Supporting Information

Synthesis of trifluoromethylated aza-BODIPYs as fluorescence-^{19}F MRI dual imaging and photodynamic agents

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1. Fluorescence quantum efficiency

1c in chloroform (Φ_f = 0.34) was used as the reference for the calculation of quantum yield. All sample were used chloroform as solvent and the concentration with UV-absorption value at 0.01-0.05 was used to reduce the reabsorption effects. Quantum yields were calculated using the following formula (1):[1]

$$\Phi_{fX} = \Phi_{fR} \times \frac{F_X}{F_R} \times \left(\frac{1 - e^{-A_R^{\lambda_{ex}}}}{1 - 10^{-A_R^{\lambda_{ex}}}} \right) \times \left(\frac{{n_X}^2}{{n_R}^2} \right) \quad (1)$$

The X and R respectively represent our compounds and the known standard reference substance **1c**. F denotes the integrated area of the fluorescence spectrum. A(λ_{ex}) stands for the absorbance at the excitation wavelength, and n represents the refractive index of the solvent.

2. Photothermal properties

The temperature changes of the sample in chloroform (20 μM) under laser irradiation (λ = 660 nm, 0.5 W/cm^2, h = 10 cm) for 6 min were recorded by a thermal imager. The final result was the average value of three parallel tests.

3. Singlet oxygen properties

The singlet oxygen generation of **1a-1f** was investigated by using 1,3-diphenylisobenzofuran (DPBF) as the singlet oxygen indicator. The compounds **1a-1f** at the concentration of 3 μM were mixed with a solution of DPBF (40 μM) in chloroform. Under irradiation (660 nm) at 0.5 W/cm^2, the absorbance changes of DPBF at 415 nm were recorded. The final result was the average value of three parallel tests. Singlet oxygen quantum yields of **1a-1f** were measured at low concentrations in chloroform to minimize the possibility of singlet oxygen quenching by the dyes. Tetraphenylporphyrin（TPP）in chloroform ($\Phi_\triangle$ = 0.55)[2] was used as the reference and

DPBF was used as the singlet oxygen indicator. The photooxidation of DPBF was monitored between 0 s to 4 min depending on the efficiency of the BODIPYs under irradiation (660 nm) at 0.5 W/cm^2. Singlet oxygen quantum yields were calculated using the following formula (2):[3]

$$\Phi_{\triangle X} = \Phi_{\triangle R} \times \left(\frac{1 - 10^{-A_R^{660}}}{1 - 10^{-A_X^{660}}} \right) \times \left(\frac{S_X}{S_R} \right) \quad (2)$$

The X and R respectively represent our compounds and the known standard reference substance TPP. $\Phi_{\triangle}$ is the quantum yield of singlet oxygen, S is the slope of a plot of difference in change in absorbance of DPBF (at 415 nm) with the irradiation time and $(1 - 10^{-A})$ is the absorption correction factor, which is given by the absorbance at the irradiation wavelength.

4. Synthesis of the compounds

3-(3,5-Bis(trifluoromethyl)phenyl)-1-phenylprop-2-en-1-one (***4a***).[4] To a solution of acetophenone **2a** (1.9 mL, 16.7 mmol, in 50 mL ethanol (EtOH)) was added a solution of sodium hydroxide (NaOH, 41.6 mmol, 5% in water). The mixture was stirred for 3 min, and then 3,5-bis(trifluoromethyl) benzaldehyde **3b** (3.0 mL, 18.3 mmol) was added in one portion. After stirring for 25 min at room temperature, the mixture was neutralized to pH 7 with 2 N hydrochloric acid (HCl). After filtration, the residue was collected, re-dissolved in EtOAc. The solution was dried with anhydrous sodium sulfate (Na_2SO_4) and concentrated under vacuum to give the crude product, which was recrystallized from EtOAc and PE to give **4a** as yellowish solid (4.4 g, yield 76%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09-8.00 (m, 4H), 7.90 (s, 1H), 7.83 (d, J = 15.8 Hz, 1H), 7.69-7.60 (m, 2H), 7.54 (t, J = 7.5 Hz, 2H).

1-(3,5-Bis(trifluoromethyl)phenyl)-3-phenylprop-2-en-1-one (***4b***).[4b] **4b** was prepared as yellowish solid in a 63% yield (8.5 g) from 3,5-bis(trifluoromethyl) acetophenone **2b** (7.0 mL, 39.0 mmol) and benzaldehyde **3a** (4.4 mL, 42.9 mmol) using the same procedure for **4a** except that the reaction was carried out in ice bath and the reaction time was reduced to 8 min. ^{1}H NMR (600 MHz, $CDCl_3$) δ 8.44 (s, 2H), 8.09 (s, 1H), 7.92 (d, J = 15.6 Hz, 1H), 7.69 (dd, J = 7.2, 2.0 Hz, 2H), 7.51 (d, J = 15.6 Hz, 1H), 7.49-7.44 (m, 3H).

Chalcone (***4c***).[4b,5] **4c** was prepared as yellowish solid in a 73% yield (8.6 g) from acetophenone **2a** (4.9 mL, 41.6 mmol) and benzaldehyde **3a** (4.3 mL, 41.6 mmol) using the same procedure for **4a** except that the reaction time was extended to 20 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06-7.99 (m, 2H), 7.82 (d, J = 15.7 Hz, 1H), 7.68-7.62 (m, 2H), 7.62-7.47 (m, 4H), 7.46-7.40 (m, 3H).

3-(3,5-Bis(trifluoromethyl)phenyl)-1-(4-methoxy-phenyl)prop-2-en-1-one (***4d***).[6] **4d**

was prepared as yellowish solid in a 89% yield (11.2 g) from 4-methoxy-acetophenone **2c** (5.0 g, 19.5 mmol) and 3,5-bis(trifluoromethyl) benzaldehyde **3b** (5.5 mL, 19.5 mmol) using the same procedure for **4a** except that the reaction time was extended to 12 h. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09-8.00 (m, 4H), 7.88 (s, 1H), 7.80 (d, *J* = 15.7 Hz, 1H), 7.66 (d, *J* = 15.7 Hz, 1H), 6.99 (d, *J* = 8.9 Hz, 2H), 3.89 (s, 3H).

1-(3,5-Bis(trifluoromethyl)phenyl)-3-(4-methoxy phenyl)prop-2-en-1-one (***4e***).[4b,7] **4e** was prepared as yellowish solid in a 31% yield (3.3 g) from 3,5-bis(trifluoromethyl) acetophenone **2b** (3.5 mL, 19.5 mmol) and 4-methoxy-benzaldehyde **3c** (2.4 mL, 19.5 mmol) using the same procedure for **4a**. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.43 (s, 2H), 8.07 (s, 1H), 7.88 (d, *J* = 15.5 Hz, 1H), 7.64 (d, *J* = 8.8 Hz, 2H), 7.38 (d, *J* = 15.5 Hz, 1H), 6.96 (d, *J* = 8.8 Hz, 2H), 3.87 (s, 3H).

1,3-Bis(4-methoxyphenyl)prop-2-en-1-one (***4f***).[5] **4f** was prepared as yellowish solid in a 84% yield (4.5 g) from 4-methoxy-acetophenone **2c** (3.0 g, 20.0 mmol) and 4-methoxy-benzaldehyde **3c** (2.7 mL, 22.0 mmol) using the same procedure for **4c** expect that the base was KOH (2.2 g, 39.9 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.9 Hz, 2H), 7.78 (d, *J* = 15.6 Hz, 1H), 7.60 (d, *J* = 8.7 Hz, 2H), 7.43 (d, *J* = 15.6 Hz, 1H), 6.97 (d, *J* = 8.9 Hz, 2H), 6.93 (d, *J* = 8.8 Hz, 2H), 3.86 (d, *J* = 13.3 Hz, 6H).

4-Nitro-1,3-diphenylbutan-1-one (**5c**).[8] **5c** was prepared as yellowish oil in a 77% yield (1.8 g) from **4c** (2.0 g, 4.5 mmol) using the same procedure for **5a**. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, *J* = 7.1 Hz, 2H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.7 Hz, 2H), 7.38-7.25 (m, 5H), 4.84 (dd, *J* = 12.5, 6.6 Hz, 1H), 4.69 (dd, *J* = 12.5, 8.0 Hz, 1H), 4.28-4.17 (m, 1H), 3.54-3.38 (m, 2H).

1,3-Bis(4-methoxyphenyl)-4-nitrobutan-1-one (***5f***).[9] **5f** was prepared as yellowish oil in 79% yield (194.1 mg) from **4f** (4.4 g, 16.4 mmol) using the same procedure for **5a** except that the base was KOH (184 mg,3.3 mmol). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90

(d, *J* = 9.0 Hz, 2H), 7.19 (d, *J* = 8.7 Hz, 2H), 6.92 (d, *J* = 8.9 Hz, 2H), 6.85 (d, *J* = 8.7 Hz, 2H), 4.80 (dd, *J* = 12.3, 6.5 Hz, 1H), 4.63 (dd, *J* = 12.3, 8.2 Hz, 1H), 4.21-4.11 (m, 1H), 3.86 (s, 3H), 3.77 (s, 3H), 3.42-3.30 (m, 2H).

BF_2 chelate of N-(3,5-diphenyl-1H-pyrrol-2-yl)-3,5-diphenyl-2H-pyrrol-2-imine (***1c***).[10] **1c** was prepared in a 22% yield (143.5 mg) as brown metal color solid from **5c** (700.9 mg, 2.6 mmol) using the same procedure for **1a** except that the solvent was n-butanol. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09-8.02 (m, 8H), 7.53-7.42 (m, 12H), 7.04 (s, 2H).

BF_2 chelate of N-(3,5-bis(4-methoxyphenyl)-1H-pyrrol-2-yl)-3,5-bis (4-methoxy-phenyl)-2H-pyrrol-2-imine (**1f**).[11] **1f** was prepared in a 28% yield (448.1 mg) as red metal color solid from **5f** (1.7 g, 5.1 mmol) using the same procedure for **1a**.1H NMR (400 MHz, $CDCl_3$) ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (dd, *J* = 8.4, 7.0 Hz, 8H), 6.99 (dd, *J* = 8.7, 4.0 Hz, 8H), 6.93 (s, 2H), 3.89 (d, *J* = 5.1 Hz, 12H).

5. UV−Vis absorption of 1b in chloroform.

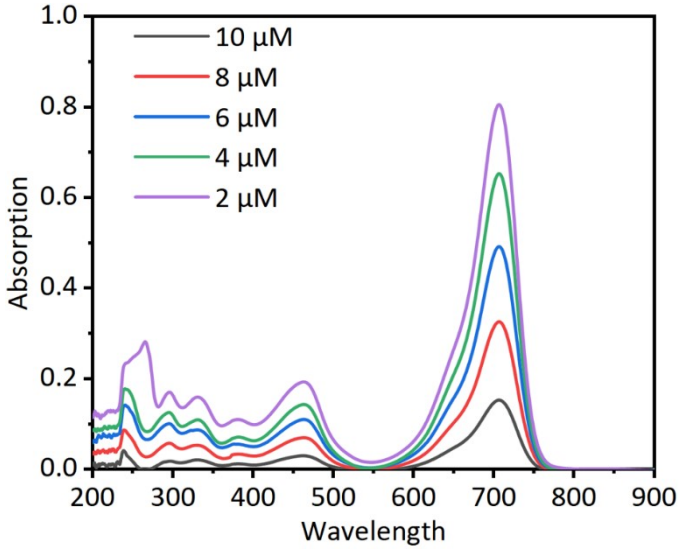


Fig. S1 UV−Vis absorption of **1b** in chloroform with different concentration (C = 2, 4, 6, 8, 10 μM).

6. UV−Vis absorption of DPBF in chloroform.

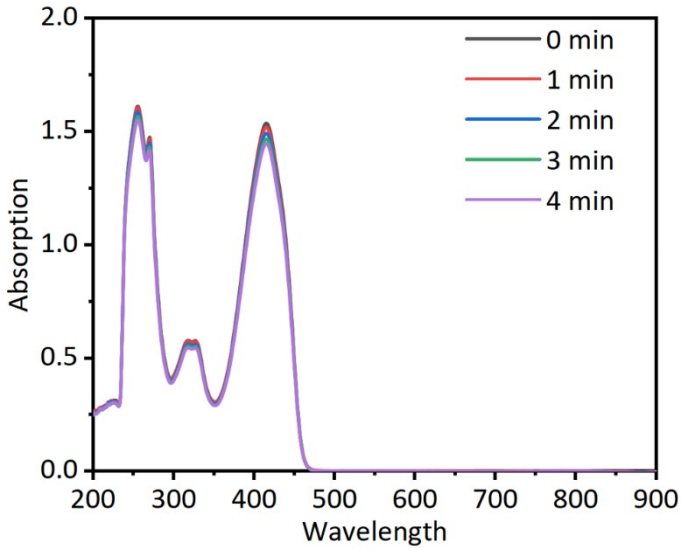
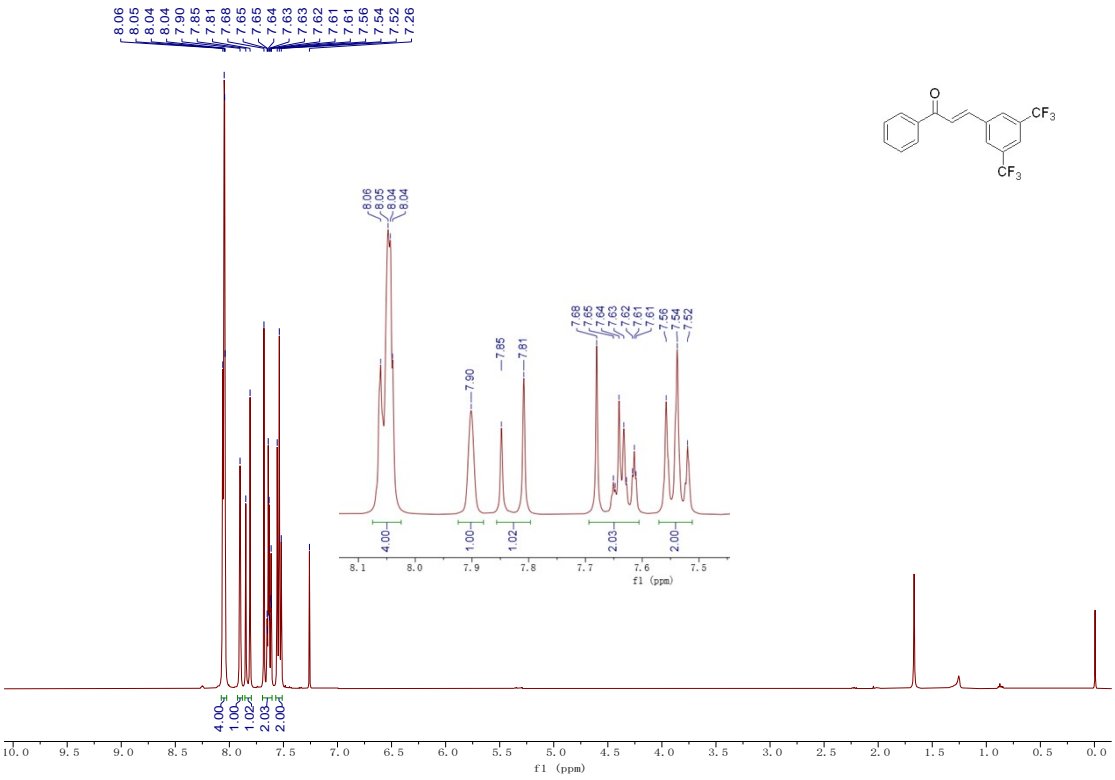
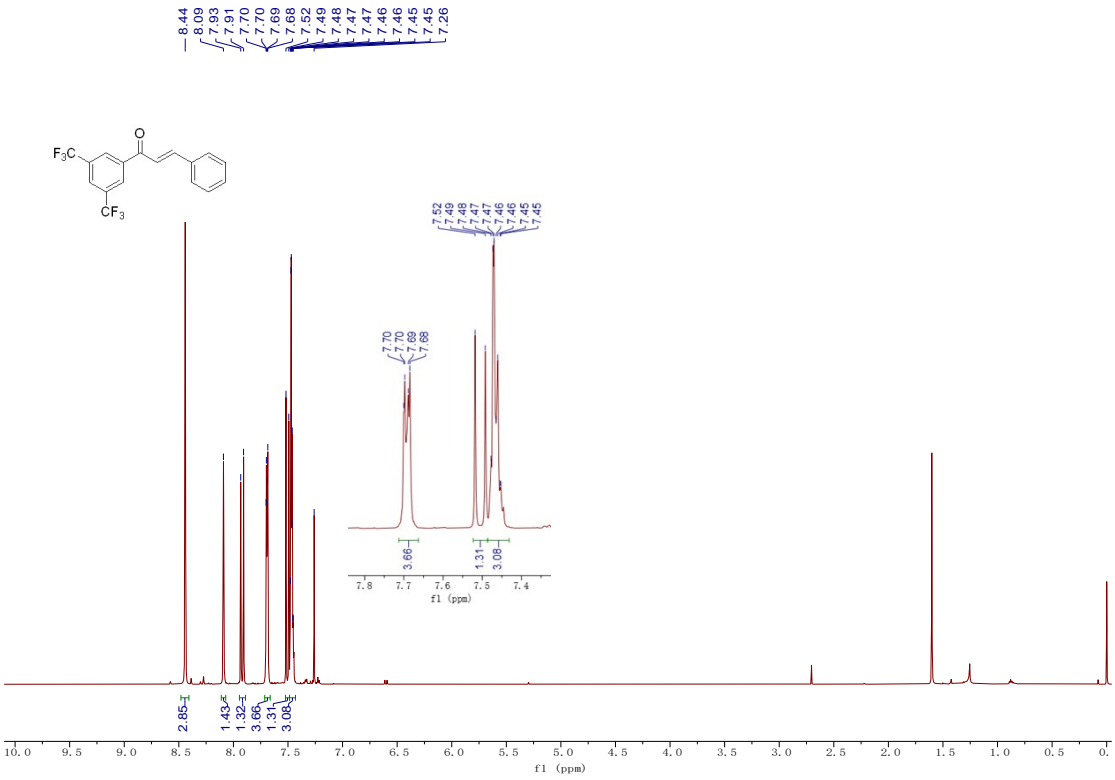


