Supporting Information for

N-heterocyclic carbene-catalyzed Stereoselective Construction of Olefinic Carbon-Sulfur Bonds via Cross-Coupling Reaction of *gem*-difluoroalkenes and Thiols

Zi-Song Cong,[a] Yang-Guo Li,[a] Lei Chen,[a] Fen Xing,[a] Guang-Fen Du*[ac] Cheng-Zhi Gu[ab] and Lin He*[ab]

[a]School of Chemistry and Chemical Engineering, Shihezi University, Xinjiang Uygur Autonomous Region 832000, PeopleIs Republic of China, E-mail:duguangfen@shzu.edu.cn; helin@shzu.edu.cn

[b] Key Laboratory for Green Processing of Chemical Engineering of Xinjiang Bingtuan

[c] Laboratory of Materials-Oriented Chemical Engineering of Xinjiang Uygur Autonomous Region

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Experimental Section

All reactions were conducted under nitrogen atmosphere in oven-dried glassware with magnetic stirring bar. ^{1}H NMR (400 MHz, $CDCl_3$), ^{13}C NMR (100 MHz, $CDCl_3$) and ^{19}F NMR (376 MHz, $CDCl_3$) spectra were recorded using deuterated chloroform as solvent, with tetramethylsilane as an internal standard and reported in ppm (δ). *Gem*-difluoroalkenes were synthesized according to literature procedure.[19] Thiols and other chemicals were obtained from Adamas-beta and used without purification. Anhydrous THF and toluene were distilled from sodium and benzophenone. DMF, CH_2Cl_2 and CH_3CN were distilled from calcium hydride.

General procedure for NHCs–catalyzed nucleophilic substitution reaction of *gem*-difluoroalkenes and thiols: IPr **A** (7.8 mg, 10 mol%) was dissolved in 2.0 mL dry CH_3CN with molecular sieve (0.2 g). *Gem*-difluoroalkenes **1a** (0.2 mmol, 44 mg) and ethanethiol **2a** (0.3 mmol, 21 uL) were added via a syringe under N_2. The reaction mixture was stirred at room temperature until full consume of the starting *gem*-difluoroalkene indicated by TLC. Then, the mixture was washed with EtOAc (5.0 mL×3) and concentrated under vacuum. The crude product was purified by flash column chromatography on silica gel (PE) to give the desired product **3a** as an inseparable 11:1 *Z/E* mixture.

Procedure for deuterium labeling experiment: IPr **A** (7.8 mg, 10 mol%) was dissolved in 2.0 mL dry CH_3CN with 4Å MS (0.2 g). *Gem*-difluoroalkenes **1a** (0.3 mmol, 66 mg) and deuterium labeled thiophenol **2l'** (0.2 mmol, 22 mg) were added via a syringe under N_2. The reaction mixture was stirred at room temperature for 15 h

until full consume of the starting deuterium labeled thiophenol indicated by TLC. Then the mixture was washed with EtOAc (5.0 mL×3) and concentrated under vacuum. The crude product was purified by flash column chromatography on silica gel (PE) to give the product.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(ethyl) sulfane (3a): colorless oil; yield 45.4 mg (87%) as an inseparable 11:1 *Z/E* mixture; R_f (petroleum ether) 0.65; Data for *Z*-**3a**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 (d, *J* = 8.5 Hz, 2H), 7.38 (d, *J* = 8.6 Hz, 2H), 6.51 (d, *J* = 18.0 Hz, 1H), 2.91 (q, *J* = 7.4 Hz, 2H), 1.36 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3a**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.02 (d, *J* = 33.4, 1H); ^{13}C NMR (100 MHz, CDCl3) δ 155.2 (d, *J* = 295.4 Hz), 131.9 (d, *J* = 10.4 Hz), 131.4, 130.2 (d, *J* = 3.2Hz), 121.0 (d, *J* = 1.9 Hz) , 114.2, 113.9, 26.1 (d, *J* = 2.9 Hz) , 15.14; Data for *Z*-**3a**: ^{19}F NMR (376 MHz, CDCl3) δ -82.46 (s, 1F). Data for *E*-**3a**: ^{19}F NMR (376 MHz, CDCl3) δ -85.17 (s, 1F); FTIR (film) 2966, 2928, 1627, 1487, 1398, 1262, 1071, 1050, 1008, 866, 810, 691 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{10}H_{11}BrFS^+$ $(M+H)^+$ 260.9743, found 260.9741.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(propyl) sulfane (3b): colorless oil; yield 50.1mg (91%) as an inseparable 8:1 *Z/E* mixture; R_f (petroleum ether) 0.71; Data for *Z*-**3b**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 (d, *J* = 8.2 Hz, 2H), 7.39 (d, *J* = 8.4 Hz, 2H), 6.48 (d, *J* = 18.0 Hz, 1H), 2.86 (t, *J* = 7.3 Hz, 2H), 1.72 (q, *J* = 145.71 Hz, 2H), 1.01 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3b**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.00 (d, *J* = 33.5Hz, 1H); Data for *Z*-**3b**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.4 (d, *J* = 295.5 Hz), 131.8 (q, *J* = 20.0 Hz), 131.4, 130.2 (d, *J* = 3.3 Hz), 121.0 (d, *J* = 1.9 Hz), 113.7 (d, *J* = 32.8 Hz), 33.7 (d, *J* = 2.6 Hz), 23.3 (d, *J* = 1.1 Hz), 13.2. Selected data for *E*-**3b**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 49.8, 41.2, 31.2; Data for *Z*-**3b**: ^{19}F NMR (376

MHz, $CDCl_3$) δ -82.27 (s, 1F). Data for *E*-**3b**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.20 (s, 1F); FTIR (film) 2966, 1686, 1629, 1488, 1073, 1010, 905, 868, 728, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{11}H_{13}BrFS^+(M+H)^+$ 274.9900, found 274.9907.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(butyl) sulfane (3c): colorless oil; yield 56.7 mg (96%) as an inseparable 8:1 *Z/E* mixture; R_f (petroleum ether) 0.71; Data for *Z*-**3c**: ^1H NMR (400 MHz, CDCl3) δ 7.50-7.45 (m, 2H), 7.41-7.36 (m, 2H), 6.48 (d, *J* = 18.0 Hz, 1H), 2.88 (t, *J* = 7.4 Hz, 2H), 1.72 - 1.63 (m, 2H), 1.48 - 1.42 (m, 2H), 0.93 (t, *J* = 7.3 Hz, 3H). Selected data for *E*-**3c**: ^1H NMR (400 MHz, $CDCl_3$) δ 6.00 (d, *J* =3 3.5Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.4 (d, *J* = 295.3 Hz), 131.9 (d, *J* = 10.5 Hz), 131.4, 130.2 (d, *J* = 3.3 Hz), 121.0 (d, *J* = 1.9 Hz), 113.7 (d, *J* = 32.8 Hz), 38.9, 31.6 (d, *J* = 52.1 Hz), 21.7, 13.5; Data for *Z*-**3c**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.25 (s, 1F). Data for *E*-**3c**: ^{19}F NMR (376 MHz, CDCl3) δ -85.20 (s, 1F); FTIR (film) 2957, 2929, 2871, 1687, 1628, 1487, 1071, 1009, 867, 799, 734, 688, 622 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{12}H_{15}BrFS^+(M+H)^+$ 289.0056, found 289.0063.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(octadecyl) sulfane (3d): white solid; mp 42.4-47.0 ℃; yield 82.6 mg (85%) as an inseparable 11:1 *Z/E* mixture; R_f (petroleum ether) 0.75; Data for *Z*-**3d**: ^1H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.45 (m, 2H), 7.40 – 7.36 (m, 2H), 6.48 (d, *J* = 18.0 Hz, 1H), 2.87 (t, *J* = 7.3 Hz, 2H), 1.74-1.62 (m, 2H), 1.28 - 1.26 (m, 30H), 0.90 (t, *J* =

6.6 Hz, 3H). Selected data for *E*-**3d**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.99 (d, *J* = 33.5 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.4 (d, *J* = 295.5 Hz), 131.9 (d, *J* = 10.4 Hz), 131.4, 130.2 (d, *J* = 3.3 Hz), 121.0 (d, *J* = 1.8 Hz), 113.7 (d, *J* = 32.7 Hz), 32.0, 31.8 (d, *J* = 2.5 Hz), 31.7, 29.8 (d, *J* = 1.1 Hz), 29.8– 29.7 (m), 29.6 (d, *J* = 8.7 Hz) , 29.5, 29.4, 29.1, 28.5, 22.7, 14.1; Data for *Z*-**3d**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.17 (d, *J* = 7.6 Hz, 1F). Data for *E*-**3d**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.17 (d, *J* = 7.1 Hz, 1F); FTIR (film) 2914, 2847, 1628, 1472, 1462, 1063, 1008, 867, 857, 818, 729, 719 cm $^{-1}$; HRMS (ESI) *m/z* calcd for $C_{26}H_{42}BrFS^{+}$ $(M+H)^{+}$ 484.2169, found 484.2164.

(*Z/E*)-Benzyl(2-(4-bromophenyl)-1-fluorovinyl) sulfane (3e): colorless oil; yield 59.6 mg (92 %) as an inseparable 11:1 *Z/E* mixture; R_f (petroleum ether) 0.45; Data for *Z*-**3e**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.5 Hz, 2H), 7.36 – 7.29 (m, 5H), 7.17 (d, *J* = 8.4 Hz, 2H), 6.50 (d, *J* = 17.3 Hz, 1H), 4.10 (s, 2H). Selected data for *E*-**3e**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.89 (d, *J* = 33.3 Hz, 1H); ^{13}C NMR (100 MHz, CDCl3) δ 154.6 (d, *J* = 295.3 Hz), 136.6, 131.6 (d, *J* = 10.1 Hz), 131.3, 130.2 (d, *J* = 3.3 Hz), 128.9, 128.7, 127.6, 121.2, 115.2 (d, *J* = 32.3 Hz), 36.2 (d, *J* = 1.8 Hz); Data for *Z*-**3e**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -81.56 (s, 1F). Data for *E*-**3e**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.15 (s, 1F); FTIR (film) 3028, 1627, 1487, 1454, 1398, 1053, 1008, 908, 810, 765, 696 cm $^{-1}$; HRMS (ESI) *m/z* calcd for $C_{15}H_{13}BrFS^{+}$ $(M+H)^{+}$ 322.9900, found 322.9903.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(isopropyl) sulfane (3f):

colorless oil; yield 50.2 mg (91%) as an inseparable 14:1 *Z/E* mixture; R_f (petroleum ether) 0.65; Data for *Z*-**3f**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.45 (m, 2H), 7.43 – 7.38 (m, 2H), 6.54 (d, *J* = 17.8 Hz, 1H), 3.58-3.47 (m, 1H), 1.38 (s, 4H), 1.36 (s, 3H). Selected data for *E*-**3f**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.06 (d, *J* = 32.8 Hz, 1H); ^{13}C NMR (100 MHz, CDCl3) δ 155.4 (d, *J* = 294.6 Hz), 131.9 (d, *J* = 10.2 Hz), 131.4, 130.3 (d, *J* = 3.4 Hz), 121.2 (d, *J* = 1.9 Hz), 115.2 (d, *J* = 33.7 Hz), 37.5, 23.3 (d, *J* = 1.1 Hz); Data for *Z*-**3f**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -77.50 (s, 1F). Data for *E*-**3f**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -80.54 (s, 1F); FTIR (film) 2965, 2926, 2865, 1626, 1487, 1461, 1398, 1243, 1051, 1009, 867, 811, 734, 692 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{11}H_{13}BrFS^+$ $(M+H)^+$ 274.9900, found 274.9907.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(cyclohexyl) sulfane (3g):

colorless oil; yield 62.5 mg (99%) as an inseparable 6:1 *Z/E* mixture; R_f (petroleum ether) 0.55; Data for *Z*-**3g**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.45 (m, 2H), 7.44 – 7.40 (m, 2H), 6.52 (d, *J* = 17.7 Hz, 1H), 3.34 – 3.25 (m, 1H), 2.06 – 2.01 (m, 2H), 1.81 – 1.75 (m, 2H), 1.69 – 1.59 (m, 2H), 1.48 - 1.44 (m 2H), 1.39 – 1.33 (m, 2H). Selected data for *E*-**3g**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.04 (d, *J* = 32.7 Hz, 1H); Data for *Z*-**3g**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.1 (d, *J* = 295.0 Hz), 132.0 (d, *J* = 10.2 Hz), 131.7 (d, *J* = 4.2 Hz), 131.4, 130.3 (d, *J* = 3.3 Hz), 115.3 (d, *J* = 33.9 Hz), 45.4, 33.4 (d, *J* = 1.0 Hz), 26.0, 25.5. Selected data for *E*-**3g**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 131.2,

130.1 (d, *J* = 8.4 Hz), 50.0 (d, *J* = 5.0 Hz), 42.9, 32.9 (d, *J* = 2.6 Hz); Data for *Z*-**3g**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -76.86 (s, 1F). Data for *E*-**3g**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -80.14 (s, 1F); FTIR (film) 2929, 2853, 1682, 1627, 1487, 1448, 1263, 1072, 1009, 906, 867, 729, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{14}H_{17}BrFS^+$ $(M+H)^+$ 315.0213, found 315.0211.

(*Z/E*)-2-(((2-(4-Bromophenyl)-1-fluorovinyl)thio) methyl)furan (3h): colorless oil; yield 46.5 mg (74%) as an inseparable 10:1 *Z/E* mixture; R_f (petroleum ether) 0.35; Data for *Z*-**3h**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.40 (m, 2H), 7.35 (dd, *J* = 1.9, 0.9 Hz, 1H), 7.24 – 7.19 (m, 2H),6.53 (d, *J* = 17.1 Hz, 1H),6.30 (dd, *J* = 3.2, 1.8 Hz, 1H), 6.24 (dd, *J* = 3.2, 0.8 Hz, 1H), 4.09 (s, 2H). Selected data for *E*-**3h**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.94 (d, *J* = 33.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.1 (d, *J* = 295.3 Hz), 149.7, 142.6, 131.5 (d, *J* = 9.9 Hz), 131.4, 130.2 (d, *J* = 3.3 Hz), 121.3 (d, *J* = 1.9 Hz), 115.9 (d, *J* = 32.6 Hz), 110.7, 108.6, 28.4 (d, *J* = 1.7 Hz); Data for *Z*-**3h**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.19 (s, 1F). Data for *E*-**3h**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.83 (s, 1F); FTIR (film) 1631, 1488, 1151, 1072, 1011, 903, 869, 723, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{13}H_{11}BrOFS^+$ $(M+H)^+$ 312.9693, found 312.9688.

(*Z/E*)-((2-(4-Bromophenyl)-1-fluorovinyl)thio)methyl acetate (3i): colorless oil; yield 57.5 mg (94%) as an inseparable 8:1 *Z/E* mixture; R_f (1:20 EtOAc/petroleum ether) 0.22; Data for *Z*-**3i**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 – 7.46 (m, 2H), 7.40 – 7.35 (m, 2H), 6.54 (d, *J* = 17.4 Hz, 1H),

3.73 (s, 3H), 3.62 (s, 2H). Selected data for *E*-**3i**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.11 (d, *J* = 33.1 Hz, 1H), ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.9, 153.1 (d, *J* = 296.3Hz), 131.5, 131.2 (d, *J* = 9.9 Hz), 130.3 (d, *J* = 3.2 Hz), 121.6 (d, J = 1.8 Hz), 115.0 (d, *J* = 31.1 Hz), 52.8, 32.8 (d, *J* = 2.5 Hz); Data for *Z*-**3i**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.58 (s, 1F). Data for *E*-**3i**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -87,44 (s, 1F); FTIR (film) 1739, 1488, 1300, 1073, 1010, 903, 722, 649 cm $^{-1}$; HRMS (ESI) *m/z* calcd for $C_{11}H_{11}BrO_2FS^+$ $(M+H)^+$ 304.9642, found 304.9643.

(*Z/E*)-2-(2-((2-(4-Bromophenyl)-1-fluorovinyl)thio) ethoxy)ethan-1-ol (3j): colorless oil; yield 61.1 mg (95%) as an inseparable 10:1 *Z/E* mixture; R_f (1:5 EtOAc/petroleum ether) 0.18; Data for *Z*-**3j**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.45 (m, 2H), 7.41 – 7.35 (m, 2H), 6.50 (d, *J* = 17.8 Hz, 1H), 3.75 – 3.69 (m, 4H), 3.58 – 3.53 (m, 2H), 3.07 (t, *J* = 6.3 Hz, 2H). Selected data for *E*-**3j**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.05 (d, *J* = 33.5 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.5 (d, *J* = 295.7 Hz), 131.6 (d, *J* = 10.2 Hz), 131.5, 130.2(d, *J* = 3.3 Hz), 121.3 (d, *J* = 1.9 Hz), 121.3 (d, *J* = 1.9 Hz), 114.3 (d, *J* = 32.4 Hz), 114.1, 72.1, 69.8 (d, *J* = 1.0 Hz), 61.7, 31.2 (d, *J* = 2.0 Hz); Data for *Z*-**3j**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.52 (s, 1F). Data for *E*-**3j**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.58 (s, 1F); FTIR (film) 2865, 1629, 1488, 1399, 1355, 1286, 1207, 1117, 1071, 1009, 906, 866, 727, 648 cm $^{-1}$; HRMS (ESI) *m/z* calcd for $C_{12}H_{15}BrFO_2S^+$ $(M+H)^+$ 320.9955, found 320.9955.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(tert-butyl) sulfane(3k): colorless oil; yield 49.3 mg (85%) as an inseparable 2:1 *Z/E* mixture; R_f (petroleum ether) 0.75; Data for *Z*-**3k**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.51 – 7.47 (m, 4H), 6.66 (d, *J* = 16.7 Hz, 1H), 1.44 (s, 9H). Data for *E*-**3k**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 – 7.39 (m, 4H), 6.13 (d, *J* = 31.3 Hz, 1H), 1.47 (s, 9H); Data for *Z*-**3k**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.8 (d, *J* = 295.7 Hz), 131.9 (d, *J* = 9.5 Hz), 131.3, 130.5 (d, *J* = 3.7 Hz), 121.4 (d, *J* = 2.2 Hz), 118.8 (d, *J* = 36.2 Hz), 49.8 (d, *J* = 3.7 Hz), 31.7 (d, *J* = 2.1 Hz). Data for *E*-**3k**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.5 (d, *J* = 309.3 Hz), 132.2 (d, *J* = 6.4 Hz), 131.7 , 130.3 (d, *J* = 8.6 Hz), 121.8 (d, *J* = 3.8 Hz), 118.9 (d, *J* = 16.0 Hz), 48.1 (d, *J* = 4.3 Hz), 31.4 (d, *J* = 1.7 Hz); Data for *Z*-**3k**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -68.30 (s, 1F). Data for *E*-**3k**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -74.42 (s, 1F); FTIR (film) 1624, 1487, 1368, 1157, 1038, 1010, 903, 814, 723, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{12}H_{15}BrFS^+$ $(M+H)^+$ 289.0056, found 289.0054.

(*Z/E*)-(2-(4-Bromophenyl)-1-fluorovinyl)(phenyl) sulfane (3l): white solid; mp 48.5-56.0 ℃; yield 51.4 mg (83%) as an inseparable 11:1 *Z/E* mixture; R_f (petroleum ether) 0.45; Data for *Z*-**3l**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 - 7.49 (m, 2H), 7.48 – 7.44 (m, 4H), 7.39 – 7.32 (m, 3H), 6.71 (d, *J* = 15.9 Hz, 1H). Selected data for *E*-**3l**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.24 (d, *J* = 32.1 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.1 (d, *J* = 297.7 Hz) , 131.6, 131.5 (d, *J* = 9.1 Hz), 130.6 (d, *J* = 2.5 Hz), 130.3 (d, *J* = 3.3 Hz),

130.1 (d, *J* = 0.9 Hz), 129.4, 127.9, 121.9 (d, *J* = 1.8 Hz), 117.4 (d, *J* = 32.4 Hz); Data for *Z*-**3l**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -78.71(s, 1F). Data for *E*-**3l**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.39 (s, 1F); FTIR (film) 1629, 1582, 1478, 1439, 1398, 1074, 1048, 1008, 882, 863, 820, 732, 684 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{14}H_{10}BrFS^+$ $(M+H)^+$ 307.9665, found 307.9661.

(*Z/E*)-(2-(4-Chlorophenyl)-1-fluorovinyl)(ethyl) sulfane (3m): colorless oil; yield 37.0 mg (85%) as an inseparable 10:1 *Z/E* mixture; R_f (petroleum ether) 0.61; Data for *Z*-**3m**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.46 – 7.42 (m, 2H), 7.34 – 7.31 (m, 2H), 6.53 (d, *J* = 18.0 Hz, 1H), 2.91 (qd, *J* = 7.4, 0.8 Hz, 2H), 1.36 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3m**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.04 (d, *J* = 33.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.1 (d, *J* = 295.1 Hz), 132.9 (d, *J* = 1.9 Hz), 131.4 (d, *J* = 10.4 Hz), 129.9 (d, *J* = 3.3 Hz), 128.4, 114.0 (d, *J* = 32.7 Hz), 26.1 (d, *J* = 2.9 Hz), 15.1 (d, *J* = 1.2 Hz); Data for *Z*-**3m**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.73 (s, 1F). Data for *E*-**3m**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.52 (s, 1F); FTIR (film) 1629, 1490, 1093, 1014, 870, 723, 649 cm^{-1}; HRMS (ESI) m/z calcd for $C_{10}H_{11}FClS^+$ $(M+H)^+$ 217.0249, found 217.0249 .

(*Z/E*)-Ethyl(1-fluoro-2-(4-methoxyphenyl)vinyl) sulfane (3n): colorless oil; yield 37 mg (87%) as an inseparable 20:1 *Z/E* mixture; R_f (petroleum ether) 0.18; Data for *Z*-**3n**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 – 7.45 (m, 2H), 6.93 – 6.88 (m, 2H), 6.57 (d, *J* = 18.2 Hz, 1H), 3.84 (s, 3H), 2.89 (qd, *J* = 7.3, 0.9 Hz, 2H), 1.36 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3n**: ^{1}H NMR

(400 MHz, $CDCl_3$) δ 6.06 (d, *J* = 33.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 158.8 (d, *J* = 1.6 Hz), 153.1 (d, *J* = 291.6 Hz), 130.0 (d, *J* = 3.2 Hz), 125.3 (d, *J* = 9.6 Hz), 115.2 (d, *J* = 32.3 Hz) , 113.7, 55.3, 26.2 (d, *J* = 1.9 Hz), 15.1 (d, *J* = 1.2 Hz); Data for *Z*-**3n**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.45 (s, 1F), Data for *E*-**3n**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -88.62 (s, 1F); FTIR (film) 1607, 1509, 1250, 1179, 1034, 904, 874, 724, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{11}H_{14}FOS^+$ $(M+H)^+$ 213.0744, found 213.0744.

(*Z/E*)-Ethyl(1-fluoro-2-(p-tolyl)vinyl)sulfane (3o): colorless oil; yield 31.9 mg (81%) as an inseparable 17:1 *Z/E* mixture; R_f (petroleum ether) 0.55; Data for *Z*-**3o**: ^1H NMR (400 MHz, $CDCl_3$) δ 7.42 (d, *J* = 8.0 Hz, 2H), 7.18 (d, *J* = 7.9 Hz, 2H), 6.59 (d, *J* = 18.3 Hz, 1H), 2.90 (qd, *J* = 7.4, 0.9 Hz, 2H), 2.38 (s, 3H), 1.36 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3o**: ^1H NMR (400 MHz, $CDCl_3$) δ 6.08 (d, *J* = 33.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.9 (d, *J* = 292.8 Hz), 137.2 (d, *J* = 1.8 Hz), 130.0 (d, *J* = 9.9 Hz), 129.0, 128.6 (d, *J* = 3.2 Hz), 115.3 (d, *J* = 31.7 Hz), 26.2 (d, *J* = 2.5 Hz), 21.2, 15.1 (d, *J* = 1.2 Hz); Data for *Z*-**3o**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.61 (s, 1F). Data for *E*-**3o**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -86.93 (s, 1F); FTIR (film) 2966, 2927, 1628, 1510, 1449, 1261, 1036, 818, 806, 712, 679, 628, 576 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{11}H_{14}FS^+$ $(M+H)^+$ 197.0795, found 197.0791.

(*Z/E*)-Ethyl(1-fluoro-2-(2-methoxyphenyl)vinyl) sulfane (3p): colorless oil; yield 34.5 mg (81%) as an inseparable 17:1 *Z/E* mixture; R_f (petroleum ether) 0.28; Data for *Z*-**3p**: ^1H NMR (400 MHz, $CDCl_3$) δ 7.62 -

7.60 (m, 1H),7.28 (td, *J* = 7.8, 1.7 Hz, 1H), 6.99 (td, *J* = 7.6, 1.1 Hz, 1H), 6.89 (d, *J* = 8.2 Hz, 1H),6.83 (d, *J* = 18.4 Hz, 1H),3.87 (s, 3H), 2.88 (qd, *J* = 7.4, 0.8 Hz, 2H), 1.35 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3p**: ^{1}H NMR (400 MHz, CDCl3) δ 6.54 (d, *J* = 35.0 Hz, 1H); Data for *Z*-**3p**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.8 (d, *J* = 3.4 Hz), 154.6 (d, *J* = 293.0 Hz), 129.6 (d, *J* = 2.2 Hz), 128.7 (d, *J* = 1.3 Hz), 121.96 (d, *J* = 9.7 Hz),120.1, 110.3, 110.0 (d, *J* = 33.3 Hz), 55.5, 26.01 (d, *J* = 2.9 Hz), 15.05 (d, *J* = 1.2 Hz). Selected data for *E*-**3p**: ^{13}C NMR (100 MHz, $CDCl_3$) δ 29.7; Data for *Z*-**3p**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.11 (s, 1F), Data for *E*-**3p**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -87.40 (s, 1F); FTIR (film) 2927, 1626, 1598, 1486, 1462, 1244, 1116, 1050, 1028, 908, 874, 748, 730, 628 cm $^{-1}$; HRMS (ESI) *m/z* calcd for $C_{11}H_{14}FOS^{+}$ $(M+H)^{+}$ 213.0744, found 213.0746.

(*Z/E*)-Ethyl(1-fluoro-2-(3-methoxyphenyl)vinyl) sulfane (3q): colorless oil; yield 37.5 mg (88%) as an inseparable 10:1 *Z/E* mixture; R_f (petroleum ether) 0.18; Data for *Z*-**3q**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.27 (m, 1H), 7.14 (t, *J* = 2.1 Hz, 1H), 7.07 (dt, *J* = 7.6, 0.9 Hz, 1H), 6.83 (dd, *J* = 8.2, 2.6 Hz, 1H), 6.57 (d, *J* = 18.6 Hz, 1H),3.85 (s, 3H), 2.91 (qd, *J* = 7.3, 0.9 Hz, 2H), 1.37 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3q**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.07 (d, *J* = 33.6 Hz, 1H); ^{13}C NMR (100 MHz, CDCl3) δ 159.4, 154.8 (d, *J* = 294.0 Hz), 134.2 (d, *J* = 10.2 Hz), 129.2, 121.5 (d, *J* = 3.3 Hz), 115.0 (d, *J* = 32.2 Hz), 114.0 (d, *J* = 3.3 Hz), 113.0 (d, *J* = 1.8 Hz), 55.2, 26.1 (d, *J* = 3.0 Hz), 15.2 (d, *J* = 1.3 Hz); Data for *Z*-**3q**: ^{19}F NMR (376

MHz, $CDCl_3$) δ -83.41 (s, 1F). Data for *E*-**3q**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.48 (s, 1F); FTIR (film) 2928, 1628, 1597, 1576, 1488, 1453, 1431, 1264, 1159, 1039, 865, 773, 690 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{11}H_{14}FOS^+$ $(M+H)^+$ 213.0744, found 213.0738.

(*Z/E*)-(2-(3-Bromophenyl)-1-fluorovinyl)(ethyl) sulfane (3r): colorless oil; yield 46.6 mg (89%) as an inseparable 6:1 *Z/E* mixture; R_f (petroleum ether) 0.65; Data for *Z*-**3r**: ^1H NMR (400 MHz, $CDCl_3$) δ 7.68 (t, *J* = 1.9 Hz, 1H), 7.43 – 7.38 (m, 2H), 7.22 (t, *J* = 7.9 Hz, 1H), 6.50 (d, *J* = 18.0 Hz, 1H), 2.92 (qd, *J* = 7.4, 0.8 Hz, 2H), 1.37 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3r**: ^1H NMR (400 MHz, $CDCl_3$) δ 6.00 (d, *J* = 33.3 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.8 (d, *J* = 296.1 Hz), 135.1 (d, *J* = 10.6 Hz), 131.4 (d, *J* = 3.2 Hz), 130.1 (d, *J* = 1.5 Hz), 129.7, 127.3 (d, *J* = 3.0 Hz), 122.3, 113.6 (d, *J* = 32.7 Hz), 26.1(d, *J* = 3.3 Hz), 15.2(d, *J* = 1.2 Hz); Data for *Z*-**3r**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -81.83 (s, 1F). Data for *E*-**3r**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.32 (s, 1F); FTIR (film) 3054, 2965, 2927, 1625, 1507, 1449, 1376, 1261, 1176, 1049, 967, 894, 861, 813, 764, 743 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{10}H_{11}BrFS^+$ $(M+H)^+$ 260.9743, found 260.9743.

(*Z/E*)-Ethyl(1-fluoro-2-(naphthalen-1-yl)vinyl)sulfane (3s): colorless oil; yield 41.0 mg (88%) as an inseparable 11:1 *Z/E* mixture; R_f (petroleum ether) 0.45; Data for *Z*-**3s**: ^1H NMR (400 MHz, $_{CDCl3}$) δ 8.05 – 7.99 (m, 1H), 7.93 – 7.89 (m, 1H), 7.86 (d, *J* = 7.1 Hz, 1H), 7.58 – 7.50 (m, 4H), 7.12 (d, *J* = 16.2 Hz, 1H), 2.86 (q, *J* = 7.4 Hz, 2H), 1.33 (t, *J* = 7.4 Hz, 3H). Selected

data for *E*-**3s**: ^{1}H NMR (400 MHz, $_{CDCl3}$) δ 6.79 (d, *J* = 31.7 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 156.3 (d, *J* = 296.0 Hz), 133.5, 131.8 (d, *J* = 3.0 Hz), 130.2 (d, *J* = 9.5 Hz), 128.6, 128.2 (d, *J* = 0.5 Hz), 127.5 (d, *J* = 2.5 Hz), 126.2, 126.0, 125.3, 124.3, 112.0 (d, *J* = 30.3 Hz), 25.8 (d, *J* = 3.2 Hz), 15.0 (d, *J* = 1.2 Hz); Data for *Z*-**3s**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -84.92 (s, 1F). Data for *E*-**3s**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -87.44 (s, 1F); FTIR (film) 1630, 1087, 903, 799, 781, 722, 648 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{14}H_{14}FS^{+}$ $(M+H)^{+}$ 233.0795, found 233.0795.

(*Z/E*)-Ethyl(1-fluoro-2-(naphthalen-2-yl)vinyl)sulfane (3t): colorless oil; yield 37.3 mg (80%) as an inseparable 6:1 *Z/E* mixture; R_f (petroleum ether) 0.45; Data for *Z*-**3t**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.86-7.82 (m, 3H), 7.73 (dd, *J* = 8.6, 1.8 Hz, 1H), 7.52 – 7.49 (m, 2H), 6.77 (d, *J* = 18.3 Hz, 1H), 2.95 (qd, *J* = 7.4, 0.9 Hz, 2H), 1.40 (t, *J* = 7.4 Hz, 3H). Selected data for *E*-**3t**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.27 (d, *J* = 33.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.9 (d, *J* = 294.3 Hz), 133.3, 132.5 (d, *J* = 1.0 Hz), 130.4 (d, *J* = 10.2 Hz), 128.0 (m), 127.8, 127.6, 126.5 (d, *J* = 2.3 Hz), 126.3, 126.1 (d, *J* = 0.9 Hz), 115.3 (d, *J* = 32.1 Hz), 26.2(d, *J* = 2.8 Hz), 15.2 (d, *J* = 1.2 Hz); Data for *Z*-**3t**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -82.89 (s, 1F). Data for *E*-**3t**: ^{19}F NMR (376 MHz, $CDCl_3$) δ -85.80 (s, 1F); FTIR (film) 1628, 1591, 1557, 1476, 1260, 1075, 904, 779, 726, 685 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{14}H_{14}FS^{+}$ $(M+H)^{+}$ 233.0795, found 233.0792.

(*Z*)-Ethyl(1-fluoro-4-phenylbut-1-en-1-yl)sulfane (3u):colorless oil; yield 5.1 mg (12%); R_f (petroleum ether) 0.65; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.30 (m, 2H), 7.26 – 7.18 (m, 3H), 5.60 (dt, *J* = 15.5, 7.8 Hz, 1H), 2.75 – 2.66 (m, 4H), 2.55 – 2.46 (m, 2H), 1.27 (t, *J* = 7.4 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.9 (d, *J* = 290.9 Hz), 141.1 , 128.6 , 128.4 , 126.0 , 115.2 (d, *J* = 24.6 Hz), 35.8 (d, *J* = 2.9 Hz), 29.3 (d, *J* = 3.4 Hz), 15.0 (d, *J* = 1.2 Hz). ^{19}F NMR (376 MHz, $CDCl_3$) δ -87.63. FTIR (film) 3027, 2929, 1683, 1647, 1603, 1496, 1454, 1287, 1261, 1074, 968, 908, 730, 698 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{12}H_{16}FS^+$ $(M+H)^+$ 211.0951, found 211.0952.

