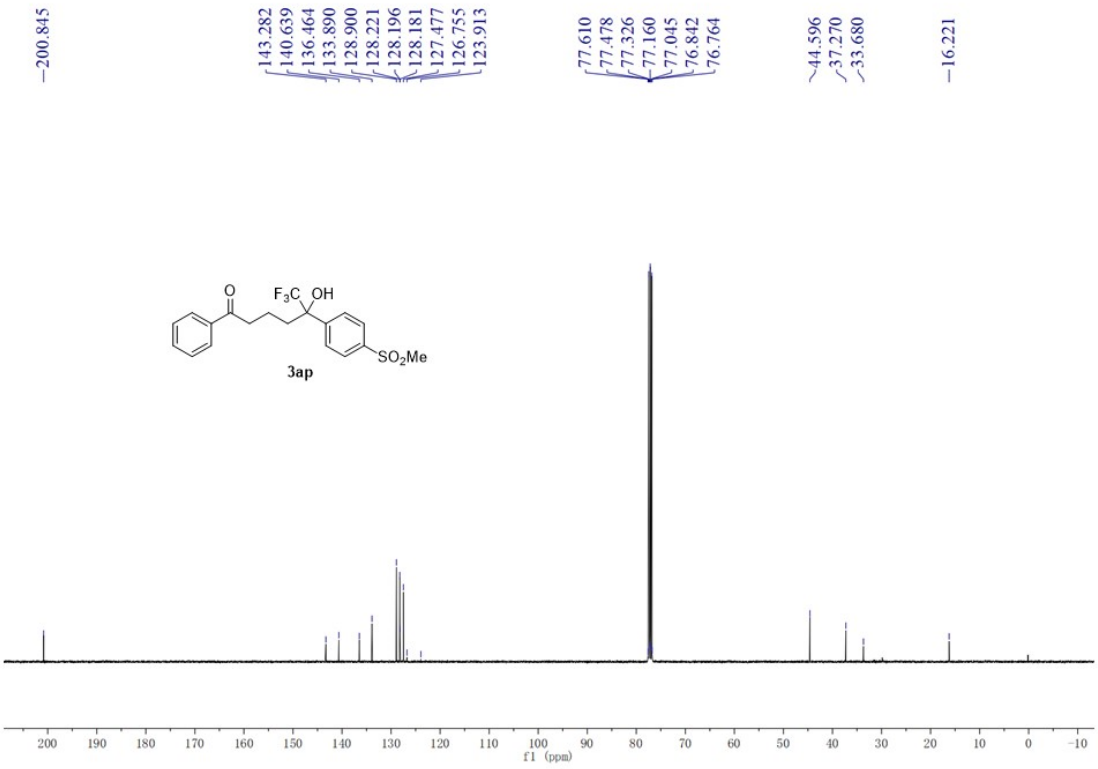
7.941
7.898
7.877
7.632
7.613
7.595
7.509
7.490
7.471
7.281
4.441
3.100
3.084
3.076
3.062
3.048
3.016
2.493
2.475
2.469
2.456
2.451
2.438
2.431
2.414
2.124
2.113
2.099
2.088
2.077
2.063
2.052
1.788
1.776
1.764
1.752
1.741
1.729
1.660
1.544
1.524
1.506
1.489
O
F3C OH
SO2Me
3ap
5.87
1.06
2.09
0.99
2.85
1.68
1.01
1.08
1.04
1.05
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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128.221
128.196
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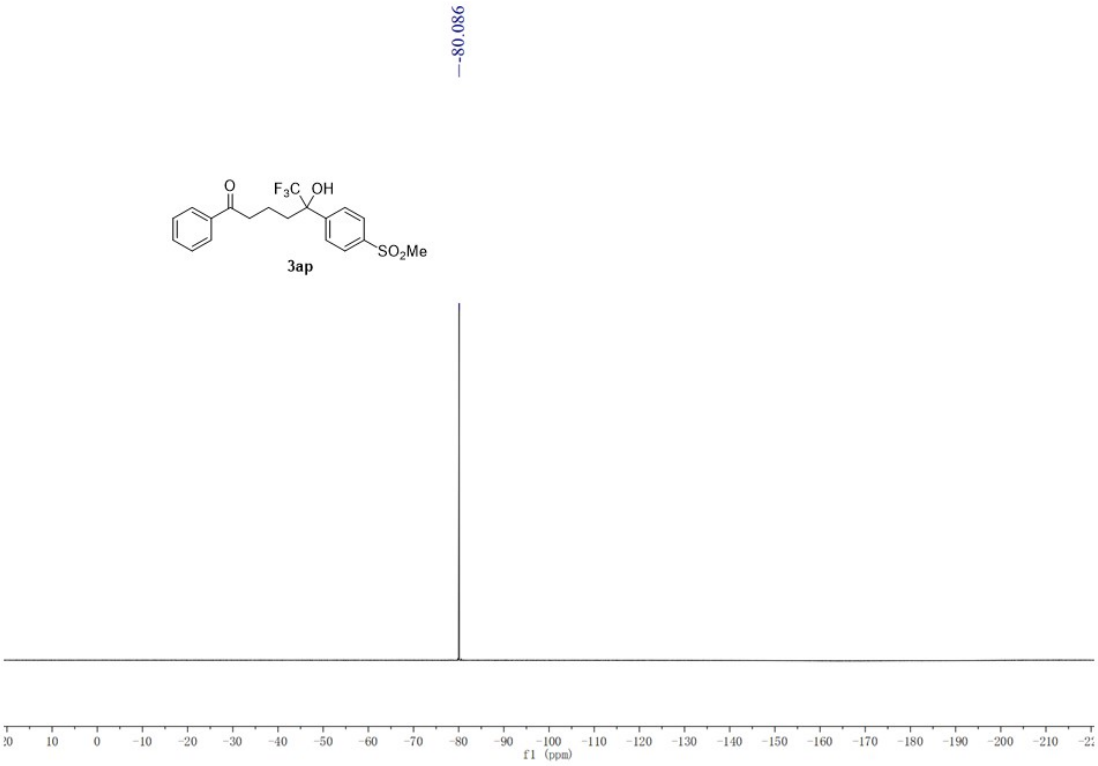
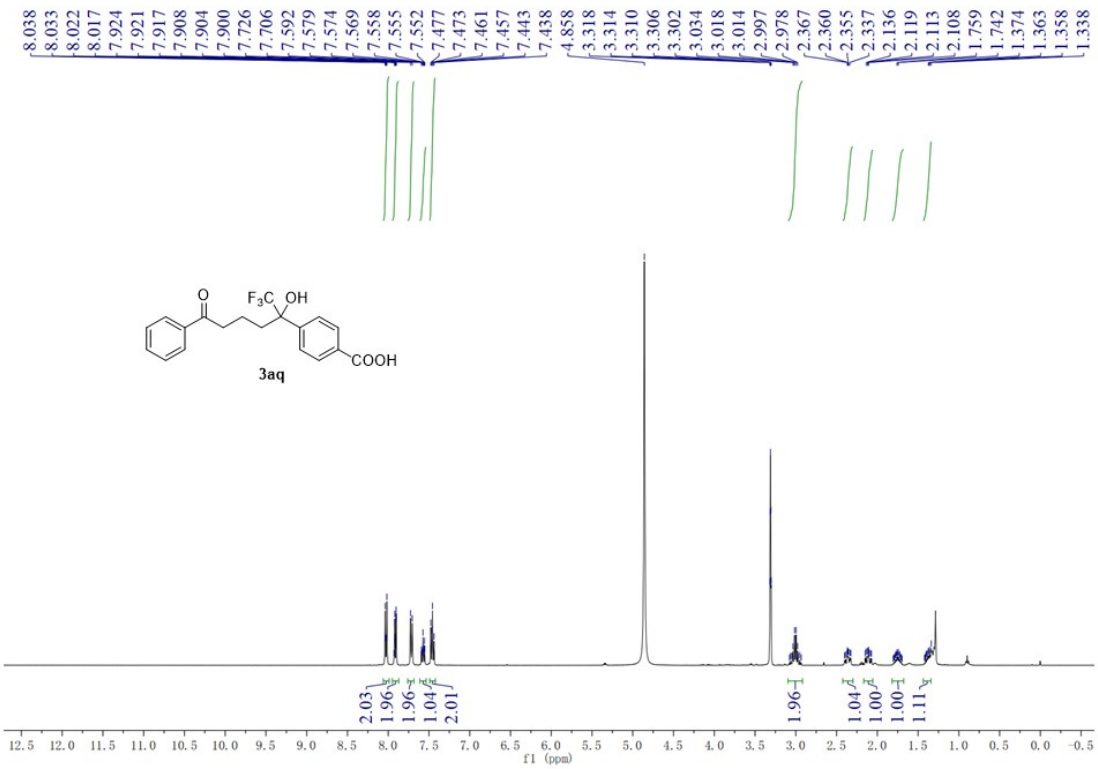
127.477
126.755
123.913
77.610
77.478
77.326
77.160
77.045
76.842
76.764
44.596
37.270
33.680
16.221
O
F3C
OH
SO2Me
3ap
f1 (ppm)


-80.086
O
F3C
OH
SO2Me
3ap
f1 (ppm)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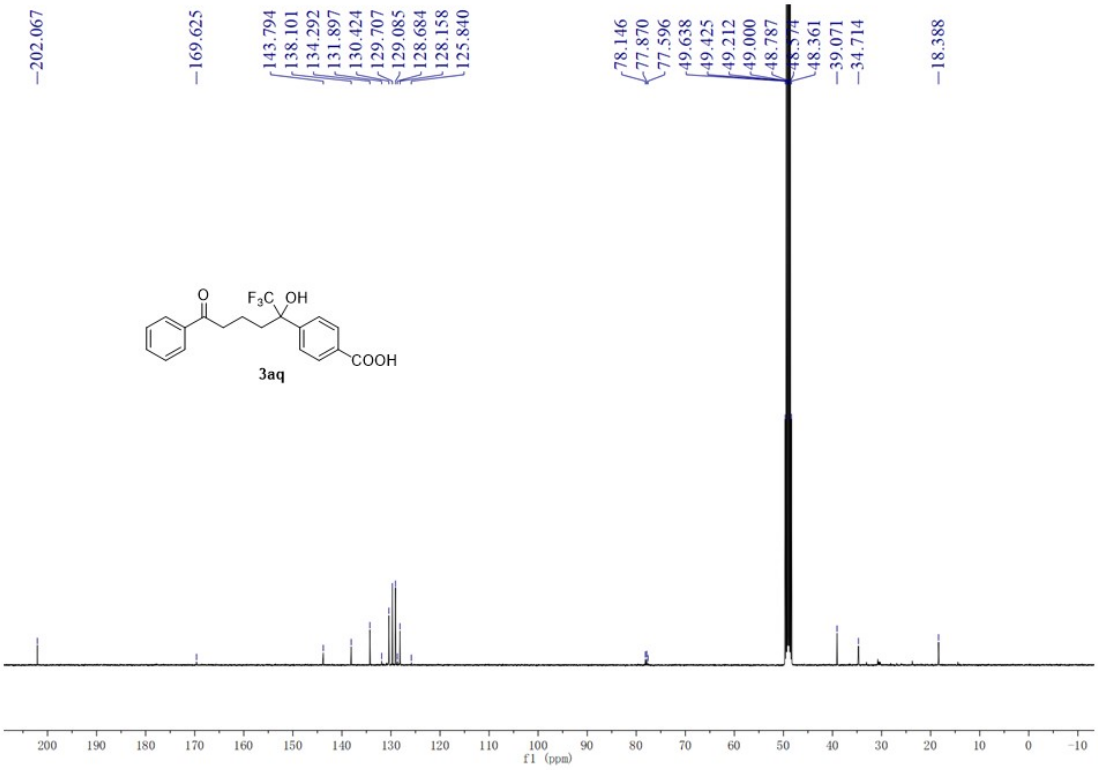
8.022
8.017
7.924
7.921
7.917
7.908
7.904
7.900
7.726
7.706
7.592
7.579
7.574
7.569
7.558
7.555
7.552
7.477
7.473
7.461
7.457
7.443
7.438
4.858
3.318
3.314
3.310
3.306
3.302
3.034
3.018
3.014
2.997
2.978
2.367
2.360
2.355
2.337
2.136
2.119
2.113
2.108
1.759
1.742
1.374
1.363
1.358
1.338
O
F3C
OH
COOH
3aq
2.03
1.96
1.96
1.04
2.01
1.96
1.04
1.00
1.00
1.11
f1 (ppm)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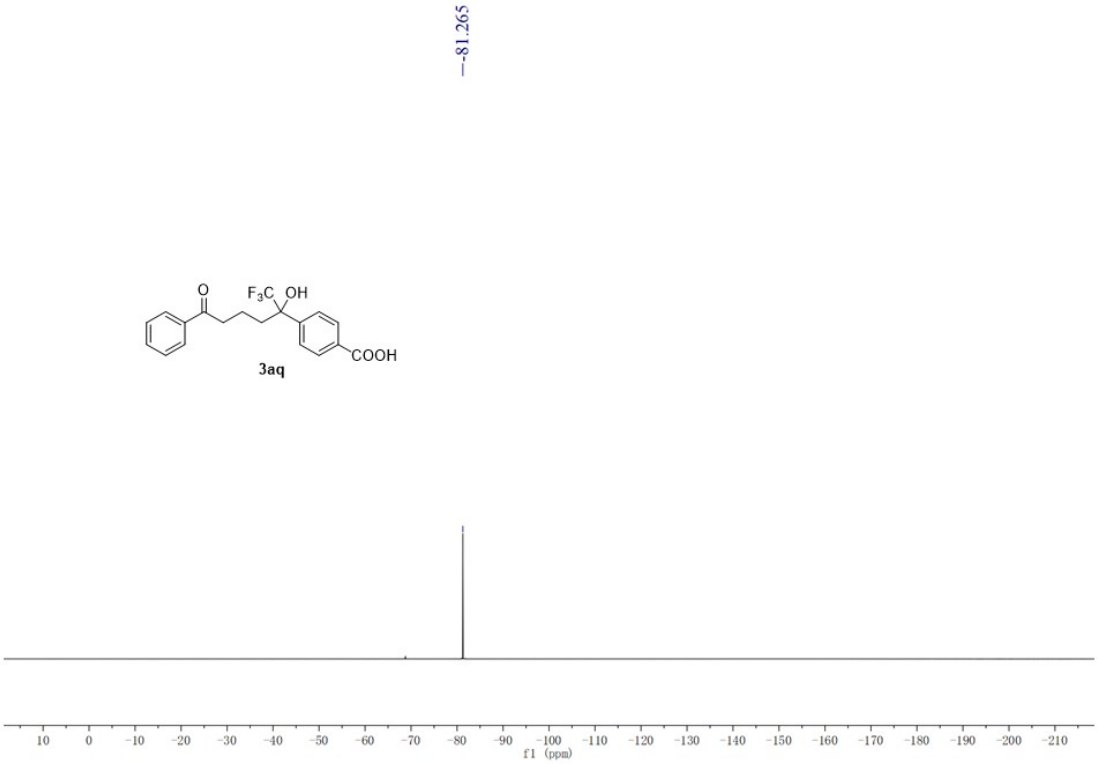
134.292
131.897
130.424
129.707
129.085
128.684
128.158
125.840
78.146
77.870
77.596
49.638
49.425
49.212
49.000
48.787
48.574
48.361
39.071
34.714
18.388
O
F3C
OH
COOH
3aq
f1 (ppm)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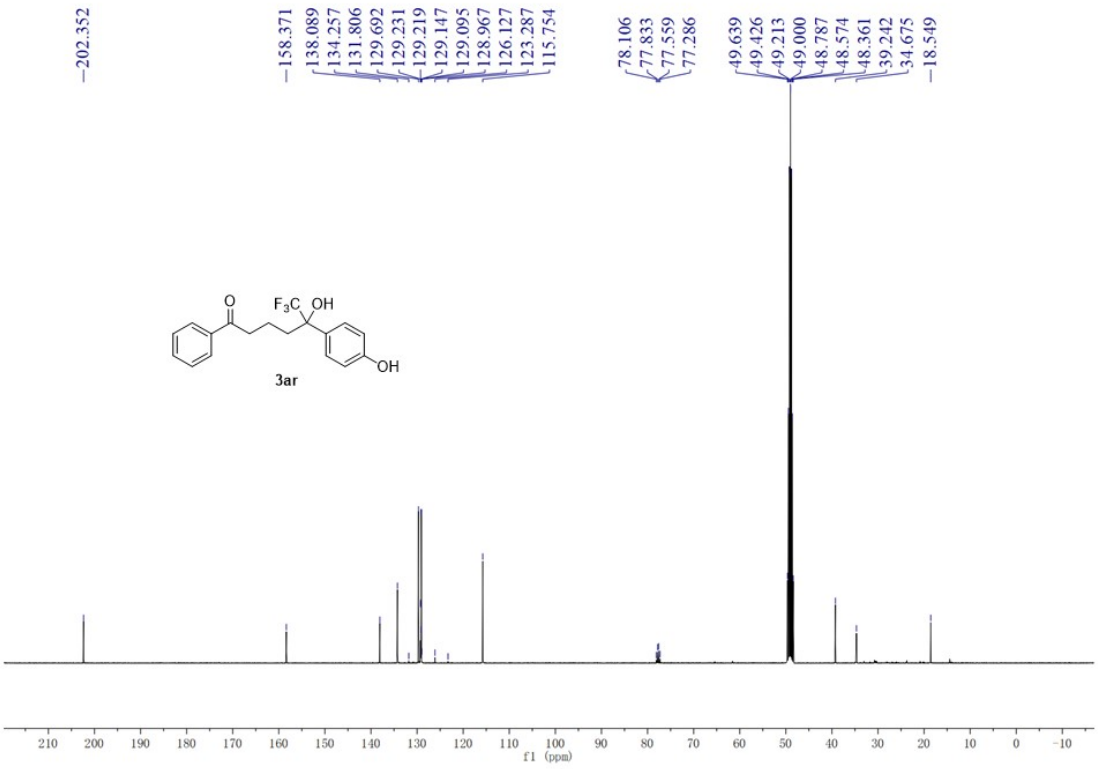
OH
COOH
3aq
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)
7.917
7.914
7.910
7.901
7.896
7.892
7.584
7.571
7.566
7.561
7.550
7.547
7.544
7.471
7.467
7.454
7.451
7.447
7.437
7.432
7.429
7.402
7.380
6.801
6.793
6.788
6.777
6.771
6.764
4.858
3.318
3.314
3.310
3.306
3.302
3.013
2.997
2.993
2.987
2.977
2.970
2.968
2.951
2.273
2.056
2.040
2.033
2.028
2.021
2.008
O
F3C
OH
OH
3ar
1.91
1.00
1.97
1.92
1.92
1.96
1.00
1.19
0.98
1.02
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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129.095
128.967
126.127
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115.754
78.106
77.833
77.559
77.286
49.639
49.426
49.213
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48.361
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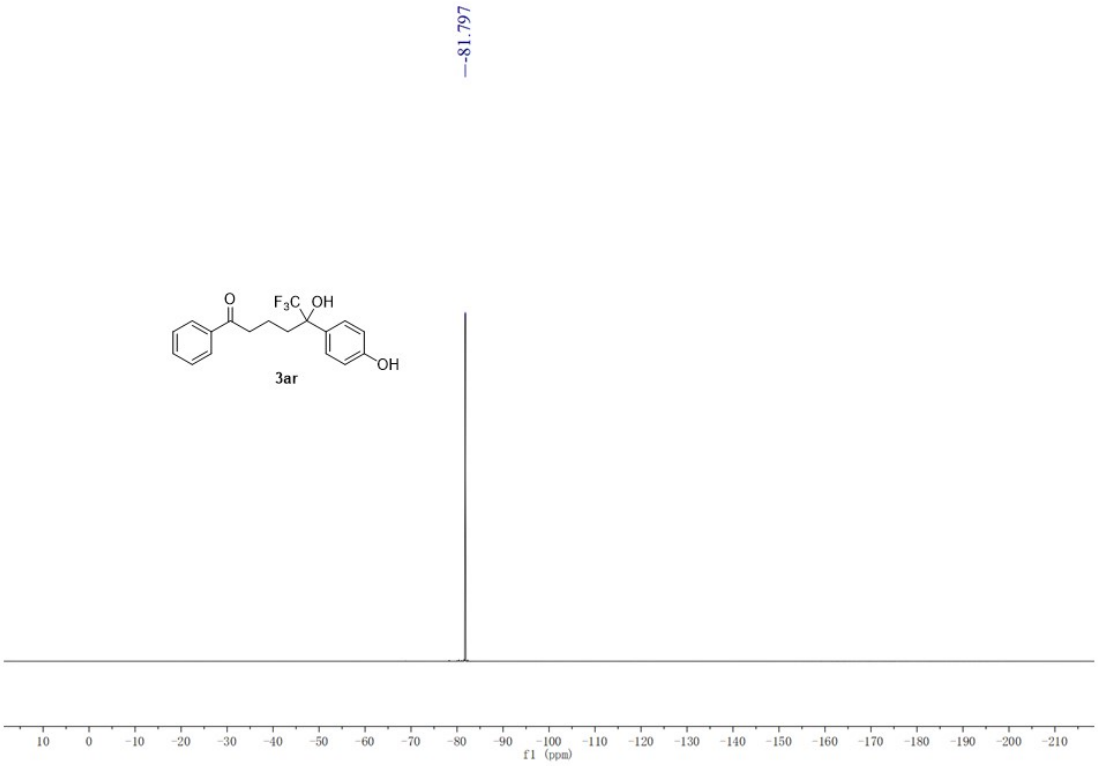
18.549
O
F3C
OH
OH
3ar
f1 (ppm)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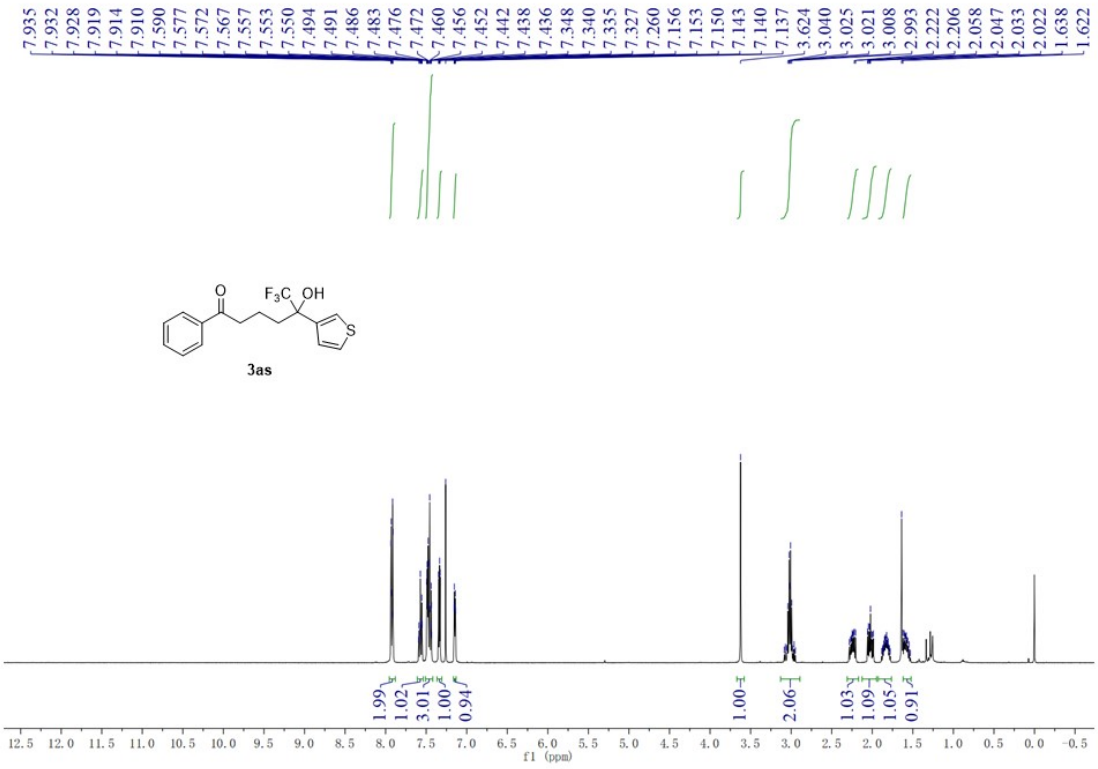
O
F3C
OH
OH
3ar
f1 (ppm)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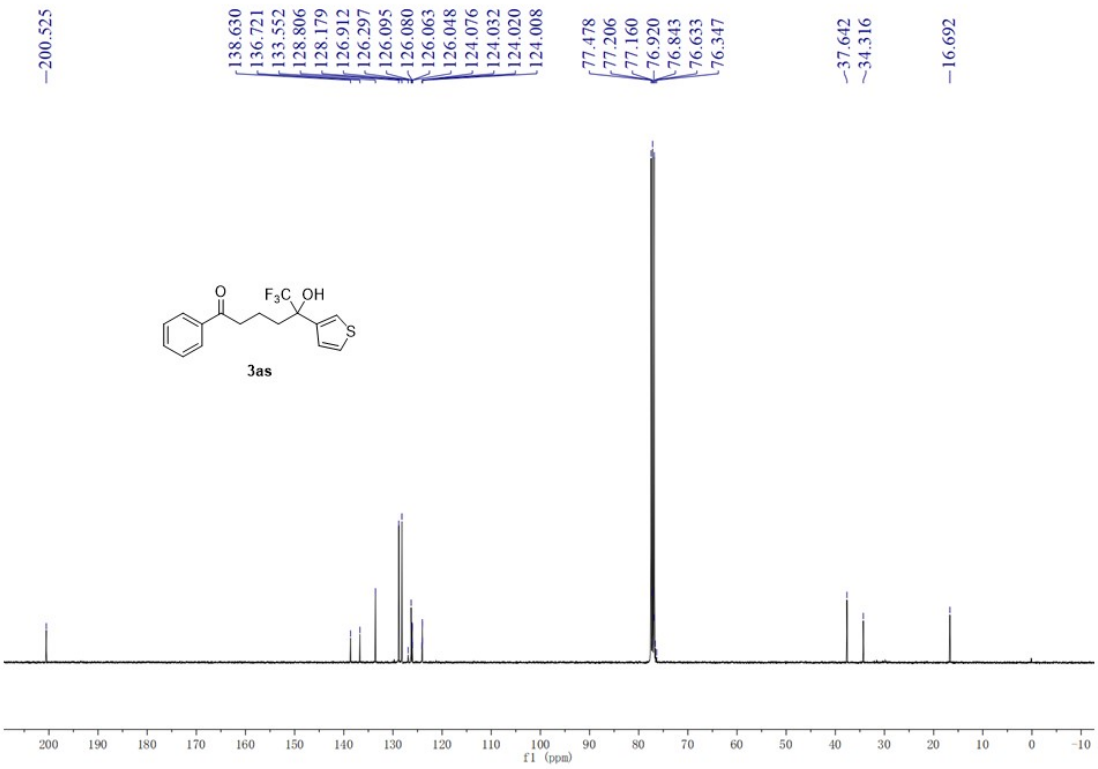
7.572
7.567
7.557
7.553
7.550
7.494
7.491
7.486
7.483
7.476
7.472
7.460
7.456
7.452
7.442
7.438
7.436
7.348
7.340
7.335
7.327
7.260
7.156
7.153
7.150
7.143
7.140
7.137
3.624
3.040
3.025
3.021
3.008
2.993
2.222
2.206
2.058
2.047
2.033
2.022
1.638
1.622
O
F3C
OH
S
3as
1.99
1.02
3.01
1.00
0.94
1.00
2.06
1.03
1.09
1.05
0.91
f1 (ppm)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126.297
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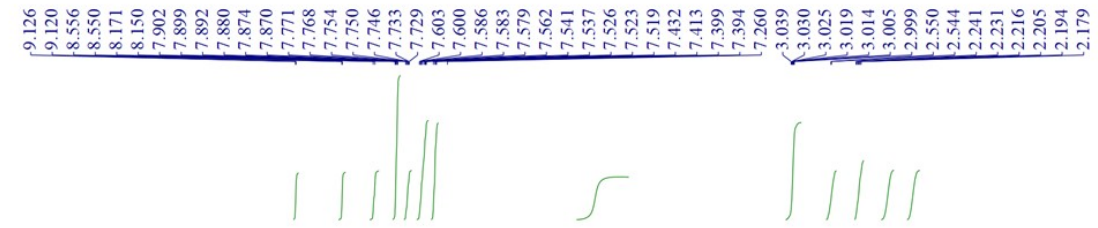
126.080
126.063
126.048
124.076
124.032
124.020
124.008
77.478
77.206
77.160
76.920
76.843
76.633
76.347
37.642
34.316
16.692
O
F3C
OH
S
3as
f1 (ppm)


