Supporting information

Lewis Acid Mediated Intramolecular Trifluoromethylthiolation of Alkenes with Phenols: Access to SCF_3-Containing Chromane and Dihydrobenzofuran Compounds

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1 General considerations

Unless otherwise noted, all reactions were carried out under an atmosphere of argon, using over-dried or flame-dried glassware equipped with a magnetic stir bar. All chemicals were purchased from commercial suppliers and used without further purification. In addition to commercially available extra dry solvents, all solvents were purified by standard operating method. Methanol (MeOH) was purchased from commercial suppliers (*Energy Chemical*) and used without further purification. Acetone was purchased from commercial suppliers (*China National Medicines Corporation Ltd*) and used without further purification. Carbon tetrachloride (CCl_4) was purchased from commercial suppliers (*Adamas-beta*) and used without further purification. Tetrahydrofuran (THF) and acetonitrile (MeCN) was purchased from commercial suppliers (*J&K Technology*) and used without further purification. Thin-layer chromatography was performed with EMD silica gel 60 F_{254} plates eluting with solvents indicated, visualized by a 254 nm UV lamp and stained with phosphomolybdic acid (PMA). **^{1}H NMR**, **^{13}C NMR and ^{19}F NMR** spectra were obtained on Bruker AM-400 and Bruker AM-500. Chemical shifts (δ) were quoted in ppm relative to tetramethylsiane or deuterated solvent as internal standard ($CDCl_3$: 7.26 ppm for **^{1}H NMR**; $CDCl_3$: 77.16 ppm for **^{13}C NMR**), multiplicities are as indicated: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet. High-resolution mass spectral analysis **(HRMS)** data was measured on a Buker impact II (Q-TOF) mass spectrum by means of the ESI technique. High-resolution gas-chromatography analysis (**HRGC**) data was measured on an Agilent Technologies 7250 GCQTOF mass spectrum by means of the EI technique. Crystallographic data were obtained from a Bruker D8 VENTURE diffractometer. Melting points were measured on a melting point apparatus and were uncorrected.

2. The preparation of substrates

2.1 The substrates **1a**[1], **1b**[2], **1c-1e**[1], **1f**[2], **1g**[1], **1h**[2], **1i-1m**[1], **1n**[2], **1o**[3], **5h**[4], **5l**[4], **5m**[5], **5n**[6] and **5o**[6] were known compounds.

Our analytical data (**^{1}H-NMR, ^{13}C-NMR and ^{19}F-NMR**) match with the literatures.[1-6]

Figure S1

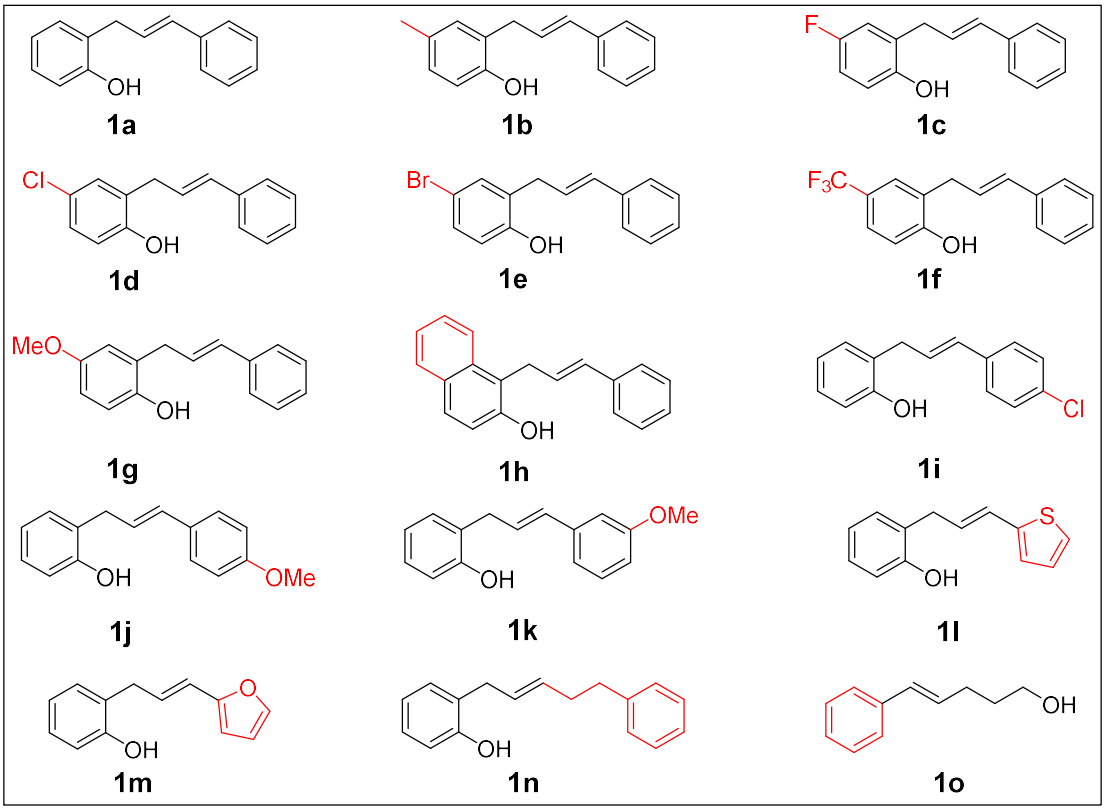
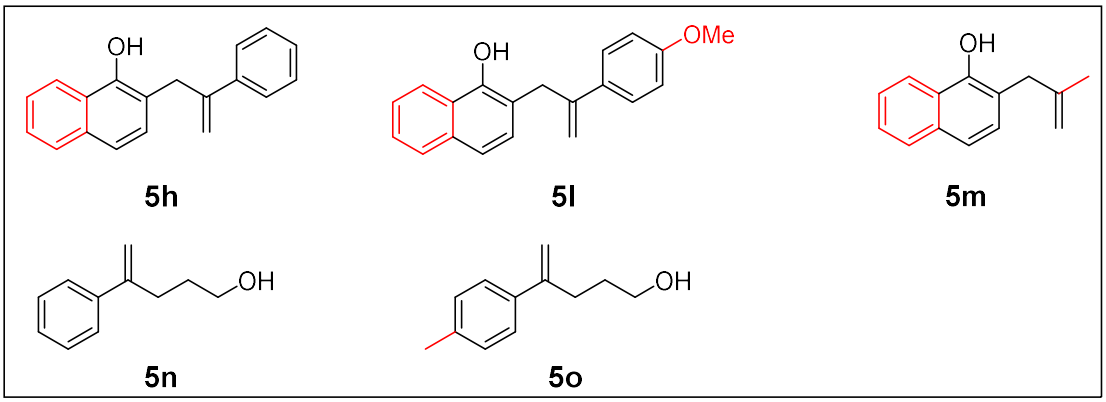
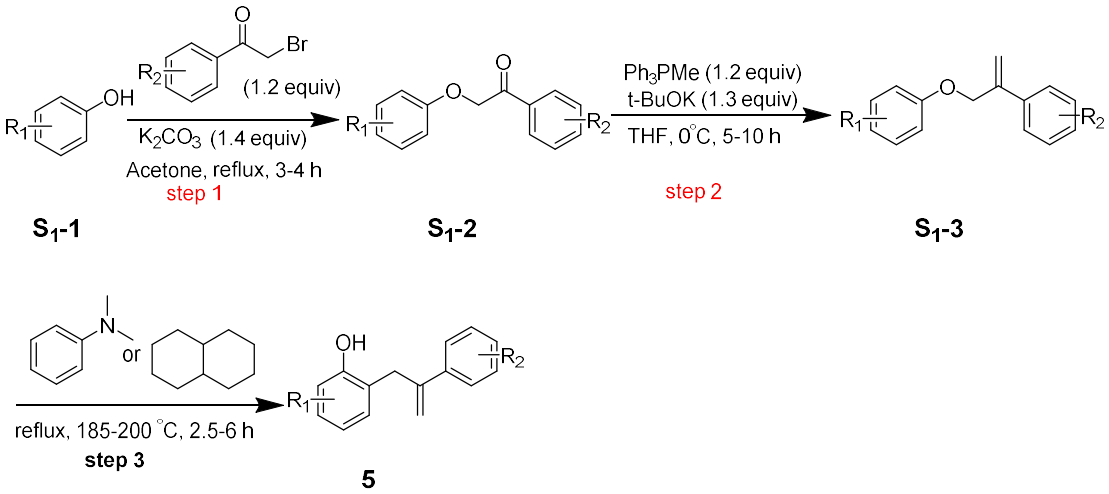


Figure S2

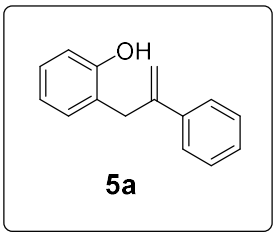


2.2 The general procedure **A** for the preparation of substrates **5a-5g** and **5i-5k**.

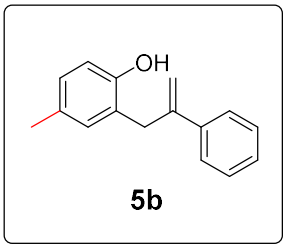


The procedure for the preparation of **S1-3** (step 1 and step 2) followed the literature exactly.[3]

Step 3: To an over-dried 25 mL round-bottomed flask equipped with a stir bar, (3-phenoxyprop-1-en-2-yl)benzene **S1-3a** (1.63 g, 7.75 mmol) and *N,N*-dimethylaniline (3 mL) were added. The solution was stirred at 200 ºC (using heating mantle) by for 6 h. When the reaction was completed, the product was purified by silica gel flash column chromatography to obtain product 2-(2-phenylallyl)phenol **5a**.

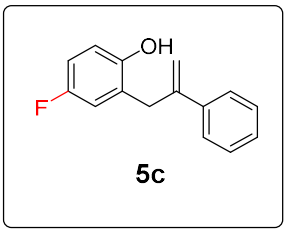


According to the general procedure **A**, at the step 3, **S1-3a** (7.75 mmol, 1.63 g) and *N,N*-dimethylaniline (3 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 6 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5a** as a colorless oil (412.5 mg, 25.3%), R_f=0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.57 – 7.44 (m, 2H), 7.41 – 7.26 (m, 3H), 7.22 – 7.08 (m, 2H), 6.89 (td, *J* = 7.4, 1.2 Hz, 1H), 6.82 (dd, *J* = 8.0, 1.2 Hz, 1H), 5.54 (d, *J* = 1.2 Hz, 1H), 5.12 – 4.89 (m, 2H), 3.86 (s, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 154.2, 146.1, 140.6, 131.1, 128.5, 128.1, 127.9, 126.2, 125.2, 121.1, 116.0, 114.2, 36.2; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{15}H_{14}NaO$: 233.0937; Found 233.0937.



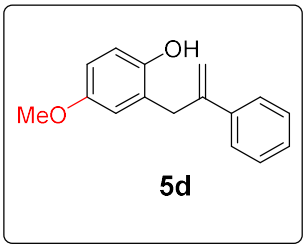
5b

According to the general procedure **A**, at the step 3, **S1-3b** (3.77 mmol, 846.3 mg) and *N,N*-dimethylaniline (3 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5b** as a colorless oil (253.3 mg, 30%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.54 – 7.46 (m, 2H), 7.38 – 7.26 (m, 3H), 7.02 – 6.87 (m, 2H), 6.72 (d, *J* = 8.0 Hz, 1H), 5.51 (d, *J* = 1.1 Hz, 1H), 5.01 (m, 1H), 4.74 (d, *J* = 1.6 Hz, 1H), 3.80 (s, 2H), 2.24 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 151.9, 146.3, 140.7, 131.7, 130.3, 128.5, 127.9, 126.2, 125.0, 115.8, 114.1, 36.3, 20.7; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{16}NaO$ 247.1093; Found 247.1091.



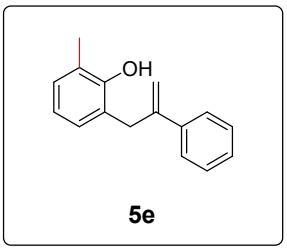
5c

According to the general procedure **A**, at the step 3, **S1-3c** (6.99 mmol, 1.60 g) and *N,N*-dimethylaniline (5 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5.5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5c** as a colorless oil (852.8 mg, 56%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.62 – 7.40 (m, 2H), 7.37 – 7.25 (m, 3H), 6.87 (dd, *J* = 9.0, 3.0 Hz, 1H), 6.80 (td, *J* = 8.2, 3.0 Hz, 1H), 6.74 (dd, *J* = 8.8, 4.8 Hz, 1H), 5.55 (q, *J* = 1.0 Hz, 1H), 5.06 (q, *J* = 1.4 Hz, 1H), 4.97 (s, 1H), 3.82 (s, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 157.3 (d, *J* = 238.9 Hz), 150.0 (d, *J* = 2.2 Hz), 145.6, 140.2, 128.6, 128.0, 127.1 (d, *J* = 7.3 Hz), 126.1, 117.2 (d, *J* = 23.3 Hz), 116.7 (d, *J* = 8.3 Hz), 114.6, 114.1 (d, *J* = 23.2 Hz), 36.1 (d, *J* = 1.2 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -123.78; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{15}H_{13}FNaO$ 251.0843; Found 251.0845.



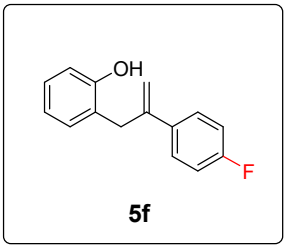
5d

According to the general procedure **A**, at the step 3, **S1-3d** (5.91 mmol, 1.42 g) and *N,N*-dimethylaniline (5 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5d** as a colorless oil. (696.8 mg, 49%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.53 – 7.42 (m, 2H), 7.36 – 7.18 (m, 3H), 6.70 (dd, *J* = 5.9, 2.8 Hz, 2H), 6.63 (dd, *J* = 8.7, 3.0 Hz, 1H), 5.49 (d, *J* = 1.2 Hz, 1H), 5.08 (s, 1H), 5.00 (q, *J* = 1.4 Hz, 1H), 3.78 (s, 2H), 3.68 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 153.7, 148.0, 146.0, 140.6, 128.4, 127.8, 126.6, 126.1, 116.6, 116.5, 114.2, 112.8, 55.8, 36.2; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{16}NaO_2$ 263.1043; Found 263.1044.



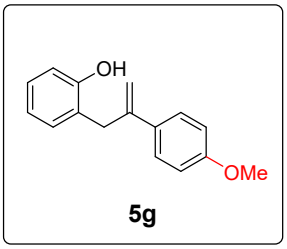
5e

According to the general procedure **A**, at the step 3, **S1-3e** (2.23 mmol, 499.4 mg) and *N,N*-dimethylaniline (3 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5e** as a colorless oil. (125.3 mg, 25%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.57 – 7.44 (m, 2H), 7.38 – 7.25 (m, 3H), 7.02 (t, *J* = 8.2 Hz, 2H), 6.79 (t, *J* = 7.5 Hz, 1H), 5.53 (d, *J* = 1.2 Hz, 1H), 5.05 (t, *J* = 1.5 Hz, 1H), 4.95 (s, 1H), 3.85 (s, 2H), 2.26 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 152.6, 146.2, 140.6, 129.5, 128.9, 128.5, 127.9, 126.2, 124.6, 124.2, 120.6, 114.3, 36.7, 16.1; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{16}NaO$: 247.1093; Found 247.1094.



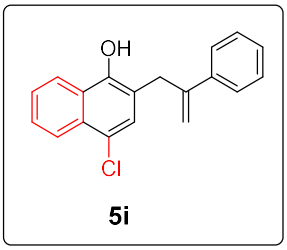
5f

According to the general procedure **A**, at the step 3, **S1-3f** (14.08 mmol, 3.21 g) and *N,N*-dimethylaniline (5 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5f** as a white solid. (1.04 g, 32%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz,$CDCl_3$) δ 7.52 – 7.39 (m, 2H), 7.13 (m, 2H), 7.07 – 6.96 (m, 2H), 6.89 (td, *J* = 7.4, 1.2 Hz, 1H), 6.81 (dd, *J* = 8.4, 1.3 Hz, 1H), 5.47 (d, *J* = 1.1 Hz, 1H), 5.13 – 4.97 (m, 2H), 3.83 (s, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 162.5 (d, *J* = 247.6 Hz), 154.0, 145.3, 136.6 (d, *J* = 3.3 Hz), 131.0 (d, *J* = 3.8 Hz), 128.1 (d, *J* = 1.8 Hz), 127.8 (d, *J* = 8.1 Hz), 125.1, 121.1, 115.9 (d, *J* = 7.0 Hz), 115.3 (d, *J* = 21.2 Hz), 114.2, 36.2; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -114.63; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{15}H_{13}FNaO$ 251.0843; Found 251.0847.



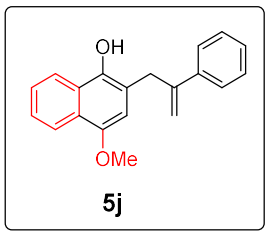
5g

According to the general procedure **A**, at the step 3, **S1-3g** (11.87 mmol, 2.85 g) and *N,N*-dimethylaniline (5 mL) were added. The solution was stirred at 200 ºC (using heating mantle) for 5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5g** as a white solid. (825 mg, 29%), R_f =0.3 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.53 – 7.35 (m, 2H), 7.22 – 7.02 (m, 2H), 6.92 – 6.83 (m, 3H), 6.81 (dd, *J* = 8.0, 1.2 Hz, 1H), 5.46 (s, 1H), 5.13 (s, 1H), 4.98 (d, *J* = 1.4 Hz, 1H), 3.83 (s, 2H), 3.80 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 159.4, 154.3, 145.4, 132.9, 131.1, 128.0, 127.3, 125.3, 121.0, 116.0, 113.8, 112.6, 55.4, 36.4; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{16}NaO_2$ 263.1043; Found 263.1042.



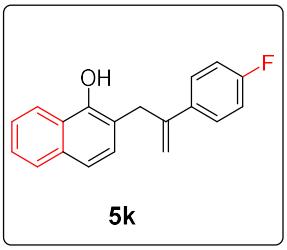
5i

According to the general procedure **A**, at the step 3, **S1-3i** (1.54 mmol, 455.1 mg) and decahydronaphthalene (3 mL) were added. The solution was stirred at 185 ºC (using heating mantle) for 2.5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5i** as a colorless oil. (91.3 mg, 20%), R_f=0.2 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.21 (m, 2H), 7.62 – 7.49 (m, 4H), 7.41 – 7.29 (m, 4H), 5.65 – 5.55 (m, 2H), 5.16 (d, *J* = 1.3 Hz, 1H), 3.97 (s, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 149.0, 145.6, 139.9, 130.7, 128.7, 128.6, 128.3, 127.0, 126.2, 126.1, 124.4, 123.4, 122.1, 118.5, 114.9, 37.1; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{19}H_{15}ClNaO$ 317.0704; Found 317.0703.



5j

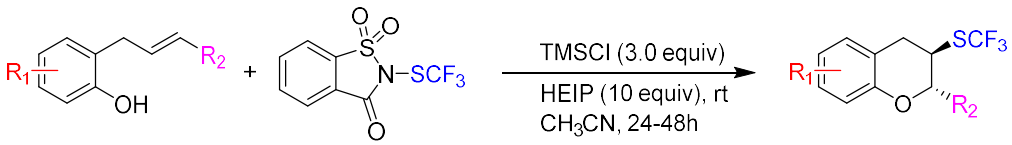
According to the general procedure **A**, at the step 3, **S1-3j** (2.79 mmol, 809 mg) and decahydronaphthalene (3 mL) were added. The solution was stirred at 185 ºC (using heating mantle) for 2.5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5j** as a white solid. (463 mg, 57%) R_f =0.2 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.20 (d, *J* = 8.2 Hz, 1H), 8.12 (d, *J* = 8.2 Hz, 1H), 7.68 – 7.41 (m, 4H), 7.33 (m, 3H), 6.61 (s, 1H), 5.55 (s, 1H), 5.11 (s, 1H), 5.06 (s, 1H), 3.98 (s, 2H), 3.93 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 149.8, 146.1, 143.1, 140.5, 128.6, 128.1, 126.2, 126.1, 126.1, 125.6, 125.3, 122.0, 121.3, 118.1, 114.3, 106.9, 55.9, 37.4; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{20}H_{18}NaO_2$ 313.1199; Found 313.1199.



5k

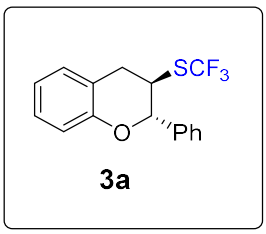
According to the general procedure **A**, at the step 3, **S1-3k** (3.12 mmol, 869 mg) and decahydronaphthalene (3 mL) were added. The solution was stirred at 185 ºC (using heating mantle) for 2.5 h. Flash column chromatography (SiO_2, PE:EA = 20:1, v/v) to afford **5k** as a white solid.(521 mg, 60%), R_f=0.2 (silica gel, PE:EA = 10:1); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.17 (m, 1H), 7.85 – 7.76 (m, 1H), 7.58 – 7.45 (m, 4H), 7.43 (d, *J* = 8.3 Hz, 1H), 7.28 (d, *J* = 0.9 Hz, 1H), 7.02 (m, 2H), 5.57 (s, 1H), 5.53 (d, *J* = 1.1 Hz, 1H), 5.16 (d, *J* = 1.3 Hz, 1H), 4.00 (s, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ162.7 (d, *J* = 248.3 Hz), 149.7, 145.2, 136.3 (d, *J* = 3.4 Hz), 133.9, 128.9, 127.9 (d, *J* = 8.1 Hz), 127.7, 126.0, 125.5, 124.9, 121.4, 120.7, 117.9, 115.4 (d, *J* = 21.2 Hz), 114.5, 37.4; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -114.19; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{19}H_{15}FNaO$ 301.0999; Found 301.1001.

3. General procedures B for the synthesis of desired products 3



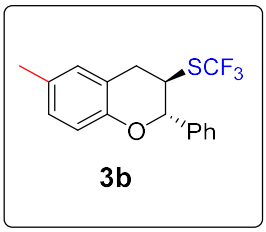
1 **2a** **3**

At room temperature, **1** (0.1 mmol) and **2a** (0.13 mmol) were added into an over-dried 10 mL flask equipped with a stir bar. Seal the flask with a septum. Anhydrous CH_3CN (1 mL) was added via a syringe, and then TMSCl (38.0 μL, 0.3 mmol) and HFIP (105.0 μL, 1.0 mmol) were added by using syringes respectively and stirred for 24-48 hours. After the reaction was completed (monitored by TLC), the solvent was removed under reduce pressure, the crude product was purified by silica gel flash column chromatography to obtain products **3**.



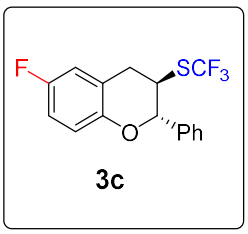
3a

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3a** as a white solid (23.1 mg, 74%), R_f=0.4 (silica gel, PE); **Mp :** 84.5 ~ 86.5 ℃; **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46 – 7.30 (m, 5H), 7.25 – 7.17 (m, 1H), 7.07 (d, *J* = 8.1 Hz, 1H), 7.03 – 6.91 (m, 2H), 5.29 (d, *J* = 6.0 Hz, 1H), 3.97 (q, *J* = 6.0 Hz, 1H), 3.22 (dd, *J* = 16.7, 5.0 Hz, 1H), 3.07 (dd, *J* = 16.7, 6.8 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 153.6, 138.8, 131.0 (q, *J* = 308.0 Hz), 129.7, 128.9, 128.8, 128.6, 126.3, 121.4, 119.0, 116.9, 76.8, 43.5 (d, *J* = 1.7 Hz), 31.0; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.01; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{13}F_3NaOS$ 333.0531; Found 333.0530.



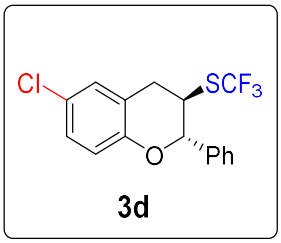
3b

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3b** as a colorless oil (21.9 mg, 68%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 – 7.28 (m, 5H), 7.09 (dd, *J* = 7.1, 1.8 Hz, 1H), 6.95 – 6.74 (m, 2H), 5.36 (d, *J* = 5.7 Hz, 1H), 3.95 (q, *J* = 5.7 Hz, 1H), 3.18 (dd, *J* = 16.7, 4.9 Hz, 1H), 3.04 (dd, *J* = 16.7, 6.4 Hz, 1H), 2.28 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 151.6, 139.2, 131.1 (q, *J* = 308.2 Hz), 129.7, 128.8, 128.6, 127.3, 126.1, 120.8, 118.3, 79.8, 43.6 (d, *J* = 1.6 Hz), 30.9, 16.2; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.14; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaOS$ 347.0688; Found 347.0692.



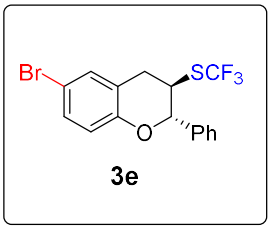
3c

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3c** as a white solid (22.6 mg, 69%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz,$CDCl_3$) δ 7.45 – 7.34 (m, 3H), 7.32 (dd, *J* = 7.6, 1.9 Hz, 2H), 6.92 (dd, *J* = 7.1, 2.3 Hz, 2H), 6.77 (dd, *J* = 8.1, 2.3 Hz, 1H), 5.26 (d, *J* = 5.9 Hz, 1H), 3.95 (q, *J* = 5.9 Hz, 1H), 3.18 (dd, *J* = 17.0, 5.1 Hz, 1H), 3.04 (dd, *J* = 16.9, 6.6 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 157.3 (d, *J* = 240.5 Hz), 149.5 (d, *J* = 2.1 Hz), 138.5, 133.4 (q, *J* = 308.2 Hz), 129.0, 128.9, 126.2, 120.1 (d, *J* = 8.2 Hz), 117.9 (d, *J* = 8.2 Hz), 115.6 (d, *J* = 23.2 Hz), 115.5 (d, *J* = 23.4 Hz), 79.7, 43.1 (d, *J* = 1.9 Hz), 31.1; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.04, -122.78; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{12}F_4NaOS$ 351.0437; Found 351.0438.



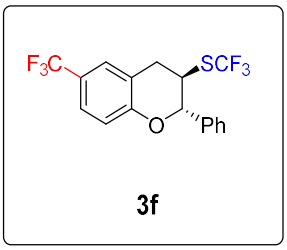
3d

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3d** as a white solid (25.3 mg, 73%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.45 – 7.33 (m, 3H), 7.30 (dd, *J* = 7.5, 1.9 Hz, 2H), 7.17 (dd, *J* = 8.7, 2.5 Hz, 1H), 7.05 (d, *J* = 2.5 Hz, 1H), 6.92 (d, *J* = 8.7 Hz, 1H), 5.30 (d, *J* = 5.6 Hz, 1H), 3.94 (q, *J* = 5.7 Hz, 1H), 3.15 (dd, *J* = 16.9, 5.0 Hz, 1H), 3.01 (dd, *J* = 16.9, 6.4 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 152.1, 138.4, 130.9 (q, *J* = 308.2 Hz), 129.3, 129.0, 128.9, 128.7, 126.2, 126.1, 120.5, 118.2, 79.8, 42.9 (d, *J* = 1.6 Hz), 30.6; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.06; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{12}ClF_3NaOS$ 367.0142, Found 367.0140.



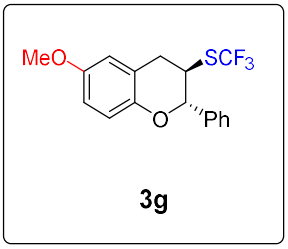
3e

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3e** as a white solid (23.9 mg, 61%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.46 – 7.33 (m, 3H), 7.30 (td, *J* = 6.0, 2.7 Hz, 3H), 7.19 (d, *J* = 2.3 Hz, 1H), 6.87 (d, *J* = 8.7 Hz, 1H), 5.30 (d, *J* = 5.6 Hz, 1H), 3.93 (q, *J* = 5.6 Hz, 1H), 3.15 (dd, *J* = 16.9, 5.0 Hz, 1H), 3.00 (dd, *J* = 16.9, 6.3 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 152.7, 138.4, 132.2, 131.6, 130.9 (q, *J* = 308.2 Hz), 129.0, 128.9, 126.1, 121.1, 118.7, 113.5, 79.8, 42.9 (d, *J* = 1.7 Hz), 30.5; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.08; **HRGC** (EI) m/z: calcd for $C_{16}H_{12}BrF_3OS$ 387.9739; Found 387.9744.



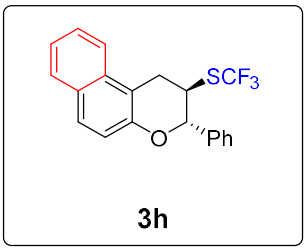
3f

According to the general procedure B, the reaction time is 48 h, flash column chromatography (SiO_2, PE) to afford **3f** as a white solid (22.7 mg, 60%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 (dd, *J* = 8.6, 2.2 Hz, 1H), 7.43 – 7.36 (m, 3H), 7.34 (d, *J* = 2.1 Hz, 1H), 7.29 (dd, *J* = 7.5, 2.1 Hz, 2H), 7.06 (d, *J* = 8.6 Hz, 1H), 5.36 (d, *J* = 5.6 Hz, 1H), 3.97 (q, *J* = 5.6 Hz, 1H), 3.21 (dd, *J* = 16.9, 4.9 Hz, 1H), 3.07 (dd, *J* = 16.9, 6.4 Hz, 1H). **^{13}C NMR** (101 MHz, $CDCl_3$) δ 156.1, 138.1, 130.8 (q, *J* = 308.2 Hz), 129.1, 129.0, 127.2 (q, *J* = 3.8 Hz), 126.1, 125.9 (q, *J* = 3.7 Hz), 124.3 (q, *J* = 272.3 Hz), 123.7 (d, *J* = 32.6 Hz), 119.3, 117.3, 80.1, 42.8 (d, *J* = 1.8 Hz), 30.5; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.07, -61.65; **HRGC** (EI) m/z: calcd for $C_{17}H_{12}F_6OS$ 378.0508; Found 378.0512.



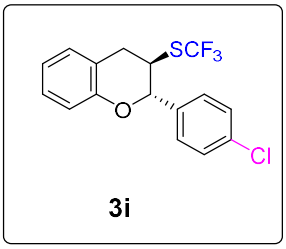
3g

According to the general procedure **B**, the reaction time is 48 h, flash column chromatography (SiO_2, PE) to afford **3g** as a white solid (26.5 mg, 78%), R_f=0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.41 – 7.29 (m, 5H), 6.91 (d, *J* = 8.9 Hz, 1H), 6.79 (dd, *J* = 8.9, 3.0 Hz, 1H), 6.58 (d, *J* = 3.0 Hz, 1H), 5.24 (d, *J* = 5.9 Hz, 1H), 3.94 (q, *J* = 6.0 Hz, 1H), 3.77 (s, 3H), 3.18 (dd, *J* = 16.8, 5.1 Hz, 1H), 3.03 (dd, *J* = 16.8, 6.6 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 154.1, 147.5, 138.9, 131.0 (q, *J* = 308.0 Hz), 128.9, 128.7, 126.3, 119.5, 117.6, 114.8, 113.9, 79.6, 55.8, 43.5 (d, *J* = 1.7 Hz), 31.3; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.04; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaO_2S$ 363.0637; Found 363.0640.



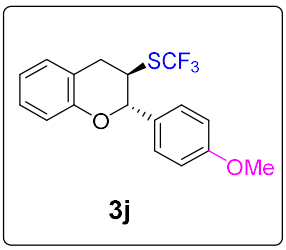
3h

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3h** as a white solid (24.3 mg, 67%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.83 (dd, *J* = 8.2, 1.2 Hz, 1H), 7.75 (dd, *J* = 8.7, 4.5 Hz, 2H), 7.53 (ddd, *J* = 8.4, 6.8, 1.3 Hz, 1H), 7.47 – 7.30 (m, 6H), 7.22 (d, *J* = 9.0 Hz, 1H), 5.35 (d, *J* = 6.2 Hz, 1H), 4.12 (q, *J* = 6.1 Hz, 1H), 3.44 (dd, *J* = 6.2, 2.7 Hz, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 151.3, 138.4, 132.6, 131.1 (q, *J* = 308.0 Hz), 129.5, 129.1, 128.9, 128.8, 128.8, 127.0, 126.4, 124.0, 121.8, 118.6, 111.1, 79.6, 43.5 (d, *J* = 1.7 Hz), 28.1; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.01; **HRMS** (ESI) m/z: $[M+Na]^+$calcd for $C_{20}H_{15}F_3NaOS$ 383.0688; Found 383.0687.



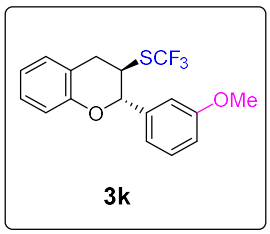
3i

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3i** as a white solid (23.2 mg, 67%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.32 (m, 2H), 7.31 – 7.26 (m, 2H), 7.25 – 7.17 (m, 1H), 7.06 (dt, *J* = 7.8, 1.2 Hz, 1H), 6.95 (t, *J* = 7.3 Hz, 2H), 5.21 (d, *J* = 6.4 Hz, 1H), 3.88 (td, *J* = 6.9, 5.2 Hz, 1H), 3.20 (dd, *J* = 16.7, 5.1 Hz, 1H), 3.07 (dd, *J* = 16.7, 7.2 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 153.4, 137.2, 134.7, 130.8 (q, *J* = 308.2), 129.7, 129.1, 128.7, 127.9, 121.6, 119.0, 116.9, 79.3, 43.4 (d, *J* =1.8 Hz), 31.3; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.00; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{12}ClF_3NaOS$ 367.0142; Found 367.0146.



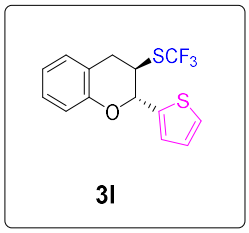
3j

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3j** as a white solid (30.0 mg, 88%), R_f=0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.32 – 7.25 (m, 2H), 7.21 (ddd, *J* = 8.4, 7.3, 1.7 Hz, 1H), 7.08 (dd, *J* = 7.5, 1.6 Hz, 1H), 7.00 – 6.89 (m, 4H), 5.18 (d, *J* = 6.7 Hz, 1H), 3.93 (td, *J* = 7.2, 5.1 Hz, 1H), 3.83 (s, 3H), 3.26 (dd, *J* = 16.6, 5.0 Hz, 1H), 3.11 (dd, *J* = 16.6, 7.5 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 160.0, 153.8, 130.8 (q, *J* = 308.2 Hz), 130.7, 129.6, 128.5, 127.8, 121.4, 119.2, 116.9, 114.3, 79.5, 55.4, 43.8 (q, *J* = 1.5 Hz), 31.7; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -38.77; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaO_2S$ 363.0637; Found 363.0634.



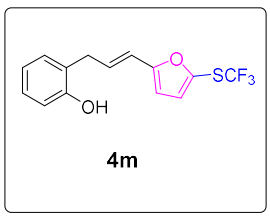
3k

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3k** as a colorless oil (27.9 mg, 82%), R_f =0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.31 (td, *J* = 7.5, 1.4 Hz, 1H), 7.21 (td, *J* = 7.7, 7.1, 1.6 Hz, 1H), 7.06 (dd, *J* = 7.6, 1.5 Hz, 1H), 7.02 – 6.85 (m, 5H), 5.26 (d, *J* = 5.9 Hz, 1H), 3.96 (q, *J* = 6.0 Hz, 1H), 3.79 (s, 3H), 3.21 (dd, *J* = 16.7, 5.0 Hz, 1H), 3.05 (dd, *J* = 16.7, 6.7 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 160.0, 153.5, 140.3, 131.0 (q, *J* = 308.0 Hz), 130.0, 129.7, 128.6, 121.4, 119.0, 118.6, 116.8, 113.9, 112.2, 79.6, 55.4, 43.4 (d, *J* = 1.8 Hz), 31.0; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.01; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaO_2S$ 363.0637; Found 363.0637.



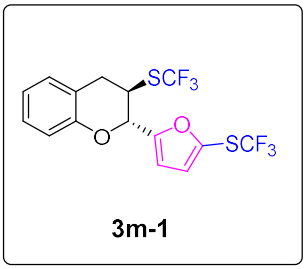
3l

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3l** as a white solid (24.5 mg, 77%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.32 (dd, *J* = 5.0, 1.3 Hz, 1H), 7.24 – 7.15 (m, 1H), 7.10 – 7.02 (m, 2H), 7.02 – 6.89 (m, 3H), 5.53 (d, *J* = 5.9 Hz, 1H), 3.96 (q, *J* = 6.1 Hz, 1H), 3.36 (dd, *J* = 16.9, 5.2 Hz, 1H), 3.11 (dd, *J* = 16.9, 6.4 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 152.9, 141.5, 130.9 (q, *J* = 308.2 Hz), 129.7, 128.5, 127.0, 126.1, 126.0, 121.8, 118.7, 117.2, 76.1, 44.1 (q, *J* = 1.7 Hz), 31.1; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -38.93; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{14}H_{11}F_3NaOS_2$ 339.0096; Found 339.0093.



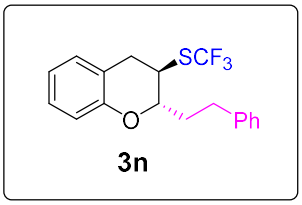
4m

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE:EA=30:1, v/v) to afford **4m** as a colorless oil (23.6 mg, 79%), R_f =0.4 (silica gel, PE:DCM=3:1, v/v); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.20 – 7.11 (m, 2H), 6.92 (td, *J* = 7.4, 1.2 Hz, 1H), 6.87 – 6.77 (m, 2H), 6.54 (dt, *J* = 15.8, 6.6 Hz, 1H), 6.31 – 6.16 (m, 2H), 4.90 (s, 1H), 3.55 (dd, *J* = 6.6, 1.7 Hz, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 158.7, 153.8, 133.1 (q, *J* = 3.0 Hz), 131.1, 130.8, 128.2, 128.0 (q, *J* = 313.1 Hz), 125.5, 125.2, 121.3, 119.1, 115.8, 109.1, 33.6; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -43.93; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{14}H_{11}F_3NaO_2S$ 323.0324; Found 323.0319.



3m-1

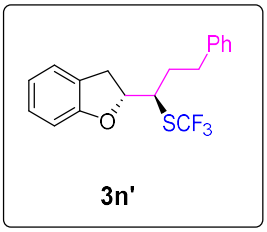
According to the general procedure **B**, the reaction time is 48 h, flash column chromatography (SiO_2, PE) to afford **3m-1** as a colorless oil (16.7 mg, 42%), R_f =0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.22 – 7.15 (m, 1H), 7.07 – 7.02 (m, 1H), 6.98 – 6.91 (m, 2H), 6.88 (d, *J* = 3.4 Hz, 1H), 6.43 (dd, *J* = 3.4, 0.8 Hz, 1H), 5.42 – 5.20 (m, 1H), 4.12 (td, *J* = 6.3, 5.3 Hz, 1H), 3.21 (dd, *J* = 17.0, 5.3 Hz, 1H), 3.06 (dd, *J* = 16.9, 6.4 Hz, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 157.0, 152.5, 135.7 (q, *J* = 3.03 Hz), 130.8 (q, *J* = 308.0 Hz), 129.8, 128.6, 128.0 (q, *J* = 313.0 Hz), 124.8, 122.0, 118.6, 117.0, 111.9, 73.8, 40.8 (d, *J* = 1.7 Hz), 31.1; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.27, -43.62; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{15}H_{10}F_6NaO_2S_2$ 422.9919; Found 422.9917.



3n

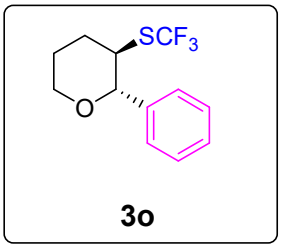
According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3n** as a colorless oil (12.5 mg, 37%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39 – 7.27 (m, 2H), 7.25 – 7.21 (m,

3H), 7.21 – 7.14 (m, 1H), 7.06 (dd, J = 7.6, 1.6 Hz, 1H), 6.99 – 6.82 (m, 2H), 4.16 (ddd, J = 9.5, 6.2, 3.7 Hz, 1H), 3.59 (td, J = 6.7, 5.5 Hz, 1H), 3.34 (dd, J = 16.9, 5.4 Hz, 1H), 3.06 (dd, J = 17.0, 6.9 Hz, 1H), 2.95 (ddd, J = 14.3, 9.2, 5.3 Hz, 1H), 2.82 (ddd, J = 13.8, 9.1, 7.3 Hz, 1H), 2.19 – 1.97 (m, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 152.9, 141.1, 131.1 (q, J = 308.0 Hz), 129.6, 128.7, 128.3, 126.3, 121.3 (d, J = 3.7 Hz), 119.1, 117.3, 76.7 (d, J = 11.8 Hz), 42.2 (d, J = 4.2 Hz), 34.6, 31.6, 31.4; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -39.05; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{18}H_{17}F_3NaOS$ 361.0844; Found 361.0845.



3n'

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3n'** as a colorless oil (14 mg, 41%), R_f=0.4 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.37 – 7.28 (m, 2H), 7.23 (td, J = 5.2, 2.8 Hz, 3H), 7.20 – 7.10 (m, 2H), 6.88 (td, J = 7.4, 1.0 Hz, 1H), 6.80 (d, J = 8.0 Hz, 1H), 5.03 – 4.88 (m, 1H), 3.44 – 3.29 (m, 2H), 3.14 – 2.95 (m, 2H), 2.78 (ddd, J = 13.8, 9.7, 6.9 Hz, 1H), 2.32 – 2.16 (m, 1H), 2.04 – 1.90 (m, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 159.4, 140.8, 131.0 (q, J = 307.8 Hz), 128.7, 128.6, 128.4, 126.4, 125.9, 125.0, 121.0, 109.6, 84.0, 50.2, 33.9, 32.6, 32.4; **^{19}F NMR** (376 MHz,$CDCl_3$) δ -38.31; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{18}H_{17}F_3NaOS$ 361.0844; Found 361.0839.

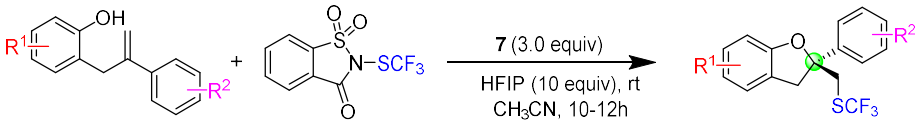


3o

According to the general procedure **B**, the reaction time is 24 h, flash column chromatography (SiO_2, PE) to afford **3o** as a colorless oil (13.1 mg, 50%), R_f=0.2 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.39 – 7.30 (m, 5H), 4.18 (d, J = 10.2 Hz, 1H), 4.15 – 4.07 (m, 1H), 3.61 (td, J = 11.6, 2.4 Hz, 1H), 3.33 (ddd, J = 11.6, 10.2, 4.0 Hz, 1H), 2.60 – 2.42 (m, 1H), 2.00 – 1.87 (m, 2H), 1.82 – 1.74 (m, 1H); **^{13}C NMR** (101

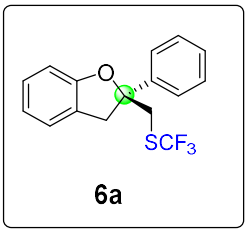
MHz, $CDCl_3$) δ 139.1, 130.7 (q, J = 308.4 Hz), 128.8, 128.6, 127.6, 83.7, 68.7, 47.5, 33.3, 27.0; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -38.01; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{12}H_{13}F_3NaOS$ 285.0531; Found 285.0531.

4. General procedures C for preparing desired products 6



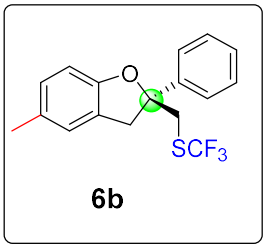
5 **2a** **6**

At room temperature, **5** (0.1 mmol) and **2a** (0.13 mmol) were added into an over-dried 10 mL flask equipped with a stir bar. Seal the flask with a septum. Anhydrous CH_3CN (1 mL) was added via a syringe, and then **7** (38.0 μL, 0.3 mmol) and HFIP (105.0 μL, 1.0 mmol) were added by using syringes respectively and stirred for 10-12 hours. After the reaction was completed (monitored by TLC), the solvent was removed under reduce pressure, the crude product was purified by silica gel flash column chromatography to obtain products **6**.



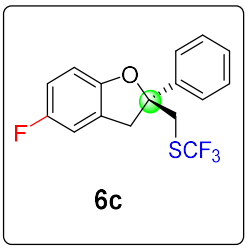
6a

According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6a** as a colorless oil (26.4 mg, 85%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.53 – 7.44 (m, 2H), 7.43 – 7.36 (m, 2H), 7.35 – 7.28 (m, 1H), 7.22 – 7.12 (m, 2H), 6.98 – 6.86 (m, 2H), 3.70 (d, J = 15.7 Hz, 1H), 3.57 – 3.48 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 158.4, 143.3, 131.0 (q, J = 307.2 Hz), 128.8, 128.6, 128.2, 125.6, 125.1, 125.1, 121.4, 110.0, 89.2, 42.3, 41.2 (d, J = 1.9 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.19; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{13}F_3NaOS$ 333.0531; Found 333.0530.



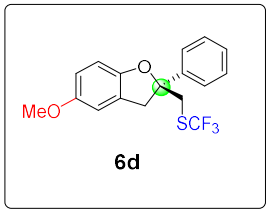
6b

According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6b** as a colorless oil (22.9 mg, 71%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.51 – 7.43 (m, 2H), 7.42 – 7.34 (m, 2H), 7.34 – 7.27 (m, 1H), 6.97 (d, *J* = 7.4 Hz, 2H), 6.82 (d, *J* = 8.7 Hz, 1H), 3.67 (d, *J* = 15.7 Hz, 1H), 3.57 – 3.44 (m, 3H), 2.28 (s, 3H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 156.3, 143.4, 131.1 (q, *J* = 306.8 Hz), 130.8, 129.0, 128.8, 128.1, 125.6, 125.6, 125.1, 109.5, 89.2, 42.4, 41.1 (d, *J* = 2.0 Hz), 20.9; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.21; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaOS$ 347.0688; Found 347.0686.



6c

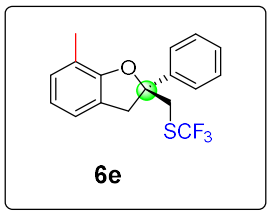
According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6c** as a colorless oil (19.7 mg, 60%), R_f=0.6 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.49 – 7.43 (m, 2H), 7.43 – 7.35 (m, 2H), 7.36 – 7.29 (m, 1H), 6.94 – 6.73 (m, 3H), 3.70 (dd, *J* = 16.0, 1.0 Hz, 1H), 3.61 – 3.40 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 158.0 (d, *J* = 239.0 Hz), 154.4 (d, *J* = 1.61 Hz), 143.0, 130.9 (q, *J* = 307.3 Hz), 128.9, 128.3, 127.0 (d, *J* = 9.1 Hz), 125.0, 114.8 (d, *J* = 24.2 Hz), 112.2 (d, *J* = 25.0 Hz), 110.1 (d, *J* = 8.5 Hz), 89.9, 42.4 (d, *J* = 1.6 Hz), 41.1 (d, *J* = 2.0 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.18, -123.40; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{16}H_{12}F_4NaOS$ 351.0437; Found 351.0439.



6d

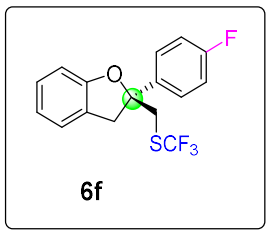
According to the general procedure **C**, the reaction time is 10 h, flash column

chromatography (SiO_2, PE) to afford **6d** as a colorless oil (24.3 mg, 71%), R_f =0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.50 – 7.46 (m, 2H), 7.43 – 7.36 (m, 2H), 7.35 – 7.27 (m, 1H), 6.85 (d, *J* = 8.4 Hz, 1H), 6.80 – 6.66 (m, 2H), 3.75 (s, 3H), 3.69 (d, *J* = 15.8 Hz, 1H), 3.57 – 3.46 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 154.8, 152.5, 143.3, 131.0 (q, *J* = 307.3 Hz), 128.8, 128.1, 126.6, 125.1, 113.6, 111.2, 109.9, 89.3, 56.1, 42.7, 41.1 (d, *J* = 1.82 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.19; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaO_2S$ 363.0637; Found 363.0637.



6e

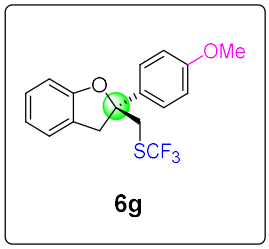
According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6e** as a colorless oil (26.2 mg, 81%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 – 7.45 (m, 2H), 7.44 – 7.35 (m, 2H), 7.35 – 7.28 (m, 1H), 6.99 (t, *J* = 7.2 Hz, 2H), 6.81 (t, *J* = 7.4 Hz, 1H), 3.70 (d, *J* = 15.6 Hz, 1H), 3.57 – 3.47 (m, 3H), 2.33 (s, 3H); **^{13}C NMR** (126 MHz,$CDCl_3$) δ 156.8, 143.5, 131.0 (q, *J* = 307.0 Hz), 129.8, 128.8, 128.1, 125.1, 124.8, 122.3, 121.2, 120.2, 88.7, 42.7, 41.3, 15.3; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.12; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{17}H_{15}F_3NaOS$ 347.0688; Found 347.0687.



6f

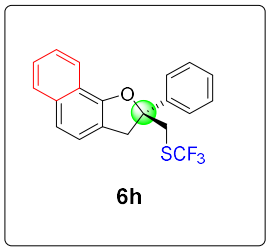
According to the general procedure **C**, the reaction time is 11 h, flash column chromatography (SiO_2, PE) to afford **6f** as a colorless oil (22.1 mg, 67%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.52 – 7.39 (m, 2H), 7.24 – 7.13 (m, 2H), 7.13 – 7.00 (m, 2H), 6.97 – 6.83 (m, 2H), 3.68 (d, *J* = 15.7 Hz, 1H), 3.53 – 3.44 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 162.5 (d, *J* = 248.0 Hz), 158.2, 139.0 (d, *J* =3.2 Hz), 130.9 (q, *J* = 307.2 Hz), 127.1, 127.0, 125.4, 125.1, 121.6, 115.7 (d, *J* = 21.7 Hz), 110.0, 88.9, 42.4, 41.1; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.19, -114.20; **HRMS** (ESI) m/z:

[M+Na]$^+$ calcd for $C_{16}H_{12}F_4NaOS$ 351.0437; Found 351.0436.



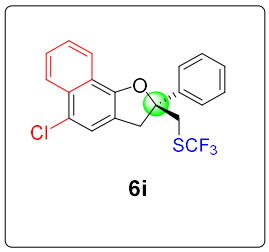
6g

According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6g** as a colorless oil (26.1 mg, 77%), R_f=0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.47 – 7.33 (m, 2H), 7.23 – 7.09 (m, 2H), 7.01 – 6.80 (m, 4H), 3.81 (s, 3H), 3.67 (d, J = 15.6 Hz, 1H), 3.55 – 3.45 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 159.4, 158.4, 135.2, 131.0 (q, J = 307.2Hz), 128.6, 126.4, 125.7, 125.1, 121.3, 114.1, 109.9, 89.1, 55.4, 42.3, 41.2 (d, J = 2.0 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.14; **HRMS** (ESI) m/z: [M+Na]$^+$ calcd for $C_{17}H_{15}F_3NaO_2S$ 363.0637; Found 363.0639.



6h

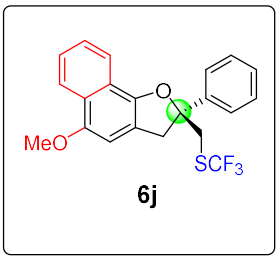
According to the general procedure **C**, the reaction time is 12 h, flash column chromatography (SiO_2, PE) to afford **6h** as a colorless oil (23.1 mg, 64%), R_f =0.6 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.15 (d, J = 8.1 Hz, 1H), 7.85 (d, J = 8.1 Hz, 1H), 7.62 – 7.37 (m, 7H), 7.37 – 7.26 (m, 2H), 3.89 (d, J = 15.5 Hz, 1H), 3.73 – 3.59 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 153.6, 143.6, 134.3, 131.0 (q, J = 307.3 Hz), 128.8, 128.2, 128.1, 126.1, 125.8, 125.0, 122.7, 121.6, 121.3, 120.6, 118.6, 90.0, 43.4, 41.4 (d, J = 1.8 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.00; **HRMS** (ESI) m/z: [M+Na]$^+$ calcd for $C_{20}H_{15}F_3NaOS$ 383.0688; Found 383.0692.



6i

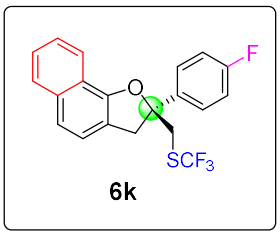
According to the general procedure **C**, the reaction time is 10 h, flash column

chromatography (SiO_2, PE) to afford **6i** as a colorless oil (17.4 mg, 44%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.26 – 8.18 (m, 1H), 8.18 – 8.05 (m, 1H), 7.62 – 7.56 (m, 2H), 7.56 – 7.49 (m, 2H), 7.45 – 7.35 (m, 3H), 7.36 – 7.29 (m, 1H), 3.87 (d, *J* = 15.6 Hz, 1H), 3.68 (d, *J* = 13.1 Hz, 1H), 3.65 – 3.56 (m, 2H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 152.9, 143.2, 130.9, 130.9 (q, *J* = 306.8 Hz), 128.9, 128.4, 127.2, 126.6, 125.0, 125.0, 123.9, 122.9, 122.1, 121.3, 118.8, 90.5, 43.1, 41.3; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.01; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{20}H_{14}ClF_3NaOS$ 417.0298; Found 417.0304.