Fig. S2 UV−Vis absorption of **DPBF** in chloroform under irradiation with different times (C = 40 μM, 660 nm, 0.5 W/cm^2).

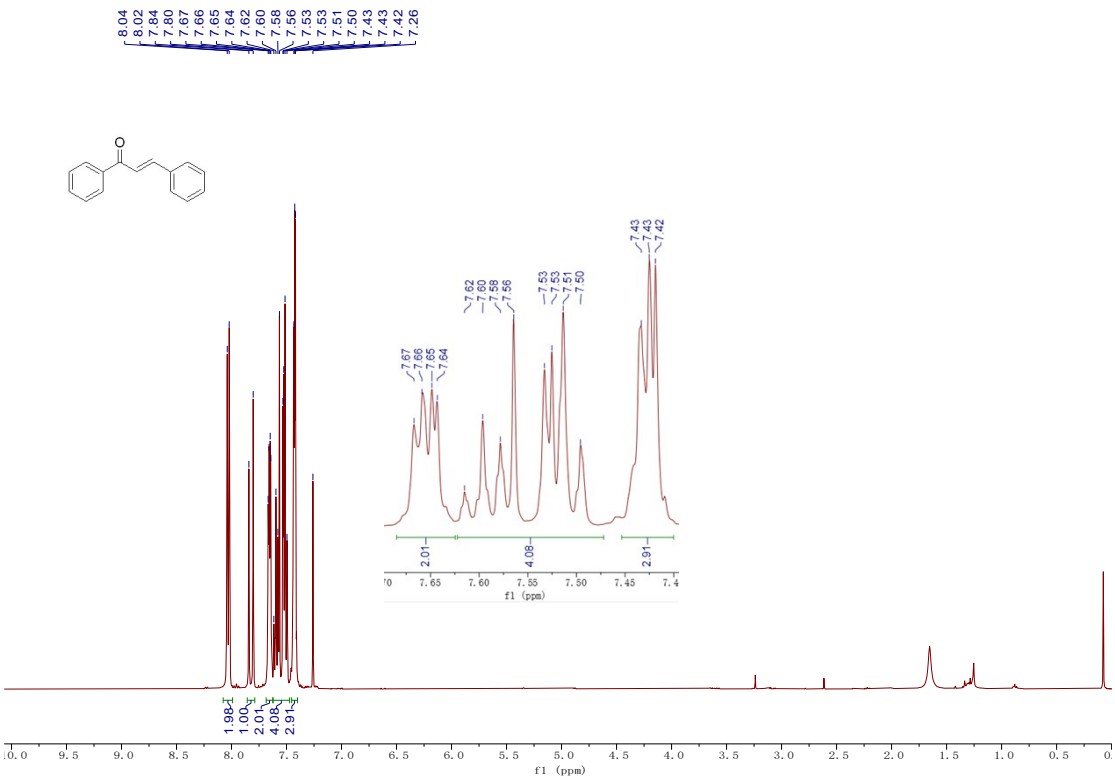
7. Copies of ^{1}H, ^{13}C, ^{19}F NMR, and HRMS spectra of compounds.



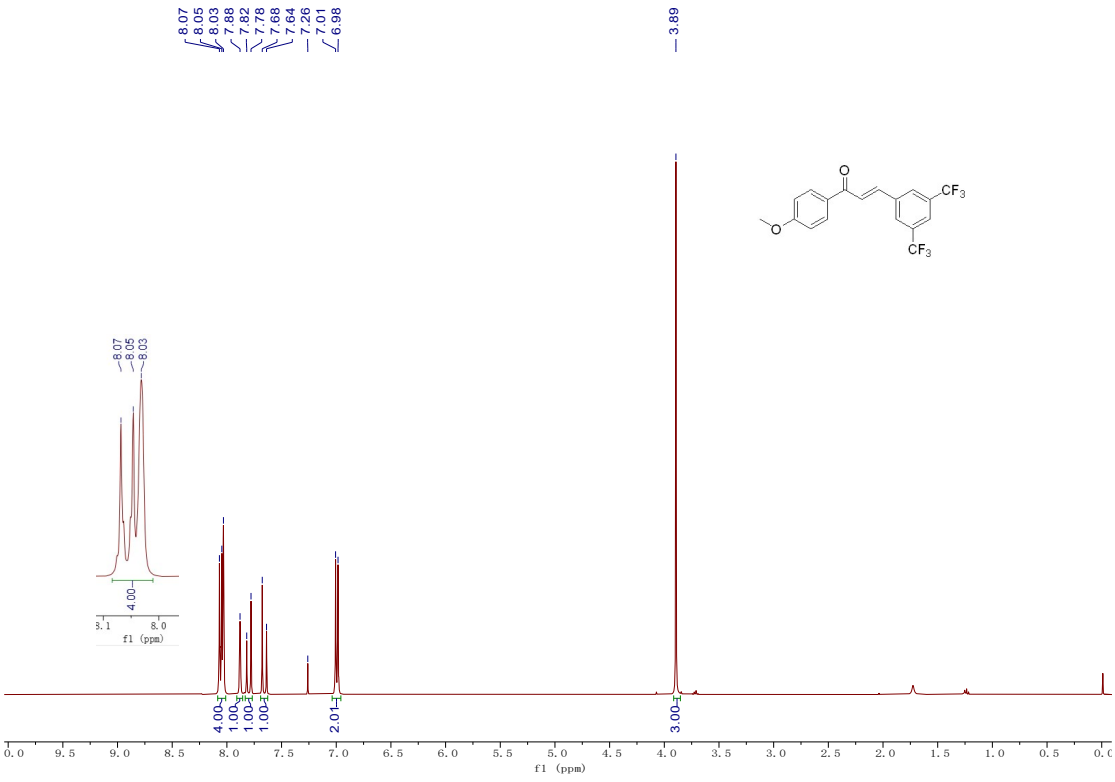
^{1}H NMR spectrum of **4a.**



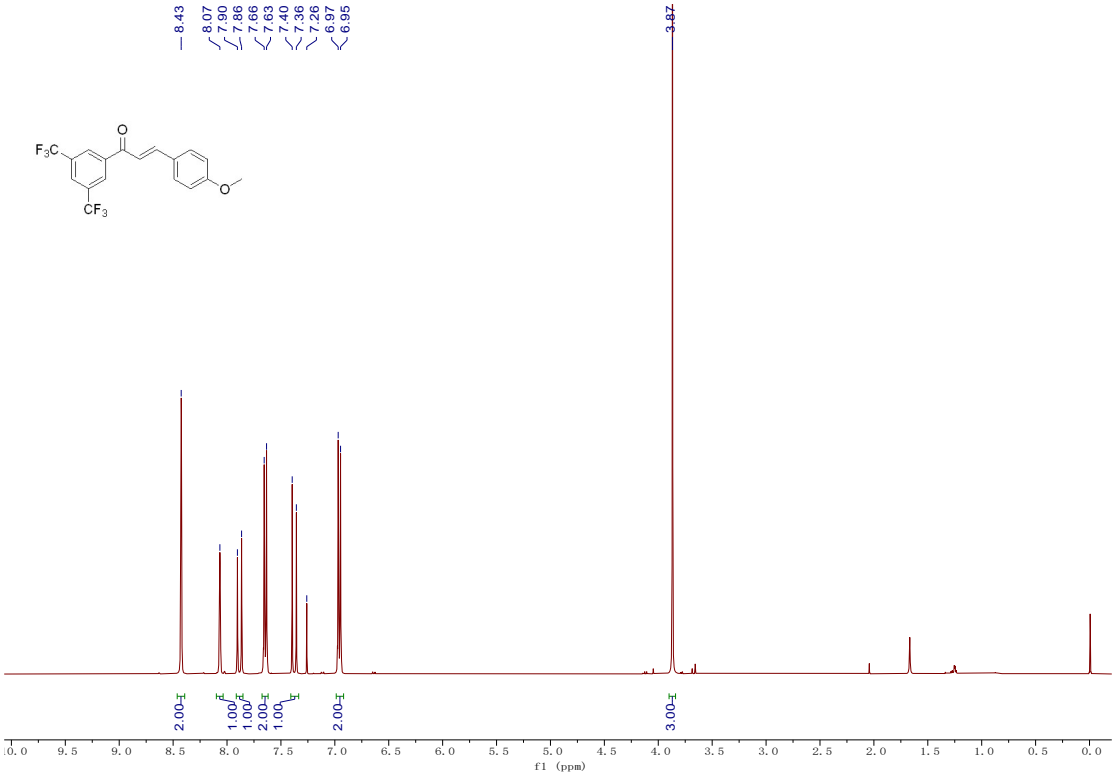
^{1}H NMR spectrum of **4b**.



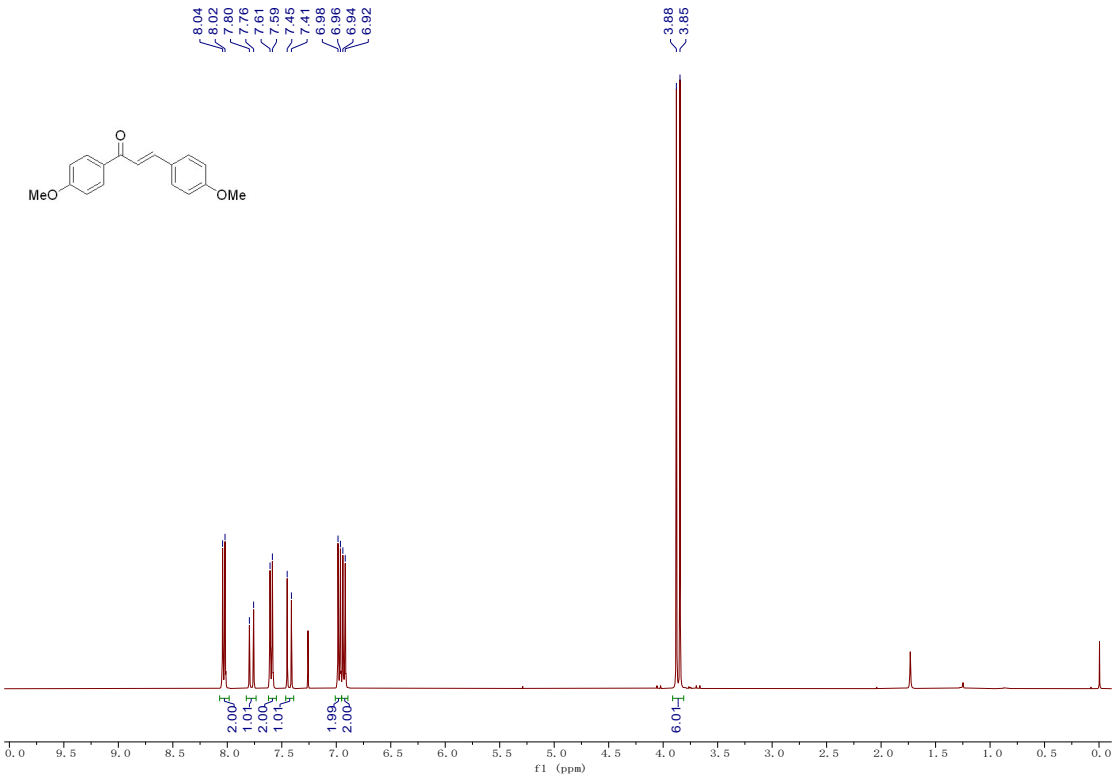
^{1}H NMR spectrum of **4c**.



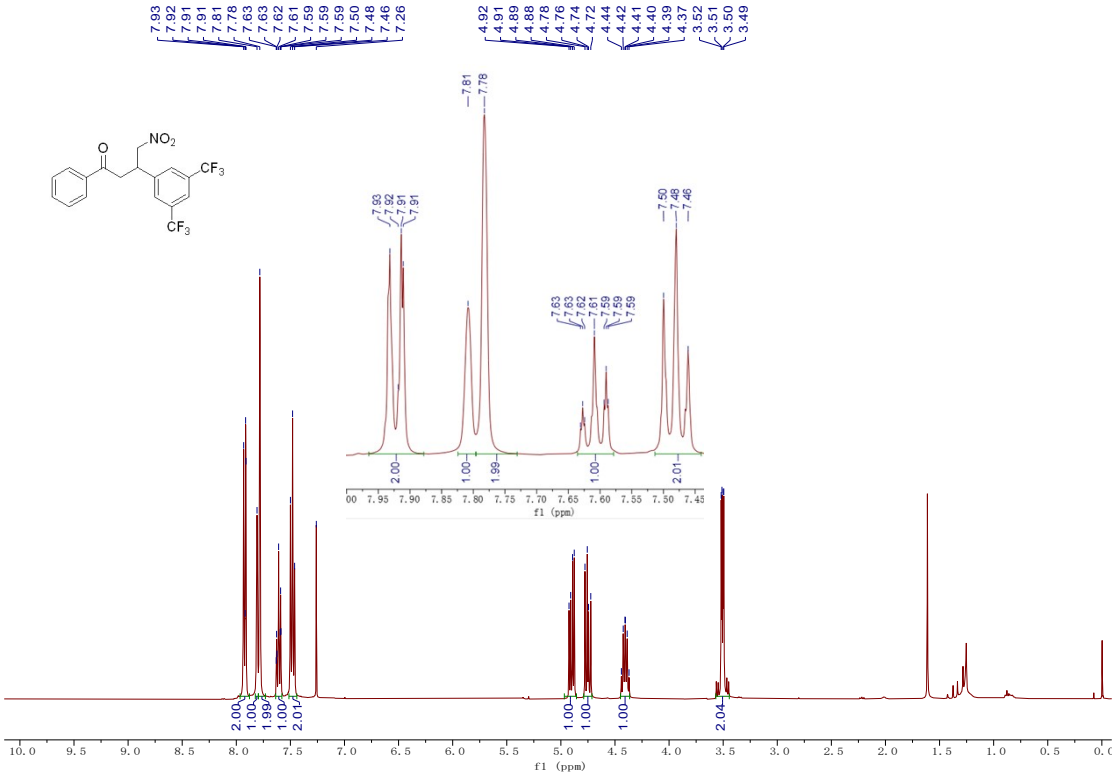
^{1}H NMR spectrum of **4d**.