-80.928
O
F3C OH
S
3as
f1 (ppm)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9.120
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8.550
8.171
8.150
7.902
7.899
7.892
7.880
7.874
7.870
7.771
7.768
7.754
7.750
7.746
7.733
7.729
7.603
7.600
7.586
7.583
7.579
7.562
7.541
7.537
7.526
7.523
7.519
7.432
7.413
7.399
7.394
7.260
3.039
3.030
3.025
3.019
3.014
3.005
2.999
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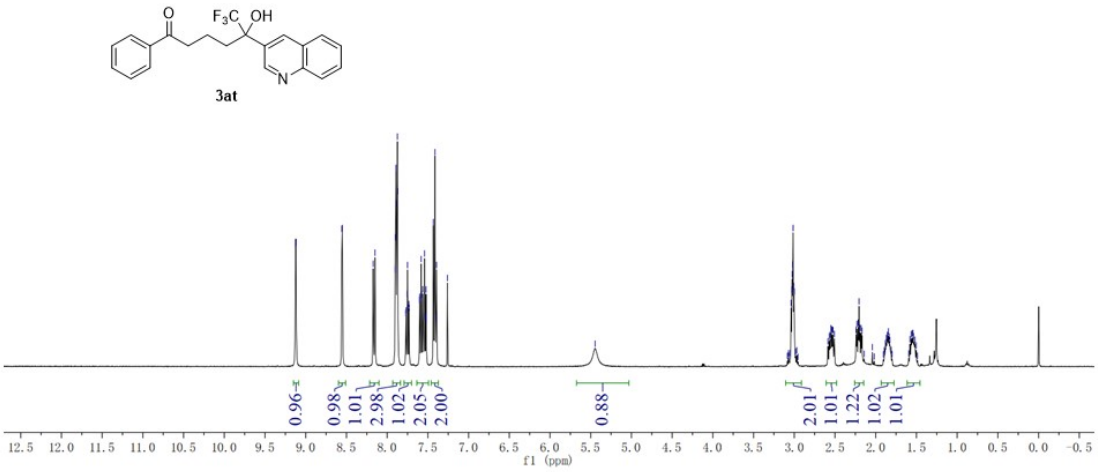
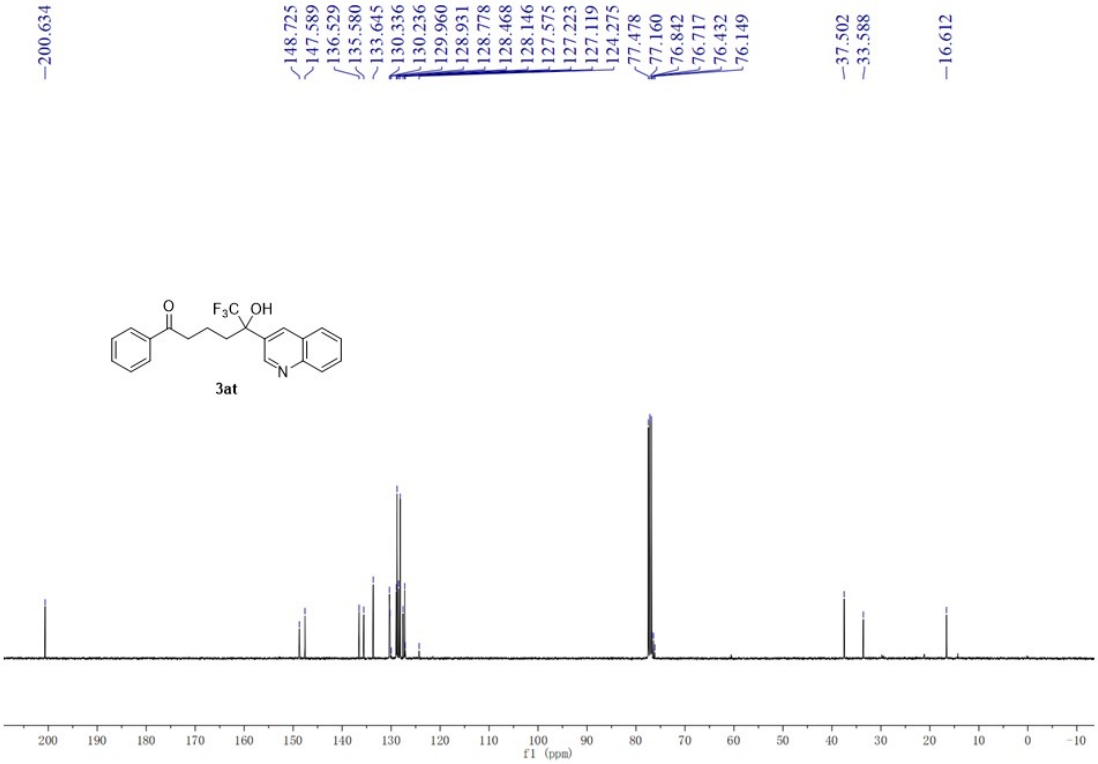
2.544
2.241
2.231
2.216
2.205
2.194
2.179