6j

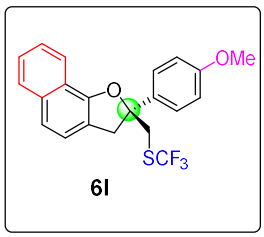
According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6j** as a colorless oil (26.1 mg, 67%), R_f=0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.24 (d, *J* = 8.5 Hz, 1H), 8.08 (d, *J* = 8.2 Hz, 1H), 7.58 – 7.55 (m, 3H), 7.49 (ddd, *J* = 8.2, 6.8, 1.3 Hz, 1H), 7.44 – 7.36 (m, 2H), 7.36 – 7.30 (m, 1H), 6.67 (s, 1H), 3.95 (s, 3H), 3.87 (d, *J* = 15.5 Hz, 1H), 3.72 – 3.53 (m, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 150.8, 147.2, 143.8, 131.1 (q, *J* = 307.2 Hz), 128.8, 128.1, 126.5, 125.7, 125.4, 125.1, 122.7 (d, *J* = 5.4 Hz), 121.3, 121.1, 117.4, 101.2 (d, *J* = 10.8 Hz), 89.4, 56.1 (d, *J* = 15.4 Hz), 44.0, 41.3; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.05; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd. for $C_{21}H_{17}F_3NaO_2S$ 413.0794; Found 413.0791.



6k

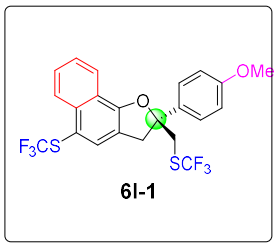
According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6k** as a colorless oil (26.5 mg, 70%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.10 (dd, *J* = 8.2, 1.4 Hz, 1H), 7.88 –

7.80 (m, 1H), 7.59 – 7.41 (m, 5H), 7.29 (d, J = 8.3 Hz, 1H), 7.08 (t, J = 8.7 Hz, 2H), 3.86 (d, J = 15.4 Hz, 1H), 3.65 (d, J = 15.5 Hz, 1H), 3.59 (s, 2H); **^{13}C NMR** (126 MHz, $CDCl_3$) δ 162.5 (d, J = 247.4 Hz), 153.4, 139.3 (d, J = 3.3 Hz), 134.3, 130.9 (q, J = 306.9 Hz), 128.1, 127.0, 127.0, 126.2, 125.9, 122.6, 121.5 (d, J = 4.0 Hz), 120.6, 118.4, 115.7 (d, J = 21.8 Hz), 89.7, 43.5, 41.6; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.05, -114.18; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{20}H_{14}F_4NaOS$ 401.0594; Found 401.0594.



6l

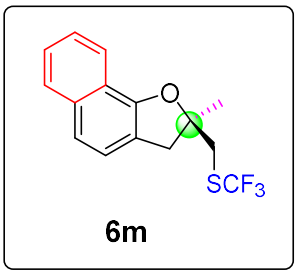
According to the general procedure **C**, the reaction time is 11 h, flash column chromatography (SiO_2, PE) to afford **6l** as a colorless oil (17.8 mg, 46%), R_f=0.3 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.10 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 7.6 Hz, 1H), 7.54 – 7.39 (m, 5H), 7.29 (s, 1H), 6.96 – 6.86 (m, 2H), 3.84 (d, J = 15.5 Hz, 1H), 3.80 (s, 3H), 3.65 (d, J = 15.5 Hz, 1H), 3.62 – 3.52 (m, 2H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 159.4, 153.6, 135.6, 134.3, 131.0 (q, J = 307.3 Hz), 128.1, 126.4, 126.0, 125.7, 122.7, 121.6, 121.2, 120.6, 118.7, 114.1, 89.9, 55.4, 43.3, 41.4 (d, J = 2.02 Hz); **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.05; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{21}H_{17}F_3NaO_2S$ 413.0794; Found 413.0793.



6l-1

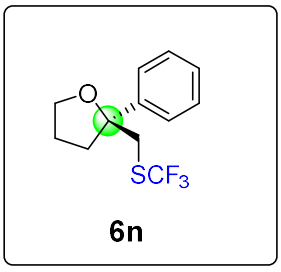
According to the general procedure **C**, the reaction time is 11 h, flash column chromatography (SiO_2, PE) to afford **6l-1** as a colorless oil (16.9 mg, 34%), R_f =0.4 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.50 (d, J = 8.4 Hz, 1H), 8.16 (d, J = 7.4 Hz, 1H), 7.79 (s, 1H), 7.67 – 7.57 (m, 2H), 7.44 (d, J = 8.8 Hz, 2H), 6.98 – 6.86 (m, 2H), 3.87 (d, J = 15.8 Hz, 1H), 3.80 (s, 3H), 3.70 (d, J = 15.6 Hz, 1H), 3.67 – 3.55 (m, 2H); **^{13}C NMR** (101 MHz,$CDCl_3$) δ 159.7, 157.3, 136.4, 135.2, 134.8, 130.8 (q, J = 307.4 Hz), 129.8 (q, J = 311.0 Hz), 128.0, 126.5, 126.5, 126.3, 122.3, 121.2, 119.2,

114.3, 112.8, 91.2, 55.5, 42.7, 41.4; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -40.96, -43.26. **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{22}H_{16}F_6NaO_2S_2$ 513.0388; Found 513.0388.



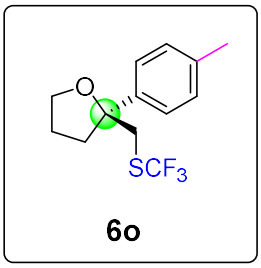
6m

According to the general procedure **C**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6m** as a colorless oil (4.0 mg, 13%), R_f=0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 8.02 – 7.87 (m, 1H), 7.85 – 7.73 (m, 1H), 7.50 – 7.37 (m, 3H), 7.30 (d, *J* = 8.2 Hz, 1H), 3.43 (d, *J* = 15.6 Hz, 1H), 3.34 (s, 2H), 3.25 (d, *J* = 15.6 Hz, 1H), 1.68 (s, 3H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 153.7, 134.2, 131.1 (q, *J* = 306.84 Hz), 128.0, 126.0, 125.6, 122.9, 121.6, 120.7, 120.7, 118.8, 87.4, 41.8, 39.9 (d, *J* = 1.92 Hz), 26.2; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.09; **HRMS** (ESI) m/z: $[M+H]^+$ calcd for $C_{15}H_{14}F_3OS$ 299.0712; Found 299.0715.



6n

According to the general procedure **B**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6n** as a colorless oil (10.7 mg, 41%), R_f =0.5 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.32 (m, 4H), 7.31 – 7.27 (m, 1H), 4.06 – 3.99 (m, 1H), 3.95 – 3.90 (m, 1H), 3.39 (d, *J* = 12.6 Hz, 1H), 3.27 (d, *J* = 12.7 Hz, 1H), 2.42 – 2.35 (m, 1H), 2.29 – 2.23 (m, 1H), 2.11 – 1.95 (m, 1H), 1.90 – 1.79 (m, 1H).**^{13}C NMR** (101 MHz, $CDCl_3$) δ 144.7, 131.3 (q, *J* = 306.84 Hz), 128.6, 127.6, 125.2, 85.1, 68.7, 41.4, 37.0, 26.0; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.43; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{12}H_{13}F_3NaOS$ 285.0531; Found 285.0531.

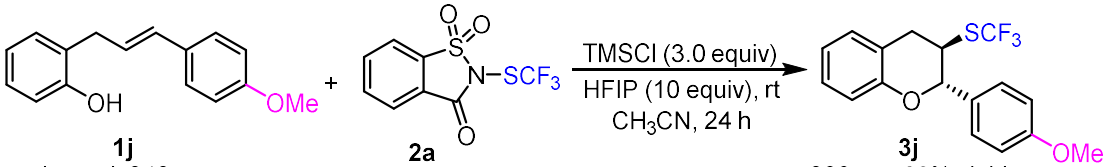


6o

According to the general procedure **B**, the reaction time is 10 h, flash column chromatography (SiO_2, PE) to afford **6o** as a colorless oil (11.7 mg, 43%), R_f=0.4 (silica gel, PE); **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.27 (d, *J* = 2.0 Hz, 1H), 7.26 -7.25 (m, 1H), 7.20 – 7.09 (m, 2H), 4.05 -3.99 (m, 1H), 3.94 - 3.88 (m, 1H), 3.38 (d, *J* = 12.4 Hz, 1H), 3.26 (d, *J* = 12.4 Hz, 1H), 2.44 – 2.30 (m, 4H), 2.27 - 2.21 (m, 1H), 2.08 – 1.96 (m, 1H), 1.89 -1.78 (m, 1H); **^{13}C NMR** (101 MHz, $CDCl_3$) δ 141.7, 137.3, 131.4 (q, *J* = 306.84 Hz), 129.3, 125.2, 85.0, 68.6, 41.5 (d, *J* = 1.72 Hz), 36.9, 26.0, 21.2; **^{19}F NMR** (376 MHz, $CDCl_3$) δ -41.42; **HRMS** (ESI) m/z: $[M+Na]^+$ calcd for $C_{13}H_{15}F_3NaOS$ 299.0688; Found 299.0688.

5. 1 Mmol scale reactions and 5 mmol scale reactions

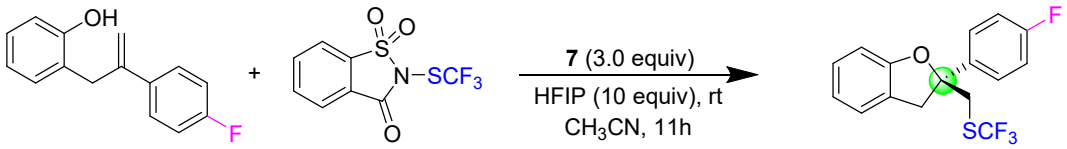
5.1 The procedure for the 1 mmol scale reaction for the synthesis of **3j**.



At room temperature, **1j** (240.3 mg, 1.0 mmol) and **2a** (368 mg, 1.3 mmol) were added into an over-dried 50 mL flask equipped with a stir bar. Seal the flask with a septum. Anhydrous CH_3CN (10 mL) was added via a syringe, then TMSCl (380 μL, 3.0 mmol) and HFIP (1053 μL, 10 mmol) were added by using syringes respectively and stirred for 24 hours. After the reaction was completed (monitored by TLC), the crude product was purified by silica gel flash column chromatography (SiO_2, PE) to afford **3j** as a white solid (283 mg, 83%), R_f=0.5 (silica gel, PE).

The procedure of 1 gram-scale reaction (5 mmol) is the same, using **1j** (1200 mg), **2a** (1840 mg), CH_3CN (50 mL), TMSCl (1.9 mL) and HFIP (5.3 mL). Product **3j** was obtained with 83% yield (1414 mg).

5.2 The procedure for the 1 mmol scale reaction for the synthesis of **6f.**



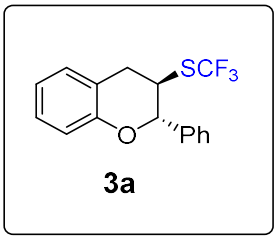
5f
1 mmol, 228 mg

2a

6f
210 mg, 64% yield

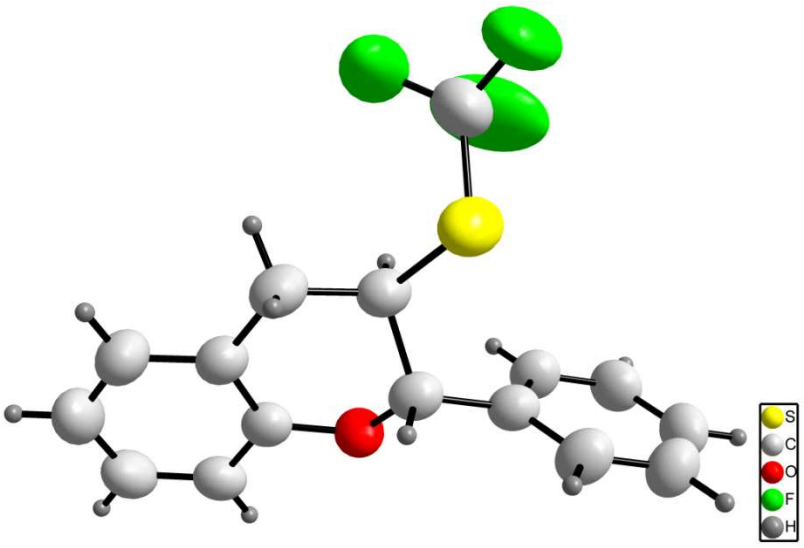
At room temperature, **5f** (228 mg, 1.0 mmol) and **2a** (368 mg, 1.3 mmol) were added into an over-dried 50 mL flask equipped with a stir bar. Seal the flask with a septum. Anhydrous CH_3CN (10 mL) was added via a syringe, then **7** (335 μL, 3.0 mmol) and HFIP (1053 μL, 10 mmol) were added by using syringes respectively and stirred for 11 hours. After the reaction was completed (monitored by TLC), the crude product was purified by silica gel flash column chromatography (SiO_2, PE) to afford **6f** as a colorless oil (210 mg, 64%), R_f=0.5 (silica gel, PE).

6. Crystals of 3a.



3a

(CCDC: 2014660)



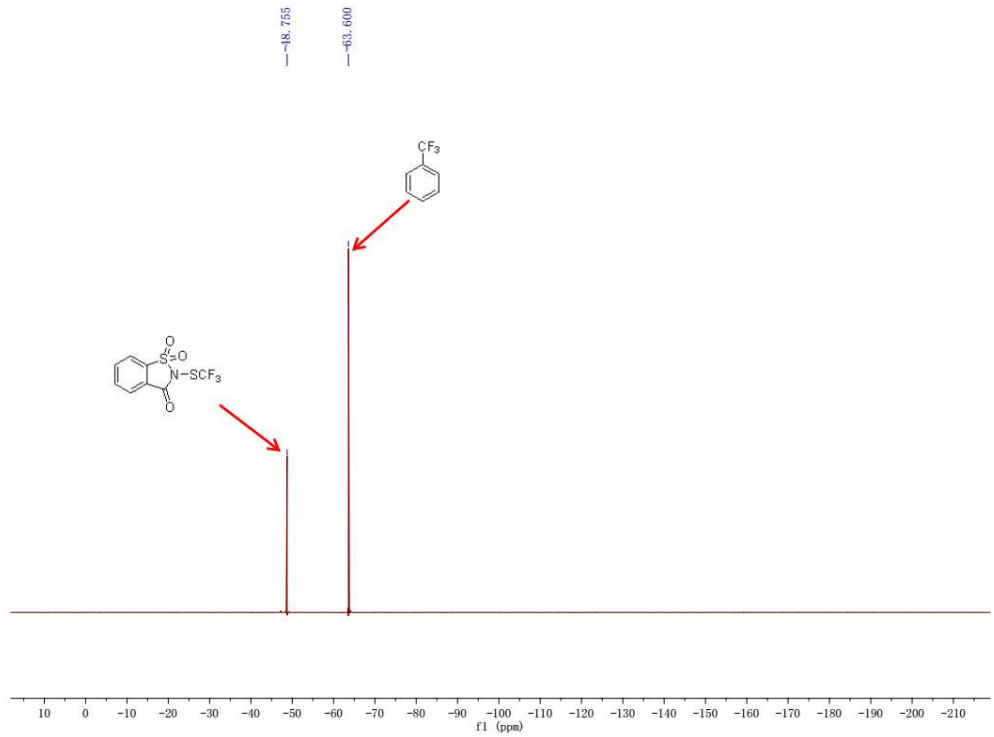
X-ray single crystal structures of **3a** with thermal ellipsoids drawn at the 50% probability level.

Procedure for the recrystallization of **3a**: To a 10 mL vial containing **3a** (20 mg), was added petroleum ether to form a clear solution. The solution was kept aside 3 days at room temperature to obtain crystals by slow evaporation. A suitable crystal was selected on a Bruker D8 VENTURE diffractometer. The crystal data was shown in Table S1:

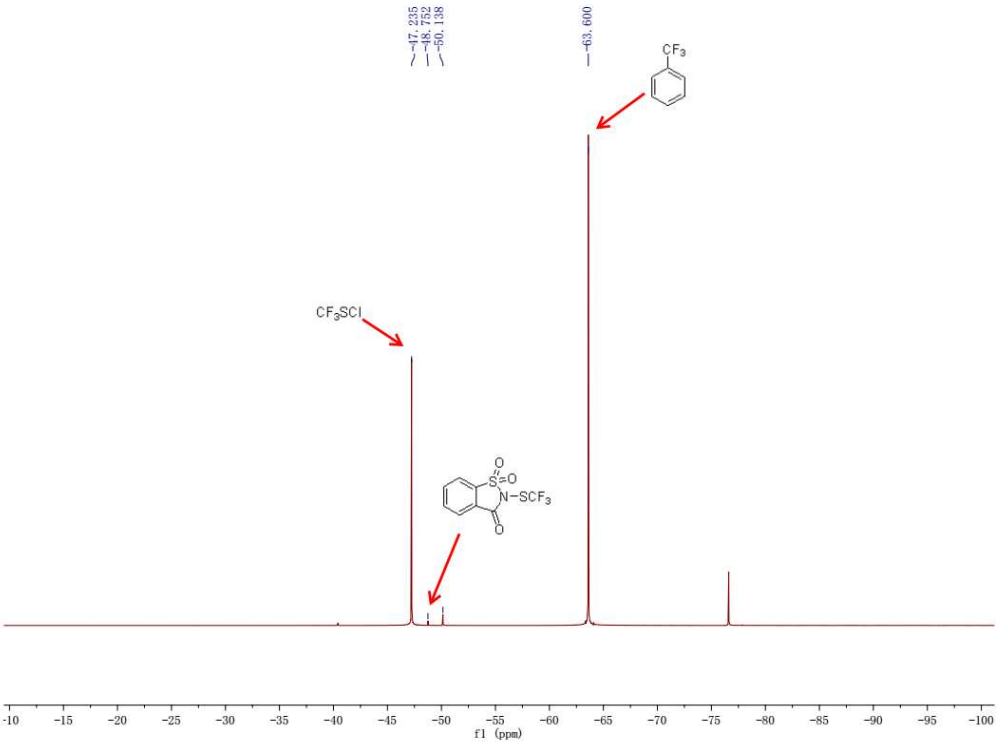
Table S1. Crystal data and structure refinement for **3a**

Identification code	**3a**
Empirical formula	C16 H13 F3 O S
Formula weight	310.32
Temperature	297(2) K
Wavelength	1.54178 A
Crystal system, space group	Monoclinic, P2(1)/c
Unit cell dimensions	a = 11.710(2) A alpha = 90 deg. b = 5.6555(9) A beta = 94.522(13) deg. c = 22.119(3) A gamma = 90 deg.
Volume	1460.3(4) A^3
Z, Calculated density	4, 1.411 Mg/m^3
Absorption coefficient	2.250 mm^-1
F(000)	640
Crystal size	0.180 x 0.160 x 0.140 mm
Theta range for data collection	4.009 to 68.245 deg.
Limiting indices	-14<=h<=14, -6<=k<=6, -26<=l<=26
Reflections collected / unique	10400 / 2641 [R(int) = 0.0440]
Completeness to theta = 67.679	98.8 %
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	2641 / 0 / 190
Goodness-of-fit on F^2	1.017
Final R indices [I>2sigma(I)]	R1 = 0.0539, wR2 = 0.1436
R indices (all data)	R1 = 0.0676, wR2 = 0.1590
Extinction coefficient	n/a
Largest diff. peak and hole	0.423 and -0.330 e.A^-3

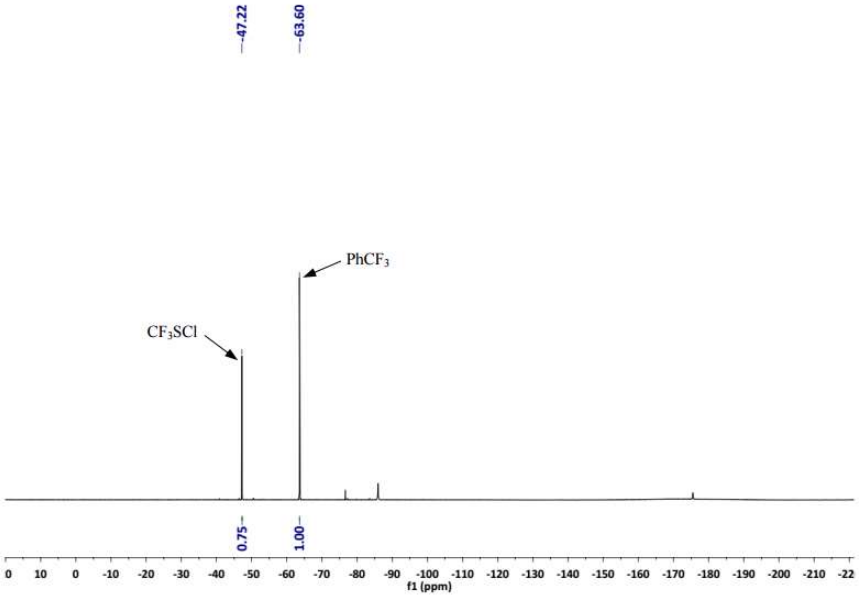
7. ^{1}H-NMR and ^{19}F-NMR spectroscopy studies



^{19}F NMR of **2a** and $PhCF_3$ in CD_3CN (376 MHz NMR)

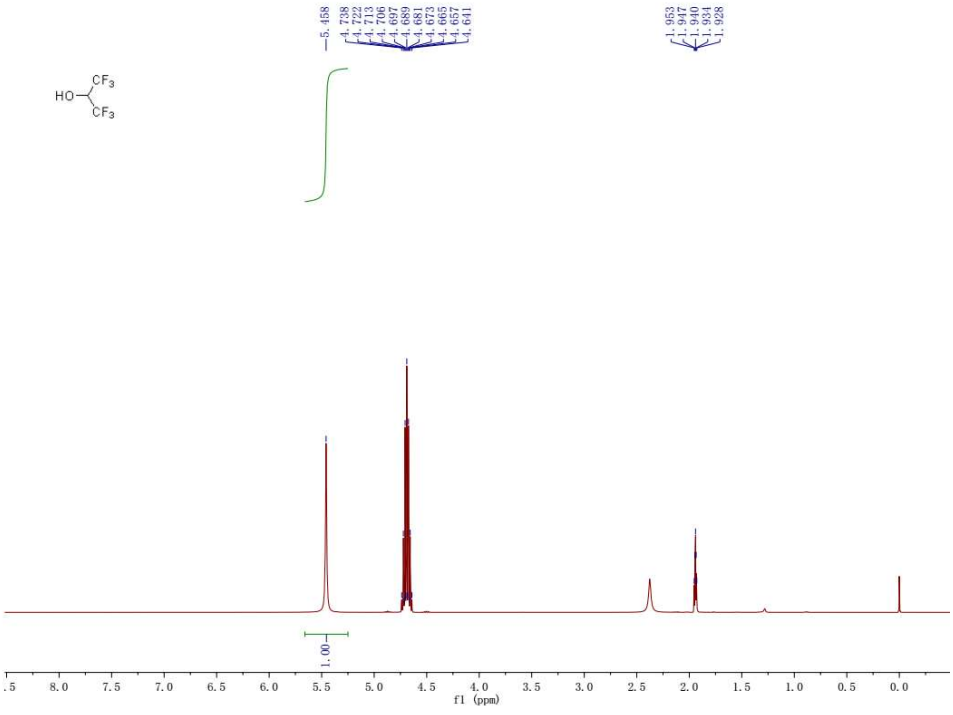


^{19}F NMR of **2a**, TMSCl and $PhCF_3$ in CD_3CN (376 MHz NMR)

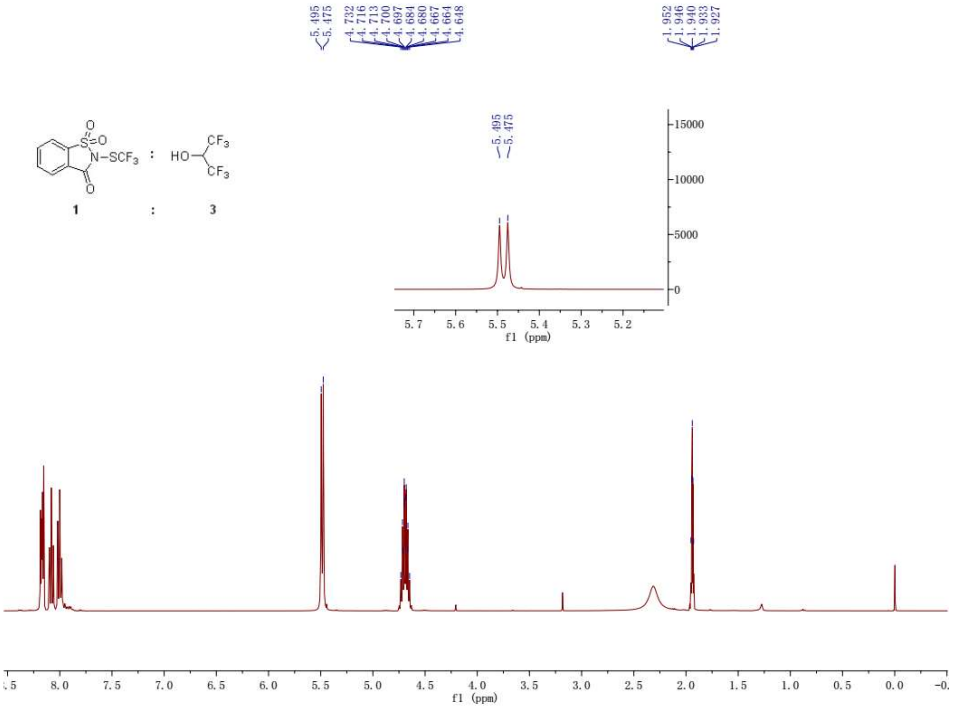


^{19}F NMR of CF_3SCl and $PhCF_3$ in reference (*Org. Chem. Front.*, **2017**, *4*, 266)

According to previous work[7], we can find that CF_3SCl was firstly formed in the present of Shen's reagent **2a** and TMSCl.

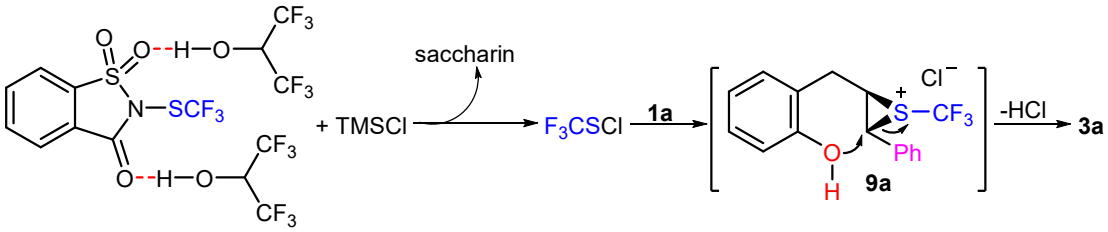


^{1}H NMR of HFIP in CD_3CN (400 MHz NMR)



^{1}H NMR of a mixture of **2a** and HFIP in CD_3CN (400 MHz NMR)

^{1}H-NMR of a mixture of **2a** and HFIP showed that a downfield shift of the OH signal of HFIP relative to that without **2a**. According to previous work[8], we surmised the role of HFIP is as a cooperative activator via hydrogen-bonding interaction.



References:

1. For the synthesis and analytical data of substrates **1a**, **1c-1e**, **1g** and **1i-1m**: Zhang, H.; Lin, S.; Jacobsen, E. N. *J. Am. Chem. Soc*. **2014**, *136*, 16485-16488.

2. For the synthesis and analytical data of substrates **1b, 1f, 1h** and **1n:** Denmark, S. E.; Kornfilt, D. J. P. *J. Org. Chem.* **2017**, *82*, 3192-3222.

3. For the synthesis and analytical data of substrates **1o:** Hoang, G. L.; Zhang, S.; Takacs, J. M. *Chem. Commun.* **2018**, *54*, 4838-4841.

4. For the synthesis and analytical data of substrates **5h** and **5l:** Tsai, J.-C.; Li, S.-R.;

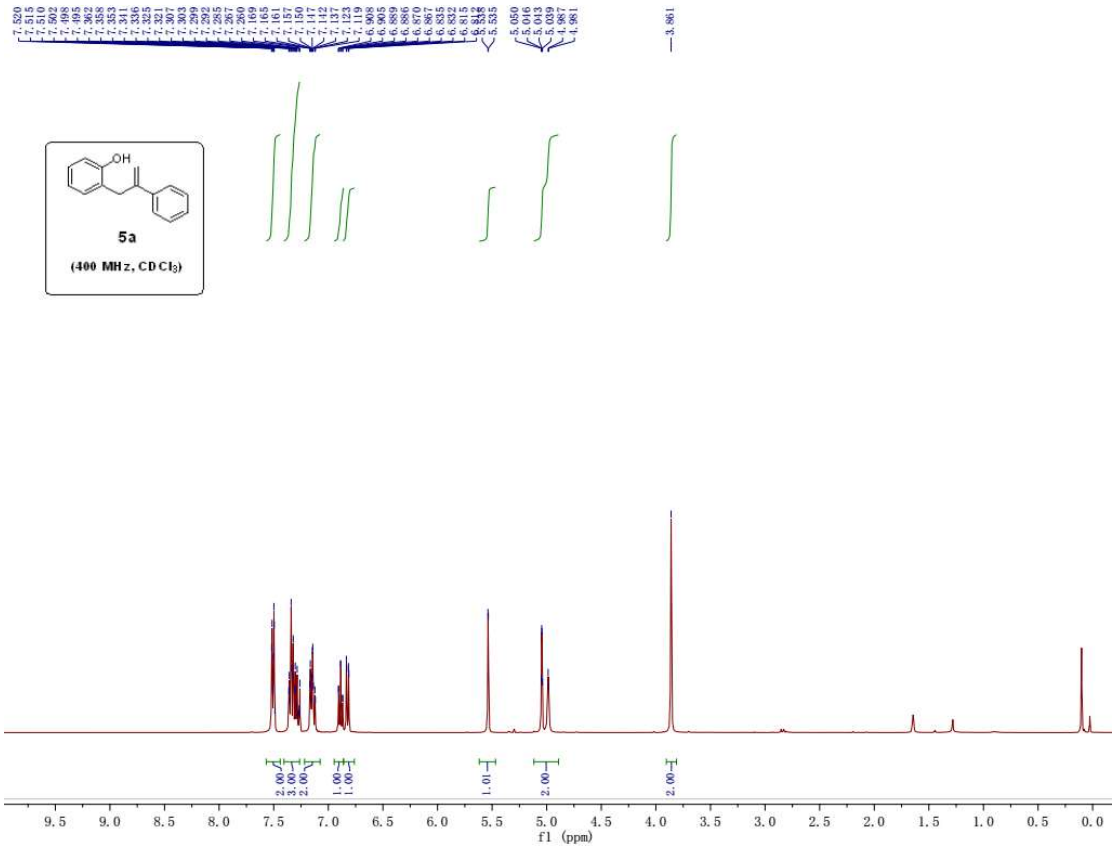
Chen, L.-Y.; Chen, P.-Y.; Hsu, S. C.-N.; Lin, Ch.-N.; Wang, E.-C. *A*RKIVOC **2008**, *12*, 205-217.

5. For the synthesis and analytical data of substrates **5m:** Lebrasseur, N.; Gagnepain, J.; Ozanne-Beaudenon, A.; Léger, J.-M.; Quideau, S. *J. Org. Chem* **2007**, *72*, 6280–6283.

6. For the synthesis and analytical data of substrates **5n** and **5o:** Chen, L.-Y.; Chen, J.-R.; Cheng, H.-G.; Lu, L.-Q.; Xiao, W.-J. *Eur. J. Org. Chem* **2014**, *22*, 4714-4719.

7. Bu, M.-J.; Lu, G.-P.; Cai, C. *Org. Chem. Front.* **2017**, *4*, 266-270.

8. Yang, X.-G.; Zheng, K.; Zhang, C. *Org. Lett.* **2020**, *22*, 2026.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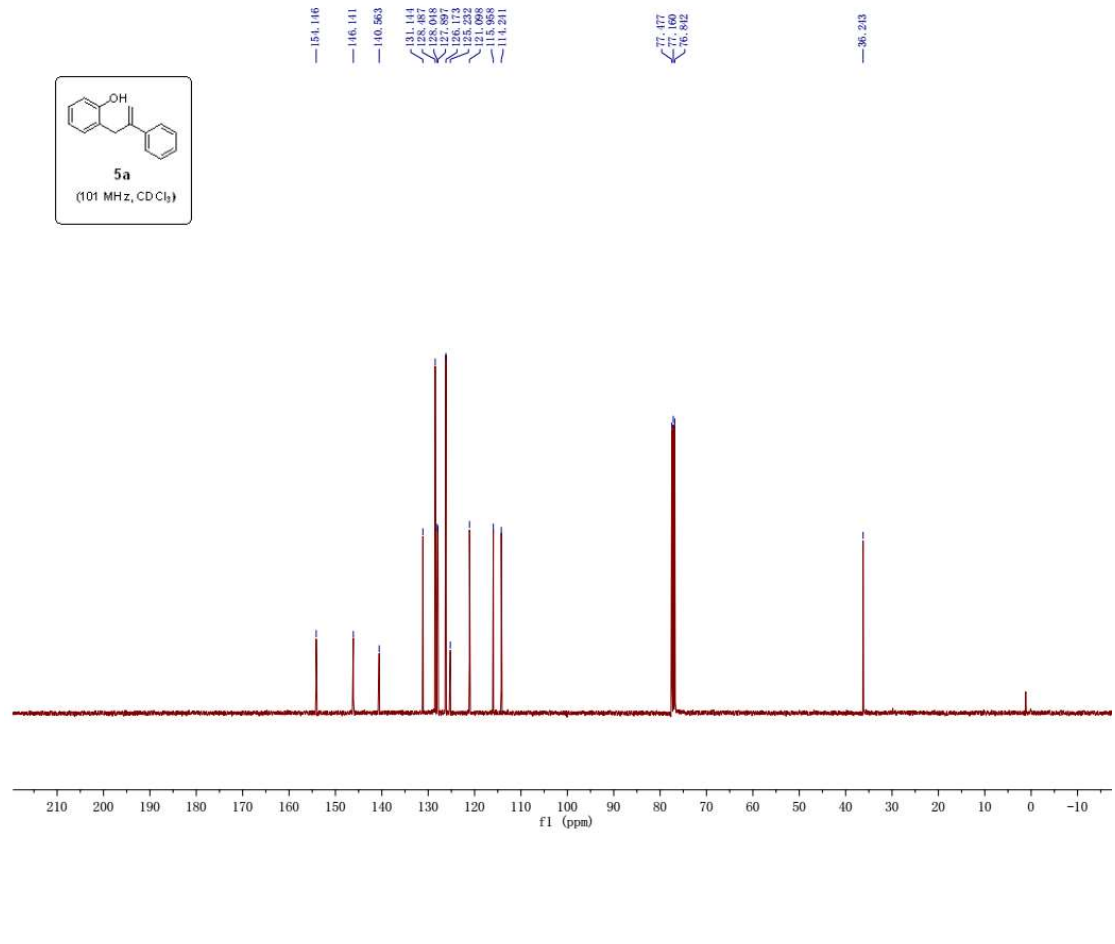
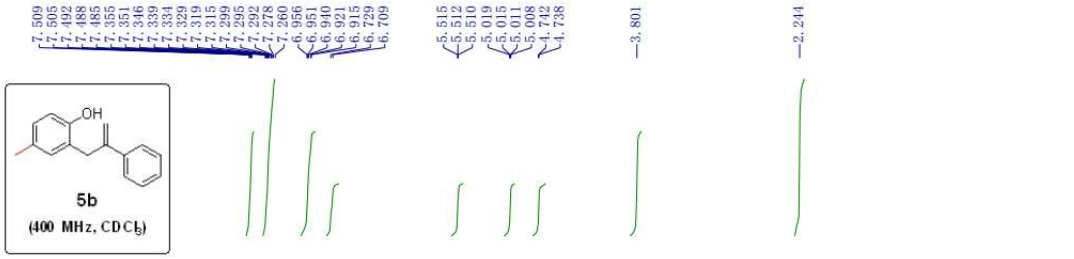
5a
(400 MHz, CDCl3)
f1 (ppm)


OH
5a
(101 MHz, CDCl3)
f1 (ppm)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7.492
7.488
7.485
7.355
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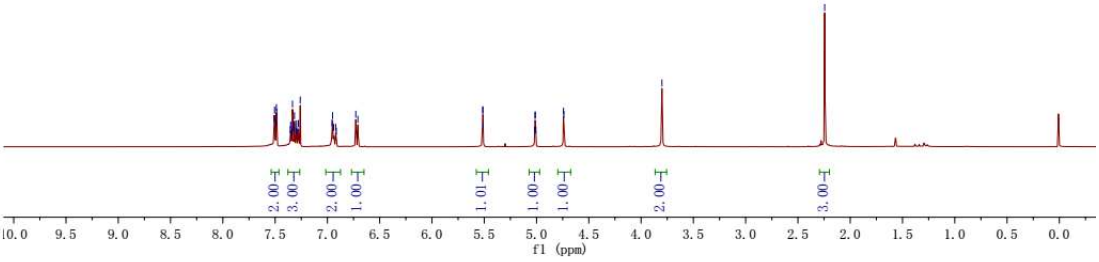
7.346
7.339
7.334
7.329
7.319
7.315
7.299
7.295
7.292
7.278
7.260
6.956
6.951
6.940
6.921
6.915
6.729
6.709
5.515
5.512
5.510
5.019
5.015
5.011
5.008
4.742
4.738
3.801
2.244
OH
5b
(400 MHz, CDCl3)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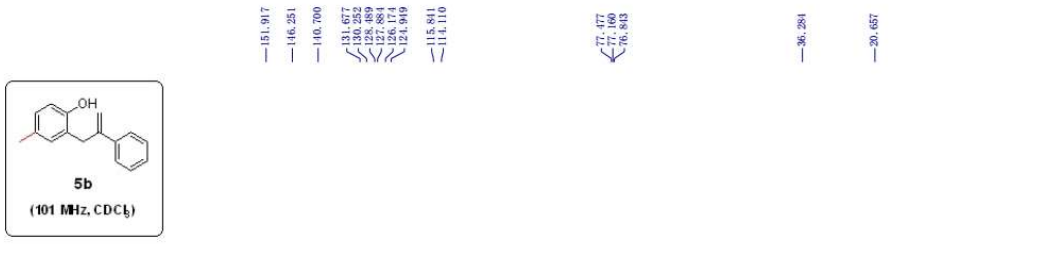
1.00
1.00
2.00
3.00
f1 (ppm)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140.700
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130.252
128.849
127.884
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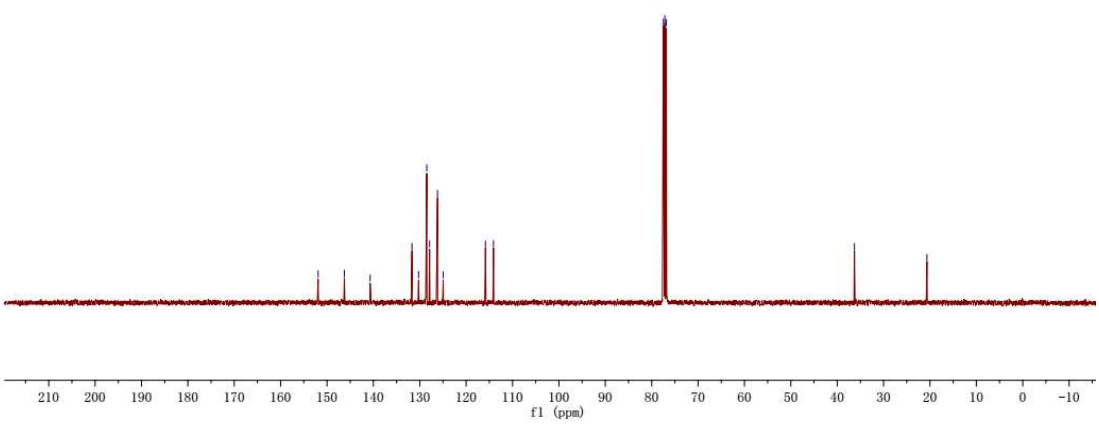
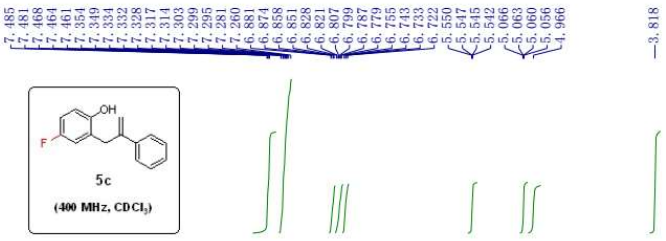
114.110
77.477
77.160
76.843
36.284
20.657
OH
5b
(101 MHz, CDCl3)


f1 (ppm)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7.328
7.317
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7.303
7.299
7.295
7.281
7.260
6.881
6.874
6.858
6.851
6.828
6.821
6.807
6.799
6.787
6.779
6.755
6.743
6.733
6.722
5.550
5.547
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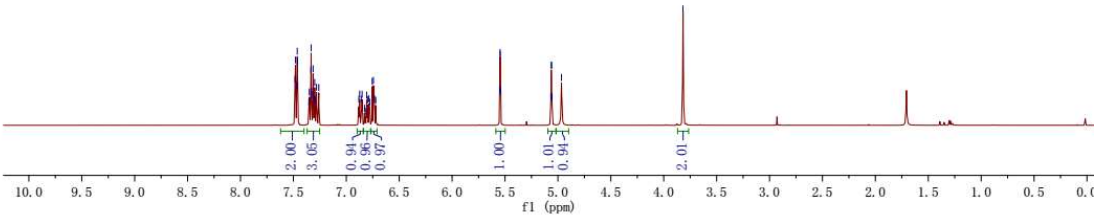
OH
F
5c
(400 MHz, CDCl3)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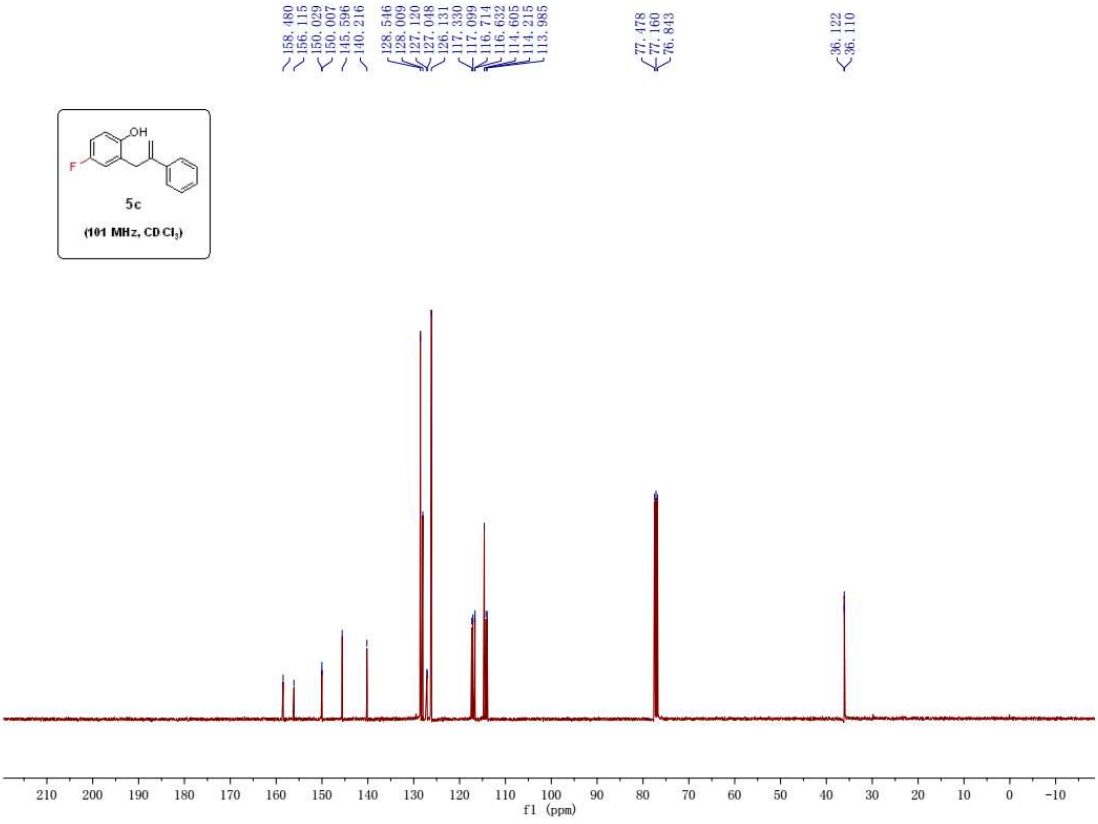
3.05
0.94
0.96
0.97
1.00
1.01
0.94
2.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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126.131
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117.099
116.714
116.632
114.605
114.215
113.985
77.478
77.160
76.843
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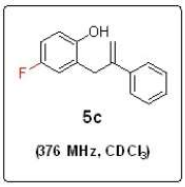
36.110
OH
F
5c
(101 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

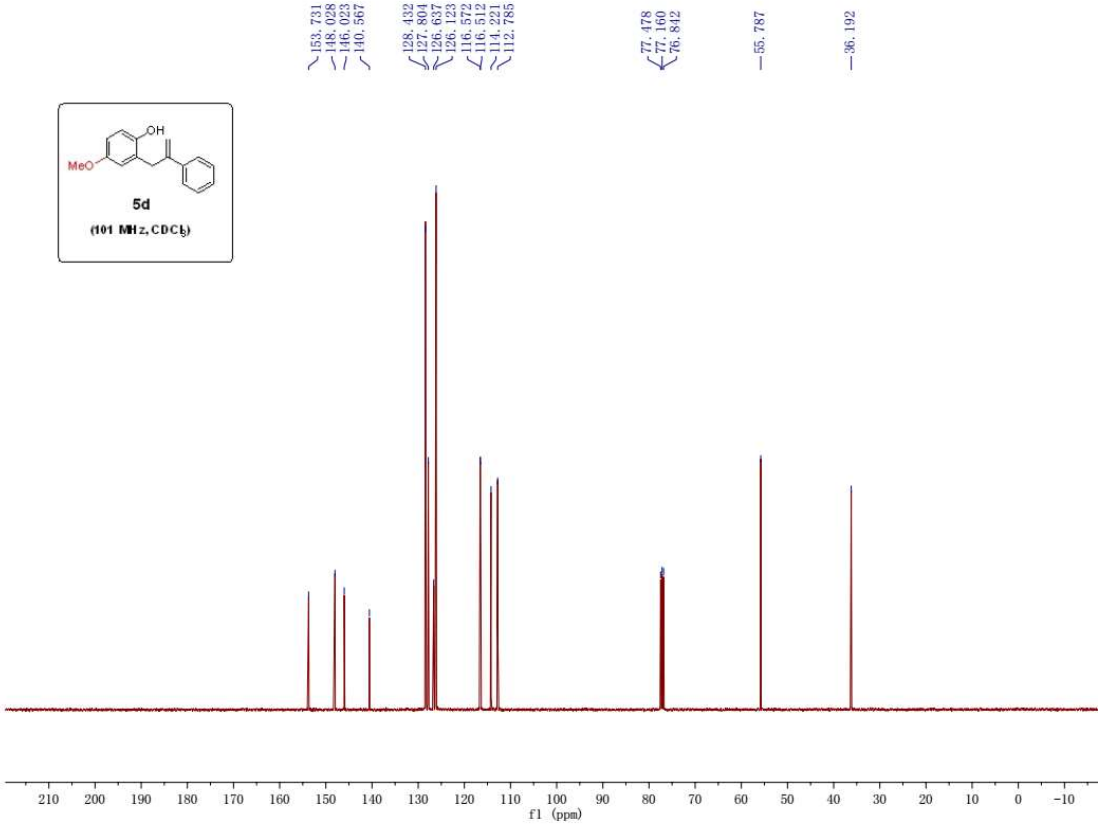


5c

(376 MHz, $CDCl_3$)