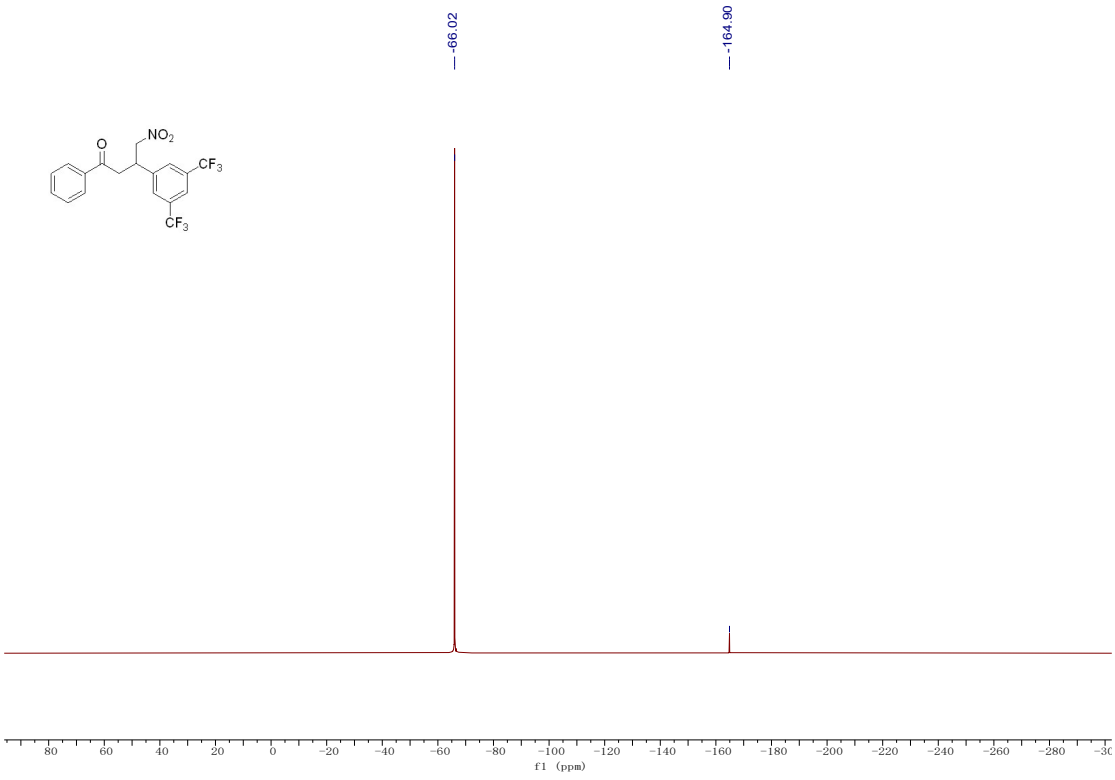
^{1}H NMR spectrum of **4e**.



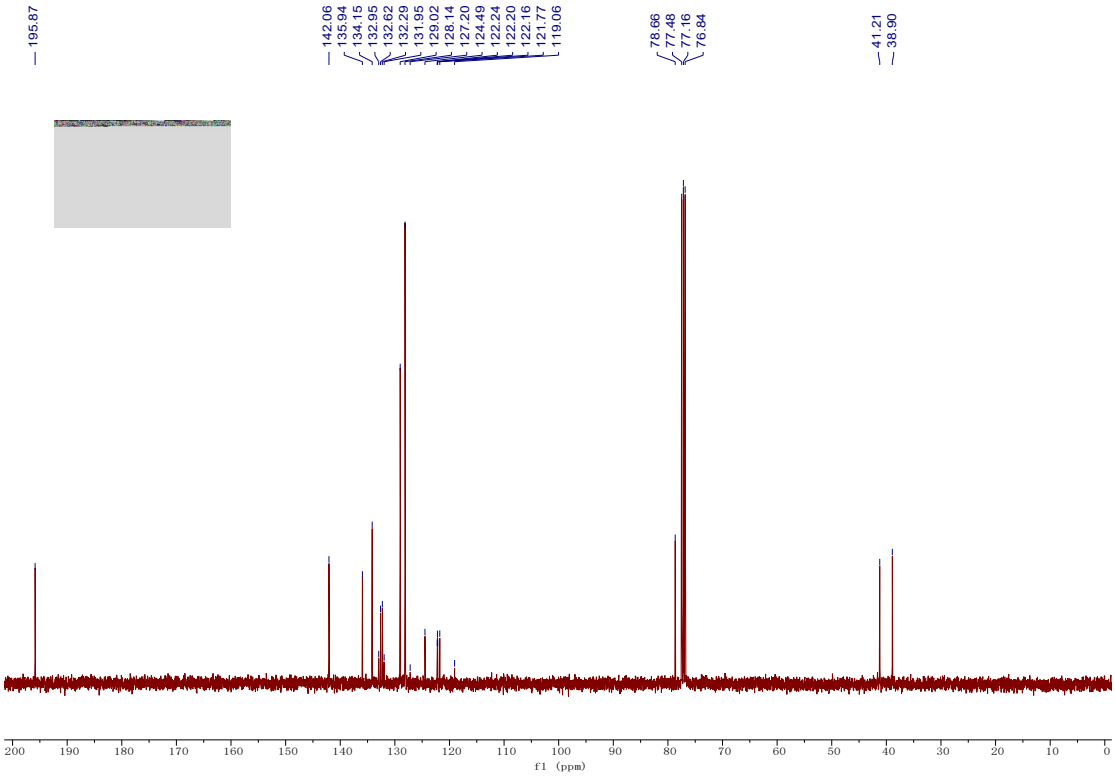
^{1}H NMR spectrum of **4f**.



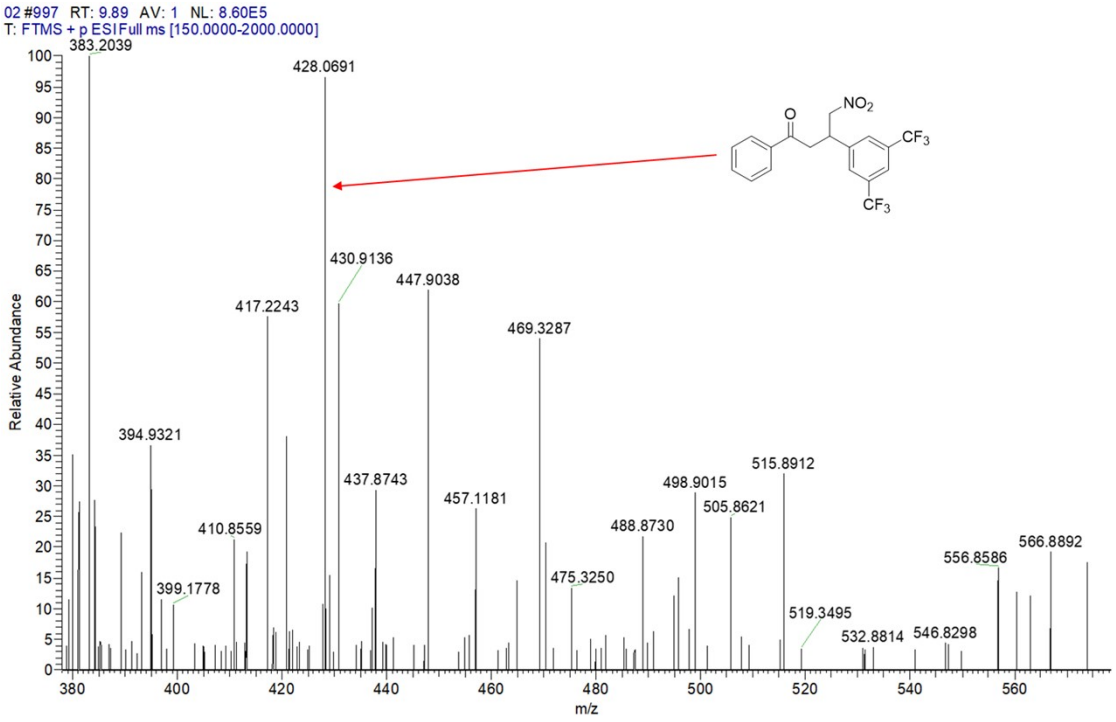
^{1}H NMR spectrum of **5a**.



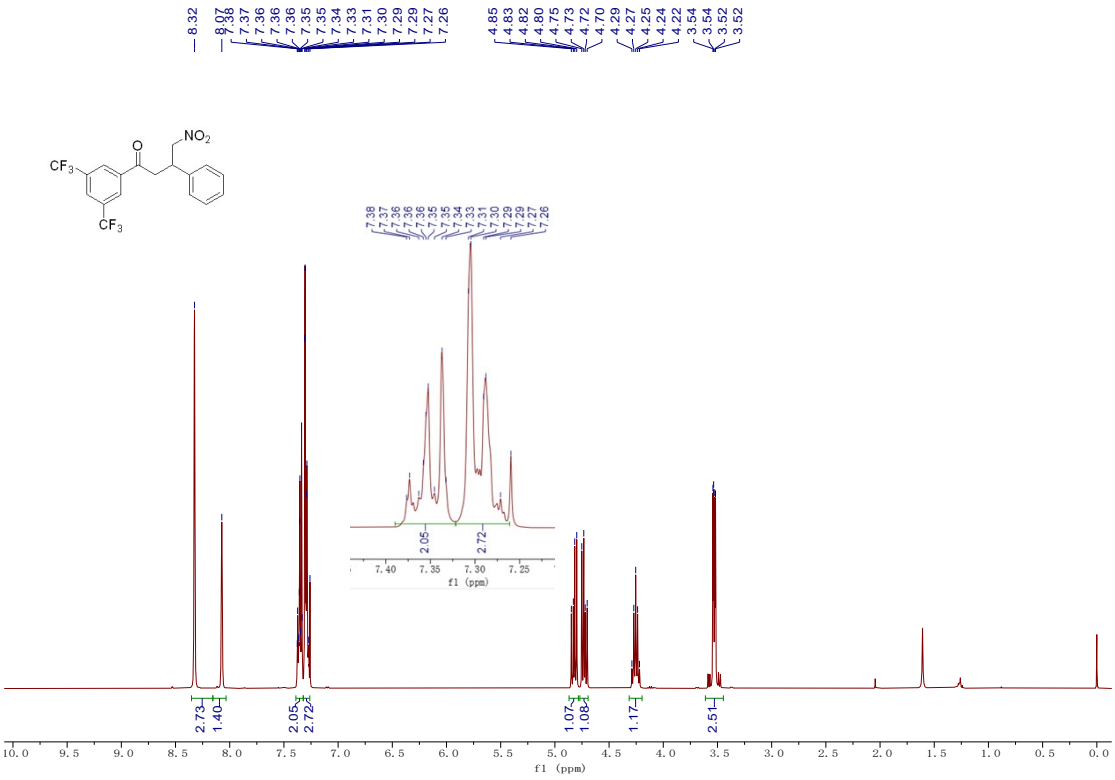
^{19}F NMR spectrum of **5a**.



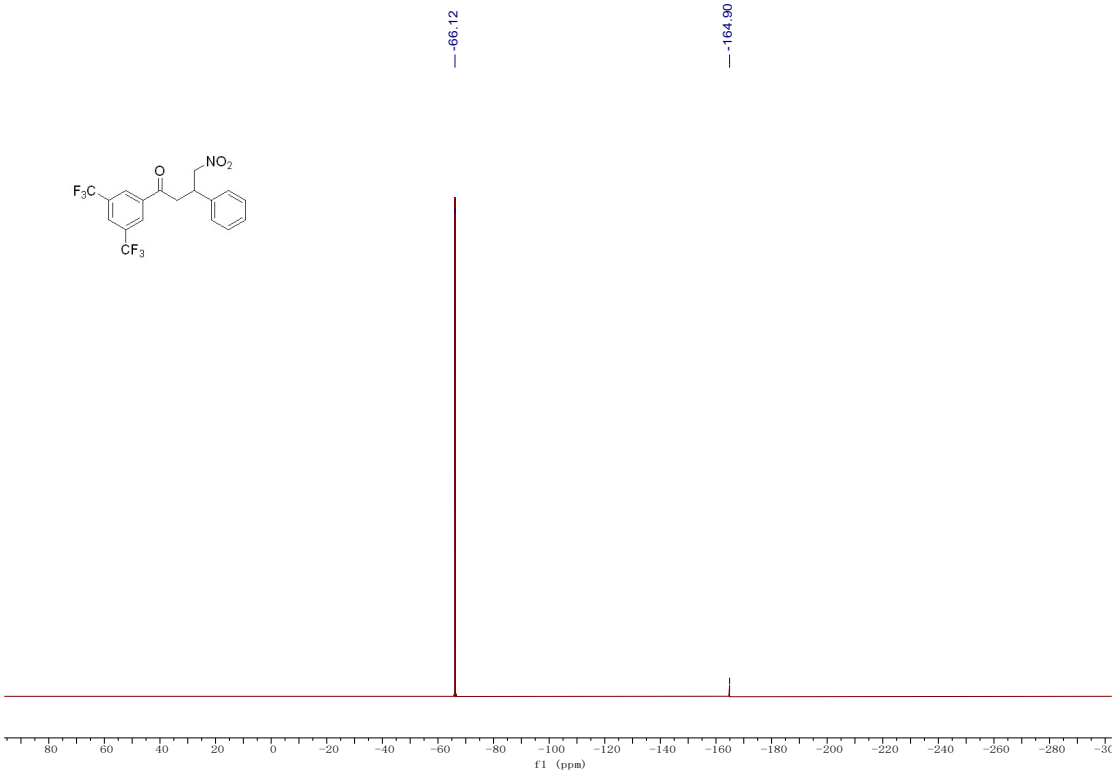
^{13}C NMR spectrum of **5a**.



HRMS (ESI) spectrum of **5a**.



^{1}H NMR spectrum of **5b**.