O
F3C OH
N
3at
0.96
0.98
1.01
2.98
1.02
2.05
2.00
0.88
2.01
1.01
1.22
1.02
1.01
f1 (ppm)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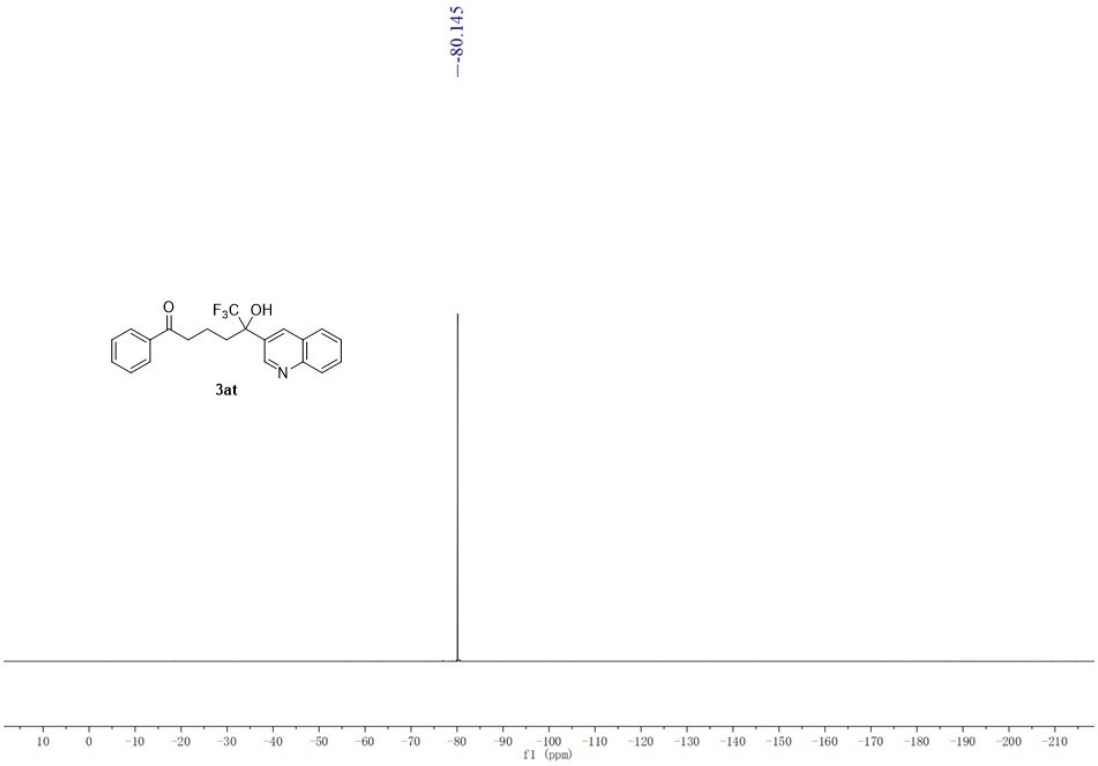
148.725
147.589
136.529
135.580
133.645
130.336
130.236
129.960
128.931
128.778
128.468
128.146
127.575
127.223
127.119
124.275
77.478
77.160
76.842
76.717
76.432
76.149
37.502
33.588
16.612
O
F3C
OH
N
3at
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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F3C
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N
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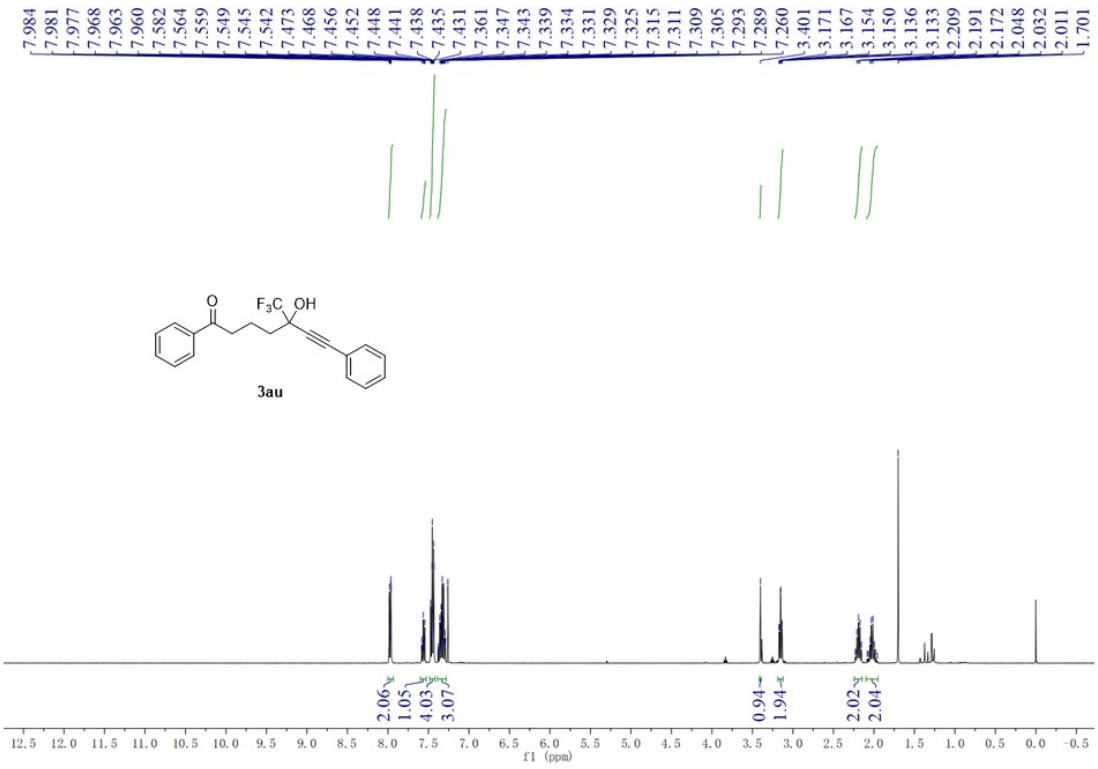
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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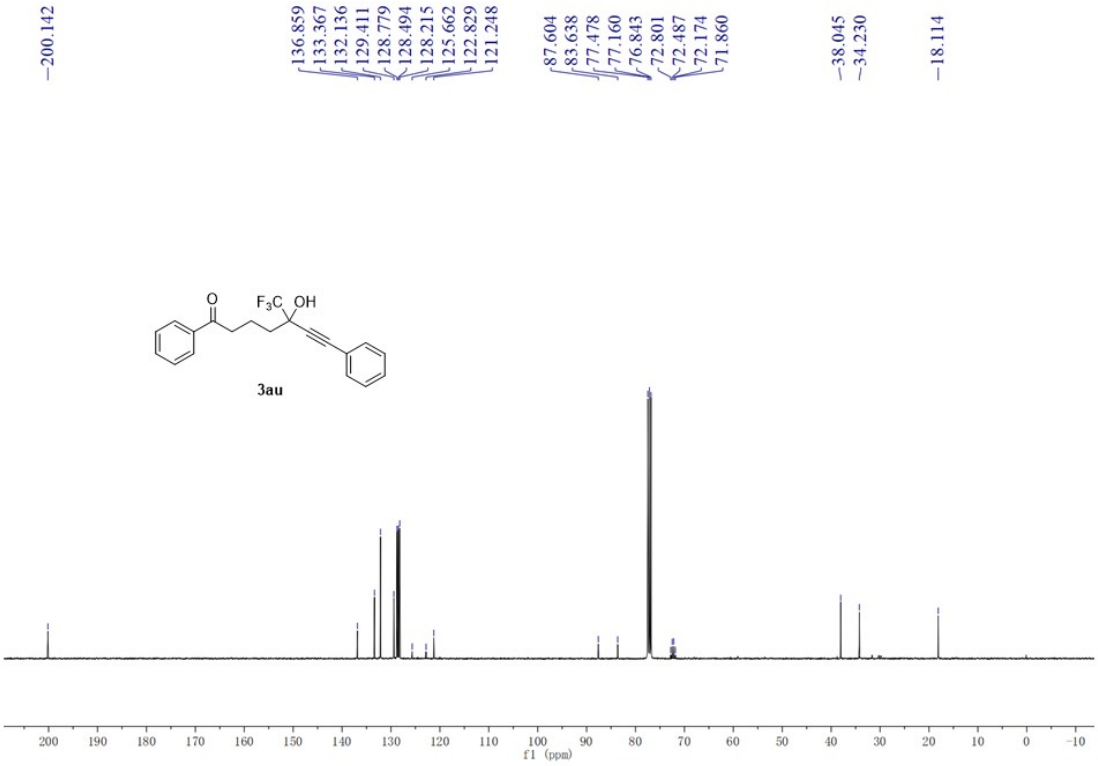
7.549
7.545
7.542
7.473
7.468
7.456
7.452
7.448
7.441
7.438
7.435
7.431
7.361
7.347
7.343
7.339
7.334
7.331
7.329
7.325
7.315
7.311
7.309
7.305
7.293
7.289
7.260
3.401
3.171
3.167
3.154
3.150
3.136
3.133
2.209
2.191
2.172
2.048
2.032
2.011
1.701
O
F3C
OH
3au
2.06
1.05
4.03
3.07
0.94
1.94
2.02
2.04
f1 (ppm)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128.494
128.215
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122.829
121.248
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83.638
77.478
77.160
76.843
72.801
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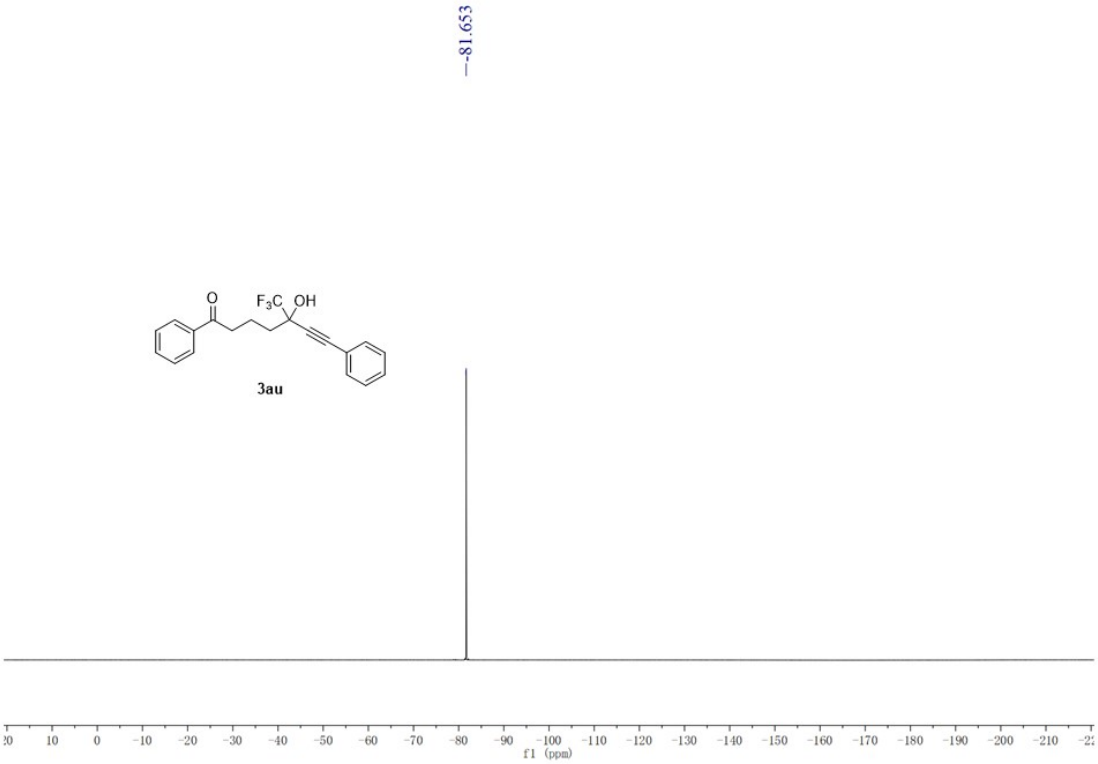
72.174
71.860
38.045
34.230
18.114
O
F3C
OH
3au
f1 (ppm)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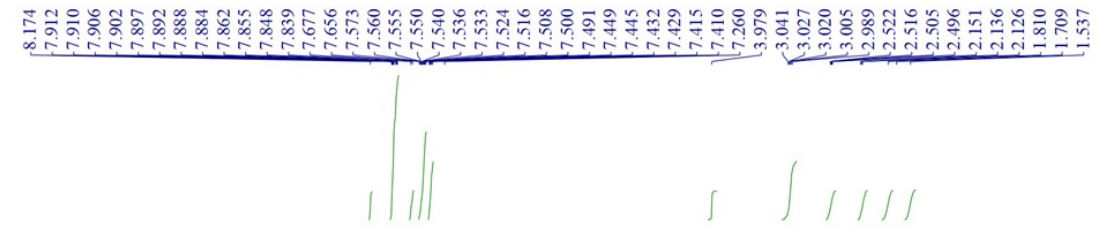
F3C
OH
3au
f1 (ppm)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7.888
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7.839
7.677
7.656
7.573
7.560
7.555
7.550
7.540
7.536
7.533
7.524
7.516
7.508
7.500
7.491
7.449
7.445
7.432
7.429
7.415
7.410
7.260
3.979
3.041
3.027
3.020
3.005
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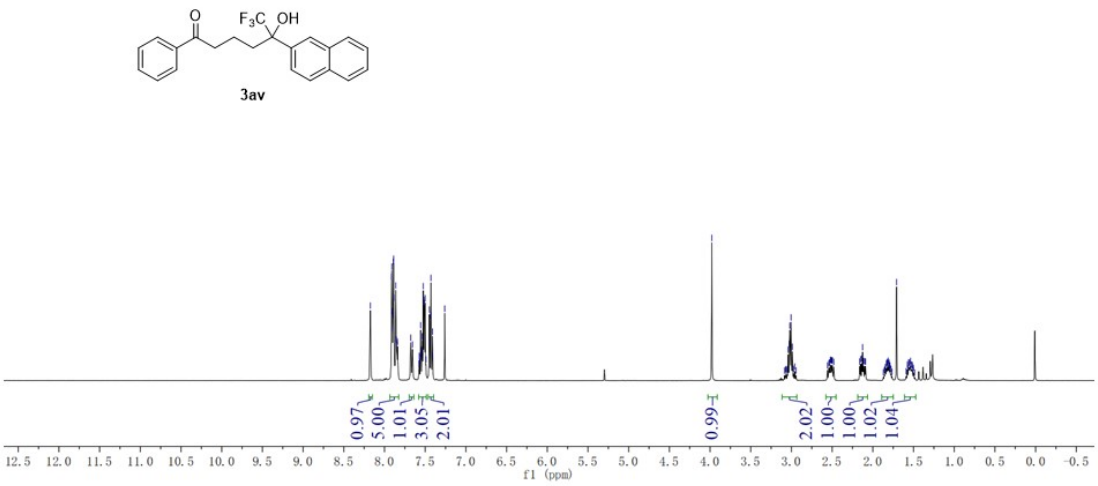
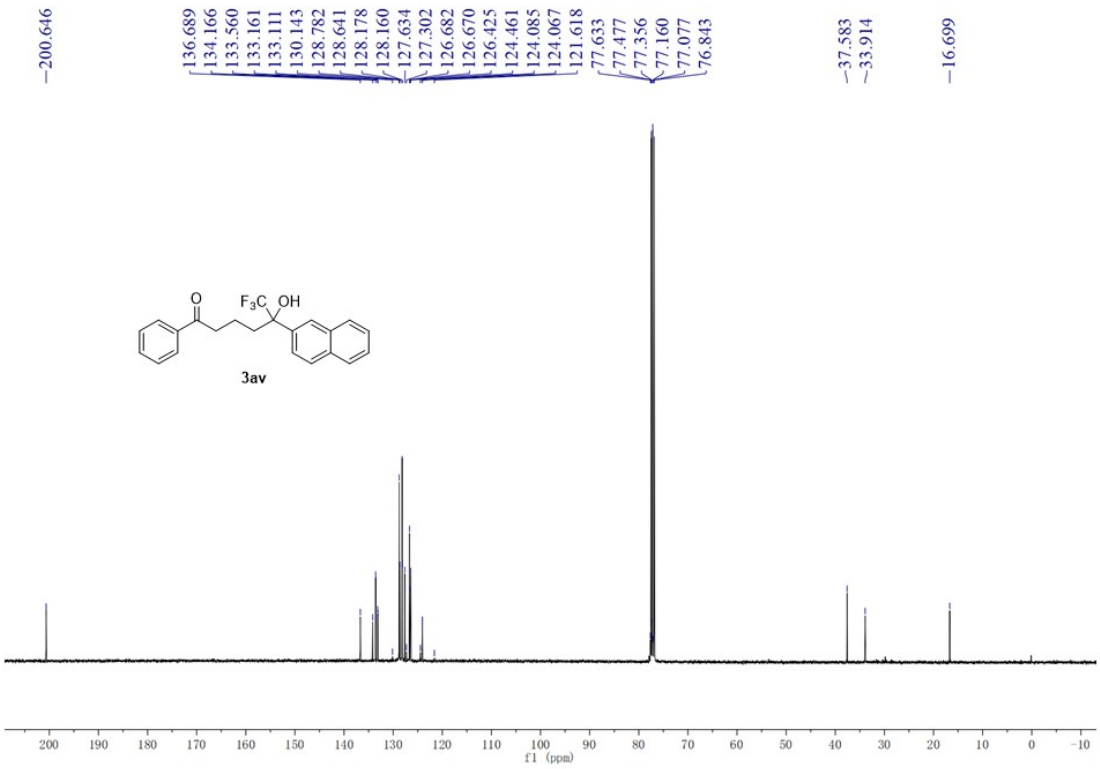
2.522
2.516
2.505
2.496
2.151
2.136
2.126
1.810
1.709
1.537


O
F3C
OH
3av
0.97
5.00
1.01
3.05
2.01
0.99
2.02
1.00
1.00
1.02
1.04
f1 (ppm)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134.166
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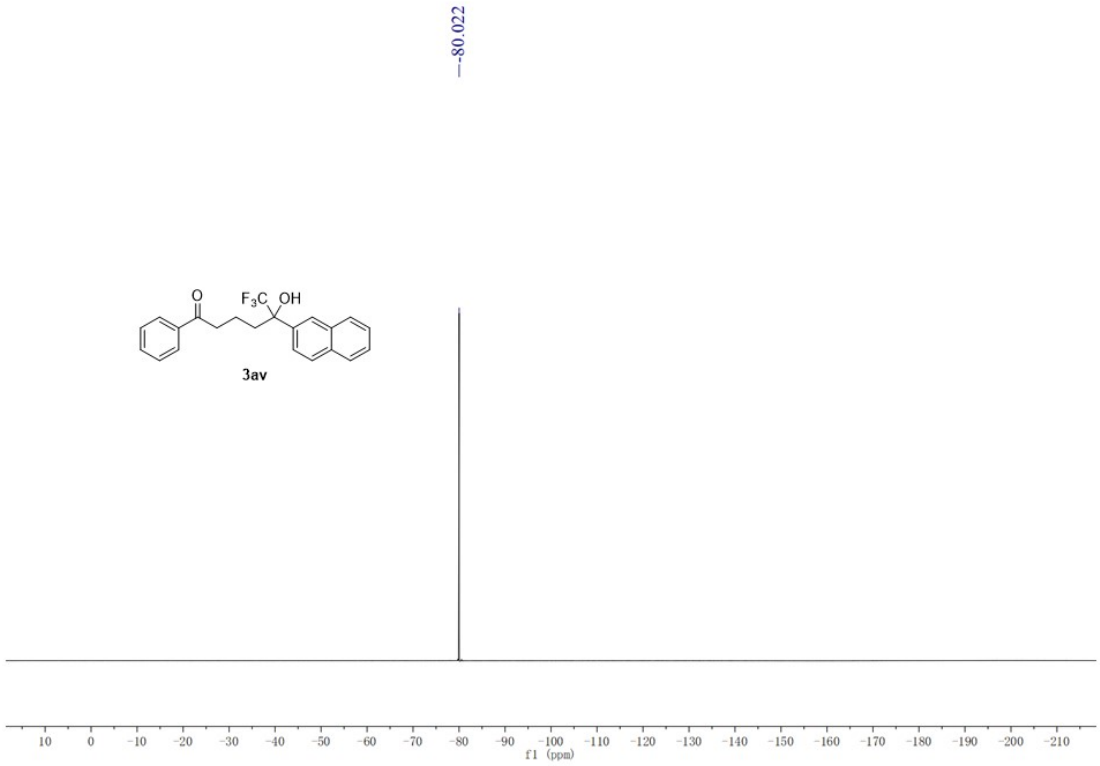
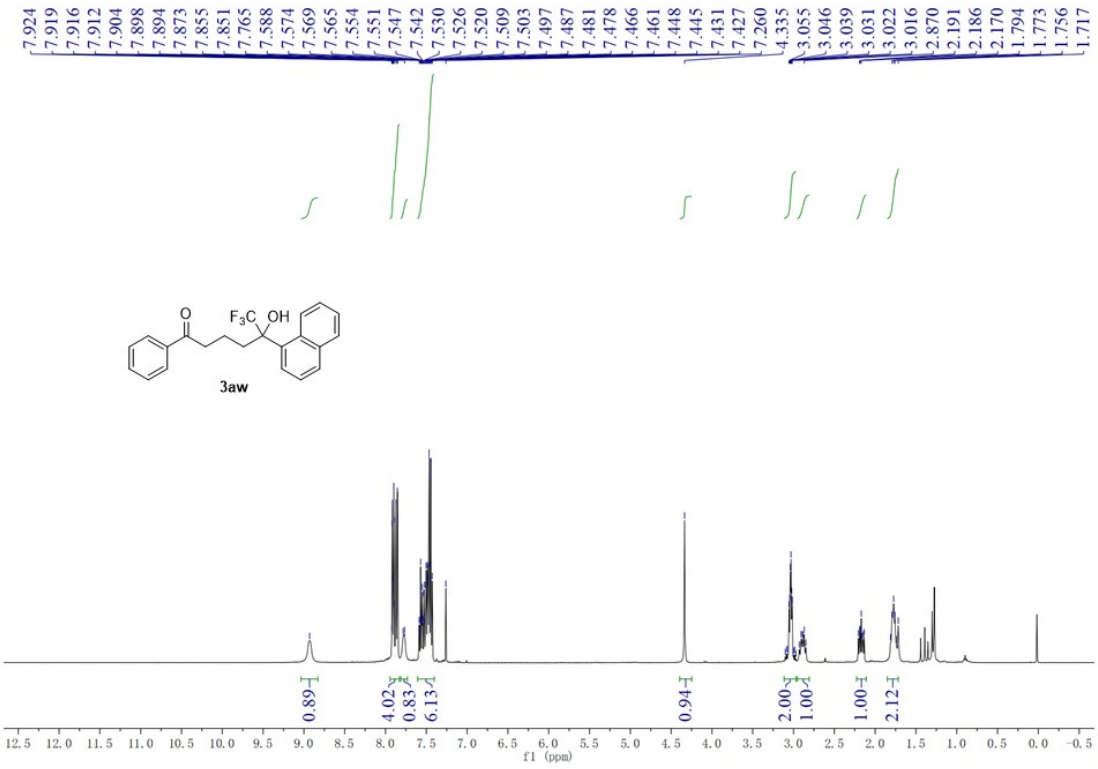
133.161
133.111
130.143
128.782
128.641
128.178
128.160
127.634
127.302
126.682
126.670
126.425
124.461
124.085
124.067
121.618
77.633
77.477
77.356
77.160
77.077
76.843
37.583
33.914
16.699
O
F3C
OH
3av
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