5d

(400 MHz, $CDCl_3$)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55.787
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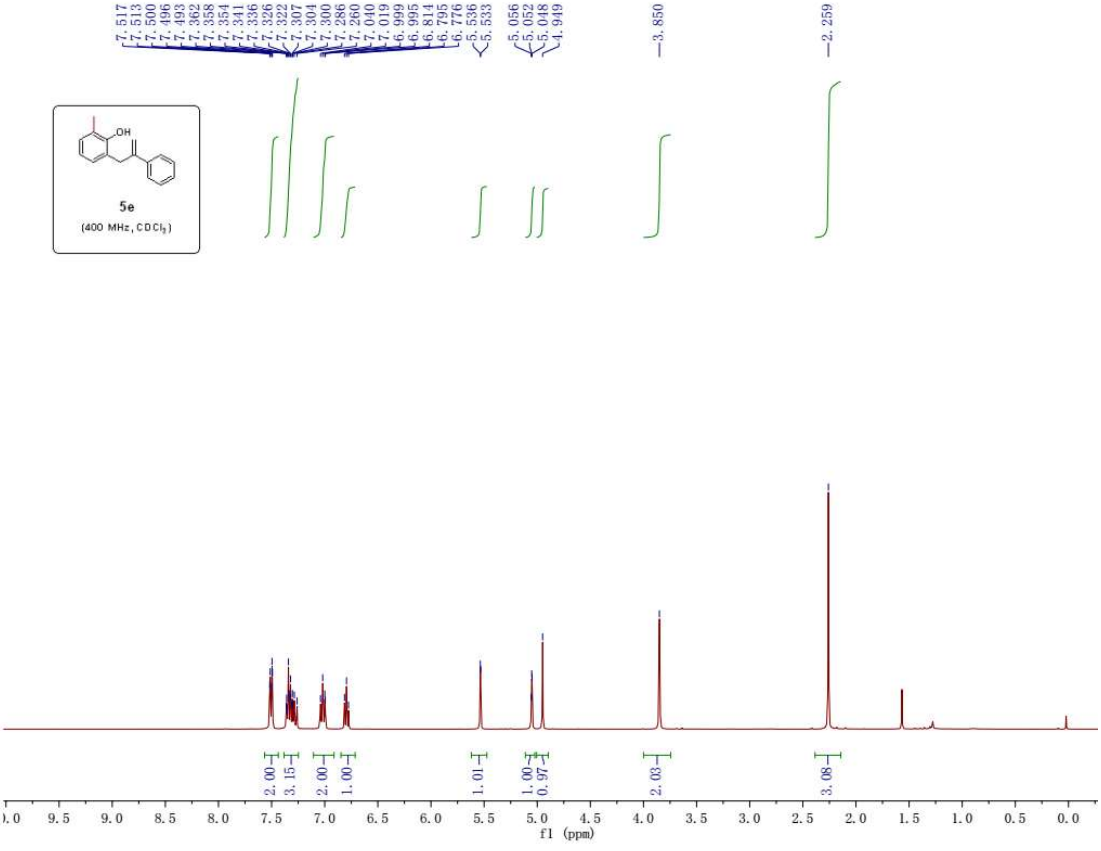
OH
MeO
5d
(101 MHz, CDCl3)
f1 (ppm)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7.336
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7.304
7.300
7.286
7.260
7.040
7.019
6.999
6.995
6.814
6.795
6.776
5.536
5.533
5.056
5.052
5.048
4.949
3.850
2.259
OH
5e
(400 MHz, CDCl3)
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1.00
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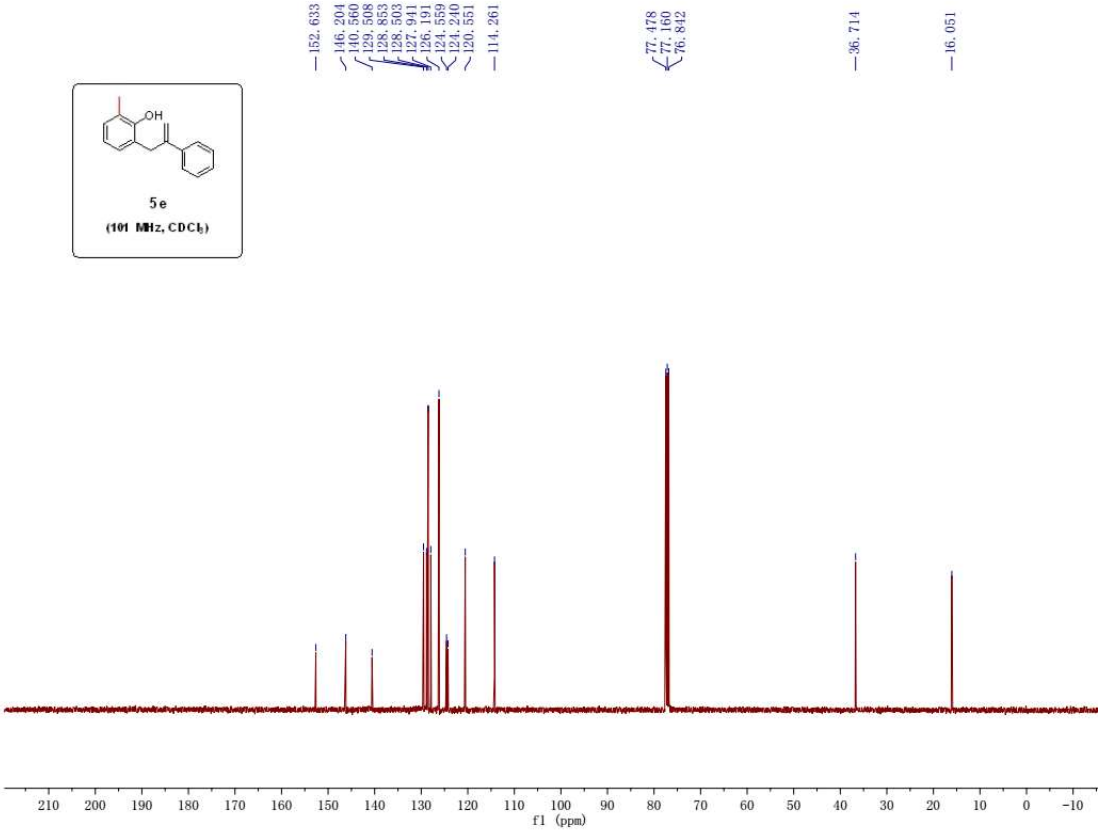
1.00
0.97
2.03
3.08
f1 (ppm)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120.551
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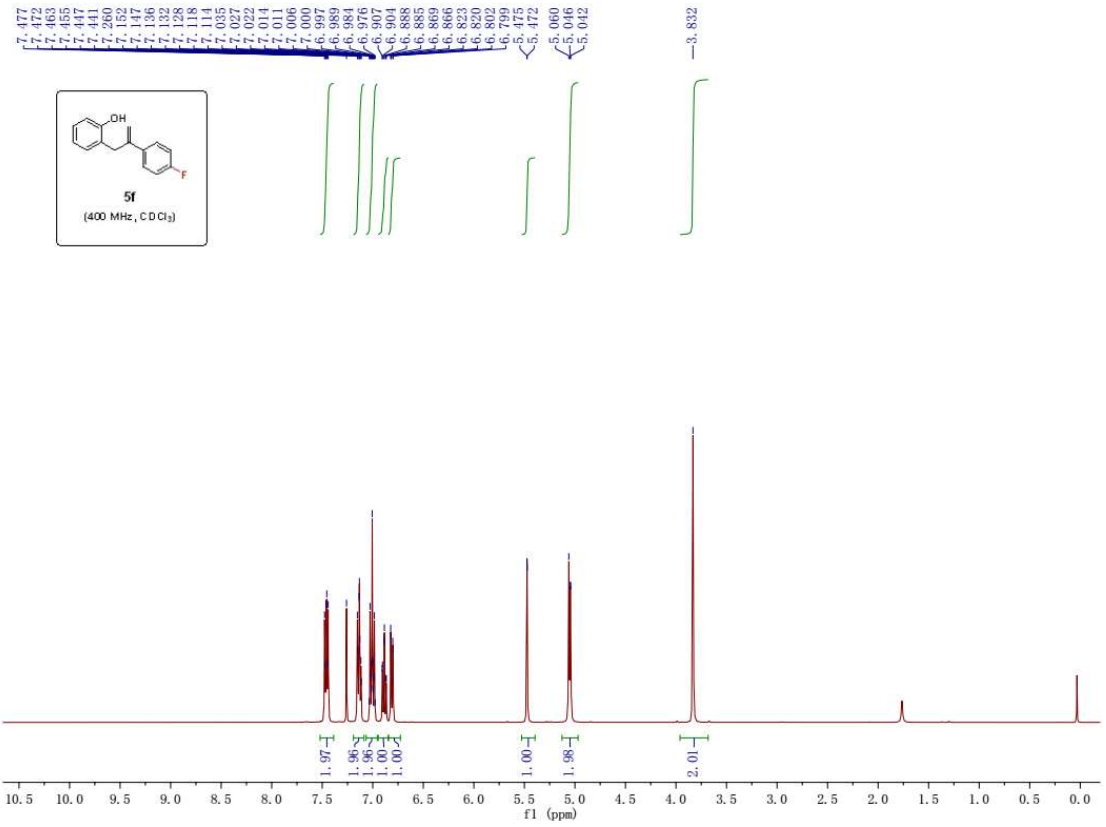
OH
5e
(101 MHz, CDCl3)
f1 (ppm)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7.000
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6.885
6.869
6.866
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6.820
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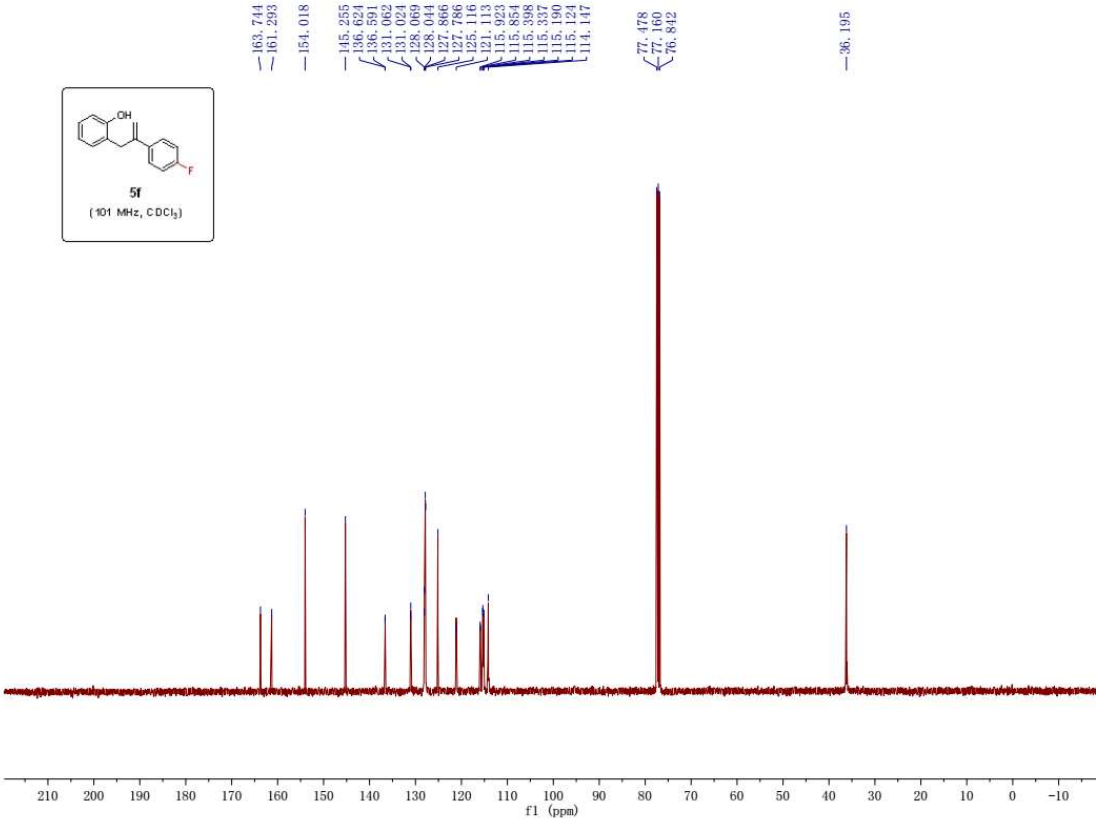
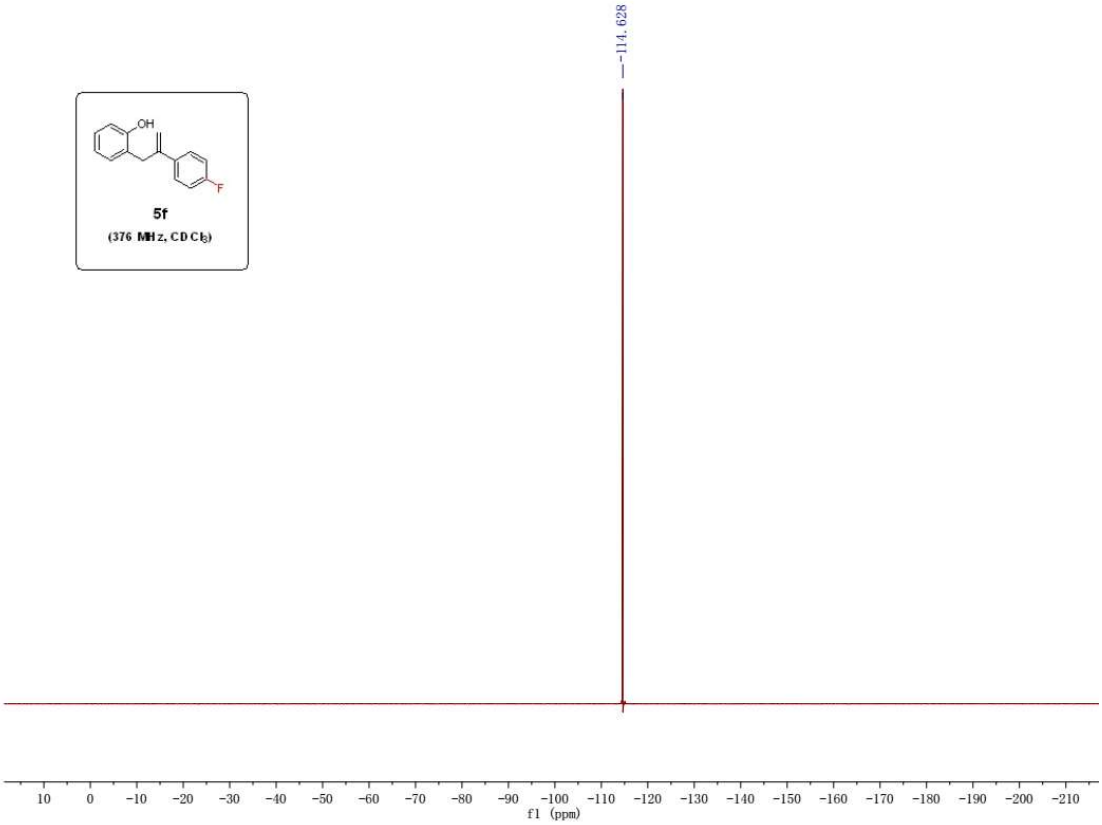
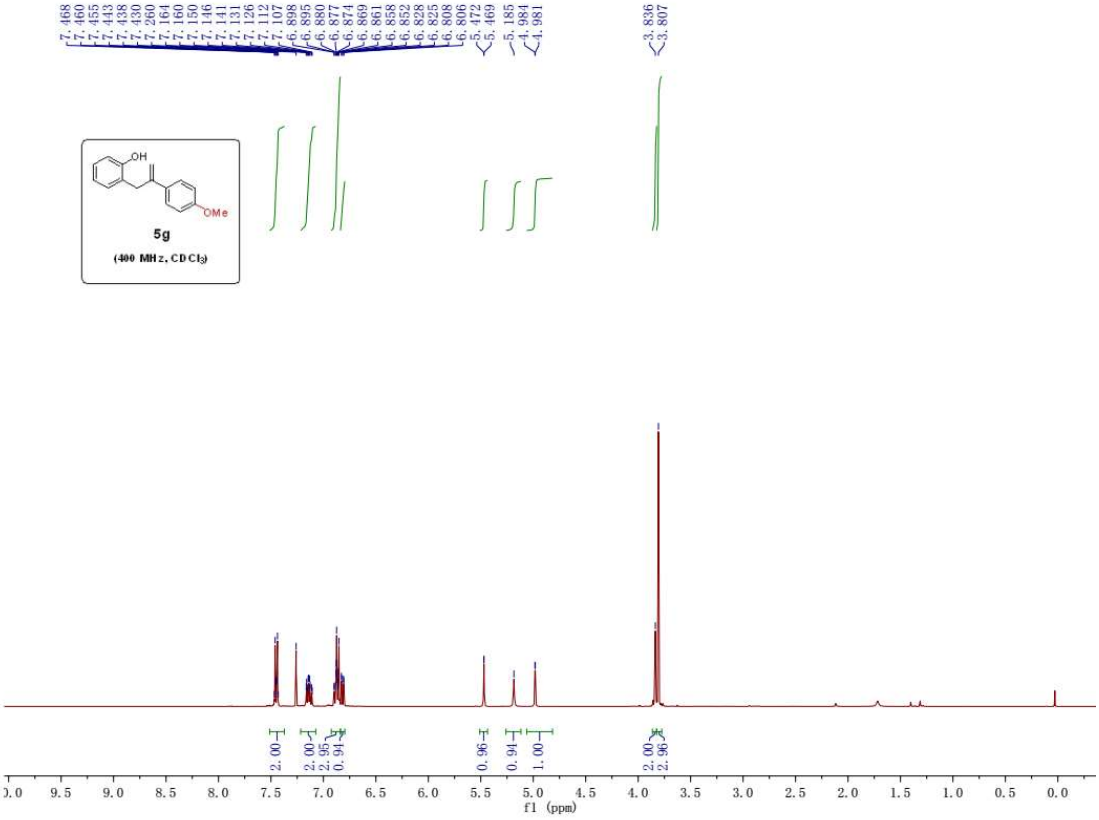
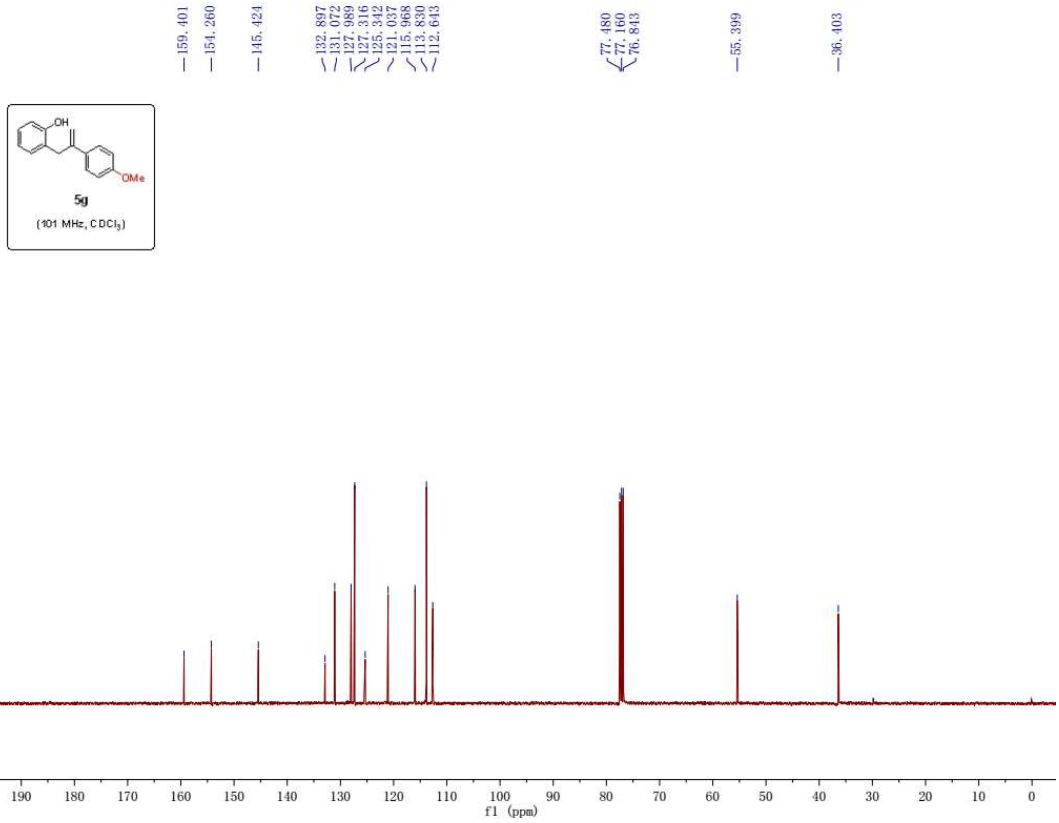
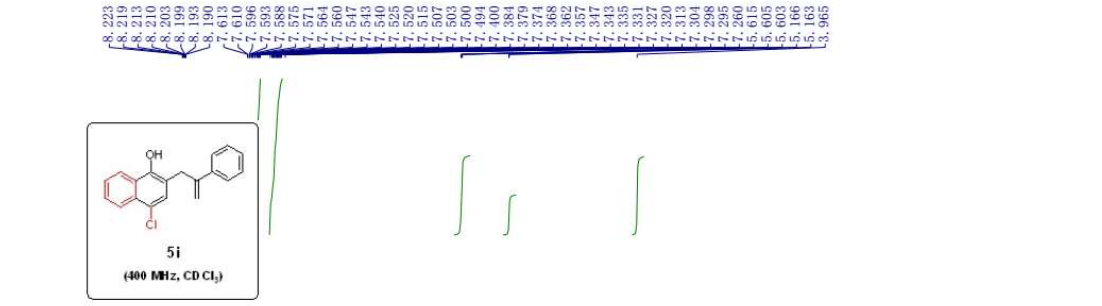
6.799
5.475
5.472
5.060
5.046
5.042
3.832
OH
F
5f
(400 MHz, CDCl3)
1.97
1.96
1.96
1.00
1.00
1.00
1.98
2.01
f1 (ppm)

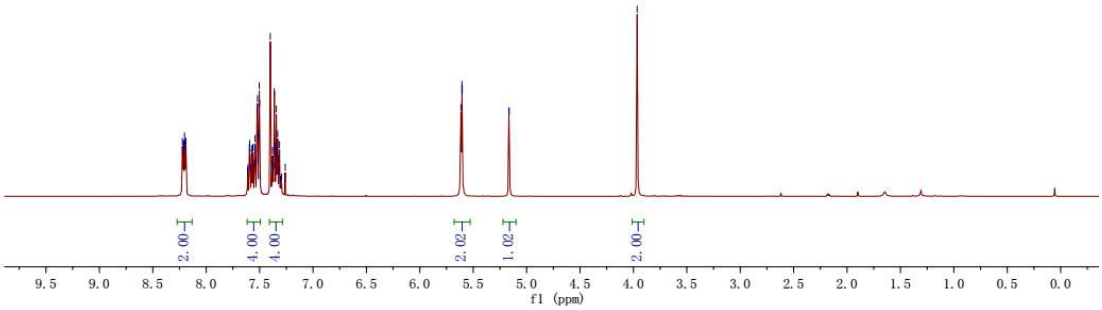

163.744
161.293
154.018
145.255
136.624
136.591
131.062
131.024
128.069
128.044
127.866
127.786
125.116
121.113
115.923
115.854
115.398
115.337
115.190
115.124
114.147
77.478
77.160
76.842
36.195
OH
F
5f
(101 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

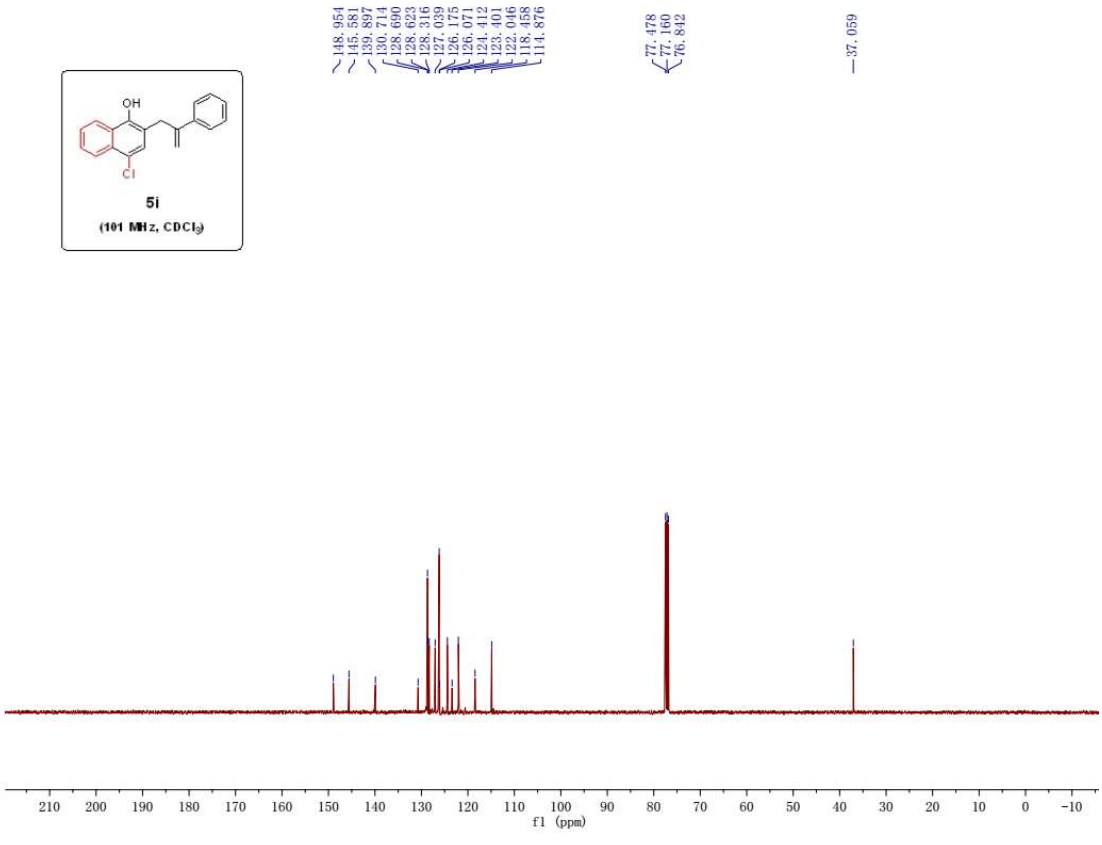

-114.628
OH
F
5f
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

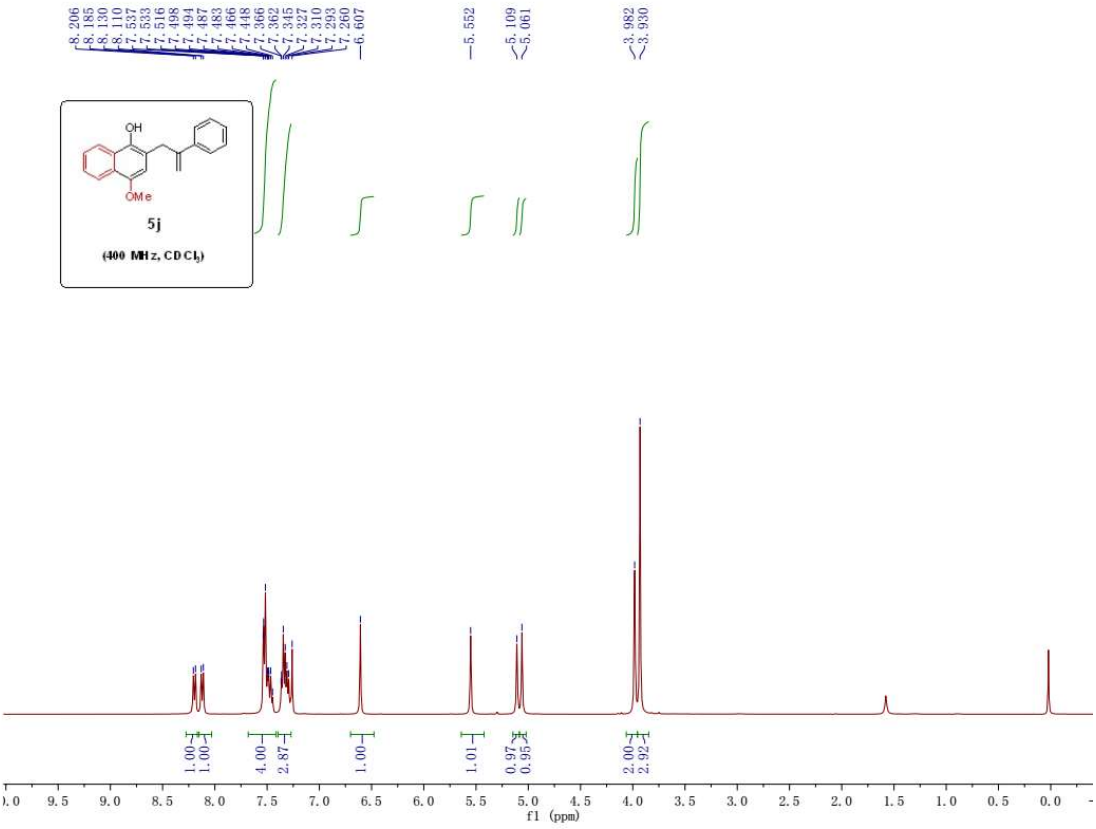

7.468
7.460
7.455
7.443
7.438
7.430
7.260
7.164
7.160
7.150
7.146
7.141
7.131
7.126
7.112
7.107
6.898
6.895
6.880
6.877
6.874
6.869
6.861
6.858
6.852
6.828
6.825
6.808
6.806
5.472
5.469
5.185
4.984
4.981
3.836
3.807
OH
OMe
5g
(400 MHz, CDCl3)
2.00
2.00
2.95
0.94
0.96
0.94
1.00
2.00
2.96
f1 (ppm)

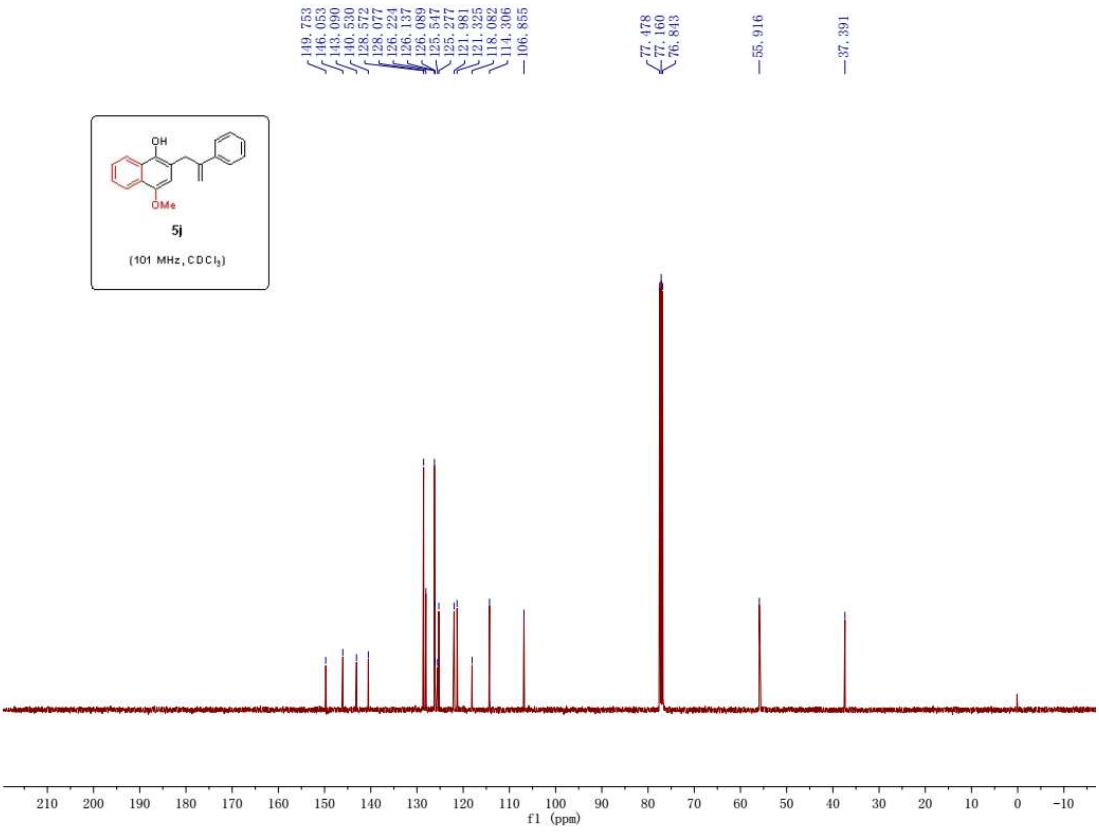

159.401
154.260
145.424
132.897
131.072
127.989
127.316
125.342
121.037
115.968
113.830
112.643
77.480
77.160
76.843
55.399
36.403
OH
OMe
5g
(101 MHz, CDCl3)
f1 (ppm)

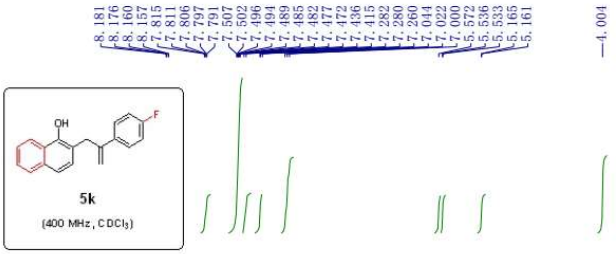

8.223
8.219
8.213
8.210
8.203
8.199
8.193
8.190
7.613
7.610
7.596
7.593
7.588
7.575
7.571
7.564
7.560
7.547
7.543
7.540
7.525
7.520
7.515
7.507
7.503
7.500
7.494
7.400
7.384
7.379
7.374
7.368
7.362
7.357
7.347
7.343
7.335
7.331
7.327
7.320
7.313
7.304
7.298
7.295
7.260
5.615
5.605
5.603
5.166
5.163
3.965
OH
Cl
5i
(400 MHz, CDCl3)

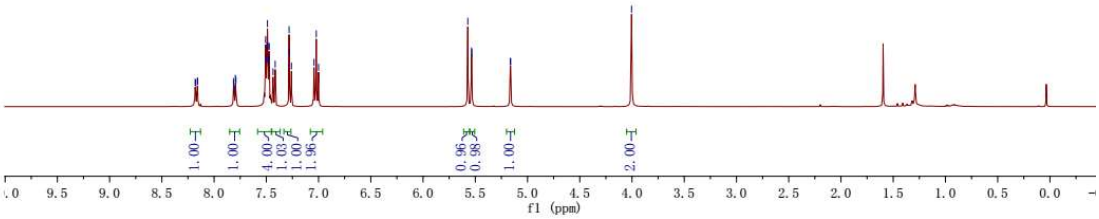

2.00
4.00
4.00
2.02
1.02
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

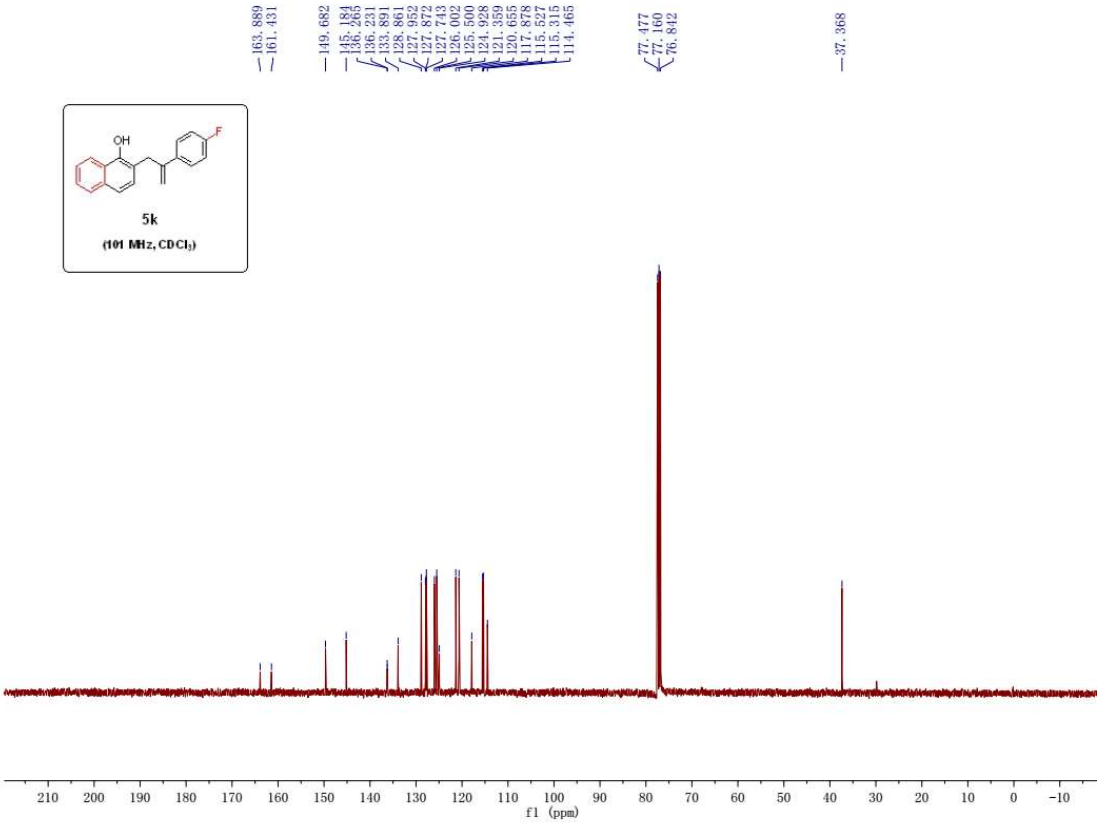

148.954
145.581
139.897
130.714
128.690
128.623
128.316
127.039
126.175
126.071
124.412
123.401
122.046
118.458
114.876
77.478
77.160
76.842
37.059
OH
Cl
5i
(101 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

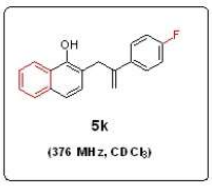

8.206
8.185
8.130
8.110
7.537
7.533
7.516
7.498
7.494
7.487
7.483
7.466
7.448
7.366
7.362
7.345
7.327
7.310
7.293
7.260
6.607
5.552
5.109
5.061
3.982
3.930
OH
OMe
5j
(400 MHz, CDCl3)
1.00
1.00
4.00
2.87
1.00
1.01
0.97
0.95
2.00
2.92
f1 (ppm)


149.753
146.053
143.090
140.530
128.572
128.077
126.224
126.137
126.089
125.547
125.277
121.981
121.325
118.082
114.306
106.855
77.478
77.160
76.843
55.916
37.391
OH
OMe
5j
(101 MHz, CDCl3)
f1 (ppm)


8.181
8.176
8.160
8.157
7.815
7.811
7.806
7.797
7.791
7.507
7.502
7.496
7.494
7.489
7.485
7.482
7.477
7.472
7.436
7.415
7.282
7.280
7.260
7.044
7.022
7.000
5.572
5.536
5.533
5.165
5.161
4.004
OH
F
5k
(400 MHz, CDCl3)

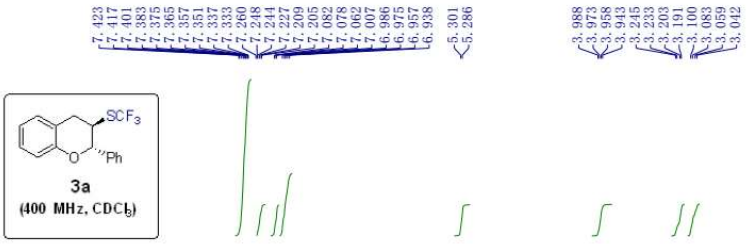

1.00
1.00
4.00
1.03
1.00
1.96
0.96
0.98
1.00
2.00
f1 (ppm)


163.889
161.431
149.682
145.184
136.265
136.231
133.891
128.861
127.952
127.872
127.743
126.002
125.500
124.928
121.359
120.655
117.878
115.527
115.315
114.465
77.477
77.160
76.842
37.368
OH
F
5k
(101 MHz, CDCl3)
f1 (ppm)



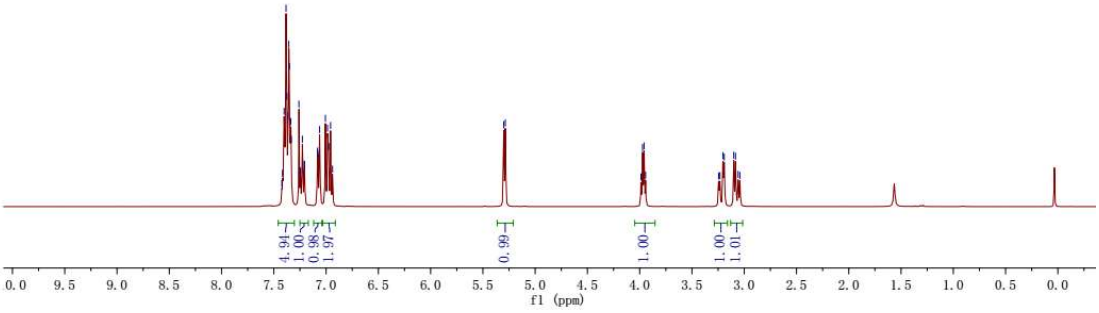
5k

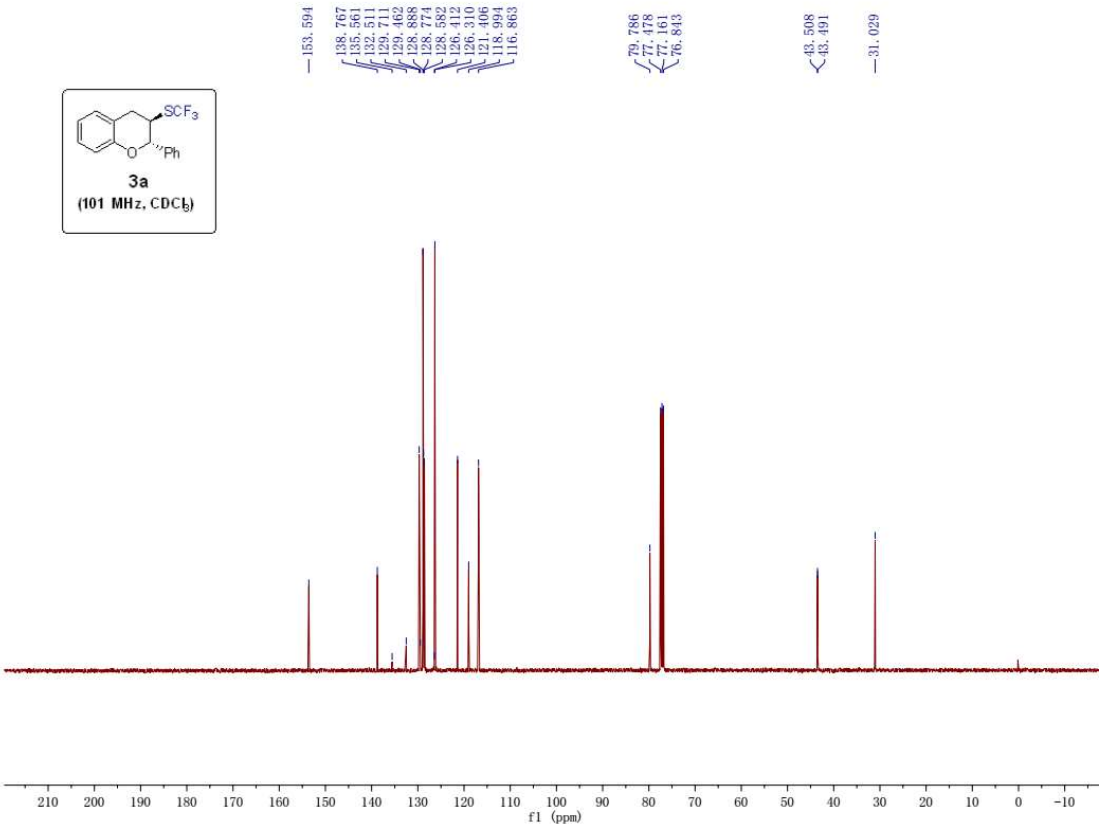
(376 MHz, $CDCl_3$)

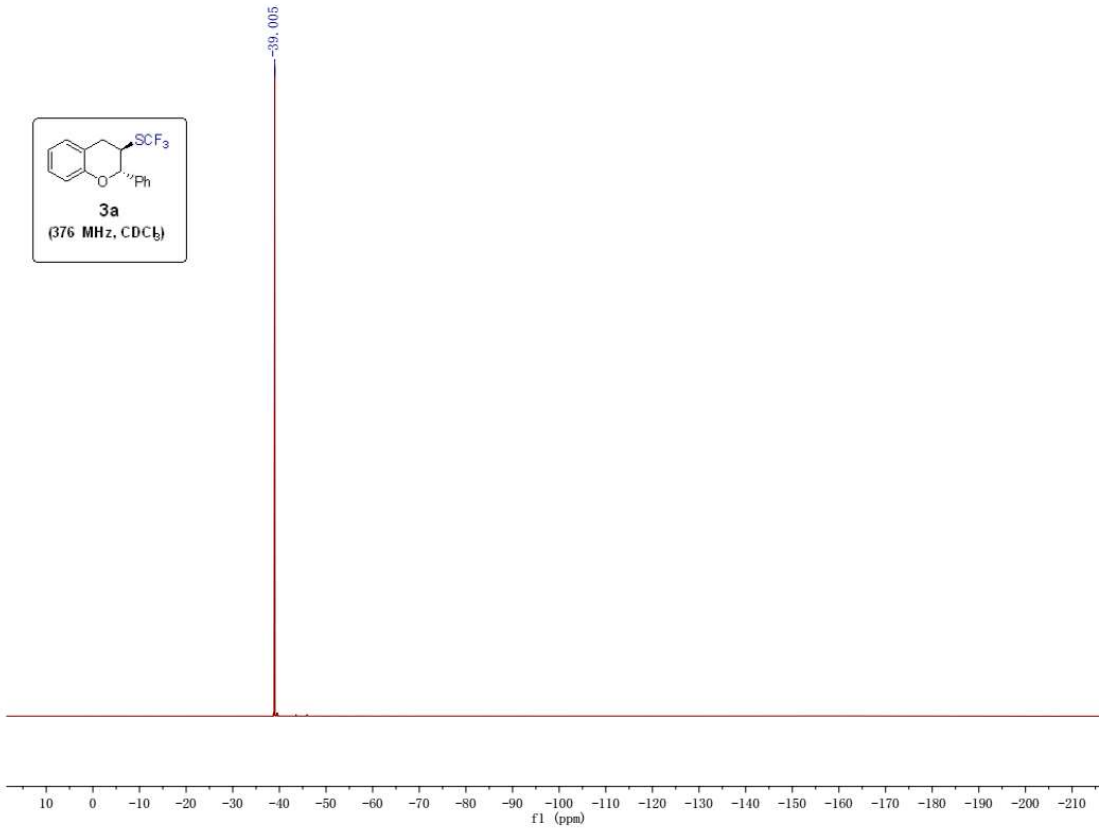


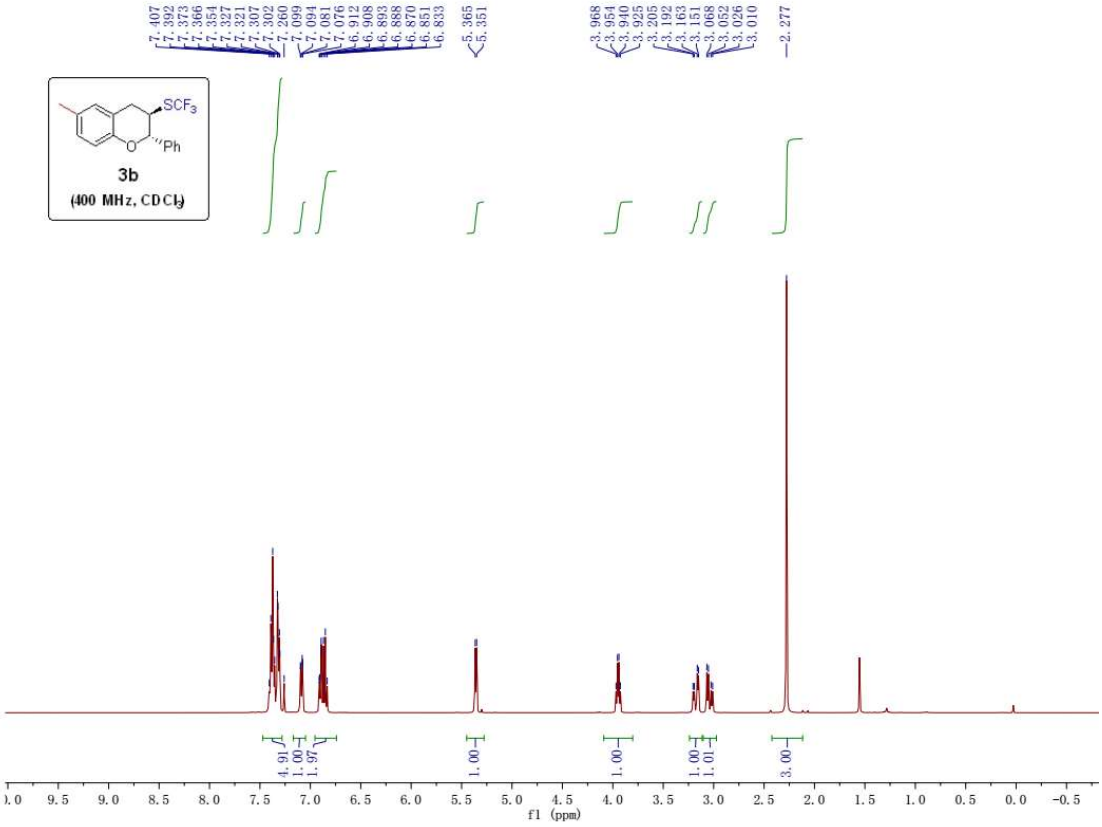
3a

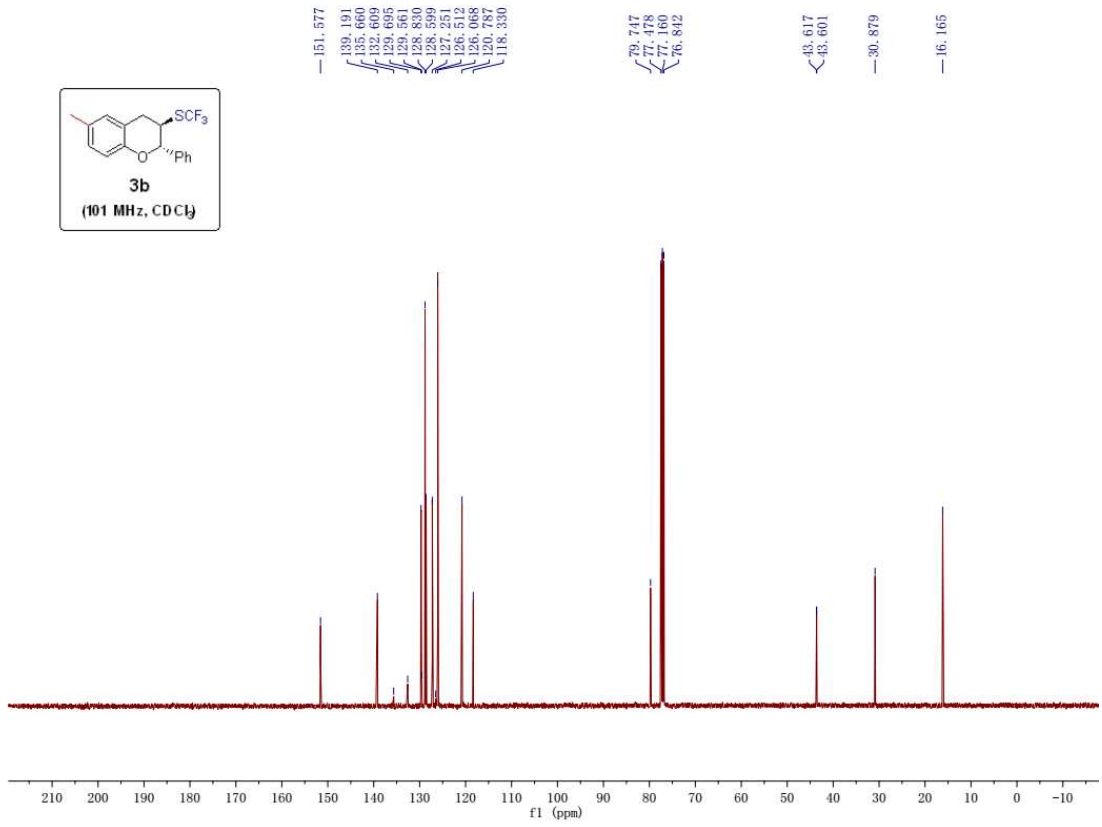
(400 MHz, $CDCl_3$)




153.594
138.767
135.561
132.511
129.711
129.462
128.888
128.774
128.582
126.412
126.310
121.406
118.994
116.863
79.786
77.478
77.161
76.843
43.508
43.491
31.029
SCF3
O
Ph
3a
(101 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


-39.005
SCF3
O
Ph
3a
(376 MHz, CDCl3)
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)


7.407
7.392
7.373
7.366
7.354
7.327
7.321
7.307
7.302
7.260
7.099
7.094
7.081
7.076
6.912
6.908
6.893
6.888
6.870
6.851
6.833
5.365
5.351
3.968
3.954
3.940
3.925
3.205
3.192
3.163
3.151
3.068
3.052
3.026
3.010
2.277
SCF3
Ph
3b
(400 MHz, CDCl3)
4.91
1.00
1.97
1.00
1.00
1.00
1.01
3.00
f1 (ppm)


151.577
139.191
135.660
132.609
129.695
129.561
128.830
128.599
127.251
126.512
126.068
120.787
118.330
79.747
77.478
77.160
76.842
43.617
43.601
30.879
16.165
SCF3
Ph
3b
(101 MHz, CDCl3)
f1 (ppm)

3b

(376 MHz, $CDCl_3$)

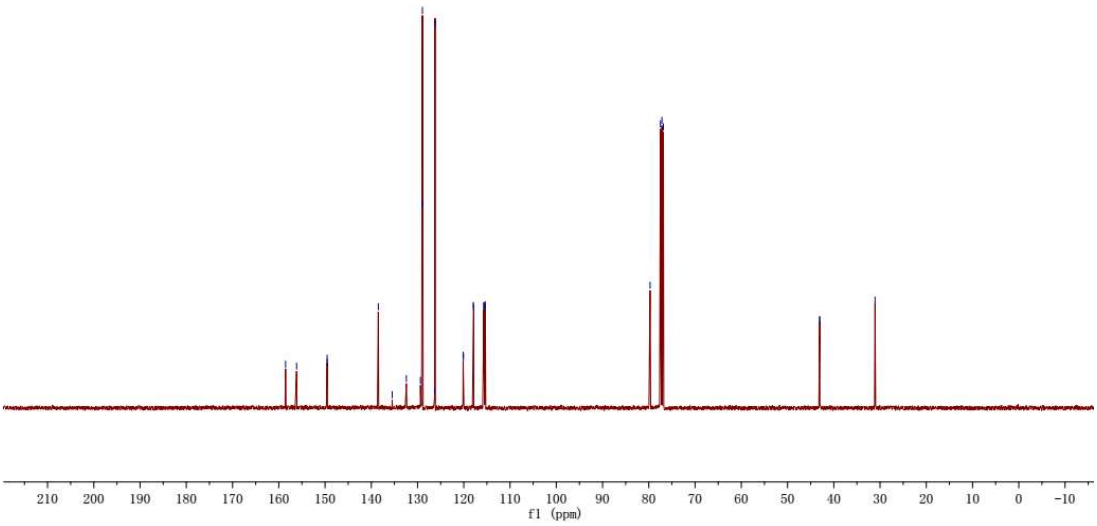
3c

(400 MHz, $CDCl_3$)

3c

(101 MHz, $CDCl_3$)

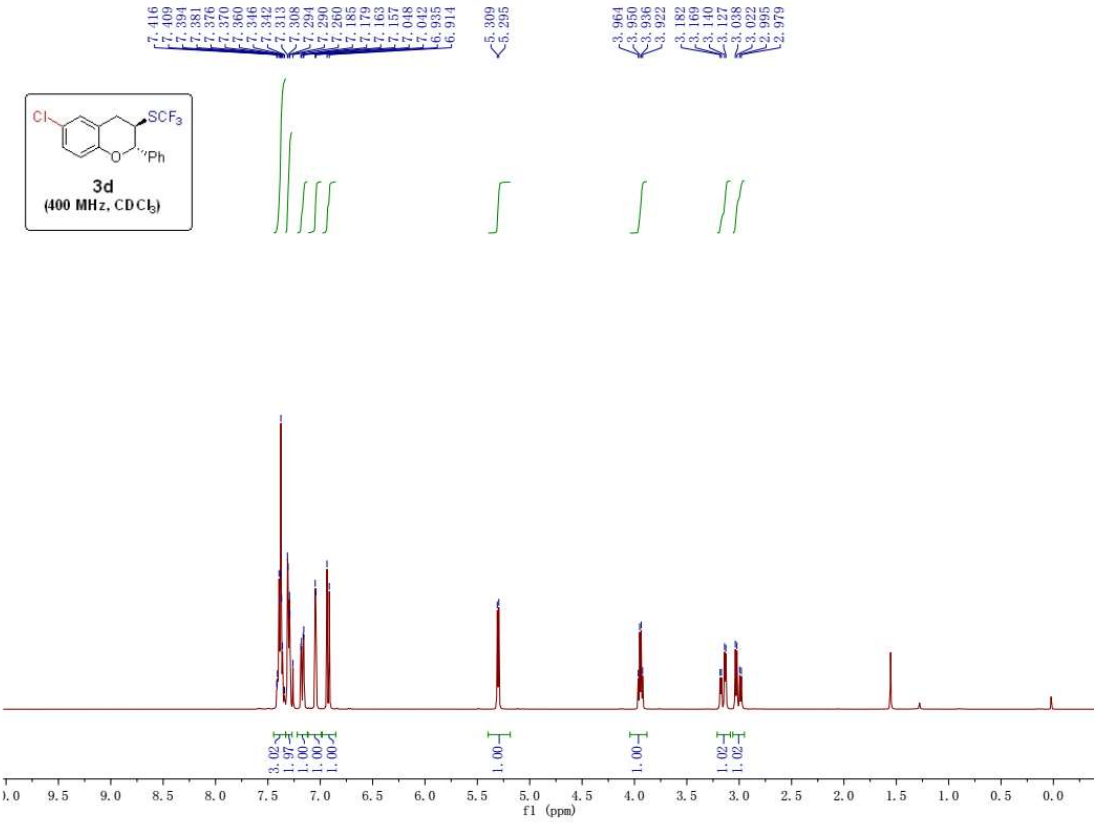
158.534
156.153
149.550
149.529
138.481
135.473
132.422
129.372
128.948
128.861
126.320
126.217
120.142
120.066
117.957
117.876
115.698
115.581
115.468
115.349
79.723
77.478
77.161
76.843
43.062
43.043
31.083