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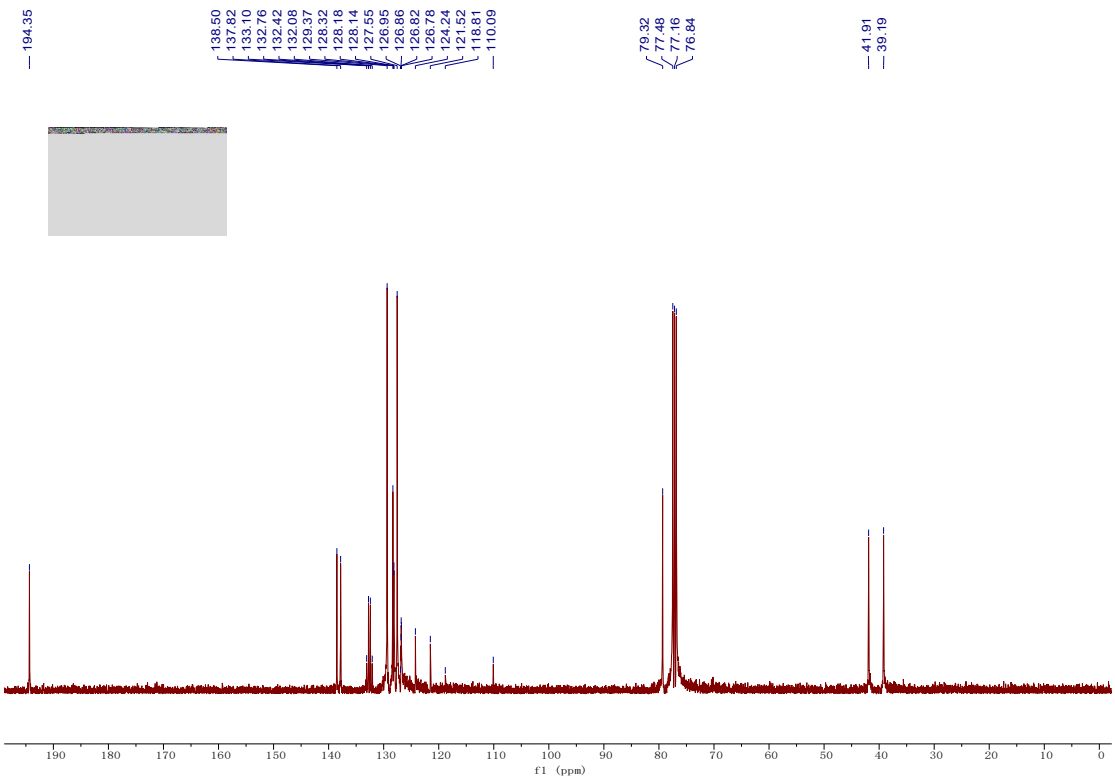

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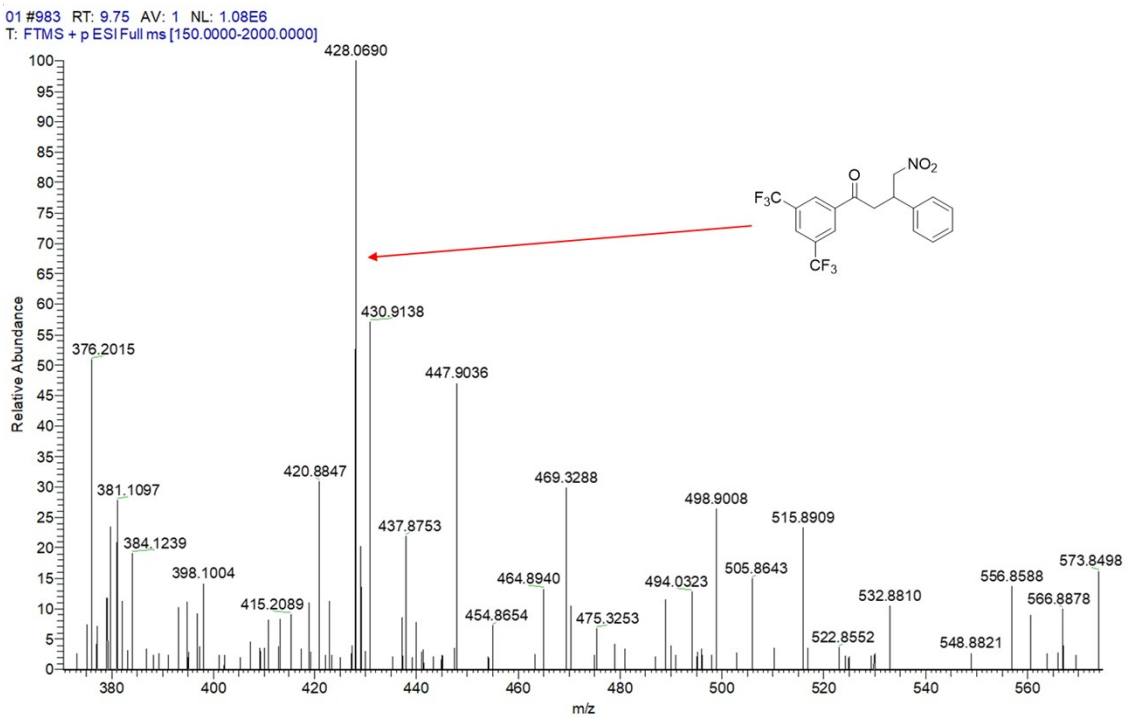
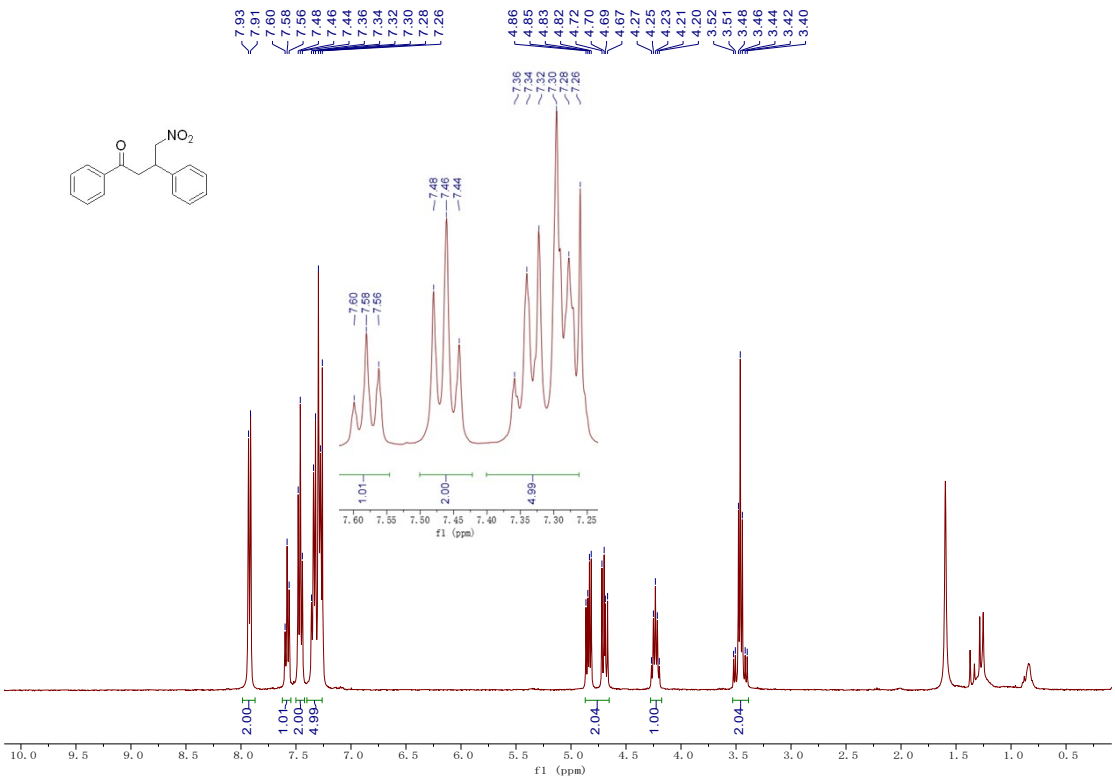
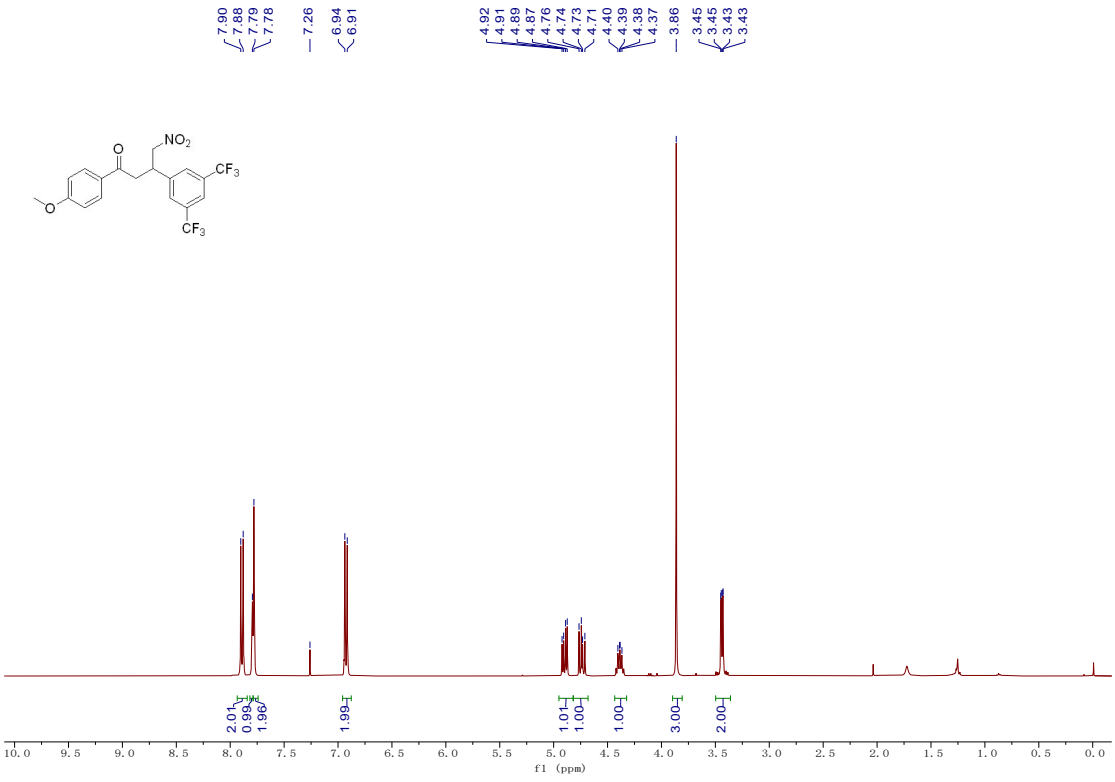


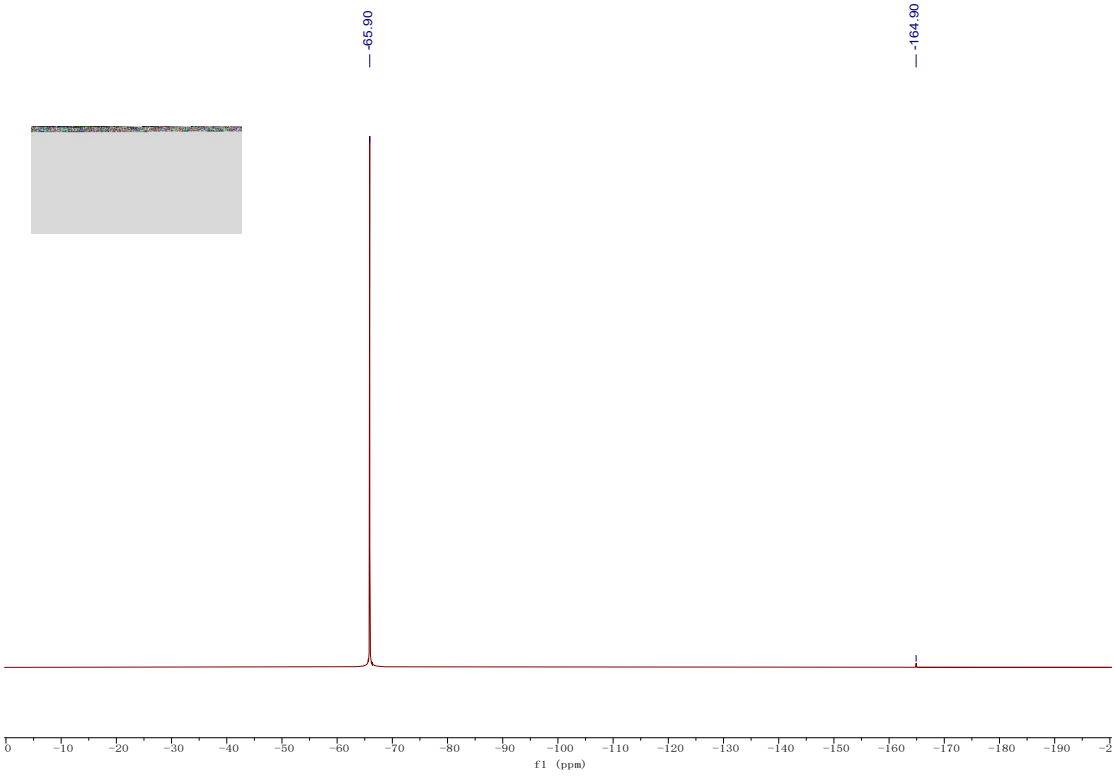
HRMS (ESI) spectrum of **5b**.



^{1}H NMR spectrum of **5c**.



^{1}H NMR spectrum of **5d**.



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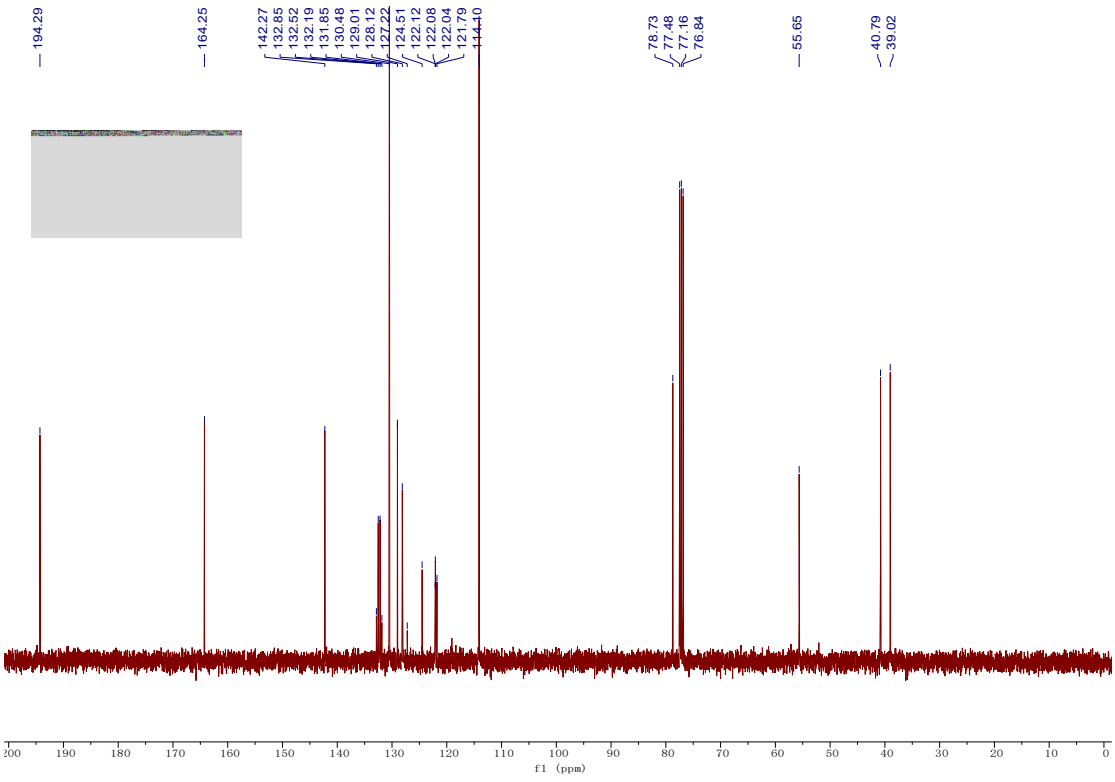