(2-(4-Bromophenyl)ethene-1,1-diyl)bis(ethylsulfane) (3v): colorless oil; yield 15.1 mg (25%); R_f (petroleum ether) 0.45; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 – 7.45 (m, 4H), 6.93 (s, 1H), 2.87 (q, *J* = 7.3 Hz, 4H), 1.33 (t, *J* = 7.3 Hz, 3H), 1.25 (t, *J* = 7.3 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 135.4, 133.5, 133.0, 131.2, 130.9, 121.0, 28.1, 27.7, 14.9, 14.2. FTIR (film) 2963, 2924, 2868, 1550, 1484, 1447, 1395, 1373, 1257, 1074, 1009, 915, 808 cm^{-1}; HRMS (ESI) m/z calcd for $C_{12}H_{16}BrS_2^+$ $(M+H)^+$ 302.9871, found 302.9872.

Ethyl(1-fluoro-2,2-diphenylvinyl)sulfane (3w): colorless oil; yield 45.0 mg (87%); R_f (petroleum ether) 0.31; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 – 7.35 (m, 6H), 7.35 – 7.25 (m, 4H), 2.88 (qd, *J* = 7.4, 0.8 Hz, 2H), 1.39 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.0 (d, *J* = 302.7 Hz), 138.6 (d, *J* = 4.8 Hz), 137.3 (d, *J* = 2.3 Hz), 130.5 (d, *J* = 3.2 Hz), 129.6 (d, *J* = 5.3 Hz),

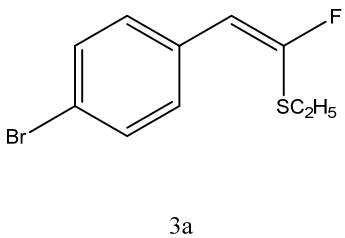
128.2, 128.1, 127.6, 127.4 (d, *J* = 1.3 Hz), 126.9 (d, *J* = 17.1 Hz), 26.3 (d, *J* = 2.8 Hz), 15.1 (d, *J* = 1.2 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -91.51 (s, 1F); FTIR (film) 2253, 1495, 1443, 1275, 1090, 903, 723, 698, 649 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{16}H_{15}FS^+$ $(M+H)^+$ 258.0873, found 258.0870.

(2,2-Bis(4-chlorophenyl)-1-fluorovinyl)(ethyl)sulfane (3x): colorless oil; yield 57.7 mg (88%); R_f (petroleum ether) 0.45; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.26 (m, 2H), 7.25 – 7.14 (m, 2H), 2.86 (qd, *J* = 7.4, 0.8 Hz, 2H), 1.36 (d, *J* = 14.7 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.8 (d, *J* = 304.5 Hz), 136.6 (d, *J* = 4.9 Hz), 135.3 (d, *J* = 2.6 Hz), 133.8, 133.3 (d, *J* = 1.5 Hz), 131.9 (d, *J* = 3.3 Hz), 130.8(d, *J* = 5.6 Hz), 128.6, 128.4, 124.4 (d, *J* = 17.6 Hz), 26.3 (d, *J* = 3.2 Hz), 15.1 (d, *J* = 1.2 Hz); ^{19}F NMR (376 MHz, $CDCl_3$) δ -89.99 (s, 1F); FTIR (film) 3675, 2988, 2960, 2923, 1617, 1491, 1399, 1265, 1088, 1015, 927, 809, 767, 689 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{16}H_{13}Cl_2FS^+$ $(M+H)^+$ 326.0094, found 326.0091.

(*E/Z*)-(1-Chloro-2-phenylvinyl)(ethyl)sulfane (3y): colorless oil; yield 9.9 mg (25%) as an inseparable 9:1 *E/Z* mixture; R_f (petroleum ether) 0.60; Data for *E*-**3y**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58 – 7.52 (m, 2H), 7.40 – 7.33 (m, 2H), 7.32 – 7.29 (m, 1H), 7.04 (s, 1H), 2.98 (q, *J* = 7.3 Hz, 2H), 1.32 (t, *J* = 7.3 Hz, 3H). Data for *Z*-**3y**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.00 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 134.9, 134.4, 129.2, 128.2, 127.8, 28.2, 14.7. FTIR (film) 3058, 2926, 2870, 1568, 1491, 1444, 1376, 1259, 1056,

910, 797, 750, 692 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{10}H_{12}ClS^{+}$ $(M+H)^{+}$ 199.0343, found 199.0342.

^{1}H NMR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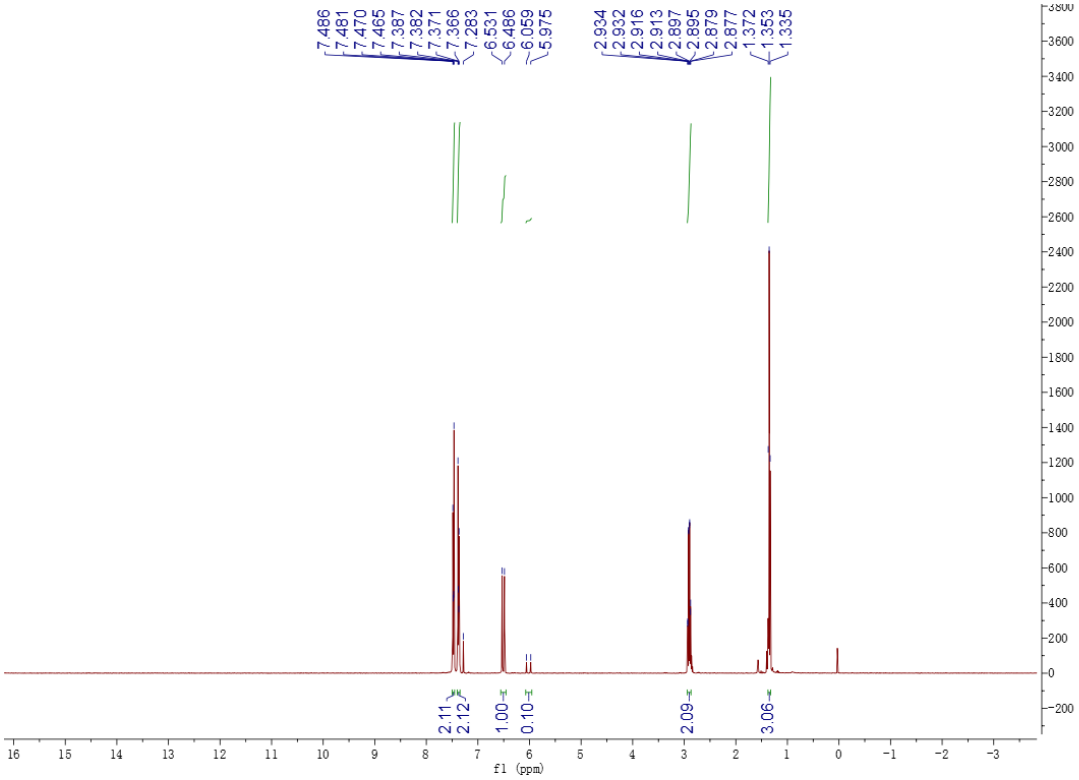
3a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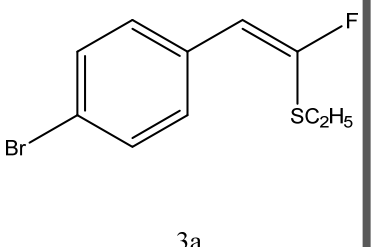
^{13}C NMR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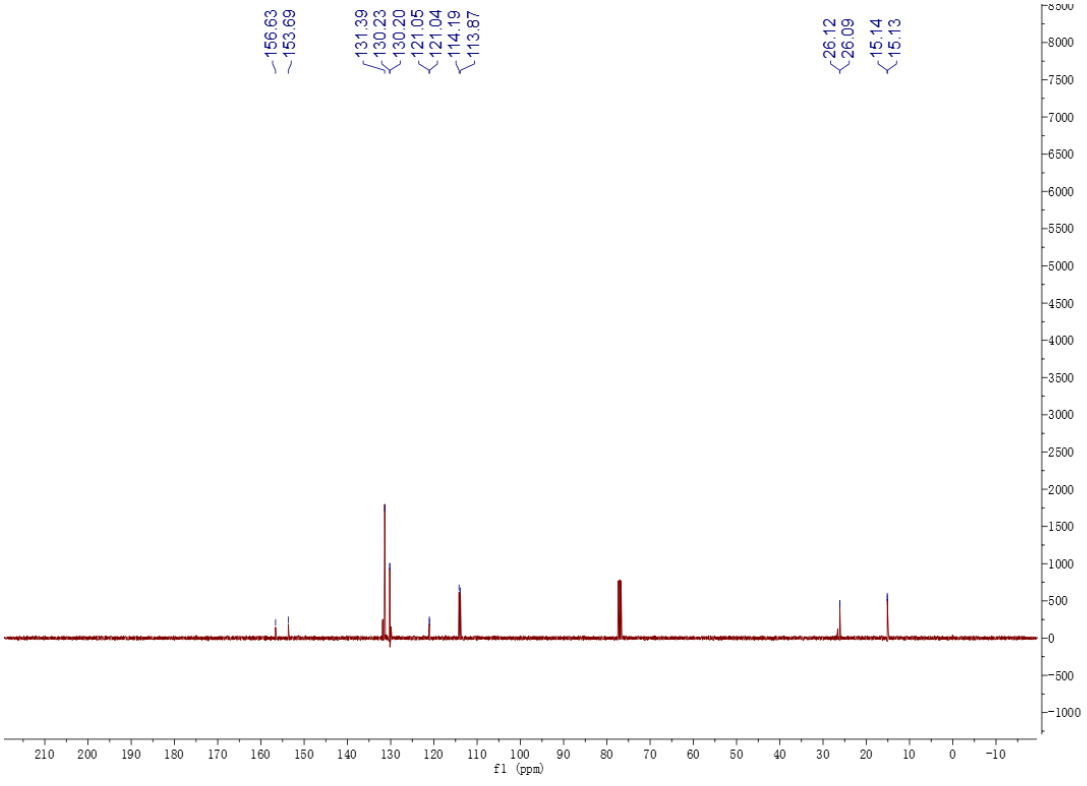
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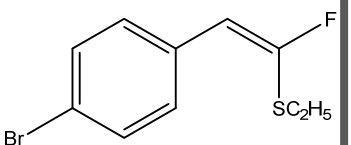
^{19}F NMR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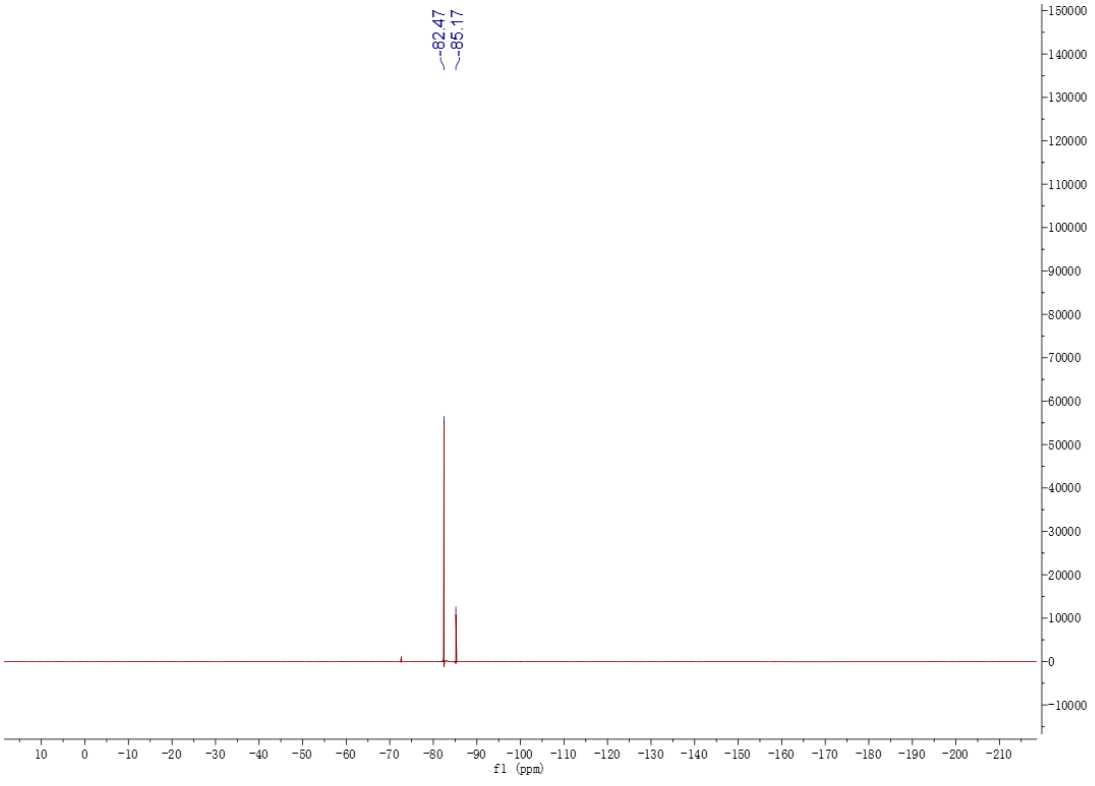
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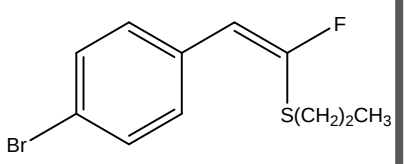
^{1}H NMR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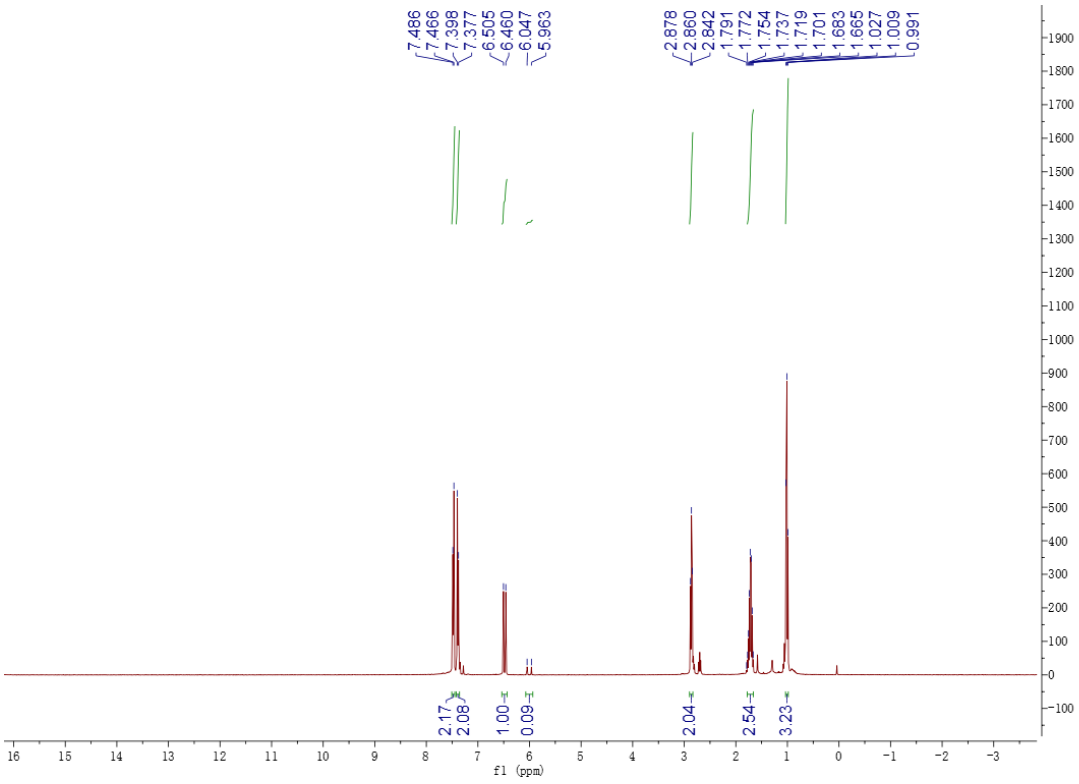
3b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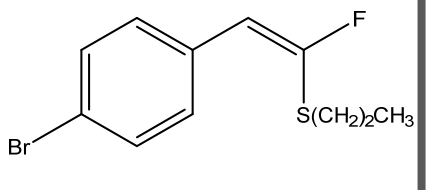
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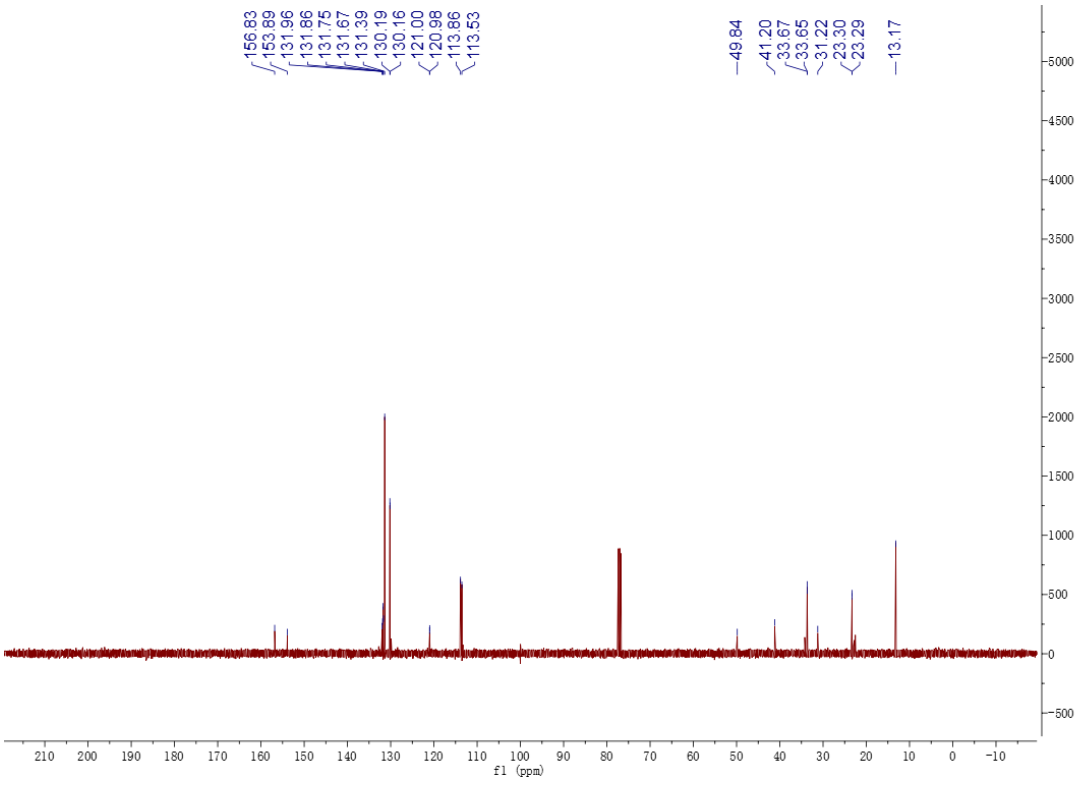
Br

3b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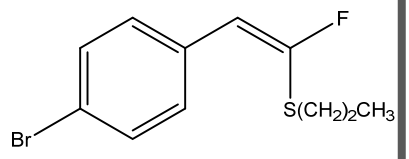
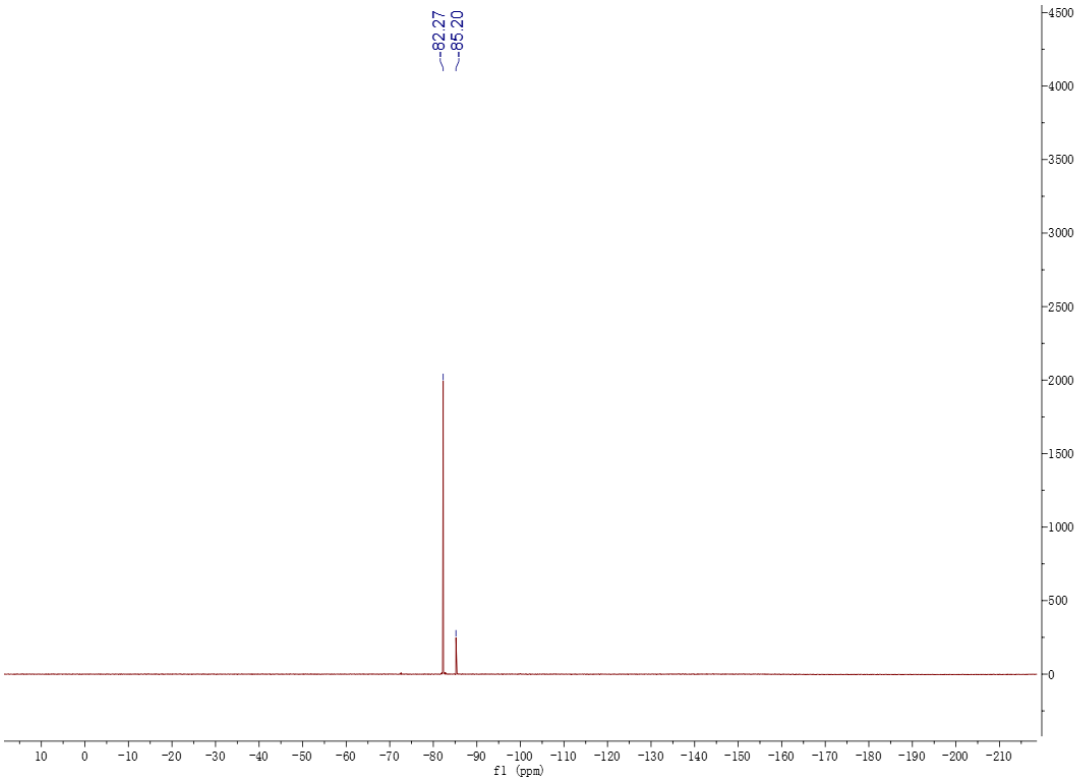
153.89
131.96
131.86
131.75
131.67
131.39
130.19
130.16
121.00
120.98
113.86
113.53
49.84
41.20
33.67
33.65
31.22
23.30
23.29
13.17
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

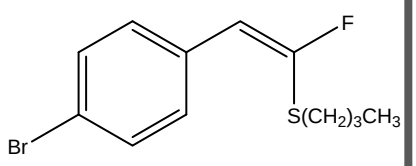
^{19}F NMR


F
S(CH2)2CH3
Br

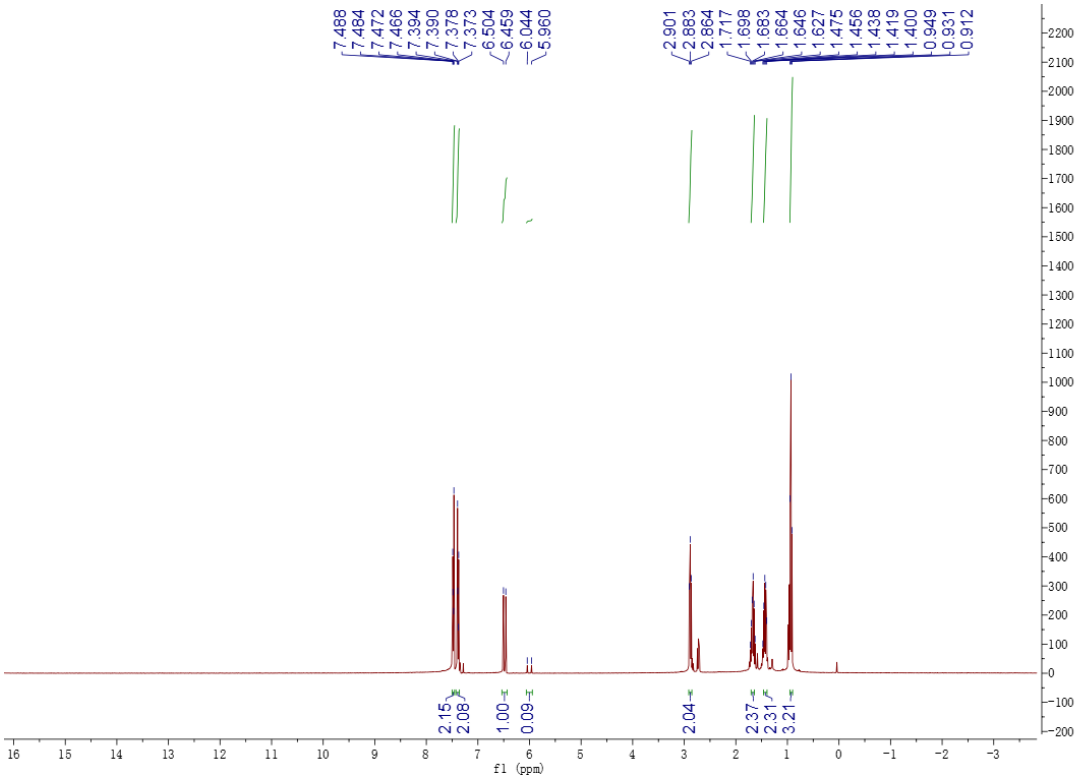
3b


-82.27
-85.20
4500
4000
3500
3000
2500
2000
1500
1000
500
0
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)

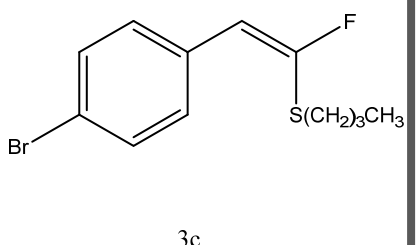
^{1}H NMR


F
S(CH2)3CH3
Br

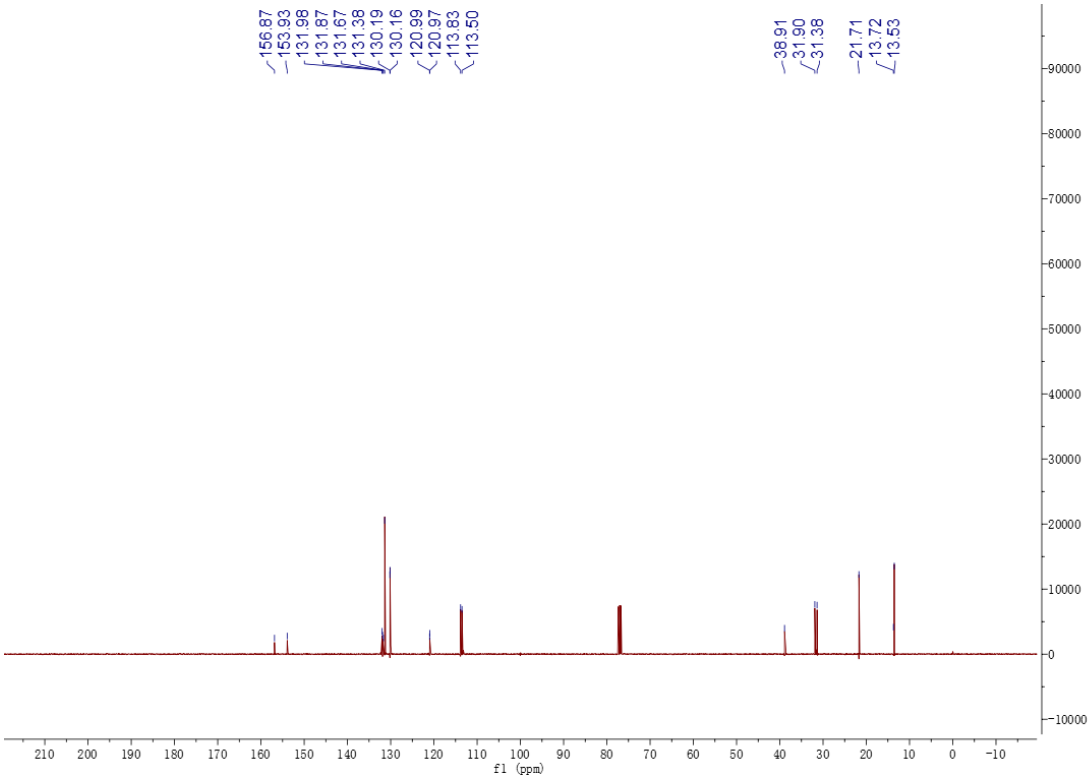
3c


7.488
7.484
7.472
7.466
7.394
7.390
7.378
7.373
6.504
6.459
6.044
5.960
2.901
2.883
2.864
1.717
1.698
1.683
1.664
1.646
1.627
1.475
1.456
1.438
1.419
1.400
0.949
0.931
0.912
2.15
2.08
1.00
0.09
2.04
2.37
2.31
3.21
f1 (ppm)

^{13}C NMR


F
S(CH2)3CH3
Br

3c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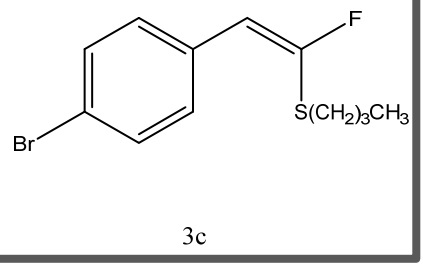
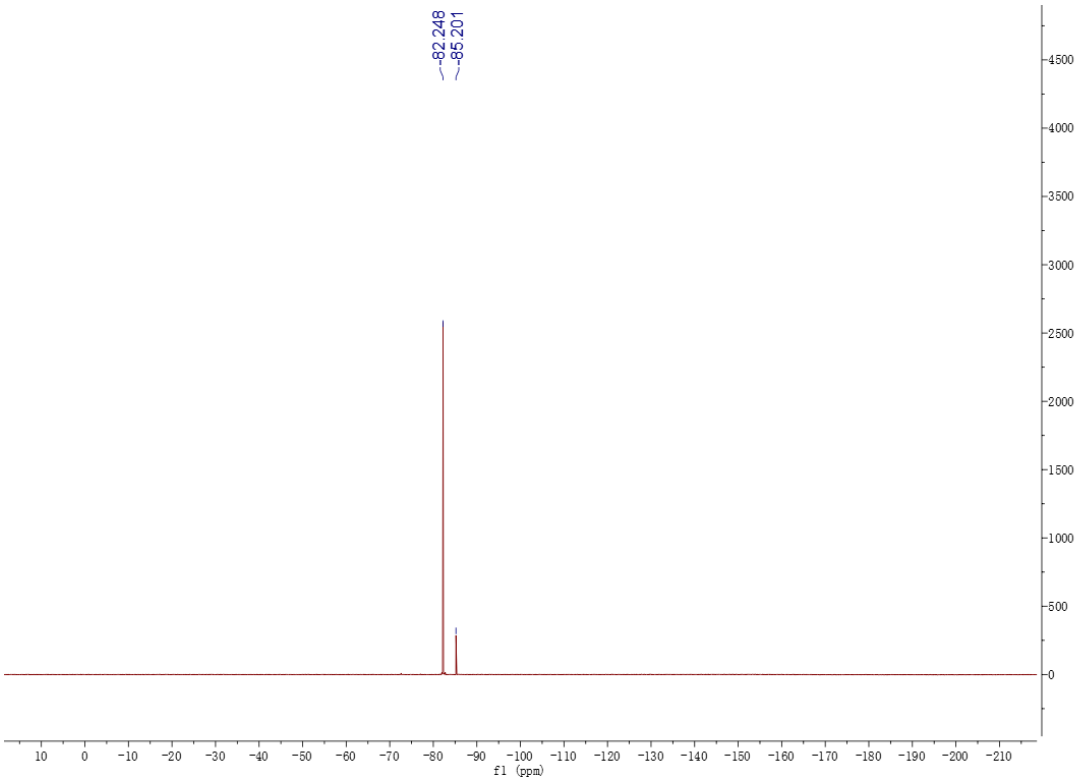
153.93
131.98
131.87
131.67
131.38
130.19
130.16
120.99
120.97
113.83
113.50
38.91
31.90
31.38
21.71
13.72
13.53
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

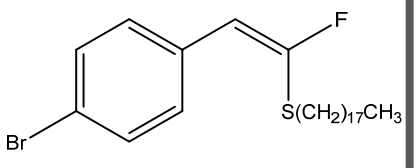
^{19}F NMR


F
S(CH2)3CH3
Br

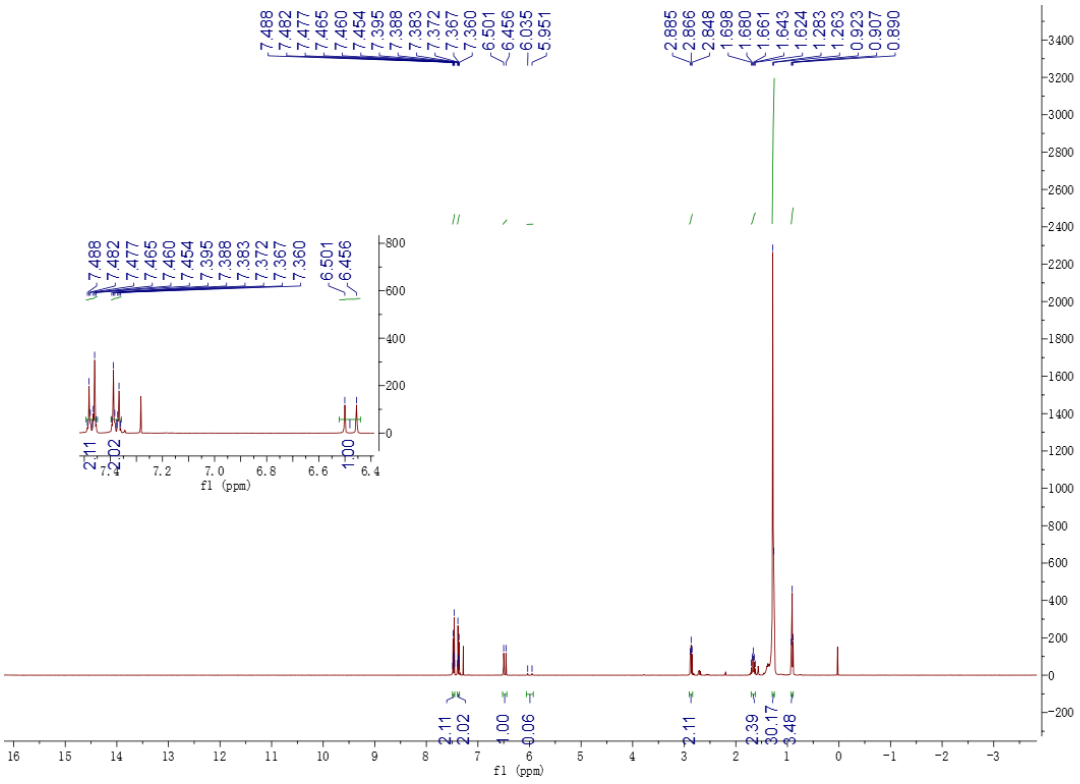
3c


-82.248
-85.201
4500
4000
3500
3000
2500
2000
1500
1000
500
0
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)