80.022
O
F3C
OH
3av
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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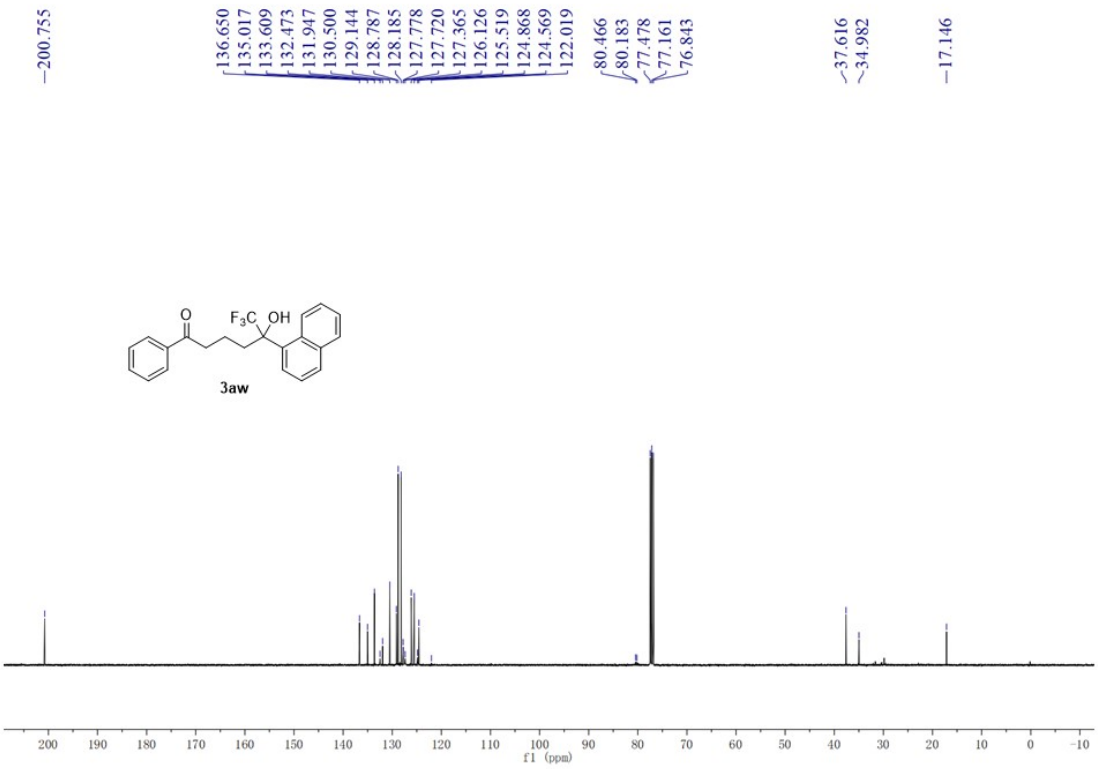
7.919
7.916
7.912
7.904
7.898
7.894
7.873
7.855
7.851
7.765
7.588
7.574
7.569
7.565
7.554
7.551
7.547
7.542
7.530
7.526
7.520
7.509
7.503
7.497
7.487
7.481
7.478
7.466
7.461
7.448
7.445
7.431
7.427
7.260
4.335
3.055
3.046
3.039
3.031
3.022
3.016
2.870
2.191
2.186
2.170
1.794
1.773
1.756
1.717
O
F3C
OH
3aw
0.89
4.02
0.83
6.13
0.94
2.00
1.00
1.00
2.12
f1 (ppm)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133.609
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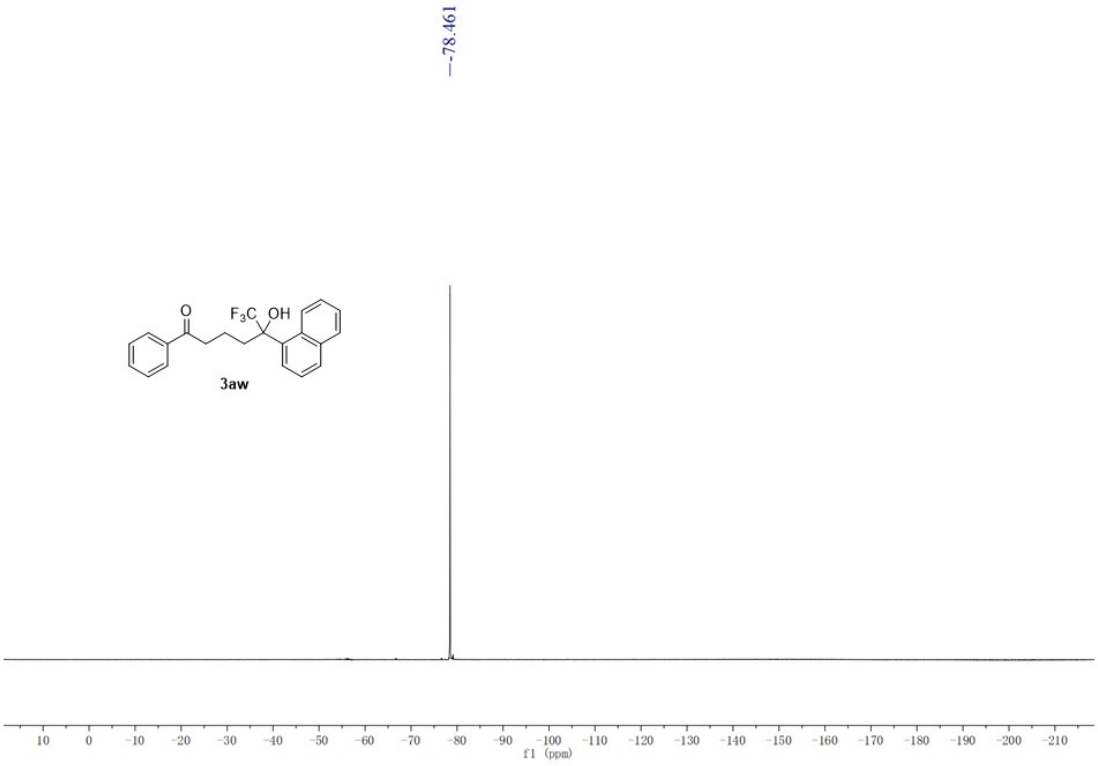
131.947
130.500
129.144
128.787
128.185
127.778
127.720
127.365
126.126
125.519
124.868
124.569
122.019
80.466
80.183
77.478
77.161
76.843
37.616
34.982
17.146
O
F3C
OH
3aw
f1 (ppm)