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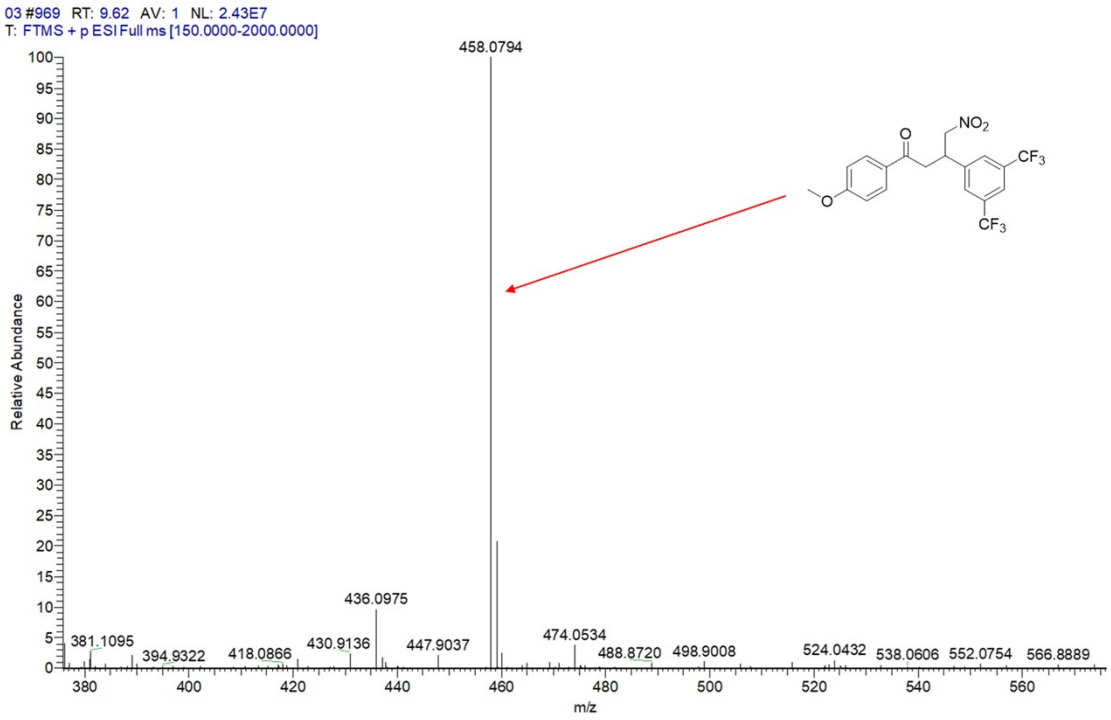
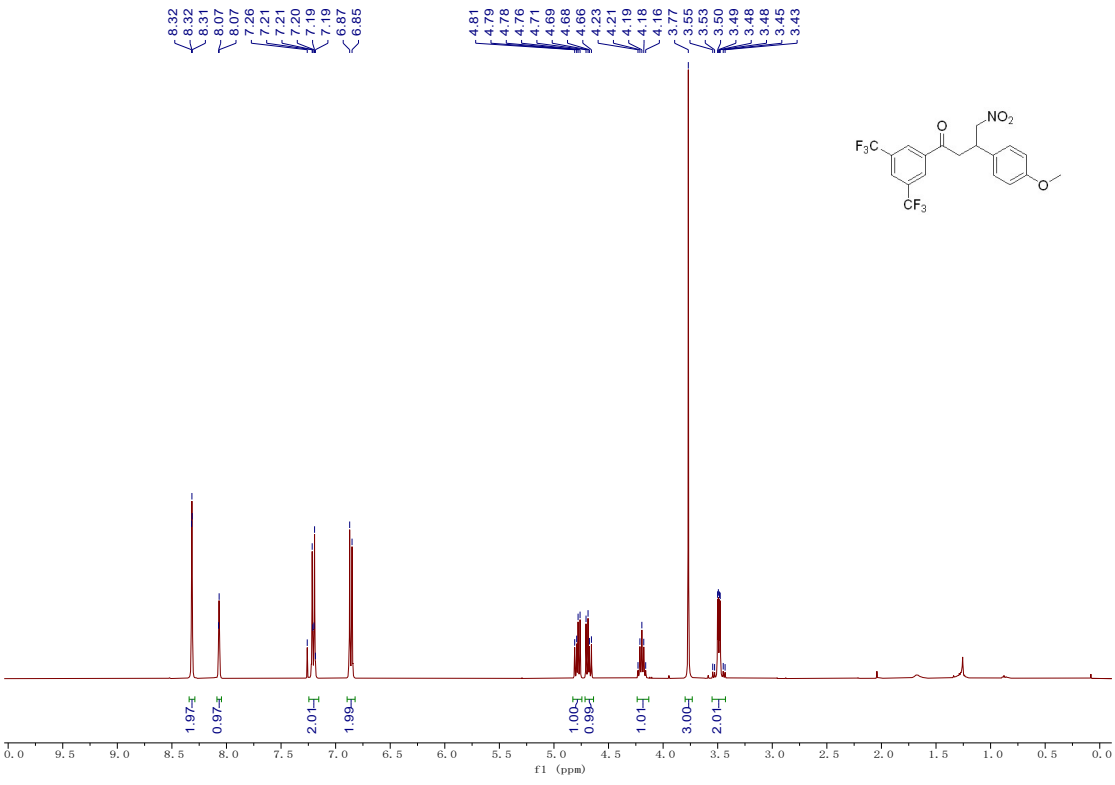
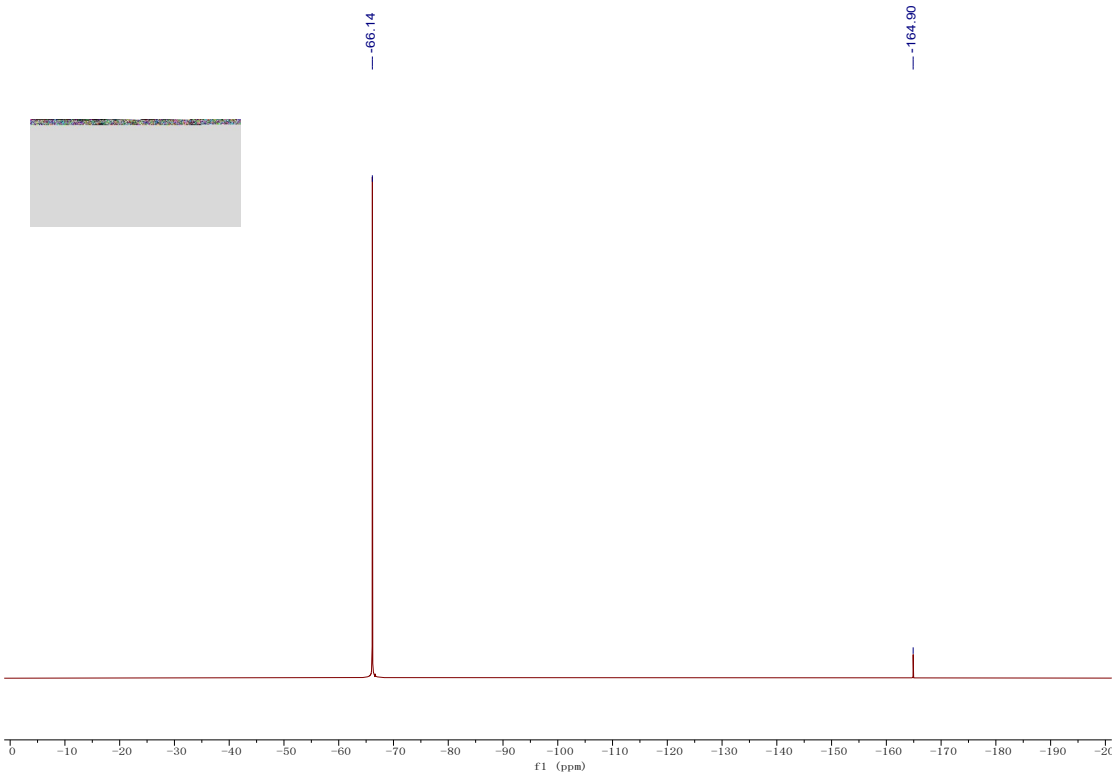


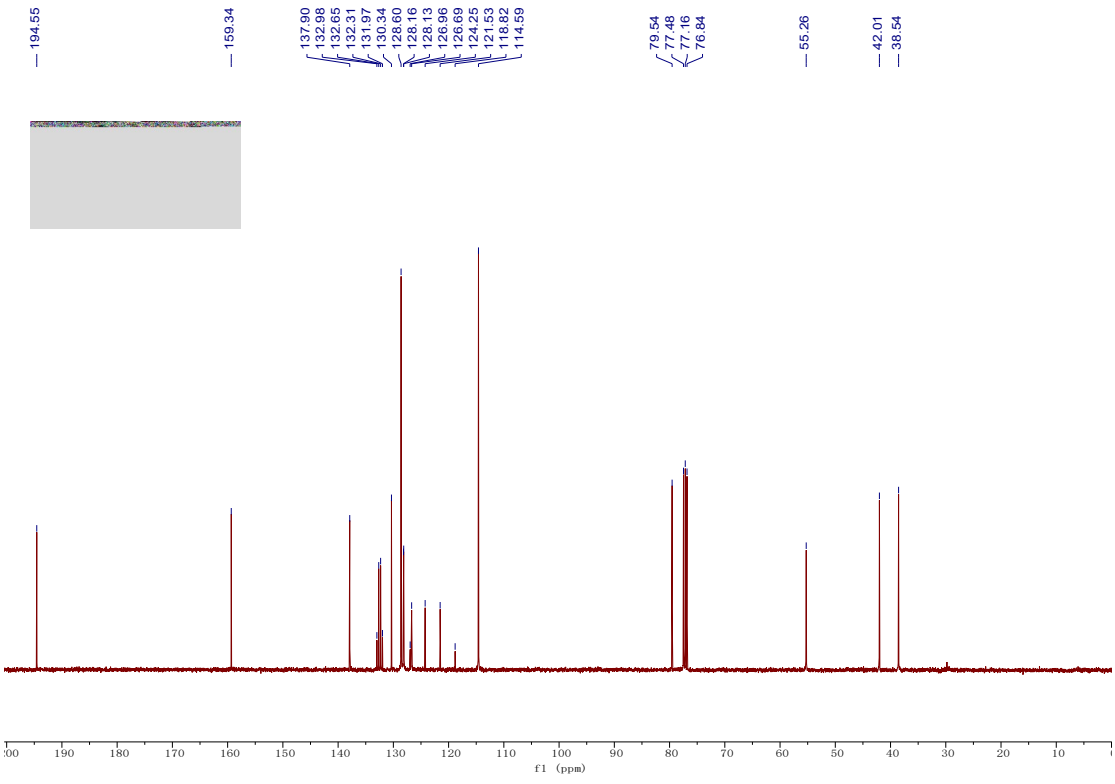
HRMS (ESI) spectrum of **5d**.



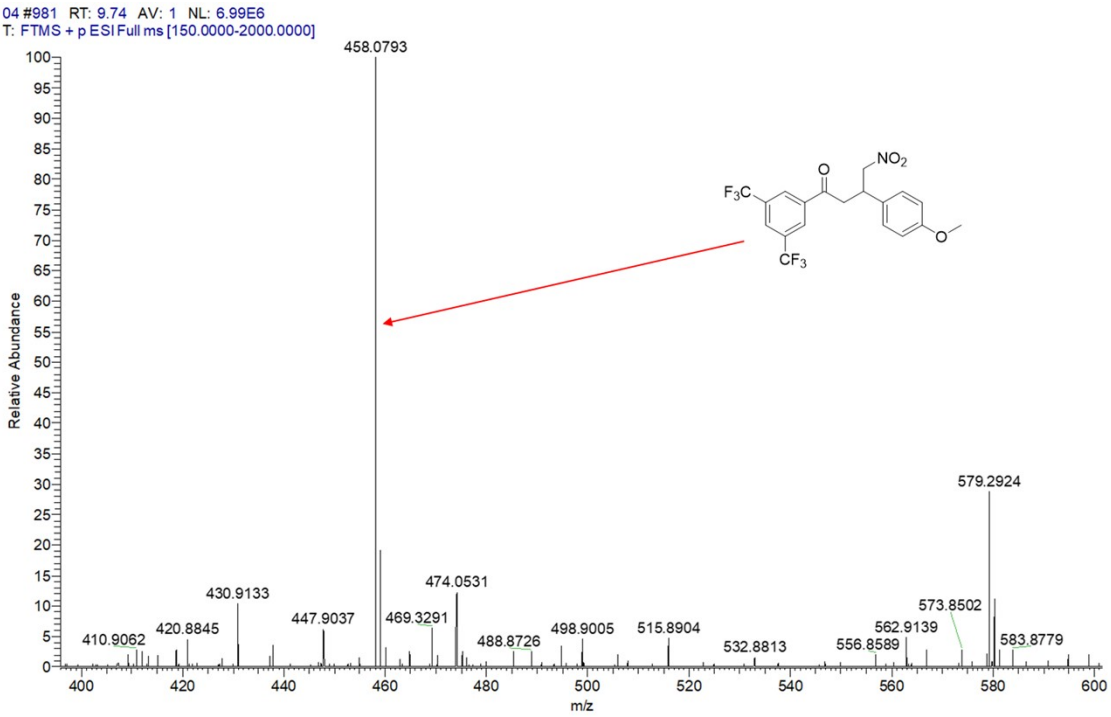
^{1}H NMR spectrum of **5e**.



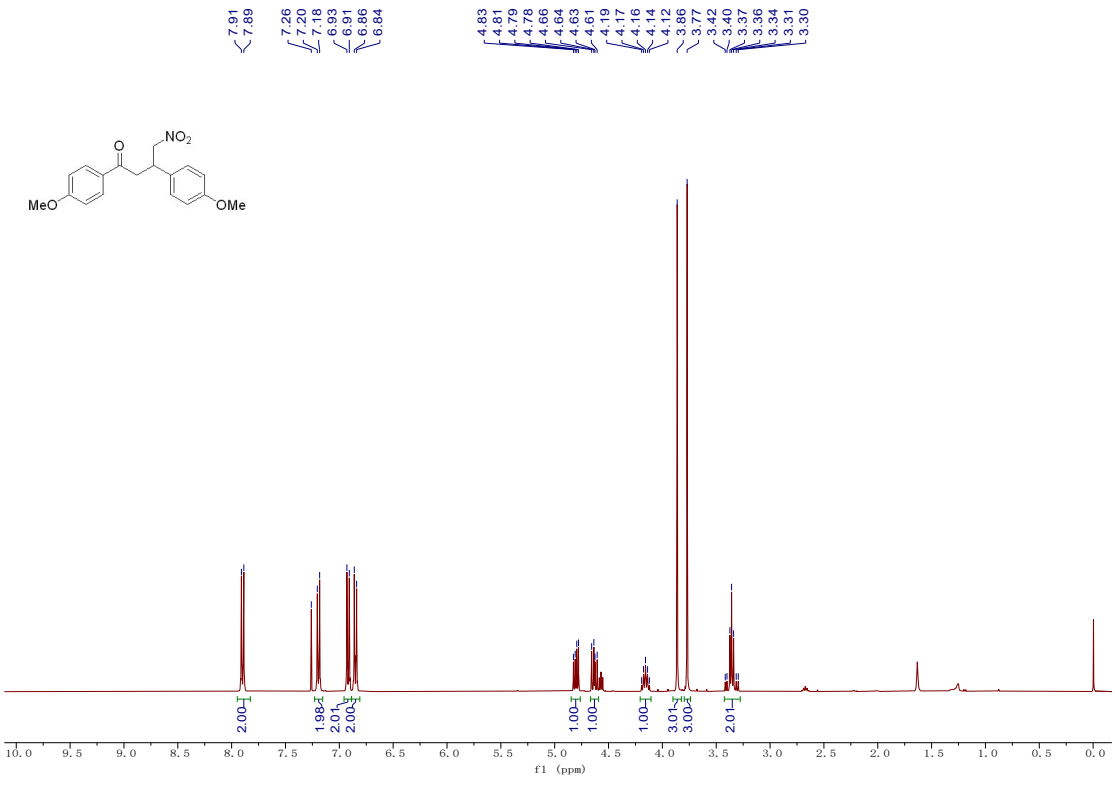
^{19}F NMR spectrum of **5e**.