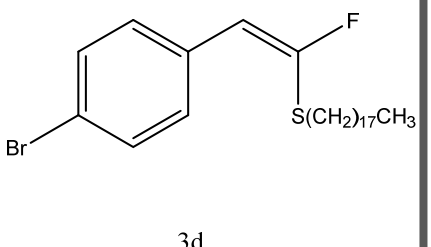
^{1}H NMR


F
S(CH2)17CH3
Br

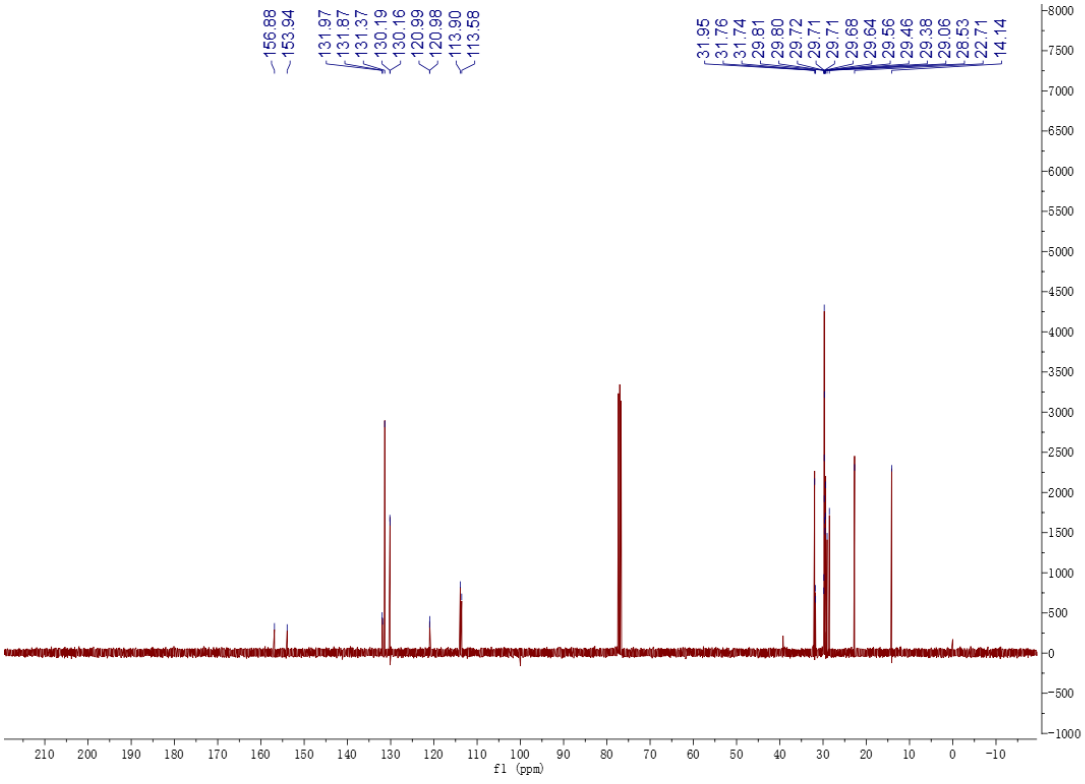
3d


7.488
7.482
7.477
7.465
7.460
7.454
7.395
7.388
7.383
7.372
7.367
7.360
6.501
6.456
6.035
5.951
2.885
2.866
2.848
1.698
1.680
1.661
1.643
1.624
1.283
1.263
0.923
0.907
0.890
2.11
2.02
1.00
0.06
2.11
2.39
30.17
3.48
f1 (ppm)

^{13}C NMR


F
S(CH2)17CH3
Br

3d


156.88
153.94
131.97
131.87
131.37
130.19
130.16
120.99
120.98
113.90
113.58
31.95
31.76
31.74
29.81
29.80
29.72
29.71
29.71
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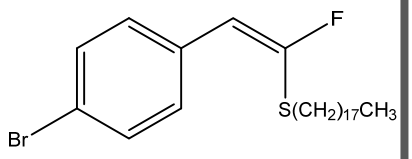
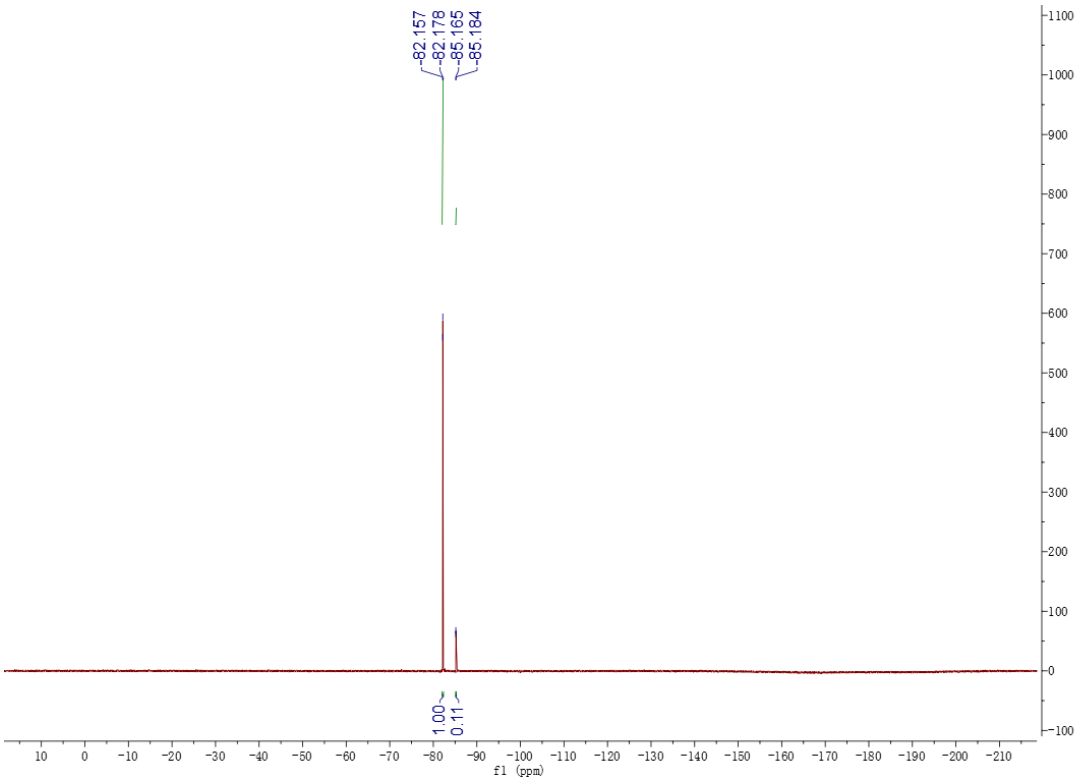
28.53
22.71
14.14
f1 (ppm)

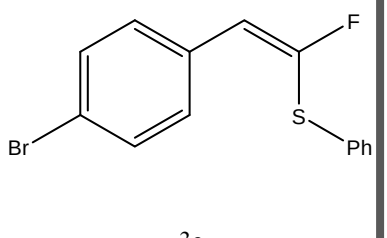
^{19}F NMR



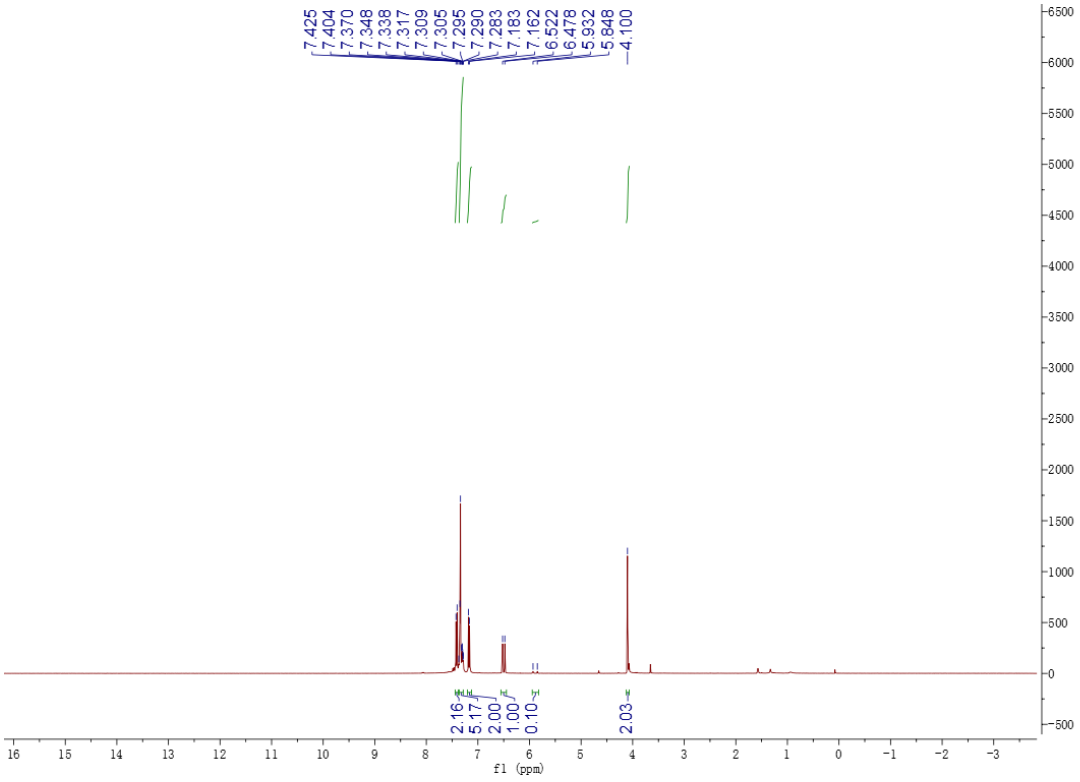
3d



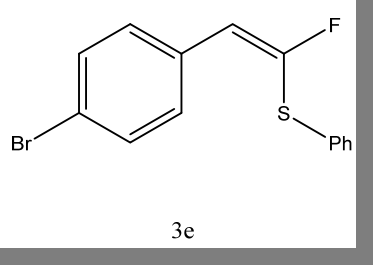
^{1}H NMR


F
S
Ph
Br

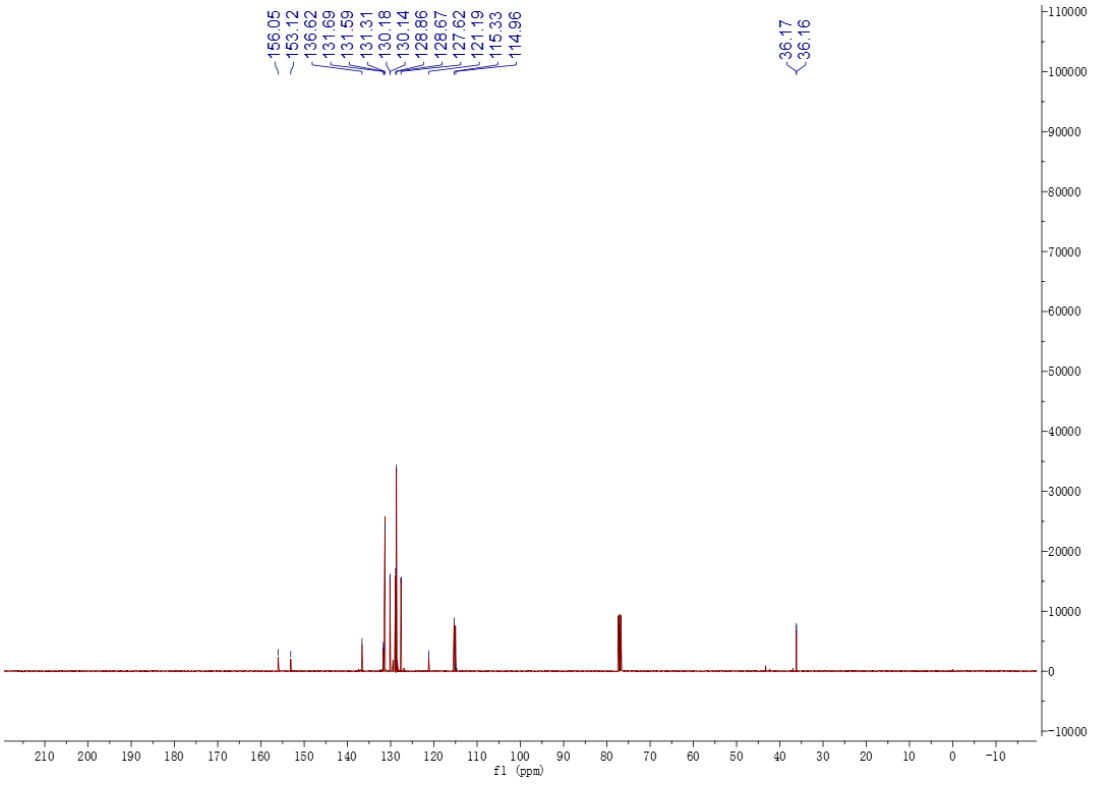
3e


7.425
7.404
7.370
7.348
7.338
7.317
7.309
7.305
7.295
7.290
7.283
7.183
7.162
6.522
6.478
5.932
5.848
4.100
2.16
5.17
2.00
1.00
0.10
2.03
f1 (ppm)

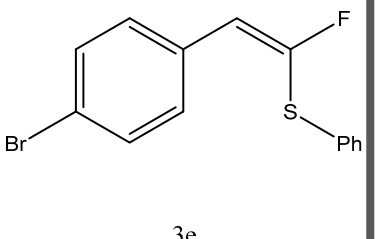
^{13}C NMR


F
S
Ph
Br

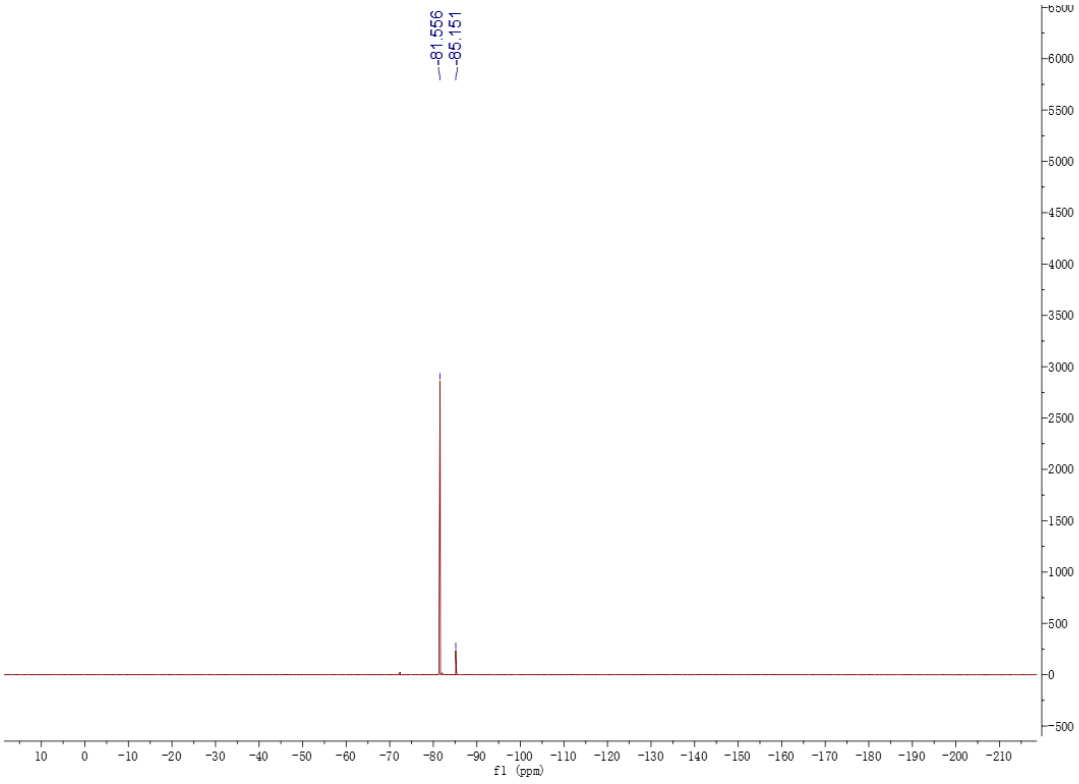
3e


156.05
153.12
136.62
131.69
131.59
131.31
130.18
130.14
128.86
128.67
127.62
121.19
115.33
114.96
36.17
36.16
110000
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
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)

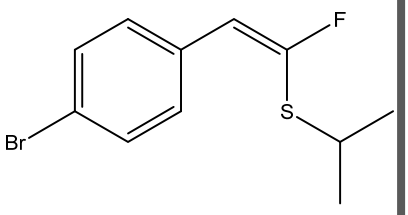
^{19}F NMR



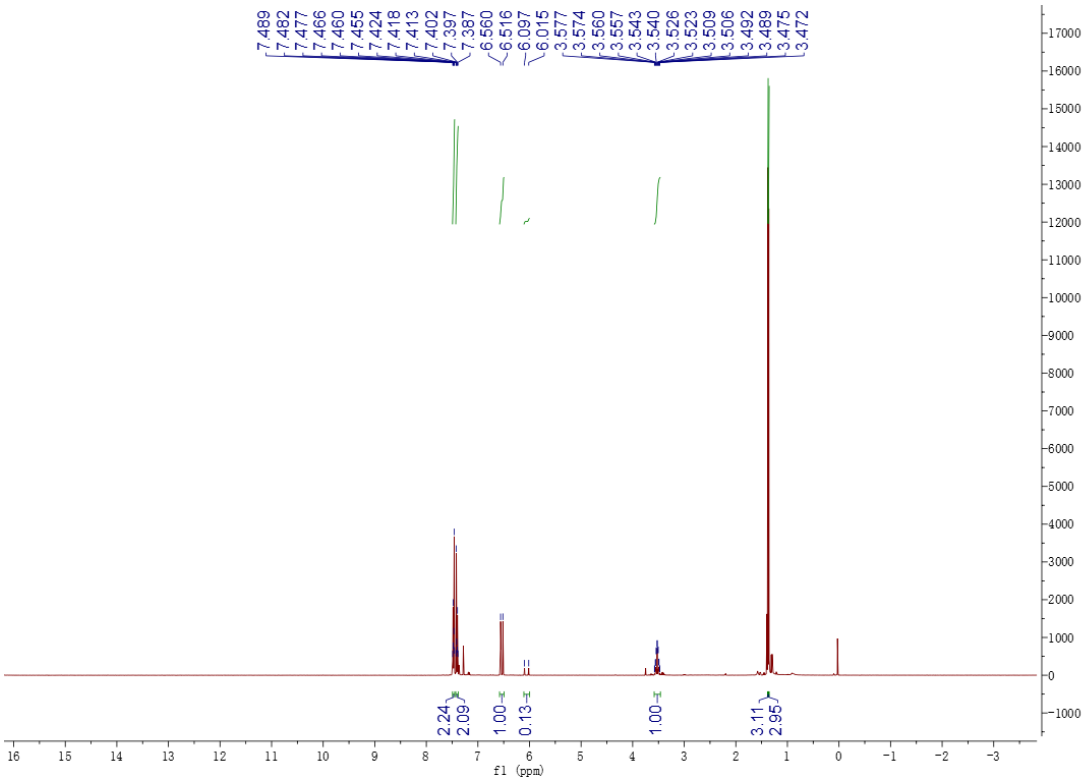
3e



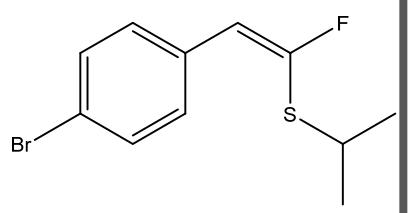
^{1}H NMR


F
S
Br

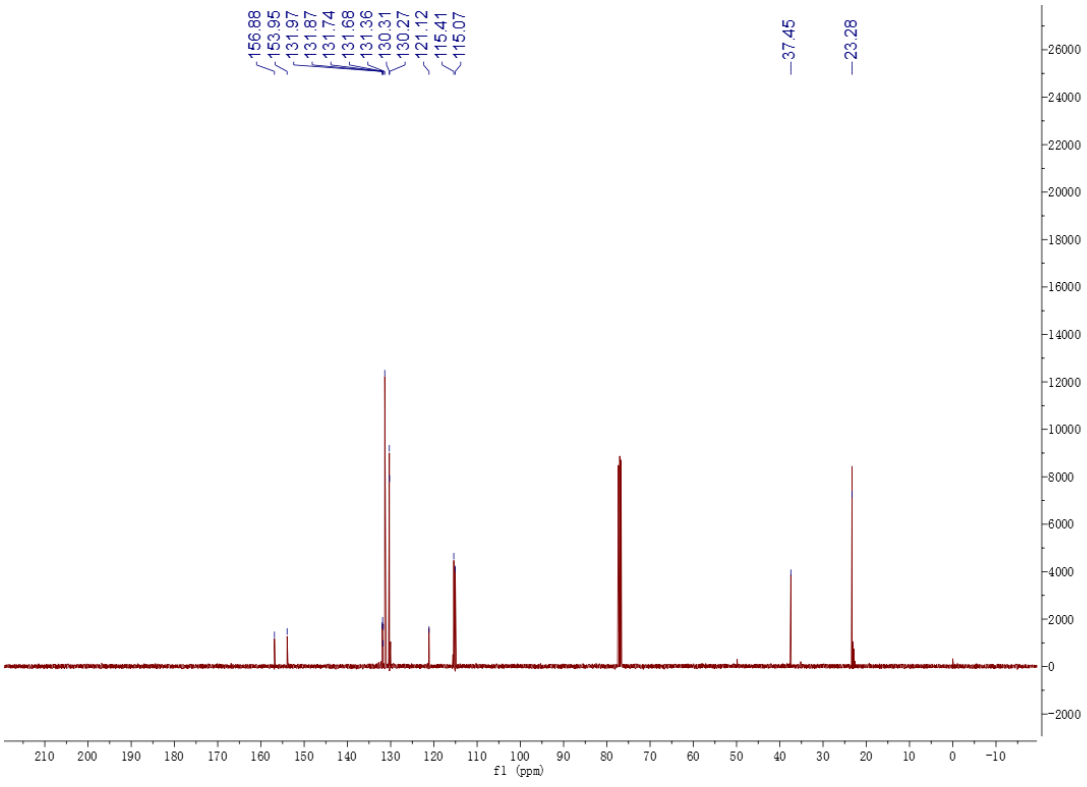
3f


7.489
7.482
7.477
7.466
7.460
7.455
7.424
7.418
7.413
7.402
7.397
7.387
6.560
6.516
6.097
6.015
3.577
3.574
3.560
3.557
3.543
3.540
3.526
3.523
3.509
3.506
3.492
3.489
3.475
3.472
2.24
2.09
1.00
0.13
1.00
3.11
2.95
f1 (ppm)

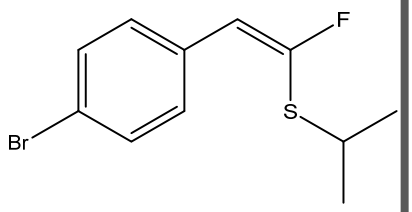
^{13}C NMR


F
S
Br

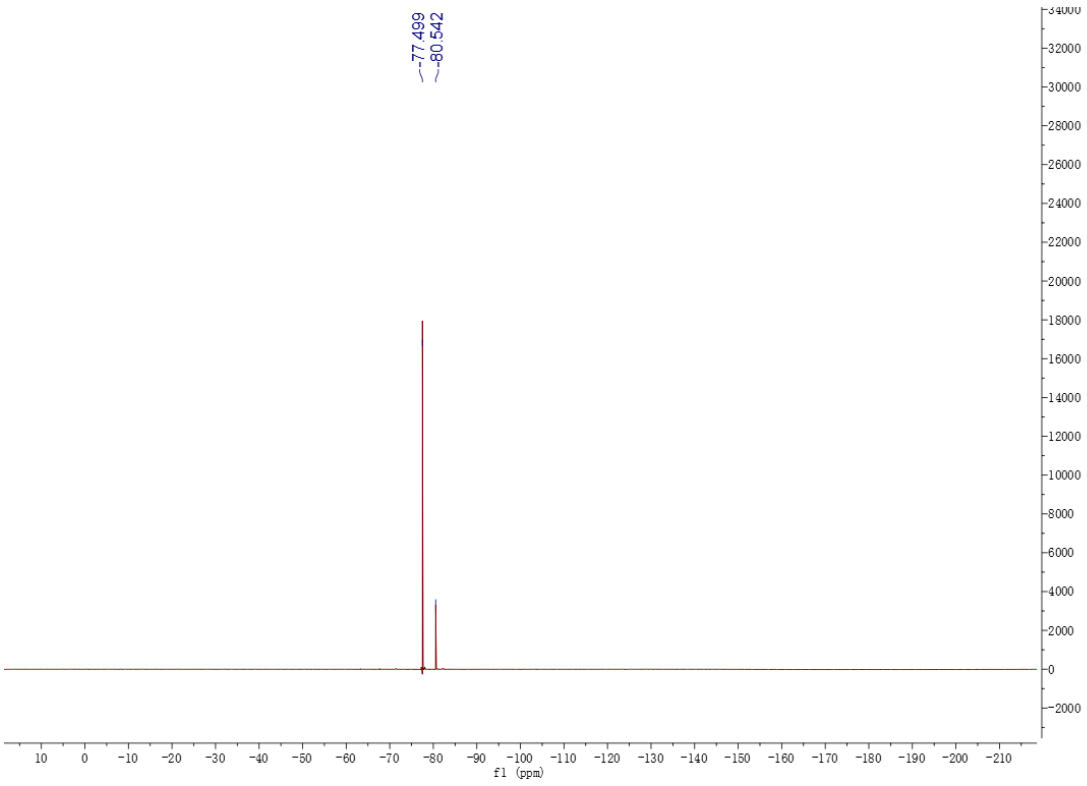
3f


156.88
153.95
131.97
131.87
131.74
131.68
131.36
130.31
130.27
121.12
115.41
115.07
37.45
23.28
f1 (ppm)

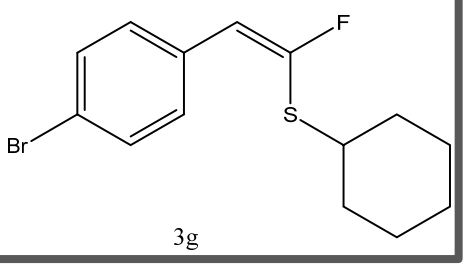
^{19}F NMR



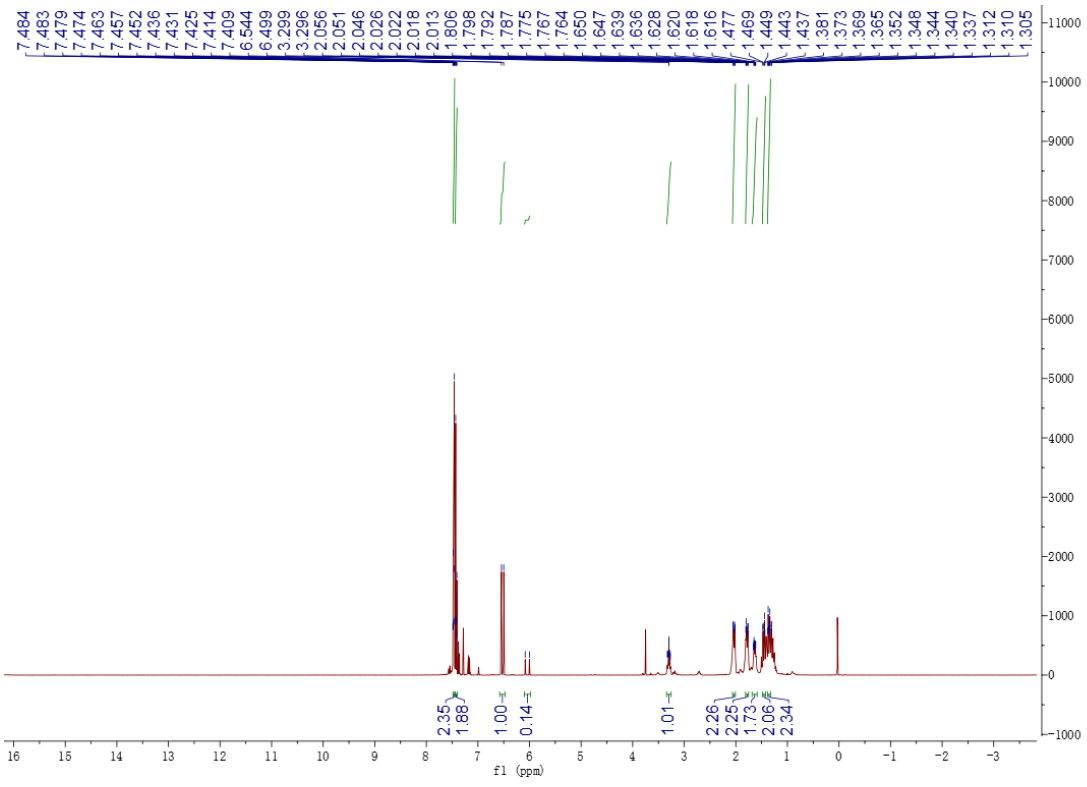
3f



^{1}H NMR


F
S
Br

3g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7.457
7.452
7.436
7.431
7.425
7.414
7.409
6.544
6.499
3.299
3.296
2.056
2.051
2.046
2.026
2.022
2.018
2.013
1.806
1.798
1.792
1.787
1.775
1.767
1.764
1.650
1.647
1.639
1.636
1.628
1.620
1.618
1.616
1.477
1.469
1.449
1.443
1.437
1.381
1.373
1.369
1.365
1.352
1.348
1.344
1.340
1.337
1.312
1.310
1.305
2.35
1.88
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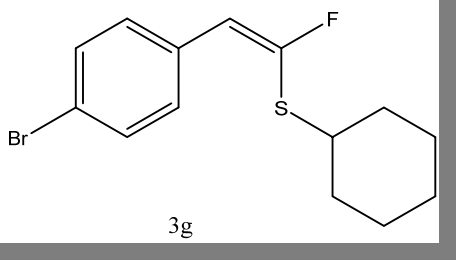
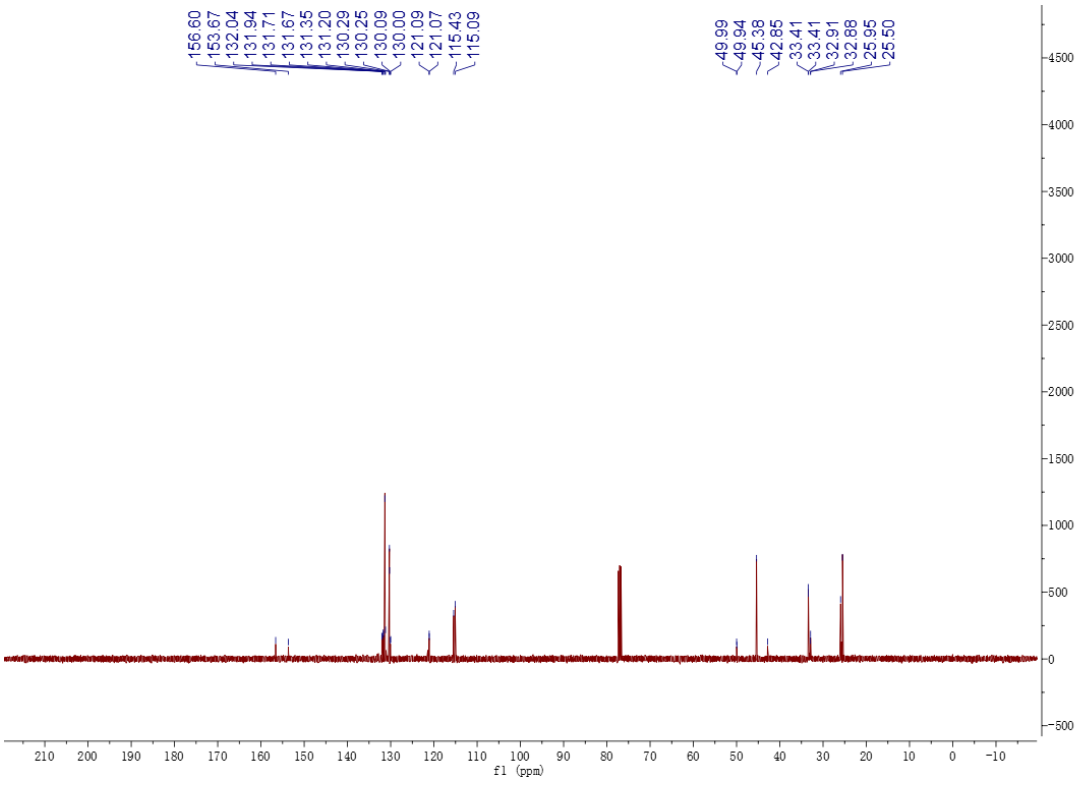
0.14
1.01
2.26
2.25
1.73
2.06
2.34
f1 (ppm)