-78.461
O
F3C
OH
3aw
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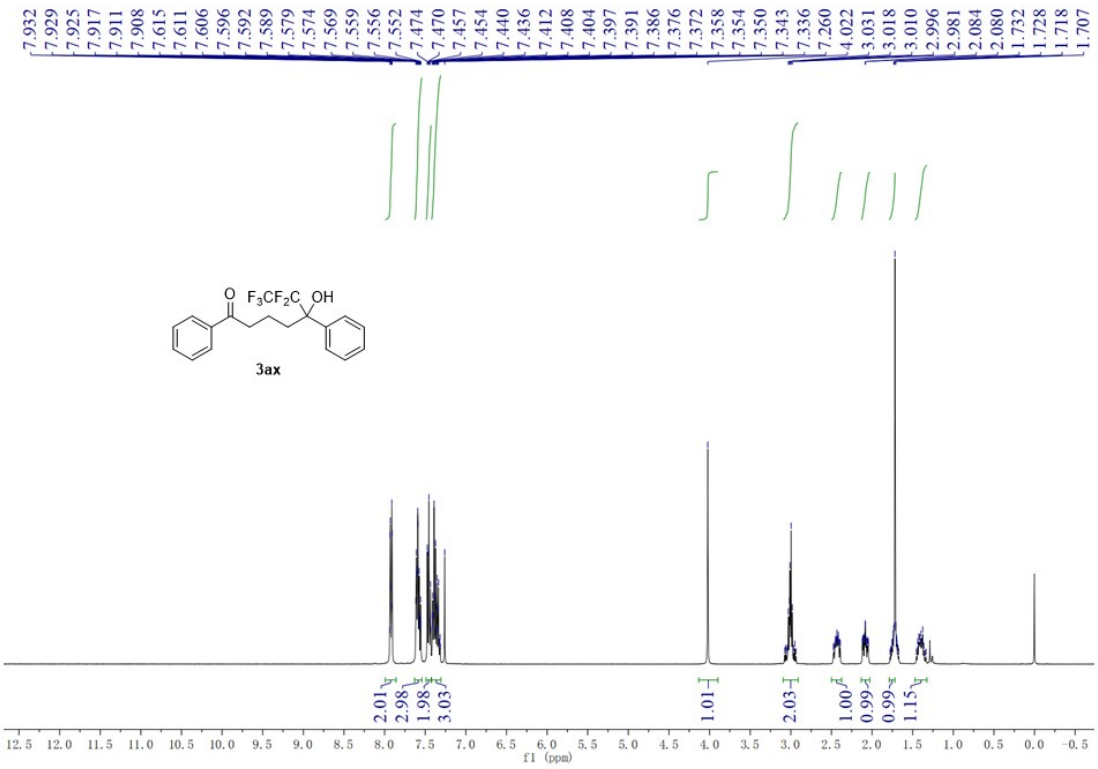
f1 (ppm)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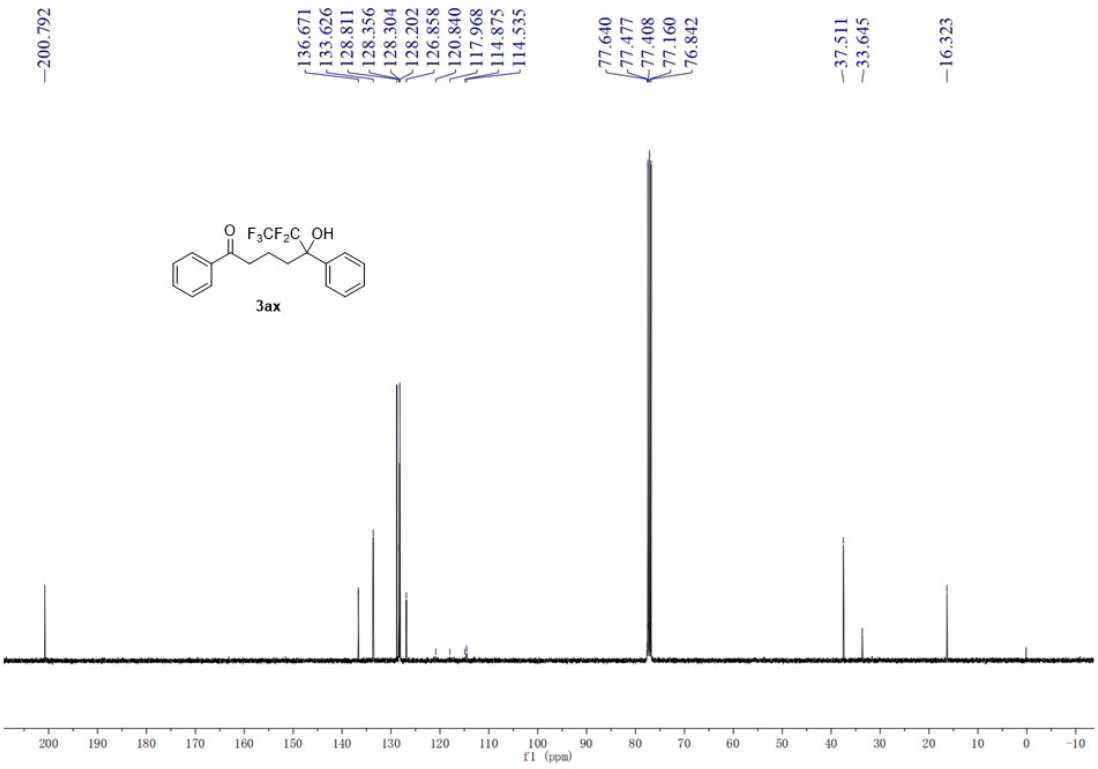
7.917
7.911
7.908
7.615
7.611
7.606
7.596
7.592
7.589
7.579
7.574
7.569
7.559
7.556
7.552
7.474
7.470
7.457
7.454
7.440
7.436
7.412
7.408
7.404
7.397
7.391
7.386
7.376
7.372
7.358
7.354
7.350
7.343
7.336
7.260
4.022
3.031
3.018
3.010
2.996
2.981
2.084
2.080
1.732
1.728
1.718
1.707
O
F3CF2C
OH
3ax
2.01
2.98
1.98
3.03
1.01
2.03
1.00
0.99
0.99
1.15
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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133.626
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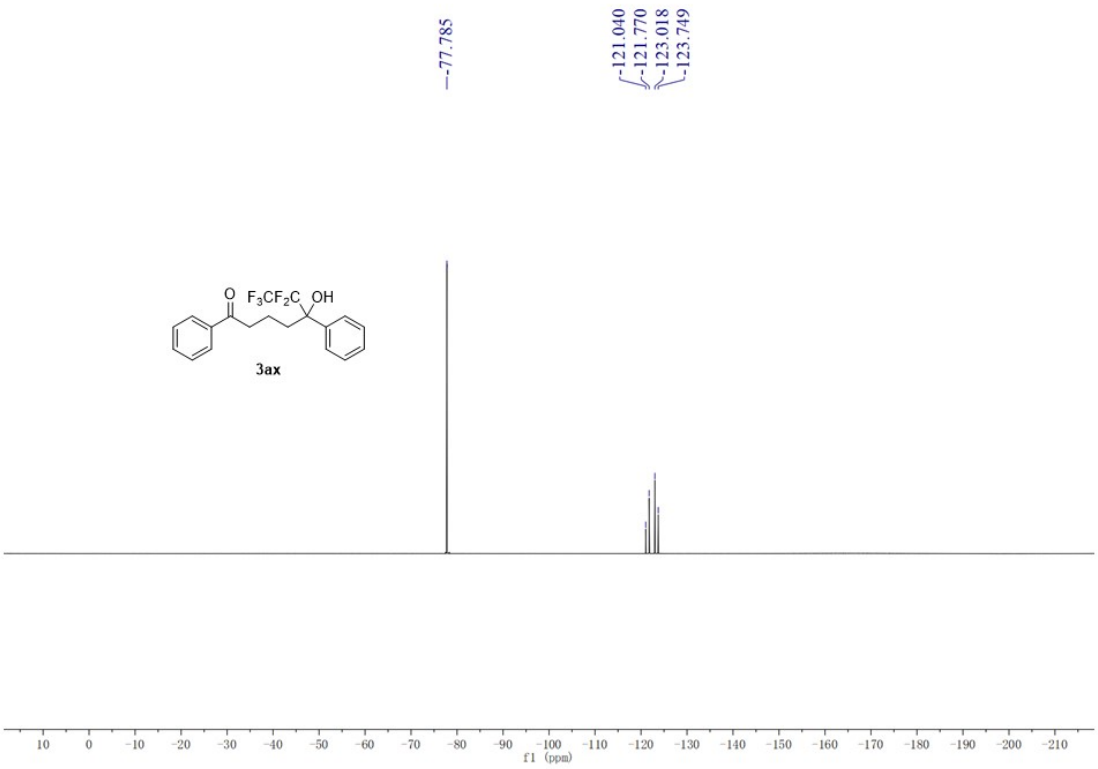
128.304
128.202
126.858
120.840
117.968
114.875
114.535
77.640
77.477
77.408
77.160
76.842
37.511
33.645
16.323
O
F3CF2C
OH
3ax
f1 (ppm)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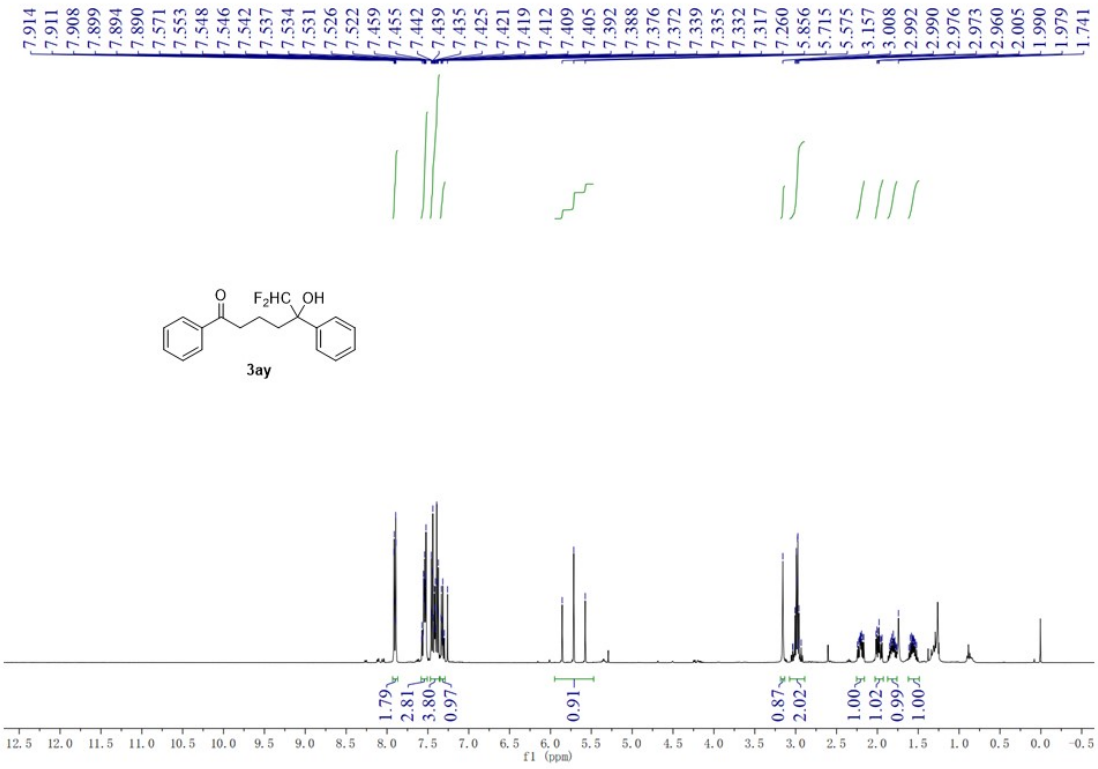
-121.040
-121.770
-123.018
-123.749
O
F3CF2C
OH
3ax
f1 (ppm)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7.908
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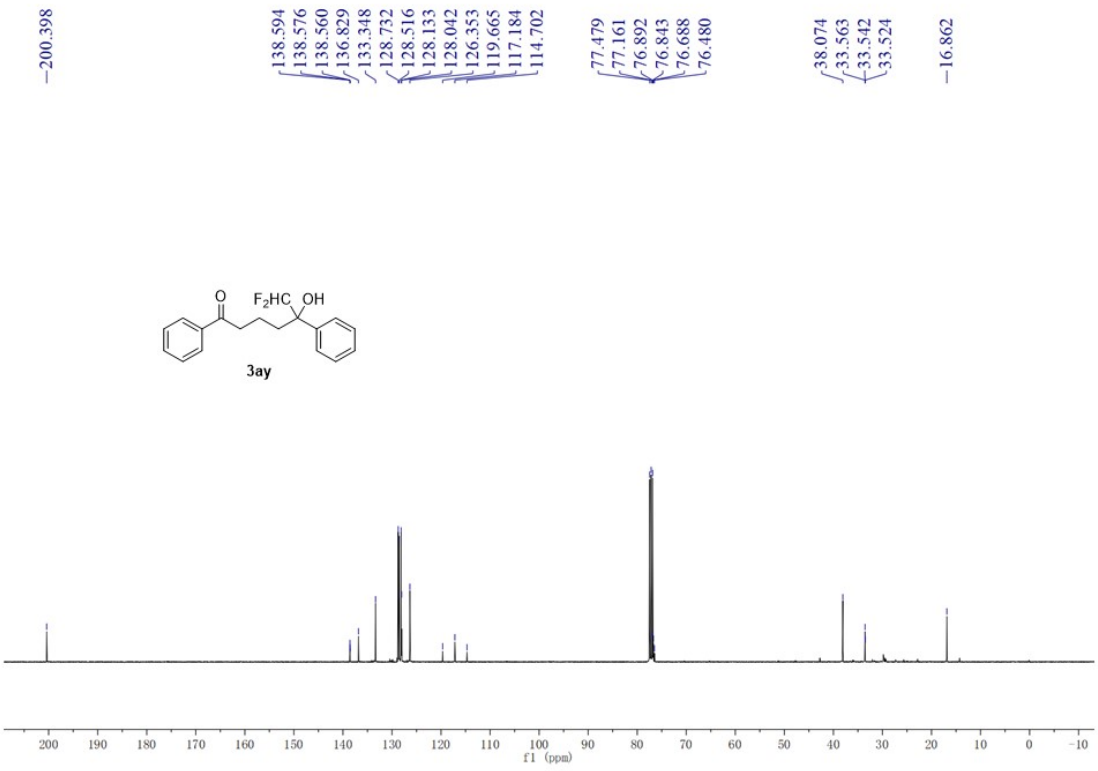
7.894
7.890
7.571
7.553
7.548
7.546
7.542
7.537
7.534
7.531
7.526
7.522
7.459
7.455
7.442
7.439
7.435
7.425
7.421
7.419
7.412
7.409
7.405
7.392
7.388
7.376
7.372
7.339
7.335
7.332
7.317
7.260
5.856
5.715
5.575
3.157
3.008
2.992
2.990
2.976
2.973
2.960
2.005
1.990
1.979
1.741
O
F2HC
OH
3ay
1.79
2.81
3.80
0.97
0.91
0.87
2.02
1.00
1.02
0.99
1.00
f1 (ppm)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128.516
128.133
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126.353
119.665
117.184
114.702
77.479
77.161
76.892
76.843
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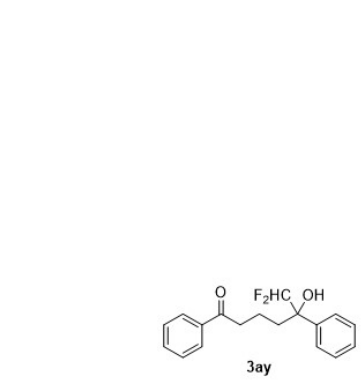
38.074
33.563
33.542
33.524
16.862
O
F2HC
OH
3ay
f1 (ppm)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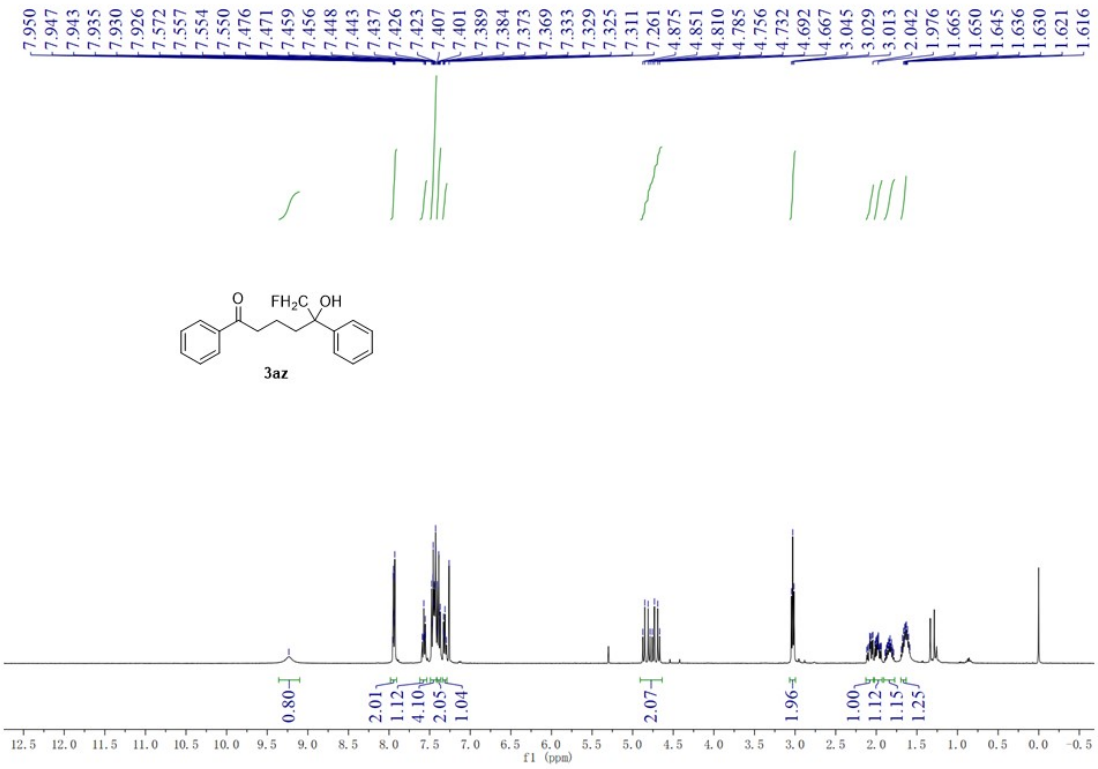
-130.192
-130.468
-131.200
O
F2HC
OH
3ay
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)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7.471
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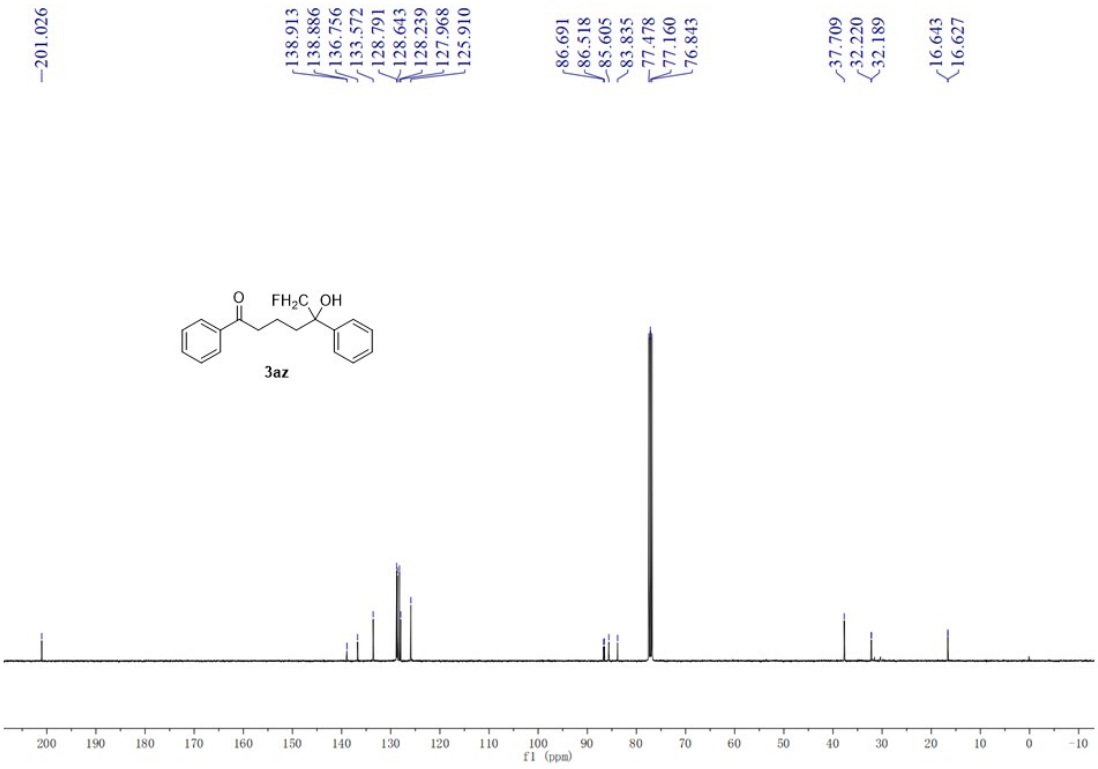
7.456
7.448
7.443
7.437
7.426
7.423
7.407
7.401
7.389
7.384
7.373
7.369
7.333
7.329
7.325
7.311
7.261
4.875
4.851
4.810
4.785
4.756
4.732
4.692
4.667
3.045
3.029
3.013
2.042
1.976
1.665
1.650
1.645
1.636
1.630
1.621
1.616
O
FH2C
OH
3az
0.80
2.01
1.12
4.10
2.05
1.04
2.07
1.96
1.00
1.12
1.15
1.25
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)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128.239
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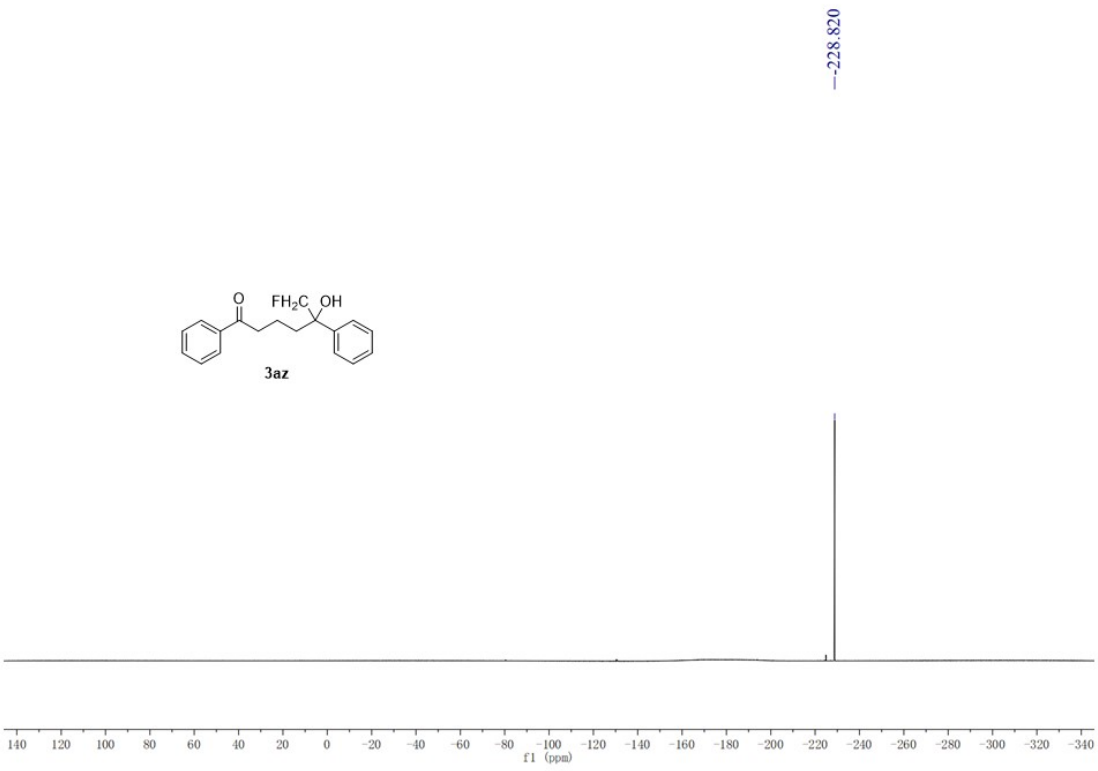
85.605
83.835
77.478
77.160
76.843
37.709
32.220
32.189
16.643
16.627
O
FH2C
OH
3az
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-228.820
O
FH2C
OH
3az
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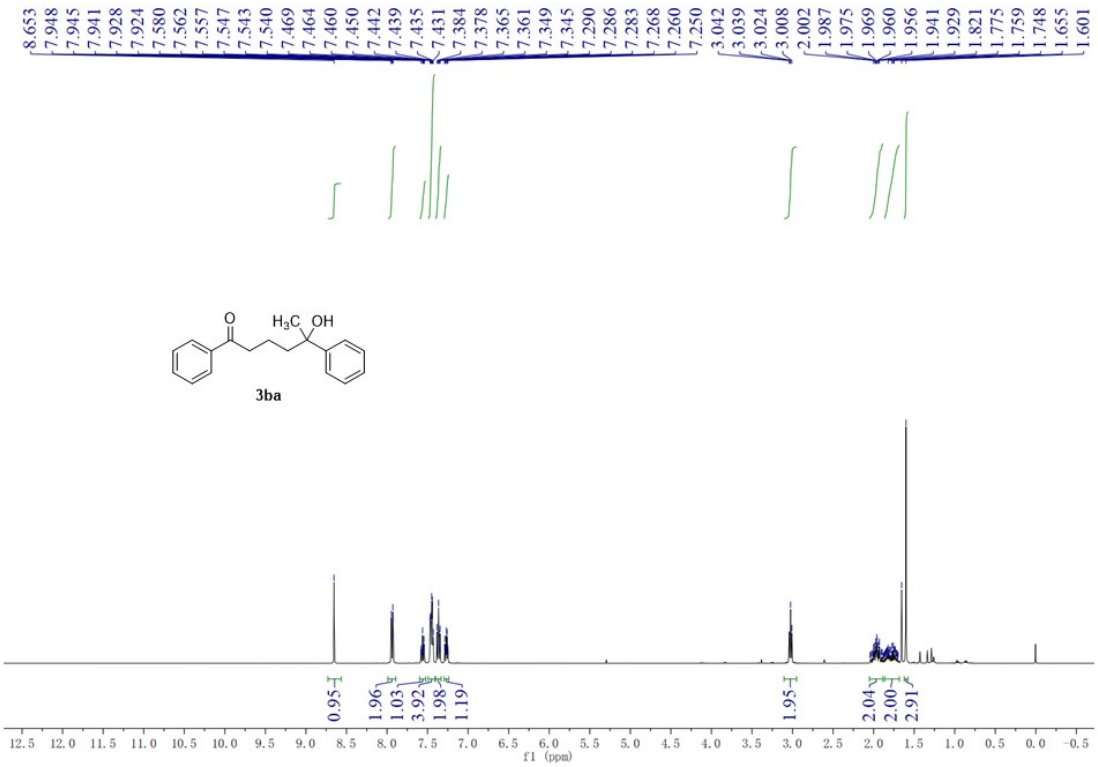
f1 (ppm)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7.562
7.557
7.547
7.543
7.540
7.469
7.464
7.460
7.450
7.442
7.439
7.435
7.431
7.384
7.378
7.365
7.361
7.349
7.345
7.290
7.286
7.283
7.268
7.260
7.250
3.042
3.039
3.024
3.008
2.002
1.987
1.975
1.969
1.960
1.956
1.941
1.929
1.821
1.775
1.759
1.748
1.655
1.601
O
H3C
OH
3ba
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1.03
3.92
1.98
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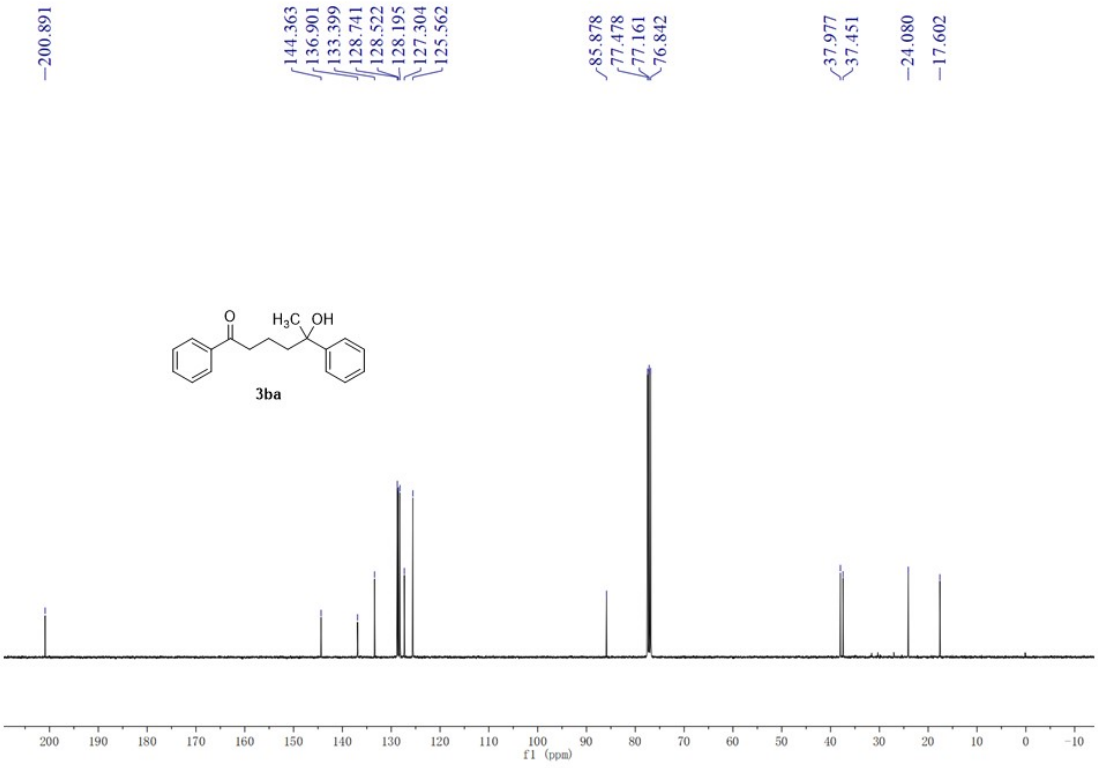
1.95
2.04
2.00
2.91
f1 (ppm)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127.304
125.562
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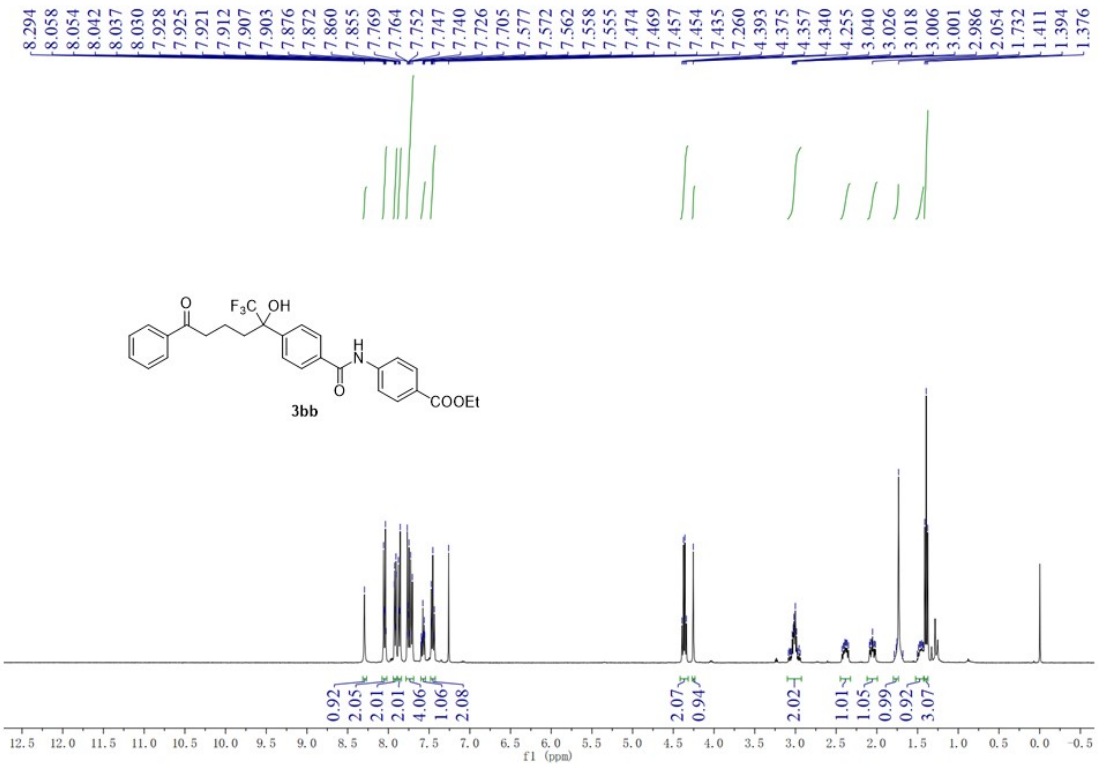
76.842
37.977
37.451
24.080
17.602
O
H3C
OH
3ba
f1 (ppm)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8.054
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7.925
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7.912
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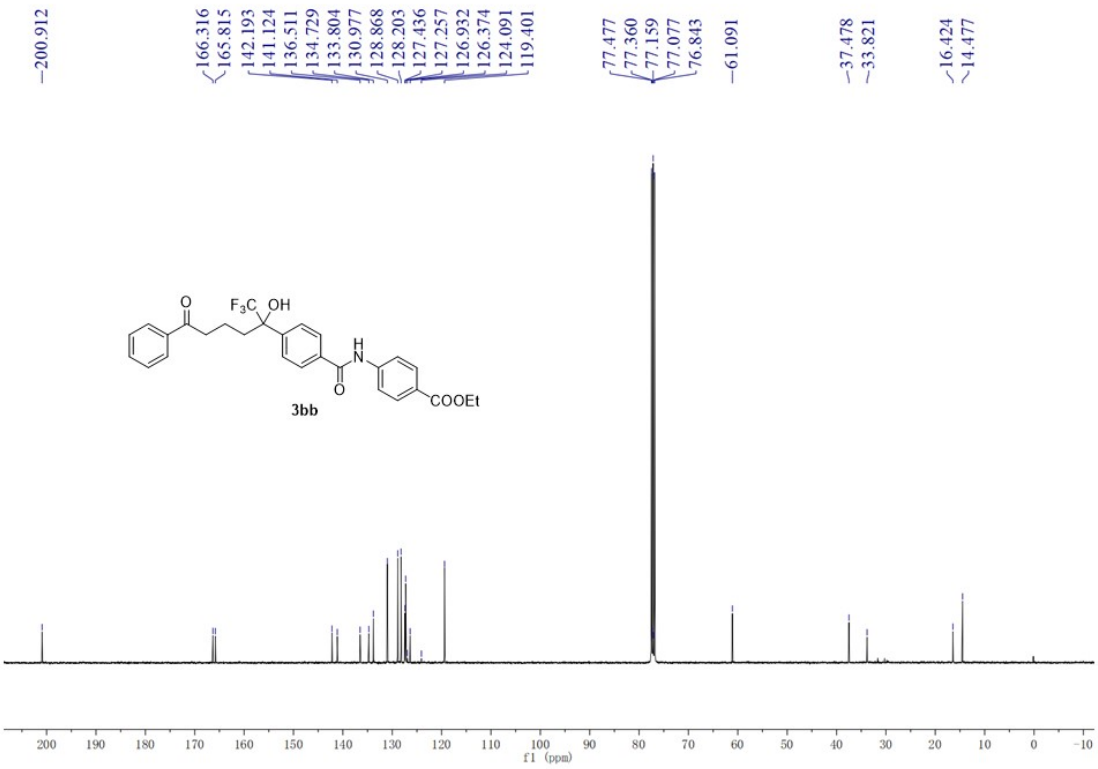
7.903
7.876
7.872
7.860
7.855
7.769
7.764
7.752
7.747
7.740
7.726
7.705
7.577
7.572
7.562
7.558
7.555
7.474
7.469
7.457
7.454
7.435
7.260
4.393
4.375
4.357
4.340
4.255
3.040
3.026
3.018
3.006
3.001
2.986
2.054
1.732
1.411
1.394
1.376
O
F3C
OH
H
N
O
COOEt
3bb
0.92
2.05
2.01
2.01
4.06
1.06
2.08
2.07
0.94
2.02
1.01
1.05
0.99
0.92
3.07
f1 (ppm)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134.729
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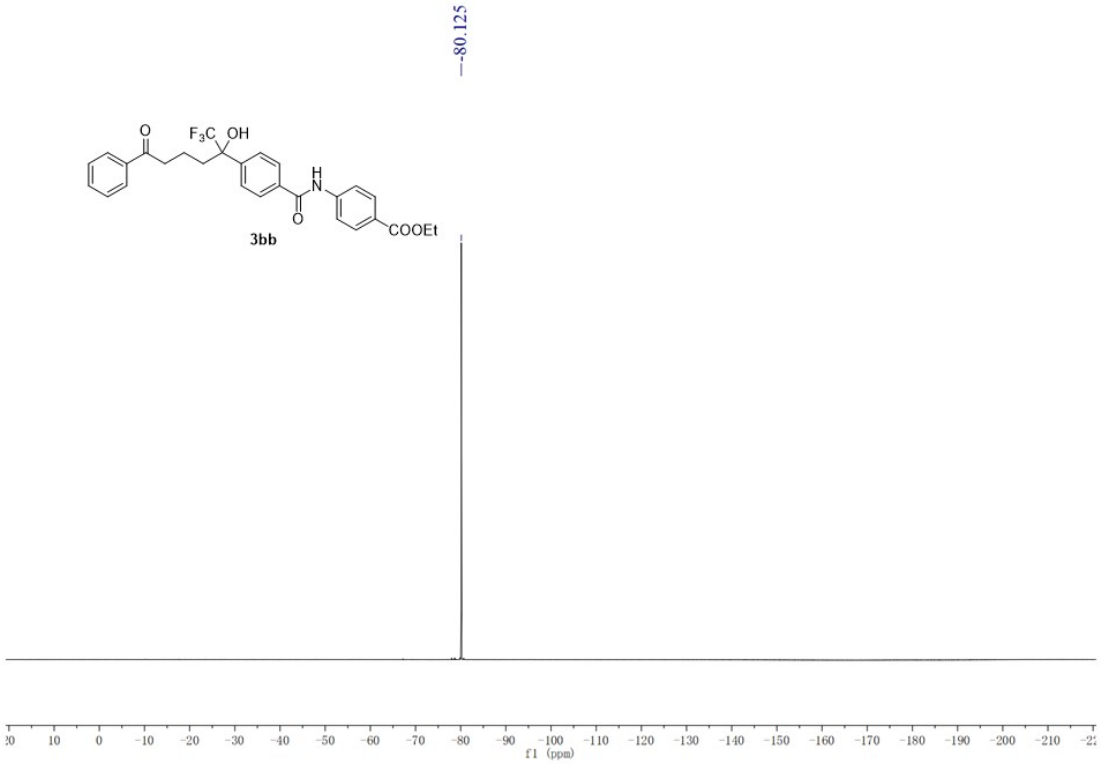
127.436
127.257
126.932
126.374
124.091
119.401
77.477
77.360
77.159
77.077
76.843
61.091
37.478
33.821
16.424
14.477
O
F3C
OH
H
N
O
COOEt
3bb
f1 (ppm)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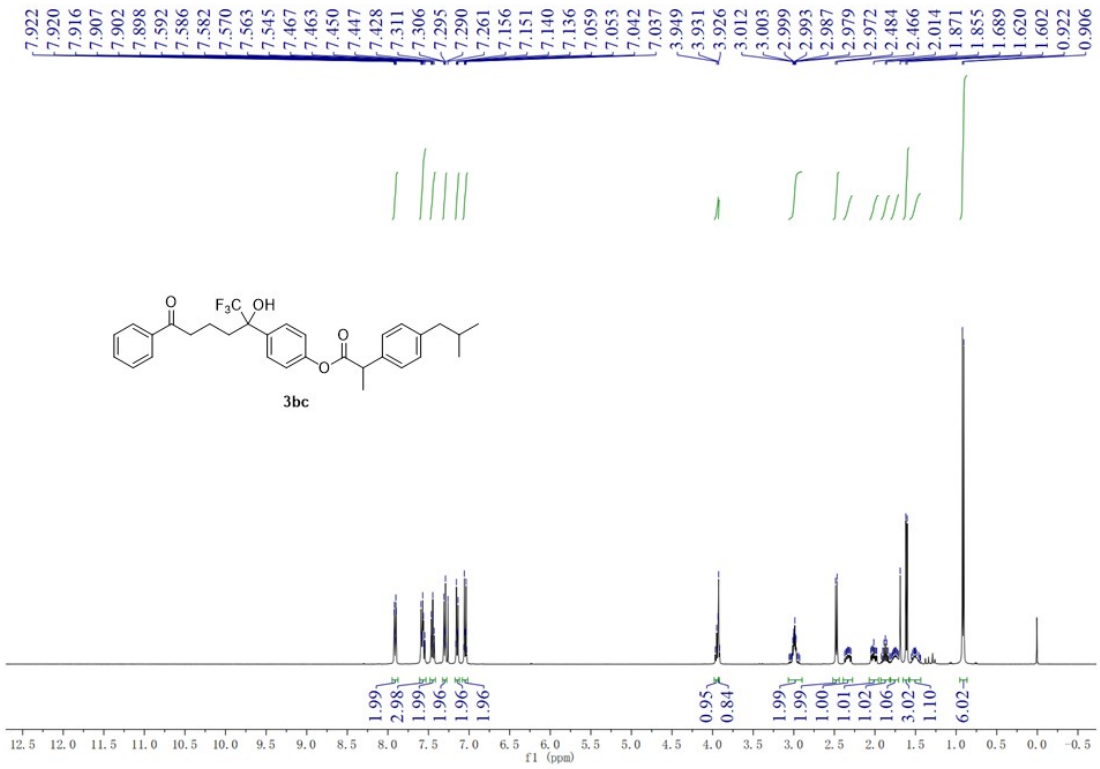
F3C
OH
H
N
O
COOEt
3bb
f1 (ppm)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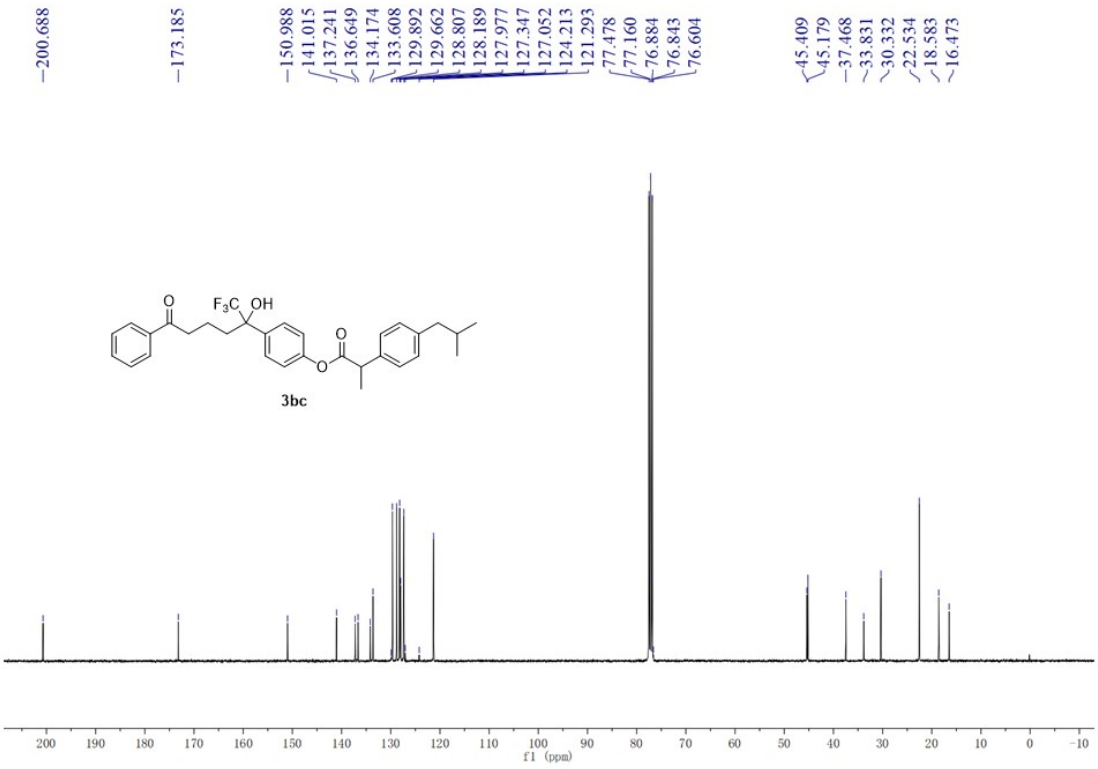
7.467
7.463
7.450
7.447
7.428
7.311
7.306
7.295
7.290
7.261
7.156
7.151
7.140
7.136
7.059
7.053
7.042
7.037
3.949
3.931
3.926
3.012
3.003
2.999
2.993
2.987
2.979
2.972
2.484
2.466
2.014
1.871
1.855
1.689
1.620
1.602
0.922
0.906
O
F3C
OH
O
O
3bc
1.99
2.98
1.99
1.96
1.96
1.96
0.95
0.84
1.99
1.99
1.00
1.01
1.02
1.06
3.02
1.10
6.02
f1 (ppm)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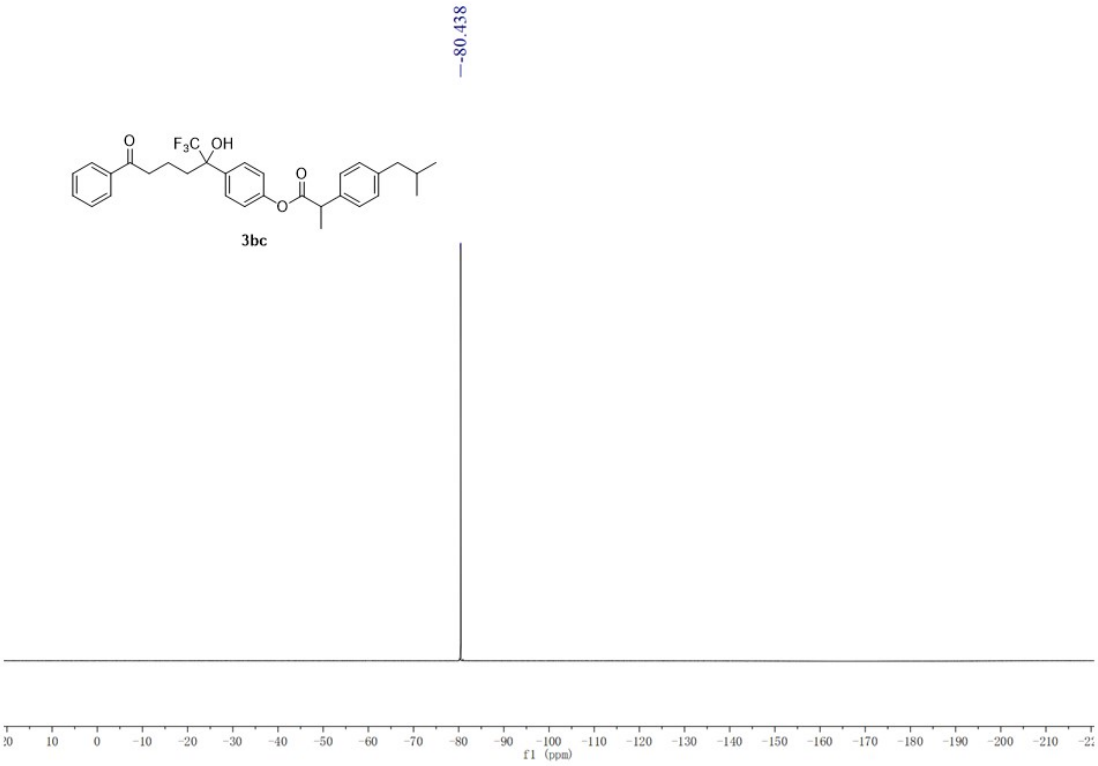
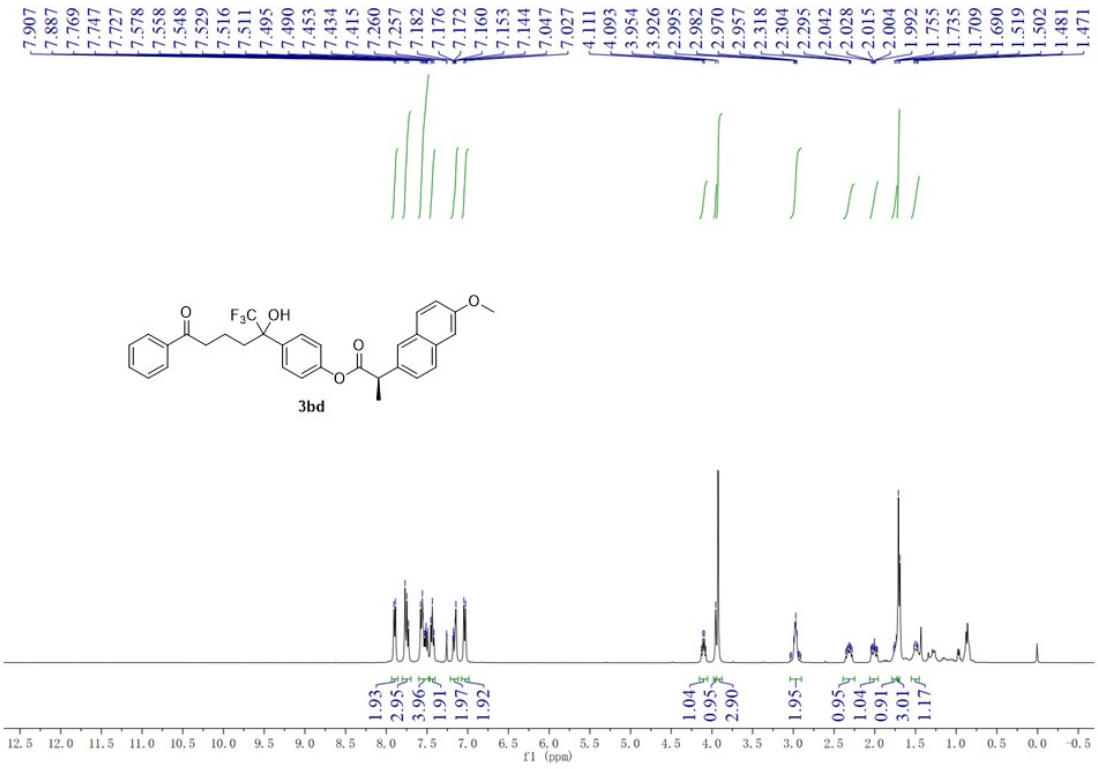
173.185
150.988
141.015
137.241
136.649
134.174
133.608
129.892
129.662
128.807
128.189
127.977
127.347
127.052
124.213
121.293
77.478
77.160
76.884
76.843
76.604
45.409
45.179
37.468
33.831
30.332
22.534
18.583
16.473
F3C OH
O
O
O
3bc
f1 (ppm)