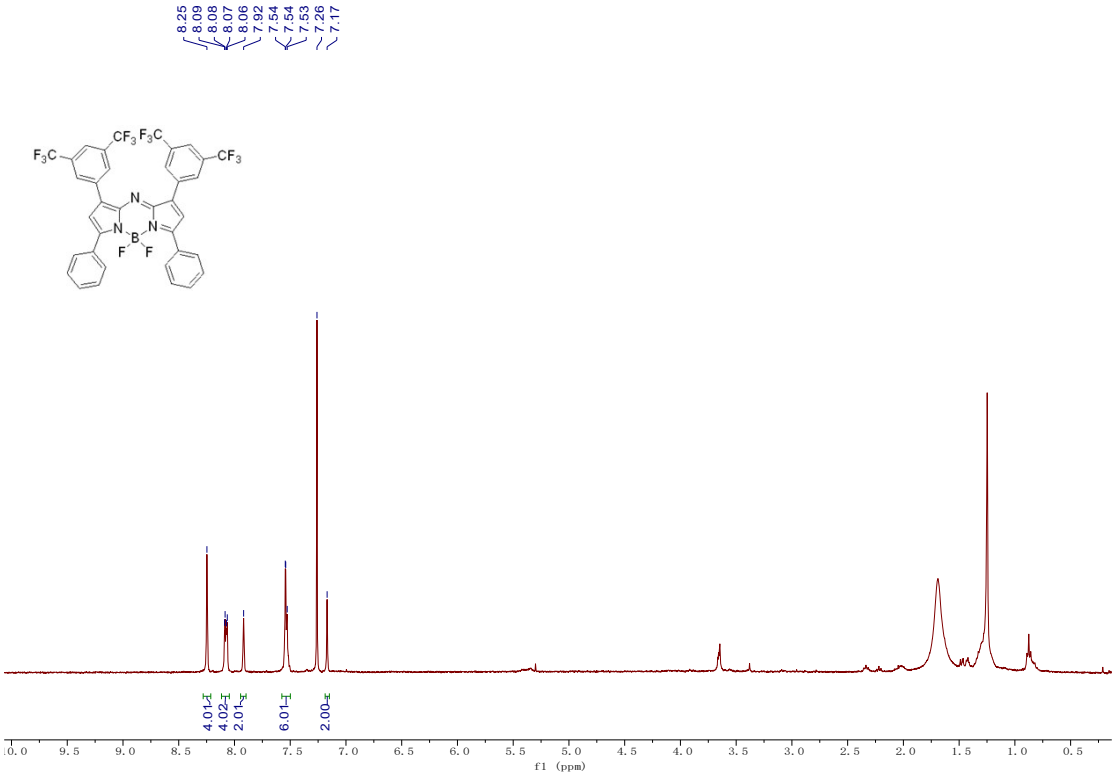
^{13}C NMR spectrum of **5e**.



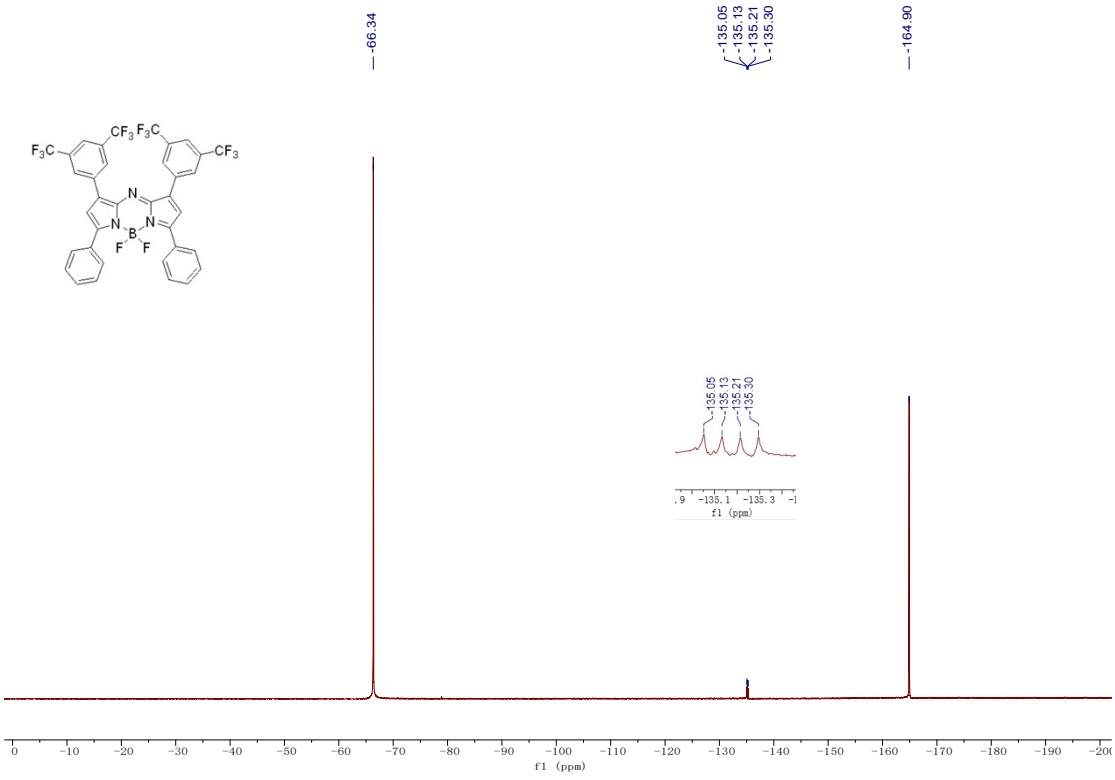
HRMS (ESI) spectrum of **5e**.



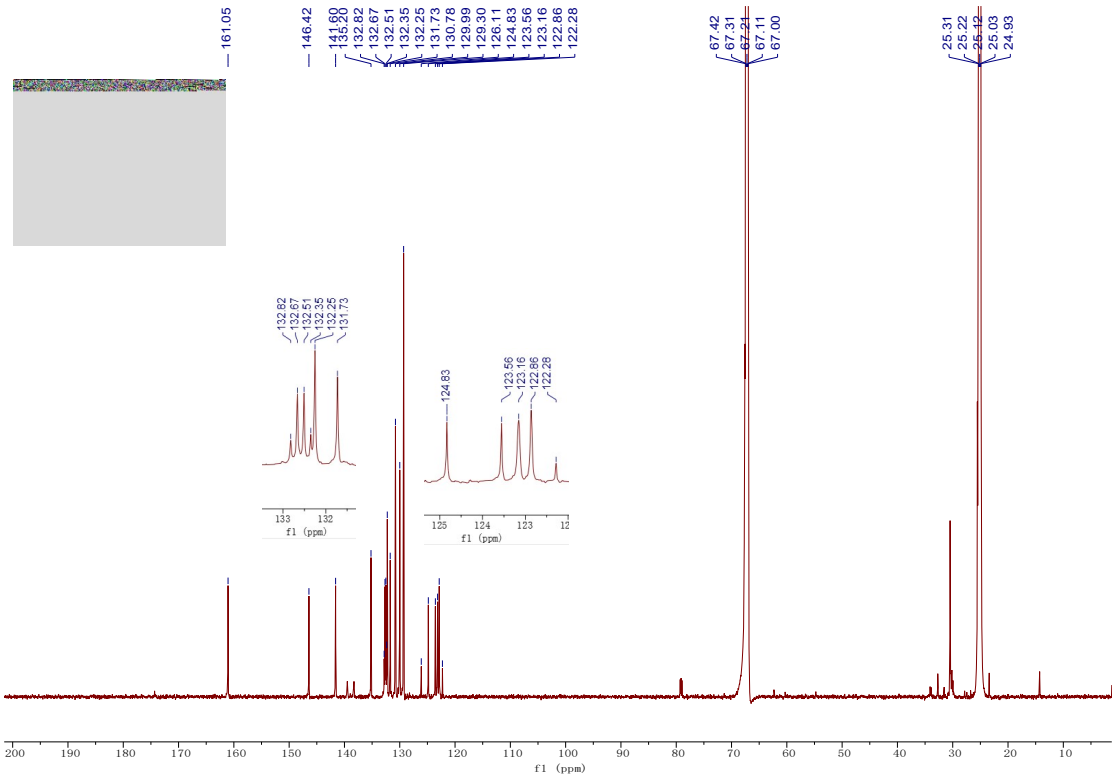
^{1}H NMR spectrum of **5f**.



^{1}H NMR spectrum of **1a**.



^{19}F NMR spectrum of **1a**.



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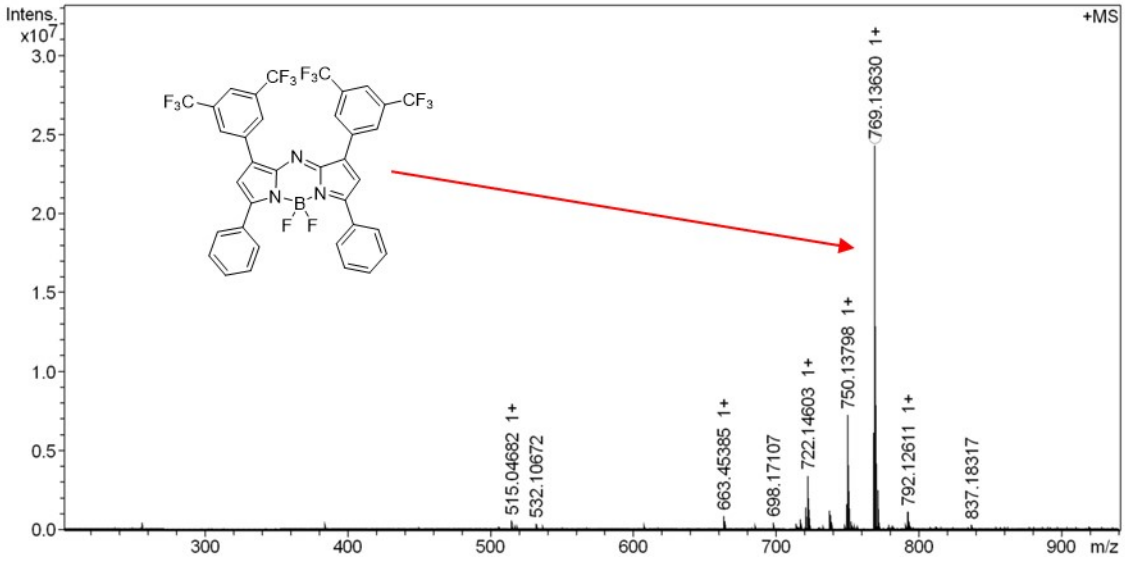
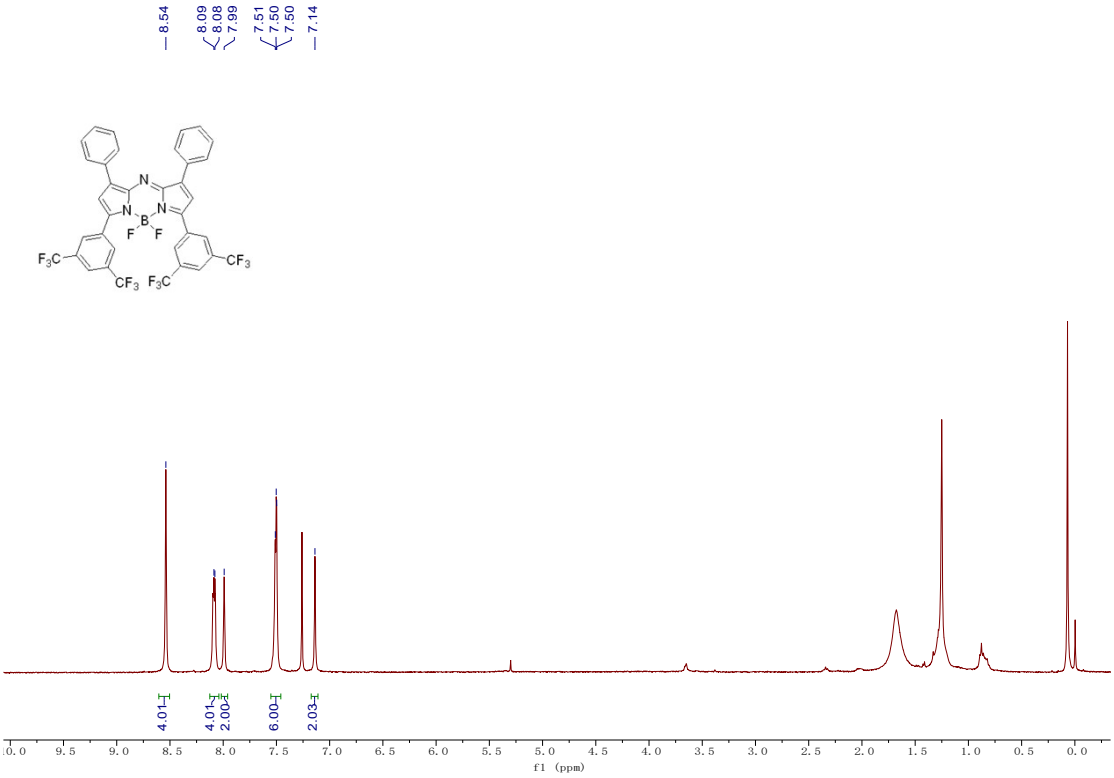
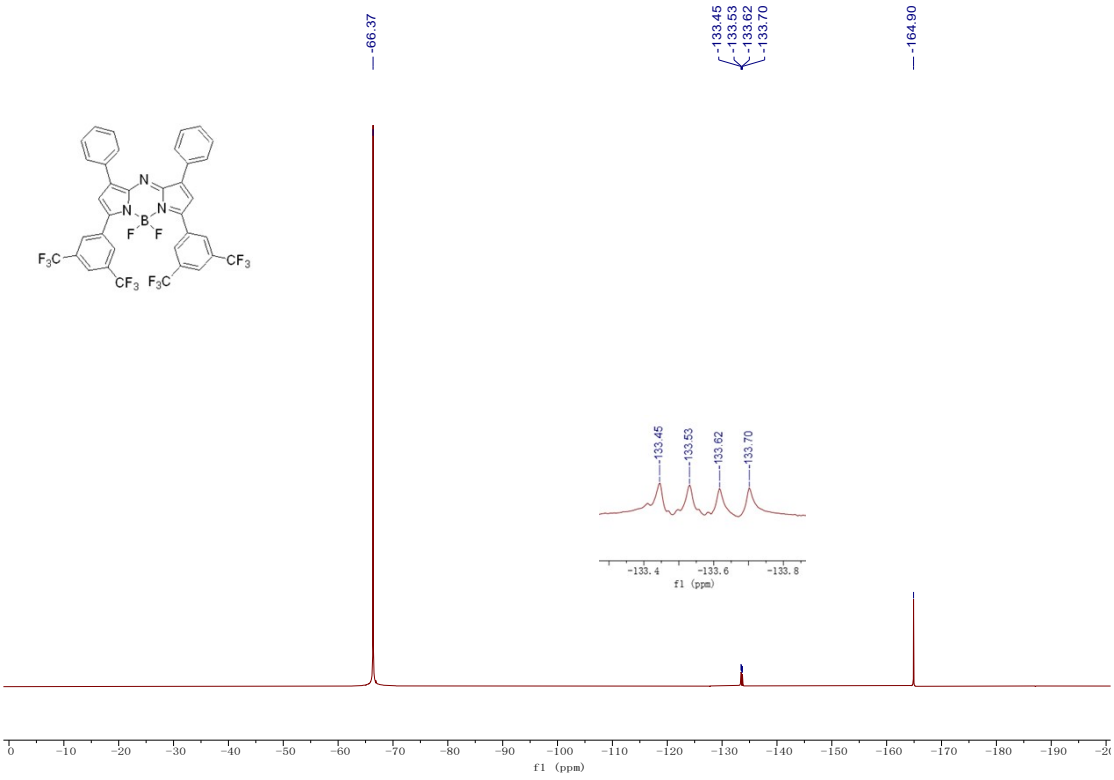