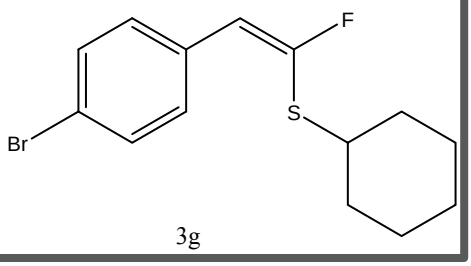
^{13}C NMR


F
S
Br

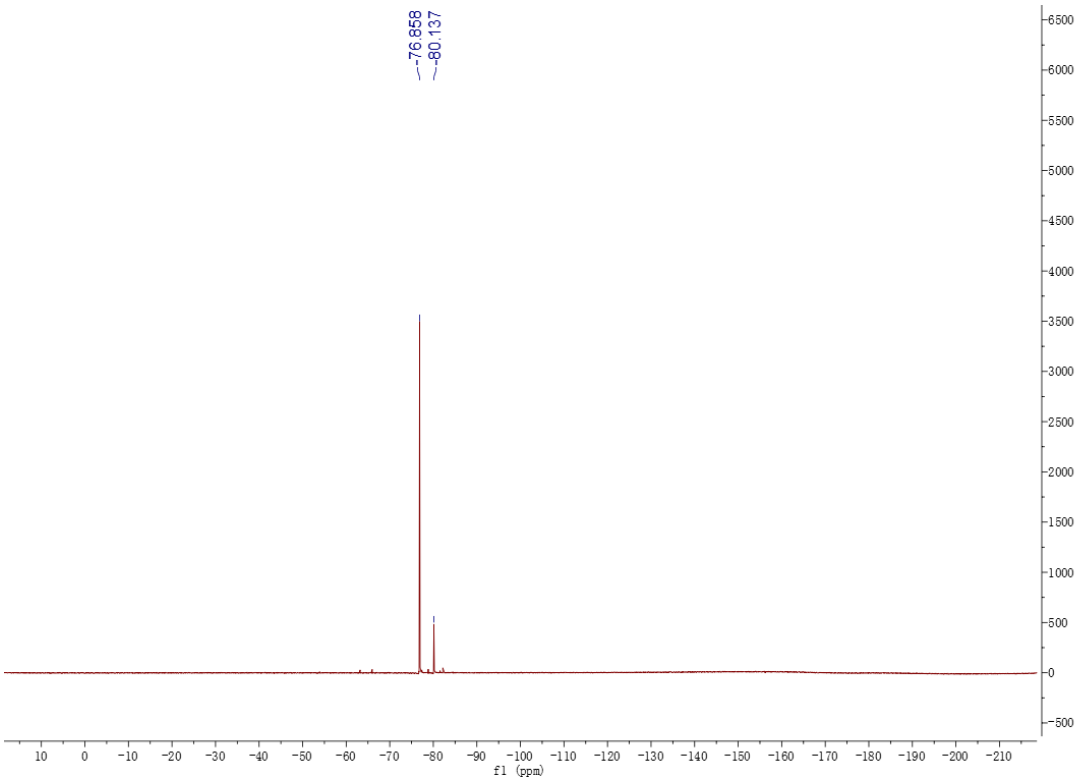
3g


156.60
153.67
132.04
131.94
131.71
131.67
131.35
131.20
130.29
130.25
130.09
130.00
121.09
121.07
115.43
115.09
49.99
49.94
45.38
42.85
33.41
33.41
32.91
32.88
25.95
25.50
f1 (ppm)

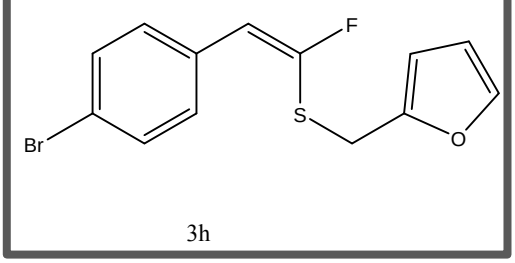
^{19}F NMR



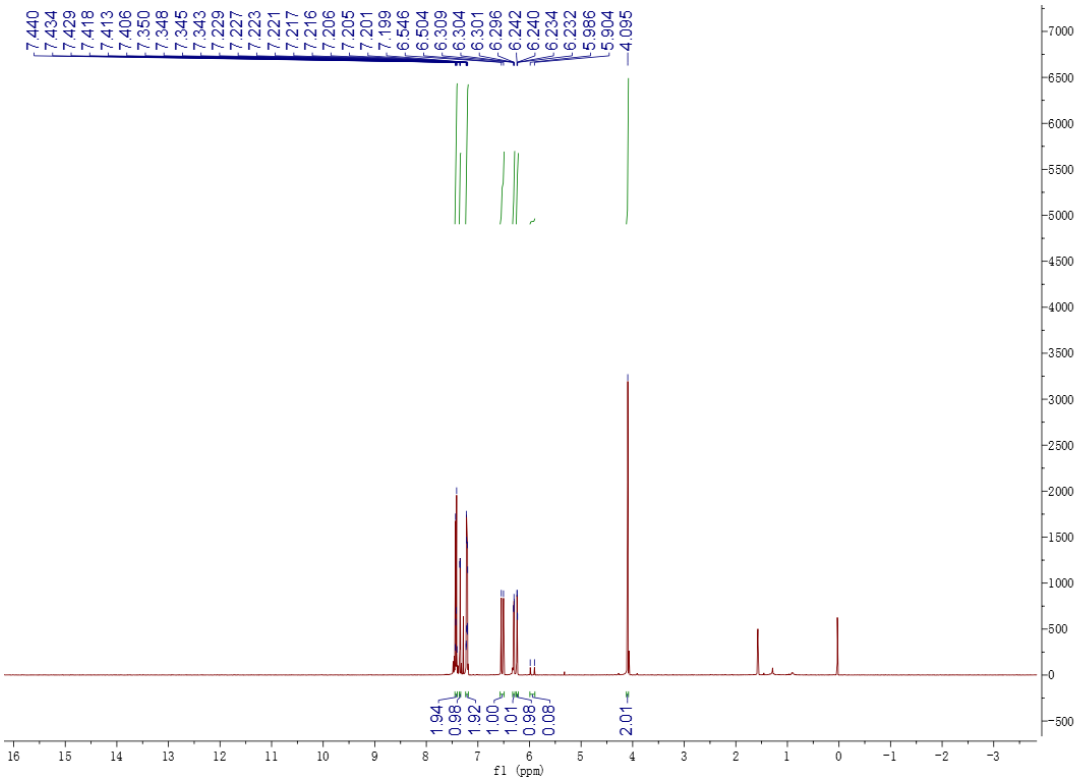
3g



^{1}H NMR


F
S
O
Br

3h


7.440
7.434
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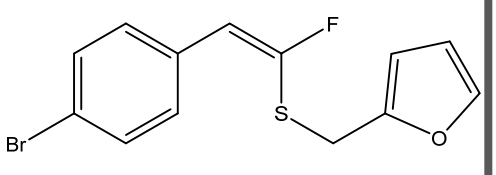
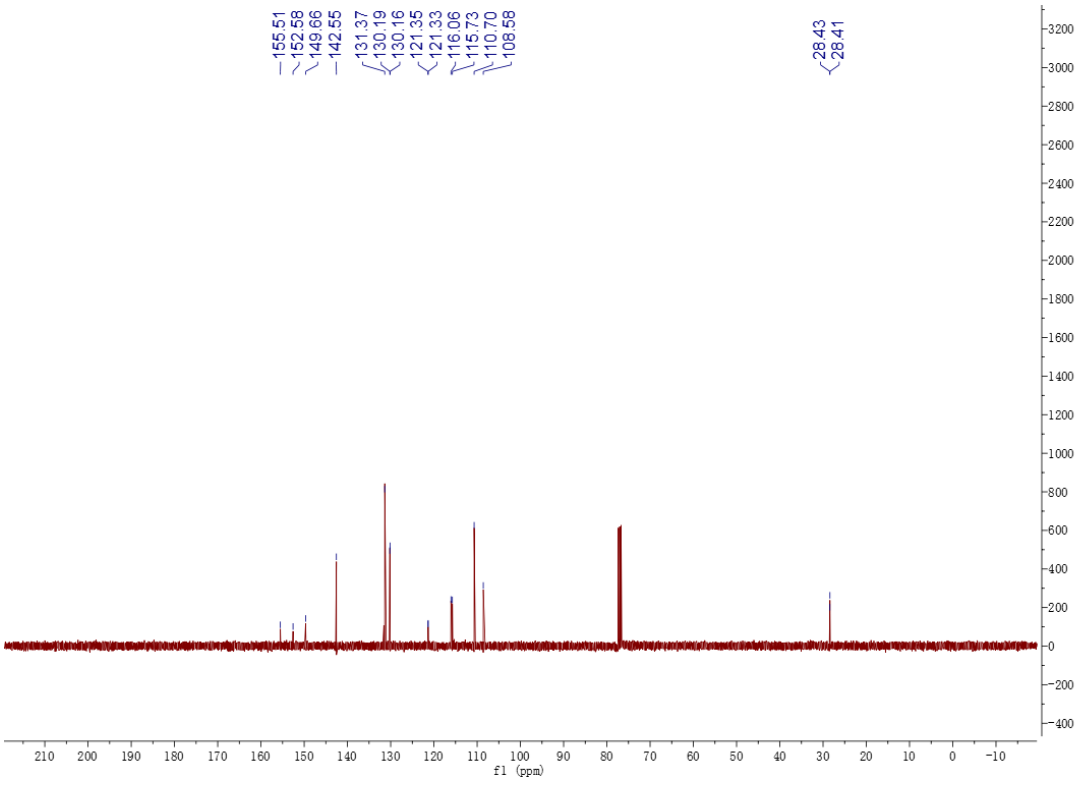
7.418
7.413
7.406
7.350
7.348
7.345
7.343
7.229
7.227
7.223
7.221
7.217
7.216
7.206
7.205
7.201
7.199
6.546
6.504
6.309
6.304
6.301
6.296
6.242
6.240
6.234
6.232
5.986
5.904
4.095
1.94
0.98
1.92
1.00
1.01
0.98
0.08
2.01
f1 (ppm)

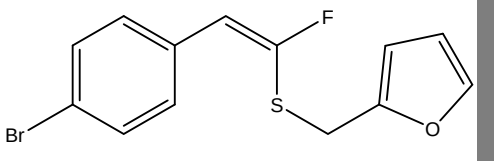
^{13}C NMR


F
S
O
Br

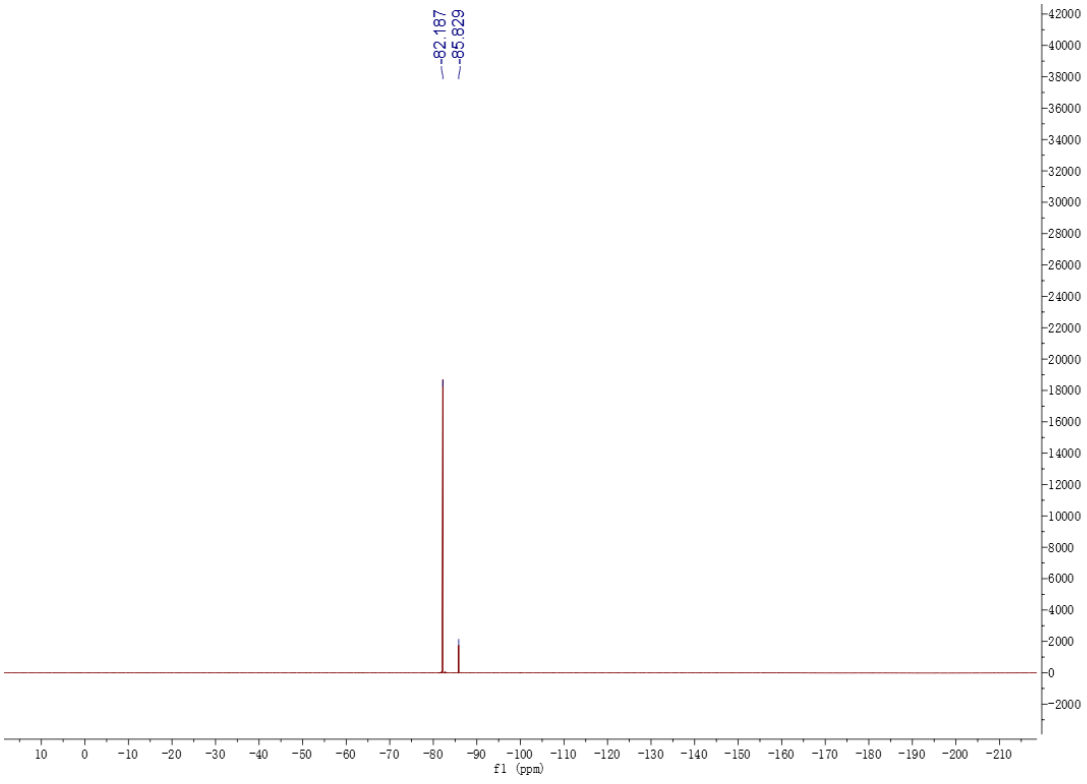
3h


155.51
152.58
149.66
142.55
131.37
130.19
130.16
121.35
121.33
116.06
115.73
110.70
108.58
28.43
28.41
f1 (ppm)

^{19}F NMR


F
S
O
Br

3h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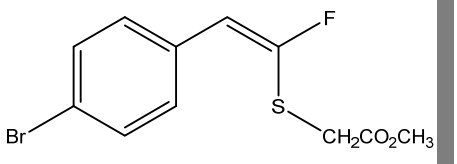
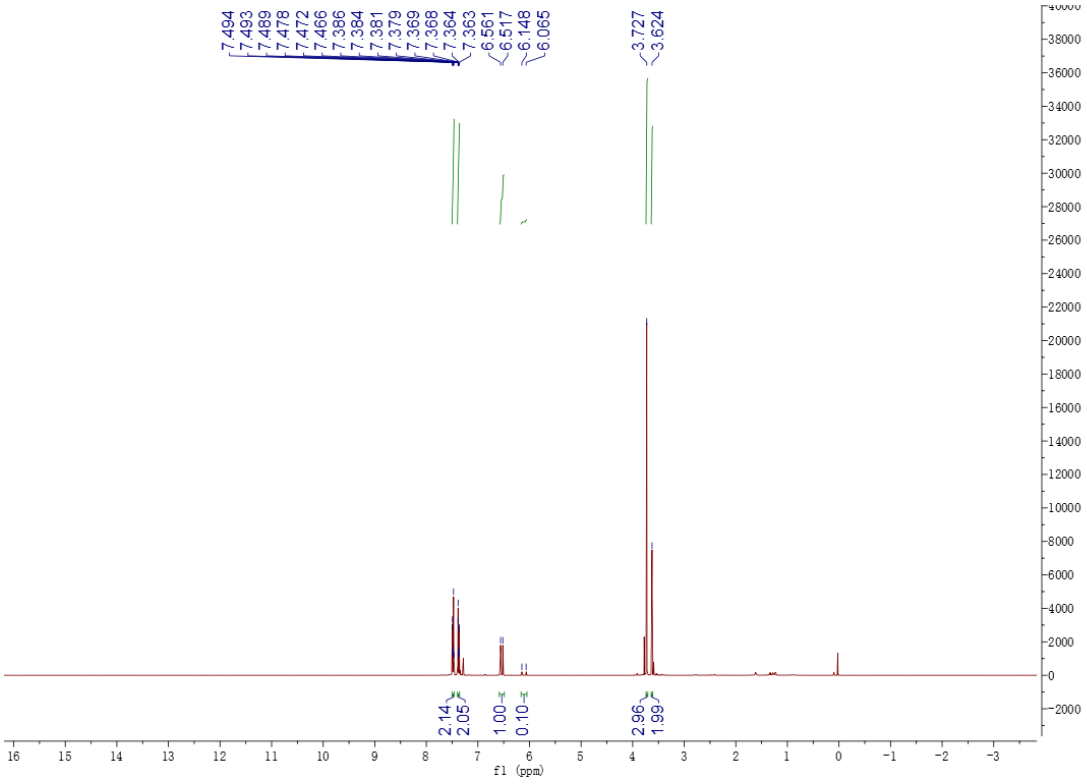
-85.829
42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

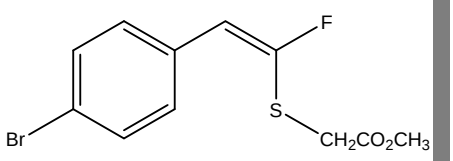
^{1}H NMR


F
S
Br
$CH_2CO_2CH_3$

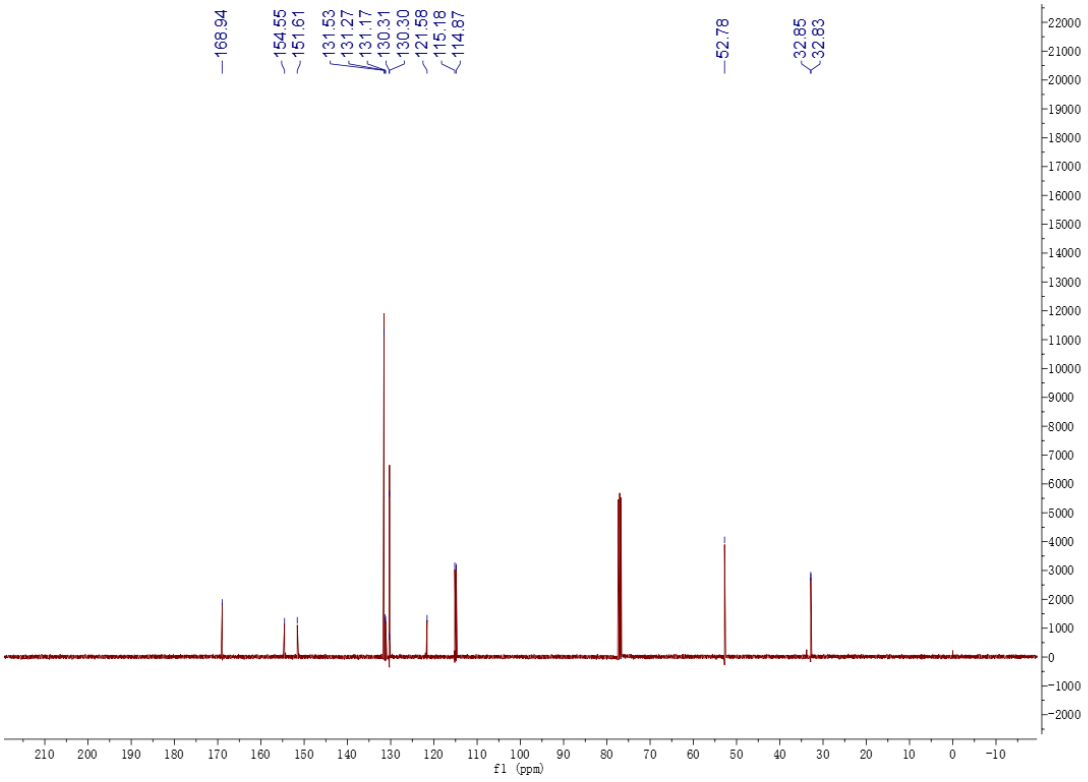
3i


7.494
7.493
7.489
7.478
7.472
7.466
7.386
7.384
7.381
7.379
7.369
7.368
7.364
7.363
6.561
6.517
6.148
6.065
3.727
3.624
2.14
2.05
1.00
0.10
2.96
1.99
f1 (ppm)

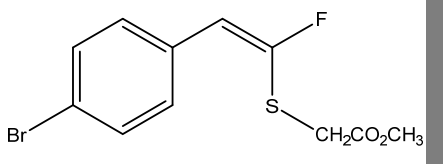
^{13}C NMR


F
S
Br
CH2CO2CH3

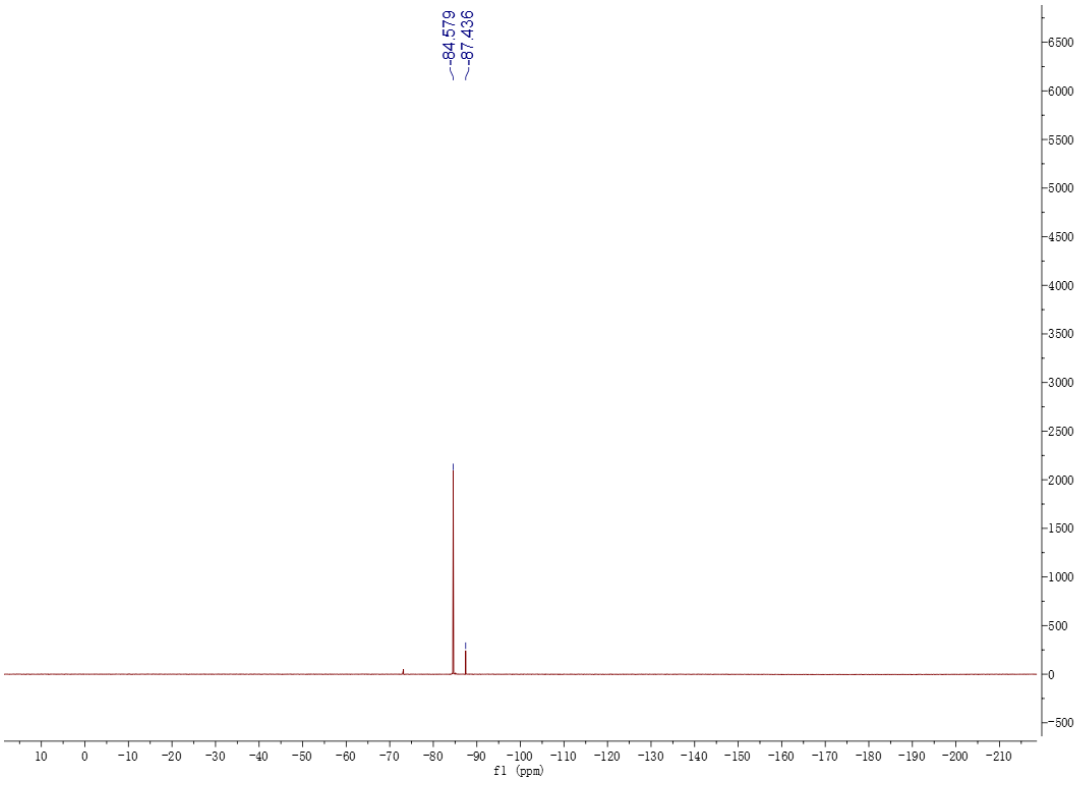
3i


168.94
154.55
151.61
131.53
131.27
131.17
130.31
130.30
121.58
115.18
114.87
52.78
32.85
32.83
f1 (ppm)

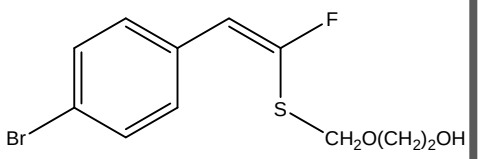
^{19}F NMR


F
S
Br
$CH_2CO_2CH_3$

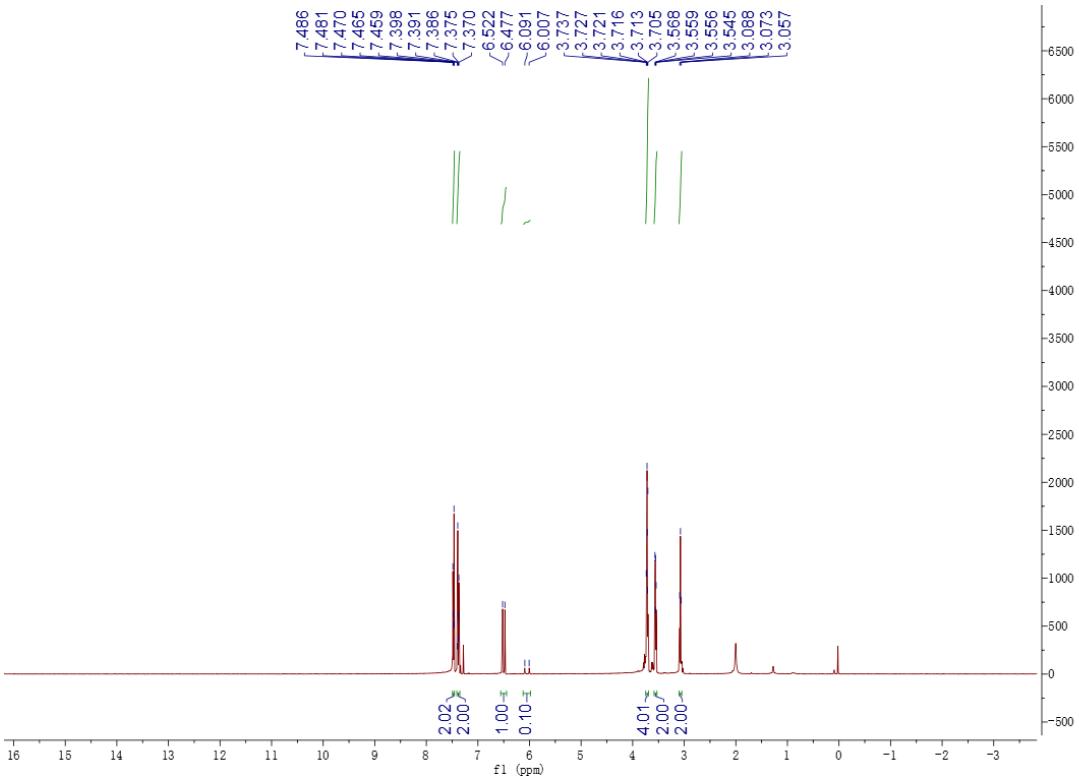
3i


-84.579
-87.436
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
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)

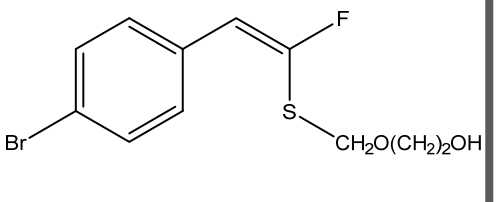
^{1}H NMR


F
S
Br
CH2O(CH2)2OH

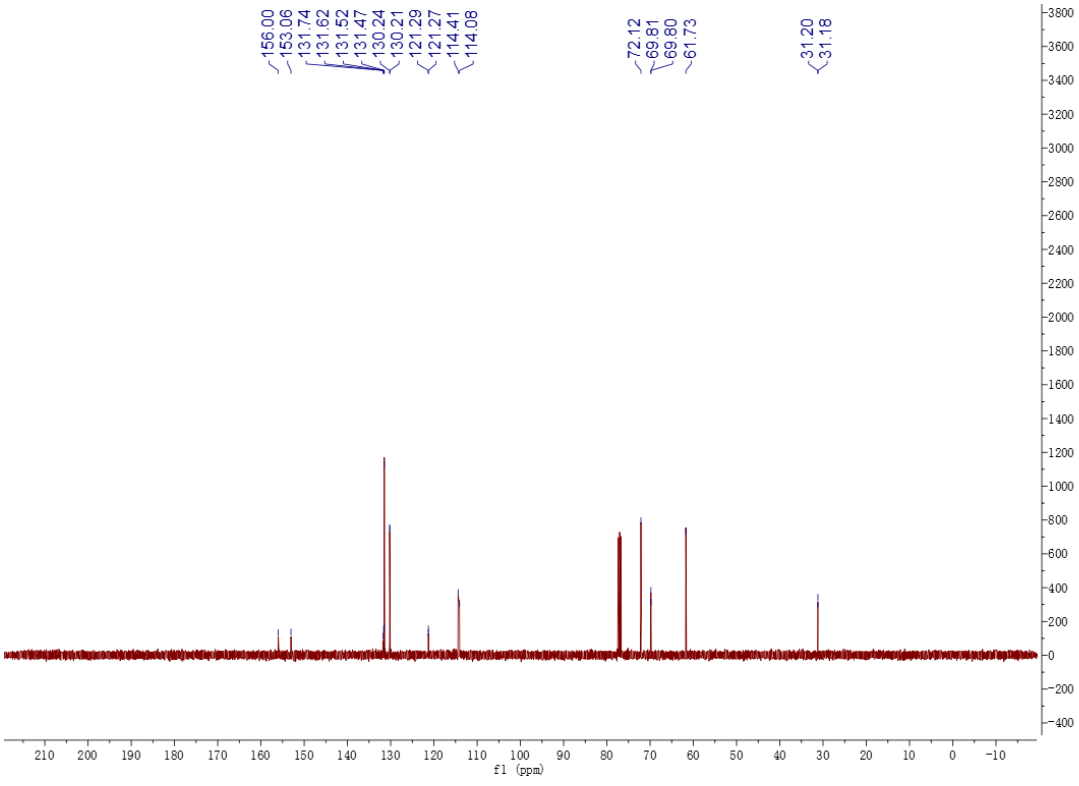
3j


7.486
7.481
7.470
7.465
7.459
7.398
7.391
7.386
7.375
7.370
6.522
6.477
6.091
6.007
3.737
3.727
3.721
3.716
3.713
3.705
3.568
3.559
3.556
3.545
3.088
3.073
3.057
2.02
2.00
1.00
0.10
4.01
2.00
2.00
f1 (ppm)

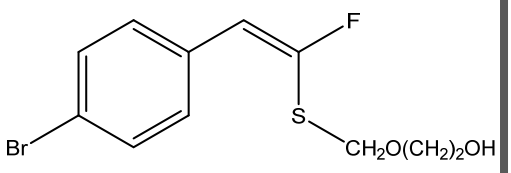
^{13}C NMR


F
S
Br
CH2O(CH2)2OH

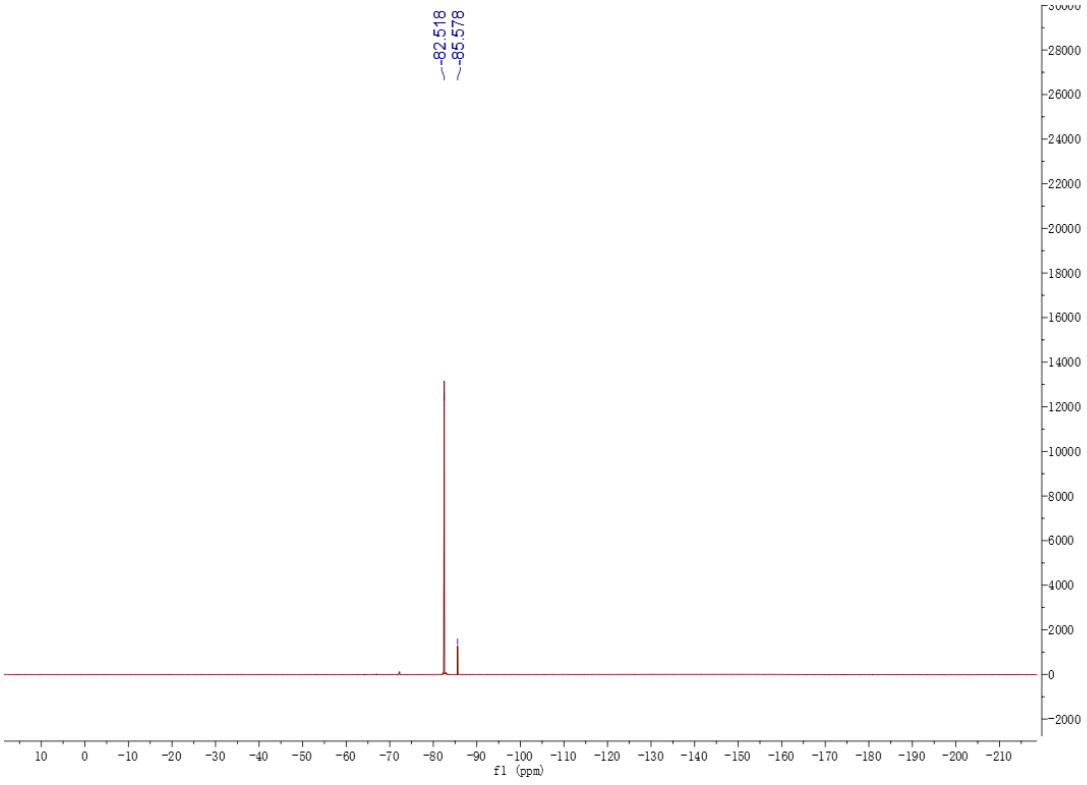
3j


156.00
153.06
131.74
131.62
131.52
131.47
130.24
130.21
121.29
121.27
114.41
114.08
72.12
69.81
69.80
61.73
31.20
31.18
f1 (ppm)

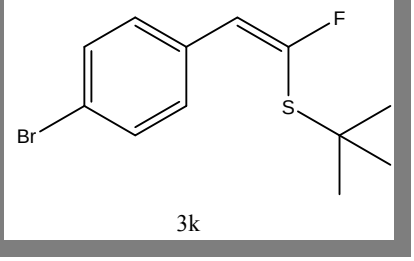
^{19}F NMR


F
S
Br
CH2O(CH2)2OH

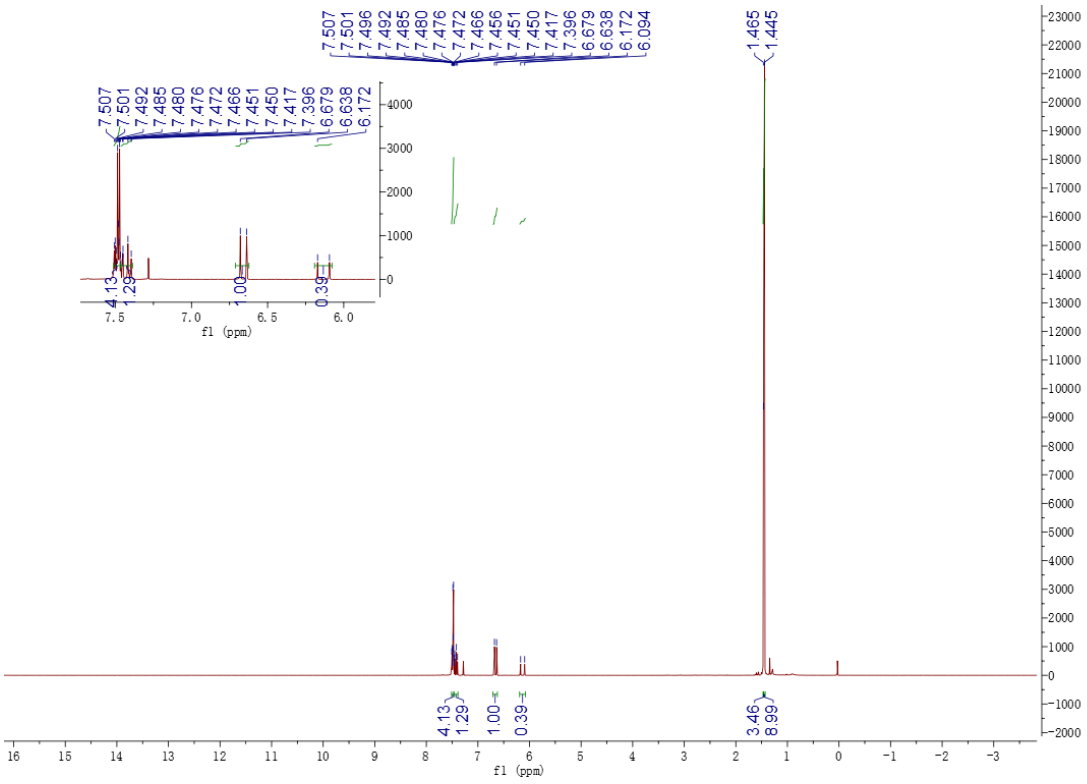
3j


-82.518
-85.578
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
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)