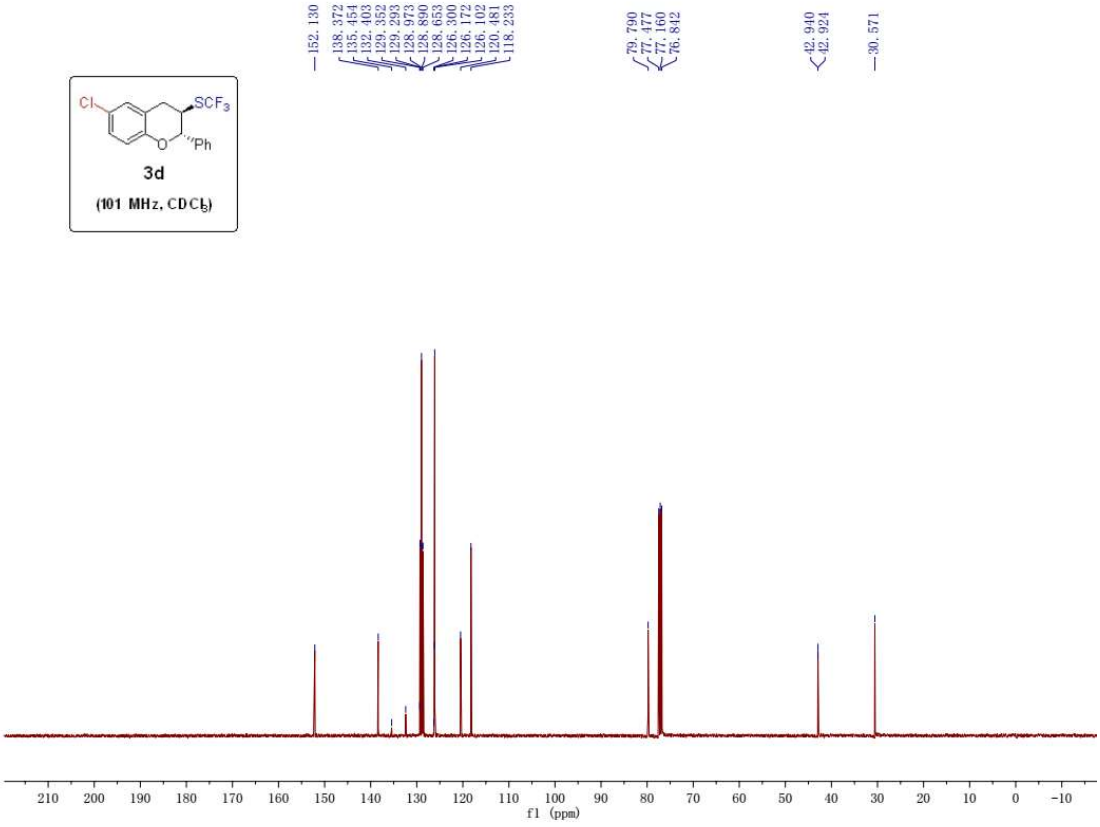


3c

(376 MHz, $CDCl_3$)

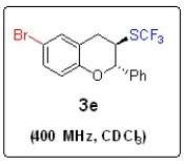
-39.039
-122.780


7.416
7.409
7.394
7.381
7.376
7.370
7.360
7.346
7.342
7.313
7.308
7.294
7.290
7.260
7.185
7.179
7.163
7.157
7.048
7.042
6.935
6.914
5.309
5.295
3.964
3.950
3.936
3.922
3.182
3.169
3.140
3.127
3.038
3.022
2.995
2.979
Cl
SCF3
Ph
3d
(400 MHz, CDCl3)
3.02
1.97
1.00
1.00
1.00
1.00
1.00
1.00
1.02
1.02
f1 (ppm)


152.130
138.372
135.454
132.403
129.352
129.293
128.973
128.890
128.653
126.300
126.172
126.102
120.481
118.233
79.790
77.477
77.160
76.842
42.940
42.924
30.571
Cl
SCF3
Ph
3d
(101 MHz, CDCl3)
f1 (ppm)

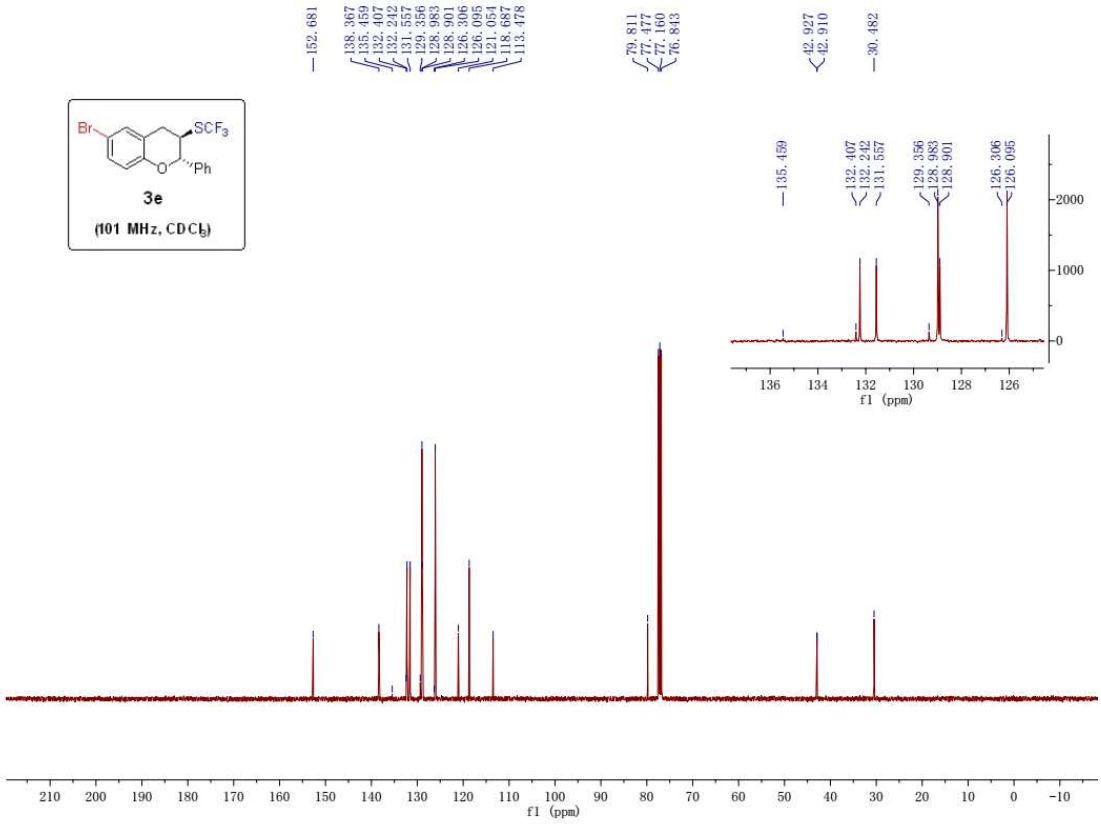
3d

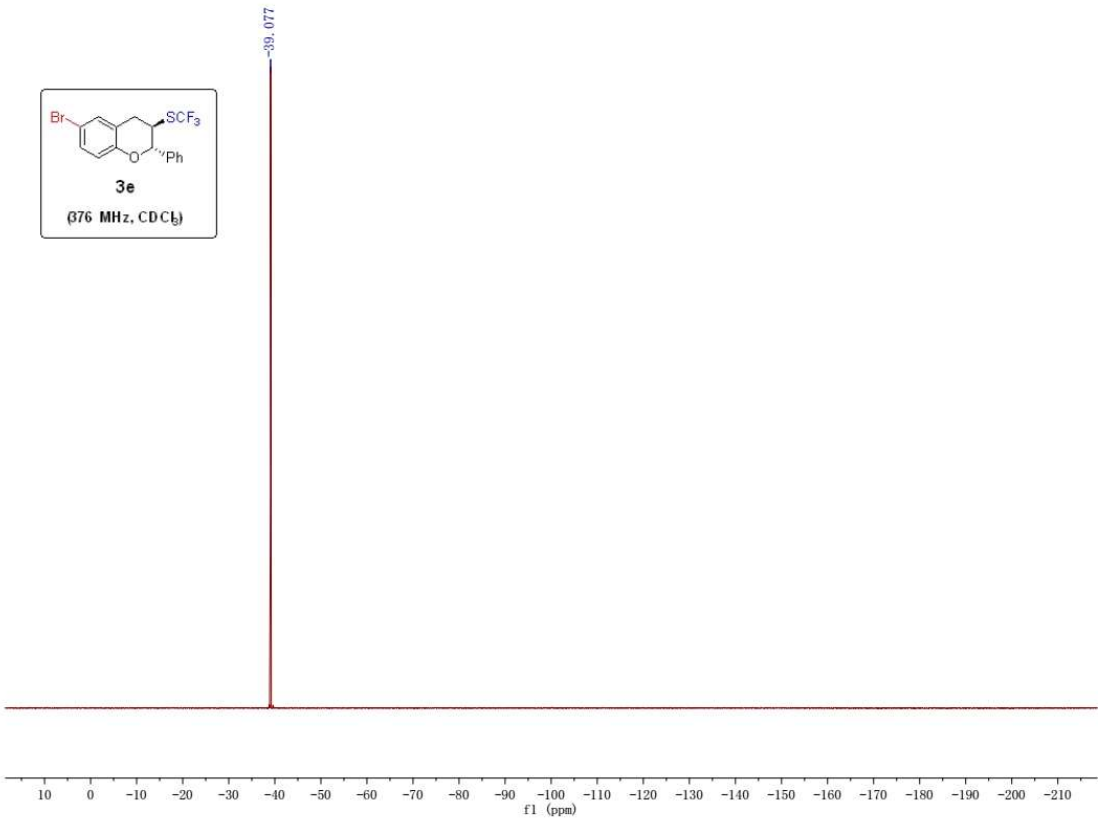
(376 MHz, $CDCl_3$)

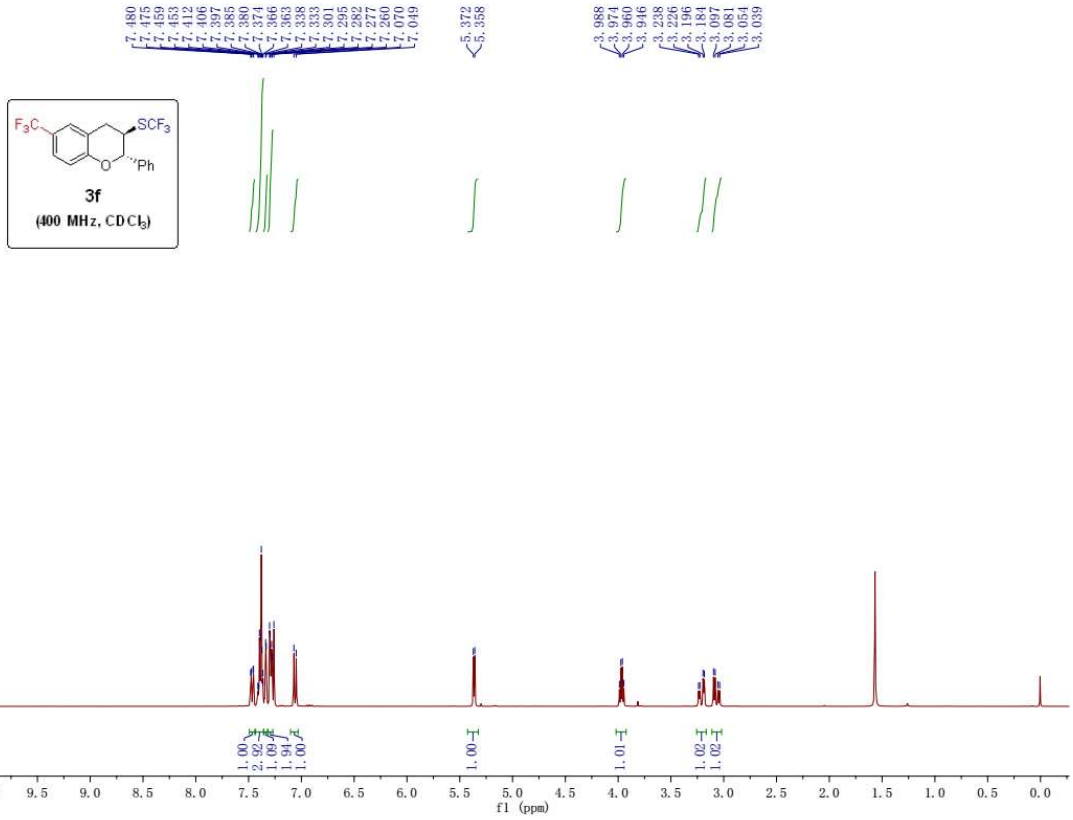


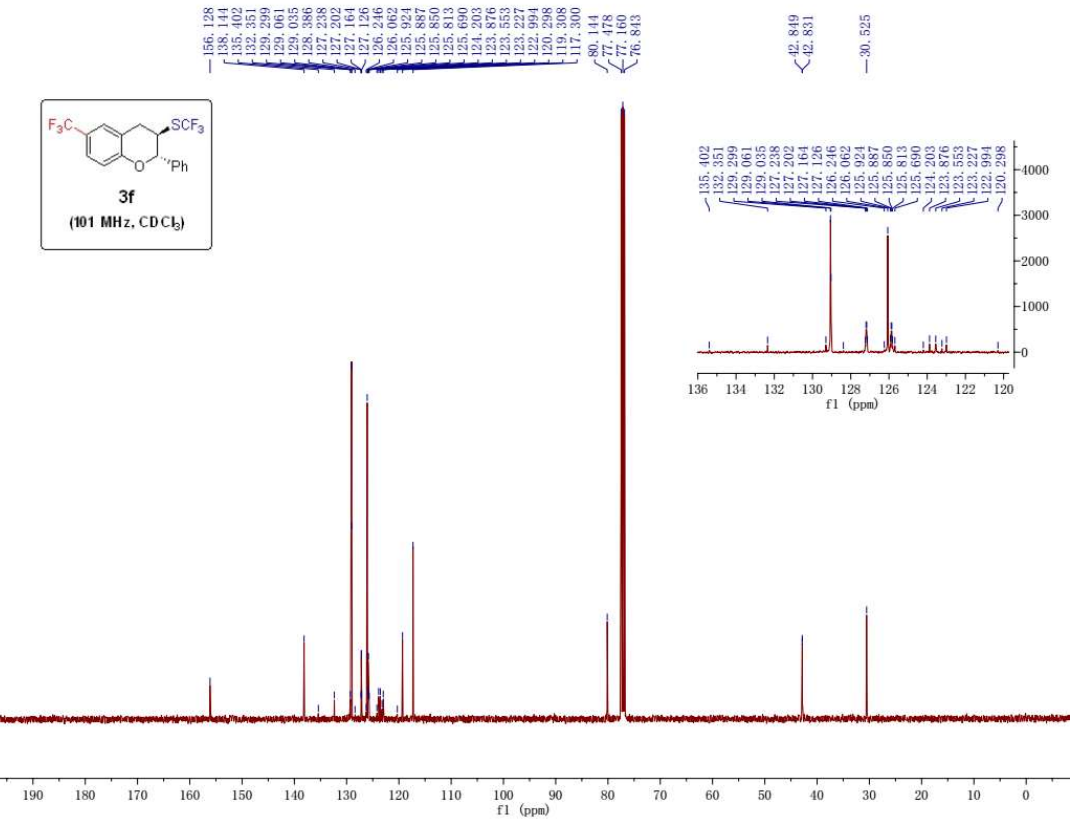
3e

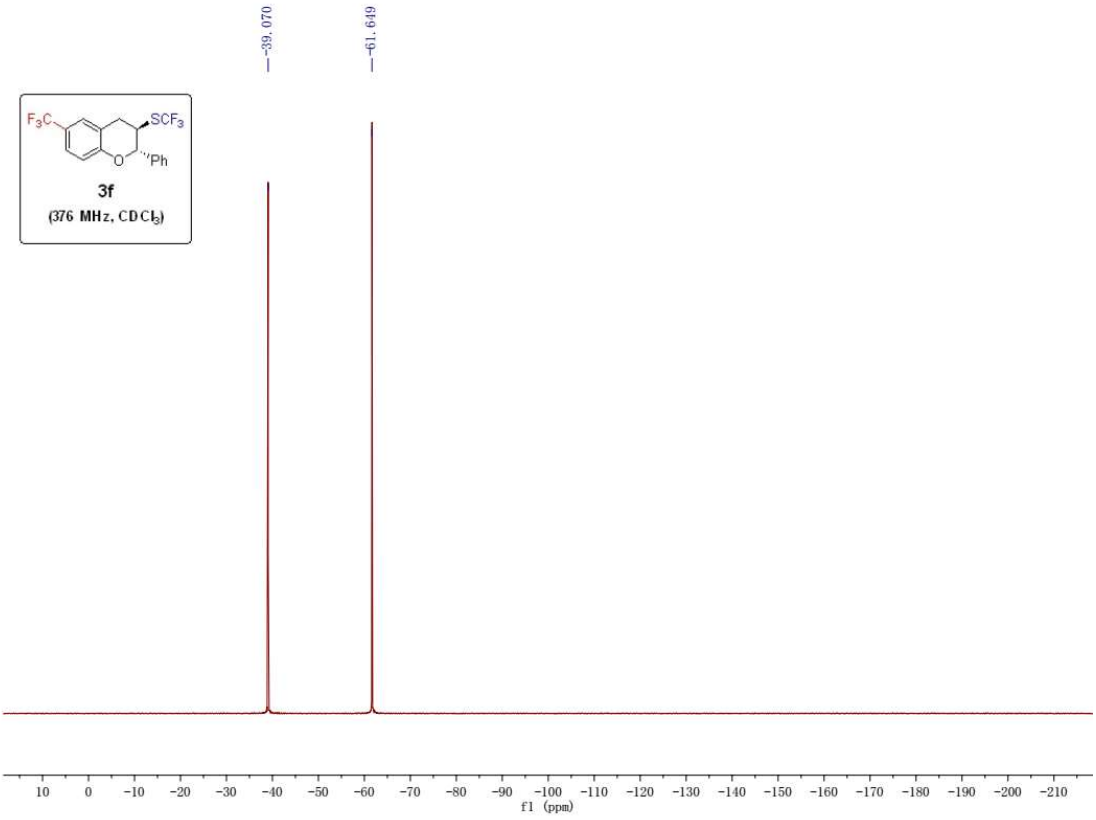
(400 MHz, $CDCl_3$)

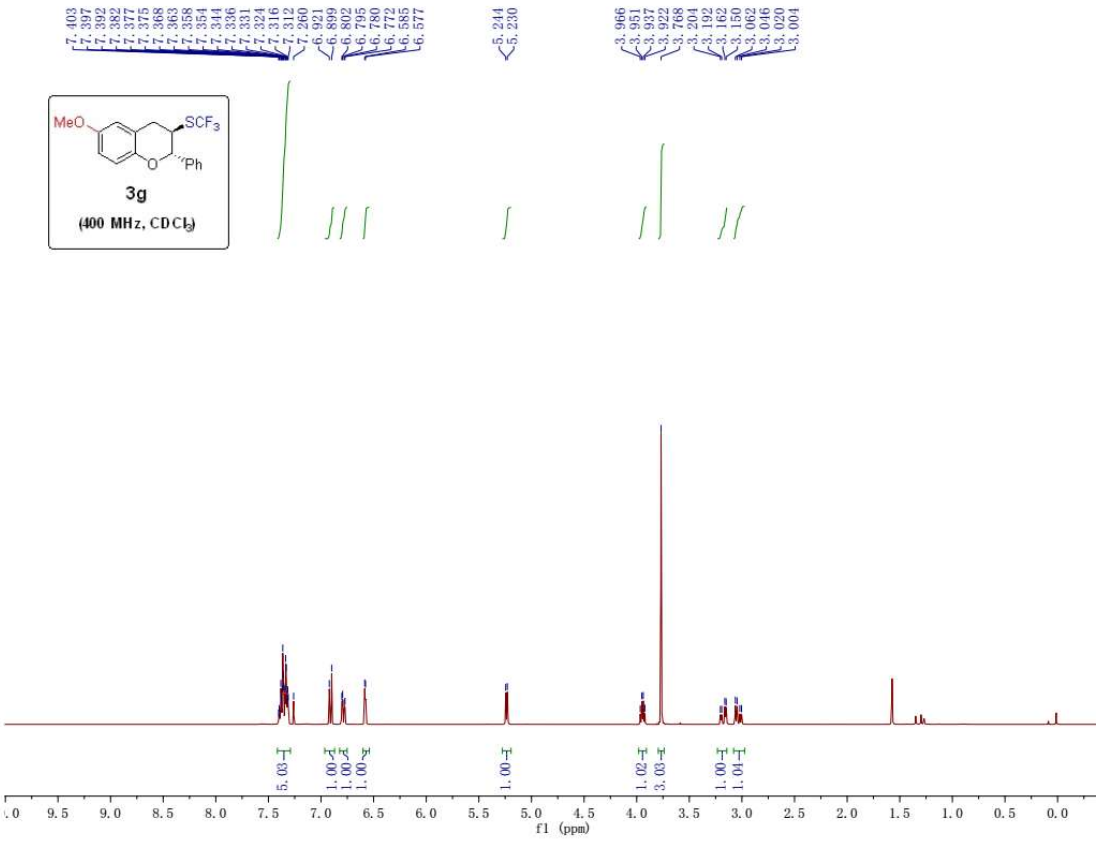

152.681
138.367
135.459
132.407
132.242
131.557
129.356
128.983
128.901
126.306
126.095
121.054
118.687
113.478
79.811
77.477
77.160
76.843
42.927
42.910
30.482
Br
SCF3
O
Ph
3e
(101 MHz, CDCl3)
f1 (ppm)

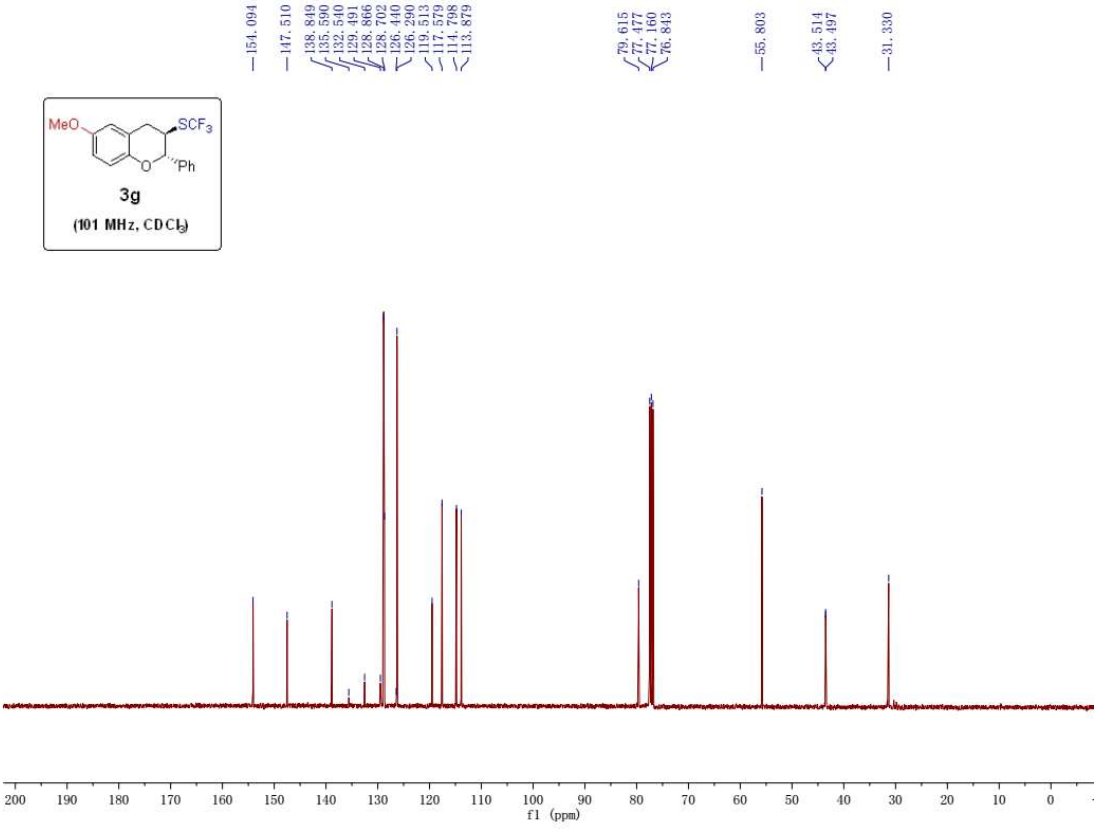

-39.077
Br
SCF3
O
Ph
3e
(376 MHz, CDCl3)
f1 (ppm)

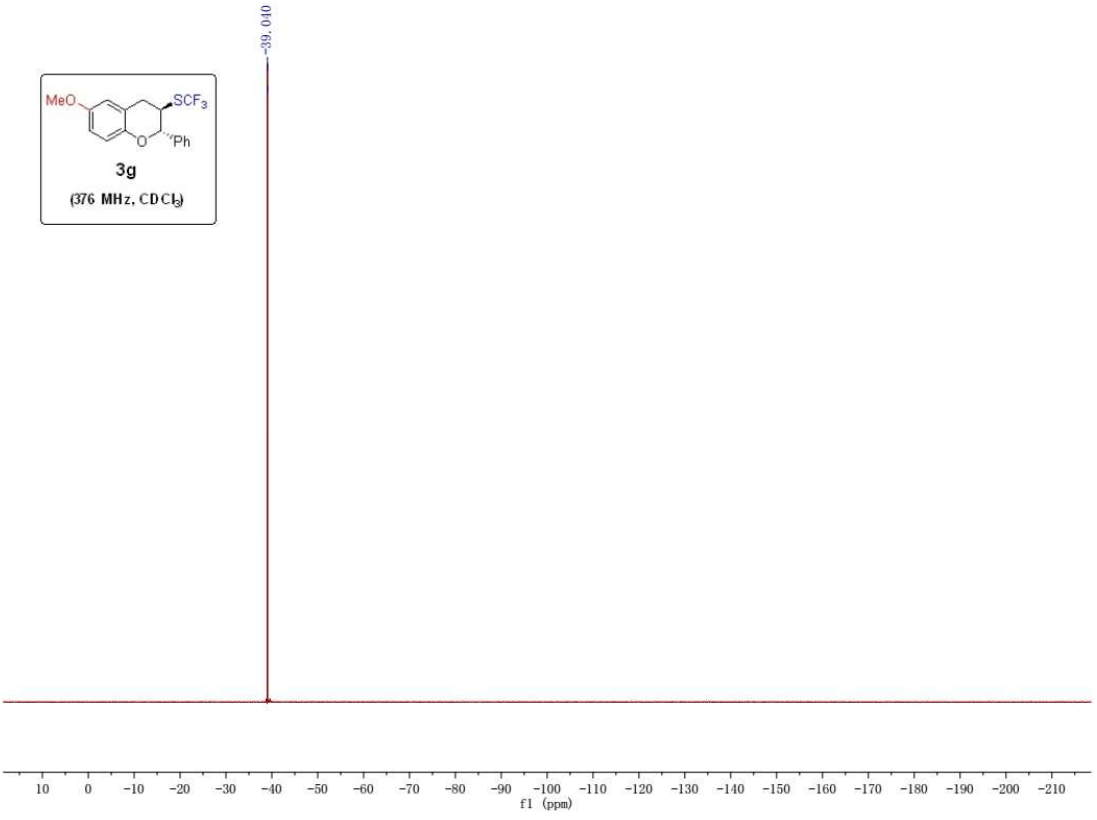

7.480
7.475
7.459
7.453
7.412
7.406
7.397
7.385
7.380
7.374
7.366
7.363
7.338
7.333
7.301
7.295
7.282
7.277
7.260
7.070
7.049
5.372
5.358
3.988
3.974
3.960
3.946
3.238
3.226
3.196
3.184
3.097
3.081
3.054
3.039
F3C
SCF3
Ph
3f
(400 MHz, CDCl3)
1.00
2.92
1.09
1.94
1.00
1.00
1.01
1.02
1.02
f1 (ppm)

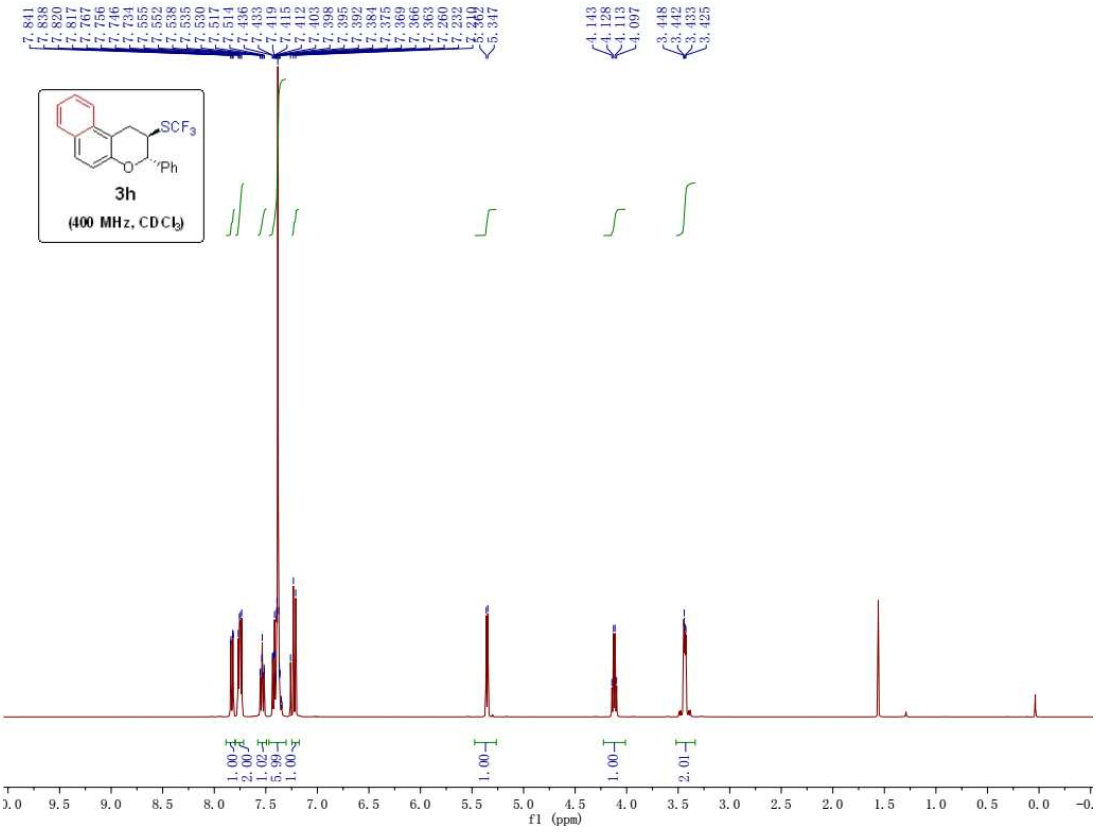

156.128
138.144
135.402
132.351
129.299
129.061
129.035
128.386
127.238
127.202
127.164
127.126
126.246
126.062
125.924
125.887
125.850
125.813
125.690
124.203
123.876
123.553
123.227
122.994
120.298
119.308
117.300
80.144
77.478
77.160
76.813
42.849
42.831
30.525
F3C
SCF3
Ph
3f
(101 MHz, CDCl3)
f1 (ppm)

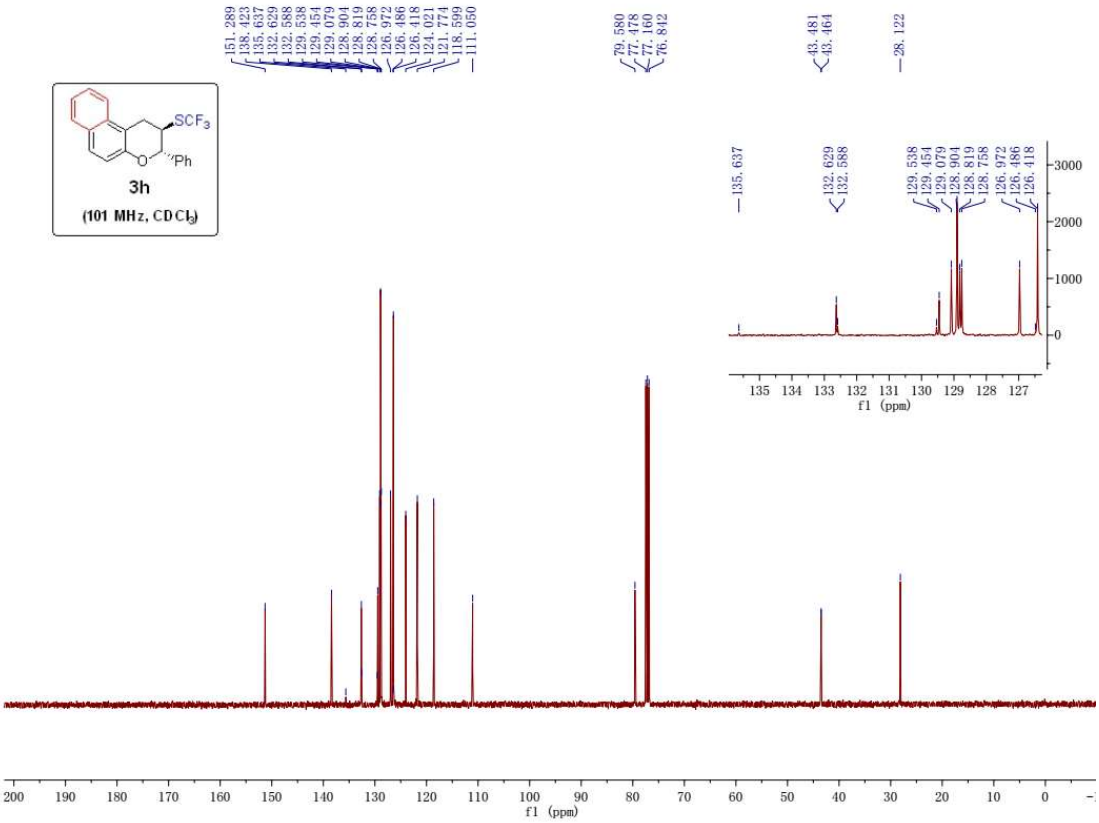

-39.070
-61.649
F3C
SCF3
Ph
3f
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

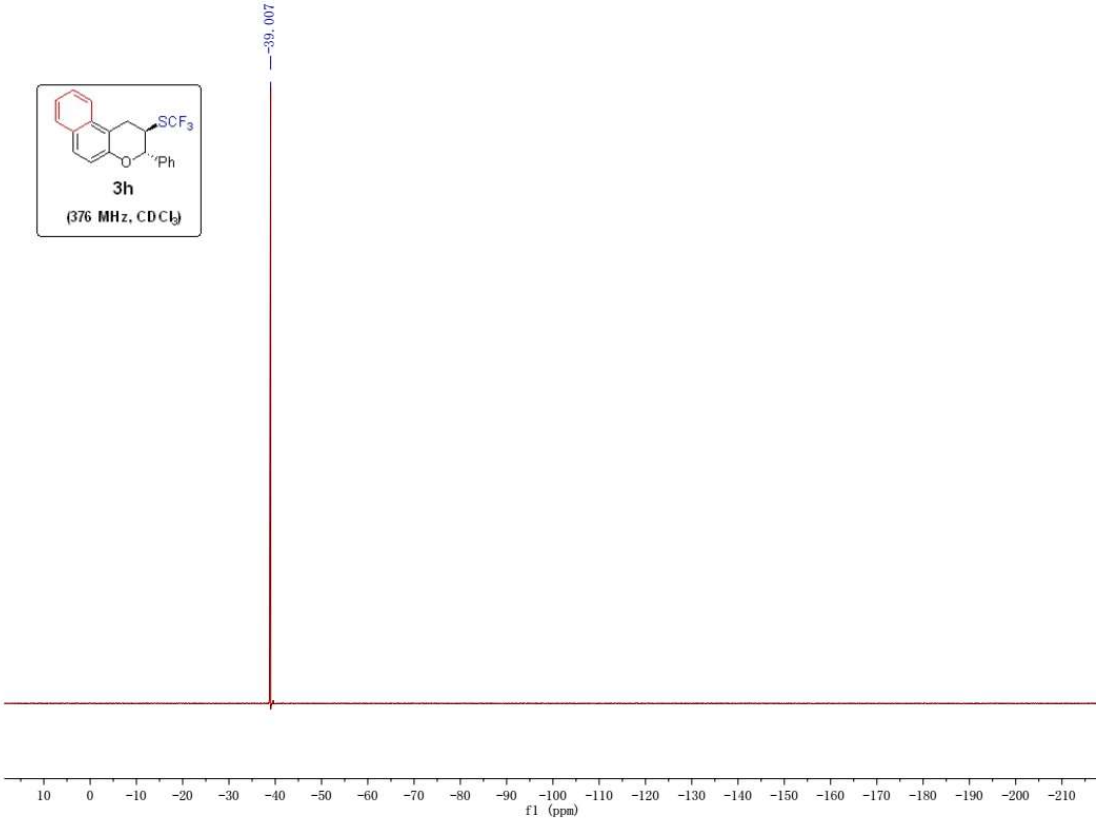

7.403
7.397
7.392
7.382
7.377
7.375
7.368
7.363
7.358
7.354
7.344
7.336
7.331
7.324
7.316
7.312
7.260
6.921
6.899
6.802
6.795
6.780
6.772
6.585
6.577
5.244
5.230
3.966
3.951
3.937
3.922
3.768
3.204
3.192
3.162
3.150
3.062
3.046
3.020
3.004
MeO
SCF3
Ph
3g
(400 MHz, CDCl3)
5.03
1.00
1.00
1.00
1.00
1.02
3.03
1.00
1.04
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

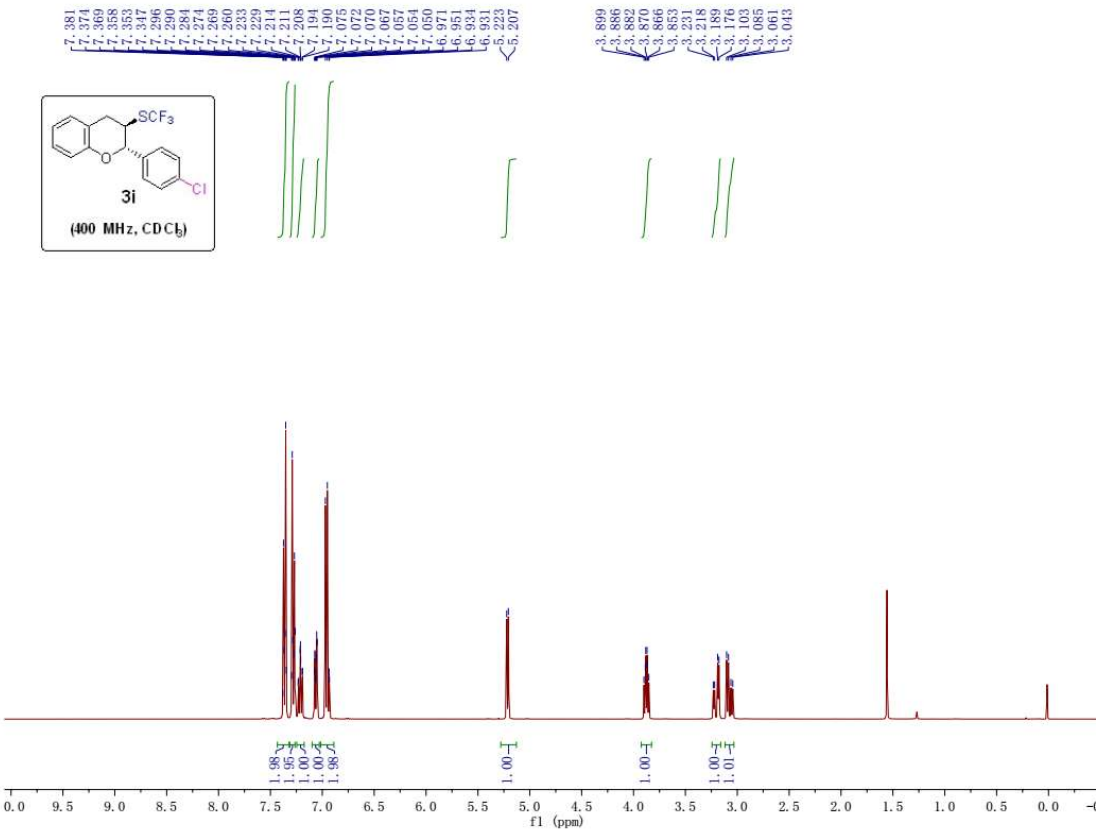

154.094
147.510
138.849
135.590
132.540
129.491
128.866
128.702
126.440
126.290
119.513
117.579
114.798
113.879
79.615
77.477
77.160
76.843
55.803
43.514
43.497
31.330
MeO
SCF3
Ph
3g
(101 MHz, CDCl3)
f1 (ppm)

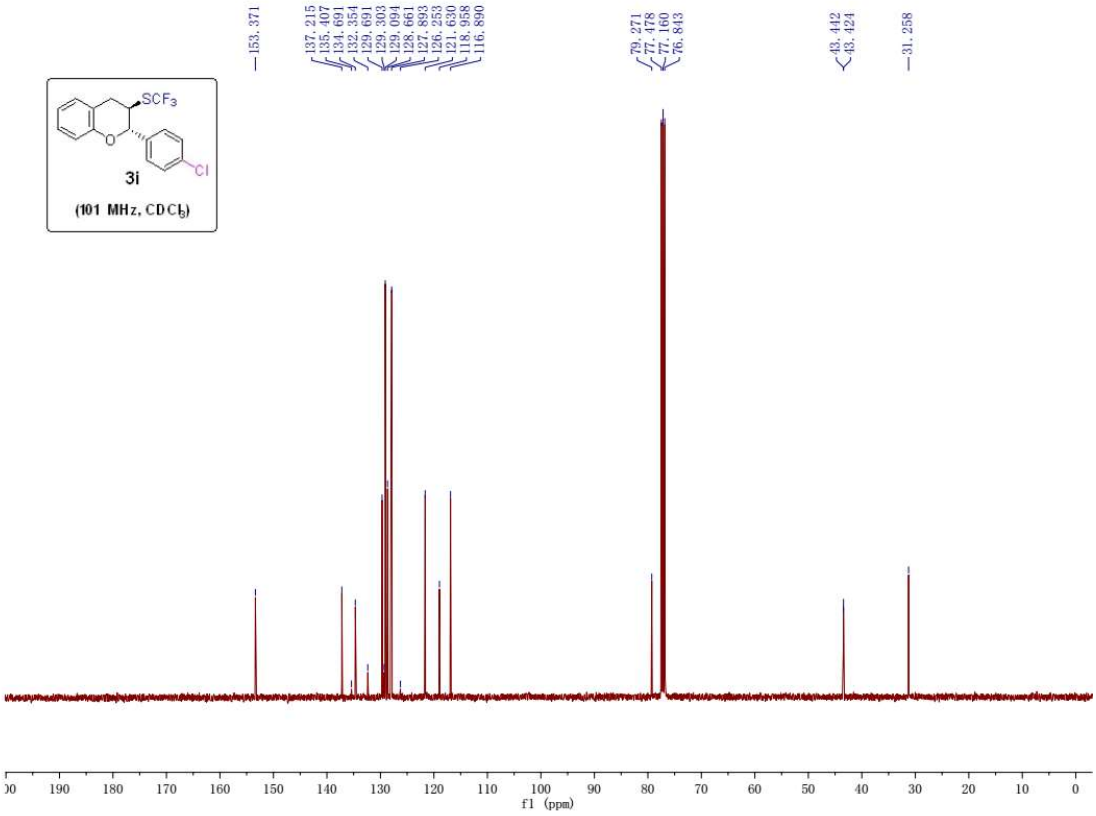

-39.040
MeO
SCF3
Ph
3g
(376 MHz, CDCl3)
f1 (ppm)

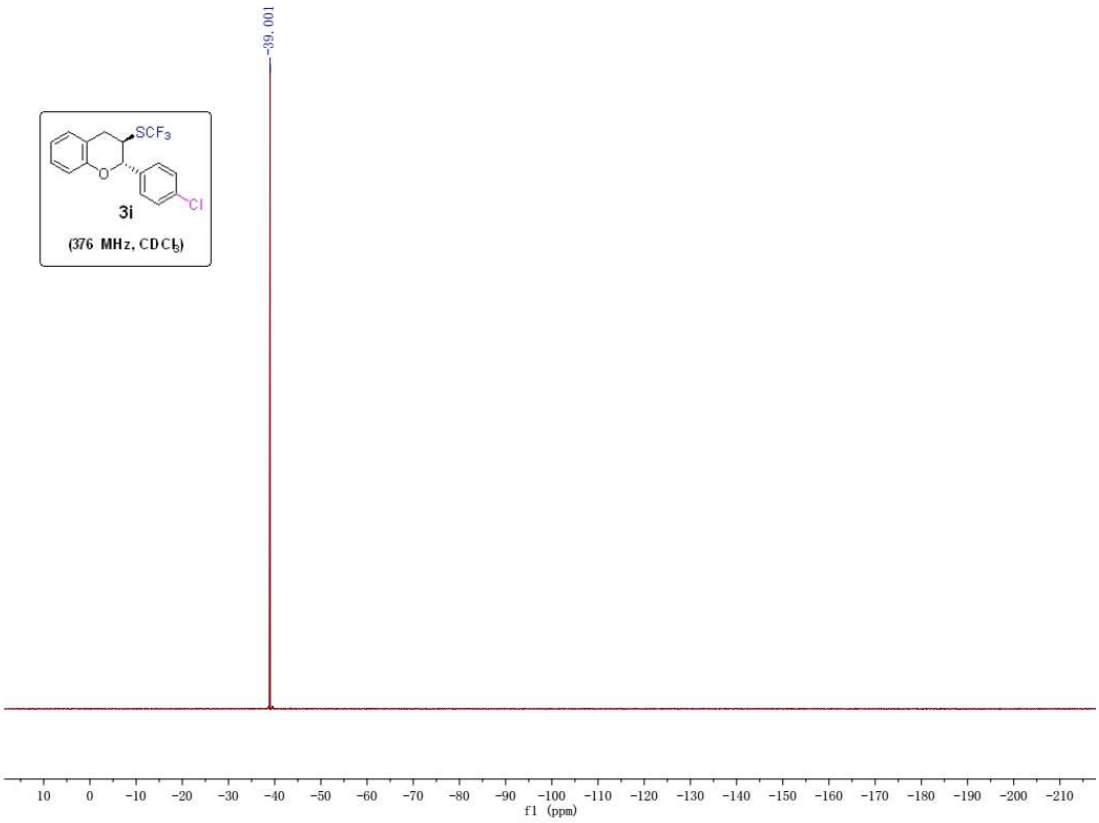

7.841
7.838
7.820
7.817
7.767
7.756
7.746
7.734
7.555
7.552
7.538
7.535
7.530
7.517
7.514
7.436
7.433
7.419
7.415
7.412
7.403
7.398
7.395
7.392
7.384
7.375
7.369
7.366
7.363
7.260
7.232
5.347
4.143
4.128
4.113
4.097
3.448
3.442
3.433
3.425
SCF3
Ph
3h
(400 MHz, CDCl3)
1.00
2.00
1.02
5.99
1.00
1.00
1.00
2.01
f1 (ppm)

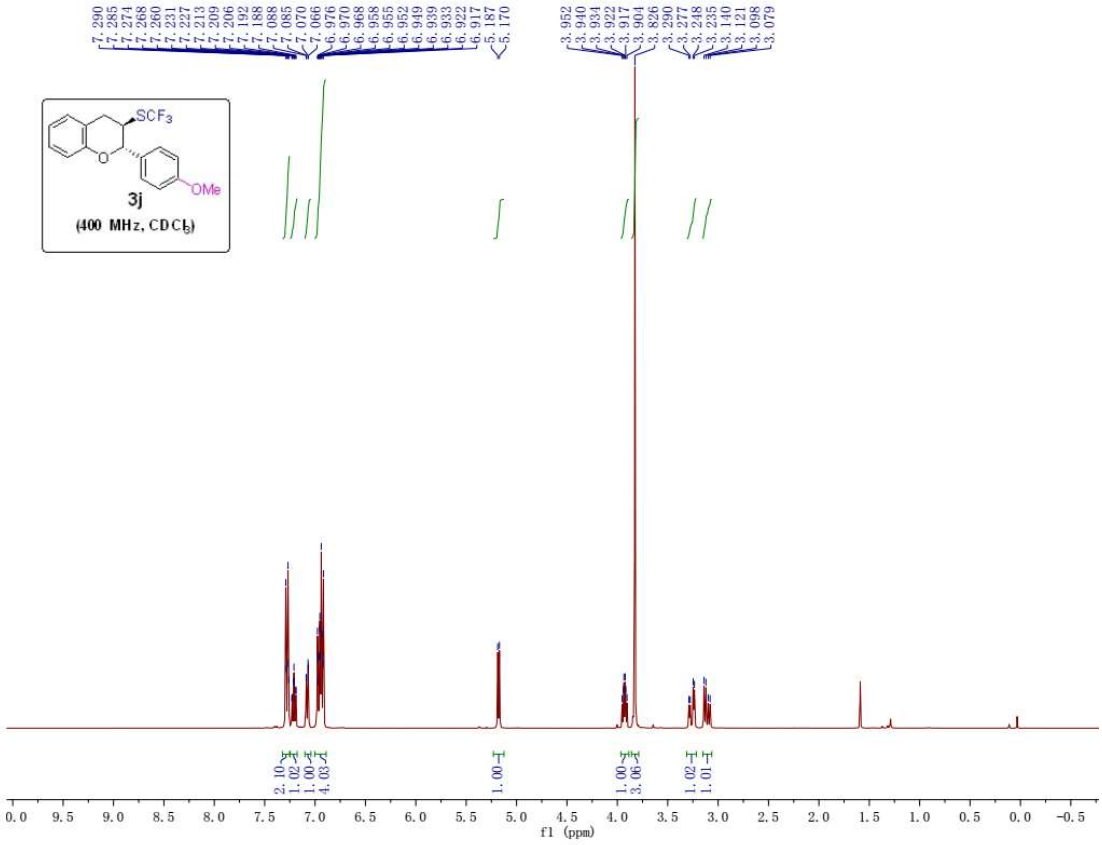

151.289
138.423
135.637
132.629
132.588
129.538
129.454
129.079
128.904
128.819
128.758
126.972
126.486
126.418
126.021
121.774
118.599
111.050
79.580
77.478
77.160
76.842
43.481
43.464
28.122
SCF3
Ph
3h
(101 MHz, CDCl3)
f1 (ppm)

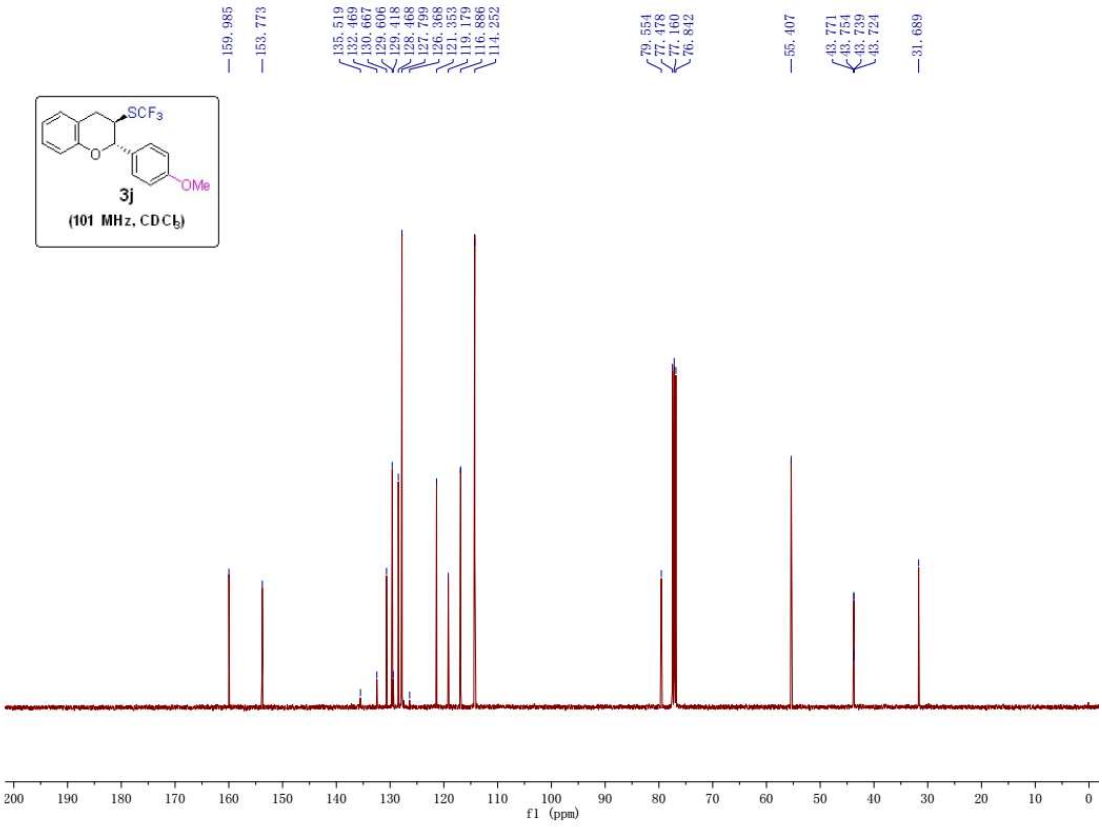

-39.007
SCF3
Ph
3h
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

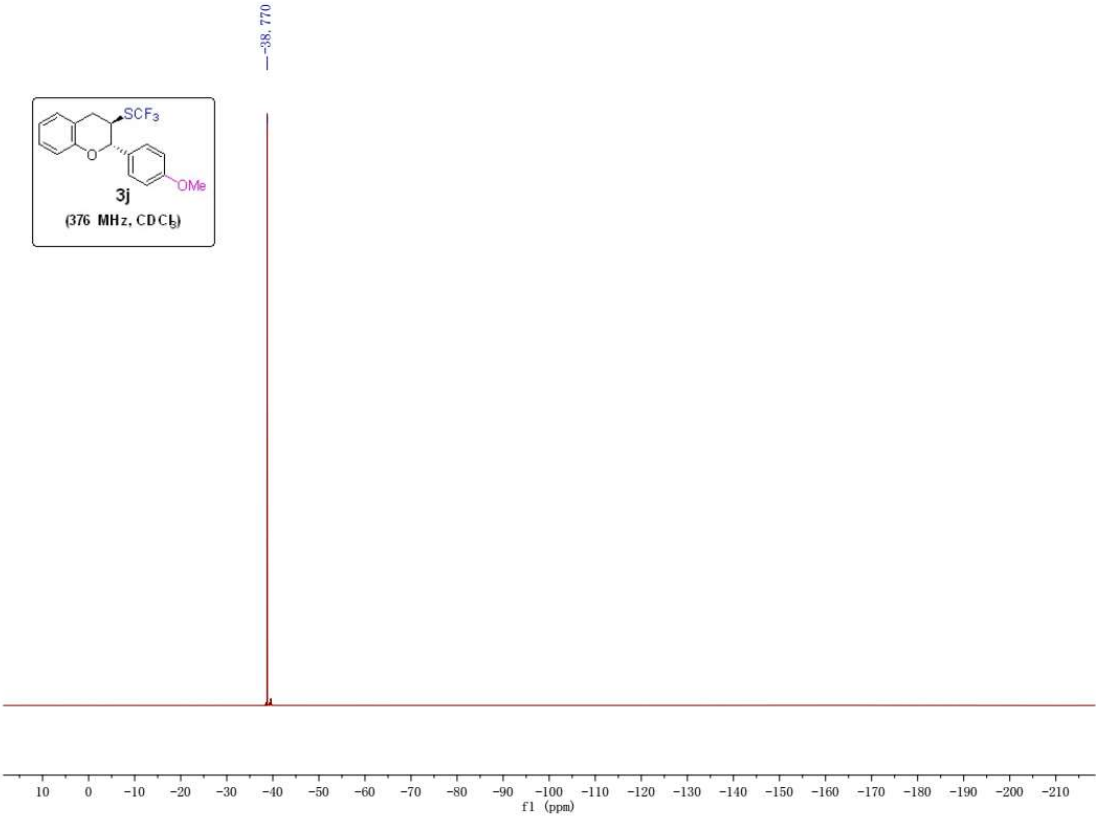

7.381
7.374
7.369
7.358
7.353
7.347
7.296
7.290
7.284
7.274
7.269
7.260
7.233
7.229
7.214
7.211
7.208
7.194
7.190
7.075
7.072
7.070
7.067
7.057
7.054
7.050
6.971
6.951
6.934
6.931
5.223
5.207
3.899
3.886
3.882
3.870
3.866
3.853
3.231
3.218
3.189
3.176
3.103
3.085
3.061
3.043
SCF3
Cl
3i
(400 MHz, CDCl3)
1.98
1.95
1.00
1.00
1.00
1.98
1.00
1.00
1.00
1.01
0.0 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
f1 (ppm)