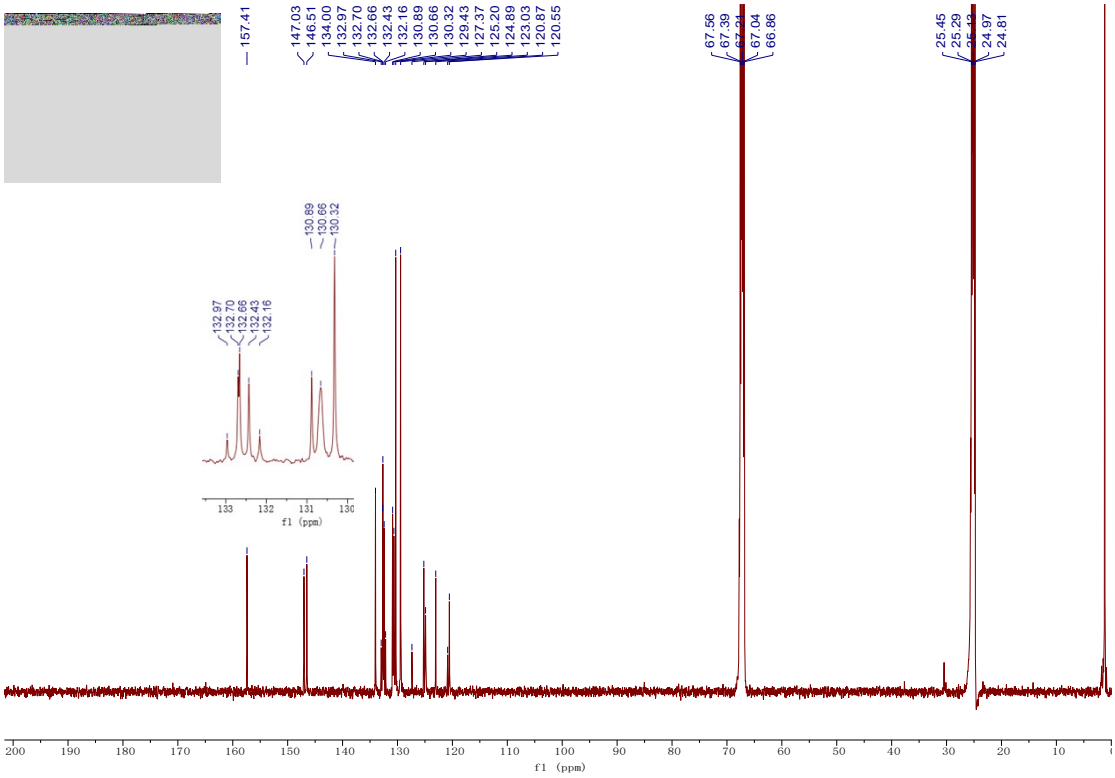
HRMS (MALDI-TOF) spectrum of **1a**.



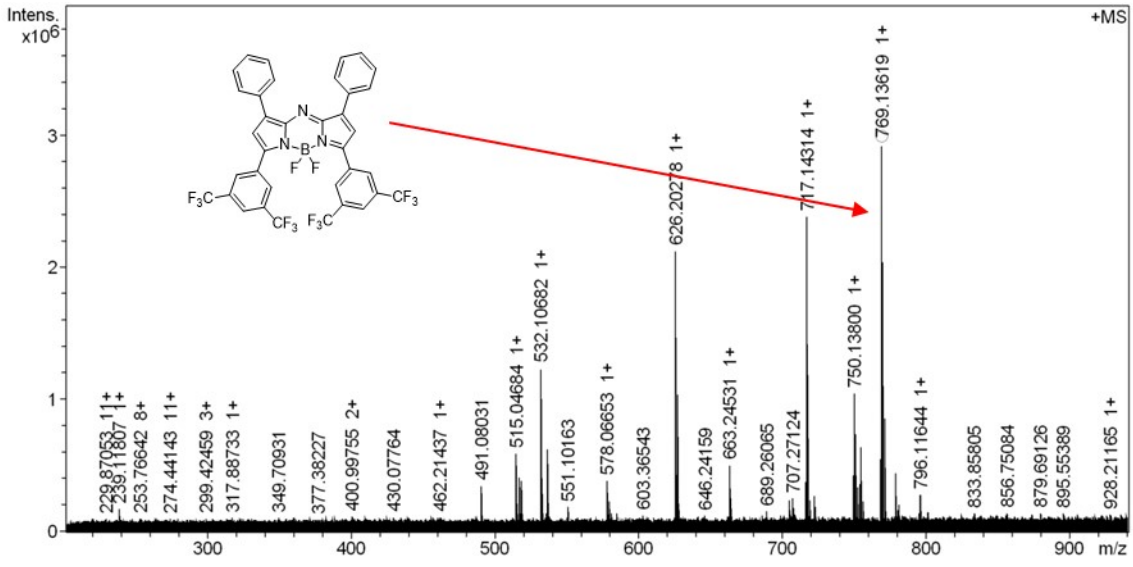
^{1}H NMR spectrum of **1b**.



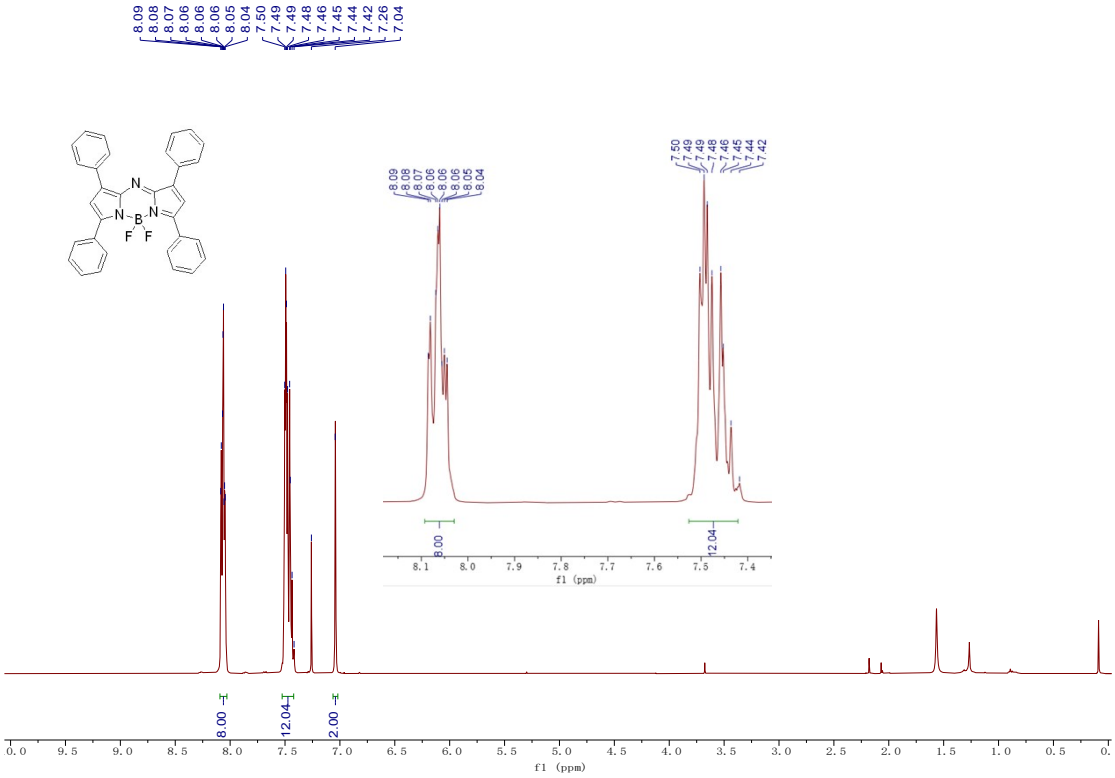
^{19}F NMR spectrum of **1b**.



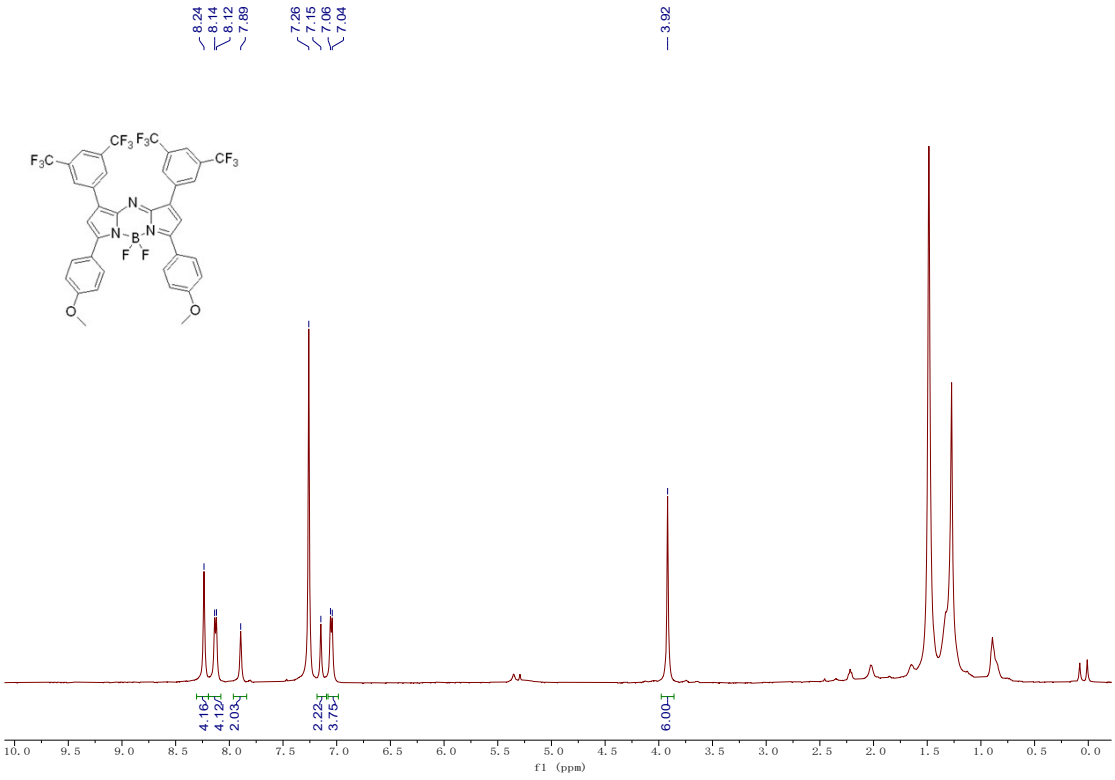
^{13}C NMR spectrum of **1b**.



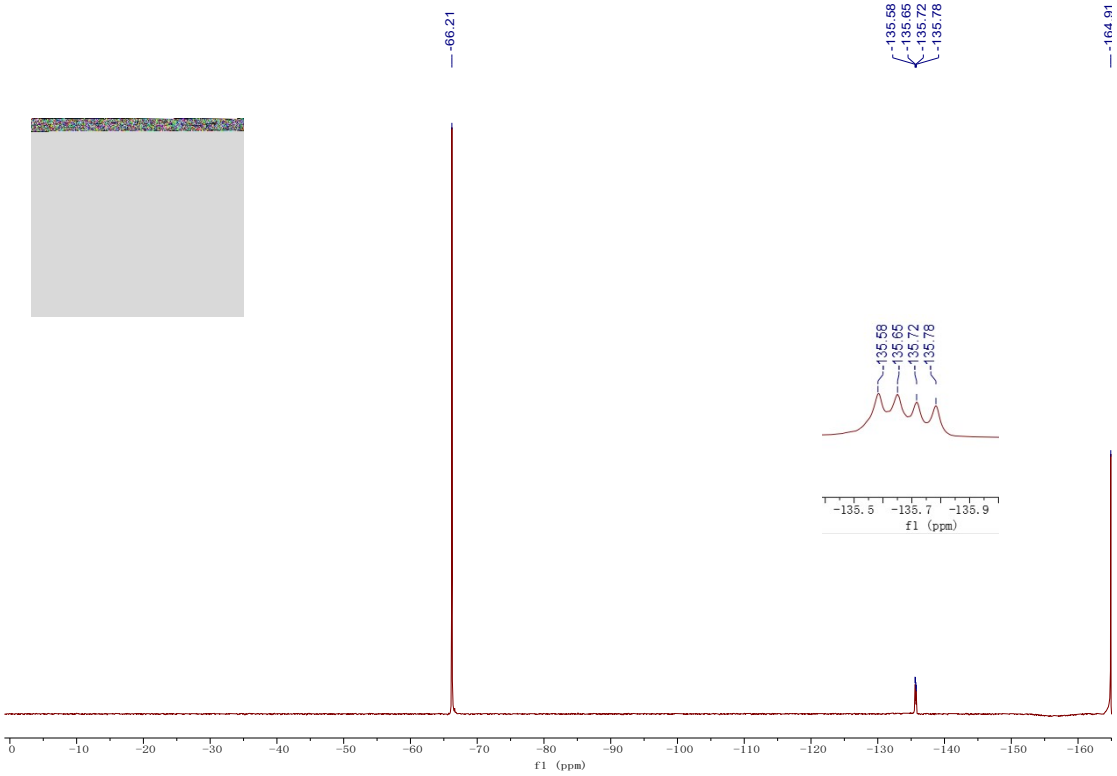
HRMS (MALDI-TOF) spectrum of **1b**.



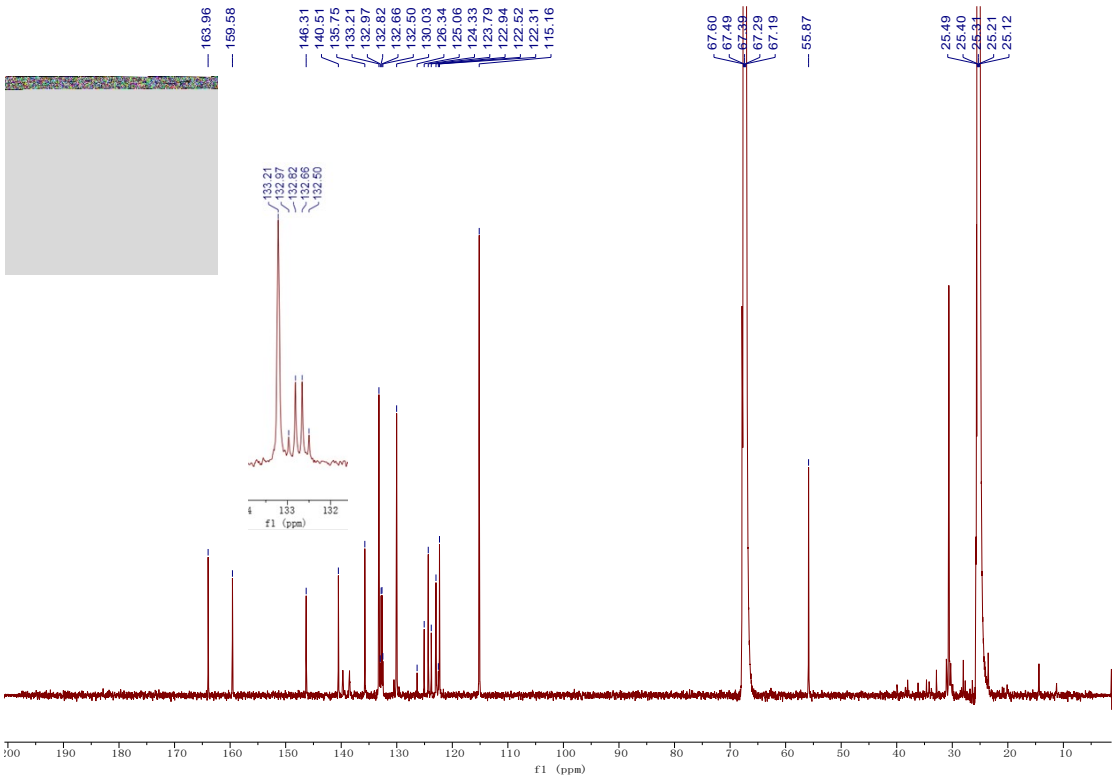
^{1}H NMR spectrum of **1c**.