-80.438
F3C OH
O
O
O
3bc
f1 (ppm)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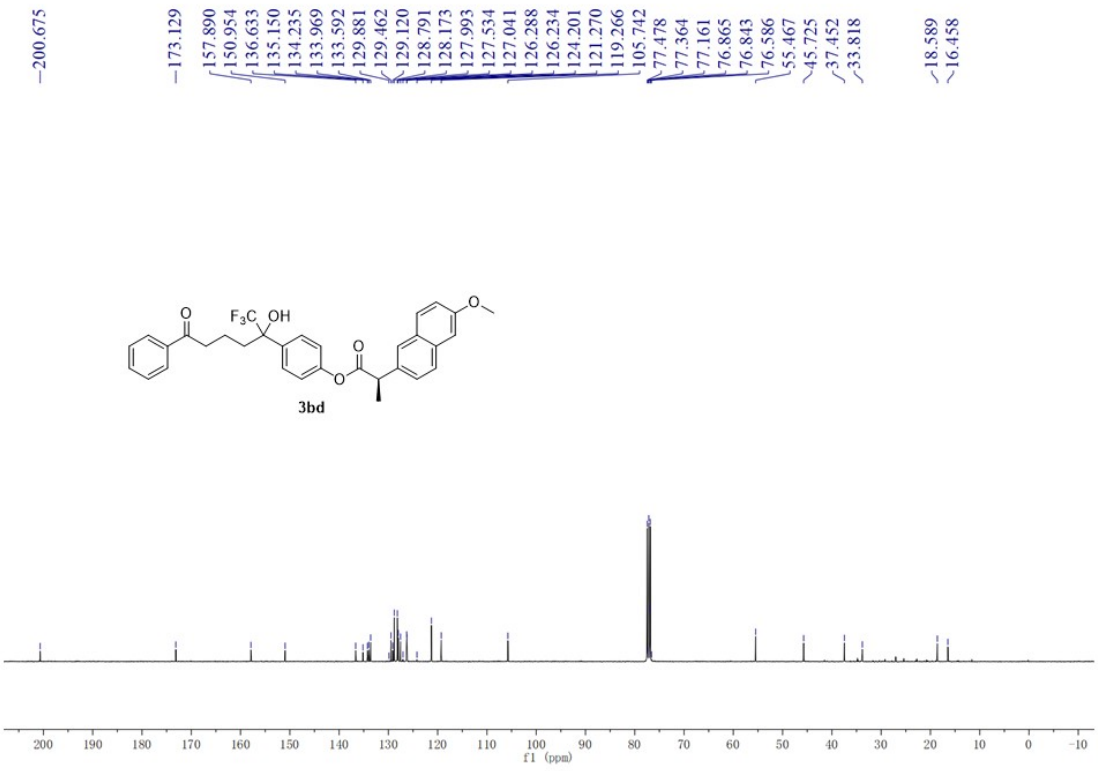
7.887
7.769
7.747
7.727
7.578
7.558
7.548
7.529
7.516
7.511
7.495
7.490
7.453
7.434
7.415
7.260
7.257
7.182
7.176
7.172
7.160
7.153
7.144
7.047
7.027
4.111
4.093
3.954
3.926
2.995
2.982
2.970
2.957
2.318
2.304
2.295
2.042
2.028
2.015
2.004
1.992
1.755
1.735
1.709
1.690
1.519
1.502
1.481
1.471
F3C
OH
O
O
O
O
3bd
1.93
2.95
3.96
1.91
1.97
1.92
1.04
0.95
2.90
1.95
0.95
1.04
0.91
3.01
1.17
f1 (ppm)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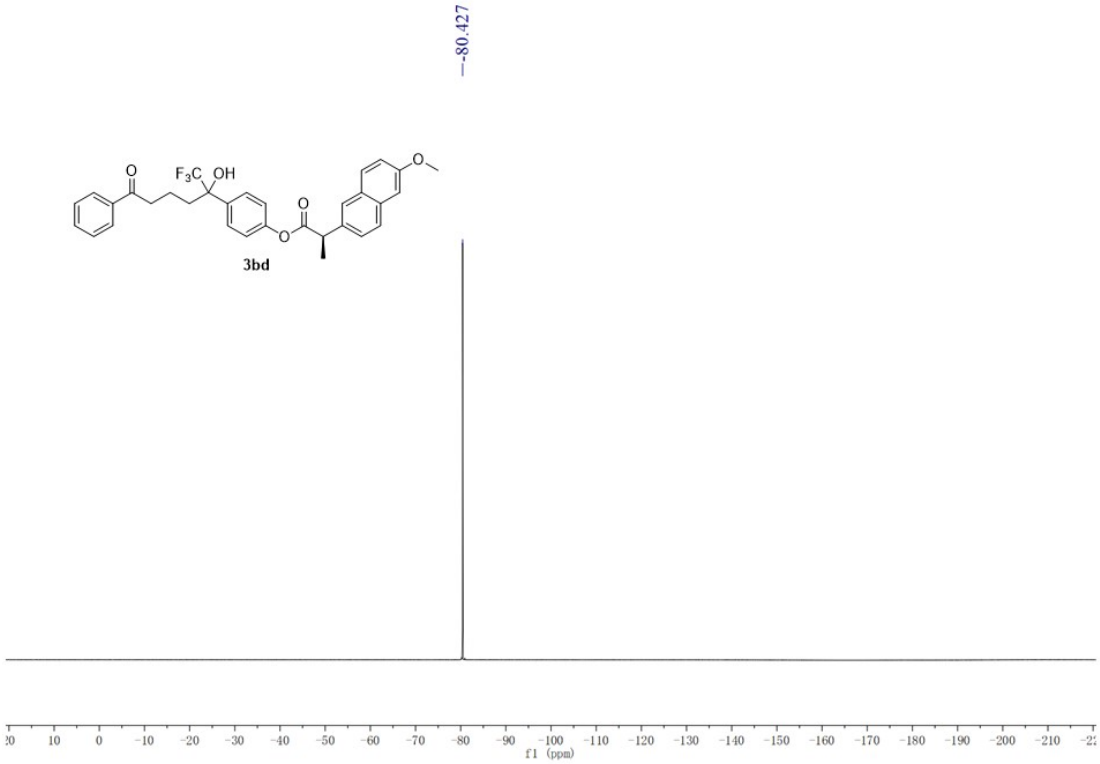
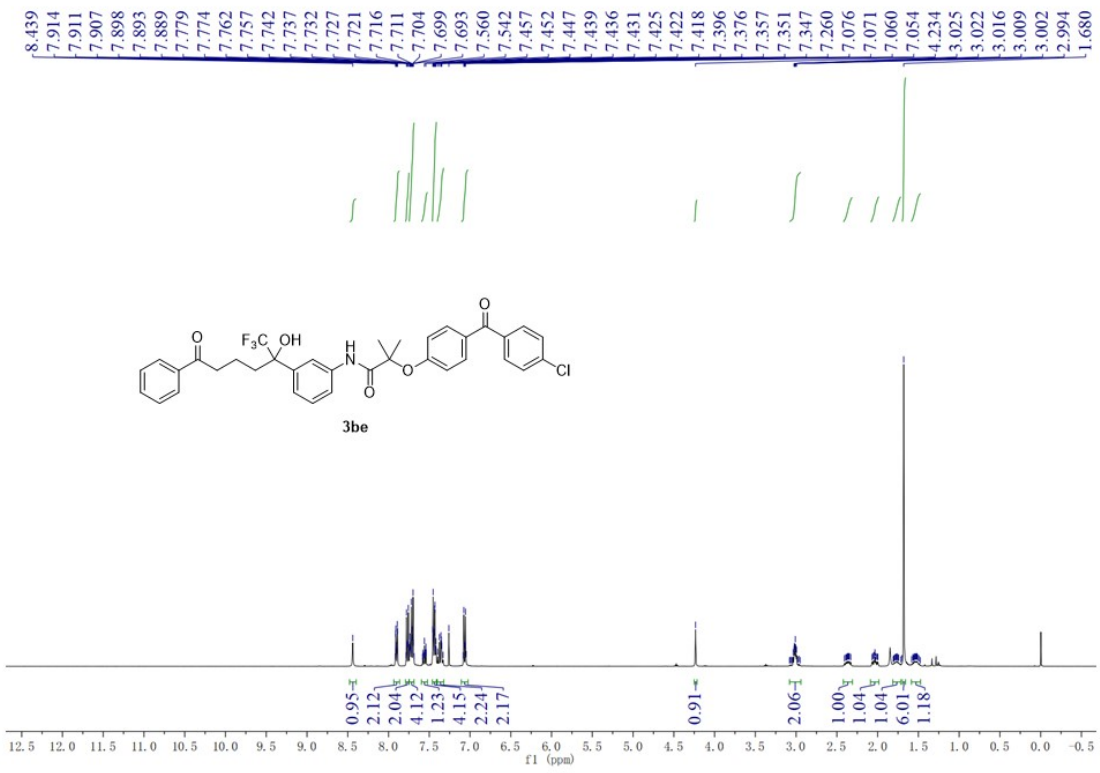
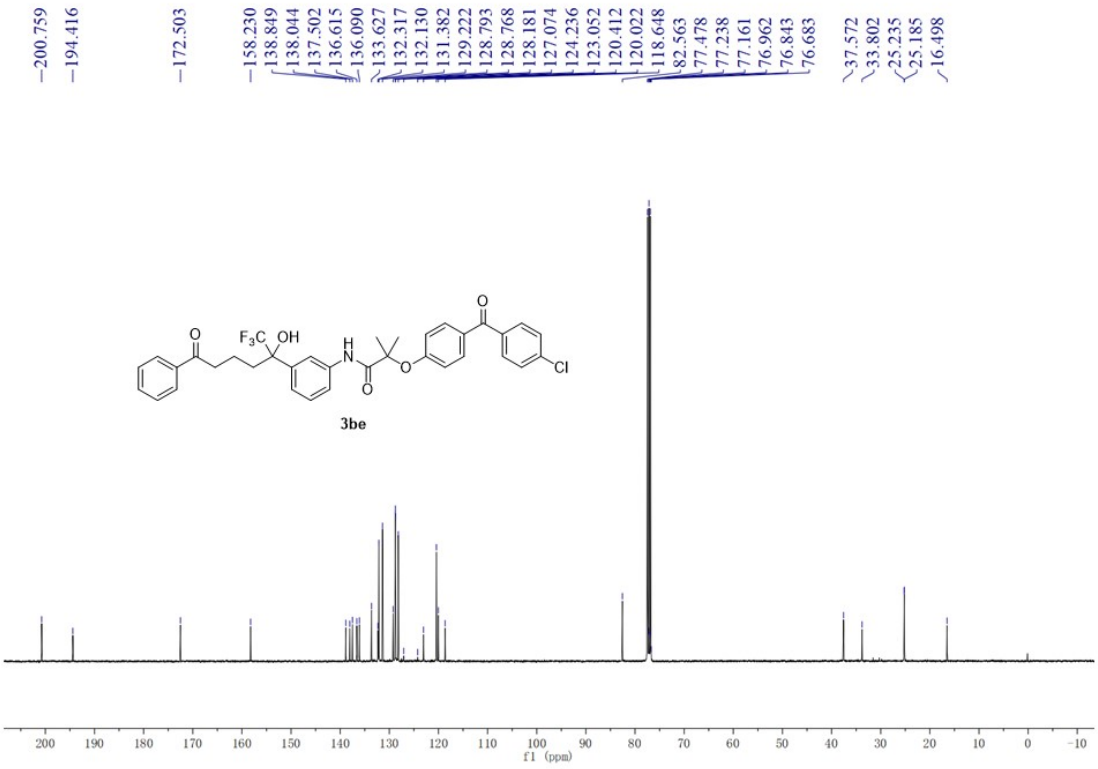
157.890
150.954
136.633
135.150
134.235
133.969
133.592
129.881
129.462
129.120
128.791
128.173
127.993
127.534
127.041
126.288
126.234
124.201
121.270
119.266
105.742
77.478
77.364
77.161
76.865
76.843
76.586
55.467
45.725
37.452
33.818
18.589
16.458
F3C
OH
O
O
O
O
3bd
f1 (ppm)