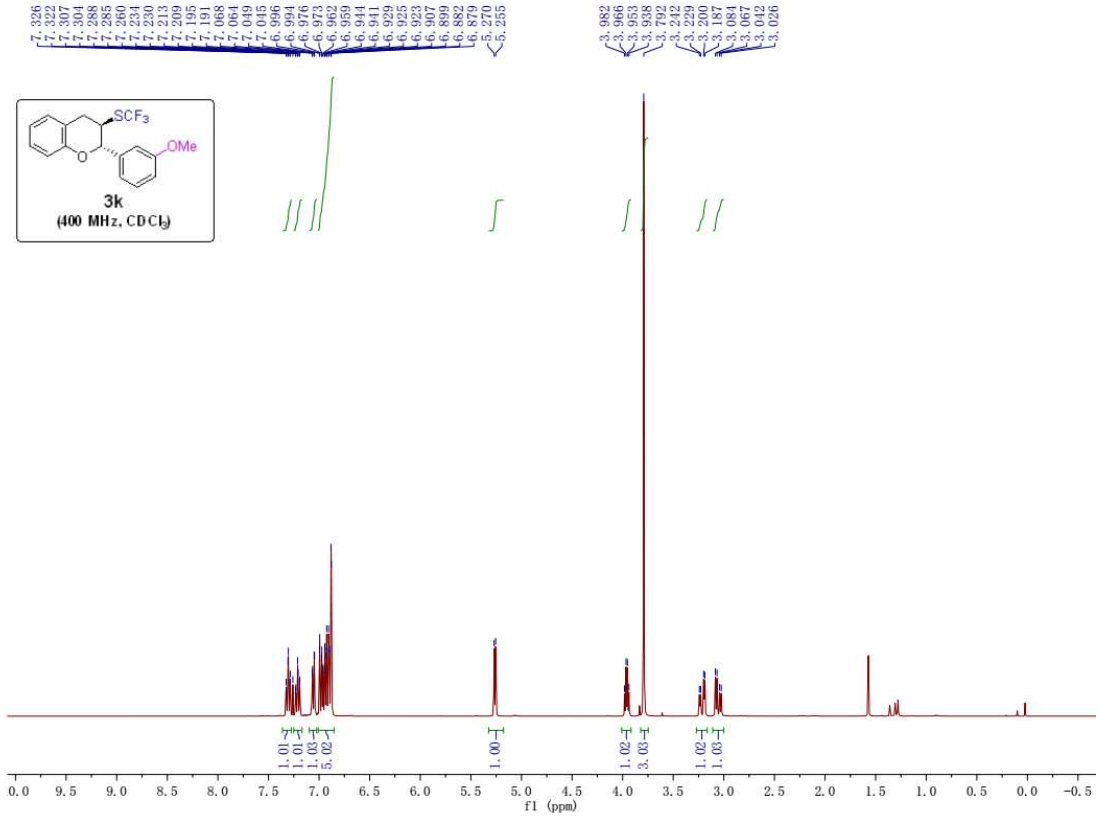

153.371
137.215
135.407
134.691
132.354
129.691
129.303
129.094
128.661
127.893
126.253
121.630
118.958
116.890
79.271
77.478
77.160
76.843
43.442
43.424
31.258
SCF3
Cl
3i
(101 MHz, CDCl3)
f1 (ppm)

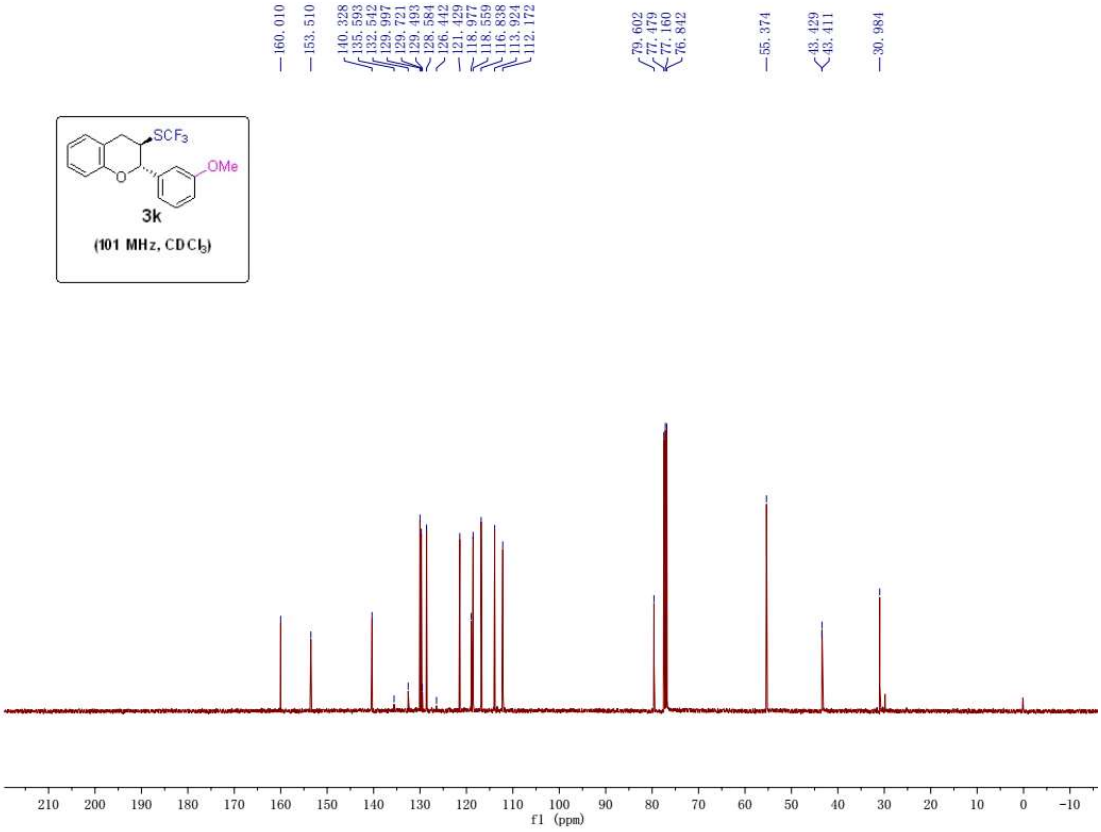

-39.001
SCF3
Cl
3i
(376 MHz, CDCl3)
f1 (ppm)

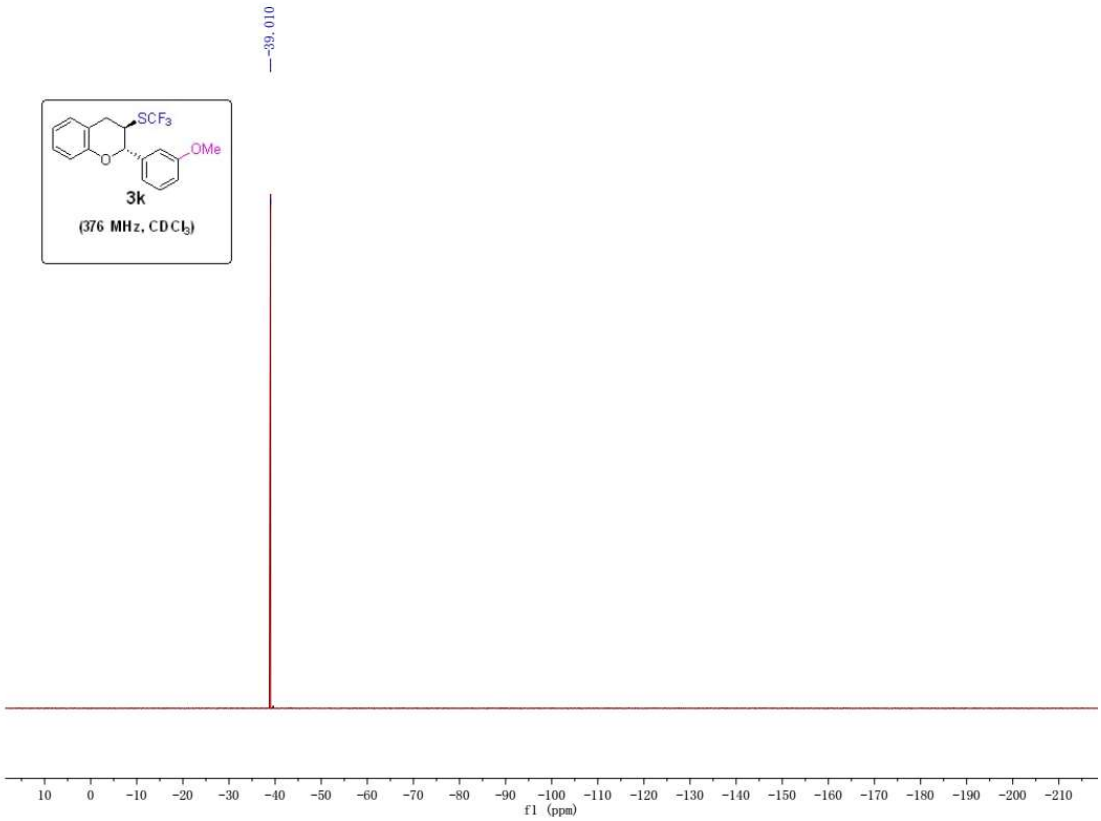

7.290
7.285
7.274
7.268
7.260
7.231
7.227
7.213
7.209
7.206
7.192
7.188
7.088
7.085
7.070
7.066
6.976
6.970
6.968
6.958
6.955
6.952
6.949
6.939
6.933
6.922
6.917
5.187
5.170
3.952
3.940
3.934
3.922
3.917
3.904
3.826
3.290
3.277
3.248
3.235
3.140
3.121
3.098
3.079
SCF3
OMe
3j
(400 MHz, CDCl3)
2.10
1.02
1.00
4.03
1.00
1.00
3.06
1.02
1.01
f1 (ppm)

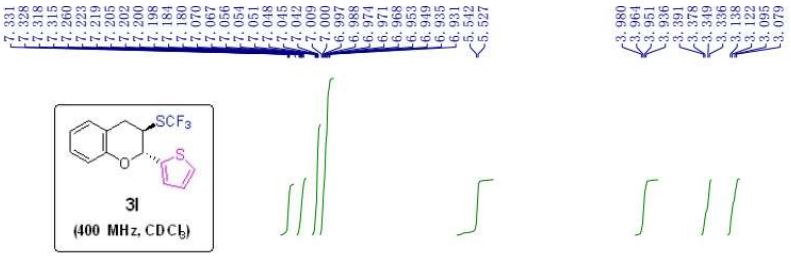

159.985
153.773
135.519
132.469
130.667
129.606
129.418
128.468
127.799
126.368
121.353
119.179
116.886
114.252
79.554
77.478
77.160
76.842
55.407
43.771
43.754
43.739
43.724
31.689
SCF3
OMe
3j
(101 MHz, CDCl3)
f1 (ppm)

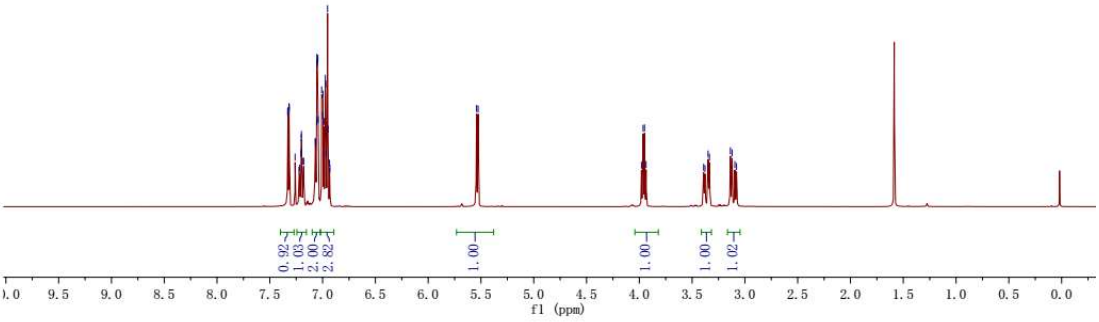

-38.770
SCF3
OMe
3j
(376 MHz, CDCl3)
f1 (ppm)

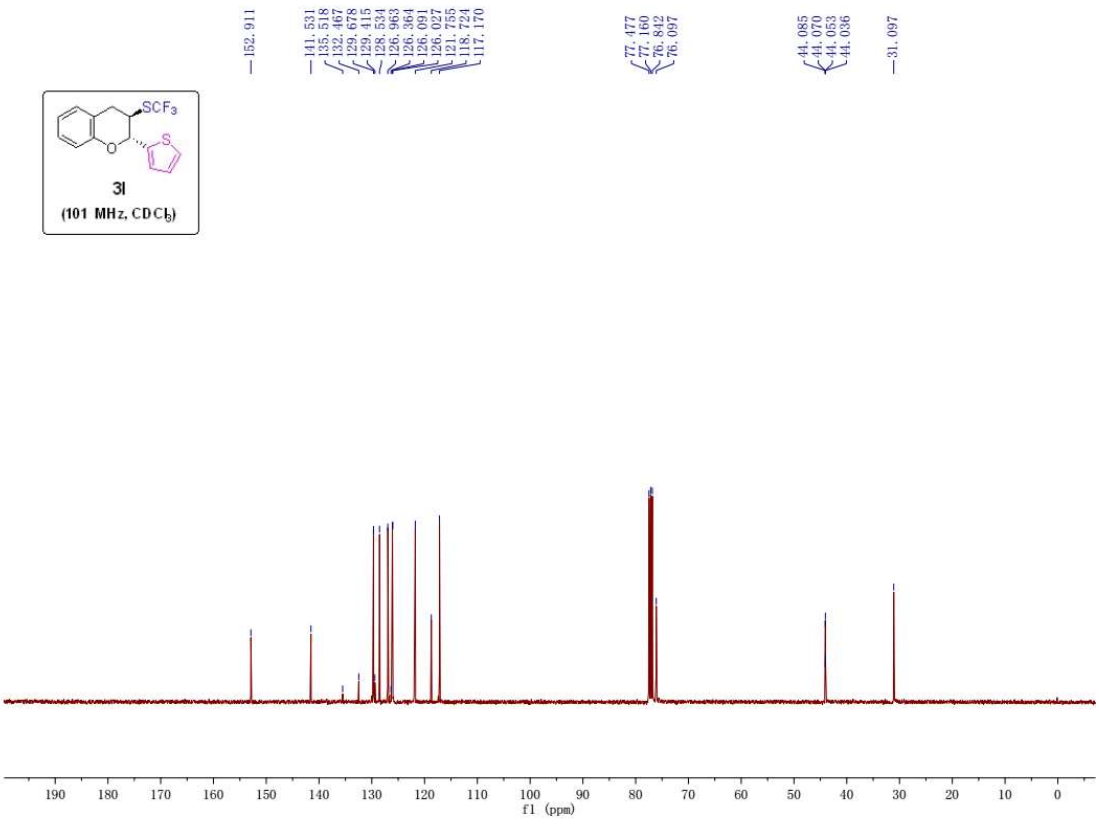

7.326
7.322
7.307
7.304
7.288
7.285
7.260
7.234
7.230
7.213
7.209
7.195
7.191
7.068
7.064
7.049
7.045
6.996
6.994
6.976
6.973
6.962
6.959
6.944
6.941
6.929
6.925
6.923
6.907
6.899
6.882
6.879
5.270
5.255
3.982
3.966
3.953
3.938
3.792
3.242
3.229
3.200
3.187
3.084
3.067
3.042
3.026
SCF3
OMe
3k
(400 MHz, CDCl3)
1.01
1.01
1.03
5.02
1.00
1.02
3.03
1.02
1.03
f1 (ppm)


160.010
153.510
140.328
135.593
132.542
129.997
129.721
129.493
128.584
126.442
121.429
118.977
118.559
116.838
113.924
112.172
79.602
77.479
77.160
76.842
55.374
43.429
43.411
30.984
SCF3
OMe
3k
(101 MHz, CDCl3)
f1 (ppm)

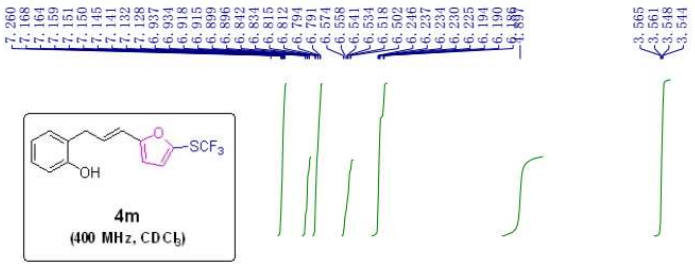

-39.010
SCF3
OMe
3k
(376 MHz, CDCl3)
f1 (ppm)


7.331
7.328
7.318
7.315
7.260
7.223
7.219
7.205
7.202
7.200
7.198
7.184
7.180
7.070
7.067
7.056
7.054
7.051
7.048
7.045
7.042
7.009
7.000
6.997
6.988
6.974
6.971
6.968
6.953
6.949
6.935
6.931
5.542
5.527
3.980
3.964
3.951
3.936
3.391
3.378
3.349
3.336
3.138
3.122
3.095
3.079
SCF3
S
O
3l
(400 MHz, CDCl3)

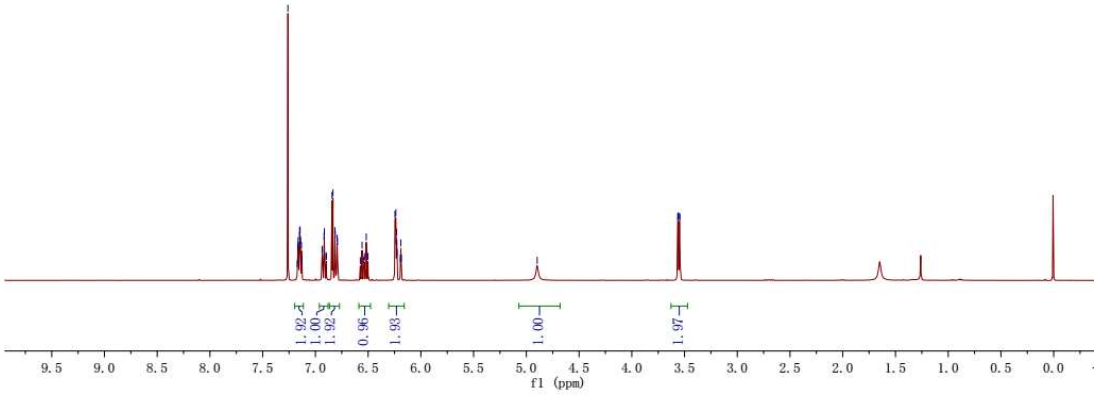

0.92
1.03
2.00
2.82
1.00
1.00
1.00
1.02
f1 (ppm)

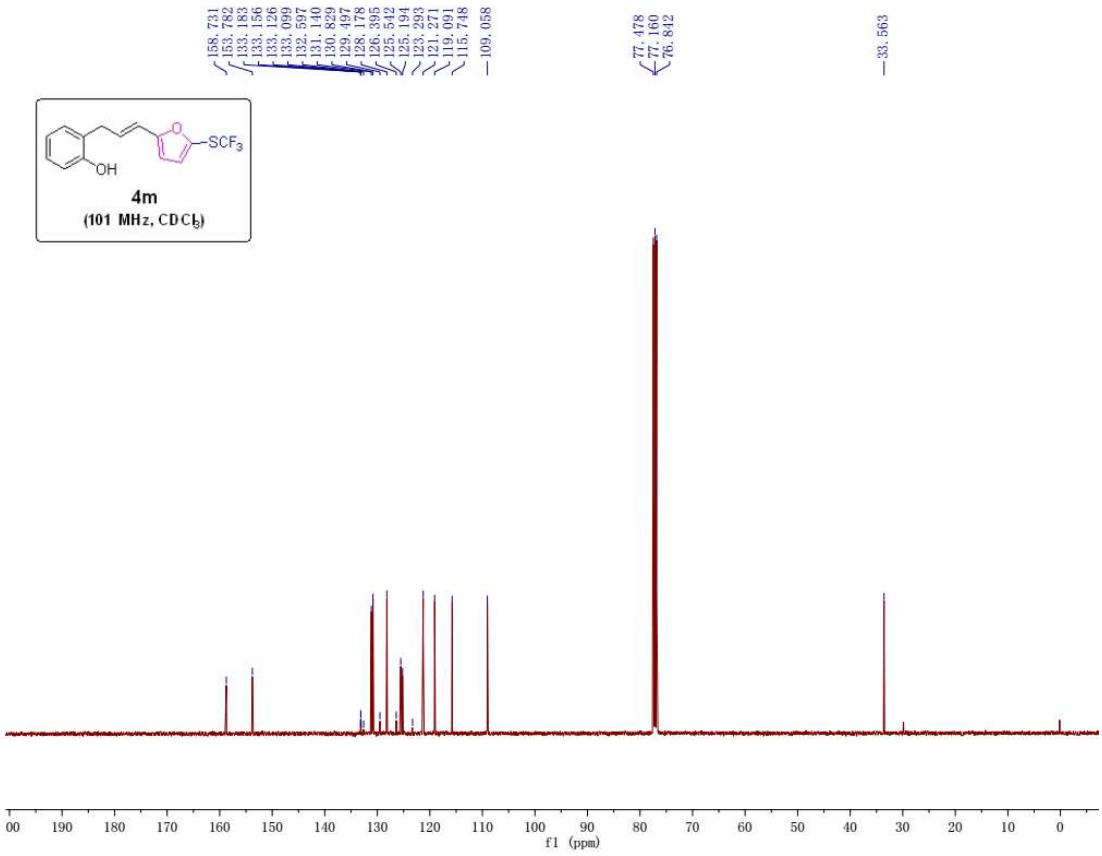

152.911
141.531
135.518
132.467
129.678
129.415
128.534
126.963
126.364
126.091
126.027
121.755
118.724
117.170
77.477
77.160
76.842
76.097
44.085
44.070
44.053
44.036
31.097
SCF3
S
O
3l
(101 MHz, CDCl3)
f1 (ppm)

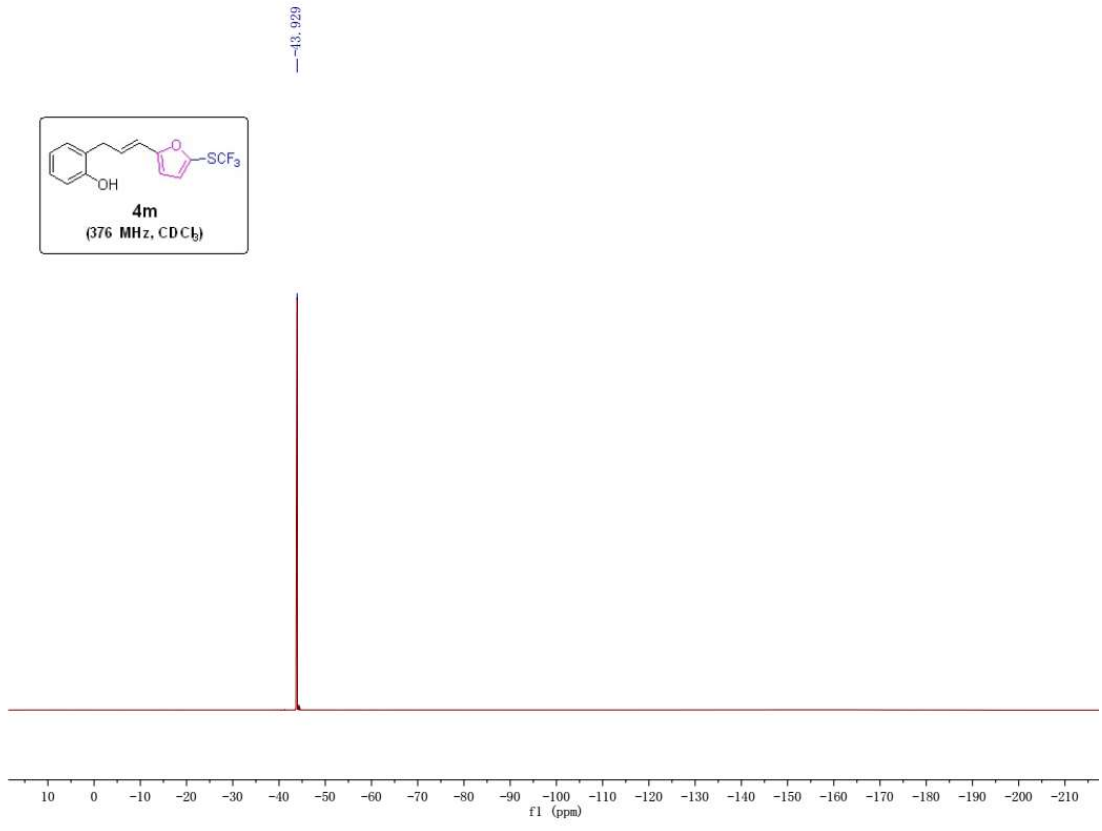
3l
(376 MHz, $CDCl_3$)

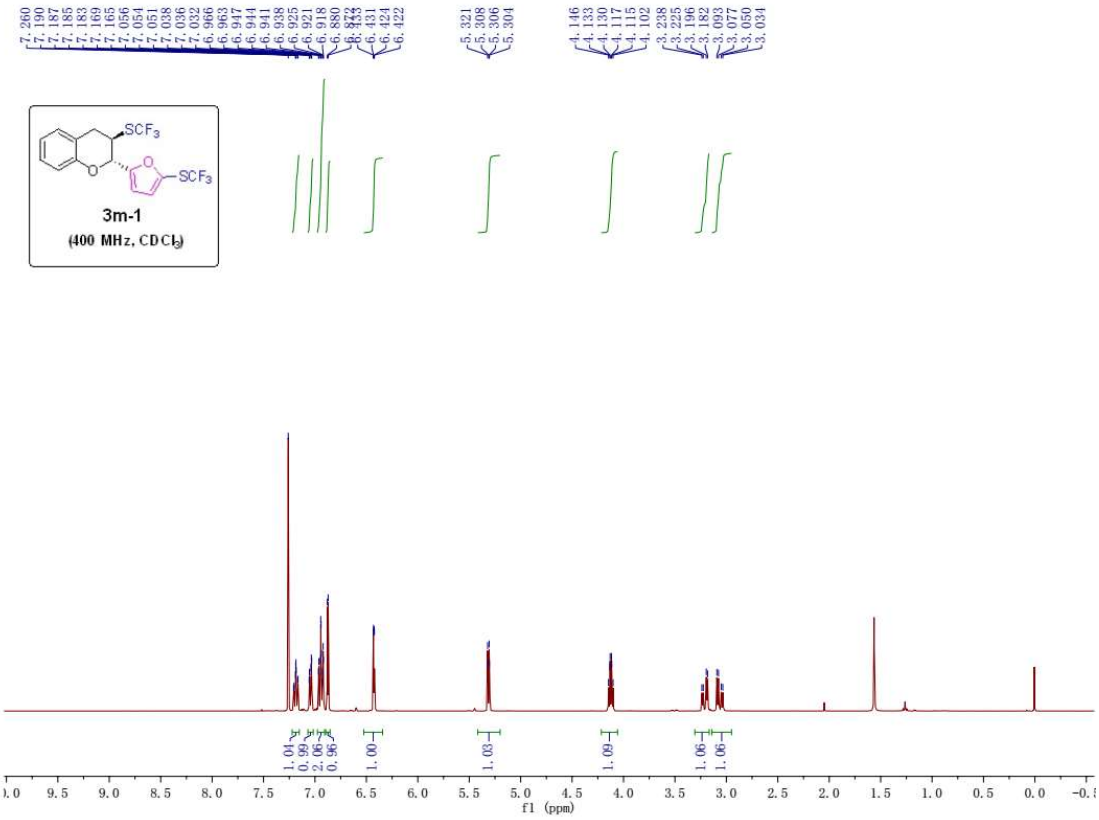


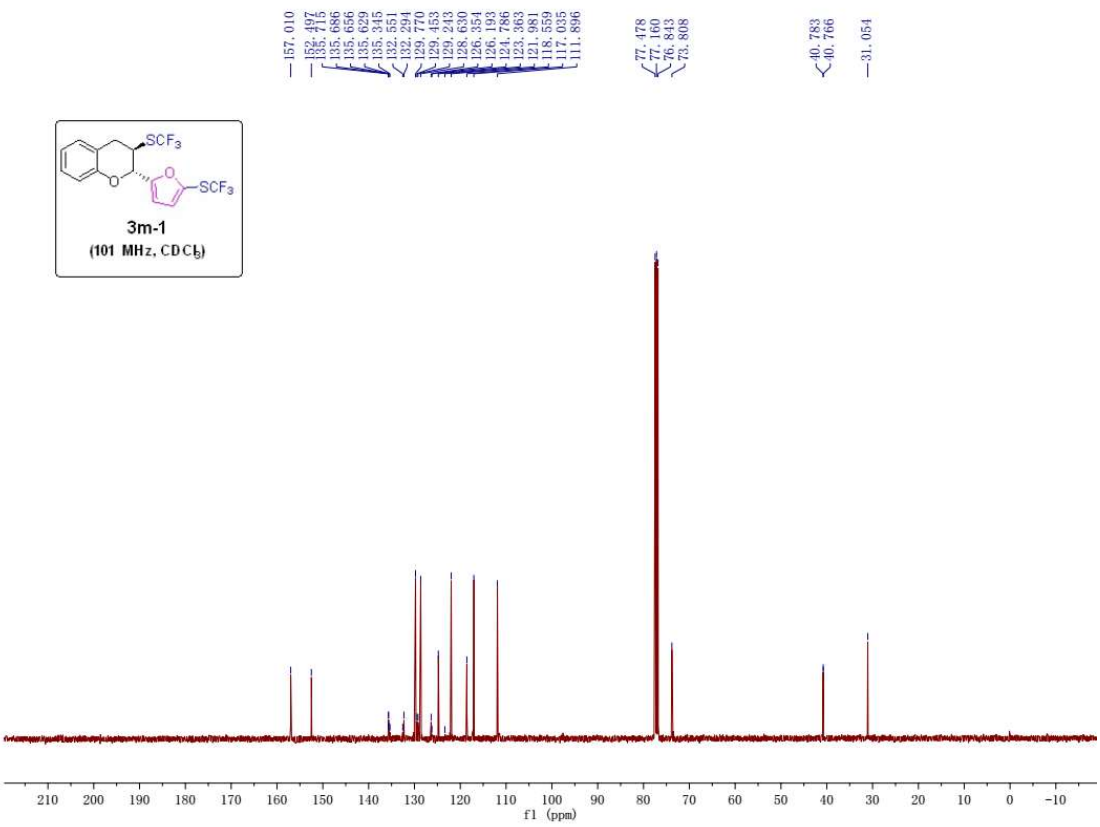
4m
(400 MHz, $CDCl_3$)

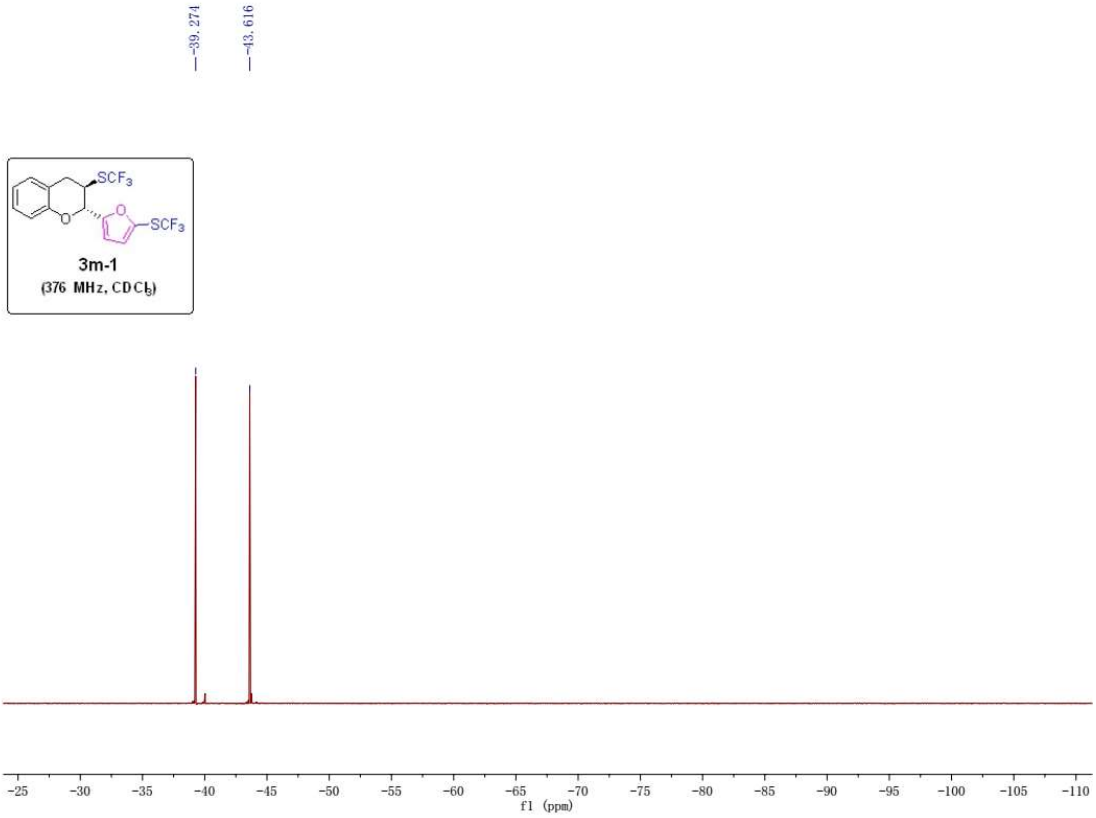


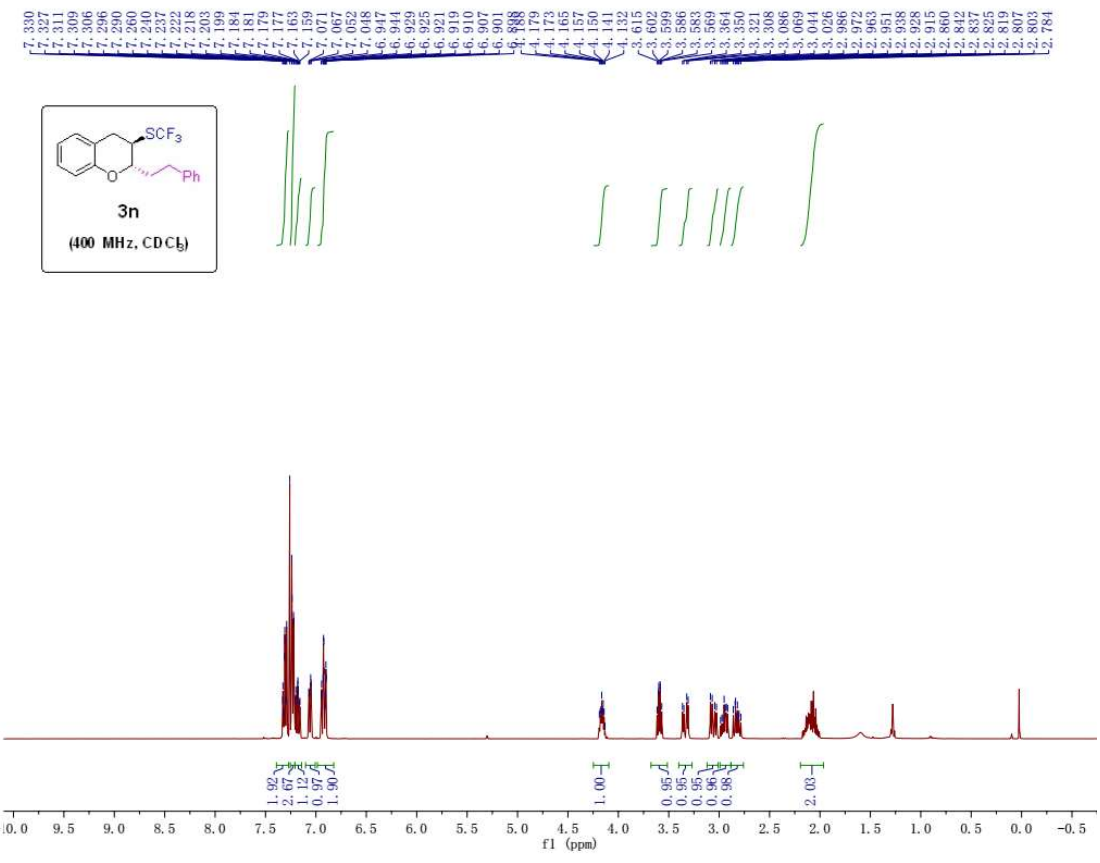

158.731
153.782
133.183
133.156
133.126
133.099
132.597
131.140
130.829
129.497
128.178
126.395
125.542
125.194
123.293
121.271
119.091
115.748
109.058
77.478
77.160
76.842
33.563
SCF3
OH
4m
(101 MHz, CDCl3)
f1 (ppm)

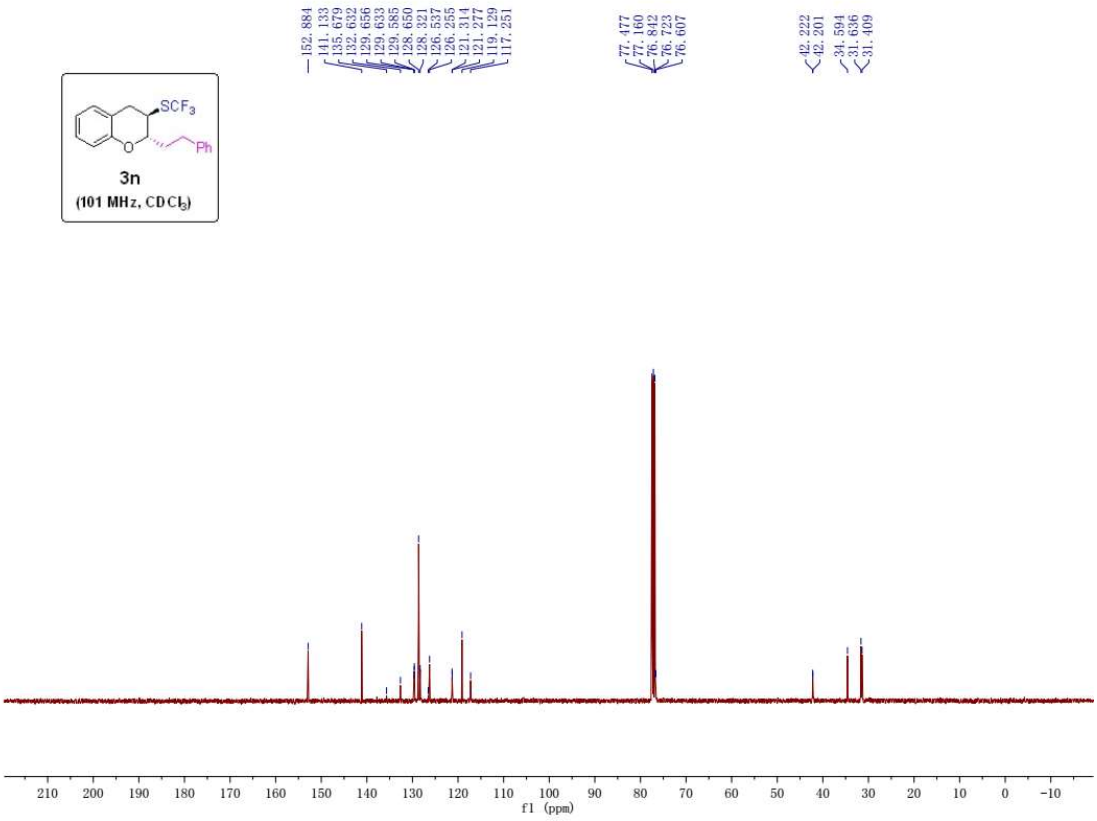

-43.929
SCF3
OH
4m
(376 MHz, CDCl3)
f1 (ppm)

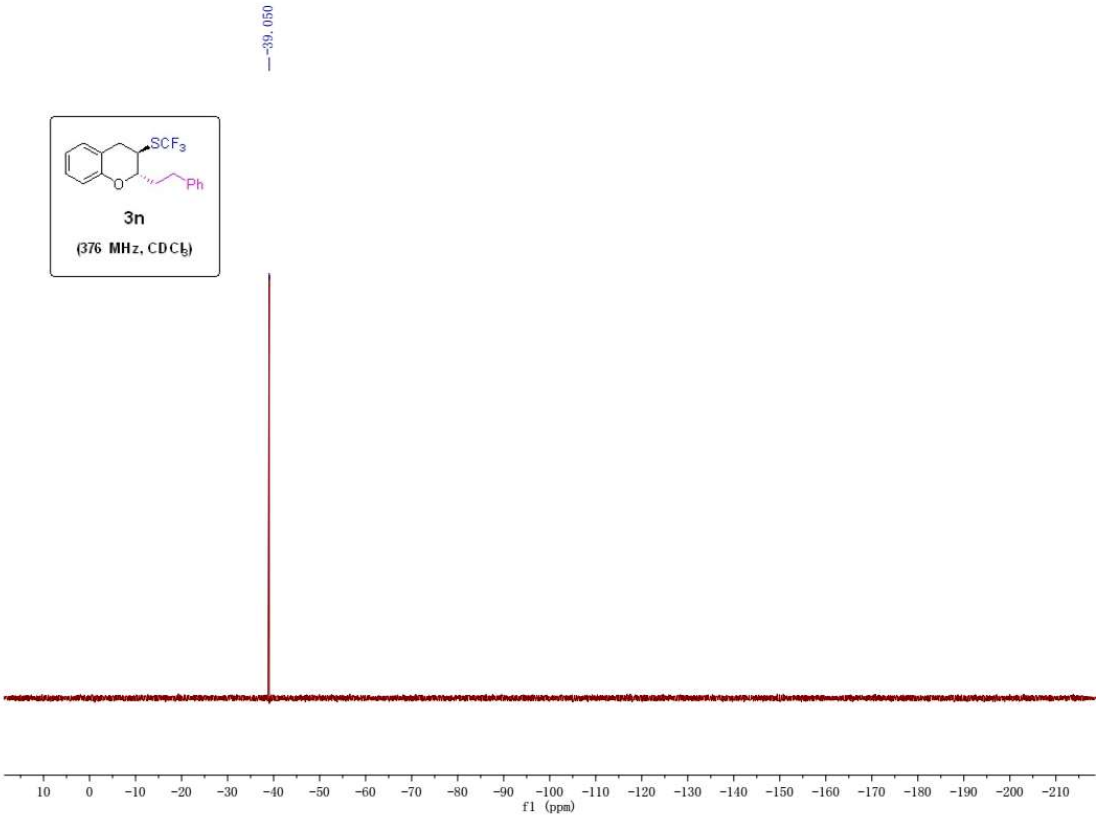

7.260
7.190
7.187
7.185
7.183
7.169
7.165
7.056
7.054
7.051
7.038
7.036
7.032
6.966
6.963
6.947
6.944
6.941
6.938
6.925
6.921
6.918
6.880
6.433
6.431
6.424
6.422
5.321
5.308
5.306
5.304
4.146
4.133
4.130
4.117
4.115
4.102
3.238
3.225
3.196
3.182
3.093
3.077
3.050
3.034
SCF3
SCF3
3m-1
(400 MHz, CDCl3)
1.04
0.99
2.06
0.96
1.00
1.03
1.09
1.06
1.06
f1 (ppm)

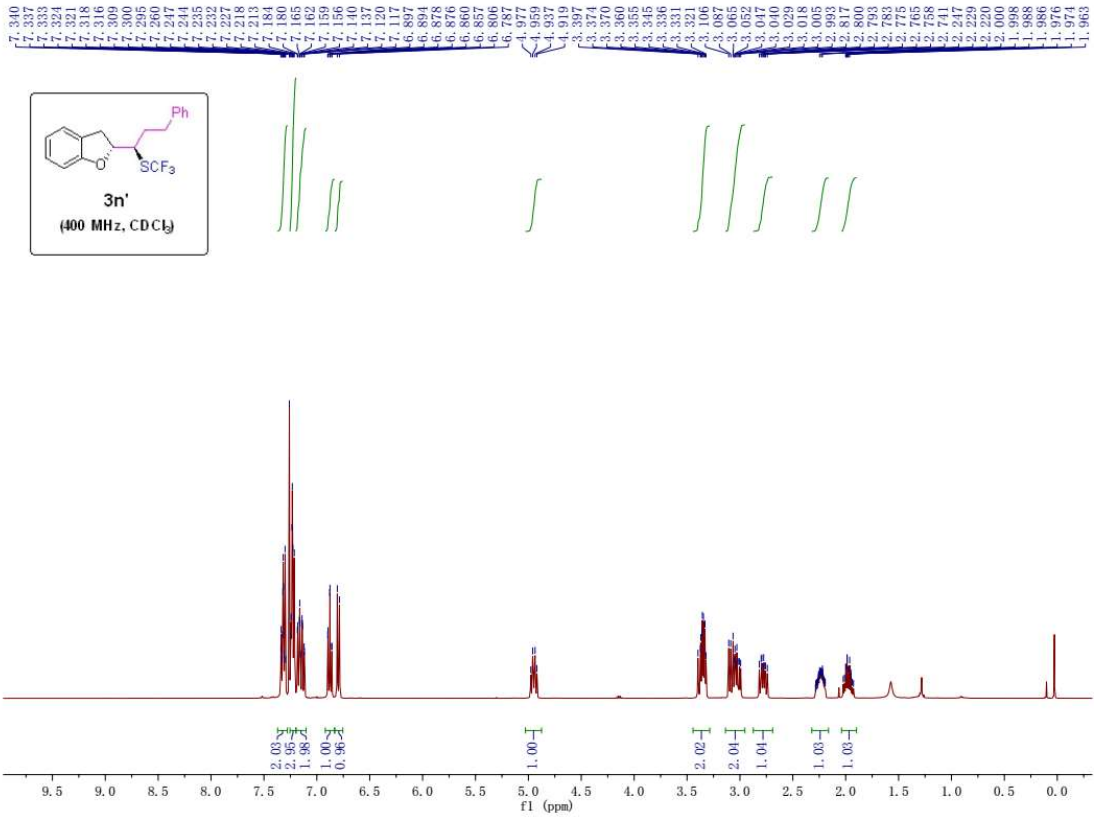

157.010
152.497
135.686
135.656
135.629
135.345
132.551
132.294
129.770
129.453
129.243
128.630
126.554
126.193
124.786
123.563
121.981
118.559
117.035
111.896
77.478
77.160
76.843
73.808
40.783
40.766
31.054
SCF3
SCF3
3m-1
(101 MHz, CDCl3)
f1 (ppm)

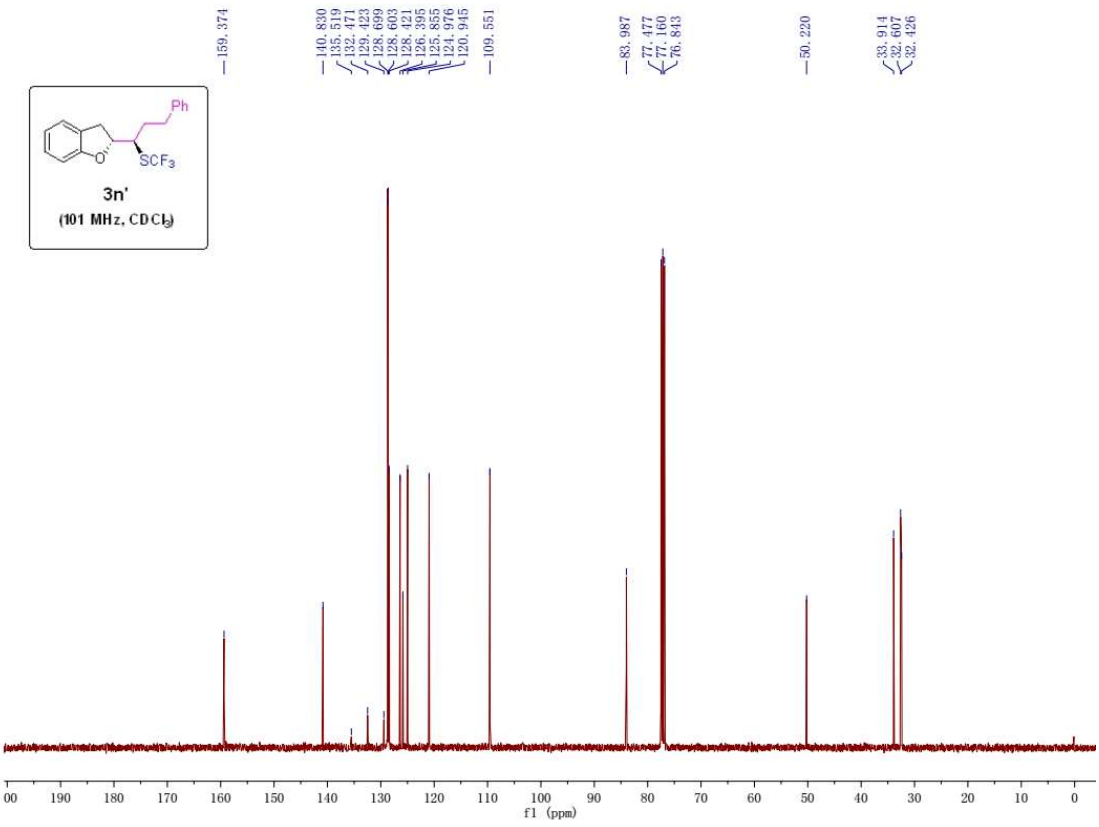

-39.274
-43.616
SCF3
SCF3
3m-1
(376 MHz, CDCl3)
f1 (ppm)

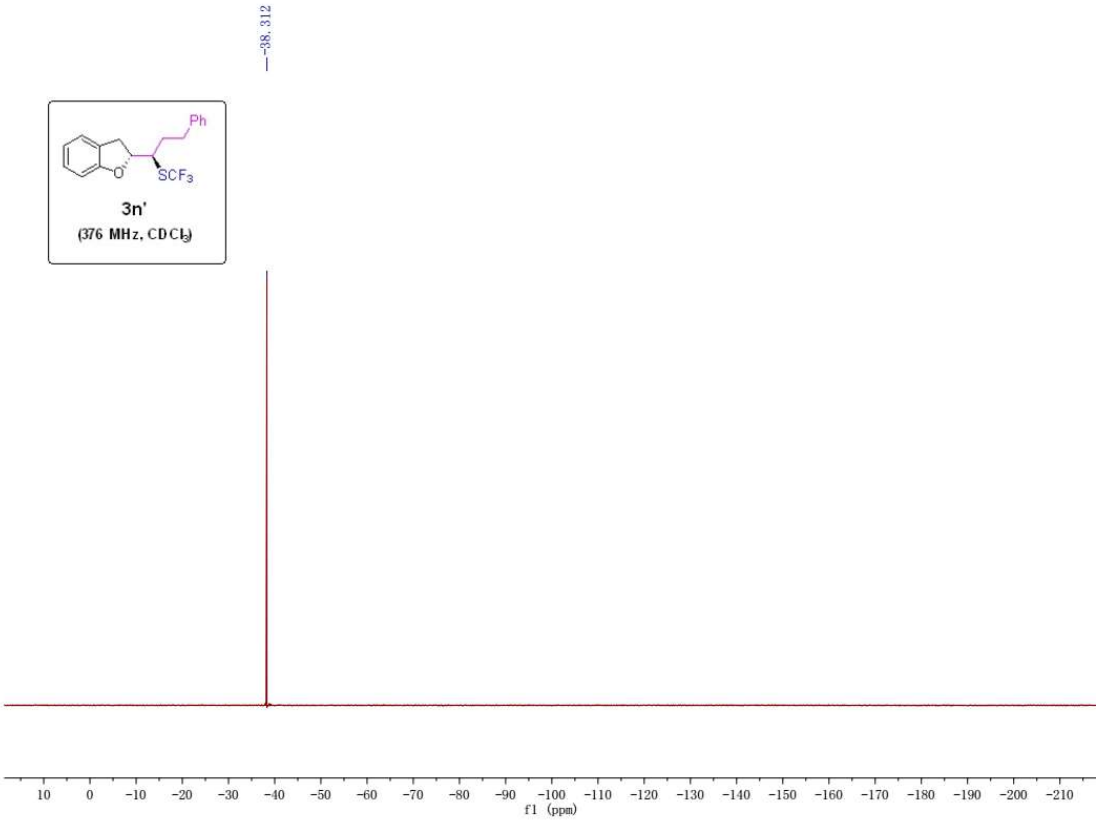

SCF3
Ph
3n
(400 MHz, CDCl3)
f1 (ppm)