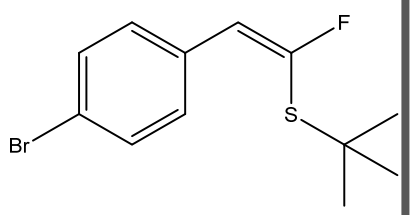
^{1}H NMR


F
S
Br

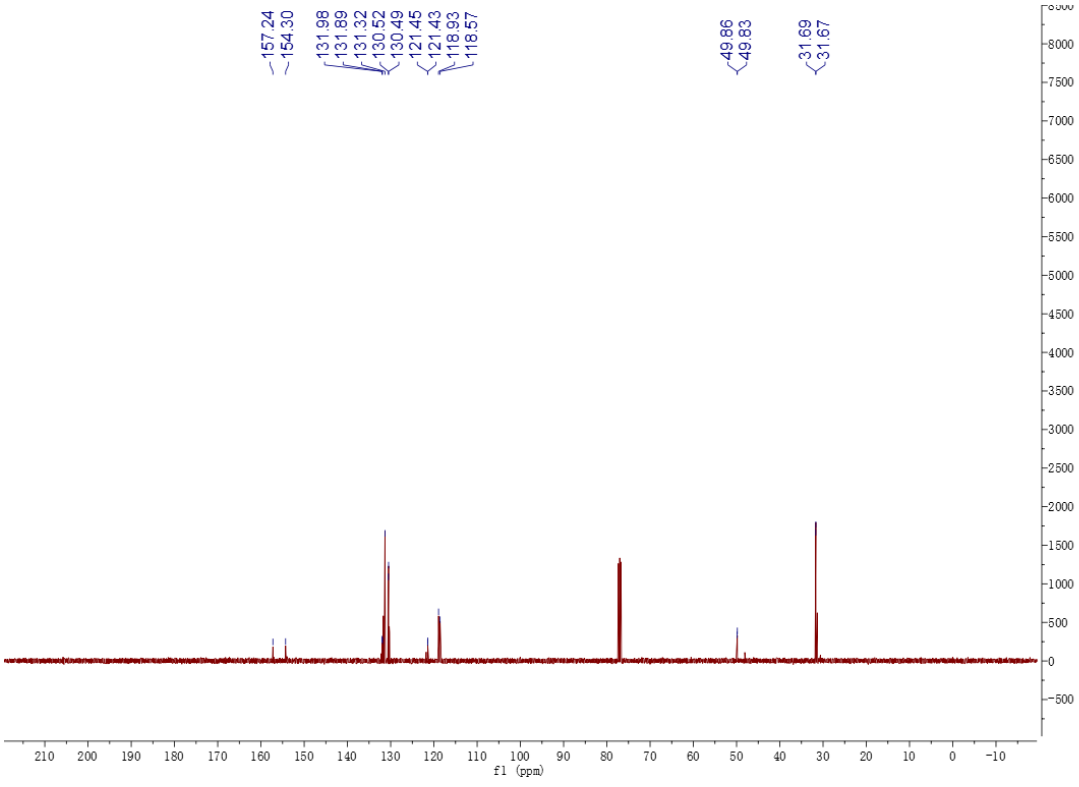
3k


7.507
7.501
7.496
7.492
7.485
7.480
7.476
7.472
7.466
7.456
7.451
7.450
7.417
7.396
6.679
6.638
6.172
6.094
1.465
1.445
4.13
1.29
1.00
0.39
3.46
8.99
f1 (ppm)

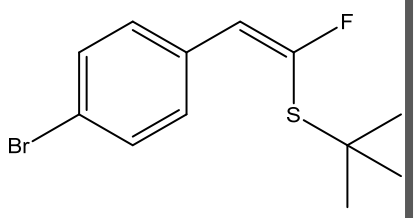
^{13}C NMR


F
S
Br

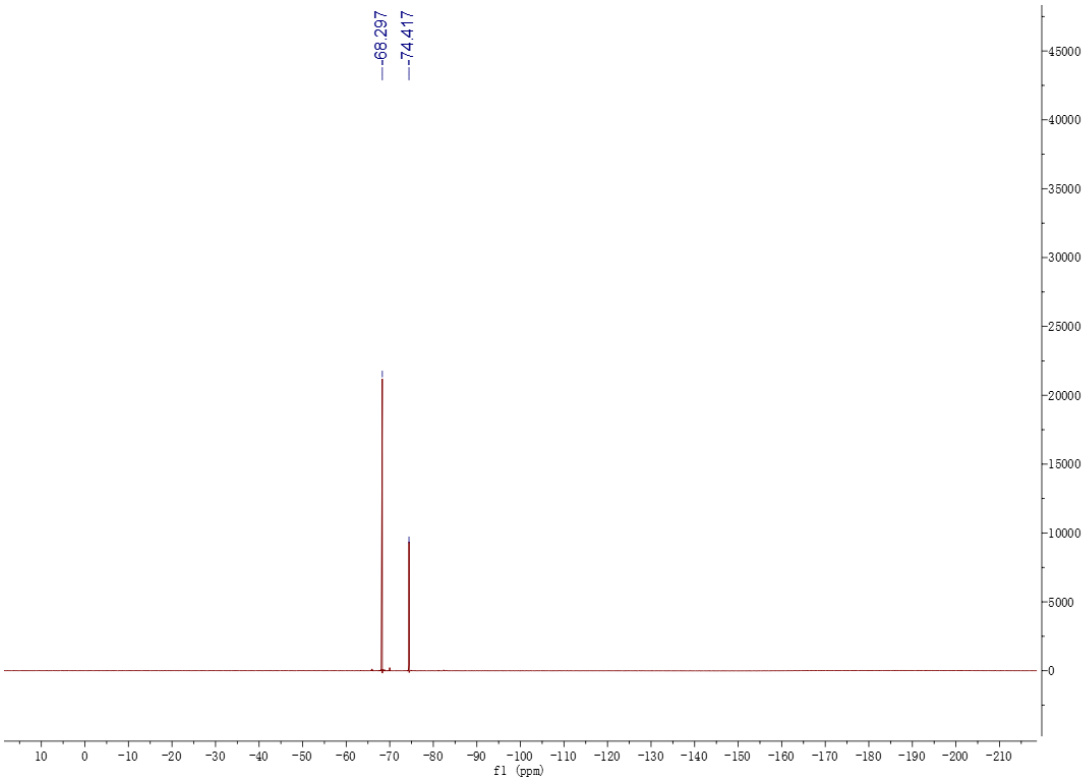
3k


157.24
154.30
131.98
131.89
131.32
130.52
130.49
121.45
121.43
118.93
118.57
49.86
49.83
31.69
31.67
f1 (ppm)

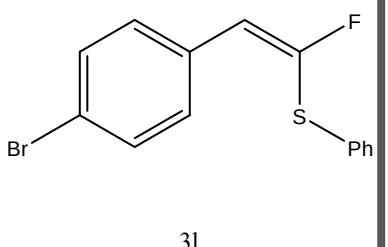
^{19}F NMR


F
S
Br

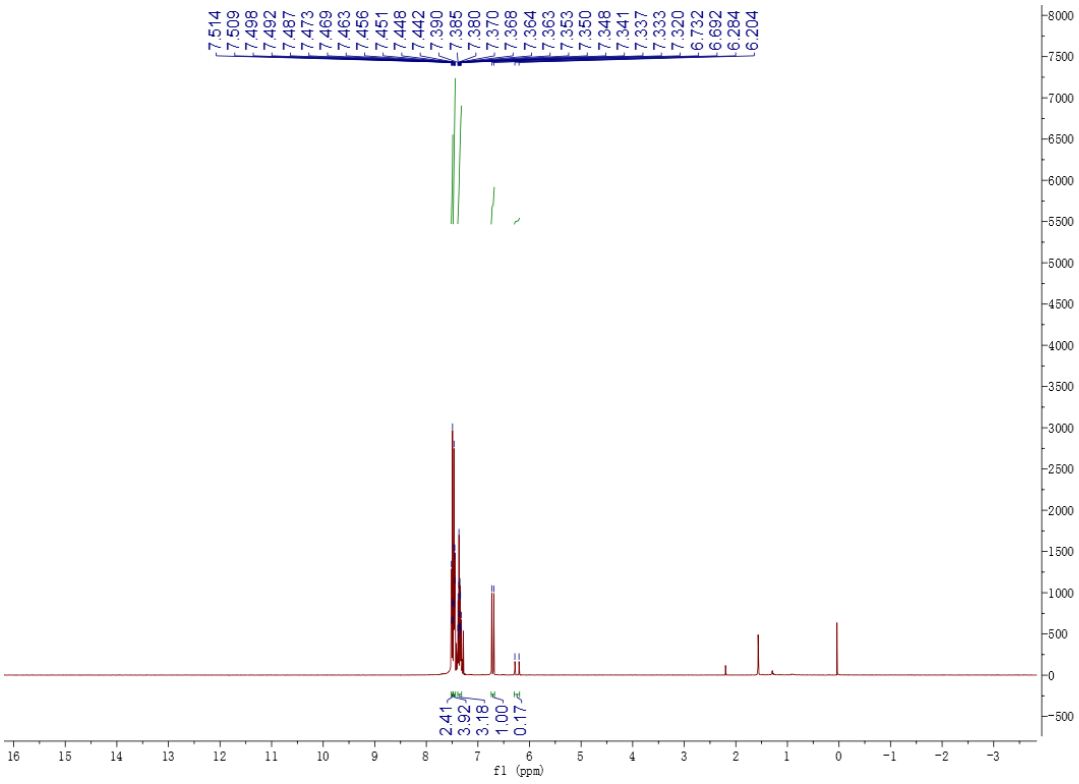
3k


-68.297
-74.417
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
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)

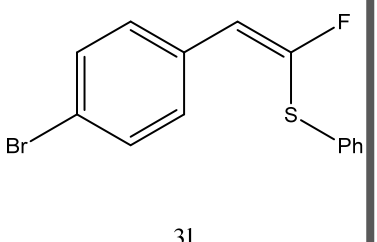
^{1}H NMR


F
S
Ph
Br

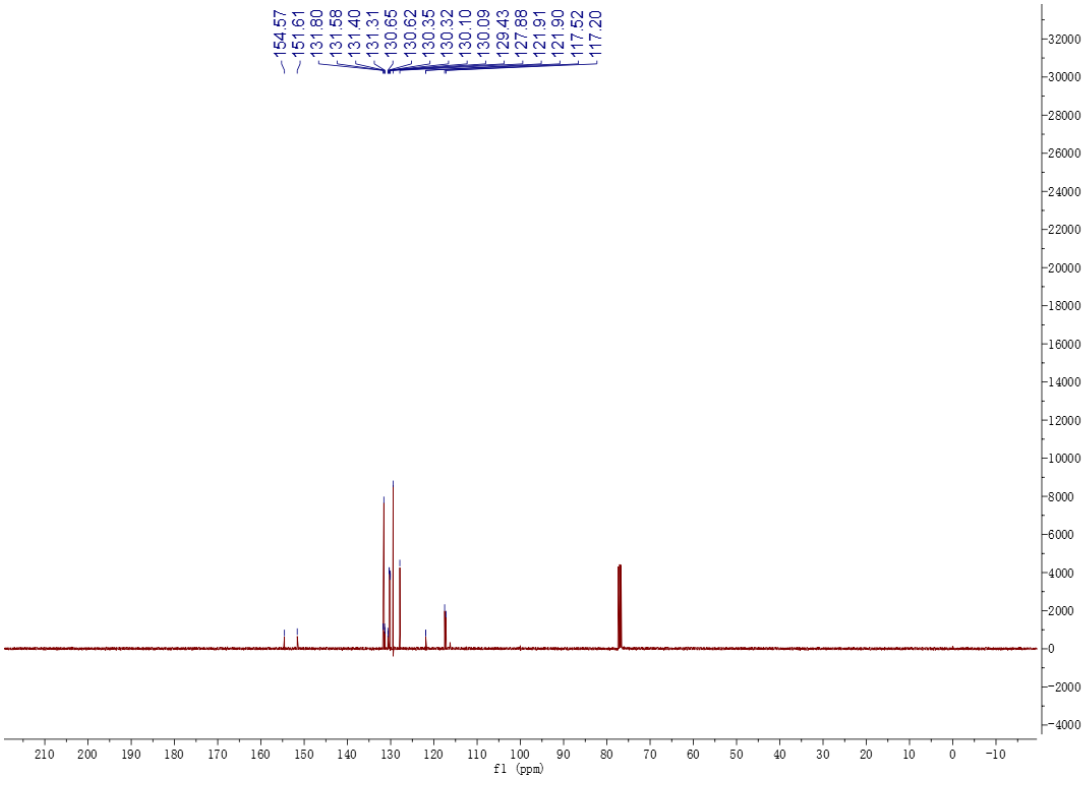
3l


7.514
7.509
7.498
7.492
7.487
7.473
7.469
7.463
7.456
7.451
7.448
7.442
7.390
7.385
7.380
7.370
7.368
7.364
7.363
7.353
7.350
7.348
7.341
7.337
7.333
7.320
6.732
6.692
6.284
6.204
2.41
3.92
3.18
1.00
0.17
f1 (ppm)

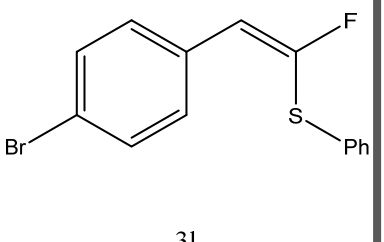
^{13}C NMR


F
S
Ph
Br

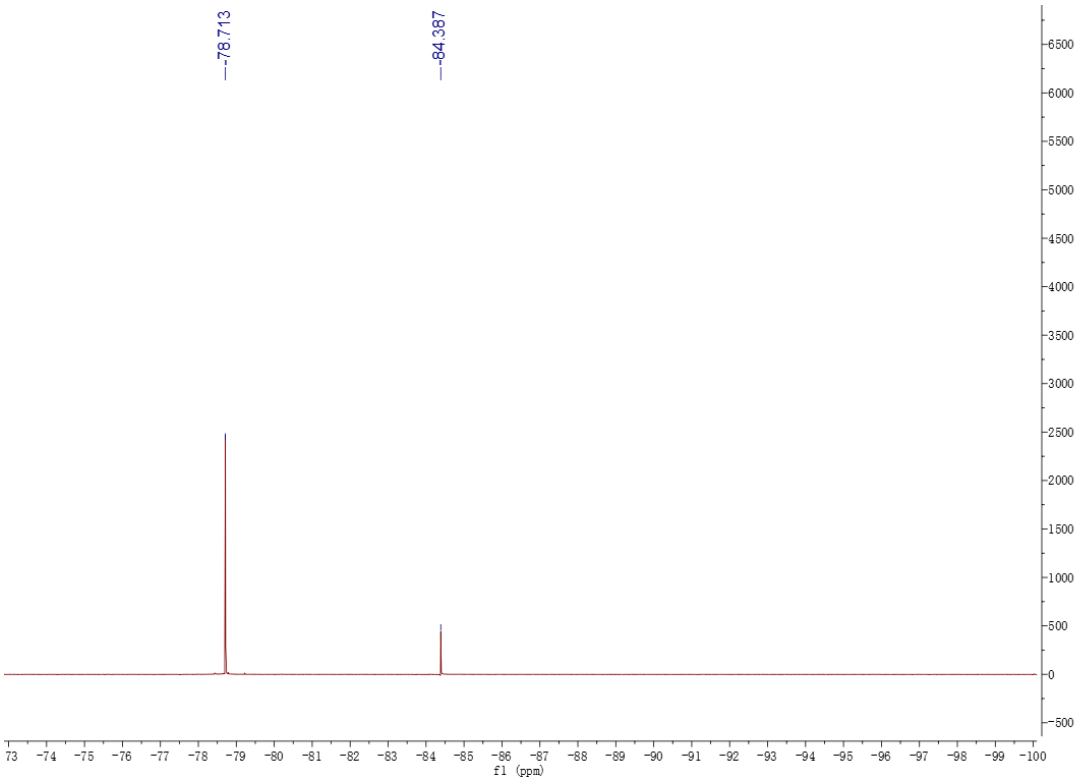
3l


154.57
151.61
131.80
131.58
131.40
131.31
130.65
130.62
130.35
130.32
130.10
130.09
129.43
127.88
121.91
121.90
117.52
117.20
f1 (ppm)

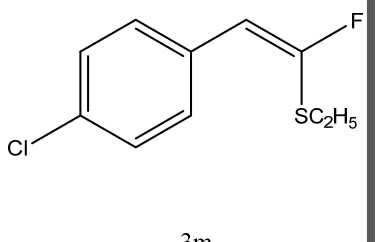
^{19}F NMR



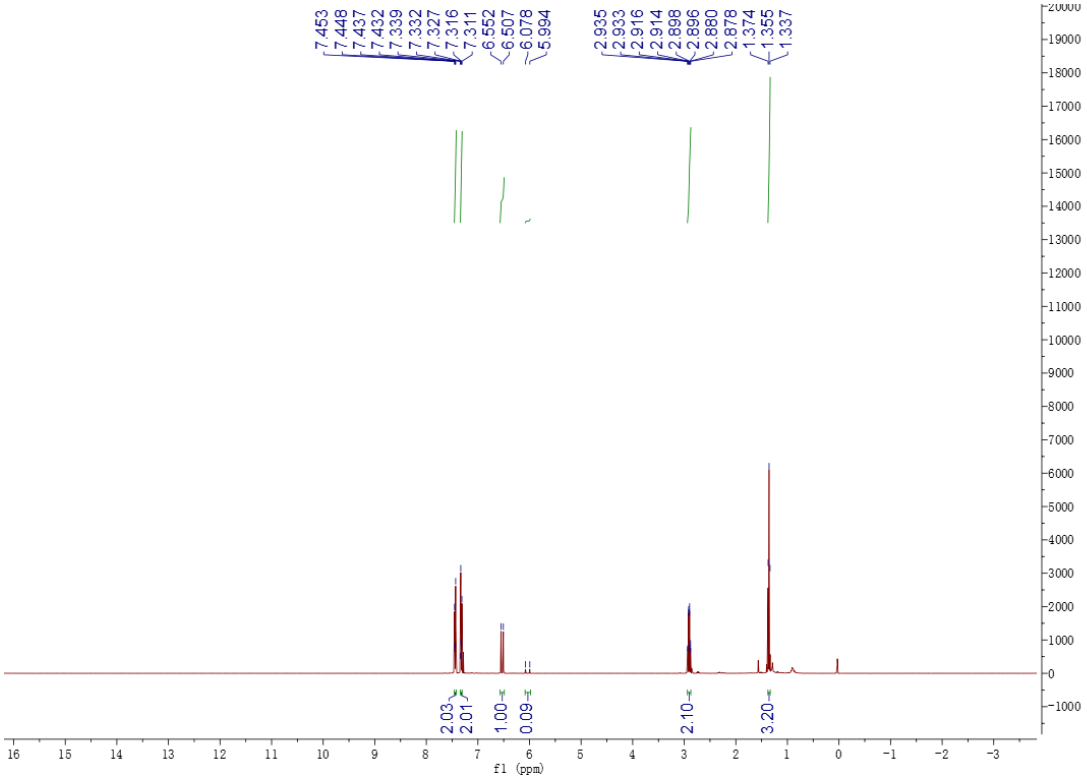
3l



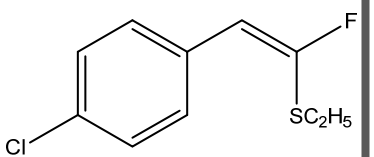
^{1}H NMR


F
SC2H5
Cl

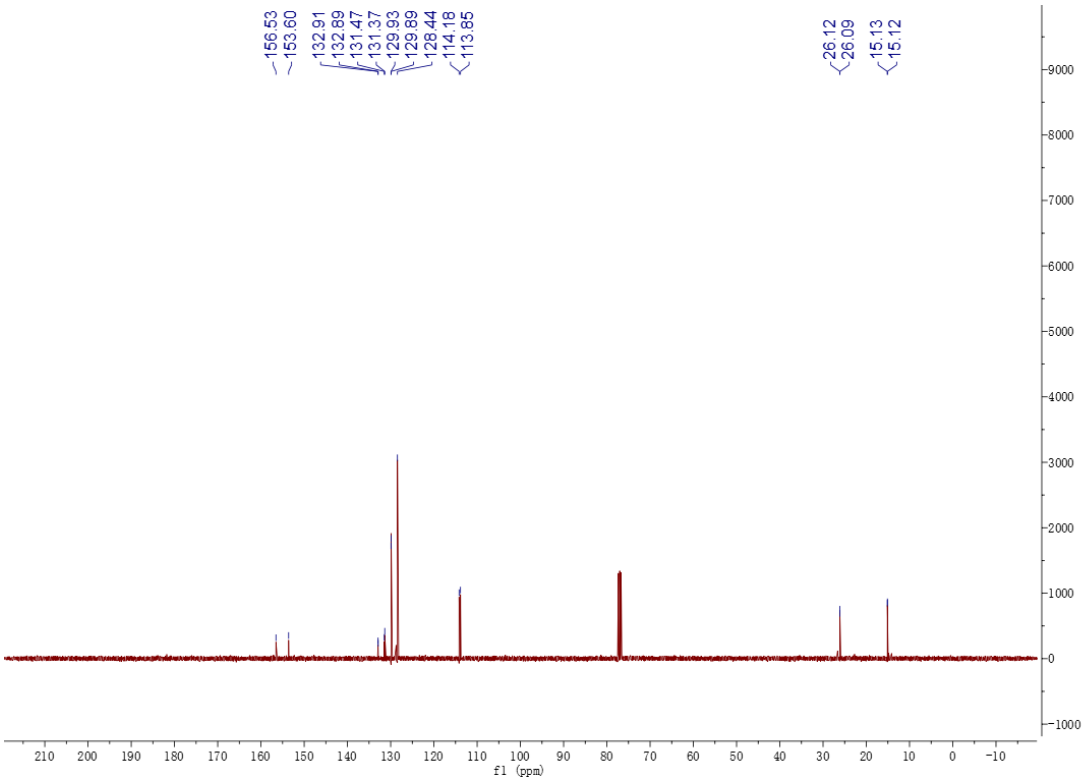
3m


7.453
7.448
7.437
7.432
7.339
7.332
7.327
7.316
7.311
6.552
6.507
6.078
5.994
2.935
2.933
2.916
2.914
2.898
2.896
2.880
2.878
1.374
1.355
1.337
2.03
2.01
1.00
0.09
2.10
3.20
f1 (ppm)

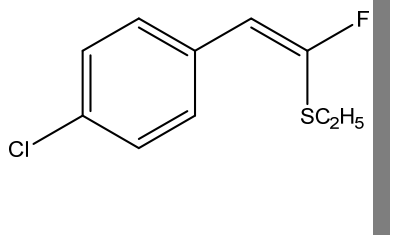
^{13}C NMR


F
SC2H5
Cl

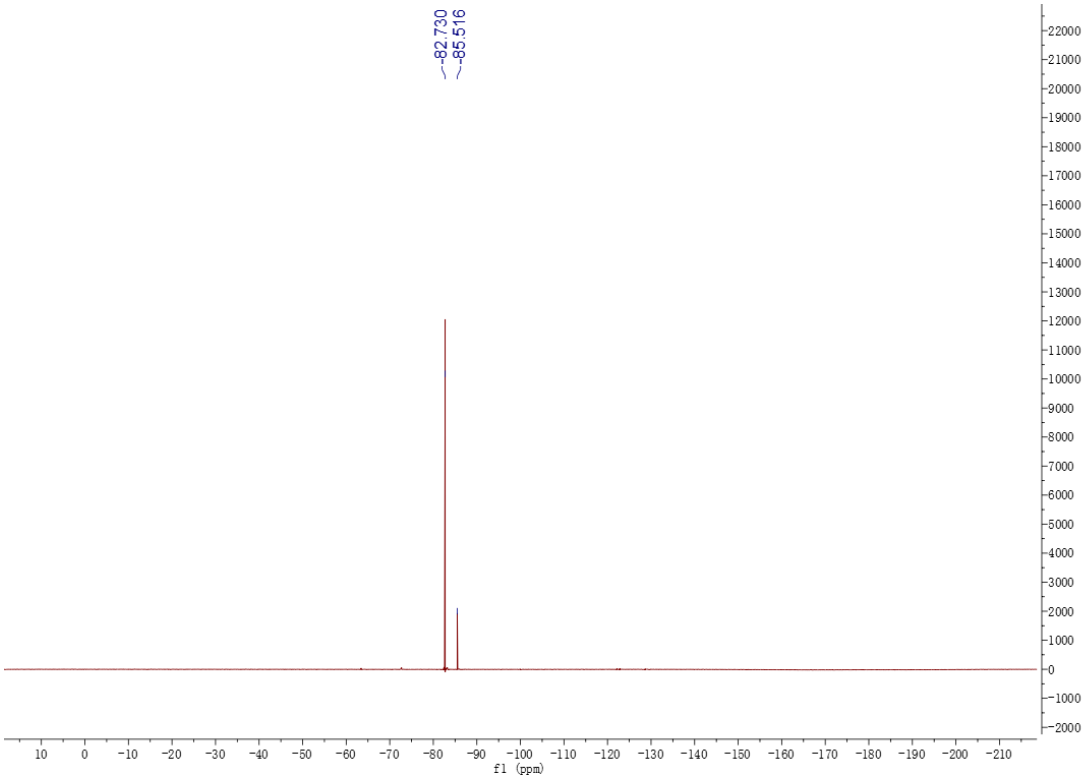
3m


156.53
153.60
132.91
132.89
131.47
131.37
129.93
129.89
128.44
114.18
113.85
26.12
26.09
15.13
15.12
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
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)

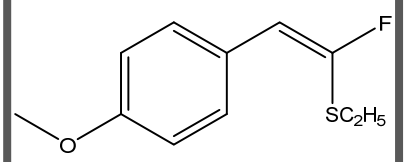
^{19}F NMR


F
SC2H5
Cl

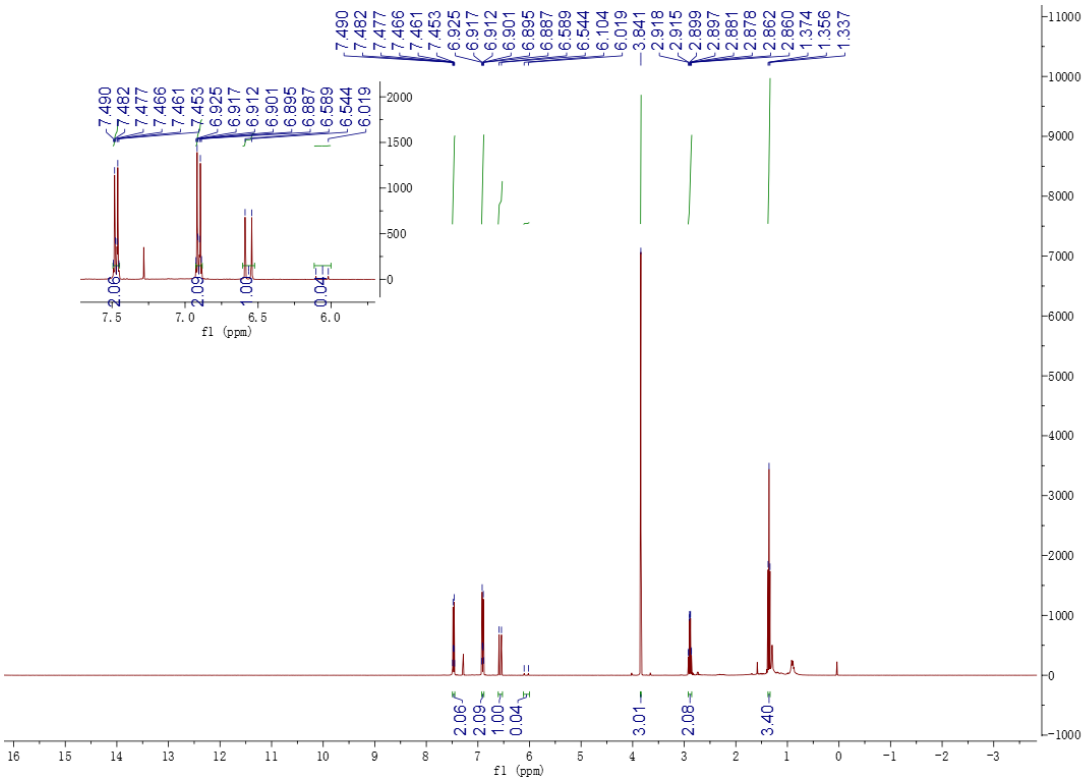
3m


-82.730
-85.516
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
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)

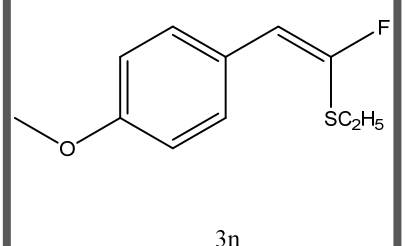
^{1}H NMR


F
SC2H5
O

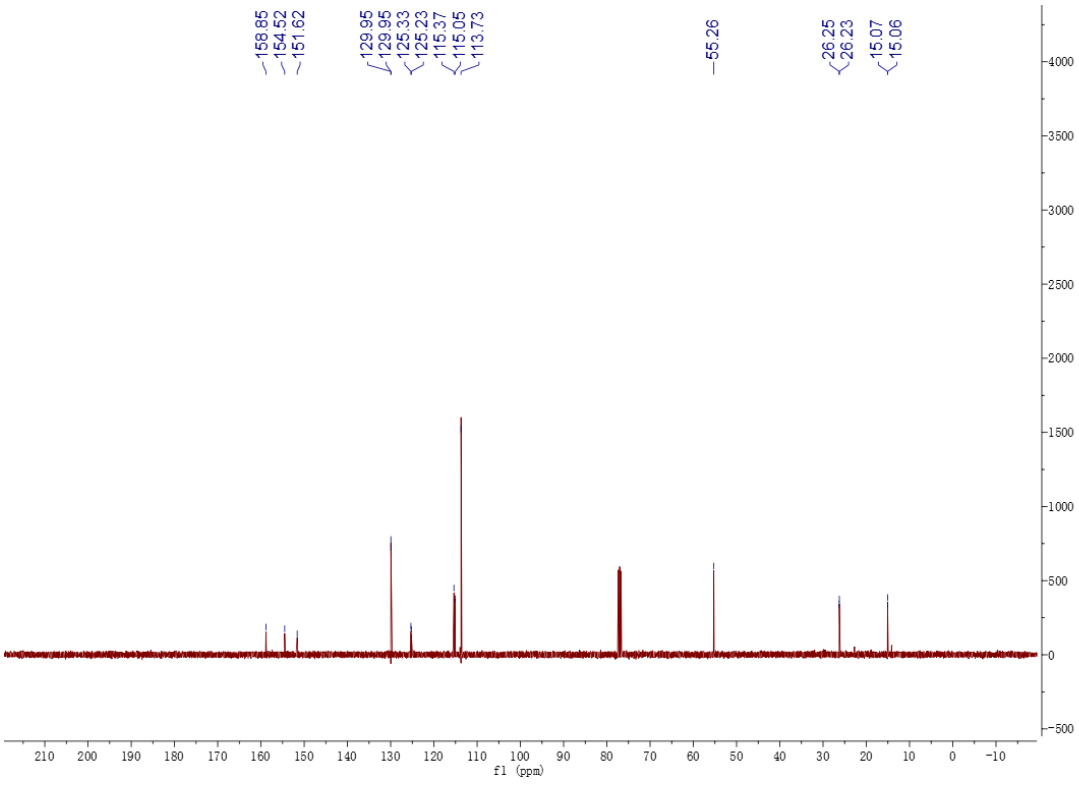
3n


7.490
7.482
7.477
7.466
7.461
7.453
6.925
6.917
6.912
6.901
6.895
6.887
6.589
6.544
6.104
6.019
3.841
2.918
2.915
2.899
2.897
2.881
2.878
2.862
2.860
1.374
1.356
1.337
2.06
2.09
1.00
0.04
3.01
2.08
3.40
f1 (ppm)