-80.427
F3C
OH
O
O
O
O
3bd
f1 (ppm)


8.439
7.914
7.911
7.907
7.898
7.893
7.889
7.779
7.774
7.762
7.757
7.742
7.737
7.732
7.727
7.721
7.716
7.711
7.704
7.699
7.693
7.560
7.542
7.457
7.452
7.447
7.439
7.436
7.431
7.425
7.422
7.418
7.396
7.376
7.357
7.351
7.347
7.260
7.076
7.071
7.060
7.054
4.234
3.025
3.022
3.016
3.009
3.002
2.994
1.680
F3C
OH
H
N
O
O
O
Cl
3be
0.95
2.12
2.04
4.12
1.23
4.15
2.24
2.17
0.91
2.06
1.00
1.04
1.04
6.01
1.18
f1 (ppm)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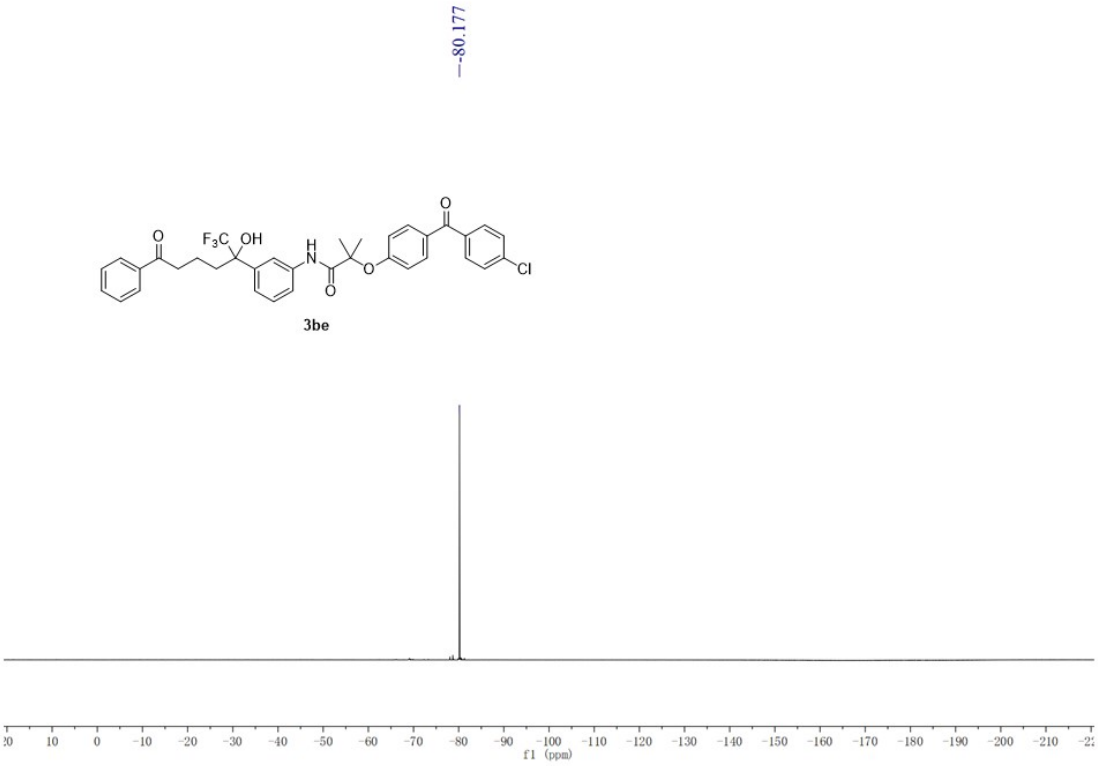
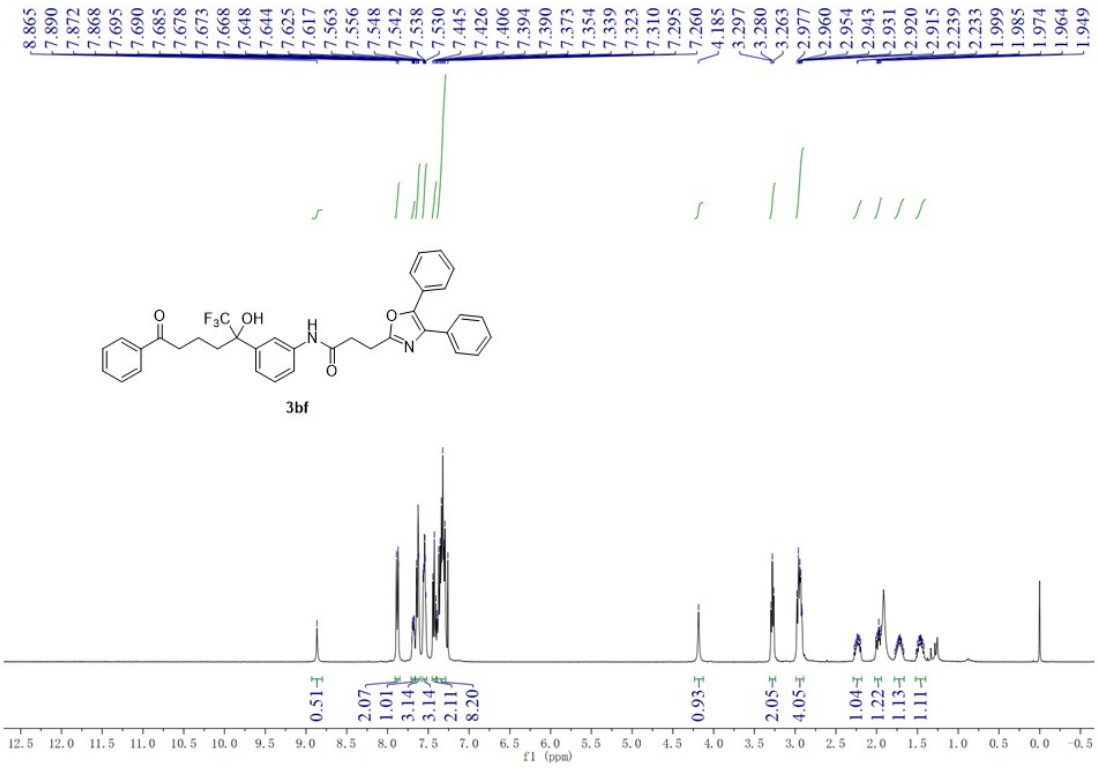
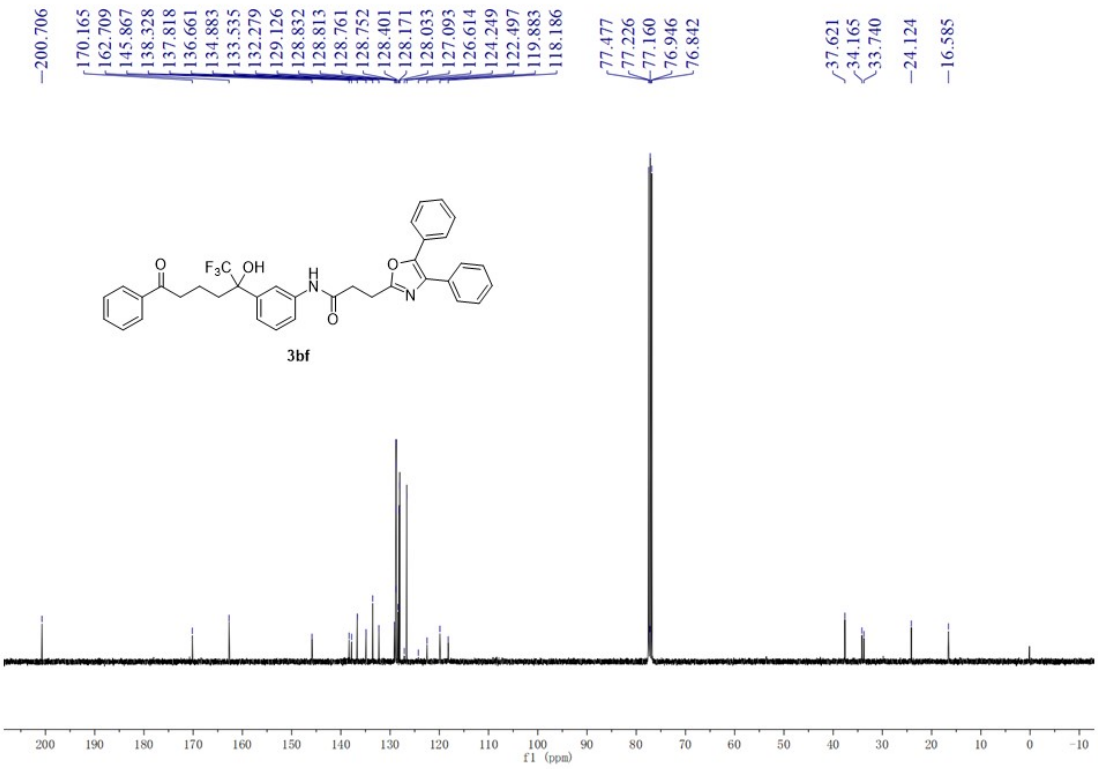
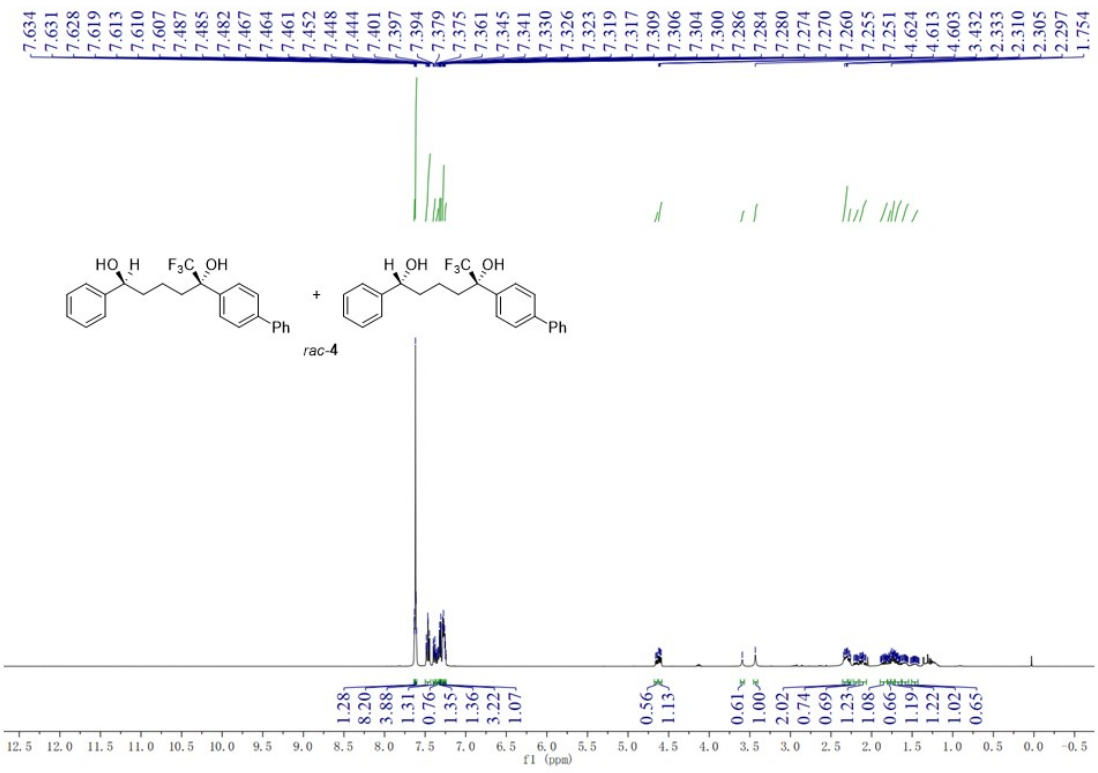
194.416
172.503
158.230
138.849
138.044
137.502
136.615
136.090
133.627
132.317
132.130
131.382
129.222
128.793
128.768
128.181
127.074
124.236
123.052
120.412
120.022
118.648
82.563
77.478
77.238
77.161
76.962
76.843
76.683
37.572
33.802
25.235
25.185
16.498
3be
f1 (ppm)