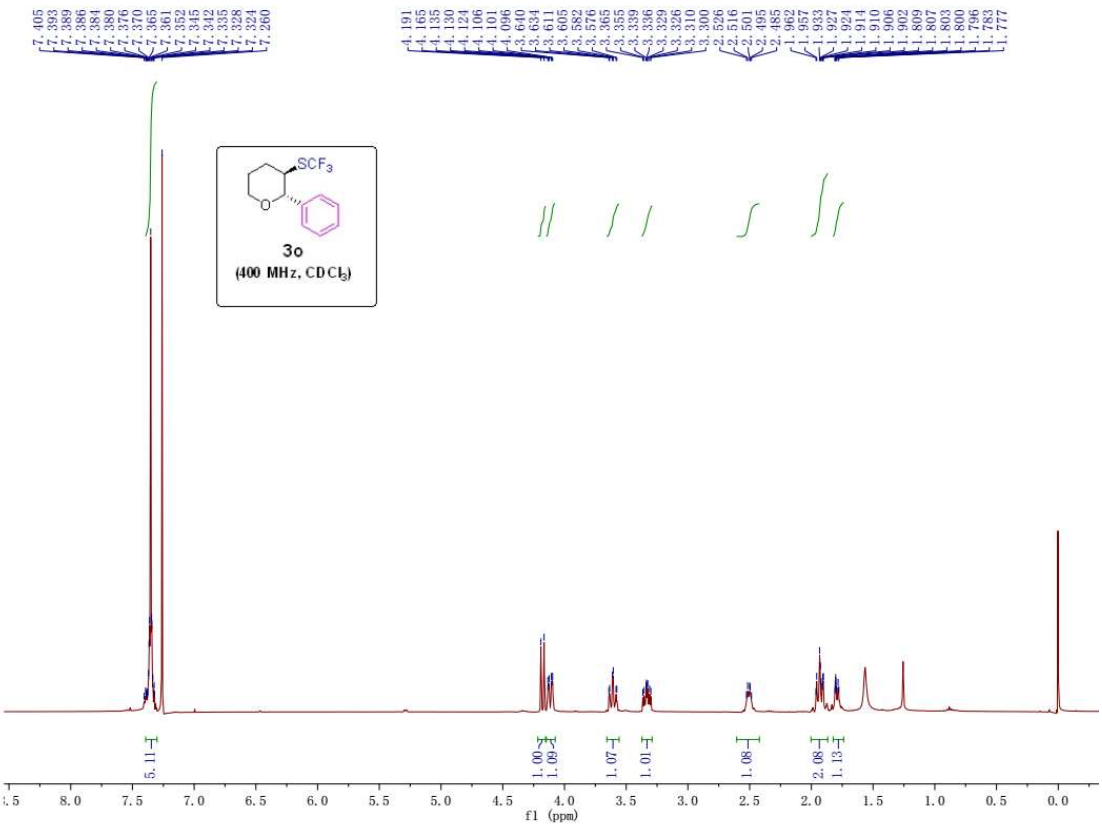

152.884
141.133
135.679
132.632
129.656
129.633
129.585
128.650
128.321
126.537
126.255
121.314
121.277
119.129
117.251
77.477
77.160
76.842
76.723
76.607
42.222
42.201
34.594
31.636
31.409
SCF3
Ph
3n
(101 MHz, CDCl3)
f1 (ppm)

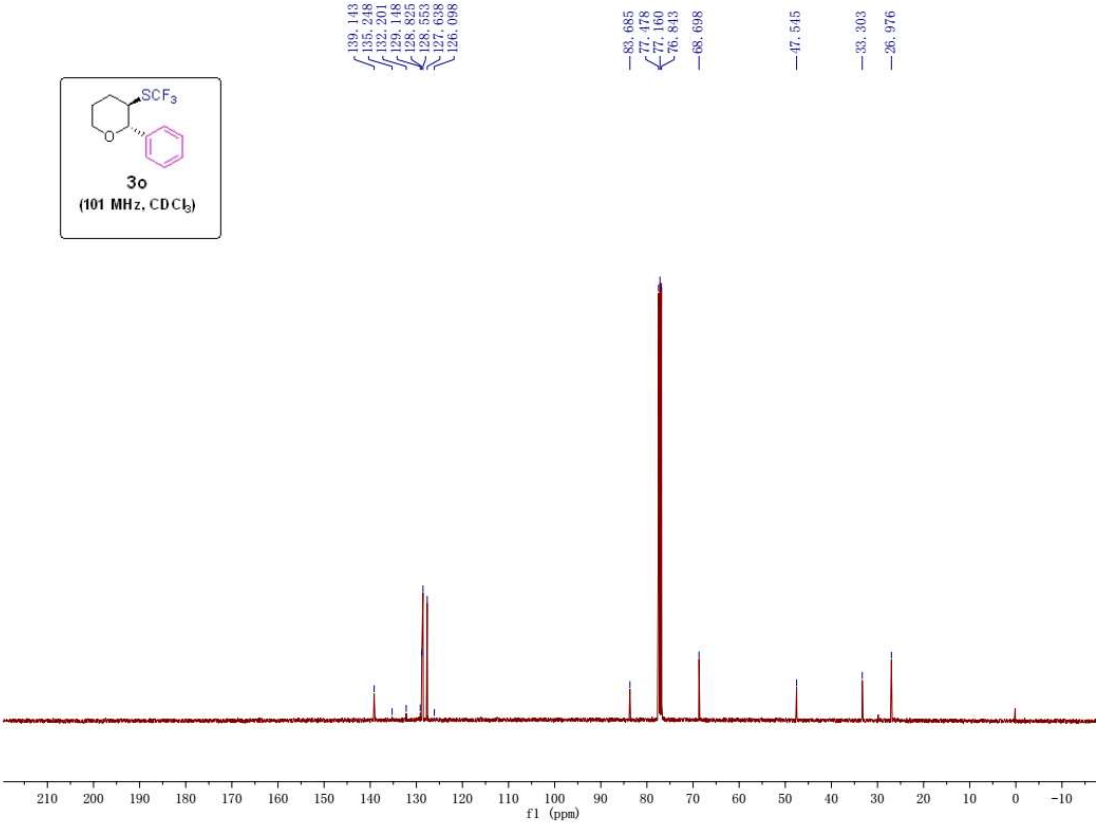

-39.050
SCF3
Ph
3n
(376 MHz, CDCl3)
f1 (ppm)

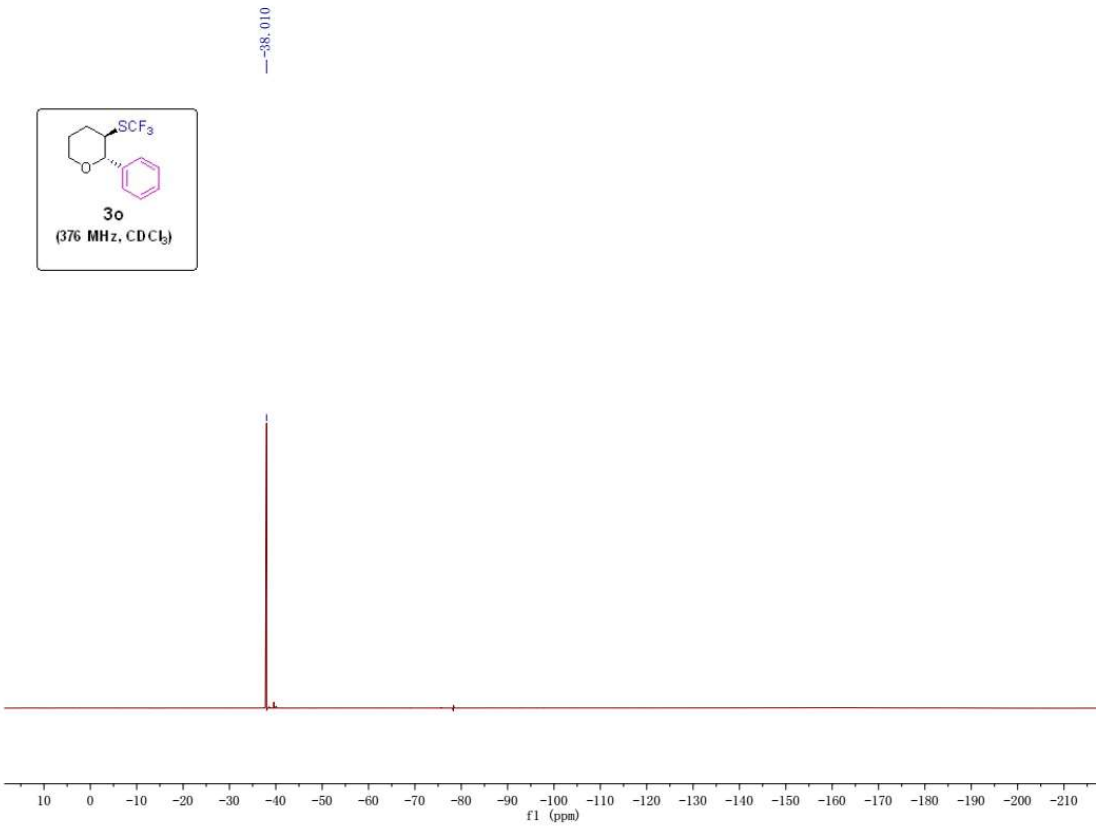

Ph
SCF3
3n'
(400 MHz, CDCl3)
f1 (ppm)

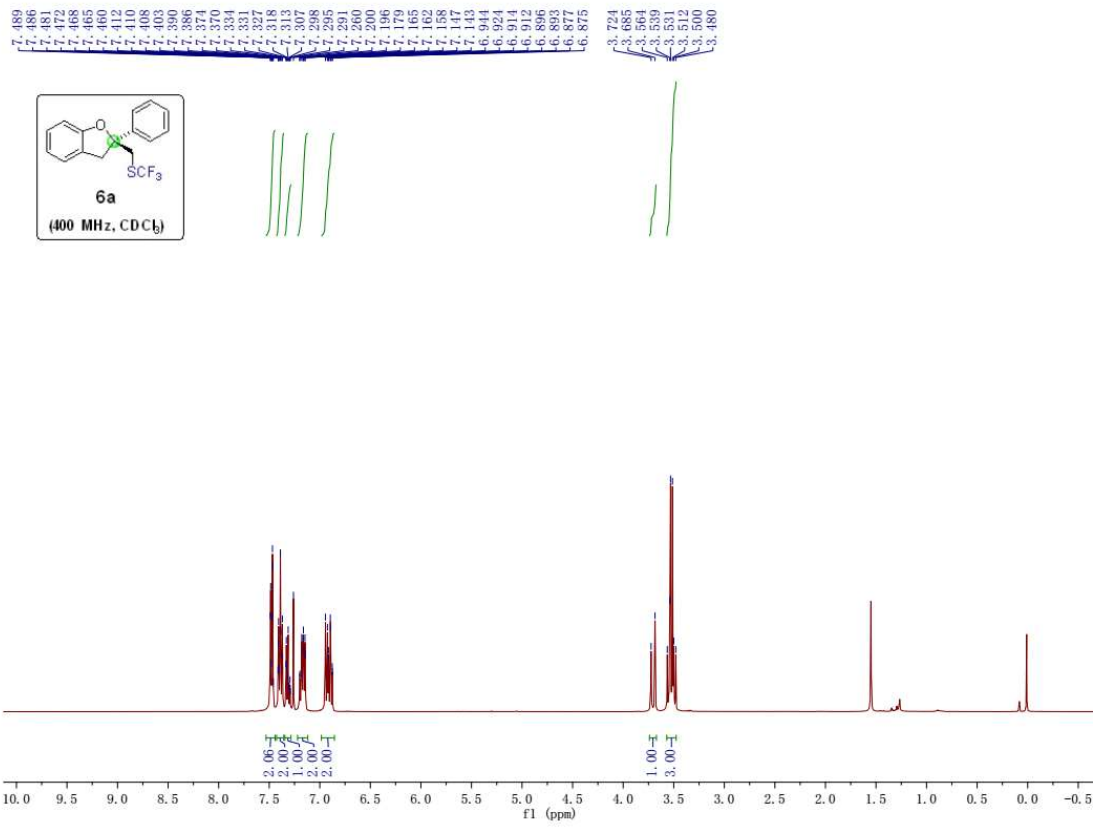

Ph
SCF3
3n'
(101 MHz, CDCl3)
f1 (ppm)

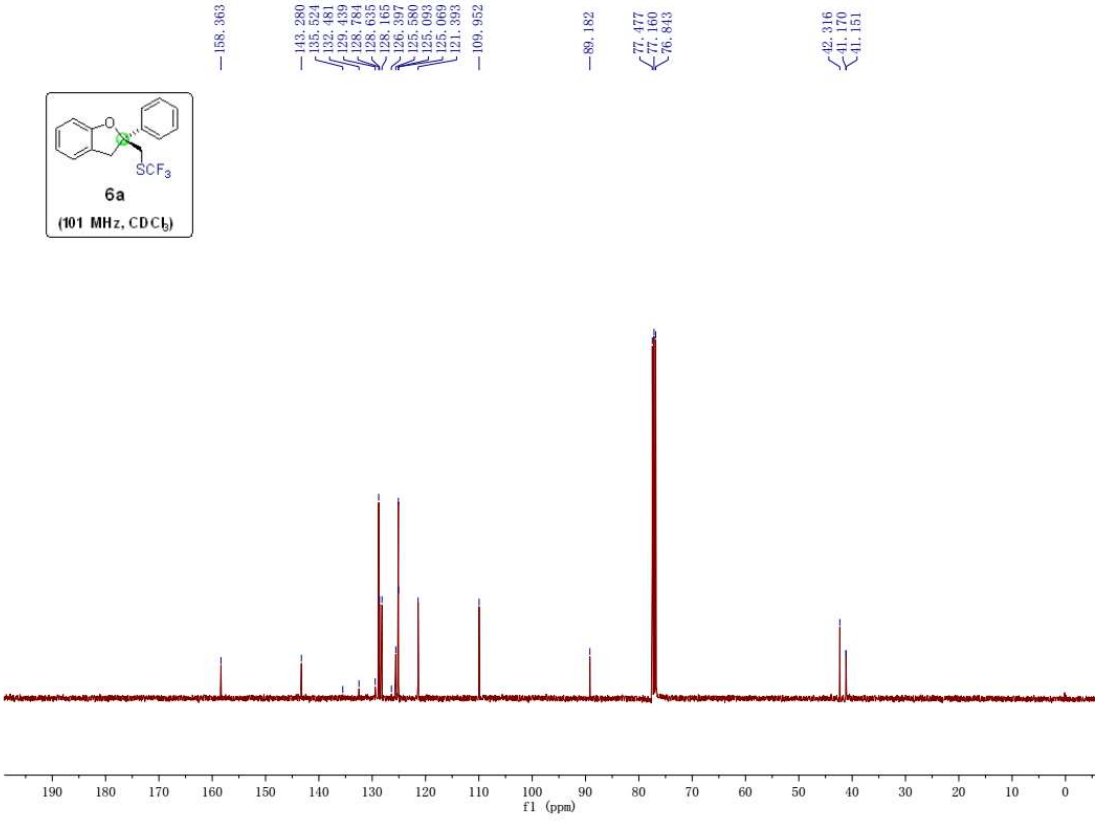

-38.312
Ph
SCF3
3n'
(376 MHz, CDCl3)
f1 (ppm)

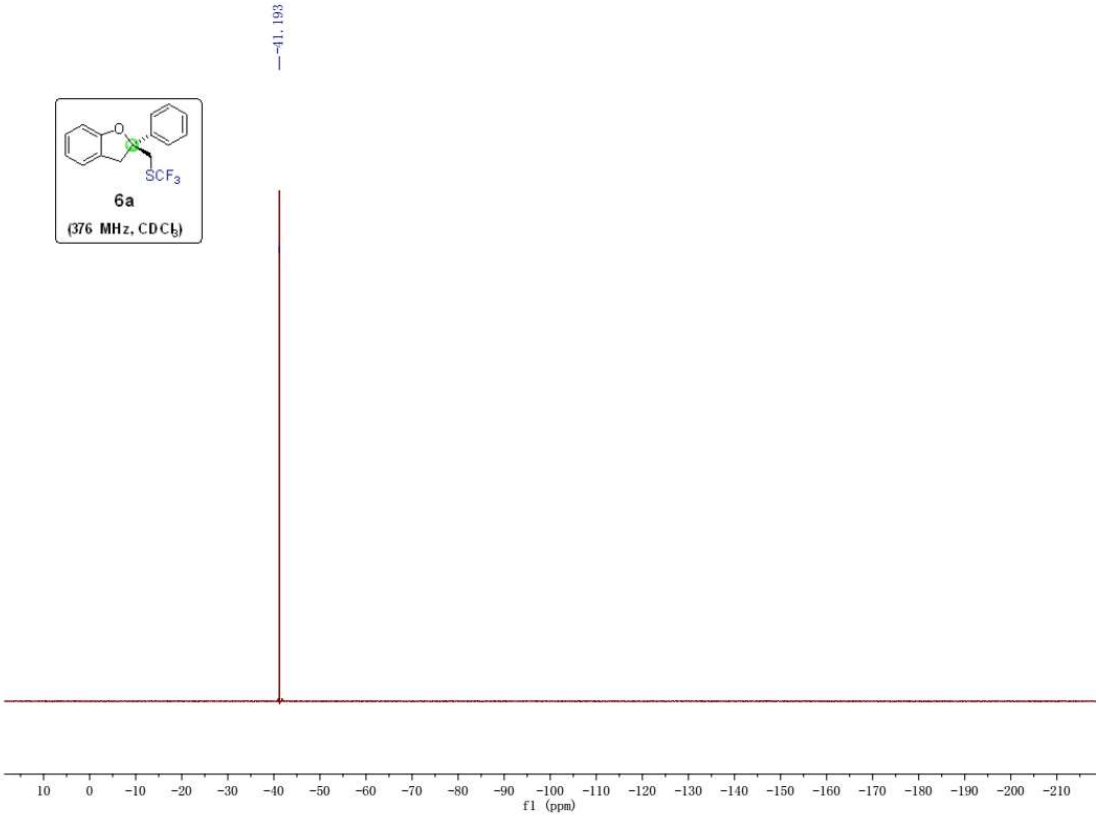

SCF3
3o
(400 MHz, CDCl3)
5.11
1.00
1.09
1.07
1.01
1.08
2.08
1.13
f1 (ppm)

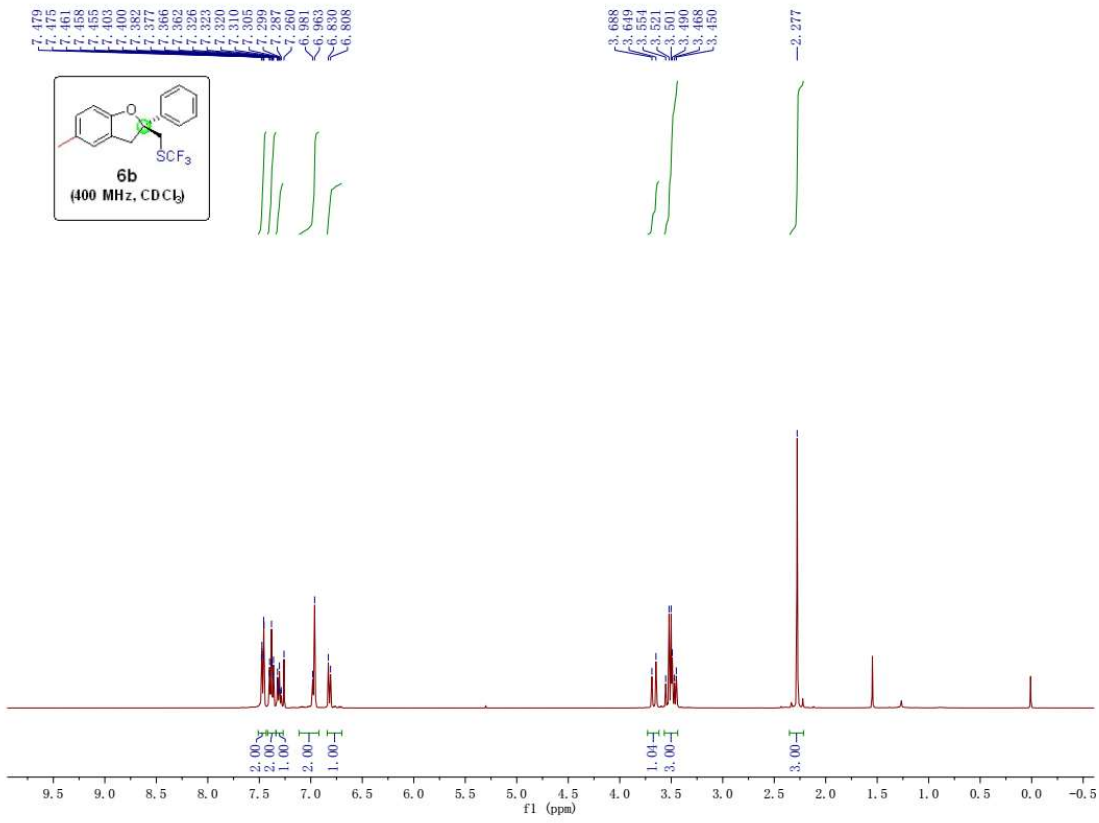

139.143
135.248
132.201
129.148
128.825
128.553
127.638
126.098
83.685
77.478
77.160
76.843
68.698
47.545
33.303
26.976
SCF3
3o
(101 MHz, CDCl3)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

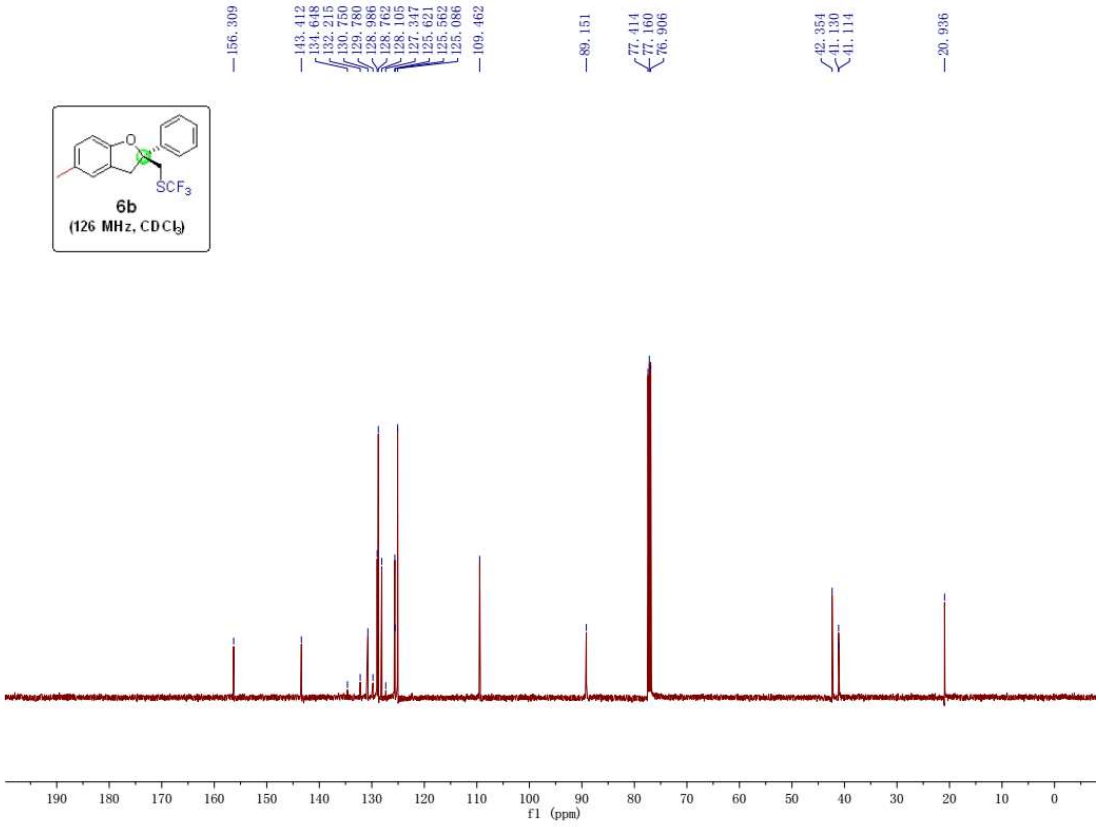

-38.010
SCF3
3o
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

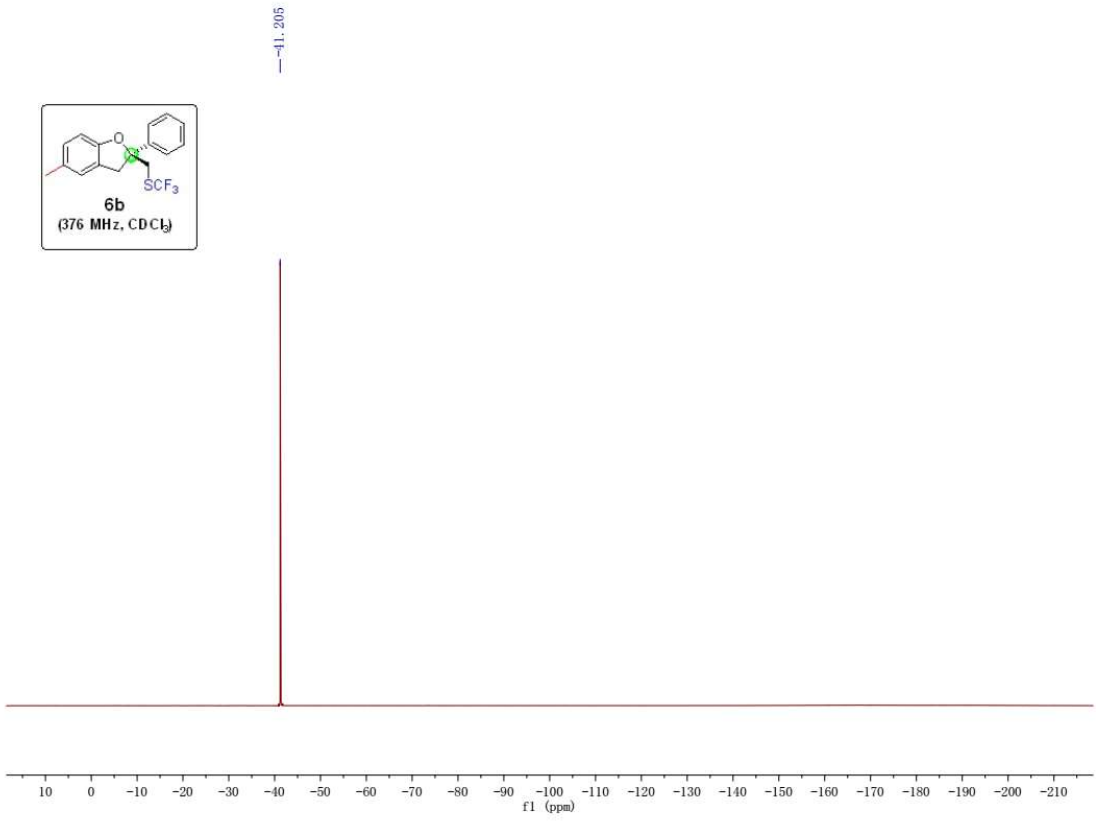

7.489
7.486
7.481
7.472
7.468
7.465
7.460
7.412
7.410
7.408
7.403
7.390
7.386
7.374
7.370
7.334
7.331
7.327
7.318
7.313
7.307
7.298
7.295
7.291
7.260
7.200
7.196
7.179
7.165
7.162
7.158
7.147
7.143
6.944
6.924
6.914
6.912
6.896
6.893
6.877
6.875
3.724
3.685
3.564
3.539
3.531
3.512
3.500
3.480
SCF3
6a
(400 MHz, CDCl3)
2.06
2.00
1.00
2.00
2.00
1.00
3.00
f1 (ppm)

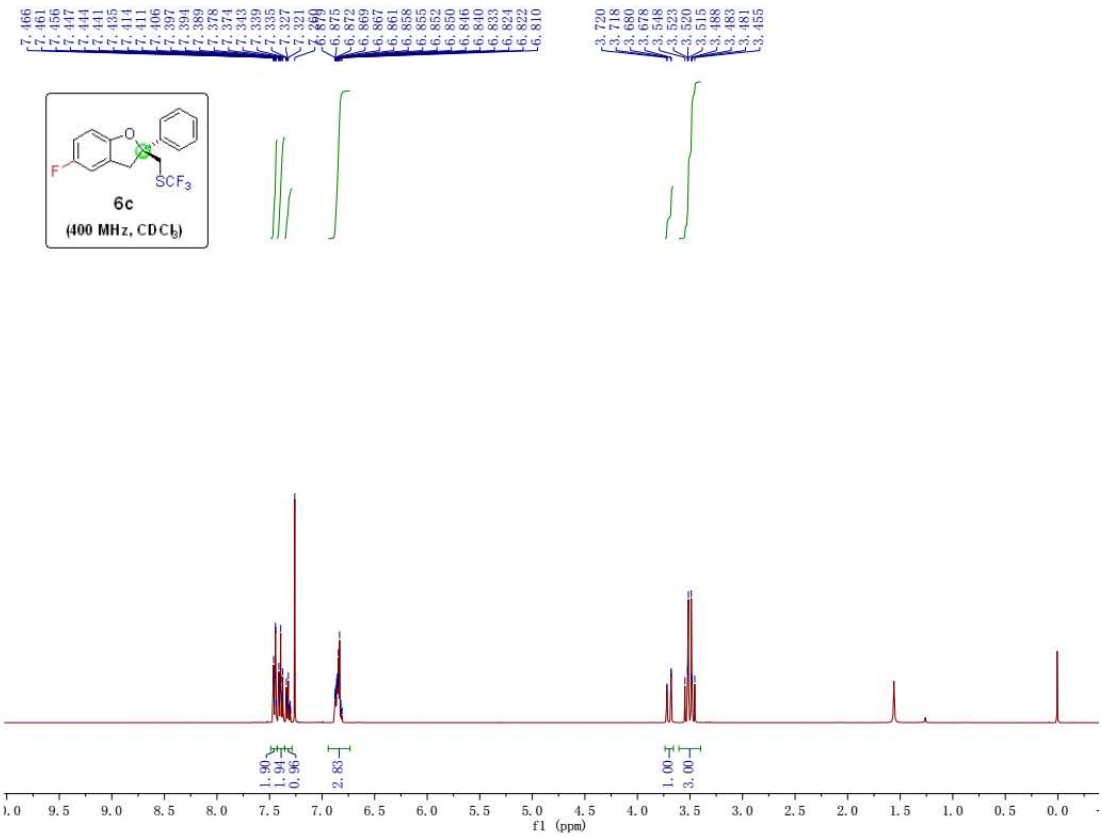

158.363
143.280
135.524
132.481
129.439
128.784
128.635
128.165
126.397
125.580
125.093
125.069
121.393
109.952
89.182
77.477
77.160
76.843
42.316
41.170
41.151
SCF3
6a
(101 MHz, CDCl3)
f1 (ppm)

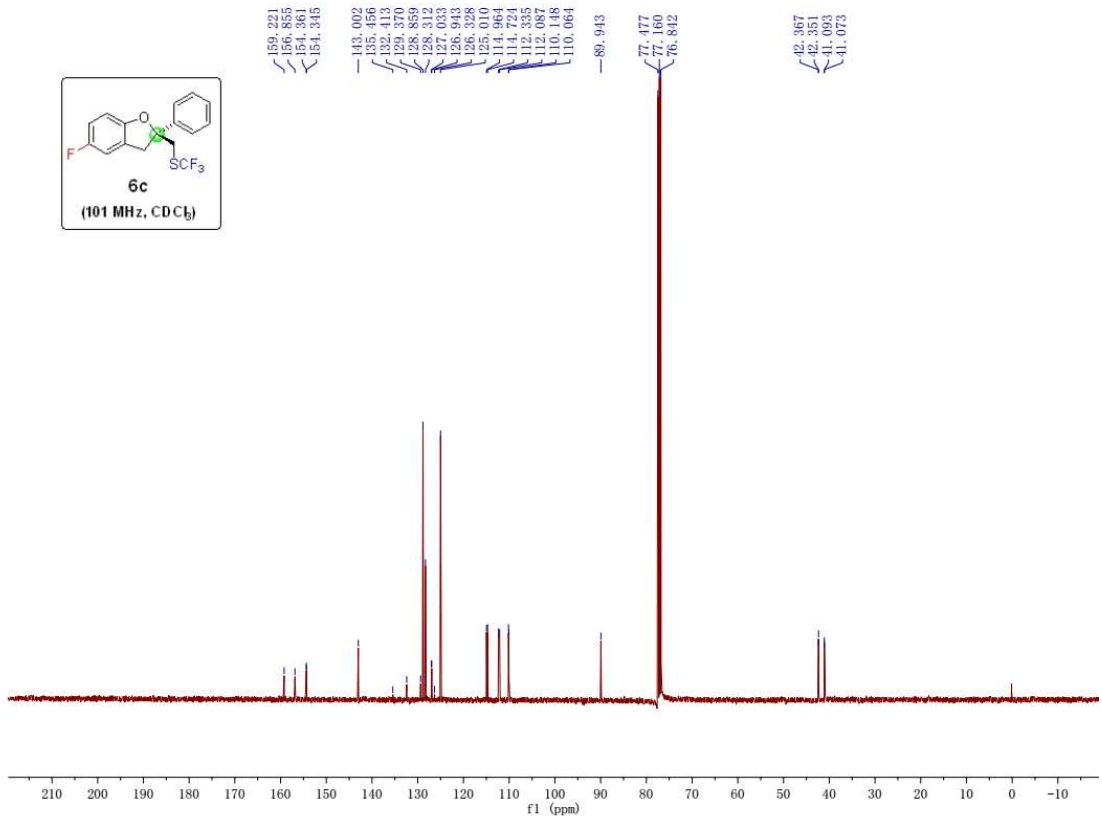

-41.193
SCF3
6a
(376 MHz, CDCl3)
f1 (ppm)

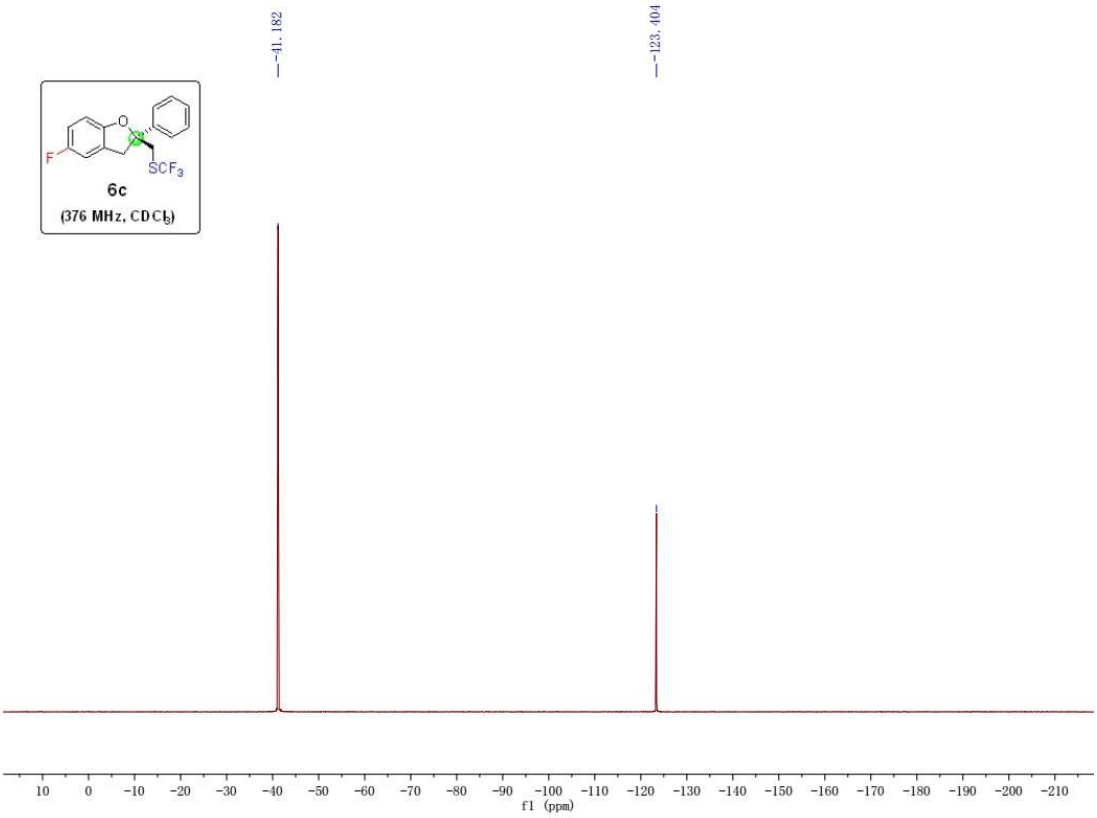

7.479
7.475
7.461
7.458
7.455
7.403
7.400
7.382
7.377
7.366
7.362
7.326
7.323
7.320
7.310
7.305
7.299
7.287
7.260
6.981
6.963
6.830
6.808
3.688
3.649
3.554
3.521
3.501
3.490
3.468
3.450
2.277
SCF3
6b
(400 MHz, CDCl3)
2.00
2.00
1.00
2.00
1.00
1.04
3.00
3.00
f1 (ppm)

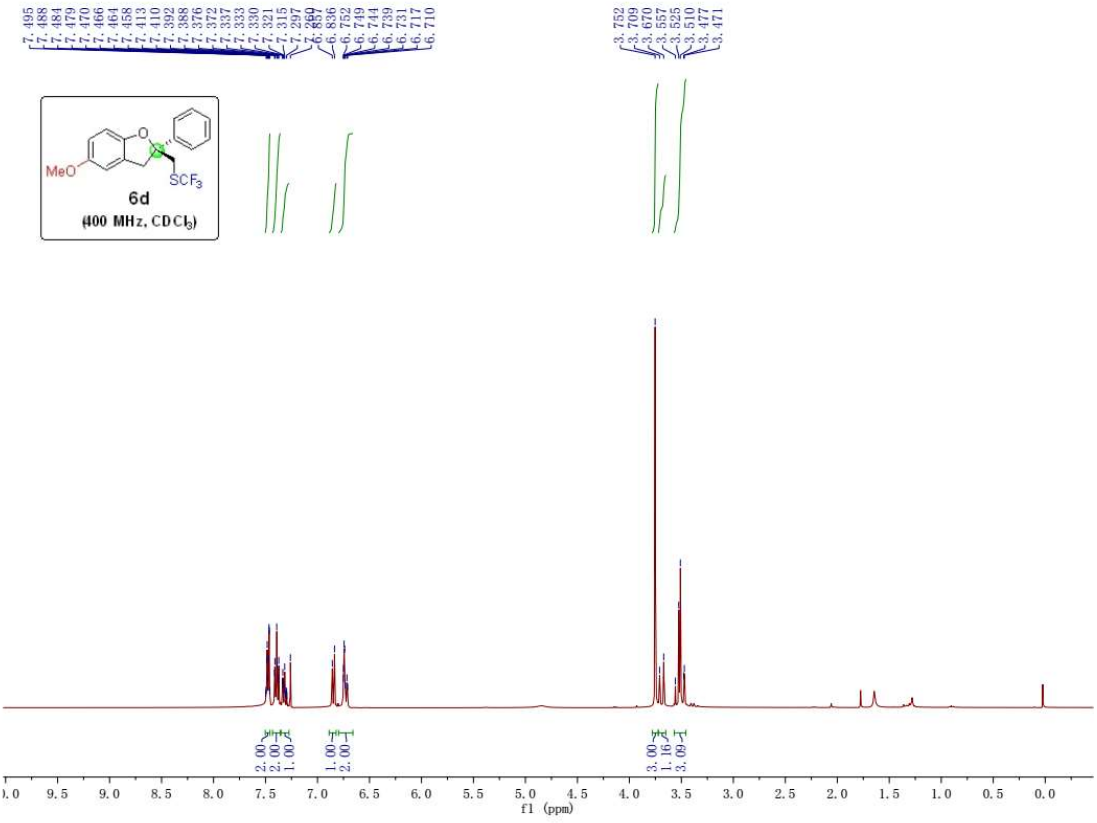

156.309
143.412
134.648
132.215
130.750
129.780
128.986
128.762
128.105
127.347
125.621
125.562
125.086
109.462
89.151
77.414
77.160
76.906
42.354
41.130
41.114
20.936
SCF3
6b
(126 MHz, CDCl3)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

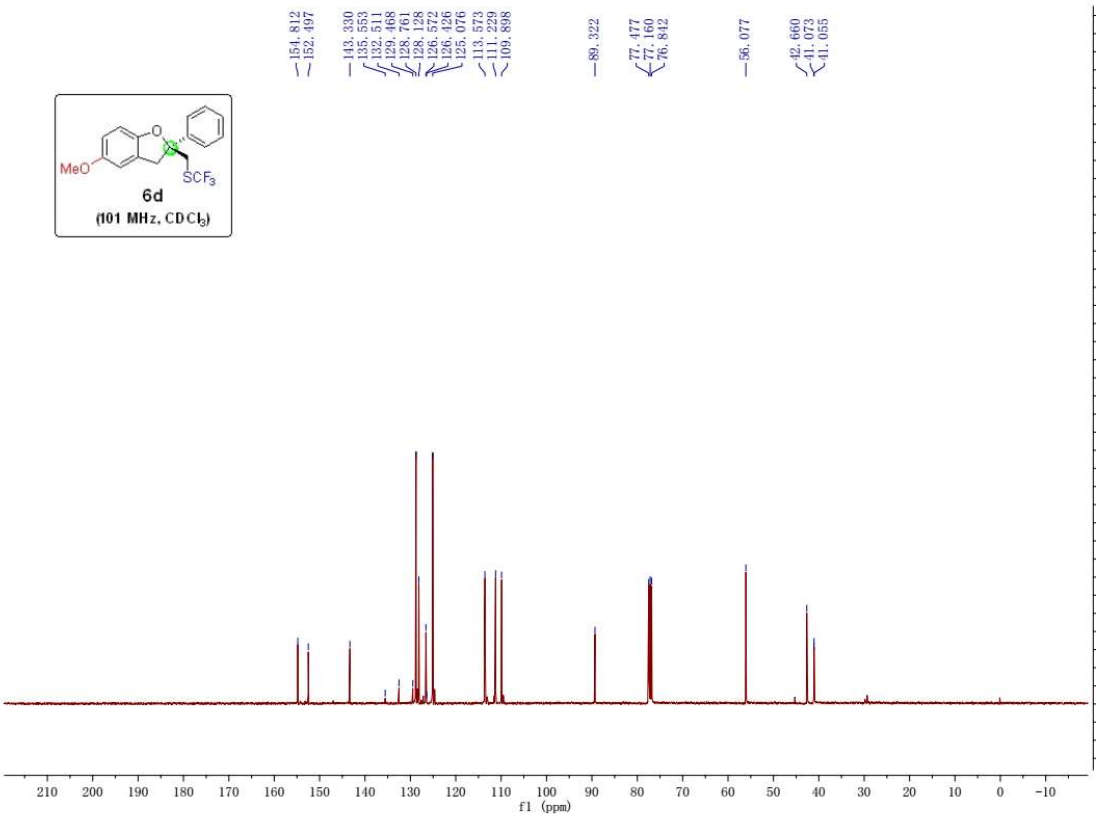

-41.205
SCF3
6b
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

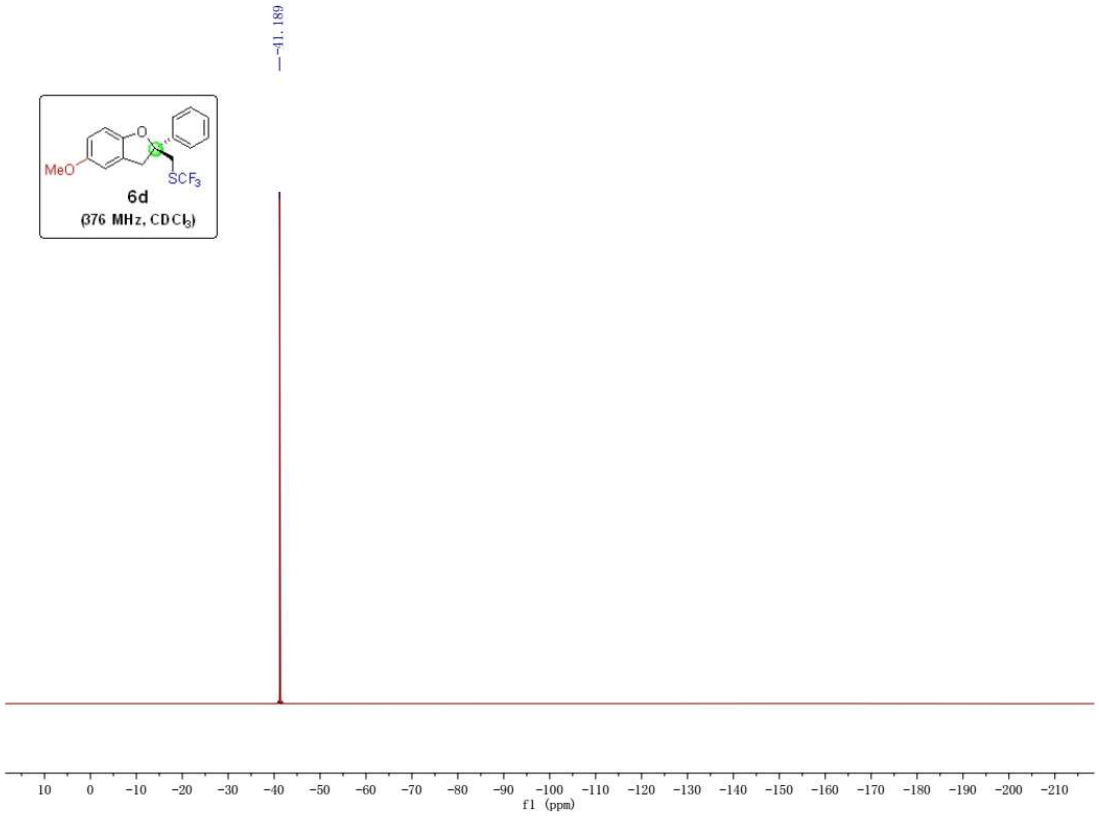

7.466
7.461
7.456
7.447
7.444
7.441
7.435
7.414
7.411
7.406
7.397
7.394
7.389
7.378
7.374
7.343
7.339
7.335
7.327
7.321
6.875
6.872
6.869
6.867
6.861
6.858
6.855
6.852
6.850
6.846
6.840
6.833
6.824
6.822
6.810
3.720
3.718
3.680
3.678
3.548
3.523
3.520
3.515
3.488
3.483
3.481
3.455
F
O
SCF3
6c
(400 MHz, CDCl3)
1.90
1.94
0.96
2.83
1.00
3.00
f1 (ppm)

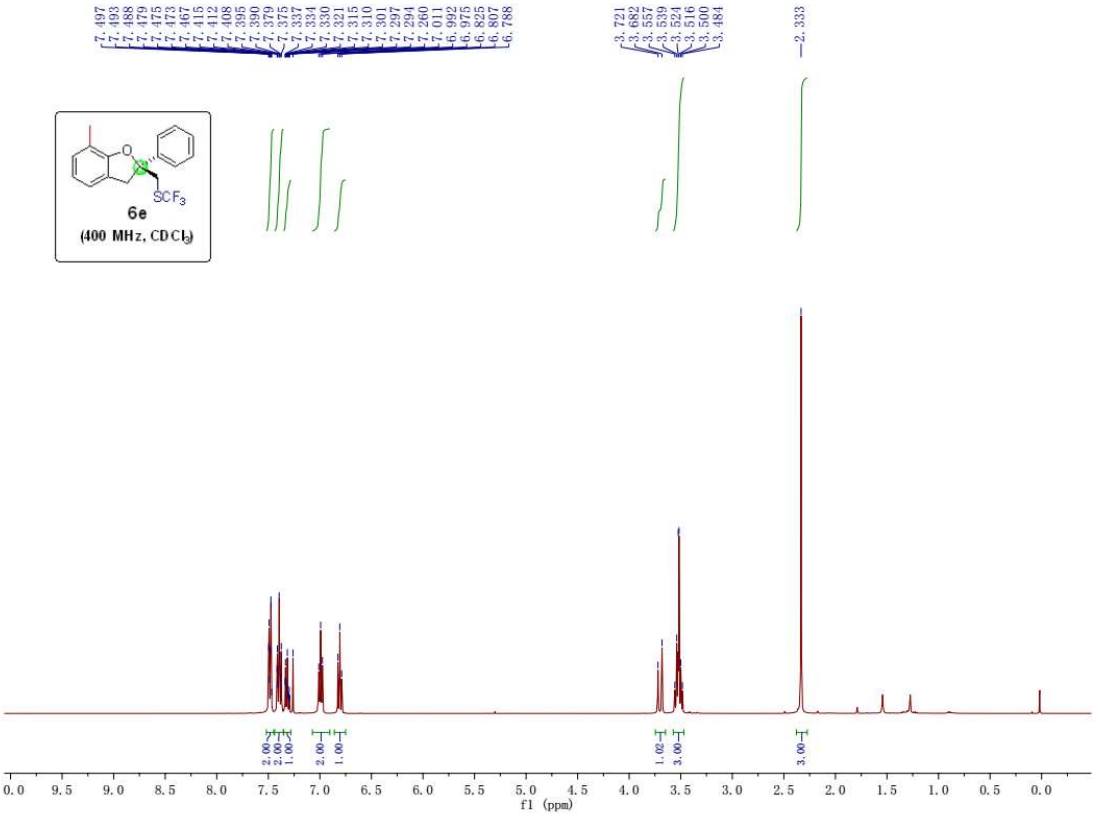

159.221
156.855
154.361
154.345
143.002
135.456
132.413
129.370
128.859
128.312
127.033
126.943
126.328
125.010
114.964
114.724
112.335
112.087
110.148
110.064
89.943
77.477
77.160
76.842
42.367
42.351
41.093
41.073
F
O
SCF3
6c
(101 MHz, CDCl3)
f1 (ppm)