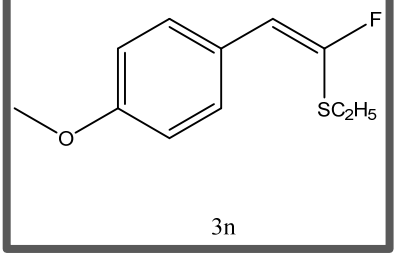
^{13}C NMR


F
SC2H5
O

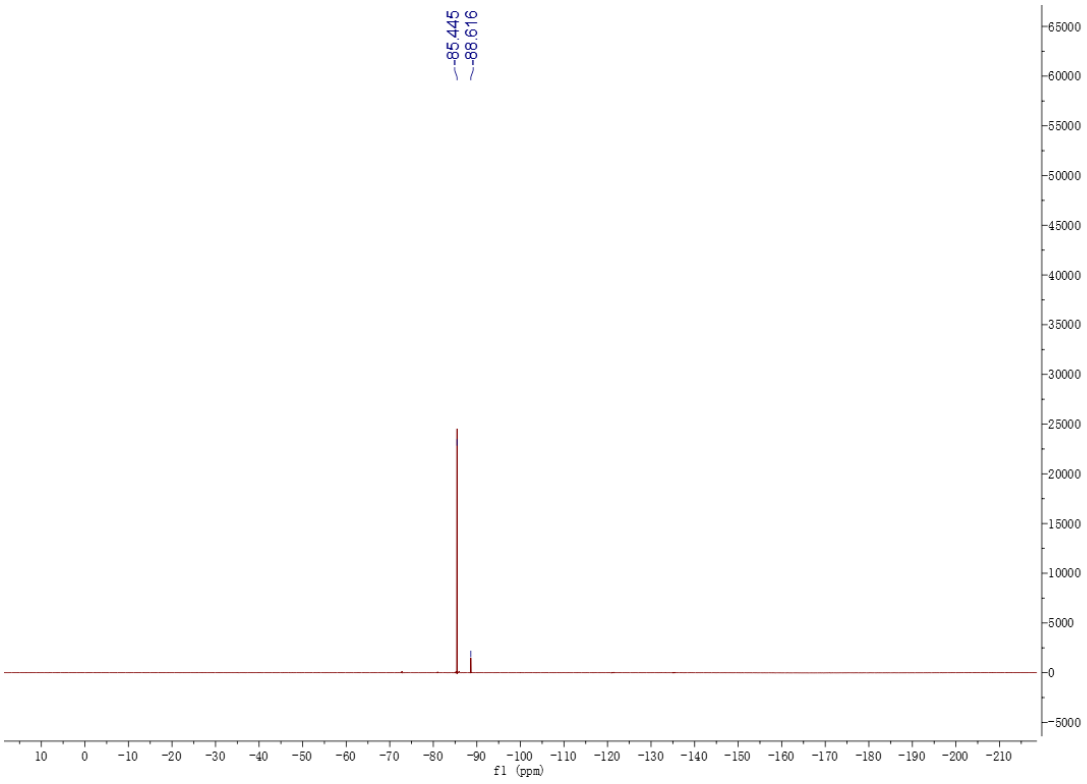
3n


158.85
154.52
151.62
129.95
129.95
125.33
125.23
115.37
115.05
113.73
55.26
26.25
26.23
15.07
15.06
f1 (ppm)

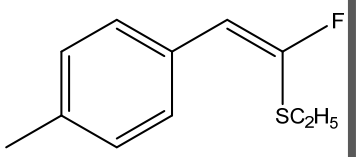
^{19}F NMR


F
SC2H5
O

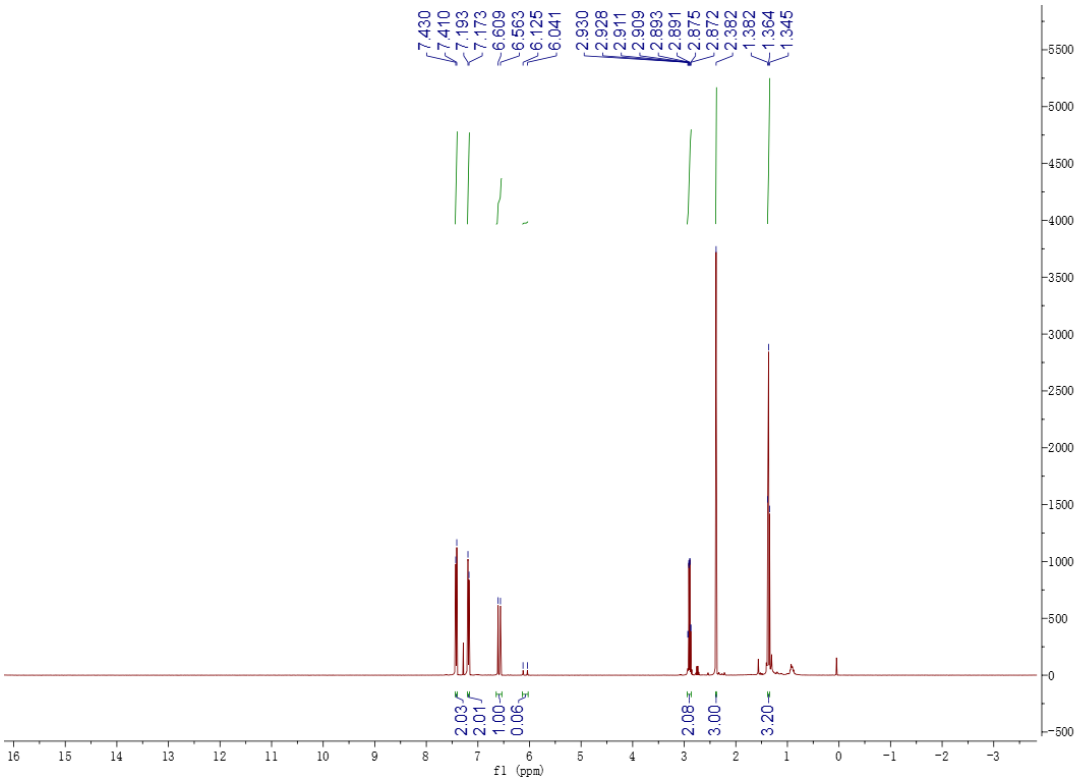
3n


-85.445
-88.616
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
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)

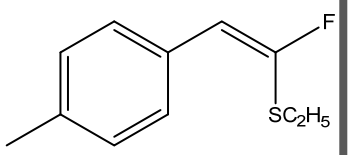
^{1}H NMR


F
SC2H5

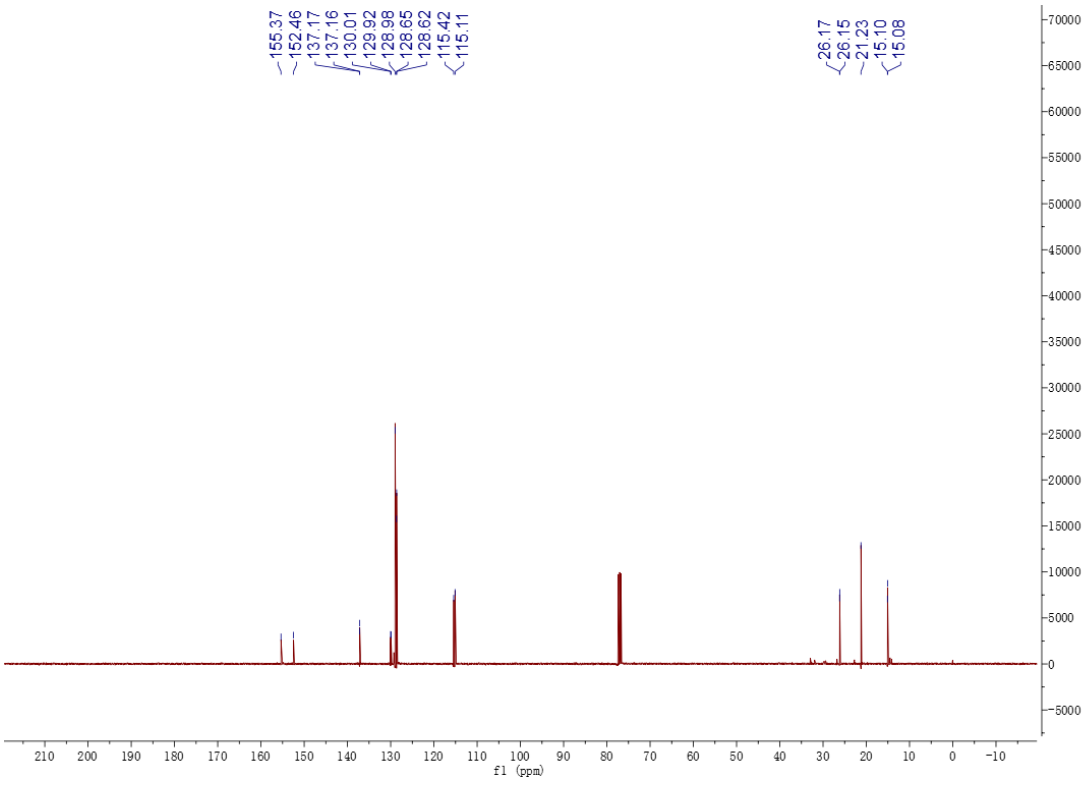
3o


7.430
7.410
7.193
7.173
6.609
6.563
6.125
6.041
2.930
2.928
2.911
2.909
2.893
2.891
2.875
2.872
2.382
1.382
1.364
1.345
2.03
2.01
1.00
0.06
2.08
3.00
3.20
f1 (ppm)

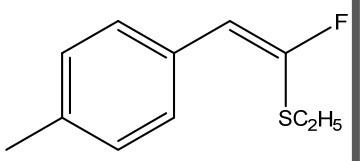
^{13}C NMR


F
SC2H5

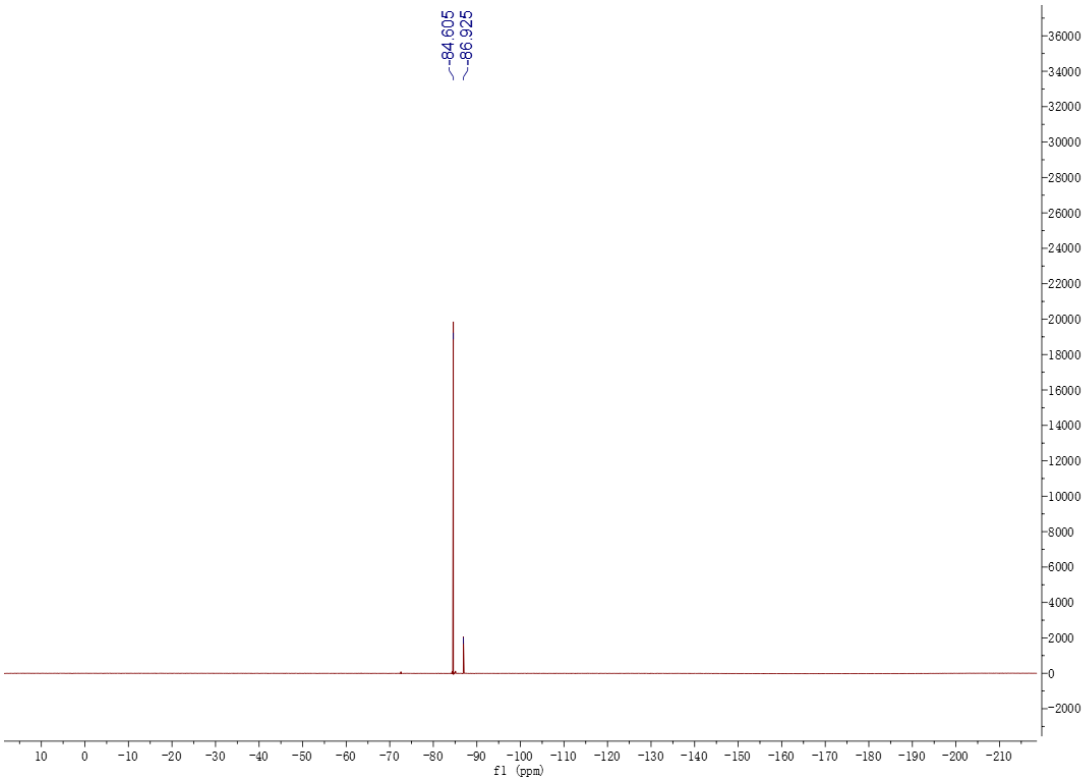
3o


155.37
152.46
137.17
137.16
130.01
129.92
128.98
128.65
128.62
115.42
115.11
26.17
26.15
21.23
15.10
15.08
f1 (ppm)

^{19}F NMR


F
SC2H5

3o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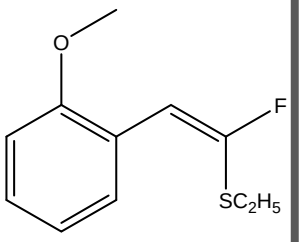
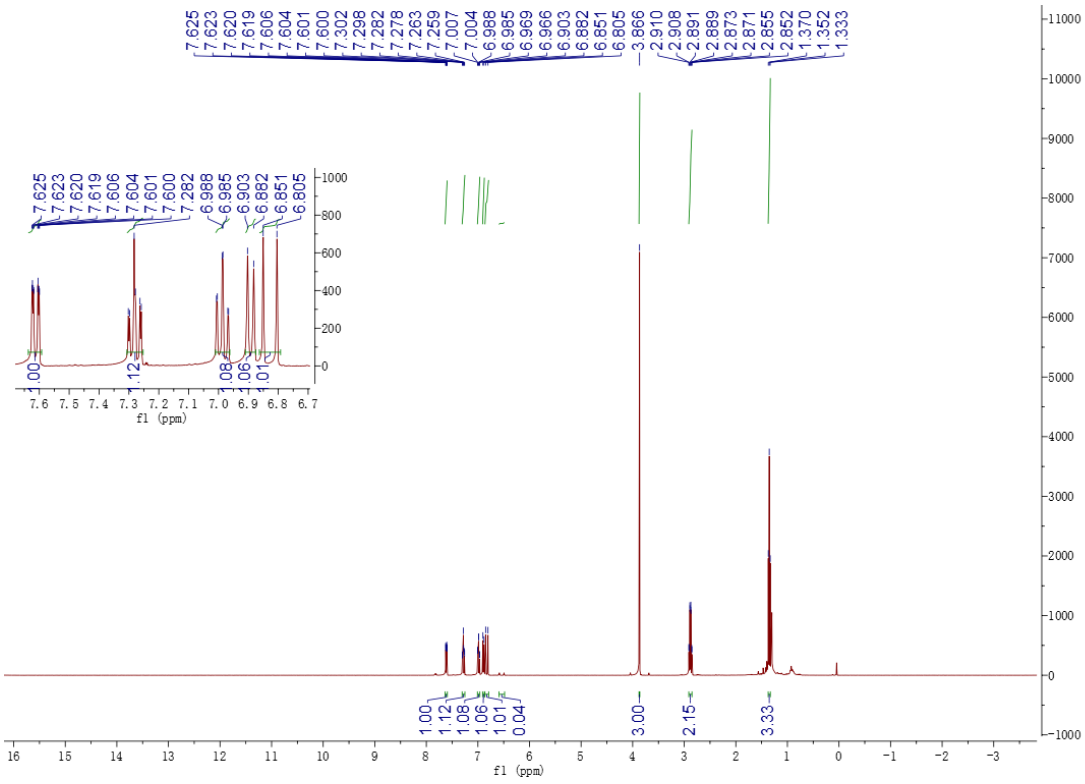
-86.925
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

^{1}H NMR


O
F
SC2H5

3p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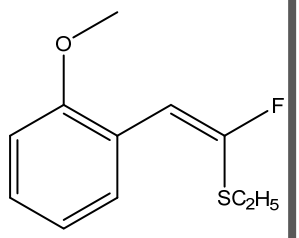
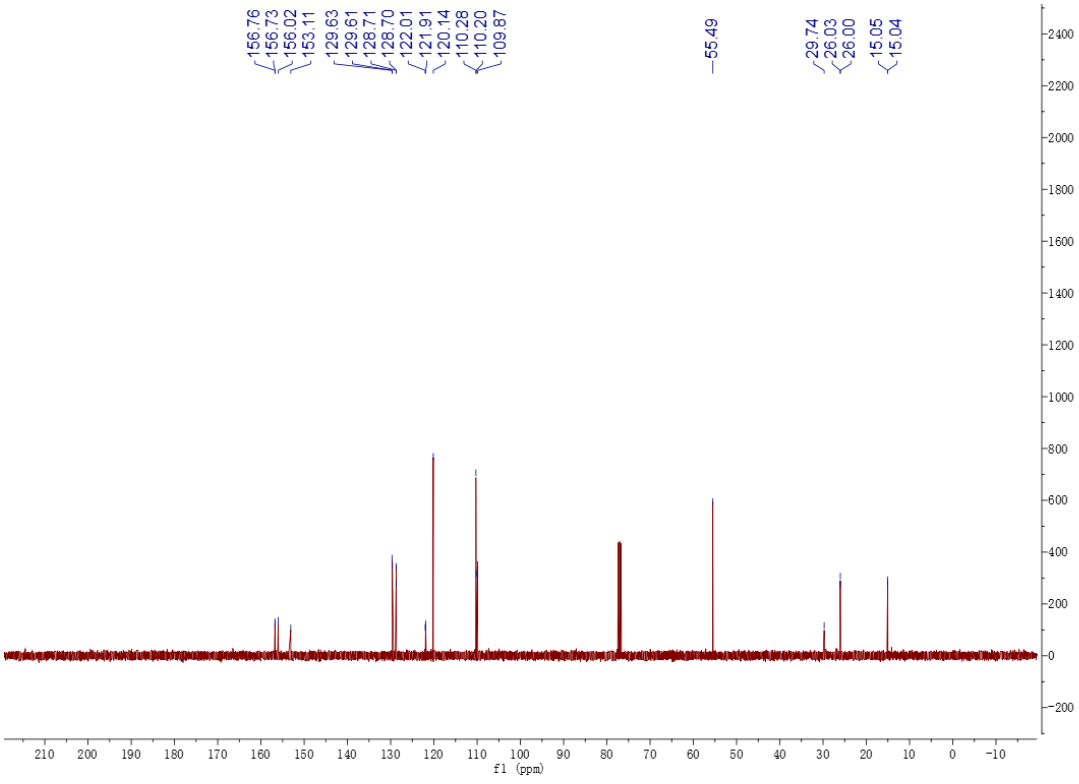
7.623
7.620
7.619
7.606
7.604
7.601
7.600
7.302
7.298
7.282
7.278
7.263
7.259
7.007
7.004
6.988
6.985
6.969
6.966
6.903
6.882
6.851
6.805
3.866
2.910
2.908
2.891
2.889
2.873
2.871
2.855
2.852
1.370
1.352
1.333
1.00
1.12
1.08
1.06
1.01
0.04
3.00
2.15
3.33
f1 (ppm)

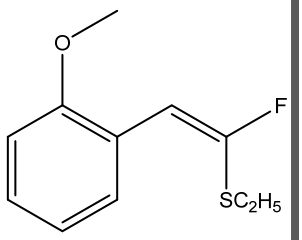
^{13}C NMR


O
F
SC2H5

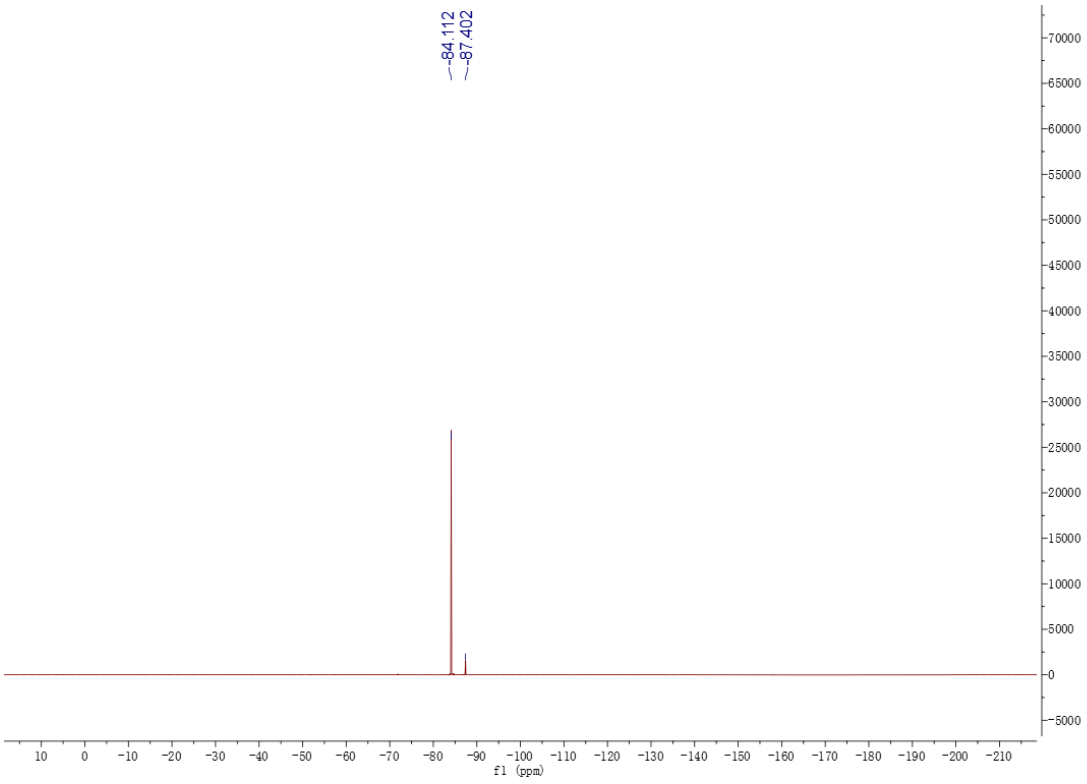
3p


156.76
156.73
156.02
153.11
129.63
129.61
128.71
128.70
122.01
121.91
120.14
110.28
110.20
109.87
55.49
29.74
26.03
26.00
15.05
15.04
f1 (ppm)

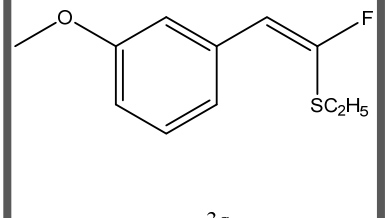
^{19}F NMR



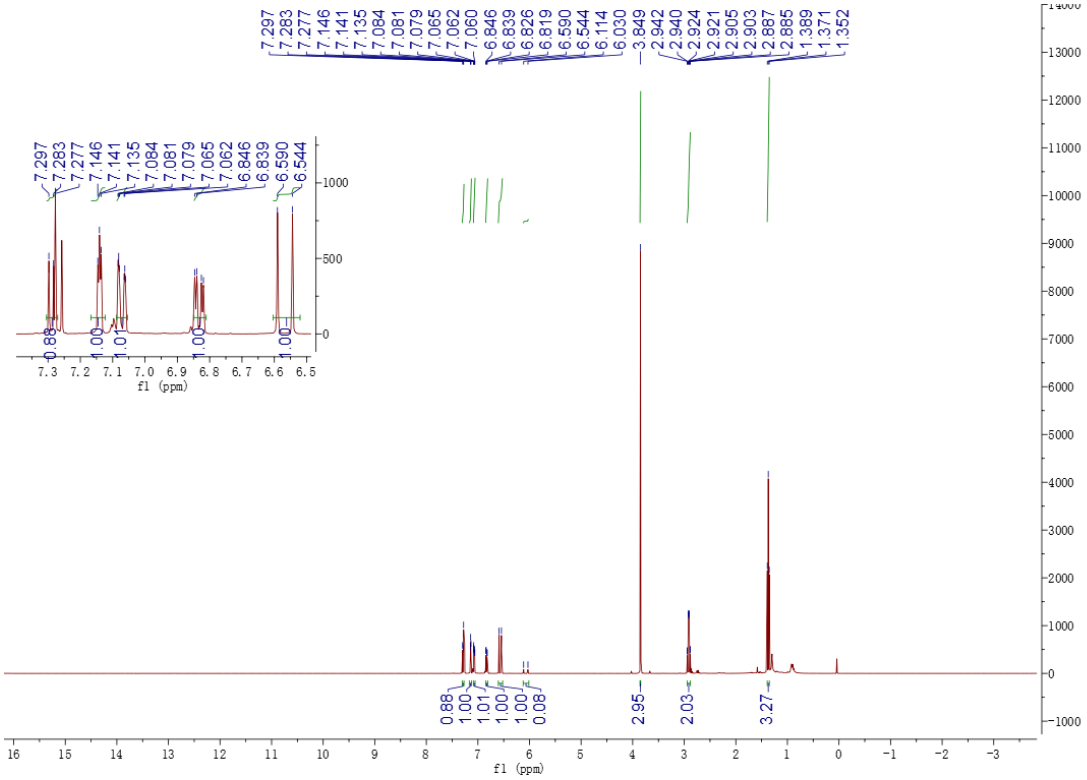
3p



^{1}H NMR


O
F
SC2H5

3q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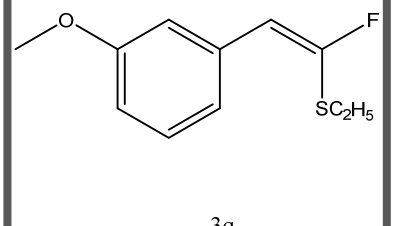
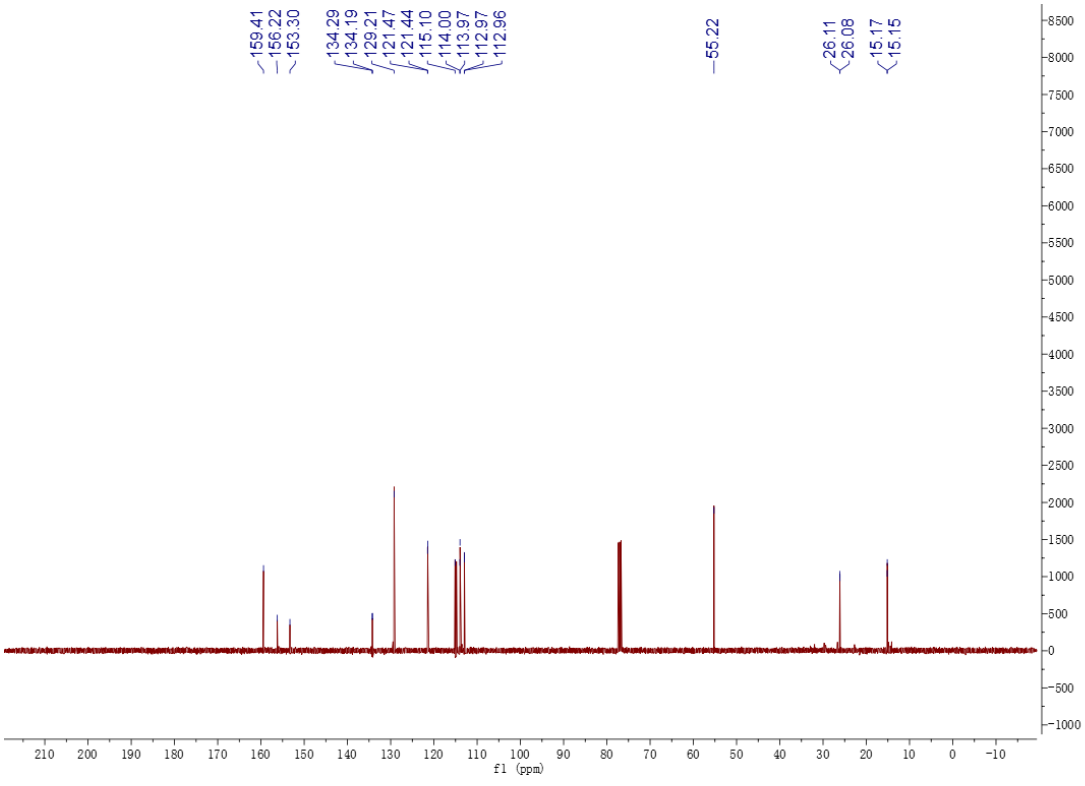
7.283
7.277
7.146
7.141
7.135
7.084
7.081
7.079
7.065
7.062
7.060
6.846
6.839
6.826
6.819
6.590
6.544
6.114
6.030
3.849
2.942
2.940
2.924
2.921
2.905
2.903
2.887
2.885
1.389
1.371
1.352
0.88
1.00
1.01
1.00
1.00
0.08
2.95
2.03
3.27
f1 (ppm)

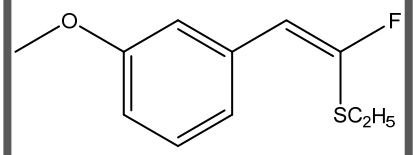
^{13}C NMR


O
F
SC2H5

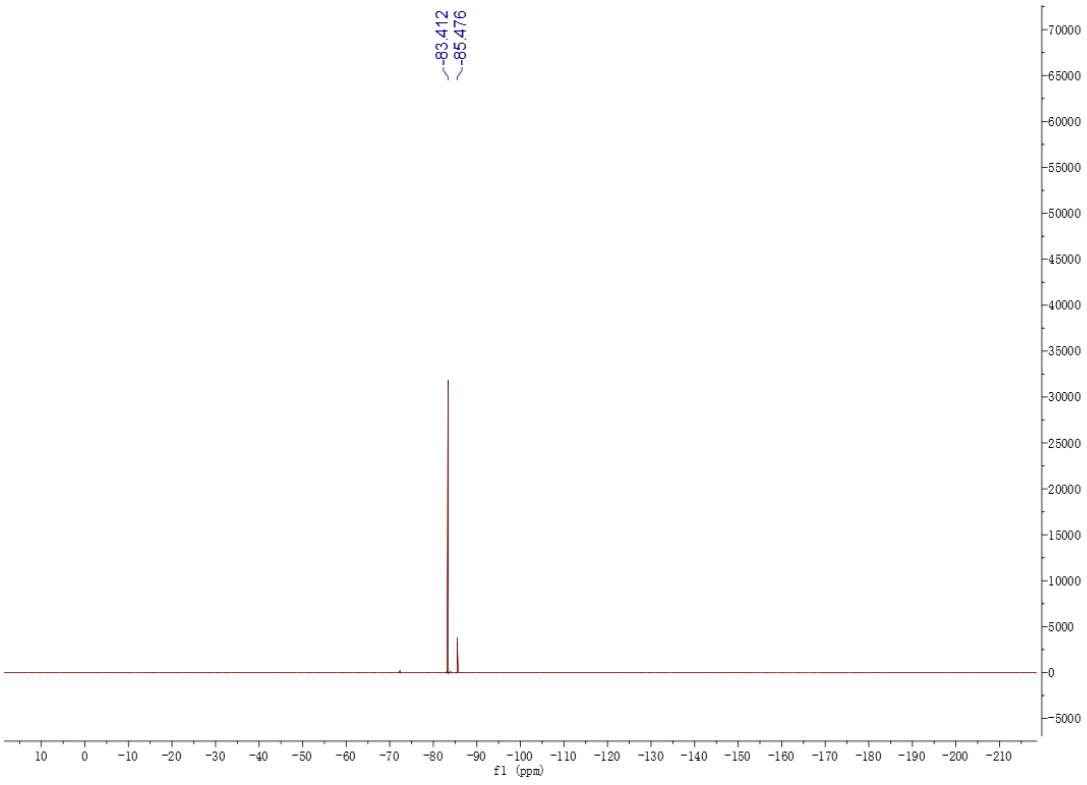
3q


159.41
156.22
153.30
134.29
134.19
129.21
121.47
121.44
115.10
114.00
113.97
112.97
112.96
55.22
26.11
26.08
15.17
15.15
f1 (ppm)

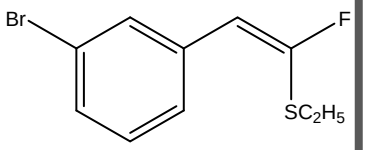
^{19}F NMR


O
F
SC2H5

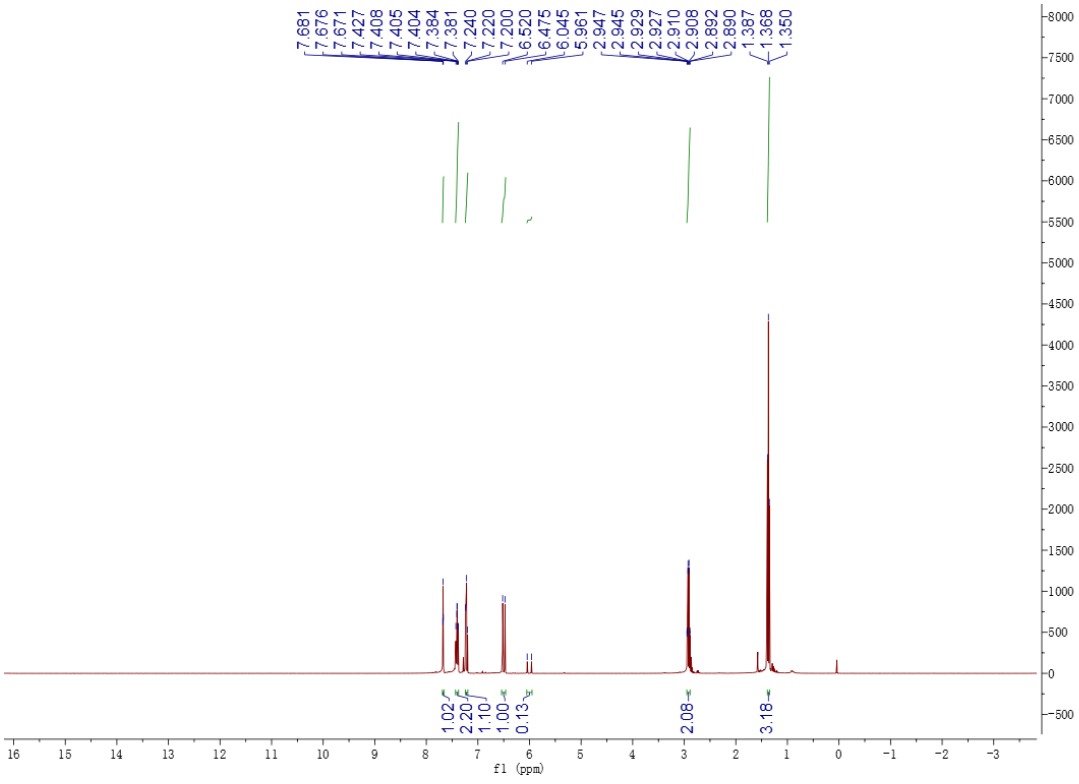
3q


-83.412
-85.476
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
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)