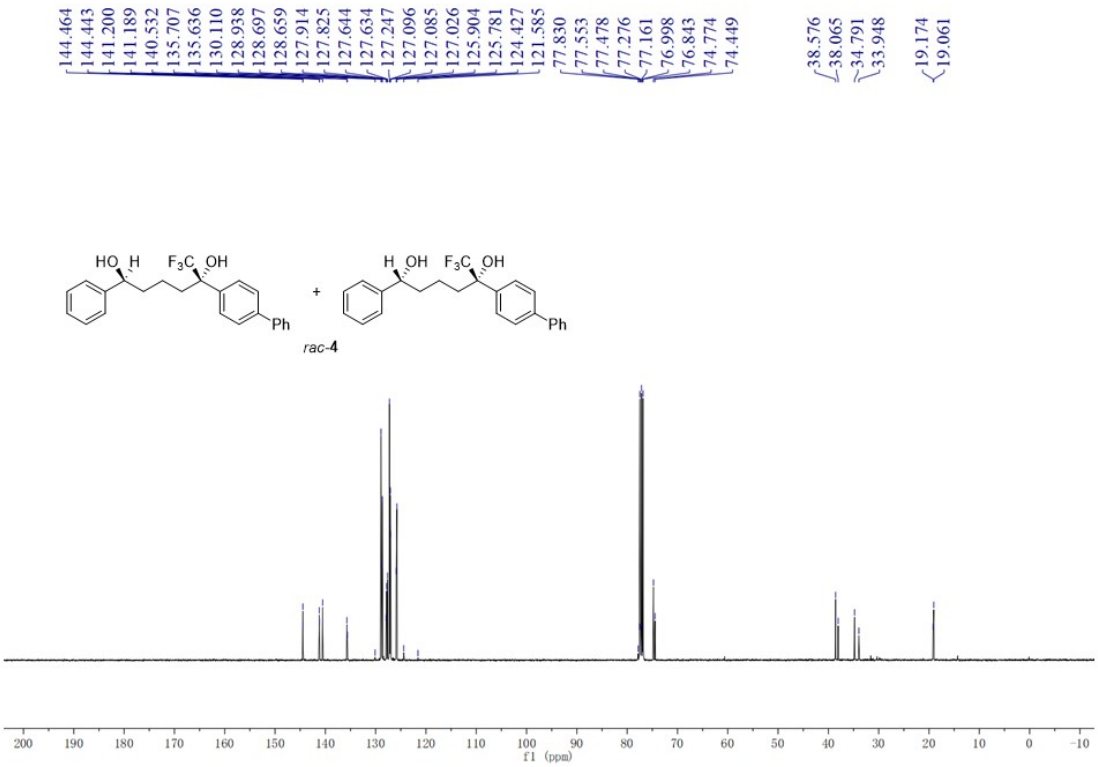

-80.177
3be
f1 (ppm)


8.865
7.890
7.872
7.868
7.695
7.690
7.685
7.678
7.673
7.668
7.648
7.644
7.625
7.617
7.563
7.556
7.548
7.542
7.538
7.530
7.445
7.426
7.406
7.394
7.390
7.373
7.354
7.339
7.323
7.310
7.295
7.260
4.185
3.297
3.280
3.263
2.977
2.960
2.954
2.943
2.931
2.920
2.915
2.239
2.233
1.999
1.985
1.974
1.964
1.949
F3C
OH
H
N
O
O
O
N
3bf
0.51
2.07
1.01
3.14
3.14
2.11
8.20
0.93
2.05
4.05
1.04
1.22
1.13
1.11
f1 (ppm)


200.706
170.165
162.709
145.867
138.328
137.818
136.661
134.883
133.535
132.279
129.126
128.832
128.813
128.761
128.752
128.401
128.171
128.033
127.093
126.614
124.249
122.497
119.883
118.186
77.477
77.226
77.160
76.946
76.842
37.621
34.165
33.740
24.124
16.585
F3C
OH
H
N
O
O
O
N
3bf
f1 (ppm)


-80.180
3bf
f1 (ppm)


7.634
7.631
7.628
7.619
7.613
7.610
7.607
7.487
7.485
7.482
7.467
7.464
7.461
7.452
7.448
7.444
7.401
7.397
7.394
7.379
7.375
7.361
7.345
7.341
7.330
7.326
7.323
7.319
7.317
7.309
7.306
7.304
7.300
7.286
7.284
7.280
7.274
7.270
7.260
7.255
7.251
4.624
4.613
4.603
3.432
2.333
2.310
2.305
2.297
1.754
HO H F3C OH
Ph
+
H OH F3C OH
Ph
rac-4
1.28
8.20
3.88
1.31
0.76
1.35
1.36
3.22
1.07
0.56
1.13
0.61
1.00
2.02
0.74
0.69
1.23
1.08
0.66
1.19
1.22
1.02
0.65
f1 (ppm)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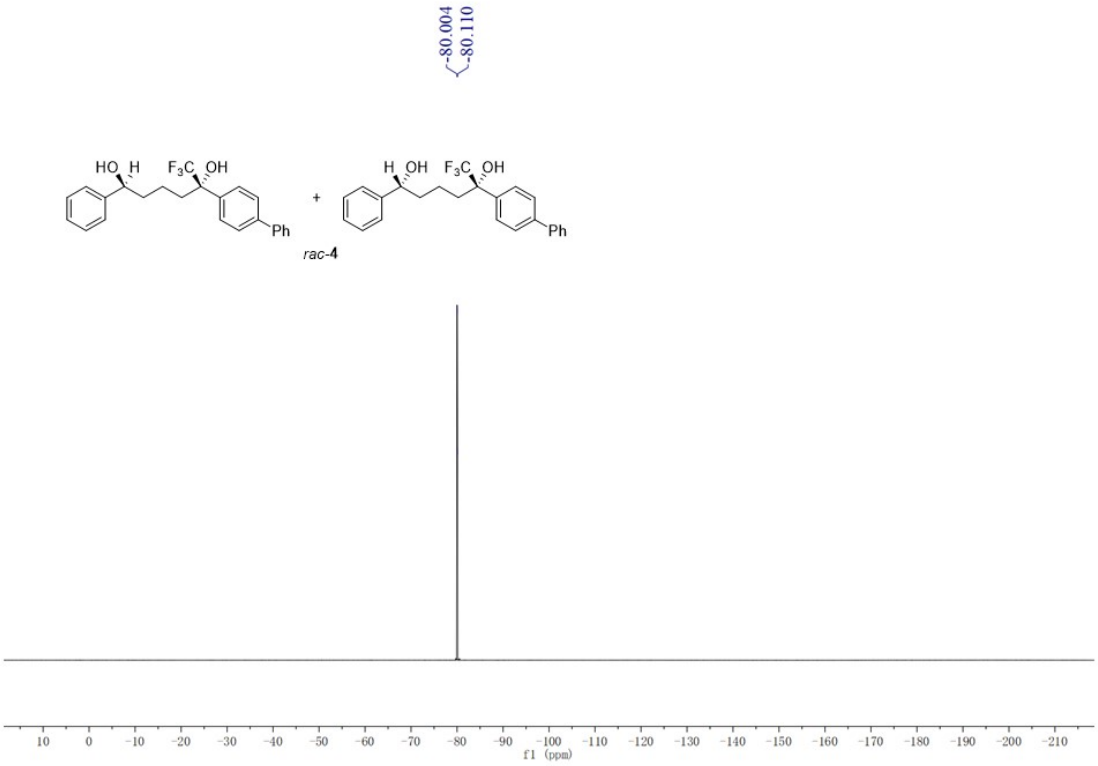
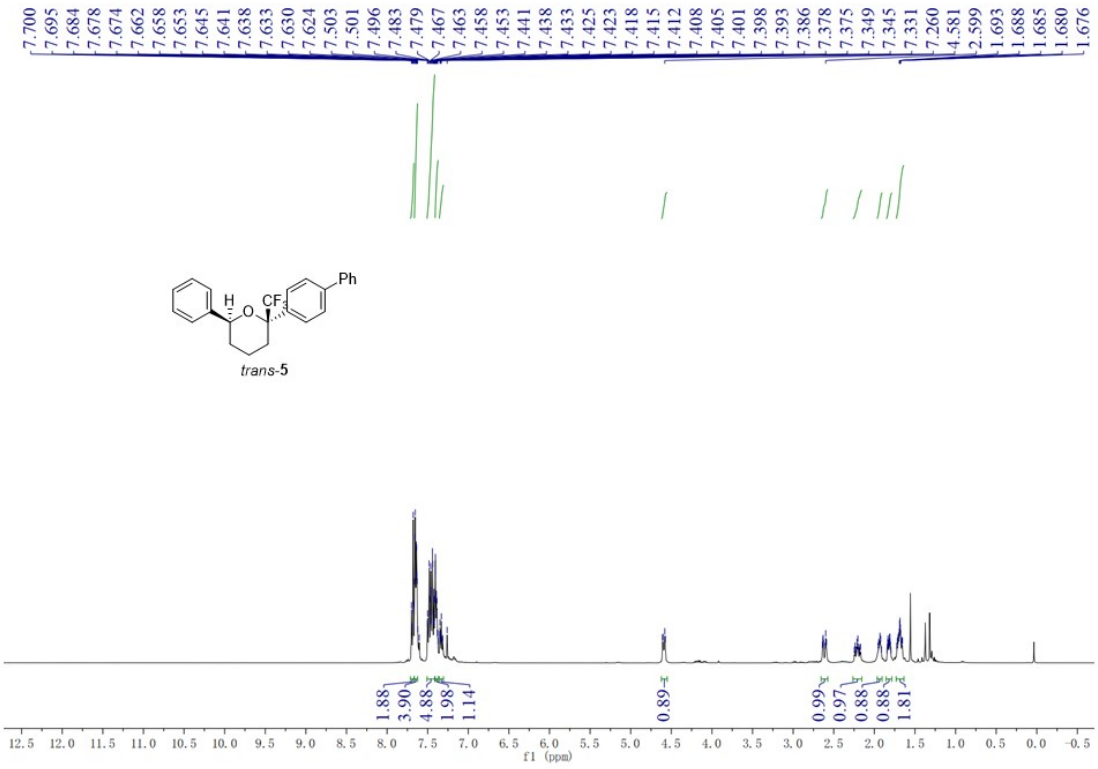
144.443
141.200
141.189
140.532
135.707
135.636
130.110
128.938
128.697
128.659
127.914
127.825
127.644
127.634
127.247
127.096
127.085
127.026
125.904
125.781
124.427
121.585
77.830
77.553
77.478
77.276
77.161
76.998
76.843
74.774
74.449
38.576
38.065
34.791
33.948
19.174
19.061
HO H F3C OH
Ph
+
H OH F3C OH
Ph
rac-4
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-80.004
-80.110
HO H F3C OH
Ph
+
H OH F3C OH
Ph
rac-4
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)


7.700
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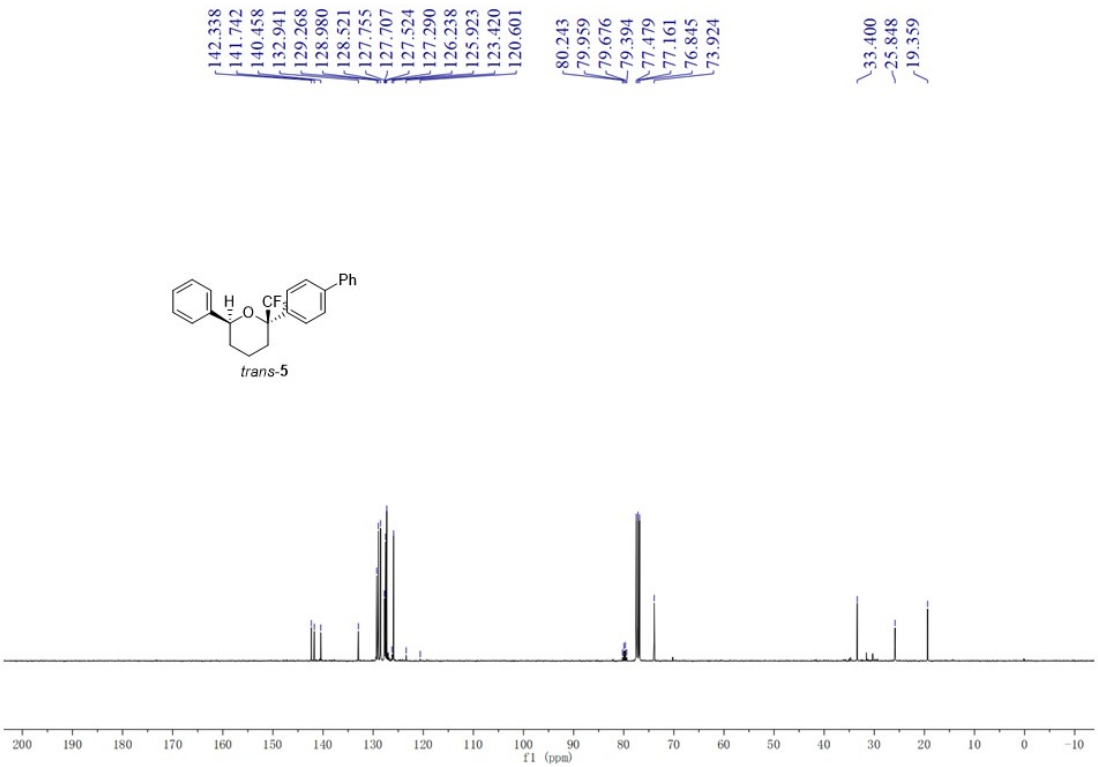
7.684
7.678
7.674
7.662
7.658
7.653
7.645
7.641
7.638
7.633
7.630
7.624
7.503
7.501
7.496
7.483
7.479
7.467
7.463
7.458
7.453
7.441
7.438
7.433
7.425
7.423
7.418
7.415
7.412
7.408
7.405
7.401
7.398
7.393
7.386
7.378
7.375
7.349
7.345
7.331
7.260
4.581
2.599
1.693
1.688
1.685
1.680
1.676
Ph
H
O
CF3
trans-5
1.88
3.90
4.88
1.98
1.14
0.89
0.99
0.97
0.88
0.88
1.81
f1 (ppm)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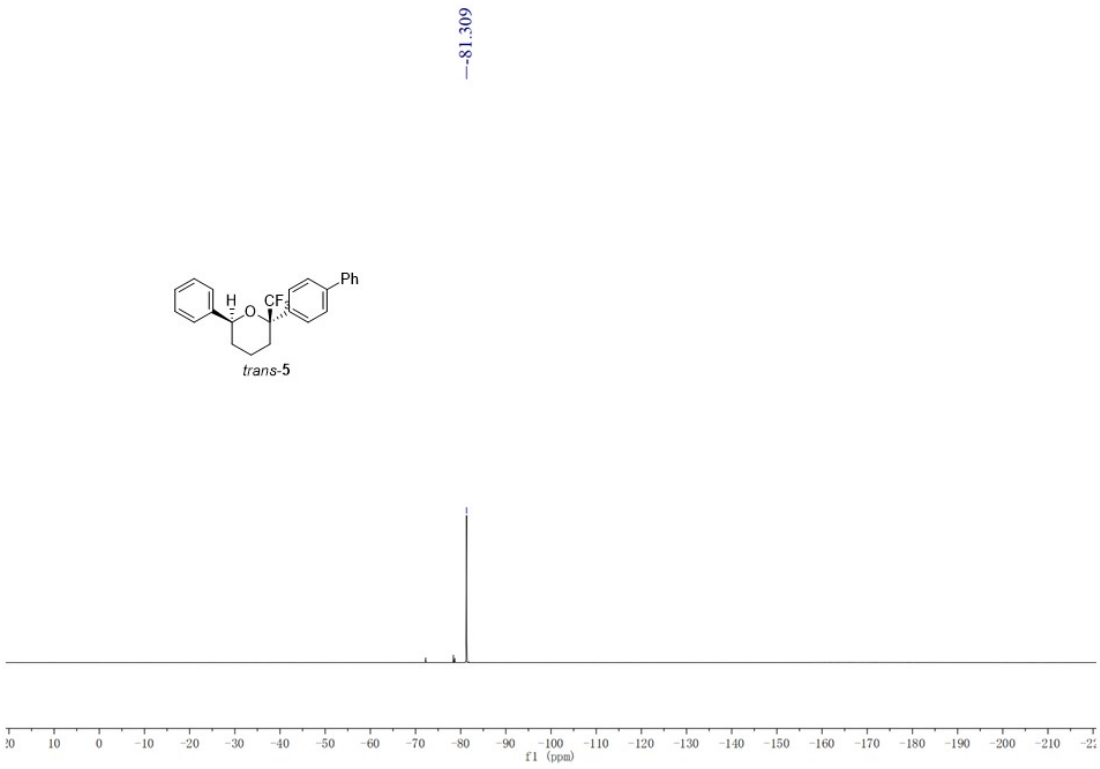
141.742
140.458
132.941
129.268
128.980
128.521
127.755
127.707
127.524
127.290
126.238
125.923
123.420
120.601
80.243
79.959
79.676
79.394
77.479
77.161
76.845
73.924
33.400
25.848
19.359
Ph
H
O
CF3
trans-5
f1 (ppm)


-81.309
Ph
H
O
CF3
trans-5
f1 (ppm)