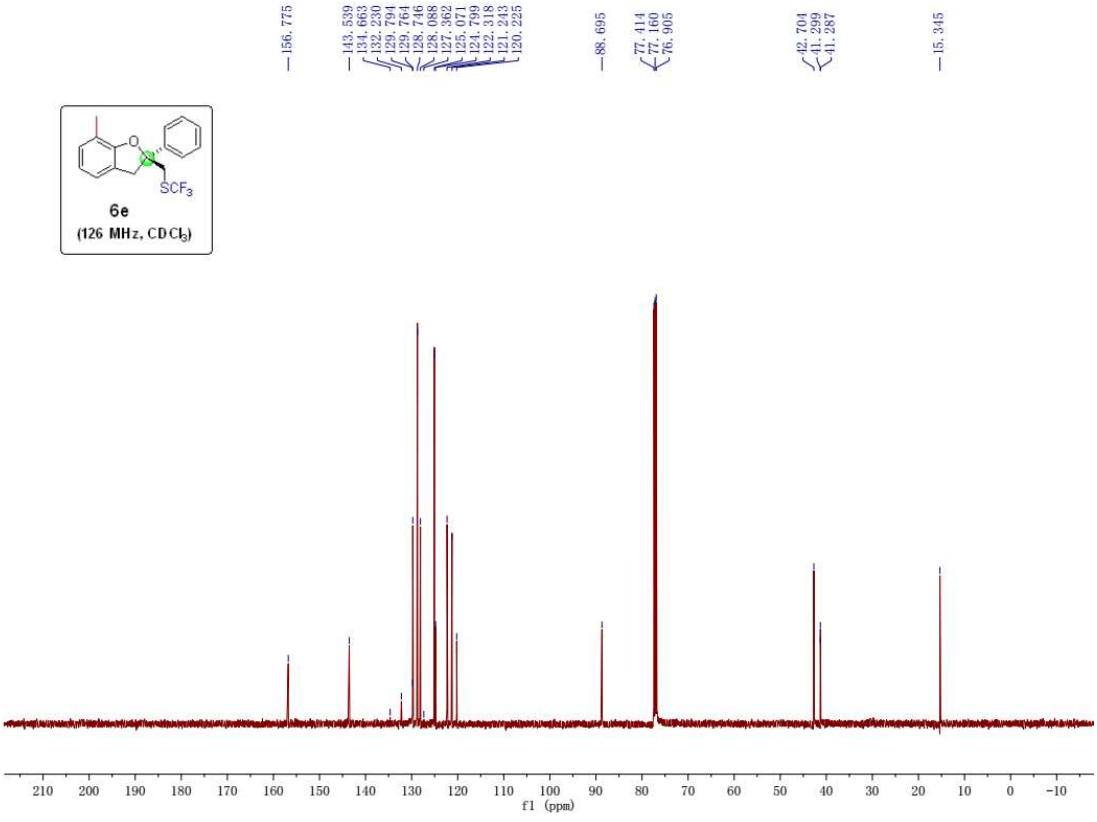

-41.182
-123.404
F
SCF3
6c
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

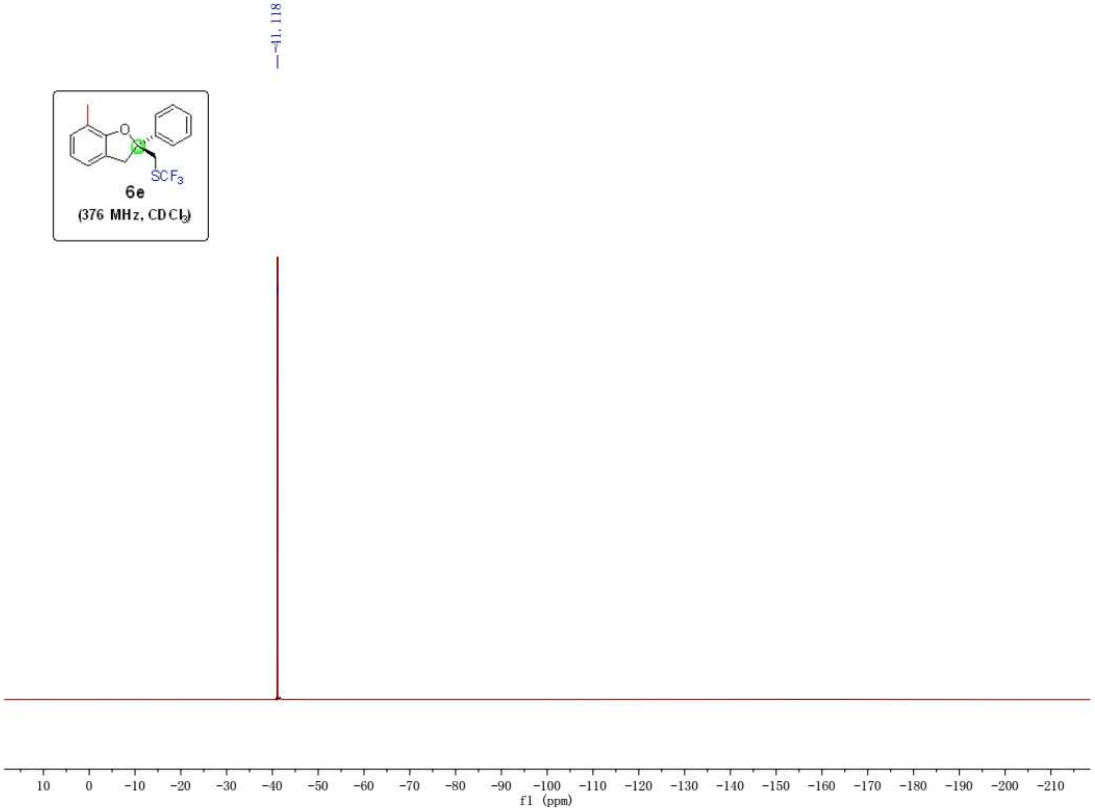

7.495 7.488 7.484 7.479 7.470 7.466 7.464 7.458 7.413 7.410 7.392 7.388 7.376 7.372 7.337 7.333 7.330 7.321 7.315 7.297 6.836 6.752 6.749 6.744 6.739 6.731 6.717 6.710
3.752 3.709 3.670 3.557 3.525 3.510 3.477 3.471
MeO
SCF3
6d
(400 MHz, CDCl3)
2.00 2.00 1.00 1.00 2.00 3.00 1.16 3.09
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

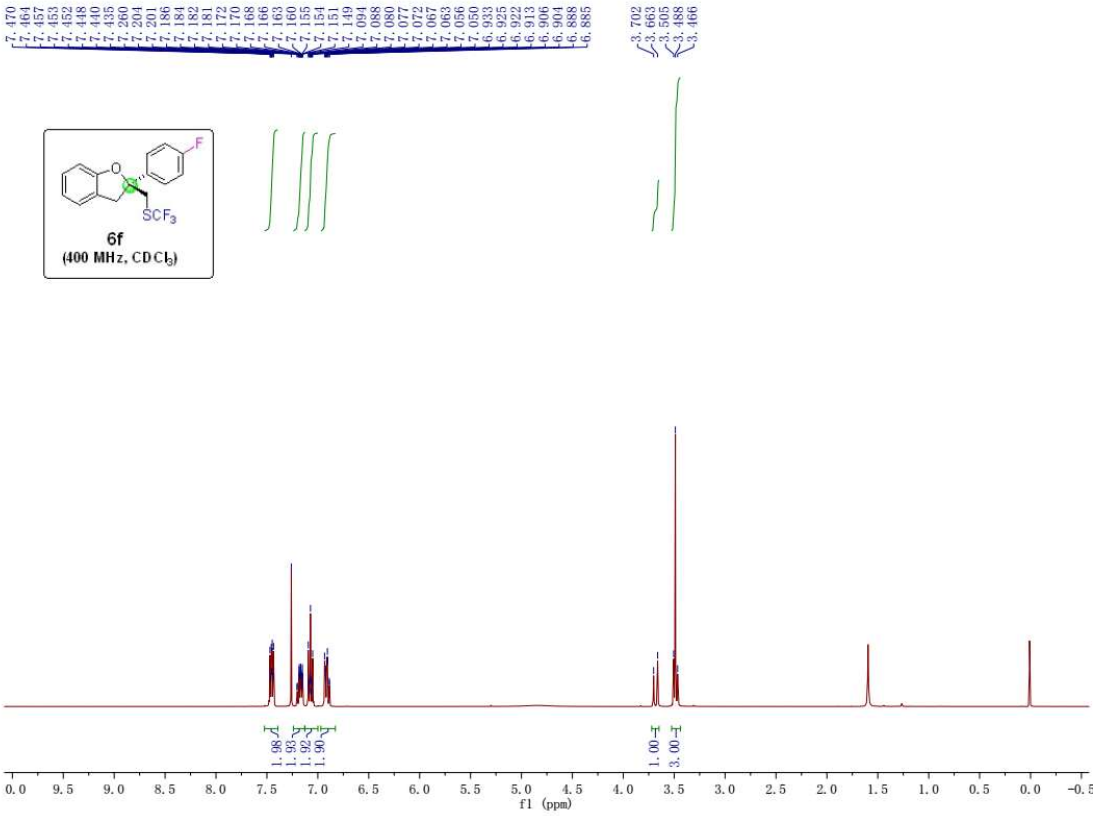

154.812
152.497
143.330
135.553
132.511
129.468
128.761
128.128
126.572
126.426
125.076
113.573
111.229
109.898
89.322
77.477
77.160
76.842
56.077
42.660
41.073
41.055
MeO
SCF3
6d
(101 MHz, CDCl3)
f1 (ppm)

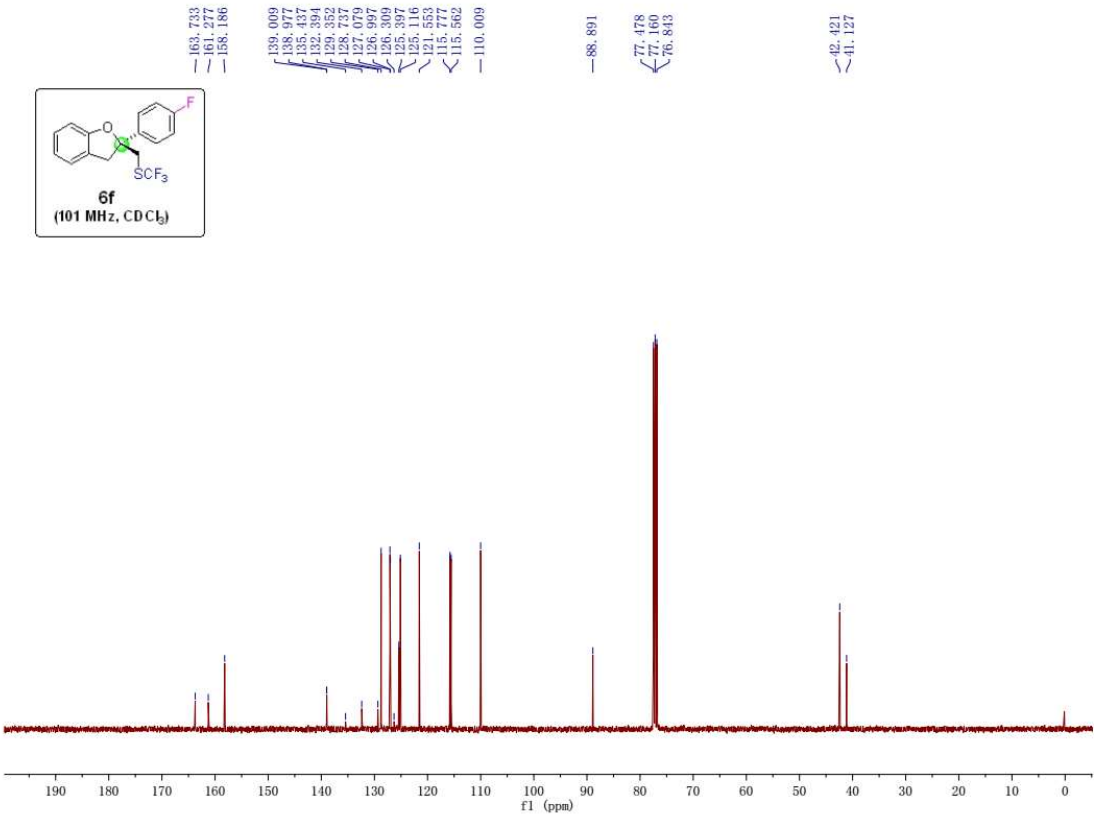

-41.189
MeO
SCF3
6d
(376 MHz, CDCl3)
f1 (ppm)

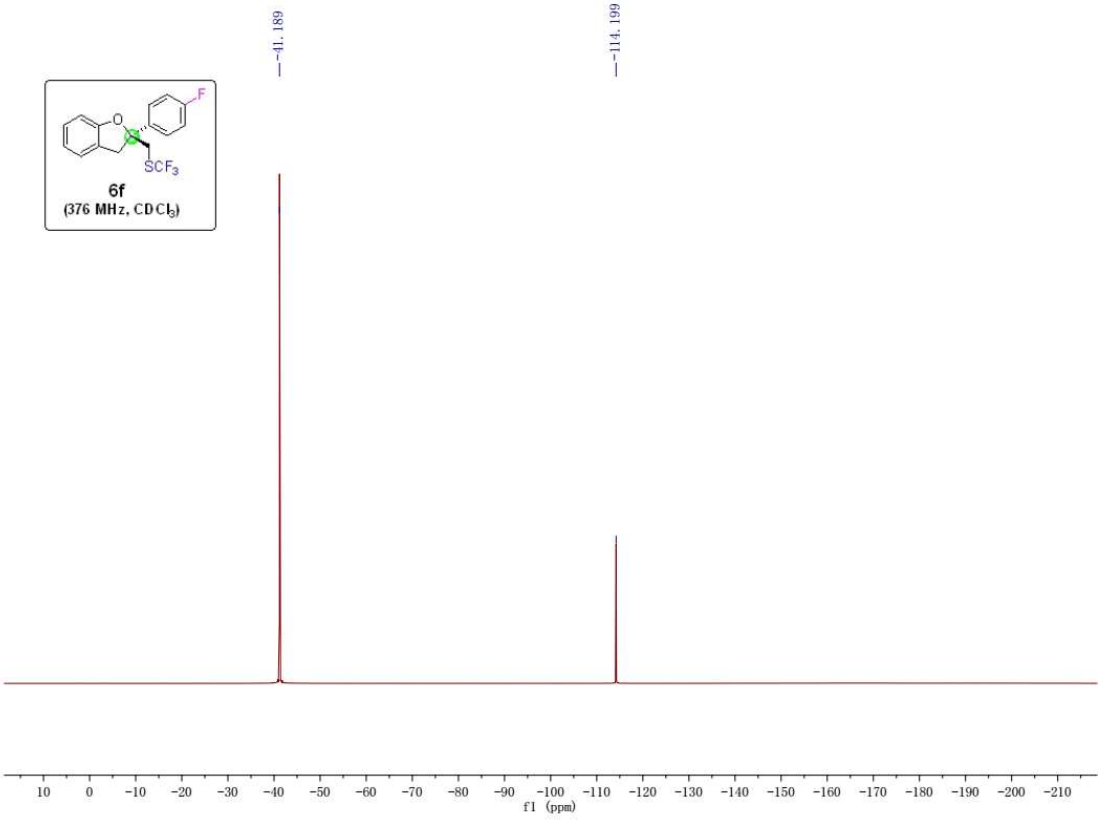

7.497
7.493
7.488
7.479
7.475
7.473
7.467
7.415
7.412
7.408
7.395
7.390
7.379
7.375
7.337
7.334
7.330
7.321
7.315
7.310
7.301
7.297
7.294
7.260
7.011
6.992
6.975
6.825
6.807
6.788
3.721
3.682
3.557
3.539
3.524
3.516
3.500
3.484
2.333
SCF3
6e
(400 MHz, CDCl3)
2.00
2.00
1.00
2.00
1.00
1.02
3.00
3.00
f1 (ppm)

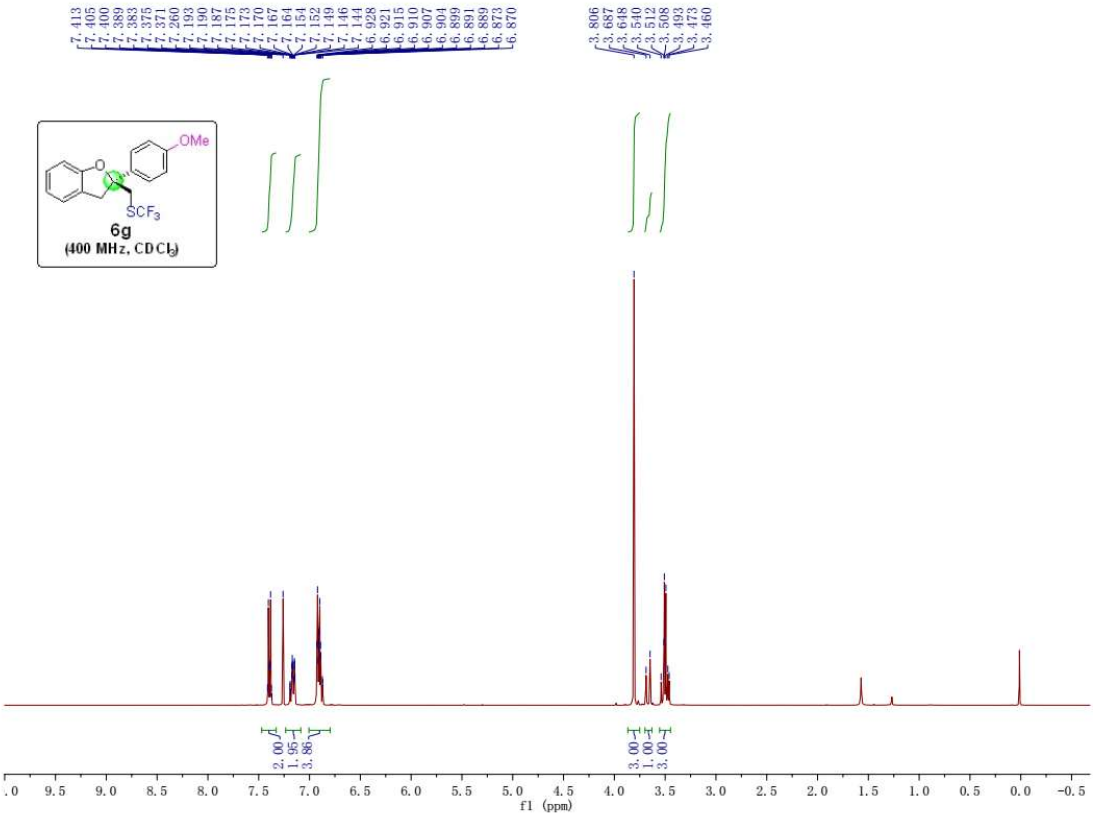

156.775
143.539
134.663
132.230
129.794
129.764
128.746
128.088
127.362
125.071
124.799
122.318
121.243
120.225
88.695
77.414
77.160
76.905
42.704
41.299
41.287
15.345
SCF3
6e
(126 MHz, CDCl3)
f1 (ppm)

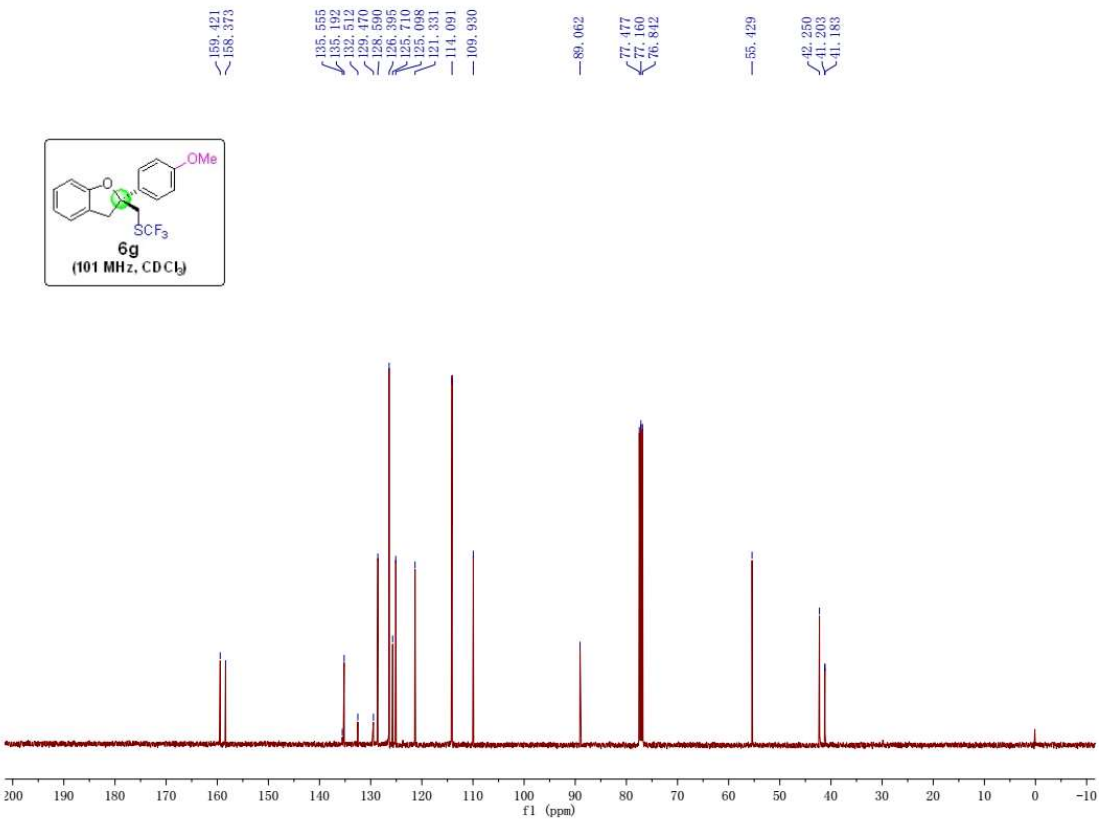

-41.118
6e
(376 MHz, CDCl3)
f1 (ppm)

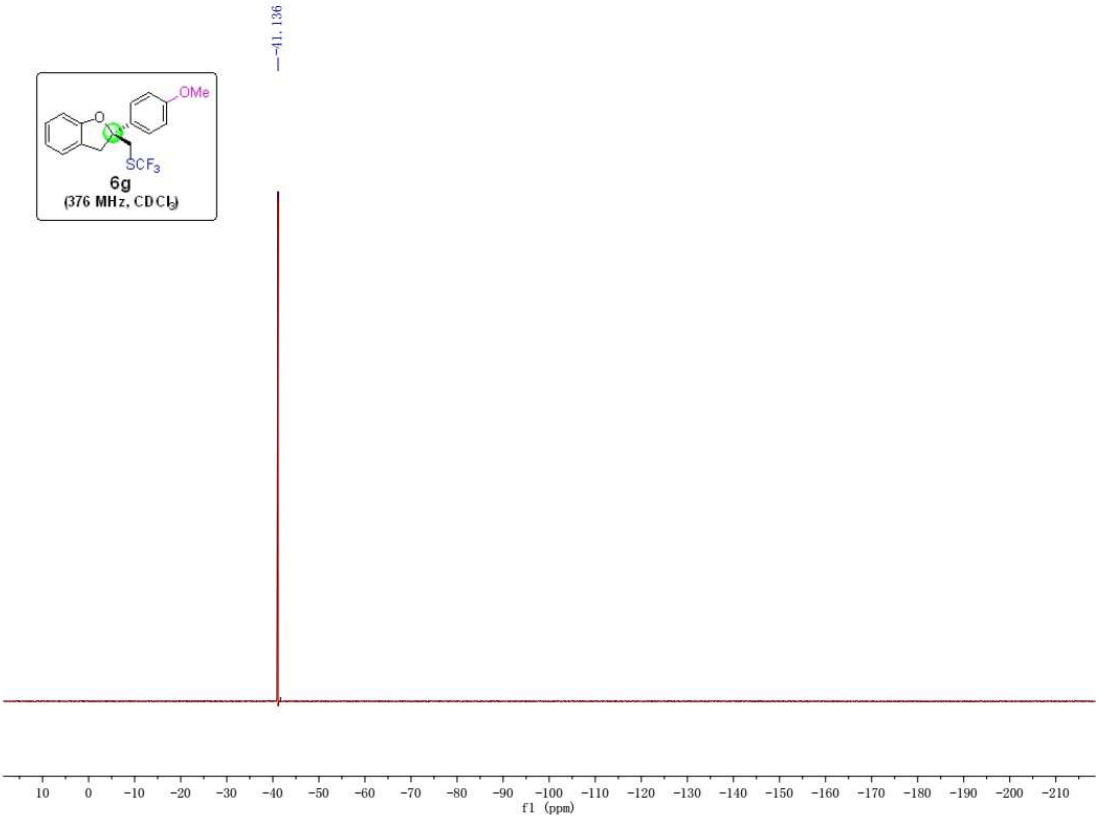

7.470
7.464
7.457
7.453
7.452
7.448
7.440
7.435
7.200
7.204
7.201
7.186
7.184
7.182
7.181
7.172
7.170
7.168
7.166
7.163
7.160
7.155
7.154
7.151
7.149
7.094
7.088
7.080
7.077
7.072
7.067
7.063
7.056
7.050
6.933
6.925
6.922
6.913
6.906
6.904
6.888
6.885
3.702
3.663
3.505
3.488
3.466
6f
(400 MHz, CDCl3)
1.98
1.93
1.92
1.90
1.00
3.00
f1 (ppm)

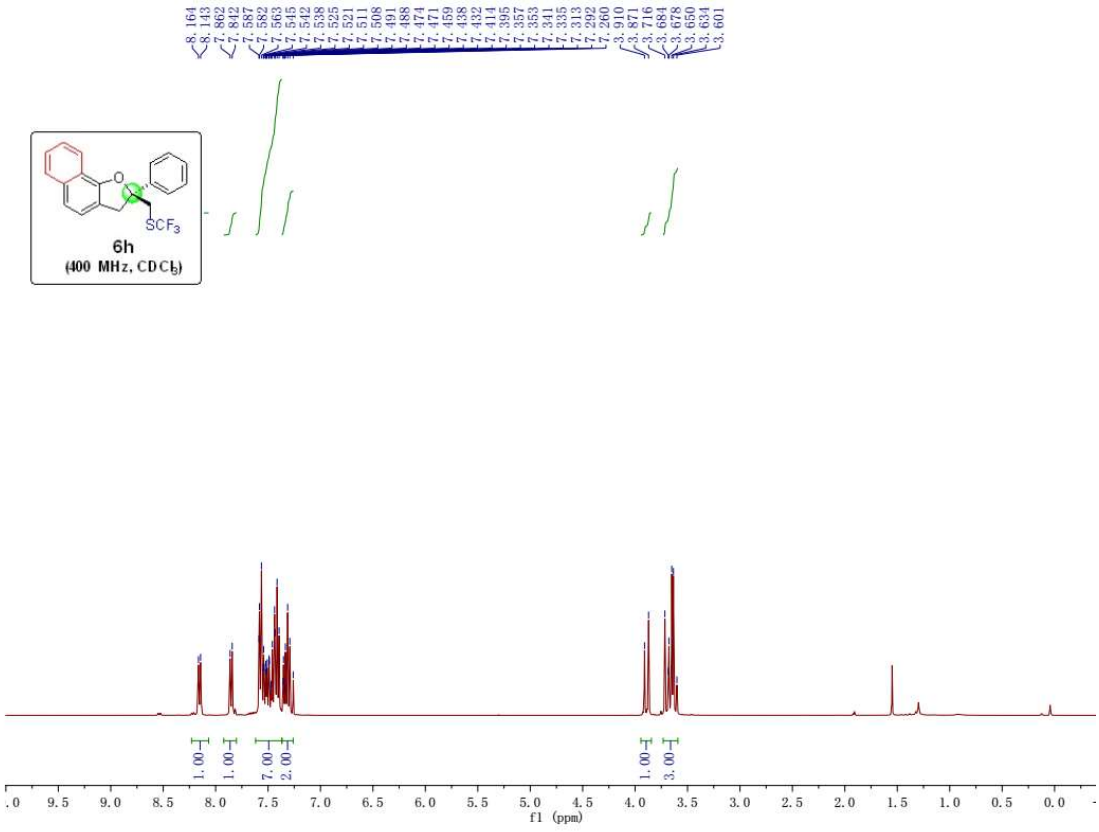

163.733
161.277
158.186
139.009
138.977
135.437
132.394
129.352
128.737
127.079
126.997
126.309
125.397
125.116
121.553
115.777
115.562
110.009
88.891
77.478
77.160
76.843
42.421
41.127
F
O
SCF3
6f
(101 MHz, CDCl3)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

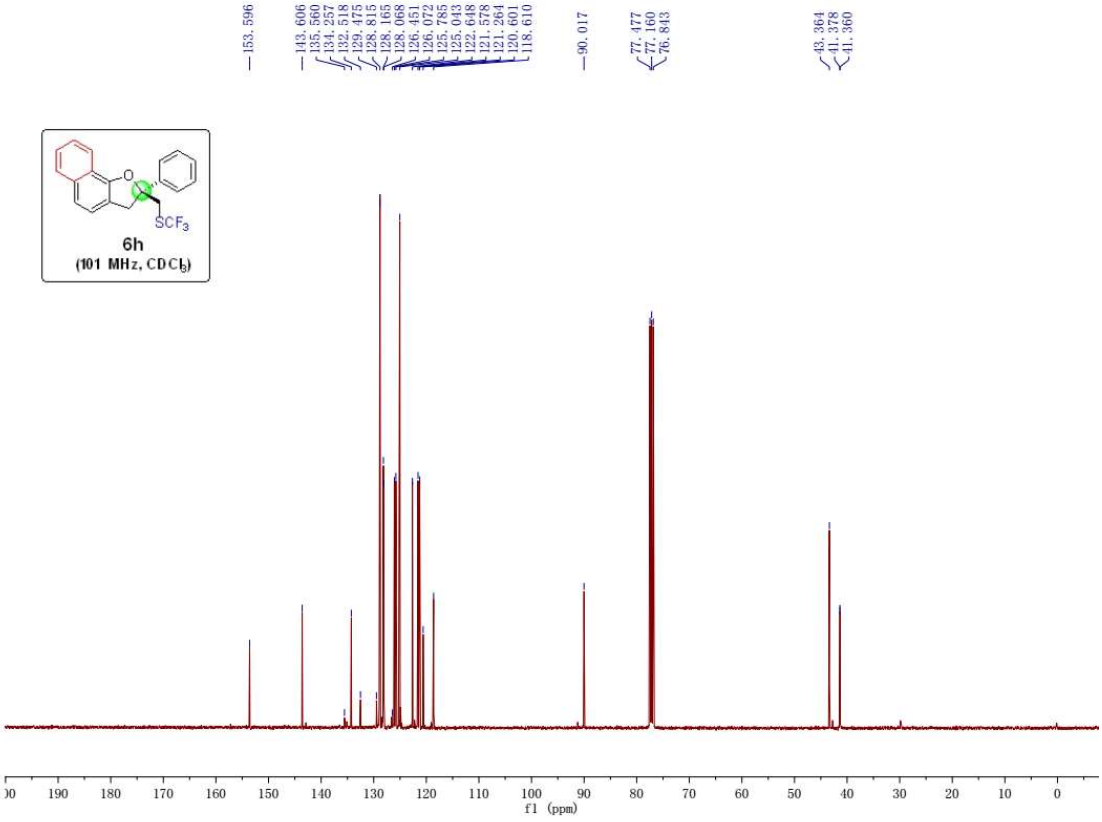

-41.189
-114.199
F
O
SCF3
6f
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

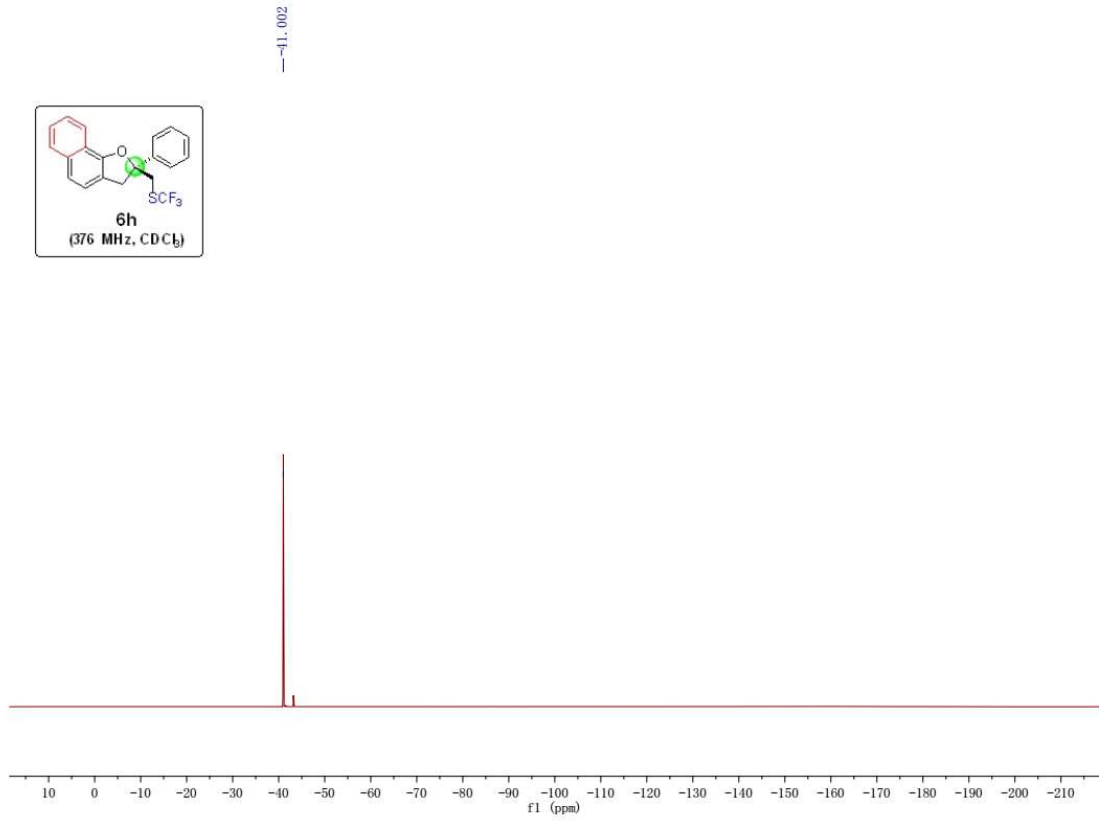

7.413
7.405
7.400
7.389
7.383
7.375
7.371
7.260
7.193
7.190
7.187
7.175
7.173
7.170
7.167
7.164
7.154
7.152
7.149
7.146
7.144
6.928
6.921
6.915
6.910
6.907
6.904
6.899
6.891
6.889
6.873
6.870
3.806
3.687
3.648
3.540
3.512
3.508
3.493
3.473
3.460
OMe
SCF3
6g
(400 MHz, CDCl3)
2.00
1.95
3.86
3.00
1.00
3.00
f1 (ppm)

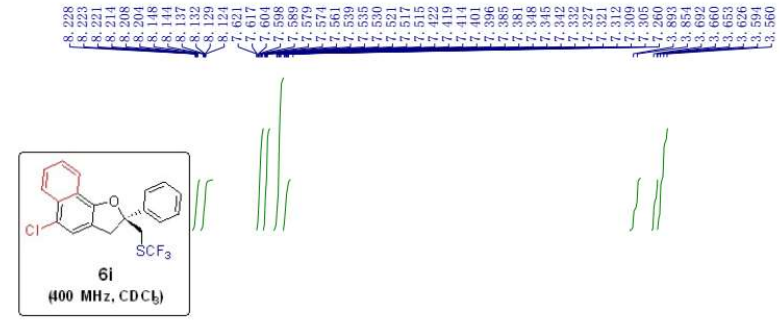

159.421
158.373
135.555
135.192
132.512
129.470
128.590
126.395
125.710
125.098
121.331
114.091
109.930
89.062
77.477
77.160
76.842
55.429
42.250
41.203
41.183
OMe
SCF3
6g
(101 MHz, CDCl3)
f1 (ppm)

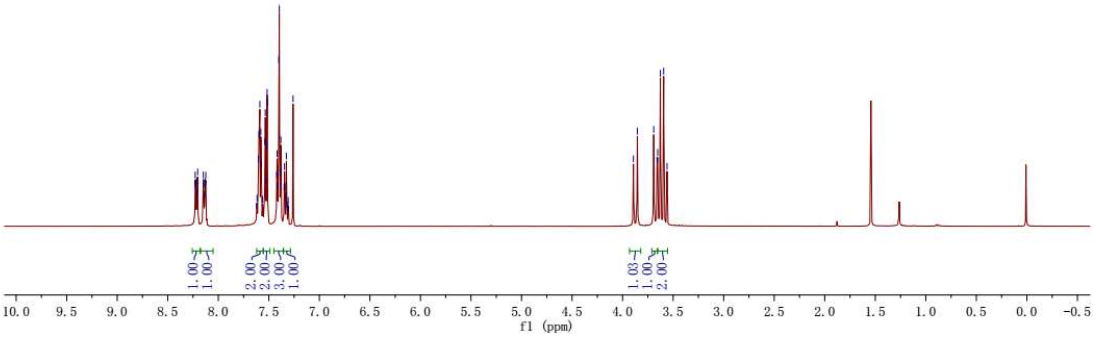

-41.136
OMe
SCF3
6g
(376 MHz, CDCl3)
f1 (ppm)

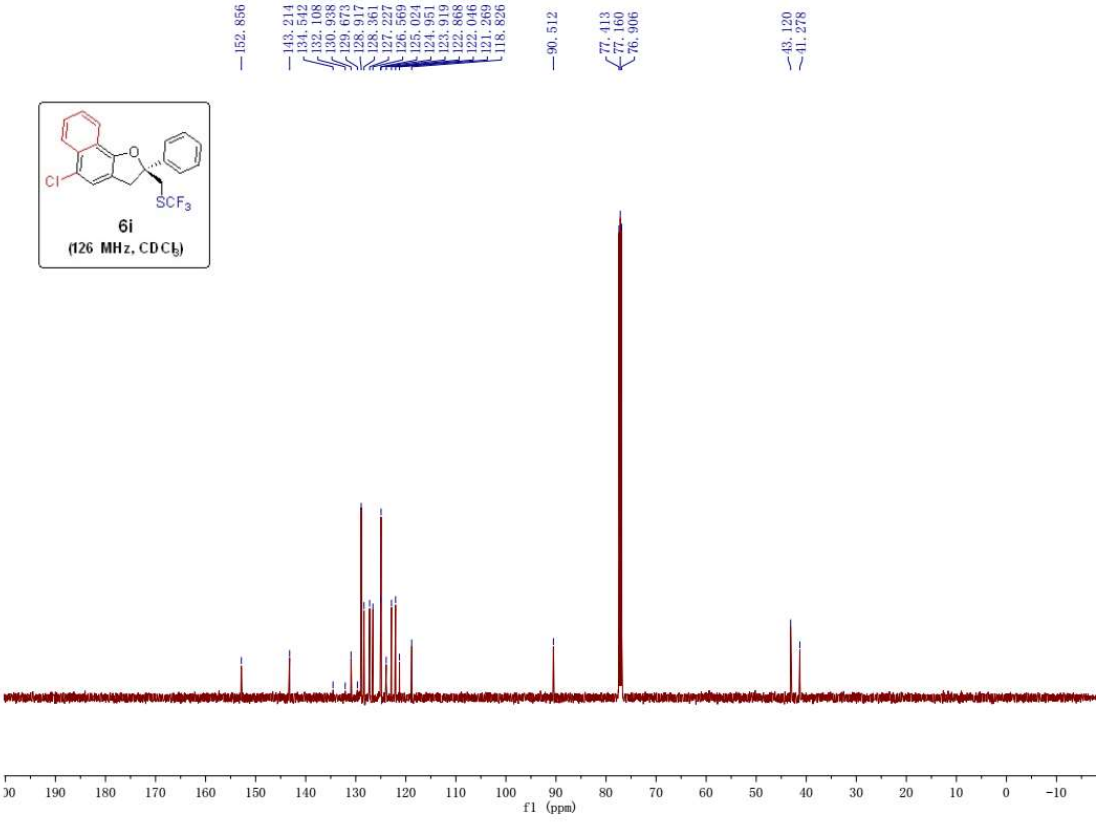

8.164
8.143
7.862
7.842
7.587
7.582
7.563
7.545
7.542
7.538
7.525
7.521
7.511
7.508
7.491
7.488
7.474
7.471
7.459
7.438
7.432
7.414
7.395
7.357
7.353
7.341
7.335
7.313
7.292
7.260
3.910
3.871
3.716
3.684
3.678
3.650
3.634
3.601
SCF3
6h
(400 MHz, CDCl3)
1.00
1.00
7.00
2.00
1.00
3.00
f1 (ppm)

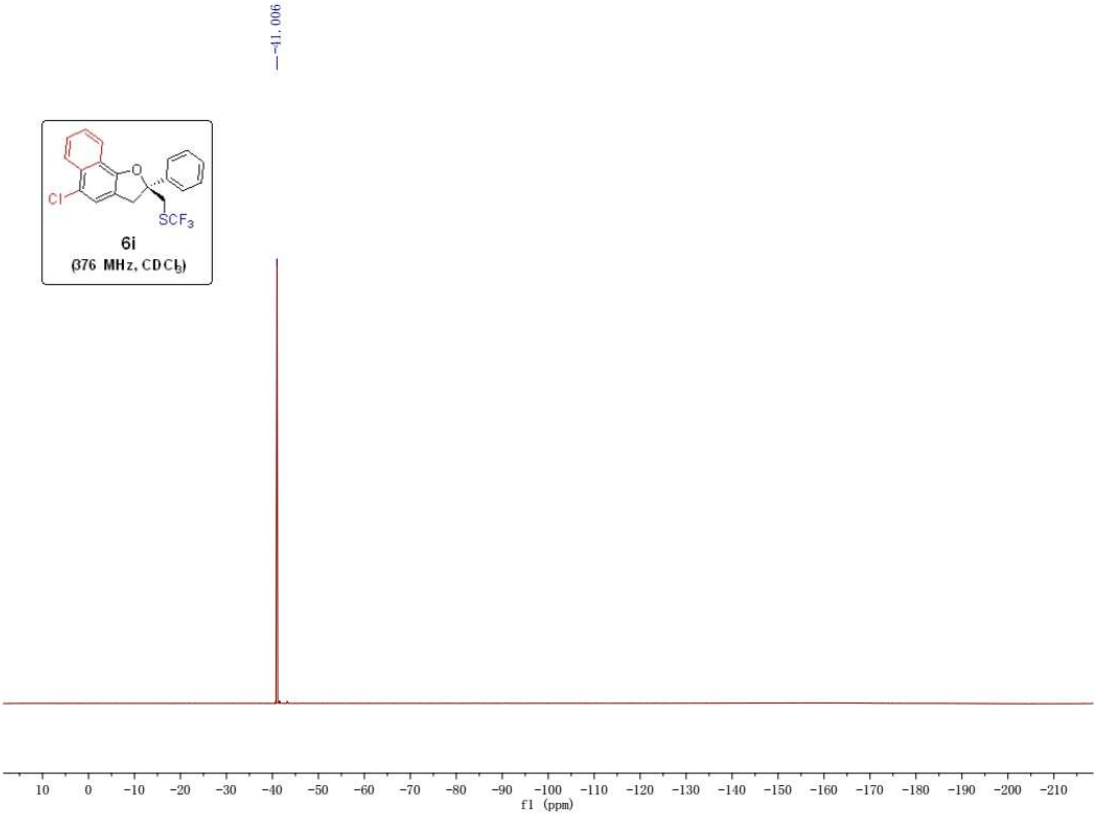

153.596
143.606
135.560
134.257
132.518
129.475
128.815
128.165
128.068
126.451
126.072
125.785
125.043
122.648
121.578
121.264
120.601
118.610
90.017
77.477
77.160
76.843
43.364
41.378
41.360
SCF3
6h
(101 MHz, CDCl3)
f1 (ppm)

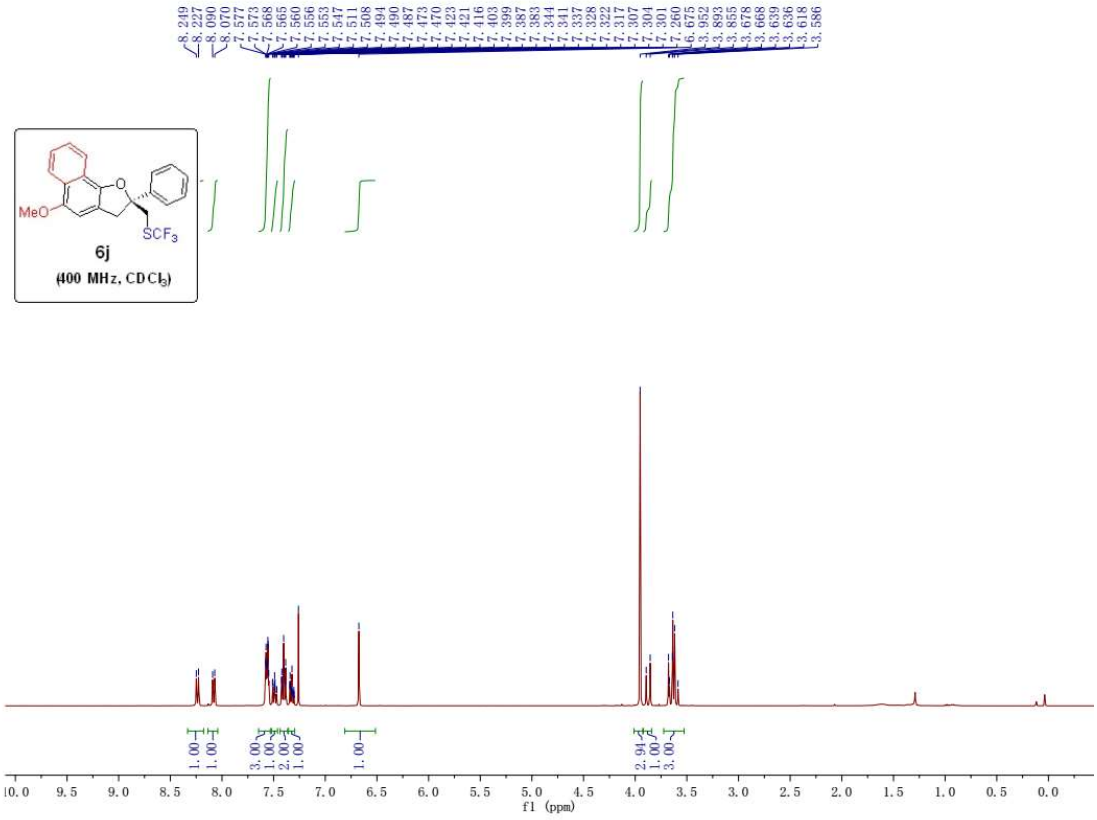

-41.002
SCF3
6h
(376 MHz, CDCl3)
f1 (ppm)

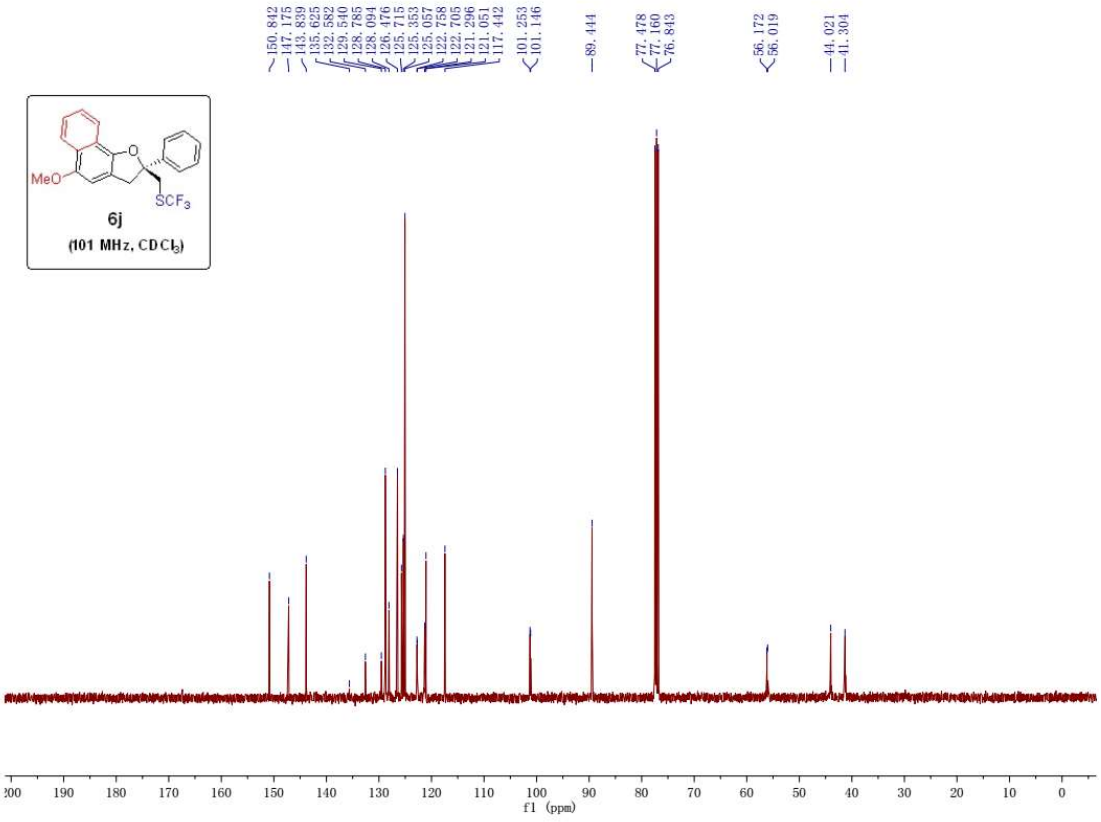

8.228
8.223
8.221
8.214
8.208
8.204
8.148
8.144
8.137
8.132
8.129
8.124
7.621
7.617
7.604
7.598
7.589
7.579
7.574
7.561
7.539
7.535
7.530
7.521
7.517
7.515
7.422
7.419
7.414
7.401
7.396
7.385
7.381
7.348
7.345
7.342
7.332
7.327
7.321
7.312
7.309
7.305
7.260
3.893
3.854
3.692
3.660
3.653
3.626
3.594
3.560
Cl
SCF3
6i
(400 MHz, CDCl3)

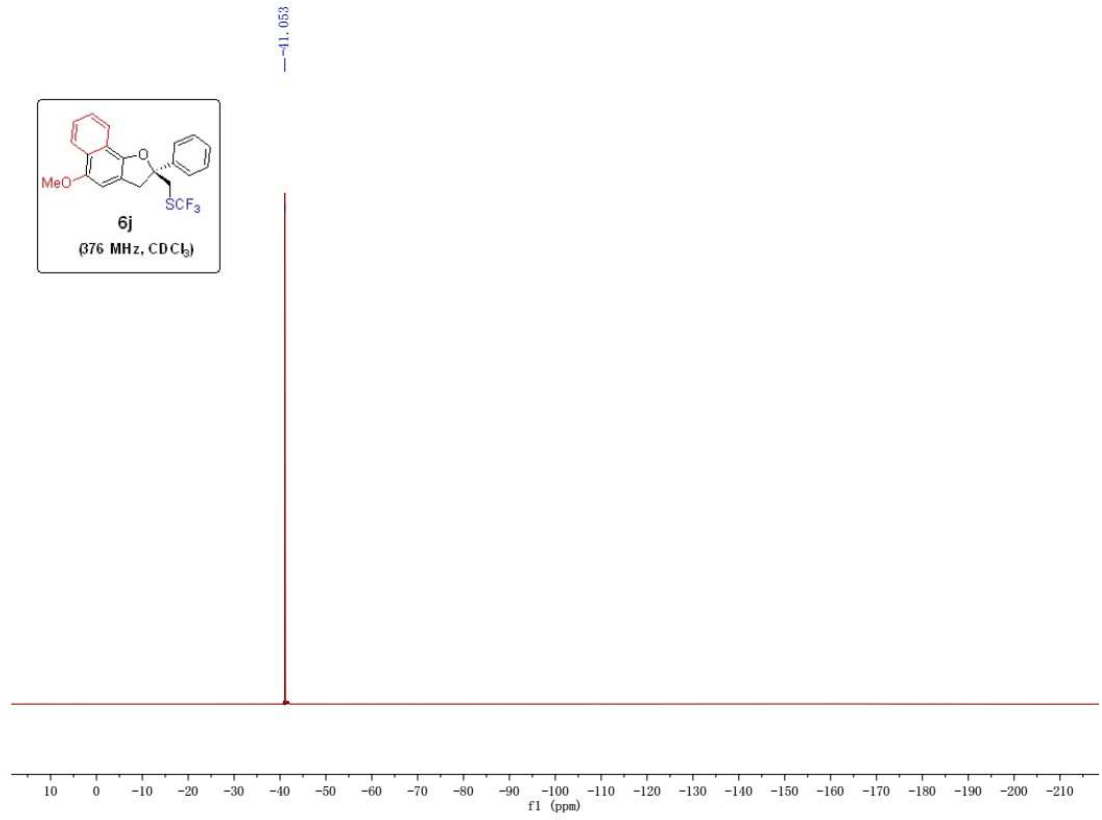

1.00
1.00
2.00
2.00
3.00
1.00
1.03
1.00
2.00
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

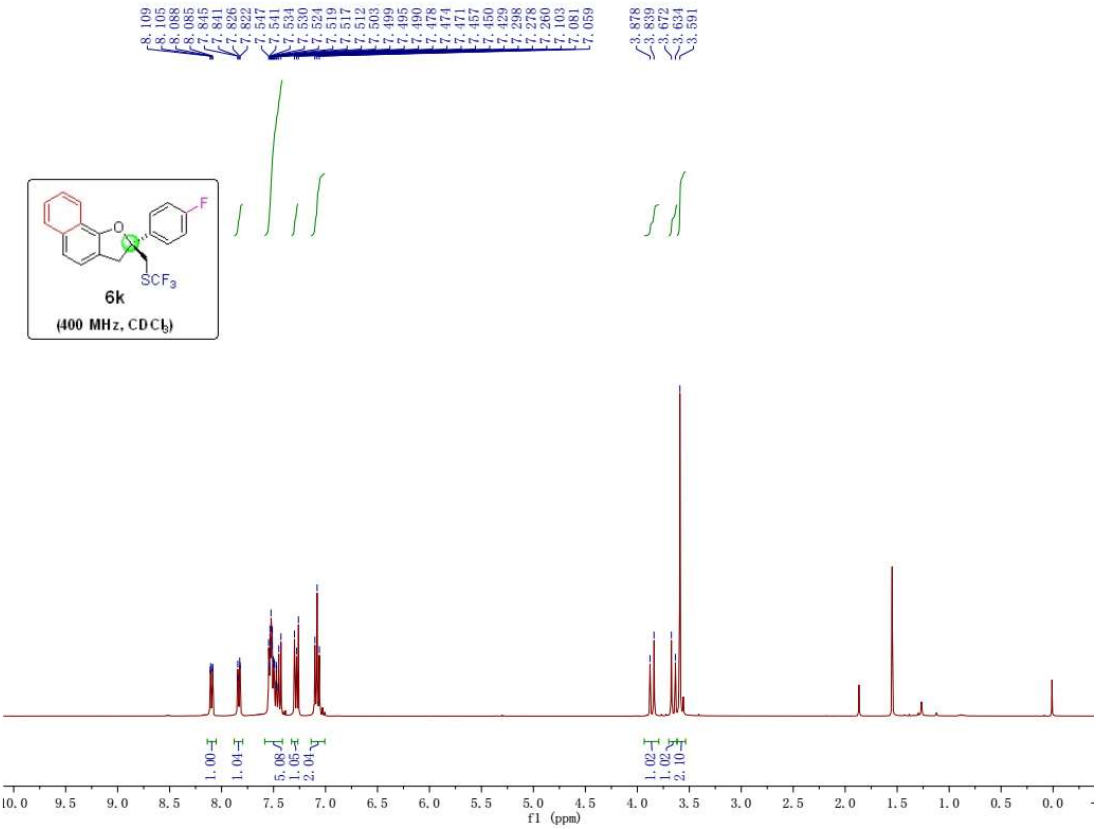

152.856
143.214
134.542
132.108
130.938
129.673
128.917
128.361
127.227
126.569
125.024
124.951
123.919
122.868
122.046
121.269
118.826
90.512
77.413
77.160
76.906
43.120
41.278
Cl
SCF3
6i
(126 MHz, CDCl3)
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