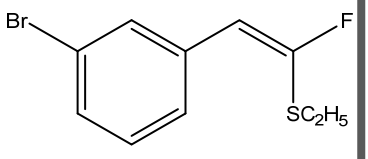
^{1}H NMR


Br
F
SC2H5

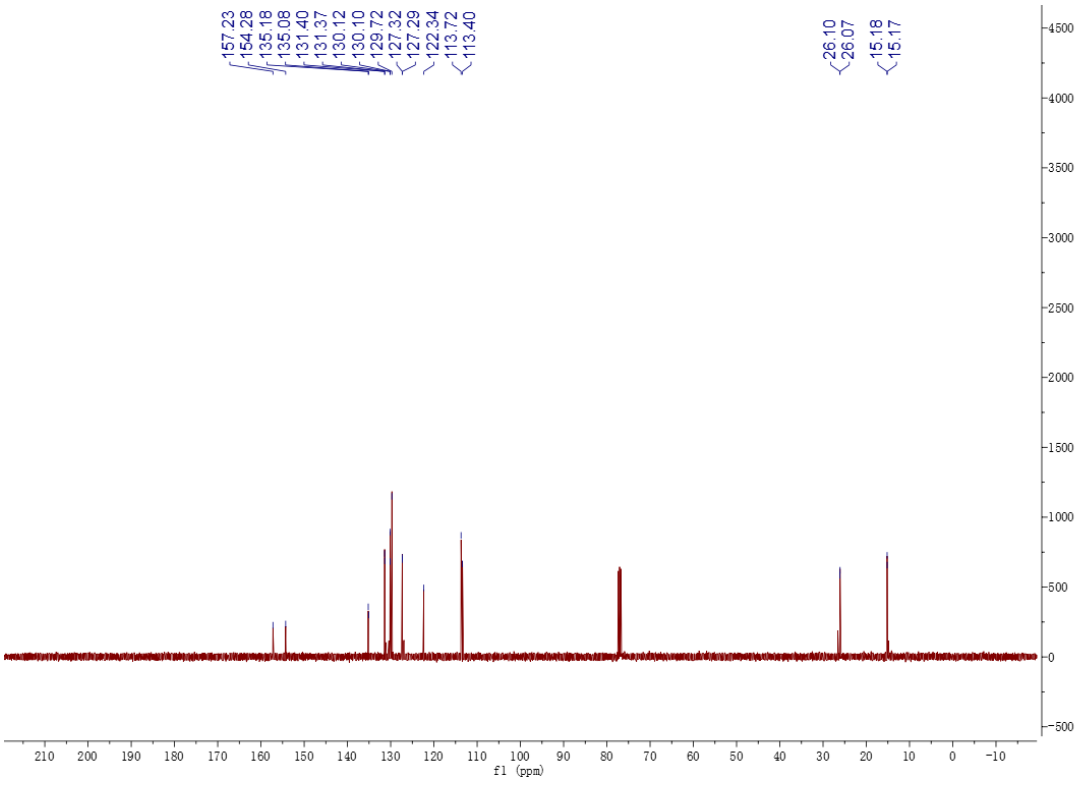
3r


7.681
7.676
7.671
7.427
7.408
7.405
7.404
7.384
7.381
7.240
7.220
7.200
6.520
6.475
6.045
5.961
2.947
2.945
2.929
2.927
2.910
2.908
2.892
2.890
1.387
1.368
1.350
1.02
2.20
1.10
1.00
0.13
2.08
3.18
f1 (ppm)

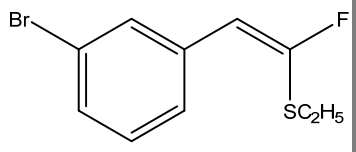
^{13}C NMR


Br
F
SC2H5

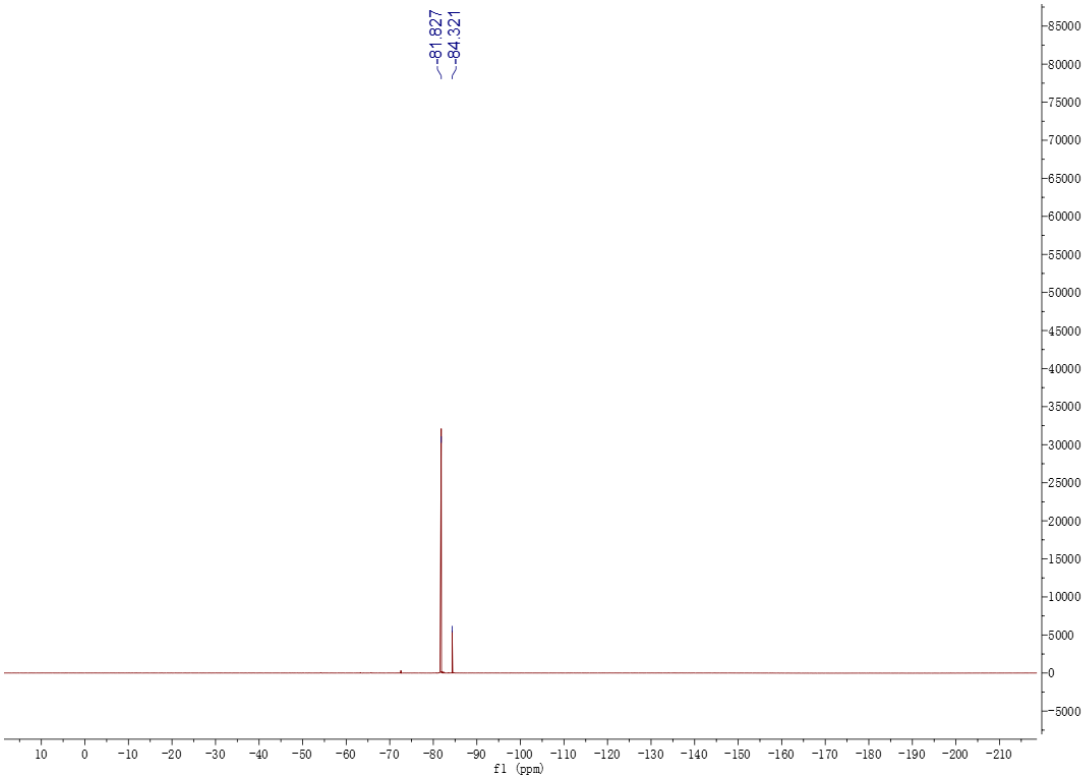
3r


157.23
154.28
135.18
135.08
131.40
131.37
130.12
130.10
129.72
127.32
127.29
122.34
113.72
113.40
26.10
26.07
15.18
15.17
f1 (ppm)

^{19}F NMR


Br
F
SC2H5

3r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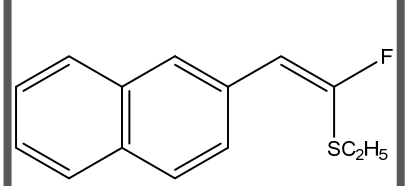
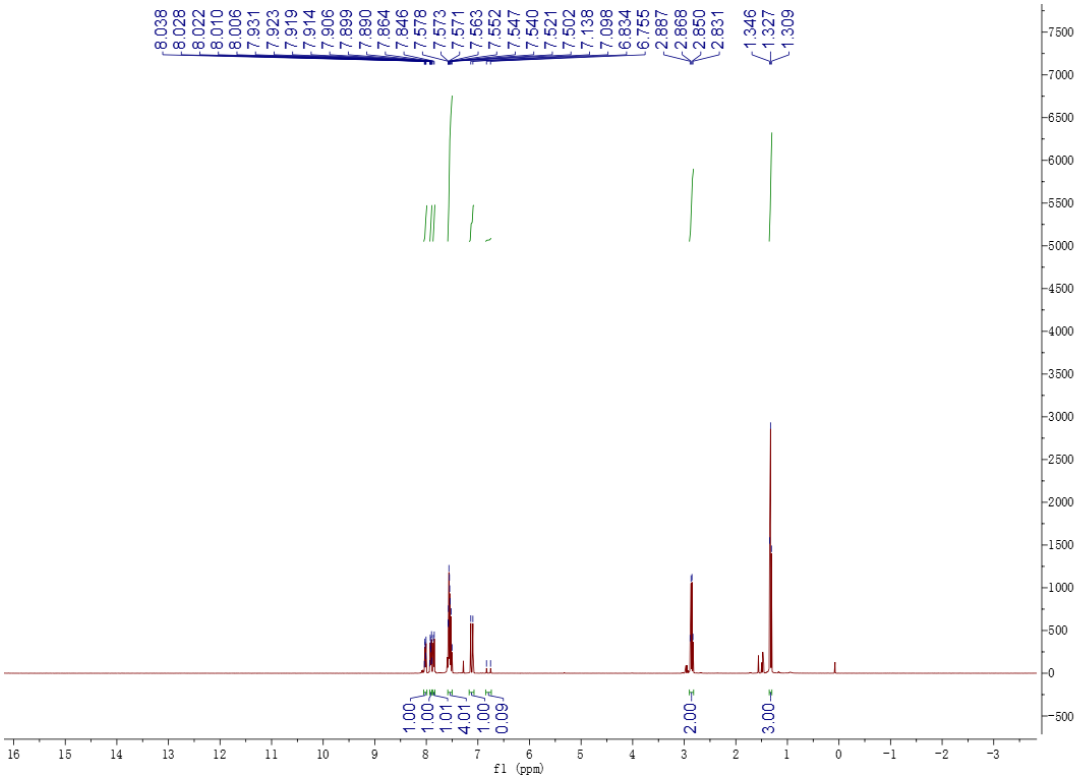
-84.321
85000
80000
75000
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

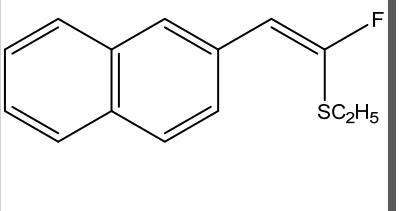
^{1}H NMR


F
SC2H5

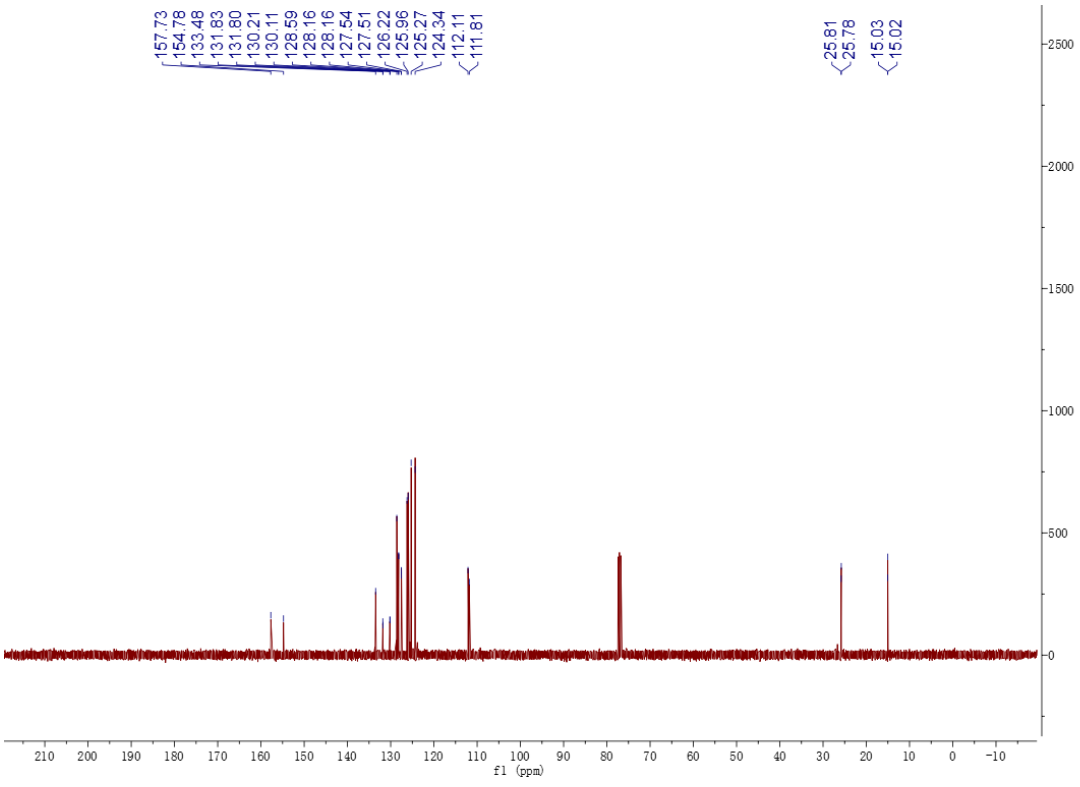
3s


8.038
8.028
8.022
8.010
8.006
7.931
7.923
7.919
7.914
7.906
7.899
7.890
7.864
7.846
7.578
7.573
7.571
7.563
7.552
7.547
7.540
7.521
7.502
7.138
7.098
6.834
6.755
2.887
2.868
2.850
2.831
1.346
1.327
1.309
1.00
1.00
1.01
4.01
1.00
0.09
2.00
3.00
f1 (ppm)

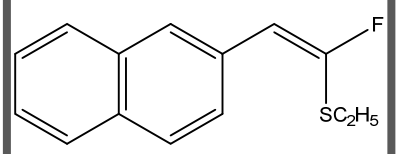
^{13}C NMR


F
SC2H5

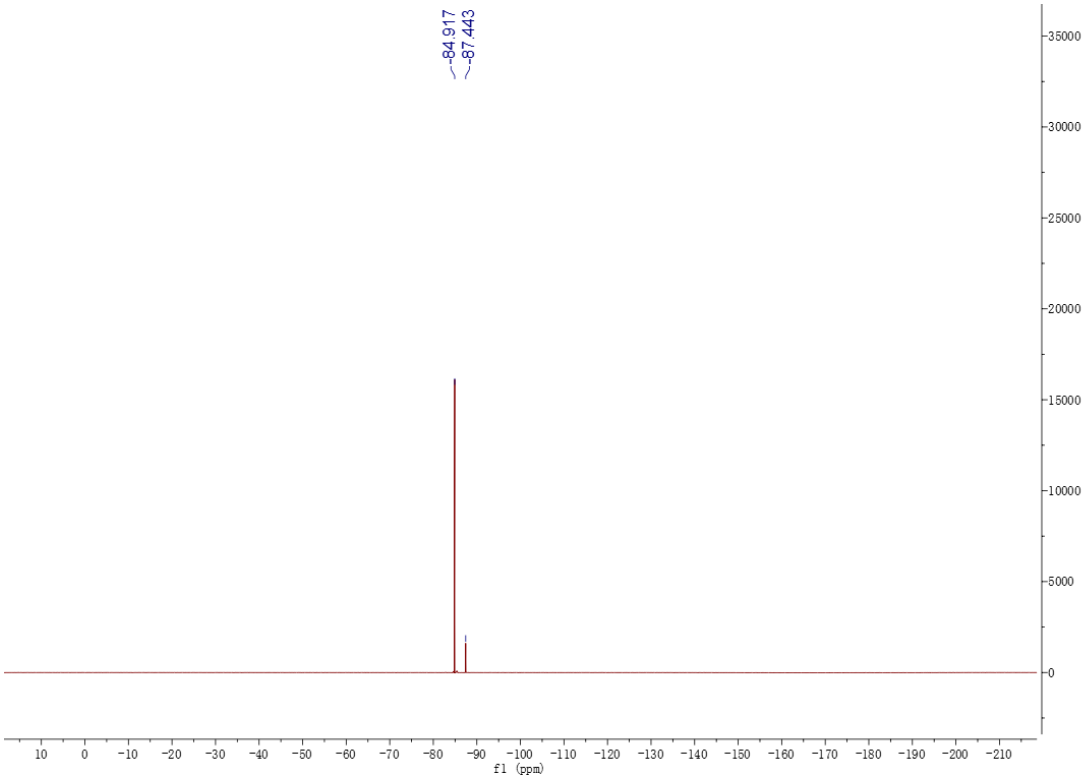
3s


157.73
154.78
133.48
131.83
131.80
130.21
130.11
128.59
128.16
128.16
127.54
127.51
126.22
125.96
125.27
124.34
112.11
111.81
25.81
25.78
15.03
15.02
2500
2000
1500
1000
500
0
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)

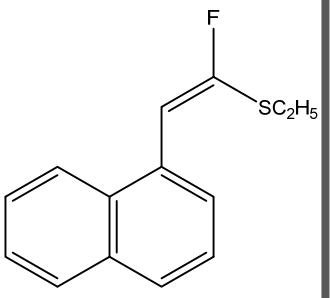
^{19}F NMR


F
SC2H5

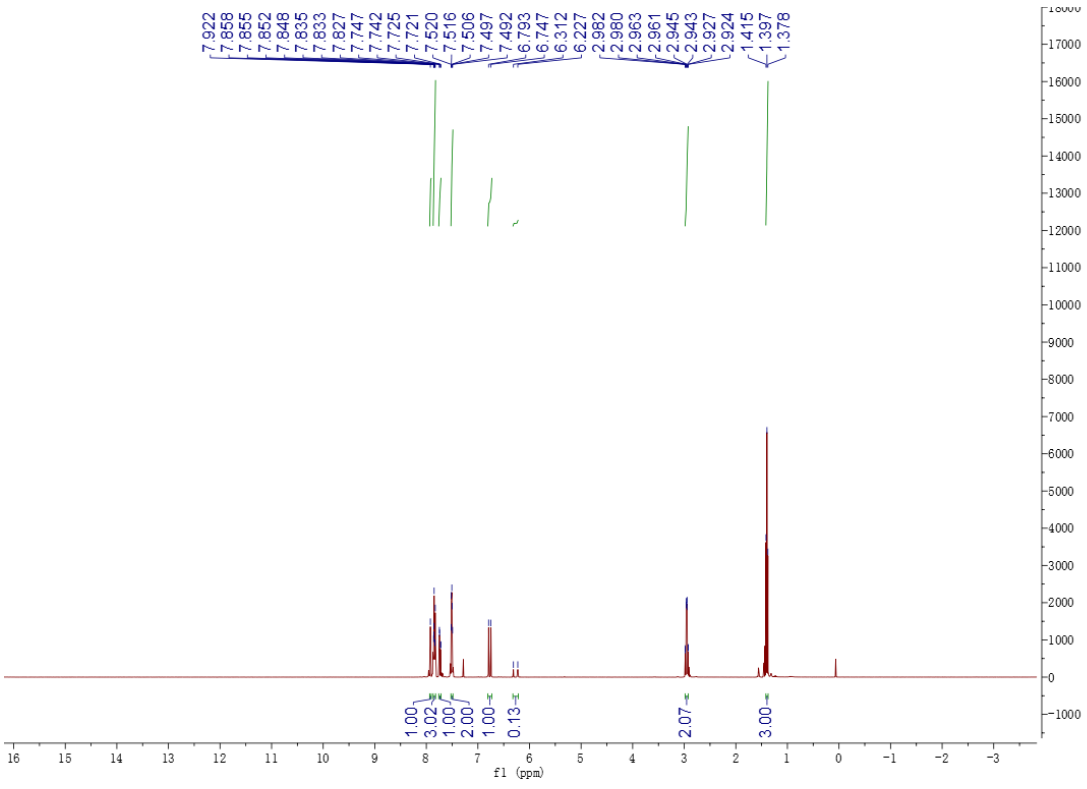
3s


-84.917
-87.443
35000
30000
25000
20000
15000
10000
5000
0
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)

^{1}H NMR


F
SC2H5

3t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7.858
7.855
7.852
7.848
7.835
7.833
7.827
7.747
7.742
7.725
7.721
7.520
7.516
7.506
7.497
7.492
6.793
6.747
6.312
6.227
2.982
2.980
2.963
2.961
2.945
2.943
2.927
2.924
1.415
1.397
1.378
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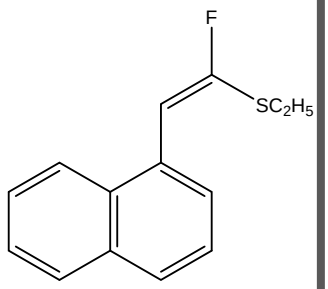
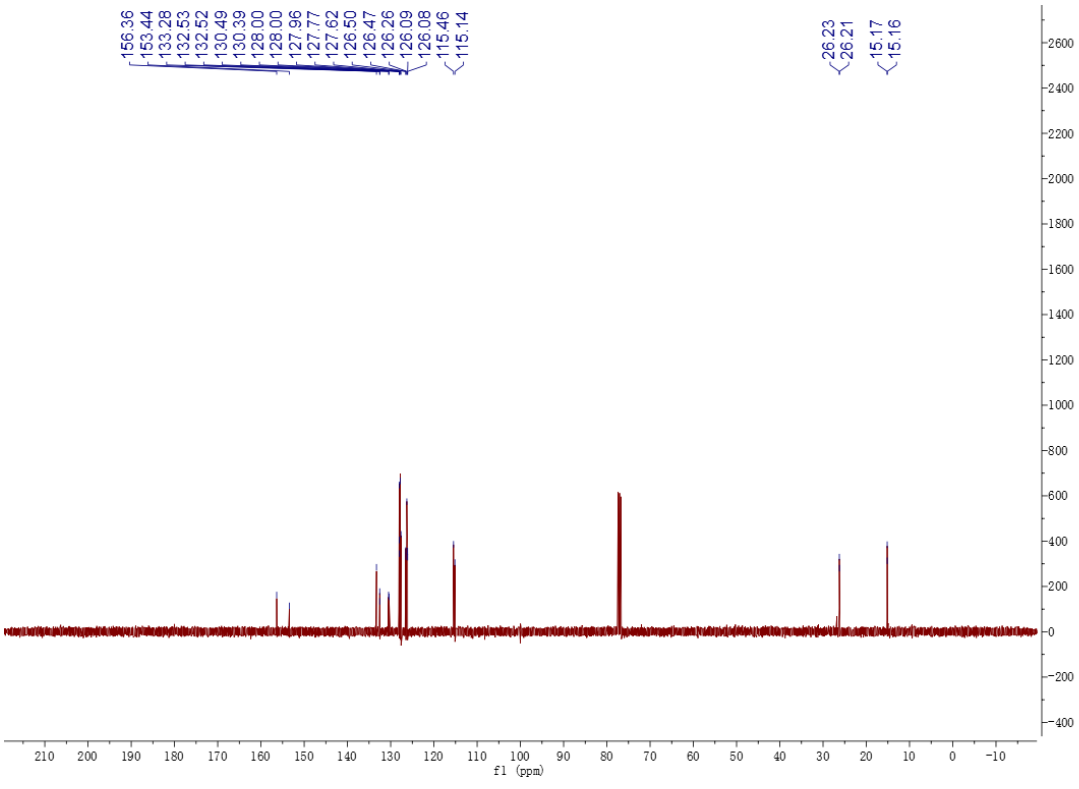
3.02
1.00
2.00
1.00
0.13
2.07
3.00
f1 (ppm)

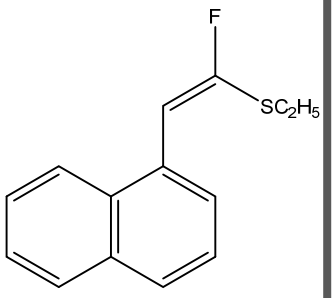
^{13}C NMR


F
SC2H5

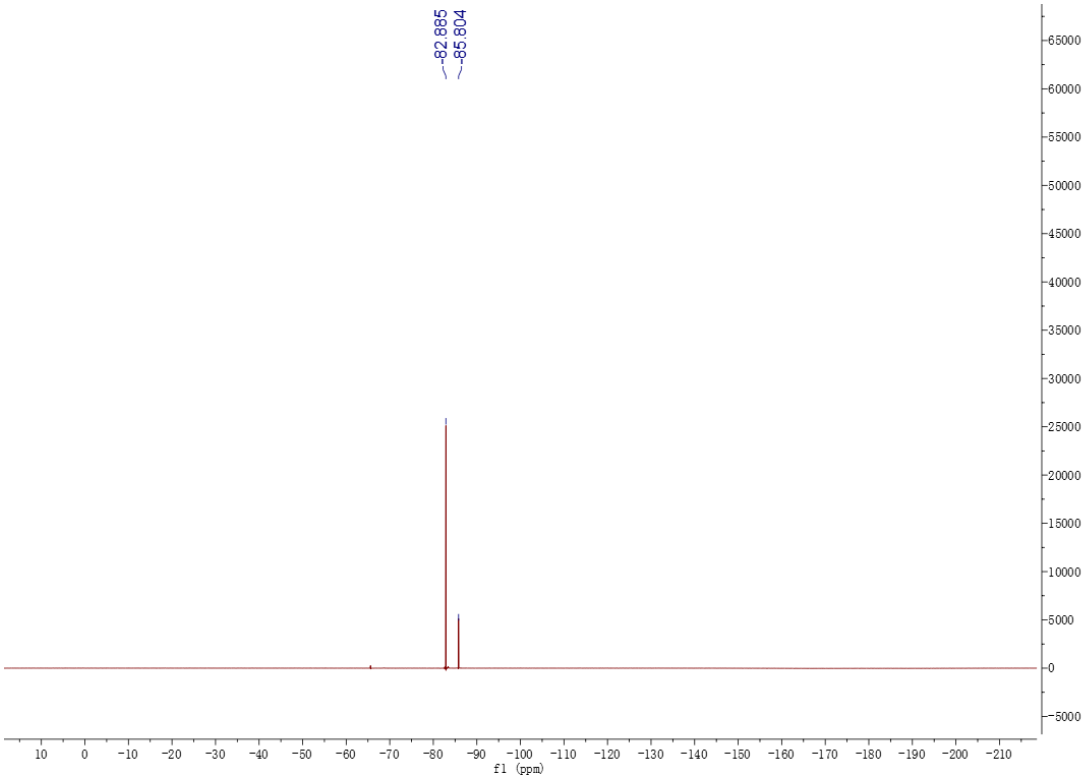
3t


156.36
153.44
133.28
132.53
132.52
130.49
130.39
128.00
128.00
127.96
127.77
127.62
126.50
126.47
126.26
126.09
126.08
115.46
115.14
26.23
26.21
15.17
15.16
f1 (ppm)

^{19}F NMR


F
SC2H5

3t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65000
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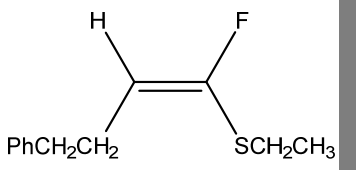
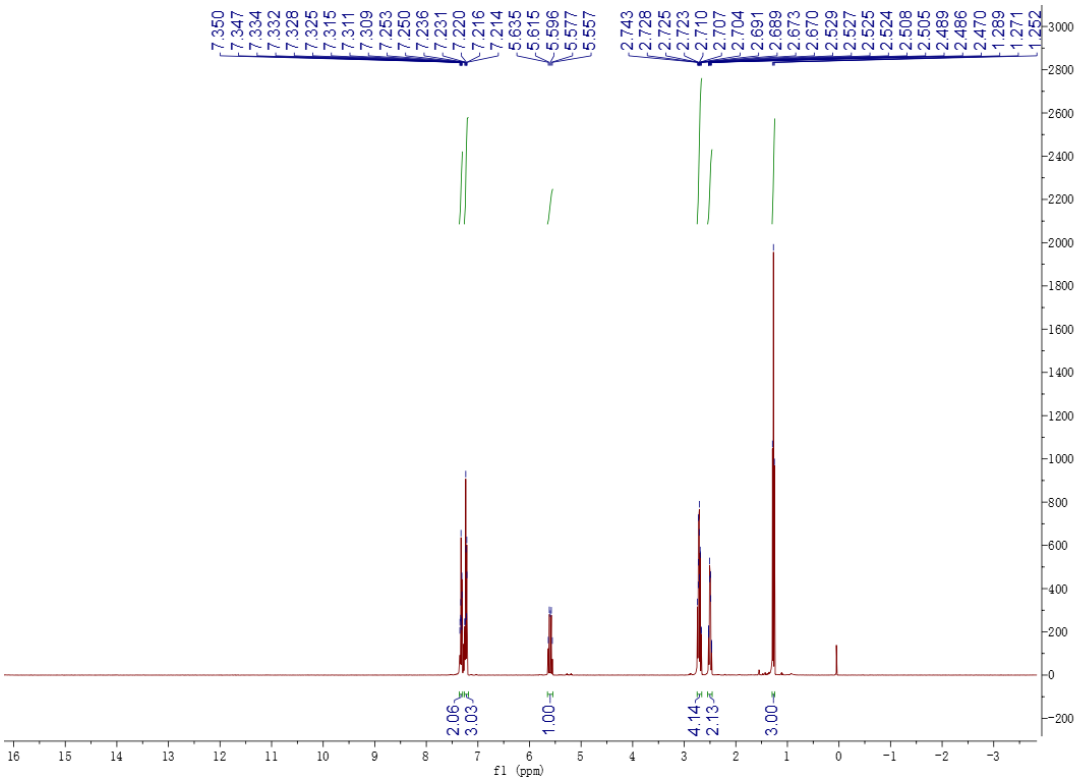
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

^{1}H NMR


H
F
PhCH2CH2
SCH2CH3

3u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7.347
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7.332
7.328
7.325
7.315
7.311
7.309
7.253
7.250
7.236
7.231
7.220
7.216
7.214
5.635
5.615
5.596
5.577
5.557
2.743
2.728
2.725
2.723
2.710
2.707
2.704
2.691
2.689
2.673
2.670
2.529
2.527
2.525
2.524
2.508
2.505
2.489
2.486
2.470
1.289
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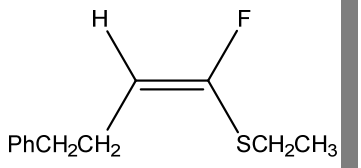
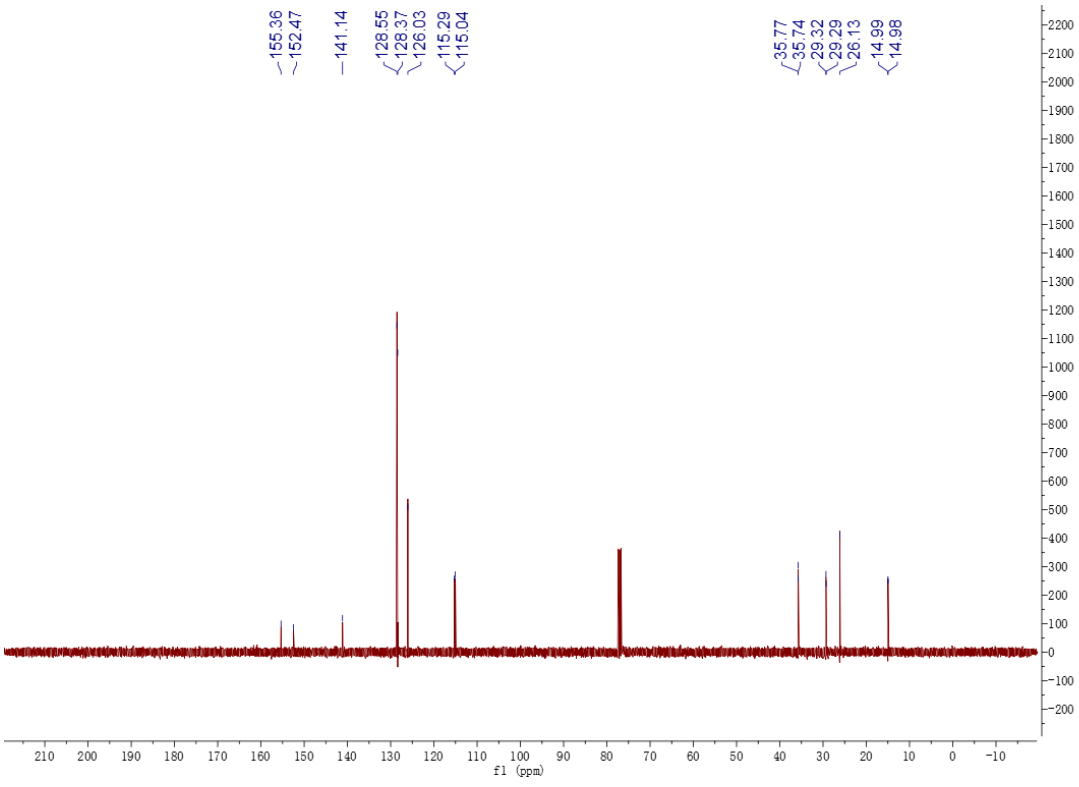
1.252
2.06
3.03
1.00
4.14
2.13
3.00
f1 (ppm)