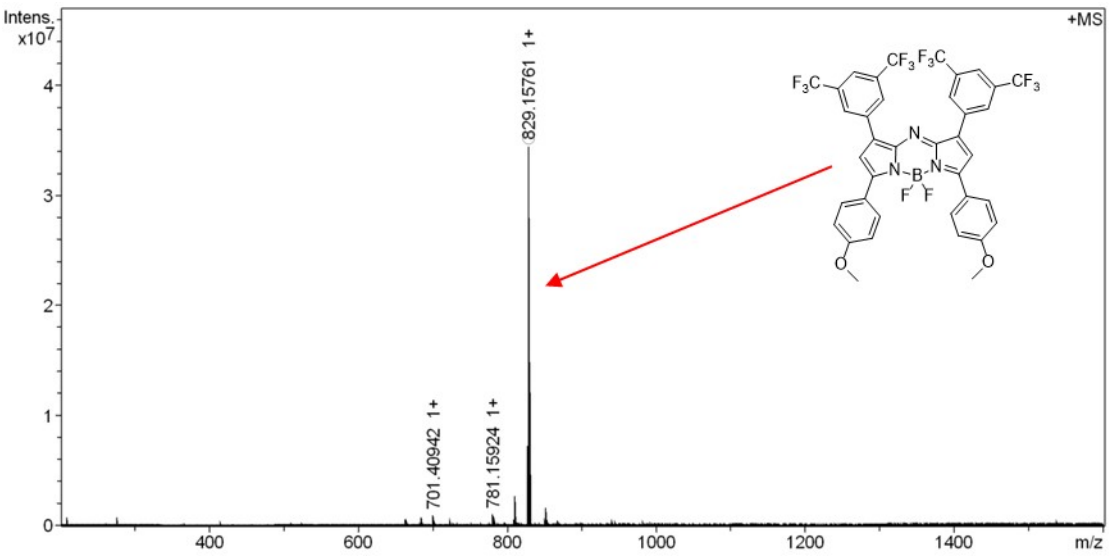
^{1}H NMR spectrum of **1d**.



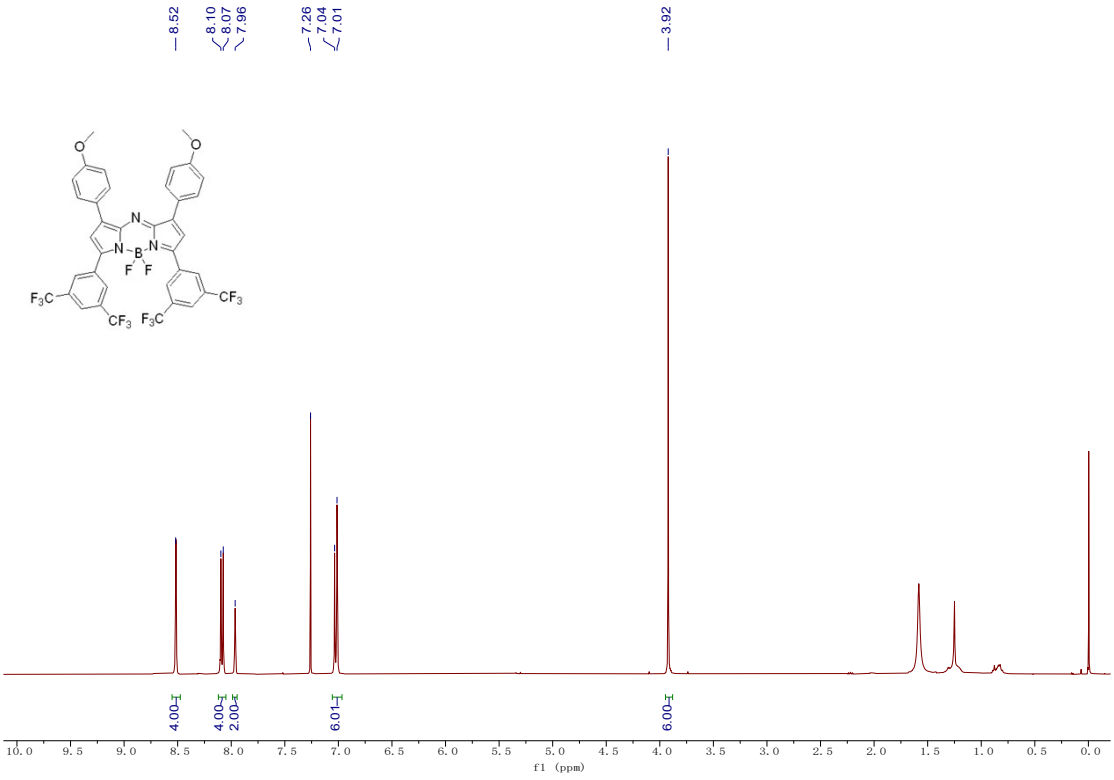
^{19}F NMR spectrum of **1d**.



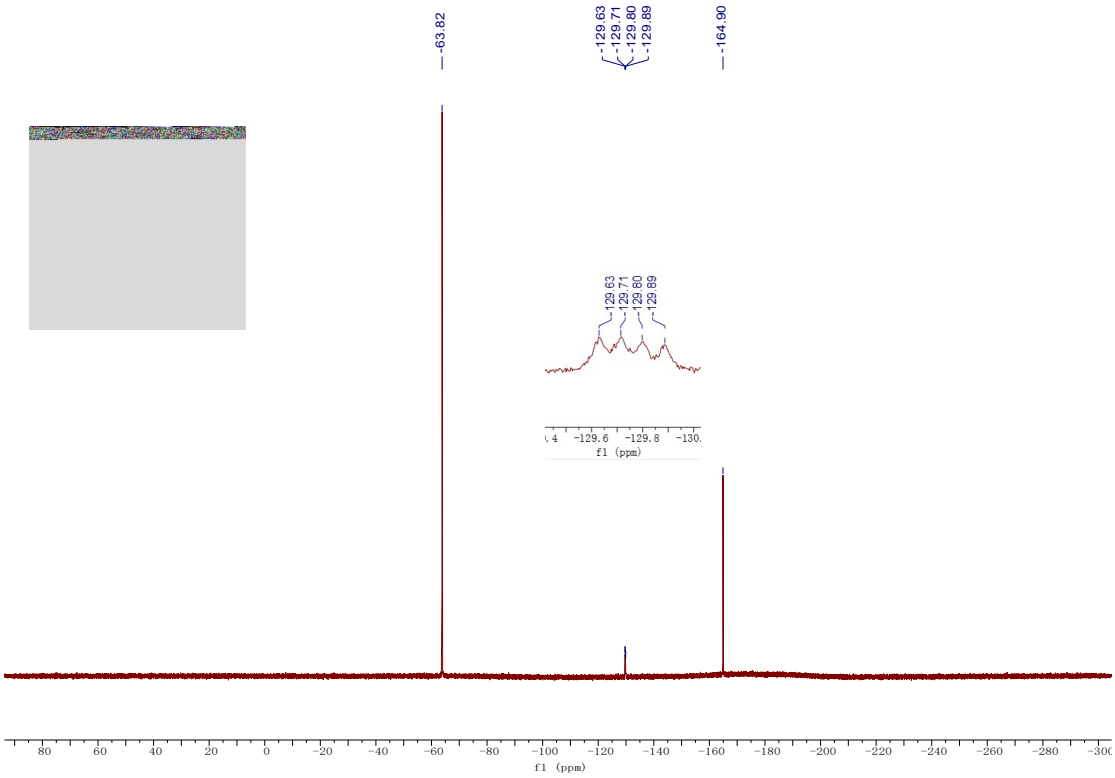
^{13}C NMR spectrum of **1d**.



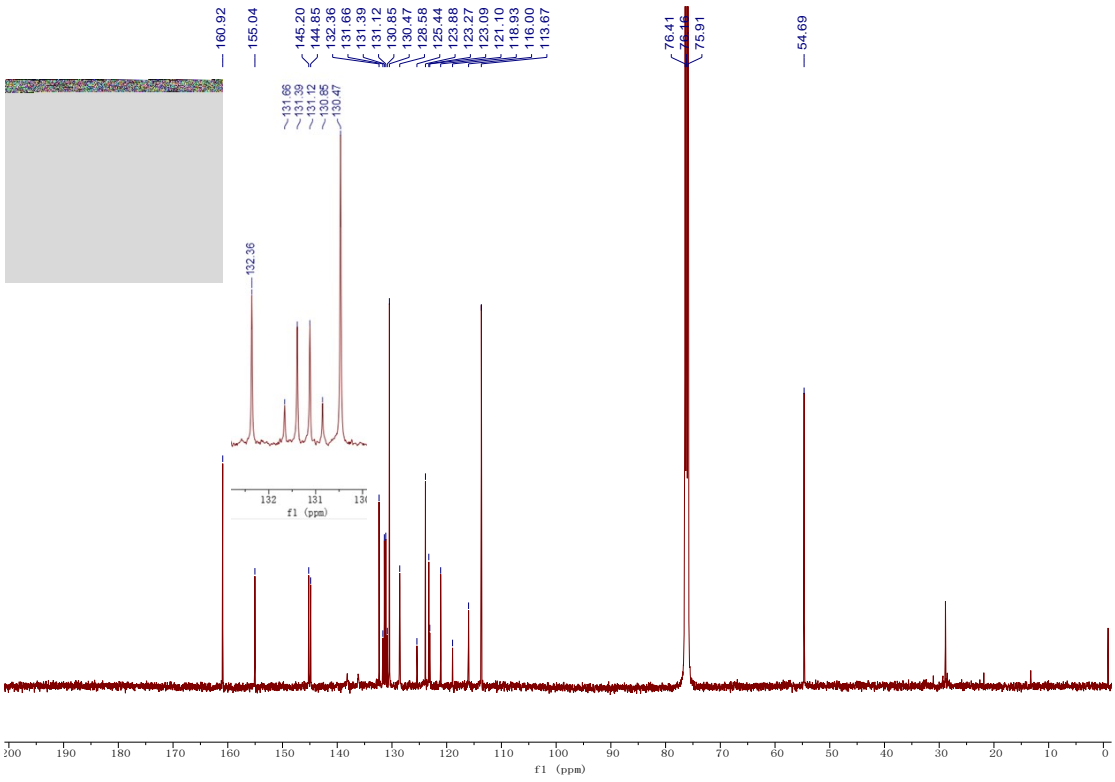
HRMS (MALDI-TOF) spectrum of **1d**.



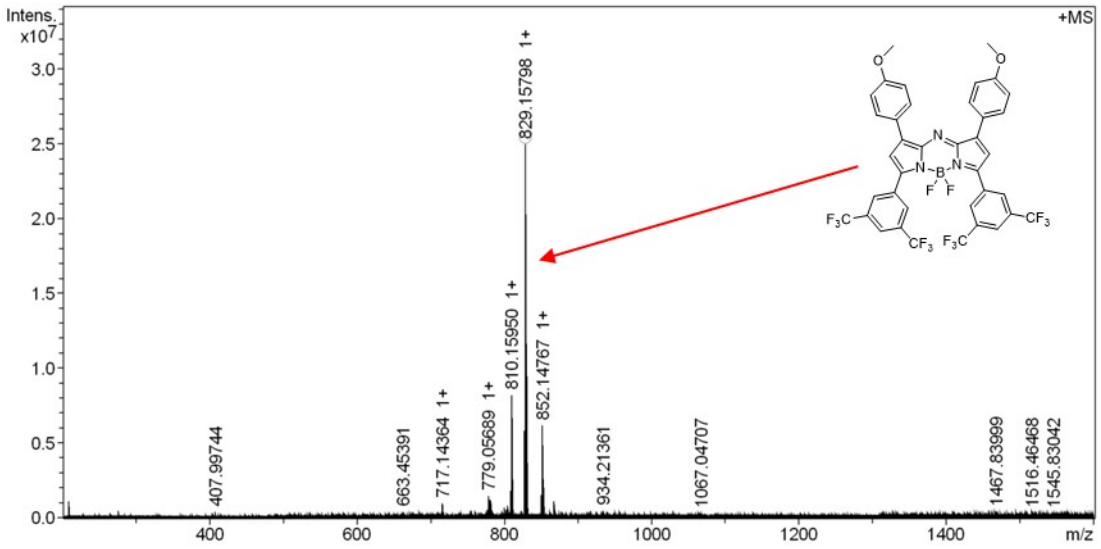
^{1}H NMR spectrum of **1e**.



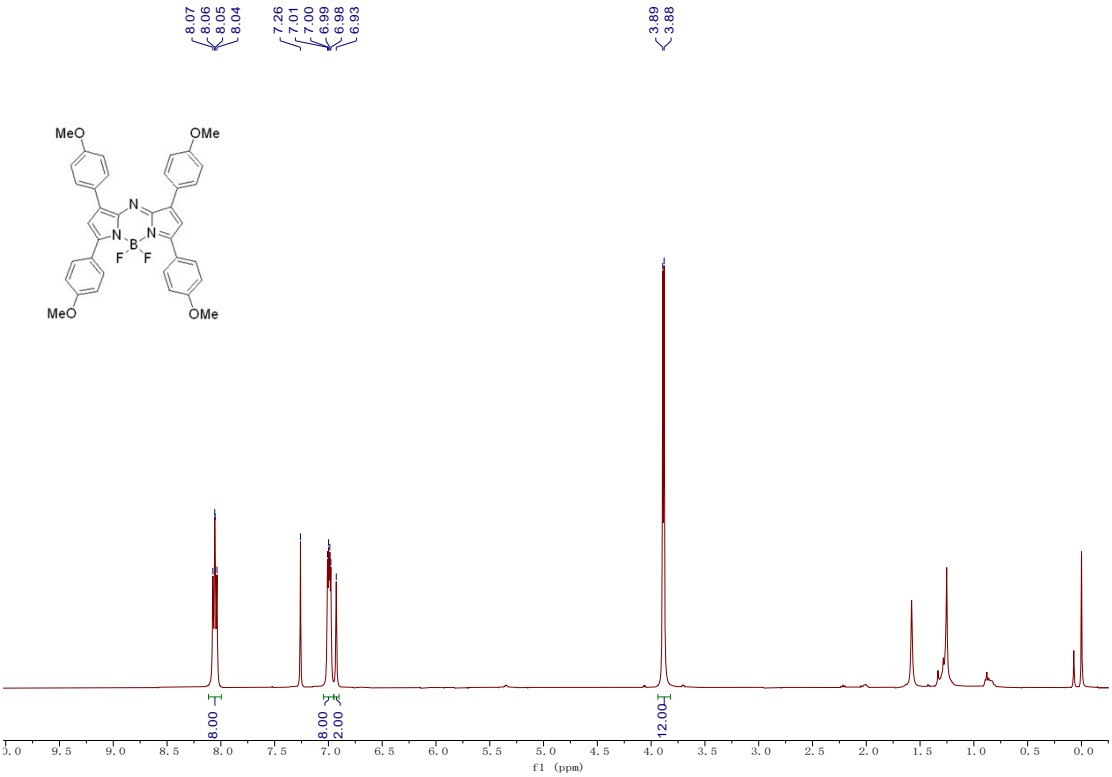
^{19}F NMR spectrum of **1e**.



^{13}C NMR spectrum of **1e**.



HRMS (MALDI-TOF) spectrum of **1e**.



^{1}H NMR spectrum of **1f**.

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