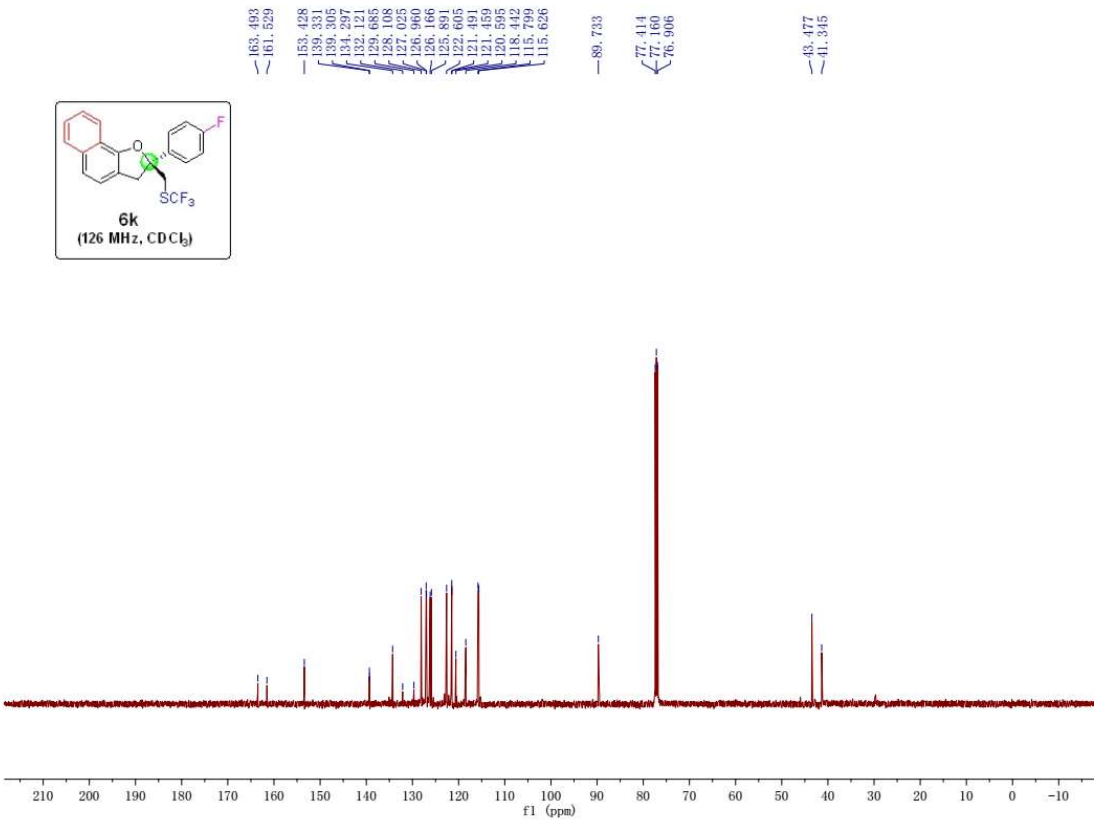

-41.006
Cl
SCF3
6i
(376 MHz, CDCl3)
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

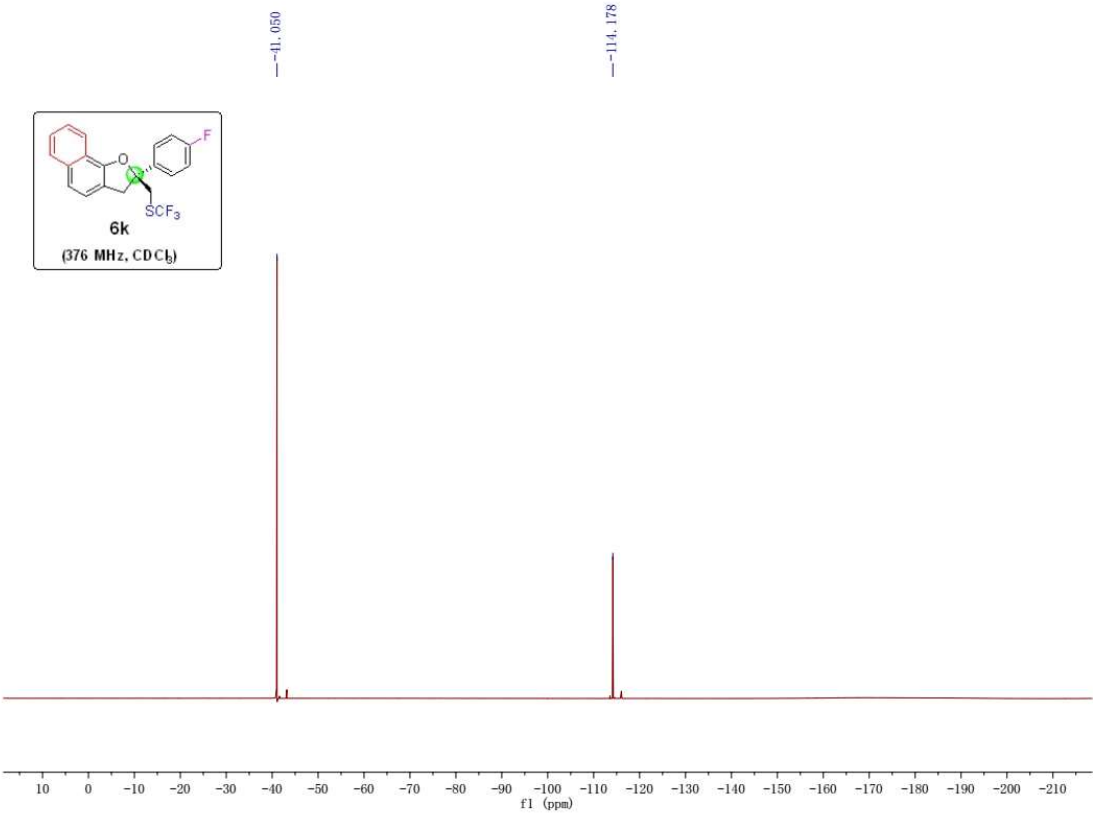

8.249
8.227
8.090
8.070
7.577
7.573
7.568
7.565
7.560
7.556
7.553
7.547
7.511
7.508
7.494
7.490
7.487
7.473
7.470
7.423
7.421
7.416
7.403
7.399
7.387
7.383
7.344
7.341
7.337
7.328
7.322
7.317
7.307
7.304
7.301
7.260
6.675
3.952
3.893
3.855
3.678
3.668
3.639
3.636
3.618
3.586
MeO
SCF3
6j
(400 MHz, CDCl3)
1.00
1.00
3.00
1.00
2.00
1.00
1.00
2.94
1.00
3.00
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
f1 (ppm)

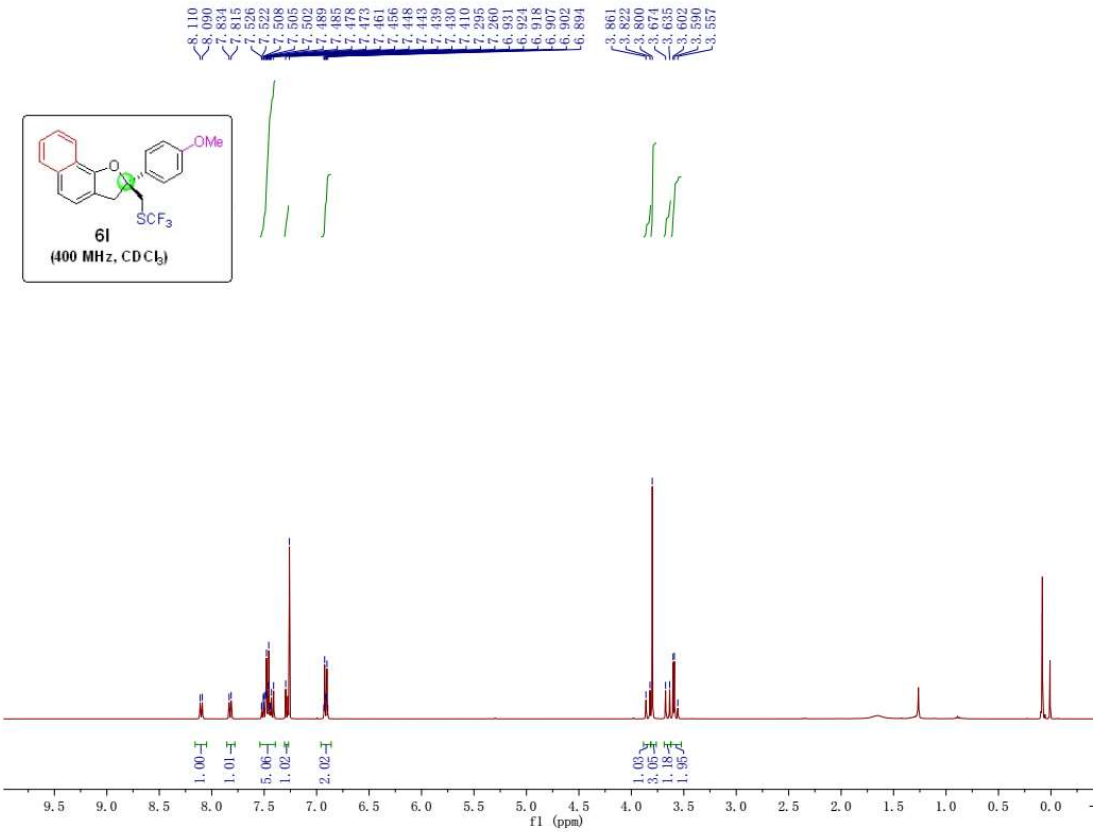

150.842
147.175
143.839
135.625
132.582
129.540
128.785
128.094
126.476
125.715
125.353
125.057
122.758
122.705
121.296
121.051
117.442
101.253
101.146
89.444
77.478
77.160
76.843
56.172
56.019
44.021
41.304
MeO
SCF3
6j
(101 MHz, CDCl3)
f1 (ppm)

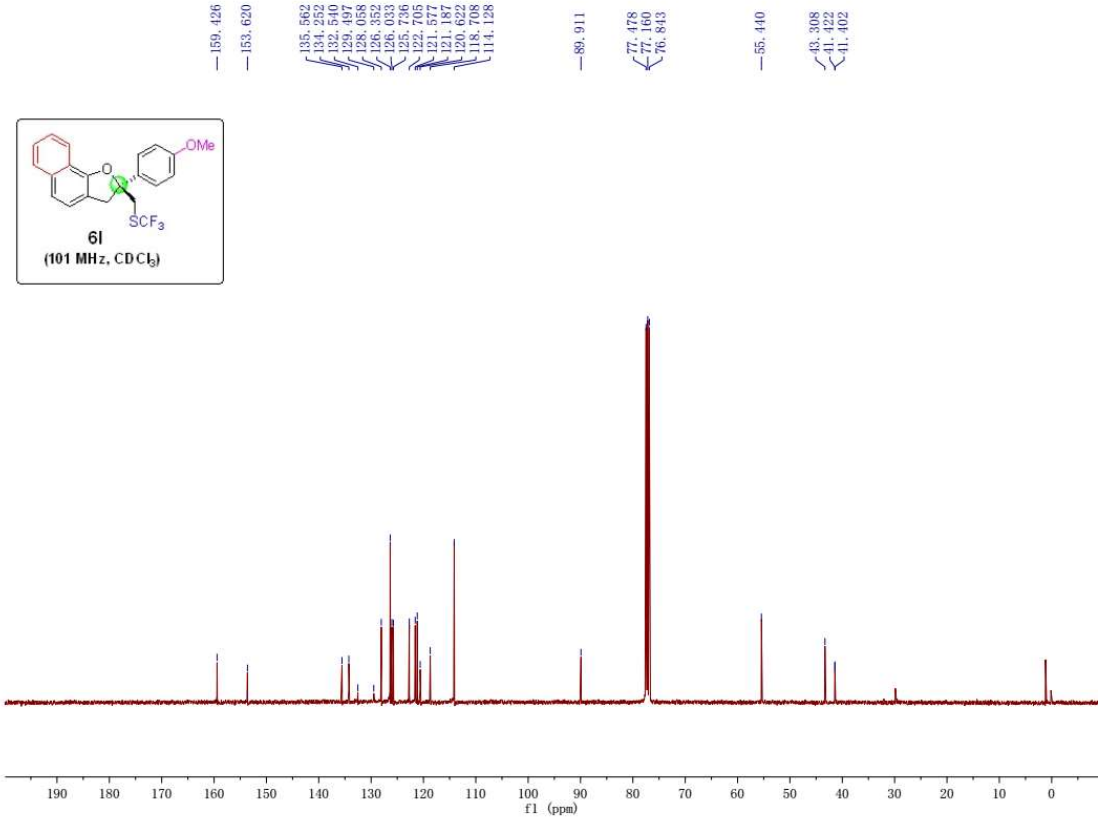

41.053
MeO
SCF3
6j
(376 MHz, CDCl3)
f1 (ppm)

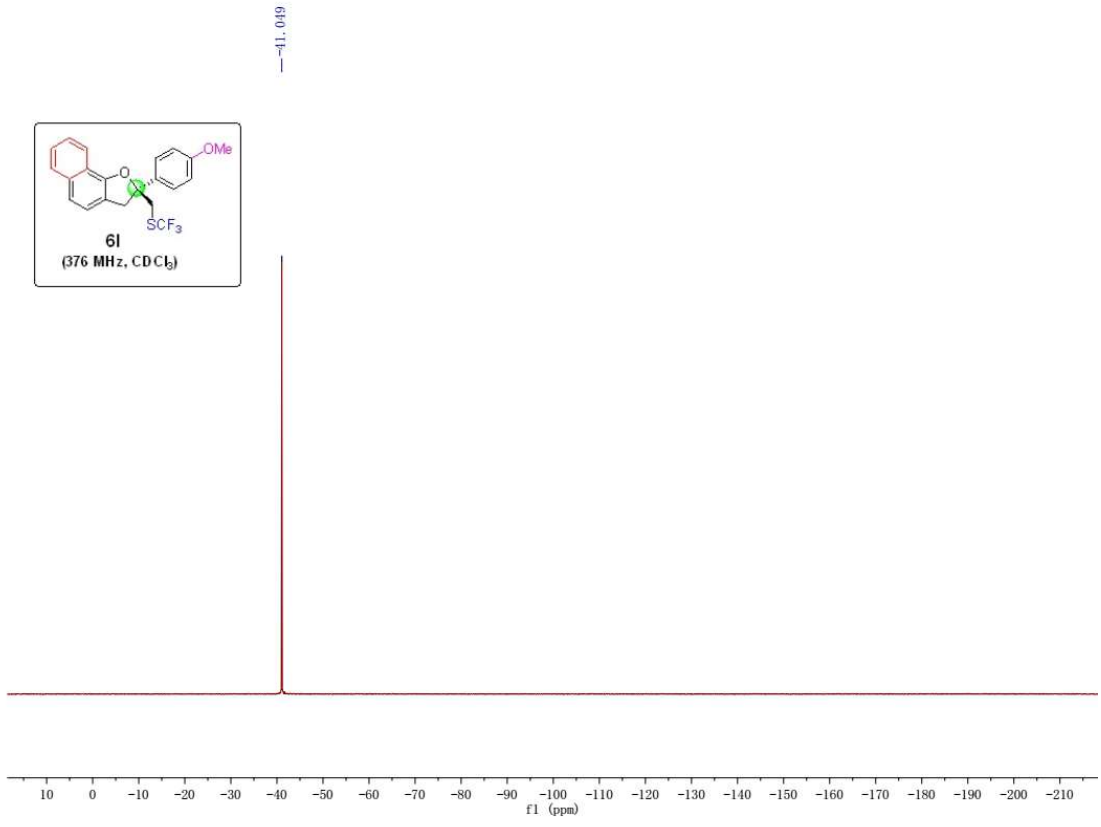

8.109
8.105
8.088
8.085
7.845
7.841
7.826
7.822
7.547
7.541
7.534
7.530
7.524
7.519
7.517
7.512
7.503
7.499
7.495
7.490
7.478
7.474
7.471
7.457
7.450
7.429
7.298
7.278
7.260
7.103
7.081
7.059
3.878
3.839
3.672
3.634
3.591
F
SCF3
6k
(400 MHz, CDCl3)
1.00
1.04
5.08
1.05
2.04
1.02
1.02
2.10
f1 (ppm)

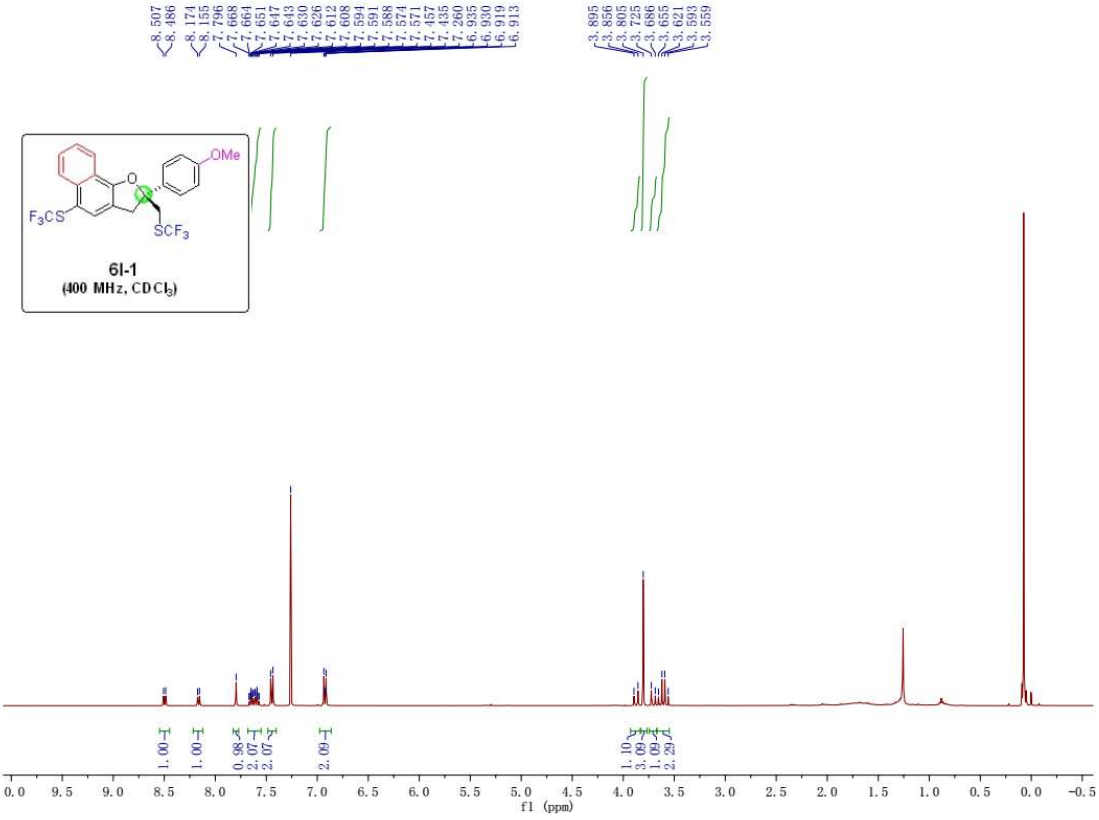

163.493
161.529
153.428
139.331
139.305
134.297
132.121
129.685
128.108
127.025
126.960
126.166
125.891
122.605
121.491
121.459
120.595
118.442
115.799
115.626
89.733
77.414
77.160
76.906
43.477
41.345
F
SCF3
6k
(126 MHz, CDCl3)
f1 (ppm)

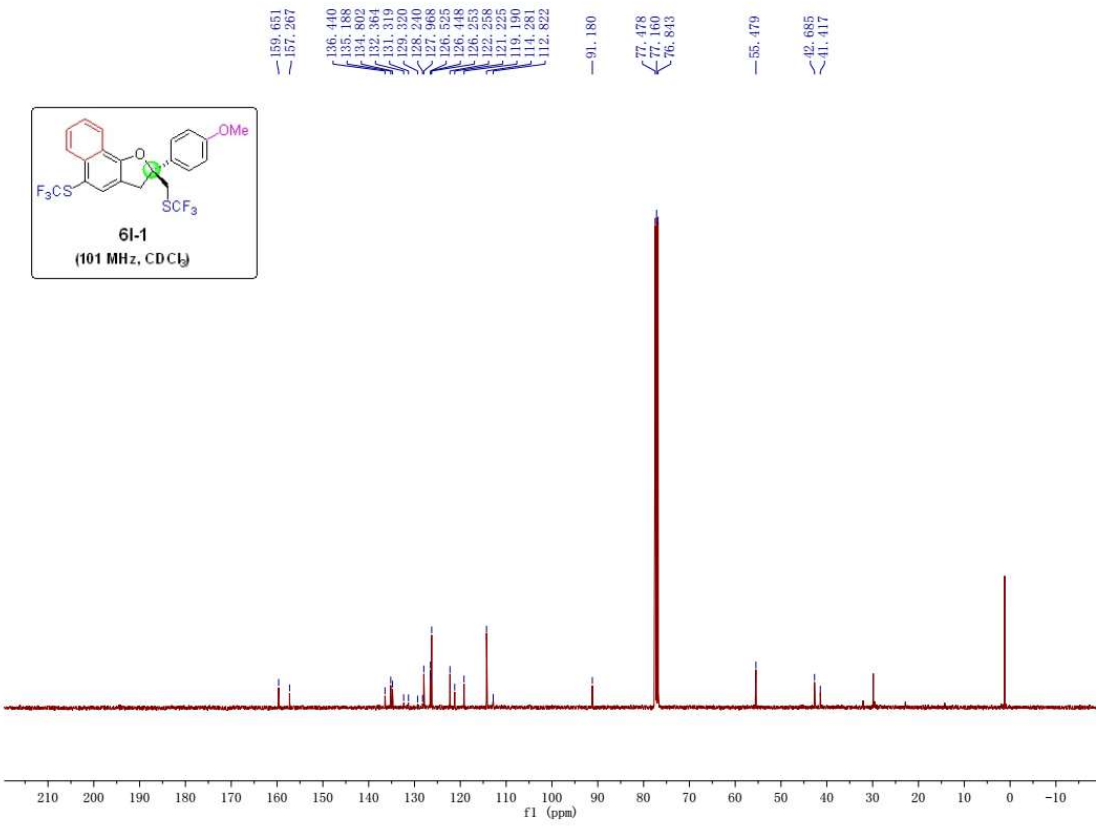

-41.050
-114.178
F
O
SCF3
6k
(376 MHz, CDCl3)
f1 (ppm)

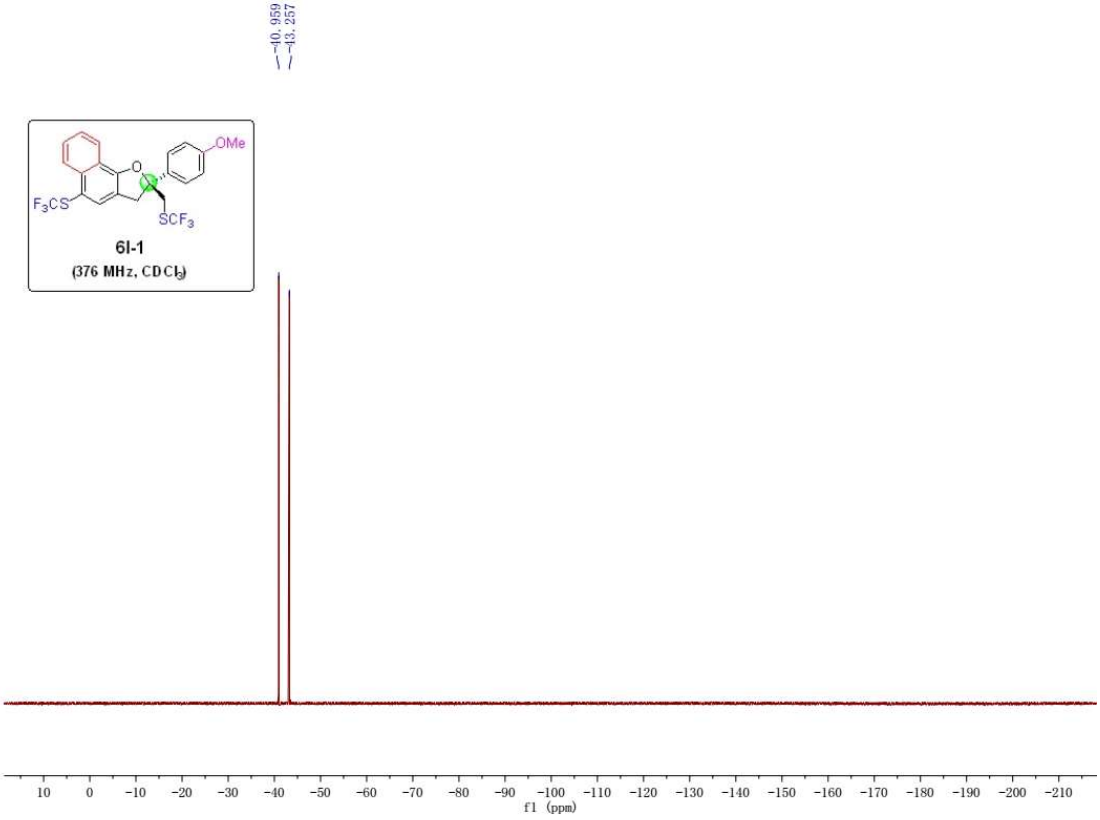

8.110
8.090
7.834
7.815
7.526
7.522
7.508
7.505
7.502
7.489
7.485
7.478
7.473
7.461
7.456
7.448
7.443
7.439
7.430
7.410
7.295
7.260
6.931
6.924
6.918
6.907
6.902
6.894
3.861
3.822
3.800
3.674
3.635
3.602
3.590
3.557
OMe
O
SCF3
6l
(400 MHz, CDCl3)
1.00
1.01
5.06
1.02
2.02
1.03
3.05
1.18
1.95
f1 (ppm)

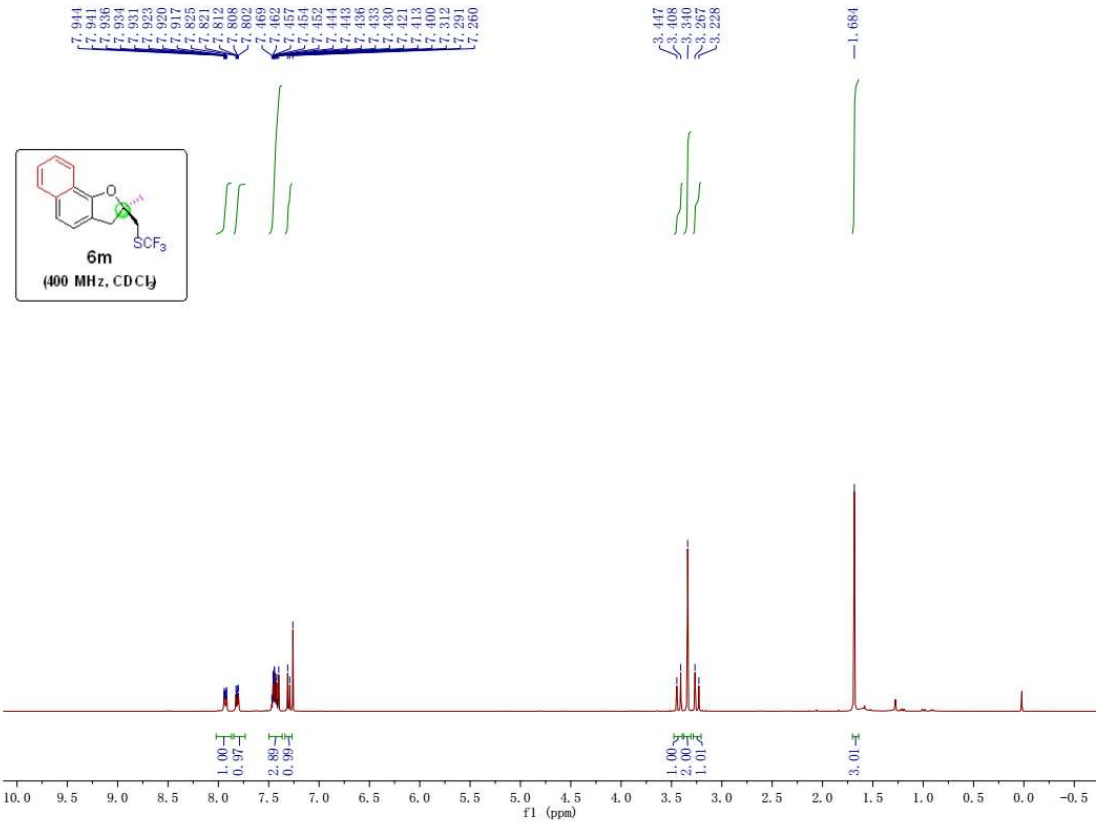

159.426
153.620
135.562
134.252
132.540
129.497
128.058
126.352
126.033
125.736
122.705
121.577
121.187
120.622
118.708
114.128
89.911
77.478
77.160
76.843
55.440
43.308
41.422
41.402
OMe
SCF3
6l
(101 MHz, CDCl3)
f1 (ppm)

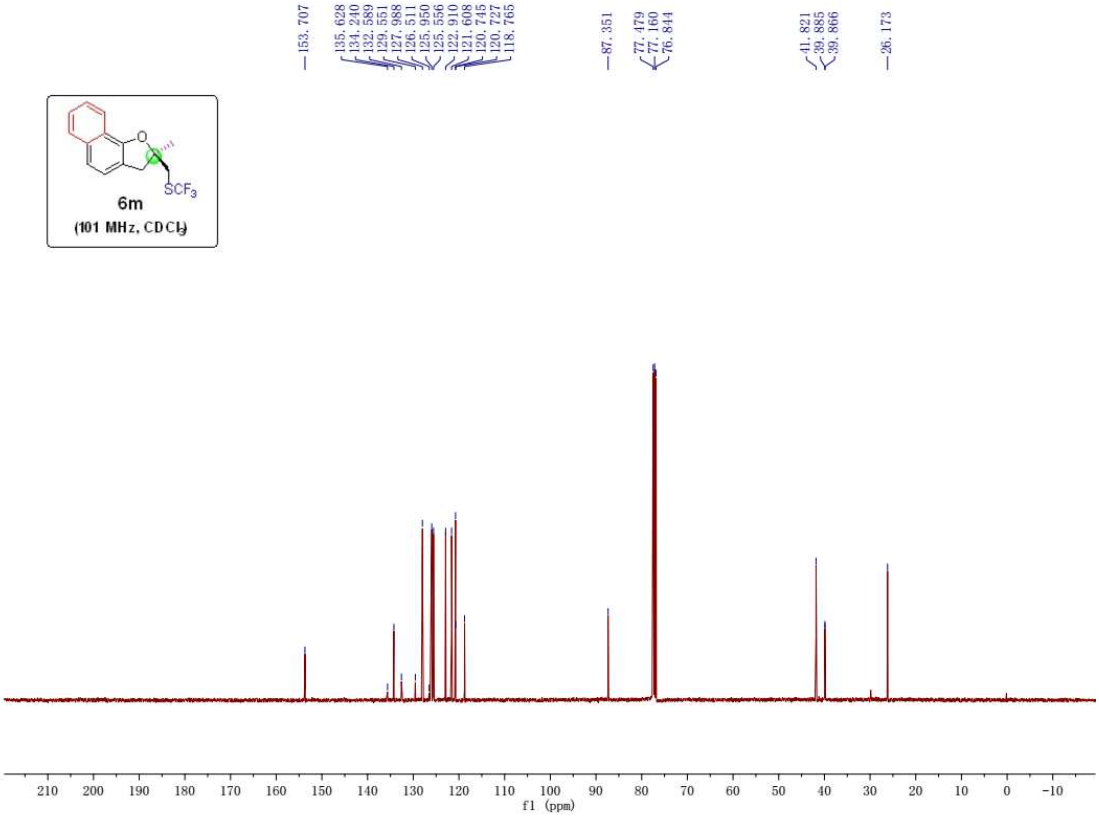

-41.049
OMe
SCF3
6l
(376 MHz, CDCl3)
f1 (ppm)

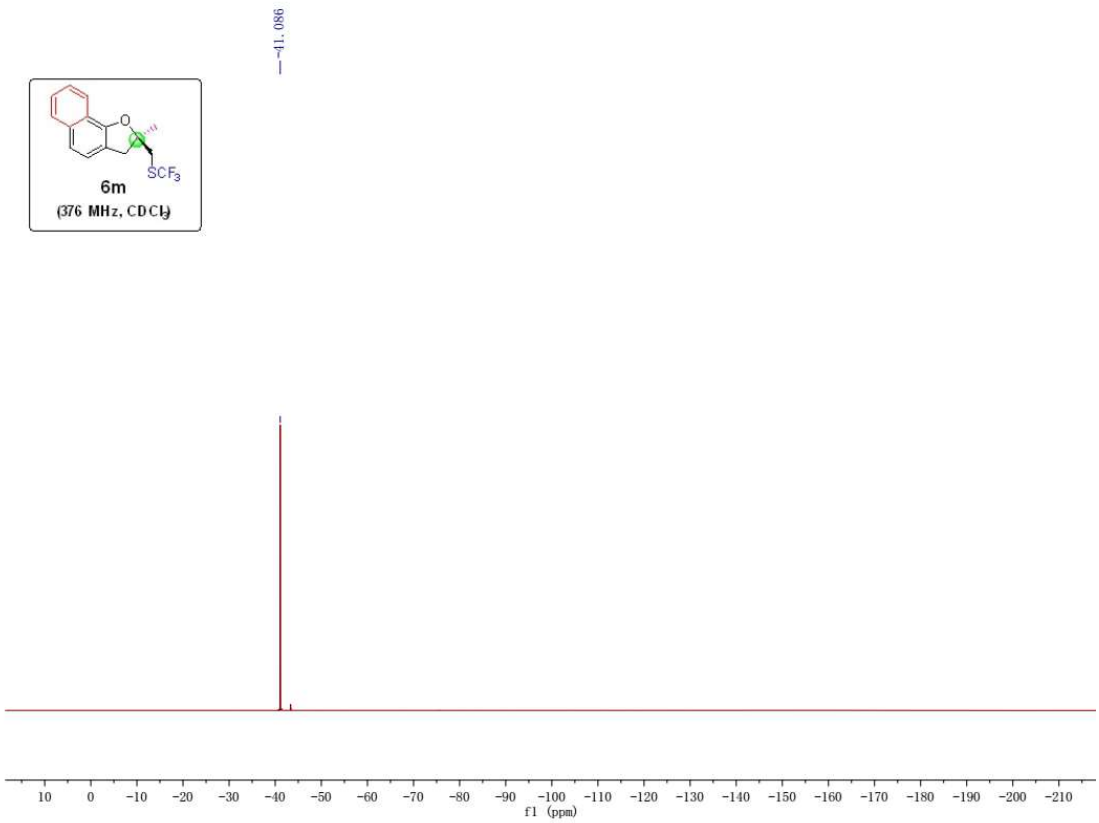

8.597
8.486
8.174
8.155
7.796
7.668
7.664
7.651
7.647
7.643
7.630
7.626
7.612
7.608
7.594
7.591
7.588
7.574
7.571
7.457
7.435
7.260
6.935
6.930
6.919
6.913
3.895
3.856
3.805
3.725
3.686
3.655
3.621
3.593
3.559
OMe
F3CS
SCF3
6l-1
(400 MHz, CDCl3)
1.00
1.00
0.98
2.07
2.07
2.09
1.10
3.09
1.09
2.29
f1 (ppm)

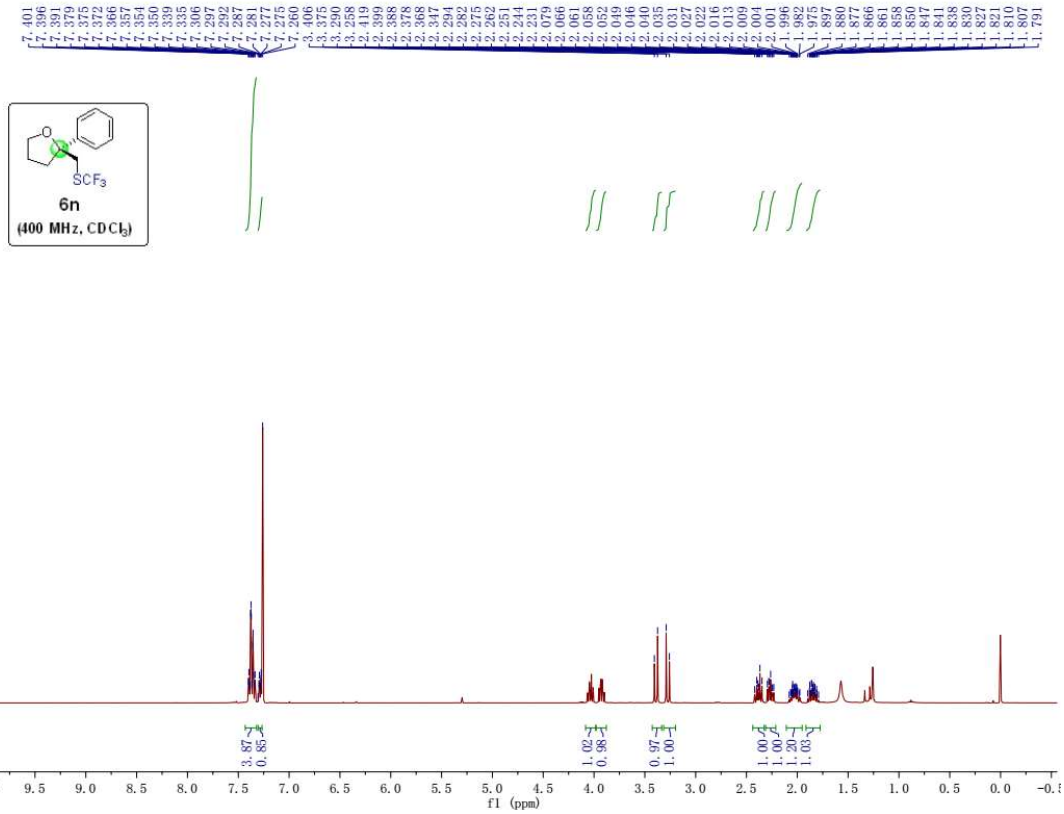

159.651
157.267
136.440
135.188
134.802
132.364
131.319
129.320
128.240
127.968
126.525
126.448
126.253
122.258
121.225
119.190
114.281
112.822
91.180
77.478
77.160
76.843
55.479
42.685
41.417
OMe
F3CS
SCF3
6l-1
(101 MHz, CDCl3)
f1 (ppm)

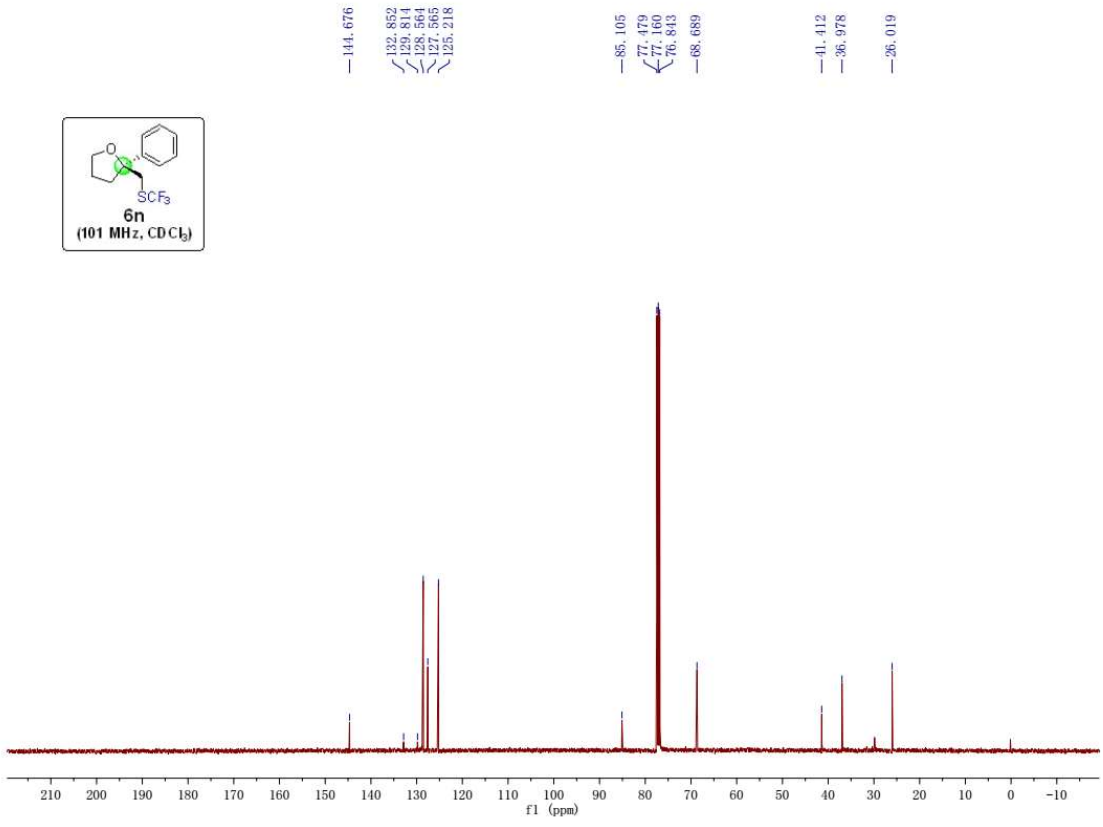

-40.959
-43.257
OMe
F3CS
SCF3
6l-1
(376 MHz, CDCl3)
f1 (ppm)

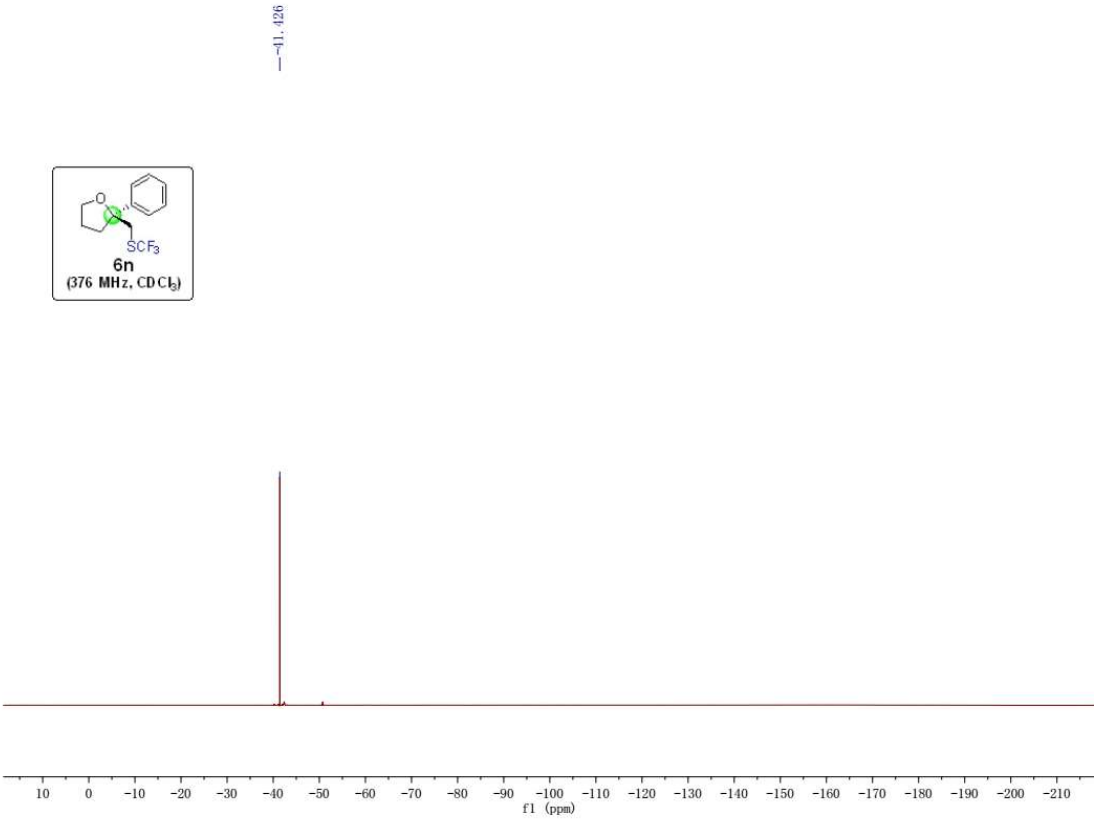

7.944
7.941
7.936
7.934
7.931
7.923
7.920
7.917
7.825
7.821
7.812
7.808
7.802
7.469
7.462
7.457
7.454
7.452
7.444
7.443
7.436
7.433
7.430
7.421
7.413
7.400
7.312
7.291
7.260
3.447
3.408
3.340
3.267
3.228
1.684
SCF3
6m
(400 MHz, CDCl3)
1.00
0.97
2.89
0.99
1.00
2.00
1.01
3.01
f1 (ppm)

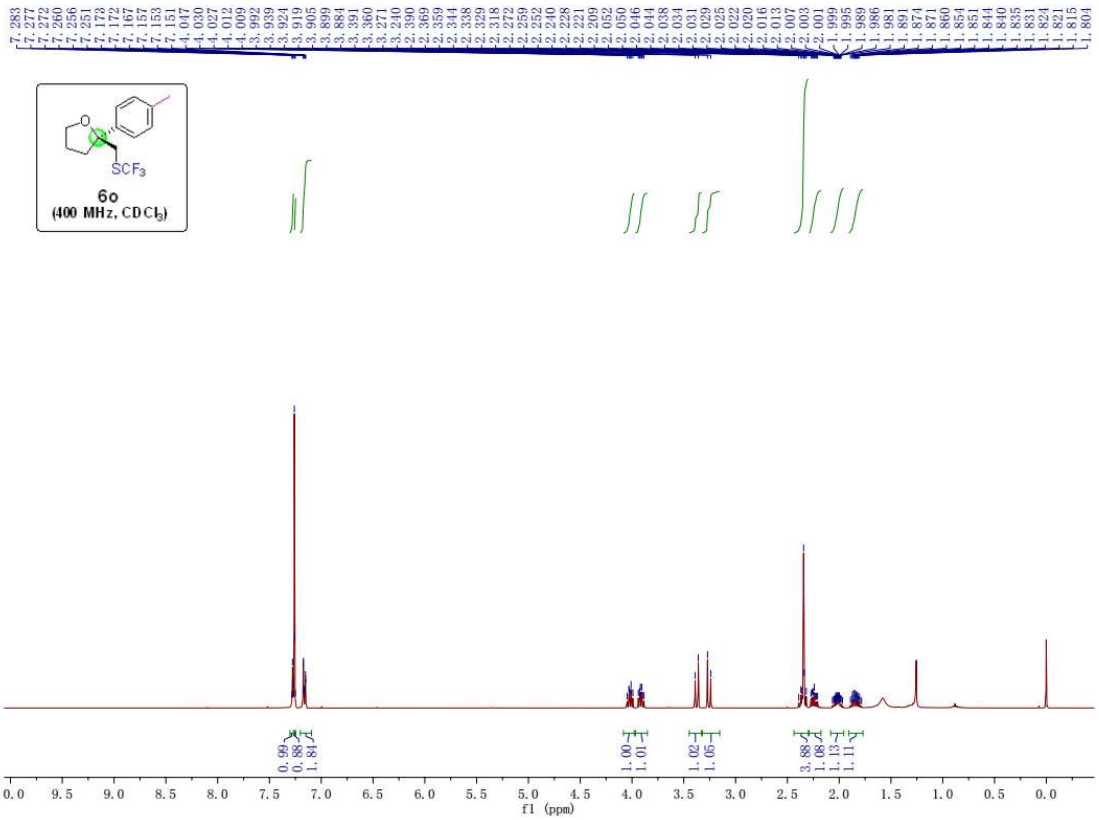

153.707
135.628
134.240
132.589
129.551
127.988
126.511
125.950
125.556
122.910
121.608
120.745
120.727
118.765
87.351
77.479
77.160
76.844
41.821
39.885
39.866
26.173
SCF3
6m
(101 MHz, CDCl3)
f1 (ppm)

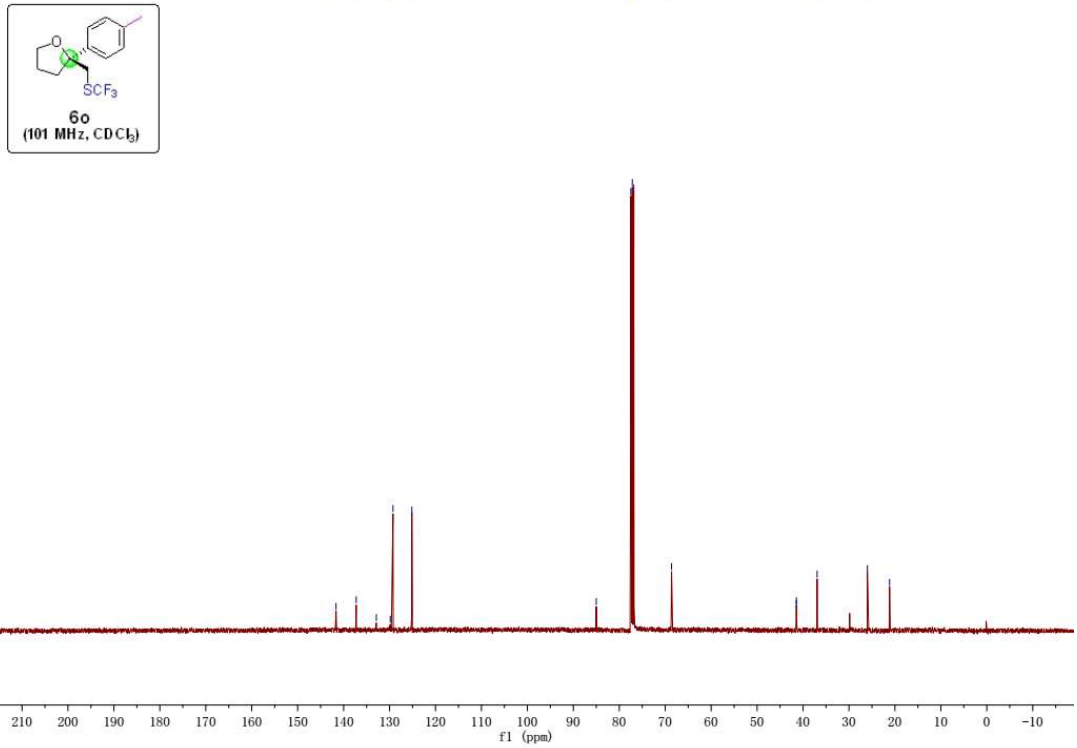

-41.086
SCF3
6m
(376 MHz, CDCl3)
f1 (ppm)

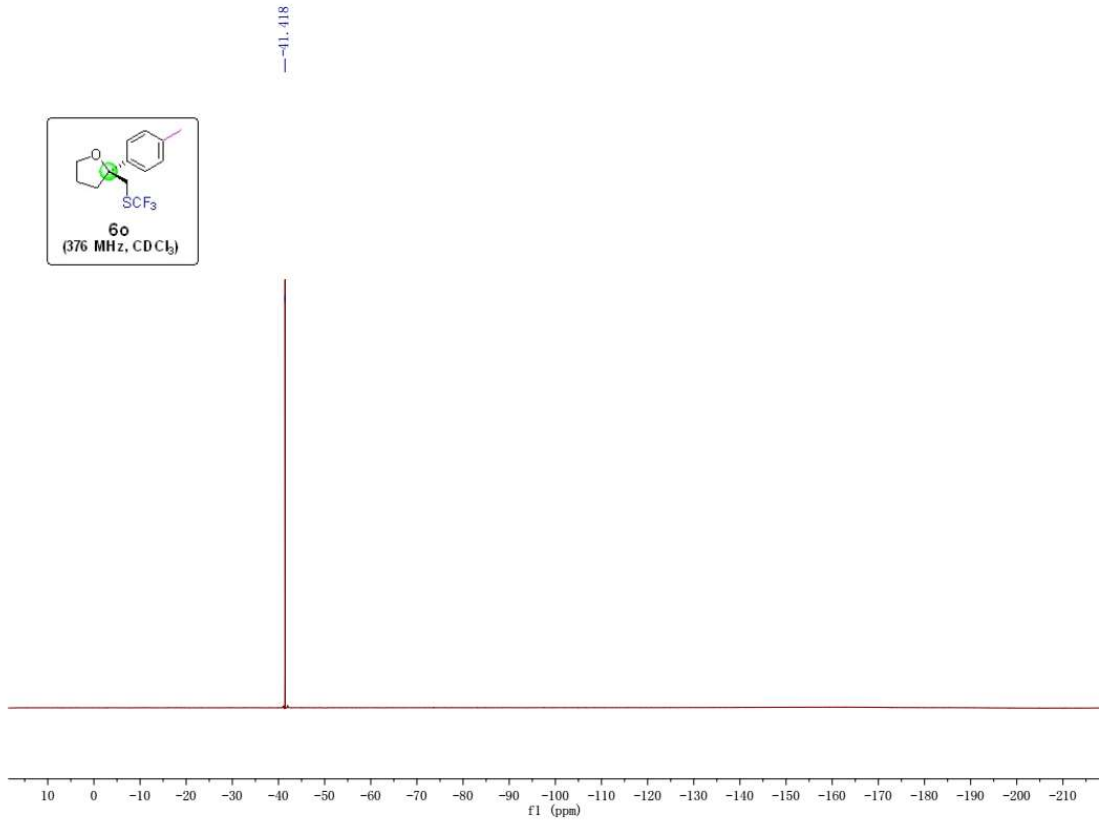

SCF3
6n
(400 MHz, CDCl3)
f1 (ppm)


SCF3
6n
(101 MHz, CDCl3)
f1 (ppm)


-41.426
SCF3
6n
(376 MHz, CDCl3)
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)


SCF3
6o
(400 MHz, CDCl3)
0.99
0.88
1.84
1.00
1.01
1.02
1.05
3.88
1.08
1.13
1.11
0.0 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
f1 (ppm)


141.650
137.256
132.878
129.840
129.251
125.147
85.006
77.477
77.160
76.843
68.616
41.462
41.445
36.941
25.994
21.165
SCF3
6o
(101 MHz, CDCl3)
f1 (ppm)


-41.418
SCF3
6o
(376 MHz, CDCl3)
f1 (ppm)