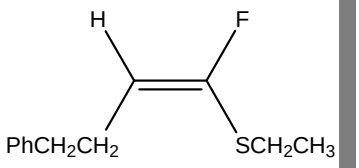
^{13}C NMR


H
F
PhCH2CH2
SCH2CH3

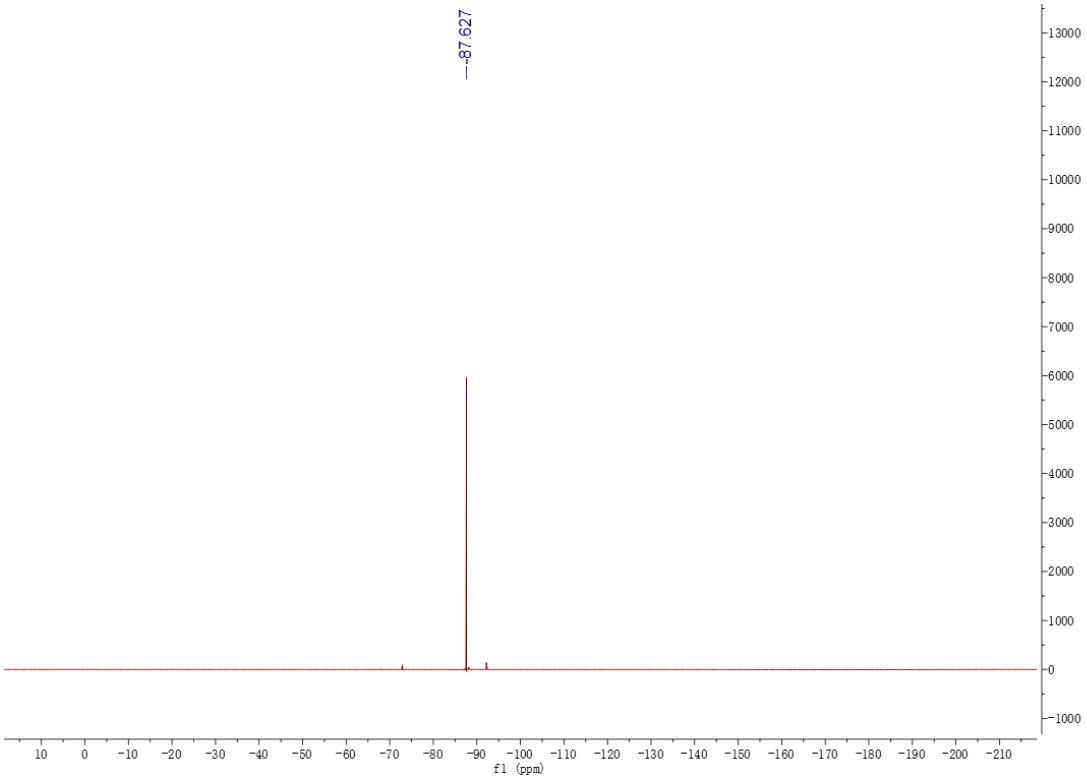
3u


155.36
152.47
141.14
128.55
128.37
126.03
115.29
115.04
35.77
35.74
29.32
29.29
26.13
14.99
14.98
f1 (ppm)

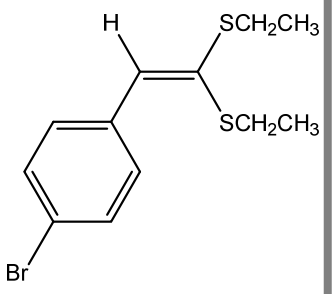
^{19}F NMR


H
F
PhCH2CH2
SCH2CH3

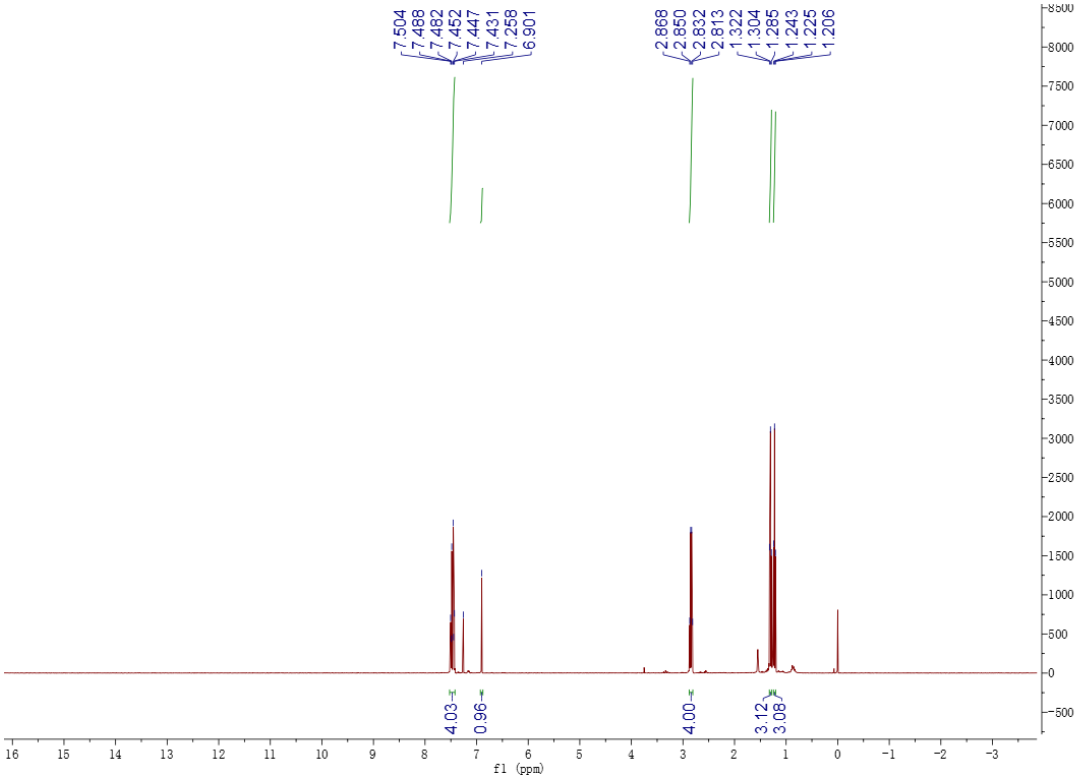
3u


-87.627
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
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)

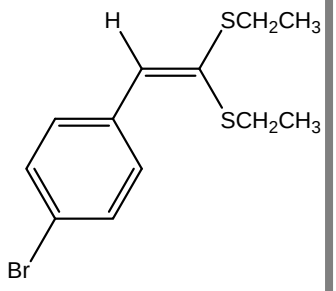
^{1}H NMR


H
SCH2CH3
SCH2CH3
Br

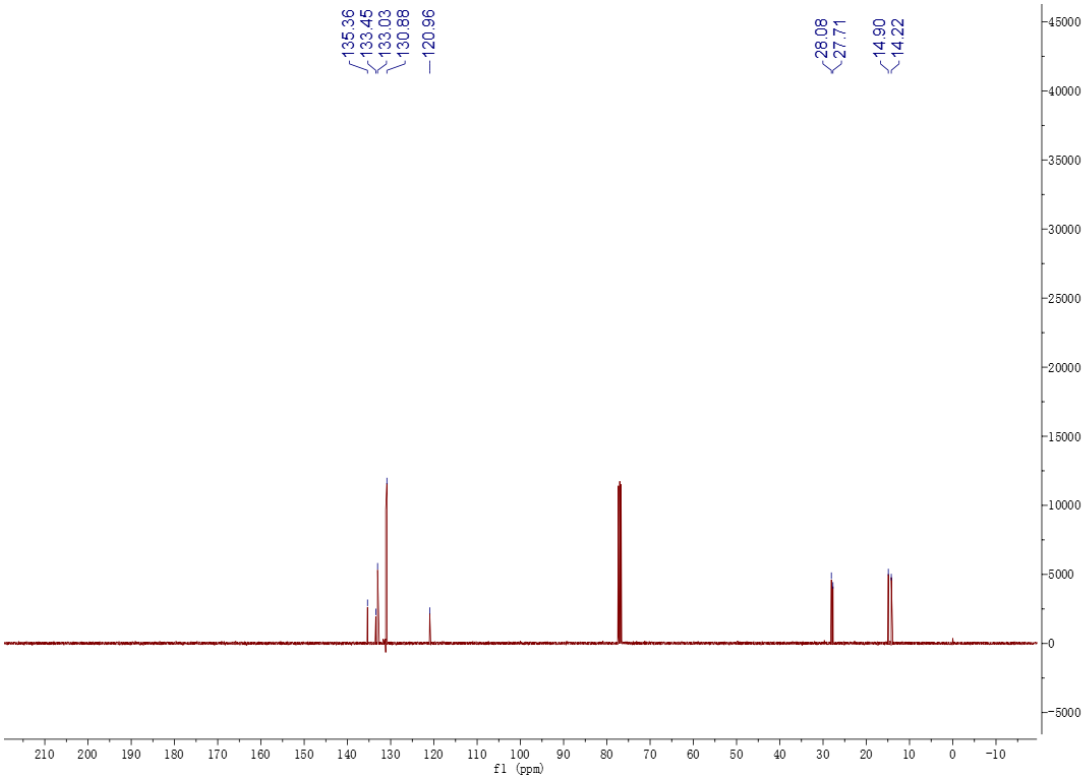
3v


7.504
7.488
7.482
7.452
7.447
7.431
7.258
6.901
2.868
2.850
2.832
2.813
1.322
1.304
1.285
1.243
1.225
1.206
4.03
0.96
4.00
3.12
3.08
f1 (ppm)

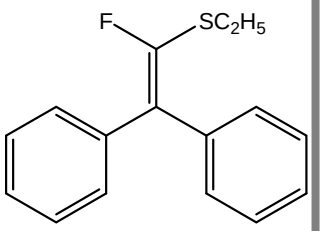
^{13}C NMR


H
SCH2CH3
SCH2CH3
Br

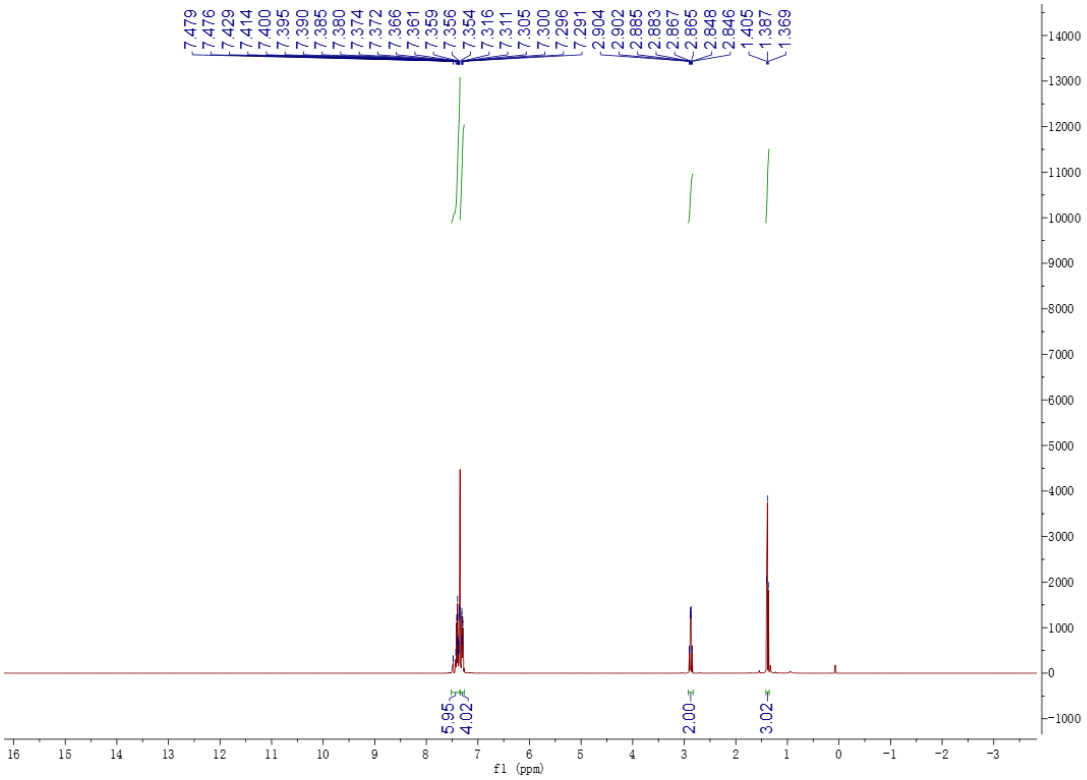
3v


135.36
133.45
133.03
130.88
120.96
28.08
27.71
14.90
14.22
f1 (ppm)

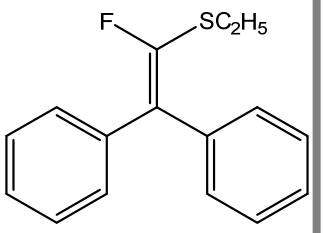
^{1}H NMR


F
SC2H5

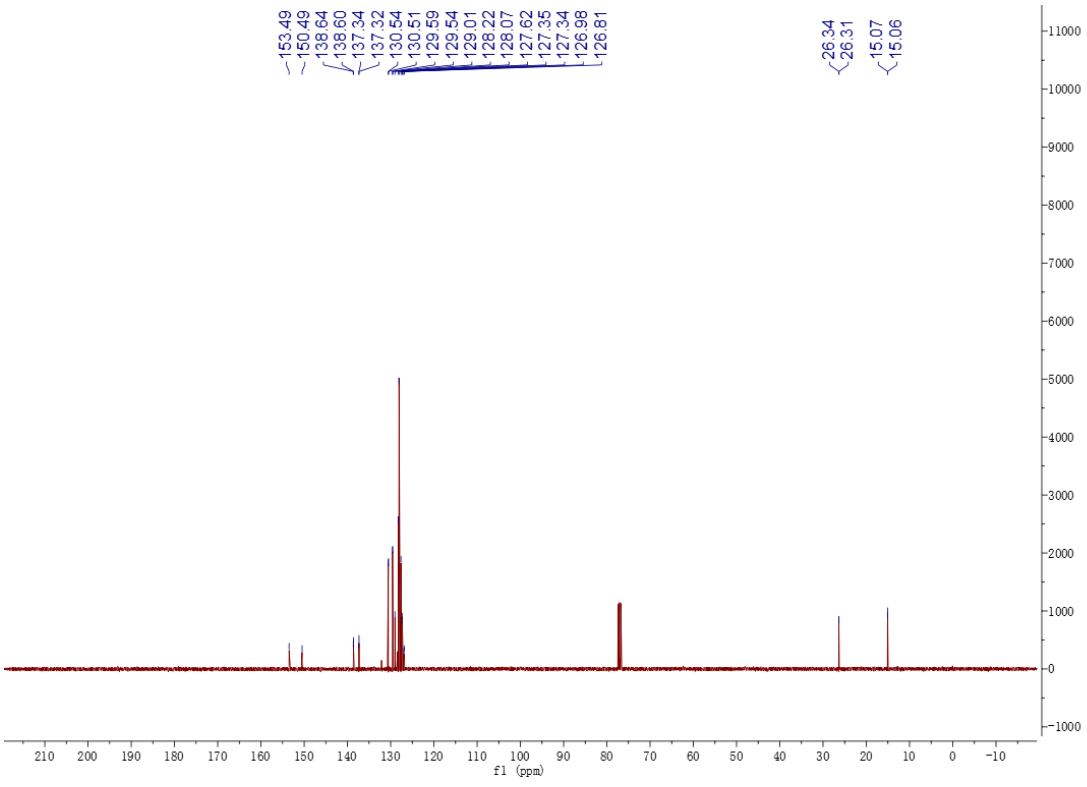
3x


7.479
7.476
7.429
7.414
7.400
7.395
7.390
7.385
7.380
7.374
7.372
7.366
7.361
7.359
7.356
7.354
7.316
7.311
7.305
7.300
7.296
7.291
2.904
2.902
2.885
2.883
2.867
2.865
2.848
2.846
1.405
1.387
1.369
5.95
4.02
2.00
3.02
f1 (ppm)

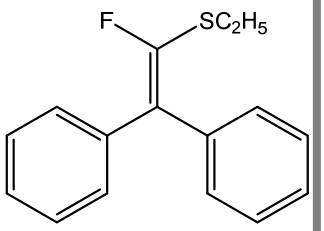
^{13}C NMR


F
SC2H5

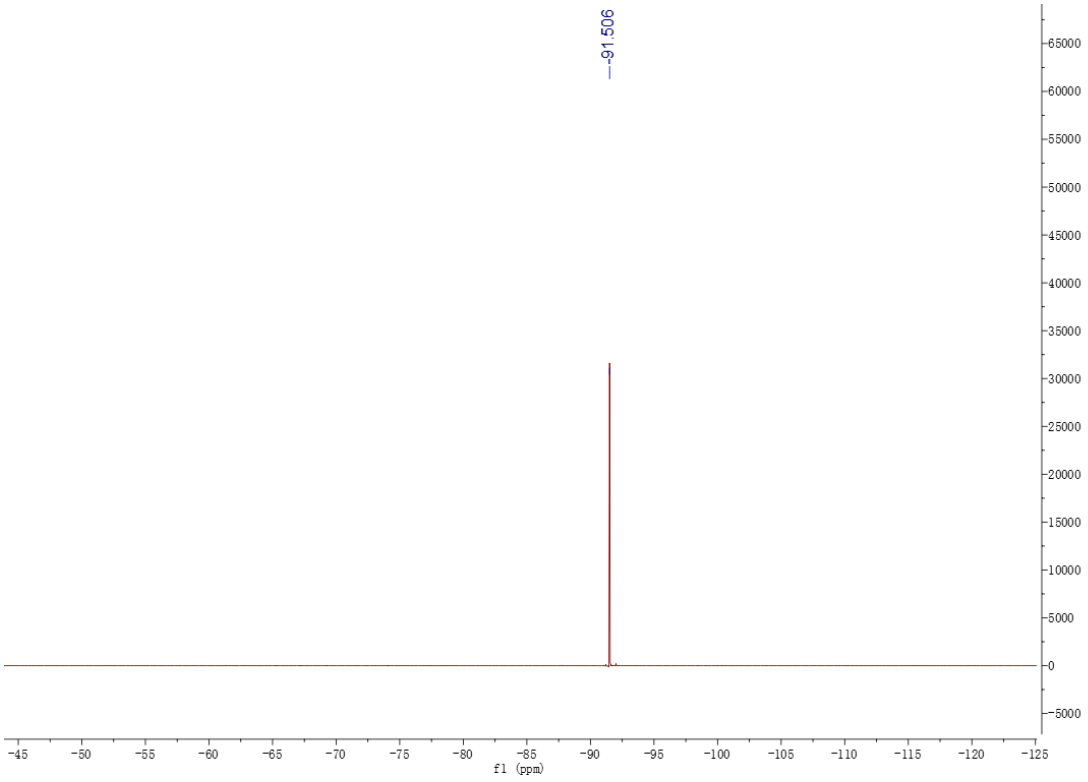
3x


153.49
150.49
138.64
138.60
137.34
137.32
130.54
130.51
129.59
129.54
129.01
128.22
128.07
127.62
127.35
127.34
126.98
126.81
26.34
26.31
15.07
15.06
f1 (ppm)

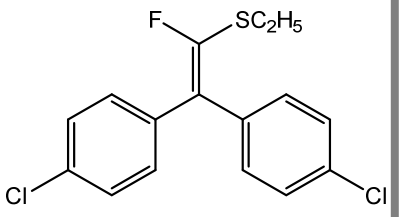
^{19}F NMR


F
SC2H5

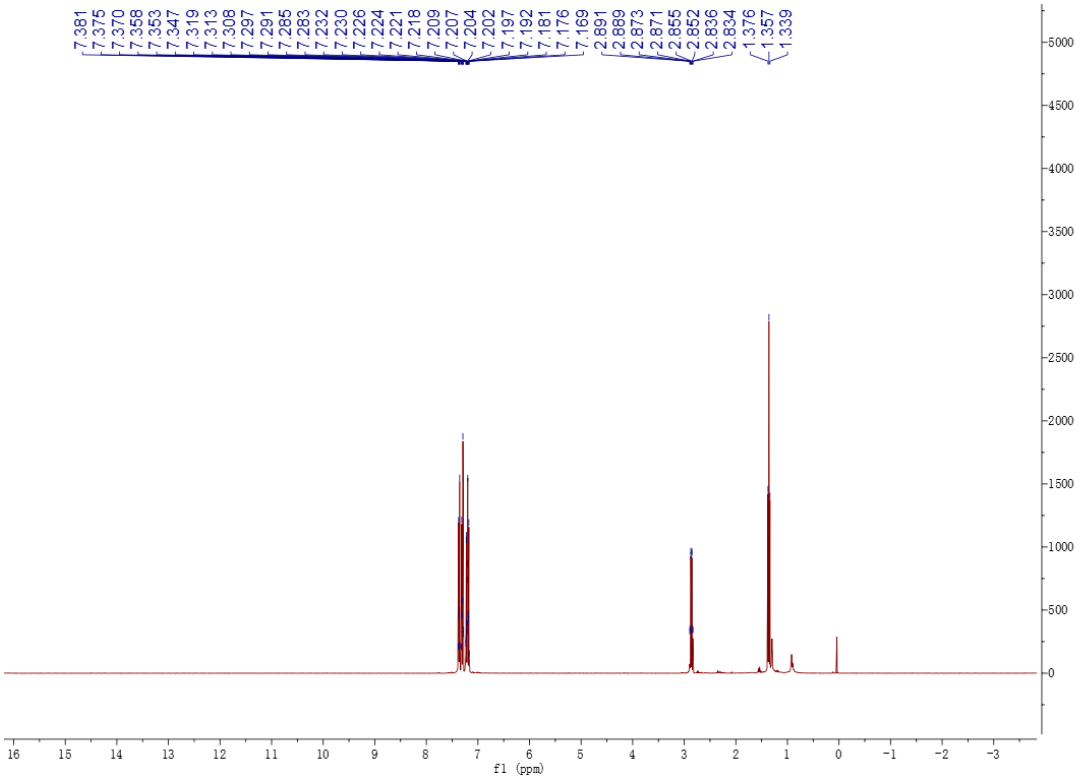
3x


-91.506
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
-45
-50
-55
-60
-65
-70
-75
-80
-85
-90
-95
-100
-105
-110
-115
-120
-125
f1 (ppm)

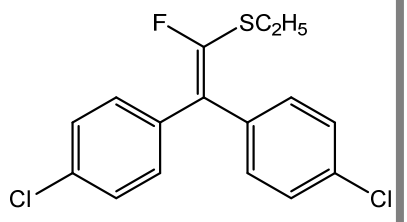
^{1}H NMR


F
SC2H5
Cl
Cl

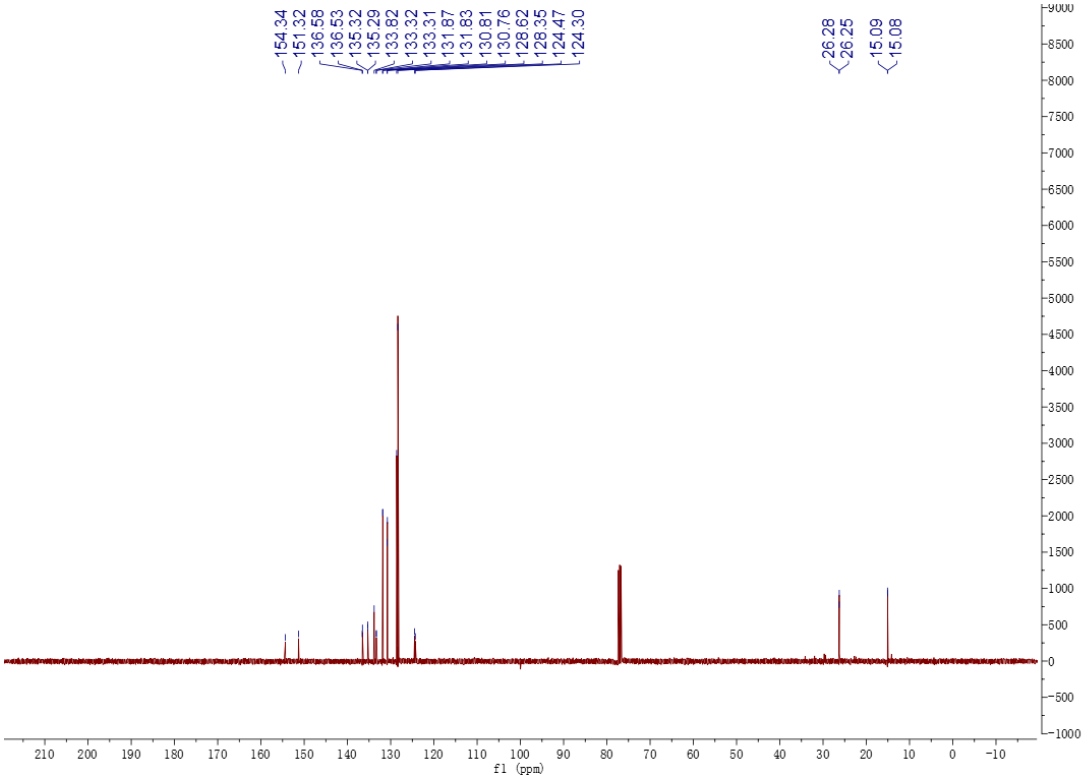
3y


7.381
7.375
7.370
7.358
7.353
7.347
7.319
7.313
7.308
7.297
7.291
7.285
7.283
7.232
7.230
7.226
7.224
7.221
7.218
7.209
7.207
7.204
7.202
7.197
7.192
7.181
7.176
7.169
2.891
2.889
2.873
2.871
2.855
2.852
2.836
2.834
1.376
1.357
1.339
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
f1 (ppm)

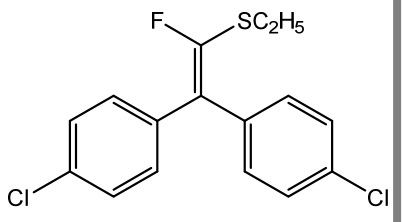
^{13}C NMR


F
SC2H5
Cl
Cl

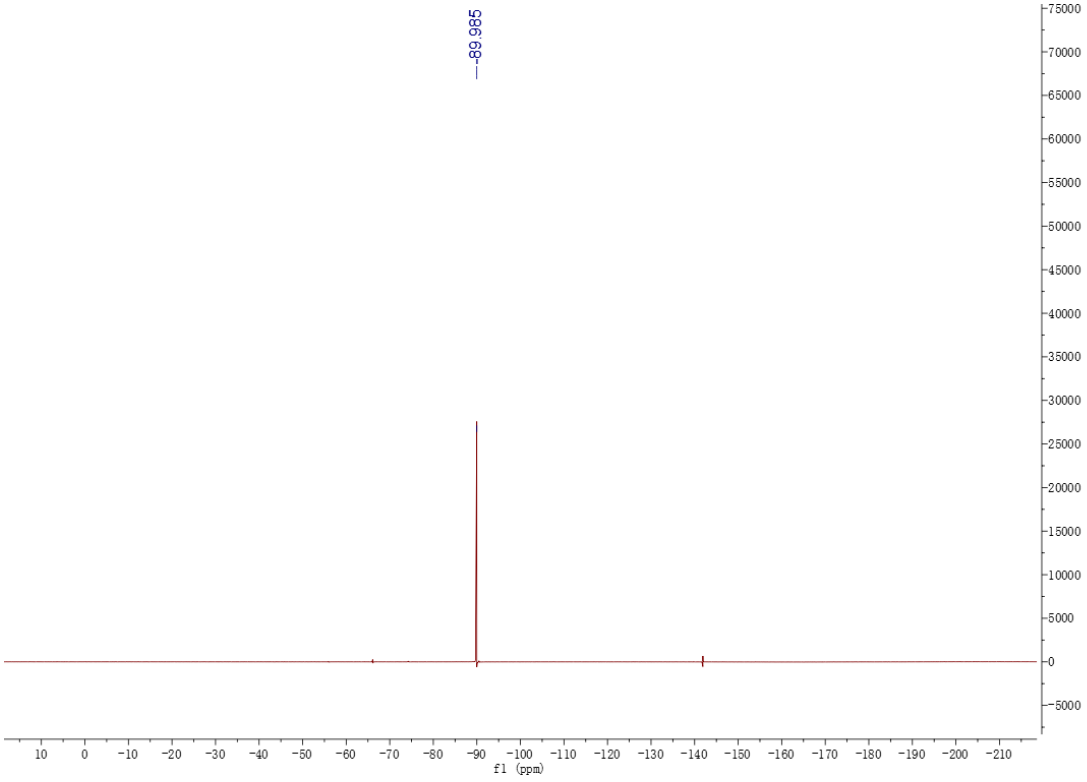
3y


154.34
151.32
136.58
136.53
135.32
135.29
133.82
133.32
133.31
131.87
131.83
130.81
130.76
128.62
128.35
124.47
124.30
26.28
26.25
15.09
15.08
f1 (ppm)

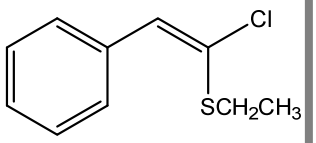
^{19}F NMR


F
SC2H5
Cl
Cl

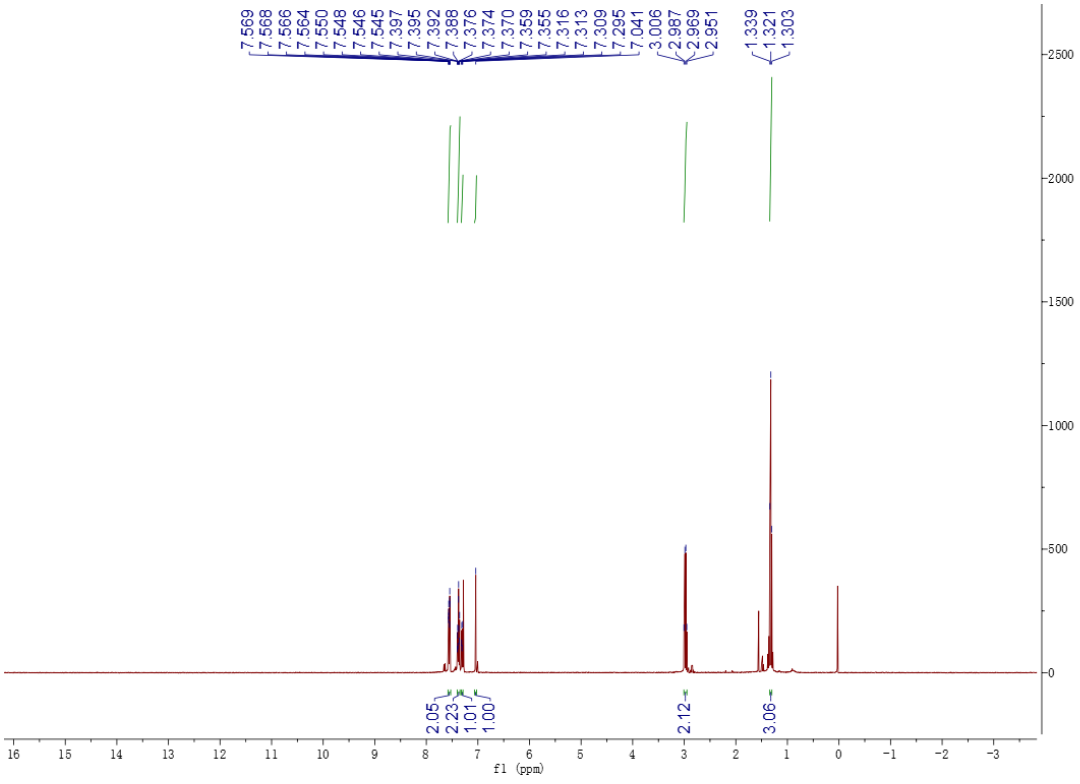
3y


-89.985
75000
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
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)

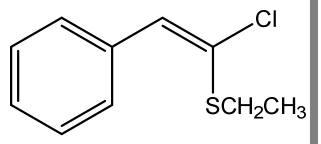
^{1}H NMR


Cl
SCH2CH3

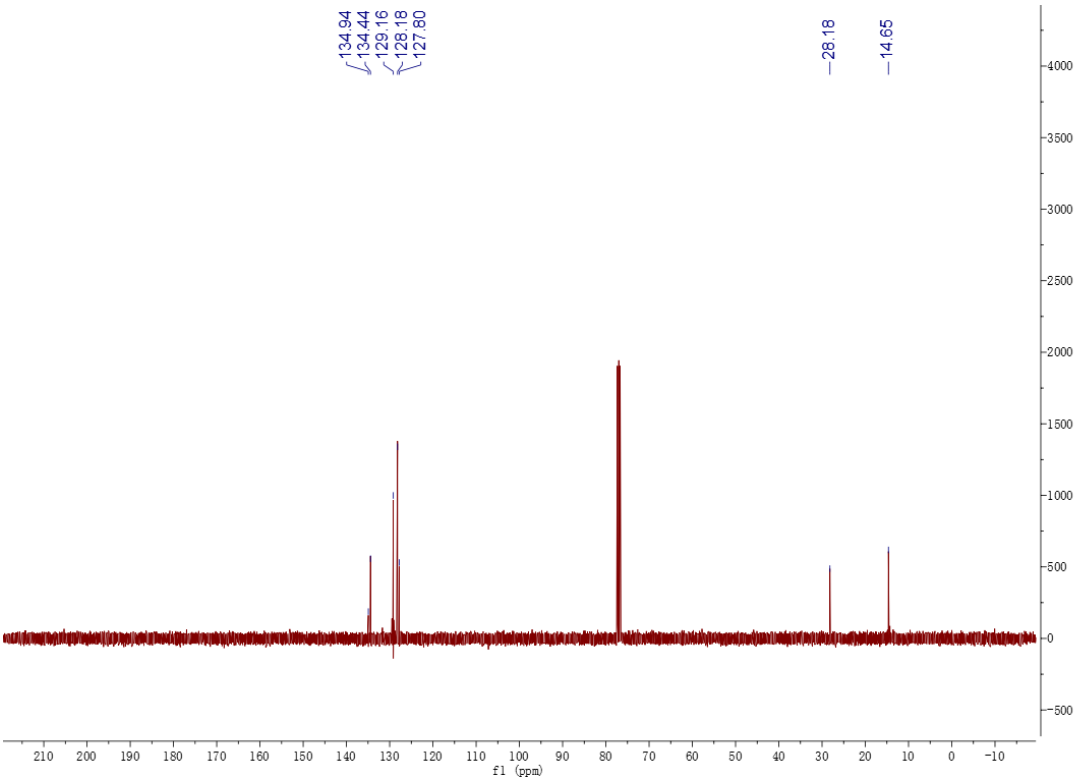
3z


7.569
7.568
7.566
7.564
7.550
7.548
7.546
7.545
7.397
7.395
7.392
7.388
7.376
7.374
7.370
7.359
7.355
7.316
7.313
7.309
7.295
7.041
3.006
2.987
2.969
2.951
1.339
1.321
1.303
2.05
2.23
1.01
1.00
2.12
3.06
f1 (ppm)

^{13}C NMR


Cl
SCH2CH3

3z


134.94
134.44
129.16
128.18
127.80
28.18
14.65
4000
3500
3000
2500
2000
1500
1000
500
0
-500
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)